Basal shear stress and choice of sliding relation in Antarctic Ice Sheet simulations

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The choice of basal sliding relation can have a large impact on simulated dynamic behaviour of the Antarctic Ice Sheet. Given that effective pressure at the bed (which depends on sub-glacial hydrology) is a key factor governing sliding behaviour, and that many of the current generation of ice sheet models do not feature hydrology models, we ask whether sliding relations featuring a parameterised representation of effective pressure at the bed are likely to offer advantages over simpler non-pressure-dependent sliding relations.

Using a Stokes flow ice dynamic model we have carried out an inversion from observed surface velocities using the adjoint method to infer basal shear stress under the Antarctic Ice Sheet. We find a gradual reduction of basal shear stress as the grounding line is approached for many major Antarctic ice streams, suggesting that a simple sliding relation in which basal shear stress is a power law function of sliding velocity may not be appropriate. We plot the spatial distribution of a sliding coefficient tuned to match our inverted Antarctic basal shear stress for several different published sliding relations, and discuss the implications of these spatial distributions to the choice of a suitable sliding relation.