EGU22-9614
https://doi.org/10.5194/egusphere-egu22-9614
EGU General Assembly 2022

Distinguishing Direct Human-driven Changes in the Global Terrestrial Water Cycle

Elisie Kåresdotter[1], Zahra Kalantari[1,2], and Georgia Destouni[1]
[1]Department of Physical Geography and the Bolin Center for Climate Research, Stockholm University, Stockholm, Sweden (elisie.karesdotter@natgeo.su.se)
[2]Department of Sustainable Development, Environmental Science and Engineering (SEED), KTH Royal Institute of Technology, Stockholm, Sweden

Growing populations contribute to increased pressures on water resource availability. Understanding the impacts of various human pressures on terrestrial water flows is important to meet the challenges of sustainable water resource management. For useful assessment of and planning for societal water-availability impacts, it is also imperative to disentangle the direct influences of human activities in the landscape from external climate-driven influences on water flows and their variation and change. One approach to such disentanglement is to use a distributed global hydrological model that can realistically represent climate and direct anthropogenic modifications of the water system. This study uses this approach to quantify and separate the climate-driven change components of key hydrological variables (evapotranspiration, runoff, soil moisture, and storage change) from the human-driven change components that are modified by interventions such as dams, water reservoirs, and water withdrawals for irrigation, industry, and households. Using a global hydrological model in two different modes, one with and one without the inclusion of human activities, the result differences indicate the direct anthropogenic influences. Human activities are found to drive changes to all hydrological variables with different magnitudes and directions depending on geographic location. The largest differences between the pristine and the human-activity model runs are seen in regions with the highest population density. In such regions, which also tend to have relatively large numbers of dams used for irrigation, water storage is largely decreasing and feeding into increased runoff and evapotranspiration. Our findings provide new knowledge of how humans affect different hydrological fluxes and storages globally, including a more complete set of hydrological variables than in previous studies. This enables closure of hydrological balances and informs further research on historic and future hydrological trends, which is of special interest for areas lacking historic data and being particularly vulnerable to water availability changes.

Keywords: Hydrological variability and change; Global hydrological modeling; Anthropogenic change; Climate-driven change; Water fluxes and storages