

Progress Report

Advancing the Caribbean Regional Integrated
Coastal Ocean Observing System (CariCOOS)

Reporting Period: 06/01/2011 - 11/30/2012

Project title: Advancing the Caribbean Coastal Ocean Observing System

Award number: NA11NOS0120035

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1) Project Summary

CariCOOS has strived to meet prioritized stakeholder needs for coastal information with an efficient design minimizing observing assets while developing complementary modeling tools. This initial system has proved effective in providing wind, wave and current data products as well as simulations supporting forecasting these for the Atlantic and Caribbean insular shelves. A hurricane driven storm surge modeling effort directed towards issuing updated MOM inundation maps for the region is close to completion and operational dissemination of the remotely sensed water quality products provides valuable information to fishermen, managers and researchers. Through the present project we intend to complete and sustain the initial CariCOOS phase and develop the required observing, modeling and skill assessment assets and tools needed in support of shoreward extension of the CariCOOS product domains. Informational access to the nearcoastal regions will allow us to bring our services to specific shore-dependent activities/sectors such as port and harbor operations, recreational activities and coastal resource management. Specifically we will focus on support to navigation safety and rapid response recovery in the most important regional ports, minimizing hazards to beachgoers and other recreational users, long term observing of climate change and ocean acidification, remediation, mitigation and adaptation to coastal hazards, data support for management of coastal resources including marine protected areas, and outreach and education to develop an "ocean literate" society. This project will continue support for the regional association in its mission including continued stakeholder engagement and representation and continuing CaRA's outreach and key alliances. We propose to undertake all steps necessary for certification of CaRA as a RICE as set forth in the Ocean Observing Act.

2) Progress and Accomplishments

Progress toward proposed *tasks* and *milestones* (in *italics*).

- ***Subawards***

The University of Maine Subaward (SA) for yr. 2 will commence on January 2013 following finalization of a current no cost extension required by UM for year 1 SA. The University of the Virgin Islands has submitted a draft Scope of Work after a delay arising from changes in lead personnel at UVI. After a delay pending negotiations between WeatherFlow and IOOS regarding mesonet data dissemination via GTS and NDBC, CariCOOS has requested WF for a SOW following the same data dissemination terms used in previous SA and contracts.

- ***Maintain existing data product availability and distribution***

CariCOOS coastal buoy and wave buoy data and product dissemination has been successfully maintained; buoy data has been “pushed” to NDBC and made available to the community through CariCOOS data interfaces and web products. Mesonet data streams continue to be operationally distributed through MADIS, WeatherFlow and CariCOOS data products and interfaces. Both data streams are available through the CariCOOS THREDDS server. Data and data products continue to be served through our CariCOOS web page (www.caricoos.org).

- ***Enhancement of DMAC subsystem***

- CariCOOS THREDDS service was renovated with the inclusion of new data streams, improved configuration options and stronger security measures.
- Dual CariCOOS computational facilities at La Parguera, Lajas and UPRM Mayaguez now provide full site and hardware redundancy. Implemented hardening measures include installation of unified threat management system.
- Recently acquired duplicate DMAC THREDDS servers will house ERDAPP and SOS services.
- CariCOOS web data products now feed from a central MySQL database.
- Implementation plan for SOS services is already in place with an expected deployment date of May 2013 with support from national IOOS and contracted developer.

