Gulf of Mexico Oil Spill & Ecosystem Science Conference

February 3-6, 2020
Tampa, FL

FINAL CONFERENCE REPORT

Table of Contents

Executive Committee 1

Partners and Supporters 2

2020 Sponsors 3

Executive Summary 4-5

Student Activities and Other Awards 6

Introduction and Plenaries 7-12

Session Organizers, Sessions, and Summaries

Session 001: 13-14
Session 002: 15
Session 003: 16-17
Session 004: 18
Session 005: 19
Session 006: 20
Session 007: 21
Session 008: 22
Session 009: 23
Session 010: 24
Session 011: 25
Session 012: 26
Session 013: 27
Session 014: 28
Session 015: 29-30
Session 016: 31
Session 017: 32
Session 018: 33
Session 019: 34
Session 020: 35-36
Session 021: 37
Session 022: 38
Session 023: 39
Session 024: 40-41
Session 025: 42
Session 026: 43
Session 027: 44
Session 028: 45

Attendance and Demographics 46-47

Appendix I: Conference Schedule

Monday, February 3 48
Tuesday, February 4 49
Wednesday, February 5 50
Thursday, February 6 51

Appendix II: Associated Workshops and Meetings 52-53

Appendix III: Gulf of Mexico Tools Café 54-55

Appendix IV: GOMOSES Communications Report 56-58

GULF OF MEXICO OIL SPILL & ECOSYSTEM SCIENCE CONFERENCE EXECUTIVE COMMITTEE

Larry McKinney - *Harte Research Institute (Chair)*
Laura Bowie - *Gulf of Mexico Alliance*
Thomas Coolbaugh - *American Petroleum Institute/ExxonMobil*
Elizabeth Fetherston-Resch - *RESTORE Centers of Excellence Research Grants Programs*
Bethany Kraft - *Volkert*
Scott Lundgren - *National Oceanic and Atmospheric Administration*
Stacey McLeroy - *U.S. Food and Drug Administration*
Jonathan Porthouse - *National Fish and Wildlife Foundation*
Chris Robbins - *Ocean Conservancy*
David Shaw - *Gulf of Mexico Research Initiative*
Kevin Sligh - *U.S. Coast Guard*
Gregory Steyer - *U.S. Geological Survey*
Buck Sutter - *Gulf Coast Ecosystem Restoration Council*
LaDon Swann - *Mississippi-Alabama Sea Grant Consortium*
Evonne Tang - *Gulf Research Program of the National Academies of Sciences, Engineering, and Medicine*
Gregory Wilson - *U.S. Environmental Protection Agency*
Denis Wiesenburg - *Gulf of Mexico Research Initiative*
Chuck Wilson - *Gulf of Mexico Research Initiative*

The Executive Committee thanks our sponsors and partner organizations for their time and support, as well as the staff of the Gulf of Mexico Research Initiative Management Team and our many volunteers, who have been working so diligently behind the scenes to ensure a successful conference year after year. A special thank you goes to Jason Mallett, of the Consortium for Ocean Leadership, for providing consistently unique and dynamic branding and other graphic design needs throughout the life of GoMOSES.

Partners & Supporters

The National Academies of SCIENCES ENGINEERING MEDICINE
GULF RESEARCH PROGRAM

CONSORTIUM FOR Ocean Leadership

GULF OF MEXICO RESEARCH INITIATIVE

Sea Grant
Texas • Louisiana • Florida
Mississippi-Alabama

FDA

EPA

GOMURC
GULF OF MEXICO UNIVERSITY RESEARCH COLLABORATIVE

NFWF

USGS
science for a changing world

Ocean Conservancy®

Gulf of Mexico
RESTORE
Centers of Excellence

VOLKERT

energy API

2020 Sponsors

Platinum Sponsor

Gold Sponsor

Bronze Sponsors

Copper Sponsors

Lanyards courtesy of:

EXECUTIVE SUMMARY

CONFERENCE OVERVIEW

In its eighth year, the Gulf of Mexico Oil Spill and Ecosystem Science (GoMOSES) Conference has cultivated a community actively engaged in collaborations and partnerships to advance scientific discovery and applications in the Gulf of Mexico. With the Gulf of Mexico Research Initiative (GoMRI) wrapping up its activities, including GoMOSES, the focus of this year's conference program, "2020: A Milestone in Gulf of Mexico Research," celebrated the accomplishments of the last 10 years and considered what the next 10 years may hold for the Gulf science and management community.

- Rita Colwell (GoMRI Research Board), through her keynote address, and invited speaker John Shepherd (GoMRI Research Board) summarized GoMRI's achievements and impacts on oil spill and Gulf ecosystem science;
- Larry McKinney (Harte Research Institute) addressed how the Deepwater Horizon oil spill changed the course of Gulf science;
- An expert panel led by LaDon Swann (Mississippi-Alabama Sea Grant Consortium) considered the future of research in the Gulf;
- Twenty-eight conference sessions offered approximately 290 oral and 130 poster presentations;
- Laura Bowie (Gulf of Mexico Alliance) and Nicole LeBoeuf (National Oceanic and Atmospheric Administration) spoke of what opportunities may exist for continued science and collaboration to inform regional, national, and international priorities over the next 10 years; and
- Larry McKinney and Laura Bowie announced the Gulf of Mexico Conference, the successor to GoMOSES, a blend of GoMOSES, the State of the Gulf Summit, and the GOMA All-Hands Meeting.

The program was planned by an Executive Committee of 16 partners representing academia, federal agencies, and nongovernmental organizations, with the generous support of several sponsors. An overview of the conference schedule is available in Appendix I (page 48).

The conference also hosted over a dozen associated workshops, meetings, and events during the week, offering attendees the opportunity to learn about and discuss interdisciplinary topics not covered by or in addition to the conference sessions. Many of these meetings emphasized collaboration among a variety of sectors, demonstrating the conference's role as a community-building venue. A list of meetings, with descriptions as available, is provided in Appendix II (page 52).

The GoMOSES Conference was pleased to host the fourth annual Gulf of Mexico Data Tools Café, which offered attendees a hands-on opportunity to learn about data management and analysis tools currently available. The five featured tools are listed in Appendix III (page 54).

The conference communications staff worked with partner organizations and universities, as well as local media outlets, to leverage networks and broaden the conference's reach through traditional and social media. Searches through *Meltwater*, a media monitoring service, returned 200 examples of coverage before, during, and after the conference with a total reach of 108.5 million people. A full report of communications activities is available in Appendix IV (page 56).

SCIENTIFIC SESSIONS

The 2020 conference was pleased to offer 28 concurrent sessions over three days, highlighting research advances in basic and applied science. Many sessions were borne from GoMRI's synthesis activities to summarize nearly a decade of research in key topics. Also, the conference was pleased to offer a track of sessions focused on restoration science and resource management, which made up nearly 25% of the program.

Gulf Ecology

- The Deepwater Horizon (DWH) oil spill caused an overall decline in species throughout Gulf waters despite mitigation measures, and years of research show different levels of recovery for different species and ecosystems. The degree of connectivity among Gulf component ecotypes means that oil spill effects in one ecotype potentially cascade among all due to water mass transport, trophic dependencies, and movement patterns of animals.

Oil Fate and Transport

- Dramatic improvements in understanding the composition of weathered and biodegraded oil have shown that weathering of oil at the surface involves a variety of mechanisms. Each mechanism individually and in combination affects chemical residues and the effectiveness of dispersants.
- Modelers and observational oceanographers need to work together to co-design cost-effective sustainable ocean observing systems to advance understanding and forecasting capabilities of Gulf circulation patterns.

Public Health and Social Sciences

- Critical coastal environments, such as wetlands and estuaries, not only provide ecosystem services, but also sociocultural services in the form of physical and emotional health. Environmental protection is directly linked to human wellbeing and positive health outcomes.
- Without baseline data on mental, physical, and community health, the impact of oil spills on health outcomes cannot be assessed. There is a need for prospective, longitudinal health studies and options to prevent or ameliorate poor health outcomes.

Restoration and Resource Management

- There is a growing community of researchers and resource managers seeking to conduct research relevant to pressing issues and incorporating the results into the decision-making process. Data from research funded by the BP settlement are already being utilized to support assessment, management, and decisions in many Gulf states.
- A more holistic understanding of the Gulf as a highly connected, complex system is necessary if future impacts are to be managed effectively. Identified chronic impacts may inhibit restoration efforts if not addressed.

Data and Modeling

- Integrative models currently in development show a clear trade-off between the level of detail represented and the range of biophysical and socioeconomic processes captured. Connections to underrepresented disciplines within the human health and socioeconomics domains need to be further developed.
- Machine learning will be a game changer in multidisciplinary studies, especially for incorporating human activity into models. Notable advances have been made leveraging the capabilities of neural network and machine learning that can support many disciplines.

Spill Response

- A real gap is an absence of a venue where academics can learn about the true scale of oil spills and clean-up operations so that synergistic research can be accomplished.
- Current response protocols should be updated using new technologies and models of both the effectiveness of dispersant use and its toxicity in field applications. A need also exists for culturally responsive recruitment methods and emergency response strategies which allow key stakeholders to identify gaps in the planning and implementation of disaster response plans.

IN SHORT

As the Session Highlights demonstrate, Gulf science has come a long way in understanding oil dynamics, weathering, and migration, and the impact of oil on ecosystems and communities. Effective communication and relationships are essential to integrating these advances and discoveries into updated policies and management plans, whether for oil spill response, community resilience, or ecosystem restoration. Increased discourse and collaboration between academia, industry, government, and the general public can help bridge differences between sectors, fill in the research gaps identified in each session, and further inform decisionmakers and stakeholders.

Greater detail and explanation of these points are available in the full session summaries (pages 13-45). Abstracts for *oral* and *poster* sessions are archived online.

STUDENT ACTIVITIES

2020 Student Presenter Support

Bringing professional development opportunities to students has become a hallmark of the conference, as evidenced by the continued support for student presenters. The Gulf of Mexico University Research Collaborative (GOMURC) and Harte Research Institute provided student presenter support, covering registration fees for student oral presenters from GOMURC institutions.

Students and early career scientists were also encouraged to take part in session organizing teams.

Graduate Student and Early-Career Networking Reception

The Gulf Research Program provided an opportunity for students and early-career professionals with research interests in the Gulf of Mexico region to meet and network with one another.

OTHER AWARDS

Wes Tunnell Lifetime Recognition for Gulf Science and Conservation honoring Chuck Wilson, Gulf of Mexico Research Initiative

Presented by Kelly Lucas, Thad Cochran Marine Aquaculture Center, and Tina Miller-Way, Dauphin Island Sea Lab

INTRODUCTION

2020 marks the 10-year anniversary of the Deepwater Horizon (DWH) disaster and is an important milestone for scientific research in the Gulf of Mexico. The culmination of a decade of dedicated research has increased our knowledge of marine oil spill science, Gulf ecosystems, and the impacts of the spill on those ecosystems and communities. Thus, 2020 presents a pivotal moment as the Gulf research and management communities enter the next phase of Gulf science.

In its eighth year, the Gulf of Mexico Oil Spill and Ecosystem Science (GoMOSES) Conference has cultivated a community actively engaged in collaborations and partnerships to advance scientific discovery and applications in the Gulf of Mexico. With the Gulf of Mexico Research Initiative (GoMRI) wrapping up its activities, including GoMOSES, the focus of this year's program, "2020: A Milestone in Gulf of Mexico Research," celebrated the accomplishments of the last 10 years and considered what the next 10 years may hold for the Gulf science and management community.

OPENING PLENARY

The Gulf of Mexico +10 Years and Counting

As Aristotle said, "The more you know, the more you know you don't know." During the decade since the Deepwater Horizon oil spill, great strides forward have been made in Gulf research — and yet, there is still more to learn about this unique region. The opening plenary attempted to summarize 10 years of scientific discoveries, innovative technology, and a greater understanding of Gulf of Mexico ecosystems and communities. Following the keynote address and invited presentations, an expert panel considered how to shape the Gulf of Mexico research "engine" going forward.

Keynote

"Basic Research Directed to Societal Benefit: The Gulf of Mexico Research Initiative Paradigm"

Rita Colwell - *GoMRI Research Board*

The Gulf of Mexico Research Initiative was set up as an independent research program for analysis and remediation of the Deepwater Horizon oil spill, with the goal of improving the societal ability to understand, respond, and mitigate impacts of petroleum pollution and related stressors on marine and coastal ecosystems. Addressing five research themes, its mission has been to determine the effects of the Deepwater Horizon incident, including environmental and public health impact of this and similar spills and releases of oil; to develop improved methods for spill mitigation, oil detection and characterization; and to advance remediation technologies. GoMRI is administered by a Research Board with 20 members, a Chief Scientific Officer, and a multi-organizational management team. Over 10 years, GoMRI awarded $445.3 million to peer-reviewed research proposals, with 71% of this funding going to institutions in Gulf states.

GoMRI has an extensive legacy. To date, GoMRI-funded researchers have published 1,409 articles, given more than 5,000 presentations, and submitted 2,811 data sets (76.5 TB) to the Gulf of Mexico Research Initiative Information and Data Cooperative (GRIIDC). Building a professional scientific workforce has been a key component of the program, which boasts 455 post-doctoral fellows, 627 Ph.D. students, 561 M.S. students, and over 1,000 undergraduates and high school students. GoMRI science has been disseminated through a vibrant communication and outreach strategy, including consortia efforts and strategic partnerships with Smithsonian Ocean Portal, the Gulf state Sea Grant programs, and Screenscope, who documented the research activities of several GoMRI-funded consortia in three episodes of "Dispatches from the Gulf." As part of its wrap-up activities, the program is currently undertaking a synthesis of research to link studies and create a holistic picture of GoMRI science.

Invited Presentations

"GoMRI Synthesis & Legacy: Overview & Update"

John Shepherd - *GoMRI Research Board*

The GoMRI Research Board is investing resources to bring the relevant communities together to synthesize GoMRI science and highlight the legacy of this 10-year program. This is more than just a summary; how can the relevant science be applied? Synthesis activities (*explained in greater detail online*) are being accomplished via two parallel processes: a "top down" approach with eight core areas by topic, plus "bottom up" consortia-led efforts. Through a series of more than 15 workshops, teams have been asked to address five key questions, keeping the user community in mind throughout discussions. Additionally, an advisory group (Core Area 8) advises the GoMRI Research Board to assist in identifying Lessons Learned, promote the effective application of GoMRI funded science, and improve operational advice. The results will be released through a series of publications, including a special issue of *Oceanography* in March 2021 (anticipated), core area overview papers, and subtopic papers.

Of course, GoMRI's legacies include, first and foremost, the wealth of science generated by 10 years of research, as well as several others. Building capacity in the region is one of GoMRI's most important legacies. GoMRI has supported a number of large research teams that will hopefully continue to tackle relevant science problems. The program has supported well over 1,000 graduate students, contributing materially to the next generation of scientists. The GRIIDC enterprise provides storage and access to all the data generated through the GoMRI investment, ensuring its availability for future research applications. Outreach products are a critical part of GoMRI's legacy, as they will live on beyond GoMRI and serve as useful informational pieces in the event of another oil disaster anywhere in the world. In light of the challenges to funding research, the Research Board views the GoMRI model itself as a great example of how the private sector can fund high-level science around a specific opportunity or otherwise. GoMRI has been a sponsor and founding member of the Executive Committee of the GoMOSES conference since it began in 2013. GoMOSES became one of the premier conferences to share Gulf-related research, and its legacy will continue through its successor, the Gulf of Mexico Conference.

"How Deepwater Horizon Changed the Trajectory of Gulf Research"

Larry McKinney - *Harte Research Institute*

Gulf science has evolved over the last 154 years, from exploration and innovation (1866-1875) to military research, fisheries, coastal ecosystems, and oceanographic studies (1940-1980). Geological research became a priority in the mid-1900s. The Department of Interior's Minerals Management Service and its successor, the Bureau for Ocean Energy Management, have funded over $1 billion in research since 1973, much of that in the Gulf of Mexico; 1,800 research projects have produced 3,600 research reports.

The Deepwater Horizon oil spill affected more than marine ecosystems and reliant communities. In 2009, a Sea Grant Gulf of Mexico Research Plan, compiled from surveys, workshops, and strategic plans, showed the highest-rated Gulf of Mexico research priorities included ecosystem health indicators; freshwater input and hydrology; habitats and living resources; sea level change, subsidence, and storm surge; and water quality and nutrients. These priorities changed after Deepwater Horizon; a similar study in 2013 listed the highest-rated Gulf research priorities as ecosystem processes and stresses; sea level change; water quality and nutrients; oil and dispersant interactions; and human and environmental health interactions. The oil spill heralded new research programs, such as GoMRI, NOAA's RESTORE Science Program, the RESTORE Centers of Excellence, and the Gulf Research Program of the National Academies of Sciences, Engineering, and Medicine (NASEM); many of which have incorporated these new research priorities in their portfolios. Nongovernmental organizations and international collaborations are also increasingly contributing to the Gulf scientific knowledge base.

