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Past, present and future anthropogenic aerosol emissions: atmospheric feedbacks in different climate conditions

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The aim of this study is to assess the impact of anthropogenic aerosols on climate from pre-industrial to 2050. For future emissions we follow the A2 IPCC scenario, the Speciated Particulate Emissions Wizard (SPEW) inventory of Streets et al, 2004 for carbonaceous aerosol, and the NIES emission inventory for SO2 (T.Nozawa pers communication). Pre-industrial and present emissions are based on the AEROCOM aerosol model inter-comparison experiment inventory (Dentener et al. 2006). We keep natural aerosol emissions unchanged for each period. Aerosol effects are estimated using the General Circulation Model from the Laboratoire de Météorologie Dynamique (LMDZ) coupled to the atmospheric chemistry - aerosol module, INCA. Snap shot simulations of 10 years were performed for 4 base periods: pre-industrial, present-time, 2030 and 2050. We analyse the anthropogenic aerosol climate feedback, especially on temperatures and hydrological cycle together with their direct and indirect radiative forcing. In a first set of simulations, we considered the modification of aerosol emissions between 2000 and 2050, under present-day climate conditions. The direct effect of anthropogenic aerosols increases from 2000 to 2030 and subsequently declines (-0.12; -0.32; -0.28 W/m^2 in 2000, 2030 and 2050). Their indirect effect decreases from 2000 to 2050 (-0.47, -0.43 and -0.40 W/m^2 in 2000, 2030 and 2050 respectively). However aerosol forcing is spatially heterogeneous and can reach -10 W/m^2 locally, particularly next to the source regions. We describe the spatial variations of the aerosol effects. The results of a second set of simulations in which we take into account the impact of climate change in 2030 and 2050, will also be discussed.