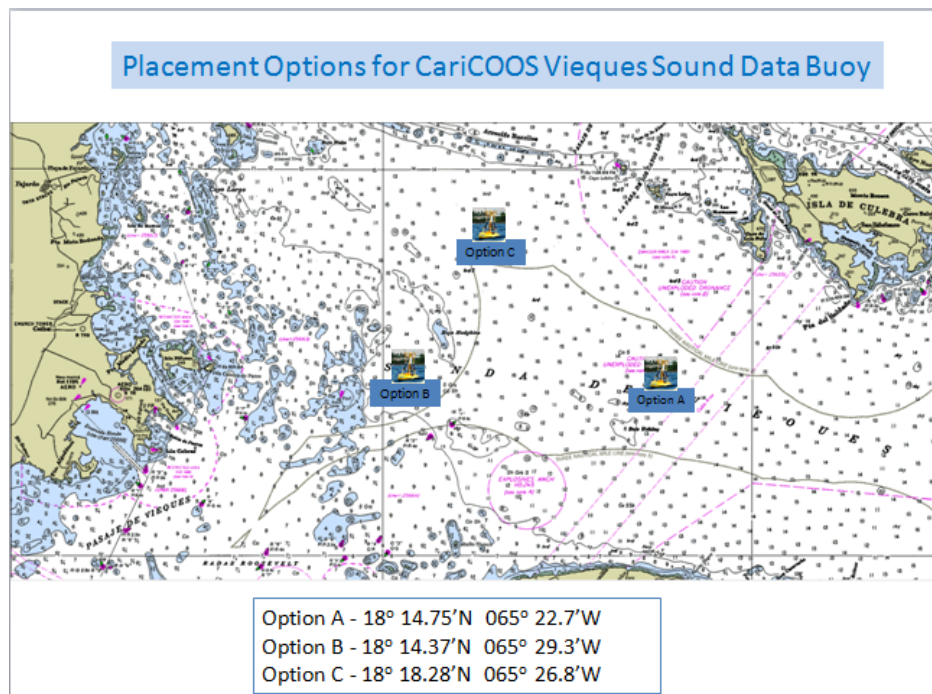
- ***Provide yearly maintenance to the existing CariCOOS coastal buoy array***

The MAPCO2 buoy operated jointly by NOAA PMEL and CariCOOS was removed from the water and thoroughly refurbished. All instruments were swapped out and replaced with re-calibrated instruments measuring air and water xCO₂, pH, temperature, salinity and dissolved oxygen. The 3 CariCOOS data buoy and the wave buoy were refurbished during the previous reporting period. Prof. Watlington and UVI personnel assisted U. Maine personnel in overhauling the data buoy stationed south of St. John, U.S.V.I.

The Datawell-built CariCOOS wave buoy stationed off Rincon beach west coast of PR was refurbished by CariCOOS personnel with valuable guidance from the Coastal Data Information Program (CDIP), Scripps Institution of Oceanography and redeployed in August 17, 2012.

- ***Deployment and operation of an additional CariCOOS coastal data buoy in Vieques Sound.***

Formal stakeholder site consultation for deployment of a CariCOOS data buoy in support of ferry and recreational operations in the Vieques Sound and Culebra region is being implemented. Morell and Corredor visited the US Coast Guard Tuesday October 30 for consultation with Captain David Flaherty (Deputy Commander Sector San Juan) and LCDR Jose Perez (Chief, Waterways Management and Facility Inspection Division) regarding location of the buoy. LCDR Perez further procured input from the PR Maritime Transport Authority regarding site preference on the part of ferry captains serving the island municipalities of Vieques and Culebra. Further consultation included dockmasters and managers from 9 marinas hosting over 3000 recreational vessels. Potential deployment locations are depicted in the map below.



A field survey by CariCOOS personnel has been planned and is awaiting appropriate weather. Following the site survey, consultations will be undertaken with NOAA NMFS and USACE prior to submission of the PATON application to the USCG.

- ***Operate and maintain 12 coastal weather MESONET stations and add 1 station***

The CariCOOS/WeatherFlow MESONET continues uninterrupted operation. A new station was added at the West Indies Company cruise ship dock, Charlotte Amalie, USVI in support of cruise ship docking operations; Charlotte Amalie harbor, St. Thomas hosts two million cruise ship passengers per year. An additional mesonet station has been deployed CariCOOS at Rincon, is fully operational and its data pushed to NDBC (http://www.ndbc.noaa.gov/station_page.php?station=PTRP4). PR Seismic network stations, at Arecibo and Mayaguez, upgraded to avoid wind flow disturbance with extended anemometer masts, continue to be fully operational. Objective analysis evidences significant data quality improvement at the latter sites.

- ***Validate SWAN (wave), ADCIRC (coastal inundation) and WRF (wind) forecasting skills***

Further to actions described in our previous report, we are currently undertaking objective validation of the regional HYCOM-ROMS general circulation model (GCM), implemented in collaboration with L. Cherubin at U of Miami, RSMAS, and the AMSEAS NCOM model (provided by NAVO, US NAVY at 3 km resolution). Input data include:

- Tidal elevations at NOAA tide recording stations in San Juan Bay (north coast) and at Isla Magueyes (south coast).
- Tidal currents at the Punta Ostiones (west coast) and Vieques Sound (east coast) NOAA harmonic prediction stations.
- Coastal currents at the PR105 (Ponce, south coast), PR203 (San Juan, north coast) and VI102 (St. Thomas, VI) CariCOOS buoys. Salinity and temperature will also be considered at these three stations.

