

Supplement of

Process-level contributions to uncertainty in aerosol effective radiative forcing: a perturbed parameter ensemble with the aerosol–climate model ICON–HAM

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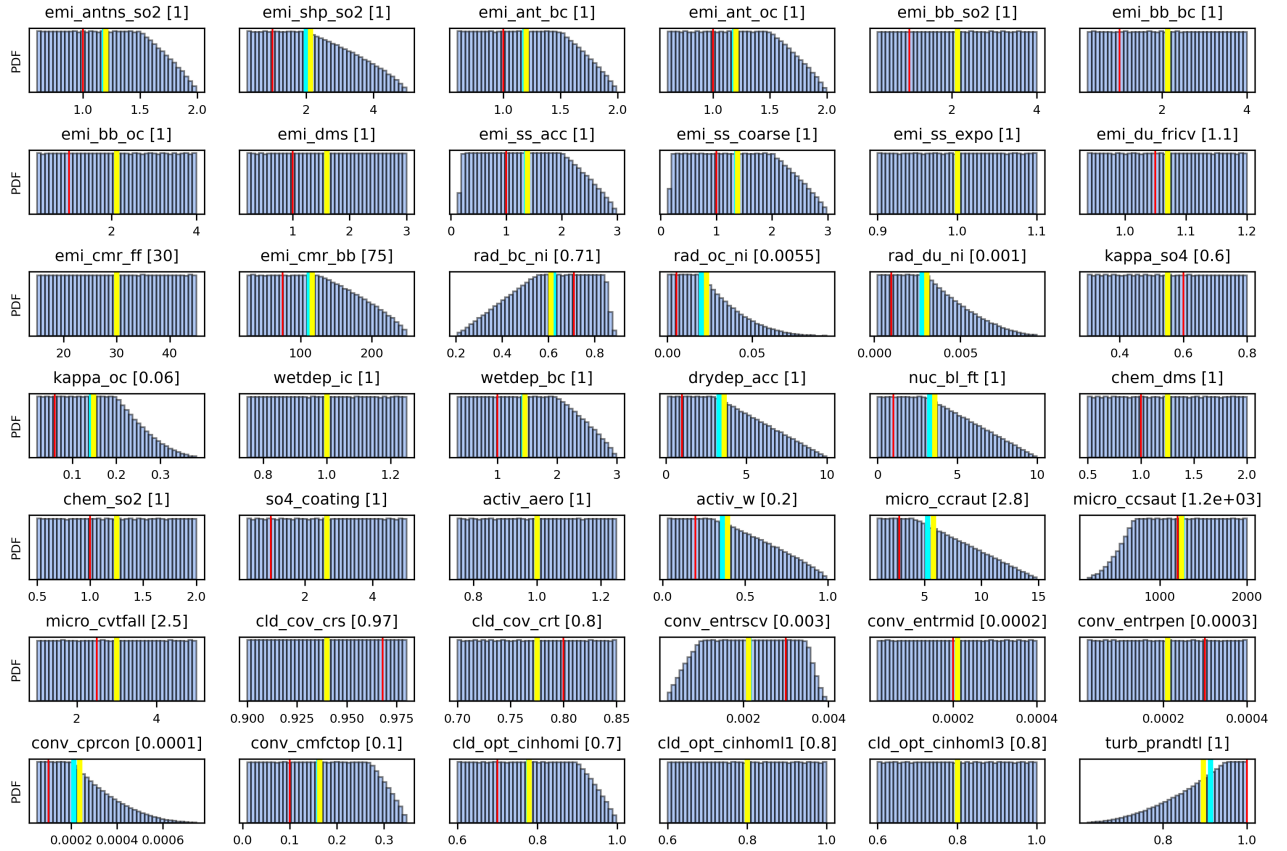


Figure S1. Probability density functions for the perturbed parameters used to generate the original PPEs (383 ensemble members). Default values from the CTRL run, along with the mean and median of the PDFs, are shown as red, blue, and yellow vertical lines, respectively. CTRL values are also indicated in square brackets.

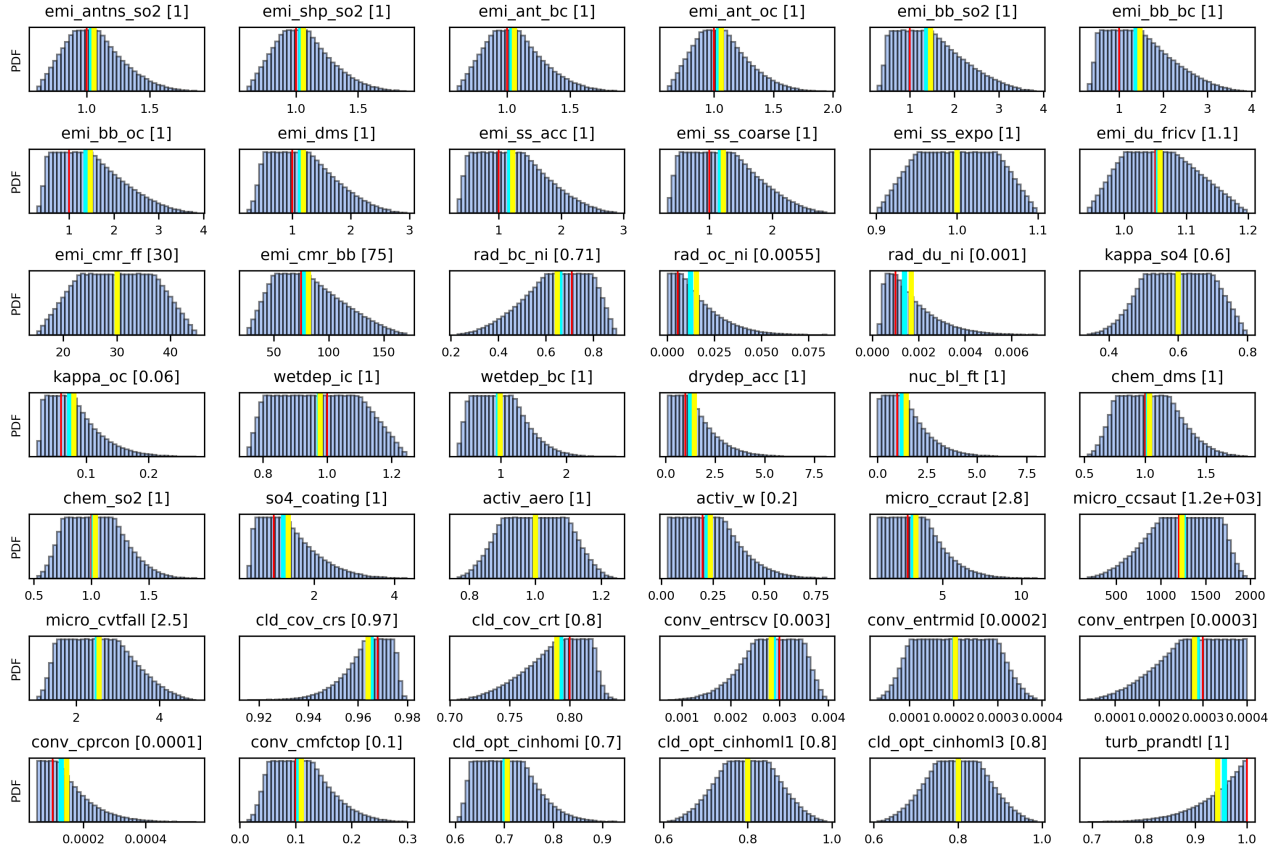


Figure S2. Same as Fig. S1, but for the expert-elicited parameter distributions used to generate the emulated PPEs (200,000 ensemble members) for the uncertainty quantification.

