



## Atlantic Estuaries Systems

**Project Number:** 29190GD  
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### Principle Investigator(s):

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**Collaborators:** U.S. EPA Chesapeake Bay Program, U.S. Naval Research Lab, Yale University, College of William & Mary, Virginia Institute of Marine Science, Maryland Geological Survey, and others.

**Statement of Problem:** Eastern U.S. estuaries have common environmental problems that have been exacerbated by land-use changes of the last century. Mitigation of these problems requires understanding of ecological, physical, and chemical changes related to climatic variability, anthropogenic factors, and regional geologic framework. This project evaluates recent changes in estuarine ecosystems in the context of their natural variability and assists resource managers in designing sustainable restoration targets.

**Objectives:** Establish geologic framework for estuarine system and watershed; evaluate impacts of land-use changes on water quality and sedimentation rates; evaluate ecosystem response to natural climate variability; identify modern sedimentation patterns, centers of deposition and sediment sources.

**Approach:** This project integrates data from surficial geologic mapping, paleoecology, geochemistry, geochronology, remote sensing, and sediment modeling to understand 1) how natural processes govern the function of estuarine ecosystems and 2) estuarine response to anthropogenic land-cover change. Incorporation of both the long-term (5,000-10,000 year) and short-term (<200 year) perspective allows assessment of baseline levels of variability against which anthropogenic changes may be evaluated as well as a basis for predictions of ecosystem response to future climatic changes. We approach the problem by undertaking geologic analyses on specific focus areas; results from the different tasks are integrated to develop an understanding of processes governing sediment and nutrient transport as well as biotic response to changes in various environmental parameters (precipitation, temperature, salinity, dissolved oxygen, water clarity). These analyses also provide data on sediment sources (shoreline erosion, oceanic, biogenic) at specific sites within estuaries and their tributaries; such information provides ground-truthing for remote sensing efforts. The time series analysis of estuarine sediment movement provided by research using SeaWiFs and MODIS images provides additional evidence for sediment sources and movement throughout the bay; this information is critical for development and ground-truthing of estuarine sediment models.

The project consists of five tasks:

Task 1—Geologic framework (Wayne Newell, task lead)

Task 2—Climate, sediment, and biota (Debra Willard, task lead)

Task 3—Land use, sediment, and biota (Thomas Cronin and Debra Willard, task leads)

Task 4—Sediment accumulation and sources (Charles Holmes, task lead)

Task 5—Remote sensing of water clarity (John Brock, task lead)

#### **Selected Reports and Other Products:**

Cronin, T.M., Dwyer, G.S., Kamiya, T., Schwede, S., and Willard, D.A., 2003, Medieval Warm Period, Little Ice Age and 20<sup>th</sup> century temperature variability from Chesapeake Bay: *Global and Planetary Change*, v. 36, p. 17-29.

Cronin, T. M. and Langland, M., (editors), 2003, A Summary of sediment processes in Chesapeake Bay and Watershed. USGS Open-file report (217 pages). Written by members of the Nutrient Subcommittee Sediment Workgroup.

Willard, D.A., Cronin, T.M., and Verardo, S., 2003, Late-Holocene climate and ecosystem history from Chesapeake Bay sediment cores, USA: *The Holocene*, v. 13, p. 201-214.

Cronin, T.M. and Vann, C., 2003, The sedimentary record of anthropogenic and climatic influence on the Patuxent Estuary and Chesapeake Bay ecosystems: *Estuaries*, v. 26, no. 2A.

Karlsen, A.W., Cronin, T.M., Ishman, S.E., Willard, D.A., Holmes, C.W., Marot, M., and Kerhin, R., 2000, Historical trends in Chesapeake Bay dissolved oxygen based on benthic foraminifera from sediment cores: *Estuaries*, v. 23 no. 4, p. 488-508.

**Relevance and Benefits:** Provides data on bay-wide sedimentation patterns over weekly to centennial time scales to improve understanding of the sources and impacts of sedimentation on estuarine water quality and biota.