Sensitivity of aerosol optical depth, single scattering albedo, and phase function calculations to assumptions on physical and chemical properties of aerosol

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In coupled chemistry-meteorology simulations, the calculation of aerosol optical properties is an important task for the inclusion of the aerosol effects on the atmospheric radiative budget. However, the calculation of these properties from an aerosol profile is not uniquely defined, because it requires a certain degree of parameterization of the aerosol physical and chemical characteristics.

In this work, we exploit the opportunity offered by the second phase of the Air Quality Model Evaluation International Initiative (AQMEII-2) (http://aqmeii.jrc.ec.europa.eu/, Im et al., 2014) to compare the aerosol optical properties (aerosol optical depth *AOD*, single scattering albedo *SSA*, and asymmetry parameter *g*) for a range of models participating in AQMEII-2. These properties are computed from bulk mass concentrations provided by the models using a unified framework, in order to estimate the uncertainty related to the underlying assumptions on chemical species mixing state, density, refractive index, and hygroscopic growth.

Several simulations, with parameters perturbed within a range of observed values, are carried out for July 2010 and compared to AERONET sunphotometer data across Europe and North America (Figure 1). We calculate 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 *AOD* and *SSA*. The choice of the core composition in a core-shell representation is of minor importance for calculation of *AOD*, while it is critical for the *SSA*. The uncertainty introduced by the choice of mixing state on the calculation of *g* is on the order of 10%. Other factors of uncertainty tested here have a maximum impact of 10% each on monthly average *AOD*, and an impact of a few percent on *SSA* and *g*.

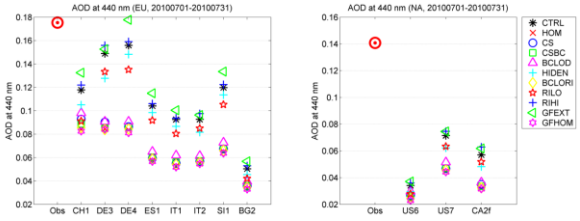

Figure 1. Average AOD in July 2010 observed from AERONET (large red circle) over Europe (left) and North America (right), and simulated by several models (labels on the abscissa) under different assumptions on species mixing state, density, hygroscopicity, and refractive index (legend).

In this presentation the effect of a simple model representation of the aerosol aging (and thus varying mixing state) and the corresponding impact on aerosol direct radiative effects is also illustrated.

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