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Contributions of Ice Thickness to the Atmospheric Response From Projected Arctic Sea Ice Loss

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# Supporting Information for “Contributions of ice thickness to the atmospheric response from projected Arctic sea ice loss”

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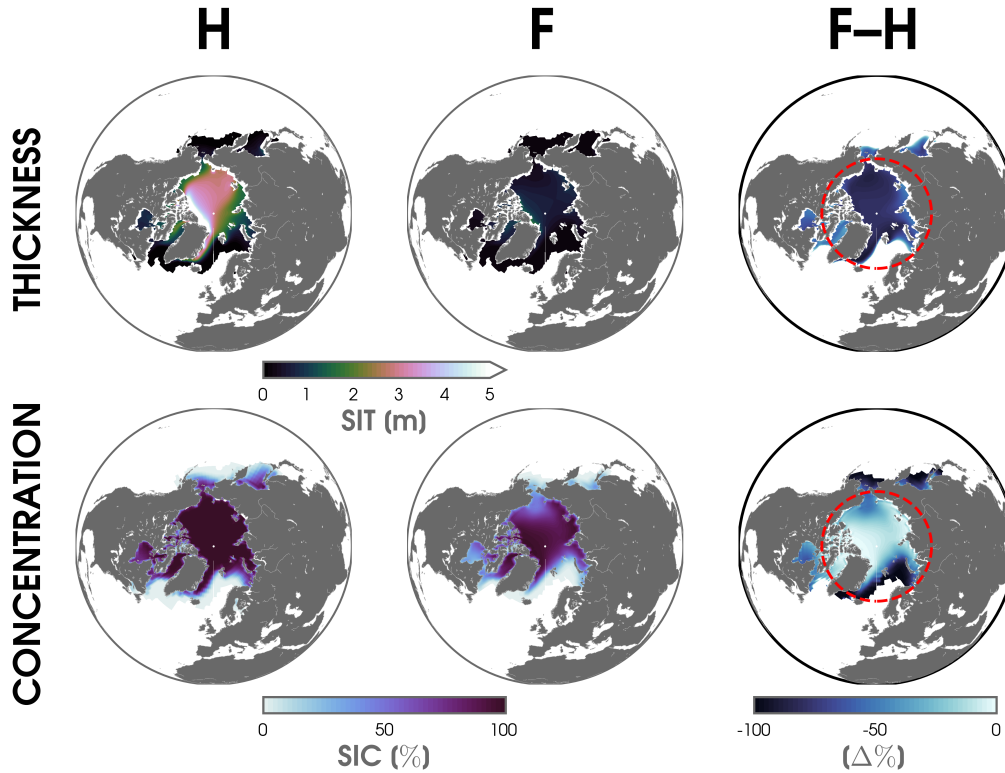
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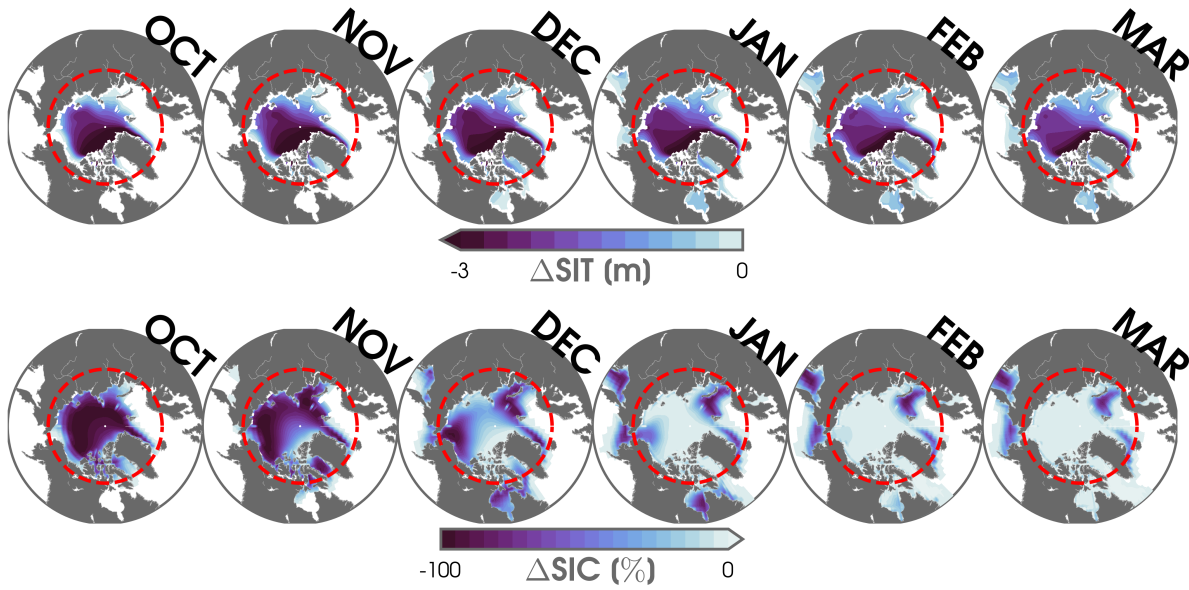
**Table S.1.** Description of WACCM4 simulations. All simulations are run for 100 ensemble members branched from a 200-year control (assessed from October to March).

