



# CARICOOS

CARIBBEAN COASTAL OCEAN OBSERVING SYSTEM

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

### PROGRAM PERFORMANCE REPORT

Reporting Period: 06/01/2019 – 05/31/2020

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

Principal Investigator: Julio M. Morell ([julio.morell@upr.edu](mailto:julio.morell@upr.edu))

Program Officer: Debra Esty, (240) 533-9446, [debra.esty@noaa.gov](mailto:debra.esty@noaa.gov)

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 fourth year of the Enhancing Coastal Intelligence in the U.S. Caribbean Archipelago: CARICOOS Cooperative Agreement. During this past program year CARICOOS was able to continue providing operational data and products to its stakeholders. However, during the second part of the program year, significant delays in field related operations have resulted from the COVID pandemic and the resulting lockdowns by the government of Puerto Rico and US regions where instrument suppliers are based. The table below details which activities were impacted. Also, the pandemic has obliged all subrecipients to request no cost extensions which have been granted.

CARICOOS leadership and staff have continued working under the COVID related limitations by implementing teleworking. Until further notice CARICOOS Investigators, Subsystem Coordinators & Leads, UPR employees, students and contractors will continue teleworking except for essential field or laboratory work. The latter will commence on July 1<sup>st</sup>. O&E efforts have also continued through social media, webinars and web-based dissemination.

The CARICOOS General Assembly has been postponed until 2021 because of the coronavirus pandemic. We will share with our Board or Directors and stakeholders the milestones achieved during the 2019 fiscal year and the impacts to tasks and operations due to the coronavirus.

The final release of the CARICOOS boat app was delayed due to issues with the Apple app store and an update of programming libraries imposed by Apple, and not related to the COVID pandemic. The app had already been released in the Android app store, and final release to the Apple app store was accomplished in June 2020.

### 1. Progress and Accomplishments

The following table takes into consideration milestone delivery dates indicated on the rescoped workplan for FY19 submitted in October 2019.

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	Completed
Maintain, validate and improve wave, wind, and hydrodynamic modeling for ports in the region to facilitate decision-making by the maritime sector					Continuous	Completed
Final release of mobile app to provide data and forecasts to small craft boaters and fishers (OTT CARICOOS)					December 2019	Completed in May 2020
Continue operation of the Yabucoa Port Metocean observation and prediction system					Continuous	Completed
* Operate the Nortek AOS real-time current meter and meteoration at Crown Bay, St. Thomas, USVI in support of cruise ship operations in Crown Bay and other mariners in the West Gregerie Channel					Continuous	<b>Delayed</b> , waiting for web developer. The new <b>anticipated date of completion for this milestone is December 2020.</b>

* Development and operation of a metocean observation and prediction system for Crown Bay/W. Gregerie, St. Thomas, USVI					March 2020	<b>Delayed</b> due to the temporary shutdown of universities and local agencies in response to the novel coronavirus. The new <b>anticipated date of completion for this milestone is December 2020.</b>
<b>MINIMIZING IMPACTS FROM COASTAL HAZARDS</b>						
Maintain and enhance the operational CARICOOS - Sea Grant Nearshore Breaker Model					Continuous	Completed
Continue to support Surfrider's BWTF efforts to monitor beach water pathogens in the northwest of Puerto Rico					Continuous	Completed
Maintenance and further development of the CARICOOS Beach App and CARICOOS Boating App					Continuous	Completed
* Further development of beach pathogen nowcasts using Doppler weather radar-based precipitation estimates					May 2020	<b>Delayed</b> , waiting for web developer
* Maintenance and further development of CARICOOS Beach Water Quality products					Continuous	<b>On hold</b> until monitoring resumes
* Include USVI beach water quality data as part of CARICOOS data products					May 2020	Historical data gathered, current data <b>on hold</b> until monitoring resumes. The new <b>anticipated date of completion for this milestone is May 2021.</b>
* 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 2020	<b>Delayed</b> due to the temporary restrictions on field and laboratory work related to COVID-19 outbreak. The new <b>anticipated date of completion for this milestone is December 2020.</b>
<b>COASTAL RESOURCES: MONITORING AND MANAGEMENT</b>						
* Continue R&D for implementing a Sargasso monitoring and tracking system					May 2020	<b>Delayed</b> due to the temporary shutdown of universities and local agencies in response to the novel coronavirus. The new <b>anticipated date of completion for this milestone is December 2020.</b>
* Implement sensor deployments for assessing impacts from Sargasso inundation events					May 2020	<b>Delayed</b> due to the temporary restrictions on field and laboratory work related to COVID-

