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Antarctic aerosol collected at Station Concordia (Dome C, East Antarctica). Seasonal trends in size distribution and chemical composition.

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Aerosol studies at Station Concordia are focused improving our knowledge on present-day source intensity, transport efficiency and atmospheric pathways (including stratosphere-troposphere interchanges) of particles reaching internal sites of Antarctica. Besides, more detailed information on atmosphere-snow interactions, including depositional and post-depositional processes, as well as the effect of sublimation/condensation processes on snow surface, will be used for improving the reconstruction of past atmosphere composition from ice core chemical stratigraphies.
Size-segregated aerosol and surface snow samples have been collected at Station Concordia (Dome C - East Antarctica, 75° 06' S, 123° 23' E, 3233 m a.s.l., about 1100 km far from the coastline), in the framework of an Italian PNRA- French IPEV joint program, by using different low- and medium-volume systems, including pre-selected cut-off samplers (PM10, PM2.5 and PM1) and multi-stage impactors. Sampling resolution and volumes ranged from 1 day to 1 month and from 2.3 to 12 m3/h.
All-year round aerosol collection for a long period (so far, covering the 2005-2009 period) allowed reconstructing the seasonal trends of the size-distribution and the chemical composition of aerosol particles, as well as investigating their main sources and transport processes. In particular, sea spray, crustal, biogenic and tropospheric(photochemistry) sources were identified by chemical markers. Besides, meteo conditions on synoptic scale and back-trajectory analysis were used in order to understand atmospheric processes leading to abrupt high concentration levels of specific aerosol components.
The chemical analysis of size-segregated aerosol and daily superficial snow samples can contribute to clarify some aspects yet under discussion. In particular: the possible seasonal pattern of sea spray aerosol could be related to sea-ice formation timing and/or to changes in zonal wind intensity and atmospheric pathway; the mineralogical analysis of insoluble dust particles can allow the identification of continental sources, by comparison with soils collected in the potential source areas (PSAs); finally, the seasonal pattern of biogenic markers (such as methanesulphonic acid and non-sea-salt sulphate) can be linked to sea surface temperature, sea-ice cover and southern-hemisphere circulation modes (e.g., SOI, AAO or SAM and ACW). Indeed, oxidised sulphur compounds deserve a particular attention because they are assumed to affect the climate system by influencing the Earth's radiative budget, both directly (solar light scattering) and indirectly (acting as cloud condensation nuclei). Methanesulphonic acid (MSA) and H2SO4 (from DMS phytoplanktonic emission), are the best tracers of marine productivity. Their use as reliable markers of oceanic biogenic emissions is hindered by poorly known mechanisms (temperature and photochemistry induced) controlling the MSA-H2SO4 ratio from DMS. Since DMS in route toward central Antarctica is subjected to lower temperatures and lower humidity and, in summer, to larger atmospheric concentrations of OH (and/or BrO) radical, all conditions promoting the preferential H2SO4 formation, non-sea-salt sulphate is the most reliable biogenic marker at Dome C.
Depositional and post-depositional processes, able to potentially modify in the time the snow composition, were also investigated. The analysis of chemical markers in aerosol, superficial snow and hoar crystals, sampled contemporaneously, allowed evaluating the contribution of some key-factors (snow acidity, solar irradiation) affecting the preservation of components reversibly fixed in the snow layers (such as, for instance, MSA, nitrate and chloride).
The study of the changes in source intensity, atmospheric processes and transport pathways of the present aerosol at Station Concordia will allow improving our understanding on past climatic and environmental changes, through ice core stratigraphies of aerosols components trapped in the snow layers by atmospheric scavenging processes. These studies will deserve particular relevance for the interpretation of the chemical records along the EDC ice core, drilled in the framework of the EPICA project.
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