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Hydrodynamic models are used in coastal oceanography to simulate the circulation of limited-area domains for studies of regional ocean dynamics, biogeochemistry, geomorphology and ecosystem processes. When operated as real-time now-cast or forecast systems, these models offer predictions that assist decision-making related to water quality and public health, coastal flooding, shipping, maritime safety, and other applications.

Here we describe the configuration and operation of such a modeling system for the shelf waters of the Mid-Atlantic Bight (MAB) – a region with a diversity of real-time models in sustained operation and a dense in situ observational data set for assimilation and skill assessment. MAB circulation is influenced by winds, tides, buoyancy input from rivers, a steady along-shelf sea level gradient, and mesoscale eddies that impinge upon the shelf edge. This spectrum of forcing, the relatively wide and shallow shelf, and the dynamic shelf edge frontal zone, makes the region and interesting test-bed for data assimilation methodologies.

The MAB is relatively densely observed, with much of the local data acquisition coordinated by the Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS) – a component of the U.S. Integrated Ocean Observing System (IOOS) network of regional coastal observatories. MARACOOS operates an extensive CODAR (Coastal Ocean Dynamics Applications Radar) network observing surface currents from the coast to the shelf edge, and deploys autonomous underwater glider vehicles (AUGV) to acquire subsurface temperature, salinity and biogeochemical data along transects throughout the MAB.

The Rutgers University Ocean Modeling Group sustains a real-time forecasting system for the MAB using the ROMS model (Regional Ocean Modeling System; www.myroms.org) with 4-dimensional Variational (4D-Var) data assimilation to adjust initial conditions, boundary conditions, and surface forcing in each analysis cycle. The data that are assimilated include CODAR velocities, satellite sea surface height anomalies (with coastal corrections), infrared and microwave satellite surface temperature, in situ temperature and salinity from AUGV and National Marine Fisheries Ecosystem Monitoring voyages, and all in situ data reported via the WMO GTS network.

The Mean Dynamic Topography that augments altimeter sea level data is derived from a complementary ROMS 4D-Var analysis constrained by mean surface fluxes, hydrographic climatology, long-term mean CODAR currents, lengthy mooring deployments, and a decade of ADCP data on a New York to Bermuda ship transect.

We describe the design and operation of the real-time system, and quantify the modeling system skill in comparison to other MAB real-time systems, in situ current-meter data, and U.S. Coast Guard Lagrangian drifters.
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