

1. AWARD INFORMATION

Project title:

Continued Development of the Northeastern Regional Coastal Ocean Observing System

Principal investigator:

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Recipient institution name and address:

Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS)

NOAA award number:

NA10NOS4730019

Period of performance:

1 April, 2011 – 30 September, 2011

2. PROJECT SUMMARY

The Northeast region of the US Integrated Ocean Observing System (IOOS) is geographically complex with five states and two Canadian Provinces, coastal waters and watersheds of the Scotian Shelf, Gulf of Maine, Southern New England Bight, and Long Island Sound. The proposed project seeks to continue the improvement and integration of the coastal ocean observing system that has been developed under the auspices of the Northeastern Regional Association of Coastal Ocean Observing System (NERACOOS) through a cooperative agreement with NOAA. Close collaboration with regional organizations, especially the Northeast Regional Ocean Council (NROC), a state-federal partnership that provides a forum for tackling and prioritizing regional scale problems, will ensure that NERACOOS directly addresses pressing regional scale issues of societal benefit. To that end NERACOOS has adopted the four priority theme areas of NROC and formalized our collaboration with a Memorandum of Understanding. The existing highly-leveraged observing, modeling, data integration, and product development infrastructure provides practical operational capacity in each priority area and the proposed effort, where possible, seeks to maintain the capacity previously funded. Under the theme of **Maritime Safety and Security**, the proposed work will provide real-time observations and forecasts directly for maritime operational safety, inform US and Canadian Coast Guard Search and Rescue Operations, and introduce new and enhance existing weather forecast products. In the area of **Ocean and Coastal Ecosystem Health**, harmful algal bloom monitoring and forecasting will be improved, monitoring and integration of water quality information will be enhanced, ecosystem based fisheries management and marine spatial planning will be enabled, and ocean acidification monitored. For the **Ocean Energy** theme, NERACOOS will provide the necessary oceanographic information to facilitate the renewable energy sector and the Data Integration Framework required for a regional approach to facilities siting. To improve **Coastal Hazards Resiliency** the proposed work will enhance and evaluate street-level inundation forecasting, expand forecasts for coastal flooding and erosion, and support emergency spill response. **Climate Change** is a central theme that cross-cuts all others as few issues may be addressed without its consideration. Continued development and implementation of a **Data Integration Framework** is central to the delivery of information and products to users of the system. Metrics for **Performance and Evaluation** will enable tracking the return on investment and **Education and Outreach** will engage our users to ensure information and products meet their needs.

3. PROGRESS AND ACCOMPLISHMENTS

By goal as detailed and numbered in the reduced scope of work for the proposed effort

1.1 Buoy operations

University of Maine – 6 Buoys were deployed for NERACOOS (B01, E01, I01, M01, N01, and F01). All buoys are reporting and E01, I01, M01, A01 were turned around during a cruise on June 1-5. Data from recovered buoys were downloaded and post processed. Data from other UMaine moorings were sent to GMRI for dissemination to NERACOOS. These include A01 (LNG mitigation and Massachusetts Water Resources Authority – MWRA – funded), D02 (Bowdoin College with NASA funding), and E02 (DeepCwind with DOE funding). Surface met

sensors and ocean currents have a data return greater than 95% for the period. Buoy N01 was turned around on a cruise from August 22-25. The planned servicing of Buoy B01 during the same cruise was not possible due to hurricane Irene and has been rescheduled for October. The reported problem with some of the real-time data from subsurface sensors during the previous buoy N and M deployments was caused by a faulty inductive cable coupler and battery problems. The majority of data not telemetered in real-time was downloaded from the instruments upon recovery. Hurricane Irene passed to the west of the array on August 29 and all buoys rode through the storm without problems and transmitted their data hourly without interruption. The highest winds were seen at A01 and E02 (36 knots with gusts to 45 knots) and the highest seas were seen at M01 (7-8 meters).

University of Connecticut – All 4 axial buoys including Eastern Long Island Sound, Central Long Island Sound, Western Long Island Sound, and Execution Rocks (ELIS, CLIS, WLIS, EXRX, respectively) and two stationary (Ledge Light, Norwalk Aquarium) sites have been operated although the wind direct from the Eastern Sound appears to be drifting aperiodically. Provisional data is transmitting in real time to LISICOS website and NDBC. The ADCP real-time data stream at Execution Rocks via an acoustic modem is operational but the Western Sound ADCP is internally logging only. Regular servicing has occurred at all sites. The WLIS and EXRX water quality sensors were serviced on June 7, July 13, August 3 and 31, and September 21. The surface water quality sensor at CLIS was swapped out on June 23, July 28, August 17 and the similar sensor for ELIS swapped on September 1. Seabird 19 instruments with refurbished Gas Tension Device (GTD) nitrogen sensors were deployed at the EXRX site at mid and bottom depths on August 3. However, real-time data streams were problematic from these instruments, stopping after severe thunderstorms during the week of August 20 prior to the arrival of hurricane Irene. Real-time telemetry from these sensors was reestablished with the August 31 servicing and internally recorded data recovered. Damaged air temperature and humidity sensors were replaced at EXRX on June 15. All systems rode out hurricane Irene without additional problems. The Central Sound Station recorded the highest winds of the moored buoys with a 15-minute average speed of 37.5 knots, and a maximum instantaneous speed of 62.4 knots at 0530 hours. Significant wave heights peaked at 2.8 meters and the maximum wave height recorded was 5.3 meters or 17 feet.

