

Study shows unprecedented warmth in Arctic

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CU-Boulder Professor Gifford Miller is shown here collecting dead plant samples from beneath a Baffin Island ice cap. Credit: Gifford Miller, University of Colorado Boulder

(Phys.org) —The heat is on, at least in the Arctic. Average summer temperatures in the Eastern Canadian Arctic during the last 100 years are higher now than during any century in the past 44,000 years and perhaps as long ago as 120,000 years, says a new University of Colorado Boulder study.

The study is the first direct evidence the present warmth in the Eastern Canadian Arctic exceeds the peak warmth there in the Early Holocene, when the amount of the sun's energy reaching the Northern Hemisphere in summer was roughly 9 percent greater than today, said CU-Boulder geological sciences Professor Gifford Miller, study leader. The Holocene is a geological epoch that began after Earth's last glacial period ended roughly 11,700 years ago and which continues today.

Miller and his colleagues used dead moss clumps emerging from receding [ice caps](#) on Baffin Island as tiny clocks. At four different [ice caps](#), [radiocarbon dates](#) show the mosses had not been exposed to the elements since at least 44,000 to 51,000 years ago.

Since radiocarbon dating is only accurate to about 50,000 years and because Earth's geological record shows it was in a glaciation stage prior to that time, the indications are that Canadian Arctic temperatures today have not been matched or exceeded for roughly 120,000 years, Miller said.

"The key piece here is just how unprecedented the warming of Arctic Canada is," said Miller, also a fellow at CU-Boulder's Institute of Arctic and Alpine Research. "This study really says the warming we are seeing is outside any kind of known natural variability, and it has to be due to increased greenhouse gases in the atmosphere."

A paper on the subject appeared online Oct. 23 in *Geophysical Research Letters*, a journal published by the American Geophysical Union. Co-authors include CU-Boulder Senior Research Associate Scott Lehman, former CU-Boulder doctoral student and now Prescott College Professor Kurt Refsnider, University of California Irvine researcher John Southon and University of Wisconsin, Madison Research Associate Yafang Zhong. The National Science Foundation provided the primary funding for the study.

Miller and his colleagues compiled the age distribution of 145 radiocarbon-dated plants in the highlands of Baffin Island that were exposed by ice recession during the year they were collected by the researchers. All samples collected were within 1 meter of the ice caps, which are generally receding by 2 to 3 meters a year. "The oldest radiocarbon dates were a total shock to me," said Miller.

Located just east of Greenland, the 196,000-square-mile Baffin Island is the fifth largest island in the world. Most of it lies above the Arctic Circle. Many of the ice caps on the highlands of Baffin Island rest on relatively flat terrain, usually frozen to their beds. "Where the ice is cold and thin, it doesn't flow, so the ancient landscape on which they formed is preserved pretty much intact," said Miller. and a decrease in solar radiation. Provided by University of Colorado at Boulder

To reconstruct the past climate of Baffin Island beyond the limit of radiocarbon dating, Miller and his team used data from ice cores previously retrieved by international teams from the nearby Greenland Ice Sheet.

The ice cores showed that the youngest time interval from which summer temperatures in the Arctic were plausibly as warm as today is about 120,000 years ago, near the end of the last interglacial period. "We suggest this is the most likely age of these samples," said Miller.

The new study also showed [summer temperatures](#) cooled in the Canadian Arctic by about 5 degrees Fahrenheit from roughly 5,000 years ago to about 100 years ago – a period that included the Little Ice Age from 1275 to about 1900.

"Although the Arctic has been warming since about 1900, the most significant warming in the Baffin Island region didn't really start until the 1970s," said Miller. "And it is really in the past 20 years that the warming signal from that region has been just stunning. All of Baffin Island is melting, and we expect all of the ice caps to eventually disappear, even if there is no additional warming."

Temperatures across the Arctic have been rising substantially in recent decades as a result of the buildup of greenhouse gases in Earth's atmosphere. Studies by CU-Boulder researchers in Greenland indicate temperatures on the ice sheet have climbed 7 degrees Fahrenheit since 1991.

A 2012 study by Miller and colleagues using radiocarbon-dated mosses that emerged from under the Baffin Island ice caps and sediment cores from Iceland suggested that the trigger for the Little Ice Age was likely a combination of exploding tropical volcanoes – which ejected tiny

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