Towards an Operational 3D Hydrodynamic Model of the San Juan Bay and Estuary System

Adail A. Rivera Nieves
University of Puerto Rico at Mayagüez
adail.rivera@upr.edu

Miguel Canals
UPRM Center for Applied Ocean Science and Engineering
miguelf.canals@upr.edu

LONG-TERM GOALS

The main goal of the present study is to develop an operational modeling system for the San Juan Bay and Estuary System (SJBES) that will provide high resolution predictions of currents, temperature, and salinity. Due to the success of the application of FVCOM to the deep ocean (Chen et al., 2009), the continental shelf (Rego and Li, 2010), and estuaries (Zheng and Weisberg, 2010), FVCOM has been selected o be implemented in the SJBES. The specific objectives of this project are as follows:

1) The implementation of the FVCOM model in the PR/USVI region to be able to predict coastal currents
2) After implementing FVCOM at the regional scale, implement a very high-resolution mesh to forecast circulation of the SJBES due to tides, wind, waves and river discharges.
3) Validate FVCOM through quantitative methods using real data from CARICOOS buoys and newly deployed instruments.
4) Daily data publication through the CARICOOS web page in different formats (i.e. maps, graphs, tables).

It is expected that the completion of these objectives will result in a better understanding of the circulation of the SJBES as well as the PR/SUVI region. This model will be of great benefit to management efforts of the SJBES, as well as to stakeholders throughout Puerto Rico and the USVI.

MILESTONES / OBJECTIVES

In order to accurately simulate the circulation of the SJBES, the model will be nested to the coarser model of the region including Puerto Rico and the U.S. Virgin Islands (PRVI):

Some tasks related to the development of the PRVI model:

1. Construct PRVI hydrodynamic mesh
2. Run a barotropic model forced with wind velocities, surface air pressure and tides
3. Add initial condition of temperature and salinity from AMSEAS
4. Add heat flux surface boundary conditions
5. Add boundary condition of temperature and salinity
6. Add boundary condition of current velocities
7. Develop beta version of operational model
8. Develop preliminary web interface, in collaboration with Candela Creative Group.

9. Model validation
10. Publication of model predictions to stakeholders (to be formally released at 2017 CARICOOS General Assembly)

The same tasks outlined above also apply to the SJBES model and are being carried out in parallel with the PRVI model development.

WORK COMPLETED

A mesh of the PRVI model has been created. The PRVI model has been implemented and is currently running operationaly every day at 1:00 am (Standard Atlantic Time). The current version of the model obtaines the currents, temperature, salinity and sea surface elevation boundary conditions from the AMSEAS model. Wind velocities and sea surface pressure are obtained from CARICOOS 2km and 6 km WRF Models. Surface heatflux conditions are prescribed by the NOAA GFS model.

MAJOR OUTCOMES

An operational 3D circulation model for PRVI has been implemented in the CARICOOS webpage. Various grids or zoomed regions (Figures 1 and 2) have been implemented for vizualization. There is also an operational validation for currents (Figures 3 and 4), temperature and salinity (Figures 5 and 6) using CARICOOS buoy data. Water level are also validated in an operational scheme using water level data from the NOAA tide stations across the PRVI (Figures 7 and 8).

