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Layer geometry as a constraint on the physics of sliding onset

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Transitions from basal no slip to basal sliding are a common feature of ice sheets, yet one that has remained difficult to observe. In this study we leverage recent advances in the processing of radar sounding data to study these transitions through their signature in englacial layers. Englacial layers encode information about strain and velocity, and the relation between their geometry and the onset of basal sliding has been demonstrated in ice flow models (the so-called "Weertman effect"). Here we leverage this relation to test the long-standing hypothesis that sliding onset takes the form of an abrupt no slip/sliding transition. By comparing the modeled signature of an abrupt sliding onset in englacial layer slopes against slope observations from the onset region of a West Antarctic ice stream (Institute Ice Stream), we conclude that observed layer geometry does not support an abrupt no slip/sliding transition. Our findings instead suggest a much smoother sliding onset, as would be consistent with temperature-dependent friction between ice and bed. Direct measurements of basal temperature at the catchment scale would allow us to confirm this hypothesis.