Seasonal and spatial variation of organic composition and source contributions of ambient particulate matter in the ultrafine and accumulation mode size range

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Ambient particulate matter (PM) in the accumulation mode (< 500 nm) and ultrafine (< 100 nm) size range is discussed to be involved in adverse health effects. Long term studies are needed to study their behaviour, properties and potential health effects. In this study we present the seasonal and spatial variation of composition and source contributions of the organic fraction of ambient particulate matter in the size range < 360 nm ($PM_{0.36}$).

A 3 stage rotating drum impactor in series with a sequential filter sampler was used to cut-off particles < 360 nm (Li, 2015). Semi continuous sampling of daily $PM_{0.36}$ was carried out from April 2014 to February 2015 in Augsburg, Germany. Samples were collected at a reference site in the urban background (Cyrys, 2006) and meanwhile in parallel at one of three traffic influenced sites (T1 to T3) or an additional urban background site (B1) in the Augsburg region. Sampling at each satellite sites was carried out for 2 weeks each in summer, spring or fall, and winter.

A total of 294 $PM_{0.36}$ samples were analysed (i) for carbon fractions using a thermo-optical carbon analyser and (ii) for organic composition using in-situ derivatization thermal desorption gas chromatography coupled with time of flight mass spectrometry (IDTD–GC–TOFMS). EPA PMF 5.0 was applied to determine the contributions of the main sources to the OC in the collected $PM_{0.36}$.

The preliminary denotation of source factors was based on factor profiles as well as seasonal variation of the factor contributions. Three factors have been separated which were interpreted as domestic heating (factor 1), biogenic SOA (factor 2), and traffic (factor 3). Factor 1 was dominated by higher molecular weight PAHs, levoglucosan and dehydroabietic acid. Factor 2 was characterized by high contributions of cis pinonic acid, OC2 and OC3. Factor 3 was dominated by hopanes and alkanes with chain lengths of about C_{22}-C_{24}.

Seasonal variation of the factor contributions at the reference site are shown in fig 1. Factor 1 contribution decreased from spring to summer and then increased remarkably in autumn and winter. Factor 2, in contrast, increased from spring to summer and then decreased a substantially in autumn and further droped to a very low level in winter. Factor 3 contributed quite constantly to the OC with slightly lower values in summer and slightly higher values in winter.

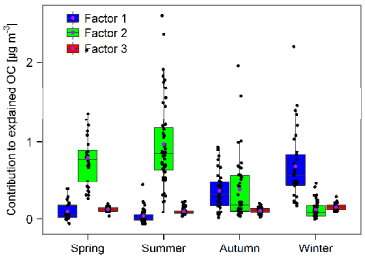

Figure 1. Seasonal variation of source factor contribution to $PM_{0.36}$ OC at the reference site.

The ongoing evaluation of the spatial variation of the factor contributions did no show significant differences within Augsburg area so far (fig. 2).

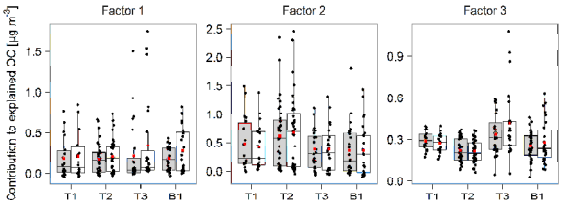

Figure 2. Spatial variation of the source factor contributions to $PM_{0.36}$ OC in comparison to the reference site. Only results from parallel sampling at the two sites each are shown.

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