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

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

Associate Investigator:
M. Richard DeVoe, SECOORA Board Chair
Executive Director
South Carolina Sea Grant Consortium
Charleston, SC 29401
P: 843-953-2078
E: rick.devoe@scseagrant.org

Associate Investigator:
Megan Lee, Chief Financial Officer
SECOORA
PO Box 13856
Charleston, SC 29422
P: 843-864-6755
E: mlee@secoora.org

Associate Investigator:
Jennifer Dorton, Deputy Director
SECOORA
PO Box 13856
Charleston, SC 29422
P: 910-443-1708
E: jdorton@secoora.org

1) Progress and Accomplishments

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

Milestone A: Maintain governance and management for the RA and RCOOS: *On-Track*

Activities	Status
Effectively manage grants and contracts	The SECOORA Year 4 Descope proposal was submitted to the IOOS office 08/29/19.
Ensure SECOORA's operational & governance structure enables us to achieve our vision	The SECOORA Board adopted the Governance Committee's recommendation to revise the SECOORA Conflict of Interest policy to restrict PI's from serving on the Board. The Governance Committee's recommendation to reduce the Board size to 11 members was approved at the January 2019 Board meeting and was approved by the membership at the SECOORRA annual meeting in June 2019.
Maintain effective communication with US IOOS and the IOOS Association	Highlights this period include meetings between IOOS Association and NOAA IOOS leadership during the OceanObs conference in Honolulu, HI, 9/16-20/19; participating in the IOOS COMT meeting 10/22-24/19 in DC; and monthly IOOS Program Office, IOOS Association Executive Committee and RA Director calls.
Expand and diversify funding.	SECOORA received $15,000 in funding from the Curtis & Edith Munson Foundation in April 2019 to re-establish three FACT acoustic sensors and add 30 water temperature sensors at established acoustic receiver stations in South Florida. As a matching campaign, SECOORA is raising funds to support a graduate student to conduct research using the instrumentation funded through the Curtis & Edith Munson Foundation. So far, SECOORA has raised $5,600.
Update and maintain SECOORA's RCOOS Plan	In January 2019, the Board of Directors decided that the next SECOORA RCOOS Plan will be used to guide the 2021 – 2026 SECOORA proposal efforts. SECOORA has a final draft of the 2021 – 2026 RCOOS Plan for Board approval at their December meeting.

Milestone B: Engage users and other stakeholders to prioritize investments: *On-Track*

Activities	Status
Improve web-based information system and web presence	SECOORA continues to track website usage with Google Analytics. There was a 45% increase in website sessions on secoora.org (from 28,350 to 41,377) this period. SECOORA is now tracking data portal sessions (portal.secoora.org). Data portal sessions have increased 7% in the reporting period (from 5,148 to 5,527).
Identify and promote opportunities for non-members to engage in SECOORA activities and initiatives	SECOORA's webinar series – *Coastal Ocean Observing in Your Community* – hosted one webinar on 10/1/19 which featured OceanReports. There were 69 participants. Webinar recordings can be found here. Educators from the Georgia Institute of Technology created sea level rise curriculum for middle school students. SECOORA hosted a four-part webinar series in which Georgia Tech educators presented the sea level rise curriculum materials. There were 45 participants and 114 registered from many different organizations (City of Naples FL, King High School, Hall Middle School, Palm Beach County Office of Resilience, and more). SECOORA is hosting the curriculum on our website. Access webinars here.
Implement an effective outreach strategy	SECOORA's outreach strategy is based on goals in the Strategic Plan and Fundraising Strategy. Primary marketing and outreach mechanisms are e-newsletters, e-mails, social-media, and the website. During this period subscription to the newsletter increased by 16% (from 884 to 1022); Facebook "likes" have grown 4% (from 452 to 471); and, Twitter "followers" have grown 7% (from 650 to 698). SECOORA shared approximately 98 Facebook posts and 151 Twitter "tweets", referring a combined 1055 sessions to the SECOORA website (increasing 82% from 579 to 1055) and 18 stories were published on the website (www.secoora.org/news).
Support citizen science opportunities	SECOORA and the South Atlantic Fishery Management Council (SAFMC) are is still actively looking for a funding mechanism to support the expansion of the Australian-developed RedMap citizen science app that has been used to track climate-based fisheries species range shifts. SAFMC personnel attended LenFest in October and the LenFest organizers have requested a conference call in early December to discuss the RedMap tool for the use in the US. The initial implementation would occur in the SECOORA region, if funded.
Engage students in problem solving using ocean observing data	In October, two USF undergraduate classes participated in field trips to the SECOORA/USF COMPS Clam Bayou station. The students learned how data from the station is important to environmental monitoring. The Clam Bayou station is a partnership between YSI Xylem, SECOORA, and USF COMPS. Over 275 students have been taught through this partnership since it began in 2014. SECOORA and GCOOS partnered to teach the community about navigation, ports, and ocean observing at the St. Petersburg Science Festival to over 80 elementary school grade students. The Vembu Subramanian Ocean Scholar award went to Kelsey Johnson-Sapp, from UM RSMAS. This funding will allow her to attend the International Coral Reef Symposium, one of the largest coral reef conferences in the world (read story). SECOORA, in partnership with Coastal Studies Institute and East Carolina University, submitted a NOAA Hollings proposal. See page 11 of this report for details.
Coordination of SOCAN activities (Wickes)	SOCAN continues to engage stakeholders within the region and nationally. Wickes presented at the American Chemical Society meeting, Safeguarding Water Quality in a Climate of Change symposium, hosted in San Diego, CA, August 27-29. The SOCAN website was updated to include webpages with state specific content. The new page for Florida will be launched 12/2019. These pages provide OA information, identify monitoring locations, and provide socioeconomic data. Three newsletters were also published: May/June, September, and October. Science working group calls were held in August and November.

Milestone C: Provide DMAC infrastructure to enable collaboration and decision-making (SECOORA and Axiom Data Science, LLC): *On-track*

Activities	Status

IOOS DMAC standards compliance and implementation of Data Management, Products, and Services	Responsible contractor: Axiom Data Science, LLC. SECOORA follows the IOOS recommended standards-based services and requirements to ingest, manage, and provide access to all our funded data streams (in-situ, remotely sensed and numerical models). See portal.secoora.org. Progress during this period is as follows:
	• Maintain IOOS compliant services and applications for integration with national products:
	   o THREDDS - Updated from 4.6.10 to 4.6.14 - https://thredds.secoora.org
	   o ERDDAP 1.82 - https://erddap.secoora.org
	   o SECOORA ISO WAF - https://thredds.secoora.org/iso
	   o NCEI Archive - https://ncei.axiomdatascience.com/secoora/
	• Expanded SECOORA data portal holdings to include:
	   o USF Coastal Ocean Monitoring and Prediction System (COMPS) - 42026 - C22 - Loop Current Pressure Point and 42026 - C22 Currents - Loop Current Pressure Point and 42022 - C12 Water Quality - WFS Central Buoy, 50m Isobath.
	   o Migrated 104 current and sea water velocity sensors for USGS Coastal and Marine Geology Program (USGS-CMGP) and resolved bad error values with data providers.
	• Maintained the SECOORA glider system for the management of SECOORA glider assets. The SECOORA glider data was updated for visualization in the portal, as well as submitted to the DAC. Progress was made by SECOORA, IOOS, and Rutgers towards resolving issues with submitting the corrected delayed mode data with the DAC.
	• Maintained submission of 66 sensor feeds to NCEI for long-term preservation. Submitted 3 new gliders missions to the IOOS Glider DAC (angus-20191101T0000, sam-20190909T0000, and franklin-20190910T0000).
	• Supported the FACT Network:
	   o Maintained the OTN FACT Node at SECOORA and making progress towards developing a smooth pathway for all FACT data to get into ATN.
	   o Maintained the FACT OTN layer to SECOORA portal which dynamically pulls from the FACT node as they update it.
	   o Developed a prototype extractor tool (Pepe: https://stage-pepe-web.srv.axds.co/) for researchers to easily pair ocean environmental and bathymetric data with fish detections.
	• Supported the WebCAT application by maintaining the WebCAT web application (http://secoora.org/webcat) and hosting the video data through SECOORA so it is discoverable via the SECOORA Website and downloadable.
	   o Added pop-up to alert for users to address issues with camera video stream display.

