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Spatial pattern oriented optimization of regional scale hydrological models

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Regional scale hydrological models are often constrained by a group of observation stations, typically for discharge, which each represent a lumped catchment response. While multi-station calibration greatly improves model fidelity, other sources of data and different calibration objectives are often required to improve models for other variables and increase robustness for ungauged areas. Satellite data has often been utilized as an additional source of information for multi-objective optimization. However, in many cases satellite-based data for other variables, such as soil moisture, AET, snow cover, storage change etc. has been applied as timeseries of catchment averages, thereby underutilizing the unique spatial pattern information they carry.

In a series of studies a simple alternative approach has been developed to capitalize on the benefits of combining spatial pattern information from satellite data with classical discharge and groundwater head observations for model optimization. By limiting the constraint by the satellite data to pattern information only a very limited tradeoff with other observations is achieved. Meanwhile, the approach ensures realistic spatial patterns of parameter fields and simulations leading to improved transferability to ungauged basins.

In light of equifinality, which is often encountered for regional scale models constrained by multiple discharge stations, the approach can as such also be seen as an efficient way of identifying spatially consistent and realistic solutions among a large sample of plausible parameter sets.

Here we present two cases, one across six central-European basins using a mesoscale hydrological model (mHM) and another using a national scale groundwater-surface model (MIKE-SHE).