How uncertainty of simulating water resources is affected by different input data information content

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Abstract

The partly-deterministic model Soil and Water Assessment Tool (SWAT) demands a large variety of spatial input data. These are commonly available in different resolutions and result from different preprocessing methodologies. Effort is made to apply the most specific data as possible for the study area to reflect the heterogeneous characteristics of landscapes. Most often, modelers prefer to use regional data, especially with fine resolution, which is not always available and is computationally demanding. Instead, global datasets are considered that are more general. This study investigates how the use of global and regional input datasets may affect the goodness-of-fit and parameter uncertainty of the model. We analyzed eight different setups for the SWAT model, combining two of each Digital Elevation Models (DEM), soil and land use maps of diverse spatial resolution and information content. The models were calibrated to discharge at two different catchments that are partly located in the north of Luxembourg and partly in the southeast of Belgium. The Winseler catchment area is about 103 km2 and Kautenbach-Clerve is about 232 km2. The regions are considered rural areas, having around 5-8% of urban areas, and the rest is almost equally divided between pasture, forests and arable lands. The Metropolis Markov Chain Monte Carlo algorithm implemented in the python package SPOTPY was used to infer posterior parameter distributions and assess parameter uncertainty. During the optimization process, we are maximizing the logarithmic likelihood and later calculating the Nash-Sutcliffe Efficiency (NSE) and the logarithm of NSE to quantify goodness-of-fitness for high and low flow, respectively. We focused on snow temperature, soil physical, groundwater and main channel parameters. Preliminary results indicate that the model has the best performance when using the regional DEM and land use map and the global soil map, indicating that SWAT cannot necessarily make use of additional soil information if they are not substantially effecting soil hydrological fluxes. Moreover, additional data or missing processes (i.e. the current model structure is not able to cover the dominant hydrological processes) are needed to improve the model's capability in simulating the hydrology of these catchments. Furthermore, all model set ups are underestimating the model uncertainty suggesting that additional source of uncertainties should be estimated simultaneously.

Keywords

uncertainty assessment, Wiltz River, Clerve River, input data