



Southeast Coastal Ocean Observing Regional Association (SECOORA): Supporting Resilient Ecosystems, Communities and Economies

Revised Scope of Work - Year 3

TOPIC AREA 1: Continued Development of Regional Coastal Ocean Observing Systems
AWARD TYPE: Cooperative Agreement
PROJECT DURATION: June 1, 2018 – May 31, 2019

This revised grant proposal is submitted in response to the Funding Opportunity Title:
Continued Development of Regional Coastal Ocean Observing Systems
Submitted: October 25, 2018
Year 3: June 1, 2018 - May 31, 2019
Funding Request: \$3,570,942

Principal Investigator:

Debra Hernandez, Executive Director
SECOORA
PO Box 13856
Charleston, SC 29422
P: 843-906-8686
E: debra@secoora.org

Associate Investigator:

Megan Lee, Business Manager
SECOORA
PO Box 13856
Charleston, SC 29422
P: 843-864-6755
E: mlee@secoora.org

Associate Investigator:

Jennifer Dorton, RCOOS Manager
SECOORA
PO Box 13856
Charleston, SC 29422
P: 910-443-178
E: jdorton@secoora.org

Associate Investigator:

Michael Crosby PhD., SECOORA Board Chair
President and CEO
Mote Marine Lab
Sarasota, FL 34236
P: 941-388-4443
E: mcrosby@mote.edu

Project Summary

SECOORA is part of the US Integrated Ocean Observing System (IOOS®), and evolved out of several earlier sub-regional programs. Its footprint covers both the eastern Gulf of Mexico (GOM) and the South Atlantic Bight (SAB), which are connected by the Loop Current- Florida Current- Gulf Stream continuum. Our members include a cross-section of regional interests from private industry, academia, non-governmental organizations and state and federal government. SECOORA integrates observations, models, data management and outreach to sustain and advance an end-to-end, regional coastal ocean observing system (RCOOS) responsive to societal needs. An information management system transforms and delivers value-added products and services consistent with priorities identified through stakeholder needs assessments. SECOORA emphasizes coordinating a multidisciplinary suite of coastal ocean observations with numerical models so that societally important phenomena may be described, understood and ultimately predicted via applications of best science practices. This work provides foundational observing, modeling and data management capabilities to predict and support preparedness to changing conditions, thus enabling resiliency.

US IOOS recognizes the importance of the coasts and ocean for their economic and ecosystem services values. SECOORA is a region where hurricane landfalls are prevalent and where consequences from oil and gas operations are significant. The region is also a major tourist destination and a commercial and recreational fishing hub. Through performance, SECOORA has demonstrated both a vision and set of accomplishments toward meeting the US IOOS goal of societally relevant applied science. SECOORA sustains observations consisting of High Frequency radars (HFR) for surface currents and waves; moored buoys for surface meteorology and water temperature, salinity and in some instances waves and currents; coastal stations for surface meteorology and water level; and, glider surveys, including bio-optical measurements, temperature, and salinity. These observational components inform and support models across multiple scales and applications. SECOORA-related modeling is used to explain various phenomena in the region, including harmful algal blooms (HABs), storm surges, oil spill trajectories, fisheries recruitment and beach water quality. SECOORA funding, therefore, supports an array of coastal ocean observations in addition to benefitting society across a spectrum of coastal ocean applications. This proposal seeks funding for the period from June 1, 2018 – May 31, 2019.

Priorities for SECOORA are to sustain critical observing, data management and modeling activities, build upon successes with users, seek new leveraging opportunities and add new multidisciplinary RCOOS components. With the \$3,570,942 funding, SECOORA specifically seeks to:

- Continue governance and management for the Regional Association (RA);
- Effectively engage users and other stakeholders to prioritize investments;
- Provide data management and communication (DMAC) infrastructure;
- Continue operation of the existing HFRs in the region, presently consisting of 15 sites distributed from Cape Hatteras, NC to west Florida, and continue coordination with the national network;
- Continue operation of 21 *in situ* stations along the NC and SC coasts and the West Florida Shelf (WFS);
- Sustain modeling and other product efforts, including: 1) SECOORA-wide daily nowcast/forecast (N/F) system for currents, waves, and primary production, 2) statistical beach and shellfish water quality predictions; 3) an improved Marine Weather Portal (MWP); 4) a high resolution WFS circulation modeling system directly linking shelf seas with estuaries; 5) develop Python analysis tools for oceanographic services; and 6) support several special projects, to include OTT Biological Data Project and the Internship support in remembrance of Vembu Subramanian.
- Address spatial observing gaps by: 1) continuing a glider observatory for the South Atlantic Bight (SAB) and 2) installing a coastal water quality and meteorological station in Charleston Harbor, SC.
- Fill the Gaps Campaign:

- Expand HFR coverage along the SE coastal region through the purchase and deployment of 6 additional WERA HFR
- Increase SECOORA's glider deployment capacity through the purchase of a new Slocum glider.
- Additional Observations Initiative: Via a competitive mini-proposal process, SECOORA will support an effort to increase observing in the region that leverages ongoing partner activities to address highly visible ocean and coastal issues challenging the region:
 - Harmful algal blooms
 - Sound in the marine environment
 - Coral disease

The goal is to increase observing within the region, provide outreach to stakeholders (e.g. state agencies, broader research community), and disseminate project results at a SECOORA meeting.

SECOORA works closely with partners to achieve our goals. Below are contributors to this effort:

- Federal: NOAA National Weather Service (NWS), Ocean Acidification Program (OAP), National Estuarine Research Reserve System (NERRS), National Marine Fisheries Service (NMFS), National Ocean Service (NOS), Ecological Forecasting Roadmap Team, National Centers for Coastal Ocean Science (NCCOS), Office of Response and Restoration (OR&R), and Gray's Reef National Marine Sanctuary (GRNMS), US Marine Corps, US Army Corps of Engineers (USACE), US Coast Guard (USCG), US Geological Survey (USGS).
- State: NC Department of Environment and Natural Resources (DENR), SC Department of Health and Environmental Control (DHEC), GA Department of Natural Resources (DNR), FL Department of Environment Protection (DEP), FL Department of Health (FL DOH), FL Fish and Wildlife Commission (FWC).
- NGOs: South Atlantic Fisheries Management Council (SAFMC), Southeastern Fisheries Association (SFA), Governors' South Atlantic Alliance (GSAA).
- Emergency managers at Federal, state and local levels: NOAA OR&R, NOAA NWS Weather Forecast Offices (WFOs), county emergency managers.

Table of Contents

| | |
|--|----|
| Introduction / Background..... | 4 |
| Connections to Users/Stakeholders and Benefits | 5 |
| Goals, Objectives, and Workplans | 5 |
| Goal 1: Continue SECOORA’s region-wide governance and communication structure to engage users and stakeholders in coastal observing science..... | 6 |
| Objective 1.1: Maintain governance and management for the RA and RCOOS. | 6 |
| Objective 1.2: Engage users and other stakeholders to prioritize investments..... | 6 |
| Objective 1.3: Provide DMAC infrastructure to enable collaboration and decision-making. | 6 |
| Goal 2: Continue existing core observation investments in the region..... | 8 |
| Objective 2.1: Maintain 15 HFRs distributed throughout the region..... | 8 |
| Objective 2.2: Maintain 21 in situ stations along the Carolina and WFS coasts. | 8 |
| Objective 2.3: Maintain the Sensors on NOAA GRNMS Buoy (NDBC 41008)..... | 9 |
| Goal 3: Begin to address geographic gaps in observations. | 9 |
| Objective 3.1: Establish a regional glider observatory in the SAB. | 10 |
| Objective 3.2: Install a new coastal water quality station in Charleston Harbor..... | 10 |
| Goal 4: Continue delivery of operational model forecasts and products to serve priority users..... | 11 |
| Objective 4.1: Enhance and operate a Coupled Marine Environmental Assessment and Prediction System. | 11 |
| Objective 4.2: Operate the West Florida Shelf (WFS) Ocean Model. | 11 |
| Objective 4.3: Provide an Early Warning System for Swimming Beach and Shellfish Harvesting Waters. | 11 |
| Objective 4.4: Optimize and enhance the SECOORA Marine Weather Portal (MWP). | 12 |
| Objective 4.5: Python Data Analysis Tools for Oceanographic Services..... | 12 |
| Objective 4.6: Special Projects | 12 |
| Goal 5: Initiate new operational products to meet additional user needs..... | 13 |
| Goal 6: Continue building critical elements of the observing system by adding biogeochemical and marine sound sensors, and HFRs..... | 13 |
| Objective 6.4: Install and operate new HFRs..... | 13 |
| User Benefits and Product Delivery..... | 14 |
| Summary | 14 |
| Milestones and Cost Proposal..... | 15 |
| Cost Proposal..... | 15 |
| Appendices..... | 17 |
| Appendix 1: Maps and Figures | 17 |
| Appendix 2: References..... | 20 |

