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Geoscientific Model Development
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Supplement of

FAMOUS version xotzt (FAMOUS-ice): a general circulation model (GCM) capable of energy- and water-conserving coupling to an ice sheet model

Robin S. Smith et al.

Correspondence to: Robin S. Smith (robin.smith@ncas.ac.uk)

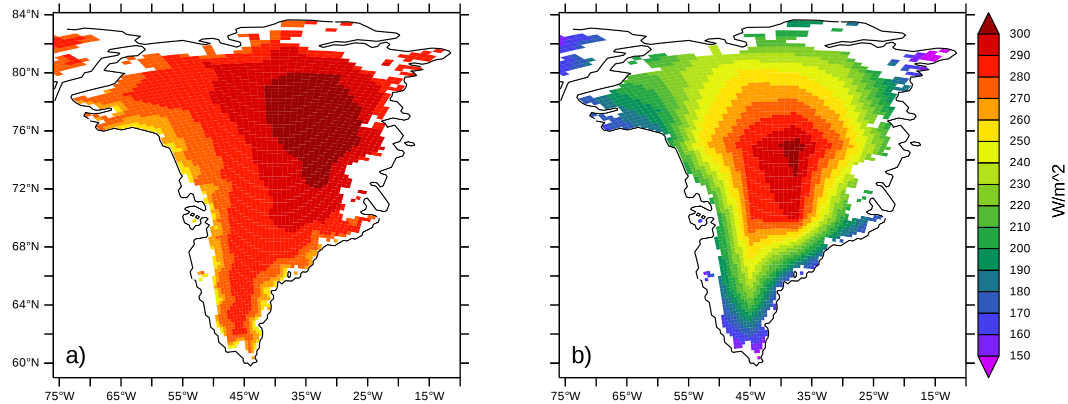

Figure S1. June-July-August average downwelling shortwave radiation at the surface ($\mathrm{W/m^2}$) for the surface of Greenland in a) MAR (1980-1999, minimum=242; maximum=306) (Fettweis et al., 2013) and b) FAMOUS-ice (minimum=102; maximum=307). To visualise the distribution on sub-gridscale tiles, FAMOUS-ice results have been trilinearly mapped to the same topography as used in MAR.

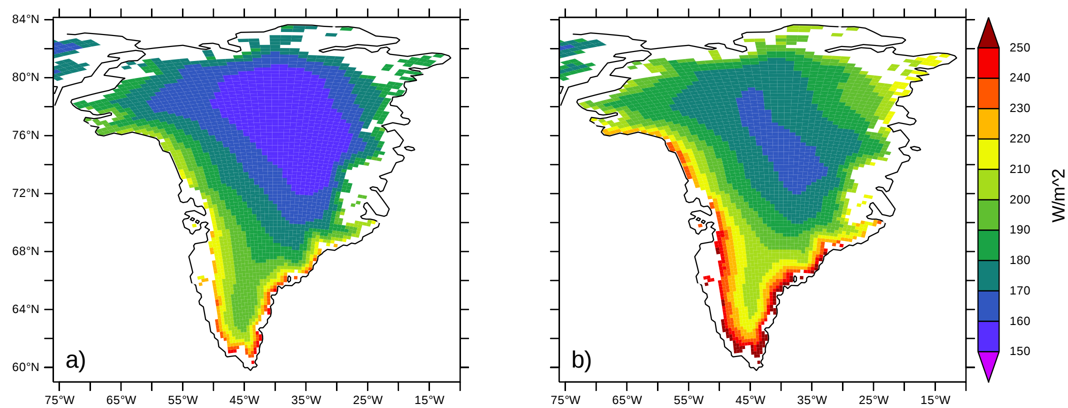

Figure S2. Annual average downwelling surface longwave radiation ($\mathrm{W/m^2}$) for the surface of Greenland in a) MAR (1980-1999, minimum=152; maximum=248) (Fettweis et al., 2013) and b) FAMOUS-ice (minimum=155; maximum=285). To visualise the distribution on sub-gridscale tiles, FAMOUS-ice results have been trilinearly mapped to the same topography as used in MAR.

