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MASS SIZE DISTRIBUTION OF ATMOSPHERIC AEROSOLS AND WATER SOLUBLE IONS AT MLADÁ BOLESLAV IN WINTER

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INTRODUCTION

The importance of the knowledge of aerosol mass size distribution for understanding aerosol behavior is well known for at least few decades. The water soluble ions represent a driving factor controlling hygroscopicity of aerosol particles that determines how the ambient relative humidity influences aerosol particle size. Therefore, hygroscopicity is a substantial parameter in phenomena like particle deposition in the human respiratory tract, particle – cloud interactions, aerosol optical effects etc. For these reasons, the mass size distribution of atmospheric aerosols and water soluble ions was studied at a Czech medium-size-town Mladá Boleslav in winter.

EXPERIMENTAL

The measurement was performed next to a sport stadium in the distance of about 60m from the closest road southward from the site. The distance from other roads in other directions was at least 200 m. Therefore, the site could be classified as an urban background site. The samples were taken using a 10 stage Berner low pressure cascade impactor (BLPI) and a 12 stage Small deposit area cascade impactor (SDI). Both impactors were equipped with PM15 sampling inlets. BLPI samples were analyzed for mass and water soluble ions, and SDI impactors for elemental composition using PIXE. Here we will report the results obtained using BLPI. The sampling point was placed about 4 m above the ground, on the roof of a sampling container. The impactors were kept at ambient conditions. The sampling period was from 14th to 28th February 2013, 10 samplings were carried out in total. Each sampling took 23 hours except for the two weekend samplings that took 71 hours.

RESULTS

The average mass concentration of atmospheric aerosol during the whole measurement campaign was 36 $\mu\text{g}/\text{m}^3$ as determined by gravimetric analysis of BLPI samples. The sampling period was split into three categories based on the ambient aerosol levels. The first period (February 14-18) exhibited high aerosol mass concentrations exceeding the PM10 limit of 50 $\mu\text{g}/\text{m}^3$, except for the last day partially influenced by the next period. The second, clean period between February 19 - 20 with concentrations around 10 $\mu\text{g}/\text{m}^3$ was followed by the third period when concentrations were in a range from 23 to 32 $\mu\text{g}/\text{m}^3$. The average mass size distributions for each of these three periods are shown in Fig. 1. The slight shift in the position of the fine mode maxima to larger particle sizes can be seen with increasing concentration. Almost

no coarse mode can be identified in the average mass size distributions. The average mass size distributions of sulphates and nitrates per each period are depicted in Fig. 2. The equivalent concentrations of sulphates were approximately three times higher than those of nitrates. A slight shift of nitrate mass size distribution to smaller particle sizes can be seen in comparison with sulphates. The effect is more pronounced for the period with the highest concentrations. This suggests that nitrates are more related to local or regional aerosol and that they condense or are formed on the surface of preexisting particles with higher content of sulphates. The last possibility might be an externally mixed aerosols of a different origin. It seems that differences in atmospheric transport and mixing were the major factors causing large differences in aerosol mass and ionic concentrations in the three selected periods.

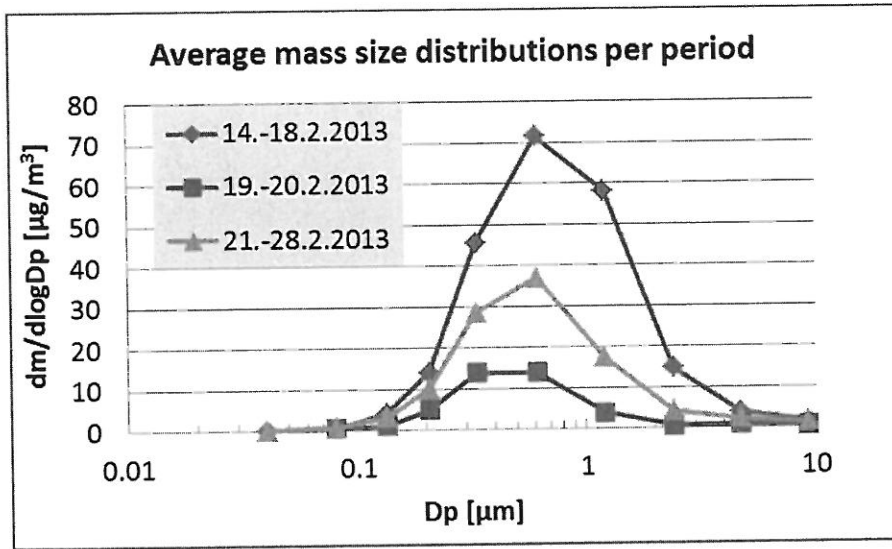


Fig. 1: The average mass size distributions for each identified period during the measurement in Mladá Boleslav.

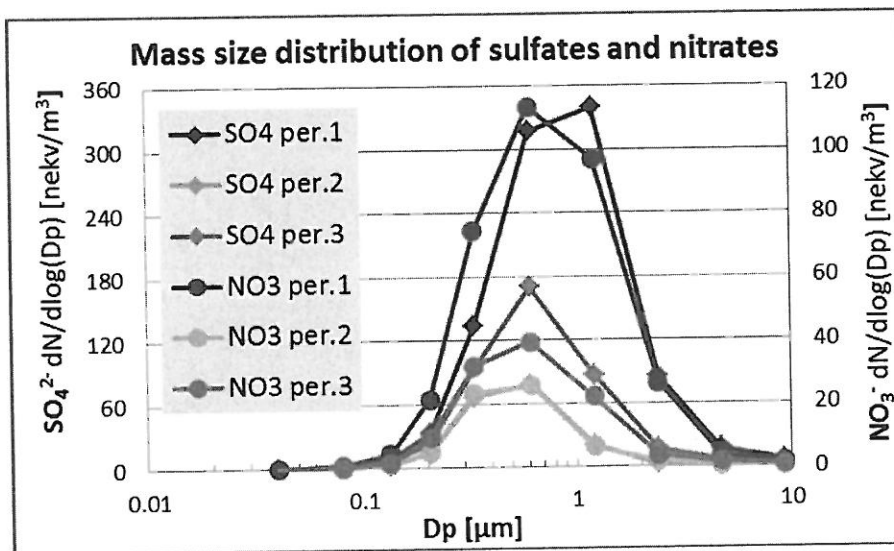


Fig. 2: Average mass size distributions of sulphates (left axes) and nitrates (right axes)

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