Human-caused warming increasing likelihood of record-breaking hot years

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Emissions from a plant chimney in Moscow, Russia. Credit: Khuroshvili Ilya/Flickr

A new study finds human-caused global warming is significantly increasing the rate at which hot temperature records are being broken

around the world.

Global annual temperature records show there were 17 record hot years from 1861 to 2005. The new study examines whether these temperature records are being broken more often and if so, whether human-caused global warming is to blame.

The results show human influence has greatly increased the likelihood of record-breaking hot years occurring on a global scale. Without human-caused climate change, there should only have been an average of seven record hot years from 1861 to 2005, not 17. Further, human-caused climate change at least doubled the odds of having a record-breaking hot year from 1926 to 1945 and from 1967 onwards, according to the new study.

The study also projects that if greenhouse gas emissions remain high, the chance of seeing new global temperature records will continue to increase. By 2100, every other year will be a record breaker, on average, according to the new study accepted for publication in *Earth's Future*, a journal of the American Geophysical Union.

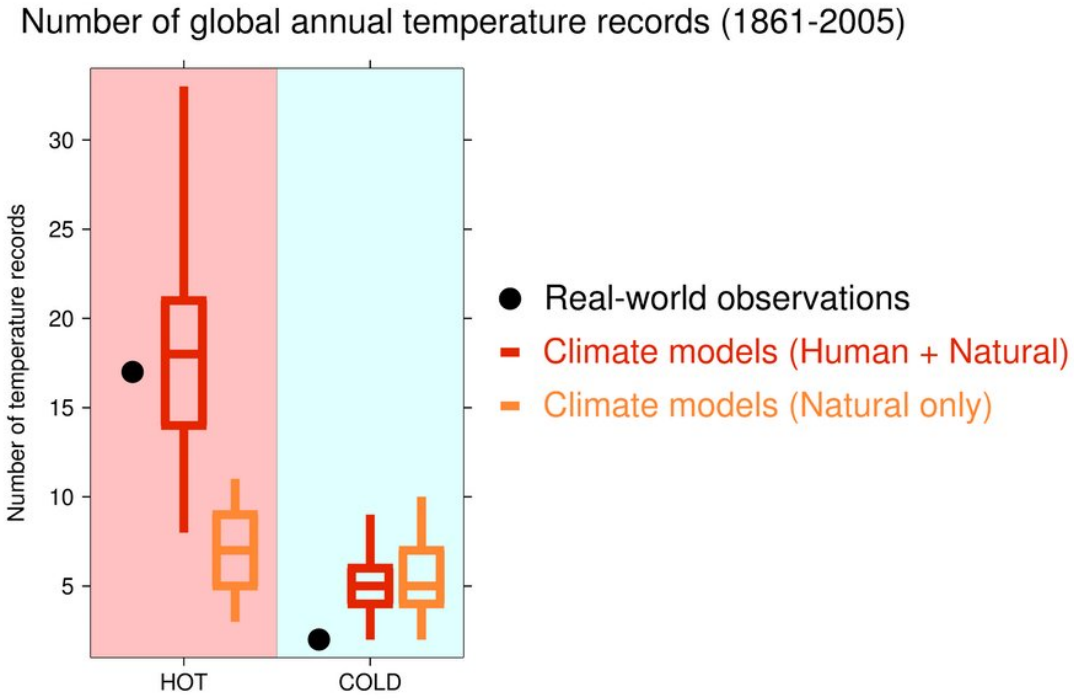
The new findings show how climate change is visibly influencing Earth's temperature, said Andrew King, a climate extremes research fellow at the University of Melbourne in Australia and lead author of the new study.

"We can now specifically say climate change is increasing the chance of observing a new temperature record each year," he said. "It's important to point out we shouldn't be seeing these records if human activity weren't contributing to global warming."

The study strengthens the link between human activity and recent temperature trends, according to Michael Mann, a climatologist and

director of the Earth System Science Center at Pennsylvania State University, who was not involved with the new research.

"This work builds on previous research establishing that, without a doubt, the record warmth we are seeing cannot be explained without accounting for the impact of human activity on the warming of the planet," Mann said.



Historically observed and model-simulated numbers of hot and cold global annual temperature records for 1861-2005. The number of real-world record occurrences are shown as black circles. The boxes represent the range of record numbers predicted by models with human and natural influences (red boxes) and natural influences only (orange boxes). The central lines in the boxes represent the median. Credit: Andrew D. King

Record-breaking heat

Record hot years have been occurring more frequently in recent decades. 2014 was the hottest year on record since 1880, but that record was quickly broken in 2015 and again in 2016. Research published earlier this year in Geophysical Research Letters found these three consecutive records in global temperatures were very likely due to anthropogenic warming.

Record-breaking temperatures tend to attract attention because they are one of the most visible signs of global warming. As a result, understanding how and why the rate of record-breaking is changing is critical for communicating the effects of climate change to the public, King said.

Previous research examined changes in rates of record-breaking temperatures in specific countries or regions. However, these studies couldn't analyze global temperature trends because they relied on gathering large numbers of daily temperature records from different sources, according to King. Additionally, they didn't directly attribute changes in record-breaking to human activity.

In the new study, King developed a method to isolate the human role in changing rates of record-breaking temperatures globally. Unlike previous studies, the method uses a single source of temperature data, in this case global annual temperatures, allowing King to study temperature records on a global scale.

King first looked at global temperature data from 1861 to 2005 and identified which years were hot record breakers. He then used a wide array of climate models to simulate global temperatures in this period.

Some of the models included only natural influences on the climate such as volcanic eruptions, while other models featured both natural influences and human influences such as greenhouse gas emissions and the release of aerosols into the atmosphere.

King found only the climate models that included human influences had the same number of record-breaking hot years as historical temperature records—15 to 21, on average. The models without human influences only had an average of seven record-breaking hot years from 1861 to 2005.

He also determined human-caused climate change at least doubled the odds of having a record-breaking hot year from 1926 to 1945 and from 1967 onwards. The odds didn't increase from 1945 to 1967 because man-made aerosol emissions generated a cooling effect, which counteracted warming due to anthropogenic greenhouse gases.

King's research can also be applied to quantify the influence of human activities on a specific record-setting event. He applied his method to record-setting hot global temperatures in 2016 and record-setting hot local temperatures in central England in 2014. He found human influence led to a 29-fold increase in the likelihood of seeing both new records compared to a situation with no human influence on climate.

More information: Andrew D. King, Attributing changing rates of temperature record-breaking to anthropogenic influences, *Earth's Future* (2017). DOI: 10.1002/2017EF000611

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