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MASS SIZE DISTRIBUTIONS OF WATER SOLUBLE IONS IN PRAGUE AND VIENNA IN SUMMER

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INTRODUCTION

Aerosol mass size distribution is a key factor that influences aerosol behavior both on local (health effects, visibility) and global (global warming) level. The content of water soluble ions is the most important factor controlling hygroscopic behavior of aerosol particles. Hygroscopicity is a substantial parameter for particle deposition in lungs, particle – cloud interactions, aerosol optical effects etc. Therefore we studied size distribution of water soluble ions in two Central European capitals – Prague and Vienna. In this work, the results from summer campaigns are presented.

EXPERIMENTAL

The measurements were done at an urban background sampling site Suchdol located in the NW suburbs of Prague on the campus of the Institute of Chemical Process Fundamentals (ICPF) at 277 m a.s.l. The closest road with traffic density 10-15 thousands car per day is located about 200 m from the site. The area can be characterized as residential with the closest house being placed about 30 m from the site. The sampling point was about 4 m above ground, on the roof of sampling container. The sampling period was from 27th June to 7th July 2012, 11 samplings were done in total. Each sampling took 23 hours.

The Vienna urban site was located on the roof of Faculty of Physics about35 m above ground, close to the inner court of the building. The building is located in downtown Vienna but there is only little traffic on the roads next to the building. The sampling period in Vienna was from 17th to 30th July 2012, with 9 samplings done in total. Each sample in Vienna took 23 hours with exception of the samples taken over the weekends. Those two samples took 71 hour each.

The instrument used for size selective sampling was a small deposit area cascade impactor (SDI) with 12 stages and operating at flow rate of 11 l/min. The cut diameters of the stages were 0.041, 0.087, 0.15, 0.23, 0.34, 0.52, 0.73, 0.99, 1.50, 2.38, 4.21, and 7.98 μm (Maenhaut et al. 1996). The samples were extracted with ultrapure water using 30 min ultrasonic bath and 1 hour shaking. The extracts were analyzed using Dionex 5000 system both for cations and anions in parallel.

RESULTS

The obtained results on mass size distributions of water soluble ions exhibit common basic features usual for ambient atmospheric aerosols. Sulfates and ammonium were almost exclusively present in fine mode. Fine nitrates were mostly low due to high summer temperatures, but they had always distinct coarse mode, sometimes dominating their size distribution. Normal size distribution of ammonium and sulfates were often almost identical being therefore in equilibrium and showing their crucial influence on hygroscopicity in fine fractions in summer. Calcium had a common size distribution dominated by coarse mode and showing prevailing influence of local dust resuspension. Magnesium was maybe the only one species where it is possible to suggest different levels on both sites despite the different periods of sampling. Two sources were apparently present – a sea salt having modal maximum around 2 μm and a resuspension dust with modal maximum at 6 μm. The

sea salt mode identification was based on sodium concentration having its maximum at 2 μm in all sampling days at both sites and with sodium to magnesium ratio in some cases. However, this ratio is always at least partially influenced by magnesium from resuspended dust. Similarly as in Schwarz et al. (2012) most of chloride in sea salt was replaced by nitrates. The size distribution of chlorides was highly variable, often having two modes but with maxima at different sizes. The size distribution of potassium suggests non-negligible influence of biomass burning especially during some sampling days. During our measurement periods, the biomass burning influence was better visible in Prague than in Vienna. The examples of measured mass size distributions of Nano equivalents of water soluble ions in Prague and Vienna are shown in fig. 1.

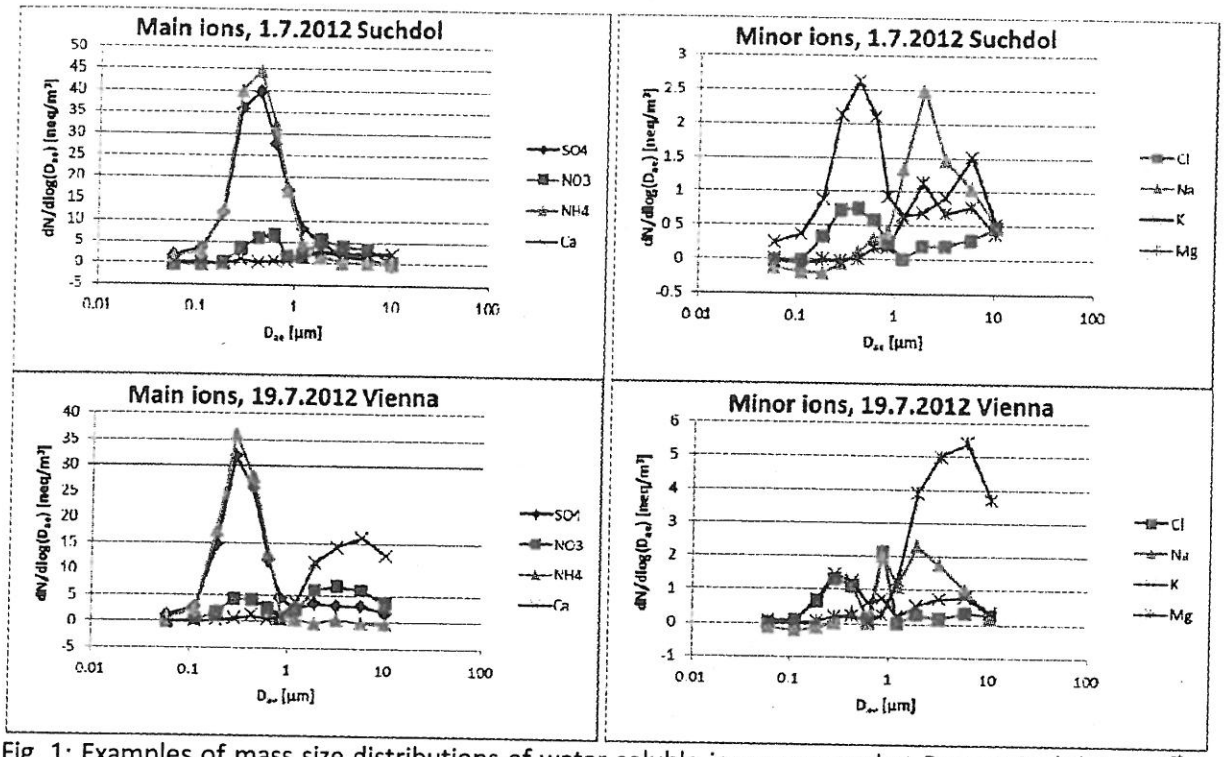

Fig. 1: Examples of mass size distributions of water soluble ions measured at Prague Suchdol on 1st July 2012 and in the center of Vienna on 19th July 2012. Concentrations are in neq/m^3. The Prague example shows aerosol influenced by sea salt together with probable influence of biomass burning, Vienna size distribution shows the relatively important influence of resuspended dust, but in both cases the absolute aerosol concentrations were very low.

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