

Testing a relationship: Arctic warming and China's summer monsoon

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Drought robs populations of drinking water, water for crops, and industrial production and can indicate climate trends. Scientists found a link between summer monsoon rainfall in China and the Arctic spring warming causing sea-ice melt and changes in atmospheric circulation. They are working to capture this phenomenon in a global climate model. Better simulation of observed climate effects will enable better predictions of future climate states.

(Phys.org) —In the late 1970s, eastern China experienced a shift in the summer monsoon circulation causing a "North-drought/South-flood" trend. In two related studies, researchers at Pacific Northwest National Laboratory and China Meteorological Administration found a climate linkage that explains this phenomenon, and they tested six global climate models to see if they captured it. The observed rainfall trend coincides with rising Arctic temperature and reduced Arctic

sea ice in the last three decades. While the atmospheric linkage between interdecadal summer precipitation changes in China and the Arctic spring warming can be established from observations, only one climate model was able to simulate both the recent decadal trends as well as their linkages. The two studies showed the importance of Arctic and mid- to high-latitude warming on the long-term variability of the East Asian summer monsoon.

Monsoons have a large influence on the world's atmospheric moisture, and directly affect millions of people who depend on summer monsoon rain to provide water for their crops, their homes, and industry. Scientists have long studied a "North-drought/South-flood" trend in eastern China. While many regions in East Asia receive abundant [rainfall](#) during the summer monsoon, others experience extreme drought. In previous studies, scientists showed the influence of tropical ocean temperatures and snowpack in the Tibetan Plateau in causing these changes; however, less is known about the influence of the Arctic and high-latitude trends on monsoon rainfall. Because Arctic warming is expected to continue, scientists are interested in understanding its impacts on the East Asian monsoon to better predict decadal rainfall. At the same time, it's important to improve climate models to reproduce the key mechanisms that link the climate and high-latitude atmospheric patterns.

To explore the linkages between Arctic warming and interdecadal rainfall variability in East China, the international research team used observational data of rainfall, sea ice, the [20th Century Reanalysis](#) of temperature and ice concentrations, and the National Centers for Environmental Prediction and National Center for Atmospheric Research (NCEP/NCAR) global reanalysis to examine various trends and spatial modes of variability. They selected model outputs from six [global climate models](#) (GCMs) developed in the United States, Canada, Germany, United Kingdom, China, and Japan that represent a wide range of

climate sensitivity from the [Coupled Model Intercomparison Project Phase 5 \(CMIP5\) data archive](#). They analyzed GCM simulations of historical conditions to determine if the models reproduced the observed differences in decadal rainfall, circulation patterns, and Arctic and mid- to high-latitude temperatures and their various relationships. However, of the six models analyzed, the team found only one model correctly reproduced observed changes in summer rainfall and the relationships between the summer monsoon rainfall and large-scale atmospheric circulation patterns.

The researchers found that Arctic and mid- to high-latitude warming may influence East Asian summer [monsoon rainfall](#) through changes in the location and strength of the Baikal high pressure center, an important climate feature that serves as the bridge linking the high-latitude and monsoon weather systems.

To further understand the mechanisms that connect the Arctic warming and East Asian summer monsoon, future studies need to more clearly show the dynamical processes linking Arctic and high-latitude warming to the monsoon circulation. Numerical experiments with [climate models](#) can be used to delineate the relative influence of the oceans, Tibetan Plateau snowpack, and Arctic warming, all of which are important factors that modulate the characteristics of the East Asian summer monsoon.

More information: Li Y, LR Leung, Z Xiao, M Wei, and Q Li. 2013. Interdecadal Connection between Arctic Temperature and Summer Precipitation over the Yangtze River Valley in the CMIP5 Historical Simulations, *Journal of Climate* 26(19):7464-7488. [DOI: 10.1175/JCLI-D-12-00776.1](#)

Li Y and LR Leung. 2013. Potential Impacts of the Arctic on Interannual and Interdecadal Summer Precipitation in China, *Journal of Climate* 26(3):899-917. DOI: 101175/JCLI-D-12-00075.1

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