



2014
Northern Gulf Institute
Annual Report

MISSISSIPPI STATE
UNIVERSITY



NGI

NORTHERN GULF INSTITUTE
a NOAA cooperative institute



Academic Members



The Northern Gulf Institute (NGI) is a National Oceanic and Atmospheric Administration (NOAA) Cooperative Institute, a partnership of five complementary academic institutions and NOAA addressing important national strategic research and education goals. Mississippi State University leads this collaboration, partnering with the University of Southern Mississippi, Louisiana State University, Florida State University, Alabama's Dauphin Island Sea Lab, and NOAA scientists at various laboratories and operational centers in the northern Gulf of Mexico region.

NGI develops, operates, and maintains an increasingly integrated research and transition program, the results of which raise awareness and understanding of the Gulf region. NGI was recognized by the NOAA Cooperative Institute Science Review Panel in October 2009 for its significant efforts to address important questions related to the NOAA Strategic Goals. NGI has been recognized as critical and well positioned to provide baseline, current, and future science and outreach needs to the region. The necessity of such a role for NGI is acutely demonstrated by northern Gulf of Mexico catastrophes like Hurricane Katrina and the Deepwater Horizon incident.

Four Research Themes

Ecosystem Management
Geospatial Data Integration and Visualization
Coastal Hazards
Climate Effects on Regional Ecosystems

Mission

NGI conducts high-impact research and education programs in the Northern Gulf of Mexico region focused on integration – integration of the land-coast-ocean-atmosphere continuum; integration of research to operations; and integration of individual organizational strengths into a holistic program. The program shall measurably contribute to the recovery and future health, safety, resilience and productivity of the region, through sustained research and applications in a geospatial and ecosystem context.

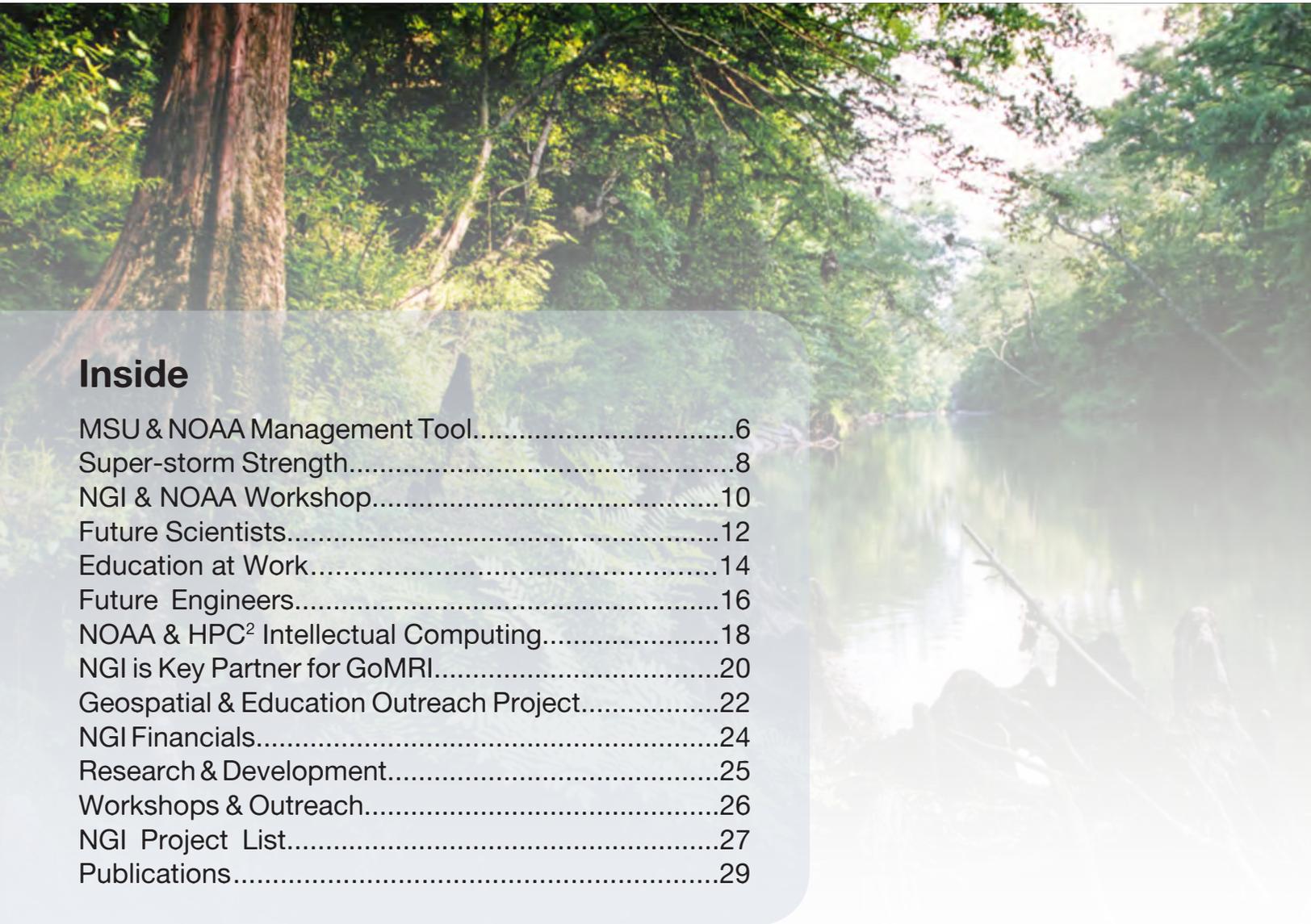
Vision

NGI will be a regional leader providing integrative research and education to improve the resiliency and conservation of the Northern Gulf of Mexico.

Infrastructure and Organization

The NGI Program Office’s strategic location at the John C. Stennis Space Center facilitates close interactions with multiple NOAA activities and key stakeholder groups including the NOAA Gulf of Mexico Regional Collaboration Team, regional Sea Grant programs, and the Gulf of Mexico Alliance. The Mississippi State University Science and Technology Center at Stennis Space Center, which houses NGI and NOAA activities, provides NGI with the foundation and the building blocks to maintain and grow its role in the northern Gulf of Mexico in the areas of environmental research and education.

NGI increased its international engagement in the Gulf of Mexico with a Memorandum of Agreement with the Consorcio de Instituciones de Investigación Marina del Golfo de México (CiiMar-GoM). Additionally, NGI and the Harte Research Institute signed a Letter of Intent in support of research being conducted by CiiMar-GoM to evaluate ecosystem response to coastal management activities in Mexico.



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Setting the Standard for NGI Research

Three councils help guide NGI research. The NGI Council of Fellows serves as a board of director's with representation from NOAA and the five university partners. The NGI Executive Council provides high level strategic guidance with representatives of several line offices within NOAA. Important stakeholders are represented on the NGI Advisory Council.

The NGI Council members represent:

- NOAA Office of Ocean and Atmospheric Research
 - Atlantic Oceanographic and Meteorological Laboratory
 - Office of Ocean Exploration and Research
- NOAA Weather Service
 - Lower Mississippi River Forecast Center
 - National Data Buoy Center
 - Southern Region Headquarters
- NOAA National Ocean Services
 - Office of Ocean and Coastal Resource Management
 - Gulf Coast Services Center
- NOAA National Marine Fisheries Services
 - Southeast Fisheries Science Center
- NOAA National Environmental Science, Data, Information Services
 - Coastal Data Development Center
 - Center for Satellite Applications and Research
- NOAA Office of Education and Sustainable Development
- EPA Gulf of Mexico Program
- NASA Stennis Space Center
- National Park Service Gulf Coast Network
- The Nature Conservancy
- USDA National Sedimentation Lab
- USGS Gulf Coast and Lower Mississippi Valley
- U.S. Army Corps of Engineers
- MS Department of Marine Resources
- Grand Bay National Estuarine Research Reserve
- Gulf of Mexico Research Initiative
- Florida Sea Grant College Program
- MS-AL Sea Grant Consortium
- Louisiana Sea Grant





MSU and NOAA Design Next Generation Management Tool to Evaluate Ocean Health

NOAA's next generation tool for ocean and coastal management design is getting an upgrade with the help of ongoing studies conducted by NGI scientists. Steve Ashby, NGI associate director, manages the team that is carrying out research at four sites in the Northern Gulf of Mexico; they include Perdido Bay, Florida; Mississippi Sound, Mississippi; Barataria Basin, Louisiana; and Galveston Bay, Texas.

The Integrated Ecosystem Assessment (IEA) tool was implemented as part of an overall Ecosystem Approach to Management (EAM). It looks at all the indicators, such as tourism and recreation, climate change, fish populations, and conservation and energy demands to evaluate ocean health. In the past, scientists, because of the limits of scientific knowledge and technology could only concentrate on individual segments and species of the ocean. This EAM approach using the IEA management assessment tool allows them to combine data and look at the ocean as a whole.

