

Ionic composition and metal content of PM10 samples collected along longitudinal and latitudinal transects in the Norwegian and Greenland Seas during the ARES 2011 cruise.

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The Arctic Glacial Sea is one of the world regions more affected by the impact of the present positive climate forcing. The consequent feedback processes, involving relevant variations of marine and coastal eco-systems (including large changes in extension and thickness of the annual and permanent sea ice and in the permafrost superficial structure) constitute a serious issue for the wild life and the human settlements at the high latitudes. The atmospheric aerosol is one of the main components of the Earth climate system through the interaction of the particles with solar and Earth radiation, the cloud formation and the changes in superficial albedo. Although these effects are well known, large uncertainties affect not only their quantitative evaluation but also the sign of the variation (positive or negative climate forcings). This lack of knowledge especially affect the Polar Regions, were just a relative little number of monitoring stations is operative. Besides, data on the chemical composition of aerosol in the open sea are very scarce.

In order to contribute to fill this knowledge gap, an intensive sampling campaign was carried out in the sea area between Norway and Svalbard Islands (Norwegian and Greenland Seas) in the framework of the ARES 2011 oceanographic cruise aboard Oceania ship.

In the period June 20th – August 12th 2011, 79 12-h PM10 samples for ionic and metal composition (Teflon filters) and 42 24-h PM10 samples for Elemental and Organic Carbon fractions (EC and OC, respectively) on quartz filters were collected. The sampling devices (low volume sequential samplers with PM10 sampling heads) were located in a platform 7-m high over the ship deck in the bow section, in order to minimize the contamination risk from ship engine emissions. The very low values measured for heavy metals and EC fraction, possibly used as fuel combustion markers, suggest that the contamination levels could be considered negligible.

One half of each Teflon filter were analysed for inorganic and selected organic anions and inorganic cations by a three-ion chromatograph system. The remaining half was used for metal determination by SF-ICP-MS after mineralization with HNO₃ + H₂O₂ in microwave oven.

Here we report the spatial distribution of the most significant aerosol components along longitudinal (Tromso – Svalbard Islands) and latitudinal (east-to-west route in the Norwegian Sea and along the western side of the Svalbard Island) transects.

In particular, the atmospheric concentrations of secondary marine aerosol (sulphuric acid and methanesulphonic acids (MSA) from phytoplanktonic emissions) was plotted as a function of the ship position in order to attempt to figure out a possible relationship between biogenic aerosol and changes in the source strength as a function of time and marine area (figure 1). From a temporal point of view, non-sea-salt sulphate and MSA show two sharp maxima in June, in phase one with each other, while lower contribution of biogenic emission are recorded in the filters collected in July. On the other hand, no clear trend along coastal to open-sea transects is evident. Higher MSA concentrations (up to 120 ng/m³) were measured near the Norwegian coast, along the Tromso-Svalbard route, and in the south-west coastal areas of the Svalbard Island, while the lowest values (few ng/m³) were found in the open-sea at north-west of the Islands

Spatial and temporal distribution of sea spray components (Na, Mg, chloride), N-cycle compounds (nitrate and ammonium salts), dust markers (Ca, Al, Fe, Mn, Ti) and selected heavy metals possibly coming from anthropic emissions were measured. C-cycle secondary aerosol components (OC fraction, light-chain carboxylic acids) were also determined in order to gain information on the possible contribution of the gas-to-particle conversion of volatile organic compounds (VOCs) in constituting a significant part of the aerosol formation nuclei.

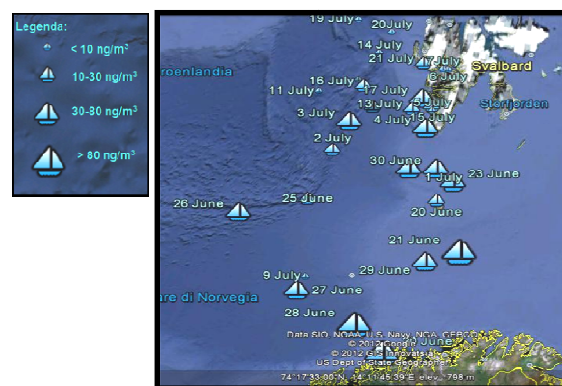


Figure 1. Spatial distribution of MSA in PM10 aerosol.

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