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

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, RCOOS Manager
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 3 Descope proposal was submitted to the IOOS office 10/29/18.
Ensure SECOORA's operational & governance structure enables us to achieve our vision	The SECOORA Governance Committee has been meeting monthly since October. The Committee is reviewing options for revising the SECOORA Conflicts of Interest policy to restrict PI's from serving on the Board, and reviewing options for revising SECOORA By-Laws related to reducing Board size.
Maintain effective communication with US IOOS and the IOOS Association	Highlights this period include meetings in DC between IOOS Association and NOAA leadership June 5-7; participating in the IOOS Fall meeting Sept. 17-20 in Annapolis; and monthly IOOS Program Office, IOOS Association Executive Committee and RA Director calls.
Expand and diversify funding.	SECOORA resubmitted an LOI to the Curtis & Edith Munson Foundation on 10/30/18. Proposed activities include working with FACT to re-establish two acoustic stations in South Florida that were damaged during Hurricane Irma and add water temperature sensors at established acoustic receiver stations.
Update and maintain SECOORA's RCOOS Plan	In January 2018, SECOORA Board of Directors decided that instead of having a large SECOORA RCOOS Plan that includes details on all of the SECOORA operational components, SECOORA would have several smaller, platform specific plans that are easier to update and can be tailored based on user and stakeholder needs. SECOORA has drafted the Autonomous Vehicles Plan. The RCOOS manager is leading the writing effort. Each plan will provide sufficient detail to outline SECOORA use of the assets and future expansion. Our revision timeline for all of these plans is every 5 years. Note that the HFR and Data Management Plans have already been developed.

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

Activities	Status
Improve web-based information system and web presence	SECOORA is now tracking website usage with Google Analytics. Analytics data will guide efforts to redesign the SECOORA website, such as making our education resources easier to find. The redesigned site will be launched in March 2019. There was a 36% increase in website sessions on secoora.org (from 16,806 to 22,940) this period. SECOORA is now tracking data portal sessions (portal.secoora.org). Data portal sessions have increased 51% in the reporting period (from 4022 to 6064). SECOORA newsletters, stories, and videos can be accessed via website, Facebook and Twitter. SECOORA implemented two surveys: One for the website and another on the SECCOORA Data Portal. The Data Portal survey received 67 responses and website survey received 40 responses. Survey data are being used to improve the website and data portal functionality and design.
Identify and promote opportunities for non-members to engage in SECOORA activities and initiatives	SECOORA issued a new Data Challenge opportunity in which non-members can participate (see Milestone B "Engage students in problem solving using ocean observing data"). SECOORA hosts the *Coastal Observing in your Community* webinar series. Three webinars were hosted this reporting period. Members and non-members presented and attended each webinar. A combined 171 people registered and each webinar is archived for future viewing. SECOORA and Axiom Data Science hosted a half-day workshop titled Data Access for the Southeast US Coasts and Oceans at Oceans18 in Charleston S.C. (10/22/18). Approximately 30 people attended the workshop.
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 3% (from 856 to 884); Facebook "likes" have grown 7.5% (from 396 to 426); and, Twitter "followers" have grown 11% (from 536 to 595). SECOORA shared approximately 137 Facebook posts and 172 Twitter "tweets", referring a combined 965 sessions to the SECOORA website (increasing 185% from 339 to 965) and 19 stories were published on the website (www.secoora.org/news). Extreme event outreach is a core communications strategy. We developed data resource pages for hurricanes and other events affecting the Southeast US. Currently, there is a hurricane resource page and red tide in Florida resource page. In addition, pages for 2018 landfalling hurricanes are available – Hurricane Michael and Hurricane Florence. SECOORA also wrote three stories on Hurricane Florence – NC member data collection, hurricane glider efforts, and a sea surface temperature comparison, resulting in news stories in WIRED and Science Magazine. SECOORA raised over $1,000 in donations on Giving Tuesday. Funds will be used to provide a larger award for the 2019 Vembu Subramanian Oceans Scholar Award (read more).
Support citizen science opportunities	SECOORA and the South Atlantic Fishery Management Council (SAFMC) are partners with NC State University on a NC Sea Grant Community Collaborative Research Grant proposal submitted 11/20/18. If funded, SECOORA and SAFMC will lead the citizen science effort to report boat utilization rates at selected artificial and natural reefs offshore of Carteret County, NC. Additionally, SECOORA and SAFMC will establish a fin kit collection program whereby fin clips will be obtained by recreational fishermen from captured fish. The fins will be sent to SC Department of Natural Resources for future genetic testing. This information will be used to describe species diversity on the targeted reefs.
Engage students in problem solving using ocean observing data	Laura McGee, NC State University, is the first Vembu Subramanian Ocean Scholar. The award will allow her to present her research, *Determining Hurricane-Induced CO2 Flux in the South Atlantic Bight*, at two conferences. McGee attended the Middle Atlantic Bight Physical Oceanography and Meteorology (MABPOM) Meeting in October 2018 and gave an oral presentation on her research. In June 2019, McGee will be attending the Coastal Ocean Dynamics Gordon Research

