

Supplementary material to "Response of the AMOC to reduced solar radiation – the modulating role of atmospheric-chemistry"

S. Muthers, C. C. Raible, T. F. Stocker

April 15, 2016

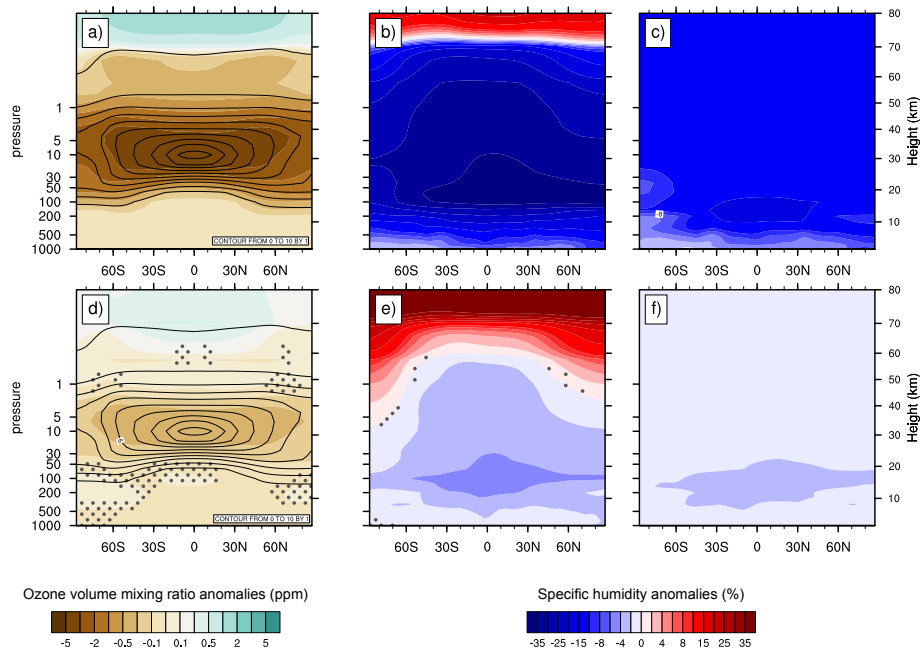


Figure S1: Differences in the ozone mixing ratios (ppm) in the (a) S2_CHEM and (d) S1_CHEM ensemble experiment with respect to the reference ensemble. Anomalies are calculated over the full solar radiation reduction (SRR) period of 30 years. Contours denote the climatological ozone distribution in the 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. Dark gray dots denotes non-significant differences (Students t-test, $p > 0.05$).

