



# CARICOOS

## Enhancing Coastal Intelligence in the US Caribbean Archipelago: The Caribbean Coastal Ocean Observing System

### PROGRAM PERFORMANCE REPORT

Reporting Period: 06/01/2020 – 11/30/2020

Project title: Enhancing coastal intelligence in the US Caribbean archipelago:  
The Caribbean Coastal Ocean Observing System

Award number: NA16NOS0120026

Recipient Institution: University of Puerto Rico at Mayaguez

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Program Office: NOS Integrated Ocean Observations Systems (IOOS)

Total Award Period: June 1, 2016 – May 31, 2021

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

## I. PERFORMANCE PROGRESS REPORT

This report informs on progress towards milestones proposed for the first semester of the fifth year of the Enhancing Coastal Intelligence in the U.S. Caribbean Archipelago: The Caribbean Coastal Ocean Observing System. During this period, CARICOOS was able to continue providing operational data and products to its stakeholders and users. However, the COVID pandemic continued impacting the system wide operations and activities ranging from annual buoy maintenance to the annual General Assembly. The table below details which activities were impacted. Also, the pandemic has impacted sub-recipients and contractors. These have been granted no cost extensions.

CARICOOS leadership and staff have continued working under the COVID-19 related limitations by implementing teleworking. CARICOOS Investigators, Subsystem Coordinators & Leads, UPR-Mayaguez employees, students and contractors will continue teleworking except for essential field or laboratory work which commenced on early July. Two season-critical operations resumed include the tuning, deployment, and recovery of 9 AOML-CARICOOS hurricane gliders and 2 NAVO gliders which sampled lines off the region's Caribbean and Atlantic coasts from the west of Puerto Rico to the east of the US Virgin Islands. Authorizations from UPR and NOAA allowing field operations also provided for recommencement of observational efforts to assess the impacts of Sargasso inundation in coastal ecosystems close to the seasonal abundance. O&E efforts have also continued through social media, webinars and web-based dissemination.

The CARICOOS General Assembly continues to be postponed until 2021 because of the coronavirus pandemic. A virtual Board of Directors meeting was held in October 2020. The agenda included informing on progress achieved and setbacks met during the 2019 fiscal year, the presentation of results from the region wide stakeholder need assessment study and the discussion and evaluation of expressions of interest submitted towards meeting prioritized needs.

The final release of the CARICOOS boat app was accomplished in June 2020. It has been widely accepted by the boating/watersports community including recreational /artisanal fishers, divers and others.

## 1. Progress and Accomplishments

The following table takes into consideration milestone delivery dates indicated on the rescoped workplan for FY20 submitted in October 2020.

MILESTONE / TASK	Q1	Q2	Q3	Q4	ORIGINAL COMPLETION DATE	STATUS / NOTE
<b>SUPPORT SAFE AND EFFICIENT MARITIME OPERATIONS</b>						
Continued dissemination of sea state data and products (winds, waves, currents) in real time					Continuous	On-Track
Maintain, validate and improve wave, wind, and hydrodynamic modeling for ports in the region to facilitate decision-making by the maritime sector					Continuous	On-Track
Continue operation of the Yabucoa Port Metocean observation and prediction system					Continuous	On-Track
Operate the Nortek AOS real-time current meter and meteo-station at Crown Bay, St. Thomas, USVI in support of cruise ship operations in Crown Bay and other mariners in the West Gregerie Channel					Continuous	On-Track
Development and operation of a metocean observation and prediction system for Crown Bay/W. Gregerie, St. Thomas. USVI					May 2021	On-Track
<b>MINIMIZING IMPACTS FROM COASTAL HAZARDS</b>						
Maintain and enhance the operational CARICOOS - Sea Grant Nearshore Breaker Model					Continuous	On-Track
Continue to support Surfrider's BWTF efforts to monitor beach water pathogens in the northwest of Puerto Rico					Continuous	On-Track
Maintenance and further development of the CARICOOS Beach App and CARICOOS Boating App					Continuous	On-Track
Maintenance and further development of CARICOOS Beach Water Quality products					Continuous	On-Track
Include USVI beach water quality data as part of CARICOOS data products					May 2021	On-Track
Continue the implementation of a remotely sensed video system to monitor coastal zone changes, provide information for beachgoer safety, storm damage safety and beach water quality					May 2021	On-Track
<b>COASTAL RESOURCES: MONITORING AND MANAGEMENT</b>						
Continue R&D for implementing a Sargasso monitoring and tracking system					May 2021	On-Track
Implement sensor deployments for assessing impact from Sargasso inundation events					May 2021	On-Track