Name	Sea Ice Thickness Forcing	Sea Ice Concentration Forcing
HIC	2-m	Historical: 1976-2005 LENS mean
HIT	Historical: 1976-2005 LENS mean	Historical: 1976-2005 LENS mean
FIT	Future: 2051-2080 LENS mean*	Historical: 1976-2005 LENS mean
FIC	2-m	Future: 2051-2080 LENS mean
FICT	Future: 2051-2080 LENS mean	Future: 2051-2080 LENS mean
FPOL	Future: $>66.6^{\circ}\text{N}$ ; 2-m elsewhere	Future: $>66.6^{\circ}\text{N}$ ; Historical elsewhere
FSUB	Future: $<66.6^{\circ}\text{N}$ ; 2-m elsewhere	Future: $<66.6^{\circ}\text{N}$ ; Historical elsewhere

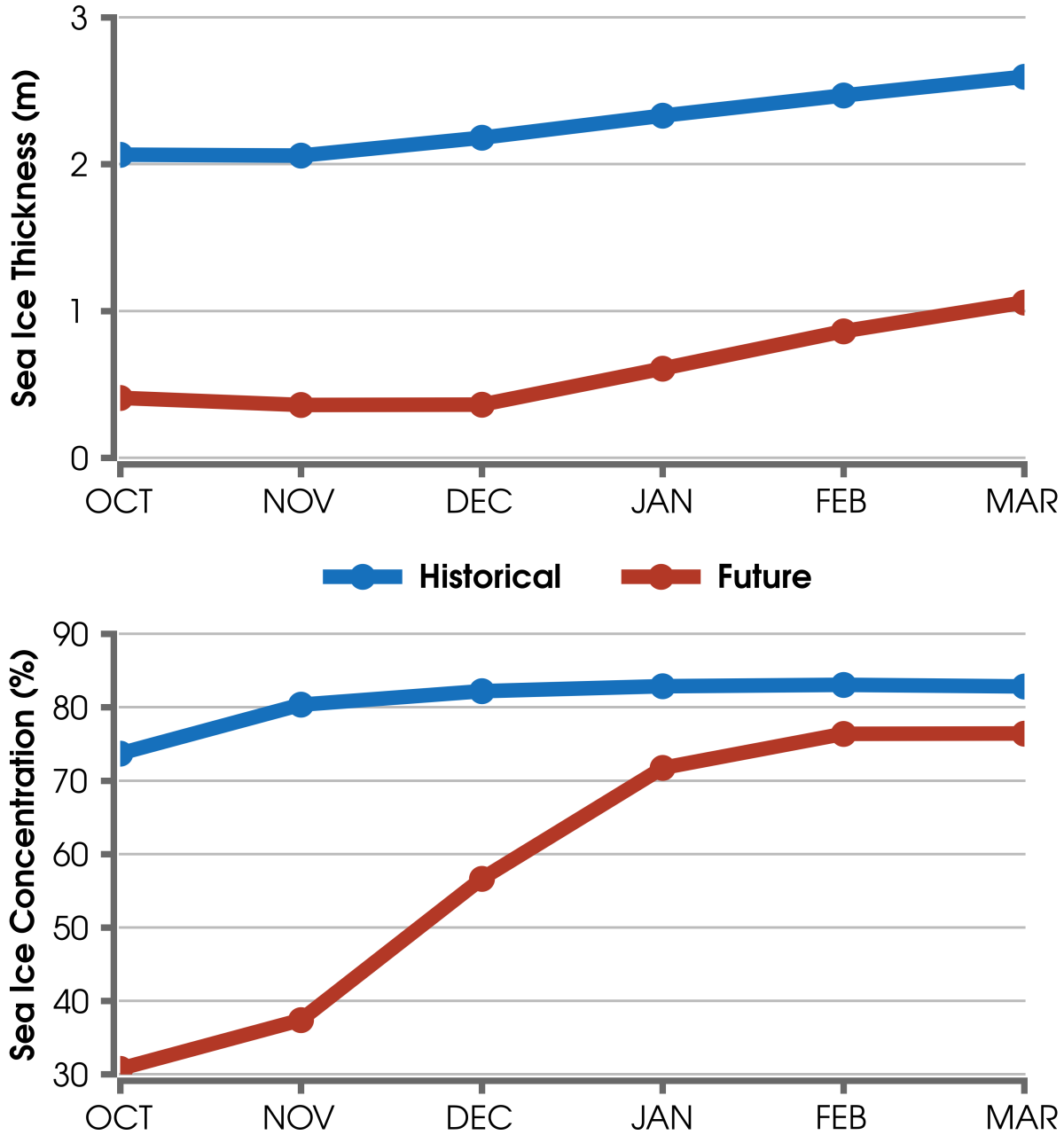
\*To preserve historical SIC, future SIT is prescribed to 0.15 m where grid cells are ice-free. Therefore, there is no change in total SIE.



