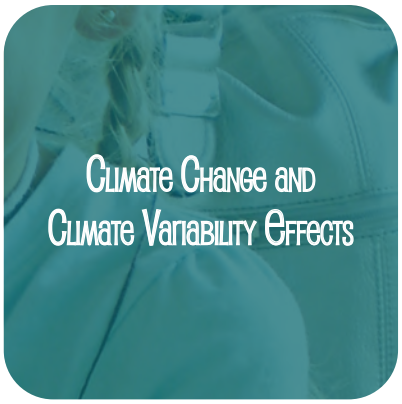
Northern Gulf Institute

PROGRESS REPORT



October 01, 2011 through June 30, 2012

NGI
Northern Gulf Institute
a NOAA cooperative institute

Mississippi State University

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NGI Progress Report

Award NA11OAR4320199

Reporting Period: October 1, 2011 – June 30, 2012

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INTRODUCTION

This Northern Gulf Institute (NGI) Annual Progress Report reviews and summarizes the research and the education and outreach goals accomplished during the reporting period of October 1, 2011 to June 30, 2012. While NGI has two NOAA awards, NA06OAR4320264 and NA11OAR4320199, the items in this report cover only award NA11OAR4320199. The report consists of two (2) sections and appendices. The first section provides the General Description of NGI, the NGI Direction, Organization and Operations, NGI Research Focus Areas and Highlights, and Distribution of funding to NGI from NOAA. The second section is titled Project Reporting. It begins with the list of all of the awards to the NGI of projects currently active. The section describes the project objective and research conducted for each project and other project details, along with contact information and related NOAA sponsor and strategic goal. Appendix A provides the total count of publications for this reporting period, and Appendix B summarizes the total number of employees and students supported by NOAA funding at NGI. Appendix C lists other agency awards NGI received during this reporting period.

NGI General Description and Core Activities

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.

The Institute contributes to NOAA's priority interests in the four NGI research themes of Ecosystem Management, Geospatial Data Integration and Visualization, Coastal Hazards, and Climate Effects on Regional Ecosystems. Important recent research accomplishments by NGI researchers, in collaboration with multiple NOAA researchers, focus on the issues and resources of the Gulf with many of the tools and protocols transferrable to other coastal environs. Additional details are available in the second section on Project Reporting.

The NGI Education and Outreach Program provides an integrated comprehensive approach to educate the public on NGI priority issues associated with NGI research and to facilitate the transition of NGI research to NOAA operational centers. The program connects universities to NOAA and works closely with the educational programs at the Gulf of Mexico Alliance, the

various Gulf of Mexico Sea Grant programs and the NOAA Gulf of Mexico Regional Collaboration Team. Together we develop communication and significant long term messaging campaigns to address identified priority issues.

NGI hosts an important conference on an annual basis – bringing together NGI researchers and educators with NOAA and other stakeholders in the northern Gulf region. As part outreach and part research planning, NGI participated in or hosted several workshops during this reporting period. The NGI Education and Outreach Program disseminates content and reports of research accomplishments through a multi-media approach including listserv emails, twitter, facebook, and continual updates to the institution's website with NGI audience relevant news. Content includes recent information about research activities and transitioned results, essential components of the collaboration, operation updates, and other outreach items of interest (*see:* www.NorthernGulfInstitute.org). One of the most exciting outreach accomplishments during this progress reporting period was publicizing establishment of the Exploration Command Center at the Mississippi State University Science and Technology Center at Stennis Space Center and the important research coordination in the Gulf of Mexico that included the Center.

The NGI Education and Outreach Program strives to enhance NOAA workforce development by including students in several aspects of the cooperative institute. They are involved in research project performance and reporting, internships, career fairs, NGI associated volunteer opportunities, and network support. NGI staff is currently exploring the development of distance learning degree and certificate programs targeted at NOAA professionals working on Gulf of Mexico related programs.

NGI Management, Mission, and Vision

The NGI leadership team adopted a ten year NGI Strategic Plan on June 24, 2011 (http://www.northerngulfinstitute.org/about/strategic_plan.php). With input from its university and NOAA partners, the NGI Program Office strives to make the complex collaborations as efficient and easy as possible for the participants with regular teleconferences, semi-annual meetings and annual conferences.

Mission and vision statements

NGI 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.

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

Organizational structure

The NGI Program Office's strategic location at the Stennis Space Center, MS, facilitates close interactions with multiple NOAA activities and key stakeholder groups including the NOAA Gulf

of Mexico Regional Collaboration Team, regional Sea Grant programs, the Gulf Coast Ecosystem Restoration Task Force, and the Gulf of Mexico Alliance. With the completion of the Mississippi State University Science and Technology Center at Stennis Space Center, which houses NGI and NOAA activities, NGI has the foundation and the building blocks to maintain and grow its role in northern Gulf of Mexico environmental research and education. MSU employees moved into the MSU Science and Technology Center in December 2011. Employees from NOAA National Marine Fisheries Service and National Coastal Data and Development Center will be moving into the Center during the next CI progress reporting period. During this period, MSU supported the installation of the NOAA Exploration Command Center in the MSU Science and Technology Center and hosted numerous researchers from around the region and country who participated in the NOAA Okeanos research cruise of the Gulf of Mexico in March and April 2012.

Since its initial award on October 1, 2006, the NGI's leadership has worked diligently to build collaborations between the five academic institutions and NOAA research and education programs. NGI entered into its second cooperative agreement with NOAA during this progress reporting period on October 1, 2011. NGI activities during this progress reporting period total $3,648,035 in NOAA support. NGI continues to use this NOAA 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. NOAA cooperative institute metrics summarizing published research and staffing support are provided in the appendices.

In 2006, the NGI Council of Fellows, consisting of a senior investigator from each of the member institutions, established an Executive Office at MSU in Starkville, Mississippi, and a Program Office at Stennis Space Center, Mississippi. Funding for the NOAA led research began in the spring of 2006 and research initiatives at the NGI partner institutions began in February 2007. Significant efforts are being made to address important questions related to NOAA's long-term goals of Climate Adaptation and Mitigation, Weather-Ready Nation, Healthy Oceans, Resilient Coastal Communities and Economics, and NOAA enterprise-wide capabilities. The second five-year cooperative agreement began in October 2011. Some final research and education activities from the first five years continued during this reporting period along with related new project activity. Several completely new activities began under this new cooperative agreement. Only activities covered under this new cooperative agreement are contained in this report.

Figure 1 illustrates the NGI organizational structure and collaborative connections. The top row reflects the oversight role of MSU. The Director of NGI, a tenured professor who reports to the MSU Vice President for Research, has his principal office on the MSU campus, but often visits Stennis Space Center, MS. The Director's responsibilities are to serve as primary liaison to NOAA's Executive Council and as the principal point of contact for the Cooperative Institute Program Manager. At the direction of the Director, the NGI Co-Director assists in this role.

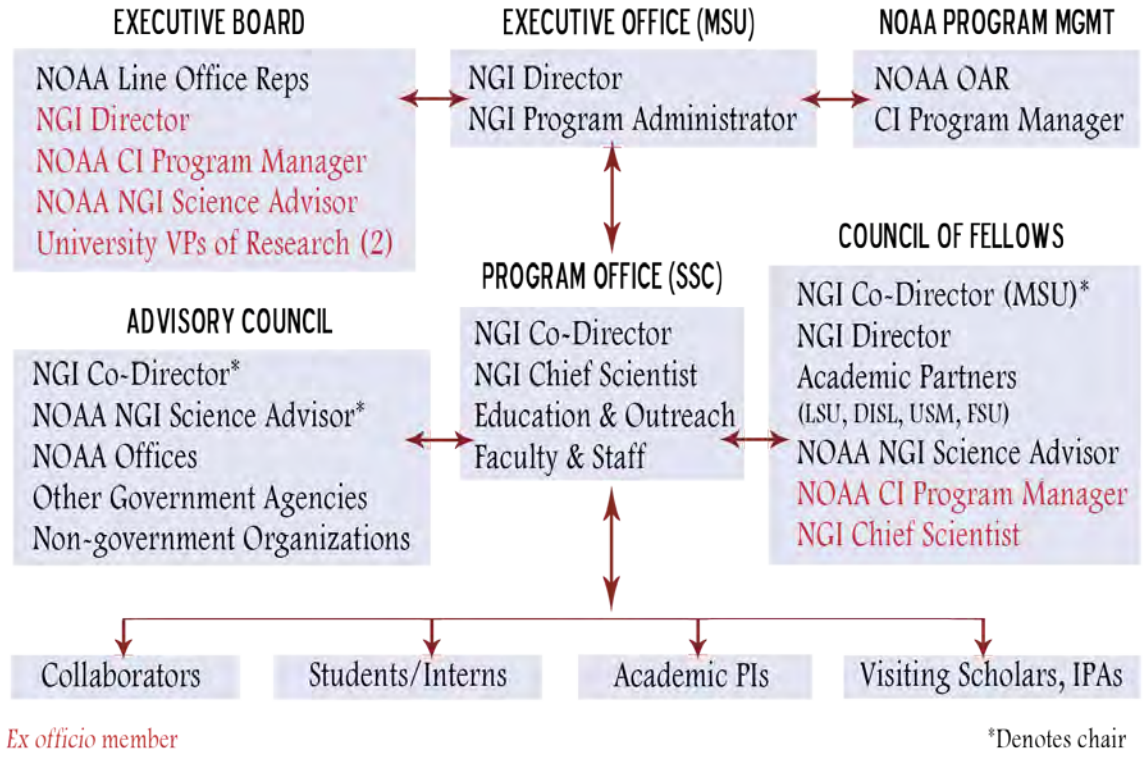

Figure 1. NGI organization diagram

NGI program operations and implementation is guided by the NOAA October 1, 2011 cooperative agreement award, adoption of a Memorandum of Agreement between MSU and NOAA, and compliance with the NOAA Cooperative Institute Interim Handbook. The Executive Office and Program Office staff coordinate with the NOAA Office of Oceanic and Atmospheric Research on amendments to the original award which support research and education by NGI in support of activities of NOAA line offices. These include the Office of Oceanic and Atmospheric Research, National Marine Fisheries Service, National Environmental Satellite Data and Information Service, and the National Ocean Service.

The NGI Program Office located at the Stennis Space Center, Mississippi, is staffed by MSU employees, including the Co-Director, Chief Science Officer, and research and outreach faculty. The Program Office is responsible for maintaining regular interaction with the Council of Fellows, the NGI Advisory Council, and the NOAA NGI Science Coordinator. NGI participates in the NOAA Gulf of Mexico Regional Collaboration Team. It also has prime responsibility for the day-to-day management of the Institute that includes project management, facilitating meetings of the Council of Fellows, the NGI Annual Conference, and NGI students, contractors and visiting scholars on-site at Stennis. The Program Office constantly upgrades services to the research and education affiliates, and applies adaptive management approaches to improve program stewardship.

NGI has 3 councils that make management and advisory contributions to the Institute. The Council of Fellows is composed of senior scientific/ technical representatives from each NGI

member academic institution, as well as the NOAA NGI Science Coordinator, and the NOAA OAR CI Program Manager. The Council is chaired by the NGI Co-Director or designee. The Council of Fellows is the principal vehicle for NGI concept development, program strategy, annual research plans, peer review, resource allocation, research and technology coordination, and achieving the overarching goal of regional and disciplinary integration.

The Council of Fellows
For period of October 2011 through June 2012, the NGI Council of Fellows consisted of:

- William McAnally, Ph.D., Mississippi State University (chair)
- Monty Graham, Ph.D., University of Southern Mississippi
- Eric Chassignet, Ph.D., Florida State University
- Chris D'Elia, Ph.D., Louisiana State University
- John Valentine, Ph.D., Dauphin Island Sea Lab

Meetings of the NGI Council of Fellows for this reporting period were held on October 18, 2011 at Louisiana State University, and in conjunction with the NGI Annual Conference on May 23-24, 2012 at Stennis Space Center, MS. At the May meeting, the Council of Fellows and the Advisory Council held a joint session to allow exchange of recommendations from the Advisory Council and updates on progress from the Fellows. The Fellows participate in regular teleconferences to remain up to date between face-to-face meetings.

The NGI Executive Council
The NGI Executive Council consists of six Senior NOAA officials and vice presidents of two NGI academic partner institutions. Dr. Bonnie Ponwith serves as Chair. The NOAA OAR Cooperative Institute Program Manager, the NOAA NGI Science Coordinator, and the NGI Director serve as *ex officio* members of the Executive Council. The Executive Council is primarily responsible for broad policy and program direction for the NGI. The Council plans to meet at least once yearly to review NGI programs and progress and to transmit NOAA strategic plans and priorities to the NGI management in order to ensure program alignment with these priorities. It last met on November 9, 2010. The Executive Council provides information regarding the NGI successes to the NOAA Administrator to justify inclusion of NGI funding in the NOAA core budget. The NGI is committed to transparency, accountability, governance control, and effective integration through the Executive Council. The NGI Executive Council consists of:

- Bonnie Ponwith, Ph.D., Director, NOAA SE Fisheries Science Center (Chair)
- Gary M. Carter, Director, Office of Hydrologic Development
- Margaret Davidson, Director, NOAA Coastal Services Center
- Louisa Koch, Director, NOAA Office of Education
- Al Powell, Ph.D., Director, Center for Satellite Applications and Research
- Alan Leonardi, Ph.D., NOAA Atlantic Oceanographic and Meteorological Laboratory
- David Shaw, Ph.D., VP for Research & Econ. Dev., Mississippi State University
- Denis Wiesenburg, Ph.D., VP for Research, University of Southern Mississippi
- Philip Hoffman, OAR CI Program Manager (Special Advisor, *Ex-officio*)

- Julien Lartigue, Ph.D., NOAA NGI Science Coordinator (*Ex-officio*)
- Robert Moorhead, Ph.D., NGI Director (*Ex-officio*)

The NGI Advisory Council

The NGI Advisory Council serves as the principal interface to the regional stakeholder community of the NGI. It has broad representation from the entities listed in the organizational chart, and meets regularly to identify and prioritize research and educational needs in the Northern Gulf region. The Advisory Council provides input on the current research and education/outreach programs of the NGI. NGI supports the formation and efforts of workgroups around each of the major themes of the NGI and accepts direction from the Advisory Council when they identify the need. The Advisory Council met May 24, 2012 (Stennis Space Center, MS) to assess NGI research directions and advise the Fellows on important issues facing the region. The NGI Advisory Council members are:

- Steven Ashby, Ph.D., MSU/NGI Co-Director (Chair)
- Duane Armstrong, NASA Stennis Space Center
- Russ Beard, NOAA National Coastal Data Development Center
- David Brown, Ph.D,, NOAA National Weather Service, Southern Region
- Miles Croom, NOAA National Marine Fisheries Service
- Alyssa Dausman, USGS Gulf Coast & LMV
- Todd Davison, NOAA Gulf Coast Services Center
- Lisa Desfosse, NOAA National Marine Fisheries Service
- Kristen Fletcher, Coastal States Organization
- Judy Haner, The Nature Conservancy
- Karl Havens, Ph.D., Florida Sea Grant College Program
- Matt Johnson, NPS Gulf Coast Network
- Julien Lartigue, Ph.D., NOAA NGI Science Coordinator
- Kristen Laursen, NOAA Fisheries Service
- Larry McKinney, Harte Research Institute
- Helmut Portmann, NOAA National Data Buoy Center
- Matt Romkens, USDA National Sedimentation Lab
- David Ruple, Grand Bay National Estuarine Research Reserve
- Ben Scaggs, EPA Gulf of Mexico Program
- LaDon Swann, Ph.D., MS-AL Sea Grant Consortium
- Robert Twilley, Ph.D., Louisiana Sea Grant
- Suzanne Van Cooten, Ph.D., NOAA National Weather Service LMRFC
- William Walker, Ph.D., MS Department of Marine Resources
- Jeff Waters, US Army Corps of Engineers
- Chuck Wilson, Ph.D., GOMRI Chief Scientist

Executive Summary of Important Research Activities

Preliminary research inquiries are yielding promise. Given a short reporting period, findings and accomplishments are surprisingly substantial. To date, initial analyses show:

- Despite a known potential for smaller embayments to have a higher level of impairment in the water column when compared to the larger water bodies with which they are connected, little evidence was found to support a higher impact of anthropogenic disturbance on smaller embayments in the Florida panhandle.
- Qualitative change in winds associated with sea surface temperatures is consistent with baroclinic changes described in terms of thermal wind, and not consistent with changes due to atmospheric stability. The relative importance of these two processes has been a long-running argument for many years.
- Despite the overall decline in shrimp fishing effort in the Gulf of Mexico, high levels of shrimping effort are associated with a decrease in relative abundance of red snapper likely due to the significant association of juvenile red snapper density with shrimping effort, depth and region. The most striking finding is an area off the TX-LA border with high density of juvenile red snapper that experienced hardly any high-level shrimp effort. If this region offers consistently good nursery conditions for red snapper, and is not among the most important shrimping areas, then it may be a good candidate to protect nursery habitat for red snapper, leading to a faster recovery of red snapper stocks.

Several projects have been able to develop products for use in continued research by the originating researchers and others in the scientific community. These include:

- A code to derive bulk turbulent fluxes from quality-processed Shipboard Automated Meteorological and Oceanographic System (SAMOS) data. The demonstrated success of this code is that automated quality processing allowed 4990 days of meteorological and sea surface temperature data to be processed and evaluated from all recruited vessels reported under 11-NGI2-07 (PI: Smith) this year.
- A prototype of a smartphone application to warn users of immediate natural hazard threats around their present location. A public version is anticipated for release during the summer of 2012.
- Delivery of and public access to a QA/QC dataset of 9,880 miles of road centerlines for 9 counties in southeastern Mississippi in the 2nd quarter of 2012. The new road databases complement 37 counties where road centerlines have been previously developed.
- High-resolution (6-inch) imagery acquisition of the six Coastal Counties during the spring of 2012 by leveraging NGI money with funds originating from the Mississippi Department of Transportation.
- A satellite-derived stress product that responds to sea surface temperature gradients in a manner qualitatively consistent with observed variability, and consistent with physical processes.
- Development of algorithms for detection of radio-frequency interference for FY-3B MWRI, AMSR-E and WindSat data.
- Quality assessment of advanced satellite microwave products from AMSU and SSMIS

- Applications of advanced satellite microwave brightness temperature data for establishing level-2 temperature climate data records using a 1D-Variational approach.
- Quality assessment of microwave measurements from FY-3A/B.

