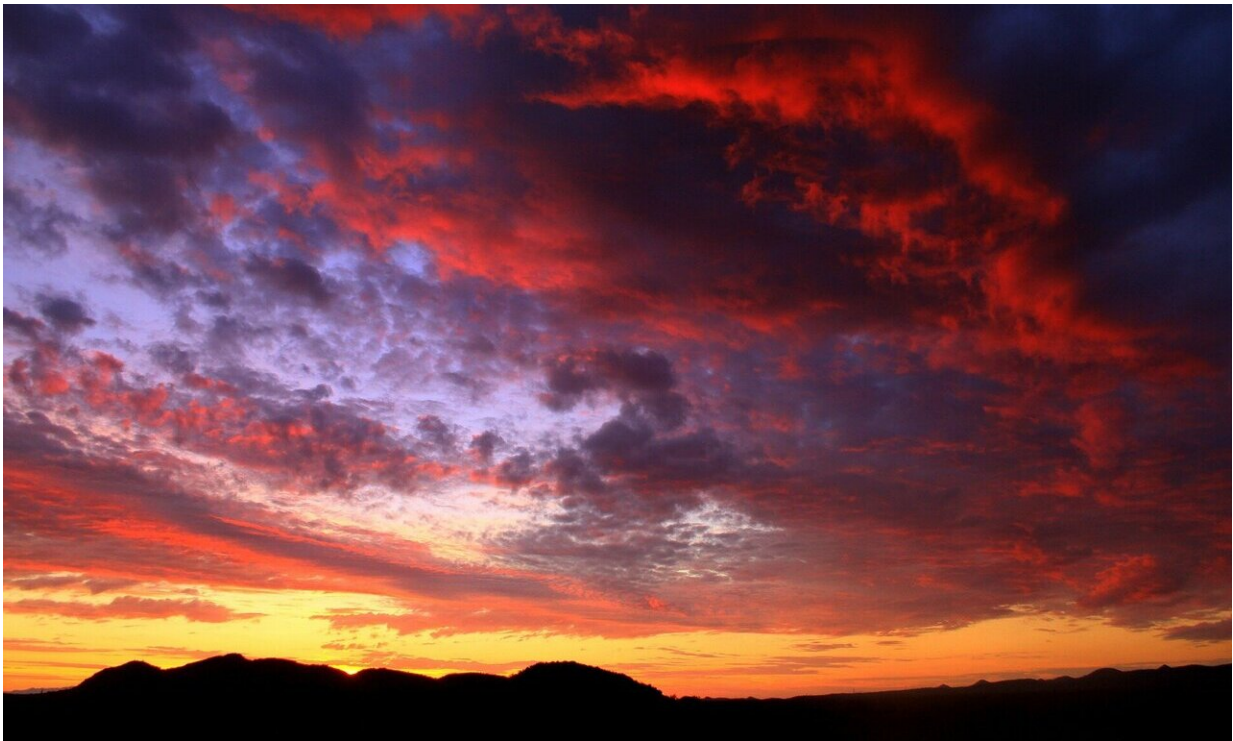


Global warming influence on extreme weather events has been frequently underestimated

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A new Stanford study reveals that a common scientific approach of predicting the likelihood of future extreme weather events by analyzing how frequently they occurred in the past can lead to significant

underestimates—with potentially significant consequences for people's lives.

Stanford climate scientist Noah Diffenbaugh found that predictions that relied only on historical observations underestimated by about half the actual number of extremely hot days in Europe and East Asia, and the number of extremely wet days in the U.S., Europe and East Asia.

The paper, published March 18 in *Science Advances*, illustrates how even small increases in global warming can cause large upticks in the probability of extreme weather events, particularly heat waves and heavy rainfall. The new results analyzing [climate change](#) connections to unprecedented weather events could help to make global risk management more effective.

"We are seeing year after year how the rising incidence of extreme events is causing significant impacts on people and ecosystems," Diffenbaugh said. "One of the main challenges in becoming more resilient to these extremes is accurately predicting how the global warming that's already happened has changed the odds of events that fall outside of our historical experience."

A changing world

For decades, engineers, land-use planners and risk managers have used historical weather observations from thermometers, rain gauges and satellites to calculate the probability of extreme events. Those calculations—meant to inform projects ranging from housing developments to highways—have traditionally relied on the assumption that the risk of extremes could be assessed using only historical observations. However, a warming world has made many extreme weather events more frequent, intense and widespread, a trend that is likely to intensify, according to the U.S. government.

Scientists trying to isolate the influence of human-caused climate change on the probability and/or severity of individual weather events have faced two major obstacles. There are relatively few such events in the historical record, making verification difficult, and global warming is changing the atmosphere and ocean in ways that may have already affected the odds of extreme weather conditions.

Predicted versus observed extreme weather

In the new study, Diffenbaugh, the Kara J. Foundation professor at Stanford's School of Earth, Energy & Environmental Sciences, revisited previous extreme event papers he and his colleagues had published in recent years. Diffenbaugh wondered if he could use the frequency of record-setting [weather](#) events from 2006 to 2017 to evaluate the predictions his group had made using data from 1961 to 2005. He found in some cases the actual increase in extreme events was much larger than what had been predicted.

"When I first looked at the results, I had this sinking feeling that our method for analyzing these extreme events could be all wrong," said Diffenbaugh, who is also the Kimmelman Family senior fellow in the Stanford Woods Institute for the Environment. "As it turned out, the method actually worked very well for the period that we had originally analyzed—it's just that global [warming](#) has had a really strong effect over the last decade."

Interestingly, Diffenbaugh also found that [climate models](#) were able to more accurately predict the future occurrence of record-setting events. While acknowledging that climate models still contain important uncertainties, Diffenbaugh says the study identifies the potential for new techniques that incorporate both historical observations and [climate](#) models to create more accurate, robust risk management tools.

"The good news," Diffenbaugh said, "is that these new results identify some real potential to help policymakers, engineers and others who manage risk to integrate the effects of [global warming](#) into their decisions."

More information: N.S. Diffenbaugh at Stanford University in Stanford, CA et al., "Verification of extreme event attribution: Using out-of-sample observations to assess changes in probabilities of unprecedented events," *Science Advances* (2020).
advances.sciencemag.org/content/6/12/eaay2368

Provided by Stanford University

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