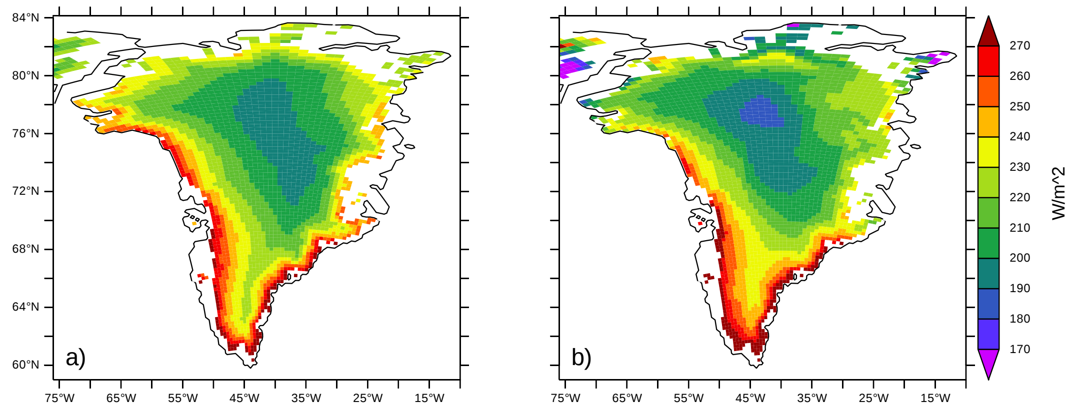

Figure S3. Annual average upwelling surface longwave radiation $(\mathrm{W/m^2})$ for the surface of Greenland in a) MAR (1980-1999, minimum=196; maximum=289) (Fettweis et al., 2013) and b) FAMOUS-ice (minimum=184; maximum=302, on the body of the ice sheet). To visualise the distribution on sub-gridscale tiles, FAMOUS-ice results have been trilinearly mapped to the same topography as used in MAR.

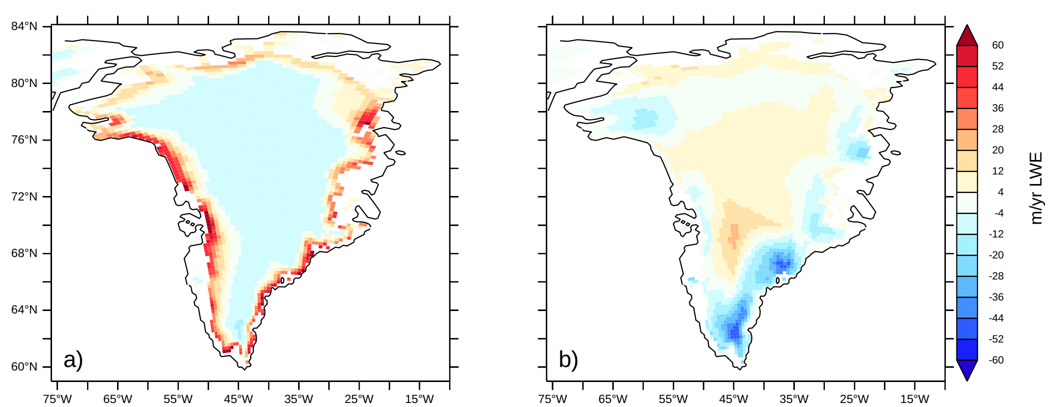

Figure S4. Annual average sublimation (mm/yr LWE) for the surface of Greenland in a) MAR (1980-1999, minimum=-13.11; maximum=76.41) (Fettweis et al., 2013) and b) FAMOUS-ice (minimum=-115.4; maximum=44.9). To visualise the distribution on sub-gridscale tiles, FAMOUS-ice results have been trilinearly mapped to the same topography as used in MAR.

