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Effects of relative humidity on aerosol light scattering

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In the field, continuous measurements of aerosol light scattering is often performed under dry conditions (relative humidity RH$<$30-40%) which differ from ambient, climate relevant ones. Since most ambient aerosol particles experience a hygroscopic growth at enhanced RH, their microphysical (particle size, refractive index) and optical properties are strongly dependent on RH, i.e., scattering coefficients can experience RH enhancement factors of 2-6 at 90% RH compared to dry conditions. The knowledge of this RH dependence is of eminent importance for the comparison of ground based observations with satellite retrievals and aerosol parameters retrieved from LIDAR and sun photometer measurements.

To model the optical properties, we have developed a model, which is based on Mie theory. Here, we show results of a first closure of modeled light scattering properties retrieved from SMPS (Scanning Mobility Particle Sizer) and H-TDMA (Hygroscopic Tandem Differential Mobility Analyzer) data and measured scattering properties, performed by an advanced humidity controlled nephelometer (WetNeph). The SMPS measured the aerosol size distribution between approx. 15 and 600 nm, while the H-TDMA determined the hygroscopic growth at the dry particle diameters of 35, 50, 75, 110, 165, and 265 nm. The WetNeph measured the humidity dependent aerosol light scattering coefficient at three wavelengths (450, 550, and 700 nm). With a second nephelometer, measuring parallel at dry conditions, the scattering enhancement factor was determined.