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Impact of catchment size and rainfall intensity on uncertainty in distributed rainfall-runoff modelling

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Especially in fast responding catchments the limited reliability and wobbliness of a deterministic flood forecast may easily jeopardise the forecast credibility. This can be overcome by considering in addition to meteorological forecast uncertainty also the uncertainty of the hydrological modelling. In our study we focus on the main sources of input and model parameter uncertainties of the rainfall-runoff process using a distributed hydrological model. These uncertainties essentially arises from insufficient catchment information (e.g. vague soil data) and the likelihood to obtain a similar calibration quality (goodness of fit) from different parameter combinations (problem of equifinality). A further component of hydrological uncertainty results in the necessary interpolation of rainfall information, which is only provided at distinct times and only at a few gauges in the catchment.

In a preliminary step these uncertainties are quantified separately according to their properties and the a-priori knowledge. Hereby the following methods are used:

- Monte Carlo simulations using Latin-hypercube sampling of distributed parameter sets to analyse the influence of uncertain soil data with respect to runoff,
- Markov Chain Monte Carlo method for assessing parameter confidence intervals of conceptual model parameters,
- Model simulations by using different precipitation realisations. These realisations, describing time and space variability of rainfall data, are generated by a turning bands method.

In a second step we combine these individual uncertainties within a Monte Carlo framework and evaluate the global uncertainty of rainfall-runoff modelling.

An application of the framework is presented for the flash flood prone region of gauge Kriebstein, a mesoscale catchment in the ore mountain, Germany. The results show a change in the behaviour pattern of uncertainty with a growing catchment area. Especially the impact of rainfall variability decreases. Investigations of different rainfall events show the impact of varying process dynamics with respect to the runoff formation. Here the variability of runoff decreases with increasing rainfall intensity because of a dominating direct runoff component. Furthermore the presentation discusses the occurring uncertainties concerning the different phases of a hydrograph.