Supplementary information for

Simulating Marine Isotope Stage 7 with a coupled climate-ice sheet model

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This PDF file contains supplementary figures, Fig. S1 to Fig. S6

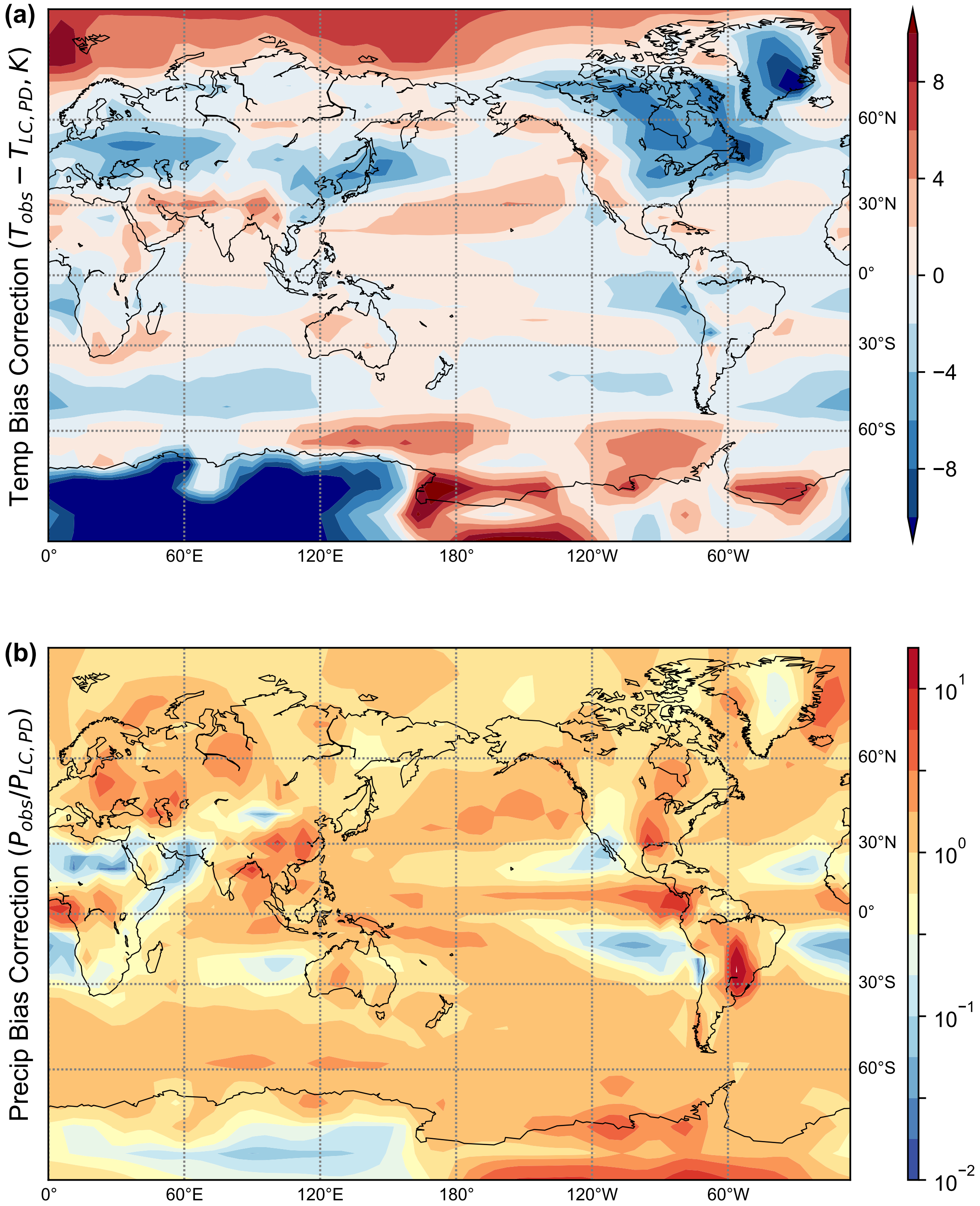

Figure S1: Bias correction used for LOVECLIM outputs. (a) Additive bias correction for annual mean surface temperature (K). (b) Multiplicative bias correction for annual mean precipitation. Colours are log normalised for the precipitation case.

