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Wflow_sbm, a spatially distributed hydrologic model: from global data to local applications

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In this contribution we present the wflow_sbm hydrologic model concept, which is a conceptual bucket-style hydrologic model based on simplified physical relationships including kinematic wave routing for surface and subsurface lateral flow. The model maximizes the use of global data for local applications and allows us to automatically setup a high resolution (~1km^2) wflow_sbm model for any basin in the world. For most discharge gauging stations in selected basins from different climate zones, wflow_sbm showed promising results without further calibration. Depending on the geographical area of interest two model parameters, besides anthropogenic interference like reservoir and lake management, show most sensitivity: rooting depth and horizontal saturated hydraulic conductivity.

We extended the parameter estimation of the wflow_sbm hydrological model for the Rhine basin (Imhoff et al, 2019) with point-scale (pedo)transfer-functions (PTFs) in conjunction with scaling operators as applied in Multiscale Parameter Regionalization (MPR) to the global scale at high resolution (~1km^2). The state-of-the-art hydro-MERIT dataset at 3 arcsec resolution (Yamazaki et al. (2019)) is scaled to model resolution whilst conserving the drainage network using a newly developed extended Effective Area Method (EAM) for flow direction scaling which builds on the original EAM (Yamazaki et al. 2009). Compared to EAM and the double maximum method, the extended EAM method shows improved skill. The automated model setup derives subgrid information about land slope, river slope and length. River widths are derived from power law relationships between hydro-MERIT river widths and global discharge estimates through multiple linear regression based on GRDC data, precipitation and upstream area with clustering on climate zones. Soil hydraulic parameters are derived from the 250m ISRIC SoilGrids product using PTFs. Furthermore, parameters for interception and rooting depth are derived and upscaled using global or regional land cover maps. Monthly LAI profiles are derived from MODIS (500m) and upscaled. Lake and reservoir parameters are derived from HydroLAKES and GRanD, respectively. The models are run using forcing from globally available data sets like ERA5 and CHIRPS.

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