

Supporting Information for "Observed winds crucial for September Arctic sea ice loss"

L. A. Roach¹ and E. Blanchard-Wrigglesworth¹

¹Department of Atmospheric Sciences, University of Washington, Seattle, WA, USA

*Now at NASA Goddard Institute for Space Studies and Center for Climate Systems Research, Columbia University, New York,

NY, USA

Contents of this file

1. Tables S1 to S3
 2. Figures S1 to S12
-

Table S1. S1. Summary of model simulations.

Experiment name	Nudging domain	Initial conditions	Ensemble-mean name
aNUUDGE-hi	60°N-90°N and 60°S-90°S	LENS member 06	
aNUUDGE-med	60°N-90°N and 60°S-90°S	LENS member 21	aNUUDGEmean
aNUUDGE-lo	60°N-90°N and 60°S-90°S	LENS member 17	

Table S2. S2. September Arctic sea ice extent trends (in million km² decade⁻¹). All trends

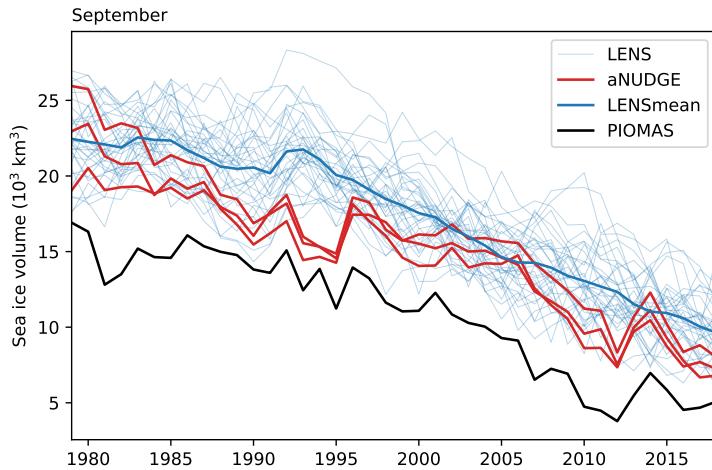
are statistically significant at the 95 % level.

	1979-2018	1979-1998	1999-2018
NSIDC CDR	-0.89 ± 0.08	-0.42 ± 0.18	-1.02 ± 0.22
LENSmean	-0.65 ± 0.03	-0.26 ± 0.06	-0.91 ± 0.04
aNUUDGEmean	-0.84 ± 0.08	-0.46 ± 0.19	-1.43 ± 0.19

Table S3. S3. Arctic (70°N-90°N) -average annual-average 2m air temperature trends (in K

decade⁻¹). All trends are statistically significant at the 95 % level.

	1979-2018	1979-1998	1999-2018
GISTEMPv4	0.80 ± 0.07	0.50 ± 0.18	1.12 ± 0.2
LENSmean	0.68 ± 0.03	0.32 ± 0.07	0.86 ± 0.05
aNUUDGEmean	0.79 ± 0.08	0.57 ± 0.21	1.28 ± 0.19

