EMPREINTE DES AÉROSOLS CARBONÉS EN UTILISANT UNE MÉTHODE AVANCÉE DE DETERMINATION DU CARBONE TOTAL-CARBONE NOIR (TC-BC(Λ)) AU SEIN DU GRAND PARIS, FRANCE

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HIGH-TIME-RESOLUTION CARBONACEOUS AEROSOLS FINGERPRINT USING AN ADVANCED TOTAL CARBON-BLACK CARBON (TC-BC(Λ)) METHOD IN GREATER PARIS, FRANCE

RESUME

Les Aérosols Carbonés (AC) sont reconnus comme contribuant au réchauffement climatique et comme un composant important des matières particulaires. Ces aérosols carbonés ont une structure chimique complexe et il est crucial d'étudier leur composition. Le système de spéciation des aérosols carbonés a été spécialement développé pour améliorer localement la surveillance de la qualité de l'air en utilisant des méthodes en ligne pour la détermination du Carbone Total (TC) et du Carbone Noir (BC). Cet article a pour but de présenter les résultats d'une campagne de mesure d'un an au SIRTA avec une approche à haute résolution temporelle, permettant d'étudier l'évolution diurne et saisonnière des différentes sources, de la transformation, de la météorologie et de ses impacts sur les émissions d'aérosols carbonés.

ABSTRACT

Carbonaceous Aerosols (CA) is recognized as contributor to global warming and significant component of particulate matter. As CA has a complex chemical structure, it's crucial to study its apportionment. The Carbonaceous Aerosol Speciation System has been especially developed to improve local air quality monitoring by using online methods for Total Carbon (TC) and Black Carbon (BC) determination. This article aims to present the results of a one-year measurement campaign at the ACTRIS SIRTA facility with a high-time-resolution approach allowing to study the diurnal and seasonal evolution of different sources, transformation, and meteorology and its impacts on the emissions of Carbonaceous Aerosols.

MOTS-CLÉS: Aérosols carbonés, carbone noir, carbone brun, aérosols organiques secondaires / **KEYWORDS:** Carbonaceaoous aerosols, black carbon, brown carbon, secondary organic aerosols

CONTENT

In recent years, Carbonaceous Aerosols (CA) have drawn much scientific attention due to their negative impact on public health and contribution to global warming. CA was also recognized as a significant component of fine particulate matter ($PM_{2.5}$). Due to the complex chemical structure of CA, different optical properties of its components, and various possible sources, the apportionment of CA to more components is crucial to prepare efficient future measures to improve local air quality and create effective mitigation strategies to limit further warming on a global scale.

In this study, we have used the Carbonaceous Aerosol Speciation System (CASS, Aerosol d.o.o., Slovenia, EU), combining two instruments, a Total Carbon Analyzer TCA08 (Rigler *et al* (2020)) in tandem with an Aethalometer AE33, which allows us to perform high-time-resolution measurements of total carbon (TC) and black carbon (BC).

Integrating different numerical algorithms to high-time-resolution measurements with CASS (i.e., Aethalometer model, EC tracer model, BrC model), we introduce an advanced method to apportion CA into six components based on their optical absorption properties and their primary or secondary origin:

$$CA=BC_{ff} + BC_{bb} + POA_{BrC} + POA_{non\text{-}abs} + SOA_{BrC} + SOA_{non\text{-}abs},$$

where BC_{ff} and BC_{bb} represent fossil fuel and biomass burning related BC components, POA_{BrC} and SOA_{BrC} are the primary emitted and secondarily formed light-absorbing organic aerosols, and POAnon-abs and SOAnon-abs non-light-absorbing aerosols (Ivančič *et al* (2022)).

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This new approach was applied to a one-year long measurements campaign at the ACTRIS SIRTA facility (located about 20km southwest of Paris city center). The high-time-resolution approach allowed to study the diurnal and seasonal evolution of different components as a function of sources, transformation, and meteorology (cf. Figure 1). Road transport (all over the year) and biomass burning are confirmed here as the main sources of primary emitted carbonaceous aerosols, this latter fraction being largely dominant in winter. On the other hand, secondary formed SOA ($SOA_{non\text{-}abs}$ + SOA_{BrC}) is overwhelming in summer afternoons when their contribution can reach 70 % of CA but is also important during nights in the colder months.

