

Project Title:

The Continued Development of the Northeastern Regional Coastal Ocean Observing System

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Recipient institution name and address:

Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS)

Award Number:

NA11NOS0120034

Period of Performance:

December 1, 2012 – May 31, 2013

1) Project Summary

Long-term goals- The overarching intent of this award is to continue operation and further the development of the integrated ocean observing system for the Northeast and to expand the user base through consultation and outreach. The major goals of this award are to coordinate regional management, maintain the observing subsystem, maintain the DMAC subsystem, maintain the Modeling and Analysis subsystem, and maintain capacity with Education and Outreach activities.

Objectives- Objectives for years one and two for this award are included below and reported on herein. Details can be found in the original work plan of the proposal submitted in the fall of 2010.

1.0 Coordinated Regional Management

1.1 NERACOOS Office maintained at base capacity

2.0 Observing Subsystem

- 2.1 Planning for future enhancement and National Synthesis of Regional Build Out Plans (Year 1 only)
- 2.2 The Gulf of Maine buoy array will be maintained at current capacity (6 buoys – UMaine).
- 2.3 The Long Island Sound buoy array will be maintained at current capacity (3 buoys – UConn).
- 2.4 The Great Bay Coastal Buoy and Coastal Marine Lab will be maintained at current capacity (UNH).
- 2.5 The Gulf of Maine HFR array will be maintained at current capacity (3 locations – UMaine).
- 2.6 Nutrient work will be maintained at base capacity (URI) and maintain capacity of the AZMP program (URI and BIO)
- 2.7 Enhanced observing capacity will also be obtained with the real-time telemetry Narragansett Bay Fixed-Site Water Quality Monitoring Network
- 2.8 HAB monitoring in the Bay of Fundy and satellite work will be maintained at current capacity (BIO).
- 2.9 Enhanced observing capacity will be achieved with continuing the deployment of Jeffrey's Ledge CDIP wave buoy
- 2.10 Enhanced observing capacity will be achieved with continuing the deployment of the Ocean Acidification buoy in the Gulf of Maine

3.0 DMAC Subsystem

3.1 DMAC coordination will be maintained at current capacity (GMRI) and include work on the IOOS Data Portal (Year 2 only, GMRI).

4.0 Modeling and Analysis Subsystem

- 4.1 The Northeast Coastal Ocean Forecast System will be maintained at current capacity (UMassD).
- 4.2 The WaveWatch III wave model will be maintained at current capacity (BIO).
- 4.3 National Search and Rescue Optimal Planning System Short-Term Predictive System (SAROPS – STPS) effort will be maintained

5.0 Outreach and Education

5.1 Current capacity at NERACOOS office will be maintained.

2. PROGRESS AND ACCOMPLISHMENTS

One award was in place during the reporting period to support the operations of the observing system for NERACOOS (#NA11NOS0120034). Activities funded under this award are reported on herein to the best of our ability.

Objective 1 – Coordinated Regional Management

1.1 The **NERAOOS office was maintained**. The NERACOOS Board of Directors continues to

meet four times a year and met on December 4 before the annual meeting on December 5. They also met by webinar on February 8 and May 9. A working group has been assessing evolving funding opportunities and membership. With this group, the office has created and implemented a membership program. During the reporting period, Bob Stankelis (Narragansett Bay NERR) and Curtis Bohlen (Casco Bay Estuary Partnership) joined the board and the following members were approved to continue their service to 2015: Fei Chai (UMaine), James O'Donnell (UConn), Peter Smith (BIO), Bruce Carlisle (MA CZM), Linda Mercer (ME DMR), Michael Szemerda (Cooke Aquaculture), and Dave Casoni (MA Lobstermen's Association). The following were approved as officers through 2014: Malcolm Spaulding as President, Peter Smith as Vice President, Anthony Kirincich as Secretary, and Linda Mercer as Treasurer. The Strategic Planning and Implementation (SPI) Team continues to hold monthly conference calls and met on April 30 in Rhode Island. The current primary focus of the SPI team is long term planning of observing equipment.