“We’re using what we call a Drivers-Pressures-States-Impact-Response (DPSIR) framework to evaluate the ecosystem assessment process and to set management goals,” said Ashby. “We really haven’t had a good system that combines and compares all the indicators that allows us to look at and ask, ‘Are we going in a positive direction, and how do we find the balance between sustainable healthy uses and a sustainable healthy ecosystem when it comes to ocean health?’ This tool will enable us to do that.”



Photo courtesy of Margaret Henderson



All of us have enjoyed a magnitude of bounty from the sea. Rewards such as a variety of seafood, opportunities for recreation, and avenues for transportation and commerce are just a few of the many ways we depend on our oceans. IEA will help managers make decisions on how to best protect resources on a local scale and the implications of those conclusions when considering the broader regional and global context of ocean health.

“This is a great opportunity for policy makers to get a better snapshot of our ecosystem,” explained Ashby. “Our next step is to more fully explore the ecosystem services at the Northern Gulf’s four sites and ‘translate’ them into measurements of human well-being.”

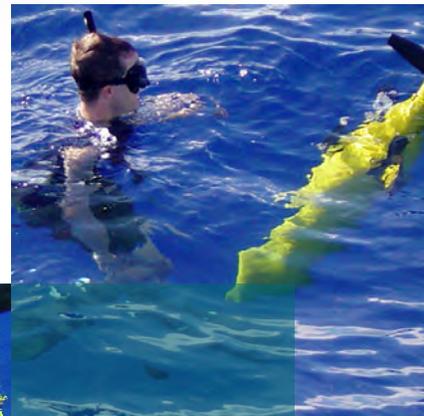




Research that Hopes to Solve the Secret of Super-storm Strength

Why some storms spin up with deadly force and others putter along, or even weaken, remains something of a scientific mystery. And so researchers who study the atmosphere have made this problem a top priority. It is true that computer models do help meteorologists to accurately predict a storm's path. Yet, atmospheric scientists like NGI's Pat Fitzpatrick and Hyun-Sook Kim, who works for NOAA's National Weather Service modeling and observing integration branch, will tell you that forecasting storm intensity remains an elusive challenge to the world's top minds. Their optimism in determining a hurricane's force wanes because there is little new skill in forecasting a change in storm intensity. Mother Nature's constant changes in wind speed, shear, and direction, along with differences in water temperature make it tough to predict what makes hurricanes rev up.

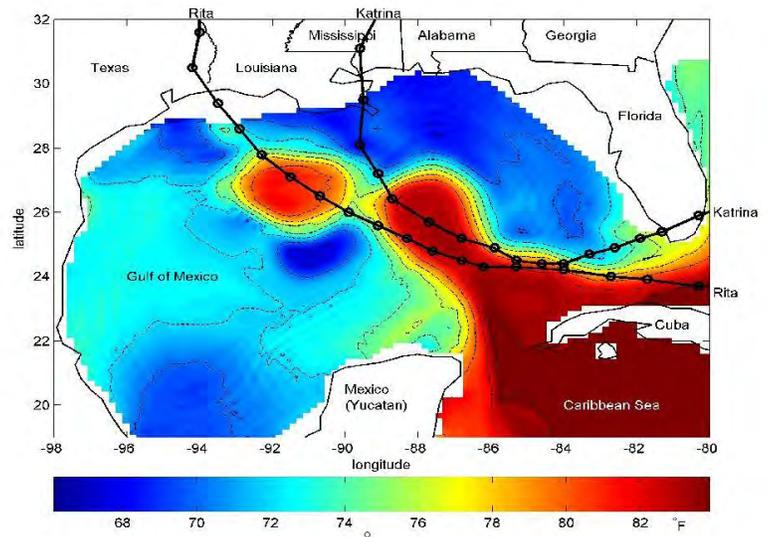
"A significant constraint is the lack of knowledge about the air-sea interaction and ocean mixing, which cools the water, complicated by the lack of ocean data in the dangerous hurricane environment. Ocean heat and moisture fluxes drive hurricanes, so making sure the water temperature is accurate is a critical element for research," Fitzpatrick explained.



Fitzpatrick and Kim are comparing and validating data from two unique components. The first sets of information come from state-of-the-art ocean models coupled to one of NOAA's hurricane models. The second is data collected from a special field program implemented during Hurricane Isaac.

“The methodologies for representing ocean data initialization, as well as the ocean physics algorithms, are handled differently in both models,” said Fitzpatrick. He further clarified what he believes will enhance this technique. “The validation effort is showing different types of biases, and different responses to ocean mixing. We will perform sensitivity tests to understand these errors better and propose methods to improve the equations.”

Experts express that the most worrisome scenario is not anticipating rapid intensification near land-fall, and the threat of storm surge. With 100 million Americans living within 50 miles of a coastline, NOAA is concerned because death tolls in coastal regions can be terrible for those who do not evacuate inundation zones. It's the main driver to solve this hurricane scientific mystery sooner rather than later.



Dotted lines represent buoy tracks as they went over warm pools of water during Hurricane Katrina and Rita. Fitzpatrick found that both storms weakened from category 5 to category 3 after leaving these warm pools. Graphic courtesy of NOAA's GFDL.



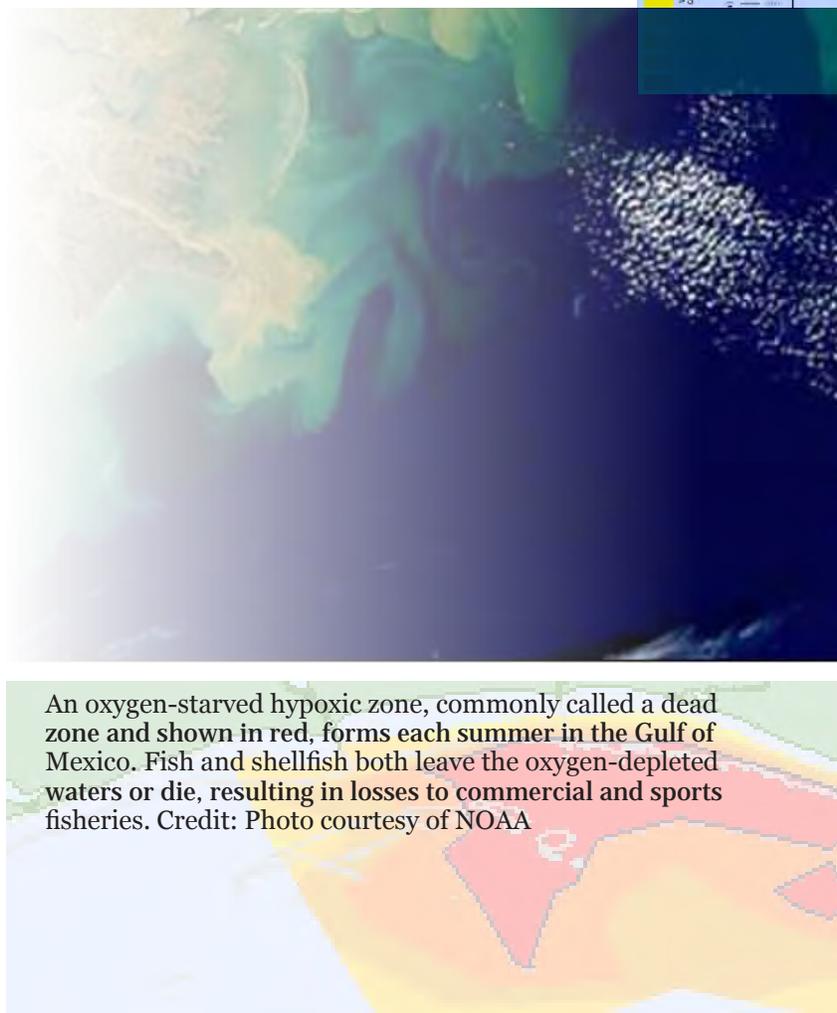
NGI and NOAA Workshop Probe Science's Top Minds



The deployment of sensors to measure currents, temperature, depth, and dissolved oxygen concentrations.

NGI and NOAA are conducting annual workshops to attract top scientists from around the world to solve a global issue—hypoxia in aquatic systems. It is a low oxygen condition—below 2 mg/L—created when nitrates from farm fertilizer and manure mixed with sewage and runoff from suburban lawns, flow 800 miles down the Mississippi River to the Gulf of Mexico. It is here that this potent blend feeds algae that bloom, die and decompose, robbing the Gulf's waters of oxygen and creating a dead zone each summer. The Gulf of Mexico's increasingly severe dead zone is one of the world's largest and the biggest one that affects a U.S. fishery. It forms in the late spring and summer and typically covers around 6,000 square miles, and in some, around 8,000 square miles - roughly the size of New Jersey.