An objective skill assessment study for the above GCM's is being undertaken by Dr. JE Capella. A report on AMSEAS NCOM performance will be submitted to Dr. F. Bub, NAVO.

Progress towards Hurricane driven Coastal Inundation maps for the US Virgin Islands:

- A revised USVI unstructured mesh is now fully functional. While having high resolution around St Thomas, St John, and St Croix, the mesh has been optimized for execution speed by decreasing the resolution around Puerto Rico since these will not affect the surge elevations in the USVI.

- A version of ADCIRC+SWAN modified by Dr. Casey Dietrich avoiding instabilities generated in zones of large bathymetric gradients has been operationally implemented. This version allows for wave refraction to be carried out all over the computational nodes.
 - Production runs already underway following. MOM maps hurricane categories: 1, 3, and 5 should be finished by March 2013.
- ***Implement inshore high resolution SWAN and ROMS for San Juan & Charlotte Amalie***

Associate Director Miguel Canals successfully completed high-resolution implementation of the SWAN wave model for the San Juan and USVI domains. These implementations are now operational and data and products are being served routinely through http://www.caricoos.org/drupal/swan_multigrid. As previously reported, harbor circulation modeling exercises for San Juan and Charlotte Amalie are now being undertaken under Dr. Stefano Leonardi's leadership. These will allow evaluation of ROMS performance with boundary conditions provided by either NAVO NCOM AMSEAS or CariCOOS HYCOM-ROMS regional implementations before committing to operational implementation.

- ***Implement water quality measurements including pH and optical properties***

Optical Properties

In situ data continues to be collected on a bi-weekly basis at five stations off the coast of southwest Puerto Rico (Guánica, La Parguera). Water samples are collected at approximately 1 m deep. Total suspended matter (TSM), corresponding to all material larger than 0.7 μm is determined by standard weight difference. Samples for chlorophyll a and colored dissolved organic matter are analyzed by fluorometry and spectrophotometry respectively. Beam attenuation in the water column is routinely measured at 3 wavelengths is using 3 WetLabs C-Star transmissometers. Remote sensing reflectance is estimated from GER-1500 field spectroradiometer measurements. Temperature, salinity and dissolved oxygen are measured using a SBE25 CTD. In situ data from this effort will provide for further refinement of regional remote sensing algorithms (Gilbes et al. 2008) for the estimation of suspended sediments and related water quality parameters with a discernible optical signature.

Ocean Acidification

Autonomous MapCO₂ and discreet "In situ" sampling program has continued as programmed. These former observations are validated and the data are routinely merged with oceanographic and meteorological data available from the nearby ICON/CREWS station. See prior report for details.

- ***Implement offshore sampling and CaTS occupations***

The serial oceanographic station to the south of PR, the Caribbean Time Series Station-CaTS was successfully occupied on September 4 with a cast to 900 m. Samples for carbon chemistry were taken to 200 m depth.

CariCOOS intern, M. Melendez participated in the October 2012 Bermuda Institute of Ocean Science BATS validation cruise #47 aboard the R/V Atlantic Explorer in the western tropical Atlantic Ocean from Puerto Rico to Bermuda. Samples were collected at standard depths and at the core of upper subsurface water masses (SUW, 18degW, and ACW) with the goal of characterizing vertical distribution and spatial variability of the carbonate system arising from dissimilar residence time of said water masses.

- ***Publish newsletters & brochures & handouts***

- Printed outreach material including brochures, posters and handouts were distributed at meetings including the Puerto Rico Harbor Safety & Security meetings; most recently at the IOOS Summit, November 13-16, and also at teacher professional development workshops including the Math and Science Partnership Program (November 4) and the Ana G Mendez University Terrestrial Sciences Program (October 20).
- CaRA/CariCOOS news items are regularly posted: <http://cara.uprm.edu/?q=node/45>.
- Three editions of CaRA-VI Update were published and distributed.
- A new brochure was designed to publicize the CariCOOS Data Buoy array.
- The CariCOOS banner continues to be posted in monthly issues of PR's nautical newspaper "La Regata".