Maintenance of DMAC infrastructure (hardware and software)	The Axiom data system is the backbone of the cyber infrastructure that is leveraged to acquire, archive, and share SECOORA data and information products. The open-source interoperability and data stewardship systems of the SECOORA infrastructure were maintained to provide full-lifecycle data management services. During this period, Axiom completed the first phase of integrating newer generation compute nodes for faster processing and new storage hardware for next storage appliance generation. Implemented two new storage servers for all Axiom applications and built the pipeline to provision a third storage server.
Establishment and release of new SECOORA Portal	Version 2.11 of the SECOORA data portal was released, which realized full integration and enhancements of the v2 sensor system and the calculation and display of QARTOD tests for observation data. This version release included the following new features: improvements to quality review flags and user interface based on feedback from QARTOD flag prototype released in v2.1; updated depth and climatology charts; data views that enable v2 sensor interface; integration of catalog search tag for QARTOD datasets; and, improved the map user interface to highlight selected parameters and to default the time slider to 'off' to reduce

Activities	Status
	confusion when exploring real-time data. Additionally, a unit manager was integrated into the portal settings to allow for custom management by parameter: https://sensors.ioos.us/#settings/units. Full release notes can be found here: https://axiomdatascience.com/portal-updates/
Address 10 requirements per NOAA IOOS Contribute Data Page	See Appendix A

Goal 2: Maintain existing core observation investments in the region

Milestone A: Maintain High Frequency Radars (HFR) distributed throughout the region

Institution/Contractor	Status
University of South Florida (USF) (Weisberg, Merz) **All HFR sites On-Track**	USF continues to operate and maintain 3 CODAR HFR sites (Naples, Venice and Redington Shores) and 2 WERA HFR sites (Venice and Ft. DeSoto Park) which overlook the USF mooring array. Data are sent to SECOORA, NOAA NDBC, and the IOOS HFR CORDC network for integration, display, and dissemination. Plots of the data are also posted on the USF COMPS Ocean Circulation Group website (http://ocgweb.marine.usf.edu). All radars performed well this reporting period with the exception of the Venice CODAR (up-time 69%) which was down due to a lightning strike which damaged the TX and RX antenna cable.
	Work also continued on a NAS-funded Gulf of Mexico Loop Current research. SECOORA is a partner on this award. USF received funding to deploy 3 new CODAR systems; one in the Dry Tortugas and two in the Keys (Marathon and Key West).
	An FCC HFR ULS license application for the new ITU bands 5.250 – 5.275 MHz (CODAR, NAS funded HFR expansion) and 13.40 -13.50 MHz (WERA, license renewal due 3/1/2020) was applied for over 6 months ago with the application status currently being returned without action awaiting receipt of the FCC ID number for the HFR equipment. Much discussion pertaining to the FCC ID number has occurred with appropriate FCC/WTB, NOAA Affiliate, and SECOORA personnel. There are two possible options in order for USF to operate new CODAR and existing HFRs: 1) The FCC ID Number issue will be resolved within 3 months through the IOOS office allowing ULS licenses to be issued, or 2) An ELS (experimental license) exception will be granted and USF will receive a 2-year ELS extension to 2022 while the FCC ID number issue is worked out. At this point, USF has reached the 3-month minimum period allowed by the FCC to apply for an ELS renewal/extension and USF has applied for a 2-year extension of our existing ELS, out to the max 2022 date, allowed under FCC-17-33.
	It is important to mention that these FCC license related changes will likely affect all HFR operators to some degree depending upon when their existing experimental licenses expire. Therefore, SECOORA must continue to work with the NOAA IOOS office in order to move forward in finding a resolution to this issue.
University of Georgia (UGA), Skidaway Institute of Oceanography (SkIO) (Savidge): **CAT On-Track** **JEK Delayed**	St. Catherine's (CAT) HFR is functional. Jekyll (JEK) is still non-operational post-Irma. Equipment needed for repairs was ordered using Hurricane Supplemental Repairs funds. Delivery is anticipated in mid- to late December 2019, and planning is underway to reinstall as soon as is feasible.
University of Miami (Shay) **STF On-Track** **VIR Delayed** **CDN Delayed**	UM has only been able to repair 1 of 3 WERA which were severely damaged in 2017 due to Hurricane Irma. Hurricane supplemental funding was provided in May 2019. SECOORA has purchased some of the required replacement parts for UM and they will be delivered in December 2019. UM has ordered two new WERA (VIR, CDN) which will be delivered in March

Institution/Contractor	Status
NKL In Progress	2020. Repairs for VIR and CDN will begin during the next reporting period.
	The North Key Largo (NKL) HFR permitting is complete. The trailer has been moved to the location. UM is waiting for the power company to hook up the trailer to the nearby power supply. Once that is complete, the antenna will be deployed, and the station will be operational.
University of NC - Chapel Hill (UNC-CH) (Seim) *CORE On-Track* Coastal Studies Institute (CSI) (Muglia) **HATY – On-Track** **DUCK – On-Track** **OCR – Delayed**	UNC-CH has turned over the management of CSI to East Carolina University; therefore, SECOORA issued two sub-awards in year 4, one to UNC-CH and one to CSI, to continue operation of these four HFR systems. UNC-CH provides operation and maintenance for CORE and overall data management support for all four stations. CSI provides operation and maintenance for HATY, DUCK, and OCR. DUCK and HATY systems performed well during the reporting period; however, Hurricane Dorian caused a brief power outage at HATY that led to downtime because the generator failed to start. Repairs to HATY, through Hurricane Supplemental Repairs funding, are in progress.
	The CORE site (up-time 58%) sustained some damage from Dorian. The area around the antennas flooded (likely impacting connectors and lightning arrestors) the shed cooling fans were damaged, and the computer failed completely. The phases on the receiver (Rx) loops were already more variable than is typical, and this may be an indication of component degradation/failure in the receive antenna. Initial attempts to get the site operating again in early October 2019 were only moderately successful. Unfortunately, erosion at the site has now led to the antenna bases readily flooding, and poor signal quality as a result.
	Through Fill-the-Gaps funding, SECOORA purchased two NSF-funded WERA located on the NC Outer Banks. The WERA located on Ocracoke stayed in place and CSI took over responsibility for operation of OCR (Ocracoke) site, to expand coverage in Raleigh Bay. The site needed some repairs; however, before work could begin, Hurricane Dorian impacted Ocracoke island significantly. The extensive flooding (up to 6 feet deep at the airport) destroyed nearly all the radar electronics in the shed at the airport; therefore, the system cannot be operated. UNC-CH and CSI are exploring deployment of a CODAR system at the site as a temporary solution.
University of South Carolina (Voulgaris) *All HFRs On-Track*	University of South Carolina is responsible for the continuous operation and maintenance the WERA HFRs located at Georgetown, SC (GTN) and Fort Caswell, NC (CSW). The operation of the two systems was continued with some minor down time during this reporting period. Rx antenna re-positioning and cable replacement was conducted at CSW. A complete antenna replacement at GTN occurred. GTN was affected by Hurricane Dorian's storm surge, but functionality was not lost. Due to computer issues in October, GTN failed to transmit data for a period time; however, the issue was resolved quickly. Finally, routine maintenance was undertaken at both sites.
	Through Fill-the-Gaps funding, SECOORA purchased two of the NSF-funded WERA located on the NC Outer Banks. The system that had been located at Frisco, NC was uninstalled and will be relocated to South Carolina with USC as the operator. USC personnel visited Waites Island, SC, on 8/28/19 with Dr. Erin Hackett of Coastal Carolina University (CCU) to determine if this would be a suitable HFR location. Waites Island is owned by CCU and the Nature Conservancy. The site is suitable and CCU is willing to host the installation upon necessary approval from the Nature Conservancy. SECOORA and CCU personnel are discussing permitting requirements and meeting with Santee-Cooper Electric to discuss power access in early December.

