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Performance Evaluation of Rainfall-Runoff Models Using Multi-Objective Optimization Approach

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We explore the effectiveness of multi-objective optimization approach for performance evaluation of rainfall-runoff models. Multi-objective optimization of the Tank Model is investigated using historical data from the Eigenji Dam Basin in Japan. $RMSE$ (Root Mean Square Error) that emphasizes the error at high flows and RR (Root mean square of Relative error) that emphasizes the error at low flows are used as objective functions and these functions are simultaneously minimized. The multi-objective ES [1] combined the Evolution Strategy (ES) with the Pareto-ranking and the MOCOM-UA method [2] are applied to this problem. Results show that the ES is superior to the MOCOM-UA in the accuracy of Pareto-optimal solutions. In addition to the Eigenji Dam Basin, the multi-objective Tank Model optimization using the ES is applied to the Osako and Syorenji Dam Basin and characteristics of Pareto-optimal solutions of three basins are examined. Results indicate that the parameter set suited for an analysis purpose can be selected rationally by using shape of Pareto-optimal solutions in objective space and the inadequacy of rainfall-runoff models can be identified by using hydrograph range corresponding to the solutions. Multi-objective optimizations of 2-layer and 3-layer Tank Model are also carried out and application results are compared with those of the Tank Model (4-layer). It is show that the inadequacy and limitation of rainfall-runoff models can be identified and the performance evaluation of rainfall-runoff models can be done by using information obtained from multi-objective optimization approach.

Keywords: Rainfall-Runoff model; Tank Model; Multi-objective optimization; Pareto-optimal solution; Model evaluation.

References

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