An Assessment of the Uncertainty in Sediment Transport Simulations Due to Parameter Estimation and the Selection of a Sediment Transport Equation

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Many water resources projects involve simulation and forecasting of fluvial characteristics using sediment transport models such as Sedimentation and River Hydraulics - One Dimension (SRH-1D). The forecasts from such models inherently contain uncertainty, which arises from the values selected for the model parameters, the choice of the sediment transport equation, and various other sources. In this paper, we aim to quantify both the parameter and model uncertainty in SRH-1D simulations using a method derived from Bayesian statistics. This method uses a multi-objective adaptation of Shuffled Complex Evolution Metropolis – Uncertainty Analysis (SCEM-UA), which allows identification of the most likely parameter values based on available observations as well as the uncertainty in the parameter values. The method also uses Bayesian Model Averaging (BMA), which evaluates the uncertainty that is associated with the selection of the sediment transport equation and determines a combined prediction based on multiple transport equations. This methodology is applied to SRH-1D simulations of two flume experiments: an erosional case and a depositional case for which bed profile and sediment size observations were obtained. For each case, three sediment transport equations are considered: the Parker (1990) equation, the Wilcock and Crowe (2003) equation, and the Modified Meyer-Peter and Müller equation (2006). Results indicate that there is more uncertainty in the values of the parameters that are directly connected to sediment transport than in the parameters related to the hydraulic behavior. Also, when BMA finds that a combination of equations predicts a set of observations best, this prediction surpasses the predictions from individual transport equations.

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