Potential accuracy and uncertainty in the hydrologic modeling of flood events

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Hydrologic watershed models are usually calibrated with reference to a limited number of events, for which measurements records should be available, e.g. to describe rainfall and runoff processes, or the soil moisture status. In this framework, the accuracy in the estimation of model's parameters can be viewed as a function of the number of both rainfall events and hydrograph points used for calibration. Moreover, to make users aware of application limits, attention has been recently devoted also to the estimation of uncertainty in hydrologic modeling.

Here a simple numerical experiment is proposed, that allows to estimate model's potential accuracy, and to analyze uncertainty in modeling watershed response to intense rainfall events. Those estimates are respectively associated to the quantity and the quality of available data. A distributed model based on geomorphologic concepts has been used. Since the experiment involves the analysis of an ensemble of model runs, it's 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, model potential accuracy, 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 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 or unreliable data sets.