Supplementary materials

Zonal mean and shift modes of historical climate response to evolving aerosol distribution

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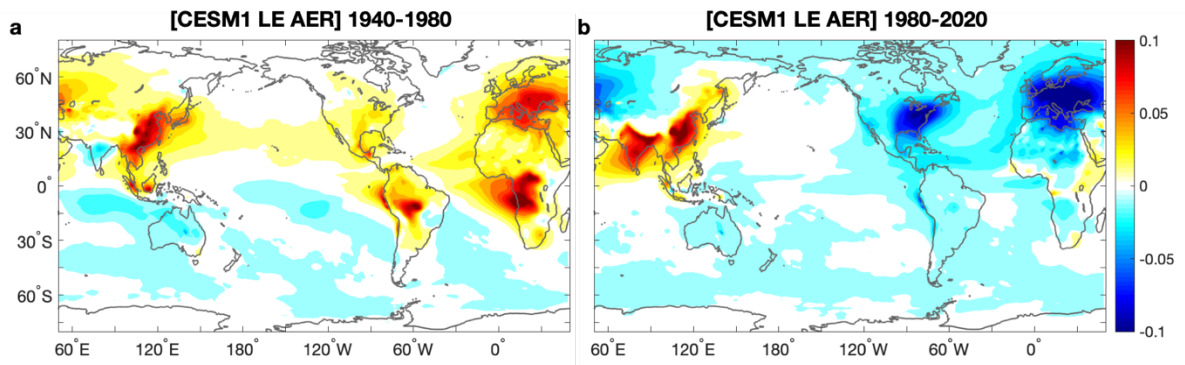[2]Scripps Institution of Oceanography, University of California San Diego, La Jolla, California, USA, 92093
