Precise Holocene temperature change and its causes estimated from trapped air in Greenland ice cores

TAKURO KOBASHI[1,2*], MICHAEL DÖRING[1,2], AURICH JELTSCH-THOEMMES[1,2], PATRIK PFISTER[1,2], MARKUS LEUENBERGER[1,2], HEINZ WANNER[2], TOSHIYUKI NAKAEGAWA[3], LAURIE MENVIEL[4]

[1]Climate and Environmental Physics, University of Bern, Switzerland (*correspondence: takuro.kobashi@gmail.com).
[2]Oeschger Centre for Climate Change Research, University of Bern, Switzerland.
[3]Meteorological Research Institute, Tsukuba, Japan.
[4]Climate Change Research Centre, University of New South Wales, Australia.

Precise understanding of Holocene climate is critical as future climate and societal evolution will occur under Holocene boundary conditions. However, it has been difficult to reconstruct multidecadal to centennial temperature variations owing to poor chronological constraints and seasonal biases on paleo-proxies. Here, we reconstructed Greenland temperatures over the Holocene using argon and nitrogen isotopes in the GISP2 ice core. The record provides seasonally unbiased estimates of multidecadal to millennial temperature changes (Kobashi et al., 2015). The reconstructed temperature indicates that Greenland experienced a gradual warming from the beginning of the Holocene (11,600 B.P) to ~9500 B.P., underwent warmer temperatures from 9000 to 6000 B.P., and then slightly cooled towards present. To interpret the reconstructed Greenland temperature variability, we employed intermediate complexity climate models (Loveclim) with the forcings of greenhouse gas, volcanic, solar, orbital forcing, topographic and albedo changes associated with changes in ice-sheets. We found that the model (Loveclim) captures long-term temperature changes in the earliest Holocene (11500-10000 B.P.) and a gradual cooling from the middle to late Holocene (7000 B.P. to present). However, it underestimates the reconstructed temperatures by a few °C from 10000-7000 B.P., indicating a missing forcing during this time. Precise temperature records can provide valuable tools to evaluate climate models and forcing estimates.

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