Ancient midges offer clues to climate variability 10,000 years ago

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University of Illinois plant biology and geology professor Feng Sheng Hu collected core samples from Alaskan lakes. The abundance and diversity of midges buried in sediments offers a reliable record of temperature fluctuations over time. Credit: Feng Sheng Hu

An analysis of the remains of ancient midges – tiny non-biting insects closely related to mosquitoes – opens a new window on the past with a detailed view of the surprising regional variability that accompanied climate warming during the early Holocene epoch, 10,000 to 5,500 years ago.

Researchers at the University of Illinois and the University of British Columbia looked at the abundance and variety of midge larvae buried in lake sediments in Alaska. Midges are highly sensitive to summer temperatures, so changes in the abundance of different species over time gave the scientists a reliable marker of temperature fluctuations over the last 10,000 years.

Northern high latitudes are thought to have been warmer than today during the early Holocene, a time of heightened solar irradiation as a result of Earth's axial tilt and orbit around the sun. The period is often referred to as the Holocene Thermal Maximum. Scientists hope to understand the ecological impacts of climate warming during that time to make better predictions about the effects of future warming. But several decades of research have yielded only ambiguous evidence of climate conditions in Alaska at that time.

The new analysis, conducted by University of Illinois doctoral student Benjamin Clegg with U. of I. plant biology and geology professor Feng Sheng Hu, who led the study, offers the first detailed record of temperature variation over the last 10,000 years in Alaska. The analysis reveals that the region was significantly cooler than expected during the early Holocene.

"This study shows that early Holocene warming did not occur everywhere in high latitudes, and exhibited important regional exceptions, even though the driving force behind it – solar input, in this case – was geographically uniform," said Clegg, who is now a postdoctoral researcher in Hu's lab.

The drivers of climate change during the early Holocene "were different than the greenhouse gases responsible for global warming today," Clegg said. "So we should not expect to see exactly the same spatial patterns of temperature anomalies in the next few decades as during the early

Holocene."

The researchers hypothesize that solar warming during the early Holocene spurred atmospheric circulation patterns that contributed to extensive sea-ice off the Alaskan coast. That, and a treeless tundra over more of the land area than at present would have increased surface reflectivity, potentially contributing to the observed cooling, Clegg said.

"This study has important ecological and societal implications," Hu said. "Nonlinear responses such as those identified here constitute a major source of potential climate 'surprises' that make it more difficult to anticipate and prepare for future regional climate scenarios."

The findings appear in the *Proceedings of the National Academy of Sciences.*

More information: "Nonlinear Response of Summer Temperature to Holocene Insolation Forcing in Alaska," *Proceedings of the National Academy of Sciences.*

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