# Assessing the impact of irrigation and groundwater pumping on the regional hydro-climate using the Earth system model MIROC-INTEG-ES

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Irrigation is an important anthropogenic forcing in the Earth system that affects natural-human interactions over a range of spatial and temporal scales. It has been shown that artificial watering of soil and water extraction of groundwater for irrigation can alter the water and heat budgets at the land surface, leading to changes in regional climate and hydrological cycles. With an expected increase in irrigation to meet growing food demand, the impact of irrigation is likely to increase further in the future. It is therefore essential to better understand the irrigation-induced changes in the various components of the Earth system, now and in the future.
The purpose of our research is to improve the quantitative understanding of the impacts of irrigation and groundwater use as anthropogenic drivers of regional climate and environmental change. We have developed an Earth system modeling framework that couples the updated Earth system model, MIROC-ES2L (Model for Interdisciplinary Research on Climate, Earth System version 2 for Long-term simulations) and newly implemented hydrological human activity modules: MIROC-INTEG-ES. This modeling framework enables simulations of a coupled natural-human system including water cycle dynamics related to irrigation.
Our preliminary results show remarkable differences between simulations with and without the irrigation process, especially, in heavily irrigated regions. We show the hydrological variables affected by irrigation and groundwater pumping and identify the regions and timings of significant impact. We also estimate the individual contribution of groundwater and surface water use to such irrigation impacts.

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