Activities	Status
	Seminar and Gordon Research Conference in Biddeford, ME.
	SECOORA issued a new Data Challenge opportunity. We are seeking contestants to transform web cameras into environmental monitoring tools. The dataset is from the NOAA NOS funded Web Camera Applications Testbed (WebCAT). Proposals are due 2/15/19.
	In October, two USF undergraduate classes participated in field trips to the 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 225 students have been taught through this partnership since it began in 2014.
	SECOORA and GCOOS partnered to host a booth at the St. Petersburg Science Festival, 10/19-20/2018, St. Petersburg, FL. The booth featured educational materials on navigation, ports, and ocean observing. Click here to read the news story.
	SECOORA is partnering with USF, middle school students at Lawton Chiles Middle Academy in Lakeland, Florida, and students throughout the Polk County Florida School District, to launch a mini-sailboat. SECOORA will display the data collected by the mini-sail boat in a special education portal. Click here to read the story.
Coordination of SOCAN activities	SOCAN Coordinator Leslie Wickes continues to engage stakeholders within the region and nationally. Leslie Wickes co-presented a "Sharing Ocean Acidification Resources for Communicators and Educators (SOARCE)" webinar entitled, "Bless your coast: communicating acidification with lessons learned in the Southeast" in June. In July, SOCAN hosted the South Carolina/Georgia Stakeholder Workshop at the South Carolina Aquarium, Charleston, SC. There were 22 attendees representing oyster growers, fishing associations, non-profits, local and state government, and academic intuitions. The workshop report provides details of the event. SOCAN launched a new website in July, www.socan.secoora.org. The website provides an overview of ocean acidification and targets issues specific to the southeast. The SOCAN newsletters, workshop reports, recorded webinars, a monitoring inventory, and other resources are all available on the site. Wickes is a co-PI on a proposal submitted on 11/14/18 to the RESTORE program titled, "Strengthening the Shellfish Industry's Production in the Gulf of Mexico: A Collaborative Approach." SOCAN is also leading a letter of intent for the NOAA Ocean Acidification Program Data Synthesis RFP which is due in December.

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 includes:
	• Maintained and made enhancements to the Active Storms and Historic Storms layers in the portal for Hurricanes Matthew and Florence. Created archives for final best storm tracks.
	• Improved upon the popular storm tracking layers by developing a prototype hurricane tracking tool which tracks parameters across the storms' path. This tool will be operationalized for live release in January 2019.
	• Maintain IOOS compliant services and applications for integration with national products:
	    o THREDDS 4.6.10 - https://thredds.secoora.org
	    o ERDDAP 1.82 - https://erddap.secoora.org
	    o SECOORA ISO WAF - https://thredds.secoora.org/iso
	    o NECI Archive - https://ncei.axiomdatascience.com/secoora/
	• Made programmatic improvements to ERDDAP services for faster and more efficient

Activities	Status
	calculation of long time-series requests. • Added tracking of data requests to and from THREDDS and ERDDAP to capture metrics on which datasets are being accessed and how much data is being downloaded. • Maintained the SECOORA Glider System for the management of SECOORA glider assets (Bass, Modena, Pelagia, Ramses, Salacia, Saltdawg). The SECOORA glider data was updated for visualization in the portal, as well as submitted to the DAC. Progress was made in collaboration with SECOORA, IOOS, and Rutgers towards resolving issues with submitting the corrected delayed mode data with the DAC. Twenty glider deployments are now available through the SECOORA portal. • Maintained submission of 66 sensor feeds to NCEI for long-term preservation. Submitted 2 new gliders missions from Hurricane Florence to the IOOS Glider DAC ([ramses-20180907T0000](#) and [sam-20180824T0000](#)). The FAU HBOI and NASA/BOEM/FACT waveglider datasets were uploaded to the Research Workspace and showed to the PIs in the SECOORA portal for confirmation before releasing them as public datasets. • Conducted audit for USF COMPS C10, C12, and C13 stations to ensure all parameters were being displayed in portal. Worked with data providers to revise collection scripts to ingest data and QC flags from THREDDS. • Implemented multiple taxa selection filter for biological data (example: SECOORA Fisheries and Wildlife Monitoring layers for [FIMMAP](#) and [MARMAP](#)). • Provided prototype of visible QARTOD flags for data provider flags (e.g. [USF CMS datasets](#)). Demonstrated the initial effort of the QARTOD testing and flagging display for feedback. • Completed the ingestion, data processing, and visualization of SOCAN cruise tracks and 55 datasets associated with SOCAN cruise surveys for visualization to the [web portal](#). • Maintained the SECOORA FACT Node. Working with the IOOS ATN (now contracted to Axiom) and OTN to develop a smooth pathway for all FACT data to get into ATN.
Maintenance of DMAC infrastructure (hardware and software)	Axiom ensured that the SECOORA data system was secure and monitored, provided technical support to address system problems, and mapped out future upgrade strategies.
Establishment and release of new SECOORA Portal	The revised SECOORA data portal was released during the last reporting period; however, ongoing site maintenance and updates continue. Portal version 2.9 data was released 11/30/18. This release features improvements to the existing search functionality and introduction of a new method to access help docs. Changes were made relative to SECOORA Members feedback from the May 2018 technical workshop. New features include: • Improved catalog search interface: Easier navigation between search types; New 'Variable Type' result type; and, Cleaner catalog interface. • Improved search ranking: Easier access to active filters for quick removal; In-map search interface; and, Users can find mappable layers and add them directly from the map. • Interactive help: Users can toggle on/off interactive help layer for direct access to help documentation and gifs. Application remains usable while help layer is visible. Expanded SECOORA data portal holdings to include: • LOBO station, Tampa Bay ([here](#)) • Cheeca Rocks Reef Mooring, NOAA PMEL ([here](#)) • CDIP wave buoy 42078- Big Pine Key, FL ([here](#)) • GOFS 3.0: HYCOM + NCODA - Global Surface ([here](#)) • GOFS 3.0: HYCOM + NCODA - Region 1 ([here](#)) • Connected Educational Passages drifting sailboard feed (USF) to be ready when it deploys
Address 10 requirements per NOAA IOOS Contribute Data Page	SECOORA, with Axiom Data Science, is working towards meeting all 10 data management and core capabilities requirements for contributing data to NOAA IOOS. See **Appendix A** for detailed responses for each requirement.

