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On the value of multiobjective optimisation for profiting from soft information in ungauged basins

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The study focuses on the use of multi-objective algorithms for the calibration of rainfall-runoff models in ungauged basins, with particular attention to the capability of the model to reproduce low flows. Regional procedures are applied to derive statistics whose fit is maximised to calibrate the model in absence of hydrometric observations. In detail different combinations of several objective functions, including the Q355 index which refers to low flows, were tested in calibration and validation mode. The analysis refers to 52 catchments located in central Italy, in a region where detailed hydrological and geomorphoclimatic information is available. These catchment are considered as gauged and ungauged in turn: a baseline for model performances is first obtained under gauged conditions and it is then compared to what would be obtained in absence of observed runoff data. The multiobjective optimisation was carried out by using a multimethod evolutionary search algorithm (AMALGAM, Vrugt and Robinson, 2007), that runs simultaneously a set of different optimisation methods (namely Non-dominated Sorting Genetic Algorithm-II, Differential Evolution, Adaptive Metropolis Search and Particle Swarm Optimisation), resulting in a combination of the respective strengths by adaptively updating the weights of these individual methods based on their reproductive success. This ensures a fast, reliable and computationally efficient solution to multiobjective optimisation problems. The results show the potential of the multiobjective approach and its capability to take advantage of different information sources in a context characterised by lack of data and therefore significant uncertainty.