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A sensitivity driven meta-model optimisation tool for hydrological models

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The calibration of rainfall-runoff-models containing a high number of parameters can be done readily by the use of different calibration methods and algorithms. Monte-Carlo Methods, gradient based search algorithms and others are well-known and established in hydrological sciences. Thus, the calibration of a model for a desired application is not a challenging task, but retaining regional comparability and process integrity is, due to the equifinality-problem, a prevailing topic. This set of issues is mainly a result of the overdeterminaton given the high number of parameters in rainfall-runoff-models, where different parameters are affecting the same facet of model performance (i.e. runoff volume, variance and timing). In this study a calibration strategy is presented which considers model sensitivity as well as parameter interaction and different criteria of model performance. At first a range of valid values for each model parameter was defined and the individual effect on model performance within the defined parameter range was evaluated. By use of the gained knowledge a meta-model, lumping different parameters affecting the same facet of model performance, was established. Hereafter, the parsimonious meta-model, where each parameter is assigned to a nearly disjoint facet of model performance is optimized. By retransformation of the lumped parameters to the original model, a parametrisation for the original model is obtained. An application of this routine to a set of watersheds in the eastern part of Germany displays the benefits of the routine. Results of the meta-parametrised model are compared to parametrisations obtained from common calibration routines in a validation study and process orientated numerical experiment.