An Operational 3D Hydrodynamic Model of Puerto Rico and U.S. Virgin Islands

Adail A. Rivera Nieves, Fabian García, Patricia Chardón, Miguel F. Canals Silander

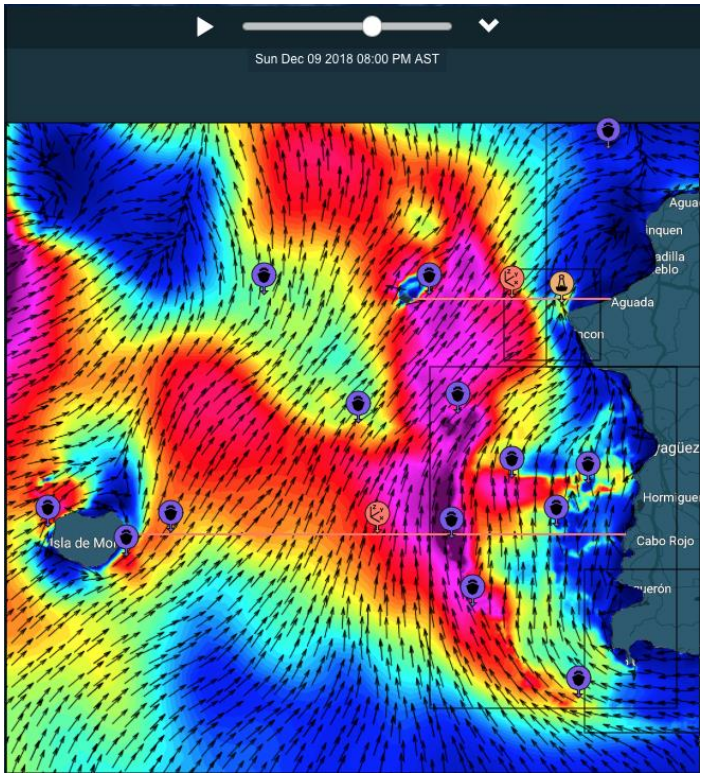
CARICOOS & UPRM Center for Applied Ocean Science and Engineering
University of Puerto Rico at Mayagüez
Performance Period: June 1 2018 – December 30 2018

LONG-TERM GOALS

The main goal of the CARICOOS coastal circulation group is to develop an operational forecasting model for Puerto Rico and the U.S. Virgin Islands that will provide high resolution predictions of water levels, currents, temperature, and salinity. Due to the success of the application of FVCOM in the deep ocean (Chen et al., 2009), the continental shelf (Rego and Li, 2010), and estuaries (Zheng and Weisberg, 2010), FVCOM has been selected as the numerical engine of the CARICOOS circulation forecasting system. Although further validation and fine-tuning is ongoing, the beta version of the model is available at:

https://www.caricoos.org/currents/forecast/FVCOM/PRVI/currents

This web-based data visualization system with real-time model validation metrics allows CARICOOS stakeholders to preview forecasted circulation fields up to 4 days into the future at an unprecedented spatial resolution for the region. An example of model output for December 2018 is shown below:



MILESTONES / OBJECTIVES

The following table includes the wave modeling milestones / tasks as included in the FY18 scope of work, and their current status.

MILESTONE / TASK	Original Completion Date	Status
Maintenance, validation and improvement of CARICOOS FVCOM circulation model	continuous	ongoing
Implement CARICOOS FVCOM to understand the hydrodynamics in La Parguera Marine Reserve (NOAA sponsored Ocean Acidification studies)	April 2019	ongoing

WORK COMPLETED

1. Maintenance, validation and improvement of CARICOOS FVCOM circulation model

Optimization and documentation of the operational model scheme has been successfully completed. Run times for each module of the operational scheme (pre-processing, model run and ploting) have been documented. Also, image output inventory for the CARICOOS webpage products is available for future product assesment. Run time for plotting scripts has been reduced by 50% of the original run time effectively reducing time of operation and load on the CARICOOS server Corriente. The interpolation scheme for atmospheric forcing was optimized to reduced the abrupt change in spatial resolution from WRF 6km and 2km grid. Finally, initial efforts in the implementation of wetting and drying capabilities led to promising initial results but has not been implemented yet.

An important change is the temproary implementation of using RTOFS baroclinic structure as boundary conditions for the operational model. HYCM fields are no longer available in the original format since October 2018. An alternate source of HYCOM daily fields for model initialization and boundary conditions forcing is being explored.

2. Implement CARICOOS FVCOM to understand the hydrodynamics in La Parguera Marine Reserve (NOAA sponsored Ocean Acidification studies)

A non-operational FVCOM implementation for the Parguera region was implemented by graduate student Fabián García in FY 2017. The further enhancement of FVCOM for Parguera and additional simulations will be led by researchers participating in the Ocean Acidifcation testebed, with support from the authors of this progress report.

MAJOR OUTCOMES

An operational 3D circulation model for PR/USVI has been designed, implemented and validated. The model is now "operational" and a mirror version has been installed in CAOSE's/CARICOOS's *Caribe* machine to provide system redundance in separate physical locations (Magueyes Island, Mayaguez). The CARICOOS FVCOM web page has a variety of tools for data visualization, including real-time model validation using HF Radar and buoy observations.

Operational model scheme has been fully optimized and documented. This helps improve troubleshooting efforts, modeler transitions and better use of available resources. Revisiting the operational scheme helped improve input datasets used for the model, such as: atmospheric forcing interpolations and temperature & salinity boundary conditions interpolations.

PUBLICATIONS & PRODUCTS

FVCOM operational web-site:

http://www.caricoos.org/currents/forecast/FVCOM/PRVI/currents

REFERENCES

Chen, C., G. Gao, J. Qi, A. Proshutinsky, R. Beardsley, Z. Kowalik, H. Lin, and G. Cowles (2009), A new high-resolution unstructured grid finite volume Arctic Ocean model (AO-FVCOM): An application for tidal studies, J. Geophys. Res., 114(C8).

Fairall, C. W., Bradley, E. F., Hare, J. E., Grachev, A. A., & Edson, J. B. (2003). Bulk Parameterization of Air–Sea Fluxes: Updates and Verification for the COARE Algorithm. Journal of Climate, 16(4), 571-591.

Rego, J. and C. Li (2010), Storm surge propagation in Galveston Bay during Hurricane Ike, Journal of Marine Systems, 82(4), 265-279.

Zheng, L. and R. Weisberg (2010), Rookery Bay and Naples Bay circulation simulations: Applications to tides and fresh water inflow regulation, Ecological Modelling, 221(7), 986-996.