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Supplementary Materials for

Overlooked possibility of a collapsed Atlantic Meridional Overturning Circulation in warming climate

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This PDF file includes:

Supplementary Figures

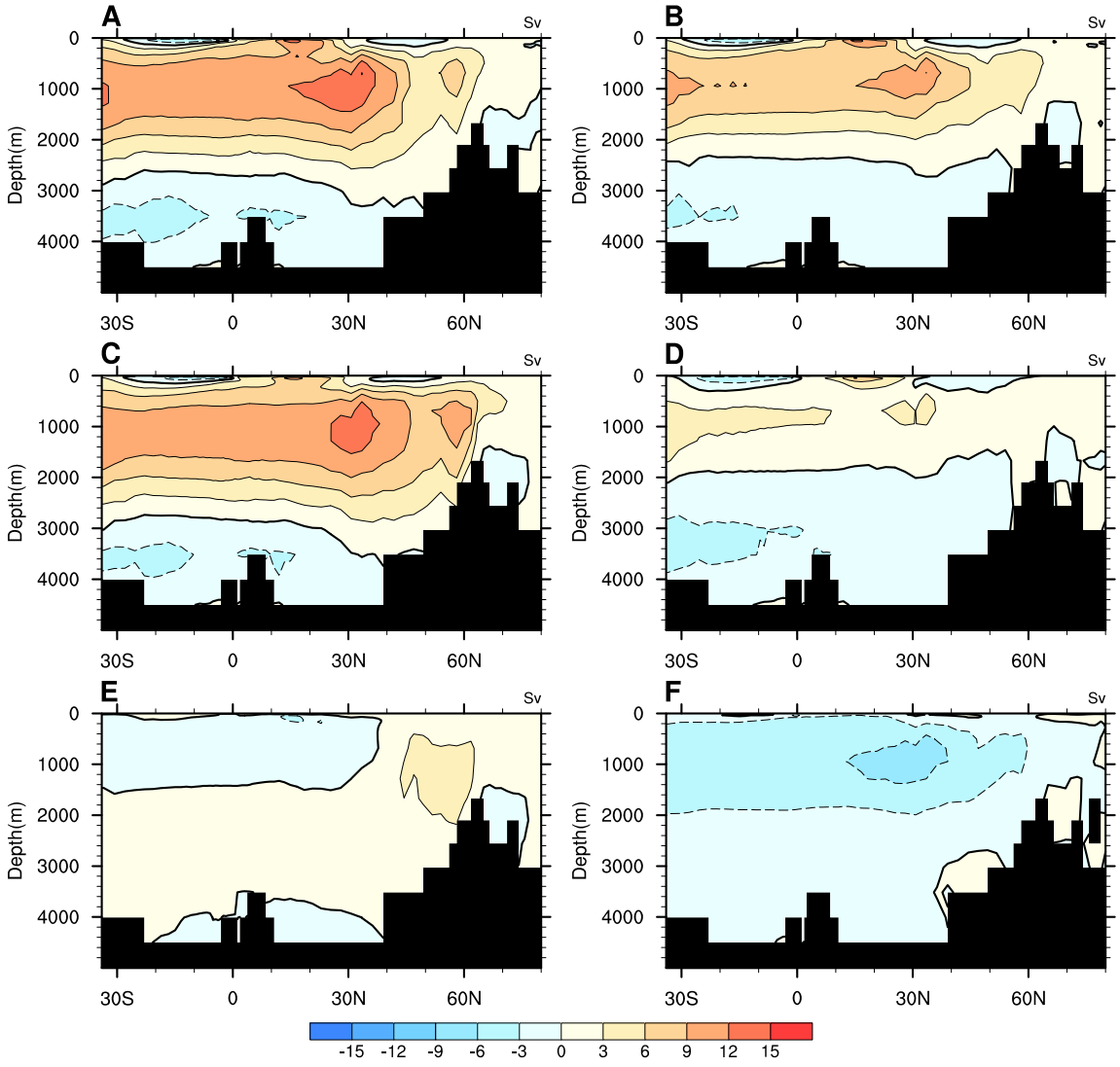

fig. S1. The depth and latitude diagram of annual mean AMOC stream function. (shading in Sv, 1 Sv = $10^6 m^3/s$) for (**A**) year 101-200 average in the CTL, (**B**) year 501-600 average in the $CTLCO_2$, (**C**) year 101-200 average in the ADJ and (**D**) year 501-600 average in the $ADJCO_2$. Panels (**E**) and (**F**) show the difference between (C) and (A) and between (D) and (B), respectively.

