About the Gulf of Mexico Research Initiative

The Gulf of Mexico Research Initiative is a 10-year, $500 million independent research program established by an agreement between BP and the Gulf of Mexico Alliance to study the effects of the Deepwater Horizon incident and the potential associated impact of this and similar incidents on the environment and public health.

Would you like to know more about the GoMRI-funded research?

Check out our Research page on the website:

http://research.gulfresearchinitiative.org/research-awards/

Upcoming Events:

GoMRI Webinar Series
June 18, 2014, 2 pm Central
Featured speaker: Dr. Jeff Chanton

Request for Proposals V Release
November 2014
For more info, see page 4

2015 Gulf of Mexico Oil Spill & Ecosystem Science Conference
February 16-19, 2015
Houston, TX

2014 Gulf of Mexico
Oil Spill & Ecosystem Science Conference

As we enter the fourth year of research following the Deepwater Horizon incident and associated investments focused on the Gulf of Mexico, the science community is now well-positioned to deliver integrated findings both within the scientific community and to stakeholder groups. With this in mind, "Collaboration, Integration and Synthesis" was the overarching goal for the second annual Gulf of Mexico Oil Spill & Ecosystem Science Conference. The sponsors of the conference share a goal to improve society's knowledge and understanding of the Gulf of Mexico ecosystem (of which humans are a part), in order to ensure its long-term environmental health. One important aspect of this is understanding the impacts of petroleum pollution and related stressors such as hypoxia on the marine and coastal ecosystems, as it will improve future response, mitigation, and restoration following spills. This ability to understand is challenged by the fact that the Gulf is a dynamic and complex system facing several issues, such as non-petroleum pollution, hypoxia, coastal development, erosion and inundation, and climate change. The goal of this conference was to engage and build a community of researchers working on all aspects of Gulf of Mexico ecosystem science and initiate dialogue with the users of that information.

The conference was planned and sponsored by a group of 10 partners representing academia, federal agencies, and non-governmental organizations. To accomplish the goals of "Collaboration, Integration and Synthesis," the 2014 conference facilitated
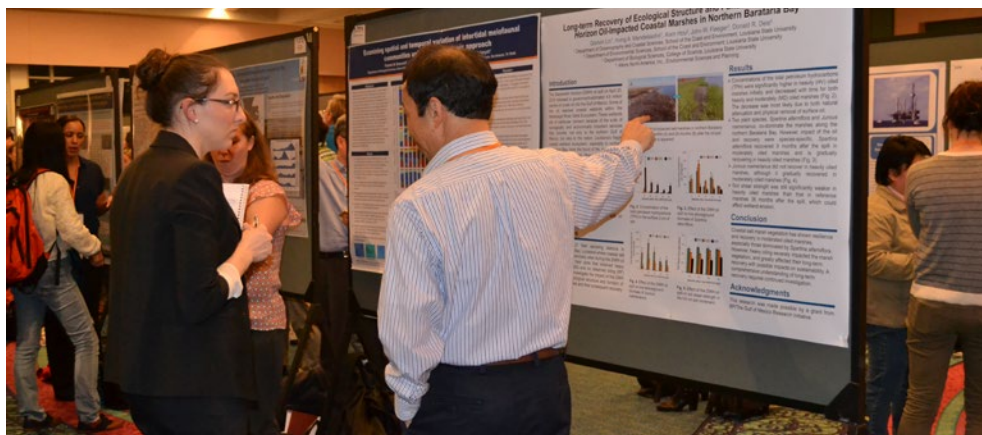
Gulf of Mexico researchers discuss research presented during a poster session.
(Image credit: Chris Kirby, GoMRI Management Team)

interdisciplinary discussion and promoted outcomes that require integration and synthesis across fields and themes.

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

The scientific sessions addressed the following integrative topics:

• Ecosystem assessment, vulnerability, and resilience: integrated cause and effect studies and trends across disciplines

• Ongoing science, technology, monitoring, and mitigation strategies with respect to the DWH oil spill response: What is needed to prepare for, support, and manage future hydrocarbon exploration and production in the Gulf of Mexico?

