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Spectroscopic characterization of Antarctic marine aerosol

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Marine aerosol constitutes an important and not thoroughly investigated natural aerosol system. In particular, the poor knowledge of the physical-chemical properties of primary (sea-spray) and secondary particles, especially over biologically active seawaters, affects the current capability of modeling the effect of marine aerosol on climate (O'Dowd et al., 2004). In polar regions, surface seawater composition and its exchanges with the atmosphere is complicated also by the presence of sea-ice and of the variety of micro-organisms (viruses, prokaryotes and microalgae) living within it (Levasseur,2013).
In the framework of the Spanish project PEGASO (Plankton-derived Emission of Gases and Aerosols in the Southern Ocean) submicron aerosol samples were collected during a 6 weeks long oceanographic cruise (2nd January 2015 - 11th February 2015) conducted in the regions of Antarctic Peninsula, South Orkney and South Georgia Islands, an area of the Southern Ocean characterized every summer by both large patches of productive waters (phytoplankton blooms) and sea-ice cover. The collected samples were analyzed by means of proton-Nuclear Magnetic Resonance (H-NMR) spectroscopy with aim of organic compounds characterization in terms of functional groups and specific molecular tracers identification (Decesari et al., 2011).
H-NMR spectral features resulted quite variable among the different samples both in terms of relative abundance of main functional groups and in terms of presence of specific compounds.
In all the samples were found biogenic markers, like low-molecular-weight alkyl-amines and methanesulphonate (MSA), of secondary origin (formed by the condensation of vapors onto particles). Resonance signals of other aliphatic compounds of possible primary origin, like lipids, aminoacids (e.g. alanine) and sugars (e.g. sucrose) are present in variable concentrations in the samples.
A hierarchical cluster analysis applied on the NMR spectra allowed to identify similarities in the samples collected close the Weddell-Sea area, showing an enhancement of biogenic alkyl-amines (including mono-, di- and tri-methylamine) and MSA and suggesting a common source probably linked with the sea-ice cover dominating that region. As such, our results point to secondary organic aerosol (SOA) sources from precursors emitted by sea ice regions around Antarctica and call for better representation of the sea ice-ocean-atmosphere biogeochemistry in Earth system models.

References:
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