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Characterization of aerosol particles at the forested site in Lithuania

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Atmospheric particulate matter (PM), especially fine particles (particles with aerodynamic diameter less than 1 μm, PM1), has been found to play an important role in global climate change, air quality, and human health. The continuous study of aerosol parameters is therefore imperative for better understanding the environmental effects of the atmospheric particles, as well as their sources, formation and transformation processes. The particle size distribution is particularly important, since this physical parameter determines the mass and number density, lifetime and atmospheric transport, or optical scattering behavior of the particles in the atmosphere (Jaenicke, 1998). Over the years several efforts have been made to improve the knowledge about the chemical composition of atmospheric particles as a function of size (Samara and Voutsa, 2005) and to characterize the relative contribution of different components to the fine particulate matter. It is well established that organic materials constitute a highly variable fraction of the atmospheric aerosol. This fraction is predominantly found in the fine size mode in concentrations ranging from 10 to 70% of the total dry fine particle mass (Middlebrook et al., 1998). Although organic compounds are major components of the fine particles, the composition, formation mechanism of organic aerosols are not well understood. This is because particulate organic matter is part of a complex atmospheric system with hundreds of different compounds, both natural and anthropogenic, covering a wide range of chemical properties.

The aim of this study was to characterize the forest PM1, and investigate effects of air mass transport on the aerosol size distribution and chemical composition, estimate and provide insights into the sources and characteristics of carbonaceous aerosols through analysis $\delta^{13}C/^{12}C$ isotopic ratio as a function of the aerosol particles size.

The measurements were performed at the Rugšteliškis integrated monitoring station (55˚26'26"N; 26˚03'60"E) in the eastern part of Lithuania in the Aukštaitija national park during 2-24 July, 2008. The Rugšteliškis station is located in a remote relatively clean forested area. An aerosol mass spectrometer (AMS), developed at Aerodyne Research, was used to obtain real-time quantitative information on particle size-resolved mass loadings for volatile and semi-volatile chemical components present in/on ambient aerosol. The AMS inlet system allows 100 % transmission efficiency for particles with size diameter between 60 to 600 nm and partial transmission down to 20 nm and up to 2000 nm.

The aerosol sampling was also carried out using a Micro-Orifice Uniform Deposit Impactor (MOUDI) model 110. The flow rate was 30 l/min, and the 50% aerodynamic cutoff diameters of the 10 stages were 18, 10, 5.6, 3.2, 1.8, 1.0, 0.56, 0.32, 0.18, 0.10 and 0.056 μm. Aluminum foil was used as the impaction surface. The aerosol samples were analyzed for total carbon using the elemental analyzer (*Flash EA1112*). Besides, samples were analyzed for $\delta^{13}C/^{12}C$ ratio by the isotopic ratio mass spectrometer (*Thermo Finnigan Delta Plus Advantage*) (Norman et al., 1999; Garbaras et al., 2008).

During campaign the dynamic behavior of aerosols was measured and quantitatively compared with meteorological conditions and air mass transport. The submicron aerosol was predominately sulphate and organic material. The AMS was able to discriminate and quantify mixed organic/inorganic accumulation mode particles (300 - 400 nm), which appeared to be dominated by regional sources and were of the origin similar to those seen in the more remote areas. The particulate organic fraction was also investigated in detail using the mass spectral data. By combining the organic matter size distribution (measured with AMS) with the total carbon (TC) size distribution (measured with MOUDI) we were able to report organic carbon to total carbon (OC/TC) ratio in different size particles. Furthermore, we measured TC $\delta^{13}C/^{12}C$ isotopic ratio on each cascade. This ratio contributed to identifying sources of carbonaceous species.

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