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Characterization of the uncertainty in a simplified rainfall-runoff model

Lorenzo Campo
CIMA Research Foundation, Savona, Italy (lorenzo.campo@cimafoundation.org)

In addition to being largely used for short-term forecast in operational flood monitoring, the rainfall-runoff models constitute a fast tool for studying some aspects of the hydrological modelling. The very small computational cost required is essentially due to he fact that they require a single input, given by the rainfall height time series (for lumped models) or interpolated or spatially-continuous rainfall height maps (if the model is distributed). In particular the large majority of the most complex (and computationally heavy) hydrological processes are extremely simplified or neglected: the reference is, for example, to evapotranspiration, base flow, soil infiltration, groundwater dynamics, etc.
In this study a simple rainfall-runoff lumped model is used as a toy-model for a statistical analysis based on the perturbation of the parameters of the model. In order to evaluate the sensitivity to the parameters (that represents the uncertainty of calibration of the model, to be added to the uncertainty due to the simplified physical representation) in an exhaustive way, the input of the model was given by a stochastic rainfall model. This stochastic generation was based on the characteristic of the observed hourly rainfall height time series in different raingauges, in order to consider the effect of different rainfall regimes.
Starting from the parameters that generate particular discharge flows time series, the effect on the deviation of the extreme flows distribution (from the reference one) was investigated. The main purpose of the study was to assess how the calibration error in a simple hydrological model can affect the uncertainty of the simulated flows.
The analysis was performed basing on the rain time series observed in the Italian raingauges network in the period 2003-2016.