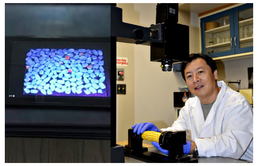
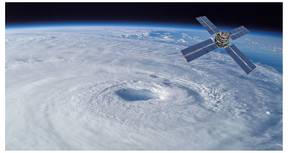
## Research with a World-Wide Impact



An associate research professor with the Geosystems Research Institute and the Mississippi Agricultural Forestry Experiment Station has captured worldwide attention because of his work in developing user friendly, inexpensive technology that will help screen a fungal metabolite in corn. Aflatoxin is a known carcinogen associated with liver and lung cancer in humans. The maize fungus is a threat to food security, human health and trade in developing countries. The current identification method is expensive, has low detection rates and is not accessible to farmers in these countries. As a result, the GATES Foundation, the United States Department of Agriculture and the United States Agency for International Development has partnered with Haibo Yao to provide funding to develop portable technology to help fight world hunger and poverty by improving nutrition through early detection and elimination of allatoxin from staple commodities.

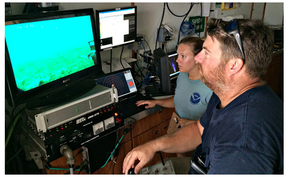
## Research Helps Improve Predictions of Hurricane Intensity

Major hurricanes classified as a category 3 or stronger undergo rapid intensification as their wind speed increases it makes it difficult for scientists, like the Northern Gulf Institute's, Andrew Mercer, to predict the intensity that builds these super storms. However, Mercer has continued to push the boundaries of science forward. Recently his NGI-funded work, in collaboration with colleagues at NOAA's Atlantic Oceanic and Meteorological Laboratory, has revealed that the energy availability through moisture and thermal characteristics of the storms, as well as their outflow, are key in diagnosing rapid intensification of hurricanes. These preliminary results are being integrated into an artificial intelligence technique to forecast rapid intensification of hurricanes that will give emergency management personnel lead times of 24 hours. For Gulf Coast residents whose homes and businesses are under the impending impact of these storms, extra minutes are considered priceless and will allow for better resource delegation and decision making for safety and evacuation plans.



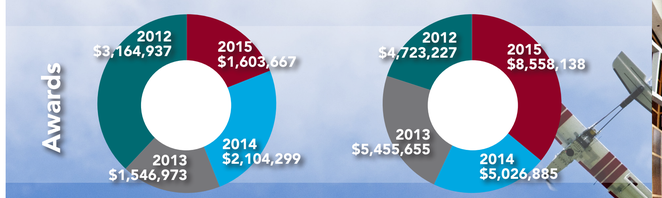
## Research that Protects and Sustains More than a $5.5 Billion Industry

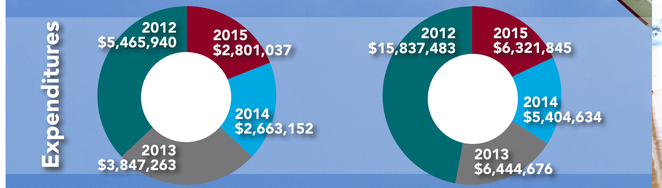
MSU researchers like Arianne Frappe and Valerie Samedy are working with NOAA's National Marine Fisheries Service to develop innovative methods for accurately estimating fish populations in the Gulf of Mexico. These ocean fisheries have a nearly $6 billion economic impact. Conducting research that ensures the long-term health of marine life in federal waters becomes of interest to everyone on some level. Research includes the use of coupled camera and acoustic systems for estimation of fish densities and catchability in a test-bed using stationary camera arrays, autonomous underwater vehicles (AUVs), and remotely operated vehicles (ROVs), and towed sleds. The use of acoustics requires highly specialized data processing that utilizes a technique called echo-integration, which integrates the return-echo strength (backscattering) from the echosounder's sampled volume. It is a very robust method and is a means to estimate the number of fish in the detection beam. These technologies provide more accurate estimates of fish populations for management decisions.










**50 Projects**
**91 Publications**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## Government Officials and AG Industry Turns to GRI UAS Experts to Cut Costs and Increase Crop Yields

GRI unmanned aerial systems researchers have been using UAS to help the agricultural industry save money and protect the environment. UAS helps farmers apply herbicide and fertilizer to only the plants that need it versus the entire field. This helps to increase crop yields and reduce agricultural runoff.

In addition to its robust research infrastructure, MSU is the only university in the state with FAA certificates of authorization to operate UAS's. For the past five years, MSU's Geosystem Research Institute has been researching practical agricultural applications for the emerging UAS technology. University scientists have been using UAS as another remote sensing tool available to collect visual and multispectral data.

"Precision agriculture is data-driven and UAS technology adds another significant layer of data for researchers and ultimately crop consultants and producers to assess and utilize in a meaningful way," said Robert Moorhead, the director of GRI.

