

Research Performance Progress Report Northern Gulf Institute

NA16OAR4320199

July 1, 2020 to June 30, 2021

Flower Garden Banks
National Marine Sanctuary



NGI
NORTHERN GULF INSTITUTE
a NOAA cooperative institute



DEPARTMENT OF COMMERCE RESEARCH PERFORMANCE PROGRESS REPORT (RPPR)

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AWARD INFORMATION	
1. Federal Agency: Department of Commerce / NOAA	2. Federal Award Number: NA16OAR4320199
3. Project Title: Proposal to Re-form the Northern Gulf Institute	
4. Award Period of Performance Start Date: 10/01/2016	5. Award Period of Performance End Date: 09/30/2022
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REPORTING INFORMATION	
Signature of Submitting Official: Whitley Alford	
16. Submission Date and Time Stamp: 07/27/2021	17. Reporting Period End Date: 06/30/2021
18. Reporting Frequency: <input checked="" type="radio"/> Annual <input type="radio"/> Semi-Annual <input type="radio"/> Quarterly	19. Report Type: <input checked="" type="radio"/> Not Final <input type="radio"/> Final
RECIPIENT ORGANIZATION	
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ACCOMPLISHMENTS

24. What were the major goals and objectives of this project?

NGI is a consortium of universities that are geographically distributed. The partner universities bring broad expertise to the NOAA partnership, although the CI focuses on four major scientific and societal issues of importance to NOAA. NGI addresses problems of significant importance and relevance to NOAA and the nation and the research covers a breadth of topics within the NGI themes.

The primary research goals outlined in the strategic plan are: (1) to understand the structure, function, and services of ecosystems across land-sea, ocean-atmosphere, and coastal waters-deep sea interfaces; (2) to synthesize information across disciplines to reduce uncertainty and to forecast ecosystem responses; and (3) to develop applications that address regional management needs.

NGI's four research themes are: (1) Climate Change and Climate Variability Effects on Regional Ecosystems; (2) Coastal Hazards; (3) Ecosystem Management; and (4) Effective and Efficient Data Management Systems Supporting a Data-driven Economy.

25. What was accomplished under these goals?

The success of the NGI Mission is in the creation of new or improved knowledge and technology and its transition to applications for improved ecosystem-based management in the northern Gulf of Mexico. Peer-reviewed documentation of NGI-funded research provides an established metric for the quality, rigor, and significance of research. Documentation of alignment of NGI projects to the outcomes of other agencies provides information about leveraging resources, extending impact, and strengthening our ties with stakeholders. Under the guidance of NGI the following significant accomplishments were achieved:

NGI Researchers provided support for the annual hypoxia cruise which was completed and report submitted to NOAA and partners, in addition to establishing an enduring mapping center to address research and development needs that advance the science and practice of hydrography and cartography, following the legislative visions of a mapping center. Our research continued to advance the science underpinning management of the hypoxic zone in the Gulf of Mexico (e.g., strengthening communication between scientists, modelers, and stakeholders) and supporting fisheries management needs, as well as supporting efforts by NOAA to provide the critical scientific, modeling, and assessment expertise to enable the Hypoxia Task Force (HTF) to set and modify nutrient reduction targets to achieve identified hypoxia action plan goals.

NGI Researchers provided rapid response UAS missions and support during and after a catastrophic flooding event to track changes in river channel structure and morphology and debris. Additionally, they detailed information on levee breaches and any inundation in near real time (location, width, depth), and provided photos to document extent of inundation to verify flash flooding, flood inundation maps, and enable production of flood maps for more locations. NGI also flew in the aftermath of Hurricane Delta, collecting data along the main stem of the Mississippi River centered around Greenville, MS, an advanced proof of ability to operate beyond visible line of sight safely using only technology (no humans).

During the reporting period, the ORION Super-Computing System located at the High Performance Computing Center housed at NGI, supported NOAA HPC research activities for 670 individual users working on a total of 69 unique projects, consuming more than 447 million wallclock-hours of CPU time.

