Project Summary

Title - CHRP 2016: Operational Lake Erie Hypoxia Forecasting for Public Water Systems Decision Support

Institutions -NOAA Great Lakes Environmental Research Laboratory; University of Michigan; City of Cleveland Division of Water; Purdue University

Investigators - Craig A. Stow, Eric J. Anderson, Steven A. Ruberg, Doran M. Mason, Mark D. Rowe, Thomas H. Johengen, Dmitry Beletsky, Hongyan Zhang, G. Allen Burton, Jr., Scott Moegling, Paris E. Collingsworth

Total Proposed Cost-$1,943,520 (with ship funds), $1,900,320 (without ship funds)

Budget Period - October 1, 2016- September 30, 2021

Project Abstract - In Lake Erie, it is common for strong water quality differences to exist between surface and bottom water during summer stratification. Weather-driven dynamics during stratification can cause water intakes to be alternately exposed to surface or bottom water, requiring public water systems to adapt treatment processes to changing raw water quality. Surface water has higher pH, and may have high concentrations of phytoplankton, dissolved organic matter, and algal toxins. In contrast, the bottom water is usually hypoxic, with a low pH and elevated iron and manganese concentrations, requiring expensive treatment. **To give public water systems advance warning of lake circulation events that are likely to cause changes in raw water quality the development of an operational dissolved oxygen forecast model for Lake Erie, coupled to an existing real-time, fine-scale hydrodynamic model is proposed.** This coupled system will allow drinking water managers to prepare when conditions that promote hypoxic water movement into the vicinity of water intakes occur. The models will be an extension of the existing, next-generation Lake Erie Operational Forecasting System that will become operational at NOAA's National Ocean Service Center for Operational Oceanographic Products and Services in 2016. The first new model will be physically-based, requiring the addition of a dissolved oxygen (DO) component to the existing hydrodynamic model. It is expected that this model will provide an experimental real-time, forecast product in the second year of the project, and be skill-assessed to begin transition to operational status near the end of the five-year project. The second new model will require addition of the chemical and biological drivers of hypoxia (nutrients, phytoplankton) to the physical DO model. Additionally, the development of the biophysical model in tandem with the physical model will offer an **opportunity to address a current, pressing management question and a broader philosophical question** regarding model complexity. **First,** under the 2012 Great Lakes Water Quality Agreement (GLWQA) the United States and Canada are committed to "minimize the extent of hypoxic zones ... associated with excessive phosphorus loading, with particular emphasis on Lake Erie". However, the available models were limited and the proposed target phosphorus load was based on the projected average hypolimnetic DO concentration, rather than the areal hypoxic extent. These new models will help differentiate the relative importance of the physical and biological drivers of hypoxia, and guide future decision-making in the Adaptive Management phase of target load implementation under the GL WQA. **Second,** the rigorous comparison of predictions from these two models will offer a basis to evaluate whether the added complexity of the biophysical model provides better predictive accuracy, a question that remains unresolved in the modeling community. Model development will be supported by field activities to gather data for a rigorous model skill assessment, and to better characterize the central basin oxygen demand sources, as well as buoy deployment to monitor DO conditions, which can change rapidly near the hypolimnion perimeter, where the drinking water intakes are located.