• Valuing ecosystem services and quantifying effects of oil spills on ecosystem services through environmental, public health, and socioeconomic science

• Promoting scientific literacy, perception, and expectations about oil spill research among stakeholders

And incorporated the following disciplinary themes:

• Understanding the dynamic physical processes of the Gulf of Mexico and related environment

• Understanding the chemistry of the Gulf of Mexico system and the evolution and interactions of pollutants introduced by humans in the coastal, open-ocean, and deep-water ecosystems

• Understanding the Gulf of Mexico ecosystem, including the sea floor, water column, coastal waters, beach sediments, wetlands, marshes, and organisms

• Technology developments for improved research and operations in the Gulf

• Understanding the impact of environmental health and function on socioeconomic conditions and public health

• Gulf of Mexico management and policy, including response, mitigation and restoration following environmental emergencies

• Education and outreach

Over 900 people registered for the 2014 conference, and of those, 675 participated in a talk or poster presentation. There was great student representation at the conference with 236 in attendance, and many of those sharing their work through talks or poster presentations. Just over 150 oral presentations were given, and 404 posters were submitted.

Geographically, thirteen countries (Netherlands, Norway, Mexico, United Kingdom, Canada, Spain, Taiwan,

Gambia, Australia, Germany, Japan, Ethiopia, and South Korea) and 37 states plus the District of Columbia (Alabama, Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Florida, Georgia, Hawaii, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Virginia, Washington, and Wisconsin) were represented at the conference.

Laura Bracken, CARTHE Outreach Manager, provides input during an education and outreach session, entitled Setting the Record Straight: Debunking Myths and Misconceptions about Oil in the Gulf and Promoting Ocean Literacy. (Image credit: Chris Kirby, GoMRI Management Team)

The gathering of almost 900 researchers in Mobile caught the attention of several media outlets! The following headlines are only a sampling of the coverage that the conference received.

Gulf of Mexico Conference discusses debunking myths and misconceptions, New Orleans Times Picayune

Mobile hosting conference on Gulf spill, Alabama Public Radio

Oil spill conference touches on Gulf fisheries and social toll in communities, AL.com

Ecological effects of oil spill dispersants among topics of academic conference, Lagniappe Mobile

Scientific spill studies, funded by BP, start to yield results, The Huffington Post

Several major themes were identified during the scientific sessions:

• Researchers are beginning to understand the acute and immediate consequences of the 2010 Deepwater Horizon oil spill. The long-term and chronic effects are much less understood and will require more attention.

• Cross-collaboration across disciplines is needed in many areas – among data managers, within the modeling community, and between the science and public health communities.

• Many conference goers highlighted the need for more ecosystem modeling. Researchers would like more metrics and more datasets for model evaluation.

• The Gulf Coast community welcomes research, but researchers need to ensure that they have the trust of the community. That will require that the community knows that researchers have a long-term commitment to understanding the problems and the Gulf Coast area.

• A continuing dialogue between the research community, agencies and industry about results is critical to federal agencies and critical to being prepared to participate and support research in the event of a further incident.

• More, different, and longer baseline information is still needed. Understanding the baseline is critical to understanding the changes in the Gulf of Mexico ecosystem (including the human population).

• New avenues for dispersant development are well underway and offer promising alternatives for using lower doses and coping with viscous crude oil. However, displacing existing dispersants in the marketplace faces challenges including government regulations, the need to work with many types of oil, cost, and questions about toxicity and biodegradation.

• The Gulf researchers have identified the importance of a Gulf observing system. There is an opportunity for it to happen if the science and monitoring communities work together, leverage resources and communicate information appropriately with funders and decision-makers. It will need to be given very high priority by the research community.

SAVE THE DATE! **February 16-19, 2015**
The Westin Galleria Hotel, Houston, TX

2015 Gulf of Mexico
Oil Spill & Ecosystem Science Conference

The deadline to submit a session proposal is June 15th
http://gulfofmexicoconference.org/

GoMRI Newsmakers

Congratulations to the following members of the GoMRI community!