NGI Researchers continued development and stewardship of the long-term data and continued to conduct data architect development and NOAA scientific data stewardship. Collation of coastal data management requirements, scientific oversight of data preparation for archiving, implementation of data standards and metadata guidelines, and related data management also continued.

Continued analysis of high-resolution radar data and correlation with observed tree damage allow further development of Damage Indicators (DI) and Degrees of Damage (DOD). Wind profile data were analyzed to determine changes in the low-level wind profile during the natural Afternoon to Evening Transition for severe storm cases.

Attach a separate document if more space is needed for #6-10, or #24-50.

ACCOMPLISHMENTS (cont'd)

26. What opportunities for training and professional development has the project provided?

While training and professional development opportunities were diminished somewhat by CoVid-19 Related restrictions, NGI researchers and partners continued to provide timely updates to local stakeholders concerning topics and conditions of the region. Concept and topic specific releases, classes and multi-disciplinary workshops for further professional development were provided to both the public and private sectors.

NGI team members regularly attend programming workshops, seminars on leadership, ArcGIS classes, and undertake coursework at affiliated universities. Students associated with the NGI attended AGU, AMS, AAPG, HPC2, US Hydro, software training for GNSS work, and the NOAA Geospatial Summit. Additionally, NGI personnel (including students) receive instruction on operation of the UAS and ASVs and their associated data collection systems.

Many opportunities were made available to undergraduate, graduate and postdoctoral scholars, which resulted in enhanced career development. Students involved with NGI have been able to continue their training for participation in the various NOAA field programs, as well as contributing to or authoring NGI and NOAA relevant publications and attending conferences either virtually or face-to-face, to present their findings.

NGI personnel have also participated in training activities and attended conferences to enhance their knowledge on HPC systems as well as to continually advocate for potential research activities that may be conducted by NOAA and others on the available NGI HPC systems. Training they receive includes computational thinking, software, hardware integration and programming for use in better management of High-Performance Computing assets used to support the NOAA mission.

NGI has also provided resources for researchers and the public to obtain professional training to stay up to date with, or in some cases learn or gain exposure to, among other things, geospatial technologies. This includes professional and workforce development opportunities for individuals concerning environmental and spatial data. NGI funding also provided analysis results to meteorologists as well as local and regional emergency managers in the field seeking to improve storm warning dissemination to vulnerable populations.

Additional professional development and outreach opportunities have been undertaken to expose not only professionals but students and teachers as well as the general public to NOAA mission specific science and STEM/STEAM related research and findings of active and often locally relevant projects. These events include participation by NGI scientists in educational summer camps, and engaging K-12 students in ocean and atmospheric coursework. Workforce and professional development mean nothing without interaction with students and future scientists. These will be discussed in depth in the section (Question 40) on Education and Outreach.

27. How were the results disseminated to communities of interest?

Results of the sponsored operations and research have been disseminated through several channels including publication in peer reviewed journals and proceedings as well as through both public and project specific specialized meetings, conferences and workshops. As a result, both the public and other local stakeholders have been given a better understanding of their associated environments.

ACCOMPLISHMENTS (cont'd)

28. What do you plan to do during the next reporting period to accomplish the goals and objectives?

The NGI and its associated researchers intend to continue to provide high-quality work and dissemination of research findings. NGI will also continue to develop and implement a more comprehensive watershed assessment for the Gulf of Mexico, to include the continued development of a land use GIS database, further hydrologic and biologic assessments, and continually enhanced water quality, oceanographical and meteorological assessments that will be used in future modeling and assessment of the regions conditions.

Products

This section should summarize information about main publications, technologies, or other products created under your award during the current reporting period. As a reminder, scholarly publications developed under the CI Cooperative Agreement must be submitted to the NOAA Institutional Repository. For more information, refer to the Special Award Condition, "Handling of Environmental Data or Peer-Reviewed Publications."

