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## The impact of perturbations to tropical aerosols and their precursors on local and remote climates

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Aerosols are a major climate forcer, but their historical effect has the largest uncertainty of any forcing, and so their mechanisms and impacts must be better understood. Due to their short lifetime, aerosols have large impacts near their emission region, but they also have effects on the climate in remote locations. In recent years, studies have investigated the influences of regional aerosols on global and regional climate, and the mechanisms that lead to remote responses to their inhomogeneous forcing. However, there has been little work on the influence of emissions from the tropics, as the aforementioned studies typically focused only on northern mid-latitude pollution effects. This work uses the new UK Earth System Model (UKESM1) to investigate the atmospheric composition and climate effects of tropical aerosols and aerosol precursor emissions. We performed three idealised perturbation experiments in which a) tropical SO<sub>2</sub> emissions were multiplied by a factor of 10; b) tropical biomass burning carbonaceous aerosol emissions were multiplied by 10; and c) tropical biomass burning carbonaceous aerosol emissions were entirely removed. Impacts on radiation fluxes, temperature, circulation and precipitation are investigated, both over the emission regions, where microphysical effects dominate, and remotely, where dynamical influences become more relevant. Increasing tropical SO<sub>2</sub> emissions causes a global cooling, and the asymmetric forcing (stronger negative forcing in the Northern Hemisphere Tropics) drives a southward shift of the intertropical convergence zone (ITCZ). The experiment with the large increase in tropical biomass burning organic carbon (OC) and black carbon (BC) features a net warming globally, and a local cooling in locations where the aerosol load increases the most, since OC and BC reduce radiation at the surface locally, causing cooling. However, whereas OC scatters radiation with a negative forcing, BC has a warming effect since it reduces the planetary albedo, and this warming wins out on the global scale. The forcing is asymmetric, but changes sign between seasons as biomass burning in Africa shifts across the Equator, driving a more complex response of the ITCZ. The removal of biomass burning OC and BC leads to opposite effects to the 10x increase, but with a smaller magnitude, and with dynamical changes playing a more important role than microphysical ones, relative to the larger perturbations. Using the Shared Socioeconomic Pathway scenarios (SSPs), transient future experiments have also been performed, testing the effect of Africa following a relatively more polluting route (SSP3-RCP7.0) to the rest of the world (SSP1-RCP1.9), relative to a global SSP1-RCP1.9 control. Preliminary results from this analysis will also be presented.

