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Supplement of

Climate and air quality impacts due to mitigation of non-methane near-term climate forcers

Robert J. Allen et al.

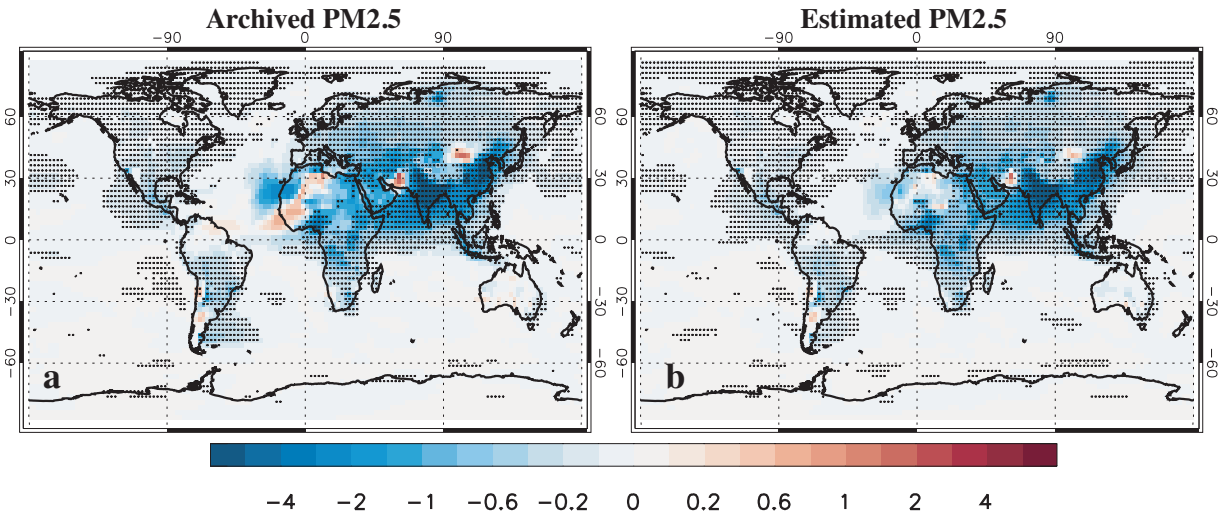
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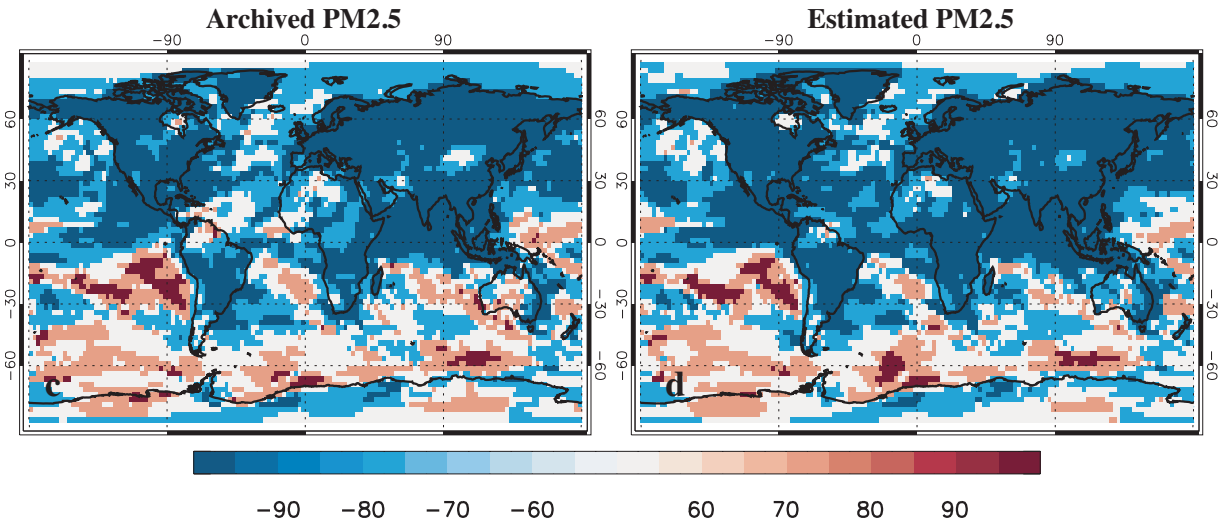
Archived PM_{2.5}

Only four models archived PM_{2.5}, including GFDL-ESM4, NorESM2-LM, MRI-ESM2-0 and MPI-ESM1-2-HAM. Each model uses a different method to calculate PM_{2.5}. Five aerosol species are present in MPI-ESM1-2-HAM: sulfate (SO₄), black carbon (BC), particulate organic matter (OM), sea salt (SS) and dust (DU). There are seven aerosol size modes (4 soluble and 3 insoluble), representing 4 aerosol size classes. The aerosol mass in the three smallest modes (nucleation, Aitken and accumulation mode) are all included in PM_{2.5}. For the coarse mode (particles larger than 1 μm in diameter) the fraction of particles smaller than 2.5 μm is computed. The aerosol sizes inside a mode are assumed to be log-normal distributed. For the coarse mode, a standard deviation of 2.00 is assumed. In the case of GFDL-ESM4, which includes nitrate (NO₃) and ammonium (NH₄), PM_{2.5} is estimated as: $0.96*SOA + DU1 + 0.25*DU2 + 0.97*SO_4 + SS1 + SS2 + 0.167*SS3 + 0.995*BCPHOB + 0.995*BCPHIL + 0.96*OMPHOB + 0.96*OMPHIL + 0.954*NO_3 + 0.973*NH_4$, where SOA is secondary organic aerosol; PHOB refers to hydrophobic and PHIL refers to hydrophilic. Numbers after aerosol species refer to the size bin (e.g., DU1 refers to the smallest dust size bin). In the case of MRI-ESM2, which includes 10 size bins for SS and DU, PM_{2.5} is estimated as: $(132.1369/96.06)*SO_4 + BC + OA + SS1 + SS2 + SS3 + 0.988*SS4 + 0.901*SS5 + 0.387*SS6 + DU1 + DU2 + DU3 + 0.988*DU4 + 0.901*DU5 + 0.387*DU6$. Sulfate is assumed to exist as ammonium sulfate, (NH₄)₂SO₄, by using a constant scaling factor of molecular weight. For NorESM2-LM, PM_{2.5} is calculated online during the simulation. The approach takes into account contributions from the 12 modes, including growth due to condensation and coagulation (which might be size dependent within a mode). The contribution from the various modes to PM_{2.5} is therefore not fixed.

