EGU23-14953, updated on 14 Apr 2024
https://doi.org/10.5194/egusphere-egu23-14953
EGU General Assembly 2023

CMIP6 multi-model projections of the groundwater response to climate change during the 21st century

Maya Costantini[1], Jeanne Colin[2], and Bertrand Decharme[3]
[1]CNRM, Météo-France/CNRS, Université de Toulouse, Toulouse, France (maya.costantini@meteo.fr)
[2]CNRM, Météo-France/CNRS, Toulouse, France (jeanne.colin@meteo.fr)
[3]CNRM, Météo-France/CNRS, Toulouse, France (bertrand.decharme@meteo.fr)

Climate change will impact every component of the climate system and water cycle. It does not spare groundwater which account for approximately one third of the human fresh water withdrawals. The combined effect of climate change and groundwater pumping could lead to water scarcity and food insecurity in some regions. Therefore, it is essential to study the groundwater response to climate change to improve the development of adaptation and mitigation plans in water management.

Here, we analyze the response of groundwater recharge to climate change using an ensemble of simulations runs with 22 fully coupled ocean-atmosphere-land models participating to the CMIP6 exercise. They are run from 1850 to 2100 and follow four of the latest IPCC scenarios of greenhouse gas future evolution. This analysis is supplemented with the assessment of the climate-driven response of groundwater level given by the CNRM global climate models (which are part of the CMIP6 exercise). These models represent the hydrogeological processes involving groundwater, including the two-way water exchanges with rivers and the unsaturated soil, the lateral groundwater fluxes, and the interactions with the atmosphere. Results show that on global average, groundwater recharge is expected to increase with climate change. The changes in groundwater recharge follow those of precipitation and, to a lesser extent, evapotranspiration and thus follow the same regional patterns.

As these CMIP6 models do not represent human groundwater withdrawals, the projected changes in recharge are somewhat optimistic and could be out of step in regions with strong groundwater pumping. To address this limitation, results are put in perspective with projections of water withdrawals following the CMIP6 experiments. This analysis shows the combined effects of climate change and groundwater pumping on groundwater and help to understand the evolution of the future large scale water resource.