- ***Continuation of CariCOOS O&E program***

- CariCOOS co-hosted the Puerto Rico Weather Camp in July 2012 (NOAA-NCAS) and the Sea Grant Cajaya 2012 summer camps.
- USVI Marine Action Group sponsored Shane Ramsey participation in NCAS
- An educational "special student project", focused on utilizing data available on CariCOOS webpage, was prepared for a UVI freshman science class ("Science 100").
- Drs. Detrés and Corredor attended the regular meeting of the PR South Coast Harbor Safety and Security Committee meeting on October 19 at the Club Náutico de La Parguera. Dr. Detrés gave a presentation entitled "CariCOOS/USCG Auxiliary Teamwork: Improving Boaters Safety & Coastal Weather Literacy".
- Dr. Detres presented interactive workshop entitled "Puerto Rico Coastal Weather" to teachers enrolled in the terrestrial science certification program sponsored by the Ana G Mendez University (UMET) Environmental School and the Puerto Rico Education Council.
- Dr. Detres presented hands-on teacher's workshop "Ocean in Motion: Implications to life" at the Math and Science Partnership Program Annual Meeting held in Fajardo, PR on November 4, 2012.

- ***Continued web page development and optimization.***

- Rearrangement of navigation buttons for quick browsing within the top ten pages on the website.
- Implementation of Hurricane Season Section to provide weather outlook during storms.
- Implementation of water quality page sections on optical water quality product development and ocean acidification.
- "quick link buttons" to Coastal Weather Educational Module, Wind tutorial and Waves Tutorial added to main page.
- New graphical interphase for new SWAN MultiGrid wave forecasting tool
- Facebook Like page and Twitter links added to homepage.

3) Scope of Work

Major Milestones for the upcoming program year include:

- Continued operation and maintenance of CariCOOS assets and data and product dissemination program
- implementation of CariCOOS DMAC system including ERDAPP and SOS services
- Skill assessment and operational implementation of CariCOOS ROMS/AMSEAS circulation model for San Juan and Charlotte Amalie harbors and approaches
- Issue a pilot web interface product in support of SJ-Harbor operations depicting high-res wave, wind and current forecasts, now-cast and real time data.
- Initiate development of Beach Hazard Forecast System
- Regional validation of CariCOOS HYCOM-ROMS and AMSEAS GCM forecasts
- Deployment of CariCOOS data buoy E off the East coast of PR
- Assist in operation / data management of UVI-EPSCoR-CariCOOS interpretative data buoy

4) Leadership Personnel and Organizational Structure

University of the Virgin islands Subaward P.I. Nasseer Idrisi has left UVI and been replaced as P.I. by Dr. Kostas Alexandridis, Assistant Professor at the Marine and Environmental Sciences Dept. UVI.

5) Budget Analysis:

Lower than projected expenditures under Personnel and Subaward budget lines are addressed below:

Personnel:

Salaries and compensations

A still underway revision of UPRM's faculty compensation mechanisms has resulted in delays in payments to CariCOOS researchers totaling \$120,000. Also a budgeted salary increase to non-faculty personnel of \$100/mo. (totaling \$35k/year), with the purpose of minimizing the cost of

living increase was not approved by UPRM. These funds will be used to cover a general salary raise approved by UPRM for July 1, 2013.

Subawards:

Delays in issuance of yr. 2 (2012) subawards (see SA tracking summary table below):

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CariCOOS SUBAWARD TRACKING SUMMARY						
	BUDGET	INVOICED	REMAINING	% REMAINING	% INVOICED	SOW % COMPLETE
<i>Subawardees:</i>						
SA University of Maine	\$216,055	\$0	\$216,055	100%	0%	0%
SA U. Virgin Islands	\$85,000	\$0	\$85,000	100%	0%	0%
SA WeatherFlow, Inc.	\$29,767	\$0	\$29,767	100%	0%	0%
SA University of Miami	\$30,186	\$18,509	\$11,677	39%	61%	50%
Subawardee Total	\$361,008	\$18,509	\$342,499	95%	5%	

6) Issues

No major issues to report other than those detailed under budget analysis (see above)