Continue expanding the regional marine biodiversity database (MBON) using Coral Reef Monitoring (CRMP) data to understand the human impact on reef systems in the US Caribbean continental shelf					May 2021	On-Track
Bi-weekly cruises in La Parguera to compare near-reef carbonate chemistry versus oceanic conditions					May 2021	On-Track
Finalize development of Caribbean Ocean Decisional Support Tool (ROP)					December 2020	<b>Delayed</b> , currently in beta testing and receiving feedback. <b>The new anticipated date of completion for this milestone is May 2021.</b>
Finalize web interface for Puerto Rico Wave Climate Atlas (ROP)					December 2020	<b>Delayed</b> , waiting for developer. <b>The new anticipated date of completion for this milestone is May 2021.</b>
Expand Wave Climate Atlas to USVI (ROP)					May 2021	On-Track
<b>MONITORING UPPER OCEAN PROPERTIES AND CLIMATE VARIABILITY</b>						
Operate La Parguera Map CO <sub>2</sub> buoy and provide data dissemination					Continuous	On-Track
Deployment, retrieval and refurbishment of NOAA-AOML, CARICOOS and US Navy underwater gliders					November 2020	Completed in November 2020
<b>OBSERVING SUBSYSTEM</b>						
Operate the CARICOOS data buoy network					Continuous	On-Track
Operate the CARICOOS HFR network					Continuous	On-Track
Operate the CARICOOS MESONET and WINDNET					Continuous	On-Track
Quarterly inspections of CARICOOS Rincón wave buoy					Continuous	On-Track
Yearly maintenance of the CARICOOS-U Maine data buoys					November 2020	<b>Delayed</b> due to the restrictions related to COVID-19 outbreak. <b>The new anticipated data of completion for this milestone is May 2021.</b>
Yearly maintenance of the CARICOOS Rincón wave buoy					August 2020	Completed in August 2020
Yearly maintenance of the La Parguera Map CO <sub>2</sub> buoy					September 2020	Completed in September 2020
Install a new data buoy to replace the UVI owned buoy in St. Thomas destroyed by Hurricane Irma					May 2021	On-Track

