Multiple Model Comparisons in the Chesapeake Bay: Hydrodynamics and Dissolved Oxygen
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The overarching goal of the Estuarine Hypoxia component of the U.S. IOOS Testbed Project was to help improve operational modeling of hypoxia in the Chesapeake Bay. This was accomplished through comparisons of the relative skill of various Bay models, a comparison of the strengths and weaknesses of various models, and an assessment of how model differences affect water quality simulations. Five biological models characterized by varying levels of complexity were embedded in five different hydrodynamic model configurations, and model skill was determined by how well the various model combinations reproduced the mean and variability of stratification and dissolved oxygen at ~40 water quality monitoring stations in 2004 and 2005.

The CBP model (CH3D-ICM) reproduced stratification better than the models based on the Regional Ocean Modeling System (ROMS), increasing our confidence in the CBP model simulations. In terms of bottom dissolved oxygen (DO) and hypoxic volume (HV), the difference between the CBP model and other models was less clear. Some of the extremely simple biological model configurations were able to reproduce bottom DO and HV as well as the significantly more biologically complex CBP model. In addition, averaging output from multiple models provided better hindcasts than relying on any individual model alone. This project has demonstrated the critical importance of (1) quantitatively assessing model skill, (2) using multiple open source community models, and (3) having multiple people from multiple institutions collaborate together on Chesapeake Bay modeling issues.

The second half of Friedrichs' presentation focused on a review of the M3.1 STAC Workshop: "Using Multiple Models for Management in the Chesapeake Bay: A Shallow Water Pilot Project". This workshop was held at the Virginia Institute of Marine Science, April 16-17, 2012 (See Friedrichs et al. (2012) for more workshop details.)

The overall recommendation from this prior workshop was that **a multiple shallow water model pilot project is key to the advancement of the CBP modeling program and should begin as soon as possible.**

M3.1 Workshop participants unanimously agreed that multiple modeling efforts were critical in order to: (1) help determine whether the regulatory CBP model is as skillful as other models of the Bay, (2) to build scientist, management and stakeholder confidence in the model at a time when confidence in the regulatory model is low and (3) to help the CBP heed recommendations suggested in several recent STAC reports and reviews. In addition, workshop participants felt that a prototype multiple modeling project should be conducted specifically in the shallow waters of the Bay because the Modeling Workgroup has recently identified limitations to the existing model framework in the shallowest, most productive parts of the Bay and have suggested that additional modeling approaches need to be considered in these waters.

As part of the proposed effort, shallow water hydrodynamic+water quality modelers would be sought for participation in a 1-2 year pilot project. Each modeling team would be asked to use a common forcing set to implement 3-5 year base case runs at specified times and sites, and provide daily distributions of variables relevant for SAV (T, S, DO, light, nutrients). In addition, each team would provide results from runs generated using specified nutrient reduction scenarios. A separate model comparison team would use the daily distributions from each model as input to a specified empirical SAV model, use state-of-the-art metrics to assess the relative skill of the participating

simulations, compare the results of the modeled nutrient change scenarios, and analyze causes and impacts of differences among the models.

The outcomes of the pilot project include: (1) the identification of a new model for the shallow waters and/or suggested improvements to the existing model, (2) confidence estimates for CBP shallow water simulations, and (3) a demonstration of the utility of using multiple CB models, in response to recommendations of previous NRC/STAC reports/reviews.

References:

Friedrichs, M., K.G. Sellner, and M.A. Johnston. 2012. USING MULTIPLE MODELS FOR MANAGEMENT IN THE CHESAPEAKE BAY: A SHALLOW WATER PILOT PROJECT. Chesapeake Bay Program Scientific and Technical Advisory Committee Report. No. 12-003, Edgewater, MD. 2012 09.