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Hydraulically-driven cavitation beneath ice sheets IAN HEWITT, University of Oxford — Fluctuations in water pressure beneath glaciers and ice sheets influence the effective slip that facilitates rapid ice motion. This is especially the case for the Greenland ice sheet, where large amounts of summer meltwater are injected through and under the ice. Since the rate of ice motion is a primary control on sea-level contribution, it is of interest to understand the mechanism controlling this slip. The ice-sheet bed is rough on a small (meter) scale, and subglacial water collects in cavities whose size is controlled by the local bed topography, the water pressure and overburden ice pressure, and the viscous and elastic properties of the ice. Existing theories have established a steady-state relationship for the size of the cavities under conditions of constant water pressure, but this theory is inadequate to describe the rapid fluctuations that have been observed through bore-hole measurements. Here, I examine theoretically the dynamics of the cavities under conditions of varying water pressure and/or volume. Each cavity can be treated as a hydraulic fracture, and neighboring cavities are coupled to each other through the elastic or viscous stresses in the ice as well as the assumed hydraulic connections. I examine how the areal extent of the cavities responds to rapidly varying forcing, and establish the impact on the effective slip length for ice flow.

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