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Vodička, Petr
2013

Dostupný z <http://www.nusl.cz/ntk/nusl-161323>

Dílo je chráněno podle autorského zákona č. 121/2000 Sb.

Tento dokument byl stažen z Národního úložiště šedé literatury (NUŠL).

Datum stažení: 19.04.2024

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CHARACTERIZATION OF FINE PARTICLES BY AEROSOL MASS SPECTROMETER AT THE PRAGUE SUBURBAN SITE DURING SUMMER AND WINTER SEASON

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Keywords: Atmospheric aerosols, Chemical composition, Prague, AMS, PM1

INTRODUCTION

The increasing interest in the role of aerosols in the atmosphere leads to a growing need to their measurements in the environment. For this reasons, the detailed studies of aerosols were also included into the existing European project ACTRIS (www.actris.net). One of the ACTRIS part is the coordinated long-term measurement of aerosol chemistry both with Aerosol Chemical Speciation Monitors (ACSM) (Ng et al., 2011) and by other types of Aerosol Mass Spectrometers (AMS) (Canagaratna et al., 2007). The measurement network includes many background stations (including urban background sites) all over Europe (<http://www.psi.ch/acsm-stations/acsm-and-emep-stations>). One of the participating stations was also an urban background site in Prague. This paper presents preliminary results characterizing the fine aerosol at this site during two intensive (summer and winter) measurement campaigns.

EXPERIMENTAL SETUP

Two measurements campaigns were carried out at the Prague suburban site (50°7'36.473" N, 14°23'5.513" E, 277m ASL) for ca 6-weeks in summer (20.6.-31.7.2012) and winter (8.1.-19.2.2013). The site is located on the edge of the plateau above Prague (ca 1.2 million population) and it is officially classified as an urban background station.

The main instrument, measuring during the above mentioned campaigns, was the Compact Time-of-Flight Aerosol Mass Spectrometer (C-ToF-AMS; Drewnick et al., 2005). This instrument measures the size and the composition of submicron aerosol particles in a real time and is able to produce complete mass spectral data for single particles. But the C-ToF-AMS can detect only non-refractory (NR) materials, that is, species that evaporate sufficiently fast at the AMS vaporizer temperature (ca 600 °C) and high vacuum conditions (ca 10⁻⁵ Pa) (Canagaratna et al., 2007). The main NR species that are successfully analyzed are organic aerosols together with major inorganic species like NH₄NO₃, (NH₄)₂SO₄, and NH₄Cl. The main refractory materials that are not detected by the AMS are dust, soot (elemental carbon), fly ash, metal oxides, and sea salt.

The sampled aerosol was dried by a Nafion dryer before analysis by AMS with a 1-min time resolution. Additional instruments were running continuously in parallel with the AMS to obtain both data for collocation comparisons and informations about refractory parts of measured aerosol. A scanning mobility particle sizer (SMPS) provided information about particle number size distributions in the size range from 10 to 510 nm. A semi-online EC/OC analyzer (from Sunset Laboratory) was used to measure an organic and elemental carbon (OC and EC) in 2-hour time resolution and PM1 filter samples were collected on quartz fiber filters with a 24-hour time resolution in order to determine water soluble ions by ion chromatography.

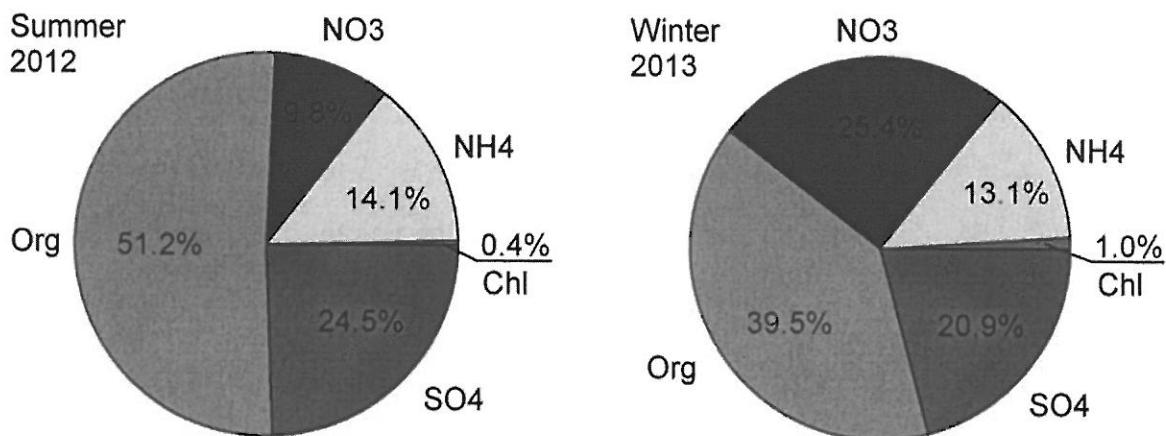


Fig. 1: An average relative composition of non-refractory aerosol measured by AMS during summer (20.6.-31.7.2012) and winter (8.1.-19.2.2013) campaigns at a Prague suburban site.

RESULTS AND PRELIMINARY CONCLUSIONS

Figure 1 shows an average relative composition of NR fine aerosol at a Prague suburban site. The major part is formed by organic aerosol in both seasons. Its contribution is more than 50% in summer and its main source is probably secondary organic aerosol. More than 2-times higher contribution of nitrates in winter compared to summer is caused mainly by thermal instability of ammonium nitrate in summer. Higher amount of non-sea salt chloride in winter may refer to a higher biomass combustion in this season. The relative share of ammonia and sulfates remains roughly the same during both seasons.

The ability of the AMS to quantify aerosol mass accurately depends on different factors. In addition to the right assignment of mass fragments for each chemical species it is necessary to correctly identify such parameters like the ionization efficiency (IE) and particle collection efficiency (CE) (e.g. Canagaratna et al., 2007). IE was determined by calibration with NH_4NO_3 particles (BFSP mode; e.g. Drewnick et al., 2005), which was properly performed at weekly intervals. The values of CE were assessed by intercomparison with collocated aerosol instruments (EC/OC, SMPS and ion chromatography). Details from these comparisons as well as a detailed study of individual fragments will be presented during the lecture.

ACKNOWLEDGEMENT

This work was supported by the Czech Science Foundation under grant P209/11/1342.

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