Relating the wavelength dependency of the absorption coefficient and the aerosol type

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Absorption of solar radiation due to aerosol particles is mainly caused by carbonaceous particles and mineral dust. The Absorption Ångström Exponent (AAE) describes the wavelength dependency of the absorption coefficient and it can give information about the type of aerosol or source (Cazorla et al., 2013). In this sense, black carbon (BC) absorption follows a λ^{-1} spectral dependency, yielding an AAE equal to 1 (Bergstrom et al., 2002), while brown carbon and mineral dust have a higher contribution to absorption in the ultraviolet and blue spectral regions yielding an AAE greater than 1 (Kirchstetter et al., 2004).

In this study, we analyzed data from an aethalometer AE31, that measures the aerosol light-absorption coefficient at 7 wavelengths (370, 470, 520, 590, 660, 880, 950 nm), installed in Granada; an urban city in the southeast of Spain (37.18ºN, 3.58ºW, 680 m a.s.l). The period of study comprises from September 2012 to January 2013.

We calculated the AAE using all the aethalometer wavelengths (AAE), using the three shorter wavelengths (AAE_UV), and using the three longer wavelengths (AAE_IR). Daily AAE values reveal that there are two distinct periods, one comprised from the beginning of the study period to November 15, and another from November 16 to the end of the study period (Fig.1).

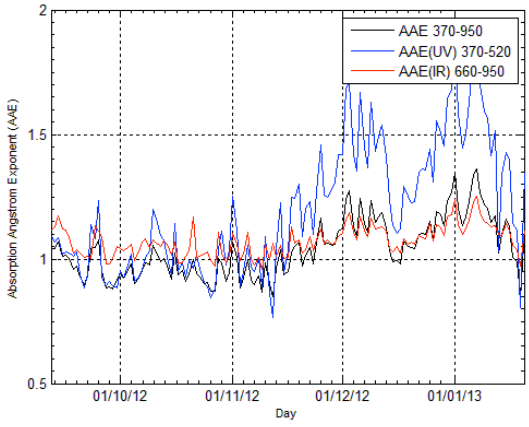

Figure 1. Aethalometer daily AAE

The first period has an AAE, AAE_UV and AAE_IR mean value of 1.0±0.3, 1.0±0.5 and 1.0±0.5 respectively; indicating the predominance of BC particles emitted by traffic source. On the other hand the second period presents an AAE, AAE_UV and AAE_IR mean value of 1.1±0.3, 1.4±0.5 and 1.1±0.3. A value of AAE greater than 1 indicates a change in the dominant absorbing type of aerosol. This change is related to seasonal changes in the emission sources; in winter domestic heating (based on fuel-oil and biomass combustion) is an additional local anthropogenic source. As we can see, this change is more pronounced for AAE calculated using the shorter wavelengths (AAE_UV), pointing out an increased contribution of brown carbon to aerosol population.

The results show the importance of measuring absorption coefficient in a wide range of wavelengths (from UV to near IR) for identifying aerosol types.

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