



Capacity and flux model parameters should be addressed separately in parameter sensitivity and identifiability analyses

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Analysing parameter sensitivity and identifiability are important steps in hydrological modelling as they help to detect the most relevant parameters and suitable parameter ranges. Within such studies we can categorize parameters in diverse ways – one of them being capacity vs. flux parameters. While capacity parameters regulate the magnitude or storage of hydrological components, flux parameters determine the timing of water flow. We demonstrate in two steps that separating capacity and flux parameters is beneficial for model analyses.

First, we conducted a temporally resolved parameter sensitivity analysis, targeting the rate of change of eight hydrological components in addition to the absolute time series. Using the rate of change as target variable improved the representation of dynamic flux parameters, while capacity parameters were more precisely represented by the absolute time series of the hydrological components.

In a second step, we conducted a parameter identifiability analysis across six contrasting German catchments using sixteen diverse performance metrics and hydrological signatures. Our analysis with four hydrological models (Raven-GR4J, HBV, SWAT+ and mHM) reveals that capacity parameters can be precisely identified using several performance criteria, in particular those related to mid and low flows. In contrast, accurate identification of flux parameters requires specific performance criteria such as hydrological signatures related to the process timing.

Separating parameters into capacity and flux parameters improves the detection of the sensitivity signal and enables a more precise identification of parameter values. The reduced uncertainty in estimating the dominant parameters is a valuable step towards efficient model calibration.