PRODUCTS

29. Publications, conference papers, and presentations

There were 63 Associated publications conference papers, and presentations generated by this project cycle. These are listed in detail in the attached MS Excel Document.

PRODUCTS (cont'd)

30. Technologies or techniques

Nothing to Report

31. Inventions, patent applications, and/or licenses

Nothing to Report

Attach a separate document if more space is needed for #6-10, or #24-50.

PRODUCTS (cont'd)

32. Other products

In addition to publications generated by the associated research, the NGI Education & Outreach team produces a quarterly newsletter of current events, notices and relevant research based upon requested researcher submissions, to the NGI Website as both a Newsletter and as Blog posts These can be viewed at <http://www.ngi.msstate.edu/portal/> and <http://www.ngi.msstate.edu/portal-blog/> respectively.

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

33. What individuals have worked on this project?

Robert Moorhead- Director NGI
Steve Ashby- Co-Director NGI
Paul Mickle- Co-Director Director NGI
Jonathan Harris- Outreach Coordinator
Whitley Alford- Program Administrator
Anna Linhoss- Associate Director NGI
Just Cebrian- Associate Director NGI

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS (cont'd)

34. Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?

Steve Ashby retired as NGI Co-Director. Paul Mickle was hired as NGI Co-Director effective January 1, 2021. Dr. Mickle's work location is Stennis Space Center. He is also an Associate Professor with the Mississippi State University Department of Wildlife, Fisheries, and Aquaculture and an Associate Director of the MSU Geosystems Research Institute. Dr. Mickle has a Ph.D. in Fish Ecology from USM. He most recently was the Chief Science Officer at the Mississippi Department of Marine Resources.

Associate Director Anna Linhoss has announced she is leaving MSU July 31, 2021. Jamie Dyer is being hired as an Associate Director to increase the experience in hydrometeorology and weather within the Directorate.

35. What other organizations have been involved as partners?

Besides NOAA, LA office of Coastal Protection and Restoration, MS Department of Marine Resources, MS Department of Environmental Quality, MS Aquarium, Maritime and Seafood Industry Museum, RESTORE Council, Gulf of Mexico Research Initiative (GoMRI), GRIIDC, the NOAA RESTORE Science Program, the National Academies of Science Gulf Research Program, and Florida A&M University

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS (cont'd)

36. Have other collaborators or contacts been involved?

AOML: NGI has placed several postdoctoral associates, and recently an assistant research scientist, at AOML. NOAA more operationally made the Director of AOML the Lead Technical NGI Program Manager.

NCEI/SSC: Since 2012, the NGI Program Office, NGI's SSC personnel, and what is now NESDIS/NCEI's Stennis Space Center group have shared a building. This relationship is crucial to NGI addressing its Data Management theme, as NCEI is NOAA's data management entity. Several NOS/OCM employees, as well as the NOAA RESTORE Science Program Manager, share the space with the NCEI/SSC employees and thus are involved at times in science discussions.

LMRFC: NGI has had a long-standing relationship with the Lower Mississippi River Forecast Center. Initially the work focused on hydrology model advancement and visualization. The relationship has shifted to exploitation of UAS based on an award from the OAR UAS Program Office. Dr. Suzanne van Cooten, the LMRFC Hydrologist in Charge, has been a co-author and co-presenter on several dissemination opportunities. NGI's support of LMRFC has been featured in a NOAA UAS news article (<https://uas.noaa.gov/News/ArtMID/6699/ArticleID/812/Another-One-in-the-Books-NOAA-UASScience-Team-Completes-Second-Milestone-Operation-to-Aid-Hydrologists-with-Improving-Flood-Forecasts>) and a NOAA Postcard from the Field entitled "Live UAS Imagery Maps Historic Flooding."

NDBC: NGI has worked with the National Data Buoy Center on several data processing / management projects. Presently one of our senior research staff members, Yee Lau, is improving NDBC's weather buoy archive process. Previous projects studied the difference in the data collected by an autonomous surface vessel encircling a buoy and the buoy itself and improvements to TAO delayed-mode data processing.

