Supplement of The Cryosphere, 18, 1863–1888, 2024
https://doi.org/10.5194/tc-18-1863-2024-supplement
© Author(s) 2024. CC BY 4.0 License.

The Cryosphere Open Access

Supplement of

Geometric amplification and suppression of ice-shelf basal melt in West Antarctica

Jan De Rydt and Kaitlin Naughten

Correspondence to: Jan De Rydt (jan.rydt@northumbria.ac.uk)

The copyright of individual parts of the supplement might differ from the article licence.

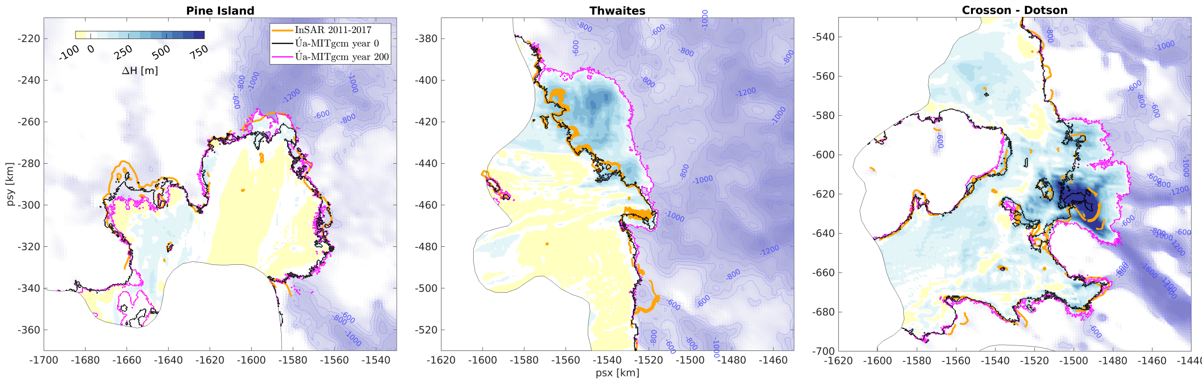

Figure S1. Change in water column thickness between year 0 and 200 of the *av_melt* experiment. The UaMITgcm grounding line for both years are shown in black and magenta, respectively. For comparison, the InSAR grounding lines between 2011 and 2017 from Rignot et al. (2016), Milillo et al. (2019) and Milillo et al. (2022) are shown in orange.

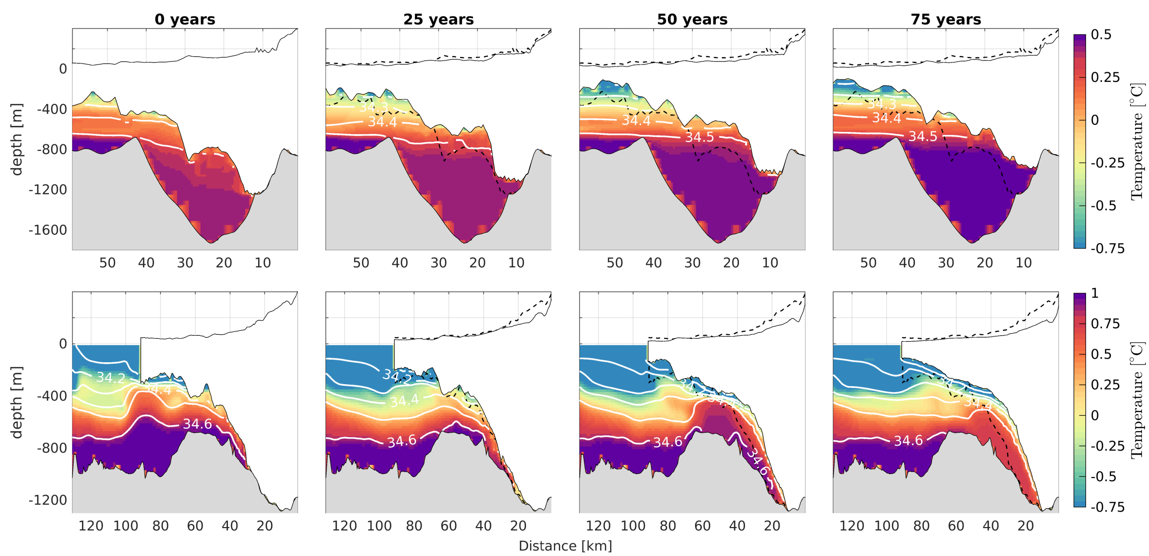

Figure S2. Vertical sections of temperature (colours) and salinity (contours) at times 0, 25, 50 and 75 years of the *hi_melt* experiment. The top row shows a section along the Dotson Ice Shelf, with location indicated by the dashed line in Fig. 4c of the main text. The bottom row shows a section along the Pine Island Ice Shelf, with location indicated by the dashed line in Fig. 4a.

