Source Apportionment of Carbonaceous Aerosols with High Time Resolution

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Abstract

With the purpose of characterising ambient aerosols and their time evolution and to assess the contribution of the main emission sources and processes leading to aerosol formation in the atmosphere a campaign was conducted in the urban centre of Moscavide (North of Lisbon, Portugal). A traffic air quality monitoring station was located close to one-way street with a total length of 1.2 km. Particulate matter (PM) was sampled and on-line black carbon (BC) (Aethalometer AE33) and total carbon (TC, measured by TCA08) measurements were performed simultaneously.

Separation of contributions to BC from different combustion sources is based on the dependence of absorption on the wavelength (*Aethalometer model*), while the measurement of TC allows the determination of equivalent OC, that is the difference between TC and EC (inferred from BC), at high time resolution (*TC-BC method*).

Introduction

Chemical composition of aerosols is characterised by a large spatio-temporal heterogeneity, being carbonaceous aerosols the major components of the submicron fraction of atmospheric PM. They are emitted by different sources that exert a negative impact on human health, and also affect the climate and the environment. The components of carbonaceous PM (TC) are organic carbon (OC), elemental carbon (EC) and inorganic carbon (IC). When EC is measured using optical methods relying on its strongly light absorbing character it is called BC, which is emitted during the incomplete combustion of fossil fuels, biofuels, and biomass burning and absorbs at all wavelengths of solar radiation.

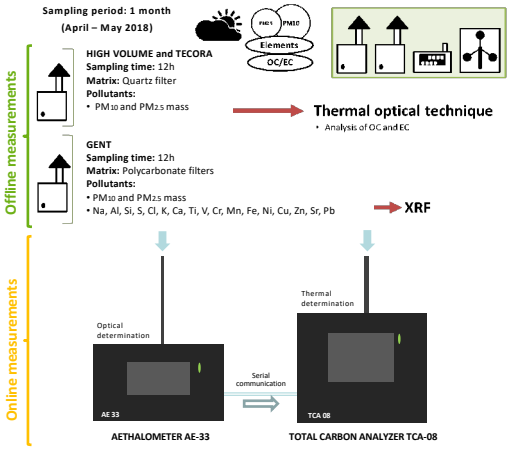
Thus, it is of main importance to determine the chemical composition of fine aerosols at high time resolution, providing the necessary information for accurate source apportionment.

Methodology

- **Study site:**

Av. Moscavide (Loures, PT) → urban-traffic background

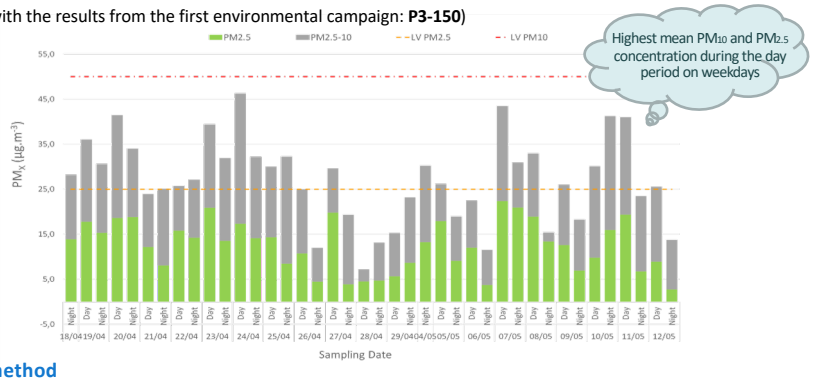
- **Experimental set-up:**



Results and Discussion

- **No sampling periods showed PM_{10} or $PM_{2.5}$ values above the limit value**

(compare with the results from the first environmental campaign: **P3-150**)



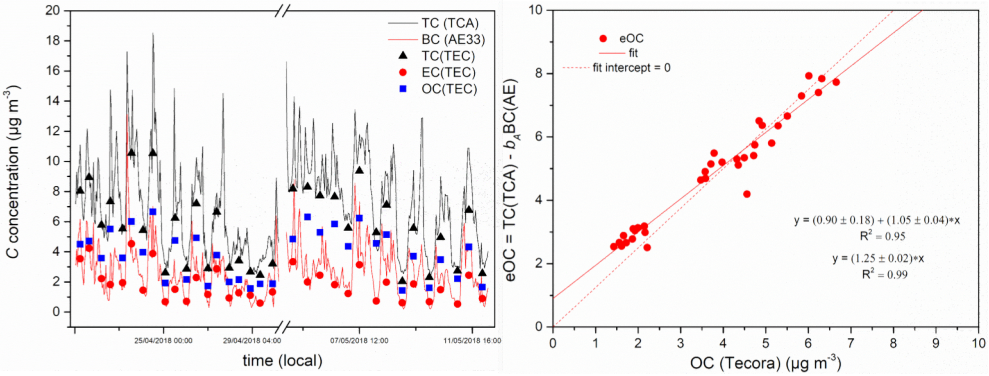
- **TC-BC method**

This method combines two different highly time resolved measurements to determine the OC fraction with **high time resolution**:

- Optical measurement of BC with Aethalometer (model AE-33)
- Thermal measurement of TC with newly developed Total Carbon Analyzer, model TCA-08

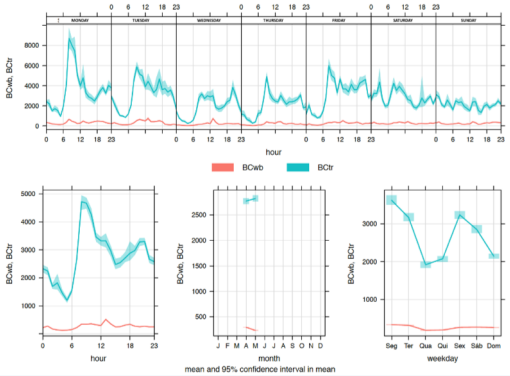
$$\mathbf{eOC = TC - b_A \cdot BC}$$

- b_A.BC is equivalent to EC, and the determined proportionality parameter b_A is region/site specific but also depends to a large extent on the thermal protocol (EUSAAR2) used to determine the EC fraction with the conventional OC/EC method.



- **Aethalometer model**

- BC source apportionment: dominated by traffic (T_{aver} ≈ 30ºC);
- Absorption Ångström Exponent (AAE) values: 1.0 for traffic (BCtr) and 2.0 for wood burning (BCwb).



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