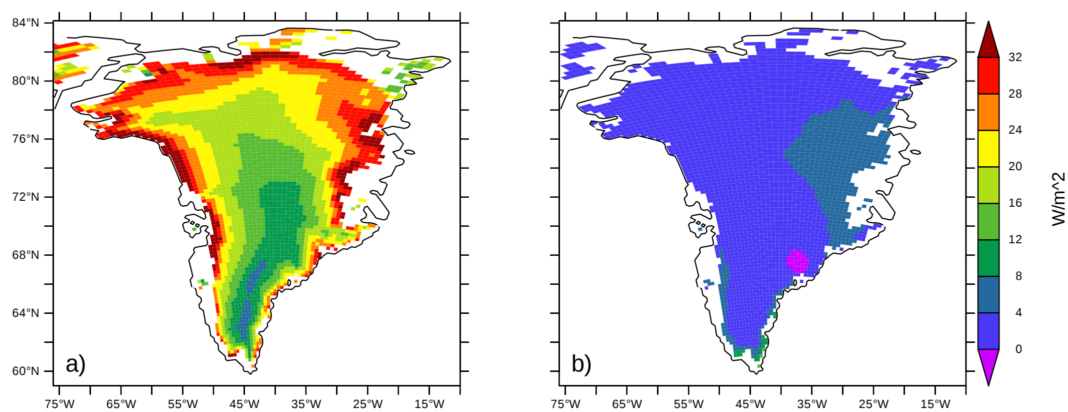

Figure S5. Annual average sensible heat flux ($\mathrm{W/m^2}$) for the surface of Greenland in a) MAR (1980-1999, minimum=5.12; maximum=41.83) (Fettweis et al., 2013) and b) FAMOUS-ice (minimum=-5.5; maximum=15.7). To visualise the distribution on sub-gridscale tiles, FAMOUS-ice results have been trilinearly mapped to the same topography as used in MAR.

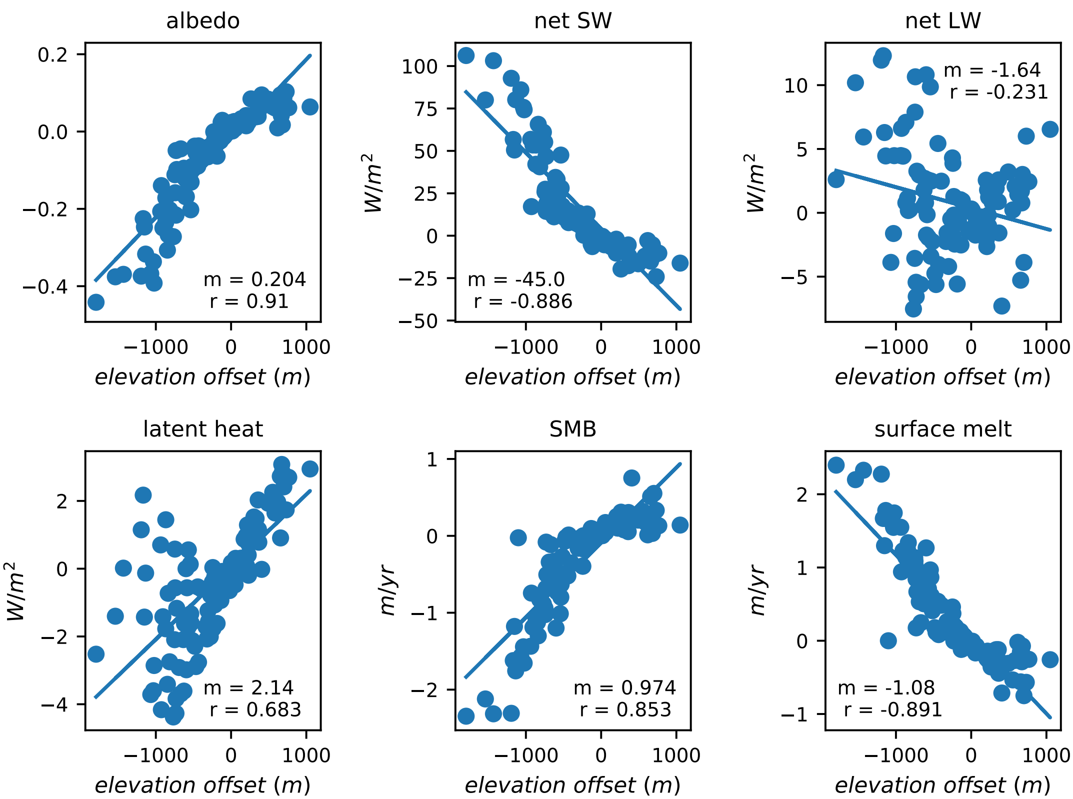

Figure S6. This figure shows how quantities relevant to surface mass balance modelled on the elevation tiles depend on their height difference from the grid-box mean altitude. A linear relationship is inferred by regression, whose slope (m, units/km) and correlation coefficient (r) are given on each panel. All panels show JJA-average relationships, except for SMB and surface melt which are annual average. These can be compared with figures 1 and 3 of (Sellevold et al., 2019), which show equivalent data for the elevation classes in CESM1 and higher resolution representations in RACMO.