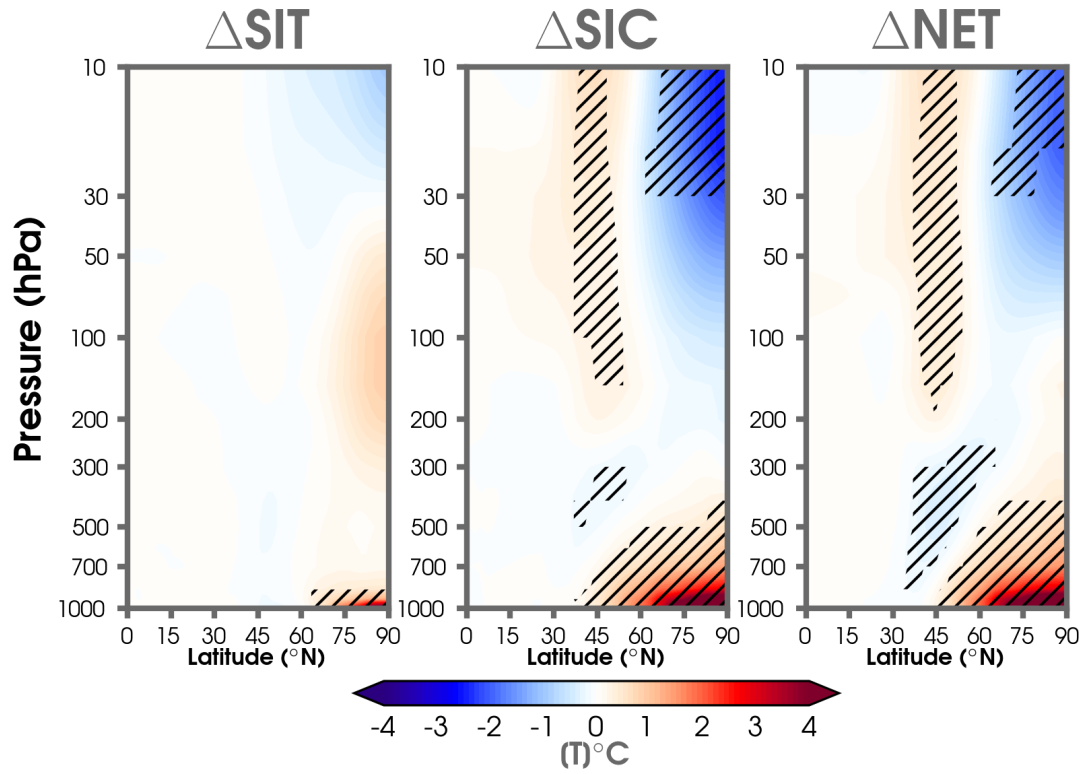
**Figure S.1.** Winter (DJF) sea ice thickness (SIT) and sea ice concentration (SIC) fields prescribed in the historical (H; left column) and future (F; middle column) experiments. Sea ice fields are taken from the mean of 40 ensemble members in LENS averaged over the 1976-2005 (H) and 2051-2080 (F) periods. The percentage differences (F-H) of SIT and SIC are shown in the right-hand column. The dashed red circle ( $66.6^{\circ}\text{N}$ ) marks the boundary between the regional sea ice anomaly experiments (FPOL and FSUB).