Introduction / Background

SECOORA seeks to leverage and augment existing observational, modeling, data management and product assets in the region; capitalizing on nearly two decades of RCOOS experience. This work provides foundational observing, modeling and data management capabilities to predict and support preparedness to changing conditions, thus enabling resiliency. RCOOS assets are used to characterize marine conditions, identify responses to stochastic events, validate existing and developing models, support decision-making and predict and verify short and long-term coastal ocean ecological and physical trends, all of which are necessary to achieve resilient ecosystems, communities and economies. SECOORA will continue engagement with regional partners and end users in the development and enhancement of products and services consistent with priorities identified by assessing their needs.

SECOORA's highest priorities are to continue supporting coastal ocean observing assets and models that provide real-time information to users, and generate long-term datasets necessary to detect, analyze and predict environmental and ecosystem changes in the SE coastal ocean. RCOOS assets to be supported with the funding include:

- Continue governance and management for the Regional Association (RA);
- Effectively engage users and other stakeholders to prioritize investments;
- Provide data management and communication (DMAC) infrastructure;
- Continue operation of the existing HFRs in the region, presently consisting of 15 sites distributed from Cape Hatteras, NC to west Florida, and continue coordination with the national network;
- Continue operation of 21 *in situ* stations along the NC and SC coasts and the West Florida Shelf (WFS);
- Sustain modeling and other product efforts, including: 1) SECOORA-wide daily nowcast/forecast (N/F) system for currents, waves, and primary production, 2) statistical beach and shellfish water quality predictions; 3) an improved Marine Weather Portal (MWP); 4) a high resolution WFS circulation modeling system directly linking shelf seas with estuaries; 5) develop Python analysis tools for oceanographic services; and 6) support several special projects, to include OTT Biological Data Project and the Internship support in remembrance of Vembu Subramanian.
- Address spatial observing gaps by: 1) continuing a glider observatory for the South Atlantic Bight (SAB) and 2) installing a coastal water quality and meteorological station in Charleston Harbor, SC.
- Fill the Gaps Campaign:
 - Expand HFR coverage along the SE coastal region through the purchase and deployment of 6 additional WERA HFR
 - Increase SECOORA's glider deployment capacity through the purchase of a new Slocum glider.
 - Additional Observations Initiative: Via a competitive mini-proposal process, SECOORA will support an effort to increase observing in the region that leverages ongoing partner activities to address highly visible ocean and coastal issues challenging the region:
 - Harmful algal blooms
 - Sound in the marine environment
 - Coral disease

SECOORA's proposed activities are structured on IOOS system design and will continue SECOORA's contributions to national and regional components of IOOS (Appendix 1, Figure 1). The full-time Executive Director coordinates RA governance and management with a Board comprised of representatives from multiple sectors. Stakeholders are regularly engaged through formal and informal mechanisms that inform SECOORA's priorities. Nearly 70% of the proposal budget is devoted to observing infrastructure and operations that include HRF systems, gliders, and moored and coastal stations, some of

which have been in continuous operation for almost 20 years. The investment in DMAC functions assures IOOS DMAC requirements and standards are met and incorporated into operations. The planned modeling activities are tightly linked to the observing subsystem and support a suite of integrated products and forecasts that address priority stakeholder needs for decision support tools. The proposal team, comprised of 19 principal investigators, represents a broad range of scientific and technical expertise and experience, and are fully capable of implementing the proposed objectives. SECOORA activities are highly leveraged and supported by many partners and stakeholders assuring the available federal funding will have maximum impact, both regionally and nationally. To summarize, the goals, objectives and supporting information of this proposal demonstrates SECOORA's alignment with the requirements of this funding opportunity as well as US IOOS program goals.

Connections to Users/Stakeholders and Benefits

Regional and national stakeholders benefit from an enhanced and sustained RCOOS through easy access to data and information required for safety, commerce, public health and ecosystem management. In October 2014, SECOORA conducted a stakeholder needs assessments¹ for the SE, vetted findings with the Board, and confirmed four thematic priority areas on which SECOORA should focus: 1) Ecosystems: Water Quality and Living Marine Resources; 2) Coastal Hazards; 3) Marine Operations; and 4) Climate Variability. The goals and objectives of this proposal reflect and address these priorities.

Our major partners are identified in the Project Summary, and SECOORA also engages stakeholders through participation in regional and national teams, meetings, conferences, science fairs, newsletters and focused workshops as well as collaborations with the other RAs. Several students are directly supported as part of this proposal and many others are engaged by PIs, resulting in significant contribution to development of future scientists. Additionally, SECOORA actively participates in regional groups such as NOAA's Southeast and Caribbean Regional Team (SECART), the Southeast Disaster Recovery Partnership, the Southeast Ocean and Coastal Acidification Network (SOCAN), and the Florida Atlantic Coast Telemetry (FACT) Network which represent key stakeholder groups. Each of these collaborations further leverages SECOORA work and outreach.

Goals, Objectives, and Workplans

With the \$3,570,942 funding, SECOORA will implement Goals 1 through 4 and 6 (as identified in our original proposal) to support SECOORA's base capacity and enhance the ROOS. SECOORA will maintain existing infrastructure and, barring significant accidents or failures, will target system uptime of 85%. In addition, SECOORA will add new observing infrastructure (Goals 3 and 6) needed to fill long-standing gaps in our regional network and build capacity required to ensure SECOORA's long-term viability as a regional enterprise.

SECOORA is a mature RA supporting extensive observing assets (Appendix 1, Figure 2), some of which have been in continuous operation since 1998. As one of 11 RAs established through US IOOS, SECOORA coordinates coastal and ocean observing activities, facilitates dialogue among stakeholders, and provides a governance framework that supports regional observing across the linked sub-regions of the SE US, including the WFS, southern and eastern FL, and the SAB. SECOORA seeks to meet SE decision-maker needs for coastal and ocean information by sustaining and advancing the RCOOS through implementation of four goals over the next five years. Objectives and tasks are also included in Table 3, Milestones. For each goal, the objectives, technical approach, data management, and product development are described.

Goal 1: Continue SECOORA's region-wide governance and communication structure to engage users and stakeholders in coastal observing science.

Objective 1.1: Maintain governance and management for the RA and RCOOS.

SECOORA's existing membership, governance, management, and communications enterprise uniquely positions SECOORA to coordinate the SE's coastal and ocean observing activities. SECOORA is a non-profit membership organization with four full-time and one part-time staff who provide program development, data and information management, communications, accounting and other program coordination and management services. Hernandez leads the team and oversees SECOORA staff and operations. Dorton is the RCOOS Manager and DMAC coordinator. Wakely is the Communications Director, leading outreach efforts including web and social media content development. Lee is the Chief Financial Officer and Knight is the part-time accountant.

SECOORA is governed by a Board of Directors and by-laws that stipulate both geographic and sector (i.e. academic, private, public/nonprofit) representation. Members represent a broad range of stakeholders and expertise with interests in the coast and ocean. SECOORA Board of Directors serve three-year terms, with approximately 1/3 of the Board elected annually by the membership. Board responsibilities include oversight of fiscal matters, and development of proposals. As of May 2017, SECOORA is a certified Regional Information Coordination Entity.

Objective 1.2: Engage users and other stakeholders to prioritize investments.