What are the impacts of this surge in research efforts? GRIIDC now holds 2,760 datasets with 76TB of data. Between 2010-2020, over 12,000 articles, proceedings, meeting abstracts, book chapters, editorials, and reviews have been published. There has been an exponential expansion of our knowledge of topics

such as fate and effect of oil spills and dispersants, along with an increased interest in and funding for understanding connections between human and environmental health, and resilience and adaptability of coastal communities. Other areas receiving more attention include deep water exploration, sea level rise, and harmful algal blooms. Investments in research vessels are holding steady. Some fields have lost funding, such as investigation of the Mississippi outflow into the Gulf and overall water quality. Not all post-DHW initiatives have succeeded, especially large international efforts. Programs stemming from Natural Resource Damage Assessment (NRDA) efforts (e.g., Open Ocean Trustee Implementation Group) and the legal settlement with BP (e.g., NASEM's Gulf Research Program and NOAA's RESTORE Science Program) are showing promise as they gain steam.

The perception of the Gulf of Mexico as an industrial area where funding can have little impact persists, and investments in the region remain stagnant. However, the funding available through the many Gulf research programs provides an opportunity to disprove this sentiment. As these programs ramp up, they must be ready to address three questions:

- Did more than $20 billion make a difference?
- Is continued investment likely to show value?
- Will the Deepwater Horizon-generated funding for Gulf research and restoration be the excuse for a return to the status quo or an opportunity to accomplish even more?

As Dr. McKinney concluded, "The Gulf of Mexico is a sea where economy and environment both coexist and contend. We can help assure that coexistence… but only by working together."

Panel Discussion

A Vision for the Future: Integrating Gulf of Mexico Research

Panelists

Moderator: LaDon Swann - *Mississippi-Alabama Sea Grant Consortium*
Christoph Aeppli - *Bigelow Laboratory for Ocean Sciences*
Ed Buskey - *University of Texas at Austin*
Jessica Henkel - *Gulf Coast Ecosystem Restoration Council*
Julien Lartigue - *NOAA RESTORE Science Program*
Steve Murawski - *University of South Florida*
Burt Singer - *University of Florida*

The panel identified potential needs for continued science and research, as well as challenges. Panelists emphasized collaborative efforts to build a structure that links Gulf-focused research programs over the next 10 years in common effort, or at least a coordinated effort. The importance of engaging Gulf state and federal political leadership and building support for continued regional research efforts was also discussed.

Panelists first highlighted increased activity in the oil and gas (O&G) sector, which will impact Gulf ecosystems and resources, and addressed several remaining questions related to this activity. For example, increased O&G hydraulic fracking inland also means more pipelines to coasts and ports. Plus, offshore O&G exploration is moving even deeper into the ocean; are responders ready for a 3,000-meter spill? The deep Gulf remains largely unknown, demonstrating a need for deep ocean exploration and research. What are the cumulative effects of many small spills on Gulf ecosystems and communities? To better prepare for the next spill, how can responders and managers best use the wealth of information that has been generated over the last decade on small routine or chronic spills? The Sea Grant program triangulates input from academia and industry, integrating science and scientists into response efforts via memos and other program activities. The Bureau of Ocean Energy Management provides another platform for engaging the O&G industry in research. Currently, O&G operators are not required to maintain baselines for biological and water quality monitoring, and geologic hazards are not well incorporated into the O&G leasing process. Updating leasing requirements to address these issues would help increase overall knowledge and understanding of Gulf ecosystems, especially in deeper waters, and reduce the likelihood of accidents.

Gulf research faces a host of challenges and needs:

- Ship time is very expensive, and the science community as a whole needs to invest in the development of technological innovations like environmental DNA (eDNA) and DNA barcoding. These approaches could become new methods for coastal biodiversity research.
- Interdisciplinary approaches are essential to better understanding key Gulf features like the Loop Current and chronic issues like sea level rise. International collaborations with researchers in Mexico and Cuba should also be supported as the Gulf is an international sea that we all affect and are affected by.
- Professional capacity needs to be sustained, with continuing opportunities for and investment in young scientists. Conferences are especially important at this career stage for networking, collaborations, and professional development.
- Socioeconomic and public health research are among the least-funded aspects of Gulf research, yet constitute one of the region's largest needs, especially for mental health. Human health observing systems are necessary for the development of socioeconomic and public health baselines. Industry-academic partnerships for health research have occurred before; these studies could serve as a model for future studies.
- Various programs are working to make big data available and accessible. The large datasets being generated are perfect for AI and supervised learning, but researchers need to feed the right questions into these systems.
- Funders should continue to support fundamental research to understand the underlying processes in the Gulf, since a small issue now may be a major one in 10 years. The interface of basic and applied research will be more prominent in the future.
- Restoration goals and endpoints have not been clearly defined, adding to existing challenges of designing restoration projects which must address changing benchmarks and cumulative stressors.

Meeting these challenges will take coordination, collaboration, and communication between the many Gulf research programs. For example, uniform methods for monitoring should be developed and implemented, and data need to be managed, curated, and deposited such that they are findable, accessible, interoperable, and reusable. Interdisciplinary collaboration with other fields and communities should be fostered, as well as public involvement. The RESTORE Science Program is one example of an effort to incorporate coordination and collaboration. Directed by Congress to focus on applied science, its leaders encourage other programs to support fundamental science. The concept of co-production, where science research is a collaborative effort between researchers and resource managers, is helping the program build relationships between these two communities. These strategies are helping the program meet their mandate for better understanding of the Gulf as a whole ecosystem applied to management. Building such baselines is essential to identifying cumulative stressors and understanding their impacts. More sophisticated risk evaluation to assess chemical stressors and toxicology are needed as well.

How does Gulf science capitalize on GoMRI's legacy with all the funding available for restoration activities from NOAA RESTORE Science Program, the RESTORE Centers of Excellence, and other programs? What will we have to show after the next 10 years? A synthesis similar to GoMRI activities? Analyzing why some scientific programs have ended prematurely provides an opportunity for current programs to adopt Lessons Learned and avoid similar pitfalls. Program leadership should also engage Congress and build their confidence in the science produced when funding and priorities are coordinated to achieve regional strategies. The Congressional Gulf Caucus needs to value the scientific output of these programs and the impact of this output for addressing regional resource management concerns. Then, they can better understand the need for delegates' support for further research initiatives.

CLOSING PLENARY

Gulf Science in the Next 10 Years

The past 10 years have seen a wealth of scientific discovery and innovation, and fostered relationships between researchers, managers, and decisionmakers. What opportunities exist or can be created to sustain collaboration within this dynamic community, keep science in the forefront of management and policy, and add to the knowledge base of the nation's most valuable coastal resource?

"Embrace the Gulf"

Laura Bowie - *Gulf of Mexico Alliance*

The Gulf of Mexico provides food, shelter, protection, security, energy, habitat, recreation, transportation, and navigation — playing an important role in our communities, states, region, and nation. To highlight the value and the vitality of the Gulf of Mexico region, the Gulf of Mexico Alliance (GOMA) is implementing a Gulf-wide awareness campaign called "Embrace the Gulf" for the entire year of 2020. The awareness campaign will culminate in a multi-stakeholder, cross-sector celebration of the importance of the Gulf of Mexico. The Embrace the Gulf campaign has five focus areas: community, tourism, economy, education, and the environment. Ways to get involved include co-branding an existing activity, participating in social media campaigns, and creating a new collaborative opportunity with GOMA.

"U.S. Ocean Science and Technology Vision"

Nicole LeBoeuf - *NOAA*

2020 marks the 10-year anniversary of Deepwater Horizon and the 30-year anniversary of the Oil Pollution Act. In light of this, are we ready for the next threat? What should we be doing to develop technology and build and strengthen relationships? Attendees of the recent Ocean Summit on Science and Technology, hosted by the White House Office of Science and Technology Policy in November 2019, discussed this very question, noting that the pace of ocean change is increasing, and sectors will need to be nimble and work together via public-private partnerships.

NOAA recognizes that the application of emerging technology is essential and has expanded the agency's application of four emerging science and technology focus areas —unmanned systems, artificial intelligence, 'omics, and the cloud — to guide transformative advancements in the quality and timeliness of NOAA science, products and services. Advances in science and technology will also impact restoration in the Gulf, since the science will move faster than expected. Additionally, scientists, managers, and decisionmakers will need to clearly identify restoration targets even as conditions are changing.

The UN Decade of Ocean Science for Sustainable Development (2021-2030) (Ocean Decade) is another opportunity for scientific engagement between the Gulf and the international community. As a framework for international collaboration in conducting science for sustainable development, the Ocean Decade will focus resources of governments, the private sector, philanthropy, and nonprofits to leverage capabilities for scientific study of important societal problems. The steering committee is currently leading an effort to co-design a science program involving all sectors. There are multiple ways Gulf scientists can provide input, including developing ideas to propose nationally and internationally to address one or more key of the Ocean Decade's research and development priority areas: mapping the entire ocean floor and processes; bolstering ocean observing systems in all basins; conducting an inventory of ecosystems and their functioning; developing and linking data and information systems; establishing an integrated multi-hazard warning system; creating new integrated models for ocean prediction; and strengthening capacities and accelerating technology transfer and ocean literacy.

"The Gulf of Mexico Conference 2021"

Larry McKinney - *Harte Research Institute and GoMOSES Executive Committee Chair*
Laura Bowie - *Gulf of Mexico Alliance*

As the successor to GoMOSES, the Gulf of Mexico Conference aims to bring together the best of the Gulf's ecosystem sciences, restoration, and management to assure a healthy and sustainable Gulf for today and tomorrow. This three-day conference will encompass GoMOSES, the State of the Gulf Summit, and the GOMA All Hands Meeting to support science-based solutions to Gulf problems. The program will consist of plenaries, three scientific tracks (GOMA Gulf management topics, Gulf restoration science, and Gulf ecosystem science), and workshops and focused meetings. The first Gulf of Mexico Conference (GOMCON) will take place April 2021 in Baton Rouge, Louisiana.

A post-conference survey distributed to GoMOSES attendees included questions designed to solicit their input for planning the inaugural GOMCON. Of the 100 respondents, approximately 94% indicated some degree of interest in attending GOMCON, depending on conference costs, attendees' funding, and relevance of the conference program to attendees' work priorities. When asked what elements from GoMOSES they would like to see carried over to GOMCON, respondents suggested maintaining the diversity of scientific topics with a transdisciplinary approach ("from chemistry to sociology"), with more emphasis on restoration. Oil spill science and results from GoMRI's synthesis efforts also ranked highly. Expanded opportunities for graduate students and early career professionals were also prioritized. Networking, developing interdisciplinary synergies, and staying current with new trends were among the top benefits to conference attendance identified.

SESSION ORGANIZERS, SESSIONS, AND SUMMARIES

Over three days, approximately 290 oral and 130 poster presentations discussed recent findings and advances in oil spill research, including 54 oral and 48 poster presentations by students. The Executive Committee thanks the 2020 session organizers for their time, expertise, and dedication in reviewing and arranging abstracts and in moderating this year's sessions.

Session OO1:

Modeling for Synthesis – Integrated Assessment of Ocean Environment, Ecosystems, Human Health, and Socioeconomics

Cameron Ainsworth *(University of South Florida),* **Cecilie Mauritzen** *(Norwegian Meteorological Institute) and* **Helena Solo-Gabriele** *(University of Miami)*

Session Overview

Tremendous progress has been made during the GoMRI years in understanding changes in the environment due to a major oil spill, including through new models simulating specific components of the environment. The aim of this session is to assess the current state of integrative models capable of addressing broad questions posed by stakeholders. To answer such questions the model must be capable of integrating natural and anthropogenic systems at various scales. It should also be quantitative, provide estimates of uncertainty, and be useful for decision making. One starting point for such a systems-level model is integrating knowledge across four domains: ocean environment, ecosystems, socioeconomics, and human health.

Session Highlights

Pathways to integrating models can include a portfolio approach (curate a family of independent models), loosely coupled models (use the output from one model as the input to the next), fully coupled (combine multiple large-scale models where information is transferred at each time step), and metamodels (create top-down models).

The models showed a clear trade-off between the level of detail represented and the range of biophysical and socioeconomic processes captured. For example, models that attempted to represent a wide range of processes tended to utilize an aggregated approach that simplified physical, biochemical, and ecosystem processes. The keynote speaker presented one such highly aggregated modeling approach, which integrated all four modeling domains using System Dynamics. In contrast, models that focused on a particular domain tended to represent processes and conditions using precise and intricately resolved mechanistic models. An example is the ADCIRC-SWAN model, which resolves hydrodynamics via coupled surge, tide, and sediment models. One presentation emphasized that coupling can also occur through agent-based models by developing boundary objects that provide a means to interface information from two different disciplinary areas.

Collectively, presentations during this session emphasized the loose coupling of models within the ocean environment and ecosystem domains. Much less was presented on coupling socioeconomics and human health. Even for the domains of ocean environment and ecosystems, there is still a need to better integrate models. Presenters showed advances in fully coupling the ocean-atmosphere, fully coupling ocean hydrodynamics with oil fate and transport, and fully coupling oil fate and transport models with ecosystem models, although all examples involved one-way data transfer. One presentation showed advances in integrating the land influences by coupling the nearshore ocean environment (storm surge model) to a river hydrological model that integrates risk of infrastructure failure coupled with contaminant fate and transport. So work is needed in all domains for fully integrating models. However, the present state of detail in models in the four domains is vastly different.

Examples of loosely coupled integrated models include SIMAP, CSOMIO, CMS-ATLANTIS, and ECOPATH. SIMAP, which includes both nearfield and far-field modeling of oceanographic processes, simulates the fate of oil and tracks animals and their exposure to chemicals. In this model exposure of the shore and animals to oil is highly dependent upon the droplet size, with larger droplets floating to the surface and smaller droplets remaining submerged. CSOMIO is another example of a loosely coupled model that integrates an atmospheric model (WRF), an oceanographic model (ROMS), and a wave model (SWAN). This model simulates biogeochemistry (GENOME), sedimentation (CSTMS), and particle aggregation (OPAMOD). GENOME simulates emergent microbial communities by tracking carbon instead of nitrogen. The CSOMIO system requires a modeling strategy that permits coupling between Lagrangian- and Eulerian-type models. As a result of this coupling, the CSOMIO is capable of modeling microbial degradation of different chemical classes. CMS simulates the ocean environment capable of simulating the degradation due to pressure, evaporation, sedimentation, multi-fraction droplets, and Stokes drift. This model is capable of modeling beaching of oil and providing estimates of polycyclic aromatic hydrocarbons (PAHs) in time series. The ATLANTIS model couples a hydrodynamic model (AMSeas) with CMS-oil for oil transport simulations, with information about food webs in the upper-, meso-, and deep-ocean. Oil exposures can occur to ecosystem organisms through feeding and transdermal transfer. Use of cloud computing in ecosystem modeling can facilitate uncertainty exploration despite long run times. Like ATLANTIS, ECOPATH simulates the entire ecosystem but does not use explicit nutrient cycling. An example shown for the Gulf of Mexico represents 1,300 species in 67 functional groups.

Modeling the impacts of an oil spill on physical human health can be accomplished through a risk assessment approach as described through the Beach Exposure and Child Health Study (BEACHES). This presentation focused on how to utilize oil trajectory output to develop chemical concentration frequency distributions of individual PAH compounds, including the alkylated forms. Other applications of integrated models focused on evaluating specific industries, such as fisheries, in terms of understanding socioeconomic impacts. The most holistic models were those that used a systems dynamics approach. Two presentations utilized this approach and presented causal loop diagrams that showed the linkages, one in the context of oil spill impacts on society, the other in the context of concerns raised by commercial fishers. Both presentations utilized a participatory approach to develop the causal loop diagrams. These diagrams can serve as a starting point for quantitative models that may be useful for decision making.

Identified Gaps and Challenges

- Need to develop a repository of data and suitable scenarios for analysis.
- Need a community supporting the integration.
- Need systematic model intercomparisons.
- Need to further develop connections to underrepresented disciplines within the human health and socioeconomics domains.
- The developed model needs to facilitate decisions and be useful to the decisionmakers.
- Without a fully coupled atmospheric and hydrodynamic model, up to 20 — 30% of the transport energy is unaccounted for. This had implications in terms of Hurricane Irma where a surge was predicted but in actuality lower water levels were recorded.
- Need more work to understand and simulate the hydrodynamics of the deep ocean.
- Exposure and toxicity estimates should be based upon a dynamic model of oil fate.
- Forecasts should remain probabilistic as it would be difficult to forecast the exact transport on short time scales.
- Chaos can be introduced into ecosystem models in certain predator structures.
- Much of the available data is concentrated in the northern Gulf. Data should be gathered from the southern Gulf in collaboration with Mexico and Cuba.
- Treatment of uncertainty.
- Resolving time step mismatch between models of different domains.

