
2014 Gulf of Mexico
Oil Spill & Ecosystem
Science Conference
Report
January 26-29, 2014
Mobile, Alabama

2014 CONFERENCE SPONSORS

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As we enter the fourth year of research following the Deepwater Horizon incident and associated investments focused on the Gulf of Mexico, the science community is now well positioned to deliver integrated findings both within the scientific community and to stakeholder groups. With this in mind, the Conference Executive Committee chose "Collaboration, Integration and Synthesis" as the overarching goal for the 2014 Conference. The conference program was designed to bring together the research community to share new scientific results among the disciplines and develop recommendations or action plans for collaborative integration and synthesis or legacy products from post-spill investment in science.

WE WOULD LIKE TO THANK THE EXECUTIVE COMMITTEE FOR ITS TIME AND DIRECTION IN PLANNING THE CONFERENCE

Charles Wilson (Chair), *Gulf of Mexico Research Initiative*
Michael Carron, *Gulf of Mexico Research Initiative*
David Conover, *National Science Foundation*
Alyssa Dausman, *U.S. Geological Survey*
Allen Dearry, *National Institute of Environmental Health Sciences*
Robert Detrick, *National Oceanic and Atmospheric Administration*
Chris Elfring, *National Academy of Sciences*
Peter Koufopoulos, *U.S. Food and Drug Administration*
Paul Sandifer, *National Oceanic and Atmospheric Administration*
David Shaw, *Gulf of Mexico Research Initiative*
Andrew Shepard, *Gulf of Mexico University Research Collaborative*
Suzanne van Drunick, *Environmental Protection Agency*
Denis Wiesenburg, *Gulf of Mexico Research Initiative*

THE CONFERENCE WOULD ALSO LIKE TO THANK THE FOLLOWING PARTNER ORGANIZATIONS:

The Gulf of Mexico Research Initiative's Management Team provided logistical and programmatic support throughout the conference.

NOAA's Coastal Services Center provided pre-conference process agenda development and on-site facilitation of scientific sessions.

The Mississippi-Alabama Sea Grant Consortium provided on-site volunteers for registration and the information desk.

EXECUTIVE SUMMARY: CONFERENCE OVERVIEW

The second Gulf of Mexico Oil Spill and Ecosystem Science Conference was held in 2014. The Sponsors of the conference shared a goal to improve society's ability to understand the Gulf of Mexico ecosystem, which includes humans, to ensure its long-term environmental health. One important aspect of this is understanding the impacts of petroleum pollution and related stressors on the marine and coastal ecosystems, as it will support future response, mitigation, and restoration following spills. But the Gulf is a dynamic and complex system that is facing several issues, such as non-petroleum pollution, hypoxia, coastal development, erosion and inundation, and climate change. The goal of this conference was to engage and build a community of researchers working on all aspects of Gulf of Mexico ecosystem science and initiate dialogue with the users of that information.

The conference was planned and sponsored by a group of 10 partners from academia, federal agencies, and non-governmental organizations.

After several years of research following the Deepwater Horizon (DWH) incident and associated investments focused on the Gulf of Mexico, the science community is now well positioned to deliver integrated findings both within the scientific community and to stakeholder groups. The Conference Executive Committee chose "Collaboration, Integration and Synthesis" as the overarching goals for the 2014 Gulf of Mexico Oil Spill and Ecosystem Science Conference. To accomplish these goals, the 2014 Conference facilitated interdisciplinary discussion and promoted outcomes that require integration and synthesis across fields and themes.

A Plenary Panel on The Role of Academia in Oil Spill Response (see page 7) offered insights to the broad topic of how academia responds in the face of natural or manmade disasters, and what lessons have been learned from the DWH oil spill experience. Associated events and meetings organized alongside the conference (see page 46) engaged the Gulf of Mexico science community in a wide variety of important topics, from a session on deep sea research organized as a tribute to Dr. Ray Highsmith to a science seminar for journalists.

Eight full day and two half day sessions were structured to include significant discussion time to help facilitate the development of specific outcomes such as synthesis findings, recommendations for applications, identification of research gaps including gaps or new questions based on preliminary results integration, plans for future interdisciplinary collaboration.

The Scientific Sessions addressed the following integrative topics:

- Ecosystem assessment, vulnerability, and resilience: integrated cause and effect studies and trends across disciplines
- Ongoing science, technology, monitoring, and mitigation strategies with respect to the DWH oil spill response: what is needed to prepare for, support, and manage future hydrocarbon exploration and production in the Gulf of Mexico
- Valuing ecosystem services and quantifying effects of oil spills on ecosystem services through environmental, public health, and socioeconomic science
- Promoting scientific literacy, perception, and expectations about oil spill research among stakeholders

And incorporated the following disciplinary themes:

- Understanding the dynamic physical processes of the Gulf of Mexico and related environment
- Understanding the chemistry of the Gulf of Mexico system and the evolution and interactions of pollutants introduced by humans in the coastal, open-ocean, and deep-water ecosystems
- Understanding the Gulf of Mexico ecosystem, including the sea floor, water column, coastal waters, beach sediments, wetlands, marshes, and organisms

James D Watkins Student Award for Excellence in Research

Three student presenters were recognized with the 2014 James D. Watkins Student Award for Excellence in Research for the work they submitted to the 2014 Gulf of Mexico Oil Spill and Ecosystem Science. Awards were given for outstanding student oral presentation and two outstanding student posters. The award strives to recognize outstanding research in order to support the next generation of ocean scientists and encourage excitement for presenting their work.

The Student Award for Excellence in Research is named after Admiral James D. Watkins, a hero in the ocean community who passed away in 2012. Admiral Watkins lived a life of public service and his extraordinary influence on the ocean science community is immeasurable. Given Admiral Watkins' lifelong pursuit of encouraging and building the next generation of ocean scientists, it was most appropriate to name this award after him, as it recognizes excellent research as a way of motivating students to continue to excel in the field of oceanography.

The student recipients are:

Jessica Henkel (Tulane University) – Impacts of the Deepwater Horizon oil spill on Shorebird Communities in the Northern Gulf of Mexico (Oral Presentation)

Karen Malone (Hamburg University of Technology) – A new experimental module for the investigation of deep-sea oil spills under in-situ conditions (Poster Presentation)

Nicholas Geitner (Clemson University) – Effects of dendrimer oil dispersants on Dictyostelium discoideum (Poster Presentation)

Students were assessed in the categories of Scientific Merit, Research Capability, Design & Style, and Knowledge of the Presenter.

- Technology developments for improved research and operations in the Gulf
- Understanding the impact of environmental health and function on socioeconomic conditions and public health
- Gulf of Mexico management and policy, including response, mitigation and restoration following environmental emergencies
- Education and outreach

Over 900 people registered for the 2014 conference, and of those, 675 participated in a talk or poster presentation. 236 students attended the conference, many sharing their work through talks or poster presentations. 152 oral presentations were given, and 404 posters were submitted.

Geographically, 13 countries (Netherlands, Norway, Mexico, United Kingdom, Canada, Spain, Taiwan, Gambia, Australia, Germany, Japan, Ethiopia, South Korea), 37 States, and the District of Columbia (Alabama, Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Florida, Georgia, Hawaii, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Virginia, Washington, Wisconsin) participated in the conference.

An unusual ice storm in the Mobile, AL area the week of conference unfortunately caused the cancellation of the second poster session. Participants were encouraged to submit their posters online as ePosters and over 200 were submitted.

The results of each of the Sessions are included in this report, but several major themes were identified:

- Researchers are beginning to understand the acute and immediate consequences of the 2010 DWH

oil spill. The long-term and chronic effects are much less understood and will require more attention.

- Cross-collaboration across disciplines is needed in many areas: among data managers, within the modeling community, and between the science and public health communities.
- Many groups highlighted the need for more ecosystem modeling. Researchers would like more metrics and more datasets for model evaluation.
- The Gulf Coast community welcomes research, but researchers need to ensure that they have the trust of the community. That will require that the community knows that researchers have committed long-term to understanding the problems and the Gulf Coast area.
- A continuing dialogue between the research community, agencies and industry about results is critical to federal agencies and critical to being prepared to participate and support research in the event of a future incident.
- More, different, and longer baseline information is still needed. It is critical to understanding the changes in the Gulf of Mexico ecosystem (including the human population).
- New avenues for dispersant development are well underway and offer promising avenues for using lower doses and coping with viscous crude oil. However, displacing existing dispersants in the marketplace faces challenges including government regulations, the need to work with many types of oil, cost, and questions about toxicity and biodegradation.
- The Gulf researchers have identified the importance of an observing system in the Gulf. There is an opportunity for it to happen if the science and monitoring communities work together, leverage resources and communicate/translate information appropriately with funders and decision-makers. It will need to be given very high priority by the research community.

Several of the Session Organizers indicated that they are planning to produce additional publications using the results of the sessions. Specific outcomes include a perspectives piece on the current understanding of impacts of the DWH oil spill on fisheries in the Gulf of Mexico, a white paper on advances in dispersant science and technology, an education and outreach document of oil spill literacy principles, and a transdisciplinary research framework integrating ecosystems, social science and public health to examine the potential impact of the Gulf of Mexico oil spill.

To view the full schedule and abstracts from the Conference visit: *http://2014.gulfofmexicoconference.org/program/abstracts/*.

General information about the conference can be found at: *http://2014.gulfofmexicoconference.org/*.

2014 PLENARY PANEL SUMMARY

THE EVOLVING ROLES OF ACADEMIA IN DISASTER RESPONSE: LESSONS LEARNED FROM THE DEEPWATER HORIZON DISASTER

Wednesday, January 29, 2014 8:30-10:30am

Moderator:

Margaret Leinen, Scripps Institution of Oceanography

Panelists:

Thad Allen, Booz Allen Hamilton, Inc.
Jane Lubchenco, Oregon State University
Bernard Goldstein, University of Pittsburg
Laurence Madin, Woods Hole Oceanographic Institution
Steven Murawski, University of South Florida

The DWH spill was completely unlike any previous oil spill. It was unprecedented in scope, complexity, and duration and in the media and public attention it attracted. It was the first spill to be declared a Spill of National Significance and to trigger the need for a National Incident Commander. And the needs for scientific engagement were unprecedented on multiple fronts. The DWH blowout resulted in a globally unprecedented mobilization of logistical, technological and intellectual capacity in response to an environmental disaster. An important part of this mobilization was the involvement of national and international academics to conduct research that was both government-organized and organized directly by teams of academic researchers. While the use of academic resources is common and anticipated in the Oil Pollution Act of 1990 (OPA-90), and this occurred during DWH, considerable research, environmental monitoring and unique (often experimental) technologies were brought to bear by the academic community acting without government or industry involvement. The level of interest expressed and contributed by the academic community was largely unanticipated by government and industry responders, particularly given academic involvement during previous environmental catastrophes.

Organizing, funding and coordinating the academic interest and response, particularly in the early days of the spill proved difficult. Traditional mechanisms including the official response (clean up) and Natural Resource Disaster Response (NRDA) aspects quickly entrained academic scientists as is common practice in oil spills. However, the scale of these activities and their requirements for controls such as chain of custody of samples proved onerous to many in academia used to a high degree of autonomy in conducting research. Also, despite a number of high-level meetings to exchange information and brainstorm solutions, the diffuse and fragmented academic community was seemingly orthogonal to the highly structured and scripted response doctrine inherent and directed under OPA-90. Layered on to the cultural differences between government responders and academia was the intense and skeptical media crush seeking immediate clarity on the threats and impacts posed by DWH that were in reality “omni-directional and indeterminate.” By and large the academic community was ill prepared to deal with the media, which is unfamiliar with the scientific method and the peer review process.

Session Description and Outcomes:

This session explored some of the lessons that have been learned as a result of the DWH disaster from the perspectives of the roles academia did and can play in future responses to environmental threats.

Given the significant issues involved in having academic scientists involved in disaster-related responses, what are the strengths and challenges associated with such involvement by the academic community?

Advantages of Academic Involvement:

- Broad knowledge base to apply to novel situations
- 'Pre-adapted' by basic research to be collaborative and seek answers to fundamental questions
- Flexible response capability and access to potentially disruptive technologies
- Independence
- Motivation to serve
- Academic standards of quality and peer review
- Ability to work outside government limitations

Challenges Faced with Academic Involvement:

- Potential conflict with priorities for safety, containment
- Unfamiliar regulatory environment
- Inadequate funding mechanism
- Different cultures and expectations from academia, industry, government, media
- Demands for data and assessments that conflict with normal academic practice

As important as incorporation of science into those response was, there was no ready mechanism to take more complete advantage of the breadth and depth of knowledge outside the government, to adequately fund academic research rapidly, or to bring non-governmental scientists up to speed quickly on the protocols, requirements, culture, and potential pitfalls of assisting with the response.

Numerous academic scientists were entrained in the response effort, especially where they had pre-existing relationships with relevant agencies. For example, teams composed of government, industry and academic scientists were constituted to determine flow rate, figure out how to stop the flow of oil, calculate the oil budget, assess impacts of dispersants on hypoxia, determine the concentration, distribution and impacts of oil, etc. These ad hoc expert working groups were unprecedented and served an invaluable role in coalescing scientific information rapidly, drawing on experts regardless of whether or not they worked for the government.

Pre-existing relationships (e.g., between BP and academic scientists/institutions and between NOAA/OR&R and academic scientists) were key to involvement of the many academic scientists in agency response efforts. Individuals who already had contracts or working relationships with agencies were brought into the response rapidly.

As the DWH progressed, ad hoc coordinating for evaluating candidate solutions to problems and synthesis of accumulating data increasingly entrained larger numbers of academic scientists. Similarly, funding mechanisms such as the National Science Foundation's RAPID grants program put more scientists in the field, which was followed by an enormous commitment by BP to fund a decade of research on the spill largely directed to academic researcher.

In addition to funding mechanisms, coordination across academic institutions is now facilitated through cross-state efforts such as GOMURC, the Gulf of Mexico Research Initiative (GoMRI) Research Board and its funded Centers, and among institutions within Gulf States (e.g. Florida Institute of Oceanography, the Northern Gulf of Mexico Institute). An equally important and generally unappreciated issue at the onset of DWH was the lack of science coordination among and within federal and state agencies tasked with spill responsibilities. These issues were largely solved through establishment of novel ad hoc committees and panels that will no doubt be invoked in future disasters.

Given the scrutiny of response efforts and academic performance post-DWH, it is instructive to consider how the response to and use of the academic community resources would differ with the next significant

environmental event. While the scenario of the next big oil spill will never be the same as DWH, the enduring legacies of DWH include the need for rapid, coordinated and authoritative organizational structures that are nimble and capable of directing resources to evolving problems. This may very well require formal changes in the oil spill response doctrines implemented under OPA-90, but much can be done using the flexibility of agencies as demonstrated during DWH. Likewise, the heightened awareness that the academic community sees themselves in a "first responder" role represents a substantial change in focus even over the past decade or so.

During the summer of 2013, a marine gas well (Hercules 265) blew out and burned in the Gulf of Mexico off the Louisiana coast. While the scale of the accident was much smaller than DWH, activation of the academic community to organize scientific expeditions was immediate and well-coordinated with responsible government entities, and tells a compelling story of how the academic community is better able to use its capacity, funding and new organizational structures to partner with traditional response mechanisms.

Plenary panelists emphasized a number of salient points in their short prepared remarks and in response to questions posed by the very large audience. Issues raised by the panelists were many and diverse. Of particular interest were the legal ramifications of being involved in what ultimately can be regulatory and legal responses between government and thee responsible parties. As well, the roles of traditional publication protocols when information is collected bearing on environmental and public health and safety.

While there were many issues associated with academic involvement in this and other disaster response and assessment activities, most involved have had positive experiences. One well-respected academic scientist remarked that this "…was the most rewarding experience of my academic life". On balance there are rewards and risks associated with involvement in disaster response that can briefly be summarized as follows:

Rewards

- Unique or valuable contributions to crisis management
- Service to the Nation
- Novel and significant scientific data and technical operations
- New colleagues and collaborations
- New funding sources
- Opportunities for further engagement with oil industry

Risks

- Disrupted work and personal life
- Missed proposals, lost opportunities
- Physical and psychological stress
- Unanticipated legal ramifications

Some suggestions for improving academic involvement in future events include:

1. Modify the protocols that are used during a crisis response to ensure that scientific guidance is sought and used, including at the highest levels of decision-making.
2. Clarify the authority of those in charge of response to constitute ad hoc scientific expert working groups to provide information to responders, and ensure these working groups can be composed of governmental and non-governmental scientists and experts.
3. Create additional mechanisms for non-governmental scientists to work with agencies on an ongoing basis on topics relevant to a response to ensure there are relationships that can be activated when a crisis occurs.
4. Provide training for academic scientists in the culture, protocols and legal aspects of response so they are prepared.
5. Create venues for discussions among scientists about cultural conflicts during a crisis so issues like intellectual property, expectations for communicating with the media, priorities during a response are better understood.

6. Create mechanisms for very rapid peer review during a crisis.
7. Create funding mechanism for immediate access to more substantial funds for research during a crisis.
8. Initiate LME-scale integrated monitoring and research programs that focus on interdisciplinary understanding of basic ecosystem and community processes, including the delivery of key ecosystem services.
9. Devise better mechanisms for rapid, ongoing, two-way communication between the academic community and government scientists to facilitate sharing of ideas and information during a crisis.
10. In short, changes are needed within both the government and academia if we are to be better prepared for the next crisis.

While this Plenary Panel primarily centered on the roles of academic scientists and government officials, a critical and yet not addressed issue is the role of industry in working with the academic community. Solving these issues requires an active three-way dialog between government, academia and industry.

2014 SCIENTIFIC SESSIONS

Session 001

EDUCATION AND OUTREACH: SETTING THE RECORD STRAIGHT: DEBUNKING MYTHS AND MISCONCEPTIONS ABOUT OIL IN THE GULF AND PROMOTING OCEAN LITERACY

Sunday, January 26, 1:00pm-6:00pm

Session Chairs:

Tina Miller-Way, Dauphin Island Sea Lab*
Teresa Greely, University of South Florida
Laura Bracken, University of Miami
Tracy Ippolito, Florida State University

In the Education & Outreach session, SETTING THE RECORD STRAIGHT: DEBUNKING MYTHS AND MISCONCEPTIONS ABOUT OIL IN THE GULF AND PROMOTING OCEAN LITERACY, ocean scientists whose research reflected the conference's disciplinary themes (i.e., physical processes, chemistry, ecosystem, and technology) and outreach specialists came together to address common misconceptions about oil, the oil spill and its impacts in the Gulf of Mexico. Research scientists addressed assumptions and false "knowledge" about the oil spill that they've encountered when talking with non-scientific audiences and presented summaries of research results for the layperson. Outreach specialists shared the challenges and success stories in communicating the science of oil spills and presented ways to make messages more accurate and informative. In the breakout group discussions, the myths and facts relayed during the presentations were discussed, distilled, and translated into public-friendly statements.

Session Report

In the aftermath of the DWH event, a great deal of scientific misinformation arose and was promulgated among the public. Education and outreach specialists felt that there was a need for a living document, written in layperson's language, that identifies major topics of concern (that can be addressed with scientific research), corrects myths, and indicates scientific uncertainty. The goal of this session was to produce a draft of a document that delineates what we do and do not yet know scientifically about the DWH event and its impacts on the Gulf of Mexico in layperson's language. Prior to the session, we surveyed the researchers, educators and outreach specialists in the Gulf region to identify concerns and topics reflected in myths and misconceptions. Survey results were augmented by web searches. Also prior to the meeting, these results were distilled into a draft set of statements (principles) that formed the basis for discussion in the breakout sessions.

Submitted and solicited presentations addressed topics of scientific misinformation and reflected the five GoMRI themes. Specifically, presentations addressed: the Gulf experience relative to the Alaska spill; the physical transport of oil and the role of modeling; oil spill impacts on benthic animal-sediment relationships; the fate of spilled oil and its impact on the seafloor; oil extraction, natural seepage and oil toxicity; partnerships and methods that were effective in information dissemination; public perceptions of the spill, the use of dispersants and uncertainty as viewed through social media; and the need for communication at appropriate levels. There were approximately 100 attendees for the session, representing academia, marine laboratories, federal agencies, state agencies, NGOs and the media.

Presentations were followed by small group discussions; each group addressed one or two topics of concern (principle). Groups were directed to develop statements in layperson's language that provided additional factual detail relevant to the principle discussed. On the basis of these outputs, a draft document of "oil spill literacy principles" was developed and presented below. We proposed a comment period for the

summary document developed. This summary precedes input from those comments. This process used to arrive at this document may also present a strategy that could be used to reduce misinformation in case of similar events in the future.

1. Every oil spill is unique with respect to the amount, type, weight and gas components of the oil released, environmental conditions, including weather during and after the spill and the use of various clean up methods.
2. In the oceans, oil is dispersed and moved about by currents at the surface and deep water currents, but also by winds acting at the water's surface. Dispersants act to modify these processes.
3. Oil released in the oceans naturally changes (weathers) over time. Weathering is dependent on environmental conditions. Oil components weather at different rates and not all components can be completely degraded.
4. The bottom of the Gulf of Mexico is underlain by several reservoirs of oil and natural gas that makes its way to the surface through natural seeps as well as human drilling. Though there are bacterial communities in the Gulf that are adapted to and degrade this release of oil, oil spills can overwhelm this process.
5. The various chemicals that make up oil are taken up by living organisms to varying degrees, and thus get into the food webs of the Gulf. The impact of this uptake depends on the biology of the organism of interest and the toxicity of oil components as well as the exposure.
6. Many techniques have been devised to help clean up spilled oil: these cleaning methods have different effects on the oil and on the environment. Natural processes can work with chemical and physical methods. Choice of techniques should be presented and discussed at the community level to identify community values.
7. Many scientists have and are studying oil spills, but there is much left to be learned before we can make predictions with less uncertainty. This uncertainty needs to be assessed and clearly communicated.
8. Effective communication is a critical element of any response and therefore deserving of sufficient funding. To be most effective, communication channels should be in place prior to an event and practiced at the community level.

Session 002

DATA MANAGEMENT AND INFORMATICS SUPPORTING GULF OF MEXICO OIL SPILL AND ECOSYSTEM SCIENCE

Sunday, January 26, 1:00pm-6:00pm

Session Chairs:

Matthew Howard, Texas A&M University*
Dave Reed, Fish and Wildlife Research Institute
Fabio Moretzsohn, Texas A&M University – Corpus Christi
Amy Merten, NOAA

The number of research studies in the Gulf of Mexico has increased recently due to the decade-long GoMRI and other concurrent programs. These studies are producing numerous heterogeneous data sets and model outputs, both large and small. The challenge is to assemble, integrate, and analyze these distributed data collections to support intelligent decision-making. Data Management (data stewardship) and Informatics (the science of processing, managing, and retrieving information) are key components of the next generation of data management systems. Regional, national, and private sector groups are working hard to develop and deploy a cyberinfrastructure for interoperable networked data systems to support contemporary environmental research. These systems will enable researchers and resource managers to locate, retrieve and visualize observations and model output more easily. This session's conveners invite all people working to integrate comprehensive environmental data sets and model output with application to scientifically-based decision-making, especially in the context of oil spill response and restoration and policy, to present their work in this session.

Session Report

This session was organized by members of the Gulf of Mexico Research Initiative Information and Data Cooperative (GRIIDC) and NOAA's Office of Response and Restoration (ORR). Data management (data stewardship) and informatics (the science of organizing and retrieving information) enable people and machines to locate, retrieve, and visualize information more easily. Oil spill studies span diverse disciplines. This diversity is apparent in the ways groups categorize, organize and publish data. This session was a venue for data managers from various backgrounds to share their current work with their contemporaries and exchange ideas about issues and solutions. About 50 people attended this session. Professions represented included oceanographers, engineers, chemists, subject matter experts, informaticists, system architects, and computer programmers. Groups represented included the private, academic, state, federal and NGOs sectors. Talk topics included database, software tools, visualization, integration and products. Recurring themes included heterogeneity of datasets (data type and disciplines), "What is a dataset?" (granularity of collections), controlled vocabularies (preferred and alternate terms), and data models (required elements of a data object). Three excellent posters (HYCOMM salinity corrections, Drifter velocity climatologies, and 2011 digital elevation model for the Northern Gulf) were discussed in the poster session.

Recommendations included more interactions between groups, such as one-on-one discussions and exchanges between GCOOS-RA and NOAA ORR or subject matter experts with specialized expertise and the GRIIDC team. A suggestion was made that a workshop should be held, perhaps adjacent to an associated event, during which time real solutions to specific issues be explored. Many attendees of Session 002 also attended the early morning meeting on "Collaboration on Data Management for Environmental Disasters" hosted by NCDDC, ORR, and the Coastal Response Research Center. Next steps are to preserve and disseminate the poster information, follow up on suggested information exchanges and participate in planning for data management activities related to environmental disasters.

Session 003

IMPACT OF GULF OF MEXICO PHYSICAL PROCESSES ON CHEMICAL AND BIOLOGICAL TRANSPORT

Monday, January 27, 9:00am-6:00pm

Session Chairs:

Eric Chassignet, Florida State University*
Tamay Ozgokmen, University of Miami
Clint Dawson, University of Texas
Gregg Jacobs, Naval Research Laboratory (Facilitator)

This session highlighted the importance of the physical processes that significantly impact chemical and biological transport in the Gulf of Mexico. The main goal of this inter-disciplinary session was to identify the physical processes (large and small scales) that need to be captured in predictive earth system numerical models for a successful depiction of oil pathways. Presentations included *in-situ* observations (physical, biological, and chemical), earth system models, process studies, laboratory experiments, and cutting-edge numerical modeling. The group discussion provided a forum for communication between physicists, chemists, and biologists.

Session Report

Desired outcomes:

1. To capture recent developments and identify those processes that need to be included in earth system numerical models for successful depiction of oil pathways
2. To provide a forum for communication between physicists, chemists, and biologists working on interdisciplinary research made possible by GoMRI
3. To issue recommendations that will facilitate interdisciplinary research

Session Participation:

Approximate number of participants: ~250

Disciplines represented: Physical oceanography, Biology, Chemistry, Engineering, Mathematics, Computational science, Meteorology, Statistics

Discussion Summary:

There is a general recognition and consensus that:

- Hypothesis testing is crucial and requires a close synergy between observationalists and modelers. Models contain a proposed hypothesis, which are the incorporated dynamics, biology and chemical processes. It is only when observations are applied to either show consistency with or to contradict a hypothesis that progress is made in understanding complex systems such as those incorporated within many of the systems discussed during the session. Confirmation from observations is typically limited due to spatial and temporal coverage. Many of the presentations and posters brought together both observations and models that encompass the different aspects governing physical, biological and chemical development within the Gulf of Mexico. New leading edge mechanisms for oil transport were demonstrated through the uptake of oil in the upper ocean surface and the subsequent downward flux of biological material, which demonstrates a clear integration of the biological processes coupled with physical dispersion of oil.
- Physical, biological and chemical processes are highly multi-scale. Several studies presented were able to provide insight to the underlying physics involved at small scales represented by direct numerical simulations of Langmuir circulation generating observed oil distributions dependent on particle size to distribution of biological activity across the Gulf of Mexico verified by satellite observations. Simultaneously, fractal designed observation systems were employed to understand dynamical dispersion across scales from tens of meters to tens of kilometers and evaluate the results against

alternative dispersion theory that postulates the existence or nonexistence of dispersive features below the mesoscale threshold. The observations are consistent with dispersive energy across the spectrum of scales.

- Observations that capture broader areas and adaptively reach small scales are needed to move forward. Results presented at the session had shown the upward cascade of deformation accumulating material from small scales at tens of meters to hundreds of kilometers into coherent structures. The results generated by numerical models are consistent with observations at scales of hundreds of kilometers to tens of kilometers. However, the structures generated at smaller scales remain unobserved and thus remain in the realm of proposed hypotheses. It was generally recognized that the prior experiments spanning scales provide a useful example to follow for future work. Additional incorporation of adaptive sampling would be necessary to adjust observational programs to developing ocean conditions as the programs are under way. This would have the potential to enable the understanding of processes down to smaller scales than previously possible that are the starting point for accumulating material in the transport process that results in large scale movement of material.
- Coordinated/simultaneous observations and modeling across disciplines are required. Each component of physical, biological and chemical reaction certainly requires intensive examination. The new science examinations presented in the session clearly indicate the important interactions between the different components of Earth system prediction. It was also apparent that individual disciplines would not reach the needed level of observational coordination to understand the interactive components. In the future, collaborative and coordinated programs are necessary to bring together the capabilities across the science disciplines. If conducted properly, these can provide sufficient information to understand the interactions between physics, biology and chemistry that have previously not been possible.

Recommendations:

- Provide metrics and datasets for model evaluation and improvements
- Perform a synthesis of observations to date
- Investigate the possible coordination of future GoMRI-funded observational efforts
- Facilitate ways to improve collaborations between physicists, biologists, and chemists

Session 004

INTEGRATED UNDERSTANDING OF THE IMPACTS OF THE DWH OIL SPILL ON FISHERIES: EXPOSURE VECTORS, BIOLOGICAL-PHYSIOLOGICAL EFFECTS AND ABUNDANCE OF FISHERIES POPULATIONS

Monday, January 27, 9:00am-6:00pm

Session Chairs:

Steven Murawski, University of South Florida*
William Patterson, University of South Alabama
David Hollander, University of South Florida
Felicia Coleman, Florida State University
Marian Hanisko, NOAA (Facilitator)
Heidi Stiller, NOAA (Facilitator)

Session Report

The Gulf of Mexico Large Marine Ecosystem (LME) is home to diverse communities of fishes and invertebrates that in turn support recreational and commercial fisheries with economic values in the many billions of dollars annually. Species complexes supporting fisheries include oysters, crabs, shrimp (several species), and reef fishes (such as red snapper and a variety of groupers), as well as coastal species and large- and small pelagics. Fishery management objectives for state, federal and international waters of the Gulf center on restoring and maintaining sustainable and abundant fish stocks. Progress in meeting these goals has been substantial, particularly since enactment of the 2007 amendments to federal requirements under the Magnuson Stevens Act requiring ending overfishing and rebuilding depleted stocks. Against this backdrop, large scale environmental events such as the DWH oil spill potentially have the potential to alter the population dynamics, species interactions and long term productivity of species, habitats, communities and ecosystems supporting Gulf of Mexico fisheries.

The DWH oil spill interacted with fishes and invertebrates in the deep sea (e.g., deep demersal species), in the mesopelagic realm, in the surface pelagic region, on the continental shelf, and in nearshore habitats. The surface expression of the spill overlapped a significant portion of the larval distributions of many important species including Gulf menhaden, bluefin tuna, butterfish, red snapper and others. Thus there is a concern for impacts of oil on survival of these vulnerable life stages. Furthermore, increased body burdens of oil in a variety of species have been documented following DWH. A wide variety of studies (many discussed in oral and poster presentations at the session) have been initiated to examine the exposure of fishes and invertebrates to oil in these various geographic domains including contaminant analyses (especially for the presence of polycyclic aromatic hydrocarbons (PAHs) in various tissues and organs), and other components leading to consequential sub-lethal effects. Moreover, studies are underway to determine the effects of contaminant composition (nature and concentration) on the mortality of various life stages, as well as growth rates and recruitment effects. Impacts can extend from the species to the community and ecosystem levels of organization. Oil remains in deep-, shelf-, and coastal sediments and thus has the potential to continue to contaminate relevant fish and invertebrate species. The situation is complicated by the dearth of contaminant load baselines pre-DWH as well as well as the existence multiple hydrocarbon sources in the Gulf of Mexico (e.g., natural seeps, leaking oil infrastructure, tanker accidents, riverine and atmospheric deposition and contaminated “produced” waters from oil production that are discharged from rigs).

This session examined exposure vectors –e.g., prey, sediments and water-, exposure scenarios (chemical composition and concentrations of contaminants), and impacts of the DWH spill on fish and fisheries of the Gulf of Mexico. It incorporated information about where oil and oil products were distributed in the environment and how they have degraded over time. Presentations and posters were integrative in nature and included multiple disciplines including toxicology, sediment dynamics, physical oceanography, population and community dynamics, and fishery economics. The selection of papers emphasized multidisciplinary, integrative studies to foster information sharing, leading hopefully to a better mechanistic

understanding of contamination/mitigation scenarios and effects. The goal of this session was to review work accomplished to date by academic, private, state and federal researchers and to stimulate interdisciplinary synthesis of such information, thus leading to a deeper understanding of the mechanisms and effects of DWH contamination. Participants also identified priorities for research necessary to resolve issues that remain and for enhancing the observing system for fisheries-related outcomes.

A total of 460 of the approximate 1,000 conference participants identified an interest in the session, with about 200 participants consistently attending throughout the day of presentations, and heavy participation at the companion poster session. The session consisted of three main components: (1) 15 oral papers, (2) 53 posters, and (3) a facilitated discussion centered around three trigger topics. At registration, conference participants were asked to list questions they would like addressed in the session. A total of 57 such questions were forthcoming for session 004, including:

- Are there measurable direct impacts on fisheries, or are they primarily theoretical?
- Is there evidence for recruitment failure in stocks that might be attributed to the spill?
- Has anyone done controlled experiments with fishes or invertebrates?
- Are the fisheries starting to come back?
- Laboratory to field extrapolation?
- What are the plans to extend monitoring to include pelagic community variability? Mid-shelf and slope?
- And many others

Most of the participant questions were addressed, to a greater or lesser extent, in the three components of session 004.

Session Description

Papers: Presentations included the keynote address by S. Murawski (University of South Florida) titled: Understanding the Impacts of DWH and Other Oil Spills on Gulf of Mexico Fisheries: An Overview, focusing on the historical identification of oil spill effects, current practice in spill effects monitoring and evaluation, an overview of some contemporary findings of DWH oil spill effects, and a discussion of strategies to deconvolve DWH from other petroleum sources in the Gulf. Consistent with the integrative nature of the session, the 14 contributed talks (by students, post-doctoral researchers and research scientists) were organized into five sub-sessions, viz:

- Biomarkers of Oil Exposure & Mercury Tracers (4 papers)
- Toxicity to Fish and Zooplankton (2 papers)
- Impacts on Fish Assemblages, marsh and shelf (2 papers)
- Oil in sediments, impacts on benthos and nutrient cycling (4 papers)
- Ecosystem Modeling (2 papers)

Posters: The poster session contributed the majority of research findings to the session, including a wide variety of studies on the topics listed and others. The poster session was heavily attended and presenters were able to interact with Conference attendees for several hours. Using the categories above, the distribution of posters by theme was:

- Biomarkers of Oil Exposure & Mercury Tracers (18 posters)
- Toxicity to Fish and Zooplankton (13 posters)
- Impacts on Fish Assemblages, marsh and shelf (5 posters)
- Oil in sediments, impacts on benthos and nutrient cycling (8 posters)
- Ecosystem Modeling (4 posters)
- Miscellaneous (5 posters)

Thus, the selection of papers roughly reflected the distribution by topic area. Noteworthy is the substantial set of contributions on the application of standard biomarkers of oil contamination to Gull of Mexico biota, and the development of novel biomarkers and ideas to help solve one of the most vexing problems in oil spill effects interpretation – that being the identification of particular animals actually exposed to the source oil in question. It is apparent that much development work in this area is ongoing, and that GoMRI-funded research is groundbreaking in this regard.

With respect to the impacts of DWH on Gulf fisheries, information presented in the keynote on recent changes in fishery ex-vessel value is instructive (Figure 1). Total fishery value declined slightly between 2009 and 2010 (the year of the spill), but has since increased by about 25% in 2011 and 2012 due primarily to increased value per pound landed in a number of species (Figure 1). Oyster landings dropped substantially in 2010, primarily due to oyster mortalities and fishery closures in Louisiana, Mississippi and Alabama. Oyster landed value has since rebounded to 2009 levels, but with changes in the state-by-state distribution of the catch. Interestingly, due to increased quotas and higher value per pound, red snapper landed value rose steadily throughout the 2009-2012 period, by about 75%. What these data do not show is the substantial decline in value in Louisiana, Alabama and Mississippi, but corresponding increases in Texas and Florida, particularly in 2010 when a substantial area (up to 1/3 of the USA Exclusive Economic Zone) was closed to fishing in the north-central Gulf. Furthermore, the value of many fisheries has been shown to increase when yield or catch per unit effort decline, thus fishery value alone can be misleading when examining fishery health.

With respect to fishery recovery, the data presented in Figure 1 do not tell the whole story because of potential demographic effects (e.g., impacts on year classes spawned since the DWH disaster), genotoxic effects which may manifest over several generations, and implications for impacts among trophically-linked species. There was considerable discussion of evidence and potential for these long term effects in the discussions that ensued in the presentations and poster sessions. Post-DWH changes in stock productivity should be available for many economically significant fisheries, such as red snapper, gag, king mackerel, and panaeid shrimps, as those assessments are completed in 2014 and 2015.

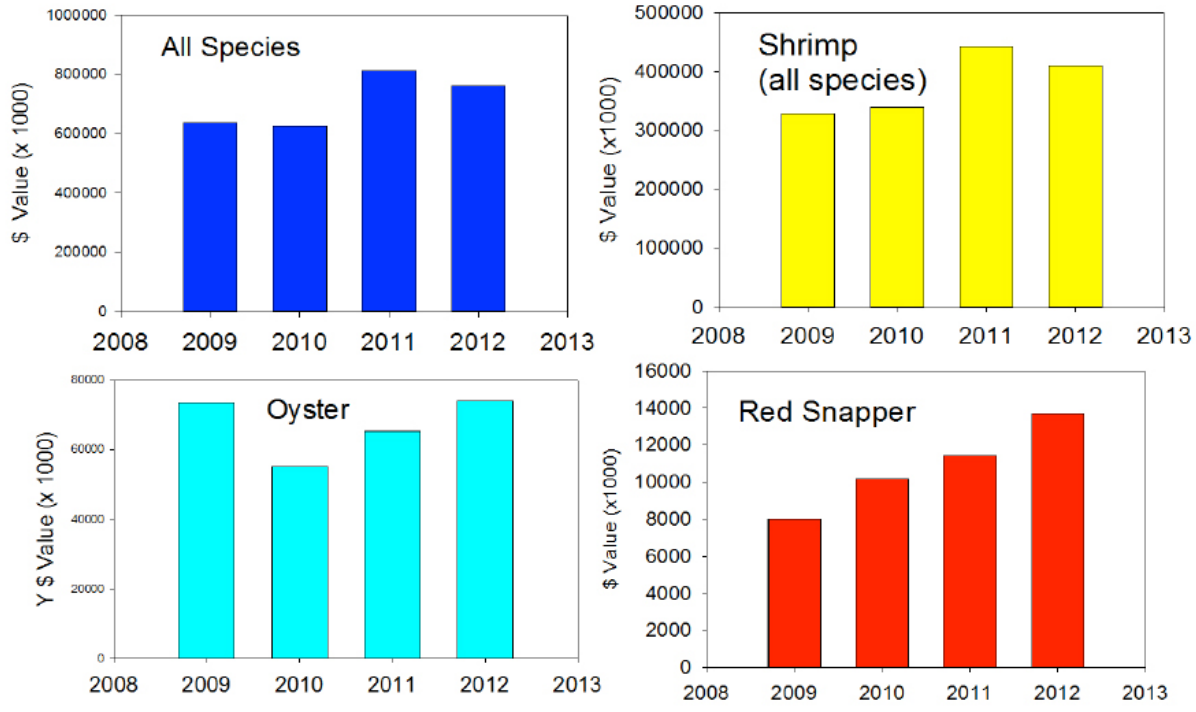

Figure 1. Recent trends in ex-vessel value of USA fisheries in the Gulf of Mexico (Source: NOAA/NMFS/Office of Science and Technology, online data portal).

Some brief highlights from the presentations/posters include:

- Several contributions described apparent declines in recruitment of some shelf species (e.g., red snapper), spawned after the DWH disaster. As well there were contributions on apparent changes in growth of reef fishes, tomtate and ongoing studies of other species including southern flounder, redfish (red drum) and spotted sea trout. If growth rates declined because of interactions with oil contamination, they have the potential to cascade through processes including net productivity and total reproductive effort. Other considerations in interpreting growth effects include understanding background variability and longer term growth effects after 2010.
- Fish community changes documented in mid-shelf reef fish species are substantial, with a reduction in demersal planktivores and increases in the invasive lionfishes. Contrariwise, community shifts were not as apparent in marsh killifish communities. Ongoing research will document how these communities respond in the longer term.
- Development of novel biomarkers of fish contamination, including otolith elemental signatures, immunological responses and links to observed symptomology (e.g., occurrence of skin lesions in fishes) has been rapid and GoMRI funding has the potential to significantly advance discoveries that may benefit oil responses in the future.
- There is a strong signal of apparent DWH oil in sediments available to various fish assemblages, particularly at the edge of the continental shelf north of the DWH site. Fishes such as tilefish interacting with these sediments have elevated PAH body burdens. However, these effects are highly species-specific reflecting differential exposure vectors and animal physiologies.
- Contamination effects are variable among species but declining in some, indicative of a large, event-driven source; much of DWH oil remains in the environment (sediments, marsh habitats, at the foot of beaches).
- Ecosystem-level models of oil spill effects on systems of interacting species (e.g., in the Gulf of Mexico and Norway) are advancing in response to the need to understand effects at the community level (see above) and to incorporate more spatial resolution. When fully parameterized, these models will allow life cycle evaluations of the consequences of tactical and strategic management response actions.

Facilitated Discussion and Participant Responses:

The final two hours of the paper session were devoted to identifying significant session findings and research and monitoring priorities moving forward. This discussion centered on three “trigger questions” (below). Data were gathered in two ways, in facilitated discussions and in written responses from participants.

- Today’s session is covering a wide range of research on fisheries impacts of oil spills. What are three major research areas (themes) that need to be addressed to better understand acute and chronic oil spill effects on fish and fisheries?
- Picking one of the three major research areas you list above, what are three specific research gaps that need to be emphasized?
- Fisheries constitute a major user community in the Gulf, with significant economic and social impacts. As part of an enhanced ocean and coastal observing system, can you provide 1-3 priorities for future fishery observing investments?

The Facilitated discussion on these topics was wide-ranging and provides information for funders, managers and scientists:

Today’s session is covering a wide range of research on fisheries impacts of oil spills. What are three major research areas (themes) that need to be addressed to better understand acute and chronic oil spill effects on fish and fisheries?

Four main topics and related subtopics were identified by workshop participants:

- Exposure and effects
  - Habitat differences
  - Duration of time affected
  - Bioavailability

  - Metabolism/depuration – biomarkers including genetic and immunologic
  - Exposure to Corexit/dispersants, and its toxicity and synergy with oil
- Ecological significance
  - Delineating multiple stressors – cumulative effects
  - Species-specific vs community impacts – differences and importance of ecosystem approaches
  - Recruitment and larval ecology
  - Population recovery (species vs community)
  - Possibilities for "control" regions
  - Management strategies for commercial and recreational fisheries
- Characteristics of oil
  - Breakdown products, declining toxicity and degradation in biota
  - Persistence in the environment and specific habitats
  - Interactions with hypoxia
  - Sedimentary linkages- characteristics and effects on fisheries
- Needs to be considered and gaps to be filled
  - Spatial and temporal sampling- temporal resolution, systematic
  - Lab experiments vs field sampling – extrapolating process from both
  - Baselines and natural variability
  - Need for long time series, especially for larval life stages and recruitment

Picking one of the major research areas you list above, what are three specific research gaps that need to be emphasized?

- Incompatibility of toxicology results collected to date (agreed protocols and QA/QC for laboratory contaminant determinations and histology)
- Need for robust common protocols for toxics exposure studies

Four thematic areas identified in plenary:

- Participants identified interests in toxicological impacts on particular species:
  - i.e. tuna, red snapper, shrimp, etc.
- Understanding trophic dynamics at play
  - Cascading effects in food webs (e.g., Copepods – shrimps- top predators- people)
  - Understanding second-order effects through more sophisticated exposure testing (e.g., feeding contaminated prey)
  - Food web models must be developed hand-in-hand with laboratory studies
- Design of controlled exposure experiments
  - Looking at Gulf as chronic low level with episodic events superimposed
  - Due to cost, researchers forced to select individual species or body part to study so studies don't necessarily translate to species or community impacts
- Ecosystem and population recovery rates- demographics and abundance
  - Understanding in lab but also real world mixtures and sources

Fisheries constitute a major user community in the Gulf, with significant economic and social impacts. As a part of an enhanced ocean and coastal observing system, provide one-three priorities for future fishery observing investments.

- Technology and Sampling
  - Need standardized methods to assess fishery communities in situ, including in untrawlable habitats; using ROVs, active and passive acoustics, gliders, towed optical systems, AUVs
  - Need better habitat mapping in order to stratify fishery-independent sampling and prioritize such studies (e.g., working with high resolution fishery-dependent data may provide insights on where to prioritize habitat mapping)
  - New tracking technologies (active and tracking network gates) that can be used to better understand

how species utilize habitats and are potentially interacting with events like oil spills

- Ecosystem-based management
  - Inferring population recovery and species interactions from analysis of MPAs and other fishery protected areas
  - Contamination baseline data, community baseline abundance and demographic data (reef fish, pelagic, etc.)
- Accessibility to historical data
- Initiation of comprehensive biomarker baselines of oil contamination (e.g. PAHs) and histology to better interpret future pollution events
  - Integrated assessment activities /ecosystem modeling programs such as those in the Gulf of Mexico and Norway are a potentially significant development
- Metadata
  - Data Synthesis Center for fishery-independent and dependent data would allow better synthesis of oil spill effects
  - Need to make data widely available and more user friendly, including integration of data from agencies (state and federal), and activities funded by NSF, GoMRI, oil companies and other sources.

In addition to the plenary discussion on the three trigger questions, input was also solicited in writing. A total of 30 participants provided written responses. While there was a variety of input, there were a number of common or similar responses. Based on these data, the “top 10” responses to the three questions are summarized in Table 1. Full summaries of the responses will be included in our perspectives paper.

Summary:

Session 004 was the first major open scientific conference to specifically consider the impacts of DWH on Gulf of Mexico fisheries. The focus of the meeting was primarily on documenting research results funded by the GoMRI. Importantly, much research on fish and fisheries impacts has been and is being conducted under the Natural Resource Damage Assessment (NRDA), very little of which has been made publically available. When fully available, the totality of research (funded by the US Government, states, BP, and GoMRI) on oil spill effects and the development of new research approaches and tools will significantly advance fishery impacts assessment in the Gulf and elsewhere.

As with the Exxon Valdez oil spill, it has taken several years to observe and comprehend fish and fishery effects associated with the DWH spill. For example, declines in Pacific herring after Exxon Valdez were only recognized several years after the event, and cause and effect remain controversial. In the case of DWH, new research reported in Session 4 points to possible recruitment declines in the iconic red snapper, post-DWH, that were documented in at least three independent data sets. Are these observations representative and if so are they associated with DWH impacts? Research approaches to understand cause and effect need to consider alternative drivers of recruitment effects. Other species and community changes are equally important and require careful cause and effect evaluation.

In addition to recruitment effects, there are ongoing studies of population dynamics of a number of fishery populations, the results of which also have not been fully considered in the context of alternative factors. There are a wide range of likely responses and non-responses to oil and the lack of attributable responses are equally important when considering the totality of effects.

The diversity of Gulf fisheries is critically dependent on all habitat types in the Gulf, and there is a high dependency of early life stages of many species on coastal and estuarine habitats, especially in the area impacted by the spill. The full breath of potential fishery effects includes not only the direct effects of the oil but the impacts of mitigation measures used to minimize impacts (e.g., release of high volumes of Mississippi River water through water control structures, construction of sand berms, use of deep and shallow dispersants, skimming, and burning of oil offshore, etc.). Understanding the impacts of these various measures is critical to informing the selection of clean up techniques for future spills, as were the lessons learned from Exxon Valdez (e.g., power washing beaches).

There is considerable research on fishery effects of DWH currently in process and many new studies that

use materials collected since the spill. New research forthcoming from NRDA-funded studies will hopefully become available in the next few years that will add considerable additional focused information on fisheries. Of particular importance re appropriate baseline data on fish population dynamics and toxicology with which to compare to time series observations taken since the spill. Part of this effort uses the paradigm of "substituting space for time," to determine oil spill effects vs. putative control locations. This is a difficult proposition in the Gulf because of multiple hydrocarbon sources and movement patterns of some fish species. However, changes in contamination levels post-spill may indicate the severity of an event-driven vs. chronic low level pollution scenario.

Session 004 participants identified an ambitious, comprehensive set of long-term studies and focused experimentation that will significantly advance oil pollution effects studies and interpretation of DWH impacts. Because of the availability of resources in the Gulf, there is the opportunity to address issues that require sustained and intensive observation. Priorities for augmenting the observing systems in the Gulf to include fishery studies were also identified by Session 004 participants. These priorities will be shared with organizers of Session 010 which considered observing system priorities for the Gulf.

Understanding the impacts of DWH on Gulf fisheries is of considerable importance from many perspectives including ecological, economic and social. Getting this right may be one of the most important enduring results of investments by the GoMRI Board and the other Conference Sponsors. Session 4 co-chairs and participants are immensely appreciative of the Conference Organizing Committee for recognizing the value of a theme devoted to understanding fishery effects and for sponsoring the session.

Next Steps:

The co-chairs and facilitators will develop a perspectives paper for publication in the journal Fisheries (American Fisheries Society) or other appropriate venue. We will also promote the use of this synthesis in developing future research programs addressing oil spill effects.

Session 005

FATE AND TRANSPORT OF OIL SPILL RESIDUES AND THEIR IMPACTS ON NEARSHORE COASTAL ENVIRONMENTS

Tuesday, January 28, 9:15am-6:00pm

Session Chairs:

Prabhakar Clement, Auburn University*
John Valentine, Dauphin Island Sea Lab
Michel Boufadel, The New Jersey Institute of Technology
Chris Reddy, Woods Hole Oceanographic Institution
Joel Hayworth, Auburn University (Facilitator)

The DWH oil spill deposited large amounts of residual emulsified oil in the form submerged residual oil mat, SRMs (or tar mats), and surface residual oil balls, SRBs (or tar balls), in beach and wetland environments located along the Gulf Coast region. The persistence of some toxic chemicals (such as PAHs and alkylated PAHs) in these residues could cause negative effects on the ecology of these shoreline environments. Furthermore, the physical presence of SRBs and SRMs could adversely impact local economies. The objective of this session was to invite research presentations that can help improve our understanding of the fate and transport of oil spill residues in nearshore coastal environments and help quantify their impacts on local ecosystems. The topics considered include: 1) Mechanistic models and laboratory studies that can help researchers understand the fate of floating oil affected by various physical transport processes including evaporation, dissolution, photo-oxidation, mixing and emulsification in the open ocean environment; 2) Processes that lead to the deposition of emulsified oil in nearshore environments; 3) Novel analytical methods used for characterizing oil spill wastes; 4) Methods for quantifying the biochemical fate and decay processes in beaches and nearshore water bodies including wetlands; 5) Methods for quantifying beach and wetland recovery processes; 6) Technologies for identifying and removing sunken oil (e.g., tar mats) from beaches and wetlands; 7) Impacts of the presence of oil spill residues on the economy of coastal communities; 8) Characterizing human and environmental toxicity of oil spill residues; and 9) Hydrodynamic and sediment transport models that can predict the long term fate and transport of oil spill residues deposited in beaches and wetlands.

Session Report

The objective of this session was to focus on nearshore (primarily beach) contamination and recovery issues related to the DWH oil spill. Our goal was to invite active researchers working in this field to present their data and ideas to improve our current understanding of the fate and transport of oil spill residues trapped and residing in nearshore coastal environments and their impacts on local ecosystems. This was the second most popular session in terms of abstract submission. We received at total of 103 abstracts; 15 were selected for oral presentations, and over 85 for poster presentations that presented a variety interesting results. We also invited three well-known oil spill experts to deliver keynote talks: Dr. Jacqui Michel (Research Planning Inc. and former chair of the National Academy of Science's panel on oil spills); Dr. Zhendi Wang (Canadian scientist who is a leading authority on oil spill characterization); and Wade Bryant (recently retired from the United States Geological Survey; he led the Operational Science Advisory Team III, OSAT-3, study). Overall, it was a well-attended session. The opening session started with a full room and on average the attendance for the talks ranged from 150 to 250 people. The session organizing committee chair, Dr. Clement, opened the session by providing a broad overview of the shoreline oil spill contamination problem using specific examples based on his team's observation of the long-term behavior of surface residual oil balls (SRBs) and submerged oil mat (SRBs) found along the Alabama shoreline. The keynote speaker, Dr. Jacqueline Michel, then provided a broader view of this problem by discussing shoreline datasets collected through the SCAT (shoreline contaminant assessment techniques) process from all four highly-impacted states (Florida, Alabama, Mississippi and Louisiana). Both Dr. Clement and Dr. Michel pointed out that DWH oil spill residues (SRBs) are unique; these residues are often referred to as tar balls, but unlike traditional tar balls, which are rubbery weathered material with little or no odor, DWH SRBs are sticky, brownish, fragile material with a strong petroleum odor. The other talks in the morning session focused on specific case

studies and also methodologies used for understanding the fundamentals of physical and biological fate and transport processes. The afternoon session was opened by our second keynote speaker, Dr. Zhendi Wang, who presented forensic fingerprinting methods for characterizing various petrogenic, pyrogenic, and biogenic hydrocarbons in oil contaminated environmental samples. Other presenters pointed out the need for understanding the chemical and biological degradation pathways of various PAHs and also highlighted the need for focusing on alkylated PAHs and other oxygenated compounds, which have the potential to persist in the environment for an extended period of time. The final evening discussion session was opened by our third keynote speaker, Mr. Wade Bryant, who provided a brief summary of the recently published OSAT-3 study which was chartered to provide a science-based review of field data collected during the MC252 spill response; to conduct directed studies and sampling as necessary to evaluate source(s), transport, and deposition of weathered residual oil from the MC252 spill; and to recommend additional operational activities to more effectively recover this material (OSAT-3, 2013). Mr. Bryant highlighted the methodologies used by SCAT teams to identify potential SRM locations off Florida, Alabama, Mississippi, and Louisiana beaches. He also showed examples of how unique hydraulic conditions (e.g., Lagoon Pass outlet in Alabama) helped bury emulsified oil in Alabama's nearshore environment. In this evening discussion session, over 75 participants with diverse interdisciplinary background actively debated various issues. The discussions primarily focused on five specific questions. These five questions were developed based on the ideas espoused in the abstracts (total of 103) submitted to this session. In the sections below we summarize the viewpoints expressed by the partipants for each of these five questions and point out some of the research gaps indentified during these discussions.

Discussion Question 1: Is the presence of SRMs and SRBs a true concern, or a perceived concern?

There was a lively debate and the audience expressed a wide variety of opinions, ranged from "it's not a problem so let us move on," to "we are currently nowhere close to understanding the long-term risks posed by the presence of oil and its transformation products to coastal ecosystems." Overall, the group consensus was that currently, researchers really don't know much about long term ecological impacts from beach system SRMs and SRBs. While it is likely that the health risks posed by these residues to humans are low, the long-term ecological risks are mostly unknown. Therefore, immediate human risks are perhaps a perceived concern, but the potential long-term ecological risk is a true concern.

Discussion Question 2: What are the best methods for locating, sampling, and characterizing submerged oil?

The field approaches used during various cleanup operations appear to have worked reasonably well since cleanup workers have removed several SRMs and large amounts of SRBs. Although a number of SRMs have been identified in the past, the remaining SRMs are hard to detect. Also, it is possible that depending on their size and shape, some SRMs can become mobile or covered under larger sand deposits during high energy events. Currently available non-intrusive technologies to detect buried material cannot be used to detect SRMs. This is because SRMs have over 80 to 90% of sand and hence it is almost impossible to differentiate SRMs from the native sand material. The percentage oil content, however, can vary and some researchers pointed out that they have found more oil rich SRMs in Louisiana. It was also noted that SRB collection data has been used to indirectly locate SRMs, and recent studies have reported that cleanup crews are using this information for this purpose. Currently, the fundamental hydrodynamic and transport processes that lead to sinking of floating oil along sandy beach shorelines and the formation of SRMs is not fully understood. Therefore, laboratory and modeling studies, guided by field observations, are needed to help us more fully understand these processes. Hydrodynamic modelers also noted that they need more physical characterization data to understand and predict the movement of SRBs/SRMs.

Discussion Question 3: What are the physical and biogeochemical processes that affect submerged oil, and how can we characterize them?

There was broad agreement that microbial processes are the key for eventually transforming the oil spill residues into innocuous products. Therefore, more microbial studies, coupled to detailed chemical characterization techniques, are needed to track weathering processes. It is possible that some of the weathered compounds (such as alkylated PAHs, oxygenated PAHs and other oxygenated compounds) could be more recalcitrant and toxic. Therefore, we need laboratory studies to quantify the toxicity of weathered compounds trapped in SRBs and SRMs. It was recommended that government cleanup teams should

consider leaving some known SRM deposits in the natural environment and let researchers manage the site to study physical and biochemical fate and transport processes. SRBs are fragile material and they are continuously shaped by coastal processes; however, recent modeling studies do not incorporate temporal changes in the size and shape of SRBs (Plant et al. 2013). Small-scale laboratory or wave tank studies are needed to quantify the physical size reduction rates of SRBs to address the question of how waves and other natural erosion mechanisms would reduce the size of SRBs over time. It was also pointed out that a considerable amount of field work has been done at other oil spill sites worldwide, where oil has been buried near the shoreline environment. Comparative field studies can help us better understand how these buried mats would behave in different types of coastal environments. There is a wide range of oil spill residues which are sequestered in different forms, and well-designed laboratory and field studies are needed to understand the chemical, biological and physical transformation rates of these residues under a variety of environmental conditions. SRM and SRB fragments that can be recovered along the northern GOM coastline are perhaps the only long-lasting records (which can be collected relatively easily) of this historic oil spill event. To collect and study these naturally-weathered residues, over the long-term, is an extremely rare opportunity which can help develop a better understanding of a variety of oil spill weathering mechanisms.

Discussion Question 4: What constitutes an acceptable amount of background residual oil (or SRB activity), and how should this be determined? How clean is clean?

One of the presenters pointed out that between April 3, 2011 and October 7, 2011, cleanup response teams have observed and documented more than 680 occurrences of non-MC252 tar balls (about 5,000 individual tar balls over 861 miles of coast) on the shorelines of all 4 states (Unified Command SCCP Report, 2011). Based on these data, the authors postulated that the historical background level of tar ball activity estimated for GOM beaches is about 6 tar balls/mile over about seven months. In his opening presentation, the conference Chair, Professor Clement, presented a recent field survey (completed a day before the conference on January 26th 2014) where his team recovered several sticky, fragile MC252 SRBs within a couple of miles from Alabama's beaches "(in this case, about 140 SRBs weighing about two pounds were collected within an hour from two beaches in Gulf Shores and Fort Morgan, Alabama). Thus, the current level of SRB activity on Alabama Beaches is well above the historic background level. Some participants noted that SRBs currently being deposited along northern GOM perhaps are only an aesthetic issue, and pose little or no immediate risk to human or ecological health. One possible, highly conservative, definition of cleanup level is a point at which other sources of oil dominate over DWH SRBs. However, most participants agreed that it is unlikely that this level will be achieved any time soon. Therefore, one should perhaps revisit defined endpoints for cleanup, since aggressive cleanup methods to achieve the original background level have the potential to cause more ecological harm than good. A few researchers questioned whether the notion of background level is even relevant, since the word "clean" depends on cultural norms. One of the participants stated that in the 1970's, finding oil on various US beaches was considered normal; more recent environmental regulations have changed our ideas of what the background norm should be. Another participant pointed out an interesting dilemma illustrating how the general public puts faith in scientific assessments related to public policy issues: while people may not let oil spill residues remain in their backyard pools, regardless of what science may say regarding its safety, they appear to have a higher level of tolerance and are willing to accept their presence in public beaches if the science can support that there are no immediate health risks. One participant noted that the public understands that there are many things in our daily lives that we are routinely exposed to, which pose more risk to human health than natural oil spill residues. Another participant suggested that the question "how clean is clean" is perhaps outside the realm of quantitative science – it is, however, a very important cross-disciplinary question that should include the perspectives and insights of social science. For example, the need for clean beaches could be quantified through worthiness analyses to estimate the price people are willing to pay for having clean beaches, as opposed to having economic opportunities that are derived from supporting oil exploration projects that have the inherent potential to contaminate their beaches.

Discussion Question 5: How can we monitor and assess nearshore ecosystem impacts and recovery?

There was a clear consensus among biological scientists that the DWH event offers a unique opportunity to develop good background information about the natural variability in community structure and function of meiofauna and macrofauna present in northern GOM beaches. We should focus our research on

understanding not only the impacts on specific organisms, but also on understanding their impacts on communities, as well as processes (e.g., community level metabolism and interactions) through both field and controlled laboratory experiments. Passive chemical monitoring methods that can measure the accumulated concentration levels of various contaminants of interest are needed to quantify possible exposure levels. One of the participants stated that from an eco-toxicity perspective, it is unclear whether we should continue to treat SRBs and SRMs as hazardous material. The fact that people are now visiting Alabama beaches, in some cases at levels exceeding those prior to the DWH event, indicates that the public perceives their risk as low. From a socio-economic impact perspective, the beaches are full and hence they could be considered as "fully recovered." Novel monitoring approaches are needed to quantify other long-term ecological impacts and recovery levels. There are numerous petroleum and chemical products that are routinely released into the GOM from various urban activities (for example, from the thousands of boats and cars in the communities bordering these beaches). Therefore, differentiating DWH oil spill impacts on shoreline ecosystems from other more routine impacts is a challenge which will require carefully designed, long-term monitoring studies that employ both chemical and biological approaches.

References

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Session 006

SOCIO-ECONOMIC ANALYSIS OF ECOSYSTEM CHANGE: FROM BASELINES TO CATASTROPHIC EVENT

Monday, January 27, 9:00am-6:00pm

Session Chairs:

David Yoskowitz, Harte Research Institute*

Rex Caffey, Louisiana State University

Oil spills, hurricanes, floods, and other man-created or natural disasters can have substantial effects on ecosystems and human well-being. Understanding the bio-physical/human well-being nexus is critical for the effective management of our natural resources, including protection and restoration, but also in the immediate response to these disasters. Currently a deficiency of socio-economic studies and comprehensive data collection efforts in the coastal and marine environment exists, yet there is growing recognition that a holistic approach (natural, social, and policy sciences) is required in ongoing baseline studies as well as event driven work. There is concern that because of the lack of relevant socio-economic data, significant opportunities for co-improvement in ecosystems and human well-being might be lost. This session examined where we currently are, what we can expect the needs to be, and where the gaps exist with regards to socio economic data and analysis.

Papers presented at this session examined the following:

- How to effectively implement large longitudinal studies in order to collect data not previously considered;
- Connecting the event to community health and well-being;
- The connection between ecological structure and function and human well-being;
- The socio-economic data gaps that exist for effective ecosystem management;
- New analysis techniques to demonstrate ecosystem service values in monetary and non-monetary terms;
- Resilient communities and the importance of social connectedness; and
- Integrated social and economic analysis of typically understudied economic sectors or communities.

Session Report

Traditionally there has been a divide between natural sciences and the social/policy sciences that has hampered truly collaborative work that could lead to effective management of our natural resources, built around the premise that environmental well-being leads to human well-being. The Clean Air Act (CAA) and Clean Water Act (CWA) are illustrations of a nation's recognition of this. While there have been significant costs associated with the implementation of these regulations (CAA=$65 bill/yr in 2020), there are also significant benefits (CAA=$2 trill/yr in 2020) . A substantial scientific infrastructure has been built around implementing, enforcing, and analyzing the CWA and CAA. But other important issues have emerged in the last couple of decades such as climate change and related extreme weather events, and man-created events, which are requiring a new method in order to be addressed: a truly integrated multidisciplinary approach where the environmental and social issues are consider at the same time and not sequentially. But there exists significant data and technique gaps in connecting the bio-physical functioning of the environment and human and community well-being.

Session 006 of the Gulf of Mexico Oil Spill & Ecosystem and Science Conference, 2014, titled: SOCIO-ECONOMIC ANALYSIS OF ECOSYSTEM CHANGE: FROM BASELINES TO CATASTROPHIC EVENTS endeavoured to take a holistic approach at linking individual and community well-being with environmental condition and identifying the gaps that would help improve current techniques and understanding. The social/policy disciplines were well represented (Sociology, Anthropology, Economics, Policy/Law, Human Health) as well as the natural sciences. A few important themes surfaced.

Community: It was stressed that we often lose sight of the trees when looking at the forest. Because of our tendency to aggregate data and information to make it generalizable in its use, we miss important insights at a very fine scale. That measurement of human well-being and resilience needs to take place at a community and individual level. Communities are distinct but not isolated. When a community is impacted from an event, such as a hurricane or oil-spill, the quickest way to get that community back to feeling "whole" again is to have them participate in the response. The community participation approach is not only important in building community resilience but it can also be very effective in the gathering of non-traditional data. Non-traditional data is data that is not collected by the various federal and state agencies (Census, Bureau of labor Statistics, etc.). These could include long-term health or anthropological studies, one-off studies from economics and sociology as well as others.

Environment and Human Well-Being Interconnectedness: The next important step in understanding the relationship between environmental condition and human well-being is developing the functional links. This will require working backwards from human well-being → ecosystem goods and services → ecosystem function → ecosystem structure. This is not the domain of one discipline but requires several from the social and natural sciences working in concert, from the beginning, in order to frame the research questions correctly.

Data Needs and Gaps: It is generally agreed that social scientists have as much of a lack of relevant data and information as the bio-physical sciences. In order to meet the next significant challenge of linking the environment and human well-being, a substantial effort must take place to collect non-traditional data, over time, so baselines can be established and changes can be measured. Below are some of the needs and gaps that were identified:

- Establishing human well-being indicators and the link to environmental condition.
- Valuing GoM ecosystem services in a systematic manner over time.
- Distinguishing between community and individual resilience and the link to environmental condition.
- Understanding coastal economics at the community and individual level.
- Modeling economic performance for marine recreational activities.
- Quantifying habitat quality linked to fishery health.
- Quantifying the difference between subsistence and recreational fishing.
- Analyzing the impacts of acute disturbances on ecosystem services and human health.
- Translating knowledge to policy.
- Connecting the offshore environment to human well-being.
- Empowering the government to provide science data that is locked up in litigation for public consumption.

Session 007

COASTAL ECOSYSTEM COUPLINGS THREE YEARS AFTER THE DWH OIL SPILL

Monday, January 27, 9:00am-6:00pm

Session Chairs:

R. Eugene Turner, Louisiana State University*
Nancy Rabalais, Louisiana Universities Marine Consortium
Linda Hooper-Bui, Louisiana State University
Brian Roberts, Louisiana State University

In order to fully understand the impacts of the DWH oil spill on coastal ecosystems it is important to examine responses over multiple timescales since the effects on some communities may be immediate while others take longer periods of time for the effects to cascade up food webs. An important additional consideration is that the time scales over which impacts persist may vary for different populations/communities of the impacted ecosystems as well as for the ecological and biogeochemical process rates that regulate these systems. This session invited contributions on how coastal marshes and nearshore water ecosystems have been affected, or not, following 3+ years of oil exposure following the DWH spill. Talks covered a wide range of topics including oil distributions and degradation in the marshes and nearshore sediments, trajectories of oil transport, marsh erosion and stability, marsh vegetation, food web studies, and specific community responses (e.g., insects, infauna, birds, fish, etc.), commercial fisheries and ecological and biogeochemical process rates. It also covered oil fate and transport: integrating field data and transport models, marsh food webs, including insects, birds; benthos, microbes, open water baseline and stressors: offshore systems, commercial fisheries: distribution of effort post-spill, biogeophysical, including microbial indicators, and research designs for the next spill.

Session Report

Session 007 was established as a forum to examine the impacts of the DWH oil spill on coastal ecosystems responses over multiple timescales. Most, but not all, of the sixteen 15 min presentations were delivered by investigators reporting on GOMRI funded research conducted as part of the Coastal Waters Consortium. Two were invited student presentations. This session invited contributions on how coastal marshes and nearshore water ecosystems were affected, or not, following 3+ years of oil exposure following the DWH spill. The talks covered a wide range of topics including oil distributions and degradation in the marshes and nearshore sediments, trajectories of oil transport, marsh erosion and stability, marsh vegetation, food web studies, specific community responses (e.g., insects, infauna, birds, fish), commercial fisheries, and ecological and biogeochemical process rates. It also covered oil fate and transport: integrating field data and transport models, and research designs for the next spill.

There were a complementary set of 41 posters that overlapped with the presentations, and a panel discussion with an ‘open microphone’ for a facilitated community discussion lasting about 2 hours. The discussion was primed by three questions identified by the session organizers before the conference began and handed out in the oral presentations and during the afternoon panel discussion. The attendees were asked to focus on these questions in their oral discussion, and to leave written comments with the organizers at any time. We received about 65 written comments about the suite of three questions. Notes were taken of the plenary discussion, and are summarized below. They may not fully represent the comments of individuals, but represent a synthesis of what appeared to be the main observations of the meetings (#2), and the responses to the three questions (#3). The attendance at the plenary session fluctuated as people moved in and out during the day; our ‘best-guess’ estimate is that there were about 205 people in the room at any one time during the plenary session, and 75 to 100 during the discussion period.

Observations about the research outcomes, to date

The DWH spill was the largest spill in the Gulf of Mexico (GOM) and, therefore, presented a new suite of research challenges. It was not the first oil spill entering GOM marshes, but certainly was the largest

in terms of oil spilled, area covered, and societal attention. The research community had expectations about what might occur in the shallow-water coastal ecosystems based on oil spill research in different systems. Some of these baseline assumptions were contradictory or unfounded, because they were based on results from other areas of different geomorphology, latitudes, community composition and oil exposure. As the research accumulates, as in other endeavors, some expectations are found wanting and others confirmed. Table 1 is a summary of 12 significant observations of unexpected outcomes.

Table 1. Some outcomes, to date, of the research on coastal systems affected by the DWH oil spill disaster. These are contrasted as widely-held expectations from before the oil spill and the significant contrasting findings three years later.

	Before the oil spill	After 3 years of invesigation
a.	Biomarkers stable	Some biomarkers are unstable (e.g., hopane)
b.	Single oiling, and oil is perhaps biodegraded within few years	Multiple oiling; PAHs last many decades
c.	Marsh oiled at the edge, and homogenously	Oiled >100 m inland, and patchy
d.	Impacts 1 year (?), and restoration happens quickly thereafter	Impacts 3+ (?) years
e.	Focus primarily on marsh grass for restoration/ recovery	Requires much more than this, e.g., insects, birds, soils, etc.
f.	Models @ 1 km grid (coarse)	A much finer grid is essential to understand the hydrology, hence dispersion of oil and how ecosystems are exposed to the oil and respond to it within a suite of stressors
g.	Marsh homogenous, therefore only few control sites are needed	Background complexity confounds simple control/ impact site selection in time and space
h.	Restoration/remediation are predictably successful	NOT so
i.	Knew a lot, and were just missing a few key pieces	Did better than in previous spills, but also learned that we don't know much (appreciation of ignorance)
j.	A dramatic and singular event	The DWH incident was one stressor acting within the context of other stressors, incl. sea level rise, climate, river diversions, multiple oilings, wetland loss, social setting
k.	Phytoplankton community adapts, or is too complex to find the ecosystem signal	Complex, yes, but there are signals of impacts, but not a coupling (yet) with the rest of the food web
l.	Impacts assumed to occur some organisms	Sometimes these impacts were less than expected, e.g., oysters and mussels, and some life stages of fish, and others unexpected (e.g., insects and birds)

a. Some oil biomarkers are used to track the movement of oil and to create a stable baseline against which the decomposition trajectory of other analytes can measured. We and others are finding out that some of the commonly used ones are not as stable as expected and that their usefulness should be re-evaluated.

b. The DWH oil spill disaster offshore was a singular event which took place over several months offshore and as it flowed into the estuary over one summer in 2010. There were dramatic pictures of marsh oiling in 2010, but the chronic effects continued. The initial impressions of marsh oiling have evolved to acknowledge that there were multiple marsh oilings in 2010, and in subsequent years, as a result of re-distribution of oil residues remaining unknown locations throughout the estuary. This re-oiling and re-distribution contaminated marshes initially set-up as control marshes (relatively unoiled marshes) and created multiple oilings of marshes.

c. There were multiple accounts based on visual surveys by multiple groups concluding that the oil did not penetrate the marsh more than 10 m and was homogenously distributed along the shoreline. This turns out to be quantitatively incorrect and probably based on the paucity of measurements of oil further in the marsh. Sediments samples have now been taken from up to 100 m into the marsh and document no such decline in oil concentration at 10 m, or even 100 m. In other areas, however, the distribution of oil was so patchy that the difference in the concentration of oil was three orders of magnitude for stations located 20 m apart.

d/e. There was a commonly-expressed distinct possibility that the oil would 'naturally decompose within a year or two, and that the impacts would decline in a proportional manner. Marsh plant recovery was expected to be a good indicator of community or ecosystem recovery. This certainly happened in some other regions of the world, especially in sandy or well-aerated soils. It is not the case in Louisiana marshes for reasons discussed at the meeting and gradually being documented in papers submitted to journals by the participants in session 7.

f. The size of the cells used to model oil trajectory in estuaries must match the dimensions of hydrologic channels and mixing forces in horizontal and vertical directions. Channels with meaningful flow volumes are almost always less than a few m across and 1 m deep. The dimension of cells used in offshore models is too coarse @ 1 km for inshore modeling. A much finer grid is essential to understand the hydrology, hence dispersion of oil and how ecosystems are exposed to the oil and respond to it within a suite of stressors.

g. The expectation that a few sites could be used for a before and after comparison with what appeared to be oiled marsh sites (a BACI design, for example) is too simplistic. It doesn't take into account variability amongst marshes across hydrologic gradients and basins that is demonstrated by the flux of elements across the air-water interface, microorganism diversity, population dynamics of organisms, and elevation gradients, among others. The background complexity confounds simple control/ impact site selection in time and space, and must be accounted for in the research design and data interpretation.

h. Whatever expectation there was about how well one or two restoration approaches would be sufficient to restore wetlands or minimize damages was discarded. Some approaches may result in some visual improvement, but are hardly applicable beyond a few local settings for reasons of cost, effectiveness, or because they made things worse.

i. Some expected that previous experience with prior spills, the subsequent oil spill response infrastructure, and ecosystem exposure from smaller spills over decades was sufficient to quickly and sufficiently correct the problems, especially if a massive effort was applied. The community did learn a lot from this prior experience and preparation, and did respond better than in previous spills. But we also learned that we don't know much about how the system 'works' (still) to meet expectations for sustainable management principles (appreciation of ignorance).

j. The DWH oil disaster, perhaps because of its size, media coverage, broad geographic distribution and consequential social consequences was often portrayed as a dramatic singular event, which is a view that colored the evaluation of impacts. What is clear, however, is that the DWH incident is viewed as an acute stressor when it is now a chronic stressor. It is, in fact, only one stressor acting within the context of other stressors, including sea level rise, climate, river diversions, multiple oilings, wetland loss, and social setting. Sampling schemes, data analysis and interpretations must include this broader perspective.

k. The problems involved in measuring or estimating the impacts of the DWH incident on phytoplankton may led to the conclusion that it was not worthwhile to investigate, or because the impacts were short-lived or minor. We agree that the complexity of these systems is an issue to grapple with, but there are signals of oil-spill related impacts offshore and from laboratory studies, but not a coupling (yet) linkage with the rest of the food web.

l. We expected, as other did, that there were some impacts on some organisms as observed in other spills. But there were exceptions and new surprises in the absence or degree of impacts for some of these. Sometimes these impacts were less than expected, e.g., oysters and mussels, and some life stages of fish, and other impacts were unexpected (e.g., insects and birds).

A synthesis of the answers to three pre-identified questions posed to the attendees:

The session covered a wide range of research efforts and findings. What are the management implications of this work?

The impacts are significant, long-lasting and incompletely revealed. Oil in marshes will stay there for a very long time; erosion, for example, is forever. Prevention, not mitigation, is the first order of the sustainable management of oil spills. There are three major points about evaluating impacts: we need baselines, baselines, and baselines: More, different, and longer kinds of baselines are needed. The placement of control sites needs to be within a context of shifting baselines, multiple stressors, and complex oiling patterns. It needs to include nimble, informed, and offer immediate responses.

How does what we have learned post-DWH influence how we might or should respond to future oil spills. What would we do differently – or urge others to do differently -- to optimize the preparation for and response to future spills?

The scientific community needs to more often communicate directly and clearly to management the essential findings of spill mitigation. Disputes are inevitable - illuminate them and learn, not avoid and continue with risky behaviors. The response trajectory of people and ecosystems remains murky and sometimes undefined, but is longer than expected; plan for that (money, expertise; assessment, monitoring); track with data not with concepts

Some effects are obvious after three years while others are less clear. How should this influence research or management efforts moving forward?

Keep monitoring far longer than we think is necessary; keep asking questions that keep pace with the innovations/findings that resulted from this spill. Emphasize including and supporting nimble minds and flexibility. The suite of stressors known and looming do not allow for a stable set of circumstances for science or management. Everyone should expect another large event within 10 years… what is needed? Plan for it, but please don't minimize the possibilities for reducing the probability of the next one happening, or the size. Finally, the GOMRI effort is validated. Learn from it and do even better next time (and there will be another).

Next steps

There are multiple efforts that will continue to 'soldier on.' A clear identification of the known and unknown contributes to better management. Scientists are urged to publish their results in respectable journals, to communicate the results through appropriate outlets, to include the lessons learned through educational outlets, and to publish. Our collaborations with the communication professionals will continue as the community understanding of this issue matures and broadens over the next few years.

Congratulations

We congratulate Ms. Jessica Henkel, Tulane University, for receiving the conference's James D. Watkins Award for Excellence in Research for her invited talk in Session 007 "Impacts of the Deepwater Horizon oil spill on shorebird communities in the northern Gulf of Mexico."

Acknowledgments

We thank Heidi Still who facilitated Session 007 and captured the essence of the discussion in an organized and clear set of notes made available to the session organizers.

Session 008

ADVANCES IN DISPERSANT SCIENCE AND TECHNOLOGY: MOLECULAR MECHANISMS, NOVEL DISPERSANT SYSTEMS, AND ENVIRONMENTAL IMPACTS

Tuesday, January 28, 9:15am-6:00pm

Session Chairs:

Norma Alcantar, University of South Florida*
Ronald Larson, University of Michigan
Ramanan Krishnamoorti, University of Houston
Berrin Tansel, Florida International University

The session focused on the new advances in dispersant science and technology focusing on translation from fundamental physiochemical aspects to the integrative aspects of dispersant fate and ecosystem impacts. A distinctive aspect of the session was the integration of length scales, from molecular concepts to the large scale of dispersant application in the open ocean environment. Additionally, the session reflected research encompassing the extremely small temporal scale of dispersant dynamics, to the long term fate of dispersants. This session included topics such as the next generation of dispersants including novel methods of delivery, assessment of performance, toxicity and fate. The session delivered unifying concepts of how dispersant design can be geared to future applications in deep sea environments, in surface spills representative of incidents in fresh, saltwater, and in the Arctic. A white paper was produced to disseminate the scope of research topics presented in the session.

Session Report

Background

The DWH oil spill triggered the need for understanding and designing the best dispersants for crude oil. On May 15, 2010, the U.S. Environmental Protection Agency (EPA) and the U.S. Coast guard authorized BP to use dispersants underwater at the source of the spill. Adding dispersants underwater at the source of a leak had never been tried and, therefore, the effects and potential risks and/or benefits were unknown.*

Session Goals

This session focused on two direct goals. First, it was directed toward new advances in dispersant science and technology, focusing on translation from fundamental physiochemical aspects to the integrative aspects of dispersant fate and ecosystem impacts. Second, it showcased research encompassing the extremely small temporal scale of dispersant dynamics to the long-term fate of dispersants.

Audience Expectations for Session

The chairs developed a survey to determine the topical expectations of session attendees and to quantify if these topics were addressed through the oral presentations. The results aligned with the questions submitted by potential attendees during registration for the session. The primary topics, with more than 63% expressing interest, included dispersant design, experiments or techniques to assess dispersant performance, how dispersants work to break the oil, and how to improve oil spill remediation by using dispersants. Topics such as identification of criteria applied to determine optimality of a dispersant, exciting opportunities for simulations to impact dispersant design, use and implementation of environmentally-friendly dispersants, the role and fate of dispersants in the DWH incident, the effects of applying dispersants at depth conditions, and Pickering emulsions dominated the audience's curiosity, with about 50% expressing interest. Topics with interest levels below 37% included how to determine the toxicity of dispersants, how to establish collaborations with experts in dispersant technology and science, outreach and education efforts in the area of dispersant science and technology, ecosystem impacts of dispersant applications, how much dispersant should be used, and dispersant carriers and the drawbacks of using them.

** Reference: http://www.epa.gov/bpsill/dispersants-testing.html*

Session Participation

Approximately 150–180 attended the first morning session and the last session in the afternoon. The session included a facilitated discussion at the end of the day with approximately 80 attendees. Disciplines represented in the sessions included chemistry (molecular, organic), physics (mixing, spreading), biology (toxicology, environmental impacts), and engineering (chemical, environmental, mechanical).

Research Topics Covered in the Session

The session received 75 abstract submissions. As shown in Figure 2, five main topics on the science and technology of dispersants were represented in 20 oral presentations, including the keynote presentation on the novel technology of "herders." The remaining abstracts were accepted as poster presentations, and authors were encouraged to participate in the Monday poster session at the convention center (the Tuesday poster presentation was cancelled due to extreme weather conditions at the conference location).

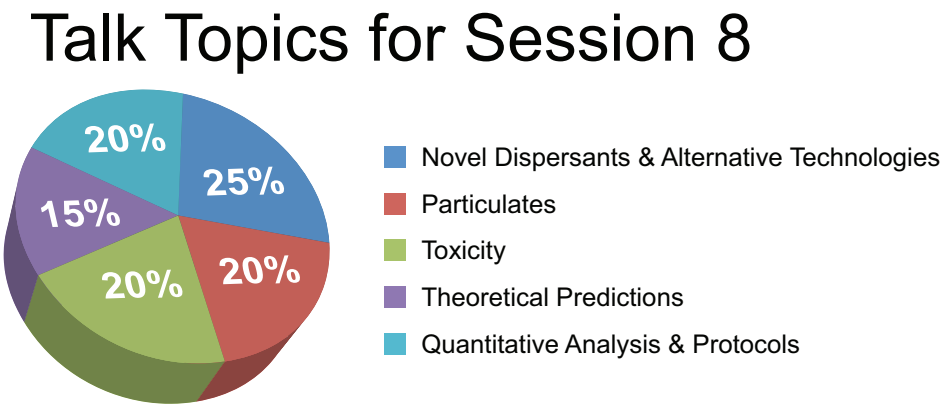

Figure 2. Distribution of topics presented in Session 8: "Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts"

Audience perception of what topics were well-covered in the session included the following: how herders work for oil spill remediation, protocols for testing the effects of dispersed oil and the effectiveness of dispersants, and how particles can be used as dispersants. Other topics perceived as more or less covered in the oral presentations included mechanisms of dispersants, required concentrations and implementation conditions of dispersants to remediate oil spills, effective dispersants, chromic toxicity or dispersant-degradation projects relevant to marine species, impact of dispersant on organisms, theoretical predictions of dispersant behavior and properties, chemistry of novel dispersants, and adverse health effects of dispersant exposure and misconceptions on this issue. One topic that was perceived not to have been covered in the presentations was: how dispersants are degraded.

Summary from Facilitated Discussion

The following issues were discussed at the end of the day in a wrap-up session. The discussion included a series of questions that members of industry, academia, federal agencies, and undergraduate and graduate students were ask to reflect upon and about which they could express their points of view, as well as their knowledge and perceptions about the issues that were presented during the oral presentations and general topics that were important related to the design of dispersants.

1. "Herders" presents an exciting prospect for contending with oil spills.
2. Testing the effects of oil or dispersants on the ecosystem must deal with realistic concentrations and time histories.
3. Acute exposure is the easiest testing procedure but must be extrapolated to estimate chronic effects of lower-dose exposures. Trans-generational effects are even more difficult to determine. New methods—for example, those involving RNA expression—offer new avenues for assessing the effects of lower doses and should be pursued.

4. Displacing existing dispersants in the marketplace must contend with governmental regulations, the need to work with many types of oil, and cost, as well as toxicity and biodegradation. Promising avenues involve dispersants that might be used at a much lower dose or that can cope with viscous crudes (> 10,000 cP).
5. Information on ecological impacts must be translated into language that decision-makers can use. Impacts on fisheries, aquatic and coastal species, and human communities of use or non-use of dispersants must be assessed in language that facilitates wise emergency decisions.

Conclusions

This session was very informative and had excellent participation from the conference audience. The most common comments, by far, related to how degradation of dispersants occurs, the design of new dispersants, and understanding dispersant performance. Information on toxicity; natural dispersants, including particulates and Pickering emulsions; and mechanisms of dispersal of oil were covered in the session. However, participants felts that more information on these topics would have been valuable to them.

Acknowledgments

The chairs of the session would like to thank Ms. Heidi Stiller (facilitator) and Ms. Jenny Hauser (note-taker) for their help to run the session smoothly and invaluable hard work. We would like to thank Dr. Tim Nedwed from Exxon Mobil Upstream Research Co. for presenting the keynote talk of this session. We would like to thank all the organizers of the 2014 Gulf of Mexico Oil Spill & Ecosystem Science Conference for providing the venue and support to make this session possible. In addition, we would like to express our gratitude for the support of the GoMRI and the Consortium for the Molecular Engineering of Dispersant Systems.

Session 009

PUBLIC HEALTH, ECOLOGY AND SOCIETY IN THE CONTEXT OF RESILIENCE: A SYSTEMS APPROACH TO ASSESSING THE POTENTIAL IMPACT OF THE GULF OF MEXICO OIL SPILL

Tuesday, January 28, 9:15am-6:00pm

Session Chairs:

Maureen Lichtveld, Tulane University School of Public Health and Tropical Medicine*
Symma Finn, National Institute of Environmental Health Sciences
Dale Sandler, National Institute of Environmental Health Sciences
Jeffrey Wickliffe, Tulane University School of Public health and Tropical Medicine
Joseph Griffit, University of Southern Mississippi

Communities on the U.S Gulf Coast have faced decades of interdependent environmental, public health, psychosocial, and economic challenges directly affecting their individual health and that of their communities. Among those challenges are historical environmental contamination, lack of preparedness against natural disasters and the impact of those disasters on physical and mental health, persistent health disparities related to chronic conditions including cancer and asthma or to birth outcomes such as preterm birth and low birth weight. In addition to previous natural disasters such as Hurricane Katrina, the Gulf of Mexico oil spill further stressed coastal habitats and communities resulting in a complex array of new scientific questions and concerns, including the role of resilience in disaster recovery of ecosystems and people. While extensive investigations are under way and progress has been made in expanding the discipline-specific knowledge base, robust interdisciplinary research has been limited. This session brought together researchers to present findings and identify gaps from an integrated environmental public health, ecosystem and social science perspective. Using a systematic environmental pathway framework, three tailored presentations modules focused on characterizing the spill-related exposures (module 1: environmental media and exposure), examining the ecosystem- and human health impacts (module 2: public health-, ecosystem- and socioeconomic impact), and evaluating evidence-based strategies to bolster community engagement in oil spill research (module 3: community engagement in research, outreach and education) with the overall aim to reduce adverse public health, ecosystems, and societal effects and improve preparedness for future events by strengthening ecosystem- and community resilience.

Session Report

The session PUBLIC HEALTH, ECOLOGY AND SOCIETY IN THE CONTEXT OF RESILIENCE: A SYSTEMS APPROACH TO ASSESSING THE POTENTIAL IMPACT OF THE GULF OF MEXICO OIL SPILL was attended by over 300 registered participants representing a diverse set of stakeholders from academia, community, industry and government. The overall goal of this session was to provide a platform for the development of a transdisciplinary research roadmap integrating ecosystems, social science and public health to examine the potential impact of the Gulf of Mexico oil spill. Through 16 oral and 22 poster presentations the session engaged speakers from across the US Gulf Coast region and the country representing community leaders and disciplines ranging from toxicology, epidemiology, medicine, psychology, anthropology, ecosystem service sciences, and economy. Session participants joined presenters in describing the overall tenets of a transdisciplinary research roadmap integrating ecosystems, social science, and public health to assess the potential impact of the Gulf of Mexico oil spill; examining the science base exploring the relationship between environmental exposures and human and ecosystem health; in identifying complex issues of science and potential transdisciplinary solutions within the context of strengthening resilience of individuals, communities, and their environment; and in discussing evidence-based strategies to facilitate improved science literacy, education and outreach in the context of the Gulf of Mexico oil spill and environmental disasters in general. Platform presentations were categorized in three modules: environmental media and exposure, public health-, ecosystem- and socioeconomic impact, and community engagement in research, outreach and education. Presenters assessed factors associated

with current chemical exposures in Gulf residents, examined associations between oil spill experience and mental health in pregnant women and women of reproductive age, and addressed gaps in resilience in the context of health and ecosystem services. Session participants were able to learn about community-based approaches for making environmental health science relevant to communities and how an emerging scholars academy targeting high school students is building a new cadre of environmental health scientists along the US Gulf coast.

An interactive, participatory strategy was deployed to identify research gaps and priorities: First, each presenter was explicitly requested to list research gaps based on the research presented; Next, at the end of each module participants and presenters prioritized the identified research gaps and were also allowed to list additional gaps not identified by the presenters; finally, at the end of the session all presenters and participants prioritized a final list of gaps.

As a result, the following research gaps were proposed to guide the development of a future transdisciplinary framework integrating ecosystem, social science, and public health research to address the impact of oil spills and disasters

- Invest in cross-disciplinary partnerships
- Assess baseline health status of different target communities
- Strengthen the science of resilience
- Characterize background exposure levels in communities to examine health status trends overtime
- Develop effective methods to advance environmental health literacy
- Promote the use of locally-collected data to inform the risk assessment decision-making process
- Prioritize inter- and trans-generational health studies in at-risk communities
- Design a new generation of cumulative exposure models

The research gaps provide important context for the proposed transdisciplinary framework and may serve as critical building blocks. For example, without investment in cross-disciplinary partnerships through accelerated and potentially preferential funding of team-based holistic approaches, complex questions of science will go unanswered. Likewise, baseline health status data and background exposure levels in communities are prerequisites to establish epidemiologically sound associations and address persistent community concerns. While resilience is implied or inferred in many instances, strengthening the science of resilience including examining resilience in the context of community is imminently needed. The gaps also represent promising strategies to answer complex questions regarding the risk paradigm prevalent in communities: interdependent challenges of health disparities, environmental threats, and disasters. Inherent in those strategies must be the collection of local data in collaboration with affected communities to aid the risk assessment decision-making process. Accurately assessing biological plausibility and risk becomes progressively difficult when exposure assessment efforts are not undertaken in the immediate aftermath of an event; Designing new generation cumulative exposure models which are able to quantify both past, “baseline” and current exposures will advance the accuracy of community-based risk assessments and allow for tailored interventions and risk reduction actions. None of this can be effectively achieved without bolstering day- to- day health literacy.

In addition to the research gaps, session participants highlighted three overarching issues: defining exposure across disciplines, emphasizing health’s physical and mental health aspects, and addressing complex issues regarding the science, policy and practice of communication. The need to contextualize “exposure” across disciplines arose from a lively session discussion regarding the implications of the use of the term among the diverse set of stakeholders. For example, environmental health scientists confirm exposure by measuring either the toxicant or its metabolite through biological specimen analyses while social scientists consider experiencing the impact of an event on overall health and wellbeing as being exposed to the consequences of that event. Likewise, in post-disaster studies it is becoming critically

important to ascertain both physical and mental health implications and the relationship between these two aspects of health. Participants also discussed the role of communication in science, policy, and practice. Specifically, implications of ineffectively communicating research findings, the community impact of disseminating poor quality science, and how to communicate “no news is good news” in the aftermath of disasters were important discussion topics. From a policy perspective, the complex issues surrounding sharing data derived from human health studies while protecting confidentiality were identified as pertinent areas for discussion in the near future. The importance of building trust and credibility by engaging all stakeholders –communities and corporations alike- was recognized as prudent practice.

The session culminated in urging investments in a new paradigm of scientific inquiry that reaches across ecology, ecosystem services, and population health. Participants also emphasized the importance of advancing resilience research with particular focus on developing indicators of resilience across disciplines and exploring the relationship between resilience and sustainability. Bolstering education and literacy was identified as a critical priority to strengthen community participation in research. A joint publication will be developed describing a transdisciplinary framework integrating ecosystem, social science and public health research, highlighting the priority research gaps to inform future GOMRI and other oil spill- related research investments, and disseminating evidence-based strategies to promote multi-stakeholder and community engagement in future research. The session leadership will also pursue opportunities to convene an expert panel workshop targeting the contextualization of “exposure” in disaster settings.

Session 010

CURRENT AND FUTURE ECOSYSTEM-MONITORING STRATEGIES IN THE GULF OF MEXICO: SPANNING DISCIPLINES, PLATFORMS, AND AFFILIATIONS

Tuesday, January 28 9:15am-6:00pm

Session Chairs:

Rebecca Green, Bureau of Ocean Energy Management*
Chris Elfring, National Academy of Sciences
Alyssa Dausman, US Geological Survey
Steven Murawski, University of South Florida

This session focused on ecosystem monitoring studies currently underway in the Gulf, as well as a vision for an expanded ocean observing network for meeting coastal and ocean decision-making needs, including oil spill response, restoration, and effects on human health. “Ecosystem monitoring” broadly spans a variety of disciplines, spatiotemporal scales, and data collection methods, all of which were topics of discussion. Specific monitoring activities addressed included (but were not limited to) continuous in situ measurements from a buoy network, periodically repeated habitat surveys, pre- and post-activity studies, and remote sensing time series. As well, ocean observing encompasses multiple disciplines, and interdisciplinary participation was of key importance, ranging from the physical, chemical, and biological sciences (e.g., hydrodynamics, pollutants, lower- to higher-trophic levels) to socio-economic considerations (e.g., societal and economic benefits). Session discussion included the numerous types of monitoring that are currently underway, including in response to the DWH oil spill, as well as the coastal and ocean community’s observing priorities and vision for an expanded, integrated observing network in support of future spill response and research.

The session strongly encouraged and incorporated interdisciplinary contributions from the various science disciplines and policy/decision makers, including universities, Non Government Organizations (NGOs), state and Federal government, and business and industry. The session agenda was a full day and was multi-faceted including a traditional science approach with invited speakers and a series of oral and poster presentations, as well as facilitated discussions incorporating a Federal Government Agency panel, online polling, and flip chart activities. The final report synthesized current monitoring assets/projects relevant to Gulf spill research, the monitoring community’s observing priorities, and recommendations on enhancements for a future “right-sized” observing operation.

Session Report

Background and Participation

In light of developing RESTORE Act programs and other sources of funding post-DWH, the overarching impetus for this session was to advance ongoing discussions for expanded and coordinated environmental monitoring in the Gulf of Mexico. Under this umbrella, session goals were three-fold as follows: (1) to begin to synthesize current monitoring projects and assets in the Gulf, (2) to determine the community’s observing priorities in a variety of disciplines, and (3) to elicit participant recommendations for an optimized, integrated observing system. A base definition for “ecosystem monitoring” was identified before the session as a continuing program of measurement, analysis, and synthesis to identify and quantify ecosystem conditions and trends to provide a technical basis for decision-making. This definition was purposely all-inclusive with regards to sampling location, discipline, platforms, and affiliations of participants and programs represented. The session agenda was a full day and was multi-faceted including a traditional science approach with invited speakers and a series of oral and poster presentations, as well as facilitated discussions incorporating a Federal Government Agency panel, online polling, and flip chart activities.

Approximately half of the conference participants (almost 1000 conference participants total) expressed interest in the session at the time of registration. Of the 59 total abstracts submitted to the session, 16 were allotted to oral presentations and 43 to poster presentations. Invited talks were provided by Dr. Rick Spinrad (Oregon State University) on “What’s the Right Observing Network?” and Mr. Ben Scaggs (Deputy Director of the RESTORE Council; for Justin Ehrenwerth, the RESTORE Council Executive Director)

on “Update on Gulf Coast Ecosystem Restoration Council Activities.” Approximately 100 people were in attendance during the session throughout the day. Online polling provided an estimate of the audience distribution amongst disciplines, affiliations, and primary regions of interest. The majority of participants were from the natural sciences (~60% of total from biological, ~20% from physical, and 9% from chemical), with some participation also from the social sciences and human/environmental health. Academia and federal government were most heavily represented, followed by participation from NGOs and State/Local governments. The vast majority of participants indicated their primary region of interest as Gulf wide, with more regional focuses and International waters also represented.

Audience Participant Recommendations

A series of questions were asked of the audience to determine the current state of understanding and coordination regarding a Gulf integrated monitoring system, as well as to elicit recommendations and identify the most immediate information needs in each discipline. Based on poll results, general consensus amongst respondents indicated the need for an improved Gulf monitoring system, composed approximately equally of both current approaches and new technologies, with significantly more coordination and identification of lead roles required to achieve an expanded observing system for the Gulf of Mexico.

Potential Contributions from Academia, Government, and NGOs to a Gulf Observing System

More than twenty different ideas were gathered on flip charts regarding what individual groups could contribute to an integrated observing system, with responses in this report aggregated by the group’s broader affiliation (academia, government, or NGO). All three affiliations provided ideas on how they could contribute broadly to coordination and planning of an integrated observing system. Ideas included providing stakeholder buy-in, facilitating coordination and connecting programs, and hosting a coordination team. Both academic and government entities indicated that they could contribute aspects of data management, collection, and processing – a topic of especial importance since data management garnered much discussion during the conference, including its own session. As well, both academic and government entities identified contributions of existing regional observing assets and long-term datasets, including for example, time series of living marine resources, coastal wetland monitoring systems, and multi-decadal environmental studies programs. Synthesis of existing information, as well as providing innovation/diverse ideas, were common contributions of NGOs and academia. NGOs uniquely said they could contribute objective peer review, providing “catalyst” money, identifying gaps, and alerts of industry spills. Unique contributions from academia included hosting a coordination team to centralize academic needs, creating an inventory of research interests/contact information/expertise, and a socio-economic observing system. Finally, government participants uniquely said they could contribute decision-making perspectives, such as related to oil spill response planning, offshore energy development, and evaluation of restoration program effectiveness.

Coordination

Numerous participant recommendations were gathered regarding how groups can better coordinate to develop an integrated system. One recommendation suggested that an Intergroup Monitoring Advisory Committee be developed with representatives from Federal/State government, NGOs, academia, and local communities with significant practice/experience in developing regional programs. Several recommendations focused around the guidelines by which any coordinating body should operate, including stakeholder engagement, the need for buy-in from the various monitoring programs, carefully defining the requirements/needs of the system to fill-in research and monitoring gaps, identifying all existing “sustainable” resources/assets to form a monitoring system backbone, and engagement of the private sector for communications, marketing, and operations and maintenance services. As well, it was recommended that a monitoring “Community of Practice” be developed and that key variables be identified for sampling and standards (QA/QC) development. Several participant recommendations focused on the need for improved funding requirements that would encourage better coordination, essentially “incentivizing” coordination, such as data sharing requirements and adequate funding to include development of end-uses.

Building on Existing Assets: What can we do with what we already have?

Session participants were also queried as to how existing assets (e.g., technologies, expertise, historical datasets, data management capabilities, etc.) can best be utilized to inform an optimized observing system. One recommended approach was to engage practitioners with long histories of developing and implementing observing systems, in order to develop lessons learned. A second recommended approach was to take system requirements from the existing Fed/State/Local/Industry systems and to form a

sustainable framework, which could be built forward with new requirements. As well, it was suggested that an inventory be made of existing assets and how they can be shared with others. Numerous participant recommendations centered around best use of existing assets through data management-related topics, such as provisions for centralized data management, greater focus on synthesis and data integration, use of data processing and analytics to do more with less staff time, asset discovery and mining, and posting available data more widely. It was suggested that these approaches should all help facilitate better sharing across academic, government, and industry datasets. Again, participants emphasized that funding groups need to provide sufficient funding for appropriate comprehensive and integrated data management. More specific recommendations for better utilizing existing assets included determining the relevant scales of time and duration for observable phenomena in order to design a more effective system and application of modeling to system design, such as via Observation System Simulation Experiments (OSSEs).

Discipline-Specific Observing Priorities

Discipline-specific observing priorities were identified based on attendees' identification and prioritization of the most immediate needs in their respective disciplines. In some cases, voting was also employed within discipline breakout groups to help rank top priorities. Common themes across disciplines and overlaps included the need to coordinate observations with modeling and the coupling of biology into the physicochemical models to inform, for example, habitat characterization (including for fish) and habitat response to anthropogenic activities. The Social Science group identified the need for a "translational lens" to incorporate human needs with biogeochemical environmental monitoring. The results for each discipline are summarized in the following.

Biological Sciences: The top three monitoring priorities based on participant input were benthic habitat mapping, habitat utilization, and bio-indicators of environmental health. Other identified observing needs included primary to secondary productivity (nearshore to blue water), higher trophic level observations (marine mammals, fish, etc.), microbial processes and productivity, deepwater biodiversity, soil development and wetlands, fisheries recruitment, bird status and trends, and abundance of pelagic Sargassum.

Chemical Sciences: The top three monitoring priorities based on participant input were nutrient processes, ocean acidification, and chemical loading. Other identified observing needs included ecotoxicology, sediment quality guidelines for offshore deepwater applications, carbon flow pathways, natural toxins/HABs, and metals.

Physical Sciences: The ability to capture full 3-D ocean circulation offshore was identified as the highest priority. Related monitoring tools from coastal areas to deep waters to capture this would include moorings, high frequency radar, gliders, and floats, which would be able to capture variables such as salinity, temperature, nutrients, surface meteorological data, waves, dissolved oxygen, and passive acoustics. For coastal areas, the highest priorities were quantifying sediment discharge rates and improved bathymetric maps for coastal restoration needs.

Social Sciences: One of the top monitoring priorities identified by this group was answering the question: What are we monitoring "for" (in terms of what people want/need)? Other top priorities included human health and environmental connections, cultural/archaeological resources (monitor status/oil spill impacts), longitudinal data for non-traditional economic variables (e.g., subsistence fisheries, communities, ecosystem services), and offshore observations to valuate ecosystem benefits (e.g., dive sites, recreational fishing, etc.). The group also acknowledged that individual versus community requirements can differ, and further identified the observation needs related to community resilience ("key indicators", such as linking health to environment) and fishing industry surveys "before" crisis (baselines). Related technology needs were also identified as requirements for achieving the above monitoring goals. Recommendations included for development of a socio-economic observing system are quick tool kits/best practices, and a set of indicators that can be measured to reflect provisioning of services.

Human and Environmental Health: Immediate needs identified in this discipline included observation of long-term biomarkers of human health in relation to contaminant exposure and psycho-social surveying to understand impacts of events on human well-being. Also identified were cross-sectional studies (long-term) in relation to occupation-based stress and long-term monitoring of seafood safety for sub-populations (subsistence fishing).

Industry: Immediate observation needs related to industry identified by participants included produced water monitoring in real-time from rigs, accidental spill reporting, high resolution bathymetry for charting purposes, vessel traffic (which could be overlaid with ecosystem services and goods), and determining acoustic sensitivity of animals (whales) related to anthropogenic activities.

Overarching Recommendations from Presentations and Posters

While there were many excellent oral presentations and posters, here are some overarching highlights provided during the session. The speakers suggested the following could significantly help advance development of an expanded, right-sized Gulf observing network.

Developing an Effective Business Model – It was recommended that a more disciplined and defensible business model needs to be built for integrated ocean observing systems, including by defining markets, prioritizing requirements, selling products, and exploiting aggressively a more realistic funding portfolio. The importance of developing public-private partnerships was stressed, in order to help fill the current gap in product service providers/developers, as well as to strengthen and tighten operational capabilities.

Highlighted Role for Advanced Technologies – Advances in technology represent an important avenue for reducing observing system costs and providing sustained observations, as recommended in numerous session posters. What were previously experimental technologies (like gliders) may now substitute for expensive research vessels to provide continuous monitoring of physical, chemical, and biological parameters. It was recommended that operationalizing of some of these new and advanced technologies should be a priority for a future Gulf observing system.

Quantify the Economic Value of an Observing System – More than one speaker stressed that "selling" the need for an observing system was of utmost importance if additional funding were to be invested in the future. A lack of funding for a Gulf Observing System, something that is seen as pertinent by the scientific community, reveals that the community has not "done its job" in communicating why an integrated monitoring system is necessary. For example, a current study underway aims to quantify both the societal value of and secondary markets ("private re-packaging") for a Gulf ocean observing network. This analysis should help communicate to politicians, decision-makers, and the public the importance of such a system and its economic and societal benefits ("how it would help people", including the public-at-large).

Building Consensus and Vision – The challenge in building consensus for a Gulf monitoring system is to integrate across multiple scales, different priorities, and numerous funding sources. One speaker suggested that increased communication between "the funders", "the doers", and "the users" would be a significant step forward.

Gap Assessment and Analysis – Preliminary results were presented of a survey and gap analysis for Gulf of Mexico monitoring programs relevant to DWH recovery. Several hundred programs have thus far been catalogued ranging from human use to deepwater communities, with more work, and funding, required to finalize. Ultimately, the results of this work will identify major gaps, contributing to and supporting related ecosystem monitoring plans.

Visualizing a Gulf Observing System as a "System of Systems" – Because of the multiple entities engaged in Gulf monitoring from coastal to offshore, with different goals and needs, as well as the various sources of money invested, no one single entity is able to implement a Gulf Observing System on its own with current funding. A Gulf Observing System will need to be seen as a "System of Systems" with different spatial and temporal scales, geographic areas, and entities working together with their individual pieces to create an observing system by coordination and cooperation.

Improved Communication of Monitoring Products – The need was identified to move beyond time series and trends in datasets to visualization and decision-making tools for users, thus making a better connection between researchers collecting data and end users charged with applying the science for societal/environmental benefit. For example, "report cards" were described as an important tool for the user community.

Single Location for Accessing Data – The recommendation was made that coordination of an expanded monitoring effort would benefit from making the various datasets within agencies' and other entities' archives more accessible. For example, during the DWH oil spill, the ERMA database provided an online mapping tool integrating key environmental response information and baseline data for decision makers. Now post-DWH, much of this data is public (e.g., RestoreTheGulf.org), including multiple datasets across agencies that can inform future environmental monitoring programs.

Session Outcomes, Summary, and Next Steps

A significant amount of input was received during this session aimed at informing current and future plans for Gulf monitoring programs. One of the consistent messages, or outcomes, from the day was surrounding challenges related to funding. First, participants seemed to consistently express there is not enough money currently invested for what is needed to support a Gulf Observing System. Second, if more funding is going to be invested in a Gulf-wide monitoring effort, the scientific community has to do a better job of communicating the need and benefit to entities that have the ability to provide funding. Third, there are substantial assets and funding invested in Gulf monitoring, however for those to be truly beneficial there is a greater need for coordination among programs, prioritization of data needs, and realistic funding for appropriate comprehensive and integrated data management. For example, some participants emphasized that someone with money and authority needs to bring and keep disparate programs together. It was recommended that an authoritative body also needs to "Prioritize, REALLY prioritize" to define monitoring requirements and identify the most crucial data needs. This also relates to the relative benefit to predictability of any single data set as revealed in "data-denial" experiments. Future monitoring prioritization should ask stakeholders to justify why they would spend the next dollar allocated to Gulf monitoring in a particular way, being realistic about what any new observation will get us and why its important to restoration.

In summary, it appears that all the money flowing to the Gulf post-DWH likely cannot, nor will not, be able to support the kind of "wish list" the scientific community has for a Gulf Observing System. However, if the science and monitoring community is working together, leveraging resources, thinking of Gulf observing as a "System of Systems", and communicating/translating information appropriately with funders and decision-makers, movement towards an integrated Gulf Observing System appears within reach. But it will also require tough decisions and prioritization of data needs based on available funding.

The information and recommendations collected during this session are being integrated into other efforts, such as the development of a logic model for a Gulf Observing System—starting with: what do we as a Gulf community envision a Gulf Observing System to be? And then: working backwards to map out a path on how to achieve that vision as a Gulf community.

Other next steps include taking the prioritized data needs among the different disciplines, and then cross-walking them in an attempt to see how data collected for one discipline can also meet the needs highlighted in another discipline. For example, in the physical sciences, the highest priority data need identified was for 3-D ocean circulation collecting parameters such as salinity, temperature, nutrients, dissolved oxygen, and passive acoustics. This data can also help meet some of biological discipline needs of habitat characterization and response for specific species. There are also examples where tagging of certain biological species can also provide information such as salinity, temperature, and depth, which would help the physical sciences discipline.

The outcomes of this session are only one step, of many, that can help the development of a Gulf Observing System, but this kind of creative thinking can inform the mapping out of an integrated Gulf Observing System that meets the needs of many disciplines and purposes.

APPENDIX 1: CONFERENCE OVERVIEW SCHEDULES

Overview Schedule Sunday, January 26, 2014

Scientific Program Schedule		
1:00pm-3:30pm	Session 001, Session 002	Convention Center
3:30pm-4:00pm	BREAK	Pre-function area (Convention Center)
4:00pm-6:00pm	Session 001, 002	Convention Center
Associated Meetings and Events		
1:00pm-6:00pm	Nearfield Modeling Session	Schooner
1:00pm-5:00pm	Advancing Deep Sea Science: A Tribute to Ray Highsmith	Mobile Bay Ballroom II & III
1:00pm-5:00pm	API & GoMRI Dispersants Session	Grand Bay Ballroom
5:00pm-6:00pm	Hydrocarbon Chemical Analyses QAQC	Grand Bay Ballroom

Overview Schedule Monday, January 27, 2014

General Opening Hours		
8:00am-6:00pm	Check-in, Exhibits, Speaker Ready Room Open	Renaissance Riverview Hotel
1:00pm-6:00pm	Poster Hang-Up	Main Ballroom (Convention Center)
Scientific Program Schedule		
Starts at 7:30am	BREAKFAST	Foyer
9:00am-11:00am	Session 003, 004, 006, 007	Renaissance Riverview Hotel
11:00am-11:30am	BREAK	Foyer
11:30am-1:00pm	Session 003, 004, 006, 007	Renaissance Riverview Hotel
1:00pm-2:30pm	LUNCH	Moonlight Ballroom (Battle House Hotel)
2:30pm-3:30pm	Session 003, 004, 006, 007	Renaissance Riverview Hotel
3:30pm-4:00pm	BREAK	Foyer
4:00pm-6:00pm	Session 003, 004, 006, 007	Renaissance Riverview Hotel
6:00pm-8:00pm	Poster Session & Reception(featuring Sessions 003, 004, 006, 007)	Main Ballroom (Convention Center)
Associated Meetings and Events		
5:30pm-7:00pm	C-MEDS/Metcalf Oil Spill Science Seminar for Journalists	Schooner
6:30pm-8:30pm	Marine Oil Snow Sedimentation & Flocculent Accumulation (MOSSFA) Town Hall meeting	Moonlight Ballroom (Battle House Hotel)

Overview Schedule Tuesday January 28, 2014

General Opening Hours		
8:00am-6:00pm	Check-in, Exhibits, Speaker Ready Room Open	Renaissance Riverview Hotel
8:00am-8:00pm	Poster Hall Open	Main Ballroom (Convention Center)
Scientific Program Schedule		
Starts at 7:30am	BREAKFAST	Foyer
9:15am-11:00am	Session 005, 008, 009, 010	Renaissance Riverview Hotel
11:00am-11:30am	BREAK	Foyer
11:30am-1:00pm	Session 005, 008, 009, 010	Renaissance Riverview Hotel
1:00pm-2:30pm	LUNCH	Moonlight Ballroom (Battle House Hotel)
2:30pm-3:30pm	Session 005, 008, 009, 010	Renaissance Riverview Hotel
3:30pm-4:00pm	BREAK	Foyer
4:00pm-6:00pm	Session 005, 008, 009, 010	Renaissance Riverview Hotel
6:00pm-8:00pm	Poster Session & Reception(featuring Sessions 005, 008, 009, 010)	Main Ballroom (Convention Center)
Associated Meetings and Events		
4:00pm-6:00pm	C-MEDS/Metcalf Oil Spill Science Seminar for Journalists	Schooner
6:00pm-8:00pm	Gulf Restoration Town Hall Meeting	Mobile Bay Ballroom

Overview Schedule Wednesday, January 29, 2014

General Opening Hours		
8:00am-3:45pm	Check-in, Exhibits Open	Foyer
8:00am-4:00pm	Poster Hall Open	Main Ballroom (Convention Center)
Plenary Program Schedule		
Starts at 7:30am	BREAKFAST	Foyer
8:30am-10:30am	Plenary Panel “The Role of Academia in Environmental Disaster Response” Followed by audience Q&A	Bon Secour Bay
10:30am-11:00am	BREAK	Foyer
11:00am-11:15am	Presentation of Student Awards, Dr. Robert Gagosian, Consortium for Ocean Leadership	Bon Secour Bay
11:15am-12:30pm	Session Report Outs Moderated by Dr. Margaret Leinen, Scripps Institute of Oceanography	Bon Secour Bay
12:30pm-2:00pm	LUNCH	Moonlight Ballroom (Battle House Hotel)
2:30pm-3:15pm	Session Report Outs	Bon Secour Bay
3:15pm-3:45pm	Conference Wrap-Up Dr. Margaret Leinen, Dr. Chuck Wilson	Bon Secour Bay
Associated Meetings and Events		
7:30am-2:00pm	NOAA RESTORE Act Science Program Information Session	Commodore Suite
4:00pm-6:00pm	C-MEDS/Metcalf Oil Spill Science Seminar for Journalists	Schooner

APPENDIX 2: ASSOCIATED MEETINGS AND EVENTS

Several side meetings and events were held in conjunction with the 2014 Gulf of Mexico Oil Spill and Ecosystem Science Conference. For more information, please contact the event organizer.

Near Field Modeling

Sunday, January 26, 1-6pm • Renaissance Hotel (Schooner Room)
Organizers: Scott Socolofsky, WK Dewar

Advancing Deep Sea Science through Long-term Observatories and Development of *In-situ* Technology and Instrumentation: A Tribute to Ray Highsmith

Sunday, January 26, 1-6pm • Renaissance Hotel (Mobile Bay Ballroom II & III)
Organizer: Samantha Joye

Dispersants: What have we learned, and opportunities for improvement to better inform decision making relevant to dispersants and their use?

Sunday, January 26, 1:00-5:00 pm • Renaissance Hotel (Grand Bay Ballroom)
Organizer: GoMRI Research Board

GoMRI Hydrocarbons Analysis QA/QC Workshop

Sunday, January 26, 5:00-6:00pm • Renaissance Hotel (Grand Bay Ballroom)
Organizer: GoMRI Research Board

C-MEDS/Metcalf Institute Oil Spill Science Seminar for Journalists

Monday, January 27: 5:30-7:00pm • Renaissance Hotel (Schooner Room)
Tuesday, January 28, 4:00-6:00pm • Renaissance Hotel (Schooner Room)
Wednesday, January 29, 4:00-6:00pm • Renaissance Hotel (Schooner Room)
Organizer: Sunshine Menenzes

Marine Oil Snow Sedimentation & Flocculent Accumulation (MOSSFA) Town Hall meeting

Monday January 27, 6:30 – 8:30 pm • Battle House Renaissance (Moonlight Ballroom)
Organizer: Nancy Kinner

Gulf Restoration Science Programs Town Hall

Tuesday, January 28, 6-8pm • Renaissance Hotel (Mobile Bay Ballroom)
Organizer: Andrew Shepard

Gulf Coast Ecosystem Restoration Science, Observation, Monitoring and Technology Program (RESTORE Act Science Program) Informational Session

Wednesday, January 29, 7:30am-2:00pm • Renaissance Hotel (Commodore Suite, 4th Floor)
Organizer: Julien Lartigue

An Information Exchange and Collaboration on Data Management for Environmental Disasters: Kick-Off Meeting

Wednesday 29 January, 7:30am – 9:30 am • Schooner Room
Organizer: Kathy Mandsager

APPENDIX 3: MEDIA COVERAGE

Date	Publication	Headline
1/23/14	AL.com	Researchers to hold conference in Mobile to discuss after-effects of the BP oil spill
1/26/14	NOLA.com	Gulf of Mexico Conference discusses debunking myths and misconceptions
1/26/14	AL.com (ran in Mobile Press Register, Huntsville Times & Birmingham News)	Marine Scientists Converge on Mobile to share research on Gulf oil spill (Opinion from the Gulf of Mexico Research Initiative)
1/26/14	Mobile Press-Register	Marine scientists gather to discuss research on spill (Print only)
1/27/14	FOX10tv.com	Gulf of Mexico Research Initiative, GoMRI
1/27/14	Alabama Public Radio	Mobile hosting conference on Gulf spill
1/27/14	AL.com	Oil spill conference touches on Gulf fisheries and social toll in communities
1/27/14	NOLA.com	BP Deepwater Horizon oil spill's impact on Gulf of Mexico fisheries discussed
1/27/14	Lagniappe	Ecological effects of oil spill dispersants among topics of academic conference
1/27/14	The Times-Picayune	Gulf oil spill conference addresses communicating facts to the public - Event runs through Wednesday in Mobile (Print only)
1/28/14	NOLA.com	Gulf coast residents not showing higher chemical exposure post-BP oil spill than rest of nation
1/29/14	NOLA.com	BP Deepwater Horizon disaster offered lessons for more rapid, cooperative response, scientists say
1/29/14	Guidrynews.com	Gulf of Mexico Oil Spill & Ecosystem Science Conference
1/30/14	WEAR Channel 3 Pensacola's ABC	2014 Gulf Conference
2/5/14	The Huffington Post	Gulf War syndrome comes to the Gulf of Mexico?
2/8/14	The Huffington Post	Scientific spill studies, funded by BP, start to yield results

PRESS RELEASE #1: FOR IMMEDIATE RELEASE:

November X, 2013

Media Contact:

Kristin Kracke
202.787.1644
kkracke@oceanleadership.org

Latest Deepwater Horizon Scientific Results to be Released at the 2014 Gulf of Mexico Oil Spill & Ecosystem Science Conference

Complimentary Registration for Credentialed Members of the Media Available

Who:

Eleven sponsoring agencies have come together to host the second joint private and federal Gulf of Mexico Oil Spill & Ecosystem Science Conference, a forum for the research community in the Gulf of Mexico to share their latest scientific results. A gathering of approximately 700 oil spill-related experts from academia, state & federal agencies and non-governmental organizations is expected.

What:

As the second Gulf of Mexico Oil Spill & Ecosystem Science Conference and fourth year of research following the Deepwater Horizon incident and associated investments focused on the Gulf of Mexico, the science community is now well positioned to deliver integrated findings both within the scientific community and to stakeholder groups. Participants of this Conference will share new scientific results and develop recommendations or action plans for collaborative integration from post-spill investment in science. The topics addressed will encompass dynamic physical processes, chemistry, biology, health, toxicology, and socio-economics that connect the Gulf of Mexico ecosystem and surrounding regions.

The three-day Conference will consist of 10 scientific sessions and approximately 550 abstracts for oral and poster presentations. A searchable database of accepted abstracts for oral and poster presentations will be available online prior to Conference. For a full Conference schedule, click here.

Where:

Renaissance Mobile Riverview Plaza Hotel, 64 South Water Street, Mobile, Alabama 36602

When:

January 26-29, 2014

Why:

The Conference sponsors share a goal to improve society's ability to understand the Gulf of Mexico ecosystem to ensure its long-term environmental health. One important aspect of this is understanding the impacts of petroleum pollution and related stressors on the marine and coastal ecosystems, as it will support future response, mitigation, and restoration efforts.

How to Register:

The registration fee will be waived for credentialed members of the media. Please send your contact information (name, media outlet, email, and phone) to Kristin Kracke and she will send you details on how to complete your complimentary registration online. Online registration will close on January 20, 2014.

For accommodation information, click here. To receive the group rate, reserve your room by December 3, 2014.

For more information, visit the Conference website and follow the Conference on Facebook and Twitter.

PRESS RELEASE #2: FOR IMMEDIATE RELEASE:

January 9, 2014

Media Contact:

Kristin Kracke
202.787.1644
kkracke@oceanleadership.org

Plenary Speakers Announced for 2014 Gulf of Mexico Oil Spill & Ecosystem Science Conference

Distinguished Panelists to Discuss Role of Academia in Oil Spill Response

Washington, D.C. – The 2014 Gulf of Mexico Oil Spill & Ecosystem Science Conference, a forum for the research community in the Gulf of Mexico to share their latest scientific results, is pleased to announce the Conference plenary panelists. The conference, taking place in Mobile, Alabama from January 26-29, is expected to draw over 800 oil spill-related experts from academia, state & federal agencies and non-governmental organizations.

The five distinguished panelists, who will present on the final day of the Conference from 8:30-10:30 a.m., will be discussing their experience as part of the response teams during and after the 2010 Deepwater Horizon oil spill and offer lessons learned for the future. Each panelist will also examine how academia currently fills various advisory roles, including those specified in the Oil Pollution Act, and the potential for assuming enhanced roles in future environmental disasters.

