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15

AIR ION MOBILITY SPECTRUM AT A RURAL AREA

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CONTENTS

LIST OF ORIGINAL PUBLICATIONS

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MAIN ARGUMENTS PROPOSED TO DEFENCE

1. Traditional classification of air ions according to mobility or size is an intuitive convention. However, the air ions can be classified using an objective criterion. According to the principal component analysis, the mobility spectrum in the range of 0.00041–3.2 $cm^2V^{-1}s^{-1}$ (diameters of 0.36–79 nm) is divided into five classes: small cluster, big cluster, intermediate, light large, and heavy large ions. The boundaries between the classes are 1.3 $cm^2V^{-1}s^{-1}$ (diameter of 0.85 nm), 0.5 $cm^2V^{-1}s^{-1}$ (1.6 nm), 0.034 $cm^2V^{-1}s^{-1}$ (7.4 nm), and 0.0042 $cm^2V^{-1}s^{-1}$ (22 nm). The five principal components that are closely correlated with the respective ion classes explain 92% of total variance of air ion mobility spectra.
2. Concentrations of the aerosol particles and air ions in weakly polluted rural air are well correlated; the correlation coefficients in a size range of 10–80 nm are 93–98%. These aerosol particles are almost quasi-steady charged. Consequently, air ion measurements could be used as a source of information about atmospheric aerosols.
3. The photochemical nucleation can initiate a burst of intermediate ion concentration (charged aerosol particles in the size range of 1.6–7.4 nm) and subsequent evolution of aerosol ion size spectra below 80 nm. The generated new aerosol particles grow toward sizes 10–15 nm during 2–3 hours. In general, the disturbed region of air ion size spectra affected by the bursts is 1.1–34 nm (0.002–1.0 $cm^2V^{-1}s^{-1}$) including the groups of big cluster ions, nanometer particles and a fraction of Aitken particles.
4. The average diurnal variation of the concentration of heavy large ions (charged Aitken particles of diameter 22–79 nm) in the warm season is opposite to that in the cold season. The different processes of aerosol particle generation (combustion versus radiolytic processes) could explain the contrast in the average diurnal variations.
5. The factors that are related to the variation of the natural mean mobility of small ions are: solar radiation (followed by diurnal variation of relative humidity and air temperature), concentration of aerosol particles (followed by a variation in concentration of heavy large ions of 52–79 nm), nucleation events (followed by the bursts of intermediate ions). These factors can explain about 50% of the variance of mean mobility.
6. The mean mobility of small air ions is a factor that can affect the conductivity of atmospheric air. The deviation of mean mobility from the average could cause changes in conductivity (induced by small ions) from about –12% to +15% and from –14% to +26% for positive and negative polarity, respectively.