Session 002:

On the Resiliency of Living Marine Resources to Gulf Oil Spills

Steven Murawski *(University of South Florida),* **Samantha Joye** *(University of Georgia), and* **Tracey Sutton** *(Nova Southeastern University)*

Session Overview

In the intervening decade since Deepwater Horizon (DWH), considerable scientific research has been conducted to document the impacts (or lack thereof) and potential recovery of Gulf living marine resources. This session sought to (1) review the records of resource response to large oil spills in order to evaluate resources potentially at risk from future large spills, and (2) summarize factors of animal life history and oceanographic processes that determine the resiliency potential of resource populations. Implications for resource management strategies that may help strengthen resiliency to future large-scale environmental events were discussed.

Session Highlights

The session consisted of a series of 12 presentations summarizing aspects of the resilience or resiliency potential of living resources to the DWH accident and oil spills generally. It aimed to summarize critical information on the status and, as appropriate, the recovery, or lack of recovery, of resource populations following DWH. Because of the large number of ongoing resource evaluation programs conducted by state and federal agencies for other purposes, there exist time series of abundance data pre-dating the DWH spill. These data sets are germane to coastal waters and the continental shelf where most fisheries are pursued. Likewise, chronological coring information indexes macrobenthos before and after DWH. However, similar data do not exist for open ocean biota, marine mammal, bird, and megabenthos populations.

The first four talks reviewed information developed for the "Core Area 3" syntheses of impacts of DWH on ecosystems. Coastal and nearshore populations of fishes, invertebrates, and marine mammals were affected both by oil transported from offshore into estuaries and by some of the oil spill mitigation measures including flooding of estuaries with fresh waters from upstream diversions of the Mississippi River. This freshwater flooding used as an oil spill countermeasure did not prevent oil from entering estuarine habitats. Fishery closures also impacted commercial and recreational fisheries, but the effect was ephemeral for most species. On the continental shelf, some species, especially small demersal fishes, declined coincident with DWH. Recovery has been complicated by rapid increases in abundance of invasive lionfishes. In the open ocean, there was a significant decline in the epi-, meso-, and bathypelagic fauna after 2011 with little subsequent rebound. In the deep benthic realm, oiled marine snow apparently impacted benthos in a wide swath surrounding the DWH site. It may take decades to a century to sufficiently "landfill" toxic elements of oil in the deep ocean.

An important aspect was the independent development of criteria and their application to categorize the degree of vulnerability of individual species to oil spills in general, and to DWH specifically, and to evaluate elements of population productivity affecting recovery potential. Participants discussed the merits of both approaches.

Several talks highlighted individual species and their potential differential vulnerability to DWH. While the life histories of most mesopelagic fishes (both diel migrators and those that have narrow depth ranges) are unknown, it appears that zooplanktivorous fishes live about one year, while their predators likely live three to seven years or more, suggesting limited productivity potential, consistent with population density estimates post DWH. Deep coral populations in the vicinity of DWH show some recovery (e.g., branches of the same colony) but recovery tends to occur slowly in deep benthic species such as corals. Coastal shrimp and bottlenose dolphins represent opposite ends of the scale of potential resiliency and recovery potential. Pelagic food webs document the cascade of nutrient and carbon isotopes throughout the ecosystem, with return to pre-spill conditions in some cases. One study examined the prey capture efficiency (reduced) in the presence of oil and dispersant combinations.

Overall, no single synthetic statement can be made regarding the recovery of natural resources following DWH. The Gulf and its component ecotypes are complex and complicated and the degree of connectivity among them means that oil spill effects in one of them potentially cascade among all due to water mass transport as well as the trophic dependencies and movement patterns of animals. Using the yardstick of the IXTOC 1 spill off Campeche, Mexico (1979-1980), DWH effects are likely to be measurable for decades to come.

Session 003:

New Tools and New Strategies in the Assessment and Forecasting of Marine Oil Snow Sedimentation and Flocculent Accumulation (MOSSFA) in Support of Emergency Response and NRDA

Adrian Burd *(University of Georgia),* **David Hollander** *(University of South Florida) and* **Antonietta Quigg** *(Texas A&M University at Galveston)*

Session Overview

The ability to predict MOSSFA events in waters and sediments in time and space will contribute to developing more accurate assessments of surface oil budgets to assist emergency responders and provided information needed to inform decisionmakers on the application of specific surface oil remediation techniques. This session focused on new forecasting/modeling tools and the development of predictive strategies for MOSSFA events in diverse areas of known oil exploration and production. The aim of the session was to bridge the gap between the academic community and first responders who are focused on how MOSSFA could improve oil spill response planning, assist environmental and NRDA impact assessment, and support the evaluation of long-term chemical recovery and ecologic/ecosystem health.

Session Highlights

- Characterization of Marine Oil Snow (MOS) in the water column and MOSSFA events in sediments
  - Shape and size of MOS particles matters.
    - Particle size (4 mm-1 cm), shape (Elongation= 1-Aspect Ratio = 0.6-0.7), and fractal dimensions (range 0.93-1.94, mean 1.45 and increase with particle size) have been determined.
    - Most MOS particles are elongated, not spherical.
    - There is little change in elongation and fractal dimension between day and night.
  - Particle abundance studies show a loss in the morning and a gain in the evening casts.
    - Possible disaggregation and reaggregation occurs below the thermocline due to turbulence.
    - Significant diel changes in MOS in upper 200 m are indicative of zooplankton grazing; most grazing occurs after dark and where MOS concentrations are scarce.
  - Preservation of MOSSFA events can occur in areas of high sedimentation rates.
    - Areas of low sedimentation rates leads to reemergence of MOSSFA derived oil via bioturbation thereby exposing benthic habitats to re-oiling.
    - MOSSFA derived sediments can be transported to northern Gulf of Mexico and southern Gulf of Mexico basinal depocenters.
- Modeling of MOSSFA
  - Researchers have developed SLAM, a Lagrangian model that tracks aggregation, composition, and sinking of MOS particles.
    - This model shows that particles with the largest radii have the highest settling velocity and are preferentially deposited. Model fluxes agree with sediment trap data.
    - SLAM model predicts the oil carrying capacity of MOS that reaches the seafloor saturates (for model parameters, this was 35%).
  - Accurate MOSSFA models require knowledge of the particle's composition, fractal dimension, porosity, stickiness, size density, and terminal settling velocity.
  - Development of simple modules in MOS modeling can be added to emergency response models to predict MOSSFA events.
    - Challenges include the variable nature of events, process/mechanisms of formation and time evolution, effects of dispersants, coupling aggregation models to far-field hydrodynamic models.
    - Uncertainty is comparable to other oil spill modeling and is able to advance from one-dimensional to three-dimensional.

- New technologies to assess MOS and new strategies to predict MOSSFA events
  - o "Sipper" and "Snow Cam" (camera imaging systems) can provide accurate assessment of MOS particle size, elongation, and abundance.
  - o Gliders outfitted with particle size, CDOM, and chlorophyll-a sensors can provide real-time spatial and temporal observations of MOS variability.
  - o Frontier directions: Evidence shows that the potential for MOSSFA formation exists in shallow water environments (e.g., Alaskan Bight, North Sea).
  - o Coupling of MODIS satellite imagery assessments of particulate organic carbon and particulate inorganic minerals with advanced numerical modeling of simulated oil spill trajectories can be used to develop regional MOSSFA probability diagrams to accurately predict areas prone to MOSSFA events.
    - — Factors include algal productivity vs. sediment load, dependence on seasonal variations in currents, river discharge, and water column stratification, and distance from river, source of sediment load, nutrients, and primary production/type.

Identified Gaps and Challenges

- What is the spatial and temporal (seasonal and interannual) variability of marine snow formation?
- Baseline determination of phytoplankton productivity and zooplankton grazing, sedimentation inventory and accumulation rates (thorium-234 and lead-210), and areas of sediment redistribution.
- What do MOS/MOSSFA models still need to investigate?
- How does MOS formation affect the ability of microbes to degrade the oil? We know biodegradation is important, but hard to quantify.
- What are the roles of microbial EPS production and large mucus aggregates?
- What are the oil consumption rates by organisms in the water column?
- What are the timescales and locations of the long-term fate of oil that reach the sediments?
- Filling all research gaps will directly support emergency oil spill response and NRDA.

Session 004:

Understanding and Predicting the Gulf of Mexico Loop Current

Steve Anderson *(Areté Associates),* **Karina Khazmutdinova** *and* **Kelly Oskvig** *(National Academies of Sciences, Engineering, and Medicine)*

Session Overview

This session explored the most recent advances in understanding and predicting the Gulf of Mexico Loop Current system as well as applications of those advances towards societal benefit for Gulf Coast communities. Talks were grouped into panels focused around four main topics: "Where Are We Right Now," "New Methods," "New Insight," and "Societal Benefit" as they related to advancing understanding and forecasting capabilities of the Loop Current and its associated eddies.

Session Highlights

- The session illustrated deeper understanding of the physical processes that control circulation in the Gulf of Mexico.
- In the past several years, more data have been collected and predictive skill of the Loop Current has been extended out to 12 weeks.
- The session illustrated successful use of drifter data to validate and adjust models.
- There have been substantial improvements in understanding where model uncertainties are and where model corrections are needed.
- Use of machine learning techniques allows prediction of a Loop Current eddy separation event up to 12 weeks in advance.
- The importance of improving forecasting capabilities of the Loop Current and its associated eddies was strongly emphasized during the final panel where discussions illustrated the impacts of the Loop Current behavior on the evolution of red tides, hurricane intensification, and oil transport.

Identified Gaps and Challenges

- There are still significant gaps in observations that can be used to constrain predictive models.
- High resolution observations of the Loop Current are needed to use machine learning techniques.
- It remains difficult to define Loop Current boundaries.
- Assessment of model run length required to have enough statistical information to explain Loop Current behavior. Is 30 years enough?
- Better understanding of stakeholder and end-user needs is needed.
- Modelers and observational oceanographers need to work together to co-design cost effective sustainable Gulf ocean observing systems to advance understanding and forecasting capabilities of the Loop Current, its associated eddies, and Gulf circulation in general.

Session 005:

Gulf Restoration: Planning, Tools and Collaboration

Christy Fellas *and* **Ramona Schreiber** *(NOAA Restoration Center) and* **Matt Love** *(Gulf Coast Ecosystem Restoration Council)*

Session Overview

The session aimed to highlight planning efforts, assessments, tools, and adaptive actions used in restoration projects to date and to share "Lessons Learned" with the Gulf restoration community. It focused on two specific areas of Gulf of Mexico restoration: (1) evaluation of restoration in achieving goals and objectives and assessing outcomes of restoration investments and (2) milestones achieved in restoration planning approaches, decision processes, and implementation of projects. Across restoration activities, collaboration, communication, and coordination were highlighted as important considerations for successful implementation. Activities individually are means to an end, but successes are magnified (if not dependent upon) communication and coordination with partners. Nearly 10 years after the oil disaster there is much still to do and gaps between projects to fill. Coordination is a mechanism to identify those gaps and seek out opportunities to bridge them.

Session Highlights

- Evaluation of restoration supported by science-based monitoring, performance indicators and empirical techniques for assessing outcomes and documenting cumulative benefits of restoration investments remains a challenge.
- Restoration planners recognize the importance of showing that restoration and investment in the Gulf of Mexico is making a measurable difference but teasing out project level effects from background drivers remains difficult and a political risk.
- Restoration coordinators are developing monitoring parameter guidance focused on the objectives of decisionmakers to allow aggregation of information across projects to signify restoration progress.
- Restoration councils are investing in decision support tools compiling information on existing monitoring data, socioeconomic benefits and shared conservation priorities, such as connectivity of habitat, from existing management plans to support decisions on future restoration investments and to tell the co-benefits story of proposed conservation actions.
- To promote adoption and data standardization, development of effective tools through stakeholder consultation is not enough. Outreach and data management consultations have been shown through practice to be one of the most important activities to implement.
- Benefits are spreading across stakeholders. Communities and resource users are seeing benefits from projects implemented (artificial reefs > additional habitat > more fish for recreation). Planners and resource managers benefit from new adaptive management tools to better understand and evaluate success from projects or needs for adaptive changes. Resource managers benefit from data collection and interpretation to improve next projects. Policymakers benefit from documented outcomes of results to support future needs and recommendations, and identification of gaps to prioritize future needs.
- While not "new" science, the application of novel gear design, fishing structure, and voluntary participation and compensation as an approach to fishery restoration could be considered "new" or different from traditional habitat-based restoration to address resource injury. Early restoration activities for highly migratory (fish) species through changes in fishing behavior is having a positive impact of fishing pressure to those injured resources. These first results from early DWH restoration are encouraging and feed into next steps to address that resource injury. Intangible benefits include the close coordination and voluntary engagement with stakeholders, creating buy-in toward the mutual goal of restored fishery resources.

Identified Gaps and Challenges

- There remains a need to assess cumulative impacts of disparate restoration activities to provide a holistic perspective to restoration planning dynamics across the Gulf.
- The restoration need far outweighs the funding available, yet the existing funds have a 10- to 20-year time horizon to be implemented across the Gulf of Mexico.
- It is challenging to gather all the data being collected in central locations that can be used for future restoration decision making and monitoring progress and improvements. This effort requires sustained and targeted coordination across many entities working on restoration in the Gulf of Mexico.

Session 006:

Evolution and Development of Spatially Related Response and Restoration Data Collection, Use, and Retrieval Tools

Steve Buschang *(Texas General Land Office) and* **Mark White** *(Research Planning, Inc.)*

Session Overview

The rapid and accurate acquisition and assimilation of spatially related data are of primary interest to many areas of spill response efforts. With the advent of personal computing, satellite GPS, internet, and cellular devices, the tools that have been and are being developed for response are changing the definition of a rapid and informed response. Data can now be collected, stored, or directly transmitted to decision makers. This session focused on understanding the current capabilities, limitations, and projected future development of next generation data sets and assessment.

Session Highlights

- Session highlighted user-friendly tools that are accessible to multiple disciplines.
- Many groups are integrating differing tools capable of supporting many disciplines. Our session highlighted incredibly powerful systems such as Common Operating Pictures (COPS), HF Radar systems, GIS spill response applications, and machine learning technologies that are being developed at an astonishing rate. These are being implemented by the private sector as well as by governmental entities.
- There are advances in visualization and awareness that leverage multiple web frameworks such as Flask, Leaflet, and other open-source web stacks.
- These tools are enabling spill decisionmakers to have much greater and faster information that can be incorporated into the response.
- Data integrations between disciplines make for a more holistic response.
- Machine learning is going to be a game changer in multiple disciplines and deserves its own session in future scientific spill related meetings.

Identified Gaps and Challenges

- It was noted that as these powerful tools are developed, the concept of how they will interchange data and work with one another was considered as an oversight or something yet to be more carefully evaluated.
- Neural network and machine learning capabilities are rapidly changing. Notable advances have been made leveraging these capabilities that can support many disciplines. Awareness of the full capabilities are still being explored.
- Data can be considered static once compiled. How will we continually update these tools and where will funding come from?

Session 007:

Tell Your Story: Making Your Data Clear, Understandable, and Usable

Emily Frost *(Smithsonian National Museum of Natural History),* **Dave Reed** *(Florida Fish and Wildlife Research Institute), and* **Lauren Showalter** *(National Academies of Sciences, Engineering, and Medicine)*

Session Overview

Over the past 10 years we have seen an influx of information, science, and research related to the Deepwater Horizon event. The question we face now is how to translate this information to make it clear, understandable, and put into practice. This session sought to explore and highlight efforts within our research community that have taken steps to communicate the science in a way that is functional and easily digestible.

Session Highlights

- Laura Bracken shared why it's important to try and share data in a visually pleasing and clear way (know your audience). Graphics and images can draw people in so one can explain the science. She shared examples of both good and bad data visualizations, including examples from the media.
- Emily Frost spoke about the importance of storytelling in sharing research, how data visualization can link to storytelling (data keeps the story accountable) and walked through the process of creating an Esri StoryMap.
- Liesl Hotaling walked through the C-IMAGE interactive timeline and map "Beneath the Horizon." This tool includes a map that highlights the 20 largest oil spills in the United States; timelines for both the Deepwater Horizon and Ixtoc 1 oil spills; as well as short stories, podcasts, and videos about the spill.
- Evan Goldstein used the collection of real-time observations on Twitter during Hurricane Irma to inform his models of coastal geomorphology. Because Twitter images are time-, date-, and location-stamped he is able to use machine learning to parse the more than 3,000 images shared during the hurricane, incorporating human activity during an event into models.
- Jaishree Beedasy and Antonia Samur also used Twitter in an analysis of the role it played during the Deepwater Horizon spill. Using over 900,000 tweets and a mix of coding, validating, and machine learning they analyzed what stories were being shared on Twitter. They found news events drive peaks of tweeting and are exploring further to assess different themes (health related concerns, for example) and the perceived reliability of information.
- Nicolas Eckhardt provided an in-depth overview of NOAA DIVER (Data Integration, Visualization, Exploration, and Reporting) which allows the public to search, visualize, and download data connected to Natural Resource Damage Assessment (NRDA) events such as oil spills, hazardous waste releases, and vessel groundings.