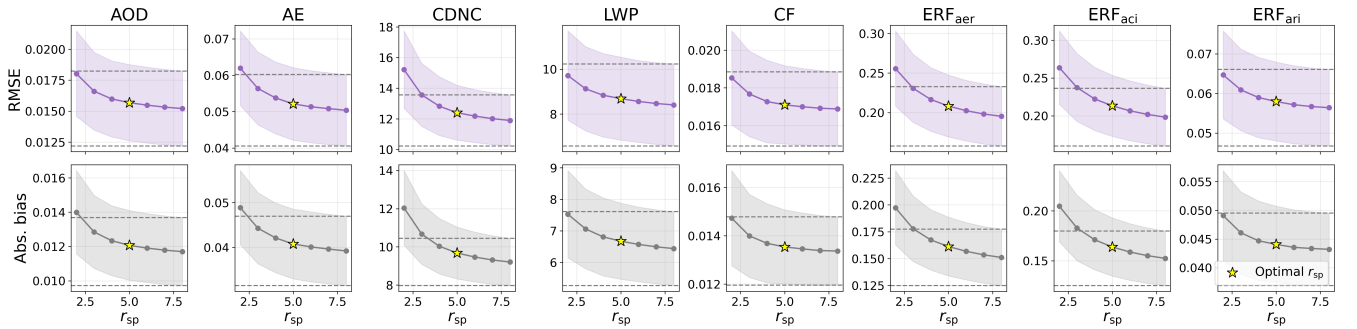


Figure S3. Same as Fig. 4, but showing RMSE and absolute bias as functions of the simulations-to-parameters ratio (r_{sp}).

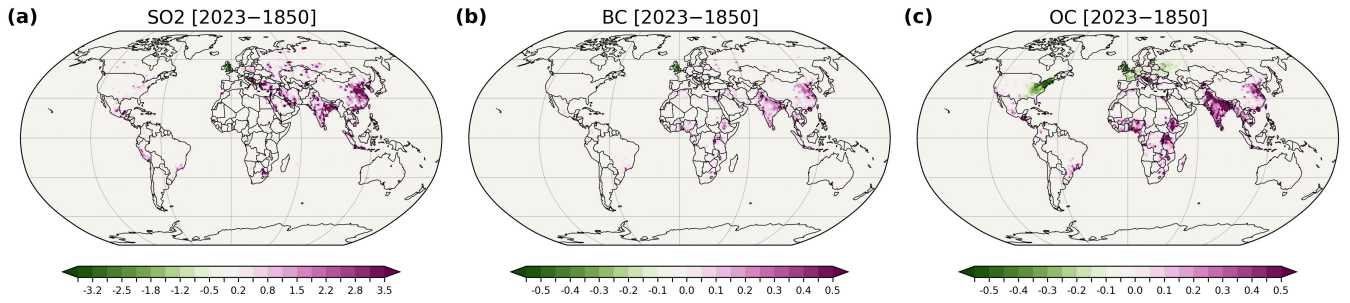


Figure S4. Differences in CEDS anthropogenic emissions between 2023 (PD) and 1850 (PI) for (a) SO₂, (b) BC, and (c) OC (g m⁻² yr⁻¹).

