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Comparison of the Shuffled Complex Evolution Family of Model-Calibrating Algorithms

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The Shuffled Complex Evolution (SCE-UA) has been used extensively and proved to be a robust and efficient global optimization method for the calibration of conceptual rainfall runoff models. Its success has encouraged some researchers to further improve the optimizing capability of the original SCE-UA algorithm. With the aim of improving the exploration capability of the SCE-UA, Muttil and Liong (2004) proposed a systematically located initial population instead of a randomly generated used in the original SCE-UA. On a suite of commonly used test functions and also on calibration of a rainfall-runoff model using synthetic data, they demonstrated that when the points in the initial population are strategically placed, it leads to a better exploration of the search space and hence significantly reduces the number of failures of the enhanced SCE-UA. In a further study, Muttil and Liong (2005) enhanced the simplex search method used in the original SCE-UA to also improve the exploitation capability of its search, which lead to a significant reduction in the function evaluations required to reach the global optimum. In another study, Vrugt et al., (2003) developed a modified version of the SCE-UA called the Shuffled Complex Evolution Metropolis algorithm (SCEM-UA). The SCEM-UA operates by merging the strengths of the Metropolis algorithm, controlled random search, competitive evolution, and complex shuffling. They claim that the stochastic nature of the Metropolis-annealing scheme avoids the tendency of the SCE-UA algorithm to collapse to a single region of attraction (i.e., the global minimum), while information exchange (shuffling) allows biasing the search in favor of better solutions. In this study, we compare the above two modified versions of the SCE-UA algorithm for their robustness and efficiency. On a suite of test functions, it is observed that the original SCE-UA and the enhanced version proposed by Muttil and Liong (2004, 2005) perform significantly better than the SCEM-UA in terms of robustness (number of failures) and efficiency (number of function evaluations to reach the global optimum). Further work on comparing the algorithms for calibrating conceptual rainfall-runoff models is underway.