The 2014 plenary panelists are:

- Admiral Thad Allen, Booz Allen Hamilton/23rd Commandant of the US Coast Guard
- Dr. Bernard Goldstein, University of Pittsburgh
- Dr. Jane Lubchenco, Oregon State University/Former Administrator of NOAA
- Dr. Laurence Madin, Woods Hole Oceanographic Institution
- Dr. Steve Murawski, University of South Florida
- Moderator: Dr. Margaret Leinen, Gulf of Mexico Research Initiative Research Board & Director of Scripps Institution of Oceanography at UC San Diego

For more information, including speaker bios, click here.

During the second annual Gulf of Mexico Oil Spill & Ecosystem Science Conference that eleven sponsoring organizations have come together to host, participants will share new scientific results and develop recommendations and action plans for collaborative integration from post-spill investment in science.

The three-day Conference will consist of 10 scientific sessions and approximately 550 abstracts for oral and poster presentations. A searchable database of accepted abstracts for oral and poster presentations is available online here. For a full Conference schedule, click here. There will also be several associated events & meetings taking place, ranging in topics from dispersants to gulf restoration to hydrocarbon analyses. For full a list of these events, click here.

The registration fee will be waived for credentialed members of the media. Please send your contact information to Kristin Kracke for details on how to complete the complimentary registration.

PRESS RELEASE #3: FOR IMMEDIATE RELEASE:

January 24, 2014

Media Contact:

Kristin Kracke
202.787.1644
kkracke@oceanleadership.org

From Impacts on Fisheries to Fate of Oil Spill Residues, New Research to be Released at 2014 Gulf of Mexico Oil Spill & Ecosystem Science Conference

Over 800 scientific experts to descend on Mobile, Alabama

Washington, D.C. – Next week, over 800 oil spill-related experts from academia, state & federal agencies and non-governmental organizations, will be sharing their latest scientific results at the 2014 Gulf of Mexico Oil Spill & Ecosystem Science Conference. With this being the fourth year of research following the Deepwater Horizon incident and associated investments focused on the Gulf of Mexico, the science community is now well-positioned to release new findings. The Conference will be held in Mobile, Alabama from January 26-29, 2014 at the Renaissance Mobile Riverview Plaza Hotel.

The three-day Conference will consist of 10 scientific sessions and approximately 550 abstracts for oral and poster presentations. Topic examples to be covered during these conference sessions and presentations are:

- Ecosystem Impacts of the Deepwater Horizon oil spill
- Chemical & Biological Transport of Oil in the Gulf
- Effect of the Deepwater Horizon oil spill on Fisheries
- Socio-Economic Analysis of Catastrophic Events
- Advances in Dispersant Technology
- Public Health and the Deepwater Horizon oil spill

After the Deepwater Horizon oil spill, the burial of weathered oil along Gulf beaches and in the marshes was well-document. Are you interested in the biological decomposition of that oil? Specifically, how much is buried or how long it will persist? Then you should listen to a presentation titled Biodegradation of MC252 Crude Oil After Mobilization by Washover Events on a Coastal Headland Beach occurring at the Conference.

How about disaster preparedness and public health? One group of researchers presenting at the Conference conducted hundreds of hours of interviews and focus groups in the Gulf to explore the differences in expectations of − and resiliency to − natural and technological disasters. You can find out the results at Prepared for the Worst? Resilience Gaps in the Natural/Technological Disaster Divide.

For a list of other hot topic presentations, click here.

A searchable database of all accepted abstracts for oral and poster presentations is available online here. For a full Conference schedule, click here.

The registration fee will be waived for credentialed members of the media. Online registration is now closed but you can still register onsite.

Additionally, the conference press release was reported over 1,000 times in publications around the world:

10 KLFY
101 the Rose WROZ-FM
14 News WFIE
1st Discount Brokerage
4-traders.com
5 KPHO
5 WNEM
740 KVOR
A.M. Best Company
About Markets
Accountability-Central.com
ADR Traders
Alamogordo Daily News
Alison and Hill Investment Advisors
American Public Media
Anchorage Daily News
Arkansas Matters
ArmbrustAviation.com
Ashland Times Gazette
Ask.com
AZCentral.com
Baton Rouge Business Report
Belleville News-Democrat
Bellingham Herald
Benzinga.com
Best Growth Stock
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BusinessWire.com
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Canadian Mining News
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Carlsbad Current-Argus
CBS 3 Springfield
CBS 2/KCAL 9 Los Angeles
CBS 5 San Francisco
CBS Atlanta
CBS3 Philadelphia
Centre Daily Times
Charlotte Observer
Cincinnati Enquirer
Cohen Independent Research
CommodityCareers
ControCostaTimes.com
Crescent-News
CW15
Daily Breeze
Daily Herald
DailyBulletin.com
Daily-Jeff.com
Daily-Record.com
Dallas Morning News
Dealbreaker
Delaware BioScience Association
Deming Headlight
Denton Record-Chronicle
El Nuevo Herald
El Paso Times
EMONEYDAILY
Energy Magazine
Epicos
Eyewitness News 3
eZanga
Farmington Daily Times
Fat Pitch Financials
FayObserver
Financial News Radio KFNN
Financial Sense
Fort Worth Star-Telegram
FOX 12 Oregon
FOX 14 TV
FOX 5 KVVU-TV
FOX Carolina
FOX23 - WXXA
Fox29 WFLX
Fresno Bee
Globalbank
GolfObserver.com
Green Faucet
HeraldNet Everett Washington
HeraldOnline.com
HPC Wire
Hydro Review
Idaho Statesman
In Denver Times
Indianapolis Business Journal
Industrial Info
Infostor
Inside Metals
InsideBayArea.com
Intelligent Value
International Business Times
InvestorPlace
Investtalk
Island Packet
Issuer Direct
KAIT
Kalem Journal
Kansas City Star
KARN News Radio
KASN - The CW
KCBD
KCOY/FOX11
KCTV 5 News
KEYETV Austin
KFVS 12
KGET - 17
KGMB / KHNL - Hawaii News Now
KGPE CBS-47
KION
KION46
KLRT - FOX 16
KLTV 7
KMEG 14
KMPH FOX 26
KMTR NewsSource 16
KNOE 8 News
KOAM-CBS 7
KOKI - FOX 23
KPLC TV 7
KPTH FOX 44
KPTM FOX 42
KSAN Concho Valley
KSAS - FOX Kansas
KSFY Action News
KSLA News 12
KTIV News 4
KTRE 9
KTTC
KUSI News
KUTV.com
KWQC Channel 6
KWWL
KXLT FOX 47
Largo Financial Services
Las Cruces Sun-News
Laser Focus World
Latin Times
Ledger-Enquirer
Lexington Herald-Leader
LIGHTWAVE
Livingston Securities
Long Beach Press-Telegram
Macon.com Telegraph
Market EDU
Market Intelligence Center
Market Pulse
Market Wrap Daily
MarketWatch
Maxim Group
Miami Herald
Minneapolis-St. Paul Star Tribune
Minnesota Public Radio NewsQ
Minyanville.com
Modesto Bee.com
Money Show
Multichannel News
My Central Oregon
My Motherlode
MY TV Wichita
MyrtleBeachOnline.com
MyVerizon
Naples Daily News
Nations Restaurant News
NBC - 2
Network Journal
News 13 KOLD
News Channel 5/CBS Alexandria
News Channel 6
News Tribune
NewsandObserver
Newschannel 34 - WVIT/WBGH
Newsday
Nfclub.eu
Northern Star Communications Ltd.
Oak Ridger
Oakland Tribune
Oil and Gas Investor
Oil and Gas Journal
Oklahoman
Oklahoma's Own News 6

Oklahoma's Own News 9
Olympian
One News Page Global
One News Page US
Ontario Daily Bulletin
OptoIQ
PaidContent.org
Pasadena Star-News
Personal Money Planning
Philanthropy World Magazine
PhotoVoltaics World - Electro IQ
Pipeline & Gas Journal Magazine
Portfolio Tilt
Press of Atlantic City
Press-Enterprise
Quoteline
RCR Wireless News
RecordPub.com
Redlands Daily Facts
Regal Securities
Renewable Energy World
Risk Management Group
Royal Gazette
Ruidoso News
Sacramento Bee
San Antonio Express-News
San Bernardino Sun
San Gabriel Valley Tribune
San Jose Mercury News
San Luis Obispo Tribune
San Mateo County Times
Santa Cruz Sentinel
SciAnswers.com
Search Bug
Sector Publishing Intelligence Ltd
Securities Technology Monitor
Sign on San Diego
SiliconValley.com
SmartGridCareers
SocialPicks
State
State Journal-Register
State-Journal.com
Stock Briefings
Stock Nod
StockChartsVideo
StockProfile.com
Street Sweeper
StreetIQ
StreetSmartPost
Sun Herald
Switching Gears
Synacor
TechWeb
TeleTrader
The Beaufort Gazette
The Birmingham News
The KXVO 15
The State Journal
The-Review.com
Trade4All.com
TriCity Herald
TTM Technologies
Tulsa CW
TV Newscheck
United Press International
UTV 44
Valley News Live
Value Investing News
Vision Monday
WAFB Channel 9
WaferNews - ElectroIQ
WAFF 48 News
WALB News 10
WallStreetSelect
WAOW Newsline 9
Washington G2 Reports
WATE
WAVE 3 News
WAWS - FOX30
WBAY Actions 2 News
WBOY.com
WBRC My Foxal
WBTV 3 News
WCSC Live 5 News
WCWG 20
WDAM Channel 7
WECT TV6
Wedbush Securities
WETM 18
WGEM
WHAM - ABC 13
WhatLNG
Whittier Daily News
WHP-TV 21
Wichita Eagle
WICU / WSEE
WIS News 10
WJZ Baltimore
WKOW 27
WKRC - Local 12
WKRN News 2
WLBT 3
WLNS 6 News
WLOX-TV 13
WMBB News 13abc
WMBF NEWS
WMC Action News 5
WOAI - NBC 4
WOIO Actions News 19
WorkBoat
Working 4 you
World Energy Source
World Net Daily
Worth
WOWKTV.COM
WPMI - LOCAL 15
WPTY/WLMT - ABC 24
WQOW TV
WR Hambrecht and Co
WRAL
WREX 13
WRIC 8 News
WSFA 12
WSJV FOX 28
WSYR - ABC Newschannel 9
wten News 10
WTEV - CBS47
WTHR Indianapolis
WTNZ FOX 43
WTOC 11
WTOL 11
WTRF.com
WTVM 9
WVNSTV.COM
WVVA TV
WWBT NBC 12
WWJ Newsradio 950
WWTI - My ABC 50
WXIX FOX 19
WXOW News 19
WXVT -CBS 15
WZVN abc 7
Yahoo! Finance
Yahoo! Finance India
Yield.com
Your Oil and Gas News
Zantrio

2014 Gulf of Mexico Oil Spill & Ecosystem Science Conference Papers and Poster Abstracts

Session 001: Setting the record straight: Debunking myths and misconceptions about oil in the Gulf and promoting ocean literacy

Session: 001
Date: Sunday, January 26 - 1:00 PM
Room: 203 (Convention Center)
Track: Setting the record straight: Debunking myths and misconceptions about oil in the Gulf and promoting ocean literacy (Half Day Session)
Type: Oral

An Education at Elmer's Island: How I spent $2K on CAT scans

Presenter: Christopher Reddy
WHOI
Authors: C. Reddy;
WHOI, Woods Hole, MA.
Abstract:
I was fooled by the passion and fear of local inhabitants and visitors to Elmer's Island (LA) in the summer of 2001. While sampling for oiled-sand patties, numerous folk encouraged me to collect large pieces of tar (about 30 x 20 x 5 cm). They convinced me that the latter was from the DWH disaster. The samples were so unusual that my lab group immediately began in depth study including taking CAT scans. Eventually, we "fingerprinted" the oil, something we should have done first, and found that the sample was from Macondo oil and likely from shallow water reservoirs. The lesson learned was that I was so passionately persuaded that I accepted the myth. It was that easy but hopefully avoidable in the future.

Session: 001
Date: Sunday, January 26 - 1:15 PM
Room: 203 (Convention Center)
Track: Setting the record straight: Debunking myths and misconceptions about oil in the Gulf and promoting ocean literacy (Half Day Session)
Type: Oral

Oil in the Gulf: This is Not Alaska!

Presenter: Christina Simoniello
Gulf of Mexico Coastal Ocean Observing System
Authors: C. Simoniello;
Gulf of Mexico Coastal Ocean Observing System, based at USF CMS, Saint Petersburg, FL.
Abstract:
From the Education and Outreach (E/O) perspective, the most prolonged misconception about the Deepwater Horizon (DWH) oil spill is that it's analogous to the *Exxon Valdez* spill. While one fundamental commonality exists--copious amounts of oil were introduced into the environment, therein ends the similarity. The two spills could hardly be more different. The nature of the spills, the conditions under which oil has been transported and degraded, and the communities impacted are radically different. Additionally, with a two-decade separation, the technologies to address the disasters differ greatly. Having a unique perspective from working on assessment and mitigation during the Alaska spill, and on E/O issues following the DWH spill, Simoniello will share the most common misconceptions she encounters working with a wide range of audiences. From students and educators to recreational fishermen and boaters, to non-profit organizations and emergency responders, the presentation will identify areas where consistent, science-based messages, fit for public consumption, are needed. As Coordinator of the Gulf of Mexico Coastal Ocean Observing System Education and Outreach Council and Steering Committee Member of the GOMA Environmental Education Network, Simoniello offers excellent opportunities to disseminate quality information, because one other commonality exists between spills. Given the lingering unknown impacts, there is tremendous need for coordinated E/O efforts.

Session: 001
Date: Sunday, January 26 - 1:30 PM
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Track: Setting the record straight: Debunking myths and misconceptions about oil in the Gulf and promoting ocean literacy (Half Day Session)
Type: Oral

Modeling and Predicting the Transport of Oil in the Gulf of Mexico and Florida Straits

Presenter: Arthur J Mariano
U of Miami/RSMAS
Authors: A. J. Mariano;
U of Miami/RSMAS, Miami, FL.
Abstract:
This talk will emphasize the difficulty in predicting where oil moves during an oil spill and the long term fate of the oil after the spill. Prediction difficulties are due to the interplay of (1) errors in the initial conditions of where the oil is; (2) imperfect numerical circulation models for ocean currents and winds; (3) sparse, inconsistent, noisy ocean and atmospheric data sets needed for the numerical model simulations; (4) bad data blending techniques; and (5) inherent nonlinear fluid dynamics of ocean and atmospheric motion. Thus the

time scale for predicting surface oil motion is on the order of one day to one week in the Gulf of Mexico, and predictions of oil transport and dispersion made with running numerical simulation models using climatological data sets are of very little value.

Session: 001
Date: Sunday, January 26 - 1:45 PM
Room: 203 (Convention Center)
Track: Setting the record straight: Debunking myths and misconceptions about oil in the Gulf and promoting ocean literacy (Half Day Session)
Type: Oral

Detecting Impacts to Animal-Sediment Relationships from the Deepwater Horizon Accident: A Worm's Eye View

Presenter: Joseph Germano
Germano & Associates, Inc.
Authors: J. Germano;
Germano & Associates, Inc., Bellevue, WA.

Abstract:
The release of oil from the MC-252 wellhead that started on April 20, 2010 and continued for another 86 days along with the accident response efforts (drilling of the two different relief wells, injection of "top kill" muds) deposited additional drilling muds, some with entrained oil, on the surrounding habitat and benthic community near the well. One of the assessment techniques used to measure the extent of that release and deposit was a combination of sediment profile and plan-view (SPI/PV) imaging. Two SPI/PV surveys were performed 12 and 18 months after the accident occurred. Dense mats of colonial thiophilic bacteria that are diagnostic of organic enrichment and commonly found around hydrothermal vents and naturally-occurring seeps were documented around the wellhead out to 1300 meters in addition to dense colonies of opportunistic polychaetes. While the areas of impact measured from the physical, chemical, and biological lines of evidence photo-documented from the SPI/PV images varied slightly from 1.3 - 2.1 km from the wellhead, the most surprising finding was the widespread occurrence of infaunal deposit feeders, which are usually one of the least pollution tolerant and last to appear in the infaunal recovery sequence that has been repeatedly documented in the literature from shallower waters worldwide.

Session: 001
Date: Sunday, January 26 - 2:00 PM
Room: 203 (Convention Center)
Track: Setting the record straight: Debunking myths and misconceptions about oil in the Gulf and promoting ocean literacy (Half Day Session)
Type: Oral

"It isn't over until it's over": fostering public understanding of the potential long-term effects of the Deepwater Horizon spill to ecosystem health

Presenter: Joel E Kostka
Georgia Institute of Technology
Authors: J. E. Kostka;
Georgia Institute of Technology, Atlanta, GA.

Abstract:
Ecologists are investigating the environmental consequences of petroleum hydrocarbon released from the deeper areas of the Gulf of Mexico on living marine resources and ecosystem health. The focus is on the northern Gulf which exhibits many hotspots of biological diversity, contains the highest biological productivity, and has tremendous economic value. For many ecosystems in the Gulf, little background information has been collected on food webs and ecosystem functioning. Thus, in order to evaluate and predict the impacts of an oil spill, we need to first understand how the Gulf works.
Public perception, especially in communities that are not directly on the coast, is that "the spill is over." Many folks ask, "Was the oil spill really such a big deal after all?" Media attention is often centered on the very visible, acute effects to ecosystems such as the smothering of shorebirds with surface oil from slicks. However, longer term or chronic effects to ecosystems that you can't see, such as to plankton or deepsea corals, often receive less attention. This presentation will address myths and misconceptions regarding effects of the Deepwater Horizon oil discharge to ecosystems of the northern Gulf. We will explore published research on acute effects and discuss ongoing research to assess the long term effects. The goal will be to build partnerships between scientists and outreach specialists to increase public awareness on the ecosystem effects of oil spills.

Session: 001
Date: Sunday, January 26 - 2:15 PM
Room: 203 (Convention Center)
Track: Setting the record straight: Debunking myths and misconceptions about oil in the Gulf and promoting ocean literacy (Half Day Session)
Type: Oral

Vocabulary of DWH Oil Spill Seafood Toxicology: Optimizing Communications and Comprehension for Gulf of Mexico Coastal Residents

Presenter: Andrew S Kane
University of Florida, Aquatic Pathobiology Laboratories
Authors: A. S. Kane[1], T. Irani[2], A. Lindsey[2], A. Lindsey[2], S. M. Roberts[3], L. D. Stuchal[3], J. Munson[4], E. J. Overton[5], E. J. Overton[5], S. Ansari[6], J. K. Wickliffe[7];
[1]University of Florida, Aquatic Pathobiology Laboratories, Gainesville, FL, [2]University of Florida, Agricultural Communication and Education, Gainesville, FL, [3]University of Florida, Center for Environmental and Human Toxicology, Gainesville, FL, [4]Aquatic Pathobiology Laboratories, Center for Environmental and Human Toxicology, Gainesville, FL, [5]Louisiana State University, Department of Environmental Sciences, Baton Rough, LA, [6]University of Texas Medical Branch, Galveston, TX, [7]Tulane University, Department of Global Health Sciences, New Orleans, LA.
Abstract:
Communication of Gulf seafood safety and potential exposure risk is complex and requires knowledge of diverse audiences. Through our work in the communities and with our community partners, We have identified multiple elements of communication and vocabulary to help share technical content in ways that are relevant to a variety of audiences including seafood workers and fishers who depend on Gulf seafood harvest for their livelihood. Communication with various target audiences includes, but is not limited to, providing scientific context and explanation regarding initial and ongoing communications from BP and federal agencies, such as the various processes applied to regulate fishery closures and reopenings. The ability to review and translate for lay audiences analytical toxicology data relevant to regional seafood is also important, and should include constructs associated with "BDL," "BLQ," non-zero analytical data, reference or baseline data, and creditability of data and data source(s). Methods to support audience engagement and credibility in outreach communications, interpret oil spill-related data, and discuss the risk assessment process are highlighted.

Session: 001
Date: Sunday, January 26 - 2:30 PM
Room: 203 (Convention Center)
Track: Setting the record straight: Debunking myths and misconceptions about oil in the Gulf and promoting ocean literacy (Half Day Session)
Type: Oral

Oil Spill and Dispersant Risk Communication

Presenter: Ann Hayward Walker
SEA Consulting Group
Authors: A. H. Walker[1], A. Bostrom[2], T. M. Leschine[3], K. Starbird[4], R. Pavia[5];
[1]SEA Consulting Group, Cape Charles, VA, [2]Evans School of Public Affairs, Univeristy of Washington, Seattle, WA, [3]Director School of Marine and Environmental Affairs, University of Washington, Seattle, WA, [4]Department of Human Centered Design and Engineering, University of Washington, Seattle, WA, [5]School of Marine and Environmental Affairs, University of Washington, Seattle, VA.
Abstract:
Three decades of research experience on oil spills and dispersant issues have shown that communications about dispersants remains a topic of nationwide concern and interest, heightened by the 2010 Gulf Oil Spill. This presentation highlights findings from research conducted collaboratively by a multi-disciplinary team to assess and address public and stakeholder information needs and risk perceptions about dispersants and oil spills. Building on a mental models approach to risk communication and leveraging a decision model for science-informed oil spill response, this project analyzed Twitter data from the Gulf Oil Spill, surveyed coastal communities nationally, examined the use of scenarios and the communication of uncertainty in oil spill response decision making, and reviewed oil spill response issues. The findings point to recommended practices that, if adopted and successfully implemented in future spill preparedness and response, may lead to a better prepared response community and better educated communities.

Session: 001
Date: Sunday, January 26 - 2:45 PM
Room: 203 (Convention Center)
Track: Setting the record straight: Debunking myths and misconceptions about oil in the Gulf and promoting ocean literacy (Half Day Session)
Type: Oral

The BP Oil well failure in the Gulf of Mexico: perceptions and reality

Presenter: Richard A Snyder
University of West Florida
Authors: R. A. Snyder;
University of West Florida, Pensacola, FL.
Abstract:
Government regulations and liability concerns hampered response and cleanup efforts and mostly excluded academics and a willing general public from participating. This exclusion, combined with missing and in some cases false information, created a general distrust for any authority, government or private concerning the oil spill. In this information vacuum the loudest and often least credible voices

found a home. Misconceptions were born and became entrenched with the public, enhancing rather than calming fears. In the Florida Panhandle, there was a great deal of concern, and fear, about toxicity, yet human exposure, except for response workers, was minimal. This presentation will address real and perceived risks associated with the oil spill, focusing on the nature of the chemicals involved, their degradation in the environment, and exposure to oil spill chemicals related to human health risk.

Session: 001
Date: Sunday, January 26 - 3:00 PM
Room: 203 (Convention Center)
Track: Setting the record straight: Debunking myths and misconceptions about oil in the Gulf and promoting ocean literacy (Half Day Session)
Type: Oral

They Don't Read the New York Times in Grand Isle II: A Scientist's Take on Dispelling Myths About DWH Science

Presenter: Philip L Hoffman
NOAA Cooperative Institute Program
Authors: P. L. Hoffman;
NOAA Cooperative Institute Program, Silver Spring, MD.

Abstract:
Scientists often have a challenge developing and delivering cutting edge localized information in that local and traditional communities appear to be impenetrable to outsiders. The challenge is often exacerbated when scientists and government public affairs officers rely on national media outlets to quickly disseminate scientific findings and rapidly changing forecasts during disasters. During the Deep Water Horizon/MC 252 oil spill and response, the federal government had to make quick decisions based on available, and rapidly changing, information to protect human health and coastal and marine resources. These decisions had often had an impact on local and traditional fishing communities, and the communication with those communities were often challenged the decision makers and scientists because it was not believed.
Based on first had observations during the federal response, and drawing on available human dimensions literature on science/community interactions, this paper will relay stories of communication opportunities lost, science challenged, and local decision makers cast as reluctant partners, as opposed to enthusiastic supporters. The paper will also highlight information and communication channels that can bear fruit in future federal responses and which require action during normal science and resource management endeavors so that relationships are robust beforehand.

Session: 001
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Setting the record straight: Debunking myths and misconceptions about oil in the Gulf and promoting ocean literacy (Half Day Session)
Type: Poster 1-1

Background oiling documented by SCAT surveys along Gulf Coast shorelines prior to and following MC252 oiling

Presenter: Elliott Taylor
Polaris Applied Sciences, Inc.
Authors: E. Taylor[1], G. E. Challenger[1], E. H. Owens[2], G. S. Mauseth[1];
[1]Polaris Applied Sciences, Inc., Kirkland, WA, [2]Owens Coastal Consulting, Bainbridge Island, WA.

Abstract:
The SCAT process was initiated in response to the Deepwater Horizon accident on 30 April 2010. In anticipation of oil reaching the Gulf Coast shoreline, the management and logistics infrastructure were created within the Environmental Unit of the Unified Command to support the program and multi-jurisdictional field teams were deployed to document shoreline conditions before oil from the accident (MC252 oil) reached shore. The first surveys were conducted on 5 May 2010 along select segments of LA, MS, AL, and FL and documented background oil in portions of these states, which were not unexpected. Timing of oil landfall in LA precluded systematic pre-landfall SCAT surveys; however, other sources of oil were noted in LA before the accident and throughout the response. We will report on background concentrations of oil measured in early surveys of the Eastern States shorelines, and compare them to background concentrations of oil reported by other scientific studies published prior to the DWH accident (e.g., Henry et al., 1993; Romero et al., 1981). We will also report on the non-MC252 oil documented from thousands of formal SCAT surveys conducted to assess oiling and to select cleanup goals after MC252 oil reached the shoreline.

Session: 001
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Setting the record straight: Debunking myths and misconceptions about oil in the Gulf and promoting ocean literacy (Half Day Session)
Type: Poster 1-2

Building a comprehensive sample repository to track the long-term impacts of the Macondo Well oil spill: an opportunity to engage citizen scientists

Presenter: Catherine A Carmichael
Woods Hole Oceanographic Institution
Authors: C. A. Carmichael[1], R. K. Nelson[1], C. Aeppli[2], C. M. Reddy[1];
[1]Woods Hole Oceanographic Institution, Woods Hole, MA, [2]Bigelow Laboratory for Ocean Sciences, East Boothbay, ME.
Abstract:
In the past, studying the long-term fate of oil spills has been hindered by long absences of sampling and a lack of sampling spread. This has limited our capacity to study how oil behaves in the environment on the time scale of years to decades. To eliminate this potential problem for the Deepwater Horizon oil spill, our lab at the Woods Hole Oceanographic Institution has started a sample repository to collect and archive oil samples for research. Over the past 26 months, our lab has collected over 700 samples along the beaches, jetties and barriers islands in the Gulf of Mexico. These samples have been shared with colleagues, analyzed in numerous scientific publications and are being used to create a NIST Standard Reference Material. The temporal and spatial trends seen among the samples provide a valuable contextual reference to how the released oil is behaving and changing in the environment.
Due to our location in Cape Cod it is challenging for us to collect as many samples as we would like to. We believe this is an excellent opportunity for a Citizen Scientist Program. This poster will provide an overview of the types of samples that can be collected, proper sample collection and archiving protocols and how petroleum behaves in the environment. A Citizen Scientist Program is a mutually beneficial effort that would increase our sample collection capabilities to allow for more extensive analytical results while simultaneously educating a future generation on the fundamentals of oil spill research.

Session: 001
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Setting the record straight: Debunking myths and misconceptions about oil in the Gulf and promoting ocean literacy (Half Day Session)
Type: Poster 1-3

Combining Art and Science to Explain the Impact of Oil Spills and Cleanup to Middle School Students

Presenter: Paul Russo
LSU
Authors: P. Russo[1], J. Pojman[1], X. Zhang[1], Y. Chen[1], W. Huberty[1], G. Dave[2], S. Youngblood[2];
[1]LSU, Baton Rouge, LA, [2]Glasgow Middle School, Baton Rouge, LA.
Abstract:
Students at Glasgow Middle School in Baton Rouge learned about the Gulf of Mexico_its economy, biology and beauty_through art. First, the students studied the Gulf itself and interpreted what they learned through imagery. A team of educators, including science teacher, art teacher, university professors and graduate students, explained key concepts of the interaction of oil, water and dispersants by designing a hands-on experience using safe household materials. Key concepts such as density and molecular symmetry were covered. The outcome is available in the art itself, and in students who perform well in science.

Session: 001
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Setting the record straight: Debunking myths and misconceptions about oil in the Gulf and promoting ocean literacy (Half Day Session)
Type: Poster 1-4

Occurrence of natural hydrocarbon seeps and deepwater coral communities in the Gulf of Mexico

Presenter: James Sinclair
Bureau of Safety and Environmental Enforcement
Authors: J. Sinclair[1], W. Shedd[2];
[1]Bureau of Safety and Environmental Enforcement, New Orleans, LA, [2]Bureau of Ocean Energy Management, New Orleans, LA.
Abstract:
The locations of hydrocarbon seeps and the deepwater live-bottom communities they support are critical information during an oil spill crisis and the subsequent assessments. Since their discovery in the Gulf of Mexico in the mid-1980's, scientists have continually studied deepwater chemosynthetic communities. The communities are associated with hydrocarbon seeps in waters about 300 meters and deeper. Deepwater coral communities frequently co-occur with chemo communities.
Recent work by geoscientists at the Bureau of Ocean Energy Management (BOEM, formerly Minerals Management Service) has identified over 28,000 seismic amplitude anomalies on the Gulf of Mexico seafloor. Over 22,000 of these are positive anomalies that

likely represent seafloor hydrocarbon seeps with hardgrounds supporting chemosynthetic and coral communities. This is an astounding figure, suggesting that these communities are much more prevalent than previously known. Two other anomaly types represent over 6000 probable seep sites with very few of them supporting chemo communities.
Over 400 anomaly sites in the Gulf of Mexico are confirmed as hydrocarbon seeps supporting chemo and coral communities. Of the anomaly sites visited by scientists, about 95 % have proven to be hydrocarbon seeps and about 80% chemo/coral sites. Shapefiles for Gulf of Mexico water bottom anomalies are free to download from the BOEM website at http://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/Map-Gallery/Seismic-Water-Bottom-Anomalies-Map-Gallery.aspx.

Session: 001
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Setting the record straight: Debunking myths and misconceptions about oil in the Gulf and promoting ocean literacy (Half Day Session)
Type: Poster 1-404

Actions to Promote Coordinated, Science-based Gulf Ecosystem Restoration

Presenter: Andrew Nelson Shepard
University of South Florida
Authors: A. N. Shepard[1], A. Dausman[2], B. Kraft[3], C. Robbins[4], J. Cowan[5], L. Swann[6], L. McKinney[7], M. MacDonald[8], M. Graham[9], R. Guillory[3], R. Merrick[5], S. Walker[5], S. Sempier[10], K. Johnson[9];
[1]University of South Florida, St. Petersburg, FL, [2]US Geological Survey, New Orleans, LA, [3]Ocean Conservancy, New Orleans, LA, [4]Ocean Conservancy, Austin, TX, [5]NOAA, Silver Spring, MD, [6]Sea Grant, Auburn, AL, [7]Harte Research Institute, Corpus Christi, TX, [8]Walton Family Foundation, Washington, DC, [9]University of Southern Mississippi, Stennis, MS, [10]Sea Grant, Ocean Springs, MS.
Abstract:
Gulf of Mexico recovery efforts must be based on “best available science” (BAS), a RESTORE Act mandate that should apply to all ecosystem restoration efforts. In 2013, scientists and managers from restoration-funded programs engaged in a workshop to identify: rationale for BAS implementation in all ecosystem restoration; priority short (1-5 years) and long-term (6-30 years) actions to implement BAS; and actions to foster engagement among restoration programs and with their stakeholders. This presentation will report on identified rationale and actions. Recommended short-term actions included: establish science advisory bodies, staff and plans to guide program implementation; plans should include criteria required to judge science-based projects, both for peer review and performance evaluation; develop conceptual models for Gulf-wide ecosystem restoration that serve to identify knowledge gaps and integrate program plans and efforts; and develop and maintain unified Gulf-wide ecosystem monitoring program, information gateway, and data management plan.

Session 002: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science

Session: 002
Date: Sunday, January 26 - 1:15 PM
Room: 204 (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Oral

Gulf of Mexico hydrocarbon database: Integrating heterogeneous data for improved model development

Presenter: Anne E Thessen
University of Maryland Center for Environmental Science
Authors: A. E. Thessen, S. McGinnis, E. North, I. Mitchell;
University of Maryland Center for Environmental Science, Cambridge, MD.

Abstract:
Particle tracking models use the predictions from hydrodynamic models to calculate the trajectories of particles in a fluid. One example of a particle tracking model is the Lagrangian TRANSport model (LTRANS) which is available as open-source code with a User's Guide. Our research group has been working to develop LTRANS to simulate the fate and transport of hydrocarbons in the Gulf of Mexico. An important part of model development is the process of validation or ground-truthing, wherein model output is compared to field data. To validate LTRANS, we are integrating oceanographic and hydrocarbon data collected in association with the Deepwater Horizon spill into a single database for comparison to model output. We have integrated data collected by federal agencies, volunteer networks, and single investigators. To effectively integrate such heterogeneous data sets, we have developed C# and SQL scripts for reconciling terms and units and extracting and normalizing data from various file formats. For comparison to model output, we have developed algorithms to find the nearest model point(s) to a given observed data point and to visualize the results. This database is currently 8.68 GB in size, containing over 7 million data points and more than 1700 different parameters. Strategies and challenges associated with assembling the database will be discussed.

Session: 002
Date: Sunday, January 26 - 1:30 PM
Room: 204 (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Oral

Dataset granularity challenges at Deep-C data center

Presenter: Shawn R Smith
Florida State University
Authors: S. R. Smith, S. Viswanathan, K. Suchdeve, D. Villa-Hamilton, O. Zavala Romero;
Florida State University, Tallahassee, FL.

Abstract:
The mission of the Deep-C data center is to accept, distribute, and ensure the long-term archival of Deep-C-funded datasets, analyses, or products. Deep-C is a diverse project resulting in heterogeneous data that include cruise, mooring, float, and aircraft observations; shore sampling; numerical modeling; self-contained laboratory experiments; and a host of laboratory analyses of field samples (water, sediment, oil, flora, fauna, etc.). The authors will focus on challenges associated with determining appropriate dataset granularity and aggregation to support a wide range of scientific users. We will present solutions being employed by Deep-C to provide datasets at the finest temporal and spatial granularity afforded by the metadata received from the submitter of the dataset. Further challenges related to linking laboratory analyses to original field samples will be addressed. Ongoing collaborations with the Gulf Research Initiative Information and Data Cooperative to develop methods to register and provide ISO metadata for highly granular and heterogeneous datasets will be described. The present status of data holdings at the Deep-C data center and an explanation of how these data can be accessed by the Gulf research community will be provided. Tools presented will include both standard tabular internet services and a GIS-based Gulf of Mexico atlas.

Session: 002
Date: Sunday, January 26 - 1:45 PM
Room: 204 (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Oral

What is a Sample? (Complexities of Sharing Contaminant Data Across Multiple Data Management Platforms)

Presenter: Peggy L Myre
Exa Data & Mapping
Authors: P. L. Myre[1], B. Shorr[2], J. Field[2], C. Severn[3], C. Sayler[4], J. Oelerich[5];
[1]Exa Data & Mapping, Port Townsend, WA, [2]NOAA Office of Response and Restoration, Seattle, WA, [3]S2 EnviroData Solutions, Inc., Las Vegas, NV, [4]Sayler Data Solutions, Inc., Kirkland, WA, [5]Maul Foster & Alongi, Inc., Portland, OR.

Abstract:

Collaboration and data sharing is challenging when partners are using different data management systems and designs. One of the key concepts, and a common primary key field, is *Sample ID*. Sampling in the Gulf of Mexico during and after the Deepwater Horizon oil spill presented an unprecedented range of sampling devices, sample handling, post-processing, and analytical techniques. In order to serve data consistently across studies, matrices, and research goals, the NOAA Data Management Team (DMT) standardized the Sample ID definition to enable data centralization, and to streamline querying and analysis. We defined the concept of a "Data Management Sample" in contrast to other sample identifiers in use by collaborative partners including Field, Chain-of-Custody, Analytical (or Laboratory) Samples, and interim samples that are created in a processing facility (e.g., dissections, splits, composites). This standard was applied to the central data management structure (Query Manager), and critical as a linkage to other data streams through NOAA's Natural Resources Damage Assessment data warehouse. Our experience has led us to recommend that collaborative partners agree on a Sample definition early in the data collection process.

Session: 002
Date: Sunday, January 26 - 2:00 PM
Room: 204 (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Oral

Gulf of Mexico Research Initiative Information and Data Cooperative (GRIIDC) Dataset Lifecycle: Early Lessons

Presenter: Felimon Gayanilo
Texas A&M University-Corpus Christi
Authors: F. Gayanilo, J. Gibeaut;
Texas A&M University-Corpus Christi, Corpus Christi, TX.

Abstract:
The Gulf of Mexico Research Initiative Information and Data Cooperative (GRIIDC), tasked to address the scientific data management needs of the Gulf of Mexico Research Initiative (GoMRI), deployed an online data management system (DMS), which has been operating for over a year. The DMS includes modules to support researchers in their data management including the identification and early documentation of datasets planned to be collected or generated, metadata development, generation of persistent identifiers, submission and registration of datasets to GRIIDC or to appropriate national data centers, data discovery and distribution, and soon to be deployed, data use analytics. Behind the information system is an organization dedicated to the effective deployment of the infrastructures supported by working groups and subject matter experts.
Working Groups were formed and several focused group meetings were held to address current system deficiencies and to identify and address future needs. Iterative and incremental modifications were made to system elements most transparent to users to adapt to changes and maintain the flexibility of the information system. Through the lifecycle of a GoMRI dataset, this paper enumerates the lessons learned during the developmental phases and deployment of the GRIIDC DMS.

Session: 002
Date: Sunday, January 26 - 2:15 PM
Room: 204 (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Oral

What's in a Name? Vocabularies for Search, Browse and Interoperability

Presenter: Matthew K. Howard
Texas A&M University
Authors: M. K. Howard[1], F. C. Gayanilo[2], C. A. Rueda[3], T. A. Chavez[4], J. C. Gibeaut[5];
[1]Texas A&M University, College Station, TX, [2]Texas A&M University-Corpus Christi, Corpus Christi, TX, [3]Monterey Bay Aquarium Research Institute, Monterey, CA, [4]University of South Florida, Tampa, FL, [5]Texas A&M University-Corpus Christi, College Station, TX.

Abstract:
The Gulf of Mexico Research Initiative Information and Data Cooperative (GRIIDC) is building a research database to index the full body of data from the $500M 10-year study on the effects of oil spills on the environment and human health. An online search and browse capability will support both human and machine queries of the database. The system will be based on Lucene software libraries for retrievals and Simple Knowledge Organization System (SKOS) approaches for binding concepts, vocabulary terms, definitions, and relationships between these into computable structures. This will enable retrieval of related items as well as exact matches. Data providers were required to submit standards-based metadata describing "who, what and where" to GRIIDC. The use of controlled-vocabularies for measured parameters, which is needed for interoperability, were recommended but not required. For some disciplines, controlled-vocabularies were readily available in the registry at the Marine Metadata Interoperability (MMI) website. While extensive, the vocabularies contained therein do not span the terminology space needed for the all elements of the project (e.g., dispersants). The authors above comprise the working group tasked to complete the GRIIDC vocabulary. They will do this by assigning each term in the database to related terms in established controlled-vocabularies and constructing a supplemental vocabulary for orphan terms. The concatenated results will be registered with MMI.

Session: 002
Date: Sunday, January 26 - 2:30 PM
Room: 204 (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Oral

Simulocean: a web-based deployment and visualization framework for coastal modeling and beyond

Presenter: Jian Tao
Louisiana State University
Authors: J. Tao, W. Yu, R. Guo, K. Hu, Q. J. Chen;
Louisiana State University, Baton Rouge, LA.

Abstract:
High performance computing (HPC) plays an important role in numerical modeling. However, most of the HPC systems can only be used with command line tools which are not intuitive to a lot of modelers. There is a need for a gateway to HPC systems for those who want to focus on their own research while relying on IT services to help with model deployment and data management on the HPC facilities.
Furthermore, for coastal modelers and very likely many others, collecting and preparing input data for numerical simulations usually takes a lot of time. A tool that can automate the process, even not completely, is of great value too. Here we present our work, Simulocean to provide a gateway to HPC resources for coastal modelers.
Simulocean is a web-based deployment and visualization framework for coastal modeling and beyond. Simulocean collects observational data, schedules modeling codes for execution on HPC systems, manages data transfer automatically, and visualizes simulation results. With all the information collected, Simulocean could potentially provide direct validation and verification for models, and generate high quality technical reports. Simulocean is built on top of the Django web development framework and uses the Advanced Message Queuing Protocol internally via Celery, a distributed task queue system to handle asynchronous tasks. Simulocean was supported by the NG-CHC (NSF Award #1010640) project. The hardware resources are provided by the Center for Computation and Technology at the Louisiana State University.

Session: 002
Date: Sunday, January 26 - 2:45 PM
Room: 204 (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Oral

Database and Visualization Tools for Complex Data Sets Generated from the Analysis of the Deepwater Horizon Oil Spill

Presenter: Ryan P Rodgers
NHMFL at Florida State University
Authors: R. P. Rodgers[1], A. G. Marshall[2], E. London[3], Y. E. Corilo[1];
[1]NHMFL at Florida State University, Tallahassee, FL, [2]Florida State University, Tallahassee, FL, [3]3D Data LLC, Tallahassee, FL.

Abstract:
Modern Fourier Transform Ion Cyclotron Resonance Mass Spectrometers can identify tens of thousands of species (at the level of elemental composition) and Comprehensive two-dimensional gas chromatography (GC x GC) identifies thousands of species (at the isomer level) from a single oil sample. The ability to obtain such detailed compositional information combined with the number and type of samples collected and analyzed (by these and many other techniques) from the Gulf of Mexico as a result of the oil spill, necessitates the creation of a highly flexibly, secure, remote access database for data storage, retrieval, sharing, visualization and post processing. Here, we present the initial creation of a Gulf of Mexico database that allows data visualization, sharing (through remote access), and post processing of complex GCxGC and FT-ICR MS data sets in a dynamic 3D environment. We highlight the strengths of the current 3D interactive data analysis environment and provide examples of data interaction within the 3D environment. Data from multiple analytical techniques are used to demonstrate the method and type of interactions possible. Work supported by NSF DMR-11-57490, Florida State University, the Future Fuels Institute, and the National High Magnetic Field Laboratory in Tallahassee, FL.

Session: 002
Date: Sunday, January 26 - 3:00 PM
Room: 204 (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Oral

Progressing from data to information: using GIS to improve management of coral and fisheries resources in the Gulf of Mexico

Presenter: Mark Mueller
Gulf of Mexico Fishery Management Council
Authors: M. Mueller, J. Froeschke;
Gulf of Mexico Fishery Management Council, Tampa, FL.

Abstract:
The Gulf of Mexico Fishery Management Council, charged with sustainably managing Gulf coral and fishery resources in federal waters, is developing a baseline of spatial information on shallow and deep-water coral habitats and associated fisheries. This baseline is being used to address management questions and to improve a surprisingly incomplete understanding of coral/fishery interrelationships.
We are compiling and synthesizing datasets on coral distribution, fisheries, habitat (oceanographic variables, bathymetry, benthic cover, sediment type, etc.) along with human-use (e.g., standing and reefed offshore platforms) and jurisdictional layers. We are developing a cloud-based interactive map viewer and data portal using ArcGIS Server and ArcGIS Viewer for Flex. Anticipated users include managers, coral and fisheries scientists, and fishermen. Ideas in development include online thematic learning/data modules and crowdsourcing to obtain usable observation information from the public. We hosted a three-day workshop in May 2013 focused on coral/fisheries relationships which provided expert feedback on important data gaps and management recommendations.

Session: 002
Date: Sunday, January 26 - 3:15 PM
Room: 204 (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Oral

Delivering an abundance of data associated with the Deepwater Horizon accident: streamlining access to DWH data

Presenter: Dennis D Beckmann
BP
Authors: D. D. Beckmann;
BP, Houston, TX.

Abstract:
In responding to the Deepwater Horizon accident, tens of thousands of environmental samples and observations were collected, both independently and in cooperation with government agencies involved in response action and natural resource damage efforts.
BP has established a web site to make these data available to the public. The data have been grouped into the following resource groups: Water, Oil Characteristics, Sediments, Aquatic Biology, Toxicology, Birds, Shoreline, Marine Mammals and sea turtles, and Other Data. Data types to be posted will include chemistry, field parameters, physical properties, fingerprinting interpretations, population counts, species identifications, aerial photographs, telemetry data and oiling observations.
The first dataset to be published will be chemistry data, associated QA, and metadata for water column surveys. At this time, published chemistry data will be focused on petroleum-related hydrocarbon parameters. BP will also publish study descriptions along with work plans, sample lists, and station location maps to provide data users the context needed to understand why, where, and how the data were collected and processed. BP believes that publication of the data in its current form will provide useful information about environmental conditions in the Gulf to the scientific community. BP will provide updates to these published datasets, and allow users to download them and associated documentation for analysis and study.

Session: 002
Date: Sunday, January 26 - 4:00 PM
Room: 204 (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Oral

Breaking Through Information Silos 1: Leveraging Business Intelligence (BI) Tools to Integrate Scientific Data

Presenter: Jim Anderton
Solea Solutions
Authors: J. Anderton[1], D. Hudgens[2], K. Kirsch[3], B. Shorr[4];
[1]Solea Solutions, Portland, OR, [2]IEc, Cambridge, MA, [3]NOAA, St. Petersburg, FL, [4]NOAA, Seattle, WA.

Abstract:
Researchers generate large quantities of scientific data organized in disparate files and databases. As a result, information sharing and cross-team collaboration may be limited by access difficulties or incomplete understanding of the studies' organization and context. To address these challenges, NOAA's Office of Response & Restoration (OR&R) leveraged tools traditionally used in the private sector for data warehousing and business intelligence that integrate information into a common organizational framework. The NOAA OR&R data

team started by developing a common framework for storing environmental data. To promote data consistency and searchability, this framework includes data fields required for all datasets as well as specialized fields specific to data types (e.g., sample results, visual observation data). To create the combined scientific repository, we developed a series of ETL (Extract, Transform, Load) steps using Pentaho's open source software. The team developed a series of documented, repeatable processes for obtaining the data from each source system, mapping fields and values to the common framework, and loading the information into the repository. As updated or new information becomes available from each source system, the data are automatically audited and pulled into the common repository. We anticipate expanding the process to allow partners to self-define their data relative to the common framework and submit their information to the repository.

Session: 002
Date: Sunday, January 26 - 4:15 PM
Room: 204 (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Oral

Breaking through Information Silos 2: Facing the Challenge of Standardizing Data from Disparate Sources

Presenter: Ann Jones
IEc
Authors: A. Jones[1], N. Tanners[1], B. Shorr[2], D. Hudgens[1];
[1]IEc, Cambridge, MA, [2]NOAA, Seattle, WA.

Abstract:
NOAA's Office of Response & Restoration (OR&R) manages an array of data streams to support its injury assessment goals. In addition to sediment contaminant chemistry and bioassay data, historically standardized into NOAA's Query Manager database standard, an injury assessment may include many additional matrices and a wide variety of non-contaminant analyses (e.g., community structure, genetics, physiology, histopathology). These data streams arrive from multiple laboratories and programs and are then distributed to data users via a common organizational framework.
Ingesting and processing these data require common standards and quality controls that are rigorous yet flexible. NOAA OR&R's data team works with individual laboratories to implement a standardized electronic deliverable that is applicable across multiple analytical methods. We match results from laboratories to field sample information and standardize sample descriptions, units, and analytical methods. Similar analyses from multiple labs are grouped together for ready comparisons and ease of retrieval. An adaptive audit system reviews each analytical program to ensure attainment of core quality standards, including sample integrity, precision and accuracy, and transparency. Using laboratory and audit information, we develop metadata and caveats to support data users. Validated datasets are shared through ERMA Gulf Response and NOAA's DWH NRDA website.

Session: 002
Date: Sunday, January 26 - 4:30 PM
Room: 204 (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Oral

Breaking through Information Silos 3: Increasing Scientific Collaboration and Learning through Advanced Data Searching, Visualizing, and Reporting

Presenter: Ben Shorr
NOAA
Authors: B. Shorr[1], D. Hudgens[2], J. Bower[3], J. Anderton[4];
[1]NOAA, Seattle, WA, [2]IEc, Cambridge, MA, [3]Sirius Solutions, Minneapolis, MN, [4]Solea Solutions, Portland, OR.

Abstract:
NOAA has developed a cutting-edge web-based tool to manage the unprecedented quantity of environmental data collected in the Gulf of Mexico. DIVER (Data Integration, Visualization, Exploration, and Reporting) addresses the challenge of integrating many datasets coming from numerous separate systems. Using compiled databases created with Pentaho tools, NOAA built DIVER to provide users with the ability to target their search on particular data of interest or across multiple data types, visualize the results in interactive maps and tables, and export the full quantity of data and accompanying metadata into the Environmental Response Management Application (ERMA) common operational picture online mapping tool) or into spreadsheet or GIS applications. The data query tools within DIVER allow users to explore the environmental datasets based upon a common core set of data fields plus specialized fields applicable to specific data types (e.g., Analysis Types.). Users can choose query templates or start from scratch to quickly obtain data, analysis, and results and also save queries. As users query the data, DIVER provides a progressively refined list of values matching the criteria defined for previously selected fields. Once the search is performed, users are presented with an interactive map displaying the results, interactive charting and table for data exploration, and data export. Data export packages include detailed FGDC metadata, field definitions, and data caveats.

Session: 002
Date: Sunday, January 26 - 4:45 PM
Room: 204 (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Oral

Integrating GNOME And Hydrodynamic Modeling For Bay And Estuary Oil Spill Prediction

Presenter: Ben R. Hodges
The University of Texas at Austin
Authors: X. Hou[1], B. R. Hodges[1], S. Negusse[2], D. Crockett[2];
[1]The University of Texas at Austin, Austin, TX, [2]Texas Water Development Board, Austin, TX.

Abstract:
The Texax General Land Office and Texas Water Development Board deploy a real-time system of hydrodynamic and oil spill transport modeling for emergency response and planning. This system is being upgraded to integrate hydrodynamic models with the new Linux version of the General NOAA Operational Modeling Environment (GNOME). Integration is accomplished with the Hydrodynamic and Oil Spill Model (HyosPy), which operates as a top-level wrapper to automatically (1) download wind, tide, and river inflow data from the internet; (2) reformat data for hydrodynamic modeling, (3) initialize, run, and analyze multiple hydrodynamic models, (4) translate hydrodynamic model output to GNOME, (5) run multiple instances of GNOME, and (6) display GNOME results in Google Earth. A major advance with HyosPy is its ability to automatically sequence multiple hydrodynamic and GNOME models on a multi-processor workstation or parallel server system. New hydrodynamic models are sequenced to start every 2 hours, with a planned deployment providing 12 models simultaneously running at all times. When an oil spill occurs, multiple GNOME models can be immediately run using 12 different hydrodynamic predictions, i.e. using wind/tide predictions that are 2, 4, 6, etc. hours old. The spread of the different GNOME oil spill prediction tracks provides a visual estimate of uncertainty in the model forecast.

Session: 002
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Poster 2-5

Validating HYCOM Salinity Predictions in the Northern Gulf of Mexico Using Samos Data

Presenter: Nicolas Lopez
Florida State University / COAPS
Authors: N. Lopez;
Florida State University / COAPS, Tallahassee, FL.

Abstract:
The HYCOM1 Gulf of Mexico ocean model uses a hybrid coordinate system, NCODA data assimilation techniques, and NOGAPS atmospheric forcing to produce 1/25° resolution forecasts. Sea surface salinity predictions produced by 3 versions of the HYCOM are compared and validated. It is hypothesized that versions 20.1, 30.1, and 31.0 of HYCOM 1/25° simulations either underestimate the amount of freshwater outflow from rivers along the northern Gulf or oversimplify their dynamics. Because freshwater outflow in the region can be transported throughout the Gulf by the Loop Current, an underestimation of salinity in this region could translate to salinity biases elsewhere. Salinity predictions are bilinearly interpolated along 53 SAMOS2 ship tracks recorded between 2010 and early 2012, primarily during the summer and fall. Differences between the in situ observations and the combined HYCOM 20.1 and 30.1 predictions are used to determine model performance in regions of the northern Gulf. The same procedure is then applied to version 31.0 of HYCOM. Results show that the 3 versions of the model greatly underestimate either the amount of freshwater transported by the Mississippi River, or the extent that river water spreads throughout the northern Gulf. Improvements in HYCOM's ability to manage rivers would improve salinity predictions and thus benefit fisheries along the Gulf Coast, particularly those near the mouth of the Mississippi River.

Session: 002
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Poster 2-6

An adaptive, minimum-variance coordinate system for calculating a near-surface velocity climatology from ocean drifters

Presenter: Lucas C Laurindo
Rosenstiel School of Marine and Atmospheric Science, University of Miami
Authors: L. C. Laurindo, A. J. Mariano, E. H. Ryan;
Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, FL.

Abstract:
Currently available near-surface velocity climatologies are based on Eulerian averaging techniques that smear the synoptic shape of intense dynamical features, such as western boundary currents, and can underestimate the maximum core velocities by a factor of 2 or more. Seeking to reduce the smoothing and smearing effects of data averaging, this work proposes a new climatology construction

technique based on spline fitting historical in-situ velocity measurements by drifters along a locally defined reference axis where variance is minimized. Specifically, data subsets for both u and v velocity components are selected within a given space-time volume, where the local Cartesian coordinate system is gradually rotated in small angle increments around the data mean position. At each angle, 1-D bicubic splines are fitted to the velocity values along the rotated x-axis, where the considered velocity estimates are found at the angle where data variance is minimized. All of the local velocity estimates are then fitted with a 2-D bicubic spline to produce a regular gridded, near-surface velocity climatology based on ocean drifter observations. Preliminary tests using near-surface velocity data from the NOAA Global Lagrangian Drifter Dataset show that the method is capable of producing time-average spatial structures and velocity magnitudes for western boundary currents qualitatively compatible with the observations. The technique is general and can be applied to other data sets.

Session: 002
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Data Management and Informatics Supporting Gulf of Mexico Oil Spill and Ecosystem Science (Half Day)
Type: Poster 2-7

A Circa 2011 Bathymetric Dynamic Digital Elevation Model for the Northern Gulf of Mexico

Presenter: Stephan J. O'Brien
The University of Southern Mississippi
Authors: S. J. O'Brien[1], J. D. Wiggert[1], D. W. Dodd[2];
[1]The University of Southern Mississippi, Stennis Space Center, MS, [2]Canadian Hydrographic Service, Sidney, BC, CANADA.

Abstract:
Circulation models applied to the Northern Gulf of Mexico are commonly used to forecast the impacts and hazards associated with sea level rise, inundation and oil spills. These circulation models rely on bathymetric data discretized in space as a regular grid in the domain of interest. Errors in these circulation models incurred through use of outdated bathymetry can be significant and lead to poor guidance on ecological and economic impacts in the Northern Gulf's vulnerable shelf and coastal regions. The research reported here documents the development of the Bathymetric Dynamic Digital Elevation Model (BDDEM), which has been used to support modeling systems operated as part of the Northern Gulf Coast Hazards Collaboratory. The BDDEM was developed using open source software. The BDDEM's initial basis was obtained by merging the five digital elevation models of the Northern Gulf region released by the National Geophysical Data Center. The final build of the BDDEM includes all of the National Ocean Service hydrographic surveys conducted in Alabama, Mississippi and Louisiana through 2011. The circa 2011 BDDEM is available as a web-accessible resource via the USM-DMS THREDDS server (OPeNDAP and FTP). Plans for future BDDEM development include: 1) web-based, visual tools to extract data from the BDDEM product; and 2) packaging the open source software tools used for bathymetric survey ingestion into an accessible toolkit for the broader research community.

Session 003: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport

Session: 003
Date: Monday, January 27 - 10:00 AM
Room: Bon Secour Bay I
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Oral

Formation of Oil-Associated Marine Snow: An Effective Transportation and Distribution Pathway for Spilled Oil in Marine Environments

Presenter: Uta Passow
Marine Science Institute, UCSB
Authors: U. Passow;
Marine Science Institute, UCSB, Santa Barbara, CA.

Abstract:
It has been hypothesized that after the Deep Water Horizon (DWH) spill in 2010, marine snow markedly influenced the distribution of oil within the Gulf of Mexico. We investigated conditions inducing the formation of oil-associated marine snow experimentally, focusing especially on the effects of oil type, photochemical aging of oil, and the presence of phytoplankton and dispersant. The oil that accumulated at the sea surface after the accident induced the formation of large, mucus-rich marine snow. This bacteria-mediated formation of oil-based marine snow in the absence of particles > 1µm, represents a unique formation pathway different from that of the physical coagulation of particles. However, phytoplankton aggregates formed by physical coagulation also incorporated oil-carbon. Whereas any type of oil was incorporated into phytoplankton aggregates, only oil that was weathered triggered the formation of oil snow in the absence of particles. The ubiquitous formation and rapid sedimentation of marine snow can explain the high sedimentation rates of oil-contaminated material observed after the DWH spill. The dispersant Corexit 9500A (Corexit: oil ratio = 1: 100) inhibited the formation of oil snow. Future justifications for using Corexit 9500A will likely require a close examination of these diverse mechanisms.(GRIIDC ID: R1.x132.139.0004)

Session: 003
Date: Monday, January 27 - 10:15 AM
Room: Bon Secour Bay I
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Oral

Quantification of Oil-Layer Resistance to Entrainment in Water

Presenter: Marieke Zeinstra-Helfrich
NHL University of Applied Sciences
Authors: M. Zeinstra-Helfrich[1,2], A. Murk[2,3], W. Koops[1];
[1]NHL University of Applied Sciences, Leeuwarden, NETHERLANDS, [2]Wageningen University, part of Wageningen UR, Wageningen, NETHERLANDS, [3]IMARES, part of Wageningen UR, Wageningen, NETHERLANDS.

Abstract:
For an informed decision about application of dispersants on surface oil, accurate prediction of the fate of oil with natural and chemical dispersion is crucial. The transition of floating oil to the water column, so called entrainment, is not yet correctly included in oil fate models. Current modelling approach includes oil viscosity but not the influence of oil layer thickness on entrainment.
This presentation presents the results of a plunging jet method, developed to quantify entrainment of oil under different circumstances. Entrainment of oil is caused by the vertical energy provided by breaking waves. A plunging jet procedure mimics the impingement of a breaking wave crest on an undisturbed water surface, mechanistically resembling the at-sea process. The method is relatively small scale and has a good repeatability. In our plunging jet procedure a specific amount of water is poured from a defined height on top of an oil layer on water. During and after the impact, the events underwater are captured by a digital (photo-) camera. The droplet sizes and volume of oil in the water column at a given time is registered and quantified using image processing software. Within the framework of the C-IMAGE research, this method is applied to obtain information on the effect of oil layer properties and the presence of dispersants on the entrainment flux and droplet sizes to further improve oil fate modeling.

Session: 003
Date: Monday, January 27 - 10:45 AM
Room: Bon Secour Bay I
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Oral

Exchange pathways between coastal and open ocean waters in the Northern Gulf of Mexico

Presenter: Robert A Arnone
University of Southern Mississippi
Authors: R. A. Arnone[1], R. Vandermuelen[1], P. Donaghay[1], H. Yang[1], S. Ladner[2];
[1]University of Southern Mississippi, Stennis Space Center, MS, [2]Naval Research Laboratory, Stennis Space Center, MS.

Abstract:

Highly dynamic filaments provide a major exchange pathway between water masses in the Northern Gulf of Mexico. These pathways lead to major physical and ecological impacts in both near shore and offshore waters. The bio-optical and physical character of filaments were monitored by coupling satellite surface ocean color products, SST and circulation models. By tracking bio-optical changes within filaments in response to circulation, we show the importance of the physical and biological interaction. We characterized the spatial and temporal variability and transport and bio-optical aspects of these filaments. Multiple times the Mississippi River plume evolved into freshwater filaments extending into the central Gulf. The growth and decay of filaments were tracked over a time periods of months. The onshore - offshore exchange and flux rates are highly variable and were observed occuring at multiple pathways with the coast. Several filaments occurred simultaneously in different stages of evolution. The subsurface filament character was defined with ship and gliders to better characterize the uncertainty of satellite observations and ocean circulation models. These exchange processes of the coastal and offshore waters have significant impacts on physical and biological properties along the Gulf Coast.

Session: 003
Date: Monday, January 27 - 11:30 AM
Room: Bon Secour Bay I
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Oral

Observations of Ocean Turbulence at the Submesoscales: Classic Similarity Theory in GLAD Surface Drifter Data.

Presenter: Andrew Poje
CUNY - CSI
Authors: A. Poje[1], T. Ozgokmen[2], B. Haus[2], B. Lipphardt[3], A. Haza[2], A. Reniers[2], E. Ryan[2], J. Olascoaga[2], E. Coelho[4], G. Jacobs[4], A. Kirwan[3], H. Huntley[3], A. Mariano[2], A. Griffa[5];
[1]CUNY - CSI, Staten Island, NY, [2]U. Miami, Miami, FL, [3]U. Delaware, Newark, DE, [4]NRL, Stennis Space Center, MS, [5]CNR, La Spezia, ITALY.
Abstract:
We analyze multi-point velocity and position statistics obtained from the near simultaneous release of over 300 GPS-tracked surface drifters deployed in the DeSoto Canyon region of the Gulf of Mexico during the GLAD observational program in July 2012. The goal of the program was to provide detailed synoptic information on spatial and temporal variability in the surface velocity field in the submesoscale (0.1-10 km) regime where rotation and stratification effects are present but not dominant. The Lagrangian observations provide, perhaps for the first time in the surface ocean, sufficient densities of two-point measurements to test classical turbulence similarity theories at these spatial scales. All observations show clear evidence of local dispersion persisting to scales ~200m, inconsistent with a steep enstrophy cascade in the underlying velocity field. Longitudinal velocity structure functions obtained from two in-canyon launches are entirely consistent with Kolmogorov/Richardson scaling for a forward energy cascade. For one launch, examination of the third-order structure function provides evidence of a well defined, scale-independent dissipation rate for separation scales 200m < l < ~3km.

Session: 003
Date: Monday, January 27 - 12:00 PM
Room: Bon Secour Bay I
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Oral

Tracer dispersion at mid-depth in the Gulf of Mexico: Field experiment and simulations

Presenter: James R Ledwell
Woods Hole Oceanographic Institution
Authors: J. R. Ledwell[1], R. He[2], Z. Xuo[2], P. Chang[3], R. Montuoro[3], J. Olascoaga[4], J. J. Kuehl[3], S. Dimarco[3], L. Spencer[3], P. Chapman[3];
[1]Woods Hole Oceanographic Institution, Woods Hole, MA, [2]North Carolina State University, Raleigh, NC, [3]Texas A&M Universtiy, College Station, TX, [4]University of Miami, Miami, FL.
Abstract:
Dispersion of a tracer, released on an isopycnal surface near 1100 m depth over the continental slope in the Gulf of Mexico, was studied with a field experiment, with numerical simulations, and with a dynamical systems approach, as part of the Gulf Integrated Spill Response Consortium (GISR). The diapycnal diffusivity along the slope was enhanced (> 10-4 m2/s), along the slope, as has been found in other regions. Stirring of the tracer proceeded rapidly, compared with the open ocean, although lateral variations of the tracer column integral were still large at the end of one year, when the tracer was spread over approximately half the Gulf. The zero-crossing of the spatial autocorrelation function of the column integral grew from ~4 km one week after release, to ~100 km at 4 months, and to ~200 km at 12 months. The overall pattern of the tracer distribution, and its statistics, will be compared with numerical simulations and with persistence patterns of Lagrangian Coherent Structures. The aim of our study is to advance the skill of real-time simulations of the dispersal of nutrients and pollutants in the Gulf, both of which are important to the mid-depth ecosystem.

Session: 003
Date: Monday, January 27 - 12:15 PM
Room: Bon Secour Bay I
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Oral

Subsurface Oil Material Trapping and Release Fate Within a Stable, Laterally Mobile, Horizontal Layer: Model and Field Data for Soluble and Droplet Fractions

Presenter: Louis J Thibodeaux
Lousiana State University
Authors: L. J. Thibodeaux[1], A. Parsons[2], E. Overton[1], K. Valsaraj[1], K. Nandakumar[1];
[1]Lousiana State University, Baton Rouge, LA, [2]National Oceanic and Atmospheric Administration, Washington, DC.

Abstract:
Among the interesting discoveries during the aftermath of the Deepwater Horizon blowout was the so-called sub-surface plume; herein after termed the “oil-trapping layer”. Its depth position in the Gulf is ~1100-1300m., vertical dimension ~200m., and composed of hydrocarbons. It formed in the stratified water-column at the junction of the cold abyssal water and the permanent thermocline. This manuscript extends previous plume models to focus on the environmental chemodynamics processes of the various oil-material fractions within the layer. A theoretical model for the fractions employing coupled advection, diffusion and reactive processes, quantifies oil-material uptake, persistence, separation, and release as they relate to its fate. The behavior of three oil material categories; soluble fraction, small dispersant-laden droplets and the larger droplets, is modeled using the law of conservation for the volume of oil trapping layer moving in a horizontal direction. First it receives material from the abyss plume source below and then loses it upon departing and entering the hydrocarbon-free water. In effect, the stratified water column behaves as a natural oil-material separator.An enhancement of the conventional box model with internal gradients allows an approach that includes a turbulent eddy diffusion coupled with droplet rise velocity and reactive decay to produce a oil-material fraction concentration within as a function of time and position. Comparison of model projected in-layer concentration profiles of alkanes and aromatics against the available field data supports the proposed theory and the resulting model.

Session: 003
Date: Monday, January 27 - 12:30 PM
Room: Bon Secour Bay I
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Oral

Volume and mass transport on the continental slope near the Macondo spill site from a moored deepwater current meter array

Presenter: Steven F DiMarco
Texas A&M University
Authors: S. F. DiMarco[1], L. Spencer[1], J. Kuehl[1], N. L. Guinasso[1], C. Nygren[1], P. Chapman[1], R. Montuoro[1], J. Kurian[1], V. Khade[1], P. Chang[1], J. R. Ledwell[2];
[1]Texas A&M University, College Station, TX, [2]Woods Hole Oceanographic Institution, Woods Hole, MA.

Abstract:
The Gulf Integrated Spill Research (GISR) Consortia deployed six deepwater moorings along the slope of the northern Gulf of Mexico from July 2012 thru July 2013. Each mooring consisted of an upward looking 75kHz ADCP in the upper 1000 meters, three deep current meters from 15m above bottom and spaced ~200m apart, and a variety of temperature and salinity sensors. The objective of the GISR mooring array is to characterize the variability along the Louisiana slope, in support of both near-field plume modeling efforts and a deep tracer release experiment. We report on transport estimates of volume, mass, and nutrients (using hydrography) and vorticity at the study region during the deployment period. The region experienced a variety of strong physical forcing including a hurricane passage through the array (Hurricane Isaac August 2012), Loop Current Eddy passage (July 2012 and May 2013), cold-core ring impact (Feb-Apr 2013), and bottom-trapped low-frequency (4-16 day period) variability (June 2013). The impact of physical forcing on property transport throughout the water column will be addressed; specific emphasis is placed on the mid-water column at the depth of the observed methane plume during the spill. The observational estimates are compared to those predicted from a coupled ocean-atmosphere numerical model of the Gulf of Mexico for the same time period and interpreted within the context of results from the large-scale deep tracer experiment.

Session: 003
Date: Monday, January 27 - 12:45 PM
Room: Bon Secour Bay I
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Oral

Effect of Langmuir Turbulence and Ekman Transport on Dilution of Oil Plumes in the Ocean Mixed Layer

Presenter: Charles Meneveau
Johns Hopkins University
Authors: C. Meneveau[1], D. Yang[1], M. Chamecki[2];
[1]Johns Hopkins University, Baltimore, MD, [2]Pennsylvania State University, University Park, PA.

Abstract:
Transport and dilution of oil plumes in the upper ocean following deep water blowouts are governed by a variety of physical processes. Under wind and wave forcing, the ocean mixed layer (OML) is affected by Langmuir turbulence with cells that cause the convergence of buoyant particles into distinct downwind bands (windrows) with enhanced downwind transport. Meanwhile, Coriolis effects lead to crosswind Ekman transport when averaged over depth in the OML. When the oil plumes from deep water blowouts reach the OML, their interactions with Langmuir turbulence and Ekman transport strongly affect the final rates of dilution and bio-degradation. In this study, we use a high-fidelity 3D large-eddy resolving numerical simulation to quantify the complex oil dispersion phenomena in the OML. We show that oil plumes with different droplet sizes are diluted and transported differently in the OML, which can be quantified by the ratio of wave-induced Stokes drift to droplet rise velocity. Particularly, Langmuir cells can inhibit the dilution of large oil droplets (i.e. small Stokes drift to droplet rise velocity ratio) and converge them into windrows, resulting in enhanced downwind transport. Conversely, the downwelling and stirring motions of Langmuir turbulence can overcome the buoyancy of small oil droplets and dilute them effectively over much of the OML. The droplets are then transported in a predominantly crosswind direction by the Ekman transport. Graphical visualizations of the LES-resolved surface oil slick shows dilution patterns consistent with the satellite and aerial images of surface oil slicks. We propose a dimensionless number (the drift to buoyancy ratio) to quantify the opposing trends. This research is supported by GoMRI RFPII.

Session: 003
Date: Monday, January 27 - 2:30 PM
Room: Bon Secour Bay I
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Oral

Near-surface flow and Stokes' drift in the northeastern Gulf of Mexico

Presenter: Allan J. Clarke
Florida State University
Authors: A. J. Clarke, N. Wienders, S. Van Gorder, E. Chassignet;
Florida State University, Tallahassee, FL.

Abstract:
Crucial to the transport of oil to the coast is the Lagrangian flow within a meter of the surface. Nearly all 300 drifter observations by the CARTHE consortium in 2012 sensed the top m of the water column, whereas the GISR consortium are using about 5000 drift cards right at the ocean surface. The deep-sea to coast results are very different for the CARTHE and GISR drifters even though deployments were made in the same general deep sea region. Specifically, only about 1% of CARTHE drifters in 2012 came close to the coast whereas 200 of the first 1250 (16%) of the drift cards were picked up by beachcombers. This striking difference suggests that the Lagrangian flow might be strongly sheared in the crucial top meter of the water column. Lagrangian Stokes' drift due to surface gravity waves can produce such a shear, and theory suggests that in the northeastern Gulf of Mexico the net wave-driven Lagrangian flow is approximately given by the Stokes' drift even when the rotation of the earth is taken into account. Our calculations, based on directional wave spectra at NDBC buoys, show that the Stokes' drift currents vary seasonally, but usually are a few cm/s at the surface with an e-folding depth decay scale of about 2 m. At the time of the Macondo oil spill, we estimate that wave-driven flow would have transported surface particles to the coast in about a month.

Session: 003
Date: Monday, January 27 - 2:45 PM
Room: Bon Secour Bay I
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Oral

Ocean dynamical effects on material deformation evolution, compacted filaments

Presenter: Gregg Jacobs
Naval Research Lab
Authors: G. Jacobs[1], F. Beron-Vera[2], E. Coelho[3], A. Haza[2], H. Huntley[4], D. Kirwan[4], B. Lipphardt[4], J. Olascoaga[2], A. Poje[5], E. Ryan[2];
[1]Naval Research Lab, Stennis Space Center, MS, [2]RSMAS, University of Miami, Miami, FL, [3]University of New Orleans, New Orleans, LA, [4]University of Delaware, Newark, DE, [5]City University of New York, Staten Island, NY.

Abstract:
Effects of a range of dynamical processes on the material deformation in the ocean are analyzed by two models that resolve frontogenesis at 3km resolution and additional mixed layer instabilities at 1km resolution. The material deformation is separated into dilation (change in area relative to original area) and stretch (extension in one direction and contraction in the perpendicular direction). The analysis is then made using the deformation strain tensor integrated along particle/tracer trajectories to separate the effects of dilation and stretch. It is shown that dynamical processes within the ocean mixed layer create a distinctly different material deformation than the predominant processes below the mixed layer. Beneath the mixed layer, the primary processes are mesoscale eddy flow that produces a predominant stretch. In here, an initial material distributed in a circle will stretch out into a filament. At the ocean surface, ageostrophic flow generates upwelling and downwelling that subjects a material constrained to the ocean surface to divergence and convergence. Dilation becomes then a significant factor due to frontogenesis, and the mixed layer instabilities add to increase this effect. The resulting features evolving over time are then filaments generated by the stretch that become denser with surface particles generated by the compacting dilation. The Finite Time Lyapunov Exponents (FTLEs) sum both the stretch and dilation effects with dilation having a comparable impact to the stretch, which results in surface compacted filaments.

Session: 003
Date: Monday, January 27 - 3:00 PM
Room: Bon Secour Bay I
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Oral

Lagrangian-based Estimates of the Statistical Properties of the Northern Gulf of Mexico Surface Velocity Field as Sampled by GLAD Drifters

Presenter: Arthur J Mariano
U of Miami/RSMAS
Authors: A. J. Mariano[1], E. H. Ryan[1], L. C. Laurindo[1], B. Haus[1], T. Ozgokmen[1], A. Haza[1], M. Iskandarani[1], J. Olascoaga[1], A. Reniers[1], G. Novelli[1], B. Lipphardt[2], D. Kirwan[2], H. Huntley[2], A. Griffa[3], M. Berta[3], A. Poje[4], G. Jacobs[5], E. Coelho[5], P. Hogan[5], J. M. Restrepo[6], D. Bogucki[7];
[1]U of Miami/RSMAS, Miami, FL, [2]U of Delaware, Newark, DE, [3]CNR-ISMAR, La Spezia, ITALY, [4]SUNY, New York, NY, [5]NRL, Stennis, MS, [6]U of Arizona, Tuscon, AZ, [7]Texas AM, Corpus Christi, TX.

Abstract:
The Grand LAgrangian Deployment, hereafter GLAD, used multi-scale sampling and SPOT technology to map the position of drifters and hence the near-surface horizontal velocity field, (u,v), at very high resolution in both space and time. Over 300 drifters were launched and tracked during the summer of 2012 near and offshore of the Deep Water Horizon (DHW) site and the De Soto Canyon in the northern Gulf of Mexico. Statistical properties of the surface velocity field were estimated using one month long segments of trajectory and velocity data from 289 Code-styled drifters drogued at 1 m depth. The dominant periods estimated from the GLAD drifters are 1-2 days, 5-6 days, 9-10 days, and two weeks or longer. These time scales can be associated with inertial/tidal motion/sea breeze, weather-band/submesoscale, mesoscale eddies, and winds, respectively. The temporal e-folding scales for u and v are bimodal with shorter time scales of 0.25-0.50 days and 1-1.5 days. The Lagrangian integral time scales for u and v increase from coastal values of 8 hours to offshore values of primarily around 2 days and peak values at 3 days. Total horizontal diffusivity estimates from the GLAD drifters vary by almost two orders of magnitude from the coastal regions with weaker flow to the stronger flows sampled by the GLAD drifters from values ranging from the order of 1,000 to the order of 200,000 m²/s. The near-surface velocity statistics are a strong function of the feature sampled and topography.

Session: 003
Date: Monday, January 27 - 3:15 PM
Room: Bon Secour Bay I
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Oral

Quantifying Droplet Size Distribution Uncertainty in a Lagrangian Oil-Fate Model Forecast using Polynomial Chaos

Presenter: Mohamed Iskandarani
University of Miami
Authors: R. Goncalves[1], A. Srinivasan[2], M. Iskandarani[1], W. C. Thacker[3], E. Chassignet[4], O. M. Knio[5];
[1]University of Miami, Miami, FL, [2]Tendral LLC, Miami, FL, [3]CIMAS, Miami, FL, [4]The Florida State University, Tallahassee,, FL, [5]Duke, Durham, NC.
Abstract:
A reliable oil-fate model requires an assessment of the uncertainty in the model's output data given the uncertainty in its input data. Here we apply the method of polynomial chaos to propagate the input uncertainty in the droplet size distribution and quantify its impact on the oil-fate model forecast. The droplet size distribution has been identified as a key variable determining where and when the oil will surface; furthermore its determination from observations is very difficult and one often relies on laboratory experiments that may not be reflective of oceanic conditions. A probabilistic approach to quantify this uncertainty is hence quite justified. The PC methodology employed is non-intrusive and requires model realizations with the uncertain droplet size parameters set to specific values. The results of an initial analysis using a particle based oil-fate model is presented along with several error metrics to check the validity of our approach.

Session: 003
Date: Monday, January 27 - 4:00 PM
Room: Bon Secour Bay I
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Oral

Material Transport Induced by Tropical Cyclone Forcing over the DeSoto Canyon Region

Presenter: Steven L Morey
The Florida State University
Authors: S. L. Morey, D. S. Dukhovskoy;
The Florida State University, Tallahassee, FL.
Abstract:
In addition to substantial near-surface currents forced by tropical cyclone winds, measurements of near-bottom currents over the outer continental shelf in the Gulf of Mexico indicate that strong (> 30cm/s) currents can also occur at depths greater than 1000m during storms, particularly over irregular and steep bathymetry. Depending on the storm track, either rapid or delayed onset of near-inertial motions can occur and there is evidence of intensification near the bottom. Slower moving storms can also force upwelling and generation of topographically trapped internal waves. Realistic and idealized numerical ocean model experiments are compared to observational data during historic storms and used to characterize the full water column response to a moving tropical cyclone in these regions. The simulations are used to explain the dynamics of these deep currents and the impacts of the storm-induced currents on material transport at different depths.

Session: 003
Date: Monday, January 27 - 4:15 PM
Room: Bon Secour Bay I
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Oral

Physical processes affecting transport in atmospheric boundary layer and upper ocean: From Hurricane Isaac to Hercules fire

Presenter: Shuyi S Chen
University of Miami
Authors: S. S. Chen, C. Lee, M. Curcic, B. Kerns;
University of Miami, Miami, FL.
Abstract:
A comprehensive study of the physical processes affecting transport of pollutants and carbohydrate in the atmosphere marine boundary layer and the upper ocean is conducted using the University of Miami Coupled atmosphere-wave-ocean-land Model (UMCM). The model is configured with a multi-nested domain with gird resolution from 10km over the outer coarse domain to 400 m over the inner most domain. UMCM model simulations of transport in a wide range of weather conditions from hurricanes to calm winds have been tested. Model results are compared with observations collected during Hurricane Isaac (2012) and Hercules fire in July 2013. It is found that the diurnal variability of surface winds and SST is dominant during Hercules fire event, which is in strong contrast to hurricanes. Multi-scale downscaling from UMCM to LES models is important for better understanding transport processes. Transport is sensitive to the physical parameterization of turbulent mixing and wind-wave coupling in UMCM.

Session: 003
Date: Monday, January 27 - 9:30 AM
Room: Bon Secour Bay I
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Oral

Satellite-derived Ocean Color Climatology for the Gulf of Mexico: Comparative analysis to Bio-Optical-Physical ocean models

Presenter: Sergio deRada
Naval Research Laboratory
Authors: S. deRada[1], S. Ladner[1], S. McCarthy[1], P. Hogan[1], R. Arnone[2], E. Chassignet[3];
[1]Naval Research Laboratory, Stennis Space Center, MS, [2]University of Southern Mississippi, Stennis Space Center, MS, [3]Florida State University, Tallahassee, FL.

Abstract:
Earth Observing Satellites have provided us unparalleled insight and understanding of our planet. Ocean Color (OC) sensors have evolved from the initial observations (~1978) made by the Coastal Zone Color Scanner (CZCS) to higher resolution and quality imagery captured by multi-spectral sensors such as SeaWiFS, MODIS, and recent follow-ons like SNPP VIIRS. Motivated by the impetus in recent Gulf research, a Gulf-wide 1 Km resolution climatology of several satellite-derived bio-optical-physical products (Remote Sensing Reflectance, Absorption, Backscattering, Attenuation, Chlorophyll, SST, etc.) was constructed for the entire SeaWiFS-MODIS period (~1997-2013). These products were systematically processed, using NRL's Automated Processing System, to create a consistent dataset specifically targeting Gulf of Mexico interests. Coupled Bio-Optical-Physical numerical ocean models (NCOM-CoSiNE, COAMPS-CoSiNE; CoSiNE: Carbon Silicate Nitrogen Ecosystem) are evaluated against these satellite derived products. The analysis reveals remarkable connections between the model and the OC data, illustrating dramatic biological activity and episodic bio-physical interactions at various temporal and spatial scales. Anticipating the benefits and added value of the higher resolution and extended product set, the "Gulf of Mexico Ocean Color Climatology" will be made publicly available via the DEEP-C consortium.

Session: 003
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Poster 3-8

Quantification of the uncertainty in the BP oil spill using a mesoscale coupled model : An ensemble based approach

Presenter: Vikram Khade
Department of Oceanography, Texas A & M University
Authors: V. Khade[1], P. Chang[1], I. Szunyogh[2], R. Montuoro[1], J. Kurian[1], K. Thyng[1];
[1]Department of Oceanography, Texas A & M University, College Station, TX, [2]Department of Atmospheric Sciences, Texas A & M University, College Station, TX.

Abstract:
The ROMS model with a resolution of 9 km is used to simulate the spread of particle trajectories during the BP Deepwater Horizon oil spill in the Gulf of Mexico. The bred vector technique is used to generate an ensemble of ocean currents over a course of 3 months. The ensemble of the ocean surface currents so obtained is used in a particle trajectory model to quantify the spread in the trajectories. Different set of simulations are run using initial and boundary conditions from different products (HYCOM and CFSR). The surface forcings are also obtained from different products (COREII and CFSR). It is found that the surface floats in the vicinity of the oil spill are advected about 100 to 200 km in one month. The uncertainty in this advection distance as given by the ensemble members is about 10 to 30 km. The control and the ensemble members are verified against the HYCOM/CFSR analysis and independent observations. The coupled WRF-ROMS model is also run over the same period, with the bred vector technique and the results are compared with the uncoupled ROMS simulations. The dynamics of the error growth in the model as given by the ensemble of perturbations is investigated.

Session: 003
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Poster 3-9

Effects of Surface Waves on Upper Ocean Transport during Hurricane Isaac (2012)

Presenter: Milan Curcic
University of Miami
Authors: M. Curcic, S. S. Chen;
University of Miami, Miami, FL.

Abstract:
Wind, waves and currents govern the transport of material on the ocean surface. This is especially true and important in hurricane conditions when the atmosphere, surface waves and ocean currents interact in a complex manner. Most current ocean circulation models and coupled atmosphere-ocean models do not include the wind-generated surface gravity waves and their impact on surface velocity, namely the Stokes drift. In this study, we use the University of Miami Coupled Model (UMCM), a high resolution coupled

atmosphere-wave-ocean model with explicit coupling physics involving waves, to quantify the contribution of waves to the surface velocity. The UMCM forecast field is compared with the surface velocity data obtained during the Grand LAgrangian Deployment (GLAD) field campaign during Hurricane Isaac (2012). We find that the hurricane-induced waves advect the surface material in anticyclonic (cyclonic) trajectories on the right (left)-hand side of the storm track, which created an along-track asymmetry in the surface velocities. In high wind speeds, the Stokes drift contributes up to 40% of the total velocity and significantly improves agreement with GLAD measurements. In the cases where the initial Eulerian current in the ocean model is in good agreement with observations, adding the Stokes drift significantly improves the predicted drifter trajectory. It highlights the importance of explicitly resolved waves in coupled models for prediction of transport of oil spill.

Session: 003
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Poster 3-10

High Resolution Forensic Analysis Of Surface Sheens Helps Pinpoint Source Of Oil Leakage From The Deepwater Horizon

Presenter: ROBERT K NELSON
Woods Hole Oceanographic Institution
Authors: R. K. NELSON[1], C. Aeppli[2], C. A. Carmichael[1], C. M. Reddy[1];
[1]Woods Hole Oceanographic Institution, Woods Hole, MA, [2]Bigelow Laboratory For Ocean Sciences, East Boothbay, ME.
Abstract:
Alkenes commonly found in synthetic drilling-fluids were used to identify sources of oil sheens that were first observed in September 2012 close to the Deepwater Horizon (DWH) disaster site more than two years after the Macondo MC-252 well was sealed. Exploration of the sea floor by BP confirmed that the well was capped and sound. BP scientists and engineers identified the likely source as leakage from an 80-ton cofferdam abandoned during a failed attempt to control the Macondo well in May 2010. We acquired and analyzed sheen samples at the sea-surface above the Deepwater Horizon wreckage as well as oil collected directly from the cofferdam using comprehensive two-dimensional gas chromatography (GC×GC). This allowed the identification of drilling-fluid C16- to C18-alkenes in sheen samples that were absent in cofferdam oil. Furthermore, the spatial pattern of evaporative losses of sheen oil alkanes indicated that oil surfaced closer to the Deepwater Horizon wreckage than the abandoned cofferdam site. Lastly, ratios of alkenes and petroleum hydrocarbons pointed to a common source of oil found in both sheen samples and recovered from oil-coated Deepwater Horizon riser pipe buoyancy compensator module debris collected shortly after the explosion. These lines of evidence suggest that the observed sheens do not originate from the Macondo well, cofferdam, or from natural seeps. Rather, the likely source is oil trapped in tanks and pits on the Deepwater Horizon wreckage, representing a finite oil leakage volume.

Session: 003
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Poster 3-11

Objective surface velocity maps from GLAD drifter observations in the eastern Gulf of Mexico

Presenter: Bruce L Lipphardt
University of Delaware
Authors: B. L. Lipphardt[1], H. S. Huntley[1], A. D. Kirwan[1], S. Chen[2], E. Coelho[3], M. Gough[2], A. Griffa[2], B. Haus[2], A. Haza[2], P. Hogan[3], M. Iskandarani[2], G. Jacobs[3], N. Laxague[2], A. Mariano[2], G. Novelli[2], M. J. Olascoaga[2], T. Ozgokmen[2], A. C. Poje[4], A. Reniers[2], E. Ryan[2], C. Smith[2], M. Wei[3];
[1]University of Delaware, Newark, DE, [2]University of Miami, Miami, FL, [3]Naval Research Laboratory, Stennis Space Center, MS, [4]CUNY Staten Island, Staten Island, NY.
Abstract:
During the GLAD experiment (July-August 2012) more than 300 drifters were launched near the Deepwater Horizon site using carefully constructed groupings designed to measure deformation and dispersion processes at scales from 100 meters to hundreds of kilometers. These CODE-style drifters, drogued at a depth of one meter, reported positions at five-minute intervals, often over periods of ninety days or more. Here, velocities from these drifters are used to construct objective maps of the surface velocity field in the eastern Gulf of Mexico for the September-October 2013 period. A normal mode analysis method is used to construct the maps by projecting drifter velocities onto two sets of orthogonal modes over a rectangular subregion. These modes partition the flow into divergence-free and vorticity-free components. The kinetic energy spectrum of the maps will be examined, and the objective maps will be used to assess model surface velocity forecasts during this period.

Session: 003
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Poster 3-12

Oil Biodegradation Cooled Down By Marine Snow!?

Presenter: Shokouh Rahsepar
Wageningen University
Authors: S. Rahsepar, M. de Klerk, A. Langenhoff, M. Smit, H. Rijnaarts;
Wageningen University, Wageningen, NETHERLANDS.

Abstract:
Biodegradation of spilled oil in the marine environment is influenced by many factors. The influence of the formation of marine snow on the biodegradation of crude oil and dispersant in the aftermath of the Deepwater Horizon accident was so far never studied. Oil pollution and dispersant application probably led to a stress response by marine phytoplankton resulting in release of extracellular polymeric substances (EPS). EPS can capture oil droplets and dispersant, and play a role in coagulation and aggregation of oily particles and other natural occurring suspended particles. It was observed at the Deepwater Horizon oil spill that these aggregates form oil-associated marine snow, resulting in a high sedimentation and accumulation on the sea bed. We hypothesize that the biodegradation of oil in the water column is limited by available electron acceptors and the bioavailability of the oil for bacteria. Also the settling characteristics and therefore the time which is available for biodegradation remains poorly understood. The objective of this study is to understand the biodegradation of chemically dispersed oil in presence of EPS and suspended particles, as well as oil-associated marine snow. We are studying the oil biodegradation in batch experiments with synthetic sea water containing phytoplankton and/or suspended solids inoculated with oil degrading bacteria. The results of these experiments will be presented and discussed in the presentation.

Session: 003
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Poster 3-13

Turbulent Diffusion of Droplets - Effect of Buoyancy

Presenter: Evan A Variano
UC Berkeley
Authors: E. A. Variano, L. J. Mazzaro, I. C. Tse;
UC Berkeley, Berkeley, CA.

Abstract:
Passive solutes diffuse through marine waters in response to stochastic velocity variations. These variations occur at both microscopic and macroscopic scales, which cause molecular and turbulent diffusion respectively. Turbulent diffusion is relatively well understood for passive solutes, but not for suspended particles, drops, and bubbles. We present unique measurements that allow us to directly quantify the turbulent diffusion for suspended particles. These measurements leverage a technique for capturing 3D particle trajectories. We conduct our measurements in a high-Reynolds-number turbulent flow, with isotropy and spatial homogeneity at length scales larger that the integral length of velocity fluctuations. Herein, we present a comparison of two different particle types. Both are hollow glass spheres, both are smaller than the Kolmogorov microscale of the turbulent flow, but one has non-neutral buoyancy. We find that the buoyant particles have a significantly higher turbulent diffusivity than the neutrally buoyant particles, which behave much like a passive solute. The implications for modeling oil droplets are that diffusion of a cloud of droplets should not be considered a function only of water column stratification and turbulent kinetic energy, but must also include information about the droplet size distribution and chemical composition of the droplets.

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Type: Poster 3-14

Influence of high pressure and dispersants on hydrocarbon degrading bacteria

Presenter: M. Schedler
Hamburg University of Technology
Authors: M. Schedler, A. Valladares, R. Hiessl, A. Meyer, G. Gust, R. Müller;
Hamburg University of Technology, Hamburg, GERMANY.

Abstract:
To investigate how the biodegradation of hydrocarbons is influenced by high pressures as being present at the sea bottom at the DWH site in the Gulf of Mexico, high pressure equipment was developed at the Hamburg University of Technology. This equipment, which allows to continually monitor the oxygen concentration in a stirred 2-phase fluid system, consists of ten high pressure reactors and ten ambient pressure reactors for control. Pseudomonas frederiksbergensis, which is known to degrade alkanes at atmospheric pressure, was used as model organism in initial biodegradation experiments. It was found that P. frederiksbergensis is able to grow well at 150 bar and to degrade different alkanes at this pressure. In addition also biodegradation of aromatic and polycyclic aromatic compounds, other main components of mineral oil, was tested at high pressure with Sphingobium yanoikuyae as model strain. Moreover the influence of Corexit on the degradation rates of these model organisms was analysed. To get a better understanding of what happens

to mineral oil in deep sea environments, the biodegradation of crude oil by strains isolated from the DWH site as well as by natural bacterial communities is currently being determined at high pressure.

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Lateral Mixing in the Northern Gulf of Mexico

Presenter: Elizabeth G Simons
Florida State University
Authors: E. G. Simons, K. Speer, C. Hancock, N. Wienders;
Florida State University, Tallahassee, FL.

Abstract:
We aim to gain insight into the pattern of circulation around DeSoto Canyon as well as the change in mixing that occurs with movement away from the coast. This goal was pursued using both historical and current float tracks. The data consists of floats released during the Surface Current and Lagrangian Drift Program (SCULP) experiment in 1996, an University of South Florida (USF) release in 2010 and the recent Florida State University (FSU) RAFOS release in 2012. The SCULP and USF releases were with drogued, surface current drifters, while the FSU release consisted of floats ballasted to 300 meters. The results from this investigation will provide a physical basis for subgrid-scale parameterizations in numerical models, as well as explaining particle distribution and mixing rates across the shelf break in the north-eastern Gulf of Mexico, here defined to be the 200 meter bathymetric contour.

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Type: Poster 3-16

Physical, chemical and toxicological characterization of micron size droplets created from MC-252 source oil

Presenter: Piero R Gardinali
Florida International University - Southeast Environmental Research Center (SERC)
Authors: P. R. Gardinali[1], K. Sandoval[1], B. Echols[1], A. Smith[1], G. Rand[1], T. Nordtug[2], B. Hansen[2];
[1]Florida International University - Southeast Environmental Research Center (SERC), North Miami, FL, [2]SINTEF - Materials and Chemistry, Trondheim, NORWAY.

Abstract:
Macondo oil released to the GOM produced heterogeneous mixtures composed of dissolved hydrocarbons and undissolved, phase-separated oil residues, including oil droplets. The size distribution, density, and composition of these droplets depend on key parameters such as the physical and chemical properties of the oil, the energy of mixing at the release point, and the water temperature and pressure at the release location. Toxicity of oil is often described as a function of the hydrocarbons present in the dissolved fractions and a considerable data gap exists on procedures to properly assess the contribution of oil droplets, in equilibrium with an aqueous phase. The main objective of this study was to evaluate a conceptual model to determine such contribution by generating droplet-specific EC50s using two well-characterized reference species (Americamysis bahia and Menidia beryllina). A turbulent-flow droplet generator developed by SINTEF and capable of producing mechanically formed oil-water dispersions (OWDs) of reproducible physical and chemical compositions was used to generate exposure media with similar droplet sizes but increasing oil concentrations. Water-soluble fractions (WSFs) of the OWDs were prepared and tested simultaneously by filtering the OWDs to determine the differential toxicity of the oil/water mixtures in the presence and absence of oil droplets. A simple, conceptual model representing the parameterized effect of droplets on aquatic toxicity was used to contrast the OWD and WSF results. Preliminary results suggest that droplets may have an effect on survivorship, but at Total PAH concentrations greater than the vast majority of the samples collected from the water column during the DWH response in 2010.

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Design of in situ measurements for validation of near field blowout models

Presenter: Binbin Wang
Texas A&M University
Authors: B. Wang, A. L. Dissanayake, S. A. Socolofsky;
Texas A&M University, College Station, TX.

Abstract:
This paper presents a design of an in situ measurement system based on optical techniques to provide detailed information in the near field of field-scale multiphase plumes typical of natural seeps to accidental oil-well blowouts. The measurement system is developed to measure the bubble size distribution, void fraction, gas flux, and bubble rising velocity, among other parameters, at different depths. Particle Image Velocimetry will be used to measure the statistics of turbulence and the upwelling velocity of the plume induced by the

rising bubbles. Two types of experiments are planned: measurements of the natural release of oil and gas from submarine seeps and an air bubble plume generated by injection of air and seawater through an engineered nozzle. The measurement system will be tested and calibrated at a laboratory-scale facility and deployed for measurements in the Gulf of Mexico, mounted on an ROV. The release point bubble size distribution will be quantified to validate the SINTEF bubble breakup model. The measured data can also be used to validate a near field blowout plume model. Previous field experiments on deepwater oil and gas releases such as Deepspill in the North Sea can only be used to validate the plume shape/trajectory predicted by models. But the in situ measurements from the experiments proposed here can be used to verify the model results, such as the upwelling flow rate, plume width, and the rate of entrainment in the near field of the blowout.

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Evaluation of Altimetry-Derived Surface Current Products Using Lagrangian Drifter Trajectories in the Eastern Gulf of Mexico

Presenter: Yonggang Liu
University of South Florida
Authors: Y. Liu[1], R. H. Weisberg[1], S. Vignudelli[2], L. Zheng[1];
[1]University of South Florida, St. Petersburg, FL, [2]Consiglio Nazionale delle Ricerche, Pisa, ITALY.

Abstract:
Lagrangian particle trajectory models based on several altimetry-derived surface current products (OSCAR and AVISO + different mean fields) are used to hindcast the drifter trajectories observed in the eastern Gulf of Mexico during May - August 2010 (the Deepwater Horizon oil spill incident). The performances of the trajectory models are gauged in terms of Lagrangian separation distances (d) and a non-dimensional skill score (s), respectively. A series of numerical experiments show that these altimetry-based trajectory models have about the same performance; however, they have slightly better skills than those of the data assimilative numerical model output from the Global HYCOM, the Gulf of Mexico HYCOM, and the IASNFS. After three days' simulation the altimetry-based trajectory models have mean d values of 103 - 134 km and 34 - 38 km (s values of 0.34 - 0.45 and 0.33 - 0.36) in the Gulf of Mexico deep water area and on the West Florida Continental Shelf, respectively. Adding surface wind Ekman components improves the AVISO-based model skills, especially over the shelf region. These satellite altimetry data products are useful for providing essential information on ocean surface currents of use in water property transport, offshore oil and gas operations, hazardous spill mitigation, search and rescue, etc

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Type: Poster 3-19

Filtering GPS errors from GLAD drifter trajectories

Presenter: Max Yaremchuk
NRL
Authors: M. Yaremchuk[1], E. Coelho[2];
[1]NRL, Stennis Space Center, MS, [2]University of Southern Mississippi, Stennis Space Center, MS.

Abstract:
A variational method for removing positioning errors (PEs) from drifter trajectories is proposed. The technique is based on the assumption of statistical independence of the PEs and drifter accelerations. The method allows reconstruction of an approximate probability density function of the accelerations consistent with the known experimental data while keeping the difference between the filtered and observed trajectory within the error bars of the positioning noise.
Performance of the method is demonstrated in an application to real data acquired during the Grand Lagrangian Deployment (GLAD) experiment in the Northern Gulf of Mexico in 2012. Applications of the technique to temporal regridding of the drifter trajectories and spatial filtering of the data acquired by towed platforms is discussed.

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The fate and transport properties of rising oil droplets & gas bubbles with hydrates from the deep ocean

Presenter: In Ok JUN
Texas A&M University
Authors: I. JUN, A. Dissanayake, S. Socolofsky;
Texas A&M University, College Station, TX.

Abstract:
Once oil and gas are emitted from a marine seep or accidental spill, their fate in the water column will depend significantly of mass transfer, thermodynamics, and transport. In any case, it is important to know if spilled oil and gas may reach the sea surface, and if so, where, when, and how much it will be-whether as a need for response planning in the case of a spill or in evaluating global gas budgets for geochemical cycles. Thus, in this study, a single bubble model is developed to estimate the transport behavior of gas bubbles and oil droplets from the deep ocean. The Lagrangian approach is used to track individual bubbles during their rise though the water column. Gas dissolution impacts the behavior of bubbles since it changes their physical properties, such as size, slip velocity, and buoyancy. The gas dissolution rate can be obtained from the solubility of gas and the mass transfer coefficient. The solubility of gas is computed by the modified Henry's law with the Peng-Robinson equation of state in McCain (1990), and the mass transfer coefficient is evaluated from correlations in Clift et al. (1978). The evolution of bubbles and drops depends on their initial bubble size, the water depth, the ambient dissolved concentration, and the thermophysical properties of seawater. Furthermore, the fate of the bubbles from the deep water is potentially affected by the formation of hydrate around or within the bubbles, which interferes in the gas exchange process. For example, a gas hydrate skin around the bubbles could enhance the lifetime of bubbles released from the seabed. The resulting model is validated to literature data for single gas bubbles in experiments and at natural seeps and for the fate of hydrocarbons released during the Deepwater Horizon accident.

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Effect of diurnal warming on stratification and mixing in the Gulf of Mexico

Presenter: Charlie N Barron
Naval Research Laboratory
Authors: C. N. Barron[1], P. L. Spence[2], J. M. Dastugue[1];
[1]Naval Research Laboratory, Stennis Space Center, MS, [2]QinetiQ North America, Stennis Space Center, MS.

Abstract:
Diurnal variations in sea surface temperature (SST) have significant impact on biological and chemical processes in the Gulf of Mexico. The diurnal warming alters stratification and mixing in the upper ocean, influencing the distribution of nutrients and phytoplankton. The phytoplankton distributions in turn affect solar attenuation and its feedback on diurnal warming. Satellite observations are shown to be useful in constraining forecasts of these processes and guiding placement mesoscale circulation features that in turn modify biological and chemical distributions. Gulf of Mexico forecasts of SST, mixing, and stratification from the Navy Coastal Ocean Model (NCOM) over 2010-2011 are evaluated to evaluate the role of diurnal variations. The effects of assimilation on the fidelity of these simulations are examined using the Navy Coupled Ocean Data Assimilation (NCODA) of alternative satellite data streams and independent in situ observations. Resulting comparisons of modeled and observed SST and mixed layer response reveal impact of diurnal variations on mixing processes and the role of satellite data assimilation in supporting
forecast accuracy.

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Quantifying Velocity Observation Representativeness Error Using Navy Coastal Ocean Model of Gulf of Mexico

Presenter: Peter Spence
QinetiQ North America
Authors: P. Spence[1], G. Jacobs[2], C. Barron[2], B. Bartels[1], C. Rowley[2], S. Smith[2];
[1]QinetiQ North America, Stennis Space Center, MS, [2]Naval Research Laboratory, Stennis Space Center, MS.

Abstract:
Accurate forecasts of chemical and biological transport are facilitated by assimilation of supporting satellite and in situ observations into Navy Coastal Ocean Model (NCOM) via the Navy Coupled Ocean Data Assimilation (NCODA) system. In this study, NCODA quality controlled input are limited to remotely sensed sea surface temperature, sea surface height anomaly (SSHA), and in situ observations of temperature and salinity (T/S). Assimilation of these observations is more effective when the model increment is introduced in a way

that appropriately preserves a geostrophic balance. A decomposition of observed velocities into geostrophic and ageostophic components is required to allow balanced increments to be introduced only for the geostrophic fraction. Enforcing geostrophic balance between velocity and geopotential is undesirable where ageostrophic flow is significant. It is desired to properly weight the velocity observation with an estimate of its representativeness error during model assimilation. Using a regional NCOM of the Gulf of Mexico for 2012, ageostrophy is computed from modeled and geostrophic currents and is correlated to wind stress and bathymetry using histograms. The geostrophic currents are computed from observed SSHA and model T/S. Velocity representativeness error is quantified as functions of wind stress and water depth.

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Large eddy simulations of vertical transport processes in the marine boundary layer during the gas leak at Hercules

Presenter: Ping zhu
Florida International University
Authors: P. zhu[1], O. Choobari[1], S. Chen[2], C. Lee[2];
[1]Florida International University, Miami, FL, [2]RSMAS, University of Miami, Miami, FL.

Abstract:
This study attempts to address two issues: (1) vertical transport of leaked gases under the typical marine boundary layer (MBL) conditions in the Gulf of Mexico and (2) the impact of shallow boundary layer clouds during the days of gas leaking on the vertical transport processes. To address these issues, we performed both hindcasting and idealized large eddy circulations (LESs) forced by UM's fully coupled simulations. The simulations show that the thermally driven large turbulent edy circulations (LTECs) in this case are largely constrained by the depth of MBL but contribute substantially to the vertical transport in the MBL. There is a clean diurnal variation of the simulated MBL including the shallow cumuli at the top of the MBL driven by a small variation of sea surface temperature (~1^0C), suggesting that a realistic depiction of vertical transport in the MBL requires a consideration of a responsive ocean even in calm wind conditions. Our analyses further indicate that the organized cloud features have a different impact on the vertical transport of scalar and momentum.

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Near-Inertial Surface Currents in the Northeastern Gulf of Mexico using HF Radar and GPS-Tracked Drifters

Presenter: Matt Gough
RSMAS - Univ. of Miami
Authors: M. Gough[1], A. Reniers[1], S. Howden[2];
[1]RSMAS - Univ. of Miami, Miami, FL, [2]Univ. of S. Mississippi, Hattiesburg, MS.

Abstract:
HF radar and GPS-tracked drifter data were collected in the northeastern Gulf of Mexico during the Grand Lagrangian Drifter (GLAD) experiment in July, 2012. These data are used to investigate energetic near-inertial motions that exhibited significant spatial variability, resonant contributions from diurnal wind and tidal forcing, and large scale (O 100km) bands of energetic currents (> 50 cm/s) propagating through the HF radar domain. The inertial period is 24 hours at 30°N which transects the HF radar domain. Diurnal wind forcing can therefore resonate with, and amplify, inertial motions in this region. In addition, decoupling diurnal tidal forcing from diurnal wind forcing can be difficult.
Harmonic analysis is used to map the spatial variability of the inertial motions. The relative contribution of diurnal wind and tidal forcing on the inertial motions are decoupled by comparing 24-hour band-passed HF radar data, NDBC buoy wind data, and OTIS-generated tidal currents. The bands of energetic inertial currents are speculated to be barotropic Poincaré waves based on observed wavelengths, phase speed, and frequency. We plan to further investigate these observations using Delft3D model simulations.

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Type: Poster 3-25

Signatures For Natural Oil Seeps In The Biogeochemistry Of The Deep Gulf Of Mexico

Presenter: Andrew R Margolin
Rosenstiel School of Marine and Atmospheric Science - University of Miami
Authors: A. R. Margolin, D. A. Hansell, P. K. Swart;
Rosenstiel School of Marine and Atmospheric Science - University of Miami, Miami, FL.
Abstract:
The biogeochemical components of seawater (carbon, nutrients, oxygen) have been sampled in the eastern Gulf of Mexico off the Florida Shelf, and in the western Gulf of Mexico near naturally occurring hydrocarbon seeps (Brine Pool, Alaminos Canyon, Green Canyon) and away from seep influences. These data sets are compared to each other to assess gradients within the Gulf of Mexico and to understand the role hydrocarbon seeps have in altering the concentration of organic carbon in seawater. These data are also compared to samples collected in the eastern Caribbean Sea along with data from the World Ocean Database, and the gradients are assessed as to responsible processes.

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Depth as a Factor in the Physiology and Ecology of Oil Droplets - Zooplankton Interactions

Presenter: J Rudi Strickler
University of Wisconsin Milwaukee
Authors: J. Strickler;
University of Wisconsin Milwaukee, Milwaukee, WI.
Abstract:
Our prime question is whether or not toxicity levels measured in the laboratories at atmospheric pressures represent toxicity at depth of the water column. On one side the physiology of the animals may be different due to hydrostatic pressure, and on the other side, the oil droplets may be different in composition and physical/chemical behavior again due to the hydrostatic pressure. We constructed the Deep Water Simulator where we can observe in the laboratory free-swimming zooplankters encountering suspended oil droplets and food particles at the spatial and temporal scales of the encounters. Our results will point to novel approaches needed to fully encompass the complexity of life with oil in the depth.

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Sub-lethal oil dispersant concentrations make algae produce marine snow

Presenter: Justine S van Eenennaam
Wageningen University
Authors: J. S. van Eenennaam[1], M. Asadi[1], G. Manyika[1], Y. Zhang[1], M. Zeinstra-Helfrich[2], A. J. Murk[1,3];
[1]Wageningen University, Wageningen, NETHERLANDS, [2]NHL University of Applied Sciences, Leeuwarden, NETHERLANDS, [3]IMARES, part of Wageningen UR, Wageningen, NETHERLANDS.
Abstract:
Greatly increased production of marine snow enhanced sedimentation of oil, particles and surface plankton during the Deepwater Horizon oil spill. The resulting thick toxic oil layer on the deep sea sediment currently still persists and prevents the benthic ecosystem from recovering.
Within the C-IMAGE research consortium, we study the hypothesis that oil spill dispersants contributed to the observed enhanced sedimentation of oil through induction of marine snow formation by stressed algae, followed by interaction of the excreted extracellular polymeric substances (EPS) with oil droplets and particles in the water. This mechanism of marine snow formation will be missed in oil fate experiments performed in clear sea water.
The presented research reveals to what extent non-lethal dispersant concentrations can induce excretion of EPS by marine phytoplankton. In addition, the composition of the EPS is characterized. Phytotoxicity and EPS excretion tests with Corexit 9500 were conducted with four quite different species of marine algae. Produced marine snow flocks were chemically analyzed for their protein and polysaccharide composition and content. The dispersant indeed induced EPS excretion by all four phytoplankton species tested, and this marine snow greatly enhanced sedimentation of oil and particles.
The results support the hypothesis that application of dispersant enhanced the sedimentation of biogenic material and oil to the ocean floor during and after the oil spill.

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Dissolved Organic Carbon and Oxygen Concentrations Within Cold-water Coral Communities of the Northern Gulf of Mexico.

Presenter: Caleb King
University of North Carolina at Chapel Hill
Authors: C. King[1], C. S. Martens[1], E. Cordes[2], C. Fisher[3];
[1]University of North Carolina at Chapel Hill, Chapel Hill, NC, [2]Temple University, Philadelphia, PA, [3]Penn State University, State College, PA.

Abstract:
Cold-water coral (CWC) communities in the Gulf of Mexico can include octocorals (Octocorallia), black corals (Antipatharia), and stony corals (Scleractinia). These corals communities in turn increase the richness and diversity of microbial and filter-feeding populations. We measured physical and chemical parameters within these ecosystems between depths of 400 and 2,000 meters during 13 Hercules ROV dives supported by E/V Nautilus from 22 June to 4 July, 2013. Concentration measurements of dissolved organic carbon, total nitrogen, and nitrate/nitrite (NOx) were made on water samples from Niskin bottles fired directly above geographically distinct CWC patches within nine different Gulf of Mexico lease blocks. Additionally, sensors strategically positioned on the ROV provided in situ measurements at 15-second intervals of dissolved oxygen, temperature and turbidity as the vehicle investigated individual coral patches. Preliminary analysis indicates dissolved oxygen concentrations immediately above (<5 meters) dense communities of CWCs range from 107 to 200 μM, increasing with the population's depth. Hotspots of increased dissolved organic carbon and total nitrogen, potentially released in the form of coral-derived mucus, were observed surrounding populations of the scleractinian coral, Lophelia pertusa.

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Quantifying the volume and frequency of bubble release from hydrocarbon seeps in the Gulf of Mexico: GC600

Presenter: Caroline Johansen
Florida State University
Authors: C. Johansen[1], A. C. Todd[2], W. Dewar[1], I. MacDonald[1];
[1]Florida State University, Tallahassee, FL, [2]North Carolina State University, Raleigh, NC.

Abstract:
This research attempts to quantify the release rate and volume of a hydrocarbon seep in the Gulf of Mexico. There are extensive studies on modeling the behavior of oil and gas bubbles as they are released from the sediments; however the quantity and release rates have not yet been studied in detail. Focusing on active gas and oil vents in lease block GC600 (1200 m depth), we used autonomous video cameras to capture images of the bubbles as they escape from the hydrate outcroppings. With this data we can determine the volume and release rate of the bubbles using image processing techniques. At site A (aka Birthday Candles) in 2010, the camera was deployed for 3 hours, and gave preliminary results of bubble release at approximately 5 bubbles/sec. The camera was deployed for about 48 hours at site B (aka Megaplume) in 2012 and gave more precise results of bubbles being released at a dominant rate of about 10 bubbles/sec. Synopitc pressure and temperature data were collected during the 2012 deployment and resolved a diurnal tidal signal. Site B was visually more rapid than the site A. However, the average bubble size between the two sites fell within the same range. Quantifying the release rate, and magnitude of the oil and gas from these conduits, can resolve some of the discrepancies of CH4 reaching the atmosphere from natural seeps, and determine a baseline of the amount of oil that is naturally present in the Gulf of Mexico.

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Linkages with dissolved inorganic/organic carbon, pH, and oil and gas emissions in the Gulf of Mexico

Presenter: Jordan Young
Texas A & M
Authors: J. Young[1], S. Yvon-Lewis[1], T. Bianchi[2], M. Shields[1], R. Reddig[1], M. Du[1];
[1]Texas A & M, College Station, TX, [2]University of Florida, Gainesville, FL.

Abstract:
The Gulf of Mexico (GOM) has an abundance of natural seeps as well as numerous man-made structures that provide a source of hydrocarbons to the water column. The breakdown and respiration of these oil compounds link them to the dissolved inorganic/organic carbon (DIC and DOC) pools, which in turn affect ocean acidification. To examine these relationships, depth-profile samples were collected on the GISR (Gulf Integrated Spill Research) cruises during the first week of July 2012 and in December 2012. These samples were analyzed for DIC, DOC and total Alkalinity (tAlk). The full suite of carbon parameters including CO2 and pH was then determined using the SeaCarb program. Here we present the results of the analysis of samples from the deep waters of the GOM to establish the state of the DIC, DOC, tAlk and pH in these waters and to assess the possible influence of the Deepwater Horizon oil spill and hydrocarbon seeps on the DOC, DIC and acidity of GOM waters.

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Gag Grouper Larvae Pathways on the West Florida Shelf

Presenter: Robert Weisberg
University of South Florida
Authors: R. Weisberg, L. Zheng, E. Peebles;
University of South Florida, St. Petersburg, FL.

Abstract:
A numerical circulation model, quantitatively assessed against in situ observations, is used to describe the circulation on the West Florida Continental Shelf over the first half year of 2007 when Gag Grouper juveniles were found in the surf zone near Tampa Bay. Simulated particle trajectories are employed to test hypotheses relating to either a surface or a near bottom transport route between offshore spawning and near shore settlement sites. The surface route hypothesis is rejected, whereas the bottom route hypothesis is found to be consistent with the findings of juveniles and their co-location with macro-algae of offshore, hard bottom origin. We conclude that Gag Grouper larvae are transported to the near shore in the bottom Ekman layer and that such transport is facilitated by remote forcing associated with Gulf of Mexico Loop Current interactions with the shelf slope near the Dry Tortugas. Being that such remote forcing occurs inter-annually and not always in phase with the preferred spawning months (late winter through early spring) Gag Grouper recruitment success should similarly vary with year and location. Our paper provides an example on how combining physical oceanographic principles with fisheries biology can lead to insights on fish ecology.

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A Northeast Gulf of Mexico Coastal Ocean Model: FVCOM Nested in GOM HYCOM, with Application to 2010

Presenter: Lianyuan Zheng
University of South Florida
Authors: L. Zheng, R. Weisberg;
University of South Florida, St. Petersburg, FL.

Abstract:
A three-dimensional, density dependent coastal ocean circulation model is developed for the northeast Gulf of Mexico by nesting the unstructured grid, Finite Volume Coastal Ocean Model (FVCOM) into the structured grid, Gulf of Mexico Hybrid Coordinate Model (GOM HYCOM). The new model domain extends from west of the Mississippi River Delta to south of the Florida Keys, and it downscales (by virtue of unstructured grid flexible resolution) from the deep ocean, across the continental shelf and into estuaries to include the interactions among these three dynamically distinct water bodies. Application is made to a calendar year 2010 simulation, with the model performance quantitatively assessed against in situ observations (from moorings, gliders and coastal sea level stations). Model veracity enables us to discuss the coastal ocean circulation during the time of the oil spill. Specific applications are also made to various topics of ecological importance such as red tide blooms and larval fish transport. The model provides a tool for future Eulerian (tracer evolution) and Lagrangian (particle) tracking needs, including harmful substances and search and rescue. The existing model may be extended to cover the entire GOM coastal ocean, and it may also be ported to other coastal ocean regions.

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GCMS Analysis of Products of Pyrolysis of BP Oil Spill Residue

Presenter: Andrew Wood
Jacksonville State University
Authors: A. Wood, P. Onkst, J. Gryko;
Jacksonville State University, Jacksonville, AL.

Abstract:
Thermal pyrolysis of oil residue at t = 350 - 500 ^{o}C produces numerous saturated and unsaturated C_9 - C_{25} hydrocarbons. Both saturated and unsaturated compounds are mainly straight-chain hydrocarbons. The amount of branched and aromatic compounds in pyrolysis gases was very small, much less than in the original BP oil. The ratio of unsaturated to saturated hydrocarbons containing the same number of carbon atoms, C_nH_{2n} /C_nH_{2n+2} was approx. 0.5 to 0.9. This means that the amount of, for example, 1-decene was similar to the amount of decane. Therefore, in the GCMS chromatograms we have observed very interesting pattern of double peaks, corresponding to the C_nH_{2n} - C_nH_{2n+2} pairs.

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Type: Poster 3-34

Long Range Stochastic Plume Simulations in the Gulf of Mexico

Presenter: Emanuel Coelho
University New Orleans
Authors: E. Coelho[1], G. Peggion[1], P. Hogan[2], P. Thoppil[2], C. Rowley[2];
[1]University New Orleans, Stennis Space Center, MS, [2]Naval Research Laboratory, Stennis Space Center, MS.

Abstract:
Major issues in characterizing and predicting the extent of the affected/sensitive regions in real-time during oil spills or other dispersive events in the ocean are a poor knowledge of the actual source functions and the fact that coastal dynamics may not be predictable in a deterministic sense. This work presents a methodology that allows assessing the ocean regions and times that can be most likely affected by spill accidents over an extended outlook period, while taking into account the uncertainty in ocean model velocities. The approach uses an ensemble of extended range forecasts (60 days) from high resolution runs of the Navy Coastal Ocean Model (NCOM) configured over the Gulf of Mexico. Each ensemble run is then coupled with an Eulerian diffusion-advection solution or with a Lagrangian Gaussian stochastic model depending on the type of problem in hands, taking into account possible estimates of source terms at the origin. The ensemble information is then integrated on stochastic plumes defined using a Risk Assessment Code (RAC) analysis. The approach associates a number from 1 to 5 along a preset grid, determined by the likelihood of reaching oil concentrations as defined in the Bonn Agreement Oil Appearance Code or on the likelihood of having tracers within the vicinity of each grid node. The likelihoods are taken from probability distribution functions derived from the ensembles concentrations or tracer distributions. Maps detailing the risk assessment will be discussed for several test cases outlining the consistency, advantages and limitations of the approach and the envisaged applications for local data assimilation.

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Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Poster 3-35

The Role of Turbulence in the Mixing and Diffusion of Oil in the Gulf of Mexico

Presenter: Zhankun Wang
Texas A&M University
Authors: Z. Wang, S. F. DiMarco;
Texas A&M University, College Station, TX.

Abstract:
This study examines and quantifies the nature of turbulence and its influence on the mixing and diffusion of oil in the Gulf of Mexico (GOM). An integrated observational field effort that makes simultaneous and collocated measurements of turbulence and fine structure has been conducted near the BP oil spill site in the northern GOM. Full water column profiles are made on the continental slope around six deepwater current moorings during two Gulf Integrated Spill Research (GISR) cruises in summer 2013. Turbulent dissipation rate (ε) is estimated from micro-temperature measured using a Rockland Scientific µRider using Batchelor spectra curve fitting. Our observations suggest that turbulence is usually strongest near surface and in the thermocline with a turbulent dissipation rate (ε) of > 10^-7 W/kg. Using relationship between turbulent eddy velocity and oil droplets terminal velocity, we develop criteria for when turbulence will dominate and when it can be ignored. The results show that for the oil drops having terminal velocity greater than 10 mm/s, the turbulence effect can be ignored on the continental slope of the Gulf of Mexico. When the rising speed is less than 0.1 mm/s, oil drops will passively move with the turbulent flow. For oil drops with rising speed between 0.1 and 10 mm/s, the role of turbulence will depend on the strength of the local turbulence and water stratification. We also relate the turbulent mixing to the size of the oil drops by estimating the terminal velocity of different size oil drops rising in water due to buoyancy and the drag force. For the crude oil with

density 860 kg/m^3 (the case during the Macondo spill), the turbulence cannot be ignored and will play a significant role for oil droplets with radii less than 100 μm.

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Single Droplet Interactions with Alcanovorax borkumensis Bacteria and Carbon Black

Presenter: Maswazi Sihlabela
Brown University
Authors: M. Sihlabela[1], M. Bookstaver[1], M. Godfrin[1], A. Bose[2], A. Chauhan[3], A. Tripathi[1];
[1]Brown University, Providence, RI, [2]University of Rhode Island, Kingston, RI, [3]University of Florida, Gainesville, FL.

Abstract:
Alcanovorax borkumensis, a naturally occurring strain of marine bacteria has been found to not only degrade long chain alkanes, but also release biosurfactants that help emulsify oil, allowing for droplets to stay longer on the water column. As such, the strain of bacteria presents an opportunity for a non-toxic, natural degradation of oils in seawater and other ecological sites. An understanding of this bacteria-dependent degradation provides potential for alternatives to use of surfactant molecules that could negative ecological effects. Carbon black particles have also been shown to stabilize oil emulsions. Although the mechanism for this is different from that of surfactant stabilized emulsions in that the oil/water interfacial tension is not reduced, there is potential for better droplet stability and improved degradation rates when used in concert. Drop shape analysis allows for observation or the surface/interface mechanisms as well as the impact of these materials on interfacial tension and droplet stability.
We have studied the effect of Alcanovorax borkumensis in seawater solutions on single octane droplets. We show that bacteria solutions reduce the interfacial surface tension between octane droplets and water leading to a stable droplet in solution. The effect of carbon black on oil-water interfacial tension in the presence of Acanivorax bacteria is also explored.

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Viscoelastic Transition of Bacteria Films at Oil-Water Interfaces

Presenter: Liana Vaccari
University of Pennsylvania
Authors: L. Vaccari[1], D. B. Allan[2], M. Molaei[3], J. Sheng[3], R. L. Leheny[2], K. J. Stebe[1];
[1]University of Pennsylvania, Philadelphia, PA, [2]Johns Hopkins University, Baltimore, MD, [3]Texas Tech University, Lubbock, TX.

Abstract:
Biofilms form by the association of bacteria to bounding surfaces. We study the dynamics of biofilm formation at oil-aqueous interfaces and their mechanical consequences. The formation and mechanics of bacterial films on solid substrates are relatively well studied. Less so are the characteristics of biofilms at fluid-fluid interfaces. The material properties of the films, affected by the packing of bacteria and macromolecular surfactants produced by the bacteria, could have important consequences in petroleum extraction and remediation. We characterize the shear response of bacterial films on oil-aqueous interfaces during formation via passive microrheology and describe them in terms of a simple viscoelastic model.

