Factor analysis of aerosol measurements in Tartu

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The aim of this work was to study the spectrum characteristics of urban aerosol measured in Tartu, Estonia and to test, whether it is possible to use factor analysis to describe the formation processes and possible sources of the measured aerosol.

The concentrations of particles were measured with electrical aerosol spectrometer (EAS), developed by Airel Ltd. EAS (Tammet *et al*., 2002) can measure size distribution of particles in 3.16 nm to 10 µm diameter range and has the size resolution of 8 channels per size decade and time resolution up to 1 second.

Factor analysis was used to investigate spectrum characteristics during nucleation events and non-event periods. Periods were determined visually by examination of aerosol size spectrum.

In the analysis, the number of factors was determined by the Kaiser criterion. Factors characterize correlative tendencies in aerosol size spectrum and can be associated with the formation processes and sources of the aerosol. Results of factor analysis were explained according to knowledge of human activities in the area, weather conditions and particle formation-, growth- and loss processes.

Aerosol spectrum from the periods without nucleation events had a lot of variability. In spring, the spectrum showed unsteady conditions, while in autumn and winter periods the spectrum demonstrated a daily pattern. The pattern is caused by local heating, traffic and stable weather conditions. On figure 1 factor 1 shows the accumulation of particles from local heating and traffic due to little dispersion.

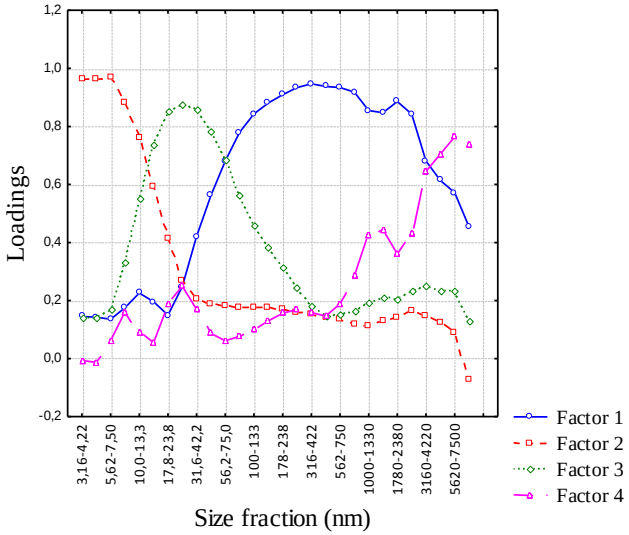

Figure 1. Results of factor analysis on a non-event period (12.12.2011-16.01.2012)

The factor analysis of nucleation periods revealed five factors. Nucleation mode was divided into three components; accumulation mode and coarse mode were also detected. The three factors in the nucleation mode were only present during nucleation events. These three modes can be linked with particle formation and growth from exhaust gases of traffic. Factor 2 on figure 2 shows accumulation of particles after growth processes and factor 1 is most likely connected to primary sources.

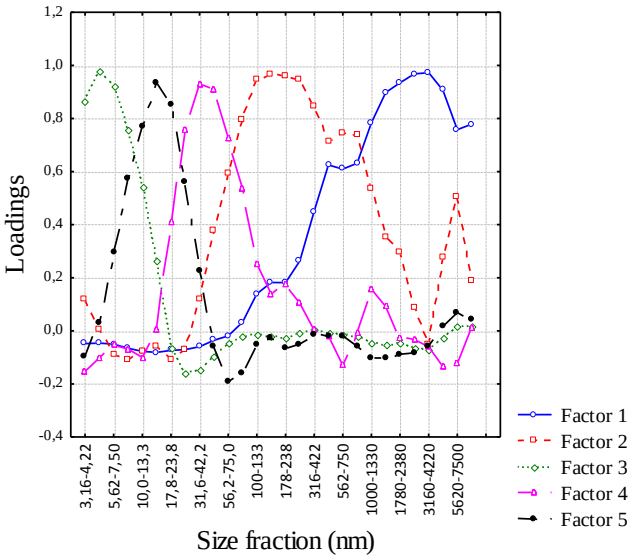

Figure 2. Results of factor analysis on nucleation event periods.

Factor analysis has previously been used to describe rural aerosol in North Estonia (Pugatšova, 2004) and urban air in other countries. However, it has rarely been used on multi-channel data. EAS measurements could also be performed with very high temporal resolution, to study aerosol distribution and development processes even in more detail in the future.

Tammet, H., Mirme, A., Tamm, E. (2002) *Electrical Aerosol spectrometer of Tartu University*, Atmospheric Research, 62, 315-324.

Pugatšova, A. (2004) *On the characteristics of the size spectrum and particle total concentration of the atmospheric aerosol depending on air mass origin*. Master's thesis, University of Tartu, Estonia. In Estonian, summary in English.