**Figure S1.** Fig. S1. Arctic sea ice volume in September.

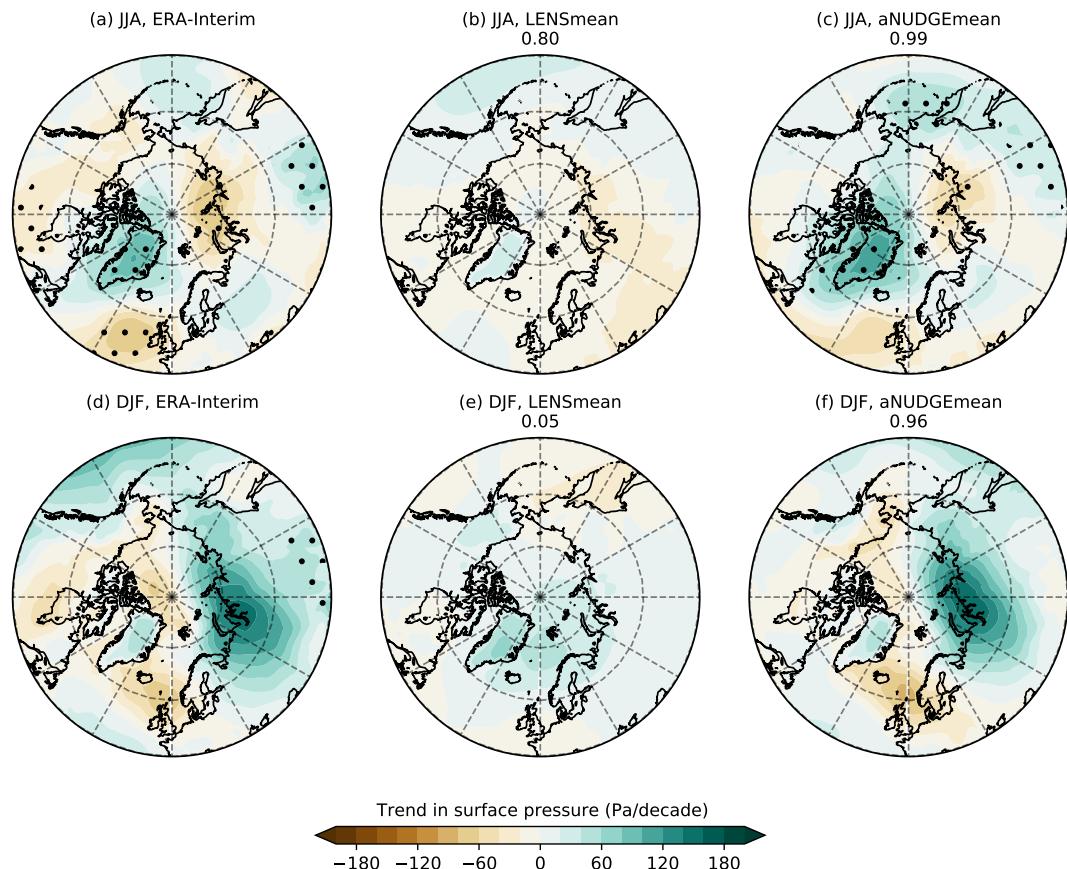


Figure S2. Fig. S2. As Fig. 1 but for surface pressure. Stippling shows linear trends that are statistically significant at the 95 % confidence level

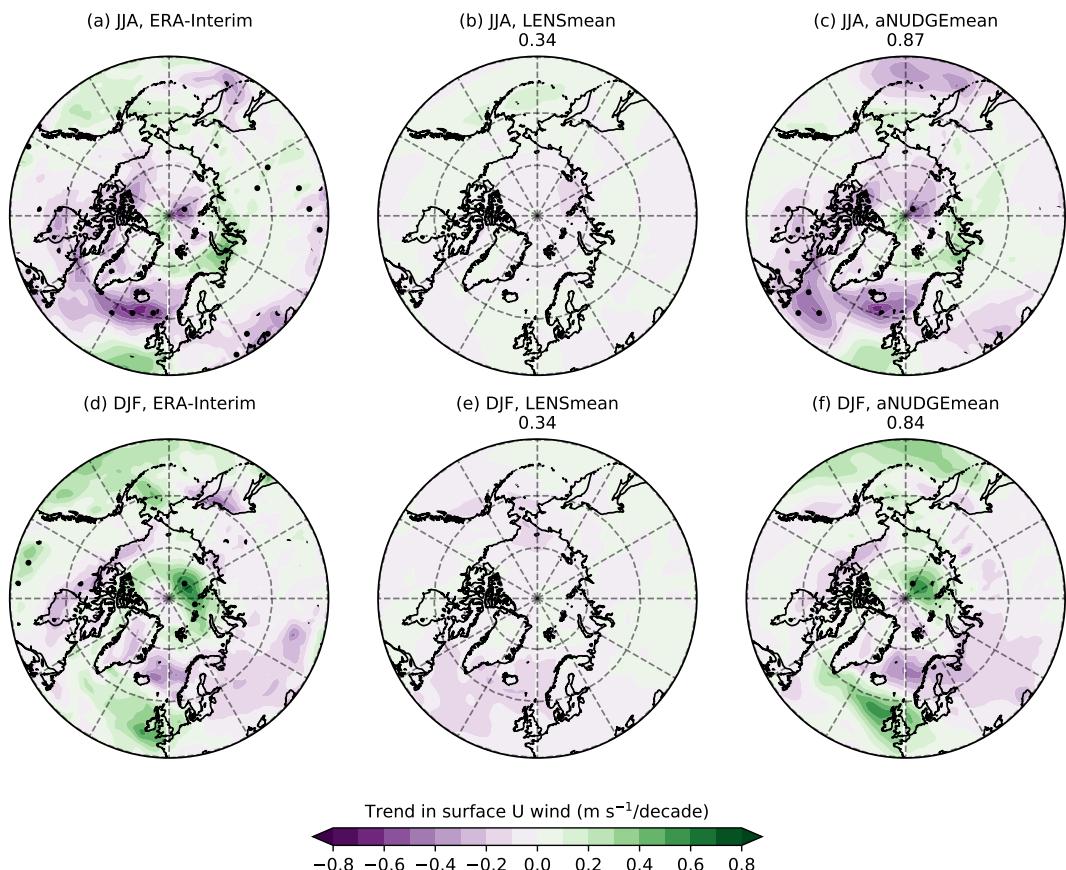


Figure S3. Fig. S3. As Fig. 1 but for surface zonal winds.