Dr. Nancy Rabalais, Director of the GoMRI Coastal Waters Consortium, was recently conferred as an American Geophysical Union (AGU) Fellow. The Fellows program recognizes AGU members who have made exceptional contributions to Earth and space sciences as valued by their peers and vetted by section and focus group committees. Dr. Margaret Leinen, the newly-inaugurated AGU President and Vice Chair of the GoMRI Research Board, presided over the ceremony.

Dr. Margaret Leinen and Dr. Nancy Rabalais at the AGU Fellow Confirmation Ceremony.

The 2014 Clair C. Patterson Award, provided by the Geochemical Society, was recently awarded to Dr. Christopher Reddy in recognition of his contributions to environmental chemistry. A marine geochemist with the Woods Hole Oceanographic Institution (WHOI) and a co-Principal Investigator with the GoMRI-funded consortium Deepsea to Coast Connectivity in the Eastern Gulf of Mexico (Deep-C), Reddy studies the effects of environmental pollutants with emphasis on major oil spills. This award was created in honor of Clair C. Patterson who developed the method to calculate the age of Earth as 4.55 billion years old – a figure that remains the most accurate measurement to this day.

Dr. Christopher Reddy

The University of Miami was recently awarded two Outstanding Achievement awards, in the categories of Science/Technology and the Natural Environment/Green, by the *Interactive Media Council* for excellence in the design, development and implementation of the Consortium for Advanced Research on Transport of Hydrocarbon in the Environment (CARTHE) website. The *CARTHE website* was created through a collaboration between the UM Rosenstiel School, where CARTHE is based, and the UM School of Communications. The interactive website serves as a web portal devoted to information and science education for scientists, students, members of the press and the general public.

Request for Proposals (RFP) V will be released in mid-November

The GoMRI Request for Proposals for Individual Investigators or Small Collaborative Teams for 2016-2018 will be released in mid-November 2014. The purpose of the RFP is to select the research activities for GoMRI Years 6–8 (1 January 2016 – 31 December 2018) involving individual investigators or collaborative efforts comprising a principal investigator and up to three co-principal investigators. The total funds available for distribution through the 2016-2018 GoMRI Individual Investigators RFP will be approximately $9 million per year.

The 2016-2018 GoMRI Individual Investigators RFP will include the five GoMRI Research Themes. Proposals may address one theme only. Letters of intent will be required in mid-January 2015 to qualify for submission of a full proposal in response to the 2016-2018 GoMRI Individual Investigators RFP in June 2015. *For more details, please see the GoMRI website.*

Note from the Research Board Chair

Dr. Rita Colwell, University of Maryland and Johns Hopkins University

The GoMRI Research Board has recently adopted _four legacy goals_ to complement the _GoMRI mission_: The ultimate goal of the GoMRI will be to improve society's ability to understand, respond to, and mitigate the impacts of petroleum pollution and related stressors of the marine and coastal ecosystems, with an emphasis on conditions found in the Gulf of Mexico.

Specified in the first goal, and inherent in all four goals, is the advancement of science. The GoMRI Research Board selects the best, most qualified proposals and scientists through the well-established peer review process practiced by the National Science Foundation. As of December 2013, approximately 290 peer-reviewed articles, book chapters, and books have resulted from the GoMRI investment.

The second goal is effective outreach that will improve the understanding, confidence, and trust of the public in the scientific process, as well as inform science-based policy and management. For this purpose, Research Consortia develop and implement strategies to achieve public education and outreach objectives integrated with the Consortia's research. Overarching GoMRI-related outreach efforts, such as those implemented through partnerships with the Smithsonian Institution and the Gulf state Sea Grant programs, aim to reach broader audiences and complement the outreach activities of the Research Consortia.

The third goal aims to build intellectual capacity through advancing technology, fostering communication between GoMRI researchers and other scientists, and building and maintaining a long-term research database to ensure that all GoMRI data is available for research now and in the future. I consider the fourth area for building intellectual capacity to be extremely important - informing and training future scientists and engineers. GoMRI has clearly taken this responsibility seriously, as evidenced through its support of 633 graduate students and 148 postdocs across 192 instructions in 37 U.S. states and seven countries. The enthusiasm and dedication of these young professionals has been exemplified in the previous two Gulf of Mexico Oil Spill & Ecosystem Science Conferences, where many students and early career scientists presented posters and oral presentations.