Several workshops and outreach activities have been conducted under the funding and goals of NGI. From these, NGI has produced:

- A summary of lessons learned, concerns, and best practices tailored to the needs and priorities of river forecast centers.
- Improved university/ federal & state agency coordination of monitoring and modeling for the 2012 Gulf Hypoxic Zone and beyond
- An 8-course curriculum in GIS applications and geospatial database management, which served 175 participants during the reporting period.

Distribution of NOAA Funding

Total NOAA funding awarded to NGI during the progress reporting period was $3,648,035. This funding spans all three NOAA CI tasks as well as each one of NGI's themes, with several projects having multiple themes.

Task I Activities

Task I funding supports the central management and coordination of the five complementary academic partners working together with NOAA. In a normal year, it also supports several post-docs and education and outreach efforts, including internships and translating the research results for general dissemination and use in teacher workshops. Because this reporting period is a shorter period and the start of a new award instrument between NOAA and NGI, the only Task I funding during the reporting period was provided by NOAA for the administration of NGI.

One of the primary Task I activities in this reporting period was to work with central offices at each institution to initialize and execute the new five-year master subaward agreements between MSU and the partner institutions. Now that those agreements are in place, future awards for funded proposals can be distributed to the partner institutions and principal investigators with greater ease. In addition to the execution of subawards, Task I activities for this period included leading the efforts of the CI as well as program and project management on each of the traditional CI projects awarded this year.

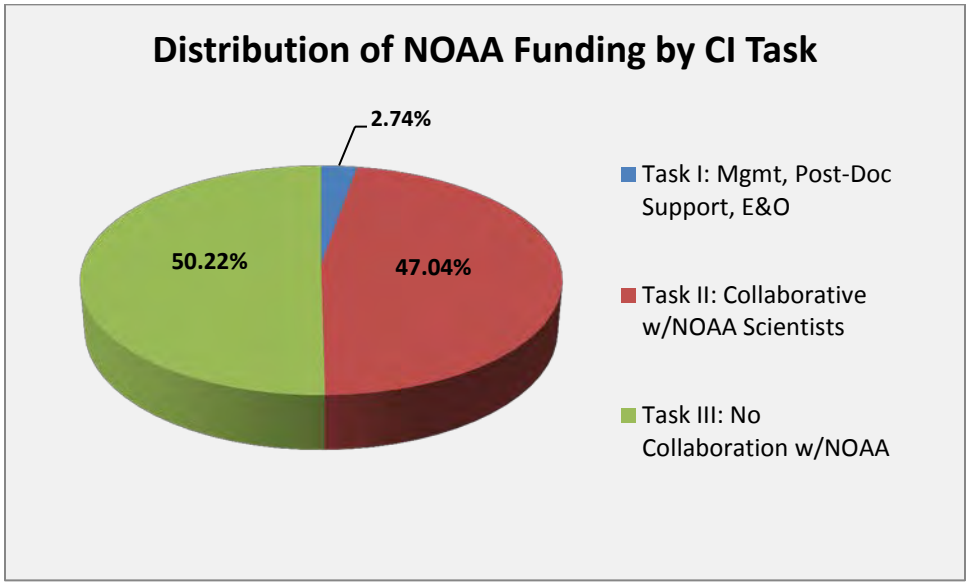

Figure 2. Distribution of NOAA funding by the three cooperative institute task categories.

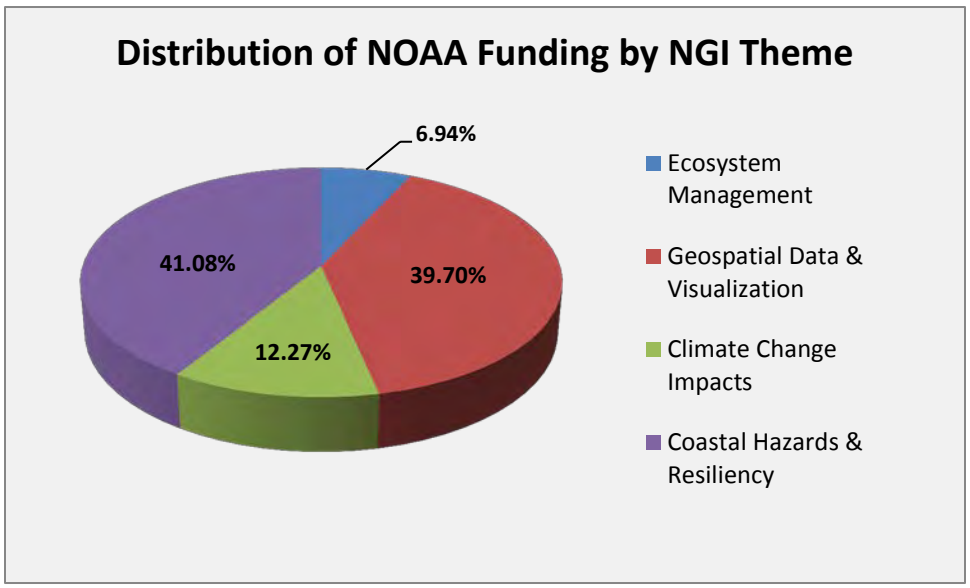

Figure 3. Distribution of NOAA funding by the four NGI themes.

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Project Title: Time-Series and Underway Assessments of Ocean Acidification and Carbon System Properties in Coastal Waters

Project Lead (PI) name, affiliation, email address: Stephan Howden, USM, Stephan.Howden@usm.edu

Co-PI(s) name(s), affiliation, email address: Robert Byrne, University of South Florida, byrne@marine.usf.edu; Wei-jun Cai, University of Georgia, wcai@uga.edu; Joseph Salisbury, University of New Hampshire, joe.salisbury@unh.edu

Project objectives and goals

This project involves a close collaboration with NOAA scientists to provide information critical to NOAA's mission and global concerns regarding ocean acidification and its impacts on ecosystems. Time-series observations of coastal ocean pH and carbon system properties in the Gulf of Mexico (GoM), the South Atlantic Bight (SAB) and Gulf of Maine (GoME) are being conducted by partnerships between NOAA and the University of Southern Mississippi (USM), University of Georgia (UGA), and the University of New Hampshire (UNH), respectively (Figure 4), augmented by a more extensive mapping of pCO_2 in the GoM and the southeastern U.S. coast via underway measurements using ships of opportunity by the University of South Florida (USF).

Figure 4. Locations of buoys with NOAA/PMEL MAPCO2 systems. USM operates a buoy in the GoM, UGA collaborates with the NOAA/NDBC buoy in the SAB, and UNH and NOAA/PMEL operate a buoy in the GoME

Description of research conducted during the reporting period and milestones accomplished and/or completed

In order to eliminate down-time of the CenGOOS buoy, the second 3-m discus buoy hull was modified by the NOAA/National Data Buoy Center to house the NOAA/PMEL MAPCO2 system (Figure 5). Three water-tight aluminum cylinders were welded into the hull to house the electronics, reference gas cylinder, and battery, respectively. The hull is being painted and is scheduled to be deployed in July, 2012 with a replacement MAPCO2 system, including a SeaBird Microcat, SAMI pH sensor and Wetlabs fluorometer. The PMEL system has a completely separate power and telemetry system from the rest of the buoy.

Figure 5. Sandblasted hull of 3-m discus buoy modified by the National Data Buoy Center to house the PMEL MAPC02 system

During the reporting period, the buoys in the northern Gulf of Mexico, the South Atlantic Bight, and the Gulf of Maine extended the time series of coastal ocean pH and carbon system processes in these three different regions. The preliminary full time-series of the mole fraction of CO2 in the near surface atmosphere and ocean are shown in Figure 6, Figure 7, and Figure 8, along with the difference and percent of oxygen saturation in the surface ocean. The most recent thirty-day time-series (unverified) are shown in Figure 9, Figure 10, and Figure 11.