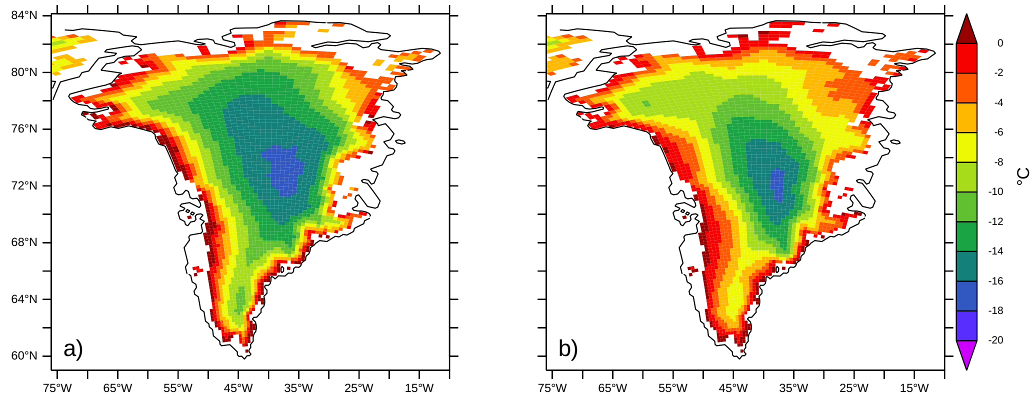

Figure S7. June-July-August average air temperature (°C) for the surface of Greenland in a) MAR (3m temperature, 1980-1999, minimum=-16.55; maximum=3.578) (Fettweis et al., 2013) and b) FAMOUS-ice (1.5m temperature, minimum=-16.54; maximum=1.913). To visualise the distribution on sub-gridscale tiles, FAMOUS-ice results have been trilinearly mapped to the same topography as used in MAR.

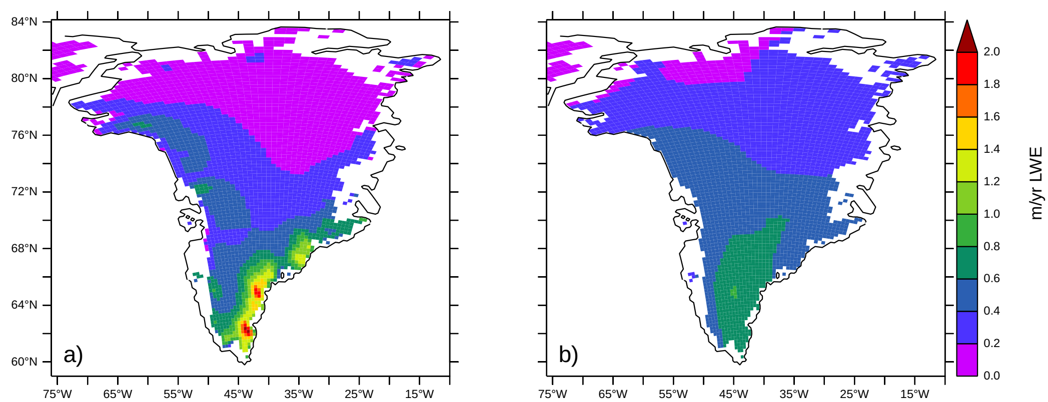

Figure S8. Annual average snowfall (m/yr LWE) for the surface of Greenland in a) MAR (1980-1999, minimum=0.08; maximum=2.12) (Fettweis et al., 2013) and b) FAMOUS-ice (minimum=0.0; maximum=0.83). To visualise the distribution on sub-gridscale tiles, FAMOUS-ice results have been trilinearly mapped to the same topography as used in MAR.