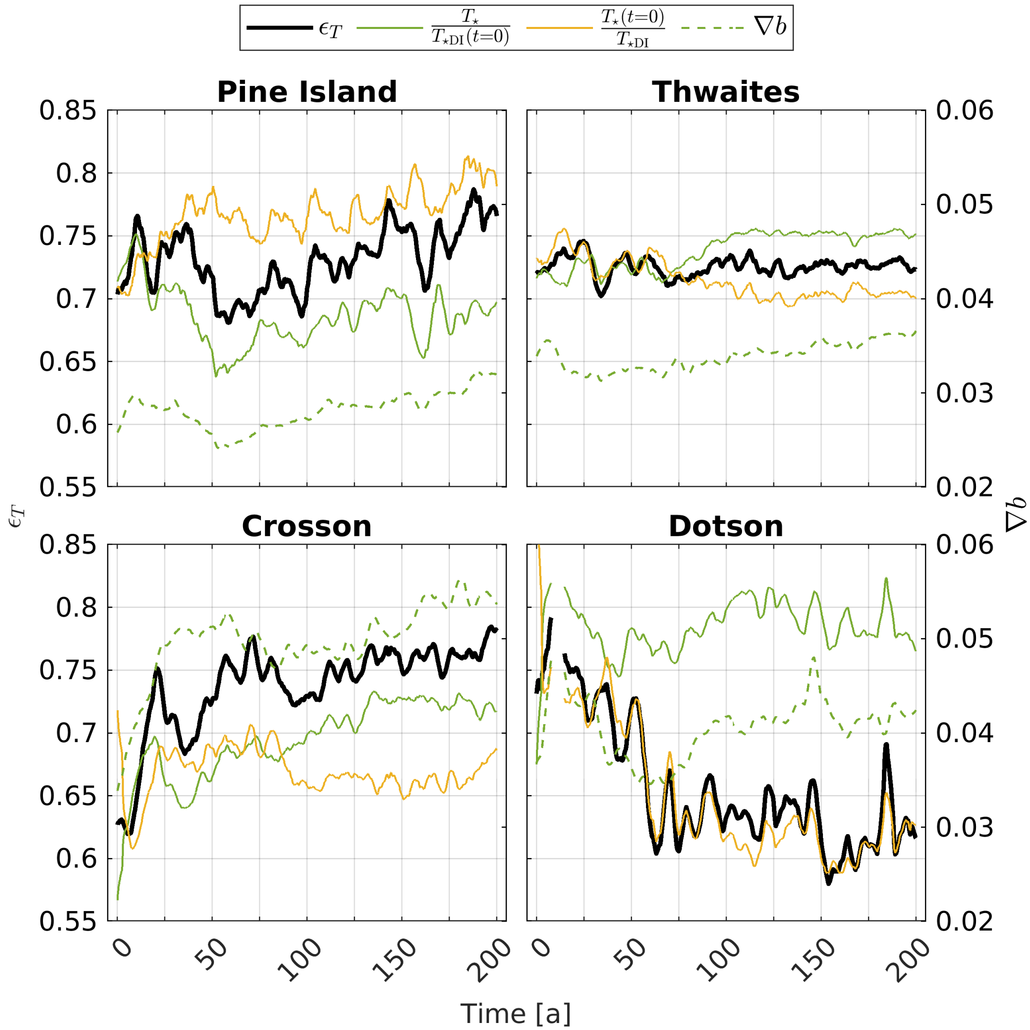

Figure S3. Five-year moving average of ϵ_T (black line), defined in Eq. 5 of the main text as the ratio between the time-varying thermal driving of the oceanic mixed layer ($T_\star$) and the time-varying thermal driving of the inflow into the deep interior cavity ($T_{\star\mathrm{DI}}$). The green and orange lines correspond to time series where $T_{\star\mathrm{DI}}$ and $T_\star$ are replaced by their constant value at t=0, respectively. The dashed green line corresponds to the average basal slope of the ice draft in the deep interior (∇b). All results are for the *hi_melt* experiment; analogous findings apply to the *av_melt* experiment and are not shown.

