

Progress Report

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

Reporting Period: 06/01/2012 - 11/31/2013

Project title: Advancing the Caribbean Coastal Ocean Observing System

Award number: NA11NOS0120035

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Program Office: NOS Integrated Ocean Observations Systems (IOOS)

Award Period: 06/01/2011 - 05/31/2016

Project Web Site: <http://www.caricoos.org>

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 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 inundation maps for the region is fully developed and operational dissemination of the remotely sensed water quality products provides valuable information to fishermen, managers and researchers. This project provides for completion and operation of the initial CariCOOS phase and is supporting the development of observing, modeling and skill assessment assets and tools required for the shoreward extension of the CariCOOS product domains. Said extension allows us to provide informational support to specific shore-dependent activities/sectors such as port and harbor operations, recreational activities and coastal resource management. Specifically we are focusing on navigation safety and rapid response recovery in the most important regional ports, minimizing hazards to recreational users, monitoring climate change including ocean warming and acidification, supporting remediation, mitigation and adaptation to coastal hazards, and assisting management of coastal resources including marine protected areas and outreach and education to develop an "ocean literate" society. This project continues to provide 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*).

- ***Observational Subsystem***

Operate, maintain and enhance CariCOOS buoy network

- CariCOOS buoys (A-D) continue in operation
- In early September CariCOOS Buoy Data E was deployed in the Vieques Sound by Commercial Divers Inc. and CariCOOS personnel. This buoy is currently operational.
- The Rincón CariCOOS Wave Buoy was successfully refurbished and deployed in August 2013. During December 2013 the Rincon wave buoy showed signs of incorrect wave spectra. To ensure data quality the data flow has been interrupted and CariCOOS and CDIP/SCCOOS personnel are currently diagnosing the problem.

Continued collaboration with NOAA's Ocean Acidification program

- Bi-weekly sampling at the MAPCO2 site and at the offshore reference site continued uninterrupted. Due to malfunction of the alkalinity titrator, samples for Total Alkalinity are being preserved and stored for ulterior analysis. Data continues to be shared through NOAA's OA program. Equipment malfunction has also hampered efforts to obtain vertical profiles of TA and pH at the CaTS station. Nevertheless CTD profile casts to 800 m are being performed and surface samples are being collected for carbon chemistry.

Continued development and publication of remote sensing water quality products

- MODIS Terra, MODIS Aqua and VIIRS chlorophyll a and Kd₄₉₀ *daily* images from The CariCOOS region and Caribbean region are now being distributed.
- MERIS Total Suspended Matter (TSM) and MERIS Chlorophyll a (Chla) archives have been finalized and are pending publication.
- Field sampling for validation of the CariCOOS Total Suspended Matter Regional Algorithm has continued.
- Efforts towards calibration of the MERIS Total Suspended Sediment imagery through a vicarious sequence going from in situ values to MODIS observations thereon to MERIS have been continued.
- Presentation: CariCOOS Remotely Sensed Data Product: Tools Supporting Management, Fisheries and Science. PRYSIC 2013, Mayaguez, PR.
- The documentation of historical (2005 to 2009) occurrence and severity of suspended sediment loading in the nearshore CariCOOS region utilizing MERIS medium resolution imagery has been initiated.

Collaboration with Fundación Surfrider Rincón (FSR) in the Blue Water Task Force (BWTF) water testing program

- CariCOOS recently completed the purchase of supplies for 500 water samples and delivered the supplies to Surfrider Foundation Rincon chapter to support their voluntary-driven, fecal contamination testing program in Puerto Rico.
- BWTF water quality data are now available via the CariCOOS website

Operation/enhancement of HF Radar system in the Mona Passage (collaboration with DHS-CSR)

- Efforts have been focused on hardening onsite computers against cyber attack. The computer at station FURA was found to be compromised resulting in excessive data use. The computer was swapped out and denial software (Deny Hosts) was installed. Unfortunately, within a week, the system was once more compromised. CariCOOS technical personnel are preparing a new unit for installation with additional protection software.
 - Quotes have been procured for a new CODAR HF Radar unit.
 - A license for operation of the new CODAR software (SeaSonde v.7) was purchased.
- ***Modeling Subsystem***

Implement CariCOOS Coastal Circulation modeling program at regional and nearshore scales

