

Advancing the Caribbean Coastal Ocean Observing System

NOPP Progress Report: Fiscal Year 2012 (1 October 2011 to 30 September 2012)

PI Julio M. Morell

PO Box 3446 Lajas PR 00667-3446

Phone: (787) 899-2048 FAX: (787) 899-2564 E-mail: julio.morell@upr.edu

CO-PI Jorge E. Corredor

PO Box 3446 Lajas PR 00667-3446

Phone: (787) 899-2048 FAX: (787) 899-2564 E-mail: jorge.corredor@upr.edu

CO-PI Miguel Canals

PO Box 3446 Lajas PR 00667-3446

Phone: (787) 899-2048 FAX: (787) 899-2564 E-mail: miguel.canals@upr.edu

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<http://www.caricoos.org>

LONG-TERM GOALS

Attuned with the IOOS mission of providing timely and accurate coastal ocean data and data products required by stakeholders to facilitate commerce and recreation, protect the environment and enhance security, CariCOOS implemented an initial system phase which has proved effective in providing coastal weather data and products for the region's Atlantic and Caribbean insular shelves. Through this effort we intend to complete the initial CariCOOS phase and develop the required additional assets and tools for a shoreward extension of the CariCOOS product domains. Informational access to the near coastal and nearshore regions will allow us to bring our services to specific shore dependent activities/sectors such as port and harbors operations, recreational activities and coastal resource management.

OBJECTIVES AND APPROACH

The base objectives of this work are the continued operation of the Caribbean Coastal Ocean Observing System (CariCOOS) including data and wave buoys, a shore-based 12 station Mesonet, existing numerical modeling systems and data management and product dissemination activities.

Building upon the above system now in place, a further objective is the shoreward extension of the CariCOOS product domains for high-priority sites. Informational access to the nearcoastal regions will allow us to bring required services to specific shore dependent activities/sectors such as port and harbors operations, recreational activities and coastal resource management. Specifically we focus on support to navigation safety and rapid response recovery in the most important regional ports and minimizing hazards to beachgoers and other recreational users. Additional regional priorities being addressed include the need for coastal water quality products, observing of climate change and ocean acidification, remediation, mitigation and adaptation to coastal hazards, data support for marine spatial planning and marine protected areas, and outreach and education to develop an "ocean literate" society.

A parallel objective is the continued support to the Caribbean Regional Association for Coastal Ocean Observing (CaRA) in its mission including continued stakeholder engagement and representation and continuing CaRA's outreach and key alliances. In this context, we are undertaking all steps necessary for certification of CaRA as a RICE as set forth in the Ocean Observing Act.

ACCOMPLISHMENTS

A core set of observing assets consisting of three data buoys, one wave buoy, one MAP CO2 buoy and a coastal MESONET of 12 hurricane hardened weather stations (and 3 additional anemometers) is maintained and operated. These assets are deployed strategically so as to provide data representative of Caribbean and Atlantic regimes and those particular to the Mona Passage, and Vieques Sound. Data generated by this array is quality controlled and archived in a Data Management and Communications (DMAC) center. Appropriately validated numerical models initialized by data input from the observing array provide nowcasts, hindcasts and forecasts of coastal winds waves and currents.

KEY INDIVIDUALS

Professor Julio M. Morell, the CariCOOS Executive Director, provides overall supervision to project scientists, contractors and technical personnel. He is assisted in these duties by Associate E Directors Dr. Jorge. Corredor and Dr. Miguel Canals. In addition to administrative duties, Dr Corredor coordinates water quality sampling and buoy maintenance and Dr. Canals coordinates wave and current measurements and sampling, the beach erosion program model validation exercises. Dr. Yasmín Detrés devotes 50% of her time to CariCOOS education and outreach. Dr. Jorge E. Capella coordinates DMAC activities and Dr. Stefano Leonardi implements HYCOM/ROMS modeling. In the US Virgin Islands, Professor Roy Watlington serves as CariCOOS outreach coordinator. Office administration is the responsibility of Ms. Vanessa Gutierrez. Information technologist José B. Rodriguez maintains HPC infrastructure and Web Master Adolfo Gonzalez curates CariCOOS and CaRA web pages. Graduate and undergraduate student interns participate in field sampling programs and modeling activities. Buoy maintenance and operation is partly implemented by the University of Maine Physical Oceanography group under the direction of Dr. Neal Pettigrew. The weather MESONET is operated and maintained by WeatherFlow Inc (WF). Dr. Luis Aponte interfaces with WF, validates wind model results and operates a few CariCOOS owned weather stations. Dr. Laurent Cherubin at the University of Miami, RSMAS implements the HYCOM model for our domain including assimilation of buoy and MESONET data.

