Existence of channelized subglacial discharge beneath Thwaites Glacier, Antarctica

Objective

It is often assumed that the meltwater drainage system beneath the Antarctic Ice Sheet lacks efficient drainage channels that would decrease basal water pressure and reduce glacier sliding. Is this an accurate assumption, and if not, what effect could subglacial channels have on Antarctic ice dynamics?

Research

- Conducted over 130 subglacial hydrology simulations of Thwaites Glacier spanning wide range of parameter values using DOE ice-sheet model *MALI*
- Evaluated model solutions against ice-penetrating radar observerations that map regions of the bed where water has pooled.
- All runs that resembled observations contained 100-200 km long subglacial channels with discharges of 35-100 $m^3 s^{-1}$; runs without subglacial channels could not reproduce observations and had much lower ice effective pressure (indicator of basal friction).
- Presence of subglacial channels implies greater basal friction and ability to buffer changes in meltwater than previously assumed.

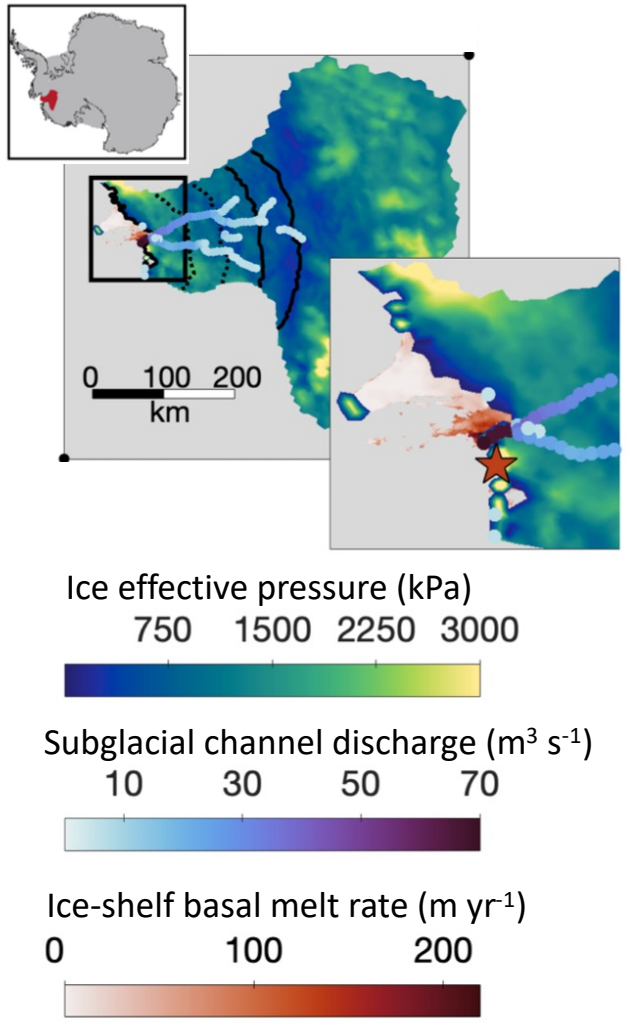

Figure: Modeled subglacial channel network and effective pressure beneath Thwaites Glacier, plotted with observed sub-ice-shelf melt rates (Adusumilli et al., 2020). The inset is an enlarged view of the near-terminus region in the black box.

Impact

The presence of subglacial channels beneath the Antarctic Ice Sheet enhances sub-ice-shelf submarine melting and increases friction at the bed. Ice-sheet model projections of ice loss from Antarctica should be accounting for the existence of subglacial channels and their enhancement of these processes.

Reference: Hager, A., Hoffman, M., Price, S., Schroeder, D. 2022. Persistent, extensive channelized drainage modeled beneath Thwaites Glacier, West Antarctica, The Cryosphere, 16, 3575–3599, doi:10.5194/tc-16-3575-2022