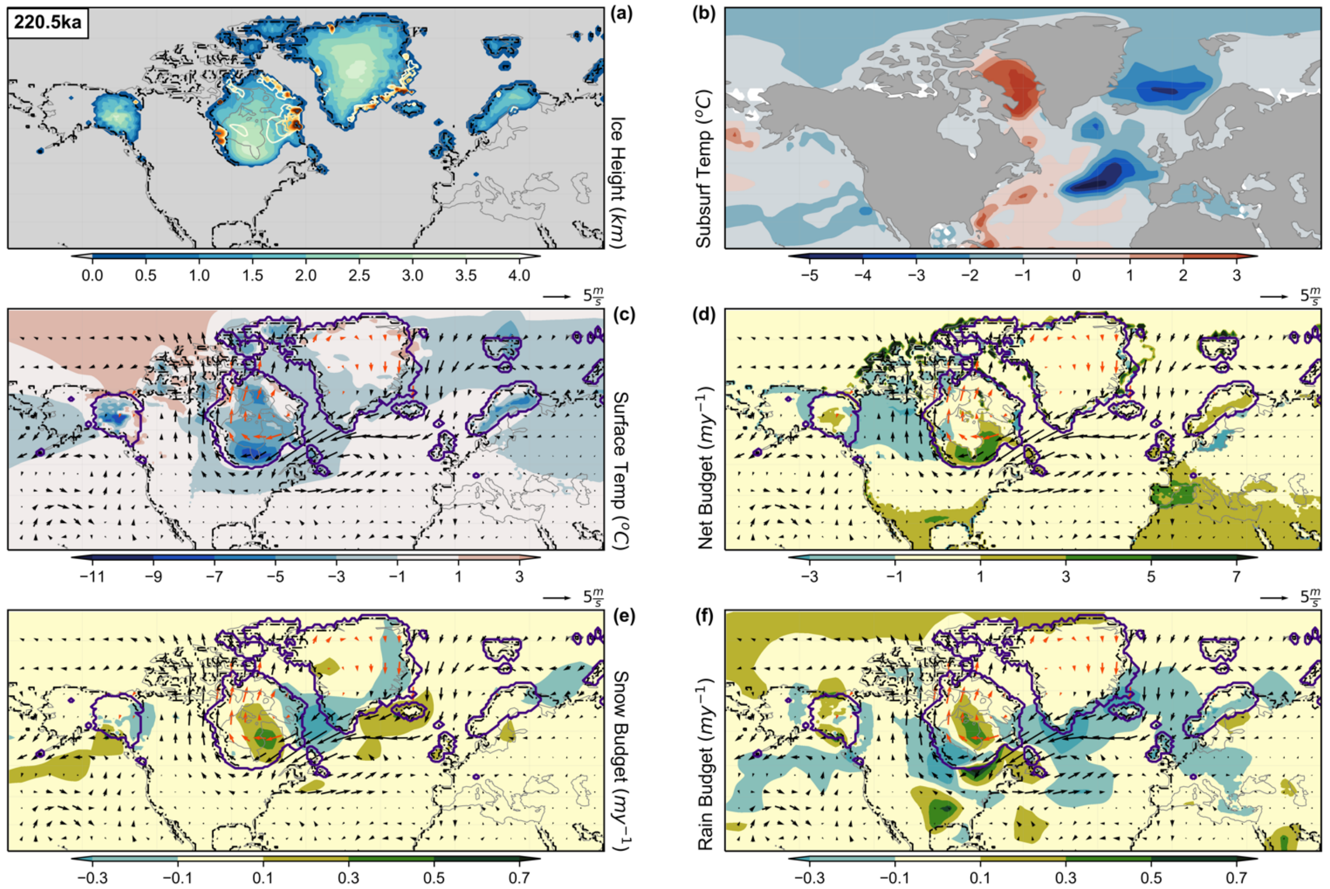

Figure S2: Simulated climate anomalies at 220.5ka over the Laurentide region. Anomalies here are with respect to the initial condition at 240ka. (a) Simulated anomalies in ice thickness (solid colors, *km*); basal ice velocity (contours, my^{-1}, contour levels same as in Fig. 4) and the grounding line (thick black lines). (b) Subsurface ocean temperature anomalies (˚C) at 400m depth. (c) Surface temperature anomalies (˚C) overlaid with anomalous wind vectors at 800hPa (ms^{-1}). The winds over regions with ice thickness greater than one km are plotted in red. (d) Net mass balance anomalies (my^{-1}) overlaid with anomalous winds (ms^{-1}). (e) Snowfall anomalies (my^{-1}) overlaid with *absolute* winds (ms^{-1}). (f) Rainfall anomalies (my^{-1}) overlaid with *anomalous* winds (ms^{-1}). The purple line in (c) to (f) mark the boundaries of the ice sheets and ice shelves. Anomalies over the Eurasian ice sheet are small and not shown.

