

1 Supporting Information

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3 **Does ocean-coupling matter for the northern extra-tropical response to
4 projected Arctic sea ice loss?**

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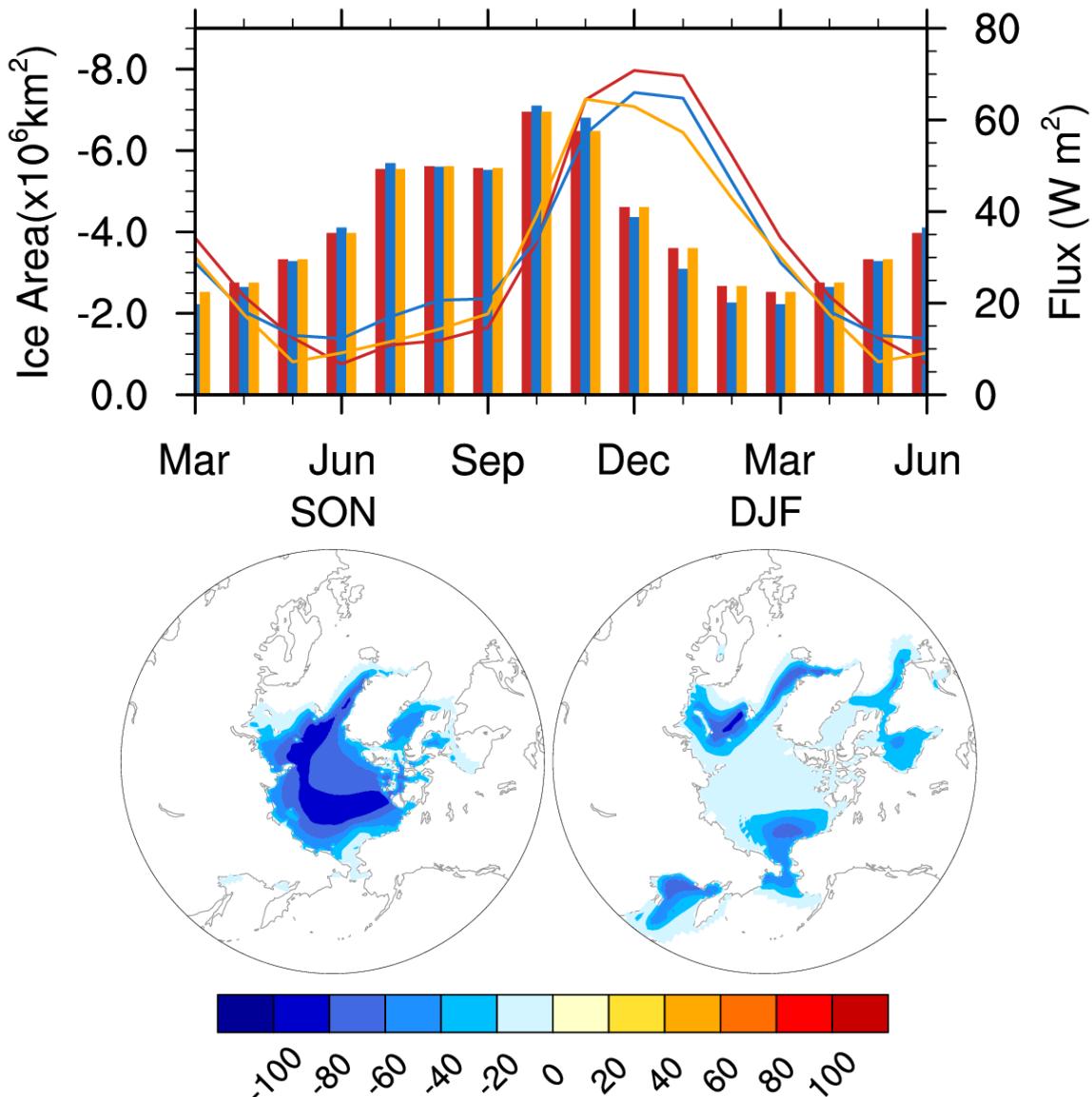
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12 Figure S1. (Top) Seasonal cycle of Arctic sea ice area (10^6 km 2) loss in the late 21st
13 century relative to the late 20th century (bars) and the corresponding net surface heat flux
14 response (Wm $^{-2}$) to the ice loss (curves) in ΔICE_NOM (yellow), ΔICE_SOM (blue) and
15 ΔICE_FOM (red) model configurations. Note that the ice area scale has been inverted.