NOS/OCM: NGI has worked with what is now NOS/OCM for over 10 years, focusing primarily on geospatial education and outreach.

NWC: NGI is working with the National Water Center in Tuscaloosa, Alabama to develop new capabilities and research applications for the National Water Model, principally focusing on flooding and agricultural applications.

IMPACT

37. What was the impact on the development of the principal discipline(s) of the project?

Additional information about processes associated with associated regions of study was developed. These findings were made available as recommendations to local stakeholders and resource managers and used to influence additional studies to be conducted in the future. On the ongoing matter of the "Gulf Dead Zone", The Hypoxia Task Force was informed about the extent of the hypoxia zone in 2019. Interactions with stakeholders in the watershed of the MS River were increased. The hypoxia zone east of the MS River was highlighted in several presentations and was highlighted again for those who did not know of its existence.

IMPACT (cont'd)

38. What was the impact on other disciplines?

These projects provide the opportunity to train the next generation of experts in NOAA related fields, and is often augmented through mentoring by NOAA scientists, providing highly qualified candidates for the future NOAA mission workforce. The results of these projects lead to increases in human resources by number and skill. The work of NGI generates an increased understanding on the impacts and influences of independent interactions among separate scientific disciplines.

39. What was the impact on the development of human resources?

Dr. Paul Mickle was hired as NGI Co-Director effective January 1, 2021 (See Question 10 for more information).
Dr. Luke Thompson, now the NGI Program Coordinator at AOML, joined NGI in July 2020 as an Associate Research Professor. His work location is the Atlantic Oceanographic and Meteorological Laboratory (AOML) in Miami, FL. He has a Ph.D. in Biology from MIT. His research centers around 'omics. Dr. Ebenezer (Eben) Nyadjro is a physical and satellite oceanographer with NGI, located at Stennis Space Center, MS. His current research focuses on database development for global microplastics and global ocean currents. He is also part of an ocean climatology team studying in-situ salinity and temperature databases. Eben has a Ph.D. in Marine Science from the University of South Carolina. Dr. Arvind Shantharam is a deep-sea oceanographer with the NGI, at Stennis Space Center, working with the Deep-Sea Coral Research and Technology Program managing deep-sea cruise data and assisting in the effort of database synthesis for conservation decision-making.
Dr. Deok Han is a research engineer working with the National Marine Fisheries Service. His work centers around the hardware (computer, cameras, etc.) for Electronic Monitoring (EM) in Gulf States fisheries. He has a Ph.D. in Electrical & Computer Engineering from Mississippi State University. Dr. Xiaomin Chen is a post-doc working with NOAA scientists at the Hurricane Research Division at the Atlantic Oceanographic and Meteorological Laboratory (AOML) in Miami, FL. His research is supporting enhancements to Hurricane Weather Research and Forecasting model (HWRF) SST sensitivity studies. Dr. Chen has a Ph.D. in Meteorology from Nanjing University. Dr. Enrique Orozco-Lopez is a post-doc joining the NGI team at Stennis beginning in January of 2021 where he will be compiling and analyzing water quality and modeling data in the Mississippi Sound. Enrique has a Ph.D. in Agricultural and Biological Engineering from the University of Florida. Dr. Taylor Shropshire graduated from FSU and was hired as a postdoc at USM to work at SEFSC-Beaufort on an NGI project. Dr. Johna Rudzin Schwing a PhD graduate of FSU is a newly appointed assistant professor of Meteorology in the Department of Geosciences at MSU and holds a joint appointment with NGI. Meghan Cromwell graduated from MSU Geosciences with an MSc., last year and was hired full-time with NOAA's National Centers for Environmental Information. Jack Prior graduated with MSc in Biology from the UWF. He is working with the NMFS lab in Pascagoula processing video data of fish in untrawlable habitats to improve stock assessment models using VIAME software. Katie Palubicki is an Outreach Coordinator with the NCEI offices. She supports the Oceanographic and Geophysical Science and Services Division (OGSSD) Scientific Information Services (SIS) in the areas of customer service, social media, engagement, communications and outreach, and scientific web content. Bryan Keller, graduated this year with a PhD in Biological Oceanography, He is working full time for NOAA as a foreign affairs specialist.
Shuhang Xue, graduated this year with a MS in Meteorology, from FSU is now employed with the Center for Ocean Atmosphere Prediction Studies. Olivia Graff, graduated from FSU this year with a BS in Meteorology. She contributed to the U.S. Research Vessel Surface Meteorology Data Assembly Center.
Homer McMillan, graduated from FSU this year with a BS in Computer Science, He contributed to the U.S. Research Vessel Surface Meteorology Data Assembly Center. Justin Stow, graduated from FSU this year with a BS in Meteorology, He contributed to two projects: U.S. Research Vessel Surface Meteorology Data Assembly Center and Climate Variability in Ocean Surface Turbulent Fluxes. Betty Tannuzzo, graduated from FSU this year with a BS in Computer Science, She contributed to the U.S. Research Vessel