The first half of the session provided the audience with an overview of the importance of sharing research in compelling ways. Storytelling techniques, maps, and visually appealing interaction were just a few of the ways discussed, with several specific examples such as the *Ocean Portal StoryMap* and *Beneath the Horizon website*. The second half of the session focused on research that used data visualization as a part of their research methods and the public NOAA database that can help users visualize their data.

Session 008:

Taking Stock: Capacity Building and the Successes of Advanced Academic Scholarship, Professional Training, and Interdisciplinary Mentoring Through the Gulf of Mexico Research Initiative

Katie Fillingham *(Consortium for Ocean Leadership)*, **Sherryl Gilbert**, **David Hollander**, *and* **Liesl Hotaling** *(University of South Florida)*

Session Overview

Since inception in 2011, GoMRI directed substantial resources to and prioritized educating and training the next generation of professionals. Graduate students and those who have graduated and moved into early career positions are considered one of the principal legacies of the program. With priorities placed on professional development, education and outreach, and data sharing, GoMRI students and early career professionals possess unique skill sets as compared with their contemporaries trained under other more traditional funding and mentoring mechanisms. What capacity has their training within the program created in the oil spill sciences? Is this unique training/mentoring preparing them adequately for career advancement and future success? This session highlighted student and early career research, training, and graduate history of the GoMRI-supported centers and provided a summary of where the graduates are currently in their career arcs and professional aspirations.

Session Highlights

- "Soft skills" or non-technical skills such as report writing management, communication, teamwork, creativity, work ethic, etc. are as important as technical skills.
- GoMRI students and early career researchers benefited from the interdisciplinary and collaborative nature of the centers and the program. One of the most important benefits of this collaboration was the ability to build broad networks, both within their own disciplines and institutions and across other disciplines and institutions.
- While students have substantial academic responsibility during their careers, the mentorship from faculty must include education in research ethics.

The focus of our session was to share the educational, training, and mentorship ideologies of the GoMRI-funded projects and learn about how these activities and opportunities were received from the students and early career researchers themselves. The first half of the session focused on the "top" down, hearing from the directors of the consortia, as well as highlighting results from the graduate student and early career professional capacity survey facilitated by the session co-chairs, and the second half of the session included presentations on what specific opportunities contributed to career advancement.

- The unique interdisciplinary nature of the GoMRI program required students to tap into skills beyond their academic training (e.g., buoy design, wave tank/laboratory development) to answer fundamental science questions.
- Undergraduates and Ph.D. students were the top two groups of students served by GoMRI funding and training. This relationship provided postgraduates mentoring experience, as many of the undergraduates were mentored and directed by M.S. and Ph.D. students.
- Student involvement in the GoMRI program provided training on complicated issues such as "big" data management and the nuances associated with international partnerships.
- Each of the centers and their associated students participated in outreach on many different levels (e.g., K-12 classroom, media/press, public), requiring students to distill complicated research into easy to understand bites (e.g., children's book).
- The pace of the GoMRI program pushed the students to make significant progress quickly.
- One important component presented on the ethics of research included the concept of putting another's research needs before one's own.

Session 009:

RESTORE Act Centers of Excellence Research Grant Programs – Filling Gaps in Gulf Research to Inform Policy and Management

Melissa Baustian *and* **Alyssa Dausman** *(The Water Institute of the Gulf),* **Kelly Darnell*** *(University of Southern Mississippi), and* **Elizabeth Fetherston-Resch** *(Florida RESTORE Act Centers of Excellence Program)*

Session Overview

As GoMRI concludes 10 years of unprecedented investment in scientific understanding of the Gulf of Mexico, this session discussed how other science funding entities are taking stock of what we have learned to date and what areas that might still benefit from additional investigation. The RESTORE Act established a number of funding entities, and as part of this Act, 2.5% of the penalty funds are dedicated to the establishment of Centers of Excellence in each of the five Gulf Coast States. Texas OneGulf, Subsea Systems Institute, the RESTORE Act Center of Excellence for Louisiana (LA-COE), Mississippi Based RESTORE Act Center of Excellence (MBRACE), and Florida RESTORE Act Center of Excellence Program (FLRACEP) strategically coordinate under the umbrella of Centers of Excellence Research Grant Programs (CERGPs) to support research in a number of disciplines. Each of the Centers works closely with a state entity to administer a competitive grants program and to ensure that applied research helps to inform policy and management decisions that are important to that state and to the region as a whole. This session highlighted the CERGPs by having presentations from Centers of Excellence representatives, whose ultimate goal is to inform state and federal management of coastal and marine systems and resources. Invited speakers from state CERGPs discussed how their Center of Excellence is working to identify and fill critical knowledge gaps in support of state and regional management needs. Florida, Mississippi, and Louisiana programs highlighted some of their funded projects and the how the state and federal partners utilize their research. In addition, the session ended with a panel discussion of the COEs.

Invited Speakers from the Centers of Excellence discussed the overall COEs programs in each state and the types of research being funded. Other speakers focused on specific research funded or how the research is utilized in management.

Session Highlights

- This was a gathering of the RESTORE Act Centers of Excellence in a conference session setting; representatives from Florida, Alabama, Mississippi, Louisiana, and Texas participated.
- Each Center is structured slightly different, but they all have to adhere to the U.S. Department of the Treasury's policies while also fulfilling the needs of their respective state agency.
- Florida, Mississippi, Louisiana, and Texas have released at least one Request for Proposal and have funded research projects.
- Each Center typically has a slightly different focus area (e.g., to date, Florida focuses on marine fisheries; Mississippi focuses on oysters; Louisiana — coastal protection and restoration; Texas OneGulf focuses on a healthy and sustainable Gulf of Mexico).
- Centers typically release funds through a competitive request for proposal.
- Most of the Centers have some type of external review panel and a research needs / strategy that help guide the research they fund.
- Timelines can be challenging for the Centers since Treasury grants are a maximum of five years and funded research projects should be a maximum of two years.
- The Centers are in favor of continuing a conference like GoMOSES beyond 2020 and are working towards supporting this effort in the future (i.e. the GOMCON in 2021).
- Outcomes of the research presented are already being utilized to support management and decisions in many of the states.

**Session Lead*

Session O10:

Movement Ecology and Ecosystem-Based Management in the Gulf of Mexico: Lessons Learned and Solutions for Moving Forward

Susan Lowerre-Barbieri *(University of Florida),* **Claudia Friess** *(Florida Fish and Wildlife Research Institute), and* **Skyler Sagarese** *(NOAA)*

Session Overview

This session drew on Lessons Learned from the past five years of the Gulf of Mexico Integrated Tracking of Aquatic Animals (iTAG) network and satellite tracking studies to address how movement data can help inform management, identify data gaps and emerging technology, and begin forming a Gulf-wide strategy to improve our understanding and protection of Gulf ecosystems.

Session Highlights

- Movement ecology is important to understand as the Gulf ecosystem is changing due to climate change and being impacted by periodic spatial stressors such as oil spills and red tides.
- Limitations in the technologies commonly used to study movement are being overcome by combining technologies and utilizing regional data sharing networks.
- A new technology that is being piloted to more accurately track marine animals is the RAFOS Ocean Acoustic Monitoring (ROAM) tag; this tag potentially has advantages over both acoustic and satellite tracking technology.
- 3-D acoustic monitoring arrays can be used to characterize movement signatures and identify predation events.
- For migratory species, tagging location matters; Marlin tagged in the eastern Gulf seem to be more likely to leave the Gulf than individuals tagged in the western Gulf.
- There is often a mismatch between the scale at which ecological processes take place and the scale of management; we should consider adding more local governance management layers.
- Our movement models are able to predict the destination of a simulated marine animal fairly well, but not the journey (path).
- Future movement models will need to go beyond random walks and incorporate individual decision making; we will have to be able to predict changes in movement.
- There is a disconnect between movement data collection, movement data analysis/modeling, and management.
- There is a need for funding to support a cross-disciplinary working group who can lay the foundation for connecting the pieces. This working group needs to draw on experts in state and federal governments, academia, and industry. Specifically, it should bring together ecologists tracking a range of species with multiple technologies, stock assessment scientists, modelers, and state and federal managers.

Session O11:

Understanding the Drivers of Biological Patterns in the Pelagic Seascape of the Gulf of Mexico

Rosanna Boyle *(Nova Southeastern University),* **Frank Hernandez** *(University of Southern Mississippi), and* **Kelly Robinson** *(University of Louisiana at Lafayette)*

Session Overview

Speakers in our session examined the underlying drivers of biological patterns in the pelagic Gulf of Mexico across a range of spatial and temporal scales, faunal groups, and life stages, from inshore to deep- and open-ocean habitats. While the open oceans (especially the deep pelagic) Gulf is poorly known relative to coastal and benthic ecosystems, the speakers in this session consistently emphasized how much progress we have made in understanding the pelagic Gulf in the decade since the Deepwater Horizon oil spill, particularly in deep waters, and in better understanding that the pelagic Gulf operates as a highly connected ecosystem, rather than one partitioned into "shallow/deep" or "inshore/offshore" components, for example. Speakers also consistently emphasized how our improved understanding is helping us to develop and refine predictive tools that will be better able to predict ecosystem responses to future change.

Session Highlights

The session started with talks focusing primarily on the inshore waters of the Gulf. deMutsert described an ensemble modeling approach to assess the effects of reduced nutrient loading and hypoxia on fisheries species, finding that gains from reduced hypoxia seemed to be offset by losses from reduced overall primary productivity. Cambazoglu presented work detailing how incorporating fine-scale information on wind direction and speed in existing models caused the flow of detritus into the Mississippi Sound to reverse compared to coarser-resolution data. Moving to the offshore Gulf, Failletaz presented modeling results examining how UV light influences the vertical distributions of embryonic mahi-mahi, and the importance of seasonality in conditioning the potential interactive effects this behavior may have had with toxic oil following DWH. Pruzinsky described how the early life stages of tunas can be classified into two primary groups ("inshore" or "offshore") based on their environmental preferences, providing novel insights into a commonly overlooked life history stage. Two speakers focused on the importance of *Sargassum* as highly productive offshore habitats. Wang described how interannual patterns in *Sargassum* growth could be driven by conditions experienced the previous year, while Zapfe described how grey triggerfish recruitment could be weakly correlated with available *Sargassum* habitat observed during the previous spring. Greer described how complex interactions between water column stratification, hypoxia, and internal waves determine fine-scale and taxon-specific spatiotemporal distributions of zooplankton.

The second half of the session highlighted the importance of the deep-pelagic realm with two talks by Calhoun and Ruzicka detailing how they intend to incorporate mesopelagic and bathypelagic data to produce a fully vertically resolved ecosystem model of the Gulf. Wang then described the environmental drivers that determine assemblage structure in mesopelagic fish larvae, while Milligan described evidence for simple ecological "rules" that seem to govern the vertical distributions and migratory patterns of adult mesopelagic fishes. Finally, Frank presented data showing a dramatic decline in deep-living crustaceans between 2010 and 2017.

Overall, the talks within this session emphasize the need for a more holistic understanding of the Gulf as a whole, highly connected, complex system if future impacts are to be managed effectively.

Session O12:

Transport, Dispersal, and Connectivity in the Gulf of Mexico: Patterns, Processes, and Implications

Cheryl Harrison *(University of Texas Rio Grande Valley),* **Santiago Herrera** *(Lehigh University), and* **M. Josephina Olascoaga** *(University of Miami)*

Session Overview

Transport in the Gulf of Mexico has implications for a wide range of studies, from oil spill dispersal to biological connectivity. In this session, researchers from across the disciplines shared their research on ocean transport, biological and pollutant dispersal, and the biological and environmental implications of transport processes in the Gulf of Mexico. Participants identified future research priorities, presented as questions, in this interdisciplinary topic.

Session Highlights

- What are the outstanding questions related to transport, dispersal, and connectivity in the Gulf of Mexico? That is, what are the outstanding questions in Lagrangian oceanography in the Gulf, and what are the associated research priorities?
- What are best practices for relating oil, observation, and modeling transport studies?
  - How well do the drifter observations represent oil?
  - Are we missing key physics in models that affect oil dispersal dynamics?
  - How do we increase communication and coordination across the subfields?
- How does near surface current vertical shear affect oil and drogued drifter studies? (Denny Kirwan, Nick Shay). (See bullet #1)
  - What are the properties of wind-induced current shear?
  - Is high current shear relative to previously thought?
- Droplet size distribution for oil spill modeling strongly affects surface vs. water column oil residence time (Claire Paris, Natalie Perlin - University of Miami modeling team).
- We need better understanding of coastal to offshore interactions with respect to transport:
  - Shelf break processes (Villy Kourafalou)
  - Influence of coastal flows on cross-shelf transport (Villy Kourafalou)
  - More (Lagrangian?) observations on the shelf
  - River plume dynamics (Villy Kourafalou)
- How do processes in the southern Gulf influence broader Gulf transport?
  - Florida Straits (Villy Kourafalou)
  - Yucatan Straits (Villy Kourafalou)
  - Campeche Bank
- How do open ocean biophysical processes, such as in Loop current eddies, affect biological processes such as transport and productivity? (Cheryl Harrison, Villy Kourafalou)
  - When eddies impinge on the shelf in the western Gulf, how does this impact cross-shelf transport, upwelling, harmful algal blooms, and hypoxia?
  - Is there any analog to the pressure point on the Florida Shelf?
- How do smaller scale (submesoscale) features, such as density fronts, Langmuir circulation, and their vertical structure (0-50 m depth) impact transport? Are the vertical velocities at the submesoscale ephemeral sinks for plastics, pollutants, etc.? (Denny)
- Where does the Loop Current take the oil and how can we predict this? (Note the Eulerian part of this question has been the thrust of the two NASEM GRP funding calls.)
  - What are the predictive limits of both the current and transport properties?
  - How can we construct uncertainty estimates for forecasts, effectively Lagrangian weather prediction?
  - How can ensemble modeling be utilized to this end?
- How well can we parameterize biodegradation and sedimentation for different oils in oil drift models (Lars Hole, MET Norway)?

Session 013:

Microbial Genomics to Improve Predictive Understanding of Disturbance in the Global Ocean System

Joel Kostka *and* **Kostas Konstantinidis** *(Georgia Institute of Technology),* **Samantha Joye** *(University of Georgia), and* **Rita Colwell** *(Gulf of Mexico Research Initiative)*

Session Overview

Microorganisms mediate biogeochemical cycles in the global ocean and play a critical role in the response of marine ecosystems to perturbations, such as oil spills, catastrophic storms, or climate change. Next generation sequencing, advanced bioinformatics tools, and the extensive application of genomics to marine microbiology have revolutionized our understanding of the structure and function of microbial communities in the world ocean. The Deepwater Horizon oil spill was the first large-scale environmental disaster where genomics techniques were applied to track the microbial response to perturbation. This session synthesized scientific achievements in microbial genomics to present advanced understanding and improved practices for assessing disturbance and environmental change in the global ocean system.

A summary for this session is not available.

Session O14:

Science to Action: Co-Production of Science to Support Resource Management in the Gulf of Mexico

Julien Lartigue *and* **Caitlin Young** *(NOAA RESTORE Science Program), and* **John Tirpak** *(U.S. Fish and Wildlife Service)*

Session Overview

Co-production is the practice of researchers and end users working together in an iterative manner to produce scientific knowledge, findings, methods, or products that are directly applicable to end users' needs. During the co-production process, end user needs are incorporated when designing the research approach, and outputs from the research are applied by the end user in the near-term, informing how they think about future challenges. This session explored the use of co-production in coastal and marine environments principally in the Gulf of Mexico region. Presenters shared their experiences delivering actionable science on a variety of resource management topics including coastal restoration, reef fish fisheries, marine sanctuaries and research reserves, migratory birds, climate projections, and coastal habitat management and protection. A panel discussion at the end of the session allowed the presenters and audience to share Lessons Learned about how to successfully employ a co-production approach and recommendations for programs who wish to support actionable science on how to give researchers and resource managers the time and resources needed undertake such an iterative approach to conducting research and applying the results.