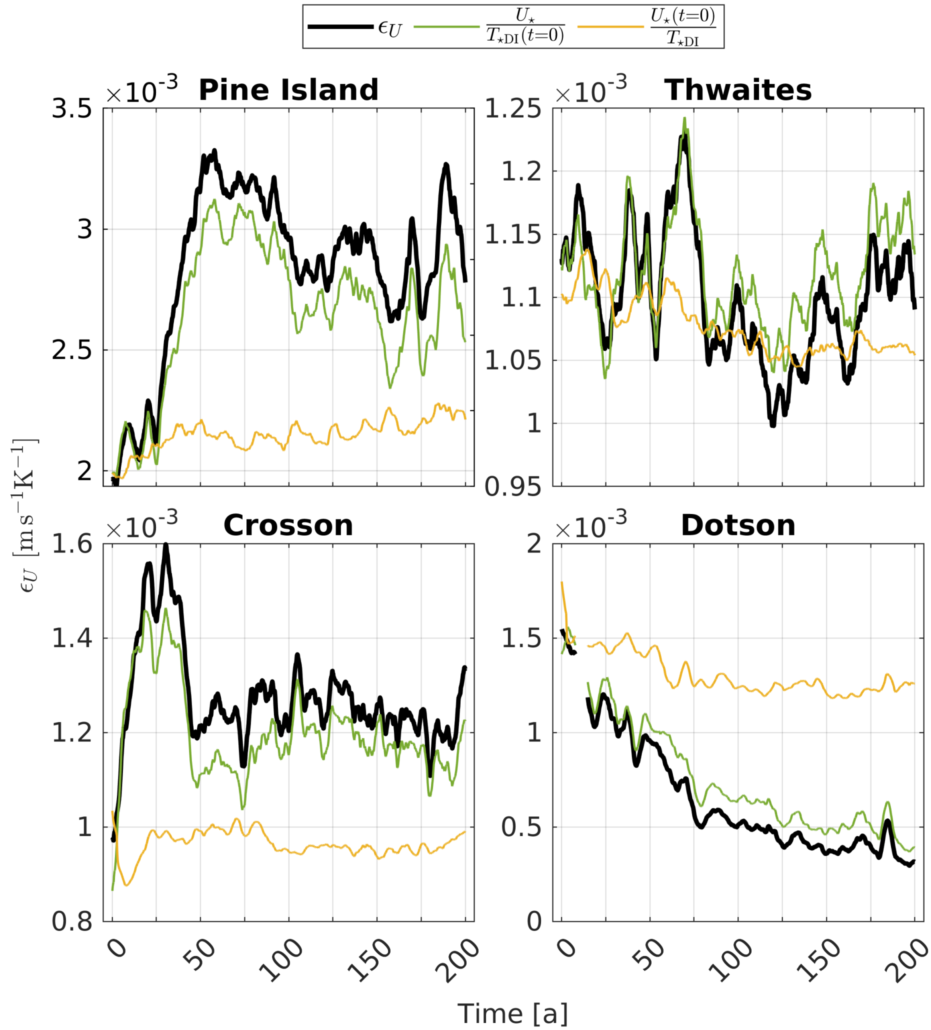

Figure S4. Five-year moving average of ϵ_T (black line), defined in Eq. 6 of the main text as the ratio between the time-varying speed of the oceanic mixed layer ($U_\star$) and the time-varying thermal driving of the inflow into the deep interior cavity ($T_{\star\mathrm{DI}}$). The green and orange lines correspond to time series where $T_{\star\mathrm{DI}}$ and $U_\star$ are replaced by their constant value at t=0, respectively. All results are for the *hi_melt* experiment; analogous findings apply to the *av_melt* experiment and are not shown.

