Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Elastic response of ice sheet-shelf system[1] ROIY SAYAG, GRAE WORSTER, DAMTP, University of Cambridge — An ice sheet that spreads into an ocean is forced to bend due to its buoyancy, and delaminate from the ground to form an ice shelf. The location of the transition between the grounded sheet and the ungrounded shelf is defined as the grounding-line. The dynamics of grounding lines may have a critical effect on the stability of ice sheets, and determining the position of those free boundaries requires additional conditions that can be hard to constrain. We model such a sheet-shelf system as an elastic sheet, partially resting on an elastic substrate and partially resting on an ocean. Solving the two parts simultaneously by matching moments across the grounding line, we can avoid imposing an explicit boundary condition at the grounding line. In the limit of very stiff ground, a Stefan-like boundary condition can be identified at the grounding line, which simplifies the problem into solving only for the shelf. We present a good agreement between our theoretical predictions and laboratory experiments made using thick elastic sheets and a dense salt solution. We evaluate the variation of grounding line position with bed stiffness numerically, and estimate the relevance of an elastic response to viscous ice sheets.

[1]NERC post-doctoral fellowship

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Date submitted: 02 Aug 2010 Electronic form version 1.4