

Supporting Information for "Greenland Ice Sheet Contribution to 21st Century Sea Level Rise as Simulated by the Coupled CESM2.1-CISM2.1"

Laura Muntjewerf¹, Michele Petrini¹, Miren Vizcaino¹, Carolina Ernani da

Silva¹, Raymond Sellevold¹, Meike D. W. Scherrenberg¹, Katherine

Thayer-Calder², Sarah L. Bradley³, Jan T. M. Lenaerts⁴, William H.

Lipscomb², Marcus Lofverstrom⁵,

¹Department of Geoscience and Remote Sensing, Delft University of Technology, Delft, The Netherlands

²Climate and Global Dynamics Laboratory, National Center for Atmospheric Research, Boulder, CO, USA

³Department of Geography, The University of Sheffield, Sheffield, UK

⁴Department of Atmospheric and Oceanic Sciences, University of Colorado Boulder, Boulder, CO, USA

⁵Department of Geosciences, University of Arizona, Tucson, AZ, USA

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References

- Enderlin, E. M., Howat, I. M., Jeong, S., Noh, M.-J., van Angelen, J. H., & van den Broeke, M. R. (2014). An improved mass budget for the greenland ice sheet. *Geophysical Research Letters*, *41*(3), 866-872. Retrieved from <https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1002/2013GL059010> doi: 10.1002/2013GL059010
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Table S1. Carbon dioxide forcing, global mean temperature change w.r.t. pre-industrial, GrIS contribution to sea level rise and partition into components, and GrIS area for contemporary, mid-century and end-of-the-century periods. Mass Balance = Surface Mass Balance – Ice Discharge + Basal Melt. Cumulative sea level rise corresponds to the periods 1850-2100 for pre-industrial, 1850-2014 for “Contemporary”, 1850-2050 for “Mid-century”, and 1850-2100 for “End of century”. The mean [standard deviations] are given for all other variables. Mass Balance and Sea Level Rise rate relate by $360 \text{ Gt yr}^{-1} = 1 \text{ mm yr}^{-1}$. *For comparison, the right-most column provides values from the idealised coupled CESM2-CISM2 simulation analysed in Muntjewerf et al. (submitted) at a CO_2 level comparable to end-of-century SSP5-8.5 (comparison of CO_2 forcing evolution in Figure S4).

	Contemporary (1995-2014)	Mid-century (2031-2050)	End of century (2081-2100)	Idealised 1% (131-150)*
Atmospheric CO_2 (ppmv)	361 (1995) 397 (2014)	458 (2031) 566 (2050)	884 (2081) 1142 (2100)	1139 (from 140)
Global mean T2m change w.r.t. pre-industrial (K)	0.8	2.2	5.4	5.2
Cumulative Sea Level Rise (mm)	5 (2014)	23 (2050)	109 (2100)	107 (150)
Sea Level Rise rate (mm yr^{-1})	0.08	0.55	2.68	2.16
Mass Balance (Gt yr^{-1})	27 [81]	-196 [71]	-964 [258]	-764
SMB (Gt yr^{-1})	564 [82]	350 [75]	-565 [278]	-367
Ice discharge (Gt yr^{-1})	568 [4]	523 [10]	379 [24]	378
Basal melt (Gt yr^{-1})	-24 [0]	-23 [0]	-20 [0]	-19
GrIS area ($10\text{e}12 \text{ m}^2$)	1.965 (2014)	1.958 (2050)	1.909 (2100)	1.907 (150)

Table S2. Comparison of mean [standard deviations] of surface mass balance (Gt yr^{-1} , upper value in the cell) and NAMOC index (Sv, lower value in the cell) for CESM2-CISM2 (first row, results of this study) and CESM-only ensemble simulations for historical and several SSP scenarios.