NERACOOS held its annual meeting on December 5th, 2012 at the Seacoast Science Center in Rye, NH. In attendance were over 60 stakeholders from many sectors including local, state and federal government, private industry, academia, and non-governmental organizations. Dr. Hauke Kite-Powell of the Woods Hole Oceanographic Institution presented the keynote address, titled "Making the Economic Case for Ocean Observing." Following the keynote presentation, a panel of NERACOOS stakeholders talked about how they and their industry use and value NERACOOS information. Dr. Ru Morrison, NERACOOS Executive Director and Zdenka Willis, IOOS Program Director, also presented on the successes and future of NERACOOS and the U.S. IOOS, respectively.

NERACOOS continues to collaborate with partner Northeast Regional Ocean Council (NROC). Through the joint planning initiatives of NERACOOS and NROC Ocean and Coastal Ecosystem Health merged Working Group, the Northeast Sentinel Monitoring Network for Climate Change has been established. This regional network, modeled after the Long Island Sound Study, will identify and observe key indicators of climate change spanning throughout the NERACOOS region. This newly formed group of collaborators will work together in the next year to produce a finalized work plan to monitor climate change throughout the region. A workshop of regional experts will gather June 27 to begin creating the plan. Funding to support the effort was requested as part of the NROC Regional Ocean Partnership grants. The monitoring initiative was one of the projects outlined with regional organizations on the *New England – Canadian Maritime Collaboration and Planning Initiative* in 2010 and plans are being made for an update meeting.

NERACOOS is also working to establish the Northeastern Coastal Acidification Network (NE-CAN) modeled after the Californian Current Acidification Network (C-CAN). Two initial calls have been held with a group comprised of shellfish industry, NGO, academic and federal partners. A smaller Steering Team is being established with the goal of holding a State of the Science workshop in 2014.

NERACOOS has attended and provided public comment at the two meetings of the Regional Planning Body for ocean planning (November 19 and 20, April 11 and 12). Since the launch of the Northeast Ocean Data Portal in June 2011, the *Northeast Ocean Data Portal Working Group* efforts have focused on continued advancement of NROC identified priorities, including the integration of key datasets for Coastal and Marine Spatial Planning and the development of functionality to access, visualize, and analyze those data. NERACOOS remains a key partner and participant in the working group's activities, and provides ESRI licenses for the working group members.

NERACOOS continues to support the Northeast Coastal and Ocean Data Partnership (NeCODP) activities, including committing the time of Tom Shyka to Chair the partnership.

NERACOOS continues to work together with other MOU partners the New England Ocean Science

Education Collaborative (NEOSEC) and Stellwagen Bank National Marine Sanctuary (SBNMS) through participation in the SPI Team. Collaboration with a variety of other organizations in the region was ongoing. NERACOOS representatives attended numerous meetings during the reporting period including those of the IOOS and IOOS Association, Gulf of Maine Council, NROC, Regional Planning Body, and Casco Bay Estuary Partnership.

NERACOOS continues to make access easier to data and tools for users. NERACOOS staff worked closely with web development partners and released a new Climatologies product on Dec 4, 2012. Updates and improvements will continue in the next year. This group also launched an updated version of our website that is optimized for mobile access due to increasing demand (Figure 1). Other data management work will be reported on in the fall supplemental.

