*Supplement of*

# Simulating ice thickness and velocity evolution of Upernavik Isstrøm 1849-2012 by forcing prescribed terminus positions in ISSM

**Konstanze Haubner et al.**

*Correspondence to: Konstanze Haubner (khu@geus.dk)*

## Model initialisation

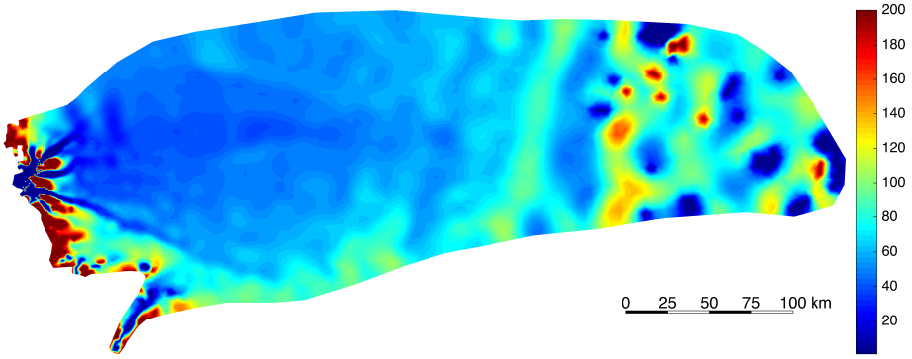


**Figure 1.** Inverted basal friction coefficient C in $(\mathrm{Pa\,yr\,/m})^{\frac{1}{2}}$