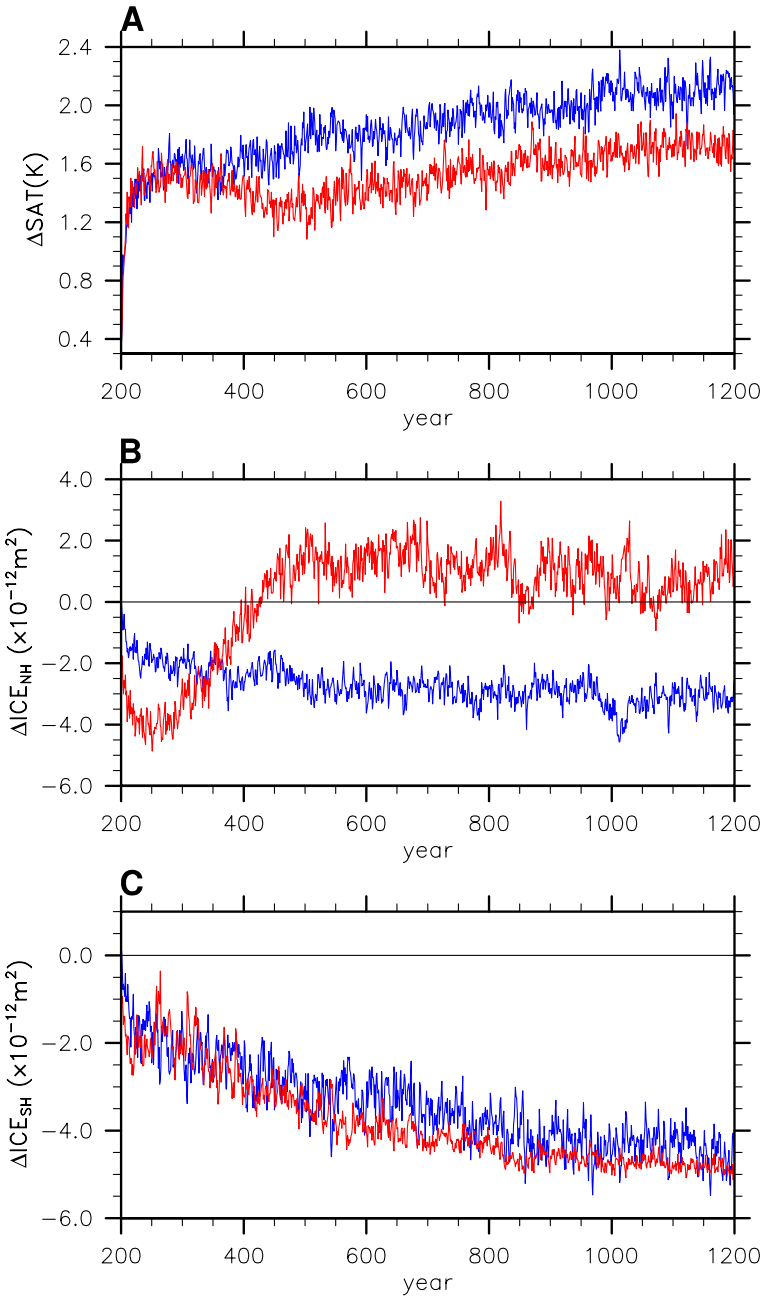

fig. S2. Annual mean anomalies in double CO_2 simulations. (relative to the climatology in the CTL or ADJ) for (**A**) global mean surface air temperature and sea ice area in the (**B**) Northern Hemisphere and (**C**) Southern Hemisphere in the CTLCO_2 (blue) and ADJCO_2 (red).

