

# Supporting Information for “Non-monotonic feedback dependence under abrupt CO<sub>2</sub> forcing due to a North Atlantic pattern effect”

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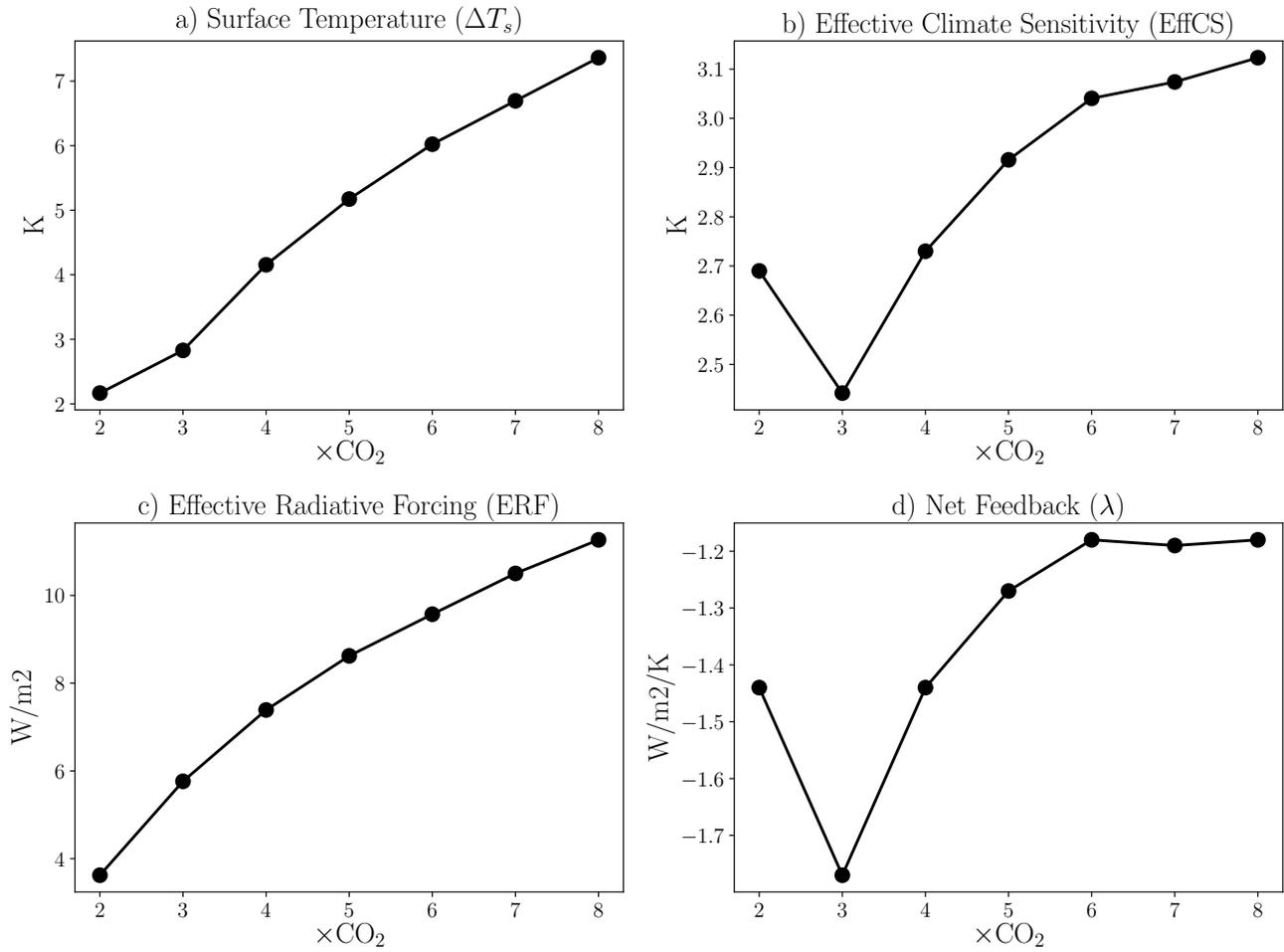
Science, University Corporation for Atmospheric Research, Boulder, CO