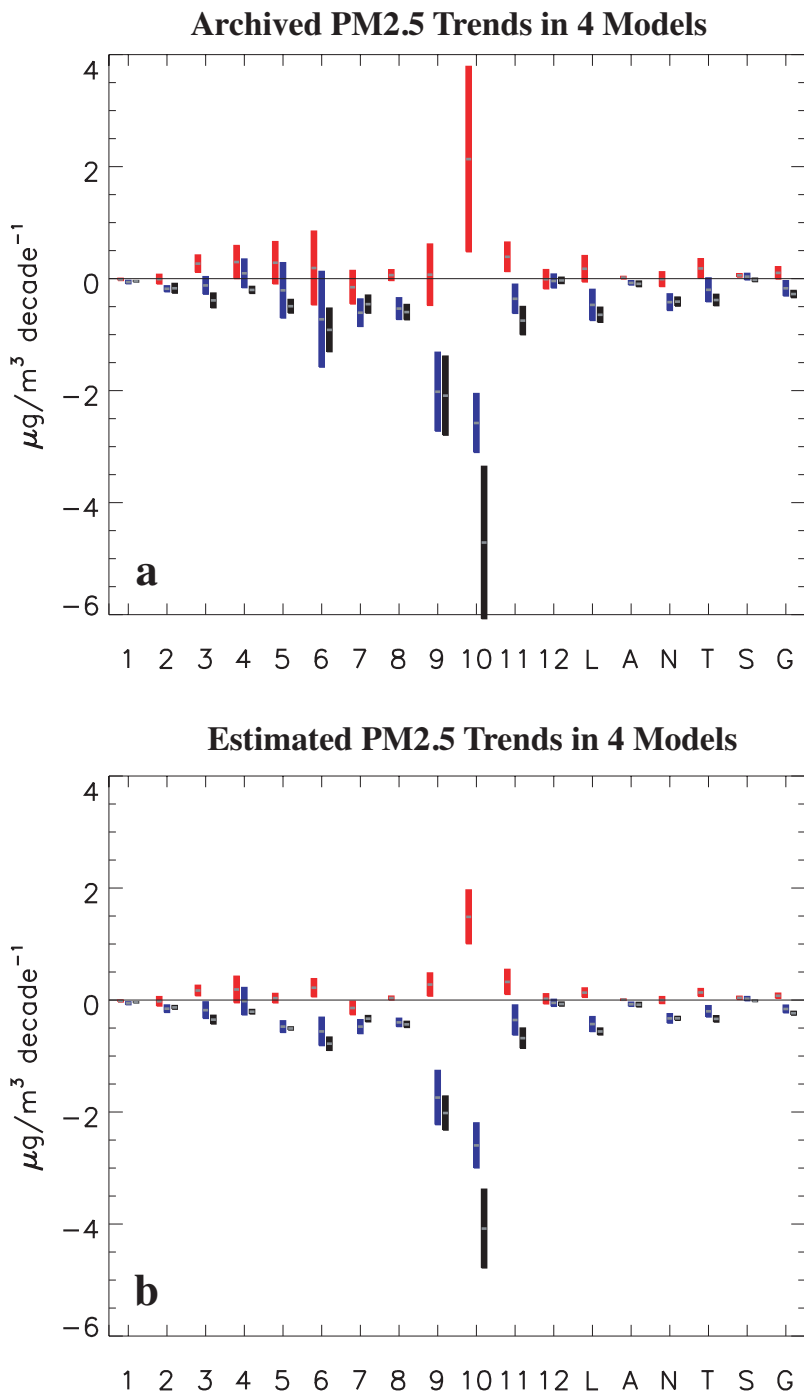
ANN PM_{2.5} Trends under NTCF Mitigation [$\mu\text{g m}^{-3} \text{ decade}^{-1}$]



ANN PM_{2.5} Trend Realization Agreement under NTCF Mitigation [%]