Session Highlights

- Challenges to successful co-production and possible solutions include:
  - The lack of technical ability at some resource management agencies can be overcome by producing more user-friendly tools and providing support for technical training at management agencies.
  - The time it takes to conduct and transition research can be lengthy and funding of co-production activities needs to be either long in duration or occur in phases.
  - Coordinating a large number of end users is a challenge which can be overcome by the use of existing management or coordinating bodies such as fisheries management bodies or joint ventures for managing wildlife.
  - The turnover in personnel at management agencies can make sustained co-production difficult, but a conscious effort to establish relationships that can continue as personnel within a management agency advance within their organization can help.
  - Traditional measures of research output (i.e. publications) may be a poor measure of the performance of co-produced research and a systematic effort should be made to encourage research institutions to incorporate the other outputs and outcomes of co-production into academic tenure and promotion reviews.
  - Funders should consider including social scientists within funded teams to evaluate the sharing of information and its incorporation into decision making.
- There is a growing community of researchers and resource managers seeking to conduct research relevant to pressing issues and incorporating the results into the decision-making process.

Session O15:

Lessons Learned from Implementing Oil Spill Science Outreach and Education Programs: Reflections 10 Years After a Major Oil Spill

Katie Fillingham *(Gulf of Mexico Research Initiative and Consortium for Ocean Leadership),* **Steve Sempier** *(Mississippi-Alabama Sea Grant Consortium and Gulf of Mexico Sea Grant Oil Spill Science Outreach Program), and* **Karena Ruggiero** *(National Academies of Sciences, Engineering, and Medicine Gulf Research Program)*

Session Overview

The Deepwater Horizon oil spill provided an unprecedented opportunity to engage a variety of audiences in oil spill science. To provide target audiences and communities with answers and resources, many outreach and education initiatives were created or expanded to share scientific discoveries from research focused on understanding the impacts of the spill and the Gulf of Mexico ecosystem more broadly.

The focus of this session was to present Lessons Learned and best practices from a variety of these education and outreach efforts. During the first part of the session, presenters shared highlights and Lessons Learned from several of the GoMRI-funded consortia outreach programs. Recommendations from the consortia outreach coordinators published in a 2018 article in the ASLO Limnology and Oceanography Bulletin were also discussed. The second part of the session featured presentations that shared examples of engagement strategies and programs, including the Gulf of Mexico Sea Grant Oil Spill Science Outreach Program, the Consortium for Resilient Gulf Community's Gulf Coast Disaster Resilience and Preparedness Survey Project, and the proposed Gulf of Mexico Community Health Observing System.

Session Highlights

- GoMRI's investment in supporting education and outreach activities, whether it was at the program level, through external partnerships, or through the funded research consortia and individual projects, was a highly successful and valuable part of the program. Prioritizing sharing GoMRI research discoveries through multiple approaches serves as a legacy of the program.
- There are a multitude of audiences that can benefit from oil spill science outreach, and those efforts should be customized for the specific audiences. Building relationships with target audiences creates trust.

Lessons Learned

- Clearly identify audiences and the most effective ways to reach them. This also includes where to meet them. Space and location are important to enhance participation. Joining a regularly occurring meeting or extending personal invitations can also encourage participation. Appropriate communication with audiences is also critical; community partners can provide insight on strategies for engagement.
- All members of the research team are essential to the activity or program's success. Capitalize on team member's unique skills or interests related to outreach. Invite others to participate and collaborate on activities. Communication within the team, across the institution, across other institutions, within the community, etc., is essential! Leverage whenever possible.
- Utilize diverse technology tools to share materials and information.
- When developing lesson plans, connect the curriculum scope to active research; this provides a logical sequence/structure and access to experts who can inform lesson plan development. Furthermore, ensure lessons plans align with teaching standards, are prototype tested, and are affordable for educators.
- When developing new outreach tools, such as the RECOVER Virtual Lab, ensure the activity is relatable, isn't too long (less is more), involves early career researchers, and includes assessment.
- Quality science content (such as GoMRI website stories) thrives with support from top level leadership and focus. Communicating and building relationships with scientists is essential, as is genuinely caring about the quality of the science outreach.

- If conducting surveys or evaluation, return to the community with research results.
- There are many ways to assess and evaluate activities or programs, which can increase their success; ensure the metrics that are being collected are appropriate for defining success. Include flexibility to adjust activities if the metrics indicate something isn't working.
- Outreach professionals provide unique expertise; include them in implementation of activities or programs, if possible, and during proposal or activity development.
- Defining a strategic plan, even an informal one, can significantly increase chances of success. Ensure budgets align with the strategic plan and remember that activities and platforms that are free to use, like social media, still require personnel time (and therefore money) to manage.

Session 016:

Human Health Effects of Oil Spills and Other Disasters: What Do We Know, What Don't We Know, What Do We Need to Know, and How Can We Get There?

Landon Knapp *and* **Paul Sandifer** *(College of Charleston), and* **Burton Singer** *(University of Florida)*

Session Overview

The Gulf of Mexico is one of the most threatened areas in the United States for natural and technological disasters. Each disaster has significant and long-lasting negative effects on the health of people who live, work, or recreate along the Gulf coast. Also important are the repetitive and cumulative effects of multiple disasters. This session of 12 presentations focused on what we have learned and still need to know about disaster impacts on people of the Gulf of Mexico.

Session Highlights

- Play behavior of young children at the beach, including wading and digging, may contribute to higher risk of exposure to oil spill chemicals and perhaps to contaminants including infectious bacteria in tar balls as compared to adults. Exposed skin abrasions on children, which were mostly due to scratched insect bites, may increase exposure risk. Adherence of beach sand to children's skin differs by beach and by sex and age, ultimately affecting their exposure risk.
- Television is the dominant medium by which people affected by a disaster track what is happening. Other media such as radio, internet, social media, and word of mouth are also used, and media channel preferences remain relatively stable across disaster phases.
- Rural community members heavily reliant upon natural resources were most affected by, and vulnerable to, disaster-associated stress and to increased depression, anxiety, and alcohol misuse. In some cases, strong community attachment appeared to help people mitigate impacts, strengthen resilience, and enhance recovery.
- Mental health outcomes and stress effects can be slow to present and long lasting (5-20+ years). Flooding is associated with lingering and persistent mental health impacts including post-traumatic stress one year after flood mediated by worry.
- The combined burden of endocrine-disrupting chemicals in the environment, including obesogens, to which people are exposed daily, potentially reduces their resilience to major disasters. DOSS, a component of dispersants used in oil spill response and in consumer products, has been identified as a possible obesogen.

Identified Gaps and Challenges

- Information is needed about chemicals and concentrations children are likely to encounter in the nearshore environment and potential for exposures to harmful bacteria such as Vibrio vulnificus. Additional research should include children less than one year old and epidemiological studies after beach play.
- Larger sample sizes and need for longitudinal, prospective survey panels.
- Better understanding of methods to ameliorate stress effects and improved measurements of seafood safety and assessments of trade-offs between positive health benefits of seafood consumption and risks of low-level toxicant consumption are needed.
- Lack of baseline data on mental, physical, and community health before disasters but also during and continuing long after, including effects of acute, chronic, and cumulative stress. Filling this gap requires an ongoing, continuously operating health observing system that systematically collects those data from a representative sample of the Gulf population. Also needed are options to prevent or ameliorate poor mental health outcomes.
- Greater understanding of the potential human health effects of DOSS and other environmental obesogens as well as policy and regulatory steps to appropriately limit their use.

Session O17:

Application of Remote Sensing to Oil Spill Monitoring and Classification

Frank Monaldo *(University of Maryland),* **Benjamin Holt** *(California Institute of Technology), and* **Lisa DiPinto** *(NOAA)*

Session Overview

The size of the Gulf of Mexico and the quantity of marine activity make the monitoring and classification of oil spills an important ongoing challenge. As a consequence, the use of both optical and microwave (active and passive) remote sensing, particularly from space, are important tools in locating and characterizing oil spills. Such efforts are important for both enforcement and damage mitigation. The goal of the session was to explore state-of-art uses of remote sensing techniques, emphasizing the potential use of these tools in an operational, near-real time environment.

Session Highlights

- UAVSAR aircraft SAR imagery operates at L-band with a very low noise floor with potential application to estimating oil spill thickness. Oil on the surface reduce radar cross section both by suppressing surface roughness and by change the surface dielectric constant. There is continuing research in relating the change in radar cross section in an oil spill area when compared to the surrounding water to oil thickness.
- Optical identification and characterization of oil spills is important for response and remediation. There are two different types of surface emulsions: water-in-oil and oil-in-water. The authors used laboratory measurements to quantify the spectral properties of these two emulsion types.
- Defining a relationship of both SAR radar cross section and optical radiance values to oil thickness requires accurate in situ measurements. During actual experiments, a small UAS (Unmanned Aircraft System) can be used both to image oil spill radiances, but also direct the deployment of in situ measurements to appropriate areas.
- Response to oil spill events depends upon rapidly providing information to responders in a useful way. NOAA's Environmental Response Management Application (ERMA) allows environmental resource managers with the data necessary to make informed decisions for environmental response.
- As ability to estimate oil thickness remotely improves, its use in an operational context is dependent upon the rapid assimilation of available data and the ability to provide it to responsible agencies in a useful time frame. Using support from NOAA and a NASA grant, the authors are developing an operational system for using SAR and optical data to estimate oil spill thickness.
- Often an estimation of oil leakage is difficult to measure from its surface expression. After an oil spill event there can be noise generated bubbles release by nozzles. Flow rate can by estimated by acoustic energy, while the bubbles size distribution is associated with the spectral frequency of the sound.

Session 018:

Impact of Multiple Stressors on Gulf Ecosystems After Oil Spills

Huan Chen* *and* **Amy McKenna** *(National High Magnetic Field Laboratory),*
Carl Childs *and* **Marie DeLorenzo** *(NOAA),* **Aixin Hou** *(Louisiana State University)*

Session Overview

This session synthesized research efforts on the cumulative effects of multiple stressors to Gulf ecosystems. It included studies that characterized how abiotic and additional chemical stressors alter oil toxicity for coastal species and affect the long-term natural recovery and resilience of plants and microbial communities.

Session Highlights

- Almost a decade after the DWH oil spill, heavy oiling still severely impacted coastal salt marshes with a wide range of adverse effects on marsh plant individual, community structure and function, and ecosystem services. Plants were able to recover from moderate levels of oiling, but success varied with species (Juncus much more sensitive to oiling than Spartina). Variation in microbial communities was related to aboveground vegetation, soil bulk density, and soil TPH. Microbial communities associated with marsh vegetation (Spartina alterniflora) generally increased the rate of oil degradation. The bacterial communities at heavily oiled sites did not return to the primitive community structure of the reference sites eight years after the spill but have evolved into a new state.
- Heavy oiling, both with and without cleanup, increased the annual marsh shoreline erosion rate by 2-3.5x over ~2 years. Planting following cleanup treatments had an immediate positive effect on decreasing erosion following the spill; this finding has direct applications for spill response and emergency restoration.
- Surrogate and DWH produce similar sulfur oxide (SOx) photoproducts in both oil and water, but subtle differences exist. For instance, sulfides produce more water-soluble SOx species than thiophenes and DWH produces higher-order oxygenated compounds.
- Laboratory testing was used to assess multi-stressor interactions with three common environmental contaminants: an insecticide, a PAH, and an antibacterial agent. Larval grass shrimp were generally more sensitive than larval sheepshead minnows. The combination of contaminants generally yielded additive toxicity, with some enhanced mixture toxicity seen with grass shrimp. A field study described the relationship between oil exposure and mercury accumulation in sparrows and marsh rats.
- Several interactive effects of oil and abiotic factors were characterized. UV light increased oil toxicity in larval Eastern oysters, and lower salinity and higher temperatures further increased toxicity. Interactive effects of oil, temperature, and hypoxia were demonstrated using metabolic performance in the red drum. Genes associated with cardiac and hepatic function were differentially expressed in Fundulus grandis larvae exposed to PAHs as well as those exposed to hypoxic conditions. Hypoxic conditions were associated with altered reproductive patterns (early transition from female to male) in seabass. A field study described how low salinity is expected to hamper recovery of invertebrate populations from the DWH oil spill.
- New chemical analyses described advances in separating oil constituents related to weathering and how they affect oil fate and toxicity. A time course study described persistence and compositional changes from 2010 to 2018 of oil on Louisiana marshes and beaches.

**Session Lead*

Session 019:

Fate of Dispersed Oil

Kelly McFarlin *(ExxonMobil) and* **Roger Prince** *(Stonybrook Apiary)*

Session Overview

The session focused on the fate of oil dispersed by physical turbulence, with or without the addition of chemical dispersants. Several described biodegradation, but physical processes such as emulsification, photooxidation and the binding of oil to sand and clay grains were also described. The experiments ranged from the laboratory to the field, and several talks showed how research in these different domains led to a congruent understanding of "the real world."

Session Highlights

- Two talks focused on whether dispersants have measurable effects beyond the designed one of getting oil slicks off the surface (or preventing their formation in subsea releases). While there is still subtle disagreement, it is clear that the rate of oil biodegradation of small dispersed droplets is much faster than when oil is present as a slick.
- There have been dramatic improvements in understanding the composition of weathered and biodegraded oil with very high-resolution mass spectrometry. Three talks described some of this progress with samples from experiments and oil-impacted parts of the Gulf of Mexico. One conclusion that might change widespread opinion is that only 20 of 112 sediment samples collected in the spill area in 2010, 2011, and 2014 unequivocally contained oil from the Macondo reservoir.
- Exciting microscopy of oil droplets in flowing seawater has identified enormous (on the scale of the droplet) biofilm "streamers" which must surely influence the hydrodynamics of those droplets, including their rise velocity.
- Unfortunately, there was only limited interest from regulatory and responder organizations, although oil companies were reasonably represented. A real gap is an absence of a venue where academics can learn about the true scale of oil spills and clean-up operations so that synergistic research can be accomplished.

Session 020:

The Deep Gulf of Mexico: Knowns and Unknowns After the Deepwater Horizon Spill

Arne Diercks *(University of Southern Mississippi),* **Isabel Romero*** *and* **Patrick Schwing** *(University of South Florida)*

The deep ocean is the largest habitat in the Gulf of Mexico affected by the Deepwater Horizon spill. Intense research for the last eight years has contributed to a much better understanding of the dynamics of this habitat influencing the fate of oil residues from the oil spill. Given the increasing motivation toward deep-water exploration, a recompilation of findings and gaps is needed between deep water pelagic and benthic habitats including the interplay among physical, chemical, and biological processes. This session shares results from the water column, sediments, and biota over a wide range of environments, with the goal of developing a conceptual model to generate an overall "big picture" of deep ocean dynamics from the water column to the seafloor.

Session Highlights

- Not all of the sedimentary pulse contained oil residue.
- There is evidence of redistribution of MOSSFA sediment southeast of the DWH wellhead (downslope).
- MOSSFA due to EPS production is greatly outpacing remineralization.
- There is no effect of corexit in experiments at 150 Bar for live or dead oil; the use of corexit at depth likely not effective.
- Methane concentrations are above 10,000 nM in northern Gulf near seeps, inertial frequency of plumes is 26.1 days.
- Chlorinated hydrocarbon dumping is taking place in the MC808 lease block, resulting in the potential contamination of the surrounding benthos.
- Two meters of Pleistocene-aged terrigenous material is found widespread throughout the north-central and northeast Gulf of Mexico. A potential revision of meltwater pulse history in the Holocene/late Pleistocene may be needed.
- A benthic foraminifera-based marine biotic index has been calibrated for the entire Gulf of Mexico which can be used as management decision support tool.
- Coral impact models suggest 66 sites were impacted by the Deepwater Horizon oil spill.
- Long-term and broader sampling of meiofauna and macrofauna produced a much larger (2x) benthic footprint of impact from the Deepwater Horizon oil spill.
- Lateral transport of contaminated sediments is likely as resuspension of material of the seafloor varies with sites on the seafloor.
- Deposition of MOSSFA material on the seafloor is likely not uniform but highly patchy due to near bottom currents and seafloor morphology.
- New technology and methods presented include sediment resuspension flume (USM), rising droplet path module (TUHH), in situ methane consumption measurements (UNC-Chapel Hill), foraminifera marine biotic index (USF/Eckerd), coral impact model (Temple), and sedimentary chemical markers of MOSSFA (USF).
- Real-time reporting of oil and ambient environmental parameters would greatly aid response efforts.
- Proper scaling and timeframe of field collections greatly impact the outcome of injury assessment.

Identified Gaps and Challenges

- The frequency of sediment resuspension events is unknown. This would provide baseline information to support impact assessments, sediment inventories, and geohazard mitigation in the future.
- Collection of ambient seawater and oil parameters regularly at rigs would greatly support response and modeling efforts during a future spill.
- An auto-identification application for benthic foraminifera and creation of handbooks for each region of the Gulf would make marine biotic indices more accessible for managers.
- Regular spacing/gridded sampling reduces bias and is needed for future injury and monitoring efforts.

