

# CARICOOS: Enhancing Coastal Intelligence in the US Caribbean

## Program Performance Report



# CARICOOS

Reporting Period: 6/01/2016 – 11/30/2016

Project title: CARICOOS: Enhancing Coastal Intelligence in the US Caribbean

Award number: NA16NOS0120026

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Award Period: 06/01/2016 - 05/31/2021

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

## I. PERFORMANCE PROGRESS REPORT

Activities programmed for the initial semester of the “CARICOOS: Enhancing Coastal Intelligence in the US Caribbean” cooperative agreement have proceeded as proposed. Working towards the overarching goal of transforming data into intelligence in support of regional focus areas (efficient marine operations-minimizing coastal hazards-informed resource management-climate monitoring), all operational observational and forecast-supporting numerical modeling efforts have been sustained and some underwent significant improvements. Enhancement of the data product suite and sector focused integrated interfaces published in <http://caricoos.org> has been well received by stakeholders. Migration of critical computing infrastructure to a cloud base service has significantly reduced downtime web services. The DMAC subsystem continues attuned to IOOS guidelines and needs while outreach, education and engagement activities progressed as planned. Moreover, governance has continued to be supported and strengthened.

### 1. Progress and Accomplishments

MILESTONE / TASK	Q1	Q2	Q3	Q4	Original Completion Date	Status
<b>Support safe and efficient maritime operations</b>						
Improve wave, current and circulation modeling for ports in the region					May 2017	<b>On-Track</b> – CARICOOS wave models received major upgrade in August 2016
Continue operation of the Yabucoa Port Metocean observation and prediction system					May 2017	<b>On-Track</b> – model operational
Provide support to USCG regarding HFR and circulation modeling					May 2017	<b>On-Track</b> – ROMS models under review
Implement a new version of the CARICOOS sea state point forecast online interface with integrated wave height maps					May 2017	<b>Complete (October 2016)</b> – already operational at CARICOOS <a href="#">website</a>
Develop an online product to provide along-track sea state forecasts (waves, wind) for popular shipping and boating routes in the region					May 2017	<b>On-Track</b> - under development, beta version should be ready for the 2017 CARICOOS General Assembly.

MILESTONE / TASK	Q1	Q2	Q3	Q4	Original Completion Date	Status
<b>Minimizing impacts from coastal hazards</b>						
Maintain and enhance the operational CARICOOS - Sea Grant Nearshore Breaker Model					May 2017	<b>On-Track</b> – model in process of upgrading to use 2D spectral partitioning
Continue to support Surfrider's BWTF efforts to monitor beach water quality in the Northwest of Puerto Rico					May 2017	<b>On-Track</b> – Surfrider continues weekly testing as scheduled
Further improve the Rincon Public Beach FIB nowcast model performance by including a combined multivariate linear-regression/binary model.					May 2017	<b>Completed (November 2016)</b> - fine-tuning ongoing
Perform a 48 hour experiment during a significant rainfall event at strategic locations along the Rincon Public Beach to further validate RPB beach water quality nowcast.					Nov 2016	<b>Completed (October 2016)</b> – data analysis ongoing
Develop two additional beach water quality nowcast models for Playa Santa-Guánica and Crash Boat-Aguadilla					May 2017	<b>On-Track</b> - base data gathering ongoing
Continue coordination of longer and more frequent monitoring campaigns in collaboration with various entities and crowd sources to help validate and fine-tune new and existing models.					May 2017	<b>On-Track</b>
Continue collaboration with the PR EQB to serve their beach water quality data, and achieve a formal collaborative agreement through an MOU.					May 2017	<b>On-Track</b>
<b>Coastal resources: monitoring and management</b>						