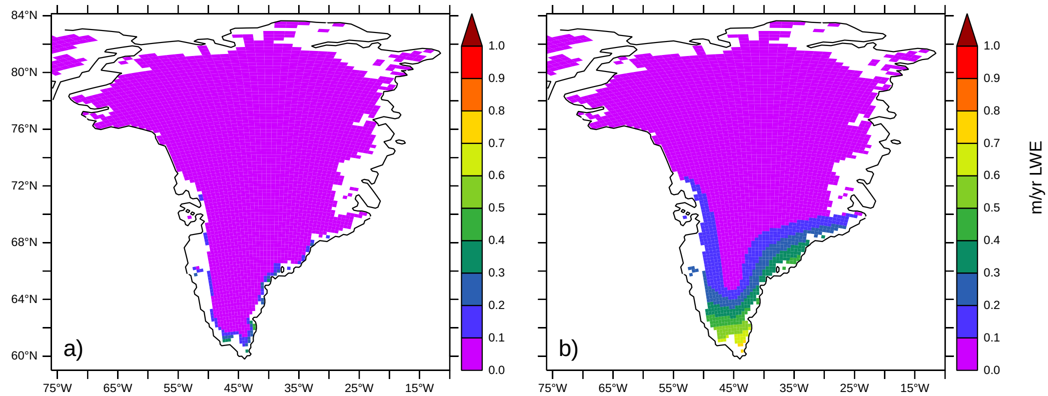

Figure S9. Annual average rainfall (m/yr LWE) for the surface of Greenland in a) MAR (1980-1999, minimum=0.0; maximum=0.45) (Fettweis et al., 2013) and b) FAMOUS-ice (minimum=0.0; maximum=0.77). To visualise the distribution on sub-gridscale tiles, FAMOUS-ice results have been trilinearly mapped to the same topography as used in MAR.

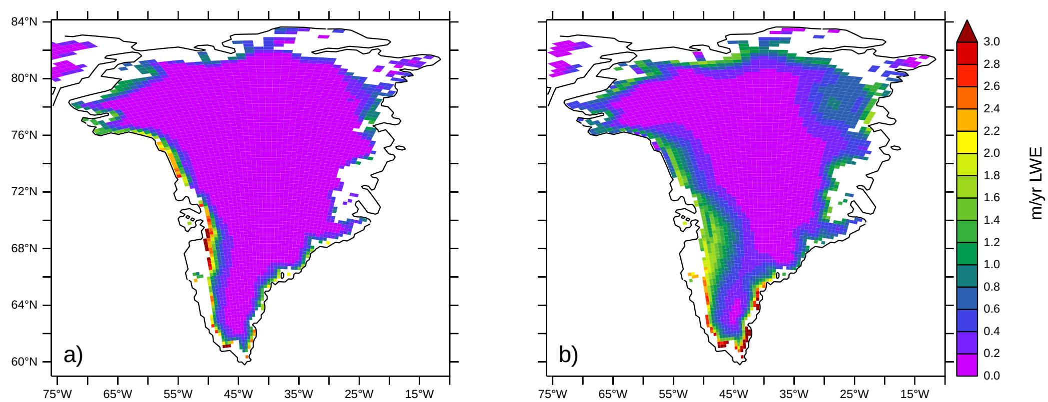

Figure S10. Annual average surface melt (m/yr LWE) for the surface of Greenland in a) MAR (1980-1999, minimum=0.0; maximum=4.06) (Fettweis et al., 2013) and b) FAMOUS-ice (minimum=0.0; maximum=5.45). To visualise the distribution on sub-gridscale tiles, FAMOUS-ice results have been trilinearly mapped to the same topography as used in MAR.

