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Diagnostics of the Global Hydrological Model WaterGAP Using Alternative Data Sources

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It is a conventional strategy to test both conceptual and more complex hydrological models with observed discharge time series. As the models are tuned against measured runoff, certain physically-based model parameters might be biased to such an extent, that their representation of catchment-specific processes is beyond reasonable limits. However, the applicability of the models for the prediction of processes beside discharge is usually not tested. But this can also be due to a lack of suitable datasets, especially on the hydrological macro-scale. The hydrological component of the global water use and availability model WaterGAP was tested against observed discharge time series at more than 700 gauges worldwide, mostly with a very satisfying performance. The calculation of water availability on a 0.5° resolution delivers suitable data for the assessment of human impacts on the water resources. In order to carry out a thorough inspection of the value of the simulations with WaterGAP, and for a better estimation of the uncertainty of the model predictions, selected processes represented by the model were investigated in this study. Therefore, data mining was used to identify alternative datasets for model testing. For selected test regions remotely sensed data, ground measurements or modelled data (delivered using different approaches) of snow cover, soil moisture and evapotranspiration were compiled. Mean values as well as interannual regimes simulated by the model were then tested against the data. Considering the different scales of the compared data (e.g., point source measured data against simulated values for individual grid boxes) and the complexity of the underlying processes, the model has demonstrated to deliver reliable predictions. However, the study also showed potential for future further developments of the model. Furthermore, this work also serves as an example for advanced learning from thorough model diagnostics. It also contributes to efforts for the prediction of hydrological processes

under data scarcity.