Abstract Submitted
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Britle failure of non-Newtonian, floating, extensional flows[1] ROIY SAYAG, MICHAEL WORSTER, DAMTP, University of Cambridge — Glacier ice is driven by gravity to flow from the land, where it is under shear, into the ocean, where it floats and extends. Owing to its non-Newtonian rheology, the ice can flow axisymmetrically over the bed but undergo brittle failure once it is floating on the ocean, as observed for example in crevassing of ice shelves. We model this coupled flow as an intrusion of a viscous gravity current into a denser ocean and study it both theoretically and experimentally. We have conducted laboratory experiments using a shear-thinning suspension that represents ice, and a denser inviscid fluid that represents an ocean. The non-Newtonian fluid was released at a constant flux through a cylindrical nozzle over a horizontal plane. The grounded, shear-dominated region of the flow was axisymmetric throughout the experiment, while past the transition line axisymmetry broke down into a seemingly ordered set of finger-like extensions (floating shelves) that demonstrated brittle behaviour. We have found that the width of the fingers as well as their radial extent increase with the flux. We attempt to explain these observations through a fingering instability that is driven by the dynamical differences between the two flow domains and by the material rheology, and we project that analysis to formulate a linkage between the material properties of ice and an upper bound on the width of ice shelves.

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