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Spatial pattern evaluation as a diagnostic approach to understand distributed hydrological model deficiencies at the catchment scale

Simon Stisen (1), Cüneyd Demirel (1), Gorka Mendiguren (1), Julian Koch (1), and Luis Samaniego (2)

(1) Geological Survey of Denmark & Greenland, Hydrology, Copenhagen K, Denmark (sst@geus.dk), (2) Helmholtz Centre for Environmental Research - UFZ, Leipzip, Germany

Spatially distributed hydrological models are valuable tools for water management and can potentially provide insights into the overall water balance, temporal dynamics as well as the internal spatial distribution of multiple hydrological states and fluxes. The spatial predictability is however severely hampered by the general lack of spatial pattern evaluation since model evaluation remains focused on spatially aggregated objective functions such as discharge and therefore ignoring the spatial component.
We would like to highlight the added value of evaluating the simulated spatial patterns of distributed models and demonstrate how this evaluation can assist the modeler in diagnosing model deficiencies and improve model process description and parameterization. The incorporation of remote sensing derived spatial pattern observations allows us to evaluate different distributed model setups based on the mesoscale Hydrologic Model (mHM) and MIKE-SHE, and interpret the information obtained by the spatial pattern of the error and how that relates to model input or process descriptions. The examples include inadequate representation of the link between patterns of soil moisture content and actual evapotranspiration as well as exaggerated coupling between groundwater and the atmosphere.