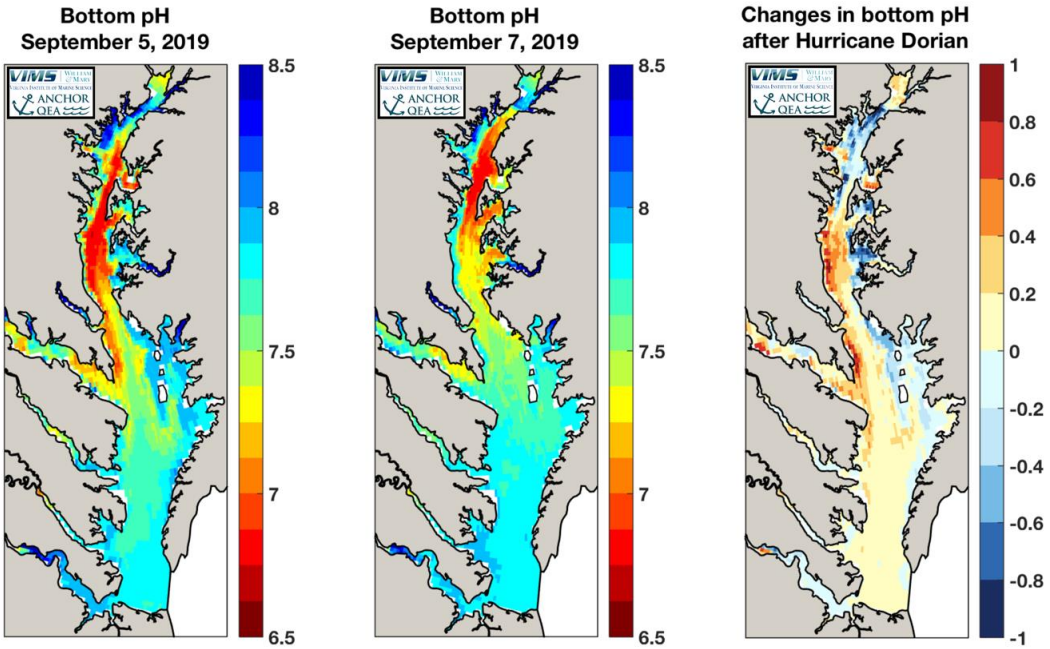
Chesapeake Bay Forecasting: A Model to Address Stakeholder Data Needs

-by Anthony Himes, Virginia Sea Grant OA Fellow

Chesapeake Bay is the largest estuarine system in the United States and supports both recreational and commercial activities that are crucial to the economic prosperity of its surrounding states. Chesapeake Bay and other coastal systems in the Mid-Atlantic are particularly susceptible to increased ocean acidification through the absorption of atmospheric carbon dioxide as well as from eutrophication due to land runoff. As changes in the environment continue to occur, monitoring environmental parameters becomes of increasing importance to help commercial industries adapt while maintaining output. Chesapeake Bay has abundant finfish and shellfish fisheries as well as an expanding shellfish aquaculture industry. Developing new forecasting tools for acidification can help harvesters and growers address future uncertainty.

One initiative to develop monitoring tools is being led by Dr. Marjorie Friedrichs from the Virginia Institute of Marine Science (VIMS). Her research group is working to expand the Chesapeake Bay water quality forecasting system to provide new real-time acidification-related information for researchers and industry stakeholders. Their 3-D model, which is based on decades of water quality monitoring data in the Bay and uses real-time weather forecast information, generates a daily nowcast and a two-day forecast of environmental conditions in the Bay. The short-term forecasts for water temperature, salinity, oxygen concentration, and acidification metrics (pH, alkalinity, and aragonite saturation state) can be used to predict complex interactions across the bay. These interactions are important to many industries as they can result in dead zones, impact nursery habitat for fish, and serve as a metric for overall ecosystem health. The 3-D projections are continuously available for each of the water quality parameters that are being monitored on the Chesapeake Bay forecast website (www.vims.edu/research/topics/dead_zones/forecasts/cbay/index.php). An example of some extreme pH changes in relation to Hurricane Dorian are provided in the figure below. Researchers, shellfish growers, and harvesters can easily access the online information from a smart phone or save and print the forecasts for later use. Friederichs' group hopes that the Chesapeake Bay water quality forecasts will help stakeholders decide on ideal times for fish harvesting and larval spawning in hatcheries.



An example of bay-wide bottom pH forecasts before and after Hurricane Dorian (September 6, 2019). The map on the far right depicts the magnitude of the changes. Much greater changes in pH are seen in the Upper Bay compared to the Lower Bay.

As acidification continues to worsen with the continued release of carbon dioxide and land use changes, the need to monitor acidification parameters in shellfish hatcheries and oyster farms will continue to grow. Shellfish growers can use the Chesapeake Bay 3-D model forecasts to determine the best windows for putting out new seed to maximize its success. Aquaculture operations can use the forecasts to make decisions about best times to pump and store water, avoiding times when salinity, pH, or oxygen concentrations are too low. Developing and expanding these tools will be fundamental to the continued success and growth of water-dependent industries around Chesapeake Bay.

Friedrichs' group hopes to continue engaging with stakeholders to understand their information needs. *"Our goal is to effectively provide opportunities for stakeholders to inform us on what they need most, and for us to translate the state-of-the-art water quality research into usable and actionable information for the stakeholders."* Currently, Friedrichs' group is working to increase the spatial resolution of the model, and also expanding beyond the bay and its tributaries to include the coastal bays along the eastern shore of Virginia and Maryland. The development of online visualizations accessible from any wireless device for the practical day-to-day use of this model output clearly demonstrate how researchers and stakeholders can work together to address data needs to better inform decision making in order to manage economically important natural resources.