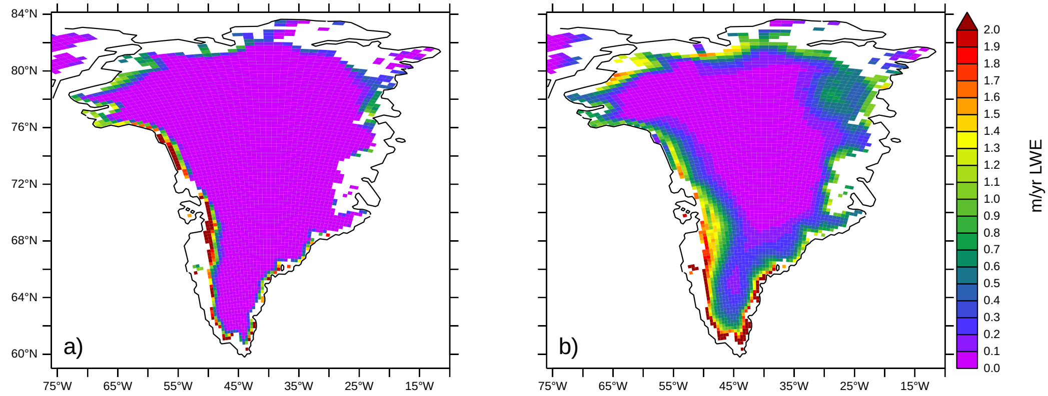

Figure S11. Annual average runoff (m/yr LWE) for the surface of Greenland in a) MAR (1980-1999, minimum=0.0; maximum=4.09) (Fettweis et al., 2013) and b) FAMOUS-ice (minimum=0; maximum=5.84). To visualise the distribution on sub-gridscale tiles, FAMOUS-ice results have been trilinearly mapped to the same topography as used in MAR.

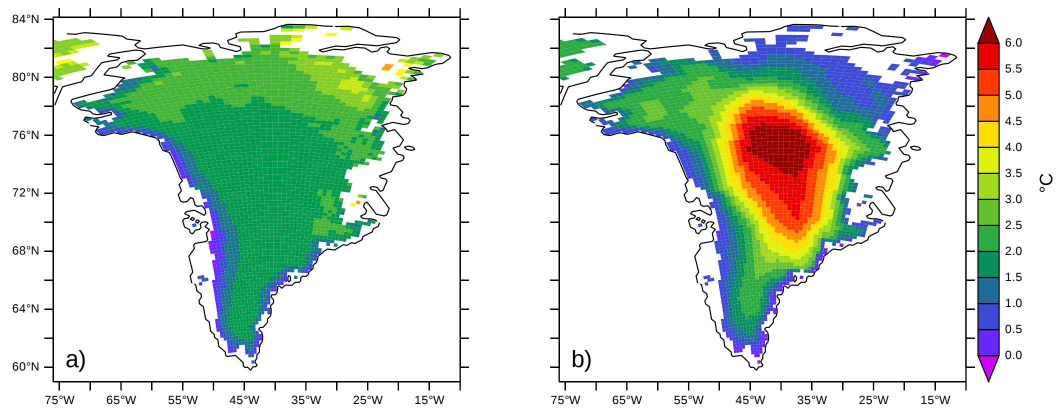

Figure S12. Change in June-July-August air temperature (^{o}C) for the surface of Greenland between the MIROC5 climate 2080-2099 under RCP4.5 and the 1980-1999 climate in figure 7. of the main paper. a) MAR (3m temperature, minimum change=0.44; maximum=4.83), b) FAMOUS-ice (1.5m temperature, minimum change=-0.02; maximum=6.838). To visualise the distribution on sub-gridscale tiles, FAMOUS-ice results have been trilinearly mapped to the same topography as used in MAR.