**Session Lead*

- Geochemistry characterization of oil-residues and other organics (e.g., chlorinated hydrocarbons) should be done to establish the new baseline of the Gulf seafloor.
- More work needs to be done on the spatial extent and fate of transformation products in deep-sea sediments as well as the long-term effect of oil-residues to benthic communities.
- Coordinated, hypothesis-driven, long-term, time series research projects in the deep Gulf benthos are needed and would greatly support majority of injury assessment unknowns in the future. Several distinct sites are needed to study water column and deep-water sediment transport and current field.

Session 021:

Outcomes from Large-Scale Fishery Monitoring Projects Following the Deepwater Horizon Oil Spill: What Have We Learned and Where Do We Go from Here?

David Reeves *(National Fish and Wildlife Foundation),* **Theodore Switzer** *and* **Kevin Thompson** *(Florida Fish and Wildlife Research Institute)*

Session Overview

This session highlighted key results and Lessons Learned from several state- and academic-led projects designed to provide enhanced fisheries monitoring data for managed fishes in the eastern Gulf of Mexico. Research presented included a broad mix of fishery-independent and fishery-dependent surveys, analysis of temporal trends in abundance, species-habitat associations and distributions, variation in life history parameters, and population responses to ecosystem perturbations.

Session Highlights

The overarching theme of talks presented in this session was the critical importance of long-term monitoring data, and the need to sustain these efforts to assess the impacts of management and environmental stressors on fisheries of the Gulf of Mexico ecosystem now and into the future. The intent of National Fish and Wildlife Foundation (NFWF) in funding these projects was to provide data to reduce uncertainty in fisheries management by improving stock assessment inputs and arming managers with the tools and information required to make rapid management decisions. Several presentations highlighted how data provided by these projects have already contributed to the assessment and management of several reef fishes despite representing relatively short time series (five years or less). Nevertheless, several sources of data critical to management will terminate as funding ends, and the loss of these data will impact stock assessments, particularly for reef fishes, in the coming years.

Several presentations within this session highlighted research that utilized various emerging technologies and novel analytical approaches. Technological advancements included the use of various camera-based approaches for quantifying the abundance and size composition of reef fish populations and characterizing benthic habitats, the application of fisheries acoustics to assess the effectiveness of camera surveys, the integration of acoustic mapping into survey design and abundance estimation, and the use of mobile phone applications to monitor recreational fishing effort. Analytical approaches that were novel included habitat-based methods to combine fishery indices, the development and use of novel fishery-dependent surveys to monitor catch and effort at improved temporal and spatial resolutions, the evaluation of survey design using power analyses for non-normal data, characterization of benthic habitats using acoustic mapping data and classification using ground-truthed imagery, and multivariate analyses of demersal fish communities.

Ultimately, Lessons Learned from enhanced fisheries monitoring have advanced both the science and management of fisheries in the Gulf of Mexico; nevertheless, aside from a few examples (e.g., the NMFS/Florida reef fish video survey), several sources of critical data will likely end in the near term (e.g., observer-based estimates of discard mortality, expanded SEAMAP trawl surveys, and several hook and line surveys) which brings into question whether we will be positioned to evaluate trends or impacts to managed fish stocks in the event another perturbation like the DWH oil spill were to occur in the future. In addition to the loss of critical data, it is equally important to recognize that these projects required significant time and investment at the outset to develop collaborative partnerships, train highly-skilled staff, and establish a strong community of practice that, once lost, will be difficult to reestablish. When determining where to allocate remaining DWH restoration and monitoring funds, we encourage resource managers to consider the benefits provided by comprehensive, long-term surveys and consider fisheries monitoring as a top priority.

Session 022:

Next Steps in Human Dimensions Research and Practice: Priority Actions for Building Community Resilience to Oil Spills

David Cochran *(University of Southern Mississippi),* **Melissa Finucane** *and* **Andrew Parker** *(RAND Gulf States Policy Institute)*

Session Overview

This session presented findings from research on the health, social, and economic impacts of the Deepwater Horizon oil spill and other hazard events on Gulf Coast residents and provided recommendations for building community resilience.

Session Highlights

- Studies used multiple methods, including focus groups, tabletop exercises, surveys, and modeling to examine socio-demographic, cultural, place-based, and other factors affecting disaster experiences and responses.
- Methods for identifying and addressing needs of vulnerable communities (e.g., Cambodian, Laotian, displaced persons) emphasized.
- Critical coastal environments, such as wetlands and estuaries, not only provide ecosystem services, but also socio-cultural services in the form of physical/emotional health. Environmental protection is directly linked to human well-being and positive health outcomes.
- "Human welfare" was identified in the National Contingency Plan and the Incident Management Handbook, but not defined; public welfare assessment technique proposed as a mechanism that could be used within the incident command response structure.
- Housing recovery policy in the United States needs to be revisited. After each major disaster, and also with smaller and moderate sized events, housing is disrupted and people are dislocated. People experience disparate trajectories; equitable disaster policy that targets resources to the most socially vulnerable community members — as opposed to excluding them — can greatly advance community recovery and improve community resilience.
- Resilience and recovery models are challenging to validate. Resilience and recovery happen over long periods of time. Primary data is resource-intensive. If we can get post-disaster household-trajectory data from a sufficient number of households, it would still only represent one disaster and one community's experience. It is critical to use a combination of verification and validation steps, including the use of stories and data, to check predictive, numerical models.
- Five research-informed recommendations suggested ways to support vulnerable communities; use social science to understand the complex context in which disaster management occurs; adopt a whole of community approach to risk management; connect the past, present, and future contexts in risk mitigation efforts; and build the evidence base for improving community resilience.

  Eleven research-informed practices recommended by oil spill U.S. Coast Guard (USCG) leaders/specialists, state representatives, and sociologists identified and demonstrated in Virginia to adapt existing preparedness and response "practice" to support and protect community resilience.

Identified Gaps and Challenges

- A need exists for culturally responsive recruitment methods and emergency response strategies emphasized to allow key stakeholders to identify gaps in the planning and implementation of disaster response plans.
- The adoption of welfare-enhancing preparedness and response practices by USCG leadership and coastal states should be expanded nationwide.
- An overarching message was the lack of baseline data and need for prospective, longitudinal studies. Prospective, longitudinal studies would provide better data for testing causal mechanisms of disaster impacts, determining the effectiveness of alternative programs/interventions aimed at supporting impacted communities, and determining factors influencing adaptive/maladaptive trajectories.
- Governance, implementation, and funding of cohorts built through the proposed Community Health Observing System need to be determined.

Session 023:

Understanding Processes Associated with Sub-Surface Oil and Gas Releases, with Special Focus on MC20 Site in the Northern Gulf of Mexico

Lisa DiPinto *(NOAA) and* **Ian R. MacDonald** *(Florida State University)*

Session Overview

Oil and gas releases, including persistent surface slicks, have been observed in the Mississippi Canyon Block 20 (MC20) site in the northern Gulf since the 2004 destruction of a production platform by Hurricane Ivan. The magnitude and fate of these hydrocarbons have been topics of active research in several disciplines. There have been many recent advances in our ability to characterize source, composition, and extent of gas and oil discharging from the site, as well as for subsurface oil collection and containment. Presentations described physical models, remote sensing data collection and analyses, field testing of developing techniques and methods for characterizing oil in the environment, and other related in situ sampling. The session included updated results from a NOAA/BSEE field project that developed and applied multiple novel technologies for characterizing the discharging oil.

Session Highlights

- Investigation of the hydrocarbon plumes emanating from the base of the downed platform reveal the source and approximate magnitude of surface oil slicks, which were confirmed by direct collection.
- Estimates of the spill rate given as 24 to 28 barrels per day, confirmed by direct collection. Chemical fingerprinting confirms thermogenic gas and reservoir oil. Transfer of approximately 1 ton of methane from the plumes to the atmosphere is demonstrated.
- Integrated assessment of mid-water hydrocarbon plume using visual and acoustic methods. Construction & successful installation of a containment system to capture discharging oil.
- The unified command has quantitative data for spill rate upon which to base response decisions. Industry has a new model for containment technology. Impacts to public resources are temporarily mitigated.
- Better understanding of plume dynamics and mid-water hydrocarbon transfer pertains to potential future oil spills and to natural seeps.

Identified Gaps and Challenges

- Further effort for visual quantification of oil/gas bubbles is needed. The MC20 site offers a natural laboratory for investigating fates of hydrocarbons released to the ocean.
- Questions posed about some of the methodologies used by the government team that investigated the spill. Response of the platform operator to new findings remains ambiguous. The release continues despite mitigation and requires a permanent solution.

Session 024:

To Disperse or Not to Disperse? That is the Question

Steven Murawski *(University of South Florida)*, **Thomas Coolbaugh** *(ExxonMobil Corporation)*, **Joseph Katz** *(Johns Hopkins University)*

Session Overview

Some of the most persistent and pervasive questions arising from significant oil spills, including Deepwater Horizon and Ixtoc 1, relate to the decision to deploy chemical dispersants at the sea surface and at the source of the blown-out well as response countermeasures. This session summarized the state of current research from various perspectives, including those of industry, academia, and the recently completed National Academies' study. Unresolved issues and next steps for additional research were discussed.

Session Highlights

The session consisted of a keynote address by Dr. Susan Roberts, Executive Director of the National Academies Ocean Studies Board, followed by 10 technical talks. The keynote focused on the recently completed National Academies study of the use and effectiveness of chemical dispersants, including findings and data gaps. One of the important findings of the Academies' study was that up to relatively high concentrations of oil, chemically enhanced water-accommodated fractions (WAFs) were no more toxic to biota than WAFs without dispersants. The study also found that procedures for conducting toxicity studies need to be standardized and include routine chemical analysis of testing media. The National Academies' study also reviewed conflicting information on the efficacy of sub-surface dispersant injection (SSDI) which was a novel delivery mode during the DWH spill. The Academies' study concluded that resolution of the critical question of the efficacy of SSDI would require (1) a larger scale high pressure testing facility, (2) an at-scale field release of gas saturated oil in the ultra-deep, and/or (3) assessment of the next deep water blowout as a "spill of opportunity" to understand the physics of such blowouts.

A number of the talks focused on various aspects of the efficacy and effects of oil spill dispersing chemicals used at the sea surface and in SSDI. A considerable amount of research has been conducted post-DWH and even after the completion of the Academies' study to apply various modeling techniques and analyses to data obtained during the spill and to understand critical oil droplet size distributions from experiments. A crucial mechanism that appears at the root of the conflicting interpretations of the existing experiments is outgassing from saturated oil droplets as they rise from the well head. If this process is rapid and a pressure drop is substantial, the result is a significant proportion of critically small oil droplets (<100 μm) which will remain neutrally buoyant even without SSDI. Without the outgassing mechanism, experiments show few small droplets in the absence of SSDI. An evaluation of the timing of daily dispersant use relative to the discovery of deep oil plumes shows that plumes existed before substantial quantities of dispersants were used, and plume formation could not be accounted for solely by small diameter holes in the collapsed riser. Thus, some mechanism other that SSDI and small diameter holes (rapid outgassing?) was responsible for the observed plumes at DWH prior to the riser cut.

Two of the talks discussed the processes of making structured decisions to use chemical dispersants during oil spill events. The SMART protocol (Special Monitoring of Applied Response Technologies), developed by the Coast Guard and other agencies, was used in the case of DWH and for other surface spills. SMART protocols in existence require fluorometer-based oil concentrations to be five-times background to elicit the use of dispersing chemicals, but these measurements are not closely associated in time. Participants discussed updating the procedures using new technologies and models of both the effectiveness of dispersant use and its toxicity in field applications. Likewise, CRA (Comparative Risk Assessment) methods have been developed to assist in formulating likely tradeoffs to decide on the "best bad alternative" to apply dispersants at the surface and/or via SSDI depending on how the decisionmakers value various ecosystem components in the relative sense.

In the case of weathering of oil at the surface, a variety of mechanisms are involved (e.g., evaporation, photo-oxidation, dissolution, and biodegradation). All of these mechanisms, individually and in combination, affect chemical residues and the effectiveness of dispersants. The viscosity of oil/water emulsions is two orders of magnitude higher than that of the crude oil. Agitating the dispersant-emulsion mixture enhances the phase separation, removing most of the entrained water. The removed fraction decreases with increasing viscosity (reduced water droplet sizes) of the original emulsion. Dispersants may

also impact physical processes in the ocean, as the surfactants used to create them reduce surface tension, dampen short gravity-capillary waves, and suppress near-surface turbulence at the sea surface. The air-sea interface undergoes modification as wind speed increases. Under tropical cyclone conditions, surfactants at the sea surface may affect heat, energy, and momentum exchanges due to altered size distribution and abundance of sea spray and spume.

Finally, participants discussed the findings of a field experiment conducted on Baffin Island, Canada in the early 1980s. This study demonstrated the relative persistence of crude oil on beaches vs. a pre-mixed crude oil/dispersant admixture.

Overall the session demonstrated increasing sophistication in understanding fundamental processes affecting dispersant effectiveness and implications for aiding first responders in making the decision to deploy chemical countermeasures in the event of future oil spills and especially sub-surface blowouts.

Session 025:

Large Marine Vertebrates in the Northern Gulf of Mexico 10 Years After the Spill: New Findings, Synergies, Collaborations, and Opportunities

Kaitlin Frasier *(University of California San Diego),* **Pamela Michael*** *(South Carolina Cooperative Fish and Wildlife Research Unit), and* **Nathan Putman** *(LGL Ecological Research Associates)*

Session Overview

Studies conducted on northern Gulf of Mexico large marine vertebrates (LMVs) since the Deepwater Horizon oil spill have made significant contributions to our understanding of the distributions, roles, and status of these marine sentinels. Information gained from new, critical baseline data and augmented data collection and new technologies have revealed significant individual- and population-level effects resulting from spill-related hydrocarbon exposure and response efforts. These findings have also highlighted critical spatial, temporal, and demographic data gaps across taxa. Leveraging and exploiting opportunities to synergize across platforms, institutions, and regions would amplify the utility of the information gained by addressing these data gaps.

Session Highlights

- There was a focus on chronic impacts on megafauna that may appear or prevent long term population recovery. Chronic impacts identified may inhibit restoration efforts if not addressed.
- Ten years after the Deepwater Horizon much more is known about distributions, life histories, and movement patterns of marine megafauna, however baseline population levels and trends remain elusive.
- The Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS) has yielded a trove of coordinated visual survey data for sea turtles, seabirds, and marine mammals, greatly enhancing the available pool of observations. However, there is a lack of data connecting those observations with the status of lower trophic levels.
- Freshwater diversion plans in Louisiana are an existential threat to the long-term survival of the Barataria Bay bottlenose dolphin population.
- New tags and tagging methods for sea turtles and marine mammals providing insight into movement patterns and life history.
- New underwater stethoscope for dolphins provided novel insight for baseline cardiac health assessment.
- Augmenting and integrating datasets are enabling comparisons between spatial modeling approaches and elevating our understanding of population dynamics.

Identified Gaps and Challenges

- Baselines and trends remain uncertain, although we are closer in our understanding than we were pre-DWH. In the event of another spill, impacts would still be difficult to quantify for oceanic megafauna.
- Connectivity between Gulf of Mexico megafauna populations in other regions: How far do individuals range, where are the sources/sinks, etc.?
    - Some studies and methods are starting to provide preliminary answers on this, including sea turtle tagging and Bryde's whale passive acoustic monitoring.
    - A comprehensive understanding of the distribution and role of *Sargassum* habitat in the Gulf.
    - The southern Gulf of Mexico was highlighted as a critical data gap for multiple taxa.
    - Understanding the origin and life-history stages of marine bird species remains a data gap.
- Lack of data on prey fields limits understanding of observed reductions and redistributions in oceanic marine mammal stocks and the resources used by marine birds.
- GoMMAPS field effort with simultaneous observations of sea birds, marine mammals, and sea turtles yielded a lot of data quickly, including winter cruises, a long-standing gap in survey effort. Continuation of the program and expansion to include teams oriented around other trophic levels (e.g., trawls) and physical oceanography (e.g., CTD stations) would improve data utility, interpretability and overall trend analyses.
- Strategic coordination of at-sea work with tagging, tracking, and shore-based monitoring and research across and beyond the region would amplify the value of each approach.

**Session Lead*

Session 026:

Modeling Oil Spills from Small to Large-Scales: Recent Research Results and Synthesis Toward Improving Oil Spill Response

Christopher Barker *(NOAA) and* **CJ Beegle-Krause** *(SINTEF Ocean)*

Session Overview

Oil spill modeling leverages research from individual fields into interdisciplinary understanding and decision support. Research on transport, weathering and fate, and effects as well as response options are building blocks for more sophisticated models and analysis. These models are crucial for improving planning and preparedness for and response to potential oil spills. Deciding among response options such as in situ burning, chemical dispersant application, or even no response requires understanding where the oil will go, how it could change, and how it will interact with the environment. This session focused on research results and efforts to bridge new research into response applications

A summary for this session is not available.