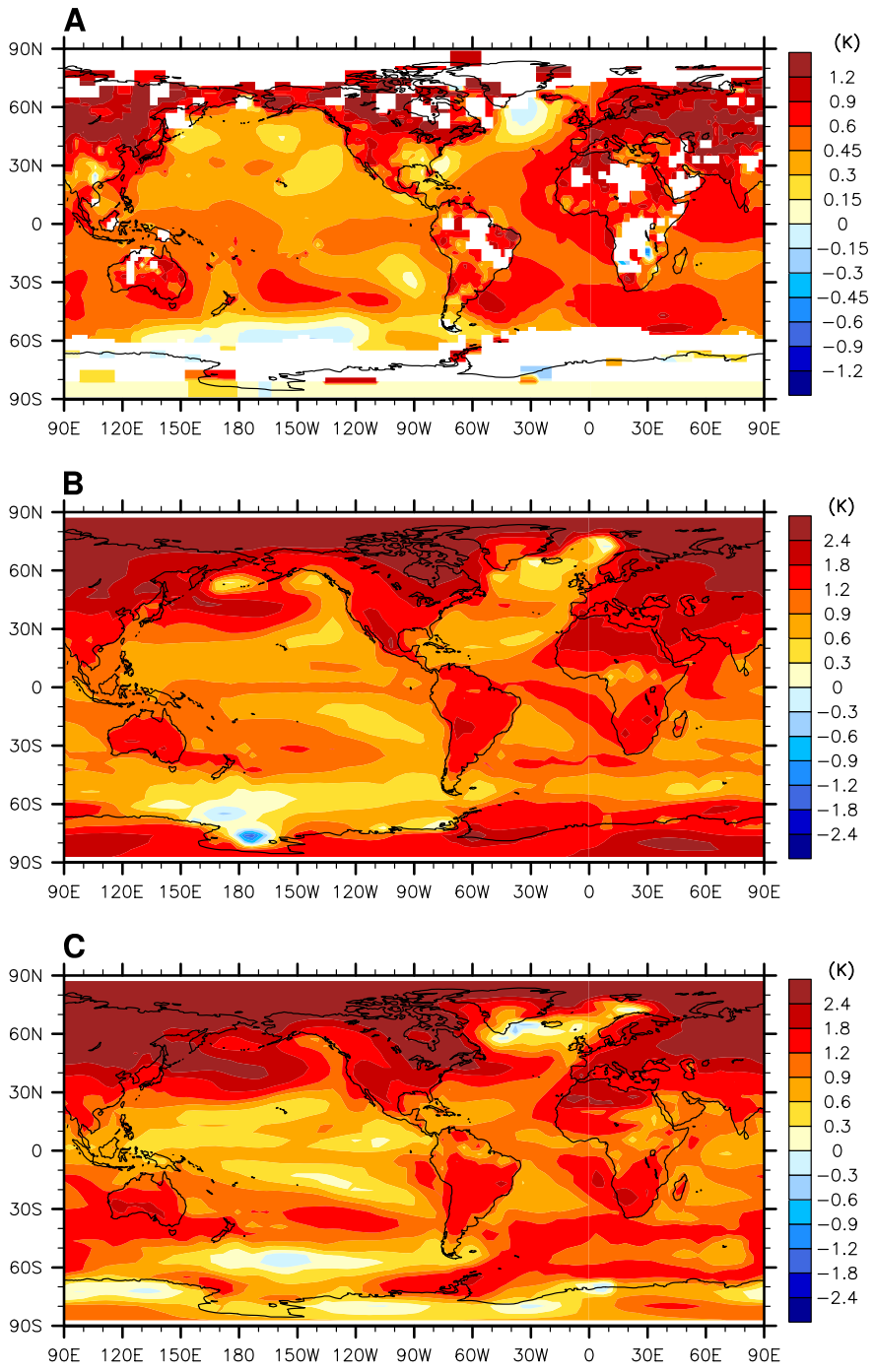

fig. S3. Short-term (0 to 30 years) surface temperature response to CO_2 increase. (**A**) The annual mean temperature difference from the GISTEMP (*39*) between 1990-2014 and 1880-1989 (shading in K). (**B**) The annual mean temperature change during the first three decades in the CTLCO_2 (shading in K). (**C**) Similar to (b) but for the change in the ADJCO_2.

