Deep snow cover in the Arctic region intensifies heat waves in Eurasia

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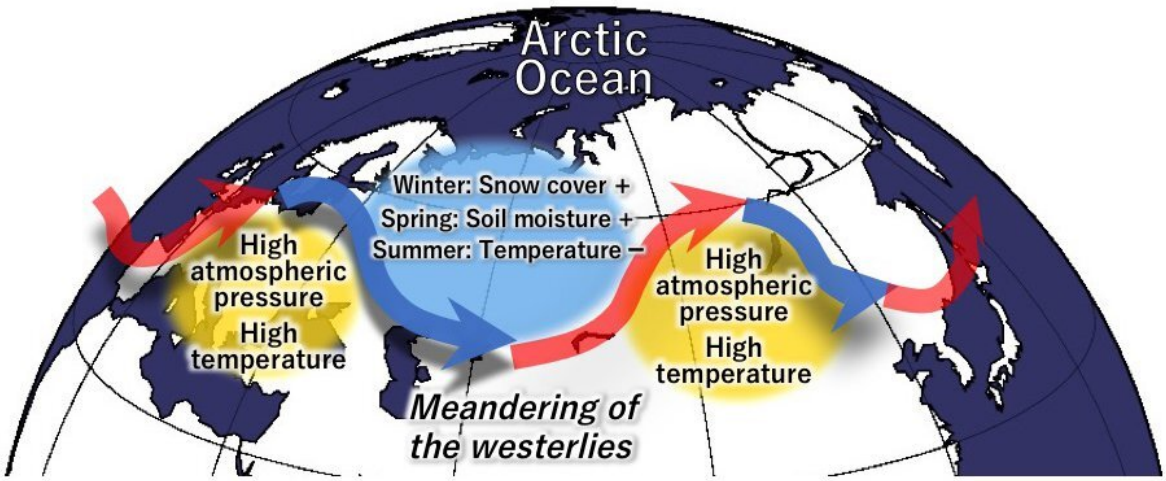

More snow cover in winter will be reflected in the level of moisture in the soil in spring, which will cause lower summer temperatures. The low summer temperatures will facilitate the meandering of the westerlies, which tend to cause high temperatures in the surrounding regions. Credit: Hokkaido University

Variations in the depth of snow cover in the Arctic region from late winter to spring determines the summer temperature pattern in Eurasia, according to Hokkaido University researchers. In particular, deeper-than-usual snow cover in Western Russia enhanced the likelihood of summer heat waves in Europe and Northeast Asia in recent years.

Persistent abnormally hot weather can cause negative impacts on human health, agriculture, and natural environments. A heat wave—a spell of hot days with the mercury rising much higher than the average temperature—has been reported more frequently in Europe and Northeast Asia in recent years.

"Internal atmosphere–land interactions in Eurasia are believed to be an important factor in triggering abnormal summer temperatures. However, the exact reasons for such interactions causing heat waves remain largely unclear," says Associate Professor Tomonori Sato of the research team.

In the present study published in *Scientific Reports*, Tomonori Sato and Tetsu Nakamura of Hokkaido University examined a large dataset derived from the "database for Policy Decision making for Future climate change" (d4PDF). The database comprises data spanning over a 60-year period (1951–2010) which incorporates observed sea surface temperature, sea ice, and natural and anthropogenic forcing.

The researchers analyzed 6,000 patterns in the spatial distribution of summer temperatures in Eurasia, and succeeded in dividing past summer temperature variations into two groups—one attributable to global warming and the other attributable to natural changes. The former exhibited the rising temperatures in Eurasia since around 1990, while the latter showed the spatial distribution of low and high temperatures that correspond to the meandering of the westerlies. The distribution shows a wave train-like structure—which demonstrates that when some regions experienced abnormally high temperatures, the surrounding areas were hit by abnormally low temperatures.

The researchers then discovered that when Western Russia had a deeper-than-usual snow cover in late winter and spring, the wave train-like distribution of temperatures appeared. When deeper snow accumulation occurs, more moisture retains in the soil after snowmelt. The soil

moisture then prevents the summer temperature from rising, which is a likely cause for making the westerlies meander, thus causing the surrounding regions to experience high temperatures.

"Our finding could help improve the accuracy of summer weather forecasting and help mitigate the adverse impacts from abnormal weather in the future," says Tomonori Sato.

More information: Tomonori Sato et al. Intensification of hot Eurasian summers by climate change and land–atmosphere interactions, *Scientific Reports* (2019). DOI: 10.1038/s41598-019-47291-5

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