16 (Bottom) Change in Arctic sea ice concentration (%) from the late 20th century to the late
17 21st century in autumn (SON; left) and winter (DJF; right) in ΔICE_FOM.
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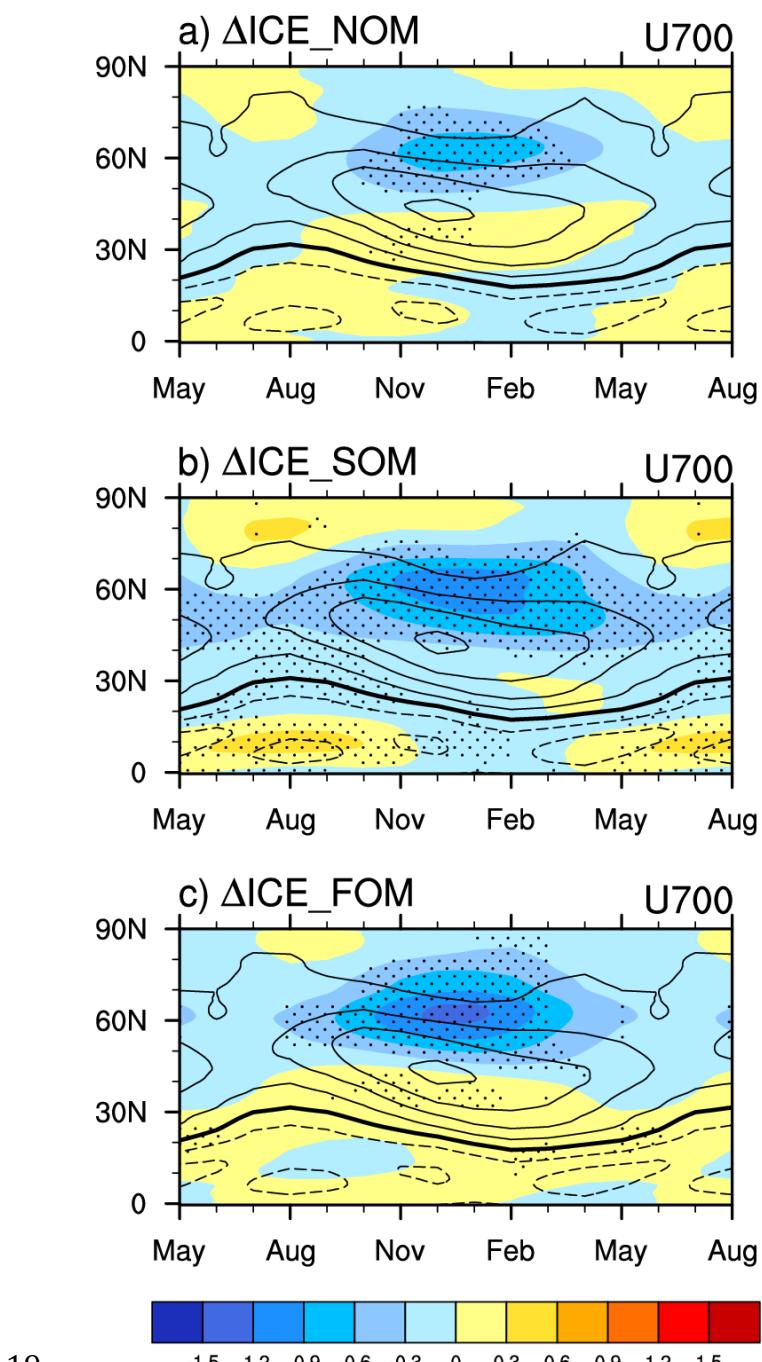
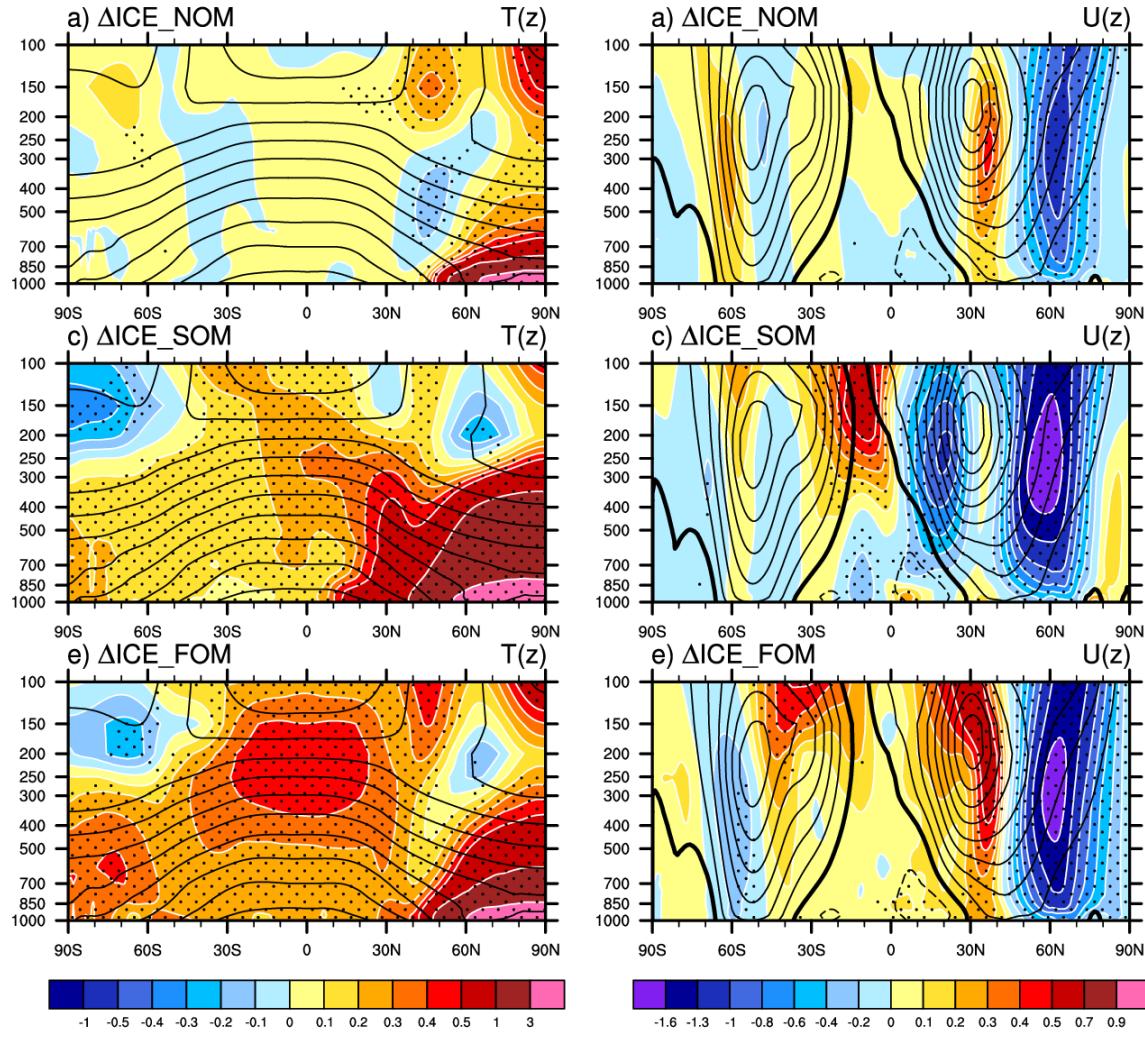


Figure S2. Monthly 700hPa zonal-mean zonal wind responses to Arctic sea ice loss in $\Delta\text{ICE_NOM}$ (top), $\Delta\text{ICE_SOM}$ (middle) and $\Delta\text{ICE_FOM}$ (bottom) model configurations. Stippling indicates where the response is statistically significant at the 95% confidence level. Note that only the NH is shown, and that the months May-August have been repeated for clarity. Contours show the 20th century climatology (contour interval of 5 ms^{-1} with the zero contour thickened).