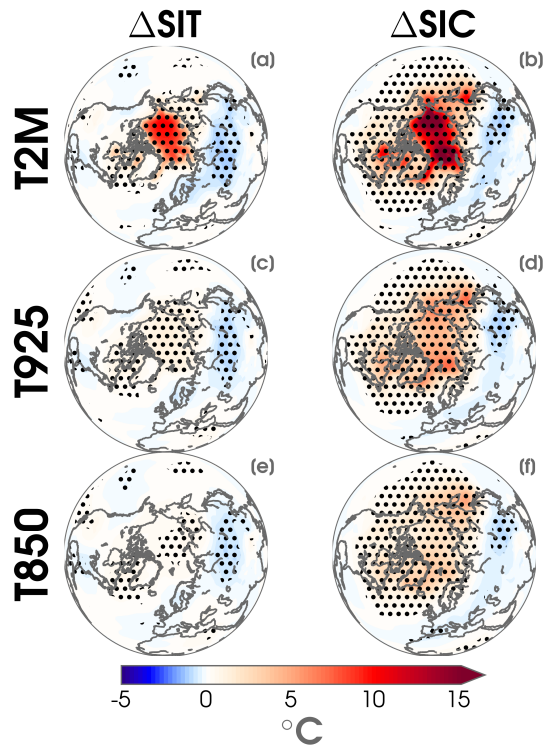
**Figure S.2.** The difference from future (F; 2051-2080) minus historical (H; 1976-2006) periods of sea ice thickness (SIT) and sea ice concentration (SIC) prescribed in the WACCM4 experiments. Sea ice fields are originally taken from the mean of 40 ensemble members in LENS. The dashed red circle ( $66.6^\circ\text{N}$ ) marks the boundary between the regional sea ice anomaly experiments (FPOL and FSUB).



**Figure S.3.** Seasonal cycles of sea ice thickness (SIT; top) and sea ice concentration (SIC; bottom) over the historical (1976-2005; blue lines) and future (2051-2080; red lines) periods. Monthly sea ice values are an area-weighted average over the Arctic Ocean (north of 65°N) for grid cells with SIT greater than 0.15 m and SIC greater than 15%.

