Study of Organic Carbon with Different Volatility

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STUDY OF ORGANIC CARBON WITH DIFFERENT VOLATILITY

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INTRODUCTION

The instrument for analysis of elemental and organic carbon (EC and OC) allows additional information about OC fractions that depends on their volatility. Based on the used temperature protocol, it is possible to distinguish and quantify pyrolitic carbon (PC) and OC1 - OC4 fractions (OC1 - the most volatile, OC4 - least volatile). This work characterizes diurnal trends of OC fractions at Prague suburban site during different seasons over the whole year. Moreover, owing to the parallel measurements at suburban site together with Czech background station Košetice during heating and non-heating season we found which OC fractions are typical for urban and rural environments and their diurnal trends.

EXPERIMENTAL SETUP

Measurements of OC fractions were made by the semi-online OC/EC analyzer from Sunset Laboratory (www.sunlab.com) equipped with PM2.5 cyclone as an inlet and were taken in two-hour intervals. Thermal-optical analyses were made by modified EUSAAR2 protocol (Vodička and Schwarz, 2010) that takes about 15 minutes. Fractions of organic carbon for this work were taken in the following temperature ranges - OC1: <200°C, OC2: 200-300°C, OC3: 300-450°C and OC4: 450-650°C.

One year measurements were done at Prague-Suchdol urban background station (50°7'36.473" N, 14°23'5.513" E, 277m ASL) for the seasonal study of OC fractions from September 2009 to August 2010. For this study over 3400 measurements were taken for each OC fraction. Parallel measurements were made at central European background site Košetice (49°35'N, 15°05'E, 534m ASL). Two campaigns were conducted in heating (15 Feb – 1 Apr 2010) and non-heating (27 May – 30 Jul 2010) seasons and during these periods over 1200 samples were collected.

RESULTS AND PRELIMINARY CONCLUSIONS

Results from this work extend previous studies (Vodička and Schwarz, 2010 and 2011) dealing with characterization of the total OC and EC. As it was mentioned in many studies there are different sources of the particles during the summer and winter. 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. This is also reflected in our results. For example, after looking at diurnal variations of OC1/OC ratios during all seasons (Fig. 1) there is well visible the largest proportion of OC1 fraction overall the total OC formed during the summer afternoon. In accordance with previous work (Vodicka and Schwarz, 2011) it corresponds with formation of secondary organic aerosols (SOA). Therefore, it can be assumed the important part of the suburban afternoon SOA consists mainly from 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 OC fractions at Prague-Suchdol site show following:

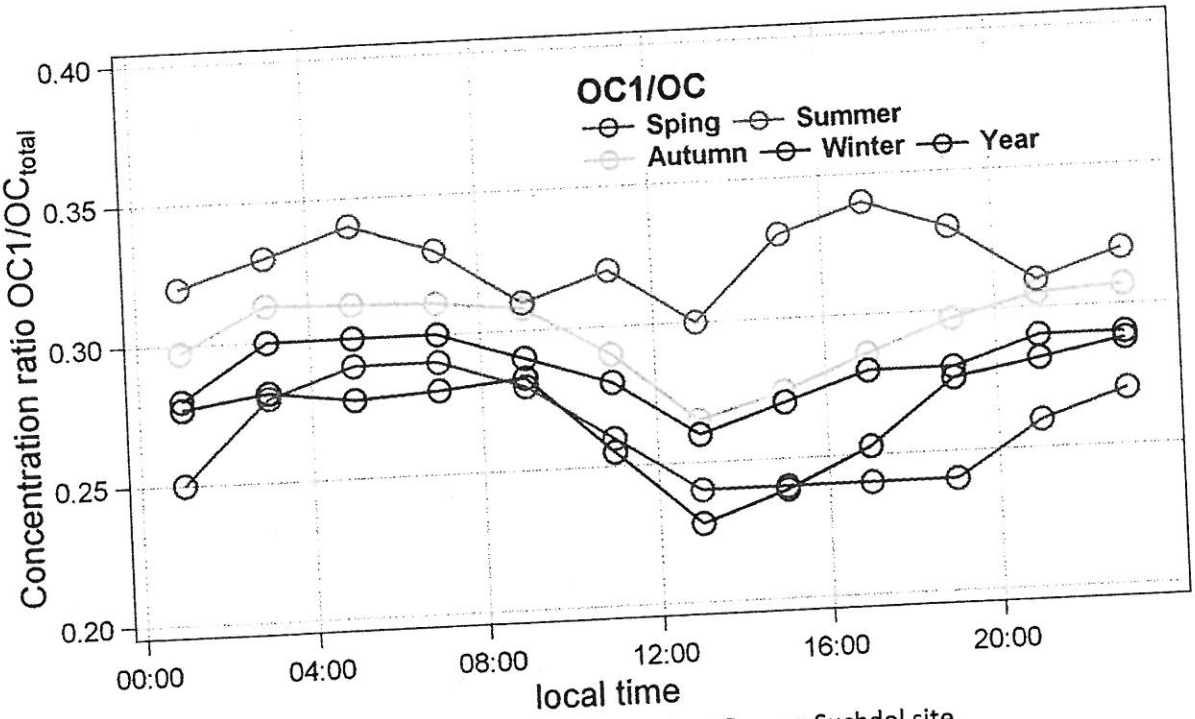

Fig. 1: Seasonal diurnal cycles of $OC1/OC_{total}$ ratio at Prague-Suchdol site.

- The suburban environment is the primary source of the most volatile OC1 fraction (especially during the night). It implies the OC1 fraction is main part of anthropogenic emissions in wintertime and also is most affected by the lower boundary layer in contrast to the less volatile fractions (OC2, OC3).
- Summer source of OC1 fraction (mainly during afternoon) are probably secondary organic aerosols.

The comparison of OC fractions from measurements at urban backround Prague-Suchdol site in parallel with rural background Košetice site implies following:

- Levels of the less volatile organic compounds (OC2 and OC3) were similar at both sites during both campaigns. It suggests they are present longer time in the atmosphere and therefore they are not of local origin.
- There is the hypothesis that the most volatile and less oxidized OC1 aerosols are generated mainly in the city and they are gradually oxidized to less volatile (OC2, OC3, OC4) which are transported over longer distances.

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REFERENCES

Vodička P., Schwarz J., Porovnání organického a elementárního uhlíku v aerosolech: město vs. pozaďová stanice. *Sborník konference České aerosolové společnosti*, ISBN 978-80-86186-25-2, str. 11, 18.-19.11.2010, Praha.

Vodička P., Schwarz J., Diurnal Trends of carbonaceous aerosols at Prague suburban station during different seasons. *Sborník XII. výroční konference České aerosolové společnosti*, ISBN 978-80-86186-31-3. p. 51, 3.-4.11.2011, Čejkovice.