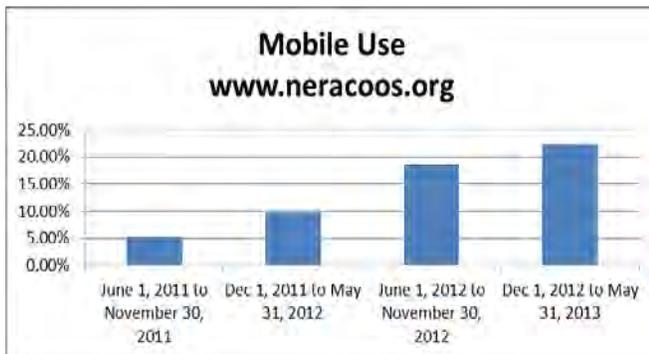


Figure 1. The percentage of people accessing the NERACOOS website from mobile devices. The NERACOOS website is now optimized for mobile devices, tailoring the experience dependent on the platform the website is being accessed from. Tailored mobile website access was chosen instead of developing an app due to increased flexibility and decreased cost.

The NERACOOS Executive Director also accompanied IOOS Director Zdenka Willis, to the Operational Oceanography meeting in Southampton UK (Jan 17-18) and represented the IOOS Program at “The Atlantic – a Shared Resource” conference (May 23-24) in Galway, Ireland. This European Union sponsored workshop brought together scientists from within the European Union, the United States, and Canada to look at how we can better cooperate on Ocean Observing and Ocean Literacy.

Objective 2- Observing Subsystem

2.1 The **Planning for future enhancement and National Synthesis of Regional Build Out Plans** was completed in year 1.

2.2 The **Gulf of Maine buoy array** was maintained by the University of Maine (UMaine). Five buoys remain in operation for NERACOOS (B01, E01, F01, I01 and N01). There was a data return of approximately 80% for the period of December 1, 2012 to February 28, 2013 for six buoys. During a winter storm on February 9, 2013 buoy M broke free from its anchor in Jordan Basin. On March 30, 2013 all instruments except the bottom part of the mooring were recovered without further damage. The bottom 4 conductivity and temperature sensors (SBE37IMs) located on the wire at depths of 100m and 250m were damaged to varying amounts. It was concluded that the buoy broke free after the mooring tethers failed during the storm when high seas (8-10m) corresponded with astronomical high tides. The mooring design has since been modified. Data from the active buoys are archived, processed, quality controlled, and made available in real-time on the web and sent to the Gulf of Maine Research Institute (GMRI) for dissemination to NERACOOS and the National Data Buoy Center (NDBC). Data from other UMaine moorings includes A01 (with funding through LNG mitigation and Massachusetts Water Resources Authority) and D02 (Bowdoin College with NASA funding, recovered in January 2013), are also being sent to the GMRI for dissemination to NERACOOS. All UMaine NERACOOS buoys continue to have fish tag telemetry receivers from NMFS. Bat detection systems were added by Stantec to buoys A01, B01, E01, F01 and I01. Spring turnaround is planned for June 19-27, 2013. The electronic control box testing has been completed; instrument cages have been sent out for modification and reinforcement; copper sensor guards installed; new underwater cable and new self-powered navigational

lights obtained; new mooring bails installed; and other general buoy supplies ordered. Buoy data issues that have occurred include: E01 has had multiple data issues in November 2012 when 20m and 50m inductive modems (IMs) both stopped reporting, the 2m Aanderaa current meter failed December 2012 and then in March 2013 the RDI Acoustic Doppler Current Profiler (ADCP) stopped working. The 20m and 50m SBE37IMs at F01 stopped reporting in May 2013. The backup Goes transmission of I01 failed in December 2012 followed by the 20m IM stopping reporting February 2013. Since May 2013 all IMs at N01 have become extremely intermittent.

