21-26 Feb 2016, submitted. 2016 Ocean Sciences Meeting, New Orleans, LA. I.D. Irby, M.A.M. Friedrichs, C.T. Friedrichs, and the COMT Estuarine Hypoxia Team. "Challenges associated with modeling low-oxygen waters in Chesapeake Bay: a multiple model comparison"

Abstract

As ecosystem and water quality models are becoming more frequently used for operational forecasts and scenario-based management decisions, it is important to understand the relative strengths and limitations of existing models of varying complexity. To this end, simulations of the Chesapeake Bay from eight three-dimensional coupled hydrodynamic-oxygen models have been statistically compared to each other and to two years of historical monitoring data. Results show that although models have difficulty resolving the variables typically thought to be the main drivers of dissolved oxygen variability (stratification, nutrients, and chlorophyll), all eight models have significant skill in reproducing the mean and seasonal variability of surface and bottom dissolved oxygen. In addition, models with constant net respiration rates independent of nutrient supply and temperature reproduced observed dissolved oxygen levels about as well as much more complex, nutrient-dependent biogeochemical models. This finding has significant ramifications for short-term hypoxia forecasts, which may be possible with very simple oxygen parameterizations. Chesapeake Bay observations indicate a stronger correlation between the depths of the top of the halocline and the oxycline than between their magnitudes, highlighting that the depth of stratification compresses livable habitat when low-oxygen conditions are present. Furthermore, this implies that improvement in hypoxia simulations will depend more on the ability of models to reproduce the correct mean and variability of the depth of stratification than the precise magnitude of stratification. This study also provides an example of how multiple community models can be used together to improve management decisions based on regulatory model results.