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 (UFS) (Weisberg, Merz) **All HFR sites On-Track**	On-track: USF continues to operate and maintain 3 CODAR system 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 National HFR CORDC Network (HFRNet) for integration, display and dissemination. Plots of the data are also being posted on the USF College of Marine Science COMPS Ocean Circulation Group web site (http://ocgweb.marine.usf.edu). The Venice WERA was down for ~6 weeks due to a lightning strike and related damage. The Redington Shore CODAR site experienced periodic times of very low data range returns. The Naples CODAR site suffered a failure in a computer hard drive and cellular modem which likely occurred from a nearby lightning/power surge. All repairs have been completed. The CODAR site computer memory and operating systems were upgraded to support the new radial Release 8 software and all the computers have been upgraded to Release 8.
University of Georgia (UGA), Skidaway Institute of Oceanography (SkIO) (Savidge): **CAT On-Track** **JEK Delayed**	Hurricanes in 2016 and 2017 have affected both the St Catherines (CAT) and Jekyll (JEK) HFR sites. CAT has been operational during this reporting period and data is being sent to the HFR DAC. JEK has not been operational since Hurricane Irma in 2017. SkIO has obtained quotes for replacement equipment and has received insurance money from UGA that will partially cover needed replacement equipment. Additional funding from NOAA through SECOORA is expected but has not been awarded yet. Despite significant erosion at the JEK site, beach renourishment is planned, so contrary to our last progress report, a new site on Jekyll Island will not be required, and the current permits will suffice for restoring operation at the site.
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. UM has repaired the HFR installation at the US Navy Test Facility at Dania Beach (STF). Repairs included laying new cables and moving computer systems inside of a Navy building to provide them with extra protection. This site became operational again in March 2018 and is providing mean radials hourly to the HFR DAC. UM requires the distribution of the Hurricane supplemental funds in order to redeploy the Crandon Park (CDN) and Virginia Key (VIR) sites. UM needs to order two new HFR and computer units from Helzel as well as new cabling from Talley. These stations will remain non-operational until supplemental funding is made available. UM is planning to deploy a 4th WERA in North Key Largo. Permits have been obtained from the Florida Department of Environmental Protection and the Division of State Lands. A final permit requesting permission to deploy infrastructure on State Owned Lands has been submitted. This permit is currently undergoing legal review with the Florida Division of State Lands-Bureau of Public Administration.
University of NC - Chapel Hill (UNC-CH) (Seim) **All HFRs On-Track**	UNC-CH operates CORE, HATY, and DUCK CODARs. CORE experienced multiple outages this reporting period. The first was a failure of its air conditioning unit in mid-May 2018 which subsequently caused intermittent shutdowns (due to overheating) and eventually to transmitter failure on 8/9/18. There were long delays in getting a new AC unit (and the older one repaired, to provide a backup) because these are DC powered, necessary as this is a low-power site. Working with CODAR, UNC personnel were able to identify and replace a failed component in the transmitter and bring it back on line 8/30/18. The site was then significantly impacted by Hurricane Florence in September. It is worth noting that this is a remote site that requires boat access. UNC personnel visited the site prior to the storm to secure the solar panels and wind generator. CORE reported through most of the storm but the site was one of the locations where there was overwash, depositing several feet of sand around the base of the antennas and solar array. Subsequent bulldozing by the National Park Service cut cabling to the antennas. Access to

Institution/Contractor	Status
	the site for damage assessments was not possible until 10/17/18. Repairs included new cabling and lightning arrestors and the site was back online 11/16/18. There is still a concern that storm damage may be slowly impacting the system performance, similar to the behavior seen at HATY after the receive antenna was knocked down into the surf-zone during Hurricane Maria in 2017. The 2017 hurricane impacts were reflected in the degraded performance of HATY during this reporting period, which resulted in reduced coverage until mid-September when the receive antenna was replaced. The transmit cable was re-terminated and lightning arrestors replaced after an apparent lightning strike in late June 2018; the cable issue was suspected to be a remnant corrosion problem from the 2017 hurricanes. It was also discovered that the BLOC HFR site had incorrectly been set to have similar or identical transmit settings to those at HATY from mid-May to late October, causing interference at HATY and reducing valid solutions, with the greatest impact being 9/6/18 -10/26/18. This was identified by Teresa Updyke and addressed in late October.
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). Systems operated without any significant down time during this reporting period. Some adjustments were made due to some storm erosion. Areas that had not needed modification for sea turtle nesting in prior years, were modified for this season's nesting. The GTN site has no dune barrier, and continued erosion has created potential issues with nesting sea turtles. Finally, routine maintenance and repairs have been made at the sites: • GTN routine maintenance and external hard drive failure and repair 6/7/18. • The CSW radar power supply failed on 6/8/18 (short at the input interface potentially due to an electric surge). Power supply repaired and returned to service on 6/14/18. Maintenance and repair of malfunctioning external hard drive on 7/26/18. • To comply with HFRnet requirements, that all WERA LLUV radial files are submitted in version 2, the USC computer operating systems were upgraded. This process took a few weeks and was completed successfully in early September. • Monitored CSW and GTN during Hurricane Florence. Power remained operational at both sites, but CSW lost TX capability on 9/14/18. Access to the site was allowed on 9/24 and it was confirmed that the beach and dune erosion had compromised the TX array. One antenna was completely lost, two were taken down by erosion and wave action, one remained upright. The TX antenna cable was separated from the splitter box due to stress placed on it by the sloughing of the dune further up the beach. The cable was re-connected and the remaining antennas were restored to functionality, but with reduced range due to altered, not optimal TX array geometry. • Loss of communication with GTN site occurred in mid-October. The Verizon modem was unresponsive in the field. It was brought back to the lab, restored, then redeployed. Communication was restored but communicaitons loss occurred again for a short period the following week. Failures were due Verizon signal loss following Hurricane Michael. • Began the process of moving the TX array at CSW site on 11/28/18 within permitted footprint. The array was moved 15m back due to beach front erosion. The receive array will also need to be moved due to the same erosion processes.