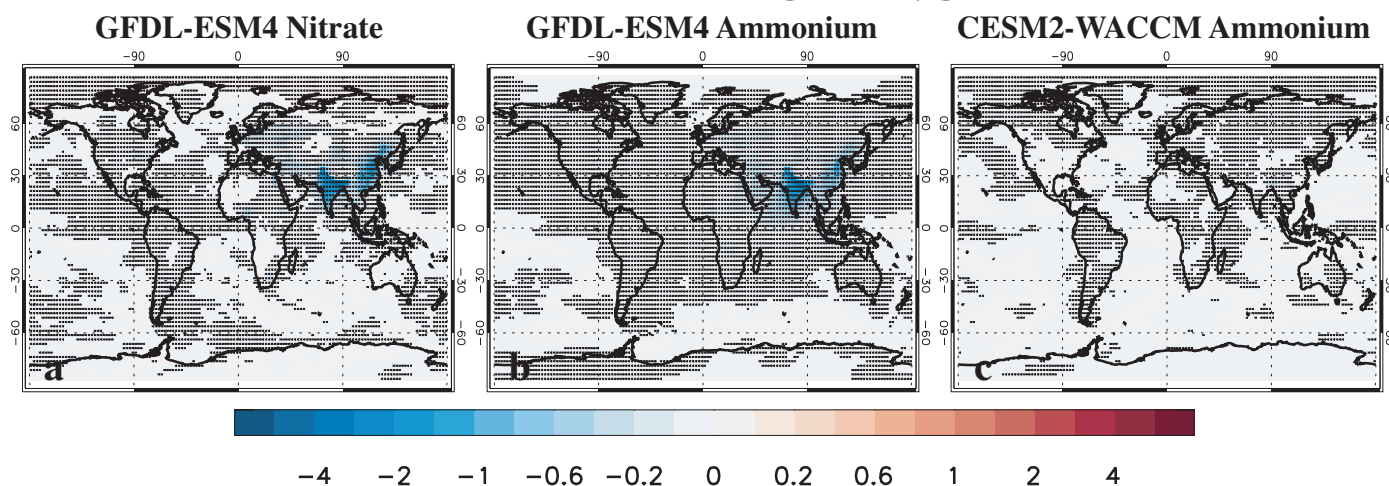


SUPPLEMENT FIGURE S1 2015-2055 annual mean surface PM_{2.5} trends and trend realization agreement under NTCF mitigation in four models. (left panels) Archived and (right panels) estimated PM_{2.5} (top panels) trends and (bottom panels) trend realization agreement. Panels are based on four models (those that archived PM_{2.5}), including GFDL-ESM4, NorESM2-LM, MRI-ESM2-0 and MPI-ESM1-2-HAM. Trend units are $\mu\text{g m}^{-3} \text{ decade}^{-1}$. Stippling denotes trend significance at the 95% confidence level based on a standard *t*-test. Trend realization agreement [%] represents the percentage of models that agree on the sign of the trend. Red colors indicate model agreement on a positive trend; blue colors indicate model agreement on a negative trend. White areas indicate lack of agreement on the sign of the trend.

