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Towards automatic calibration of hydrodynamic models - evaluation of gradient based optimisers

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The calibration of two-dimensional hydraulic models is still underdeveloped in the present survey of scientific research. They are computationally very demanding and therefore the use of available sophisticated automatic calibration procedures is restricted in many cases. Moreover, the lack of relevant data against the models can be calibrated has ever to be accounted. The present study considers a serious and well documented flood event that occurred on August 2002 on the river Mulde in the city of Eilenburg in Saxony, Germany. The application of the parallel version of the model gradient-based optimiser PEST, that gives the possibility of automatic and model independent calibrations, is here presented, and different calibration strategies, adopting different aggregation levels of the spatially distributed surface roughness parameters, are compared. Gradient-based methods are often criticized because they can be sensitive to the initial parameter values and might get trapped in a local minimum of objective functions. But on the other hand they are computational very efficient and may be the only possibility to automatically calibrate CPU time demanding models like 2D hydraulic models. In order to test the performance of the gradient based optimiser the optimisation results were compared with a sensitivity analysis testing the whole parameters space through a Latin hypercube sampling, thus emulating a global optimiser.
The results show that it is possible to use automatic calibration in combination of 2D hydraulic model, and that equifinality of model parameterisation can also be caused by a too large number of degrees of freedom in the calibration data in contrast to a too simple model setup. Also the sensitivity analysis showed that the gradient based optimiser was always able to find the global minimum. Based on these first results it can be concluded that a gradient based optimiser appears to be a viable and appropriate choice for automatic calibration of hydraulic models.