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Response of the AMOC to reduced solar radiation – the modulating role of atmospheric chemistry

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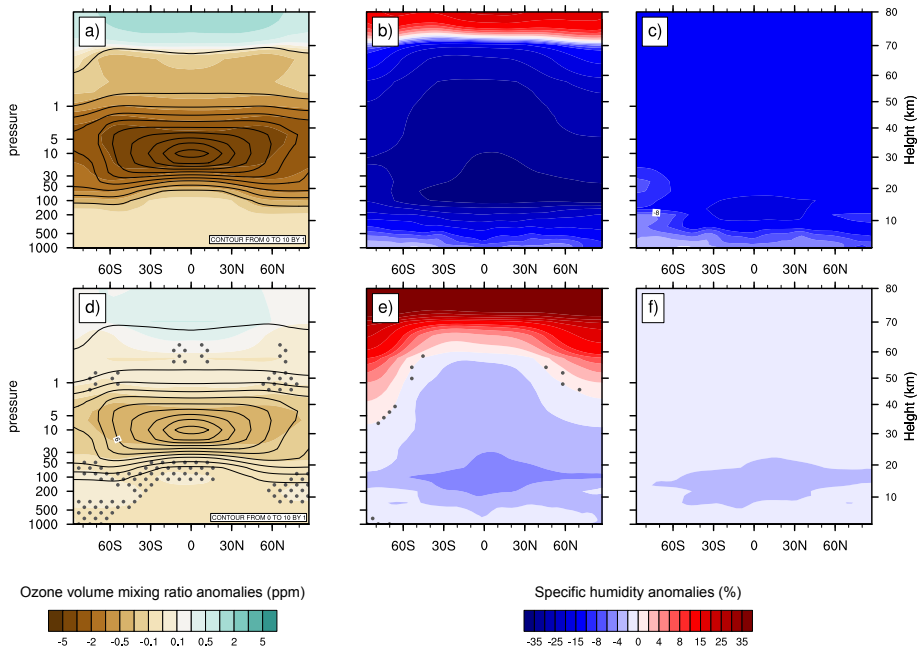

Figure S1. Differences in the ozone mixing ratios (ppm) in the (a) S2_CHEM and (d) S1_CHEM ensemble experiment with respect to the reference ensemble. Anomalies are calculated over the full solar radiation reduction (SRR) period of 30 years. Contours denote the climatological ozone distribution in the reference experiment. Relative water vapour change (%) during the SRR in comparison to the reference for (b) S2_chem, (c) S2_NOCHEM, (e) S1_CHEM, and (f) S1_NOCHEM. Dots denotes non-significant differences (Students t-test, $p>0.05$).

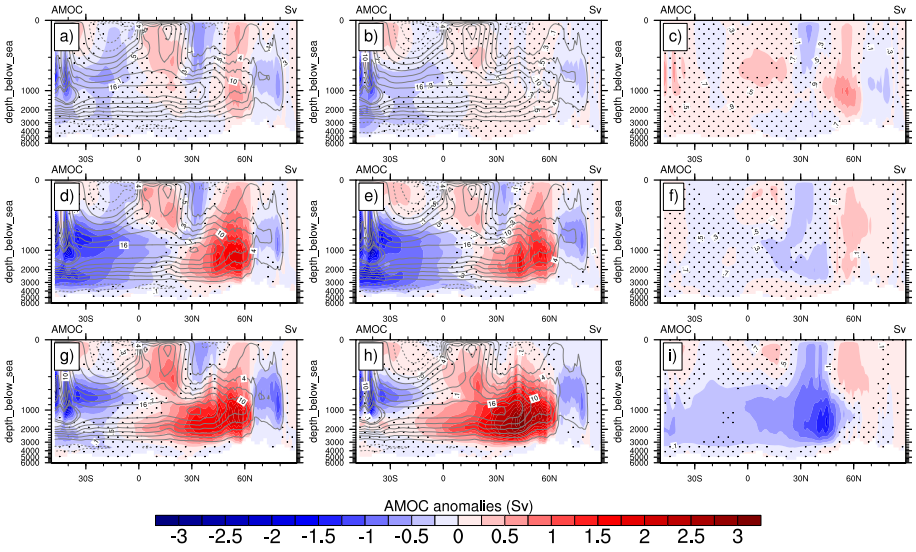

Figure S2. Atlantic meridional overturning streamfunction anomalies (Sv) for (a,d,g) S2_CHEM and (b,e,h,e) S2_NOCHEM and (c,f,i) the difference between the two experiments (S2_CHEM – S2_NOCHEM). Top row (a-c) displays anomalies for the first 10 years of the solar reduction period; anomalies for the second decade are shown in middle (d-f) and the last decade is shown in the bottom row (g-i). Dots denotes non-significant differences (Students t-test, $p>0.05$).