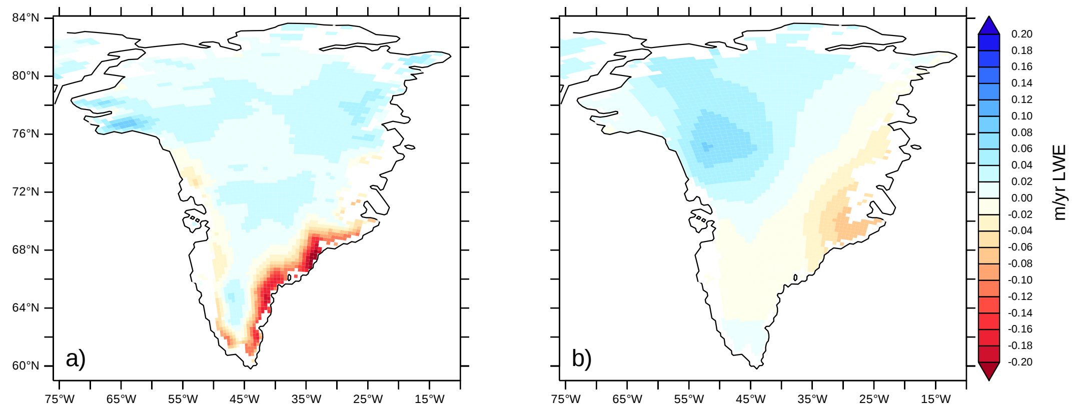

Figure S13. Change in annual average snowfall (m/yr LWE) for the surface of Greenland between the MIROC5 climate 2080-2099 under RCP4.5 and the 1980-1999 climate in figure S8. a) MAR (minimum change=-0.26; maximum=0.10), b) FAMOUS-ice (minimum change=-0.07; maximum=0.08). To visualise the distribution on sub-gridscale tiles, FAMOUS-ice results have been trilinearly mapped to the same topography as used in MAR.

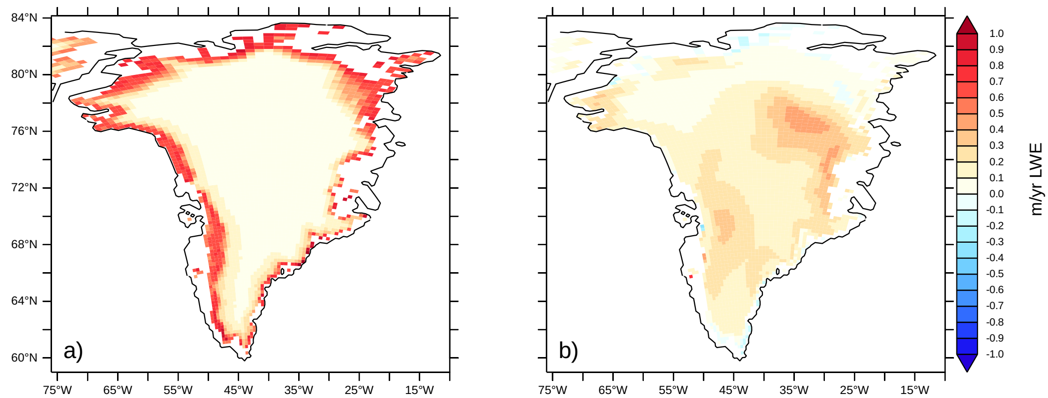

Figure S14. Change in annual average surface melt (m/yr LWE) for the surface of Greenland between the MIROC5 climate 2080-2099 under RCP4.5 and the 1980-1999 climate in figure S10. a) MAR (minimum change=0.0; maximum=1.14), b) FAMOUS-ice (minimum change=-0.35; maximum=0.75). To visualise the distribution on sub-gridscale tiles, FAMOUS-ice results have been trilinearly mapped to the same topography as used in MAR.

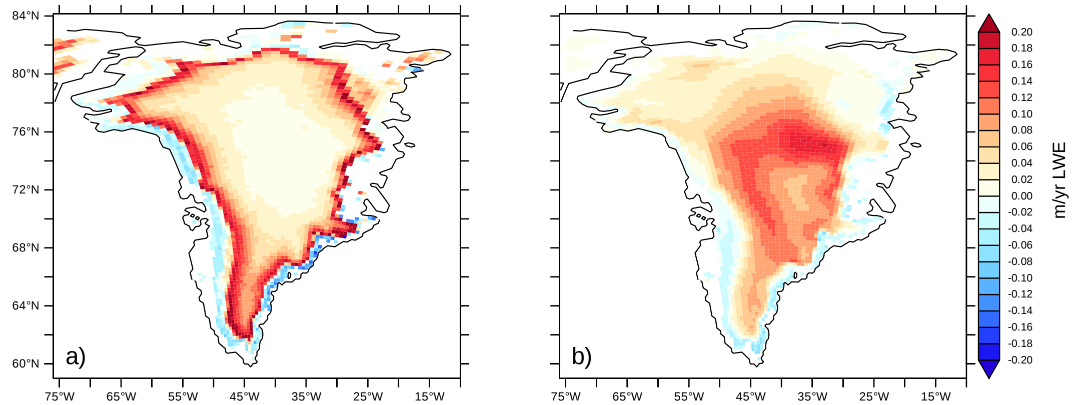

Figure S15. Change in annual average snow pack refreezing (m/yr LWE) for the surface of Greenland between the MIROC5 climate 2080-2099 under RCP4.5 and the 1980-1999 climate in figure 7 of the main paper. a) MAR (minimum change=-0.32; maximum=0.27), b) FAMOUS-ice (minimum change=-0.07; maximum=0.18). To visualise the distribution on sub-gridscale tiles, FAMOUS-ice results have been trilinearly mapped to the same topography as used in MAR.