Milestone B: Maintain in-situ stations along the Carolina and West Florida Shelf (WFS) coasts

Institution/Contractor	Status
USF (Weisberg) - Coastal Ocean Monitoring and Prediction System	**Operations:** Three real-time, data transmitting surface moorings (C10, C12, C13) were maintained, along with two non-real-time subsurface moorings (C11 and C15). All data from C11 and C15 continue to be uploaded to Research Workspace for data archival and sharing with

Institution/Contractor	Status
(COMPS) moorings ***All moorings On Track***	SECOORA and NCEI. In collaboration with Dr. Kim Yates (USGS) the C12 mooring includes an experimental ocean acidification package; however, USF and USGS are still trying to correct failure points in the system. Along with the SECOORA-funded buoys, USF continues to maintain two additional real time stations. One is the RESTORE Act-funded real time station (C21) offshore of St Pete Beach, FL. The second is a "pressure point mooring" (C22) located at the southwest corner of the WFS to the northeast of the Dry Tortugas. This mooring was deployed on 6/27/19. Deployment and operation of C22 is through the NASEM Gulf Research Program funding. The following table indicates up-time percentages for USF real-time moored observations.

	C10	C12	C13	C21	C22
Wind	91%	99%	99%	28%	97%
Air Pressure	91%	99%	99%	28%	97%
Water Temperature	91%	97%	86%	*	97%
Salinity (Surface)	91%	97%	86%	*	97%
Air Temperature	61%	99%	99%	28%	97%
Relative Humidity	61%	99%	99%	28%	97%
Longwave Radiation	91%	N/A	N/A	N/A	N/A
Shortwave Radiation	91%	N/A	N/A	N/A	N/A
ADCP	85%	89%	96%	29%	96%
Waves	N/A	N/A	N/A	29%	N/A

Discussion of low stats:

C10 - The AT/RH sensor failed during this time period. There were delays due to weather and scheduling a small boat to take personnel to the site to replace the sensor.

C21 – There is an ongoing problem with bird droppings covering the solar panels. USF relies on passing rain events to keep the solar panels clean. When rain events are scarce, the battery is unable to charge, and technicians must visit the site to clean the panels and replace the battery. Because RESTORE funding for this station has run out, USF can only service the station at the same time other COMPS stations are serviced. The asterisk (*) for water temperature and salinity denotes that this sensor has not been deployed.

Data Management: USF has implemented QARTOD recommended QC test for all near real time data. This was accomplished as part of the complete re-design of the COMPS web pages. We continue to provide the moored observations through SECOORA data management channels as well as making these available to NDBC. The moored observations continue to be incorporated into USF modeling and the ecological studies.

Institution/Contractor	Status
USF (Luther) - Coastal tidal & meteorological stations ***All stations On-Track***	**Operations:** Sites collecting water level and surface meteorological parameters are Big Carlos Pass, Clam Bayou, Fred Howard Park, Aripeka, and Shell Point. A full suite of water quality sensors are operated on the Clam Bayou site in partnership with YSI/Xylem. • All sites have been visited within the past year and routine/preventative maintenance performed. Preventive maintenance includes cleaning solar panels and protective wells for Aquatrak water level sensors, checking and replacing batteries, checking bearings on Wind Monitor anemometers, and checking all components for signs of damage, corrosion or biofouling etc. and remedy as possible. For the Clam Bayou site, routine maintenance includes removal, cleaning, calibration, and replacement of the multi-parameter water quality sonde in collaboration with YSI/Xylem at 4 to 6 week intervals. Other episodic

Institution/Contractor	Status

maintenance includes repairing or replacing failed sensors, data collection platforms, satellite transmitters/radios and other system components as needed and as possible with on-hand spares and financial resources.

- Aripek: Water temperature monitoring capability was restored and maintenance performed on 6/7/2019.
- Shell Point was refurbished on 11/13/2019. Preparations were made to add the radar water level sensor capability to this site.

	APK	FHP	SHP	CLB
Water Level	97	95	99	94
Air Pressure	99	99	99	99
Air Temperature	99	99	99	99
Relative Humidity	99	99	99	99
Wind Speed	99	99	99	99
Wind Direction	99	99	99	99
Precipitation	99	99	99	99
Water Temperature	N/A	N/A	N/A	78*
Water Quality	N/A	N/A	N/A	78*

Discussion of Low Statistics: Clam Bayou water quality and temperature sensors removed for recalibration during the month of May.

Data Management: See USF (Weisberg).

Partner Activities: USF is working with the Tampa Bay Estuary Program, the US Fish and Wildlife Service, and the Tampa Port Authority to analyze Automatic Identification System vessel tracking data (AIS; see https://www.navcen.uscg.gov/?pageName=AISworks) to estimate the impacts of ship wakes on critical marine habitat in Tampa Bay. A report on this effort can be found here.. The project team is mining the AIS data for other Maritime Domain Awareness applications, such as identification of optimal vessel transit windows and automated anomaly detection, in collaboration with the port authority, the Tampa Bay Pilots, and other regional maritime interests. See http://cmps.marine.usf.edu/research/

University of North Carolina - Wilmington (UNCW) (Leonard) - Coastal Ocean Research and Monitoring Program (CORMP) mooring network
All stations On-Track

Operations: UNCW operates 9 moorings in NC and SC coastal waters. Buoy statistics for the reporting period are below. Note that ILM2, LEJ3, and SUN2 have co-located WaveRider buoys (i.e. 2 moorings on station) that provide spectral wave data and water temperature.

	ILM2	ILM3	LEJ3	SUN2	CAP2	FRP2
Air Temperature	100%	100%	100%	100%	100%	100%
Air Pressure	100%	95%	100%	100%	100%	100%
Wind Speed, Gust, Direction	100%	100%	100%	100%	100%	100%
Salinity	99%	72%	86%	100%	100%	86%
Surface Water Temperature	99%	72%	86%	100%	100%	86%
Waves	100%	N/A	100%	92%	N/A	N/A
Currents	N/A	N/A	N/A	0%	N/A	N/A

Discussion of Low Buoy Statistics:

ILM3, LEJ3, and FRP2 - The passage of Hurricane Dorian as well as a very strong late fall Nor'easter subjected these buoys to damaging wave conditions. The inductive loop used to communicate with the CTDs on these buoys became compromised and was replaced as soon as was feasible.

SUN2WAVE: Due to ongoing difficulties and delays associated with the repair of the Teledyne NEMO ADCPs, CORMP technicians secured a "loaner" Datawell Waverider buoy from CDIP and

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	deployed it at the SUN2WAVE site on 6/13/19 so that wave data continues to be provided to SECOORA, NDBC, and made available on the CORMP website. On 10/23/19, CORMP deployed a new Nexsens CB-650 buoy equipped with an SVS-603 wave sensor near the Waverider in order to evaluate the data quality of the Nexsens system. The data from the Nexsens buoy is being evaluated to assess performance and once assessments are complete, and data quality deemed good, CORMP will return the CDIP Datawell buoy and transition wave data services entirely to the Nexsens buoy at SUN2WAVE. Both buoys are reporting standard NDBC wave parameters twice an hour. All telemetry and datalogging features on the Nexsens buoy are maintained by CORMP technicians and data are subjected to applicable QARTOD tests. **Data Management**: • Cloud Computing: CORMP continues to rely on its cloud-based data collection platform during extreme events, such as Hurricane Dorian. Although use of Amazon requires a nominal fee, this approach allows the CORMP data management team to circumvent issues associated with UNCW ITS security requirements, network maintenance, and local power failures. Migration to the cloud also ensures continued access to CORMP data should UNCW be impacted by a natural disaster or campus power issue. Although primary data acquisition takes place on computers in the CORMP lab, CORMP also maintains an Amazon Cloud Workspace and when necessary, the "cloud-PC" can be quickly and seamlessly activated to ensure uninterrupted data collection. This "failsafe" approach was successfully used in early May when campus experienced a partial internet failure leaving the lab PC offline. • "On-The-Fly" Extreme Event reporting changes: At the request of the NWS, CORMP increased the reporting frequency for all MET buoys during Hurricane Dorian from once per hour to four times per hour. The frequency increase was a temporary state intended to help the NWS produce more accurate storm surge and high wind alerts for residents of southeastern North Carolina. Buoy reporting reverted back to the normal frequency after the storm. Since CORMP pushes data direct to NDBC and data are available via the SECOORA ERDDAP, Hurricane Dorian provided an opportunity for NDBC to test the ability of their scripts to harvest data when a provider modifies its reporting frequency. Overall this was a successful endeavor. **Partner activities:** CORMP continues to work with FACT partners (SERC, Florida Wildlife Commission and Georgia DNR) to maintain the VEMCO acoustic receivers on the three Onslow Bay buoys and a non-real time bottom frame in Onslow Bay (OB27). VEMCOs are downloaded and cleaned during scheduled mooring maintenance, and data are submitted to the FACT node.