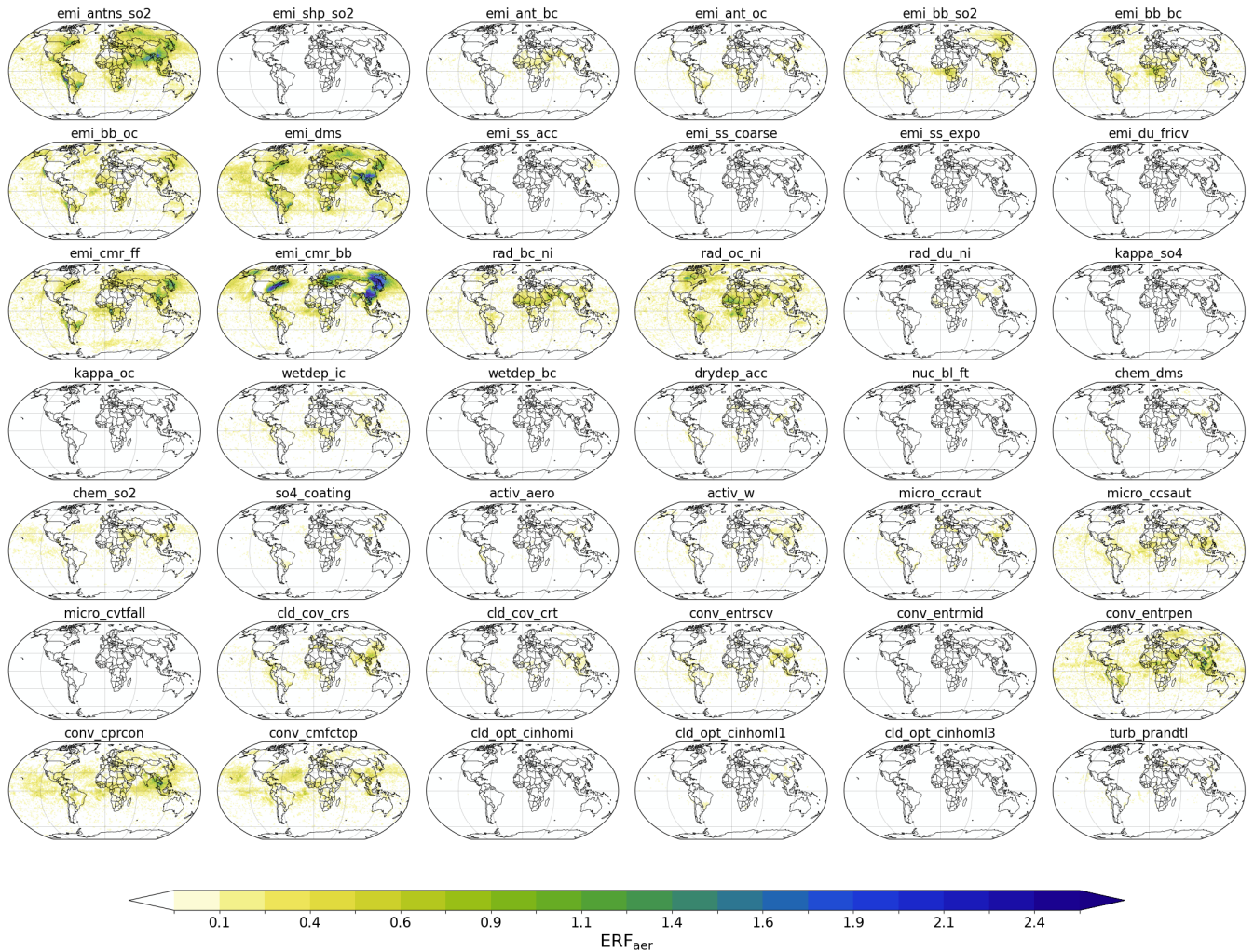


Figure S5. Parametric uncertainties (2σ across 200,000 emulated model variants) of ERF_{aer} (W m^{-2}) over 1850–2025, caused by individual parameters only.

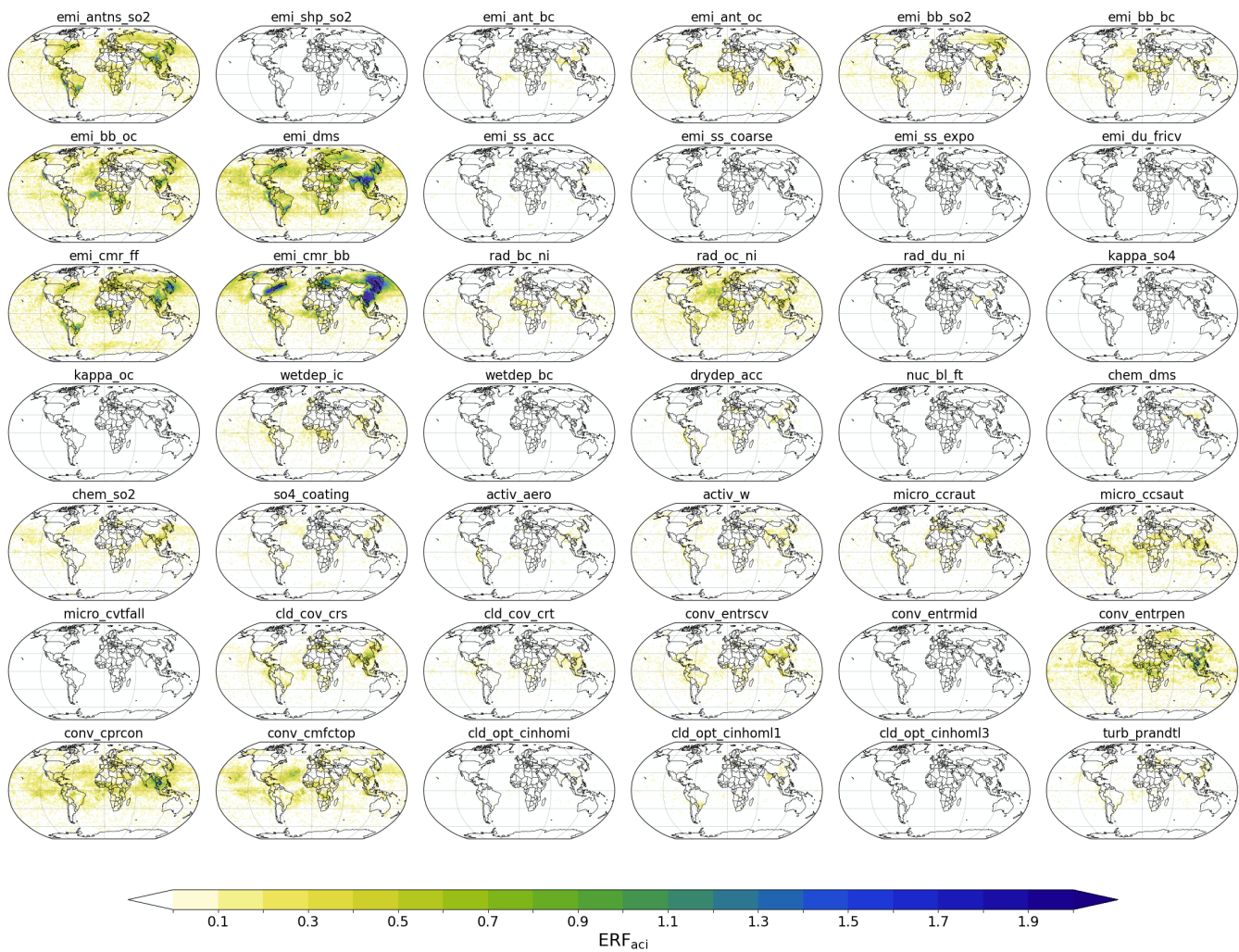


Figure S6. Same as Fig. S5 but for ERF_{aci} (W m⁻²).