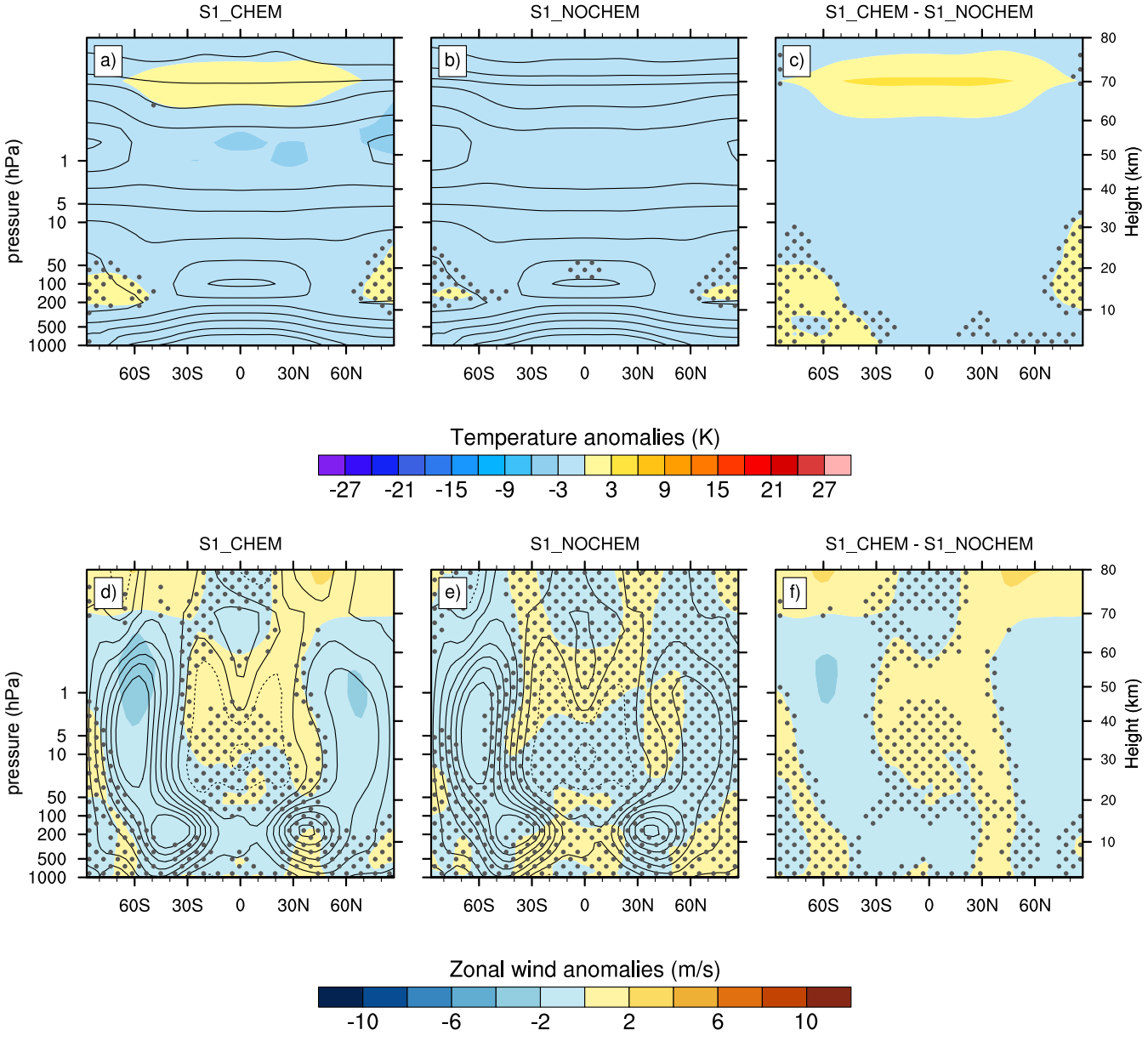

Figure S3. Similar to Fig. 5, but for the S1 experiments.