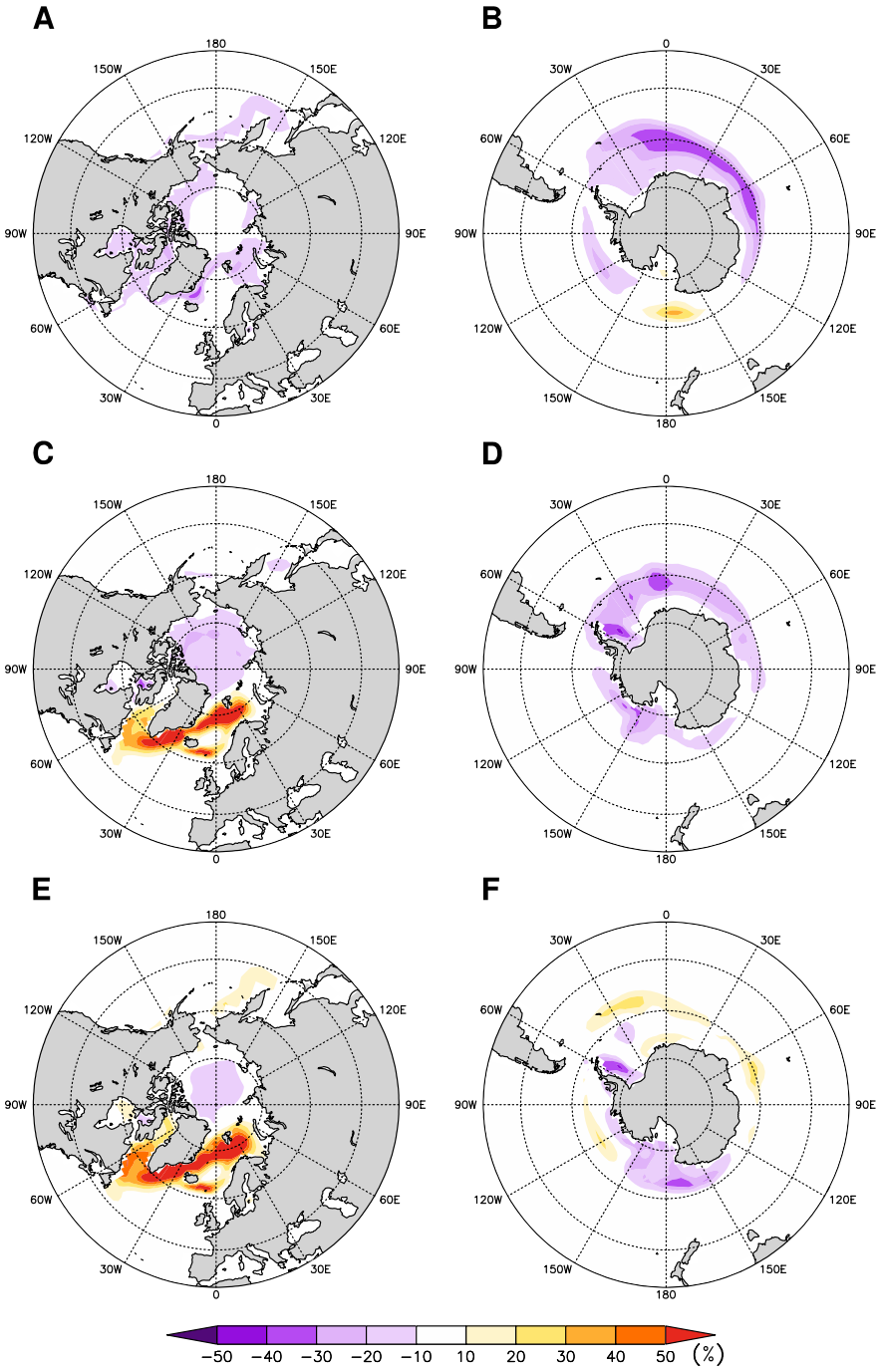

fig. S4. Long-term (after 300 years) response of sea ice coverage to CO_2 increase. Left column shows annual mean sea ice converge in the Northern Hemisphere (shading in percentage): (**A**) the CTLCO_2 minus the CTL, (**C**) the ADJCO_2 minus the ADJ, and (**E**) the difference between (C) and (A). Right column is similar to left column but for the results in the Southern Hemisphere.