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 (COMPS) moorings	**Operations:** Three real time surface moorings (C10, C12, C13) were maintained along with two non-real-time subsurface moorings (C11 and C15). Real-time data are shared with SECOORA and NOAA's NDBC. Additionally, USF personnel worked with Axiom to submit all archived data (July 1998 – Present) and create metadata for C11 and C15 via Research Workspace. These uploads

Institution/Contractor	Status
All moorings On Track (delays for some mooring sensors)	will continue each time data is recovered from these moorings. USF efforts at restoring our three real time stations that were damaged by Hurricane Irma were bolstered by the receipt of a NASEM-GRP Irma damage award. This award enabled USF to purchase of some of the necessary replacement sensors and to send some damaged sensors back for repair. These funds were insufficient to purchase all necessary replacement sensors and spares. USF is awaiting the Irma supplemental funds to purchase the remaining necessary items. Additional setbacks were caused when Tropical Storm Gordon passed over C13 and damaged one wind sensor and the data cable connecting the ADCP to the logger/transmitter. Discussion table and text below

	C10	C12	C13
Wind	90%	100%	93%
Barometric Pressure	91%	4%	92%
Water Temperature	91%	100%	91%
Salinity (Surface)	91%	100%	91%
Air Temperature	28%	4%	93%
Relative Humidity	24%	4%	93%
Longwave Radiation	24%	N/A	N/A
Shortwave Radiation	24%	N/A	N/A
Currents (ADCP)	89%	92%	56%

Discussion of low stats: Data returns from C10 (air temperature, relative humidity, longwave radiation and shortwave radiation) and C12 (barometric pressure, air temperature and relative humidity) are still compromised by damaged sensors from Hurricane Irma. USF is awaiting supplemental funding to purchase new sensors. The low data return for ADCP data on C13 is due to the cable damage caused by TS Gordon. While not showing up in the statistics as a low data return, there were some missing hourly data in October and November. This corresponds to the timing of bulletins sent out by NOAA advising users about the transition of data transmissions from the GOES-15 to GOES-17 satellite.

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. • Shell Point: Site was visited on 7/9/18 and 8/15/18. Temperature/Relative Humidity sensor was replaced on 7/9. Precipitation gauge was replaced and calibrated on 8/15. Cleaned Aquatrak water level well, replaced lower section of sounding tube with copper tubing for biofouling prevention. Investigating replacement of Aquatrak acoustic water level sensor with WaterLog radar sensor to alleviate sedimentation issues. • Clam Bayou: Site was visited on 7/10-11/2018, 8/21-22/2018, 10/17-18/2018, 11/27-28/2018. On each visit, USF/COMPS, YSI/Xylem, and FWRI personnel removed, cleaned, calibrated, and re-deployed the multiprobe water quality sonde; inspected/cleaned all components; and collected in-situ calibration/evaluation data for chl, CDOM, pH, alkalinity, and pCO2. The back-up water level bubbler system was reinstalled after factory maintenance on 10/17/18. A new cable and water quality sonde were installed on 10/18/18. The removed sonde was returned to YSI for service due to a damaged connector. • Big Carlos Pass: Site was visited on 7/18/2018. Barometric pressure offset was changed to correct to MSL, other routine maintenance was performed. • Fred Howard Park: Offset, calibration for the KPSI water level sensor verified on 7/9/2018. • Aripeka (ARP): Site visit will be scheduled in 2019 for routine maintenance and cleaning.
University of North Carolina - Wilmington (UNCW) (Leonard) - Coastal Ocean Research	**Operations:** UNCW operates 9 moorings in NC and SC coastal waters. Buoy statistics for the reporting period are below. Note that ILM2 and LEJ3 have co-located WaveRider buoys (i.e. 2 moorings on station) that provide spectral wave data and water temperature. SUN2 has a co-located acoustic system (comprised of an ADCP and Nemo) to provide wave data and surface

Institution/Contractor	Status
and Monitoring Program (CORMP) mooring network ***All stations On-Track***	and bottom water currents (2 moorings on station). Hurricane Florence (9/13/18) impacted the three Onslow Bay buoys (ILM2, ILM3, and LEJ3) and local data collection services. Physical damage to the buoys was minimal, but numerous sensors were damaged by the storm. The presence of redundant sensors provided a full dataset throughout and after the storm. The ILM2, ILM3 and LEJ3 buoys were successfully swapped during the Onslow Bay fall maintenance cruise aboard the *RV Savannah* 10/24 –26/18. Additional platform maintenance included: 1) ADCP and battery swap on SUN2WAVE, 8/6/18, and 2) troubleshooting communications at SUN2WAVE on 11/19/18. The ADCP and CTD on the OB27 bottom frame (non-real time station) were serviced on 7/31/18 and 10/31/18. The bottom frame and installed sensors received no damage from Hurricane Florence. CORMP technicians worked with Axiom to share historic data from OB27 and create metadata using Research Workspace.

	ILM2	ILM3	LEJ3	SUN2	CAP2	FRP2
Air Temperature	99%	98%	98%	99%	99%	75%
Air Pressure	94%	97%	93%	99%	99%	75%
Wind Speed, Gust, Direction	99%	98%	98%	99%	99%	75%
Surface Salinity	99%	98%	98%	94%	99%	75%
Surface Water Temperature	99%	98%	98%	94%	99%	75%
Waves	99%	N/A	99%	74%	NA	N/A
Currents	N/A	N/A	N/A	74%	N/A	N/A

Discussion of Low Buoy Statistics: FRP2 was the only platform to perform below 85%. The primary issue with this station was failure of the buoy power supply. The power supply failed 10/17/18 but could not be replaced until 11/30/18 due to weather and boat availability.