Attach a separate document if more space is needed for #6-10, or #24-50.

IMPACT (cont'd)

40. What was the impact on teaching and educational experiences?

Due to CoVid-19 related restrictions, many of the traditional educational and outreach events NGI typically participates in were cancelled or transitioned to virtual interactions. As such this did impact our public interactions somewhat. Even so, NGI impact on our community has been significant. NGI Education & Outreach specialist continued to develop both online/virtual and hands on STEAM curriculum and professional development opportunities for educators. Including the use of 3D Weather Visualization Software to teach methods of instruction for Computational Thinking and Meteorology, as well as further development of Travelling Trunk and Lesson Plan Database development. Partnerships with education organizations allowed for integration of those virtual resources, where feasible, into the regional classrooms and allowed for development of future face-to-face classroom activities and training opportunities.

The NGI through its associated Education & Outreach offices and personnel have been able to provide significant opportunities to local and regional educators and students alike, through design and implementation of STEAM curriculum, and alongside the various states departments of education, as well as through individual teachers and students, including training and professional development for teachers on lesson plan design, incorporation of current scientific data and research, and integration of technology. In addition to directly training and providing professional development opportunities, NGI also actively takes part in outreach, engagement, and STEAM related education events. These events include participation by NGI scientists in educational summer camps, and engaging K-12 students and faculty in ocean and atmospheric research and coursework. NGI also takes a great interest in forging community STEAM engagement events, with active demonstrations, displays and activities for students and members of the public. Limited interactions with The Infinity Science Center, The MS Aquarium, and Lynn Meadows Discovery Center provided instructional contact with 150, 250 and 200 students respectively. NGI Provided STEAM lessons and support to Starkville-Oktibbeha County School District (150 students) STEAM students through assistance with laboratory and field related outreach and equipment.

The geospatial education and outreach (GEO) project offered 9 workshops during this reporting period (6 online and 3 hybrid) with a total of 98 individuals from local, state, and federal government agencies participating. Additional GEO efforts include maintenance of multiple geospatial web applications. The subcontract to MDEQ allowed for continued development of 1:4800-scale surface hydrology databases for multiple areas of Mississippi.

Projects that the NGI Education and Outreach Team have developed include "Travelling Trunk Shows which include Science based curriculum and equipment packaged and designed to support the national college and career readiness standards and provide STEAM focused interactions to large numbers of schoolchildren, their parents, teachers and administrators. We have also implemented a "Scientists Get Involved" program that includes science, engineering and mathematics faculty from departments spanning all NGI partner institutions, giving visiting, timely, guest lectures (where possible or allowed) in classrooms of local schools, children's museums, and limited public events and festivals throughout the region.