Milestone C: Maintain the sensors on NOAA GRNMS buoy

Institution/Contractor	Status
UGA (Noakes) – Support to NOAA's Ocean Acidification Program NDBC Gray's Reef National Marine Sanctuary (GRNMS) NDBC ID #41008 buoy ***On-Track***	**Operations**: The primary MAPCO2 system has been operating at 100% during this reporting period. On 8/17/19, the Seabird CTD mounted on the buoy bridle stopped reporting and on 10/30/19, the SAMI-pH sensor stopped reporting. On 11/25/19, personnel visited the buoy to access the sensors and found that the communication cables for both instruments had been cut. The Seabird CTD sustained additional damage due to entanglement of something around the buoy bridle. One of the bulkhead connectors on the Seabird housing had been pulled out leaving wires exposed. In addition, the copper door on the fluorometer was missing. The SAMI-pH cable had also been cut, so divers removed the instrument and returned it to UGA for inspection and cleaning. The only damage incurred with the SAMI-pH was that the intake tube was missing. It is hoped that the intake tube can be replaced at UGA and a fresh battery pack installed making the instrument ready for deployment in early 2020. NOAA OAP also requested that UGA investigate design concepts to streamline instrument deployment on the NDBC 3-meter buoys; specifically, to find ways to eliminate the need for

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	divers to manually install/remove instruments from under the buoy. A meeting was held on 9/12/19 with NDBC engineers at the Stennis Space Center. Through-hull mounting concepts were developed at the UGA Instrument Shop for installing the Seabird and SAMI instruments from the topside deck of the buoy, eliminating the need for divers to work under the buoy and allow for buoy operations to occur in a slightly higher sea state than when divers are involved. The design for the new sensor deployment will continue with the construction of a benchtop model for testing. If all parties (UGA, NDBC and PMEL) are satisfied with functionality, the next step is to have one of the MAPCO2 equipped buoys modified and tested by NDBC to ensure that modifications do not interfere with overall buoy performance.

Goal 3: Begin to address geographic gaps in observations

Milestone A: Establish a regional glider observatory in the South Atlantic Bight (SAB)

Institution/Contractor	Status
UGA SkIO (Edwards) North Carolina State University (NCSU, He) UNC-CH (Seim) USF (Lembke) Georgia Institute of Technology (GIT, Zhang) *Glider operations On-Track*	**Operations**: Three SECOORA glider observatory deployments were conducted: two deployments on the Georgia shelf, May – June, and one deployment during hurricane season. The new SECOORA G3 glider, Franklin, was deployed with SkIO's G3, Angus, for simultaneous 24-day missions on the Georgia shelf. These shakedown missions tested the new G3 glider's performance and collected acoustic data in fairly close proximity (2-25 km separation) under stratified conditions. During the third mission, the G1 glider Pelagia suffered a digifin malfunction a little less than 2 days after deployment and ejected its weight shortly thereafter. Data from Pelagia continued to be reported to the NGDAC as she floated at the surface for 5 days awaiting recovery, thanks to a procedure developed during hurricane season the prior year. Work in the lab has not revealed a mechanical cause for the error. The manufacturer suggests influence of remoras. This theory will be tested on the glider's next deployment, with new armoring of its fin to prevent remora attachment. For each deployment, NCSU provided CNAPS model nowcast/forecast output to help guide glider deployments.
	During this reporting period, several factors significantly affected the program's ability to meet its objectives: repair delays and G3 board failures. A significant board design failure prevented the emergency power circuit from being enabled in case the primary batteries ran out. SkIO performed board repairs on both Angus and Franklin in June 2019 to correct this. In August another board failure, identified by USF, was discovered after the Iridium satellite phone failed on their new G3. The four G3s in the SECOORA glider observatory were sidelined until the cause of the problem could be identified and repairs made. The USF gliders were repaired by the manufacturer, and SkIO conducted these electronics repairs in house on the other gliders.
	Hurricane Gliders: Gliders were deployed off FL and GA for Hurricane Gliders missions beginning in early September. The G1 glider, Sam (USF), and Franklin (SECOORA/SkIO) collected data for 35 and 33 days, respectively. Both reported data in real time for assimilation into ocean models for the evaluation of the potential to propagate valuable information about the ocean heat content and stratification into tropical forecasts.
	Navy Gliders request: In addition to the SECOORA-funded activities, SkIO also conducted an externally funded glider deployment at Gray's Reef National Marine Sanctuary (Navy-SURTASS funding) to develop metrics for soundscape evaluation in marine protected areas.

Milestone B: Install a new coastal water quality and meteorological station in Charleston Harbor, SC:

Institution/Contractor	Status
South Carolina Department of Natural Resources (Sanger) ***Charleston Harbor - Delayed***	The Charleston Harbor station remains non-operational. PI Sanger has decided to move the instrumentation from the original site to an upstream location on SC DNR property. This site will be more protected and the likelihood of being hit by a vessel is reduced. Environmental Compliance paperwork for the deployment of the YSI on an existing structure is underway.

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

Milestone A: Enhance and operate a Coupled Marine Environmental Assessment and Prediction System for the SE

Institution/Contractor	Status
NCSU (He) - Support and enhance SABGOM model ***On-Track***	The project team is on-track with modeling efforts. The team maintains the SABGOM and CNAPS ocean prediction systems to run on a 24/7 basis, providing time- and space-continuous regional marine environment predictions on a user-interactive web portal. NCSU continues making progress in advanced data assimilation schemes and have successfully completed a set of data assimilative hindcast experiments for 2017-2019. They are now in the process of implementing and testing the data assimilation scheme in the nowcast/forecast system. The CNAPS model is being used by the glider team to assist with glider path planning and guidance. Additionally, modeled current data is being used by NC renewable energy projects to help design an underwater power generator (CSI) and an underwater turbine (UNC-Charlotte).

Milestone B: Operate the WFS FVCOM ocean model

Institution/Contractor	Status
USF (Weisberg) ***On-Track***	Real time data and model simulations are publicly available on the internet (http://ocgweb.marine.usf.edu and the SECOORA web site), and are transmitted via THREDDS server to NOAA GOODS. Output from the West Florida Shelf Coastal Ocean Model (WFCOM) and high-resolution Tampa Bay Coastal Ocean Model (TBCOM) are also available via THREDDS server (http://ocgtds.marine.usf.edu:8080/thredds/catalog.html). USF works with Florida Fish and Wildlife Research Institute (FWRI) on HABs tracking and modeling. FWRI provides observations of *Karenia brevis* red tide cell concentrations that are input into WFCOM and TBCOM. USF provides short-term predictions consisting of a 1 day hindcast and 3.5 days forecast of the red tide trajectories for both near surface and near bottom water columns. Consideration of both surface and bottom is important as the flow field is three-dimensional and cells leaving at the surface may be replaced by new cells arriving along the bottom. Noting that spatial sampling is limited and that blooms may be patchy, USF further produces a more general and user-friendly map on Wednesdays and Fridays to show where a red tide bloom may occur along the coast over the next 3 days.