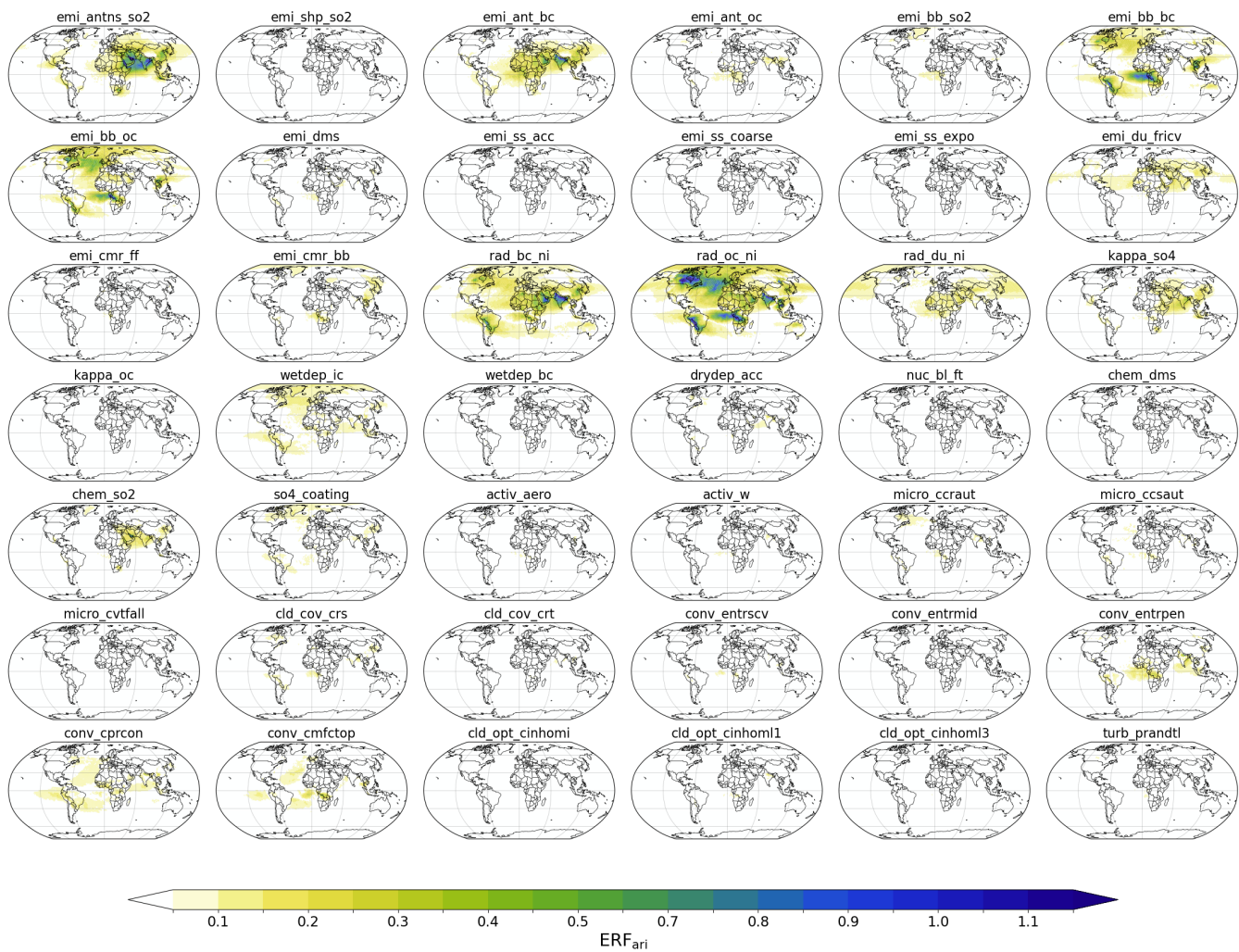


Figure S7. Same as Fig. S5 but for ERF_{ari} (W m⁻²).

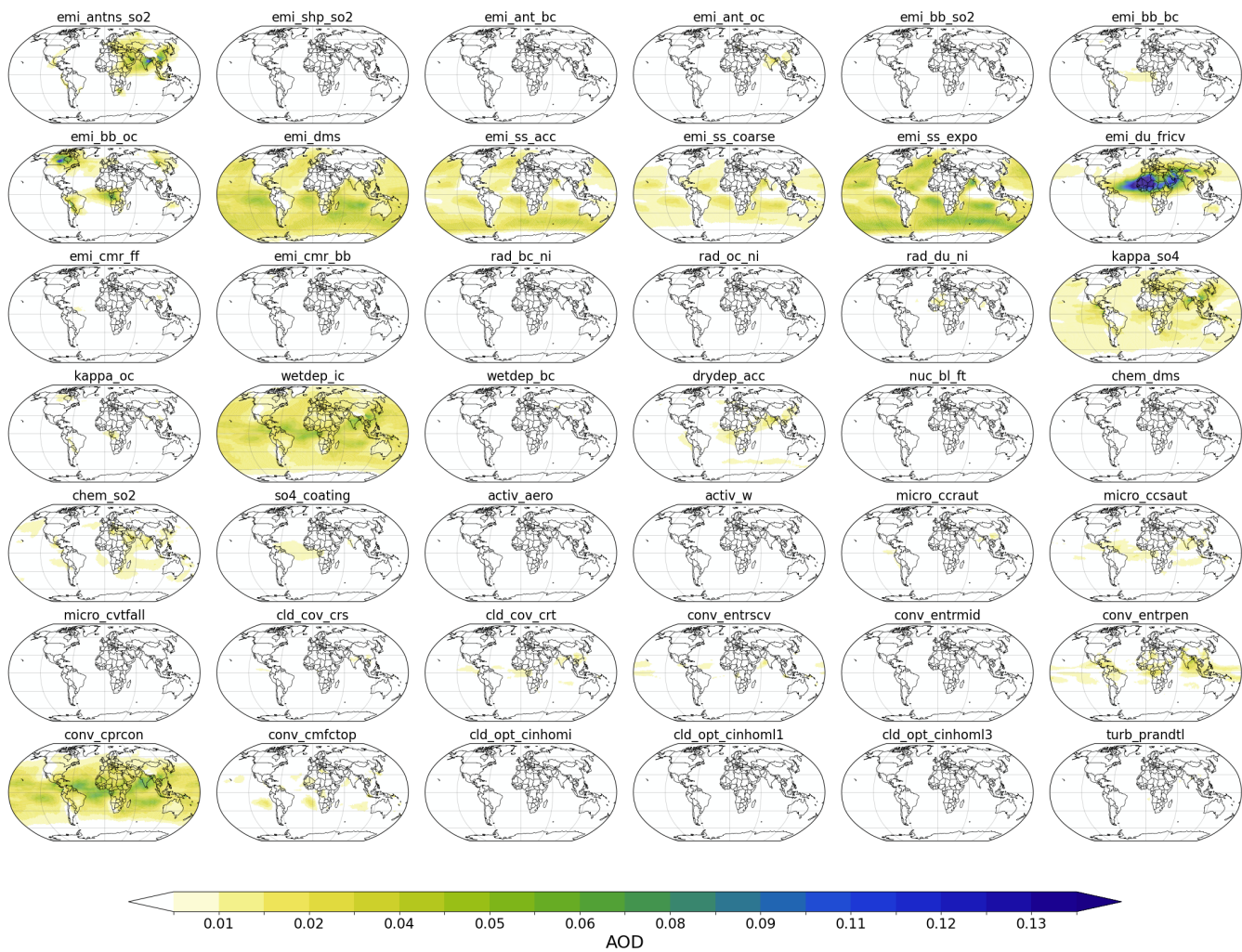


Figure S8. Same as Fig. S5 but for AOD (unitless).

