

Modeling hydrodynamics, water quality, and benthic sediment processes to predict ecological effects in Narragansett Bay

The environmental fluid dynamics code (EFDC) was used to study the three dimensional (3D) circulation, water quality, and ecology in Narragansett Bay, RI. Predictions of the Bay hydrodynamics included the behavior of the water surface elevation, currents, salinity, and temperature in 3D during the full year of 2009. Water quality predictions covered 21 state variables in the water column and 27 state variables in the benthic sediment. The water quality in the water column and in the benthic sediment were fully coupled with the depositional flux of particulate organic matter from the water column to the sediment and the upward flux of the remineralized nutrients from the sediment back to the water column. All benthic fluxes were calibrated to existing regressions of observations from the Bay. Model performance for hydrodynamics and transport was evaluated with a matrix of nine skill parameters to compare predictions to observations at twelve buoy stations.

Seasonal hypoxia in the water column was studied by modeling dissolved oxygen concentration together with three groups of phytoplankton (cyanobacteria, green algae, and diatoms). Periods of low oxygen concentrations in bottom waters were identified for acute and chronic levels that can affect pelagic and benthic biota. Scenarios for various mitigation measures were examined including reduction of nutrient loads from waste water treatment plants.