

# 'No doubt left' about scientific consensus on global warming, say experts

Extensive historical data shows recent extreme warming is unprecedented in past 2,000 years

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Wed 24 Jul 2019 18.00 BST

Last modified on Wed 24 Jul 2019 18.23 BST



A desert road in Death Valley national park, California. Photograph: sara\_winter/Getty/iStockphoto

The scientific consensus that humans are causing global warming is likely to have passed 99%, according to the lead author of the most authoritative study on the subject, and could rise further after separate research that clears up some of the remaining doubts.

Three studies published in *Nature* and *Nature Geoscience* use extensive historical data to show there has never been a period in the last 2,000 years when temperature changes have been as fast and extensive as in recent decades.

It had previously been thought that similarly dramatic peaks and troughs might have occurred in the past, including in periods dubbed the Little Ice Age and the Medieval Climate Anomaly. But the three studies use reconstructions based on 700 proxy records of temperature change, such as trees, ice and sediment, from all continents that indicate none of these shifts took place in more than half the globe at any one time.

The Little Ice Age, for example, reached its extreme point in the 15th century in the Pacific Ocean, the 17th century in Europe and the 19th century elsewhere, says **one of the studies**. This localisation is markedly different from the trend since the late 21st century when records are being broken year after year over almost the entire globe, including this summer's European heatwave.

Major temperature shifts in the distant past are also likely to have been primarily caused by volcanic eruptions, according to **another of the studies**, which helps to explain the strong global fluctuations in the first half of the 18th century as the world started to move from a volcanically cooled era to a climate warmed by human emissions. This has become particularly pronounced since the late 20th century, when temperature rises over two decades or longer have been the most rapid in the past two millennia, notes **the third**.

The authors say this highlights how unusual warming has become in recent years as a result of industrial emissions.

“There is no doubt left – as has been shown extensively in many other studies addressing many different aspects of the climate system using different methods and data sets,” said Stefan Brönnimann, from the University of Bern and the Pages 2K consortium of climate scientists.

Commenting on the study, other scientists said it was an important breakthrough in the “fingerprinting” task of proving how human responsibility has changed the climate in ways not seen in the past.

“This paper should finally stop climate change deniers claiming that the recent observed coherent global warming is part of a natural climate cycle. This paper shows the truly stark difference between regional and localised changes in climate of the past and the truly global effect of anthropogenic greenhouse emissions,” said Mark Maslin, professor of climatology at University College London.

Previous studies have shown near unanimity among climate scientists that human factors – car exhausts, factory chimneys, forest clearance and other sources of greenhouse gases – are responsible for the exceptional level of global warming.

A 2013 study in [Environmental Research Letters](#) found 97% of climate scientists agreed with this link in 12,000 academic papers that contained the words “global warming” or “global climate change” from 1991 to 2011. Last week, that paper [hit 1m downloads](#), making it the most accessed paper ever among the 80+ journals published by the Institute of Physics, according to the authors.

The pushback has been political rather than scientific. In the US, the rightwing thinktank the Competitive Enterprise Institute (CPI) is reportedly putting pressure on Nasa to remove a [reference to the 97% study](#) from its webpage. The CPI has [received event funding](#) from the American Fuel and Petrochemical Manufacturers and Charles Koch Institute, which have much to lose from a transition to a low-carbon economy.

But among academics who study the climate, the convergence of opinion is probably strengthening, according to John Cook, the lead author of the original consensus paper and a follow-up study on the “consensus about consensus” that looked at a range of similar estimates by other academics.

He said that at the end of his 20-year study period there was more agreement than at the beginning: “There was 99% scientific consensus in 2011 that humans are causing global warming.” With ever stronger research since then and increasing heatwaves and extreme weather, Cook believes this is likely to have risen further and is now working on an update.

“As expertise in climate science increases, so too does agreement with human-caused global warming,” Cook [wrote on the Skeptical Science blog](#). “The good news is public understanding of the scientific consensus is increasing. The bad news is there is still a lot of work to do yet as climate deniers continue to persistently attack the scientific consensus.”

## Climate change: Current warming 'unparalleled' in 2,000 years

By Matt McGrath  
Environment correspondent  
6 hours ago



**The speed and extent of current global warming exceeds any similar event in the past 2,000 years, researchers say.**

They show that famous historic events like the "Little Ice Age" don't compare with the scale of warming seen over the last

century.