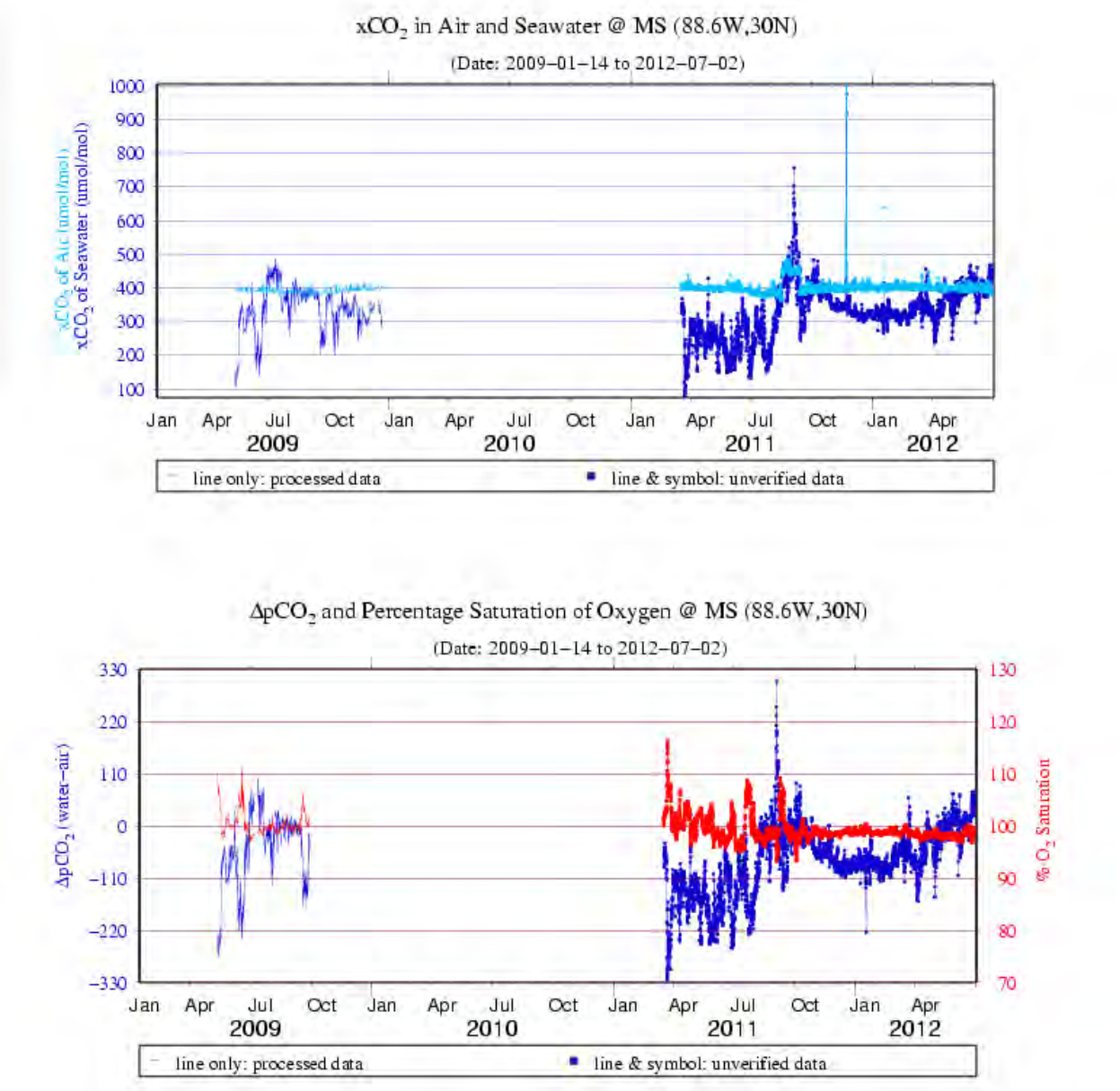

Figure 6. Complete MAPCO2 time series for CenGOOS buoy

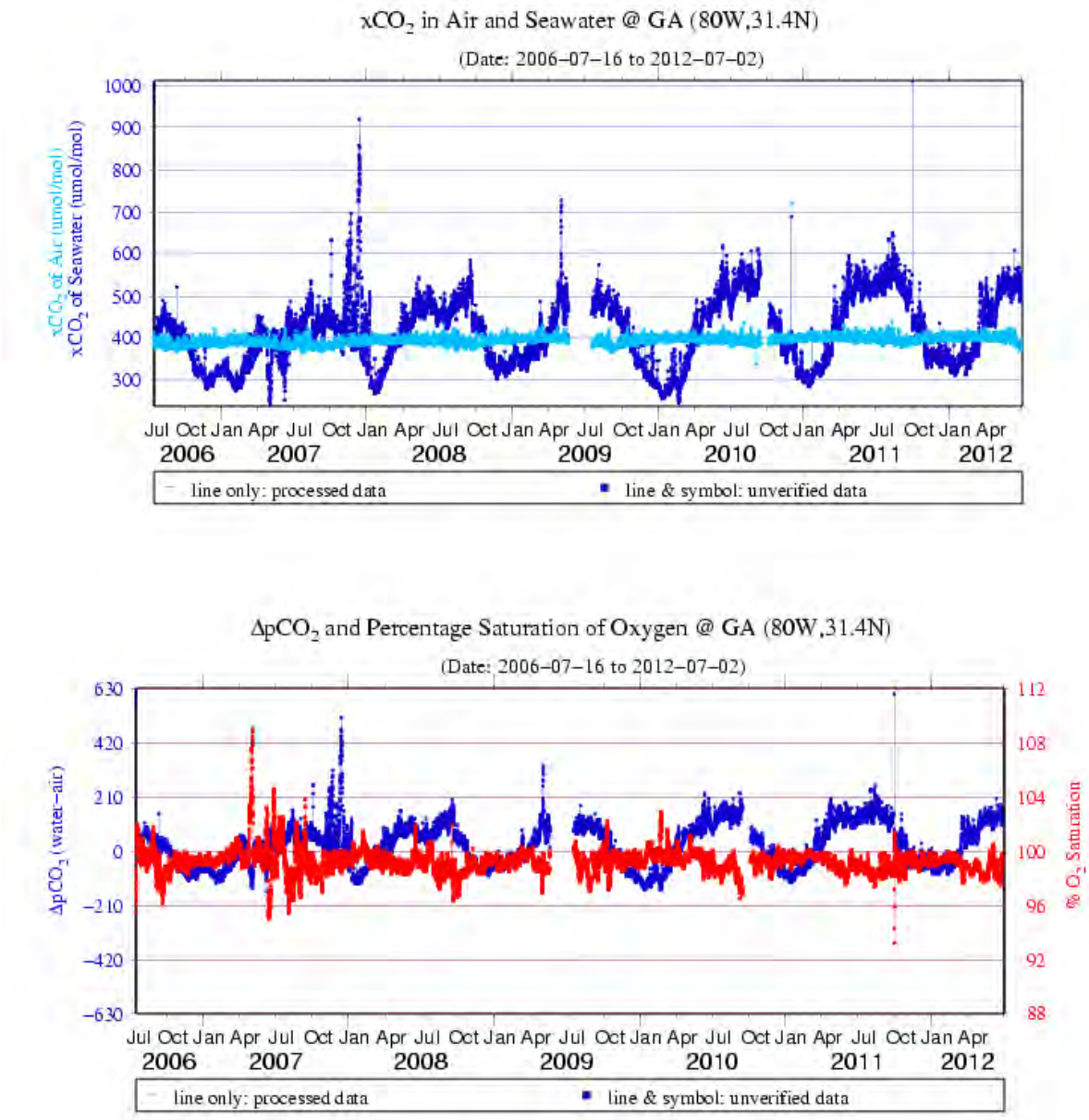

Figure 7. Complete MPACO2 time-series for Gray's Reef NDBC buoy

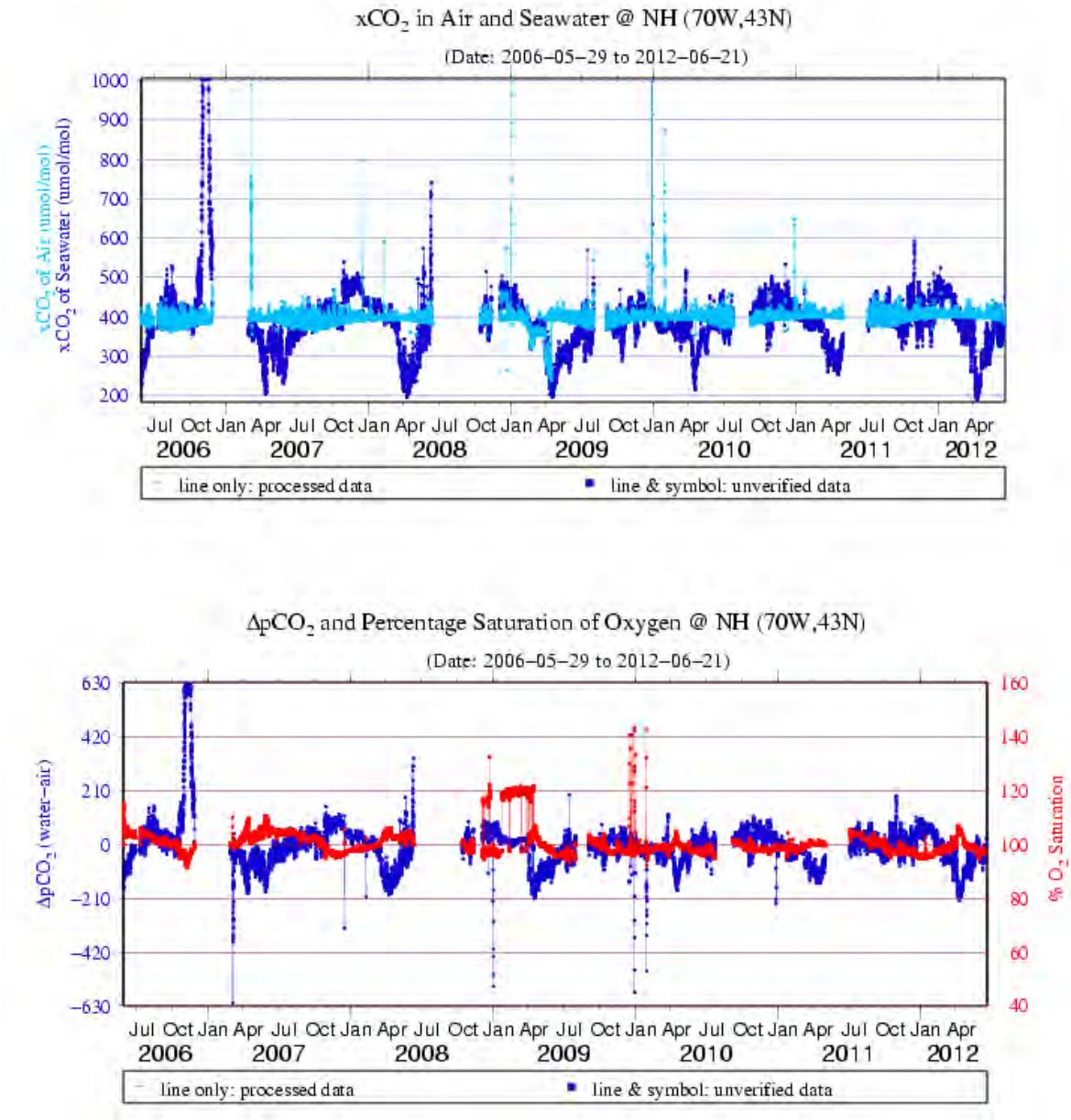

Figure 8. Complete MPACO2 time-series for UNH buoy

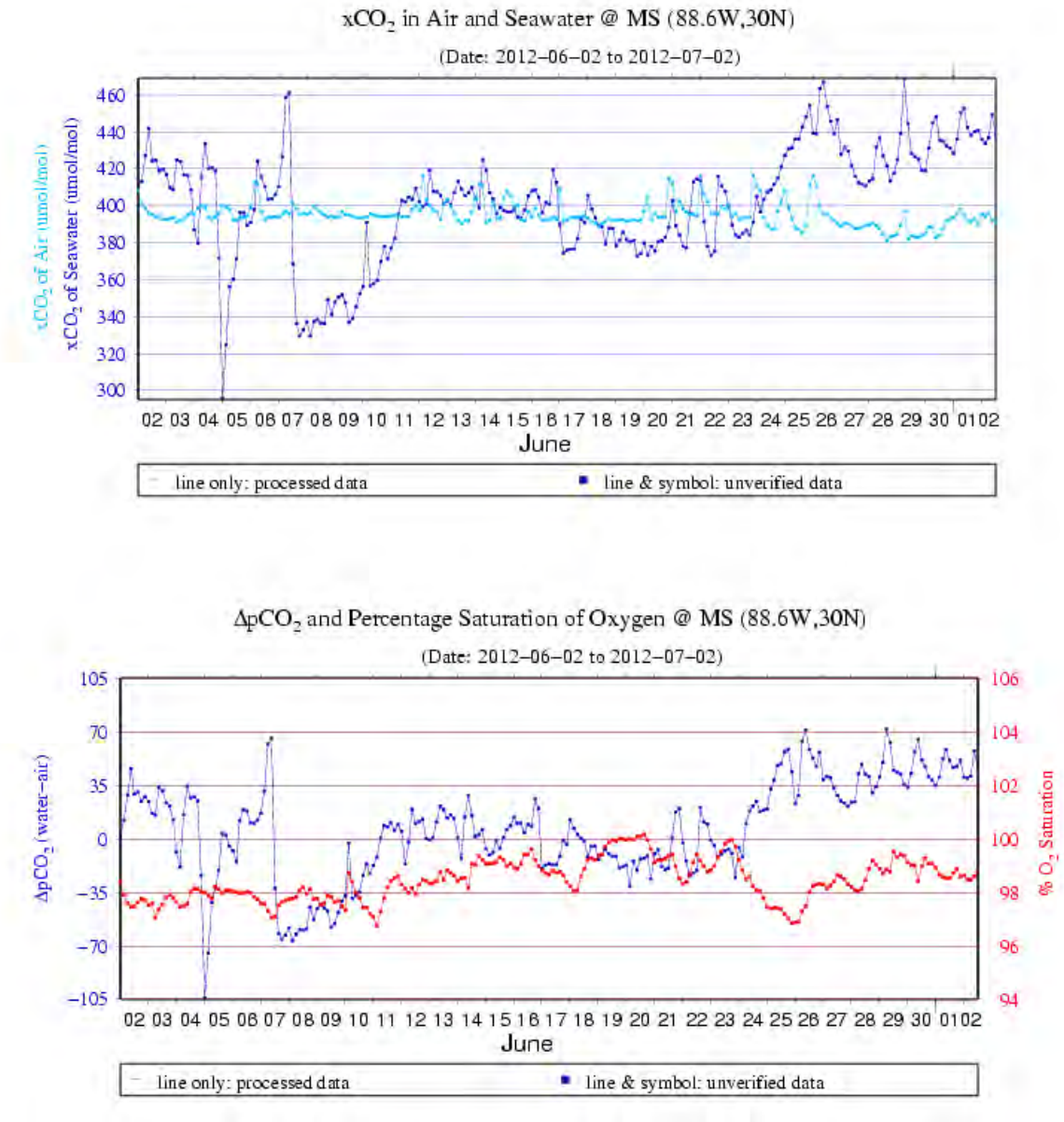

Figure 9. 30-day MAPCO2 time series for CenGOOS buoy

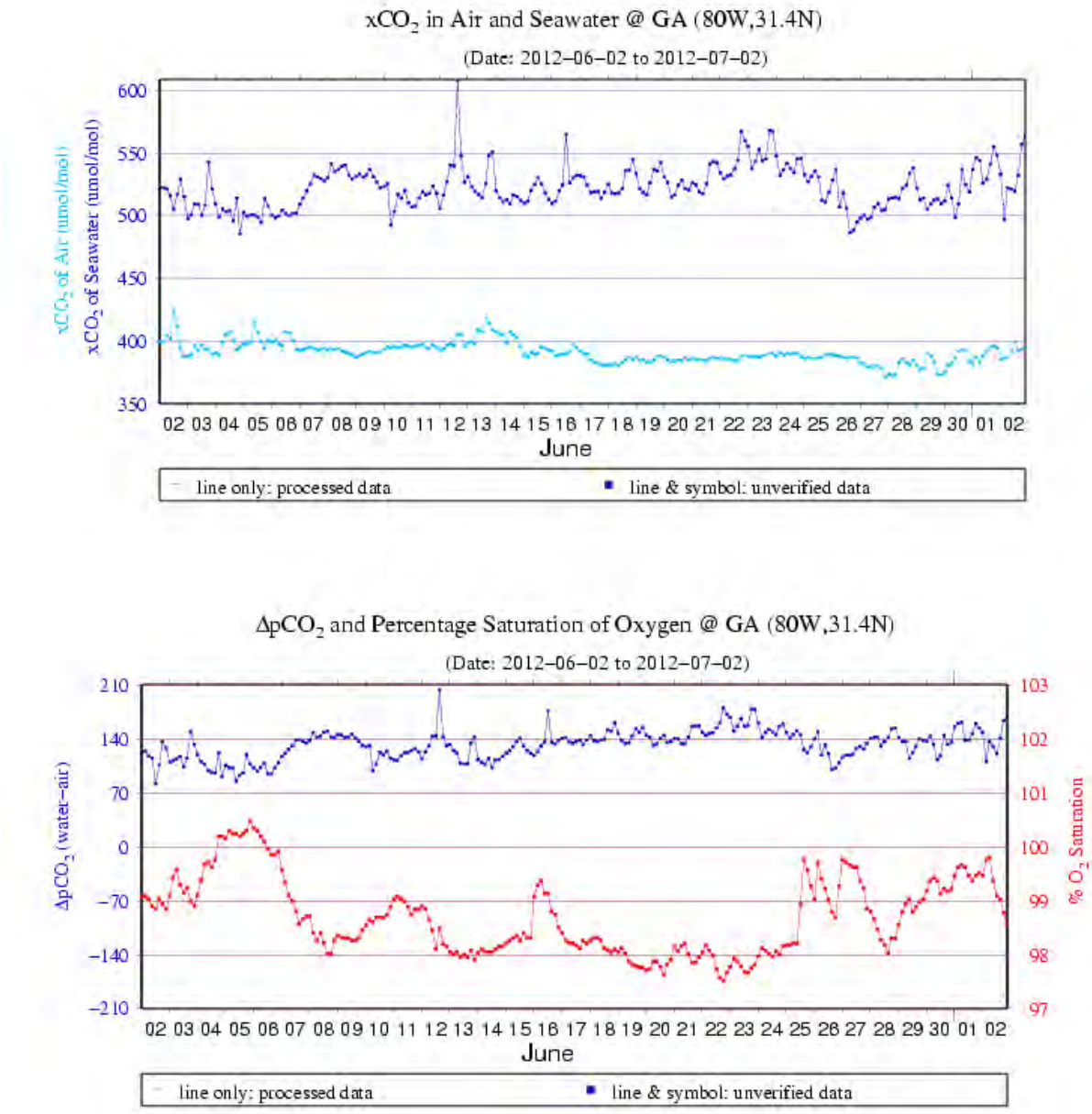

Figure 10. 30-day MPACO2 time-series for Gray's Reef NDBC buoy

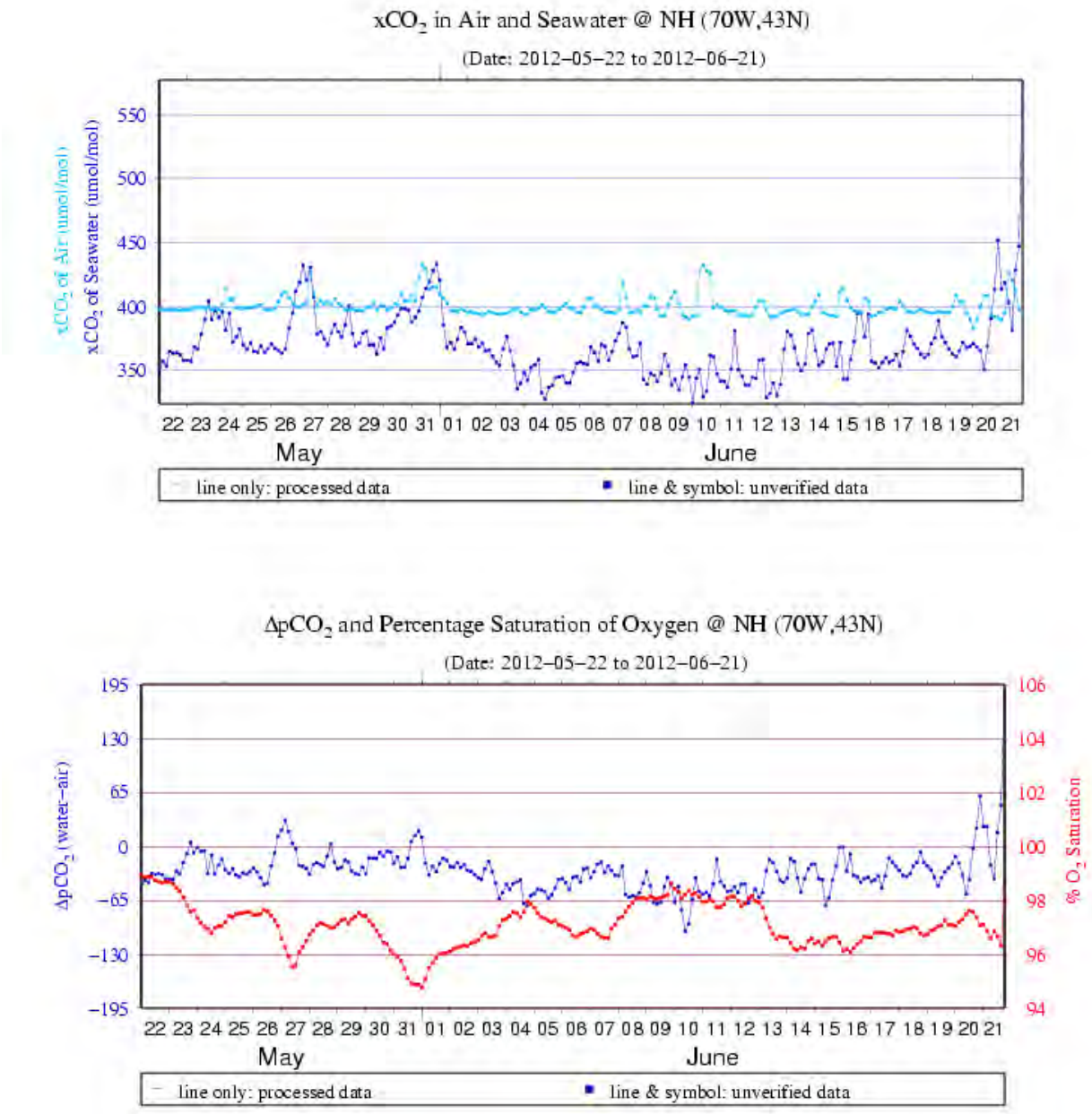

Figure 11. 30-day MPACO2 time-series for UNH buoy

In previous years, the ocean at the buoy location has been a net source of CO_2 only for the month of July. The June 2012 ΔpCO_2 for the CenGOOS site is positive, in contrast to June 2009 and June 2011. SST anomalies for early to mid-June 2012 are greater than those for 2009 and 2011 and may have tipped the balance between increasing seawater pCO_2 due to temperature driven solubility decreases, and reduced pCO_2 due to productivity.

Description of significant research results, protocols developed, and research transitions

Time-series of T, S, pCO_2 and pH in the GoME are shown in Figure 12. A manuscript dealing with seasonal controls on ΔpCO_2 and aragonite saturation state is in preparation. Ten UNH cruises supported by NOAA, NASA and NSF have been used to take ancillary measurements and data for validation. Quality control efforts comparing the continuous data stream to discrete samples are being conducted.

The Gray's Reef National Marine Sanctuary site, which lies in the middle of the SAB, sits near the boundary of the inner shelf and mid-shelf where substantial spatial and seasonal variation in CO_2 and pH dynamics occur. A recent study has illustrated that the SAB mid- to outer shelf is often a sink of atmospheric CO_2 and most likely of net autotrophic on an annual basis, while the inner shelf is more frequently net heterotrophic, i.e., releasing CO_2 to the atmosphere and ocean interior. A MAPCO2 has been deployed on the NDBC buoy 41008 and has been working nearly continuously since July 2006. Data collected so far suggest that pCO_2 at this site follows the general cycle of seasonal temperature; however, there are clear signals that cannot be explained by temperature change alone (Figure 12).

Previous studies in the northern GoM have demonstrated high seasonal variability in CO_2 fluxes and the episodic existence of localized oceanic sinks. However, during a 2009 deployment of the USM buoy from May through December, the northern GoM was primarily a sink for CO_2 (Figure 13) with only July being a mean source. Water samples for ancillary measurements and validation data have been taken on a monthly basis through December 2011, as part of a USM project funded by the Northern Gulf Institute.

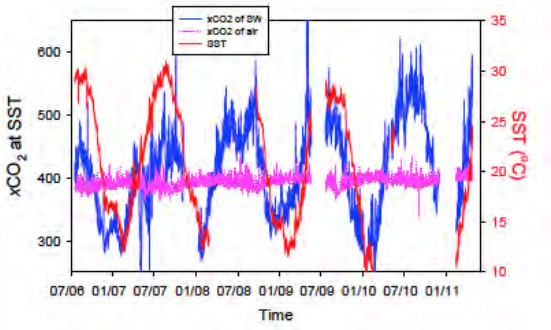

Figure 12. Mole fraction of CO_2 (χCO_2 , ppm) of seawater and cCO_2 of air and SST recorded by the Autonomous pCO_2 Monitoring System deployed on NDBC buoy 41008

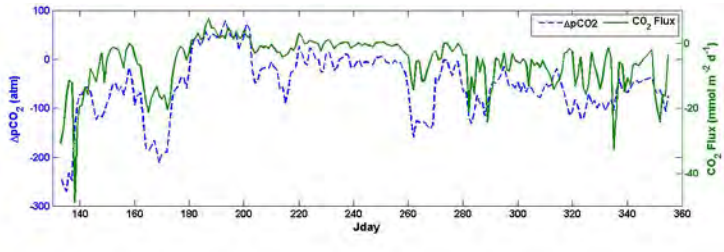

Figure 13. Time series of mean daily ΔpCO2 with mean daily air-sea CO2 flux from May through December, 2009

USF has collected water samples for analysis of TA and DIC to depths of 1,000 m in the GoM. Novel methods were developed that will allow shipboard TA and DIC measurements, in addition to measurements of pH on discrete samples. The SEAS II systems are being modified to allow long term monitoring of pH on moorings and the MICA II systems have been refined for

shipboard CO2 system measurements of underway pH, TA and DIC.

Information on collaborators / partners:

The USM/NGI project *Monitoring and Assessment of Coastal and Marine Ecosystems* (PI Stephan Howden) was leveraged by this project to provide monthly sampling at the USM/CenGOOS buoy location. The support of this project provided free boat use and an enhanced set of ancillary data. The monitoring project ended on December 31, 2011, and this project had to shift to quarterly sampling. The next sampling is scheduled for the buoy turnaround cruise in July 2012.

