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# Comparison between different direct search optimization algorithms in the calibration of a distributed hydrological model

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The modern distributed hydrological models allow the representation of the different surface and subsurface phenomena with great accuracy and high spatial and temporal resolution. Such complexity requires, in general, an equally accurate parametrization. A number of approaches have been followed in this respect, from simple local search method (like Nelder-Mead algorithm), that minimize a cost function representing some distance between model's output and available measures, to more complex approaches like dynamic filters (such as the Ensemble Kalman Filter) that carry on an assimilation of the observations. In this work the first approach was followed in order to compare the performances of three different direct search algorithms on the calibration of a distributed hydrological balance model. The direct search family can be defined as that category of algorithms that make no use of derivatives of the cost function (that is, in general, a black box) and comprehend a large number of possible approaches. The main benefit of this class of methods is that they don't require changes in the implementation of the numerical codes to be calibrated. The first algorithm is the classical Nelder-Mead, often used in many applications and utilized as reference. The second algorithm is a GSS (Generating Set Search) algorithm, built in order to guarantee the conditions of global convergence and suitable for a parallel and multi-start implementation, here presented. The third one is the EGO algorithm (Efficient Global Optimization), that is particularly suitable to calibrate black box cost functions that require expensive computational resource (like an hydrological simulation). EGO minimizes the number of evaluations of the cost function balancing the need to minimize a response surface that approximates the problem and the need to improve the approximation sampling where prediction error may be high. The hydrological model to be calibrated was MOBIDIC, a complete balance distributed model developed at the Department of Civil and Environmental Engineering of the University of Florence. Discussion on the comparisons between the effectiveness of the different algorithms on different cases of study on Central Italy basins is provided.