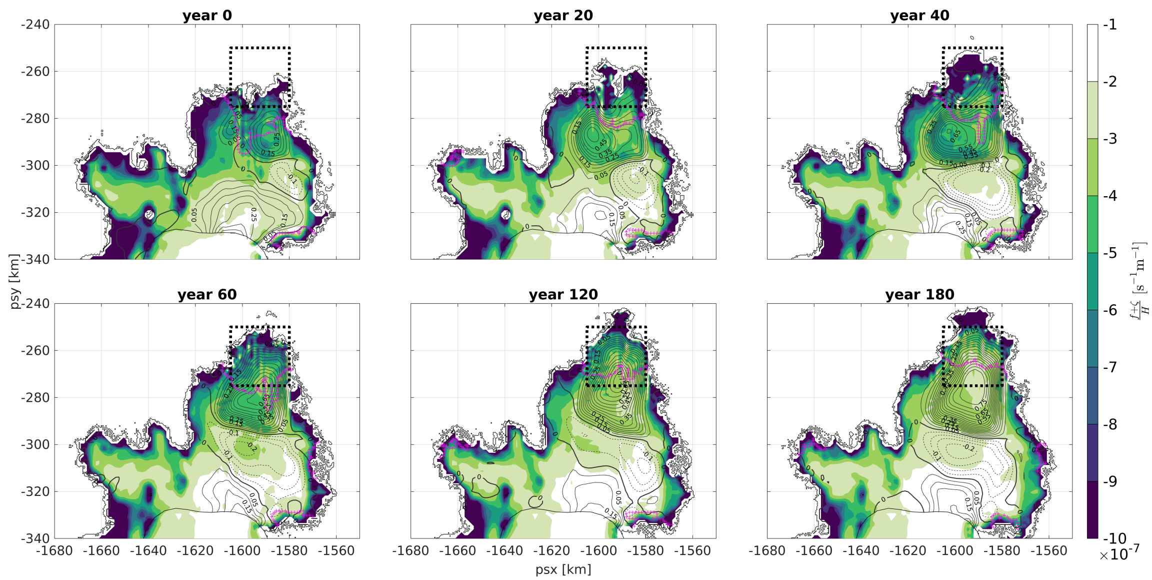

Figure S5. Temporal evolution of the barotropic potential vorticity (colours, see Sect. 4.4 for a definition) and the barotropic streamfunction (contours) for the Pine Island Ice Shelf cavity between 0 and 180 years in the *hi_melt* experiment. Negative, zero and positive streamfunction contours are represented by dashed, thick solid, and thin solid lines, respectively. As discussed in Sect. 4.4, the cyclonic circulation in the deep interior increases from 0.25 Sv to 0.8 Sv, as the gyre expands into an area highlighted by the square with dashed lines. The deep interior is defined as the area of the cavity with ice draft below -400 m; the -400 m ice draft contour is indicated by the magenta line.

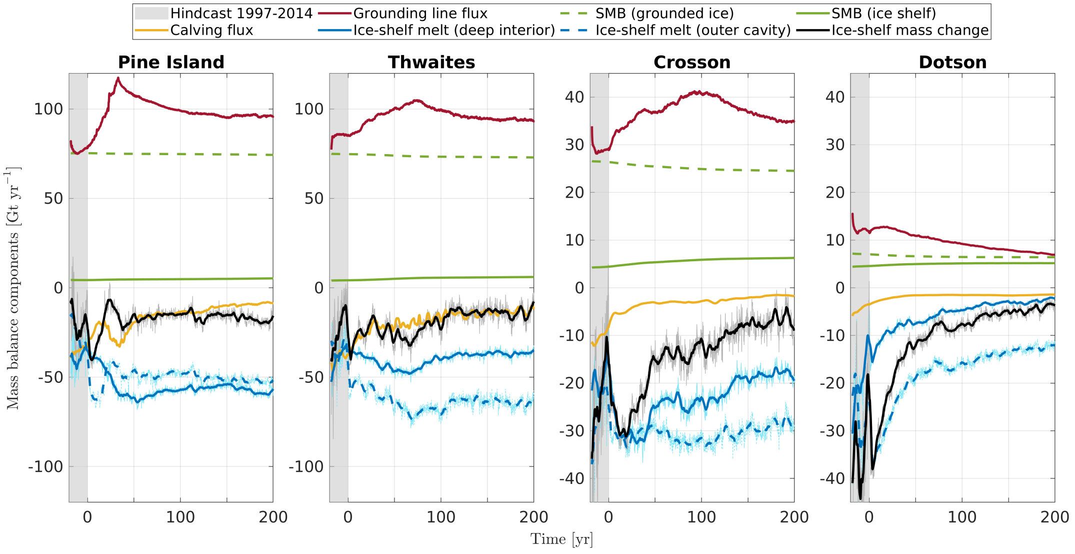

Figure S6. Temporal evolution of integrated mass balance components in the hindcast experiment (grey shaded area, see Appendix A for details) and the *hi_melt* experiment (0 to 200 years, see Sect. 2.2 for details). Ice-shelf mass changes (black curve) are equal to the sum of the grounding line flux (red curve), surface mass balance (SMB, solid green curve), calving flux (orange line), ice-shelf melt in the deep interior (solid blue line), and ice-shelf melt in the outer cavity (dashed blue line). For reference the SMB of the grounded ice is represented by the dashed green line.

References

Milillo, P., Rignot, E., Rizzoli, P., Scheuchl, B., Mouginot, J., Bueso-Bello, J., and Prats-Iraola, P.: Heterogeneous retreat and ice melt of thwaites glacier, West Antarctica, Science Advances, 5, 1–9, https://doi.org/10.1126/sciadv.aau3433, 2019.

Milillo, P., Rignot, E., Rizzoli, P., Scheuchl, B., Mouginot, J., Bueso-Bello, J. L., Prats-Iraola, P., and Dini, L.: Rapid glacier retreat rates observed in West Antarctica, Nature Geoscience, 15, 48–53, https://doi.org/10.1038/s41561-021-00877-z, 2022.

Rignot, E., Mouginot, J., and Scheuchl, B.: MEaSUREs Antarctic Grounding Line from Differential Satellite Radar Interferometry, Version 2, 2016.