Climate of the Past
An Interactive Open Access Journal of the European Geosciences Union

Clim. Past, 3, 577-589, 2007
www.clim-past.net/3/577/2007/

Ice thinning, upstream advection, and non-climatic biases for the upper 89% of the EDML ice core from a nested model of the Antarctic ice sheet

P. Huybrechts[1,2], O. Rybak[2,3], F. Pattyn[4], U. Ruth[2], and D. Steinhage[2]

[1]Departement Geografie, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussel, Belgium

[2]Alfred-Wegener-Institut für Polar- und Meeresforschung, Postfach 120161, 27515 Bremerhaven, Germany

[3]Scientific Research Centre, Russian Academy of Sciences, Teatralnaya 8-a, 354000 Sochi, Russia

[4]Laboratoire de Glaciologie Polaire, Département des Sciences de la Terre et de l'Environnement (DSTE), Université Libre de Bruxelles, CP160/03, Av. F. Roosevelt 50, 1050 Bruxelles, Belgium

Abstract. A nested ice flow model was developed for eastern Dronning Maud Land to assist with the dating and interpretation of the EDML deep ice core. The model consists of a high-resolution higher-order ice dynamic flow model that was nested into a comprehensive 3-D thermomechanical model of the whole Antarctic ice sheet. As the drill site is on a flank position the calculations specifically take into account the effects of horizontal advection as deeper ice in the core originated from higher inland. First the regional velocity field and ice sheet geometry is obtained from a forward experiment over the last 8 glacial cycles. The result is subsequently employed in a Lagrangian backtracing algorithm to provide particle paths back to their time and place of deposition. The procedure directly yields the depth-age distribution, surface conditions at particle origin, and a suite of relevant parameters such as initial annual layer thickness. This paper discusses the method and the main results of the experiment, including the ice core chronology, the non-climatic corrections needed to extract the climatic part of the signal, and the thinning function. The focus is on the upper 89% of the ice core (appr. 170 kyears) as the dating below that is increasingly less robust owing to the unknown value of the geothermal heat flux. It is found that the temperature biases resulting from variations of surface elevation are up to half of the magnitude of the climatic changes themselves.

Final Revised Paper (PDF, 5858 KB) | Supplement (508 KB) | Discussion Paper (CPD)

Citation: Huybrechts, P., Rybak, O., Pattyn, F., Ruth, U., and Steinhage, D.: Ice thinning, upstream advection, and non-climatic biases for the upper 89% of the EDML ice core from a nested model of the Antarctic ice sheet, Clim. Past, 3, 577-589, 2007. Bibtex | EndNote | Reference Manager