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Calculation of aerosol optical properties under different assumptions on mixing state, refractive index, density and hygroscopicity: uncertainties and importance of representation of aerosol mixing state

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The calculation of aerosol optical properties from aerosol mass is a process subject to uncertainty related to necessary assumptions on the treatment of the chemical species mixing state, density, refractive index, and hygroscopic growth. We used the FlexAOD post-processing tool to calculate the optical properties (aerosol optical depth (AOD), single scattering albedo (SSA) and asymmetry parameter (g)) from chemistry-transport model aerosol profiles, using a wide range of assumptions on aerosol chemical and physical properties. We calculated that the most important factor of uncertainty is the assumption about the mixing state, for which we estimate an uncertainty of 30–35% on the simulated aerosol optical depth (AOD) and single scattering albedo (SSA). The choice of the core composition in the core–shell representation is of minor importance for calculation of AOD, while it is critical for the SSA. Other factors of uncertainty tested here have a maximum average impact of 10% each on calculated AOD, and an impact of a few percent on SSA and g. We then tested simple parameterizations of the aerosol mixing state, expressed as a function of the aerosol aging, and verified that they may be helpful in reducing the uncertainty when comparing simulations with AERONET retrievals.