Hindcasting the 2005 *Alexandrium fundyense* Bloom

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A coupled physical/biological modeling system is used to hindcast the 2005 *Alexandrium fundyense* bloom and investigate the relative importance of factors governing the bloom's initiation and development. The coupled system consists of a state-of-the-art, free-surface primitive equation Regional Ocean Modeling System (ROMS) tailored for the Gulf of Maine (GOM) circulation using a multi-nested configuration, and an *A. fundyense* population dynamics model developed recently by Stock et al. (2005). The system is forced by realistic momentum and buoyancy forcings, major rivers runoffs in the gulf, observed *A. fundyense* cyst abundance, and climatological nutrient fields. Extensive comparisons are made between modeled (both physical and biological) fields and in-situ observations. The hindcast model is capable of simulating the large-scale structure of the 2005 bloom in its initiation and development phases. The mechanisms of bloom termination remain enigmatic.

Sensitivity model experiments are conducted to distinguish roles of three major factors hypothesized contributing to the bloom: 1) the high abundance of newly deposited cysts in western GOM sediments; 2) several strong storms with prevailing downwelling favorable winds; and 3) large amount of fresh water entering the gulf due to abundant rainfall and heavy snowmelt. It is found that the newly deposited cysts in western GOM were the main cause of the 2005 bloom. Wind forcing was an important regulator, as episodic bursts of northeast winds caused onshore advection of offshore populations. These downwelling favorable winds also accelerated the along-coast flow, resulting in transport of high cell concentrations into Massachusetts Bay. Anomalously high river runoff in 2005 resulted in stronger buoyant plumes/currents, which then transported more nutrients to the Western GOM as indicated by in-situ nutrient measurements. While affecting cell abundance in Massachusetts Bay, these buoyant plumes were confined near to the coast, and had limited impact on the broad, gulf-wide bloom distribution.

With cyst abundance data collected by post-bloom surveys in the fall 2005, the coupled modeling system is being used to project *A. fundyense* bloom conditions in the upcoming spring and summer seasons in 2006.