Data Management: In response to an anticipated loss of power at the UNCW during Hurricane Florence, CORMP migrated data collection software and processes to an Amazon Cloud Workspace. This move insured continual data collection and uninterrupted access to buoy data by the general public and NDBC during the storm.

CORMP continues to utilize the Data Quality Dashboard to perform QA/QC on all collected data. A nearest neighbor test has been implemented on all meteorological parameters, testing primary and secondary sensors onboard the buoys to spot potential sensor failures or poor measurements. This test is particularly useful for detecting problems with wind direction measurements that do not trigger other QARTOD flags.

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 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 ***Overall On-Track but SAMI-pH and Seabird***	**Operations**: On 6/6/18, six water samples were collected at the GRNMS buoy and sent to colleagues at the University of Delaware for analysis. PI Noakes and technicians visited the GRNMS buoy again on 8/27/18 onboard the R/V Joe Ferguson. The MAPCO2 system including the electronics, battery, spare gas and equilibrator were all successfully replaced. Unfortunately, the team was short one NOAA working diver (2 NOAA working divers are required for under buoy operations) so the SAMI-pH sensor and Seabird CTD could not be replaced. A GRNMS vessel is currently scheduled for the week of December 3 to make another attempt at changing out the SAMI-pH and Seabird sensors. The primary MAPCO2 system has been operating 100% during this reporting period. The auxiliary sensors, SAMI-pH and Seabird CTD, have not been reporting, but it is anticipated that the Seabird is currently running in

Institution/Contractor	Status
CTD swap delayed.	autonomous mode and storing the data internally. The condition of the SAMI-pH sensor is currently unknown as it is no longer reporting.

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**: The SECOORA regional glider observatory is a collective effort among five institutions, which jointly conduct missions. For this reporting period, the observatory conducted 5 missions. • Shelf edge mission 8/8 – 9/4/18 (lead USF). The glider was deployed off of Cape Canaveral, FL and retrieved off of Jacksonville, NC. During the deployment, it is thought that the glider was struck by a vessel or predator, shearing one of its wings on 8/18. Following this, on 8/30, the glider became pitch-unstable due to the forward battery pack becoming un-lodged. All data were sent to the Glider DAC. • Hurricane Florence deployment 9/10-9/21 (lead SkIO). As part of a rapid response to Hurricane Florence, a glider was deployed off the GA/SC border three days before landfall. The glider blew its emergency weight due to unexpectedly fresh water offshore as the storm made landfall but continued to transmit surface data. All data were sent to the Glider DAC, and it was verified that both profile and surface data were used in assimilation by GOFS3.1. Further developments with the Hurricane Gliders program are given below. • Hurricane Florence/PEACH deployment 9/7-9/29 (lead SkIO/UNC). The glider was deployed for an NSF-funded program off Cape Hatteras; all data were sent to the DAC and made available for the Hurricane Gliders program through collaboration with SECOORA. • Deployment for SkIO's new G3 at Gray's Reef National Marine Sanctuary (lead SkIO), 1 day shake-out mission. • NSF-funded work: The PEACH project (Edwards/Seim are co-PIs) funded an additional 4 missions totaling 83 days. Data from at least 20 of these glider-days were sent to the DAC through SECOORA support. **Software development:** • GIT has further developed the multi-time scale path planning tool to assist with glider navigation. The tool uses real-time input from HFR and from the glider itself to plan the optimal path given a navigation goal. During the reporting period, two presentations were given at MTS/OCEANS in Charleston, and one paper was published. • UNC has continued development of QA/QC processing routines to correct for issues associated with the unpumped CTD on the G1 Slocum gliders. • The observatory processed and submitted a post-deployment full dataset to the national glider DAC as a test, with the help of Axiom and Rutgers. **Hurricane Gliders:** The SECOORA glider observatory leveraged its operations to participate in this year's Hurricane Gliders experiment and had two gliders out in advance of Hurricane Florence and within 100 miles landfall. PI Edwards coordinated with the Hurricane Gliders team before, during, and after hurricane season, participated in a hurricane panel with IOOS Director Carl Gouldman and Travis Miles (Rutgers) at MTS/OCEANS, and presented results at the NOAA/Navy hotwash. SECOORA will participate in 2019-2020 Hurricane glider efforts. **Glider Fleet Expansion:** SECOORA ordered a new G3 glider from Teledyne Webb on 11/17/18. The glider should be delivered in February 2019. SECOORA has drafted an MOU with SkIO, whereby SkIO will pilot the new glider for SECOORA. Edwards/SkIO took delivery of a new G3 glider in August 2018, and it will be used along with the SECOORA glider for SECOORA and externally funded missions.

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 was fully operational until 8/30/18 when it was struck by a dredge scow and completely destroyed. The Army Corps of Engineers Charleston District is working with Great Lakes Dredging and Dock to replace the infrastructure and scientific equipment. All data and metadata prior to the ship strike has been submitted to the NERRS Centralized Data Management Office. Stats reflect the station being down for half of the reporting period. Stations stats: June 1 – Nov. 30<table><tr><td>Water Temperature</td><td>43%</td></tr><tr><td>Salinity/Specific Conductivity</td><td>43%</td></tr><tr><td>Dissolved Oxygen</td><td>43%</td></tr><tr><td>pH</td><td>43%</td></tr><tr><td>Turbidity</td><td>44%</td></tr><tr><td>Chlorophyll Fluorescence</td><td>44%</td></tr><tr><td>Depth</td><td>43%</td></tr></table>

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 (http://omgsrv1.meas.ncsu.edu:8080/CNAPS/). Model skill assessments are underway. In the first quarter of 2019, the team will implement a prototype nowcast/forecast system for testing.

