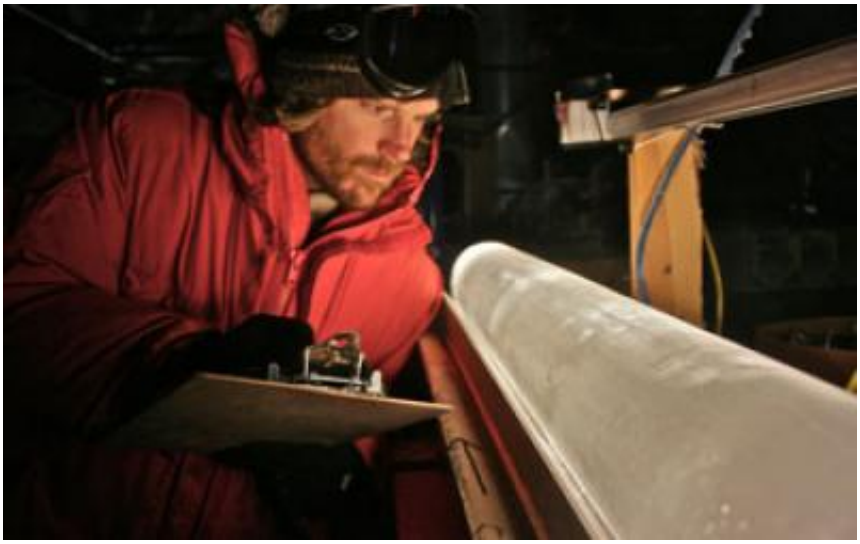
Earth is warmer today than during 70 to 80 percent of the past 11,300 years

March 7 2013



Scientists look at an ice core from the West Antarctic Ice Sheet Divide coring site. Credit: Thomas Bauska, OSU

Using data from 73 sites around the world, scientists have been able to reconstruct Earth's temperature history back to the end of the last Ice Age, revealing that the planet today is warmer than it has been during 70 to 80 percent of the time over the last 11,300 years.

Of even more concern are projections of global temperature for the year 2100, when virtually every climate model evaluated by the Intergovernmental Panel on Climate Change (IPCC) shows that temperatures will exceed the warmest temperatures during that

11,300-year period known as the Holocene – under all plausible greenhouse gas emission scenarios.

Results of the study, by researchers at Oregon State University and Harvard University, were published this week in the journal *Science*. It was funded by the National Science Foundation's Paleoclimate Program.

Lead author Shaun Marcott, a post-doctoral researcher in Oregon State's College of Earth, Ocean, and Atmospheric Sciences, noted that previous research on past global temperature change has largely focused on the last 2,000 years. Extending the reconstruction of global temperatures back to the end of the last Ice Age puts today's climate into a larger context.

"We already knew that on a global scale, Earth is warmer today than it was over much of the past 2,000 years," Marcott said. "Now we know that it is warmer than most of the past 11,300 years. This is of particular interest because the Holocene spans the entire period of human civilization."

Peter Clark, an OSU paleoclimatologist and co-author on the *Science* article, said many previous temperature reconstructions were regional in nature and were not placed in a global context. Marcott led the effort to combine data from 73 sites around the world, providing a much broader perspective.