2.3 The **Long Island Sound buoy array** was maintained by the University of Connecticut (UConn). During the reporting period three axial buoy data streams (Central Long Island Sound, Western Long Island Sound, and Execution Rock) and two stationary (Ledge Light and Norwalk Aquarium) sites remained operational. These data streams were transmitted in real-time to the Long Island Sound Integrated Coastal Observing System (LISICOS), NDBC, and NERACOOS websites. It was discovered that on the Western Long Island Sound buoy, a snapped cable to the bottom water quality sensor caused a short throughout the cable causing communication loss to the water quality sensors this winter, expected to redeploy in June 2013. All three axial buoys were serviced in December 2012, Western Sound and Execution Rock serviced in February 2012, and all three buoys serviced again in April 2013. During the December service all YSIs (surface, mid and bottom) were swapped out of Western Sound and Execution Rock; the surface YSI was serviced at Central Long Island Sound; and both of the bottom SBE37 IDO's were removed for maintenance. In February and April all three USIs (surface, mid and bottom) were once again swapped out at the Western Long Island Sound and Execution Rock buoys. In April the anemometer was replaced at Execution rock and the surface USI was serviced at Eastern Long Island Sound.

2.4 During the reporting period, the University of New Hampshire (UNH) maintained the **Great Bay Coastal Buoy**. Recovered for the season on December 6th the data management and telemetry systems were upgraded over the winter to an Axys Watchman 200 system. The Great Bay Buoy was redeployed on May 20, 2013 and is actively collecting and servicing data. For the first time the buoy has been deployed with a Sunburst SAMI CO2 sensor, as well as a Satlantic HyperOCR radiometer (currently not collecting data).

The **Coastal Marine Lab** was also maintained by UNH and collected and served data. The CO2 sensor, SSS, SST, O2, ac-9, PAR and some met variables were active in the reporting period. The met tower's temperature sensor is down and in late June the entire met sensor will be replaced and the PAR sensor cleaned. The ac-9 was redeployed November 17, 2012 and in summer 2013 is scheduled to be replaced with a recently calibrated instrument. This winter a new method of drying the sample CO2 gas known as the reflux method was tested making the system more efficient and robust because it no longer requires drying tanks. Aside from short gaps due to periodic cleaning, the calibrated time series of CO2 highlighted dynamics due to storms, salinity changes, and seasonal phytoplankton blooms. Recently a weekly sampling program for carbonate parameters was begun to validate the instruments.

2.5 The **Gulf of Maine High Frequency (HF) Radar** array was maintained by the University of Maine (UMaine). All intended work was completed at each of the three sites and good data coverage was seen. All data was sent to the National Coastal Ocean Dynamic Applications Radar (CODAR) backbone site in California. On February 14, 2013 it was discovered that the Wild Blue satellite antenna had shifted its orientation during a big wind storm on January 31, 2013. The antenna was then realigned and communication was re-established with the station. During the reporting period new license keys for software upgrades for GRMN and CSTM were ordered.

2.6 University of Rhode Island (URI) continued **nutrient work**. The Sensor Array for the URI-GSO

Pier is being serviced and made ready for deployment at the end of June on the URI-GSO Pier. The Satlantic SUNA-NO3 will be co-deployed with a WET Labs WQM and the sensor data will be sent to NERACOOS in real-time. **Atlantic Zonal Monitoring Program (AZMP) program** work continued at the BIO. Nutrient sampling at ten hydrographic stations spanning the Northeast Channel was conducted on April 14-15, 2013. Properties measured will be compared with data from the NERACOOS N01 mooring and used in assessment of regional numerical model.

2.7 URI continued to enhance capacity with **Narragansett Bay real-time telemetry**. Field testing with newly improved ChemFIN Nitrate sensor has been delayed because it also needs to be rebuilt by SubChem. It is intended to be deployed on one of the YSI Buoys in Narragansett Bay once the network connection has been completed to NERACOOS. Engineering work is in progress by SubChem to develop and demonstrate the capability to have nutrient sensors coupled to some of the NBSFMN stations, and will report nutrient data to the NBSFMN and NERACOOS in real-time. Engineering work by SubChem, URI and Rhode Island Department of Environmental Management (RI-DEM) and GMRI is in progress to configure and implement a local data management tool to network multiple water quality measurements stations in Narragansett Bay for real time observations and reporting to NERACOOS. With the help of Eric Bridger from GMRI it should be operational by the end of June 2013.

