CHRP2016: Predicted impacts of climate change on the success of alternative management actions in the Chesapeake Bay: Using multiple community models in support of hypoxia management decision-making

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Abstract:

Coastal hypoxia is an increasingly critical stressor for living resources in the Chesapeake Bay, not only because of excess nutrient inputs derived from agriculture, sewage and storm water runoff, but also because of predicted increases in atmospheric temperatures and changes in precipitation patterns. Together, the combined effects of anthropogenic nutrient inputs and climate change are leading to one of society's major environmental challenges. In order to address this problem, water quality assessment and projection tools that can account for both climate and nutrient impacts must be developed and operationalized. This project will apply a trans-disciplinary approach to aid in the development of sustainable solutions for managing nutrient reduction in the face of a changing climate. The two overarching goals of the proposed work are to quantitatively predict: (1) the impacts of future changes in climate and anthropogenic nutrient inputs on the spatial and temporal extent of hypoxia in the Chesapeake Bay and (2) the impacts of climate change on the effectiveness of various alternative management actions designed to reduce hypoxia and improve water quality.

These objectives will be accomplished by integrating decades of NOAA and EPA monitoring observations collected in the Chesapeake Bay with a multiple modeling framework, which has been strongly recommended to the Bay Program. This ecosystem-based scenario forecast modeling system includes multiple climate and land use projections fed into multiple terrestrial and estuarine models: two mechanistic land ecosystem/watershed models (one academic and one operational/regulatory) and two coupled estuarine water quality models (one academic and one operational/regulatory). The power of the multiple modeling framework is the ability to capture the likely range in future conditions. Factorial model simulations will isolate the effects on hypoxia of long-term climate-related changes in temperature, precipitation, and sea level and from anthropogenic changes in land-use, land-cover, and management practices. Communication with relevant stakeholders will be initiated early in the project via a Management Transition Advisory Group (MTAG), which will include state representatives as well as coastal managers from multiple federal agencies. Through input from the MTAG, additional simulations with the multiple model combinations will be designed to identify specific regional management practices that will mitigate impacts of hypoxia on living resources, maximizing social and economic return. Simulations with all four pairs of watershed/estuarine model combinations forced by multiple climate and land use projections will help provide independent confidence bounds for management decisions, and hence build scientist, management, and stakeholder confidence in the modeling system. Dialog with the MTAG throughout the project lifetime will ensure development of outputs that are timely and in a useful form for the regional management of hypoxia.