DOI: https://doi.org/10.14232/MAK.2024.17

# Absorption based source apportionment of atmospheric carbonaceous particulate matter using Aethalometer and Photoacoustic methods

Tibor Ajtai[1], Noémi Utry[1], Csilla Gombi, Imre Salma[2], Rahman Abdul[1], Zoltan Bozoki[1]

[1]Department of Optics and Quantum Electronics, University of Szeged, Hungary
[2]Eötvös Loránd University, Budapest, Hungary

To understand the significance of atmospheric black carbon (BC) and its impact, thorough physicochemical characterization and correlation analysis of measured quantities are crucial. However, the complex, variable nature of BC, along with its dynamic physicochemical features in constantly changing atmospheric conditions, pose challenges for its characterization and source apportionment of light absorbing carbonaceous (LAC) particulate matter. Employing receptor-based models that involve extended filter-sampling periods followed by chemical analysis for source apportionment underscores the importance of revealing and quantifying correlations between these measurements with the real-time characterizations of atmospheric aerosols. This approach provides deeper insight into the dynamic evolution of LAC in relation to the emission strengths of different sources. In the present work, we demonstrate a comparative analysis of spectral based source apportionment of traffic and wood burning aerosols using Aethalometer- and photoacoustic (PA)-model [**1**]. The measurements and collection of aerosol samples were carried out at the Budapest platform for Aerosol Research and Training (BpART) [**2**]. A strong and positive correlation of off-line measured source specific quantities with absorption Ängström exponent (AAE) is demonstrated, especially the source specific ratios of $^{14}C/^{12}C$, the $TCM_{nonfossil}/TCM_{fossil}$ are deduced from the radiocarbon measurements and their correlation with AAE data was revealed and quantified for the first time. For comparison purpose, we use different but widely accepted assumptions for defining source specific AAEs in the Aethalometer model. Applying the site-specific and wavelength-independent correction factors for compensation of multiple scattering effect in Aethalometer, result in different mass concentrations of the emitted sources. The percentage difference in average mass concentration in case of different AAE values with same wavelength-independent correction factor falls between 52% and 180%, while for the wavelength-dependent and wavelength-independent correction factors alongside with source and site-specific AAE, the percentage difference turns out to be 45% and 26% for traffic and wood burning aerosols respectively. We also demonstrate the source apportionment results of PA-model, which shows significantly different results than Aethalometer model regardless of the applied AAE and correction schemes. The key findings of our study highlight the significant limitations of the Aethalometer-model and that the outcome of the spectral based source apportionment strongly depends on the applied method.

1. Ajtai, T. Atmospheric Environment, 122, 313-320, (2015).
2. Salma, I. Atmospheric Chemistry and Physics, 16, 8715–8728, (2016).