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A K-profile parameterization of Langmuir turbulence in shallow water

Presenter: Andres Tejada-Martinez
University of South Florida
Authors: A. Tejada-Martinez[1], N. Sinha[1], C. Grosch[2], G. Martinat[2];
[1]University of South Florida, Tampa, FL, [2]Old Dominion University, Norfolk, VA.

Abstract:
Langmuir turbulence in shallow water is often characterized by full-depth Langmuir circulation (LC) interacting with the bottom boundary layer and potentially serving as an important mechanism for sediment re-suspension and oil sedimentation. Langmuir turbulence is generated by the interaction between the wind-driven shear current and the Stokes drift velocity induced by surface gravity waves. Large-eddy simulations (LES) of Langmuir turbulence with full-depth LC in a wind-driven shear current have revealed that mixing due to LC erodes the bottom log-law velocity profile inducing a profile resembling a wake law. Meanwhile, near the surface, Stokes drift shear serves to intensify small scale eddies leading to enhanced mixing and disruption of the surface log-law. A K-profile parameterization (KPP) comprised of local and nonlocal components is introduced capturing these basic mechanisms by which Langmuir turbulence and full-depth LC impact the mean flow. Single water column Reynolds-averaged Navier-Stokes (RANS) simulations with the new

parameterization are presented showing good agreement with LES in terms of mean velocity profiles. The new KPP is shown to lead to better predictions than traditional models such as k-epsilon which are not equipped to account for Langmuir turbulence.

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Modeling ocean circulation and biogeochemical variability in the Gulf of Mexico

Presenter: Ruoying He
North Carolina State University
Authors: R. He[1], Z. Xue[1], K. Fennel[2], W. Cai[3], S. Lohrenz[4], C. Hopkinson[5];
[1]North Carolina State University, Raleigh, NC, [2]Dalhousie University, Halfax, NS, CANADA, [3]University of Delaware, Newark, DE, [4]University of Massachusetts Dartmouth, New Bedford, MA, [5]University of Georgia, Athens, GA.

Abstract:
A three-dimensional coupled physical-biogeochemical model is applied to simulate and examine temporal and spatial variability of circulation and biogeochemical cycling in the Gulf of Mexico (GoM). The model is driven by realistic atmospheric forcing, open boundary conditions from a data assimilative global ocean circulation model, and observed freshwater and terrestrial nutrient input from major rivers. A 7 yr model hindcast (2004-2010) was performed, and validated against satellite observed sea surface height, surface chlorophyll, and in-situ observations including coastal sea-level, ocean temperature, salinity, and nutrient concentration. The model hindcast revealed clear seasonality in nutrient, phytoplankton and zooplankton distributions in the GoM. An Empirical Orthogonal Function analysis indicated a phase-locked pattern among nutrient, phytoplankton and zooplankton concentrations. The GoM shelf nutrient budget was also quantified, revealing that on an annual basis ~80% of nutrient input was denitrified on the shelf and ~17% was exported to the deep ocean.

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Uncertainty Analysis Of Bubble Plumes In A Stratified Environment

Presenter: Tamay Ozgokmen
University of Miami
Authors: T. Ozgokmen[1], M. Iskandarani[1], A. Fabregat[2], A. Poje[2], W. Dewar[3], G. Novelli[1], N. Wienders[3], B. Deremble[3];
[1]University of Miami, Miami, FL, [2]City University of New York, Staten Island, NY, [3]Florida State University, Tallahassee, FL.

Abstract:
Large eddy simulations of turbulent bubbly plumes are conducted within the context of a Boussinesq model, in which the buoyancy effects of bubbles are included. Our main focus is on the processes that set the level of lateral intrusions spreading away from the vertical plume. These intrusions are where the lateral underwater spreading is thought to take place in the case of deep water oil/gas blow outs. We find a high sensitivity of the intrusion layers to model resolution and turbulence levels. A novel analysis is carried using Polynomial Chaos methods in order to quantify the sensitivity of intrusion levels to uncertainties in Reynolds number and the ambient stratification.

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Deep Water Horizon Oil in Gulf of Mexico Waters after TwoYears: Transformation into the Dissolved Organic Matter Pool

Presenter: Thomas S Bianchi
University of Florida
Authors: T. S. Bianchi[1], C. Osburn[2], S. Yvon-Lewis[3], M. Shields[1], J. Young[3], L. Guo[4], Z. Zhou[4];
[1]University of Florida, Gainesville, FL, [2]North Carolina State University, Raleigh, NC, [3]Texas A&M University, College Station, TX, [4]University of Wisconsin-Milwaukee, Milwaukee, WI.

Abstract:
Recent work showed the presence of anomalous dissolved organic matter (DOM), with high optical yields, in deep waters 15 months after the Deepwater Horizon (DWH) oil spill in the Gulf of Mexico (GOM) (Zhou and Guo, 2012). Here we use the fluorescence excitation-emission matrix (EEM) technique coupled with parallel factor (PARAFAC) modeling, measurements of bulk organic carbon, dissolved inorganic carbon (DIC), oil indices, and other optical properties to examine the chemical evolution and transformation of oil components derived from the DWH oil in deep waters of the northern GOM. Seawater samples were collected on a cruise in the GOM from 7/5/2012 to 7/11/2012. We used fluorescence component characteristics determined by a modified PARAFAC model fit on samples collected near the wellhead during the spill (Zhou et al. 2013), as a signature for DWH oil. PARAFAC modeling identified 6 fluorescence components that indicated the presence of a DWH oil siganture in DOM at our sites. There was no correlation between DOC, fluorescence components, and estimated oil equivalents. It appears that DWH oil has been transformed and now exists largely in the DOM pool. Based on concentrations of the 6 components observed in earlier work, this signature has decreased over the past 2 years, which suggests it is being metabolized. Finally, we report if there any evidence for linkages between the distribution of component 6 (indicative of degraded DWH oil) and circulation patterns in this region of the GOM.

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Hydrostatic Modeling of the Near-Field and Far-Field Multi-phase Plume in a Deepwater Blowout.

Presenter: Ashley Stroman
Florida State University
Authors: A. Stroman, W. Dewar, N. Wienders, B. Deremble;
Florida State University, Tallahassee, FL.

Abstract:
In the near-field region of a deepwater oil-well blowout, the flow is described as a turbulent plume consisting of immiscible constituents, such as oil, gas, and water. The objective of this study is to investigate the plume structure, and the interactions of the plume with the far-field. In particular, we aim to determine whether the plume is best described as an active plume, where the plume has an effect on the surrounding ocean, or as a passive plume, where the plume is just advected by currents. The case where a crossflow is present will also be discussed.

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Type: Poster 3-43

The Influence of Grid Resolution and Wind Specification on the Prediction of Transport of Oil at the Surface

Presenter: Ian Mitchell
University of Maryland Center for Environmental Science
Authors: I. Mitchell[1], E. North[1], R. He[2], R. Hetland[3], P. Chang[3], R. Montuoro[3];
[1]University of Maryland Center for Environmental Science, Cambridge, MD, [2]North Carolina State University, Raleigh, NC, [3]Texas A&M University, College Station, TX.

Abstract:
Prediction of oil transport is fundamentally influenced by the hydrodynamic model which makes circulation predictions. We investigate the influence of hydrodynamic model grid resolution and wind specification on the prediction of surface oil transport using the Lagrangian TRANSport (LTRANS) model and three Regional Ocean Model System (ROMS) hydrodynamic models. Two of the hydrodynamic models are Gulf-wide and have grid resolutions of 5 km (SABGOM) and 3 km (CRCM). One is forced with winds from the North America Regional Reanalysis (SABGOM) while the other (CRCM) is fully coupled to an atmospheric model (WRF). In addition, a high resolution coastal model (TXLA) has 1 km grid spacing. All were applied in hindcast mode to simulate the Deepwater Horizon oil spill. Trajectories of oil at the surface were simulated within both Gulf-wide model domains, and from the Gulf-wide models into the

coastal model domain. Results are compared between models and with observations of oil slick locations to identify how grid resolution and wind parameterization influence prediction of surface oil transport. Findings and challenges will be discussed.

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Effects of chemically patterned surfaces on bacterial movement and growth

Presenter: Maryam Jalali
Texas Tech University
Authors: M. Jalali, M. Molaei, J. Sheng;
Texas Tech University, Lubbock, TX.

Abstract:
The accidental release of crude oil severely impacts marine environment and coastal ecosystem. It was widely speculated that microbes are responsible for rapid degradation of oil and speedy clean up. In this work, we investigate the dynamic interactions between bacteria and chemically patched oil-water interfaces under flow conditions. Using both soft lithography and micro-contact printing techniques, we have established a surface with an array of micro oil patches whose individual size ranges from 10um to 50um. This oil patterned surface is further integrated with a PDMS microfluidics as its bottom substrate. This unique lab-on-a-chip device allows us to investigate the complex interactions microscopically and over a long time. Our experiments evaluate the effects of this chemically structured surface on bacteria attachment and detachment processes in-situ. The growth rates and morphological of bacterial colony and biofilm are also investigated. To further elucidate complex hydrodynamic mechanisms involved such as shear erosion, bacteria swimming characteristics, such as swimming velocity, angle, tumbling frequency and dispersion, are also measured.

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Integrating Models and Observations to Estimate Subsurface Degradation Rates and Oil Transport

Presenter: Elizabeth North
University of Maryland Center for Environmental Science
Authors: Y. Lee[1], E. North[2], A. Thessen[2], S. McGinnis[2], E. Adams[3], R. He[4], M. Du[5], J. Kessler[6];
[1]Bigelow Laboratory for Ocean Sciences, East Boothbay, ME, [2]University of Maryland Center for Environmental Science, Cambridge, MD, [3]Massachusetts Institute of Technology, Cambridge, MA, [4]North Carolina State University, Raleigh, NC, [5]Texas A&M University, College Station, TX, [6]University of Rochester, Rochester, NY.

Abstract:
Central challenges for predicting the fate and transport of subsurface oil include simulating circulation patterns as well as determining hydrocarbon degradation rates. We integrated a 3D coupled numerical model with observations to estimate subsurface transport and degradation of hydrocarbon compounds from the Deepwater Horizon oil spill. A database was compiled, called the 'GISR Deepwater Horizon database', which contains >7 million data points of chemical and physical conditions during and after the Deepwater Horizon oil spill. The 3D coupled model was created by linking an analytical multiphase plume model to predict initial hydrocarbon plume depths, the 3-D South Atlantic Bight and Gulf of Mexico hydrodynamic model (SABGOM) to predict circulation patterns, and the Lagrangian TRANSport model (LTRANS) to predict trajectories of hydrocarbons. In model simulations, passive particles were released from the start of the spill in April, 2010, until the well was capped, and were tracked until October, 2010. We inferred degradation rates by applying various half-lives for degradation along particle trajectories and comparing results to observations from >200 m deep, with the initial result of 3-, 5-, 15-, and 25-day half-lives for benzene, n-Alkanes from C25 to C28, naphthalene, and dissolved oxygen anomaly (a proxy for total hydrocarbons), respectively. Quantitative metrics for model-data comparison and their influence on half-life predictions and transport of subsurface hydrocarbons will be discussed.

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The effect of natural solar radiation on crude oil degradation and microbial community structure

Presenter: Hernando P Bacosa
Marine Science Institute, The University of Texas at Austin
Authors: H. P. Bacosa, D. L. Erdner, Z. Liu;
Marine Science Institute, The University of Texas at Austin, Port Aransas, TX.

Abstract:
Photooxidation and biodegradation are important processes in the transformation of crude oil in marine environments. However, the effect of solar radiation on microbial communities in the presence of oil and/or dispersants, and the combined effect of photooxidation and biodegradation on oil composition remain poorly understood. We conducted shipboard and laboratory experiments using surface water from the DWH site amended with MC252 crude oil and/or dispersant (Corexit), and incubated in natural sunlight or in the dark. Hydrocarbon-degrading bacteria were estimated by the MPN method, and microbial community structure was analyzed by PCR-DGGE. The growth of hydrocarbon degraders peaked at day 20 for most cultures. Highest bacterial density was observed in light cultures with oil and dark cultures with oil+dispersant. The dendogram describing pattern similarities of the DGGE profile on day 20 revealed that light and dark controls (no oil or dispersant) clustered together. On the other hand, cultures under light treatments (oil and oil+dispersant) grouped together and were distinctly clustered from dark treatments (dispersant and oil+dispersant). These results suggest that solar radiation could be a major driver of the changes in microbial community structure during the DWH oil spill. Microbial community composition will be examined in detail by pyrosequencing analysis. GC/MS data on residual alkanes and PAHs after 5, 10, 20, 27, and 36 days will also be presented.

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The stratigraphic absolute abundances and compositional characteristics of calcareous nannofossils in the De Soto Canyon pre- and post-Macondo oil spill sediments.

Presenter: Aisha Agbali
Florida State University
Authors: A. Agbali[1], S. Wise[1], B. Flower[2], S. Foley[1];
[1]Florida State University, Tallahassee, FL, [2]University of South Florida, St. Petersburg, FL.

Abstract:
Calcareous nannoplankton are important phytoplankton and one of the major primary producers in the Gulf of Mexico. Variations in their abundance in the underlying sediments through time and space indicate a response to changes in the physical, chemical and nutrient conditions of the water. Hence, calculation of absolute nannofossil abundances in the De Soto canyon sediments is valuable for stratigraphic evaluation of post-spill effects on the assemblages. In addition, it provides a tool to examine possible causes of the high sedimentation rates recorded in the GOM in some sediment cores. In essence, the goal of this work is to study any effects of the Macondo oil spill on the accumulation and preservation of calcareous nannofossils in sediments in the Gulf of Mexico. The main question is whether the oil spill caused a bloom in phytoplankton production, and hence influenced their sedimentation rate.

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Variation in efficiency and effectiveness Corexit dispersants in salt water with increasing hydrostatic pressure

Presenter: Berrin Tansel
Florida International University
Authors: B. Tansel, D. Boglaienko, C. Feelemyer, A. Arreaza;
Florida International University, Miami, FL.

Abstract:
The purpose of this study was to determine the effect of hydrostatic pressure in the surface tension as well dissolution of crude oil in salt water (34 ‰) in the presence of Corexit 9500A and Corexit 9527 and Louisiana crude oil. For the experiments with dispersants and oil, dispersant was premixed with crude oil to prepare mixtures with dispersant to oil ratios (DOR) of 1:10 and 1:20 (v/v). For all the solutions containing LCO, 1 mL oil was used for 175 mL of salt water. Dispersants were added as 0.05, 0.1, 0.3, 0.5, 0.7 mL into the 175 mL solutions of salt water. For the experiments which were conducted at 1:20 and 1:10 DOR, the oil concentration was 1 ml/175 mL of salt water and the dispersant concentration was 0.05 and 0.1 mL, respectively.

Experiments were conducted in the pressure range from 1 to 80 bars (corresponding to water depths from 0 to 786 meters). The surface tension of salt water increased from 110±2 dynes/cm at 1 bar to 80±2 dynes/cm at 40 bars, and to 29±2 dynes/cm at 80 bars. Hydrostatic pressure alone decreased the surface tension of salt water from 110±2 dynes/cm at 1 bar to 80±2 dynes/cm at 40 bars, and to 29±2 dynes/cm at 80 bars. Presence of crude oil also decreased the surface tension of salt water. A second order polynomial model was adequate for estimating the surface tension in relation to pressure and dispersant concentration. The critical micelle concentration (CMC) of Corexit 9500A increased with increasing pressure. However, for Corexit 9527, a clear trend between the CMC and pressure was not observed.

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Water Column Inertial and Sub-Inertial Oceanic Response to Hurricane Isaac in the Deepwater Gulf of Mexico

Presenter: Laura J Spencer
Texas A&M University
Authors: L. J. Spencer[1], S. F. DiMarco[1,2], J. Kuehl[2], R. Montuoro[1], V. M. Khade[1], J. Kurian[1], P. Chang[1];
[1]Texas A&M University, College Station, TX, [2]Geochemical and Environmental Research Group, College Station, TX.
Abstract:
A group of six upward-looking 75 kHz ADCPs were deployed between 336 m and 1145 m on deepwater mooring arrays located in water depths between 836 m and 2145 m in the Mississippi Fan region of the northern Gulf of Mexico during July 2012 as part of the Gulf Integrated Spill Research program. Tropical Storm Isaac entered the Gulf of Mexico on August 27, 2012 and gradually strengthened to become a category 1 hurricane shortly before making landfall in southern Louisiana. Hurricane Isaac passed directly over the center of the mooring array. Maximum current speeds of 41.3 cm/s at 100 m, 35.5 cm/s at 300 m, and 32.7 cm/s at 500 m depth were observed during the passage of the Hurricane Isaac. Maximum near bottom current speeds ranged between 16.1 cm/s at 2125 m depth and 34.0 cm/s at 1020 m depth. Inertial band oscillations (1/2-2 days) are seen to 800 m depths, with energy propagation speeds on the order of 100 m/day. Sub-inertial oscillations (4-8 days) are initiated throughout the full water column at the time of the storms closest approach and persist for approximately 10 days. The low frequency velocity components become coherent with a short phase lag within days of the hurricane's closest approach. Observations are compared to a coupled numerical ocean circulation atmospheric model of the Gulf of Mexico in order to improve the understanding of the transport of chemical and biological components in response to major events such as hurricanes.

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Analysis Of Deep Currents In The Gulf Of Mexico From The 1/25-degree HYCOM

Presenter: Dmitry Dukhovskoy
FSU
Authors: D. Dukhovskoy, E. Chassignet, S. Morey;
FSU, Tallahassee, FL.
Abstract:
Large amounts of residual oil deposited to the Gulf of Mexico seafloor after the Deepwater Horizon oil spill. Sediment core samples collected after the oil spill indicated the presence of a substantial layer of fresh oily sediment covering a vast area in the northern Gulf of Mexico. The fate and transport of oil spill residues in the deep ocean is mainly determined by dynamical characteristics of the near-bottom currents. Observational and model studies demonstrate that strong currents exist in the deep Gulf of Mexico. These strong currents can carry oil spill residues over long distances and can potentially transport the residues to shallow regions. Characteristics and statistics of deep currents in the Gulf of Mexico are analyzed from long-term simulation of the 1/25-degree HYCOM with 40 vertical layers. Impact of varying vertical resolution on representation of the deep circulation in the model is discussed.

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Polarimetric Sea-Surface Measurements During The GLAD Experiment

Presenter: Nathan Laxague
University of Miami
Authors: N. Laxague[1], B. Haus[1], D. Bogucki[2], N. Williams[1];
[1]University of Miami, Miami, FL, [2]Texas A&M, Corpus Christi, Corpus Christi, TX.

Abstract:
Here we present an application of shipboard polarimetry and infrared imaging with a focus on quantifying the evolution of wavenumber slope and temperature gradient spectra. The polarimetry method in particular allows fine-scale measurement of features that figure strongly into processes ranging from gas transfer to turbulent kinetic energy dissipation. Precise sea-surface measurements enhance our ability to carry out the fate-of-oil mission of the Consortium for Advanced Research on Transport of Hydrocarbon in the Environment (CARTHE). Field data was collected aboard the R/V F.G. Walton Smith during the Grand LAgrangiand Deployment (GLAD), an upper-ocean dispersion experiment that took place during the Summer of 2012 in the Gulf of Mexico. To derive wavenumber spectra from the polarimetry required image rectification and normalization considering boat motions and variable illumination. We will focus on rectified data collected during several days of intensive near-surface turbulence measurement via the optical turbulence sensor (OTS). The link between wind forcing, surface roughness, and TKE dissipation will be explored.

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Wetland Surface Water Motion Due To Waving Vegetation

Presenter: Evan Variano
UC Berkeley
Authors: M. R. Foster, E. Variano;
UC Berkeley, Berkeley, CA.

Abstract:
We investigate the effect of honami motions in a wetland system, where ‘honami’ refers to the wind-driven movement of vegetation. We hypothesize that this movement stirs the water column and thus contributes to mass transport through the wetland surface water. This mass transport is relevant for oil in suspension, aqueous-soluble hydrocarbons, and volatile organic compounds. In this study, we begin by measuring the effect of honami motions on the transfer rate of dissolved gases across the air-water interface. To understand the magnitude of this effect, a wetland honami was simulated in the laboratory using an array of plastic tubes to represent vegetation. Starting from deoxygenated water, we measured dissolved oxygen at mid-depth in the water column using a YSI ProODO as the water equilibrated with the atmosphere. From this DO timeseries, we calculated the gas transfer velocity, k, using the thin film gas transport model. We present these results and compare them to k-values caused by other drivers of wetland surface water stirring. The next stage of this research is to measure the motion-augmented diffusivity (analogous to an “eddy diffusivity”) in wetland surface water due to honami motion. We plan to present these results, in at least a preliminary state.

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Settling Velocity Of Marine Snow At A Seep Site And A Spill Site In The Northern Gulf Of Mexico

Presenter: Clayton Dike
The University of Southern Mississippi
Authors: C. Dike;
The University of Southern Mississippi, Stennis Space Center, MS.

Abstract:
Marine snow aggregates throughout the water column, and often achieves sinking speeds of 100-250m/day. The speed of settling is significant in the vertical export of nutrients and organic carbon from the surface to depth. In the case of the Macondo oil spill, hydrocarbons incorporated in snow transported from the surface and subsurface plumes may reside in a flocculent layer where they can be redistributed by currents. To analyze settling velocity of flocculent and marine snow, a camera system was developed and deployed 80 m from the bottom along with an ADCP and two time-series sediment traps at MC297, a site southwest of the Macondo well. The camera system consists of a stilling tube attached to a clear box. As aggregates settle into the box, they are photographed and their sinking speeds can be determined. Another camera system was deployed for comparison in September of 2012 at GC600, an active natural seep site about 250km to the west.. The sinking speed vs. size results are then compared to the ADCP data, as well as synthesized with findings from collaborators, to elucidate the role of snow in the transport of hydrocarbons. Settling velocities of flocculent snow may be used in contaminant redistribution projections. This technique may be useful in the examination of hydrocarbon distribution in future oil spills.

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Hydrocarbon Processing At A Natural Seep In The Gulf Of Mexico

Presenter: Christof Meile
University of Georgia
Authors: E. King, R. Sibert, J. Battles, L. Fields, S. Joye, C. Meile;
University of Georgia, Athens, GA.

Abstract:
The Gulf of Mexico (GoM) contains approximately 1,000 natural seeps that discharge on the order of 1,000 barrels of oil per day with seepage characterized as slow, diffuse, and variable in both time and space. While this discharge only accounts for 3% or less of the daily discharge from the Macondo well during the blowout, the study of natural seeps provides insight to how environments are affected by and respond to hydrocarbon inputs.
To better understand environmental responses to hydrocarbon inputs and quantify subsurface metabolic processes, we developed a sediment model to characterize the degradation of oils percolating through natural seep sediments of the GoM. A reactive transport model that takes into account seepage, sedimentation, diffusion, (bio)advective transport, and kinetics of reactions involved in carbon and nitrogen cycling was used to quantify processes related to hydrocarbon degradation. Model parameters were constrained using geochemical data from sediment cores, isotopic data, and process rate measurements from GC600, a prolific natural seep along the lower continental slope. The impacts of seepage velocity and reactivities associated with distinct fractions of oil on terminal electron acceptor usage and benthic hydrocarbon fluxes were assessed.

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Marine Snow Aggregate Abundance Near The Macondo Well Site

Presenter: Vernon Asper
University of Southern Missippi
Authors: V. Asper[1], A. R. Diercks[1], U. Passow[2], C. Dike[1], K. Ziervogel[3];
[1]University of Southern Missippi, Stennis Space Center, MS, [2]University of California at Santa Barbara, Santa Barbara, CA, [3]University of North Carolina, Chapel Hill, NC.

Abstract:
A profiling camera system was used to quantify the size and distribution of marine snow aggregates (>0.5mm) throughout the water column at several sites in the Gulf of Mexico both during and after the spill. During the spill, large concentrations of aggregates were observed in the deep plume with large aggregates both above and below it. Since that time, aggregated concentrations have returned to near background levels in most cases. One exception was during a “snowstorm” event wherein a near bottom layer comprised of numerous aggregates was detected. Unlike a normal nepheloid layer, the highest concentrations were at 200m above the bottom with lower concentrations below. We tentatively interpret this as an indication of resuspension of flocculent material at a nearby site with lateral transport bringing it to the areas where it was detected..

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Experimental investigation of generation of oil-seawater aerosol by breaking waves

Presenter: CHENG LI
Johns Hopkins University
Authors: C. LI, A. HOSLER, J. KATZ;
Johns Hopkins University, Baltimore, MD.

Abstract:
Under the action of breaking waves, oil slicks form on the water surface, and subsequently break up into droplets by breaking waves. Some of these droplets become airborne. The role of breaking waves in the generation of marine aerosols has been investigated extensively, revealing phenomena such as splash-up resulting from wave plunging, as well as formation of micro-droplets as rising bubbles burst at the water surface. The potential effect of these processes on the generation of oil aerosols has not received significant attention. Little is known about the size and spatial distribution of these droplets and their impact on air quality. Addition of dispersants alter the size distribution of the droplets, and consequently, the size of airborne droplets. In our on-going experimental study, we investigate the breakup of an oil slick and generation of sub-surface and airborne oil droplets and bubbles by breaking waves. The experiments are performed in a specialized transparent facility. Slicks of crude oil (MC252 surrogate), some premixed with the dispersant Coexist 9500-A, are exposed to controlled breaking waves. High speed imaging elucidates processes involved with the formation of droplets. Time-resolved inline digital holographic microscopy is used to measure the size and spatial distribution of sub-

surface droplets and bubbles and aerosols above the water as a function of wave strength and shape (plunging vs. spilling) as well as the oil and dispersant Weber No.

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Long Internal Waves in the Northern Gulf of Mexico: Unraveling Coastal Transport Mechanisms

Presenter: Kimberly Arnott
Texas A&M University-Corpus Christi
Authors: K. Arnott[1], D. Bogucki[1], C. Mitchell[1], E. Coelho[2], T. Ozgokmen[3], B. Haus[3], A. Reniers[3], A. Valle-Levinson[4], M. Gough[5];
[1]Texas A&M University-Corpus Christi, Corpus Christi, TX, [2]Naval Research Laboratory, Stennis Space Center, MS, [3]University of Miami, Miami, FL, [4]University of Florida, Gainesville, FL, [5]University of Miami, Miami, TX.

Abstract:
Evidence supporting surface transport induced by long internal waves emerged though hydrographic, acoustic, and surface drifter observations collected during GLAD in the northern Gulf of Mexico. Three reductions in near-surface water density measurements were the first indication of long internal waves. Acoustic measurements also demonstrated internal wave activity in the distribution of vertical shears of horizontal velocity, which displayed 3 to 4 m downward displacements of the pycnocline and confirmed long internal waves of depression. An EOF analysis of the north-south velocities determined onshore propagation, characterized by a second EOF-mode representing 21% of the variance. This EOF-mode 2 featured a vertically sheared (7 m depth) spatial structure. The Taylor Goldstein equation provided a phase speed of ~ 0.5 m/s and upper layer thickness of 8 m. Theoretical horizontal surface transport was estimated using varying wave amplitudes derived from the acoustic measurements, from wavelengths estimated via the GPS positions of surface density reductions, and from upper layer thicknesses obtained through both the EOF analysis and Taylor Goldstein solution. To determine whether internal waves influenced drifter transport, the north-south drifter displacements were filtered to remove wind and tidal influences and compared to theoretical estimates. The total displacements during long internal wave episodes in the onshore (north) direction ranged from 1.2 km to 4.2 km and 1.2 km to 4.6 km in the offshore (south) direction. The drifter observations fell within the range of the theoretically estimated surface transport, which was 1.8 km to 6.4 km.

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Validation of Preconditioning and Level-Set Methods for Multi-Phase Flow Simulations

Presenter: Ge-Cheng Zha
University of Miami
Authors: D. A. Espinal, G. Zha;
University of Miami, Coral Gables, FL.

Abstract:
In this paper 2D incompressible flows are solved using preconditioned RANS equations coupled with the Level-Set equation. High order WENO schemes are used with a E-CUSP Riemann solver. For viscous effects a Baldwin-Lomax turbulence model is used. The Level-Set equation has a conservative form and is used to determine equations-of-state and interface jump conditions. Validation is first performed for low speed, low Reynolds number flows for water and air comparing flat-plate simulation results with the theoretical solution from Blasius. Next, a two-phase simulation of uniform water flow over stationary air is used to test shear-stress and surface tension jump conditions. A 2D dam-break problem is used to compare simulation results with experiments. Finally 2D and 3D Rayleigh-Taylor instabilities are simulated to show preconditioning capability to solve compressible flows.

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Type: Poster 3-59

Methane sources and distributions in the water column of the northern Gulf of Mexico after the Deep Water Horizon oil spill

Presenter: Cédric Magen
Florida State University
Authors: C. Magen, J. P. Chanton;
Florida State University, Tallahassee, FL.

Abstract:
In April 2010, the Deep Water Horizon oil spill released a massive amount of methane in the Gulf of Mexico. Following the event, we establish the distribution of methane in the northern Gulf of Mexico and compare it to what was known before the event. In 2012 and 2013, water column samples were taken at and near a natural oil seep site, in the vicinity of the Macondo well, at several stations in the Desoto Canyon, and near the Florida Gulf coast. Using concentrations and stable isotopes of methane, we investigate the sources and sinks of sub-surface water methane. Results show that, as was the case before the oil spill, methane concentrations display a peak within the euphotic zone, ranging from 5 to 25 nM in most cases and reaching as much as 60 nM. The presence of this peak suggests that methane is produced in the presence of O_2, and questions the idea that methanogenesis is strictly anaerobic. Interestingly, this peak was within a nutrient minimum and coincided strongly with the chlorophyl maximum. Values of $\delta^{13}C$ of the methane in the euphotic zone ranged between -41‰ and -50‰. Bottom methane concentrations reached 42 nM at the natural oil seep, with an isotope signature of -42‰, concurrent with a more thermogenic origin of the methane. Near the coast, concentrations of methane in surface waters were not significantly higher, despite the proximity of rivers.

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Fragmentation, dispersion and clustering of oil drops in water

Presenter: Andrea Prosperetti
Johns Hopkins University
Authors: A. Prosperetti, Y. Tseng, S. Chu;
Johns Hopkins University, Baltimore, MD.

Abstract:
In the first part of this work we show how a single interfacial instability mechanism leads to a variety of different fragmentation phenomena of liquid masses immersed in an immiscible liquid. The process involves the nature of the flow in the vicinity of zero-vorticity points (or lines) on the interface. In this region the flow compresses surface disturbances causing their amplification. This mechanism is universal and it can be seen at work in the formation of so-called "skirts" behind rising drops and bubbles, streaming from the tips of drops in a straining flow and others. It is found that it is strongly intensified by the presence of surfactants. The second part of the work is concerned with the interaction of droplets and turbulence. Direct numerical simulations of oil droplets dispersed in a turbulent water mass are conducted to study the clustering and coalescence of drops in dependence on size, concentration and turbulent intensity.

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Multiple lines of evidence for elevated phytoplankton pigments near natural oil seeps in the Northern Gulf of Mexico

Presenter: Nigel A D'souza
Lamont-Doherty Earth Observatory, Columbia University
Authors: N. A. D'souza[1], A. Subramaniam[1], A. Juhl[1], M. Hafez[1], A. Chekalyuk[1], B. Yan[1], I. MacDonald[2];
[1]Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, [2]Florida State University, Tallahassee, FL.

Abstract:
Satellite images from 1998 to 2007 revealed a 10-30% increase in chlorophyll concentrations at sites impacted by surface oil slicks caused by natural seeps in the Northern Gulf of Mexico. To overcome limitations of spatial and temporal resolution normally associated with shipboard measurements, we paired an Advanced Laser Fluorometer (ALF) with the ship's GPS and thermosalinograph, and connected it to the ships underway intake system for continual monitoring of surface waters over the entire cruise track for five cruises conducted during 2012-13. This provided instant assessment of chlorophyll, three taxa-specific spectral types of phycoerythrin, chromophoric dissolved organic matter (CDOM), and CDOM-corrected Fv/Fm assessments of phytoplankton photophysiology. In addition to describing the pigment-derived biogeography of surface phytoplankton, our analyses revealed increased chlorophyll fluorescence in surface waters at locations where oil slicks had been documented, consistent with radar and ocean-color satellite data. An autonomous profiler deployed near an active seep also revealed elevated sub-surface chlorophyll fluorescence, as well as

pycnocline shoaling, suggestive of enhanced physical mixing near regions where persistent oil slicks were observed. While the exact mechanisms involved in the processes at these sites remain unclear, our results highlight influence of natural oil seeps on phytoplankton distribution and abundance in surface waters.

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Hydrocarbon degrading bacteria near oil water interface

Presenter: Mehdi Molaei
Texas Tech University
Authors: M. Molaei, M. Jalali, J. Sheng;
Texas Tech University, Lubbock, TX.

Abstract:
Biodegradation of crude oil by microbes are widely speculated to contribute to the rapid breakdown of oil spill and subsequent speedy cleanup. However, the mechanisms of microbes interacting with oil droplets and their consequential impacts on biodegradation are less studied. Here, we apply the state-of-the-art Digital Holography Microscopy (DHM) and phase contrast microscopy to study 3D locomotion of bacteria assemblage near oil-water interface under different flow shears. The DHM allows us to track 3D motion of individual bacteria within a dense suspension over a significant depth and simultaneously to quantify surrounding fluid flow with exceptional spatial resolutions. Four well-known hydrocarbon degraders, Pseudomonas sp, Marinobacter hydrocarbonoclasticus, Alcanivorax borkumensis, and Oceanobacter kriegii, are selected for the investigations. Additional six bacteria species isolated directly from Gulf of Mexico are also used for comparisons. Two crude oil, Louisiana sweet and source oil recovered from the well head are selected. Hexadecane oil model is also used as the Alkane source without dissolved components. Using novel microfluidic devices and surface functionalization technique, we establish well controlled vertical oil-water interface within microfluidics, which enables us to observe bacterial motility near the interfaces and track each individual bacteria in three dimensions over the time. The interactions are quantified using time history of swimming speed and cell orientation. Chemotaxis, dispersion are also quantified. Preliminary results show substantial difference in bacterial motility near a crude oil water interface in comparison to the one established between Hexadecane and water.

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Tracer age as a diagnostic for understanding the relationship between surface and boundary forcing and estuarine circulation

Presenter: Matthew D Rayson
Stanford University
Authors: M. D. Rayson[1], E. S. Gross[1], R. D. Hetland[2], O. B. Fringer[1];
[1]Stanford University, Stanford, CA, [2]Texas A&M University, College Station, TX.

Abstract:
Estuarine circulation is driven by competing forcing mechanisms that vary on a wide range of space and time scales. Due to the non-linear nature of the circulation, attributing a flow regime to a particular forcing mechanism is difficult via analytical or statistical means. Therefore, other metrics are necessary to analyze numerical model data for the development of useful relationships that can enhance our understanding of estuaries. We employ both Eulerian and Lagrangian tracer ages as metrics that can be used to understand the relationships between different estuarine circulation regimes that arise from different forcing mechanisms. We demonstrate using a five-year unstructured-mesh SUNTANS hind-cast dataset of Galveston Bay that the relationship between estuarine flushing time and river discharge is better represented by an inverse power law and not a simple linear function. Time-varying exchange flow at the Gulf entrance is investigated as a mechanism for modulating the flushing time of the system. Simple relationships like this give environmental managers a better predictive capability for determining when and which regions of an estuary, such as Galveston Bay, may be at risk of exposure to an oil spill.

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Sediment Resuspension In The Deep Gulf Of Mexico Affects Redistribution And Transformation Of (Oil-Rich) POM

Presenter: Kai Ziervogel
University of North Carolina-Chapel Hill
Authors: K. Ziervogel[1], J. Sweet[2], U. Passow[2], A. Juhl[3], V. Asper[4], A. Diercks[5], C. Arnosti[1];
[1]University of North Carolina-Chapel Hill, Chapel Hill, NC, [2]University of California-Santa Barbara, Santa Barbara, CA, [3]Lamont-Doherty Earth Observatory at Columbia University, Palisades, NY, [4]The University of Southern Mississippi, Stennis Space Center, MS, [5]The University of Southern Mississippi-NIUST, Abbeville, MS.

Abstract:
Particulate organic matter (POM) that has reached deep-sea sediments can be subject to flow-induced resuspension, affecting particle redistribution and elemental cycling in bottom waters. We measured sediment resuspension and bacterial transformation of POM in bottom waters containing resuspended particles at 8 deep-sea sites in the area of the sunken Deepwater Horizon (DWH) oil rig in the northern Gulf of Mexico in June 2013. Surficial sediments were resuspended at shear stresses generated by bottom water currents of 25 to 35 cm/s, i.e. comparable to maximum flow speeds measured near the seafloor in the investigated area. In bottom waters, sediment resuspension enhanced activities of heterotrophic bacteria that are mainly responsible for organic matter transformation. We demonstrate that sedimented POM can be subject to resuspension and redistribution during high flow events even in the deep-sea. Our results reveal insights into the fate of oil-rich particulate matter fallout that covered large areas of the seafloor near the DWH site in 2010.

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Analysis of moored observations to understand the physics of the connectivity between the deep sea and the coast through the DeSoto Canyon

Presenter: Allan J. Clarke
Florida State University
Authors: A. J. Clarke[1], N. Wienders[1], S. Van Gorder[1], P. Hamilton[2], K. Speer[1];
[1]Florida State University, Tallahassee, FL, [2]SAIC, Raleigh, NC.

Abstract:
From May 2012 to May 2013 currents, temperatures and salinities were measured in and near the head of the DeSoto Canyon at 6 moorings at depths 53 m, 79 m, 97 m, 106 m, 206 m and 715 m. Subinertial flow on the shelf was quasi-barotropic, approximately followed the isobaths, and was mainly driven remotely by winds to the east and south along the west Florida shelf in accordance with coastally trapped wave theory. Southward winds were effective in driving upwelling up onto the shelf near the head of the canyon. Two instances of very strong subinertial flows, with westward peak velocities of greater than 60 cm/sec, were associated with the influence of Hurricane Isaac (21 August - 1 September 2012) and Tropical Storm Debby (23-27 June 2012). Apart from Hurricane Isaac, subinertial flow from the beginning of July to the end of October was not wind-driven, and consisted of 2-week periodicity flow with peak-to-peak oscillations of about 30 cm/s. A description of all these flows and an analysis of the flow physics will be presented.

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Initial Descriptions of Macrofaunal Community Structure of the DeSoto Canyon Following the Deepwater Horizon Oil Spill.

Presenter: Amy Baco-Taylor
Florida State University
Authors: A. Baco-Taylor[1], A. Shantharam[1], C. Wei[2], G. Rowe[3];
[1]Florida State University, Tallahassee, FL, [2]Memorial University of Newfoundland, St. John's, NL, CANADA, [3]Texas A&M University at Galveston, Galveston, TX.

Abstract:
Deepwater benthic ecosystems in the vicinity of the Horizon oil spill may have been impacted by subsurface plumes of oil, or by the increased flux of marine snow in the months following the spill. We sampled sediment macrofauna in the DeSoto Canyon, just northeast of the spill site, to look for oil impacts on these communities. Ten stations are characterized in terms of community structure, ecosystem function, and important environmental factors. Results are compared to baseline data from two of these stations collected in 2000 and 2002. Results of this comparison indicate no change in levels of biodiversity, but a statistically significant difference in community structure and increase in macrofaunal density between the two sampling periods. There may also be changes in ecosystem function as

evidenced by changes in trophic types between sapling periods. We examine potential causes of these differences, including changes in environmental parameters. An in depth exploration of the taxonomic composition and dominant taxa of communities during the two sampling periods suggests that organic enrichment may be contributing to the observed changes.

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Velocities and Lagrangian transport estimates from GLAD data clustering at various scales via the Lagrangian assimilation algorithm LAVA.

Presenter: Guillaume Novelli
UM
Authors: M. Berta[1], A. Griffa[1], M. Magaldi[1], A. Poje[2], G. Novelli[3], A. Haza[3], T. Ozgokmen[3], J. Olascoaga[3], M. Iskandarani[3], G. Jacobs[4], E. Coelho[5], B. Lipphardt[6], D. Kirwan[6], A. Mariano[3], H. Huntley[6], E. Ryan[3], F. Beron-Vera[3], B. Haus[3], A. Reniers[3], D. Bogucki[7];
[1]CNR-ISMAR, La Spezia, ITALY, [2]CUNY, New York, NY, [3]UM, Miami, FL, [4]NRL, Stennis Spc. Ctr., MS, [5]UNO, Stennis Spc. Ctr., MS, [6]UD, Newark, DE, [7]TAMU, Corpus Christi, TX.

Abstract:
The GLAD (Grand Lagrangian Deployment) dataset is blended with AVISO velocity fields through LAVA (LAgrangian Variational Analysis), to estimate surface velocities and the Lagrangian transport at various scales in the Gulf of Mexico (GoM). This application is developed in the framework of the CARTHE (Consortium for Advanced Research on Transport of Hydrocarbon in the Environment) project.
The GLAD dataset includes more than 300 drifters deployed in the Deepwater Horizon drilling rig area. For the LAVA application, trajectories are selected through a clustering algorithm. LAVA is here applied in three cases: to correct AVISO velocity field in i) the interior ocean and ii) the shelf and De Soto area; but also iii) to reconstruct the velocity field using only drifters.
Drifters' trajectories compare better with velocities in the interior ocean than in the shelf area due to the lack of details in the AVISO products near coastlines. Nevertheless, when LAVA blended fields are considered, Lagrangian transport estimates are improved from 30% to 50% in the interior ocean and shelf area, respectively. Velocity fields reconstructed from only drifters show an unprecedented look at the submesoscale. This represents a crucial information that can be promptly made available since the drifters' release in case of accidents at sea.

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Presence of Specific Calcareous Nannoplankton Assemblages Along the NE Florida Continental Margin: A Look at Loop Current Eddy Shedding.

Presenter: Jarrett Cruz
Florida State University
Authors: J. W. Cruz[1], A. Agbali[1], A. Avery[1], J. Nienow[2], S. Wise[1];
[1]Florida State University, tallahassee, FL, [2]Valdosta State University, Valdosta, GA.

Abstract:
There have been many hypotheses proposed detailing a variety of different mechanisms to account for the shifting patterns in water-property characteristics occurring annually in the Gulf Of Mexico (GOM). Most of the hypotheses rely heavily on numerical experimentation and long-term, acoustic-based ship-board analysis. Another useful tool may be calcareous nannoplankton, an important protist and large component of the base of the food chain. Their presence along the continental margin off the Florida panhandle provides a biostratographic and geomorphologic toolkit. Specific species, such as Florisphaera profunda, are normally found in oligotrophic waters, deep in the photic zone. When such species are observed outside of their preferred habitat they can signal circulation abnormalities. When warm-core eddy spin-off events are evident in the numerical data, the biological evidence may be helpful in tracing Loop Current Shedding Events back to their origin. We began periodic sampling of the August/November assemblage along three transects across the shelf of the Florida Panhandle in 2011. So far, we have taken over 500 samples through the photic zone via Niskin-bottle rosettes; these are being used to develop a quantitative census of the nannoplankton via scanning electron microscopy. Our goal is to use these data to link specific nannoplankton species to eddy shedding events in order to help gain a better understanding of seasonal fluctuations in GOM water properties.

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The SailBuoy Experiment

Presenter: Nico Wienders
Florida State University
Authors: N. Wienders[1], L. R. Hole[2], D. Peddie[3], M. Hasan[2];
[1]Florida State University, Tallahassee, FL, [2]Norwegian Meteorological Institute, Bergen, NORWAY, [3]CMR Instrumentation, Bergen, NORWAY.

Abstract:
The CMR SailBuoy is an unmanned ocean vessel capable of traveling the oceans for extended periods of time. It navigates the oceans autonomously, transmitting data at regular intervals using the Iridium network for two way communications. The SailBuoy can be used for a wide variety of ocean applications from measuring ocean and atmospheric parameters to tracking oil spills or acting as a communication relay station for subsea instrumentation.
As part of the Deep-C project (Deep Sea to Coast Connectivity in the Eastern Gulf of Mexico), a two month campaign was carried out from March to May 2013 with the purpose of collecting sea surface data (temperature, salinity and oxygen) during the spring bloom. The SailBuoy was deployed south of Cape San Blas, remotely controlled, and sailed for approximately 840nm from the Florida Panhandle to Louisiana. The SailBuoy project is part of Deep-C's physical oceanography component which seeks to, among other things, understand how particles and dissolved substances (such as oil) can travel from the deep sea to the shorelines. This involves cross-shelf transports, upwelling mechanisms, interactions with river plumes.

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A submesoscale eddy field along the Mississippi/Atchafalaya River plume front

Presenter: Robert Hetland
Texas A&M
Authors: R. Hetland;
Texas A&M, College Station, TX.

Abstract:
In summer, seasonal winds cause fresh water associated the Mississippi/Atchafalaya river plume to pool on the Louisiana shelf. During this time, evidence for an energetic submesoscale eddy field that forms along the plume front can be seen in satellite images and hydrographic observations, and is reproduced in numerical simulations of shelf circulation. There is evidence from numerical model simulations that these eddies enhance cross-shelf exchange, are an important factor in exporting fresh water off of the shelf, and could enhance cross-shore transport of an oil slick. The character of stratification over the shelf is investigated using a realistic hydrodynamic model of shelf circulation, and these results show that these eddies are likely formed by baroclinic instabilities, with a Richardson number close to one, similar to surface mixed layer submesoscale eddies. Idealized numerical models are able to qualitatively reproduce the bulk characteristics of the eddy field. Idealized model results are also used to demonstrate the limits of eddy formation; the slope Burger number must be small.

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Modeling of Multi-Phase Environments at the Air-Sea Interface in the Presence of Oil and Dispersants

Presenter: Alexander Soloviev
Nova Southeastern University Oceanographic Center
Authors: A. Soloviev[1], M. McGauley[1], B. Haus[2], D. Ortiz-Suslow[2], N. Laxague[2], B. Hamilton[1];
[1]Nova Southeastern University Oceanographic Center, Dania Beach, FL, [2]University of Miami Rosenstiel School of Marine and Atmospheric Science, Miami, FL.

Abstract:
A multi-phase model of the air-sea interface using the Large Eddy Simulation Volume of Fluid method has been applied for simulating dynamcis of the air-sea interface and microscale process involved in the oil spill breakdown into droplets. The breakdown of a spill due to surface tension effects and turbulence has been reproduced. We have explored a range of wind speeds, up to hurrciane force winds, and cases of the air-water interface with surfactants, thin oil layers and thick oil layers. The numerical simulation has been conducted in parallel with laboratiory experiments at the University of Miami Air-Sea Interaction Salt Water Tank. Coordinated numerical and laboratory experiments help in verification of the model results and their extrapolation to the real ocean. The ultimate goal of this activity is to develop an advanced parameterization of hydrocarbon fluxes, which is based on the air-sea interface microphysics and compatible with the larger scale ocean and atmosphere models.

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Geomorphological and sedimentary characterization of the erosional channels system in Desoto Canyon, Gulf of Mexico, using sub-bottom profiler and multi-beam data.

Presenter: Mauricio Silva
Florida State University
Authors: M. Silva[1], S. D. Locker[2], I. R. MacDonald[1];
[1]Florida State University, Tallahassee, FL, [2]University of South Florida, St. Petersburg, FL.

Abstract:
Sub-bottom profilers (SBP) or chirp sonars are used to obtain information regarding the upper layers of marine sediment. Using SBP data collected during the Deep-C Geomorphology Cruise (June, 2013) on the R/V Weatherbird II, we describe sedimentary layers in a series of large erosional channels located in Desoto Canyon. This information is added to previous multi-beam and backscatter data (Okeanos Explorer, NOAA) and several photo-transects recorded for the same study area. For this purpose, a high-resolution chirp sonar (EdgeTech 2400-Dw-424, 1-10 kHz) was deployed on the MILET tow camera platform, also equipped with an IP still camera, an HD still camera. A series of transects was conducted across the channels using two different surveys modes: 1) MILET kept on a standard altitude (approx. 100 -150 m above the bottom) which provides just SBP record, and 2) MILET 3 m above the bottom in order to conduct the photo survey and recording high resolution SBP data.
Preliminary results of SBP data analysis show a clear and continuous stratification of sediment layers outside of channel between 0 to 20 m. below the sea floor. Two different modes of sedimentation setting inside the channels were found: in some areas sedimentary layers tend to go deeper and get thinner, which may indicate continuous erosion processes probably mediated by currents and gravity flows. In other areas, SBP sections shows an abrupt erosion, showing areas with a complete vanishing of sediment layers, deeper sediment layers get shallower and exposed, and zones with sediment accumulation. A planned campaign of piston core collection will provide more information on the sedimentary history of those features.

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Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Poster 3-74

Interaction Between Geomorphology, Sedimentary Processes, And Circulation - Northeastern Gulf Of Mexico

Presenter: Stan Locker
University of South Florida
Authors: S. Locker[1], N. Wienders[2], I. MacDonald[2], K. Speer[2], P. Hamilton[3], R. Weisberg[1], L. Zheng[1], A. Hine[1];
[1]University of South Florida, St. Petersburg, FL, [2]Florida State University, Tallahassee, FL, [3]Science Applications International Corp., Raleigh, NC.

Abstract:
In support of the Deep-C Consortium efforts to model the fate of oil-spill related contaminants moving through the Desoto Canyon region in the northeastern Gulf of Mexico we have investigated relationships between shelf margin geomorphology using seafloor mapping (bathymetry and backscatter) and circulation studies. The physical oceanographic component is concerned with transfer of material on and off the shelf. The geomorphology component includes an assessment of bathymetry for the circulation modeling, and the association of bottom types and sedimentary processes. A variety of sediment accumulation and transport pathways are indicated by the relationship between bathymetry and backscatter. Large sand dunes that flank the base of shelf-break slope reflect long-term sediment transport related to current intensification along the slope. Low-gradient seafloor along the base of the margin exhibits fine-grained mud accumulation. More energetic conditions influence sedimentation along the shelf margin and landward. Small shelf-break canyons act as sediment traps. We examine the relationships between the patchiness in sediment accumulation patterns and current flow patterns established from circulation modeling.

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Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Poster 3-75

Experiments In The Near-Surface Ocean Layer

Presenter: Guillaume Novelli
University of Miami
Authors: G. Novelli, R. Pennel, D. Ortiz-Suslow, N. Laxague, C. Smith, T. Özgökmen, A. Reniers;
University of Miami, Miami, FL.

Abstract:
Observations and measurements of the upper ocean currents are crucial for our understanding of transport of near-surface material, such as oil and fish larvae, but also to validate ocean models and assimilate data into them. The interface between the atmosphere and the ocean is subject to a high variability at many spatial and temporal scales, which makes it challenging to obtain synoptic and precise velocity measurements.
In this study, we target the upper 1-meter of the ocean. The experiments consist of tracking several types of surface Lagrangian drifters during successive short deployments (less than 30 minutes), combined with simultaneous CTD casts, wind, waves and Eulerian current measurements. This way we obtain a comprehensive view of the sea surface vertical velocity profile in a small area, working around the limitations of each instrument alone. We repeat this strategy under different wind conditions at diverse locations in both coastal and open ocean areas, to sample representative sea states.
As a result of these observations, we identify a variety of vertical structures of the surface currents and their consequences in terms of transport.

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Type: Poster 3-76

Phytoplankton associations in the northeastern Gulf of Mexico: Changes in the association with depth

Presenter: James A Nienow
Valdosta State University
Authors: J. A. Nienow[1], A. V. F. Nienow[1], C. M. Bryller[1], M. N. Waters[1], S. Wise[2];
[1]Valdosta State University, Valdosta, GA, [2]Florida State University, Tallahassee, FL.

Abstract:
We are conducting a multi-year study of phytoplankton in the vicinity of DeSoto Canyon, northeastern Gulf of Mexico, as part of a larger project aimed at assessing the potential transport of bottom water (and oil) up the canyon and possible impacts this transport on the local ecosystem. Here we report on observed changes in the structure of the phytoplankton with depth, with an emphasis on comparisons between surface population and those found in the deep chlorophyll maximum (DCM). Samples were collected from 15 stations along three transects extending up to 80 km from the coast during cruises in June and September, 2013. At each station 1-liter samples were collected at regular intervals to depths of up to 200 m, with additional 8-liter samples collected from the surface and from the DCM. 1-liter samples were filtered onto 0.45 µm nitrocellulose filters and air-dried; estimates of the numbers of diatoms, coccolithophorids, and armored dinoflagellates were made at the species level, where possible, using SEM. 8-liter samples were filtered onto glass fiber filters and frozen; the filters were later extracted and the pigments analyzed using HPLC. The results from both techniques indicate that the composition of the DCM, when present, is distinctly different from the surface association, with a mixture of shallow and deep water species. Contrary to expectations, surface waters in June contained higher concentrations of degradation products than the DCM.

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Satellite Imagery Derived Near-Surface Flow in the Northern Gulf of Mexico

Presenter: Haoping Yang
University of Southern Mississippi
Authors: H. Yang[1], R. Arnone[1], J. Jolliff[2];
[1]University of Southern Mississippi, Stennis Space Center, MS, [2]Naval Research Laboratory, Stennis Space Center, MS.

Abstract:
Ocean surface currents are retrieved from NPP satellite imagery in the Northern Gulf of Mexico to demonstrate the utility of improved maximum cross correlation (MCC) techniques. Time-lapsed sequential images are smoothed by low-pass filter to reduce noise and then used to find the advections of ocean color and thermal near-surface features by locating the correlation peaks in windowed patterns of image pairs. Multiple post-processing filters are applied to eliminate fictitious vectors. The sensitivities of solution to the influence of various constraints are examined. The MCC velocities are compared among the products obtained from different types of satellite overpasses, as well as with the vector arrays provided by ADCP and CODAR. The common features and differences are summarized and discussed together with the underlying mechanisms between the movement of water masses and the dynamical re-

distribution of bio-optical properties. Products are also evaluated by estimating the velocity errors in a series of BIOCAST experiments loaded with synthetic current vectors and by comparing the velocity outputs of a numerical model directly with the MCC velocities independently derived from its own sequential snapshots. MCC derived velocity fields are usually sparse and provide poor spatial coverage. To improve this situation, we combine the MCC velocities with those estimated by Optical Flow algorithm. Particularly, several methods are attempted to merge these two different types of velocity fields. One method applies a simple model with weighted-averaging techniques. A second method uses a flow decomposition and reconstruction procedure with simplified open boundary conditions to obtain synthetic velocities in the entire domain.

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High resolution flux measurements of methane and carbon dioxide reveal the influence of the depth of release on emission rates to the atmosphere

Presenter: Mengran Du
Texas A&M University
Authors: M. Du[1], S. Yvon-Lewis[1], D. Valentine[2], S. Mendes[2], J. Kessler[3];
[1]Texas A&M University, College Station, TX, [2]University of California, Santa Barbara, Santa Barbara, CA, [3]University of Rochester, Rochester, NY.
Abstract:
While insignificant quantities of methane were found to be released to the atmosphere during the Deepwater Horizon disaster, natural gas released from future spills at shallower water depths may have a different fate. In order to test the influence of the depth of seafloor emission on methane flux to the atmosphere, we measured methane and carbon dioxide concentrations with high spatial and temporal resolution in the surface waters of the massive natural seep field near Coal Oil Point (COP), California. This natural seep field aggressively emits methane at depths ranging from 5 m to 70 m. Methane and carbon dioxide concentrations were continuously recorded with an integrated equilibrator (EQ) and Cavity Ring-down Spectrometer (CRDS) system during an expedition in September 2011. Comparing the diffusive air-sea flux of methane with seafloor depth indicates significant air-sea fluxes where the water depth is shallower than 150 m, and insignificant air-sea fluxes from deeper areas. The total sea to air emission rate (direct bubble injection and indirect diffusion from dissolved methane) constitutes 42% of the rate of methane release at the seafloor; the remainder of the released methane was dispersed in ocean waters with an ultimate fate of either microbial oxidation or emission to the atmosphere outside of the area surveyed. However, within the area surveyed, the air-sea flux of carbon dioxide did not appear to be significantly influenced by methane oxidation processes.

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Type: Poster 3-79

Deep Sea Hydrocarbon Seep Surveys using AUVs

Presenter: Arne R Diercks
University of Southern Mississippi
Authors: A. R. Diercks[1], V. Asper[2], R. Jarnagin[1], M. Woolsey[1], M. D'Emidio[3], S. Tidwell[3], C. Dike[2], A. Conti[4];
[1]University of Southern Mississippi, Abbeville, MS, [2]University of Southern Mississippi, Stennis Space Center, MS, [3]University of Mississippi, University, MS, [4]University of Rome, Rome, ITALY.
Abstract:
Data of the combined work of NIUST's two deep sea AUV's collected during ECOGIG cruises in 2012 and 2013, funded by the Gulf of Mexico Research Initiative (GOMRI) at sites MC297, AT357 and GC600 aboard the R/V Pelican will be presented at the meeting. The Eagle Ray AUV, a 2200m deep water Explorer class mapping autonomous underwater vehicle, accomplished during these cruises 7 full length dives to a record depth of 1633 m. Multibeam Echo Sounder and Sub Bottom Profiler data were recorded along several hundred km of combined line length, covering a combined area of ~95 km2 at spatial pixel resolutions of 1m or less. Mola Mola, a 2000m rated SeaBed class AUV, acquired over 20,000 images on its missions with a pixel resolution of 1.5 mm, covering several thousand square meters. We will discuss the approach of using two different autonomous underwater vehicle types, deployed in sequence and in parallel, to collect acoustic and photographic data aimed at understanding the process of natural oil and gas seeps in the deep Gulf of Mexico.

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The interaction of Alcanivorax Borkumensis with carbon black stabilized emulsions

Presenter: Michelle Bookstaver
Brown University
Authors: M. Bookstaver[1], M. Godfrin[1], A. Bose[2], A. Chauhan[3], M. Levine[2], A. Tripathi[1];
[1]Brown University, Providence, RI, [2]University of Rhode Island, Kingston, RI, [3]University of Florida, Gainesville, FL.
Abstract:
Alcanivorax borkumensis is a known hydrocarbon-degrading microorganisms found in crude-oil-containing seawater. Although it is found in small amounts in non-polluted water, it is more common in polluted water. A.B. is a surface bacteria meaning it has a large degree of interaction with the oil/water interface. Because of this characteristic and the prominence in oil contaminated water, A.B. has been studied as a bioremediation molecule.
Recent work has investigated the use of carbon black particles to create stable oil in water emulsions. Carbon black is regarded as a safe (GRAS) surfactant to sea life. It is used to contain the oil in the most efficient way possible so that the bacteria have enough time to degrade the oil molecules. It is desirable to determine what impact carbon black has on these oil eating bacteria. Because the bacteria also create their own biosurfactants, it is necessary to see what the interaction is between the bacteria and the carbon black stabilized oil in water emulsion.
We have studied the interaction of bacteria with carbon black stabilized oil in water emulsions. We present the effect of the carbon black on the bacteria's ability to propagate and use the oil as its carbon source. The interaction between the bacteria's surfactant and the carbon black stabilized emulsion is also explored

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A new technique to derive dissipation of temperature variance from infrared images at the ocean surface

Presenter: Fabio L Augusto
Texas A&M - Corpus Christi
Authors: F. L. Augusto[1], D. Bogucki[1], K. Arnott[1], N. Laxague[2], B. Haus[2], A. Reniers[2], T. Ozgokmen[2], P. Polito[3];
[1]Texas A&M - Corpus Christi, Corpus Christi, TX, [2]University of Miami, Miami, FL, [3]University of Sao Paulo, Sao Paulo, BRAZIL.
Abstract:
Air-sea interaction plays a major role in weather, climate and ocean dynamics. In the interface between these two fluids, the near surface turbulence acts in the exchange of mass, energy and momentum. Although near surface turbulence is a key parameter, measurements in the surface of the ocean are hard to achieve because of the vertical mobility of the ocean surface, wave breaking and the inertia of the equipment used to make this kind of measurements. A new technique is proposed to quantify dissipation of temperature variance using plan view infrared images of the sea surface. The dimensions of these images is 2.090 meters height (x) by 1.193 meters width (y). The images of the infrared camera can be analyzed in physical and spectral spaces. The spectral analysis was performed using the Fourier Transform of the images. The original height by width dimensions was converted to wavenumbers in these both directions. The analysis of temperature dissipation in physical space was achieved by calculating gradient with respect to x and y of temperature between each pixel and its closest neighbors. The results may be used to infer the vertical structure of near surface turbulence and examine short surface waves. This new technique can be performed with high resolution cameras and avoid the laborious deployment of sensors and profilers in the ocean. Eventually, these accomplishments will be used to make a more accurate air-sea gas transfer estimates.

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Type: Poster 3-82

Real-Time Coupled Ocean-Atmosphere-Wave Simulations in the Gulf of Mexico

Presenter: Patrick J Hogan
Naval Research Laboratory
Authors: P. J. Hogan[1], T. A. Smith[1], T. Campbell[1], P. Thoppil[1], E. Chassignet[2];
[1]Naval Research Laboratory, Stennis Space Center, MS, [2]Florida State University, Tallahassee, FL.

Abstract:
Results from the U.S. Navy's Coupled Ocean-Atmosphere Mesoscale Prediction System (COAMPS) are presented. This system includes the COAMPS atmosphere, SWAN wave model, NCOM ocean model, and NCODA (ocean) and NAVDAS (atmosphere) data assimilation systems. Recent improvements to the system include increasing the resolution of the atmosphere from 6 km to 4 km, addition of the wave to ocean coupling, decoupling of the atmosphere/ocean assimilation update cycles, and host-forcing by the global GOFS system (ocean) and NAVGEM system (atmosphere The 4 km atmosphere includes sophisticated microphysics for cloud parameterization and results in well-resolved coupled ocean-atmosphere processes. The wave and ocean models are 3 km resolution. The system was initialized from the global NCOM model on 07 August 2012, runs in real-time, and produces up to a 72 hour forecast every 24 hours.
Details of the system are discussed, including observations, the system components, and the data assimilation. Comparisons between the 3 km coupled system and a 3 km non-coupled system (also based on NCOM) are discussed. A hindcast covering the DWH time frame is discussed in the context of system verification and validation. The impact on the ocean response by including/excluding the wave coupling is contrasted during and after Hurricane Issac (28 August 2012). Both surface and subsurface ocean circulation features are compared to available observations.

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Effects of dispersant application on oil contamination of sub tidal sediments: A meta-analysis.

Presenter: Sophie M Vonk
University of Wageningen
Authors: S. M. Vonk[1], W. Koops[2], N. Davaasuren[3], A. J. Murk[1];
[1]University of Wageningen, Wageningen, NETHERLANDS, [2]University of Applied Sciences, Leeuwarden, NETHERLANDS, [3]Institute for Marine Resources and Ecosystem Studies, Den Helder, NETHERLANDS.

Abstract:
During the Deepwater Horizon (DwH) oil spill, an unexpected thick layer of persistent toxic deposits was found on the deep seabed. It was hypothesized that dispersants applied had induced algae to produce great amounts of marine snow . In combination with particulate matter, this facilitated the concentration of oil in the sediments. It is unknown whether this effect also occurred in historical large oil spills under the same conditions of high densities of phytoplankton and particulate matter and dispersant application. We will present the results of a meta-analysis of historical oil spills, to investigate the role of chemical dispersants enhancing deposition of oil. Of all oil spills reviewed, 52 were > 10 000 t. Subtidal sediment studies were conducted in 26 spills and contamination was reported for 24 of these spills. Four sedimentation mechanisms were distinguished: (1) shore erosion; (2) interaction of oil with particles; (3) (changing) physical properties of oil; and (4) interaction of oil with organisms. No reports were found on enhanced marine snow formation or sedimentation rates. Based on GIS-based chlorophyll densities and reported dispersant application, a number of spill sites were identified where large deposits of oily toxic sediments could be expected as well. A sediment survey at selected sites could provide further information on the mechanism of oil sedimentation and short and longer term developments to be expected in the Gulf of Mexico DwH spill site.

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Numerical Investigation of Ambient Flow Effect on Oil/Gas Spill in Deep Water

Presenter: Youhei Takagi
Osaka University
Authors: Y. Takagi[1], S. Kawahara[2], T. Ban[1], Y. Okano[1], N. Kato[2];
[1]Osaka University, Toyonaka, Osaka, JAPAN, [2]Osaka University, Suita, Osaka, JAPAN.

Abstract:
We propose the new tracking system of spilled oil and gas (SOTAB project). This project consists of the measurements with buoy robots and numerical simulation, and experimental and numerical data are utilized mutually to improve the tracking precision. In this paper, we investigated the precision of numerical model for deep water spill and discussed the ambient flow effect on oil and gas spills in deep water. The main solver of tracking plume structure arising from seabed adopted Lagrangian control volume and Lagragin particle tracking methods. The conservations of momentum, heat and mass were considered in each control volumes and methane gas hydration was also implemented. The temperature, salinity and pressure were given to the solver at each depth level and velocity distribution of ambient water was the ocean models of POM and HYCOM. The scenarios of oil and gas spill were considered for the Gulf of Mexico and the Japan Sea. Firstly, we validated these ocean models. The computation domain in the horizontal direction was limited to reduce numerical cost and boundary condition at inlet/outlet of ocean current affected internal flow field. The proper boundary condition and sufficient grid resolution were assessed and fully developed ocean current was predicted qualitatively. Then, by using the current data, oil and gas tracking simulations were conducted. The horizontal diffusion of spilled oil and gas was strongly depended on temporal change of ambient flow, on the other hand, the vertical concentration of methane gas was affected by the physical and chemical modeling of methane hydration.

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Online monitoring of mineral oil biodegradation at high pressure

Presenter: Ana Gabriela Valladares
Hamburg University of Technology
Authors: A. Valladares[1], M. Schedler[1], H. Kadimesetty[1], G. Gust[1], D. Achatz[2], M. Finck[3], R. Mueller[1];
[1]Hamburg University of Technology, Hamburg, GERMANY, [2]PreSens - Precision Sensing GmbH, Regensburg, GERMANY, [3]Eurotechnica, Bargteheide, GERMANY.

Abstract:
Bacteria play a major role in the degradation of petroleum in marine spills. Deep-sea, high-pressure environments such as the DWH well, can be mimicked in our laboratory using reactors that withstand pressures of up to 400 bar. Some of these reactors have a glass or sapphire pressure-resistant window that allows their interiors to be viewed. In order to quantify the extent of petroleum biodegradation, it is necessary to measure one or more of these parameters: bacterial, oxygen, carbon dioxide or oil concentration. Because of the hydrophobic nature of the oil, at least two immiscible phases appear when mixed with seawater and sediments, making it impossible to sample the system representatively. It is also not possible to sub-sample reactors without depressurizing them. Therefore the online measuring of the O2 and CO2 parameters via the transparent window of the reactor was chosen as correlation to the amount of degraded oil. Using the Fibox 3 oxygen sensor and the VisiSens system (Presens, Regensburg), degradation of oil and of methane have been measured using different bacterial isolates and marine sediments as inocula. Online monitoring of O2 and CO2 thus provides insight into biodegradation in a simulated deep-sea environment. Future work will be done on monitoring the oil concentration online by fluorometry.

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Inertial particle dynamics in the ocean

Presenter: Maria J Olascoaga
RSMAS-U.MIami
Authors: M. J. Olascoaga[1], F. J. Beron-Vera[1], J. Trinanes[2], G. Haller[3];
[1]RSMAS-U.MIami, Miami, FL, [2]CIMAS-U.Miami, Miami, FL, [3]ETH, Zurich, SWITZERLAND.

Abstract:
Observations appear to indicate a tendency of buoyant material in the ocean to cluster within coherent material eddies revealed from altimetry data. The buoyant material includes drifting buoys, sargassum, and chlorophyll. We consider inertial (finite-size and buoyancy) effects on the motion of particles advected by altimetry-derived velocities in an attempt to provide an explanantion for the observed behavior.

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Sorption/desorption of polycyclic aromatic hydrocarbons with Gulf Coast marine sediments: Effects of oil dispersant, oil, temperature and pressure

Presenter: Xiao Zhao
AUBURN UNIVERSITY
Authors: X. Zhao[1], Y. Gong[1], Z. Cai[1], S. O'Reilly[2], D. Zhao[1];
[1]AUBURN UNIVERSITY, AUBURN, AL, [2]Bureau of Ocean Energy Management, New Orleans, LA.

Abstract:
This work investigated effects of dispersant Corexit EC9500A and dispersed oil on sediment sorption/desorption of model polycyclic aromatic hydrocarbons (PAHs), naphthalene and pyrene, under simulated Gulf coast surface and deepwater conditions. Batch tests showed that the dispersant at 18 mg/L enhanced naphthalene and pyrene uptake by ~3% and 18%, respectively; and the presence of the dispersant during desorption hindered desorption of the PAHs and resulted in a desorption hysteresis. The presence of oversaturated oil (1 g/L) and water accommodated oil (prepared at oil:water=1:200)increased naphthalene uptake by 5% and 3%, respectively, and the presence of dispersant further increased the PAH uptake by ~2%. The same hysteretic effect of the dispersant on PAH desorption was observed in simulated deepwater conditions (4 °C and 160 atm). In all cases (22 °C+1 atm, 22 °C+160 atm, 4 °C+1 atm, or 4 °C+160 atm), increasing the initial dispersant concentration nearly linearly enhances the naphthalene uptake. However, the extent of enhancement varies remarkably with temperature and pressure. While the deepwater low temperature enhances uptake of PAHs, the high pressure reduces the sorption. Overall, the temperature effect outweighed the pressure effect, resulting in an elevated PAH uptake under deepwater conditions than under surface water conditions. This information is useful for understanding roles of dispersants on the fate and transport of petroleum PAHs in marine systems.

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Subsurface Turbulence Measurements During GLAD Experiment

Presenter: Darek Bogucki
Texas A&M University-Corpus Christi
Authors: D. Bogucki[1], K. Arnott[1], N. Laxague,[2], B. Haus[2], A. Reiners[2], A. Soloviev[3], F. Leke[1];
[1]Texas A&M University-Corpus Christi, Corpus Christi, TX, [2]University of Miami/RSMAS, Miami, FL, [3]Nova Univeristy, Miami, FL.
Authors: D. Bogucki[1], K. Arnott[1], N. Laxague,[2], B. Haus[2], A. Reiners[2], A. Soloviev[3], F. Leke[1];
[1]Texas A&M University-Corpus Christi, Corpus Christi, TX, [2]University of Miami/RSMAS, Miami, FL, [3]Nova Univeristy, Miami, FL.

Abstract:
As a part of the the Grand LAgrangiand Deployment (GLAD) we have collected field data collected aboard the R/V F.G. Walton Smith in the Northern part of the Gulf of Mexico in the Summer of 2012. In the experiment we have carried out nearsurface (in the 0.1m- 2 m) measurements of the turbulent kinetic energy (TKE) and the temperature dissipation (TD). We have observed distinct TD vertical structure such that TD is relatively constant within the wave affected part of the water column (a~0.3 m) followed by a dissipation scaled sublayer TD~z^(-1/2) with an underlying wall like sublayer TD~z (-1). The TD vertical profiles are compared to TKE profiles. The subsurface horizontal variability of TD during 5 km long transect exhibits large changes, varying by 2 orders of magnitude from 10^(-3)degC^2/s to 10^(-5)degC^2/s. The horizontal TKE variability exhibited variability on the scale of 100m possibly related to submesoscale structures. In the presentation we discuss the observed turbulent variability in the context of turbulent dispersion and remote sensing.

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Impact of Submesoscale Flows on Particle Distributions in a Gulf of Mexico Star Eddy.

Presenter: Angelique C Haza
RSMAS / University of Miami
Authors: A. C. Haza[1], T. M. Ozgokmen[1], A. Poje[2], G. Jacobs[3], P. Hogan[3], H. Huntley[4], B. Lipphardt[4], A. Kirwan[4], M. Olascoaga[1], F. Beron-Vera[1], E. Coelho[3];
[1]RSMAS / University of Miami, Miami, FL, [2]CUNY, Staten Island, NY, [3]NRL, Stennis Space Center, MS, [4]University of Delaware, Newark, DE.

Abstract:
Mixed-layer frontal instabilities are one of the leading mechanisms for submesoscale flows (SMF). Since some of these fronts coincide with the edges of eddies, mesoscale transport barriers, traditionally identified using Lagrangian coherent structures (LCS) are likely to be affected by SMF. The impact of SMF on particle distributions is investigated by releasing particle-based tracers in an anticyclonic eddy simulated by a 1-km resolution HYCOM of the Gulf of Mexico. Comparison with mesoscale control is done by filtering the model

velocity field and/or the sea surface height field as a proxy for satellite-based altimetric data. Results indicate that while the flow is steered in the general direction imposed by the mesoscales, the concept of transport barriers breaks down since SMF allow the tracer to cross them via the more transient submesoscale LCS.

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Texas-Louisiana shelf connectivity and time variability using particle tracking

Presenter: Kristen M Thyng
Texas A&M University
Authors: K. M. Thyng, R. D. Hetland;
Texas A&M University, College Station, TX.

Abstract:
A large concern with surface slicks of oil in the Gulf of Mexico is determining how much oil will reach the shoreline. We address this question for the Texas-Louisiana shelf using process studies in a high resolution numerical circulation model run in the Regional Ocean Modeling System (ROMS). Using numerical surface drifters run with the TRACMASS tracking algorithm, we examine the connectivity of several bays with nearby waters on multiple time scales as well as connectivity across the shelf, all of which will directly impact oil transport. Additionally, we examine the dependence of these results on seasonal and interannual variabilty, particularly with respect to wind patterns, which largely control the dynamics on the inner shelf. Metrics used to evaluate connectivity and transport include the Lagrangian probability density function and dispersion statistics. Results show distinct behavior between summer and non-summer behavior.

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Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Poster 3-91

Interactions between dispersants, dispersed oil and suspended sediment particles and their effects on particle settling and contaminant transport

Presenter: Zhengqing Cai
Auburn University
Authors: Z. Cai, Y. Gong, X. Zhao, J. Fu, D. Zhao;
Auburn University, Auburn, AL.

Abstract:
Sediments serve as important sinks for persistent oil components (e.g., polycyclic aromatic hydrocarbons, PAHs) and interact with oil dispersants and dispersed oil. Using three model dispersants (Corexit EC9500A, Corexit 9527 and SPC 1000) and four model sediments, this study investigated effects of the dispersants and dispersed oil on the settling properties of suspended sediment particles under various environmental conditions. The results showed that all dispersants significantly accelerated the settling velocity of the sediments at neutral or alkaline pH, and the effects were more profound for sediments of a higher organic matter content. The nonionic surfactants (Tween 80 and Tween 85) in the dispersants played most critical roles for the enhanced settling rate. While increasing salinity in seawater remarkably increased sediment settling, the effect was alleviated in the presence of the dispersants. Combining the dispersant with humic acid showed synergistic acceleration of the settling velocity. The dispersant effect on sediment settling became less significant at the simulated deepwater temperature (4 °C). The presence of dispersed oil remarkably increased the settling rate. While all sediments were able to adsorb the dispersants, sediments of higher organic content offered much greater sorption capacity. The presence of dispersants and dispersed oil transferred more PAHs to the sediment phase and inhibited desorption of PAHs, which prolongs the transformation of PAHs.

Session: 003
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Poster 3-92

The Influence of Sulfate Availability and Gas Concentration on the Oxidation of Short Chain Alkanes

Presenter: Ryran Sibert
University of Georgia
Authors: R. S. Sibert, K. Hunter, S. B. Joye;
University of Georgia, Athens, GA.

Abstract:
Short-chain alkanes such as methane, ethane, propane, and butane are common constituents of natural gas mixtures found in organic-rich marine sediments. These alkane-rich gas mixtures comprise a large portion of the labile organic carbon pool, particularly in deep-seafloor sediments, likely linking microbial degradation of these gases with other biogeochemical processes. While there is a substantial body of work focused on the anaerobic oxidation of both methane (i.e., C1; anaerobic oxidation of methane) and longer-chain alkanes (>C6), there is much less information available on the fate of C2 - C4 (i.e. ethane, propane, and butane) in the environment. Recent enrichment studies of Guaymas Basin, Gulf of Mexico, Juan de Fuca flanking sediments have documented that oxidation of short-chain alkanes (C1 - C4) occurs over a wide range of temperatures and suggests that their oxidation is mediated by sulfate-reducing deltaproteobacteria. The role of sulfate availability and alkane partial pressure on alkane oxidation rate has yet to be explored. Therefore, we examined these factors in sediments from an active oil/gas seep in the Gulf of Mexico. Anaerobic alkane oxidation rates were strongly regulated by alkane concentration but sulfate is not the only electron acceptor capable of supporting alkane oxidation in these sediments.

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Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Poster 3-93

Deepwater variability as seen by the GISR mooring array

Presenter: Joe Kuehl
Geochemical and Environmental Research Group, Texas A&M University
Authors: J. Kuehl[1], L. Spencer[2], S. DiMarco[3], N. Guinasso[1], C. Nygren[2];
[1]Geochemical and Environmental Research Group, Texas A&M University, College Station, TX, [2]Texas A&M University, College Station, TX, [3]Texas A&M University, Geochemical and Environmental Research Group, College Station, TX.

Abstract:
Beginning in early July 2012, the GISR consortia deployed six moorings in the vicinity of the Deepwater Horizon spill site (M1 28.5N 88.5W, M2 28.75N 88.75W, M3 28.75N 88.25W, M4 28.5N 89.0W, M5 28.25N 88.75W, M6 28.0N 89.0W, approximately). While each mooring spans most of the water column, the primary objective of this mooring array was to characterize the deep variability along the Louisiana slope, in support of both near-field plume modeling efforts and a deep tracer release experiment.
Bottom intensification of currents was observed with significant energy trapped within 400m of the bottom. Current oscillations in this lower portion of the water column were observed at 1, 4, 8, and 20 day periods, in addition to some semi-diurnal energy at the shallower moorings (M2, M4). Inertial band bottom currents display 5-10 cm/s amplitudes with peaks near 15-20 cm/s, while sub-inertial bottom currents are slightly more energetic, 10-15 cm/s amplitudes and peaks near 20-25 cm/s. Total bottom current variability of amplitude 15-25 cm/s with peaks between 25-35 cm/s varying on inertial time scales may affect plume and subsurface intrusion development.
The wide range of time scales and bottom trapping strengths indicates a variety of dynamical mechanisms are at work in the region. Initial interpretation of the data will consider topographic Rossby waves, resonant internal waves and fundamental current instabilities to explain the observations, in addition to standard statistical analysis.

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Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
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A new experimental module for the investigation of deep-sea oil spills under in-situ conditions

Presenter: Karen Malone
Hamburg University of Technology
Authors: K. Malone, K. Laqua, J. Schmidt, D. Krause, M. Schlueter, G. Gust;
Hamburg University of Technology, Hamburg, GERMANY.

Abstract:
Many details of the behavior of the hydrocarbon particles released in the DWH oil spill are as yet unknown, especially with regard to the influence of the deep-sea nature of the spill on this behavior. Within the C-IMAGE consortium, Hamburg University of Technology experimentally investigates the hydrodynamic behavior of hydrocarbons under artificial deep-sea conditions, i.e. at high pressure (15

MPa) and low temperature (4 °C).
For this purpose, a new experimental module for the existing high-pressure lab facilities has been developed. This “Jet Module” (JM) enables the generation of single gas bubbles and oil droplets of different diameters from several millimeters to the sub-millimeter range as well as single- and multiphase jets surrounded by seawater with adjustable phase composition, volume flow and exit velocity. To meet with the rising system complexity of the experiments in proceeding from single particles via single-phase jets to multi-phase jet of oil, gas, water and gas hydrates, the JM is accordingly realized in those three stages of jet composition.
After determination of the rising velocities of single methane bubbles as first stage, the second stage of the module has now been reached for the determination of particle size distributions (PSD) of single-phase oil and gas jets and local velocities. A new endoscopic technique is used for on-line analysis of the PSD in the jet. The influences of pressure, temperature and dispersants are investigated.

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Estimating uncertainties of Lagrangian trajectory and Lagrangian Coherent Structure using ensemble in the GOM

Presenter: Mozheng Wei
Naval Research Laboratory
Authors: M. Wei[1], G. Jacobs[1], C. Rowley[1], C. N. Barron[1], P. Martin[1], P. Spence[2], P. Muscarella[3];
[1]Naval Research Laboratory, Stennis Space Center, MS, [2]QinetiQ-North America, Stennis Space Center, MS, [3]ASEE Post doc at NRL, Stennis Space Center, MS.

Abstract:
The US Navy’s RELO ensemble system with 32-member and 3-km resolution is used to provide probabilistic forecasts and uncertainty estimates in the GOM in the summer of 2012. It is shown that ensemble mean is more superior to the single deterministic forecast in terms of accuracy and skill. The ensemble provides not only the most likely Lagrangian trajectory for particles in ocean, but also the uncertainty estimates that directly reflect the complicated ocean dynamics. The examples show that the calibrated ensemble with more reliability can capture trajectories in different, even opposite, directions, which would be missed by the un-calibrated ensemble. Repelling and attracting Lagrangian coherent structures (LCSs) which have major impacts on the ocean tracer dispersion such as oil spills in the GOM are computed. The uncertainties of LCSs are assessed using the ensembles. The impacts of ensemble spread and model resolutions on Lagrangian predictability are studied. The repelling and attracting LCSs are found to intersect at many locations and create complex mesoscale eddies and barriers. As a result, the movements of particles near the Deepwater Horizon location are severely limited.

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Oil Spill Forecast in the Gulf of Mexico Using a High Resolution Coupled Ocean-Atmosphere Model

Presenter: Raffaele Montuoro
Texas A&M University
Authors: R. Montuoro, J. Kurian, P. Chang, R. Saravanan;
Texas A&M University, College Station, TX.

Abstract:
The challenge of providing both prompt and accurate forecasts of oil spills has presented itself since the Deepwater Horizon incident in 2010. Traditionally, ocean-only models have been used for oil spill forecasting. This approach relies on the accuracy of available weather forecast products that provide surface forcing to drive ocean forecast models. Currently available weather forecast products for the Gulf of Mexico have spatial resolutions ranging from 12 km (regional forecast) to 30 km (global forecast) and temporal resolution of 3 to 6 hours. At these resolutions, the forcing does not fully resolve rapid developing storm systems in the Gulf, nor does it include meso-to-frontal scale ocean-atmosphere interactions associated with intense storms.
In this talk, we will present the results of forecasts obtained using a high-resolution coupled ocean-atmosphere model that explicitly resolves convection and rapid air-sea exchange processes. We will compare the coupled model forecast with ocean-only model forecast (with the same ocean component of the coupled model) forced with surface fields derived from such weather products as NOAA’s North American Mesoscale (NAM) Forecast Model. Attention will focus on differences in tracer spread and diffusion both at the surface and near the bottom of the Gulf, as well as in the mixing rate occurring between the surface and below the thermocline as Hurricane Isaac passes over oil patches in relatively shallow waters. Model forecasts will also be validated against field observations collected during Hurricane Isaac.

Session 004: Integrated Understanding of the Impacts of the DWH Oil Spill on Fisheries: Exposure Vectors, Biological-Physiological Effects and Abundance of Fisheries Populations

Session: 004
Date: Monday, January 27 - 10:00 AM
Room: Bon Secour Bay II
Track: Integrated Understanding of the Impacts of the DWH Oil Spill on Fisheries: Exposure Vectors, Biological-Physiological Effects and Abundance of Fisheries Populations
Type: Oral

Polycyclic aromatic hydrocarbons in fish: 2 years after the DWH oil spill

Presenter: Isabel C Romero
University of South Florida
Authors: I. C. Romero[1], D. J. Hollander[1], W. F. Patterson[2], S. W. Ross[3], A. S. Kane[4], S. Murawski[1], E. Quintana-Rizzo[1], E. A. Goddard[1], J. J. Torres[1];
[1]University of South Florida, St Petersburg, FL, [2]University of South Alabama, Dauphin Island Sea Lab, AL, [3]University of North Carolina at Wilmington, Wilmington, NC, [4]University of Florida, Gainesville, FL.

Abstract:
Spatial and temporal variability in polycyclic aromatic hydrocarbons (PAHs) of tissue (liver, muscle) sampled from reef and mesopelagic fishes in the northern Gulf of Mexico were used to assess biological uptake and impacts of the Deepwater Horizon oil spill (DHOS). Mesopelagic fishes sampled during 2007 indicated a baseline level of muscle PAH concentrations of 0.3-1.3 µg/g dry wt, which increased in 2010 and 2011 up to 10-fold. Similarly, reef fishes sampled during summer 2010 indicated a baseline level of liver PAH concentrations about 0.3 µg/g dry wt, which increased in fall 2010 and in 2011 up to 20-fold. Furthermore, high variance was observed in each post-DHOS period sampled, indicating large differences among and within reef species related to trophic position. PAH levels (mean ± sd) observed post-DHOS in 2010 (4.1±10.9 µg/g dry wt, range: 0.2-50.9 µg/g dry wt) and 2011 (4.9±11.4 µg/g dry wt, range: 0.9-74.2 µg/g dry wt) were on average higher than the established threshold PAH levels for adverse biological effects (4.0 µg/g dry wt). Results suggest that both fish populations were exposed to hydrocarbons after DHOS. Mechanisms explaining elevated PAH concentrations and composition, relationships to trophic position, and PAH levels from 2012 are discussed.

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Type: Oral

Tracing Persistent Exposure Of Burrow-forming Fishes To Oil Contamination Following The Deepwater Horizon Blowout

Presenter: Susan M Snyder
University of South Florida
Authors: S. M. Snyder[1], E. Pulster[2], I. C. Romero[1], H. Ramirez[3], D. Wetzel[2], D. Hollander[1], S. A. Murawski[1];
[1]University of South Florida, St Petersburg, FL, [2]Mote Marine Laboratory, Sarasota, FL, [3]Eckerd College, St Petersburg, FL.

Abstract:
Subsequent to the Deepwater Horizon blowout, sediment cores revealed oil on the northern Gulf of Mexico seafloor. The interaction between oil, sediments, and the health of infaunal fishes, at present, is poorly understood. Using biomarkers of exposure, this study evaluates temporal and spatial differences in exposure to hydrocarbon contamination between two burrow-forming species, golden tilefish (Lopholatilus chamaeleonticeps) and king snake eel (Ophichthus rex) and a demersal, non-burrow-forming species, red snapper (Lutjanus campechanus).
Bile, sediment cores and biometric data were collected from longline and coring surveys in the northern Gulf between 2011-2013. Biliary polycyclic aromatic hydrocarbon (PAH) metabolites of naphthalene, phenanthrene and benzo[a]pyrene were quantified using high-performance liquid chromatography with fluorescence detection (HPLC-F). Preliminary results reveal that tilefish have higher levels of the low molecular weight (LMW) PAHs (naphthalene, phenanthrene) compared to king snake eel and red snapper, in which LMW PAHs appear to be declining over time. The persistent higher levels of biliary PAHs in tilefish may be indicative of their burrowing lifestyle, in which they bioturbate potentially contaminated sediments, with their body and mouth, while maintaining large funnel-shaped burrows. Future studies include correlating biliary PAH metabolites to down-core variations in PAH concentrations in sediment cores collected from the same locations.

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Type: Oral

Looking For Evidence Of Oil Exposure In Fish Otoliths: Comparison With Genomic And Physiological Responses

Presenter: Paola C. Lopez-Duarte
Rutgers University Marine Field Station
Authors: P. C. Lopez-Duarte[1], F. J. Fodrie[2], O. Jensen[3], A. Whitehead[4], F. Galvez[5], B. Dubansky[6], K. W. Able[1];
[1]Rutgers University Marine Field Station, Tuckerton, NJ, [2]University of North Carolina Chapel Hill, Morehead City, NC, [3]Rutgers University, New Brunswick, NJ, [4]University of California Davis, Davis, CA, [5]Louisiana State University, Baton Rouge, LA, [6]University of North Texas, Denton, TX.

Abstract:
Short-term effects linking oil contamination to genomic and physiological responses in marsh-resident killifish (Fundulus grandis) were documented in Whitehead et al (2011). In the present study, we analyzed the same fish to determine if trace metal signatures associated with the Deepwater Horizon oil spill (or Macondo blowout) can be detected in sagittal otoliths. Trace metals in the environment are incorporated into otoliths in daily growth increments, thus providing a record of the fish's chemical environment. We quantified the levels of trace elements in otoliths using laser ablation with highly sensitive mass spectrometry and detected differences in the multi-elemental signatures. However, we found no evidence of increased concentrations of two elements associated with oil contamination: Nickel and Vanadium. An increase in Barium (Ba) concentration was observed in otoliths from oil-exposed fish. Ba uptake can vary as a function of temperature, salinity, and availability. No change in Ba was observed in otoliths from unoiled fish in similar environmental conditions, indicating the possibility that increased Ba levels could be associated with increased bioavailability. One possible source is from Barite (BaSO4), present in drilling muds used in an attempt to stem the flow from the Macondo blowout. Our ability to detect changes in these trace elements is likely due to differences in spatial and temporal bioavailability and the pathways into the otolith.

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Type: Oral

Mercury Stable Isotopes As Tracers Of Hg Cycling In The Water And Food webs Of The Northeastern Gulf Of Mexico

Presenter: Vincent Perrot
National High Magnetic Field Laboratory, Florida State University
Authors: V. Perrot[1], V. E. Eller[1], W. M. Landing[2], V. J. M. S. Salters[1];
[1]National High Magnetic Field Laboratory, Florida State University, Tallahassee, FL, [2]Department of Earth, Ocean, and Atmospheric Science, FSU, Tallahassee, FL.

Abstract:
Our study investigates the Hg stable isotopic composition of different fish species from different areas of the northeastern Gulf of Mexico: seagrass beds, off-shore reefs and pelagic off-shore areas. Combining both Hg isotope mass-dependent and mass-independent fractionation signatures (MDF and MIF, represented as δ202Hg and Δ199Hg, respectively) we were able to discriminate Hg cycling between different species and habitats. The magnitude of MIF for odd Hg isotopes (i.e. 199 and 201) archived in aquatic organisms is characteristic of the intensity of photodemethylation processes in their habitat since they accumulate the residual MMHg. The efficiency of photochemical processes is directly connected with light penetration. Indeed, we observed that pelagic (shallow depth) fish had the highest Δ199Hg values. Fish living mostly on the upper part of the reef had Δ199Hg values higher than fish living in deeper habitat in the reef. This would also partly explain why we observed higher Hg levels in reef fish (less demethylation) than in pelagic fish (more demethylation). Seabass from seagrass beds displayed the lowest Δ199Hg values that might be explained by weak light penetration due to the high amount of organic matter and particles but also to the accumulation of a higher fraction of MMHg directly produced from methylation in the seagrass that is not residual from demethylation. The later hypothesis is more likely as the seabass also display lower δ202Hg values which are expected for MMHg produced by methylation.

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Type: Oral

Acute toxicity of dispersed Macondo oil to young of the year Gulf menhaden and Florida pompano

Presenter: Edward J. Chesney
LUMCON
Authors: E. J. Chesney[1], W. Childress[1], R. Portier[2], D. Baltz[2];
[1]LUMCON, Chauvin, LA, [2]Louisiana State University, Baton Rouge, LA.

Abstract:
Young of the year (age 0) Gulf menhaden (Brevoortia tyrannus) and Florida pompano (Trachinotus carolinus) were captured in the wild and exposed to dispersed Macondo oil with Corexit 9500™ to determine acute toxicity (24 hr LC50s) of CEWAF (Chemically Enhanced Water Accommodated Fraction) in a series of static exposures. Exposures were conducted at a temperature of 24.5 oC and salinity of 22 PSU. Mean sizes of Florida pompano (6.0 cm TL, 2.8 g wet wt.) were similar to Gulf menhaden juveniles (mean=7.8 cm TL, 4.7 g wet wt). Gulf menhaden were significantly more sensitive to CEWAF exposure than Florida pompano juveniles of similar sizes and stage of development. Threshold concentrations of CEWAF that caused mortality of Gulf menhaden occurred at concentration less than 1 ppm compared to > 2 ppm for pompano. Total mortality occurred at a concentration of < 2 ppm of CEWAF for Gulf menhaden compared to > 6 ppm for pompano juveniles. 24 hr LC50 for Gulf menhaden was estimate at 0.89 ppm compared to 3.47 ppm of dispersed Macondo crude oil for Florida pompano juveniles under similar environmental conditions (temperature, salinity, D.O.).

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Type: Oral

Investigations Into Sublethal Effects Of Crude Oil On Coastal Marine Zooplankton And Their Susceptibility To Fish Predators

Presenter: Brad J Gemmell
University of Texas at Austin
Authors: B. J. Gemmell, R. Almeda, E. J. Buskey;
University of Texas at Austin, Port Aransas, TX.

Abstract:
Copepods are key links in marine food webs and are the primary food source for small and juvenile fish. To combat high predation pressure, copepods have developed powerful escape responses to the presence of hydromechanical signals generated by approaching predators. Most crude oil toxicology studies with zooplankton have been focused on the lethal effects of crude oil, but little is known about the sublethal effects, such as behavior. In addition, sublethal effects relating to fish susceptibility and potential for bioaccumulation remain unknown. We investigated the effect of sublethal concentrations of crude oil (1-10 µL L^{-1}) and dispersant (0.05-0.5 µL L^{-1}) on the ability of copepods to escape from predators. Using high speed, 3-dimensional video techniques (2000 frames per second) we quantify the escape response of the copepod *Acartia tonsa*. We find that escape speed and distance were significantly lower for exposed copepods relative to controls. Maximum escape speeds drop from 674 ±45 mm s^{-1} to 452 ±92 mm s^{-1} and total escape distance decreases from 7.5 ±0.9 mm to 4.4 ±1.1 mm. Average escape speed falls below that of the strike speed of many planktivorous fish suggesting that fish will capture exposed copepods more frequently and the risk of bioaccumulation of hydrocarbons in the food web is discussed.

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Type: Oral

Fish Assemblages In Louisiana Salt Marshes: Effects Of The Macondo Oil Spill

Presenter: Keneth W Able
Rutgers University Marine Field Station
Authors: K. W. Able[1], P. C. Lopez-Duarte[1], F. J. Fodrie[2], O. Jensen[3], C. W. Martin[4], B. J. Roberts[5], C. Filosa[3], S. C. Halbert[6], K. O'Connor[7], J. Valenti[8];
[1]Rutgers University Marine Field Station, Tuckerton, NJ, [2]University of North Carolina Chapel Hill, Morehead City, NC, [3]Rutgers University, New Brunswick, NJ, [4]Louisiana State University, Baton Rouge, LA, [5]Louisiana Universities Marine Consortium (LUMCON), Chauvin, LA, [6]Haverford College, Lower Merion, PA, [7]Colby-Sawyer College, New London, NH, [8]The Richard Stockton College of New Jersey, Galloway, NJ.

Abstract:

Marsh-resident fishes play important roles as both predators and prey in coastal systems, influence secondary production, and are an important trophic links to adjacent coastal waters. An evaluation of the marsh fish responses to the Macondo Oil Spill was conducted in the spring and early summer of 2012 and 2013 by sampling in both oiled and unoiled marshes. The fauna, collected with traps, was dominated by cyprinodontiform fishes (Fundulus grandis, Adinia xenica, Cyprinodon variegatus, Poecilia latipinna) and complemented by others (F. pulvereus, F. jenkinsi, F. similis) in this group. Among the dominant species, subhabitat (marsh pools, creeks, surface depressions) use was taxon specific. Abundance was generally highest in marsh pools and depressions, while catch rates in creeks were intermediate, and fishes were largely absent from the marsh edge habitat. Comparisons across representative oiled and unoiled sites from Caminada, Terrebonne, and Barataria Bays, Louisiana did not reflect any consistent differences in species composition, abundance, or size as a function of oiling 2-3 years after the oil spill reached Louisiana marshes. This interpretation may be confounded by the variability in magnitude and extent of oiling within subhabitats and between sites, as well as multiple stressors, including natural events (e.g., oil redistribution by storms, seasonal flooding of the marsh surface) and other man-made perturbations (e.g., freshwater discharges).

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Type: Oral

Acute and chronic effects of the Deepwater Horizon Oil Spill on reef fish community and trophic structure

Presenter: William F Patterson
University of South Alabama
Authors: W. F. Patterson[1], J. T. Tarnecki[1], C. H. Jagoe[2], I. C. Romero[3], D. J. Hollander[3], M. James[4];
[1]University of South Alabama, Dauphin Island, AL, [2]Florida A&M University, Tallahassee, FL, [3]University of South Florida, St. Petersburg, FL, [4]University of Florida, Gainesville, FL.

Abstract:
Northern Gulf of Mexico (86.6W to 88.4W) natural reefs (n=16) were studied between May 2009 and Aug 2013. Fish communities were sampled with an ROV and fish were collected to examine growth and trophic ecology. Liver tissue was sampled following the Deepwater Horizon Oil Spill (DHOS) to assess exposure to polycyclic aromatic hydrocarbons (PAHs). Community shifts occurred as early as summer 2010, with the greatest effect occurring in small (< 10 cm) demersal planktivores, many of which declined by 100% following the DHOS. Large fishes (e.g., snappers, jacks, and triggerfish) also declined by up to 70% in the year following the spill. Trophic shifts included declines in demersal planktivores and piscivores but increases in pelagic planktivores. Muscle stable isotope ratios indicated a shift toward more benthic versus pelagic prey sources in several species. Livers with high PAH concentrations (e.g., >4 µg/g) were rich in alkyl homologs, thus indicating a petrogenic source. Presence of PAHs and induction of enzymes that catabolize PAHs indicate community structure and trophic shifts were most likely due to toxicological effects of DHOS. High total PAH concentrations were measured in reef fish liver samples more than a year following the spill, but reef fish community structure began to resemble pre-spill structure by early 2013. Recovery in small planktivores has lagged, which may be due in part to the rapid increase in invasive lionfish observed in the region.

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Type: Oral

Sedimentation Pulse in the NE Gulf of Mexico Following the 2010 DWH Blowout

Presenter: Gregg R Brooks
Eckerd College
Authors: G. R. Brooks[1], R. A. Larson[2], P. T. Schwing[3], I. Romero[3], C. Moore[1], G. Reichart[4], T. Jilbert[5], J. P. Chanton[6], D. W. Hastings[1], W. A. Overholt[7], K. P. Marks[7], J. E. Kostka[7], C. W. Holmes[8], D. Hollander[3];
[1]Eckerd College, Saint Petersburg, FL, [2]Eckerd College/USF, Saint Petersburg, FL, [3]USF, Saint Petersburg, FL, [4]University of Utrecht/NIOZ, Utrecht, NETHERLANDS, [5]University of Utrecht, Utrecht, NETHERLANDS, [6]FSU, Tallahassee, FL, [7]Georgia Tech, Atlanta, GA, [8]Environchron, Bradenton, FL.

Abstract:
Sediment cores collected in the NE Gulf of Mexico (GoM) recorded a brief, but rapid depositional pulse during the late summer and fall of 2010. Multiple independent lines of evidence indicate that the surficial 0.4-1.2 cm depth interval was distinct from underlying sediments, and was deposited in a 4-5 month period at mass accumulation rates (MAR) considerably higher than average rates over the previous ~100 years. A time series database from sites reoccupied during multiple cruises over a two-year period indicates that MAR declined from 2010 to 2012.
We hypothesize that the depositional mechanism, which accounts for a rapid flux of sediments to the seafloor, was a massive marine snow event documented in NE GoM surface waters following the 2010 Deepwater Horizon (DWH) blowout. Once buoyancy was lost, the marine snow likely settled rapidly and eventually blanketed the seafloor, possibly creating temporary anoxic conditions. This, in-turn shutdown bioturbation (i.e., mixing), resulting in the (temporary?) preservation of the surface, sedimentary pulse layer. Continued observation will help to determine if/how the pulse layer is preserved in the sedimentary record, and how short-term deposition relates to longer-term accumulation.

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Type: Oral

Changes in sediment redox conditions following the BP DWH Blowout event

Presenter: David Hastings
Eckerd College
Authors: D. Hastings[1], P. Schwing[2], T. Bartlett[1], G. Brooks[1], R. Larson[1], K. Quinn[2], T. Roeder[1], I. Romero[2], D. Hollander[2];
[1]Eckerd College, St. Petersburg, FL, [2]University of South Florida, St. Petersburg, FL.

Abstract:
The large depositional event following the blowout of the Macondo well resulted in substantial changes in sediment redox conditions. This is demonstrated by downcore and temporal changes in the concentration of redox sensitive metals: Mn, Re, and Cd. Sediment cores collected in the NE Gulf of Mexico from December 2010 -August 2013 were extruded at 2 mm intervals; samples were microwave digested then analyzed by ICP-MS. The formation and aggregation of mucous-rich marine snow and rapid deposition to sediments are the likely cause for the documented sedimentation event. Subsequent respiration of labile organic carbon consumed pore water oxygen and led to a shoaled redoxcline. As a result, two distinct sedimentary Mn peaks exist following the event, one in the top 10 mm, the other at 20-30 mm. Between the Mn maxima, a modest (15-30%) enrichment of Re consistent with reducing sediments typically exists. A time series of three stations sampled over three years following the event reveal that sediment Re increased 2 - 4 times compared to the pre-impact baseline value. A community-wide decrease in benthic foraminifera is coincident with reducing conditions, demonstrating the important consequences of changing redox conditions on benthic ecosystems. Determination of redox sensitive metals will continue to constrain the temporal evolution of reducing conditions, which will serve to document the long term effects of the spill, and the possible return to pre-event conditions.

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Date: Monday, January 27 - 2:30 PM
Room: Bon Secour Bay II
Track: Integrated Understanding of the Impacts of the DWH Oil Spill on Fisheries: Exposure Vectors, Biological-Physiological Effects and Abundance of Fisheries Populations
Type: Oral

Characterizing the Deep Sea Benthic Foraminifera Impact and Response to the Deepwater Horizon Event in the Northeastern Gulf of Mexico

Presenter: Patrick T Schwing
University of South Florida
Authors: P. T. Schwing[1], I. C. Romero[1], D. W. Hastings[2], G. R. Brooks[2], R. A. Larson[2], D. J. Hollander[1], L. M. Reilly[1], J. P. Chanton[3];
[1]University of South Florida, Saint Petersburg, FL, [2]Eckerd College, Saint Petersburg, FL, [3]Florida State University, Tallahassee, FL.

Abstract:
Sediment cores were collected from the Gulf of Mexico to assess the benthic foraminifera (BF) response to the Deepwater Horizon (DWH) event. Short-lived radioisotope geochronologies (210Pb and 234Th), organic geochemical toxicity assessments, and redox metal concentrations were determined to relate changes in sedimentation rate, toxicity levels, and redox conditions with BF abundance. Records from December 2010 document a community-wide event characterized by a decrease in concentration and benthic foraminifera accumulation rate (BFAR) in the surface 10 mm relative to the down-core mean. The decline in abundance occurs at the same depths as reducing sediments (anoxic) as well as a 2-to-3-fold increase in polycyclic aromatic hydrocarbon concentration. There is also depletion in the δ13CCaCO3 record (relative to down-core values) constructed from benthic foraminifera test calcite, synchronous with the decline event in the surface of the sediment cores. This suggests that petroleum carbon was incorporated into the BF tests. Preliminary mass balance calculations argue that 0.1-7% of the test calcite is composed of petroleum carbon. Integrating records of BF abundance with other sedimentary chemical records has shown to be effective in quantifying the benthic response and will continue to be valuable in determining the long-term effects of the DWH event and potential recovery on a larger spatial scale.

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Date: Monday, January 27 - 2:45 PM
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Type: Oral

N2-fixation in deep waters of the Northern Gulf of Mexico: Spills. Seeps, and links between the N and C cycles.

Presenter: Joseph Montoya
Georgia Institute of Technology
Authors: J. Montoya[1], S. C. Weber[1], J. Battles[2], C. C. Padilla[1], S. B. Joye[2];
[1]Georgia Institute of Technology, Atlanta, GA, [2]University of Georgia, Atlanta, GA.

Abstract:
Nitrogen availability commonly limits biological productivity in the upper water column of offshore systems, creating a tight connection between the N and C cycles in surface waters. We measured C- and N-fixation rates in both surface and deep waters of the Northern Gulf of Mexico during a series of five cruises beginning shortly after the Deepwater Horizon spill (OC468, 21 Aug-16 Sep 2010) and extending through the summer of 2013 (EN527/528, 19 Jun - 24 Jul 2013). We found measurable, and frequently high rates of N2-fixation in surface waters, particularly in areas affected by the Mississsippi River plume as well as surprisingly high rates of N-fixation in waters more than 200m below the surface. The vertically integrated rates below 200 m depth frequently exceeded those at the surface (>1 mmol N m^-2 d^-1) and appeared to be associated with elevated concentrations of CH4 in the water column. We will discuss the hydrographic and biogeochemical context of our experiments, which document a novel and important linkage between the N and C cycles in the Northern Gulf of Mexico, and potentially in other waters affected by natural and anthropogenic inputs of oil and gas to the water column.

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Date: Monday, January 27 - 3:00 PM
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Track: Integrated Understanding of the Impacts of the DWH Oil Spill on Fisheries: Exposure Vectors, Biological-Physiological Effects and Abundance of Fisheries Populations
Type: Oral

An ecosystem-based modeling system for predicting oil spill impacts in the marine environment

Presenter: JoLynn Carroll
Akvaplan-niva
Authors: J. Carroll[1], G. M. Skeie[2], B. Bogstad[3], C. Klok[4], R. Nepstad[5], J. Juselius[6], O. J. Broch[7], U. Brönner[5], K. Eiane[8], P. Geraudie[1], B. E. Grøsvik[3], B. H. Hansen[5], J. Hendriks[9], M. Hjorth[10], L. de Hoop[9], D. Howell[3], C. Janssen[11], F. de Laender[12], Ø. Langangen[13], J. Moe[14], T. Nordtug[5], G. H. Olsen[15], E. Ravagnan[16], M. Reed[5], S. Sanni[16], C. Spikkerud[2], D. Slagstad[7], L. C. Stige[13], Ø. Varpe[1], K. Viaene[11], F. Vikebø[3], P. de Vries[4];
[1]Akvaplan-niva, Tromsø, NORWAY, [2]Akvaplan-niva, Ski, NORWAY, [3]Institute of Marine Research, Bergen, NORWAY, [4]Institute for Marine Resources and Ecosystem Studies, Den Helder, NETHERLANDS, [5]SINTEF Materials & Chemistry, Trondheim, NORWAY, [6]University of Tromsø, Tromso, NORWAY, [7]SINTEF Fisheries and Aquaculture, Trondheim, NORWAY, [8]University of Nordland, Bodø, NORWAY, [9]Radboud University Nijmegen, Nijmegen, NETHERLANDS, [10]COWI, Kongens Lyngby, DENMARK, [11]Ghent University, Ghent, BELGIUM, [12]University of Namur, Namur, BELGIUM, [13]Centre for Ecological and Evolutionary Synthesis, Oslo, NORWAY, [14]Norwegian Institute for Water Research, Oslo, NORWAY, [15]Akvaplan-niva, Trondheim, NORWAY, [16]International Research Institute of Stavanger, Randaberg, NORWAY.

Abstract:
The Deepwater Horizon oil spill in the Gulf of Mexico served to illustrate the need for further advancement in software technology to simulate ecosystem impacts linked to oil spill scenarios in the marine environment. Such a system is needed to support ecosystem based decision-making before, during, and after an accident occurs. The integrated modeling framework known as SYMBIOSES links existing population models for adult fish, fish eggs & juveniles, phytoplankton, zooplankton and oil exposure and effect models. This modeling framework is being developed for the Lofoten/Barents Sea area: a region potentially rich in petroleum resources and characterized as key spawning and egg and larval drift areas for North Atlantic commercial fish species. It simulates processes in three dimensional space and time to allow for impacts on larval survival to be traced through the population in order to observe the effect of oil spills on overall fish stocks. Initial test results based on hypothetical exposure scenarios demonstrate the utility of the framework approach to evaluate potential impacts of oil exposure on copepods, fish larvae and fish stock recruitment. This presentation will demonstrate how such approaches help provide stakeholders with more detailed information to proactively avoid or minimize some impacts from oil spills.

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Track: Integrated Understanding of the Impacts of the DWH Oil Spill on Fisheries: Exposure Vectors, Biological-Physiological Effects and Abundance of Fisheries Populations
Type: Oral

Development of an Atlantis ecosystem model to study food web impacts of DWHOS

Presenter: Cameron Ainsworth
University of South Florida
Authors: C. Ainsworth[1], L. Dornberger[1], M. Drexler[1], M. Masi[1], H. Perryman[2], D. Die[2], B. Babcock[2], M. Schirripa[3];
[1]University of South Florida, St. Petersburg, FL, [2]University of Miami, Miami, FL, [3]NOAA, Miami, FL.

Abstract:
We describe development of a Gulf of Mexico Atlantis model. This 3-dimensional biogeochemical ecosystem simulation model will be used to forecast recovery time and analyze changes in ecosystem structure and function following the Deepwater Horizon oil spill and subsequent mediation actions. We synthesize data from laboratory experiments, field research, and physical and biological modelling emerging from the C-IMAGE and DEEP-C consortia to simulate oil toxicity, dispersant effects, fisheries closures and other impacts of the oil spill. New software has been developed for Atlantis in collaboration with CSIRO Australia to make the best possible use of available GOMRI data. The new routines allow us to represent spatial mortality, recruitment and growth effects on fish and invertebrates. Several novel methodologies have been developed to support modelling efforts including statistical prediction of fish biomass, statistical description of trophic relationships, and analysis of larval dispersal patterns. Collaborators in model development include USF, UM-RSMAS, FWRI, SEFSC-NOAA, NCDDC-NOAA and CSIRO Australia.

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Type: Oral

Conducting and Communicating Science in the Midst of an Environmental Crisis: *Examples from EXXON Valdez to Katrina and Deepwater Horizon*

Presenter: Usha Varanasi
University of Washington
Authors: U. Varanasi;
University of Washington, Tacoma, WA.

Abstract:
Background: Over past twenty years, United States has experienced several natural or anthropogenic environmental crises of epic proportions. Environmental catastrophes such as the *EXXON Valdez* oil spill in pristine waters of Prince William Sound to more recent events such as Hurricane Katrina and Deepwater Horizon oil spill in the Gulf of Mexico raised deep concerns over human safety, seafood contamination, damage to marine life and economic losses. Conducting good and objective science, being responsive to public fear and distress, and communication of scientific findings in response to environmental disasters remains challenging but critically important. In all these events, it was necessary to identify and use relevant scientific techniques, as well as develop new methods, to rapidly respond to critical questions about the presence in seafood of polycyclic aromatic hydrocarbons (PAHs), the toxic components of petroleum that are the compounds of public health concern. It was a challenge to communicate our scientific findings that showed PAHs do not accumulate in vertebrates (e.g., fish, marine mammals) because of efficient metabolism and excretion, and that invertebrates (e.g., shellfish, molluscs) tend to bioacculmulate these compounds. Also it was difficult to explain that organisms with efficient metabolism can still be at risk of PAH toxicity, especially during early developmental stage. Applying as many of the lessons learned in terms of clean-up methods and application of detection techniques in response to *EXXON Valdez* to the Hurricane Katrina and Deepwater Horizon disasters advanced our knowledge, but also proved to be challenging because of physical ocean differences (i.e., water temperature, natural oil seepages), causes of the disaster and cultural differences of communities affected. Nonetheless, it is imperative that communication of scientific results to a wide range of audiences be independent, accurate, reliable and consistent in order to rebuild confidence in seafood advisories and to assess ecological damage after an environmental crisis in a politically charged and media intensive atmosphere. This presentation will cover challenges of advancing science in the midst of environmental emergencies.

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Type: Poster 4-97

Declines in Small Demersal Reef Fishes: Confounding Effects of the Deepwater Horizon Oil Spill and Invasive Lionfish

Presenter: Kristen Dahl
University of South Alabama
Authors: K. Dahl, W. Patterson, III, J. Tarnecki;
University of South Alabama, Dauphin Island, AL.

Abstract:
Significant declines were observed in northern Gulf of Mexico (nGOM) reef fish communities following the Deepwater Horizon Oil Spill (DHOS), with small (<10 cm) demersal planktivores showing declines as great as 100%. Other species or trophic guilds began showing signs of recovery by early 2013, but demersal planktivore densities continued to be depressed. A likely reason for that is the rapid invasion of red lionfish, Pterois volitans, which were first reported in the GOM in 2009 and quickly became established residents on both artificial and natural reefs. Lionfish densities on artificial reefs off northwest Florida are currently among the highest reported in the western Atlantic (~20 fish 100 m-2), while their densities on natural reefs have been an order of magnitude lower. As part of a broader study examining their impact on native fishes, lionfish (n = 441) were collected with spears by SCUBA divers during 2013 to evaluate their feeding ecology at artificial versus natural reefs (depth range 20-40 m). Diet was significantly different between reef types (PERMANOVA, $p < 0.001$). Lionfish captured at artificial reefs had higher percentages of non-reef associated benthic fishes in their diet, while their diet at natural reefs consisted mostly of small demersal reef fishes, such as blennies, damselfish and cardinalfish. Without greater control on lionfish numbers, it is unclear if these demersal planktivores will fully recover from post-DHOS declines.

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Type: Poster 4-98

Implementation of new spatial forcing functions in the Atlantis modeling framework to accurately represent oil spill impacts in the Gulf of Mexico

Presenter: Lindsey Dornberger
University of South Florida
Authors: L. Dornberger, C. Ainsworth;
University of South Florida, St Petersburg, FL.

Abstract:
The C-IMAGE & DEEP-C consortia have been vigorously studying various individual aspects of the Deepwater Horizon oil spill; changes in fish hormone levels, immune protein levels, general immune system health indicators, and body growth changes are just a few examples. Along with these individual processes, both consortia have begun to build Atlantis ecosystem models. Atlantis is an end to end ecosystem model that incorporates everything from hydrodynamics to fisheries fleets. Field and laboratory data from these consortia are being integrated as spatial forcing functions on population ecology using a new module developed for Atlantis working in collaboration with CSIRO. These functions allow for dynamic changes over space and time of population dynamics, such as direct increase in mortality and vulnerability to predation of fishes suggested by immune assays, and recruitment reduction based on abnormal hormone levels. The transition from organism level effects to population-wide effects was done by examining the magnitude of changes seen and the relative certainty of correlation between the biochemical indicator and life history trait. Model results will be validated with empirical community structure observations.

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Type: Poster 4-99

Ichthyoplankton Populations Exposure to Oil Resulting from an Oil Well Blowout

Presenter: Emily Chancellor
University of South Florida
Authors: E. Chancellor[1], S. Murawski[1], C. Paris[2];
[1]University of South Florida, Saint Petersburg, FL, [2]Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, FL.

Abstract:
The larvae of many economically important fish species occur in Gulf of Mexico water exposed to oil from the Deepwater Horizon event. In the event of another oil spill, there is a need for a method to better predict what percent of ichthyoplankton will be exposed.
We will use data from the Southeast Area Monitoring and Assessment Program (SEAMAP) plankton surveys from years 1982 to 2011 to build a comprehensive model predicting the location and quantity of ichthyoplankton found in the Gulf of Mexico. These surveys are completed semi-annually in the Gulf of Mexico by NOAA and the relevant states and provide a summary of the ichthyoplankton found in the top 200 meters at numerous stations throughout the Gulf. We will examine variables in the plankton surveys including species abundance and diversity, in relation to dependent variables including location variables, time of year, and associated oceanographic parameters, using Generalized Additive Models (GAMs). The percentage of each species population located within the observed surface oil footprint is computed.
The results from the GAM models are combined with the Far Field Oil Plume Model developed by (C. Paris, University of Miami) to predict where oil plumes will occur within the water column and at the surface if a blowout occurs. Layering this plume model with the ichthyoplankton model will provide a comprehensive tool for predicting the exposure of the ichthyoplankton populations as a percent of species distribution resulting from the DWH blowout and potential future blowout or spill events.

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Type: Poster 4-100

Hercules 265 rapid response: hydrographic, methane, and rate measurements quantify ecosystem impacts of a rig blowout incident.

Presenter: Sarah C Weber
Georgia Institute of Technology
Authors: S. C. Weber[1], J. Battles[2], S. B. Joye[2], J. P. Montoya[1];
[1]Georgia Institute of Technology, Atlanta, GA, [2]University of Georgia, Athens, GA.

Abstract:
In late August 2013, the Hercules 265 natural gas platform in the Northern Gulf of Mexico experienced a catastrophic loss of control. ECOGIG and collaborating consortia mounted a rapid response cruise to sample the waters around the Hercules rig during and immediately after the blowout. We measured nutrient and methane concentrations, the elemental and isotopic composition of suspended particles, and the rates of methane consumption and N2-fixation in waters surrounding the wellhead. We will discuss our nutrient, isotopic, and rate measurements in the context of the greatly elevated methane concentrations.

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Type: Poster 4-101

Large-scale tracking of oil-derived hydrocarbons in deep-sediments of the Gulf of Mexico after the Deepwater Horizon oil spill

Presenter: Isabel C Romero
University of South Florida
Authors: I. C. Romero[1], G. A. Toro-Farmer[1], K. Watson[1], G. R. Brooks[2], R. A. Larson[2], P. Schwing[1], D. Hastings[2], F. Muller-Karger[1], D. J. Hollander[1];
[1]University of South Florida, St Petersburg, FL, [2]Eckerd College, St Petersburg, FL.

Abstract:
The Deepwater Horizon oil spill (DHOS) discharged 4.9 million barrels of oil at 1520m depth. Understanding the fate of this oil is critical for evaluating the impact on natural ecosystems, specifically for the unaccounted ~30% of the total oil released. To determine the amount/spatial distribution of spilled oil and the timing of its deposition, we utilized short-lived radioisotopes (234Th, 210Pb), data from our sampling core surveys, and a regional database (PAHs, aliphatics, biomarkers) compiled by NOAA and EPA. Following the DHOS in the DeSoto Canyon, concentration of hydrocarbon compounds such as aliphatics and PAHs were higher than pre-DHOS (7-fold and

2-fold higher, respectively), and comprised of terrestrial, oil-derived and algal sources. Three distinct transport pathways to the bottom were identified: oil-contaminated marine snow, sinking of burned-oil particles, and advective transport of dissolved-oil from the deep intrusion at ~1000-1200 m depth. Large-scale analysis revealed also higher concentration of hydrocarbons in post-DHOS sediments (105.7±544 ppm) relative to pre-DHOS sediments (18.3±75.4 ppm). 85% of the stations (N=548) were contaminated with hydrocarbons varying up to 90-fold. These results are consistent with the hypothesis of a regional-scale, particle-rich depositional event, which occurred after the DHOS. A map of the spatial distribution of sedimentary oil and a revised oil budget taking into account oil deposition will be presented.

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Type: Poster 4-102

Effects of the Deepwater Horizon Oil Spill on Abundances and Distributions of Larval Fishes in the Northern Gulf of Mexico

Presenter: Jesse E Filbrun
The University of Southern Mississippi
Authors: J. E. Filbrun, J. T. Ransom, F. J. Hernandez;
The University of Southern Mississippi, Ocean Springs, MS.
Abstract:
The effects of the Deepwater Horizon oil spill on fisheries in the northern Gulf of Mexico remain largely unknown. Recent studies have shown that oil carbon entered the lower food web, and direct exposure of Gulf killifish eggs to oiled sediments decreased hatching success and increased the incidence of developmental abnormalities in hatched larvae as compared to eggs exposed to unoiled sediments. However, it is unclear whether larval fish in the water column during the oil spill were affected by changes in their planktonic prey, direct exposure to toxic hydrocarbons released during the event, both, or neither. To determine potential population-level effects of the oil spill on fishes, we examined overall patterns in larval fish assemblages and larval abundances of three targeted species with varying ecological and commercial importance (Atlantic bumper, Spanish mackerel, and red snapper). Specifically, we used Southeast Area Monitoring and Assessment Program (SEAMAP) and Fisheries Oceanography of Coastal Alabama (FOCAL) plankton surveys to examine broad and fine-scale patterns in the abundances and distributions of these larvae before, during, and after the oil spill. We show from initial analyses that the overall larval fish assemblages in summer 2010 were similar to those in the years before and after the oil spill, and that larvae of all three targeted species were relatively abundant in the water column in 2010. Thus, relatively large cohorts of larval fish were exposed to the released hydrocarbons, warranting further investigation of the effects of the oil spill on larval fish diets, growth, and condition.

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Type: Poster 4-103

Dispersed MC252 crude oil impacts behavior and development of queen conch and pink shrimp larvae at sublethal levels

Presenter: Amber Garr
EA Engineering, Science, and Technology, Inc.
Authors: A. Garr[1], S. Laramore[2];
[1]EA Engineering, Science, and Technology, Inc., Hunt Valley, MD, [2]Florida Atlantic University - Harbor Branch Oceanographic Institute, Fort Pierce, FL.
Abstract:
Impacts on behavior (activity, swimming, molting) and larval development of queen conch (*Strombus gigas*) and pink shrimp (*Litopenaeus duorarum*) were assessed for larvae exposed to sublethal levels of dispersed oil. While conducting acute toxicity studies, behavioral responses to solutions of MC252 crude oil, the dispersant (Corexit 9500A), and dispersed oil were recorded. Swimming activity and patterns were disrupted for conch larvae at concentrations lower then LC_{50} levels. Significantly altered behavioral responses (activity, molting) of mysis stage shrimp were also observed at sublethal concentrations. Responses varied with different larval stages, where newly hatched conch were more tolerant and postlarvae (PL) shrimp were the least effected. After completing acute toxicity studies, newly hatched conch and shrimp were exposed to a sublethal (LC_{10}) concentration (50 mg/L and 23 mg/L) of dispersed oil for 24 hrs and cultured in uncontaminated water for the remainder of the larval cycle. Although displaying an initial lag in growth and development, by the third day of the larval cycle, queen conch larvae exposed to the dispersed oil displayed no differences in comparison to the controls. Shrimp development from nauplii V to zoea III proceeded at the same pace, yet development from zoea III into mysis 1 (day 5) was slower in the exposed groups, causing a subsequent lag in development in mysis 2 and mysis 3 stages (day 7-9). However, by day 11, both groups had reached PL stage.

