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Consistency and variability of spatial and temporal patterns of parameter dominance on four simulated hydrological variables in mHM in a large basin study

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Model parameters are implemented in hydrological models to represent hydrological processes as accurate as possible under different catchment conditions. In the case of the mesoscale Hydrological Model (mHM), its parameters are estimated via transfer functions and scaling rules using the Multiscale Parameter Regionalization (MPR) approach [1]. Hereby, one consistent parameter set is selected for the entire model domain. To understand the impact of model parameters on simulated variables under different hydrological conditions, the spatio-temporal variability of parameter dominance and its relationship to the corresponding processes needs to be investigated.

In this study, mHM is applied to more than hundred German basins including the headwater areas in neighboring countries. To analyze the relevance of model parameters, a temporally resolved parameter sensitivity analysis using the FAST algorithm [2] is applied to derive dominant model parameters for each day. The temporal scale was further aggregated to monthly and seasonal averaged sensitivities. In analyzing a large number of basins, not only the temporal but also the spatial variability in the parameter relevance could be assessed. Four hydrological variables were used as target variable for the sensitivity analysis, i.e. runoff, actual evapotranspiration, soil moisture and groundwater recharge.

The analysis of the temporal parameter sensitivity shows that the dominant parameters vary in space and time and in using different target variables. Soil material parameters are most dominant on runoff and recharge. A switch in parameter dominance between different seasons was detected for an infiltration and an evapotranspiration parameter that are dominant on soil moisture in winter and summer, respectively. The opposite seasonal dominance pattern of these two parameters was identified on actual evapotranspiration. Further, each parameter shows high sensitivities to either high or low values of one or more hydrological variable(s). The parameter estimation approach leads to spatial consistent patterns of parameter dominances. Spatial differences and similarities in parameter sensitivities could be explained by catchment variability.

The results improve the understanding of how model parameter controls the simulated processes in mHM. This information could be useful for more efficient parameter identification, model calibration and improved MPR transfer functions.

References

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