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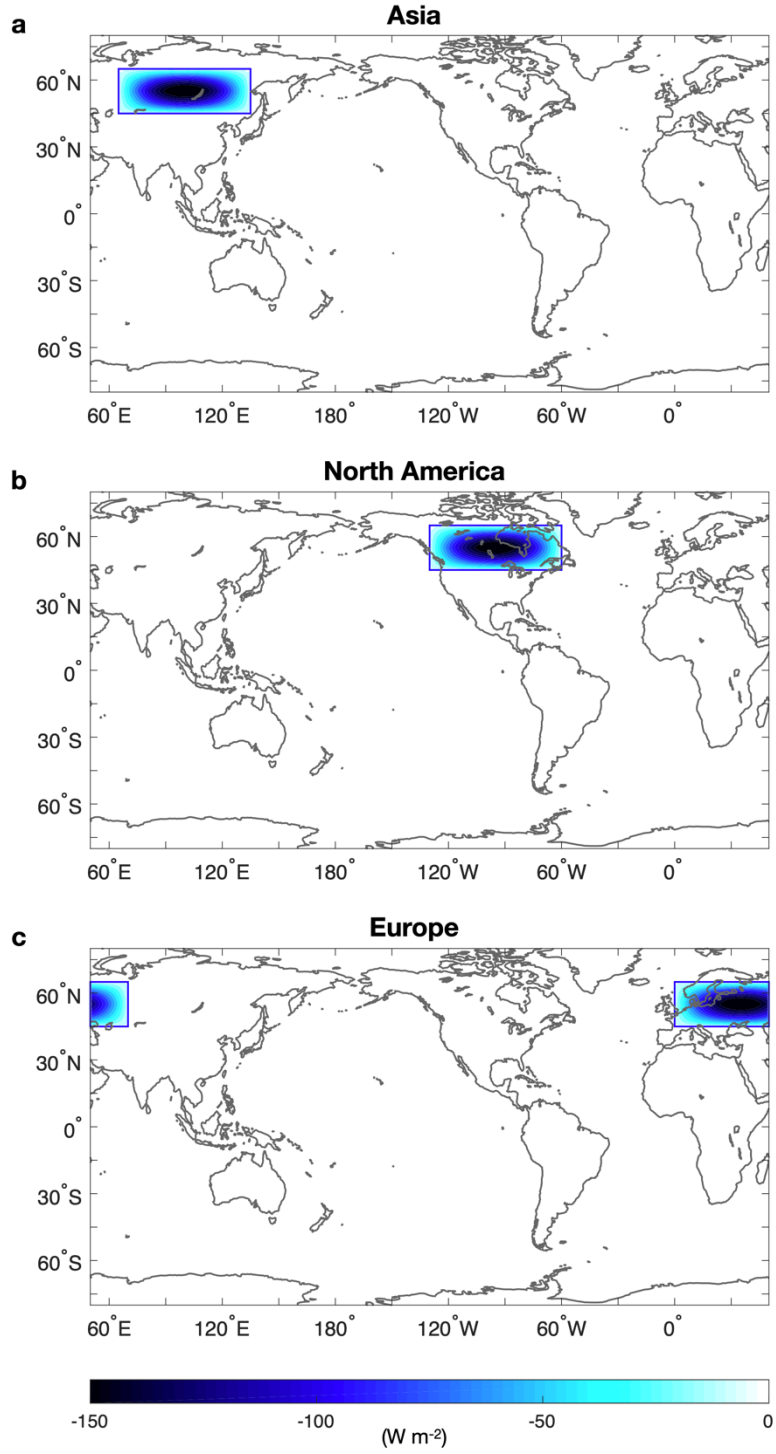[4]National Oceanographic and Atmospheric Administration, Princeton, New Jersey, 08540
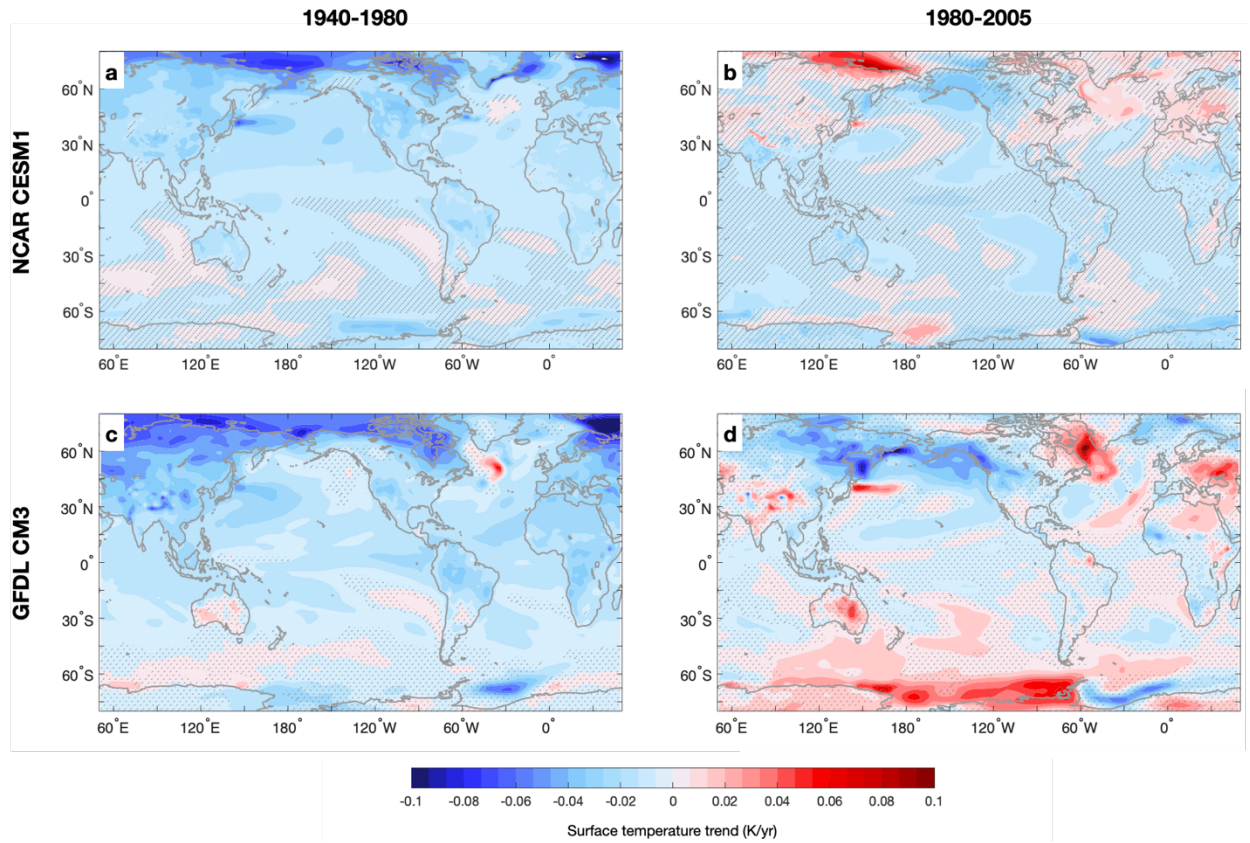[5]University Corporation for Atmospheric Research, Boulder, Colorado, USA, 80307
