

**Chesapeake Bay Forecast System: An integrated ecological modeling framework**

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The Chesapeake Bay Forecast System (CBFS) is a flexible, end-to-end expert regional Earth System prediction tool for decision-makers that is designed to provide customizable, designer forecasts for regional climate, air and water quality, ecosystems, and other resources from days to decades. With the dynamic downscaling of the global forecasts (GFS 14-days, IRI-seasonal forecast), CBFS produces a 20-member ensemble 14-day forecast every day and a 15-member ensemble seasonal outlook every month with Weather Research and Forecast Model (WRF) coupled to NOAA. In the current configuration, WRF output forces the Chesapeake Regional Ocean Modeling System (ChesROMS) and SWAT (Soil Water Assessment Tool) for the 14-day and seasonal prediction of SST and salinity in the Chesapeake Bay and freshwater discharge, nutrient loads and sediment loads from watershed to the Bay. The long-term water quality data were collected and assembled to develop ecological models and these models were forced by WRF and ChesROMS outputs to produce linked ecological products like forecasts of dissolved oxygen, sea nettles, harmful algal blooms, striped bass habitat suitability, and human pathogens in the Chesapeake Bay. The predicted oxygen values and other physical outputs from downscaling of regional weather and climate predictions, or forecasts from hydrodynamic models can be used to forecast various ecological components with economic and human health relevance. Such forecasts would also be useful for recreational and commercial users of the Bay. An interactive prototype tool is developed for exploring the impact of land use change, urban growth, agricultural practices and Smartgrowth implementations on Bay health: from regional air and water quality to extreme hypoxia and toxic algae proliferation. The framework in its current configuration and the details of the latest Earth System forecasts are presented along with the future evolution of the decision-support tool for sustainability.