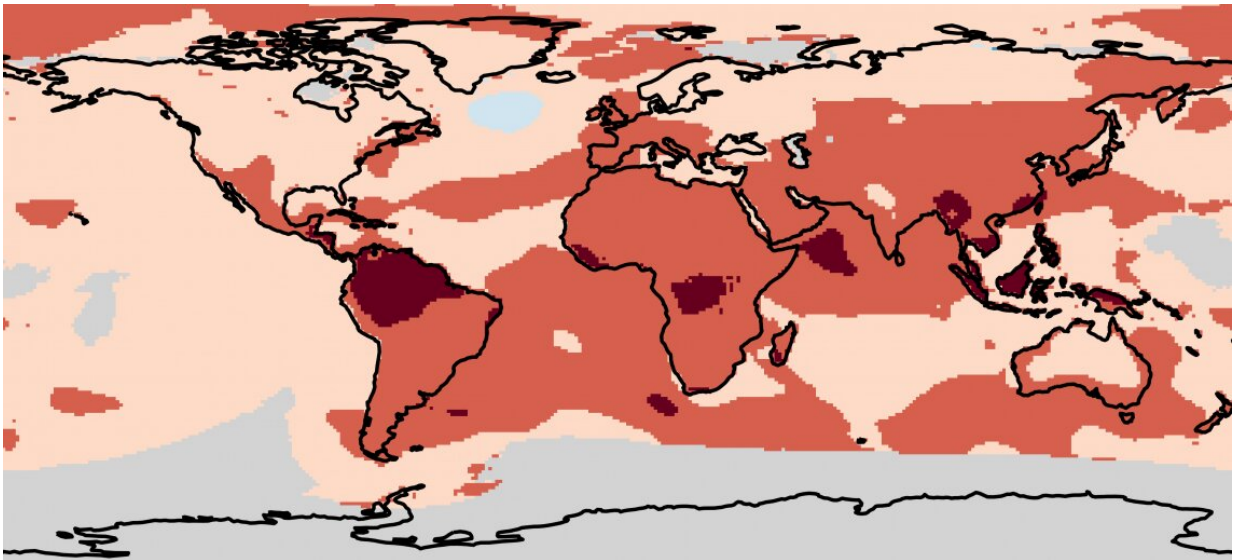


Record-breaking temperatures more likely in populated tropics

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More record-breaking temperatures and heat events will occur in the tropics rather than the poles, like many once thought. This region contains a larger share of the world population and more biodiversity. Credit: The University of Washington and the University of Arizona

Icebergs crumbling into the sea may be what first come to mind when imagining the most dramatic effects of global warming.

But new University of Arizona-led research, published in *Geophysical Research Letters*, suggests that more record-breaking temperatures will

actually occur in the tropics, where there is a large and rapidly growing population.

"People recognize that polar [warming](#) is much faster than the mid-latitudes and tropics; that's a fact," said lead study author Xubin Zeng, director of the UArizona Climate Dynamics and Hydrometeorology Center and a professor of atmospheric sciences. "The second fact is that the warming over land is greater than over ocean. The question now is: Where do we see more extreme heat events? Over [polar regions](#) or the tropics? Over land or ocean? That's the question we answer."

Zeng and his collaborators analyzed [temperature](#) data from the last 60 years in two different ways: by looking at raw temperature trends and normalized [temperature trends](#). Raw temperature is the actual temperature measured outside, whereas normalized temperature is raw temperature divided by the year-to-year variations.

Raw temperature data over the polar region reveals a huge range in temperature. Over the tropics, where it's warm and humid, raw temperature data reveals smaller temperature fluctuations. But when temperature is normalized—or divided- by the temperature fluctuations over the same period, the data shows that the tropics have greater normalized warming and are actually experiencing more record-breaking heat events.

This new perspective allowed Zeng and his team describe the threat to these areas in a new way.

"We realized that very few researchers have addressed the relationship between warming and extreme hot events between different regions, but when you do, the answer is unexpected," said Zeng, who is also the Agnes N. Haury Endowed Chair in Environment in the Department of Hydrology and Atmospheric Sciences.

Mitigating Harm

It is generally understood that warming trends would increase the occurrence of extreme events in a given region. For instance, Arctic amplification, which is the scientific way of saying there's a larger temperature increase at the poles, has been emphasized in all five Intergovernmental Panel on Climate Change, or IPCC, reports. But it can overshadow what's happening in regions like the tropics, around the equator, where less dramatic swings in temperature are the norm.

"Temperature trends in the tropics don't need to be as large to break records and affect the environment, ecosystem and human well-being," Zeng and his study co-authors write.

The study authors also identified two surprising "hot spots" for the occurrence of extreme events: over the Northern Hemisphere's ocean and over the Southern Hemisphere's [tropical](#) land.

This is important because marine heat waves are not well understood but would likely have large impacts on marine ecosystems.

"These regions we've identified should receive more attention due to their significant impacts on ecosystem and environment. People know tropical forests are important, but here we're saying they're even more important because suddenly we realized there are going to be more extreme events and weather over the Amazon rainforest," Zeng said.

Species can navigate change—if the change is gradual—via adaptation, but extreme events occur too quickly and often.

Zeng also publishes annual hurricane forecasts for the North Atlantic. He said ocean warming not only leads to more intense hurricanes, but ocean temperatures also affect climate and weather in other ways.

"For example, when we talk about the current drought over the western United States, it's linked to the ocean surface temperature," he said.

"Earth system models for IPCC reports should not only use raw temperature data, but also normalized [temperature data](#) to understand the impacts of global warming on the occurrence of [extreme heat events](#)."

More information: Xubin Zeng et al, Quantifying the Occurrence of Record Hot Years Through Normalized Warming Trends, *Geophysical Research Letters* (2021). [DOI: 10.1029/2020GL091626](https://doi.org/10.1029/2020GL091626)

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