

Using a multi-wavelength Aethalometer to determine the contributions of fossil fuel and biomass burning to aerosols in Ispra, Italy

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Source apportionment of carbonaceous aerosols is important for the development and implementation of action plans for air quality improvements and to assess the impact of carbonaceous aerosols on climate forcing. With the increased use of biomass for residential heating instead of fossil fuel, the contribution of carbonaceous aerosols from biomass burning will certainly increase.

Sandradewi et al. (2008) recently introduced an Aethalometer model to quantitatively attribute the particulate matter contribution from traffic exhaust, i.e. fossil fuel, and wood burning that uses a linear superposition of the different light absorption properties of these sources.

For this study we used a one year time series recorded in 2007 at the EMEP-GAW station in Ispra, Italy (45 °49' N, 8 ° 38' E, 235m asl). The station is located between the Northern edge of the Po valley and the Alpine foothills and it is representative of a semi-rural environment. Due to the topography, this region is characterised by low wind speed conditions. Together with frequent inversion layers near ground in the winter season, the dispersion of pollutants emitted in the region is hindered. This situation results in frequent exceedences of the EU 24 h limit value of 50 µg m⁻³ PM10 (see Van Dingenen et al., 2004).

The aerosol light absorption was measured with a Magee Scientific AE31 Aethalometer at seven wavelengths, i.e. λ= 370, 470, 520, 590, 660, 880, and 950 nm in 10-min cycles during the entire year.

Figure 1 shows the daily averages of the time series of the different aerosol absorptions at the infrared and UV channels of the Aethalometer. Both absorptions follow a seasonal cycle with maximum in winter and minimum in the summer. The cycle for the UV channel though is much more pronounced than the one for the IR.

Looking in figure 2 at the absorption Ångström exponent $\alpha = -\ln(b_{\text{abs}}/K)$ using all seven wavelengths, one observes a very different behaviour in summer and winter. During summer, α lies between 0.8 and 1, whereas during winter it is significantly bigger, averaging around 1.5. Reported values for α vary in the literature between 0.8 and 1.1 for traffic and diesel soot and 0.9 and 2.2 for fresh wood smoke.

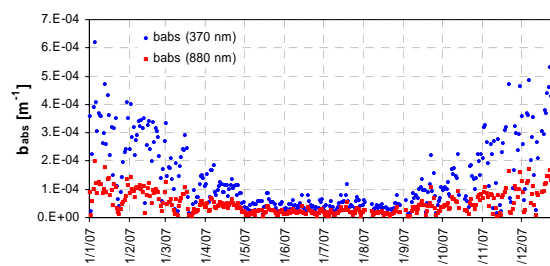


Fig. 1: Daily average of the absorption coefficients for the entire year 2007.

Therefore our findings clearly indicate that during summer time the light absorbing aerosol consists mainly of soot from fossil fuel, whereas in winter also the contribution of aerosols from biomass burning is significant.

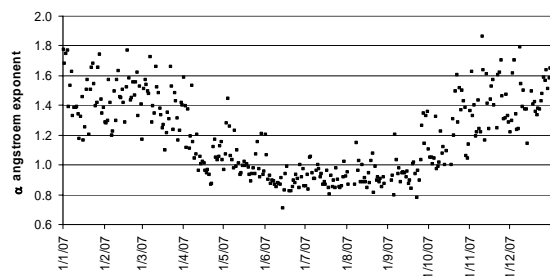


Figure. 2 Daily average of the absorption Ångström exponent α ($\lambda= 370\text{nm}-880 \text{ nm}$) for 2007.

Using the Aethalometer model from Sandradewi et al. (2008), we will present a quantitative estimate of the biomass burning and fossil fuel contribution to the light absorbing aerosol in Ispra.

- R. Van Dingenen et al. (2004) A European aerosol phenomenology - 1: physical characteristics of particulate matter at kerbside, urban, rural and background sites in Europe, Atmospheric Environment, **38**, 16, 2561-2577
- J. Sandradewi, et al. (2008). Using aerosol light absorption measurements for quantitative determination of wood burning and traffic emission contributions to particulate matter. Environ. Sci. Technol., **42**, 3316-3323.