University of New Hampshire – The Great Bay Coastal Buoy was deployed on May 13 after delay for bad weather for the sixth year of collecting biogeochemical and optical data. It was recovered July 25 for routine maintenance including removing bio-fouling from subsurface surfaces and swapping out instruments. The buoy was redeployed on July 28 and all systems are operational. The CYCLE-PO4 phosphate sensor is nearing the end of its endurance and will have to be returned to WETLabs for refurbishment. Work is continuing with the New Hampshire Department of Environmental Services to further quality control the data so it can be used for upcoming NH water quality reporting. The Coastal Marine Laboratory station continues to collect data including nutrient and ocean acidification information. The pCO₂ system was down July 7-20 while being used during the NASA sponsored Discovery AQ cruise in Chesapeake Bay.

1.2 HF Radar operation

University of Maine – All three CODAR stations (Greens Island, Grand Manan, and Cape St Mary) are operational with full range between 190 and 200 km when ionospheric and atmospheric conditions are good. Windy afternoons have the best coverage. The Greens Island site experienced some satellite communication issues but the system work properly during this time and data was recovered. The site homeowners are looking to remodel the small building which has housed the equipment for the last ten years necessitating cable routing work. UMaine is also working with CODAROS to establish multi-static processing at all three sites which should increase range and accuracy from the standard backscatter geometry. The environmental assessment report for the Grand Manan site was finally received on May 5 from the Canadian Coast Guard. The University of Maine's lawyers were supposed to review this for one month before signing any written site usage documents, however problems have emerged with the amount of liability insurance that the Canadian environmental consultants were supposed to hold. A new consultant has been recently identified but there has still been no progress with the University.

1.3 NECOFS Model operation

University of Massachusetts, Dartmouth – NECOFs has run stably on the new updated cluster system. Work has continued on 1) improving the surface wave forecast, 2) testing the forecast capability for hurricane inundations, 3) developing the nested module to link FVCOM with the global structured grid model, 4) continuing the effort on the validation of the Scituate inundation model, and 5) hindcasting the 3-D circulation, temperature, and salinity for the region from 1978 to 2010. The major effort has been maintaining the NECOFS operation and improving the NECOFS website to include the model-data comparison. NeCOFS was operational and providing information to the National Weather Service until 5 pm on Friday August, 26 when it was shut down due to institutional hurricane preparedness policy. Investigations are underway to find more hardened infrastructure for the system operation.

1.4 WaveWatch II

Bedford Institute of Oceanography –The new NOAA operational standard version of WW3 (3.14) has finished its evaluation, has been transitioned to operational forecasts, and the necessary verification tests are nearly complete.

1.5 Nutrient monitoring

University of Rhode Island – The multi-sensor testing was continued off the URI-GSO Pier with the two nutrient sensor test arrays developed with NOPP Funding. [*Sensor Array 1*: SubChem APNA multi-nutrient analyzer (NO₃, NO₂, PO₄, NH₃), WET Labs WQM (CTD, O₂, Chl), and SubChem Data to internet communication module. *Sensor Array 2*. Wet Labs Cycle-PO₄, Satlantic Suna-NO₃, SubChem ChemFin-NO₃, SeaBird SBE 49 FastCAT CTD, WET Labs ECOPuck (Chl, CDOM, Scattering), Aanderra O₂ Optode, and SubChem Data to internet communication module.]. Nutrient levels are routinely verified with discrete water samples and both showed low nitrate levels this summer. Both sensor arrays were removed in mid-July for

servicing and repair and Sensor Array 1 was redeployed in mid-August. The array was removed at the end of August to prevent damage from hurricane Irene which arrived on August 28 knocked out the electrical supply to the pier for approximately one week. Monitoring was resumed on September 7. Two of the sensors from Sensor Array 2 were returned to the manufacturer for maintenance and repair.

Bedford Institute of Oceanography – Nutrient sampling at ten hydrographic stations spanning the Northeast Channel of the Gulf of Maine was completed during the semi-annual cruise sponsored by the DFO's Atlantic Zonal Monitoring Program (AZMP) between April 12 to 13. Preparations are underway for a similar suite of measurements during the fall AZMP cruise scheduled for October 3. Analyses of both spring and fall samples are underway.