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Type: Poster 4-104

Petrogenic polycyclic aromatic hydrocarbons (PAHs) analysis of marine species after the Deep Water Horizon Oil Spill

Presenter: Harshica Fernando
University of Texas Medical Branch at Galveston
Authors: H. Fernando, R. Kakumanu, K. K. Bhopale, S. Warnakulasuriya, B. S. Kaphalia, G. A. S. Ansari;
University of Texas Medical Branch at Galveston, Galveston, TX.

Abstract:
The Gulf of Mexico oil spill in April 2010 discharged an estimated 4.9 million barrels of crude oil to the open water. Main concerns of the spill are how PAHs present in crude oil affect marine species and ultimately on the overall human health. In response to the concerns of affected Gulf coast communities (Louisiana, Alabama, and Mississippi) we analyzed the presence of petrogenic PAH's in oysters, blue crab, shrimp (white and brown), and finfish samples collected from defined areas in the three states at different time points. A total of 313 samples were analyzed with 185 from Louisiana, 53 from Alabama and 75 from Mississippi during November 2011-July 2013. Extraction of the PAH's was performed using the QUACHERs/dsPE extraction method and the samples analyzed using a Gas chromatography-Mass spectrometry. The data from slowest (oyster) and the fastest (finfish) metabolizing species will be presented. Some of the samples analyzed showed the presence of naphthalene's (parent, C-1 and C-3 analogues) which varies with location and species. However, the presence of higher ring PAH's in the samples if present are at very low concentrations and masked by the matrix components.

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Type: Poster 4-105

Hydrocarbons in shrimp and fishes of the Southwestern Gulf of Mexico

Presenter: Adolfo Gracia
Instituto de Ciencias del Mar y Limnología
Authors: A. Gracia[1,2], H. Alexander[1];
[1]Instituto de Ciencias del Mar y Limnología, Mexico City, MEXICO, [2]Universidad Nacional Autónoma De México, México City, MEXICO.

Abstract:
Hydrocarbons in muscle of main crustacean and fish species collected in the southwestern Gulf of Mexico (off Veracruz, Tabasco and Campeche states) were analyzed in summer 2010. Organisms were collected in 30 sampling locations with an otter trawl net using the R/V JUSTO SIERRA of the Universidad Nacional Autónoma de México. Total, aliphatic and aromatic hydrocarbons in 80 organisms of two shrimp and 29 fish species were measured. Shrimp muscle total hydrocarbons registered a range of 345.4 to 12996.3 µg/kg with a mean of 3499.7 µg/kg. Aliphatic hydrocarbons represented 98 % and Aromatic 2 % of total shrimp muscle hydrocarbons with means of 3452.7 and 46.9 µg/kg, respectively. In fishes total hydrocarbons range was 78.3-12657.2 µg/kg with a mean of 2422.9 µg/kg. Also, aliphatic hydrocarbons in fishes represented 98 % and aromatic hydrocarbons 2 % of the total, with means of 2375.1 and 47.9 µg/kg, respectively. Aliphatic hydrocarbons content were different in shrimp and fishes. The most common aliphatic hydrocarbons in shrimp were n-Eicosane, n-Pentacosane, n-Nonadecane, n-Heptacosane and n-Hexacosane; whereas for fishes were n-Dodecane, n-Henicosane, Pristane, n-Tetratriacontane and n-Tetradecane. Highest mean shrimp registers of aromatic hydrocarbons corresponded to Biphenyl, Naphthalene, Phenanthrene, 1-Methylnaphthalene and 2,6-Dimethylnaphthalene with 96.28, 91.17, 41.19, 34.57 and 32.10 µg/kg, respectively. In fishes, the aromatic hydrocarbons with the highest values were Biphenyl, Anthracene and Phenanthrene with 691.12, 425.12 and 407.47 µg/kg, respectively. Highest records of total hydrocarbons (>5,000 µg/kg) were found along the study area in front of Alvarado, Dos Bocas, Ciudad del Carmen and Celestún.

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Type: Poster 4-106

Temporal Changes in the Microbiological Ecosystem in Near-shore and Soil Samples Affected by the 2010 Gulf Oil Spill

Presenter: William R Widger
University of Houston
Authors: W. R. Widger[1], G. Golovko[2], Z. Xu[2], M. Rojas[2], J. Santarpia[3], Y. Fofanov[4];
[1]University of Houston, Houston, TX, [2]University of Texas Medical Branch, The Sealy Center for Structural Biology & Molecular Biophysics (SCSMB) University of Texas Medical Branch, Galveston, TX, [3]Sandia National Labs, Albuquerque, NM, [4]Department of Pharmacology and Toxicology, University of Texas Medical Branch, Galveston, TX.

Abstract:
Starting in June 2010, oil from the Deepwater Horizon oil spill reached hundreds of miles of Louisiana, Alabama, Mississippi, and Florida shoreline disturbing the ecological balance and economic stability of the region. Although visible damages were seen in wildlife populations and marine estuaries, the effect of oil and dispersants on the most basic level of the ecosystems, the bacterial and plankton populations were not well studied. Basic metabolic activities of microbial communities determine the overall status of any ecosystem where abrupt and severe changes can produce long term effects on the entire ecosystem. Changes in the metagenome including the microbial population were monitored from the high throughput sequencing of DNA from near-shore water and soil samples collected in Grand Isle, Louisiana and Gulf port, Mississippi, before and during the appearance of oil. Our findings indicate a significant loss in oxygen producing photosynthetic organisms, a decline of low abundance of aromatic oxidizers, a general decline of many bacteria, as well as unexpected decrease in hydrocarbon degrading organisms. These changes could lead to decreases in water oxygen levels. Significant fluctuations were observed in bacteria including a large spike in the human pathogen Vibrio cholera in the water samples from both locations. Whether the oil or dispersants caused these changes in the microbiome is unknown, the effects of a long term disruption to the microbiome has not been studied and represents another and less visible change to the environment due to spilled oil.

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Type: Poster 4-107

Species and Tissue Specific Turnover and Oil Depuration Rates of Fishes in the Gulf of Mexico

Presenter: Jenny Fenton
University of South Florida
Authors: J. Fenton, E. Peebles, D. Hollander;
University of South Florida, St. Petersburg, FL.

Abstract:
We propose a new method to determine species- and tissue-specific turnover rates, simultaneous solution for time (t). The present study will analyze the δ13C and δ15N of different body tissues to derive information on tissue turnover rates. Different tissues will assimilate isotopic signatures at different rates because different tissues breakdown and re-synthesize at different rates, known as turnover. Because different tissues have different turnover rates, simultaneous solution for time (t) in turnover equations provides a theoretical time since an individual has experienced a change in carbon or nitrogen isotopes. Turnover rates for tissues are known to range from a few days to years. By using internal isotopic records acquired from sampling multiple tissues we can constrain the method, thus forcing it to have only one solution. A captive study whereby we will acquire empirical tissue-specific isotopic turnover rate data from fish in captivity will validate these methods. This new approach will be applied in a field study to obtain species and tissue-specific turnover rate data from commercially fished families in the Gulf of Mexico and in a captive study to evaluate changes in tissue turnover rates with respect to oil depuration. The results of this study will contribute to our understanding of the rate at which various tissues depurate oil and to filling the void in information regarding species-specific tissue turnover times as expressed in previous studies.

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Type: Poster 4-108

Detecting trace element anomalies in offshore fish otoliths coincident with the Deepwater Horizon oil spill

Presenter: Jennifer E Granneman
University of South Florida College of Marine Science
Authors: J. E. Granneman, D. L. Jones, S. A. Murawski, E. B. Peebles;
University of South Florida College of Marine Science, St. Petersburg, FL.

Abstract:
Fish otoliths are useful as they provide a record of both fish age and ambient water chemistry. The objective of this study was to describe the lifetime otolith element composition of several offshore fish species collected from the Gulf of Mexico following the Deepwater Horizon (DWH) oil spill. Additionally, we determined the timing of any trace element concentration anomalies within otolith element profiles to evaluate whether they were concurrent with the DWH oil spill. We analyzed otoliths of the following offshore fish species: Lutjanus campechanus, Epinephelus morio, Epinephelus flavolimbatus, Brotula barbata, Urophycis floridana, and Lopholatilus chamaeleonticeps. Otoliths were analyzed through laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) for a suite of 26 isotopes: 7Li, 23Na, 24Mg, 31P, 43Ca, 45Sc, 51V, 53Cr, 55Mn, 57Fe, 59Co, 60Ni, 63Cu, 64Zn, 65Cu, 72Ge, 85Rb, 88Sr, 89Y, 114Cd, 118Sn, 137Ba, 197Au, 208Pb, 232Th, and 238U. Ablation of otoliths occurred along a transect extending from the primordium to the edge of the otolith thus providing an otolith element profile over the entire life of the individual. This technique allowed us to establish a baseline for the ambient water conditions a fish was exposed to prior to the DWH oil spill. We identified fish with trace element anomalies in their otolith profiles that occurred during the time frame of the DWH oil spill event.

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Type: Poster 4-109

Investigation Of Methylmercury Bioaccumulation And Detoxification In Gag Grouper (Myctoperca microlepis) From The Northeastern Gulf Of Mexico Using Hg Stable Isotopes

Presenter: Vincent Perrot
National High Magnetic Field Laboratory, FSU
Authors: V. Perrot[1], V. E. Eller[1], W. M. Landing[2], V. J. M. S. Salters[1];
[1]National High Magnetic Field Laboratory, FSU, Tallahassee, FL, [2]Department of Earth, Ocean, and Atmospheric Science, FSU, Tallahassee, FL.

Abstract:
Since the Gulf of Mexico (GoM) is a privileged site for recreational and commercial fisheries, the understanding of Hg accumulation in its food webs is critical. We investigated Hg species and Hg isotope distribution in gag grouper, a very frequently consumed fish in the southeastern US, from a marine protected area (Madison Swanson) of the northeastern GoM. 43 specimens from 24 to 130 cm length displayed mass-dependent fractionation (MDF) of Hg isotopes in the muscle that was linked to [Hg], length and δ15N, suggesting that bioaccumulation of Hg in gag grouper leads to an enrichment of heavier isotopes in the muscle. However, no significant variation of mass independent fractionation (MIF) was observed among samples (average Δ199Hg=1.20±0.18‰). Hg isotopic composition measured in livers of some samples revealed that the liver was consistently depleted in heavier isotopes relative to the muscle (by about 1‰) and this was linked to the fraction of MMHg (livers have 45 to 68% of inorganic Hg). However, no MIF differences were observed between liver-muscle couples. This implies that the Hg in liver and muscle of gag has the same origin (i.e. the prey) but that Hg transformation(s) (likely demethylation) produce kinetic MDF of Hg isotopes in vivo before subsequent storage of Hg species (i.e. MMHg and inorganic Hg) in their target organs. Our results strongly suggest that gag grouper demethylates a significant fraction of MMHg accumulated throughout their lifespan as a process of detoxification.

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Assimilation of oil-derived elements by oysters due to the deepwater horizon oil spill

Presenter: Ruth H Carmichael
Dauphin Island Sea Lab
Authors: R. H. Carmichael[1,2], A. Jones Knobloch[3], H. K. Patterson[1,2], W. C. Walton[4], A. Perez-Huerta[5], E. B. Overton[6], M. Dailey[7], K. L. Willett[7];
[1]Dauphin Island Sea Lab, Dauphin Island, AL, [2]University of South Alabama, Mobile, AL, [3]Rutgers, The State University of New Jersey, New Brunswick, NJ, [4]Auburn University, Dauphin Island, AL, [5]University of Alabama, Tuscaloosa, AL, [6]Louisiana State University, Baton Rouge, LA, [7]The University of Mississippi, University, MS.

Abstract:
During and after the Deepwater Horizon Oil Spill (DWHOS), oysters (Crassostrea virginica) were exposed to oil and susceptible to incidental consumption of surface and subsurface oil materials. We determined the contribution of oil materials from the DWHOS to diet of oysters by comparing carbon (C) and nitrogen (N) stable isotope ratios in oyster shell to ratios in suspended particulate matter (SPM) and in fresh and weathered oil. Average δ13C and δ15N values in oyster shell (−21 ± 1‰ and 9−11‰, respectively) were consistent with consumption of naturally available SPM as opposed to values in oil (−27 ± 0.2‰, 1.6 ± 0.4‰). Stable isotope ratios in oyster adductor muscle were similar to shell for δ15N but not δ13C, suggesting either a recent shift in diet composition or differential assimilation of C between tissue types. We found no evidence of assimilation of oil-derived C and N and, therefore, no evidence of an oyster-based conduit to higher trophic levels. Trace elements in shell were inconclusive to corroborate oil exposure. These findings are not an indication that oysters were not exposed to oil; rather they imply oysters either did not consume oil-derived materials or consumed too little to be detectable compared to natural diet.

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Type: Poster 4-111

Potential effects of the Deepwater Horizon oil spill on blue crab (*Callinectes sapidus*) population connectivity

Presenter: Joanna Gyory
Tulane University
Authors: J. Gyory[1], B. T. Jones[2], E. K. Grey[3], C. M. Taylor[1];
[1]Tulane University, New Orleans, LA, [2]Woods Hole Oceanographic Institution, Woods Hole, MA, [3]University of Notre Dame, Notre Dame, IN.

Abstract:
The Deepwater Horizon oil spill occurred during the 2010 blue crab (*Callinectes sapidus*) spawning season, when female blue crabs were migrating out of estuaries into the coastal ocean to release eggs that hatched into surface-dwelling planktonic larvae. The oil spill produced surface slicks, and it is likely that at least some larvae were in close proximity to or came in direct contact with oil and associated contaminants. In this study, we couple oceanographic and individual-based models to predict the trajectory of larvae and determine where and when they would have encountered oil. We explore two scenarios. In the first, we assume that contact with oil was lethal to larvae, and we determine how this would have changed patterns of population connectivity in the northern Gulf in 2010. In the second scenario, we assume that contact with oil was not lethal, but led to uptake of contaminants that were then transported around the Gulf. We examine which estuaries along the coast would be predicted to have received the highest proportion of “oiled” larvae and were therefore most likely to have been impacted under this scenario.

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Type: Poster 4-112

Detection of oil-spill and wastewater contaminants in blue crab (Callinectes sapidus) megalopae in the northern Gulf of Mexico

Presenter: Susan C Chiasson
Tulane University
Authors: S. C. Chiasson, D. A. Grimm, C. Taylor;
Tulane University, New Orleans, LA.

Abstract:
The blue crab, Callinectes sapidus, is an integral part of the ecosystem in the northern Gulf of Mexico (nGOM) in addition to its great commercial value in the nGOM. Because of its life history, blue crabs are likely to come into contact with pollutants from both the Gulf and from wastewater sources. Post-larval stages (megalopae) of blue crabs were collected from May until October at seven sites along the northern Gulf of Mexico coast from Florida to Texas in the year of the oil spill (2010) and four sites in 2011. GC-MS analyses on megalopae were conducted to scan for both spill-related and wastewater contaminants and we conducted an analysis to detect correlations between pollutants.
With regards to oil-spill contaminants, we found no evidence of PAHs but we did detect long straight-chain alkanes that may be indicative of petroleum contamination. However, the timing and location of the alkane detection in the crabs does not match well with the location of oil released from the DWH spill suggesting the alkanes come from a different source. We also detected wastewater contaminants, 4-nonylphenol and BHT, and found a strong correlation between the levels of 4-nonylphenol and BHT at some sites but not at others. 4-nonylphenol is considered an endocrine disruptor, and high levels were detected at some sites. Relative levels of contamination between the two years will be discussed.

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Polycyclic aromatic hydrocarbons in continental-shelf sediments two years after the Deepwater Horizon Blowout

Presenter: Haley M Ramirez
Eckerd College
Authors: H. M. Ramirez[1], I. C. Romero[2], S. Snyder[2], R. A. Larson[2], P. Schwing[2], G. R. Brooks[1], S. Murawski[2], D. Hollander[2];
[1]Eckerd College, St. Petersburg, FL, [2]University of South Florida, St. Petersburg, FL.

Abstract:
Following the Deepwater Horizon blowout in 2010, sediment analyses revealed the presence of oil in sediments collect from 1000m-1500m depth in the Gulf of Mexico. In order to assess the presence of source-oil hydrocarbons in less- studied areas and in association with contamination studies of demersal fishes, sediment cores were collected from seven sites on the continental shelf north and southwest of the Deepwater Horizon wellhead. Polycyclic aromatic hydrocarbons (PAHs), recognized as major contaminants to demersal fishes, were analyzed for abundance, composition, and vertical distribution in sediment cores. A core taken near the mouth of the Mississippi River showed high concentrations of total PAHs (361-1027ng/g dry weight), containing on average 81±4 % HMW PAHs (4-6 rings) and only 19±4% LMW PAHs (2-3 rings). This preliminary data suggests there was a large input of pyrogenic PAHs (HMW PAHs) distinct from previous analyses in deeper areas. Further downcore analysis of sediment chronology and PAHs will help elucidate if continental shelf sediments, collected in 2012, were exposed to multiple source-hydrocarbons in 2010 and 2011. Analysis of additional cores will expand our understanding of how PAHs are distributed on the continental shelf sediments two years after the Deepwater Horizon blowout.

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Effects of the Deepwater Horizon Oil Spill on Diets, Growth, and Condition of Larval Spanish Mackerel (Scombermorus maculatus) in the Northern Gulf of Mexico

Presenter: John Ransom
The University of Southern Mississippi
Authors: J. Ransom, J. Filbrun, C. Culpepper, F. Hernandez;
The University of Southern Mississippi, Ocean Springs, MS.

Abstract:
The impacts of the Deepwater Horizon (DWH) oil spill on fish populations in the Northern Gulf of Mexico remain largely unknown. Of special concern are the fate of fish eggs and larvae present in the water column during the event, because these are the most vulnerable life stages and small changes in hatching success, larval growth, and survival can drive large fluctuations in their adult populations. Studies have already shown that oil carbon entered the coastal plankton food web, and that the released oil and dispersants can have adverse toxicological effects on fish eggs and larvae. Using historical samples collected by the Fisheries Oceanography of Coastal Alabama (FOCAL) plankton survey, we seek to resolve the effects of the DWH oil spill on larval fish by comparing the diets, growth, and condition of targeted species collected during summer months in years before, during, and after the event. In this study, we present our initial comparisons of Spanish mackerel (Scomberomorus maculatus) gut fullness, diet composition, and prey selection; growth rates (from otoliths); and body condition (from morphometrics and dry weight at length) over the time series. Our results will fill critical information gaps needed by marine ecologists and fisheries managers to understand and predict the short and long-term effects of the DWH oil spill on important commercial and recreational fisheries in the Northern Gulf of Mexico.

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Type: Poster 4-115

Combined Effects of Low Dissolved Oxygen and Oil Contaminants in the Gulf Killifish Fundulus grandis

Presenter: Christopher Klinkhamer
Purdue University
Authors: C. Klinkhamer[1], T. Bosker[2], S. Deguise[2], C. Perkins[2], R. Griffitt[3], M. Sepúlveda[1];
[1]Purdue University, Lafayette, IN, [2]University of Connecticut, Storrs, CT, [3]University of Southern Mississippi, Ocean Springs, MS.

Abstract:
Ensuring the integrity of experiments involving aquatic species necessitates environmental conditions, including the level of dissolved oxygen (DO), be accurately measured and maintained. For our experiments with the Gulf killifish, Fundulus grandis, we need to maintain low DO levels (2.0 ppm, achieved by bubbling nitrogen into the test media) for a period of ~ 16 days (throughout embryo development) while at the same time we administer different oil mixtures. Although colorimetric, titrimetric, and polarographic methods of measuring DO exist and provide accurate results, these methods may be inappropriate when disturbing the sample water or its chemistry is undesirable. We utilize an accurate, reliable, and cost effective method of measuring DO, which requires no physical or chemical disturbance of the sample water. By dissolving TiO2 micro-particles, and Pt(II) meso-Tetra(pentafluorophenyl)porphine, an oxygen sensitive fluorescent dye, in polystyrene, we are able to paint oxygen sensors directly on the test chamber, in contact with the sample water, and measure DO by quantifying any emitted fluorescence. Readings may be taken either through a clear glass or plastic test chamber or through the surface of the water, allowing for minimal manipulation of the sample during the experiment. Sensors can be re-used. We will present data on the effectiveness of this method in oil chronic toxicity tests carried out at low levels of DO, with and without renewal of sample water.

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Type: Poster 4-116

Spatiotemporal Variation of Exposure of Southern and Gulf Flounder to Crude Oil following the Deepwater Horizon Oil Spill using Otoliths and LA-ICPMS

Presenter: Philippa Kohn
University of Florida
Authors: P. Kohn, D. Murie, D. Parkyn;
University of Florida, Gainesville, FL.

Abstract:
Habitat use, prey preferences, and life history of Southern and Gulf Flounder make them ideal species to examine the effects of oil exposure following the Deepwater Horizon oil spill. These benthic-dwelling fishes are especially prone to contact with any degraded oil contaminants in the sediments and are found across the Gulf of Mexico, allowing for a spatial analysis of exposure to spilled oil. Otoliths are comprised of calcium carbonate and incorporate elements and isotopes from ambient water and diet. Because otoliths are metabolically inert, resorption of elements and isotopes is prevented once accreted. As such, otoliths can serve as a recorder of exposure by incorporating elements and isotopes derived from spilled oil. In this study, spatiotemporal variation in otolith geochemistry of Southern and Gulf Flounders from across the Gulf of Mexico will be assessed using Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICPMS). Differences in age-specific growth of flounder before and after the spill will be assessed for flounders identified as being exposed versus non-exposed using LA-ICPMS. Based on the occurrence and concentration of oil contaminants in otoliths, spatial pattern analysis using GIS will identify clusters and hot spots of exposure to further assess the fate of spilled oil in the Gulf of Mexico, identify areas that are at risk for chronic impacts, and provide further information on the impact of exposure on flounder.

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Did Deepwater Horizon Hydrocarbons Transit to the West Florida Continental Shelf?

Presenter: Robert Weisberg
University of South Florida
Authors: R. Weisberg, L. Zheng, Y. Liu, S. Murawski, C. Hu, J. Paul, D. Hollander;
University of South Florida, St. Petersburg, FL.

Abstract:
Hydrocarbons of Deepwater Horizon origin were observed at the surface along west Florida's northern coastline in June 2010. An eastward advance to the vicinity of Cape San Blas occurred in the last week of June before the surface oil retreated back westward and dissipated. Surface oil was not observed to the southeast of Cape San Blas. Nevertheless, there were numerous anecdotal occurrences of reef fish caught on the West Florida Shelf (WFS) with lesions and other deformities. Subsequent sampling provided additional evidence for damage to WFS reef fish that extended as far south as the Dry Tortugas.
We examine the possibility that hydrocarbons of Deepwater Horizon origin transited the WFS beneath the surface. A numerical circulation model simulation quantitatively gauged against in situ observations is used. A passive tracer is introduced into the model to mimic the movement of subsurface hydrocarbons, either dissolved, or of sufficiently small particle size to effectively be dissolved. The tracer, driven primarily by an anomalously strong and persistent upwelling circulation, eventually covered most of the WFS. Using reasonable estimates of what the initial tracer concentration may have been with respect to hydrocarbons, we conclude that the transport of subsurface hydrocarbons to the WFS is both plausible and consistent with the observed distribution of fish lesions and other chemical and ecological evidence.

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Type: Poster 4-118

Changes in Commercial Fishing Behavior as Associated with the Deepwater Horizon Blowout

Presenter: Marcy L Cockrell
University of South Florida
Authors: M. L. Cockrell[1], S. A. Murawski[1], A. Strelcheck[2];
[1]University of South Florida, St. Petersburg, FL, [2]National Marine Fisheries Service, Southeast Regional Office, St. Petersburg, FL.
Abstract:
Fisheries closures in federal waters extended to a maximum of 88,522 square miles, or nearly 37% of U.S. waters in the Gulf of Mexico, as a consequence of the Deepwater Horizon oil spill (DWH). Subsequently, the spatial distribution of fisheries, catch quantity, and species composition of landings changed in response to these regulations.
Total economic loss for fisheries and related industries in the years after the spill has been estimated at $8.7 billion. Public perception of seafood safety, associated 'market recovery time,' and consumer demand play substantial roles in this impact. At the same time, decisions made by fishermen of where and when to fish - both during and after DWH - affect potential economic losses and recovery trajectories.
Using high-resolution fishery-dependent data we will quantify the spatial and temporal patterns in commercial fishing before, during, and after DWH. We will quantify fishery-specific shifts and associated changes in landings and economic returns as a result of DWH. The results of this study will highlight the importance of decision making in fishing fleet behavior and the need for better information on socioeconomic impacts to be utilized in disaster planning and mitigation.

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Type: Poster 4-119

Using otolith microchemistry of Gulf killifish (Fundulus grandis) to differentiate estuaries and identify chemical signatures indicative of oil exposure

Presenter: Thomas Reid Nelson
Auburn
Authors: T. R. Nelson[1], D. R. DeVries[1], R. A. Wright[1], J. E. Gagnon[2];
[1]Auburn, Auburn, AL, [2]Windsor University, Windsor, ON, CANADA.
Abstract:
The Gulf killifish (Fundulus grandis) is an important component of coastal marsh ecosystems. Because individuals exhibit limited movement and remain close to the marsh throughout their life, they are a potential indicator species for environmental impact studies. In addition, fish otoliths grow continuously, providing a record of growth and incorporating microchemical markers from the surrounding environment. Here we sampled F. grandis from 10 sites across 4 states in the northern Gulf of Mexico. Louisiana and Alabama both had paired oiled/non-oiled sites (oiled sites were exposed to Deepwater Horizon oil from the 2010 spill). Sites in Mississippi included one adjacent to an oil refinery and a control site, while our Florida site was unexposed to Deepwater Horizion oil. We found distinct microchemical signatures across states, but paired estuaries within states could not be distinguished, suggesting minimal effects from the 2010 spill. We also found a seasonal component, with otolith microchemical differences between states more distinct during fall versus winter. Given the lack of paired site differences and a gradient of increasing oil wells from east to west, we found differences in several elements (Mg, Al, V, Cr, Cu, Zn, Se, Rb) as possible otolith microchemical indicators of prolonged oil exposure in this region.

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Type: Poster 4-120

Determining the effects of the Deepwater Horizon Oil Spill on the Benthic Foraminifera community in the Northeastern Gulf of Mexico

Presenter: Emily M Hladky
Eckerd College
Authors: E. M. Hladky[1], P. T. Schwing[2], M. Martinez-Colon[2], D. J. Hollander[2];
[1]Eckerd College, St. Petersburg, FL, [2]University of Southern Florida College of Marine Science, St. Petersburg, FL.

Abstract:
Sediment cores were collected in the Gulf of Mexico from 2010-2012 to assess the effects of the Deepwater Horizon (DWH) Oil Spill on the community structure of benthic foraminifera at the species level. Cores were collected from two sites with increased petroleum concentrations related to the DWH event, one control site with no increase in petroleum during the DWH event, and one natural hydrocarbon seep site. A benthic foraminiferal assemblage constructed from a sediment core collected in 1975, near the more recently sampled sites, was also incorporated as a control community. All cores were extruded and sub-sampled at 2 and 5mm increments. Foraminifera were picked from each sample, identified to the species level and counted. Pre-DWH and post-DWH community structures will be assessed using 3 indices; the Shannon-Weiner Index, the Equitability Index, and the Fisher's Alpha Index, which measures species richness and density. The use of these indices will address questions such as: (1) Are the pre-DWH and post-DWH communities different and if so, how?; (2) How are the benthic foraminiferal communities recovering from the DWH event?; and (3) How long will it take for the communities to fully recover from the DWH event? Changes in benthic foraminiferal communities are indicative of environmental stressors and potential trophic disruptions, and thus it is very important to document such changes in relation to an event of such magnitude as the DWH.

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Type: Poster 4-121

Impacts of the Deepwater Horizon Oil Spill on trophic ecology and population dynamics of tomtate, Haemulon aurolineatum, in the northern Gulf of Mexico

Presenter: Michael Norberg
University of South Alabama - Dauphin Island Sea Lab
Authors: M. Norberg, W. Patterson, III.;
University of South Alabama - Dauphin Island Sea Lab, Dauphin Island, AL.

Abstract:
The tomtate is a small (<30 cm) invertivore that is among the more abundant reef fishes in the northern Gulf of Mexico, yet little is known about its trophic ecology or population dynamics. We examined differences in tomtate trophic ecology and size at age between natural (NR) and artificial (AR) reefs, as well as between fish collected before vs. after the
Deepwater Horizon Oil Spill (DHOS). Trophic ecology was examined with stable isotope ratios of white muscle, while size at age was examined via sagittal otolith thin sections. Neither habitat type nor time period (pre- vs. post-spill) significantly affected $\delta^{13}C$ values (ANOVA, $p > 0.3$), thus indicating no difference in sources of primary production. Tomtate trophic position ($\delta^{15}N$) was not significantly different between habitat types(ANOVA, $p = 0.158$), but higher post-spill values, thus trophic position, were observed (ANOVA, $p = 0.014$). Lower $\delta^{34}S$ values for NR fish indicate they foraged on more benthic prey than tomtate on AR (ANOVA, $p = 0.03$). However, no significant difference in foraging strategy was evident pre- vs. post-spill (ANOVA, $p = 0.21$). Size at age was tested with a two-way ANOVA (factors = age and time period), with the time period effect sliced by age. Size of age-2 and age-3 fish decreased following DHOS ($p < 0.01$), but there was no difference in size at age for age-4 and age-5 fish ($p > 0.12$). Overall, study results indicate greater differences in tomtate ecology due to the DHOS than habitat effects.

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Microbial community succession and hydrocarbon biodegradation in surface and seafloor pressure incubations

Presenter: Sara A Lincoln
The Pennsylvania State University
Authors: S. A. Lincoln[1], A. G. Valladares Juarez[2], H. S. Kadimesetty[2], M. Schedler[2], R. Müller[2], J. L. Macalady[1], K. H. Freeman[1];
[1]The Pennsylvania State University, University Park, PA, [2]Hamburg University of Technology, Hamburg, GERMANY.

Abstract:
As much as 30% of oil from the DWH spill may have reached marine sediments (1). Understanding its long-term fate and impact on benthic communities is critical for informing remediation policies, but gaps in our knowledge of hydrocarbon biodegradation hinder this effort. In particular, how high hydrostatic pressures (~150 bars at the DWH site) impact biodegradation is unclear, and is increasingly salient as deep water drilling expands. Although early experiments showed that biodegradation proceeded more slowly at elevated pressures (e.g., 2), most studies have been conducted at surface pressure, and their results may not be applicable to the deep ocean. Here, we revisit this problem using Macondo oil and mixed microbial communities in Gulf of Mexico surface sediments collected near the DWH site. Sediment slurries amended with oil were incubated in pressure cells at 1 and 150 bars with continuous online measurement of O2 and CO2. We compare hydrocarbon concentrations and bacterial and archaeal community composition (determined by rDNA amplicon sequencing) in samples collected at different stages of O2 drawdown, putatively correlating to different growth phases of the community. These experiments enable us to evaluate potential differences in microbial community succession and the efficiency of hydrocarbon degradation at surface and DWH pressures.
(1) Schrope, 1/28/2013. Nature News.
(2) Schwarz et al., 1974. Appl. Microbiol. 28:982-986

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The Deepwater Horizon Oil Spill and Mercury Concentrations in Northwest Florida Reef Fishes

Presenter: Alexandra R Harper
Florida State University
Authors: A. R. Harper[1], J. Chanton[1], J. Nelson[2], W. Landing[1], D. Grubbs[1];
[1]Florida State University, Tallahassee, FL, [2]N.E. Climate Science Center, Woods Hole, MA.

Abstract:
The Florida Panhandle Bight is characterized by a gently sloping continental shelf spotted with patchy “hard bottom” reef habitat. The Deepwater Horizon oil spill resulted in areas of reduced oxygen concentration (Kessler et al., 2011) and an influx of organic carbon to the sediment (Passow et al. 2012). Methyl mercury is primarily produced in anoxic coastal marine sediments by sulfate-reducing bacteria (Compeau and Batha, 1985). This study aims to determine whether more reducing conditions caused by the oil spill led to higher levels of mercury in commercially important reef associated organisms. We compared pre-spill (collected 2007-09) and post-spill (collected 2012-13) fish species of similar length and δ15N signatures from hard-bottom reefs on the West Florida Shelf. Preliminary results indicate that post-spill reef associated species exhibit consistently higher total mercury (THg) loads (mean THg = 1.74 ± 1.32 ug/g dry weight) than their pre-spill counterparts (mean THg = 1.34 ± 1.32 ug/g dry weight). Jacks (Seriola rivolinia and S. dumerili) exhibit the greatest increase in THg concentrations (mean pre-spill Hg = 0.82 ± 0.25 ug/g dry weight; mean post-spill THg = 2.88 ± 1.63 ug/g dry weight). Pinfish (Lagodon rhomboides) and seabasses (Centropristis ocyurus and C. philadelphica) showed only moderate increase in THg concentrations while groupers (Mycteroperca phenax, Hyporthodus flavolimbatus, and H. niveatus) THg loads remained roughly the same. We also determined that pinfish alone are responsible to transporting approximately 1.9 lbs. of MeHg offshore during their annual fall egress and represent an important component of a dynamic system contributing to the toxicity of GOM commercial fishes.

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Type: Poster 4-124

Comparative responses of the bay anchovy (Anchoa mitchilli) and blue crab (Callinectes sapidus) to oil, dispersed oil and Corexit

Presenter: Tara A Duffy
LUMCON
Authors: T. A. Duffy, E. J. Chesney;
LUMCON, Chauvin, LA.

Abstract:
Bay anchovy (Anchoa mitchilli) and blue crab (Callinectes sapidus) are ecologically and economically important species in the Gulf of Mexico. Because they are spring and summer spawners, larvae of these species likely encountered oil during the DWH spill at both lethal and sub-lethal concentrations. In an effort to compare differential responses, larvae were exposed to the water-accommodated fraction (WAF) of Macondo surrogate oil, chemically-enhanced WAF (CEWAF), and dispersant (Corexit9500) at multiple life-stages. No mortality was induced by 24 or 48 hour WAF exposure, but CEWAF exposure induced differential mortality between species. Further, comparable-age bay anchovy larvae were nearly seven times more sensitive to CEWAF than blue crab zoea, with an LD50 of 134 mg/L and 880 mg/L (nominal oil loading), respectively. Bay anchovy demonstrated similar sensitivity to CEWAF between 5 dph and 20 dph, but mortality appeared to be size-dependent. Further, CEWAF produced with 0 ppt water was considerably more toxic than CEWAF at 25 ppt. The establishment of baseline mortality data will allow us to determine WAF and CEWAF concentrations that induce changes in behavior and development in these early life stages. For example, CEWAF exposure induced visible changes in swimming ability and phototaxis in survivors. These alterations in behavior will be quantified in future studies.

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Type: Poster 4-125

Investigating the presence of oil in deep sediments and the water column in the Gulf of Mexico using carbon isotopes

Presenter: Joanna Kolasinski
Tulane University
Authors: J. Kolasinski, B. E. Rosenheim, M. A. Pendergraft, J. Tang, A. Fernandez, N. J. Leone;
Tulane University, New Orleans, LA.

Abstract:
On April 2010, the Deepwater Horizon rig explosion and subsequent leak of the Macondo Well in the Gulf of Mexico released crude oil composed of a variety of hydrocarbon compounds at deep depth (1500m).We used a combination of stable carbon isotope (d13C), radiocarbon (Δ14C) and ramped pyrolysis analysis as potential tools to depict oil at the basis of benthic (sedimentary organic matter) and pelagic (dissolved organic carbon) food webs. Here we present a comparison of pre- and post- spill data from two oceanographic cruises conducted in 2012 and 2013 in the central north of the Gulf. Progress made in the recognition of oil in deep sediment cores and the water column will be discussed and the production of background data for future oil spills will be emphasized. A relationship between PAH composition and d13C difference from background data is suggested by our results, however Δ14C measurements comparisons to literature values are highly dependent on depth in the sediment core.

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Type: Poster 4-126

Comparison of otolith-based growth rates and microchemistry in inshore fish before, during, and after the Deepwater Horizon oil spill

Presenter: Brock C. Houston
University of South Florida
Authors: B. C. Houston, E. Peebles, S. A. Murawski;
University of South Florida, St. Petersburg, FL.

Abstract:
The Deepwater Horizon oil spill polluted thousands of miles of Louisiana coastline during the summer of 2010. Oil invaded inland coastal habitats, potentially causing species living in those areas to be exposed to toxic chemicals. The purpose of this study is to examine otoliths from four species of inshore fish for evidence of reduced growth rate and stress. Growth rate is a good indicator of overall fish condition that translates into changes in survival and lifetime reproductive potential. The width of otolith growth annuli will be

compared before, during, and after the oil spill. Dendrochronology-based methods will be used to create annual growth profiles, and otolith microchemistry using laser ablation ICP-MS will be used to investigate associations between any observed reduced growth and the temporal profiles of putative oil-marker elements. Stress-indicator elements will also be analyzed within the same temporal framework.

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Type: Poster 4-127

Polycyclic Aromatic Hydrocarbon Biomarkers in Gulf of Mexico Fishes in the years following the Deepwater Horizon Oil Spill

Presenter: Arianne E Leary
University of North Florida Biology department
Authors: A. E. Leary[1], J. Gelsleichter[1], D. Grubbs[2];
[1]University of North Florida Biology department, Jacksonville, FL, [2]Florida State University, Talahassee, FL.

Abstract:
The Deepwater Horizon Oil Spill released large quantities of liquid petroleum into the Gulf of Mexico. This was the largest oil spill in U.S. history and the depth that it occurred at creates a unique yet challenging research opportunity. It is vital to determine the effects on Gulf wildlife from oil-related pollutants, particularly the polycyclic aromatic hydrocarbons (PAHs), which are the most toxic components of oil. A variety of PAH biomarkers have been used to evaluate health impacts from the oil spill. Due to the rapid metabolism of these compounds, detoxification enzymes activity such as, cytochromeP450 a1a and glutathione-S-transferase were measured to asses PAH exposure. Additionally PAH metabolites from these processes were measured in bile. Thus far results suggest continued exposure with several species indicating significant increases in GST activity and FAC concentration from 2011 to 2012. This increase likely represents the redistribution of PAHs settle in sediment. Samples from 2013 are currently being analyzed.

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Type: Poster 4-128

Changes in fish sound production in the Gulf of Mexico following the Deepwater Horizon oil spill

Presenter: Ana Širović
Univ of California San Diego
Authors: A. Širović[1], S. Friedman[2], S. C. Johnson[1], J. A. Hildebrand[1];
[1]Univ of California San Diego, La Jolla, CA, [2]Univ of Washington, Seattle, WA.

Abstract:
Passive acoustic recording was used to evaluate changes in the presence of soniferous fishes at a site located on the continental shelf (90 m depth) approximately 30 miles from the Deepwater Horizon site from July 2010 through 2011. Seven distinct sounds were detected in 2010, but only four of them were detected in 2011. Croaks (likely produced by the Atlantic croaker, Micropogonias undulatus) and “jet-ski” calls (likely produced by the Atlantic midshipman, Porichthys plectrodon) were among the most common during 2010 with unique diel patterns. Only croaks increased in numbers in 2011 and maintained their nocturnal pattern. Jet-ski sounds were less common in 2011 and no longer exhibited crepuscular pattern observed in 2010. The difference in recorded sounds is likely an indicator of a change in the fish community structure at this site between the two years. Factors that could explain this change include interannual variability due to the extent of anoxic zones, variability in ocean temperature and circulation, or possible impact of the oil spill on fishes in the area. Further investigation on the behavioral context of these sounds would provide insight into likely consequences of the change in calling to these soniferous fishes.

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Type: Poster 4-129

Who's Oil is it Anyway? Evaluating *Deepwater Horizon* in Relation to Multiple Hydrocarbon Sources Affecting Gulf of Mexico Fishes

Presenter: Steven A. Murawski
University of South Florida
Authors: S. A. Murawski[1], J. E. Stein[2], G. M. Ylitalo[2], D. Wetzel[3], S. Snyder[1];
[1]University of South Florida, St. Petersburg, FL, [2]Northwest Fisheries Science Center, Seattle, WA, [3]Mote Marine Laboratory, Sarasota, FL.

Abstract:
Previous studies of the 'oil budget' in Gulf of Mexico waters have identified multiple sources of hydrocarbon pollution. These include natural hydrocarbon seeps, atmospheric deposition, coastal runoff, large river inputs, produced waters from oil and gas facilities, and oil infrastructure-related leaks and spills. This study evaluates the concentration and composition of polycyclic aromatic hydrocarbons (PAHs) in fishes and how they relate to the volume, composition and weathering of various sources of hydrocarbon inputs, including *Deepwater Horizon* (DWH). Results from pre-spill baselines, weathering models and post-spill monitoring provide insights into contributions by various sources to the oil pollution budgets affecting Gulf of Mexico fishes, and their temporal trends. The apparent PAH signals from DWH in fishes were spatially coherent, widespread, and have declined significantly over time in some fishes towards an unknown baseline level that should become more apparent over time.

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Type: Poster 4-130

Utilizing 234Th as a geochronometer in sediment cores following the 2010 DWH blowout

Presenter: Rebekka A Larson
Eckerd College/USF
Authors: R. A. Larson[1], G. R. Brooks[2], P. T. Schwing[3], I. Romero[3], C. Moore[2], G. Reichart[4], T. Jilbert[5], J. P. Chanton[6], D. W. Hastings[2], W. A. Overholt[7], K. P. Marks[7], J. E. Kostka[7], C. W. Holmes[8], D. Hollander[3];
[1]Eckerd College/USF, Saint Petersburg, FL, [2]Eckerd College, Saint Petersburg, FL, [3]USF, Saint Petersburg, FL, [4]University of Utrecht/NIOZ, Utrecht, NETHERLANDS, [5]University of Utrecht, Utrecht, NETHERLANDS, [6]FSU, Tallahassee, FL, [7]Georgia Tech, Atlanta, GA, [8]Environchron, Bradenton, FL.

Abstract:
Cores from the NE GOM following the DWH blowout provide a unique opportunity to study a sedimentary response to an event in real time. Between Aug. 2010 and Aug. 2013 >100 cores were collected from >60 sites. Cores were extruded at 2-5 mm intervals and samples were analyzed for sediment texture, composition and short-lived radioisotope geochronology (210Pb, 234Th). With a half-life of ~24 days, 234Th is typically used as an indicator of surface mixing (e.g., bioturbation), but may be used as a geochronological tool if sediments are unmixed. Multiple independent lines of evidence indicate that the surficial 0.4-1.2 cm was distinct from underlying sediments, interpreted as a lack of vertical mixing. Excess 234Th was determined by subtracting the supported (determined by downcore activities and/or re-analysis of samples >130 days from collection) from the total 234Th activity. Activities of excess 234Th were "Decay Corrected" for activity lost between the time of core collection and sample analysis. Excess 234Th profiles reflect deposition of the 0.4-1.2 cm surface layer in a 4-5 month period in the late summer/fall of 2010, with higher mass accumulation rates (MARs) compared to average rates (past ~100 yrs). Using the same 234Th methodology, MARs have decreased over the two years following the event. Analyses of cores collected in Aug. 2013 are in progress to continue the time series of sedimentation and potential recovery to pre-event conditions.

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Type: Poster 4-131

The first transcriptomes of the blue crab, Callinectes sapidus and the lesser blue crab, C. similis: new tools for basic and applied research

Presenter: Joseph Neigel
University of Louisiana at Lafayette
Authors: J. Neigel, B. Yednock;
University of Louisiana at Lafayette, Lafayette, LA.

Abstract:
New methods for sequencing the entire transcriptomes of non-model organisms have created novel opportunities for research in population genetics and eco-physiology and provided powerful new tools for fisheries management and conservation biology. In this talk we will present our rationale for sequencing transcriptomes of the blue crab and a related species and provide an overview of our most recent data. We will also show how this data can now be used to advance our understanding of the biological effects of oil spills as well as address long-standing questions about population connectivity and local adaptation in populations of blue crabs within the Gulf of Mexico.

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Type: Poster 4-132

Direct Sub-Lethal Effects of Corexit® 9500 and Oil on the Eastern oyster (*Crassostrea virginica*)

Presenter: Lindsay Jasperse
University of Connecticut
Authors: L. Jasperse[1], K. Tsantiris[1], M. Levin[1], S. Martin[1], C. Perkins[1], J. E. Ward[2], S. De Guise[1];
[1]University of Connecticut, Storrs, CT, [2]University of Connecticut, Groton, CT.

Abstract:
The direct toxicity of the oil dispersant Corexit® 9500 on marine organisms is not well studied. Oysters are an economically and ecologically important marine species in the Gulf of Mexico. Oyster filter-feeding behavior results in significant interaction with particulate matter in water, indicating that oysters may serve as sentinel species for oil and dispersant exposure. The objectives of this study were to evaluate the toxic effects of Corexit® 9500, crude oil, and a dispersant/oil mixture on immune functions, clearance rates, tissue concentrations and histopathology of Eastern oysters (Crassostrea virginica) following acute exposure. Hemolymph was collected from the adductor muscle sinus for the evaluation of two innate immune functions: the ability of hemocytes (granulocytes and hyalinocytes) to engulf fluorescent beads (phagocytosis) and produce H2O2 (respiratory burst), using flow cytometry. Corexit® did not affect phagocytosis, but significantly reduced respiratory burst at concentrations ≥ 20 ppm. Corexit® concentrations ≥ 20 ppm also significantly reduced oyster clearance rates. Tissue concentrations revealed that oysters could quickly and efficiently take up Corexit® from the water. This continuing study will assess toxicity of sweet Louisiana crude oil and a Corexit®/oil mixture to achieve a more accurate risk assessment concerning the impact of Corexit® and oil on the health of oysters and aid in making scientifically sound decisions regarding dispersant use in future spills.

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Deepwater Horizon Oil Spill effects on *Lopholatilus chamaeleonticeps*

Presenter: Monica I Collazos
University of North Florida
Authors: M. I. Collazos, A. Leary, J. Gelsleichter;
University of North Florida, jacksonville, FL.

Abstract:
The Deepwater Horizon Oil Spill (DHOS) released large quantities of oil in the Gulf of Mexico. Exposure to polycyclic aromatic hydrocarbons (PAH), the most toxic components of oil, is typically evaluated to determine effects from oil spills. However, since PAHs are rapidly metabolized after exposure, biomarkers are typically used as indicators of exposure and effects of these compounds. In this study, two types of PAH biomarkers, enzymes involved in PAH metabolism (glutathione-S-transferase) and biliary metabolites of various PAHs (chrysene, phenanthrene, pyrene, naphthalene, benzo(a)pyrene), were measured to examine oil exposure in the great Northern tilefish, Lopholatilus chamaeleonticeps. Since this species is a burrowing fish, it has a high risk for exposure to oil that has settled in the sediment.

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Population biology of the blackfin gulper shark, Centrophorus isodon, in the Northern Gulf of Mexico

Presenter: Jacquelin J Hipes
University of South Florida
Authors: J. J. Hipes, K. Rosario, M. Breitbart, S. A. Murawski;
University of South Florida, St. Petersburg, FL.

Abstract:
During three long-lining cruises in the Northern Gulf of Mexico from 2011 to 2013, several hundred elasmobranch specimens were morphologically identified as blackfin gulper sharks, Centrophorus isodon, a deep-water species previously described as residing in the Bahamas and Indo-Pacific. This poster examines the systematics of specimens from these collections in relation to published phylogenies for this family of sharks, using gene sequencing and morphological factors to confirm the population's identity. Information on the spatial distribution, density, species associations, size composition by sex, and sex ratio are used to describe the population biology of this poorly documented species. Due to its proximity to the Deepwater Horizon blowout, this population was potentially impacted by the oil spill and the possible vulnerability of the species to oil contamination will be reviewed.

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Type: Poster 4-135

Cloning and expression analysis of IL-1β, IL-8, IL-10, and TNFα in red snapper and golden tilefish in relation to PAH exposure

Presenter: Kristina L Deak
Mote Marine Laboratory
Authors: K. L. Deak[1,2], S. Murawski[2], C. Walsh[1], D. Wetzel[1];
[1]Mote Marine Laboratory, Sarasota, FL, [2]University of South Florida, St. Petersburg, FL.

Abstract:
Polycyclic aromatic hydrocarbons (PAH's) are immunosuppressive in teleosts. Although their mechanism of toxicity has not been fully elucidated, PAH-induced alteration of cytokine expression may be critical, as cytokines are pleiotropic signaling proteins that regulate many aspects of the vertebrate immune response. Recent work demonstrates differential expression of cytokine genes upon exposure to PAH's in fish, however, red snapper and tilefish have not been studied. Spleen and blood were sampled from red snapper and tilefish in the vicinity of the Deepwater Horizon oil spill in 2013. Here, the cloning and sequencing of three pro-inflammatory (IL-1β, IL-8, and TNFα) cytokines and one anti-inflammatory (IL-10) cytokine from these species are performed, cytokine expression in field-collected samples is quantified, and differential expression in response to in vitro PAH exposure examined. The genes will be identified in spleen samples using degenerate teleost primers, followed by creation of species-specific primers. The entire gene will be cloned and sequenced using 5'- and 3'-RACE PCR. Quantitative Real-Time PCR will be used to measure gene expression in field-collected samples. Cultured red snapper spleen cells will be dosed with individual PAH's and DWH crude to investigate expression change upon toxin exposure in vitro. This work will enhance our understanding of teleost cytokines and examine possible impacts of DWH spill on commercially-relevant Gulf fishes.

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A more efficient route to Atlantis: new tools for developing and comparing Atlantis models applied to new models for the eastern Gulf of Mexico

Presenter: J. Stephen Gosnell
Coastal and Marine Laboratory
Authors: J. Gosnell;
Coastal and Marine Laboratory, St. Teresa, FL.

Abstract:
Ecosystem models offer methods for exploring how ecological communities are structured and respond to contemporary concerns such as fishing, oil spills, and climate change. However, use of these models is limited by several factors. Developing ecosystem models is data-, time-, and computationally-intensive. Results and future application can also be impacted by subjective decisions such as choice of focus groups or spatial resolution. To address these issues, I demonstrate the use of new tools, developed in the R language, that expedite the development and comparison of Atlantis ecosystem models. Biological parameters for models are derived by combining data available to a given researcher or group with available public data. For the Gulf of Mexico, oceanographic data is derived from a high-resolution, downloadable HYCOM model. These tools promote the development and comparison of Atlantis models by allowing new and nested models to easily share existing data and specifications. Taking advantage of the flexibility of the Atlantis modeling platform, these tools can be used to quickly produce models that vary in complexity and resolution (spatial, temporal, taxonomic) and better our ability to consider how model-specific decisions impact outcomes. I demonstrate the application of this process in developing a new Atlantis model for the eastern Gulf of Mexico and discussing how taxonomic grouping impacts model outcomes.

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The effects of sample processing methods on light stable isotope and mercury analyses of fish muscle

Presenter: Johanna L Imhoff
Florida State University
Authors: J. L. Imhoff, A. Mickle, C. T. Peterson, R. Grubbs;
Florida State University, Tallahassee, FL.

Abstract:
Investigating the trophic relationships of fishes of the shelf edge, continental slope, and deep sea is central to understanding potential effects of the DWH oil spill on the biota of the northeastern Gulf of Mexico. When using fish white muscle samples for trophic and mercury contamination studies, it is important to consider the effects of sample processing protocols on $\delta^{13}C$ and $\delta^{15}N$ values. This is particularly true for elasmobranch fishes which retain isotopically light nitrogenous wastes, including urea, in their muscles, confounding $\delta^{15}N$ results and their interpretation. Lipid extraction can remove some nitrogenous wastes from elasmobranch muscle, but a separate rinsing step for urea extraction may also be necessary. The objective of this study was to investigate the effects of lipid and urea extraction on stable carbon and nitrogen isotope ratios and mercury concentrations in coastal and deepwater elasmobranchs, and the effect of lipid extraction on stable carbon and nitrogen isotope ratios and mercury concentrations in coastal and deepwater teleosts. Results of this study will be used to determine appropriate tissue processing methods for elasmobranchs, determine if muscle can be processed the same way for both coastal and deepwater fishes, and determine if bulk muscle can be processed once for both stable isotope and mercury analyses.

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Splenic Macrophage Aggregates As Potential Biomarker of Exposure in Red Snapper Sampled From The Northern Gulf of Mexico Post-DWH Oil Spill

Presenter: Andrew S Kane
University of Florida, Aquatic Pathobiology Laboratories
Authors: A. S. Kane[1], J. Pine[1], M. O. James[2], I. C. Romero[3], D. J. Hollander[3], W. F. Patterson[4];
[1]University of Florida, Aquatic Pathobiology Laboratories, Gainesville, FL, [2]University of Florida, Gainesville, FL, [3]University of South Florida, St. Petersburg, FL, [4]University of South Alabama, Dauphin Island Sea Lab, Dauphin Island, AL.

Abstract:

Macrophage aggregates were histologically observed and ranked in the spleens of red snapper (Lutjanus campechanus; n=19) collected in 2011 and 2012 from the northern GoM. This study evaluated macrophage (MΦ) aggregate numbers, sizes and distribution based on fish condition index, location of capture, and available hepatic biotransformation enzyme activity data and analytical toxicology. MΦ rank data was validated based on correlations between aggregate ranks, and MΦ numbers and areas. A positive correlation between splenic macrophage severity rank and fish total length (p=0.05), but not fish weight (p=0.15), was observed. Metrics data further suggest that larger fish may have lower condition indices compared with literature values for red snapper from the northern Gulf in previous years. No differences in MΦ aggregate severity ranks were observed in red snapper sampled from multiple zones distributed east to west in the GoM (F=0.668, p=0.57). However, enzyme activities for both aryl hydrocarbon hydroxylase and glutathione transferase had a positive relationship with MΦ aggregate severity. Observations from individual red snapper with PAH data suggest that MΦ aggregate severity may be indicative of PAH exposure. These limited data support immuno-toxicological impact associated with PAH exposure in red snapper as observed by alterations in splenic macrophage aggregate severity.

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Type: Poster 4-139

Correlational changes in benthic foraminifera abundance and sedimentary redox conditions after the Deepwater Horizon Blowout event

Presenter: Corday R. Selden
Eckerd College
Authors: C. R. Selden[1], D. Hastings[1], P. Schwing[2], G. Brooks[1], D. Hollander[2];
[1]Eckerd College, St. Petersburg, FL, [2]University of South Florida, St. Petersburg, FL.

Abstract:
Rapid accumulation of sediment occurred after the Deepwater Horizon oil event, changing sediment redox conditions and contributing to widespread decline in benthic foraminifera abundance. The decline likely resulted from sudden and persistent reducing conditions and exposure to polycyclic aromatic hydrocarbons (PAH). This delivery of organic carbon and PAH to the sediments may be explained by two hypothetical processes: (1) the flocculent blizzard, referring to the formation and rapid deposition of marine snow, and (2) the bathtub ring, referring to the impingement of the hydrocarbon intrusion on the continental slope between 1000 to 1300 m water depth. Redox sensitive metals (Mn, Re, Cd) in cores collected in the NE Gulf of Mexico from August 2010 to August 2013 revealed greater reducing conditions in surface sediments, and a shoaled redoxcline. The abundance of the most prevalent deep infaunal (dysoxia tolerant), shallow infaunal (transitional), and epifaunal (dysoxia intolerant) genera of benthic foraminifera were documented down-core as a function of redox conditions at two sites affected by the event, and compared to a control site. A natural seep site was also assessed to identify foraminifera genera dynamics where hydrocarbons are naturally deposited. Our research will help constrain the mechanism for the decrease of benthic foraminifera after the DWH event, which is an important component in understanding the larger and long-term ecological consequences.

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Type: Poster 4-140

The Effects of Ontogeny, Habitat, and DWH Oil Spill on Red Snapper, Lutjanus campechanus, Diet and Trophic Ecology in the Northern Gulf of Mexico

Presenter: Joseph H Tarnecki
Dauphin Island Sea Lab
Authors: J. H. Tarnecki[1,2], W. F. Patterson III[1,2];
[1]Dauphin Island Sea Lab, Dauphin Island, AL, [2]University of South Alabama, Mobile, AL.

Abstract:
Red snapper were sampled from 2009-2011 at natural (n=35) and artificial (n=28) reef sites as part of a broader study of reef fish feeding ecology at natural versus artificial reefs in the northern Gulf of Mexico. Stomachs (n=708) were extracted and their contents preserved for gut content analysis, while muscle tissue samples (n=200) were dissected and frozen for IR-MS analysis (δ13C, δ 15N, and δ 34S). Forty-eight percent of stomachs had identifiable prey. An unplanned factor was incorporated into the study when the Deepwater Horizon Oil Spill (DHOS) occurred in summer 2010. Fish length (PERMANOVA, p=0.029) and the DHOS (PERMANOVA, p=0.001) significantly affected red snapper diet, but interactions between habitat type and the DHOS (PERMANOVA, p=0.032) also were significant. The habitat and DHOS interaction was driven by a decrease in zooplankton consumed among both habitat types, increased benthic prey on natural reefs, and increased fish prey on artificial reefs. Stable isotope data indicated an increase in red snapper trophic position (15N enrichment, ANOVA, p<0.001) and an increase in benthic versus pelagic prey (34S depletion, ANOVA, p<0.001) post-spill. Results clearly indicate the DHOS affected red snapper diet and, potentially, prey resources. Study results also confirm the utility of stable isotope analysis to infer aspects of reef fish trophic ecology.

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Detection of Oil Spill Microbe and Colonization of Shrimp Species of the Gulf of Mexico

Presenter: Illya Tietzel
Southern University at New Orleans
Authors: I. Tietzel, G. Kiffin, K. A. Perkins;
Southern University at New Orleans, New Orleans, LA.

Abstract:
The ecological consequences of major oil spills such as the Deepwater Horizon in the Gulf of Mexico remain to be studied. More specifically, no reports exist whether the oil spill associated microbes cause changes of the microbial communities inside the digestive tract of fish or shrimp. Based on the reported presence of oil degrading microbes in the Gulf of Mexico and the findings that externally applied microbes impact the microbial community of the intestine of fish and shrimp, it is hypothesized that oil degrading microbes such as of the genus Alcanivorax will be present in the digestive tract of fish and potentially cause changes of the microbiota. To test this hypothesis, fish captured from oil spill sites near Chauvin, LA in September, October and November of 2010 were analyzed with Polymerase Chain Reaction (PCR) specific for Alcanivorax borkumensis. DNA was isolated from fecal matter of fish. Primers for alkB1 and alkB2 genes were used. A lab strain of Alcanivorax borkumensis served as positive control. Shrimp captured in 2013 were also analyzed. A. borkumensis was detected in Gulf Menhaden, but not in Atlantic Croaker. The data for the shrimp such as Farfantepenaeus aztecus and Litopenaeus setiferus were inconclusive. Longitudinal studies will study the long term effects of the oil spill. The research was funded by NSF MCB-1051237, LEQSF-EPS(2012)-SURE-63 and NSF DBI-1040966.

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Date: Monday, January 27 - 6:00 PM
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Track: Integrated Understanding of the Impacts of the DWH Oil Spill on Fisheries: Exposure Vectors, Biological-Physiological Effects and Abundance of Fisheries Populations
Type: Poster 4-142

Towards the quantitative visualization of dynamic interactions between bacterial biofilms and solitary oil-droplets

Presenter: George E. Kapellos
Texas Tech University
Authors: G. E. Kapellos, M. Molaei, S. Vanapalli, F. Hussain, J. Sheng;
Texas Tech University, Lubbock, TX.

Abstract:
Understanding of the basic mechanisms of interaction between bacterial communities and oil droplets will enable reliable prediction of oil dispersion and contamination risk assessment in aquatic ecosystems. However, the analysis of the process under consideration is challenging because the structure of the physical system exhibits a hierarchy of characteristic length scales that span several orders of magnitude and, further, there exists an intricate interplay between hydrodynamic, physicochemical and biological processes at different characteristic time scales. The focus of this work is on a micro-scale of observation (tenths to hundreds of micrometers). The primary scope is the development of controllable microfluidic platforms that permit real-time noninvasive observation (e.g., with digital holographic microscopy) of bacterial locomotion, pattern formation as well as of the physical interactions between the bacterial assemblages or biofilms and individual oil droplets. Ultimately, the ability of these bacterial formations to actively degrade key components of the crude oil-droplets will be evaluated and quantified.

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Post-DWH sedimentation: Insights from archaeal tetraether lipids

Presenter: Sara A Lincoln
The Pennsylvania State University
Authors: S. A. Lincoln[1], I. C. Romero[2], D. J. Hollander[2], J. L. Macalady[1], K. H. Freeman[1];
[1]The Pennsylvania State University, University Park, PA, [2]University of South Florida, St. Petersburg, FL.

Abstract:
An intense marine snow event occurred after the DWH blowout (1). Some fraction of the large, oil- and mucus-rich particles observed in surface waters likely sank, providing a mechanism for hydrocarbon export to sediments (2). Marine snow may also have formed in subsurface oil intrusions (1), and sinking particles from any depth could have “scrubbed” the water column, incorporating hydrocarbons, suspended particulate matter and microbial plankton during transit to the seafloor. To better understand these unique post-DWH sedimentation processes we are employing archaeal lipids in a novel tracer application. Glycerol dialkyl glycerol tetraether (GDGT) membrane lipids are synthesized by archaea living throughout the marine water column, but the relative abundances of GDGT structures typically differ between the shallow and deep ocean (3). GDGTs exported to depth derive primarily from shallow waters (4)

but contributions from mid-depths may be possible in some circumstances. Using high-resolution GDGT data from DeSoto Canyon sediment cores and 36 suspended particulate matter samples collected in 2013, we test the hypothesis that GDGT ratios in sediments record mid-depth export associated with “scrubbing” or deep marine snow formation post DWH and assess whether these ratios can be used to reconstruct sedimentation processes associated with previous marine oil snow episodes.
(1) Passow et al., 2012
(2) Romero et al., in review
(3) Turich et al., 2007
(4) Wuchter et al., 2006

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Type: Poster 4-144

Modeling population connectivity, larval drift, and cumulative contaminate exposure mortality in the Gulf of Mexico

Presenter: Michael Drexler
University of South Florida
Authors: M. Drexler, C. H. Ainsworth;
University of South Florida, St. Petersburg, FL.
Abstract:
The full scope of impacts resulting from the Deepwater Horizon oil spill has yet to be fully understood. The potential negative effects on recruitment resulting from pelagic larvae interacting with the oil field have received little attention. An agent based model was developed to track passive particle movement across the entire Gulf of Mexico for numerous species and multi-species groups from the region. The model incorporates previous estimates of adult abundance over a $1/10^0$ grid and empirical calculations of the number of eggs released by those populations. The drift trajectories of 25,000 equally spaced agents, dependent upon adult abundance at that location, were estimated using daily Hybrid Coordinate Ocean Model (HYCOM). Biological data pertaining to spawning dates and the pelagic duration of larvae were incorporated for all the simulated groups. Simulations spanning multiple years will be incorporated to estimate annual variability in particle movement and meta-population connectivity. In addition to larval drift and connectivity, the individual agents are also able to track the cumulative time that each particle is exposed to a contaminate field, which allows for the development of a mortality function relating the total time of exposure to the mortality of larvae. The results of these simulations will be used to evaluate population connectivity for spatial ecosystem modelling experiments, such as the Atlantis ecosystem model for the Gulf of Mexico, and to investigate various larval mortality functions in response to the Deepwater Horizon event.

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Type: Poster 4-145

Did the Growth Rates of Gulf of Mexico Red Snapper, Lutjanus campechanus, Change Following the 2010 Deepwater Horizon Blowout?

Presenter: Elizabeth Herdter
University of South Florida
Authors: E. Herdter, S. Murawski;
University of South Florida, St. Petersburg, FL.
Abstract:
Red snapper, Lutjanus campechanus, is a long-lived, reef finfish and an important commercial and recreational species in the Gulf of Mexico (GOM). Mature individuals between ages 2 and 8 inhabit much of the shallow-water oil infrastructure in the northern Gulf of Mexico. Because of their close proximity to oil infrastructure, they are particularly vulnerable to oil contamination, and much of their range in the northern GOM overlaps the surface oil distribution from the 2010 Deepwater Horizon blowout. Previous research on acute oil contamination in juvenile fish has shown significant decreases in weight, growth and condition indices- all factors tied to population productivity. The goal of this study is to understand annual growth rate variation before and after 2010 in GOM red snapper through increment analysis of sagittal otoliths collected between 2011-2013 via scientific demersal long-line sampling. The measured annual growth increments, and ancillary environmental data including GOM wind direction and speed and sea surface temperature data obtained from the NOAA World Ocean Atlas, will be treated with an ANOVA to determine the significance of variation in annual growth rates by age, and year and relationships to these exogenous environmental parameters. Preliminary results indicate a decline in growth rate at age during 2010-2011 and the following years.

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Type: Poster 4-146

Exploring Factors that Impact the Activity of a Polycyclic Aromatic Hydrocarbon Exposure Biomarker, EROD, in Livers of Finfish from the Gulf of Mexico

Presenter: Marci Smeltz
University of Florida
Authors: M. Smeltz[1], L. Glicksman[1], G. Zhong[1], L. Rowland-Faux[1], A. S. Kane[1], W. Patterson[2], M. O. James[1];
[1]University of Florida, Gainesville, FL, [2]University of South Alabama, Dauphin Island, AL.

Abstract:
Following the 2010 oil spill, there has been concern about exposure of fish to polycyclic aromatic hydrocarbons (PAHs). A well-established and widely used biomarker of PAH exposure, ethoxyresorufin O-deethylase (EROD) activity, was assayed in hepatic post-mitochondrial supernatant fractions from 13 species of finfish captured from natural and artificial reefs in the Northwest Gulf of Mexico between December 2011 and December 2012. EROD activity varied 400-fold among the sampled species, suggesting some of the fish were exposed to PAHs. One species, gray triggerfish (Balistes capriscus), stood out as having higher activities ($p<0.001$) than all others. EROD activity in gray triggerfish was 13.7 ± 0.76 pmol/min/mg protein (mean ± SEM, n=87) and was 3.52 ± 0.22 (n=262) in all other species. The pale and fatty liver of these triggerfish presented visible fat globules when homogenized in buffer. Heptane extracts of fat were analyzed for total PAH-type fluorescence (Ex 360nm; Em 475nm) with benzo(a)pyrene (BaP) as a reference. All extracts possessed substances that fluoresced under these conditions. Some extracts were evaporated to dryness, dissolved in methanol, and analyzed by C18 reverse-phase HPLC with fluorescence detection (Ex 375; Em 435). Most samples contained a peak that co-migrated with BaP, with one to three earlier-eluting fluorescent peaks. The presence of PAHs in gray triggerfish liver possibly explains the generally elevated EROD activities observed in this species.

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Type: Poster 4-147

Isotopic indicators of oil and gas impacts on plankton: Natural abundance of carbon and nitrogen isotopes in particles in the Northern Gulf of Mexico after the Deepwater Horizon spill

Presenter: Katherine Smith
Georgia Tech
Authors: K. Smith, S. Weber, J. Montoya;
Georgia Tech, Atlanta, GA.

Abstract:
We measured the natural abundance of 13C and 15N in particles from the Northern Gulf of Mexico on annual cruises beginning one month after the Deep Water Horizon (DWH) wellhead was capped (July 2010) and continuing through July 2013. In August 2010, we encountered a large, turbid, low d13C feature over 150 miles southwest of the wellhead and associated with the deep SW plume produced by the spill. Over the subsequent sampling period, we consistently measured low, yet variable, d13C values through the water column at sites near the DWH wellhead and at large natural seeps (GC600). The natural abundance of 13C near the wellhead ranged from -35.1 to -12.8 permil, while d13C values at GC600 ranged from -27.9 to -18.8 permil. The most 13C depleted particles (-35.1 permil) were found in September 2012 within 30 miles to the NW and SE of the DWH, and were accompanied by visible surface oil slicks. We found variable depletion of 15N (d15N ranging from -2.0 to 19.6 permil) across our sampling sites, reflecting the input of N to the food web via N2-fixation, and the coupling of the N and C cycles via methanotrophs.

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Type: Poster 4-148

Zooplankton and larval crab distribution in the Gulf of Mexico

Presenter: Sarah M Giltz
Tulane University
Authors: S. M. Giltz[1], E. K. Grey[2], C. M. Taylor[1];
[1]Tulane University, New Orleans, LA, [2]University of Notre Dame, New Orleans, IN.

Abstract:
The Blue crab, Callinectes sapidus, is an economically and ecologically important species in coastal Gulf of Mexico whose early life history is incompletely known.

We analyzed surface plankton tows from the near-shore northern Gulf of Mexico to better understand spatiotemporal distribution of offshore zoeal stages and the co-occuring zooplankton community. Our sampling began in the months following the Deepwater Horizon oil spill and continued in the following non-oil spill year. The distribution of zoea from our samples helps fill the information gap concerning the offshore life history of GOM Blue crabs, including the distribution of different size classes and the seasonality of the spawning events. We found that blue crab zoea are distributed along the coast of Louisiana from near shore to the 50 miles offshore limit of our sampling. Zoea are found throughout the entire sampling area across the coast of Louisiana, but peaks in abundance were seen at certain locations and times. The distribution will be analyzed to determine correlations with environmental factors including temperature and salinity as well as time of year, distance from shore and oil spill versus non oil spill year. The distribution will be compared across the two sampling years 2010, the year of the Deepwater Horizon oil spill, and 2011.

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Type: Poster 4-149

Neustonic early life stages of fishes in the northern Gulf of Mexico during the Deepwater Horizon oil spill

Presenter: Frank Hernandez
University of Southern Mississippi
Authors: F. Hernandez, K. Bayha;
University of Southern Mississippi, Ocean Springs, MS.

Abstract:
Of great concern in the wake of the Deepwater Horizon (DWH) event were the impacts of oil, its weathered by-products, and chemical dispersant on fish populations. While many adult stages are highly mobile, most egg and larval stages are planktonic, and therefore may have been at greater risk of exposure. Many early life history stages of fishes accumulate at the neuston layer through a combination of behaviors (e.g., vertical migration of fish larvae), physical properties (e.g., specific gravity of eggs), and oceanographic processes (e.g., Langmuir circulation). The large size of the surface slick, combined with the surface application of chemical dispersant, would have impacted many fish eggs and larvae, but these assemblages are either not well-documented (larvae) or completely undescribed (eggs). Here we summarize information on the early life stages of marine fishes in the neuston layer during the DWH event based on a long-term ichthyoplankton survey off the coast of Alabama (including the summer of 2010). Specifically, our objectives are to describe: 1) the neustonic larval fish assemblage; 2) the neustonic fish egg assemblage using DNA barcoding methods; and 3) the overall vertical distribution patterns of fish eggs. The overall goal is to identify which fish species would have been at greater risk of exposure to surface contaminants, which would have increased the already high mortality rate experienced during the egg and larval stages.

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Type: Poster 4-150

Mississippi coastal fish assemblage structure and dynamics before and after the Deepwater Horizon oil-spill

Presenter: Jacob Schaefer
University of Southern Mississippi
Authors: J. Schaefer, B. Kreiser, N. Frazier, J. Barr;
University of Southern Mississippi, Hattiesburg, MS.

Abstract:
Anthropogenic disturbances have been shown to have a variety of effects on ecosystem processes and function. As a result of the April 2010 Deepwater Horizon (DWH) incident, oil and oil dispersants were introduced into northern Gulf of Mexico ecosystems. Rigorous empirical data are required to assess the potential impact of the DWH to coastal ecosystems. To assess potential impacts to fish assemblages, we utilized a previously published dataset (1992-1994) and our own collections (2011-2013) to assess patterns of current and pre-DWH fish assemblage structure and dynamics. Sampling included a total of 254 pre-DWH and 180 post-DWH trawl samples covering estuary and subestuary habitat across the Mississippi coast. The final dataset contains over 40,000 individuals representing over 100 species.

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Type: Poster 4-151

Native Species in Ecotoxicological Assessments: Using Non-Standard Organisms to Assess Ecological Impairment Following the Deepwater Horizon Oil Incident

Presenter: Brandi Echols
Florida International University
Authors: B. Echols, A. Smith, B. Seda, G. Rand;
Florida International University, North Miami, FL.

Abstract:
Recommended test species are often used to assess the potential risk to an aquatic ecosystem, either prior to or in response to a perturbation. However, these species may be less sensitive than the native organisms inhabiting a system. Native species are not frequently used in laboratory toxicity studies due to a number of reasons, including limited availability, sensitivity to handling stress, a lack of established testing guidelines and insufficient background information on sensitivity and reproducibility of test results. As part of the Natural Resource Damage Assessment program in response to the Deepwater Horizon Oil incident, a toxicological testing program was developed and included the use of representative native species, including sensitive life stages of vertebrates and invertebrates. Studies were conducted with MC252 source and field-collected weathered oils, as well as a reference toxicant. Acute responses of sensitive life stages have been evaluated for fish species, including Red Drum, Spotted Sea Trout, Red Porgy, Florida Pompano and Cobia. Invertebrate species are also being evaluated. Results of fish tests suggest that the native fish species are generally more sensitive to both reference toxicants as well as water- accommodated fractions of weathered and unweathered oils, compared to the standard test organism, Menidia beryllina. Juvenile fish were also more sensitive to unweathered oil, than the weathered oil.

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Type: Poster 4-405

The NOAA NRDA Gulf of Mexico Offshore Fish and Nekton Program: Rationale, Design and Sampling/Sensing Synopsis

Presenter: Tracey Sutton
Nova Southeastern University
Authors: T. Sutton[1], K. Boswell[2];
[1]Oceanographic Center, Nova Southeastern University, Dania Beach, FL, [2]Florida International University, North Miami, FL.

Abstract:
The Deepwater Horizon Oil Spill was not only unique for its material volume but also for its depth, ~1500 m, necessitating a whole-water-column approach for assessment. Given the absence of data regarding the pelagic fauna at these depths, a large-scale program was developed that included at-sea sampling/sensing, sample analysis, and database management. A four-cruise survey aboard the NOAA ship *Pisces* was conducted to provide data on the pelagic nekton from the surface to 1600 m, with emphasis between 800-1400 m (subsurface plume depth). Multi-frequency acoustic data were collected simultaneously to further characterize the horizontal and vertical distribution of pelagic biomass. Additionally, a 107-station survey grid was sampled over nine months on the R/V *Meg Skansi* using discrete-depth trawl gear paired with multi-frequency acoustics. Given the wide geographic (LA to FL, 29-27N), temporal (4 seasons), and depth (0-1600 m) ranges encompassed in the program, this is putatively the largest deep-pelagic sample set ever collected. Biological sample with coupled acoustic data analysis is currently ongoing, with initial results reflect the speciose character of the Gulf of Mexico oceanic province.

Session 005: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments

Session: 005
Date: Tuesday, January 28 - 10:00 AM
Room: Bon Secour Bay I
Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Oral

The State of Alabama's Beaches Post-Deepwater Horizon

Presenter: Joel Hayworth
Auburn University
Authors: J. Hayworth, P. Clement, G. John, F. Yin;
Auburn University, Auburn, AL.

Abstract:
Since the first arrival of MC252 oil on Alabama's beaches in June, 2010, our research team has closely monitored Alabama's shoreline from the Alabama-Florida border to Mobile Bay. Our interests have primarily been to observe and document the physical and chemical evolution of Alabama's sandy beach system in response to, and as a consequence of, the presence of MC252 oil, particularly focusing on tar mats and tar balls. This work has included many sampling events along Alabama's beaches and nearshore waters, and detailed chemical analysis of these samples (focusing on polycyclic aromatic hydrocarbons (PAHs)). In this talk, we describe our sampling approach and our understanding of the evolving physical conditions of Alabama's beaches in response to the Deepwater Horizon event. We also discuss some of our analytical results in the context of their potential long-term environmental and ecological ramifications.

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Date: Tuesday, January 28 - 10:15 AM
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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Oral

Light Component Vaporization and Heavy Residue Sinking from a Surface Oil Slick: Binary Mixture Theory and Experimental Proof-of-Concept

Presenter: Louis Thibodeaux
Lousiana State University
Authors: C. Stevens, L. Thibodeaux, K. Valsaraj, K. Nandakumar, A. Rao, N. Walker;
Lousiana State University, Baton Rouge, LA.

Abstract:
Oil spills are an unfortunate reality that must be addressed as the global demand for refined products continues to increase. The first question is "Where does all the oil go?" To track the movement it is necessary to consider the chemical and physical changes spilled oil undergoes as weathering can drastically alter its composition; these processes begin immediately. Hydrocarbon evaporation is the dominant initial weathering event with majority occurring in the first day and may account for more than half of the loss, depending on the initial oil composition. The objective is to develop a process-based, binary mixture, oil weathering theoretical model for evaporation-sinking theory and support it with laboratory experiments using "model" oils.The binary component, volatile (A) and non-volatile (B), model provides an estimate of the density and weathering time required to produce droplets from an oil surface slick due to evaporation and/or dissolution. The model and experiments demonstrate four fractions of oil are produced initially: volatile chemicals entering the atmosphere, soluble material dissolved into the water beneath the slick, a negatively-buoyant material sinking downward in the water column and a surface residual in the case of real oils. With the model oils crafted for experiments no floating residue remained on the surface. Although simple in mathematical structure, the model captures the combined evaporation-sinking process and clearly demonstrates the proof-of concept. In addition it provides the fundamental theoretical approach with experimental backing for taking the idea to the next level using actual oils and multi-component mixtures.

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Type: Oral

Distribution And Weathering of MC252 On Louisiana Coastal Headland Beaches: Why Are These Ecosystems the Last in Active Response?

Presenter: John Pardue
Louisiana State University
Authors: J. Pardue[1], J. Williams[2], V. Elango[1];
[1]Louisiana State University, Baton Rouge, LA, [2]University of Hawaii-Manoa, Honolulu, HI.

Abstract:

Louisiana coastal headland beaches were disproportionately impacted by MC252 oil during the spill and several of those shoreline segments remain in active response. This presentation will summarize recent research on crude oil weathering in these environments and the impact of coastal processes and geomorphology on oil fate, transport and persistence. Measurements of physical, chemical and biological characteristics of 2 unique oil forms, small oil-sand aggregates, termed “surface residue balls” and larger agglomerated mixtures of sediment and oil, termed “oil mats” will be discussed. Sampling has focused on comparing and contrasting impacts of biogeochemistry on fate of oil stranded in five headland microenvironments; supratidal, intertidal, and subtidal beach environments, and mudflats and marsh/mangrove wetland environments. Weathering indices, including double ratio plots of C2/C3 phenanthrenes and C2/C3 dibenzothiophenes will be presented that allow classification of residual oil in different categories. These data, coupled with biogeochemical data from the oil forms and microenvironments, allow for grouping of these areas into 3 different regimes helpful for understanding fate of MC252 crude oil components; an oxygen-limited regime in the subtidal and intertidal zone, a moisture-limited regime on the supratidal, and a tidal-regime in the mudflats and marsh. Transport of oil forms between these regimes occurs via storm surge washover events during tropical storms and hurricanes in the Summer and Fall and strong cold fronts in the Winter and Spring. Poorly developed dune systems and an underlying clay layer from the relict marsh are geomorphological features that have contributed to oil mobility and persistence.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Oral

Did the Mitigation Strategies of Deepwater Horizon Surfacing Oil Intensify Processes Associated with Oil-Flcoculation and Increase the "Footprint" of Sedimentary Oil Deposition?

Presenter: David J Hollander
University of South Florida
Authors: D. J. Hollander[1], I. Romero[1], P. Schwing[1], R. Larson[1], G. Brooks[2], D. W. Hastings[2], G. Toro-Farmer[1], T. Murk[3], J. Kostka[4], J. Chanton[5], S. Murawski[1], F. Muller-Karger[1];
[1]University of South Florida, St. Petersburg, FL, [2]Eckerd College, St. Petersburg, FL, [3]Wageningen University/IMARES, Wageningen, NETHERLANDS, [4]Georgia Tech, Atlanta, GA, [5]Florida State University, Tallahassee, FL.
Abstract:
Sediment cores collected throughout the northern Gulf of Mexico after the DWH blowout are characterized by the widespread deposition of a thick flocculent layer comprised of fine-grained clays, petrogenic and pyrogenic poly-aromatic hydrocarbons (PAH) and biomass of surface-dwelling organisms. To account for observed variations in sediments, large-scale oceanographic and biogeochemical processes linking river influences, oil-dispersant-algal interactions, marine biota exposure, and effective sedimentation of surface particles must be invoked- Marine Oil Snow Sedimentation and Flocculent Accumulation event (MOSSFA). To mitigate oil contamination in coastal marshes, floodgates of Mississippi River (MR) and associated outfalls were opened releasing large volumes of freshwater, clays and nutrients to the continental shelf and slope. Oil purged from marshes and oil surfacing directly from the DwH were treated with dispersant decreasing oil-droplet size (increasing surface) and enhancing binding between clay minerals and oil. River-sourced nutrients increased algal production, however, algal exposure to and interactions with oil and dispersants promoted a physiological stress response leading to the formation of a “web-like” biopolymer structure that efficiently trapped oil-clay aggregates and products of in situ oil burning (pyrogenic PAHs and soot). The ballasting and rapid sinking of algae-oil-clay flocculants effectively removed particles from surface waters leading to the deposition of sedimentary oil. Our results indicate that mitigation strategies used for surfacing oil during the DwH led to the intensification of MOSSFA processes and increased the “footprint” of sedimentary oil deposition.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Oral

Monitoring and Remediation of PAHs in the Coastal Environment

Presenter: Upal Ghosh
University of Maryland Baltimore County
Authors: U. Ghosh;
University of Maryland Baltimore County, Baltimore, MD.
Abstract:
Polycyclic aromatic hydrocarbons (PAHs) introduced in the coastal environment through petroleum or other sources poses a major concern
for ecological and human health impacts. However, the extent of biological impacts is often controlled by the nature of the source and sorption of PAHs to geochemical domains in the sediment environment that ultimately controls bioavailability. The freely dissolved concentration of hydrophobic chemicals like PAHs in sediment porewater is emerging as a useful metric to describe bioavailability and tendency of the pollutant to escape into the overlying water. However, the ultra-low concentrations of hydrophobic compounds in water are difficult to measure directly and has resulted in the emergence of passive sampling methods. This presentation will provide an overview of our recent work on developing passive sampling techniques to measure freely dissolved concentrations of PAHs in sediments and using that information to interpret bioavailability and fate and transport processes. The availability of accurate tools to assess low levels of porewater concentrations has also allowed us to develop and test novel approaches for the management of

polluted coastal sediments based on bioavailability control. We have demonstrated that hydrophobic chemicals in sediments can be managed by enhancing the sorption capacity of the native sediment with sorbent amendments that reduces porewater concentrations, thus decreasing pollutant bioavailability and impact to the aquatic environment. This approach for in-situ remedy by altering sediment geochemistry is now being implemented in several pilot and full-scale projects in contaminated coastal environments.

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Type: Oral

Hydrocarbon-degrading microbial communities and the fate of oil in beach sands impacted by the Deepwater Horizon oil spill

Presenter: Joel E Kostka
Georgia Institute of Technology
Authors: J. E. Kostka[1], W. A. Overholt[1], L. M. Rodriguez-R[1], K. Marks[1], J. C. Gaby[1], C. Hagan[2], J. Kaba[2], K. Konstantinidis[1], M. Huettel[2];
[1]Georgia Institute of Technology, Atlanta, GA, [2]Florida State University, Tallahassee, FL.

Abstract:
A large amount of oil from the Deepwater Horizon oil spill was transported to and subsequently buried in Gulf of Mexico beaches. The objective of this research is to characterize the in situ response of microbial communities in parallel with the fate and chemical changes to oil hydrocarbons. Results indicate a rapid depletion of hydrocarbons, and an increase in oxygen consumption rates in beach sands after the oil arrived. This was paralleled by a bloom in bacterial abundance, a decrease in diversity, and a succession of microbial populations in the oiled sands. Comprehensive iTag (>300 samples) and metagenomic datasets reveal consistent shifts in community structure with time. Genes involved in hydrocarbon utilization and nutrient acquisition were substantially enriched relative to housekeeping genes in oiled samples. By June, 2011, extractable hydrocarbons were close to detection limits, and microbial community structure/ diversity was very similar to pre-spill samples. Quantitative PCR of nitrogen fixation genes provided evidence for nutrient limitation as oiled samples contained an 8X higher relative abundance of genes for nitrogen fixation than did clean sands. Overall, multiple lines of independent evidence from a time series describe the microbial response to hydrocarbon discharge as a succession dynamics model driven by nutrient availability and hydrocarbon chemistry.

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Date: Tuesday, January 28 - 12:00 PM
Room: Bon Secour Bay I
Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Oral

The Degradation of Hydrocarbons in Sandy Sediment of the Northeastern Gulf

Presenter: Markus Huettel
Florida State University
Authors: M. Huettel[1], J. E. Kostka[2], C. Hagan[1], J. Kaba[1], B. Wells[1], W. Overholt[2], S. Dudley[1], C. Okolovitch[1];
[1]Florida State University, Tallahassee, FL, [2]Georgia Tech, Atlanta, GA.

Abstract:
With a time series study conducted at Pensacola Beach we followed the degradation of crude oil hydrocarbons and PAHs that were deposited on the beach and in the shallow sublittoral after the Deepwater Horizon accident. Hydrocarbons and PAHs were extracted from sediment samples and analyzes via GC/MS. The times series shows a rapid decrease of the hydrocarbon concentrations and a distinct response after the deep cleaning procedure that was initiated by the local authorities in order to remove embedded tar material from the beach. Laboratory studies, initiated to elucidate details of the degradation process reveal a prompt response of the sediment microbial community to the crude oil addition and different transport rates of the hydrophobic substances through the permeable sediments. Our results suggest that the sediment characteristics as well as the environmental settings in the Gulf accelerated the decomposition of the crude oil.

Session: 005
Date: Tuesday, January 28 - 12:15 PM
Room: Bon Secour Bay I
Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Oral

Microbial Population Dynamics And Oil Biodegradation In Louisiana Coastal Marsh Sediments Following The Deepwater Horizon Oil Release

Presenter: Ronald Atlas
University of Louisville
Authors: R. Atlas[1], S. Faith[2], D. Stoeckel[2], A. Minard-Smith[2], E. Heizer Jr[2], C. Bartling[2], J. Thorn[3];
[1]University of Louisville, Louisville, KY, [2]Battelle Memorial Institute, Columbus, OH, [3]Battelle Memorial Institute, Duxbury, MA.

Abstract:
The relationships between microbial populations and oil composition were examined as biodegradation proceeded in marsh sediments impacted by oil released from the Deepwater Horizon accident. Cores were collected over a 2 year period at sites in Bay Jimmy (Upper Barataria Bay), Louisiana. Hydrocarbons were extracted and analyzed by GC-MS. DNA was extracted and metagenomic analyses were performed. Microbial community composition varied with level of oiling, depth, and extent of biodegradation. Anaerobic oil-degrading taxa predominated at the oil-contaminated sites. Analyses showed high levels functional genes responsible for anaerobic hydrocarbon degradation in samples collected in 2010 but these genes and associated anaerobic oil degrading populations decreased as biodegradation proceeded and the oil concentrations declined. Desulfococcus oleovorans represented up to 51% of total sequences identified in the near-surface and Methanoplanus petrolearius initially dominated the microbial populations in the subsurface at heavily oiled sites. These populations declined as the biodegradation of the biodegradation of the residual oil proceeded. The diversity of the microbial community was initially low at heavily oiled sites but increased as the oil was biodegraded, approaching values of reference sites indicative of ecological recovery.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Oral

Identification Of Microbial And Abiotic Degradation Of Macondo Well Oil At The Sea Surface And On Beaches

Presenter: Christoph Aeppli
Bigelow Laboratory for Ocean Sciences
Authors: C. Aeppli[1], R. K. Nelson[2], F. S. Kinnaman[3], D. L. Valentine[3], C. M. Reddy[2];
[1]Bigelow Laboratory for Ocean Sciences, East Boothbay, ME, [2]Woods Hole Oceanographic Institution, Woods Hole, MA, [3]University of California, Santa Barbara, Santa Barbara, CA.

Abstract:
Petroleum consists of thousands of compounds with a great range in physico-chemical properties and susceptibility towards biodegradation. Taking advantage of this complexity and investigating relative changes in the molecular and isotopic petroleum composition allows for a better understanding of ongoing oil (bio)degradation processes in the environment. To this end, we used comprehensive two-dimensional gas chromatography (GCxGC) and stable oxygen isotope analysis and analyzed a time series of weathered oil collected at the sea surface and on beaches after the Deepwater Horizon disaster. We found evidence that aliphatic hydrocarbon-degrading microbes were active throughout the observed time scale of two years, degrading simple linear as well as complex cyclic alkanes. Based on indicative disappearance of aromatic biomarker compounds, we also found evidence of concurrent photooxidation as a second oil-degrading process. These degradation processes led to the formation of a major fraction of recalcitrant oxygenated metabolites. We developed a stable oxygen isotope-based approach to determine whether biotic or abiotic process was responsible for their formation. Preliminary results suggest that oxygenated hydrocarbons were primarily formed due to photooxidation. Overall, this study demonstrates that comprehensive analysis of petroleum hydrocarbons and its degradation products greatly helps identifying oil degradation processes that are occurring in the environment.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Oral

Behavioral Response of Marsh Nekton to Macondo Oil

Presenter: Charles Martin
Louisiana State University
Authors: C. Martin[1], K. Able[2], J. Fodrie[3], O. Jensen[4], P. Lopez-Duarte[2];
[1]Louisiana State University, Baton Rouge, LA, [2]Rutgers University Marine Field Station, Tuckerton, NJ, [3]University of North Carolina at Chapel Hill, Chapel Hill, NC, [4]Rutgers University, New Brunswick, NJ.

Abstract:
The explosion of the Deepwater Horizon drilling platform and the subsequent discharge of oil into Gulf of Mexico is one of the most challenging environmental disasters in history. To date, studies of ecological effects on coastal fishes have been slow to emerge and yield a complex portrait of community responses. For example, numerous laboratory studies have indicated that oil has widespread and

pervasive impacts on the physiology of marsh fishes. Despite this, many field studies document little change or actual increases in the abundance and biomass of fishes post spill, suggesting negative effects at the individual level may not translate to population or community-level consequences. One potential explanation for this discrepancy is that mobile organisms may have the capacity to detect and avoid oil, which was very patchily distributed in coastal environments throughout 2010. Here, we present the results of a series of flume experiments using the most commonly found species of marsh fishes and invertebrates designed to determine if nekton show avoidance behaviors at small spatial scales. Results are critical to understanding the resiliency of marsh organisms to anthropogenic disasters such as oil spills and are essential for the continued successful management of living, motile resources such as marsh nekton.

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Date: Tuesday, January 28 - 2:30 PM
Room: Bon Secour Bay I
Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Oral

Forensic fingerpringting and source identification of hydrocarbons in oil contaminated environmental samples

Presenter: Zhendi Wang
Environment Canada
Authors: Z. Wang;
Environment Canada, Ottawa, ON, CANADA.

Abstract:
A forensic chemical fingerprinting methodology using GC-MS and GC-FID has been developed to characterize and differentiate pyrogenic (combustion derived) and biogenic (organism derived, in situ) hydrocarbons from petrogenic (petroleum derived) hydrocarbons in environmental samples from the Canadian oil sands region. The characterized target hydrocarbons include hydrocarbon groups such as total petroleum hydrocarbons (TPH), *n*-alkanes, alkylated polycyclic aromatic hydrocarbon (PAH) homologous series and other EPA priority unsubstituted PAHs, biomarker terpanes and steranes, bicyclic sesquiterpanes, and diamondoids. Between 2009 and 2012, hundreds of oil sands environmental samples including matrices such as water (such as snow melt water, river water, groundwater, and tailings pond water) and sediments (from river beds and tailings ponds) have been analyzed. These samples were taken from sites where assessments of wild fish health, invertebrate communities, toxicology and detailed chemistry are being conducted as part of the Canada-Alberta Joint Oil Sands Monitoring Plan (JOSMP). This study describes the distribution patterns and potential sources of polycyclic aromatic hydrocarbons (PAHs) from these integrated JOSMP study sites, and findings will be linked to responses in laboratory bioassays and in wild organisms collected from these same sites. It was determined that hydrocarbons in Athabasca River sediments and waters were most likely from four sources: (1) Petrogenic heavy oil sands bitumen hydrocarbons; (2) Biogenic compounds; (3) Petrogenic hydrocarbons of other lighter fuel oils; and (4) Pyrogenic PAHs.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Oral

Oil Fingerprinting and Polarimetric Radar Mapping of Macondo-252 Oil in Gulf Coast Marshes

Presenter: Buffy M Meyer
Louisiana State University, Dept. of Environmental Sciences
Authors: B. M. Meyer[1], E. Ramsey, III[2], A. Rangoonwala[3], E. B. Overton[1], T. Bannister[4], C. E. Jones[5];
[1]Louisiana State University, Dept. of Environmental Sciences, Baton Rouge, LA, [2]U.S. Geological Survey, National Wetlands Research Center, Lafayette, LA, [3]Five Rivers Services, LLC, Colorado Springs, CO, [4]University of Lafayette, Lafayette, LA, [5]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA.

Abstract:
In order to clarify whether the presence of Macondo-252 (MC-252) oil caused pre- to post-spill changes in polarimetric synthetic aperture radar (PolSAR) backscatter in nearshore and interior coastal marshes of Louisiana, we performed a study that confirmed MC-252 oil had reached into interior marshes exhibiting a backscatter change. A total of 29 in-situ sediment samples were collected from Louisiana coastal marsh locations determined to be “oiled” by changes in PolSAR backscatter. An oil-source fingerprinting methodology was developed to determine if oil detected in the samples was MC-252 oil or from another source by isolating and statistically comparing specific diagnostic biomarker ratios within the chromatographic profiles of the hopanes, steranes, and the triaromatic steroids of MC-252 oil. The aggregate of the statistical comparison of the unknown and MC-252 samples for each diagnostic ratio allowed each unknown sediment sample to be separated into those containing and those not containing MC-252 oil. Samples that could not be clearly designated into either category underwent supplemental polytopic vector analyses. Of the 29 samples collected, MC-252 was present at seven shorelines of known oiling and six nearshore-interior marsh sites. While shoreline results further confirm that the backscatter change was oil related, results also prove that MC-252 oil penetrated into the interior marsh where oil was not observed but backscatter change was documented.

Session: 005
Date: Tuesday, January 28 - 3:00 PM
Room: Bon Secour Bay I
Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Oral

Apples and Oranges? Characterizing spilled and seeped oil in the GOM

Presenter: Beizhan Yan
Lamont-Doherty Earth Observatory
Authors: B. Yan[1], U. Passow[2], M. Pitiranggon[1], N. D'Souza[1], A. Juhl[1], A. Subramaniam[1];
[1]Lamont-Doherty Earth Observatory, West Nyack, NY, [2]Marine Science Institute, University of California Santa Barbara, Santa Barbara, NY.

Abstract:
Crude oil enters the Gulf of Mexico (GOM) through catastrophic spills, such as the Deepwater Horizon Oil Spill, and through numerous natural oil and gas seeps. Fully characterizing and unambiguously distinguishing hydrocarbons from these different sources remains a challenge. To compare oil originating from a spill to that from a natural seep, samples were collected from bottom sediments and water column sediment traps from two locations, a site close to the Deepwater Horizon well head (OC26) and a natural oil seep site (GC600). The levels and molecular distributions of alkanes, alkenes (olefins), PAHs, and hopanes were characterized. Through these samples, the hydrocarbon inputs from spilled and seeped oil were calculated, and the molecular difference between these types of oil was characterized. The OC26 trap and sediment samples spanned the time period from summer 2010 to 2013 and the GC600 samples were collected in 2011 through 2013. In these samples, three independent source-sensitive markers consistently indicated that the amount of spill-related hydrocarbons in the site of OC26 decreased slowly in the first several months after the spill and then tailed off until March 2011. While samples from OC26 clearly showed that the location had received hydrocarbons originating from the spill, concentrations of total hydrocarbons, which were highly weathered, in the sediments at the GC600 site, were more than 20 times higher. Such elevated hydrocarbon levels pose an ecological threat to benthic living organisms as well.

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Date: Tuesday, January 28 - 3:15 PM
Room: Bon Secour Bay I
Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Oral

Resilience and Recovery of Salt Marsh Benthic Communities

Presenter: Charles C Wall
LUMCON
Authors: C. C. Wall[1], L. Pride[1], A. Fontenot[1], E. Robinson[2], N. N. Rabalais[1];
[1]LUMCON, Chauvin, LA, [2]Louisiana State University, Baton Rouge, LA.

Abstract:
The Deepwater Horizon oil spill in 2010 resulted in direct oiling of salt marsh habitat across the Gulf of Mexico, causing mortality of benthic organisms and accelerated marsh erosion. However, little is known about the long-term chronic effects of oil exposure on salt marsh benthic communities, and how these effects may combine with other environmental factors that structure benthic communities, such as salinity, sediment properties, and degree of tidal inundation. We conducted a field study of salt marsh benthos, sediment properties, and sediment oil residues at six oiled salt marsh sites and six paired unoiled reference sites across three regions in coastal Louisiana. Densities and composition of epi- and infauna varied by site, region, salinity, sediment type, and vegetative cover, but were not significantly different between oiled and unoiled marshes. These findings point toward the need for multivariate approaches to detect oil pollution impacts amongst many other changing environmental factors, and the need for time series data to elucidate magnitudes of impacts and processes of recovery. Three years after the original oil spill, petroleum hydrocarbons were still elevated in the sediments of previously oiled marshes, suggesting that burrowing or deposit feeding animals may be chronically exposed to oil at these sites, or that storm events will result in acute re-exposure of oiled sediments.

Session: 005
Date: Tuesday, January 28 - 9:30 AM
Room: Bon Secour Bay I
Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Oral

Distribution, Fate, Behavior and Removal of Stranded Oil during the Response to the Deepwater Horizon Oil Spill

Presenter: Jacqueline Michel
Research Planning, Inc.
Authors: J. Michel[1], S. Zengel[2], N. Rutherford[3], Z. Nixon[1], F. Csulak[3];
[1]Research Planning, Inc., Columbia, SC, [2]Atkins, Tallahassee, FL, [3]NOAA, Seattle, WA.

Abstract:
Based on comprehensive and repetitive surveys by shoreline assessment teams, the oil from the 2010 Deepwater Horizon spill in the Gulf of Mexico was documented as stranding on 1,773 km of shoreline across FL, AL, MS, LA, and TX. Of the shorelines oiled, beaches comprised 50.8%, marshes 44.9%, and other shoreline types 4.3%. One year later, oil remained on 847 km; two years later, oil remained on 687 km; and three years later, oil remained on 634 km, with 73% of the remaining oiled shoreline classified as trace (<1%) oiling. Shoreline cleanup activities were authorized on 660 km, or 73.3% of oiled beaches starting in May 2010. Because the oil stranded over a three-month period and when the beaches were in a relatively eroded condition, the oil became deeply buried as sand

accreted back onto the beaches and posed many challenges to its removal. Furthermore, oil mixed with sand in the surf zone, forming very persistent submerged oil mats consisting of 80-90% sand and located mostly between the beach and the first offshore bar. The continued remobilization of oil resulted in the chronic re-oiling of sand beaches at trace levels for over three years and extensive efforts during shoreline treatment to remove the buried oil and submerged mats.

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Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-152

Efficiency and effectiveness of Corexit dispersants for removing Louisiana crude oil from contaminated natural surfaces in salt water environment

Presenter: Berrin Tansel
Florida International University
Authors: B. Tansel, M. Lee, D. Boglaienko;
Florida International University, Miami, FL.

Abstract:
Experiments were conducted with natural materials exposed to crude oil and Corexit dispersants. The natural materials studied included sea sand (collected from the east coast beaches in South Beach in Miami, Florida), red mangrove leaves (*Rhizophora mangle*), and sea shells (coquina shells, e.g., *Donax variabili*). Tests were inducted by placing the contaminated natural materials in salt water at two different salinities (17 and 34 ppt) using two types of Corexit dispersants (9500A and 9527A) in concentrations ranging from 0 to 350 mg/L.
The efficiency of the dispersant was determined by surface tension measurements. Surface tension of the aqueous samples was measured by a surface tension apparatus (Fisher Scientific, Suwanne, Georgia, USA). The effectiveness of dispersant was evaluated by calculating the proportion of oil dispersed in the aqueous phase expressed as percent dispersion effectiveness. The oil-dispersant suspensions were extracted with dichloromethane (DCM) following the liquid/liquid extraction procedures described in the swirling flask dispersant effectiveness test by U.S. Environmental Protection Agency.
The sorption capacities of the natural surfaces were determined as mg oil per mg of sample in reference to the oil amount measured in the blank solution containing only oil and dispersant. Residual oil remaining on the natural materials after exposure to dispersants was estimated as mg oil per mg material as well as mg oil per square meter of exposed surface.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-153

GOM Deepwater Horizon Oil Spill: Combustion-Derived Hydrocarbons

Presenter: Christina Palomo Beizhan Yan PALOMO
Northwestern State University
Authors: C. B. Y. M. PALOMO;
Northwestern State University, Natchitoches, LA.

Abstract:
An estimated amount of 210 million gallons of crude oil was released into the Gulf of Mexico (GOM) from April 20th to July 15th 2010 during the Deepwater Horizon Oil Spill. The spill caused a tremendous environmental and health impact and continues to affect the GOM today. Variations in hydrocarbons including polycyclic aromatic hydrocarbons (PAHs) can be analyzed to better understand the oil spill and assist in oil source identification. Sediment samples, two tar ball samples, and one surface water oil sample were obtained from distinct locations in the GOM and within varying time frames from May to December 2010. Each sample was extracted through the ASE 200 solvent extractor, concentrated down under nitrogen gas, purified through an alumina column, concentrated down again with nitrogen gas and analyzed via GC/MS and two-dimensional GC- TOFMS. Various hydrocarbon “fingerprints,” such as parental to alkylated PAH ratios, high molecular weight PAHs to low molecular weight PAH ratios, and carbon preference index were calculated in order to better understand the depth and spatial variations of petrogenic and pyrogenic PAHs. Based on the calculated ratios, it is evident that the sediment core taken in October of 2010 was greatly affected by combustion sources. This trend was confirmed by the soot and char ratio in these samples.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-154

Changes In Sedimentary Ratios Of Oil-Derived Biomarkers Within Three Years Following The Macondo Blowout

Presenter: Lydia Babcock-Adams
University of Georgia
Authors: L. Babcock-Adams, S. B. Joye, P. M. Medeiros;
University of Georgia, Athens, GA.

Abstract:
In the spring of 2010, approximately 700 million liters of oil were released into the Gulf of Mexico waters following the Macondo wellhead blowout. A time series of sediments, encompassing surface and subsurface samples, were collected in May, September, and November of 2010, as well as in July of 2011, 2012, and 2013. Sedimentary biomarker concentrations have been used to calculate biomarker ratios in order to track chemical transformations of oil-derived compounds. Preliminary results using biomarker ratios from surface sediments indicate a change in oil composition (e.g. pristane/phytane) between May and September 2010, and an overall increase in maturity (e.g. C23-tricyclic/17α(H),21β(H)-hopane) especially from September to November 2010 at stations close to the wellhead. In contrast, subsurface sediments show little to no change using the various biomarker ratios studied. Analysis of results is complicated by constant input of oil from natural seeps and the use of dispersants in the early stages of the spill.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-155

Molecular Evidence of Heavy Oil Degradation Following the M/V Cosco Busan Spill

Presenter: Christopher M. Reddy
Woods Hole Oceanographic Institution
Authors: K. L. Lemkau[1,2], A. M. McKenna[3], D. C. Podgorski[3], R. P. Rodgers[3], E. B. Kujawinski[2], C. M. Reddy[2];
[1]University of California, Santa Barbara, Santa Barbara, CA, [2]Woods Hole Oceanographic Institution, Woods Hole, MA, [3]National High Magnetic Field Laboratory, Tallahassee, FL.

Abstract:
The study of oil spills has relied predominantly on one-dimensional, gas chromatography (GC)-based techniques. However, higher molecular weight and polar components prominent in heavy fuel oils (HFOs) are not detectable via traditional GC-based techniques without prior modification and are often overlooked after a spill. We refer to these overlooked compounds as the non-GC amenable fraction. We used molecular-level techniques (Fourier transform ion cyclotron resonance mass spectrometry; FT-ICR MS) to examine the compositional evolution of this fraction in a HFO from the 2007 M/V Cosco Busan spill (San Francisco Bay, CA). This spill has served as a test-bed for novel approaches to study weathering of the Deepwater Horizon oil spill. With time, this fraction of the oil underwent numerous compositional changes likely due to biodegradation and photodegradation. With increased weathering, trends consistent with general oxidation and dealkylation of aromatic structures were observed. Environmental weathering resulted in removal or alteration of larger alkylated compounds with preservation/formation of environmentally stable core structures. Coupled with losses of lower molecular weight species, this suggests the presence of stable compounds likely to remain in the environment years after the spill. These results suggest that the non-GC amenable fraction of oil potentially contains indicators for source identification and can provide new insights into oil spill weathering.

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Type: Poster 5-156

Comprehensive Characterization Of The Formerly 'Unresolved Complex Mixture' Reveals Evolution Of Chemical Composition During Weathering Of Crude Oil In The Gulf Of Mexico

Presenter: David R Worton
U.C. Berkeley
Authors: D. R. Worton[1], H. Zhang[1], C. Aeppli[2], C. M. Reddy[2], J. de Gouw[3], K. R. Wilson[4], A. H. Goldstein[1];
[1]U.C. Berkeley, Berkeley, CA, [2]Woods Hole Oceanographic Institution, Woods Hole, MA, [3]NOAA, Boulder, CO, [4]Lawrence Berkeley National Laboratory, Berkeley, CA.

Abstract:
The molecular composition of crude oil residues in the environment following a maritime spill contains critical information for understanding their transformational history following the spill. However, analyses of the composition of weathered crude oil presents analytical measurement challenges as a result of the large number of constitutional isomers and their oxidation products that are present in the form of an unresolved complex mixture (UCM). Recently, two-dimensional gas chromatography with vacuum ultraviolet photoionization and high resolution time of flight mass spectrometry (GC×GC/VUV-HRTOFMS) has been shown to provide near complete characterization and quantification of the UCM. Components are separated by carbon number, number of double bond equivalents and degree of molecular branching. Peak fitting of the high resolution mass spectral data separates the pure hydrocarbon and oxygenated fractions and sample derivitization facilitates the detection of highly polar compounds typically not measurable through GC. Weathered oil samples, originating from the Deepwater Horizon deep sea blowout, were collected from surface slicks in the Gulf of Mexico and from contaminated sand and rocks along the Gulf Coast and analyzed using GC×GC/VUV-HRTOFMS providing unprecedented characterization of the residual hydrocarbon components and oxygenated hydrocarbon residues. Samples were collected from 29 to 658 days following the start of the blowout and span a range of environmental weathering providing insights into the compositional evolution that can constrain understanding and modeling of the fate of oil in the Gulf of Mexico.

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Type: Poster 5-157

Persistent Radicals in Tar Balls

Presenter: Slawo M Lomnicki
Louisiana State University
Authors: S. M. Lomnicki, L. Kiruri, B. Dellinger;
Louisiana State University, Baton Rouge, LA.

Abstract:
Tar balls collected from the Gulf of Mexico shores of Louisiana and Florida after the BP oil spill have shown the presence of electron paramagnetic resonance (EPR) spectra characteristic of organic free radicals as well as transition metal ions, predominantly iron(III) and manganese(II). Two types organic radicals were distinguished: an asphaltene radical species typically found in crude oil (g = 2.0035) and a new type of radical resulting from the environmental transformations of crude (g = 2.0041-47). Pure asphaltene radicals are resonance stabilized over a polyaromatic structure and are stable in air and unreactive. The new radicals were identified as products of partial oxidation of crude components and result from the interaction of the oxidized aromatics with metal ion centers. These radicals are similar to semiquinone-type, Environmentally Persistent Free Radicals (EPFRs) previously observed in combustion-generated particulate and contaminated soils.

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Type: Poster 5-158

APCI and APPI-GC/MS for Characterization of the Macondo Oil Spill

Presenter: Vladislav V Lobodin
National High Magnetic Field Laboratory
Authors: V. V. Lobodin[1,2], R. P. Rodgers[1,2], A. G. Marshall[1,3];
[1]National High Magnetic Field Laboratory, Tallahassee, FL, [2]Future Fuels Institute, FSU, Tallahassee, FL, [3]Department of Chemistry and Biochemistry, FSU, Tallahassee, FL.

Abstract:
We continue development of analytical methods and instrumentation for comprehensive characterization of the 2010 Macondo oil spill. In the current work we first utilized Atmospheric Pressure Gas Chromatography (APGC) combined with tandem mass spectrometry (MS/MS) for trace analysis of petroleum biomarkers from the Macondo crude oil. A commercially available APGC ion source ionizes the petroleum compounds by Atmospheric Pressure Chemical Ionization (APCI) and produces abundant molecular ions and subsequent MS/MS analysis provides high sensitivity.

Aromatic hydrocarbons (PAHs and alkylated PAHs) and their sulfur and nitrogen-containing analogues (PASHs and PANHs), even though less abundant in the Macondo crude oil, are environmentally persistent and thus potentially available for bioaccumulation. To obtain high sensitivity and specificity for aromatic compounds, we developed an Atmospheric Pressure Photo Ionization (APPI) source that, in combination with GC separation and MS/MS analysis, can provide an efficient analytical tool for evaluation of fate and transport of oil spill residues in the Gulf and coastal environments. Work supported by NSF DMR-11-57490, the Florida State University Future Fuels Institute, BP/The Gulf of Mexico Research Initiative to the Deep-C Consortium, Waters Corporation, and the State of Florida.

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Date: Tuesday, January 28 - 6:00 PM
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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-159

Using experimental wetlands to examine oil spill impacts and restoration potential in Alabama salt marshes

Presenter: Christopher Anderson
Auburn University
Authors: C. Anderson, T. Hess;
Auburn University, Auburn, AL.

Abstract:
Wetland mesocosm and greenhouse studies were used to determine the susceptibility and restoration potential of Alabama salt marshes (dominated by *Juncus roemerianus*, henceforth *Juncus*) contaminated by oil. A total of 32 mesocosms were constructed using oil-free marsh sod from the Alabama coast and used to examine *Juncus* response to oil dosage (6-, 12-, and 24-L m^{-2}) and weathering duration (none, 3-days, and 3-weeks) over a 10-week period. Dosage had a significant effect on *Juncus* survival, photosynthetic rate, and C-assimilation rate while weathering effects were less apparent. Further analyses on polycyclic aromatic hydrocarbons (PAHs) were conducted on a subset of 6 mesocosms across a range of initial sediment concentrations (108 to 906 mg kg^{-1} dry weight). Over the 10-week study, all mesocosms had similar rates of PAH analyte degradation (based on hopane ratio) however wetlands with higher initial PAH concentrations (>659.4 mg kg^{-1} dry weight) showed significantly higher total reduction rates which was attributed to hydrologic export. Finally, marsh restoration potential using native salt grass (*Distichlis spicata*, henceforth *Distichlis*) was examined. Using oiled mesocosm sod, 84 microcosms were planted with *Distichlis* plugs, and monitored in a greenhouse for 9 weeks. Oiled sod coupled with fertilization actually enhanced *Distichlis* growth compared to control and no negative effects of oil were detected suggesting this species may be suitable for marsh
restoration.

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Type: Poster 5-160

Examining the mechanisms of oil degradation with infrared spectroscopy and two-dimensional correlation analysis

Presenter: Patrick Williams
Haverford College
Authors: P. Williams, H. White, C. Londergan;
Haverford College, Haverford, PA.

Abstract:
Oil originating from the Deepwater Horizon oil spill has been recovered from a variety of Gulf of Mexico environments over the past 3 years and has been extensively studied to determine how it has been degraded in the marine environment. The major factors affecting oil degradation and transformation, are the presence of light (photooxidation) and microbes (biodegradation), but the relevant importance of these two mechanisms is not well understood. To examine this, surrogate Macondo oil was incubated with seawater in the presence and absence of sunlight and microbes for three months. Oil recovered from this incubation experiment was then analyzed by Fourier-transform infrared spectroscopy (FT-IR) to determine IR spectral signatures of oil that are specific to different weathering mechanisms. These spectra were processed using two-dimensional correlation analysis to further elucidate trends in the way in which oil is degraded under varying environmental conditions. Spectra were also compared to environmentally weathered samples gathered from Gulf of Mexico beaches to determine the relevance of these IR spectral signatures to real world samples. Overall, this study aims to expand our understanding of both the mechanisms and products of oil weathering in the marine environment.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-161

Nearshore Sticky Waters

Presenter: Juan M Restrepo
University of Arizona
Authors: J. M. R. Restrepo[1], S. Venkataramani[1], C. Dawson[2];
[1]University of Arizona, Tucson, AZ, [2]University of Texas, Austin, Austin, TX.

Abstract:
Wind- and current-driven flotsam, oil spills, pollutants, and nutrients, approaching the nearshore will frequently appear to park just beyond the break zone, where waves break. Moreover, the portion of these tracers that beach will do so only after a long time. Explaining why these tracers park and at what rate they reach the shore has important implications on a variety of different nearshore environmental issues, including the determination of what subscale processes are essential in computer models for the simulation of pollutant transport in the nearshore. Using a simple model we provide an explanation for the underlying mechanism responsible for the parking of tracers, not subject to inertial effects, the role played by the bottom topography, and the non-uniform dispersion which leads, in some circumstances, to the eventual landing of all or a portion of the tracers. We refer to the parking phenomenon in this environment as nearshore sticky waters.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-162

Inhibition of Microbial Growth is Dependent on Photochemical Changes in MC252 Water Accommodated Fractions

Presenter: Wade H Jeffrey
University of West Florida
Authors: W. H. Jeffrey[1], T. Morrison[1], P. Vaughan[1], M. Ederington-Hagy[1], W. New[2], G. Battel[2], R. Snyder[1], H. Chen[3], A. McKenna[3], R. Rogers[3];
[1]University of West Florida, Pensacola, FL, [2]Pensacola High School, Pensacola, FL, [3]Florida State University, Tallahassee, FL.

Abstract:
The effects of solar radiation on the formation of Water Accommodated Fractions (WAFs) developed from MC252 oil and surrogate oil was determined and the subsequent effects on microbial growth was investigated. WAFs were generated under varying solar but controlled temperature conditions. Total exposure to sunlight was manipulated by neutral density screens, duration of exposure, and UV-blocking broad band cut-off filters. These full sun and UV-blocked treatments were compared with WAFs made in darkness. After all WAFs were collected, each was added to a coastal seawater sample and their effects on bacterial production or phytoplankton photosynthesis determined. Results from both assays demonstrated that WAFs produced in the dark had minimal effects on growth while inhibition was proportional to the amount of solar exposure. Broad-band cut-off filters also showed that the majority of the inhibition was from photochemical reactions driven by visible light. Chemical analyses, while ongoing, demonstrate significant changes in the chemical composition of the WAFs caused by solar exposure. The results imply that the ecological effects caused by oil spills are light dependent and thus would vary by season, location, and time of year.

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Aerobic Methanotrophy Along The Chemocline of a Methane Rich Brine Basin : Patterns, Limitations and Implications to Pelagic Ecosystems

Presenter: Jessica J Battles
University of Georgia
Authors: J. J. Battles[1], J. P. Montoya[2], S. B. Joye[1];
[1]University of Georgia, Athens, GA, [2]Georgia Institute of Technology, Atlanta, GA.

Abstract:
The Deepwater Horizon oil spill resulted in massive amounts of oil and gas released into the Gulf of Mexico. Aerobic methane oxidation is a microbially mediated process that leads to net removal of methane from the environment. Thus methanotrophs act as a biological filter that may reduce the flux of methane from the ocean to the atmosphere. Methanotrophs consume methane and utilize it as a source of energy and carbon. To better understand the factors regulating methanotrophy in the pelagic ocean environment, we examined methane oxidation in the Orca Basin, a brine-filled basin on the lower continental slope. The brine-seawater interface in the Orca Basin is characterized by a strong chemocline where methane rich brine fluids flux upwards and intersect oxygen rich seawater. Along this chemocline, several hot spots of methanotrophy were observed. The rates, patterns and controls on aerobic methanotrophy along the Orca Basin chemocline were much more dynamic and diverse than expected, highlighting the complexity of methanotrophic microbial community and revealing the controls on their metabolism.

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A Graphical User Interface for Simulating the Biodegradation of Subsurface oil on the Shorelines

Presenter: Jagadish Torlapati
New Jersey Institute of Technology
Authors: J. Torlapati[1], X. Geng[1], M. Boufadel[1], K. Lee[2];
[1]New Jersey Institute of Technology, Newark, NJ, [2]CSIRO, Queensland, AUSTRALIA.

Abstract:
We developed a user-friendly numerical model to simulate the biodegradation of oil entrapped within shorelines. The model takes the oil properties and the environmental conditions as input, and produces the variation of oil concentration with time, up to a duration of several years from the time of the spill. The model applies to various components of oil, but is mostly trained for dealing with the alkanes and the aromatics as groups. The model is equipped with a graphical user interface (GUI) that is accessible and user friendly. The model was shown capable of reproducing the field and laboratory data on oil biodegradation within the sediments. The accessibility and easy to use interface allows the user to quickly produce several biodegradation and bioremediation scenarios before they are implemented at the contaminated shoreline. The model is also useful for the evaluation of predicting oil biodegradation and the intrinsic bioremediation capabilities in a given beach environment. The GUI presents the results from the remediation scenarios as variation of oil concentration with time, which allows the results to be visualized quickly without any further post-processing.

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Laboratory and Natural Beach Modeling to Characterize the Impact of Evaporation on Groundwater Dynamics in a Sandy Beach Polluted with the Deepwater Horizon Oil Spill

Presenter: Firas Saleh
New Jersey Institute of Technology
Authors: F. Saleh, X. Geng, M. C. Boufadel;
New Jersey Institute of Technology, Newark, NJ.

Abstract:
This study investigates the impact of evaporation on subsurface salinity distribution and its potential impact on bioremediation in tidally influenced beaches. The selected beach is located in Grand Isle, Louisiana, which is one of barrier islands fringing Gulf of Mexico. Site surveys showed that beach indentation and ponds were formed in this beach due to storm events and excavation operations following the Deepwater Horizon (DWH) oil spill. The salt concentration increased rapidly in these ponds as the seawater is evaporated and the beach sand grains become covered with a glaze of solid salt. This high substrate salinity is known to be a major factor limiting oil biodegradation in beaches contaminated by oil. As high tide seawater reaches the beach, the accumulated salt reaches solubility limits due to dilution. Under such conditions, infiltrated water can become denser than sea water, and thus sink forming a potentially high saline bottom layer that flows seaward.
The first part of this study consisted of using the MARUN model to simulate the movement of salt water intrusion at the solubility rate (360 g/l) in a laboratory beach subject to high evaporation levels and tide. We found that accounting for intrusion of solutes effects gives different groundwater dynamics from the case where these effects are neglected.
The next step consisted of scaling these finding to model the Grand Isle beach that was affected by the Deepwater Horizon oil spill. The model was calibrated by fitting numerical simulations of water table and salinity to the field measurements. The findings from the natural beach simulations were consistent with that of the laboratory beach. The study provides useful guidelines for natural beaches under similar stresses.

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Studies of Crude Oil of its Surface Tension and the Contamination of Sand

Presenter: Yufei Duan
Tulane University
Authors: Y. Duan, F. Fornerino-Barboza, K. D. Papadopoulos;
Tulane University, New Orleans, LA.

Abstract:
The capillary forces in the porous media depend on the surface and interfacial tension of solids and fluids, the pore size, geometry and the wetting behavior of the system. Therefore, in order to study the transport of crude oil in porous media after the Deepwater Horizon oil spill, surface or interfacial tension is of significant importance. In these experiments, we are measuring the equilibrium surface tension and investigating how the dynamic surface tension varies as the temperature is increased or decreased rapidly between room temperature 26 °C and 200 °C for crude oil in n-hexadecane solutions. Our video set up with the micro-capillary system makes it uniquely possible to achieve both high-temperature and high-speed measurement of dynamic surface tension. To further simulate the contamination of the porous media in sand, transparent miniature cryolite packed bed system is studied. It is observed that the oil (n-decane) travelling behavior in SDS aqueous solution immersed packed bed is dependent on its capillary number.

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Identification of Water-Soluble Compounds Formed After Irradiation of Macondo Well Oil

Presenter: Phoebe Z. Ray
University of New Orleans
Authors: P. Z. Ray[1], H. Chen[2], A. McKenna[2], M. Tarr[1];
[1]University of New Orleans, New Orleans, LA, [2]National High Magnetic Field Laboratory, Florida State University, Tallahassee, FL.