All SECOORA members and PIs represent their institutions, peers, and/or interest groups in SECOORA decision-making and serve as ambassadors for SECOORA and IOOS. RA staff, PIs, and partners actively engage in local, regional, and national stakeholder groups (e.g. NOAA SECART, Florida Atlantic Coast Telemetry (FACT), Integrated Tracking of Aquatic Animals in the GOM (iTAG), local American Meteorological Society, Marine Technology Society, etc.), which help SECOORA establish priorities, identify leveraging opportunities, and reduce redundant efforts in our region. Examples of prioritization activities include: SECOORA leading SOCAN in partnership with NOAA's OA Program; in cooperation with FACT, GA DNR, and the Smithsonian Environmental Research Center, SECOORA members added acoustic receivers to moorings in Onslow Bay, NC to increase fisheries tracking efforts and fill geographic gaps in the animal telemetry network; and, SECOORA hosting the FACT website (<http://secoora.org/fact>), the FACT telemetry node, and actively participates in FACT meetings.

SECOORA uses formal and informal communications to engage members and stakeholders. Communication activities and products include an annual report,² informational one-pagers and other print material, presentations at meetings, press releases, e-newsletters, a webinar series, and content for website and various social media outlets. Finally, SECOORA regularly surveys³ users and stakeholders regarding priorities and requirements. These efforts increase stakeholders' awareness of observing activities and their relevance.

Objective 1.3: Provide DMAC infrastructure to enable collaboration and decision-making.

SECOORA continues to enhance its DMAC subsystem to improve efficiency, coordination, and sustainability of the system as a whole, while maintaining all existing data partnerships. Axiom Data Science, LLC (Axiom) provides the DMAC infrastructure and management support for SECOORA. Dorton will coordinate the DMAC activities with the Axiom project team (Wilcox, team lead) and SECOORA DMAC will function under the direct supervision of staff. Axiom provides comprehensive technical solutions to meet data management needs, while using open source software resources, high performance computing clusters, and interoperability services. This framework will directly leverage systems, capabilities and lessons learned from ongoing DMAC activities for the Alaska Ocean Observing System, the Central and Northern California

Ocean Observing System, and US IOOS. The resulting DMAC system will increase data access and use and allow SECOORA to develop new capabilities and tools to meet a variety of user needs.

SECOORA is committed to implementing the standards and guidelines set forth by the US IOOS DMAC subsystem. We will continue to work with our funded PIs and other RAs, data partners, and the US IOOS program office on the implementation of QARTOD (both technically and by providing feedback on draft manuals) and will participate in all national DMAC efforts and meetings. SECOORA will ensure that all data products are discoverable and broadly accessible to user groups through implementation of standard IOOS services. As data discovery evolves using interoperability services, such as Open Geospatial Consortium (OGC) Catalog Service for the Web and access systems, OGC Sensor Observation Service, Open-source Project for a Network Data Access Protocol (OpenDAP), Environmental Research Division's Data Access Program (ERDDAP), and OGC Web Mapping Service, scientific numerical synthesis activities will be accelerated by the availability of larger numbers of high quality data sets that can be operated on in sophisticated ways (visualized, subset, and transformed).

Effective Communication with Users and Stakeholders: Axiom will update SECOORA's website and data portal in order to maintain a state-of-the-art streamlined platform to distribute information, tools, and products. New applications developed will follow the branded style guide. The Axiom framework manages a variety of ocean data types (*in situ*, mobile, remotely-sensed, numerical multidimensional grids, geographic information system, and other structured formats), exposes managed data through interoperability systems based on IOOS service standards, and uses several user interface tools that allow data to be discovered and explored by the broader community. Using this framework to power the SECOORA DMAC system will enable the partners to ingest or connect to data sources relevant to SECOORA and efficiently develop advanced user tools and data products. These data sources include SECOORA-supported assets as well as relevant data from local, state, regional, and federal sources. The proposed efforts will redevelop the current catalog interface to effectively search and query the entire DMAC infrastructure and allow users to find all SECOORA data resources (e.g., buoy, HFR, glider, satellite or model), and immediately be presented with metadata and the ability to extract and visualize the data.

Simplified Coordination and Integration of Data Lifecycle: The data provider relationship facilitates efficient data transfer. For example, *in situ* data providers currently submit their data to NDBC independently; here it is proposed to centralize the NDBC data submission process for data providers that do not have dedicated data management infrastructure through the SECOORA DMAC infrastructure. SECOORA PIs are using Research Workspace, a scientific collaboration platform and data management tool developed by Axiom, to generate US IOOS compliant metadata, share data files among their collaborators, publish final data files to the SECOORA data portal and data catalogs, and ultimately archive datasets with NCEI for long-term preservation. As this system is refined during Year 3, all SECOORA data providers will use Research Workspace to create metadata for glider deployments and real-time moorings. Additionally, Axiom and SECOORA staff will work with data providers to share non real-time data and archived data, and to generate associated metadata through Research Workspace. These improvements to the DMAC infrastructure will allow for better quality control, reliable delivery of data and products, archiving to national data centers, distribution of data to NDBC and the World Meteorological Organization Global Telecommunication System, distribution through US IOOS standard services and data formats, and controlled metadata standards and vocabularies. This expertise and infrastructure will also be available to support appropriate inclusion of relevant local, state, and regional data sources not currently discoverable.

DMAC Sustainability: Through Axiom, SECOORA has access to larger computational and storage resources. This allows processing and integration of larger and more complex datasets into the DMAC system and better positions SECOORA to respond to user requests for high performance computing, such as oil spill trajectory modeling⁴. The SECOORA data assembly center, replicated at data centers in Portland,

OR and Providence, RI, are designed to be highly redundant to support recovery in the event of failure. All databases and code repositories are backed-up on nightly, weekly and monthly schedules. In-progress development is replicated to source control servers to ensure that source code is preserved. All servers undergo routine maintenance to swiftly address security vulnerabilities. Servers containing source code and databases are located behind an Enterprise level firewall and are physically secure with environmental regulation systems, redundant power, Uninterrupted Power Supply systems and fire suppression.

Goal 2: Continue existing core observation investments in the region.

Objective 2.1: Maintain 15 HFRs distributed throughout the region.

HFR arrays currently maintained and operated in the region (Appendix 1, Figure 2) map surface currents at high spatial and temporal resolution across the coastal ocean and the outer shelf and slope. These arrays include Coastal Ocean Dynamics Applications Radar (CODAR) and Wellen Radars (WERA), most of which have operated for at least 10 years. Five SECOORA members (UNCCH, USC, UGA Skio, UM, USF) operate 13 priority HFRs. USF operates an additional 2 WERA that overlook the WFS. An additional priority radar is planned for deployment in North Key Largo. This station will be managed by UM and it is in the final phases of permitting. All of the HFR provide surface current data in near real time (NRT) to SECOORA and to the HFR National Network at Scripps Institute of Oceanography (Scripps) and Rutgers through the US IOOS-sponsored HFR Surface Current Mapping Initiative. WERA installations also provide surface wave measurements as a function of position and time over a subset of the domain. Both operational and quality metrics are routinely checked. This includes assessment of daily variations in coverage and uptime using metrics such as database latency, range of coverage, and number of solutions as implemented by the National HFR Network. Expansion of the HFR network is covered in section 6.4.

Objective 2.2: Maintain 21 *in situ* stations along the Carolina and WFS coasts.

Strategically placed *in situ* arrays address marine user observational needs and provide a critical component in the development, validation and application of state-of-the-art numerical circulation models. The observations and models are part of a coordinated system that informs a variety of scientific exploration and societally relevant (economic and environment) issues. Two institutions (UNCW and USF) will continue to operate and maintain for this five-year proposal 20 *in situ* stations along the coasts of the Carolinas and WFS (Appendix 1, Figure 2), several of which have been operational for almost 20 years. USF will sustain four offshore real-time meteorological/oceanographic stations (three buoys, one tower); two non-real-time subsurface stations; and five real-time meteorological and water level stations, some equipped with water temperature and salinity sensors. The Clam Bayou coastal station, maintained in partnership with YSI/Xylem, measures water quality variables⁵ and Big Carlos Pass includes an acoustic sensor for measuring fish activity. UNCW will sustain nine real-time meteorological/oceanographic stations located offshore of NC and SC and one non real-time station located in Onslow Bay, NC. Two of the real-time stations include WaveRider buoys co-located with a meteorological buoy and these are operated and maintained in partnership with USACE and the Coastal Data Information Program (CDIP) at Scripps. One station includes a small co-located mooring with an ADCP/NEMO for the provision of waves and currents. All of these *in situ* stations augment a number of existing real-time observing sites operated by federal and state agencies. At a minimum, the stations are outfitted with sensors that collect wind speed/gust/direction, relative humidity, air temperature, barometric pressure, water temperature and salinity. Some of the stations collect water column temperature, salinity and currents which are important contributions to the validation of forecast models. Table 1 provides the list of variables measured by the *in situ* assets.