The fourth legacy goal challenges the Research Board to demonstrate that the responsiveness of the GoMRI model is appropriate and effective in serving the public good by enabling and overseeing timely and independent research funded through a private-public partnership with industry.

The _GoMRI Research Board members_ are all extremely proud of the accomplishments to date as we enter the fourth year following the Deepwater Horizon incident.

GoMRI and SeaGrant Partner

In an effort to increase engagement with people who will directly benefit from oil spill research, GoMRI has partnered with the four Sea Grant college programs in the Gulf of Mexico. The key groups for this outreach project are those whose livelihoods depend on a healthy Gulf of Mexico or who are involved in the management of Gulf of Mexico coastal, marine, and human resources. Other professionals, such as environmental non-profit staff and university scientists, will also be impacted through this outreach program and will benefit from the large volume of new information produced as a result of GoMRI research. Specialists with the four Sea Grant college programs will translate and deliver findings from GoMRI research into useable products and information. They will also solicit input from the key groups, university scientists, and environmental non-profit staff. The input will be delivered to the GoMRI Research Board to be incorporated into future GoMRI actions.

Sea Grant has funded research, extension, outreach and education activities throughout the Gulf of Mexico for more than 40 years. The four Sea Grant college programs support about 100 extension and education professionals working in the areas of healthy coastal ecosystems, sustainable fisheries and aquaculture, resilient communities and economies, and environmental literacy and workforce development. The Sea Grant extension, outreach, communications, legal and education specialists have strong grassroots connections with coastal communities around the Gulf of Mexico. Four full-time Sea Grant specialists will exclusively focus on oil spill science outreach, and a part-time coordinator will support the GoMRI/Sea Grant outreach program.

Participants try to get a good look at bird species that call the marsh home during a boat tour of the salt marsh. (Image credit: Murt Conover, LUMCON and CWC)

Education Spotlight:

The Education & Outreach section of the *CWC website has resources* specifically for K-12 teachers and students, the public, undergraduate students, and education events, *including printable materials in Spanish*.

Deep-C led the first Project GOO (Gulf Oil Observers) field study. Project GOO is a citizen science initiative aimed at exposing high school students to scientific research as well as adding to researchers' understanding of the path of oil from the 2010 Deepwater Horizon oil spill. Marine science students from West Florida High School for Advanced Technology, alongside their mentors from Florida State University and Woods Hole Oceanographic Institution, combed beaches for oiled sand patties in the hope of adding to a growing database of such samples. The effort was a huge success, with more than 75 patties collected and cataloged. Watch the Video Clip of the Quarter to see Project GOO in action!

CWC scientists Dr. Sabrina Taylor and Dr. Phil Stouffer recently led field activities for the Gulf Lagniappe adult education workshop, where twenty intrepid bird enthusiasts ventured to LUMCON's DeFelice Marine Center. Participants learned about life on the edge as lived by Seaside Sparrows and how scientists are studying the population and lives of these amazing little marsh sentinels after the oil spill.

Video Clip of the Quarter

Project GOO (Gulf Oil Observers)

Check out this video from Project GOO (Gulf Oil Observers) - a citizen science initiative involving high school students, teachers, and other volunteers in the collection of oil samples and other data along the shores of the Gulf of Mexico!

www.youtube.com/watch?v=x6qCb4Srj6g

Keeping up with the Consortia Blogroll!

Several of the Consortia have been updating blogs. Check them out!

R/V Pelican Expedition: **ECOGIG**

Voices from the Field: **Deep-C**

A Day in the Life of a DROPPster: **DROPPS**

GoMRI Interview Questions
with Dr. Demetri Spyropoulos and Lexi Temkin

Using Embryonic Stem Cell Fate to Determine Potential Adverse Effects of Petroleum/Dispersant Exposure

1. Tell us a bit about your research. What are the goals of your project?

Our goals are to assess potential long-term, even multigenerational, effects of crude oil and dispersant (e.g. COREXIT) as they relate to disease development in humans. Our lab uses stem cells as a surrogate for fetal growth to assess potential downstream, life-long effects of in utero exposures. We are focusing on how exposure to crude oil fractions, COREXIT components and/or mixtures could impact obesity and a variety of common disorders (e.g. metabolic, cancer, inflammation/immunity, cardiovascular and neurological).

