Global Sensitivity Analysis of the SRH-1D Sediment Transport Model Applied to Two Physical Experiments

Morgan D. Ruark and Jeffrey D. Niemann
Department of Civil and Environmental Engineering, Colorado State University, Fort Collins

Blair Greimann
Bureau of Reclamation, Denver

Mazdak Arabi
Department of Civil and Environmental Engineering, Colorado State University, Fort Collins

Abstract. Numerical sediment transport models are widely used to evaluate the impacts of water management activities on endangered species, identify appropriate strategies for dam removal, and other projects. The SRH-1D (Sedimentation and River Hydraulics - One Dimension) numerical model, formerly known as GSTAR, is used by the U.S. Bureau of Reclamation for many such evaluations. This model includes hydraulic and sediment transport components. The predictions from models such as SRH-1D include some uncertainty due to errors in the model's mathematical structure, uncertainty in parameter values, and other sources. Quantifying this uncertainty and its origins could provide guidance for efficient data collection and calibration and could reduce project design requirements. In this research, we seek to identify the parameters in SRH-1D with the most influence on model outputs. This assessment uses the Fourier Amplitude Sensitivity Test (FAST), which is a method for global sensitivity analysis. Eight input variables (critical shear stress, hiding factor, active layer thickness, recovery factors for deposition and scour, bed load adaptation length, weight of bed load fractions, and Manning's roughness) were varied in FAST. The sensitivities of output variables describing sediment size, stream velocity, bed elevation, and volume of deposition were analyzed. The model was applied to two flume experiments: a fining experiment described by Seal et. al (1997) and a scour experiment described by Ashida and Michiue (1971). Because coarse material is present in both experiments, Parker's (1990) empirical gravel transport equation was used. For the scour experiment, the key variables identified by the sensitivity analysis are critical shear stress, hiding factor, and Manning's roughness. For the fining experiment the key variables include the same three with the addition of the weight of the bed load fractions.