The USM/NOAA/GCOOS project *Central Gulf of Mexico Ocean Observing System* (PI Stephan Howden) provides buoy platforms for the NOAA/PMEL MAPCO2 systems in the Mississippi Bight. That project paid NOAA/NDBC to modify a 3-m discus buoy aluminum hull to house the MAPCO2 system.

Oceanic, Coastal and Estuarine Observing Networks: North Atlantic Ocean, East and Gulf Coasts. PI: Dr. Rik Wanninkhof (NOAA/AOML). Co-I's: Dr. Anne Michelle Wood (NOAA/AOML), Dr. Christopher Sabine (NOAA/PMEL), Dr. Richard Feely (NOAA/PMEL) and Dr. Jon Hare (NOAA/NMFS/NEFSC).

- Gulf of Mexico and East Coast Carbon Cruise -2 July 21-August 13 (Figure 14). AOML Chief Scientists: Rik Wanninkhof (AOML) Michele Wood (AOML).
- Funding for present project through the Northern Gulf Institute

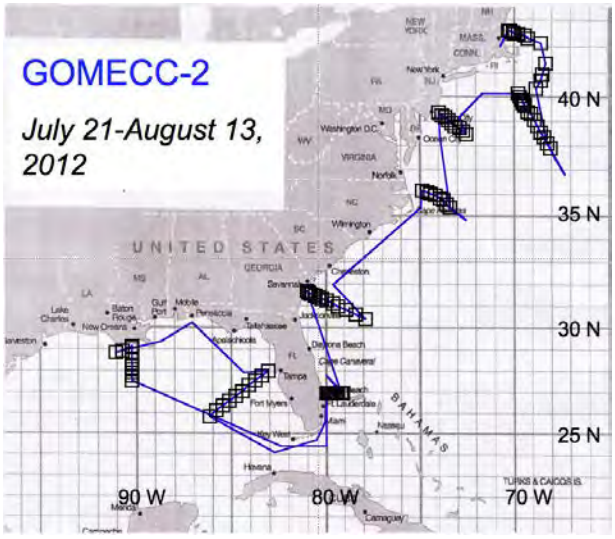

Figure 14. Cruise track and stations for the GOMECC-2 cruise on the R/ Ron Brown, 17 July-13 August, 2012

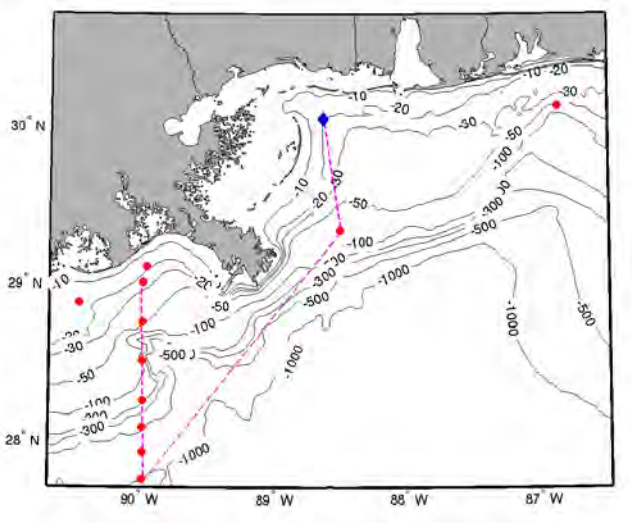

Figure 15. NOAA/NGI/USM/Liquid Robotics CO2 Waveglider pilot project. The pink dashed line shows tentative glider track. It will be launched from a ship out of Houma, Louisiana, follow along GOMECC-2 stations (red circles), and finish at the CenGOOS buoy (blue diamond). A rendezvous with the R/V Ron Brown will be attempted.

The NASA funded project *Assessing Impacts of Climate and Land Use Change on Terrestrial-Ocean Fluxes of Carbon and Nutrients and Their Cycling in Coastal Ecosystems,* (PI: Stephan Howden) provides partial funding for ship-time for buoy recovery and deployment.

A NOAA/NGI project *Waveglider Pilot Project in Support of the NOAA Ocean and Great Lakes Acidification Research Implementation Plan* (PI: Stephan Howden) is scheduled for July-August 2012 to utilize a Liquid Robotics, Inc. Wave Glider for ocean acidification monitoring in the northern Gulf. The track of the glider (Figure 15) has been chosen to partially follow stations of the GOMECC-2 cruise (Figure 14). The R/V Ron Brown will attempt a rendezvous with the Wave Glider during the GOMECC cruise.

Information on any outreach activities:
Howden, S. D. *CO_2 and Ocean Acidification*. Climate Change Community Outreach Initiative (CCCOI) “Ocean Acidification” September 29, 2011 Gulfport Mississippi. This CCCOI Workshop was sponsored by the National Oceanic Atmospheric Administration (NOAA)-Office of Education through the FL Aquarium, in cooperation with the IMMS-CMER off Lorraine Rd. in Gulfport, MS. The educational program is for middle-school science teachers, and approximately 20 teachers participated in this workshop.

NOAA sponsor and NOAA office of primary technical contact: Libby Jewett, OAR

Related NOAA strategic goals: Climate Adaptation and Mitigation, Healthy Oceans, Resilient Coastal Communities and Economies

Related NOAA enterprise objectives: Science and Technology

NGI FILE #11-NGI2-02

Project Title: Monitoring in Small Embayments as Early Warning System for Ecosystem Change on Larger Spatial Scales

Project Lead (PI) name, affiliation, email address: Just Cebrian, DISL, jcebrian@disl.org

Co-PI(s) name(s), affiliation, email address: Bart Christiaen, DISL/University of South Alabama, bchristiaen@disl.org

Project objectives and goals

Because of their limited depth, low flushing rates and close proximity to land, small embayments, such as bayous and coastal lagoons, are potentially more vulnerable to excessive inputs of nutrients and organic matter than the larger bodies of water they are connected with. This project has as primary objective to test if these small systems could function as an early warning system for changes in ecosystems on larger spatial scales. More specifically, our goals are to detect if:

1. shallow embayments and lagoons are more impaired in water column quality compared to the larger bodies of water they are connected with;
2. there are differences in the degree of impairment between three embayments with different degrees of anthropogenic disturbance and different flushing rates;
3. shallow embayments react faster and more intense to changes in the watershed than the bodies of water they are connected with.

Description of research conducted during the reporting period and milestones accomplished and/or completed

We set up 6 permanent monitoring stations inside and outside three small embayments with different degrees of anthropogenic disturbance. From July 2011 to June 2012, each of these sites has been sampled 5 times (total of 15 sample events). We collected 192 water samples, which are being analyzed for nutrients (particulate and dissolved), total suspended solids, organic carbon (particulate and dissolved) and water column chlorophyll. A subset of these samples is being used to assess abundance and diversity of the microbial community inside and outside each of the lagoons. From September 2011 to June 2012, we collected subsamples for the determination of cyanobacteria, heterotrophic bacteria and viruses in the water column. From January 2012 to June 2012, we filtered additional water for DNA extraction. Each time we visited the embayments, we measured light attenuation using a Licor LI-400 equipped with spherical bulbs. In addition, we made 15 pair-wise deployments of YSI-6600 probes, equipped with sensors for temperature, salinity, DO and relative fluorescence (as a proxy for water column chlorophyll). The data, collected by these sensors, is being used to calculate flushing rates and ecosystem metabolism inside and outside the embayments.

At this time, we completed the field sampling described in the project narrative. However, we are planning at least one more round of sampling in each of the lagoons. Approximately 70% of samples have been analyzed for nutrients, organic carbon, total suspended solids and water column chlorophyll. We collected data on precipitation and river flow from nearby weather stations and the USGS. These data will be related to water quality once all samples have been processed. The project is scheduled to be complete at the end of September 2012.

Description of significant research results, protocols developed, and research transitions

Our three sample sites (State Park, Kee's Bayou and Gongora) connect to the same body of water and experience similar tidal cycles, but each is impacted differently by human activities. State Park is the most pristine lagoon; Kee's Bayou is the intermediate site, while Gongora is the most impacted, both in terms of nutrient loading and physical disturbance. State Park and Kee's Bayou contain sizable beds of shoalgrass (*Halodule wrightii*) and widgeongrass (*Ruppia maritima*), but Gongora has no seagrass beds. The lack of seagrass beds in Gongora is in part caused by higher water column chlorophyll concentrations, and consequently by higher light attenuation in the water column.

Preliminary results show that total dissolved nitrogen, dissolved organic carbon and light attenuation are consistently higher inside the embayments compared to the larger bodies of water they are connected with. However, the magnitude of these differences does not seem to be a significantly different between embayments with varying degrees of anthropogenic disturbance. There is no clear trend in water column chlorophyll for State Park and Kee's Bayou, although Gongora has always higher chlorophyll concentrations compared to its immediate environment. In winter, the environmental characteristics within in the embayments are similar to those outside. In summer, diurnal shifts in dissolved oxygen are more extreme inside the lagoons compared to the surrounding bodies of water. During the warmest months, the water column within the embayments often becomes hypoxic at night.

There seems to be no difference in net ecosystem metabolism (NEM) between either of the sites and between the sites and their immediate environment. However, for State Park and Kee's Bayou, respiration and gross primary production are always higher inside the embayments compared to the bodies of water they are connected with. The magnitude of the differences inside and outside the lagoons is positively correlated with water temperature. For Gongora, gross primary production and respiration are usually lower inside, compared to the body of water it is connected to. The spatial and temporal patterns in gross primary production and respiration are clearly related to the distribution of submerged aquatic vegetation within and outside the lagoons.

Although our dataset is still incomplete, the emerging patterns indicate that small embayments are more impaired in water column quality compared to the larger bodies of water they are connected with. However, our preliminary data shows little evidence of a difference in water quality between the three embayments, despite their different degrees of anthropogenic disturbance.

Information on collaborators / partners: None Reported

Information on any outreach activities: None Reported

NOAA sponsor and NOAA office of primary technical contact: Russ Beard, NESDIS

Related NOAA strategic goals: Healthy Oceans

Related NOAA enterprise objectives: Science and Technology

NGI FILE #11-NGI2-03

Project Title: Climate Variability in Ocean Surface Turbulent Fluxes

Project Lead (PI) name, affiliation, email address: Mark Bourassa, FSU, mbourassa@coaps.fsu.edu

Co-PI(s) name(s), affiliation, email address: Shawn Smith, FSU, ssmith@coaps.fsu.edu

Project objectives and goals

FSU produces fields of surface turbulent air-sea fluxes and the flux related variables (winds, SST, near surface air temperature, near surface humidity, and surface pressure) for use in global climate studies. Surface fluxes are by definition rates of exchange, per unit surface area, between the ocean and the atmosphere. Stress is the flux of horizontal momentum (imparted by the wind on the ocean). The evaporative moisture flux would be the rate, per unit area, at which moisture is transferred from the ocean to the air. The latent heat flux (LHF) is related to the moisture flux: it is the rate (per unit area) at which energy associated with the phase change of water is transferred from the ocean to the atmosphere. Similarly, the sensible heat flux (SHF) is the rate at which thermal energy (associated with heating, but without a phase change) is transferred from the ocean to the atmosphere. In the tropics, the latent heat flux is typically an order of magnitude greater than the sensible heat flux; however, in the polar regions the SHF can dominate.

We examine these fluxes on the basis of in situ data (funded solely by NOAA) and satellite data (leveraged from several NASA projects and from the PI being the NASA Ocean Vector Winds Science Team Leader). The in situ product is well suited for long time scale studies, and comparisons to reanalyses. We find that the variability between flux products is far greater than the accuracy need to resolve climate variability, indicating that a great deal more work is needed to make products that are well suited to ocean process studies where the processes are sensitive to the fluxes (as is often the case). We have also found that it is very important to consider high frequency variability (e.g., finer scale synoptic variability) in the calculation of longer-term average fluxes (particularly the ocean uptake of CO_2), and in the case of the Gulf of Mexico's West Florida Shelf, for correctly modeling the regional ocean climate. This is very important for the local ecosystem including some important finfish and shellfish. We maintained our website on variability in northern hemisphere tropical cyclone activity through most of the year; however, it is now moved to the website of the former student that did the work and maintained the site. These studies add to the evidence demonstrating the importance of the ocean and the atmosphere as coupled for climate applications.

The FSU activity is motivated by a need to better understand interactions between the ocean and atmosphere on weekly to interdecadal time scales. Air-sea exchanges (fluxes) are sensitive indicators of changes in the climate, with links to floods and droughts and East Coast storm intensity and storm tracks. On smaller spatial and temporal scales they can be related to storm surge and tropical storm intensity. On longer temporal scales, several well-known climate variations (e.g., El Niño/Southern Oscillation (ENSO); North Atlantic Oscillation (NAO), Pacific Decadal Oscillation (PDO)) have been identified as having direct impact on the U.S. economy and its citizens. Improved predictions of ENSO phase and associated impact on regional weather patterns could be extremely useful to the agricultural community. Agricultural decisions

in the southeast U.S. sector based on ENSO predictions could benefit the U.S. economy by over $100 million annually. A similar, more recent estimate for the entire U.S. agricultural production suggests economic value of non-perfect ENSO predictions to be over $240 million annually. These impacts could easily be extended to other economic sectors, adding further economic value. Moreover, similar economic value could be foreseen in other world economies, making the present study valuable to the global meteorological community.

ENSO, PDO, and NAO (AO) each have atmospheric and oceanic components that are linked through the surface of the ocean. Changes in the upper ocean circulation result in modifications to the SST and near surface wind patterns. Variations in SSTs can be related to ENSO and other climate patterns; however, it is the fluxes of heat and radiation near the ocean surface that transfer energy across the air-sea interface. It is an improved understanding of these turbulent fluxes and their variability that motivates our research (radiative fluxes are difficult to accurately estimate from in situ data; however, satellite-based estimates are available). By constructing high quality fields of surface fluxes we provide the research community the improved capability to investigate the energy exchange at the ocean surface.

FSU produces both monthly in-situ based (the FSU3) and hybrid satellite/numerical weather prediction (NWP) fields of fluxes and the flux-related variables. Our long-term monthly fields are well suited for seasonal to decadal studies, and our hybrid satellite/NWP fields will be ideal for daily to inter- annual variability and quality assessment of the monthly products. The flux-related variables are useful for ocean forcing in models, testing coupled ocean/atmospheric models, ENSO forecasts, and for understanding climate related variability (e.g., the monthly Atlantic surface pressure is a good indicator of extreme monthly air temperatures over Florida).

The flux project at FSU targets the data assimilation milestones within the Program Plan. Our assimilation efforts combine ocean surface data from multiple Ocean Observing System networks (e.g., Voluntary Observing Ship, moored and drifting buoys, and satellites). One set of performance measures targeted in the Program Plan is the Air-Sea Exchange of Heat, Momentum, and Fresh Water. These fluxes can be related to Sea Surface Temperature and Ocean Heat Content. Additional targets are Ocean Transport and Thermohaline Circulation. Surface winds (stress) contribute to upper ocean and deep ocean transport. The heat and moisture fluxes also contribution to the thermohaline circulation. Ocean Carbon Uptake is highly dependent on wind speed. We have recently worked with other members NOAA climate observing team to estimate the importance of using six hourly winds vs. monthly averaged winds on estimates of Ocean Carbon Uptake. The FSU flux project also focuses on the task of evaluating operational assimilation systems (e.g., NCEP and ECMWF reanalyses) and continues to provide timely data products that are used for a wide range of ENSO forecast systems. The FSU fluxes support a broad user community. Our web data portal currently shows 169 registered users from 16 countries. Fifty-seven users are from academic institutions, 35 at governmental agencies, four from public/non-profit entities, and one from the military. Although we do not track the users applications, we know that many are using the FSU winds and fluxes to support tropical SST forecast models (e.g., Lamont-Doherty Earth Observatory model; http://rainbow.ldeo.columbia.edu/~dchen/forecast.html).

Description of research conducted during the reporting period and milestones accomplished and/or completed

Deliverables for FY2011 and their current status include:

1. *Continue operation production of the 2 ° Tropical Pacific and 1 ° Legler Tropical Indian Ocean products.* The Legler tropical Indian Ocean products were produced for each month during period covered by this grant.
2. *Ocean FSU3 wind products.* The FSU3 wind products were produced as stated.
3. *Develop a multi-satellite wind product.* Great progress has been made the development of the satellite-derived stress product. We have demonstrated that our assimilation technique responds to sea surface temperature gradients in a manner qualitatively consistent with observed variability, and consistent with physical processes represented in our assimilation technique. We tested the Pegion et al. (2000) method for tuning weights in our objective method, and found that it would not work in the manner originally employed by Pegion et al. We began developing a new method that we might later be able to integrate into the Pegion et al. objective approach.
4. *Design a satellite-based flux product, based on (2).* We have acquired the SeaFlux near surface data for air temperature and humidity. We also selected an SST field to be used in these analyses, and found that the SST gradients in the Reynolds satellite products were too noisy for our application. We started exploring appropriate smoothing techniques.
5. *Engage new users of (2) and (3).* We continue to work with users and answer questions related to the products under (2). We did not engage users for products under (3) because the products are not ready for testing.
6. *Continue interaction with national and international satellite and in situ wind groups.* We worked with groups in NOAA and NASA applications of satellite and in situ winds.
7. *Continue interaction with national and international flux groups.* We completed a submission on High Latitude surface fluxes, as well as another paper on averaging issues contributing to errors in monthly fluxes. The PI has been helping organize a flux workshop.