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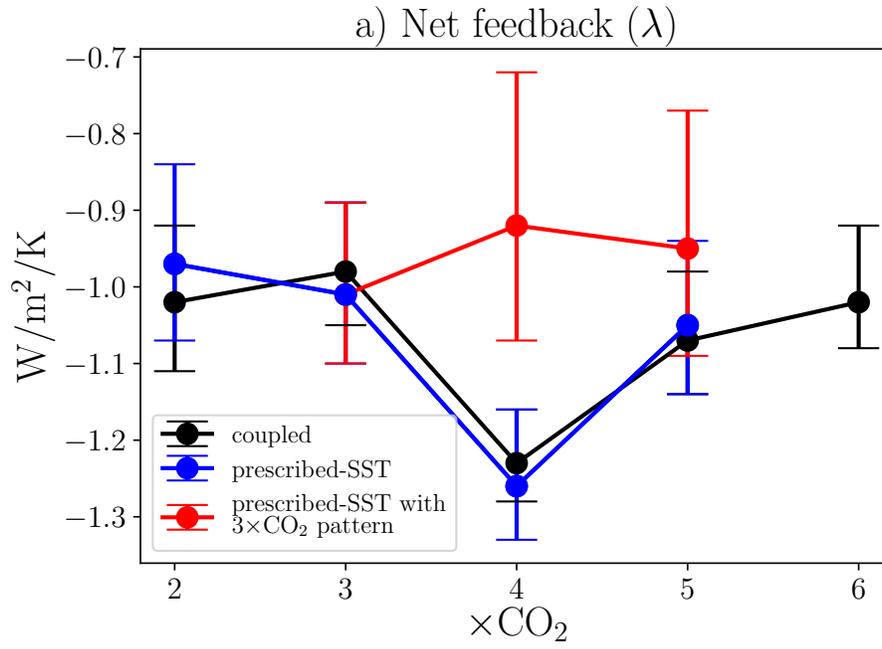
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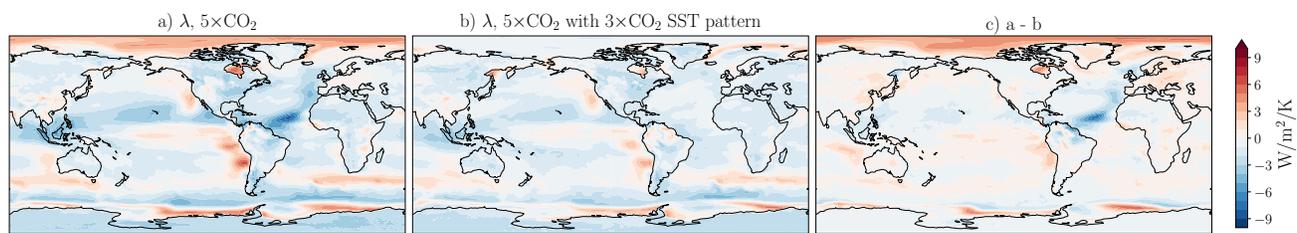
Figures S1-S7.



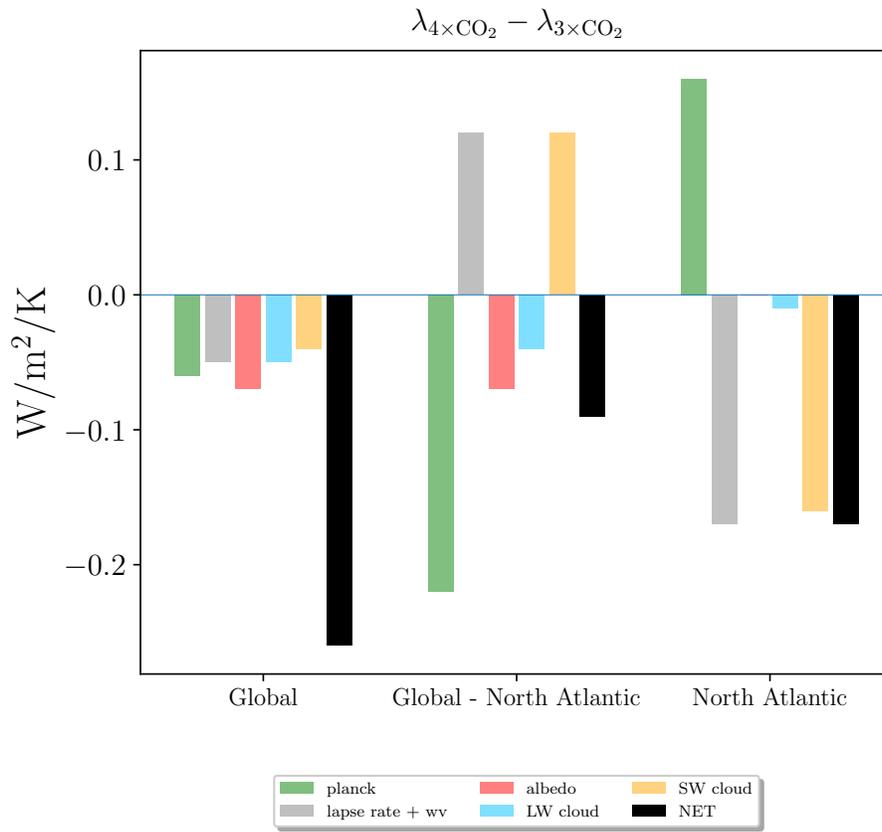
**Figure S1.** Same as Figure 1 in main text but for the GISS-E2.1-G model.



