Geophysical Research Abstracts, Vol. 7, 02027, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02027

Modelling the coupled evolution of the ice shelf/stream flow system and the oceanic circulation in the ice-shelf cavity.

A. J. Payne (1), P. Holland (2), D.L. Feltham (2) and A. Jenkins (3)

(1) Centre for Polar Observation and Modelling, University of Bristol, UK, (2) Centre for Polar Observation and Modelling, University College London, UK, (3) British Antarctic Survey, Cambridge, UK (a.j.payne@bristol.ac.uk / Fax: +44 117 928 7878 / Phone: +44 117 954 5972)

Recent satellite-based observations highlight the importance of coastal processes on the dynamics of the West Antarctic and Greenland ice sheets. In particular, the ice streams of the Amundsen Sea embayment, West Antarctica, as well as Jakobshavns Isbrae, Greenland, appear to be thinning in response to a recent oceanic trigger. One hypothesis is that enhanced melt from the underside of floating ice shelves and ice plains is causing the ice to thin and reducing the traction exerted by ice rises and other bedrock protrusions. This, in turn, may lead to accelerated flow over the grounding line and thinning of the ice streams. While there is a large amount of observational evidence suggesting that the ice sheets are more tightly coupled to their surrounding oceans than previously thought, the modelling of these interactions is still in its infancy.

We investigate these processes by coupling a two-dimensional plume model of sub-shelf oceanic circulation with a three-dimensional, higher-order model of ice flow in the shelf/stream system. Coupling between the two systems arises in three ways. Firstly, through the basal melt rates determined by the plume model which largely control the mass balance of the ice shelf. Second, through the changing basal geometry of the ice shelf that plays an important role in the momentum balance of the plume. Finally, through the subglacial meltwater flux across the grounding line that provides the initial impetus for plume development.

We conduct a series of coupled experiments in which the ice shelf/stream and plume are allowed to reach equilibrium. We then assess the sensitivity of the predicted melt

and freezing rates to the three primary oceanic inputs of shelf water temperature and salinity, as well as turbulent mixing coefficients. Finally, we conduct a series of perturbation experiments in which the effects of incremental changes to these parameters on the coupled system will be assessed.