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Seasonal variation of marine aerosol properties over the North Atlantic

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During the year 2002 we performed measurements of size-resolved chemical and the physical properties of aerosols collected in Ireland, at Mace Head Atmospheric Research Station Ireland (53°19'N, 9°54'W), under clean marine conditions. A Berner low pressure impactor was used to collect aerosol particles in eight size fractions, between 0.03 and 16.0 μm according to the following 50% equivalent aerodynamic cut-off diameters: 0.063, 0.125, 0.25, 0.5, 1, 2, 4, 8, 16 μm. Submicron aerosol size distributions were measured over the range of 10 nm to 263 nm using a scanning mobility particle sizer (SMPS). Mass size distribution of water-soluble inorganic ions and the total, organic, black and water-soluble carbon content have been obtained by chemical analysis. A detailed characterisation of WSOC was performed: the complex mixture of water-soluble organic compounds is separated into few main classes of compounds according to their acidic character and a functional group analysis is performed by Proton Nuclear Magnetic Resonance, HNMR. Both the micro-physical and chemical properties of clean marine aerosol possessed a clear seasonal pattern which followed the biological activity in the North Atlantic A marked contrast was found between the spring through to autumn period and the winter period with respect to the relative concentration of inorganic salts, total organic carbon (TOC), water-soluble organic carbon (WSOC) and water-insoluble organic carbon (WIOC). In winter, corresponding to the period of low biological activity in the North Atlantic, sea-salt dominated all size fractions with a 94% (1.38 μg m-^{3}) contribution to the submicrometer mode mass. By contrast, during the spring through to autumn period where phytoplankton

blooms occurred, a marked increased in the TOC fraction was observed, particularly for the submicrometer sizes. TOC contributed 56% (0.93 μg m-^{3}) of the submicrometer mass, whereas sea salt (0.39 μg m-^{3}) and nss-sulphate (0.26 μg m-^{3}) accounted for the remaining mass with a 23% and 16%, respectively. In particular, WIOC represented the dominant submicron aerosol species, contributing 39% (0.65 μg m-^{3}) to the measured mass, during period of intense biological activity. Furthermore, detailed analysis of WSOC aerosol indicated the large abundance of partially oxidized species with extended aliphatic moieties partly attributable to high-molecular-mass humic-like substances. Finally, recently efforts have been devoted to investigate the importance of bio-chemical and biological components - as proteins, DNA, bacteria and viruses - in clean organic marine aerosol. Analysis of microbiological and biochemical parameters performed on both surface water and aerosol particles can potentially help to elucidate the link between the two phases and quantify the contribution of the biological source to organic content of clean marine aerosol.