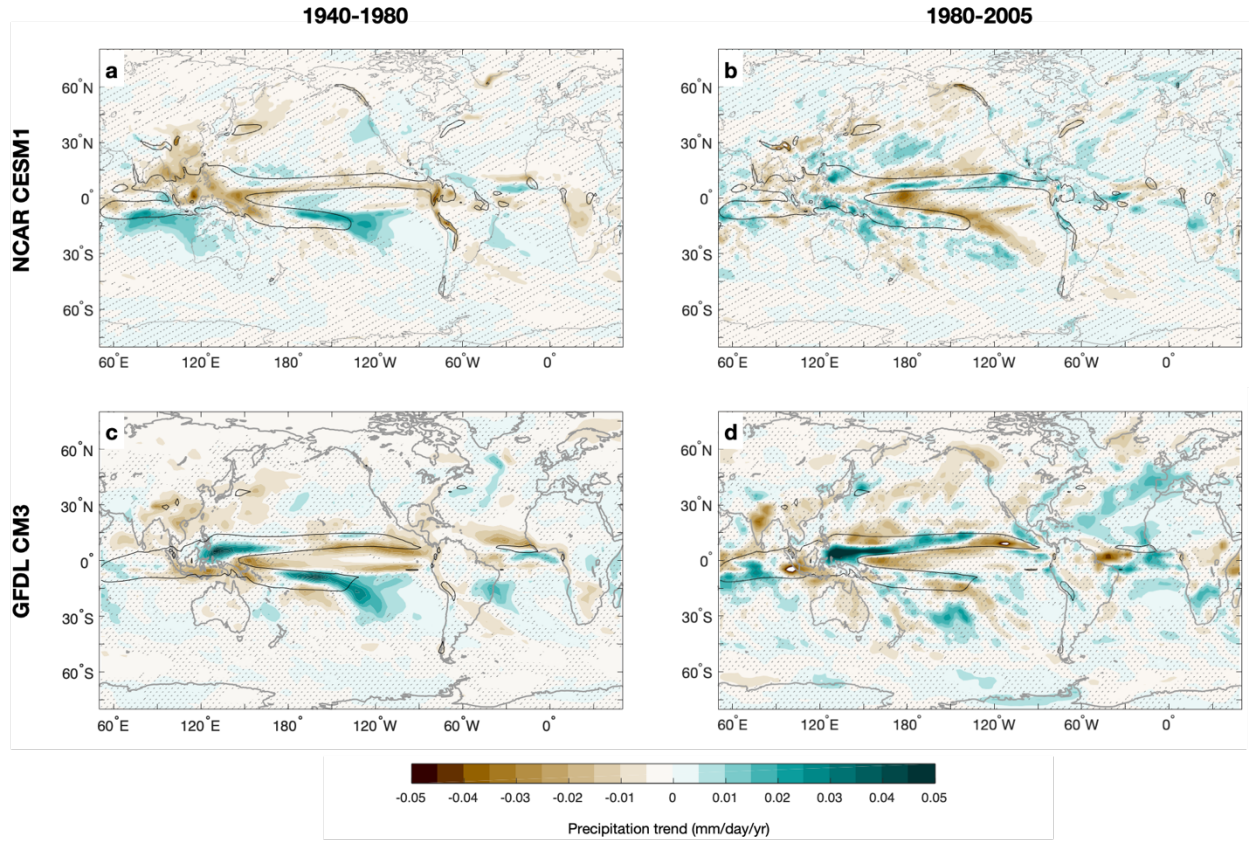

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Fig. S1. Aerosol Optical Depth (AOD) trends pattern. Spatial distribution of linear trends of AOD at a wavelength of 550 nm in CESM1 LE AER during (a) 1940-1980 and (b) 1980-2020.