Description of significant research results, protocols developed, and research transitions

We found that piracy off the Somalia coast has severely altered the sampling from Volunteer Observing Ships. The merchant marine traffic was moved further offshore to avoid pirates. Consequently, there are very few observations within 500km of the coast, which is an area that has several strong climate signals that are not well represented at the locations of current observations. Furthermore, the few observations that do occur within 500km of the shore are restricted to high wind conditions (poor conditions for the pirate's small boats) which are not representative of typical conditions. Piracy has severely impacted the climate record in this region. This research attracted a great deal of national and international attention.

A paper (in press) describes the impact of sampling and averaging-related biases in the latent heat flux, and the consequences on biases in modeled sea surface temperature. Another paper (in review) outlines the current state of high-latitude flux observations and modeling, and provides recommendations for improvements. A comparison of relative biases in existing flux products has also been published.

We demonstrated that the qualitative change in winds associated with sea surface temperatures was consistent with baroclinic changes described in terms of thermal wind. We showed that they are not consistent with changes due to atmospheric stability. The relative importance of these two processes has been a raging argument for many years.

Information on collaborators / partners:

Name of collaborating organization: NCDC
Date collaborating established: unknown (earlier than 1994)
Does partner provide monetary support to project? Amount of support? No
Does partner provide non-monetary (in-kind) support? No
Short description of collaboration/partnership relationship: NCDC provides in situ marine observations for use in our FSU3 wind and Indian Ocean product

Name of collaborating organization: ICOADS Program
Date collaborating established: unknown (earlier than 1994)
Does partner provide monetary support to project? Amount of support? No
Does partner provide non-monetary (in-kind) support? No
Short description of collaboration/partnership relationship: The higher quality and quantity of ICOADS surface marine data are used in reprocessed versions of our FSU3 and products.

Name of collaborating organization: SeaFlux
Date collaborating established: 2009
Does partner provide monetary support to project? Amount of support? No
Does partner provide non-monetary (in-kind) support? No
Short description of collaboration/partnership relationship: We are working on using the SeaFlux satellite retrievals of near surface air temperature and humidity in the satellite-based that we are developing.

Name of collaborating organization: CIRES
Date collaborating established: 2009
Does partner provide monetary support to project? Amount of support? No
Does partner provide non-monetary (in-kind) support? No
Short description of collaboration/partnership relationship: We are working on using the CIRES (from Darren Jackson) satellite retrievals of near surface air temperature and humidity in the satellite-based that we are developing

Information on any outreach activities:

General Description The principle investigators collaborated on an EOS article that described the impact of piracy in the northwest Indian Ocean on our ability to collect marine climate observations. An article co-authored by Bourassa in EOS resulted in

several media requests. Mr. Smith conducted and interview with Nature News which resulted in a secondary media piece (the Nature News article also included comments from our NOAA colleague Mike McPhaden regarding the impact on Indian Ocean moorings). Mr. Smith also conducted a phone interview with the German Public Broadcasting Network focused on piracy and climate research.

From spring 2010 through now we have worked with an undergraduate honors student interested in how cold air outbreaks modify the temperature of the Gulf Stream waters passing through the Florida Strait. We continue to train graduate students in flux related activities.

NOAA sponsor and NOAA office of primary technical contact: Joel Levy, OAR

Related NOAA strategic goals: Climate Adaptation and Mitigation, Weather-Ready Nation, Healthy Oceans, Resilient Coastal Communities and Economies

Related NOAA enterprise objectives: Science and Technology, Engagement

NGI FILE #11-NGI2-04

Project Title: Optimal UAS River Observing Strategy

Project Lead (PI) name, affiliation, email address: Robert Moorhead, MSU, rjm@gri.msstate.edu

Co-PI(s) name(s), affiliation, email address: Jim Aanstoos, MSU, aanstoos@gri.msstate.edu

Project objectives and goals

The goal of this proposal is to determine the optimal UAS platforms and instruments for inland flooding prevention, detection, and mitigation, by examining the needs and the available technology. This will be accomplished in 4 steps:

- By documenting available UAS platforms and instruments that can reasonably be used in the NAS to monitor floods and levees, as well as collecting in writing some of the river forecast center (RFC) needs.
- By hosting a workshop at which NOAA RFC scientists will learn about the various platforms and instruments. Selected platform providers and instruments providers would be invited, based on the initial paper study to provide information on their technology. The NOAA scientists will identify their science problem, explain their needs, and react to the technology providers. The technology providers will explain their existing and planned platforms and instruments. The goal being to determine optimal configurations and theorize optimal operational scenarios. For example, radar systems are an optimal way to detect ice jams (it can detect the difference in surface roughness between water and ice), but a visible camera in general is lighter and should be able to be flown with a lighter platform, reducing operating cost and potentially allowing a less demanding approval process from the FAA. Is the radar worth the extra cost and hassle? A presentation on the issues in obtaining a certificate of authorization (or waiver) would also be an informative presentation.
- By compiling a report of the workshop presentations, discussions, and conclusions.
- In addition to the workshop-related efforts, a small test of one candidate UAS will be conducted which will provide performance data for an additional option to be considered by the workshop participants. This UAS will be a small, low-cost, low-altitude vehicle. The test will show to what extent data obtained from such a vehicle can support some of the RFC needs. An airborne Laser Altimeter for surface and vegetation height profiling will be flown on the MSU X-RV UAS.

The surface height profiles from the X-RV payload will allow local angle-of-incidence information to be computed, and will also provide limited resolution information on surface profile and vegetation cover. Angle of incidence is an important parameter used in processing radar data to estimate soil moisture, and in the vicinity of natural or manmade levees a significant local incidence angle effect is present. The X-RV payload will be an instrument package built at MSU to the design of the CULPIS (Colorado University LIDAR Profilometer and Imaging System) instrument, which includes both a laser altimeter and digital still and video cameras. The CULPIS is a low cost, low mass instrument package built from COTS components and simple

timing control circuitry suitable for deployment on a small UAV. It has been successfully used to measure the height of ice sheets in one application.

The X-RV aircraft is a long endurance variant of the highly successful X-2C UAV developed at Mississippi State University. The X-2C couples a robust student designed and built airframe with a combination of commercial off-the-shelf (COTS) hardware and student-designed software components into a dynamic system capable of gathering imagery of targets of interest during fully autonomous flight. The airframe is fabricated using pre-impregnated carbon/fiberglass hybrid material and able to carry a payload of up to 25 lbs. The onboard systems include a Piccolo LT autopilot, a digital pan/tilt/zoom camera, and a broadband Ethernet bridge. The X-RV UAV will be flown at a low enough altitude that it can provide high-resolution optical imagery on short notice in selected areas.

The outcome of the 4 steps would be to determine what platform(s) and instrument(s) configurations would be appropriate ones to seek to obtain a COA to test the configuration and to execute some trial runs.

Description of research conducted during the reporting period and milestones accomplished and/or completed

- Preliminary Whitepaper constructed
- Workshop held, at which the state of the art in UAS technology was presented
- Workshop summary compiled, with an appendix entitled, “Multi-Agency UxS Lessons Learned, Concerns and Best Practices.”
- Multiple visits with LMRFC personnel

Description of significant research results, protocols developed, and research transitions

The summary of the workshop documents and prioritizes the RFC needs.

Information on collaborators / partners:

Name of collaborating organization: National Weather Service LMRFC
Date collaborating established: May 2008
Does partner provide monetary support to project? Amount of support? No
Does partner provide non-monetary (in-kind) support? Yes, time and advice. They assist in providing requirements.
Short description of collaboration/partnership relationship We have worked with the LMRFC in the past to design and build a software tool called “FloodViz” that allows 3D visualizations of river data. It allows one to see the depth of the water in context.

Information on any outreach activities:

General Description: A workshop to educate RFC leaders on UAS technology, to ascertain RFC needs, and to develop a list of requirements and wants

Hosted speakers, workshops and/or any training:

Type (speaker, workshop, training): workshop

Name of event: Optimal Unmanned Aircraft Systems River Observing Strategy workshop

Date: Feb 21-23, 2012

Location: Boulder, CO

Description: A workshop to educate RFC leaders on UAS technology, to ascertain RFC needs, and to develop a list of requirements and wants

Approximate Number of Participants: 44

NOAA sponsor and NOAA office of primary technical contact: Robbie Hood, OAR

Related NOAA strategic goals: Climate Adaptation and Mitigation, Weather-Ready Nation

Related NOAA enterprise objectives: Science and Technology

NGI FILE #11-NGI2-05

Project Title: Hypoxia Research Coordination Support

Project Lead (PI) name, affiliation, email address: John Harding, MSU, jharding@ngi.msstate.edu

Project objectives and goals

There is a need for Hypoxia Research Coordination Workshops in several U.S. regions, including the Gulf of Mexico. In spring 2012, the 3rd Annual Gulf of Mexico Hypoxic Zone Research Coordination Workshop will be convened in Bay St. Louis, Mississippi. The overarching goal of the Workshop is to improve coordination of monitoring and modeling for the Gulf Hypoxic Zone for 2012 and beyond, and to facilitate management of the Hypoxic Zone by incorporating research findings and plans into the Gulf Hypoxia Task Force Annual Progress Report and Annual Operating Plans. The workshop objectives are to: (1) bring stakeholders together to share on-going hypoxia activities in the Gulf of Mexico region and to discuss key results and research plans for the remainder of FY11 and FY12; (2) discuss synergies and leveraging opportunities among the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Gulf of Mexico Alliance, and Gulf Coast Ecosystem Restoration Task Force; (3) review status of and solicit input regarding the hypoxia monitoring matrix and implementation plan, hypoxia modeling matrix, FY11 Dead Zone Forecast, hypoxia data management plans, hypoxia communications plan, and Hypoxia Impacts on Gulf of Mexico Fisheries Report and Plan; (4) discuss hot topics/issues (e.g., oil spill, new methodologies, ship and platform issues) related to hypoxia activities that might have broad relevance to all participants.

Description of research conducted during the reporting period and milestones accomplished and/or completed

Sponsored 3rd Annual Workshop to Coordinate Gulf of Mexico Hypoxic Zone Research, 27-28 March 2012

Description of significant research results, protocols developed, and research transitions

Improved university/ federal & state agency coordination of monitoring and modeling for the 2012 Gulf Hypoxic Zone and beyond and facilitated management of the Hypoxic Zone by identifying research findings for incorporation into the Gulf Hypoxia Task Force Annual Progress Report and Annual Operating Plans.

Information on collaborators / partners:

Name of collaborating organization: Alan Lewitus, NOAA NCCOS Center for Sponsored Coastal Ocean Research
Date collaborating established: Jul 1, 2009
Does partner provide monetary support to project? Amount of support? Yes
Does partner provide non-monetary (in-kind) support? Yes
Short description of collaboration/partnership relationship: Workshop co-sponsor

Name of collaborating organization: David Scheurer, NOAA NCCOS Center for Sponsored Coastal Ocean Research
Date collaborating established: Jul 1, 2010
Does partner provide monetary support to project? Amount of support? Yes
Does partner provide non-monetary (in-kind) support? Yes
Short description of collaboration/partnership relationship: Workshop co-sponsor

Information on any outreach activities:

General Description: Workshop to coordinate Gulf of Mexico hypoxic zone research
Hosted speakers, workshops and/or any training:

Type (speaker, workshop, training): Workshop
Name of event: 3rd Annual Workshop to Coordinate Gulf of Mexico Hypoxic Zone Research
Date: Mar 27-28, 2012
Location: Bay St. Louis, MS
Description: Workshop designed to improve university/ federal & state agency coordination of monitoring and modeling for the 2012 Gulf Hypoxic Zone and beyond and facilitate management of the Hypoxic Zone by identifying research findings for incorporation into the Gulf Hypoxia Task Force Annual Progress Report and Annual Operating Plans.
Approximate Number of Participants: 90

NOAA sponsor and NOAA office of primary technical contact: Alan Lewitus, NOS

Related NOAA strategic goals: Climate Adaptation and Mitigation, Healthy Oceans

Related NOAA enterprise objectives: Science and Technology, Engagement

NGI FILE #11-NGI2-06

Project Title: Linkage Between the Commercial Shrimp Fishery & Juvenile Red Snapper in the Northern Gulf of Mexico

Project Lead (PI) name, affiliation, email address: Paula Moreno, USM, Paula.Moreno@usm.edu

Project objectives and goals

The main goals of this project are to: 1) characterize the distribution of the juvenile red snapper (RS) and the shrimp fishery in the northern Gulf of Mexico; 2) help determine how strong the association between juvenile red snapper occurrence and the shrimp fishery is, and 3) help identify where the association is strongest.

Description of research conducted during the reporting period and milestones accomplished and/or completed

To date, the following research tasks and milestones have been conducted and completed:

Tasks

- Compilation and preparation of the different data sources for analysis. Shrimp fishery data consists of shrimping effort provided by NMFS Galveston Laboratory. Juvenile RS catch per unit effort data (CPUE) is provided by NMFS Mississippi Laboratories;
- Selection of the analytical unit, based primarily on the temporal and spatial resolutions of the sampled variables;
- Associate all data sources spatially and temporally within the analytical unit (geo-referenced grid);
- Perform statistical/GIS analysis to examine the association between the distribution of the juvenile RS and shrimp fisheries and determine if there are regions of strong association;
- Presentation at annual NGI meeting.

Milestones

- Data gathering, preparation and analysis.

Methodology

We utilized age-1 red snapper catches (CPUE) and other environmental parameters (e.g. depth) from bottom trawl summer surveys conducted by NMFS between from 2005 to 2008 and ELB data (10-minute tows) collected year-round from commercial shrimp vessels for the same years. To develop the multivariate and spatial models, datasets were projected to a customized North America Albers Equal Area Conic projection and synchronized temporally and spatially using a geo-referenced grid extending from the Texas-Mexico border to west of the Mississippi River Delta consisting of 20 km by 20 km cells. We divided the study area into three regions: west, center and east (Figure 16).

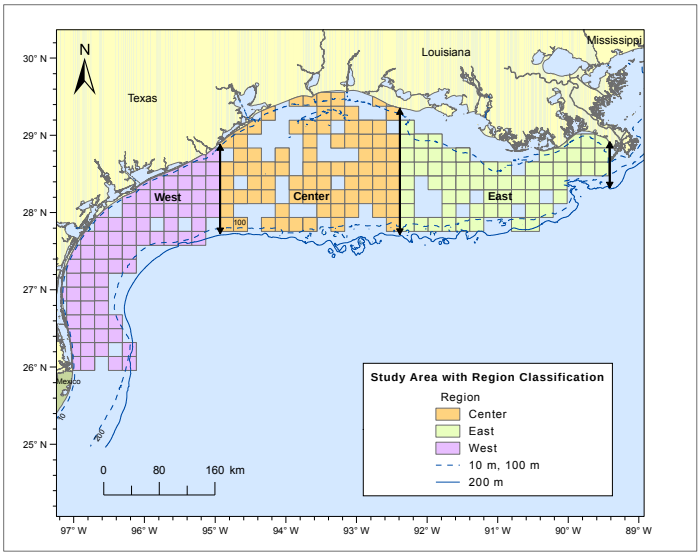

Figure 16. Study area showing the three regions: west, center and east. Blank cells within the grid result from un-sampled locations.

To characterize the distribution of the juvenile red snapper (RS) and the shrimp fishery effort, we used GIS (ArcGIS) to calculate and map their annual and/or mean distributions. Juvenile and commercial shrimping effort were classified as High (upper quartile) or Low (Lower quartile), respectively, and annual maps were produced. To examine the stability of High RS and Low shrimping effort areas, we determined and mapped the persistence, i.e. number of years, of High/Low areas from 2005 to 2008.

To examine the association of juvenile RS and the shrimp fishery, we developed a Generalized Additive Model (GAM) using a log link function with a Quasi-Poisson error distribution, with juvenile RS as a function of shrimping effort, depth and region. In addition, we mapped the peak positive responses of RS to these environmental conditions, which correspond to prime habitat for juvenile RS, as predicted by the model. These criteria were used to identify a potential shrimp fishery closure within the provisioned seasonal closure area (Federal Register, 2008, 73(19):5117-5128) that maximizes the protection of RS nursery habitat, while minimizing disruption to the shrimp fishery.

Description of significant research results, protocols developed, and research transitions

Significant Results

We found that from 2005 to 2008, juvenile RS density (CPUE) was consistently high in certain areas of the northern Gulf of Mexico to the west of the Mississippi River delta, as indicated by the higher persistence (Figure 17). These areas were primarily in the west and center regions of the study area. Conversely, high persistence of low shrimping effort, was more prevalent in the center and east regions. Since persistence can be influenced by year to year variations in sampling effort, we only used the GAM to identify the best location for a potential seasonal closure of the shrimp fishery.

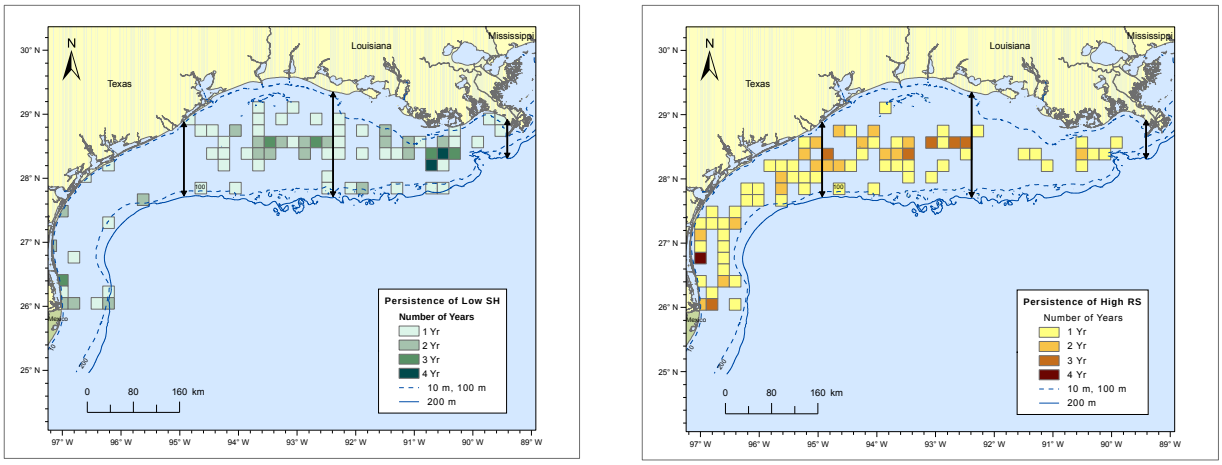

Figure 17. Persistence (number of years) of regions with low shrimping effort (left) and high juvenile red snapper density (right).