Abstract:
Macondo Well oil from the Deepwater Horizon disaster was exposed to simulated sunlight over pure water. After exposure, the water-soluble organics (WSO) were analyzed using FT-ICR-MS. Results were compared to a dark control. For dark and irradiated samples, base/neutral and acid fractions were separated by solvent extraction. Base/neutral extracts were analyzed by positive ESI and acid extracts were analytzed by negative ESI. Dramatic changes in the WSO molecular distribution were observed after irradiation. For the irradiated acid extract, the most abundant compound class was O5 or O4, while the dark sample had O2 species as the most abundant compound class. The irradiated samples were dominated by O3, O4, O5, O6, and O7 species, which were of very low abundance in the dark. These results demonstrate a dramatic shift in the oxygen content upon irradiation with sunlight. The base/neutral fraction showed substantial loss of the dark-prevalent N1 species with simultaneous growth of oxygenated N1 compounds after irradiation. The predominance of multiply oxygenated species suggests that the molecules remain susceptible to oxidation after their initial oxidation. These observations provide previously unavailable details about changes in molecular composition of crude oil upon exposure to sunlight. Work performed at the National High Magnetic Field Laboratory was supported by NSF (DMR-11-57490), BP/GoMRI for the Deep-C Consortium, and the State of Florida.

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Productivity of waterbirds in potentially-impacted areas of Louisiana in 2011

Presenter: Joanna Burger
Rutgers University
Authors: J. Burger;
Rutgers University, Piscataway, NJ.

Abstract:
The Deepwater Horizon oil spill (2010) could potentially affect presence and reproduction of waterbirds. This research examined the productivity of colonial waterbirds in colonies in the northern Gulf of Mexico. We compare 2011 productivity in an area of potential impact (API; Atchafalaya Basin, Louisiana east to Alabama-Florida border) with historical productivity rates. Eight colonies were randomly sampled in each of four types in the API: mainland oiled, mainland not oiled, separated from mainland and oiled, separated from mainland but not oiled. Data were collected during peak breeding (April 15 - July 1) on all species of colonial waterbirds, but the focus was on Brown Pelican, Black Skimmer, Great Egret and Laughing Gull. Every active nest was counted in colonies with less than 200 birds, but larger colonies were sampled by plots representing 20% of the colony, using ground and aerial counts. Written SOPs were followed. We discuss the efficacy of the methods, and the results of the aerial counts and productivity estimates.

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Stable isotope composition of weathered oil: Implications for tracing oil degradation and bioassimilation

Presenter: Heather K Patterson
Dauphin Island Sea Lab
Authors: R. H. Carmichael[1,2], H. K. Patterson[1,2];
[1]Dauphin Island Sea Lab, Dauphin Island, AL, [2]University of South Alabama, Mobile, AL.

Abstract:
The ability to define movement and fate of oil-derived substances in local habitats and food webs is important to defining effects of the Deepwater Horizon oil spill on the northern Gulf of Mexico ecosystem. Stable isotope (SI) ratios are useful to define source inputs and trophic transfers, but distinctive endpoints are needed to distinguish oil-derived sources from background. To define these endpoints, we sampled tar balls, mats, and semisolid oil forms along the shoreline from the FL-AL border to barrier islands of MS. Samples were collected from Jun 2010 to Dec 2011 and analyzed for C and N SI ratios. Data were compared across longitudes and through time to determine if distance or time post-spill mediated SI ratios. To further test “weathering” (sample aging) as a source of variation, we measured shifts in SI ratios of each oil form incubated at 60°C for up to two weeks, using temperature and evaporative processes as a proxy for “weathering.” δ13C values in oil-derived materials resembled freshwater sources, averaging -27‰ in most samples, regardless of location or age. δ15N values were more variable, ranging from 1 - 4‰, showing no pattern with location, but decreasing with time. Similarly, samples artificially weathered in the lab, showed no shift in δ13C with duration of exposure to heat, while δ15N decreased. A corresponding increase in C:N corroborated loss of N during “weathering.” If assimilated into local food webs, oil-derived substances will be difficult to detect and trace due to ongoing changes in composition of bioavailable products. Trophic studies will benefit from multiple indicators of oil exposure and bioassimilation.

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Impact Of Exposure Of Crude Oil And Dispersant (COREXIT® EC 9500A) On Denitrification And Organic Matter Mineralization In A Louisiana Salt Marsh Sediment

Presenter: Kewei Yu
Troy University
Authors: R. Shi, K. Yu;
Troy University, Troy, AL.

Abstract:
In response to the 2010 oil spill from the explosion of the Deepwater Horizon oil rig in the Gulf of Mexico, this experiment aims to study the ecological impact of the crude oil and dispersant (COREXIT® EC 9500A) in a coastal salt marsh ecosystem. The marsh sediment was incubated under an anaerobic condition with exposure to the crude oil or/and dispersant. The experiments were conducted in two continuous phases of nitrate addition to study denitrification potential using acetylene blockage technique and organic matter mineralization potential indicated by CO2 production in the sediment. Results show that the oil slightly ($p > 0.05$) increased both the denitrification and organic matter mineralization activities, likely due to oil components serving as additional organic matter. In contrast, the dispersant significantly ($p < 0.05$) inhibited denitrication, but stimulated organic matter mineralization activities in the sediment due to unknown mechanisms. As a consequence, redox potentials (Eh) were much lower in the dispersant treated systems. The ecological impacts from the dispersant exposure may come from two fronts. First, loss of organic matter from the coastal marsh will threaten the long-term stability of the ecosystem, and the decrease in denitrification activity will weaken the N removal efficiency. Secondly, more reducing conditions developed by the dispersant exposure will likely preserve the oil in the ecosystem for an extended period of time due to weaker oil biodegradation under anaerobic conditions.

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Effects of mechanical stress, size, and ambient temperature on the degradation rates of tarballs in shallow nearshore environments

Presenter: John Kaba
Florida State University
Authors: J. Kaba;
Florida State University, Tallahassee, FL.

Abstract:
This study quantified the aerobic decomposition of Deepwater Horizon tarballs of different size at different controlled temperatures with and without mechanical stress. A first experiment exposed different volumes of tar incubated in slowly rotating vials to initially air-saturated seawater at a temperature of 18C. The disintegration of the tarballs within one day emphasizes the role of currents and wave action on the tarball degradation when they are moved around on the sediment surface by the bottom flows. Oxygen consumption rates scaled linearly with tar mass (r2=0.96) and DIC, DOC, and TN production rates increase with tar mass, reflecting microbial decomposition. Incubations of equal amounts of tar in a temperature gradient spanning 0C to 39.6C without rotation revealed a linear oxygen consumption increasing between 7C and 32C (r2=0.9184) and no change in rate past 32C.
A third experiment, that confirmed the linear oxygen consumption rate increase with increasing temperature (r2=0.8874), showed the correlation of DIC production rates with temperature (r2=0.6167) suggesting complete degradation of tarball components. Our findings show that the aerobic degradation of tarballs is strongly affected by mechanical stress and temperature, with degradation rates tripling when temperatures were increased from 10 to 30°C. Our results can partly explain the relatively rapid disappearance of the tarballs along Florida beaches during summer 2010. If the Deepwater Horizon accident had occurred in fall instead of spring, nearly four times as much tar may have persisted in the sublitteral during the winter of 2010, and degradation rates would stay low until the temperature increase in springs.

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A Long-term Investigation Of Spatial And Temporal Distribution Of Polycyclic Aromatic Hydrocarbons In Deepwater Horizon Oil Spill Samples Collected From Alabama Shoreline<

Presenter: Fang Yin
Auburn University
Authors: F. Yin, G. F. John, V. Mulabagal, J. S. Hayworth, P. T. Clement;
Auburn University, Auburn, AL.

Abstract:
On April 20th, 2010, Deepwater Horizon (DH), a semi-submersible drilling rig while exploring for crude oil at the Macondo Prospect (MC252) exploded in Gulf of Mexico. Over the past three years (June 2010 to June 2013), our group has been continuously monitoring tar ball activities resulting from the DH-oil related tar mats which are trapped along the Alabama shoreline. In order to fully understand the risks due to the presence of polycyclic aromatic hydrocarbons (PAHs) in these trapped tar mats in the near shore of Alabama, the first arrived DH-oil related mousse in June 2010 and various tar mat and/or tar ball samples collected from Alabama shoreline have been analyzed to characterize the spatial-temporal variation in the PAHs levels. A robust method that uses a state-of-the-art gas chromatography-triple quadrupole mass spectroscopy method (using Agilent's 7000B QQQ GC/MS/MS) was employed for this analysis. The spatial data show that the PAHs found in tar mat samples are evenly distributed along the Alabama shoreline, except in few samples collected near the Fort Morgan region. The temporal results demonstrate that PAH concentration levels measured in the samples collected over the past three years were similar to those levels in mousse collected in June 2010. These data indicate that while considerable reduction in PAH levels occurred when the spilled oil was weathered by ocean-scale transport processes, the degradation rates slowed down considerably once the residual oil was buried in the near shore environment along Alabama's beaches.

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Oil Spill Model Validation: A Topological Approach

Presenter: Jonathan Ubnoske
Florida State University
Authors: J. Ubnoske, D. Dukhovskoy, S. Morey;
Florida State University, Tallahassee, FL.

Abstract:
We consider a new approach to oil spill model validation in the context of metric space theory, the topic in point-set topology which studies notions of distance in the abstract. In particular, we introduce a shape-sensitive validation metric which exhibits a high correlation to the human perception of shape. Significant empirical evidence indicates the metric outperforms its predecessors in this context. We provide an example of the metric's application to models of the Deepwater Horizon oil spill and consider potential directions for future research.

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'All stressed out'. The science behind algae-dispersant interaction driving oil sedimentation and persistence.

Presenter: AlberTinka J Murk
Wageningen University
Authors: A. J. Murk[1,2];
[1]Wageningen University, Wageningen, NETHERLANDS, [2]Wageningen IMARES, IJmuiden, NETHERLANDS.

Abstract:
Proper response to an oil spill is obviously of great importance to minimize the environmental and economic damage. An often used method of getting the oil into the water column is chemical dispersion. The assumption is that in deep enough waters, dispersed small oil droplets will be diluted and biodegradation enhanced. However, this scenario is based on experiments with clean sea water, while natural sea water may contain particles and phytoplankton. During the DWH oil spill, enhanced marine snow formation resulted in an extra thick, toxic sediment layer at the deep ocean floor. The oil actually had become concentrated and its persistence increased.
The research performed by the Dutch C-IMAGE group, funded by the GoMRI, mainly concerns the vertical fate processes, persistence and consequences for benthic ecosystems. Results will be presented about the dispersant induced biopolymer formation by marine algae and how this sticky, persistent, material binds oil and particles and settles. The settling complexes could also bring down pelagic plankton and suffocate benthic species. The persistence of the toxic sludge on the sediment hampers biodegradation, bioturbation and recovery. Therefore, oil spill response decision support tools should take location- and season-specific conditions into account, as well as decide on the most relevant local ecosystem services to be protected.

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FT-ICRMS Analyses of Photochemical Changes in Water Accommodated Fractions of MC252 and Surrogate Oil Created During Solar Exposure

Presenter: Pamela P Vaughan
University of West Florida
Authors: P. P. Vaughan[1], W. H. Jeffrey[1], M. Ederington-Hagy[1], H. Chen[2], A. McKenna[2], R. Rodgers[2];
[1]University of West Florida, Pensacola, FL, [2]Florida State University, Tallahassee, FL.

Abstract:
The relative contributions of abiotic (photochemical) and biotic weathering of petroleum have long been debated in literature. To determine the effects of abiotic degradation, surrogate oil and Macondo MC 252 were exposed to various solar radiation exposures under sterile conditions. Water accommodated fractions (WAFs) were created after 1 and 7 days in darkness, full sunlight, and with ultraviolet radiation filtered out. All exposures were conducted under temperature controlled conditions (20°C). WAFs were extracted and analyzed by ultra high resolution FT-ICRMS to determine effects of photochemical weathering. When comparing compositional differences of WAFs, oxygenation rates and number of peaks identified were different based on exposure. These comparisons based on treatment will help to disentangle photo-oxidation from other degradation pathways.

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Influence of buried crude oil and algal material on oxygen consumption in sediments collected along a depth transect through DeSoto Canyon

Presenter: William Wells
Florida State University
Authors: W. Wells[1], M. Huettel[1], J. Kostka[2], W. Overholt[2], J. Kaba[1], I. Bociu[1];
[1]Florida State University, Tallahassee, FL, [2]Georgia Tech University, Atlanta, GA.

Abstract:
The purpose of this study was to determine the effect of buried Macondo Well crude oil on oxygen consumption rates of sediments along a depth transect in the DeSoto Canyon from the shelf to the deep sea and to evaluate the influence of phytodetritus for the degradation process. Sediments of different type (sand, sandy mud, mud) were collected from three depths (20 m, 325 m, 1000 m) and replicates were incubated at in-situ temperature with one of three treatments 1) with algae, Thallassia Weisflogii, 2) with weathered MC252 crude oil, or 3) with a combination of the two. Dissolved oxygen was measured over time for calculation of respiration rates. DIC and DOC samples were taken at regular intervals to monitor the evolution of decomposition products. Samples for microbial community analysis were collected to assess changes in community structure in response to the treatments. Results showed that the algae addition enhanced the degradation of crude oil in all three sediment types. This effect was reduced as temperature decreased with depth. Microbial community results showed no significant change, which be attributed to the relatively short duration of the experiments. Oil and algal decomposition in the warm, shallow, permeable shelf sediments was faster in the cold, deep sea muds despite the much coarser grain size of the shelf sands.

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Quantification of Stokes Drift as a Mechanism for Surface Oil Advection in the DWH Oil Spill

Presenter: Matthew Clark
Florida State University
Authors: M. Clark;
Florida State University, Tallahassee, FL.

Abstract:
Stokes drift has previously been qualitatively shown to be a factor in ocean surface particle transport, but has never been comprehensively quantified. In addition, most operational ocean particle advection models used during the Deepwater Horizon oil spill do not explicitly account for Stokes drift, instead using a simple parameterization based on wind drift (or ignoring it completely). This research works to quantify Stokes drift via direct calculation, with a focus on shallow water, where Stokes drift is more likely to have a relatively large impact compared to other transport processes such as ocean currents. For this study, WaveWatch III modeled waves in the Gulf of Mexico are used, from which Stokes drift is calculated using the peak wave period and significant wave height outputs. Trajectories are also calculated to examine the role Stokes drift plays in bringing surface particles (and specifically surface oil slicks) onshore. The impact of Stokes drift is compared to transport by currents and traditional estimates of wind drift.

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PAH concentrations and biomarkers of exposure in plankton and neuston from two sites in the Gulf of Mexico after the Deepwater Horizon oil spill

Presenter: LaTrisha Allen
Florida A & M University
Authors: L. Allen[1], D. Rumbold[2], A. N. Loh[2], C. Jagoe[1];
[1]Florida A & M University, Tallahassee, FL, [2]Florida Gulf Coast Univeristy, Ft Myers, FL.

Abstract:
During and after the Deepwater Horizon blowout, surface sheens were visible in the northern Gulf, and oil and dispersants occurred in the water column. We hypothesized that oil and dispersants might partition into the sea-surface microlayer (SSML), increasing polycyclic aromatic hydrocarbon (PAH) exposure and toxicity to organisms near the surface. We collected plankton and neuston along 40 Km transects in the northern Gulf near Pensacola, and a reference area in southwest Florida. SSML and subsurface samples were collected with an unmanned surface vehicle with a rotating Teflon drum. There were no statistically significant vertical or offshore-onshore gradients in PAH concentrations in water or tissues. Water and tissue PAH concentrations did not differ between the northern Gulf and SW Florida. PAH concentrations in neuston and plankton were sometimes correlated, but neither was correlated with PAHs in

the water. Plankton and neuston were assayed for ethoxyresorufin-o-dethylase (EROD), glutathione-S-transferase (GST), and superoxide dismutase (SOD) activity. EROD was undetectable in most samples. Median SOD activities were 7.8 and 6.0 units mg-1 protein from SW FL and the northern Gulf, respectively. Median GST activity was also higher in SW FL than in the northern Gulf. These findings do not support the idea that PAH concentrations and biomarkers of exposure in plankton/neuston were higher in the SSML or subsurface waters in the northern Gulf at the time of collection.

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Nutrient and electron acceptor impacts on biodegradation of MC252 crude oil in coastal wetlands

Presenter: Matthew Rodrigue
Louisiana State University
Authors: M. Rodrigue, V. Elango, J. Pardue;
Louisiana State University, Baton Rouge, LA.

Abstract:
The persistence and fate of MC252 oil under different redox conditions were studied in three oil-contaminated wetland sites in Louisiana. Locations included a salt marsh and a mangrove site near Port Fourchon, Louisiana as well as a more heavily oiled marsh site in Barataria Basin, Louisiana. High-resolution nutrient and electron acceptor profiles were obtained at different locations at each site using pore water dialysis samplers. Zones of depleted sulfate were observed coincident with oiling depths. PAHs and alkanes were also measured at various locations within each site at 3 different time intervals. Using known PAH weathering patterns of certain petrogenic PAHs (i.e, C1, C2, C3, and C4-phenanthrenes, C2, C3-dibenzothiophenes and C1, C2-chrysenes), it was possible to determine the stage of degradation of each field sample. To supplement the field studies, a laboratory microcosm study was performed to observe biodegradation under different redox conditions and nutrient addition scenarios at all three study sites. The study focuses on 6 different treatments: no nutrients added, sulfate-amended, ammonium-amended, sulfate and ammonium amended, and a killed control all under anaerobic conditions. These were compared and contrasted to an aerobic incubation. Anaerobic weathering ratios were generally similar to killed controls, demonstrating that these higher molecular weight PAHs are not biodegradable under these conditions. Implications for long-term recovery of these systems will be discussed.

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Oil sheen weathering post deepwater horizon

Presenter: Christopher M Reddy
Woods Hole Oceanographic Institution, Woods Hole, Massachusetts
Authors: M. Y. Kellermann[1], M. C. Redmond[2], C. M. Reddy[3], C. Aeppli[4], R. K. Nelson[3], D. L. Valentine[1];
[1]University of California, Santa Barbara, Santa Barbara, CA, [2]University of North Carolina at Charlotte, Charlotte, North Carolina, Charlotte, NC, [3]Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, Woods Hole, MA, [4]Bigelow Laboratory for Ocean Sciences, East Boothbay, Maine, East Boothbay, ME.

Abstract:
A recently published study identified the source of the reoccurred oil sheens close to the Deepwater Horizon (DWH) disaster site as a finite contamination most likely derived from tanks and pits on the DWH wreckage itself. Here we use geochemical fingerprinting and microbial community analysis to better understand the fate and weathering processes affecting these surface oils. Both, alkanes and polycyclic aromatic hydrocarbons (PAHs) are shown to reflect a linear decrease of hydrocarbon compounds with increasing distance to the DWH wreckage site (equivalent to exposure time on the sea surface). These results indicate that in the early stage of weathering the combined effects of dissolution and evaporation dominate the degradation of these surface oils. Sheen microbial communities were dominated by Cyanobacteria, Planctomycetes, Verrucomicrobia, Flavobacteria, Alphaproteobacteria, and Deltaproteobacteria, with low relative abundances of Gammaproteobacteria likely to be hydrocarbon degraders (no more than 15% of sequences in each sample). However, some of these Gammaproteobacteria were closely related to putative hydrocarbon degraders observed in abundance in deep water plumes during the primary Deepwater Horizon spill, suggesting that very low levels of biodegradation may be also occurring. This in situ weathering experiment provides new insights in hydrocarbon weathering dynamics and shows how chemical and biological changes can potentially be masked by large evaporative losses of compounds smaller than C18 n-alkanes.

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Uptake and Deposition of Pyrogenic and Petrogenic PAHs on Spartina Leaves at Two Field Sites

Presenter: Yasmin Mohammad
Louisiana State University
Authors: Y. Mohammad, V. Elango, J. H. Pardue;
Louisiana State University, Baton Rouge, LA.

Abstract:
Saline marshes dominated by Spartina alterniflora were disproportionately impacted by MC252 crude oil along Louisiana's shoreline. This study is quantifying the uptake of PAHs into Spartina from field samples at two sites, a light oiled, more saline marsh near Port Fourchon, LA and a less saline, more heavily oiled marsh near Bay Jimmy in the Barataria Basin, LA. The objective of this study is to compare and contrast the relative uptake and deposition of petrogenic and pyrogenic PAHs in Spartina leaves. A three-step sequential extraction procedure was developed for the extraction and analysis of PAHs on Spartina leaves based on methods available in literature. First, particles deposited on the leaf were first dissolved in an EDTA solution. Second, the leaf cuticle was dissolved in dichloromethane. These steps were performed in the field. Finally, the leaf tissue was extracted using accelerated solvent extraction and subjected to silica gel cleanup prior to analysis via GC-MS. Results to date demonstrate that the cuticles were substantially thicker in the more saline marsh site. Concentrations of petrogenic, lower-molecular weight PAHs (primarily C2-naphthalenes and C1-phenanthrenes) were detected in both the cuticle and leaf tissue in the oiled areas three years after the spill. Detection of these compounds are consistent with MC252 PAHs present in the rhizosphere that would be more amenable to plant uptake through the roots. Cuticle-air partition coefficients of petrogenic PAHs are being measured in the greenhouse and these results will be described at the conference.

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Investigation of recent sediments around the Deepwater Horizon blowout in the Gulf of Mexico using FTICR-MS techniques

Presenter: C. Ken Chanthamontri
University of Calgary
Authors: C. Chanthamontri, P. Weerawardhena, S. Larter, T. Oldenburg;
University of Calgary, Calgary, NW, AB, CANADA.

Abstract:
The Deepwater Horizon blowout resulted in the largest marine US oil spill in history in the Gulf of Mexico. Whereas most of the oil was captured/burned by human interventions and degraded/evaporated by natural means, the fate of the remaining oil (about 30%) is still uncertain. There is some evidence that both oil and gas are still remained in the Gulf of Mexico water column and in the sediments. Thus, sediment samples from near the oil spill area as well as from more distant locations around the spill site including to the northwestern (Mississippi delta), northeastern, southwestern, and southeastern of the oil spill were collected, extracted, and investigated by Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FTICR-MS) techniques. For the spatial study, qualitative data were examined and compared among the sediments from the different sites. In addition, a few sites near the oil spill were sampled over a period of time from December 2010 to October 2012 to investigate temporal changes of the oil residues.

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A practical reassessment of common conventions about preservation and holding times for samples collected for contaminant chemistry analysis

Presenter: Gregory F Baker
NOAA
Authors: G. F. Baker[1], D. Beckmann[2], N. Rothman[3], W. B. Driskell[4], J. R. Payne[5], J. N. Hall[6];
[1]NOAA, Menlo Park, CA, [2]BP Gulf Coast Restoration Organization, Houston, TX, [3]New Environmental Horizons, Inc., Skillman, NJ, [4]Consultant, Seattle, WA, [5]Payne Environmental Consultants, Inc., Encinitas, CA, [6]EcoChem, Inc., Seattle, WA.

Abstract:
The scale of sampling and analysis performed for the Deepwater Horizon oil spill challenged pre-existing systems and presumptive limitations for processing environmental samples and data. NOAA and BP revisited common assumptions about sample preservation, extraction, analysis, and other aspects of sample and data management. Modified sample management criteria may be appropriate for future sampling studies.

EPA has published guidance on holding times for the chemical analysis of environmental samples (EPA 1997). Recommended holding times are dependent upon type of sample, preservation, and analytical testing. EPA recommended holding times are not necessarily based on evidence of sample degradation, and environmental investigations often require analysis of samples archived frozen over timeframes far beyond the EPA recommended holding times, leading to potential uncertainty about the usability of such data. We undertook both a literature review of sample stability and a laboratory analysis of archived oyster tissue samples tested several years prior to evaluate whether or when samples stored following standard preservation requirements are measurably altered. Based on our findings we developed an analytical quality assurance plan with holding times extended to as many as four years in place of EPA's recommendation of one year; however, our analysis indicates that a holding time of even greater than four years may be appropriate in certain situations.

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RNA in mercuric chloride-poisoned sediment trap material: Preservation or growth?

Presenter: Barbara J MacGregor
University of North Carolina
Authors: B. J. MacGregor[1], U. Passow[2];
[1]University of North Carolina, Chapel Hill, NC, [2]University of California Santa Barbara, Santa Barbara, CA.

Abstract:
Direct sequencing of ribosomal RNA (rRNA) and rRNA genes from environmental samples allows the description of highly diverse natural microbial communities. Because rRNA (unlike DNA) is poorly preserved extracellularly in most environments, it is considered a marker of the currently active community. In the Gulf of Mexico, we are using the natural-abundance carbon isotopic composition of rRNA to help constrain the degree to which isotopically light natural gas and petroleum carbon are incorporated into microbial biomass. Unexpectedly, high concentrations of bacterial (and in one case archaeal) rRNA were recovered from HgCl2-preserved sediment trap samples. Whether this represents preserved material or results from microbial growth within the traps is an important question for the interpretation of sediment trap data. Low concentrations of excess nutrients, considered to result largely from metabolic activity after capture, suggest that there has been little growth in the sediment trap cups. rRNA sequence analysis based on total, bacterial, and archaeal RNA from trap material is in progress; this may shed light on whether microbial community composition changes post-capture. Incubations of trap material with and without preservative are planned as a direct test of the efficacy of HgCl2 as an RNA preservative, which to our knowledge has not been done to date.

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Fates of dissolved inorganic nitrogen in natural oil seep habitats along the Gulf of Mexico deep slope

Presenter: Lindsey Fields
University of Georgia
Authors: L. Fields, S. Joye;
University of Georgia, Athens, GA.

Abstract:
Naturally occurring oil seeps are abundant in the Gulf of Mexico; they are fuelled by hydrocarbon seepage at the seafloor and support accumulation of diverse chemosynthetic communities. Microorganisms form the base of the food chain at cold seeps, making these sites hot spots of biogeochemical cycling. While many studies have examined sulfate reduction at cold seeps, recent work indicates that denitrification is also an important process in oil seep sediments. Oxygenated cold seep bottom waters are rich in nitrate, which can be assimilated/stored, converted to ammonium through dissimilatory reduction (DNRA), or converted to N_2 via denitrification and anammox. We collected sediment cores from two seeps on the deep slope of the Gulf of Mexico: Green Canyon block 600 (GC600) and Mississippi Canyon block 118 (MC118) during the summer of 2013. We used stable isotope (^{15}N) tracer techniques to measure the capacity of surface and sub-surface sediments to reduce nitrate by denitrification and anammox, and measured concurrent changes in nitrate, nitrite, ammonium, and nitrous oxide concentrations. Our findings have implications for the biogeochemical N cycle and its interaction with other elemental cycles in oil seep habitats.

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The effect of chemical dispersants and crossflow on turbulent crude oil jets and plumes

Presenter: David Murphy
Johns Hopkins University
Authors: D. Murphy, J. Katz;
Johns Hopkins University, Baltimore, MD.

Abstract:
The Deepwater Horizon blowout, which introduced several million barrels of crude oil into the Gulf of Mexico, saw the first subsea injection of dispersants. Dispersants reduce oil/water interfacial tension and promote the formation of fine oil droplets that stay entrained in the water. Almost 800,000 gallons of dispersant were injected into the buoyant jet of crude oil and gas issuing from the sea floor. Due to these dispersants, part of the spilled oil formed fine droplets and, along with entrained seawater, formed a subsurface plume. The effect of dispersants on the behavior of such plumes is uncertain, but they clearly affect the droplet size distribution, and consequently, their buoyancy, and indirectly, the plume shape. We present results of experimental high speed visualizations of turbulent jets (which become plumes) of crude oil premixed with Corexit 9500A at various dispersant to oil (DOR) ratios. Observations were conducted in a 0.9 m x 0.9 m x 2.5 m towing tank, where large-scale behavior of the jet/plume, both stationary and towed at various speeds to simulate cross-flow, was recorded. Results include both plume shape and droplet size and spatial distributions within it. They were measured using a submerged videoscope, which records the droplets located within a pulsed light sheet. As expected, when mixed with dispersants at high DOR, a cloud of micron-size oil droplets forms; these droplets remain suspended in the water column essentially indefinitely.

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Oil dispersant Corexit EC9500A accelerates photodegradation of pyrene in seawater

Presenter: Dongye Zhao
Auburn University
Authors: J. Fu[1], Y. Gong[1], S. O'Reilly[2], D. Zhao[1];
[1]Auburn University, Auburn, AL, [2]BOEM, New Orleans, LA.

Abstract:
Large quantities of oil dispersants were applied during the 2010 Deepwater Horizon (DWH) oil spill. Due to interactions between dispersants and oil components, oil dispersants are expected to impact oil weathering. Yet, few quantitative data are available in this regard. This study investigated the effects of Corexit EC9500A (the primary dispersant used for the DWH oil spill) on the simulated sunlight-facilitated photodegradation of pyrene (a model polycyclic aromatic hydrocarbon in oil). The presence of 18 mg/L of Corexit EC9500A increased the first-order reaction rate constant of pyrene from 0.0022 min-1 to 0.0063 min-1. The surfactants Span 80 and Tween 85 in Corexit EC9500A were found to play critical roles in facilitating the photodegradation of pyrene. These oil-based surfactants tend to render a vertical concentration gradient in the water column, with the higher concentration in the upper layer. In addition, the surfactants also facilitate production of more reactive radicals and greater light absorption. GC-MS analysis indicated that 1-hydroxypyrene and pyreneuinones are the major photodegradation by-products. Furthermore, the dispersant was found to be susceptible to photodegradation and various degradation by-products derived from dispersant components were detected. The information is helpful for assessing the dispersant effects on the photochemical weathering of oil and the environmental fate of oil dispersants.

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Modeling Aging Oil

Presenter: Juan M Restrepo
University of Arizona
Authors: J. M. Restrepo, N. Balci, S. Venkataramani;
University of Arizona, Tucson, AZ.

Abstract:
Crude oil has a very complicated chemical composition. Large scale models for the fate of hydrocarbons in oceanic environments cannot
practically track the myriad of chemicals individually.
In the Nearshore CARTHE Oil Fate Model, which we are presently developing, we track composite chemical species. As a result of the

agglomeration of chemicals, the resulting composites will have exotic behavior, for example, with regard to their evaporation, photolysis, emulsification, and sedimentation rates. We describe how the CARTHE Oil Model takes into account such "aging" effects.

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Facile Detection of PAHs via Three-Component Energy Transfer in Complex Environments for Oil Spill Response

Presenter: Nicole Serio
University of Rhode Island
Authors: N. Serio, M. Levine;
University of Rhode Island, Kingston, RI.

Abstract:
Gamma-cyclodextrin simultaneously binds a fluorophore and analyte to facilitate proximity-induced energy transfer via ternary complex formation, wherein the analyte acts as an energy donor to the fluorophore (energy acceptor). Energy transfer to and emission from the fluorophore occurs upon excitation of the analyte, and the resulting emission wavelength is unique to each fluorophore-analyte combination. These unique signals can lead to the array-based detection of the analytes. Analytes of interest, including environmentally-persistent PAHs (ex: anthracene, benzo(a)pyrene, and pyrene) and other carcinogens (including PCBs) were tested with three fluorophores in various environments. Energy transfer has been successfully observed in simple systems (such as phosphate buffered saline) and complex ones, including: oils (motor, vegetable, fish, and pump), seawater, human plasma, and human breast milk. Progress is being made in the understanding of these ternary complexes so that the array-based detection of such analytes can be enacted in complex systems. The successful detection of these carcinogenic analytes, in a variety of complex environments, highlights the utility of this detection scheme and its applicability to different phases of oil spill response in understanding PAH release: quantification, characterization, and detection in both environmental and biological systems. As such, this scheme can be a valuable tool for both scientists and first responders.

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Variability in the hydrocarbon composition of oil films on rocks along the Gulf coast post the Deepwater Horizon disaster

Presenter: Bryan James
Woods Hole Oceanographic Institution
Authors: B. James;
Woods Hole Oceanographic Institution, Woods Hole, MA.

Abstract:
Oil films that are 1 to 30 mm thick from the Deepwater Horizon disaster continue to be found on rocks and other solid substrates along the Gulf coast. Our overarching interest is whether there is a gradient in weathering along the thickness of these oil films. That is, are the outer layers close to the elements more weathered than those closer to the rock face? Here we define weathering as the extent of biodegradation and changes in compound-classes to more oxidized components.
To study the possibility of variable weathering, we harvested oil films from two rocks, one in coastal Alabama (35 mm thick in 2012) and the other in coastal Mississippi (13 mm thick in 2013). We adapted principles of thin sectioning of rocks and other geological samples and used plaster of Paris to embed the oil. We then sectioned the embedded oil at 1-mm increments along the thickness of the film with a tabletop deli-slicer. Each slice was analyzed with gas chromatography with flame ionization detection (GC-FID) and thin-layer chromatography with flame ionization detection (TLC-FID) to measure any differences in weathering.
For both oil films, we observed no change in the extent of biodegradation by thickness by monitoring the n-C18/phytane ratios, a classic indicator of this process in which the smaller the value correlates to greater degradation.
However, both films did show evidence of biodegradation with ratios of ~0.88 and 0.39 for the Alabama and Mississippi films, respectively when compared to the original oil that had a ratio of 2.56. (And also no changes for compound-class composition).
We are currently considering two hypotheses for why there are no gradients. We are continuing to investigate these samples and other films.

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PAHs Degradation In The Emerged And The Submerged Marsh Wetland Sediments Studied In A Laboratory Mesocosms

Presenter: Doorce Batubara
Louisiana State University
Authors: D. Batubara, M. S. Miles, D. D. Adrian, R. F. Malone;
Louisiana State University, Baton Rouge, LA.

Abstract:
A laboratory mesocosm with a pneumatic water cycle system was used to examine the degradations of some polycyclic aromatic hydrocarbons (PAHs) in the submerged and the emerged marsh wetland sediments. The experiments were performed in 30-L mesocosms which could simulate tidal movements and dilution system daily in a natural coastal wetland. Phenanthrene (Phe), pyrene (Pyr), and benzo[e]pyrene (BeP) were three kinds of different PAHs spiked to the coastal marsh sediment, both for the submerged and the emerged. After about 16 weeks, 96% of Phe, 92% of Pyr, and 79% of BeP were removed from the emerged sediment; and 86% of Phe, 76% of Pyr, and 72% of BeP were removed from the submerged sediment. The degradation rates of Phe, Pyr, and BeP were higher in the emerged sediment and were significantly different between the two sediments. BeP stays longer in sediment and is more persistent than the other two compounds as its molecular weight is higher than that of Phe and Pyr and its water solubility is lower than that of Phe and Pyr. Gas exchange of oxygen during low tide in the emerged sediment promotes formation on the sediment of a thin aerobic layer, which is a favorable environment for microorganisms to utilize Phe, Pyr, and BeP. Thus, these three compounds are degraded more completely in the low tide cycles in the emerged sediment than in the submerged sediment.

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Biodegradation Of MC252 Components In Oil:Sand Aggregates On The Supratidal Beach Environment

Presenter: Vijaikrishnah Elango
Louisiana State University
Authors: V. Elango, J. Pardue, K. Lemelle, M. Urbano;
Louisiana State University, Baton Rouge, LA.

Abstract:
Biodegradation of MC252 crude oil components in oil:sand aggregates was studied on the beach environment of the Caminada Headlands, LA. Aggregates were sampled across transects perpendicular to the beach from the intertidal to the supratidal. Chemical composition of aggregates was measured including concentrations of n-alkanes, PAHs, hopanes, salinity, nutrients and electron acceptor concentrations. Microbial characterization was also conducted using DGGE and sequencing of dominant bands. Sampling focused on comparing and contrasting impacts of biogeochemistry on biodegradation of oil stranded in three beach microenvironments; supratidal surface; subtidal subsurface (permanently inundated) and intertidal subsurface (intermittently inundated). Supratidal surface samples were depleted in n-alkanes and lower-molecular weight PAHs. Geochemically, aggregates located in these environments had low salinities (1.3-1.5 ppt), O2 at near saturation and nutrient concentrations (N and P) significantly lower than those deposited in the intertidal and subtidal. Intertidal and subtidal subsurface oil samples were characterized by elevated nutrient concentrations and salinities, consistent with regular seawater inundation. Inundation leads to O2 consumption in the aggregates after several days. PAHs and n-alkanes were comparatively unweathered in the subtidal subsurface samples consistent with O2 limitations. Sequences of known PAH degraders were isolated from the supratidal and intertidal aggregates. Weathering indices computed from double ratio plots of C2/C3 phenanthrene and C2/C3 dibenzothiophene clearly show that biodegradation proceeds in the supratidal despite suboptimal moisture and nutrient regimes.

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Impacts of the 2010 Macondo Oil Spill on Marshes in Barataria Bay, Terrebonne Bay, and Breton Sound, Louisiana, Using Landsat and ASTER Data

Presenter: Michael S Kearney
University of Maryland
Authors: M. S. Kearney[1], A. Riter[1], R. E. Turner[2];
[1]University of Maryland, College Park, MD, [2]Louisiana State University, Baton Rouge, LA.

Abstract:
The 2010 Macondo Oil Spill's effects on marsh vegetation health in marshes of Terrebonne Bay, Barataria Bay, and Breton Sound were investigated using Landsat and ASTER data collected between 1984 and 2011 and 2000 and 2013. Marsh losses vary spatially and temporally in these marshes. Marshes less than 40 km from the coast were less stable than freshwater and most brackish marshes: between 1984-1992 vegetation health and marsh area in coastal marshes were relatively stable with minor inter-annual fluctuations and some local areas of marsh loss. By 1994, shoreline and tidal creek erosion, and erosion of soil banks adjacent to canals, had increased, primarily in seaward marshes. Damage from Hurricane Ivan in 2004 was minor; whereas, Hurricanes Katrina and Rita in 2005, and Gustav and Ike in 2008, caused local extensive erosion of vegetation and the marsh substrate. Freshwater and intermediate marshes in the Caernarvon diversion showed the greatest damage from these storms, and Naomi and West Point a La Hache diversions marshes were also badly affected. Overall, coastal marshes showed less long-term hurricane damage than inland marshes. The Macondo Oil Spill has yet to show definitive impacts in the Landsat and ASTER data on oiled marshes that can distinguished from dieback and other factors. The 2005 and 2008 hurricanes remain the causes of the most significant changes in marshes of the study area.

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A Radiocarbon-Based Determination of the Flux of Oil to the Sea Floor

Presenter: Jeff Chanton
Florida State University
Authors: J. Chanton[1], T. Zhao[1], J. Cherrier[2], S. Joye[3], D. Hollander[4], C. Brunner[5], J. Montoya[6], U. Passow[7], V. Asper[5], S. Bosman[1], A. Mickle[1];
[1]Florida State University, Tallahassee, FL, [2]Florida A&M University, Tallahassee, FL, [3]University of Georgia, Athens, GA, [4]University of South Florida, Saint Petersberg, FL, [5]University of Southern Mississippi, Stennis, MS, [6]Georgia Tech University, Atlanta, GA, [7]University of California, Santa Barbara, CA.

Abstract:
Using natural abundance radiocarbon as a tracer of petroleum input we calculate that 2.9 ± 1.7% of the oil that issued from the 2010 spill was deposited on the Gulf sea floor. This estimate was accomplished by determination of surface sediment 14C content of seafloor organic matter which varied from -500‰ to -140‰ on the DELTA 14C scale. We produced a contour map of 14C values collected from 62 core samples collected in 2010 and 2011. We used our contour map to calculate the distribution and inventory of seafloor 14C content by areal extent in m^2. We then employed a two end-member mixing model to calculate the fraction of the organic matter that was fossil (petroleum derived) carbon within each contour interval. The end-member values were -1000‰ for petro-carbon and -200±20‰ for the background value of surface sediment carbon prior to the spill. We found that petro-carbon laced sediment was deposited over pre-spill sediments with this background (-200±20‰) value. These fraction-fossil carbon values were multiplied by measured % organic carbon (approximately 2%) and porosity (0.9) and integrated over a 1 cm interval to yield the total amount of petro-carbon on the seafloor. The total inventory of petro-carbon on the sea floor was divided by estimates of the amount of carbon released over the duration of the event to yield a value of 2.9 ± 1.7%. Measurement of radiocarbon as a function of depth in 8 sediment cores indicated that the oil deposition was confined to the upper 1 to 2 cm of the sediment, and that our radiocarbon map was not influenced by collections at natural seeps.

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Oily marine aerosol production at the air-sea interface

Presenter: David Murphy
Johns Hopkins University
Authors: D. Murphy, C. Li, J. Katz;
Johns Hopkins University, Baltimore, MD.

Abstract:
Oil slicks often form at the air-sea interface as a result of oil spills such as the Deepwater Horizon blowout. Ranging in thickness from sub-micron to several millimeters, these slicks affect normal air-sea interface processes in an unknown manner. Formation and

propagation of marine aerosol is an important air-sea interface process. The impact of marine aerosol, or sea spray, comprising micron to millimeter-sized water droplets, on weather and climate, biogeochemical cycling, and regional air quality is well known. The introduction of an oil slick has the potential of generating aerosolized oil, a topic that has not received significant attention. In this study, we focus on formation of airborne oil droplets resulting from the impact of raindrops directly, or due to subsequent bursting of entrained air bubbles. Water drops at speeds of 1-10 m/s impinge on a controlled surface layer of crude oil premixed with varying concentrations of Corexit 9500A dispersant. High speed imaging elucidates mechanisms contributing to the formation of aerosols, and digital holographic microscopy is used to measure the resulting droplet size and ejection speed distributions. We also developed a system for collecting samples of the airborne oil droplets for future chemical analysis. Experiments quantify the effects of oil film thickness, raindrop momentum, dispersant to oil ratio, and presence of previously generated emulsions containing micro oil droplets below the water surface.

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Partitioning Behavior of Low Molecular Mass Xenobiotic Components within Live Crude Oil/Seawater Systems

Presenter: Gavin M Phinney
Petroleum Reservoir Group, Department of Geoscience, University of Calgary
Authors: G. M. Phinney, R. W. Snowdon, A. P. Stopford, S. R. Larter, T. B. P. Oldenburg;
Petroleum Reservoir Group, Department of Geoscience, University of Calgary, Calgary, AB, CANADA.
Abstract:
Xenobiotic compounds are exogenous chemical species, not normally synthesized by an organism, which have the potential to instigate acute or chronic toxicity in organisms, even causing death in extreme cases. A major source of xenobiotic compounds is found within petroleum, a naturally occurring complex mixture of hydrocarbons and other organics, and its release into the environment typically follows improper anthropogenic use or accidental spillage. Upon the blowout of the Macondo exploratory well, causing the 2010 Deepwater Horizon oil spill of 4.9 million barrels of petroleum, increased interest in the environmental fate of xenobiotic crude oil components at deep ocean conditions developed. We have fabricated a unique instrument that can replicate the partition behavior of these compounds between saline waters and methane-charged crude oil over a range of pressure (0 - 17 MPa) and temperature (4 - 80°C). This allows us to extract partition coefficients at various ocean conditions for low molecular mass xenobiotics, including BTEX and C0 - C3 alkylated phenols, by GC-MS/FID. These coefficients will aid in near-field and far-field distribution modeling for the environmental fate of the ejected crude oil components of interest and assist in the prediction of component migration pathways for potential oil spills. In this presentation we will show the first experimental results of this unique device.

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238U-234Th disequilibria as a tracer of Polycyclic Aromatic Hydrocarbon fluxes in Northern Gulf of Mexico

Presenter: Somiddho Bosu
Louisiana State University
Authors: S. Bosu, K. Maiti, P. Adhikari;
Louisiana State University, Baton Rouge, LA.
Abstract:
234Th is a naturally occurring radioisotope, formed by decay of 238U in ocean water. 234Th is preferentially scavenged by sinking particles resulting in deficiency of 234Th with respect to 238U in the water column. Similarly, a major removal mechanism of Polycyclic Aromatic Hydrocarbons (PAHs) entering the surface ocean is by adsorption onto sinking particles. This allows the application of 238U-234Th disequilibria as a proxy for estimating vertical PAHs fluxes. Here we present the potential for applying 234Th as a tool to estimate vertical PAHs fluxes in ocean. Water column samples from upper 500m were collected from three stations around the Deep Water Horizon oil spill site during two research cruises in April of 2012 and 2013. Samples were analyzed for 238U-234Th disequilibria as particulate 234Th and PAHs concentrations. Calculated water column 234Th fluxes at 150m, 250m and 350m were translated to PAHs fluxes using depth specific particulate PAHs-234Th ratios, which ranged between 0.001-0.005 µg/dpm. Preliminary results indicate two times higher PAHs fluxes in 2012 compared to 2013, ranging between 3-8 µg m-2 day-1. The PAHs fluxes were found to vary little with depth for both years and could not be related to particulate PAHs concentration in water column. 234Th derived PAH fluxes were found to be consistent with direct measurements from sediment traps at the same depths, indicating that 234Th can be used effectively as a tracer for vertical PAHs fluxes in this region.

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Electrical Resistivity Imaging for Long Term Autonomous Monitoring of Hydrocarbon Degradation: Lessons from the Deepwater Horizon Oil Spill

Presenter: Jeffrey Heenan
Rutgers - Newark
Authors: J. Heenan[1], L. D. Slater[1], D. Ntarlagiannis[1], E. A. Atekwana[2], B. Z. Fathepure[2], S. Dalvi[2], C. Ross[2], D. D. Werkema[3], E. A. Atekwana[2];
[1]Rutgers - Newark, Newark, NJ, [2]Oklahoma State University, Stillwater, OK, [3]US EPA, Las Vegas, NV.
Abstract:
Electrical resistivity imaging (ERI) has been used to monitor various subsurface processes, including the migration/degradation of contaminants (e.g. hydrocarbons). Conceptual models for the geophysical responses associated with hydrocarbon degradation suggest that the long term fate of the plume will result in a more conductive anomaly than the initial contamination. In response to the Deepwater Horizon (DH) spill, an autonomous resistivity monitoring system was deployed on Grand Terre 1, LA, in an attempt to monitor natural degradation processes in hydrocarbon impacted beach sediments, the first such attempt in this type of setting. Geophysical and geochemical in situ measurements, along with fluid and soil samples measurements, were collected between January 2011 and August 2012. A progressive decrease in the resistivity of the Deepwater Horizon spill impacted region of the subsurface was observed with time and detailed analysis of pixel/point behavior within the imaged area showed that these decreases were largely confined to the DH impacted sediments, with most of the surrounding sediments showing minimal change. Microbiological testing revealed that only the native communities from the DH impacted locations include active hydrocarbon degraders. The resistivity data, supported by the microbiological evidence, suggest that the changes in resistivity seen during the experiment non-invasively capture the evolution of the natural oil degradation processes at the site.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-199

Temporal Variability In Polycyclic Aromatic Hydrocarbons Transport In The Northern Gulf Of Mexico

Presenter: Puspa L Adhikari
Louisiana State University
Authors: P. L. Adhikari, K. Maiti, E. Overton;
Louisiana State University, Baton Rouge, LA.
Abstract:
Particle mediated vertical transport is the major pathway of removal of lipophilic organic pollutants such as polycyclic aromatic hydrocarbon (PAHs) in marine systems. Although there are large number of oil related researches in the northern Gulf of Mexico (GOM) especially after Deepwater Horizon (DWH) oil spill in 2010, none of them have address this critical pathway. In this study, we estimate all four components; dissolved, particulate, sinking and PAHs in bottom sediments to quantify vertical flux, sinking velocity, residence time, accumulation rate and in general fates of PAHs in the GOM. Water, suspended, settling and bottom sediment samples were collected and analyzed for PAHs in 2012 and 2013 in the vicinity of DWH spill site. The concentrations of particulate ΣPAHs ranged from 0.29 to 0.72ng/L in 2012 and 0.17 to 1.31ng/L in 2013. Particle-bound PAHs contributed only about 0.75 to 2.7% of the total PAHs in the water column. Trap based particulate ΣPAHs fluxes ranged from 2.21 to 7.78µg/m2/d in 2012 and from 1.95 to 2.53µg/m2/d in 2013. The residence time of the particulate PAHs in the upper 350m of the water column were calculated to be ~29d and ~52d in 2012 and 2013, respectively. Measurement of export fluxes and residence time of PAHs provides us with a necessary first step to better constrain related models of pollutant cycling which will be invaluable for understanding fate of PAHs in general and specifically the impact of any future oil spill.

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Type: Poster 5-200

Using Detailed Chemical Composition of Surfaced Oil to Model Evaporative Weathering and Predict Secondary Aerosol Formation Potential

Presenter: Greg Drozd
UC Berkeley
Authors: G. Drozd, D. Worton, E. Variano, A. Goldstein;
UC Berkeley, Berkeley, CA.

Abstract:
The transport and fate of oil after a massive spill must be known to accurately assess environmental impacts. Three natural weathering processes for the oil are: evaporation, dissolution, and biodegradation, and each can change the chemical composition of the oil in specific ways. For example, evaporation will remove volatile oil components and biodegradation may enhance the fraction of branched alkanes. Accurate modeling of oil weathering process will aid in reconstructing the history and effective removal processes of spilled oil. In this work we use GC×GC-VUV-HRTOFMS to achieve unprecedented characterization of both oil composition and volatility from the Deepwater Horizon (DWH) oil spill. Roughly 75% of the total mass of the alkane mixture comprising the oil was classified according to degree of branching, number of cyclic rings, aromatic character, and molecular weight. Such detailed and comprehensive characterization of the DWH oil allows for bottom-up estimates of the relationship between oil volatility and composition. Knowledge of the comprehensive chemical composition of DWH oil allows detailed, time-dependent predictions of surface-oil composition and evaporation along with subsequent atmospheric secondary aerosol formation. Good agreement between surface-weathered oil composition and our predicted composition following evaporation suggests detailed chemical composition of surface oil can be used to infer the extent and rate of loss processes following release from the wellhead. With detailed knowledge of chemical composition, gas-particle partitioning and aerosol yields of their oxidation products are known, and organic aerosol formation from oil vapors and their oxidation products was also modeled.

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Type: Poster 5-201

Development Of A Novel Analytical Method Using Gas Chromatography-Tandem Mass Spectrometry For Characterizing Alkylated Chrysenes In Crude Oil Samples

Presenter: Gerald F. John
Auburn University
Authors: G. F. John[1], F. Yin[1], V. Mulabagal[2], J. S. Hayworth[1], T. Clement[1];
[1]Auburn University, Auburn, AL, [2]Tuskegee University, Tuskegee, AL.

Abstract:
Recent advances in mass spectrometry have led to the development of triple quadrupole mass spectrometry (or GC-MS/MS spectrometry) that allows identification of target analytes in complex environmental samples with more certainty. GC-MS/MS methods simultaneously monitor a precursor ion, yielded from the electron impact process, and several characteristic product ions, yielded from collision cell reactions of the precursor ion, to improve the selectivity of target analytes. In this study, we developed a GC-MS/MS method for characterizing chrysene and its alkylated homologues in crude oil samples. Commercially available standards were used to study the fragmentation patterns of alkylated chrysenes under full-scan and product-ion-scan conditions. The information inferred from these data was then used to predict the fragmentation patterns of other isomers for which standards are not commercially available. The experimental and theoretical fragmentation data was then used to develop a GC-MS/MS method for identifying and quantifying the total concentrations of C1, C2, C3, and C4-chrysene homologues found in typical crude oil and/or oil spill samples. The developed method was used to characterize MC252 crude oil, which was spilled into the Gulf of Mexico during Deepwater Horizon oil spill event and other crude oils.

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Type: Poster 5-202

The fate of oil in sunlight exposed thin films is affected by polycyclic aromatic hydrocarbon sensitized photochemistry

Presenter: Dustin D Kountz
University of New Orleans
Authors: D. D. Kountz;
University of New Orleans, New Orleans, LA.

Abstract:

Among the important processes affecting oil fate, photochemistry has been proposed as an important pathway, especially since its action can alter higher molecular weight species that are resistant to biodegradation, rendering them more bioavailable and less recalcitrant. However, detailed mechanisms of oil phototransformation are not readily available. Photodegradation of selected polycyclic aromatic hydrocarbons (PAHs) in an n-alkane hydrocarbon matrix was followed for individual PAHs and mixtures of PAHs. Selected PAHs were prepared in a tetradecane matrix at concentrations similar to that found in oil from the Deepwater Horizon spill. Samples contained either an individual PAH or a mixture of two or more PAHs. Thin films of these samples were coated on water and exposed to simulated sunlight equivalent to 0.75, 1.5, and 3 days of sunlight in the Northern Gulf of Mexico. Phenanthrene in tetradecane showed minimal photodegradation at shorter times, while the 3 day irradiation showed 30% degradation. When irradiated alone in a tetradecane matrix, anthracene showed a much higher degradation rate, ranging from 60-90%, depending on irradiation time. Pyrene alone behaved similarly to anthracene, with degradation in the 30-80% range. When mixtures of PAHs in tetradecane were irradiated, very different results were observed. For example, when anthracene was irradiated in the presence of phenanthrene, anthracene was 90% degraded after only 0.75 days of irradiation (compared to 60% when irradiated by itself). Such results suggest that PAHs are important in photosensitizing the degradation of other compounds.

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Type: Poster 5-203

Study of the Photophysics and Photodynamic occurring in thin films of crude oil

Presenter: Nicholas A Leed
Tulane University
Authors: N. A. Leed, K. Martinez, R. Schmehl;
Tulane University, New Orleans, LA.
Abstract:
In addition to direct photo-oxidation of crude oil upon exposure to sunlight, the possibility exists that the aromatic and polyaromatic components of the crude oil can produce reactive oxygen species (ROS) upon irradiation, particularly, singlet oxygen. As crude oil is a complex mixture, models based on one or more aromatic components may not sufficiently predict the photophysics and photodynamics which occur within films of crude oil. This study focuses on time resolved luminescence spectroscopy of thin films and dilute solutions of crude oil recovered from the Deepwater Horizen oil spill to explore the excited state dynamics and quantify singlet oxygen production.

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Type: Poster 5-204

A new biodegradation index for weathered oils based on saturated hydrocarbons: insights from the Deepwater Horizon disaster

Presenter: Christopher Reddy
Woods Hole Oceanographic Institution
Authors: C. Reddy[1], J. Gros[2], C. Aeppli[3], C. A. Carmichael[1], R. K. Nelson[1], J. Arey[2];
[1]Woods Hole Oceanographic Institution, Woods Hole, MA, [2]Swiss Federal Institute of Technology at Lausanne (EPFL), Lausanne, SWITZERLAND, [3]Bigelow Laboratory of Ocean Sciences, East Boothbay, ME.
Abstract:
A new biodegradation index for weathered oils based on saturated hydrocarbons: Insights from the Deepwater Horizon disaster

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-205

Using Hopane and Sterane Biomarker Ratios to Determine the Origin of Oil Residues in the Gulf of Mexico

Presenter: David M Findley
Haverford College
Authors: D. M. Findley, P. W. Williams, H. K. White;
Haverford College, Haverford, PA.

Abstract:
The Deepwater Horizon (DWH) oil spill is the largest spill in U.S. history and, as such, weathered oil originating from the wellhead reached a variety of environments via an assortment of transport mechanisms. Assessing the weathering patterns of these oil residues remains a priority for researchers in the Gulf of Mexico, informing our overall understanding of the fate of oil in the marine environment. Natural seepage and continued human activity in the Gulf of Mexico, however, obfuscate these investigations as the oil from the DWH spill becomes mixed with oil from other sources. As a result, the analysis of recalcitrant biomarkers such as hopanes and steranes that are present in oil, is essential for determining the source of the oil. This study analyzed biomarker ratios from an array of samples that were collected over the three years since the DWH disaster from sites thought to be impacted by the DWH spill. These samples include oil-soaked sand patties, deep-sea sediments, and sediment subfractions. The vast majority of biomarker ratios calculated from the oil recovered from these samples indicates that the samples originated from the DWH spill. The findings from this study verify how well-preserved these biomarker ratios are in the marine environment and highlight the persistence of oil from the DWH spill in the environment.

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Type: Poster 5-206

Estimating the Potential Cross-shore Distribution of Oil Mat Formation in the Surf Zone during the Deepwater Horizon Oil Spill

Presenter: Soupy Dalyander
U.S. Geological Survey
Authors: S. Dalyander, J. Long, N. Plant, D. Thompson;
U.S. Geological Survey, St. Petersburg, FL.

Abstract:
Oil from the Deepwater Horizon spill that reached the surf zone mixed with sediment to form dense sand/oil agglomerates ranging from cm-size patties to 10's of meters long mats. Exhumation of buried patties and mats by ocean processes continues to cause beach re-oiling. Within the swash zone, oil was brought in direct contact with the beach; however, it was unknown if waves might resuspend sufficient sediment from deeper (m-scale) depths and extend the offshore limit of mat formation. In this study, we calculated the amount of sediment required to form a sand/oil mat, and compared it to estimates of surface sediment concentrations under numerically modeled waves off of Alabama and Florida (from the shoreface to depths of up to 50 m) during the time of oiling. Analysis indicates that non-breaking waves and spilling breakers are not likely to suspend sufficient sediment to the surface to drive mat formation. However, resuspension and convective mixing associated with plunging breakers might allow mat formation. We determined that plunging breakers occurred at depths greater than 2 m less than 10% of the time of oiling in the study area. The percentage of time potential mat formation conditions existed at depths greater than the swash zone dropped to 2% if a 50 W/m^2 plunging breaker dissipation threshold was also imposed, and 0.2% for those conditions to occur at the primary breaker line. These results indicate mat formation was most likely in shallow depths (< 1 m).

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Type: Poster 5-207

Hindcast Oil Plume Spreading by a High Resolution Ocean Model Coupled to an Oil Spill Model

Presenter: david E dietrich
San Diego State University
Authors: d. E. dietrich;
San Diego State University, Lakeland, FL.

Abstract:
The spreading of oil material injected into the Gulf of Mexico (GoM) at the BP/Macondo well site during April-July, 2010 is simulated using: a full featured oil spill model; and GoM regional models nested in global models. A Modified Analog Method based forecast approach is described, and applied to simulating the path of well material. Short term (few days to months) effects of the nearby Loop

Current are demonstrated and explained. On a longer term (years), the fate of deeply suspended oil and material loosely deposited on bottom sediments is also discussed. Notably: GoM material residence time is decades to centuries; and, forebodingly, hurricanes may energize upwelling of even subthermocline material, and carry entrained/suspended oil material to the surface and blow it ashore, as did even weak category 1 hurricane Isaac.

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Type: Poster 5-208

Near Real-Time Determination of Volatile Organic Compounds in Air and Water Samples Associated with Dispersed Crude Oil

Presenter: Parichehr Saranjampour
Louisiana State University
Authors: P. Saranjampour, E. B. Overton, M. S. Miles, K. L. Armbrust;
Louisiana State University, Baton Rouge, LA.

Abstract:
Hazardous impacts can occur from spilled crude oil, dispersed oil and the subsequent release of volatile organic compounds (VOCs) in air and water. In this study, water was exposed to South Louisiana crude oil and a 1:20 mixture of Corexit 9500 dispersant and oil. Samples (n=200) from the air above the spill surface and 10 cm water below the oil slick were collected at various intervals before and after the spill experiments. Air/water samples included background, in the presence of oil (effects of natural dispersion of VOCs), and dispersed oil (1:20) at two sinusoidal wave tank conditions of 30 and 35 cycles per minute (cpm). Air and head space water samples were analyzed in the field with a portable fast small-scale gas chromatograph. The major volatile oil constituents, benzene, toluene, o-, m-, and ρ-xylene were detected in air and water samples. The detection limit of the state-of-the-art instrument for these VOCs is in the 50 - 100 part per billion range.

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Type: Poster 5-209

Examining the Environmental and Geochemical Controls on the Degradation of Oil by Fungi Isolated from Oil-Soaked Sand Patties in the Gulf of Mexico

Presenter: Rachel L Simister
Haverford College
Authors: R. L. Simister, J. Reeve, S. L. Lyons, H. K. White;
Haverford College, Haverford, PA.

Abstract:
Filamentous fungi of the division Ascomycota were found growing on oil-soaked sand patties that originated from the Deepwater Horizon oil spill. To test the ability of this fungi to utilize crude oil as a sole carbon source, isolates were removed from the sand patties and adapted to grow on an Artificial Seawater (ASW) minimal medium supplemented with crude oil. To investigate the mechanisms of oil degradation employed by the fungi, the change in oil quantity and composition was examined via gas chromatography-mass spectroscopy (GC-MS) analysis. An overall decrease in the amount of total oil was observed in all experiments where fungi were present, but differences in the relative abundance of individual oil-derived compounds such as alkanes and polycyclic aromatic hydrocarbons (PAHs) were observed between fungal isolates. These findings suggest that the fungi employ multiple mechanisms for oil degradation, highlighting the versatility of Ascomycota. We have begun a preliminary investigation to characterize these oil-degradation mechanisms with the aim of determining how these are influenced by geochemical and environmental forces.

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A Qualitative Time-Dependent Model of the Fate of MC252 Oil and Gas in the Gulf of Mexico

Presenter: Gilbert Rowe
TAMUG
Authors: G. Rowe;
TAMUG, Galveston, TX.

Abstract:
A numerical simulation is used to illustrate the fates and transformations of the oil and gas from the deep BP Macondo 252 (MC252) oil well explosion and commensurate debouchment into the Gulf of Mexico(GM). The ‘losses’ of the original total mass (4.9E6 barrels) are parameterized as a function of time resulting from evaporation, photo-degradation, biological degradation, physical weathering and chemical dispersal. The concentrations of oil and gas (in barrels or barrel equivalents) in nine different habitats are included in a set of

coupled differential equations that are solved simultaneously. The changes in 'state' of the hydrocarbons or the transfers between habitats are parameterized as time-dependent fluxes. The solutions of these equations predict how the material has changed or 'disappeared' over time. While the surface slick is thought to have disappeared within a month or so after the well was capped, the model suggests that the contamination of oyster reefs and wetlands would persist for several years. As new data are accrued over time by research since the event, the variables in the equations will be adjusted (corrected).

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GISR Drift Card Program: Surface Transport Observation

Presenter: Joe Kuehl
Geochemical and Environmental Research Group, Texas A&M University
Authors: J. Kuehl[1], K. Thyng[2], P. Chapman[2];
[1]Geochemical and Environmental Research Group, Texas A&M University, College Station, TX, [2]Texas A&M University, College Station, TX.

Abstract:
Beginning April 2012, the GISR lead Drift Card Program has released (as of October 2013) 3320 drift cards, in groups of 10 or 50, throughout the Gulf of Mexico, of which 322 have been recovered. These 5x3x0.25 inch, environmentally friendly, wooden cards, deployed by vessels of opportunity, provide an inexpensive means to better understand surface transport. By floating on the ocean surface, like a surface oil slick, they are influenced by both winds and surface currents, thus providing a fundamentally different dataset than drogued drifters or regular "surface" drifters. To fill in the gaps between deployment and recovery, the drift card dataset is compared with numerically tracked particles from both numerical model output and satellite derived geostrophic velocity fields (with and without wind effects). The key objective of this study is to assess the influence of wind on surface transport barriers and basic drift card statistics will be discussed.
To date, several drift cards have exited the Gulf, being recovered on the east coast of Florida. In addition, several cards release in USA waters have been recovered in Mexico. The drift card data is updated monthly and available through an interactive map at http://gisr.tamu.edu/driftcard

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Optimization of a Novel Method to Isolate Interfacially Active Species from Crude Oil and Characterization by Electrospray Ionization FT-ICR Mass Spectrometry

Presenter: Amy C Clingenpeel
Florida State University
Authors: A. C. Clingenpeel[1], J. M. Jarvis[2], S. M. Rowland[1], W. K. Robbins[3], A. G. Marshall[1,2], R. P. Rodgers[1,2];
[1]Florida State University, Tallahassee, FL, [2]National High Magnetic Field Laboratory, Tallahassee, FL, [3]Future Fuels Institute-Florida State University, Tallahassee, FL.

Abstract:
Petroleum crude oil can enter the environment through natural seeps or anthropogenic sources. Knowledge of compounds that exist at the crude oil/water interface can help in the understanding of emulsion stability and in the determination of remediation efforts. Here, Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR MS) is utilized to characterize the interfacially active species within crude oil. Interfacial material is isolated by a novel method, the wet silica method. The wet silica method has been optimized since its initial implementation and is detailed here. The parent crude oil and the interfacially active species were characterized by a custom-built 9.4 T FT-ICR mass spectrometer. Data were calibrated and processed with custom software packages (PREDATOR[1] and PetroOrg, copyright 2012). Work supported by NSF DMR-11-57490, Florida State University, the Future Fuels Institute, and the National High Magnetic Field Laboratory in Tallahassee, FL.(1) Blakney, G. T.; Hendrickson, C. L.;
Marshall, A. G. *Int. J. Mass Spectrom*. 2011, *306*, 246-252.

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Biodegradation Of Long Chain Alkanes And Alkenes By Enrichment Cultures Under Methanogenic, Sulfate-Reducing And Iron-Reducing Conditions

Presenter: Martijn P Smit
Wageningen University
Authors: A. Cavaleiro[1], A. Langenhoff[2,1], M. P. J. Smit[2], A. J. M. Stams[2,1], M. M. Alves[1], D. Z. Sousa[2];
[1]University of Minho, Braga, PORTUGAL, [2]Wageningen University, Wageningen, NETHERLANDS.

Abstract:
Hydrocarbon degradation in oxygen-limited environments occurs in deep water and sediments after oil spills. This relates to the objective of this study; to understand and enhance the biodegradation of oil.
To study the ability of non-adapted microbial communities to degrade aliphatic hydrocarbons, six enrichment cultures were obtained. Non-adapted anaerobic granular sludge was used as inoculum, and cultures were grown with 1 mM hexadecane or hexadecene under sulfate reducing, iron reducing or methanogenic conditions. Degradation of the hydrocarbons was determined by the reduction of the electron acceptor or methane production, and compared with cultures without the hydrocarbons.
After 3 successive transfers, hexadecene biodegradation was observed in all the enrichments, whereas hexadecane utilization only occurred under iron reducing conditions. In hexadecane and hexadecene cultures, 51% and 41% of the available Fe3+ was reduced after 52 days of incubation. In the hexadecane enrichments, 44% of the sulfate was reduced after 300 days of incubation, and 8 mM methane was produced in the methanogenic enrichments, which corresponds to 65% of the stoichiometric value.
The microbial communities are characterized by 454 pyrosequencing of the 16S rRNA genes and will be presented as well.
This work shows that the biodegradation of long chain alkanes and alkenes is more widespread in nature than previously thought, and can be used for the removal of oil after an oil spill.

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Near Real-Time Determination of Volatile Organic Compounds in Air and Water Samples Associated with Dispersed Crude Oil

Presenter: Parichehr Saranjampour
Louisiana State University
Authors: P. Saranjampour, M. S. Miles, E. B. Overton, K. L. Armbrust;
Louisiana State University, Baton Rouge, LA.

Abstract:
Hazardous impacts can occur from spilled crude oil, dispersed oil and the subsequent release of volatile organic compounds (VOCs) in air and water. In this study, water was exposed to South Louisiana crude oil and a 1:20 mixture of Corexit 9500 dispersant and oil. Samples (n=200) from the air above the spill surface and 10 cm water below the oil slick were collected at various intervals before and after the spill experiments. Air/water samples included background, in the presence of oil (effects of natural dispersion of VOCs), and dispersed oil (1:20) at two sinusoidal wave tank conditions of 30 and 35 cycles per minute (cpm). Air and head space water samples were analyzed in the field with a portable fast small-scale gas chromatograph. The major volatile oil constituents, benzene, toluene, o-, m-, and ρ-xylene were detected in air and water samples. The detection limit of the state-of-the-art instrument for these VOCs is in the 50 - 100 part per billion range.

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Recombinant Antibodies That Recognize Alkylated Polycyclic Aromatic Hydrocarbons (PAHs)

Presenter: Yue Sun
Tulane University Sch. of Med.
Authors: Y. Sun[1], B. Ban[2], G. A. S. Ansari[3], D. A. Blake[1];
[1]Tulane University Sch. of Med., New Orleans, LA, [2]Xavier University of Louisiana, New Orleans, LA, [3]University of Texas Medical Branch, Galveston, TX.

Abstract:
Our laboratories are focused upon developing antibodies that specifically recognize alkylated PAHs, which are derived almost exclusively from oil spills and seeps. 2-Methylphenanthrene (2-MP) and 2,7-dimethylphenanthrene (2,7-DMP) were conjugated to protein and used as immunogens. Libraries of single chain antibodies (scFvs) were constructed from the cDNA of mouse immune cells, and scFv libraries were displayed on the surface of phage particles for selection of antibodies that specifically recognized methylated

phenanthrenes. Initial selections were performed to accumulate high affinity binders, and subsequent selections were designed to exclude undesirable binding activities (to the protein carrier, unmethylated phenanthrene and the phenanthrene-protein conjugate). Phage ELISAs against a panel of immobilized antigens (2-MP, 2,7-DMP, phenanthrene or pyrene) revealed that this strategy enriched for scFvs that recognized PAHs of the phenanthrene family. The 2-MP antigen was more easily distinguished from unmethylated phenanthrene than 2,7-DMP, most likely due to the asymmetry of 2-MP. Selected scFvs will be transferred to a yeast display system and FACS will be used to select those clones that bind with highest affinity to the methylated phenanthrenes. Supported in part by the NIEHS (U19ES020677).

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Type: Poster 5-216

Understanding the effects of Gulf crude oil and/or Corexit on behavioral alterations and hematological changes in rodents

Presenter: Dwipayan Bhattacharya
Auburn University
Authors: D. Bhattacharya, T. Clement, M. Dhanasekaran;
Auburn University, Auburn, AL.

Abstract:
Introduction: Humans and marine animals/birds have been impacted by the 2010 Gulf of Mexico oil spill. During the spill, Corexit was used to disperse the crude oil contamination. The toxic effects of crude oil and Corexit have not been well elucidated. Hence,studies involving in vivo animal models would help assess the health risks posed by the Gulf oil spill and/or Corexit on human exposure, and on sensitive species such as Alabama beach mouse (endangered species).
Aim: To Investigate the effects of Gulf sweet crude oil and/or Corexit on behavioral alterations and hematological changes in rodents.
Methods: C57BL/6 mice were administered (i.p) with crude oil and/or Corexit for one week. Saline treated mice acted as controls. During the dosing schedule body weight, temperature & different behaviors were monitored daily. Blood and different tissues were collected for studying the toxicity. Statistical analysis was performed using Sigma-stat.
Key Findings: Gulf crude and/or Corexit induced significant loss of body weight and caused severe behavioral alteration as seen by the change in mood and movement/mobility. The environmental toxins also induced significant hematological changes as seen by increased neutrophils, decreased platelets & lymphocytes. Dohle bodies were found in combined crude oil and Corexit treated mice. Absence of diarrhea or tumor was observed in this acute toxic study.
Significance: Exposure to Gulf crude oil and/or Corexit can induce environmental toxicity.

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Weathering patterns for various aliphatic and aromatic hydrocarbons in laboratory biodegradation studies of both fresh and dispersed Macondo oil

Presenter: Ed Overton
Louisiana State University
Authors: E. Overton[1], S. Miles[1], B. Meyer[1], H. Gao[1], J. Farr[2];
[1]Louisiana State University, Baton Rouge, LA, [2]NOAA OR&R, Emergency Response Division, Seattle, WA.

Abstract:
Spilled oil undergoes compositional changes due to weathering processes as it moved through various environmental sectors. These changes are initially caused by primarily evaporation and dissolution of the lower molecular weight components. Additionally, bacterial degradation plays a prominent role in the transformation of oil-derived hydrocarbons into biomass and CO2. We studied the compositional changes of fresh Macondo oil, both with and without dispersants, as it was weathered for one month in a laboratory setting under near optimal conditions for determining compositional changes due to biotic and abiotic processes. These included shaker flask weathering of oil and dispersed oil over artificial seawater and water collected from the Gulf of Mexico. There were no significant differences between the weathering pattern of oil incubated with and without dispersants. Most of the weathering took place in the first half a month with only small changes thereafter. Saturate hydrocarbons generally degraded at a faster rate than aromatics, and under these conditions, there was no significant compositional changes in the hopane, sterane and triaromatic steroid biomarkers.

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Impact of Photolyzed vs. Non-Photolyzed Oil on Sulfate-Reducing Bacteria in Gulf of Mexico Sediments

Presenter: Jamie M. Cote
University of Oklahoma, Department of Microbiology and Plant Biology
Authors: J. M. Cote[1], B. H. Harriman[1], D. D. Kountz[2], I. A. Davidova[1], J. M. Suflita[1,3], M. A. Tarr[2], A. V. Callaghan[1];
[1]University of Oklahoma, Department of Microbiology and Plant Biology, Norman, OK, [2]University of New Orleans, Department of Chemistry, New Orleans, LA, [3]University of Oklahoma, Institute for Energy and the Environment, Norman, OK.

Abstract:
Photodegradation is an important process contributing to the fate of crude oil in marine systems. This study investigated the impact of photolyzed vs. non-photolyzed oil on the respiratory activity of indigenous sulfate-reducing bacterial communities (SRB), which can play a biological role in oil degradation. Sediments were collected from three Gulf of Mexico locations. Overlying water was analyzed for pH, salinity, temperature, conductivity, and anions. The water chemistries of the sites differed with respect to salinity (10 to 26 ppt), sulfate concentration (7.8 ± 0.04 to 19.5 ± 0.06 mM), and chloride concentration (225.1 ± 0.62 to 542.8 ± 1.15 mM). Phylogenetic analysis of microbial DNA via Illumina MiSeq revealed significant differences in the Deltaproteobacterial populations among the sites. The impact of aqueous extracts of photolyzed oil was assessed via $^{35}SO_4$-sulfate reduction assays in sediment slurries amended with various amounts (0.1-10% v/v) of photolyzed or non-photolyzed oil extracts. There was generally no significant change in the endogenous rate of sulfate respiration due to amendment with photolyzed vs. non-photolyzed oil extracts at the concentrations tested. However, one site appeared to be slightly stimulated at the 5% v/v level. Ongoing efforts will increase the concentration of photoxidation products and investigate the toxicity of individual oil photooxidation compounds to better assess the potential impact of photodegradation products on SRBs.

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Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-219

Biodegradation of MC252 crude oil after mobilization by washover events on a coastal headland beach

Presenter: David N Curtis
Louisiana State University
Authors: D. N. Curtis[1], V. Elango[2], J. Pardue[2];
[1]Louisiana State University, LaPlace, LA, [2]Louisiana State University, Baton Rouge, LA.

Abstract:
Washover events on coastal headland beaches occur when storm surge from coldfronts, high tides, tropical storms, and hurricanes move across the beach,reworking and depositing sand in the back marshes and shallow mudflat areas. OnFourchon Beach, Louisiana, a 9-mile coastal headland beach impacted by the Deepwater Horizon oil spill, these washover events have intermittently moved oil from the subtidal and intertidal portion of the beach to the supratidal mudflats and marsh areas. Field measurements of washover event samples were analyzed by several weathering ratios including C30-hopane ratios and C2/C3 phenanthrene and C2/C3 dibenzothiophene double ratio plotting. These results were supplemented by a laboratory microcosm study conducted to understand the biogeochemical controls on oil biodegradation in the new environment (washover mudflat) and how these controls impact its ability to degrade naturally. The study used intact surface residue balls (SRBs) that were deposited on the beach and marsh from various washover events. Anaerobic and aerobic treatments consistent with the flooded mudflat areas are amended with nitrogen to determine if nutrients are limiting in the washover environment. Treatments were established for both crushed and intact SRBs. Results to date indicate that PAHs degrade optimally when the SRB's are crushed up and are placed under non-flooded conditions with C1-C4 phenanthrenes, C1-C3 dibenzothiophenes and C1-C2 chrysenes all showing a decrease in concentration over 150 days. These studies will be discussed in the context of remedial measures during the emergency response phase used on Fourchon Beach to prevent washover impacts.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-220

Interannual Recruitment Dynamics for Resident and Transient Marsh Species: Evidence for a Lack of Impact by the Macondo Oil Spill

Presenter: Ryan Moody
Dauphin Island Sea Lab
Authors: R. Moody;
Dauphin Island Sea Lab, Dauphin Island, AL.

Abstract:
Emulsification of oil at the Deepwater Horizon (DWH) well head relegated much of the released hydrocarbons to the deep sea, facilitated the incorporation of oil into microbial and planktonic food webs, and limited the severity of direct, wetland oiling to coastal Louisiana. Nevertheless, many transient fish and invertebrate species rely on offshore surface waters for egg and larval transport before settling in coastal habitats, potentially impacting the recruitment of transient species to coastal nursery habitats quite distant from the well site. We compared the use of salt-marsh habitats by transient and resident nekton before and after the DWH accident in coastal Alabama over a two-year period.
Overall, we detected few significant differences in the recruitment of resident and transient nekton in coastal Alabama following the DWH accident. Our results, therefore, provide little evidence for severe acute or persistent oil-induced impacts on organisms that complete their life cycle within the estuary and those that spend portions of their life history in potentially contaminated offshore surface waters. Our negative findings are consistent with other assessments of nekton in coastal vegetated habitats and bolster the notion that, despite the presence of localized hydrocarbon enrichment in coastal habitats throughout the northern Gulf of Mexico, the most severe oil impacts were relegated to coastal Louisiana and the deep sea.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-221

Polycyclic Aromatic Hydrocarbons of Deepwater Horizon oil buried in Pensacola Beach sands and their changes over time

Presenter: Christopher Hagan
Florida State University
Authors: C. Hagan[1], J. Kaba[1], B. Wells[1], S. Dudley[1], J. Kostka[2], M. Huettel[1];
[1]Florida State University, Tallahassee, FL, [2]Georgia Tech University, Atlanta, GA.

Abstract:
Polycyclic Aromatic Hydrocarbons (PAHs) include substances that can pose health risks to humans and animals and, thus, PAH concentrations in beach sediments are of interest to coastal managers. In this contribution we present data on Polycyclic Aromatic Hydrocarbons (PAHs) and their spatial and temporal degradation patterns in Pensacola Beach sediments, Florida after the Deepwater Horizon oil washed onto Florida's beaches in 2010. Sediment cores were taken from Pensacola Beach beginning June 30, 2010. Following collection of cores on two dates in July, subsequent cores were then taken approximately once per month thereafter. Cores were sampled from three areas, starting in the partly saturated intertidal zone and moving inland with the second core taken at the high water line and the third core collected from the more dry sediment just above the spring tide high water line. Cores were analyzed for the EPA 16 Priority PAHs using GC/MS/MS. The results show that except during an initial short phase spanning approximately one month, PAH concentrations remained below concentrations that would be considered a health risk. The most prominent PAHs were four and five ring compounds such as chrysene and benzo_a_pyrene. The data will be used to characterize PAH degradation over space and time in Pensacola Beach sediment and also to assess the effects of BP's "Operation Deep Clean" by comparing PAH concentrations in the beach sediments before and after the cleanup effort.

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Compressive sensing multispectral imaging for oil spill sensing and ecosystem monitoring

Presenter: Wei-Chuan Shih
University of Houston
Authors: J. Lu[1], L. Liu[1], V. Manian[2], Z. Han[1], W. Shih[1];
[1]University of Houston, Houston, TX, [2]University of Puerto Rico at Mayaguez, Mayaguez, PR.

Abstract:
We propose a compressive sensing multispectral imaging framework for environmental monitoring applications at high detection sensitivity, fast detection speed, and low cost. Taking advantage of compressive sensing theory, the original 3-dimensional spatial and spectral data cube is computationally reconstructed without the need or with only partial of prior information about the environmental scene to be surveyed. One distinct feature of this approach is that a sparse representation of the full 3-dimensional field of view can be obtained in a snap shot instead of requiring time-consuming raster scan. Therefore, the effective field of view is much larger than scanning-based approach at any instance. Also distinct from filter-based approach, there is no “waste” of out-of-band photons in this approach. We propose the application of this framework on two problems: oil spill thickness sensing and ecosystem monitoring. Numerical and experiment results will be discussed in terms of the effectiveness of proposed framework.

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Type: Poster 5-223

Biogeochemical controls on fate of subsurface oiled sands on a coastal headland beach

Presenter: Autumn Westrick
Louisiana State University
Authors: A. Westrick;
Louisiana State University, Baton Rouge, LA.

Abstract:
The fate of subsurface oiled sands collected from Fourchon Beach in Louisiana was determined while modifying biogeochemical controls on the microbial degradation of PAHs and alkanes. Groundwater on the beach has intrinsically low oxygen concentrations, which may limit natural biodegradation of the crude oil components. The intent of this research is to characterize the biogeochemical properties and degradability of oiled sands (with >10% of pore filled with MC252 oil) using a combination of laboratory flow-through reactor studies, field measurements and time-series microelectrode profiles of down-flow and cross flow geometries. In the reactor experiments greater than 90% reduction was observed for C1-,C2-,C3-,and C4-phenanthrenes in down-flow reactors with aerated and fertilized (N and P) seawater. PAHs persist longer under low oxygen conditions. Nutrient consumption, specific oxygen uptake rates and soluble PAH concentrations will be presented. Cross-flow reactor studies, which mimic the presence of oiled sands over clay deposits, are ongoing and will be reported at the conference. The microelectrode profiles indicate that over time, the down-flow reactors had greater oxygen penetration (10,000-14,000 µm) than cross-flow geometries, which remained largely oxygen deficient at depths greater than 7,000 µm. Research is ongoing, yet it can be hypothesized that low oxygen concentrations in natural groundwater at Fourchon Beach, in conjunction with low oxygen penetration depths and limited nutrients will limit the rate of oil degradation in these environments.

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Date: Tuesday, January 28 - 6:00 PM
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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-224

Optimization of Mass Range, Dynamic Range, Signal-to-Noise Ratio, Mass Resolution, and Mass Accuracy for Characterization of Oil Spills by FT-ICR Mass Spectrometry

Presenter: Alan G Marshall
Florida State University
Authors: A. G. Marshall, G. T. Blakney, T. Chen, Y. Chen, C. L. Hendrickson, N. K. Kaiser, D. G. McIntosh, A. M. McKenna, J. P. Quinn, R. P. Rodgers, C. R. Weisbrod;
Florida State University, Tallahassee, FL.

Abstract:
Fourier transform ion cyclotron resonance mass spectrometry offers the highest mass resolution and mass accuracy for compositional analysis of complex organic mixtures, notably petroleum and its products. This poster will describe several recent advances that extend FT-ICR figures of merit by an order of magnitude: phase correction; three-term segmented mass calibration; distributed post-excitation ICR radius; ion funnels; programmed ion injection; dynamically harmonized ICR cell with 120 degree excitation and detection and segmented end caps; conditional signal averaging; and mass spectral segment extraction. The result is nonpareil performance for oil spill analysis. Work supported by NSF DMR-11-57490, NSF CHE-10-19193, Florida State University, BP/The Gulf of Mexico Research Initiative to the Deep-C Consortium, and the National High Magnetic Field Laboratory in Tallahassee, FL.

Session: 005
Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-225

Swimming characteristics of Escherichia coli cells in restricted geometries

Presenter: Yuly A Jaimes-Lizcano
Tulane University
Authors: Y. A. Jaimes-Lizcano, D. D. Hunn, K. D. Papadopoulos;
Tulane University, New Orleans, LA.

Abstract:
Microbial life accounts up to 50% of the total volume in soil pores with more than 80% of bacteria preferentially located in the region termed ‘inner part’ which hosts micropores with diameters from 2 to 6 μm; whereas the “outer part” of the soil is formed by pores with diameters greater than 6 μm. Bacterial motility in natural porous media plays a significant role in bioremediation of contaminated sites. Whereas natural microorganisms may eventually degrade pollutants in contaminated soils, sands or sediments, for effective in-situ bioremediation, flagellated-bacterial migration through the pores of porous media can determine their access to the contaminants. This work describes the motility of E. coli swimming cells inside model pore-sized geometries. Two different strains were used, one wild-type RP437 and the other non-chemotactic UU2612. The effect of bacterial length on the swimming characteristics was addressed. The bacterial migration of long bacteria inside micrometer-sized spaces with imposed slow flow rates exhibited assisted-upstream motility for bacteria close to surfaces. The reported phenomena provided a simple approximation of what occurs in the bacterial transport under natural water currents occurring in natural porous media.
Understanding the factors that control bacterial transport through porous media may help the development of effective bioremediation strategies that could help mitigate the impact of environmental disasters such the one cause by the BP-oil spill.

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Type: Poster 5-226

How do bacteria respond to MC252 crude oil in offshore deep sea and surface Gulf of Mexico waters?

Presenter: Jiqing Liu
The University of Texas at Austin Marine Science Institute
Authors: J. Liu, Z. Liu;
The University of Texas at Austin Marine Science Institute, Port Aransas, TX.

Abstract:
Microbial degradation is a key process to removing crude oil in the Gulf of Mexico. To better understand the fate of oil and bacterial community shifts in response to the massive influx of petroleum hydrocarbons within the Gulf of Mexico ecosystems, we studied the biodegradation of Macondo MC252 oil using the deep (1537 m) and surface (2 m) seawater collected at the Deepwater Horizon accident site in May 2013. The experiments were conducted in laboratory microcosms under dark at 4°C and 25°C, respectively. During the 50-day incubation, hydrocarbon concentrations, bacterial abundances and community compositions, and nutrient levels were monitored. Our preliminary data showed that bacteria grew faster in the incubation at 25°C, compared to the incubation at 4°C. This

result indicates that crude oil may be more toxic at low temperature and may have inhibited some bacterial growth in the deep water during the initial 5 days. Our results also showed that the initial bacterial communities from the deep water instantly responded to the crude oil addition, which indicated that the deep sea bacterial communities may contain more oil degraders than surface water bacterial communities. For example, the bacterial abundance in the deep water incubation increased from 7.8 x 103 cells mL-1 to 9.4 x 106 cells mL-1 in 5 days at 25°C, compared to the increase from 1.0 x105 cells mL-1 to 8.2 x 106 cells mL-1 in the surface water incubation. Alternatively, water chemistry, especially the nutrients, may have played an important role in the bacterial development in the deep water incubation. Analyses of petroleum hydrocarbons and nutrients are on-going, and results will be presented.

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Type: Poster 5-227

Spatial and temporal biogeography of aerobic methane-oxidizing bacteria surrounding Gulf of Mexico methane seeps

Presenter: Matthew A Saxton
University of Georgia
Authors: M. A. Saxton[1], L. M. Nigro[2], J. J. Battles[1], P. L. Tavormina[3], S. B. Joye[1];
[1]University of Georgia, Athens, GA, [2]University of North Carolina, Chapel Hill, NC, [3]California Institute of Technology, Pasadena, CA.
Abstract:
Cold methane seeps represent an important source of carbon to the deepwater of the Gulf of Mexico (GoM) and of methane, a potent greenhouse gas, to the atmosphere. Methane is also a large potential energy source that is readily exploited by microorganisms. While measureable rates of aerobic methane oxidation occur at a variety of sites throughout the GoM, less is known about the diversity and distribution of the microbes mediating aerobic methane oxidation. Ongoing studies of the diversity of aerobic methanotrophs have revealed high diversity within the community, suggesting lineage-specific variations in methane metabolism and substrate preference. Less is known about the distribution of these groups in relation to seeps and each other. In this study we use group-specific qPCR primers targeting the pmoA gene, which encodes the enzyme central to aerobic methane oxidation, to investigate the distribution of several groups of planktonic methanotrophic bacteria in space and time at three sites in the GoM: two natural seeps, GC600 and MC118, and OC26, which has no natural seepage. We pair methanotroph abundance data with geochemical data and methane oxidation rates to develop a holistic understanding of the environmental conditions that select for specific ecotypes in the environment around seeps. This study advances the knowledge of how methanotroph diversity fills the cold methane seep niche, and builds a foundation for further studies into the role of these microbes in the marine C cycle.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-228

Polycyclic Aromatic Hydrocarbon Distribution and Modification in the Sub-surface Plume Near the Deepwater Horizon Wellhead

Presenter: Alan M Shiller
University of Southern Mississippi
Authors: A. M. Shiller[1], D. Joung[1], T. Wade[2];
[1]University of Southern Mississippi, Stennis Space Center, MS, [2]Texas A&M University, College Station, TX.
Abstract:
A significant concern associated with oil spills is the toxicity associated with the polycyclic aromatic hydrocarbon (PAH) component. Ratios of various PAH's have also been used as indicators of oil sources. During a late May/early June 2010 cruise, 57 samples for PAH analysis were collected in the vicinity of the Deepwater Horizon wellhead. Most samples were from the previously reported sub-surface oil plume, centered near 1100 m depth. PAH concentrations ranged up to 117 µg/L and rapidly diminished in the subsurface with distance from the wellhead. Within a few km of the wellhead, the percentage of methyl-naphthalenes in the sub-surface plume was generally higher than in the source, suggesting preferential solubilization of this low molecular weight fraction. However, the percentage rapidly decreased away from the well also suggesting rapid destruction or removal of the naphthalenes. The pyrogenic index was <0.05 for all samples, indicating a petroleum origin. For a few samples, some other PAH ratios (e.g., MP/P and P/A ratios) suggested a combustion origin. However, these ratios also tended to vary both with percent methyl-naphthalenes and distance from the wellhead, suggesting anomalous ratios originating from solubilization/weathering effects. We also obtained a more limited set of surface water samples, generally avoiding the most contaminated areas as well as areas of oil burning. For these surface water samples, similar trends were observed as at depth, probably resulting from selective volatilization and photo-degradation. Overall, the data illustrate how environmental factors lead both to reduced concentrations and fractionation of the PAH's.

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Type: Poster 5-229

Ecological impact of oil and dispersants on tidal flats tested in mesocosms

Presenter: Edwin Foekema
IMARES Wageningen UR
Authors: E. Foekema[1], A. Murk[2];
[1]IMARES Wageningen UR, Den Helder, NETHERLANDS, [2]IMARES Wageningen UR/Wageningen University, Wageningen, NETHERLANDS.

Abstract:
The ecological impact of spilled oil with or without chemical dispersants was determined in a series of mesocosm studies in the Netherlands. The applied mesocosms (outdoor, 18 m^2 surface area, 1.2 m water depth during high tide) mimicked the tidal flats as can be found in the Dutch/German Wadden Sea. The mesocosms were exposed to 'topped Forties' (a North Sea oil), and the dispersant Finasol OSR5 separately and in combination. Oil/dispersants were applied ones in springtime and the development of the mesocosms ecosystem was monitored during the following 12 months. The addition of the dispersant alone resulted in several acute toxic effects to the community, such as increased mortality of bivalve molluscs. In the mesocosm treated with oil only, the floating oil layer was partly adsorbed by the sediment during low tide, causing acute and chronic effects on the benthic community. The presence of the dispersant did not reduce these effects, as it resulted in very high oil concentrations in the water column which directly affected the community. The long term effects (including increased primary production) were here similar or more severe than in mesocosms where oil without dispersants was added. The studies were performed already in the 1980-1990s, and the outcome was used to determine the Dutch legislation on the application of dispersants in case of an oil spill. The majority of these studies has never been published in open literature. It is our intention to prepare a summarising manuscript in the coming months.

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Type: Poster 5-230

Evaluating theToxic Effects of MC252 Crude Oil trapped in"Tarmat Deposits"

Presenter: Dwipayan Bhattacharya
Auburn University
Authors: D. Bhattacharya, T. Clement, M. Dhanasekaran;
Auburn University, Auburn, AL.

Abstract:
Introduction: The Deepwater Horizon oil spill/BP oil spill associated "tarmat" has been found in large amounts along the Gulf region and the beach users have been routinely exposed to tar balls emanating from these deposits. Tarmat may pose substantial risk to wildlife and human health in the Gulf region. However, the toxic effects and mechanism of toxicity of tarmat have not been well established.
Aim: To evaluate the cytotoxic effects and assess the mechanism of toxicity of MC252 tarmats/tarballs
Methods: Cytotoxicity of water accommodated fraction of tarmat was elucidated by the MTT assay and cellular morphology assessment. We used hippocampal, nephronal and epithelial cells to elucidate the toxic effects of tarmat. Markers of oxidative stress and apoptosis were assessed.Statistical analysis was performed using Sigma-stat.
Key Findings: Tarmat inhibited the cell viability in the H19-hippocampal, HEK293-nephronal and MCF10A-epithelial cells. Furthermore, tarmat induced distinctive cellular morphological changes associated to cytotoxicity. With regard to the mechanism of toxicity, tarmat generated significant amount of reactive oxygen species increased the activity of superoxide dismutase and induced lipid peroxidation. Tarmat enhanced caspase activity without any DNA damage.
Significance: Our data clearly show that tarmat exposure can increase the health risk and hence further in vivo studies are required to assess the tarmat-induced toxic effects.

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Fate Of Chemically Dispersed Oil Undergoing Aerobic Biodegradation Under Controlled Conditions

Presenter: Yves Robert Personna
New Jersey Institute of Technology
Authors: Y. Personna[1], T. King[2], S. Zhang[1], M. Boufadel[1];
[1]New Jersey Institute of Technology, Newark, NJ, [2]2.Fisheries and Oceans Canada, Bedford Institute of Oceanography, Dartmouth, NS, CANADA.

Abstract:
We conducted laboratory-scale experiments to evaluate the fate of chemically dispersed (CD) Endicott oil in high salinity (29.1 ppt) seawater (Prince William Sound, Alaska) undergoing aerobic biodegradation at 15±0.5 °C. These microbially-mediated processes could potentially lead to the formation of recalcitrant and toxic compounds, so-called oxyhydrocarbons, and/or ultimately to non-toxic CO_2. We

evaluated these processes under high nutrient (HN) (addition of 100 mg NO_3-N/L and 10 mg PO_4-P/L to background seawater) and low nutrient (LN) (background seawater) treatments. Within 14 days of the experiments, the total Endicott oil removal was 41% and 12 % in HN and LN treatments, respectively. Both measured CO_2 production and O_2 consumption were clearly more pronounced in HN treatment than LN treatment. These results clearly indicated that the addition of nutrients to CD Endicott oil in seawater accelerated the biodegradation processes and, subsequently, resulted in a significant increase in oil removal (> triple of LN). In addition to total oil removal, gas chromatography/mass spectrometry (GC/MS) and thin layer chromatography/flame ionization detection (TLC/FID) analyses are being performed to determine temporal changes in the chemical composition of oil components. These analyses would provide further insight into the fate of Endicott oil (relative fraction of saturated, aromatic and oxygenated compounds) during its weathering by aerobic biodegradation processes.

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Type: Poster 5-232

Interactions between oil droplets and surfaces immersed in water

Presenter: Noshir Pesika
Tulane University
Authors: N. Pesika, J. Cremaldi, D. Cutting, K. Wollman;
Tulane University, New Orleans, LA.

Abstract:
Dispersed oil droplets have the potential to wet a variety of marine surfaces such as the skin of animals, leaves of plants and shells of crustaceans. In this talk, we will present our work on gaining a better understanding of how oil interacts with a variety of model surfaces with different surface energies and textures. Specifically, quantitative and qualitative data was obtained for the adhesion force of an oil droplet to these model surfaces. We will also show data for an oil droplet interacting with a marsh grass leaf and suggest ways that new dispersant formulations may prevent oil from spreading on marine surfaces.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-233

How do environmental factors affect biodegradation of crude oil in Gulf of Mexico waters?

Presenter: Zhanfei Liu
The University of Texas at Austin
Authors: Z. Liu, J. Liu, H. Bacosa, D. Erdner;
The University of Texas at Austin, Port Aransas, TX.

Abstract:
As one of the major weathering processes, biodegradation of crude oil in marine waters depends on many environmental factors, such as solar irradiance, temperature, nutrients and initial bacterial community, yet their respective roles have not been systematically studied. This knowledge is critical to evaluate the fate of oil, considering that oil spills, such as the *Deepwater Horizon* (*DWH*) one, are often across large environmental gradients in marine waters. Based on on-deck incubations at the *DWH* site in May 2012, our preliminary data showed that petroleum hydrocarbons, including *n*-alkanes and aromatic hydrocarbons, degraded in a similar amount (30%) among waters from surface (1m), middle (700 m) and deep (1500m) depths under in situ temperatures, yet the microbial communities developed during the incubation were distinctly different between surface and deep waters. The surface water incubation was dominated by *Pseudomonas, Alcanivorax, Marinobacter, Thalassobius, Altererythrobacter* and *Erythrobacter, whereas* the deep water incubations were dominated by *Colwellia* within three weeks. The differences in temperature (4 vs. 25ºC), water chemistry (mainly nutrient levels), or initial bacterial communities between surface and deep waters were all the possible factors affecting the development of oil-degraders. We conducted further on-deck incubations in May 2013 at the *DWH* site to decipher the role of temperatures and initial communities, and the results will be presented.

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Track: Fate and Transport of Oil Spill Residues and their Impacts on Nearshore Coastal Environments
Type: Poster 5-234

Characterization and fate of crude oil derived water-soluble polar organic components in seawater

Presenter: Yina Liu
Woods Hole Oceanographic Institution
Authors: Y. Liu, E. B. Kujawinski, A. K. Boysen;
Woods Hole Oceanographic Institution, Woods Hole, MA.

Abstract:
Despite tremendous efforts to study the fate and transport of the oil after the Deepwater Horizon spill, the chemical composition, fate, and environmental impact of water-soluble polar fraction of the oil remain largely unknown. This particular fraction of the oil is potentially more toxic and refractory, and is not detected with traditional GC-based analytical tools. We employed the state-of-art ultrahigh resolution mass spectrometry with electrospray ionization (ESI) to conduct fundamental studies for a better understanding of chemical interactions between seawater and oil. Laboratory experiments were conducted to assess chemical components (heteroatom classes) that can readily dissolved in seawater. Results from the experiments were compared with field samples collected after the oil spill, which may provide new insights to the fate and transformation of oil components in seawater.

Session 006: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events

Session: 006
Date: Monday, January 27 - 10:00 AM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

Moving Targets and Interconnected Webs: Studying Socioeconomic Effects of Ecosystem Change

Presenter: Diane Austin
University of Arizona
Authors: D. Austin[1], B. Marks[2], P. Prakash[1], B. Rogers[3], V. Phaneuf[4], L. Penney[1], J. Whalen[1], C. Ware[2], K. McLain[1], L. Feldman[1], P. Singh[1], R. Templeton[5], L. Curole[6], M. Verdin[7], J. Sliver[8], C. Hogan[9], C. Fortune[10], S. Williams[11], S. Dosemagen[12], T. McGuire[1], B. McMahan[1], L. Jahnke[1], A. Wechsler[1];
[1]University of Arizona, Tucson, AZ, [2]Louisiana State University, Baton Rouge, LA, [3]Cornerstones, New Orleans, LA, [4]Shippensburg University, Shippensburg, PA, [5]Independent, South Terrebonne Parish, LA, [6]United Houma Nation, Houma, LA, [7]Independent, St. Bernard Parish, LA, [8]Dulac Community Center, Dulac, LA, [9]Independent, Plaquemines Parish, LA, [10]Independent, Biloxi, MS, [11]Katrina Research Center, Long Beach, LA, [12]Public Laboratory for Open Technology and Science, New Orleans, LA.

Abstract:
Humans are an integral part of the Earth's ecosystems. Our dependence on those ecosystems is at once both obvious and unnoticed. We recognize that we eat seafood from the ocean while at the same time not noticing how dependent we are on the oxygen it provides. We also acknowledge that spending time at the beach is part of who we are while not realizing how strongly our cultural practices are linked to the industries that operate from those beachfronts. This embeddedness also makes it impossible to distinguish natural- from human-caused events, whether they be large oil spills or hurricanes. In addition, the social and socioeconomic effects of such events derive not only from physical and material changes within the ecosystem but also from differential harms and benefits, perceptions of changes and causes for those changes, differences between expectations and what happens, and the uncertainty associated with each event and response. Using the Deepwater Horizon as an example, this paper discusses the challenges of trying to identify the social and socioeconomic effects of that disaster, especially in light of the context within which it occurred and its spatial and temporal scales. The paper discusses the strengths and weaknesses of economic, demographic, and ethnographic data collection and analysis, including efforts to capture and understand information shared through online media and social media outlets.

Session: 006
Date: Monday, January 27 - 10:15 AM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

Developing A Barometer Of Health And Balance: Measuring Community Well-Being For Coastal Counties In The Gulf Of Mexico

Presenter: Maria K Dillard
Hollings Marine Laboratory, JHT
Authors: M. K. Dillard, S. Lovelace;
Hollings Marine Laboratory, JHT, Charleston, SC.

Abstract:
To prepare for and respond to environmental events like Deepwater Horizon (DWH), decision makers,resource managers, and other government officials need information about the social and economic aspects of their communities. In order to characterize the baseline context and changes in society, secondary data were collected and analyzed to develop a quantification of community well-being at the county level for the US Gulf of Mexico, a region impacted by multiple,
large-scale disasters. The final framework for well-being includes the
following indicators: health, safety, economic security, governance, education, basic needs, social services, social connectedness, and environmental condition. By establishing a method for monitoring societal changes over time, this project can be used to fill information gaps regarding the status of impacted communities and their recovery from major ecosystem service disruptions of the past decade. Indicator scores and rankings for coastal counties in the Gulf will be presented alongside county well-being profiles.

Session: 006
Date: Monday, January 27 - 10:30 AM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

Your Good Humor May Depend On Mother Nature- Identifying Relationships Between Coastal Environmental Health And Well-Being In The Gulf Of Mexico

Presenter: Susan Lovelace
Hollings Marine Laboratory, JHT
Authors: S. Lovelace, M. K. Dillard;
Hollings Marine Laboratory, JHT, Charleston, SC.

Abstract:
While the Millennium Ecosystem Assessment makes it clear that well-being is contingent uponecosystem services; in the U.S. some are confident that we have minimized the dependency. Industrial disasters such as the Deepwater Horizon explosion and natural disasters such as Hurricane Isaac serve to remind us of the acute power of the relationship. However, we are learning that disasters and more subtle changes in environmental health may have a prolonged or chronic impact on the social and economic and health aspects of communities. To better understand these relationships secondary social, economic, and environmental data were analyzed to quantify relationships between selected measures and indicators during the last decade. The researchers will identify changes in well-being measures that are linked to changes in environmental condition and discuss findings that describe relationships at the county level. This much needed information can assist decision makers planning for environmental change in coastal environments.

Session: 006
Date: Monday, January 27 - 10:45 AM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

Recovery and restoration of the Gulf of Mexico: An initial appraisal of concerns and values

Presenter: John Carriger
US EPA
Authors: J. Carriger[1], W. Benson[2], S. Jordan[2];
[1]Gulf Ecology Division, US EPA, Gulf Breeze, FL, [2]U.S. Environmental Protection Agency, Gulf Breeze, FL.

Abstract:
Background: Important societal decisions can affect human health and safety, wildlife species, the economy, and other things that people value. Understanding what is important or valued before making a decision can enhance transparency, communication, participation, learning, and lead to better decisions. The field of decision analysis provides useful guidance and tools for defining and structuring what is valued by stakeholders. Stakeholders are people who are impacted by decisions and might include residents, businesses, governmental and nongovernmental organizations, and resource users. From a review of diverse reports including those developed by policy makers and NGOs, a preliminary list was derived to describe ecological, social, and economic features of importance in the Gulf of Mexico restoration. In practice, these steps should be developed with involvement of stakeholders to ensure their values are properly represented. Clarifying the values of stakeholders can foster realistic, creative, and informed management decisions.

Session: 006
Date: Monday, January 27 - 11:30 AM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

An Ecosystem Services Approach to Assessing the Impacts of the Deepwater Horizon Oil Spill in the Gulf of Mexico

Presenter: kim waddell
national academies
Authors: k. waddell;
national academies, Washington, DC.

Abstract:
As the Gulf of Mexico recovers from the Deepwater Horizon oil spill, natural resource managers face the challenge of fully understanding the impacts of the spill and setting priorities for restoration work. The full value of losses resulting from the spill cannot be captured, however, without consideration of changes in ecosystem services--the benefits delivered to society through natural processes. The use of an ecosystem services approach to damage assessment is currently limited by an incomplete understanding of ecosystem interactions and the lack of data, especially on the economic and societal effects that derive from environmental changes. Since the oil spill, there have been numerous studies by the academic research community, the private sector, and the federal government aimed at understanding the environmental impacts on the Gulf of Mexico. However, environmental impacts tell only part of the story. The people who live and work around the Gulf of Mexico depend on services offered by the ecosystem for their well-being and livelihood. Disruptions in the ecosystem caused by the oil spill could impair these services, leading to economic and social impacts

that may not be apparent from an assessment of environmental damage alone.
This study found that evaluating changes to ecosystem services would help capture and value the full breadth of impacts to the ecosystem and the public, and expands on that finding, discussing challenges associated with using an ecosystem services approach to assess the impacts of the Deepwater Horizon oil spill, and offering suggestions for areas of future research.

Session: 006
Date: Monday, January 27 - 11:45 AM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

The Political Economy of Oil Spill Damage Assessment: The NRDA and Deepwater Horizon

Presenter: Matthew K Nichols
The Monterey Institute of International Studies
Authors: M. K. Nichols, J. Scorse;
The Monterey Institute of International Studies, Monterey, CA.
Abstract:
Economic analysis of the market impacts of the 2010 Deepwater Horizon oil spill typically neglects the more nuanced and equally critical aspects of ecosystem services. Research from Yoskowitz, et al. (2011)
suggests the damage to saltwater marshes in Louisiana, Mississippi and Alabama could be $1.2 billion, in terms of lost flood mitigation, wave attenuation and water purification. The degradation of these ecosystems due to irresponsible oil development and poor government oversight will have consequences for the resiliency of coastal communities, especially in light of climate disturbance and increased storm intensity.
The federal effort to quantify these damages, Phase II of *United States of America v. BP Exploration and Production*, centers on the National Resource Damage Assessment process. The findings of the NRDA will remain sealed from both researchers and affected maritime communities until litigation has been settled with fines for the company's Clean Water Act violations and damages to coastal ecosystems. This multi-year legal process further retards progress in using the latest science to inform policy for the future of off-shore oil. This paper examines how the political economy of legal procedures, damage assessment processes, and maritime communities has created winners and losers in the aftermath of DWH. Furthermore, using both international and intranational comparisons, it proposes how the NRDA process might be reformed to improve transparency.

Session: 006
Date: Monday, January 27 - 12:00 PM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

Ecosystem Valuation in Chesapeake Bay, Too Little Too Late? Lessons for the Gulf of Mexico

Presenter: Douglas Lipton
NOAA Fisheries
Authors: D. Lipton;
NOAA Fisheries, Silver Spring, MD.
Abstract:
The last 40 years of ecosystem restoration in the Chesapeake Bay can be a cautionary tale for the application of ecosystem valuation in the Gulf of Mexico. The Chesapeake Bay Program a state/federal partnership to restore the health of the Bay began in 1983. In 2010, given the failure to achieve restoration goals, a Chesapeake Bay total maximum daily load (TMDL) was established for nitrogen, phosphorus and sediment. At a Congressional hearing in 2011, EPA committed to documenting both the costs and benefits of implementing the TMDL. The results of that analysis are due shortly.
In this paper, we review the previous studies that attempted to determine benefits from improved water quality in Chesapeake Bay. We find that, methodologically, the approaches taken significantly contributed to the advancement of ecosystem valuation approaches. However, from an implementation perspective, they were never applied in a comprehensive way to inform management decisions and policy direction. If they had been, it is likely that the focus of Bay restoration would have shifted towards a broader set of goals rather than the use values of living marine resources that currently drive the TMDL levels. Comparisons and lessons learned for ecosystem valuation related to the restoration and protection of the Gulf of Mexico are provided.

Session: 006
Date: Monday, January 27 - 12:15 PM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

Challenges to Social-Ecological Resilience in the Apalachicola Bay Oyster Industry

Presenter: Brian Mayer
University of Arizona
Authors: B. Mayer[1], J. Flocks[2], A. Lindsey[2];
[1]University of Arizona, Tucson, AZ, [2]University of Florida, Gainesville, FL.

Abstract:
Resilience, the ability of a system to absorb disturbance and still retain its basic function and structure, is a function of the complex interactions between social and ecological systems. Recognizing the complexity of constantly adapting linkages and feedback loops between social and ecological systems requires a paradigmatic shift towards a new kind of "resilience thinking." Yet the inherently challenging attempts to manage such systems often fail due to unforeseen shocks in the form of unexpected disasters. In a region experiencing several decades of declining amounts of freshwater vital to the health of its oyster fishery, the acute system shocks caused by the Deepwater Horizon oil spill have led to unanticipated consequences for both the social and ecological systems of Apalachicola, Florida. Our research on the socioeconomic effects of the oil spill reveals that the tenuous management of the gradually changing Apalachicola estuary was severely disrupted following the oil spill; when harvesting regulations were lifted virtually entirely which resulted in a major economic shock to the region as the fishery came close to collapse shortly after. This paper examines the immediate impact of the oil spill on local social-ecological resilience and the long-term efforts to better manage the bay through the Seafood Management Assistance Recovery Team (SMART), a representative stakeholder body with a long-term focus on sustainably managing the bay's resources.

Session: 006
Date: Monday, January 27 - 12:30 PM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

Coastal resiliency and natural disasters: The case of the recreational for-hire fishing industry

Presenter: Michelle A. Savolainen
Louisiana State University Agricultural Center, Center for Natural Resource Economics & Policy
Authors: M. A. Savolainen[1,2], R. F. Kazmierczak[1], R. H. Caffey[1,2];
[1]Louisiana State University Agricultural Center, Center for Natural Resource Economics & Policy, Baton Rouge, LA, [2]Louisiana Sea Grant College Program, Baton Rouge, LA.

Abstract:
The financial condition of U.S. Gulf of Mexico recreational-for-hire (RFH) fishing firms post-hurricane damages were examined within the context of the industry's contribution to the resiliency of coastal socio-ecological systems (SES). Three key financial ratios -- return-on-assets, assets turnover ratio, and debt-to-assets ratio -- were calculated for 2009 from balance sheets and cash flow statements constructed from surveys of 247 RFH firms operating in the five Gulf states. The ratios were then recalculated using reported damage and operational losses from at least one named storm in the 2004-2008 period and combined with the results of a logistic regression model of profitability loss to assess the resiliency of the RFH industry. Results suggest that RFH firm resiliency was a function of operating class (head, charter, and guide boats), home port, and the way in which the business was structured. Firms appeared to be the most resilient when they employed smaller vessels in intensively managed operations, perhaps due to their ability to move a vessel out of the path of storms and because their profitability and efficiency advantages allowed for self-insurance against losses. As a result, community contributions to, and benefits from, resiliency in the RFH industry may hinge on the development of more modern port facilities and well-functioning insurance markets.

Session: 006
Date: Monday, January 27 - 12:45 PM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

Assessing the Impact of the Deep Water Horizon Oil Spill on Gulf Travel, Tourism, and Recreation: Quantitative and Qualitative Data Analysis

Presenter: Lou Nadeau
Eastern Research Group, Inc.
Authors: L. Nadeau[1], M. Jensen[2], M. Sands[1], C. Goodhue[1], A. Stillings[1];
[1]Eastern Research Group, Inc., Lexington, MA, [2]Bureau of Ocean and Energy Management, New Orleans, LA.

Abstract:
The Deep Water Horizon (DWH) oil spill on April 20, 2010 had major implications for the travel, tourism, and recreation industries in the Gulf. Under this project, the Bureau of Ocean and Energy Management (BOEM) and Eastern Research Group, Inc. (ERG) developed data and methods for assessing the impact of the DWH spill on the travel, tourism, and recreation industries in the Gulf. The presentation will summarize the data, methods, and findings associated with a number of key project activities, including (1) an analysis of data collected by the Gulf Coast Claims Facility (GCCF); (2) summary of relevant articles about tourism impacts published in the Gulf-area press; (3) estimating county-level measures of travel, tourism, and recreation in the Gulf using data created under the project based on federal sources; and (4) field interviews conducted with local tourism officials, trade associations, and business in the Gulf. The results of our data analyses found that (1) the DWH oil spill had significant negative impacts on travel and tourism business establishments and levels of employment in the Gulf, (2) the spill had economic impacts over a wide geographic range, including areas well beyond the counties directly impacted by oil, (3) the spill had significant impacts on hotels and restaurants in the Gulf, and (4) perception is an important economic driver when it comes to tourism and disasters.

Session: 006
Date: Monday, January 27 - 2:30 PM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

Linking Deep Sea Ecosystems to Human Well-Being

Presenter: Travis W Washburn
Texas A&M University - Corpus Christi
Authors: T. W. Washburn, D. Yoskowitz, P. Montagna;
Texas A&M University - Corpus Christi, Corpus Christi, TX.

Abstract:
The deep sea (>200 m) is the single largest habitat on Earth, comprising as much as 90% of the total biosphere. The deep sea is often overlooked when examining human impacts on the environment, but the recent Deepwater Horizon oil spill provided a startling example of how much humans can influence this habitat. Although we can measure changes in environmental parameters or community structure, do alterations in the deep sea affect humans? In order to answer this question ecosystem services (human benefits) provided by the deep sea must first be identified and understood. These services must then be linked to ecosystem functions or processes. Finally, ecosystem functions must be linked to measurable environmental parameters such as heavy metals or biological diversity. In this way measurable human effects on the environment can be linked back to services provided to humans. Work is currently being done to identify important ecosystem services provided by the deep Gulf of Mexico. Furthermore, ways in which these services can be measured are being explored. Ecosystem services of the deep GoM will be discussed as well as gaps in current information which need to be filled in order to better understand what and how ecosystem services are provided by the deep GoM.

Session: 006
Date: Monday, January 27 - 2:45 PM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

Gulf of Mexico Research Priorities Identified from Broad Regional Input in 2007-2013

Presenter: Stephen H. Sempier
Mississippi-Alabama Sea Grant Consortium
Authors: S. H. Sempier[1], K. Havens[2], R. Twilley[3], P. Plotkin[4], L. Swann[1];
[1]Mississippi-Alabama Sea Grant Consortium, Ocean Springs, MS, [2]Florida Sea Grant College Program, Gainesville, FL, [3]Louisiana Sea Grant College Program, Baton Rouge, LA, [4]Texas Sea Grant College Program, College Station, TX.

Abstract:
During the past seven years, people from diverse professional backgrounds have provided input on Gulf-wide research priorities through 11 surveys and interactive workshops organized or coordinated by the four Gulf of Mexico Sea Grant college programs. These efforts have contributed to the Gulf of Mexico Research Plan (GMRP) and subsequent interim reports. As part of the GMRP planning effort, longitudinal surveys were administered in 2007, 2010 and 2013. One thousand or more people responded to each of the surveys and more than 1,600 people responded to the 2013 survey. The information gathered through these surveys indicates trends in priorities and how they have changed in the three years before, during and after the Deepwater Horizon oil spill. A comparison of the

results of the three surveys and a summary of the 2013 survey results will be shared. Socioeconomic research priorities identified by people that completed the surveys or participated in workshops also will be highlighted. This information will provide background in the open-discussion portion of the session.

Session: 006
Date: Monday, January 27 - 3:00 PM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

Longitudinal Marine Fisheries Economic Data Collection in the U.S. Gulf of Mexico: Rational and Future Opportunities

Presenter: Alexander L Miller
Gulf States Marine Fisheries Commission
Authors: A. L. Miller;
Gulf States Marine Fisheries Commission, Ocean Springs, MS.

Abstract:
Recent natural and man-made disasters and a challenging fisheries management climate in the U.S. Gulf of Mexico have shown the need for clear and unbiased longitudinal economic data from the regional seafood and recreational industry. The need for longitudinal marine fisheries economic data also continues to increase as various state and federal regulations mandate that marine resource agencies perform economic analysis when changes to fisheries management policies are promulgated. Economic data collection from marine fisheries has historically been scant, piecemeal, and infrequent which has made it difficult to understand the impact and recovery from disasters, the economic contributions of these industries to the economy, and the possible implications of fisheries policy decisions. With experiences gained through recent economic data collection by the Gulf States Marine Fisheries Commission's Economics Program, various lessons learned and a suggested plan forward for future fisheries longitudinal economic data collection will be presented. Understanding the long-term economic performance and recovery of Gulf fisheries will be of utmost importance as disaster recovery funds and subsequent projects are implemented and monitored and as fisheries work to improve in coming years.

Session: 006
Date: Monday, January 27 - 3:15 PM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

Gulf of Mexico Ecosystem Services Valuation Database (GecoServ): a one-stop shop for Ecosystem Services Valuation Literature

Presenter: Carlota L Santos
Harte Research Institute
Authors: C. L. P. Santos;
Harte Research Institute, Corpus Christi, TX.

Abstract:
The Gulf of Mexico Ecosystem Services Valuation Database (GecoServ) is an inventory of ecosystem services (ES) valuation studies relevant to the Gulf of Mexico. This database, developed by the Harte Research Institute (HRI) at Texas A&M University- Corpus Christi, allows for the distribution and sharing of information about said studies and the identification of current gaps in the ES valuation literature. It fills a void left by non-ES specific environmental databases, highlights the lack of longitudinal research for some ecosystems and associated services, and provides background information for future ES valuation studies. GecoServ serves as a uniquely centralized source of information for researchers, educators, NGOs, Governmental agencies, and natural resource managers. It intends to inform users about the value of certain ecosystems and ES and to facilitate the inclusion of such values in the decision-making process. It currently houses 469 studies providing 1,318 ES estimates associated with ten different ecosystems and 24 ecosystem services.

Session: 006
Date: Monday, January 27 - 9:30 AM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

Factors Influencing the Design and Implementation of Environmental Human Health Studies

Presenter: Maureen Yvette Lichtveld
Tulane University, School of Public Health and Tropical Medicine
Authors: M. Y. lichtveld, J. A. Lybarger, E. Harville, F. Arosemena;
Tulane University, School of Public Health and Tropical Medicine, New Orleans, LA.

Abstract:
Environmental epidemiologic studies use trans-disciplinary, complex approaches to answer seemingly simple questions from communities such as is the seafood safe to eat or the air safe to breathe. Human health studies differ distinctly from animal studies in design and implementation. From a design perspective, randomized controlled trials, the gold standard in providing the most direct evidence of causation, are not possible because exposures to contaminants have often already occurred and prospectively exposing humans is ethically inappropriate. Common study limitations are insufficient exposure characterization, especially past exposures, lag time between exposure and study, obtaining a representative study sample and control subjects, and confounding social determinants which may influence environmental studies' findings. Integral to implementing human studies are regulatory controls to protect participants assuring among other issues voluntary participation and withdrawal, and minimal risk. Since studies are conducted in a public forum, earning community trust is critical. In the case of participatory research, both technical and community oversight are key quality control practices. If logistical or design limitations significantly reduce study power, other health services may be more appropriate to address community concerns. Post oil-spill and national case studies demonstrate strategies to overcome these challenges while preserving science and community trust.

Session: 006
Date: Monday, January 27 - 9:45 AM
Room: Mobile Bay Ballroom I & II
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Oral

Overlooking the Real Catastrophe: Why are Human Impacts Discounted in Oil Spill Research and Recovery Efforts?

Presenter: Steve Picou
University of South Alabama
Authors: S. Picou, K. Nicholls;
University of South Alabama, Mobile, AL.

Abstract:
This paper reviews the relative lack of funding for both systematic social science research and community intervention programs for the two largest oil spills in the history of North America - the Exxon Valdez and the Deepwater Horizon. The ecological-symbolic theoretical model established the critical nexus between "renewable resource communities" and their biophysical environments over 30 years ago in Environmental Sociology. In contrast to natural disasters, technological disasters pose a series of complications for social science inquiry. These include the actions of principal responsible parties, the impact of litigation, the exclusion of legislated government response, and community fragmentation, all of which have consequences for the pace and effectiveness of post-disaster recovery efforts. The priorities of major funding agencies do not reflect the importance of understanding these consequences. Furthermore, the amelioration of negative social and psychological impacts should be a funding priority equal to the restoration of damaged ecosystems. A review of 25 years of research and interventions related to the Valdez spill, as well as the three-year history of the Deepwater Horizon spill are used to illustrate these points. We suggest a more holistic approach to prioritizing research and interventions for the Deepwater Horizon spill as we move forward. We conclude with general suggestions for enhancing timely community recovery from catastrophic oil spills.

Session: 006
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Poster 6-235

Socioeconomic Studies in Coastal Communities along the U.S. Gulf of Mexico: The Offshore Petroleum Industry as a Significant Driver of Effects

Presenter: Diane Austin
University of Arizona
Authors: D. Austin, T. McGuire;
University of Arizona, Tucson, AZ.

Abstract:
Since 1996, researchers from the Bureau of Applied Research in Anthropology (BARA) at the University of Arizona have worked with demographers, economists, and historians to describe and analyze the socioeconomic effects of the offshore petroleum industry in the Gulf of Mexico on people and communities of coastal Texas, Louisiana, Mississippi, and Alabama. Sponsored by the Bureau of Ocean Energy Management, these studies have examined the history and evolution of the offshore industry; the effects of industry cycles, work schedules, and labor demands on individuals, households, and communities; and the evolution of fabrication and shipbuilding and sites where they occur. They have focused on communities and regions from Brownsville, TX through Baldwin County, AL. While they have provided rich data for understanding socioeconomic conditions, livelihood options and strategies; and household and community response to change; they also have identified data gaps, limits to socioeconomic analysis, and challenges in integrating across approaches, This poster will summarize the research that has been done and discuss key opportunities and challenges that remain.

