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Automatic calibration of hydrological model using fast global optimization algorithm with adaptive objectives

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One important aspect on hydrological modeling is the selection of best parameter values of the model that can best represent or simulate the hydrological behavior of a catchment, or often so-called model calibration. An automatic calibration technique for the Mike NAM rainfall-runoff model using fast global optimization algorithms is outlined. Various types of adaptive objective functions, like high/low peak weighted error and weighted error with extreme detection, are introduced for managing the high uncertainties. The high uncertainties here involve long period of missing data for calibration, improper imputation of missing data, underestimations of the Thiessen-derived precipitation data from raingauges and the radar-derived precipitation data, physical structure and measurement changes, as well as inaccurate flow estimations by a rating curve extrapolation. A number of catchment case studies with various uncertainty issues were selected to test the automatic calibration performance. Equifinality of the calibration results was resolved by measuring the metric distance to the parameter sets defined by a decision tree. The proposed model calibration technique using global optimization algorithms with adaptive objectives demonstrates a good performance on calibrating hydrological models with various uncertainties and is able to estimate the proper shape and magnitude of high-flows in the hydrograph in case of these flows were missing or inaccurately-estimated.