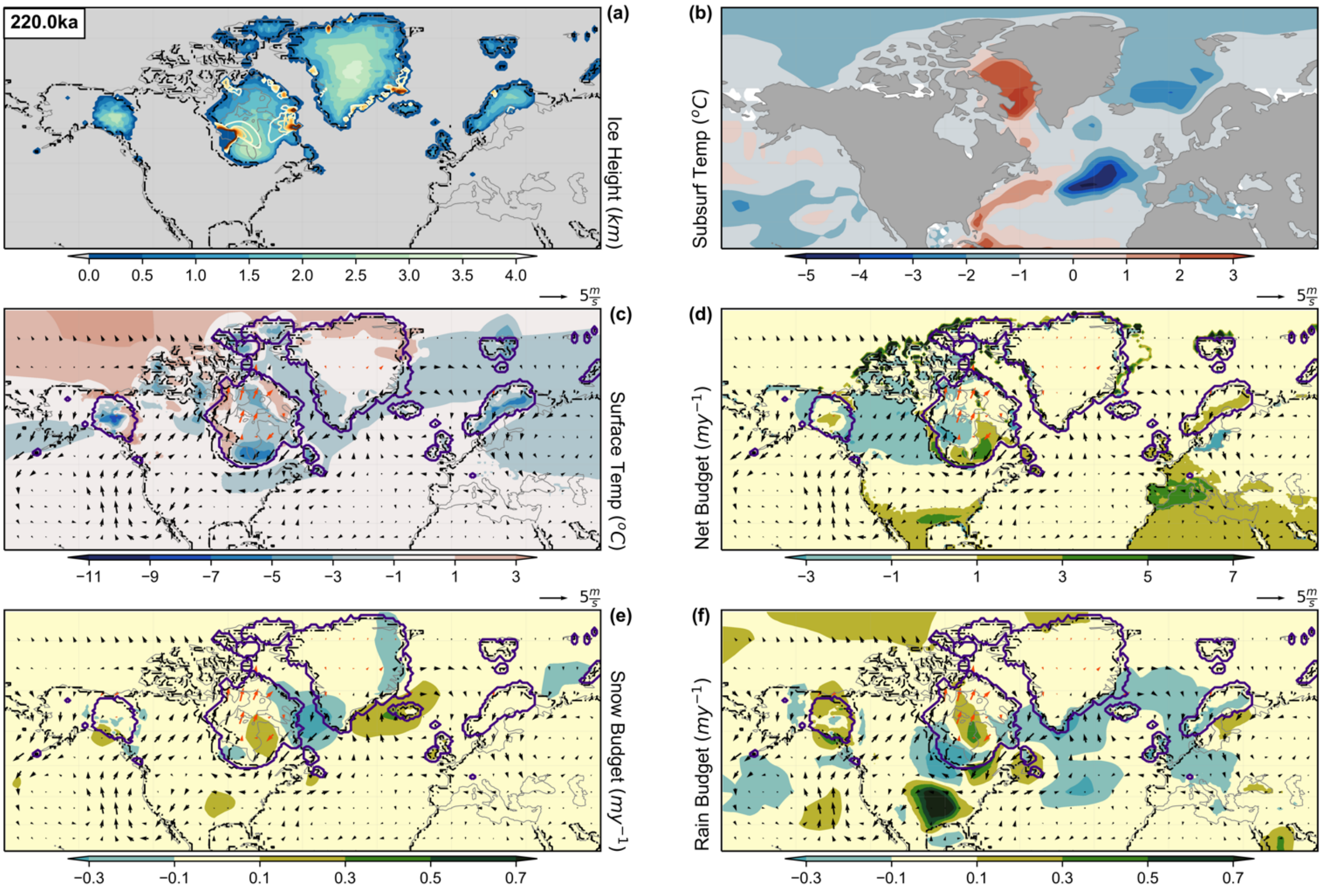

Figure S3: Simulated climate anomalies at 220.0ka over Laurentide. Anomalies here are with respect to the initial condition at 240ka. (a) Simulated anomalies in ice thickness (solid colors, *km*); basal ice velocity (contours, my^{-1}, contour levels same as in Fig. 4) and the grounding line (thick black lines). (b) Subsurface ocean temperature anomalies (˚C) at 400m depth. (c) Surface temperature anomalies (˚C) overlaid with anomalous wind vectors at 800hPa (ms^{-1}). The winds over regions with ice thickness greater than one km are plotted in red. (d) Net mass balance anomalies (my^{-1}) overlaid with anomalous winds (ms^{-1}). (e) Snowfall anomalies (my^{-1}) overlaid with *absolute* winds (ms^{-1}). (f) Rainfall anomalies (my^{-1}) overlaid with *anomalous* winds (ms^{-1}). The purple line in (c) to (f) mark the boundaries of the ice sheets and ice shelves. Anomalies over the Eurasian and Siberian ice sheets are small and not shown.

