Brown Carbon at Three Platforms During the Actris-2 Experiment in Summertime in the Po Valley (Italy)

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Organic aerosol (OA) is a dominant component of atmospheric fine particles affecting air quality and possibly climate. Nevertheless, the optical properties of OA are far from being completely understood. Light absorbing OA, also known as brown carbon (BrC), accounts for up to 20% of anthropogenic aerosol warming [1]. In addition, recent measurements indicate that BrC short wavelength absorption can be larger than BC absorption, due to its vertical distribution [2]. Ambient observations indicate that different types of BrC are produced as primary pollutants during combustion at low temperature and smoldering, or can be formed in the atmosphere through atmospheric processing.

We investigated OA optical, microphysical, and chemical properties in summertime at three platforms located in the Po Valley Italy, one of the European pollution hot-spots. Measurement platforms included Monte Cimone (remote mountain site, 44°12' N, 10°42' E, 2165 m asl), Bologna (urban background site, 44°31' N 11°20' E, 39 m asl), and San Pietro Capofiume (rural site, 44°39' N, 11° 37' E, 11 m asl). During the ACTRIS-2 experiment in July 2017 we deployed on-line high time resolution measurements (High resolution – Time of Flight – Aerosol Mass Spectrometer HR-ToF-AMS, and Aerosol Chemical Speciation Monitors ACSM), together with off-line OA UV-Visible light absorption measurements. Subsequent source apportionment analysis of OA spectra allowed for the quantification of OA components, whose mass absorption cross-sections (MAC) were calculated using bulk OA UV-Visible spectra.

OA accounted for more than 50% of fine particle mass at all the sites. OA MAC at 365nm varied between 0.2 and 0.8 m^2 g^{-1}, in agreement with observations at locations dominated by secondary OA (SOA) [3,4]. Primary OA from fossil fuel combustion did not contribute to light absorption in the range 300-700 nm, while SOA components absorbed UV-Visible light, especially at short wavelengths. In agreement with literature data [4,5], aged SOA was characterized by higher MAC compared to fresh and local SOA. MAC dependency on OA oxygen content suggests that SOA at the low altitude sites was mainly from ageing of anthropogenic emissions. MAC values for specific OA types estimated by this study can improve models in describing the OA impact on climate.

References

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