- Objective assessment through RMSE analysis confirms that integration of wind forcing taken from NWS NDFD wind model with the ROMS coastal circulation model now provides improved resolution of the wake produced by the island in the west. A study of the effect on current circulation, temperature and salinity has been presented at the American Physical Society Division of Fluid Dynamics 66th Annual Meeting November 24-26, 2013.
- In general, a stable prediction system has been achieved for the area of PR and VI. A first version of an operational currents forecast system has been developed. Automatic cron-jobs running Matlab scripts now download, pre-processed and stored data.
 - Since the beginning of November, ocean currents forecast have been published in the CariCOOS web page for the domain of interest.
 - Simulations of one day hindcast, and 72 hours forecast are performed daily. Comparisons of the sea surface height with tidal gages at different locations are being performed as part of the validation process of the forecast system.

- Currently, a high-resolution simulation is being performed for the area of San Juan bay on a daily basis using boundary information from the PR-VI simulation.

Continue operation and enhancement of CariCOOS Nearshore Wave Model (CNWM)

- The CNWM has performed flawlessly with an up-time of 99.8% during the last year.
- A new very high resolution grid was implemented in August 2013 for the Northeast Corridor Natural Reserve (NECR) and the Fajardo area.
- Also in August 2013, the spatial resolution of the USVI grid was increased to 240 meters to better resolve the wave diffraction and refraction processes in the USVI archipelago

Finalize and publish updated Storm Surge Atlas for the CariCOOS region

- The US Virgin Islands Storm Surge Atlas has been finalized. The coupled version of ADCIRC+SWAN was used after validation with available tide and offshore wave gauges. The bathymetry was obtained from the USVI NGDC DEM and topography was obtained from USCoE bare-earth LIDAR available since 2007.
- The atlas for Puerto Rico has been started.
- On November 1, 2013, the new applied research project (A Puerto Rico/US Virgin Islands Surge and Wave Inundation Model Testbed) was started, involving several institutions and agencies.

Operation and development of the CariCOOS Coastal Weather modeling (WRF)

- A comparative assessment of wind speed and direction forecasting skill of the CariCOOS WRF 1km resolution implementation and the currently operational 2km version (NWS NDFD wind model) was carried out. Data from the CariCOOS 1km WRF implementation showed significant improvements particularly for areas sheltered by topographic features.
- The above results were presented to NWS-SJ-WFO forecasters who pointed out the potential for utilizing WRF 1km output for forecasting thunderstorm and waterspout formation. Further numerical validation of precipitation forecasts is required. The possibility of deploying a CariCOOS server capable of hosting pre-operational WRF 1km runs at the SJ WFO will be explored.

- Once fully deployed output from CariCOOS WRF 1km is expected to provide wind forcing to the CariCOOS SWAN multigrid wave forecasting system and regional HYCOM-ROMS hydrodynamic model implementations.

- ***DMAC, Products & Computational Subsystems***

Construct and distribute new data products

- CariCOOS Assets ArcGIS project: ArcGIS Story telling map tour combining an interactive map of PR and USVI, CariCOOS assets photos, text panels including a brief description of individual assets and link to real-time data, and a thumbnail carousel.
<http://www.arcgis.com/apps/MapTour/index.html?appid=46d5bae798d94844a66e8e5fd5d38863&webmap=5e59ce36220840f49c1f2e10c2b60d80>
- CariCOOS Data Buoy E, Vieques Sound, : Data online
- CariCOOS WRF 1KM experimental Tool
(<http://www.caricoos.org/zplayer/wrf1>)
- CariCOOS Roms/Amseas Model Assessment Tool
(<http://www.caricoos.org/zplayer/roms3>)
- NWS Doppler Radar imagery now on CariCOOS real time data map
- Ocean Color Images from Aqua, Terra and VIIRS now available online
- Wind data base optimized for rapid data readout (3 seconds versus 19 seconds)

Continue operation and development of DMAC subsystem in compliance with IOOS requirements.

- Efforts continue to maintain DMAC standards and towards the improvement of CariCOOS products while existing data and data product availability and distribution are maintained. Work continues, in conjunction with U. Maine, towards addressing data gaps and formatting issues of CariCOOS buoy data holdings. Dr. Jorge Capella attended the National IOOS DMAC Meeting in September.
- SOS implementation is our priority and continues to be work in progress towards meeting the National deadlines in 2014.

Operate, maintain and enhance CariCOOS computational resources

- A new server (NEW_SWAN) WAS purchased and has been installed for operational runs of the SWAN model. This machine is twice as powerful as its predecessor and provides five times the storage space.