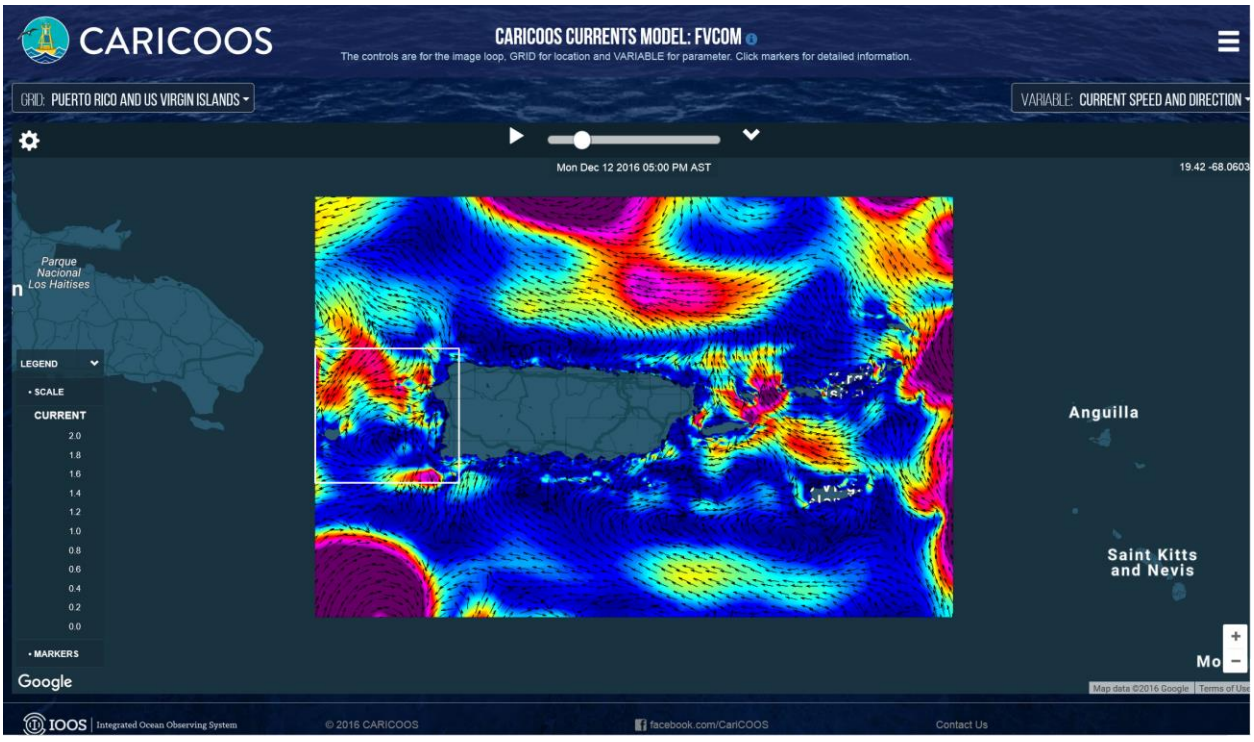

Figure 1: PRVI zoom grid of the CARICOOS FVCOM Circulation Model

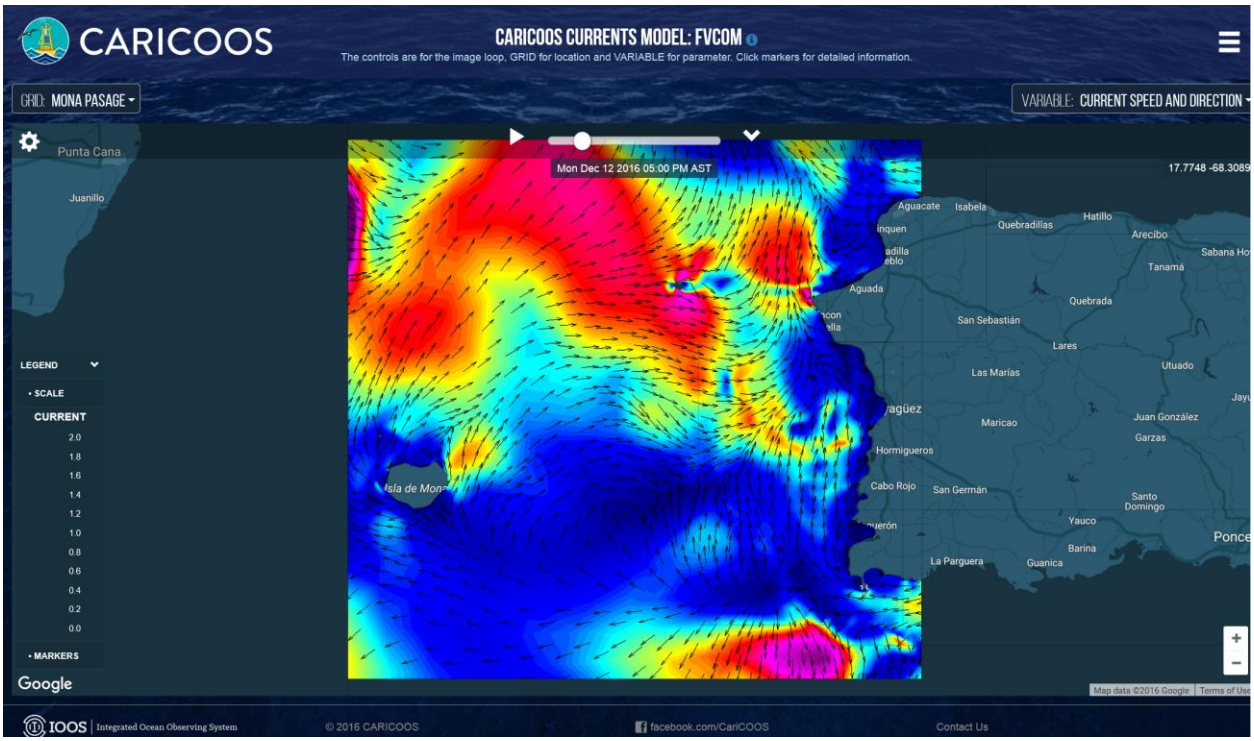

Figure 2: Mona Passage zoom grid of the CARICOOS FVCOM Circulation Model

