Improving parameter identifiability by computing weighted performance criteria based on daily sensitivity time series

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In hydrological models, parameters are included to adapt the model to the characteristics of the catchment. Model parameters are usually identified by optimizing performance criteria for the complete discharge time series. However, the dominance of model parameters changes in time. Neglecting this in parameter identification can lead to inappropriate parameter values. In such cases, parameters remain as a crucial factor of uncertainty.

To overcome this limitation, we introduce in this study an innovative approach focusing on the temporal relevance of model parameters. For this, daily time series of parameter sensitivities are computed using a temporally resolved parameter sensitivity analysis. These daily parameter sensitivities are included as weighting factor in computing a weighted RSR (RSR_w) for each model parameter. In this way, periods of higher relevance of a model parameter are higher weighted in the model evaluation.

We tested this approach in four contrasting catchments. Higher parameter identifiability is obtained in all cases when using RSR_w compared to the common RSR. Using the weighted RSR, the identifiability increases for model parameters that are dominant for a short time period (e.g. surface runoff parameters) or which have strong seasonal variability such as snow parameters. By doing so, the information extracted from model simulations is improved and more hydrologically meaningful parameter values are identified. In this way, a higher number of model parameters is precisely identified leading to decrease in parameter uncertainty and equifinality.