Northern hemisphere summers warmest in 600 years (Update)

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People cool off in the water of the Trocadero's fountains on August 19, 2012 in Paris. Summers in the northern hemisphere are now warmer than at any period in six centuries, according to climate research published on Wednesday in the science journal Nature.

Harvard researchers are adding statistical nuance to our understanding of how modern and historical temperatures compare.

Through developing a statistical model of Arctic temperature and how it

relates to instrumental and proxy records derived from trees, ice cores, and lake sediments, Martin Tingley, a research associate in Harvard's Department of Earth and Planetary Sciences and Peter Huybers, Professor of Earth and Planetary Sciences, have shown that the warmest summers in the last two decades are unprecedented in the previous six centuries. Their work is described in an April 11 paper published in *Nature*.

"We call upon multiple proxies—-including those derived from trees, ice cores, and lake sediments—-to reconstruct temperature back through time using a Bayesian statistical approach," Tingley said. "What we are trying to do is put statistical inference of past changes in temperature on a more solid and complete footing."

"Saying this year is warmer than all other years included in the reconstruction is a very different thing than saying this year is warmer than a particular year in the past," he added. "You have to think about the uncertainty in the temperature estimate for each year, and then be able to say that recent years are warmer than all past years simultaneously."

To assess such probabilities, Tingley and Huybers use a statistical model that gives a large ensemble of equally likely temperature histories for the last 600 years, as opposed to the single best estimate provided by most other reconstructions of Earth's temperature. "By sorting through these many plausible realization of what Earth's temperature may have looked like", Huybers said, "it becomes possible to find the probability associated with a great variety of relevant quantities, such as whether the 2010 Russian heat wave was more anomalous than all other events or whether the trend in average temperature over the last 100 years is uniquely large."

Perhaps the most basic quantity is average Arctic temperature, and

Tingley said that the summers of 2005, 2007, 2010 and 2011 were each warmer than all years prior to 2005 in at least 95% of the ensemble members. Furthermore, the rate of temperature increase observed over the last century is, with 99% probability, greater in magnitude than centennial trends during any other interval in the last 600 years. At a more regional level, the summer of 2010 featured the warmest year in western Russia with 99% probability and also featured the warmest year in western Greenland and the Canadian Arctic with 90% probability.

Also notable, Tingley said, was that although summer temperatures are clearly on the rise, they found no indication that the variability of temperature has changed. Events like the 2010 Russian heat wave and the 2003 Western European heat wave are consistent with the increase in mean temperature, after accounting for the fact that they are selected as some of the hottest years and locations.

"Insomuch as the past is prologue for the future", Tingley said, "these results suggest that the hottest summers will track along with increases in mean temperature." He explained that, "if instead the distribution of temperatures were becoming wider, as well as shifting towards higher values, then the probability of extreme events would go up even more rapidly."

But Tingley also pointed out the limitations of the results and the need for further work. "The proxies, unlike thermometers, generally only give information about seasonal average temperatures, and we have not explored changes in variability at the daily and weekly timescales associated with weather patterns. It will be interesting to further explore instrumental records and higher resolution proxies for trends at these shorter timescales."

More information: Paper: dx.doi.org/10.1038/nature11969

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