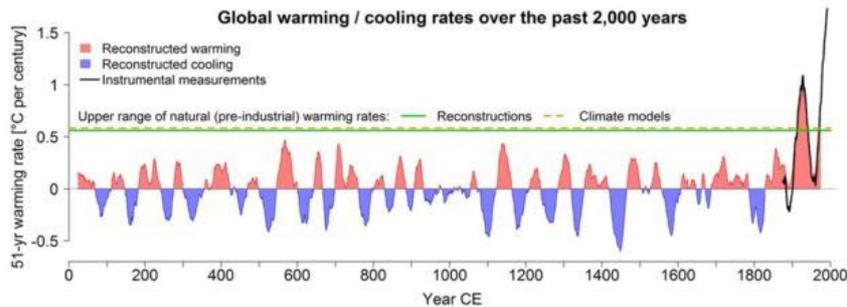
The **research suggests** that the current warming rate is higher than any observed previously. The scientists say it shows many of the arguments used by climate sceptics are no longer valid.

When scientists have surveyed the climactic history of our world over the past centuries a number of key eras have stood out.

These ranged from the "Roman Warm Period", which ran from AD 250 to AD 400, and saw unusually warm weather across Europe, to the famed Little Ice Age, which saw temperatures drop for centuries from the 1300s.

The events were seen by some as evidence that the world has warmed and cooled many times over the centuries and that the warming seen in the world since the industrial revolution was part of that pattern and therefore nothing to be alarmed about.

Three new research papers show that argument is on shaky ground.



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The science teams reconstructed the climate conditions that existed over the past 2,000 years using 700 proxy records of temperature changes, including tree rings, corals and lake sediments. They determined that none of these climate events occurred on a global scale.

The researchers say that, for example, the Little Ice Age was at its strongest in the Pacific Ocean in the 15th Century, while in Europe it was the 17th Century.

Generally, any longer-term peaks or troughs in temperature could be detected in no more than half the globe at any one time,

The "Medieval Warm Period", which ran between AD 950 and AD 1250 only saw significant temperature rises across 40% of the Earth's surface.

Today's warming, by contrast, impacts the vast majority of the world.

"We find that the warmest period of the past two millennia occurred during the 20th Century for more than 98% of the globe," one of the papers states.

"This provides strong evidence that anthropogenic (human induced) global warming is not only unparalleled in terms of absolute temperatures but also unprecedented in spatial consistency within the context of the past 2,000 years."



Heatwaves in Europe have been made more likely by climate change, scientists say

What the researchers saw is that prior to the modern industrial era, the most significant influence on climate was volcanoes. They found no indication that variations in the Sun's radiation impacted mean global temperatures. The current period, say the authors, significantly exceeds natural variability.

"We see from the instrumental data and also from our reconstruction that in the recent past the warming rate clearly exceeds the natural warming rates that we calculated - that's another view to look at the extraordinary nature of the present warming," said Dr Raphael Neukom, from the University of Bern, Switzerland.

While the researchers did not set out to test whether humans were the chief influence on the current climate, their findings indicate clearly that this is the case.

"We do not focus on looking at what's causing the most recent warming as this has been done many times and the evidence is always agreeing that it is the anthropogenic cause," said Dr Neukom.

"We do not explicitly test this; we can only show that natural causes are not sufficient from our data to actually cause the spatial pattern and the warming rate that we are observing now."

Other scientists have been impressed with the quality of the new studies.



Winter skating on ice in Europe in centuries gone by was a common event during the Little Ice Age

"They have done this across the globe with more than 700 records over the past 2,000 years; they have corals and lakes and also instrumental data," said Prof Daniela Schmidt from the University of Bristol, UK, who was not involved with the studies.

"And they have been very careful in assessing the data and the inherent bias that any data has, so the quality of this data and the coverage of this data is the real major advance here; it is amazing."

Many experts say that this new work debunks many of the claims made by climate sceptics in recent decades.

"This paper should finally stop climate change deniers claiming that the recent observed coherent global warming is part of a natural climate cycle," said Prof Mark Maslin, from University College London, UK, who wasn't part of the studies.

"This paper shows the truly stark difference between regional and localised changes in climate of the past and the truly global effect of anthropogenic greenhouse emissions."

The three papers have been published in the journals Nature **(1)** and Nature Geoscience **(2), (3)**.