According to the Association for Unmanned Vehicle Systems International, the domestic UAS market is projected to create more than 100,000 jobs and $82 billion in economic impact in the first decade after FAA integration is complete. During the same period, the UAS industry could create more than 1,200 jobs and approximately $973 million in economic impact in Mississippi alone. Expert and industry entrepreneurs state that what can be done with these UAS is only restricted by one's imagination.

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## MSU, Hinds CC Create Precision Agriculture Partnership

MSU and Hinds Community College have forged a 2 Plus 2 academic partnership in precision agriculture. The program will provide students opportunities to learn about cutting-edge technology—including Unmanned Aerial Systems—and prepare them for leadership roles in 21st century agribusiness. MSU's Geosystems Research Institute, which specializes in remote sensing UAS research, and Hinds are creating a program that draws on the use of computers and Global Navigation Satellite Systems, as well as unmanned aircraft technology, remote sensing, global positioning, geographic information systems and variable rate technology.

UAS technology has many uses in precision agriculture, allowing for more efficient operations. For instance, it can be used for creation of topographical maps of farmland that help in deciding what to plant and where, irrigation and pest control. GRI's UAS pilots Sean Meacham and David Young once served as instructors at Hinds to teach the hands-on skills that students need to contribute productively to the vital Mississippi agricultural industry.

## Researchers Use UAS as Valuable Lifeline to Protect Marine Habitat

Monitoring harmful algal blooms with Unmanned Aerial Systems helps scientists recognize harmful algal blooms (HAB) outbreaks with greater accuracy, speed and geographic coverage. And that's important because many HABs have significant economic impacts, such as shellfish closures, wild or farmed fish mortalities, and scared consumers who avoid purchasing seafood causing major loss of sales revenue in the fisheries and tourism industries. Dash, "Dr Dash," Padmanava, a Northern Gulf Institute researcher and his team of students Saurav Silwal, Christopher Zarzar, and John Van Horn are monitoring the water quality of the lower Pearl River estuary in an effort to protect numerous coastal shellfish beds that could be negatively impacted by HABs because of freshwater input through the estuary. The Dash team is using UASs equipped with several onboard sensors, including optical and hyperspectral and multi-spectral camera-based technology to help them identify suspended sediments, HABs and other colored dissolved organic matter faster than the traditional methods of satellites, ships, aircraft, balloons, and surface-based sensors. UAS expands these researchers' ability to observe and access otherwise inaccessible areas to gather critical information needed to conserve and protect valuable marine resources.

## Researchers 'Soup-up' Emergency Integrated Life Saving Lanyard to Save Lives in More Ways than Intended

EMILY was first used to assist beach lifeguards in rescuing the lives of drowning victims trapped in turbulent currents and choppy water. Today, it is a sleek 65 inch long all weather oceangoing small unmanned surface vehicle outfitted with high definition environmental sensors. Designed to withstand high seas and super storms, Adam Skarke, a Northern Gulf Institute scientist, is using EMILY USVs to collect and relay real-time oceanographic and atmospheric data from within hurricanes and tropical storms in order to improve forecasts of storm intensity. Part of Skarke's work at NGI is focused on validating onboard environmental sensors and testing the capacity of the EMILY USVs for field deployment in the Gulf of Mexico. The addition of mapping sensors will allow the vehicles to rapidly detect coastal marine debris and navigational hazards following a catastrophic event, such as a hurricane landfall. Further development of the EMILY platform has the potential to benefit coastal stakeholders through improved hurricane forecasts and more efficient responses to catastrophic coastal events.

## Wave Gliders® Surf Intense Waves to Provide Essential Weather-related Data

A research project involving NOAA, Mississippi State and a California company, Liquid Robotics, Inc., could improve future hurricane forecasting. Last fall Pat Fitzpatrick, Adam Skarke, Robert Moorhead and Yee Lau led a 100-day deployment of Wave Gliders® in the eastern Gulf of Mexico. These platforms, propelled by waves and with solar powered electrical systems, transmitted meteorological and oceanographic data in real-time to NOAA's National Data Buoy Center. Some big advantages of using Wave Gliders® are they can be deployed for several months at a time and researchers can program them to track themselves into a storm to collect data in a storm environment. For three months the unmanned Wave Gliders® fed scientists with critical temperature, pressure and wind measurements taken from the ocean's surface to help them better predict storm intensity. Validation efforts showed accuracy relatively similar to buoy measurements. Such platforms can potentially target events requiring enhanced observations such as hurricanes, or substitute as short-term replacements for malfunctioning or offline buoys.

## GoMRI Team Shares Research News of Gulf Coast Recovery

The Northern Gulf Institute is a member of the GoMRI management team, providing support for program administration, communications, and outreach. To date the program has funded $315.6M in research (214 projects) at 246 institutions in 43 states, DC, Puerto Rico, and 12 countries. This research has generated ~600 publications, ~2,290 conference presentations, and supported over 750 graduate students.

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.