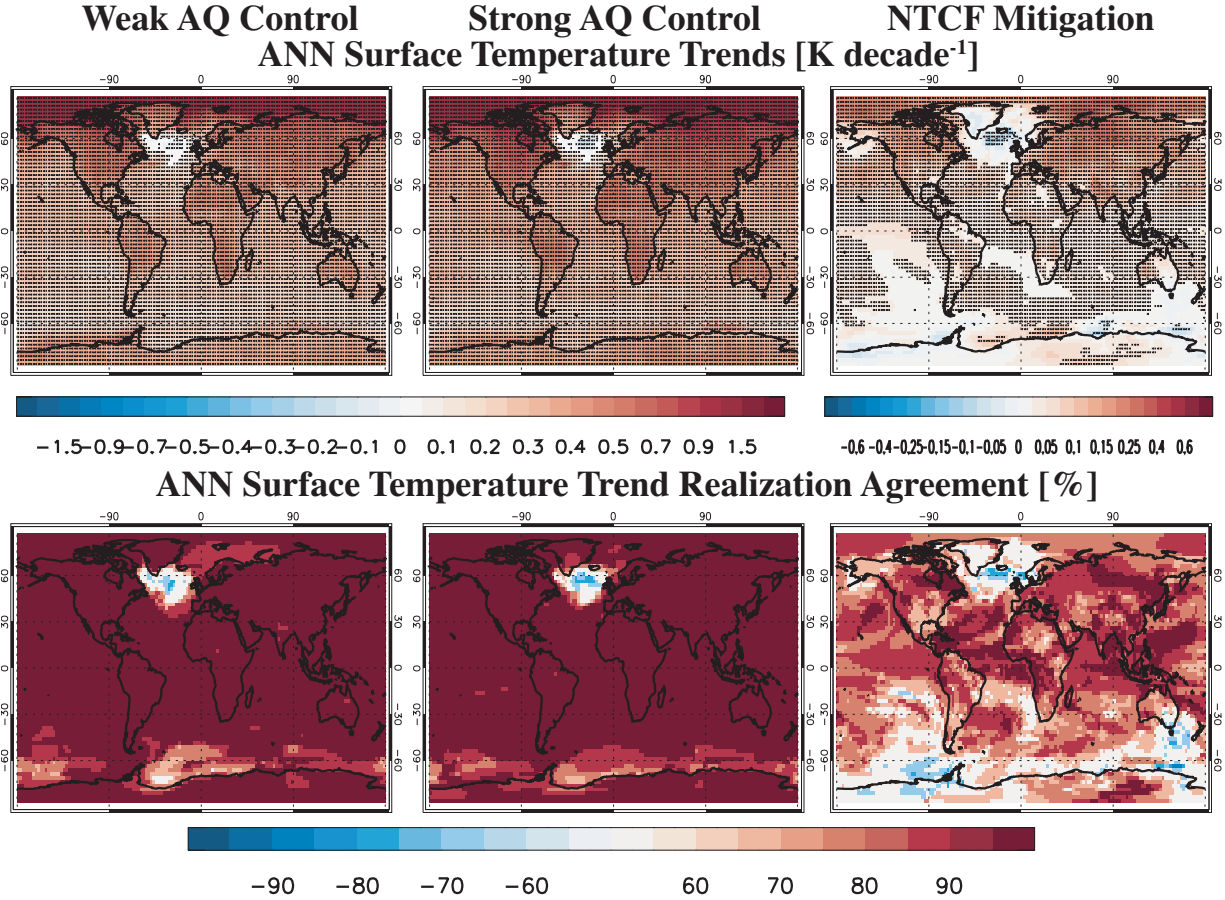


SUPPLEMENT FIGURE S2 **2015-2055 regional surface PM_{2.5} responses in four models.** (Top panel) Archived and (bottom panel) estimated regional trends in surface particulate matter (PM_{2.5}) for weak (red) and strong (blue) air quality control, and NTCF mitigation (black). Plots are based on four models (those that archived PM_{2.5}), including GFDL-ESM4, NorESM2-LM, MRI-ESM2-0 and MPI-ESM1-2-HAM. Bar center (gray horizontal line) shows the multimodel mean trend, estimated as the average of each model's mean trend. Bar length represents the 95% confidence interval, estimated as $2\sigma/\sqrt{n}$, where σ is the standard deviation of the individual model mean trends and n is the number of models. World regions are identical to those in the manuscript (e.g., Figure 5). Trend units are $\mu\text{g m}^{-3} \text{ decade}^{-1}$.

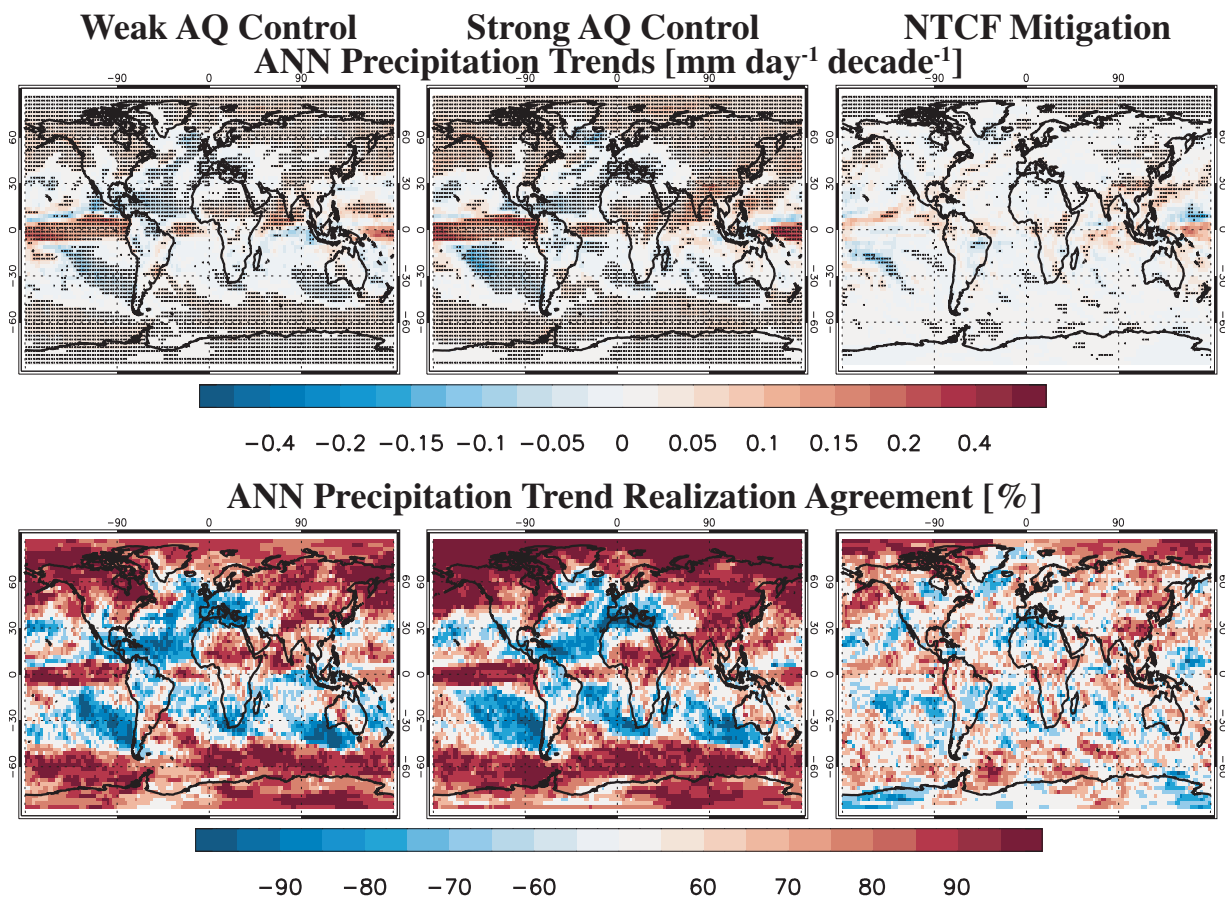
ANN Trends under NTCF Mitigation [$\mu\text{g m}^{-3} \text{ decade}^{-1}$]