The results are evaluated with complementary air quality measurements (e.g., gaseous pollutants, ultrafine particles, $PM_{2.5}$, ACSM).

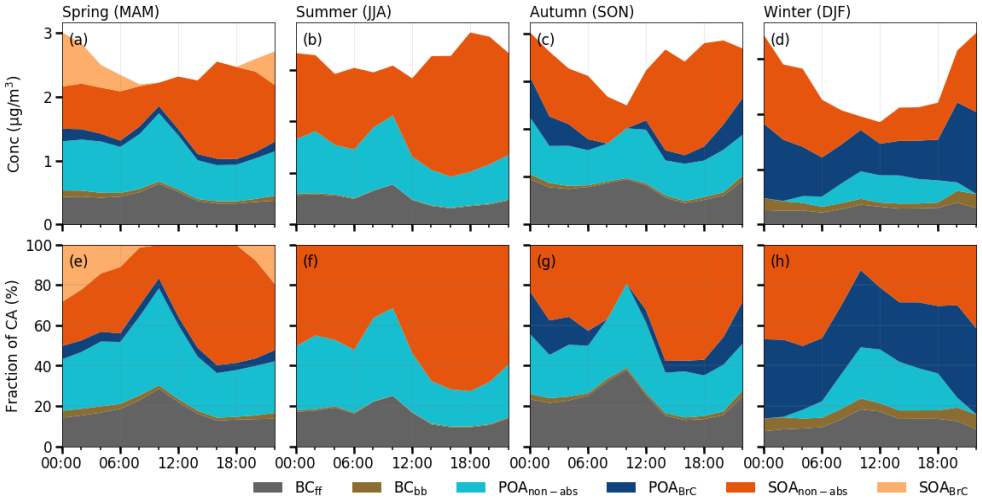

Figure 1. CA's diurnal profiles apportioned to BC_{ff}, BC_{bb}, $POA_{non\text{-}abs}$, POA_{BrC}, $SOA_{non\text{-}abs}$, and SOA_{BrC} in SIRTA: (a-d) contain medians, and (e-h) relative fractions.

Finally, we have compared the average CA fingerprint from SIRTA (cf. Figure 2) to other locations, illustrating the interest of applying our high time-resolution CA source apportionment to provide important information for the adaptation of air pollution abatement strategies in different environments.

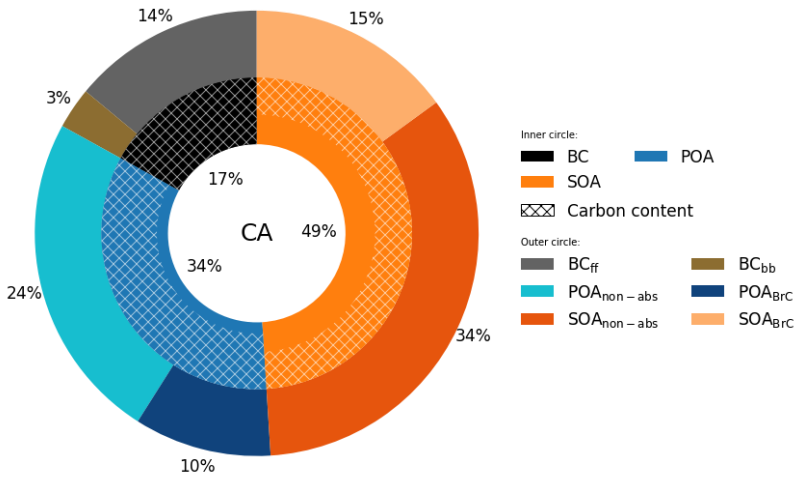

Figure 2. One-year average CA fingerprint in SIRTA.

Rigler *et al* (2020) Atmospheric Meas. Tech. 13, 4333–4351.
Ivančič *et al* (2022) Sc. of the tot. Envir., 848:157606.

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