Milestone C: Provide an early warning system for swimming beach and shellfish harvesting waters

Institution/Contractor	Status
USC (Porter) *On-Track*	The project team continues to maintain the platform howsthebeach.org and provide public access to daily estimates of swimming beach bacteria levels for Myrtle Beach, SC, Sarasota, FL, Charleston, SC, and Kill Devil Hills, NC. The project team also developed http://howsmyscriver.org for the Saluda River Monitoring Coalition. The Coalition was formed to monitor *fecal coliform* at 11 sampling sites on the Saluda, Broad, and Congaree rivers. The website provides access to monitoring data. Two challenges continue to be encountered as the team tries to expand nowcasting efforts to additional swimming beaches: 1) availability of data; and, 2) developing useful forecasts in areas where water quality is consistent. Modeling conditions when there is little variability in the variable of interest is challenging. In efforts to address both of these challenges, and in collaboration with the EPA Monitoring Community of Practice, the team is now focusing on the use of gradient boosting modeling techniques. Consistent with current R-based ensemble modeling techniques, gradient boosting algorithms are an ensemble Machine Learning (ML) decision tree approach to developing predictive outputs. The team is initiating an assessment of current ensemble nowcasting models with gradient boosting approaches for current swimming beaches where data are most sparse and water quality is least variable.

Milestone D: Optimize and enhance the SECOORA Marine Weather Portal (MWP)

Institution/Contractor	Status
SECOORA (Dorton)/ Second Creek Consulting (Galvarino) *Complete*	The MWP is hosted on the SECOORA website: http://mwp.secoora.org/.

Milestone E: Python Data Analysis Tools for Oceanographic Services

Institution/Contractor	Status
Independent Contractor, Filipe Pires Alvarenga Fernandes, Oceanographer, Brazil *On-Track*	Activities conducted fall into three areas of work. 1. Assist in development of IOOS.us Documentation and Demonstration sub-pages; 2. Support current and continue developing software packages to IOOS; and, 3. Ensure software deployment via conda-forge packages and updates. All work is reviewed by the IOOS program office. Full details, listing accomplishments this period, are found in Appendix B.

Milestone F: Special Projects

Institution/Contractor	Status
Unmanned Aircraft System (UAS) workshop **On-Track**	SECOORA, in conjunction with NOAA SECART and CariCOOS, will host a UAS technology workshop in Beaufort, NC, March 31 – April 2, 2020. Workshop registration was opened in December. This workshop will address UAS use for estuary, coastal and ocean research, and coastal management issues. Workshop focus areas: 1) UAS applications; 2) legal and regulatory requirements for UAS operation; 3) data quality assurance and quality control; and, 4) data processing and management.

Institution/Contractor	Status
OTT Biology pilot projects ***On-track***	SCDNR conducts the SEAMAP-SA fisheries independent surveys for the south Atlantic. SCDNR has provided datasets to Axiom for the OTT Biology project. During this reporting period, Axiom has completed the following: ● Data processing and preview of a subset of fish abundance, specimens, and fish length distribution data for two species in the SECOORA data portal map and in an example data view for discovery of data patterns. ● Ingested the hydrocast data on its own platform page in the SECOORA data catalog. ● Transformed data and metadata to Darwin Core format in the Research Workspace. ● Met with the SEAMAP researchers in November 2019 to map out a technical strategy for expanding the pilot database to the full Reef Fish dataset and applying elements of the existing user reporting.
OTN/ATN ***On-Track***	SECOORA established contracts with Joy Young, Fisheries Data Solutions and Chris Kalinowsky, Georgia Department of Natural Resources. Progress reports from Young and Kalinowsky have been submitted to the IOOS ATN manager. These reports are included in Appendix C.
Scholarship ***On-track***	SECOORA worked with members at the UNC Coastal Studies Institute (Mike Muglia and John McCord) to submit a 2020 Hollings Scholar opportunity. After a phone interview between Natalie Murphy and personnel from IOOS, SECOORA, and CSI, Ms. Murphy selected the CSI opportunity. A site visit to CSI will be scheduled in Spring 2020.
Regional Ocean Data ***On-track***	Negotiations are underway with The Nature Conservancy and another contractor, Megan Treml, to implement a regional ocean data sharing plan focused on sand resources. A variety of activities are underway to map and evaluate sand resources in the Southeast. Regionally, the U.S. Army Corps of Engineers (USACE) has included a sand study as part of their South Atlantic Coastal Study (SACS), the Bureau of Energy Management (BOEM) provided funding to state agencies and universities to evaluate sand resources in state waters, and the NOAA has led a seafloor mapping initiative that includes sand habitats. In addition, there are local efforts to understand coastal bathymetry (GA), complete regional sediment management plans (SC, USACE Charleston District). This project is designed to enhance collaboration across these varied projects, with the goal of developing a region-wide sand resource mapping framework. Objectives: ● Foster collaboration amongst organizations mapping sand resources and seafloor habitat across the southeast, including BOEM, USACE, NOAA, state agencies and universities. ● Connect technical leads with coastal managers and communities to identify information needs and develop a framework for long-term sand management planning. ● Define, evaluate, and potentially create spatial data and tools that support long-term sand management across the southeast. ● Understand costs associated with filling data and mapping gaps in order to jointly communicate funding and capacity needs.
Southeast and Caribbean Disaster Recovery Partnership (SCDRP)	SCDRP hired a new coordinator, Barbara Bischoff. The SCDRP is transitioning from the previous focus of regional state projects (NC, SC, GA, FL) to an organization that focuses on partnership and stakeholder development in the southeast and Caribbean, with the goal of producing an SCDRP strategic plan for growth. The SCDRP annual meeting will be held January 28-29, 2020, in Jacksonville, FL. The Meeting Planning Committee developed meeting outreach materials, organized the meeting venue and accommodations, and arranged speakers and panelists.

Institution/Contractor	Status
Additional Observations Initiative **On-track**	SECOORA hosted a competitive mini-proposal opportunity during the last reporting period. Dr. Eric Montie, USC Beaufort, received $30,000 for his proposal, "Integrating Biological Sound and Noise Measurements into Regional Coastal Ocean Observing Systems (RCOOS) in Estuaries of South Carolina. Project start date, 6/1/2019. The project team deployed passive acoustic recorders, water level loggers, and temperature loggers at study sites in Charleston Harbor and North Inlet Winyah Bay. The recorders will be retrieved, and data downloaded in March 2020.

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

Milestone A: Implement a HAB forecasting system for the WFS.

Institution/Contractor	Status
Florida Fish and Wildlife Research Institute (FWRI) (Hubbard) **On-track**	The project start date was 9/2019 which coincided with the beginning of a *Karenia brevis* bloom. The project team participated in a water quality field survey led by Chris Kelble and NOAA-AOML from November 18-24 onboard the R/V *Walton Smith*. The cruise track covered areas spanning much of the West Florida Shelf from Tampa Bay to the Keys, as well as several sites offshore of Miami. These water quality surveys occur bimonthly, and SECOORA funding helped extend the duration of this survey by 2 days which allowed for additional transects north of Charlotte Harbor, an area not typically sampled during the AOML surveys. FWRI, USF, and Mote Marine Laboratory collected samples specific to *K. brevis* for analysis. Remote sensing data was provided by USF prior to and during the cruise to allow for adaptive sampling and helped determine the final cruise plan including the addition of new sampling sites while the cruise was ongoing. Short-term predictive forecasts provided by USF further informed cruise sampling and our understanding of the ocean circulation in critical bloom areas.

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

Milestone A: Implement a regional ocean sound observing initiative to characterize and measure sources of sound production and establish acoustic baseline levels.

Institution/Contractor	Status
Mote Marine Laboratory (Locasio) **On-track**	PI and project team are in the process of developing the steps for labeling data for use in machine learning. PI met with SECOORA and Axiom staff to discuss data storage and metadata associated with acoustic recordings; these include calendar period, sample rate, hydrophone sensitivity, and location. Mote Marine Laboratory volunteers will be used to review data to create libraries of known and unknown sounds. The next steps will be to organize all acoustic data for review by volunteers and create a block diagram for the process of classifying and analyzing data with machine learning algorithms.

