EGU22-13501
https://doi.org/10.5194/egusphere-egu22-13501
EGU General Assembly 2022

Investigating basal thaw as a driver of mass loss from the Antarctic ice sheet

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Contemporary mass loss from the Antarctic ice sheet primarily originates from the discharge of marine-terminating glaciers and ice streams. The rate of mass loss is influenced by warming ocean and atmospheric conditions, which lead to subsequent thinning or disintegration of ice shelves and
increased outflow of upstream grounded ice. It is currently unclear how the basal thermal state of grounded ice could evolve in the future - for example as a result of accelerated ice flow or changes in the ice sheet geometry - but a change in the basal thermal state could impact rates of mass loss from Antarctica. Here, we use a combination of numerical simulations and ice-penetrating radar analysis to investigate the influence of basal thawing on 100yr simulations of the Antarctic ice sheet's evolution. Using the Ice-sheet and Sea-level System Model, we find that thawing patches of frozen bed near the ice sheet margin could drive mass loss extending into the continental interior, with the highest rates of loss coming from the George V - Adélie - Wilkes Land coast and the Enderby - Kemp Land regions of East Antarctica. This suggests that the thawing of localized frozen bed patches is sufficient to cause these East Antarctic regions to transition to an unstable mass loss regime. We constrain model estimates of the basal thermal state using ice-penetrating radar surveys and analyze radar characteristics including bed reflectivity and attenuation. In combination, our work identifies critical regions of Antarctica where the ice-bed interface could be close to thawing and where basal thaw could most impact mass loss.