1.6 HAB monitoring

Bedford Institute of Oceanography – Field sampling for the 2011 season in the Bay of Fundy continues after starting April 1 and is expected to be completed in mid October. Although some sampling weeks were lost in early May due to inclement weather there is sufficient data from the extended season for the blind testing of the prototype satellite-based HAB risk assessment product. Work on the latest MERIS satellite algorithm continues and the product will be delivered to Jennifer Martin by the end of November for the “blind test” of the product against the field data

1.7 DIF and product development

Gulf of Maine Research Institute – During the performance period, 24 non-federal observing assets including NERACOOS funded buoys and shore stations were integrated into the regional data system. The nine NDBC buoys and four CMAN stations were also made available as well as real-time feeds from the four National Estuarine Research Reserves in the region, and the 22 water level stations operated by NOAA CO-OPS. Three Environment Canada buoys were included as well as two buoys from the SmartBay program in Newfoundland. One of the most recent additions are the ten Cornell right whale listening buoys in the Boston shipping channel.

GMRI is also continuing to support NERACOOS Web maintenance and operations with; web and aggregation database maintenance, daily checks, trouble shooting, bug fixes (ongoing); response to user requests for data and technical support; finalization of the Cornell whale acoustic buoys in the Boston Shipping Channel display on NERACOOS website, redeployed buoys from the Universities of Maine and New Hampshire were fully integrated into NERACOOS website, and rapid response to switch failure at remote web hosting facility and restoration of production websites and data streams. At a national level, Eric Bridger, as the DMAC representative for NERACOOS, has participated in bi-weekly regional DMAC conference calls and email list including providing input on IOOS standards, in particular on move to SWE2.0 (ongoing). GMRI also helped develop and participated in the Northeast Coastal Ocean Data Partnership (NeCODP) Annual Meeting in June.

Several days prior to the arrival of Irene, NERACOOS rapidly deployed a tool to integrate the KML feeds from NHC of Irene's current storm track, forecast, past track, cone of probability and

coastal advisories into the NERACOOS real-time buoy map. Once Irene looked likely to hit the northeast, NERACOOS was able to quickly integrate this feature and access the newer feeds from NHC. The functionality has the capacity to be automated to appear for every tropical storm.

2.7 STPS for HF Radar

University of Connecticut – The CODAR-STPS performance evaluation was completed for the West Coast and data is being published online¹. Some of the regions are being fine-tuned, as coverages are not always adequate. The STPS for the Gulf of Mexico is also operational and being published online².

2.13 Education and Outreach

NERACOOS has made significant progress in both education and outreach (E&O) planning and implementation over the past reporting period. NERACOOS staff have developed a draft strategic communications plan that will guide our overall communications and E&O efforts. This effort includes the formation of a NERACOOS E&O advisory committee that will provide strategic guidance and help facilitate collaboration with regional E&O partners. NERACOOS staff have also continued to carry out a variety of education and outreach activities and many of these were conducted through collaborations with regional E&O partners. These activities include:

- Participated and provided updates at the Northeast Regional Ocean Council (NROC) meetings
- Participated and provided updates at the Gulf of Maine Council on the Marine Environment meetings
- Worked with with regional Centers for Ocean Science Education and Excellence (COSEE) on collaborative efforts
- Presented to the to the Osher Life Long Learning Institute (OLLI) on ocean observing
- Hosted an IOOS display and led a workshop on using ocean observing data at the National Marine Educators Annual meeting in Boston, MA
- Co-hosted a regional ecosystems indicators workshop
- Participated in the “Families by the Sea” project, which is a NOAA funded ocean literacy project
- Participated in the New England Ocean Science Education Collaborative (NEOSEC) strategic planning
- Participated on a water quality panel at Coastal Zone 11
- Participated and presented at regional US Coast Guard Port Safety forums
- Extensive communications conducted with a variety of stakeholder groups about regional issues, priorities and ocean observing needs through the Regional Build out Plan and user survey processes
- Integrated NERACOOS into MMSA Easie Project’s Lesson Plans and Buoy podcast.
- Participated in the Gulf of Maine Marine Educators Annual meeting.

¹ http://lisicos.uconn.edu/stps.php?site=westcoast6kmstps_ge

² http://lisicos.uconn.edu/stps.php?site=gulf6kmstps_ge

Subaward Meetings:

GMRI – Eric Bridger gave NERACOOS DMAC update at the NeCODP Annual Meeting and Metadata Workshop on June 8th and 9th at UNH

Regional Build Out Plan Meeting – a number of the PIs attended the Regional Build Out Plan meeting at the Great Bay Discovery Center (Greenland, NH) of the Great Bay National Estuarine Research Reserve. Information requirements needed to address societal issues were used to design an observing system for the region.