Steve Ashby, NGI co-director explained that, "Most organisms avoid, or become physiologically stressed, in waters with oxygen below this concentration. The dead zone kills marine organisms which cannot escape the low-oxygen water, affecting commercial harvests and the health of impacted ecosystems."



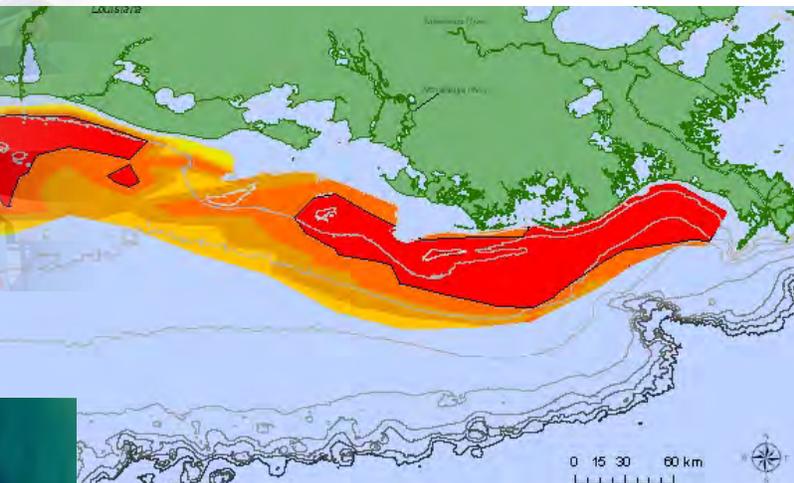
An oxygen-starved hypoxic zone, commonly called a dead zone and shown in red, forms each summer in the Gulf of Mexico. Fish and shellfish both leave the oxygen-depleted waters or die, resulting in losses to commercial and sports fisheries. Credit: Photo courtesy of NOAA

Since the dead zone's discovery four decades ago, the federal government has spent millions of dollars to study its origins and reduce its impact, yet the flow of nitrates into the Gulf has not decreased — along with the average size of the dead zone. For the past five years NGI and NOAA have conducted workshops to figure out how to monitor and mitigate the problem.

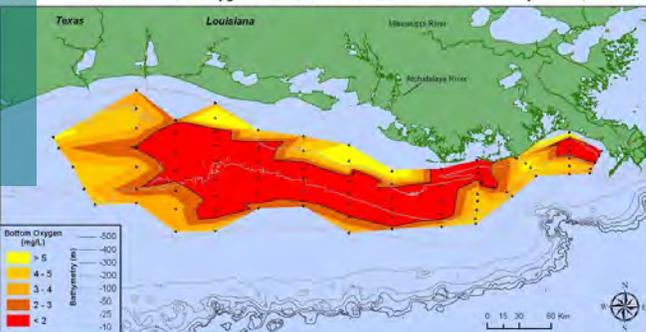
“The workshop provides a forum to share monitoring and modeling output data, and coordinate Gulf hypoxic zone research that help to inform and refine management plans,” Ashby said. “We assess the management practices to mitigate hypoxia to create best practices that inter-agencies like the Gulf of Mexico Hypoxia Task Force and the Gulf of Mexico Alliance can implement into effective control and eradication strategies.”

In addition to hypoxia, another issue discussed at the latest (2014) NGI/NOAA workshop was the application of ecosystem modeling to assess impacts of Mississippi River diversions on fisheries. Ecological and socio-economic impacts of diversions and hypoxia are critical aspects of planned restoration activities that require detailed investigations and stakeholder interactions. For instance, the combined effects of diversions and hypoxia may affect brown shrimp distribution. In turn, this may influence shrimpers' boat fuel and labor costs. Diversions may help mitigate hypoxia or make the problem worse, so research is critically needed to help managers determine whether their restoration practices are beneficial to fisheries or are in need of corrective measures.

A technical paper is being developed, based on the 2014 conference proceedings, and titled “Ecosystem Modeling Adaptive Management Framework” for advancing ecosystem modeling of hypoxia and diversion effects on fisheries in the northern Gulf of Mexico. The paper should be a valuable resource to help guide ecosystem restoration strategies of state and federal managers.



Bottom-water dissolved oxygen across the Louisiana shelf from July 22-28, 2013



Data source: N.N. Rabalais, Louisiana Universities Marine Consortium, R.E. Turner, Louisiana State University
 Funded by: NOAA, Center for Sponsored Coastal Ocean Research

Future Scientists Discover How Research Impacts Society

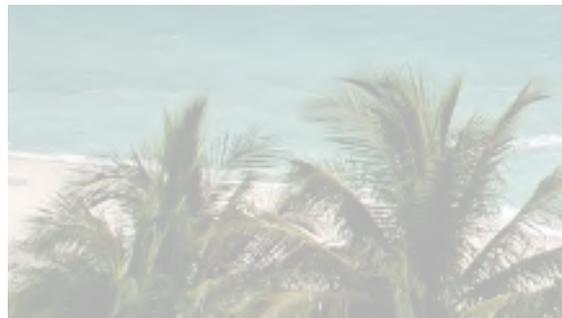


NGI and NOAA's National Data Buoy Center (NDBC), located at the John C. Stennis Space Center created a partnership to help the next generation of atmospheric scientists transfer classroom knowledge into real-world research experiences. In this case, an undergraduate and graduate student assisted scientists in reading data collected from weather buoys world-wide.

The future and veteran researchers examined measurements of wind speed and direction, air temperature, rainfall, and ocean temperature to assess conditions in the ocean that help forecast weather. The NDBC researchers and students were trying to develop an innovative way to analyze and compare data from different wind speed and direction methods to determine if the data could be combined to enhance atmospheric calculations and procedures that ultimately would improve weather forecasts.

"Ultimately we're taking the student experience beyond the classroom walls and using our teaching, research and service to address the next generation's ability to give more accurate weather forecasts," explained, Steve Ashby, NGI's co-director. "It's important that students recognize how the research we do as scientists transfer into treatments, products, or practices that have a real societal impact."

The practical application lead former graduate student Sathishkumar (Sathish) Samiappan to partner with NOAA scientists Raymond Beets, Karen Grissom and Dawn Petraitis to author a paper titled, "Improvements to the TAO web-based Data Management System" that they presented at NOAA's 38th Climate Diagnostics and Prediction workshop. This learning milestone gave Samiappan access to a professional network that connected him to a job offer after earning his Ph.D.





Samiappan, a post doctorate at the GeoSystems Research Institute at Mississippi State University, is now conducting research using data collected by unmanned aerial systems. “At research intensive organizations like the NDBC, interns gain clarity on their interests, strengths and weakness. This internship helped me gain professional confidence and to expand my professional network of references. All of which helped me qualify for and land the research job I have now.”

Veteran NOAA researchers and student interns agree that educational outreach experiences like this one are important because students are able to do more than read about the more exciting aspects of science; it gives them a preview of activities that prepares them for the world and careers they will enter.

“It’s important that students recognize how the research we do as scientists transfer into treatments, products, or practices that have a real societal impact,” said Steve Ashby, NGI co-director.

Education at Work: The NCI-NOAA Diversity Internship Program



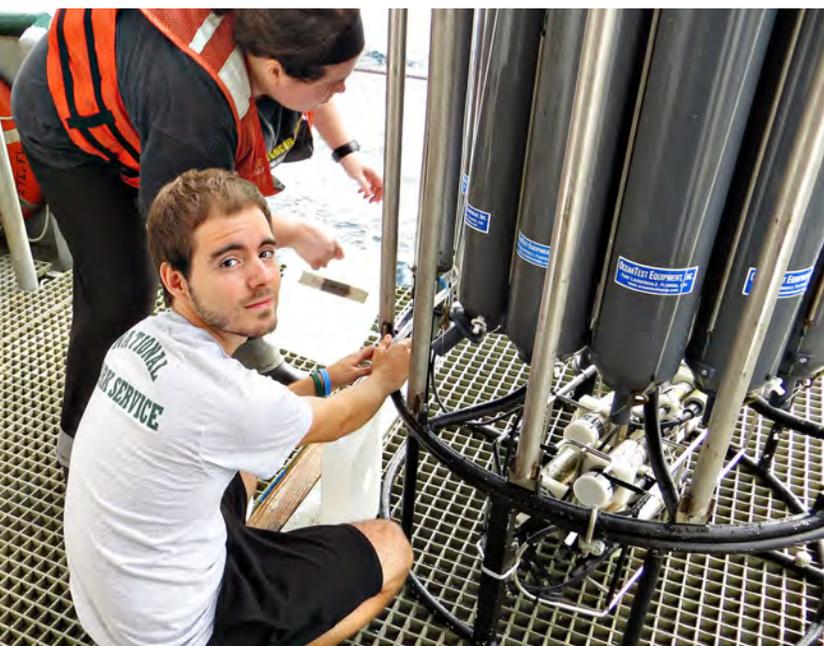
Experts say that one of the reverberating challenges facing businesses today is finding employees who are “workforce” ready. To answer the science, technology engineering and math (STEM) profession’s appeal for help to find more qualified professionals, NOAA and NCI collaborated to create the Diversity Internship Program. Since its inception in 2008, the NOAA-NCI DIP has provided workforce experiences for 64 higher education students. In 2014 eight students completed the program.