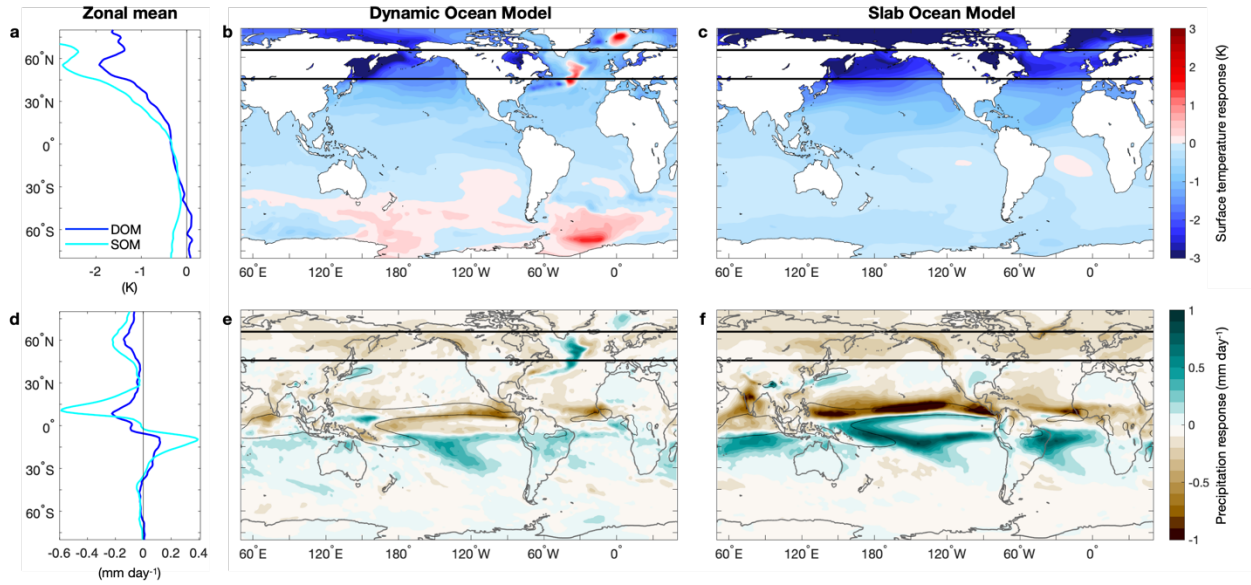
Fig. S2. Idealized experiment design. Prescribed radiative forcing over (a) Asia, (b) North America and (c) Europe perturbed experiments.

Fig. S3. Aerosol-forced surface temperature trend. The linear trend of surface temperature from aerosol single-forcing simulations with CESM1 LE and GFDL CM3 for the two epochs, 1940-1980 and 1980-2005. Hatched regions indicate statistically insignificant values at the 95 % confidence level based on a two-sided *t*-test.