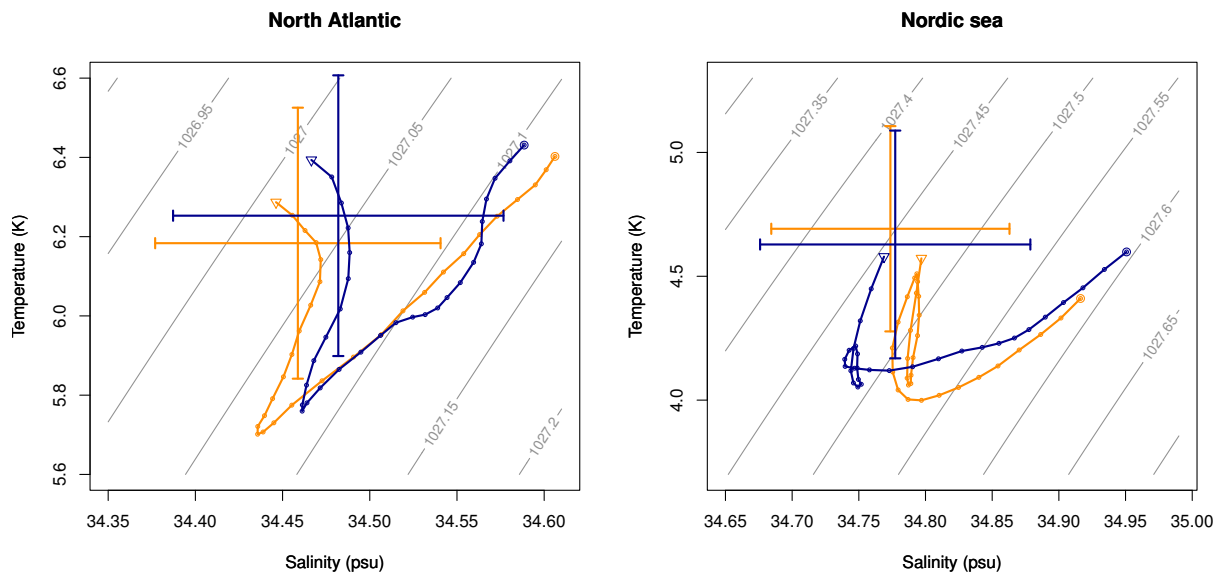


Figure S2: Temperature salinity averaged over the upper 220 m for the two deep water formation region North Atlantic and Nordic Sea. The deep water formation regions cover all grid cells with an annual mean mixed layer depth ≥ 250 m in the corresponding ocean basins. The lines show the salinity and temperature development from the beginning (triangle) to the end (large dot) of the SRR for the S2_CHEM (orange) and S2_NOCHEM (blue) experiments. To improve visibility, the values are smoothed using a 15-yr low pass filter. Error bars denote the mean and the standard deviation of the corresponding control ensembles. Contours represent the water density.