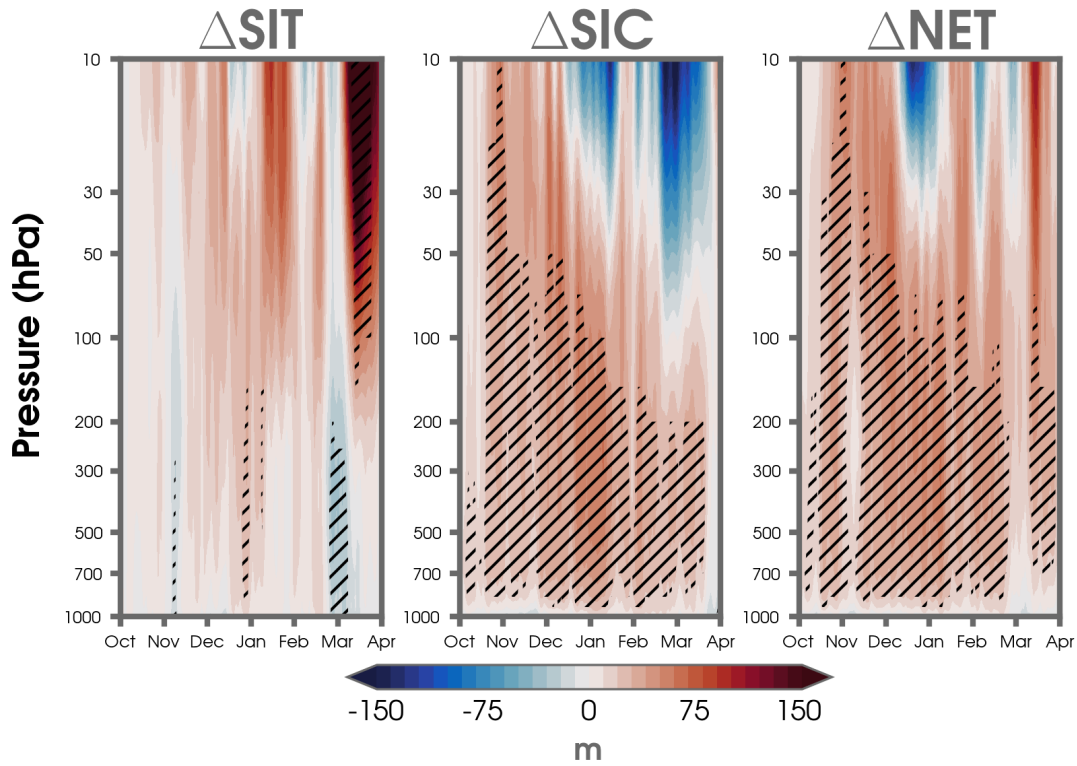


**Figure S.4.** DJF zonal-mean air temperature ( $T$ ; °C) responses from future sea ice thickness loss ( $\Delta$ SIT; FIT minus HIT), future sea ice concentration loss ( $\Delta$ SIC; FIC minus HIC), and the net future sea ice effect ( $\Delta$ NET; FICT minus HIT). Statistically significant responses at the 95% confidence level are shown by the black hatching.

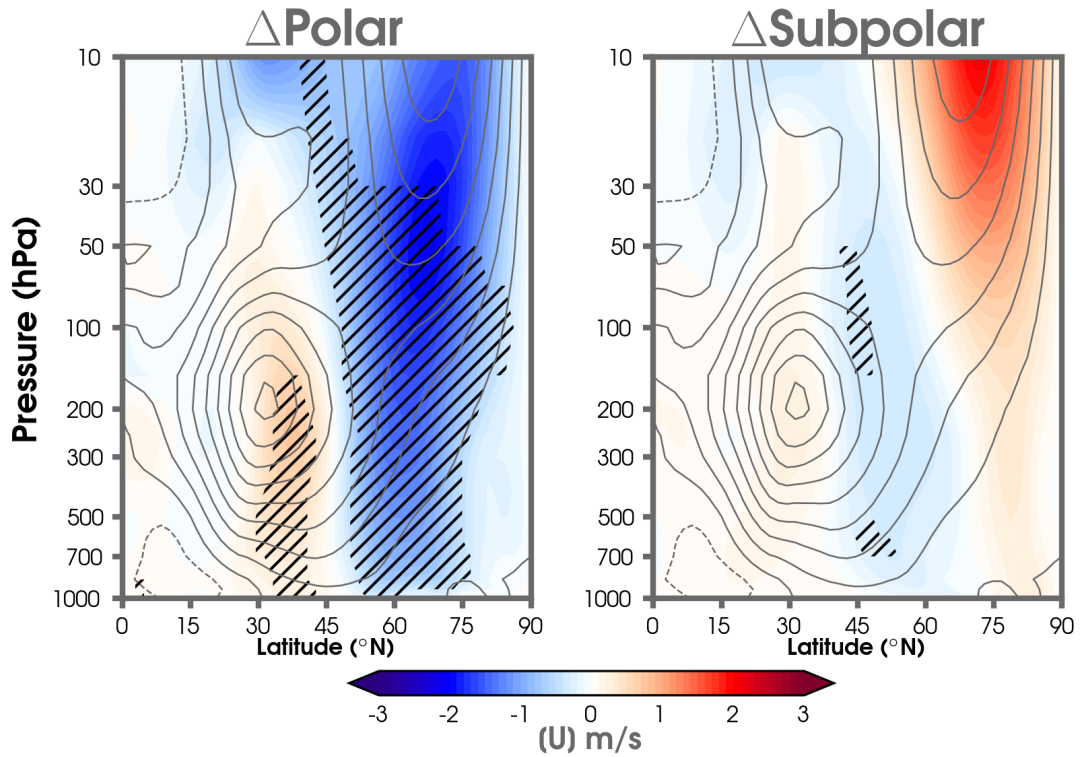


**Figure S.5.** Mean winter (DJF) air temperature responses ( $^{\circ}\text{C}$ ) are shown at 2-m (a,b; T2M), 925-hPa (c,d; T925) and 850-hPa (e,f; T850) from future sea ice thickness ( $\Delta\text{SIT}$ ) and future sea ice concentration ( $\Delta\text{SIC}$ ). Statistical significance at the 95% confidence level is identified by the black stippling. Note the difference in color scaling between positive and negative values.