2.8 During the reporting period, Bedford Institute of Oceanography (BIO) continued their work on **Harmful Algal Bloom (HAB) monitoring in the Bay of Fundy**. All samples collected during the 2012 sampling season have been analyzed for *A. fundyense* cell abundance as well as diatom and total counts. These data will be used to help assess the skill of the warning product algorithm. The 2013 sampling season began in April. Weekly samples are collected from 7 sites as well as broader Bay of Fundy samplings in mid and late May with more planned for June and July. Work continues on the development of a remote-sensing-based HABs warning product for the Bay of Fundy. Satellite data for the 2012 field season are considered compromised due to the demise of the MERIS satellite, so the focus will be on 2011 data and earlier. **MERIS satellite work** was also continued (BIO). The Envisat satellite, which carried the MERIS sensor stopped sending data to Earth in April 2012. The successor to MERIS, the OLCI sensor on Sentinel 3 is expected to be launched in April 2014. Given the better spectral resolution and high ground resolution of MERIS the loss of this data stream is a significant challenge to the plans to develop and then implement a harmful-algal-bloom watch for *Alexandrium* in the Bay of Fundy area. The plans envisage a combination of satellite and in situ observations. Adaption of the diatom algorithm to the MODIS sensor has been dubbed not feasible, so we will wait for Sentinel III data to arrive.

2.9 UNH continued operation of the **Jeffrey's Ledge Datawell waverider buoy**. Although this was only an objective for year 1, the buoy remains deployed with data feeding into the NERACOOS system. This effort complements the other CDIP buoy in the region operated by the US Army Corps of Engineers off Block Island that is already integrated into NERACOOS and contributes to the National Wave Plan. It is anticipated that NERACOOS will reestablish its support for the buoy with FY13 funds.

2.10 UNH continued the operation of the UNH Pacific Marine Environmental Laboratory (PMEL) **Ocean Acidification buoy** in the Gulf of Maine, measuring Carbon Dioxide, Oxygen, Temperature, and Salinity. The buoy will be turned around in August. During this time the mooring will also be rebuilt. The data can be seen on the NERACOOS and PMEL websites.

Objective 3- Data Management and Communications (DMAC) Subsystem

3.1 The NERACOOS Executive Director Ru Morrison continued his work on the Interagency Ocean Observation Committee DMAC Steering Team and attended the February 27-28 meeting. The Gulf of

Maine Research Institute (GMRI) continued **DMAC coordination** efforts. GMRI has developed a Regional Data Management Framework plan for NERACOOS. The plan was presented at the SPI team meeting on April 30, 2013. Research has begun to implement the plan through crossover with the IOOS portal effort. GMRI has also remained active by participating in SOS reference team/Implementation follow up tests, continued participation in ncSOS implementation plan development, and monthly Regional DMAC conference calls. During the reporting period GMRI presented twice during the Regional DMAC conference calls; in December to present the NERACOOS Climatology tool; and again to present at a webinar on the CSC IOOS Data Portal.

3.2 GMRI also worked on the IOOS Data Portal.

Objective 4- Modeling and Analysis Subsystem

4.1 During the reporting period the University of Massachusetts at Dartmouth (UMassD) maintained the **Northeast Coastal Ocean Forecast System (NECOFS)** and monitored system performance daily. UMassD has continued to test and improve the Hampton-Seabrook FVCOM inundation model. Working with the Taunton NERFO office UMassD is working to download the river data in Canada for the northeastern region in the Global-FVCOM-NECOFS nested system. There has also been work underway for two-way nesting codes of FVCOM. This will allow UMassD to run all sub-domain models parallel at the same time. With additional funds to add 40-60 nodes in the cluster NECOFS can be more efficient. Testing also continues to advance research WRF to include hurricane simulation. This will update NECOFS to a fully atmospheric and ocean coupled forecast system. UMassD is also working to convert NECOFS forecast data in NetCDF into a structured-grid GRIB2 file format. Providing NECOFS output in this new format will allow the National Weather Service forecast offices to directly upload the data. Once completed this will enable the local forecasters to quickly look at all the surface NECOFS weather, waves, elevation, current, and temperature fields.