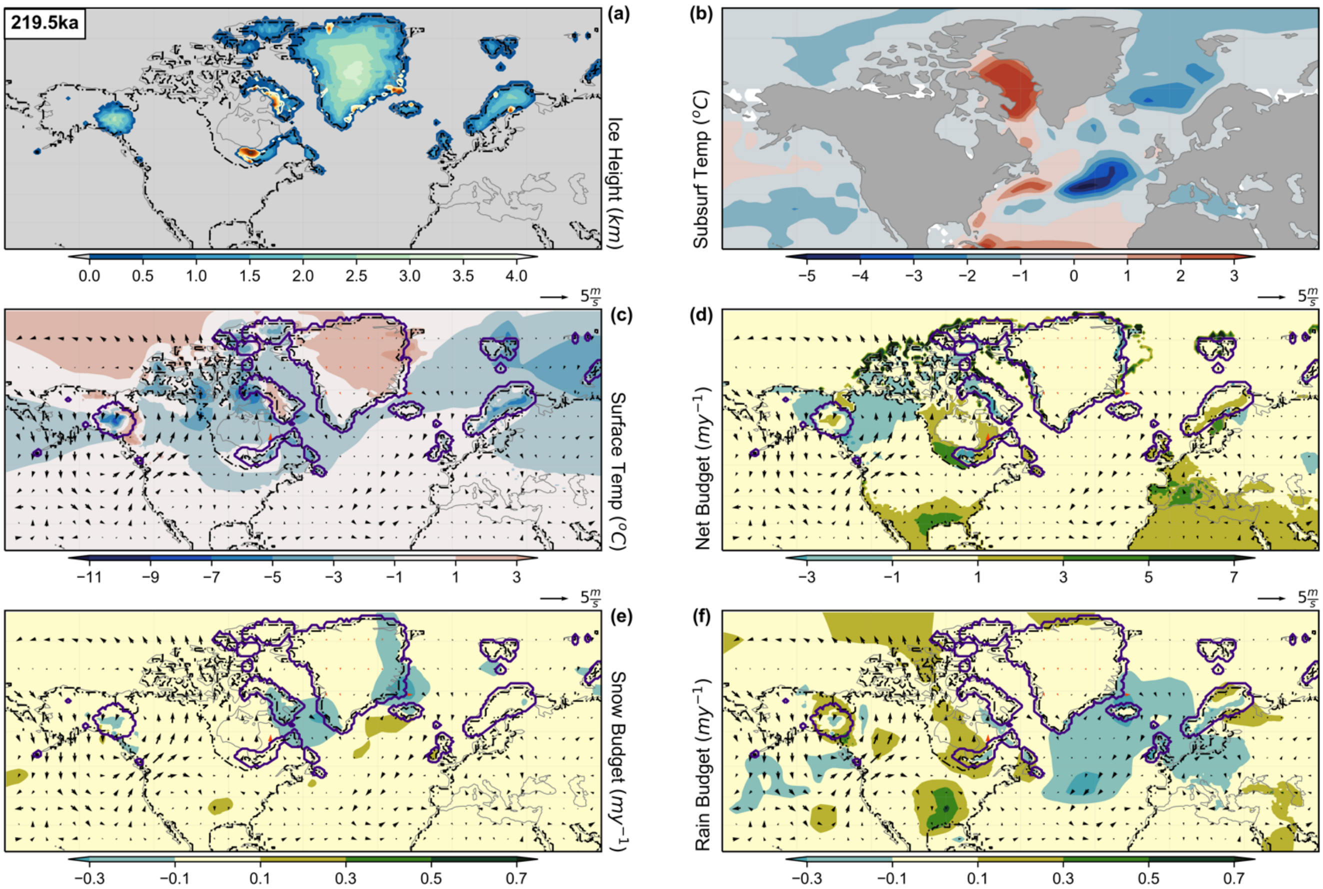

Figure S4: Simulated climate anomalies at 219.5ka over Laurentide. Anomalies here are with respect to the initial condition at 240ka. (a) Simulated anomalies in ice thickness (solid colors, *km*); basal ice velocity (contours, my^{-1}, contour levels same as in Fig. 4) and the grounding line (thick black lines). (b) Subsurface ocean temperature anomalies (˚C) at 400m depth. (c) Surface temperature anomalies (˚C) overlaid with anomalous wind vectors at 800hPa (ms^{-1}). The winds over regions with ice thickness greater than one km are plotted in red. (d) Net mass balance anomalies (my^{-1}) overlaid with anomalous winds (ms^{-1}). (e) Snowfall anomalies (my^{-1}) overlaid with *absolute* winds (ms^{-1}). (f) Rainfall anomalies (my^{-1}) overlaid with *anomalous* winds (ms^{-1}). The purple line in (c) to (f) mark the boundaries of the ice sheets and ice shelves. Anomalies over the Eurasian and Siberian ice sheets are small and not shown.

