

Study Links Humans to Warming in Arctic

By Rosanne Skirble
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Darrell Kaufman, Northern Arizona University

The previous extent of a glacier that feeds Upper Greyling Lake in south-central Alaska is marked by the sharp-crested ridges of debris (lateral moraines) that descend into the lake

Arctic temperatures are now higher than at any time in the last 2,000 years, research reveals. Changes to the Earth's orbit drove centuries of cooling, but temperatures rose fast in the last 100 years as human greenhouse gas emissions rose.

The study in the journal *Science* documents 2,000 years of geological history using tree rings, glacier ice and lake sediment to reconstruct the Arctic summer temperature record.

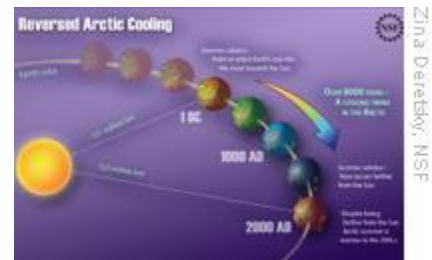
Lead author **Darrell Kaufman**, professor of environmental science and environmental sustainability at Northern Arizona University, says the warming trend over the last 50 years interrupted what was a natural cooling cycle.

"We noted that the timing of the rapid increase in temperature coincides with the timing of the buildup of greenhouse gases, and there is no other mechanism or forcing that we can come up with that would explain the rapid reversal of that natural cooling," he said.

The earth's cool-down period started about 7,000 years ago. Arctic temperatures bottomed out during the so-called "Little Ice Age" that lasted from the 16th to the mid-19th centuries.

The root cause of the slow cooling was the orbital "wobble" that slowly varies over thousands of years.

Some skeptics have argued that the fact that the Earth wobbles in its axis of rotation has helped determine recent warming, rather than human activity. But the new study shows that this wobble - which affects how much sunlight Earth receives in the middle of the summer - actually accounts for a long-term cooling trend in the Arctic, which has been reversed only in the past half-century.



How a wobble in the Earth's axis of rotation caused a cooling trend that lasted at least 1,900 years

Studies show the earth had been cooling at the rate of .2 degrees Celsius per millennium. The last decade, however, was the warmest of the last 2,000 years,

averaging 1.4 degrees Celsius higher than would have been expected if the cooling trend had continued.



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Researchers take a sediment core from the bottom of Goat Lake in south-central Alaska, which is 50 meters below the surface

Kaufman says his research adds to the evidence that human-produced greenhouse emissions contribute to global warming.

"I think that the important point there is that the very slow orbital cycles would take thousands of years before the earth could enter an ice age, before ice sheets miles thick would build up on the continent," he said. "The rapid warming that we are experiencing presently far out competes any kind of cooling trend that the natural cycle would dictate."

Kaufman says another important finding came from collaboration with the National Center for Atmospheric Research, which simulated orbital variations over a 2,000 year time period.

"And the output from that computer model showed the same amount of temperature change for the arctic that we documented based on the geologic evidence," he said. "So it is this match of the output of the computer models and the natural data that gives us confidence in the ability of the model to simulate the effects of factors that we know causes climate to change."

Kaufman says the evidence is conclusive that recent Arctic warming is unusual, that greenhouse gases play a role, and that it's time to take decisive action to reduce carbon emissions. The study was conducted by an international team of scientists and primarily funded by the National Science Foundation.