4.2 The **Wavewatch III model** has continued operation by BIO. Currently BIO is working on a project to display -48 hr to +48 hr timeline showing model-buoy comparisons. To do this the obstruction files have been implemented at higher resolution topography. The obstruction files allow advanced modeling and simulation of headland coastal features and islands that are too small to be resolved in the topography and the land-mask of the implemented grid. When testing is complete these new features will be moved to operational model simulations.

4.3 UConn continued **national SAROPS – Short Term Prediction System (STPS)** efforts. UConn operated the computer system to automatically retrieve data from the national HF Radar database hourly for the national grid and compute the STPS forecasts for 24 hours and share the results with the United States Coast Guard's Environmental Data Server. The Gulf of Mexico, Florida and Hawaii, and West Coast are also operational and streaming on the web.

Objective 5- Education and Outreach

5.1 NERACOOS continues to collaborate with the New England Ocean Science Education Collaborative (NEOSEC) for its educational efforts by participating in the NEOSEC Governing Council during its calls (March) and meetings (January and May). The greatest success this reporting period is that NERACOOS co-sponsored a drifter building workshop with the Massachusetts Marine Educators and NOAA in March. NERACOOS also sponsored a drifter for the Global Charter Learning School and continues to integrate drifter data from the Northeast Fisheries Science Center into school webpages at www.neracoos.org/drifters. Work as science and technology partner to Families by the Seaside grant ended at the final meeting in January. NERACOOS continues participation in IOOS Association Education and Outreach Committee monthly calls. The exhibit at the Seacoast Science Center in Rye, NH to highlight Right Whale research in Stellwagen Bank National Marine Sanctuary was completed in

May. A World Oceans Day event was held on June 8 for families in the NH seacoast area. Adults participated in presentations and discussions with local and regional experts on Ocean Acidification while children played games, watched videos, and learned about what they can do to help the oceans.

NERACOOS continued to implement its stakeholder outreach program, which is focused on informing new and existing stakeholder of NERACOOS products and services, soliciting their feedback on existing products, gathering their needs and priorities for new data and products, and documenting how they are using NERACOOS products and services in their work and recreation. NERACOOS used a variety of outreach channels to reach its stakeholders including, a quarterly e-newsletter, website features, weekly Facebook updates, participation in stakeholder meetings, conferences, etc., focus groups, and press releases. The Gloucester Maritime Summit on February 7 where the NERACOOS Executive Director gave the lunchtime keynote address provided a great venue to engage with a number of stakeholders resulting in coverage in local media.

One of our key outreach strategies is to participate in meetings of priority stakeholders. This allows us to effectively and efficiently engage these user communities throughout the region. Some of the meetings NERACOOS participated in during the reporting period included: the Fishermen and Scientists Research Society in Truro, NS; the Massachusetts Lobstermen's weekend in Falmouth, MA; the Northeast Regional Ocean Council winter meeting in Boston, MA; the Maine Fishermen's Forum in Rockport, ME; a storm surge social science meeting in Portsmouth, NH; the ME/NH Port Safety Forum in Augusta, ME; and the Long Island Sound Research Conference in Port Jefferson, Long Island, NY.

Other highlights of our outreach efforts include:

- Continuation of our quarterly newsletter and facebook posts. During the time period two NERACOOS newsletters and one member newsletter were released.
- Collaborating with regional NWS forecast office on public service announcements for safe boating week (May 18-24)
- Coordinating and issuing a press release with regional partners to announce the deployment of a new tide gauge in the Hampton-Seabrook, NH estuary.
- Collaboration with IOOS program office in developing a IOOS "success story" template
- Development a World Oceans Day (June, 8) event with a focus on ocean acidification