Apšviečiant aerozolio daleles miesto aplinkoje: juodosios anglies šaltinių kilmės atskyrimas ir optinis aerozolio dalelių klasifikavimas Vilniuje ir Varšuvoje šiltuoju sezonu 2022

Shedding light on urban aerosols: black carbon source apportionment and identification of aerosol types in Vilnius and Warsaw during the warm season of 2022

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The driving force behind our work was the quest to uncover aerosol optical characteristics, namely absorption, scattering and single scattering albedo (SSA), black carbon (BC) mass concentration, and source contribution in two neighbouring capitals Vilnius and Warsaw.

The measurement sites in urban (Warsaw) and urban background (Vilnius) environments were equipped with Aethalometers (AE33) and Nephelometers (TSI model 3563 in Vilnius and Aurora 4000 in Warsaw). The measurements took place simultaneously from May to August 2022. BC source apportionment was performed using the Aethalometer model to assess the contribution of fossil fuel combustion and biomass burning [1].

Aerosol types were classified via the Absorption Ångström Exponent (AAE) and Scattering Ångström Exponent (SAE) optical division scheme suggested by Cappa et al. (2016). The results reveal that the "BC-dominated" aerosol type was the most prevailing (92% in Vilnius and 88% in Warsaw) throughout the warm season in both sites. Meanwhile, the second most abundant mixing state was "Large particle/BC mix" which comprised 6% in Vilnius and 11% in Warsaw. Mostly during May, both in Vilnius and in Warsaw, 1% of particles were attributed to "Mixed BC, BrC" type which also correlated with the higher contribution of biomass-burning-related BC (up to 30%).

Observed BC mass concentration patterns were similar at the two sites throughout the campaign. Although, differences were observed in the absolute level of the values: a 40% higher BC mass concentration was observed in Warsaw (1.1 µg/m^3) compared to Vilnius (0.7 µg/m3). Source apportionment results showed that fossil fuel combustion contributed the most to BC pollution at both sites (84% in Vilnius and 86% in Warsaw), despite the different proximity to major roads.

The study provides a better perception of prevailing aerosol types, their optical characteristics and the impact on atmospheric radiative transfer which have not been addressed previously during the warm season in urban environments in the region of Lithuania and Poland.

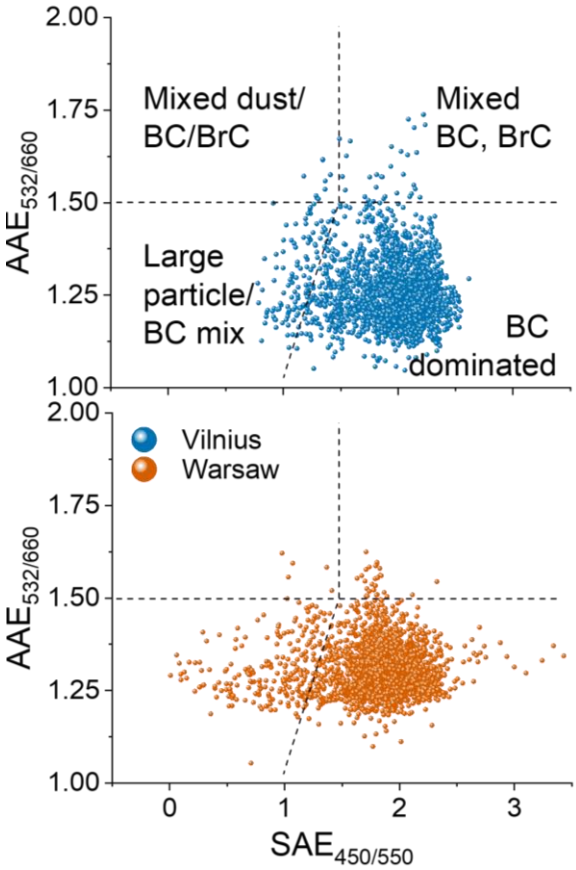

Figure 1. Relationship between the AAE and SAE in Vilnius and Warsaw during the warm season of 2022. The optical division scheme was proposed by Cappa et al. [2].

Keywords: Optical properties, absorption Ångström exponent, scattering Ångström exponent, Black Carbon, Source Apportionment.

References

[1] J. Sandradewi, A. S. H. Prévôt, E. Weingartner, R. Schmidhauser, M. Gysel, and U. Baltensperger, Atmos. Environ. **42**, 101 (2008).
[2] C. D. Cappa, K. R. Kolesar, X. Zhang, D. B. Atkinson, M. S. Pekour, R. A. Zaveri, A. Zelenyuk, Q. Zhang, Atmos. Chem. Phys. **16**, 6511 (2016).