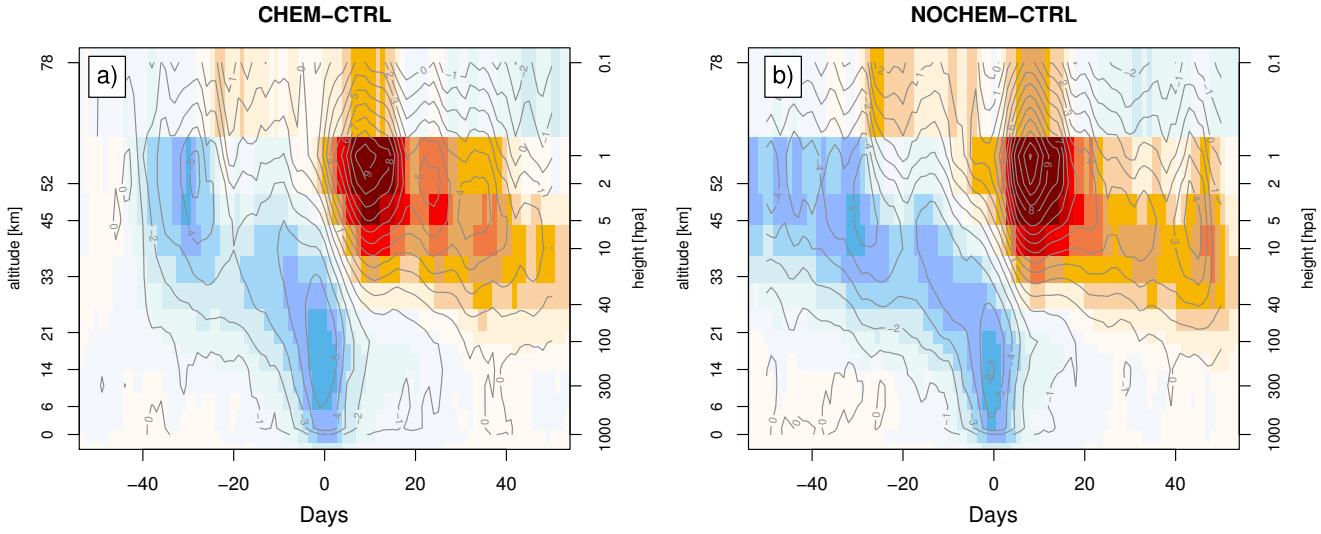

Figure S4. October to April composite of the zonal mean zonal wind at 60°N for a negative state of the Arctic Oscillation (daily AO index $\leq -2\sigma$) for CHEM_CTRL (a) and NOCHEM_CTRL (b). Day zero represents the date where an AO index $\leq -2\sigma$ occurred; for days > 0 represent the zonal wind conditions up to 50 days after this event and days < 0 the preceeding 50 days. Contours and shadings from –8 to 8 m/s (contour step 1 m/s).

