Ice cores and isotopic climate emulation to reconstruct the Last Interglacial Greenland Ice Sheet

The Greenland Ice Sheet (GIS) contribution to the Last Interglacial (LIG) sea level high stand is uncertain. Published studies show wide range of LIG ice loss estimates, varying from 0.3 to 5.5 meters of sea level equivalent. Here we propose to combine, for the first time, a compilation of stable water isotopic ($\delta^{18}O$) information from Greenland deep ice cores with isotopic climate emulation to provide new constraints on GIS ice volume and configuration changes during the LIG. Greenland ice records show that between present-day and the LIG climatic optimum, there was a rise in $\delta^{18}O$ of at least 2.5‰.

Isotopic LIG climate simulations are performed with a wide range of GIS morphologies. The outputs from the isotope-enabled climate model (HadCM3) are used to build an emulator of the response of $\delta^{18}O$ to all possible changes in the shape and extent of the GIS at 125ka. By applying this rather novel emulation technique, we show that strong ice loss occurred over southern Greenland, possibly resulting in a two dome structure, with a small remnant dome covering the south of Greenland and a larger one in the north. We also demonstrate the sensitivity of the solution to DYE3 ice core data. This shows where the most valuable ice core data lies in order to reduce uncertainties on GIS ice volume change estimates during the LIG.