

TEMPORAL VARIATION OF SECONDARY ORGANIC AEROSOL IN DOWNTOWN BUDAPEST

Imre SALMA¹, Willy MAENHAUT², Tamás WEIDINGER³, Joseph PINTO⁴

¹ Eötvös University, Environmental Chemistry, H-1518 Budapest, P.O. Box 32, Hungary,

² Ghent University, Institute for Nuclear Sciences, Proeftuinstraat 86, B-9000 Gent, Belgium,

³ Eötvös University, Department of Meteorology, H-1518 Budapest, P.O. Box 32, Hungary,

⁴ US Environmental Protection Agency, MD-52, Research Triangle Park, NC 27705, U.S.A.

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METHODS

As part of a comprehensive aerosol characterisation research project, aerosol samples were collected with a PM_{2.5} filter holder on quartz fibre filters within an urban canyon (kerbside) in Budapest, Hungary, from 23 April through 5 May 2002. A total of 11 samples for daylight periods, and 12 samples for nights together with 6 field blanks were collected. A tandem filter set-up was utilised for correcting the sampling artefacts for OC by the subtraction method (Kirchstetter *et al.*, 2001). The number of vehicles passing the street in both directions was obtained on line from counting devices mounted into the roadway for controlling traffic lights near the sampling site. Criteria air pollutants and meteorological parameters were measured at one end of the street canyon, and some meteorological parameters above roof-top were also recorded. Aerosol mass in PM_{2.5} size fraction was determined gravimetrically; atmospheric concentrations of organic (OC) and elemental carbon (EC) were measured by thermal-optical transmission method (Birch and Cary, 1996) in Ghent. In order to convert the measured amount of OC into organic matter (OM), the OC data were multiplied with a conversion factor of 1.6 suggested for oxidizing urban environments (Turpin and Lim, 2001). Temporal variation and relationships of the OC/EC ratio with different meteorological parameters and atmospheric co-pollutants were examined (Salma *et al.*, 2004) in order to estimate the amount of secondary organic carbon (SOC) using EC as tracer for the primary OC emissions (Turpin and Huntzicker, 1995). The SOC data calculated were further utilised to derive the concentrations of secondary organic aerosol (SOA) by applying the conversion factor of 1.6.

RESULTS

The daily concentration for PM_{2.5} mass varied between 8 and 55 $\mu\text{g}/\text{m}^3$ with a median of 29 $\mu\text{g}/\text{m}^3$. The aerosol mass was made up, on average, of 43(\pm 9)% of OM in the PM_{2.5} fraction, while EC accounted for 14(\pm 6)% of the PM_{2.5} mass. Contributions of SOA to OM mass over daylight periods and nights were in the range of 1–55% and 23–71%, respectively with mean and standard deviation of 37(\pm 18)% and 46(\pm 16)%, respectively. Hence, primary OM dominated, on average, but the SOA exceeded the primary contribution during some photochemical episodes. The temporal variation for SOC is presented in Fig. 1. It is seen that the nights exhibited generally larger values than the daylight periods due possibly to variation in the meteorology, to aging of organic aerosol, to the transport of SOA produced during the previous day to the receptor site, and partially due to night time chemistry. No significant correlation between the SOA and ambient temperature, horizontal wind speed, solar radiation, relative humidity, traffic intensity, EC, NO, CO, SO₂ and fine S concentrations was observed; while the correlation coefficients of SOA and PM mass, O₃ and OC concentrations were about or above 0.7. This supports the idea that formation of the SOA is advanced by oxidizing of reactive organic gases by gas-phase reactions in the polluted urban atmosphere, while partitioning to the aerosol phase takes place further from the emission sources of the (anthropogenic) precursor gases mainly via condensation on the available particles. Secondary organic aerosol, some meteorological parameters and co-pollutants were subjected to canonical correlation analysis in order to identify a reasonable subset of variables exhibiting significant impact on the temporal variation of SOA, and to assess their relative importance. It seems that temperature,

boundary layer height, horizontal wind speed, atmospheric concentration of O₃, OC and fine S are among the variables that explain the major temporal variation of SOA.

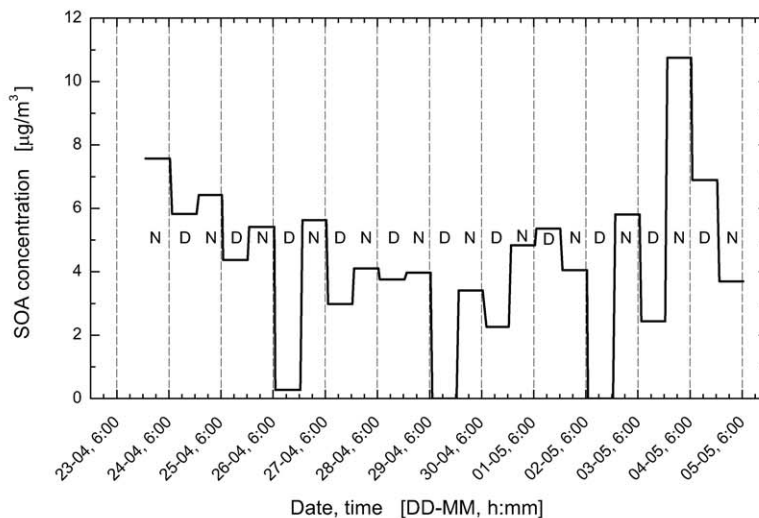


Fig. 1. Calculated concentration of secondary organic aerosol in downtown Budapest over nights (N) and daylight periods (D)

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