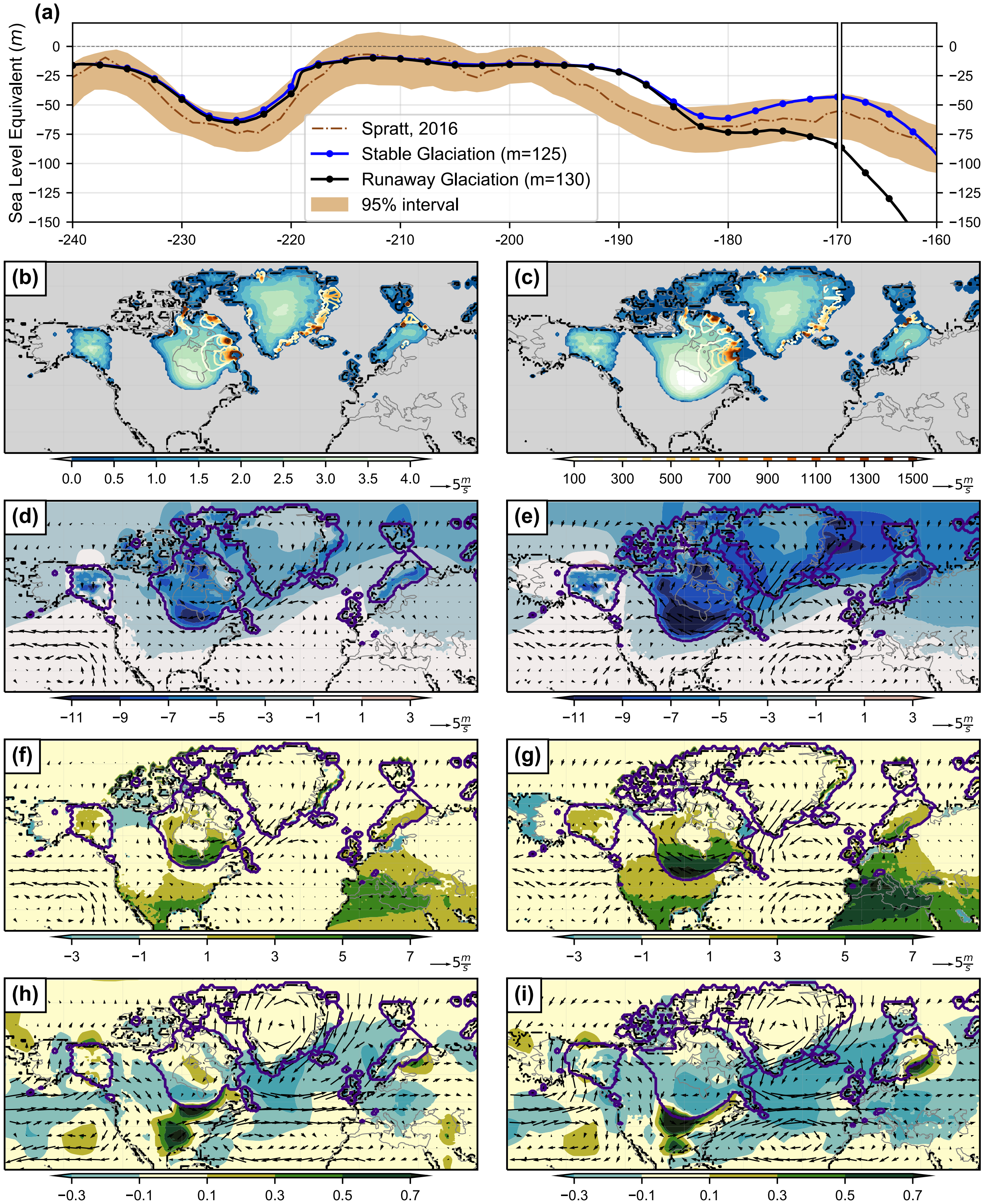

Figure S5: Bifurcation of the system at 170ka while transitioning into MIS 6 over Laurentide. (a) Sea level reconstruction (m) and 95% confidence interval of Spratt and Lisiecki (2016) (brown). Total ice volume (in terms of SLE, m) from two ensembles of LOVECLIP, one that leads to a stable glacial inception (blue; α=2, m=125 Wm^{-2}) and another into a runaway glaciation (black; α=2, m=130 Wm^{-2}). Climate and ice sheet variables at 170ka from the stable glaciation on the left column (b, d, f and h) and runaway glaciation on the right (c, e, g and i). (b,c) Ice thickness (solid colors, km) overlaid with basal ice velocity (colored contours, my^{-1}) and the grounding line (black dotted lines). (d,e) Surface temperature anomalies (*°C*) overlaid with *anomalous* wind vectors at 800hPa (ms^{-1}). (f,g) Net mass balance anomalies (my^{-1}) overlaid with *anomalous* winds (ms^{-1}). (h,i) Rainfall anomalies (my^{-1}) overlaid with *absolute* winds (ms^{-1}).The purple contours in (d) to (i) mark the boundaries of the ice sheets. Anomalies here are with respect to the initial condition at 240ka. Anomalies over the Eurasian and Siberian ice sheets are small and not shown.

