Chemical characterization and optical properties of submicron particles measured in M'Bour, Senegal during 2015/2016 dry season

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Recently, several studies have focused on possible relationships between aerosols physicochemical and optical properties. Nonetheless, most of them have limited their analysis on specific species like mineral dust or Brown Carbon (BrC) (Ealo et al., 2016). Only a few have investigated the link between remote sensing aerosol measurements and PM_1 chemical characterization at high time resolution (Nicolae et al., 2014).

The aim of this work is to establish links between optical properties and PM_1 chemical composition measured in West Africa. For this purpose, a specific instrumental platform has been implemented on the AERONET station of M'Bour (Senegal) during the SHADOW (SaHAran Dust Over West Africa) campaign. The latter was divided in two intensive observations periods: IOP-1 (Mar. - Jun. 2015) and IOP-2 (Dec. 2015 - Jan. 2016). Chemical composition (furthermore detailed in a companion abstract), microphysics and optical properties were obtained by coupling in situ and remote sensing (ground-based and air-borne) measurements.

During IOP-1, intense but short Non-RefractoryPM_1 pollution events, sea breeze phenomena and long mineral dust episodes were observed. IOP-2 was marked by the occurrence of additional biomass burning (BB) events as shown in Figure 1 for January 3rd 2016, with a strong increase of ACSM (Aerosol Chemical Speciation Monitor) organic (Org) concentrations and m/z 60 signal -levoglucosan marker linked to BB- after 8 p.m.

During the dry season, M'Bour aerosol loads are influenced by several kinds of absorbing compounds: Black Carbon (BC), BrC and Iron Oxide contained in Mineral Dust. Thus it was necessary to deconvolute absorption measurements by taking into account the contribution of these different species. This has been achieved by using their differences in absorption wavelength dependence. Our deconvolution algorithm – coupling Sandradewi et al. (2008) and Fialho et al. (2014) methods – has been applied to aethalometer (AE33) absorption measurements by using m/z 60 signal as an indicator of BB influence. It has to be noticed that Fe concentrations can be retrieved only in the absence of BrC.

BB impacts on PM_1 optical properties are observed in Figure 1 through the large increase of both absorption and scattering coefficients, especially at shorter wavelengths. Associated scattering Angström exponents show values of ~0.3 before 8 p.m and ~1 after, underlying changes of chemical composition and fine particles content.

Next step will be to compare these in-situ ground-based observations with coincident remote sensing measurements of column integrated and vertical profiles of aerosol optical properties made by LIDAR and AERONET sun/sky photometer.

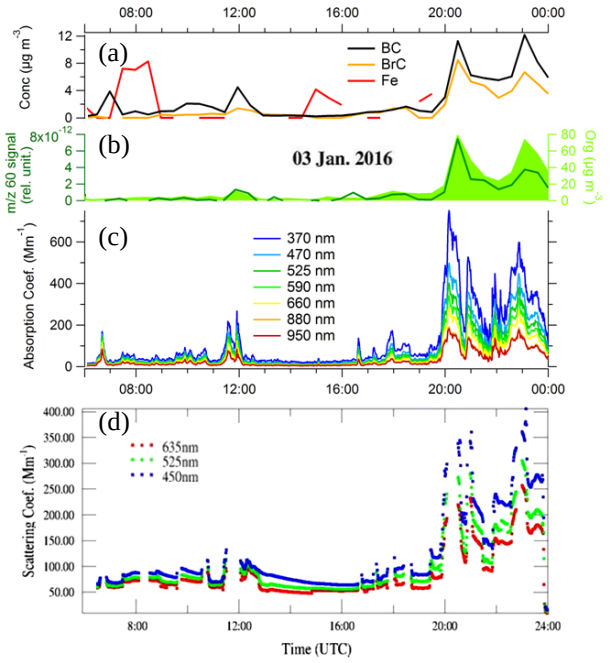

Fig. 1.Case study of Jan. 3rd 2016 with (a) BC, Fe, BrC, (b) Org concentrations and m/z 60 signal. (c) Absorption and (d) scattering coefficients.measured in PM_1 at different wavelengths.

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