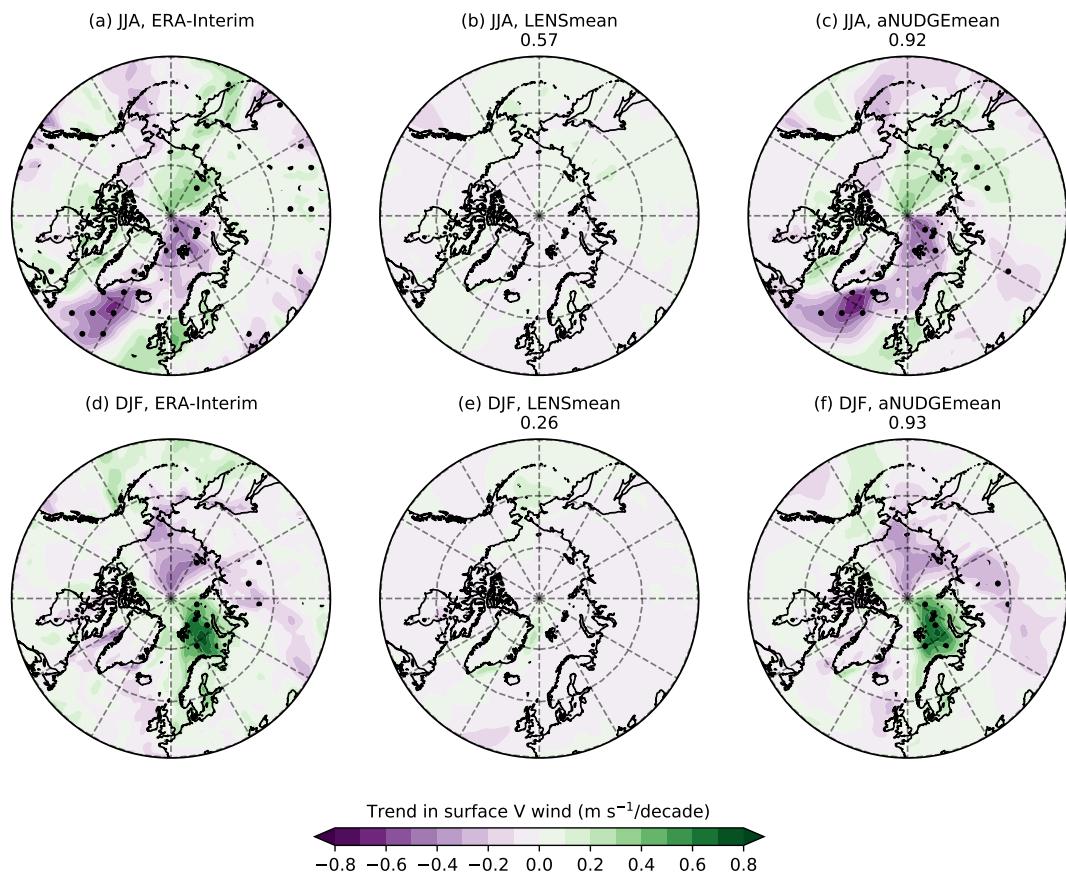


Figure S4. Fig. S4. As Fig. 1 but for surface meridional winds.