2. What is your background and how did you get involved with this kind of work?

Lexi: I'm currently a PhD candidate working with Demetri Spyropoulos at the Medical University of South Carolina. Before coming to MUSC I did my undergraduate degree in Biology and Dance at Connecticut College. After graduating college, I worked as a research technician studying DNA methylation at the Institute for Cancer Genetics at Columbia University, which is a way to measure environmental impacts on cellular activities. I've always been passionate about environmental health, personally and scientifically, so the Marine Biomedicine Program at MUSC and specifically Demetri's research on crude oil and COREXIT as potential endocrine disruptors was a natural fit for me. Demetri's background was in animal viruses (like the ones we use to make stem cells), developmental biology and stem/cancer cell research.

Alexis Temkin, PhD candidate at the Medical University of South Carolina, gets up close and personal during an alligator release trip. (Image credit: Jessica Cloy-McCoy, RFP-II: Using Embryonic Stem Cell Fate to Determine Potential Adverse Effects of Petroleum/Dispersant Exposure)

3. What are some of the most significant or exciting findings so far in your work?

Lexi: I think our most exciting results so far come from our work on engineered cells used as sensors for fat-inducing factors (so-called "ligand binding assays"). In these experiments we are looking for fractions of oil, COREXIT, or oil/COREXIT mixtures that activate molecular switches in circuits known to be responsible for regulating fat cell differentiation. Current results indicate that oil/COREXIT mixtures as well as COREXIT alone activate these receptors, potentially resulting in an obesogenic response (or promoting fat cell differentiation and obesity) due to exposure. We are now testing individual components of COREXIT to see if we can identify compounds that are responsible for receptor activation and one in particular has been identified (Manuscript in preparation). If we can identify the "toxic" component, this could potentially help guide dispersant development in the future by eliminating or substituting these harmful chemicals.

4. Can you tell us about what some of the broader implications of this work are, in terms of public health?

Demetri: In terms of public health, this work will have many implications. Firstly, we hope to be part of a fundamental change in the current school of thought: from one in which a toxic compound is something that kills you or subsets of cells in you in a relatively rapid fashion to one in which a toxic compound changes the way cells and tissues in the body behave, impacting overall immunological, neurological, cardiovascular, reproductive and/or cancer-free health. People often ignore warnings about risky lifestyle choices (e.g. smoking) but may be more responsive if they knew that these choices could hurt their children.

5. The impact of oil spills on public health is one of the five research themes that GoMRI has identified. In your opinion, what are some of the most important issues related to oil spills and public health? What are some of the research gaps in this area?

Lexi: I think the most important issues related to oil spills/dispersants and public health are seafood contamination and exposure assessments, especially regarding developing adequate methods for testing.

Demetri: We are just at the beginning of identifying components of oil/dispersant that may have long-term impacts on human health. Translating that into seafood contaminant and human exposure testing is a big step. We tend to think that a certain compound in oil or dispersant will accumulate in exposed individuals, with a certain concentration of it signifying a dangerous level. More likely, that compound will be metabolized in the body, affecting various processes, with persistent exposure leading to permanent changes in the body's processes. It's further complicated by the likelihood that the level at which that compound becomes dangerous is lower than we think, because of other compounds in the environment having additive effects. Before you feel too hopeless, we do have good clues to all of these, but as with any good detective novel, it will not be easy or straightforward.

6. Do you see areas in which public health and other scientific disciplines can integrate?

Lexi: Sure! There are certainly research gaps but I also think there is a communication gap between researchers, epidemiologists and the public. I think making sure the public understands research questions, the importance and reasoning behind them, as well as the impacts of the results, will greatly improve public health and general well being.

Demetri: On a practical level, individuals living in regions impacted by the Gulf oil spill should have regular physicals performed, including standard methods currently applied to blood and urine samples. Any trends in physical health or blood/urine chemistry indicating poorer health (relative to national and other regional statistics) should be of special interest. This would especially be useful in subsistence fishing communities where the link between potentially exposed seafood and humans is greatest.