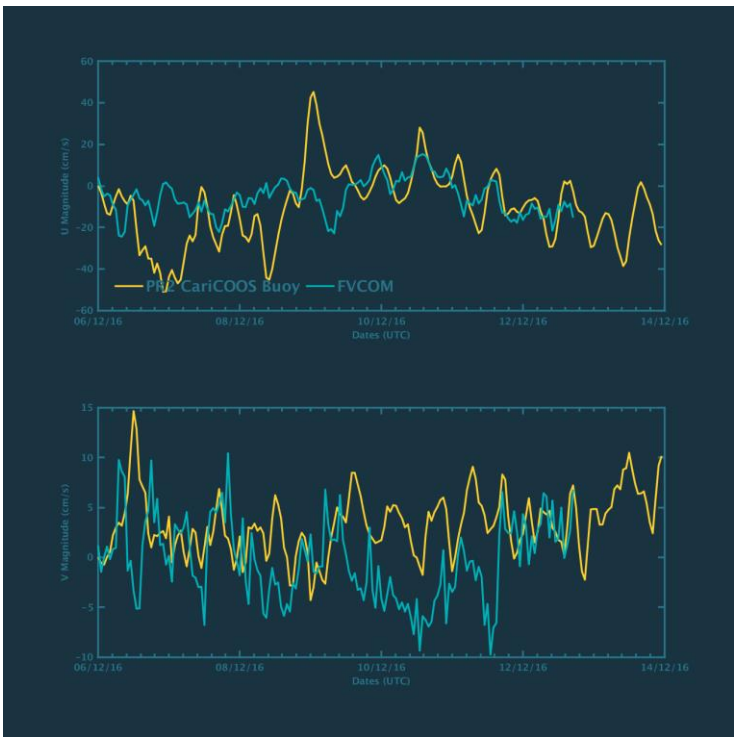

Figure 3: FVCOM currents validation at CARICOOS PR2 buoy (San Juan).

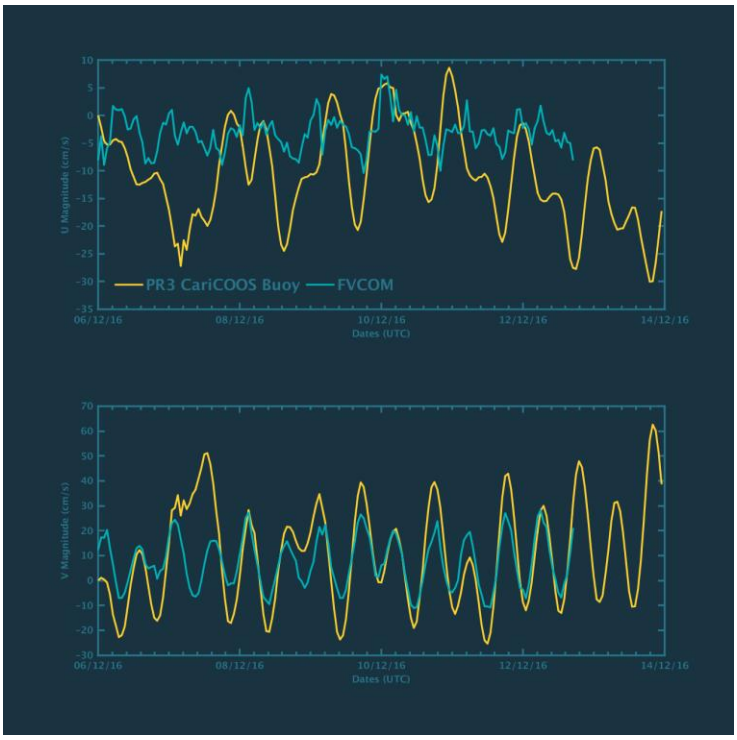

Figure 4: CARICOOS Currents Model: FVCOM currents validation at CARICOOS PR3 buoy.