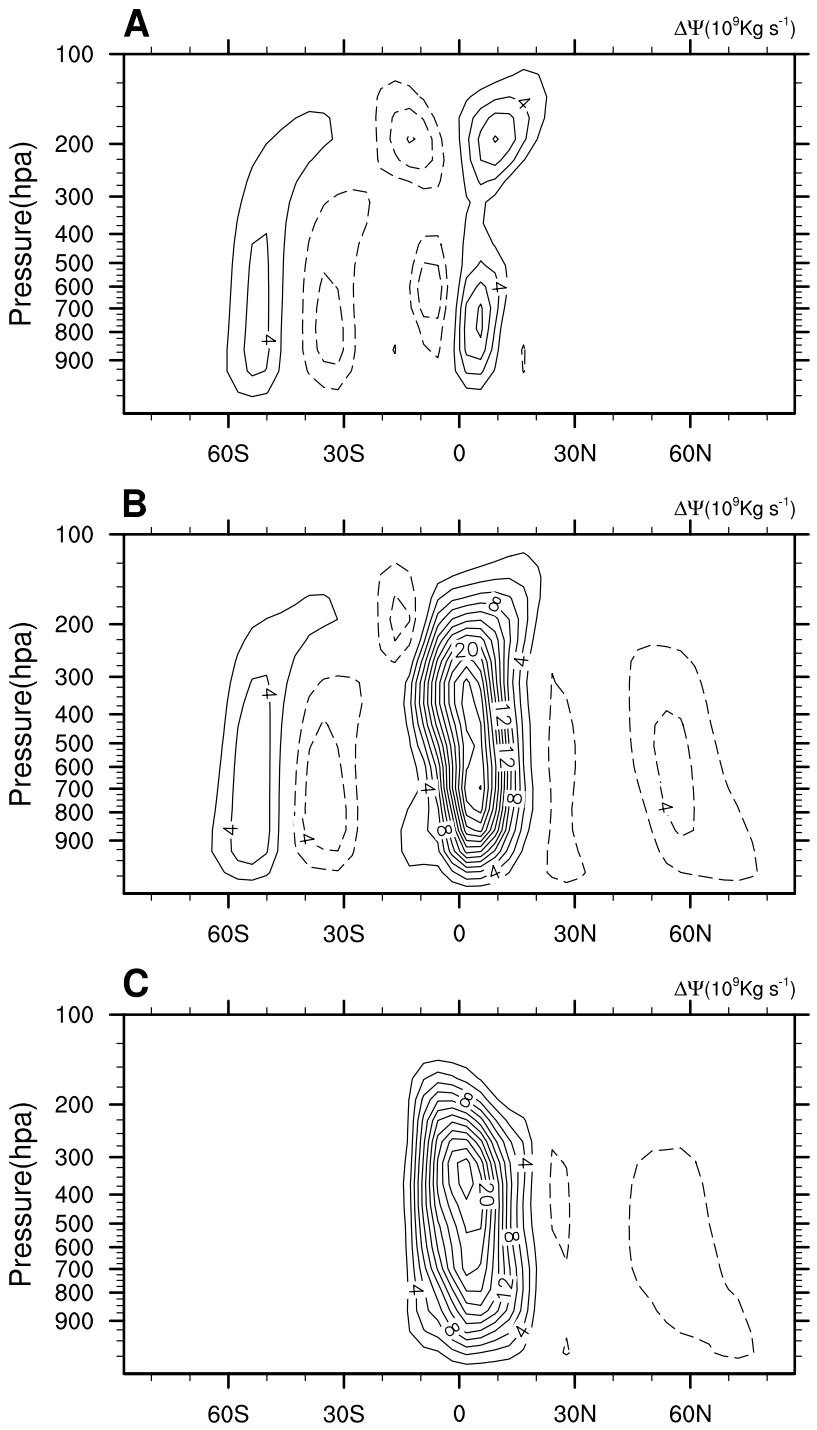

fig. S5. Response of the Hadley cell 300 years after CO_2 increase. The altitude and latitude diagram of annual mean atmospheric mass stream-function (contour in 10^9Kg s^{-1}) for (**A**) the CTLCO_2 minus the CTL (**B**) the ADJCO_2 minus the ADJ and (**C**) the difference between (B) and (A).