While meeting the definition of diversity in many respects, including the typical categories of ethnic/racial composition, internship discipline, education level, home institution, and host institution, Tina Miller-Way, the programs director said, “The program’s unifying characteristic is a research or work-effort focus on the Gulf of Mexico. Through their projects, interns contribute to our understand-



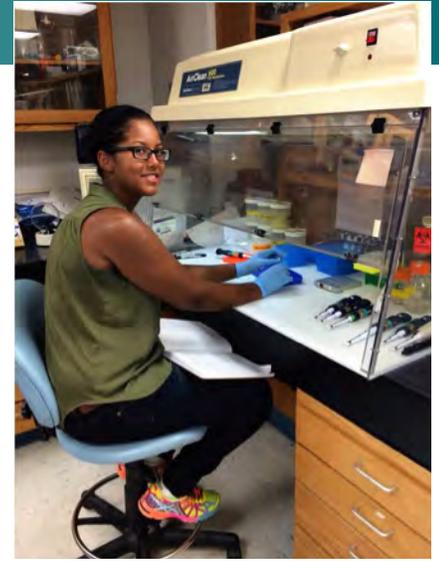
ing of the Gulf of Mexico, but also come to understand how important the Gulf of Mexico is to the nation.”

Student program evaluations have shown that DIP internships increased awareness of career opportunities at federal facilities and raised confidence levels when using data skills, including data management. Internships also give students critical on-the-job-training and access to a network of STEM professionals so they can pursue their academic interests. Intern project results have been included at professional meetings and in peer-reviewed journal publications.



“These internships represent an investment of time and energy by the mentor that is paid back two-fold with increased productivity and intellectual collaboration, as well as knowing they have invested in the next generation of scientists,” Miller-Way explained.

The growing need for STEM professionals combined with the decrease in available jobs at traditional research institutions make programs that increase awareness and provide skill development increasingly critical. These next generation of scientists also need to learn how to bridge the communication gap by informing the public of how the interconnectedness of their research data affects the Gulf of Mexico’s health and Gulf coast residents’ quality of life. Everyone needs to understand science at some level so they can appreciate the alternatives and consequences of policy choices.



Future Engineers Protect NOAA's Drifting Data



Its job is critical because it provides data that allows scientists to give hours of advance notice to affected populations that a tsunami, hurricane or tropical storm is headed their way. The difference between warning time and when a storm hits is often the difference between life and death. Yet, the life of a weather data buoy is not one to be admired; nor is it appreciated. It is usually subject to human acts of vandalism; marine wildlife rest on it; it is often demolished in shipwrecks; fishermen accidentally entangle lines around it, and then there is the meek survival rate of enduring Mother Nature's storms at sea. So, it is no small feat for NOAA's National Data Buoy Center to protect weather data buoys from damage. NDBC's Buoy maintenance and upgrades cost an estimated \$10 million a year, so preserving them becomes a priority not only motivated by money, but these buoys are a vital part of the National Weather Service's observation systems, providing wind speed and direction, wave height, pressure changes and other key data about marine conditions.

If a buoy's job is critical, then NGI researcher, Jane Moorhead's work of analyzing the electronic equipment aboard the floatation device is crucial and a little demanding—electrical devices and water, especially salt water are usually not a favorable mix. In addition, she wanted her electrical engineering students to participate in the analysis of a way to protect weather anemometers. The opportunity for students to experience a real-world application not only could help the NDBC save thousands of dollars in prolonging the life of electrical equipment aboard buoys, but give the students direct insight into how to apply the theories taught in the classroom.

“It is kind of difficult to keep buoys alive and the electrical equipment they have on board dry and in top working condition; so yes, it is a challenge in normal conditions to gather data to test, yet my job was to test data acquired from NDBC's modems, transmitters, antennae, and anemometers gathered during hurricane Isaac, Moorhead explained. “NDBC engineers wanted to investigate the possibility of interference to the GPS signal due to a PVC cover on the GPS antenna on weather buoy applications. In the classroom, students normally only work with theoretical data.”

To prevent the leaking, NDBC designed a cover for the antenna that completely sealed the RF connection from the environment—using electrical tape and schedule grey PVC



“NDBC engineers wanted to investigate the possibility of interference to the GPS signal due to a PVC cover on the GPS antenna on weather buoy applications. In the classroom, students normally only work with theoretical data.”

with the cover bolted with three stainless steel bolts. Due to the extremely small signal strength from the GPS satellites, there was concern that the PVC cover might be attenuating the signal causing intermittent signal outages, or causing destructive interference to the GPS signals.

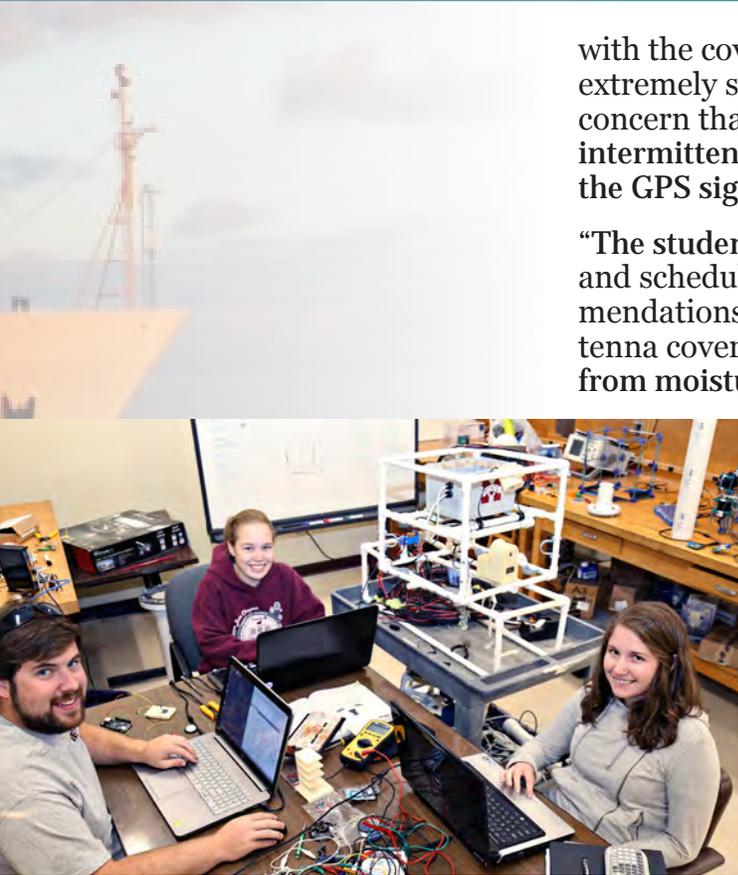
“The students discovered that the combination of electrical tape and schedule grey PVC worked beautifully. My classroom recommendations from the analysis were to continue using the GPS antenna covers as they provide good protection to the RF connections from moisture invasion, and do not appear to have a major impact on GPS signal strength,” Moorhead said. “The advantages of using the PVC cover outweighed the minimal signal differences. Since there was a possibility of RF interference due to the stainless steel bolts used to hold the PVC cover in place, we made the suggestion to use a more RF transparent material.”

