Uncertainty and sensitivity in bank stability modeling: implications for estimating phosphorus loading

Roderick W. Lammers and Brian P. Bledsoe
Department of Civil and Environmental Engineering, Colorado State University

Abstract. Eutrophication of lakes and streams is one of the most pressing water quality concerns in the U.S. and around the world. Non-point sources are recognized as major contributors to nutrient pollution. However, nutrient loading from bank erosion has been largely overlooked, despite field studies demonstrating that this source can account for up to half of the total phosphorus budget of a watershed. Soil-bound phosphorus can enter streams when banks are eroded by fluvial entrainment or collapse due to geotechnical instability. Substantial effort has been made to develop mechanistic models to predict bank erosion and instability. However, these models do not account for inherent natural variability in input values. Providing only single outputs with no quantification of associated uncertainty can complicate management decisions focused on reducing bank erosion and nutrient loading to streams. To address this issue, uncertainty and sensitivity analyses were performed on the Bank Stability and Toe Erosion Model (BSTEM), a mechanistic model developed by the USDA-ARS. A probabilistic modeling approach (a large number of model runs with variable inputs) was applied to data from a watershed-scale sediment and phosphorus loading study in Vermont to quantify uncertainty associated with these published results. In addition, a sensitivity analysis was performed to quantitatively rank variables in order of their influence on model output. This ranking will inform the future development of a simplified model with fewer required inputs. This talk will discuss the results of these analyses and their implications for modeling watershed-scale nutrient loading from bank erosion.