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ON USAGE OF SIZE SEGREGATED PARTICLE NUMBER CONCENTRATION TO GUESS THE ORIGIN OF PM2.5 AT THE RURAL BACKGROUND SITE KOŠETICE

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INTRODUCTION

Rural background studies serve mainly to assess the long-range transport influence and long-term trends. However, it is difficult to find a place with no influence of local sources. This is also the case of Košetice observatory having three small settlements within two km from the observatory. Therefore we attempted to analyze if the influence of these or other nearby sources can be seen in our data on PM2.5 chemical composition. Besides other possibilities like specific ratios of various gaseous compounds we concentrated on using size resolved number concentration data because of their dynamics that leads in general into particle growth until they reach accumulation mode. Several similar studies (e.g. Cusack et al. 2013) were performed during recent years.

EXPERIMENTAL SETUP

PM2.5 chemical composition was measured using two parallel samplers equipped with PM2.5 sampling heads. Double 47 mm in diameter quartz fibre filters were used in one sampler while TEFLO (47 mm in diam., 2 μm porosity) was used in the other one. 24 hour sampling was done every 6th day from February 2009 till March 2010 leading to 70 sampling days in total. The quartz fiber filters were analyzed for water soluble ions using IC, for EC and OC using TOT method, and for levoglucosan using GC-MS. The TEFLO filters were analyzed using PIXE for elemental composition. Number size distributions were obtained with 5-min time resolution in parallel using SMPS that measured within EUSAAR project. Average concentrations for each sampling day were calculated in 6 size fractions: 10-25 nm, 25-50 nm, 50-80 nm, 80-150 nm, 150-300 nm, and 300-800 nm. Correlation matrix was provided using Spearman correlation coefficients for all analyzed compounds and number concentrations in each fraction. Besides the correlations for the whole period, correlation analysis was carried out also separately for cold and warm period of the year.

RESULTS AND CONCLUSIONS

Correlations of individual analyzed species were quite common. PM2.5 highly correlated with ammonium (Spearman correlation coefficient r=0.90), sulphate (0.81), and OC (0.82). An influence of industry or coal combustion can be deduced from its correlation with Zn (0.89) and Pb (0.78) (Pacyna et al. 2007). Correlation of PM2.5 with K (0.84) supports the influence of biomass combustion.

While correlations for the cold period were similar to overall correlations (PM2.5 correlated with sulphate (0.84), ammonium (0.84), OC (0.86), Zn (0.90), Pb (0.72), and K (0.86)), the warmer season correlations were partially different. Species that may be connected with industrial sources had similar correlation with PM2.5 as for the whole period (sulphates (0.94), ammonium (0.94), Pb (0.83), and Zn (0.76)), whereas correlations of others, such as OC, were much lower.

Correlations between PM2.5 and chemical species with number concentration of particles in individual size fractions also differed between cold and warm period of the year. During cold part of the year PM2.5 correlated highly with number concentration of particles between 300-800 nm (N300-800; r= 0.98), but also with N150-300 (0.92) and N80-150 (0.83). In contrast, during the warm period PM2.5 correlated highly only with particle number concentration of N300-800 (0.85). The correlation obtained for the next smaller particle size interval N150-300 was much lower (0.54). Such differences in correlations with particle number size distributions can provide us with information not only about particle sources but also about the aerosol age. The example described above suggests that PM2.5 aerosol mass is of mainly aged, long range transported or regional origin during warmer part of the year, i.e. with little influence of local sources, whereas during the cold period we observed quite important influence of local aerosols.

Similar reasoning, based on correlations of individual chemical species with particle number concentrations in six size classes, lead us (Schwarz *et al.* 2016) to conclusion that the aged industrial and coal combustion sources form major part of PM2.5 aerosol at Košetice site during warmer period. Nevertheless, secondary organic aerosol could not be inferred directly from our data while some influence of biomass combustion was seen even in warm period.

On the other hand, although aged industrial and coal combustion sources remained significant in the cold period, biomass and wood combustion aerosol exhibited important role in PM2.5 as well, nevertheless being connected with more local sources. More data are needed to enable full PMF source apportionment analysis of PM2.5 at this site.

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