Seasonal Variations of Organic Carbon with Different Volatility at Suburban Site

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The instrument for analysis of elemental and organic carbon (EC and OC) yields also additional information about volatility of individual OC fractions. Depending on the temperature protocol used, it is possible to distinguish and quantify pyrolitic carbon (PC) and OC1 to OC4 fractions (OC1 being the most and OC4 the least volatile one). This work characterizes diurnal trends of OC fractions at Prague suburban site during various seasons throughout the year.

Measurements of OC fractions were done by the field OC/EC analyzer (Sunset) provided with PM2.5 cyclone inlet. Sampling frequency was 2 hours. Thermal-optical analyses were performed by a modified EUSAAR2 protocol (Cavalli *et al*, 2010) that takes about 15 minutes. Fractions of organic carbon were taken in the following temperature ranges - OC1: <200°C, OC2: 200-300°C, OC3: 300-450°C and OC4: 450-640°C. OC_{total} = OC1+OC2+OC3+OC4+PC. One year data series was collected at Prague-Suchdol urban background station (50°7'36.473" N, 14°23'5.513" E, 277 m ASL) between September 2009 and August 2010. Over 3400 measurements were carried out for each OC fraction in this work.

In many studies published so far, various sources of carbonaceous particles had been mentioned during summer and winter seasons (e.g. Aurela *et al*, 2011). While in winter there is a significant impact of household heating, the influence of secondary OC of both anthropogenic and biogenic origin prevails in summer. Results of this study are in-line with these findings.

The highest concentrations of the most volatile OC1 fraction were found during wintertime (Fig. 1) with diurnal afternoon minima in all seasons. However, after looking at diurnal variations of $OC1/OC_{total}$ ratios during all seasons (Fig. 2), there is well visible the largest proportion of OC1 fraction during summer afternoons, and it corresponds to formation of secondary organic aerosols (SOA). Therefore, it can be assumed that the important part of summer suburban afternoon SOA is formed mainly by the most volatile components of OC. Other OC fractions were studied by a similar way as OC1 fraction and preliminary conclusions from one year measurements of individual OC fractions at Prague-Suchdol site show the following:

- The suburban environment is mainly the source of the most volatile OC1 fraction (especially during the night). It implies that the OC1 fraction is main part of anthropogenic emissions in wintertime and, in contrast to the less volatile fractions (OC2, OC3), it is also most affected by the thinner boundary layer.
- Secondary organic aerosols are the most probable summer source of OC1 fraction being formed mainly during afternoon hours.
- During interpretation of results it is necessary to pay attention to temperature profile of used protocol. For example, OC2 has both the lowest temperature step and absolute concentrations.

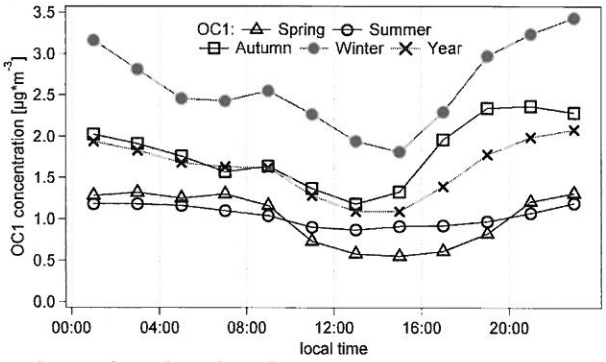

Fig.1. Diurnal cycles of OC1 concentrations averaged according to seasons.

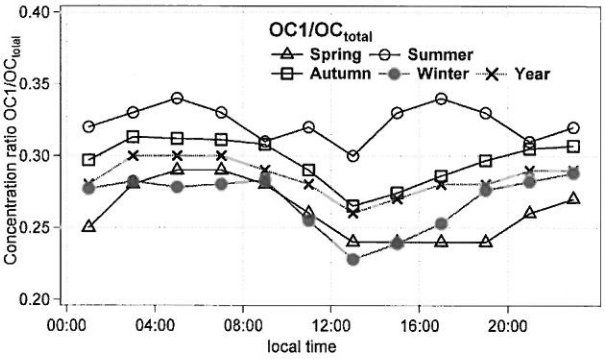

Fig.2. Diurnal variations of $OC1/OC_{total}$ ratio averaged according to seasons.

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Cavalli, F., Viana, M., Yttri, K. E., Genberg, J. and Putaud, J.-P. (2010) *Atmos. Meas. Tech.*, **3**, 79-89.

Aurela, M., Saarikoski, S., Timonen, H., Aalto, P., Keronen, P., Saarnio, K., Teinilä, K., Kulmala, M., Hillamo, R. (2011) *Atmospheric Environment* 45, 1394-1401.