Increased melting of Pine Island Ice Shelf: cause or effect?

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Previous interpretations of Pine Island Ice Shelf (PIIS)'s rapid thinning have attributed observed increases in basal melting to increases in ocean heat content. However, the discovery of large-amplitude bedrock topography underneath the ice shelf suggests a role for glaciological and/or coupled processes. Here, as an outgrowth of a calibrated ensemble projection project spanning a wide range of glaciological and oceanic parameter space, we investigate changes in basal melting and ice shelf shape following perturbations in ice flux and/or ocean heat content. Increases in ice flux comparable to those observed in PIIS give increases in the area-averaged basal melt rate similar to those resulting from large increases in ocean temperature, and larger than those resulting from a shoaling of the thermocline. Though the final steady state achieved following an increase in ice flux is often characterized by a thicker ice shelf, local thinning may persist for decades. Using idealized representations of bedrock topography, we then show that the evolution of ice shelf shape and melt rates following removal from pinning points is strongly governed by this fast flux/melting feedback. Although we do not rule out the role of a change in ocean heat content as a trigger for PIIS's rapid retreat, we find that the transient melt rate and ice shelf shape is only weakly dependent upon the magnitude of oceanic perturbations.