WORKPLAN FOR UPCOMING YEAR:

Major Milestones for the upcoming year include:

- Continued operation and maintenance of CariCOOS systems
- Validation and operational implementation of CariCOOS ROMS/AMSEAS circulation model for San Juan and Charlotte Amalie harbors and approaches
- Issuing of 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 streams.
- Initiate development of Beach Hazard Forecast System
- Regional validation of CariCOOS HYCOM-ROMS forecasts
- Deployment of CariCOOS data buoy E off the East coast of PR
- Provide for data management and assist in operation of UVI-EPSCoR-CariCOOS interpretative data buoy

WORK COMPLETED

- The three CariCOOS data buoys were successfully retrieved, refurbished and redeployed over the period May 4 - June 4. Buoy data is now routinely delivered to NDBC. The fourth buoy, in storage at present, has also been refurbished and new equipment was purchased (Micro Cat SBE37SMCTD and NORTEK Aquadopp ADCP) for use aboard this buoy.
- Consultations for a 4th data buoy to be deployed in Vieques Sound are underway.
- The Caribbean Time Series (CaTS) station was occupied twice aboard oceanographic vessels with casts to 1,000 m.
- We have completed the customized hazardous currents warning signs for Jobos Beach and Domes Beach, two of the deadliest beaches for beachgoers in Puerto Rico. These signs developed using wave modeling and field observations to validate the model at each location, depict the most common current patterns at these beaches under significant wave forcing. As planned we passed the material to UPR Sea Grant for poster preparation and eventual installation by personnel from the Puerto Rico Department of Natural and Environmental Resources. We are also finishing warning signs for Mar Chiquita Beach, Los Tubos Beach and Poza del Obispo.
- Wind data observational gaps were filled by supplementing Puerto Rico Seismic Network Stations with hurricane hardened instrumentation at Mayaguez, Rincon and Arecibo.
- A high resolution version of the CariCOOS SWAN wave model was recently launched. Improvements implemented include utilizing wind forcing from the NWS-National Digital Forecast Database (NDFD),
- An inundation workshop was convened in lieu of the proposed CI-FLOW expert visit. A community-wide proposal for an IOOS Puerto Rico and U.S. Virgin Islands Coastal and Ocean Modeling Testbed as a component of the SURA/IOOS COMT proposal resulted from this workshop.
- The CaRA Stakeholders Council and General Assembly were convened March 2012. One hundred participants attended including (notably) the Administrator of the Island of St. Thomas USVI, the Commander of the US Coast Guard sector San Juan and the Acting Meteorologist-in-Charge of the NWS PR San Juan Weather Forecast office.
- The Education & Outreach program underway included launching of the CariCOOS educational module “Climas costeros de nuestras islas” and web based tutorials. These materials have been developed with the specific purpose of training stakeholders in the use of CariCOOS data and products. The Cabo Rojo US Coast Guard Auxiliary Flotilla is receiving training in the use of CariCOOS products for formal inclusion in their boating & seamanship course.

RESULTS SUMMARY

A robust observing system is now in place allowing operational output of data and data products now widely used throughout the region. Important milestones achieved towards the “shoreward” extension of the program include operational deployment of the enhanced CariCOOS SWAN wave forecasting system and pilot implementation of the Beach Current Hazard program. Strong partnerships have been forged with diverse federal, state and private sector partners who regularly use CariCOOS data and products.

IMPACT AND APPLICATIONS

National Security

The US Coast Guard, sector San Juan and the National Weather Service Weather Forecast Office in San Juan have both explicitly recognized the value of the CariCOOS contribution to safety and security. Real time buoy data, the MESONET meteorological data set, the radar array in the Mona Passage and field validated model output all contribute to safety at sea, secure borders and enhanced operational capacity.

Economic Development

Ocean-related recreational activities constitute a mainstay of the regional economy. Real time data and model output contribute to provide for maintaining the quality of marine recreational experience of by informing about potentially hazardous condition and identifying areas with conditions favorable for activities such as surfing, boating, diving and sportfishing. Commercial operations including inter-island ferries and small cargo vessels operating in the region are made safer.

Quality of Life

CariCOOS carries out long-term monitoring of variables pertinent to climate change including sea surface temperature, sea surface salinity and ocean acidification. Such data provides early warning for adaptation and resilience. Water quality parameters are being developed to calibrate remote sensing imagery in order to identify and characterize critical watersheds in the region and support proactive management thus minimizing beach closures and reef degradation.

