

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 October, 2010 – 31 March, 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, and N01). All buoys are reporting and B01, F01, and N01 were turned around during the period. 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 90% for the period. Preparations are underway for the spring turnarounds of half of the array (M01, I01, and E01). The only significant problem in the array is that several of the buoys (M01, N01, and E01) have intermittent or missing inductive modem data (subsurface SBE37 temperature and salinity readings). The cause of this is under investigation. It is believed that the high-resolution (3-minute) data recorded by the sensors will be available once each buoy is recovered.

University of Connecticut – All 4 axial buoys (ELIS, CLIS, WLIS, EXRX) and two stationary (Ledge Light, Norwalk Aquarium) sites have been operated. 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. Damage to the air temperature and relative humidity data sensors from Execution Rocks was discovered during servicing of water quality sensors on March 30th and replacements will be purchased. The Thames River buoy was recovered on January 1 and is currently not slated to be redeployed due to funding limitations.

University of New Hampshire – The Great Bay Coastal Buoy was recovered for the winter on December 1st to prevent ice damage. The buoy is currently being refurbished and will be redeployed in April to continue monitoring water quality including nutrient concentrations. Work is underway 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 is actively collecting data including nutrient and ocean acidification information.

1.2 HF Radar operation

University of Maine – All three CODAR stations are operational with full range between 190 and 200 km when ionospheric and atmospheric conditions are good. Windy afternoons have the best coverage. No significant problems or down-times at any of the sites have been seen. All data are being sent to the national CODAR backbone site in California. A site license agreement between UMaine's Systems Office and Canadian Coast Guard is needed for the CODAR station at Grand Manan. The University is waiting for the results of an environmental impact survey report commissioned by the Canadian Coast Guard before they will agree to sign the agreement. This report is scheduled to be available shortly (original due date March 31st). No significant changes can be made to the Grand Manan site until the site license agreement is signed. The University of Maine administration will require 30 days to review the study before they will be ready to go ahead with a written contract with Canada. Next steps include a trip to Greens Island to address Wild Blue satellite modem issues which have at times delayed data transmission. An Ethernet power controller also needs to be installed which will allow remote restarts of computer and equipment. Additionally this spring, an equipment enclosure will be procured and installed at the site to help regulate temperature, humidity, and dust. At Grand Manan, CODAROS has suggested the installation of a loading coil on the receive antenna to reduce the noise floor. Time frame for this will be Spring or early Summer 2011.

1.3 NECOFS Model operation

University of Massachusetts, Dartmouth – This period NECOFS has been moved to a new quadruple cluster system. WRF/FVCOM operation have been significantly improved, but wave-current interaction for Scituate seems slower. The reason for this is currently under investigation. UMassD is playing leading role in SURA extratropical storm inundation testbed. Hindcasts of Scituate inundation during 2005 and 2007 storms inundation have been made and model-model and model-data comparisons started. Hindcasts of the December 26th 2010 Nor'easter inundation in Scituate have been made and are being compared with observational data including Rebecca Road HWMs, Scituate harbor tide data time series, and NDBC 44013 weather and wave time series data. The Scituate inundation forecast system is ready to run operational forecasts and will be initiated after NECOFS runs stably on the new quadruple cluster system. Additionally, NECOFS has been used to help Cape Wind to design the foundation for the wind energy plant in Nantucket Sound and investigate a spill of plastic disks from the Hooksett, NH waste water treatment plant. Next steps include operationalizing the Scituate inundation forecast and meeting with the Taunton WFO to identify mechanisms to send them output information.

1.4 WaveWatch II

Bedford Institute of Oceanography – The present implemented version of WAVEWATCHIII (WW3) has been maintained, resolving issues, as required, in order to obtain consistent reliable wave forecasts. A series of tests have been conducted and a preliminary implementation of new NOAA operational standard version of WW3 (3.14). This version includes a mosaic two-way coupled grid for connecting fine-resolution and coarse resolution domains. Preliminary tests have been completed for the Patriots Day storm 2007 as test case for using WW3 version 3.14 to provide boundary wave spectra for fine-resolution coastal domain implementation of SWAN to simulate nearshore and coastal ocean waves in the southwest portion of the Gulf of Maine. Next steps include transition from the presently implemented version of WW3 to the version 3.14 for all routine operational forecasts for NERACOOS domain.