**Simulation comparison: 1849 to 2012**

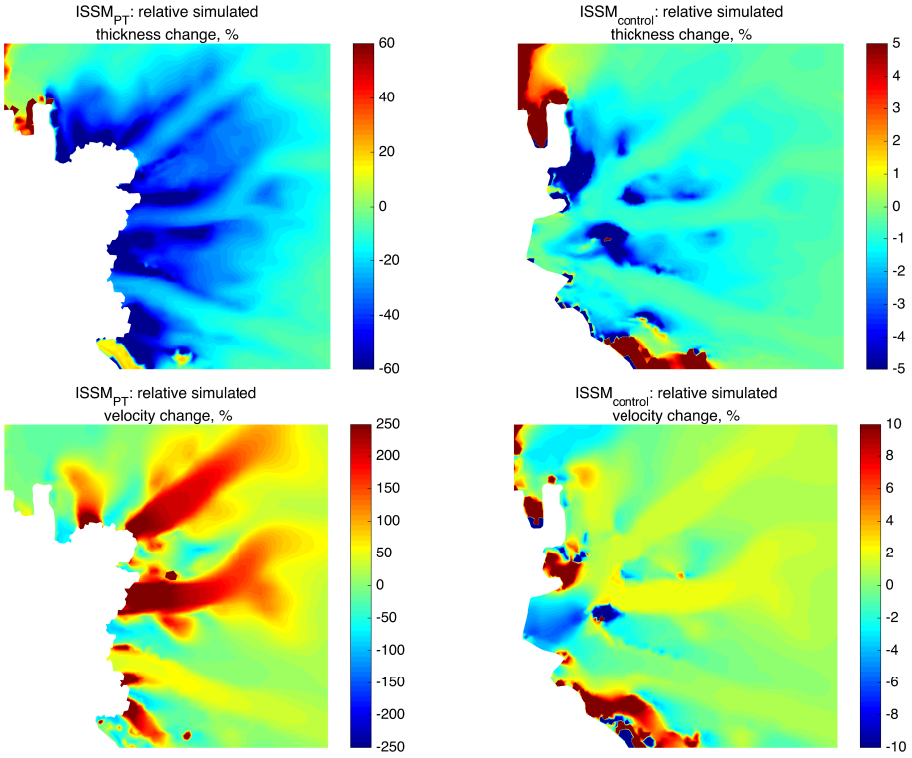


**Figure 2.** Simulated ice thickness and velocity changes 1849–2012.

**Ice thickness comparison: simulation - observations**

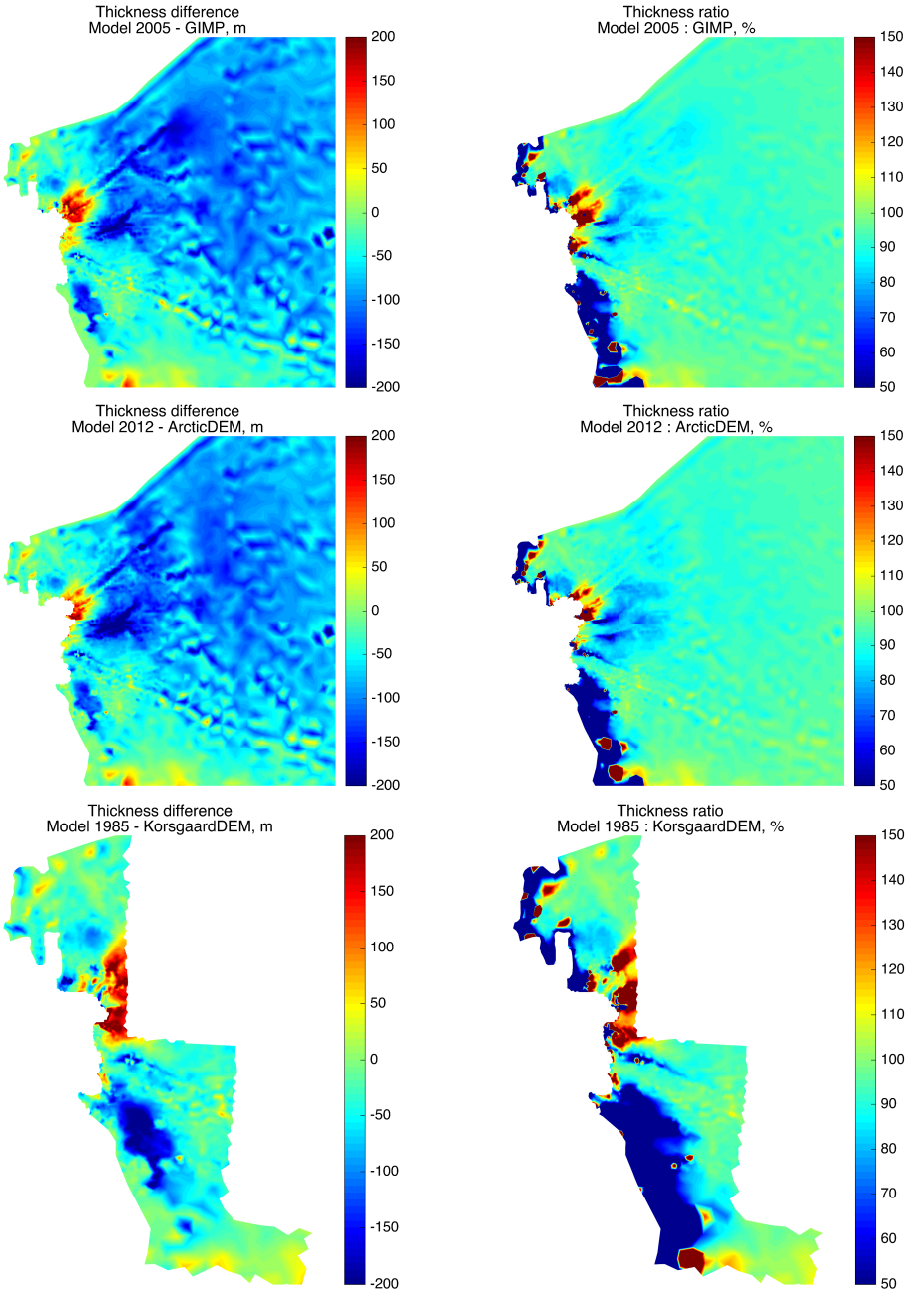


**Figure 3.** Comparison of simulated and observed ice thickness in 1985 (Korsgaard DEM), 2005 (GIMP) and 2012 (ArcticDEM).

