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A calibration framework for data scarce basins: sequential use of information from conventional and remote sensing data

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We present a calibration framework based on the Generalized Likelihood Uncertainty Estimation (GLUE) with limits of acceptability that can be used to profit from any available information while modeling scarcely gauged catchments. The framework provides (a) conditioned model parameter distributions and (b) sequential learning what additional information may be beneficial to further reduce the parameter uncertainty. Thus, further data collection (be it ground or remote sensing data) can be tailored to the understanding gained from the available, scarce data.

The information content used comes from signatures, typically apparent in conventional data even if these are uncertain, intermittent, collected at the wrong time scale or even non-concomitant. On the other hand, remotely sensed data can further condition the prior parameter distribution. The framework is based on the idea that model parameter sets are accepted when they reproduce the signatures identified from these data sources within some limits of acceptability. In the present framework, these limits are defined based on year-to-year variability of the signatures within the available time series.

Applying the developed approach to a case study in the Luangwa River in Southern Africa, we demonstrate that non-concomitant satellite rainfall and discharge records constrain considerably the model parameters that separate discharge processes into fast and slow flow. The results indicate that the evaporation regime is highly uncertain. Therefore, satellite-based evaporation maps were introduced in the calibration framework as well, which allowed for further constraining of the evaporation regime and of the spatial distribution of the parameters.