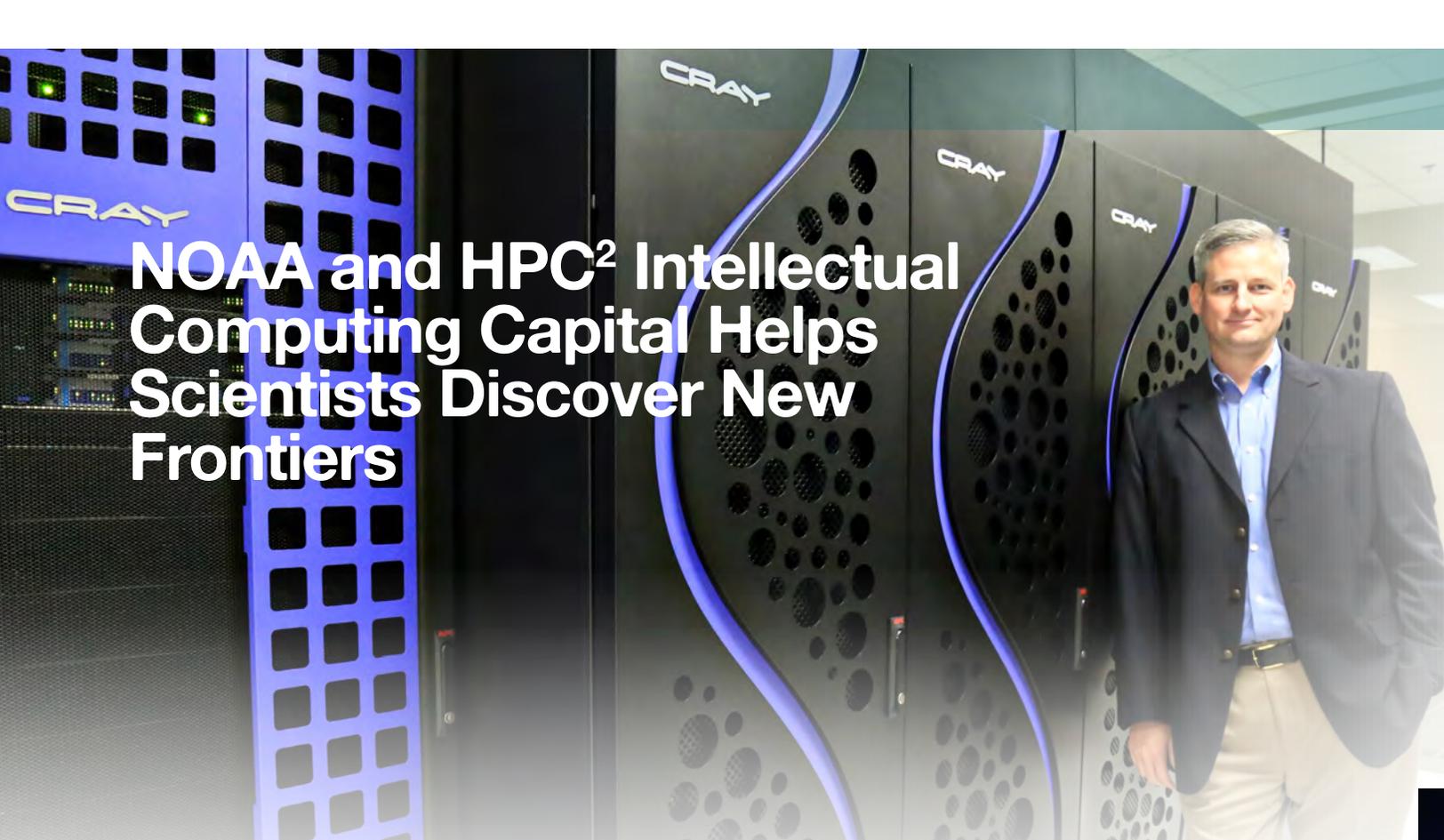
NDBC researchers were elated to gather this data in hurricane conditions, because to have the buoy in the right place at the right time and to have the luck of it to survive and to transmit data is pretty incredible. It is rare that buoys survive fierce hurricanes. In this situation, they not only saved money, but trained future engineers.

“Our last set of data involved testing the operation of an older propeller anemometer’s detection of wind speed against an upgrade called a sonic anemometer’s ability to detect wind speed,” Moorhead noted. “Although the differences were greater for the wind direction than for the wind speed, the sonic anemometer provided comparable results. As equipment is updated to the sonic anemometer, our recommendation is that users can expect the same high quality that was being achieved with the propeller anemometer.”

Assessing the power and the likely path of tropical storms and hurricanes is not an easy task, but it is imperative that the electronic hardware aboard buoys survive the soaking of 30-plus foot waves. Scientists rely on that information to give the most accurate forecast and use it to warn and keep mariners and residents who live close to the Gulf of Mexico out of harm’s way.

“I’m proud of the fact that my students realize that using low cost items for a high-tech solution of gathering storm system data is beneficial. They proved that their investment of creativity and common sense combined with the use of everyday hardware materials is one that pays many dividends.”





NOAA and HPC² Intellectual Computing Capital Helps Scientists Discover New Frontiers

NOAA scientists and NGI explorers are blazing a path that others can follow. Since 2012, the Okeanos Explorer has been sharing secrets of the sea live via two way high-definition video and audio. The Exploration Command Center is based at the Mississippi State University Science and Technology Center located at the John C. Stennis Space Center. MSU's High Performance Computing Collaboratory (HPC²) and NOAA's Coastal Data Development Center's technological collaboration has enabled engineers aboard research vessels in the Gulf of Mexico to communicate live with scientists on shore. Since the ECC went live two years ago, the Okeanos Explorer has shared high-definition video and audio of six expeditions.

Trey Breckenridge, director of high performance computing for MSU, and the lead for the Stennis Exploration Command Center project, designed and built an avant-garde, telepresence Exploration Command Center that uses satellite and Internet2 network technologies to transmit high definition video from the NOAA ship Okeanos Explorer to scientists ashore. The ECC technology allows scientists, students and Stennis visitors who are on shore to participate in the ship's exploration expedition in real time.

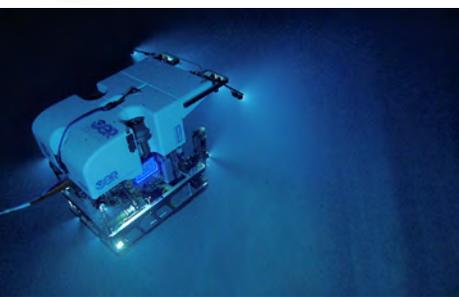
"The Exploration Command Center provides shore-side locations where researchers can gather, access data and share expertise with shipboard scientist colleagues, in real-time, to provide shared analysis and mission guidance," Breckenridge explained.



NOAA Ship *Okeanos Explorer*, "America's Ship for Ocean Exploration," is the only federally funded U.S. ship assigned to systematically explore our largely unknown ocean for the purpose of discovery and the advancement of knowledge. Telepresence, using real-time broadband satellite communications, connects the ship and its discoveries live with audiences ashore. Image courtesy of NOAA Office of Ocean Exploration and Research.



Benthic cnidarians are common in the deep-sea canyons and seamounts we are exploring. Here, octocorals, cup corals, and anemones share a rock at 1,459 meters depth in Hendrickson Canyon. Image courtesy of NOAA Okeanos Explorer Program, Our Deepwater Backyard: Exploring Atlantic Canyons and Seamounts.



ROV Deep Discoverer as seen from the second part of the two-bodied system, camera sled Seirios. Image courtesy of NOAA Okeanos Explorer Program, Our Deepwater Backyard: Exploring Atlantic Canyons and Seamounts 2014.



Towards the end of Dive 4, ROV Deep Discoverer came upon a unique geological feature that our team dubbed the “Octopus Grottoes.” Densely packed stony corals surrounded these cave-like structures and almost every one had its own octopus! Image courtesy of NOAA Okeanos Explorer Program, Our Deepwater Backyard: Exploring Atlantic Canyons and Seamounts 2014.

“Telepresence technology brings a world of expertise to an expedition at sea; it also gives members of the public an opportunity to view live video streaming from the ocean floor and hear scientists at sea and ashore collaborate about discoveries as they occur.”

This past year the Mississippi State designed ECC has supported four pioneering Okeanos Explorer expeditions that generated more than 22 Terabytes of video stream data from the Okeanos Explorer voyagers. One voyage uncovered an early 19th century shipwreck that was under more than 4,300 feet of water. Scientists believe the armed vessel is likely a privateer.

“The ship deploys remotely operated vehicles called ROVs that dive to a depth of approximately 7,000 meters—about 5 miles. The ROVS working underwater are sending video and data back to the ship’s anchored satellite,” Breckenridge explained. “The satellite telemetry system is designed to provide data at rates up to 21 megabytes-per-second from the ship to the shore and up to 4 Mb/s from shore back to the ship. It’s amazing the amount of fine detail and color the signal produces from these depths. It’s better quality than Hollywood digital cinematography.”

The Stennis Exploration Command Center is one of six nationwide. The other locations include the Inner Space Center at the University of Rhode Island; the Joint Hydrography Center at the University of New Hampshire; Mystic Aquarium and the Institute for Exploration in Mystic, Connecticut; NOAA’s Pacific Marine Environmental Lab in Seattle, Washington; and NOAA’s Science Center in Silver Spring, Maryland.

NGI is a Key Partner for the \$500-million Gulf of Mexico Research Initiative



Since the establishment of the Gulf of Mexico Research Initiative (GoMRI) about four years ago, the Northern Gulf Research Institute (NGI) has played an active role in the GoMRI program. NGI is a member of the GoMRI management team, providing support for program administration, communications, and outreach. GoMRI 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.