Science Education and Communication

The CariCOOS educational module “Clima Costero de Nuestras Islas” has been presented and made available to over 200 science teachers in the region. The educational module has been complemented with professional development workshops. The PR Department of Public Education is evaluating the module for integration in the local schools curriculum. The Coastal Weather Guide for Boaters is now in use by recreational and commercial boaters.

TRANSITIONS:

National Security

Observations and forecasts of marine conditions including winds, wave and currents are used by ICE, Coast Guard, FURA and municipal police in support of marine operations including patrolling. Wind and wave data generated by CariCOOS buoys is being used by NWS for operational forecasting.

Economic Development

Information on coastal weather conditions and ocean color are utilized by fishermen to optimize their fishing effort thus avoiding unnecessary investments in fuel and time.

Science Education and Communication

CariCOOS provides training in the use of CariCOOS coastal weather products to the US Coast Guard Auxiliary Flotilla 1-8. A coastal weather boaters guide was developed to supplement the Boating Skills

and Seamanship course in support of recreational boating safety in the region. Other flotillas have expressed their interest in adopting the CariCOOS applications.

RELATED PROJECTS

The National Center for Secure and Resilient Maritime Commerce – CSR. CSR is a Department of Homeland Security Center of Excellence for Maritime Security, Island and Extreme/Remote Environment Security. CSR is responsible for conducting research and developing new ways to strengthen Maritime Domain Awareness and safeguard populations and properties unique to U.S. islands, and remote and extreme environments. In close collaboration with CariCOOS, CSR in Puerto Rico operates a High Frequency Radar array on the Mona Passage for the dual purposes of surface current mapping and vessel tracking. To assist in the later, CSR also operates a network of AIS receiving stations.

Puerto Rico Northeast Corridor Reserve. During FY 12 we are working with the NOAA Coral Reef Conservation Program, assisting with the development of the management plan for the marine section of the Puerto Rico Northeast Corridor Reserve. Our task consists of evaluating the hydrodynamic connectivity patterns of the reserve. In FY12 we have created custom graphical products to forecast waves and coastal circulation for the NECR domain. We have implemented a nearshore wave model for the region nested within the CariCOOS Nearshore Wave Model. Nowcast and hindcast wave data for the NECR may be found at http://www.caricoos.org/drupal/swan_multigrid/NECR. We have also created dedicated graphical forecasts of circulation for the NECR domain by analyzing real-time output of the NCOM AMSEAS circulation model, and these forecasts may be found at http://www.caricoos.org/drupal/ncom_amseas.

NCAS PR Weather Camp. CariCOOS has been co-sponsored the NOAA Center for Atmospheric Sciences *Puerto Rico Weather Camp* since 2010. In this residential summer camp students explore the fields of meteorology, atmospheric sciences, and oceanography. Participants also learn about the diverse academic and professional opportunities in these areas.

Coastal Inundation Program. A direct spinoff of the CariCOOS Coastal Inundation Program is the approval of the proposal entitled “Storm Surge Modeling in Puerto Rico in Support of Emergency Response, Risk Assessment, Coastal Planning and Climate Change Analysis”. This was funded by the Puerto Rico Coastal Zone Management Program and the University of Puerto Rico Sea Grant Program. One of the main goals is to evaluate the changes in inundation brought about by including different sea level rise scenarios and potential increased strength of the most extreme hurricanes.

PUBLICATIONS

Anselmi-Molina C. M. M. Canals, J. Morell, J. Gonzalez, J. Capella and A. Mercado. 2012. Development of an Operational Nearshore Wave Forecast System for Puerto Rico and the U.S. Virgin Islands. *J. Coastal Res.* 28 (5) 1049–1056.

Canals, M., J.M. Morell, J.E. Corredor and S. Leonardi. In Press. Expanding the Caribbean Coastal Ocean Observing System into the Nearshore Region. *Marine Technology Society Journal*.

Nesterenko, Ekaterina P., Pavel N. Nesterenko, Brett Paull, Melissa Melendez and Jorge E. Corredor.
In Press. Fast Direct Determination Of Strontium in Seawater Using High-Performance Chelation
Ion Chromatography. Microchemical Journal.

OUTREACH MATERIALS

CariCOOS outreach and education materials. Copies available upon request.

1. Clima Costeros de Nuestras Islas – educational module – booklet, DVD & CariCOOS portal
2. Wind & Waves Tutorials (English & Spanish) – DVD & CariCOOS portal
3. CariCOOS Poster
4. Coastal Weather: Boaters Guide - CariCOOS portal