Milestone B: Install and operate new HFRs: *On Track*

Institution/Contractor	Status
Florida Institute of Technology (FIT)/Maul **Delayed**	FIT is in the process of obtaining permission from the U.S. Air Force to locate one HFR at Patrick AFB. PI Maul has attended numerous on-line briefings, leading to the final decision by the Secretary of the Air Force to be made in December. FIT was informed that Sebastian Inlet State Park will not allow the HFR deployment. This was unexpected as other state parks have granted such approval. FIT is now searching for a suitable site in Indian River County.

Institution/Contractor	Status
SkIO/Savidge **On-Track**	Through the Fill the Gaps campaign, SECOORA and SkIO purchased the used WERA from the NSF PEACH project (PI Savidge). SECOORA purchased two systems and SkIO, through a subaward from SECOORA, purchased the other two. SkIO has removed the two WERA from their PEACH-related sites on the NC Outer Banks and they are seeking permission to deploy the two WERA in Florida; one at Kennedy Space Center and the second at Cape Canaveral National Park. Discussions are underway with both organizations.

2) Scope of Work

Scope of work is as described in the Year 4 Statement of Work.

3) Personnel and Organizational Structure

Current lists of SECOORA Members and Board are available on our website. Additionally, SECOORA personnel job descriptions and employee CVs are available on: http://secoora.org/certification.

4) Budget Analysis

SECOORA's October 31, 2019 financial report for Year 1 funds shows a budget balance remaining of approximately $24,000. The October 31, 2019 financial report for Year 2 funds shows a budget balance remaining of approximately $114,000. The October 31, 2019 financial report for Year 3 funds shows a budget balance remaining of approximately $1.2M. The October 31, 2019 financial report for Year 4 funds shows a budget balance remaining of approximately $3.2M. We are within budget and on track with spending. SECOORA continues to receive invoices regularly from our sub-awardees and we process them during bi-monthly administration meetings. All invoices are paid within forty-five days. SECOORA continues to draw from ASAP monthly. As a reminder SECOORA pays out its monthly operational costs (i.e. payroll, etc.) and then conducts the ASAP draws in the middle of the following month for both the preceding month's operational expenses and the sub-awardee invoices.

Appendix A – IOOS Data Management and Data Sharing Requirements

1. **Open Data Sharing**

The SECOORA Data System provides data resources in a one stop data portal, free to the public, with data assets originating from federal and state agencies, local municipalities, academic institutions, research organizations, private companies, non-profit organizations, and community observers. Real-time and near real-time data are served as soon as practical as the data become available.

SECOORA works with data providers and its data partner, Axiom Data Science, to establish and maintain freely available data streams that allow for timely ingestion, processing, and serving of data. When possible, SECOORA aims to provide real-time or near real-time (as defined in RICE IOOS Guidelines) quality assured and quality-controlled data. SECOORA adheres to data and metadata standards established by IOOS and leverages the experience and expertise of the community of data providers to improve data quality.

Status: All data currently served by the SECOORA data portal carries with it the permission to view and access and carries no privacy or ethical restrictions. Data access is defined here as being permitted to download data through the SECOORA data portal.

Challenges: Metadata for some data packages are sparse, often due to a lack of quality metadata from upstream data providers or the historic nature of the dataset; efforts are underway to enhance metadata records and develop tools to ease and democratize metadata curation using the SECOORA Research Workspace.

2. **Data management planning and coordination**

Data management is an increasingly important aspect of IOOS activities. Data management plans and the coordination of activities between Regions and the IOOS Program Office ensure that data are maintained in easily accessible formats that are archived for long-term storage.

The SECOORA Data Management Plan provides the approach to the necessary implementation, describing how data are ingested, managed and distributed from the source to public dissemination.

The primary processes involved with data management and flow include data ingestion, standards and format, metadata and discovery, quality control, stewardship and preservation, access and dissemination, archival and security. SECOORA and its data management partner, Axiom Data Science, serve data to users in common machine-readable data formats and provides the feeds to the GTS with their service-oriented architecture. SECOORA works with Axiom and data providers to ensure that IOOS standard ontologies and vocabularies are being used. SECOORA strives to maintain standards-compliant metadata and provide information to the IOOS catalog. All data received and made available through the SECOORA data portal is stored in standardized community driven formats on an infrastructure developed by Axiom. Axiom maintains onsite storage at their facilities, as well as at a redundant offsite storage location. Axiom also makes available open-source resources of software developed through the Axiom Data Science (@axiom-data-science) and SECOORA (@SECOORA) public GitHub organizations.

SECOORA officially became RICE certified by NOAA in 2017. As part of this process, the SECOORA Data Management plan was completed (April 2017) and the plan will be updated routinely (minimum 5 years) as needed to meet new requirements from the IOOS DMAC.

3. **Provision of data to the Global Telecommunication System (GTS)**

SECOORA has maintained their commitment to provide data to the GTS though NDBC. In some instances, the data is flowing from the SECOORA funded data provider (i.e. UNCW, USF COMPS buoys). The Big Carlos Pass station will be submitted to NDBC directly by SECOORA. Finally, CDIP moorings within the region are reported to the GTS by the CDIP program.

Update 2019: As of December 2019, the National IOOS Office has been working collaboration with NDBC to setup data ingestion from IOOS RAs through standardized ERDDAP instances. This work includes updating the IOOS metadata 1.2 profile, updating the IOOS Compliance Checker to handle 1.2 profile, and developing pathways to serve data from the IOOS Catalog to IOOS RA ERDDAP instances. NDBC is actively pulling test data through this pipeline process.

4. **Data access services**

All data and products are registered in the IOOS Catalog. SECOORA offers six access points:
1. *Thematic Realtime Environmental Distributed Data Services (THREDDS)* - SECOORA provides THREDDS access points for raster (gridded) data stored in NetCDF format. THREDDS 4.6.10 - http://thredds.secoora.org and SECOORA ISO WAF - https://thredds.secoora.org/iso.
2. *Open-source Project for a Network Data Access Protocol (OPeNDAP)* - SECOORA provides OPeNDAP access points for raster (gridded) and time-series data.
3. Web Map Service (WMS) - SECOORA provides WMS access points for point, vector, and polygon information, as well as raster (gridded) data.
4. Web Feature Service (WFS) - SECOORA provides WFS access points for point, vector, and polygon information, as well as time-series and raster (gridded) data.
5. Environmental Research Division's Data Access Program (ERDDAP) - SECOORA primarily uses this service to facilitate device-level downloads (e.g., tabular data). ERDDAP 1.84 - http://erddap.secoora.org
6. File Downloads - SECOORA often provides data as downloadable files. These files are mostly served in the standard shared data file formats above, or in the case of project-specific data, in their native file formats.

Challenges: Large datasets and heavy usage can strain data access servers and negatively impact user experiences; Axiom and SECOORA are continually tuning and enhancing data service software and developing deployment techniques to maximize performance and stability of these services. As new data types and variables come on-line routine coordination between Axiom, SECOORA, and IOOS will be required to make them available. Currently the IOOS Glider DAC only makes available a subset of data types transmitted by the profiling gliders.

5. Catalog registration
SECOORA maintains a WAF (https://thredds.secoora.org/iso), which is harvested by the IOOS Catalog. All data and products are registered in the IOOS catalog.

6. Common data formats
SECOORA offers data in IOOS compliant formats through the use of ncSOS, THREDDS and ERDDAP.
SECOORA provides nearly all data in four open, standardized forms:
1. *Network Common Data Form (NetCDF)* - a self-describing, machine-independent data format that SECOORA uses primarily for raster (gridded) data. Some data stored as unstructured grids use this format as well.
2. *Comma Separated Values (CSV)* - a human-readable ASCII format that is nearly universally accepted by spreadsheet and programming languages. SECOORA uses CSV formats to allow users to download (1) time-series extractions from raster data, and (2) GIS vector and polygon information (e.g., boundaries).
3. *Shapefile* - an open geographic information system format for point, vector, and polygon data. SECOORA allows users to download shapefiles of static GIS layers such as boundaries, biologic distributions, etc.
4. *Portable Network Graphics (PNG)* - PNG is a lossless, image format provided as an alternative to shapefiles in the SECOORA catalog. PNGs are limited in use as they are pre-projected, pre-scaled, and pre-sized images of data layers. However, SECOORA provides PNG files as example WMS requests, which are useful to users who cannot access GIS services and who do not understand how to manipulate WMS requests.

