New model shows greater likelihood, frequency of urban extreme heat events

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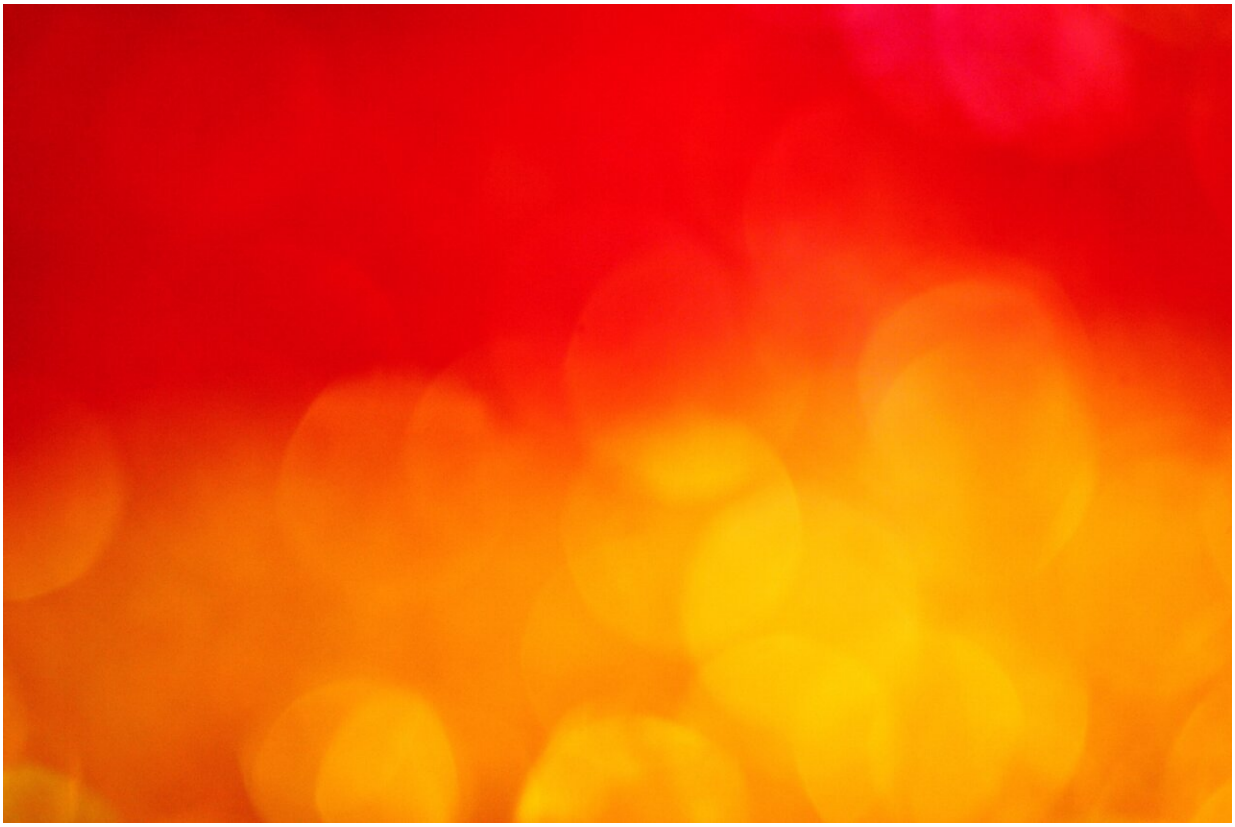

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Extreme heat waves in urban areas are much more likely than previously thought, according to a new modeling approach designed by researchers including University of Illinois Urbana-Champaign Civil and

Environmental Engineering (CEE) assistant professor Lei Zhao and alumnus Zhonghua Zheng. Their paper with co-author Keith W. Oleson of the National Center for Atmospheric Research, "Large model structural uncertainty in global projections of urban heat waves," is published in the journal *Nature Communications*.

Urban heat waves (UHWs) can be devastating; a 1995 heat wave in Chicago caused more than 1,000 deaths. Last year's heat wave on the west coast caused wildfires. Global warming is expected to increase the incidence and severity of UHWs, but if cities fully understand their risk, they can prepare better with forecasts and warnings, safety guidance and improving access to health facilities like cooling centers and hospitals. Longer-term strategies include adaptation practices, which help cities adapt to the warmer temperatures induced by climate change—such as highly reflective roofs and pavements and green infrastructure—and mitigation practices, which help reduce the carbon emission—like renewable energy.

In recent years, though, an increase in record-breaking UHWs has caused concerns that the computer models used to predict them are flawed, leading to a systematic underestimation of their frequency and severity. Without accurate models, cities may dramatically misjudge their risk and fail to prepare accordingly, putting their citizens at greater risk as the world heats up.

Zhao's team has developed a model that closes two major gaps in urban climate modeling. First, most traditional climate models effectively ignore cities entirely. Urban areas make up only 2-3 percent of the earth's land, so their effect on global models is negligible, but more than half of the world's population lives in urban areas, so their impact is significant. The team's new modeling approach addresses that by providing urban-specific climate signals.

Second, because of this lack of urban representation in state-of-the-art climate models, there were no global-scale, multi-model projections for urban climates. The multi-model projections are critical to characterize the robustness and uncertainty of the projections, which is very important for estimating the climate-driven risks, for example, the likelihood of climate extremes. The new model provides global multi-model projections of local urban climates.

The paper also highlights four high-stakes regions—the Great Lakes region, southern Europe, central India and north China—and finds that cities in those areas had dramatically lower probabilities of risk with a single-model approach than with the researchers' multi-model approach. For example, the researchers found that using only traditional models, the Great Lakes region was expected to experience an extreme heat event only once in 10,000 years; with the researchers' new modeling technique, such events could be expected once every four years.

"This work highlights the critical importance of having multi-model projections to accurately estimate the likelihood of extreme events that will occur in the future under climate change," Zhao said.

More information: Zhonghua Zheng et al, Large model structural uncertainty in global projections of urban heat waves, *Nature Communications* (2021). DOI: 10.1038/s41467-021-24113-9

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