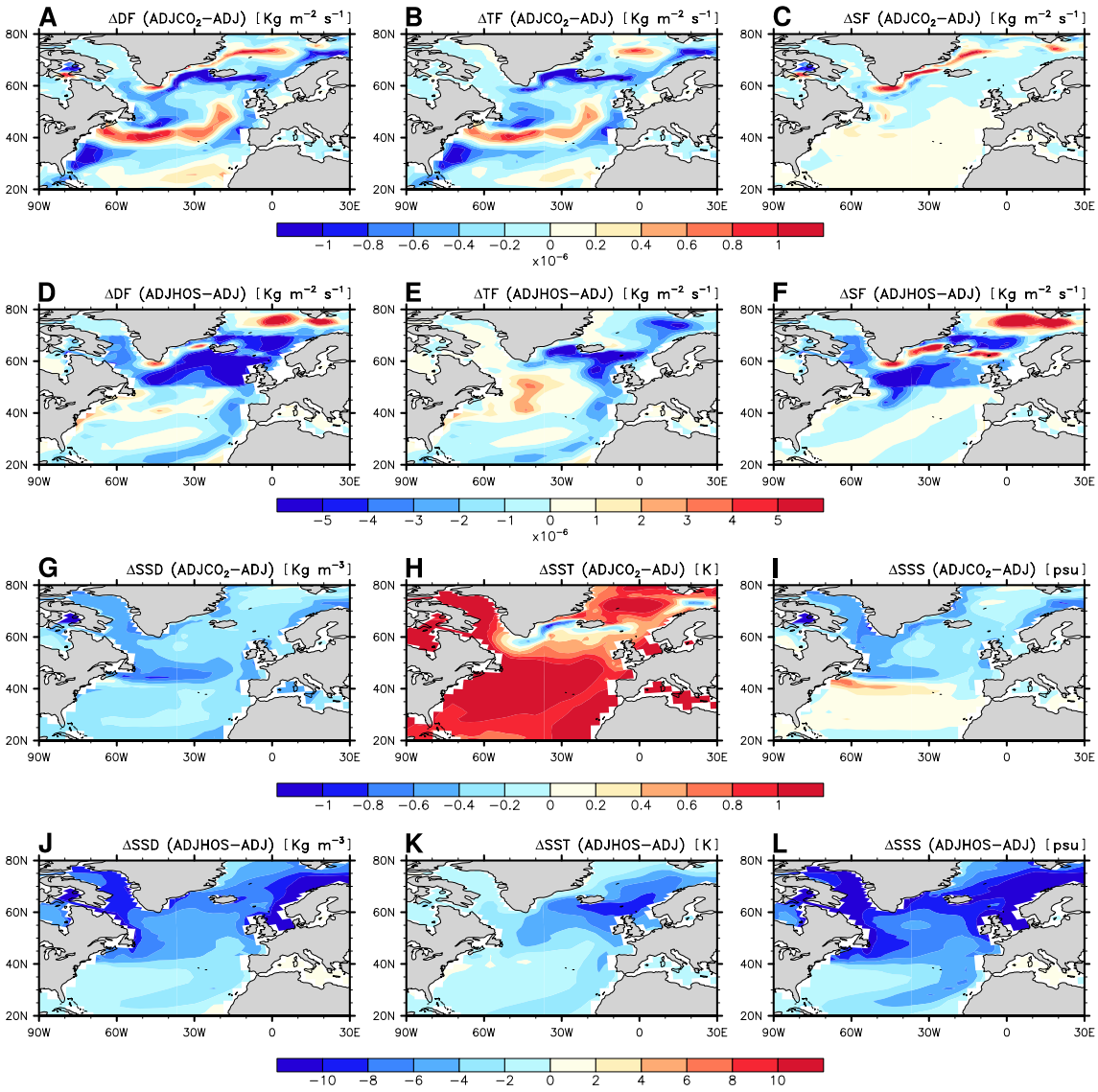

fig. S6. Changes in the surface fluxes and variables over the North Atlantic in the first 30 years after CO_2 increase. The top panel shows the change of (**A**) density flux (DF) and (**B**) thermal (TF) and (**C**) haline (SF) contributions (shading in Kg m^{-2} s^{-1}) in the double CO_2 experiment (the $ADJCO_2$ minus the ADJ). The second panel is similar to the top panel but for the results from the hosing experiment (14) (the ADJHOS minus the ADJ). The third panel is similar to the top panel but for the change of sea surface (**G**) density (shading in Kg m^{-3}), (**H**) temperature (shading in **K**) and (**I**) salinity (shading in psu). The bottom panel is similar to the third panel but for the results from the hosing experiment.