The buoy and coastal station designs are robust, with both the Carolinas and WFS arrays surviving prior hurricanes. Moorings and coastal stations are generally deployed for one year with intermediate ser-

ving as needed. This annual schedule requires instrument calibration and repairs, expendables replacement, ship-time, engineering support, and data management support. USF WFS network data telemetry is via the NOAA Geostationary Operational Environmental Satellite (GOES) network and UNCW uses Iridium and cell phone services. UNCW (through Second Creek Consulting) and USF address data management and US IOOS data certification requirements such as QA/QC, data delivery, operational system alerts and system performance monitoring. All data feeds into the SECOORA DMAC system.

Objective 2.3: Maintain the Sensors on NOAA GRNMS Buoy (NDBC 41008)

SECOORA continues to support ocean acidification and water quality monitoring at the Gray’s Reef National Marine Sanctuary (GRNMS) as part of NOAA’s international effort to quantify the effects of ocean acidification on the world’s oceans. The sensors deployed at this station include pCO₂, pH, dissolved oxygen (DO), turbidity, chlorophyll, salinity and water temperature. UGA is responsible for the maintenance of the sensors on the buoy. Partners on the GRNMS water quality and ocean acidification buoy include NOAA PMEL and NDBC as well as the USCG.

Table 1. Moored and Coastal Stations

| | Wind Spd, Gust, Dir. | Air Temp | Barometric Pressure | Rel. Humidity | SW/LW Radiation | Water Temp | Currents | Waves | Cond/ Salinity | Water Level | Fish Acoustic Sensors |
|------------------------------|-------------------------|----------|------------------------|------------------|--------------------|---------------|----------|-------|-------------------|----------------|-----------------------------|
| UNCW Moorings | | | | | | | | | | | |
| LEJ3 - Outer Onslow Bay | X | X | X | X | | X | | | X | | X |
| LEJ3Wave | | | | | | X | | X | | | |
| ILM3 - Outer Onslow Bay | X | X | X | X | | X | | | X | | X |
| ILM2 - Inshore Onslow Bay | X | X | X | X | | X | | | X | | X |
| ILM2Wave | | | | | | X | | X | | | |
| SUN2 - Northern Long Bay | X | X | X | X | | X | | | X | | X |
| SUN2Wave | | | | | | X | X | X | | | |
| CAP2 - Inshore Capers Island | X | X | X | X | | X | | | X | | |
| FRP2 - Inshore Fripp Island | X | X | X | X | | X | | | X | | |
| OB27 - Onslow Bay* | | | | | | X | X | X | X | | X |
| USF Moorings | | | | | | | | | | | |
| C10 - WFS Central nearshore | X | X | X | | X | X | | | | | |
| C12 - WFS Central offshore | X | X | X | | X | X | | | | | |
| C13 - WFS South | X | X | X | | X | X | | | | | |
| C11 - WFS Subsurface* | | | | | | X | X | X | | | |
| C15 - WFS Subsurface* | | | | | | X | X | X | | | |
| C21 - Tower* | X | X | X | X | | X | X | X | | | |
| USF Coastal Stations | | | | | | | | | | | |
| Shell Point | X | X | X | | | | | | | X | |
| Aripeka | X | X | X | | | | | | | X | |
| Fred Howard State Park | X | X | X | | | | | | | X | |
| Clam Bayou | X | X | X | | | X | | | X | X | |
| Big Carlos Pass | X | X | X | | | | | | | X | X |

*Non real-time station

Goal 3: Begin to address geographic gaps in observations.

Although the SE region benefits from a number of legacy subregional observing programs, major gaps remain in the spatial extent of the observatory. SECOORA proposes investments in a new glider and the Charleston Harbor station to continue to build-out the RCOOS in order to meet priority stakeholder needs.

Objective 3.1: Establish a regional glider observatory in the SAB.

Shelf circulation and water properties in the SAB are affected by a variety of processes and characteristics that are unique to the region (i.e., broad and shallow shelf, influence of strong boundary currents, strong tidal forcing, distributed river input, passage of powerful tropical storms and hurricanes). Those processes have wide ranges of spatial and temporal scales not easily observed with traditional technology, which has led to a historic lack of information on density stratification⁶ and horizontal and vertical structure of biologically relevant variables. *In situ* observations are particularly limited in winter and during storm conditions, when shipboard measurements are difficult to obtain.

Glider data provides regional 4-D information about temperature, salinity and density structure, and oxygen/turbidity/CDOM/chl-a concentrations. These measurements will be used to: 1) investigate hydrography and circulation dynamics, bottom temperatures and cross-shelf pathways between the shelf edge and nearshore; 2) use control theory and ocean models to develop intelligent control capabilities⁷ allowing gliders to recognize and correct for fronts and strong currents; 3) prepare glider data for integration into circulation and ecosystem modeling efforts; 4) efficiently deliver information to the modeling community and stakeholders (e.g., bottom temperature maps to NOAA fisheries science centers) through SECOORA DMAC and the IOOS glider data assembly center (DAC); and 5) use this base of regional glider operations for leveraged efforts supported by GRNMS, National Science Foundation, NASA, and state agencies.

Three gliders from the pool of instruments owned by SECOORA, SkIO, USF, UNC, and NCSU will be deployed from locations in Florida and Georgia on shelf- and shelf-edge sampling missions with northward trajectories. These mapping missions serve as a baseline of operations, providing spatial coverage for data assimilation and fisheries applications. In Year 3, SECOORA will purchase a new G3 Slocum glider, through the IOOS Association Fill the Gaps Campaign. The glider will be based at SkIO. The current glider observatory is an aging fleet and the new glider will improve operational capacity for the region.

USF and SkIO will deploy two gliders off Cape Canaveral and coastal Georgia, respectively, on shelf survey missions, with operations approximately between the 20m and 50m isobaths. The USF glider will use Gulf Stream currents to survey the shelf edge and Gulf Stream along the entire SAB before recovery off North Carolina. At least one of these missions will be timed with hurricane season to maximize the impact of near-surface heat content information for tropical weather prediction. An additional 1-2 deployments leveraged by SECOORA and GRNMS will focus on Gray's Reef National Marine Sanctuary for fisheries-driven studies that will double as test deployments for new instruments.

Glider operations will integrate and take advantage of *in situ* and HFR observations, satellite imagery and regional model predictions to optimize glider tracks. All gliders deployed will incorporate Vemco Mobile Transceivers (VMT), acoustic monitoring receivers to track tagged fish⁸ and at least one glider is outfitted with an integrated VMT to transmit detections in real time. Acoustic data will be shared with the fisheries research community (Ocean Tracking Network, FL Atlantic Coast Telemetry, iTAG, GRNMS). Collaborative work between oceanographers and engineers at UGA SkIO, Georgia Tech, and NCSU will explore new methods of acoustic telemetry facilitated by autonomous platforms operated using intelligent control strategies.

Objective 3.2: Install a new coastal water quality station in Charleston Harbor.

SC DNR was able to install the pilings for the water quality station summer 2017 and in December 2107, the YSI EXO2, data logger, and communications equipment were deployed on the USACE piling. The YSI EXO2 sonde was located near the bottom to measure water temperature, conductivity/salinity, dissolved oxygen, pH, turbidity, chlorophyll fluorescence, and water depth. The station has received NERRS secondary station classification and the data is telemetered to the NERR Centralized Data Management Office.

Unfortunately, in late summer 2018, the station was hit by a barge and destroyed. During Year 3, SECOORA project team members will work with partners to re-establish the station.

Goal 4: Continue delivery of operational model forecasts and products to serve priority users.

A central goal of SECOORA is to develop, in partnership with end users, operational products that will support decision-making. Along with ongoing delivery of the regional model forecasts that fill temporal and spatial gaps in observations, SECOORA will develop and enhance products in collaboration with our partners to support their operational needs. Product delivery plans are included in Table 2 and geographic scope is shown in Appendix 1, Figure 2.

