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Vertical profiles of aerosol radiative forcing - a comparison of AEROCOM phase 2 model submissions

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Aerosols in the earth's atmosphere affect the radiation balance of the planet. The radiative forcing (RF) induced by a given aerosol burden is however sensitive to its vertical density profile, in addition to aerosol optical properties, cloud distributions and surface albedo. Differences in vertical profiles are thought to be among the causes for the large intermodel differences in RF of the aerosol direct effect.

As part of the AEROCOM phase 2 direct radiative forcing experiment, this study compares 3D concentration fields of black carbon from fossil fuel burning (BC) and sulphate (SO4) from a set of major global climate models. The participating models were run using a prescribed set of emissions of aerosol and aerosol precursors and the same meteorological year.

We assume that model differences due to the aerosol vertical profile can be factored out from other differences such as aerosol physics, radiative transfer or ground albedo. We consequently analyse model RF variability using profiles of normalized RF (radiative forcing per unit mass, NDRF) calculated from a single model. This tool allows us to quantify the fraction of the intermodel variability due to differences in aerosol vertical profiles.

We show that there are still significant differences between both modelled vertical density profiles, treatment of aerosol physics and other factors influencing the RF profiles.