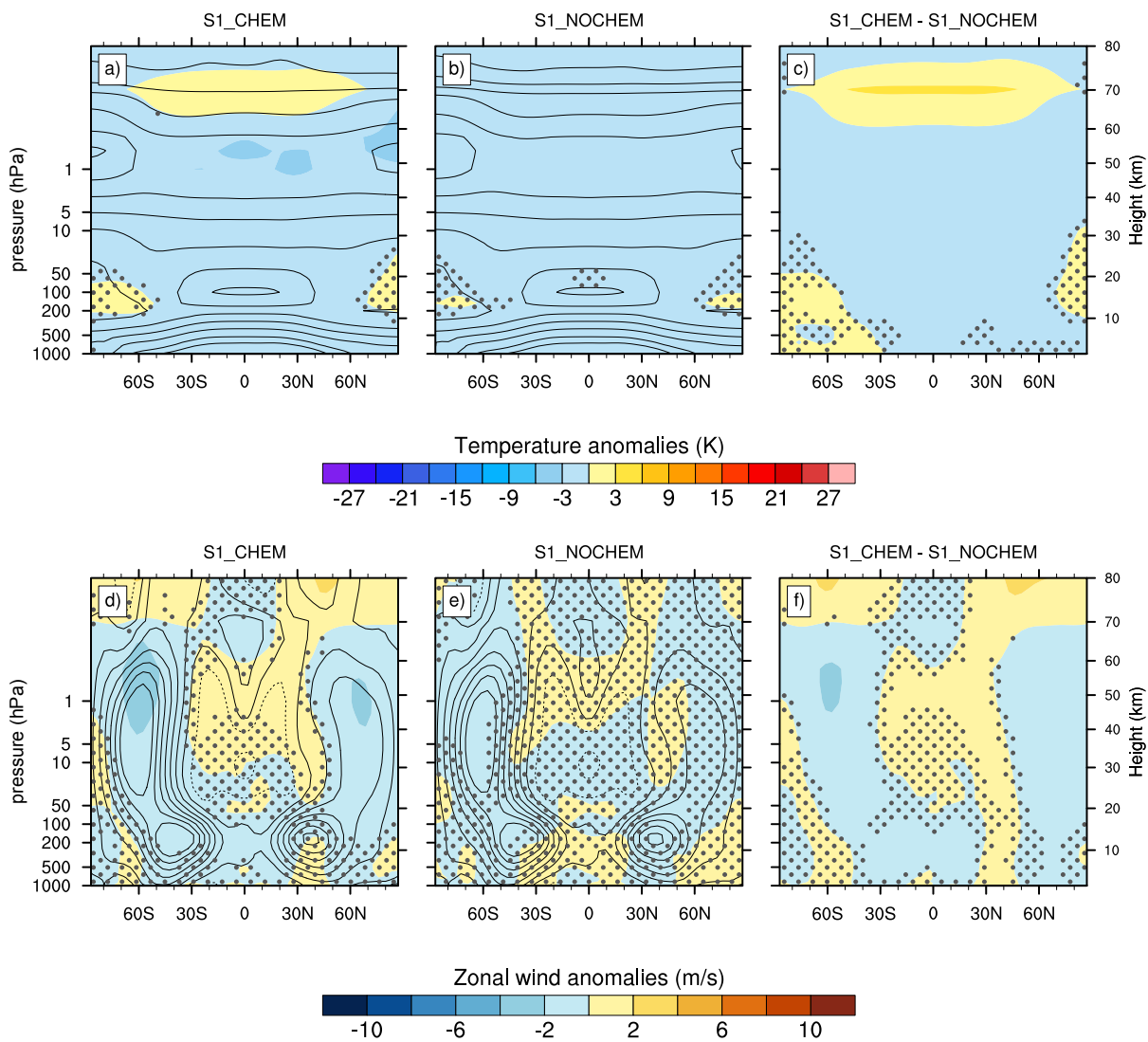


Figure S3: Similar to Fig. 4, but for the S1 experiments.

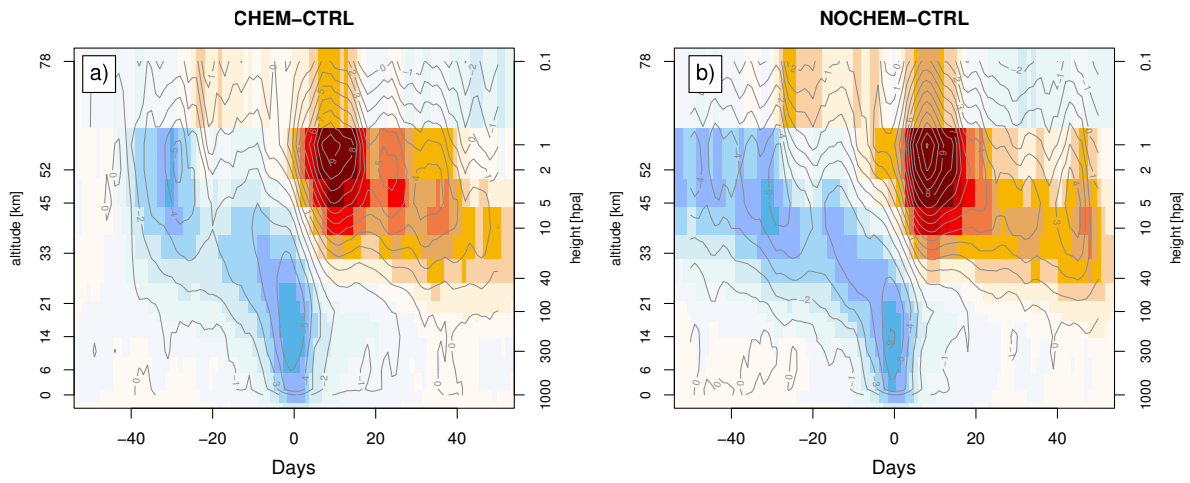


Figure S4: Oktober to April composite of the zonal mean zonal wind at 60°N for a negative state of the Arctic Oscillation (daily AO index $\leq -2\sigma$) for CHEM_CTRL (a) and NOCHEM_CTRL (b). Day zero represents the date where an AO index $\leq -2\sigma$ occurred; for days > 0 represent the zonal wind conditions up to 50 days after this event and days < 0 the preceding 50 days.