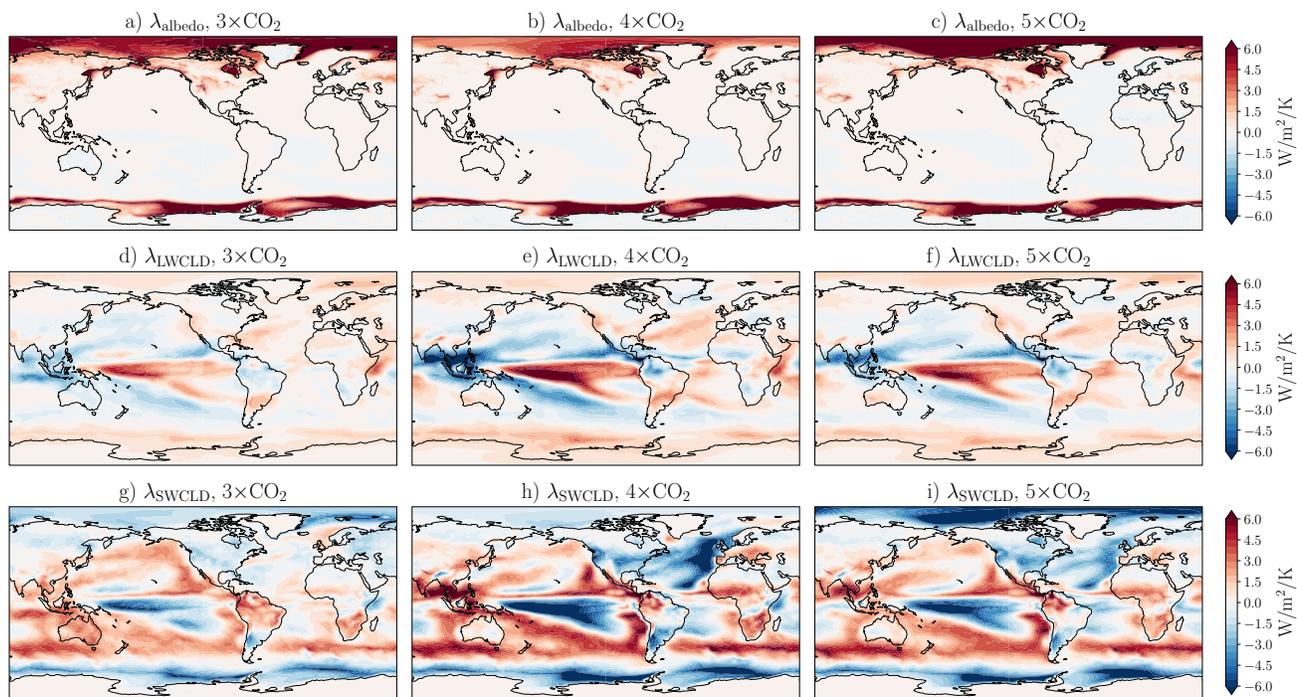
**Figure S2.** Same as Figure 2a in main text but with 95% confidence intervals. The confidence intervals are 95% obtained by resampling the linear regressions 10,000 times.