Objective 4.1: Enhance and operate a Coupled Marine Environmental Assessment and Prediction System.

SECOORA member NCSU strives to implement an advanced regional marine environment assessment and prediction capability for SECOORA by using a suite of fully coupled ocean-atmosphere-wave-marine ecosystem prediction models informed and updated continuously through data assimilation. Such a system will predict coastal ocean conditions over the entire SECOORA footprint with a high degree of scientific accuracy and provide detailed sub-regional information through relocatable grid refinement and nesting technology, and update and transmit such information to stakeholders (e.g. fishery resource managers) in a timely and clear fashion. SECOORA will work with members at NCSU to build off of Year 1 and 2 advances, specifically: 1) continue refining the full couplings of wave, atmosphere and ocean circulation models; 2) sustain NCSU's ocean circulation nowcast/forecast modeling system to generate regional nowcasts and forecasts of ocean circulation, waves, marine weather on the routine basis and implement google analytics to track their usage; 3) continue implementing and refining low trophic level marine ecosystem predictions; 4) continue implementing and refining advanced data assimilation schemes into the prediction system; 5) implement a prototype data assimilation nowcast/forecast system and carry out its routine operation experiment; 6) continue model skill assessment for marine environmental variables through appropriate comparisons with independent (non-assimilated) observations (e.g., mooring observations). Through this work, SECOORA can implement an advanced regional marine environmental assessment and prediction capability over the entire SECOORA domain with associated error estimates, and update and transmit information to stakeholders in a timely and clear fashion.

Objective 4.2: Operate the West Florida Shelf (WFS) Ocean Model.

The WFS model focuses on the GOM and provides daily, automated ocean circulation N/F by nesting Finite Volume Coastal Ocean Model (FVCOM) into HYbrid Coordinate Ocean Model (HYCOM). The model simulations are quantitatively gauged against *in situ* observations⁹ for the region from west of the Mississippi River Delta to south of the Florida Keys with real time river inflows versus climatology. This West Florida Coastal Ocean Model (WFCOM), with resolution beginning with that of HYCOM (4km) along the open boundary, includes the various estuaries, telescoping down to 150m in both Tampa Bay and Charlotte Harbor. WFCOM provides the tracking capability for WFS HABs (in collaboration with FWC) and has been used by emergency managers for an oil spill training exercise (for which model simulations were accessed from NOAA GNOME through the NOAA GOODS using THREDDS data server capabilities developed with the assistance of SECOORA DMAC). These multidisciplinary applications will continue to develop new products via stakeholder outreach.

Objective 4.3: Provide an Early Warning System for Swimming Beach and Shellfish Harvesting Waters.

There are currently no widely-available tools to explore the likely effects of changing land-use practices and climate change scenarios on bacteria pollution in the coastal areas of NC, SC, and FL. Building on existing

SECOORA, NOAA, EPA, USGS and state-supported coastal and ocean observing efforts and SECOORA and EPA modeling efforts, Year 3 work will enhance existing decision support tools currently in operation in the Long Bay region of SC, Sarasota Beach region of FL, the Chesapeake Bay, the Charleston Harbor region of SC, and under development in Kill Devil Hills, NC. Specifically, Year 3 efforts will: 1) Expand on an existing decision support tool that couples rainfall, water temperature, wind, tide, and salinity data (provided by the NWS, ocean observing systems, and state programs) with direct measures of *Enterococcus* concentrations to provide daily forecasts of bacteria concentration for locations along the Myrtle Beach, SC Grand Strand, in the Charleston Harbor, SC region, Sarasota, FL swimming beaches and under development for Kill Devil Hills, NC; 2) Expand upon the shellfish management decision support tool previously developed to predict fecal coliform levels in SC shellfish harvest areas in Murrells Inlet, SC and expand it for use in selected areas. Preliminary areas have been identified based on requests by state shellfish managers and NGOs in SC and NC. The project team is hosting a stakeholder meeting with beach managers and state shellfish managers from NC and SC in fall/winter 2018. Stakeholder input from this meeting will help identify the specific location for the year 3 expansion; and, 3) Work with the SECOORA Marine Weather Portal project (Objective 4.4) to support integration of developed tools into existing How's the Beach web and mobile app, and into the enhanced Marine Weather Portal.

Objective 4.4: Optimize and enhance the SECOORA Marine Weather Portal (MWP).

The MWP is the most viewed product on the SECOORA website. NOAA's NWS offices within the eastern and southern regions (SECOORA and GCOOS RA domains) were engaged in the MWP redevelopment efforts and many offices are pushing users to the new site (<http://mwp.secoora.org>). This project will leverage resources from SECOORA, USC, Second Creek Consulting, state and local resource management and public health agencies, NWS, and NOAA's Office for Coastal Management / NERRS. Year 3 MWP tasks include: 1) maintain the revised MWP and add new products from the NWS, SECOORA (e.g. How's the Beach), and other NOAA products and services; 2) Conduct outreach with NWS offices, local bait and tackle shops, marinas, fishing organizations, etc. to increase awareness of the site and generate feedback on the site. This feedback can provide valuable information regarding site improvements or potential spin-off web or data products; 3) present lessons learned at conferences such as Oceans 18 in Charleston, SC.

Objective 4.5: Python Data Analysis Tools for Oceanographic Services

Data analysis tools for oceanographic services are being developed by Filipe Fernandes. The primary Year 3 objectives are: 1) Support the evaluation and enhancement of interoperability services and tools that serve the IOOS data discovery capabilities, binding data discovery to data access services, and data access; 2) In support of the IOOS Catalog, continue developing the evolving software packages developed by RPS/ASA that are important to the IOOS enterprise; 3) Continue to support best practices for open source software development to bolster the IOOS investment by engaging the larger open source community; and, 4) Perform documentation/planning/testing to further mature the projects and maximize the likelihood of external contributions.

Objective 4.6: Special Projects

Increasing awareness of Ocean Acidification in the Southeast: The Southeast Ocean and Coastal Acidification Network (SOCAN) was established in fall 2014 through a partnership between NOAA's Ocean Acidification Program (OAP) and SECOORA. With funding in Year 3, SOCAN will: 1) continue to fund a part-time program coordinator; 2) increase capacity building by establishing a new working group to leverage partnerships and identify funding opportunities; 3) launch a new website and continue distribution of communication products through webinars, web materials and newsletters; and 4) execute a stakeholder workshop

for South Carolina and Georgia stakeholders.

Scholarship: SECOORA supports Hollings Scholars annually. The goal is for the scholars to work with a SECOORA member and learn all facets of an ocean observing program; from the science to the at-sea operations. Scholarship funding will be provided to the institution that hosts the Hollings scholar. These funds support the scholar above and beyond the Hollings funding to assure that the scholar has a well-rounded experience.

OTT Biology pilot projects: SECOORA will work with the IOOS program office to: 1) build understanding of regional needs for biological observations, data, and products (i.e. needs identification); and, 2) make recommendations on how to better integrate MBON, ATM, and SECOORA. SECOORA will interview 3-5 key stakeholders within in the region to identify their biological data needs. Interviewees may include MBON project personnel, representatives from federal management agencies (e.g. NOAA NMFS, NOAA NMS, NASA), South Atlantic Fisheries Marine Council, NERRS, etc. Interview results will be shared with the IOOS program office.

Additional Observations Initiative: Via a competitive mini-proposal process, SECOORA will support an effort to increase observing in the region that leverages ongoing partner activities to address highly visible ocean and coastal issues challenging the region:

- Harmful algal blooms
- Sound in the marine environment
- Coral disease

\$30,000 is the anticipated award value. The goal is to increase observing within the region, provide outreach to stakeholders (e.g. state agencies, broader research community), and disseminate project results at a SECOORA meeting.

Goal 5: Initiate new operational products to meet additional user needs

Funds are not available for this goal.

Goal 6: Continue building critical elements of the observing system by adding biogeochemical and marine sound sensors, and HFRs

Objectives 6.1-6.3: Funds are not available for these objectives.

Objective 6.4: Install and operate new HFRs

Through funding generated by the IOOA Association Fill the Gaps Campaign, SECOORA PIs will be able to expand HFR coverage along the U.S. East Coast. Project partners at FIT will deploy two WERA systems in the Port Canaveral, FL region. The project team has identified one location, Sebastian Inlet State Park in Melbourne Beach, FL, and the second location is currently being determined.