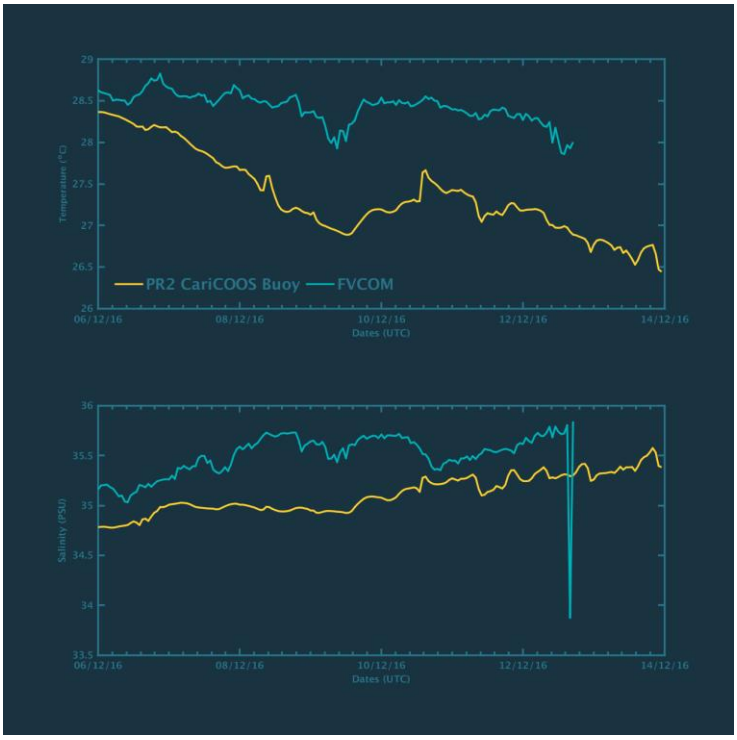

Figure 5: FVCOM temperature and salinity validation at CARICOOS PR2 buoy.

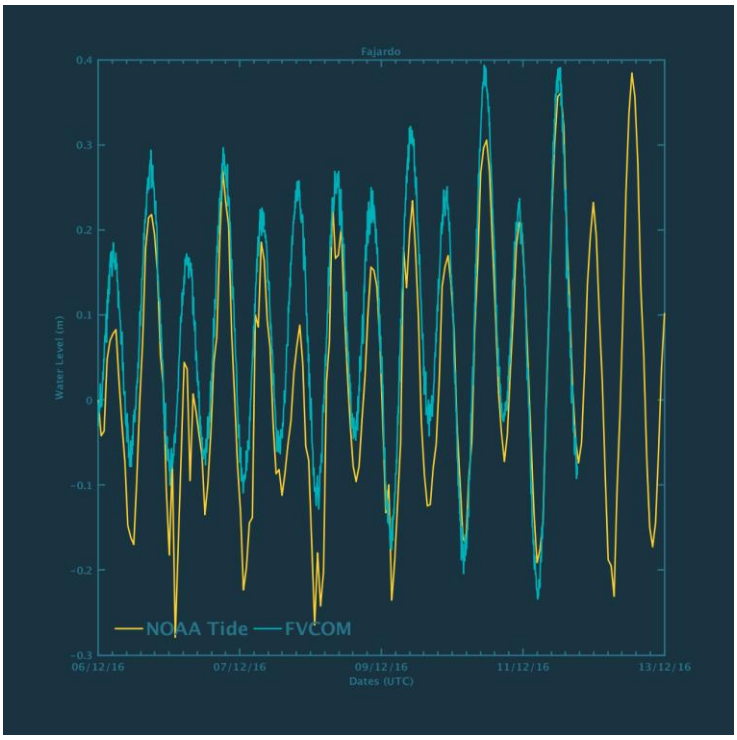

Figure 6: FVCOM water level validation at NOAA's Fajardo Tide Station.

RELATED PROJECTS

None

WORK PLAN FOR UPCOMING PERFORMANCE PERIOD (Dec. 1 – May 31 2016)

During the remainder of FY16 the SJBES nested model will be developed and validated with observations obtained with instruments to be deployed during December 2016.

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).

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.

PUBLICATIONS & PRODUCTS

CARICOOS Currents Model: FVCOM
(http://staging.caricoos.org/currents/forecast/FVCOM/PRVI/currents)