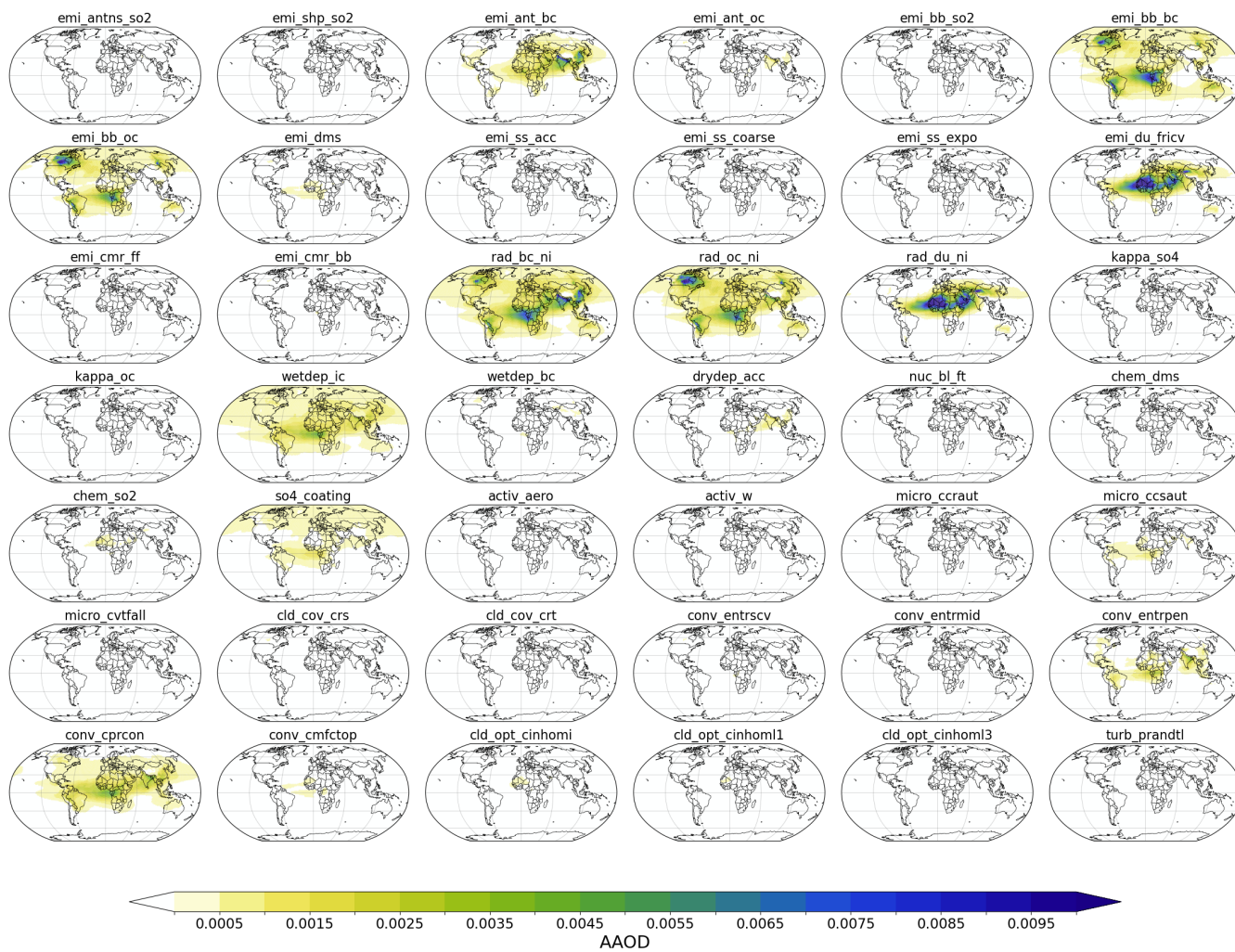


Figure S9. Same as Fig. S5 but for AAOD (unitless).

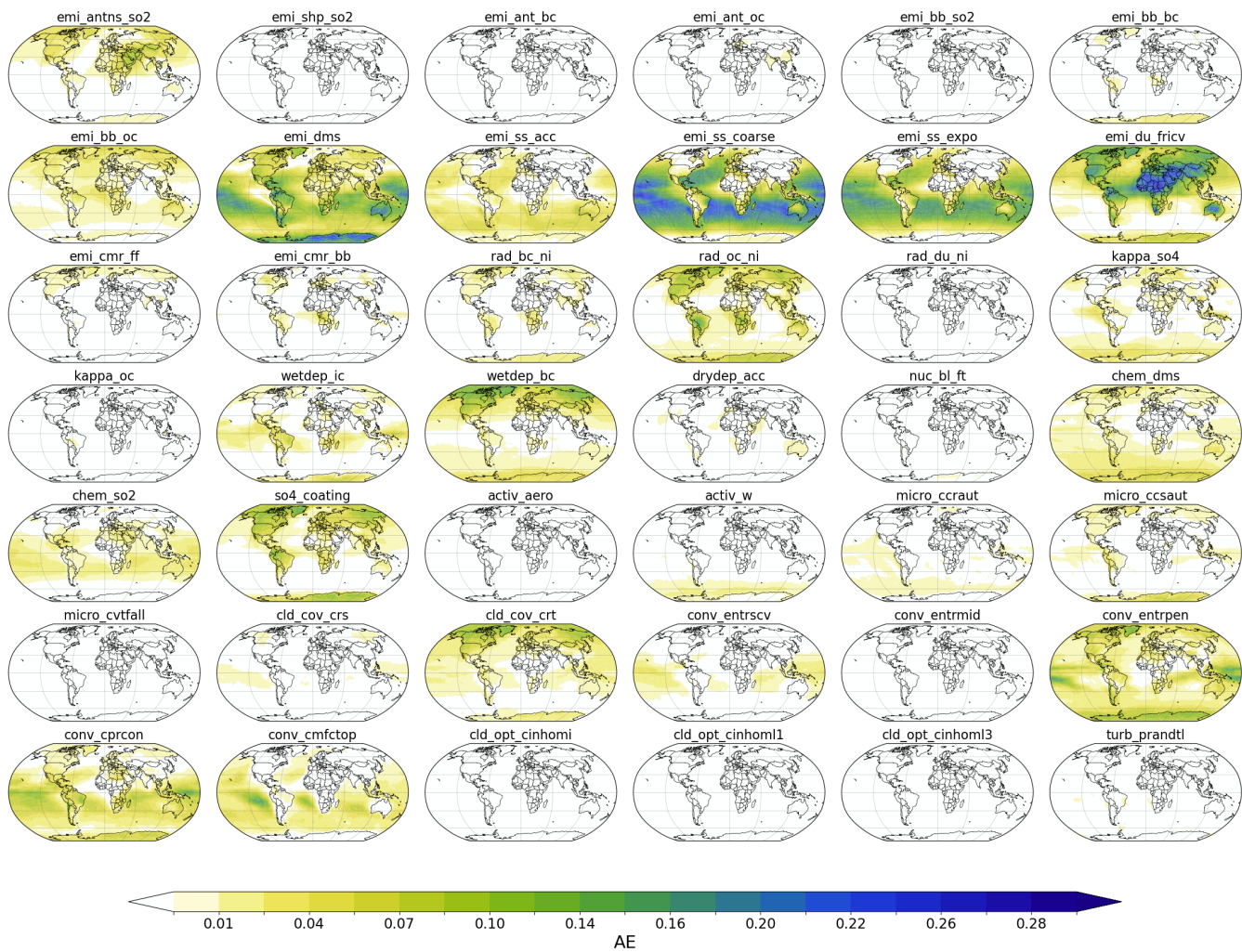


Figure S10. Same as Fig. S5 but for AE (unitless).

