LANCANG-MEKONG NEWSLETTER

February 2025, No. 11

Project Title:
Impacts of climate change on the water-food-energy nexus in the Lancang-Mekong River Basin

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Project Period:
January 2024 – Decemer 2028

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Project Office

February 12

Professor Junguo Liu's Research Group Reveals the Impacts of Cropland Expansion and Deforestation on Lancang-Mekong Basin Hydrology

The research team conducted a systematic investigation in the Lancang-Mekong River Basin (LMRB) from 1980 to 2010 (a period marked by rapid and significant cropland expansion and deforestation) using a surface-groundwater coupled model and designing two scenario experiments. The study finds that cropland expansion reduces the correlation between soil moisture and the drought index, as well as between soil moisture and groundwater storage. This is because cropland expansion is accompanied by increased irrigation dependent on groundwater, which leads to increases in soil moisture and decreases in groundwater storage. Meanwhile, forest loss reduces infiltration, exerting a soil moisture-decreasing impact, an impact opposite to that of cropland expansion. Furthermore, the areas where forest loss occurs are mainly in regions with steep topography, where increases in lateral groundwater flow can offset the decrease in groundwater.

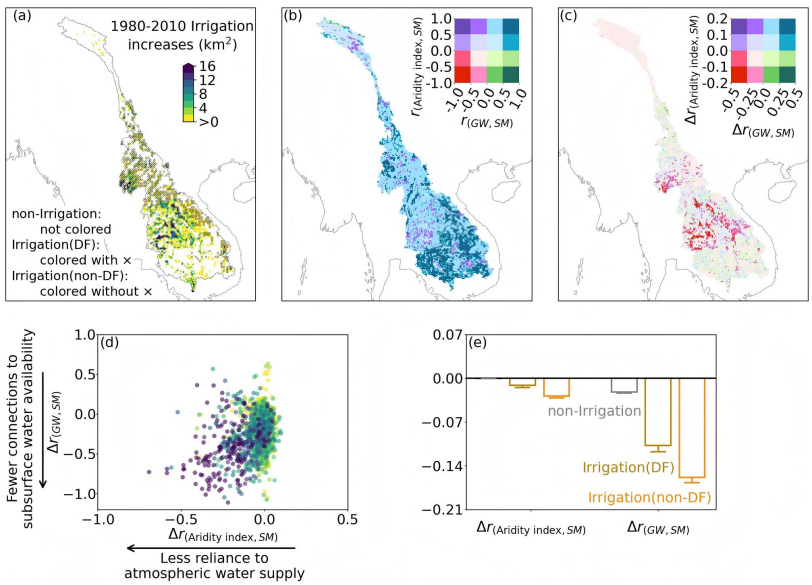

Fig.Weakened coupling due to irrigation increases and deforestation.

Partial information decomposition from information theory was used for the multivariate system of soil moisture-evapotranspiration-surface runoff. The increase in soil moisture and evapotranspiration caused by cropland expansion exerted opposing effects on surface runoff: the former promoted an increase, while the latter led to a decrease. At the same time, cropland expansion also imposed opposing impacts on runoff by reducing surface runoff and increasing baseflow, which resulted in a decrease and an increase in runoff, respectively. Ultimately, these combined effects led to inconsistent variations in runoff and its components across different regions in LMRB. These findings provide important reference value for the research and assessment of complex basin systems.

The study was published in Communications Earth & Environment. Huang Hao as the first author and Professor Junguo Liu as the corresponding author. This work was supported by the National Natural Science Foundation of China (Grant No. 42361144001), the 111 Project (Grant No. D25014), the National Foreign Experts Program (Category S) (Grant No. S20240116). It was also partly supported by the Henan Provincial Key Laboratory of Hydrosphere and Watershed Water Security.