	Ensemble size	Historical (1850-2014)	Contemporary (1995-2014)	Mid-century (2031-2050)	End of century (2080-2099)
CESM2-CISM2 (this study)	1	588 [90] 24.0 [1.0]	571 [80] 23.8 [0.7]	359 [84] 18.2 [1.4]	-511 [283] 8.6 [1.5]
Historical ens. mean	11	455 [39] 23.8 [0.9]	390 [28] 23.8 [0.9]		
SSP1-2.6 ens. mean	2			252 [65] 18.1 [1.5]	88 [97] 11.6 [0.6]
SSP2-4.5 ens. mean	3			267 [58] 17.9 [1.4]	21 [80] 10.4 [0.8]
SSP3-7.0 ens. mean	2			227 [76] 19.1 [1.1]	-269 [106] 12.0 [1.1]
SSP5-8.5 ens. mean	2			192 [90] 18.8 [1.5]	-906 [307] 8.6 [1.3]

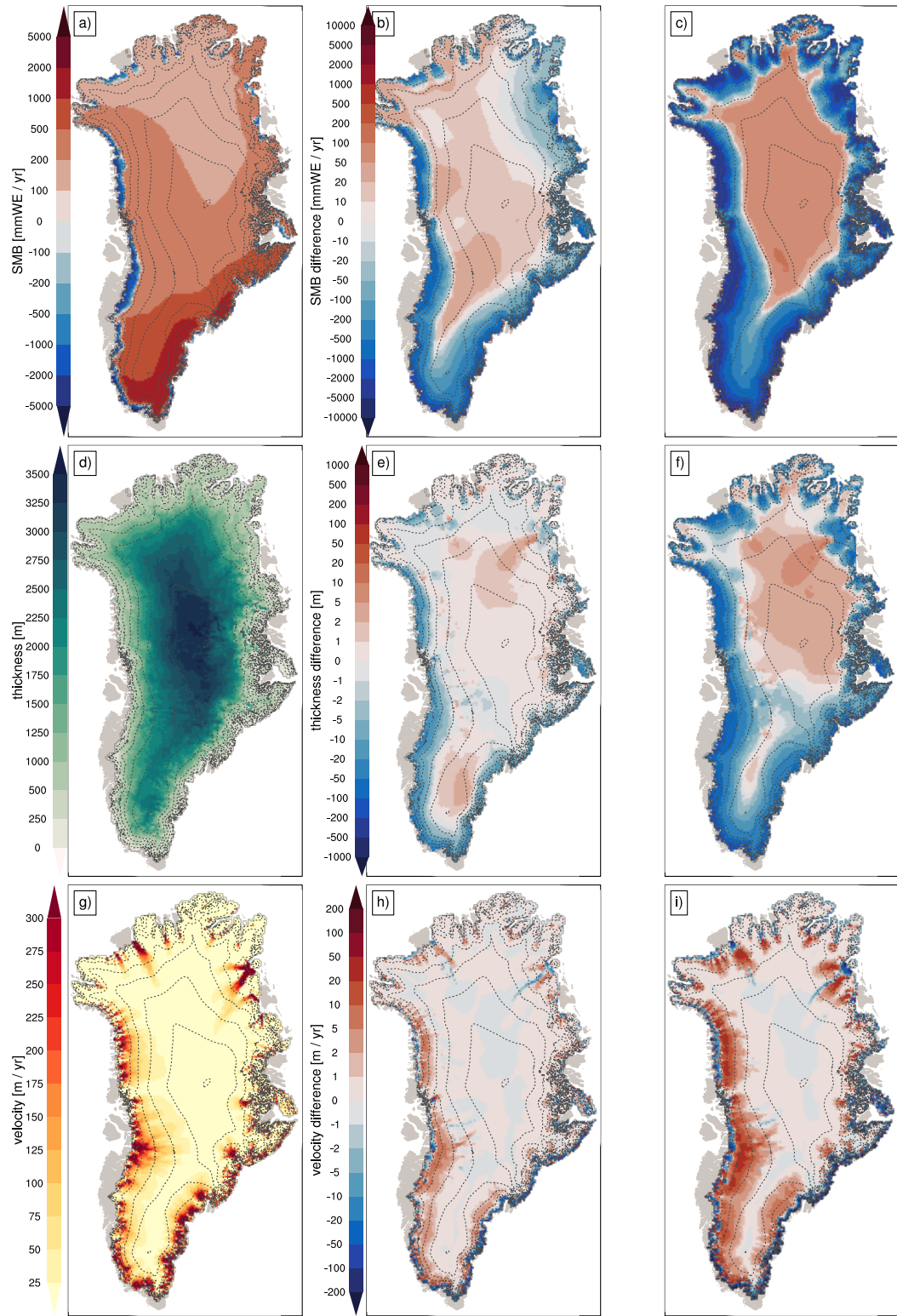


Figure S1. Change in SMB ($\text{kg m}^{-2} \text{yr}^{-1}$), surface velocities (m yr^{-1}), and thickness (m) by mid-century (middle) and end-of-century (right) with respect to the contemporary period (1995-2014, left, absolute values).

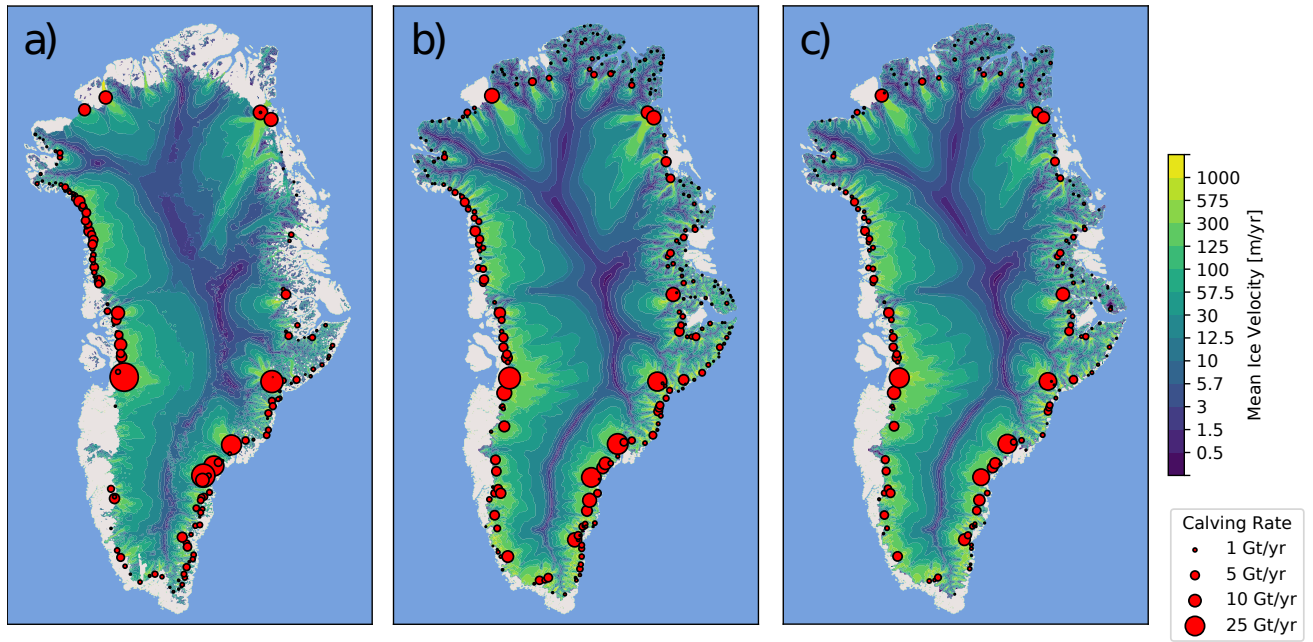


Figure S2. Maps of ice discharge a) observations (2000-2012, from (Enderlin et al., 2014) Enderlin et al. (2014), b) model historical period (2000-2012), and c) model end of SSP8.5 (2081-2100).

