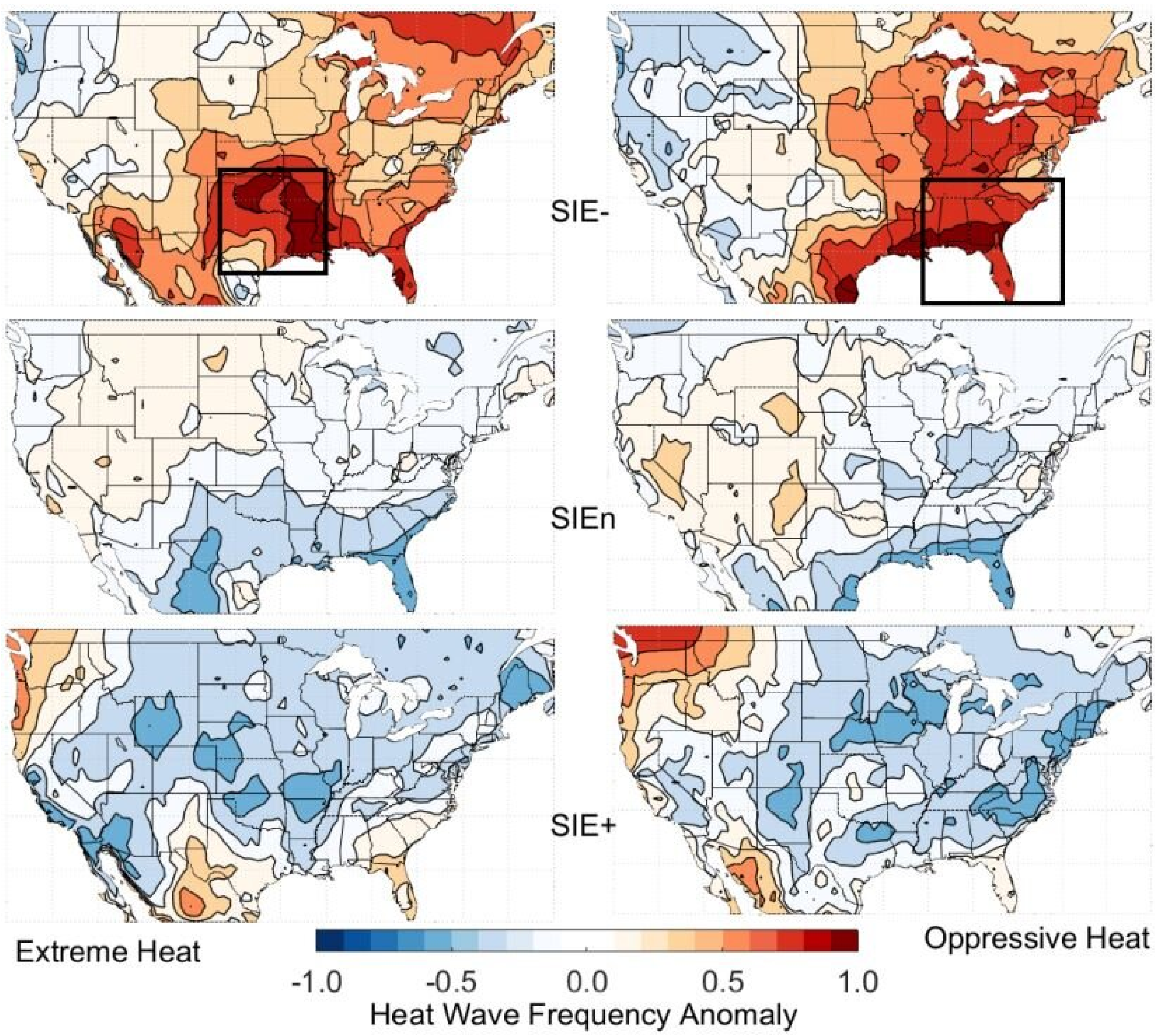
Loss of Arctic sea ice stokes summer heat waves in southern U.S.

June 4 2019, by Mary Caperton Morton



Composites of summer extreme (left panels) and oppressive heat wave (right panels) frequency during summers of low (top), neutral (middle) and high (bottom) Hudson Bay sea ice extent. Credit: AGU

Over the last 40 years, Arctic sea ice thickness, extent and volume have declined dramatically. Now, a new study finds a link between declining sea ice coverage in parts of the Canadian Arctic and an increasing incidence of summer heat waves across the southern United States.

The new study in AGU's *Journal of Geophysical Research*: Atmospheres explores how seasonal fluctuations of sea ice coverage trigger changes in atmospheric circulation patterns during the boreal summer.

The study draws upon four decades of satellite data of Arctic sea ice coverage collected between 1979 and 2016, overlapped with heat wave frequency data across the United States during the same time period.

The team found evidence for a strong statistical relationship between the extent of summer sea ice in the Hudson Bay and heat waves across the southern Plains and southeastern U.S.

"The latest research on this topic suggests that declining Arctic sea ice may be linked to increased incidence of extreme weather patterns across the northern hemisphere," said Dagmar Budikova, a climatologist at Illinois State University in Normal and lead author of the new study. "Our results confirm this hypothesis by offering further evidence that Arctic sea ice variability has the potential to influence extreme summer temperatures and the frequency of heat waves across the southern U.S."

A better understanding of the physical relationships may allow scientists to forecast heat wave-prone summers, Budikova said.

"If Arctic sea ice continues to decline as predicted, then we could expect more summer heat waves across the southern U.S. in the future," she said.

Warm Arctic spring, hot southern summer

The new study finds the loss of sea ice across the Arctic begins with warmer-than-usual spring temperatures in the Hudson Bay and Labrador regions in the southeastern Canadian Arctic.

"This process starts when temperatures across the southeastern Canadian Arctic and northwestern Atlantic are 2 degrees [Celsius] warmer than expected in March, April and May," Budikova said.

This springtime warming lessens the north-to-south change in temperature between the high and middle latitudes of eastern North America, leading to a reduction in the strength of regional wind patterns. These conditions are symptomatic of weakened large-scale movements of air that appear to persist into the summer months, Budikova said.

The weakened circulation typically leads to increased undulation in the jet stream and the formation of persistent high-pressure systems over the southern U.S. The presence of high-pressure systems, also known as an atmospheric block, ultimately promotes unseasonable surface and atmospheric warming, and increased heat wave incidence.

Heat waves can last for days or weeks as high-pressure zones inhibit wind, clouds and other weather systems from entering the area.

"Local humidity, soil moisture, and precipitation conditions are shown to influence the 'flavor' of the heat waves, which are more likely to be oppressive in the southeastern U.S. and extreme across the southern Plains during summers experiencing low Hudson [sea ice extent]," Budikova and colleagues wrote in the new study.

The next step will be to use dynamic modeling to confirm the statistical relationships between Arctic sea ice coverage and summer heat waves, and explore in detail the physical and dynamic atmospheric processes that make such linkages possible.

"General circulation models would further elucidate the processes that are taking place in the atmosphere to drive these connections," Budikova said.

More information: Dagmar Budikova et al. United States Heat Wave Frequency and Arctic Ocean Marginal Sea Ice Variability, *Journal of Geophysical Research: Atmospheres* (2019). DOI: 10.1029/2018JD029365

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