1.5 Nutrient monitoring

University of Rhode Island – The planned nutrient sensor deployments in Narragansett Bay, Long Island Sound and on the Martha's Vineyard Coastal Observatory (MVCO) are seasonal and will start in Spring/Summer, 2011. An exception is the multi-sensor testing, which will resume in March 2011 off the URI-GSO Pier. Two nutrient sensor test arrays have been developed for deployment on the URI-GSO Pier. [Accomplished 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.]. The first sensor array was deployed in March on GSO Pier to test auto-concentration calculation algorithms and CTD and nutrient concentration data web-posting protocol. Further refinement of the equipment and data acquisition, calculation and communication software will occur in the next period as well as continued deployment of the

two sensor arrays on the URI-GSO Pier [all accomplished with leveraged (i.e. non-NERACOOS) funding].

1.6 HAB monitoring

Bedford Institute of Oceanography – Field sampling ended in September. Dr. Forget from BIO visited the St. Andrews Biological Station (SABS) laboratory in September to work on the cultures that were growing there. Most samples from the summer have been analyzed. A productive teleconference was held on 17 February to discuss arrangements for the upcoming field season in the Bay of Fundy. It was felt that the weekly sampling program needed to commence earlier in the season, as the May start last year missed the initiation of the bloom period. The need for additional stations further offshore to address remote sensing issues was also expressed, requiring a faster and more capable vessel. The CCG Viola, the new DFO vessel at SABS, will be in refit for the month of April, but the Huntsman Lab vessel, Fundy Spray is available for that time period, and is adequate for offshore stations. Recently the Fundy Spray has been procured for four weeks in April, and an existing staff person has been retained for the month to assist with the sampling and analysis. In addition, two summer students will be recruited at SABS; one to work with the SABS team to perform *Alexandrium* counts and another to assist the BIO team with the ongoing bio-optic program.

In addition, a new prototype HABs warning product has been developed based on the field and laboratory work already done on this project. So far, the algorithm has been evaluated using historical coarse resolution SeaWiFS data against field samples from 2003-07. The results to date show promise. Next steps include a validation of the algorithm using 2008-10 data and further evaluation using higher resolution (300mX300m) MERIS imagery in a blind test against new SABS data from this season.

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.

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; work with Cornell acoustic lab on integration of whale acoustic buoys in the Boston Shipping Channel (web service has been set up on production server and working with data feed and set up of DB for storing data to provide trend reports), redeployed buoy D0205 data 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). Eric

is also a member of the Regional DMAC Organizing Committee, helping to finalize the agenda with IOOS office, confirm speakers and attendees and developing content for 1-day metadata workshop to precede the conference.

2.7 STPS for HF Radar

University of Connecticut – The CODAR-STPS performance evaluation was completed for the northern Gulf of Mexico. The dynamics controlling the surface current variability was much different than in Block Island Sound and the Mid-Atlantic Bight regions. This required modification to the forecast input parameters – specifically those related to the tidal characteristics, autocorrelation analysis and noise estimates. After these modifications to the methodology, the performance of the STPS improved significantly. STPS error analysis routines are being adapted for eventual use on California coast data and drifter trajectory error analysis in the Mid-Atlantic Bight is in progress.

2.13 Education and Outreach

A significant milestone in increasing capacity for outreach in the northeast was the hiring of Tom Shyka (previously with GMRI and GoMOOS) as the NERACOOS Outreach and Communication Specialist in October. Since then Tom has been developing an Outreach and Communication Strategy and working closely with Cassie Durette on educational activities. Cassie has continued NERACOOS' engagement in the New England Ocean Science Education Collaborative (NEOSEC) and all three NERACOOS staff are participating in a number of educational projects established with external funds. The NERACOOS office had a booth and made a presentation at the Massachusetts Lobstermen Weekend and the Maine Fishermen Forum. More details can be found in reports for the NERACOOOS RA Planning grant.

Subaward Meetings:

BIO – Elements of the HABs work were presented at a recent workshop focused on fisheries applications of remote sensing data (Toronto, Ontario, CANADA, January 5-6) and at the Canadian Conference for Fisheries Research (Toronto, Ontario, CANADA, January 6-8).

