

Air-movement pattern portends US heatwaves

Large-scale atmospheric circulation system signals greater chance of extreme heat weeks later.

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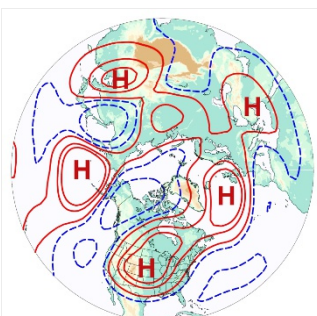
ZORAN MLICH/Reuters/Corbis

Changes in mid-latitude air circulation can increase the risk of US heatwaves.

Scientists studying US climate models have identified an atmospheric circulation pattern that signals a higher risk of extreme heat spells. The pattern's occurrence indicates only that a US heatwave is more probable than usual, but it does so 2–3 weeks in advance — a major step beyond the 10-day reach of current forecasting technology.

Previous research has attempted to link US heatwaves to tropical conditions such as sea surface temperatures or the strength of the Asian monsoon. But a study published today in *Nature Geoscience*¹ finds a strong link to a mid-latitude air-circulation pattern, known as 'wavenumber 5', in which five major high-pressure and five low-pressure zones, spaced thousands of kilometres apart, encircle the globe.

Because extreme heatwaves happen only once every few years, the researchers turned to computer climate models to look for signals that foreshadow a severe hot spell. Led by Haiyan Teng, a climate scientist at the National Center for Atmospheric Research in Boulder, Colorado, the scientists examined 2,300 heatwaves from 12,000 years' worth of simulated US weather. "The really great thing is that they were able to leverage those model runs to get good statistics," says Siegfried Schubert, a meteorologist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, who is collaborating with Teng and her team on a related project.



Haiyan Teng

The analysis revealed that major heatwaves were four times more likely to develop after a strong wavenumber-5 system formed at mid-latitudes. Teng says that this particular pattern can stagnate, leading to slow-moving high-pressure zones that can produce prolonged heat.

Still, even when a wavenumber-5 system is present in the atmosphere, the overall risk of a US heatwave is still small, she adds. Any given summer day in the United States has a 1.5% chance of being part of a heat wave. The existence of a strong wavenumber-5 pattern increases the chances of a heatwave to only 6% — not enough to allow meaningful warnings.

The next step toward eventually producing that kind of advance forecast is to pinpoint the conditions

An air circulation pattern known as 'wavenumber-5', shown here, is associated with US drought.

that create wavenumber-5 patterns, says Schubert. Another valuable research direction would be to identify similar atmospheric signals for heatwaves that strike Europe and Asia, he adds.

Upmanu Lall, a hydroclimatologist at Columbia University in New York, says that the work is a nice counterpoint to his own research to identify large-scale atmospheric conditions that can produce flooding. Lall sees a need for more work that bridges the gap between weather forecasting and climate research, with the ultimate goal of producing long-term warnings of extreme weather events.

Advance warnings of heatwaves would be especially useful in large cities, says Marshall Shepherd, an atmospheric scientist at the University of Georgia in Athens. "Heat waves can be particularly amplified in urban areas," he says. "If you had a couple of weeks notice, you could mobilize cooling stations and adjust resources to mitigate mortality and morbidity," and power companies could plan for increased demand driven by air-conditioner use.

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References

1. Teng, H., Branstator, G., Wang, H., Meehl, G. A. & Washington, W. M. *Nature Geosci.* <http://dx.doi.org/10.1038/ngeo1988> (2013).