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Multi-criterial calibration of a global hydrological model for the Mississippi basin: Exploring the effect of the number of calibration units

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The predictive ability of a hydrological model depends among others on how well the model is calibrated by model parameter adjustment. When calibrating spatially distributed models such as global hydrological models in which river basins are represented by laterally connected grid cells of mostly 0.5° latitude by 0.5° longitude, it is not appropriate and possible to adjust the parameters of each grid cell individually. This is mainly due to the lack of high-resolution observations but also due to the required computational effort. It needs to be investigated which spatial extent of calibration units for which parameters are uniformly adjusted, is optimal given the available observations and the characteristics of the region or river basin. To explore the effect of size and number of calibration units, the WaterGAP Global Hydrological Model (WGHM) was calibrated for a large river basin in North America, the Mississippi basin, successively dividing the basin into smaller calibration units, i.e., sub-basins, in order to examine the feasibility and value of reducing the size of calibration units for the given set of observations. Total water storage anomalies from GRACE satellites, snow cover from MODIS and in-situ streamflow were used as observations in an ensemble-based multi-criterial Pareto Optimization Calibration (POC) framework using the Borg-MOEA optimization algorithm.