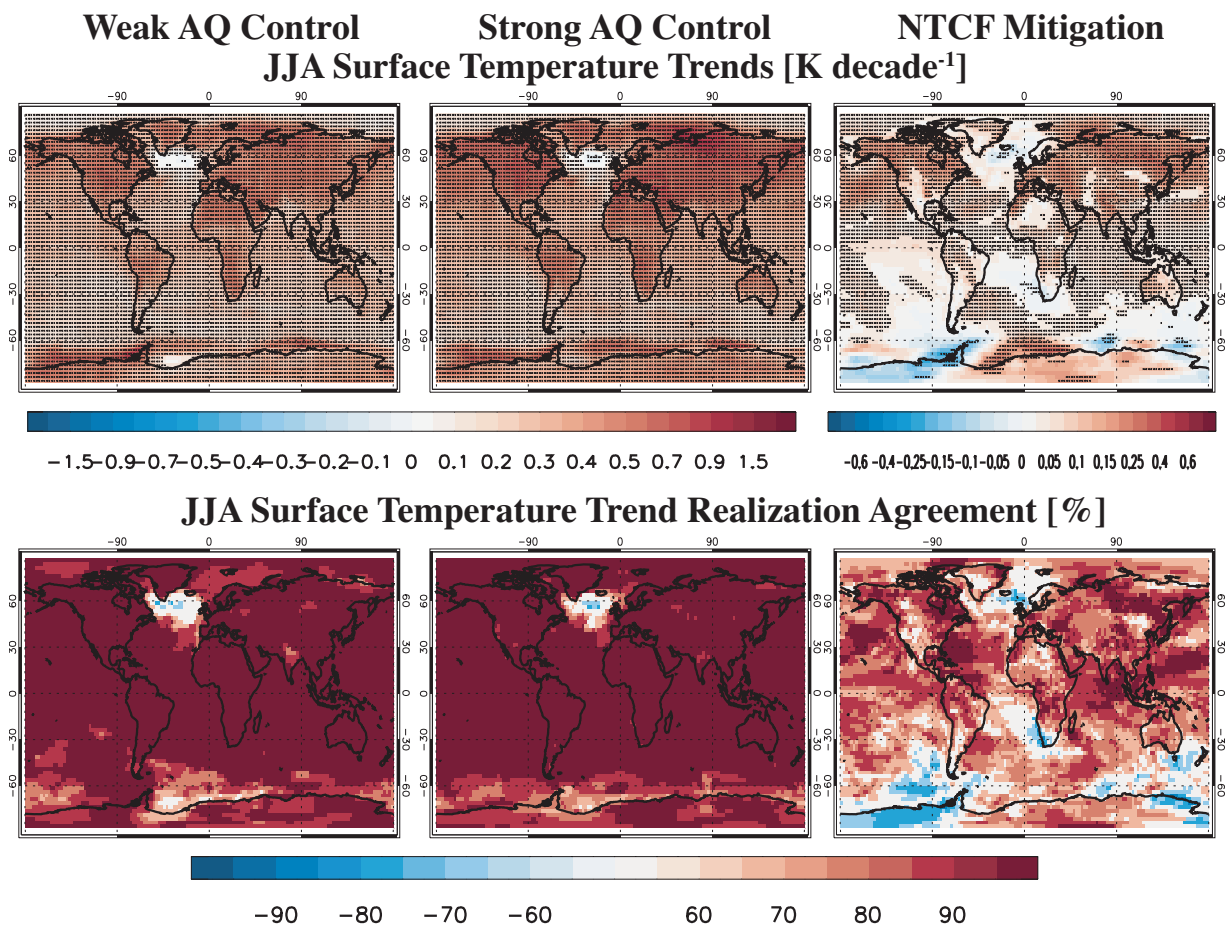
SUPPLEMENT FIGURE S3 2015-2055 annual mean surface nitrate and ammonium trends under NTCF mitigation in two models. GFDL-ESM4 trends in (a) nitrate and (b) ammonium. CESM2-WACCM trends in (c) ammonium. Trend units are $\mu\text{g m}^{-3} \text{ decade}^{-1}$.



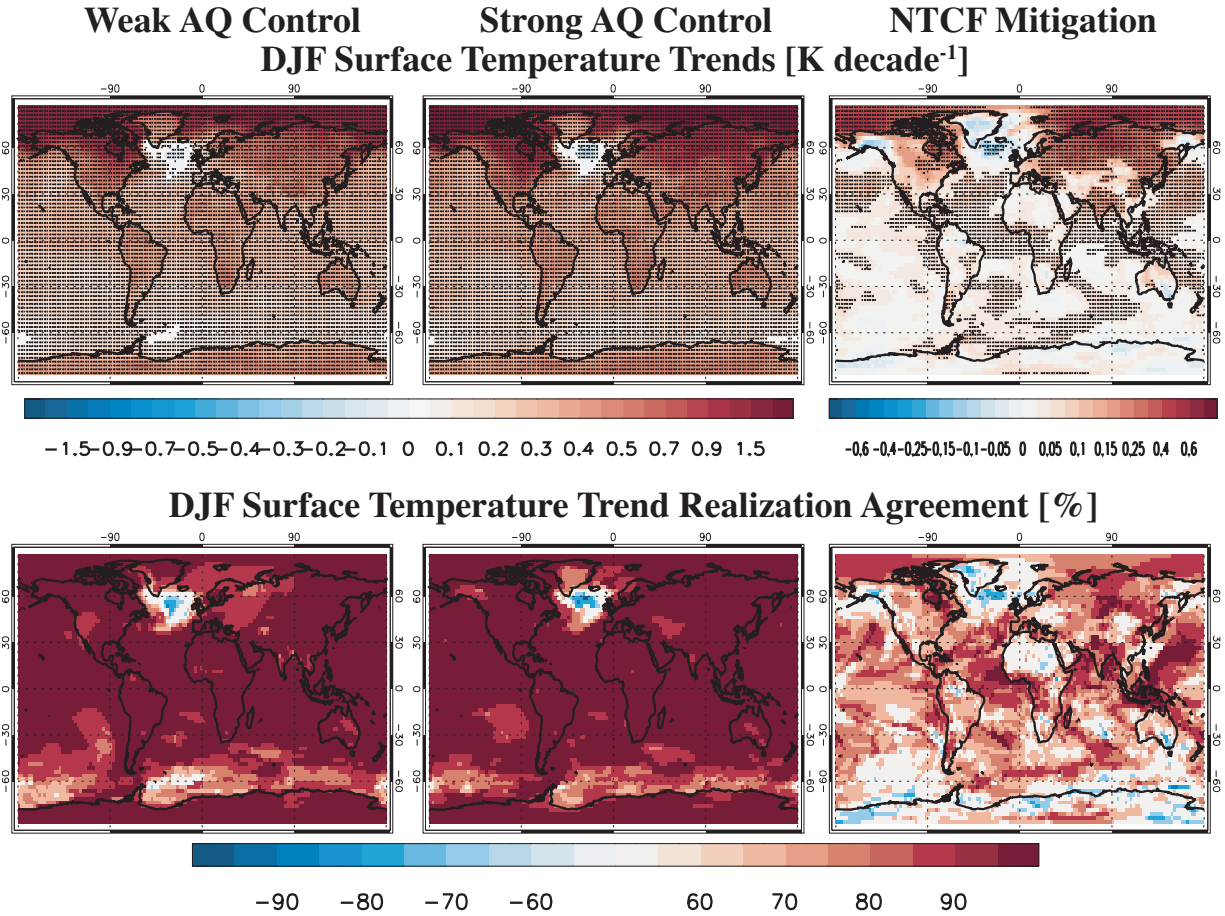
SUPPLEMENT FIGURE S4 2015-2055 annual mean surface temperature trends and model trend realization agreement. Surface temperature (top panels) trends [K decade⁻¹] and (bottom panels) model trend realization agreement [%] for (left panels) weak air quality control; (middle panels) strong air quality control and (right panels) NTCF mitigation. Stippling denotes trend significance at the 95% confidence level based on a standard *t*-test. Trend realization agreement represents the percentage of models that agree on the sign of the trend. Red colors indicate model agreement on a positive trend; blue colors indicate model agreement on a negative trend. White areas indicate lack of agreement on the sign of the trend.



