Comparison of Evolutionary Multi-objective Algorithms for Hydrologic Model Calibration

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Calibration of distributed integrated hydrologic models is a challenging problem due to their complex model structures and large parameter sets. This study provides the first comprehensive assessment of state-of-the-art evolutionary multi-objective tools' relative effectiveness in calibrating a semi-distributed integrated hydrologic model. This study assesses the relative computational efficiency, accuracy, and ease-of-use of the Epsilon Dominance Non-dominated Sorted Genetic Algorithm-II (ε-NSGAII), Multi-objective Shuffled Complex Evolution Metropolis algorithm (MOSCEM-UA), and the Strength Pareto Evolutionary Algorithm 2 (SPEA2). The three algorithms are used to solve two alternative multi-objective calibration strategies for a multi-state integrated semi-distributed hydrologic model applied to the Shale Hills watershed within the Valley and Ridge Province of the Susquehanna River Basin in north central PA. The impacts of alternative objective formulations are assessed using formal metrics for solution set convergence and diversity. This study provides insights into the advantages and disadvantages of both the optimization algorithms and the hydrologic model. Additionally, this study highlights the computational constraints posed multi-objective model calibration and the computing resources necessary for addressing these constraints.