7. As a member of the "GoMRI" community, what would you like to see this program accomplish over 10 years?

Lexi: I would really like to see more collaboration between industry, the medical community and academia. GoMRI is a unique group of scientists because the members and study questions cover a broad range of disciplines driven by different factors. It is evident that this collaboration is producing incredibly strong data sets. Hopefully the sense of community, support, and collaboration will continue longer after the funding runs out.

8. If funding were not an issue, what would you add to your project?

Lexi: Ideally I would want to recreate the oil spill in a contained micro environment simulating the Gulf of Mexico. This way you could expose a variety of organisms, particularly commercial fish and prey species, to oil and COREXIT over an extended period of time. I would then do extensive analysis on the fish to determine exposure levels for a multitude of compounds marking oil and COREXIT exposure. These fish could also be used for reproductive studies to determine the effects on the next generation.

Demetri: Point blank range, we would "go big" on what we are doing right now: we would combine our current studies on obesogen identification and stem cell differentiation to look at all components of COREXIT and a wide array of crude oil components. Working with dispersants, we would replace obesogenic components of COREXIT with new dispersants/solvents that are currently being produced by GoMRI researchers to test the safety of these new agents. On the crude oil side, molecules found to be obesogenic could then potentially be targeted for breakdown or inactivation. We would expand from working only with obesogens to working with other hormone disruptors, especially including pollutants commonly found in the Gulf (e.g. herbicides/pesticides). This information could then be used in modified toxicological testing to identify "safer" dispersants and safer crude oil and oil products.

Other avenues we might consider are tests from the stem cells of different organisms (e.g. human, marine mammal, shore birds, estuarine alligators, seafood, etc.) with different exposure histories, which might tell us if (and why) a species is particularly sensitive or resistant to the obesogens and thereby used to follow or even alter the rise and fall of species. With substantial funds we could also test over several generations to assess the long-term health impacts on one organism (e.g. reproductive development/fertility, disease, cancer, longevity, etc.), but also impacts on offspring several generations out. We've also been looking at ways to by-pass the use of animal species for these studies, which is more ethical and could speed up how quickly we improve our understanding.

9. What are your future hopes?

The work discussed may serve as one of several foundations for making us better stewards of the planet – working at the interface between product development and human health, which ultimately relies on proper environmental/ecosystem management.

To learn more about this project, *click here*.

Florida Oceans Day

Three GoMRI Consortia, C-IMAGE, Deep-C, and CARTHE, joined together for the 14th annual Florida Oceans Day on April 9, 2014. Held in Tallahassee at the Florida Capitol, Florida Oceans Day joins legislators with scientists and researchers to promote awareness and stewardship of the state's ocean resources. This year's theme, "Tomorrow's Ocean Workforce," highlighted the contributions of the ocean and coastal economy for job creation in the Sunshine State. Representatives from C-IMAGE, Deep-C, and CARTHE helped call attention to the need for healthy oceans and coasts and build support for scientific research in the Gulf of Mexico by explaining GoMRI and their Consortia to political staffers, researchers, NGOs, and visitors to the Capitol.

Below: Representatives from C-IMAGE, Deep-C, and CARTHE speak with participants in this year's Florida Oceans Day. (Image credit: Laura Bracken, CARTHE, and Tracy Ippolito, Deep-C)

Science Corner
Published science highlights from the GoMRI program

Study Confirms Methane-Eating Bacteria Contributed to Carbon Entering Food Web
J. Cherrier, J. Sarkodee-Adoo, T. P. Guilderson, and J. P. Chanton
Environmental Science & Technology Letters, 2014, 1, 108-112

Study Reveals Recovery and Loss in Oiled Louisiana Marshes
Brian R. Silliman, Johan van de Koppel, Michael W. McCoy, et al.
Proceedings of the National Academy of Sciences, 2012, 109 (28), 11234–11239

Modeling Study Adds Evidence that Oil Compounds Traveled to West Florida Shelf
Robert H. Weisberg, Lianyuan Zheng, Yonggang Liu, et al.
Deep Sea Research Part II: Topical Studies in Oceanography, 2014, In Press

Study Indicates "Memory" of Benzene Remains in Marsh Sediment and Affects Its Future Degradation
Jiou Yu, Rui Tao, and Kewei Yu
Ecological Engineering, 2012, 40, 6-10

Study Demonstrates Substantial Role of Mississippi River in Oil Transport
Vassiliki H. Kourafalou* and Yannis S. Androulidakis
Journal of Geophysical Research: Oceans, 2013, 118 (8), 3823-3842

To see all GoMRI publications, please visit the GoMRI Publication Database.