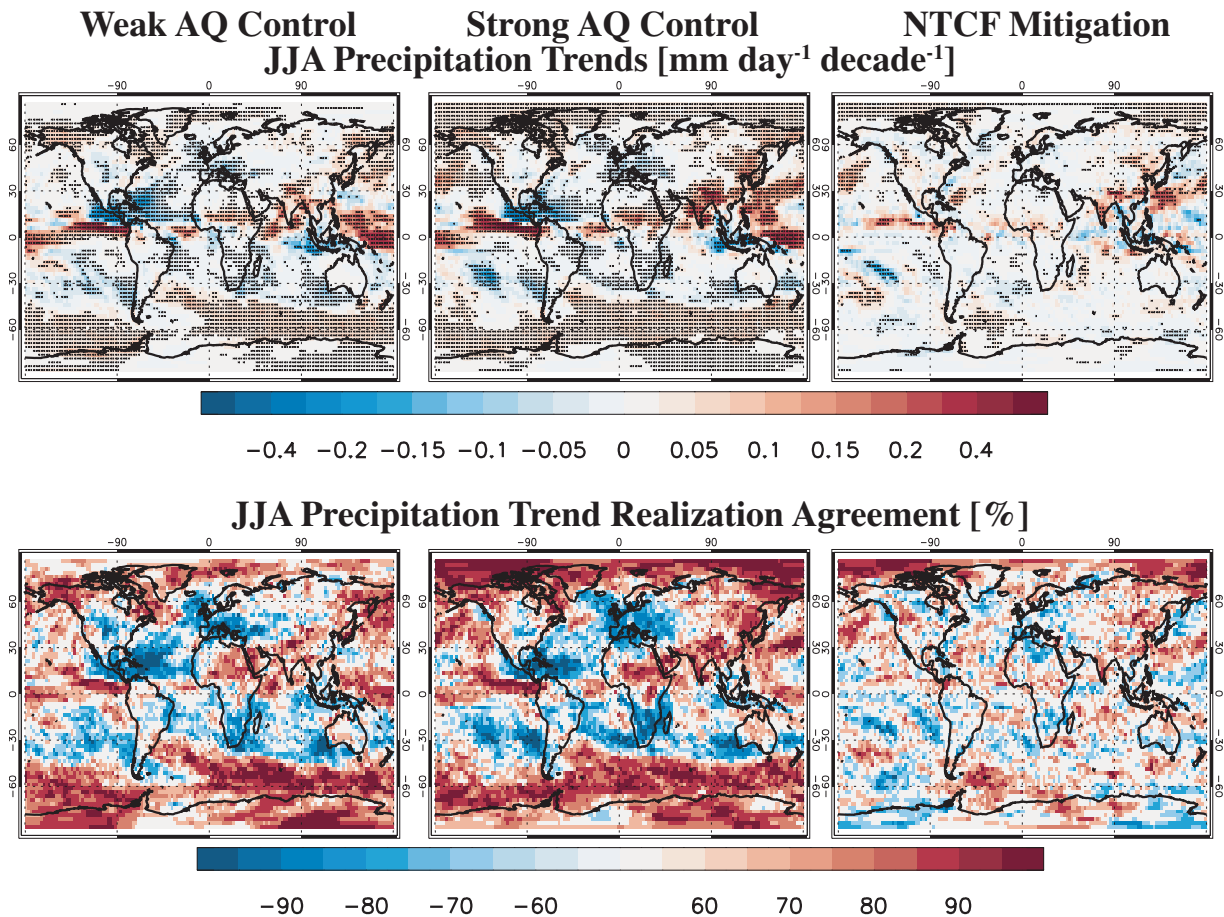
SUPPLEMENT FIGURE S5 **2015-2055 annual mean precipitation trends and model trend realization agreement.** Precipitation (top panels) trends [mm day⁻¹ decade⁻¹] and (bottom panels) model trend realization agreement [%] for (left panels) weak air quality control; (middle panels) strong air quality control and (right panels) NTCF mitigation. Stippling denotes trend significance at the 95% confidence level based on a standard *t*-test. Trend realization agreement represents the percentage of models that agree on the sign of the trend. Red colors indicate model agreement on a positive trend; blue colors indicate model agreement on a negative trend. White areas indicate lack of agreement on the sign of the trend.