Session 027:

Biogeochemical Tracers in Oil Spill Science: Advances, Lessons Learned and Future Directions

Will Patterson *(University of Florida) and* **Jeff Chanton** *(Florida State University)*

Session Overview

The session attracted a wide variety of tracer studies from radiocarbon to radon/radium to hopanes, sterane, and PAH tracers. Some 75% of the talks were given by graduate students, possibly their first oral presentation at a national meeting.

Session Highlights

- A wide variety of tracers exist for a wide variety of applications. Oil pollution can be preserved in a wide variety of ways and their tracers exist at differing time scales. They record differing interactions from oil deposition to sediments to oil presence in the food web. Not everything that one thinks of will work, but many do.
- While useful for many parameters, mussel shells don't record metal pollution.
- Interpretation of PAH data needs additional work as to sourcing of contaminants.
- The session highlighted the work of a number of graduate students who presented work on stable isotopes, radiocarbon radium/radon, metals, and organic pollutants. The Gulf food web definitely incorporated petrocarbon from the oil spill to some degree. Isotopic excursions in fish muscle tissue and otolith carbonates were indicative of this process. On the other hand, shells from mussels were not useful for identifying oil pollution via associated metals. Radium is elevated in petroleum and can partition into the water. It was unclear why it partitions into petroleum in the first place, however. Perhaps it is associated with the oil field brines which are also released with oil recovery, but this was not clear from the presentation.

Session 028:

From Databases to End Users – Transforming the Myriad of Coastal Information and Data Sets into Wickedly Useful Tools

Barb Kirkpatrick *(Gulf of Mexico Coastal Ocean Observing System),* **Kirsten Larsen** *(NOAA), and* **Emily Maung-Douglass** *(Louisiana Sea Grant College Program)*

Session Overview

Many data tools exist but few stand out for their user-friendly nature. This session took a closer look at critical steps in data tool development that lead to enhanced user experience and tool utility.

Session Highlights

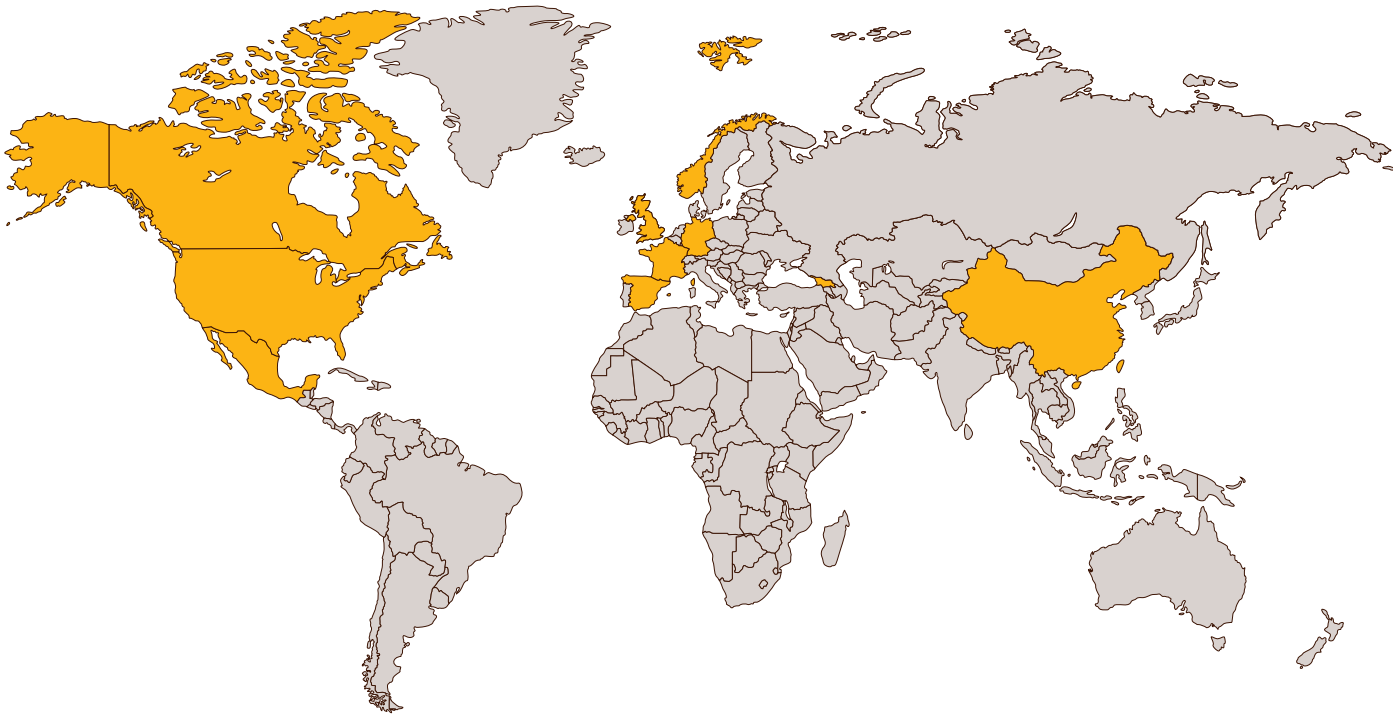
- Defining the goals and philosophy of data tools is important as they may vary by user group. Examples may include:
  - Bridging the gap between data and information for the users;
  - Making the same data available multiple places and serving it up multiple ways, such as tables, maps, photographs, and charts; and
  - Helping users differentiate and/or prioritize information, including land-use conservation approaches, other data tools available according to user-described needs, changes in runoff according to land-use, historical ocean data, or oil properties.
- Many factors and approaches increase the utility of a data tool and enhance the users' experiences. Some examples of best management practices include:
  - Making tools easy for users to access;
  - Attributing data sources;
  - Keeping costs low for developers and users;
  - Determining who the target end-users are, such as natural resource managers, emergency responders, educators, legislators, scientists;
  - Assessing the needs of end-users;
  - Beta-testing and incorporating feedback prior to final release of tool;
  - Making metadata available to end-users; and
  - Developing tools for one specific use but envisioning other possible uses as well.

ATTENDANCE AND DEMOGRAPHICS

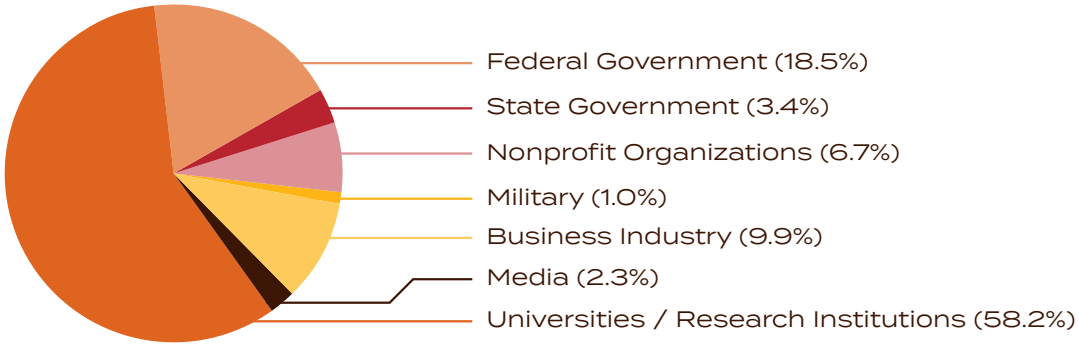
The 2020 conference hosted over 700 attendees who represented:

10 COUNTRIES

Canada, China, France, Georgia, Germany, Mexico, Norway, Spain, United Kingdom, and United States

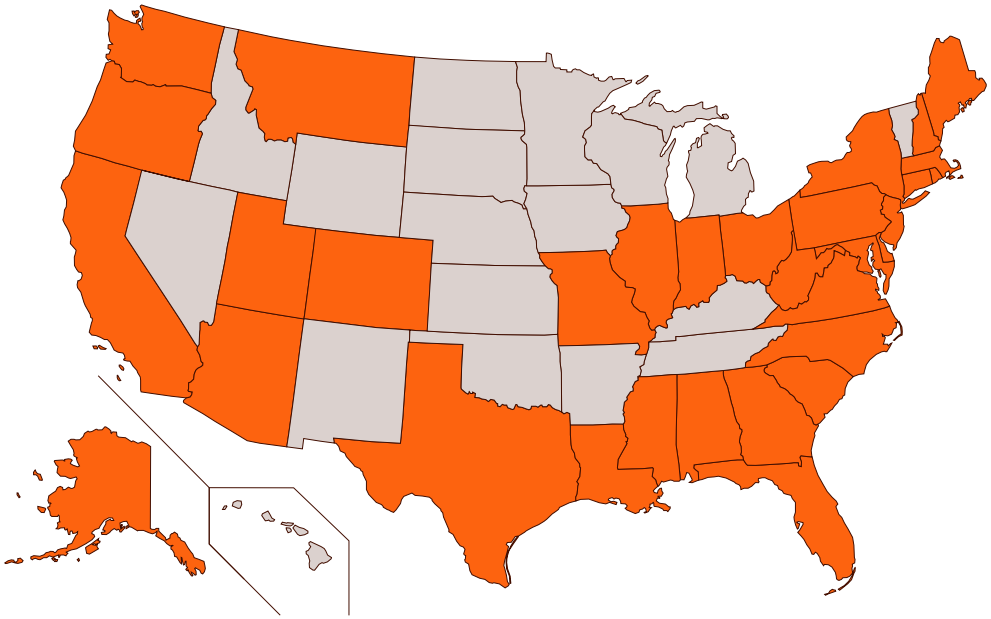


ATTENDEES BY SECTOR



32 STATES

Alabama, Alaska, Arizona, California, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Louisiana, Maine, Maryland, Massachusetts, Mississippi, Missouri, Montana, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, South Carolina, Texas, Utah, Virginia, Washington, West Virginia, and Washington, D.C.



COMMUNICATIONS

To support the conference's thematic pivot toward restoration science, a key element to the 2020 GoMOSES communications plan was to enact targeted outreach to the Gulf restoration and resource management communities to encourage participation as session organizers, presenters, attendees, and sponsors. As a result, nearly 25% of the scientific program consisted of restoration and resource management sessions, and attendees included representatives from relevant state and federal agencies, nonprofit organizations, and private firms.

As part of media exposure for the conference, two press releases were distributed through *PRNewswire*, a national press release service, and conference partners, while updates and news were announced via the conference email list, the Consortium for Ocean Leadership e-newsletter, and social media. Searches through *Meltwater*, a media monitoring service, returned 200 examples of coverage before, during, and after the conference with a total reach of 108.5 million people. Social media engagement resulted in 69 uses of the conference hashtag (#GoMOSES) on Twitter, 523 Twitter followers, and 460 Facebook followers.

The full media report is available in Appendix IV (Page 56).

Appendix I: Conference Schedule

Monday, February 3

Time	Event	Location
8:00a – 5:30p	Registration and Check-In Open	Grand Foyer
12:00p – 5:30p	Presentation Upload Open	Grand Foyer
2:00p – 5:30p	Exhibit Set Up	Grand Foyer
2:00p – 5:30p	Poster Set Up	Florida Ballroom

Workshops and Associated Meetings

1:00p – 5:00p	An Introduction to the Environmental Unit's Role and Responsibilities During an Oil Spill	Meeting Room 5
1:00p – 5:00p	Recent Advances in Estimating and Measuring Oil Slick Thickness (Closed)	Grand Salon A
5:00p – 7:00p	Graduate Student and Early-Career Networking Reception	Il Terrazzo Room (1st Floor)

Tuesday, February 4

Time	Event	Location
7:30a – 5:30p	Registration and Check-In Open	Grand Foyer
7:30a – 6:00p	Presentation Upload and Exhibits Open	Grand Foyer
7:30a – 7:30p	Poster Hall Open	Florida Ballroom

Opening Plenary Program Schedule

Starting at 7:30a	BREAKFAST	Grand Foyer
9:30a – 10:45a	Welcome and Introduction: The Gulf of Mexico +10 Years and Counting	Grand Salon E/F
10:45a – 11:00a	BREAK	Grand Foyer
11:00a – 12:00p	Panel and Discussion	Grand Salon E/F
12:00p - 2:00p	LUNCH BREAK	

Scientific Program Schedule

2:00p – 3:30p	Session 001	Grand Salon A/B
	Session 002	Grand Salon F
	Session 003	Grand Salon C/D
	Session 004	Grand Salon E
	Session 005	Grand Salon G/H
	Session 006	Grand Salon I/J
3:30p – 4:00p	BREAK	Grand Foyer
4:00p – 5:30p	Session 001	Grand Salon A/B
	Session 002	Grand Salon F
	Session 003	Grand Salon C/D
	Session 004	Grand Salon E
	Session 005	Grand Salon G/H
	Session 007	Grand Salon I/J
5:30p – 7:30p	Poster Session and Reception (Featuring Sessions 001 – 014)	Florida Ballroom

Workshops and Associated Meetings

12:00p – 2:00p	Canada's Multi-Partner Research Initiative	Meeting Room 5
12:30p – 1:30p	*Dispatches from the Gulf 3* Screening	Grand Salon A/B
12:30p – 2:00p	GRIIDC Advisory Board Lunch (Closed)	Meeting Room 12
5:30p – 7:30p	Gulf of Mexico Data Tools Café	Florida Ballroom

Wednesday, February 5

Time	Event	Location
7:30a – 5:30p	Registration and Check-In Open	Grand Foyer
7:30a – 6:00p	Presentation Upload and Exhibits Open	Grand Foyer
7:30a – 7:30p	Poster Hall Open	Florida Ballroom

Scientific Program Schedule

Starting at 7:30a	BREAKFAST	Grand Foyer
8:30a – 10:00a	Session 008	Meeting Room 5
	Session 009	Grand Salon I/J
	Session 010	Grand Salon C/D
	Session 011	Grand Salon F
	Session 012	Grand Salon E
	Session 013	Grand Salon A/B
	Session 014	Grand Salon G/H
10:00a – 10:30a	BREAK	Grand Foyer
10:30a – 12:00p	Session 008	Meeting Room 5
	Session 009	Grand Salon I/J
	Session 010	Grand Salon C/D
	Session 011	Grand Salon F
	Session 012	Grand Salon E
	Session 013	Grand Salon A/B
	Session 014	Grand Salon G/H
12:00p - 2:00p	LUNCH BREAK	
2:00p – 3:30p	Session 015	Meeting Room 5
	Session 016	Grand Salon A/B
	Session 017	Grand Salon C/D
	Session 018	Grand Salon I/J
	Session 019	Grand Salon E
	Session 020	Grand Salon G/H
	Session 021	Grand Salon F
3:30p – 4:00p	BREAK	Grand Foyer
4:00p – 5:30p	Session 015	Meeting Room 5
	Session 016	Grand Salon A/B
	Session 018	Grand Salon I/J
	Session 019	Grand Salon E
	Session 020	Grand Salon G/H
	Session 021	Grand Salon F
5:30p – 7:30p	Poster Session and Reception (Featuring Sessions 015 – 027)	Florida Ballroom

Workshops and Associated Meetings

7:00a – 8:30a	Gulf Restoration and Science Programs Coordination Forum (Closed)	Meeting Room 11
12:00p – 2:00p	GoMRI Scholars Lunch (Closed)	Meeting Room 12
12:30p – 1:30p	*Dispatches from the Gulf 3* Screening	Grand Salon A/B
6:30p — 7:30p	Women in Emergency Management Networking	Meeting Room 5

Thursday, February 6

Time	Event	Location
7:30a – 12:00p	Registration and Check-In Open	Grand Foyer
7:30a – 10:30a	Presentation Upload Open	Grand Foyer
7:30a – 12:00p	Poster Hall and Exhibits Open	Florida Ballroom

Scientific Program Schedule

Starting at 7:30a	BREAKFAST	Grand Foyer
8:30a – 10:00a	Session 022	Grand Salon I/J
	Session 023	Grand Salon C/D
	Session 024	Grand Salon E
	Session 025	Grand Salon F
	Session 026	Grand Salon G/H
	Session 027	Grand Salon A/B
10:00a – 10:30a	BREAK	Grand Foyer
10:30a – 12:00p	Session 022	Grand Salon I/J
	Session 023	Grand Salon C/D
	Session 024	Grand Salon E
	Session 025	Grand Salon F
	Session 026	Grand Salon G/H
	Session 028	Grand Salon A/B
12:00p - 2:00p	LUNCH BREAK	

Closing Plenary Program Schedule

2:00p – 3:30p	Wes Tunnell Award Gulf Science in the Next 10 Years Conference Wrap Up	Grand Salon E/F

Workshops and Associated Meetings

12:30p – 1:30p	*Dispatches from the Gulf 3* Screening	Grand Salon A/B
3:00p – 5:00p	NOAA RESTORE *Sargassum* Project Annual Site Visit Meeting (Closed)	Grand Salon A/B

Appendix II:

Associated Workshops and Meetings

An Introduction to the Environmental Unit's Role and Responsibilities During an Oil Spill

Organized by Ramboll

The Environmental Unit (EU) is established within hours of a spill and is responsible for all environmental issues during the response. This course aimed to educate participants on what the EU does and does not do. One of the primary roles of the EU is to minimize inadvertent damage from response activities to natural and cultural resources. During the Deepwater Horizon oil spill response, this minimization was accomplished via the Natural Resource Advisor (NRA) program. The NRA program was managed by the organizers of this course and was discussed thoroughly during this workshop. Additional EU responsibilities include identifying resources at risk; managing the Shoreline Cleanup Assessment Technique (SCAT) program; managing waste streams; and coordinating internal and external environmental stakeholder issues as they pertain to response activities. The main function that the EU does not perform is to assess injury or damage from the release. This is addressed via the Natural Resource Damage Assessment (NRDA) process. The workshop provided an overview of the NRDA process and discussed areas of overlap between response activities and NRDA. This was a discussion-based, four-hour workshop taught by experienced spill response consultants who have worked on responses in the Gulf (e.g., the Bayport Channel Collision, ITC Fire, MC 252 Deepwater Horizon, Ivar Exporter, Texas City Y, MTBE release in LaPorte, TX, and Bay Long, LA) and many other spills across the United States.