7. Metadata standards
All IOOS data providers are expected to ensure relevant metadata is produced, accessible and compliant with IOOS conventions, and to participate as appropriate in the development of such conventions. Descriptive information about datasets, sensors, platforms, models, analysis methods, quality-control procedures is essential for the long-term usability and reuse of information.

SECOORA requires standards-compliant metadata for project-level data (SECOORA or IOOS-funded projects). Though SECOORA does not require specific metadata standards for ingesting other types of data, most modern data submittals are accompanied by standard ISO/FGDC metadata records.

RW is the SECOORA web-based data management application. RW is being phased in within SECOORA and it will be used to assemble, store, and share data by researchers or SECOORA partners. RW provides users with a web-based interface that allows researchers to create *projects* to represent particular scientific studies or focuses of research within a larger effort. Standard, discovery-level ISO 19115-2 and 19115-10 compliant metadata can be generated for both projects and individual datasets.

Many historical datasets come with informal metadata documentation that is variable in terms of completion and detail required by modern standards. Some data sets are only accompanied with narrative information. In these cases, SECOORA plans to work with the data provider to create more up-to-date metadata records and share the data within RW so that it can be ingested into the SECOORA data portal.

Challenge: It may be challenging to get historical data from non-SECOORA funded researchers, input into RW. SECOORA and Axiom staff will assist these researchers in an effort to encourage them to share their historical data through RW. Axiom and SECOORA will do their best to make these valuable data resources available with as much documentation as possible.

8. Storage and archiving

SECOORA ingested data is stored in a secure, professionally managed external facility and currently has total storage space for over 1.8 petabytes of data. Those resources are geo-replicated between Portland, Oregon and Providence, Rhode Island. All aggregated data is stored indefinitely beyond the life of each individual project. Real-time sensor feeds will become historical sensor feeds one-month after collection. The only assets that are not kept indefinitely in storage are webcam images.

As a federally funded program, SECOORA is required to submit data it generates to a national archive center. SECOORA is working with the National Centers for Environmental Information (NCEI) to assist with the archival of appropriate data types accepted by NCEI. SECOORA maintains an NCEI archive WAF at https://ncei.axiomdatascience.com/secoora/ which is regularly harvested by NCEI. The bulk of the data assets managed by SECOORA are non-real-time, nonfederal assets, sometimes from small data originators, and often from distinct research projects or large, integrated ecological research programs. These data may not fall under the purview of the NCEI. Accordingly, SECOORA plans to archive these data in the DataONE network through RW.

9. Ontologies, vocabularies, common identifiers

SECOORA makes use of IOOS ontologies, vocabularies and common identifiers as needed.

10. Consideration for Long-term Operations

The SECOORA Data System hosts several integrated data management tools to ease data access, storage, and sharing by its users including the RW and its metadata editor, and the SECOORA Portal and catalog system. The SECOORA RW, the web-based data management application, will be used to assemble, store, and share data by researchers or SECOORA partners.

RW includes an integrated metadata editor to support the documentation of data and facilitate its accuracy and reuse. Content collected in the RW metadata editor uses fields from the ISO 19115 suite of standards for geospatial metadata, which is the FGDC endorsed successor to the CSDGM, extended to describe taxonomic classification for biological datasets. Standard, discovery-level ISO 19115-2 and 19115-10 compliant metadata can be generated for both projects and individual datasets.

Axiom Data Science has made significant progress redesigning the back end SECOORA Data System to implement and support QARTOD checks for real-time data. Axiom has implemented the display of QARTOD flags to be available through the SECOORA data portal. The basic/required quality tests for IOOS RA assets are now being run on observation data with documentation of the test code and thresholds available through open-source QARTOD libraries accessible through the portal. Flags from quality tests run by data provider are viewable and available for download in the data portal and/or ERDDAP data servers for the SECOORA region. This work will be ongoing as QARTOD manuals are further developed for additional parameters to provide the correct level of guidance for implementing appropriate QC at the regional level. SECOORA will continue working with regional data providers and experts to develop user established ranges tests that are specific to each sensor and its location.

Appendix B – Python Data Analysis Tools for Oceanographers

Progress and Accomplishments during the reporting period (June 1, 2019 - November 30, 2019)

The tasks were divided into:

1. Assist in the development of the IOOS.us Documentation and Demonstration sub pages;
2. Support current and continue developing important software packages to the IOOS enterprise;
3. Ensure software deployment via conda-forge packages and updates.

1) Assist in the development of the IOOS.us Documentation and Demonstration sub pages.

The main update in the IOOS Data Demo Center was the addition of Python 3.8 support (ioos/notebooks_demos #345). We also fixed broken environments due to the lack of *cftime* (ioos/notebooks_demos #344).

2) Support current and continue developing important software packages to the IOOS enterprise

This activity can be divided into two three-sections: (a) packages from the IOOS GitHub organization, (b) packages from third party organizations that are important for IOOS, and (c) pangeo/cloud support.

a)

- *compliance-checker*: Fix and modernize AppVeyor (ioos/compliance-checker #657), only restrict *OWSLib* version upper bound for Python 2 (ioos/compliance-checker #700), fix appveyor failures (ioos/compliance-checker #707), and test against Python 3.8 (ioos/compliance-checker #701).
- *erddapy:* check manifest files (ioos/erddapy #81), do not check server URL for failures too early (ioos/erddapy #82), publish to PyPI when building the docs to avoid race conditions (ioos/erddapy #84), pass the *protocol* key word to the URL builder (ioos/erddapy #94), add a server-side function *distinct* (ioos/erddapy #99), and issue a new release (ioos/erddapy #95 and tag/v0.5.1).

  Additionally we deprecated both QARTOD libraries from ASA-RPS and IOOS in lieu of *ioos_qc* (asascience-open/QARTOD #71 and ioos/qartod #16), added *odvc* and a couple of types of data to *x-stairs* (ocefpaf/x-stairs #6), and bumped the minimum pandas versions support in *ioos_tools* (pyoceans/ioos_tools #21)

b) Some work was done to improve packaging of the following Software: simplify *force_cython* logic in *shapely* (Toblerity/Shapely #741), fixed AppVeyor testing for *netCDF4-python* and *nco* (Unidata/netcdf4-python #952 and nco/nco #137), fixed tarball creation and testing for *pysal* stack (pysal/esda #66, pysal/mgwr #69, and pysal/pysal #1128), update testing and tarball for *folium* and branc*a* (python-visualization/branca #65 and python-visualization/folium #1174), and *intake-stac* (pangeo-data/intake-stac #21). We also issued new releases of *depfinder* and *stdlib* with python 3.8 support (jackmaney/python-stdlib-list #26, ericdill/depfinder #33, and ericdill/depfinder #34) which will allow us to inspect python 3.8 environments with *nbrr*.

c) Conda-based cloud environments should always avoid using *pip* to avoid packages dependencies clobbering conda install Software (pangeo-data/pangeo-cloud-federation #305 and pangeo-data/pangeo-stacks #53). In addition to avoiding *pip* we should always activate the *strict* channel configuration option for conda (jupyter/repo2docker #714). The *pangeo-stacks* deployment are too slow to be built in serial, we proposed a fix for that parallelizing the builds in pangeo-data/pangeo-stacks #98.

3) Ensure software deployment via conda-forge packages and updates

This effort can be separated into (a) infrastructure maintenance, (b) new packages, and (c) packages updates.

a) Thanks to the ESIP-Lab grant conda-forge now uses a migration system that can be easily set to update the entire dependency graph of a certain package. Recently we ended the *Qt* migration (regro/cf-scripts #699) that was running in the old system and updated the pinning for *hdf5*, *pyqt*, *readline*, *geos*, *cfitsio*, and *libdap4* (conda-forge-pinning #233, #234, #242, #243, #246, #255, #515, #523, #527, #533, #534, #541, #552, and #557).

