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Advancing sensitivity analysis to precisely characterize temporal parameter dominance

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Parameter sensitivity analysis is a strategy for detecting dominant model parameters. A temporal sensitivity analysis calculates daily sensitivities of model parameters. This allows a precise characterization of temporal patterns of parameter dominance and an identification of the related discharge conditions.
To achieve this goal, the diagnostic information as derived from the temporal parameter sensitivity is advanced by including discharge information in three steps. In a first step, the temporal dynamics are analyzed by means of daily time series of parameter sensitivities. As sensitivity analysis method, we used the Fourier Amplitude Sensitivity Test (FAST) applied directly onto the modelled discharge. Next, the daily sensitivities are analyzed in combination with the flow duration curve (FDC). Through this step, we determine whether high sensitivities of model parameters are related to specific discharges. Finally, parameter sensitivities are separately analyzed for five segments of the FDC and presented as monthly averaged sensitivities. In this way, seasonal patterns of dominant model parameter are provided for each FDC segment.
For this methodical approach, we used two contrasting catchments (upland and lowland catchment) to illustrate how parameter dominances change seasonally in different catchments. For all of the FDC segments, the groundwater parameters are dominant in the lowland catchment, while in the upland catchment the controlling parameters change seasonally between parameters from different runoff components.
The three methodical steps lead to clear temporal patterns, which represent the typical characteristics of the study catchments. Our methodical approach thus provides a clear idea of how the hydrological dynamics are controlled by model parameters for certain discharge magnitudes during the year. Overall, these three methodical steps precisely characterize model parameters and improve the understanding of process dynamics in hydrological models.