Additionally, SECOORA will work with SkIO to purchase four WERA that were leased by SkIO for an NSF-funded project led by SkIO. One of these WERA will remain in Ocracoke, NC to fill a coverage gap in Raleigh Bay along the NC Outer Banks. SkIO plans to site two of the HFRs north of the FIT Cape Canaveral HFRs to continue building radar coverage towards the Georgia border. The fourth radar location is still to be determined; however, it may be located in Long Bay, SC. See Appendix 2, Figure 3 for details on proposed HFR locations. These locations are dependent on stakeholder input, site suitability and permitting.

User Benefits and Product Delivery

SECOORA’s approach to developing end-user applications begins with identification and engagement of local, regional, and national partners who have articulated a need that can be addressed through coastal ocean observations or applications. Partners are engaged to develop specifications that guide the product and service development effort. End-users participate in the design, development, and validation of such products. Each product or service to be developed under this proposal has a clear link between specific stakeholders and specific SECOORA-supported observation, model, or prediction data. SECOORA ensures that proper and complete metadata are generated and maintained, and that products are made available to the wider user community through commonly used dissemination protocols via SECOORA DMAC system. All observational data, maps, models and other coastal and ocean observing information and products are easily accessed via the SECOORA website, social media outlets, and e-newsletters.

Our product delivery plans are tailored to meet user needs and provide important benefits. All SECOORA generated data is delivered through a variety of web services and webpages, and benefits include support for NOAA NWS marine weather forecasts and marine hazards advisories, USCG SAR operations, and USACE modeling and sediment management applications. Data and data products also support ecosystem management and fisheries stakeholders. Resource managers, recreational anglers and commercial fishers will benefit from improved efficiency in catching target species and less fuel usage. SECOORA’s rich data repository also allows stakeholders to access historic data. Examples of uses of this archived data include: 1) informing managers and the public of the paths and intensities of past tropical storm systems and coastal water levels associated with these events; 2) visualizing when and where polluted water could move into coastal areas; and 3) providing data to inform climate vulnerability assessments. Table 2 outlines additional delivery plans for products included in this proposal and Figures 2 and 3 in Appendix 1 show observing locations and areal extent of products included in this proposal.

Table 2. Product Delivery Plans and Users

| Goals and Objectives | | Delivery Plans and Users: |
|--|---|--|
| 4 Continue delivery of operational model forecasts and products to serve priority users | | |
| 4.1 | Coupled Marine Environmental Assessment and Prediction System | N/F model results served via web services. Stakeholder groups include USCG, NOAA NMFS, NOAA OR&R, Bureau of Ocean Energy Management, NC DENR, SC DNR, GA DNR, FL FWC, NWS and SAFMC. |
| 4.2 | West Florida Coastal Ocean Model | N/F model results served via web services. Stakeholder groups include USCG, FL FWC, recreational mariners, NOAA Office of Response and Recovery. |
| 4.3 | Advisory System for Beach and Shellfish Waters | Smartphone apps and web services. Products include nowcast tools and forecasting products derived by coupling the nowcasting tools and climate change model scenarios. User groups, including resource managers, public health officials, and representatives of potentially vulnerable populations will be convened to provide guidance, input and review in support of tool development. |
| 4.4 | Marine Weather Portal (MWP) | Served via web services. Project personnel will work with NWS offices and mariners to provide iterative feedback on the enhanced product. Users include the marine stakeholder community (fishermen, boaters, NWS, beachgoers). |

Summary

The proposed \$3,570,942 funding will support the core RCOOS framework which provides:

- Regional coverage over a geographically large and diverse section of the US coastal ocean;
- Stakeholder engagement relative to RCOOS components, including moorings and coastal stations, HFR, and model data on which citizens, decision-makers, and scientists have come to depend;
- Cross-state and intra-regional cooperation;
- Maintenance of critical in-water infrastructure, data flow from offshore to the web, and proven technical capabilities and experience in operational coastal ocean observing; and,

- Expansion of SECOORA’s HFR footprint and a more robust glider observatory through the IOOS Fill the Gaps campaign.

As a mature RA in a region with significant observing gaps, SECOORA must balance maintenance, filling important gaps in observations and creating new connections to users through thoughtful expansion of products and services to build-out the RCOOS. The proposed activities will deliver stakeholders the ongoing observations and modeling products they rely on, and new integrative project components that leverage existing SECOORA efforts (observations, models and DMAC) to create new and exciting opportunities. For example, the glider observatory will use SECOORA HFR data and circulation N/F model predictions to optimize glider data collection, which will then be assimilated into the newly enhanced regional modeling N/F system and inform fisheries managers. The MWP, regional ocean model, WFS model and shellfish and beach advisories will incorporate SECOORA data streams to improve decision-making. The DMAC system will enable users and stakeholders to combine various components of the SECOORA network in novel ways. By creating synergies, adding new capabilities in an intelligent way and supporting core operations, SECOORA will continue to lead observing science in the SE.

Milestones and Cost Proposal

Table 3. Goals, Objectives/Milestones and Schedule

| Goals and Objectives | 2018-2019 (Quarter) | | | |
|--|---------------------|---|---|---|
| | 1 | 2 | 3 | 4 |
| Goal 1: Continue SECOORA’s region-wide governance and communication to manage RA and engage users and stakeholders in coastal observing science | | | | |
| Maintain governance and management for the RA and RCOOS | x | x | x | x |
| Engage users and other stakeholders to prioritize investments | x | x | x | x |
| Maintain and operate DMAC | x | x | x | x |
| Goal 2: Maintain existing core observation investments in the region | | | | |
| Maintain 15 HFR distributed throughout the region | x | x | x | x |
| Maintain 21 <i>in situ</i> stations along the Carolina and WFS coasts | x | x | x | x |
| Maintain the Sensors on NOAA GRNMS Buoy | x | x | x | x |
| Goal 3: Begin to address geographic gaps in observations | | | | |
| Establish and maintain a regional glider observatory in the SAB | x | x | x | x |
| Purchase a new glider and integrate into the SECOORA glider fleet | | x | x | x |
| Install a new coastal water quality and metrological station in Charleston Harbor, SC | x | x | x | x |
| Goal 4: Continue delivery of operational model forecasts and products to serve priority users | | | | |
| Enhance and operate a Coupled Marine Environmental Assessment and Prediction System for the SE | x | x | x | x |
| Operate the West Florida Shelf Ocean Model | x | x | x | x |
| Provide an Early Warning System for Swimming Beach and Shellfish Harvesting Waters | x | x | x | x |
| Optimize and enhance the SECOORA MWP | x | x | x | x |
| Python Data Analysis Tools for Oceanographic Services | x | x | x | x |
| Special Projects | x | x | x | x |
| Goal 6: Continue building critical elements of the observing system by adding biogeochemical and marine sound sensors, and HFRs | | | | |
| Work with SECOORA PIs to expand HFR footprint within the region | x | x | x | x |

Cost Proposal. Summarized costs of this 2018-2019 effort are in Table 4. \$3,570,942 will support Goals 1 through 4 and 6. All components of this effort are leveraged; however, it is difficult to provide exact dollar values on contributions. Most of the observing assets were purchased with non-IOOS funds, and ongoing maintenance is subsidized by other grants. The same is true of most of the modeling work, i.e. models

were initially developed with other funds. Five percent of the SECOORA Executive Director's and Communications Director's salary is supported from member dues, as is a portion of their travel. Finally, a number of PIs are working at very subsidized rates or at no cost.

