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Quantification of the uncertainty in direct radiative forcing from aerosol state of mixing, size distribution and hygroscopicity

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Aerosol state of mixing and uncertainties on size distribution and hygroscopicity have hampered attempts to reduce the incertitude on the direct radiative forving of aerosols. Here, we apply Mie calculations for 3 rules of aerosol mixing: external, homogeneous internal and concentric spheres. We compute the optical parameters (optical depth, asymmetry parameter and single scattering albedo) for all 3 different mixing states, for variation in aerosol radii up to $\pm$ 20% from a reference case, and for variations of aerosol water up to $\pm$ 50%. The daily mean fields of optical parameters from the global aerosol model INCA are then used to construct probability density functions based on the 1,323 cases computed and normalized for each model gridbox. We report 1-sigma and 2-sigma uncertainties in these parameters. Based on these computations the 2-sigma uncertainty reaches maxima of 50% for the optical depth, 5% for the asymmetry parameter and 8% for the single scattering albedo. The geographical patterns are presented.

These uncertainties are then propagated to derive the overall uncertainty in direct radiative forcing.