Source apportionment of the carbonaceous aerosols during winter at an urban background site of Vilnius (Lithuania)

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Carbonaceous aerosols are one of the most important constituents in the atmosphere, formed by different types of processes. During winter biomass burning is one of the major sources of organic aerosol (OA) in many parts of Europe (Puxbaum *et al*., 2007). Typically OA comprising 20-90% of the submicron particulate mass (Jimenez *et al*., 2009).

As part of the AEROLIT project, an intensive one month long field measurement of non-refractory submicron (NR-PM1) aerosol species including organics, sulphate, nitrate, ammonium, and chloride was performed in Vilnius during winter (Fig. 1). Continuous real-time measurements were carried out on the top floor of the academic building of the Center for Physical Sciences and Technology campus located in Vilnius (54° 38' N, 25° 10' E, 197 m a.s.l.). The inlet of the sampling system was placed on the top floor about 20 m above the ground level, 12 km southwest of downtown area. The urban sampling site was relatively far from the local sources of primary particles. The nearest roadway was 300 m to the southwest; on the opposite side a low traffic road was 600 m away. The location can be described as an urban background.

An ACSM (Aerodyne Research, Inc., Billerica, MA, USA) was deployed. Particle losses in the line were estimated to be lower than 2%. During this study, the ACSM was operated with a time resolution of 28 min for typical aerosol loadings (several μg m^{-3}) with a scan rate of 220 ms amu^{-1} from *m/z* 10 to 140 (approximately 31.9 s per scan and 1.126 s pause, 56 scans and data interval 29 min 48 s).

PMF analysis (Canonaco *et al*., 2013) of ACSM mass spectra of OA identified four components, i.e., hydrocarbon-like OA (HOA), secondary OA (SOA), N-containing organic aerosol (NOA) and biomass burning OA (BBOA) (Fig. 1(d)). The mass spectrum of HOA showed overall similarity to HOA components determined at other urban sites, which are characterized by the hydrocarbon fragment ions like $C_nH_{2n+1}^+$ (e.g. *m/z*'s 27, 41, 55, 69, 83, 97) and $C_nH_{2n-1}^+$ (e.g., *m/z*'s 29, 43, 57, 71, 85). CO_2^+ (*m/z* 44) and H_2O^+ (*m/z* 18) were detected, both of which are fragments of larger organic molecules of OOA. The BBOA profile is characterized by higher contributions at *m/z* 29 (CHO^+), 60 ($C_2H_4O_2^+$) and 73 ($C_3H_5O_2^+$) which are associated to the fragmentation of sugars such as levoglucosan. The SOA component had the characteristics of oxidized organic aerosol with pronounced relative intensity of *m/z* 18 and 44, indicating more aged aerosol.

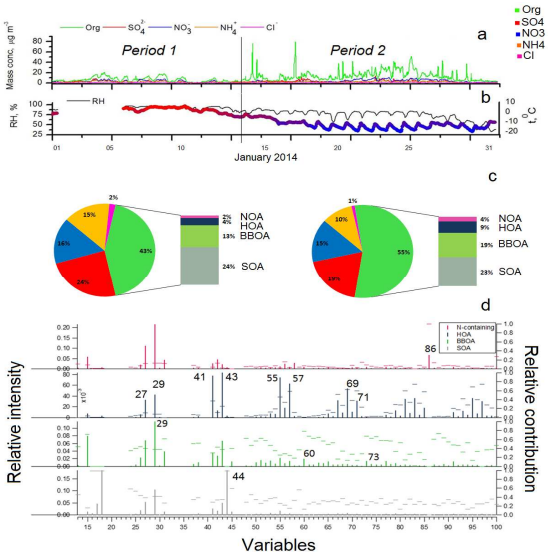

Figure 1. Chemical compositions of the NR-PM1: time series of (a) chemical composition; (b) T and RH; (c) average chemical components of NR-PM1 during Period 1 (left) and Period 2 (right); (d) mass spectra for the components contributing to OA mass loadings. Two periods corresponds to the mean temperature.

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