Table 4. Costs by Objective, PI and Institution

| Obj. | PI/Contractor | Inst. | YR 3 |
|---------------|---|---|--------------------|
| Goal 1 | Governance, Outreach & DMAC | | |
| 1.1-2 | Hernandez (Governance & Outreach) | SECOORA | 479,285 |
| 1.3 | Wilcox (DMAC) | Axiom | 209,716 |
| | Goal 1 Sub-total | | 689,001 |
| Goal 2 | Maintain existing core observations | | |
| 2.1 | High Frequency Radars | | |
| | Shay | UM | 110,000 |
| | Voulgaris | USC | 90,916 |
| | Savidge | UGA/SkIO | 91,000 |
| | Seim | UNCCH | 110,000 |
| | Weisberg | USF | 110,000 |
| | Hernandez (Operating funds for additional HFR) | | 88,082 |
| | Sub-total HFR | | 599,998 |
| 2.2 | Moored & Coastal | | |
| | Leonard (Carolinas) | UNCW | 372,300 |
| | Weisberg (WFS Moor.) | USF | 255,000 |
| | Luther (WFS Coastal) | USF | 51,000 |
| 2.3 | GRNMS Buoy | | |
| | Noakes (Gray's Reef) | UGA | 80,806 |
| | Sub-total Moored & Coastal & GRNMS | | 759,106 |
| | Goal 2 Sub-total | | 1,359,104 |
| Goal 3 | Address geographic gaps in observations | | |
| 3.1 | Gliders | | |
| | Edwards | UGA/SkIO | 34,469 |
| | Zhang | GA Tech | 21,022 |
| | Seim | UNCCH | 27,217 |
| | He | NCSU | 9,243 |
| | Lembke | USC | 34,139 |
| | Hernandez (New glider) | SECOORA | 223,345 |
| | Hernandez (Holdback for expenses) | SECOORA | 32,909 |
| | Sub-total Gliders | | 382,344 |
| 3.2 | Sanger (Chas. Harbor) | SCDNR | 20,000 |
| | Goal 3 Sub-total | | 402,344 |
| Goal 4 | Continue delivery of operational models and products | | |
| 4.1 | He (Regional Model) | NCSU | 132,600 |
| 4.2 | Weisberg (WFCOM) | USF (Funding included in Objective 2.2) | |
| 4.3 | Porter (Beach/Shellfish) | USC | 102,000 |
| 4.4 | Dorton (MWP) | SECOORA | 31,735 |
| 4.5 | Fernandes (Python Tools) | Brazil | 63,525 |
| 4.6 | Special Projects | Various | 58,886 |
| | Goal 4 Sub-total | | 388,746 |
| Goal 6 | | | |
| 6.4 | Maul | FIT | 167,532 |
| | Hernandez (New WERA) | SECOORA | 202,400 |
| | Savidge (Used WERA) | UGA/SkIO | 210,275 |
| | Hernandez (Used WERA) | SECOORA | 151,540 |
| | Goal 6 Sub-total | | 731,747 |
| | GRAND TOTAL | | \$3,570,942 |

Appendices

Appendix 1: Maps and Figures

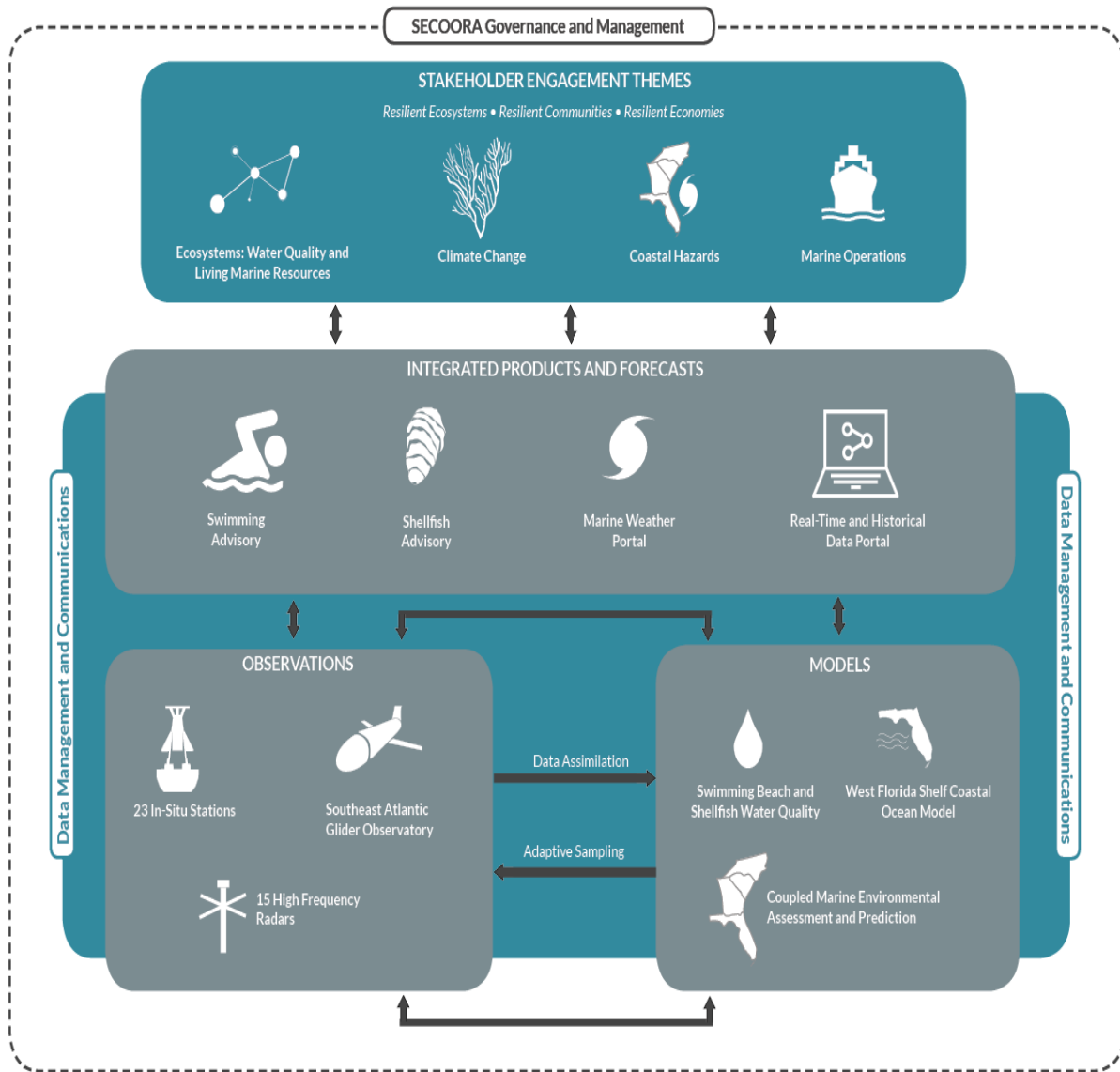


Figure 1: This schematic is a visual representation of the overall proposal. With oversight from Governance and Management, and in collaboration with PIs, Data Management and Communications successfully manages and integrates data for a suite of tools and applications. Each component is linked to priority stakeholder needs under four theme areas.

