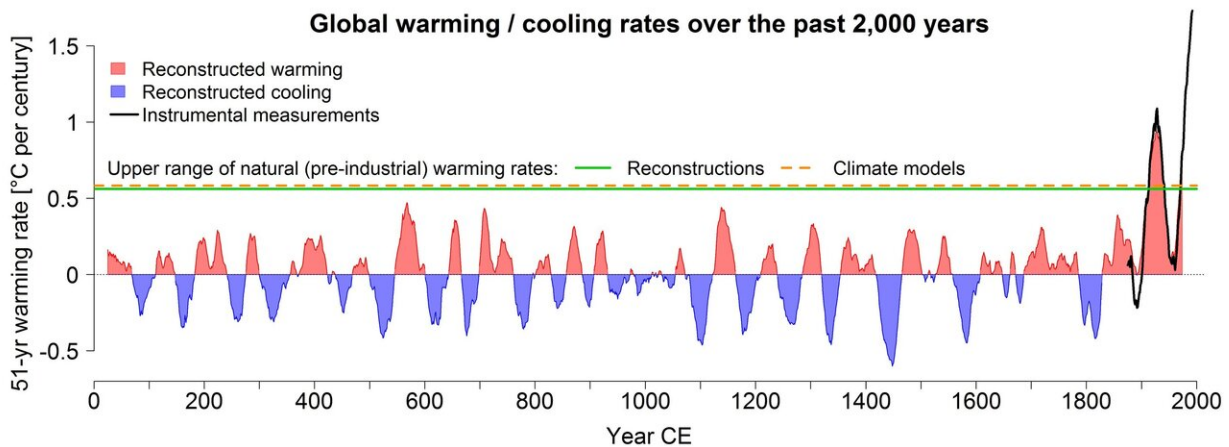


The climate is warming faster than it has in the last 2,000 years

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Global mean warming / cooling rates over the last 2,000 years. In red are the periods (each across 51 years) in which the reconstructed temperatures increased. Global temperatures decreased in the periods in blue. The green line shows that the maximum expected warming rate without anthropogenic influence is just under 0.6 degrees per century. Climate models (dashed orange line) are able to simulate this natural upper limit very well. At more than 1.7 degrees per century, the current rate of warming is significantly higher than the expected natural rate of warming, and higher than values for every previous century. Instrumental measurements since 1850 (in black) confirm these figures. Credit: University of Bern

Many people have a clear picture of the "Little Ice Age" (from approx. 1300 to 1850). It's characterized by paintings showing people skating on

Dutch canals and glaciers advancing far into the alpine valleys. That it was extraordinarily cool in Europe for several centuries is proven by a large number of temperature reconstructions using tree rings, for example, not just by historical paintings. As there are also similar reconstructions for North America, it was assumed that the "Little Ice Age" and the similarly famous "Medieval Warm Period" (approx. 700—1400) were global phenomena. But now an international group led by Raphael Neukom of the Oeschger Center for Climate Change Research at the University of Bern is painting a very different picture of these alleged global climate fluctuations. In a study which has just appeared in the well-known scientific journal *Nature*, and in a supplementary publication in *Nature Geoscience*, the team shows that there is no evidence that there were uniform warm and cold periods across the globe over the last 2,000 years.

Climate fluctuations in the past varied from region to region

"It's true that during the Little Ice Age it was generally colder across the whole world," explains Raphael Neukom, "but not everywhere at the same time. The peak periods of pre-industrial warm and cold periods occurred at different times in different places." According to the climate scientist from Bern, the now-debunked hypothesis of climate phases occurring at the same time across the globe came about because of an impression that is defined by the climate history of Europe and North America. In the absence of data from other parts of the earth, this notion was applied to the whole planet, raising expectations that relatively cold or warm periods throughout the last 2,000 years were globally synchronous phenomena. But it has now been shown that this was not the case.

The authors of the study in *Nature* see the explanation for that as being

that regional climates in pre-industrial times were primarily influenced by random fluctuations within the climate systems themselves. External factors such as volcanic eruptions or solar activity were not intense enough to cause markedly warm or cold temperatures across the whole world for decades, or even centuries.

The researchers relied on a database from the international research consortium PAGES (Past Global Changes, <http://www.pastglobalchanges.org>), which provides a comprehensive overview of climate data from the last 2,000 years, for their investigation of five pre-industrial climate epochs. In addition to tree rings, it also includes data from ice cores, lake sediments and corals. To really put the results to the test, the team led by Raphael Neukom analyzed these data sets using six different statistical models—more than ever before. This allowed for the calculation of the probability of extremely warm or cold decades and centuries, and not just the calculation of absolute temperatures. The result was that no globally coherent picture emerged during the periods being investigated. "The minimum and maximum temperatures were different in different areas," says Raphael Neukom. So thermal extremes across the world cannot be inferred from regional temperature phenomena like the oft-mentioned "Medieval Warm Period" in Europe and North America.

The current warm period is happening across the world for the first time

The results look very different for recent history. Both studies show that the warmest period of the last 2,000 years was most likely in the 20th century. They also show that this was the case for more than 98 percent of the surface of the earth. This shows—once again—that modern climate change cannot be explained by random fluctuations, but by anthropogenic emissions of CO₂ and other greenhouse gases. What we

didn't know until now is that not only average global temperatures in the 20th century are higher than ever before in at least 2,000 years, but also that a warming period is now affecting the whole planet at the same time for the first time. And the speed of global warming has never been as high as it is today.

More information: No evidence for globally coherent warm and cold periods over the preindustrial Common Era, DOI: *Nature Geoscience* (2019). 10.1038/s41586-019-1401-2 DOI: 10.1038/s41586-019-1401-2

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