Characterization of Black Carbon concentration, sources and age using an Aethalometer AE33

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Filter-based measurements of aerosol optical absorption are widely used to determine Black Carbon (*BC*) concentrations in real time. Measurements at multiple wavelengths permit the separation of contributions of *BC* from different combustion sources (Sandradewi 2008). However, filter-based methods can suffer from non-linearity due to a »loading« effect as a function of increasing deposit density on the filter (Gundel 1984, Weingartner 2003, Arnott 2005, Virkkula 2007). Static algorithms to compensate for the effect fail to capture the details and potential variability of these aerosol optical properties. This impacts the accuracy of source apportionment using the data.

The dual-spot Aethalometer (Magee Scientific model AE33) provides a real-time the model introduced determination of a loading effect, based on the model introduced by Virkkula (2007): $BC_{compensated} = BC\ (1-k*ATN)$. The compensation parameter k is determined in real time for each of the operational wavelengths, and is used in the same manner as has been developed for off-line post-processing. This provides a time resolved specific spectral fingerprint that may be interpreted in terms of aerosol composition.

Optical and chemical properties of aerosols were measured with high time resolution during summer and winter EMEP campaigns in Paris (France) and Payerne (Switzerland). An Aerosol Chemical Speciation Monitor (ACSM) and an Aerodyne High Resolution Time-of-Flight Aerosol Mass Spectrometer (AMS) were used to measure quantitative chemical composition for non-refractory aerosol particles. During summer we observed complex temporal variation of k, where k(880 nm) changed from approximately 0.006 for fresh aerosols to near zero for aged aerosols as shown using Potential Source Contribution Function (PSCF) method for back trajectory analysis.

We have combined the Aethalometer and ACSM/AMS measurements, and normalized the sum of inorganic secondary and organic aerosol mass to BC. Values of this ratio are expected to be high for air parcels containing aged aerosols. The ratio correlates well with the loading compensation parameter k measured by the Aethalometer at 880 nm (Figure 1). This indicates that the compensation parameter k can be used for discrimination between local (fresh) and regional (aged) air pollution aerosols.

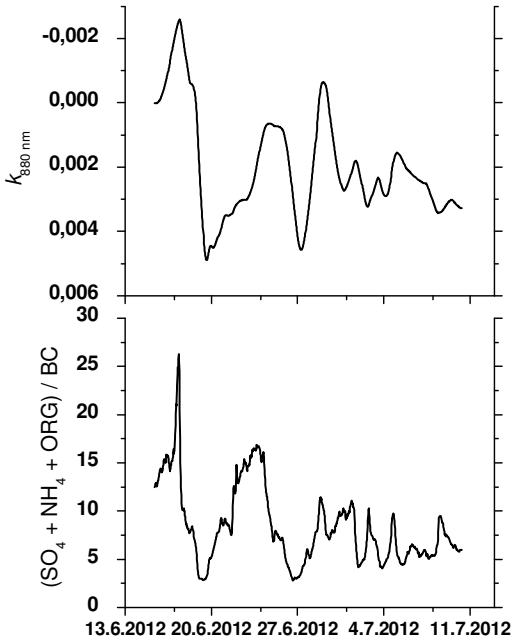

Figure 1. Time series of loading effect compensation parameter k(880 nm), compared to sum of inorganic secondary and organic aerosol mass normalized to BC, during the summer EMEP campaign at the Paris SIRTA-LSCE site.

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