Greenland temperature responses to climate forcings over the past 4000 years

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To understand Greenland temperature responses to climate forcings is critical for projections of sea-level rise associated with melting of the Greenland ice-sheet. A new Greenland temperature record reconstructed from argon and nitrogen isotopes in trapped air in GISP2 ice core provides high-resolution (< 20 years) and precise annual average temperature estimates over the past 4000 years (Kobashi et al., 2011). Owing to tight age-controls and abundant paleoclimatic information from the ice core, the temperature record provides an exceptional opportunity to investigate the late Holocene climate in a multi-decadal to millennial time scale. To investigate causes of Greenland temperature variability over the past 4000 years, we calculated high latitude temperature (70-80ºN) change using a one-dimensional energy balance model with reconstructed climate forcings including orbital, solar, volcanic, and greenhouse gas forcings. Greenland temperature was calculated from the high latitude temperature considering negative Greenland temperature responses to solar variability based upon our earlier study, which significantly correlated with the ice-core-derived Greenland temperature. Therefore, the past variability of the climate forcings can explain at least 10% of multi-decadal to millennial Greenland temperature variability over the past 4000 years. A North Hemisphere (NH) average temperature trend over the past 4000 years was also inferred from the ice-core derived Greenland temperature. Lines of evidence indicate that current decadal average temperature of NH is likely warmer than anytime over the past 4000 years.

References

Kobashi, T., Kawamura, K., Severinghaus, J. P., Barnola, J.-M., Nakaegawa, T., Vinther, B. M., Johnsen, S. J., and Box, J. E.: High variability of Greenland surface temperature over the past 4000 years estimated from trapped air in an ice core, Geophys. Res. Lett., 38, 10.1029/2011GL049444, 2011.