

Chemical composition (ions and selected metals) of size-segregated aerosol samples collected at Ny Alesund (Svalbard Island - Norway) during the 2010 and 2011 summer campaigns.

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The atmospheric aerosol plays a relevant role in the complex feedback processes between environmental conditions and climatic changes because of the scattering and absorption processes of the solar radiation and its contribution in the hydrological cycle by promoting the cloud formation. IPCC 2007 report shows very large uncertainties in sign and intensity of the climate forcing induced by the atmospheric particulate. For instance, the black carbon particles act as positive forcings because light absorption processes prevail. On the contrary, liquid droplets of sulphuric acid exert a negative forcing due to the prevalent scattering effect on the incoming solar radiation. Such effects are even more complex in the polar regions, where the high superficial albedo can play a higher scattering than aerosol particle or cloud surface. In this case, the presence of aerosol or cloud coverage represents a positive climate forcing. Finally, a reliable evaluation of the climatic effect of the aerosol particles in the Polar Region is hindered by an incomplete spatial coverage of the monitoring sites.

In order to improve our knowledge on the size distribution and chemical composition of the Arctic aerosol, since 2010 an observatory was installed at Ny Alesund (78.6 °N, 11.6 °E), Svalbard Islands.

During two summer (March-September) campaigns (2010 and 2011), several hundred samples were collected by different devices: PM10 sequential samplers (on Teflon filters for inorganic components and quartz filters for organic compounds), 4-stage (>10, 10-2.5, 2.5-1, < 1 μm) and 12-stage (> 10 μm to 0.040 μm) Dekati impactors (for ions, metals and elements analysis), and medium-volume PM10 collector (for trace metals content). Aerosol samplings were carried out with a temporal resolution from 1 to 4 days and were coupled with continuous size distribution measurements by a Scanning Mobility Particle Sizer (SMPS), working in the range 6 - 500 nm, and an Aerodynamic Particle Sizer (APS), able to count the atmospheric particulate in the range 0.5 - 20 μm . The two instruments were synchronized in order to obtain a unique spectrum of 106 size-classes in the range 6 nm - 20 μm every 10 minutes. Aerosol filters were analysed by Ion Chromatography (inorganic anions and cations and selected organic anions), ICP-AES and ICP-MS (selected metals, including Rare Earth Elements), PIXE (elemental composition) and thermo-optical SUNSET analyser (EC and OC fractions).

Here we report temporal profiles of the most significant chemical components, used as markers of emission sources and/or transport processes. Particular attention was spent in depicting the seasonal (spring-fall) trend of the main components of the bio-geo-chemical cycles of sulphur (sea salt sulphate, non-sea-salt sulphate, methanesulphonic acid), nitrogen (nitrate and ammonium salt) and carbon (short-chain carboxylic acids, OC fraction). Besides, the measurements of the EC fraction can be used in assessing the relationship between the optical effect of the black carbon particles (measured by absorption techniques) and the actual content of elemental carbon in size-segregated particles. Figure 1 shows the temporal trends of four relevant components of the secondary aerosol in the daily PM10 samples in March-September 2010. Sulphate, ammonium and oxalate show the input of long-range transport of polluted air masses from continental areas occurring in the early spring. On the contrary, MSA profile points out the higher biogenic emissions of marine biogenic sources in late spring-early summer.

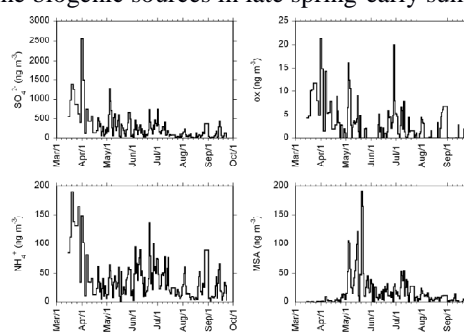


Figure 1. Temporal trends of selected markers in PM10.

The chemical composition has been compared with the high-resolution particle size-distribution, meteorological conditions and back-trajectory reconstruction to better understand the effect of changes in source intensity and transport processes. Besides, a multivariate statistical analysis based on a receptor model (Positive Matrix Factorization and Absolute Principal Components Analysis) was applied to the data set for source apportionment analysis.

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