Supplementary Figures: Tropical climate responses to projected Arctic and Antarctic sea ice loss

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Supplemental Figure 1: The seasonal cycle of (a) Arctic and (b) Antarctic SIE \( \times 10^6 \text{ km}^2 \) averaged over the years 1979-2000 from six WACCM historical runs (grey) and observational data from the NSIDC Sea Ice database (NSIDC, 2019) (blue). The shading show the \(+/-2\sigma\) envelope.

Supplemental Figure 2: (a) The zonally averaged temperature response \(^\circ\text{C}\) to both Arctic and Antarctic sea ice loss as a function of latitude and height. (b) The linear sum of the response to Arctic sea ice loss and the response to Antarctic sea ice loss. (c) The difference between panels a and b. Contours show the climatological temperature structure with intervals of 15\(^\circ\text{C}\).
Supplemental Figure 3: (Shading) The annual mean surface temperature response [°C] to (a) Arctic sea ice loss, (b) Antarctic sea ice loss and (c) both Arctic and Antarctic sea ice loss compared to (d) the projected changes under RCP8.5, the 15-year average of 2085-2099 minus the 15-year average of 1955-1969, (scaled by a factor of 1/5). The contours show the climatological surface temperature with contour intervals of 4°C.
Supplemental Figure 4: (a) The surface temperature response [°C] after subtracting the mean tropical SST warming (shaded contours) and the surface wind response [m/s] (vectors) to combined Arctic and Antarctic sea ice loss. (b) As in panel (a) except for the linear sum of the response to Arctic sea ice loss and the response to Antarctic sea ice loss. (c) The difference between panels a and b.
Supplemental Figure 5: The response of annual mean condensational heating rate $[\times 10^{-2}\text{Kday}^{-1}]$ to (a) Arctic sea ice loss, (b) Antarctic sea ice loss and (c) both Arctic and Antarctic sea ice loss. (d) The projected change in annual mean condensational heating rate under RCP8.5, the 15-year average of 2085-2099 minus the 15-year average of 1955-1969. Note that the response in panel (d) is scaled by a factor of 1/5.
Supplemental Figure 6: (Shading) The response of the zonally averaged precipitation [mm/day] to (a) Arctic sea ice loss, (b) Antarctic sea ice loss and (c) both Arctic and Antarctic sea ice loss. (d) The projected change under RCP8.5, the 15-year average of 2085-2099 minus the 15-year average of 1955-1969. Note that the response in panel (d) is scaled by a factor of 1/5. Stippling shows a statistically significant response at 95% confidence. (Contours, black) The zonally averaged precipitation with contour intervals of 2mm/day. Regions are highlighted (contours, red) in which the response is over 20% of the RCP8.5 response.
Supplemental Figure 7: As in Supplemental Figure 6 but for the Pacific sector (130°E-260°E).
Supplemental Figure 8: (Shading) The depth-latitude response of the Pacific subtropical meridional overturning circulation [Sv] to (a) Arctic sea ice loss, (b) Antarctic sea ice loss and (c) both Arctic and Antarctic sea ice loss. (Contours) The climatological meridional overturning circulation with contour intervals of 5 Sv. The solid lines indicate positive values (clockwise flow), the dashed lines indicate negative values (anti-clockwise flow) and the thick black contour indicates the 0 Sv contour.
Supplemental Figure 9: (a) Average vertical velocity in the upper-100m of the ocean in the control run. The white contours enclose the subduction zones, which we define to be $\pm 6$ cm/year. (b) The response of mean sea level pressure [hPa] (shaded) and surface wind [m/s] (vectors) to Antarctic sea ice loss. (c) The response of the vertical Ekman velocity to Antarctic sea ice loss. Positive values indicate anomalous upwelling (Ekman suction) and negative values indicate anomalous downwelling (Ekman pumping). As in panel (a) the black contours enclose the subduction zones. (d) Same as panel (b) but for the atmosphere-only experiments.
Supplemental Figure 10: Averaged over the three subduction zones (the Indian, Pacific and Atlantic; as shown in Extended Data Fig. 9a), the response of the vertical velocity in the upper-100m to Antarctic sea ice loss (black bars) and the vertical Ekman velocity response (white bars) [cm/year].