Jay Ritchie, the NGI social sciences coordinator and project PI, serves as the Gulf Coast liaison for the GoMRI administrative unit. The NGI team includes Maggie Dannreuther, Suzanne Shean, Stephanie Ellis, and Lindy Nelson, all based at the Stennis Space Center. The team leads the development and maintenance of the GoMRI Research Information System (RIS) and supports the GoMRI communications and outreach activities for the internal program administration, the science community and broader audiences.

“Our first task was to develop a comprehensive information system to provide organization, storage, and retrieval of the program’s research information – the GoMRI RIS,” Ritchie explained. “This system consists of three primary components: a project inventory, the program roster (the people), and a research bibliography compiling all the GoMRI-funded publications and presentations.”



Kate Woodall, Naval Postgraduate School, injects EPA-approved dye in the surf zone in Ft. Walton Beach. Photo courtesy of CARTHE.

“Our NGI team produces the stories that share the importance and the impact of GoMRI research with the outside world,” said Jay Ritchie, the NGI social sciences coordinator and project PI, who serves as the Gulf Coast liaison for the GoMRI administrative unit.

The GoMRI RIS serves as the core information source for the GoMRI administrative needs: a public interface for funded research, internal program metrics for oversight, and metadata for scientific datasets. The RIS is publically available on the GoMRI web site tab “Research” (research.gulfresearchinitiative.org).

“Our team works closely with the GoMRI Administrative Unit, the chief science officer and the research board to track and manage all that data. We also maintain the web interface that shares that information with the science community and broader audiences.” Ritchie said. “Communications and outreach is the other big aspect of our project. We are working to get the science ‘Out There.’”

As part of the communication effort, NGI leads content development for the GoMRI website (<http://gulfresearchinitiative.org>), producing 60-75 different stories a year that highlight research activities, educational outreach, scientists, students, and peer-reviewed publications.

Ritchie continued, “Our NGI team produces the stories that share the importance and the impact of GoMRI research with the outside world.”

The team is developing an education site (<http://education.gulfresearchinitiative.org>) to provide a central, curated collection of K-12 targeted educational materials and activities that GoMRI-funded projects produce. Additionally, the NGI team is leading the GoMRI Scholars Program (<http://gulfresearchinitiative.org/graduate-students-recognized-gomri-scholars-oil-spill-research/>), which will

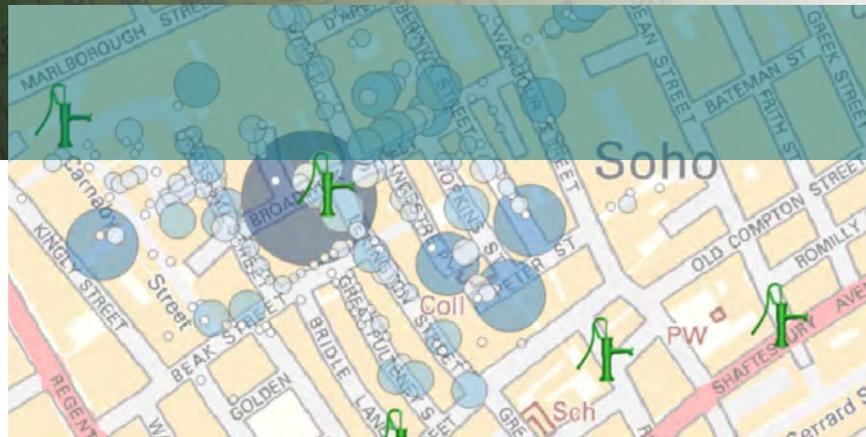
identify and track graduate students who are members of GoMRI-funded research projects. This program intends to support this student community in the near term and document the impact of their involvement in GoMRI research on future education and career paths.

“There is a good chance these student scientists will continue to conduct research on the Gulf of Mexico as a result of their being funded by and involved with the GoMRI program. We would like to know ‘Where did they end up and what are they doing now?’” Ritchie explained. “It will be interesting in the future to be able to look back and see the program’s impact on their careers. In addition to GoMRI’s scientific contributions, these next-generation scientists will be an enduring legacy of the GoMRI program.”



The Deep-C Sail Buoy began its mission in the northeastern Gulf of Mexico. The Sail Buoy was at sea for almost two months, during which time it collected scientific data. Photo courtesy of CMR/Deep-C Consortium.

GEO is the Largest Outreach Project of its Kind in the United States



The Geospatial and Education Outreach Project is training Mississippi's workforce to become more organized and efficient. GEO's value is realized in various applications by different business entities and government organizations. For instance logistic employees use geographical information systems to plan optimal delivery routes; insurance assessors use GIS to measure risk and vulnerability; emergency personal use it to share street name/location and building floor plans with first responders; farmers use it to improve their yield per bushel of grain; and the business industry uses it to offer consumers optimal service. Since 2006 more than 3,000 Mississippians have participated in over 300 workshops across the state.

"We're teaching a skill set to the residents of our state that once was exclusive to only government personnel and scientist," explained Scott Samson, GRI professor, who developed the Mississippi State Extension Service project based at the Geosystems Research Institute, an NGI sister institute. GEO is part of the Mississippi Digital Earth Model funded by NOAA. "Public awareness and accessibility of this technology has improved our state's communities in the building and execution of successful disaster management plans."

Providing citizens access to geospatial technologies not only restores the importance of understanding people and place interactions in disaster situations, but in an array of activities. And that helps build the state's economic base. The Boston Consultant group conducted a study that shows the global geo services industry is valued at up to \$270 billion per year and pays out \$90 billion in wages. In the U.S., it employs more than 500,000 people and is worth \$73 billion.

Samson added there is another economic added benefit, "Having in-state training saves Mississippi about \$5.5 million compared to the cost if workshop participants had to go out of state to take the same training."

ESRI Inc., the largest GIS software vendor in the world, has identified GEO Project as the largest outreach effort of its kind in the United States.

Mississippi Digital Earth Model (MDEM)

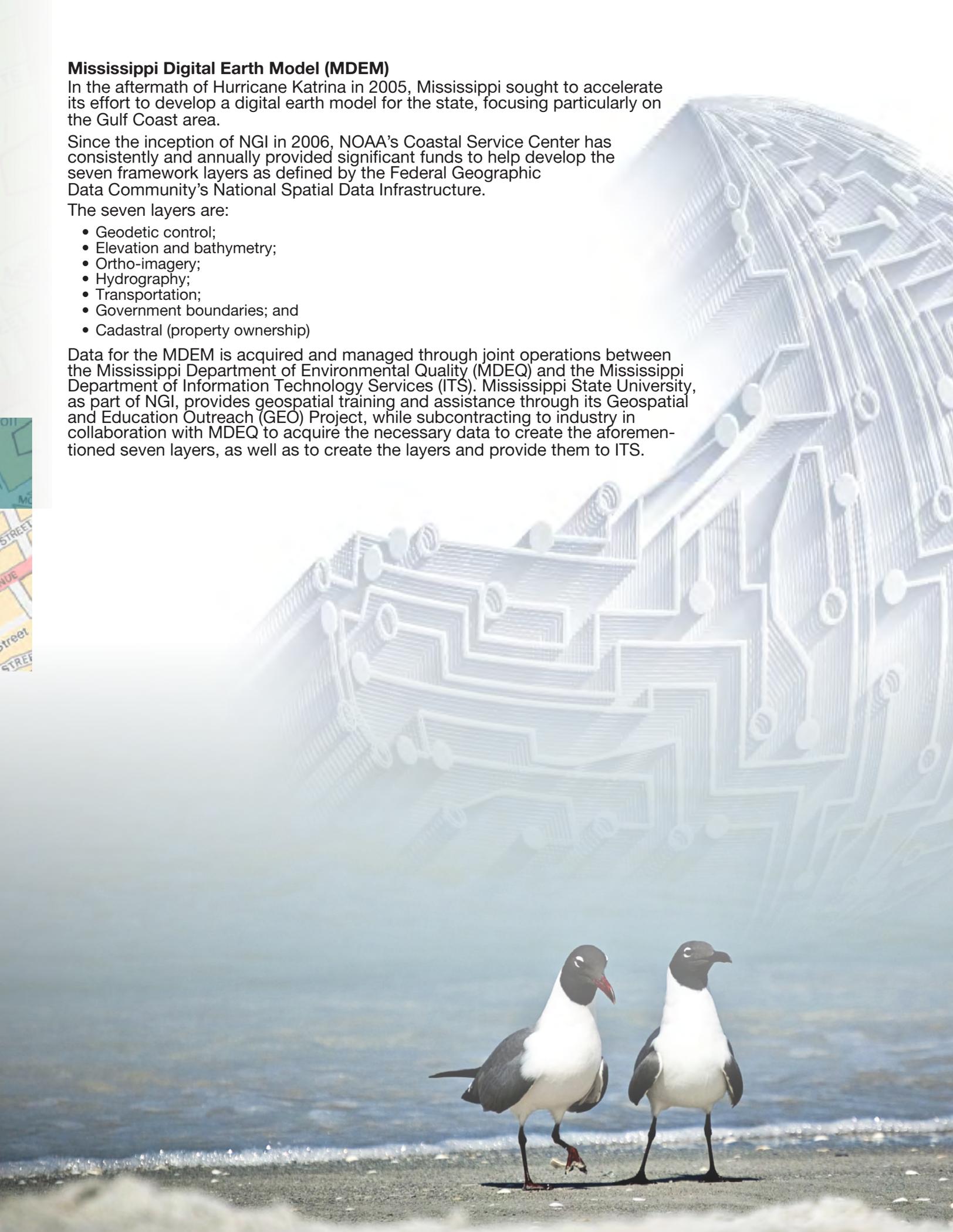
In the aftermath of Hurricane Katrina in 2005, Mississippi sought to accelerate its effort to develop a digital earth model for the state, focusing particularly on the Gulf Coast area.

