Extensive validation of the global water resources model
PCR-GLOBWB 2.0: incorporating human impacts

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1 Introduction

With growing populations, economic expansion and rising standards of living the demand for water is increasing across the globe. Demographic developments and a changing climate will further aggravate the pressure on global water resources. In the EU FP7 project EartH2Observe in-situ data, earth observations, and models are assimilated to provide a comprehensive reanalysis of the global water resources, accounting for all components of the global water cycle including information on the impacts of human activities. Synthesizing as many sources of information as possible bears great potential to improve global water balance estimates and to consequently allow for consistent decisions in water management. One of the modelling suites participating in EartH2Observe is the global hydrological model PCR-GLOBWB\(^1\) which accounts for anthropogenic perturbations in the water cycle. Here we present an extensive validation of the latest model version PCR-GLOBWB 2.0.

2 Data and Methodology

PCR-GLOBWB is a large-scale hydrological model providing a grid-based representation of terrestrial hydrology with a typical spatial resolution of less than 50×50 km (currently 0.5° globally) on a daily basis. The two presented model runs ‘NATURAL’ and ‘HUMAN’ were driven with the WFDEI\(^2\) forcing data. While land cover consists of short and tall vegetation for the NATURAL run the additional cover types paddy and non-paddy are used under anthropogenic influence. Validation: We evaluate the HUMAN and NATURAL model simulations for different parts of the hydrological cycle. Evaporation is validated with FLUXNET-MTE\(^3\) and ERA-I LAND\(^4\), soil moisture with ESA CCI SM\(^7\) and the base flow index (BFI) with GSCD\(^8\). Discharge is compared with GRDC\(^9\) data.

3 Results

The impact of dynamically incorporating human influences into PCR-GLOBWB was shown for different parts of the terrestrial water cycle. In general the model agrees well with the observations. Due to an on average smaller crop factor of non-paddy crops compared to grassland evaporation reduces over non-paddy fields, which also results in a weaker model performance for some areas of the world. For monthly mean discharges the incorporation of anthropogenic impacts lead in total to some decrease in model performance. Soil moisture simulations could partly be improved through incorporating human influences as could simulations of the baseflow index. Using BFI and Evaporation (validation) datasets to calibrate PCR-GLOBWB can help to overcome some of the weaknesses of the model and will be analyzed in a future study. The use of additional/different land cover types and improving the reservoir scheme are further promising developments.

4 Summary, Discussion and Outlook

Soil moisture simulations could partly be improved through incorporating human influences as could simulations of the baseflow index. Using BFI and Evaporation (validation) datasets to calibrate PCR-GLOBWB can help to overcome some of the weaknesses of the model and will be analyzed in a future study. The use of additional/different land cover types and improving the reservoir scheme are further promising developments.

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