

Tree rings confirm unprecedented warming in Central Asia

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Researchers sample a dead tree in northern Mongolia. Credit: Nicole Davi

A new study of tree rings from Mongolia dating back more than 1,000 years confirms that recent warming in central Asia has no parallel in any known record. In recent decades, temperatures have been ascending more rapidly here than in much of the world, but scientists have lacked much evidence to put the trend into a long-term context. The study does not explicitly raise the issue of human-induced warming, but is sure to be seen as one more piece of evidence that it is at work. The study appears in the journal *Quaternary Science Reviews*.

"Central Asia has very short and incomplete meteorological records, so our understanding of the climate system there is extremely limited," said lead author Nicole Davi, an adjunct associate research scientist at

Columbia University's Lamont-Doherty Earth Observatory. She said that the new temperature record fills a void. "Knowing what has happened gives us a baseline to understand what can happen in the future," she said. Mongolia has suffered devastating drought in recent years, and some scientists think the warming may be connected.

Much of Mongolia is open grassland, but some old forests exist in mountainous northern regions. Davi's colleagues traveled several days on horseback to the remote Khuvsgul Nuur area, near the border with Siberia to collect samples. Working at elevations of about 7,500 feet, along the upper reaches of the treeline, they sampled rings of more than 200 Siberian larches, both alive and dead. The area is extremely cold and dry, and trees grow very slowly. They respond strongly to changes in temperature, producing wider rings in warmer years and narrower ones when it is cold.

The team found living trees going back as far as the year 1374, and many well-preserved dead ones going back to the 700s. They sampled living trees by removing harmless straw-size cores from the trunks, and sawed out cross sections from some dead ones. From their collection, they assembled a chronology of temperatures spanning 931 to 2005. The rings showed many ups and downs, largely corresponding with previous periods of warmth and cold known from tree rings and other records elsewhere.

The 20th and early 21st centuries showed the most sustained and highest warming, with the most recent years topping the record. The warmest 20-year period was 1986-2005, with an average summer temperature of 17.5 degrees C (63.5 degrees F), compared to a long term mean of 15.8 degrees C (about 60 degrees F). Average summer temperatures by 1999-2004 were 65 degrees F, and the six hottest years of the entire record were 2000-2005. The higher temperatures helped the high-elevation larches grow better, but corresponding increases in lower-

elevation areas, where livestock raising comprises the main economy, may have contributed to droughts there. The last big one, running from 1999-2002, killed millions of animals across Mongolia, and drove hundreds of thousands of herders into the capital city of Ulan Bataar. Further severe weather since then has forced many more from the countryside.

The [tree rings](#) also confirmed multiple episodes in which big volcanic eruptions cooled the atmosphere for a year or two. This phenomenon, caused by sun-blocking particles spewed into the air, is well known from some past individual eruptions. But here it was laid out in global fashion, over a long timespan. Known eruptions corresponded with very narrow rings, or in some cases no rings, indicating that the trees had been stressed. These included rings in 935 (corresponding with an eruption of at Eldgja, Iceland); 1177 (eruptions in Japan and Iceland); 1258 (Indonesia); 1454 (Vanuatu); 1601 (Peru); 1783 (Iceland); 1884 (the great eruption of Indonesia's Krakatoa); and 1912 (the eruption of Alaska's Katmai).

In cooperation with Mongolian colleagues, Lamont-Doherty scientists have been [working in Mongolia since the 1990s](#), assembling climate records from different regions of the country.

More information: "A long-term context (931–2005 C.E.) for rapid warming over Central Asia," *Quaternary Science Reviews*, Volume 121, 1 August 2015, Pages 89-97, ISSN 0277-3791, [dx.doi.org/10.1016/j.quascirev.2015.05.020](https://doi.org/10.1016/j.quascirev.2015.05.020)

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