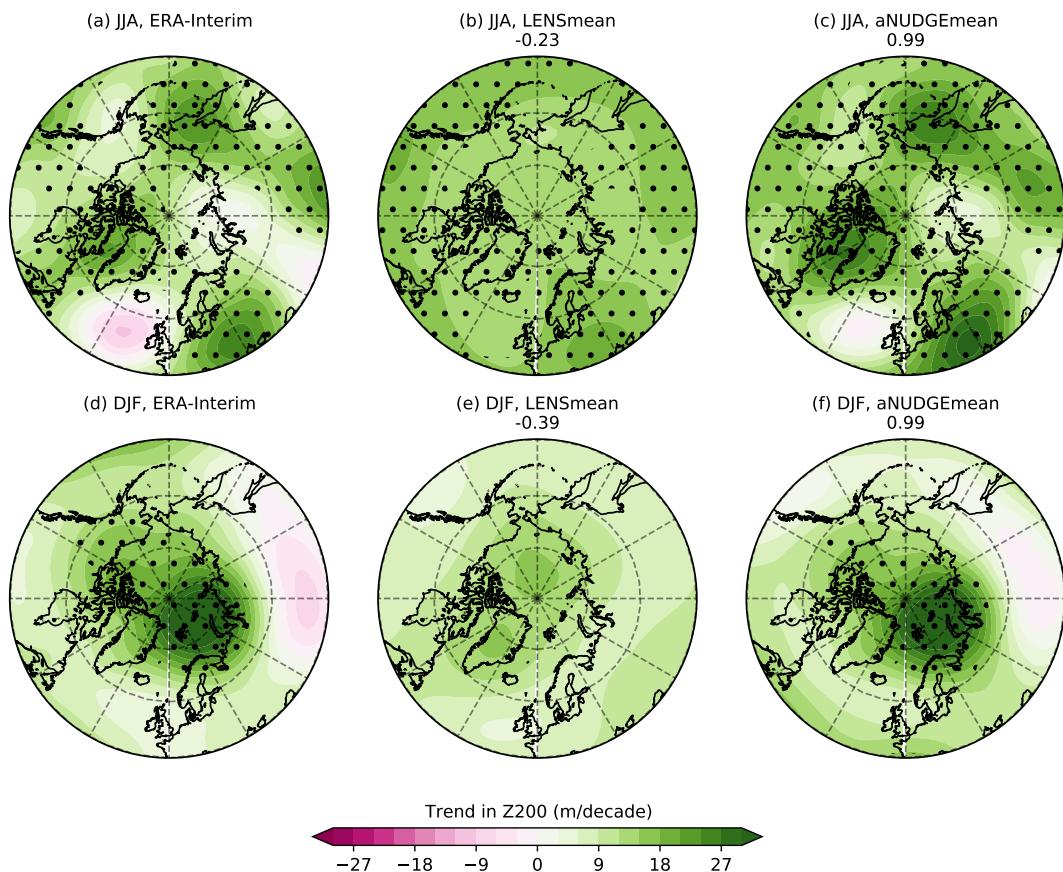


Figure S5. Fig. S5. As Fig. 1 but for 200hPa geopotential height.