Milestone B: Operate the WFS FVCOM ocean model

Institution/Contractor	Status
USF (Weisberg) ***On-Track***	A new red tide tracking product based on the higher resolution Tampa Bay Circulation Model (TBCOM) has been developed and served online to the public: http://ocgweb.marine.usf.edu.tbm/hab/. This new product parallels the existing WFCOM-based red tide tracking product but focuses on the Tampa Bay area by using the higher-resolution TBCOM. These short-term (4.5-day) products are produced in a Collaboration for the Prediction of Red tide (CPR) between the USF College of Marine Science and the Florida Wildlife Research Institute (FWRI). FWRI provides observations of Karenia brevis red tide cell concentrations that are input to both WFCOM and TBCOM. The FWRI observations are a day old when received by USF, so the short-term predictions consist of a 1 day hindcast and a 3.5 day forecast of the red tide trajectories for both near surface and near bottom water columns. Noting that spatial sampling is limited and that blooms may be patchy, USF 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. This project is also funded through a competitive RESTORE Act award from Pinellas County who may now be considered another IOOS/SECOORA stakeholder.

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

Institution/Contractor	Status
USC (Porter) *On-Track*	This project is on track. The project team focused water quality forecasting efforts on the Charleston Harbor watershed and adjacent swimming beaches and shellfish harvesting waters in SC, and Kill Devil Hills, NC. All of the project sites are on http://howsthebeach.org/. For the Charleston Harbor watershed, historical datasets (rainfall, water temperature, wind, tide, salinity data, etc.) were pulled from USGS/SC Department of Health and Environmental Control, near real-time USGS/NOAA NOS gauges, met stations, etc., and from NWS Nexrad rainfall data where available. These data were coupled with data collected by the monitoring efforts (*Enterococcus* concentrations) of the Charleston Waterkeeper to produce predictive models using multiple linear regression. Near real-time data now feed directly to 20 daily forecast models from five study sites (Brittlebank Park, Folly Beach, and three sites along Shem Creek) in Charleston. The project team has completed the development of statistical models for beach areas in Kill Devil Hills, NC and has incorporated the daily forecasts into the mobile app. One issue encountered is a lack of long-term, high resolution salinity estimates for use as predictors in the bacteria models. The project used modeled salinity data from three models: HYCOM, Rutgers, and Copernicus, which provide data at a resolution that is coarser than preferred. Having a THREDDS server with long term, high resolution, local models would be useful for the modeling process; higher resolution salinity estimates will likely improve the model performance. In collaboration with the EPA Virtual Beach Environmental Modeling Community, the project team also started experimenting with gradient boosting machine (GBM) learning on its best and least predictive sites to discover if this tool added any value to the modeling process. Two approaches for GBM modeling are being examined: The EPA's Virtual Beach tool and the XGBoost library. The team is also evaluating the application of Machine Learning via TensorFlow, an open source library supported by Google.

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

Institution/Contractor	Status
SECOORA (Dorton)/ Second Creek Consulting (Galvarino) *On-Track*	The MWP is hosted on the SECOORA website: http://mwp.secoora.org/. Development efforts included the incorporation of an auto-refresh function, additional user-selectable water level datums, and user-selectable (toggle) forecasted wind speed and wind gust. The MWP relies on nowCOAST for forecasts, hurricane maps, NWS watch and warning maps, and NWS point forecasts. During tropical storm events, nowCOAST has capacity issues which means the MWP end users cannot access hurricane maps and information. Second Creek Consulting is investigating alternate data sources for tropical storm events – specifically pulling data directly from NOAA's National Hurricane Center. Jennifer Dorton presented on the MWP at the Oceans18 meeting held in Charleston, SC, October 22-25. The MWP project team members (Dorton, Galvarino, Porter) will participate in the Charleston Boat Show, 1/25-27/19. During this event, they will highlight the MWP (as well as other SECOORA products) and request feedback on the site.

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
Total Water Initiative (Fathom Science, LLC) **Complete**	All funds have been expended. The team is writing a final report and creating slides for the project for submission to the IOOS office. Conclusions: • Affordability: The project team found that cloud-based computing is much more affordable than university and foundational High Performance Computing (HPC) infrastructure. • Extensibility: Traditional HPC infrastructure requires significant initial investment to initiate the model framework, followed by continual investment in hardware and effort as model development expands. The cloud-based computing business model is beneficial since expanding model development (e.g. improved model resolution, more complex parameterizations) simply requires spinning up additional instances (e.g. adding another virtual computer to the pool of resources).
NOS Web Camera Applications Testbed (SECOORA and Surfline) **Complete**	The Web Camera Test Bed project final team meeting was held November 14-15. The following website provides a meeting description and links to meeting presentations. The final report from the workshop will be uploaded to this site once complete. https://secoora.org/webcams-for-environmental-monitoring-workshop-2018/
OTN/ATN **On-Track**	SECOORA established contracts with Joy Young (10/19/18) and Chris Kalinowsky, Georgia Department of Natural Resources (12/4/18). Joy Young has been working to upload data to the FACT/SECOORA node: 462 active stations registered, 873 stations retired, 1,852 animal tags registered, 2,324 expired tags registered, 31 project arrays registered, 52 tag projects registered, and 41,000,000 detections registered. Joy has been able to successfully mirror projects between FACT/SECOORA node and OTN node. This means projects can be shared between nodes. Funding for the GA DNR will support the maintenance of existing acoustic receivers and the tagging of sportfish species. The Environmental Compliance Questionnaire was completed and submitted to the NOAA IOOS office for review on 11/19/18. Further documentation was requested from Ga DNR on 12/10/19. Once the NEPA obligations are met, this project can begin.
OTT Biology pilot projects **Start date Jan 2019**	This project will begin in early 2019. Conference calls held this period initiated the exchange of information and pilot datasets from SCDNR, who conducts the SEAMAP-SA fisheries independent surveys for the south Atlantic, to Axiom. Next steps are being evaluated.
Scholarship **On-Track**	SECOORA worked with members at the UNC Coastal Studies Institute to submit a Hollings Scholar opportunity on 11/15/18, titled "NOAA-IOOS Ocean Energy and Physical Oceanography Internship: Field Observations, Analysis, and Public Communication". This is a multidisciplinary project allowing the student to better understand ocean observing systems, their importance, and methods for communicating science to public audiences. If a student selects this opportunity, then the scholarship funding will be used to support the students' travel to other UNC-system campuses and participate in additional fieldwork opportunities.
Additional Observations Initiative **Start date Jan 2019**	This project will begin in early 2019. 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 such as harmful algal blooms, sound in the marine environment and coral disease. $30,000 is the anticipated award value. The SECOORA Board of Directors will discuss this opportunity at their January 15-16 meeting to provide input on the mini-proposal process and establishment of a review panel for submitted proposals.