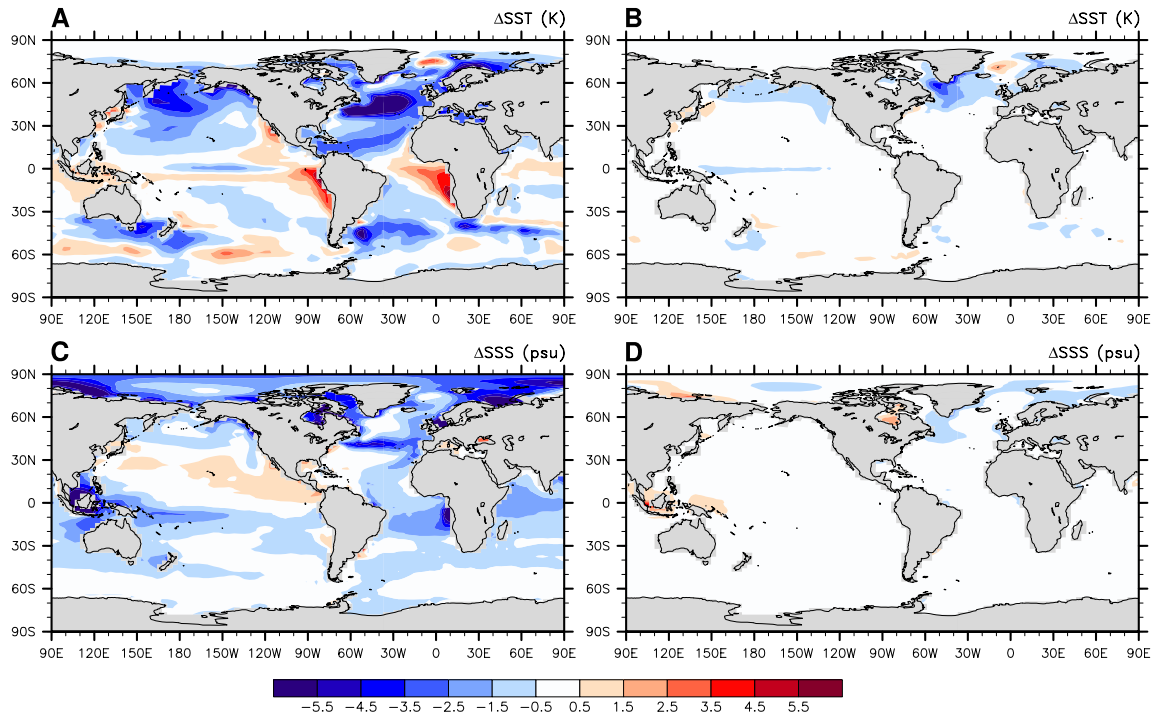

fig. S7. Annual mean SST and SSS biases. Panels (**A**) and (**C**) show the results from the CTL, and panels (**B**) and (**D**) show the results from the ADJ.