Session: 006
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Socio-Economic Analysis of Ecosystem Change: From Baselines to Catastrophic Events
Type: Poster 6-236

Economic resilience of the GoM business supply chain towards multiple disasters occurring over time

Presenter: Negar Dahitaleghani
LSU
Authors: N. Dahitaleghani, M. Tyagi;
LSU, Baton Rouge, LA.

Abstract:
The Deepwater Horizon oil spill was the largest U.S. oil spill in volume and also the most devastating for the regional economy as well as the environment. With recent exploration/discovery of deepwater reservoirs and continued developments of deepwater drilling and production, it remains very important to have a comprehensive and quantitative risk assessment of the drilling/production processes including effective response to deal with such disasters. The afore-mentioned risk analysis must also address both the socio-economic impacts to the various regional business supply chains and the environmental impacts to the GoM ecosystem.Resilience is usually defined as the ability to prepare and plan to: absorb impacts from, recover from, and more successfully adapt to a variety of adverse events. Enhanced resilience allows for better anticipation of disasters and improved planning to reduce or mitigate disaster losses - as compared to waiting for an event to occur and paying for it afterwards. The effective response time plays a critical role in determining the extent of the environmental damage, the economic impacts to various businesses, and the subsequent demographics comprising of people who are directly or indirectly affected by such disasters. In this research study, four different scenario levels (minor, moderate, significant and worst case) are presented. Using a time series analysis of impacts due to multiple events in a simplified model of regional economy, one can answer the following questions: What measures must be taken to recover from the disaster scenario of a hurricane impacting the same region in the aftermath of an oil spill? How do we plan and respond to multiple disaster events to minimize their socio-economic impacts?

Session 007: Coastal Ecosystem Couplings 3 years after the DWH oil spill

Session: 007
Date: Monday, January 27 - 10:00 AM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

Distinct Responses of Gulf of Mexico Phytoplankton Communities to Crude Oil and the Dispersant Corexit® EC9500A Under Different Nutrient Regimes

Presenter: Koray Ozhan
Louisiana State University
Authors: K. Ozhan, S. Bargu;
Louisiana State University, Baton Rouge, LA.

Abstract:
This study examines the potential effects of exposure to South Louisiana Sweet crude oil (LSC), Corexit® EC9500A, and dispersed oil on enclosed phytoplankton communities under different nutrient regimes. Three distinct microcosm experiments were conducted to assess changes to the structure of natural communities from the Gulf of Mexico as quantified by temporal changes in the biomasses of different phytoplankton groups. Overall, the contaminants LSC and Corexit® EC9500A led to a decrease in the number of sensitive species and an increase in more resistant species. However, the specific responses differed considerably between the two contaminants. Moreover, remarkable differences in phytoplankton succession and community shifts were observed under different nutrient regimes. Phytoplankton communities showed more sensitivity to LSC under nutrient-limited conditions. The addition of nutrients to initially nutrient-limited treatments lessened the inhibitory effect of LSC in the short term. Centric diatoms benefited most from this enrichment, but pennate diatoms demonstrated considerably greater tolerance to crude oil at low crude oil concentrations in nutrient-enriched treatments. Dinoflagellates showed relatively higher tolerance in nutrient-limited treatments and high crude oil concentrations. Corexit® EC9500A inputs significantly increased the toxicity of crude oil. Corexit® EC9500A alone had a highly inhibitory effect at 63 ppm on phytoplankton communities. This study highlights the fact that different nutrient regimes play a major role in determining the shifts of the phytoplankton community in response to exposure to different concentrations of crude oil and dispersant.

Session: 007
Date: Monday, January 27 - 10:15 AM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

Differences in petroleum hydrocarbon compounds from Louisiana coastal marshes correspond to specific changes in microbial community composition

Presenter: Annette S Engel
University of Tennessee-Knoxville
Authors: A. S. Engel[1], C. Drennen[1], A. T. Paterson[1], C. Liu[2], R. E. Turner[3], E. B. Overton[4];
[1]University of Tennessee-Knoxville, Knoxville, TN, [2]Louisiana State University, School of Soil, Plants and Environmental Science, Baton Rouge, LA, [3]Louisiana State University, Department of Oceanography and Coastal Sciences, Baton Rouge, LA, [4]Louisiana State University, Department of Environmental Sciences, Baton Rouge, LA.

Abstract:
Louisiana coastal marshes received varied amounts of hydrocarbon contamination after the 2010 Deepwater Horizon disaster. Sediments from eight marshes were sampled for 2 years following the oil spill to correlate changes in microbial community composition with fluctuations in alkane compounds, polycyclic aromatic hydrocarbons (PAHs), and C1 to C3 or C4 alkyl homolog families associated with the PAHs. Between May 2010 and Sept 2011, the relative abundances of microbial communities 16 months later were significantly different than communities prior to oiling (p-value = 0.0001). Prior to oiling, marsh edge microbial communities were dominated by Proteobacteria, and their relative abundances strongly correlated to the water content of marsh sediments, as well as to inland vegetation cover and water temperature. By Sept 2010, Firmicutes dominated the edge microbial communities. The occurrence of this group correlated to naphthobenzothiophene, which peaked in concentration during Sept 2010, and inversely to the presence of target alkanes. One year later, relative abundances of Chloroflexi, Spirochaetes, and Planctomycetes increased, which correlated to higher total alkane concentrations at the marsh edge, as well as to higher amounts of naphthalene and other PAHs like benzo(a)pyrene at all of the marsh edge sites. Continued changes to specific microbial communities may reveal the fate of PAHs and their degradation products in the marshes over time.

Session: 007
Date: Monday, January 27 - 10:30 AM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

Abundance and Community Composition of Ammonia-Oxidizing Microorganisms in Louisiana Salt Marshes Impacted by the Deepwater Horizon Oil Spill

Presenter: Anne Bernhard
Connecticut College
Authors: A. Bernhard[1], J. Marton[2], B. Roberts[2], A. Giblin[3];
[1]Connecticut College, New London, CT, [2]Louisiana Universities Marine Consortium, Chauvin, LA, [3]The Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA.

Abstract:
We investigated impacts of oil exposure on the abundance and community composition of ammonia-oxidizing bacteria (AOB) and archaea (AOA) in Louisiana salt marshes 2-3 years after the Deepwater Horizon oil spill. We found significant differences in abundance of both AOA and AOB, measured by abundance of amoA genes, that were dependent on the type of vegetation and distance from the marsh edge. In areas dominated by Avicenia, both AOA and AOB were significantly more abundant in areas unimpacted by oil compared to oiled areas, but we detected no significant oil effect on community composition, based on terminal restriction fragment length polymorphism analysis of the amoA genes. Conversely, in areas dominated by Spartina and within 3 meters of the marsh edge, AOA and AOB were more abundant in oiled areas compared to unoiled areas and the communities were also different. Further into the marsh (5-20 m), we detected no significant differences in abundance or community composition of AOA or AOB related to oiling, although AOA showed consistent trends of decreased abundance in oiled areas in some regions. Our results suggest that ammonia oxidizers respond differentially to oil dependent on the dominant vegetation and the location in the marsh, which is likely a reflection of marsh elevation and the degree of oiling. Furthermore, differences in relative abundance of some ammonia-oxidizing populations between oiled and unoiled areas suggest that some populations may be more sensitive to oil than others.

Session: 007
Date: Monday, January 27 - 10:45 AM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

The interaction between sediment bioturbators and sediment microbes on the distribution and degradation of oil in sediment

Presenter: Paul L. Klerks
University of Louisiana at Lafayette
Authors: P. L. Klerks, F. R. Louka, N. Deb Adhikary, A. Kascak, D. L. Felder, A. Oguma, G. Ducharme, A. Chistoserdov;
University of Louisiana at Lafayette, Lafayette, LA.

Abstract:
Sediment bioturbators often function as ecosystem engineers, moving large amounts of sediment and changing sediment characteristics. During the biological transport of sediment, oil present in (or on) the sediment will be moved as well. Thus bioturbation may result in the oil being further buried or brought closer to the surface and re-released to the water column. The bioturbation-mediated change in sediment characteristics (such as redox conditions, organic content and particle size distribution) will also affect microbial populations and could thereby affect oil biodegradation. We are experimentally addressing the influence of bioturbators on oil distribution and biodegradation in laboratory microcosms. Microcosms contain beach sediment, seawater and bioturbators (the ghost shrimp Lepidophthalmus louisianensis or the razor clam Tagelus plebeius) and are dosed with surrogate oil. Hydrocarbon concentrations are monitored in overlying water, surface sediment, and subsurface sediment. In order to assess the interplay with the microbial community, the latter's composition and hydrocarbon-degradation potential are monitored as well. Experiments are currently in progress. Preliminary results indicate that bioturbation by ghost shrimp is affecting sediment characteristics. Results on oil distribution and hydrocarbon-degradation potential of the microbial community will be presented.

Session: 007
Date: Monday, January 27 - 11:30 AM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

Biogeochemical responses of Louisiana salt marsh soils following the Deepwater Horizon oil spill

Presenter: Brian J Roberts
Louisiana Universities Marine Consortium (LUMCON)
Authors: B. J. Roberts[1], J. M. Marton[1], A. E. Bernhard[2], A. E. Giblin[3];
[1]Louisiana Universities Marine Consortium (LUMCON), Chauvin, LA, [2]Connecticut College, New London, CT, [3]The Marine Biological Laboratory, Woods Hole, MA.

Abstract:
We quantified the effects of the Deepwater Horizon oil spill on Louisiana salt marsh biogeochemical process rates 2-3 years post-spill through a combination of high temporal resolution sampling in Terrebonne Bay (TB), high spatial resolution sampling (12-13 sites across 3 regions) 3 times/year, and/or in focused, intensive studies during summer. Nitrification potentials showed either no differences or lower rates in oiled marshes (strongest patterns in TB and Avicennia germinans soils). Nitrate reduction was dominated by dissimilatory nitrate reduction to ammonium (DNRA) instead of denitrification but did not show significant differences with oil status. Phosphorus sorption was highly variable between and within marshes but did not differ with oil status. Iron reduction was higher in unoiled marshes but did not differ between vegetation types. Oiled marshes tended to have lower soil CO2 and N2O fluxes with similar fluxes from Spartina alterniflora and Avicennia germinans soils; whereas CH4 production was greater in oiled marshes and Avicennia soils. Several processes showed patterns with distance from the marsh edge (although these patterns often differed between regions). Process rates were often correlated with soil organic matter properties which similarly varied in space and appear to be driven by small-scale variations in marsh elevation. The combined results indicate differential responses of biogeochemical processes to the oil spill with many exhibiting impacts sustained for at least 3+ years post-spill.

Session: 007
Date: Monday, January 27 - 11:45 AM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

Differential Biogeochemical Responses Of Spartina alterniflora And Avicennia germinans Soils Following The Deepwater Horizon Oil Spill

Presenter: John Marton
Louisiana Universities Marine Consortium
Authors: J. Marton[1], B. Roberts[1], A. Bernhard[2], A. Giblin[3], S. Mack[4], T. Moore[5];
[1]Louisiana Universities Marine Consortium, Chauvin, LA, [2]Connecticut College, New London, CT, [3]Marine Biological Laboratory, Woods Hole, MA, [4]University of Maryland College Park, College Park, MD, [5]Rice University, Houston, TX.

Abstract:
We measured biogeochemical processes in soils dominated by Spartina alterniflora and Avicennia germinans from two marshes oiled by the 2010 Deepwater Horizon oil spill and compared them to two unoiled reference marshes in Barataria Bay, LA. We collected four cores with one meter from the marsh edge from each habitat in each site and measured soil properties and quantified rates of Fe3+ reduction, CO2 and CH4 production, and N cycling rates. Iron reductions rates were significantly greater in unoiled than in oiled marshes, though no significant differences were found between Spartina and Avicennia soils. Similarly, CO2 production and nitrification were greater in unoiled marshes and comparable between vegetation types. Conversely, CH4 production was greater in oiled marshes and Avicennia soils. Iron reduction and CO2 production were positively correlated to soil organic carbon and C:N ratio, and negatively correlated to soil pH and CH4 production rates. Most soil properties (e.g., organic C, pH, water content) were comparable between Spartina and Avicennia soils, whereas these values in general were greater in unoiled marshes relative to oiled marshes. These results suggest increased carbon respiration following the oil spill has resulted in lasting differences in both soil properties and anaerobic microbial respiration rates.

Session: 007
Date: Monday, January 27 - 12:00 PM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

Response Of Spartina alterniflora To Chemical And Herbivore Stressors

Presenter: Rachael E Blake
Louisiana State University
Authors: R. E. Blake, J. A. Olin;
Louisiana State University, Baton Rouge, LA.

Abstract:
Saltmarshes are subject to many stressors both anthropogenic (oil spills, climate change) and natural (herbivory, predation), yet they provide critical ecosystem functions such as sediment stabilization, storm buffering, fisheries production, and nutrient cycling.Saltmarshes in coastal Louisiana are dominated by the important foundation species Spartina alterniflora, and are subject to

large-scale stressors such as hurricanes and oil spills in addition to biotic stresses such as herbivory by snails, insects, and crabs.Understanding how S. alterniflora responds to these stressors is key to being able to predict resiliency and persistence of this important habitat. We conducted a factorial mesocosm experiment to test the response of S. alterniflora to simultaneous chemical (South Louisiana crude oil and the dispersant Corexit 9500A) and herbivore (the snail Littoraria irrorata and the insects Prokelisia marginata and P. dolus) stressors.We found that chemical stressors negatively affected S. alterniflora more strongly than biotic stressors.Treatments with oil had fewer new stems emerge, likely due to reduced ability of below-ground roots and rhizomes to support vegetative growth.Oiled plants were also more stressed than control plants, with reduced photosynthesis, greater photochemical quenching, and fewer open photosynthesis reaction centers indicated by generally lower fluorescence values (Fv/Fm).Oiling also influenced grazers, with almost no insects surviving and snails being less active in oiled treatments.These results demonstrate the acute effects of oiling on S. alterniflora and associated grazers, and the need to fully understand the role of oiling in reducing the resiliency of these saltmarsh systems.

Session: 007
Date: Monday, January 27 - 12:15 PM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

Effect Of Macondo Oil On Saltmarsh Terrestrial Arthropod Food Webs

Presenter: Linda Hooper-Bui
Louisiana State University
Authors: L. Hooper-Bui, B. Hesson, X. Chen, A. Sabo, R. Strecker;
Louisiana State University, Baton Rouge, LA.

Abstract:
The marshes that fringe the northern Gulf of Mexico were inundated with Macondo oil in 2010. Acrobat ants, Crematogaster pilosa, form colonies inside hollow stems of the dominant plant, Spartina alterniflora. We used these omnivorous ants as indicators of environmental stress and to tease out trophic effects of the Macondo oil as well as catastrophic storms. We identified and marked colonies of ants, identified food sources, documented mating flights and new colonies, and followed colonies for >3yrs. Simultaneously on the same plots, we collected terrestrial arthropods using sweep-net sampling and clip plots. In 2010, ants were suppressed 30% in oiled marshes compared with reference marshes. By 2011, the arthropods available for ants to eat declined, and the ant population fell in oiled marshes. Tropical storm Lee surged >30hr over ant plots; we found ant populations were not different afterward. In 2012, mated queens flew into and populated oiled marshes in spring, but those colonies died in July 2012, presumably because of lack of food; new colonies in reference marshes survived. On Aug 29, 2012 Hurricane Isaac surged >62hr over the ant plots. In early 2013, populations of ants in all areas were suppressed by >98% due to Isaac. However, in summer 2013, ant populations began to recover in both oiled and unoiled areas. All ant colonies in oiled areas failed to survive until October 2013 because of suppression of prey items by the ongoing impacts of the Macondo oil disaster.

Session: 007
Date: Monday, January 27 - 12:30 PM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

Impacts of the Deepwater Horizon Oil Spill on Shorebird Communities in the Northern Gulf of Mexico

Presenter: Jessica R Henkel
Tulane University
Authors: J. R. Henkel[1], B. J. Sigel[2], C. M. Taylor[1];
[1]Tulane University, New Orleans, LA, [2]Nevada State College, Henderson, NV.

Abstract:
The U.S. coastline of the Gulf of Mexico (GOM) is an important region for 34 species of shorebirds. The Deepwater Horizon oil (DWH) spill impacted more than 650 miles of this coastline. Given the already declining population trend of many species of shorebirds, this event has the potential to impact populations from long-term exposure to toxins, degraded habitats, and altered food chains. Our research addresses the impacts of the DWH oil on 7 species of shorebirds that winter or stopover along the northern GOM. From October 2010 - May 2012 we took samples from 698 shorebirds trapped at 6 non-breeding sites that experienced varying levels of contamination from the spill. Of birds sampled, 22 were lightly oiled. Three oiled birds were trapped more than 1 year after the DWH well was capped. While only 3% of the total birds captured between 2010-2012 showed visible signs of oiling, an unknown but potentially larger number of shorebirds were likely exposed to indirect effects of the spill, such as decreased foraging time due to oiling of sites, or due to disturbance from cleanup activities. Investigations of shorebird fuel stores and fattening rates, as measured through plasma metabolites, did not indicate a significant relationship with site oiling level. However, level of cleanup activity was a significant predictor of both fuel stores and refueling rates, suggesting that shorebirds stopping over on spring migration may have had difficulty reaching necessary pre-migratory fuel stores in Spring 2011 due to the high level of disturbance on oiled beaches.

Session: 007
Date: Monday, January 27 - 12:45 PM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

Consequences of the Deepwater Horizon oil spill on breeding Seaside Sparrows

Presenter: Christine M Bergeon Burns
Louisiana State University AgCenter
Authors: C. M. Bergeon Burns[1], S. Woltmann[2], P. C. Stouffer[1], S. S. Taylor[1];
[1]Louisiana State University AgCenter, Baton Rouge, LA, [2]Austin Peay State University, Clarksville, TN.

Abstract:
Oil spills can have immediate and lethal effects on organisms residing in affected areas, but toxic pollutants such as polycyclic aromatic hydrocarbons (PAHs) contained in crude oil can also persist in the environment for many years, presenting potential for long-term physiological effects. To assess the continuing impact of the Deepwater Horizon oil spill on terrestrial vertebrates, we examined Seaside Sparrows (Ammodramus maritimus) breeding in coastal Louisiana salt marshes two and three years following the spill. Seaside Sparrows occur only in coastal marshes, where they are common year-round residents, and so may serve as a valuable indicator of the impact of environmental disturbance in this ecosystem. From April-June 2012 and 2013, we monitored population density and nesting attempts of free-living birds breeding in areas that varied in the degree of contamination from the oil spill. We found lower abundance of Seaside Sparrows in more heavily oiled areas, as well as decreased nest success, suggesting negative impacts of oil exposure on reproductive outcome. Blood samples were collected from birds breeding in each of these areas to compare circulating levels of stress hormones. A subset of adult birds were collected, and quantitative PCR is being used to examine whether those exposed to more heavily oiled habitats showed increased expression of CYP1A, a gene commonly used as a biomarker for PAH exposure.

Session: 007
Date: Monday, January 27 - 2:30 PM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

Development of a chronic toxicity test to determine effects of fresh and weathered MC252 oil and dispersant on Eastern oyster larvae

Presenter: Bill Stubblefield
Oregon State University
Authors: S. Pargee[1], C. Langdon[1], B. Stubblefield[2], E. Stefansson[1], S. Blunt[1], S. Gage[1];
[1]Oregon State University - Hatfield Marine Science Center, Newport, OR, [2]Oregon State University, Corvallis, OR.

Abstract:
We developed 10-day and 28-day static-renewal toxicity test methods to estimate chronic effects for larvae of the Eastern oyster (Crassostrea virginica), a species native to the Gulf of Mexico, exposed to fresh and weathered Macondo (MC252) oil and Corexit 9500 (dispersant) from the Deepwater Horizon (DWH) incident. All studies were conducted using low energy, water-accommodated fractions (WAFs). Endpoints for the 10-day chronic test were larval survival, proportion normal, and growth. The 28-day test included all endpoints determined in the 10-day test as well as survival and the proportions of larvae that were normal, eyed or settled on day 28. Effect concentrations (EC10s) for growth, survival and the proportion of normal larvae in the 10-day tests were lower than those observed in previous acute studies, with growth being the most sensitive endpoint. EC10s for survival and proportion normal in the 28-day test were comparable to those observed in 10-day tests. EC10s for the proportions of eyed and settled larvae were comparable to 10-day growth EC10s, with the proportion settled being the most sensitive 28-day endpoint. Under test conditions in this study, weathered oils were less toxic than fresh oils, and non-dispersed oil was less toxic than dispersed oil or dispersant alone (on a percent WAF basis) - a result consistent with those found in 48-hour acute tests with bivalve larvae.

Session: 007
Date: Monday, January 27 - 2:45 PM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

Short and long term effects of the Deepwater Horizon oil spill on the health and ecosystem services of oysters

Presenter: Jerome La Peyre
Louisiana State University Agricultural Center
Authors: J. La Peyre[1], M. Vozzo[2], J. Kay[2], S. Casas[1], Q. Xue[1], K. Brown[2];
[1]Louisiana State University Agricultural Center, Baton Rouge, LA, [2]Louisiana State University, Baton Rouge, LA.

Abstract:
Field and laboratory studies assessed the short and long term effects of DHE on oysters. For long-term effects, field studies were conducted at DHE oil impacted and control sites in high and low salinity. Field studies consisted of (1) evaluating recruitment of oysters, (2) comparing the health of caged oysters using a suite of biomarkers (3) placing mesh bags filled with cultch to examine effects on commensal diversity and (4) placing concrete surfaces on PVC poles (“reefsicles”) to determine long term differences on benthic succession. For shorter term effects, settlement tiles and cultch were pre-soaked in Louisiana light crude oil, and retrieved after one

month in the field. Laboratory studies determined the impact of salinity and Perkinsus marinus infection on oyster responses to oil-contaminated sediments. Tile experiments suggested similar oyster recruitment, commensal diversity and benthic succession among oiled and control sites, and that salinity and predation were important for recruitment success. Shorter term studies indicated oiled tiles had fewer and smaller barnacles, but only at some sites. Oiled cultch did however lower short term recruitment and biodiversity. Differences in biomarkers measures among sites are more likely associated with factors such as salinity and P. marinus infection intensities as demonstrated in laboratory studies. Our working hypothesis is that hydrocarbon contamination was not high enough nor consistent enough to impact oyster health and lower recruitment success or reef biodiversity in Barataria Bay.

Session: 007
Date: Monday, January 27 - 3:00 PM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

What Happened to the Offshore Rhodoliths and Other Seaweeds in the NW Gulf of Mexico Since the 2010 DWH oil spill?

Presenter: Suzanne Fredericq
University of Louisiana at Lafayette
Authors: S. Fredericq, T. Sauvage, S. Self, J. Richards, D. Felder, W. E. Schmidt;
University of Louisiana at Lafayette, Lafayette, LA.

Abstract:
In the northwestern Gulf of Mexico beds of rhodoliths and unconsolidated rubble are associated with unique offshore deep bank habitats, the salt domes, at 45-90m depth. These rhodolith habitats harbored the highest known seaweed diversity in the northern Gulf prior to the 2010 BP Deepwater Horizon oil spill disaster. Five post-spill collecting cruises to two biodiversity-rich pre-oil sites offshore Louisiana revealed a dramatic die-off of seaweeds at those sites. During our most recent sampling in November 2012, seaweeds were significantly repressed in Fish Haven and Sackett Banks and had not recovered to pre-spill diversity and biomass. Dredged “bare” or partly algal-denuded rubble maintained as “live rocks” in 20-gallon tanks in our laboratory gradually became covered by a suite of red, green and brown seaweed germlings that to this day continue to grow to adult size, reproduce, go through a series of temporal biomass decline and subsequent regrowth, reflecting pre-spill composition at each site. SEM-EDS enables us to understand the complex micro-anatomy of the nodules’ surface and their internal structures and microbiota. Cryptic diversity associated with the rhodolith community is being targeted using Next-Generation sequencing tools. We hypothesize the function of rhodoliths and rubble as marine seedbanks for biological diversity and explore the role of cryptic stages in overall community resilience following a major anthropogenic disaster.

Session: 007
Date: Monday, January 27 - 3:15 PM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

Salt Marsh Remediation and the *Deepwater Horizon* Oil Spill, the Role of Planting in Ecological Recovery

Presenter: Scott Zengel
Atkins North America
Authors: S. Zengel[1], B. Bernik[2], N. Rutherford[3], Z. Nixon[4], J. Michel[4], F. Csulak[5];
[1]Atkins North America, Tallahassee, FL, [2]Tulane University, New Orleans, LA, [3]NOAA, Seattle, WA, [4]Research Planning, Inc. (RPI), Columbia, SC, [5]NOAA, Highlands, NJ.

Abstract:
The *Deepwater Horizon* oil spill resulted in heavy oiling conditions across ~50 km of salt marsh shorelines in northern Barataria Bay, Louisiana. A series of salt marsh remediation field tests were conducted in ~50 m^2 plots to assist in the development of shoreline treatment recommendations (STRs) for the region, involving test treatments (including manual cleanup), oiled controls (untreated), and adjacent reference plots. Later, operational-scale mechanical treatments were also applied in the test area under an approved STR. Additional experiments involved planting smooth cordgrass (*Spartina alterniflora*) shortly after mechanical treatments as a form of emergency restoration. Previously reported results, based on data collected more than two years after initial impact, included: a. vegetation recovery positively influenced by cleanup treatments; b. the near complete absence of marsh periwinkles (*Littoraria irrorata*) in oiled plots, whether treated or not; c. fiddler crab (*Uca* spp.) burrow densities similar to reference conditions across oiled plots; d. possible differences in fiddler crab species composition with heavy oiling; and e. accelerated marsh shoreline retreat with heavy oiling. This presentation will summarize new data collected in 2013, more than three years after oil came ashore, focused on the comparison of oiled controls, mechanical treatments with planting, mechanical treatments without planting, and reference plots. Specific emphasis will be placed on the role of planting in vegetation and marsh periwinkle recovery in heavily oiled marshes.

Session: 007
Date: Monday, January 27 - 9:30 AM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

Weathering patterns of hopane, sterane and triaromatic steroid biomarkers in sediments from coastal marsh sites impacted by the Macondo Oil Spill

Presenter: Ed Overton
Louisiana State University
Authors: E. Overton, S. Miles, B. Meyer, H. Gao, G. Turner;
Louisiana State University, Baton Rouge, LA.

Abstract:
Spilled oil undergoes compositional changes due to weathering processes as it moved through various environmental sectors. These changes are initially caused by primarily evaporation and dissolution of the lower molecular weight components. In addition to emulsification, sedimentation, and photo-oxidation processes, bacterial degradation plays a prominent role in the transformation of oil-derived hydrocarbons into biomass and CO2. These weathering compositional changes also cause changes in the oils physical properties, thus impacting the oil's impact on various environmental compartments. One group of petroleum-derived hydrocarbons is very resistant to these weathering compositional changes, and these compounds are frequently called oil-fingerprinting-biomarkers compounds. Comparing the composition of these biomarker compounds in the initial spilled oil with their composition in weathered oil samples can provide convincing evidence that the heavily weathered, compositional changed oil residues were from the initial spill. We have tested this hypothesis by examining the biomarker compositional details in several samples collected in 2010, 20111 and 2012 from areas known by SCAT surveys to be heavily impacted during the summer of 2010. All oil residues were heavily weathered, with some biomarker profiles affected by heavy weathering. This information can aid in assessing the ultimate impact of this major oil spill.

Session: 007
Date: Monday, January 27 - 9:45 AM
Room: Bon Secour Bay III
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Oral

Vulnerability of Deltaic Louisiana Estuaries to Pollution from an Offshore Oil Spill

Presenter: Dubravko Justic
Louisiana State University
Authors: D. Justic, L. Wang, H. Huang, N. Walker, W. Benger, I. Ayyala;
Louisiana State University, Baton Rouge, LA.

Abstract:
Deepwater Horizon incident has clearly shown that deltaic Gulf of Mexico estuaries are highly vulnerable to pollution from an offshore oil spill, yet there have been few modeling studies dealing with oil transport in these systems. The implementation of 3-dimensional hydrodynamic models is particularly challenging because deltaic estuaries have extremely complex geomorphology and so numerical grids need to resolve both the complex bathymetry and intricate channel and wetland features. Modeling of estuarine-shelf exchanges is additionally complicated by the fact that estuarine residence times are strongly affected by pulsed freshwater discharges from river diversions on the lower Mississippi River. Diversions are used primarily for salinity control but increasingly proposed also as a major way to deliver sediments and nutrients to coastal wetlands impacted by the construction of flood control levees. The impacts of river diversions on surface oil transport in Barataria and Breton Sound estuaries, the sites of the two largest freshwater diversion projects, were investigated using a high resolution, three-dimensional, Finite-Volume Coastal Ocean Model (FVCOM). The model was driven by tidal and subtidal forcing at the open Gulf of Mexico boundary, freshwater discharge from the diversions, and surface wind stress. We discuss some important challenges in developing oil spill trajectory models in these systems that pertain to model resolution, bathymetry, forcing, and calibration issues.

Session: 007
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Poster 7-237

Metagenomic analysis of a microbial consortium associated with natural crude oil from the Santa Barbara Channel: Extending our knowledgebase of Hydrocarbon Microbiology beyond the Gulf of Mexico

Presenter: Matthias Hess
Washington State University
Authors: E. R. Hawley[1], N. M. Scott[2], S. Malfatti[3], I. Pagani[4], M. Huntemann[4], A. Chen[4], T. Glavina del Rio[4], B. Foster[4], A. Copeland[4], J. Jansson[4,5], H. Piao[1], A. Pati[4], S. Tringe[4,5], J. A. Gilbert[2,6], T. D. Lorenson[7], M. Hess[1,8];
[1]Washington State University, Richland, WA, [2]Argonne National Laboratory, Lemont, IL, [3]Lawrence Livermore National Laboratory, Livermore, CA, [4]DOE Joint Genome Institute, Walnut Creek, CA, [5]Lawrence Berkeley National Laboratory, Berkeley, CA, [6]University of Chicago, Chicago, IL, [7]USGS, Menlo Park, CA, [8]Pacific Northwest National Laboratory, Richland, WA.

Abstract:
The potential of DNA sequencing to enhance our knowledge of the microbial response to large oil spills was recognized immediately following the Deepwater Horizon (DWH) blowout. Results from projects initiated after the DWH oil spill let to the hypothesis that the indigenous microbial community of the Gulf of Mexico (GoM) was primed for large spills by the numerous natural oil seeps of this area. To develop sustainable and readily available bioremediation strategies for diverse regions, it will be essential to extend our current knowledgebase of microbial hydrocarbon degradation beyond the GoM. Here, we focused on the microbial communities and processes of the Santa Barbara Channel (SBC), one of the world's largest natural hydrocarbon seep regions. We generated >50 Gb of metagenomic sequence data from crude oil collected from a seep located offshore of Goleta Point. The assembled sequence data represented >1 million genes, primarily from chemolithoautotrophic bacteria. Interestingly, less than 2% of the assembled genes were derived from members of the bacterial order Oceanospirillales. In contrast, >60% of the metagenomic data generated from the DWH oil plume that developed in 2010 were assigned to members of the Oceanospirillales. This suggests that members of the Oceanospirillales might play a less significant role in the microbially mediated hydrocarbon conversion within the SBC seep oil then they did in the DWH plume oil. The phylum Euryarchaeota recruited >95% of the assembled archaeal sequences from the SBC oil seep metagenome, with >50% of the sequences assigned to members of the orders Methanomicrobiales and Methanosarcinales. We hypothesize that these archaeal orders may be essential to the microbial ecosystem of the SBC.

Session: 007
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Poster 7-238

Did the coastal phytoplankton community change in response to the Macondo oil spill?

Presenter: Michael Parsons
Florida Gulf Coast University
Authors: M. Parsons[1], N. Rabalais[2], W. Morrison[2];
[1]Florida Gulf Coast University, Fort Myers, FL, [2]Louisiana Universities Marine Consortium, Cocodrie, LA.

Abstract:
Phytoplankton communities can be significantly impacted by oil spills. Crude oil can stimulate the growth of some species while at the same time inhibit the growth of others, both of which can result in a change in the abundance and composition of the phytoplankton assemblage. Water samples were collected between April and October 2010 (before, during, and following the Deepwater Horizon (DWH) oil spill) west of the Mississippi River and analyzed for phytoplankton and crude oil components related to the DWH spill. The 2010 phytoplankton data were compared with data collected in 1999 and 2008 (the two years most similar in terms of river discharge and nitrogen loading, respectively). Multidimensional scaling analysis results demonstrate that June and August 2010 samples had phytoplankton assemblages that were distinctive from other samples in 1999, 2008, and 2010, suggesting a possible phytoplankton response to the oil spill. Crude oil analyses, however, found very little to no evidence of Macondo oil in the samples collected. PRIMER BEST analysis results indicate that the phytoplankton community in general appears to respond most strongly to changes in salinity, temperature, ammonium, and phosphate concentrations (when oil is not present). The significance of the oil spill in this context will be discussed.

Session: 007
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Poster 7-239

Benthic Foraminifera Diversity and Distribution in the Gulf of Mexico

Presenter: Chelsea McCurry
Center for Environmental Diagnostics and Bioremediation
Authors: C. McCurry, J. A. Moss, S. Tominack, W. H. Jeffrey, R. A. Snyder;
Center for Environmental Diagnostics and Bioremediation, Pensacola, FL.

Abstract:
Benthic foraminifera are widely distributed protozoa used as ecological indicators in both modern and palaeo oceanography. Knowledge of
the ecological properties and distribution of these organisms in the Gulf of Mexico (GOM) is limited. Clone libraries (17S rRNA) were created from sediment samples collected using shipek grabs and coring along transects on the northwest Florida GOM shelf (30-100m) and from regions within DeSoto Canyon (100-1500m) near the Deep Well Horizon to characterize the community dynamics with respect to temporal and spatial scale. Clone library sequences and subsequent rarefaction curves suggest limited diversity with a majority of sequences aligning to known organisms listed in the NCBI database. A few species were shown to dominate the coastal communities including *Glabratellina* sp., *Trochammina* sp., and *Textularia sagittula* and *Bathysiphon argenteus* as well as members of genera *Astrammina*, *Bolivina*, *Cibicides* and *Cibicidoides*. The data indicate a degree of spatial specificity with respect to depth. These standard molecular analyses, coupled with multivariate analysis of associated environmental parameters should serve to clarify key foraminfera species, as well as identify foramineral biofaces and related patterns in diversity in the Gulf of Mexico.

Session: 007
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)

Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Poster 7-240

Stable isotopes as chemical indicators of Spartina alterniflora productivity in a multiple stressor mesocosm experiment

Presenter: Jill A Olin
Louisiana State University
Authors: J. A. Olin, R. E. Blake;
Louisiana State University, Baton Rouge, LA.

Abstract:
The response of salt marshes to natural and anthropogenic stressors is most commonly measured as degradation and/or loss of plant biomass. However, physiological responses of salt marsh plants may occur prior to visible signs of reduced condition, possibly providing the opportunity for better management of at risk areas. Stressed plants have been observed to alter their elemental composition and stable isotope values, suggesting that leaf chemistry may be good indicator of growth condition. Field data of Spartina spp. sampled from areas affected and unaffected by the Macando oil spill in Barataria Bay, Louisiana indicated correlations with %S and δ34S in addition to correlations with δ13C and δ15N. Initial interpretation of these data suggest that the combination of these four chemical markers is tracking the plant productivity response occurring in the field, with lower CNS isotope values and higher %S values observed in the more productive plants. To evaluate these field observed relationships and to understand how these chemical markers correlate with actual plant productivity (as measured by growth, biomass and photosynthesis), we conducted a factorial mesocosm experiment to test the stable isotope response of Spartina alterniflora to simultaneous chemical (South Louisiana crude oil and the dispersant Corexit 9500A) and herbivore (the snail Littoraria irrorata and the insects Prokelisia marginata and P. dolus) stressors. We expect stressed plants to have higher δ13C and lower %S content concomitant with reduced growth and biomass estimates relative to control plants. Developing these chemical markers as indicators of stress will potentially provide a tool for evaluating the condition of salt marshes in the field.

Session: 007
Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Poster 7-241

The Effects of Large Nitrogen Loading and Low Oxygen Conditions on Nitrogen Removal Processes in Coastal Waters

Presenter: Mary Katherine Rogener
University of Georgia
Authors: M. K. Rogener[1], B. Roberts[2], N. Rabalais[2], S. B. Joye[1];
[1]University of Georgia, Athens, GA, [2]Louisiana Universities Marine Consortium, Chauvin, LA.

Abstract:
Excess nitrogen in coastal environments can lead to eutrophication, harmful algal blooms, habitat loss, oxygen depletion and reductions in biodiversity. As such, biological nitrogen (N) removal through the microbially-mediated processes of denitrification and anammox are critical ecosystem functions that help mitigate the negative consequences of excess nitrogen loading. Denitrification can release nitrous oxide, a potent greenhouse gas, as a byproduct under some environmental conditions. To understand how excess nitrogen loading impacts denitrification and anammox, we measured rates of both processes in the water column and sediments of the Gulf of Mexico “Dead Zone.” The Dead Zone is generated by excessive nitrogen loading from the Mississippi and Atchafalaya Rivers, which leads to a large seasonal hypoxic/anoxic area in the coastal waters of the LA-TX shelf. We quantified rates of denitrification and anammox rates along 5 transects along the shelf. The production of dinitrogen gas was calculated using the 15N isotope pairing technique and the production of nitrous oxide was measured concurrently using gas chromotography. Water column oxygen, sulfide, and dissolved organic carbon concentrations appear to interactively regulate rates of denitrification, anammox and nitrous oxide production within the Dead Zone.

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Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Poster 7-242

Taxonomic, metabolic, and physiological properties of bacteria from Gulf of Mexico deep-sea sediments impacted by the Deepwater Horizon oil spill

Presenter: Bryan Davis
University of West Florida
Authors: B. Davis, C. Wallace, H. Chau, J. A. Moss, C. Riesenfeld, W. H. Jeffrey, R. A. Snyder, J. E. Lepo;
University of West Florida, Pensacola, FL.

Abstract:
Studies of microbial response to oil spills often rely on non-culture based molecular biological tools (e.g., T-RFLP, metagenomics) for community structure analyses. To complement these studies, we enriched and isolated bacteria that utilize petroleum hydrocarbons as their sole C-source. Deep-sea sediments collected along a transect crossing the well-head of the Gulf of Mexico BP oil spill were stored at 4°C. Homogenized sediments were inoculated to Bushnell-Haas broth containing n-hexadecane, or a PAH mix, or artificially weathered crude oil. Enrichments were shaken at 25°C until turbid, then streaked to trypticase-soy agar. Unique colonies inoculated to sole C-source (various PAHs or hexadecane) media ensured ability to grow on those substrates. To date, 94 strains have been isolated and maintained. The 16S rRNA genes of isolates were PCR amplified, and 50 were sequenced; members of phyla Proteobacteria, Actinobacteria, and Firmicutes are represented. Further sequence analyses elucidated fourteen genera within four classes (Alphaproteobacteria, Gammaproteobacteria, Actinobacteria, Bacilli). Selected strains have been characterized using standard microbiological staining and testing, e.g., gram reaction, catalase, hemolysis (which may suggest biosurfactant capabilities), motility, sulfide production, and nitrate respiration. Some of our isolates are known hydrocarbon degraders; others have been confirmed in our laboratory as hydrocarbon degraders.

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Post-Deepwater Horizon oil spill Abundance and Diversity of Marsh Nekton in the Mississippi River delta

Presenter: Thomas Sevick
Loyola New Orleans
Authors: T. Sevick, F. Jordan;
Loyola New Orleans, New Orleans, LA.

Abstract:
A central challenge to assessing effects of major environmental disturbances such as the BP Deepwater Horizon Oil Spill (DHOS) is the lack of quantitative distribution and abundance data from prior to the disturbance. This is especially true for species that are not commercially or recreationally harvested and are therefore not regularly monitored by state and federal resource management agencies. Fortunately, we collected quantitative abundance, habitat use, and distribution data for non-game marsh nekton prior to the DHOS as part of a multi-year evaluation of wetland restoration efforts in the Mississippi River delta. To assess ecological response to the DHOS and several other major ecological disturbances (e.g., Hurricanes Katrina and Rita), we revisited five historically monitored sites in Pass-a-Loutre Wildlife Management Area in August 2012 and sampled marsh fishes and invertebrates in adjacent patches of submerged aquatic vegetation, emergent vegetation, and Phragmites using a combination of 1-m2 throw traps and minnow traps. Oil and dispersants from the DHOS probably did not directly settle on these locations, so a nearby impact and associated control site were also sampled during August 2012. Importantly, many of the common nekton (e.g., juvenile blue crabs and brown shrimp, speckled worm eels) found in these marshes spend part or all of their lives in the nearby Gulf of Mexico. Our preliminary results indicate that diversity and abundance of nekton in the Mississippi River delta two years following the DHOS are comparable to historical data.

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Spatial and temporal variations in the community structure of marine Archaea in the Northeastern Gulf of Mexico

Presenter: Sarah Tominack
University of West Florida
Authors: S. Tominack, J. Moss, C. Riesenfeld, W. Jeffrey, R. Snyder;
University of West Florida, Pensacola, FL.

Abstract:
Since the Deepwater Horizon oil spill in 2010, much emphasis has been placed on understanding processes, both physical and biological, that occur in the Gulf of Mexico. On the micro-scale, bacterioplankton and archaeplankton play major roles in the cycling of nutrients through the microbial loop, and then the macro-scale biogeochemical cycles. Understanding changes occurring in the community structure of Archaea in the Gulf of Mexico over space and time has the potential to shed new light on the transfer of energy into and out of the system as well as through higher trophic levels. Samples were collected from near shore, shelf break, and offshore sites in three separate transects along the NW Florida shelf during winter and summer research cruises. Using clone libraries constructed with the archaeal 16S rRNA sequence, samples were compared seasonally and spatially and also compared by physical and chemical water column parameters during time of collection and overall current movement. Preliminary results suggest that chlorophyll a concentration, inorganic nutrients, temperature, and depth correlate highly with marine Archaea community structure in the Gulf of Mexico.

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Louisiana salt marsh soil greenhouse gas fluxes following the Deepwater Horizon oil spill

Presenter: Brian J Roberts
Louisiana Universities Marine Consortium (LUMCON)
Authors: B. J. Roberts[1], J. M. Marton[1], A. M. Marti[2], T. S. Moore[3];
[1]Louisiana Universities Marine Consortium (LUMCON), Chauvin, LA, [2]University of Wisconsin-Stevens Point, Stevens Point, WI, [3]Rice University, Houston, TX.

Abstract:
We quantified the effects of the Deepwater Horizon oil spill on greenhouse gas (GHG) fluxes from oiled and unoiled Louisiana marsh soils. Two years of seasonal GHG flux measurements from 2 unoiled and 2 oiled Terrebonne Bay (TB) marshes showed significant monthly variability (CO_2 and N_2O highest in May/June); oiled sites tended to have lower CO_2 and N_2O and higher CH_4 fluxes; CO_2 was the major driver of soil radiative balance at all sites, but CH_4 accounted for ~1/3 of forcing in oiled sites; CO_2 fluxes increased with distance from marsh edge and increased with soil C, N and water content; and CO_2 and CH_4 fluxes were higher at shallow water depths. Soils from 4 unoiled and 4 oiled TB and Barataria Bay (BB) marshes incubated at different salinities (5, 15, 25, 35 ppt) showed CH_4 production was higher in TB and unoiled soils; CO_2 and CH_4 production decreased with increased soil C:N and increased with water content; CO_2 production increased and CH_4 production decreased with salinity. Laboratory incubations of unoiled and oiled BB soils associated with Spartina alterniflora and Avicennia germinans showed CO_2 production was greater in unoiled marshes and comparable between vegetation types; CH_4 production was greater in oiled marshes and Avicennia soils; CO_2 production increased with soil organic C and decreased with soil pH and CH_4 production. These results have important implications for wetland carbon models and how fluxes may respond to both episodic (e.g., oil spills) and climate-related (e.g., altered salinity and vegetation) stressors.

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The Effects of the Deepwater Horizon Oil Spill on Blue Crab Megalopal Settlement: A Field Study

Presenter: Elizabeth Robinson
Louisiana State University-Baton Rouge
Authors: E. Robinson[1,2], N. Rabalais[2];
[1]Louisiana State University-Baton Rouge, Baton Rouge, LA, [2]Louisiana Universities Marine Consortium, Chauvin, LA.

Abstract:
Numerous species of crabs rely on chemosensory signals to detect suitable habitat. These data are part of a preliminary field study examining if oil affects blue crab megalopal settlement. Megalopae were collected at three marsh sites where oil came ashore in 2010, and three adjacent “unoiled” sites within Terrebonne Bay, Louisiana over a one-week period in August 2013. Early results indicate that

megalopal settlement is different between oiled and “unoiled” sites. “Unoiled” sites appear to have more settlement than oiled sites. This suggests that blue crab megalopae could detect adverse conditions in the oiled marshes and then relocate to more suitable habitat prior to settlement. Future research will examine oil’s effect as a chemical cue during megalopal settlement.

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Determining the sources and availability of food for the Seaside Sparrow in oiled and reference Louisiana Salt Marshes

Presenter: Wokil Bam
Department of Oceanography and Coastal Sciences, Louisiana State University
Authors: W. Bam[1], L. M. Hooper-Bui[2], P. C. Stouffer[3], S. Taylor[3], C. M. Bergeron Burns[3];
[1]Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, LA, [2]Department of Entomology, LSU AgCenter, Baton Rouge, LA, [3]Renewable Natural Resources, LSU AgCenter, Baton Rouge, LA.

Abstract:
Salt marshes are one of the most productive ecosystems, supporting high abundance of specialist species. Resident birds such as the Seaside Sparrow (Ammondramus martimus fisherii) are completely dependent on salt marsh habitats for all phases of their annual cycle. In Louisiana salt marshes, Seaside Sparrows feed on seeds, insects, amphipods, spiders and mollusks and have the potential to be a good indicator species of overall marsh health. Oil spill events such as the Macondo well explosion may have significant long-term negative impacts on salt marsh birds their habitat and food. To determine the effects of the Macondo oil spill on the salt marsh terrestrial food web, twelve sites along the coast of Louisiana were studied: 3 lightly-oiled, 4 heavily oiled sites in Barataria Bay, and 5 reference unoiled sites in South of Delacroix, St. Bernard Parish, and Northeast of Barataria Bay. Insects were collected monthly via sweep net, 20m inland from shoreline between April and June of 2013. During the same time frame, fecal and stomach contents of adult A. m. fisherii were also collected from each field site. From a subset of these sites, food items delivered by adult Seaside Sparrows to nestlings were collected via throat ligatures, and nestling fecal samples were saved. Preliminary results combined with previous sampling at these sites show a significant decrease in the insect population which may be reducing prey availability for Seaside Sparrows in oiled sites versus unoiled reference sites.

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Understanding Atmospheric Hg Deposition Above A Coastal Area Of The Gulf Of Mexico (Pensacola, FL) Using Hg Stable Isotopes

Presenter: Vincent Perrot
National High Magnetic Field Laboratory, Florida State University
Authors: V. Perrot[1], W. M. Landing[2], V. J. M. S. Salters[1];
[1]National High Magnetic Field Laboratory, Florida State University, Tallahassee, FL, [2]Department of Earth, Ocean, and Atmospheric Science, FSU, Tallahassee, FL.

Abstract:
The source of Hg in marine waters is recognized to be mostly via atmospheric dry and wet deposition. Hg can have different sources, is highly reactive and undergoes multiple processes of transformation in the atmosphere before its deposition. Our study is investigating the isotopic composition of the different Hg species present in the atmosphere (Gaseous elemental mercury, GEM; Reactive gaseous mercury, RGM; Particulate mercury, RPM; total Hg in rain) 21km NW of Pensacola, FL, collected at the surface from July 2010 to August 2012. GEM, which constitutes more than 95% of atmospheric Hg is enriched in heavier isotopes compared to RPM. RGM had very variable isotope composition depending on the season. RPM and RGM are both deposited via dry deposition, and are also scavenged in rain droplets, which is corroborated by our observations because rain displayed an Hg isotopic composition intermediate RGM and RPM. Hg samples also displayed mass independent fractionation (MIF) that is negative for GEM, positive for RPM and rain, and either slightly negative or positive for RGM. This suggests that GEM at this site comes from marine surface evasion and global transport rather than local pollution. The positive MIF in RPM also demonstrates that photoreduction of Hg readily occurs in aerosols. The RGM isotope composition (no significant MIF and high variability of MDF) is consistent with a very reactive Hg species with very short life time related to oxidation/reduction transformations and gas-particle partitioning.

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Impact Of The Deepwater Horizon Oil Spill And Dispersant Application On Marine Bacterial Populations

Presenter: Suja Rajan
University of Alabama
Authors: S. Rajan[1], N. Flournoy[1], M. J. Beazley[1], R. J. Martinez[1], T. C. Hazen[2,3], P. A. Sobecky[1];
[1]University of Alabama, Tuscaloosa, AL, [2]Lawrence Berkeley National Laboratory, Berkeley, CA, [3]University Of Tennessee, Knoxville, TN.

Abstract:
The Deepwater Horizon (DWH) oil spill in April 2010 released more than 200 million gallons of crude oil and approximately 2 million gallons of dispersants into the Gulf of Mexico. The primary objective of our study is to determine short-term and long-term responses of coastal microbial communities to hydrocarbon and dispersant impacts as a result of the oil spill event. The objectives of this research include (1) Monitoring annual changes in the microbial community composition and function at an impacted salt marsh site in coastal Alabama (2) To determine the impact of dispersants on community composition of coastal microbial communities. Total nucleic acids were extracted from sediment samples collected during visible oiling of the study site and from samples collected up to three years after the oil spill. High-throughput microarrays for profiling microbial populations and determining functional gene abundances were used to conduct molecular-based analysis of microbial communities at the site. Significant changes in the hydrocarbon-degrading community composition were observed in the samples collected annually after the spill. Microbial community response to increasing concentrations of surfactants used in dispersant formulations was also determined. Preliminary culture-based analyses indicate that while surfactants can be toxic to certain microbial taxa, there is an enrichment of organisms that are capable of metabolizing the surfactant and using it as an energy source.

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Effect of Hurricane Isaac and Macondo Oil on Saltmarsh Terrestrial Arthropods

Presenter: Gerald Soderstrum
Louisiana State University
Authors: L. Hooper-Bui[1], G. Soderstrum[2], B. Hesson[2], X. Chen[2], R. Strecker[2];
[1]Entomology, Louisiana State University, Baton Rouge, LA, [2]Louisiana State University, Baton Rouge, LA.

Abstract:
Background: Salt marshes on the Gulf of Mexico are exposed to frequent tropical storms and hurricanes, which negatively impact the productivity of terrestrial arthropods. These marshes typically experience two daily tidal changes <50cm with salinity ranges from 8-12 ppt. Strong winds from tropical storms and hurricanes push large volumes of high salinity seawater into the marsh, often several meters deep. These storm surges inundate the habitat for 30-70hrs. This vast fluctuation of water and salinity levels has a tremendous impact on insects and spiders living in the exposed marsh grasses, primarily *Spartina alterniflora*. These organisms live both in the interior and exterior of the grasses, most frequently occurring on the upper 2/3 of the external stems. These arthropods play a vital role in the salt marsh food web, serving as a chief food source for birds, fish, and frogs. To better understand the impact of storm surge on marsh terrestrial arthropods we sampled marshes in Barataria Bay and Breton Sound two days before Hurricane Isaac (August 2012) made landfall. Sweep nets were used to collect samples (in the same areas) before and after the storm, twice within a week of the hurricane passing, and then weekly for 10 weeks. They were brought back to the lab for sorting and identification. Although saltmarsh insects are capable of withstanding ~30h of storm surge inundation, the surge from Isaac radically suppressed terrestrial arthropods, even when we separate the effects of oil.

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Effect Of Macondo Oil On Fiddler Crab Burrows In Barataria Bay, Louisiana

Presenter: Linda Hooper-Bui
Louisiana State University
Authors: L. Hooper-Bui, A. Sabo, T. Byers, B. Hesson, G. Soderstrum, T. Crupi, R. Strecker;
Louisiana State University, Baton Rouge, LA.

Abstract:
Fiddler and marsh crabs are commonly seen feeding by sifting through the sediment in the most oil-impacted areas of Barataria Bay, La. These fragile intertidal communities were severely impacted by the deposition of Macondo oil in 2010 and crabs interact with the sediment during burrowing and foraging. NOAA found that fiddler crab apertures were significantly lower in oiled marshes than in reference marshes in summer 2010, but indicated that aperture number was not different between control restored plots and reference by December 2010. In 2012, we counted burrow apertures, caste burrows and collected crabs. We found an average of 19

apertures/m2 in unoiled plots and 14 apertures/m2 in oiled plots (P=0.204, t=1.369 df=9). Because multiple apertures might lead to a single burrow, we compared number of burrows per plot to each other in oiled and unoiled areas and found they both averaged 14 apertures/m2. Additionally, the length, the depth, and the aperture diameter of the burrow were not significantly different between oiled and unoiled areas. However, there were differences in the diameter of the burrows at depth and subsequently the burrows in the oiled area had significantly smaller volume than those in unoiled areas. The difference in volume could be due to decreased populations of crabs in oiled areas indicating decreased use of burrows.

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DNA analysis of surfactant and oil associated bacteria in the sea surface microlayer

Presenter: Bryan Hamilton
Nova Southeastern University
Authors: B. Hamilton[1], N. Kurata[2], K. Vella[3], C. Dean[1], A. Soloviev[1], A. Tartar[4], M. Shivji[1], W. Perrie[5], S. Lehner[6];
[1]Nova Southeastern University, Dania Beach, FL, [2]Smithsonian, Washington, DC, [3]State College of Florida, Bradenton, FL, [4]Nova Southeastern University, Davie, FL, [5]Bedford Institute of Oceanography, Burnside, NS, [6]German Aerospace Center (DLR) Remote Sensing Technology Institute, Bremen, GERMANY.

Abstract:
The sea surface microlayer is known to play a vital role in air-sea gas exchange, biochemical cycling, climate-active aerosol production, and surface temperature. Some types of oil associated marine bacteria are known to produce surfactants, and they may play an important role in the presence of natural sea slicks on the sea surface. The dampening effect that surfactants found in the microlayer can have on sea surface capillary waves can be significant, often being detectable in synthetic aperture radar (SAR) satellite imagery. Sea slicks formed by surfactants in the microlayer may serve as an indicator to the presence of oil in the water column below, where oil degradation by bacterial communities can take place. In this study, new microlayer sampling techniques (Kurata et al. 2013) are used to minimize contamination that is prevalent in other methods used today. Samples were collected in the Straits of Florida in 2010 and 2013 coinciding with RADARSAT 2 and TerraSAR-X satellite overpasses, and we are in the process of collecting samples in the Gulf of Mexico. Microlayer and subsurface samples in both slick and non-slick areas are taken for comparisons. Samples are analyzed using DNA techniques (454 sequencing and qPCR) to determine differences in bacterial diversity and abundance in the microlayer and subsurface water column. Linking surfactant and oil associated bacteria to features seen in satellite imagery may help to monitor oil spills under low wind speed conditions.

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Oil, Nutrients, And Predation Synergistically Control Planktonic Oxygen Consumption In The Gulf Of Mexico.

Presenter: Andrew R Juhl
Lamont Doherty Earth Observatory
Authors: A. R. Juhl[1], N. D'souza[1], K. Ziervogel[2], K. Bullock[1], B. Yan[1], A. Subramaniam[1];
[1]Lamont Doherty Earth Observatory, Palisades, NY, [2]University of North Carolina, Chapel Hill, NC.

Abstract:
When oil hydrocarbons enter the Gulf of Mexico, whether from natural or anthropogenic sources, they are subject to breakdown by oil-degrading microbes. Oxygen drawdown in the water column due to microbial respiration is of potential ecological concern. Shipboard experiments were conducted to assess the ecological and chemical factors affecting water column O2 consumption following an oil input event to offshore waters in the Gulf of Mexico. Dilution experiments, to minimize predation on bacteria, were combined with additions of oil and inorganic nutrients (N, P, trace metals) while O2 consumption, bacterial growth rates, and exoenzyme activities were measured. Addition of oil, nutrients, and lowered bacterivory each independently increased biological oxygen demand, with concomitant increases in bacterial cell counts, and in enzymatic activities potentially involved in oil degradation. Combinations of the treatments increased these trends synergistically. Our results underscore the need to consider both top-down (predation), and bottom-up (nutrient availability) controls in assessing the microbial process involved in oil degradation.

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Rhodoliths offshore the NW Gulf of Mexico: before and after, inside and out

Presenter: Thomas Sauvage
University of Louisiana at Lafayette
Authors: T. Sauvage, W. E. Schmidt, S. Self, J. Richards, O. Camacho, D. Venera-Ponton, K. Clinton, D. Felder, S. Fredericq;
University of Louisiana at Lafayette, Lafayette, LA.

Abstract:
Prior to the 2010 BP Deepwater Horizon oil spill disaster, rhodolith beds at Fish Haven/Ewing Bank 2 in the northwestern Gulf of Mexico (~28o05.710'N, 91o01.289'W) harbored diverse algal assemblages at 55-75m depth. As of October 2013 these beds have not recovered to pre-spill abundance in terms of species richness and abundance (biomass). Nonetheless, in laboratory studies, these algal-denuded rhodoliths maintained as live rocks in 20-gallon closed systems at UL Lafayette Lafayette have gradually became covered by a suite of macroalgal (red, green and brown seaweeds) germlings from seemingly ecologically cryptic stages (e.g. spores, filaments) present in the epilithic and/or endolithic microbiota of the rhodoliths nodules. Using universal tufA primers targeting photosynthetic biodiversity (prokaryotic and eukaryotic), we establish the phylogenetic profiles of several pre- and post-spill rhodolith microbiota to demonstrate their critical role as refuge and marine seedbanks mediating algal community recovery in face of environmental stochasticity caused by natural or anthropogenic causes such as the Deepwater oil spill.

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Ciliate Microbial Diversity in the Gulf of Mexico

Presenter: Joseph A Moss
Center for Environmental Diagnostics and Bioremediation
Authors: J. A. Moss, C. McCurry, S. Tominack, W. H. Jeffrey, R. A. Snyder;
Center for Environmental Diagnostics and Bioremediation, Pensacola, FL.

Abstract:
Understanding biogeochemical processes in the Gulf of Mexico warrants analysis of key components of the microbial loop. Microzooplankton (e.g., ciliophora) act as integrators of bacteria and phytoplankton production. Their dynamics are being analyzed spatially and temporally over the Florida Panhandle Shelf as well as in deepwater sites between the Deepwater HorizonBP MC252 well blowout and DeSoto Canyon. Clone libraries (17S rRNA) were created to evaluate ciliate community structure in samples from the water column, surface sedimentsand the sediment-water interface. Sequence alignment with the NCBI database identified a large percentage of putative species as unclassified clones. A small fraction of clones was found to be unique via sequence similarity (97%) and use of BLAST. A few aloricate species were repeatedly found
in ~70% of water column samples. These core species include but are not limited to *Pseudotontonia simplicidens* and several unclassified ciliate sequences. Other common sequence identities align with *Scuticociliatia* (small bacterivores) and the genus *Strombidium*. Interface libraries are distinct from those of the water column with several clones aligned to demersal organisms including *Pseudoamphisiella quadrinucleata*, *Spirotrachelostyla tani*, *Euplotidium arenarium*, and *Parauronema longum*. Further investigation with FlowCam image analysis and sequences of isolated single cells will provide identities for unknown sequences to improve database quality.

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Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
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Combined Effect of Solar Radiation and Crude Oil on Microbial Community Structure in the NE Gulf of Mexico

Presenter: Josette M Hutcheson
University of West Florida
Authors: J. M. Hutcheson, K. A. Houghton, J. A. Moss, C. S. Riesenfeld, R. A. Snyder, W. H. Jeffrey;
University of West Florida, Pensacola, FL.

Abstract:
Bacterioplankton are a crucial part of the planktonic community and serve key roles in the function of the microbial loop. Ultraviolet radiation causes a number of changes to marine plankton including damage to DNA and decreases in productivity. While many studies have examined the effects of oil on bacterial communities, a majority of these studies were performed in the dark and excluded photochemical and photobiological interactions. Our previous data has shown that oil that has been exposed to light undergoes photodegradation that affects microbial production. Its effects on bacterial community structure, however, are not known. Seawater was collected from offshore surface waters in the northeast Gulf of Mexico in April and September 2013. Three optical treatments were established; full sun, visible light (blocking UV), and dark. Each of these was incubated in triplicate with or without the addition of 50 ppm surrogate oil for 48 hours in a temperature controlled water bath at in situ temperature. Analysis of microbial community structure

was performed on PCR amplified 16S ribosomal RNA genes. Preliminary analysis of April samples suggests that UV is a stronger factor in changing bacterial community structure than is oil. September sample analysis is ongoing and results will also be presented.

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Oscillations In Rhizosphere Microbiomes: Examining The Effects Of Crude Oil On Microbial Community Structure Over Time And Space

Presenter: Demetra Kandalepas
Tulane University
Authors: D. Kandalepas[1], M. J. Blum[1], J. H. Pardue[2];
[1]Tulane University, New Orleans, LA, [2]Louisiana State University, Baton Rouge, LA.

Abstract:
Plant performance and wetland function can strongly correspond to rhizosphere microbiome community structure. Consequently, alterations in soil composition that influence microbiome community structure may result in a cascade of changes in plant productivity, food webs, and ecosystem function. Conversely, microbial shifts could result in remediation, resilience, and recovery of degraded ecosystems. In this study we use a metagenomics approach and time series analysis to examine spatial and temporal shifts in rhizsophere and root microbiome communities associated with Spartina alterniflora in two coastal marshes in southeast Louisiana, Bay Jimmy and Port Fourchon, that were affected by the Deepwater Horizon Oil Spill. Within each marsh, we collected a year long time series of soil cores up to 30 cm deep along transects spanning a 100-meter oiling gradient. In addition we calculated plant species diversity, stem density, and total cover within 30cm2 plots along each transect. This has enabled us to assess whether microbiome community structure correlates to hydrocarbon signatures, testing the hypothesis that rhizosphere microbiome communities shift toward higher abundances of oil-degrading entities with increases in oil concentration. Over time, however, we expect that as oil is assimilated, microbial communities shift to correlate more closely to plant productivity and composition, as well as with major environmental gradients that structure Gulf coast plant communities.

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Phytoplankton associations in the northeastern Gulf of Mexico: Changes in the net plankton association, 2011 - 2013

Presenter: Courtney M Bryller
Valdosta State University
Authors: C. M. Bryller[1], J. A. Nienow[1], A. V. F. Nienow[1], S. Wise[2];
[1]Valdosta State University, Valdosta, GA, [2]Florida State University, Tallahassee, FL.

Abstract:
We are conducting a multi-year study of phytoplankton in the vicinity of DeSoto Canyon, northeastern Gulf of Mexico, as part of a larger project aimed at assessing the potential transport of bottom water (and oil) up the canyon and possible impacts this transport on the local ecosystem. Here we report on our preliminary analysis of net plankton samples. Samples were during 17 cruises conducted between January, 2011, and September, 2013, along three transects extending up to 80 km from the coast. At each station, net-plankton (vertical tows of up to 100 m, using a 25µm mesh net) samples collected for the analysis of larger forms. These were immediately fixed in Lugol's iodine and returned to the laboratory. In the laboratory, the relative abundance of each of 12 categories (Ceratium spp., Dinophysis spp., other dinoflagellates, Rhizosoleniaceae, Chaetocerotaceae, Hemiaulaceae, Thalassionemataceae (Thalassionema spp.), Bacillariaceae, other chain-forming diatoms, other diatoms, cyanobacteria (Trichodesmium), and zooplankton), was determined by light microscopy. The results suggest that the association was prone to domination by individual groups during the first half of 2011 to a greater degree than was evident in subsequent years. It is not clear whether this represents natural variation in the system or is the result on changes in the system brought about by the oil spill.

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Pensacola Beach Surf Zone Microbial Communities Before, During, and After Oil Contamination

Presenter: Christian Riesenfeld
University of West Florida
Authors: C. Riesenfeld[1], W. H. Jeffrey[1], B. Davis[1], W. Overholt[2], J. E. Kostka[2], J. E. Lepo[1], R. A. Snyder[1];
[1]University of West Florida, Pensacola, FL, [2]Georgia Tech, Atlanta, GA.

Abstract:
Biweekly surf zone sediment samples were collected for alkane, PAH, and microbial community structure along the Pensacola Beach, FL area before, during, and after oil washed on the beach on June 23, 2010. For the six sites along the coastline in the Pensacola Beach area, Illumina barcode sequences were generated from approximately 150 DNA extracts yielding an ~4 million read dataset. Mothur k-nearest neighbor classification to Silva, RDP, and GreenGenes reference databases was used for community composition determination. A rich assemblage of microbial life, consisting of 4,542 cumulative distinct taxa at 97% OTU cluster threshold was detected with Proteobacteria being most prevalent (~50% of the reads). The sampled environment includes 178 single occurrence OTUs. Alcanivorax, an oil-linked-genera, was observed in low abundance (0.0069%) of total sequence reads. While numerically low, it was observed to increase in samples known to have been oiled. At the Pensacola Pier location, for example, these organisms, below detection limit initially, increased considerably (30-fold) after oil was observed to have washed onto the beach. The numbers then declined for three weeks post exposure, but remained detectable for several months. Complete data analysis including detailed spatial and temporal variability of specific taxa is ongoing.

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High Site Fidelity of the Gulf Killifish (Fundulus grandis) in Northern Gulf of Mexico Marshes: An Empirical and Modeling Approach to Help Address Oil Effects

Presenter: Charles Martin
Louisiana State University
Authors: C. Martin[1], O. Jensen[2], K. Able[3], J. Fodrie[4], P. Lopez-Duarte[3], B. Roberts[5];
[1]Louisiana State University, Baton Rouge, LA, [2]Rutgers University, New Brunswick, NJ, [3]Rutgers University Marine Field Station, Tuckerton, NJ, [4]University of North Carolina at Chapel Hill, Chapel Hill, NC, [5]Louisiana Universities Marine Consortium, Chauvin, LA.

Abstract:
The gulf killifish (Fundulus grandis) has been highlighted as a sentinel species for studying impacts of the Macondo oil spill, largely as a result of its high abundance, widespread distribution, intermediate trophic position, and high stress tolerance. However, its home range and dispersal capabilities remain unclear. Given the spatial scale between many oiled and unoiled sites (10s-100s of meters), this information is essential for use of F. grandis as a model species. Here, we present the results of a field study to determine the site fidelity of gulf killifish (>40mm TL) using 4 hydrologically separated marsh creeks (<60 m in length) near Cocodrie, LA. Wire tags were injected into the dorsal musculature of at ~100-200 fish per site before release at a central point in each creek. Recapture efforts were made at 5-10 meter intervals along each creek (30-90m) 1-2x per month up to 1 year post-release. Results indicate that F. grandis exhibit high site fidelity, with initial recapture rates as high as 49% and some recaptures occurring after 1 year. These data suggest that observed responses to oil are likely to be local and F. grandis likely provide reliable metrics of site-specific oil exposure throughout the region and are critical to the development of reliable modeling approaches.

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Fungal Response to the Deep Water Horizon Oil Spill: What can fungi tell us about our environment?

Presenter: Demetra Kandalepas
Tulane University
Authors: D. Kandalepas[1], S. A. Van Bael[1], M. J. Blum[1], J. H. Pardue[2];
[1]Tulane University, New Orleans, LA, [2]Louisiana State University, Baton Rouge, LA.

Abstract:
Endophytes are symbiotic fungi that live cryptically within all plant tissue. These symbionts can positively affect the physiology and immunity of terrestrial plants, but little is known about their role in coastal plants. Changes in endophyte communities have important implications for plant health, food webs, and ecosystem function, as they can influence community responses to stress and disturbance. We have found that endophyte diversity and composition shift with environmental alterations, but no studies have examined the effects of oil exposure on these fungi. In this study we use a metagenomics approach and time series analysis to examine spatial and temporal shifts in root endophyte communities associated with Spartina alterniflora in two coastal marshes in southeast Louisiana, Bay Jimmy and Port Fourchon, that were affected by the Deepwater Horizon Oil Spill. Within each marsh, we collected a yearlong time series of soil cores up to 30 cm deep, containing S. alterniflora roots along transects spanning a 100-meter oiling gradient. We are assessing whether endophyte community structure correlates to hydrocarbon signatures, testing the hypothesis that root endophyte diversity decreases with increasing oil concentration, and is dominated by relatively few fungi. Over time, we expect that, as soil microbes metabolize the oil, endophyte diversity will increase and the fungal composition will reflect natural marine fungal communities along the Gulf of Mexico's coast.

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Changes in nitrogen cycling in Louisiana salt marsh soils following the Deepwater Horizon oil spill

Presenter: Anne E Giblin
Marine Biological Laboratory
Authors: A. E. Giblin[1], J. Marton[2], B. J. Roberts[3], A. E. Bernhard[4];
[1]Marine Biological Laboratory, Woods Hole, MA, [2]LUMCON, Chauvun, LA, [3]LUMCON, Chauvin, LA, [4]Connecticut College, New London, CT.

Abstract:
We measured the effects of the Deepwater Horizon oil spill on nitrogen cycling processes in Louisiana salt marsh soils in July 2012 from sites within three regions: Terrebonne Bay (TB), West Barataria Bay (WB) and East Barataria Bay (EB). Within each region we sampled 2-3 sites which had reported to have been impacted by oil after the Deepwater Horizon spill and 2 site where no oil was observed. Potential rates of denitrification, anammox, total nitrate reduction and dissimilatory nitrate reduction to ammonium (DNRA) were made in soils located 5, 10, 15 and 20 meters from the marsh boundary in each site. At all sites rates of denitrification were low and rarely exceeded 100 nmol/gwd/d. These rates are less than half of what we have measured in New England salt marshes. Anammox was not a significant nitrate reduction process as has been found in salt marshes elsewhere. Total nitrate reduction was nearly an order of magnitude higher than denitrification and DNRA largely accounted for the nitrate disappearance. Rate of DNRA were similar to rates measured in northern marshes. We did not find significant differences overall between "oiled" and "non-oiled" sites for any measure of nitrate reduction, although some sites and locations were different from others. Measurements of the oil content of specific locations may be needed to positively determine if there are any impacts on N cycling from recent oiling.

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Deepwater Horizon Oil Spill and Gulf of Mexico Shelf Hypoxia

Presenter: Nancy N Rabalais
Louisiana Universities Marine Consortium
Authors: N. N. Rabalais[1], L. M. Smith[2], R. E. Turner[3], E. B. Overton[3], X. Hu[4], W. Cai[5];
[1]Louisiana Universities Marine Consortium, Chauvin, LA, [2]Your Ocean Consulting, LLC, Knoxville, TN, [3]Louisiana State University, Baton Rouge, LA, [4]Texas A&M University, Corpus Christi, Corpus Christi, TX, [5]University of Delaware, Lewes, DE.

Abstract:
The northern Gulf of Mexico 'dead zone' received much media attention in 2010, the year of the BP Deepwater Horizon oil spill, because it was larger than average and the distribution of the oil in the surface waters laid above hypoxic bottom waters in its eastern portion nearer the Mississippi River. Here we examine whether the hypoxic zone on the shelf in 2010 was larger because of the spill.

To do so, we compared oil samples with fluorescence casts taken during the July 2010 hypoxic mapping cruise to develop a measure of oil exposure, and compared long-term dissolved oxygen data with ancillary parameters using multivariate techniques to tease apart dominant forcing factors. The actual size of the hypoxic zone in 2010 was 99% of the predicted value, suggesting that the net effect of the 2010 oil spill on the hypoxic zone size was negligible. The usual conditions that lead to hypoxia were in force. Mississippi River in 2010 was well above average with three peaks in spring and above average flow from July to October. The high flow had the effect of extending the conditions sustaining hypoxia formation and maintenance through the summer (high nutrient-enhanced production in surface waters, flux of carbon to the seabed, and strong stratification). Oil sample analyses did not detect significant oil exposure within the hypoxic area. Intriguing bottom-water dissolved inorganic carbon to apparent oxygen utilization ratios for four stations within 20- to 50-m water depth in areas where oil may have been present in the surface waters indicated a potential oil degradation signal. This may also be related to the high load of petroleum PAHs discharged by the Mississippi River.

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Increased marsh deterioration associated with changes in microbial diversity following the 2010 Deepwater Horizon oil spill

Presenter: Chanda Drennen
University of Tennessee
Authors: C. Drennen, A. Summers Engel, A. Paterson;
University of Tennessee, Knoxville, TN.

Abstract:
Coastal salt marsh health can be defined according to hydrological function, sedimentation rates, and biological diversity of plants, animals, and microbes. Differences between healthy and deteriorating marshes are measured from the presence of invasive species and sedimentation changes that could cause erosion. Microbial diversity, bulk carbohydrate, bulk density, and porewater pH have been evaluated from soils in 11 Louisiana coastal marshes following oil contamination due to the Deepwater Horizon disaster. Statistical analyses of 16S rRNA gene diversity indicated that microbial communities from marsh soils 5 m inland and sediments 1 m away from the marsh edge were different. Inland cores were taken from up to 10 cm depth, and in general, oil-impacted marsh microbial communities were dominated by Gammaproteobacteria and Chloroflexi, but less impacted marshes were dominated by other proteobacterial groups. For some marshes, bulk carbohydrate amounts from inland soils were higher just under the surface and less at depth, while heavily oil-impacted marshes had similar carbohydrate values both for surface and depth. Decreased soil strength, as evidenced from soil bulk density, correlated to degree of oil impact, suggesting that oil-impacted marshes may be more vulnerable to erosion at the marsh surface and that differences in microbial community compositions may affect cycling hydrocarbons and other organic compounds within the marshes.

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Trajectory of changing DWH oil in Louisiana marshes, 2010-2013

Presenter: R. Eugene Turner
Louisiana State University
Authors: R. Turner[1], E. B. Overton[1], B. Meyer[1], M. Miles[1], G. McClenachan[1], L. Hooper-Bui[1], A. Summer Engel[2], J. Lee[1], C. Milan[1], H. Gao[1];
[1]Louisiana State University, Baton Rouge, LA, [2]University of Tennnessee, Knoxville, TN.

Abstract:
We measured the concentration of 26 normal alkanes and 43 PAH analytes in surface sediment samples from selected Louisiana coastal wetlands collected before the Deepwater Horizon disaster led to their broad-scale oiling, and then sampled nine times afterwards up to June 2013. The immediate effect of oiling was to raise the average concentration of alkanes and PAHs above the baseline values by 480 and 47,000 times, respectively. Oil was distributed with slight attenuation up to 100 m inland, and was not well-circumscribed by the rapid assessments of relative oiling conducted by Federal-State damage assessment protocols in 2010. The October 2012 concentrations of target alkanes and PAHs were about 98% and 90%, respectively, of the September 2010 concentrations, but remained at 10X and 4,800X higher, respectively, than in May 2010, and 2X and 650X higher, respectively, than in June 2013. The sites with the lowest concentrations of target alkanes and PAHs measured in June 2013, were nearly equal and 65X higher, respectively, than in May 2010. A trajectory of recovery suggests that the concentration of alkanes may be near baseline values by the end of 2014, but that it will take decades for the PAH concentrations to be that low. A continuing assessment of the recovery is therefore warranted. Nine indicators of oil degradation were either inconclusive or misleading (alkanes) or confirmed the meager degradation of aromatics. The concentration of five aromatic analytes increased.

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Effects Of Oil Pollution On Ant Community In Coastal Dunes Of Louisiana

Presenter: Xuan Chen
Louisiana State University
Authors: X. Chen, B. Hesson, R. Strecker, L. Hooper-Bui;
Louisiana State University, Baton Rouge, LA.

Abstract:
Coastal dunes have a worldwide distribution and play important ecological functions. They protect inland habitats and support high biological diversity. However, dunes are fragile ecosystems and suffer from many kinds of natural and anthropogenic disturbance. On June 30, 2010, waves driven by hurricane Alex pushed oil onto dunes in Grand Isle State park, Elmer's Island, and Port Fourchon. Quadrat sampling and hand collecting were used to study ants in the above sites and Mae's beach (reference site) before and after oil pollution. We found that although the α-diversity was not affected, ant community structure and the composition of functional groups were influenced by oil pollution and beach cleaning activities. In addition, the changes to the dunes haven't recovered after three years. Our study emphasizes the importance of using ant as bioindicators of evaluating environmental stress, and their use in long-term studies about impacts of oil on ecosystems. Data from this research provides a benchmark to examine trajectories of coastal dune ecosystem degradation.

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Summer phytoplankton communities in Kwangyang Bay and around Taeanhaean Marine National Park near the Hebei Spirit oil spill site of Korea

Presenter: Wonho Yih
Kunsan National University
Authors: J. Park[1], H. Kim[2], M. Oh[2], H. Jeong[3], W. Yih[2];
[1]National Fisheries Research & Development Institute, Busan, KOREA, REPUBLIC OF, [2]Kunsan National University, Kunsan, KOREA, REPUBLIC OF, [3]Seoul National University, Seoul, KOREA, REPUBLIC OF.

Abstract:
Inter-annual variation in summer phytoplankton communities was explored in Kwangyang Bay (GYB), bridging the Seomjin River Estuary to the South Sea of Korea, and around Coastal waters of Taeanhaean Marine National Park (TMNP) where the Hebei Spirit oil spill hit its norther area in December 2007. Located at the mid-western coast of Korea TMNP is open to the Yellow Sea, and covers the coastal area with its north-south orientation. In GYB the abubance of dinoflagellates are mostly less than 1% of diatoms that is predominated by the centric ones such as *Skeletonema* , *Chaetoceros*, and *Thalassiosira* throughout the whole monitoring period. Surprisingly enough, percent dominance by dinoflagellate species were gradullay increasing since the outbreak of the Hebei Spirit oil spill in TMNP. Moreover, inter-annual succession of the dominant species was also noted during our phytoplankton community analyses. Right after the oil spill the summer phytoplankton commuity was predominated by cryptophytes (30%) in 2008, and then *Chattonella* and cryptophytes (2009-2010), which was followed by a sudden appearance of *Ceratium fusus* and *C. Furca* (50% in 2011 and 50% in 2012). The exceptional predominance of a few dinoflagellate species among summer coastal phytoplankton communities in temperate latitudes (TMNP) is still open to discussion.

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Bacterioplankton community structure after exposure to oil and dispersants using 16S rRNA and alkB genes in the northeastern Gulf of Mexico

Presenter: Katelyn A Houghton
University of West Florida
Authors: K. A. Houghton, J. M. Hutcheson, J. A. Moss, C. Reisenfeld, R. A. Snyder, W. F. Jeffrey;
University of West Florida, Pensacola, FL.

Abstract:
The Deepwater Horizon Oil Spill in 2010 significantly impacted the planktonic ecosystem of the northern Gulf of Mexico. A key element of this ecosystem is the bacterioplankton that are the base to the food web and are instrumental in the degradation of oil. It has been hypothesized that exposure to oil and or dispersants may change microbial community structure by selecting for those strains capable of degradation, while selecting against those for whom oil and or dispersants are inhibitory. Water samples were collected at two off-shore sites in winter and summer at surface and bottom depths. Bioassays were performed on water amended with oil, oil and Corexit, and Corexit and compared to an un-amended control. Samples were incubated at in situ temperatures for two days in the dark and 16S rRNA and alkane hydroxylase (alkB) genes were amplified and sequenced. Community structure shifts were most associated with oil,

while Corexit alone had a minimal effect. Oil amended samples were dominated by Alteromonas and Pseudoalteromonas while the Corexit treatment was also dominated by Vibrio spp.

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Stable Isotope Composition of Remineralizing Organic Carbon In The Northern Gulf of Mexico Continental Shelf Sediments

Presenter: Hongjie Wang
Texas A&M University-Corpus Christi
Authors: H. Wang[1], X. Hu[1], R. Turner[2], W. Cai[3], N. Rabalais[4];
[1]Texas A&M University-Corpus Christi, Corpus Christi, TX, [2]Louisiana State University, Baton Rouge, LA, [3]University of Delaware, Lewes, DE, [4]Louisiana Universities Marine Consortium, Chauvin, LA.

Abstract:
There have been a number of studies on stable isotope compositions (δ13C) of sedimentary organic carbon in the northern Gulf of Mexico. Little is known, however, about the δ13C of the organic carbon that is undergoing remineralization in surface sediments. Three sets of surface sediment in the B, C, and I transects were collected on the July 2013 Shelf-Wide Hypoxia Cruise. Sediments collected from transect B and I were incubated on board the research vessel at in situ temperature, and transect C sediments were incubated at room temperature at the TAMUCC lab. An analysis of dissolved inorganic carbon (DIC) and its δ13C from the incubation experiments suggests that the apparent respiration of organic carbon exhibits a decreases going away from the Mississippi Delta (from -16.8‰ to -18.8‰). Furthermore, these values are all more positive than the δ13C values of sedimentary organic carbon that typically range from -19‰ to -22.2‰ in this area. Slight carbonate dissolution may have occurred during these incubations. We will use a mass balance model that incorporates bulk organic carbon and carbonate carbon, as well as pore water DIC and alkalinity, to constrain the δ13C of the remineralizing organic carbon.

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Recovery of Ecological Structure and Function of Coastal Marshes Impacted by the *Deepwater Horizon* Oil Spill in Northern Barataria Bay

Presenter: Qianxin Lin
Louisiana State University
Authors: Q. Lin[1], I. A. Mendelssohn[1], A. Hou[1], J. W. Fleeger[1], D. R. Deis[2];
[1]Louisiana State University, Baton Rouge, LA, [2]Atkins North America, Tallahassee, FL.

Abstract:
Louisiana's fragile coastal wetlands bore the brunt of the damage during the *Deepwater Horizon* (*DWH*) oil spill event. We have conducted a series of field studies to assess oil impacts to coastal salt marshes and their subsequent recovery. In the salt marshes of northern Barataria Bay, one of the most heavily oiled habitats, we established replicated field stations that received heavy, moderate and no oiling. Impacts of Macondo oil to coastal marsh vegetation were severe in some areas and moderate to minimal in others. Heavy oiling almost completely killed fringing coastal marsh plants, and left many un-vegetated shoreline marshes. Although there has been variable recovery in oiled marshes 36 months after the spill, total plant aboveground biomass was still significantly lower in heavily oiled marshes compared to reference marshes, but recovered in moderately oiled marshes. Interestingly, impact and recovery were species-specific, i.e., greater recovery for *Spartina alterniflora* than for *Juncus roemerianus* with moderate oiling, and little recovery for *Juncus* with heavy oiling. In the absence of complete recovery, live belowground biomass in heavily oiled marshes was significantly lower compared to reference marshes, and consequently the shear strength of marsh soil decreased. Surface erosion was visually apparent in some heavily oiled marshes. Further study on the long-term recovery and sustainability of the *DWH* oil spill impacted marshes is underway.

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Examining the spatial and temporal variation of intertidal meiofaunal communities using a metagenomic approach

Presenter: Pamela M Brannock
Auburn Univeristy
Authors: P. M. Brannock[1], D. S. Waits[1], J. Sharma[2], K. M. Halanych[1];
[1]Auburn Univeristy, Auburn, AL, [2]University of Texas at San Antonio, San Antonio, TX.

Abstract:
Meiofauna, which comprise animals less than 1mm that live between sediment grains, is an important component of food webs and for nutrient exchange between the benthos and water column. These animals were shown to be greatly affected by the Deepwater Horizon Oil Spill, with drastic community shifts from predominately metazoan taxa prior to the spill to predominately fungal composition after. Unfortunately, knowledge of seasonality and variability of meiofaunal communities in the Gulf of Mexico is lacking. To better understand natural variation, we examined five marine intertidal locations along Dauphin Island and Mobile Bay, Alabama including localities shown to have been negatively impacted by the spill. The upper 0-3cm and 3-10cm sediment depth fractions of these sites were sampled bi-monthly for a year. Using a metagenomic approach targeting the eukaryotic hypervariable V9 region of the small subunit rRNA, spatial and temporal variation in meiofaunal community structure was assessed with high-throughput genomic approaches. Similar to pre-spill communities, annelid, nematode, and arthropod taxa dominated samples. Fungal species were present, but were found in low abundances. Compositional variation between locations and collection date was quantified. This study provides important information on the recovery of these communities while providing a fundamental baseline to examine community impacts of future natural and anthropogenic disturbances in the Gulf of Mexico region.

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Louisiana commercial fishing industry response to the Deepwater Horizon oil spill

Presenter: Giovanna McClenachan
Louisiana State University
Authors: G. McClenachan, R. Turner;
Louisiana State University, Baton Rouge, LA.

Abstract:
The Deepwater Horizon oil spill (20 April - 15 July 2010) and resulting mitigation efforts have been predicted to significantly lower landings and revenue in the Gulf of Mexico. In 2009, the commercial fishing industry in Louisiana harvested over 1 billion pounds of fish, second in the United States only to Alaska, and generated nearly $250 million in revenue. Yet, there has been minimal research on how the decreased catches of certain important commercial species (shrimp, oyster, and blue crab, which constitute over 70% of the total revenue) may change the commercial fishing industry of Louisiana as a whole and whether the change will be permanent or temporary. We used data collected on landings, value, trips, vessel size, and gear type from commercial fishery trip tickets provided by the Louisiana Department of Wildlife and Fisheries. These data were used to determine the trajectory of recovery of the industry temporally and spatially from the oil spill. The data were separated by basin and aggregated monthly from 2000-2012. Preliminary results suggest that as areas affected by the oil spilled were closed to fishing, fishing pressure increased in areas to the west, which were unaffected by the oil spill and subsequent fishing closures. Fishing did not cease with the oil spill, but rather shifted to different basins. We will also compare the commercial fishery results to the independent fishery datasets to determine if they accurately depict the commercial fishing industry.

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Bacterial abundances in the water column near natural oil seeps and other oil-impacted areas in the Northern Gulf of Mexico

Presenter: Kendra Bullock
Lamont-Doherty Earth Observatory, Columbia University
Authors: K. Bullock[1], N. D'souza[1], A. Juhl[1], J. Montoya[2];
[1]Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, [2]Georgia Institute of Technology, Atlanta, GA.
Abstract:
Increased microbial activity following the Deepwater Horizon oil spill was responsible for breaking down a majority of oil and gas released. Subsequent experimental work in microcosms revealed significant increases in bacterial activity and abundance in response to additions of oil and nutrients to water samples from the Gulf of Mexico. These findings prompted us to investigate whether water column bacterial abundances at sites with persistent oil and gas inputs were higher than other locations. Samples were collected in 2012 and 2013 at known natural seeps in the Northern Gulf of Mexico, a site near the Deepwater Horizon well head, and at a nearshore site near the sunken Taylor Energy Platform - where persistent oil slicks have been observed. We compared these sites with similar sites without known oil inputs. Differences in bacterial abundance between reference sites and sites with persistent oil sources were smaller than gradients in bacterial abundance from nearshore to offshore sites, or with depth gradients in abundance. Our results are consistent with the simultaneous need for nutrients, and time following an oil input to allow bacterial growth to increase abundances.

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Diazotrophs in the northern Gulf of Mexico: distribution and hydrocarbon/dispersant effects on nitrogen-fixation in Trichodesmium and diatom symbioses

Presenter: Tracy A. Villareal
Univ. of Texas at Austin
Authors: T. A. Villareal[1], K. M. Collier[2], M. O'Dell[3], X. M. Hermosillo[1];
[1]Univ. of Texas at Austin, Port Aransas, TX, [2]University of New England, Portland, ME, [3]Massachusetts Institute of Technology, Boston, MA.
Abstract:
The Deepwater Horizon spill originated in an offshore system dominated by the low nutrient conditions and the distinctive phytoplanktonic flora typical of these oligotrophic systems. Nitrogen-fixation is a dominant nitrogen input in these oligotrophic waters and at least one major diazotrophic group, Trichodesmium spp., is positively buoyant and is likely to be immediately impacted by exposure to oil. Another major group, the diatom-diazotroph associations (DDAs), is responsible for substantial C and N flux to depth, particularly in river plumes. We examined the abundance and distribution of these diazotrophs using traditional water samples as well as in-situ optical techniques to assess the distribution of these important taxa in the northern Gulf of Mexico as well as conducted studies on field samples and laboratory cultures to assess the effects of hydrocarbon and dispersants on nitrogen-fixation rates. Trichodesmium dominated in the open waters of the Gulf of Mexico in multiple years at > 10 colonies per L at the surface. DDAs dominated over the shelf, particularly in the waters west of the LA delta over the hypoxic zone. Both groups exhibited immediate reduction in nitrogen-fixation rates when exposed to 1 ppt oil; time dependent effects were observed in DDA cultures. Field measurements of Trichodesmium were challenging due to significant site to site variation in both controls as well as high variability in rates.

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Effects of Dispersant on Benzene Biodegradation in Salt Marsh Sediment

Presenter: Miluska Olivera-Irazabal
Troy University
Authors: M. Olivera-Irazabal, K. Yu;
Troy University, Troy, AL.
Abstract:
Large quantities of dispersants were applied as part of the cleanup effort for the Deepwater Horizon oil platform explosion incident in 2010. The effect of dispersants on petroleum biodegradation is largely unknown. In this study, benzene was selected as a model petroleum hydrocarbon to study its biodegradation under different concentrations of dispersant (COREXIT® EC 9500A). A salt marsh sediment sample was incubated under anaerobic conditions with addition of benzene:dispersant raito of 10:1, 20:1, and 40:1. The

results show that benzene degradation in the marsh sediment was inhibited by the dispersant in comparison with the control treatment where no dispersant was added. The inhibition effect was proportionally higher with increase of the dispersant concentration. Dispersant has long been used to promote oil degradation by increasing the oil surface area for microbial degradation. However, this stimulating effect may not be apparent for the biodegradation of more soluble oil components, such as benzene.

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Relative rates and stoichiometry ratios of organic matter respiration in bottom water of the northern Gulf of Mexico during summertime

Presenter: Xinping Hu
Texas A&M University - Corpus Christi
Authors: J. Xue[1], W. Cai[2], X. Hu[3], W. Huang[2];
[1]University of Texas Marine Science Institute, Port Aransas, TX, [2]University of Delaware, Newark, DE, [3]Texas A&M University - Corpus Christi, Corpus Christi, TX.

Abstract:
The Mississippi-Atchafalaya river system brings a large amount of terrestrial organic carbon and inorganic nitrogen into the Louisiana continental shelf. While the respiration of marine and terrestrial organic carbon (OC) produces dissolved inorganic carbon (DIC), the inorganic nitrogen promotes DIC uptake through primary production. These two contrasting processes make the dynamics of DIC on continental shelf complicated but of great interest. Specifically, quantifying OC respiration on the whole shelf is challenging because of the strong dynamics of nutrient and dissolved O2.
Here we present the distribution of bottom water DIC, total alkalinity, dissolved O2, and nutrients from several summer cruises between 2006-2012 in the northern Gulf of Mexico. We analyzed our data using an improved Optimum Multi-Parameter analysis. We found that O2/C/N/P remineralization ratios generally followed those of the Redfield ratios. Preliminary results showed that the rate of DIC release increased steadily in June and July, peaked in August, and dropped slightly in September. This temporal pattern reflects the balance between OC plume export and DIC release through OC respiration during summer. Our study provides a solid baseline context of the offshore water biogeochemistry before and after the 2010 oil spill and could be used to detect subtle impacts of oil spill on water biogeochemistry and ecosystem production and respiration.

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Date: Monday, January 27 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Coastal Ecosystem Couplings 3 years after the DWH oil spill
Type: Poster 7-277

Nitrate Addition Has Minimal Effect on Anaerobic Biodegradation of Benzene in Coastal Saline (salt), Brackish and Freshwater Marsh Sediments

Presenter: Rui Tao
Troy University
Authors: R. Tao, K. Yu;
Troy University, Troy, AL.

Abstract:
In response to the 2010 British Petroleum (BP) Deepwater Horizon Macondo well oil spill, saline (salt), brackish and freshwater marsh sediments were used to study whether nitrate addition could stimulate petroleum biodegradation. Benzene was selected as a model petroleum hydrocarbon, and its biodegradation was assumed to follow first-order kinetics. The results show that the intrinsic benzene degradation activities in the marsh sediments were inversely correlated ($R2 = 0.83$, $n = 9$) with the sediment salinity, with following order of benzene degradation rate regardless of nitrate treatments, freshwater > brackish > salt ($P<0.05$). Addition of nitrate shows a minimal potential to stimulate the benzene degradation. Increase of redox potentials by addition of nitrate even shows a slight inhibition effect on benzene degradation in these coastal marsh sediments without a clear mechanism. Excessive loading of nitrate has been causing frequent occurrence of coastal eutrophication and hypoxia in the Gulf of Mexico. Therefore, application of additional nitrate to the coastal marsh sediments for the remediation of the 2010 BP oil spill is not recommended.

Session 008: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts

Session: 008
Date: Tuesday, January 28 - 10:00 AM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Simulations-based Design of a Hydrophobically-modified Chitosan Dispersant

Presenter: Steven Benner
NC State University
Authors: S. Benner[1], C. Hall[1], J. Genzer[1], V. John[2];
[1]NC State University, Raleigh, NC, [2]Tulane University, New Orleans, LA.

Abstract:
There is currently a need for new biocompatible dispersants that are still effective at both the ocean surface and in deep water conditions. We are using molecular simulations to design a biocompatible oil dispersant based on hydrophobically-modified chitosan (HMC) to supplement experiments by Dr. Vijay John and coworkers at Tulane University. The HMC's have a comb copolymer architecture with a hydrophilic chitosan backbone and hydrophobic alkane modification chains for the "teeth" of the comb. Discontinuous molecular dynamics (DMD) simulations allow us to understand the effect of HMC architecture on its ability to prevent oil aggregation. The length of the chitosan backbone (50 - 400 spheres), length of the modification chains (4 - 20 spheres), modification density (0 - 33%), and interaction range (1.75 - 3.75 Å) are being varied to determine their role in stabilizing oil. Two simulation scenarios are considered: a bulk oil scenario, and an interfacial oil scenario. Preliminary results using short backbone HMC's (50 sphere backbone) show that increasing modification chain length and modification density leads to increased oil surface area in bulk simulations and a thicker oil interface for interfacial simulations. However, there appears to be a saturation concentration of modification spheres above which increasing modification chain length does not improve oil dispersion. Long backbone HMC's (400 sphere backbone) increase the surface area of oil by providing nucleation sites at different locations for oil to attach, but when modification chains become too long, they promote aggregation rather than preventing it. Our results are being compared to experiments by John and coworkers.

Session: 008
Date: Tuesday, January 28 - 10:15 AM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

A safe and effective dispersant for oil spills based on food-grade amphiphiles

Presenter: Jasmin C Athas
University of Maryland, College Park
Authors: J. C. Athas[1], K. Jun[1], C. McCafferty[1], O. Owoseni[2], V. John[1], S. R. Raghavan[1];
[1]University of Maryland, College Park, College Park, MD, [2]Tulane University, New Orleans, LA.

Abstract:
About 2 million liters of synthetic dispersants such as the Corexits were used to disperse the oil spilled into the ocean during the Deepwater Horizon event. These dispersants contain a blend of synthetic surfactants in a base of petroleum distillates. Concerns have arisen regarding the aquatic toxicity and long-term environmental impact of the surfactants and solvents in these formulations. Accordingly, there is a need for a new class of dispersants that combine low toxicity with efficient dispersion of crude oil in sea water. We have embarked on a study to evaluate food-grade amphiphiles for their ability to disperse (emulsify) oil in water. Our principal findings concern two food-grade amphiphiles: lecithin (L), a phospholipid extracted from soybean, and Tween 80 (T), an amphiphile used in many food products including ice cream. We find that L/T mixtures are very effective in creating oil-in-water emulsions, although neither L or T is effective on its own. This synergistic L/T effect is attributed to the following reasons: (i) L and T pack closely at the oil-water interface; (ii) L has a low tendency to desorb, which strengthens the interfacial film; and (iii) the large head group of T provides steric repulsions between the oil droplets and prevents their coalescence. A comparison of L/T and Corexit 9500 at identical concentrations shows that the former leads to the droplets remaining stable to coalescence for a much longer time. The stability of crude oil droplets is believed to be important for their eventual microbial degradation in the ocean. Our findings show that L/T mixtures could be a safer and more biocompatible alternative to the Corexits for treatment of oil spills while also exhibiting comparable or higher effectiveness as a dispersant.

Session: 008
Date: Tuesday, January 28 - 10:30 AM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Cactus Based-Mucilage as an Alternative Natural Dispersant to be Incorporated in Oil Spill Response Strategies

Presenter: Fei Guo
University of South Florida
Authors: F. Guo, D. Stebbins, R. Falahat, S. Thomas, R. Toomey, N. Alcantar;
University of South Florida, Tampa, FL.

Abstract:
The purpose of this work is to evaluate the effect of the cactus mucilage from Opuntia ficus-indica on the surface tension, droplet size and stability of dispersed crude oil dispersed in water. The extraction process yields two types of mucilage: the non-gelling extract (NE) and the gelling extract (GE). Cactus mucilage and conventional dispersants has been evaluated under different conditions, including two concentrations of oil (3, 6% v/v) and several dispersant to oil ratios (1:1, 1:10, 1:20, 1:50, 1:100) at room temperature and at 4 °C. The results were compared with results using conventional dispersants (Corexit EC9500A and EC9527). The average droplet size was smaller in the systems with cactus mucilage (1.5% of NE, 5 µm droplets) when compared with the systems using the conventional dispersant Corexit EC9500A (1.5% of EC9500A, 6.2 µm droplets). Although the mucilage is known as a non-toxic substance and eatable the toxicity of the two mucilage extracts were assessed in cold blood animals. A standard test using Daphnia magna colonies exposed to both NE and GE mucilage extracts in concentrations ranging from 0 to 5000 mg/L has shown that mucilage can be considered as non-toxic to the evaluated species with a median lethal concentration (LC50) above 2000 mg/L. Cactus mucilage can be an alternative technology to mitigate the damage that oil may cause to the aquatic ecosystem and minimize undesired effects associated with the use of synthetic dispersants in oil spills.

Session: 008
Date: Tuesday, January 28 - 10:45 AM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Nanoemulsions obtained via bubble bursting at a compound interface

Presenter: Jie Feng
Princeton University
Authors: J. Feng[1], M. Roché[1], D. Vigolo[1], L. N. Arnaudov[2], S. D. Stoyanov[3], T. D. Gurkov[4], G. G. Tsutsumanova[4], H. A. Stone[1];
[1]Princeton University, Princeton, NJ, [2]Unilever Research and Development, Vlaardingen, NETHERLANDS, [3]Wageningen University, Wageningen, NETHERLANDS, [4]University of Sofia, Sofia, BULGARIA.

Abstract:
The bursting of bubbles at an air/liquid interface is a familiar occurrence that is important to foam stability, cell cultures in bioreactors and mass transfer between the sea and the atmosphere. In the last case, bubble bursting leads to the dispersal in the atmosphere of aerosols generated through both the disintegration of the top cap of the bubble and the fragmentation of the upward jet formed at the end of bubble collapse. Here we document a hitherto unrealized phenomenon of how bubble bursting at a compound air/oil/water-with-surfactant interface leads to the dispersal into the water column of submicrometre oil droplets with a moderate polydispersity. We show that dispersal results from the detachment of an oil spray from the bottom of the bubble cavity towards the water during bubble collapse. We provide evidence that the size of the droplets is selected by molecular-scale physicochemical interactions between the oil molecules and the surfactants. The dispersal mechanism can play an unrecognized role in the fate of the sea surface micro-layer and of pollutant spills, and we illustrate this claim by showing that bubble bursting can disperse petroleum in bulk water. Finally, our system provides a highly energy efficient route to produce nanoemulsions for applications in drug delivery, food production and material science, and we demonstrate the capability of our method to produce polymeric submicrometre particles.

Session: 008
Date: Tuesday, January 28 - 11:30 AM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Sequential adsorption studies of Tween 80 and Aerosol-OT at an oil/aqueous interface

Presenter: Stephanie M Kirby
Carnegie Mellon University
Authors: S. M. Kirby, S. L. Anna, L. M. Walker;
Carnegie Mellon University, Pittsburgh, PA.

Abstract:
Understanding the interaction of multi-component surfactant systems at oil/water interfaces is crucial for improving dispersant design and application efficacy. This study aims to characterize the behavior of a model dispersant system of two surfactants, Tween 80 and AOT (two main components in Corexit®) at a squalane/water interface. A recently developed microtensiometer device is used to measure the dynamic interfacial tension of the system. Tween 80 has been shown to irreversibly adsorb to oil/water interfaces; we use this property to control the amount of Tween 80 on an interface by rinsing the interface with DI water to halt adsorption. This interface is then exposed to a bulk solution containing solely AOT. We observe AOT adsorption on a pre-coated Tween 80 interface as a function of concentration and ionic strength, and interpret the resulting interfacial tension values using a Langmuir isotherm model. The presence of Tween 80 on the interface inhibits AOT adsorption, reducing the maximum surface coverage as compared to a clean oil/water interface.

Session: 008
Date: Tuesday, January 28 - 11:45 AM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Dendritic polymers as oil spill dispersants: Effectiveness and toxicity compared to Corexit 9500

Presenter: David A Ladner
Clemson University
Authors: Y. Tu, P. Xie, R. Ulmer, R. Goins, D. A. Ladner;
Clemson University, Anderson, SC.

Abstract:
Hydrocarbons have been shown to partition into the hydrophobic core of dendritic polymers, suggesting a novel oil dispersant. Several dendritic polymers were evaluated here for their dispersant effectiveness and toxicity, with a focus on hyperbranched polyethylene imine (Hy-PEI). Hy-PEI was tested over a range of molecular weights (1.2 to 750 kDa) with Louisiana light sweet crude oil. The effectiveness increased as molecular weight increased, but on a per-mass basis the 10 kDa size was optimal. Hy-PEI was 70 to 100% as effective as Corexit 9500, depending on the test method. The ratio of dispersant to oil suggested that not only do hydrocarbons partition into the polymers, but the polymers or polymer-oil complexes also adsorb to oil droplet surfaces similar to protein-stabilized emulsions or perhaps pickering emulsions. Pendant drop measurements showed that the polymers were not as effective as Corexit at reducing the interfacial tension between water and oil, except at high polymer loading, consistent with theory. The toxicity of Hy-PEI to algae was much higher than that of Corexit, probably due to the positively charged external functional groups of Hy-PEI at seawater pH. However, Hy-PEI toxicity was reduced or eliminated in the presence of oil, suggesting that oil adsorption decreased Hy-PEI bioavailability. Results were consistent for two algal species, Dunaliella sp. and Synechocystis sp. Additional external-group functionalities are being explored to decrease toxicity while retaining the oil-dispersing capabilities of dendritic polymers.

Session: 008
Date: Tuesday, January 28 - 12:00 PM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Does subsea injection of dispersant make any difference? Study of dispersant injection - a down-scaled experimental approach

Presenter: Per Johan Brandvik
SINTEF
Authors: P. Brandvik, Ø. Johansen, U. Farooq;
SINTEF, Trondheim, NORWAY.

Abstract:
The research described in this paper was performed in a specialised facility for studying subsurface releases of oil. This facility consists of a six meter high tower basin containing 42 000 Litres of natural sea water and is located at SINTEF in Trondheim, Norway. Oil and gas is released from the base of the basin and the oil droplets are monitored by both laser scattering techniques and in-situ macro cameras. The shift in oil droplets sizes towards smaller sizes are used to quantify the effect of the dispersant injection. The effect of a broad variation of injection techniques, oil types, dispersant products and dispersant dosages (0.1 - 4%) are documented in this study. This paper shows that dispersant injection into a jet of oil emanating from a point source significantly reduces the average size of oil droplets released to the environment. Further, the paper illustrates the importance of where the dispersant was injected relative to the release point of the oil. The highest effectiveness where found when the dispersant was injected a few release diameters before or after the oil release opening. This comprehensive dataset are used to develop and calibrate existing algorithms to predict droplets sizes from subsurface releases and the effect of dispersant treatment. The improved algorithms are implemented in current operational models and used to describe subsurface use of dispersant and fate of the dispersed oil in the water column. This study was funded by the American Petroleum Institute under contract 2012-106675

Session: 008
Date: Tuesday, January 28 - 12:15 PM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Quantifying the transport and surface expression of oil under different dispersant treatments using a particle tracking model

Presenter: Jeremy M Testa
Chesapeake Biological Laboratory
Authors: J. M. Testa[1], E. Adams[2], E. North[3];
[1]Chesapeake Biological Laboratory, Solomons, MD, [2]Massachusetts Institute of Technology, Cambridge, MA, [3]Horn Point Laboratory, Cambridge, MD.

Abstract:
A series of model simulations were made to evaluate the effect of dispersant application on the transport and surface expression of oil released during the Deepwater Horizon oil spill. We used the Larval TRANSport Lagrangian model (LTRANS) model coupled to the SABGOM hydrodynamic model to track the fate of individual oil droplets after the June 3, 2010 riser cutting. The initial number and size of oil droplets were determined by fitting log-normal distributions around the semi-empirically-derived volume median size (mm) of droplets for a given dispersant scenario. Three broad scenarios were examined, including the case of (1) no dispersant application and also dispersant application with a (2) 50% and (3) 100% efficiency. Due to the larger droplet sizes in the no-dispersant scenario, all of the released oil reached the surface (< 2m) within 12 hours, while only 61% and 28% of the oil had reached the surface at 12 hours for the 50% and 100% dispersant efficiency cases, respectively. Because a larger volume of oil reached the surface more rapidly in the no-dispersant case, larger amounts of oil were more widely distributed at the surface than in the cases with dispersant. We conclude that the application of dispersants at the well head will have the following effects: (1) less oil will reach the surface in the initial 6-12 hours after application, (2) oil will have a longer residence time in the water-column, and (3) oil will be more highly influenced by sub-surface transport.

Session: 008
Date: Tuesday, January 28 - 12:30 PM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Laboratory Experimental Demonstration Of The Effect Of Oceanic Whitecap In Transferring Oil And Dispersant Compounds to Atmosphere

Presenter: Paria Avij
Louisiana State University
Authors: P. Avij[1], F. Ehrenhauser[2], V. Dugas[1], X. Shu[1], Z. Zhang[1], M. Perkins[3], J. Field[3], F. Hung[1], K. Valsaraj[1];
[1]Louisiana State University, Baton Rouge, LA, [2]Audubon Sugar Institute, St. Gabriel, LA, [3]Oregon State University, Corvallis, OR.

Abstract:
During the Deep Water Horizon oil spill, vast quantities of crude oil were released into the sea-surface environment of the Gulf of Mexico. There has been ample research focused on the transportation of oil into the different environmental sections including air, water, sediment, and biota. In our work, we study the aerosolization of oil and dispersant matter by whitecaps which are simulated by bursting bubbles in a laboratory aerosolization reactor.
Once the oil/dispersant material is adsorbed at the air-water interface, it is ejected by bursting bubbles into the atmosphere. Scanning electron microscope coupled with energy dispersive X-ray images identifies the carbon fraction associated with salt particles of aerosols. The application of both Corexit 9500 and Corexit 9527 facilitates aerosolization by enhancing the dispersion of the oil in the water column and improving the flotation capacity of the bubbles. Also, mechanistic experiments of a bursting bubble, observed with a high speed camera, clearly show enhancement in droplet production when we add dispersant to oil.
Our results show the aerosolization by bursting bubbles is of particular importance for the fate of SVOC (semi-volatile organic compounds) such as alkanes with more than eighteen carbon atoms, as dissolution and evaporation are negligible for these compounds. Additionally, molecular dynamics simulations support the observed propensity for alkanes at air/saltwater interfaces of breaking bubbles.

Session: 008
Date: Tuesday, January 28 - 12:45 PM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Collision Rates and Mechanisms for Oil Droplets and Marine Snow

Presenter: Evan A Variano
UC Berkeley
Authors: E. A. V. Variano, R. A. Lambert;
UC Berkeley, Berkeley, CA.

Abstract:
Particle aggregates in the ocean, such as marine snow, are responsible for scavenging droplets and particles in the water column. This process has implications for the natural removal of oil droplets during an oil spill. Often, chemical dispersant is applied to an oil spill in order to reduce droplet size. In this study we explore the effect of droplet size on the collision process of oil droplets with marine floc. We calculate the relative rate at which oil is removed from the water column, as a function of droplet size at constant oil concentration. The results of the comparison show that for a constant volume of oil, droplet size does alter the amount of oil removed from the water column during collisions with marine snow. The findings suggest that using chemical dispersant on deep-sea oil spills to reduce droplet size will alter the total volume of oil that becomes attached to marine snow. The result is non-monotonic: the initial and final droplet size determines whether droplet size reduction increases or decreases the volume of oil that attaches to marine floc. For droplets larger than roughly 1 micron, reduction in droplet size reduces the volume of oil that attaches to marine floc. The results of this study are based on an analytical evaluation of three dominant collision mechanisms responsible for bringing marine floc and oil droplets into contact: Brownian diffusion, differential sedimentation, and turbulent diffusion. We model the collision process using existing collision kernels derived using the particle pair probability method. An additional result is that the collision process is driven by Brownian diffusion for smaller droplets, turbulent diffusion for medium sized droplets, and differential sedimentation for the larger droplets.

Session: 008
Date: Tuesday, January 28 - 2:30 PM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Effects of hydrophobic particles on the rheology of hydrate-forming Pickering emulsions

Presenter: Amit Ahuja
Benjamin Levich Institute for Physico-Chemical Hydrodynamics, The City College of New York
Authors: A. Ahuja[1,2], J. F. Morris[1,2], J. W. Lee[2,3];
[1]Benjamin Levich Institute for Physico-Chemical Hydrodynamics, The City College of New York, New York, NY, [2]Department of Chemical Engineering, The City College of New York, New York, NY, [3]Department of Chemical and Biomolecular Engineering, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, KOREA, REPUBLIC OF.

Abstract:
We report the effects of hydrophobic silica nanoparticles on the rheology of hydrate-forming emulsion. Liquid cyclopentane (CP) was used as the hydrate former to prepare the hydrate slurry in a Couette geometry at atmospheric pressure from a density-matched water-in-oil emulsion by quenching it to a low temperature at a fixed shear rate in a stress-controlled rheometer. Dispersed water droplets convert to hydrate particles, which agglomerate and lead to a measured effective viscosity jump by orders of magnitude. The hydrate inhibition performance of the particles present at the water-oil interface was characterized using two time scales involved in the slurry preparation, namely critical time and growth time. Seeding with small hydrate particles is done at t = 0 to eliminate the stochastic induction time. The critical time is described as the onset of steep viscosity rise after the seeding, while the growth time is the time measured from the critical time to a final steady state. We found that the critical and growth times are dramatically retarded when the interface is covered with particles. Adding up to 1.5% wt. (based on CP mass) of particles delays the critical time by an hour for a 25% water-in-oil emulsion at T = -2°C. The final viscosity was found to be same as observed in the slurry with no particles. Due to gelling in the emulsion for 2.5% wt. or higher particle concentration, the final slurry viscosity was higher than the slurry with no particles.

Session: 008
Date: Tuesday, January 28 - 2:45 PM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

The rheology of carbon black stabilized emulsions with surfactant interactions

Presenter: Michael Godfrin
Brown University
Authors: M. Godfrin[1], A. Tiwari[2], A. Chauhan[3], M. Levine[4], A. Tripathi[1];
[1]Brown University, Providence, RI, [2]Thapar University, Patiala, INDIA, [3]University of Florida, Gainesville, FL, [4]University of Rhode Island, Kingston, RI.

Abstract:
For oil spill situations, surfactant molecules are used to emulsify oil into stable, discrete droplets that ideally stay in the water column long enough to allow for the natural degradation of the oil molecules through naturally occurring bacteria. Surfactant molecules, however, will eventually leave the oil/water interface and diffuse into the bulk water; they have been reported to be toxic to sea life. Carbon black particles are generally regarded as safe (GRAS) to sealife. Modified carbon black particles have been shown to stabilize oil droplets at conditions that mimic sea water. Pickering emulsion droplets are believed to be sterically stabilized, whereas surfactant stabilized droplets result in reduced interfacial tension. It is desirable for some applications to have reduced interfacial tension, and therefore understanding the behavior of oil droplets emulsified by a combination of particles and molecular dispersants is necessary. Naturally occurring bacteria synthesize their own biosurfactants that potentially have implications on the stability of carbon black stabilized emulsion droplets. The behavior of emulsion droplets stabilized by a combination of carbon black and surfactant would provide insight into how carbon black stabilized droplets would react to the presence of bacterial biosurfactants. We have studied the rheology of carbon black stabilized emulsions. We present the effect of carbon black concentration on the behavior of droplets in solution. We show that at higher concentrations of carbon black, droplets tend to aggregate and resist flow. We also present the effect of local oil concentration on the rheology. The effect of carbon black and surfactant interactions on emulsion rheology is also explored.

Session: 008
Date: Tuesday, January 28 - 3:00 PM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Pickering Emulsion Formation using Iron Oxide Nanoparticles Stabilized with Novel Surfactant Bilayers

Presenter: Pranav S Vengsarkar
Auburn University
Authors: P. S. Vengsarkar, C. B. Roberts;
Auburn University, Auburn, AL.

Abstract:
Magnetic nanoparticles have highly tunable physicochemical properties which are extremely important in applications like catalysis, biomedicine, environmental remediation and data storage. Unique interfacial properties resulting from the nanoparticles' small size can be used to stabilize oil-in-water Pickering emulsions, where the nanoparticles adsorb at the surface of the oil droplet in water. Specifically, iron oxide based emulsions have been considered as alternative dispersants for oil-spill applications. The objective of this work is to investigate the effect of the primary particle characteristics and stabilizing agent chemistry on the stability of oil-in-water Pickering emulsions. Iron oxide nanoparticles were synthesized by the co-precipitation method using stoichiometric amounts of Fe2+ and Fe3+ salts and ammonium hydroxide. These particles were then coated with layers of sodium stearoyl lactylate, an FDA approved emulsifier, and subsequently dispersed in aqueous and organic solvents depending upon their nature. Formation of a monolayer or a bilayer coating on the nanoparticles was also controlled through systematic changes in reagent amounts. Characterizations of these nanoparticles were performed through the use of transmission electron microscopy (TEM), dynamic light scattering (DLS) and Fourier Transform Infrared spectroscopy (FTIR) to analyze their size distribution and ligand-solvent interactions. In this study, using a control test-system of n-dodecane (organic phase) and aqueous phases of various pH values, the capacity of these bilayer coated nanoparticles to stabilize oil-in-water emulsions was also systematically determined using optical microscopy and Zeta-potential analysis.

Session: 008
Date: Tuesday, January 28 - 3:15 PM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Effective Nanoparticle-Based Dispersants for Oil-in-Synthetic Seawater Emulsions

Presenter: Lynn M Foster
The University of Texas at Austin
Authors: L. M. Foster, J. Dong, A. J. Worthen, J. A. Bollinger, T. M. Truskett, S. L. Bryant, C. W. Bielawski, K. P. Johnston;
The University of Texas at Austin, Austin, TX.

Abstract:
Formation of small and stable oil droplets in water is important for the natural remediation process of oceanic oil spills. Adding nanoparticles to surfactant dispersants can potentially reduce the required concentration of surfactants necessary for emulsion stability, due to irreversible adsorption of nanoparticles at the oil-water interface. We demonstrate the effective formation and stabilization of dodecane-in-synthetic seawater emulsions with three nanoparticle-based dispersant systems. (1) A weakly interacting mixture of a zwitterionic surfactant and hydrophilic bare silica nanoparticles produced finer emulsions with greater stability to coalescence relative to the behavior with either nanoparticles or surfactant alone. The high salinity of seawater promoted the synergistic effects due to the flocculation of the nanoparticles. (2) An oil-dispersible formulation with natural clay particles and an ethoxylated amine surfactant allowed the delivery of nanoparticles from the oil phase to stabilize emulsions. Emulsion droplet size and stability were a strong function of nanoparticle:surfactant ratio and water volume fraction. (3) Iron oxide nanoparticles grafted with amphiphilic polymers significantly reduced interfacial tension and produced stable emulsions at a very low amphiphile concentration. The emulsions were characterized by static light scattering to determine the droplet size distributions, optical photography to quantify phase separation due to creaming, and by both optical and electron microscopy to observe emulsion microstructure.

Session: 008
Date: Tuesday, January 28 - 4:00 PM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Toxicity of Corexit 9500 and its major components to early life stage Sheepshead Minnows

Presenter: Subham Dasgupta
Stony Brook University
Authors: S. Dasgupta, B. Brownawell, B. Adewale, A. McElroy;
Stony Brook University, Stony Brook, NY.

Abstract:
Use of dispersants to mitigate the effects of spilled oil requires a thorough understanding of the potential toxicity of dispersants and their breakdown products, and the interaction of these chemicals with petroleum hydrocarbons. In our study, we are using early life stages of sheepshead minnows (Cyprinodon variegatus) to assess the relative toxicity of dispersants, their components and breakdown products in the presence and absence of oil. Results obtained to date demonstrate that yolk sac larvae are more sensitive to Corexit 9500 than embryos, with 48hr LC 50s of 62 and 156 mg/L respectively. Evaluation of the major components of Corexit showed that Tween 80 and 85, Span 80, and dipropylene glycol butyl ether (DPGBE) are not acutely toxic to yolk sac larvae (48hr LC50>200 mg/L), while DOSS was much more toxic than Corexit 9500 (48hr LC50 of 7 mg/L). These results indicate that DOSS is a major contributor to the toxicity observed with Corexit 9500. LC-MS analysis demonstrated both DOSS and DPGBE were relatively stable during 48 hr incubations while all other components analyzed showed rapid degradation, which might be limiting their potential toxicity. Interestingly, in the presence of sheepshead embryos and larvae, Corexit 9500 stimulated microbial growth in a time and concentration dependent manner. The mutagenic potential of Corexit 9500, DOSS and DPGBE was also assessed using the Comet assay. All three were found to significantly increase DNA damage, with DOSS and DPGBE being significantly more genotoxic than Corexit 9500. Future work will examine interactions between these components and fresh and weathered oil as it relates to acute mortality and genotoxicity in sheepshead larvae.

Session: 008
Date: Tuesday, January 28 - 4:15 PM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Corexit in Gulf of Mexico Sediments

Presenter: Matt J Perkins
Oregon State University
Authors: M. J. Perkins, J. A. Feild;
Oregon State University, Corvallis, OR.

Abstract:
Approximately 200 million gallons of Corexit was applied in the Gulf of Mexico in response to the Macondo oil spill of 2010. Corexit, a mixture of surfactants, is capable of reducing the interfacial tension between aqueous and oil phases, reducing oil droplet size and promoting dissolution and dispersion in the water column. It has been proposed that the surfactant components of Corexit will undergo rapid dispersion and microbially driven degradation in marine systems such as the Gulf of Mexico. Yet nearly three years after the original emergency response action, the main anionic surfactant of Corexit, bis-(2-ethylhexyl)sulfosuccinate (DOSS), has been detected in sediments near the original site of application at concentrations approaching two parts per billion. A method for the exhaustive extraction from marine sediments and the quantitative analysis of DOSS with minimal sample preparation via direct injection large volume LC-MS/MS is presented. A quantitative spatial and temporal analysis of DOSS in sediments collected during the tail end of the emergency response through the summer of 2013 from sites paralleling the path of the deep water oil plume observed during the emergency response is also presented.

Session: 008
Date: Tuesday, January 28 - 4:30 PM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Response of deep-water corals to oil and dispersant exposure

Presenter: Danielle M Young
Temple University
Authors: D. M. Young, E. E. Cordes;
Temple University, Philadelphia, PA.

Abstract:
The Deepwater Horizon incident released an unprecedented amount of oil at depth in the Gulf of Mexico, with known adverse effects on deep-sea ecosystems. During the ensuing cleanup efforts, dispersants were also applied at depth for the first time. The response of deep-sea organisms to both the oil and dispersant are not fully understood. Quantifying these effects on the surrounding communities is crucial to determining long-term environmental consequences at the species and population levels. It has been previously observed that cold-water corals in the vicinity of the Deepwater Horizon oil plume exhibited characteristic signs of stress and mortality (White et al. 2012). We conducted live coral experiments at sea to investigate the physiological effects of surrogate oil and dispersant exposure on two deep-sea corals, Callogorgia americana and Paramuricea biscaya. We found that the dispersant only exposure and the combined crude oil and dispersant exposures had a more pronounced effect on both coral species than crude oil treatments alone. RNA samples from P. biscaya were also extracted from a known impact site, MC294, and non-impacted areas in the GoM to investigate possible gene expression changes in response to environmental stressors using Illumina RNAseq technology. Our results provide insights into the responses of deep-sea corals to hydrocarbon and dispersant exposure and the implications of applying dispersants to deep-sea oil spills.

Session: 008
Date: Tuesday, January 28 - 4:45 PM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Dispersant COREXIT 9500A Increases the Toxicity of Crude Oil to Marine Zooplankton

Presenter: Rodrigo Almeda
University of Texas at Austin Marine Science Institute
Authors: R. ALMEDA[1], S. BACA[2], C. G. BROWN[1], B. GEMMELL[1], T. HARVEY[1], C. HYATT[1], E. J. BUSKEY[1];
[1]University of Texas at Austin Marine Science Institute, Port Aransas, TX, [2]University of Texas at El Paso, El Paso, TX.

