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

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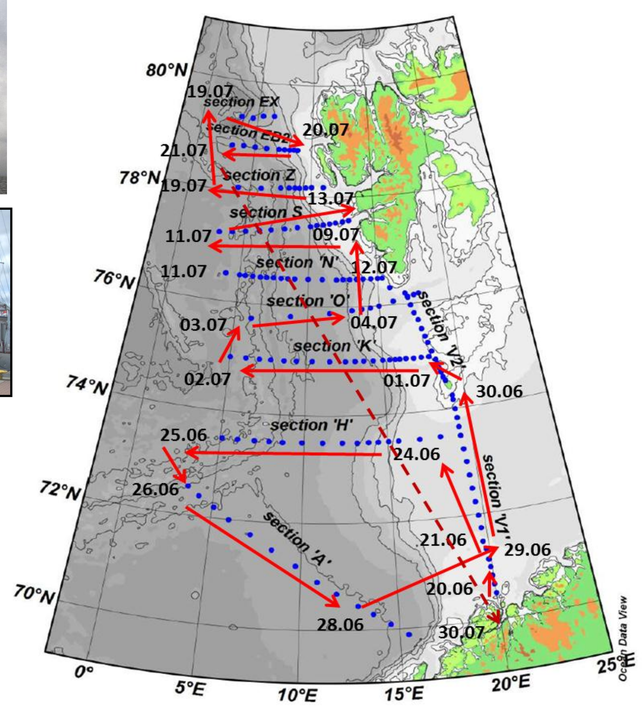
The Arctic Glacial Sea is one of the world regions more affected by the impact of the present positive climate forcing. The consequent feedback processes, involving relevant variations of marine and coastal eco-systems (including large changes in extension and thickness of the annual and permanent sea ice and in the permafrost superficial structure) constitute a serious issue for the wild life and the human settlements at the high latitudes. Although the effects of the aerosol on the climate are well known, large uncertainties affect not only their quantitative evaluation but also the sign of the variation (positive or negative climate forcings), especially in 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, intensive sampling campaign was carried out in the sea area between Norway and Svalbard Islands (Norwegian and Greenland Seas) in the framework of the AREX 2011 oceanographic cruise aboard Oceania ship. In the period 20 Jun – 12 Aug 2011, 79 12-h PM10 samples for ionic and metal composition and 42 24-h PM10 samples for Elemental and Organic Carbon fractions were collected.

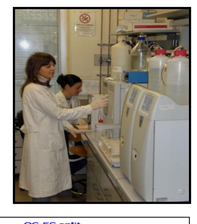
Sampling

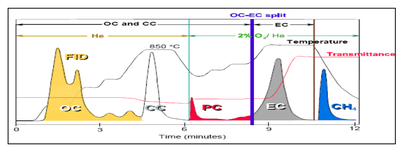


Chemical Analysis

ICP-SFMS: Al, Si, Fe, Ti, Mn, V, Cu and some Rare Earth Elements

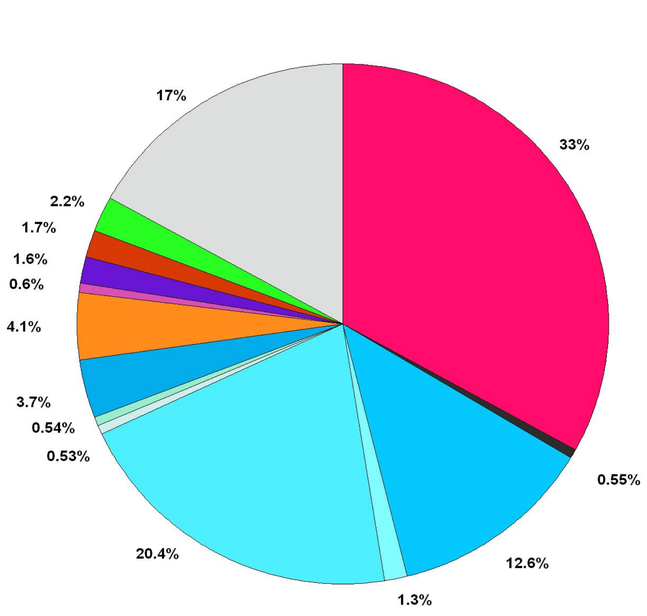
Thermo Optical Transmission Analyser C & EC Carbon fractions

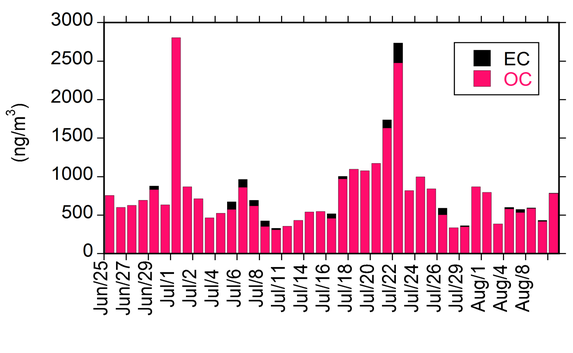




Ion chromatography : Na, NH_4, K, Mg, Ca, Cl, NO_3, SO_4, MSA, oxalate, acetate,formate, glycolate.