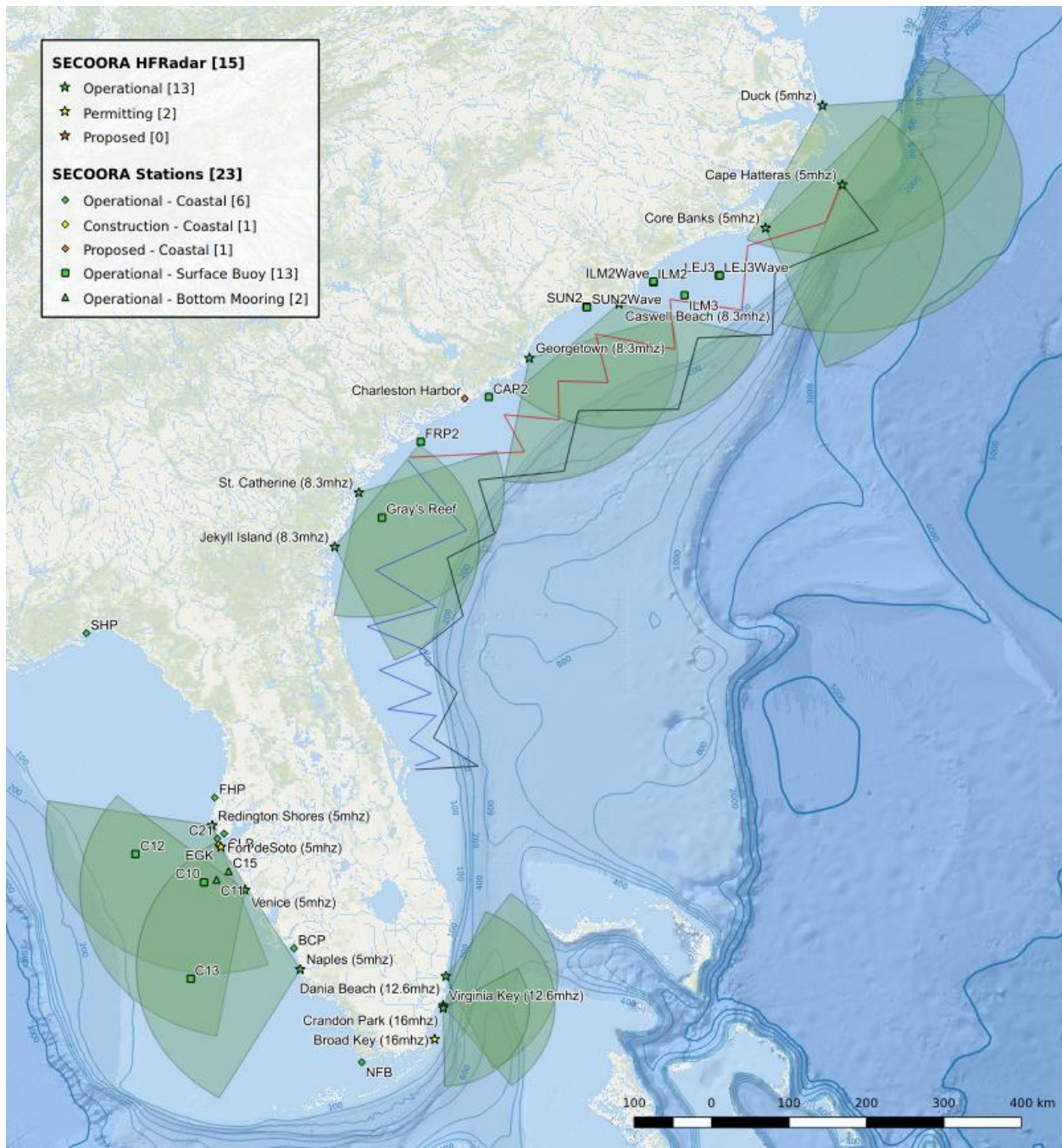


Figure 2: Map of existing SECOORA observations (buoys, coastal and HFR station locations). Glider sampling missions in South Atlantic Bight (SAB) are represented by blue, red and black sawtooth lines.

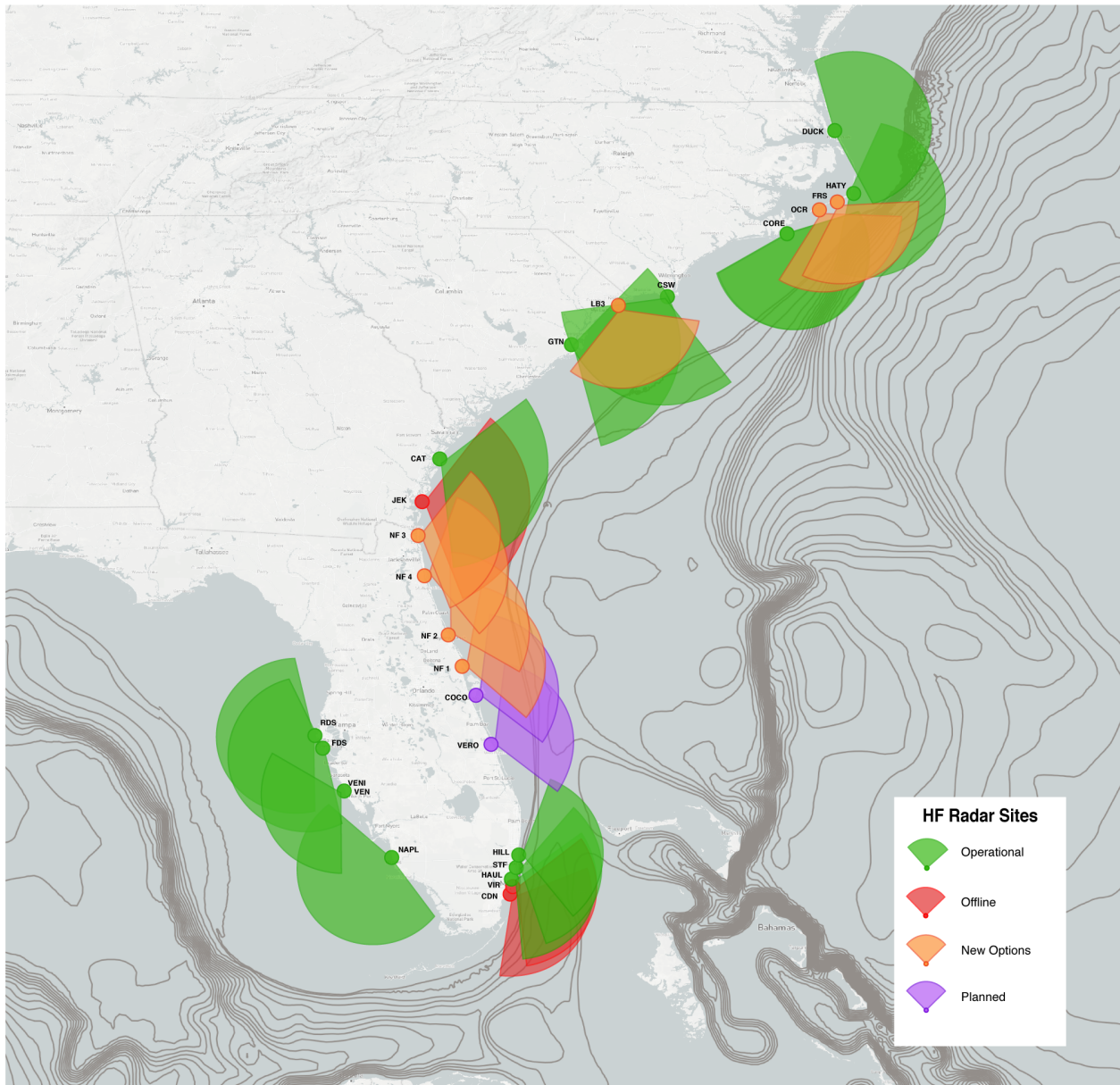


Figure 3. Currently deployed and operational SECOORA and FAU HFR are highlighted in Green. The Red HFR correspond with JEK, VND, and VIR. Each of these stations were adversely impacted by Hurricane Irma. Supplemental funding will be used to restore these stations. The planned HFR (in purple) are nominal locations for the two sites that will be deployed by the Florida Institute of Technology near Cape Canaveral. The locations noted in Orange are potential locations for the four used HFR that SECOORA and Skidaway Institute of Oceanography are purchasing. These locations will be reviewed with stakeholders, SECOORA Pls, and the IOOS office.

Appendix 2: References

- ¹ SECOORA User Needs Assessment (2014, October) http://secoora.org/webfm_send/1235
- ² SECOORA Communications Page, <http://secoora.org/communications>
- ³ SECOORA Member and Stakeholder Survey (2014). http://secoora.org/webfm_send/1581
- ⁴ SECOORA User Needs Assessment, page 3, (2014, October). http://secoora.org/webfm_send/1235
- ⁵ Clam Bayou Station, <http://comps.marine.usf.edu/index?view=station&id=CLB>
- ⁶ Castelao, R. (2011). Intrusions of Gulf Stream waters onto the South Atlantic Bight shelf. *J. Geophys. Res. Journal of Geophysical Research*, 116(C10).
- ⁷ Chang, D., Zhang, F., & Edwards, C. (2015). Real-Time Guidance of Underwater Gliders Assisted by Predictive Ocean Models. *J. Atmos. Oceanic Technol. Journal of Atmospheric and Oceanic Technology*, 32, 562-578.
- ⁸ Oliver, M., Breece, M., Fox, D., Haulsee, D., Kohut, J., Manderson, J., & Savoy, T. (2013). Shrinking the Haystack: Using an AUV in an Integrated Ocean Observatory to Map Atlantic Sturgeon in the Coastal Ocean. *Fisheries*, 38(5), 210-216.
- ⁹ Zheng, L. & Weisberg, R.H. (2012). Modeling the West Florida Coastal Ocean by Downscaling from the Deep Ocean, Across the Continental Shelf and into the Estuaries, *Ocean Modeling*, 48 (2012), 10-29.