## Remote Sensing Research to Reinforce Levees Across the Globe

An international partnership featuring researchers from Mississippi State University, the Colorado School of Mines, University of Delft and Twente University, both out of the Netherlands, are examining earthen dams and levees' critical infrastructure that provides flood protection, fresh water storage and renewable energy to society. For three years the scientists have collaborated and conducted research on multi-scale monitoring science to enable a sustainable future for the vast worldwide array of EDLs. Using polarimetric and interferometric synthetic aperture radar, more commonly known as SAR, they examine earth deformations at a very small scale. Of primary interest to the researchers are the internal conditions of the EDLs, their interaction with the natural environment and how they will perform with climate change. To date the researchers have published their results in a journal publication, Engineering Geology, and presented two papers at the American Society of Civil Engineers and the IEEE Geoscience and Remote Sensing Society conferences. The research documents are accessible to the public and produced to inform levee managers on how a remote-sensing based approach can help focus and prioritize EDL inspection and maintenance activities.

## Protecting Precious Natural Resources with Collaborative Conservation Research

Kristine Evans, a Geosystems Research Institute geomatics researcher and her Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative team are using the latest Geography Information Systems technology to reach across boundaries to negotiate with people with diverse and conflicting interests to find common ground in the goal of protecting our natural resources.

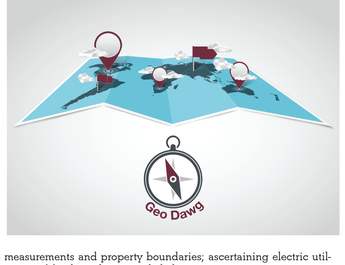
GRI partners closely with the GCPO LCC, a consortium of public and private partners working together to develop a shared vision of sustainable natural resource conservation in this region. Through this partnership GRI has worked with the LCC to fund over $5 million in research, including supporting 27 LCC research projects and two full time GRI staff. Research emphasizes taking a large-scale and data-driven approach to assessing ecosystem status, predicting impacts of changing climate and land use, and working collaboratively to design the conservation landscape of tomorrow. With this research the collective natural resource conservation community has a better idea of where our most vulnerable priority ecosystems are, how they are anticipated to change in the near and long-term, how species interact with these systems, and how better to collaboratively plan to sustain our most precious resources. http://gcpolcc.org.


## Research that Builds Knowledge-Based Workforce

The Geospatial Education and Outreach project collaborates with the state's business, industry and government entities by offering geographical informational system instructional courses to Mississippi's workforce. The open GIS software course curriculum offers introductory GIS classes to the more advanced courses on spatial database server systems. The option of using GIS functionality with open source software versus purchasing commercial software saves tax payer dollars and cuts corporate expenses.

Scott Samson, GRI professor, and Gunnar Olson, GRI research associate, design the workshop curriculum based on the needs of Mississippi GIS users. Students learn how to expand conventional databases to geographically locate data ranging from recognizing patterns of the spread of pine beetle; site analysis in proximity of West Nile infection; determining rainfall location and amounts; assessing acreage measurements and property boundaries; ascertaining electric utility infrastructures; to allocating locations and resources of food, medicine, and shelter in emergency situations.

From June, 2006 the course has taught 3,306 participants in 330 courses. Sampson developed the Mississippi State Extension Service Project based at GRI.




## Smart Science Equals Effective Environmental Decisions and Efficient Use of Public Funding

The Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative is a partnership covering 180 million acres across parts of 12 states, and includes the entire state of Mississippi. Qingmin Meng, a Mississippi State geosciences professor and GRI remote sensing specialist, has figured out a way to configure remote sensing data to digitally map those millions of acres and display them in 1/4 acre increments at a resolution far above high definition. This land mass area contains over 100 types of ecological systems, and thanks to Meng and graduate students, Corey McCarn and Tianyu Li, with assistance from GRI researcher, Lee Hathcock, conservation managers can now select any segment of land they wish to assess in one step at the speed of a computer mouse click. For the first time in 15 years, from a satellite view, conservationists will be able to differentiate between a longleaf pine savanna and a loblolly pine forest that have completely different ecological affects and functions. Thus, these incredibly detailed images give conservationists accurate, updated images that will help them make efficient and effective conservation management and investment decisions based on the best land cover data ever available.

## Unmanned Aerial Systems May Reveal Meteorological Mysteries Pivotal to Improving Weather Forecasts

Boundary layer clouds found in the atmospheric gap between the surface of the earth and satellites are important to understand to give more reliable weather predictions. Jamie Dyer, a researcher with the Northern Gulf Institute, plans to monitor the atmospheric boundary layer in almost real-time by using sensors mounted on UAS. The ability to sample the lower atmosphere in difficult to reach, remote locations where weather data is scarce gives university scientists invaluable information for a variety of applications. These include studying land-atmosphere interactions and verifying numerical weather model output. Improving the resolution and reliability of this information can be used to improve local-scale weather predictions, especially over agricultural areas where crop type and irrigation can influence atmospheric characteristics, such as temperature and moisture. The UAS platforms offer a rapid, cost-effective means to observe weather patterns and features in the lower atmosphere, and show tremendous promise and potential for atmospheric research.

GRI NGI Northern Gulf Institute a NOAA cooperative institute

GRI and NGI are member institutes of the High Performance Computing Collaboratory at Mississippi State University.
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