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

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

Florida Institute of Technology (FIT)/Maul	FIT will receive funding to operate and maintain two HFRs in the Cape Canaveral area. Dr. George Maul is working with Dr. Nick Shay (UM) to identify sites for HFR deployment. The goal is for the HFR to provide coverage of the Oculina Bank Habitat Area of Particular Concern, an important fishery area off the east coast of Florida. Sebastian Inlet State Park has been identified as one HFR location and a review of potential locations for the second array is underway. SECOORA will work with FIT to secure permits and complete NEPA requirements prior to the HFR deployment.
SkIO/Savidge	SECOORA and SkIO finalized discussions on the purchase of the used WERA that are part of the NSF PEACH project (PI Savidge). The lease terms for the WERA terms are complete in March 2019. In early 2019, prior to the end of the lease, SECOORA will pay for the used WERA so that they can remain in the region and be repurposed to meet IOOS goals. It is anticipated that one WERA will remain on the NC Outer Banks to increase coverage of Raleigh Bay and two WERA will be moved to north Florida to help increase coverage to the north of the FIT WERA. The final destination for the fourth WERA is to be determined.

2) Scope of Work

Scope of work is as described in the Year 3 Statement of Work.

3) Personnel and Organizational Structure

A current list of SECOORA Members and Board is 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, 2018 financial report for Year 1 funds shows a budget balance remaining of approximately $30k. SECOORA's October 31, 2018 financial report for Year 2 funds shows a budget balance remaining of approximately $680K. SECOORA's October 31, 2018 financial report for Year 3 funds shows a budget balance remaining of approximately $3.4M We are within budget and on track with spending. SECOORA continues to receive invoices regularly from our sub-awardees and we process them at one of two 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.

Challenge: Currently, PIs submit data to NDBC. Bringing submission under the SECOORA DMAC structure could make it more efficient. As of December 2018, the National IOOS Office is working in collaboration with NDBC to setup data ingestion from IOOS RAs through standardized ERDDAP instances. If this happens it could take much of the pain in submitting data to NDBC out of the 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, available 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. Through fall 2018, Axiom will be working to implement and display QARTOD flags to be available through the SECOORA data portal. 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

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

The notebooks require updates and fixes as the packages and services accessed are updated. During this quarter the following notebooks were failing and required some tweaking:

- *erddapy*: fixed the API calls and created (ioos/notebooks_demos #313, #314) and improved install instructions (ioos/notebooks_demos #315);
- *HFRadar* currents: updated dependencies (ioos/notebooks_demos #316) and added xmltodict after a user request (ioos/notebooks_demos #317).

In addition to the updates the publication framework and IOOS environment received a number of PRs to improve installation and to automate the webpage documentation publication.

- Added slim version of the IOOS environment that does not include the *R* language (ioos/notebooks #314)
- Use stable binder link (ioos/notebooks_demos #319)
- Created auto-publication mechanisms for *ugrid*, *gridgeo* (ugrid-conventions/ugrid-conventions #44) (pyoceans/gridgeo #41)

A new framework for reproducible notebook repos with *depfinder* (ericdill/depfinder #21, #23, #24, #25, #26, and #28), *python-stdlib-list* (jackmaney/python-stdlib-list #13, #14, #15, and #18), and *nbconvert* (jupyter/nbconvert #919) was created to simplify the publication of notebooks and simple environments to run them.

2) Support current and continue developing important software packages for IOOS. This activity can be divided into two sub-sections:

a) packages from the IOOS GitHub organization

- Adapted *compliance-checker* to use *cf_units* 2.0 and fixed the dependencies locking issue, bogus dependency declaration, and install requirements fragmentation (ioos/compliance-checker #588, #605, and #606)
- Fixed and updated the *pyoos* testing framework (ioos/pyoos #85) to reflect server updates

