Chemical composition, and mass closure of Siberia aerosols at ZOTTO, Russia, April 2010 to February 2011

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Atmospheric aerosols are currently a subject of high scientific and political interest mainly due to their role in climate and their effects on human health (Andreae and Crutzen 1997). Aerosols are a complex mixture of many different chemical species originating from a variety of natural and anthropogenic sources. Their chemical composition is determined by their sources and subsequent transformation while airborne, and is temporally and spatially highly variable. The major aerosol components (aerosol types) normally include organic matter (OM), elemental carbon (EC) or Black carbon (BC), sulfate, nitrate, ammonium, crustal matter, and sea salt. Data on aerosols chemical composition are necessary for source identification and apportionment, and also needed for the testing and validation of numerical aerosol models, which are becoming tools to extrapolate monitoring data. During the last decades, a growing number of scientific studies have been investigating the chemical composition of aerosols at various sites around world. However, the data for chemical aerosols composition in Siberia, a vast region in Central Eurasia, are still lacking. This is highly contradictory to the global relevance of the Siberian landmass as a source and sink for aerosol particles, and their role in the global radiation budget.

In order to characterize the Siberia aerosols, filter sampling were started at Zotto site (60.80°N and 89.35°E, 114 m a.s.l.), Russia in April 2010. Nuclepore polycarbonate and quartz fibre filter samples were taken in parallel with real time aerosols optical properties measurements and some tracer gas measurements. Up to March 2011, 66 samples were taken for each samplers. The quartz fibre filters were analysed for the particulate mass by weighing, and analysed for organic carbon (OC) and elemental carbon (EC) by sunset OC/EC analyser. The Nuclepore filters were analysed for major anions and cations by ion chromatography (Dionex, ics-1100), and for water soluble organic carbon (WSOC) with a Shimadzu TOC analyzer. With help from high time resolution CO and light absorption results and Hysplit back trajectories calculations, the filter samples were separate to episode samples and non-episode samples. The aerosols chemical compositions were clearly different between episode and non-episode samples, and between winter and other three seasons. The winter episodes associated with elevated concentrations for most of species, and were usually related to anthropogenic pollution, the air masses during such episodes had passed over the central Siberian region around Omsk and Novosibirsk – a heavily industrialized area. During spring and fall, a number of samples exhibited high K^+, and oxalate levels, indicating an impact from biomass burning. In addition a notable episode with extreme high Na^+, Cl^-, and Mg^{2+} were observed for the samples collected between 20 to 24 December 2010, which may result from long range transport of sea salt from North. More than 80% of OC are found to be Water soluble in summer non-episode period, which may due to the enhancement of secondary organic aerosols formation.

In the aerosol chemical mass closure calculations, six aerosol types were considered. Organic matter (OM) contributed by far the most to the PM mass; it accounted for about 40-70% of the average PM mass. Followed by Secondary Inorganic Aerosols species (SO4, NH4, and NO3), more than 30% of PM mass. OM contribution to PM mass was lower in winter than that in the other three seasons, while EC, Ammonium and Nitrite show higher contribution in winter. The mean PM mass attribution to the different aerosol types for April to November 2010 at Zotto during non-episodes periods were similar to those for the 2007 campaign at the forested site of Hyytiälä, Finland. EC and Nitrate were more important and Ammonium was clearly less important at Zotto, though.

Andreae, M O, and P J Crutzen (1997) *Atmospheric aerosols: Biogeochemical sources and role in atmospheric chemistry*, Science 276 (5315):1052-1056.

Maenhaut et al., (2011) *Chemical composition, impact from biomass burning, and mass closure for PM2.5 and PM10 aerosols at Hyytiälä, Finland, in summer 2007*, X-ray spectrometry, 40: 168-171.