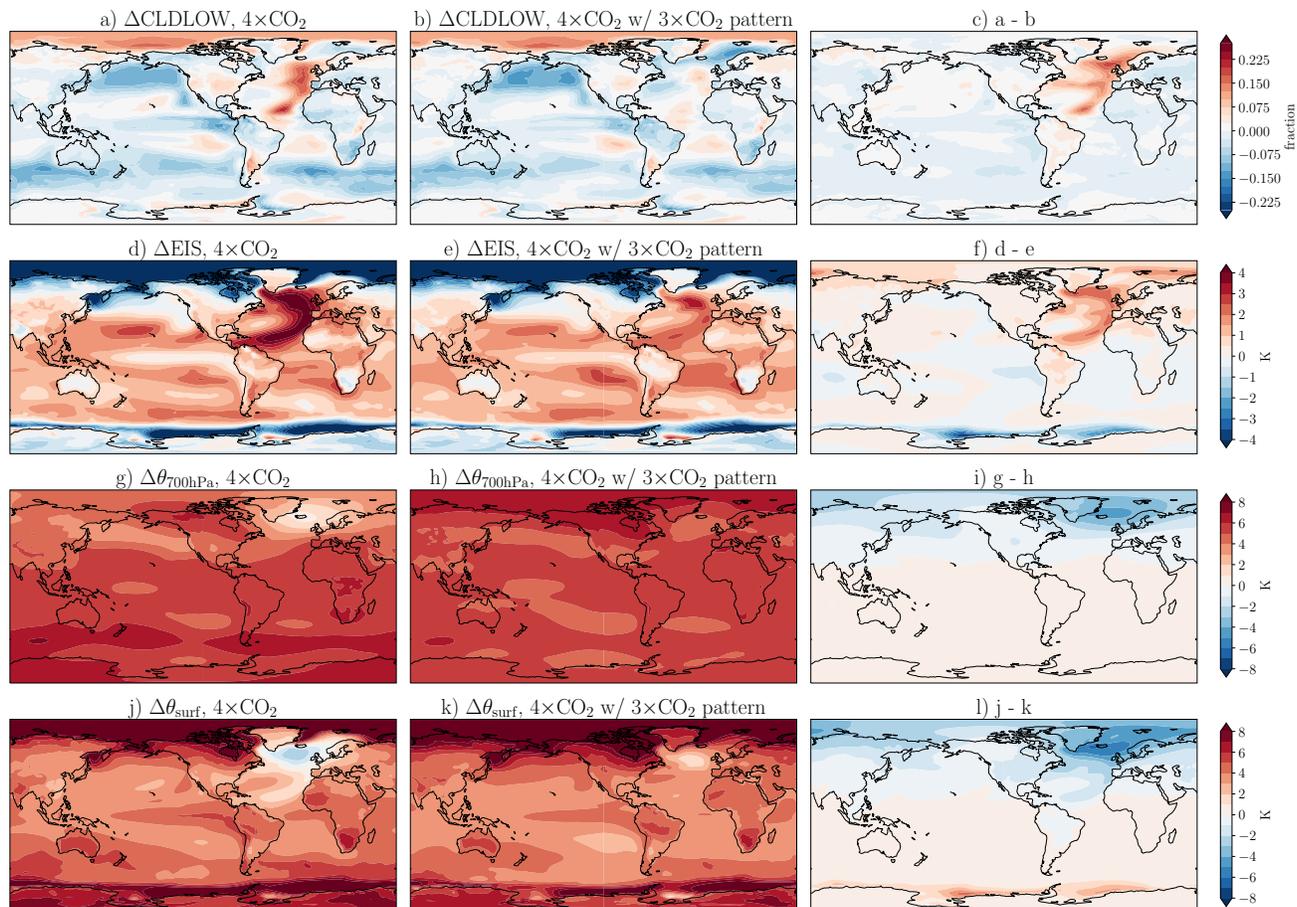
**Figure S3.** Same as Figure 2b-d in main text but for  $5\times CO_2$ .



