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Calibration process of highly parameterized semi-distributed hydrological model

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Hydrological phenomena take place in the hydrological system, which is governed by nature, and are essentially stochastic. These phenomena are unique, non-recurring, and changeable across space and time. Since any river basin with its own natural characteristics and any hydrological event therein, are unique, this is a complex process that is not researched enough. Calibration is a procedure of determining the parameters of a model that are not known well enough. Input and output variables and mathematical model expressions are known, while only some parameters are unknown, which are determined by calibrating the model. The software used for hydrological modelling nowadays is equipped with sophisticated algorithms for calibration purposes without possibility to manage process by modeler. The results are not the best.
We develop procedure for expert driven process of calibration. We use HBV-light-CLI hydrological model which has command line interface and coupling it with PEST. PEST is parameter estimation tool which is used widely in ground water modeling and can be used also on surface waters. Process of calibration managed by expert directly, and proportionally to the expert knowledge, affects the outcome of the inversion procedure and achieves better results than if the procedure had been left to the selected optimization algorithm.

First step is to properly define spatial characteristic and structural design of semi-distributed model including all morphological and hydrological phenomena, like karstic area, alluvial area and forest area. This step includes and requires geological, meteorological, hydraulic and hydrological knowledge of modeler.

Second step is to set initial parameter values at their preferred values based on expert knowledge. In this step we also define all parameter and observation groups. Peak data are essential in process of calibration if we are mainly interested in flood events. Each Sub Catchment in the model has own observations group.

Third step is to set appropriate bounds to parameters in their range of realistic values.

Fourth step is to use of singular value decomposition (SVD) ensures that PEST maintains numerical stability, regardless of how ill-posed is the inverse problem

Fifth step is to run PWTADJ1. This creates a new PEST control file in which weights are adjusted such that the contribution made to the total objective function by each observation group is the same. This prevents the information content of any group from being invisible to the inversion process.

Sixth step is to add Tikhonov regularization to the PEST control file by running the ADDREG1 utility (Doherty, J, 2013). In adding regularization to the PEST control file ADDREG1 automatically provides a prior information equation for each parameter in which the preferred value of that parameter is equated to its initial value.

Last step is to run PEST. We run BeoPEST which a parallel version of PEST and can be run on multiple computers in parallel in same time on TCP communications and this speedup process of calibrations.

The case study with results of calibration and validation of the model will be presented.