Abstract:
In 2010, more 1.8 million gallons of Corexit dispersant (Corexit 9527A and Corexit 9500A) were released in the Gulf of Mexico to treat the Deepwater Horizon oil spill. However, our knowledge concerning the impact of these Corexit dispersants and chemically dispersed oil on planktonic communities is very limited despite the fact that plankton play an important role in marine food webs and biochemical cycles. We conducted exposure experiments to investigate the acute toxicity of crude oil, dispersant (Corexit 9500A) and dispersant-treated crude oil to some representative groups of marine zooplankton, including copepods, meroplanktonic larvae and microzooplankton (nauplii, tinntinids, aloricate ciliates and heterotrophic dinoflagellates). The addition of dispersant to crude oil increased the mortality rates and reduced egestion rates, egg production and egg hatching in marine copepods. The combination of oil and dispersant caused a decrease in the survival and growth rates of meroplanktonic larvae. Among microzooplankton, copepod nauplii, tintinnids and aloricate ciliates were extremely sensitive to dispersant and dispersed oil. Heterotrophic dinoflagellates showed a higher tolerance to crude oil and dispersant than other microzooplankton groups. Overall, our results indicate that the use of Corexit 9500A increases the toxicity of crude oil to marine zooplankton, which may increase the impact of oil spills in the marine environment.

Session: 008
Date: Tuesday, January 28 - 9:15 AM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Herders for Rapid *in situ* Burning of Oil Spills on Open or Ice-Covered Water

Presenter: Tim Nedwed
ExxonMobil Upstream Research Company
Authors: T. Nedwed[1], I. Buist[2];
[1]ExxonMobil Upstream Research Company, Houston, TX, [2]SL Ross Environmental Research Limited, Ottawa, ON, CANADA.

Abstract:
Herders are surfactants (like those used in dispersants) that cause an oil slick to thicken when they are sprayed on the water around the slick perimeter. Herders were studied in the 1970s as a technique to enhance mechanical recovery. In this application herders were limited to relatively calm conditions because the herder itself dissipated and respread in tens of minutes, which likely isn't enough time to skim, and slicks were still mobile requiring challenging repositioning of equipment. *In situ* burning of slicks at sea requires only

minutes to implement. Further, the complete process of herding and burning can potentially be implemented from either manned or remote-controlled helicopters. Responding rapidly by helicopter to very dynamic oil slicks at sea is a significant advantage compared to boat-based response.
We will describe feasibility testing, biodegradation studies, and toxicity testing performed on herder formulations. Positive small-scale tests led to a field test where over 90% of a slick was successfully herded and burned. One of the herders was found to be readily biodegradable and have low toxicity. The positive results of these studies have led to commercialization of the herders and development of a helicopter-based delivery system.
We believe that herders will turn a rarely used oil spill response option (at-sea *in situ* burning) into a readily available response option because it is aircraft deployable.

Session: 008
Date: Tuesday, January 28 - 9:45 AM
Room: Bon Secour Bay II
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Oral

Complex surfactant layers at fluid-fluid interfaces and the impact on droplet coalescence

Presenter: Lynn M Walker
Chemical Engineering, Carnegie Mellon University
Authors: L. M. Walker, M. D. Reichert, S. L. Anna;
Chemical Engineering, Carnegie Mellon University, Pittsburgh, PA.

Abstract:
The dynamics of adsorption of single and multicomponent surfactant mixtures at oil-water and air-water interfaces has been characterized using a microtensiometer. The use of microscale interfaces allows the transport processes involved in adsorption to be analyzed and both diffusion and kinetic parameters characterized. The scale of the device allows the bulk solution in contact with the interface to be changed rapidly. We are able to remove the bulk surfactant at different points in during the dynamics of adsorption by rinsing the interface and continuously replacing the bulk fluid with surfactant-free aqueous phase to investigate the reversibility of adsorption. For a bulky nonionic surfactant, Tween-80, a critical interfacial tension arises that links the transport dynamics to the onset of partial reversibility in the system. By measuring the mechanical properties of pre-rinsed and rinsed interfaces, we also find a critical interfacial tension that leads changes in the elasticity of the interfaces. This interfacial tension correlates well with the critical interfacial tension that indicates the onset of partial reversibility. To determine the effects of interfacial elasticity and concentration changes on the stability of an emulsion, we bring two surfactant-coated interfaces into contact and monitor coalescence times and initial droplet shape profiles. We discuss these coalescence results in the context of film drainage, and as drainage time relates to the elasticity of the contacted interfaces.

Session: 008
Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-278

The impact of mass transfer on the dynamics of droplets released in quiescent medium

Presenter: ABHIJIT RAO
Louisiana State University
Authors: A. RAO[1], R. Reddy[1], A. Huang[1], S. Pandey[2], K. Nandakumar[1], K. Valsaraj[1];
[1]Louisiana State University, Baton Rouge, LA, [2]Indian Institute of Technology, Kharagpur, INDIA.

Abstract:
Oil is a composite mixture of various hydrocarbons. The hydrocarbons contained in the oil can broadly be categorized as light hydrocarbons, that are soluble in surrounding environment and non-volatile components, which are immiscible. So, as the oil droplets rise in the water column the light soluble hydrocarbons tend to move from oil to surrounding water medium. In this study,we have investigated the phenomenon of dissolution of hydrocarbons from oil phase to water through experiment and numerical modeling.
A model organic droplet was prepared to represent an oil droplet morphologically. Chlorobenezene formed the immiscible component and acetonitrile represented the soluble component. A droplet was released through the glass nozzle into a quiescent water column. The initial mixture density of droplet is less than that of water and the buoyancy allows it to rise in water column. The loss of acetonitrile causes the droplet density to rise which in turn decelerates droplet. The droplet passes through a stationary phase when its density becomes equal to that of surrounding. Further loss of the solute causes it to sink. Experiments were conducted with initial mixture densities ranging from 920 to 980 kg/m3. The effect of surfactant addition on the mass transfer was also studied.
A numerical model was developed to account for the mass transfer and thereby predict the trajectory of droplet .Volume of Fluid method was used for tracking interface between the dispersed phase and the continuous phase. Species transport model was included, to capture the concentration variation of solute both in continuous as well as dispersed phases. The detailed understanding developed from this study can be incorporated into large scale plume dynamics models.

Session: 008

Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-279

Micellization of Alcohol Ethoxylate Surfactants

Presenter: Andrew M. Bodratti
University at Buffalo - The State University of New York
Authors: A. M. Bodratti, S. M. Kong, E. M. Benz, M. Tsianou, P. Alexandridis;
University at Buffalo - The State University of New York, Buffalo, NY.

Abstract:
We consider non-ionic surfactants in terms of their ability to stabilize oil-in-water emulsions or dislodge oil adsorbed on surfaces, on their own, or in a formulation containing other surfactants (ionic and/or non-ionic) or nanoparticles. Fundamental information about the micellization of surfactants in aqueous solution can be used to assess the compatibility and potential synergism with other surfactants, and the surfactant affinity to oil. We examine here a homologous series of surfactants consisting of a single-branch C10-alcohol with varying degrees of ethoxylation, and report results on the onset of micellization (cmc), micellization thermodynamics, and local environment in the micelles formed in aqueous solutions in the presence of cosolvents and electrolytes. [We thank Dr. Elvira Stesikova, BASF Care Chemicals, for providing surfactants]

Session: 008
Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-280

Dispersing Droplets with Solid Particles: how interface shape and particle crowding affect capillary forces

Presenter: Wei He
University of Massachusetts Amherst
Authors: W. He, N. Senbil, A. D. Dinsmore;
University of Massachusetts Amherst, Amherst, MA.

Abstract:
Developing effective formulations that use solid particles to stabilize oil droplets requires a better understanding of the forces that act on these particles when they bind at fluid interfaces. We measure these forces by monitoring the deflection of a cantilever as we push a millimeter-sized particle across an interface. At the same time, we image the interface at high contrast and with high resolution to obtain the contact angles and interfacial curvature throughout the process. We find that the maximum force required to remove a particle from the interface is reduced by the presence of other particles floating at the interface. We attribute this change to a curvature of the interface induced by the floating particles. In separate experiments, we find that the force on a single sphere by itself also changes with the mean curvature of the interface. We also find the advancing and receding contact angles of a sphere depend on the interfacial curvature. These results may lead the way to effective particulate-based dispersants by elucidating the roles of interfacial shape, particle coverage, particle shape and other parameters. This work is supported by the Gulf of Mexico Research Initiative through the C-MEDS consortium and by the National Science Foundation through grant no. CBET-0967620.

Session: 008
Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-281

Polyester-based Photocatalytic Nanocomposite Microsponges for Water Clean-up

Presenter: Fei Liu
University of Alabama at Birmingham
Authors: F. Liu, V. Kozlovskaya, E. Kharlampieva;
University of Alabama at Birmingham, Birmingham, AL.

Abstract:
Deep water Horizon disaster continues to place an urgent demand for new solutions to address oil removal and the marine environment recovery. Our study is focused on designing a novel type of mutlifunctional nanocomposites based on integration of poly lactide which formed porous polyester matrices with titania nanoparticles. This approach integrates the inherent advantages of both components for the development of nanocomposites with high photocatalytic activity, elevated loading capacity, and tunable degradability so that it would be realistic to apply this green nanocomposite in cleaning of the real world. The poly lactide acid matrix with titania-forming capabilities and tunable degradability was synthesized and new principles for ‘as mixed’ and ‘in situ’ integration of the polyester matrix with titania nanoparticles was developed. The new method for the synthesis of photocatalytically-active crystalline titania at mild reaction conditions and low temperature introduced here make it more simple and environmental friendly during the processing. We have found that both systems effectively absorb and degrade organic impurities. Rhodamine 6G and Nile Red two representative dye

were chosen to be the template dyes to test the absorbing and degrading ability. Moreover we have demonstrated that the sorption capacity, dye degradability, and poly lactide acid disintegration can be controlled by varying microparticle porosity and concentration of incorporated titania nanoparticles. The study also focused on the photocatalytic degrading ability as well as biodegradability related to the effect of poly lactide/titania interactions.

Session: 008
Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Impact of Gulf of Mexico Physical Processes on Chemical and Biological Transport
Type: Poster 8-282

Light and Heavy Crude Oil Droplets Stabilized with Carbon Black and Surfactants: Shear Flows and Bacteria Interactions

Presenter: Sarah Mirza
Brown University
Authors: S. Mirza[1], M. Godfrin[1], M. Bookstaver[1], A. Bose[2], A. Chauhan[3], M. Levine[2], A. Tripathi[1];
[1]Brown University, Providence, RI, [2]University of Rhode Island, Kingston, RI, [3]University of Florida, Gainesville, FL.

Abstract:
Crude oil is considered one of the most complex organic mixtures found in nature; composed of a wide range of chemical components that vary in their physical properties and in their molecular composition. In terms of emulsion formation, crude oil additionally contains surface-active molecules that have the ability to recognize oil-water interfaces. The formation of stabilized emulsions plays an essential role in oil spill remediation, as they tend to overcome many factors responsible for oil destabilization, observed in sea water such as coalescence and flocculation. Surfactants are widely used in forming oil-in-water emulsions. These molecules exhibit hydrophilic-hydrophobic (amphiphlic or Janus-like) properties, which enable them to reduce oil/water interfacial tension. On the other hand, particles do not require such properties, as the partial wettability of a particle in both immiscible liquid phases is sufficient to situate it at oil/water interfaces. The particles of carbon black were selected as an effective nontoxic product to stabilize crude oil emulsions. These particles are interfacially active, and have the ability to stabilize emulsions by promoting the oil/water phase separation. Here, we investigate the effect of carbon black particles and cetyltrimethylammonium bromide (CTAB), a positively charged surfactant, on the formation of oil-in-water emulsions of three distinct densities of crude oil classified as light, medium, and heavy. The shear flow findings represent the flow properties, the behavior and the stability percentage of these oil emulsions. The impact of flow on the interaction of bacteria (Alcanivorax borkumensis) with carbon black stabilized oil in water emulsions is further explored.

Session: 008
Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-283

Molecular dynamics simulation of oil dispersion using hydrophobins

Presenter: Yuwu Chen
Louisiana State University
Authors: Y. Chen[1], F. R. Hung[1], P. Russo[2];
[1]Louisiana State University, Baton Rouge, LA, [2]Georgia Institute of Technology, Atlanta, GA.

Abstract:
Molecular dynamics (MD) simulations were performed to explore the feasibility of using hydrophobins as oil dispersant. Hydrophobins are a class of proteins produced by filamentous fungi in soil. Preliminary results from Russo's group using the hydrophobin Cerato Ulmin (CU) suggest that these proteins can encapsulate oil (to form "blobs") and air (to form "bubbles") in cylindrical structures. These unique surface-active properties, combined with the natural abundance of hydrophobins, and the fact that they can also be biosynthesized on an industrial scale, suggest that one could use these proteins as "natural" oil dispersants. However, a fundamental understanding of the physics behind the striking surface activity of hydrophobins is still lacking. Here we report results from classical MD simulations of systems of hydrophobins, oil hydrocarbons and salt water using all-atom and coarse-grained representations of these species. Relevant interfacial properties of these systems, such as free energies, density profiles, radius of gyration, moments of inertia and structure and stability of nanometer-sized oil blobs are investigated and discussed in this study.

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Room: Main Ballroom (Convention Center)
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-284

Dynamic Behavior of Cerato Ulmin - A Class II Hydrophobin

Presenter: Xujun Zhang
Louisiana State University
Authors: X. Zhang, B. Blalock, W. Huberty, L. Aiken, P. Russo;
Louisiana State University, Baton Rouge, LA.

Abstract:
Cerato ulmin (CU) is a Class II hydrophobin which forms rod-like bubbles in aqueous suspensions. Other hydrophobins tend to form asymmetric structures too. These proteins have multiple potential applications within the environmental and materials sciences fields due to their unusual properties. Cleaning-up of oil spills is of particular interest. In this work, we explored possible methods to form bubbles reproducibly and control their size. The techniques used were rocking and acoustic pulsation. Bubbles display a very wide range of sizes. Smaller bubbles were studied by light scattering to assess their stability as a function of time. We also investigated the ability of CU hydrophobin to encapsulate gases and oils such as butane, natural gas, nitrogen, hexane, dodecane and crude oil. Qualitative observation of larger bubble formation, proliferation, shape, and contents was achieved by video optical microscopy.

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Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-285

Factors Affecting the Sorption of DOSS to Coastal Louisiana Sediments

Presenter: Bruce J Brownawell
Stony Brook University
Authors: B. S. Adewale, B. J. Brownawell;
Stony Brook University, Stony Brook, NY.

Abstract:
DOSS (1,4 bis(2-ethylhexyl) sodium sulfosuccinate) is an anionic surfactant and a major component in Corexit 9500 and 9527. Its sorption to suspended particles or sediments may affect its bioavailability, fate, and transport especially in shallower coastal waters. This poster will present results examining the effects of salinity, sediment properties, and concentration of DOSS on sediment water distribution coefficients (Kd). The Kds increase with salinity to a greater degree than expected based on knowledge gained from the effects of Na and Ca on the sorption of anionic linear alkylbenzene sulfonates. Sorption onto six coastal Louisiana sediments, with diverse combinations of properties, was consistent with trends related to total organic carbon (TOC) and surface area, with Kds varying between 14 L/Kg (TOC = 0.21%) and 320 (TOC = 8.1%). Sorption isotherm experiments conducted to date at aqueous concentrations ranging from of 20 - 2000 nM indicate little change in Kd with concentration (nearly linear isotherms). At the solid-water ratios and the concentrations tested, DOSS was sorbed at very low surface coverages. We had expected higher Kd values based on the degree of chromatographic retention in reverse phase HPLC and a variety of observations of loss of DOSS to surfaces of containers and instruments. Future work will focus on experiments at lower DOSS concentrations and longer timescales where sorption may be appreciably higher.

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Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-286

Mechanisms of Emulsion Stabilization by Surface Modified Carbon Black

Presenter: Kristin M Conrad
University of Florida
Authors: K. M. Conrad, A. Chauhan;
University of Florida, Gainesville, FL.

Abstract:
We report the mechanisms of carbon black (CB) transport to oil-water interfaces and its effect on viscoelasticity and emulsion stability. The adsorption of carboxyl terminated CB on the dodecene-water interface was studied by measuring the dynamic surface tension and the interfacial elasticity. Particle size distributions were analyzed for aqueous suspensions of varying salt and CB concentrations. Results showed that CB particles do not cause a decrease in surface tension suggesting negligible surface activity. Low interfacial viscoelasticity also suggests small adsorption of CB at the interface. These results contradict the improvements in stability observed with CB nanoparticles. Based on these observations and the fact that emulsions only form with the addition of salt, we rationalize that the CB nanoparticles form flocs, which adsorb at the interface due to inertia. In a pendant water drop the CB flocs lack the inertia to migrate to the interface leading to negligible adsorption. To prove this hypothesis, we observed CB settling of large flocs onto oil-water interface of an inverted oil drop such that the inertia generated by the settling is adequate to obtain O(1) Reynolds number. With the

modified set up, we observed significant adsorption of CB flocs at the interface proving that inertial migration of CB flocs is the key mechanism for emulsion stabilization by CB particles. This understanding is essential in designing remediation strategies based on CB particles.

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Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-287

Clathrate Hydrate Formation at Particle-laden Interfaces

Presenter: Jae W Lee
The City College of New York
Authors: J. W. Lee[1], M. Cha[1], J. F. Morris[1], S. Baek[2];
[1]The City College of New York, New York, NY, [2]KAIST, Daejeon, KOREA, REPUBLIC OF.

Abstract:
The global energy demand is projected to increase as the world population is to be continuously growing. This increase has led to more exploration for the conventional energy sources including liquid fuels and natural gas. Exploration for more reservoirs requires expeditions off-shore crude oil and gas recovery. The low-temperature and high-pressure conditions at many of these harsh sites provide ideal environments for clathrate hydrate formation. Clathrate hydrates consist of small guest molecules (i.e., methane, ethane, propane, cyclopentane, and carbon dioxide) and host molecules (i.e., water). The formation of clathrate hydrates inside oil/gas extraction pipelines, and the subsequent aggregation impose serious flow assurance issues with great impedance to the continuous extraction and production. The current focus on circumventing hydrate plugs has shifted from prevention of hydrates using traditional thermodynamic inhibitors to risk management using kinetic inhibitors and anti agglomerants. In the risk management, the formation of hydrates is allowed as long as appropriate conditions are preserved to minimize flow assurance issues. In this work, we introduce hydrophobic silica nanoparticles as a surface-active agent to the interface of solid hydrate and water and investigate the growth behavior of clathrate hydrate. Unique conical hollow crystals of cyclopentane hydrates has been observed at the hydrate and water interface without any particle. However, the addition of the hydrophobic particles to the interface significantly reduces the size of the crystal and retards the clathrate formation. We will discuss how the hydrophobic particles inhibit the clathrate formation at the interface.

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Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-288

The biological footprint of oil and dispersant exposure

Presenter: Iliana Baums
The Pennsylvania State University
Authors: I. Baums[1], D. Ruiz-Ramos[1], C. Fisher[1], A. Bracco[2], Y. Cardona[2];
[1]The Pennsylvania State University, University Park, PA, [2]Georgia Tech, Atlanta, GA.

Abstract:
The deep sea is difficult to access and yet it is influenced by human activities. The most dramatic example is the Deep Water Horizon oil spill. Coral species that build the foundation of deep water benthic ecosystems were directly impacted. Oily material settled on the branches of corals and killed tissue thus changing the demography of the affected species (White et al. 2012). In laboratory experiments, oil/dispersant mixtures and dispersant exposure alone lead to coral tissue death. Consequences of tissue loss include reduced reproductive output,however, the geographic footprint of reduced reproductive output is not known for these corals. The footprint depends in part on the connectivity among populations. Corals reproduce via releasing larvae into the water column where they disperse to connect populations. Connectivity is a function of the life history of the species (i.e. timing of spawning, time spent in the water column, settlement behavior), the physical (currents, eddies) and biotic (predators, food) environment. To assess the ongoing impact of the oil spill on the black coral, *Leiopathes glaberrima*, we studied the scale over which sites and populations are connected with genetic and Lagrangian integrations using a high resolution regional ocean model. A better understanding of the geographic footprint of oil spills will lead to smarter management decisions and a better understanding of the processes that structure deep sea ecosystems.

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Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-289

Analysis of Corexit oil spill dispersants and their degradation products in seawater by high-resolution tandem mass spectrometry

Presenter: P. Lee Ferguson
Duke University
Authors: P. L. Ferguson[1], G. J. Getzinger[1], S. J. Choyke[1], B. J. Brownawell[2];
[1]Duke University, Durham, NC, [2]Stony Brook University, Stony Brook, NY.

Abstract:
We have developed a comprehensive analytical method based on high-resolution mass spectrometry for separation and structural analysis of Corexit components and their degradation products in seawater. The method utilizes ultra-performance liquid chromatography (UPLC) for the separation of dispersant surfactants, allowing for rapid and high throughput analysis. Exact mass measurements were performed with a hybrid linear ion-trap orbitrap mass spectrometer (LTQ Orbitrap Velos), allowing structural elucidation with high sensitivity and accuracy. In addition, the high resolving power of the LTQ Orbitrap (R>100,000) allowed differentiation of nominally isobaric dispersant components often found in the polyethoxylated compounds used in the formulation of dispersants. For example: a nominal mass of 809 was observed in two dominant polyethoxlated series. Exact mass analysis (< 1.0 ppm) allowed identification of these nominally isobaric compounds. A series containing *m/z*=809.4866 was determined to be the $[M+2Na]^{+2}$ ions of polyoxyethylene sorbitan monooleate, $C_{24}H_{44}O_6(C_2H_4O)_{26}$ (Δppm=0.38); while another distinct series containing *m/z*=809.4425 was determined to be the $[M+2Na]^{+2}$ series of a polyethylene glycol substituted sorbitan, $C_6H_{12}O_5(C_2H_4O)_{32}$ (Δppm=0.49). The developed method was applied to aerobic biodegradation experiments to test transformation of Corexit dispersant components in oxygenated Gulf Stream seawater. Results of these experiments will provide invaluable data on the potential for persistence and transport of these compounds in marine waters.

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Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-290

Chemical dispersants used in oil spill response alter microbial community composition and evolution but not microbial activity

Presenter: Samantha Joye
University of Georgia
Authors: S. Joye[1], M. Seidel[1], P. Medeiros[1], K. Hunter[1], S. Grim[2], M. Sogin[2], K. Ziervogel[3], M. Perkins[4], J. Field[4], S. Kleindienst[1];
[1]University of Georgia, Athens, GA, [2]Marine Biological Laboratory, Woods Hole, MA, [3]University of North Carolina, Chapel Hill, NC, [4]Oregon State University, Corvallis, OR.

Abstract:
In 2010, the Macondo Blowout discharged unprecedented amounts of hydrocarbons into deep-waters of the Gulf of Mexico and large quantities of chemical dispersants were applied to stimulate oil biodegradation. We used microcosms to simulate the infusion of Gulf deep water with chemically dispersed oil or oil alone. The results show that chemically dispersed oil altered the microbial community composition but did not stimulate oil biodegradation. The presence of dispersants selected for Colwellia, while oil alone stimulated Marinobacter. Specific hydrocarbon oxidation rates in dispersant-amended microcosms were less than or equal to those observed in oil-amended microcosms. The observed succession of microbial populations in dispersant-amended microcosms resembled field observations made in the aftermath of the Deepwater Horizon oil spill. Extrapolating these comprehensive results to marine oil spills suggests that chemical dispersants do not stimulate oil-biodegradation and underscores the need to consider the efficiency of dispersant applications prior to use in oil spill response.

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Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-291

How do oil dispersants work? Exploring the physical phenomena which drive chemical oil spill dispersion

Presenter: David Riehm
University of Minnesota
Authors: D. Riehm, A. McCormick;
University of Minnesota, Minneapolis, MN.

Abstract:

Dispersion effectivenesses of dispersants employing the three surfactants Tween 80, Span 80, and dioctyl sodium sulfosuccinate (DOSS) have been characterized using a modified Swirling Flask test. Trends in effectiveness have been correlated with trends in both initial and dynamic interfacial tensions as dispersant composition is varied. Based on these correlations, optimal dispersant composition is shown to be constrained by: (1) initial oil-water interfacial tension upon dispersant application; (2) rates of surfactant adsorption to the interface; and (3) rates of surfactant leaching from oil to seawater. This framework for understanding dispersant behavior is expected to inform future efforts to formulate more effective and/or less toxic dispersants, as well as to facilitate increased understanding of the environmental impact of dispersant-treated oil.

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Date: Tuesday, January 28 - 6:00 PM
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Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-292

Guidance for Improving Dispersed Oil Toxicity Testing

Presenter: Tom Parkerton
ExxonMobil Biomedical Sciences Inc
Authors: T. Parkerton;
ExxonMobil Biomedical Sciences Inc, Houston, TX.

Abstract:
The complex nature and limited solubility of crude oil poses challenges for evaluating the aquatic toxicity of these substances. While considerable research has investigated the effects of dispersed oils to aquatic organisms, differences in design and conduct of these studies often make results impossible to compare and correctly apply in decision-making. A review of toxicity assessment using the water accommodated fraction (WAF) procedure is discussed. Differences in the multicomponent dissolution and resulting exposure concentrations of dissolved hydrocarbons in WAFs obtained from different test procedures based on nominal oil loadings or WAF dilutions are illustrated using several case studies. A key consideration shown to impact dissolved hydrocarbon exposures in studies that rely on WAF dilutions is the carry over and dissolution of oil droplets. This process can complicate interpretation of observed toxicity relationships. Recent advances in passive sampling methods that allow accurate quantification of dissolved hydrocarbon exposure in WAF tests are discussed. Based on insights from this analysis, guidance is provided for standardizing exposure characterization and applying a mechanistic framework in the interpretation of future oil toxicity studies. Adoption of these recommendations will increase comparability across studies, improve the utility of data in hazard and risk assessments and avoid unsupported conclusions that could misguide rational spill response.

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Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-293

Polymer-Modified Silica Nanoparticles: Modulation of Interactions by Displacers

Presenter: Andrew M. Bodratti
University at Buffalo - The State University of New York
Authors: A. M. Bodratti, P. Alexandridis, M. Tsianou;
University at Buffalo - The State University of New York, Buffalo, NY.

Abstract:
We consider silica nanoparticles in terms of their ability to disperse oil in water. The surface properties of silica are modified by a change in the solution pH and/or the adsorption on the surface of amphiphilic polymers of the poly(ethylene oxide)-poly(propylene oxide)-poly(ethylene oxide) (PEO-PPO-PEO) family. The physical adsorption of amphiphiles, and corresponding interactions between silica nanoparticles, can be modulated by the addition of displacers such as polar organic solvents, PEO homopolymers, or electrolytes. The connection that we establish between (a) the amphiphile organization on the nanoparticle surface and in the bulk solution and (b) macroscopic properties of the dispersions can guide the design of oil-in-water dispersants incorporating environmentally benign nanoparticles.

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Extraction and quantification of DOSS from deep-sea sediments

Presenter: Shelby L Lyons
Haverford College
Authors: S. L. Lyons[1], S. J. Harrison[1], E. B. Kujawinski[2], H. K. White[1];
[1]Haverford College, Haverford, PA, [2]Woods Hole Oceanographic Institution, Woods Hole, MA.

Abstract:
In response to the 2010 Deepwater Horizon oil spill, dispersants were applied to surface waters and at depth to promote the mixing and degradation of oil in the water column. A major compound present in the dispersant used, is the anionic surfactant dioctyl sodium sulfosuccinate (DOSS). DOSS was observed to persist in the water column for 64 days after the dispersant application, but its fate in deep-sea sediments is not well known. In this study, we developed a method to extract DOSS from sediment samples in order to analyze and quantify it via liquid chromatography with tandem mass spectrometry (LC/MS/MS). To reduce the interference from fine sedimentary material, a 1:1 MeOH:H2O solvent system was used for extraction in conjunction with two centrifugation steps. With this method, 104% (+/- 15%) of the DOSS added to spiked-sediment samples was recovered. This method was then implemented to examine the presence of DOSS in impacted sediments collected in December 2010, 11km from the site of the Macondo well. With this study, we aim to provide a more complete understanding of the fate of dispersants in Gulf of Mexico deep-sea environments.

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Adsorption and Release of Active Species into and from Multifunctional Ionic Microgel Particles

Presenter: Haobo Chen
Arizona State University
Authors: H. Chen, L. L. Dai;
Arizona State University, Tempe, AZ.

Abstract:
Solid particles serve as potential alternative dispersants in oil drilling, cleaning, and recovery. This presentation focuses on the synthesis and characterization of ionic microgel particles, which are responsive to environmental stimuli such as pH and temperature. Microgels synthesized with the addition of different constituent copolymers can possess either one or both cationic and anionic functional groups. These ionic microgel particles exhibit large size transition behaviors which, if needed, can be tuned to exhibit varying parabolic swelling/deswelling behaviors in response to pH. More importantly, we have investigated the use of these functionalized microgel particles for controlled absorption and release of active species, such as rheology modifiers. This approach may offer an innovative method to engineer the viscoelasticity of the oil-water interfaces.

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Effects of photodegraded crude oil and crude oil-dispersant mixtures on marine species, Arbacia punctulata and Vibrio fisheri

Presenter: Robyn M Hallowell
University of Colorado - Boulder
Authors: R. M. Hallowell, K. Linden;
University of Colorado - Boulder, Boulder, CO.

Abstract:
Chemical dispersants, such as Corexit 9500 and 9527, are approved by the U.S. government to reduce the environmental impact of crude oil spills. Such chemicals are effective as oil dispersants but the implications of their use remains largely unknown. Laboratory studies have yielded conflicting evidence regarding the toxicity of dispersed oil. Marine environments are dynamic and difficult to replicate in the laboratory; therefore, little is known about the effects of natural elements such as sunlight on dispersed oil mixtures. This study evaluated the photodegradation of dispersed oil and quantifies the toxic effect, if any, on marine invertebrates and microbial populations. Degradation of constituents of Corexit in the presence of oil in seawater was studied under direct sunlight and in the presence of sunlight generated reactive oxygen species. Samples of the sunlight-exposed dispersant-oil mixtures were subjected to toxicity assays. Arbacia punctulata embryos were exposed to varying concentrations of treated oil-dispersant mixtures and fertilization

and mortality rates and embryonic development were measured. Further, a luminescent bacterium, Vibrio fisheri, was used to measure microbial toxicity. Research is currently underway and findings will be reported in this paper presentation.

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The Toxicity Of Particle-based Dispersants For Marine Oil Spills And Their Impact On Benzene Toxicity Using The Model Organism Artemia franciscana

Presenter: April L Rodd
Brown University
Authors: A. L. Rodd, M. Creighton, C. A. Vaslet, R. H. Hurt, A. B. Kane;
Brown University, Providence, RI.

Abstract:
Fine particles like carbon black can assemble at water-oil interfaces to stabilize oil droplets, forming what is known as a Pickering emulsion. These novel dispersants not only stabilize oil droplets like traditional surfactant-based dispersants, they can also adsorb toxic, water-soluble fractions of petroleum. Benzene was used as a model aromatic compound to determine the extent of the adsorption and retention of these fractions bound to carbon particles as a function of tunable surface hydrophilicity. Using a model marine microcrustacean, Artemia franciscana (brine shrimp), the toxicity of carbon dispersants, benzene, and mixtures was characterized using mortality and compared to a high-surface area powdered activated carbon adsorbent. Hsp70 protein expression was also measured as a sublethal endpoint to measure the general stress response of the larvae. At all concentrations tested (up to 50mg/L), the carbon black materials had no effect on brine shrimp viability, and no increase in Hsp70 expression up to 25mg/L. Induction of Hsp70 by the carbon black mixtures demonstrated an additive relationship between carbon black and low doses of benzene. These studies provide information on the potential impact of novel particle-based dispersants deployed after a marine oil spill. Research supported by BP/The Gulf of Mexico Research Initiative, US Dept. of Education GAANN Award, NIEHS Training Grant T32 ES07272, and the generous support of Donna McGraw Weiss '89 and Jason Weiss.

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The Cytotoxic and Genotoxic Impacts of Chemical Dispersants, Oil and Chemically Dispersed Oil on Sperm Whale Skin Cells

Presenter: John Pierce Wise
University of Southern Maine
Authors: C. F. Wise[1,2], J. T. F. Wise[1,2], S. S. Wise[1,2], J. P. Wise[1,2];
[1]University of Southern Maine, Portland, ME, [2]Maine Center for Toxicology and Environmental Health, Portland, ME.

Abstract:
The Deepwater Horizon oil crisis in the Gulf of Mexico created an urgent need to understand the toxicological impacts of chemical dispersants, and chemically dispersed oil, which are poorly understood, especially in mammals. Thus, the objective of this study was to determine the cytotoxicity and genotoxicity of two chemical dispersants (Corexit 9500 and 9527), Alaskan and Gulf oil, as well as chemically dispersed oil. We used the chromosome damage assay as a measure of genotoxicity as it is a widely accepted test for carcinogenic potential. The data show Corexit 9500 and 9527 are both cytotoxic to sperm whale cells. Corexit 9527 is less cytotoxic than 9500. S9 mediated metabolism did not alter the cytotoxicity of either dispersant. Both dispersants were also genotoxic to sperm whale cells; S9 mediated metabolism increased Corexit 9527 genotoxicity. Oil experiments were performed using the water accommodated fraction of oil (WAF). Alaskan WAF was not cytotoxic to sperm whale skin cells at the maximum possible doses that could be administered. However, chemically dispersed Alaskan oil (CEWAF) was cytotoxic. Both WAF and CEWAF were genotoxic with the CEWAF inducing more damage. S9 mediated metabolism increased genotoxicity caused by CEWAF and WAF. These data indicate there is reason for concern for human and marine mammal health from exposure to chemical dispersants and chemically dispersed oil. Work considering oil and dispersed oil from the Gulf of Mexico is pending.

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Real-World versus Laboratory: Understanding the Implications of Scientific Design and Exposure Methodology for Oil and Dispersed Oil Research

Presenter: Gina Coelho
HDR|Ecosystem Management
Authors: G. Coelho, J. Clark, D. Aurand;
HDR|Ecosystem Management, Lusby, MD.

Abstract:
Despite more than forty years of research on dispersants and dispersed oil fate and effects, a disconnect continues to exist between scientists, policy-makers, and spill decision-makers on how to generate and apply laboratory data to real-world oil spill response decisions. Recently there has been renewed interest and funding of laboratory studies to examine the toxicity of oil, dispersants, and dispersed oil. The hope is that new research will add to the existing body of knowledge to help inform the response community's understanding of the fate and effects of oil and dispersed oil during oil spill emergencies. However, several papers have been published recently that have employed poor or inappropriate testing methods, and at times, have lacked chemical analysis to support study conclusions and recommendations. This presentation aims to highlight the inter-relationship between a) responsible science and gap analysis; b) regulatory policy relating to oil spills and dispersant use; and c) spill response planning information needs. Further, the presentation will review the historical development of standardized methods for conducting dispersed oil aquatic toxicity testing and will emphasizes key elements of exposure methods that will best allow for extrapolation of laboratory data to real-world oil spills.

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A Comparison of the Effectiveness of Solid and Solubilized Dioctyl Sodium Sulfosuccinate on Oil Dispersion Using a Baffled Flask Test

Presenter: Emmanuel Nyankson
Auburn University
Authors: E. Nyankson, R. B. Gupta, C. A. Ober, M. J. DeCuir;
Auburn University, Auburn, AL.

Abstract:
The application of chemical dispersants is one of the few feasible response measures for minimizing the impact of a large oil spill at sea. Effective use of dispersants can accelerate oil biodegradation and prevent the oil spill from coming ashore and damaging sensitive coastal ecosystems. However, indiscriminate application of dispersant to subsea and surface oil spills results in a significant amount of dispersant not coming into contact with the oil and is washed away and wasted. To increase dispersant efficiency, the use of solid water-insoluble wax particles which contain the active ingredient in chemical dispersants, a surfactant, are being studied for their potential in oil dispersion. In such a formulation the surfactant is only released when in contact with oil, at which time the polymer matrix dissolves in the oil. Furthermore, the ability of particulates to orient at the oil-water interface may allow for continuous release of surfactant directly where it is needed. In this study, the effectiveness of oil dispersion using the surfactant dioctyl sodium sulfosuccinate (DOSS) was compared by delivering the surfactant from wax particles and liquid solvents using the EPA's baffled flask procedure. The particles were prepared by ultrasonically spray drying paraffin wax and DOSS molten solution varying the wax to surfactant ratios. The amount of encapsulated DOSS was determined by suspending the particles in water and measuring the amount of DOSS released using a methylene blue complexation procedure. Liquid delivery of DOSS was accomplished by dissolving the surfactant in propylene glycol. The results of this study show the potential of surfactant-wax particles to replace liquid dispersants in oil spill remediation.

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Novel water-based dispersant gels for the treatment of oil spills

Presenter: Olasehinde Owoseni
Tulane University
Authors: O. Owoseni[1], J. He[1], G. McPherson[1], V. John[1], S. Raghavan[2];
[1]Tulane University, New Orleans, LA, [2]University of Maryland, College Park, MD.

Abstract:
Oil spill dispersants are a blend of surfactants in a solvent. While surfactants are the active ingredients, the solvent aids surfactant transport through the oil layer to the oil-water interface where it reduces the interfacial tension. Typical dispersants are formulated with organic solvents such as light hydrocarbon distillates and 1-(2-butoxy-1-methylethoxy) propanol. However, there have been concerns over the toxicity of these organic solvents. Here, we seek to develop a novel dispersant gel formulation with a predominantly water-based solvent. We show that a gel-like surfactant mesophase is formed upon addition of water to a micellar solution consisting of an anionic surfactant, sodium bis (2-ethylhexyl) sulfosuccinate (AOT, DOSS) and zwitterionic surfactant, phosphatidylcholine (lecithin) in a small amount of paraffin such as isooctane. This crystalline mesophase consists of nanostructured aqueous and organic domains that transition from reverse hexagonal at low water content to multilamellar vesicular structures at high water content as shown by cryo-electron microscopy and small angle neutron scattering. The introduction of nonionic surfactants such as Polysorbate 80 (Tween 80) and Sorbitan monooleate (Span 80) into the gel system serves to lower interfacial tensions to levels appropriate for dispersion of oil. The use of a widely available phospholipid and the minimization of organic solvent requirements is the key to the development of such alternative dispsersant systems.

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A dual function system for the sequestration and detection of oil-spill related polycyclic aromatic hydrocarbons

Presenter: Mindy Levine
University of Rhode Island
Authors: M. Levine, N. Serio, L. Prignano, C. Chanthalyma;
University of Rhode Island, Kingston, RI.

Abstract:
Reported herein is the use of γ-cyclodextrin for the sequestration of polycyclic aromatic hydrocarbons and the promotion of energy transfer from the PAHs to fluorophores that are bound simultaneously in the cyclodextrin cavity. Preliminary efforts to use this system to detoxify PAHs by converting them into non-planar analogues will also be reported. The resulting multifunctional system (sequestration, detection, and detoxification) has significant implications in oil-spill cleanup and environmental health science.

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Toxicity of a Promising Oil Spill Dispersant to Daphnia magna

Presenter: Maryam Salehi
University of South Alabama
Authors: M. Salehi, A. Boettcher, S. Powers, A. J. Whelton;
University of South Alabama, Mobile, AL.

Abstract:
The acute toxicity of a promising oil spill dispersant on Daphnia magna was studied and compared to the toxicity of Corexit 9500. Toxicity of hyperbranched polyethyleneimine (HPEI) with various molecular weights (1,200 g/mol, 1,800 g/mol, 10,000 g/mol, 70,000 g/mol and 750,000 g/mol) and Corexit 9500 was determined according to US Environmental Protection Agency (EPA) instructions. The LC50 concentration for each experiment was determined using Probit Analysis with a 95% confidence interval. Acute toxicity was found to be a function of HPEI polymer molecular weight. Greater HPEI polymer toxicity to daphnids was observed for HPEI with greater molecular weight. The greatest toxicity was exhibited by the 750,000 g/mol HPEI polymer whereas the 1,200 g/mol HPEI polymer exhibited the least toxicity. Toxicity is likely due to the increased number of amine functional groups. The LC50 of Corexit 9500 was found to be 0.11 ppm. Corexit 9500 was slightly more toxic than the 10,000 g/mol HPEI polymer [LC50 of 0.166 ppm]. Results indicated that only the 750,000 g/mol HPEI polymer was more toxic than Corexit 9500. Six day old adult daphnids were more resistant to Corexit 9500 and HPEI compared to offspring daphnids (<24 hr old).
Keywords: Oil Spill Dispersant, Toxicity, Corexit, Daphnia magna

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Impact of dispersant exposure on the deep-water coral Leiopathes glaberrima

Presenter: Dannise V Ruiz-Ramos
The Pennsylvania State University
Authors: D. V. Ruiz-Ramos, C. Fisher, I. B. Baums;
The Pennsylvania State University, University Park, PA.

Abstract:
Corals form vibrant communities in the deep Gulf of Mexico and serve as habitat for many species in the region. However, these communities are susceptible to anthropogenic impacts related to oil exploration. Two million gallons of dispersants were applied during the deep water horizon oil spill as a remediation technique. Yet, the effects of dispersants on deep-sea corals are not well understood. Here, we focus on the deep-water antipatharian Leiopathes glaberrima. To understand how crude oil and dispersant alter gene expression in this species we exposed the black corals to treatments of oil, dispersant, and oil and dispersant mixtures over 24 hours. RNA samples were barcoded by color phenotype of the colonies (red and white) and treatment, before sequencing on the Illumina platform. Sequences were assembled using Trinity. Expressed genes were discovered using Edge R, and annotated with Blast2Go. 351 candidate genes were expressed when corals were exposed to dispersant. This compares to 191 genes expressed when corals were exposed to oil. Moreover, the genes expressed differed among treatments suggesting a distinct response to dispersant versus oil exposure. Understanding the physiological response of Cnidarians to hydrocarbons/dispersants is essential in designing effective oil spill remediation strategies.

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Amphiphilic copolymer-grafted silica nanoparticles as a template for novel oil dispersants

Presenter: Kyle C Bentz
University of Southern Mississippi
Authors: K. C. Bentz[1], S. Walley[1], N. Bhikha[2], D. A. Savin[1];
[1]University of Southern Mississippi, Hattiesburg, MS, [2]Univeristy of Mississippi, Oxford, MS.

Abstract:
Silica nanoparticles (NPs) have been grafted with amphiphilic block copolymers, polycaprolactone-b-polyethylene glycol, with varying grafting densities, using both grafting-from and grafting-to processes. It has been shown that brush height scales differently depending on the grafting density. In this reaction, grafting density was controlled by synthesis of a monolayer on the surface of NPs using varied ratios of 3-aminopropyldimethylethoxysilane and trimethylethoxysilane. This afforded silica nanoparticle surfaces that ranged from fully saturated with reactive amine groups or very sparsely functionalized. Amphiphilic block copolymers were attached by first using a grafting-from reaction in which the amine-functionalized silica nanoparticles served as the initiating species in a ring opening polymerization ε-caprolactone and catalyst triethyl aluminum to yield polycaprolactone-functionalized silica nanoparticles. The hydroxy-terminated polycaprolactone was then reacted with a carboxylic acid functionalized polyethylene glycol using activated ester coupling in a grafting-to reaction to yield amphiphilic block copolymer functionalized silica nanoparticles. Amphiphilic block copolymer grafted nanoparticles were characterized using dynamic light scattering and transmission electron microscopy. These materials are expected to be excellent candidates for oil remediation.

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A Novel Route to the Formation of Pickering Emulsions

Presenter: Amitesh Saha
University of Rhode Island
Authors: A. Saha[1], V. John[2], A. Bose[1];
[1]University of Rhode Island, Kingston, RI, [2]Tulane University, New Orleans, LA.

Abstract:
Particles that are partially wettable in two immiscible liquids are usually required to form stable emulsions. Here, we begin with completely hydrophilic and highly hydrophobic particles that do not, by themselves, form emulsions. When these particles are suspended in aqueous and organic phases respectively, and the two suspensions mixed, attractive Van der Waals forces between these types of particles cause them to assemble physically into entities that are partially wettable in both phases. These entities are very effective at stabilizing emulsions. Particle material, size, shape and concentration in suspension, as well as the choice of liquids are all important for creating the physically assembled particulate entities that stabilize emulsions. This provides an interesting platform for the development of new class of dispersant systems with particles bearing different physical and chemical properties assembling at oil-water interfaces to stabilize oil drops in water column relevant to oil spill remediation.

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Macromolecular Characterization of Novel Concentration-Independent Dispersants for Improved Oil Spill Remediation

Presenter: Alina Alb
Tulane University
Authors: M. Ejaz, A. Alb;
Tulane University, New Orleans, LA.

Abstract:
The efficiency of complimentary macromolecular materials in encapsulating oils is investigated in this study. Amphiphilic polymers (biocompatible or biodegradable) grafted to well-defined, functionalized silica nanoparticles were synthesized by several routes. Light scattering-based unique methodologies together with traditional methods were used in the characterization studies with major focus on understanding of how critical structural parameters, such as polymer chain length, hydrophilic/hydrophobic block ratio, size of nanoparticle core, affect their performance as dispersants for remediation. One of the original methods developed at the Tulane Center for Reaction Monitoring and Characterization, the multi-detector Automatic Continuous Mixing (ACM) was the main tool used in the nanoparticle characterization. By circulating continuously the nanoparticle solutions through ACM different detectors (viscometer, multi-angle light scattering, refractive index and UV detectors), a continuum of data points were collected, under various conditions. Experiments were designed to monitor stability and dynamics of the nanoparticles in aqueous solutions, to measure kinetics and quantity of entrapment loading of organic components by the novel nanoparticles and unimolecular micelles and measure kinetics and conditions for release. It is hoped that the knowledge gained from these studies will offer convincing arguments in proving that the novel amphiphilic materials synthesized, represent efficient concentration-independent biocompatible dispersants.

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Structural-thermodynamic relationships for adsorption of Corexit® surfactants from coarse-grained simulations

Presenter: Kyle J Huston
University of Michigan, Ann Arbor
Authors: K. J. Huston, R. G. Larson;
University of Michigan, Ann Arbor, Ann Arbor, MI.

Abstract:
Walker and Reichert recently demonstrated partially irreversible adsorption behavior for Tween 80, a component of Corexit® dispersants used for oil-spill mitigation. The ability of Tween 80 to persist for long periods of time at an oil/water interface could be a crucial property for such dispersants, as they are used in huge excess of brine, which can wash them away from the interface. We seek to determine through molecular dynamics simulations whether this persistence at the interface is attributable to a particular moiety of Tween 80 or is dependent on its overall structure. Answering such questions of structural-thermodynamic relationships is important to

design of novel dispersants which retain the most important properties of existing ones. We target this question by probing molecular design space with inexpensive coarse-grained (CG) models. A CG model for polysorbates was developed based on atomistic simulation. Using the model, potentials of mean force (PMFs) were calculated for the simulated pulling of polysorbates from oil-water interfaces - both with and without surfactant monolayers. Results of the pulling simulations will be presented, and the roles of the hydrophobic tail and polyethylene glycol discussed. Time permitting, simulation results for Aerosol OT will also be presented.

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Co-Stabilization of Octane/Water Emulsions by Silica Particles and Charged Surfactants

Presenter: Anju Gupta
Texas A&M International University
Authors: A. Gupta[1], G. Bothun[2], S. Fields[3], H. Zhang[3], V. Oyanedel-Craver[3];
[1]Texas A&M International University, Laredo, TX, [2]University of Rhode Island, Kingston, RI, [3]University of Rhode Island, Kingtson, RI.
Abstract:
This work focuses on formation of stable oil-in-water water emulsions by systematically tuning the hydrophobicity of silica nanoparticles (NP) and addition of charged surfactants. The influence of co-existence of the particles and surfactants on the emulsions that arise from hydrophobic and electrostatics interactions is demonstrated. The effects of varying particle and surfactant concentrations (above CMC), and presence of salts are studied using a variety of analytical and microscopy techniques. Our preliminary investigations with aerosol-OT indicate formation of both oil-in-water and water-in-oil emulsions. For all the systems, the more hydrophobic particles demonstrated formation of an interphase between seawater and octane. A decrease in zeta potential of the particles dispersed in seawater suggests adsorption of the salt cations on the hydroxyl groups. The formation of inverted emulsions (water-in-oil) can be attributed to the binding of the headgroups of AOT to particle surface that may have resulted in partitioning and positioning of the emulsifiers at the oil-water interphase.

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Development of an anti-deposition dispersant to mitigate fouling of coastal flora and fauna by spilled oil.

Presenter: Robert Y. Lochhead
The University of Southern Mississippi
Authors: R. Y. Lochhead[1], L. E. Kemp[1], A. G. Marks[2], H. Pearson[1], S. E. Morgan[1];
[1]The University of Southern Mississippi, Hattiesburg, MS, [2]Jones County Junior College, Ellisville, MS.
Abstract:
A technology gap exists within oil spill dispersant capability. Current dispersants are designed to only distribute the oil droplets within the water column. However, even dispersed oil can be washed ashore where it can spread on coastal substrates such as sediment, plants, and birds. Once fouled, remediation of these substrates can be difficult and costly and damaging to local economies. Booms, sorbents and skimmers do not keep all of the spilled oil from reaching the shore. Thus, there is a need for a dispersant that prevents or mitigates the fouling of animal life, coasts, and inland waters from oil spills.
In order to address this need we embarked on NSF-funded RAPID and AIR projects to seek effective dispersants that would prevent the deposition of oil on coasts and the flora and fauna thereon. We have developed dispersants to mitigate the deposition of oil on solid coastal surfaces including soil, sand, plants, and wild-life (especially birds). These dispersants are formulated from commodity ingredients that are GRAS for human consumption to provide an economical and environmentally friendly option for oil spill treatment. The dispersant comprises a primary emulsifier, such as soy lecithin, and certain polysaccharides as steric stabilizers to prevent deposition of oil at the oil/water/solid interfaces.
The concept of preventing oil deposition on bird feathers was proven and the dispersant has now been scaled to the pilot scale for necessary environmental testing

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Dispersion Effectiveness of Corexit 9500A in Deep Salt Water Environment

Presenter: Daria Boglaienko
Florida International University
Authors: D. Boglaienko, A. Arreaza, B. Tansel;
Florida International University, Miami, FL.

Abstract:
Chemical dispersants are utilized both for surface and deepwater oil spills. In the deep sea environment the factors that can affect dispersant effectiveness are oil composition, viscosity and API gravity, the type and amount of dispersant, hydrostatic pressure, temperature and salinity of water, surface tension, and the degree of mixing of dispersant, oil, and water. Among these factors, the effect of the hydrostatic pressure on the dispersant effectiveness is not a well-studied research area. Under different hydrostatic pressures, surface tension of a liquid can vary due to possibility that force of attraction between molecules might be altered. Decreased surface tension of oil may lead to higher effectiveness of dispersion if a dispersant is utilized. The objective of this research was to analyze the impact of different hydrostatic pressures on the effectiveness of the dispersant with correlation to surface tension alteration of a dispersant, oil and water mixture.
The effect of hydrostatic pressure was studied on the dispersant Corexit 9500A and Louisiana crude oil. A swirling flask effectiveness test, modified with pressure equipment, was performed for the dispersant oil ratios 1:10 and 1:20, salinity 34‰, room temperature, and pressures 1-100 Bar. Effectiveness was measured by UV spectrophotometer following the EPA protocol for swirling flask test.
We hypothesize that under different hydrostatic pressures surface tension of dispersant, oil and water mixture and the effectiveness of the dispersant would change. It is possible that there is negative correlation relationship between surface tension of the mixture and the dispersant effectiveness.

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Surface tension of crude oil contaminated saltwater in the presence and absence of Corexit dispersants: Effect of hydrostatic pressure

Presenter: Ariadna Arreaza
Florida International University
Authors: A. Arreaza, C. Feelemyer, D. Boglaienko, B. Tansel;
Florida International University, Miami, FL.

Abstract:
Dispersants are utilized to reduce the surface tension by breaking up oil into tiny droplets so bacteria and chemical processes can degrade it more quickly. The purpose of this study is to analyze the effect of Corexit dispersants (Corexit 9500A and Corexit 9527A) on the surface tension of Louisiana crude oil contaminated saltwater under the effect of different hydrostatic pressures.
A series of experiments were designed to analyze surface tension of dispersant and saltwater mixtures, using a range of concentrations of dispersants Corexit 9500A and Corexit 9527A from 0.05 mL to 0.7 mL in the 175 mL of saltwater. Another set of experiments were performed for the analysis of the surface tension of dispersant, oil and saltwater mixtures at dispersant-to-oil ratios 1:10 and 1:20. The surface tension of saltwater contaminated oil was also tested as control. All the experiments were conducted for the pressure range from 1 to 80 bars at room temperature, and salinity of 34‰. Pressure tests were conducted for 30 minutes with LWC Diver 125 Pressure Tester.
The results showed significant impacts by pressure on surface tension. In presence of Corexit dispersants, lower surface tension values were observed in the pressure range from 1 to 20 bars when Corexit 9500A was utilized. Same lower values were observed in the pressure range from 60 to 80 bars when Corexit 9527A was present.

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Effects of Corexit EC9500A Used for Oil Spill Remediation on Denitrification Rates of Louisiana Coastal Wetland Soil

Presenter: Jason Pietroski
Louisiana State University
Authors: J. Pietroski, J. R. White, R. D. DeLaune;
Louisiana State University, Baton Rouge, LA.

Abstract:
On April 20, 2010, the BP-Macondo Deep-water Horizon oil platform experienced an explosion which triggered the largest marine oil spill in US history. Approximately 7.9 million liters of dispersant, Corexit EC9500A, was used during the spill between May 15th and July 12th. Sediments were collected from an unimpacted coastal marsh site proximal to areas that suffered light to heavily oiling. Potential denitrification rates were determined over 48 hrs using dispersant to field moist soil weight ratios of 0:10, 1:10, 1:100, 1:1,000, and 1:10,000. The 1:10 treatment resulted in non-detectable denitrification while the 1:100 was 7.6±2.7% of the control and the 1:1,000 was 33±4.3% of the control. The 1:10,000 treatment was not significantly different from the control. Exposure to chemical dispersants has the potential to diminish the ability of the marsh to remove nitrate. Additional studies are needed to determine longer-term impacts to denitrifiers following exposure to dispersants.

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Use of the OHMSETT Facility to Provide Researchers with an Enhanced Awareness of Oil Spill Dispersant Performance in Near Real World Conditions

Presenter: Erik D DeMicco
ExxonMobil
Authors: E. D. DeMicco[1], T. Coolbaugh[2], E. Kennedy[3];
[1]Research and Engineering, ExxonMobil, Fairfax, VA, [2]ExxonMobil, Fairfax, VA, [3]American Petroleum Institute, Washington, DC.

Abstract:
Following the Macondo Well oil release in the Gulf of Mexico in 2010, a large number of research projects were started with the goal of understanding the science of oil spill response technologies and their after effects, in large part through the establishment of and funding from the Gulf of Mexico Research Initiative. A significant percentage of these projects include dispersants as an area of scientific interest. The majority of oil spill-related research before the Macondo release was conducted by industry-contracted laboratories, but the expanding interest has brought a community of academic researchers into this field of study. Many of these researchers have not generally had access to field trials and large-scale wave tank test facilities. Recognizing an opportunity to spread awareness of earlier industry-sponsored efforts and share information on available facilities, several open house / workshops were conducted at OHMSETT, the National Oil Spill Response Research & Renewable Energy Test Facility. The objective was to provide an opportunity for primarily academic researchers to see the OHMSETT test facility first hand, to gain experience in the specifics of dispersant use, and to gain a broader understanding of the extent of R&D that has been carried out on oil spill response dispersants. This presentation will summarize the discussion topics and outcomes of the sessions at OHMSETT.

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Copolymer Grafted Nanoparticle-based Oil Dispersants

Presenter: Daehak Kim
University of Houston
Authors: D. Kim, R. Krishnamoorti;
University of Houston, Houston, TX.

Abstract:
The oil-water interfacial tension is reduced when nanoparticles segregate to the oil-water interface and this segregation is governed by the interparticle interactions of the nanoparticles. In this study, water-soluble hydrophilic-oleophilic copolymers were grafted from silica nanoparticles using a living radical atom transfer polymerization in order to tune the interactions with oil and water. We have studied the nature of interfacial activity of such copolymer based hybrid nanoparticles using pendant drop interfacial tension measurements, and correlated these with their structure using small angle X-ray scattering. Amphiphilic copolymers grafted from nanoparticles promote

their segregation to the interface and make it possible to reduce the oil-water interfacial tension significantly. Moreover, stability of the oil-water emulsions was tested usingthe hybrid nanoparticles exclusively and as mixtures with standard dispersion packages mixtures.

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Bioconcentration of Corexit® Dispersant Surfactant in the Oyster Crassostrea gigas

Presenter: Andrea Boorse
OES
Authors: A. Boorse;
OES, Beaverton, OR.

Abstract:
Abstract
The oil dispersants Corexit 9527 and 9500 A were used in mass quantities in treatment of the Deep Water Horizon Gulf of Mexico oil spill of 2010. There has been much concern and controversy over the effect and toxicity of these oil dispersants on marine biota. Studies were conducted by EPA in 2010 on the toxicity of various oil dispersants and their oil mixtures. Primary active ingredients in oil dispersants are surfactants. To date, very little research has been conducted on the effect, toxicity or bioaccumulation of these surfactants on marine organisms. This investigation focused on the short term bioconcentration of Dioctyl Sulfosuccinate Sodium Salt (DOSS), the primary surfactant found in Corexit products, in the Pacific oyster Crassostrea-Gigas. DOSS is water soluble and fat soluble and has the potential to accumulate in the fatty tissues of organisms. Oysters were exposed to approximately 500 µg/L of Corexit 9500 A over an approximate 60 hour period of time. Oyster and water samples were taken at approximately six hour intervals, frozen and shipped to a laboratory for DOSS analysis by liquid chromatography tandem mass spectroscopy (LC/MS/MS). The results of this bioconcentration study are discussed.

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NEBA of dispersant use should consider persistent residues formed by competing weathering processes

Presenter: Roger C. Prince
ExxonMobil Biomedical Sciences Inc.
Authors: R. C. Prince[1], J. Butler[1], R. K. Nelson[2], C. M. Reddy[2], C. Aeppli[3];
[1]ExxonMobil Biomedical Sciences Inc., Annandale, NJ, [2]Woods Hole Oceanographic Institution, Woods Hole, MA, [3]Bigelow Laboratory for Ocean Sciences, East Boothbay, ME.

Abstract:
Crude oils released at sea are subject to a range of weathering processes that ultimately remove them from the biosphere. While physical processes such as evaporation and dissolution merely move molecules to a different compartment of the biosphere, biodegradation and combustion ultimately convert the oil to CO_2 and H_2O. Other chemical processes, most notably photooxidation, have been shown to oxygenate oil hydrocarbons, leading to tarry masses that resist other weathering for decades. This process can partially or completely sequester unaltered hydrocarbons that could potentially be released to the environment at some later date. We show here that biodegradation does not generate significant amounts of such recalcitrant molecules when oil is dispersed and biodegradation is prompt and extensive. Indeed the biodegradation of dispersed oil includes the biodegradation of resins and asphaltenes present in the original oil. The spill response tool of adding dispersants thus not only removes oil from the sea surface and stimulates hydrocarbon biodegradation, but also encourages the biodegradation of the resins and asphaltenes in the initial oil, and removes the molecules that would otherwise be liable to photooxidation leading to long-term persistence. Net Environmental Benefit Analyses should weigh this when considering the potential short-term negative impacts that could arise with dispersant use.

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Anti-Redeposition Properties of Cellulose-Based Oil Dispersant Determined by Quartz Crystal Microscopy and Atomic Force Microscopy

Presenter: Sarah E Morgan
University of Southern Mississipi
Authors: S. E. Morgan, Y. Zong, R. Y. Lochhead;
University of Southern Mississipi, Hattiesburg, MS.

Abstract:
Commercial oil dispersants provide excellent dispersing properties, but they generally allow re-association of the oil droplets which results in fouling of coastal plants and marine life. A patent-pending, biocompatible dispersant based on food-grade natural polymers has been developed which provides anti-redeposition properties. The dispersant forms stable oil droplets with a lifetime compatible with microbial degradation of the dispersed oil, and the dispersant itself will undergo biodegradation over a longer time period. The dispersed oil will not deposit onto natural surfaces. The mechanisms of the deposition processes of dispersant formulations were examined by dynamic quartz crystal microscopy (QCM-D) and atomic force microscopy (AFM) onto model biological surfaces. QCM-D allows determination of deposition of nanogram level quantities onto model surfaces from a flowing solution or suspension, and provides information about the viscoelastic properties and the stability of the deposited layer. AFM was used to evaluate the morphology of deposited thin films. A proposed model for the mechanism of dispersion and anti-redeposition will be presented.

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Molecular Dynamics Simulation Of Oil Alkanes And Dispersants In Atmospheric Air/Salt Water Interfaces

Presenter: Zenghui Zhang
Louisiana State University
Authors: Z. Zhang[1], T. P. Liyana-Arachchi[2], F. S. Ehrenhauser[1], P. Avij[1], K. T. Valsaraj[1], F. R. Hung[1];
[1]Louisiana State University, Baton Rouge, LA, [2]University of Minnesota, Minneapolis, MN.

Abstract:
Molecular dynamics simulations were conducted to investigate the properties of several intermediate- and semi-volatile n-alkanes from oil, as well as model dispersants, at the air/salt water interface. These studies are relevant to the possible transport of oil and dispersants from the sea surface into the atmosphere via mechanisms such as bubble bursting and whitecaps (breaking waves). Our simulations show that the n-alkanes and the model dispersants have a strong preference to remain at the air/salt water interface, as indicated by the presence of deep free energy minima at these interfaces; therefore, n-alkanes are very likely to adsorb at the surface of bubbles or droplets and be ejected to the atmosphere by sea surface processes such as whitecaps and bubble bursting. The free energy minimum at the interface becomes deeper as the chain length of the n-alkanes increases, and as the concentration of dispersant at the interface increases. These simulation results are consistent with experiments using a laboratory aerosolization reactor, where it was found that more oil hydrocarbons are ejected when Corexit 9500A is present in the system. These trends strongly suggest that aerosolization through bubble bursting and breaking waves at the sea surface is an important transport mechanism for the ejection of spilled oil hydrocarbons into the atmosphere.

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Synthesis of “single nanoparticle micelles”: Grafting amphiphilic polymers from silica nanoparticles using poly(caprolactone) and PEG

Presenter: Scott M. Grayson
Tulane University
Authors: S. M. Grayson, M. Ejaz, A. M. Alb, W. F. Reed;
Tulane University, New Orleans, LA.

Abstract:
The use of small molecule surfactants for dispersing hydrocarbons in water is complicated by the fact that all such surfactants exhibit a critical micelle concentration. As a result, upon sufficient dilution, micelles from these surfactants will break up, and their contents will be released. One solution to this problem is the preparation of amphiphilic nanoparticles, which are designed to act as single, stable

micelles. The synthesis of such nanomaterials was explored by a two-step process: the first, the divergent grafting of poly(caprolactone) from an activated silica nanoparticle surface, and the second, the attachment of poly(ethylene glycol) chains via activated ester coupling. Due to the hydrophilic PEG corona, the resulting grafted nanoparticles exhibited the stable suspensions in water. However, upon exposure to model alkanes, they demonstrated the uptake of hydrophobic compounds.

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Comparison of DOSS Extraction Techniques Suitable for Seafood Matrices

Presenter: Darrell L. Sparks
Mississippi State Chemical Laboratory
Authors: D. L. Sparks[1], C. L. Foster[1], A. N. Meredith[1], J. Atkins[1], B. Brownawell[2], A. McElroy[2], L. Ferguson[3];
[1]Mississippi State Chemical Laboratory, Mississippi State, MS, [2]Stony Brook University, Stony Brook, NY, [3]Duke University, Durham, NC.

Abstract:
In response to the Deepwater Horizon oil spill, seafood monitoring programs were established to test for polyaromatic hydrocarbons and dispersant components. In Mississippi, the Department of Marine Resources collects seafood samples monthly and submits them to the Mississippi State Chemical Laboratory (MSCL) for analysis. Currently, dioctylsulfosuccinate (DOSS) is the only dispersant component that is required to be monitored; however, as part of a Gulf of Mexico Research Initiative Phase II grant, the MSCL has partnered with Stony Brook University as well as Duke University to begin identifying other components besides DOSS that may be present in seafood. As part of this research, we are evaluating various extraction techniques for recovery of dispersant components from shrimp, fish, and oysters. The work presented here compares Accelerated Solvent Extraction (ASE) with QuEChERS (Quick, Easy, Cheap, Effective, Rugged, and Safe) Extraction in terms of relative advantages and disadvantages of each method. All samples were analyzed on an Agilent 6430 Triple Quadrupole Mass Spectrometer with electrospray ionization.

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Evaluation of Droplet/Bubble Models for Subsurface Dispersant Application

Presenter: Eric Adams
Massachusetts Institute of Technology
Authors: E. Adams[1], S. A. Socolofsky[2], M. Boufadel[3];
[1]Massachusetts Institute of Technology, Cambridge, MA, [2]Texas A & M, College Station, TX, [3]New Jersey Institute of Technology, Newark, NJ.

Abstract:
Before Deepwater Horizon, chemical dispersants had never been applied subsurface at a large scale blowout, and little was known about how best to apply them or how effective they were in this mode. An important aspect of effectiveness is oil droplet size, which influences whether oil remains in the deep ocean or makes it to the surface.
Our study involves two parts. The first evaluates models that predict droplet size distributions, with and without dispersants, as a function of oil and gas properties/flow rates, and various release and ambient conditions. Droplet models generally fall into two classes: equations that predict characteristic droplet size as a function of dimensionless parameters such as Weber and Reynolds numbers, and models that simulate the transient break-up and coalescence of droplets as they are transported with a rising plume. Models of both types are being compared against available laboratory and field data on droplet size distributions.
In the second part, droplet sizes computed with different models, and with the same model with and without dispersants, are input to oil transport models ranging from near-field plume and intrusion models to integrated models that simulate transport and fate over distances of 1000s of km. Our work will culminate in a workshop scheduled for January 2014 in which modeling groups are being invited to use their particular transport model to assess the efficacy of dispersants in a range of standardized case studies.

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Interfacial Thermodynamics of Pickering Emulsions Stabilized by Two-Dimensional Materials

Presenter: Robert Hurt
Brown University
Authors: M. Creighton[1], A. Bose[2], R. Hurt[1];
[1]Brown University, Providence, RI, [2]University of Rhode Island, Kingston, RI.

Abstract:
An important class of alternative dispersants uses fine particles that localize at oil-water interfaces to achieve emulsification. These so-called Pickering emulsions commonly employ equi-axed particles, but may also use plate-like particles, such as phyllosilicate minerals or two-dimensional (2D) synthetic materials. This study combines experiments and thermodynamic analysis to explore unique features of plate-stabilized emulsions, which include high mass potency, high stability to droplet coalescence, and barrier properties that control molecular transfer between droplet and continuous phases. We present a first interfacial thermodynamic analysis for ultrathin and atomically thin two-dimensional materials, and derive expressions for the free energies of emulsion stabilization that account for geometry, Van der Waals transparency and opacity, and variable hydrophobicity. The performance of these 2D stabilizers is shown to be the result of high atom efficiency and multilayer conformal tiling. The model is applied to emerging graphene materials, which are now widely available in a range of layers numbers, lateral dimensions and surface chemistries. The model successfully predicts that graphene oxide but not pristine few-layer graphene is suitable for Pickering emulsion stabilization. Emulsions stabilized by 2D materials show barrier behaviors with dramatically reduced evaporation rates from the dispersed phase relative to spherical particles or molecular surfactants.

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Amphiphilic Polymer Grafted Silica Nanoparticles by Combination of Ring Opening Polymerization of ε-Caprolactone and Coupling of Poly(ethylene Glycol) by Esterification

Presenter: Muhammad Ejaz
Tulane University
Authors: M. Ejaz, S. M. Grayson;
Tulane University, New Orleans, LA.

Abstract:
The synthesis of amphiphilic polymer grafted silica nanoparticles (AGNs) as critical micelle concentration (CMC)-independent unimolecular micelle dispersants (UMDs) was explored. While small molecule surfactants can form micelle that can act as dispersants, their effectiveness at low concentrations is hampered by their CMC. UMDs are expected to provide a benefit to the affected ecosystem by breaking up the oil into microdroplets, without disaggregation under high dilution. The synthesis of AGNs was achieved by grafting biocompatible amphiphilic diblock polymers shells onto silica nanoparticles cores (SNPC), through surface-initiated ring opening polymerization (SIROP) and activated ester coupling. The grafting of poly(ε-caprolactone) (PCL), biodegradable and hydrophobic, was achieved by SIROP of CL onto the SNPC. The grafted PCL chains exhibited compatibility with organic solvents, but could not form a suspension in water. The PCL inner block exhibited OH end groups that were then coupled with monomethyl ether carboxyl terminated polyethylene glycol (PEG-COOH), through esterification of the OH of PCL and the COOH of PEG-COOH to form the outer part of shell. With this hydrophilic PEG corona, AGNs exhibited stable suspensions in water. The structure and morphology of AGNs were characterized and confirmed by FTIR, TGA and TEM. Using 4-heptylphenol as a model for oil sequestration, it was demonstrated that the AGNs can effectively absorb this UV active hydrocarbon from water.

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Photoenhanced Toxicity of Crude Oil and Chemically Dispersed Oil to Copepods

Presenter: Sarah Baca
University of Texas at El Paso
Authors: S. Baca[1,2], R. Almeda[2], E. J. Buskey[2];
[1]University of Texas at El Paso, El Paso, TX, [2]University of Texas at Austin, Port Aransas, TX.

Abstract:
Chemical dispersants are commonly used in response to oil spills, however, little is understood about their toxicity or their effect on the toxicity of crude oil to zooplankton. Also, recent studies suggest that UVB radiation (UVB) may play an important role on the toxicity of crude oil. We determined the effects of the dispersant Corexit 9500A and UVB on the toxicity of petroleum to copepods by investigating lethal and sublethal effects in adults and nauplii of Acartia tonsa and Pseudodiaptomus pelagicus. At the ratio of dispersant to oil commonly used in oil spills (1:20), exposure to dispersant-treated petroleum resulted in increased mortality and reduced egg production, hatching and egestion rates in adult stages of A. tonsa, compared to oil alone. Nauplii survival and growth rates were significantly lower when exposed to dispersant-treated petroleum than to petroleum alone. UVB radiation increased the lethal and sublethal effects of crude oil and chemically dispersed oil to copepod nauplii. The median lethal concentration for nauplii decreased from 1.9 µLL-1 without UVB to 1.2 µLL-1 with UVR. Similarly, we found that toxicity of petroleum and dispersant-treated petroleum increased from 24% to 66% and from 67% to 100%, respectively, under UVB exposure. Overall, our results show that copepod nauplii are highly sensitive to petroleum and that toxicity of petroleum to zooplankton increases with the use of dispersant and under UVB radiation.

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Probing oil-water-dispersant interaction at the nanometer length scale using small angle x-ray scattering

Presenter: Amitava Roy
Louisiana State University
Authors: L. Bovenkamp, A. Roy;
Louisiana State University, Baton Rouge, LA.

Abstract:
The interaction of hot crude oil with seawater and dispersant at depth involves complex physical and chemical processes. Different fractions of crude oil, defined by molecular weight and solubility, is expected to respond differently during this interaction leading to phase separation, droplet formation, bubble formation, etc. Scattering by light, X-rays and neutrons can be used to study these processes at length scales from nanometers to micrometers. In situ experiments can also be conducted. These techniques also allow measurement without any sample pre-treatment. The present focus of this study is the structure at tenths to hundreds of nanometer length scale by small and wide angle X-ray scattering (SAXS and WAXS).
A suite of samples from BP's Deepwater Horizon accident was studied by SAXS and WAXS. The samples included emulsified oil, in situ burn residue, tar balls, and riser oil with or without Corexit 9527A. WAXS showed that emulsification or burning lead to expulsion of n-napthene from the heavier fraction crude oil (mostly asphaltene). Addition of dispersant Corexit and emulsification increased the size of the dominant structure in the riser oil from 0.9 nm, to 2.3 nm to 7.0 nm.

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Effects of dendrimer oil dispersants on Dictyostelium discoideum

Presenter: Nicholas K Geitner
Clemson University
Authors: N. K. Geitner, R. R. Powell, T. Bruce, D. A. Ladner, F. Ding, P. Ke;
Clemson University, Clemson, SC.

Abstract:
Cationic poly(amidoamine) (PAMAM) dendrimers have been proposed as novel, biocompatible oil dispersants. Here, we investigate the effect of such dendrimer oil dispersants on the soil amoeba Dictyostelium discoideum, using phenanthrene as a model polyaromatic hydrocarbon. In examining cell culture proliferation and changes in membrane potential, we find that low concentrations of cationic generation-4 PAMAM dendrimers were non-toxic to Dictyostelium discoideum. In comparison, the same low concentration of the primary surfactant in the COREXIT oil dispersant, Tween 80, did display limited acute cytotoxicity. Higher concentrations of dendrimer

oil dispersant elicited cytotoxicity due to significant depolarization of the cell membrane resulting from the uptake of highly cationic PAMAM dendrimers. Cellular uptake of cationic PAMAM dendrimers was confirmed by a cellular association experiment conducted at room temperature and 2ºC, using fluorescence imaging. The uptake and corresponding membrane depolarization was found to be significantly inhibited by the presence of phenanthrene within and around the periphery of the dendrimers. In response to the physical effects of cationic PAMAM dendrimers, we also examine the fundamental interactions between model hydrocarbons and PAMAM dendrimers of varying surface charge. This study offers a new insight on the environmental implications of oil dispersants.

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Lipid-coated silica nanoparticle oil dispersants

Presenter: Sarah Fields
University of Rhode Island
Authors: S. Fields, G. Bothun;
University of Rhode Island, Kingston, RI.

Abstract:
Currently it is of interest to develop alternatives to traditional dispersants that are used in response to oil spills. This study investigates lipid-coated silica nanoparticles as oil-responsive particles for creating oil-in-water dispersions. The lipid coating is in the form of an adsorbed bilayer that inhibits particle aggregation in water, but restructures and renders the particles hydrophobic at an oil/water interface and capable of forming Pickering emulsions. Dipalmitoylphosphatidylcholine (DPPC) and dioleoylphosphatidylcholine (DOPC) were examined to test the effects of lipid phase state on dispersion performance. At room temperature DPPC exhibits an ordered gel phase, while DOPC exhibits a disordered fluid phase. The stability and performance of these particles were tested in water as a function of ionic strength, as well as with representative components of crude oil. The effect of these particles in conjunction with traditional surfactants, such as aerosol-OT or Tween-80, is also examined. Preliminary results suggest that DOPC-coated particles form the most stable Pickering emulsions. These novel lipid-coated silica particles can be dissolved in water, rather than an organic solvent, and have the potential to be an alternative to traditional surfactants used currently in the bioremediation of oil spills. This research is supported by BP/The Gulf of Mexico Research Initiative Grant No. SA 12-05/GoMRI-002.

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Design and synthesis of well-defined “polysoaps” to serve as uni-molecular micelles for oil spill remediation

Presenter: Phillip D. Pickett
University of Southern Mississippi
Authors: C. L. McCormick, P. D. Pickett;
University of Southern Mississippi, Hattiesburg, MS.

Abstract:
Conventional surfactants have been shown to be inefficient for oil spill remediation due to oil re-deposition upon dilution of the surfactant micelles below the critical micelle concentration. The goal of this work is to design unimeric micelles with low toxicity that can efficiently sequester hydrocarbons while exhibiting no concentration dependence. Both anionic and cationic amphiphilic polymeric surfactants (“polysoaps”) have been prepared via RAFT polymerization resulting in precise structures with controlled molecular weights and narrow molecular weight distributions. Initial studies have shown that the anionic polysoaps with varying composition of hydrophobic dodecyl acrylamide and hydrophilic AMPS monomer units consist of a hydrophobic domain for hydrocarbon sequestration surrounded by a hydrophilic exterior for stabilization in water. Several of the anionic polysoaps exhibit unimolecular micelle behavior with increased capabilities of sequestering hydrocarbons and up to 60x less cytotoxicity as compared to the small molecule surfactant analog, SDS. The behavioral properties and concentration dependence of the uni- vs multi-molecular micelles are being studied by varying the composition and structure of the hydrophobic/hydrophilic monomers incorporated into the polysoaps. The conceptual aspects of this approach, as well as the synthesis, characterization and behavioral properties of these polysoaps will be discussed.

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Chemical Herding and the Anchoring of Surface Oil Layers using an Environmentally Benign Biopolymer

Presenter: Olasehinde G Owoseni
Tulane University
Authors: O. G. Owoseni[1], P. Venkataraman[1], E. Frenkel[1], J. He[1], G. McPherson[1], A. Bose[2], S. Raghavan[3], V. John[1];
[1]Tulane University, New Orleans, LA, [2]University of Rhode Island, Kingston, RI, [3]University of Maryland, College Park, MD.
Abstract:
Dispersants such as COREXIT 9500A are used in oil spill remediation with the objective of reducing the oil-water interfacial tension and breaking the slick into small oil droplets that are entrained in the water column for microbial degradation. In the treatment of surface spills it is often desired to use such surfactants as oil-herding agents to thicken the surface slick sufficiently (2-3 mm desired) to allow for in-situ burning or enhanced removal without the need for mechanical containment. However, surface diffusion of such herding agents over large areas leads to re-thinning of the slick and the inability to sustain burning. Here we seek to utilize an environmentally benign biopolymer, high molecular weight hydrophobically modified chitosan (HHMC) as a gelling agent to enhance herding of spill oil. We first use surfactants as oil-herding agents to corral the oil slick on water by the Marangoni effect. Then, the hydrophobically modified chitosan with alkyl groups attached to the chitosan backbone is applied to the thickened oil layer. The hydrophobic side chains insert in the oil phase, anchoring the polymer to the oil water interface, and leading to the formation of a gel-like matrix. Our results indicate that the application of the HHMC biopolymer changes the rheological properties of the oil-in-water emulsion to that of a weak gel. The ability of the biopolymer to tether the oil droplets into a gel-like matrix has significant applications in the immobilization of surface oil spills.

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Sorption of Corexit Ingredients to Gulf of Mexico Sediments

Presenter: Bruce J Brownawell
Stony Brook University
Authors: B. J. Brownawell[1], B. S. Adewale[1], D. L. Sparks[2];
[1]Stony Brook University, Stony Brook, NY, [2]Mississippi State University, Mississippi State, MS.
Abstract:
Sorption of dispersant ingredients to suspended particles and sediments may affect their biogeochemistry, bioavailability, and whether they accumulate or persist in sediments. Corexits and alternative dispersant formulations are complex mixtures of contaminants, possessing a wide range of solution phase and surface properties. Our goal is to better understand how the properties of sorbents, surfactants, and surfactant residues influence sorption. Here we focus on results and insights garnered to date, emphasizing effects of structure on sorption, and implications of our findings on the fate of Corexit ingredients in the Gulf of Mexico. Negligible sorption was detected for the highly soluble dipropylene glycol butylether and a mixture of persistent metabolites of TWEEN 80/85, suggesting that they could be ideal candidates for use as water mass tracers. Sorption of many nonionic fatty acid esters present in TWEEN and SPAN surfactants is high enough that they may be significantly scavenged from seawater in environments with modest levels of suspended particles. While sorption of anionic DOSS was less than that of nonionic surfactants, the range of sediment-water distribution coefficients measured to date (14 - 320 L/Kg at > 20 nM for a range of sediment types) are lower than might be expected from reverse phase HPLC retention times or reports of substantial loss of DOSS to surfaces of labware or analytical instruments. DOSS was hypothesized to act as conservative tracer in the subsurface plume resulting from the Deep Water Horizon spill. Unless sorption is orders of magnitude greater at the lower concentrations of DOSS observed in the plume, particle scavenging should not be an important process affecting the distribution of DOSS measured.

Session: 008
Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-332

The use of natural ammonia removing agents for preserving bait and fresh caught fish

Presenter: Wen Zhao
University of South Florida
Authors: W. Zhao, Y. Zhang, D. Stebbins, S. Pettit, S. Ergas, N. Alcantar;
University of South Florida, TAMPA, FL.
Abstract:

Sea water or fresh water fishing is one of the most popular outdoor entertainments in the U.S.A., in particular, Florida. Conventionally, fish tanks are aerated to maintain up to 99.5% saturation of dissolved oxygen. However, high concentrations of ammonia produced by fish waste can be lethal in fish tanks, even though oxygen availability is rich enough to keep fish breathing. The aim of this project is to develop a commercial product that is user-friendly, sustainable, affordable, and able to extend the life of the fish by removing ammonia safely. The research approach was twofold. The first part focused on identifying the ammonia produce rates when fish was stored in aeration systems of various volumes in fresh and salt water environments. The second part centered on using natural chabazite pellets as an ammonia trapping agent. Chabazite is an inexpensive tectosilicate mineral of the zeolite group that has high ion-exchange capacity. By controlling the temperature, pH, salinity and dissolved oxygen concentration separately in both fresh and salt water systems, the optimum chabazite amounts and pretreatment was determined. We found that 15 g of deionized (DI) water pre-washed chabazite with particle sizes ranging from 1 to 2 mm can remove 73 ± 3% of NH4-N for up to 5 days when fish density is very high. Meanwhile, natural chabazite also works in seawater environments. We found that 15 g of chabazite can remove 64 ± 5% of NH4-N for up to 5 days in high fish densities, and 60 ± 6% of NH4-N in low density fish.
It is expected that this product can be widely used in fisheries and individual fish tanks to preserve both bait and fresh caught fish.This technology is also expected to aid in dispersant deployment.

Session: 008
Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Advances in Dispersant Science and Technology: Molecular Mechanisms, Novel Dispersant Systems, and Environmental Impacts
Type: Poster 8-333

Rheology of Pickering Emulsions: Effect of Particle Shape

Presenter: Hari Katepalli
University of Rhode Island
Authors: H. Katepalli, A. Bose;
University of Rhode Island, Kingston, RI.

Abstract:
Pickering emulsions are stabilized by the strong adsorption of colloidal particles at the oil-water interfaces which acts as mechanical barriers against droplet coalescence. Size, shape and wettability of the particles will have great influence on the formation and stability of the emulsions. Stability of the droplets can be assessed by looking at the interfacial viscoelastic properties of the emulsion droplets which depend on the shape of the particles (the effective coverage and the particle-particle interactions on the droplet surfaces depends on particle shape). So, we are looking at the rheological properties of oil in water emulsions stabilized with spherical and fumed silica particles. Systematic studies are being done by changing the particle concentration and oil volume fraction and the effect of particle shape on the module are being scaled to understand strength of the particle network on the droplets.

Session 009: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill

Session: 009
Date: Tuesday, January 28 - 10:00 AM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

Food Frequency Questionnaire to Discern Seafood Consumption Patterns in Northern Gulf of Mexico Communities As Relevant to the DWH Oil Spill

Presenter: Makyba K. Charles
University of Florida, Aquatic Pathobiology Laboratories
Authors: M. K. S. Charles[1], L. D. Stuchal[2], S. M. Roberts[2], A. E. Mathews[3], B. A. Brumback[4], R. Brooks[1], A. S. Kane[1,2];
[1]University of Florida, Aquatic Pathobiology Laboratories, Gainesville, FL, [2]University of Florida, Center for Environmental and Human Toxicology, Gainesville, FL, [3]University of Florida, Food Science and Human Nutrition, Gainesville, FL, [4]University of Florida, Department of Biostatistics, Gainesville, FL.

Abstract:
The Deepwater Horizon oil spill had notable direct and indirect impacts on coastal Gulf of Mexico communities. To estimate impacts on commercially harvested Gulf seafood, the US FDA conducted a risk assessment based on standard assumptions and methods. Regulatory agencies concluded that Gulf-harvested seafood is safe to consume, yet varying degrees of distrust by Gulf coast residents persisted. This distrust, in part, was associated with conclusions and policy decisions based on assessments that may not adequately reflect risk in individual coastal communities. Use of national average statistics (i.e., 80 kg adult body weight, daily average consumption of 49g, 12g and 13g of fish, oysters and shrimp/crab, respectively) and lack of toxicity adjustment for early-life susceptibility have detached the risk assessment from the communities most impacted by the oil spill. In an effort to optimize risk assessment and include important regional differences, we developed a food frequency questionnaire (FFQ) to analyze community-specific body weight and seafood consumption patterns, including non-commercial inshore species. Household data amassed from this FFQ will be used to estimate consumption of inshore Gulf seafood, including finfish, shrimp, blue crab and oyster, and to perform risk assessment on a regional scale. Questionnaire components that exemplify approaches to the community-specific seafood consumption assessment, and seafood safety perception, are highlighted.

Session: 009
Date: Tuesday, January 28 - 10:15 AM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

Simultaneous exposure to chronic hypoxia and dissolved PAHs results in reduced egg production and larval survival in the sheepshead minnow (Cyprinodon variegatus)

Presenter: Bryan Hedgpeth
University of Southern Mississippi
Authors: B. Hedgpeth, R. J. Griffitt;
University of Southern Mississippi, Hattiesburg, MS.

Abstract:
Previous research has indicated possible crosstalk between the molecular pathways fish use to respond to hydrocarbon and hypoxia stress. Given that estuarine fish in the northern Gulf of Mexico are annually exposed to hypoxia, the interaction between oil exposure and hypoxia is worthy of investigation. To investigate this interaction, we exposed adult and larval Sheepshead minnow (Cyprinodon variegatus, SHM) to crude or dispersed oil under both normoxic and hypoxic conditions. We examined total egg production, egg hatching success, larval survival post hatch, and expression of cytochrome P450 1A (CYP1A). Our results indicate that co-exposure to crude or dispersed oil and hypoxia resulted in a significant decrease in egg production, as well as a significant decrease in both egg hatch success and larval survival post hatch in co- exposed eggs. Interestingly, expression of CYP1A when SHM were exposed to crude or dispersed oil and hypoxia was higher than when SHM were exposed to crude or dispersed oil alone. The mechanism for this is under investigation. The significant impact on reproductive success following crude or dispersed oil and hypoxia exposure indicates the importance of including environmental parameters such as hypoxia when evaluating the impact of an oil spill.

Session: 009
Date: Tuesday, January 28 - 10:30 AM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

Exposure and Health Impact Differences Between an Exposure and Epidemiological Study

Presenter: Jaishree Beedasy
Columbia University
Authors: D. Abramson[1], J. Beedasy[1], L. Peek[2];
[1]Columbia University, New York, NY, [2]Colorado State University, Fort Collins, CO.

Abstract:
Understanding the association between pediatric physical and mental health symptoms and exposure to the Deepwater Horizon Oil Spill is critical to public health assessments of potential population impacts. This presentation will focus on the differences between two population samples in the Gulf Coast, one constituted as an exposure study and the other an epidemiological study constituted to estimate the prevalence of oil spill exposure and health effects. The exposure study, entitled the Gulf Coast Population Impact project (GCPI), surveyed 1,437 randomly sampled parents in a four-state region from Florida to Louisiana in 2012. Census blocks were selected based upon a standardized oil impact score composed of BP compensation claims data and NOAA oil monitoring data. Despite considerable variation in reported oil exposure among respondent households, it was expected that these rates would be higher than population rates since the census blocks were expressly selected as more likely to have been exposed to the economic and environmental hazards associated with the oil spill. The epidemiological study, the Women and Their Children Health Study (WaTCH), is an ongoing cohort study that has enrolled a representative sample of over 300 children and youth to date in a seven-parish region in Louisiana. Categorical and multi-variate regression analyses will be conducted to (1) contrast post-spill physical and mental health symptom prevalence, (2) pool the data and examine the association of health effects and reports of direct exposure, and (3) control for such confounders as age, race/ethnicity, and socioeconomic status. We will explore implications of different sampling strategies as well as the strength of pooled analyses.

Session: 009
Date: Tuesday, January 28 - 11:30 AM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

Associations between oil spill experience and mental health in pregnant and reproductive-aged women

Presenter: Emily Harville
Tulane University
Authors: E. H. Harville, M. Jacobs, A. Shankar;
Tulane University, New Orleans, LA.

Abstract:
Experiencing natural or technological disasters can be associated with worsened mental health. 485 pregnant and reproductive-aged women were recruited from southern Louisiana areas affected by the Deepwater Horizon oil spill. Women were interviewed about their exposure to oil and personal effects of the oil spill, and completed the Edinburgh Depression Scale and the Post-traumatic Checklist. Log-linear models were used to assess the relative risk of worse mental health associated with oil spill experiences, with adjustment for age, BMI, education, race, and marital status. Most strongly associated with mental health were spending time in an area where oil, oily materials, or chemicals were being used (aRR for depression, 2.14, 95% CI 1.25-3.68); having someone close to you injured or killed in the explosion (aRR for depression 4.25, 1.93-9.33); losing income or earning capacity due to the spill (aRR for depression 1.17, 1.00-1.37); and coming into contact with oil during activities such as fishing (aRR for depression 1.71, 1.07-2.74; for PTSD 2.15, 1.02-4.54). There were no associations with being involved in cleanup work, handling wildlife, spending time on the beaches, or using areas affected by the spill. Involvement in legal proceedings was, if anything, protective against mental health problems (aRR for depression for “believe legal representation is needed”, 0.84, 0.71-1.00; for “there have been a lot of demands made by litigation” 0.84, 0.71-1.00). Direct and severe experience of the oil spill was associated with depression, but other indicators of oil spill exposure were not. Unlike some previous studies, involvement in legal proceedings did not worsen mental health.

Session: 009
Date: Tuesday, January 28 - 11:45 AM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

New Evidence for the Impact of Cumulative Life Trauma on Mental Health Outcome after the Gulf of Mexico Oil Spill

Presenter: Lynn M Grattan
University of Maryland School of Medicine
Authors: L. M. Grattan[1], L. K. Baker[1], B. A. Brumback[2], S. M. Roberts[1], S. F. Holobaugh[1], X. Mi[2], A. C. Toben[1], J. G. Morris[3];
[1]University of Maryland School of Medicine, Baltimore, MD, [2]University of Florida, Gainesville, FL, [3]University of Florida Emerging Pathogens Institute, Gainesville, FL.

Abstract:
The psychological consequences of the Gulf of Mexico Oil Spill Disaster may be among the most widespread, costly, and long-term of all spill-related impacts. However, behavioral reactivity does not occur in a vacuum as most adults bring a history of tragedies and triumphs to stressful situations. This study examined the role of cumulative trauma in mental health outcome one year after the Gulf of Mexico Oil Spill Disaster. Seventy-five adult men and women from Alabama and NW Florida coastal communities were studied with standard measures of traumatic life events, risk perception, and mental health outcome one year post oil spill. Based upon a multivariate proportional odds model, cumulative traumatic life events, income loss, and risk perception had a significant association with persistent mental health problems (p = .004; p = .036; p = .003, respectively). Age, race, and gender were not contributory. Natural disasters (93%), sudden death of a loved one (92%), and other accidents (e.g., motor vehicle accident; 80%) were the most frequently reported traumatic events in the history of study participants. Findings support the need to assess mental health outcomes within the context of cumulative life trauma after oil spill disaster. Early interventions should take into account the interplay of multiple cumulative stressors on mental health reactivity.

Session: 009
Date: Tuesday, January 28 - 12:00 PM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

Mental health symptoms among GuLF STUDY participants involved in the Deepwater Horizon oil spill clean-up

Presenter: Richard Kwok
NIEHS
Authors: R. Kwok[1], L. Engel[2], C. Ekenga[1], A. Miller[1], A. Blair[3], D. Sandler[1];
[1]NIEHS, Research Triangle Park, NC, [2]University of North Carolina at Chapel Hill, Chapel Hill, NC, [3]NCI, Bethesda, MD.

Abstract:
Background: Workers and communities impacted by previous oil spills have shown increases in depression, anxiety, and other adverse mental health outcomes. The GuLF STUDY is a longitudinal investigation of potential health effects among workers involved in the Deepwater Horizon oil spill clean-up. Participants confronted a range of potential physical and psychosocial stressors including exposures to oil and dispersants, income uncertainties, and challenges of family and community disruption.
Methods: Demographic, exposure, and health information was collected during telephone interviews. Standardized surveys administered to 11,210 participants during home visits captured mental health outcomes including depression, anxiety, PTSD, resiliency and coping. Mental health findings were evaluated in relation to task-based qualitative estimates of spill-related exposures as well as socioeconomic factors.
Results: Preliminary findings will be presented which reflect how mental health symptoms were influenced by participant exposures after accounting for socioeconomic and other factors that contribute to mental well-being.
Conclusions: Adverse psychosocial and mental health outcomes appear to play an important role in the aftermath of the Gulf oil spill. Improved understanding of risk factors and health effects can lead to enhanced preparedness, resiliency, and recovery for workers, and their communities.

Session: 009
Date: Tuesday, January 28 - 12:15 PM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

Prepared for the Worst? Resilience Gaps in the Natural/Technological Disaster Divide

Presenter: Brian Mayer
University of Arizona
Authors: B. Mayer, H. Clarke, K. Bergstrand;
University of Arizona, Tucson, AZ.

Abstract:
Disaster preparedness is a common cultural norm for communities along the Gulf of Mexico coast. Generations of experience with natural disasters, largely in the form of hurricanes, has created a cultural script based on local ecological knowledge, past experience and community cohesion that forms the basis for preparedness, response, and recovery. Despite these feelings of self-efficacy and community preparedness, the Deepwater Horizon oil spill challenged many assumptions about individuals' and community's abilities to bounce back. Based on hundreds of hours of interviews and focus groups with community stakeholders in the eastern Gulf Coast, this paper explores the differences in expectations of and resiliency to natural and technological disasters. We find that several key aspects differentiated natural disasters from experiences with the oil spill, most prominently the stress and anxiety-inducing uncertainty inherently not only in the long term ecological effects of the oil spill but also in the complex short-term response from various emergency management agencies. In addition to high levels of uncertainty, a lack of control imposed by the strict legal structures governing the response lead to low levels of self-efficacy regarding response - leading to elevated levels of individual and community distress. In conclusion, we argue that future preparedness efforts need to take into account the potentially divergent experiences from natural and technological disasters by developing response plans that better translate local experience and knowledge into a variety of scenarios.

Session: 009
Date: Tuesday, January 28 - 12:30 PM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

Resilience of Ecosystem Services and Coastal Communities

Presenter: David Yoskowiitz
Harte Research Institute
Authors: D. Yoskowiitz;
Harte Research Institute, Corpus Christi, TX.

Abstract:
Human well-being and community resilience are closely tied to ecosystem resilience, especially for coastal communities that rely on the environment for inputs into the production of market goods (food, fiber, etc···) or non-market goods and services (storm protection, water filtration, etc···). We will present the findings on resilience in the final National Research Council report from the Committee on Ecosystem Services and the Deepwater Horizon Oil Spill. Considerations of resilience are especially important in systems that can undergo persistent and fundamental shifts in structure and function following disturbances, such as a hurricane or oil spill. Increasing resilience can reduce the risk that the system will cross critical thresholds and undergo a detrimental regime shift. On the other hand, decreasing resilience can increase the probability of a beneficial regime shift. Can factors that increase system resilience be identified and managed to increase (decrease) the resilience of a system to a "desirable" ("undesirable") state? System resilience can play an important role in maintaining conditions that promote the sustainable provision of ecosystem services that contribute to human well-being. However, a narrow focus on trying to stabilize complex systems to provide a constant flow of ecosystem services may reduce system resilience and increase vulnerability. An event like the DWH oil spill may disrupt service provision, but a resilient ecosystem will allow faster recovery so that service provision will return sooner rather than later or never.

Session: 009
Date: Tuesday, January 28 - 12:45 PM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

Coastal resilience and the market for Gulf seafood

Presenter: Rex H. Caffey
Center for Natural Resource Economics & Policy, Louisiana Sea Grant College Program
Authors: R. H. Caffey, M. A. Savolainen;
Center for Natural Resource Economics & Policy, Louisiana Sea Grant College Program, Baton Rouge, LA.
Abstract:
As part of ongoing efforts to profile and integrate metrics of coastal resiliency across multiple disciplines, this presentation focuses on indicators of economic resilience for the Gulf of Mexico seafood industry. A case study is used to demonstrate how post-spill concerns regarding coastal seafood safety may have impacted resilience and market share. The study examines the demand for Gulf seafood using a non-linear almost ideal demand system (AIDS) model based on domestic landings and import data (1997 to 2012) from the National Marine Fisheries Service. Four share equations were estimated for the different geographic sources of seafood: Gulf region, Atlantic region, Pacific region, and imported. A time trend variable was incorporated into the time series model, and the seasonality of dockside demand was accounted for through the use of dummy variables by quarter. A dummy variable was also used to estimate any permanent shifts in demand for each geographic source of seafood beginning in April 2010. Seasonality in dockside demand was clearly a significant factor for each category of seafood examined. Perhaps more interesting, preliminary results suggest that a permanent shift in the demand for Gulf seafood occurred post-spill. Results are discussed in the context of interdisciplinary research with the goal of identifying opportunities for longitudinal data collection efforts and the establishment of pre-disaster baselines.

Session: 009
Date: Tuesday, January 28 - 2:45 PM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

Use of the Community Assessment for Public Health Emergency Response (CASPER) to Meet the Data Needs of a New Interstate and Interagency Partnership

Presenter: Lauren Czaplicki
Louisiana Public Health Institute
Authors: L. Czaplicki[1], M. Morrison[2], S. Francois[1];
[1]Louisiana Public Health Institute, New Orleans, LA, [2]Alabama Department of Public Health, Bay Minette, AL.
Abstract:
The Louisiana Public Health Institute (LPHI) administers the Gulf Region Health Outreach Program (GRHOP) Primary Care Capacity Project (PCCP) across 17 Gulf Coast counties. The goal of PCCP is to increase access to integrated primary care with linkages to mental, behavioral, environmental and occupational health care for residents in areas vulnerable to the impact of man-made and natural disasters. One key component of the PCCP is to conduct regional community health assessments alongside GRHOP partners to identify sub-county health disparities and inform priority-setting and financial investment in community health centers. In 2010 and 2011, the Alabama Department of Public Health successfully completed two years of data collection using the CASPER. In 2012, to support local health assessment efforts, LPHI partnered with state, county and academic entities in Alabama to conduct a third CASPER. LPHI engaged partners across jurisdictions to identify common objectives; partner agencies collaborated on questionnaire design, sampling frame selection and the development of an analysis plan. The CASPER was an effective, rapid method of obtaining a third year of primary data; a total of 749 questionnaires were completed over five days across four sampling frames with high completion rates (85-92%). The collaboration successfully minimized duplication of efforts and informed collaborative community health activities with a focus on increasing access to high quality, integrated primary care.

Session: 009
Date: Tuesday, January 28 - 3:00 PM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

Utilizing A Community Advisory Committee To Define Future Community Efforts For The Healthy Gulf, Healthy Communities Project

Presenter: Angie B Lindsey
University of Florida
Authors: A. B. Lindsey[1], T. A. Irani[1], S. R. Mathews[2];
[1]University of Florida, Gainesville, FL, [2]University of West Florida, Pensacola, FL.
Abstract:

At the foundation of the Healthy Gulf, Healthy Communities (HGHC) project, funded by NIEHS, is the community based participatory research model. Our initial work included establishing community partners and a community advisory committee (CAC) with representatives from affected communities. Partners have developed initial design, data collection, outreach efforts and communication of results with the HGHC Team. In August 2013, the Community Outreach and Dissemination (COD) Core team conducted an environmental scan with nine members of the CAC. Their input was indicative of the evolution of the communities away from the disaster of the DWH oil spill to refocusing on longstanding societal problems. Partners discussed that generational poverty hampers resilience. They indicated that the demand for services continues to be above pre-DWH disaster levels and spoke of the growing problem that NGOs, faith-based organizations, and other groups supporting recovery and resiliency faced with diminishing resources to support continued recovery. In response to the feedback from our community partners, the COD team have refocused efforts to include developing a regional network to support NGO development and community resiliency, providing training for communities that fosters consortium building, identifying initiatives by partners for mitigating key factors limiting resiliency and exploring development of a regional community resource organization incubator and community resiliency center.

Session: 009
Date: Tuesday, January 28 - 3:15 PM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

Making Environmental Health Science Relevant at the Grass Roots: a CBPR collaboration among fishermen and scientists to investigate human health and ecosystem integrity post DWH oil spill

Presenter: John P Sullivan
University of Texas Medical Branch
Authors: J. P. Sullivan[1], S. Croisant[1], W. Subra[2], M. Orr[2], S. Ansari[1], H. Fernando[1], G. Rowe[3], L. Kuklyte[3], M. Howarth[4], A. Khan[1], D. P. Jackson[1], (. Alabama Fisheries Cooperative[5], C. Elferink[1];
[1]University of Texas Medical Branch, Galveston, TX, [2]Louisiana Environmental Action Network (LEAN), Baton Rouge, LA, [3]Texas A & M, Galveston, TX, [4]University of Pennsylvania, Philadelphia, PA, [5]Alabama Fisheries Cooperative, Coden, AL.
Abstract:
A Community Based Participatory Research design promotes grassroots environmental health education and meaningful citizen involvement in all aspects of the research cycle. The “Gulf Coast Health Alliance: Health Risks Related to the Macondo Spill” (GC-HARMS) fosters a strong collaborative network informed by CBPR values and principles shared among community hub coordinators, Community Outreach & Dissemination (COD) project staff, and fishing communities affected by the DWH oil spill. Direct involvement in data collection empowers community fishermen to actively participate in the process as citizen field scientists and peer-to-peer environmental health educators. Through curricula developed and deployed by GC-HARMS staff and the Louisiana Environmental Action Network, fishermen volunteers are trained in sampling techniques, sample preparation protocols, and sample handing / chain of custody maintenance. They gather, label and GPS log samples of targeted species during commercial and subsistence fishing activities and prepare / deliver samples for GC-MS analysis of petrogenic PAH content. COD staff and community sampling hub coordinators present recurring fishermen’s forums to disseminate site-specific updates on sampling data, and discuss evolving data interpretation and general ecosystem health. These iterative meetings are hosted by each community sampling / information dissemination site in the network.

Session: 009
Date: Tuesday, January 28 - 4:00 PM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

Secondary Science Education in Southeast Louisiana_Connecting with Teachers and Students Through Higher Education Environmental Health Sciences

Presenter: Lynette Perrault
Tulane University
Authors: L. Perrault, M. Lichtveld, J. Wickliffe;
Tulane University, New Orleans, LA.
Abstract:
The Emerging Scholars Environmental Health Sciences Academy at Tulane University was designed to help bolster science education in southern Louisiana through active participation in the environmental health sciences. With funding from the Environmental Health Literacy and Capacity Project under the Gulf Region Health Outreach Program, we developed a multipurpose training grant for developing mentoring skills in postdoctoral fellows, while simultaneously engaging high school students in rigorous environmental health science research and instruction. Nine scholars were selected for the program following intensive outreach and recruitment of upperclassmen from public/charter/magnet high schools. Scholars completed an 8-week program in summer 2013 that resulted in the completion and presentation of an environmental health sciences research project. In addition, 11 high-school science teachers participated in a 2-day workshop that provided them with classroom tools, instructional modules, and field experience demonstrating environmental health and scientific principles. All objectives were aligned with Louisiana Environmental Science Grade Level

Expectations and the recently released Next Generation Science Standards. Our continuing goals include program evaluation and impact with an overarching objective of helping to improve environmental health and science literacy in secondary public education.

Session: 009
Date: Tuesday, January 28 - 5:15 PM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

A Research Roadmap for the Future

Presenter: Bernard Goldstein
University of Pittsburgh
Authors: B. Goldstein;
University of Pittsburgh, Pittburgh, PA.

Abstract:
Background: Much is being done to investigate the health challenges facing the Gulf communities subject to the Deepwater Horizon oil spill. But the surface has barely been scratched. What is increasingly obvious is the importance of research capable of exploring the linkage between public health, environmental and psychosocial impacts. This requires collaboration across disciplinary, institutional and geographical boundaries. Such research cannot be effective unless there is full cooperation with the affected communities, including involvement of community members in the design, carrying out and evaluation of projects. Long term studies built on carefully obtained baseline information are necessary, as is recognition that the vibrancy of the Gulf communities requires the researchers to be alert to unexpected shifts in inputs that affect outputs and outcomes. The criteria for such research must focus on informing choices for the future rather than merely unraveling the past. While the challenges remain significant, based on the work to date there is reason for confidence that long term sustained cross-disciplinary research can significantly impact on the health of Gulf communities now and in the future.

Session: 009
Date: Tuesday, January 28 - 9:30 AM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

Human Research: Where are we?

Presenter: Linda Birnbaum
National Institute of Environmental Health Sciences
Authors: L. Birnbaum;
National Institute of Environmental Health Sciences, Triangle Park, NC.

Abstract:
Background: Each environmental or man-made disaster, such as the Deep Water Oil Spill, with its attendant health consequences is unique. However, valuable lessons can be learned from each one that can inform responses to future disasters. As such, NIH and NIEHS intramural and extramural funded investigators, in partnership with workers and numerous community groups, are engaged in an array of research efforts regarding the impacts of the oil spill including large-scale exposure reconstructions, toxicology research into mixtures of polycyclic aromatic compounds, seafood analyses, mental health and resiliency research, education and training, and improvements in disaster science preparedness. Additionally, epidemiologic investigations of at-risk community populations, as well as the GuLF STUDY of over 32,000 clean-up workers, are well under way. While these efforts provide an essential foundation for critical health research, the overarching strategy moving forward will be to build on this platform to further our understanding of the long-term effects on established cohorts, risk factors and markers, including genetic & epigenetic, of susceptibility and disease, and the complex stressors and interactions that contribute to community and individual resiliency or vulnerability. Leveraging of these, and other DWH research investments, through ongoing partnerships and new multidisciplinary collaborations will help to reduce adverse health effects and better prepare us for the future.

Session: 009
Date: Tuesday, January 28 - 9:45 AM
Room: Mobile Bay Ballroom I & II
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Oral

Factors Associated with Current Chemical Exposures in Gulf Residents

Presenter: Dale P Sandler
National Institute of Environmental Health Sciences/NIH
Authors: D. P. Sandler[1], C. Ekenga[1], L. Engel[2], A. Miller[1], D. Chambers[3], A. Blair[4], R. Kwok[1];
[1]National Institute of Environmental Health Sciences/NIH, Research Triangle Park, NC, [2]University of North Carolina, Chapel Hill, NC, [3]Centers for Disease Control, Atlanta, GA, [4]National Cancer Institute/NIH, Rockville, MD.

Abstract:
Background: Gulf residents have expressed concern that Deepwater Horizon oil spill exposures may have led to currently increased levels of related chemicals in blood and adverse health effects. Although benzene, toluene, ethylbenzene, and xylenes (BTEX) made up a large portion of the oil plume, most air measurements of volatile organic chemicals (VOCs) including BTEX collected from April - October 2010 did not exceed Occupational Exposure Limits. The biological half-life of these chemicals is short and other sources of exposure such as smoking can confound results. To address community concerns, we measured VOCs in a subgroup of participants in the GuLF STUDY, a prospective study of potential health effects associated with oil-spill clean-up.
Methods: In 2012 and 2013, we measured blood levels of VOCs in 1,148 participants. We also identified factors associated with exposure levels, including potential determinants of exposure and health measures.
Results: The proportion of samples above the limits of detection (LOD) ranged from 56% to 99% for BTEX chemicals and styrene, but median levels among nonsmokers were within US population ranges. For 33 of 40 other VOCs, fewer than 10% of participants had exposures above the LOD. We will present preliminary results from this study.
Conclusions: Information on sources of current chemical exposure and potential health effects may be useful to individuals and community leaders in evaluating oil-spill related health concerns.

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Type: Poster 9-334

Integrating Indicators of Social Vulnerability and Community Resilience to Assess Long-Term Recovery

Presenter: Brian Mayer
University of Arizona
Authors: K. Bergstrand[1], B. Mayer[1], B. Brumback[2], E. Benites-Gambirazio[1];
[1]University of Arizona, Tucson, AZ, [2]University of Florida, Gainesville, FL.

Abstract:
3.Social vulnerability pertains to the conditions that make communities susceptible to greater losses from hazards, while community resiliency refers to coping with and recovering from such threats. Together these concepts inform how communities may be differentially affected by disasters, with some experiencing higher losses and requiring greater resources to recover than others. Communities that are more vulnerable are likely to be the strongest candidates to need financial assistance and other resources to recuperate from disasters. More resilient communities may be able to mobilize internal resources, making them less dependent on outside systems of compensation for recovery. However, the communities that are the most vulnerable and the least resilient may also be unsuccessful at obtaining outside aid due to a lack of familiarity with claims processes, isolating those in most need of help and prolonging their path to recovery. To investigate these concepts, we examine 50 counties along the Gulf Coast affected by the oil spill. In this presentation, we examine community resilience and social vulnerability measures for each county, controlling for other factors such as oil exposure, to evaluate how these indices affect actual BP-related claims. These results suggest that future compensation processes should include programs responsive to the vulnerability and resilience levels of communities to ensure that such monies are equitably distributed to all areas in need of aid.

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Type: Poster 9-335

Metabolism of Representative Alkylated and Oxygenated Petrogenic Polycyclic Aromatic Hydrocarbons in Human Hepatoma (HepG2) Cells

Presenter: Meng Huang
University of Pennsylvania
Authors: M. Huang, L. Zhang, C. Mesaros, I. A. Blair, T. M. Penning;
University of Pennsylvania, Philadelphia, PA.

Abstract:
Exposure to petrogenic polycyclic aromatic hydrocarbons (PAHs) in the food-chain is the major human health hazard associated with the Deepwater Horizon gulf-oil spill. Risk assessment is based on the assumption that petrogenic and pyrogenic PAHs have similar toxicological profiles yet petrogenic PAHs are either alkylated or oxygenated and information on their metabolism is lacking. We report the metabolic fate of 6 representative alkylated petrogenic PAHs in the Macondo oil, and 3 representative oxygenated petrogenic PAHs that result from weathering in human HepG2 cells. The structures of the metabolites were identified by HPLC-UV-fluorescence detection, ion trap LC-MS/MS and Orbitrap LC-HRMS/MS. Alkylated petrogenic PAHs show no evidence of metabolism on the alkyl side chain. Metabolism is ring-based and involves formation of phenols and tetraols (P450 derived), *o*-quinones and catechols (AKR derived). Pretreatment with oil extracts inhibits P450 mediated metabolism indicating that parental alkylated PAHs may persist after absorption. Oxygenated PAHs show evidence for catechol and catechol conjugates (detoxication) and quinone metabolites that can still redox-cycle. These pathways show evidence for both detoxication and metabolic activation. Sulfated and glucuronidated catechols are observed as metabolites of both alkylated and oxygenated PAHs, and can be used as biomarkers of human exposure. (Supported by U19ES020676-03 to TMP)

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Type: Poster 9-336

Developing a Rapid Community Prioritization Process for the Gulf Region Health Outreach Program's Primary Care Capacity Project

Presenter: Alexandra Priebe
Louisiana Public Health Institute
Authors: A. Priebe, S. Francois, H. Farb, L. Czaplicki;
Louisiana Public Health Institute, New Orleans, LA.

Abstract:
The Gulf Region Health Outreach Program (GRHOP) is a 5-year program consisting of four integrated projects intended to strengthen healthcare and resiliency in 17 Gulf Coast counties and parishes in Louisiana, Mississippi, Alabama, and the Florida Panhandle. The Primary Care Capacity Project (PCCP), is a community-advised investment project intended to result in high quality, accessible, integrated, and sustainable community health centers that have an expanded relationship with additional health and human services and are more responsive to local community health needs. In December 2012, the Louisiana Public Health Institute (LPHI) convened GRHOP partners and community stakeholders from multiple sectors and conducted a guided prioritization process for stakeholders to explore key health needs and barriers to care within their communities in Mississippi, Alabama, and Florida. Stakeholder participants collectively reviewed primary and secondary data and voted in real-time on their top community health priorities. Key community stakeholder meetings for Louisiana will be conducted in November of 2013. The process developed by LPHI was informed by the work of National Association of County and City Health Officials on community needs assessments. This presentation will describe how LPHI conceptualized, planned, and implemented a rapid community health assessment and prioritization process in order engage key community informants from the identified counties and parishes. It will also briefly describe findings for each state convening and lessons learned.

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Total Disruptions, Personal Trauma and PTSD symptomolgy in impacted Alabama adolescents post Deepwater Horizon oil spill.

Presenter: Jennifer Langhinrichsen-Rohling
University of South Alabama
Authors: J. Langhinrichsen-Rohling, A. McCullars, A. Var, N. Vann, A. Hackett;
University of South Alabama, Mobile, AL.

Abstract:
Technological disasters tend to produce more long-term psychological distress, including PTSD. PTSD symptomology can present differently in adolescents and may be a function of social support, family reactions, and personal trauma impacts. PTSD symptom presentation in school-aged adolescents is important because PTSD is related to reduced academic achievement and impaired pro-social behaviors.
Thus, the current study investigated disruptions in an adolescent's life (n = 2,130 students from two impacted high schools) as a composite score of self-reported school, social, and family disruptions (i.e. total disruptions [TD]) after the Deepwater Horizon Oil Spill. The relationships between TD (scored as none, some, and many) and perceptions of personal trauma (PPT) (four groups) and the dependent variable of overall PTSD symptoms was determined. A second multivariate analysis was conducted with the same IV's and the four PTSD subscales (i.e. depression [PTSD-D], re-experiencing [PTSD-R], avoidance [PTSD-A], and hyperarousal [PTSD-H]) as the dependent variables. The first univariate analysis revealed a significant main effect for Total Disruption groups (all three groups differed, $p < .001$) and the four levels of Personal Trauma (all four groups differed; $p < .001$) as well as a significant interaction effect between the TD and PPT on PTSD symptoms ($p = .001$). The combination of the greatest sense of Personal Trauma in conjunction with high levels of disruption was associated with the greatest reports of PTSD symptoms. These findings held in a multivariate analysis which included each of the four PTSD subscales, with the exception of non-significant PTSD-H subscale interaction.

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Type: Poster 9-338

Assessing the exposure of benthic foraminifera to hydrocarbons by stable isotopic analysis

Presenter: Lauren M Reilly
University of South Florida
Authors: L. M. Reilly;
University of South Florida, St. Petersburg, FL.

Abstract:
Sediment cores were collected in the Northeastern Gulf of Mexico (GoM) in response to the Deepwater Horizon (DWH) oil blowout in 2010. These cores were collected to determine the effect of hydrocarbons on the benthic fauna, specifically the benthic foraminifera Cibicidoides spp. Cibicidoides spp. incorporates carbon isotopes into its test in equilibrium with the surrounding seawater dissolved inorganic carbon (DIC), which makes it an appropriate genus for determining exposure to petroleum which is δ13C depleted. The cores were sub-sampled at two or five millimeter resolutions. The sub-samples were thoroughly washed and all Cibicidoides spp. were picked throughout each sample down-core. The δ13C of the foraminifera calcite ($CaCO_3$) tests were analyzed from each sample using a ThermoFisher MAT 253 Stable Isotope Ratio Mass Spectrometer (SIRMS). The δ13C in the surface section of the cores (~ 10 mm), is depleted by 0.12‰ at the site closest to the wellhead, and 0.16 - 0.21‰ at the site farther afield, relative to the down-core sections. The depletion at the surface of three of the cores is significantly outside the natural variability. Records of δ13C in Cibicidoides spp. were paired with short-lived radionuclide (210Pb and 234Th) geochronologies to determine when the δ13C depletion occurred. Considering that the depletion takes place in 2010 - 2011, this suggests a petroleum contribution to the δ13CCaCO3. δ13C has proven to be an effective tool to document the incorporation of petroleum carbon in foraminiferal calcite tests. Further work is necessary to determine the amount of petroleum incorporated in foraminiferal calcite.

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Type: Poster 9-339

Integrating Mental and Behavioral Care into Schools and Clinics in Developing a System of Care and Promote Recovery and Resilience

Presenter: Anne Ciccone
LSU Health Sciences Cente
Authors: J. D. Osofsky, H. J. Osofsky, J. H. Wells, A. Ciccone;
LSU Health Sciences Cente, New Orleans, LA.

Abstract:
Following the Deepwater Horizon Oil Spill, surveillance data indicated increased mental health symptoms in children and adults in impacted communities still recovering from Hurricane Katrina and other disasters. The Mental and Behavioral Health Capacity Project in Louisiana (MBHCP-LA) is an integral part of the Gulf Region Health Outreach Program funded under preliminary agreement for the BP Deepwater Horizon Medical Settlement. With stakeholder, school and clinic input, MBHCP-LA utilizes a public health, inter-professional approach to provide supportive services and integrated direct therapeutic services in schools and clinics. Over 6,000 students are receiving screening evaluations annually with further services provided as indicated with full parental consent and involvement. Approximately 1000 children and adults are receiving culturally tailored, integrated mental and behavioral care in primary care clinics annually; this includes close interprofessional collaboration, onsite and telemedicine services, care management, and careful follow-up. To date, follow-up results demonstrate decreases in mental health and physical health symptoms and increases in self efficacy. Schools and clinics report benefits of the services as greater resilience in preparing for future disasters. This model, which addresses the interdependence of the exosystem and the ecosystem, has applicability to response and recovery plans for future disasters.

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Type: Poster 9-340

Assessing Personalized Exposures of Importance: Paired Indoor/Outdoor Air Sampling and Seafood Analyses in Southeast Louisiana

Presenter: Jessi Howard
Tulane University
Authors: J. Howard[1], T. Stock[2], E. Overton[3], D. Gauthe[4], D. Nguyen[5], M. Wilson[1], J. Wickliffe[1];
[1]Tulane University, New Orleans, LA, [2]University of Texas School of Public Health, Houston, TX, [3]Louisiana State University, Baton Rouge, LA, [4]Bayou Interfaith Shared Community Organizing, Thibodaux, LA, [5]MQVN Community Development Corporation, New Orleans, LA.

Abstract:
During and following the Deepwater Horizon accident in 2010, concerns regarding negative impacts on air and seafood quality were paramount. Though individual perceptions varied, many people in coastal communities in southeast Louisiana felt that they experienced increased exposure to oil- and dispersant-related compounds. An unprecedented effort in air and seafood monitoring during and following the spill indicated that this was likely not the case. Though seafood monitoring efforts continue and indicate the seafood is safe for human consumption, some individuals still consider the seafood contaminated and unsafe for consumption. To better inform individuals as to what chemicals are in their indoor and outdoor air, we have been conducting home assessments involving participants in risk analyses. We are also analyzing seafood or fish samples of most interest to participants for the presence and levels of polycyclic aromatic hydrocarbons (PAHs) including many that are specific to crude oil. Preliminary results indicate that levels of the selected volatile organic compounds are generally higher in indoor air samples when compared to paired-outdoor air samples. Seafood and fish analyses do not support the presence of PAHs at any levels that would represent a consumption health risk. We will discuss the implications of our findings to date and how involving individuals in the risk analysis/assessment process may aid informed decision-making.

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Type: Poster 9-341

Gulf Coast Health Alliance: health Risks related to the Macondo Spill (GC-HARMS) Study

Presenter: Sharon A Croisant
UTMB
Authors: S. A. Croisant;
UTMB, Galveston, TX.

Abstract:
GC-HARMS focuses on understanding the long-term health effects of the 2010 Gulf oil spill, resulting from the consumption of seafood contaminated by petrogenic PAHs. GC-HARMS partners include UTMB, the University of Pennsylvania, Texas A&M at Galveston, LSU, and impacted Gulf Coast communities: the Louisiana Environmental Action Network, the Center for Environmental and Economic Justice, the MS Coalition for Vietnamese Fisherfolk and their Families, the United Houma Nation, the AL Fisheries Cooperative, and Bayou Interfaith Shared Community Organizing. Our goals are to 1) assess seafood contamination, 2) determine PAH toxicity, 3) evaluate exposure and health outcomes in a longitudinal cohort study, and 4) disseminate findings to stakeholders. Local shrimpers, oystermen, crabbers and fin fishermen trained in the sampling process have collected 172 samples for testing via GC-MS; results will be used to develop consumption guidelines. Three research sites for human sampling were selected to include two communities from MS and one from LA with Galveston, TX serving as a comparison site. One hundred participants from each community will include representative samples of children, adults, and older adults, with approximately equal numbers of males and females. Each participant will be followed for three years to include baseline then follow-up surveys and a comprehensive physical exam including collection of biological samples (blood and urine). By December, 300 will be enrolled.

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Type: Poster 9-342

Quality of Life in NE Gulf Coast Communities Two Years After the Gulf of Mexico Oil Spill

Presenter: Lorien K. Baker
University of Maryland School of Medicine
Authors: L. K. Baker[1], S. Holobaugh[1], S. Roberts[1], J. G. Morris, Jr.[2], L. M. Grattan[1];
[1]University of Maryland School of Medicine, Baltimore, MD, [2]Emerging Pathogens Institute, University of Florida, Gainesville, FL.