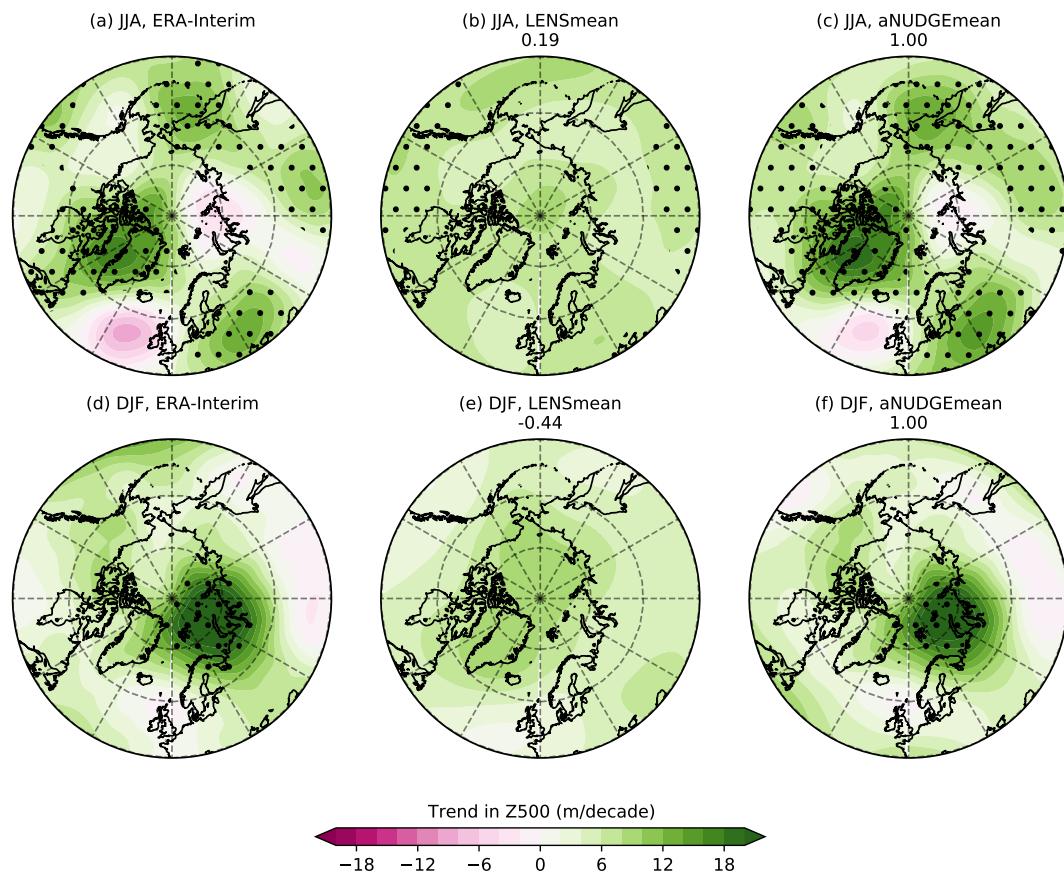


Figure S6. Fig. S6. As Fig. 1 but for 500hPa geopotential height.

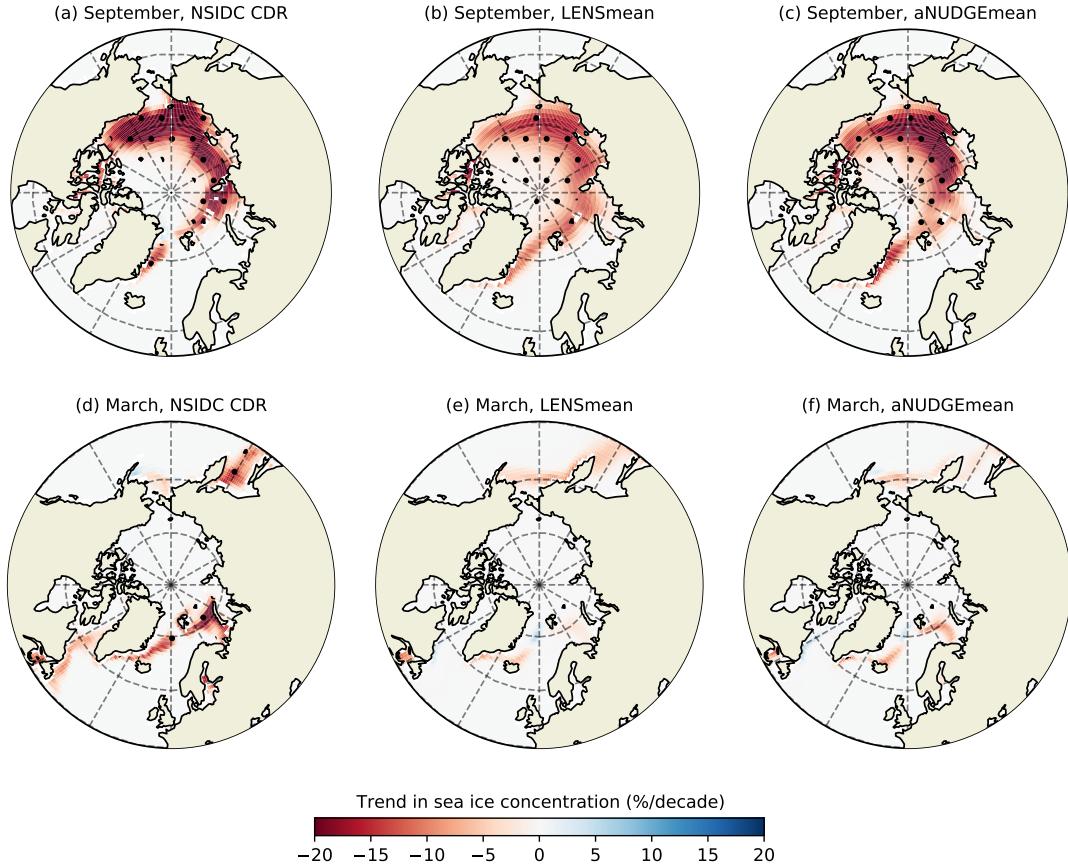


Figure S7. Fig. S7. The linear trend in sea ice concentration over 1979-2018 in (top) September, and (bottom) March in the NSIDC Climate Data Record sea ice observations, the ensemble-mean of LENS and the ensemble-mean of the aNUDGE experiments. Stippling shows linear trends (with an absolute magnitude exceeding 1% per decade) that are statistically significant at the 95 % confidence level