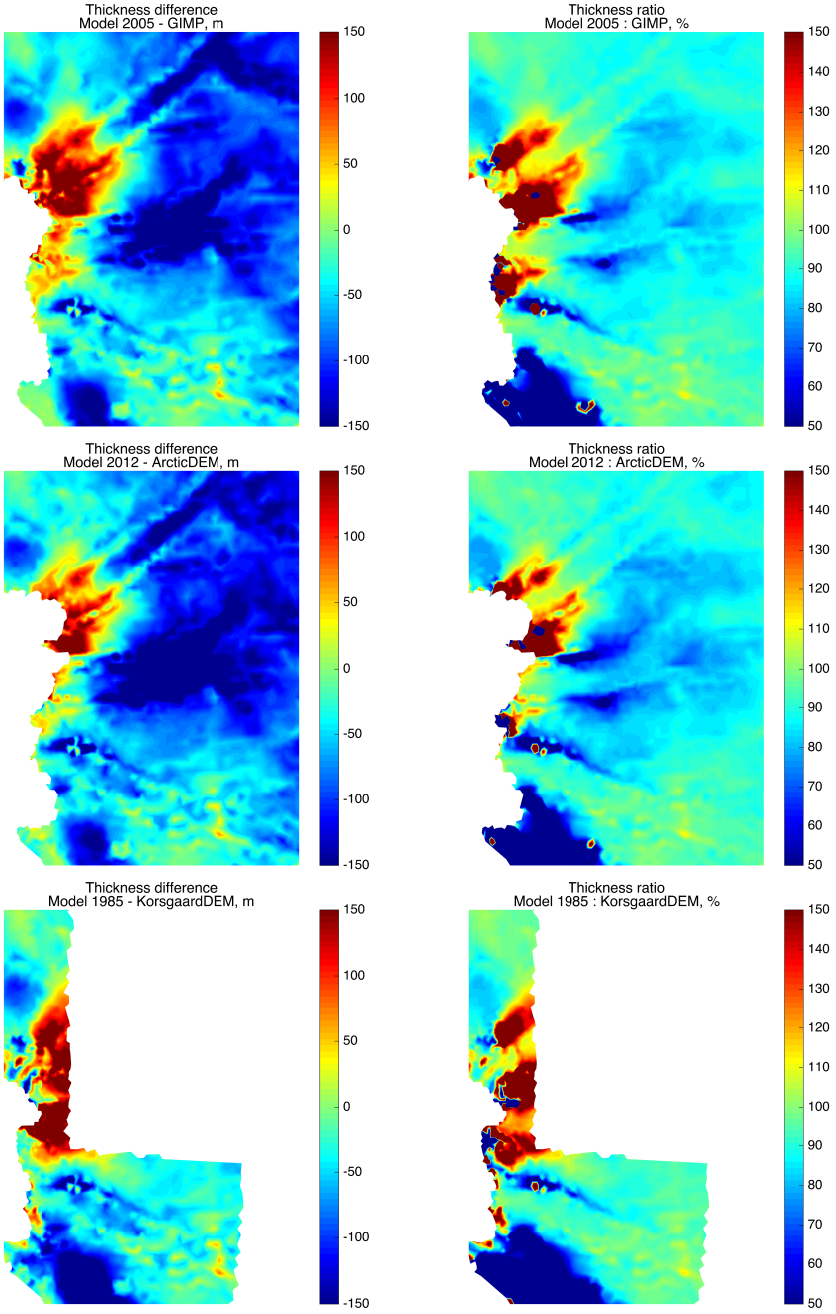


**Figure 4.** Detailed view of the near-terminus region on results shown in Fig. 3: Comparison of simulated and observed ice thickness in 1985 (Korsgaard DEM), 2005 (GIMP) and 2012 (ArcticDEM).

