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Regional assessment of water balance at the water bodies scale using hydrological signatures

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With recent droughts and floods causing severe damages in Central Europe, there is a significant demand for water management tools capable of evaluation of water balance including basin water use in the scope of multiple possible climate/water use scenarios in fine spatial detail. Conceptual rainfall-runoff models are practical tools for assessment of components of hydrological balance also when measurement data are scarce. Using information on water balance components such as soil moisture can reduce model parameter uncertainty. The aim of this study is to develop a system of models describing hydrological behaviour of water bodies (>1100) in the Czech Republic, which will be further used for water management in water scarcity situations and for evaluation of climate and water use scenarios. A six parameter lumped model Bilan in daily time step was calibrated for each water body using time series of precipitation, temperature and reported water use as inputs. Since most of the water bodies are ungauged the model is calibrated considering the estimates of specific quantiles of streamflow (derived by regionalization of observed streamflow by the Czech Hydrometeorological Institute). In addition, estimates of potential evapotranspiration, actual evapotranspiration, soil moisture and snow water content from the SoilClim model (operated by the Global Change Research Institute of the Czech Academy of Sciences) are used to constrain the hydrological balance components simulated by Bilan. The simulated balance is validated against observed runoff for 156 catchments in addition, the spatial distribution of model parameters is also compared to relevant catchment characteristics. It is shown that even in the lack of observed data the presented approach reduces uncertainty in model parameters and can be successfully applied at ungauged catchments, provided at least some basic characteristics of hydrological regime can be estimated.