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Impact of rainfall spatial uncertainty on distributed runoff modeling: the Weisse Elster case study, Germany

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This work presents the application of a Monte Carlo Markov Chain (MCMC) algorithm to estimate parameters and uncertainty of the WASIM-ETH model in a small catchment ($100 km^2$) of Weisse Elster basin in Germany with and without prior consideration of the rainfall spatial uncertainty. First, the simulation has been done without considering the rainfall spatial uncertainty, for the 200m grid size for which the use of a statistical likelihood function led to well identified posterior distributions of the parameters. The model performed well in both calibration and validation periods, with reliable performance proven by small uncertainty bounds. More than 85% of the observed discharge values find themselves within the predictive uncertainty bounds while only 7% of these find themselves within the parametric uncertainty bounds. This is one of the limitations of the present method and could be an effect of not considering the errors in the input data in the calibration approach. As rainfall is one of the major inputs for hydrological modeling, the rainfall uncertainty has been further considered in the Bayesian calibration approach. To the difference of the classical statistical approaches of dealing with input uncertainty, in this study the rainfall uncertainty has been considered prior to the hydrological model calibration. 50 random spatial rainfall scenarios have been created using the Turning Bands algorithm. The goal of the methods of geo-statistical simulation is to create a series of field realizations of rainfall which show the same variability as the observations. Conditional simulation additionally preserves the observations at the measurement locations as far

as possible.

For each generated scenario, the MCMC algorithm has been applied and the WASIM-ETH model posterior parameter distributions have been updated. These allowed updating the parametric and predictive posterior distributions of the simulated discharges. The results after considering the rainfall spatial uncertainty will be presented in this study and hints concerning the most important sources of errors that affect the hydrological modeling will be highlighted.