Our model suggested (Figure 18) a significant association of juvenile RS density with shrimping effort, depth and region. The RS responses to shrimping effort and depth were non-linear, supporting the use of GAMs. There was a slight positive effect at moderate shrimp effort (~25 to ~1,700 tows) and at more intensive shrimping effort the effect on RS density became negative. Regarding the effect of depth, the peak of the positive response occurred at depths between approximately 35m to 65m. According to this model, this intermediate depth range represents prime habitat for juvenile RS. Regarding regions, there was no difference between the west and center regions, whereas the east region had a negative effect.

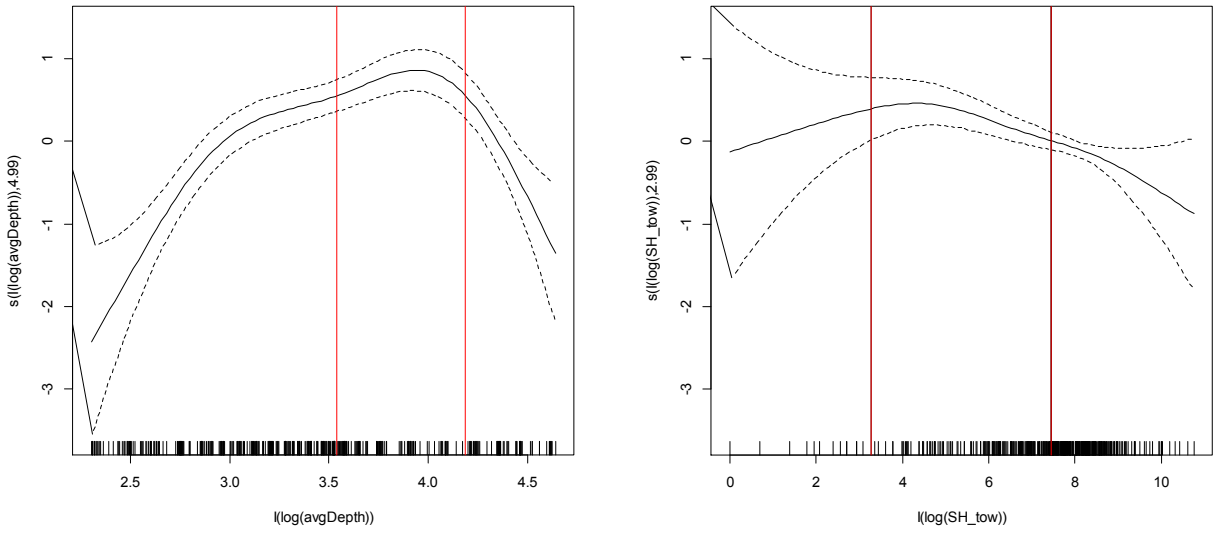

Figure 18. Graphical summary of GAM model fit. Estimated smooth terms (solid line) describing the dependence of RS CPUE on depth (left) and shrimping effort (right). On the y-axis is the log of the 4th root of red snapper CPUE. On the x-axis are the log-transformed covariates. Dashed curves are the 95% confidence intervals with covariate observations as a rug plot along the x-axis. Red lines show the interval of covariate values used, along with regions west and center, to map most favorable habitat conditions.

The area predicted as the highest RS density was substantially smaller than the total sampled area and was distributed in the west and center regions (Figure 19). This high RS density area, excludes the most intensively fished areas. The largest contiguous area of high RS density occurred in the center, while in the west the areas of high RS densities were more dispersed. Therefore, we selected the buffered zone in the center region, as the most appropriate for the location of additional provisioned shrimp fishery closures, if such measures are warranted. More than half of the selected area overlapped the seasonal Texas closure. Thus, to some extent the selected area would facilitate implementation of new closure measures by extending the duration of the Texas closure.

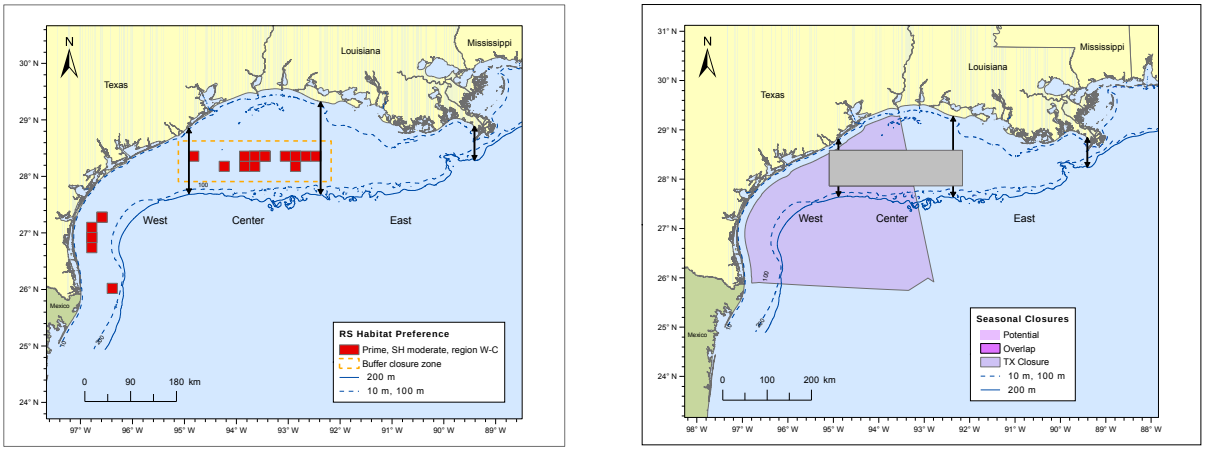

Figure 19. The map on the left shows the areas where the RS response was highest (red cells) derived from the GAM model. Also shown is the selected seasonal closure zone (dashed rectangle). The map on the right, indicates the degree of overlap between the selected seasonal closure and the Texas closure (light purple).

In summary, if—as suggested by this model—the region located off eastern Texas and western Louisiana offers consistently good nursery conditions for red snapper, and is not among the most important shrimping areas, then it would be a good candidate to protect nursery habitat for red snapper to promote a faster recovery of red snapper stocks, while minimizing adverse impacts on the shrimp fishery.

This large-scale study demonstrates how spatial zoning of the northern GOM can be achieved by identifying priority habitats for important commercial and recreational species, e.g, red snapper, while minimizing impacts on other fisheries activities, e.g, shrimp fishery. To reduce conflict in competing uses of natural resources and preserve ecosystem integrity is a main goal of coastal and marine spatial planning (CMSP).

Remaining Tasks

The second phase of the project will involve: discussions with NOAA Fisheries collaborators to obtain feedback on research findings; review of red snapper and commercial shrimp fishery literature, and composition of final report.

Information on collaborators / partners:

Name of collaborating organization: NOAA Fisheries, Southeast Fisheries Science Center, Galveston Laboratory and Pascagoula Laboratory
Date collaborating established: Aug 2011 (Galveston Lab), Mar 2010 (Pascagoula Lab)
Does partner provide monetary support to project? Amount of support? No
Does partner provide non-monetary (in-kind) support? Yes, collaborators provide data, fisheries programs documentation, feedback, and advice
Short description of collaboration/partnership relationship Dr. Jim Nance, Chief, Fishery Management Branch, Galveston Laboratory, is the interface with LGL Ecological Research Associates, Inc. to provide Electronic Log-Book (ELB) data used in characterizing shrimp vessel activity. We also consult with Dr. Jim Nance on protocols and receive feedback on results. Finally, Dr. Nance is instrumental in obtaining gray literature relevant to documenting the ELB program and the shrimp fishery in the Gulf of Mexico.

Dr. Walter Ingram, Pascagoula Laboratory, heads the Data Analysis Unit and provided data on juvenile red snapper from NMFS systematic fisheries-independent surveys (SEAMAP). Also, we consult with Dr. Ingram to discuss survey protocols, data inconsistencies, results.

Information on any outreach activities:

General Description: Oral presentation, Q&A
Hosted speakers, workshops and/or any training:
Type (speaker, workshop, training): Speaker
Name of event: NRL Summer Seminar Series
Date: Jun 13, 2012
Location: Stennis Space Center, MS
Description: Presentation of “Understanding habitat drivers of juvenile red snapper distribution in the Gulf of Mexico: a step toward marine spatial planning.”
Approximate Number of Participants: 35-45

NOAA sponsor and NOAA office of primary technical contact: Lisa Desfosse, NMFS

Related NOAA strategic goals: Healthy oceans

Related NOAA enterprise objectives: Science and technology

NGI FILE #11-NGI2-07

Project Title: U.S. Research Vessel Surface Meteorology Data Assembly Center

Project Lead (PI) name, affiliation, email address: Shawn R. Smith, FSU, ssmith@coaps.fsu.edu

Co-PI(s) name(s), affiliation, email address: Mark A. Bourassa, FSU, mbourassa@coaps.fsu.edu

Project objectives and goals

The central activity of the U.S. Research Vessel Surface Meteorology Data Assembly Center (DAC) at the Florida State University (FSU) is developing and implementing the Shipboard Automated Meteorological and Oceanographic System (SAMOS) initiative (http://samos.coaps.fsu.edu/). The SAMOS initiative focuses on improving the quality of and access to surface marine meteorological and oceanographic data collected in-situ by automated instrumentation on research vessels. In the past year, 26 U.S.-operated and 3 Australian research vessels routinely transmitted daily emails containing one-minute averaged meteorology and surface oceanographic data to the DAC. Broadband satellite communication facilitates this daily transfer at ~0000 UTC. A preliminary version of the data is available via web services within five minutes of receipt. The preliminary data undergo common formatting, metadata enhancement, and automated quality control (QC). Visual inspection and further scientific QC result in intermediate and research-quality products that are nominally distributed with a 10-day delay from the original data collection date. All data and metadata (e.g., instrument height, type, units) are version controlled and tracked using structured query language (SQL) databases. These data are distributed free of charge and proprietary holds via http://www.coaps.fsu.edu/RVSMDC/html/data.shtml, and long-term archiving occurs at the U.S. National Oceanographic Data Center (NODC).

The DAC activities focus primarily on NOAA Strategic Plan Goals 2 and 3 by providing high-quality weather and near-surface ocean data to validate complementary satellite observations; global analyses of the ocean-atmosphere exchange of heat, moisture, and momentum; and computer-model-derived analyses of climate, weather, and ocean parameters. The data distributed by the DAC address the Office of Climate Observation (OCO) program deliverables related to sea surface temperature, surface currents (via the wind), and air-sea exchanges of heat, momentum, and fresh water.

Research vessels, mobile observing platforms, are an essential component of the global ocean observing system, They are equipped with computerized data systems that continuously record navigational (ship position, course, speed, and heading), meteorological (winds, air temperature, pressure, moisture, rainfall, and radiation), and near-surface ocean (sea temperature and salinity) parameters while a vessel is underway. Research vessels travel to remote, hard to observe ocean locations far from the shipping lanes sampled by merchant vessels. Research vessels provide essential observations between the fixed locations of surface moorings and support side-by-side comparison to mooring data when moorings are deployed or serviced.

The DAC provides data that quantify the physical and thermodynamic processes governing the interaction between the ocean and atmosphere, key to our understanding of how marine weather systems evolve, how these systems impact the ocean, and how the oceans impact the weather. On longer time scales, understanding the interaction between the ocean and atmosphere is necessary to assess our changing global climate system. The DAC provides high-quality marine meteorological and surface ocean measurements to the research and operational community so that they can identify and model the interactions between the ocean and atmosphere. Benefits include improved weather and climate models and forecasts that provide the public and private sector with the tools to make decisions affecting agricultural productivity, the energy industry, and daily life.

Our user community includes scientists developing algorithms to retrieve marine observations from space, those working to define the range of air-sea exchanges in extreme environments (e.g., the Southern Ocean), and atmospheric and ocean modelers seeking to verify model analyses and forecasts. For many applications, our users require observations in the extremes of the marine environment (e.g., very high or low winds) and need frequent sampling in space and/or time to identify local marine features (e.g., weather and ocean fronts). The research vessels providing observations to the DAC meet these needs and the DAC quality evaluation ensures the users receive fully documented observations to complete their analyses.

Description of research conducted during the reporting period and milestones accomplished and/or completed

Over the past year, we have concentrated on continued data quality evaluation (from collection to archival) for previously recruited vessels and on the scientific application of SAMOS data. We also continued active participation in the international marine climate community.

Deliverables for FY2011 included the following:

1. Recruit any outstanding or new NOAA vessels to the SAMOS initiative.

2. Engage OMAO to obtain full metadata for all recruited NOAA vessels.

3. Continue routine quality evaluation of meteorological data for SAMOS vessels currently contributing to the DAC. Research-quality visual evaluation will only be conducted for NOAA vessels and those vessels recruited prior to 1 July 2009.

4. Begin routine submissions to ICOADS.

5. Engage new user communities.

6. Continue liaison activities with U.S. and international (limited) government agencies, archives, climate programs, and throughout the marine community.

7. Create turbulent air-sea fluxes for vessels contributing to SAMOS and use fluxes to evaluate recent NWP and satellite products.

Progress on these deliverables specifically target the program deliverables related to sea surface temperature, surface currents (via wind observations), and the air-sea exchanges of heat, momentum, and freshwater. The DAC strives to make high-quality observations readily available to the research and operational marine climate community. Our FY2011 deliverables address the collection, quality evaluation, and distribution of surface marine observations to the community.

Vessel recruitment [Deliverable 1]
Four new vessels have been recruited in the past year with 29 vessels providing routine observations (Table 1). Our partnership with the Australian IMOS project resulted in the addition of the *Tangaroa* (operated by New Zealand). The inclusion of the *Tangaroa* provides observations in the poorly observed South Pacific Ocean.

Recruitment of the *Robert Gordon Sproul, New Horizon*, and *Thomas G. Thompson* was supported by complementary funding from the National Science Foundation (NSF) Ocean Instrumentation and Technical Services program (these vessels are listed here for completeness). Progress on each deliverable is briefly summarized in the following sections. The NOAA vessel Bell M. Shimada was recruited in the past year under our present NOAA support.

Expand vessel metadata [Deliverable 2]

We continued to emphasize, with OMAO and other operators, the importance of ship and instrument metadata with the operators through individual email communication and at technical meetings (e.g., RVTEC). We received updated metadata (including new sensor make/model, calibration date, and some location information) from the *Ha'Ialakai*, *Ka'Imimoana*, and *Okeanos Explorer*. We also received new digital imagery from the *Gordon Gunter* and the *Ha'Ialakai*. Instrument metadata, especially instrument location and digital imagery, are critical for accurate scientific application of the observations and for identifying sensor/data problems during visual QC. The struggle to keep metadata up to date for rapidly changing RV sensor systems continues.

Data quality control [Deliverable 3]
Automated quality processing is completed on every set of data received from recruited vessels (Table 1). The automated processing continues to be a smooth operation with each data set being versioned and tracked via an SQL database. In the past year, we evaluated 4990 days of underwater meteorological and sea surface temperature data. These data cover most of the coastal regions around North America and extend into poorly sampled regions of the South Pacific, North Atlantic, and Southern oceans (Figure 20). The extent of these data from the tropics to the polar latitudes, along with many reports on the continental shelf, provide

Table 1. Ships transmitting observations to SAMOS DAC during the reporting period. Several new vessels recruited leveraging additional funding from NSF are shown for completeness.

Vessel	Operator	7/1/2011 – 6/30/2012
Atlantic Explorer[1,2]	BIOS	181
Atlantis	WHOI	332
Aurora Australis[1]	IMOS/Australia	199
Bell M. Shimada	NOAA	82
Gordon Gunter	NOAA	178
Healy	USCG	220
Henry B. Bigelow	NOAA	157
Hi'ialakai	NOAA	136
Ka'imimoana	NOAA	205
Kilo Moana[1,2]	U. Hawaii	269
Knorr	WHOI	329
Lawrence M. Gould	NSF/Raytheon	331
McArthur II	NOAA	49
Melville[1,2]	SIO	162
Nancy Foster	NOAA	139
Nathaniel Palmer	NSF/Raytheon	219
New Horizon[1,2]	SIO	10
Oceanus	WHOI	129
Okeanos Explorer	NOAA	156
Oregon II	NOAA	137
Oscar Dyson	NOAA	176
Oscar Elton Sette	NOAA	163
Pisces	NOAA	139
Robert Gordon Sproul[1,2]	SIO	13
Roger Revelle[1,2]	SIO	338
Ronald Brown	NOAA	116
Southern Surveyor[1]	IMOS/Australia	151
Tangaroa[1]	IMOS/New Zealand	270
Thomas G. Thompson[1,2]	SIO	4
		4050

[1]No research-quality visual data quality control completed.
[2]NSF funding supported recruitment (part of UNOLS Rolling Deck to Repository project).

observations from the wide range of environmental conditions required by our users to meet objectives in satellite, air-sea exchange, and physical oceanographic studies. The data collected and quality controlled by the DAC directly support the OCO program deliverables related to sea surface temperature, currents (via wind data), and the air-sea exchange of heat, momentum, and fresh water.

