Fog Induced Changes in Optical Properties of Interstitial Aerosol Particles in the Po Valley (Italy)

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Introduction

The interaction between aerosol and atmospheric water (within fog and cloud) can affect microphysical and chemical properties of atmospheric particles [1]. Nevertheless, there is lack of knowledge about fog related changes in chemical and optical properties. Several studies have proved the influence of fog on aerosol size and chemical composition [2]. The increasing frequency of fog in rising economy countries, characterized by high aerosol emissions, urges a better knowledge of aerosol-fog interaction.

Methods

We investigated aerosol optical properties in San Pietro Capofiume (rural background site) in the Po Valley. During experiments in November-December 2015, we deployed an Aerosol Mass Spectrometer (HR-ToF-AMS), a 7-wavelength Aethalometer, and an integrating Nephelometer (TSI). Ancillary measurements included liquid water content and the meteorological parameters (relative humidity, temperature and wind speed). We used Positive matrix factorization (PMF) analysis of AMS organic aerosol mass spectra to further characterize the sources of ambient organic aerosol (OA). Black Carbon (BC) source apportionment was performed [3] and relative contributions of wood burning, fossil fuel and brown carbon (BrC) combustions to light absorption were evaluated. Furthermore, absorption Angström exponent (AAE), scattering Angström exponent (SAE) and single scattering albedo (SSA) were calculated.

Results and conclusions

4 radiative fog events were investigated. For this database, we chose three-factor solution consisting of hydrocarbon-like organic aerosol (HOA), biomass burning organic aerosol (BBOA) and oxygenated organic aerosol (OOA). During fog events the highest scavenging efficiency was observed for OOA (varied between 55% and 74%). The changes in aerosol optical properties 1 h before and during the fog formation were observed (Fig 1). During all fog events, AAE changes according to BBOA PM1 mass fraction. The variability of other optical parameters of interstitial aerosols (absorption and scattering coefficients, SAE and SSA) was controlled by particle size changes. BC source apportionment analysis showed that relative contributions of light absorbing materials were not affected by the fog formation. Identified changes in atmospheric aerosol optical properties due to the aerosol-cloud interaction can be used to better describe aerosol radiative forcing and the climate implications.

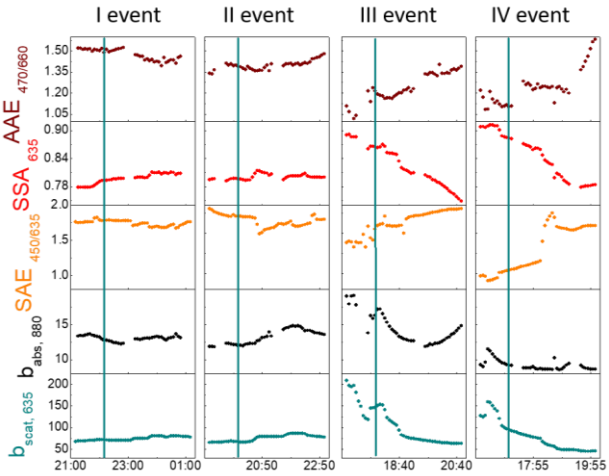

Figure 1. Time trend of AAE, SSA, SAE, b_{abs} and b_{scat} one hour before and three hours after the beginning of each fog event. Light-blue vertical lines indicate the formation of each fog.

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