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Simulating the impact of climate, land use and human water use on the hydrological system over the period 1850-2100 using PCR-GLOBWB

Joyce Bosmans (1), Rens van Beek (1), Marc Bierkens (1,2)

(1) Utrecht University, Faculty of Geosciences, Department of Physical Geography, Utrecht, Netherlands, (2) Deltares, Utrecht, Netherlands

In this study we investigate the impact of humans on the global hydrological system by separating the impacts of climate change, land use and land cover change, and human water use in a series of experiments with the PCR-GLOBWB hydrological model (e.g. van Beek et al., 2011; Sutanudjaja et al., 2014). We force PCR-GLOBWB with input from the EC-Earth and CESM GCMs, allowing us to extend our experiments from the pre-industrial (1850) to the end of the century (2099). Two greenhouse gas emission scenarios are used for the coming century: Representative Concentration Pathway 2.6 (RCP2.6), a low-end scenario, as well as the high-end RCP8.5 scenario. Precipitation, temperature and reference potential evapotranspiration are applied to PCR-GLOBWB, after bias-correction using the ISI-MIP method (Hempel et al., 2013). The reference potential evapotranspiration is computed using the Penman-Monteith equation with GCM wind, radiation, temperature, humidity and pressure as opposed to the Hamon method used as default in PCR-GLOBWB.

To evaluate the impacts of climate change as well as land use and land cover (LULC) change, we apply a combination of fixed and transient LULC scenarios. First, LULC is kept fixed at 1850 values, so the hydrological model is only experiencing changes in precipitation, temperature and reference potential evapotranspiration. Then, LULC is allowed to vary according to historical reconstructions (HYDE) and future projections per RCP (Hurtt et al., 2011). In these experiments, anthropogenic effects are excluded. This is the first study to evaluate PCR-GLOBWB with pre-industrial or transient LULC in combination with present and future climate change.

The next step is to investigate human impacts on the water system, by comparing the experiment with varying LULC to an experiment that additionally includes reservoir operations, human water abstractions including irrigation (paddy and non-paddy) and subsequent return flows. We aim to project future human impacts using information based on Shared Socioeconomic Pathways (SSPs). In previous studies, domestic, industrial and irrigation water demand were varied over the past decades in PCR-GLOBWB. Here we improve the analyses of human impacts on the hydrological system by looking further into the past and the future, as well as by comparing the impact of human water use to impacts of climate and LULC change.

van Beek et al (2011), Global monthly water stress: 1. Water balance and water availability. Water Resources Research, Vol 47.

Hempel et al (2013), A trend-preserving bias correction – the ISI-MIP approach. Earth System Dynamics, Vol 4.

Hurtt et al (2011), Harmonization of land-use scenarios for the period 1500–2100: 600 years of global gridded annual land-use transitions, wood harvest, and resulting secondary lands. Climatic Change, Vol 109.

Sutanudjaja et al (2014), Development and validation of PCR-GLOBWB 2.0: a 5 arc min resolution global hydrology and water resources model. EGU General Assembly Conference Abstracts