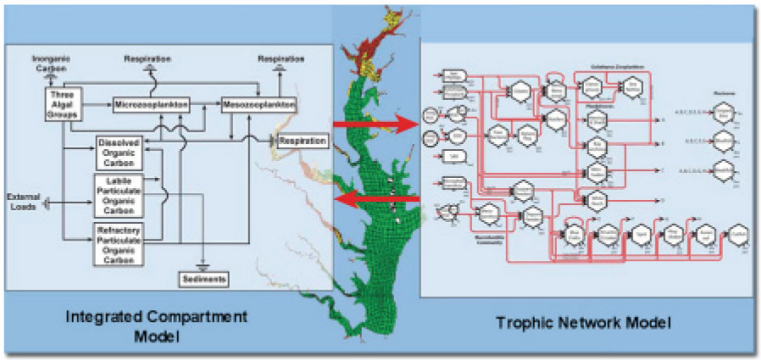
System-Wide Water SWWRP Resources Program

Integrated Compartment Model (ICM)



Description: The ICM was developed as one component of a model package to study eutrophication processes in Chesapeake Bay. The model computes concentrations and transformations of nutrients and other substances. The calculations can be computed in one-, two-, or three-dimensional configurations depending on the system studied.

Up to 32 state variables can be included in the calculations. Examples of state variables include biological properties such as algae and zooplankton and physical properties such as carbon, nitrogen, phosphorus, silica, and dissolved oxygen. Additionally, the model allows for two general toxicants and a pathogen.

The benthic sediment submodel is a significant feature of the model. It provides predictions of the interaction of sediment with water, oxygen, and nutrient fluxes. These fluxes may also be specified based on observations. A second significant feature is the direct computation of living resources including submerged aquatic vegetation, filter-feeding benthos, and deposit-feeding benthos.

Application: ICM has been deployed at: Florida Bay, FL (U.S. Army Engineer District, Jacksonville), San Juan Bay, PR (U.S. Army Engineer District, Jacksonville), Delaware Inland Bays, DE (U.S. Army Engineer District, Philadelphia), Newark Bay, NJ (U.S. Army Engineer District, New York), St. Johns River, FL (U.S. Army Engineer District, Jacksonville), Lake Washington, WA (King County Dept. of Natural Resources and Parks). Most recently, ICM has been used to estimate the ecosystem effects of native oyster restoration (U.S. Army Engineer District, Norfolk).

Benefits: The product is used extensively in evaluating Total Maximum Daily Loads (TMDLs) in coastal systems. ICM can be coupled with the Hydrological Simulation Program-FORTRAN (HSPF) and other watershed models for comprehensive analysis of watersheds and receiving waters. ICM provides a rational, well-established basis for efficient and cost-effective system-wide management efforts.

Future Capabilities: Water quality is usually managed using a “bottom up” approach where nutrient loads are reduced to limit excess phytoplankton production and those effects associated with excess phytoplankton (i.e., low dissolved oxygen, reduced water clarity, species shifts). Recently, a “top down” approach for water management is being studied. The “top down” approach is based on the premise that restoration of algal predators, such as oysters and menhaden, will limit excess phytoplankton production and minimize the need for costly nutrient control programs. We are in the

more . . .

Integrated Compartment Model (ICM)

process of integrating ICM with a network model of higher trophic levels adapted from fisheries management. When we are finished, we will have capability to address questions such as:

- How does management in a watershed affect fisheries harvest in adjacent water bodies?
- How does fisheries management affect water quality problems such as low dissolved oxygen?

Point of Contact: Carl F. Cerco, Environmental Laboratory, U.S. Army Engineer Research and Development Center, CEERD-EP-W, 3909 Halls Ferry Road, Vicksburg MS 39180, (601) 634-4207, Carl.F.Cerco@erdc.usace.army.mil.

System-Wide Water SWWRP Resources Program