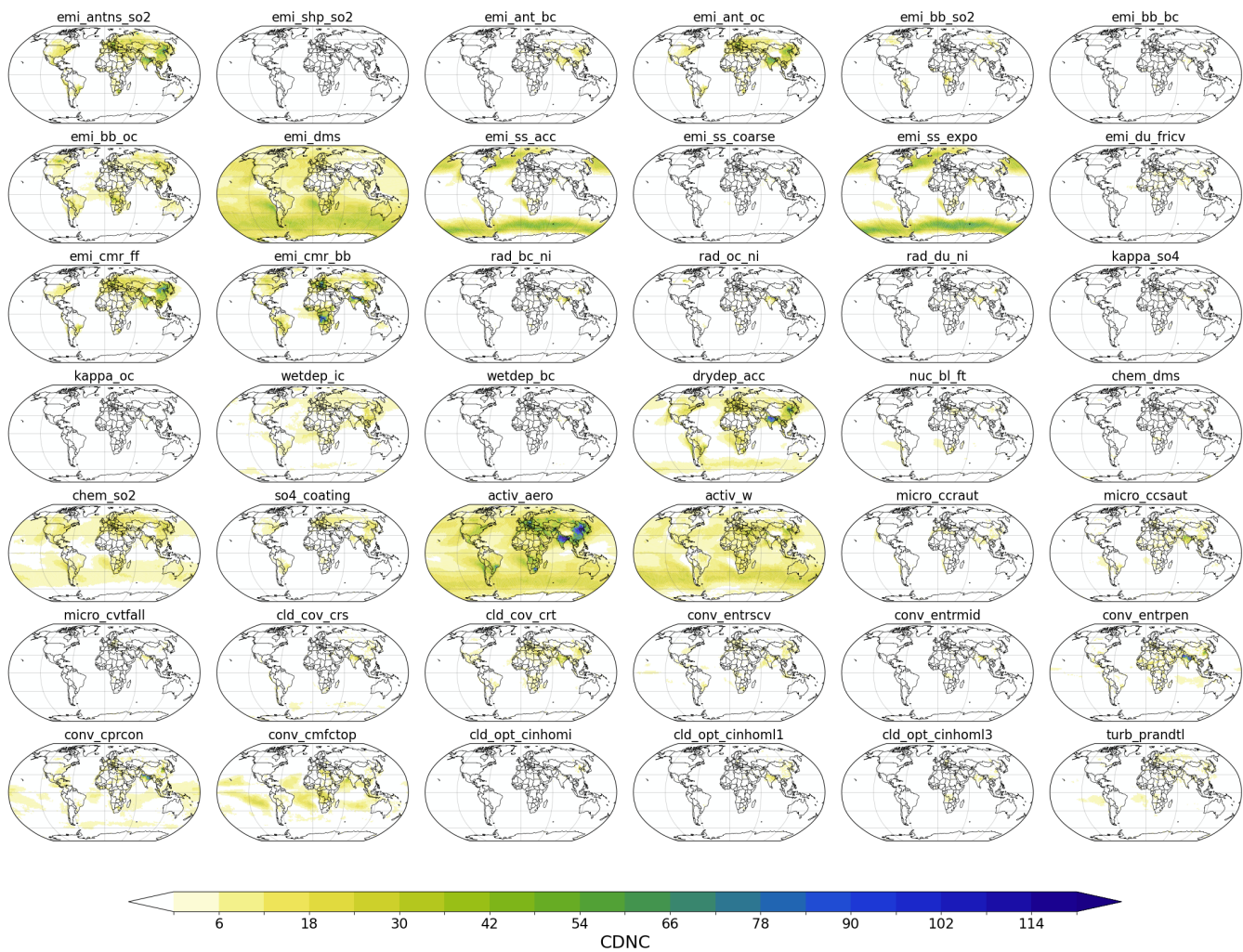


Figure S11. Same as Fig. S5 but for CDNC (cm^{-3}).