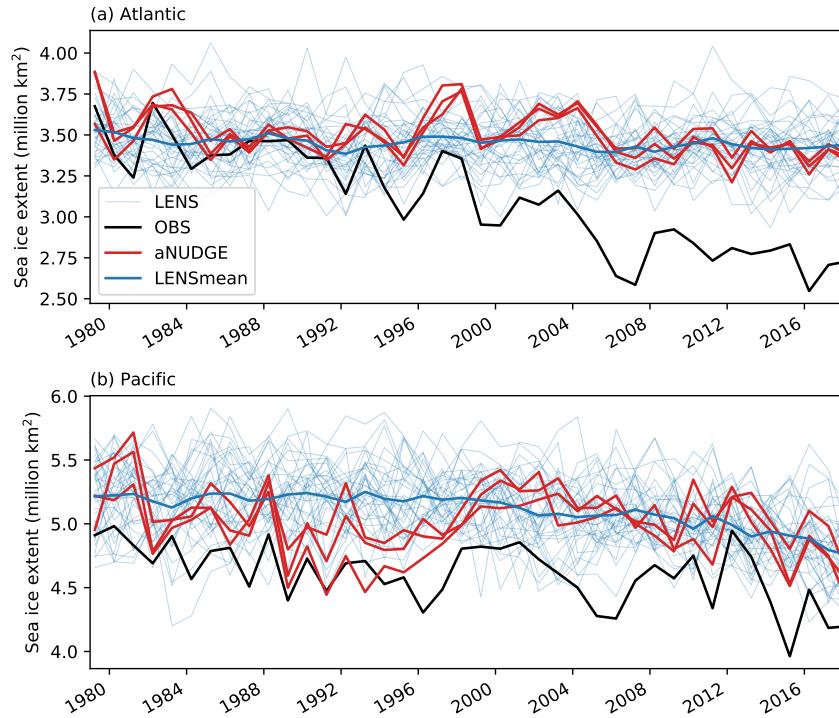


Figure S8. Fig. S8. Time series of March sea ice extent in (a) the Atlantic (consisting of Baffin Bay and the GIN, Barents, Kara and Labrador seas) and (b) the Pacific (consisting of the Sea of Okhotsk and the Bering, Laptev, East Siberian, Chukchi and Beaufort seas). Regions are defined using the NSIDC region masks.

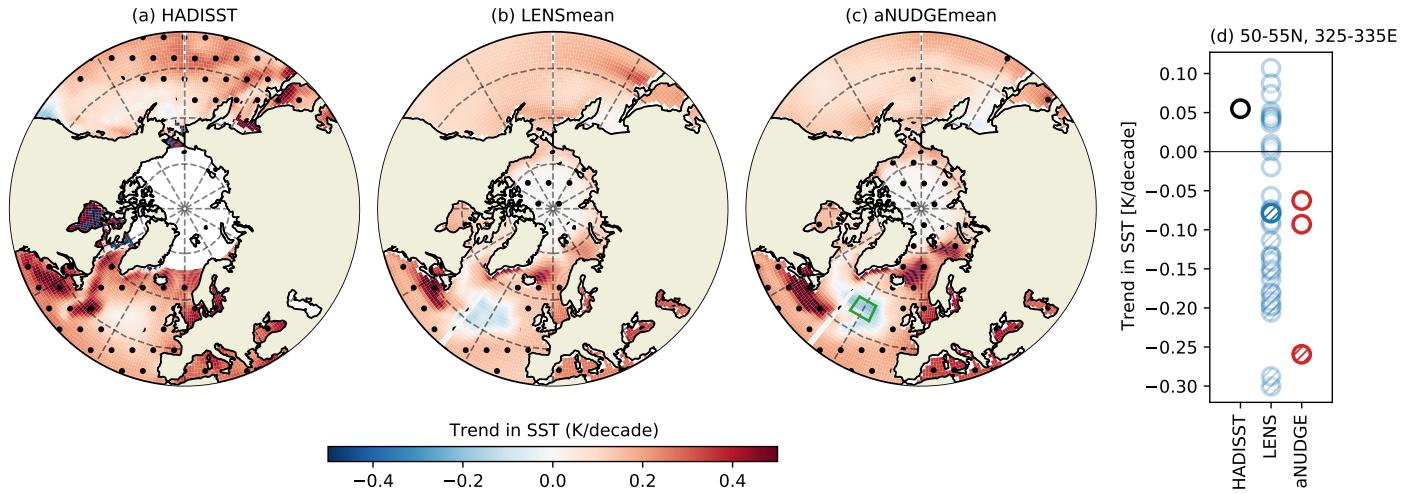


Figure S9. Fig. S9. The linear trend in annual-mean sea surface temperature over 1979-2018 in (a) the HADISST reanalysis (masked out polewards of 70N), (b) the ensemble-mean of LENS and (c) the ensemble-mean of the aNUDGE experiments. Stippling shows linear trends that are statistically significant at the 95 % confidence level. (d) shows the 1979-2018 linear trend in annual-mean sea surface temperature averaged over the region marked by the green box shown in (c) for HADISST and all model experiments. Trends that are statistically significant at the 95 % level are hatched in (c).

