Project Summary
Rocky Mountains Cooperative Ecosystem Studies Unit

Project Title: Design and Testing of Computationally-Efficient Methods to Evaluate Parameter and Model Uncertainty

Type of Project : Research

Project Discipline : Natural

Funding Agency: Bureau of Reclamation

Other Partners/Cooperators: Colorado State University

Effective Dates: 6/1/2012 – 8/15/2016

Funding Amount: $200,000

Investigators and Agency Representative:

Agency Representative:

Investigators: Prof. Jeff Niemann, Associate Professor, College of Engineering, Colorado State University, Fort Collins, CO; 970-491-3517; jneimann@engr.colostate.edu

Project Abstract:
The long-term objective of this research is to develop and test methods to assess the uncertainty in the predictions from hydrologic, hydraulic, and sediment transport models so that data collection and model calibration strategies can be modified to reduce this uncertainty. To constrain the immediate scope, this project focuses on evaluating parameter and model uncertainty, but similar methods can also be used to evaluate input uncertainty. This project also focuses on applying the methods to a sediment transport model, which is used in assessments of aquatic habit among other applications, but the methods are transferrable to other types of models.

The project will build on prior research on this topic. In particular, methods have been proposed to assess both parameter and model uncertainty. Multi-Objective Shuffled Complex Evolution Metropolis – Uncertainty Analysis (MSU) can assess the uncertainty that remains in parameter values after calibration and the impact of that uncertainty on model forecasts (Vrugt et al., 2003; Van Griensven and Meixner, 2007). Similarly, Bayesian Model Averaging (BMA) characterizes model uncertainty and its impact on model forecasts (Raftery et al., 2005). Both tools have been previously coupled with a commonly-used model called Sedimentation and River Hydraulics – One Dimension (SRH-1D) (Huang and Greimann, 2010) and applied to three simple flume experiments. In these applications, MSU/BMA was found to provide better uncertainty analyses than previously-proposed approaches. However, MSU required so many simulations to make the assessment that it would be difficult to use with complex model applications. In this project, we aim to develop an improved uncertainty methodology that: (1) requires few enough simulations to be applied to complex model applications and (2) retains enough formality to be used for evaluation of data collection and model calibration strategies.

Outcomes with completion dates (reports, publications, workshops, videos, etc.):

Keywords: uncertainty testing, hydrologic, hydraulic, and sediment transport models; Bureau of Reclamation; Colorado State University