$PM_{2.5}$ chemical composition at Košetice; relation with seasons, meteorology, and size segregated particle number concentration

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$PM_{2.5}$ chemical composition studies at rural sites are needed to make a ground for determination of city related emission measures impact on a potential improvement of pollution situation and also determination of the influence of long range transport. To separate it from the influence of local sources, correlations with size segregated particle number concentrations were used at the Czech ACTRIS, EMEP, and GAW rural background site.

The Košetice site (N 49°35', E 15°05'; 534 m.a.s.l.) is located 60 km SE of Prague, and a closest town lies 15 km to the south, with a population of 16 thousand inhabitants. However, there are also several small settlements within a 3 km radius, of which Košetice village is the largest, and the village of Kramolin is the closest (1.2 km to the SW, 10 inhabitants). Major national highway is situated 6 km north of the site. Finally, an industrial biomass burning plant lies 7.5 km SW from the site.

The 24h $PM_{2.5}$ samples were collected every 6th day over 13 months period. The two $PM_{2.5}$ samplers were used one using TEFLO and the other one double quartz fibre filters. Chemical analysis of samples provided elemental (PIXE), water soluble ion (IC), organic and elemental carbon (OC/EC, TOT, EUSAAR2) and levoglucosan (LVG, GC-MS) concentrations in $PM_{2.5}$. In addition to that, number size distributions were measured continuously using SMPS and the data averaged to 24 h sampling periods were used for correlation analysis of size segregated particle number concentrations with $PM_{2.5}$ and its components using Spearman correlation coefficients (r).

Organic matter from biomass burning was calculated using OC_{BB} to LVG ratio equal 10 (Szidat *et al.* 2009) and OM_{BB} to OC_{BB} ratio 1.6, based on Elsasser *et al.* (2013). OM_{REST} was all OM other than OM_{BB}. All details can be found in Schwarz et al. (2016).

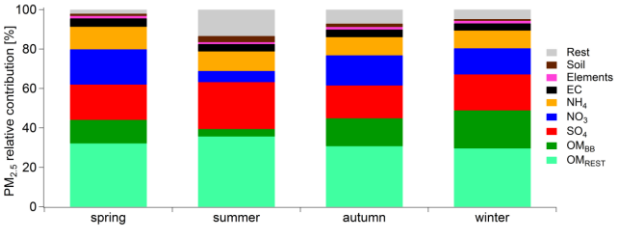

Figure 1: Seasonal mass closure at the site

The seasonal mass closure showed in Fig 1 showed the highest variability among a species increment for nitrates due to their thermal instability in summer and for OM_{BB} showing prevailing OM_{BB} emission from residential heating in colder period of the year.

Correlation analysis was provided for both chemical species and size segregated number concentrations in six electrical mobility size fractions (10-25nm, 25-50nm, 50-80nm, 80-150 nm, 150-300 nm and 300-800nm). For the whole sampling period the high Spearman correlation coefficient r=0.90 was found between $PM_{2.5}$ and number of particles between 300 and 800nm (N300-800) supporting high influence of aged and cloud processed particles. Despite the similarity in correlation of chemical species between correlations found for the whole period and heating season (HS) only, the correlation of $PM_{2.5}$ with particle number size fraction were larger (N300-800: 0.98), and more importantly also very high for smaller particles (N150-300: (0.92), N80-150: (0.83)). The last two high correlations suggested a higher influence of local sources during HS. Carbonaceous aerosols coming from nearby villages' residential heating were identified as influenced by local sources during heating season. OC correlated most with N150-300 (0.84) having similar correlation coefficients 0.82 for N300-800 and 0.81 for N80-150. This was even more pronounced for EC that exhibited correlation coefficient O.77 with N80-150 and 0.76 with N150-300, while the correlation coefficient with N300-800 was only 0.64.

A correlation in HS was found between Na and the smallest particles (N10-25 (0.63) and N25-50 (0.64)), which probably resulted from a dilution effect connected with strong westerly winds that at the same time allowed for transport of sea salt to the site. The cleaning of the atmosphere might also enable new particle formation through decreasing condensational sink. This is further supported by the significant anti-correlations between Na and $PM_{2.5}$ (-0.46) and N300-800 (-0.52).

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