Scientists upgrade database tracking global temperatures across millennia (Update)

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A consortium of international scientists led by a climate expert from USC have upgraded an open-source global database tracking the Earth's temperatures since 1 A.D. that further confirms that the Earth is

warming at a rate unprecedented in recent geologic history.

The database by the PAGES 2k Consortium relies on proxy data such as tree rings, corals, glacier ice, marine sediment and other such data to track the Earth's temperature shifts.

Julien Emile-Geay, an associate professor for the USC Dornsife College of Letters, Arts and Sciences, said he and other climate scientists with the international PAGES 2k Consortium have updated the organization's original 2013 database to include more, and higher quality, records from around the world. It now has nearly 692 records, up from the original 501.

The increasing amount of data, and the quality control applied by the 98 author led to a more accurate database, Emile-Geay said.

Version 2 of the database from PAGES 2k was announced on July 11 in *Scientific Data*, a Nature journal. Emile-Geay was the corresponding author for the paper announcing the upgraded data.

PAGES, or Past Global Changes, was launched in 1991 as a project intended to improve scientific research and understanding of climate change by studying the past. In 2006, the PAGES 2k Network was started to compile and analyze global data for the past 2,000 years. The database involves contributions from nearly 100 scientists from 22 countries.

Scientists have found that the average global temperature on Earth has increased about 1.4 degrees Farenheit (0.8 Celsius) since 1880. [corrected]

Adding records to the PAGES 2k database improves the database's accuracy and narrows the margin of error for tracking global

temperature changes, said Emile-Geay, an expert in climate modeling . The database is open source so that both scientists and citizens can study it.

"It adds weight to the idea that the current rate of warming is unprecedented in the past 2,000 years, and, together with many other sources of evidence, further indicative of a human influence on climate," Emile-Geay said. Most records in the PAGES 2k dataset are from the past 2,000 years. The scientists said records from this period provide a comprehensive, high-resolution view of a climate system that resembles today's.

Much of the published information comes from tree rings, which can indicate a warm growing season (wide rings) or a cold growing season (narrow rings). Because trees can live many years, they can provide a natural record of temperature change and long-term climate shifts.

However, in many regions, such as California's central valley, trees feel thirsty more often than they feel cold, so it is critical to obtain information from other archives. To cross-check changes inferred from tree-rings, scientists compare them to those from other proxies, such as glacier ice, speleothems (cave formations), corals, sediments from lake and ocean bottoms, and historical documents. Combined in the database, these varied data sources prove remarkably consistent, which gives scientists great confidence that they really are sensing a common climatic phenomenon: global warming.

The data records were from the scientific literature or online databanks. The authors summarized the database by charting global-scale trends, averaging the values from the individual records. Temperature summaries based on the data showed that the Earth experienced a long cooling trend up until the 19th century, with a sharp uptick starting around the time of the Industrial Revolution.

This shape was first published in 1998 by climate researchers Michael Mann of the University of Virginia, Raymond S. Bradley of the University of Massachusetts Amherst, and Malcolm Hughes of the University of Arizona. They dubbed the shape of this uptick, the "hockey stick," and it has been a lightning rod in public perceptions of global warming ever since.

Some changes in the Earth's climate in that 2,000-year stretch can be attributed to natural influences - such as the slow changes in the Earth's orbit which redistributed incoming solar radiation, fluctuations in solar activity, and major volcanic eruptions. However, only the rise in greenhouse gas concentrations due to the burning of fossil fuels can explain the sharp rise in temperature seen since 1850 - which, as this data show, is highly anomalous in the context of the past 2,000 years.

Emile-Geay said he is often asked if there is a point-of-no-return or a scientific threshold that could indicate whether it is too late to slow or reverse the Earth's warming.

"Here's how I think of it: Imagine you are a smoker, and your doctor tells you 'if you don't stop smoking now, you will soon die of a very painful lung cancer.' Should your next question be 'How many more cigarettes can I smoke before cancer is definitely untreatable?,' or 'How can you help me stop smoking tomorrow?'"

"It comes down to this: we know the human burning of fossil fuel is very rapidly warming the planet, and we know that the longer we wait, the harsher the consequences and the more costly it is to prevent them," Emile-Geay said. "What is the point of endlessly delaying action?"

More information: Julien Emile-Geay et al, A global multiproxy database for temperature reconstructions of the Common Era, *Scientific Data* (2017). DOI: 10.1038/sdata.2017.88

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