EGU22-10439
https://doi.org/10.5194/egusphere-egu22-10439
EGU General Assembly 2022

A new ice shelf melt model that accounts for freshwater discharge and application to Denman Glacier, East Antarctica

Tyler Pelle[1], Adrian Jenkins[2], Christine Dow[3], and Jamin Greenbaum[1]
[1]UC San Diego, Scripps Institution of Oceanography, La Jolla, United States of America (tpelle@ucsd.edu)
[2]Northumbria University, Geography and Environmental Sciences United Kingdom of Great Britain – England, Scotland, Wales
[3]Department of Geography and Environmental Management, University of Waterloo, Waterloo, Ontario, Canada

Ice shelf basal melting is the primary mechanism by which the Antarctic Ice Sheet loses mass. While ocean forcing is the principal driver of basal melting, recent evidence suggests that localized melt maxima are located along deep grounding lines where large quantities of subglacial water are being discharged into sub-ice shelf cavities. As any change in the configuration of the grounding line can drastically influence the stress regime of the entire upstream grounded glacier, it is crucial we resolve this subglacial discharge-driven melting in a basal melt rate parameterization that can be used in standalone ice sheet models. Here, we extend the application of a 1D ocean and subglacial discharge driven melt parameterization into a 2D ice sheet model and apply it in forward simulations of Denman Glacier, East Antarctica. Using subglacial hydrology model outputs to constrain the discharge inputs, we find that this parameterization resolves both local maxima and the large-scale spatial distribution of melt beneath the ice shelves buttressing Denman, Totten, Thwaites, and Pine Island glaciers. In the forward simulations of Denman Glacier, the melt contribution from subglacial discharge is required to reproduce contemporary patterns of grounding line retreat and rates volume loss. Under realistic 21st century ocean and subglacial forcing scenarios, Denman and Scott glaciers undergo largescale retreat and Denman Glacier retreats upstream to a ~10 km prograde section of bed topography upon which the grounding line stabilizes. However, under enhanced forcing, it is possible that Denman's grounding line can overcome this topographic high and retreat inland into the deepest submarine trench on Earth beyond 2100