MILESTONE / TASK	Q1	Q2	Q3	Q4	Original Completion Date	Status
Research cruise focused on spatial variability of carbonate chemistry in La Parguera					Nov 2016	<b>Completed</b> (November 2016)
Construction of a graphical application depicting existing near surface temperature measurements in the region and subsurface anomalies detected by comparing temperature sections collected by the SeaGliders with the WOA 2009 climatology					Feb 2017	<b>Complete (October 2016)</b> – Example <a href="#">here</a>
Implement an early warning system for USVI coral bleaching					May 2017	<b>On-Track</b> – pending deployment of thermistor chain by UVI
Begin R&D for implementing a Sargasso tracking and warning system					May 2017	<b>On-Track</b>
<b>Monitoring climate variability</b>						
Retrieval and refurbishment of NOAA-AOML Glider SG609					Aug 2016	<b>Complete (July 2016)</b>
Deployment of NOAA-AOML Gliders SG609 and 630 off La Parguera P.R					Aug 2016	<b>Complete (July 2016)</b>
Retrieval and refurbishment of NOAA-AOML Gliders SG609, 610, 60X, 630 and 547					Nov 2016	<b>Complete (November 2016)</b>
Deployment of NOAA-AOML Glider SG609 off La Parguera P.R, observations along Caribbean track for seasonal forecast					Feb 2017	<b>On-Track</b>
Deployment of NOAA-AOML Glider SG610 off San Juan P.R., sample along Atlantic track for seasonal hurricane forecast					Feb 2017	<b>On-Track</b>
Operation of La Parguera MAP CO2 buoy, data dissemination					May 2017	<b>On-Track</b> – <a href="#">data products</a> available in web page; repairs as required
<b>Observing Subsystem</b>						
Operate the CARICOOS data buoy network					May 2017	<b>On-Track</b> – San Juan buoy malfunctioned – repaired and redeployed in Oct 2016

MILESTONE / TASK	Q1	Q2	Q3	Q4	Original Completion Date	Status
Yearly maintenance of the CARICOOS-UMaine data buoys					May 2017	On-Track
Yearly maintenance of the CARICOOS Rincón wave buoy					May 2017	On-Track
Yearly maintenance of the UVI-EPSCOR St. Thomas buoy					May 2017	<b>On-Track</b>
Yearly maintenance of the La Parguera MAP CO2 buoy					January 2017	<b>On-Track</b>
Maintenance and operation of MESONET					May 2017	<b>On track</b>
Maintenance and operation of CARICOOS HF radar network					May 2017	<b>On track</b>
Occasional CARICOOS drifter deployments from ships of opportunity or event-driven					May 2017	<b>On track</b> - 2 deployments to date
Maintenance and operation of W. Gregerie Channel- USVI ADCP by UVI personnel					November 2016	<b>Delayed</b> – Installed but data delivery delayed due to instrument malfunction
Beach pathogen monitoring					May 2017	<b>On-track</b>
Deployment of thermistor chain off St. Thomas by UVI personnel					May 2017	<b>On-Track</b> – awaiting permits
<b>Modeling &amp; Analysis Subsystem</b>						
Continue and enhance SWAN modeling					May 2017	<b>On-Track</b> – Major upgrade in August 2016, included 2D spectral partitioning
Explore operational implementation of unstructured SWAN					May 2017	<b>On-Track</b>
Continue and enhance WRF modeling					May 2017	<b>On Track</b>
Continue and enhance FVCOM modeling					April 2017	<b>On-Track</b> – beta version of operational model online by December 2016
Continue and enhance ROMS modeling					May 2017	<b>On-Track</b> – major revisions ongoing to ROMS operational system
Full transition of ROMS modeling system from UT Dallas to UPRM					May 2017	<b>On Track</b>
Maintain and upgrade CARICOOS computational infrastructure					May 2017	<b>On-Track</b> – partial migration to cloud ongoing

MILESTONE / TASK	Q1	Q2	Q3	Q4	Original Completion Date	Status
<b>DMAC Subsystem</b>						
Continue current CARICOOS DMAC and Regional DAC efforts as detailed in the SOP					May 2017	<b>On Track</b>
Custom data product development in response to stakeholder needs					May 2017	<b>On Track</b>
Continued improvement and debugging of our recently launched web page					May 2017	<b>On Track</b>
Entries/holdings/queries in the IOOS Registry and Catalog will be increased while achieving full compliance with IOOS DMAC metadata, file and data discovery standards and checks					May 2017	<b>On Track</b> - Preparing for the unveiling of the new IOOS Catalog in December
Implement Amazon Web Services (AWS S3) buckets as repositories of data and model output used in the various products and displays available through our web page					May 2017	<b>Complete (October 2017)</b> - Fully operational at AWS
Set up a test THREDDDS/OPeNDAP server as an EC2 AWS instance to complement, and eventually replace one of, our two physically distant servers; test for cost effectiveness, reliability and bandwidth					May 2017	<b>Complete (October 2017)</b> - Fully operational at AWS. Seamlessly replaces one of our two local and redundant THREDDDS/OPeNDAPP servers
Attend IOOS DMAC meeting					June 2016	<b>Completed (June 2016)</b> - Attended virtually due to end of FY administrative issues
Continue operating DMAC and computational infrastructure					May 2017	<b>On Track</b>
Maintain and enhance new CARICOOS website					May 2017	<b>On Track</b> - Extensive backstage improvements resulting from our migration of the scripts and THREDDDS/OPeNDAPP servers to AWS. New products have been created in the AWS script server.

