



## **Extending the Greenland Ice Core Chronology 2005 (GICC05) back to 60 kyr b2k**

A. Svensson, K.K. Andersen, H.B. Clausen, S.J. Johnsen, S.O. Rasmussen, J.P. Steffensen, B.M. Vinther.

Niels Bohr Institute, University of Copenhagen, Denmark (as@gfy.ku.dk)

A new Greenland Ice Core Chronology (GICC05) covering the last 60 kyr has been constructed from annual layer counting of high-resolution records from three Greenland ice cores. Dating of the Holocene period back to 10 kyr b2k (before the year 2000 AD) is mainly based on new and published stable isotope measurements of the Dye-3 (GISP1) ice core, and on Electrical Conductivity Measurements (ECM) and Continuous Flow Analysis (CFA) of three chemical species in the GRIP ice core. Beyond 10 kyr b2k the time scale is obtained from NorthGRIP ice core records: CFA of 5 chemical species, dust and electrolytical conductivity, ECM, and the light intensity curve of the Visual Stratigraphy (VS). During cold glacial periods, the counting is mostly based on VS, ECM and electrolytical conductivity, which have the highest resolution.

A conservative uncertainty estimate of the time scale is obtained from identification of 'uncertain' annual layers, which are counted as  $0.5 \pm 0.5$  years. On average the uncertainty is  $< 1\%$  during the Holocene and  $\sim 5\%$  in the glacial. Uncertainties for GICC05 ages are quoted as  $2\sigma$ , which is equal to the sum of uncertain annual layers (the maximum counting error).

The new time scale places the Holocene/Pleistocene transition at  $11.70 \pm 0.10$  kyr b2k, the onset of Greenland Interstadial 3 (GIS3) at  $27.8 \pm 0.8$  kyr, the onset of GIS8 at  $38.2 \pm 1.4$  kyr, and the center of the Laschamp  $^{10}\text{Be}$  maximum in GIS10 at  $41.3 \pm 1.6$  kyr. In the interval 10-42 kyr (GIS1-10) GICC05 is generally in good agreement with both the GISP2 counted time scale of Meese and Sowers and with the NorthGRIP modeled time scale 'ss09sea', although there are discrepancies on shorter time scales. At the onset of GIS3 there is a  $> 1$  kyr disagreement with the Shackleton-Fairbanks GRIP time scale (SFCP04) based on  $^{14}\text{C}$  calibration of a marine core.

The dating of the interval 42-60 kyr (GIS10-17) is preliminary. In this section the new time scale falls in between the 'ss09sea' and the GISP2 time scales which differ by several thousands of years. The North Atlantic Ash Zone II (Z2) located at the termination of GIS15 is dated to  $55.4 \pm 2.1$  kyr b2k. This result is in accordance with the Hulu cave record and in very good agreement with the recent Kleegruben speleothem record from the Austrian Alps.