We also improved the users and developers documentation with the minimum conda version supported, how to "get help", and guidance to save the build logs (conda-forge/conda-forge.github.io #872, #880, and #899),

b) The following packages were added:
Crayons, requests-file, imagecodecs-lite, astropy-helpers, property-cached, tabulizer, pynmea2 and *arlpy, r-piecewisesem, rio-cogeo* and *supermercado, nbgitpuller, sat-stac, sat-search, nteract_on_jupyter, eds-stack, r-saga, richdem, proj-datumgrids, empyrical-dist, opt-einsum, jaxlib, pandana, pockets, sphinxcontrib-napoleon,* and *urbanaccess* ([#10101](), [#10109](), [#10200](), [#10230](), [#10236](), [#10315](), [#9960](), [#8537](), [#8591](), [#8592](), [#8607](), [#8608](), [#8640](), [#8654](), [#8655](), [#8657](), [#8719](), [#8753](), [#8811](), [#8812](), [#8980](), [#8982](), [#8989](), and [#8990]())/

c) The package updates list can be found in the Pull Requests links section at the end of the document.

Stakeholder engagement and outreach efforts during the reporting period

During this reporting period we improved the lesson materials for the Ocean Hack Week and the IOOS code sprint ([oceanhackweek/preliminary #4](), and [https://www.glos.us/code-sprint]()). The latter was expanded into a package skeleton documentation for the IOOS community ([https://github.com/ioos/ioos-python-package-skeleton]()).

Pull Requests links

- [boost-cpp #58]()

- [cartopy #65]()

- [cartopy #72]()

- [cdo #68]()

- [cfitsio #18]()

- [check-manifest #4]()

- [click #14]()

- [cmocean #14]()

- [conda-smithy #158]()

- [conda-smithy #159]()

- [conda-smithy #160]()

- [conda-smithy #166]()

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Appendix C – OTN Progress Reports

FACT Data Wrangler Progress Report to ATN: Joy Young

Timeframe: 1 June – 30 November 2019

Communication

- Invited presenter at the Nelson Symposium at the annual American Elasmobranch Society meeting in Snowbird, Utah in 24 – 29 July 2019. The presentation focused on the role of acoustic telemetry in movement ecology with emphasis on the FACT Network as an example of how collaborative networks advance the science of data sharing.
- Attended Animal Telemetry Network (ATN) Steering Group meeting via google hangouts. Provided feedback on ATN data policy.
- Previously submitted article on the history and evolution of the FACT Network in a special issue of Marine and Coastal Fisheries journal was accepted.
- Attended the American Elasmobranch Society meeting 24- 28 July 2019 in Snowbird, Utah. Invited speaker during the Nelson Symposium. Presented on the role of acoustic telemetry networks in advancing movement ecology.

Data Acquisition

- Recruited 8 new projects including 3 historic projects (Total number of projects registered is 101).
- Completed two major data processing events in August and October. Between the two events:
    - Processed data from 48 tag and array studies
    - Number of detections increased by 15% (110.2 to 129.4 million detections)
    - Number of deployments nearly doubled (4770 to 7996 deployments)
    - Number of tags increased by 17% (4966 to 5979 acoustic tags)
- The number of unmatched detections (e.g., yet to be resolved and false detections) has decreased from 16% to 10% of total detections.
- Growth is expected to increase at a similar rate as more new and historic projects and organizations are added.

Quality Assurance Quality Control

- Worked with OTN staff to identify flags in the time drift notebook. Specifically, to develop a process that better describes what is flagged in the time drift QA/QC and how to resolve the flags before further processing.
- Identified an issue in using VUE (Vemco) to export event logs from VR2Tx receivers. File size exceeded VUE capabilities, resulting in partially exported files or never-ending loops. Vemco recently released new software (Fathom) that can process event files faster.
- Updated to Python 3 to accommodate newest Jupyter notebooks. In the process of transitioning to Fathom Software (Vemco) to process event files for non-VR2/VR2W receivers.
- Worked with Axiom staff to receive email notifications when files are uploaded to any FACT project. This has been an ongoing issue. Some but not all emails notifications were received. Resolved the issue by changing my log on with a direct email, instead of an email address that is forwarded to another email server. Will monitor to assure all notification emails are coming through.

Georgia Department of Natural Resources Progress Report to ATN: Chris Kalinowsky

Data from the Georgia DNR Coastal Receiver Array (CRA) have been shared with 46 different research groups from 10 different state, federal, and non-governmental organizations. These data represent 41 different species (670 different individuals) inclusive of threatened and endangered species. Included in this number are 179 Atlantic Sturgeon, 13 Loggerhead sea turtles *Caretta caretta*, 15 Kemp's Ridley sea turtles *Lepidochelys kempii*, 58 Atlantic Tripletail *Lobotes surinamensis*, 10 Red Drum *Sciaenops ocellatus*, 28 Tiger Sharks *Galeocerdo cuvier*, and 40 White Sharks *Carcharodon carcharias*. This collaboration continues to provide groundbreaking data on the movements of marine animals. For example, Cobia *Rachycentron canadum* detection data collected by the CRA is being used by resource managers with the South Atlantic Fishery Management Council (SAFMC) to guide current and future resource management. Data from Georgia's CRA were used as part of the SAFMC Southeast Data, Assessment, and Review (SEDAR) Atlantic Cobia Stock

Identification Workshop hosted April 10-12, 2018. The results from this workshop were used to provide stock delineation guidance to the SAFMC SEDAR 2019 Atlantic Cobia Stock Assessment.

The continuous operation and strategic location of the CRA have proven valuable for many studies that track animal movements between overwintering habitat in Florida and critical habitats to the north. Being that the array has changed very little since it was established, researchers are able to examine repeat migrations of animals through the region across multiple years. The array fills a major gap between similar arrays in South Carolina and Florida. Data from the array are vital to several recently funded regional studies. This includes an ongoing tagging study on the migrations of Cobia by researchers in Virginia, North Carolina, South Carolina, Georgia, and Florida. Without Georgia's array there would be a significant and detrimental gap in array coverage in the Southeast.

In summer 2019 new receivers (12) were purchased to replace units deployed along the shipping channel (ATON mounted receivers) and to serve as backups for the offshore line. The ATON receivers had not been fully updated since the beginning of the original project in 2014 and several had been lost over time to storms or damage. This update required a slight modification to the original design for each receiver rigging. The original design sometimes tangled with the ATON bridle chains below the surface. To reduce the potential for entanglement we decided to shorten the design by 6". These new riggings were fabricated by working with a local shop that specialized in stainless steel cable rigging. The ATON rigging design was modified slightly (shortened) to reduce the potential for snagging in the bridle chains beneath the steel buoys. The replacement receivers and riggings (8) were fully deployed in November 2019 (Figure 2).

Future missions are planned for winter 2019/2020 to deploy 2 additional receivers to the end of the nearshore line. These 2 additional receivers will bring the total number in the nearshore line up to 10 and will close the gap between the end of the nearshore line and the beginning of the offshore line (Figure 1). In addition to new receivers, 15 tags (Vemco V16) were purchased to be deployed in large adult Red Drum in Georgia waters. These deployments will continue in winter 2019/spring 2020. This effort will complement the Georgia Red Drum Escapement Study, a tagging project that began summer 2019, in Wassaw Sound (Savannah).

In situ receivers were downloaded during missions conducted in August (2019) (offshore line) and November 2019 (nearshore/ATON line). These downloads resulted in 12,032 confirmed detections of 111 different individuals across 15 identified species and include 17 unidentified individuals listed as tagged by Greg Skomal (Mass. Division of Marine Fisheries) (Table 1). These data were shared with 20 different research groups/projects (Table 2). In addition to the identified tags, there were unknown/unidentified tags (335 detections) that could not be matched to a project or research group. These unknown tags will be passed through the FACT node and further attempts will be made to identify them. Future expansion and increased participation in the FACT node will help further resolve these unknown tags so that those data can be shared with the proper owners.