Climate change's future impact uncertain on Midwest water cycle, study finds

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A Dartmouth College-led study finds that it remains uncertain whether climate change will make the US Midwest drier or wetter during the summer growing season for corn and other crops. Credit: Andreas Krappweis

Will climate change make the U.S. Midwest drier or wetter during the summer growing season? A new Dartmouth-led study finds that the answer remains uncertain.

The findings are important given the Midwest's agricultural output is critical to the U.S. economy and global food security.

The study appears in the journal *Water Resources Research*. The study included researchers from Dartmouth College, Columbia University, National University of Singapore and Massachusetts Institute of Technology.

A potential consequence of climate change is significant modification of the water cycle in farming areas, such as the Midwest. Multiple studies have investigated the response of surface air temperature and precipitation to climate change across the Midwest and United States, but few studies have examined the response of soil moisture and still fewer have assessed soil moisture using a combination of model simulations and regional observations. Soil moisture is a key indicator of the water cycle, reflecting dynamics of precipitation, evaporation, plant transpiration and runoff.

The Dartmouth-led team ran multiple regional climate model experiments to project summertime changes in the water cycle over a representative area of the Midwest. Some of their experiments predict drier soil conditions over the Midwest, while others predict wetter soil conditions, with the response strongly dependent on the choice of global climate model used to provide input to the regional climate model.

To resolve the contradictory predictions, the researchers also assessed an extensive and unique observational dataset of the water budget in Illinois. Their results show no statistically significant trends in soil moisture, precipitation, streamflow, groundwater level or surface air temperature over a recent 26-year period. Model simulations unanimously project increased temperatures in the Midwest, but the observed trend has been insignificant so far in contrast to climate trends across the world, where most places have already warmed significantly.

"Based on our analysis of model simulations and regional observations, we conclude that climate change impacts on the water cycle of the

Midwestern United States remain uncertain," says lead author Jonathan Winter, an assistant professor of geography at Dartmouth, whose research explores climate prediction and the impacts of climate variability and change on water resources and agriculture. "Our findings also suggest that while increases in surface air temperatures have been insignificant so far, adaptation to projected increases in temperature should be given priority as the signal is robust and could have large impacts on crop yields. Our findings highlight the need for expanded observations of soil moisture and improved simulations of soil moisture by climate models."

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