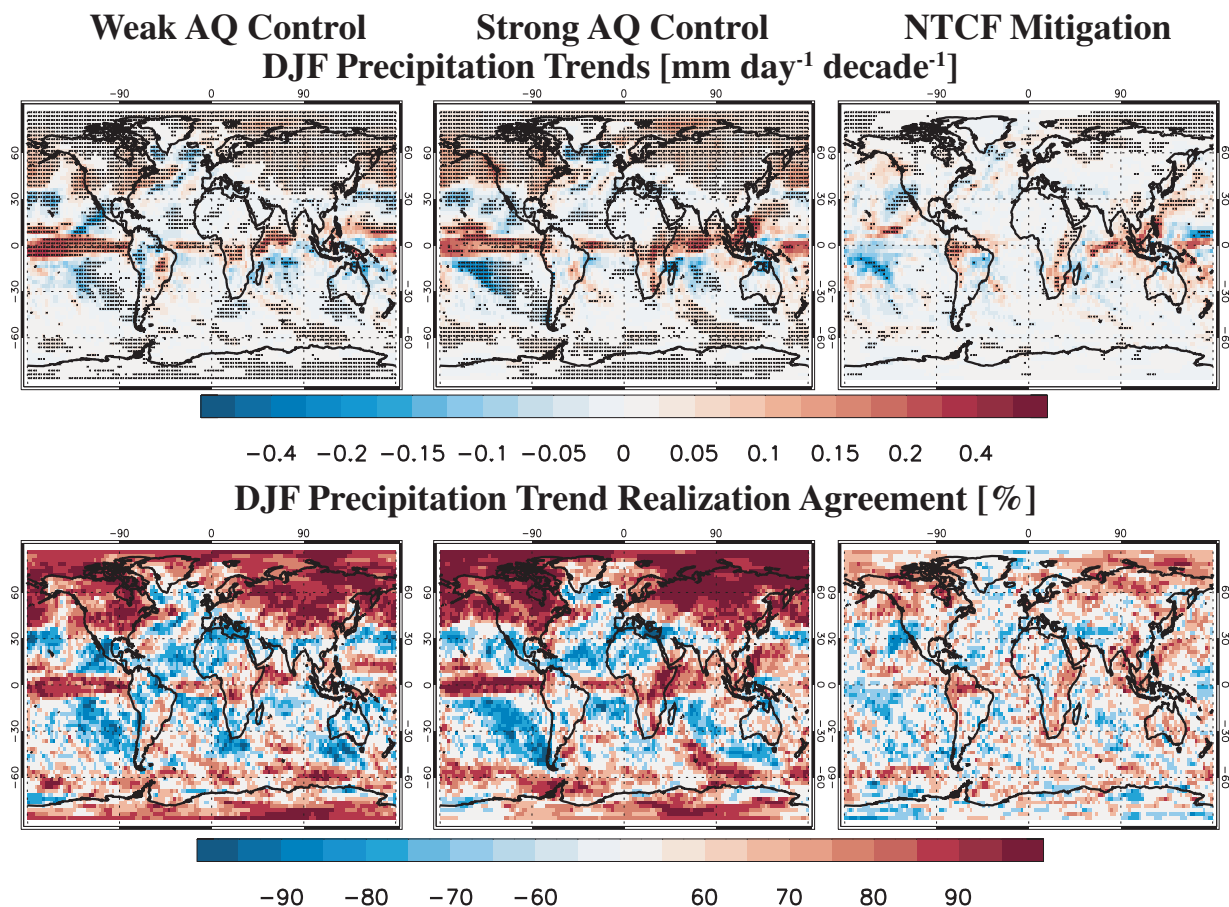
SUPPLEMENT FIGURE S6 2015-2055 June-July-August (JJA) mean surface temperature trends and model trend realization agreement. Surface temperature (top panels) trends [K decade⁻¹] and (bottom panels) model trend realization agreement [%] for (left panels) weak air quality control; (middle panels) strong air quality control and (right panels) NTCF mitigation. Stippling denotes trend significance at the 95% confidence level based on a standard *t*-test. Trend realization agreement represents the percentage of models that agree on the sign of the trend. Red colors indicate model agreement on a positive trend; blue colors indicate model agreement on a negative trend. White areas indicate lack of agreement on the sign of the trend.