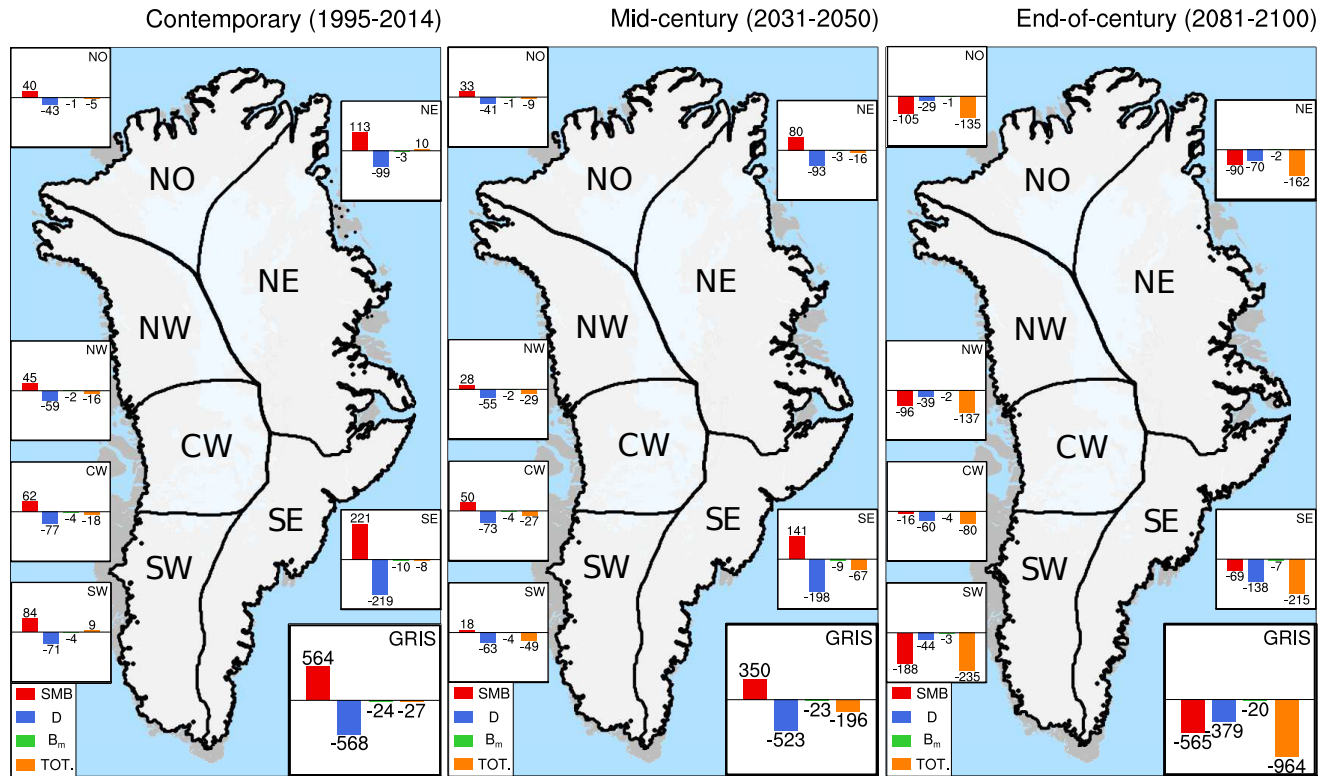


Figure S3. Mass budget (TOT) and components for the Greenland Ice Sheet (GRIS) and individual basins (NO, NE, SE, SW, CW, NW, NO) in the last 30 years of the historical simulation (contemporary period, 1995-2014). Right panel: same as in the left panel, with values expressed as anomalies to the PI-control simulation. TOT (Orange)=SMB (Red) + D(Discharge) + Bm (Basal Melt). Note that discharge is defined as negative.

