Air mass back trajectories and dry atmospheric aerosol mass size distributions in Prague

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Keywords: mass size distribution, air mass back trajectories, water soluble ions

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Ambient aerosol size distribution is an important factor influencing aerosol behavior and properties including particle deposition in lungs and aerosol influence on clouds. Both influences are also driven by aerosol hygroscopicity. Cascade impactors used for size resolved determination of chemical composition suffer from changes of ambient RH during sampling. Due to this factor the same particle might be deposited at different impactor stage when it is sampled at noon at 40% RH or in the early morning at 99% RH. Therefore, we used a diffusional aerosol dryer and a 7-stage modified Berner low pressure impactor with a back-up filter (Štefancová et al., 2011) during the heating (shown as "winter" and non-heating season (shown as "summer") campaigns in 2008. The samples were analyzed for water-soluble ions (Cl^-, SO_4^{2-}, NO_3^-, Na^+, NH_4^+, K^+, Mg^{2+}, Ca^{2+}) and water-soluble organic carbon as a main species that influence aerosol hygroscopicity. Due to the drying, the aerosol size distributions were not influenced by the daily variability of ambient relative humidity.

The results cover the measurements from both campaigns (11 "winter" sampling days and 10 "summer" sampling days). The aerosols sampled on individual days were classified based on the connected air mass back trajectories into three classes: sea-influenced aerosol (SIA), continental aerosol (CA), and mixed aerosol (MA) for samples of intermediate origin.

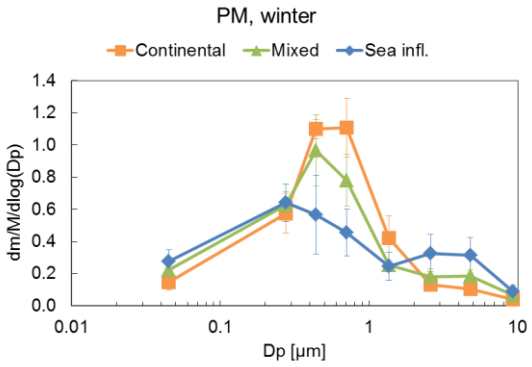

Fig. 1. Average normalized mass size distributions for the PM in the continental, mixed, and sea influenced aerosol samples of the winter campaign.

The differences between CA and SIA were substantial both when looking at the normalized mass size distributions of the particulate matter (PM, Fig. 1) and of the individual species (see an example for SO_4^{2-} in the summer in Fig. 2) and when taking into account

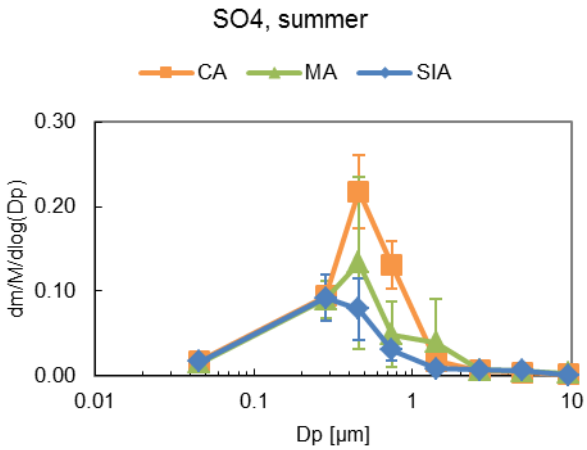

Fig. 2. Average normalized mass size distributions for the PM in the continental, mixed, and sea influenced aerosol samples of the summer campaign.

the absolute concentrations in the fine and coarse size fractions. The shift in the position of fine mode maxima could be explained by the prevailing influence of condensation or droplet mode formation of the accumulation mode particles (Hering and Friedlander, 1982). However, relative humidity profiles along the air mass trajectories could not explain the differences in size distributions in this way. Therefore another reason leading to explanation of the described differences (Schwarz et al., 2012) should be taken into account. As the first hypothesis, we suggest that the differences in average SO_2 concentration fields above Europe could explain our observations if the SO_2 concentration above Western Europe was so low that the diffusional limitation of SO_2 transport into droplets becomes important. This would change size dependence of sulphate formation rate from volume proportional to surface proportional.

This work was supported by the Czech Science Foundation under grant No. P209/11/1342.

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Schwarz, J.; Štefancová, L.; Maenhaut, W., Smolík J. and Ždímal V.: (2012) *Sci. Tot. Environ.* **437**, 348-362.