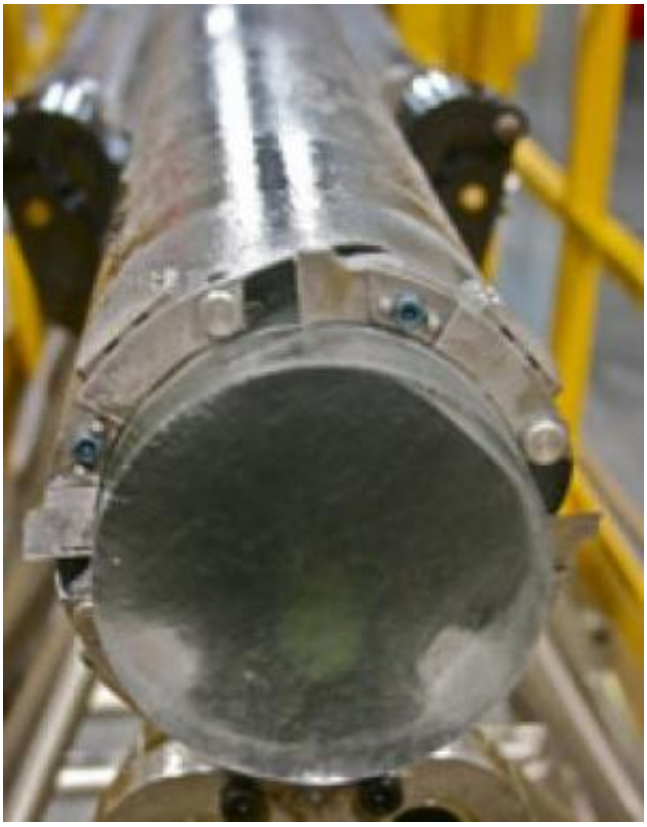
A West Antarctic Ice Sheet Divide ice core barrel is shown. Cores show past air temperatures. Credit: Thomas Bauska, OSU

"When you just look at one part of the world, the temperature history can be affected by regional climate processes like El Niño or monsoon variations," noted Clark. "But when you combine the data from sites all around the world, you can average out those regional anomalies and get a clear sense of the Earth's global temperature history."

What that history shows, the researchers say, is that over the past 5,000 years, the Earth on average cooled about 1.3 degrees (Fahrenheit) – until the past 100 years, when it warmed~ 1.3 degrees (F). The largest changes were in the northern hemisphere, where there are more land masses and greater human populations.

Climate models project that global temperature will rise another 2.0 to 11.5 degrees (F) by the end of this century, largely dependent on the magnitude of carbon emissions. "What is most troubling," Clark said, "is that this warming will be significantly greater than at any time during the past 11,300 years."

Marcott said that one of the natural factors affecting global temperatures over the past 11,300 years is gradual change in the distribution of solar insolation associated with Earth's position relative to the sun.



An ice core taken from the West Antarctic Ice Sheet Divide is shown in its sampling barrel. Credit: Thomas Bauska, OSU

"During the warmest period of the Holocene, the Earth was positioned such that Northern Hemisphere summers warmed more," Marcott said. "As the Earth's orientation changed, Northern Hemisphere summers became cooler, and we should now be near the bottom of this long-term cooling trend – but obviously, we are not."

Clark said that other studies, including those outlined in past IPCC

reports, have attributed the warming of the planet over the past 50 years to anthropogenic, or human-caused activities – and not solar variability or other natural causes.

"The last century stands out as the anomaly in this record of global temperature since the end of the last ice age," said Candace Major, program director in the National Science Foundation's Division of Ocean Sciences, which co-funded the research with NSF's Division of Atmospheric and Geospace Sciences. "This research shows that we've experienced almost the same range of temperature change since the beginning of the industrial revolution as over the previous 11,000 years of Earth history – but this change happened a lot more quickly."

The research team, which included Jeremy Shakun of Harvard University and Alan Mix of Oregon State, primarily used fossils from ocean sediment cores and terrestrial archives to reconstruct the temperature history. The chemical and physical characteristics of the fossils – including the species as well as their chemical composition and isotopic ratios – provide reliable proxy records for past temperatures by calibrating them to modern temperature records.

Using data from 73 sites around the world allows a global picture of the Earth's history and provides new context for climate change analysis.

"The Earth's climate is complex and responds to multiple forcings, including CO2 and solar insolation," Marcott said. "Both of those changed very slowly over the past 11,000 years. But in the last 100 years, the increase in CO2 through increased emissions from human activities has been significant. It is the only variable that can best explain the rapid increase in global temperatures."

More information: "A Reconstruction of Regional and Global Temperature for the Past 11,300 Years," by S.A. Marcott, *Science*, 2013.

Provided by Oregon State University