~~The NGI Education and Outreach Program continues to be positioned to provide high impact, curriculum based support to students~~

41. What was the impact on physical, institutional, and information resources that form infrastructure?

Nothing to Report

IMPACT (cont'd)

42. What was the impact on technology transfer?

Nothing to Report

43. What was the impact on society beyond science and technology?

While there is constant evolution in science, we believe that several areas are perhaps due for increased investment. NGI is actively exploring the following areas:

- Regional Hazards (more than just coastal). The VORTEX-SE project has identified several scientific facts that lead to more deaths and damage in the southeast than the Great Plains from the same tornado intensity. Flood prediction varies based on topography; in general, the Gulf of Mexico regional is flatter than other regions.
- Socioeconomic issues: How can we get society to believe scientist results? How do we get society to consider ecological issues equally with economic issues? How do we communicate tornado, hurricane, and other severe storm warnings appropriately?
- Because of these ongoing projects there has been an increase in public understanding of the environment including watershed and associated downstream impacts on water quality, marine habitat environment and climate of the region.

IMPACT (cont'd)

44. What percentage of the award's budget was spent in foreign country(ies)?

0 , null

CHANGES/PROBLEMS

45. Changes in approach and reasons for change

Nothing to Report

CHANGES/PROBLEMS (cont'd)

46. Actual or anticipated problems or delays and actions or plans to resolve them

CoVid-19 restrictions and impacts have played a key role in limiting operations and interactions of NGI personnel. Please see the attached list of all projects that were extended beyond their originally scheduled project end date, address reasons for the delays and plans to resolve them.

47. Changes that had a significant impact on expenditures

Nothing to Report

CHANGES/PROBLEMS (cont'd)

48. Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents

Nothing to Report

49. Change of primary performance site location from that originally proposed

Nothing to Report

PROJECT OUTCOMES

50. What were the outcomes of the award?

The NGI contributes to NOAA's priority interests, supporting a Data-driven Economy. Important recent research accomplishments by NGI researchers, in collaboration with multiple NOAA researchers, focus on the issues and resources of the Gulf, with many tools and protocols transferrable to other coastal environments.

Significant outcomes of the award include: Numerous presentations and publications which have improved hazardous weather warnings to the public, state, local, and professional entities. Increased understanding of physical (e.g., wind, stress, waves, and cyclonic characteristics), chemical (e.g. salinity), and biological (fish dynamics and phytoplankton distribution) processes in the Gulf of Mexico lead to improved simulations and forecasting related to water quality patterns (e.g., salinity and oxygenation) and currents. Coastal resiliency to impacts of sea level rise was enhanced with the ongoing development of a geospatial based decision support tool.

DEMOGRAPHIC INFORMATION FOR SIGNIFICANT CONTRIBUTORS (VOLUNTARY)

<p>Gender:</p> <p><input type="radio"/> Male</p> <p><input type="radio"/> Female</p> <p><input type="radio"/> Do not wish to provide</p>	<p>Ethnicity:</p> <p><input type="radio"/> Hispanic or Latina/o Not</p> <p><input type="radio"/> Hispanic or Latina/o Do not wish to provide</p>
<p>Race:</p> <p><input type="radio"/> American Indian or Alaska Native Asian</p> <p><input type="radio"/> Black or African American</p> <p><input type="radio"/> Native Hawaiian or other Pacific Islander</p> <p><input type="radio"/> White</p> <p><input type="radio"/> Do not wish to provide</p>	<p>Disability Status:</p> <p><input type="radio"/> Yes</p> <p style="margin-left: 20px;"><input type="checkbox"/> Deaf or serious difficulty hearing</p> <p style="margin-left: 20px;"><input type="checkbox"/> Blind or serious difficulty seeing even when wearing glasses</p> <p style="margin-left: 20px;"><input type="checkbox"/> Serious difficulty walking or climbing stairs</p> <p style="margin-left: 20px;"><input type="checkbox"/> Other serious disability related to a physical, mental, or emotional condition</p> <p><input type="radio"/> No</p> <p><input type="radio"/> Do not wish to provide</p>

Attach a separate document if more space is needed for #6-10, or #24-50.