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# Stepped calibration of a PUB model using evaporation and discharge spectral properties

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In this research we explore the parameter space of a conceptual hydrological model in a stepped approach using remotely sensed evaporation and 'old' in-situ discharge data in the Luangwa river in Zambia, a large ungauged river basin. The proposed model calibration method shows how non concomitant observed discharge time series and 'new' forcing and calibration data, mainly empirically derived from remote sensors, can be combined in hydrological modeling of sparsely gauged catchments.

The river basin is sub-delineated in hydrotopes with an unsupervised classification based on one year of SPOT NDVI images. Within one hydrotope, parameters are considered lumped. In the first parameter estimation step, dry-season remotely sensed evaporation estimates are employed as calibration data for 3 evaporation-sensitive parameters of the prescribed conceptual model structure. The values of the 3 parameters vary for each hydrotope. In the next step, the remainder of the parameters is calibrated on the spectral properties of an old discharge time series, using the Whittle likelihood. To explore the prediction uncertainty related to the forcing data, we repeated this step with 3 different rainfall estimates (also derived from remote sensors). In this approach, we assume that the spectral properties of discharge do not change over time (e.g. due to land cover or climate change). This stepped approach has two advantages: first, the amount of parameters calibrated per calibration step is reduced, which increases parameter identifiability. Second, the Whittle likelihood enables the use of an 'old' discharge time series as calibration data for a model, forced by 'modern' time series.

The approach is very promising for gaining understanding of hydrology in the framework of Predictions in Ungauged Basins (PUB), because it makes optimal use of all public domain available data.