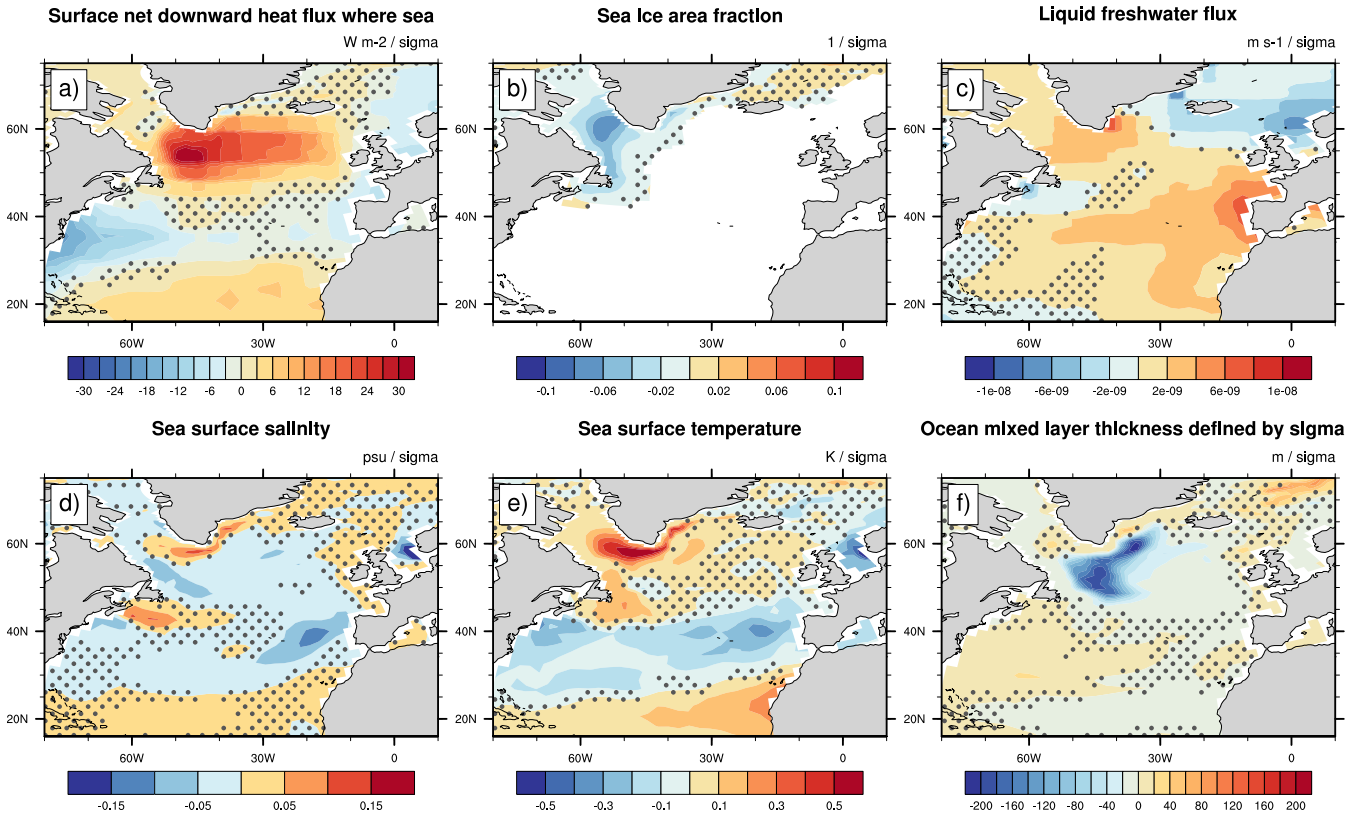

Figure S5. Similar to Fig. 8, but for CTRL_NOCHEM.

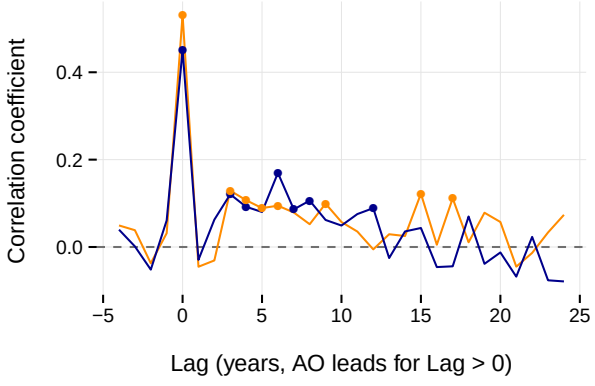

Figure S6. Pearson correlation coefficients between winter (Nov. – Mar.) AO and AMOC index in CTRL_CHEM (orange) and CTRL_NOCHEM (blue). Significant correlation coefficients ($p<0.05$) are highlighted by dots.

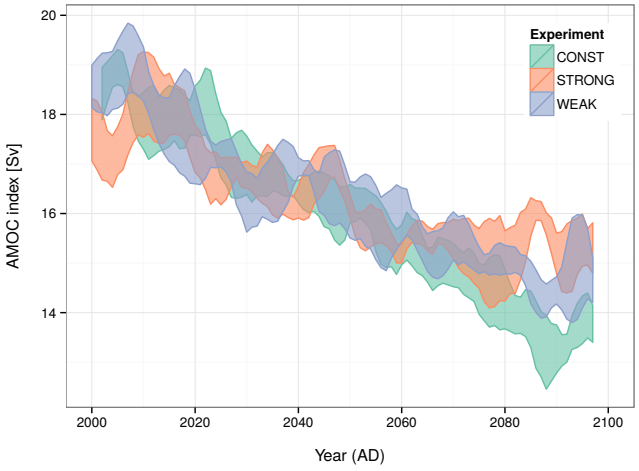

Figure S7. AMOC index in experiments of Anet et al. (2013). CONST: constant solar forcing, WEAK: weak solar minimum with an amplitude of 4 Wm^{-2}, and STRONG: TSI reduction of 6 Wm^{-2}. Each experiment consists of two simulations and all experiments were performed under the RCP 4.5 scenario (see details in Anet et al., 2013). Shadings resemble the spread of two simulations. The AMOC time series are smoothed by a 11-yr low pass filter.

References

Anet, J. G., Rozanov, E. V., Muthers, S., Peter, T., Brönnimann, S., Arfeuille, F., Beer, J., Shapiro, A. I., Raible, C. C., Steinhilber, F., and Schmutz, W. K.: Impact of a potential 21st century "grand solar minimum" on surface temperatures and stratospheric ozone, Geophys. Res. Lett., 40, 4420–4425, doi:10.1002/grl.50806, 2013.