Our lead analyst, Jeremy Rolph, continues to conduct daily (not 24/7) visual inspections of all observations. This inspection, a quick-look, does not allow for adding/altering quality control flags on the data. It is a means of ensuring that the data received from the vessel are free of major sensor failures or other problems that would require notification of the vessel at sea. These at-sea notifications are highly desired by the vessel operators and onboard technicians and are the core benefit to the vessel operator. Prompt notification of problems results in quick resolution of sampling issues and adds value to the investment made by the operators in expensive marine observing systems.

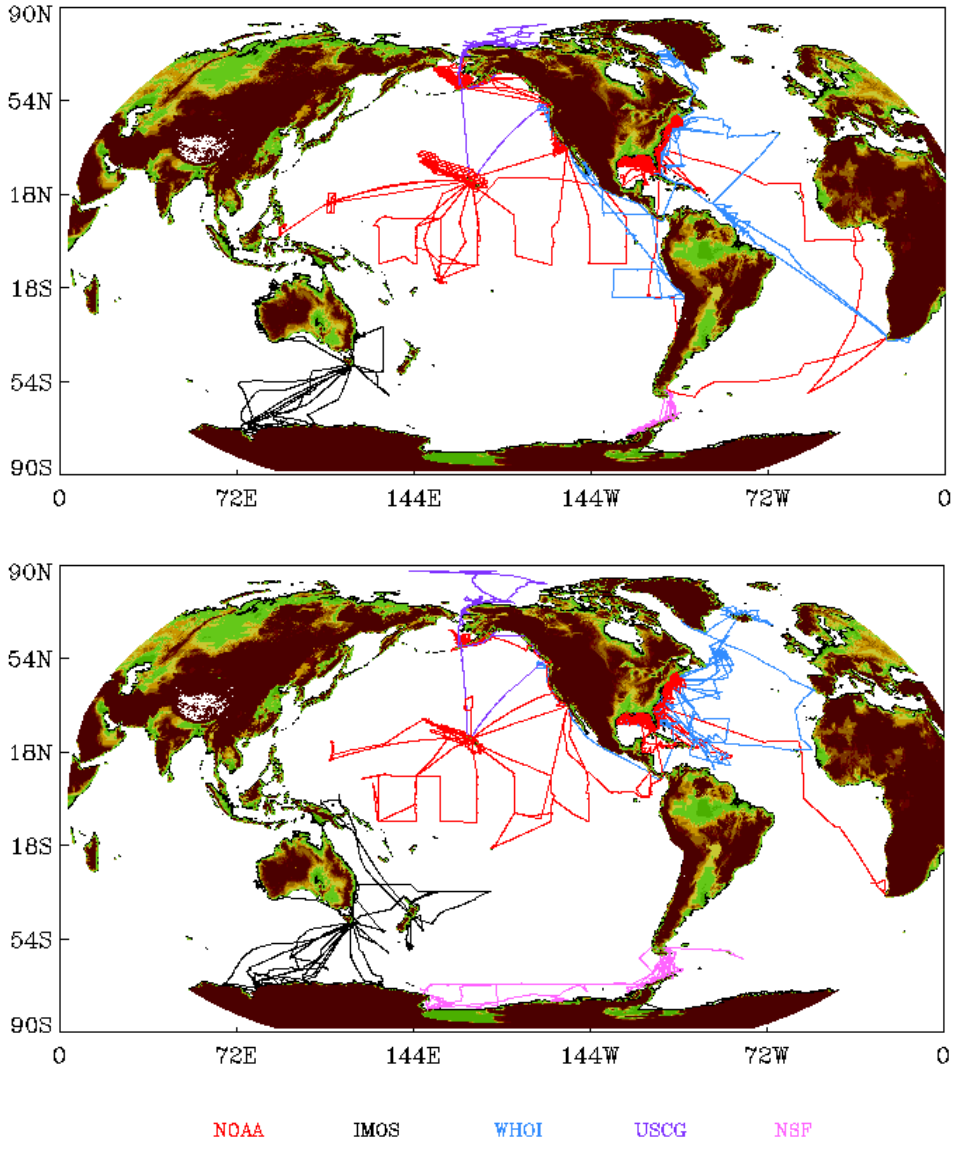

Figure 20. Cruise tracks showing data provided to the SAMOS DAC for FY2010 (top) and FY2011 (bottom). Data are color coded by the primary data providers. The four vessels recruited under NSF support are excluded from the maps.

Over the past year, Kristen Briggs, our visual data quality analyst, completed research quality QC for most of the recruited vessels (the exceptions are noted in Table 1). Visual QC allows the analyst to review, add, or modify data quality flags on the merged files. Visual quality control is

manpower intensive and has been successful for 2011 only because the DAC continues to leverage NSF funding and shift resources and tasks for our two quality analysts. NSF funds are focused on vessels from the U.S. academic fleet, so our OCO funds have been focused on the quality evaluation of SAMOS observations received from the NOAA, USCG, and polar vessels. The Australians conduct visual QC for IMOS vessels. Even with the additional funding from NSF, we are unable to provide research quality visual QC for newly recruited vessels, with the exception of any new NOAA vessels that come on line.

We again produced an annual report that summarizes the data quality for all vessels contributing data for the calendar year 2011. The report has been distributed to all operators of SAMOS vessels and provides a foundation for developing automated weekly and monthly reports for operators.

Routine submission of data to ICOADS [Deliverable 4]
Initial plans for submission of all SAMOS observations to the International Comprehensive Ocean Atmosphere Data Set (ICOADS) were made during a meeting with the ICOADS team in Boulder (October 2011). We anticipated beginning routine (monthly) submissions starting with release 2.6 of ICOADS in mid-2012. Recent plans by NOAA ESRL to cease all support for ICOADS have placed this project on hold. If funding for ICOADS is pulled, then this deliverable will not go forward.

Scientific advances through user engagement [Deliverable 5]
Leveraging funding from NASA NEWS, the PIs established an active partnership with Darren Jackson and Gary Wick at NOAA ESRL whereby the SAMOS observations are used to aid development of new satellite retrieval algorithms for surface air temperature and humidity. SAMOS air temperature and humidity observations from the *Knorr* are adjusted to a common 10-m height using a bulk flux algorithm and the resulting values are collocated with ESRL-derived satellite retrievals (Figure 21). The comparison shows unbiased agreement at nearly all temperatures with an overall bias near zero (Figure 21, top). Regional biases are revealed in March (orange) over the Gulf Stream and in December (purple) near the west coast of Africa (Figure 21, bottom). Developing satellite-based surface air temperature and humidity products has long been a challenge for the marine community, and the contribution of SAMOS data to these validation efforts will allow bias corrections to be developed in the retrievals, particularly in regions where seasonal effects (e.g., cold-air outbreaks over western boundary currents) on atmospheric temperature and humidity profiles can adversely impact current satellite retrievals.

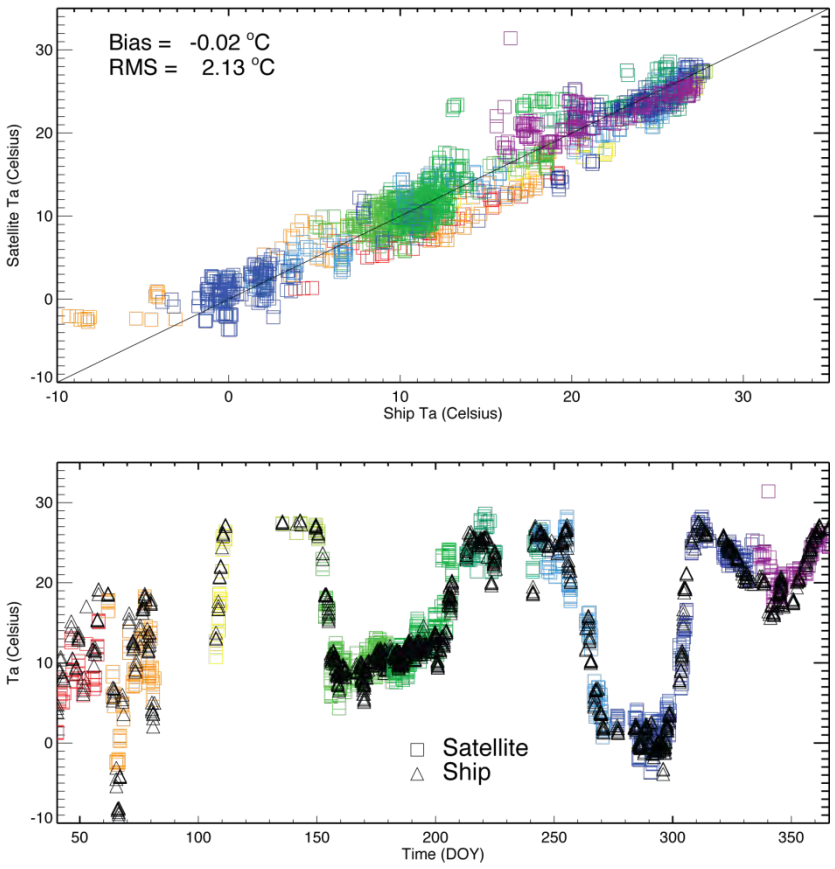

Figure 21. Comparison between SAMOS air temperature from the Knorr and dual sensor satellite retrievals developed by NOAA ESRL. A total of 1627 collocations are shown for 2007 (color coded by month). Figure created by Darren Jackson at NOAA.

FSU is actively applying SAMOS observations to validate sea surface temperature and salinity fields from the HYbrid Coordinate Ocean Model (HYCOM). HYCOM is widely used by physical oceanographers and marine biologists. FSU is focusing on validating HYCOM in the northern Gulf of Mexico, a region of high productivity for the U.S. fishing industry. The project began with work by two high school interns and has been continued by an undergraduate student (Nicolas Lopez) leveraging additional funding from the HYCOM project. The preliminary results (Figure 22) reveal an overestimation of the surface salinity in HYCOM near the northern Gulf Coast. The hypothesis is that HYCOM is underestimating the freshwater input from the major rivers along the coastline. Use of SAMOS observations to validate ocean models provides a significant opportunity to quantify model biases and provide direction for future model improvements.

Other known users of SAMOS observations include Jim Manning (NOAA NE Fish Science Center), an international researcher (Mr. Lim) doing satellite wind product validation in the Southern Ocean, John Gunn (Earth & Space Research), and Chad Cary from NOAA's Environmental Modeling Center (Arctic SST data). The NASA PO.DAAC has also included the SAMOS data in one of its data mining tools.

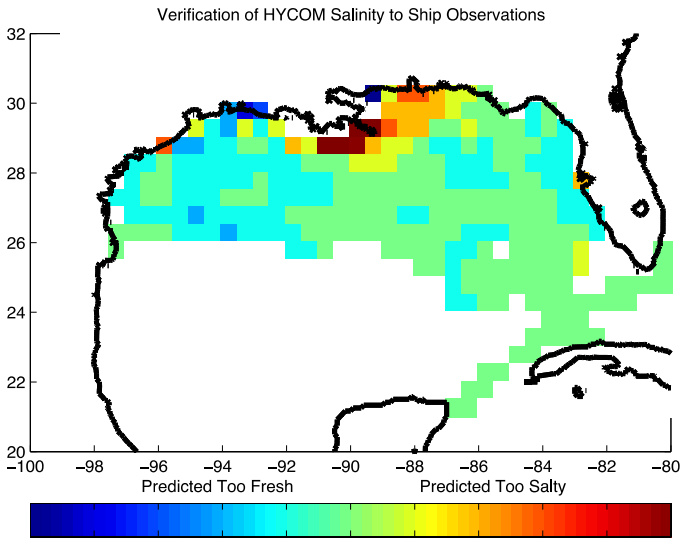

Figure 22. Sea surface salinity difference between HYCOM and a composite of 18 SAMOS ship tracks in the Gulf of Mexico. At total of 280,363 individual one-minute HYCOM-Ship differences are binned on a 0.5˚ grid. Ship-to-HYCOM matches are constructed through a bilinear interpolation of the HYCOM 1/25˚ daily data to the individual ship positions.

Liaison activities [Deliverable 6]
The SAMOS project continues to exemplify strong data stewardship practices for underway data from research vessels and maintains an active partnership with the Australian IMOS project, the UNOLS Rolling Deck to Repository (R2R) project, and the NOAA R2R initiative. The PI routinely receives requests from other marine data programs to share the lessons learned from SAMOS. Without ongoing support from NOAA, the SAMOS project would never have become a model for the management of underway atmospheric and surface ocean data.

The SAMOS DAC serves as the project office for the entire SAMOS initiative. In this capacity, DAC personnel facilitate U.S. and international collaborations on topics such as data accuracy, data acquisition and exchange, training activities, and data archival. The PI performs an active role in the international marine climate community, serving on two Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) task teams (*Delayed-Mode Voluntary Observing System* and *Instrument Systems*). The PI was lead author on a published meeting summary. The PI continues to support the international ship observation programs of the WMO and IOC.

Air-sea fluxes from ship observations [Deliverable 7]
We have completed, tested, and implemented a code to derive bulk turbulent fluxes from the quality processed SAMOS data. Fluxes have been calculated for the *Knorr*, *Atlantis*, and *Aurora Australis* to support the satellite algorithm development at NOAA ESRL. These preliminary flux files are available via FTP (ftp coaps.fsu.edu, anonymous access, cd /pub/hu/XXXX_flux, where XXXX=vessel call sign) only.

Impact of funding reductions
The science community drives requests for additional vessels to be included in the SAMOS program. At OceanObs'09, numerous white papers recommended that SAMOS be expanded to include more international vessels. Additionally, vessel operators are now aware of the value in having shore-side quality evaluation of their data and real-time feedback concerning instrument problems while at sea. Although operator interest is expanding and the scientific need for observations is growing, flat NOAA funding for the SAMOS DAC (a net loss when inflation is included) has limited our ability to further increase the number of vessels contributing data to the DAC. We do not actively recruit new vessels at present, but we will accept new vessels when approached (e.g., new IMOS vessels). Thanks to NSF, we are leveraging additional resources, but NSF will fund recruitment of only UNOLS, not international, vessels. Vessel recruitment is labor intensive in the early stages, requiring numerous communications between the vessel operator and our lead data analyst (Mr. Rolph). In-person visits to vessels are highly productive, but we have not been able to fund these visits (except in conjunction with a co-located meeting) for several years.

We also note that the failure by NOAA as a whole to support the ICOADS project will severely limit the long-term usefulness of the SAMOS data. Plans to include SAMOS data in this internationally respected data set will not be completed and the subsequent loss of the modern RV data combined with 300+ years of historical marine meteorology data will limit the ability of the community to place SAMOS data in a historical context.

Continued funding reductions will limit the role of the SAMOS data center and PI in JCOMM activities. Opportunities to attend meetings to expand collaboration with the European research vessel community and to contribute to the WMO planned revisions to the delayed-mode VOS climate summaries were missed in 2011. We anticipate that no international travel will be possible in FY2012, further limiting the role of SAMOS in the international community.

Data distribution
All near real-time (preliminary, 5-min delay from receipt) and delayed-mode (intermediate or research, 10-day delay from receipt) data are available via web (http://samos.coaps.fsu.edu/, under “Data Access”), ftp (samos.coaps.fsu.edu, anonymous access, cd /samos_pub/data/), and THREDDS (http://coaps.fsu.edu/thredds.php) services. We routinely test our web services and respond rapidly to failures of the system. The SAMOS web site also includes an overview of the initiative and provides links to relevant literature and best practices guides as well as access to past SAMOS workshops. The web site also provides access to recruitment materials for vessels, desired SAMOS parameters, accuracy requirements, and training materials.

SAMOS data are not presently provided to the Global Telecommunication System (GTS). As part of our work with JCOMM we plan to reopen discussions with the US VOS program to establish GTS distribution. The PI notes that our major user community continues not to require GTS access to retrieve the data. Our current web, ftp, and THREDDS systems meet their needs.

SAMOS data are archived at the U.S. National Oceanographic Data Center on a monthly schedule. To ensure integrity, each archival set includes files that contain the original, preliminary, and research-quality data and metadata (e.g., file naming and format descriptions), a file manifest, and a message-digest algorithm 5 (MD5) checksum for each file. NODC makes the archival sets available online via two types of Dissemination Information Packages: the public may download individual files in the archival set—each file has a unique URL—or the entire archival set in one “tarball” file. Users may find all the SAMOS data by searching for SAMOS under “Contributing projects” on the Open Archive System at http://www.nodc.noaa.gov/Archive/Search. Periodically the PI downloads SAMOS data from NODC to ensure system integrity.

Description of significant research results, protocols developed, and research transitions
None Reported

Information on collaborators / partners: None Reported

Information on any outreach activities: None Reported

NOAA sponsor and NOAA office of primary technical contact: Joel Levy, OAR

Related NOAA strategic goals: Climate Adaptation and Mitigation, Weather-Ready Nation, Healthy Oceans, Resilient Coastal Communities and Economies

Related NOAA enterprise objectives: Science and Technology, Engagement

NGI FILE #11-NGI2-08

Project Title: Applications of Advanced Satellite Microwave Radiances and Retrieval Products to NWP and Climate Studies

Project Lead (PI) name, affiliation, email address: Xiaolei Zou, FSU, xzou@fsu.edu

Project objectives and goals

- Develop advanced satellite microwave products for improving typhoon and hurricane predictions.
- Transition of existing algorithms and products to the operational centers.
- Generate climate-quality of observations to better our understanding of the climate variations at global and regional scales.

Description of research conducted during the reporting period and milestones accomplished and/or completed

- Development of algorithms for detection of radio-frequency interference (RFI) for FY-3B MWRI, AMSR-E and WindSat data.
- Quality assessment of advanced satellite microwave products from AMSU and SSMIS
- Applications of advanced satellite microwave brightness temperature data for establishing level-2 temperature climate data records using 1D-Var approach.

