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Assessing the importance of rainfall uncertainty on hydrological models with different spatial and temporal scale

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Precipitation is one of the key inputs for hydrological models. As long as the values of the hydrological model parameters are fixed, a variation of the rainfall input is expected to induce a change in the model output. Given the increased awareness of uncertainty on rainfall records, it becomes more important to understand the impact of this input - output dynamic. Yet, modellers often still have the intention to mimic the observed flow, whatever the deviation of the employed records from the actual rainfall might be, by recklessly adapting the model parameter values. But is it actually possible to vary the model parameter values in such a way that a certain (observed) model output can be generated based on inaccurate rainfall inputs? Thus, how important is the rainfall uncertainty for the model output with respect to the model parameter importance?

To address this question, we apply the Sobol' sensitivity analysis method to assess and compare the importance of the rainfall uncertainty and the model parameters on the output of the hydrological model. In order to be able to treat the regular model parameters and input uncertainty in the same way, and to allow a comparison of their influence, a possible approach is to represent the rainfall uncertainty by a parameter. To tackle the latter issue, we apply so called rainfall multipliers on hydrological independent storm events, as a probabilistic parameter representation of the possible rainfall variation.

As available rainfall records are very often point measurements at a discrete time step (hourly, daily, monthly,...), they contain uncertainty due to a latent lack of spatial and temporal variability. The influence of the latter variability can also be different for hydrological models with different spatial and temporal scale. Therefore, we perform the sensitivity analyses on a semi-distributed model (SWAT) and a lumped model (NAM). The assessment and comparison of the importance of the rainfall uncertainty and the model parameters is achieved by considering different scenarios for the included parameters and the state of the models.