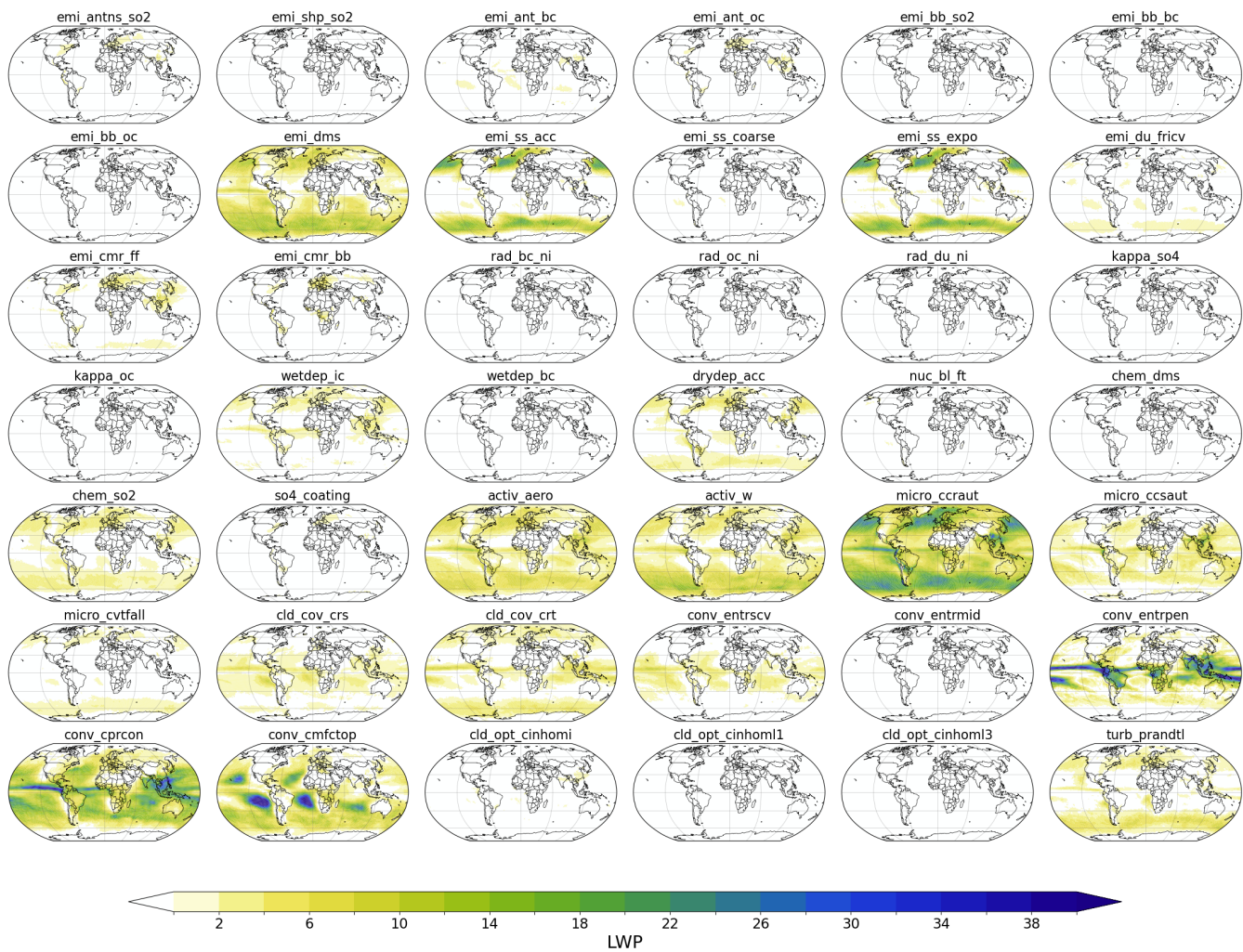


Figure S12. Same as Fig. S5 but for LWP (g m⁻²).

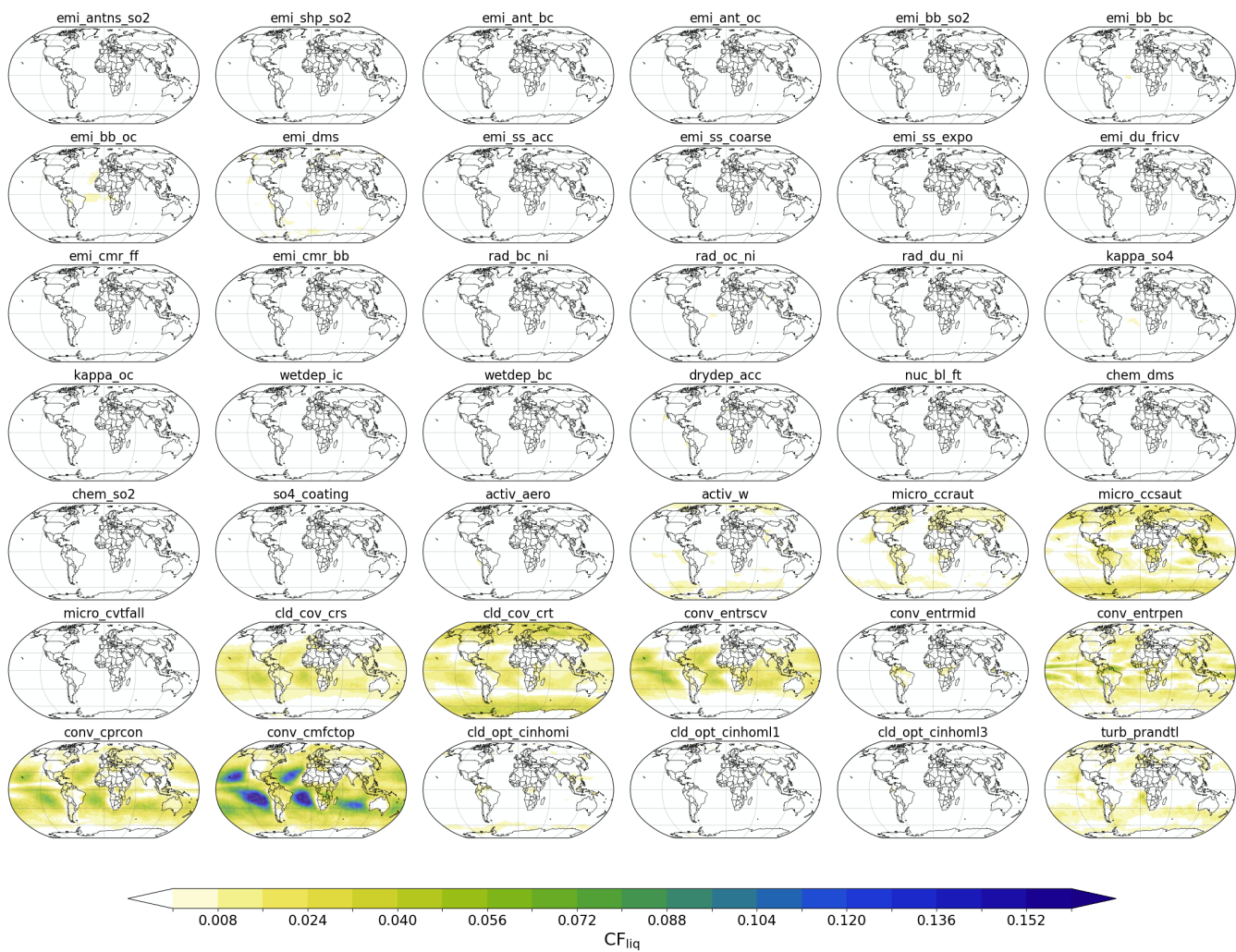


Figure S13. Same as Fig. S5 but for CF_{liq} (unitless).