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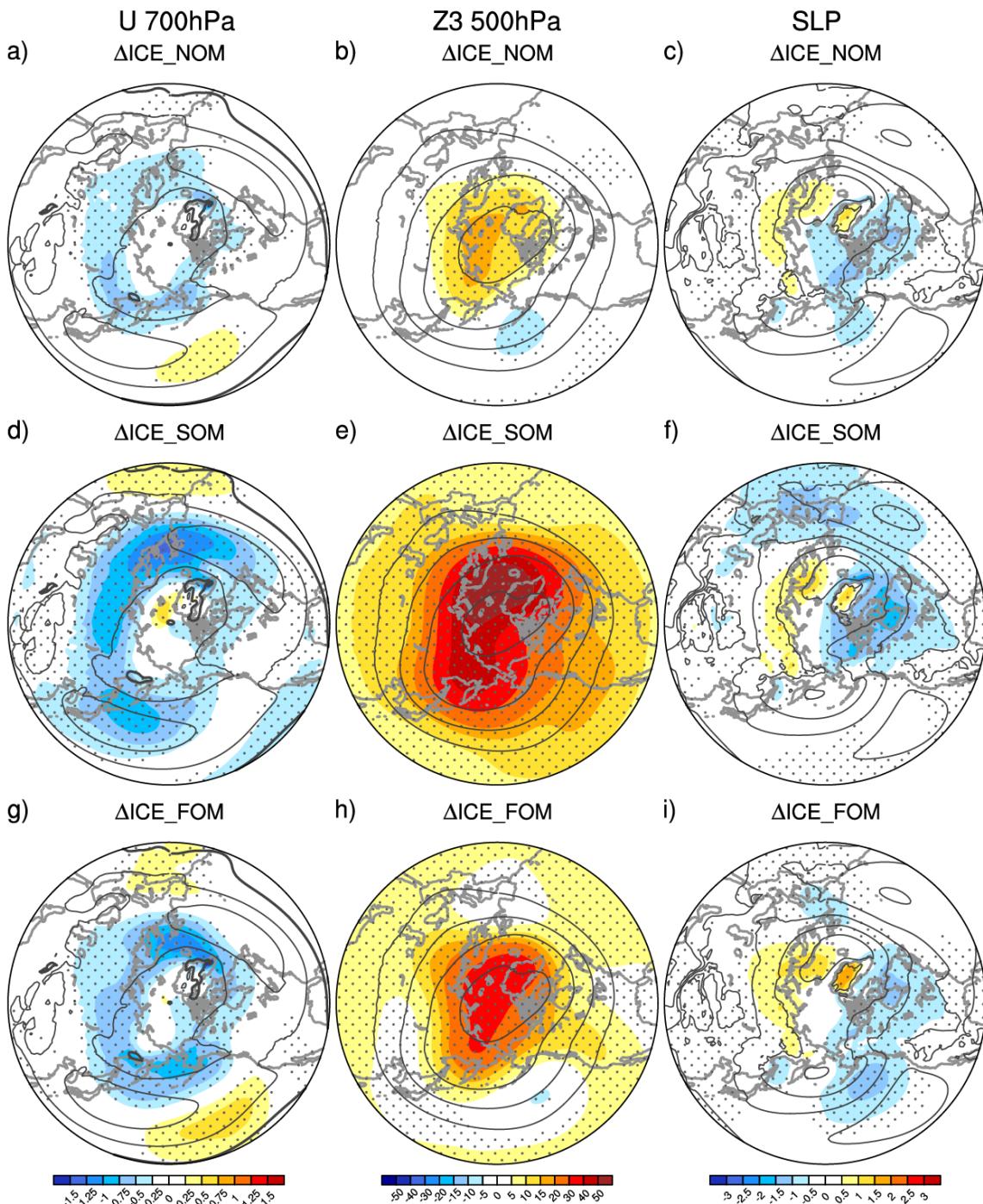
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34 Figure S3. DJF zonal-mean (left) temperature ($^{\circ}\text{C}$) and (right) zonal wind (ms^{-1})
35 responses to Arctic sea ice loss in the (a, b) in $\Delta\text{ICE_NOM}$, (c, d) $\Delta\text{ICE_SOM}$ and (e,
36 f) $\Delta\text{ICE_FOM}$ model configurations (color shading: color bars at the bottom of each
37 column; note the non-linear scales). Stippling indicates where the response is
38 statistically significant at the 95% confidence level. Contours indicate the 20th
39 century climatology (contour interval of $10 ^{\circ}\text{C}$ for temperature and 5 ms^{-1} for zonal
40 wind with the zero contour thickened).

