Smithsonian study: Sediment prediction tools off the mark

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A recent study led by Smithsonian ecologist Kathy Boomer suggests it is time for a change in at least one area of watershed management. Boomer has been examining the tools scientists and managers use to predict how much sediment runs into the Chesapeake Bay, and by her account, they are way off the mark. The study, co-authored by SERC ecological modeler Donald Weller and ecologist Thomas Jordan, appears in the January/February issue of the *Journal of Environmental Quality*.

Sediment running into the bay reduces light, suffocates underwater organisms and is a significant source of phosphorous, a nutrient that essentially fertilizes the water promoting algal blooms and many other problems in the bay.

“Cities and counties are under increasing pressure to meet total maximum daily loads set by state and federal agencies and to understand where sediments come from,” she said. “So we tested the tools most widely used now to predict sediment delivery.”

Her work has led to a new tactic. “We’re moving away from focusing on upland erosion and looking more at what happens near streams and in streams during events with high levels of stream sediments.”

The new study compared actual measurement of sediments in more than 100 streams in the Chesapeake watershed with predictions from several of the most up-to-date models. All the models failed completely to identify streams with high sediment levels.

“There was no correlation at all between the model predictions and the measurements,” said Boomer. The study is among the first to directly compare predictions of the widely used models with actual observations of sediments in a large number of streams.

The problem, she said, is that the most widely used models all begin with the same tool, the Universal Sediment Loss Equation. The USLE estimates erosion from five factors: topography, soil erodibility, annual average rainfall amount and intensity, land cover, and land management practices. Boomer emphasized that the USLE was developed to help farmers limit topsoil loss from individual fields rather than to predict sediment delivery from complex watersheds to streams.

As often applied, the USLE gives an average annual erosion rate for the whole watershed draining into a stream. But not all of the eroded soil makes it into the water, so the estimates do not translate directly into sediment delivery rates. To account for the discrepancy, different models incorporate a wide variety of adjustments. According to Boomer, the adjusted models still do not work, partly because erosion rate is not the best information to start with.

During the study, Boomer and colleagues Weller and Jordan compared erosion rates and sediment yields estimated from regional application of the USLE, the automated Revised-USLE, and five widely used sediment delivery ratio algorithms to measured annual average sediment delivery in 78 catchments of the Chesapeake Bay watershed.

“We did the same comparisons for an independent set of 23 watersheds monitored by the U.S. Geological Society,” Boomer said.

Sediment delivery predictions, which were highly correlated with USLE erosion predictions, exceeded observed sediment yields by more than 100 percent. The RUSLE2 erosion estimates also were highly correlated with the USLE predictions, indicating that the method of implementing the USLE model did not greatly change the results.

“Sediment delivery is largely associated with specific rain events and stream bank erosion,” she said. “So, USLE-based models that emphasize long-term annual average erosion from uplands provide limited information to land managers.”

With a new focus on what is happening in and near the streams themselves, Boomer and her colleagues hope to develop more reliable tools to predict sediment running into Chesapeake Bay—tools that can be used in other lakes and estuaries as well.

Source: Smithsonian