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Svalbard Islands — PM₁₀ sampling

Long-range transport processes
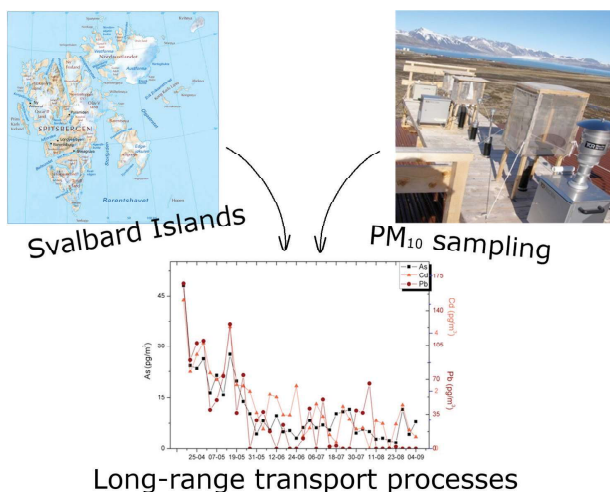
The chemical composition of atmospheric particulate matter (PM) has a strong variability, as it is heavily influenced by environmental conditions (season, weather and geographical area) and human activities [1]. Conversely, PM composition is able to strongly influence the climate changes, by altering cloud formation and the radiative balance of the atmosphere. This is particularly true for the polar regions, as they play a key role in regulating the global climate systems, by means of complex feedback mechanisms [2]. For this reason, the identification of local and global sources and the understanding of transport mechanisms and deposition processes of polar PM has a great importance [3].

This study investigated the inorganic composition of PM_{10} collected in a polar environment (Ny-Ålesund, Arctica), with the purpose to identify its sources and to understand the short- and long-range transport processes, their possible future evolution and their effects on the radiative balance of the atmosphere.

The results obtained so far on samples collected over four subsequent summer seasons (2010-2013) evidence a remarkable seasonal trend for most of the investigated elements. For both geogenic and anthropogenic elements, concentrations are generally higher in March and April, period during which the ground is almost entirely covered by snow and ice, suggesting that long-range transport processes might be taking place. On the other hand, the concentration of elements typically deriving

from the marine aerosol (i.e. K, Mg, Na) present a peak in late spring and summer, together with Co, Ni and V, typical anthropogenic analytes related to ship emissions. A peak in the concentration of K (typical marker of biomass burning) was registered in correspondence to the occurrence of a large fire in North America, in good agreement with the direction of the air currents.

By comparing data obtained for Ny-Ålesund with data registered by other researchers on PM_{10} collected in industrial, urban, and rural areas all over the world, it emerges that the concentrations obtained in this study are, for most of the analytes, the lowest; this is true not only for anthropogenic elements but also for geogenic ones, as the snow and ice covering the ground for most of the year prevent the local soil dust resuspension. As expected, the concentrations registered for PM_{10} collected in Terra Nova Bay (Antarctica) are generally similar to the ones obtained in this study.

Enrichment factors have been calculated with respect to the mean values for the Earth's crust reported by Turekian and Wedepohl [4], in order to distinguish elements having natural, anthropic or mixed origin. Principal Component Analysis, Hierarchical Cluster Analysis and Factor Analysis have been executed for identifying correlations among variables and similarities among samples.

Acknowledgements

References

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