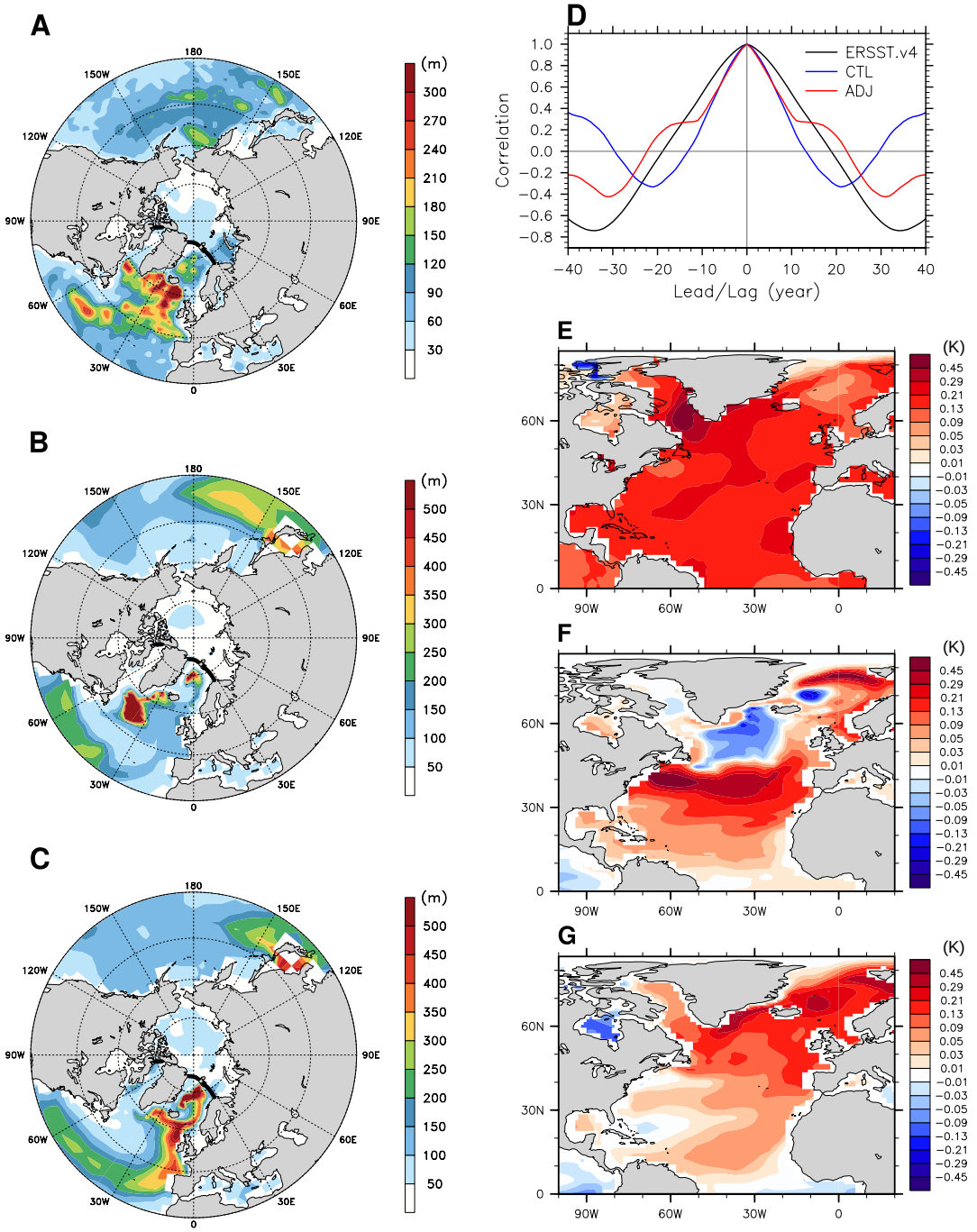

fig. S8. Observed and simulated formation areas of NADW and Atlantic multidecadal oscillation. The formation areas of NADW are estimated as the sites of deep mixed layer in boreal winter in the northern North Atlantic. Left column shows March mixed layer depth (shading in m) in (**A**) observation (MIMOC) (*38*), (**B**) the CTL and (**C**) the ADJ. The northern boundary of the Atlantic is denoted by thickened black

curves. Right column shows observed and simulated AMO in modern climate. (**D**) Autocorrelation of the Atlantic multidecadal oscillation (AMO) index in observation (ERSST.v4 (*36*, *37*), black), the CTL (blue) and the ADJ (red) with lags from -40 to 40 years. (**E**)-(**G**) Regression of the North Atlantic SST on the normalized AMO index (shading in K) for (E) observation (ERSST.v4), (F) the CTL and (G) the ADJ.

Supplementary Table

table S1. The CMIP5 models used in this study and their sponsors, countries, and names.

Sponsor, Country	Model Name
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	ACCESS1.3
Beijing Climate Center (BCC), China	bcc-csm-1-1
	bcc-csm-1-1-m
Canadian Center for Climate Modeling and Analysis, Canada	CanESM2
National Center for Atmospheric Research (NCAR), USA	CCSM4
	CESM1-BGC
	CESM1-CAM5
	CESM1-FASTCHEM
	CESM1-WACCM
Météo-France/Centre National de Recherches Météorologiques, France	CNRM-CM5
National Oceanic and Atmospheric Administration (NOAA)/Geophysical Fluid Dynamics Laboratory (GFDL), USA	GFDL-CM3
	GFDL-ESM2G
	GFDL-ESM2M
National Aeronautics and Space Administration (NASA)/Goddard Institute for Space Studies (GISS), USA	GISS-E2-R
	GISS-E2-R-CC
Met office Hadley Center, UK	HadGEM2-AO
	HadGEM2-CC
	HadGEM2-ES
Center for Climate System Research (University of Tokyo), National Institute for Environmental Studies, and Frontier Research Center for Global Change (JAMSTEC), Japan	MIROC-ESM
	MIROC-ESM-CHEM