Internal and external uncertainty in the calibration of hydrologic rainfall-runoff models

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Hydrologic rainfall-runoff models are usually calibrated with reference to a limited number of recorded flood events, for which rainfall and runoff measurements should be available. In this framework, model's parameters consistency depends on the number of both events and hydrograph points used for calibration, and by measurements reliability.

Recently, to make users aware of application limits, major attention has been devoted to the estimation of uncertainty in hydrologic modeling. Here a simple numerical experiment is proposed, that allows the analysis of uncertainty in rainfall-runoff modeling associated to the quantity and the quality of available data.

A distributed rainfall-runoff model based on geomorphologic concepts has been used. Since the experiment involves the analysis of an ensemble of model runs, its set up holds even if a different hydrologic model is used.

With reference to a set of 100 synthetic rainfall events characterized by a given rainfall volume, the effect of uncertainty in parameters calibration, related to the intrinsic structure of the model, is first studied. An artificial truth (perfect observation) is created by using the model in a known configuration. The range of parameters' value able to "reproduce" the observation is studied. An external source of uncertainty is then introduced by assuming realistic, i.e. uncertain, discharge observations to calibrate the model. The associated increase in model uncertainty is evaluated and discussed.

The experiment gives useful indications about the number of both events and points needed for a careful and stable calibration in both ideal and realistic conditions. Moreover, an insight on the expected and maximum error in flood peak discharge simulations is given: errors ranging up to 40% are to be expected if parameters are calibrated on insufficient data sets.