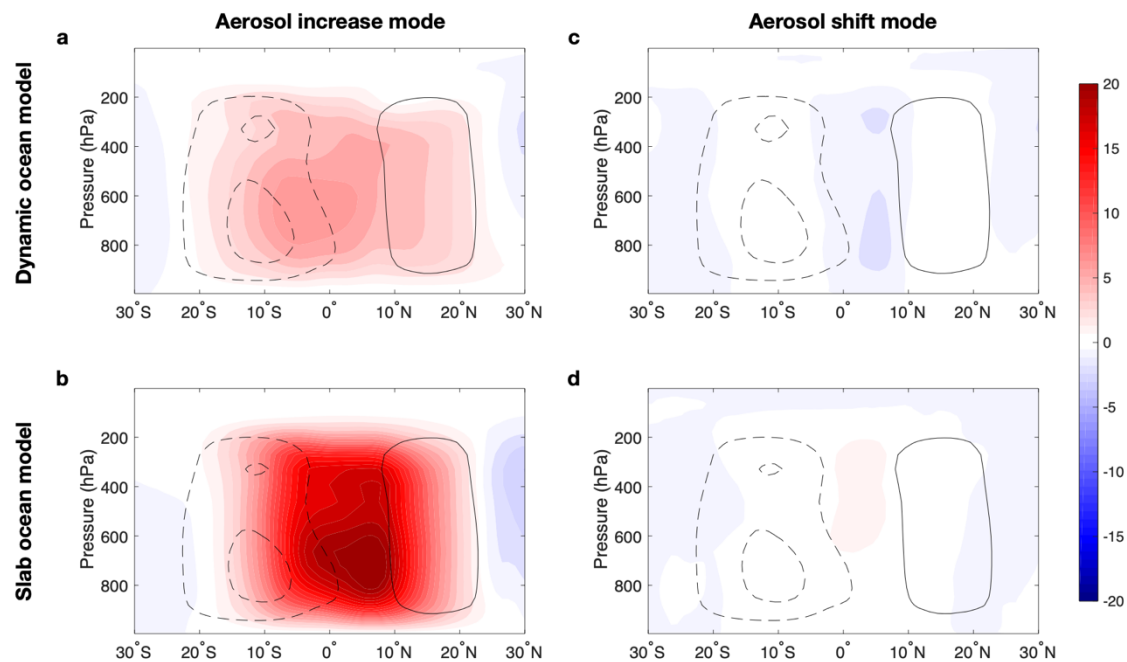
Fig. S4. Aerosol-forced precipitation trend. The linear trend of precipitation from aerosol single-forcing simulations with CESM1 LE and GFDL CM3 for the two epochs, 1940-1980 and 1980-2005. The black contours show the 6 mm day⁻¹ isopleth of the precipitation climatology between 1920-2005 from the respective control experiment. Hatched regions indicate statistically insignificant values at the 95 % confidence level based on a two-sided *t*-test.

Fig. S5. Zonally uniform forcing experiment. Surface temperature anomalies in (a) the zonal-mean, (b) dynamic ocean model (DOM), and (c) slab ocean model (SOM) experiments. (d-f) Same as (a-c) but for precipitation anomalies. The black contours in e,f show the 6 mm day^{-1} isopleth of the precipitation climatology from the preindustrial control simulation. The global mean forcing in the zonally uniform forcing experiment is twice that in the aerosol increase mode, so that the climate responses are halved for easier comparison. This experiment is part of the Extratropical-Tropical Interaction Model Intercomparison Project (ETIN-MIP).

Fig. S6. Hadley circulation response. The mean meridional stream function anomaly (unit = 10^9 kg s^{-1}) for aerosol increase mode in (a) dynamic ocean model (DOM) and (b) slab ocean model (SOM) experiments. (c,d) Same as (a,b) but for aerosol shift mode. Positive values indicate clockwise anomalies and negative values indicate counterclockwise anomalies. The control climatology is displayed in contours, with a clockwise circulation in solid and a counterclockwise circulation in dashed (contour interval = 50×10^9 kg s^{-1}).