Abstract:
A wide range of negative attitudes, perceptions and mental health outcomes have been reported in Gulf Coast residents in reaction to the stresses associated with the Gulf of Mexico Oil Spill. The purpose of this study was to examine quality of life (QOL) of NE Gulf Coast residents who were impacted by the oil spill, and the relationship between QOL and community of residence, income stability, and behavioral health outcomes. Participants included 179 adult men (n = 91) and women (n = 88) from an Alabama and NW Florida Gulf Coast community. Findings indicated that across all participants, the Environment domain of QOL was more disrupted than Physical Health, Psychological, and Social Relationship domains. With respect to participant subgroups, there were differences between the communities and income groups. The Overall QOL and General Health Quality (GHQ) index was better for the AL community compared to FL (t = -1.92, p =.05). For individuals with stable incomes post oil spill, both the Environment (t = 4.40, p < .001) and Overall QOL and GHQ (t = 2.22, p = .03) indices were significantly higher compared to persons who suffered income loss. Finally, QOL domain scores had strong, significant correlation with the mental health measures. In conclusion, QOL, general well-being, or personal satisfaction in NE Gulf Coast communities appears to be influenced by community recovery, income, and mental health status post oil spill.

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Type: Poster 9-343

Assessment of Petrogenic Polycyclic Aromatic Hydrocarbon Toxicity in Gulf Shellfish and Finfish

Presenter: Dan Jackson
University of Texas Medical Branch
Authors: D. Jackson, H. Fernando, G. A. S. Ansari, C. J. Elferink;
University of Texas Medical Branch, Galveston, TX.

Abstract:
The GC-HARMS consortium is conducting a 5-year longitudinal study to explore the health impact and community resiliency related to the 2010 Deepwater Horizon disaster. Risk assessment is based on the assumption that petrogenic and pyrogenic polycyclic aromatic hydrocarbons (PAH) have similar toxicological profiles. However, evidence for the toxicity of petrogenic PAHs is largely non-existent. This report describes results obtained using the EPA-approved Chemical Activated Luciferase gene eXpression (CALUX®) bioassay designed to measure aryl hydrocarbon receptor (AhR) mediated biological responsiveness to environmental contaminants including PAHs. Hepa1 cells stably expressing an AhR-responsive reporter construct were exposed to PAHs extracted from shellfish and finfish species caught in the waters affected by the Deepwater Horizon oil spill. Benzo[a]pyrene (BaP) was used as the reference compound and the results obtained with extracted PAHs are reported as BaP toxic equivalence. Extracts from shellfish and finfish harvested in gulf regions not affected by the Deepwater Horizon spill were used as controls. The results provided the basis for preliminary seafood consumption guidelines contributed to the community partners who participate in the GC-HARMS consortium. These findings along with pending human exposure studies will inform future risk assessments of Gulf seafood safety. (Supported by U19ES020676-03 to CJE).

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Type: Poster 9-344

Were women vulnerable to social adversities also vulnerable to the oil spill?

Presenter: Emily Harville
Tulane University
Authors: E. H. Harville[1], A. Shankar[1], M. Jacobs[1], R. Boynton-Jarrett[2];
[1]Tulane University, New Orleans, LA, [2]Boston University, Boston, MA.

Abstract:
Populations that experience multiple adversities may be rendered vulnerable to other types of disasters. We explored whether women who had a higher experience of lifetime adversities also had a greater experience of the oil spill. 485 pregnant and non-pregnant reproductive-aged women were recruited from southern Louisiana areas affected by the Deepwater Horizon oil spill. Women were interviewed about their exposure to oil and personal effects of the oil spill, and completed the Adverse Childhood Experience (ACE), the Child Trauma Questionnaire (CTQ), and the Traumatic Events Inventory (TEI), which covers lifetime experience. Log-Poisson models with robust variance were used to predict the risk of oil spill experiences based on the scores on the adversity scales, with adjustment for age, BMI, education, race, and marital status. We also examined whether pregnant and nonpregnant women differed with respect to their oil spill experience. Women who scored higher on any of the scales were more likely to come into contact with oil, to have spent time in areas where there was oil, and to have had someone near them injured or killed in the explosion. Women who scored higher on the TEI were also more likely to report that they had spent time on the beaches, that members of their families had come into contact with oil, and that the oil spill damaged areas where they or household members fished commercially or for private use. There were no differences in exposure between pregnantand non-pregnant women. Women with a history of childhood and adult adversity were more likely to be hard hit by the oil spill.

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Type: Poster 9-345

A systematic comprehensive training evaluation process for assessing impact and effectiveness of the Gulf oil spill health and safety training

Presenter: Sue Ann Sarpy
Sarpy and Associates, LLC
Authors: S. Sarpy[1], F. Rabito[2];
[1]Sarpy and Associates, LLC, Charlottesville, VA, [2]Tulane University, New Orleans, LA.

Abstract:
In response to the Deepwater Horizon disaster, the National Institute of Environmental Health Sciences facilitated the delivery of health and safety training to over 147,000 workers (e.g., on-shore and off-shore volunteers, technical specialists) across the four Gulf states. The health and safety training was designed to assist the workers in rapid and efficient mitigation of continued environmental contamination while ensuring minimal impact to public health. A comprehensive evaluation process was implemented to systematically assess the effectiveness of the health and safety training during the Gulf of Mexico oil spill disaster response efforts. Using community-based organizations, evaluation data was gathered from workers receiving the training, including two distinct sub-populations from the Gulf states (i.e., Isleno and Vietnamese workers assisting in the environmental clean-up efforts). Significant and meaningful differences were found regarding the effectiveness and impact of the training among the worker sub-populations. Results will be discussed with respect to encouraging community engagement and resiliency in disaster response and recovery efforts. The application of this comprehensive evaluation system will be highlighted including the importance of considering social and cultural aspects of the local workers in strengthening worker health and safety training interventions in disaster response and guiding related policy development.

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Type: Poster 9-346

Pre and Post-Deepwater Horizon (DWH) Oil Spill Exposure Patterns among Elementary School Children in Mobile County, Alabama

Presenter: Meghan Tipre
University of Alabama at Birmingham
Authors: M. Tipre, A. Turner-Henson, J. Gohlke, M. Leader, N. Sathiakumar;
University of Alabama at Birmingham, Birmingham, AL.

Abstract:
Information on the potential impact of the DWH oil spill on children is limited. The purpose of this study was to compare environmental exposures and fish-eating patterns pre- and post oil spill among children residing within a 20-mile radius of the Gulf of Mexico (coastal group) compared to children residing outside 20 miles (inland group).
In a cross-sectional study of children in Mobile County, Alabama, conducted 11 months after the DWH oil spill, we randomly selected 3 coastal and 3 inland schools from the 55 elementary schools. We then randomly selected children from K-4th grades in these schools. A mail-in survey to parents elicited information on socio-demographics, parental occupations, exposure-related activities and children's diet. We used chi-square statistic to compare differences between the two groups in the pre-and post-oil spill periods.
A total of 180 children (coastal, n=90; inland, n=90) were included. The age range was 5 -11 years; 36% were males. Post-oil spill, children and their families in both groups significantly reduced their exposure-related activities such as visiting Gulf shores, playing in sea and sand, fishing, and intake of seafood compared to the pre-oil spill period. When compared to the inland group, the coastal group had higher exposure-related activities including seafood intake ($p < 0.01$) during post-oil spill period.
Results of this study suggest that despite overall reduction in risk-related activities pertaining to the DWH oil spill, children in the coastal communities were likely to have higher potential exposure compared to children from inland communities. Disaster preparedness plans need to include the early identification and education of vulnerable populations to reduce such exposures.

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Type: Poster 9-347

The West Florida Shelf Controversy

Presenter: John H Paul
USF
Authors: J. H. Paul[1], J. Basso[1], D. Wetzel[2];
[1]USF, St Petersburg, FL, [2]Mote Marine Lab, St Petersburg, FL.

Abstract:
Despite the massive amounts of oil released from the Deepwater Horizon Oil Spill, no one knows where it all went. Undoubtedly much of the oil was microbially remediated in situ, and the remainder partitioned between advection and sedimentation. Three independent lines of inquiry suggest that at least some of the Macondo 262 oil ended up on the West Florida Shelf: current modeling and predictions indicated that some oil could have been upwelled on the WFS, the occurrence of lesioned fish on the WFS, and time-dependent increase in water column toxicity and mutagenicity. Here we examine the occurrence of HC principally in the sediments of the WFS, the concomitant mutagenicity and toxicity, and PAH hydrocarbon profile as a method to help identify the source of these compounds. Sand patties collected from beaches off the WFS had total PAH concentrations from 0.34-1.96 ug/gm dw. Abundant compounds included apthobenzothiophenes,chrysene, benzo [a] pyrene, and benzo [a] anthracene. The source of these compounds is still under investigation.

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Type: Poster 9-348

Does in ovo exposure to an endocrine disruptor, tributyltin (TBT), skew sex ratios in the American alligator (Alligator mississippiensis)?

Presenter: Melissa C. Bernhard
College of Charleston
Authors: M. C. Bernhard[1], D. D. Spyropoulus[2], L. J. Guillette, Jr.[2], S. Kohno[2];
[1]College of Charleston, Charleston, SC, [2]Medical University of South Carolina, Charleston, SC.

Abstract:
DWH oil/Dispersant mixtures and fractions are under investigation to study their obesogenic effects. Although the obesogenic chemical(s) in DWH oil have not been identified, long-term influences of the obesogenic compound(s) are a concern for humans as well as wildlife. Based on the “developmental origins of adult disease” scenario, the developmental exposure needs to be investigated. The American alligator (Alligator mississippiensis) has been used as sentinel species for the local environment, especially in the investigations of endocrine disrupting contaminants (EDCs) due to their life history and high site fidelity. Sex determination in the alligator relies on the ambient temperature during their development, called temperature-dependent sex determination (TSD). This requires appropriate endocrine signals at critical timing, which can be interrupted by EDCs. Tributyltin (TBT; an obesogenic EDC) has been used as an antifouling agent on boat hulls and can induce sex reversal in teleost fishes via decreased estrogen production. Thus, we investigated effects of exposure to TBT in ovo on sex determination/differentiation and adipogenesis in the American alligator. Alligator embryos were sensitive to TBT in their survival rate, which was significantly lower survival at 2 µg TBT/g egg weight as compared with control group (7 and 97 percent, respectively). The effects of developmental exposure to TBT on gonadal development and adipogenesis will be reported. These results will be discussed as they relate to other animal (in vivo) and stem cell culture (in vitro) models.

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Type: Poster 9-349

Assessment of Health Following the 2010 Gulf of Mexico Oil Spill in Two Coastal Communities: Mobile and Baldwin County, Alabama, 2010, 2011, 2012

Presenter: Melissa A Morrison
Centers for Disease Control and Prevention
Authors: A. Rikhi[1], A. Bianchi[2], M. L. Sanchez[1], S. Davidson[1], M. A. Morrison[3,1];
[1]Alabama Department of Public Health, Montgomery, AL, [2]University of Alabama at Birmingham School of Public Health, Birmingham, AL, [3]Centers for Disease Control and Prevention, Atlanta, GA.

Abstract:
Assessments were conducted in coastal communities of Baldwin and Mobile Counties in August 2010 to identify sub-acute household-level impacts of the 2010 Gulf of Mexico Oil Spill; respiratory and cardiovascular conditions were included in the assessment. The

assessments were repeated in 2011 and 2012 to identify changes in health and long term health effects in those communities. Responses were compared to identify differences across 2010, 2011, and 2012 for each county; additionally,
Mobile and Baldwin County assessments were compared across all years to identify differences between the counties. When comparing the percent of households reporting any respiratory or cardiovascular symptoms across all years, there were no significant differences in either Mobile or Baldwin County, suggesting that the reported conditions represent the baseline for each county. Although not statistically significant, a higher percent of households reported symptoms in Mobile than in Baldwin County for most conditions. For example, in 2012, 62.4% of the households in Mobile reported respiratory symptoms compared to 55.2% in Baldwin; cardiovascular symptoms were reported by 27.8% of the households in Mobile compared to 23.7% in Baldwin. When comparing Mobile and Baldwin across all years, only sinus infections were significantly different in 2012 (37.3% in Mobile, 18.8% in Baldwin). Community assessments can monitor health impacts during the acute and recovery phases of a public health response.

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Type: Poster 9-350

"The Policy Implications and the Stakeholders' Perspective of the Closure of Louisiana Territorial Sea Following the 2010 BP/ Deep Water Horizon Gulf Oil Spill".

Presenter: Olalekan A Ogunsakin
Tulane University
Authors: O. A. Ogunsakin, M. Lichtveld, J. Wickliffe, M. Wilson;
Tulane University, New Orleans, LA.
Abstract:
On April 20 2010, there was an explosion as a result of a wellhead blowout on the BP- operated oil rig named Macondo Prospect. This was adjudged the biggest marine oil spill accident in the history of the petroleum industry in the Country. The explosion killed 11 people and crude oil gushed out from the sea floor for 87 days until it was capped on the 15th of July, 2010. In their response, the FDA, NOAA, National Marine Fisheries Service, EPA, the U.S. Coast Guard, and the Gulf coast states took important policy steps to ensure the safety of the seafood in contaminated waters. Several areas of exposure to the spill were immediately closed and Seafood Safety Program was put in place to ensure good harvest. During the oil spill peak period, more than one third of the federal waters in the gulf and most of the state waters were under closure from harvesting. Following the abatement of the spill, the states and the federal government agencies conducted series of sampling and testing of the seafood namely; the fish, shrimp, oysters and crabs. It should be emphasized at this juncture that no harvest area was allowed to re-open unless it has passed a double testing of both sensory and chemical analysis. The primary objective of this research is to examine the policies that were employed in response to this disaster, with respect to the stakeholders' perspective of the impact of these policies
on the seafood industry and consumption. The secondary objective is to assess the policy implications of the oil spill response to the socio - economic factors among the study population (fishing communities) in Louisiana.

Session: 009
Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Poster 9-351

Differences and similarities between coastal communities in two Alabama counties: Comparison of community assessments conducted in 2010, 2011 and 2012

Presenter: Melissa A Morrison
Centers for Disease Control and Prevention
Authors: A. Rikhi[1], A. Bianchi[2], M. L. Sanchez[1], S. Davidson[1], M. A. Morrison[3,1];
[1]Alabama Department of Public Health, Montgomery, AL, [2]University of Alabama at Birmingham School of Public Health, Birmingham, AL, [3]Centers for Disease Control and Prevention, Atlanta, GA.
Abstract:
Community assessments were conducted in the coastal counties of Baldwin and Mobile in August 2010 to identify acute household-level impacts of the 2010 Gulf of Mexico Oil Spill. The assessments were repeated in 2011 and 2012 to monitor recovery and were compared to those conducted in 2010. No statistically significant change between years for the percent of households reporting decreased income was found within either county and remained higher in Mobile (41.3%) than Baldwin (32.3%) in 2012. Reports of decreased activities (swimming, time outdoors, boating, local seafood consumption) declined significantly from 2010 to 2011 in each county and all were significantly declined in Baldwin in 2012, but local seafood consumption was the only decline in Mobile. In both counties, the percent of individuals reporting depressive symptoms significantly decreased from 2010 to 2011 (Mobile 24.2 to 13.2%, Baldwin 15.2 to 7.8%); neither significantly changed in 2012. Quality of life (QoL) measures (≥14 days of physically unhealthy, mentally unhealthy, or activity limitation days) all significantly improved in Mobile from 2010 to 2011 and did not change in 2012. QoL measures did not significantly change in Baldwin from 2010 to 2011, but significantly less physically unhealthy days were reported in 2012. These

findings suggest that while significant, sustainable recovery can be achieved in the year following a disaster, the influence of community-specific factors should be further examined.

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Date: Tuesday, January 28 - 6:00 PM
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Type: Poster 9-352

Disaster Health Research: Lessons Learned from the Gulf Spill and New Efforts to Address our National Needs

Presenter: Aubrey K. Miller
National Institute of Environmental Health Sciences (NIEHS), National Institutes of Health
Authors: A. K. Miller[1], J. Hughes[2], S. Garantziotis[2], A. Bennett[3], J. Remington[2], S. Arnesen[4], K. Yeskey[5], B. Eagin[6];
[1]National Institute of Environmental Health Sciences (NIEHS), National Institutes of Health, Bethesda, MD, [2]NIEHS, Durham, NC, [3]NIEHS, Bethesda, MD, [4]National Library of Medicine, National Institutes of Health, Bethesda, MD, [5]MDB, Inc, Washington,, DC, [6]MDB, Inc, Washington, DC.

Abstract:
Each environmental or man-made disaster, with its attendant health consequences, is unique. However, valuable lessons can be learned from each one that can inform responses to future disasters, potentially reducing both acute and long-term adverse health effects. Use of surveillance data and information collected during a crisis, although highly beneficial for response efforts, are not a substitute for timely and properly conducted health and scientific research to address longitudinal questions and concerns. Robust epidemiologic studies and medical testing can be critical to understanding the many uncertainties surrounding these situations and enabling good decision-making, asset allocation, and recovery. Unfortunately, our disaster preparedness and response efforts have not focused on such concerns and the necessary infrastructure (funding mechanisms, institutional review boards, scientific oversight, data collection, referral networks) to support the timely research within a disaster setting.
The National Institute of Environmental Health Sciences' (NIEHS) response to the Gulf Oil Spill disaster, which included the GuLF Study (research of 32,000 spill clean-up workers), an extramural academic research consortia, and worker education and training efforts, will serve as a framework for discussing current issues and gaps in performing time-critical investigations. Additionally, we will highlight a new NIH "Disaster Research Response Project," designed to help improve our capabilities (i.e., off-the-shelf web accessible surveys and protocols, training for researchers, national network) to rapidly and effectively conduct human health research in a disaster setting.

Session: 009
Date: Tuesday, January 28 - 6:00 PM
Room: Main Ballroom (Convention Center)
Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Poster 9-353

Building responder resilience and reducing mental health consequences during disasters through training

Presenter: Joseph Thomas Hughes
HHS-NIH-NIEHS
Authors: J. T. Hughes, J. Remington, K. Yeskey, N. Kelly;
HHS-NIH-NIEHS, RTP, NC.

Abstract:
As in prior major disasters, data collected after the Deep Water Horizon (DWH) oil spill disaster indicate a significant mental health component to the health consequences of the event. To better assess the best practices and solutions to mental health concerns for workers during response to disasters, NIEHS Worker Education and Training Program (WETP), in partnership with the Substance Abuse and Mental Health Services Administration (SAMHSA), has proposed a three phase process to address the mental health training issues identified post-DWH. For the first phase, NIEHS held a meeting in New Orleans with primary care physicians, mental healthcare practitioners, community groups and academia to obtain their input into what work-related information, training, or other interventions may improve resiliency. Two main themes came out of the meeting: 1) Pre-training of workers provides more competent and resilient workers and pre-disaster training of workers is highly recommended. 2) Performing as a community team, involving public health, primary care, community programs, and mental health providers results in better outcomes than does working in silos. NIEHS has created a training advisory work group to help identify curriculum content, review curriculum and pilot the curriculum. An extensive literature has been completed as well as a consultation with subject matter experts in responder mental health issues. The consultation discussed peer interventions to prevent or mitigate behavioral health illness, the role of training and education in prevention and the role of clinicians in managing these issues. Key findings and themes from both of these activities will be explored by panelists as well as next steps of the project.

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Date: Tuesday, January 28 - 6:00 PM
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Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Poster 9-354

Using Stem Cell Fate to Determine Potential Adverse Effects of Oil/ Dispersant Exposure: Cross-Species Crude Oil Obesogenicity Assays

Presenter: Alexis Temkin
Medical University of South Carolina
Authors: A. Temkin[1], D. Ellisor[1], M. Patton[2], J. Baatz[1], S. Kohno[1], L. Guillette[1], D. Spyropoulos[1];
[1]Medical University of South Carolina, Charleston, SC, [2]St Benedict College, St. Cloud, MN.

Abstract:
Obesity is a global health epidemic implicated by genetics and epigenetics. Exposures to environmental obesogens have emerged as key contributing factors. Identification of obesogens is critical to reduce exposures and improve health. We focused on testing the obesogenicity of MC252 crude oil fractions, opening the possibility to develop more targeted oil spill clean-up strategies. Human, mouse, pygmy sperm whale, dolphin and alligator stem cells are being exposed to serial dilutions of MC252 crude oil/dispersant mixture and monitored for quantitative changes in cell type specific gene expression and fat cell differentiation. Optimization of the human adipogenic assay was used as the prototype for other species. With this system we demonstrate the importance of several parameters, including cell passage for optimal responsiveness and differentiation component concentrations to reveal subtle differences in fraction induction of adipocyte differentiation. We present adipogenic dose response curves to 48 hour treatment exposures, using the pharmaceutical and environmental obesogens, Rosiglitazone and tributyltin. Results presented indicate that our assay is robust and suitable for identification of obesogenic fractions in MC252 oil/dispersant mixtures for all species. Furthermore, we have also developed a high throughput molecular assay using cell-type specific genes, CD105, FSTL1, and Leptin to rapidly identify and quantify obesogenic potential.

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Track: Public Health, Ecology and Society in the Context of Resilience: a Systems Approach to Assessing the Potential Impact of the Gulf of Mexico Oil Spill
Type: Poster 9-355

Challenges in Recruiting and Retaining Participants in the Women and Their Children's Health (WaTCH) Study Cohort

Presenter: Daniel Harrington
LSU School of Public Health
Authors: D. Harrington, A. Rung, E. Oral, E. Trapido, E. Peters;
LSU School of Public Health, New Orleans, LA.

Abstract:
The Women and their Children's Health Study is a prospective cohort of women’s health in 7 coastal Louisiana parishes affected by the Deepwater Horizon Oil Spill (DWOS) and other traumatic events. Research on previous traumatic events combined with preliminary data suggests a variety of health impacts for exposed residents. The objective of this presentation is to describe the technical and logistical challenges associated with recruiting and retaining a population-based sample of women exposed to the DWOS. Adult women were recruited through a commercial listing of residential telephone numbers and addresses. After introductory letters were mailed, women were called and invited to complete a one-hour telephone interview about environmental exposures, physical health, and behavioral health. Subsequently home visits were scheduled to obtain anthropometric measures and biologic samples. From an original sample of over 43,000 women, we contacted 40,000 to elicit participation. Of these 27% refused upon contact, 15% of the phone numbers were disconnected, 23% of the numbers repeatedly went to voice mail, 11% of the contacts were ineligible, and just over 5% completed the telephone interview. Of the women who completed the telephone interview 62% also completed the home visit. This population has been the object of many studies; therefore characterization of barriers and challenges to recruitment is critical for developing appropriate messaging and refusal conversion methods to assemble valid study populations to inform public health research and advocacy.

Session 010: Current and Future Ecosystem-Monitoring Strategies in the Gulf of Mexico: Spanning Disciplines, Platforms, and Affiliations

Session: 010
Date: Tuesday, January 28 - 10:00 AM
Room: Bon Secour Bay III
Track: Current and Future Ecosystem-Monitoring Strategies in the Gulf of Mexico: Spanning Disciplines, Platforms, and Affiliations
Type: Oral

Update on Gulf Coast Ecosystem Restoration Council Activities

Presenter: Justin Ehrenwerth
Gulf Coast Ecosystem Restoration Council
Authors: J. Ehrenwerth;
Gulf Coast Ecosystem Restoration Council, n/a, LA.
Abstract:
The Gulf Coast Ecosystem Restoration Council (Council) is responsible for restoring and protecting the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, coastal wetlands and economy of the Gulf Coast. The Council is committed to science-based decision making. Accordingly, decisions made by the Council will be made pursuant to the Initial Comprehensive Plan and will be based on the best available science which the RESTORE Act defines as science that "(A) maximizes the quality, objectivity, and integrity of information, including statistical information; (B) uses peer-reviewed and publicly available data; and (C) clearly documents and communicates risks and uncertainties in the scientific basis for such projects." The Council is also committed measuring outcomes and impacts in order to achieve tangible results and ensure that funds are invested in meaningful way. The Council will consider a variety of methods to measure and report on the results and impacts of Council-Selected Restoration Component activities and will include project- or program-specific measurement and reporting requirements in funding agreements with Council Members.

Session: 010
Date: Tuesday, January 28 - 10:30 AM
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Track: Current and Future Ecosystem-Monitoring Strategies in the Gulf of Mexico: Spanning Disciplines, Platforms, and Affiliations
Type: Oral

GCOOS Contributions to the Deepwater Horizon Response and Collaborative Planning for a Gulf Regional Observing System

Presenter: Stephanie Watson
Consultant in Ocean Observing and Coastal Management
Authors: S. Watson[1], C. Simoniello[2], A. E. Jochens[3], M. K. Howard[3], R. L. Mullins-Perry[3], L. Bernard[4];
[1]Consultant in Ocean Observing and Coastal Management, Mandeville, LA, [2]Institute for Marine Mammal Studies, University of South Florida College of Marine Science, St. Petersburg, FL, [3]Texas A&M University, College Station, TX, [4]Gulf of Mexico Coastal Ocean Observing System/University of Southern Mississippi, Stennis Space Center, MS.
Abstract:
During and after the Deepwater Horizon oil spill, the Gulf of Mexico Coastal Ocean Observing System-Regional Association (GCOOS-RA) staff and partners assisted with the response in many ways. These included, for example, providing real-time, near real-time, and delayed-mode data, compiling data for the NOAA's Office of Response and Restoration (OR&R) models, providing new data layers for the Environmental Response Management Application, helping disseminate accurate information through the GCOOS Education and Outreach network, aggregating oil spill resources on the GCOOS website for easy responder access, and participating in a U.S. Integrated Ocean Observing System (IOOS)-coordinated glider fleet deployed to detect subsurface oil from the spill. Lessons learned are being incorporated in the regional Gulf observing Build-Out Plan (BOP). The BOP is a living document, developed by a wide range of stakeholder experts in the Gulf, that describes a multi-application Gulf observing system for current needs, 5-10 years in the future, and 10 years and beyond. This evolving plan, used as a foundation for complementary groups such as the Gulf of Mexico Alliance, describes a system that can help with oil spill response, restoration, and human health protection by providing real-time, near real-time, and delayed-mode observations from various platforms on physical, meteorological, chemical, and biological parameters, as well as longer-term data. The plan details the budget necessary to establish and sustain the system.

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Date: Tuesday, January 28 - 10:45 AM
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Track: Current and Future Ecosystem-Monitoring Strategies in the Gulf of Mexico: Spanning Disciplines, Platforms, and Affiliations
Type: Oral

Measuring the private and social economic benefits of the Gulf of Mexico Coastal Ocean Observing System (GCOOS)

Presenter: Rex H Caffey
Louisiana State University
Authors: R. H. Caffey, R. F. Kazmierczak, J. M. Fannin, M. A. Savolainen;
Louisiana State University, Baton Rouge, LA.

Abstract:
GCOOS provides a wide array of science-based data to both private and public sector decision makers tasked with the management of human-built infrastructure, centers of population, and environmental and natural resources in the southeastern United States. Little is known, however, about the economic importance of this data and the various analyses that it supports. This presentation will outline a new study that seeks to: (i) characterize the major users of GCOOS data; (ii) detail how current, and potentially improved, GCOOS information is used in both private and public decision making; (iii) measure the social economic value associated with GCOOS data through a stated-preference approach; (iv) create a framework for analyzing the private economic value of GCOOS data, including an analysis of the role of GCOOS data in value-added information markets; and (v) develop extension outreach materials designed to educate direct and indirect GCOOS stakeholders. Preliminary data from objective (i) and (ii) will be highlighted, along with information about the structure of data collection for objective (iii) and how session participants can become involved in enhancing the quality of overall project outcomes.

Session: 010
Date: Tuesday, January 28 - 11:30 AM
Room: Bon Secour Bay III
Track: Current and Future Ecosystem-Monitoring Strategies in the Gulf of Mexico: Spanning Disciplines, Platforms, and Affiliations
Type: Oral

The GOMA Gulf Monitoring Network: foundational water quality and biological monitoring to assess overall sustainability of Gulf health

Presenter: Steven H. Wolfe
Gulf of Mexico Alliance, Water Quality Team
Authors: S. H. Wolfe[1,2], F. Leslie[3], R. Rebich[4];
[1]Gulf of Mexico Alliance, Water Quality Team, Tallahassee, FL, [2]Florida Institute of Oceanography, St. Petersburg, FL, [3]Alabama Dept. of Environmental Management, Montgomery, AL, [4]U.S. Geological Survey, Mississippi Water Science Center, Jackson, MS.

Abstract:
The Gulf Monitoring Network (GMN) was designed by the Gulf of Mexico Alliance (GOMA) with two primary functions: A) provide integrated monitoring to answer prioritized water-quality questions for estuaries, coastal waters, and the open Gulf; and B) establish a solid foundation of data that supports Gulf monitoring of all types (e.g., fisheries and ocean observing). The physical design and the priorities were developed through a comprehensive process including direct participation by 28 state and federal agencies, academic institutions, and NGOs from within the U.S. and by two programs in Mexico.
The design requires high-quality hydrodynamic, water quality, and ecosystem models, collection of the meteorological and oceanographic data on which these depend, and collection of satellite and other remote sensing data. These combine to minimize the cost of necessary physical sampling of water quality and biota.
A Foundational Monitoring portion of the GMN could be funded by a stable source (e.g., an endowment) that would not be affected by fluctuations in state and federal budgets. While full implementation of the design is required to address all priority questions and maximize cost savings to other monitoring programs, the design can be adjusted for partial implementation based on the importance of long-term data continuity and benefit to the greatest number of monitoring programs. However, this could hinder the ability to document improvements resulting from restoration efforts and reduce the benefit to existing monitoring programs.

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Date: Tuesday, January 28 - 11:45 AM
Room: Bon Secour Bay III
Track: Current and Future Ecosystem-Monitoring Strategies in the Gulf of Mexico: Spanning Disciplines, Platforms, and Affiliations
Type: Oral

Developing a Decision-Making and Governance Framework for a Coordinated Gulf-Wide Observational Program

Presenter: Monty Graham
The University of Southern Mississippi
Authors: M. Graham[1], L. Bernard[1,2], L. Bowie[3], A. Jochens[4,5], L. McKinney[6], W. Nowlin[5], A. Shepard[7], S. Wolfe[8,9];
[1]The University of Southern Mississippi, Stennis Space Center, MS, [2]Gulf of Mexico Coastal Ocean Observing System, Steennis Space Center, MS, [3]Gulf of Mexico Alliance, Ocean Springs, MS, [4]Gulf of Mexico Coastal Ocean Observing System, College Station, TX, [5]Texas A&M University, College Station, TX, [6]Harte Research Institute, Corpus Christi, TX, [7]Gulf of Mexico University Research Collaborative, St. Petersburg, FL, [8]Gulf of Mexico Alliance, St. Petersburg, FL, [9]Florida Institute of Oceanography, St. Petersburg, FL.
Abstract:
In the wake of the Deepwater Horizon oil spill and other short- or long-term drivers of change, there exists an urgent need to develop a Gulf-wide, long-term observational system beyond the scope of current state, regional and federal operational systems. Such a system can provide both real-time tracking of the state of the Gulf's varied ecosystems, as well as provide historical context and predictive capacity for ecosystem change. With lessons of both success and difficulty learned from other ongoing state, regional and national efforts, a Gulf-wide observational framework could be an incredibly positive investment for the region and nation. It could also suffer from the typical challenges of a large, basin-wide effort without a sound decision-making process in place before funds become available. We propose a decision-making and governance structure to guide the development of a Gulf-wide observational framework that builds upon existing capacity and governance structures. This decision-making format allows for coordinated system planning and execution, encourages strong data management policies and promotes communication and synthesis.

Session: 010
Date: Tuesday, January 28 - 12:00 PM
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Track: Current and Future Ecosystem-Monitoring Strategies in the Gulf of Mexico: Spanning Disciplines, Platforms, and Affiliations
Type: Oral

Gulf of Mexico Monitoring Programs: Preliminary Results of a Survey and Gap Analysis

Presenter: Matt Love
Ocean Conservancy
Authors: M. Love[1], A. Baldera[1], C. Robbins[2], S. Senner[3], R. Spies[4];
[1]Ocean Conservancy, Baton Rouge, LA, [2]Ocean Conservancy, Austin, TX, [3]Ocean Conservancy, Portland, OR, [4]Applied Marine Sciences, Livermore, CA.
Abstract:
The Oil Pollution Act requires restoration of injured natural resources and lost services caused by the Deepwater Horizon (DWH) oil spill. The DWH Natural Resource Trustees must know the status of injured resources and whether recovery strategies are working, which requires long-term monitoring of injured resources, supporting predator and prey populations and changes in the Gulf of Mexico marine ecosystem, with emphasis on the Northern Gulf. These key monitoring components are partially covered by past and existing marine research and monitoring programs, but large gaps must be filled for an integrated program. Ocean Conservancy is surveying and synthesizing monitoring programs in the Gulf to identify those that relate to injured resources and to identify important gaps. We are documenting resources monitored, spatial and temporal coverage, sampling frequency, funding status, and other information. We will present preliminary results of the monitoring program survey and gap analysis and our initial conclusions on long-term monitoring needs under a DWH Damage Assessment and Restoration Program. Development of such a program should be organized around a conceptual model of the Gulf of Mexico large marine ecosystem and employ adaptive management to optimize efficiency, costs and lasting contributions to our knowledge.

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Date: Tuesday, January 28 - 12:15 PM
Room: Bon Secour Bay III
Track: Current and Future Ecosystem-Monitoring Strategies in the Gulf of Mexico: Spanning Disciplines, Platforms, and Affiliations
Type: Oral

Establish a satellite-based virtual buoy system for coastal water quality monitoring and decision support

Presenter: Chuanmin Hu
University of South Florida
Authors: C. Hu[1], B. B. Barnes[1], B. Murch[1], P. Carlson[2];
[1]University of South Florida, St. Petersburg, FL, [2]Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL.

Abstract:
Ecosystem-based management requires frequent assessment of the water quality state in estuaries and other coastal waters, yet systematic water quality monitoring faces significant challenge due to lack of resources to conduct routine ship-based or buoy-based measurements. Recently, a virtual antenna system (VAS) has been established at the University of South Florida College of Marine Science to obtain low-level satellite data and then generate higher-level data products using both NASA standard algorithms and regionally customized algorithms in near real-time. Based on the VAS, a virtual buoy system (VBS) is now implemented to facilitate visualization and interpretation of satellite-based water quality assessment. The VB stations are predefined to cover water quality gradients in several estuaries and some coastal waters, where multi-year time series at monthly and weekly intervals are extracted for the following parameters: sea surface temperature (SST, oC), chlorophyll-a concentration (Chla, mg m-3), turbidity (NTU), diffuse light attenuation at 490 nm (Kd(490), m-1) or secchi disk depth (SDD, m), absorption coefficient of yellow substance, and bottom available light (BAL, %). The time-series data are updated routinely and provided in both ASCII and graphical formats via a user-friendly web interface where all information is available to the user through a simple click. The VAS and VBS also provide necessary infrastructure to implement peer-reviewed regional algorithms to generate and share improved water quality data products for other estuaries and coastal waters with the user community, once algorithms are tuned and data products are validated.

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Date: Tuesday, January 28 - 12:30 PM
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Track: Current and Future Ecosystem-Monitoring Strategies in the Gulf of Mexico: Spanning Disciplines, Platforms, and Affiliations
Type: Oral

Environmental monitoring: BOEM at a crossroad

Presenter: Alexis Lugo-Fernandez
Bureau of Ocean Energy Management
Authors: A. Lugo-Fernandez, R. E. Green, P. F. Roscigno;
Bureau of Ocean Energy Management, New Orleans, LA.

Abstract:
Among BOEM's regulatory responsibilities, *assessing environmental impacts from regulated activities* is our focus. This mission requires coordination with affected States and Federal agencies to gather extant information and initiate or join ongoing activities for gathering the required information needed. This brings our program to a crossroad of sorts. Because State and Federal agencies often lack funds or have other priorities, BOEM often subsidizes and provides the needed information.
This Agency initially conducted prelease descriptive baseline studies, but our scientific advisors in NAS Review indicated these studies inadequately separated natural from anthropogenic variability. So, ensuing environmental studies were process-oriented. BOEM has a mandate to monitor "the human, marine, and coastal environments to identify significant changes in the quality and productivity of such environments, establish trends, and design experiments to identify causes of such changes." Further crossroads thus arise. What information is needed and how to collect it? How long to monitor to establish trends?
BOEM embraces the promise of an environmental monitoring program. Specifically, we are interested in monitoring the Gulf's deep water and helping design such a system by using our extensive Gulf physical and biological databases.

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Track: Current and Future Ecosystem-Monitoring Strategies in the Gulf of Mexico: Spanning Disciplines, Platforms, and Affiliations
Type: Oral

Operational Monitoring of Subsea Dispersant Operations

Presenter: Gina Coelho
HDR|Ecosystem Management
Authors: G. Coelho[1], S. Walker[2], J. Staves[1], M. Drieu[3];
[1]HDR|Ecosystem Management, Lusby, MD, [2]BP, Houston, TX, [3]Wild Well Control, Inc., Houston, TX.

Abstract:
Oil spill monitoring includes monitoring of the operational response and environmental impacts. This presentation focuses on operational monitoring of dispersant application to provide real-time feedback about ongoing dispersant application. Subsea dispersant use during incidents like the *Deepwater Horizon* prompted the National Response Team to develop procedures to address both types

of monitoring. In September 2013, API's Subsea Dispersant Joint Industry Task Force produced monitoring guidelines intended specifically to support operational response decision-making.
Key elements of the API monitoring plan are covered, emphasizing the importance of rapid, phased deployment of scientific monitoring; focusing on ecological implications as well as response worker health and safety; employing scientific methods that provide real time support of response decisions; using field proven technologies; considering operational timelines; and identifying clear "Action Thresholds" to trigger reassessment of continued dispersant operations.

Session: 010
Date: Tuesday, January 28 - 2:30 PM
Room: Bon Secour Bay III
Track: Current and Future Ecosystem-Monitoring Strategies in the Gulf of Mexico: Spanning Disciplines, Platforms, and Affiliations
Type: Oral

SEAMAP Plankton Monitoring Activities: past, present and future

Presenter: Glenn Zapfe
NOAA/NMFS/SEFSC/Mississippi Labs
Authors: G. Zapfe[1], J. Lyczkowski-Shultz[1], A. Millett[2];
[1]NOAA/NMFS/SEFSC/Mississippi Labs, Pascagoula, MS, [2]Riverside Technology, Inc., Pascagoula, MS.
Abstract:
Plankton sample and environmental data collection have been ongoing in the Gulf of Mexico since 1982 under the federal-state cooperative program known as SEAMAP (Southeast Area Monitoring and Assessment Program). The original goal of SEAMAP plankton surveys was to build and maintain a long term database on the occurrence, distribution and abundance of fish eggs and larvae captured in bongo and neuston net samples. These data continue to be used as fishery-independent indices of relative abundance in the stock assessments of an ever growing number of species. The value of SEAMAP data in resource damage assessment was universally recognized during the 2010 DWH oil spill when the SEAMAP plankton database provided crucial information on the potential harm to fish eggs and larvae in the path of the oil spill. It is now providing the primary source of pre-spill data for use in damage assessment models. In recent years, however, sample and data collection have been significantly augmented with the use of new sampling methods, analysis of the invertebrate zooplankton component of samples (especially decapod crustacean larvae) and improved taxonomic resolution of specimen identifications. Current and planned collaborations with both federal, state and university researchers have led to expanded utilization of the data, observations and samples taken during SEAMAP plankton surveys. Results from these collaborations have, and will continue to, improve resource assessment and ecosystem monitoring in the Gulf of Mexico.

Session: 010
Date: Tuesday, January 28 - 2:45 PM
Room: Bon Secour Bay III
Track: Current and Future Ecosystem-Monitoring Strategies in the Gulf of Mexico: Spanning Disciplines, Platforms, and Affiliations
Type: Oral

Out of Sight But Not Out of Mind: Research Priorities to Assess and Monitor the Health and Status of Gulf of Mexico Marine Mammals and to Inform Restoration Efforts

Presenter: Victoria Cornish
Marine Mammal Commission
Authors: V. Cornish[1], D. Epperson[2], T. Rowles[3], L. Engleby[4], J. Lewandowski[5];
[1]Marine Mammal Commission, Bethesda, MD, [2]Bureau of Safety and Environmental Enforcement, New Orleans, LA, [3]NOAA Fisheries, Silver Spring, MD, [4]NOAA Fisheries, Saint Petersburg, FL, [5]Bureau of Ocean Energy Management, Herndon, VA.
Abstract:
Marine mammals are integral and critical components of the Gulf of Mexico ecosystem. As a result of the Deepwater Horizon oil spill, wildlife response for marine mammals was initiated through stranding response and aerial and boat surveys. In addition, numerous studies were initiated to assess the impacts of the spill on marine mammals and the Gulf ecosystem. Although impacts on many species may never be fully quantified, information collected during and after the spill indicated that exposure occurred to many populations of cetaceans and injuries may have occurred and may still be present in several cetacean populations. The Marine Mammal Commission, with input from other federal agencies, prepared a statement of research needs to guide assessment and monitoring of the spill's long-term effects on the health and status of Gulf marine mammals and to identify high priority restoration projects. In addition, subsequent stakeholder workshops sponsored by NOAA Fisheries identified specific resources and capabilities needed to implement highest priority assessment and monitoring projects. Areas of highest priority for assessment and monitoring included aerial and ship-based stock assessment surveys (including tagging, photo-identification, and biopsy sampling); enhancement of the marine mammal health and stranding response program; live capture/release health studies; deployment of passive acoustic arrays to monitor marine mammal movements and ambient sound; and multi-disciplinary ecosystem/prey studies. Recommendations will be presented for highest priority long-term research to assess and monitor the health and status of Gulf marine mammals and to inform restoration efforts.

Session: 010
Date: Tuesday, January 28 - 4:00 PM
Room: Bon Secour Bay III
Track: Current and Future Ecosystem-Monitoring Strategies in the Gulf of Mexico: Spanning Disciplines, Platforms, and Affiliations
Type: Oral

Gulf Coast Ecosystem Restoration Science, Observation, Monitoring and Technology Program

Presenter: Russ Beard
NOAA
Authors: R. Beard[1], S. Walker[2], B. Allee[1], J. Lartigue[1];
[1]NOAA, Stennis Space Center, MS, [2]NOAA, Silver Spring, MD.

Abstract:
The RESTORE Act authorized the National Oceanic and Atmospheric Administration (NOAA) to establish the Gulf Coast Ecosystem Restoration Science, Observation, Monitoring, and Technology Program (NOAA RESTORE Act Science Program). The mission of the program, as directed in the Act, is to initiate and sustain an integrative, holistic understanding of the Gulf of Mexico ecosystem and support, to the maximum extent practicable, restoration efforts and the long-term sustainability of the ecosystem, including its fish stocks, fishing industries, habitat, and wildlife through ecosystem research, observation, monitoring, and technology development. In developing the Program, NOAA has engaged stakeholders to identify and prioritize research and observing needs in the region. Stakeholders who have submitted input to the Program and participants in the Program's engagement activities consider the current monitoring and observing assets in the region inadequate and noted the need for a more comprehensive and coordinated approach. Specifically, participants mentioned the need to conduct more biological monitoring, focus on long-term monitoring, coordinate across funding sources and use existing assets and plans (e.g., Gulf of Mexico Coastal Ocean Observing System), and more closely link observing and modeling activities for the purposes of model calibration and verification. This presentation will provide an overview of the NOAA RESTORE Act Science Program and discuss how observations and monitoring could fit into the Program's investment approach and how a broader suite of observations and monitoring efforts could be developed and integrated to address Gulf-wide issues, complemented by the science the Program will support.

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Room: Bon Secour Bay III
Track: Current and Future Ecosystem-Monitoring Strategies in the Gulf of Mexico: Spanning Disciplines, Platforms, and Affiliations
Type: Oral

Scaling up comprehensive coastal wetland and barrier island monitoring in Louisiana: A potential approach and template for a gulf-wide network

Presenter: Gregory D Steyer
U.S. Geological Survey
Authors: G. D. Steyer[1], D. M. Lee[2];
[1]U.S. Geological Survey, Baton Rouge, LA, [2]Louisiana Coastal Protection and Restoration Authority, Thibodaux, LA.

Abstract:
The U.S. Geological Survey and Louisiana Coastal Protection and Restoration Authority, in association with other partnership agencies, have developed a system-wide assessment and monitoring approach for coastal wetlands and barrier islands in Louisiana. This integrated approach includes the development of common statistical designs, the selection of baseline indicators, the utilization of compatible sampling methodologies, the development of appropriate analytical techniques, the incorporation of ecosystem report cards, and advances in data delivery and visualization. Since implementation in 2005, the Coastwide Reference Monitoring System (CRMS) - Wetlands and the Barrier Island Comprehensive Monitoring (BICM) Program have (1) reduced data redundancies, (2) maximized agency resources, (3) improved evaluations of restoration efforts, and (4) provided comprehensive, long-term datasets for understanding status and trends of these ecosystems, and for developing comprehensive models of wetland and barrier island systems. An overview of CRMS and BICM focusing on the costs and benefits of a comprehensive coastal monitoring program will be highlighted in the panel discussion, as well as how each module could be scaled up and fit into an integrated Gulf of Mexico observing system that supports adaptive decision-making at ecosystem scales.

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Type: Oral

NASA Remote Sensing

Presenter: Duane Armstrong
NASA Stennis Space Center
Authors: D. Armstrong;
NASA Stennis Space Center, Stennis Space Center, MS.

Abstract:

Background: Remote sensing is a major component of a comprehensive coastal and ocean observing program. Information from NASA's satellite and airborne sensors, and insights provided by NASA's basic and applied research programs, enables the creation of science-based decision-making tools for localities, state and federal agencies, industry, NGOs, tribes, and the public at large. Gaps and limitations of current observation systems help guide the design of future remote sensing instruments, the contents of the agency's basic and applied research programs, and engagement with external organizations.
NASA has a robust Earth science program and operates a fleet of research satellites and aircraft that collect terabytes of information about this planet daily. NASA is launching multiple Earth observing satellites over the next year that will enhance current observation capabilities. Furthermore, the agency's Gulf of Mexico Initiative, which is managed by Stennis Space Center, is evolving into a broader coastal applied science program that will turn research ideas into decision-making tools. NASA's Earth science program will continue to play an important role in coastal and ocean observing programs.

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Linking Ecosystem Condition to Goods and Services: Monitoring to Inform the Science and Vision of Gulf Coast Restoration

Presenter: Janis Kurtz
U.S. Environmental Protection Agency
Authors: J. Kurtz;
Gulf Ecology Division, U.S. Environmental Protection Agency, Gulf Breeze, FL.
Abstract:

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The importance of an Integrated Ocean Observing System

Presenter: Pasquale Roscigno
Bureau of Ocean Energy Management (BOEM)
Authors: P. Roscigno;
Environmental Studies Program Gulf of Mexico Region, Bureau of Ocean Energy Management (BOEM), New Orleans, LA.
Abstract:
Background: BOEM's Environmental Studies Program has had a forty year history of gathering data on the biological communities, the air and water quality, and the oceanography of the Gulf of Mexico. This information has been used to understand the impact of the development and production of hydrocarbons, marine minerals, and renewable energy on the human, coastal, and marine environments of the Gulf of Mexico region. Long-term monitoring programs of benthic and pelagic communities, such as the Flower Garden Banks, deepwater *Lophelia* coral, chemosynthetic communities, and Gulf SERPENT, have established baselines from which environmental impacts can be assessed. Post-*Deepwater Horizon*, the proliferation of efforts conducting damage assessments, recovery studies, and restoration projects provides a unique opportunity to develop a long-term comprehensive ecosystem monitoring network that unifies existing monitoring programs and expands to fill gaps in current monitoring. The future challenge is to meet the needs of multiple ocean uses with a large-scale, integrated ecosystem monitoring system that operates under common scientific goals to protect the environment, detect natural and anthropogenic change, and assess recovery.

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Type: Oral

What's the Right Observing Network?

Presenter: Richard Spinrad
Oregon State University
Authors: R. Spinrad;
Research Office, Oregon State University, Corvallis, OR.
Abstract:
Background: The last 3 decades have served as an important period for the development of ocean observing systems. We've made serious advances, built significant expectations and faced certain challenges. What will happen in the future? Our capabilities have expanded impressively, as expressed in sensors (remote and in situ), platforms (above, on, and in the sea, as well as living and robotic), systems (for data acquisition, communication and archive) and products (for predictions and projections). Now we need to build a more disciplined and defensible business model for integrated ocean observing systems. We need to define markets, prioritize

requirements, and sell our products. We need to exploit aggressively a more realistic funding portfolio, to include investment options and crowdsourcing. And, we must think like a business to define our workforce. All of this embraces a wholly new vision for integrated ocean observing systems.

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Type: Poster 10-356

Enhancing Remote Sensing Capabilities Of The Sargassum Early Advisory System (SEAS) Through The Use Of NASA EOS And Open Source GIS

Presenter: Ross Reahard
NASA DEVELOP National Program
Authors: R. Reahard, B. Arceneaux, S. Barrett, M. Germu-Smith;
NASA DEVELOP National Program, Stennis Space Center, MS.

Abstract:
Sargassum is a pelagic brown macroalgae that can be found floating in large, dense mats in the Gulf of Mexico. In open water, these Sargassum mats serve as a valuable habitat to unique communities of marine organisms. However, when these large quantities of Sargassum land on Galveston, TX beaches, they pose a serious threat to local tourism. The decomposition of Sargassum and the organisms therein give rise to unattractive odors. Sargassum can also trap plastics, paper, medical and industrial waste including oil from oil spills. The removal of these large mats is both costly and time consuming, especially if unexpected. When provided with early notice of the arrival of Sargassum, land managers can be better prepared to allocate resources for beach cleanup. Scientists at Texas A&M University at Galveston are exploring the use of NASA EOS, specifically Landsat images, to track Sargassum mats in the Gulf of Mexico as they approach the Texas Gulf Coast. This Sargassum Early Advisory System (SEAS) aims to forewarn coastal managers of these Sargassum mats so that managers are better prepared for proper cleanup efforts and resources can be allocated appropriately. Building upon previous work by Hu et al. (2012), this project aims to provide SEAS with an improved method for processing Landsat data into enhanced visualization products in which Sargassum mats can be detected as they approach the Texas Coast. Multiple methods were assessed for enhancing NASA supported satellite imagery into Sargassum detection products, including computing of surface water monitoring indices, such as Normalized Difference Vegetation Index (NDVI), Floating Algae Index (FAI), and various multi-reflectance band RGB composites.

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Type: Poster 10-357

Surface Oil Dispersion During the Deepwater Horizon Blowout

Presenter: Ian R MacDonald
Florida State University
Authors: I. R. MacDonald[1], O. Garcia-Pineda[1], A. Solow[2], S. Daneshgar Asl[1];
[1]Florida State University, Tallahassee, FL, [2]WHOI, Woods Hole, MA.

Abstract:
Oil discharged as a result of the Deepwater Horizon disaster was detected on the surface of the Gulf of Mexico by synthetic aperture radar satellites from 25 April 2010 until 4 August 2010. SAR images were not restricted by daylight or cloud-cover. We used a texture classifying neural network algorithm for semi-supervised processing of 166 SAR images from the ENVISAT, RADARSAT I, and COSMO-SKYMED satellites. This yielded an estimate the proportion of oil-covered water, which was compiled as a 5-km equal area grid covering the northern Gulf of Mexico. Because few images covered the entire impact area, analysis was required to compile a regular time-series of the oil cover. A Gaussian kernel using a bandwidth of 2 d was used to estimate oil cover percent in each grid at noon and midnight throughout the interval. Variance and confidence intervals were calculated for each grid and for the global 12-h totals. Oil cover reached an early peak of 17032.26 sq km (sd 460.077) on 18 May, decreasing to 27% of this total on 4 June, following by sharp increase to an overall maximum of 18424.56 sq km (sd 424.726) on 19 June. There was a piece-wise negative correlation between wind stress and the total area of oil cover throughout the time-series. These results suggest improved monitoring strategies for future discharges.

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Type: Poster 10-358

Basic tenets for coastal ocean ecosystems monitoring

Presenter: Robert Weisberg
University of South Florida
Authors: R. Weisberg, L. Zheng, Y. Liu;
University of South Florida, St. Petersburg, FL.

Abstract:
Addressing matters of coastal ocean ecology requires a systems science approach because ecology integrates all processes responsible for organism success. By determining the distribution of water properties, the circulation is the starting point, and K. brevis red tide provides an example. No bloom occurred on the West Florida Shelf (WFS) in 2010 because of anomalous upwelling. The condition under which larval fish transit from spawning to settlement provides another example. Systems science requires both observations and models. Three-dimensionality and spatial extent preclude ever having enough observations to fully describe the coastal ocean so models are required for integration. But, models need observations for initialization, boundary values and veracity testing; hence both must be coordinated. Observations must include a variety of sensors and sensor delivery systems (moorings, profilers, gliders, ships, satellites). Similarly, hierarchies of models (ocean-atmosphere interactions, ocean circulation, and the biological interactions that, together with the circulation, comprise ecology) are needed, and no single model can be expected to handle all of the connections. What may account for deep ocean processes cannot account for estuarine processes, necessitating the downscaling from the deep-ocean, across the continental shelf and into the estuaries. Given these tenets, we present a WFS concept that may also provide a basis for applications elsewhere.

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Type: Poster 10-359

Turbulent Mixing and Diel Vertical Migrations of Zooplankton in Relation to Potential Oil Spill Problems: Observations and Numerical Simulation

Presenter: Cayla W Dean
Nova Southeastern Univeristy
Authors: C. W. Dean[1], A. V. Soloviev[1], A. C. Hirons[1], T. J. Frank[1], J. Wood[2];
[1]Nova Southeastern Univeristy, Hollywood, FL, [2]Ocean Data Technologies, Marsons Mills, MA.

Abstract:
A strong sound scattering layer undergoing diel vertical migration was observed using a bottom mounted ADCP at 244 m depth in the Straits of Florida. Data collection was a part of the Electromagnetic Observatory funded by the Office of Naval Research and analysis of biophysical interactions is ongoing under the Gulf of Mexico Research Initiative. This project aims to understand biophysical interactions associated with diel vertical migrations in a strong current. Zooplankton that undergo migrations can have an impact on oil transport through the water column and oil can have a negative effect on the health of the organisms. A computational fluid dynamics model was used to model the effects of diel vertical migrations on the velocity field and turbulence signature of the Gulf Stream and Loop Current. Zooplankton were represented through a discrete phase model. Temperature stratification was set for both summer and winter conditions to observe seasonal differences. For each season, results from the model with particles were compared to results run in the same conditions without particles to confirm the changes in profiles were due to the zooplankton. Analysis of the ADCP data from the Straits of Florida indicates a measureable distortion to the velocity field at sunrise and sunset, which is seasonally varying and presumably associated with turbulence due to diel vertical migrations.

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Type: Poster 10-360

Bacterial community dynamics in oil polluted seafloor sediment (May 2010 - July 2011)

Presenter: Tingting Yang
University of North Carolina
Authors: T. Yang, K. Speare, S. B. Joye, A. Teske;
University of North Carolina, Chapel Hill, NC.

Abstract:
The huge load of hydrocarbons during the Deepwater Horizon oil spill directly changed the bacterial community structures in the sediment close to the Macondo wellhead. Compared to the 16S rRNA clone libraries from unpolluted sediments in early May 2010, the September 2010 bacterial community from oil-contaminated sediments shows a sharp increase in Alphaproteobacteria and Verrucomicrobium. In October 2010, sediment samples which were collected closely to the wellhead show high abundance in Bacteroidetes, the sulfate-reducing bacterial families Desulfobacteraceae and Desulfobulbaceae, as well as Cycloclasticus. Phylotypes of the genus Cycloclasticus were previously found both in surface oil slick and the deep hydrocarbon plume. The Desulfobacteraceae and Desulfobulbaceae clones do not appear in non-polluted surface sediments, and differ from the sulfate reducers commonly found at natural hydrocarbon seeps in the Gulf of Mexico. The succession of the bacterial community indicated that the oil-derived sedimentation pulse triggered bacterial community perturbations and possibly created patchy anaerobic mini-environments that favored sulfate-reducing bacteria, even at the sediment/seawater interface. A secondary heterotrophic consumption peak was indicated by a Planctomycetes peak in July 2011, one year after the oil spill. Sediment microbial community dynamics reveals the deposition of the oil-derived sedimentation pulse together with its continuing microbial processing.

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Type: Poster 10-361

Graphene -metal oxide (TiO2, ZnO) nanocomposite for Organic Decontamination from Water

Presenter: srikanth Gunti
University Of South Florida
Authors: s. Gunti, M. Ram, A. Kumar;
University Of South Florida, Tampa, FL.

Abstract:
The organics and heavy metals remediation from water are generally performed by combination of physical, chemical and biological techniques. However, the use of photocatalyst (i.e, titanium oxide (TiO2)) shows the complete remediation of organics without generation of residues under UV-light. The previous studies from our group on graphene-TiO2 and graphene-TiO2-biosurfactant based photocatalysts have shown to remediate the organics in visible light. In the present work, G-zinc oxide (ZnO) and G-(ZnO+ TiO2) nanocomposite photocatalysts were synthesized using chemical methods, and characterized by using FTIR, X-Ray Diffraction and SEM techniques. Attempts are made to remediate methyl orange (MO), naphthalene and organic oil using G-ZnO and G-(ZnO+ TiO2) photocatalysts, and have been compared using graphene- TiO2. The novel photocatalysts reveal that the complete remediation of organics from water could be made under sun light.

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Type: Poster 10-362

Key indicator species, Rangia cuneata, in the Mission-Aransas National Estuarine Research Reserve: a preliminary assessment of abundance and distribution

Presenter: Maria C Rodriguez
Texas A&M University-Corpus Christi
Authors: M. C. Rodriguez[1], J. S. Gray[1], S. Madsen[2], J. W. Tunnell, Jr[1];
[1]Texas A&M University-Corpus Christi, Corpus Christi, TX, [2]University of Texas Marine Science Institute, Port Aransas, TX.

Abstract:
Rangia cuneata are brackish water clams that act as key indicator species of freshwater inflow in Texas coastal watersheds. They are more abundant at the mouth of rivers where they enter into bays. The Mission-Aransas National Estuarine Research Reserve (MANERR), established in 2006, is one of the newest in the National Estuarine Research Reserve (NERRS) system. It is about 30 miles north of Corpus Christi, TX, and its main purpose is to provide relatively natural settings for long term research. It is important to know abundance and distribution of R. cuneata to determine habitat quality in coastal watersheds. The objectives of this project were to determine whether the clams are present in the MANERR, and, if present, determine preliminary distribution and abundance. This study was conducted throughout June and July of 2013. The Aransas and Mission River systems were surveyed. A dredge was used every mile up the river from the mouth, and live and dead R. cuneata were enumerated, when found. Once a bed of live clams was located, quadrat sampling was used. There were no beds found in the Mission system. In Aransas River, however, 3 beds were found and surveyed. At each site, 5 quadrats were taken, and any extra clams found were measured and collected. The data collected did not yield a clear picture of abundance and distribution, however, R. cuneata are present in small refuge populations during the current extended drought. Future research should be conducted to determine more detailed abundance and distribution.

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Type: Poster 10-363

Patterns of Crustacean Zooplankton Abundance in the Northern Gulf of Mexico during Summer 2013

Presenter: Timothy S. Lee
University of South Florida
Authors: T. S. Lee[1], K. L. Daly[1], K. A. Kramer[2];
[1]University of South Florida, St. Petersburg, FL, [2]Larcos Aquaculture, LLC., St. Petersburg, FL.

Abstract:
In August 2013, eleven stations in the Northern Gulf of Mexico, including the Deepwater Horizon (DWH) platform site, were sampled for zooplankton densities and environmental parameters with an imaging instrument, the Shadow Image Particle Profiling and Evaluation Recorder (SIPPER). The zooplankton images taken by SIPPER were automatically identified to the lowest possible taxa using PICES (Plankton Imaging Classification Extraction Software). Our primary interest was to assess abundance patterns of crustaceans in the mixed layers across the Northern Gulf. Multivariate analysis of twelve crustacean taxa densities across all one-meter increments of mixed layer in all stations showed that most of the stations' mixed layer depths had similar crustacean compositions, except for DWH and the surface layers of three stations nearest to DWH; this suggests the possibility of how oil dispersants and freshwater input from the nearby Mississippi River delta can shape crustacean communities in the mixed layers. To compare environmental parameters with crustacean density patterns, the BIO-ENV (Primer 6.1) was used; the oxygen content, salinity, and transmissivity were most influential in describing different crustacean zooplankton abundance patterns. The knowledge of long-term patterns on zooplankton abundances and dynamics in the Gulf of Mexico still remain scant. While this study showed that the crustacean abundances in mixed layers throughout the Northern Gulf appeared very similar for summer 2013, comparisons with other years of data in the region are necessary to better understand the annual summer abundance patterns.

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In situ time series measurements of biogeochemical processes in the benthic boundary layer at GC600, Gulf of Mexico

Presenter: Christopher S Martens
UNC-Chapel Hill
Authors: C. S. Martens[1], H. Seim[1], H. Mendlovitz[1], D. C. King[1], L. Lapham[2], B. Orcutt[3], M. D'Emidio[4], A. Dercks[5];
[1]UNC-Chapel Hill, Chapel Hill, NC, [2]U Md Center for Environmental Science, Solomons, MD, [3]Bigelow Laboratory for Ocean Sciences, East Boothbay, ME, [4]U. Mississippi, University, MS, [5]U Southern Mississippi, Abbeville, MS.
Abstract:
Physical and chemical in situ sensor arrays were deployed on seafloor landers in the benthic boundary layer at lease block GC600 in the northern Gulf of Mexico to investigate the role of near bottom processes in production, consumption and transport of dissolved methane and oxygen on time scales of hours to months. Over 14 total months of in situ data were collected at 0.5 to 3 minute intervals in continuous sampling bursts of two to five months between 24 April 2012 and 20 Sept 2013. Sensor arrays were deployed at three upper slope sites: MC118 (883m depth), featuring nearby gas hydrates, GC600 (1174-1226m), featuring natural hydrocarbon seeps and OC26 (1617m), providing background data from deeper water. Dissolved oxygen concentrations and temperature were inversely correlated at all sites as a result of water mass mixing processes. Temporal variability in current direction and velocities from near zero to over 30 cm/s within two m of the sediment surface revealed strong influences of bathymetrically focused currents, the influence of diurnal tides on local and regional transport processes and episodic surface ocean events. Open cylinder benthic chamber measurements revealed the potential of sediment oxygen demand and lower flushing rates to create localized hypoxia during restricted water transport conditions.

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Evolution of the SEAMAP reef fish video survey from traditional fisheries gears to a video based, multi-gear, ecosystem level sampling platform

Presenter: Matthew D Campbell
NOAA Fisheries
Authors: M. D. Campbell;
NOAA Fisheries, Pascagoula, MS.
Abstract:
Reef fish habitat in the Gulf of Mexico (GOM) includes not only coral reefs found in the Florida Keys and Flower Gardens Banks, but rocky banks, ridges and pinnacles found on the continental shelf, shelf edge break and upper slope. The Southeast Assessment and Monitoring Program (SEAMAP) reef fish survey of shelf and shelf-edge banks in the GOM was initiated in the late 1980's out of a need to sample in habitats that are inaccessible to traditional fishery gears. The survey evolved from using a single-funnel fish trap to its present stationary stereo-video format because it was recognized that trap catches were highly biased. Video-camera-visual surveys are all effective gears for ecosystem level sampling with the additional benefits of being minimally intrusive, non-extractive, and less selective than traditional gears. Negatives include exclusion of biological samples (e.g. otoliths), difficulty in obtaining representative length-age relationships for stock assessment, ongoing debate concerning appropriate metrics, time intensive video processing, and problematic system calibrations. To address ecosystem based assessment needs anticipated in the future, the SEAMAP reef fish video survey has transitioned to a multi-gear approach. Data streams in the survey now include traditional video information such as habitat composition, abundance and length estimates, and has expanded to include age, reproduction, and stomach content from vertical line gear as well as habitat mapping and total biomass from acoustic gears.

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Polarimetic Imaging of Surface Slopes and Slicks Over a Wide Range of Wind Speeds Including Spray

Presenter: Brian K Haus
University of Miami
Authors: B. K. Haus, N. J. M. Laxague, D. G. Ortiz-Suslow;
University of Miami, Miami, FL.

Abstract:
The most consistently available technology for tracking oil spills are satellite based radars because of their ability to penetrate clouds and insensitivity to lighting and optical properties of the ocean surface. However to be most effective for this purpose they need to be calibrated with appropriate in-situ observations. Recent advances in polarimetric imaging technology have led us to explore this technologies use for this purpose. Of particular interest to satellite remote sensing applications is the ability to quantify the spatial energy present in specific wavenumber bands well into the capillary regime. While it is relatively straightforward to extract the surface wavenumber from the imagery, extracting the energy at particular wavenumbers is more challenging. Here we will report on laboratory measurements designed to calibrate the slope observations and to determine the effect that longer waves and sea-spray have on the small scale observations. Simultaneous, collocated optical, infrared and in-situ wave slope observations were collected over a range of wind, wave and illumination conditions. The implications for at-sea observation of short wave slopes and their interpretation in satellite radar images in both low and high wind regimes will be discussed.

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Type: Poster 10-367

Evaluating the scale of oil spill impacts on deepwater shipwrecks in the Gulf of Mexico: From microbiomes to macrostructures

Presenter: Leila J Hamdan
George Mason University
Authors: L. J. Hamdan[1], M. Damour[2], C. Horrell[3];
[1]George Mason University, Manassas, VA, [2]Bureau of Ocean Energy Management, New Orleans, LA, [3]Bureau of Safety and Environmental Enforcement, New Orleans, LA.

Abstract:
Shipwrecks serve as artificial reefs in the deep ocean. Because of their inherent diversity compared to the surrounding environment and their random distribution, shipwrecks are ideal ecosystem monitoring platforms. To explore their ecological role in the deep biosphere, a multidisciplinary study is underway through a partnership of Federal agencies, academic institutions, and the private sector. The study provides a comparative assessment of *Deepwater Horizon* spill impacts on shipwreck microbiomes, the microbiomes of resident deepwater corals, and the synergistic effects of contaminants on these communities and the physical structures that support them. A molecular approach will reveal the taxonomic structure and function of microbiomes and the local sedimentary and aquatic environment in differentially spill-impacted areas. This approach could inform about the role of microorganisms in establishment and maintenance of the artificial reef environment, while providing information about ecosystem feedbacks resulting from the spill. Additionally, archaeological analyses incorporating emergent 3D laser scanning technology will assess meso to macro-scale impacts vis-à-vis changes in degradation rates and site formation processes on wooden versus metal-hulled wrecks. This coupled biological and archaeological approach bridges the gap between micro and macro scale impacts on monitoring platforms and provides the basis for long term monitoring of artificial reefs on the seafloor.

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Type: Poster 10-368

Teaching and Research in Environmental Crime & Related Courses in the Criminal Justice Curriculum: The Case of Gulf of Mexico Research Initiative and Criminal Justice Programs in Louisiana

Presenter: Ekwuniru C Nwokeji
Southern University at New Orleans
Authors: E. C. Nwokeji;
Southern University at New Orleans, New Orleans, LA.

Abstract:
The Deep Water Horizon oil spill reviews lack of adequate involvement of criminal justice educators in environmental crime, responses, and protection. Following the tragedy, BP announced a commitment of $500 million over ten years to fund an independent research program to study the effect and potential impact of hydrocarbon releases on the environment and public health, as well as to develop improved spill mitigation, oil detection, characterization and remediation technologies. Funds to conduct these studies are distributed to governmental or nonprofit academic and research institutions in the Gulf Coast State. About 202 projects from different university programs are funded. No project is traceable to criminal justice program currently.
The paper hypothesized that less than 5% criminal justice programs in Louisiana teach and research environmental crime and related courses. The methodological approach to the study is qualitative using archival study, survey, and interview.
The paper advocates that the challenges of environmental crime require the involvement of criminal justice educators through teaching and research in environmental crime and related courses in the curriculum. The paper further emphasizes the need for environmental agencies, businesses, public, government and non-governmental organizations to support this development through funding, grants, job placements, and internships.

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Oil Sedimentation Pathway: Marine Snow Distributions in the NE Gulf of Mexico, 2010-2013

Presenter: Kendra Daly
University of South Florida
Authors: K. Daly, K. Kramer, A. Remsen;
University of South Florida, St Petersburg, FL.

Abstract:
The Deepwater Horizon oil spill in 2010 was notable for the formation of oil-associated marine snow, which was one pathway by which oil sedimented to the seafloor. The C-IMAGE project has completed 15 cruises since July 2010 in order to understand the impacts of the oil spill on the lower trophic food web, as well as impacts of the ecosystem on oil deposition. We used the SIPPER camera imaging system to assess the temporal variability in abundance, distribution, and size frequency (0.23 to 9 mm2) of marine snow particles. In addition to impacts from the oil spill, Mississippi river low salinity outflow strongly influenced NE Gulf of Mexico surface seawater densities during both August 2010 and 2013 and potentially marine snow concentrations. Results from a time-series station (DSH09), 52 km to the NE of the DWH wellhead, indicate that the greatest percentage of particles was typically in the 0.23 - 1 mm-2 size range. Maximum marine snow densities were significantly higher in near surface waters during August 2010 (62,470 m-3), than during September 2011 (2,059 m-3), August 2012 (3,641 m-3), or August 2013 (12,086 m-3). Thus, riverine influence alone does not explain the high marine snow densities observed shortly after the wellhead was capped. These results are a contribution to the Marine Oil Snow Sedimentation and Flocculent Accumulation (MOSSFA) working group.

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Type: Poster 10-370

Implementation of a Towed Camera System Indexing Reef Fish Density: Applications to MPA Assessment

Presenter: Sarah Grasty
University of South Florida
Authors: S. Grasty, C. Lembke, S. Butcher, A. Silverman, G. Gonzalez, G. Gonzalez, S. Murawski;
University of South Florida, St. Petersburg, FL.

Abstract:
The development of rapid assessment methods to estimate abundances and map the ranges of Gulf of Mexico reef fishes is a management priority. These data are integral for exploited species management and evaluations of conservation alternatives such as marine protected areas (MPAs). Here we present habitat and fish abundance data gathered from the use of a towed camera system, C-BASS (Camera-Based Assessment Survey System). This platform has the capability to facilitate large-scale quantitative assessments of economically important reef fish stocks. Three areas off the West Florida Shelf were surveyed in this study: Steamboat Lumps, Madison-Swanson, and the Florida Middle Grounds. Fish density was estimated by analyzing footage from six analog and high resolution digital cameras. Coincident environmental data - temperature, depth, turbidity, chlorophyll and altitude above bottom - were also recorded during deployment. This system's utility is enhanced through the simultaneous use of high resolution hydroacoustics to estimate the fraction of fish occurring above the camera height. Imagery from the camera system also documents the extent of the red lionfish (P.volitans). We provide density estimates and distribution data for this and other selected reef fish species along the west Florida Shelf stratified by habitat type. Potential biases and uncertainties in these estimates are also discussed.

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Type: Poster 10-371

Cold-water Coral Associated Benthos in the Gulf of Mexico Before And After The Deepwater Horizon Oil Spill

Presenter: Amanda W Demopoulos
US Geological Survey
Authors: A. W. J. Demopoulos[1], J. R. Bourque[2], K. M. Stamler[3];
[1]US Geological Survey, Gainesville, FL, [2]Cherokee Nation Technology Solutions, Contracted to the US Geological Survey, Gainesville, FL, [3]Cherokee Nation Technology Solutions, Contracted to the US Geological Survey, Patuxent, MD.

Abstract:
Cold-water corals support diverse and dense populations of benthic invertebrates that provide vital ecosystem functions and services. Yet due to their sedentary existence, these associates are vulnerable to perturbation and contaminant exposure. Between 2009 and 2012 sediment cores were collected near deep-coral ecosystems, allowing quantitative assessment of the biological and environmental conditions before and after the Deepwater Horizon oil spill in the Gulf of Mexico. Multivariate analysis of macrofaunal and meiofaunal abundance, diversity, sediment particle size, metals, and hydrocarbon concentrations was used to assess the impact at sites located 6-194 km from the wellhead, allowing for separation of spill impacts from any impacts from natural seeps. Macrofaunal densities at three sites near the wellhead varied between 2010 and 2011, while those at two un-impacted sites northeast of the wellhead remained similar between 2009 and 2011. Within individual sites near the wellhead, hydrocarbon concentrations in surface sediments were patchy, corresponding with high variability in faunal community composition and abundance. Multi-year data provide a baseline for assessing recovery of benthic communities residing adjacent to deep-sea corals in future monitoring and restoration activities.

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Type: Poster 10-372

Mapping Of Sedimentary Microbial Communities And Identification Of Bioindicators For Oil Degradation In Sediments Of The Northeastern Gulf Of Mexico

Presenter: Xiaoxu Sun
Georgia Institute of Technology
Authors: X. Sun[1], W. Overholt[1], K. Marks[1], B. Shin[1], K. Chin[2], J. E. Kostka[1];
[1]Georgia Institute of Technology, Atlanta, GA, [2]Georgia State University, Atlanta, GA.

Abstract:
Benthic microbial communities provide key ecosystem services such as organic matter decomposition and nutrient regeneration in the Gulf. Main objectives of this research are to: 1) elucidate the rates, pathways, and controls of biodegradation of oil hydrocarbons, and 2) quantify the effects or impacts of hydrocarbon discharge on the functional diversity of sedimentary microbes. Our time series database encompasses >500 sediment core samples collected from the shallow continental shelf to the deepsea in the Desoto Canyon region from 2010 to 2013. An Illumina MiSeq platform was used to obtain an average of 12000 SSU rRNA gene amplicon sequences per sample. Degradation rates of Macondo oil were quantified at close to ambient (4 oC) and room temperatures (20 oC). Degradation rates under cold conditions rivaled those of warmer conditions. Ten strains of oil-degrading bacteria from two groups (Rhodococcus and Halomonas) were isolated from deepsea sediments. Gene sequences retrieved from deepsea sediments showed high sequence identity to those of the cultivated strains. Highly diverse microbial communities were observed in all samples and community composition correlated with both core depth and water column depth. This research elucidates model bacterial strains that may be used as microbial indicators of hydrocarbon degradation as well as for understanding the ecophysiology of hydrocarbon metabolism in the deepsea.

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Type: Poster 10-373

Use of genetic tools to monitor populations of Paramuricea, a genus of deep-sea gorgonian corals impacted during the 2010 oil spill

Presenter: Erik Cordes
Temple University
Authors: E. Cordes[1], A. Quattrini[1], D. Young[1], C. Doughty[2];
[1]Temple University, Philadelphia, PA, [2]Villanova University, Villanova, PA.

Abstract:
Species in the genus Paramuricea are among the most common corals in deep waters (>200 m) of the Gulf of Mexico. Since these corals were directly impacted during the Deepwater Horizon oil spill, there is a critical need to monitor their populations and to develop ways to monitor for future impacts that may not be visually apparent. Using remotely operated vehicles from 2009-2011, we documented the abundances and size frequency distributions of Paramuricea across 21 sites at depths of 250-2500 m. Molecular barcoding (mtCOI+igr+MutS) was used to identify 7 different haplotypes of Paramuricea, which segregated by depth. Microsattelite loci were used to define patterns in gene flow among populations, which will inform future restoration efforts. Abundances of Paramuricea spp. were mapped onto high-resolution bathymetric data, which confirmed the corals' patchy distribution on topographic highs composed of hard substrata. Modeling of mortality and recruitment rates revealed low natural adult mortality, and low and variable recruitment, suggesting that these corals are highly susceptible to anthropogenic disturbance. Comparisons of the gene expression of coral colonies that were impacted during the spill to nearby control corals revealed patterns in the regulation of stress-response genes that may be used as a tool to monitor for exposure to environmental toxins in the future.

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Type: Poster 10-374

Gene expression and stress response of the flatback mud crab Eurypanopeus depressus exposed to crude oil from the Deepwater Horizon oil spill

Presenter: Keith A Crandall
George Washington University
Authors: H. D. Bracken-Grissom[1], D. L. Felder[2], B. P. Thoma[2], J. M. Wong[1], K. A. Crandall[3];
[1]Florida International University, North Miami, FL, [2]University of Louisiana at Lafayette, Lafayette, LA, [3]George Washington University, Ashburn, VA.

Abstract:
During the Deepwater Horizon oil spill (DWH), millions of gallons of oil were leaked and an unprecedented amount of dispersant was added to the waters in the Gulf of Mexico. Little is known of the physiological affects of oil and dispersant on marine organisms and the resulting ecological and environmental impacts. Gene expression studies are currently underway to characterize the affects of the DWH on decapod communities in the Gulf of Mexico. Flatback mud crabs (Eurypanopeus depressus) were collected from unaffected sites and experimentally exposed to Macondo crude oil, as well as to combined oil and dispersant under laboratory conditions. Samples were harvested and placed directly in liquid nitrogen before being thawed and dissected in RNAlater ICE. Total RNA was extracted from muscle tissues and assessed for quality and quantity of RNA. Analyses of next-generation transcriptome data is ongoing to identify and characterize genes that are differentially expressed in controls and treatments as well as identify rare transcripts that are correlated with hydrocarbon exposure and stress response. In addition to characterizing the genetic response of E. depressus, this study will be placed into the broader context of other crustacean communities and serve to identify the candidate genes suitable for further investigation in other invertebrate systems.

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Type: Poster 10-375

Deep Sea Coral-Associated Bacterial Community Composition Analysis Using 16S rDNA

Presenter: Richard Dannenberg
Penn State University
Authors: R. Dannenberg, I. Baums, D. Ruiz, C. Fisher;
Penn State University, State College, PA.

Abstract:
There is a growing recognition that even deep-sea corals are much more than simply animal tissue and that their physiology can be modified and enhanced by their symbionts. In shallow water corals, both dinoflagellate and bacterial symbionts are fairly well characterized. However, in deep water corals, which lack Symbiodinium dinoflagellates, the importance of bacteria is still largely unknown. The goal of this work is first to examine the composition of the bacterial communities specifically associated with various deep-sea coral species and within some different lineages of corals of a single species. Secondly, we are quantifying community composition and transcriptomic response of several of these corals and their bacterial symbionts to oil and dispersant exposure. Bacterial community composition was analyzed on the Illumina platform using 16S ribosomal DNA to create a separate library from each coral sample. Preliminary results show specific bacterial communities associated with some corals and indicate differences in symbiont populations among species, treatments, color morphs, and in some cases subspecies in varying proximities to active seepage.

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Coral injuries observed at Mesophotic Reef Communities following the Deepwater Horizon oil discharge

Presenter: Mauricio Silva
Florida State University
Authors: M. Silva[1], P. J. Etnoyer[2], A. W. J. Demopoulos[3], I. R. MacDonald[1];
[1]Florida State University, Tallahassee, FL, [2]NOAA's Center for Coastal Environmental Health and Biomolecular Research, Charleston, SC, [3]Southeast Ecological Science Center, U.S. Geological Survey., Gainesville, FL.

Abstract:

Pathologies in over 400 octocoral and antipatharian sea fan colonies were quantified at water depths of about 65 to 75 m at two Gulf of Mexico mesophotic coral community sites in the Pinnacle Reefs area offshore Mississippi and Alabama. Photographic sampling using video and digital macro cameras deployed from an ROV examined the gorgonian and antipatharian corals communities of six sites in total. Injuries were documented at three sites, listed in order of injury frequency: Alabama Alps Reef (AAR), Roughtongue Reef (RTR) and Yellowtongue Reef (YTR). Injured taxa listed in order of frequency included the following provisional designations: Hypnogorgia pendula, Bebryce sp., Thesea sp., Swiftia sp., Antipathes sp., and Stichopathes sp. The most conspicuous injuries observed were retracted polyps, mucus secretion, flocculent material covering branches, and overgrowth by hydroids. Extreme injuries were characterized by tissue necrosis, naked skeleton and broken branches. Our results suggest that coral injuries may be connected to a catastrophic event such as the Deepwater Horizon (DWH) oil discharge rather than a natural event. PAHs analyses of sediments at AAR and CTR found levels elevated above pre-DWH discharge values, although the concentrations were well below toxicity thresholds. Elevated PAH concentrations were also measured in octocoral and echinoderm samples from AAR and CTR. We suggest that Tropical Storm Bonnie could have facilitated mixing process of dispersant-treated hydrocarbons droplets into the water column and resulting in injurious contact with coral colonies.

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Type: Poster 10-377

A Time Series Hydrographic Dataset for the Northeastern Gulf of Mexico

Presenter: Sarah Tominack
University of West Florida
Authors: S. Tominack, M. Gaona, J. Rosanbalm, C. Hester, J. Moss, W. Jeffrey, R. Snyder;
University of West Florida, Pensacola, FL.

Abstract:
Oil spill response at the University of West Florida included the initiation of time series datasets for the Northwest Florida Bight Shoreline and Shelf. Data has been collected along three transects of 9 stations each covering the shelf south of Pensacola, Destin, and Panama City, Florida and the head of DeSoto Canyon. Sampling was at near monthly resolution from January 2011 to May 2012, and continues quarterly within the Deep-C GoMRI consortium. Data includes CTD hydrographic data (salinity, temperature, dissolved oxygen, Chl and CDOM fluorescence, turbidity) light attenuation (PAR, UVA, UVB), nutrient and chlorophyll a concentrations, as well as phytoplankton and bacterial biomass and production measures. During the Mississippi River flood in the spring of 2011 a freshwater lens could be detected nearly 80 km off Pensacola Bay, indicating that even rather disparate areas can be influenced by flooding of this major river. Historical hydrographic data will be organized and added to the datasets. Sediment samples have been collected and analyzed for PAHs, chlorophyll a, and C:N composition. The datasets will be available on the UWF Center for Environmental Diagnostics and Bioremediation webpages (http://uwf.edu/cedb) and through the DEEP-C Research consortium.

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Type: Poster 10-378

An Ecosystem Monitoring System in the Mississippi Bight

Presenter: Stephan D Howden
The University of Southern Mississippi
Authors: S. D. Howden, K. Gundersen, D. Redalje, K. Martin;
The University of Southern Mississippi, Stennis Space Center, MS.

Abstract:
The Mississippi Bight (MSB) is bordered to the west by the Mississippi River (MSR), and to the east by Cape San Blas. The northern border of the MSB is split by Mobile Bay, which has the 5th largest discharge in North America. Large estuaries created by offshore barrier islands in the western MSB include the Mississippi, Chandeleur, and Breton Sounds, all of which were impacted by the Macondo Well oil spill. Seasonal and interannual variability in river discharge creates pulsed freshwater forcing, and can lead to drastic changes in the western MSB when flooding on the MSR leads to opening of the Bonnet Carre Spillway, and other smaller spillways on the eastern side of the river. Adding the threat of tropical storms leads to a challenging environment for autonomous monitoring. Large gradients in water properties develop because of the fluvial inputs and pose challenges to achieving sufficient spatial resolution in both the vertical and horizontal. The sea surface to seafloor density gradient becomes so large in the summer that until recently no commercially available buoyancy glider was able to traverse the full water column. The present monitoring system that was utilized during the Macondo Well oil spill will be described and a plan for an enhanced system that is both more capable of monitoring the next oil spill, and of providing information on the state of the ecosystem will be presented. Among the phenomena that this system is meant to monitor are the development of stratification, eutrophication, seasonal hypoxia, and effects and efficacy of restoration projects, including southeast Louisiana coastal restoration projects, barrier island restoration projects, and expansion of the Port of Gulfport.

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Undersea vehicles: Vital component of undersea ecosystems monitoring

Presenter: Max Woolsey
National Institute for Undersea Science and Technology
Authors: M. Woolsey[1], P. M. Lowe[2], S. Tidwell[2], R. Jarnagin[1], C. B. Lutken[2], M. D'Emidio[2];
[1]National Institute for Undersea Science and Technology, Abbeville, MS, [2]University of Mississippi - Mississippi Mineral Resources Institute, University, MS.

Abstract:
A major scientific objective of the ECOGIG consortium is time series data collection from seafloor landers. The landers must be deployed in close proximity to environmental targets, serviced, and eventually recovered, requiring surveys and manipulation from both autonomous and tethered undersea vehicles. The study areas of these landers span from 900 to 1700 meters depth.
The I-SPIDER is a battery-powered tethered system that communicates to the surface control station via a fiber optic cable. In its standard format, it holds lights and video cameras outstretched on eight arms. It contains systems for navigation, payload interface, and precision instrument deployment. One commonly used payload is a scanning sonar capable of detecting equipment and active seeps. The I-SPIDER has carried landers to target areas on the seafloor, and held them until an ideal location or specific target is confirmed visually.
For manipulating the lander systems and preparing them for recovery, the Station Service Device (SSD) can be used. This a remotely operated vehicle (ROV) consists of several thrusters, cameras, and a hydraulic manipulator. It is used in concert with the I-SPIDER, with the latter providing an overview of the work area. Upon deploying a lander, the SSD can push sampling probes into the seafloor and place other samplers atop targets of interest such as seeps and bacterial mats. Landers have been deployed, serviced, and recovered with their months of data by the SSD and I-SPIDER.

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Type: Poster 10-380

Oil Spill in SAR Satellite Imagery

Presenter: Alexander Soloviev
Nova Southeastern University Oceanographic Center
Authors: S. Lehner[1], D. Velotto[1], S. Singha[1], A. Soloviev[2];
[1]German Aerospace Center (DLR), Bremen, GERMANY, [2]Nova Southeastern University Oceanographic Center, Dania Beach, FL.

Abstract:
The new generation of high-resolution SAR satellites (TerraSAR-X, Tandem-X, RADARSAT-2, COSMO-SkyMed constellation, ALOS PALSAR) have opened new opportunities in the oil spill detection and monitoring on regional and global scales. Satellite SAR can complement airborne SAR and the other active and passive remote sensing tools that are now available for oil spill detection and monitoring. We have conducted a number of studies involving in-situ observations including controlled fish oil releases in the Straits of Florida during TerraSAR-X and COSMO SkyMed satellite overpasses. During these experiments, a new approach to distinguish between oil spills and look-alikes in SAR images of the ocean surface has been tested. This approach is based on the analysis of the co-polarized phase difference. We will also provide examples of oil detection with TerraSAR-X Wide Scan SAR Mode (200km range) from the African coast and discuss observations of natural oil seeps in the Gulf of Mexico.

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Better Access to Gulf Researchers, Resources, and Biodiversity Information for Improved Disaster Preparedness

Presenter: Fabio Moretzsohn
Harte Research Institite, Texas A&M University-Corpus Christi
Authors: F. Moretzsohn, J. W. Tunnell, Jr., L. McKinney;
Harte Research Institite, Texas A&M University-Corpus Christi, Corpus Christi, TX.

Abstract:
GulfBase.org is a portal on research resources in the Gulf of Mexico developed by the Harte Research Institute in 2002 to provide researchers, policy makers and the public access to Gulf information. Currently it lists over 2400 researchers, 500 institutions, 600 events (upcoming and past), and other information related to the Gulf. The Deepwater Horizon blowout has made clear the need for quick access to information and experts. In response, GulfBase is developing new “products” to foster collaborations and to improve disaster preparedness: 1) partnership with IUCN Red List and Global Marine Species Assessment to review the conservation status of

Gulf species, augment HRI's Biodiversity of the Gulf of Mexico database (which has information on over 15,000 Gulf species), and create an expert directory; 2) Gulf of Mexico University Research Collaborative (GOMURC) inventory of ocean assets (research vessels, ROVs, platforms, etc.) to encourage more partnerships among universities and better utilization of their resources; and 3) Gulf of Mexico Alliance (GOMA) Directory of Education and Outreach Professionals to facilitate finding outreach partners, especially since virtually all grants now require an outreach component. Additionally, a new GulfBase website with new features will be released in early 2014.

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Framework for Adaptive and Dynamic Offshore Oil Spill Wireless Sensor Networks

Presenter: Shikher Mishra
University of South Alabama
Authors: S. Mishra, W. K. Al-Assadi;
University of South Alabama, Mobile, AL.

Abstract:
Wireless Sensor Networks (WSN) is an emerging technology which consists of small, limited powered and low-cost devices that have the capability of computation, sensing and wireless communication. Sensor nodes deployed to detect and monitor oil-spill can collect and deliver data to the sink without requiring manual control. Remote Sensing is an alternative technology but has limitations like manual processing and spatial & temporal resolution. We have developed the framework for an adaptive and dynamic WSN that will enable rapid detection and monitoring of oil-spill. We have considered various aspects of WSN that include routing, localization, data exchange and time-synchronization. Routing and localization were given more consideration as their implementation becomes a challenge with non-stationary sensor nodes, which is inevitable in such WSN. The proposed routing method is a minimum-hop routing strategy with tables-driven optimization. With the use of this routing method there is no need to fix route-tables prior to installation of sensor nodes. Signal strength is used to adapt routing in accordance with the dynamics of the network. If there are some pre-defined locations, adversity of dynamic network can be utilized for localization. Infeasibility of nanosecond timer was given due consideration in localization of such sensor nodes, when radio signals are used. Movement between predefined locations can be predicted with the help of drift velocity. Various conditions were tested during simulation, which affects performance to efficiency ratio accordingly. Thus ultimate implementation of such a design depends upon the requirements and available resources.

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Building Capacity and Decision Support for Risk Assessment and Marine Biodiversity Conservation in the Gulf of Mexico

Presenter: Fabio Moretzsohn
Harte Research Institute, Texas A&M University-Corpus Christi
Authors: F. Moretzsohn[1], R. McManus[2], B. Polidoro[3,4], H. Harwell[5], M. Comeros-Raynal[4], K. Carpenter[4], C. Linardich[4], J. Wood[6], G. Ralph[4], T. Lacher[7,2];
[1]Harte Research Institute, Texas A&M University-Corpus Christi, Corpus Christi, TX, [2]Species Survival Commission, International Union for Conservation of Nature, Washington, DC, [3]Arizona State University, Tempe, AZ, [4]IUCN Species Programme, Global Marine Species Assessment / Marine Biodiversity Unit, Old Dominion University, Norfolk, VA, [5]Christopher Newport University, Newport News, VA, [6]Texas A&M University-Corpus Christi, Corpus Christi, TX, [7]Texas A&M University, College Sation, TX.

Abstract:
The IUCN, in collaboration with the Harte Research Institute (HRI), is conducting Red List Assessment workshops with panels of marine species experts to review and assess the conservation status of all marine vertebrates, selected plants and invertebrates of the Gulf. Results from these workshops will provide comprehensive data on the distribution, life history, habitat requirements, and other ancillary information to augment HRI's Biodiversity of the Gulf of Mexico (BioGoMx) database. The initiative will identify current knowledge gaps, help inform decision makers, enable development of more effective conservation priorities and programs. It will also support major recovery and restoration efforts funded via the RESTORE Act and other investments made in response to the Deepwater Horizon blowout. Developing spatial modeling capacity protocols with species distribution maps and creating an 'Expert Directory' will improve disaster preparedness and identify needs for species-specific conservation action in the face of immediate threats to marine biodiversity within the region.

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Type: Poster 10-384

Combining Aquarius And MODIS Measurements To Assess Nearshore Salinity Levels In The Northern Gulf Of Mexico

Presenter: Shelby Barrett
NASA DEVELOP National Program
Authors: S. Barrett, A. Brooks, M. Arguelles, J. Thompson;
NASA DEVELOP National Program, Stennis Space Center, MS.

Abstract:
This project was conducted to investigate the feasibility of improving nearshore sea surface salinity (SSS) estimates using Total Suspended Solids (TSS) products derived from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) sensor data in conjunction with open water SSS measurements from the NASA Aquarius sensor. The coarse spatial resolution Aquarius data collected over open water was used to derive a linear regression between its salinity estimates and the most temporally and spatially relevant cloud-free MODIS data available. The resulting linear regression equation was then applied to the MODIS TSS data to compute an estimate of SSS for nearshore waters. These data were validated using available in situ salinity measurements acquired from multiple agencies. The resulting products yielded a much higher spatial resolution estimate of SSS and extended closer to the shoreline than the SSS products using only Aquarius measurements. This preliminary project provided information on the technical feasibility of measuring nearshore SSS by combined use of MODIS and Aquarius data. These methods were communicated to project partner the Coalition to Restore Coastal Louisiana, a local non-profit organization whose goal is the protections and restoration of a sustainable Louisiana coast.

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Preliminary predictive models of microbial community interactions during the Deepwater Horizon Oil Spill in the Gulf of Mexico (GoM) using Microbial Assemblage Prediction (MAP)

Presenter: Nicole M Scott
University of Chicago
Authors: N. M. Scott[1], P. E. Larsen[2], T. Yang[3], A. P. Teske[3], J. A. Gilbert[2,1];
[1]University of Chicago, Chicago, IL, [2]Argonne National Laboratory, Argonne, IL, [3]University of North Carolina, Chapel Hill, NC.

Abstract:
The Deepwater Horizon oil spill, with its complex hydrocarbon plume, created spatial-temporal shifts in microbial community structure as microorganisms dynamically responded to heterogeneous and transient nutrient sources. The relationship between microbial community structure and geochemical markers, allows us to model these dynamical relationships through time. Using MAP, we model the web of community interactions as an artificial neural network (ANN) derived from metabolic predictions, taxonomic data, and environmental data to create models that predict the relative abundance of microbial communities through time and space as a function of environmental conditions. We hypothesize that our models will validate previously published spatial-temporal trends and may better explain the ecology of these trends. To test our hypothesis, we use 200 16S data sets and metadata to develop the Bayesian network model of species-environment interactions. To determine the relationships between nodes we use 100 16S data sets and associated metadata to train a set of ANNs. These models are validated using in-situ data and highlight the niche relationships between bacterial taxa and the changing environmental conditions of the GoM. Our preliminary results predict that species associated with denitrification are more abundant with increased hydrocarbon contamination and this prediction is significantly correlated with ammonium and nitrogen in samples. This research represents the first attempt to model the successive states of the microbial community degrading the oil spill. Such models are necessary to determine how changes in nitrogen cycling and primary productivity in the GoM can influence regional and global climate.

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Quantifying hydrocarbon emission and biodegradation rates with measurements of natural stable isotopes and current velocity

Presenter: John D Kessler
University of Rochester
Authors: J. D. Kessler[1], S. Mau[2], S. Sylva[3];
[1]University of Rochester, Rochester, NY, [2]Alfred Wegener Institute, Bremerhaven, GERMANY, [3]Woods Hole Oceanographic Institution, Woods Hole, MA.

Abstract:
The rates of hydrocarbon emission and biodegradation are two essential parameters for both the response and recovery phases of marine oil spills. Having rapidly deployable and user friendly techniques would enable both of these parameters to be assessed quickly and concurrently on numerous platforms for better spatial and temporal analysis. Here we present a new method for determining both of these parameters concurrently for specific hydrocarbons. This method incorporates measurements of hydrocarbon concentration, natural stable isotopes, and current velocity into a new model of isotope kinetics and mixing. While hydrocarbon concentration and stable isotope measurements can require more specialized analyses in land or ship based laboratories, water samples only require hydrocasts for collection and thus can be collected concurrently from multiple vessels; current velocity is often determined via ADCP. This method was applied to methane data collected in June 2010 during the Deepwater Horizon disaster and produced rates of methane emission and biodegradation in agreement with previously published, independently determined results. The functionality of this technique is also displayed with example data collected from natural methane seepage off the coast of Costa Rica, providing estimates of the spatial distribution of methane emission and biodegradation in this area.

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Type: Poster 10-387

Analysis of Bragg Scattering of Oil Types under Radar Microwaves

Presenter: Oscar Garcia Pineda
Florida State University
Authors: O. Garcia Pineda, A. Hale, I. MacDonald;
Florida State University, Tallahassee, FL.

Abstract:
Oil spills in the marine environment are destructive to sea life including fish, marine mammals and sea birds. Accurate detection of the oil spills locations, allows more efficient response operations. In this regard, using satellite Synthetic Aperture Radar (SAR) imagery, we have developed interactive mapping tools that allow us to accomplish this task. However, it is of great interest to resolve the bragg scattering on the SAR images that could be indicative of the thickest layers of floating oil inside the spill extent. In this context, the objective of this project is the design and construction of a RADAR that would mimic the signal from the SAR satellites. This radar is being used to transmit and receive microwaves aimed to layers of floating oil with different thicknesses.
The radar consists on a c-band (~5.4 GHz) bistatic microwave antennas (mounted vertically) for detecting various media of targets, while modeling a SAR satellite signal. A shallow wave pool (approximately 4x1 meters) is being used for as the target area. The antennas are situated about 30ft above ground level on a scaffolding tower. The goal of the project is to determine a difference in return signal powers of various media, such as sea water, pure oil, and different ratios of oil-water emulsions in the tank. The hypothesis of the experiment is that due to the different dielectric properties of oil and oil emulsions, different return signals are expected from these materials.

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Type: Poster 10-388

Optimization of the oxygen concentration in a high pressure reactor for aerobic biodegradation of mineral oil

Presenter: Ana Gabriela Valladares Juarez
Hamburg University of Technology
Authors: A. Valladares Juarez, M. Schedler, L. Heide, A. Meyer, G. Gust, R. Mueller;
Hamburg University of Technology, Hamburg, GERMANY.

Abstract:
When oil is spilled in the ocean, bacteria can remove the oil by metabolizing it. However, biodegradation of oil in high-pressure sites such as the seafloor around the DWH well is poorly studied. High pressure can influence the physicochemical behaviour of oil and bacterial viability, which affect the biodegradation rates of oil. To investigate such effects, several pressure reactors ranging in volume from 100 mL to 100 L are run in batch mode in our high pressure faciilities. The amount of oil degraded is quantified indirectly by offline analysis of bacterial concentrations. For conducting long-term studies, reactors must contain sufficient nutrients and oxygen to sustain bacteria over the course of the experiments. With our current apparatuses it is not feasible to supply oxygen continuously when the system is pressurized at 150 bar, so the maximum amount of oxygen tolerated by bacteria should be supplied to the system at the start. Adding oxygen in excess, however, can lead to inactivation of the bacteria; oxygen is a strong oxidant and has been found to damage bacteria at concentrations above 35-70 µg/mL (Zobell and Hittle, 1967). E. coli and the marine alkane-degrading bacterium, P. frederiksbergensis were compared for resistance to increasing oxygen partial pressures. E. coli was able to withstand pressures one order of magnitude larger than P. frederiksbergensis. With this knowledge the proper oxygen dose can be supplied for long-term biodegradation experiments.

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Type: Poster 10-389

Analysis of meiofauna and sediment from the northern Gulf of Mexico continental shelf following the Deepwater Horizon Oil Spill

Presenter: Ceil Martinec
Troy University
Authors: C. Martinec[1], J. M. Miller[1], N. Barron[1], S. C. Landers[1], K. Yu[1], P. M. Stewart[1], A. C. Nichols[2], D. Steffy[2];
[1]Troy University, Troy, AL, [2]Jacksonville State University, Jacksonville, AL.

Abstract:
This study examined meiofauna distribution and relationship to environmental variables from the north central Gulf of Mexico continental shelf after the Deepwater Horizon oil spill. Sediment samples were collected in 2012 with a Shipek® grab sampler at depths ranging from 59-361 m, with an average sample depth of 108 m. Meiofauna were subsampled in triplicate and preserved in 5% formalin. Additional subsamples were analyzed for granulometric characteristics as well as metals, organic carbon, and PAH concentrations. Data were analyzed using Spearman's correlations ($\alpha \leq 0.05$). Correlations suggested a general increase in nematode density and an increase in the nematode: copepod ratio with metal concentrations, silt and clay percentage, depth, and organic carbon content. PAH concentrations were relatively low at the sample depths studied, with all sites having less than 1100 ppb total PAHs and less than 400 ppb total EPA priority pollutant PAHs. PAHs tended to increase in the eastern areas of the study along the continental shelf of the Florida panhandle, while the concentration of metals such as Al, Ba, Cu, Ni, Pb, V, and Zn were higher on the southeastern Louisiana shelf. Currently the nematodes and copepods are being identified to allow for a community analysis of the animals. This research was made possible by a grant from BP/The Gulf of Mexico Research Initiative.

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Type: Poster 10-390

Hercules 252 Gas Blowout Rapid Response: Water Sample Estimated Oil Equivalents

Presenter: Terry L Wade
Texas A&M University
Authors: T. L. Wade, D. Shi, P. Chapman, S. T. Sweet, N. L. Guinasso;
Texas A&M University, College Station, TX.

Abstract:
Hydrocarbons in the water column can be from spills, natural seepage, oil production activities, ship activities, coastal run-off and atmospheric deposition. Total scanning fluorescence (TSF) is a rapid screening tool to determine estimated oil equivalent concentrations (EOE). On July 23, 2013 the Hercules 252 rig blew out releasing gas and condensate and producing an intermittent sheen. All rig workers were safely evacuated before the rig caught fire and burned. The leak was bridged over by sand and sediment flowing into the well bore and plugging the well. Scientists from five GoMRI consortia (ECOGIG, CWC, GISR, CARTHE, C-IMAGE) assembled and deployed a rapid response team. As part of this response 29 water samples were collected (7/23/13 to 7/30/13) and analyzed. The EOE ranged from 0.7 to 14.7 µg/L. EOE analyses of water samples collected during the Deepwater Horizon (DWH) spill had EOE concentrations between 2 and 440 µg/L. Analysis of selected samples for polycyclic aromatic hydrocarbons (PAH) confirmed the presence of petroleum in samples with elevated TSF/EOE. Water samples collected near the Loop Current during the DWH release had EOE of not detected (0.7 ug/l) to 5.07 ug/l. Water samples collected in July 2012 in the vicinity of the DWH had EOE concentrations of 0.2 to 4.2 µg/L. The Hercules 252 incident EOE are lower concentrations than in the DWH oil spill plume but slightly higher compared to samples collected in 2012.

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Type: Poster 10-391

Distribution of Water Column Hydrocarbon from the Deepwater Horizon Oil Spill

Presenter: Terry L Wade
Texas A&M University
Authors: T. L. Wade, J. L. Sericano, S. T. Sweet, N. L. Guinasso;
Texas A&M University, College Station, TX.

Abstract:
There was an unprecedented number of water samples collected from Federal waters during the release of oil from the Deepwater Horizon oil spill. Reported here are the results of the hydrocarbon analyses of more than 11,400 water column samples, collected from May 17 to December 15, 2010 as part of the DWH response and NRDA which included multiple response agencies, trustees and BP. Of these 2,700 are from BP studies that have not previously been published. In addition over 3,300 results were reprocessed and revised to show hydrocarbons at lower detection limits. The samples were collected in all directions from within a few 100 meters of the well to over 45 km from the well. Concentrations of total petroleum hydrocarbon (TPH) ranged from not detected >200 ug/L to 730,000 ug/L. The concentration of total polycyclic aromatic hydrocarbons (PAH) ranged from not detected (>0.005 ug/L) to 1,200 ug/L. The spatial and temporal distribution of hydrocarbons will be discussed as well as compared to EPA toxicological benchmarks. This data will be valuable for the assessment of the extent of hydrocarbon transport, fate and impact. This data set is being made available for use by the scientific community.

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Type: Poster 10-392

Building a comprehensive sample repository to track the long-term impacts of the Macondo Well oil spill: an opportunity to engage citizen scientists

Presenter: Catherine Carmichael
Woods Hole Oceanographic Institution
Authors: C. Carmichael[1], C. Aeppli[2], R. K. Nelson[1], C. M. Reddy[1];
[1]Woods Hole Oceanographic Institution, Woods Hole, MA, [2]Bigelow Laboratory for Ocean Sciences, East Boothbay, ME.

Abstract:
In the past, studying the long-term fate of oil spills has been hindered by long absences of sampling and a lack of sampling spread. This has limited our capacity to study how oil behaves in the environment on the time scale of years to decades. To eliminate this potential problem for the Deepwater Horizon oil spill, our lab at the Woods Hole Oceanographic Institution has started a sample repository to collect and archive oil samples for research. Over the past 26 months, our lab has collected over 700 samples along the beaches, jetties and barriers islands in the Gulf of Mexico. These samples have been shared with colleagues, analyzed in numerous scientific publications and are being used to create a NIST Standard Reference Material. The temporal and spatial trends seen among the samples provide a valuable contextual reference to how the released oil is behaving and changing in the environment.
Due to our location in Cape Cod it is challenging for us to collect as many samples as we would like to. We believe this is an excellent opportunity for a Citizen Scientist Program. This poster will provide an overview of the types of samples that can be collected, proper sample collection and archiving protocols and how petroleum behaves in the environment. A Citizen Scientist Program is a mutually beneficial effort that would increase our sample collection capabilities to allow for more extensive analytical results while simultaneously educating a future generation on the fundamentals of oil spill research.

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Type: Poster 10-393

Bacterial community dynamics in oil polluted seafloor sediment (May 2010 - July 2011)

Presenter: Tingting Yang
UNC-Chapel Hill
Authors: T. Yang[1], K. Speare[1], S. Joye[2], A. Teske[1];
[1]UNC-Chapel Hill, Chapel Hill, NC, [2]University of Georgia, Athens, GA.

Abstract:
The huge load of hydrocarbons during the Deepwater Horizon oil spill directly changed the bacterial community structures in the sediment close to the Macondo wellhead. Compared to the 16S rRNA clone libraries from unpolluted sediments in early May 2010, the September 2010 bacterial community from oil-contaminated sediments shows a sharp increase in Alphaproteobacteria and Verrucomicrobium. In October 2010, sediment samples which were collected closely to the wellhead show high abundance in Bacteroidetes, the sulfate-reducing bacterial families Desulfobacteraceae and Desulfobulbaceae, as well as Cycloclasticus. Phylotypes of the genus Cycloclasticus were previously found both in surface oil slick and the deep hydrocarbon plume. The Desulfobacteraceae and Desulfobulbaceae clones do not appear in non-polluted surface sediments, and differ from the sulfate reducers commonly found at natural hydrocarbon seeps in the Gulf of Mexico. The succession of the bacterial community indicated that the oil-derived sedimentation pulse triggered bacterial community perturbations and possibly created patchy anaerobic mini-environments that favored sulfate-reducing bacteria, even at the sediment/seawater interface. A secondary heterotrophic consumption peak was indicated by a Planctomycetes peak in July 2011, one year after the oil spill. Sediment microbial community dynamics reveals the deposition of the oil-derived sedimentation pulse together with its continuing microbial processing.

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Type: Poster 10-394

Efficacy of data assimilation on numerical simulation of spilled oil drifting on the sea

Presenter: Satoaki Tsutsukawa
Osaka University
Authors: S. Tsutsukawa, H. Suzuki, N. Kato;
Osaka University, Suita, Osaka, JAPAN.

Abstract:
We propose the autonomous buoy system tracking spilled oil and gas. This system is constructed by the buoy robot (SOTAB: Spilled Oil Tracking Autonomous Buoy) and the numerical simulation to forecast the state of spilled oil and gas. The robot can monitor and track the spilled oil or gas and measure the hydrographic conditions and weather conditions around the spilled oil or gas. The numerical simulation can incorporate the real time measured data which obtained from the robot.
In this paper, we investigated the efficacy of data assimilation on the numerical simulation of spilled oil drifting on the sea. The simulation model is constructed by Weather Research and Forecasting (WRF) as an atmospheric model and Regional Ocean Modeling System (ROMS) as an ocean model. The calculation procedure is as follows. Firstly, we calculated the atmospheric variables using WRF. Next, the result was provided to ROMS. Lagragian particle tracking method was used for spilled oil drifting. The changes of oil property were calculated in three steps, evaporation, emulsification, and spreading. Since drifting oil tended to be affected by wind, we used the data assimilation applied to WRF. Because the buoy robot was under development, numerical experiment was conducted to verify its validity by providing pseudo observations to the numerical model. In the numerical experiment, oil spill accident by Russian heavy oil tanker Nakhodka, which broke in the stormy weather off the coast of Shimane prefecture of Japan in 1997, was simulated as a test case. We compared the simulation result with observations at the accident, and report some of the results.

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Type: Poster 10-395

Estimated Oil Equivalents in the Water Column three years after the Deepwater Horizon Oil Spill

Presenter: Dawei Shi
Texas A&M University
Authors: D. Shi, T. L. Wade, S. T. Sweet, N. L. Guinasso;
Texas A&M University, College Station, TX.

Abstract:
Sources of hydrocarbons in the water column include oil spills, natural seepage, oil production activities, ship activities, coastal run-off and atmospheric deposition. Total scanning fluorescence (TSF) is an effective screening tool to detect the presence of aromatic hydrocarbons derived from petroleum or combustion sources in water samples. TSF analyses of over 300 discreet water samples collected at various depths throughout the water column during and soon after the Deepwater Horizon (DWH) Spill indicted oil was present. The presence of polycyclic aromatic hydrocarbons (PAH) confirmed petroleum in samples with elevated TSF. Additional water samples (337) were collected through out the water column on July 2012 GISR cruise on the R/V Pelican in the vicinity of the DWH. A total of 298 of these were analyzed by TSF and estimated oil equivalence (EOE) determined. In addition 38 samples were analyzed for PAH by GC/MS. Larger water volumes (2 to 4 L) were used to achieve lower detection limit. During 2013 GISR cruses GO4 and GO5, and additional 84 and 70, respectively were collected. The presence and spatial extent of petroleum two to three years following the spill will be compared to results during and just after the spill.

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Type: Poster 10-396

Pre- and Post- Deepwater Horizon Spill Sediment Trap Study: A Geochemical Perspective

Presenter: Nancy G Prouty
US Geological Survey
Authors: N. G. Prouty[1], F. Mienis[2], P. L. Campbell[1], J. P. Chanton[3], S. W. Ross[4], A. W. J. Demopoulos[5], S. Brooke[6];
[1]US Geological Survey, Santa Cruz, CA, [2]Royal Netherlands Institute for Sea Research (NIOZ), Texel, NETHERLANDS, [3]Florida State University, Tallahassee, FL, [4]University of North Carolina, Wilmington, Wilmington, NC, [5]US Geological Survey, Gainesville, FL, [6]Florida State University, St Teresa, FL.

Abstract:
Sediment trap studies in the Gulf of Mexico highlight the dominance of the Mississippi-Atchafalaya River as the source of sediment and nutrient transport to the seafloor of this region. The large quantities of nutrients and terrestrial organic matter (OM) stimulate primary productivity, causing OM to flocculate and sink to the seafloor. To investigate the impact of the Deepwater Horizon Spill on sediment and nutrient transport to the deep-sea, sediment traps from two year-long deployments between 2008 and 2011 were analyzed for a suite of geochemical tracers (e.g., trace metals, lipid biomarkers, stable isotopes). Sediment samples were analyzed from ~monthly sub-samples collected at 480 m depth in the Viosca Knoll area, a reef-like deep-sea coral ecosystem dominated by the coral Lophelia pertusa. Sterols and n-alkanes show high intra-annual variability, linked to seasonal changes in primary productivity triggered by fluctuation in Mississippi River discharge. Organic carbon flux values are lower after the spill, consistent with lower satellite-derived estimates of surface water particulate organic carbon content. Post-spill δ13C values are also reduced, potentially linked to an oil and gas depleted-13C carbon source. Sediment trap trace metal concentrations were also elevated after the spill. Consistent with metal distributions after the explosion, sediment trap concentrations increase significantly for cobalt, followed by chromium, copper, vanadium and nickel.

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Type: Poster 10-397

Monitoring Deep-sea Benthos in Response to the Deepwater Horizon Blowout in the Gulf of Mexico

Presenter: Paul A Montagna
Texas A&M Univ.-Corpus Christi
Authors: P. A. Montagna[1], J. Hyland[2];
[1]Texas A&M Univ.-Corpus Christi, Corpus Christi, TX, [2]NOAA, National Ocean Service, Charleston, SC.

Abstract:
It is apparent that oil from the Deepwater Horizon blowout reached the bottom of the Gulf of Mexico leading to the question “were deep-sea living benthic resources affected?” Sediment cores were collected in fall 2010 and summer 2011 to assess potential effects on deep-sea sediments. Interdisciplinary measurements are necessary to perform assessments, so abiotic (chemicals and sediment characteristics) and biotic (macrofauna and meiofauna - the two main soft-bottom benthic invertebrate groups) responses were measured. This multivariate dataset was reduced to a new variable representing the oil spill footprint, which was then mapped in GIS to calculate the area affected. Changes in the abundance and diversity of these fauna were found with distance from the wellhead in various directions, and the effects were correlated to total petroleum hydrocarbon and barium concentrations and distance to the wellhead, and not distance to known hydrocarbon seeps.

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Crossing trophic levels with ecosystem models: Data needs during evolution of DWH event

Presenter: Jason M. Lenes
University of South Florida
Authors: J. M. Lenes[1], B. P. Darrow[1], J. J. Walsh[1], K. L. Daly[1], R. A. Snyder[2];
[1]University of South Florida, St. Petersburg, FL, [2]University of West Florida, Pensacola, FL.

Abstract:
In marine systems, secondary producers such as micro- and mesozooplankton represent an ecological crossroads that link a set of complex trophic interactions over a wide range of size classes. While nutrient resources ultimately limit production within an ecosystem, consumers can dictate the spatio-temporal pattern. The balance between these heterotrophs and their potential food sources not only exerts top down controls on the microbial loop and primary production, but represents the bulk energy flux to support higher trophic levels. In addition, sinking zooplankton fecal pellets can account for a significant portion of carbon flux to the shelf and deep ocean. Thus, a detailed understanding of the net community response across multiple trophic levels during an anomalous perturbation, as observed during the Deepwater Horizon spill (DWH) in the northern Gulf of Mexico, cannot be fully rectified without examining this trophic middleman. Here we discuss a new NPZD model, the ZOOplankton SIMulation (ZOOSIM), designed for flexible application to many regions. ZOOSIM tracks the mass flux of carbon, nitrogen, phosphorus, silica and iron through explicit pools of bacteria, phytoplankton and zooplankton in order to reproduce both bottom up and top down controls in relation to how perturbations such as the DWH event can alter nutrient and particle deposition, thus impacting community composition. A wide range of data are needed to properly parameterize and test such a model due to the complexity of the non-linear response within the ecosystem.

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Aerial Survey Validation of Satellite SAR Monitoring of Anthropogenic Hydrocarbon Discharges in the Gulf of Mexico

Presenter: Samira Daneshgar Asl
Florida State University
Authors: S. Daneshgar Asl[1], J. Amos[2], P. Woods[2], O. Garcia-Pineda[1], I. R. MacDonald[1];
[1]Florida State University, Tallahassee, FL, [2]SkyTruth, Shepherdstown, WV.

Abstract:
We used satellite remote sensing and aerial surveillance to quantify hydrocarbon releases of the Taylor offshore platform cataloged in the Gulf of Mexico. National Response Center (NRC) oil pollution reports were collected and filtered for the period of 2010 to 2012 to determine which of the reports coincided with archived SAR images. In all, 1154 NRC reports were attributed to the Taylor Energy and MC020 lease block. Of the reports in the vicinity of MC020, 45 reports could be investigated in our SAR images and 29 of 45 reports were visible in the images. The NRC reports of area and oil slick areas measured using semi-supervised texture classifying neural network algorithm (TCNNA) or geographic information system (GIS) tools showed that on average the measured areas are 41 times larger than described in the NRC reports by the standard deviation of 108. The consistent under-reporting we observed indicates that the Taylor site represents a substantial source of petroleum to the coastal marine region offshore Louisiana. The formation of long wind-driven layers of floating oil released from the Taylor site was verified with aerial monitoring and measurements on the continuous, constant-scale, geo-referenced mosaics of the images, field sampling, and biomarker analysis on 22 May, 2012 and 4 August, 2013. Surveillance by SAR and aerial photography are demonstrated to be comparable methods for detecting or verifying oil discharges. Consistent application of these technologies would improve accuracy for estimates of chronic anthropogenic oil pollution.

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Type: Poster 10-400

Marine Oil Snow Sedimentation and Flocculent Accumulation (MOSSFA)

Presenter: Uta Passow
UCSB
Authors: U. Passow[1], J. Chanton[2], K. Daly[3], D. Hollaender[4], N. Kinner[5];
[1]UCSB, Santa Barbara, CA, [2]Earth Ocean and Atmospheric Science, Talahassee, FL, [3]College of Marine Science, USF, St. Petersburg, FL, [4]College of Marine Science, USF, Talahassee, FL, [5]Coastal Response Research Center & Center for Spills in the Environment, UNH, Durham, NH.

Abstract:
A unique aspect of the Deep Water Horizon oil spill in 2010 was the formation of rapidly sinking particles that contained oil and therewith significantly impacted the transport and distribution of oil-carbon in marine ecosystems. The MOSSFA Working Group facilitates the integration and synthesis of data relating to the inclusion of oil-carbon into marine snow, the sedimentation of such particles through the water and their deposition as floc at the seafloor, as well as the impact of these processes on pelagic and benthic ecosystems. Different pathways involving physical coagulation or biological aggregation may lead to the formation of oil-associated particles, which sink rapidly. Formation of oil associated marine snow is spatially and temporally patchy because of environmental gradients due to river run-off, mineral resuspension, oil weathering and the distribution of biological productivity. During their descent and after their deposition at the seafloor, the sinking particles may coat organisms and habitats, or they may be ingested inadvertently or utilized intentionally. Oil-carbon thus enters pelagic and benthic food webs and habitats with consequences for individual organisms to community structure and whole ecosystems. Differences in processing and sediment characteristics result in spatial heterogeneity of the biogeochemical fate of accumulated floc at the seafloor. We will present synthesis results from the workshop describing the temporal and spatial variability in the distribution pathway of oil associated with sinking particles and the respective ecological consequences in pelagic and benthic environments.

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Type: Poster 10-401

Overview of SEAMAP in the Gulf of Mexico

Presenter: Jeff Rester
Gulf States Marine Fisheries Commission
Authors: J. Rester;
Gulf States Marine Fisheries Commission, Ocean Springs, MS.

Abstract:
The Southeast Area Monitoring and Assessment Program (SEAMAP) is a State/Federal/University program for collection, management, and dissemination of fishery-independent data and information in the southeastern United States. SEAMAP is a cooperative program whereby Texas, Louisiana, Mississippi, Alabama, Florida, and the National Marine Fisheries Service jointly plan and conduct surveys of economically significant fish and shellfish and the critical habitats that support them. The main goal of SEAMAP is to collect long term, standardized, fishery-independent data on the condition of regional living marine resources and their environment primarily for use in stock assessments. Since SEAMAP began collecting data in 1982, SEAMAP data have become the backbone of fisheries and habitat management in the Gulf of Mexico. SEAMAP currently conducts a Winter, Spring, and Fall Plankton Survey; a Summer and Fall Shrimp/Groundfish Survey; a Vertical Line Survey; a Reef Fish Survey; and a Bottom Longline Survey. Data collected through SEAMAP surveys have been used by federal and state fishery managers, universities and other institutions to expand the knowledge of life histories, define essential fish habitat, develop fishery management plans, determine the impact of fishery regulations, and link population trends with changes in environmental conditions such as nutrient enrichment.

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Type: Poster 10-402

Oil-derived marine aggregates - hot spots of polysaccharide degradation by specialized bacterial communities

Presenter: Andreas Teske
University of North Carolina
Authors: C. Arnosti, K. Ziervogel, T. Yang, A. Teske;
University of North Carolina, Chapel Hill, NC.

Abstract:
Aggregates generated in the laboratory from incubations of seawater and surface-water oil collected in the initial phase of the Deepwater Horizon oil spill have proven to be similar to the oil-aggregates observed in situ. Here, we investigated the microbial community composition of laboratory-generated oil-aggregates, and the abilities of these communities to degrade polysaccharides, the abundant constituents of exopolymeric substances (EPS) generated by oil-associated bacteria in response to the presence of oil. The patterns and activities of polysaccharide-hydrolyzing enzymes in oil aggregates differed strongly from those in surrounding water, and uncontaminated control water. The distinct hydrolysis profiles point to specialized metabolic abilities among the oil-aggregate communities compared to oil-water and ambient water communities. The composition of the oil-aggregate community was also distinct, consisting of Gammaproteobacteria (mostly the obligately PAH-degrading genus Cycloclasticus and the EPS producer Halomonas), Alphaproteobacteria (mostly the marine Roseobacter cluster), Bacteroidetes (family Flavobacteriaceae), and members of the Planctomycetales; the latter three groups most likely catalyze the breakdown of oil-derived bacterial biopolymers. Formation and aging of oil-aggregates encourages the growth and transformation of microbial communities that are specialized in degradation of petroleum, as well as their secondary degradation products.

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Type: Poster 10-403

Passive acoustic monitoring of sperm whales (*Physeter macrocephalus*) in the Gulf of Mexico: From detection to density estimation

Presenter: Kaitlin E Frasier
Scripps Institution of Oceanography
Authors: K. E. Frasier[1], S. M. Wiggins[1], T. A. Marques[2], K. P. Merkens[1], D. Harris[2], L. Thomas[2], J. A. Hildebrand[1];
[1]Scripps Institution of Oceanography, San Diego, CA, [2]University of St. Andrews, St. Andrews, UNITED KINGDOM.

Abstract:
This study aims to quantify the population density of sperm whales (*Physeter macrocephalus*), at three sites in the Gulf of Mexico on a weekly basis since the start of the Deepwater Horizon (DWH) oil spill. To accomplish this, High-frequency Acoustic Recording Packages (HARPs) have been passively recording sperm whale echolocation clicks at these sites for over three years.
The challenge is in translating sperm whale click detections into a local density of animals. A combination of ocean conditions and animal behavior makes it unlikely that animals will be uniformly distributed and detected around the recorders. Monte Carlo methods are used to simulate the probability of detection. The result is a model-based approximation of click detectability based on estimated parameters that describe environmental features, signal characteristics, and animal behavior. In this study, we compared our modeled probability of detecting sperm whale clicks to results from in situ field experiments in which animals were tracked visually and acoustically. By ground-truthing the model, we improved our density estimates and refined our monitoring efforts, improving assessment of population trends and understanding of the effects of the DWH oil spill on these endangered cetaceans.