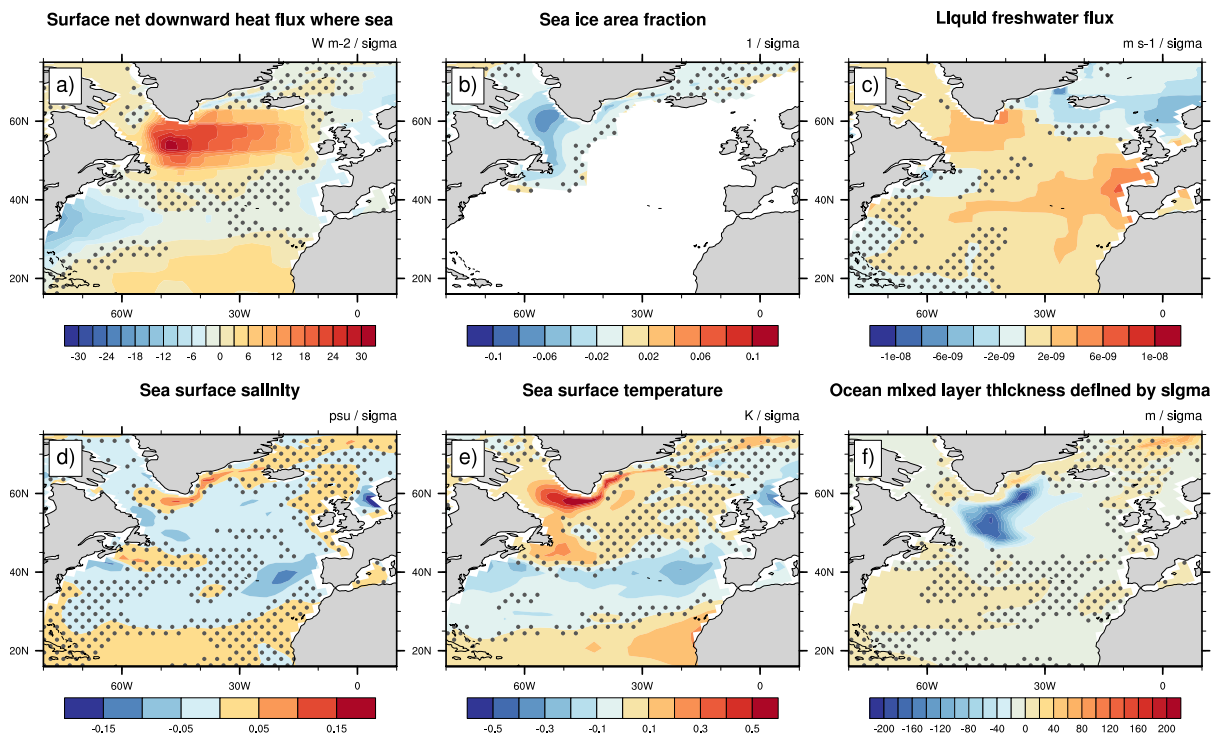


Figure S5: Similar to Fig. 7, but for CTRL_NOCHEM.

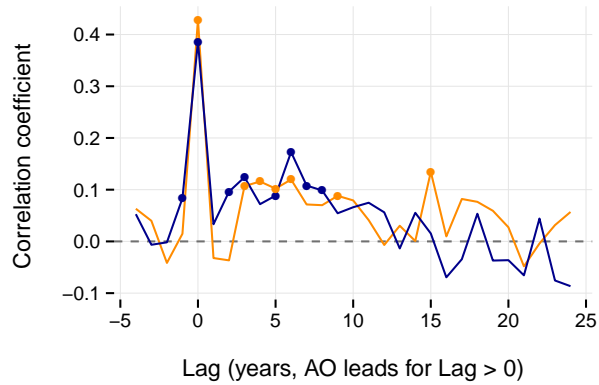


Figure S6: Pearson correlation coefficients between winter (Nov. – Mar.) AO and AMOC index in CTRL_CHEM (orange) and CTRL_NOCHEM (blue). Significant correlation coefficients ($p < 0.05$) are highlighted by dots.

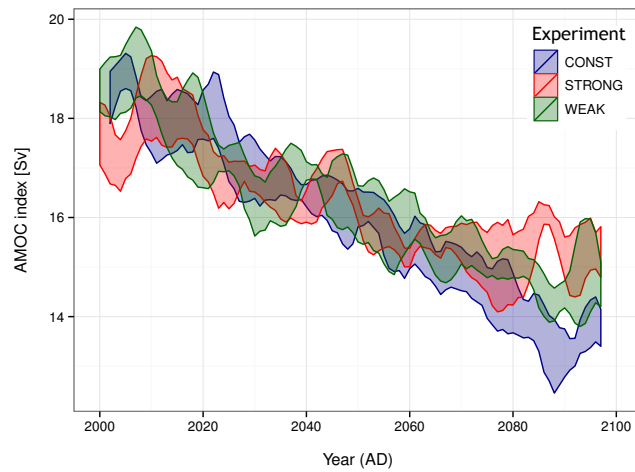


Figure S7: AMOC index in experiments of Anet et al. (2013). CONST: constant solar forcing, WEAK: weak solar minimum with an amplitude of 4 Wm^{-2} , and STRONG: TSI reduction of 6 Wm^{-2} . Each experiment consists of two simulations and all experiments were performed under the RCP 4.5 scenario (see 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.