Automated Calibration for Numerical Models of Riverflow

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Abstract

Calibration of numerical models is fundamental since the beginning of all types of hydro system modeling, to approximate the parameters that can mimic the overall system behavior. Thus, an assessment of different deterministic and stochastic optimization methods is undertaken to compare their robustness, computational feasibility, and global search capacity. Also, the uncertainty of the most suitable methods is analyzed. These optimization methods minimize the objective function that comprises synthetic measurements and simulated data. Synthetic measurement data replace the observed data set to guarantee an existing parameter solution. The input data for the objective function derivate from a hydro-morphological dynamics numerical model which represents an 180-degree bend channel.

The hydro- morphological numerical model shows a high level of ill-posedness in the mathematical problem. The minimization of the objective function by different candidate methods for optimization indicates a failure in some of the gradient-based methods as *Newton Conjugated* and *BFGS*. Others reveal partial convergence, such as *Nelder-Mead*, *Polak und Ribieri*, *L-BFGS-B*, *Truncated Newton Conjugated*, and *Trust-Region Newton Conjugated Gradient*. Further ones indicate parameter solutions that range outside the physical limits, such as *Levenberg-Marquardt* and *LeastSquareRoot*. Moreover, there is a significant computational demand for genetic optimization methods, such as *Differential Evolution* and *Basin-Hopping*, as well as for *Brute Force* methods. The Deterministic *Sequential Least Square Programming* and the scholastic *Bayes Inference theory* methods present the optimal optimization results.

keywords: Automated calibration of hydro-morphological dynamic numerical model, Bayesian inference theory, deterministic optimization methods.