Geophysical Research Abstracts
Vol. 14, EGU2012-1480, 2012
EGU General Assembly 2012

In-situ quantification of ice rheology and direct measurement of the Raymond Effect at Summit, Greenland using a phase-sensitive radar

F. Gillet-Chaulet (1), R. C. A. Hindmarsh (2), H. F. J. Corr (2), E. C. King (2), and A. Jenkins (2)

(1) UJF-Grenoble 1/CNRS, LGGE, France, (2) Physical Sciences Division, British Antarctic Survey, Natural Environment Research Council,Cambridge, UK

The Glen exponent n characterizes the stress-dependence of ice deformation, directly influencing the rate at which ice masses respond to external forcing. The slow deformation in large ice-sheets makes laboratory rheometry at representative strain-rates difficult. We develop a new technique to estimate n in-situ, deploying a phase-sensitive radar to measure vertical strain rates of around $10{-}4$ yr^{-1} within the top 1000 m of ice across ice divides at Summit and NEEM, Greenland. A fluid-dynamical feature, the Raymond Effect, predicts strong vertical strain-rate variation across divides over distances of a few ice-thicknesses. We achieve sufficient resolution to show this pattern, enabling us to estimate n = 4.5 by inverting our observations with flow modelling. This is higher than values previously used but consistent with other indirect measurements, implying laboratory measurements do not explore the full range of ice rheology and the consequent possibility of a greater sensitivity and responsiveness in ice-sheet dynamics.