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Calibration of spatially-distributed hydrological models: possible strategies and analysis of the effects of data availability.

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Spatially-distributed rainfall-runoff models are increasingly used by both researchers and practitioners in hydrology. In principle, it should be possible to estimate at least part of the model parameters by means of in-situ measurements or physical reasoning. Actually, it is well known that a parameter calibration is needed for any real-world application of these models. This operation is highly computer intensive, as the computational time of distributed models is typically longer with respect to lumped approaches. The purpose of this study is an evaluation of a series of automatic calibration experiments (using the Shuffled Complex Evolution method) performed with a highly conceptualised, continuously simulating, distributed hydrologic model. The calibration and validation data consist of real precipitation and discharge observations referring to a mid-sized, highly vegetated watershed, located in the Apennine Mountains in Italy. Major flood events that occurred in the 1990-2000 decade are simulated with the parameters obtained by calibrating the rainfall-runoff model referring to different scenarios of historical data availability. A first set of experiments investigates the length of the calibration period required for an efficient parameterisation. The second analysis focuses on the influence on model calibration of the spatial resolution of the rainfall input and is carried out by varying the size and distribution of the raingauge network. A third aspect regards the analysis of the reliability of model parameters in simulating the discharge in ungauged river sections. The aim of the study is to provide the user with indications for appropriately selecting the historical data base to be used for model calibration. The results indicate how reducing the length of the calibration period under the extension of three months seems to deteriorate significantly the rainfall-runoff model performances. The model simulations are satisfactory also

under the hypothesis of spatially uniform rainfall, provided that the mean areal rainfall intensity is estimated on the basis of a sufficiently extended number of raingauges, whereas there is a strong worsening with an excessive reduction of the raingauge network density. Moreover, the distributed model has proven to be able to provide reliable simulations referring to ungauged internal river sections. Finally, a discussion about the different objective functions that can be used for model calibration is presented.