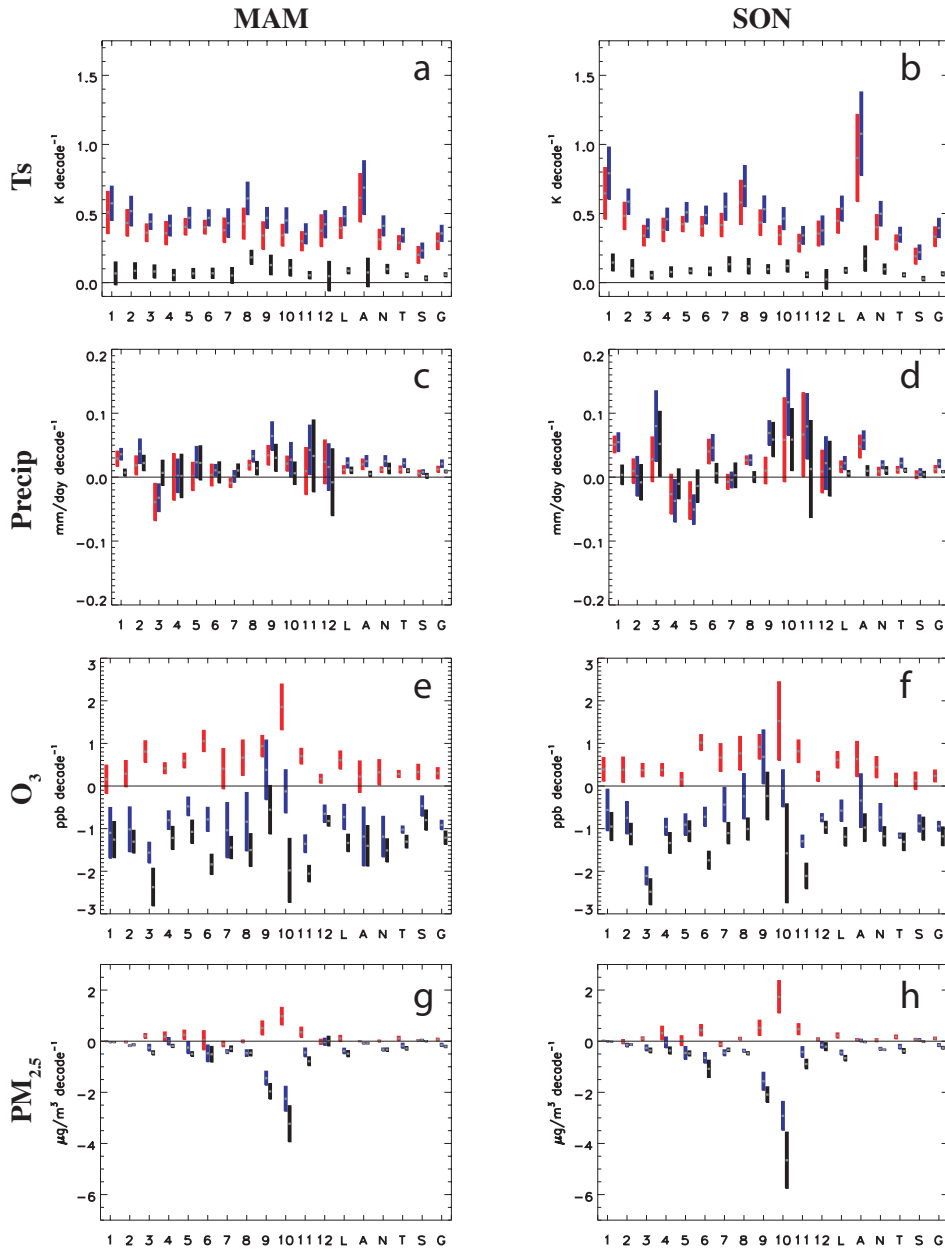
SUPPLEMENT FIGURE S7 **2015-2055 December-January-February (DJF) mean surface temperature trends and model trend realization agreement.** Surface temperature (top panels) trends [K decade⁻¹] and (bottom panels) model trend realization agreement [%] for (left panels) weak air quality control; (middle panels) strong air quality control and (right panels) NTCF mitigation. Stippling denotes trend significance at the 95% confidence level based on a standard *t*-test. Trend realization agreement represents the percentage of models that agree on the sign of the trend. Red colors indicate model agreement on a positive trend; blue colors indicate model agreement on a negative trend. White areas indicate lack of agreement on the sign of the trend.



SUPPLEMENT FIGURE S8 **2015-2055 June-July-August (JJA) mean precipitation trends and model trend realization agreement.** Precipitation (top panels) trends [mm day⁻¹ decade⁻¹] and (bottom panels) model trend realization agreement [%] for (left panels) weak air quality control; (middle panels) strong air quality control and (right panels) NTCF mitigation. Stippling denotes trend significance at the 95% confidence level based on a standard *t*-test. Trend realization agreement represents the percentage of models that agree on the sign of the trend. Red colors indicate model agreement on a positive trend; blue colors indicate model agreement on a negative trend. White areas indicate lack of agreement on the sign of the trend.



SUPPLEMENT FIGURE S9 2015-2055 December-January-February (DJF) mean precipitation trends and model trend realization agreement. Precipitation (top panels) trends [mm day⁻¹ decade⁻¹] and (bottom panels) model trend realization agreement [%] for (left panels) weak air quality control; (middle panels) strong air quality control and (right panels) NTCF mitigation. Stippling denotes trend significance at the 95% confidence level based on a standard *t*-test. Trend realization agreement represents the percentage of models that agree on the sign of the trend. Red colors indicate model agreement on a positive trend; blue colors indicate model agreement on a negative trend. White areas indicate lack of agreement on the sign of the trend.



SUPPLEMENT FIGURE S10 **Regional climate and air pollution seasonal responses to NTCF mitigation.** Bar plots show regional 2015-2055 March-April-May (MAM; left panels) and September-October-November (SON; right panels) trends in (a-b) surface temperature (T_s); (c-d) precipitation (Precip); (e-f) surface ozone (O_3); and (g-h) surface particulate matter ($PM_{2.5}$) for weak (red) and strong (blue) air quality control, and NTCF mitigation (black). Bar center (gray horizontal line) shows the multimodel mean trend, estimated as the average of each model's mean trend. Bar length represents the 95% confidence interval, estimated as $2\sigma/\sqrt{n}$, where σ is the standard deviation of the individual model mean trends and n is the number of models. World regions are identical to those in Figure 5. Trend units are $K\ decade^{-1}$ for T_s ; $mm\ day^{-1}\ decade^{-1}$ for Precip; $\mu g\ m^{-3}\ decade^{-1}$ for $PM_{2.5}$; and $ppb\ decade^{-1}$ for O_3 .