							19 outbreak. The new <b>anticipated date of completion for this milestone is December 2020.</b>
Continue developing a 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 2020	Completed in May 2020
* Monthly validation cruises in La Parguera to validate MAPCO2 buoy measurements and document carbonate chemistry along the oceanic to nearshore reef gradient						May 2020	<b>Delayed</b> due to the temporary restrictions on field and laboratory work related to COVID-19 outbreak. The new <b>anticipated date for resuming cruises is July 2020.</b>
<b>MONITORING UPPER OCEAN PROPERTIES AND CLIMATE VARIABILITY</b>							
Operate La Parguera Map CO <sub>2</sub> buoy and provide data dissemination						Continuous	Completed
Deployment, retrieval and refurbishment of NOAA-AOML gliders						November 2019	Completed in November 2019
Deployment and retrieval US NAVY gliders						November 2019	Completed in November 2019
<b>OBSERVING SUBSYSTEM</b>							
Operate the CARICOOS data buoy network						Continuous	Completed
Operate the CARICOOS HF radar network (HFR)						Continuous	Completed
Operate the CARICOOS MESONET and WINDNET						Continuous	Completed
Quarterly inspections of CARICOOS Rincón wave buoy						Continuous	Completed
* Yearly maintenance of the CARICOOS-U Maine data buoys						April 2020	<b>Delayed</b> due to the temporary restrictions on travel, shipping, and field and laboratory work related to COVID-19 outbreak. The new <b>anticipated date of completion for this milestone is December 2020.</b>
* Yearly maintenance of the CARICOOS Rincón wave buoy						May 2020	<b>Delayed</b> due to the temporary restrictions on travel, shipping, and field and laboratory work related to COVID-19 outbreak. The new <b>anticipated date of completion for this milestone is December 2020.</b>

* Yearly maintenance of the La Parguera Map CO <sub>2</sub> buoy					February 2020	<b>Delayed</b> due to the temporary restrictions on travel, shipping, and field work related to COVID-19 outbreak. The new <b>anticipated date of completion for this milestone is September 2020.</b>
Operation and maintenance of CARICOOS MESONET					Continuous	Completed
* Install a new data buoy to replace the UVI owned buoy in St. Thomas destroyed by Hurricane Irma					May 2020	<b>Delayed</b> due to the temporary restrictions on travel, shipping, and field and laboratory work related to COVID-19 outbreak. The new <b>anticipated date of completion for this milestone is December 2020.</b>
* Install HFR antenna in St. Thomas					December 2019	<b>Delayed</b> due to the temporary restrictions on travel, shipping, and field and laboratory work related to COVID-19 outbreak. The new <b>anticipated date of completion for this milestone is December 2020.</b>
Repair and replace the HFR equipment damaged by Hurricane María					December 2019	Completed in May 2020
* Beach pathogen monitoring					May 2020	<b>On hold</b> until field operations by CARICOOS and partners are allowed to resume.
* Install a new HFR system in Puerto Rico					May 2020	<b>Delayed</b> due to the temporary restrictions on travel, shipping, and field and laboratory work related to COVID-19 outbreak. The new <b>anticipated date of completion for this milestone is December 2020.</b>
<b>MODELING &amp; ANALYSIS SUBSYSTEM</b>						
Operate and maintain CARICOOS Nearshore Wave Model					Continuous	Completed
Operate and maintain CARICOOS WRF Model (1 km & 2 km resolution)					Continuous	Completed
Improve the CARICOOS WRF model to provide other parameters to stakeholders					May 2020	Completed in May 2020
Maintain, validate and improve CARICOOS FVCOM circulation model					Continuous	Completed

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 2020	Completed in May 2020
* Continue further validation of CARICOOS ROMS to optimize assimilation approaches.					December 2019	<b>Delayed</b> , waiting for web developer
<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	
* Develop a data portal to provide real-time acidification data collected by La Parguera Map CO <sub>2</sub> buoy and derived ecosystem metabolic rates					May 2020	<b>Delayed</b> , waiting for web developer
Compliance with IOOS DMAC metadata, file and data discovery standards and checks					Continuous	Completed
Continue CARICOOS DMAC and Regional DAC efforts as detailed in the RICE DMS Plan					Continuous	Completed
Continue operating DMAC and computational infrastructure					Continuous	Completed
Historic data archival					Continuous	Completed
Hosting of CARICOOS summer interns					August 2019	Completed in August 2019
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 2020	Completed in May 2020
Maintain and enhance CARICOOS website					Continuous	Completed
Maintain the HPC infrastructure					Continuous	Completed
RICE DMAC Review					As required	
Technical transfer to in-house IT, improvement and debugging of our web page					Continuous	Completed
<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 2020	Completed in May 2020
Develop and deliver products training workshops					May 2020	Completed in May 2020

