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A granular model for the transient response of subglacial till KATARZYNA WARBURTON, Univ of Cambridge, DUNCAN HEWITT, UCL, JEROME NEUFELD, Univ of Cambridge — Glaciers frequently rest on beds of subglacial till - a mixture of clay, grains, and water - over which the ice slides. The dynamics of glaciers are tied to the degree of deformation in the till. Many ice streams show velocity variations that have been linked to tidal fluctuations in subglacial water pressure. Experimental evidence characterises till as a plastic material with pressure dependent yield stress, contrary to current models which treat it as a viscous layer. To understand the tidal response requires extending the models of these steady-state experiments to include the time-dependent response of the till. We start from a one-dimensional, two-phase model of coupled fluid and solid flows, using Darcy flow for the fluid phase and a wet granular rheological model for the solid part. After verifying our model against experimental steady-state rheology, we force the model with a fluctuating confining pressure at its upper surface and infer the resulting relationship between porosity, applied shear stress, and deformation throughout the till. We find that shear dilation introduces internal pressure variations and hysteretic behaviour in low-permeability materials, which may help explain the large-scale transient response of ice sheets to changes in the hydrological system.

Katarzyna Warburton
Univ of Cambridge

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