Publications and Presentations:

UMaine - Pettigrew, N.R., R.J. Fleming, C.P.Fikes: The History of the First Decade of the Observing System in the Gulf of Maine, and Plans for the Second Decade. Oceans 2011, accepted.

BIO – Paper accepted as book chapter by the American Fisheries Society (Gulf of Maine symposium volume). Smith, P.C., N.R. Pettigrew, P. Yeats, D.W. Townsend, and G.Han: Regime Shift in the Gulf of Maine (in final revision stage).

4. SCOPE OF WORK

Priorities for the next funding period remain the same as the previous one. Technical issues and next steps for most elements are described above. There are no anticipated changes to any of the work elements originally described in the proposal and subsequent descope of activities.

5. LEADERSHIP PERSONNEL AND ORGANIZATIONAL STRUCTURE

Ted Diers replaced Paul Currier who retired earlier this year as the co-investigator from NH DES. Cassie Durette assumed the role of Program Coordinator for NERACOOS on June 1, 2011

6. BUDGET ANALYSIS

NERACOOS has received funds from NOAA for the 2010 Implementation award and disbursed them to subawardees. Records at NERACOOS as of 09/30/2011 (Table 1) indicate that 46 % of funds for the one year project have been spent. A one year no cost extension was applied for and granted. The text of the application for the no cost extension is given below.

“We are respectfully requesting a no cost extension for NOAA Award NA10NOS4730019, entitled “Continued Development of the Northeastern Regional Coastal Ocean Observing System” The principal investigator is John Ruairidh Morrison (Northeastern Regional Association of Coastal Ocean Observing Systems, NERACOOS), and the co-investigators Tom Shyka (NERACOOS), Changsheng Chen (University of Massachusetts, Dartmouth), Robert Beardsley (Woods Hole Oceanographic Institution, WHOI), Scott Gallagher (WHOI), Michele Dionne (Wells National Estuarine Research Reserve), Paul Currier (New Hampshire Department of Environmental Services), Neal Pettigrew (University of Maine), James O’Donnell

(University of Connecticut), Joe Salisbury (University of New Hampshire), Al Hanson (University of Rhode Island), John Annala (Gulf of Maine Research Institute), Peter Smith (Bedford Institute of Oceanography), Annette deCharon (University of Maine), Hauke Kite-Powell (WHOI), Christine Tilburg (Gulf of Maine Council on the Marine Environment), Wendy Graham (RMC Research Corp.), Craig Swanson (Applied Science Associates), James Manning (NOAA, National Marine Fisheries, Northeast Fisheries Science Center). The award from NOAA goes to the NERACOOS and the other participating institutions are funded by subawards. The total award amount is \$1,449,000.00. The major portion of the funding has supported longstanding ocean observing systems, principally including moorings and high-frequency radar arrays, in the Gulf of Maine and Long Island Sound. The remainder of the funding has supported an estuarine mooring, development and testing of nutrient sensors, and data management and communication. The project began on 1 October 2010 and at present is scheduled to end on 30 September 2011. A no-cost extension of one year is proposed here, so that the new end date will be 30 September 2012. The purposes of the no-cost extension are completion of the regional modeling work (carried out by the University of Massachusetts Dartmouth and extended operation of selected elements of the mooring array in Long Island Sound and buoy in Great Bay (carried out by the Universities of Connecticut and New Hampshire, respectively). The regional modeling work because of vendor delays and other events beyond the control of the principal and co-investigators. The extended measurements in Long Island Sound and Great Bay are possible because of economies and supplementary sources of funding. The award amounts that will be unspent as of the existing project end date of 30 September 2011 are expected to be approximately \$50 thousand at each of the University of Massachusetts Dartmouth, the University of Connecticut, and the University of New Hampshire. The project work will be completed and the unexpended funds will be spent by the end of the proposed no-cost extension on 30 September 2012.”

Table 1. Summary of funding and expenditures on NERACOOS FY2010 Implementation grant.

| | Award FY10 Oct 2010 -Sept 2011 | Spent ITD | Balance |
|--------------|--------------------------------------|----------------|----------------|
| BIO | 30,000.00 | 0 | 30,000 |
| GMRI | 89,999.00 | 60,175 | 29,824 |
| UNH | 115,001.00 | 27,038 | 87,963 |
| URI | 60,000.00 | 48,845 | 11,155 |
| Umass Dart | 80,000.00 | 53,910 | 26,090 |
| UMaine | 705,000.00 | 219,090 | 485,910 |
| Uconn | 322,000.00 | 244,297 | 77,703 |
| NERACOOS | 47,000.00 | 19,212 | 27,788 |
| Total | 1,449,000.00 | 672,566 | 776,434 |