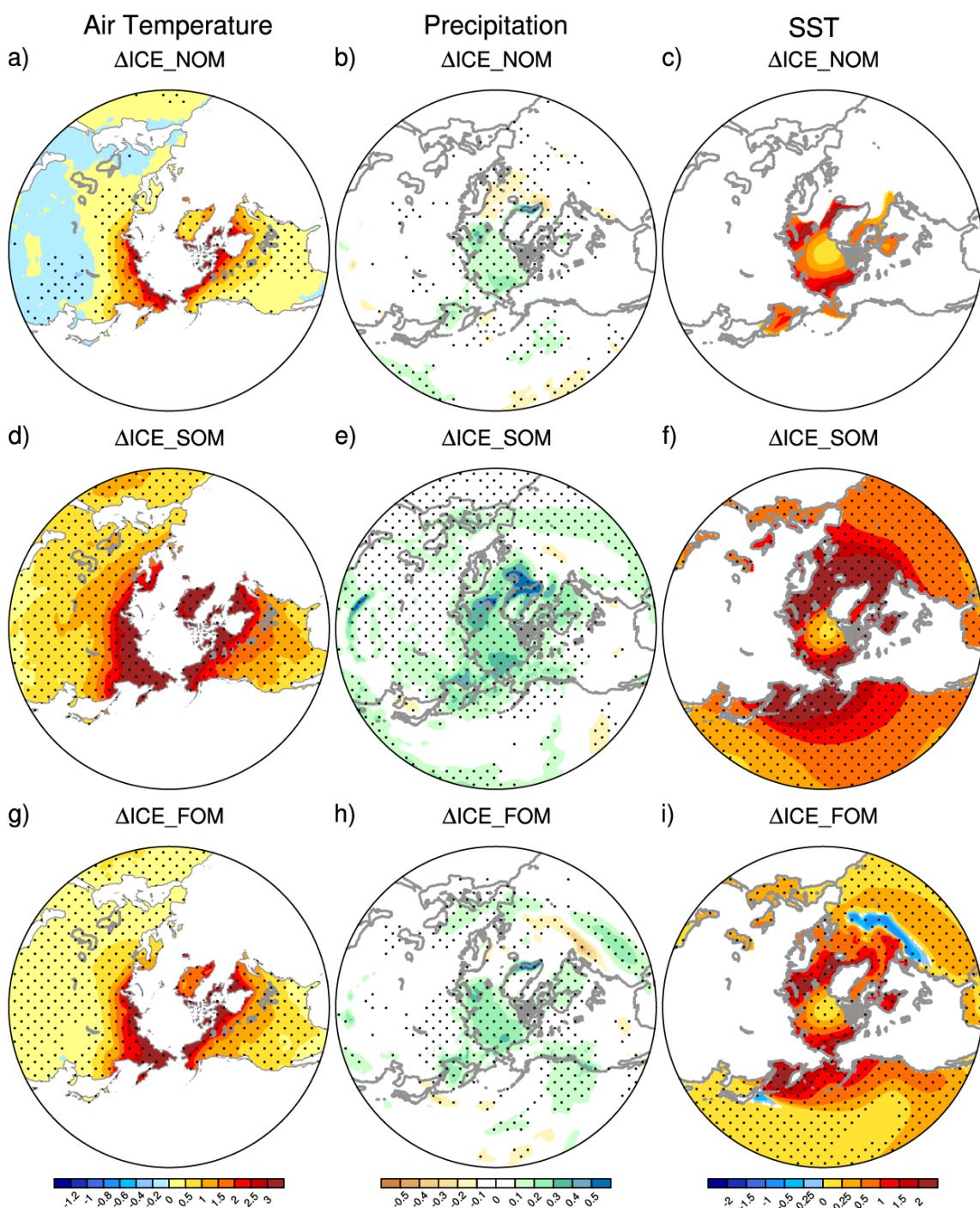
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46 Figure S4. Annual-mean 700 hPa zonal wind (ms^{-1}), 500 hPa geopotential height
 47 (Z500; m), and SLP (hPa) responses to Arctic sea ice loss in the (a, b, c) $\Delta\text{ICE_NOM}$,
 48 (d, e, f) $\Delta\text{ICE_SOM}$ and (g, h, i) $\Delta\text{ICE_FOM}$ model configurations. Stippling indicates
 49 where the response is statistically significant at the 95% confidence level. Contours
 50 indicate the 20th century climatology (contour interval of 5 ms^{-1} for zonal wind with
 51 the zero contour thickened, 500 m for Z500, and 10 hPa for SLP).

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56 Figure S5. Annual-mean surface air temperature ($^{\circ}\text{C}$; land only), precipitation (mm d^{-1})