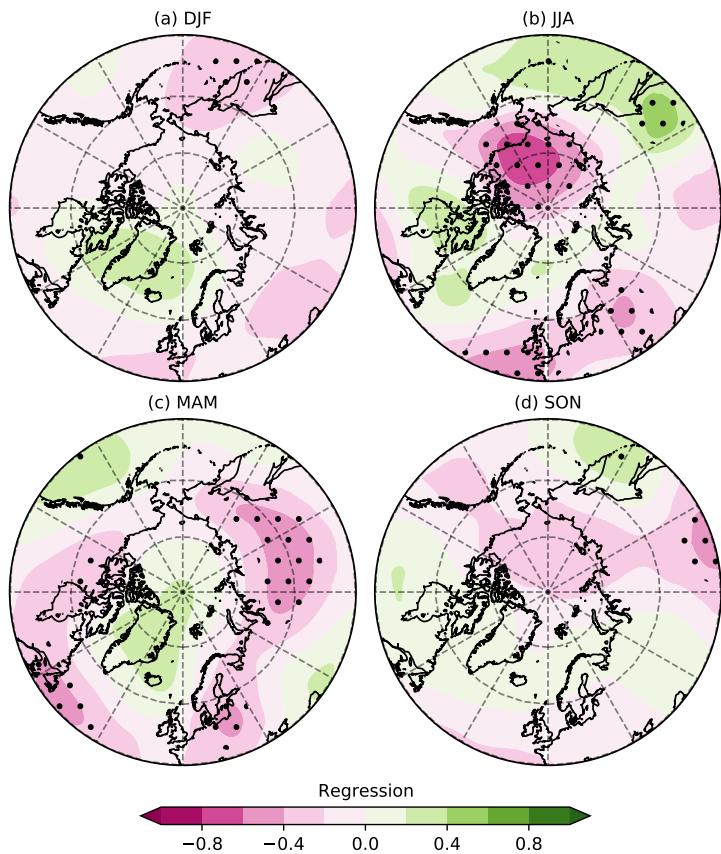


Figure S10. Fig. S10. The regression of the (a) DJF, (b), JJA, (c) MAM and (d) SON linear trend in Z500 over 1979-2018 with the September sea ice extent trend over 1979-2018 within LENS ensemble members. Stippling shows regressions that are statistically significant at the 95 % confidence level.

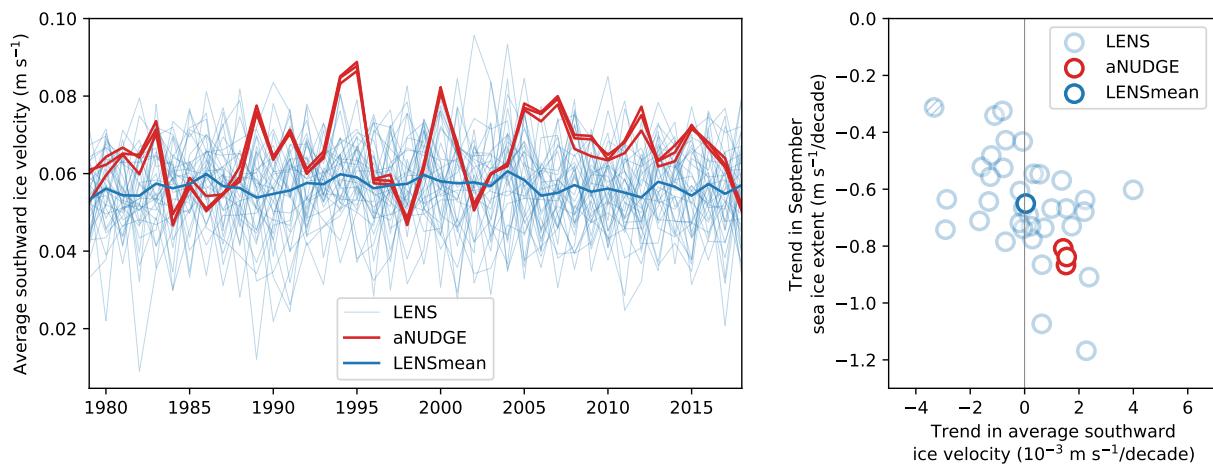


Figure S11. Fig. S11. (a) The annual-average southward velocity in Fram Strait (defined as 81.5-82.5N, 348E-20E). (b) September sea ice extent trend as a function of the the linear trend in (a). Velocity trends that are statistically significant at the 95 % level are hatched.

