Source apportionment combining off-line and on-line measures approaches using EPA PMF 5.0 model and Multilinear Engine (ME-2) in an urban traffic station

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Particulate matter (PM) is one of the major environmental issues that influence climate change and lead to harmful effects on human health, causing annually millions of premature deaths (EEA, 2020). To face these issues, it is essential to identify the emission sources that impact atmospheric particle concentration in order to develop effective and efficient strategies to control PM levels. This study aims to analyse the source contributions for the PM_{10} levels in an urban area by source apportionment (SA), combining off-line and on-line measuring approaches using two different receptor models (RMs).

This study was performed in an urban traffic station located in Coimbra, Portugal. Measurements were conducted for 6 months. PM mass concentrations were gravimetrically determined and filters were chemically analysed for the elemental composition, water-soluble ions, sugars and carbonaceous content. The input optical data was the absorption coefficient (b_{abs}) for seven different wavelengths (λ = 370, 470, 520, 590, 660, 880, 950 nm) obtained by an Aethalometer model - AE33. The methodology applied joined optical and chemical parameters of aerosol by using EPA Positive Matrix Factorization model version 5.0 (PMF) and Multi-linear engine program (ME-2) and comparing both results.

The ME-2 approach allowed the input of experimental data with different time resolutions, while in PMF the chemical and optical data was analysed in 24h resolution. ME-2 coupled chemical speciation with 24h resolution and optical data with three time intervals (00h-7h, 7h-20h, 20h-00h) that can better identify some specific sources (e.g., traffic and biomass burning). In both RMs, some constraints were implemented for a better physical description of the factors and the bootstrap analysis supported the goodness of the solution. Using these two different approaches, the same sources and similar % distributed for each were identified. The final solution obtained for the investigated site consisted of seven factors: traffic, road dust, soil, biomass burning, secondary aerosol + fuel, sea salt and bioaerosol, being the first three emissions sources that mainly contributed to the PM_{10} mass. The input of b_{abs} allowed more robust identification of sources, such as biomass burning and traffic.

This type of approach, combining high and low time resolution, proved to be advantageous since identified more robustly the emission sources. Furthermore, the introduction of b_{abs} allowed the retrieval of optical apportionment and optical characterisation of the sources, as it provided estimates for source specific atmospheric Absorption Ångström Exponents (α), which are typically assumed *a-priori* in optical apportionment models. In addition, the results of SA provided valuable information to help policymakers to identify regional cost-effective air quality measures to abate the personal exposure to the pollutants, and consequently improve human health and wellbeing.

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