

Recent developments in modeling ice sheet deformation

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ICE FLOWS BY DEFORMATION AND SLIP



adapted from Graham et al. (2018)

FLOW RELATIONS DERIVED FROM DEFORMATION EXPERIMENTS



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- 1. ESTAR better matches ice shelf flow (upper right panel)
- Glen simulates >70% basal sliding in slow-flowing interior (bottom panels)
- 3. ESTAR predicts up to three times more vertical shear deformation than Glen in lead-up to grounding line (bottom panels)

Deformation speed fraction = surface speed - basal speed surface speed

THWAITES GLACIER DEFORMATION

Membrane stresses (horizontal shear and compression/extension) play a different role in ESTAR and Glen in balancing the basal shear and gravitational driving stresses



THWAITES GLACIER BASAL SHEAR STRESSES



Key regions of uncertainties:

- 1. Grounding line, where there is an abrupt change in the stress configuration
- 2. Where there are abrupt transitions in the basal shear stresses (e.g. from deformationdominated interior of catchment to sliding-dominated zone)
- 3. Where the membrane stresses vary, but under constant basal shear stress configuration

WHERE WE NEED MORE CONSTRAINTS: GROUNDED ICE



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To better constrain flow relations, we want:

- 1. Strain rates through the ice sheet (to the base), particularly in zones of abrupt stress transitions
- 2. To work with field glaciologists to help improve flow relations for modelling

WHERE WE NEED MORE CONSTRAINTS: GROUNDED ICE





WHERE WE NEED MORE CONSTRAINTS: ICE SHELVES