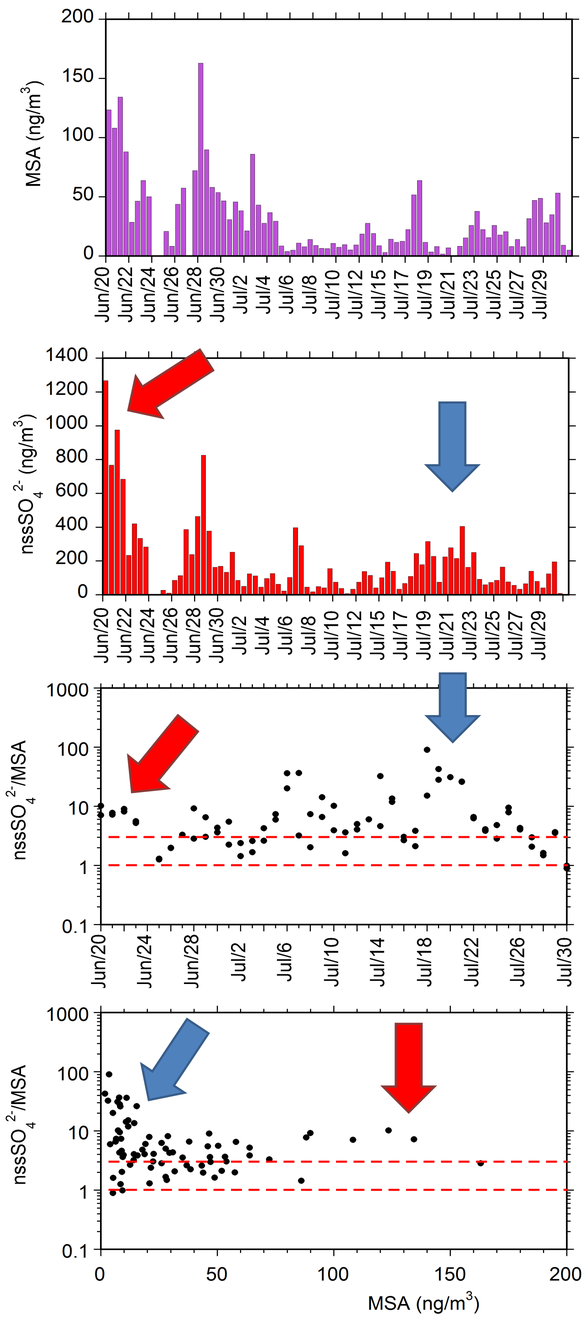
Mass Reconstruction

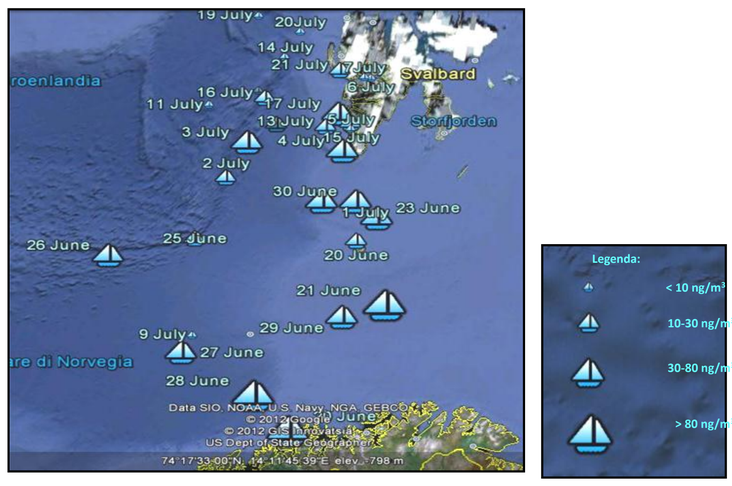




The Particulate Organic Matter (POM) fraction, reconstructed by OC measurements (OC-POM conversion coefficient = 2) , covers about 33% of the PM10 mass, so constituting the major component of the marine Arctic aerosol in this area. The very low EC contribution demontrates the low contamination by the ship engines