**Surface velocity comparison: simulation - observations**

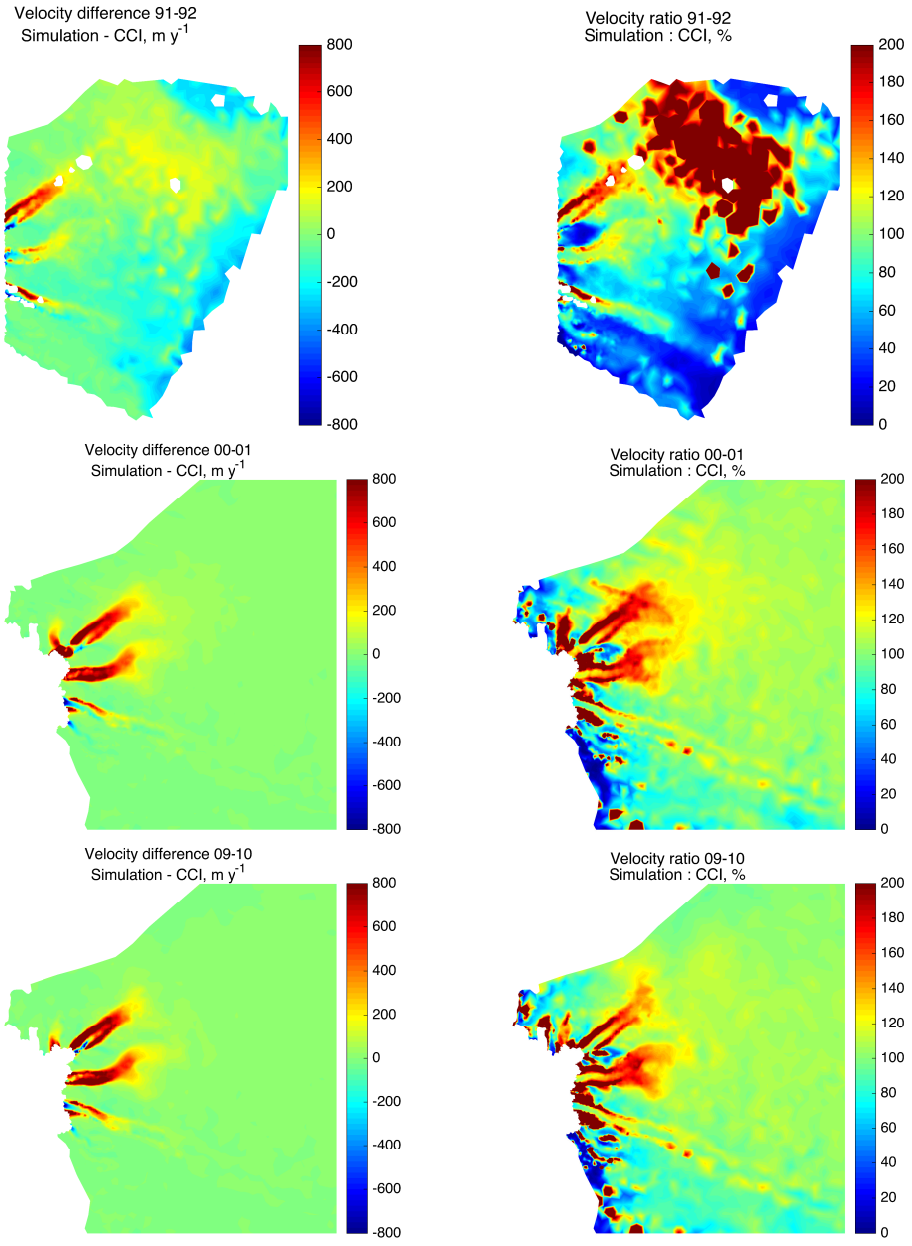


**Figure 5.** Comparison of simulated and observed ice surface velocity in 1991/1992 (CCI, Envisat), 2000/2001 (MEaSUREs) and 2009/2010 (MEaSUREs), representing begin, middle and end of observation time.

