Examining the slope-driven control of basal melting

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Previous studies of ice shelf basal melting [e.g. Jenkins 1991] note that slope-dependent entrainment of heat into the oceanic mixed layer is an important control of the rate of basal melting. Because ice shelf thickness gradients may vary by an order of magnitude along an ice shelf, even weak slope-sensitivity drives strong gradients in melting.

Here, we summarize the results of Little et al. [2009], in which a 3-D numerical ocean model is used to analyze the sensitivity of basal melting to temperature and ice shelf basal slope. Entrainment of heat occurs predominately under deeper, steeper sections of the ice shelf; local and area-integrated melting rates are most sensitive to changes in slope in this "initiation region" [see figure]. Stratification, tides, and small-scale topographic features are neglected in these simulations; turbulent heat fluxes are parameterized. In this poster, alternate configurations and parameter choices are included for comparison.

As basal slopes steepen and melt rates increase, dynamic and thermodynamic glaciological responses become important [Walker et al. 2008]. Although the oceanographic caveats highlighted here deserve further investigation, local slope remains the dominant driver of mixed layer temperature and melting gradients, indicating that a simple form of slope-dependent melting may be sufficient to investigate the coupled ice-ocean response [Little et al. 2009].

References:

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