Install a new HFR system in Puerto Rico and St. Thomas					May 2021	On-Track
Beach pathogen monitoring					May 2021	On-Track
Bi-weekly carbonate chemistry sampling					May 2021	On-Track
Monitoring acidification/hypoxia by Sargasso inundation					May 2010	On-Track
<b>MODELING &amp; ANALYSIS SUBSYSTEM</b>						
Maintain and enhance CARICOOS Nearshore Wave Model					Continuous	On-Track
Maintain and enhance CARICOOS WRF Model (1 km & 2 km resolution)					Continuous	On-Track
Maintain, validate and improve CARICOOS FVCOM circulation model					Continuous	On-Track
Continue with the implementation of CARICOOS FVCOM to understand the hydrodynamics in La Parguera Marine Reserve (NOAA sponsored Ocean Acidification studies) and nearshore processes.					May 2021	On-Track
Continue further validation of CARICOOS ROMS to optimize assimilation approaches.					May 2021	On-Track
Implementing and validating Sargasso beaching forecast					May 2021	On-Track
<b>DMAC SUBSYSTEM</b>						
Add ROMS and FVCOM model output to CARICOOS ERDDAP as these models become operational					As required	
Attend IOOS DMAC meeting					As required	
Continue with the development of the data portal to provide real-time acidification data collected by La Parguera Map CO <sub>2</sub> buoy and derived ecosystem metabolic rates					May 2021	On-Track
Compliance with IOOS DMAC metadata, file and data discovery standards and checks					Continuous	On-Track
Continue CARICOOS DMAC and Regional DAC efforts as detailed in the RICE DMS Plan					Continuous	On-Track
Continue operating DMAC and computational infrastructure					Continuous	On-Track
Historic data archival					Continuous	On-Track
Continue to review, process, and enter regional biological dataset into OBIS/MBON. Supported when Supplemental Funding as it becomes available. May undergo a training phase for CARICOOS staff and possibly a contractor.					May 2021	On-Track
Maintain and enhance CARICOOS website					Continuous	On-Track
Maintain the HPC infrastructure					Continuous	On-Track
RICE DMAC Review					As required	On-Track
Technical transfer to in-house IT, improvement and debugging of our web page					Continuous	On-Track
<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 2021	On-Track
Develop and deliver products training workshops and webinars					May 2021	On-Track
Participate in recreational ocean-related activities to promote safety through the use of CARICOOS product and services					Continuous	On-Track
Assess awareness and evaluate product feedback and interpretation through formal surveys					Continuous	On-Track
Continued assessment of stakeholder/user needs					Continuous	On-Track
Host training workshops or webinars for teachers to facilitate interpretation of data and products and obtain essential feedback.					May 2021	On-Track
Host the CARICOOS summer internship program					August 2021	On-Track
Continue to procure an active presence in pertinent forums, such as Harbor Safety & Security Committees, PR Climate Change Council, UPR Sea Grant Advisory Board, JBNERRs Research Advisory Board. Continue working meetings with key governmental agencies including US Coast Guard, WFO-San Juan, PR CZM office, among others.					Continuous	On-Track
Consult stakeholders via direct/virtual communication and interaction at CARICOOS General Assembly meeting and at sector focused meetings					May 2021	Delayed
Expand the CARICOOS kiosk network					Continuous	On-Track
Continue to issue CARICOOS communications via quarterly newsletters, social media, and CARICOOS School (O&E webpage)					Continuous	On-Track
Stakeholder engagement throughout the region					Continuous	On-Track
Conduct Board of Directors meetings					May 2021	On-Track
Support CARICOOS Inc. administrative operations					Continuous	On-Track
Host annual CARICOOS General Assembly					May 2021	On-Track

## 2. Scope of Work

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

## 3. Leadership Personnel and Organizational Structure

CARICOOS Technical Director, Patricia Chardón, will also serve as Deputy Director, a position formerly occupied by Dr. Sylvia Rodríguez who will continue collaborating as Co-PI. There are no additional changes to CARICOOS leadership personnel and organizational structure.

#### 4. **Budget Analysis**

Funds allotted to CARICOOS for project year 2020-2021 total \$2,491,166.66. Fiscal transactions to date include direct expenditures totaling \$446,077 and \$1,437,875 encumbered in formalized sub awards. Drawdowns to date total \$634,815. Remaining funds are expected to suffice for the scheduled program year activities.

##### a. **FY20 Fill the Gaps Planned Project**

###### i. *Gliders*

During the 2020 Atlantic hurricane season, 9 NOAA-AOML and 2 US NAVY underwater gliders were deployed in the CARICOOS region. While 7 lines were occupied in US Caribbean waters, 4 lines were sampled in the Western Tropical Atlantic north of Puerto Rico. Data collected during the 1,165 glider-days will support data assimilation into hurricane forecast models as well as ocean model validation. Expenditures required for glider ops, totaling \$57,411, included glider storage, vessel rental for deployments and retrievals, maintenance, and personnel.

###### ii. *HF Radar network*

Support allowed for a siting exercise and initial consultation required for the deployment of a 13MHz SeaSonde HFR to cover the PR to USVI sea lane. A quote for the latter has been requested and a purchase order should be issued. Support also provided for the acquisition of materials and minor equipment required for the maintenance of the systems.

###### iii. *Biology*

The Department of Natural and Environmental Resources Long Term Coral Reef Monitoring Program database (DNER-PRCRMP) is now publicly accessible as a map layer in the MBON data portal. This product is the first coral reef monitoring layer that allows the visualization of spatial and temporal trends in the U.S. Caribbean by processing site-specific transect biological data. To further develop the repository of Caribbean biological data available in MBON it will be key to continue and expand targeted [outreach efforts](#) that instruct users on how to navigate the MBON mapping application, extract data, and create data views. Specific examples of data views base on relevant species or research questions resulted in effective engagement of webinar participants.

