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Constraining ice shelf basalt melting rates from isochrone data

Vjeran Visnjevic[1], Reinhard Drews[1], Clemens Schannwell[2], and Inka Koch[1]
[1]University of Tübingen, Earth System Sciences, Glaziologie und Geophysik, Tübingen, Germany (vjeran.visnjevic@uni-tuebingen.de)
[2]Max Planck Institute for Meteorology, Hamburg, Germany

Ice shelves buttress ice flow from the continent towards the ocean, and their disintegration results in increased ice discharge. Ice-shelf evolution and integrity is influenced by surface accumulation, basal melting, and ice dynamics. We find signals of all of these processes imprinted in the ice-shelf stratigraphy that can be mapped using isochrones imaged with radar.

Our aim is to develop an inverse approach to infer ice shelf basal melt rates using radar isochrones as observational constraints. Here, we investigate the influence of basalt melt rates on the shape of isochrones using combined insights from both forward and inverse modeling. We use the 3D full Stokes model Elmer/Ice in our forward simulations, aiming to reproduce isochrone patterns observed in our data. Moreover we develop an inverse approach based on the shallow shelf approximating, aiming to constrain basal melt rates using isochronal radar data and surface velocities. Insights obtained from our simulations can also guide the collection of new radar data (e.g., profile lines along vs. across-flow) in a way that ambiguities in interpreting the ice-shelf stratigraphy can be minimized. Eventually, combining these approaches will enable us to better constrain the magnitude and history of basal melting, which will give valuable input for ocean circulation and sea level rise projections.