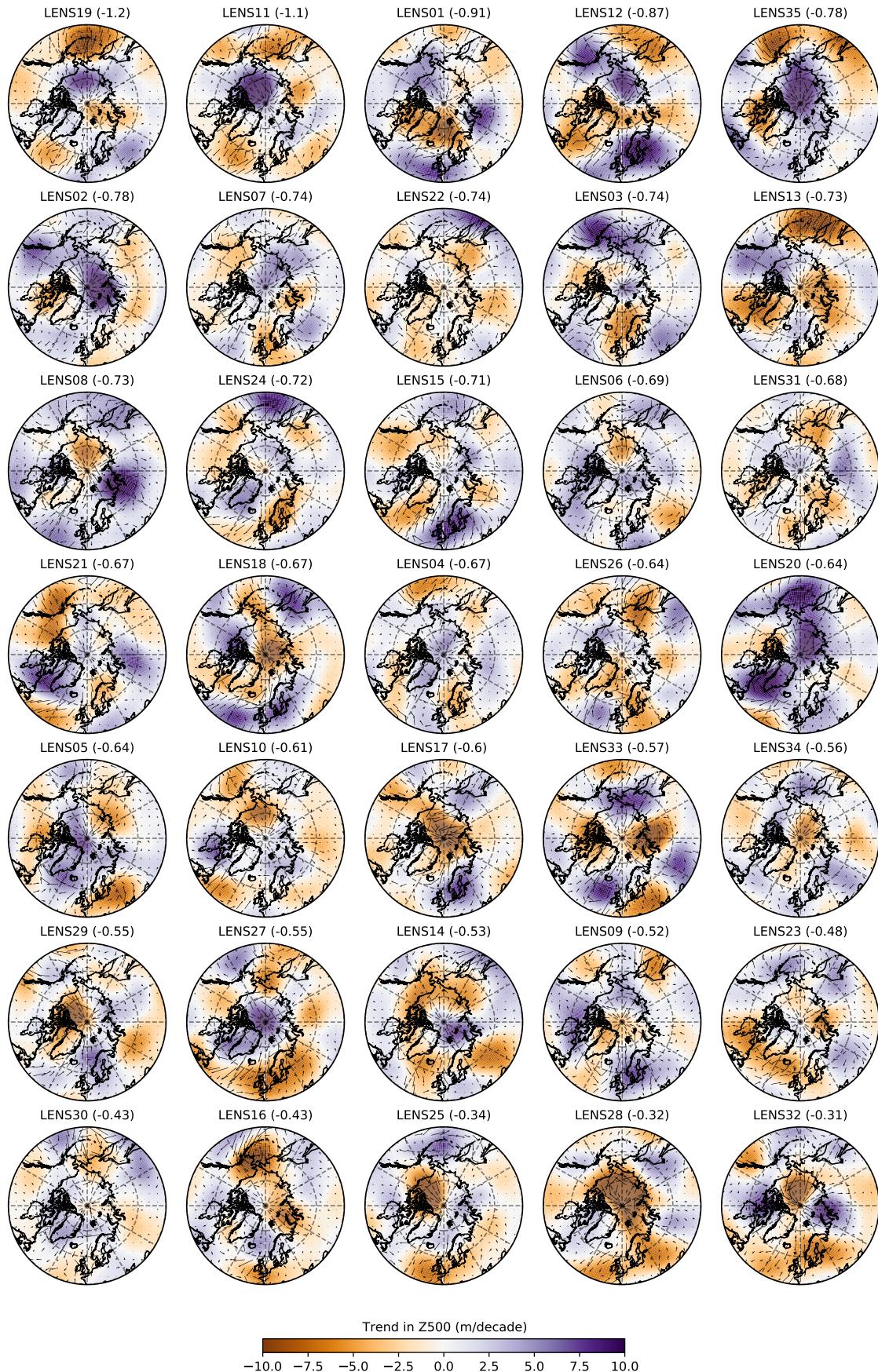


Figure S12. Fig. S12. Difference in September sea ice extent trends between each individual LENS member and the LENSmean in (colours) Z500 and (vectors) surface winds. The ensemble members are ordered from most to least September sea ice loss. The September sea ice extent trend over 1979-2018 for each ensemble member is noted in brackets (in million km² decade⁻¹).