- Computational assets are acquired and dynamically reassigned according to priorities and needs. Thus the server known as Model3 has now been reassigned for operational WRF runs for NWS backup.
 - A new dedicated computer cluster for inundation modeling, now with 192 cores, soon to be upgraded to 320 cores, and acquired with funding from the PR Coastal Zone Management Program-PRDNER has been installed and tested. This will allow for faster execution of the multiple computer runs required for the atlas.
 - UPRM has now re-assigned to CariCOOS the Blade Cluster server used for circulation modeling.
- ***Outreach and Education Subsystem***

Continue the CariCOOS summer intern program

The CariCOOS summer intern program provides undergraduate students with an opportunity to spend the summer (eight weeks) working side-by-side with a CariCOOS researcher in areas related to the observing system mission.

Successful Conclusion of the CariCOOS 2013 Summer Internship: Undergraduate students Estefanía Quiñones (UPRM, Physics Department), Edward Rivera (UPRM, Mechanical Engineering Department) and Luis Pomales (UPRH, Physics & Electronics Department) successfully concluded their CariCOOS 2013 summer internship. During their internship period (June 3 to July 26, 2013) students worked on specific topics relevant to the observing system mission under the supervision of Dr. Stefano Leonardi, Dr. Miguel Canals and Prof. Julio Morell, CariCOOS Co-PI's and executive director, respectively. The students enthusiastically presented their work to the CariCOOS team in a seminar held at Isla Magueyes Field Station on August 2, 2013. Estefanía and Edward continued their participation in CariCOOS as research assistants during the ongoing semester. Luis is expected to commence graduate training in the UPRM Dept. Marine Sciences Graduate on January and is expected to assist in the CODAR operations and numerical modelling efforts. The 2014 program announcement and the new on-line application process are under development.

Issue a media toolkit for press to help expand and enhance CariCOOS abilities to educate stakeholders through media

Communication with WSI, Broadcast Division of the Weather Company in charge of the generation of weather data, production tools and visualization features for television channels in Puerto Rico is scheduled for January 2014.

Present the CariCOOS traveling exhibit at different venues

The exhibit, a showcase of CariCOOS observing assets, services and products to motivate the target public (students, recreational boaters and general public) to understand and make use of ocean observations, was presented at a launching and fund raising event for the proposed "Eco Exploratorium" Science Museum (Nov 14, 2013). Tentative agreements are in place for a permanent CariCOOS presence at the "Eco Exploratorium" to be built on grounds adjacent to the PR Convention Center in San Juan.

Produce and disseminate of educational television and radio spots informing the general audience about CariCOOS products and services

Maria Falcon, Prize-winning Puertorican TV producer, has agreed to assist CariCOOS in this endeavor and is working on a proposal

"In-Service" teachers training for K-12 educators from school districts of the PR and USVI

The first CariCOOS coastal weather "in-service" teacher training is being coordinated for April 2014 in partnership with the UPR's Sea Grant College Program and their new Center for the Education on Environmental Climate Change (CENECCA). The CENECCA project is a climate change education center that will provide the needs for scientific information aimed at the development of actions, programs, activities and adaptation policies related to climate change including, natural hazards and sea level rise in order to minimize potentially adverse social and environmental impacts.

Strengthen the CariCOOS-USCG Auxiliary teamwork

Pending for 2014

Expand and enhance CariCOOS abilities to educate stakeholders through media

A series of public presentations and publications, disseminated in newspapers, nautical newsletters and magazines, and on-line to encourage the use of CariCOOS products and services and enhance CariCOOS abilities to educate stakeholders:

- **El mar visto como nunca antes** (Spanish) at "El Nuevo Día", daily (print and on-line) newspaper distributed in Puerto Rico.
(http://storage.caricoos.org/education/links/endi_news.pdf)

- **Nueva boya CariCOOS para información marina confiable en el este de Puerto Rico** (Spanish) in "La Regata" nautical newsletter http://storage.caricoos.org/education/links/la_regata/102013.pdf
- **Coastal ocean observing system facilitates navigation in waters of Puerto Rico and Virgin Islands** (English & Spanish) submitted to Nautica, nautical magazine with distribution in Puerto Rico, Dominican Republic and US Caribbean.
- **CariCOOS Newsletter (Fall 2013)** - Quarterly newsletter to keep CariCOOS stakeholders informed about activities and program highlights. Fall edition was distributed to approximately 400 stakeholders and observing system users from PR, USVI and Continental USA.