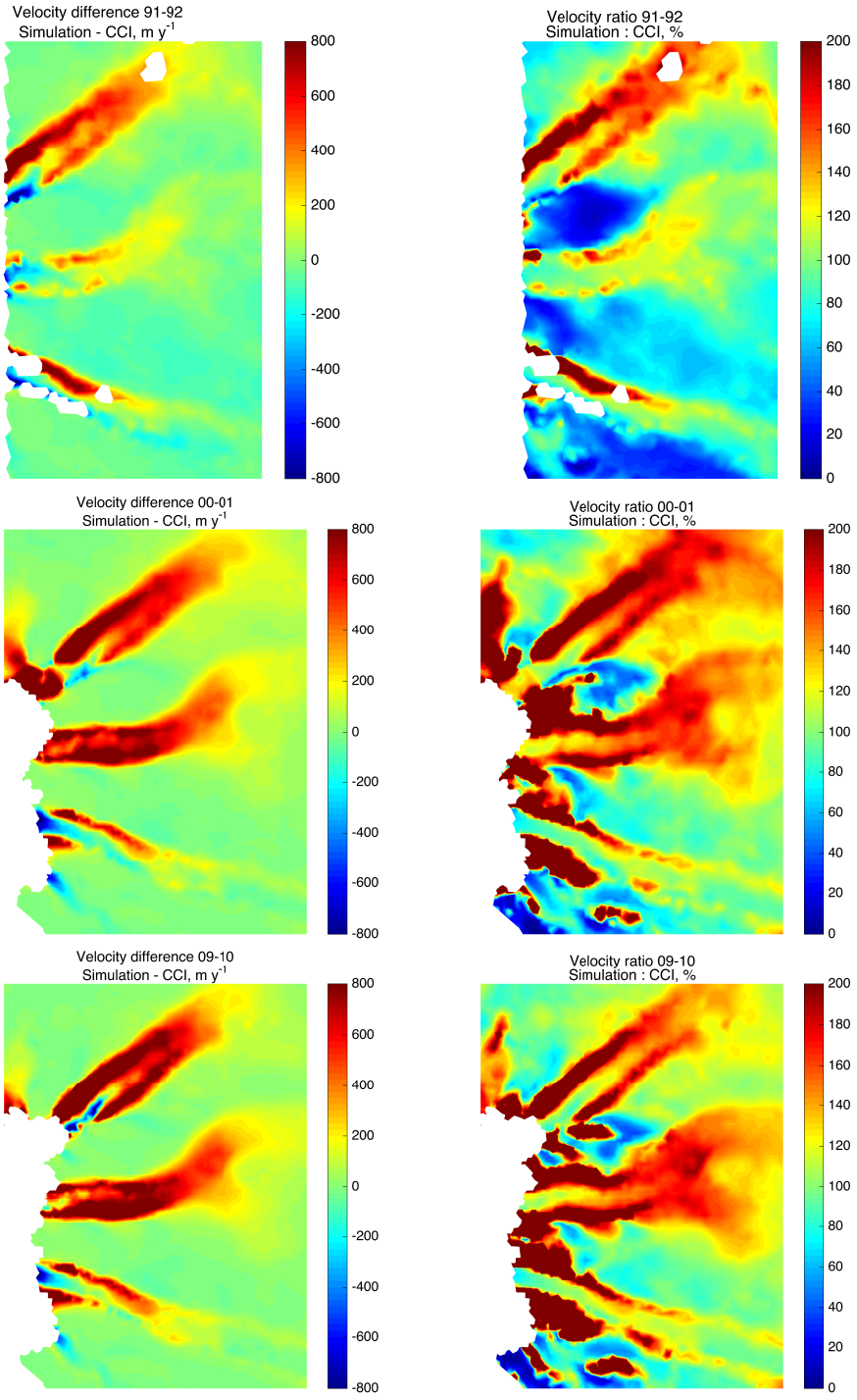


**Figure 6.** Detailed view of the near-terminus region on results shown in Fig. 5: Comparison of simulated and observed ice surface velocity in 1991/1992 (CCI, Envisat), 2000/2001 (MEaSUREs) and 2009/2010 (MEaSUREs), representing begin, middle and end of observation time.

