Spring irrigation can reduce summer heat wave events

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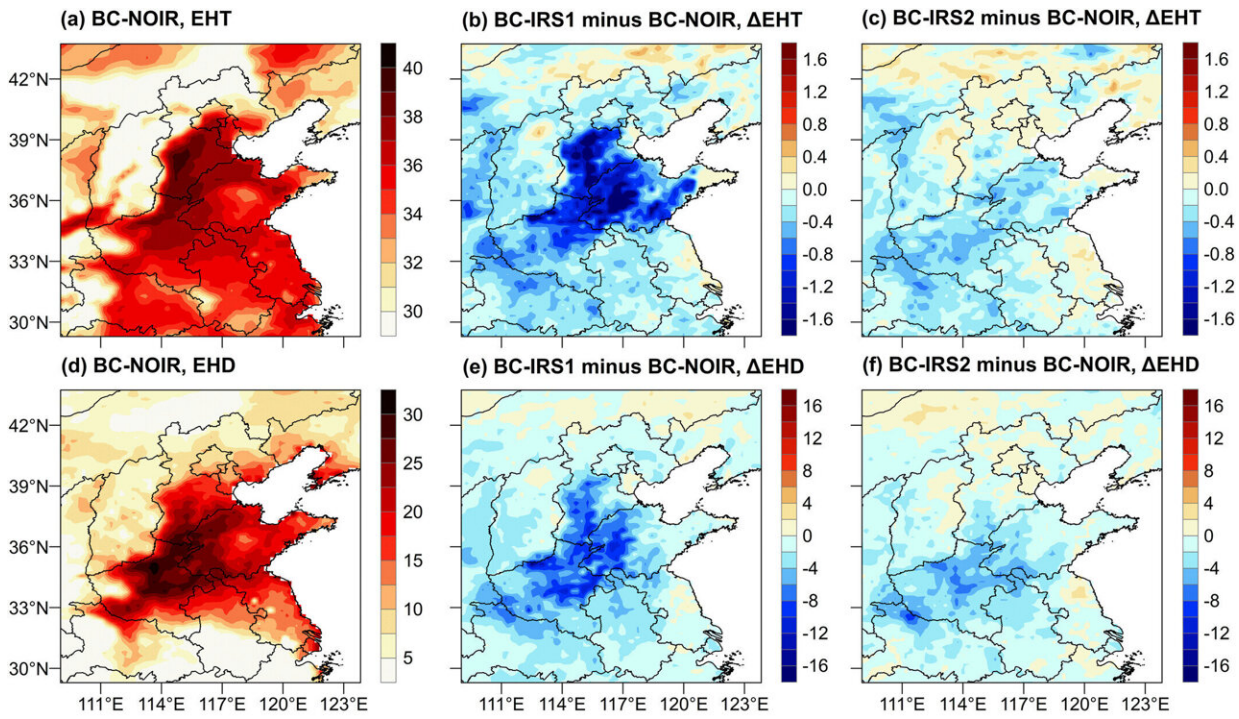


Impact of spring and summer irrigation on extreme heat wave events. Modeled temperature and event length anomalies for no irrigation (a, d), both spring and summer irrigation (b, e) and solely spring irrigation (c, f). Credit: *Geophysical Research Letters* (2024). DOI: 10.1029/2023GL107094

Heat waves are becoming more extreme as climate change exacerbates, with susceptible locations experiencing more frequent, prolonged and higher intensity events. As such, they pose a hazard to agricultural