##### b. ***Streamlined Access to Observations***

###### i. *Forecasting major Sargasso beaching/inundation events*

An initial version of the forecasting tool, developed by H. Roarty under a subaward to Rutgers (<https://marine.rutgers.edu/~hroarty/caricoos/animations/>), is in test-phase. Validation has been hampered by restrictions to field operations. For the upcoming season, particle dispersion forecasts will be validated versus Sat-GPS tracked Sargasso mats. AOML/USF Sargasso inundation report, Dr. Hu's (USF) AFCAI and CGOM CoastWatch MCI imagery will be published in CARICOOS.org

ii. *Assessing the impact of Sargasso beaching/inundation on coastal ecosystems*

CARICOOS commenced a monitoring program for documenting the impact of Sargasso inundation in neo-tropical coastal ecosystems. A sensor package (C, T, S, pH, CDOM, CHL a, Turbidity & PCO<sub>2w</sub>) was programmed to be deployed but its delivered was delayed by the pandemic. As part of the impact assessment program water samples are collected in weekly cruises at sites hosting representative ecosystems including seagrasses, coral reefs and mangrove lined coastlines (6 stations). Early results confirmed the occurrence of persistent hypoxia/anoxia and extremely acidic conditions associated with Sargasso inundation events. This sampling program will be extended for the upcoming program year and expanded with the addition of the above sensor package. During the upcoming season (March 2021 on), the latter will be rotated for deployments at all designated stations where it will be deployed for 36-hr periods. A graduate student and a field technician will be responsible for field ops and sample analysis.

c. *Vembu Subramanian Scholarship*

A call for applications was issued and interviews has been performed to select the candidate for the scholarship. Announcement of the award will take place later this year.

d. *Regional Ocean Partnership*

As part of the Regional Ocean Partnership, we proposed formal consultations with key stakeholders and members of CARICOOS Board of Directors regarding unmet high priority ocean data needs of ocean and coastal zone managers, marine scientists, coastal fisheries managers, among other potentials stakeholders. Although said consultation effort has been hampered by the pandemic, it has occurred via electronic communication media.

Work completed to date includes the development and publication of CostaVisPR: Aerial View of PR Coastal Transformation tool (<http://CostaVisPR.org>) through a collaboration with the Interdisciplinary Center for Coastal Studies (UPRM CIEL) and Sea Grant Puerto Rico. Also, a CARICOOS CROP Data Portal Beta version has been deployed (<https://crop.caricoos.org>). Once fully developed, the product will be presented to key stakeholders to obtain feedback that will be shared with the developer. An additional achievement has been the creation publication of the Caribbean Ecosystem Restoration, Conservation and Monitoring Projects Interactive Web App ([Ecosystem Restoration Projects](#)). In addition, the original Caribbean Regional Ocean Partnership (CROP) has been recovered and the original GIS data (110 layers) uploaded as an ArcGIS Online Web Mapping Application [CROP Spatial Planning GIS Layers](#) currently under review.

## II. 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.



### III. PERFORMANCE PROGRESS REPORT ADDENDUM

#### 1. Outreach

The CARICOOS Education and Outreach Inventory has been updated.

#### 2. Observing Assets

##### *a. Update the RA Observing Asset Inventory*

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

#### 3. HF Radar Asset and Staffing Inventory

Staff Member	(% FTE or #person-months)
Lead Scientists	Miguel Canals (5%) & Patricia Chardón (5%)
Technicians/Engineers	Colin Evans (50%) & Jose Torres (10%)

Other: CARICOOS extends a subaward to RUCOOL for HF Radar technical assistance.

Total # of Radars Supported: 5
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Site Code	Location	City, Country	Frequency	Institution
FURA	18°17.514'N, 67°11.897'W	Añasco, PR	13.45 MHz	CARICOOS
CDDO	18°05.997'N, 67°11.428'W	Cabo Rojo, PR	13.45 MHz	CARICOOS
FARO	17°56.002'N, 67°11.520'W	Cabo Rojo, PR	4.35 MHz	CARICOOS
PYFC	17°57.766'N, 66°37.100'W	Ponce, PR	4.35 MHz	CARICOOS
MABO	17°59.288'N, 65°53.100'W	Maunabo, PR	4.35 MHz	CARICOOS

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

#### 4. Annual glider days

The glider-days inventory for calendar year 2020 has been completed and uploaded as an attachment. There was a total of 1,165 CARICOOS glider days in 2020.