Center for Environmental & Applied Fluid Mechanics

Speaker: Dr. Jian Shen (Virginia Institute of Marine Science)
Title: *"Using Transport Timescales to Interpret Estuarine Eutrophication of the Chesapeake Bay"*

Date: **Friday, November 4, 2011**
Time: 11:00 a.m.
Location: Gilman Hall 50 (Marjorie M. Fisher Hall)

Abstract

Both the amount of the nutrients discharged into estuaries and the nutrient retention time contribute to the eutrophic conditions of estuaries, while estuarine gravitational circulation and stratification are the key dynamic factors controlling the onset of the development of hypoxia. The transport timescales for measuring nutrient retention, quantifying estuarine exchange flow and vertical mixing processes provide a linkage between the dynamic and biochemical processes. The concept of using timescales to provide insight into the nutrient retention and relationships between dynamics and bottom water dissolved oxygen are discussed. A transport timescales is used to quantify nutrient transport and retention in the estuary. Two timescales are introduced to diagnose the competition between mixing and gravitational circulation and their impact on the dissolved oxygen level in deep waters. Coupling with a biochemical timescale of oxygen consumption, the hypoxic conditions in deep waters in the Chesapeake Bay may be successfully interpreted with the relative magnitudes among the timescales.

However, the transport timescales are highly variable, depending strongly on the competition among tide, wind, and buoyancy forcings interacting with complex bathymetry of the Chesapeake Bay. The dynamic characteristics of the timescales were studied through three-dimensional numerical model simulations with respect to forcing variations. The numerical model results demonstrate that freshwater discharge is the dominant factor controlling the long-term transport. Estuarine stratification and weak ventilation favors excessive oxygen consumption of biochemical processes resulting in the development of hypoxia in the deep channel of the estuary. The influence of wind pulse on the mixing processes and horizontal density-induced transport is significant. The short-term wind forcing has a strong accumulative effect on the long-term mass transport in the Chesapeake Bay.

Bio

Dr. Jian Shen received his Master’s degree (1993) and his PhD (1996) in Marine Science from the Virginia Institute of Marine Science (VIMS), the College of William and Mary. He then served as a Senior Environmental Engineer at Tetra Tech, Inc. in Fairfax, VA for 5 years, where he primarily conducted research on watershed model development and three-dimensional numerical modeling of eutrophication and toxic transport processes in estuaries, lakes, and rivers. In 2002 he returned to VIMS on the physical sciences faculty and now serves as a Research Associate Professor. His research interests include estuarine circulation, water quality and eutrophication modeling, storm surge simulation, and data assimilation. Specific interests include biochemical and physical coupling in estuarine and coastal environments, inverse modeling of water quality in estuaries, and transport timescales of estuarine processes.