Presentations:

CariCOOS remotely sensed data products: tools supporting management, fisheries and science. Presentation by Belitza A. Brocco (CariCOOS staff) at the National meeting on Remote Sensing and Geographical Information Systems of Puerto Rico (PRYSIG) with participation of representatives from academia, governmental agencies and the private sector.

- ***IOOS, CaRA and IOOS Association***
 - **Participate in IOOS activities, meetings and teleconferences**
Dr. Miguel Canals attended the Fall IOOS Meeting
 - **Participate in IOOS Association meetings and teleconferences**
Dr. Jorge Capella attended the fall DMAC meeting.
 - **Development and execution of a CaRA/CariCOOS certification plan**
The service of Marichal, Juarbe & Hernandez Inc., attorneys at law are being retained for certification consultations and to draw up a plan for incorporation of CaRA under section 501c3
 - **Support CaRA activities and provide legal and administrative support**
The firm of Torres and Associates continues to be retained as legal counsel
 - **Convene Council Meetings**
In planning for March 2013
 - **Convene yearly General Assembly**
In planning for March 2013

- ***Contractual***

A contract with WeatherFlow Inc. (WF) for operation of the CariCOOS/WF MESONET was negotiated during the reporting period and a requisition for these services has been issued by UPRM R&D Center. Although in the past WF has collaborated under a Subaward, UPRM administration ruled that the nature of their participation, primarily as a data supplier, would fit the purchase order model and thus simplify the invoicing and monitoring requirements.

A contract with Caribbean Wind LLC for incorporation of CariCOOS assets into the Caribbean Assets Explorer, promotion of CariCOOS products and assets in the wider Caribbean region and to support CaRa's international strategy has likewise been issued. This product will provide for depiction of data and model output in a flexible and user manageable interface. Coverage of the wider Caribbean region is included as a CariCOOS IOOS contribution to the neighbor nations and international observing efforts and initiatives including GOOS and IOCARIBE.

Contracts for field and laboratory technicians have been issued as follows:
Field Technicians Jorge Sabater and Roberto Castro, Photographer Efrain Figueroa, DMAC and Modeling Coordinator, Dr. Jorge Capella.

Contracts for legal services have been drafted and are pending signature for: Torres y García for CaRA legal counsel and Marichal, Juarbe & Hernandez Inc. for certification consultations.

Professor Roy Watlington declined the proposed contract as CariCOOS liaison with the University of the Virgin Islands. Professor Watlington has offered to provide assistance on a "pro bono" basis.

Special Appointments (employees) include Carlos Ortiz (field tech, diving operations), Belitza Brocco (GIS and water quality), José Rodriguez (cyber systems/computational resources), Adolfo Gonzalez (web master), Valentine Hensley (lab tech), Yasmin Detrés (E&O Director) Vanessa Gutierrez (Administrative Assistant)

- ***Subawards***
 - UVI subaward – The SA contract, signed by UVI officials, has been officialized
 - U Texas circulation modeling – Submitted to UT for signature
 - U Maine buoy operation and data handling – Submitted to U Maine for signature

3) Scope of Work

Continuation and completion of all tasks detailed in the revised milestone list.

4) Leadership Personnel and Organizational Structure

No alteration to CariCOOS organizational structure.

5) Budget Analysis:

Personnel:

Modifications to the proposed scientific staff and support personnel structure serving CariCOOS: UPRM granted 9 credit hours of release time to Jorge Corredor to work for CariCOOS thus saving \$39,294 plus fringe in academic time-buyout. He still commits 54% percent of his time to the project. We will use said funds to employ an administrative assistant (\$6,500 plus fringe) to be hired from January to May 2014 assist Associate Director Canals in managing CariCOOS's office on the main campus (UPRM) and a research associate (\$10,166 plus fringe) who will work on the upkeep and revision of the Ocean Acidification program from January 1, 2013 to May 31, 2014.

Subawards:

Although in the past WeatherFlow Inc has collaborated with CariCOOS under a Subaward, UPRM administration ruled that the nature of their participation, primarily as a data supplier, would fit the purchase order model and thus simplify the invoicing and monitoring requirements. All other proposed subawards will proceed as proposed.

6) Issues

No major issues.