Effect of ambient air gas concentrations on the shape of air ion mobility spectra

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Aerosol particle formation is known to depend on several factors (Kulmala & Kerminen 2008). Formerly, we have studied the links between the shape of the individual size distributions of charged particles and meteorological conditions (Luts et al., 2009). Also, we have studied the effect of acetonitrile (Parts et al., 2009). Now, we study the effect of the ambient air concentrations of CO, NO_x, O_3, and SO_2.

We use two air ion mobility spectrometers: the BSMA (Tammet, 2006) and the KAIS (Luts & Parts, 2008). BSMA measures atmospheric positive and negative air ion mobility distributions (spectra) in the range of 0.032 – 3.2 $cm^2V^{-1}s^{-1}$. KAIS has an extra corona ionizer in the inlet and it records the one-second aged ion spectra generated in ambient air in the mobility range of 0.6 – 2.6 $cm^2V^{-1}s^{-1}$. Gas concentration data are recorded about 600 m away from SE direction, and are given as 30 min averages. Here we report the results derived from the data recorded during August-December 2008. First we classified the KAIS and BSMA spectra, applying mathematical criteria of similarity of their shapes. We obtained about 15 classes, with very various frequency of occurrence (Luts et al., 2009; Luts & Parts, 2008). Then, we searched for the links between the particular mobility spectra classes and the ambient air concentrations of CO, NO_x, O_3, and SO_2.

Examples of the classes and the links to gases are shown in Figs. 1 and 2. Often, O_3 demonstrates a negative correlation with CO, NO_x, SO_2 probably due to variation in polluted and clean air episodes.

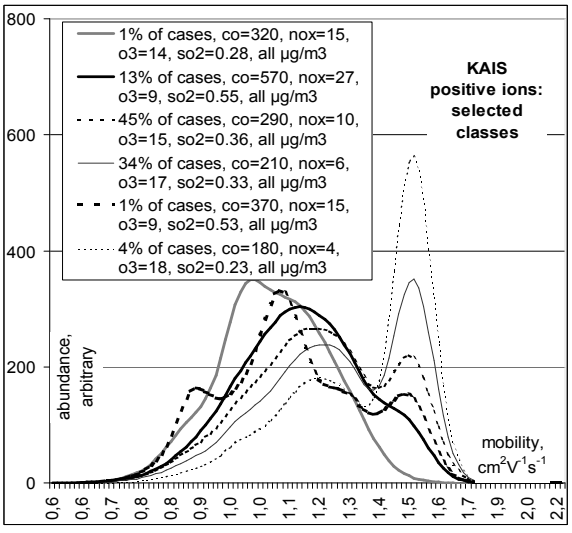

Fig. 1. Selected classes of KAIS positive ion spectra and corresponding gas concentrations.

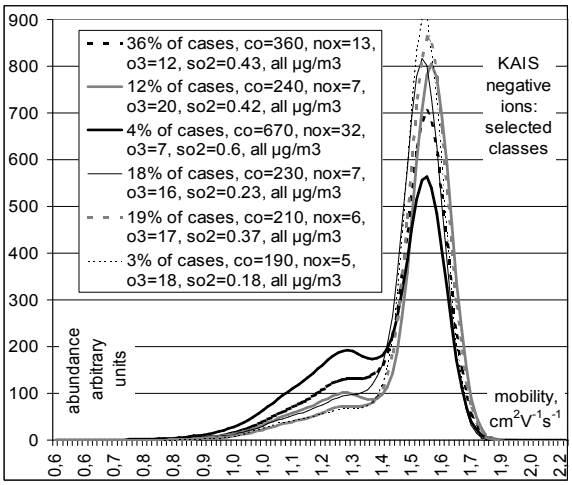

Fig. 2. Selected classes of KAIS negative ion spectra and corresponding gas concentrations.

For that reason, it was not easy to found out individual effects of every particular gas. The data in Fig.1 illustrate a conclusion that together with an increase in the concentration of O_3, the positive ion peak at about 1.5 $cm^2V^{-1}s^{-1}$ grows up and the peak at a lower mobility near 1 $cm^2V^{-1}s^{-1}$ grows down. Fig. 2 illustrates another conclusion that with an increase in the concentration of SO_2, the negative ion peak with lower mobility at about 1.2 $cm^2V^{-1}s^{-1}$ grows up and the part of common peak at about 1.55 $cm^2V^{-1}s^{-1}$ decreases.

In fact, the negative correlation within the concentrations of gases has several exceptions, and in future we will study the links more in detail.

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