Geophysical Research Abstracts
Vol. 13, EGU2011-9174, 2011
EGU General Assembly 2011

Conversion of the aerosol optical properties from dry to ambient RH at the JRC-Ispra station for atmospheric research

Mariana Adam, Jean-Philippe Putaud, Sebastiao Martins Dos Santos, Alessandro Dell'Acqua, and Carsten Gruening

European Commission, Joint Research Centre, Institute of Environment and Sustainability, Ispra, Italy (adammariana@gmail.com, 39 0332785022)

Usually, aerosol in situ measurements are taken in dry conditions (i.e. less than 40% relative humidity), in order to have a consistency within networks. However, the aerosol optical properties used as input within radiative transfer models must be determined as for ambient conditions (e.g. aerosol absorption and extinction coefficient and aerosol asymmetry factor). In order to convert the various aerosol optical variables from dry to ambient conditions, a correction has to be applied to the former. Our procedure implies measurements taken by several instruments and the Mie theory. The instruments involved are: Hygroscopicity Tandem Differential Mobility Analyzer (HTDMA) which provides GF90, the aerosol hygroscopic factor at 90% relative humidity (RH) for five diameters (35, 50, 75, 110 and 165 nm), Differential Mobility Particle Sizer (DMPS) and Aerodynamic Particle Sizer (APS) which provide the particles number size distribution over the range from 10 nm to 10 [U+F06D]m, Nephelometer which provides the aerosol scattering coefficient at 450, 550 and 700 nm and Aethalometer, from which is derived the aerosol absorption coefficient at 450, 550 and 700 nm. Through the closure between dry measurements of the aerosol scattering and absorption coefficients and the Mie theory we first determine the dry aerosol refractive index. Then, GF90, taken as monthly diurnal averages, is used to determine the volume fraction of hydrophilic and hydrophobic material in the aerosol, from which we calculate the aerosol GF at ambient RH. This is used to correct for the dry diameter as measured by DMPS and APS, as well as to calculate the aerosol-bound water fraction. Next, the wet refractive index is computed taking into account the volume fraction. Once the wet refractive index and wet diameters are computed, the Mie theory is used to compute the wet optical properties (aerosol absorption, scattering and extinction coefficients). The aerosol asymmetry factors are provided as well. From the dry and wet measurements/computations, the aerosol enhancement factors are determined for absorption, scattering, backscattering, and extinction coefficients. The computations covered 12 months over 2008 and 2009. After outliers' removal, correlations between Mie versus measured aerosol scattering shows slopes of 0.95, 0.99 and 1.02 for 450, 550 and 700 nm respectively. For aerosol absorption coefficient, we obtained slopes of 0.99, 0.96 and 1.06 for 450, 550 and 700 nm respectively. Note that correlations coefficients R^2 were > 0.99 for all cases. Combining both parameters, the slopes for aerosol extinction coefficients are 0.96, 0.99 and 1.03, and for the mean dry asymmetry factors determined empirically and theoretically 0.59, 0.57, 0.48 for 450, 550 and 700 nm, respectively. For the wet conditions, the average asymmetry factors for the three wavelengths were 0.74, 0.73, 0.70 (Mie) and 0.64, 0.63, 0.55 (empirical). Enhancement factors increase with the RH and depend also on the aerosol composition. Thus, the scattering enhancement factor can reach values above two for RH higher than 85 % (five for RH higher than 90 %). Similar results (slightly smaller) are obtained for the backscatter enhancement factor. Note that for the absorption enhancement factor we obtain values larger than unity for RH larger than 80 % (around three for RH approaching 100 %). Below 80%, the enhancement factor is smaller than unity (approaching 0.6 towards dry conditions). More results and details will be given during presentation.