**Mass change comparison - GRACE**

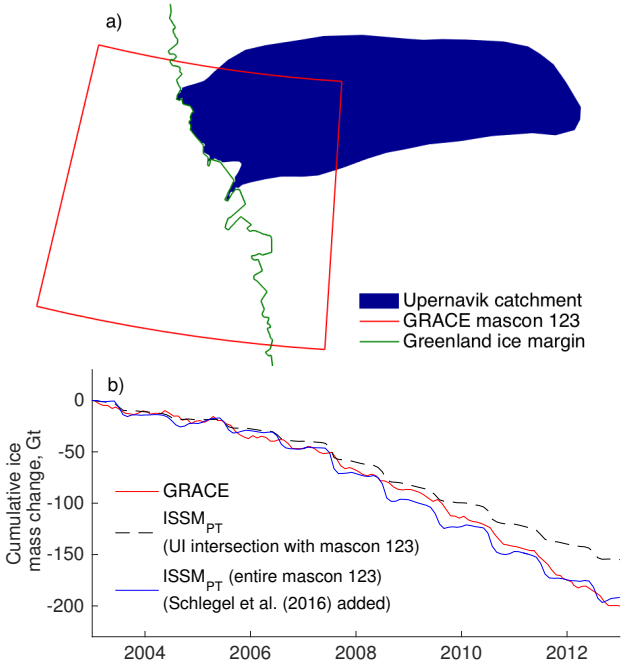


**Figure 7.** (a) GRACE area overview. UI catchment and model domain (blue polygon), present Greenland ice margin (green line) and the GRACE mascon (red line). (b) Mass change comparison between 2003 and 2012. GRACE (red), simulated mass loss of the intersection area of mascon 123 and model domain (dashed line) and a simulated mass loss (sum of $ISSM_{PT}$ simulated mass loss in mascon 123 and the ISSM SSA model output of Schlegel et al. (2016) to cover the entire domain) (blue line).

### Ice surface elevation evolving from 1849–2012

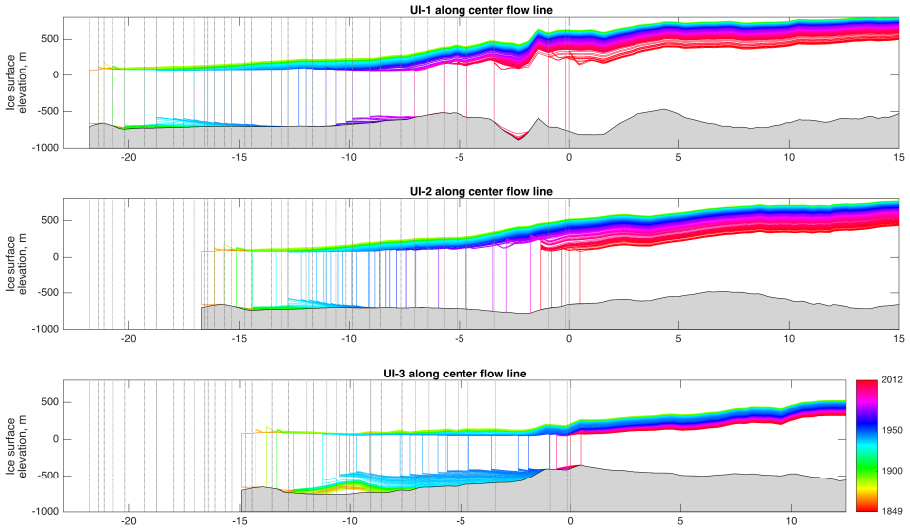


**Figure 8.** Glacier surface elevation along the centre flow lines og UI-1, UI-2 and UI-3 shown at 5 y intervals over the 163 y simulation period. The grey areas show the bed geometry. Prescribed termini changes are marked with dashed (observations) and dotted (interpolation) lines.