Since the inception of NGI in 2006, NOAA's Coastal Service Center has consistently and annually provided significant funds to help develop the seven framework layers as defined by the Federal Geographic Data Community's National Spatial Data Infrastructure.

The seven layers are:

- Geodetic control;
- Elevation and bathymetry;
- Ortho-imagery;
- Hydrography;
- Transportation;
- Government boundaries; and
- Cadastral (property ownership)

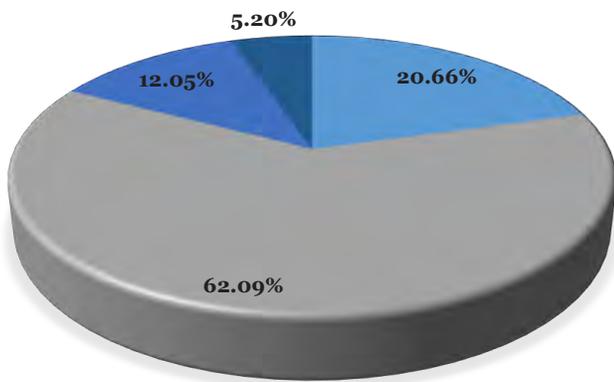
Data for the MDEM is acquired and managed through joint operations between the Mississippi Department of Environmental Quality (MDEQ) and the Mississippi Department of Information Technology Services (ITS). Mississippi State University, as part of NGI, provides geospatial training and assistance through its Geospatial and Education Outreach (GEO) Project, while subcontracting to industry in collaboration with MDEQ to acquire the necessary data to create the aforementioned seven layers, as well as to create the layers and provide them to ITS.



NGI conducts research worth more than \$12-million in funding

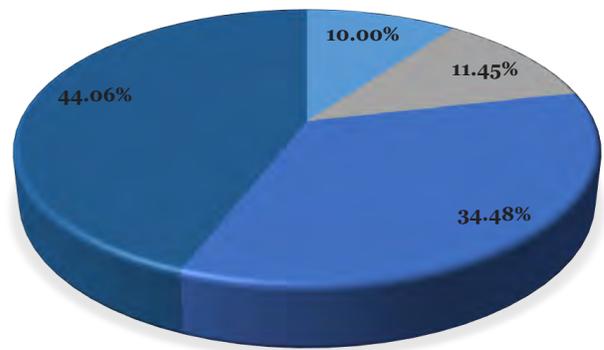
The Northern Gulf Institute's 2014 Annual Report includes research accomplishments and findings for 33 ongoing projects. The total funding equates to \$12-million, including \$4-million in new fiscal backing. The research ventures and 16 technical publications feature topics like expansion of ocean observations, for instance, the use of unmanned vehicles and enhanced satellite data analysis. This cutting-edge technology gives scientists improved measurement readings to better understand ocean acidification, manage fisheries and estuaries, predict freshwater and oil spill plumes, and forecast tropical storm activities. This research will provide critical information in support of natural restoration activities and fisheries management in the Northern Gulf of Mexico.

DISTRIBUTION OF NGI TASK I FUNDING SUPPORT



- Administration
- Education & Outreach
- Student Support
- Other Research Support

DISTRIBUTION OF NOAA FUNDING BY NGI THEME



- Ecosystem Management
- Geospatial Data & Visualization
- Coastal Hazards & Resiliency
- Climate Change Impacts

Executive Summary of Important Research Activities

Preliminary research inquiries are yielding promise. Given a short reporting period, findings and accomplishments are surprisingly substantial. Major emphasis is currently on data collection and synthesis and product development for ocean and atmospheric assessments. Examples include:

- Use of autonomous vehicles (ocean wave gliders and unmanned aerial systems) to augment data collection for ocean acidification and river hydrograph forecasting
- Assessment of ocean surface current predictions associated with climate change predictions and applied to fish (larval and adult) movement
- Expanding strategic initiatives relating to marine observing systems in the Gulf of Mexico. For instance, the Gulf of Mexico Coastal Ocean Observing System plan includes a section on ecological monitoring that is extremely useful for fisheries management and restoration activities
- The Surface Meteorology Data Assembly Center continues to provide a high-quality, well-documented, surface underway dataset for use by a diverse community. In the past year, SAMOS data have been used to validate ocean model estimates of the freshwater inflow to the Gulf of Mexico under flood conditions (Androulidakis and Kourafalou 2013) and to examine the influence of the Mississippi River freshwater plume on a surface oil patch in the Gulf of Mexico

Research and Development of projects continues through ongoing analysis by the originating scientists and others in the scientific community:

- ATMS De-Striping Optimal Filter to remove television frequency interference signals that contaminate satellite microwave imager measurements, which can result in erroneous retrievals of oceanic environmental parameters
- Operational production of the quick-look 2° tropical Pacific (<http://coaps.fsu.edu/RVSMDC/html/pacmonyqrq.shtml>) and 1° tropical Indian (<http://coaps.fsu.edu/woce/html/ndnquick.htm>) ocean pseudo-wind stress products
- Protocols to continually update NOAA's Okeanos Atlas, an interactive, geospatial application that provides access to data information corresponding to exploration missions conducted aboard the R/V Okeanos Explorer (OKEX). Typically, these protocols involve Google map overlays which are created from a geotif using bathymetric (multibeam) and CTD data products collected from OKEX missions
- Evaluations of Impacts of Assimilation of ATMS Data in Hurricane Weather Research and Forecasting (HWRF) on Track and Intensity Forecasts of 2012 Four Landfall Hurricanes to demonstrate the added benefits of assimilating the Advanced Technology Microwave Sounder (ATMS) radiances in the HWRF systems.
- SST algorithms for the VIIRS sensor were tested and evaluated and the OSI SAF Algorithm was selected as the NOAA operational algorithms. The VIIRS ocean color products was shown to produce high quality bio-optical products which can be compared with MODIS satellite
- A local, regime-dependent cloud mask (CM) algorithm was developed for isolating cloud free pixels from cloudy pixels for Geostationary Operational Environmental Satellite. (GOES) imager radiance assimilation using mesoscale forecast models. Based on MODIS CM results, the average Probability of Correct Typing (PCT) reaches 92.94% and 91.50% over land and ocean, respectively

- Improved Tropical Storm Forecasts with GOES-13/15 Imager Radiance Assimilation and Asymmetric Vortex Initialization in HWRF
- Delivery of and public access to a QA/QC dataset of 10,000 miles of road centerlines for 14 counties in southeastern Mississippi

Workshops and Outreach Activities:

- Hypoxia Research Coordination Workshop was conducted to advance fisheries ecosystem management in the northern Gulf to inform efforts to assess and predict the potential ecological and socioeconomic effects of diversions and hypoxia. Emphasis was on assessing ecological impacts of diversions on aquatic habitats and potential impacts on the development of hypoxic zones. This is in support NOAA's Ecological Roadmap Initiatives:

Action HY2: "Initiate more robust user needs assessment of living resource/habitat impacts" [of Gulf hypoxia] and

Action HY8: "Integrate nutrient-based models (water quality management) with living resource models (fisheries management)."