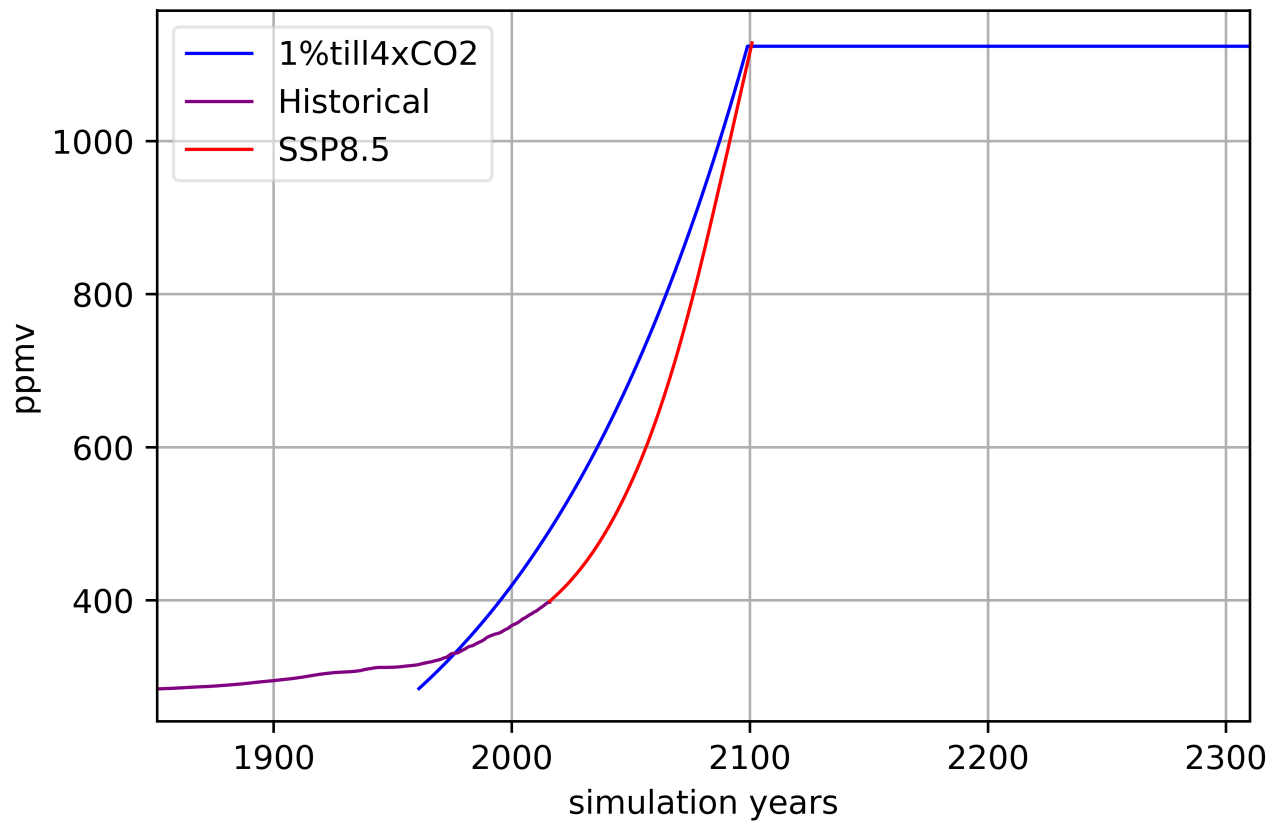


Figure S4. Atmospheric CO₂ concentration in the historical, the SSP5-8.5, and the 350-year idealised simulation with 1% increase per year from pre-industrial values until quadrupling as evaluated by Muntjewerf et al. (submitted), aligned on the x-axis to match the maximum CO₂ concentration in the SSP5-8.5 scenario.