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Black Carbon source apportionment using time-dependent Absorption Angstrom Exponent (AAE)

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Among the aerosol particles optical properties, the Absorption Angstrom Exponent (AAE) is a crucial parameter describing the spectral dependence of light absorption by aerosols. It is intensively employed for black carbon (BC) source apportionment and aerosol characterization (e.g., BC, Brown Carbon "BrC," and dust). AAE has been widely investigated using data from filter-based absorption photometers such as the AE33 that measure light absorption at seven wavelengths (370-950 nm). BC source contribution is commonly obtained by applying the most frequent source apportionment method, the Aethalometer model. This model requires a-priori knowledge of the AAE of the fossil and non-fossil (e.g. biomass burning) BC sources and values of around 1 (AAE_{ff}; fossil) and 2 (AAE_{wb}; non-fossil) are commonly used. In this work, in order to improve the results of the aethalometer model for BC source apportionment, we investigate the model performances resulting from using site-dependent AAE_{ff} and AAE_{wb} determined from the experimental data. These latter were obtained by studying the frequency distributions of experimental AAE calculated from AE33 data collected at urban sites in the frame of the RI-URBANS project. However, AAE can also vary with time depending on changing burning fuels and burning conditions, and single constant AAE_{ff} and AAE_{wb} values cannot be representative of the whole measurement period considered. For this reason, we also evaluated the use in the Aethalometer model of experimental time-dependent rolling AAE_{ff} and AAE_{wb}. This improved AAE-frequency-distribution-based Aethalometer model could be applied in near-real time to obtain the BC source apportionment. Thus, it could help to improve our understanding of AAE values considering uncertainties to provide a better and more accurate quantity to differentiate between BC sources.