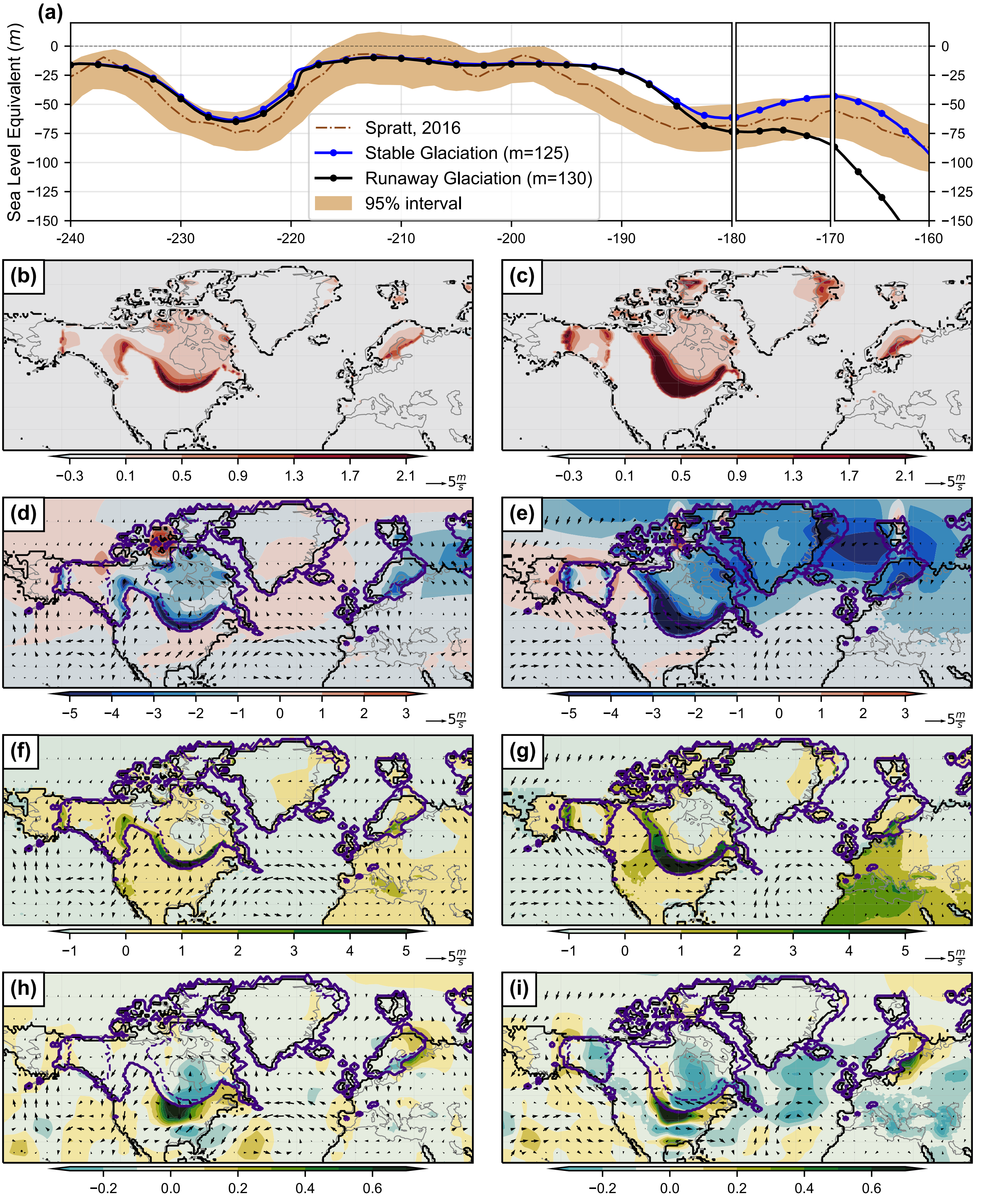

Figure S6: Difference between the simulations at the 180ka and 170ka over Laurentide. (a) Sea level reconstruction (m) and 95% confidence interval of Spratt and Lisiecki (2016) (brown). Total ice volume (in terms of SLE, m) from two ensembles of LOVECLIP, one that leads to a stable glacial inception (blue; α=2, m=125 Wm^{-2}) and another into a runaway glaciation (black; α=2, m=130 Wm^{-2}). Difference in values between the runaway ensemble and the stable ensemble at 180ka (left column) and 170ka (right column) for (b,c) Ice thickness (solid colors, km); (d,e) surface temperature (°C) and winds at 800hPa (vectors, ms^{-1}); (f,g) net mass balance (my^{-1}) winds at 800hPa (vectors, ms^{-1}); and (h,i) rainfall (my^{-1}) winds at 800hPa (vectors, ms^{-1}). The solid and dashed purple lines in (d) to (i) mark the boundaries of the ice sheets from the runaway ensemble and the stable ensemble respectively. Anomalies over the Eurasian and Siberian ice sheets are small and not shown.

References:

Spratt, R. M., and Lisiecki, L. E.: A Late Pleistocene sea level stack, Climate of the Past, 12, 1079-1092, 2016.