### Ice surface elevation and velocity changes during model relaxation

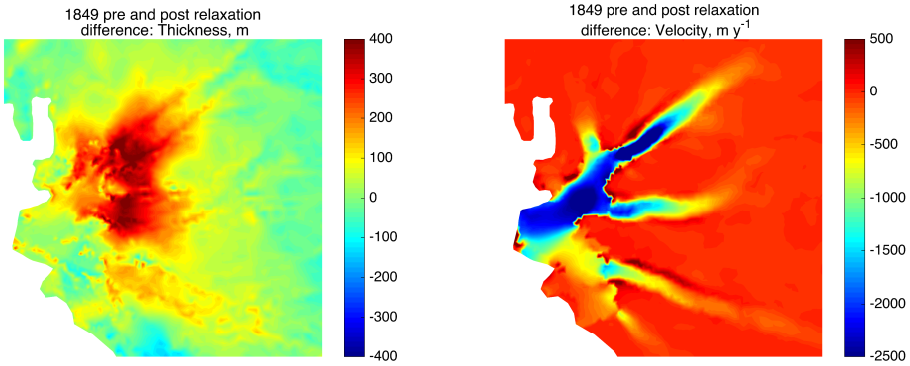


**Figure 9.** Changes in surface elevation and velocity during model relaxation.

**Sensitivity of simulation results to introduced intermediary prescribed terminus front positions**

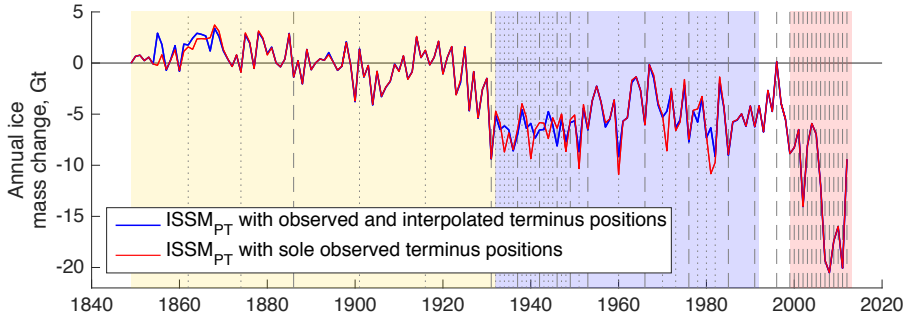


**Figure 10.** Annual ice mass changes from ISSM$_{PT}$ (blue) and a test simulation (red) that is sole prescribed with observed front positions to estimate sensitivity of the prescribed-terminus change method to intermediate prescribed frontal changes. Prescribed termini changes are marked with dashed (observations) and dotted (interpolations) lines.

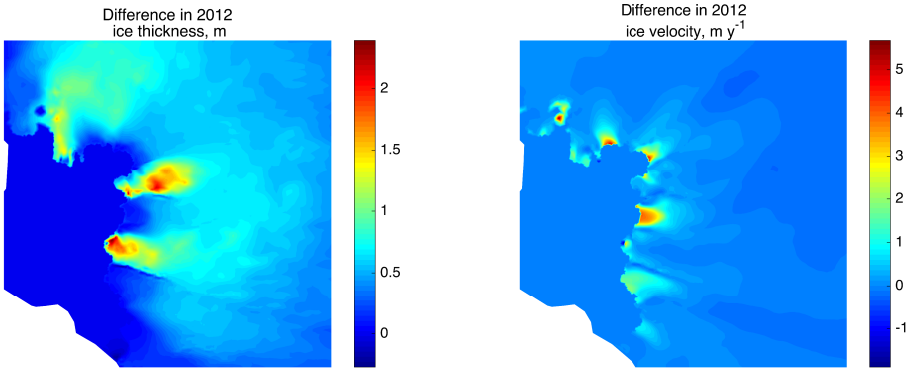


**Figure 11.** Spatial difference between ISSM$_{PT}$ and a test simulation (red) that is sole prescribed with observed front positions.

## References

Schlegel, N.-J., Wiese, D. N., Larour, E. Y., Watkins, M. M., Box, J. E., Fettweis, X., and van den Broeke, M. R.: Application of GRACE to the assessment of model-based estimates of monthly Greenland Ice Sheet mass balance (2003-2012), The Cryosphere, 10, 1965–1989, doi:10.5194/tc-10-1965-2016, 2016.