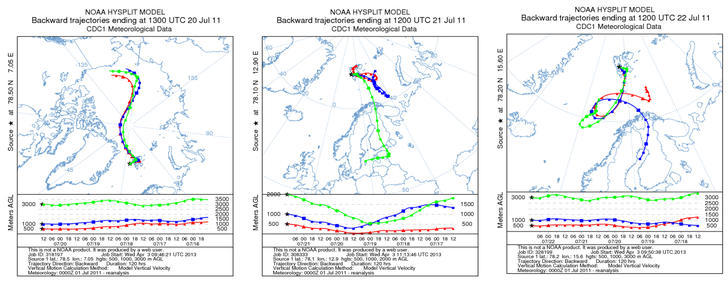
Biogenic Contribution



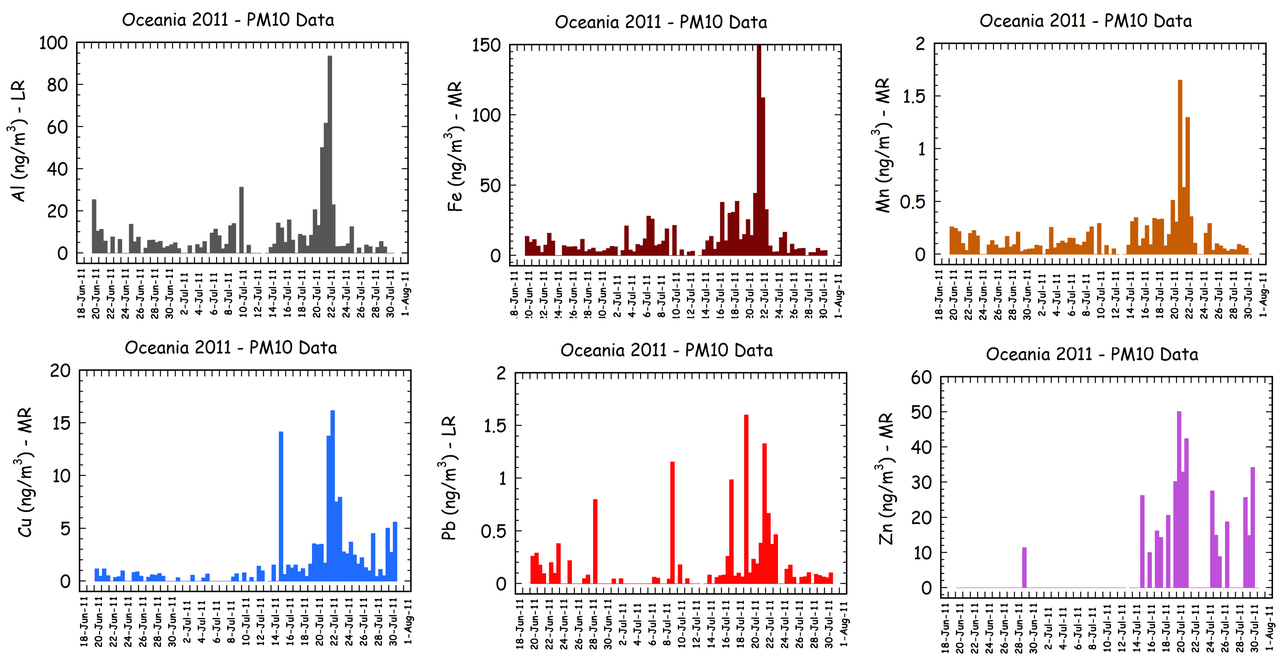


Aerosol samples show two sharp maxima of non-sea-salt sulphate and MSA in June, while lower contribution of biogenic emission are recorded in July. Besides, no clear trend along coastal to open-sea transects is evident. Higher MSA concentrations (up to 120 ng/m^3) were measured near the Norwegian coast, along the Tromso-Svalbard route, and in the south-west coastal areas of the Svalbard Islands, while the lowest values (few ng/m3) were found in the open-sea at north-west of the Islands.

The $nssSO_4^{2-}$/MSA ratio show highest values in July 18-22, when low MSA concentrations and high EC and OC values were measured (blue arrows in the plots). This behavior could be related to transport processes from anthropized areas; indeed, backward trajectories show transport from northern region with some trajectories coming from central Europe



When biogenic source become relevant (high MSA concentrations) the $nssSO_4^{2-}$/MSA ratio range from 1 to 3. Such values can be representative of the ratio between the species arising from DMS and it is in accord to previous result obtained in polar region (Arctic and Antarctica) from measurements in aerosol and snow. Conversely, at the start of the cruise, values of $nssSO_4$/MSA around 10 (red arrows) were found even if the biogenic contribution (MSA) is high. Such high $nssSO_4$/MSA values could be related to the latitudinal effects: at lower latitudes, the oxidation of DMS is shifted toward higher $nssSO_4^{2-}$ yields.



Crustal and anthropic metals show larger contributes in the western coastal areas of the Svalbard Islands