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Predicting Coastal Circulation and Harmful Algal Blooms in the Gulf of Maine: From Ensemble Seasonal Forecasting to Data Assimilative Hindcasting

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The Gulf of Maine (GOM) is a continental shelf sea that supports productive shellfisheries that are frequently impacted by harmful algal blooms (HABs) of Alexandrium fundyense, a species of dinoflagellate that produces toxins causing paralytic shellfish poisoning (PSP). To predict HAB abundance and distribution in the GOM, we have coupled a population dynamics model for A. fundyense into a regional ocean circulation modeling framework. Simulations initiated from A. fundyense cyst distributions capture large-scale seasonal patterns in the distribution and abundance of A. fundyense cells, and support the hypothesis that cyst abundance is a first-order predictor of regional bloom magnitude in the following year. Cyst abundance may thus hold the key to interannual forecasts of PSP severity.

We will discuss our approaches to performing an ensemble forecast before the bloom season, near real-time weekly nowcast/forecast during the bloom season, and data assimilative model hindcasts after the bloom season. A newly implemented 4-dimensional data assimilation method has allowed the physical model to better account for anomalies in coastal circulation and water mass properties, which are crucial for more accurate HAB prediction. The challenges and potential for an operational red tide forecasting system in the GOM will also be discussed.