Participate in recreational ocean-related activities to promote safety through the use of CARICOOS product and services					Continuous	Completed
Assess awareness and evaluate product feedback and interpretation through formal surveys					Continuous	Completed
Continued assessment of stakeholder/user needs					Continuous	Completed
Host training workshops for teachers to facilitate interpretation of data and products and obtain essential feedback.					May 2020	Completed in May 2020
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	Completed
Consult stakeholders via direct communication and interaction at CARICOOS General Assembly meeting and at sector focused meetings					May 2020	Completed in May 2020
Expand the CARICOOS kiosk network					Continuous	Completed
Continue to issue CARICOOS communications via quarterly newsletters, social media, and CARICOOS School (O&E webpage)					Continuous	Completed
Stakeholder engagement throughout the region					Continuous	Completed
Conduct Board of Directors meetings					March 2020	Completed in November 2019
Support CARICOOS Inc. administrative operations					Continuous	Completed
* Host annual CARICOOS General Assembly					May 2020	The CARICOOS General Assembly has been <b>postponed</b> until 2021 because of the coronavirus pandemic. We will share with our Board or Directors and stakeholders the milestones achieved during the 2019 fiscal year and the impacts to tasks and operations due to the coronavirus.

## 2. Scope of Work

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

### 3. Leadership Personnel and Organizational Structure

No changes to CARICOOS leadership personnel and organizational structure.

### 4. Budget Analysis

Funds allotted to CARICOOS for project year 2019-2020 total \$2,501,262. Fiscal expenditures to date for the period total \$1,429,092. Remaining funds correspond to subawards operating under no cost extensions and indirect costs pending to be drawn down by UPR.

#### a. **FY19 Fill the Gaps Planned Project**

##### i. Gliders

During this performance period, a purchase order was issued to Hydroid for the acquisition of a Seaglider M1 T-S system. Hydroid is experiencing delays for fulfilling and delivering orders since the outbreak of COVID-19. The new instrumentation is expected to arrive by early 2021. Support also provided for the acquisition of materials. The hurricane glider line of the southeastern end of Puerto Rico will still be occupied using a glider loaned by NOAA-AOML. The CARICOOS hurricane glider deployment cruise is scheduled to commence on July 2020. The total expenses incurred from the project to date is \$186,076, which includes the purchase of a new Seaglider, 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 purchase order was issued for the acquisition of a new 13MHz Seasonde system. Support also provided for the acquisition of materials and minor equipment required for the installation. The total expenses incurred from the project to date is \$122,389, which includes the purchase of a new HF Radar system, maintenance, and personnel.

##### iii. Biology/MBON

During this performance period, the Department of Natural and Environmental Resources Long Term Coral Reef Monitoring Program database (DNER-PCRMP) was successfully translated following Darwin Core standards and submitted to OBIS. Currently, the data is being ingested to MBON data portal. To ensure the data is projected correctly, the MBON data visual tool is currently under a series of revisions such as updates of occurrence information, measurement data, and data ingestion function. The total expenses incurred from the project to date is \$12,013.

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

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

Several improvements to the Sargassum forecasting tool are being developed by H. Roarty under a subaward to Rutgers (<https://marine.rutgers.edu/~hroarty/caricoos/animations/>). A validation page showing the comparison between CARICOOS HF Radar network and the ocean model trajectories have been developed. The relative



dispersion of surface drifters is color coded based upon the AFAl concentration from the University of South Florida satellite product. For the upcoming version, particle dispersion surface trajectory skill will be evaluated using RTOFS and CARICOOS FVCOM model.

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

Initial discrete samplings evidence strongly enhanced acidification and persistent hypoxia after Sargasso inundation in low energy mangrove lined cays. Moreover, an analysis using remotely sensed data indicates substantial impact on mangrove and seagrass coverage. Implementation of continued monitoring using autonomous sensors has been delayed due the postponement of instrument construction and deliveries due to COVID.

*c. **Vembu Subramanian Scholarship***

Three awardees, all graduate students at the University of Virgin Islands, were identified as recipients of the Vembu Subramanian Award. The funds acquired from this award supported USVI students research that provided new insights in their chosen academic field.

*d. **Regional Ocean Partnership***

As part of the Regional Ocean Partnership (ROP) efforts, Dr. Yasmin Detrés (CARICOOS ROP program coordinator), together with CARICOOS Principal Investigators, has continued hosting remote meetings and workshops with stakeholders from Puerto Rico and the U.S. Virgin Island to identify and prioritize ocean data needs and challenges. A conceptualization of a decisional support tool prototype integrating data products, visualizations, and information from various sources to support planning and resource management is under development.

**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.