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Physical and chemical characterization of urban aerosol particles through Soot Particle Aerosol Mass Spectrometry

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Introduction

Urban aerosol particles consist of complex mixtures, including organic compounds, salts and black carbon. The physical and chemical properties of the particles determine their effects on human health and climate, and gives clues to their origins and atmospheric fates. We report a preliminary characterisation of the submicrometer street side Copenhagen aerosol during the winter of 2011-12.

Method

Aerosol mass spectrometry (AMS) is a powerful tool for on-line chemical measurements of PM1. The High Resolution Time of Flight (HR-ToF)-AMS probes non-refractory PM (NR-PM) with high sensitivity and time resolution, and with a mass resolution sufficient for elemental analysis. Size-resolved measurements are possible through use of Particle Time of Flight (PToF). NR-PM is defined as the fraction of PM that vaporizes when impacted on a heated (600 °C) tungsten (W) surface under vacuum.

Refractory black carbon (rBC) is an important component of PM. This has prompted the development of the Soot Particle-AMS (SP-AMS), in which an intracavity laser (1064 nm) is used to vaporize particles which contain rBC (Onasch et al 2012). In this campaign the SP-AMS was used in dual vaporizer mode, where the W vaporizer is used alternated with combined laser and W vaporization. The data produced is comparable with standard HR-ToF AMS data, but contains additional information about the rBC content of particles. Furthermore, comparing the two alternating measurements yields information on the internal mixing of rBC with other species.

Results and Conclusions

It was found that on average the particles sampled consisted of 44% organic compounds, 20% rBC, 14% nitrate, 13 % sulphate and 6 % ammonium by mass. About half of the rBC occurred in small particles, with a high degree of internal mixing with organic PM. Virtually no nitrate or sulfate was found in these smaller particles, which likely originated from freshly emitted vehicular exhaust. The remaining rBC was found in larger size particles, to some degree internally mixed with organic and inorganic compounds. This fraction of rBC is attributed to long range transport.

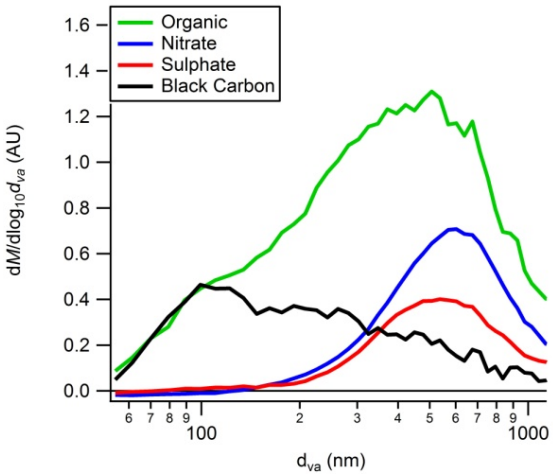

Figure 1: Chemically resolved size distributions, campaign average.

The mass loadings of rBC and organic aerosol were highly variable, brief (<1 min) spikes with elevated loadings were frequent. These likely originate from exhaust emitted close to the measurement site.

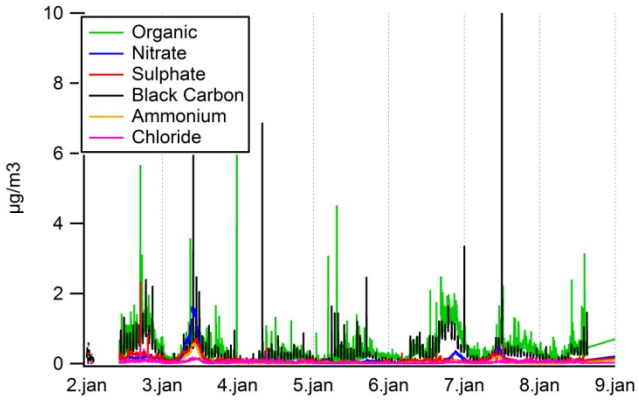

Figure 2: Timeseries from the first week of january 2012.

Onasch, T.B., Trimborn, A., Fortner, E.C., Jayne, J.T., Kok, G.L., Williams, L.R., Davidovits, P. and Worsnop, D.R. *Aerosol Science and Technology*, 46, 804-817, 2012.