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Field Hearing on Progress in Safeguarding Chesapeake Bay
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Chairman Davis, Congressman Schrock, members of the Committee, thank you for the opportunity to appear before you today. I am Eileen E. Hofmann, Professor in the Department of Ocean, Earth, and Atmospheric Sciences at Old Dominion University in Norfolk, VA. My comments today are based on my research and experience as a scientist and are my own and should not be attributed to Old Dominion University.

My comments are given in three parts. The first part addresses the importance of maintaining modeling and monitoring programs. The second part describes an ongoing effort to improve modeling of the Chesapeake Bay system and the final part of my comments provides an example of a new direction for modeling the Chesapeake Bay system.

I would like to begin my comments by saying that the combined circulation-water quality-watershed model structure and concurrent Bay-wide monitoring program initiated in the mid 1980s by the Chesapeake Bay Program defined a state-of-the-art approach to managing marine resources that has influenced other marine resource management programs. It is now inconceivable that a marine system would be managed without the combined input of modeling and data collection programs. The Chesapeake Bay Program deserves credit for taking such a monumental step at the start.

The Need for Modeling and Monitoring

Predictions of nutrient loadings and the extent of regions of low-oxygen waters in an estuary such as Chesapeake Bay are difficult at best. The recent articles in the public media suggest that implementation of the Chesapeake Bay modeling and monitoring program is problematic and possibly flawed. The apparent discrepancies between results obtained from model simulations and those obtained from data analyses in regard to nutrient loads and dissolved oxygen distributions in Chesapeake Bay have resulted in suggestions that the model does not represent real conditions, that the modeling effort has not made good use of available data, and that the modeling effort be abandoned and only observations be used to determine the state of the Bay.

The reliance on models versus monitoring data for assessing the state of a system has long been debated within the marine sciences community. It is now recognized that both are needed. Data collection systems are capable of providing continuous high-quality measurements. Mathematical modeling and computer technology have made tremendous advances in the past decade. Combining data via models provides a powerful approach for understanding marine systems and for making predictions about future states. So, to suggest that the Chesapeake Bay Program abandon or lessen its reliance on models in favor of a data-only approach is not appropriate and is not in keeping with the current state of understanding and scientific ability. So, what can be done to better integrate the Chesapeake Bay Program modeling and monitoring efforts? An effort now ongoing in the Chesapeake Bay academic and research communities provides an approach for how this might be done and brings me to the second part of my comments.

Chesapeake Community Modeling Project

In the late 1990s, the scientific community of the region participated in a review, through the Chesapeake Bay Scientific and Technical Advisory Committee, of the Chesapeake Bay model by an external committee that included Dr. Scott Nixon from the University of Rhode Island as Chairman and Dr. Hugh Ducklow from the Virginia Institute of Marine Science and me as members. The committee report (available at: http://www.chesapeake.org/stac/stacpubs.html) noted that the modeling and monitoring components of the Chesapeake Bay Program were not well integrated, that the Chesapeake Bay circulation-water quality-watershed models were lacking in ability to include in simulations the effects of processes such as variations in freshwater inflow and winds known to influence nutrient loading and dissolved oxygen distributions, and that the reliance on a single model structure had stifled scientific advances and reduced estimates of confidence in model output.

One result of this review was the development of a "grass roots" modeling effort within the Chesapeake Bay scientific community, which has become the Chesapeake Community Modeling Project (see http://ccmp.chesapeake.org/CCMP and the attached Chesapeake Community Modeling Project Implementation Plan). The goal of the Chesapeake Community Modeling Project is to improve the ability to model and predict physical and biogeochemical processes in Chesapeake Bay and its watershed. The foundation of the effort is a collaborative, open-source, research-oriented modeling framework designed to focus and coordinate the intellectual resources of the Chesapeake Bay research institutions and the broader scientific community, and promote free and open exchange of information, data, models, and results. Within this framework, the Chesapeake Community Modeling Project is developing a range of models and the availability of multiple models will greatly enhance the ability to evaluate model skill and predictions, providing some measure of confidence through multiple model predictions.

An explicit goal of the Chesapeake Community Modeling Project is to develop state-of-the-art, coupled watershed and estuarine models for the Chesapeake Bay region based upon the latest technologies and modeling approaches. This is intended to foster the development of a diversity of approaches and models, and to promote model inter-comparison efforts. This

approach fosters scrutiny of all aspects of the models and simulations, including assessments of projections derived from single models that will likely drive Chesapeake Bay restoration. This is something that has been missing in the Chesapeake Bay modeling program.

The Chesapeake Bay Program is a partner in this new effort. There is much that the research community and Bay Program can provide to one another and the last part of my comments highlights one example.

Example of a Potential Change in Modeling Approach

The Chesapeake Bay Program is in a unique position of having, through its monitoring program, a robust data set with space and time resolution that is adequate for developing and implementing data assimilative models of the Bay system; these are models that incorporate observations into the model to 'adjust' model output towards observations, an approach used routinely in numerical weather forecast models and numerical ocean circulation models. Because real data include dynamics responsible for a particular process or distribution in the estuary, inclusion of the observed data will improve model simulations and predictions. Therefore, development of data assimilative circulation, ecosystem, water quality, and watershed models would ensure that the monitoring and modeling efforts are combined.

Combining modeling and monitoring efforts via data assimilation will improve model predictions, model structure, and the design of the monitoring program. The use of data assimilation allows event scale features, such as storms or variations in freshwater inflows, to be resolved and influence model predictions, something not possible with the present Chesapeake Bay model configuration or with the planned Phase 5 modifications to the model.

One note of caution: the process of development of data assimilative models may potentially result in revisions to the dynamics included in the circulation, water quality, and watershed models, thereby making comparisons with previous models difficult and perhaps calling into question previous model-based conclusions. The latter is appropriate, enabling open discussion for science-based resolution of the most beneficial practices for Bay restoration. Data assimilation can be used to determine optimal sampling designs and the frequencies at which data need to be collected, allowing more efficient use of monitoring resources.

In summary, the development of data assimilative models is just one example of the changes needed in infrastructure, philosophy, and approach in the Chesapeake Bay modeling program to bring it to a state-of-the-art system. The need to provide accurate predictions with far-reaching policy and social implications make it imperative that the Chesapeake Bay modeling and monitoring programs be aware of and take full advantage of current practices and advances in marine resource modeling.

Thank you for the opportunity to address you today. I will be happy to answer any questions you may have.

Attachments: 1) Chesapeake Community Modeling Project Implementation Plan, 2) Hofmann current and pending support forms