- The NOAA-NGI Diversity Internship Program supported eight interns at eight academic and federal locations across the Gulf coast. Interns were from three demographic groups underrepresented in NOAA's workforce (African-American, Asian and Hispanic/Latino) and included undergraduate students and Master's candidates. Six of the eight interns were females. Internship activities and focus areas were very diverse. Project areas included water quality – monitoring and storm water management, fisheries research – groundfish surveys, gut analyses, ichthyoplankton distributions, GIS analyses of landform changes, diatom distribution and abundance in the Gulf of Mexico after the DWH, the use of stable oxygen isotopes as tracers and social science research on the effects of oyster attributes on people's willingness to pay.
- Nineteen workshops were delivered to 189 participants representing municipalities, counties and state agencies across Mississippi

NGI Project List

Just Cebrian • University of South Alabama
Monitoring in Small Embayments as Early Warning System for Ecosystem Change on Larger Spatial Scales

Steve Ashby • Mississippi State University
Summer Internship for the NGI Ecosystem Data Assembly Center

Vernon Asper • University of Southern Mississippi
Developing an Enhanced Stereo Camera System for Environmental Monitoring

Stephan Howden • University of Southern Mississippi
Waveglider Pilot Project in Support of the NOAA Ocean and Great Lakes Acidification Research Implementation Plan

Steve Ashby • Mississippi State University
Student Assistance with Statistical Analysis of Meteorological and Oceanographic Data

Jane Moorhead • Mississippi State University
Analysis of Engineering Test Data

Pat Fitzpatrick • Mississippi State University
Evaluating Baseline Operational Ocean Surface Current Predictions and Low-member Multi-Model Ensembles in the Gulf of Mexico

Shiao Wang • University of Southern Mississippi
Persistence of Microbial Indicators, Source Tracking Markers, Pathogens, and their Molecular Signatures in Gulf Beach Waters

Eric Chassignet • Florida State University
Increasing our Understanding of the Interaction between Physical and Ecological Processes in the Gulf of Mexico and Caribbean

Scott Milroy • University of Southern Mississippi
Geospatial Data Visualization and Access for NOAA's Exploration Data Collection

Monty Graham • University of Southern Mississippi
Assessing and Coordinating NDBC's Strategic Initiatives Relating to Marine Observing Systems

Xiaolei Zou • Florida State University
Bias characterization and hurricane initialization using ATMS, SSMIS, and AMSR-2

Xiaolei Zou • Florida State University
Applications of Advanced Satellite Microwave Radiances and Retrieval Products to NWP and Climate Studies

Steve Ashby • Mississippi State University
Ecosystem Approach to Management for the Northern Gulf

Stephan Howden • University of Southern Mississippi
Time-Series and Underway Assessments of Ocean Acidification and Carbon System Properties in Coastal Waters

William Patterson • Dauphin Island Sea Lab
Data Management in Support of NOAA's Integrated Ecosystem Assessment for the Gulf of Mexico through the NGI

Scott Milroy • University of Southern Mississippi
Development of Geospatial Data Products for NOAA's Exploration Data Collection

Mark Bourassa • Florida State University
Climate Variability in Ocean Surface Turbulent Fluxes

Bob Arnone • University of Southern Mississippi
Calibration and Validation of NPP VIIRS - Color and SST Ocean Products for Monitoring Oceans

Shawn Smith • Florida State University
U.S. Research Vessel Surface Meteorology Data Assembly Center

Shiao Wang • University of Southern Mississippi
Pilot Genomic Observatories to Characterize Gulf of Mexico Microbial Populations

Pat Fitzpatrick • Mississippi State University
An Examination of Ocean-Forcing Issues in HWRF-POM and HWRF-HYCOM

Scott Samson • Mississippi State University
Enhancing the Mississippi Digital Earth Model (MDEM)

Jerry Wiggert • University of Southern Mississippi
Lagrangian Based Habitat Assessment for Bluefin Tuna (*Thunnus Thynnus*) Spawning in the Gulf of Mexico

Robert Moorhead • Mississippi State University
Engineering Studies for NOAA UAS Program

Xiaolei Zou • Florida State University
Toward Operational Uses of Geostationary Imagery & FY-3 Polar-Orbiting Microwave Radiance Data in the GSI Analysis System

Ken Barbor • University of Southern Mississippi
Development of Detailed Habitat Maps along the Continental Shelf of the Gulf of Mexico using Previously Collected Multibeam Sonar Data

Steve Ashby • Mississippi State University
Hypoxia Research Coordination Workshop

Dean Grubbs • Florida State University
Determination of Habitat use and Movement Patterns for Adult Small-tooth Sawfish

Ruth Carmichael • Dauphin Island Sea Lab
Support of NOAA's Marine Mammal Health and Stranding Response Program (MMSHRP) in the Northern Gulf of Mexico through the NGI: Alabama Marine Mammal Stranding Response

Monty Graham • University of Southern Mississippi
Establishing Secure Long-Term Archival for NOAA/NMFS Preserved Specimens at USM's Plankton Archival Facilities

Tina Miller-Way • Dauphin Island Sea Lab
Northern Gulf Institute Diversity Internship Program

Trey Breckenridge • Mississippi State University
Telepresence and Information Management for Stennis Exploration Command Center

Publications:

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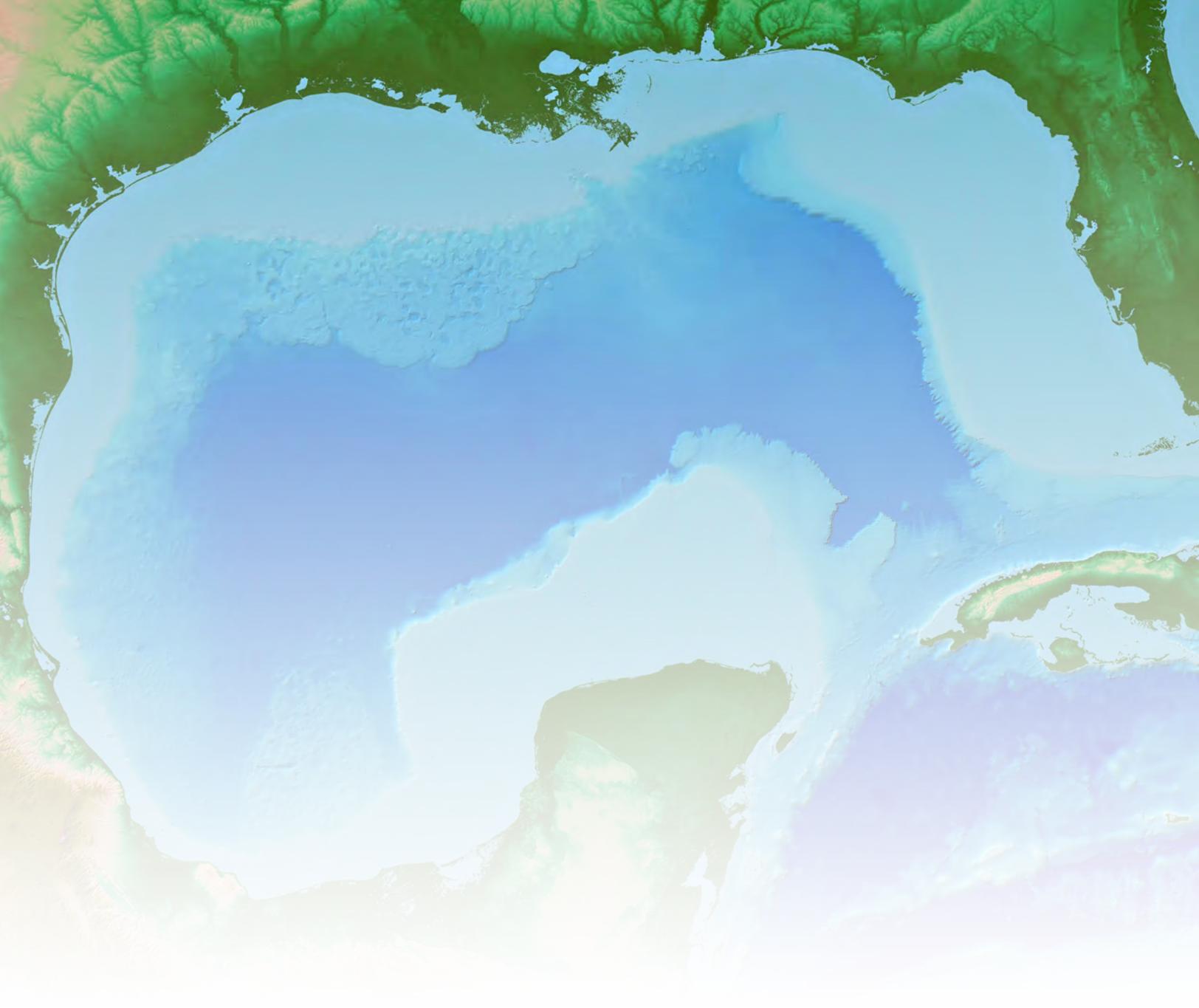
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Since its initial award in 2006, NGI's leadership has worked diligently to build collaborations between the five academic institutions and NOAA research and education programs. NGI continues to use NOAA's investment to contribute to the recovery and future health, safety, resilience and productivity of the Northern Gulf of Mexico region through sustained research and applications in a geospatial and ecosystem context.



The Northern Gulf Institute is a member center of the High Performance Computing Collaboratory at Mississippi State University. The information contained in this publication is for the annual reporting period beginning July 1, 2013 through June 30, 2014.

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