COMPARISON OF HISTORICAL AND RECENT SEDIMENT LOADS OF THE DELAWARE RIVER

Daniel I. Duval\textsuperscript{1} and Christopher K. Sommerfield\textsuperscript{2}

College of Earth, Ocean, and Environment, School of Marine Science and Policy, University of Delaware, Lewes, DE 19958 USA
\textsuperscript{1}dduval@udel.edu \textsuperscript{2}cs@udel.edu

In an effort to improve our ability to predict sediment delivery to Delaware Estuary, we are investigating whether archived U.S. Geological Survey suspended-sediment concentration (SSC) measurements for the Delaware River at Trenton are representative for the current system through a comparative analysis of old and new data. The results provide insight to the extent of natural and human influences on sediment production and transport in the watershed.

Introduction

Historic SSC data follow a seasonal cycle with highest values in the spring associated with snowmelt and rainstorm runoff. High SSC can occur in fall with the occurrence of large storm systems and river discharge. The 2010 SSC data follows the same pattern and within range of the historic SSC values.

Comparison of Historical and Recent Sediment Rating Parameters

As observed in other mid-latitude rivers, rating parameters for the Delaware vary intra-annually with seasonal changes in watershed runoff, sediment transport, and storage. However, there are no apparent net trends for the period of record that could be related to widespread changes in the river sedimentary system.

Recent and Historic Suspended Sediment Loads

Years characterized by large suspended-sediment load are dominated by years with large peak discharge events (floods). In the last two decades there has been a higher frequency of large peakflows and also higher mean annual water discharges. Both factors have lead to larger-than-average annual sediment loads during the past decade. The long-term mean annual sediment load of the Delaware at Trenton (dashed line at right) is estimated at 717,600 tons/yr with a standard deviation of 554,260 tons/yr.

Methods

The study involved two components: 1) analysis of data collected by USGS (1949-1982); and 2) collection and analysis of new SSC data. In March 2010, an automated water sampler (ISCO) was installed at USGS site 01463500 in Morrisville, PA, across river from Trenton, NJ. Water samples were returned to the lab, filtered, and SSC computed following standard methods. Sediment rating curves were created for the archived USGS data and the new UDEL data, and the regression coefficients compared to ascertain whether the sediment production and background SSC characteristics of the river have changed through time. The USGS dataset includes 11,900 daily measurements of SSC and water discharge whereas 113 SSC measurements were made by UDEL in 2010. Of these, 279 correspond to USGS turbidity observations made continually at Morrisville.

Historic SSC data follow a seasonal cycle with highest values in the spring associated with snowmelt and rainstorm runoff. High SSC can occur in fall with the occurrence of large storm systems and river discharge. The 2010 SSC data follows the same pattern and within range of the historic SSC values.

In general, SSC plotted with water discharge (Q) exhibits a power-law relationship described by $SSC=AQ^B$, where A and B are the y-intercept and slope of the trendline, respectively. Regression yields two coefficients known as rating parameters. Parameter $A$ reflects the “background” SSC of the river as related to soil erodibility in the watershed, whereas $B$ represents the erosive power of the river and its sediment-production capacity in terms of Q.

Significantly, monthly-computed rating parameters values for the two datasets overlap. This indicates that SSC productivity and background levels have not changed since 1949, and suggests that land-use change in the watershed has not altered the river SSC response to variations in Q.

Acknowledgments

We thank the Delaware Department of Natural Resources and Environmental Control for the use of ISCO samplers, and USGS Water Resources for access to the Morrisville monitoring site. This work is supported in part by an NSF grant to C.K. Sommerfield (OCE-0928496).