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The influence of varying Holocene boundary conditions on Greenland ice core δ^{18}O, temperature, height and latitude relationships

Peter L. Langen (1), Tim Brücher (2), Bo M. Vinther (2), Sigfus J. Johnsen (2), and David Noone (3)

(1) MISU & Bert Bolin Centre for Climate Research, Stockholm University, Stockholm, Sweden, (2) Centre for Ice and Climate, Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark, (3) ATOC & CIRES, University of Colorado, Colorado, USA

The stable water isotope composition in ice cores is routinely used to infer detailed information about a host of climate variables such as regional temperatures, accumulation rates and moisture sources. Recently, Vinther et al. (2009) were able to reconstruct Holocene histories of Greenland ice sheet height assuming a constant slope of the δ^{18}O relationship with deposition altitude. Whether this slope has remained constant throughout the Holocene is the object of this study. Sime et al. (2009) have found that the δ^{18}O/temperature slope in East Antarctica is likely to be smaller in warmer climates and we investigate whether similar nonlinearities may be at play in Greenland.

We employ the NCAR CAM3 atmosphere general circulation model with an implementation of stable water isotope processes which reproduces with reasonable fidelity the present-day Greenland slopes between δ^{18}O of precipitation and surface temperature, altitude and latitude. By varying Greenland ice sheet topography and sea surface temperatures we explore the dynamical influences that realistic Holocene changes in boundary conditions can have on these slopes.