Recent Advances in Estimating and Measuring Oil Slick Thickness

Organized by Water Mapping, LLC, NOAA, and U.S. EPA

In 2018, the GoMOSES conference was the venue for our first workshop in which we gathered first responders and researchers from agencies, academia, and oil spill industry who are advancing in situ and remote oil characterization tools and methods. Once again, the 2020 GoMOSES was be an opportunity to follow up developments on technology and science on this topic.

Overview: Characterization of the extent and degree of surface oil during and after an oil spill is a critical part of emergency response and Natural Resource Damage Assessment (NRDA) activities. More specifically, understanding floating oil thickness in real-time is a key piece of information needed to:

1. Help guide response efforts by directing limited assets to priority cleanup areas (actionable oil);
2. Aid in the assessment of 'volume released' estimates;
3. Support modeling platforms for predicting transport and fate of oil; and
4. Support natural resource injury determinations.

Format: Brief research presentation of study methods and findings by selected panel followed by discussion of challenges and advances in oil slick thickness characterization.

Goals: Provide forum for discussion of recent and ongoing oil thickness research collective advances. Identify achievements and limitations, and application of new tools and methods to future incidents. Discuss ways to leverage limited resources and opportunities for conducting research and developing tools and methods. Identify priorities and next steps in advancing our ability to characterize floating oil thickness.

Canada's Multi-Partner Research Initiative (MPRI)

Organized by Fisheries and Oceans, Canada

Canada's Ocean Protection Plan (OPP) is a comprehensive, transformative $1.5B strategy to build a world-leading marine safety system to protect Canada's marine ecosystems and coastal communities. A key component of the OPP is the Multi-Partner Research Initiative (MPRI), led by Fisheries and Oceans Canada (DFO) in collaboration with other Government of Canada Departments (Environment and Climate Change Canada, Canadian Coast Guard, Natural Resources Canada, and Transport Canada) which aims to advance oil spill research by fostering a national/international research network that brings together scientific experts in the field.

A primary objective of the MPRI is to improve our understanding of how oil spills behave, how best to contain and clean them, and how to minimize their environmental impacts to support science-based decision making for oil spill preparedness and response operations. In order to answer these questions, the MPRI has funded projects based on five program areas (Alternative Response Measures — ARMs) and three cross cutting themes:

ARMs:

1. Spill treating agents
2. Oil translocation
3. *In situ* burning
4. Natural attenuation
5. Decanting/oily waste disposal

Cross-cutting Research Themes:

1. Analytical chemistry
2. Oil detection/monitoring & modeling
3. Toxicology

To reduce duplication of research effort and to optimize the use of resources, this program has created a network drawing upon the expertise and experience of the science community both in Canada and abroad (including a number of participants funded under the GoMRI program). To date, MPRI has funded over 35 projects for a total of $46M.

This workshop was open to anyone interested in learning about MPRI and potential future research partnership opportunities. It provided an open forum for MPRI team members attending the GoMOSES Conference to provide an overview of their current activities and findings to date for discussion and feedback, and a venue to foster new research partnerships to be leveraged in the future by the MPRI.

Women in Emergency Management Networking

Organized by Coastal Response Research Center

The goal of this event, sponsored by the Coastal Response Research Center, was to bring together women who have careers in preparedness, response, restoration, and recovery with those who are interested in exploring working in the field of emergency management. The meeting promoted camaraderie, dialogue, and networking and included a panel of women who work in the public and private sectors and have a broad range of experience in the field answering questions about their careers.

Dispatches from the Gulf 3 Screening

Organized by Screenscope

The final episode in the trilogy of the decade!

"Has the Gulf of Mexico recovered from the Deepwater Horizon oil spill?" As the 10th anniversary of the disaster approaches, this question is regularly posed. Scientists have spent nearly that long studying its environmental impact on humans, wildlife, and the ecosystem. They provide assessments of the current state of the Gulf, but lingering questions are challenging their ability to predict the long-term impacts. Narrated by Matt Damon.

Appendix III:

Gulf of Mexico Tools Café

Ocean Reports Tool

BOEM

This tool is intended for coastal and marine planners, public-sector resource managers, private sector companies, legislative staff, researchers, and the general public who are not otherwise skilled in Geographic Information Systems (GIS). Specific topical areas where the tool is relevant include aquaculture siting, offshore energy development, natural resource management, and navigation planning.

OceanReports allows users to select an Area-of-Interest (AOI) in the ocean space and instantly obtain over 70 unique infographics containing analyses of the location; its energy and minerals, natural resources, transportation and infrastructure, and oceanographic and biophysical conditions; and its contribution to the local ocean economy. Users can select infographics of interest, explore pertinent ocean data through interactive pop-ups and visualizations, toggle map displays of each layer related to infographic content, share results by web link, and print custom reports to inform various permitting processes. Metadata, background information, and the analysis rule-sets are all available for each infographic.

Gulf of Mexico Research Initiative Information & Data Cooperative (GRIIDC) Data Management System

GRIIDC

This tool is designed for Gulf of Mexico Research Initiative (GoMRI)-funded investigators and administration; RESTORE Act Centers of Excellence funded investigators and administration; academic researchers; natural resource managers; policymakers; emergency responders; nongovernmental organizations; and the general public.

The tool was initially designed to manage and distribute data generated by GoMRI-funded projects. The data management applications that assist with planning, documenting, and submitting data to GRIIDC are designed for investigators and data managers. GRIIDC also issues a DOI for discrete data packages that provides researchers with a citable reference for their efforts. These tools are available to GoMRI, Florida RESTORE Act Centers of Excellence Program (FLRACEP), Mississippi Based RESTORE Act Center of Excellence funded investigators, and the Harte Research Institute for Gulf of Mexico Studies. The GRIIDC program is also developing new partnerships to continue our mission of ensuring a data and information legacy that promotes continual scientific discovery and public awareness of the Gulf of Mexico ecosystem. Potential partnerships with Louisiana and Alabama RESTORE Act Centers of Excellence, the NASEM Gulf Research Program, oil and gas industry, and others will allow more investigators to use these tools to manage and share their data using the GRIIDC system. The system allows data submissions to be tracked through the data package workflow by both investigators and program administration via the dataset monitoring application. The GRIIDC data discovery portal and dataset landing pages are designed for anyone who is interested in obtaining data about the Gulf of Mexico, including academic researchers, natural resource managers, policymakers, emergency responders, nongovernmental organizations, and the general public.

Strategic Conservation Assessment of Gulf Coast Landscapes - A Web-Based Geospatial Tool Suite

LandScope and Mississippi State University

The Strategic Conservation Assessment of Gulf Coast Landscapes (SCA) project serves land and resource agencies working in the five Gulf states: Alabama, Florida, Louisiana, Mississippi, Texas. The SCA tool suite is relevant and useful to the broader Gulf conservation community, including member agencies of the RESTORE Council, land trusts, nongovernmental organizations, and private industry.

Land and resource decisionmakers currently have an unprecedented opportunity for land conservation in the Gulf Coast Region (GCR) yet identifying optimal projects to meet conservation goals is a persistent challenge. The SCA project provides a suite of planning-support tools to assist Gulf conservation stakeholders in integrating shared priorities for land conservation and evaluating co-benefits of potential projects in a geospatial environment given individual stakeholder values.

DIVER (Data Integration, Visualization, Exploration, and Reporting) Tool

NOAA

The DIVER (Data Integration Visualization Exploration and Reporting) application is a data warehouse and query tool that manages the integration of environmental data and restoration project information and monitoring data, and makes this data available to stakeholders, scientists, and the public for querying and download for further analysis. The vast majority of environmental data that support the Programmatic Damage Assessment and Restoration Plan (PDARP) that were collected by trustees (federal/state/local) are available through DIVER Explorer. The data warehouse aspect of the DIVER application supports the ability to integrate and organize field collected data including observations, samples, photographs, oceanographic data, and laboratory analysis or interpretation, and make the results and supporting information available for query and download. DIVER Explorer is a web-based querying tool which provides the user with the ability to search and filter environmental data and information by keywords (e.g., “salt marsh”) or by a specific project or workplan; search by a specific area (draw a shape on the map or choose from existing state or water boundaries); and download results with metadata and additional notes and documentation. The DIVER data warehouse provides the opportunity to integrate or link restoration monitoring data from across the Gulf of Mexico and make data available through the DIVER Explorer query tool. Restoration project information from NRDA-funded projects is also managed and made available through the DIVER tool, with collaboration workspaces for each Technical Implementation Groups (TIG).

Gulf of Mexico ERMA (Environmental Response Management Application)

NOAA

ERMA is a mapping and visualization tool that provides access to a vast amount of environmental and operational data that is key to decision making for environmental responses, assessment, planning and restoration. ERMA has most recently served as the USCG Common Operational Picture (COP) for Hurricanes Florence and Michael to coordinate activities across federal and state partners. ERMA was used intensively by the federal DWH response effort as the COP during the active clean-up phase, providing up-to-the-minute updates on things like status, trajectories, sampling and results that were used for decision making. ERMA served as the primary visualization tool for environmental datasets that were used to develop the Deepwater Horizon Programmatic Damage Assessment and Restoration Plan. The team of trustees that spanned federal, state, and other partners used ERMA to visualize and communicate analysis and results. Gulf of Mexico ERMA is now focused on the DWH environmental restoration effort, including a partnership with the Ocean Conservancy where the datasets used for their Gap Analysis of Gulf of Mexico Long-Term Monitoring are displayed in ERMA. The ERMA application is also actively used for responding to current environmental disasters including hurricanes and oil or hazardous materials spills.

Appendix IV:

GOMOSES Communications Report

Media Outreach Objectives & Outcomes

1. Entice Media Attendance

- Provided easy access to conference information for media on the conference website (*http://gulfofmexicoconference.org/*). Note that as the conference has now concluded, the website has gone offline. An archive of conference materials has been placed on the GoMRI website (*here*).
- Reached out to potentially interested media
  - Created targeted local and national media lists to send pre-event release and invitation
  - Contacted individuals directly who covered the spill, previously attended GoMOSES conferences, or contacted us directly to be on the media distribution list
  - Sent out two pre-conference press releases via PR NewsWire
    - PR1 (Dec. 10): Total Pick-ups = 135; Potential Audience Online = 84,033,989
    - PR2 (Jan 15): Total Pick-ups = 142; Potential audience = 88,203,936; 16,377 Twitter followers
  - Conference announcements (e.g., session proposals, abstracts, registration) were distributed, as appropriate, through the Consortium for Ocean Leadership Ocean News Weekly (ONW) e-Newsletter with a distribution of more than 6,000 people.
  - Updated information on AP planner website
  - Coordinated with contacts at the University of South Florida to engage local science media contacts (*USF Release*).
  - *Posted a guest blog* on the Ocean Conservancy website to distribute conference information through their networks.

2. Inform media of key findings presented at the conference

- Created a media kit for distribution at the conference (at information table)
  - Key message document
  - "Hot topics" document — Summaries of 15 noteworthy abstracts
  - Schedule of events & speaker bios (conference program)
- Promoted the conference on social media accounts

3. Obtain positive, in-depth conference media coverage

- Provided and staffed a press information table in the main registration area
- Provided access to a quiet interview space as needed
- Connected media with scientists from "hot topics" document
- Received and coordinated media inquiries
- See discussion of publications in below sections

4. Take full advantage of social media

- Promoted and encouraged use of #GoMOSES hashtag
  - Included hashtag on all conference materials and press releases
    - Total number of uses of conference hashtags: 71
    - #GoMOSES: 69
    - #gulfscienceconference: 2
- Monitor following on Facebook and Twitter:
  - Facebook followers: 460 page "likes", 474 page followers
  - Twitter followers: 523
    - 5,586 impressions from 19 tweets across the 4 days of the conference
    - Gained 8 new followers in February

5. Summary Numbers

- Media Tracking
  - Before Conference
    - PR 1: 84M; PR 2: 88.2M = 172.2M (potential audience)
    - Meltwater Coverage: 199 articles with a reach of 45.6M
  - After conference
    - 4 articles published with a combined reach of 62.8M
- Media attendees at the Conference
  - 12 Media Attendees
- Interviews during the Conference:
  - Times Picayune, The Washington Post, The Villages Media
- Social Media
  - Twitter Followers: 523
  - Facebook Followers: 460 page "likes"
  - #GoMOSES use: 69
  - #gulfscienceconference use: 2

Press Coverage Summary Report

1. Mechanisms Accomplished: Conference Communications Plan

- Created and updated media section on the *Conference website*
- Created targeted media lists
- *Posted a guest blog* on the Ocean Conservancy website to distribute conference information through their networks.
- Distributed two press releases through email and PR Newswire
- Received media inquiries and facilitated media interviews
- Promoted Conference on social media accounts
  - Continued Conference *Facebook* and *Twitter* accounts
  - Hashtag: #GoMOSES
- Developed key message document specific to the Conference
- Determined Conference "hot topic" science sessions and pitched to media
- Provided a Press Info and Registration Table; quiet interview space available upon request

2. News Media Attendance

- 12 members of news media registered; outlets represented include The Times-Picayune, Washington Post, and Village Daily Sun

3. News coverage:

Searches through Meltwater returned over 200 examples of coverage before, during, and after the meeting with a total reach of 108.5M. The coverage includes stories in newspapers, magazines, and various Internet sites, including blogs & press-release aggregators. Note that there is some overlap between the Meltwater results and the Press Release results from PRNewsire. To date, total circulation (Meltwater + PRNewswire) for the event is 280,711,267.

Press Release 1: A Decade After Deepwater Horizon, the Gulf of Mexico Oil Spill & Ecosystem Science Conference Explores Future Directions of Marine Oil Spill Research

Posted Dec. 10, 2019 11:02 AM ET

Total pick up

135 Postings

4,729 Release Views and Hits

Total Potential Audience

84,033,989 visitors/day

74 Engagement Actions (e.g. click throughs)

Press Release 2: A Decade After Deepwater Horizon, the Gulf of Mexico Oil Spill & Ecosystem Science Conference Explores Future Directions of Marine Oil Spill Research

Posted Jan. 15, 2020 11:20 AM ET

Total pick up

146 Postings and Tweets

4,329 Release Views and Hits

Total Potential Audience

88,203,936 visitors/day

226 Engagement Actions

16,377 Twitter followers

Before Conference Article Totals (Meltwater)

PR1: 97 articles; 20,308,533 reach

PR2: 102 articles, 25,340,221 reach

Post/During Conference Articles (Meltwater)

University of South Florida & C-IMAGE Consortium Reveal Significant Takeaways from Deepwater Horizon

Mirage News 2/6/2020, circulation 220,000

Top 10: University of South Florida & C-IMAGE Consortium Reveal Significant Takeaways from Deepwater Horizon Oil Disaster Research During International Conference

USF News 2/5/2020

The toxic reach of Deepwater Horizon's oil spill was much larger — and deadlier — than previous estimates, a new study says

The Washington Post 2/12/2020, circulation 60,294,685

BP oil spill size may have been much larger, reaching Texas and Florida Keys, study says

The Times-Picayune | NOLA | The New Orleans Advocate 2/12/2020, circulation 1,685,903

BP's Deepwater Horizon oil spill may have been much larger than thought

The Anchorage Daily News 2/13/2020, circulation 624,000

Gary Finch Outdoors: 2020 marks 10 years since Deepwater Horizon Oil Spill

WKRG 2/15/2020

Total 6 articles with an estimated reach of 62,824,588 readers

2020
GoMOSES
Tampa, FL