 57 and SST ($^{\circ}\text{C}$) responses to Arctic sea ice loss in the (a, b, c) $\Delta\text{ICE_NOM}$, (d, e, f)
 58 $\Delta\text{ICE_SOM}$ and (g, h, i) $\Delta\text{ICE_FOM}$ model configurations. Stippling indicates where
 59 the response is statistically significant at the 95% confidence level.

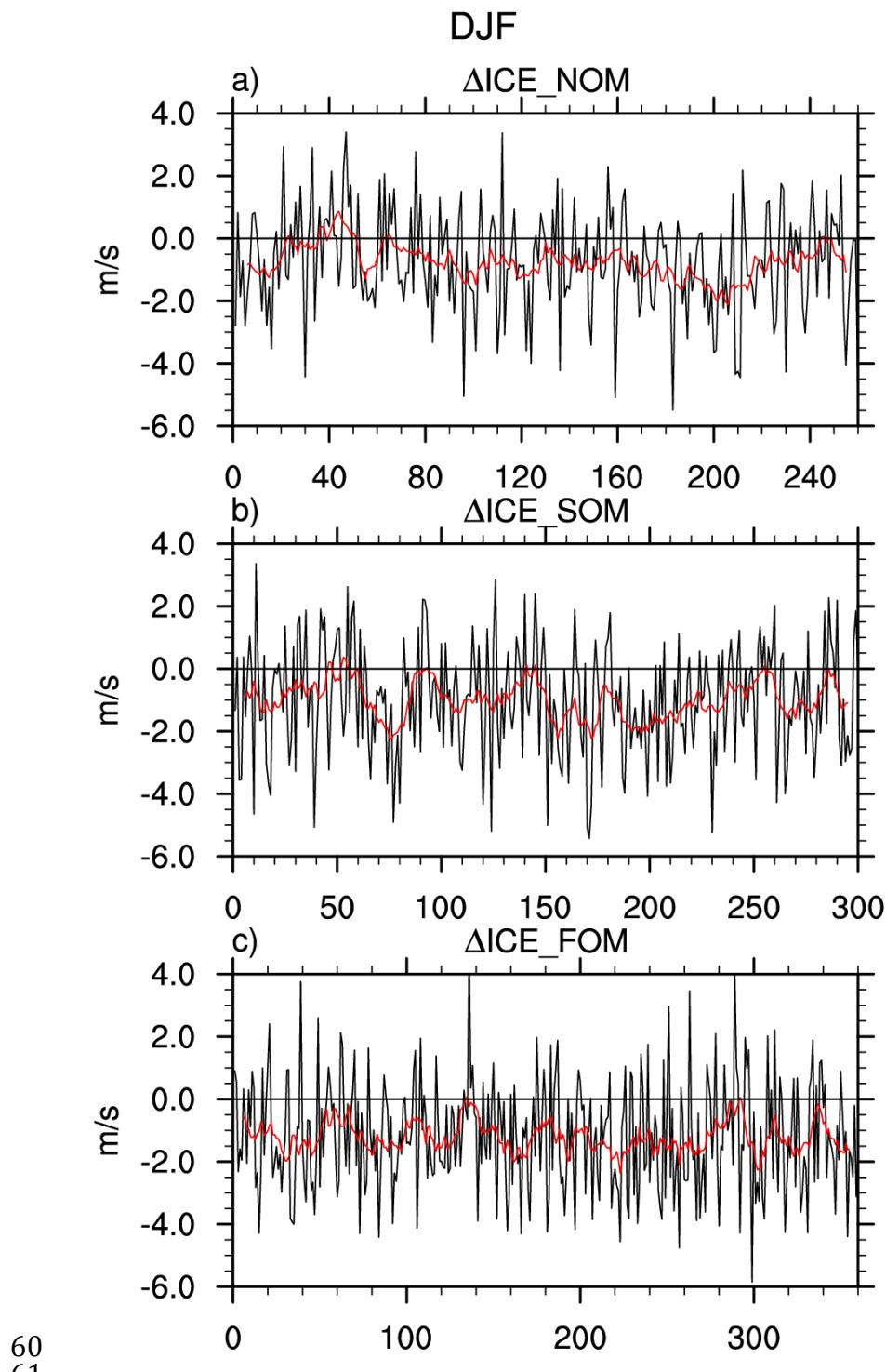


Figure S6. Time series of DJF zonal-mean zonal wind response (ms^{-1}) at 700 hPa averaged over 55° - 70°N from (a) $\Delta\text{ICE_NOM}$, (b) $\Delta\text{ICE_SOM}$, and (c) $\Delta\text{ICE_FOM}$. Note that the $\Delta\text{ICE_FOM}$ experiment is 360 years long, while the $\Delta\text{ICE_NOM}$ and $\Delta\text{ICE_SOM}$ experiments are 260 years long. The black curves show the unfiltered DJF time series, and the red curves show the time series smoothed with an 11-year running mean.

68 **Table S1.** Details of the model experiments. Acronyms are defined as: NOM (No Ocean
 69 Model); SOM (Slab Ocean Model); FOM (Full Ocean Model).

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Experiment name	Model configuration	Arctic sea ice and local SST conditions	Remarks
NOM_20	CAM4	Prescribed from SOM_20	No interactive ocean
NOM_21	CAM4	Prescribed from SOM_21	No interactive ocean
SOM_20	CAM4-SOM	1980-1999 average	Mixed layer ocean
SOM_21	CAM4-SOM	2080-2099 average	Mixed layer ocean
FOM_20	CCSM4	1980-1999 average	Full-depth dynamical ocean
FOM_21	CCSM4	2080-2099 average	Full-depth dynamical ocean

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