Karthaus projects 2024

The sensitivity of grounding-line retreat to ice-shelf buttressing

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Introduction

Mass loss of the Antarctic ice sheet is essentially localized in marine basins where the ice sheet is in contact with the ocean and where warm ocean water penetrate underneath the floating ice shelves. These two projects gauge the sensitivity of marine ice sheets to changes in ice shelf buttressing and its effect on mass loss and grounding line migration. In order to investigate this sensitivity, we will employ the Kori-ULB ice sheet model. One group will focus on an idealized marine ice sheet geometry, while the other group will apply the model to a marine ice sheet mbasin in Antarctica, likely the Thwaites Glacier basin.

The Kori-ULB ice sheet model

The Kori-ULB ice sheet model is written in Matlab and can be downloaded from `https://github.com/FrankPat/Kori-ULB`. Either download all files and subroutines, make the path available and things hsould run. To test, just type KoriModel in the prompt and the model should run a square ice sheet (with graphical output).

Yoiu can further use one of the scripts from `https://github.com/FrankPat/Karthaus` to do some further testing of simple geometries. The PDF file with the manual can also be downloaded and gives a comprehensive overview on how to use the ice sheet model.

Group I: MISMIP+

We will use a synthetic setup of a marine terminating glacier with a geometry that mimics the geometry of Pine Island Glacier, Antarctica. The geometry has been defined in Gudmundsson et al. (2012) and is used for the MISMIP+ experiments described in Cornford et al. (2020).

- Initialize the model with a steady-state grounding line positioned on the upward sloping bed (see script for details). Use the hybrid model in order to make a comparison with the real-world experiments possible.
- Perform sensitivity experiments by applying subshelf melting.
- Sensitivity of sliding law (regularized Coulomb versus Weertman)
- Sensitivity to serval magnitudes of subshelf melting (using the MISMIP+ melt parameterization

Group II: Thwaites Glacier, Antarctica

Consider Thwaites Glacier basin at the same spatial resolution as the MISMIP+ experiments.

- Initialize the model using the two-step optimization scheme (first step being SIA grounded ice sheet; second step including ice shelves with the hybrid model).
- sensitivity to different rates of subshelf melting – preferably using the MISMIP+ subshelf melting scheme to allow for comparison.

References

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Gudmundsson, G. H., Krug, J., Durand, G., Favier, L., and Gagliardini, O.: The stability of grounding lines on retrograde slopes, The Cryosphere, 6, 1497–1505, https://doi.org/10.5194/tc-6-1497-2012, 2012.