MILESTONE / TASK	Q1	Q2	Q3	Q4	Original Completion Date	Status
Achieve cloud-based computing and improve HPC infrastructure					May 2017	<b>On Track</b> - Computational tests are being conducted at Amazon Web Services and at Sabalcore. Price quotes and code performance are being evaluated.
Historic metadata archival					May 2017	<b>On Track</b>
<b>Education &amp; Outreach Subsystem</b>						
Continue O&E formal and informal activities focused on enhancing awareness and appropriate utilization of CARICOOS products and services					May 2017	<b>On-Track</b> , 18 engagement activities completed, plus participation in 11 radio shows and 2 TV shows
Develop and deliver new products training workshops					May 2017	<b>On-Track</b> , 5 training/educational activities completed and 4 video tutorials developed
Continued assessment of stakeholder/user needs					May 2017	<b>On-Track</b>
Host training workshops for teachers to facilitate interpretation of data and products and obtain essential feedback.					June 2016	<b>Completed (June 2016)</b>
Renewed assessment of USVI user needs					May 2017	<b>On-Track</b>
Host the CARICOOS summer internship program.					July 2016	<b>Completed</b> , 3 students supported
Continue to procure an active presence in pertinent forums, such as Harbor Safety Committees, PR Climate Change Council, Caribbean Regional Ocean Partnership, UPR Sea Grant Advisory Board, the Caribbean Landscape Conservation Cooperative, among others					May 2017	<b>On-Track</b> , 6 activities completed

MILESTONE / TASK	Q1	Q2	Q3	Q4	Original Completion Date	Status
Consult stakeholders via direct communication and interaction at CARICOOS General Assembly meeting					May 2017	<b>On-Track</b>
CARICOOS Drifter Day, a high-school student workshop in which students design and track their own drifters					May 2017	<b>On-Track</b> , high school identified
<b>Governance Subsystem</b>						
Stakeholder engagement throughout the region					May 2017	<b>On-Track</b>
Conduct Board of Directors meetings					May 2017	<b>On Track</b> – Next meeting scheduled for early 2017
Support CARICOOS Inc. administrative operations					May 2017	<b>On Track</b>
Celebrate the Annual CARICOOS General Assembly					April 2017	<b>On Track</b>

## 2. Scope of Work

No substantive changes to the project's SOW are anticipated at the moment.

## 3. Leadership Personnel and Organizational Structure

No major changes

## 4. Budget Analysis

All sub-awards have been fully formalized except for the U. Maine. The latter shall be in place before the end of December 2016. Expenditures and encumbrances totaling \$356,638 have proceeded as planned. The latest financial report submitted by UPRM in 10/06/2016 reflects no disbursements. A formal explanation for this has been requested from UPRM's R&D Center.

Major equipment purchased includes an Aquadopp ADCP (\$20k) for use aboard our buoys.



## II. PERFORMANCE PROGRESS REPORT - ADDENDUM

### 1. Confirmation that O&E has been updated –

The O&E addendum has been updated to include recent education and outreach materials, newsletters, CARICOOS news blogs, among others. Previous materials have been updated and links were confirmed to be working properly.

