Similarity between aerosol physico-chemical properties at a coastal station and open ocean over the North Atlantic

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Organic marine aerosol (of both primary and secondary origin) represents a potentially important component of the marine biota and climate feedback system involving aerosols and clouds (O’Dowd et al., 2004; Cavalli et al., 2004).

In order to assess the potential influence of coastal environment on marine aerosol chemical composition, both organic and inorganic, two parallel aerosol data sets, collected in two campaigns in the framework of the EC project MAP, are compared in this work. The field experiments have been carried out from June 5th and July 5th 2006, during the period of high oceanic biological activity at Mace Head Atmospheric Research Station (coastal site) and on board of the oceanographic vessel “Celtic Explorer” (open ocean site). At both the sites the sampling has been fixed approximately at 10 m height above the sea level.

Aerosol samples were collected, under clean conditions (Cavalli et al., 2004) by means of 8-stages Berner impactors equipped with tedar foils, collecting particles in eight size fractions between 0.060 and 16 μm diameter. In order to obtain a detailed chemical characterization of organic fraction, aerosol samples were also collected by high volume virtual impactors, segregating fine (a.d. less than 1 μm diameter ) and coarse particles (a.d. between 1 and 10 μm diameter ) on quartz filters.

Three parallel aerosol samples were collected during the campaigns as a result of sampling time of the order of 50 hours each. WSOC (Water Soluble Organic Carbon) and main inorganic ions analyses were performed on tedar foils, while high volume samples were used for Total Carbon (TC) analyses and for organics chemical characterization (HPLC fractionation, HNMR functional group analyses and tensioactive properties analysis).

Non-sea-salt (nss) sulphate is the dominant species in submicron fraction in both samples sets, showing a similar trend both in coastal and in open ocean samples. For each stage of the fine fraction coastal site samples show an average nssSO$_4^{2-}$ concentration higher than the open ocean samples.

On the contrary, average WSOC concentration in the fine fraction is very similar for samples collected at Mace Head Station and at the open ocean site. The ratio between WSOC and WIOC (Water Insoluble Organic Carbon) is slightly lower in samples collected at the coastal site, being WSOC the dominant fraction of organics in both samples sets.

Coarse fraction is dominated by sea salt in all the size intervals; however, in terms of absolute mass the coastal samples result enriched in sea salt as compared to open ocean samples.

Concerning WSOC chemical characterization, HNMR analyses show that functional groups distribution in samples collected during the cruise is consistent with the one of samples collected at Mace Head Station, suggesting the same chemical composition and the same origin. Moreover, the investigation of tensioactive properties of fine fraction isolated WSOC highlights the same behaviour for both samples collected in middle ocean and at the coastal site.

In conclusion, our results show strong similarity between aerosol physico-chemical properties at coastal station and open ocean site, especially for the main organic components thus excluding potential effects of the shore line environment on marine organic aerosol.