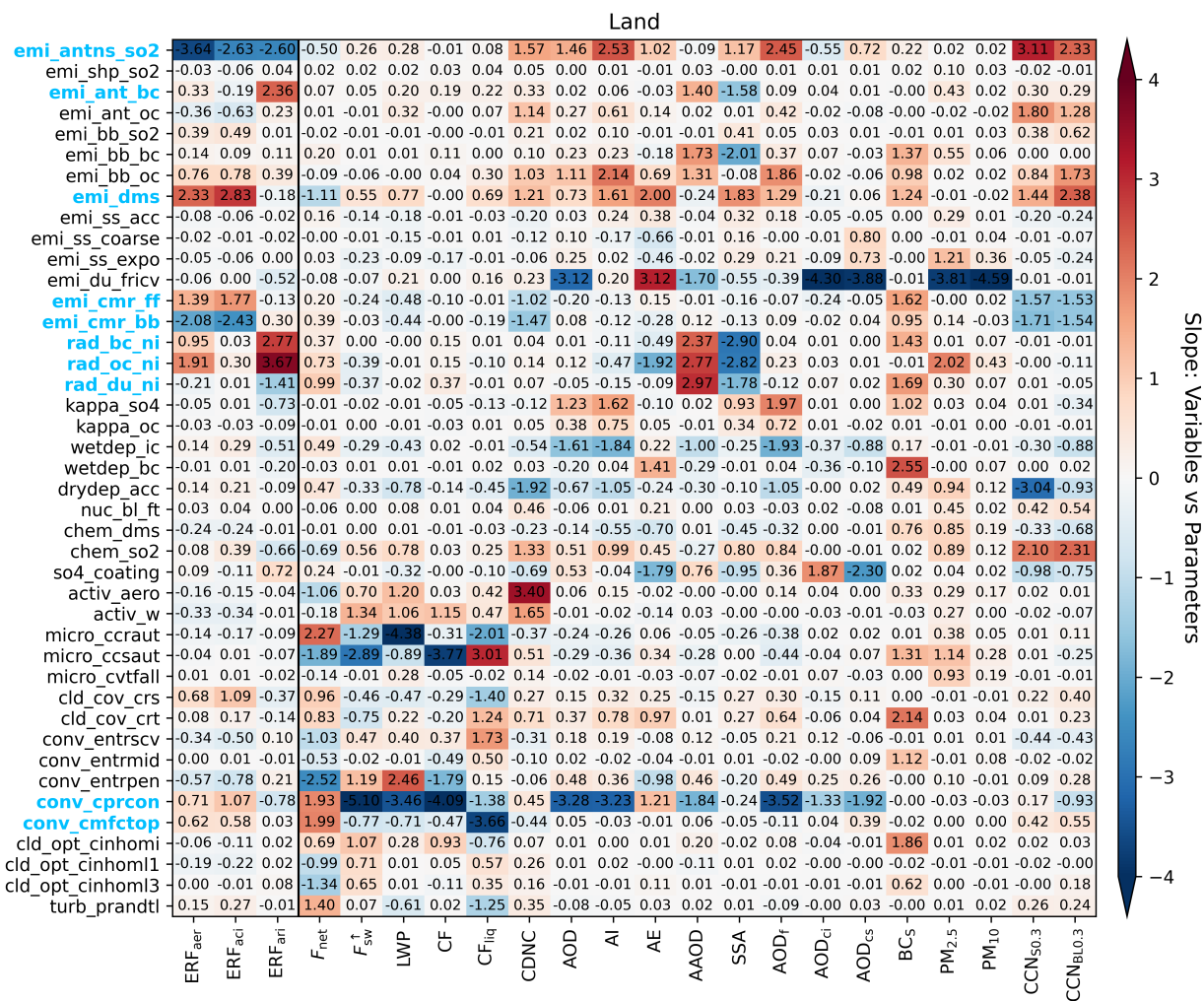


Figure S14. Same as Fig. 10 but showing results over land only.

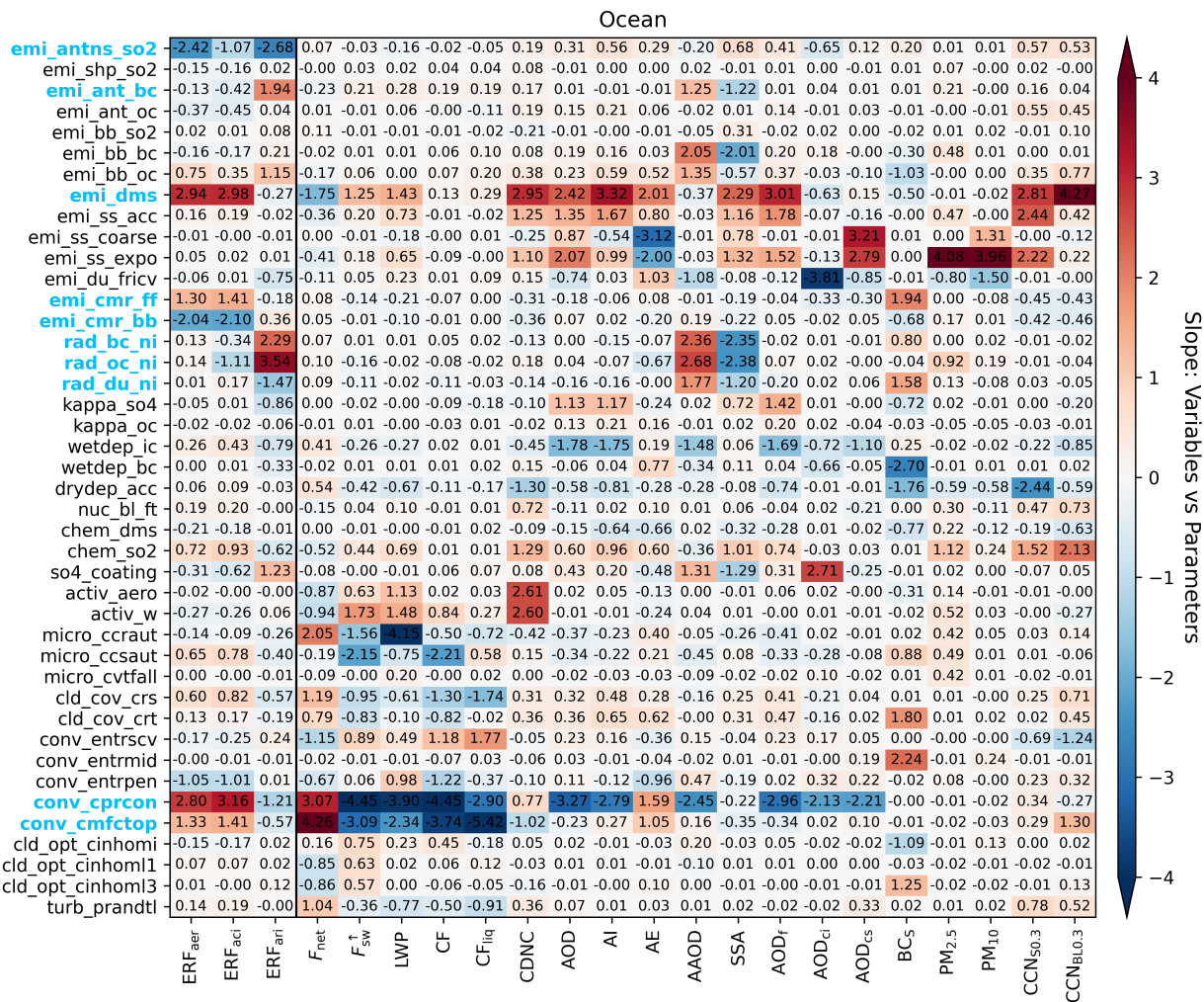


Figure S15. Same as Fig. 10 but showing results over oceans only.