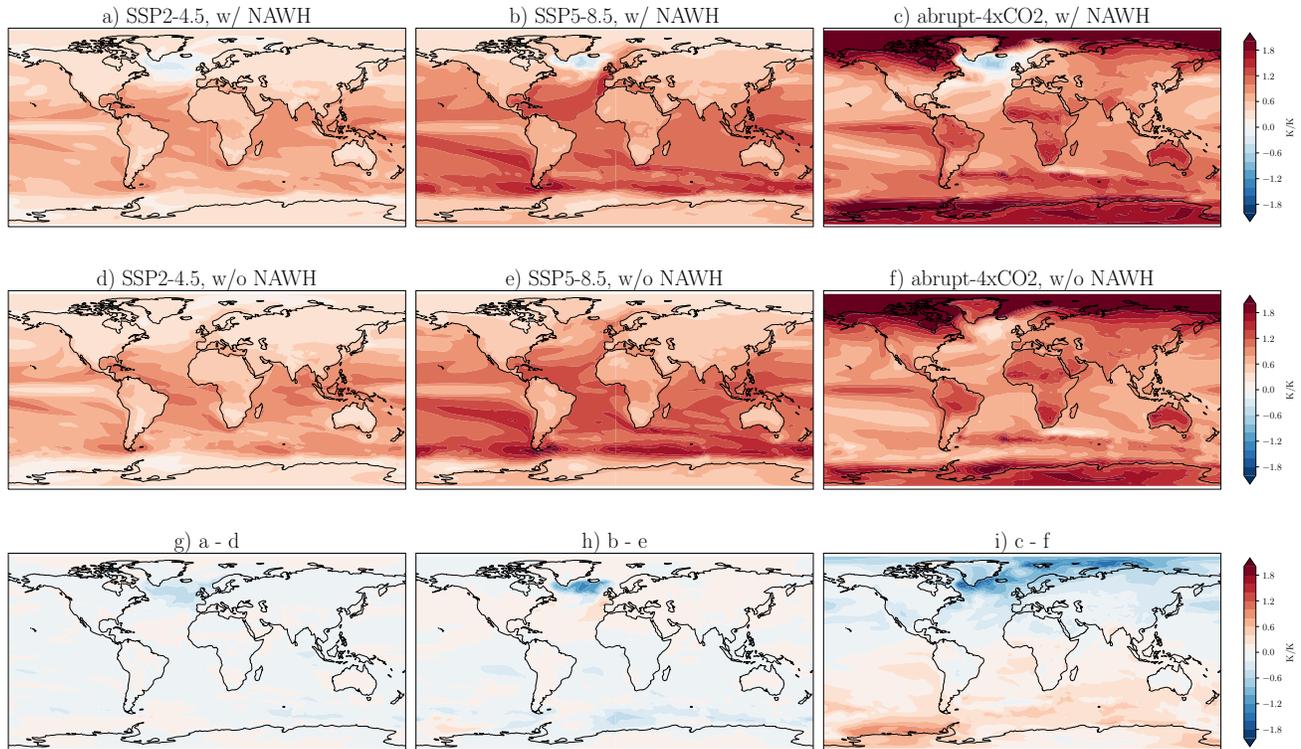
**Figure S4.** Individual feedback difference between  $4\times\text{CO}_2$  and  $3\times\text{CO}_2$  for Global, Global - North Atlantic, and the North Atlantic region. The North Atlantic is defined as a box between 0 to 60N and 80W to 10E.



**Figure S5.** Maps of individual feedbacks calculated from prescribed-SST runs for: a-c) albedo, d-f) longwave cloud, and g-i) shortwave cloud.



**Figure S6.** Maps of a-c) low cloud content, d-f) estimated inversion strength (EIS), and potential temperature g-j) near 700 hPa and j-l) surface. The left panels (a,d,g,j) are  $4\times\text{CO}_2$  runs with with prescribed-SSTs, middle panels (b,e,h,k) are  $4\times\text{CO}_2$  runs with  $3\times\text{CO}_2$  pattern, and the left panels (c,f,i,l) are the difference.



**Figure S7.** Maps of surface temperature patterns from two CMIP6 models composites with (a,b,c) and without (d,e,f) North Atlantic Warming Hole (NAWH), defined as cooling in the North Atlantic, and the difference (g,h,i). Composites are shown for SSP2-4.5 (a,d,g), SSP5-8.5 (b,e,h), and abrupt-4xCO<sub>2</sub> scenario (c,f,i). The models without NAWH are ACCESS-CM2, AWI-CM-1-1-MR, CAMS-CSM1-0, CMCC-CM2-SR5, CanESM5, INM-CM4-8, IPSL-CM6A-LR, MIROC6, MPI-ESM1-2-HR, MPI-ESM1-2-LR. Models with NAWH are BCC-CSM2-MR, CESM2-WACCM, FGOALS-g3, GFDL-ESM4, IITM-ESM, KACE-1-0-G, MRI-ESM2-0, NorESM2-MM, TaiESM1. The surface temperature patterns are calculated as local surface temperature changes regressed to global surface temperature response for years 2015 to 2100 for the SSP scenarios and the first 150 years of the abrupt-4xCO<sub>2</sub> runs, and then averaged across models.