### 2. DMAC Progress and Challenges

The major outcome from DMAC during the reporting period was the migration to the Cloud, which has resulted in less downtime and greater stability of our webpage and data servers. This move is in response to power and network interruptions we have experienced since our inception. We have accelerated the following initiatives in order to minimize downtime:

- a. Implement Amazon Web Services (AWS S3) buckets as repositories of data and model output used in the various products and displays available through our web page
- b. Set up a test THREDDS/OPeNDAP server as an EC2 AWS instance to replace one of our two physically distant servers; test for cost effectiveness, reliability and bandwidth
- c. Achieve cloud-based computing and improve HPC infrastructure

The greatest challenge to be addressed during the 3<sup>rd</sup> and 4<sup>th</sup> Q of FY16 is the poor representation of CARICOOS datasets in the IOOS Catalog and Registry. We will strive to reach the high standards set by our sister RAs now that the Cloud migration, and the resulting hardening of our data services, is almost finished. Specifically, we note that:

- a. We are currently in the process of updating our WAF thredds crawling scripts to generate up-to-date WAF metadata records for the IOOS Catalog.
- b. Registry information for CARICOOS is being updated
- c. Our metadata records need to be greatly improved

Below we provide specific comments on the ten DMAC IOOS requirements:

#### **2.1. Open Data Sharing**

We continue serving regional data openly through our web page Data Download tab, through our webpage products and through our dual THREDDS/OPeNDAPP servers.

## **2.2. Data management planning and coordination**

A Data Management System (DMS) Plan has been finalized as part of our RICE application process. The DMS Plan discusses all our data, data management, servers and services in great detail.

## **2.3. Provision of data to the Global Telecommunication System (GTS)**

All our metocean data are uploaded to the GTS either directly by us or through NDBC.

## **2.4. Data access services**

We provide a Data Access page and dual/redundant THREDDS/OPeNDAPP access as well as links to the data pages of the HFR DAC, the Glider DAC and for AOML drifter. Data may be accessed in NetCDF and/or text format depending on the data type. Data access from NetCDF source files through our THREDDS/OPeNDAPP servers is the preferred method; however, csv text files are available for near-real-time data. We try to accommodate all user requests and format preferences.

## **2.5. Catalog registration**

We are registered in the IOOS Registry. See above.

## **2.6. Common data formats**

The two most common data formats are NetCDF and text CSV.

## **2.7. Metadata standards**

CARICOOS conditions all subcontracted data providers to follow current metadata and data discovery standards.

## **2.8. Storage and archiving**

The Archival section of the DMS Plan provides details of our Request to Archive documentation at NCEI.

## **2.9. Ontologies, vocabularies, common identifiers**

We need to increase our efforts in terms of NetCDF file compliance as assessed through the use of the IOOS and NCEI compliance checkers. This effort is ongoing.

## **2.10. Consideration for Long-term Operations**

These details are included in the CARICOOS Data Management Plan.

### 3. Observing Assets

#### 3.1. Update the RA Observing Asset Inventory

The CARICOOS asset inventory has been updated and included as a spreadsheet in a separate file.

#### 3.2. HFR-Asset-and-Staffing-Inventory

Staff Member	(% FTE or #person-months)
Technical Director (HFR Lead)	Miguel Canals (5%)
Technicians/Engineers	Patricia Chardon (25%), Jose Torres (10%), David Carrero (20%)
Students	Colin Evans (50%), Luis Pomales (10%)

Other: CARICOOS extends a subaward to RUCOOL for HFR technical assistance and for rental of HFR antenna.

Total # of Radars Supported: 5
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Site Code	Location	City, State	Frequency	Institution
FURA	18°17.514'N,067°11.897'W	Añasco, P.R.	13.45 MHz	CariCOOS
CDDO	18°05.997'N,067°11.428'W	Cabo Rojo, P.R.	13.45 MHz	CariCOOS
FARO	17°56.002'N,067°11.520'W	Cabo Rojo, P.R.	4.35 MHz	CariCOOS
PYFC	17°57.766'N,066°37.100'W	Ponce, P.R.	4.35 MHz	CariCOOS
MABO	17°59.288'N,065°53.100'W	Maunabo, P.R.	4.35 MHz	CariCOOS

HF radar maintenance and operation expenditures are included in a separate spreadsheet.

#### 3.3. Annual glider days

The glider days inventory for calendar year 2016 has been completed and uploaded as an attachment. There were a total of 498 CARICOOS glider days in 2016.

### **III. ENVIRONMENTAL COMPLIANCE**

No activities outside those considered in the final U.S. IOOS PROGRAMMATIC ENVIRONMENTAL ASSESSMENT and found as posing no significant impact (FONSI 6/29/2016) were undertaken in the period here reported.

A buoy owned by the U. of Virgin Islands (UVI) and supported by CARICOOS will be repositioned to the north of the USVI. UVI has submitted the required permits applications.