Frequently Asked Questions by Dr. Chuck Wilson

Dr. Chuck Wilson, Chief Scientific Officer for the Gulf of Mexico Research Initiative (GoMRI), answers a few of the most frequently asked questions about the program.

Question: Why is numerical modeling important to GoMRI?

Answer: Numerical (computer) modeling is a powerful tool in the sciences that can be used to address many of society's needs. For example, numerical models can be used to forecast the weather, hurricane direction, strength and impact at landfall, stock market trends, and even the likelihood of individual credit card risk. Following the Deepwater Horizon oil spill, models were used to predict the direction of released oil movement at the surface and under the water and understand how the oil/gas mixture would behave after entering the marine environment from the wellhead. NOAA and the Coast Guard are responsible for the maintenance of the operational ocean and atmospheric forecast models used in the event of an oil spill and they often incorporate high resolution Navy models. Many of the Consortia currently funded by GoMRI include modeling research components. The overarching goal for all of these modeling efforts is to better forecast how oil will behave following an accidental release. GoMRI scientists are improving modeling efforts on all scales and these results will have application across a number of different disciplines.

Question: What kind of modeling work is being done through GoMRI?

Answer: Micro-scale modeling can predict how small oil droplets will behave in the presence and absence of dispersants and at different pressure and temperature. Important modeling parameters at the micro-scale level involve shear forces (friction between the oil droplet and surrounding water molecules), buoyancy and density, which affect turbulent motions. C-Meds and DROPPS are involved in micro-scale modeling.

Sub-mesoscale modeling can predict how small scale structures (eddies, filaments) form at the ocean surface or in the deep near a wellhead. As the warmer, more buoyant oil rises to the surface, it mixes with the surrounding water and its motion is influenced by larger scale currents driven by density differences. The mixing efficiency will depend on the amount of dispersant present in the water column. C-IMAGE, CARTHE, DEEP-C, and GISR are involved in modeling sub-mesoscale processes to help scientists estimate how fast the oil gets to the surface, the size of the oil droplets and how mid-water depth plumes form, move, and dissipate.

Mesoscale and basin-scale modeling can predict chemical and biological transport at the surface and at depth across large bodies of water (bays, lakes, and oceans). Important parameters involved in large scale modeling research include rotation and driving forces such as atmospheric fields (winds, temperature, pressure, and precipitation), solar radiation, and tides. Modeling accuracy at these scales relies on the ability of the models to represent the above-mentioned sub-mesoscale processes. Gulf of Mexico-specific models such as NCOM and HYCOM are standard oceanographic models used to predict water movement in the Gulf of Mexico. These models were used during the Deepwater Horizon oil spill to predict the direction that oil would flow once it reached the surface, as well as where mid-depth plumes might have gone. DEEP-C, CARTHE, CWC, and GISR are involved in mesoscale and basin-scale modeling research.

Ecosystem modeling can predict how physicochemical and biological elements in an ecosystem interact and impact one another. Several GoMRI Consortia conduct ecosystem modeling to determine how an oil spill might affect things such as fish behavior or marsh grass recovery times. Ecosystem models tend to be extremely complex, integrating both physical and biological research results across spatial and temporal scales. C-IMAGE, DEEP-C, and CWC are involved in ecosystem modeling.

Question: How does modeling research help?

Answer: The ultimate goal for modeling research is to help scientists and the public better understand and predict how man and nature interact with and affect an ecosystem. In the event of another oil spill, or other anthropogenic or natural event, improvements of models on all scales and their integration into ecosystem models will enable scientists to more accurately anticipate what will happen and better improve our preparedness and responsiveness.