GMRI –

- Eric Bridger attended Unidata THREDDS Training Class in anticipation of establishing TDS for NERACOOS partners, including funded UMO Satellite Lab (Boulder, CO, November 8-10).
- Eric Bridger participated in the CMSP Discovery Vocabularies Workshop (WHOI, December 1-3).
- Riley Young Morse attended the ICAN (International Coastal Atlas Network) Workshop (Madison, WI, September 13-15) and presented on IOOS and Coastal Atlas integration.
- Riley Young Morse has been working on the Regional Data Portal effort with MOP, TNC, NERACOOS and CSC. A meeting was held in late January and we are developing a work plan for the upcoming NERACOOS funded data portal project.

- Eric Bridger gave a presentation on the development of the IOOS Catalog/Viewer product at the Coastal GeoTools meeting (Charleston, SC, March 22-24), also promoting the upcoming DMAC workshop and NeCODP workshop/meeting.

UMASS-D – Hindcasts of Scituate inundation during 2005 and 2007 storms inundation have been made and model-model and model-data comparisons started. Chen, Beardsley, and Fake reported on progress and visualization methods at the Inundation Testbed workshop (UNC, March 7-8).

Publications and Presentations:

UMaine

- Paper accepted by the Marine Technology Society Journal. Pettigrew, N.R, C.P. Fikes, and K. Beard: Advances in the Gulf of Maine Ocean Observing System: Technical Capabilities and Scientific Results (in final revision).
- Paper accepted by the Marine Technology Society Journal. Beard, K., J. Emerson, H.E. Deese, A. Rude, M. Scott, and N.R. Pettigrew: The EventViewer: a tool for visualizing and exploring events extracted from Ocean Observing System Data (in final revision).

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).

UCONN – Two oral presentations given at the 5th Connecticut Conference on Natural Resources, held at the University of Connecticut, Storrs, CT on March 7th. Todd Fake presented “Long Island Sound Storm Surge Modeling and Visualization”; Jim O’Donnell presented “Detecting Changes in Water Quality in Long Island Sound”.

UNH and URI – Co-Authors on ASLO 2011 Poster Presentation: Performance validation of the CYCLE-PO4, an instrument for in-situ and long-term orthophosphate monitoring. Andrew Barnard,¹ Corey Koch,¹ Peter Egli,² Alfred Hanson,² Thomas Gregory,³ Matthew A. Ragan,⁴ Burton Jones,⁴ Rob Campbell,⁵ Joseph Needoba⁶ 1-WET Labs Inc., 2-Subchem Systems Inc., 3-University of New Hampshire, 4-University of Southern California, 5-Prince William Sound Science Center, 6-Oregon Health and Sciences University.

UNH – NERACOOS cited as funding source for 3 invited talks by Salisbury et al.

- Ocean Acidification: Potential Impacts on Fisheries. J. Salisbury, M. Green, D. Vandemark, C. Hunt. Presentation to the Maine State Legislature (Invited). April, 2011.
- Influence of land - ocean exchange on coastal acidification. J. Salisbury, M. Green, D. Vandemark, C. Hunt, D. Gledhill, National Shellfish Association (Invited). Baltimore, MD, March, 2011
- Influence of land - ocean exchange on carbonate mineral saturation state. J. Salisbury, M. Green, D. Vandemark, C. Hunt, D. Gledhill, W. McGillis, C. Sabine. AGU 2010, (invited talk at Ocean Acidification session). San Francisco, Dec. 13-17.

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

The only significant change in leadership is that Riley Young-Morse replaced Tom Shyka as the co-investigator from GMRI.

6. BUDGET ANALYSIS

NERACOOS has received funds from NOAA for the 2010 Implementation award and disbursed them to subawardees. Records at NERACOOS as of 03/31/2011 (Table 1) indicate that 16 % of funds for the one year project have been spent. However, some expenditures are not reflected because of delays in invoicing.

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	0.00	30,000.00
GMRI	89,999.00	25,718.47	64,280.53
UNH	115,001.00	15,272.94	99,728.06
URI	60,000.00	0.00	60,000.00
Umass Dart	80,000.00	0.00	80,000.00
UMaine	705,000.00	112,133.61	592,866.39
Uconn	322,000.00	67,831.39	254,168.61
NERACOOS	47,000.00	12,744.74	34,255.26
Total	1,449,000.00	233,701.15	1,215,298.85