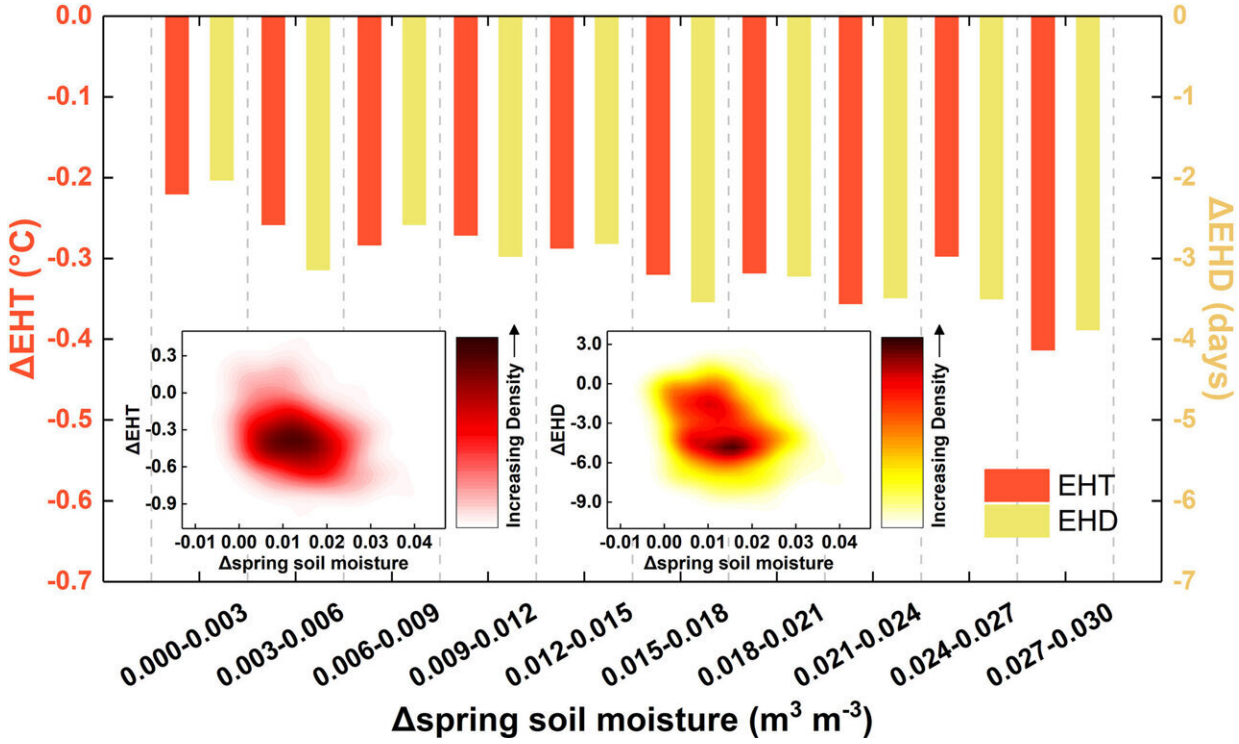
practices that rely upon sufficient water to ensure sustainable food supplies.

Irrigation is used to help alleviate warm, dry climates by maintaining soil moisture levels to promote growth as well as exerting a cooling effect on the immediate local climate (within a few meters of the surface), but extracts freshwater from resources that may also be threatened by shrinkage with more evaporation in a warmer world.

New research, published in *Geophysical Research Letters*, has investigated the dampening effect irrigating land in spring can have on the intensity of summer heat waves by retaining higher soil moisture levels between seasons, known as soil moisture memory.

Dr. Guoshuai Liu, of Hohai University, China, and colleagues focused on spring (March–May) and summer (June–August) irrigation practices on the North China Plain to simulate regional climate responses. This is one of the most intensively irrigated areas in China, being an agricultural zone spanning 400,000 km^2 that rotates between crops of wheat in winter and maize in summer, accounting for 37% of the country's production.

The research team analyzed models of root-zone soil moisture data from 1980 to 2018 and combined this with a forecasting model to simulate the effect of irrigation on extreme summer heat wave events from 2004 to 2018. They ran three tests, one with no irrigation, one with both spring and summer irrigation, and the last solely with spring irrigation.



Simulated changes in summer extreme heat wave temperature and duration with respect to increasing soil moisture due to irrigation of the North China Plain. Credit: *Geophysical Research Letters* (2024). DOI: 10.1029/2023GL107094

Dr. Liu and colleagues found that spring irrigation reduced the intensity of summer heat waves by 0.29°C and 2.5 days, and when combined with summer irrigation this extends to a reduction of 1°C and 6.5 days. With the simulated regional means of extreme heat waves being temperatures of 35.8°C and lasting 21.7 days, the combined impact of spring and summer irrigation can have a significant effect, especially on the longevity of the event.

Similar patterns of soil moisture memory impacting interseasonal climate have also been observed in the southern Great Plains, Huang-Huai-Hai Plain and the middle to lower parts of the Yangtze River.

This research is important as it suggests applying a surplus of water in spring helps to alleviate water stress in the following summer months, and is less wasteful of water resources that evaporate more in summer (especially from the top 1 m of soil), while also supporting regions that experience an imbalance in precipitation through the year.

Though the intensity of extreme heat wave events may be reduced, these climatic challenges will persist in the future, so it is important to apply these results in water resource management and adaptation planning strategies.

More information: Guoshuai Liu et al, Spring Irrigation Reduces the Frequency and Intensity of Summer Extreme Heat Events in the North China Plain, *Geophysical Research Letters* (2024). DOI: 10.1029/2023GL107094