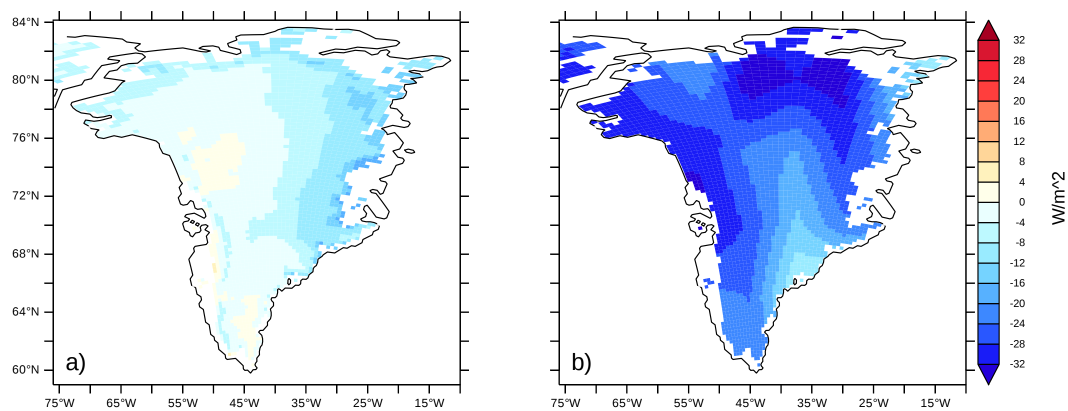

Figure S16. Change in June-July-August downwelling shortwave (W/m^2) for the surface of Greenland between the MIROC5 climate 2080-2099 under RCP4.5 and the 1980-1999 climate in figure S1. a) MAR (minimum change=-19.73; maximum=5.70), b) FAMOUS-ice (minimum change=-35.32; maximum=-8.30). To visualise the distribution on sub-gridscale tiles, FAMOUS-ice results have been trilinearly mapped to the same topography as used in MAR.

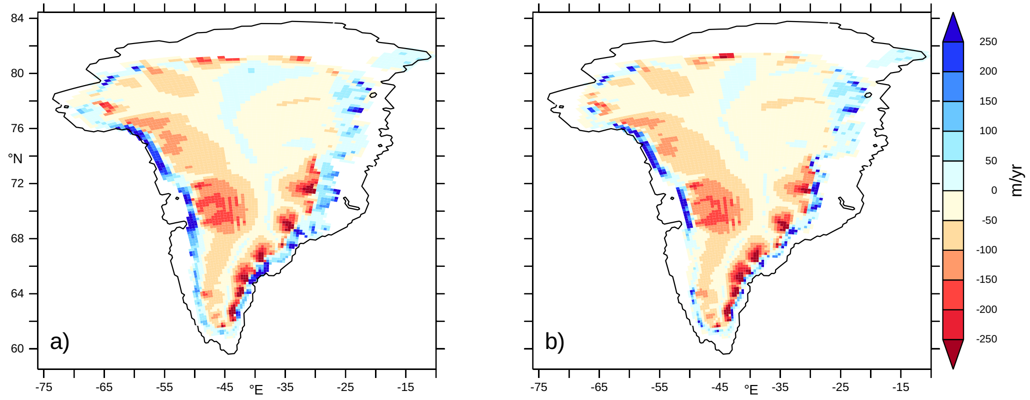

Figure S17. Change in Glimmer ice velocity (m/yr) at the end of the spinup periods shown in figure 9 of the main paper. Calving is imposed either (a) at the marine margin as resolved on the Glimmer grid or (b) near the initial ice edge.

References

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