b) packages from third party organizations that are important for IOOS

- Overhaul of the *ogh* module to allow its packaging (Freshwater-Initiative/Observatory #19)
- Fixed *cf_units* to work with Python 3.7 and files manifest (SciTools/cf-units #116 and #104)
- Ensure *iris* works with latest *netcdf4* and fixed numpy deprecation warning (SciTools/iris #3031 and #3212)
- Adapt *nc-time-axis* to use *cftime*, fixed README info, update CI testing, (SciTools/nc-time-axis #30, #32,#33, #34, and #37)
- Fixed Windows testing for the Python *gsw* package, added auto deploy on PyPI, many testing updates, and support Windows paths (TEOS-10/GSW-Python #30, #33, #34, #35, and #37)
- Fixed AppVeyor build for Unidata's *udunits2* (Unidata/UDUNITS-2 #64)
- Fixed bogus dependency and Windows testing for *cftime* (Unidata/cftime #61 and #62)
- Fixed AppVeyor testing for *netcdf4* (Unidata/netcdf4-python #831)
- Fixed package *rise* installation (damianavila/RISE #390)
- Fixed CI testing for *rasterio* and requirements file (mapbox/rasterio #1400 and #1483)
- Release *folium* v0.6.0 (python-visualization/folium #930 and #931), added Python 3.7 testing for *folium* and *branca* (python-visualization/branca #45 and python-visualization/folium #974), fixed headless browser in *folium*, added *AntPath* plugin, bugfix for the *HeatMap* plugin (python-visualization/folium #1015, #1016, #1017, #1022)
- Improved recipe generation in *conda-build* and purge the *.la* files from the built packages (conda/conda-build #2972 and #3102)
- Fixed *python-oceans* failing tests, add mixed layer calculation, and improved packaging (pyoceans/python-oceans #55,#56, and #57), refactored *python-oceans* datasets module and added autoublish mechanism (pyoceans/python-oceans #58 and #59)
- Use *cftime* in *ioos_tools*, run testing suite, and improve packaging (pyoceans/ioos_tools #10, #11, #12, and #14)
- A new version of *erddap* was issued with many improvements and bugfixes: cache queries for faster responses, better docs simplified object constructor, better packaging, fixed *download_url* without constraints, use *f-strings* everywhere to improve code readability, and auto deployment of the new releases, (#37, #39, #40, #41, #42, #44, #45, #46, #49). The next release will have better docs,parsing of *csvp*, update servers, opendap URL support,

improved testing, option for *iris* cube output, refactor tmpfiles for better Windows support, added categorize URL ([pyoceans/erddapy #50](#), [#51](#), [#52](#), [#53](#), [#54](#), [#55](#), [#56](#), [#57](#), [#58](#), [#59](#), [#60](#), [#61](#), and [#62](#))

- Added Python 3.7 testing for *gridgeo* and extra examples ([pyoceans/gridgeo #42](#) and [#43](#))
- Added CI testing for *EarthAnnotator* tutorial ([dbuscombe-usgs/EarthAnnotator #1](#))
- Added license file in *OWSLib* ([geopython/OWSLib #518](#))
- Fixed Windows testing in nco ([nco/nco #107](#))

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

Added the following new packages: *md_toc*, *fpyutils*, *mdx_gh_links*, *fusepy*, *dask-kubernetes*, *xgcm*, *dask-tensorflow*, *tensorflow-hub*, *easyargs*, *l18n*, *pandas_flavor*, *satsearch*, *paramnb*, *parambokeh*, *panel*, *tomlkit*, *pyrsistent*, *cachy*, *shellingham*, *intake*, *demoshell*, and *libdrs_f* ([conda-forge/staged-recipes# 5964](#), [# 5965](#), [# 6054](#), [# 6055](#), [# 6056](#), [# 6070](#), [# 6072](#), [# 6184](#), [# 6267](#), [# 6301](#), [# 6577](#), [# 6802](#), [# 6833](#), [# 6959](#), [# 6960](#), [# 6962](#), [# 6963](#), [# 7045](#), [# 7083](#), and [# 7130](#)). Many existing packages required updates and build fixes for new versions. They are listed in the section "Pull Requests links."

4) Relevant new products or tools developed during the reporting period: A new tool, NBRR, was developed for publishing reproducible notebooks and GitHub "executable" environments with binder: https://github.com/pyoceans/nbrr. NBRR aims to be a simple framework for scientists to share their notebooks with version control, testing, and reproducible environment.

Pull Request Links

conda-forge/basemap-feedstock# 34
conda-forge/basemap-feedstock# 35
conda-forge/bunch-feedstock# 2
conda-forge/c99-to-c89-feedstock# 6
conda-forge/cartopy-feedstock# 53
conda-forge/cartopy-feedstock# 55
conda-forge/cc-plugin-ncei-feedstock# 15
conda-forge/cdo-feedstock# 41
conda-forge/cdo-feedstock# 42
conda-forge/cdo-feedstock# 51
conda-forge/cf_units-feedstock# 14
conda-forge/cf_units-feedstock# 17
conda-forge/cf_units-feedstock# 22
conda-forge/cftime-feedstock# 4
conda-forge/cftime-feedstock# 8
conda-forge/ciso-feedstock# 10
conda-forge/colorama-feedstock# 11
conda-forge/compliance-checker-feedstock# 28
conda-forge/conda-forge-ci-setup-feedstock# 30
conda-forge/conda-forge-pinning-feedstock# 126
conda-forge/conda-forge-pinning-feedstock# 137
conda-forge/conda-forge-pinning-feedstock# 141
conda-forge/conda-forge-pinning-feedstock# 153
conda-forge/conda-forge-pinning-feedstock# 154
conda-forge/conda-forge-pinning-feedstock# 155
conda-forge/conda-forge-pinning-feedstock# 82
conda-forge/conda-forge-pinning-feedstock# 83
conda-forge/conda-forge.github.io# 609
conda-forge/conda-smithy# 807
conda-forge/conda-smithy# 809
conda-forge/conda-smithy# 902
conda-forge/cryptography-vectors-feedstock# 20

conda-forge/curl-feedstock# 31
conda-forge/cytoolz-feedstock# 11
conda-forge/distributed-feedstock# 64
conda-forge/erddapy-feedstock# 6
conda-forge/erddapy-feedstock# 7
conda-forge/erddapy-feedstock# 9
conda-forge/esmf-feedstock# 32
conda-forge/expat-feedstock# 14
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conda-forge/fiona-feedstock# 84
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conda-forge/h5py-feedstock# 36
conda-forge/hdfeos5-feedstock# 23
conda-forge/holoviews-feedstock# 48
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