The Model Optimization, Uncertainty, and SEnsitivity Analysis (MOUSE) Toolbox: Overview and Application

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Abstract. For several decades, optimization and sensitivity/uncertainty analysis of environmental models has been the subject of extensive research. Although much progress has been made and sophisticated methods developed, the growing complexity of environmental models to represent real-world systems makes it increasingly difficult to fully comprehend model behavior, sensitivities and uncertainties. This presentation provides an overview of the Model Optimization, Uncertainty, and SEnsitivity Analysis (MOUSE) software application, an open-source, Java-based toolbox of visual and numerical analysis components for the evaluation of environmental models. MOUSE is based on the OPTAS model calibration system developed for the Jena Adaptable Modeling System (JAMS) framework, is model-independent, and helps the modeler understand underlying hypotheses and assumptions regarding model structure, identify and select behavioral model parameterizations, and evaluate model performance and uncertainties. MOUSE offers well-established local and global sensitivity analysis methods, single- and multi-objective optimization algorithms, and uses GLUE methodology to quantify model uncertainty. MOUSE has a robust GUI that: 1) allows the modeler to constrain objective functions for specific time periods or events (e.g., runoff peaks, low flow periods, or hydrograph recession periods); and 2) permits graphical visualization of the methods described above in addition to access and visualization of numerous tools contained in the Monte Carlo Analysis Toolbox (MCAT) including dotty plots, identifiability plots, and Dynamic Identifiability Analysis (DYNIA). Following a brief system overview, we present a basic application of MOUSE to the HyMod conceptual hydrologic model.