Description of significant research results, protocols developed, and research transitions

None Reported

Information on collaborators / partners:

Name of collaborating organization: NOAA NESDIS
Date collaborating established: Aug 2010
Does partner provide monetary support to project? Amount of support? Yes
Does partner provide non-monetary (in-kind) support? Yes
Short description of collaboration/partnership relationship Help mentoring of graduate students and postdoctoral fellow; provide data support

Information on any outreach activities: None Reported

NOAA sponsor and NOAA office of primary technical contact: Fuzhong Weng, NESDIS

Related NOAA strategic goals: Climate Adaptation and Mitigation, Weather-Ready Nation

Related NOAA enterprise objectives: Science and Technology

NGI FILE #11-NGI2-09

Project Title: Toward Operational Uses of Geostationary Imagery & FY-3 Polar-Orbiting Microwave Radiance Data in the GSI Analysis System

Project Lead (PI) name, affiliation, email address: Xiaolei Zou, FSU, xzou@fsu.edu

Project objectives and goals

This project will continue refining the assimilation process of GOES-11/12/13 imager radiance assimilation in National Centers for Environmental Prediction (NCEP) global forecast systems. The goal is to incorporate these data into NCEP operational forecast systems and to use them as preparation for the GOES-R data.

Description of research conducted during the reporting period and milestones accomplished and/or completed

- Evaluating added benefits of assimilating GOES imager radiance data in GSI for coastal QPFs.
- Testing and refining cloud detection algorithms
- Quality assessment of microwave measurements from FY-3A/B.

Description of significant research results, protocols developed, and research transitions
None Reported

Information on collaborators / partners:

Name of collaborating organization: NOAA NESDIS
Date collaborating established: Aug 2010
Does partner provide monetary support to project? Amount of support? Yes
Does partner provide non-monetary (in-kind) support? Yes
Short description of collaboration/partnership relationship Help mentoring of graduate students and postdoctoral fellow; provide data support

Information on any outreach activities: None Reported

NOAA sponsor and NOAA office of primary technical contact: Fuzhong Weng, NESDIS

Related NOAA strategic goals: Weather-Ready Nation

Related NOAA enterprise objectives: Science and Technology

NGI FILE #12-NGI2-11

Project Title: Enhancing the Mississippi Digital Earth Model (MDEM)

Project Lead (PI) name, affiliation, email address: Scott Samson, MSU, ssamson@gri.msstate.edu

Co-PI(s) name(s), affiliation, email address: Robert Moorhead, MSU, rjm@gri.msstate.edu

Project objectives and goals

The objective of the Mississippi Digital Earth Model (MDEM) is to enhance the resource base in both GIS proficient personnel and the development of state-wide GIS databases. This objective is reached through (1) an extensive education and outreach effort for state and local government employees and (2) the development of a state-wide GIS database addressing the data layers as specified in the National Spatial Data Infrastructure guidelines.

Description of research conducted during the reporting period and milestones accomplished and/or completed

Mississippi legislation created in 2003 allocates public sector responsibilities for (1) research and education and (2) implementation in remote sensing and geographic information systems. The law's coordination has uniquely positioned Mississippi to leverage federal, state, and local funds to become the national leader in this rapidly evolving technology. The law created the Mississippi Coordinating Council for Remote Sensing and Geographic Information Systems to "set and assure enforcement of policies and standards to make it easier for remote sensing and geographic information system users around the state to share information and to facilitate cost-sharing arrangements to reduce the costs of acquiring remote sensing and geographic information system data." The law requires the Mississippi Department of Environmental Quality (MDEQ) to develop seven base data layers of geographic information for the state, referred to as the MDEM.

The MDEM is composed of seven framework layers as defined by the Federal Geographic Data Community's National Spatial Data Infrastructure. Data for the MDEM is acquired and managed through joint operations between the MDEQ and the Mississippi Department of Information Technology Services. The on-going program will be largely self-funded in the long term because of coordinating regular governmental and agency data acquisition plans and efficiencies in coordinating statewide data purchases. In the near term, however, federal funding to help transition research results into an operational implementation in developing the initial data layers and an efficient data delivery system will be necessary.

The GEO (Geospatial Education and Outreach) Project was charged with the development and implementation of educational programs throughout local and state government agencies in Mississippi. The government workforce is becoming increasingly technologically competent in the utilization of the geospatial applications derived from NGI research activities.

The GEO Project was developed in response to the limited availability of geospatial data needed by first responders immediately following Hurricane Katrina of August 29, 2005. An assessment was conducted of the educational needs of Mississippi's local governments, especially the localities in the southern portions of the state most susceptible to the effects of

hurricanes. A series of intensive 2, 3 and 5 day workshops were conducted that would provide a strong foundation in the fundamentals and applications of GIS. Courses offered range from basic concepts of GIS to advanced, enterprise database management systems. Technical assistance is provided to local governments following classroom preparation as a means to increase the success rate of implementation of GIS in the work place.

Milestones Accomplished:

- The MDEQ acquired, processed and assessed the QA/QC of 9, 880 miles of road centerlines for 9 counties in southeastern Mississippi. The data was delivered to the public in the 2rd quarter of 2012. The new road databases complement 37 counties where road centerlines have been previously developed.

- High-resolution (6-inch) imagery was acquired for the six Coastal Counties during the spring of 2012. MDEM funds were leveraged with funds originating from the Mississippi Department of Transportation.

- Since Oct 1 of 2011, 18 workshops were delivered to 175 participants representing 23 of the 82 counties in Mississippi.

- A 1-day GIS workshop for “users of geographic information” was developed for a new demographic unfamiliar with conventional GIS technology. Examples of this demographic are county emergency management employees and personnel in MSU Extension Service in county offices.

- The GEO Project developed a prototype of a smartphone application to warn users of immediate natural hazard threats around their present location. A public version is anticipated for release during the summer of 2012.

A 1-1/2 day workshop was held in Biloxi on April 26 and 27 to solicit input from various agencies having a role in hazard mitigation along the Mississippi Gulf Coast. Results from the workshop are under review by the Digital Coast Partners.

Description of significant research results, protocols developed, and research transitions

This project is focused on outreach, education and data acquisition. There is not a research component.

The Extension Service model of the land-grant university is used to assist in technology transfer. Workshops, presentations and on-site assistance have been proven to be effective in educating the citizens of Mississippi. A network of county extension offices and state-level specialists provide efficient support in a wide range of areas, such as crop production, youth development through 4-H and geospatial technologies.

Information on collaborators / partners:

Name of collaborating organization: Mississippi Department of Environmental Quality
Date collaborating established: Jul 1, 2009
Does partner provide monetary support to project? Amount of support? No
Does partner provide non-monetary (in-kind) support? Yes
Short description of collaboration/partnership relationship The MDEQ has been given the charge by the State of Mississippi to develop the 7 National Spatial Data Infrastructure (NSDI) layers for the MDEM. A subcontract was issued from this project to support MDEQ with their tasks.

Information on any outreach activities:

General Description: Workshops and training: The GEO Project curriculum consists of 8 courses in GIS applications and geospatial database management. Eighteen 2 and 3 day workshops with 175 participants at various locations across the state (Table 2).

Table 2. Workshops hosted during the reporting period.

Course Name	Date	Location	Participants
Introduction to ArcGIS Server	Jun 14, 2012	Mississippi Emergency Management Association	6
Building Geodatabases	Jun 7, 2012	Pearl River Community College	12
Introduction to Geoprocessing Scripts using Python	May 31, 2012	Pearl River Community College	10
ArcGIS Desktop I: Getting Started with ArcGIS (10)	May 24, 2012	Mississippi Emergency Management Association	7
ArcGIS Desktop I: Getting Started with ArcGIS (10)	May 17, 2012	Mississippi Forestry Commission	8
ArcGIS Desktop II: Tools and Functionality (10)	May 10, 2012	Holmes Community College	10
ArcGIS Desktop II: Tools and Functionality (10)	Apr 18, 2012	Holmes Community College	11
Introduction to ArcGIS Server	Apr 18, 2012	Pearl River Community College	12
ArcGIS Desktop III: GIS Workflows and Analysis (10)	Apr 11, 2012	Mississippi Emergency Management Association	9
ArcGIS Desktop III: GIS Workflows and Analysis (10)	Mar 28, 2012	Pearl River Community College	14
ArcGIS Desktop II: Tools and Functionality (10)	Mar 1, 2012	Mississippi Emergency Management Association	10
ArcGIS Desktop I: Getting Started with ArcGIS	Feb 9, 2012	Copiah-Lincoln Community College	5
ArcGIS Desktop I: Getting Started with ArcGIS (10)	Jan 26, 2012	Mississippi Emergency Management Association	12
Working with ArcGIS Spatial Analyst	Dec 15, 2011	Pearl River Community College	4
Introduction to Geoprocessing Scripts using Python	Dec 7, 2011	Pearl River Community College	11
ArcGIS Desktop II: Tools and Functionality	Nov 17, 2011	U.S. Army Corps of Engineers-Grenada	12
ArcGIS Desktop I: Getting Started with ArcGIS	Nov 9, 2011	U.S. Army Corps of Engineers-Grenada	12
ArcGIS Desktop II: Tools and Functionality (10)	Oct 19, 2011	Copiah-Lincoln Community College	10

NOAA sponsor and NOAA office of primary technical contact: Nicholas (Miki) Schmidt, NOS

Related NOAA strategic goals: Weather-Ready Nation, Resilient Coastal Communities and Economies

Related NOAA enterprise objectives: Engagement

NGI FILE #12-NGI2-12

Project Title: Data Management in Support of NOAA's Integrated Ecosystem Assessment for the Gulf of Mexico through the NGI

Project Lead (PI) name, affiliation, email address: Ruth H. Carmichael, DISL, rcarmichael@disl.org

Project objectives and goals

This project continues a NOAA affiliation with the Dauphin Island Sea Laboratory (DISL) on ecosystem data management systems. The goal is to maintain and expand a NGI member institution internal data management system that links to the existing data management program within the EDAC. Specifically, our objectives are to a) enhance and support integration of regional ecosystem data management into the NGI Ecosystem Data Assembly Center via NOAA's National Coastal Data Development Center, b) continue NOAA's affiliation with DISL to meet NOAA data management goals, c) continue creation and publication of place-based meta-data and associated summary data sets as DISL's contribution to this assimilative effort with NOAA, d) continue testing and integrating automated end-to-end data management (sensor to archive) techniques (this year we will update our approach to meet NOAA's new standards), and e) support NGI research efforts (graduate & PI level) that are beneficial to both NOAA integrated ecosystem assessment (IEA) and REDM efforts. Making datasets readily available and accessible and overcoming hurdles to faculty and student participation in metadata creation will facilitate scientific studies, public education, and outreach. The resulting data management systems will enhance the Regional Ecosystem Data Management effort and expand the capability of EDAC to gather ecosystem data.

Description of research conducted during the reporting period and milestones accomplished and/or completed

- Hire and training of new data management specialist
- Transition period for new hire to meet faculty, students, staff and begin learning their research
- 1 new metadata record in progress
- All metadata records reviewed and assessed for necessary updates, if any
- Metadata training provided to NGI Diversity Internship participants
- DISL's Data Management Center website was continually updated
- Participation in the National Science Foundation's second EarthCube charette, Washington, DC (by invitation from NSF)

Description of significant research results, protocols developed, and research transitions

The Data management program at DISL, consisting of a formal Data Management Center, Senior Data Manager, Data Management Specialist, and Data Management Committee has been extremely successful at incorporating metadata creation, data archiving, and overall data management into the regular process of research at DISL. We are currently in the process of

writing a manuscript that describes our approach, successes, and hurdles that we hope will benefit and guide other institutions as they adopt data management practices. In 2012, we hired a new data management specialist to replace Rachel Nowlin, who served in this capacity for 4 years. We have had two major accomplishments during the three month period covered by this report: 1) to transition in a new Data Management Specialist, provide training to the new hire, familiarize our Data Management team about NOAA's new data-management standards, and establish contact between NOAA and the new hire, while maintaining ongoing relationships with faculty, staff, and students to update or create metadata records; 2) to attend the second NSF EarthCube charette in Washington, DC. Attendance at the charette was a direct result of a visit to NSF in spring 2012 by PI R. Carmichael to discuss DISL's data management efforts with a program officer in the NSF "Big Data" program. Dr. B. Ransom subsequently invited DISL's Data Management Specialist to participate in the EarthCube effort and provide feedback on the program to NSF. A summary of the Data Management Specialist (Mimi Tzeng) report can be viewed at http://earthcube.ning.com/profiles/blogs/coming-back-up-from-the-deep-end.

Information on collaborators / partners: None

Information on any outreach activities: Outreach activities included training interns as part of the Diversity Program, attendance at the NSF EarthCube charette, and posting on the NSF EarthCube blog.

NOAA sponsor and NOAA office of primary technical contact: Russ Beard, NESDIS

Related NOAA strategic goals: Climate Adaptation and Mitigation, Weather-Ready Nation, Healthy Oceans, Resilient Coastal Communities and Economies

Related NOAA enterprise objectives: Science and Technology, Engagement, Organization and Administration

APPENDIX A. PUBLICATION DOCUMENTATION

All items listed are under award number NA11OAR4320199.

Table 3. Publication and presentations completed during the reporting period

Amend Number	Forum	Date	Vol	Pages	Citation
02	***Project Title: Monitoring in Small Embayments as Early Warning System for Ecosystem Change on Larger Spatial Scales***				
	Conference of the Coastal & Estuarine Research Federation	Nov 2011	-	-	-
03	***Project Title: Climate Variability in Ocean Surface Turbulent Fluxes***				
	J. Atmos. Oceanic Technol.	Jun 2012	29	822-833	10.1175/JTECH-D-11-00165.1
	Forum on Trends in Extreme Winds, Waves, and Extratropical Storms along the Coasts	Jan 2012	-	-	-
	JAXA-NASA Science Meeting	Mar 2012	-	-	-
	Chinese-French Oceanographic Satellite Meeting	Nov 2011	-	-	-
	2012 International Ocean Vector Winds Science Team Meeting	Jun 2012	-	-	-
	Ocean Sciences 2012	Feb 2012	-	-	-
	AMS 30th Conference on Hurricanes and Tropical Meteorology	Apr 2012	-	-	-
	11th Annual AMS Student Conference and Career Fair	Jan 2012	-	-	-
06	***Project Title: Linkage Between the Commercial Shrimp Fishery & Juvenile Red Snapper in the Northern Gulf of Mexico***				
	Northern Gulf Institute Annual Meeting	May 2012	-	-	-
07	***Project Title: U.S. Research Vessel Surface Meteorology Data Assembly Center***				
	EOS, Trans. Amer. Geophys. Union	Oct 2011	92	376	10.1029/2011EO430005
	Sea Technology	Jun 2012	-	-	-
	Ocean Sciences 2012	Feb 2012	-	-	-
	WCRP Open Science Conference	Oct 2011	-	-	-
08	***Project Title: Applications of Advanced Satellite Microwave Radiances and Retrieval Products to NWP and Climate Studies***				
	J. Ocean Atmos. Tech.	Mar 2012	29	417-432	10.1175/JTECH-D-11-00108.1
	Clim. Dyn.	Feb 2012	-	18 pp.	10.1007/s00382-012-1296-1
	J. Geophy. Res.	Mar 2012	117	D06219	10.1029/2011JD016452
	Antarctic Science	Mar 2012	-	8 pp.	10.1017/S0954102012000417
09	***Project Title: Toward Operational Uses of Geostationary Imagery & FY-3 Polar-Orbiting Microwave Radiance Data in the GSI Analysis System***				
	J. Ocean Atmos. Tech.	Oct 2011	28	1206-1227	10.1175/JTECH-D-11-00023.1
	Mon. Wea. Rev.	Nov 2011	139	3711-3729	10.1175/MWR-D-10-05040.1
	AMS Annual Conference	Jan 2012	-	-	-

Table 4. Summary of publications and presentations reported in Table 3

	Institute Lead Author	NOAA Lead Author	Other Lead Author
*Peer-reviewed (8)**	3	0	5
*Non peer-reviewed (23)**	13	0	10

*Numbers are not directly additive from Table 3 because in some instances a single record for a conference represents multiple presentations

APPENDIX B. EMPLOYEE SUPPORT

Personnel

Total # of employees by job title & terminal degree that receive at least 50% support from the NGI NOAA CI funds, postdocs & visiting scientists

Category	Number	B.S.	M.S.	Ph.D.
>= 50% Support				
Research Scientist	5	-	-	5
Visiting Scientist	1	-	-	1
Postdoctoral Fellow	-	-	-	-
Research Support Staff	-	-	-	-
Administrative	-	-	-	-
Total (>= 50% support)	**6**	**-**	**-**	**6**

Employees (including postdocs & visiting scientists) that receive < 50% NOAA Funding (not including students)

Category	Number	B.S.	M.S.	Ph.D.
Employees w/ <50% support	12	1	4	6

Total # of undergrad & grad students receiving any level of support

Category	Number	B.S.	M.S.	Ph.D.
Undergraduate Students	1	-	-	-
Graduate Students	9	-	3	6

Other

Category	Number	
# of employees / students that receive 100% of their funding from an OAR lab and/or are located within that Lab (include name of lab)	-	
# of employees / students that were hired by NOAA within the last year	-	

APPENDIX C. OTHER AGENCY AWARDS

PI Name	Project Title	Lead NOAA Collaborator	Awarding Agency	Funding Amount
Moorhead, Robert J.	Modeling and Ocean Color Remote Sensing in Oceanic and Coastal Waters	N/A	Naval Research Laboratory	$46,000.00
Moorhead, Robert J.	Modeling and Ocean Color Remote Sensing in Oceanic and Coastal Waters	N/A	Naval Research Laboratory	$25,000.00
Hodge, Sharon Hatch	Instruction on International Maritime Law to our International Hydrographic Management and Engineering Program (Cat B)	N/A	U.S. Dept of Navy	$1,500.00
			Total	**$72,500.00**