Measurements of the aerosol particle physical properties and particle chemical composition in Vilnius city

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The investigation of the atmospheric aerosols physical properties and the particle chemical composition allow understanding the aerosol particle dynamical processes in the atmosphere, finding danger pollution sources and solving important problems for human health, live conditions and climate. In this work, we concentrated on a study of the atmospheric aerosols in the urban environment of Vilnius city. The study gives insights into the aerosol chemical composition, particle optical and physical properties measuring the chemical composition of the non-refractory fraction of submicron aerosol particles, the light scattering coefficient and the particle size distribution. The measurements were reached by modelling of the backward trajectories of the coming air mass and calculations of the aerosol optical depths.

The aerosol chemical composition was measured by Quadrupole Aerosol Mass Spectrometer (Q-AMS). The light scattering coefficient was examined for the wavelength of 450, 550 and 700 nm using the integrating nephelometer TSI3563. The aerosol particle size distribution was measured with scanning mobility particle sizer TSI3936 and with the aerodynamical particle sizer TSI3321. Thus, the range of the measured particle size distribution was from 3 nm to 10 µm. The bottom range was determined by detection efficiency of the used condensation particle counter TSI3076 and particle diffusion losses in the sampling line. The upper limit is affected by geometry of the used sampling system and ambient conditions. The ambient conditions were measured at 10 m height meteorological station. In the macro scale, the coming air masses were characterised by HYSPLIT 4. A model of Navy Aerosol Analysis and Prediction System gives information about aerosol optical depths measured by MODIS satellite and regional dust and sulfate distributions.

The particle chemical composition (organic matter, sulfate, nitrate and ammonium) of the non-refractory fraction of submicron aerosol particles (D_{va}<1µm) were investigated during spring. The typical measured particle chemical composition is presented in Fig. 1. It shows that the organic matter comprised the largest fraction (74%) of the non-refractory fraction of submicron aerosol particles, while sulfate, nitrate and ammonium made up 14%, 8% and 4%. The average concentrations of organic matter, sulfate, nitrate and ammonium were 7.40, 1.36, 0.76, 0.39 µg m^{-3}, respectively. The average mode diameter of the organic matter and nitrate was 300 nm. However, the sulfate had a characterized mode diameter of 400 nm. The typical particle size distribution is presented in the Fig. 2. It illustrates the increasing of the total particle number concentration affected by production of the primary and secondary aerosol particles of nucleation and Aitken modes. The primary organic particles detected in the urban environment are manly directly emitted from local combustion sources: light and heavy vehicles, house heating and industry. The emitted particles are modified immediately by various atmospheric oxidants. As result, the physicochemical properties (size, scattering coefficient and particle chemical composition) changed a lot comparing to their precursor primary particles (Donahue et al., 2009). The secondary organic particles are formed from the reactions of the volatile organic compounds affected by meteorological conditions. Thus, the assembly of different processes: primary aerosol particle emissions, secondary particle formations with continuous particle growth, the effect of the far located pollution sources on the regional environment, were investigated in our study.

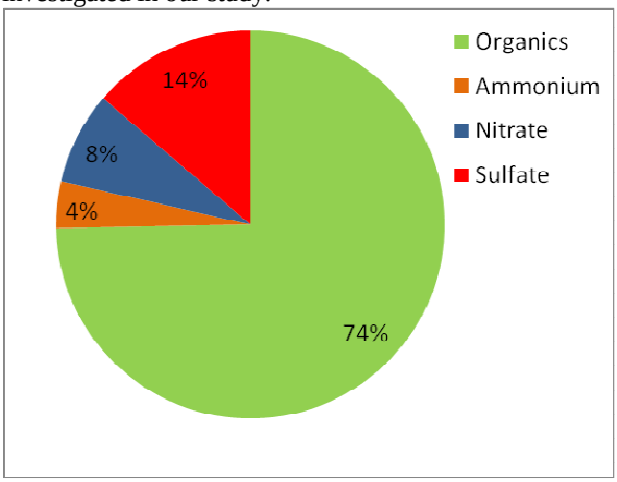

Fig. 1. The typical particle chemical composition in Vilnius city during spring.

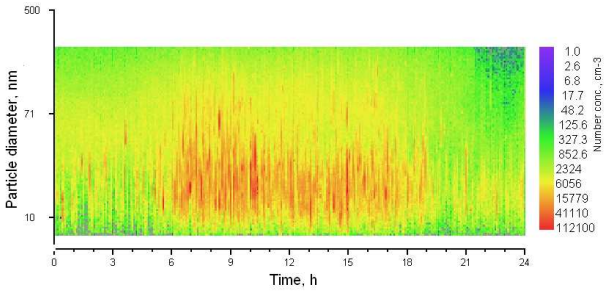

Fig. 2. The typical particle size distribution in Vilnius.

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Donahuea N.M., Robinsona A.L., Pandis S.N. (2009) *Atm.Env.***43(1)**, 94-106.