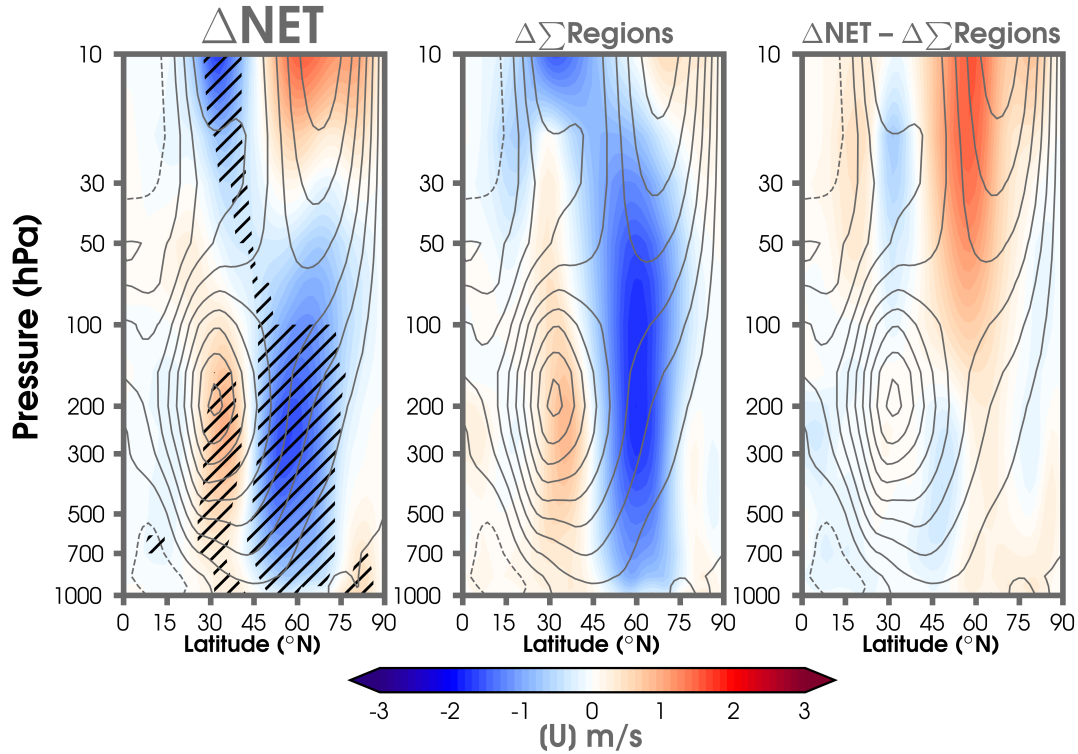




**Figure S.6.** Daily polar cap (>65°N) geopotential height responses as a function of height (pressure) from future sea ice thickness loss ( $\Delta$ SIT; FIT minus HIT), future sea ice concentration loss ( $\Delta$ SIC; FIC minus HIC), and the net future sea ice effect ( $\Delta$ NET; FICT minus HIT). Anomalies are shown from October 1 through March 31. Statistically significant responses at the 95% confidence level are shown by the black hatching.



**Figure S.7.** DJF zonal-mean zonal wind ( $U$ ;  $\text{m s}^{-1}$ ) responses comparing the effect of polar ( $>66.6^{\circ}\text{N}$ ) sea ice anomalies ( $\Delta$ Polar; FPOL minus HIC; colored shading) and the effect of subpolar ( $<66.6^{\circ}\text{N}$ ) sea ice anomalies ( $\Delta$ Subpolar; FSUB minus HIC; colored shading). Climatological zonal-mean zonal wind from HIC is overlaid by the grey contours (interval of  $5 \text{ m s}^{-1}$ ). Statistically significant responses at the 95% confidence level are shown by the black hatching.



**Figure S.8.** DJF zonal-mean zonal wind ( $U$ ;  $\text{m s}^{-1}$ ) responses are shown for the net future sea ice effect ( $\Delta\text{NET}$ ; FICT minus HIT; left), sum of the regional responses ( $\Delta\Sigma\text{Regions}$ ;  $\Delta\text{Polar}$  plus  $\Delta\text{Subpolar}$ ; middle), and  $\Delta\text{NET}$  minus the sum of the regional responses ( $\Delta\text{NET}$  minus  $\Delta\Sigma\text{Regions}$ ; right). Climatological zonal-mean zonal wind from HIC is overlaid by the grey contours (interval of  $5 \text{ m s}^{-1}$ ). Statistically significant responses at the 95% confidence level are shown by the black hatching for  $\Delta\text{NET}$ .

