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USGS Chesapeake Bay Activities

River Input Monitoring and Analysis

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Collaborators:

- Maryland Department of Natural Resources (MD DNR)
- Virginia Department of Environmental Quality (VA DEQ)
- Susquehanna River Basin Commission (SRBC)
- Metropolitan Washington Council of Governments (MWCOG)
- Maryland Department of Health and Mental Hygiene (MD DHMH)
- Chesapeake Bay Laboratories (CBL)

Statement of Problem: Elevated nutrient and suspended solid levels in the Chesapeake Bay adversely affect water clarity and DO levels, stressing living resources in the Bay and its tributaries. In 1987, the Chesapeake Bay Agreement called for 40% reduction in controllable nutrients entering the Bay by the year 2000. In 2000, a renewed Chesapeake Bay agreement was created to reinforce and redefine efforts toward these nutrient reductions. In an effort to reduce nutrients and sediments entering the Bay, management strategies have been implemented in the tributary basins. Quantification of loads and trends is useful for assessing the success of these management practices in improving water quality and living resource response.

Objectives:

1. Monitor nutrient and sediment concentrations in the nine major tributaries of the Chesapeake Bay above the tidal zone. These nine tributaries are the Susquehanna, Potomac, Patuxent, Choptank, Rappahannock, Mattaponi, Pamunkey, James and Appomattox Rivers.

2. Quantify trends in nutrient and sediment data collected from the nine major river basins for the period of record.

3. Estimate nutrient and sediment loads for the monitored tributaries.

4. Provide nutrient and sediment data for calibration of the Chesapeake Bay Watershed Model (WSM) and the Chesapeake Bay Water-Quality (WQ) Model.

5. Work with Chesapeake Bay Program to link patterns in observed water-quality loads and concentrations to processes and features within each of the nine watersheds (e.g. land-use changes and land management activities).

Approach: The Maryland and Virginia USGS collect water-quality samples from the nine major tributaries of the Chesapeake Bay. These water-quality samples are collected approximately 25 times per year during a range of hydrological conditions. The samples are analyzed for various nitrogen, phosphorus, and organic carbon constituents as well as suspended sediment and chlorophyll a. Theses water-quality data are quality assured through the use of statistical analyses.

Nutrient and suspended-sediment loads for the tributary sites will be estimated using the ESTIMATOR model, which is a seven-parameter log-linear model that estimates daily concentration (or load) as a function of discharge, time, and seasonality. The methodology used to run the ESTIMATOR model is described in the USGS Water-Resources Investigations Report (WRIR) 00-4156 (Yochum, 2000). The method estimates load using the fifth, or center, year of a sliding 9-year window. Each year a new model is run for each station and constituent, the most recent year is added, and the previous 4 years of estimates are updated. The minimum variance unbiased estimator (MVUE) of Bradu and Mundlak (1970) will be employed to correct for the bias introduced by formation of concentration estimates from logarithmic space to real space. The adjusted maximum likelihood estimator (Cohn, 1988) will be used to assign concentration values to censored data, which are data reported as less than the reporting limit. Model results and regression summaries will be used to characterize the relation of constituent concentration to river discharge and season, and to determine long-term trends in constituent concentration.

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Relevance and Benefits: State and Federal resource managers use water-quality concentrations, discharge values, loads, and trends provided by the River Input Monitoring Program to plan non-tidal tributary strategies for controlling nutrient and sediment loads to the Chesapeake Bay.

The River Input Monitoring Program Web site is http://va.water.usgs.gov/chesbay/RIMP/ .