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Comparison of different multi-objective calibration criteria using a conceptual rainfall-runoff model of flood events

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Abstract. A conceptual lumped rainfall-runoff flood event model was developed and applied on the Gardon catchment located in Southern France and various single-objective and multi-objective functions were used for its calibration. The model was calibrated on 15 events and validated on 14 others. The results of both the calibration and validation phases are compared on the basis of their performance with regards to six criteria, three global criteria and three relative criteria representing volume, peakflow, and the root mean square error. The first type of criteria gives more weight to large events whereas the second considers all events to be of equal weight. The results show that the calibrated parameter values are dependent on the type of criteria used. Significant trade-offs are observed between the different objectives: no unique set of parameters is able to satisfy all objectives simultaneously. Instead, the solution to the calibration problem is given by a set of Pareto optimal solutions. From this set of optimal solutions, a balanced aggregated objective function is proposed, as a compromise between up to three objective functions. The single-objective and multi-objective calibration strategies are compared both in terms of parameter variation bounds and simulation quality. The results of this study indicate that two well chosen and non-redundant objective functions are sufficient to calibrate the model and that the use of three objective functions does not necessarily yield different results. The problems of non-uniqueness in model calibration, and the choice of the adequate objective functions for flood event models, emphasise the importance of the modeller's intervention. The recent advances in automatic optimisation techniques do not minimise the user's responsibility, who has to choose multiple criteria based on the aims of the study, his appreciation on the errors induced by data and model structure and his knowledge of the catchment's hydrology.

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