Characterization and temporal evolution of the inorganic component of PM_{10} collected near to Ny-Ålesund (Norwegian Arctic)

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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. 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. 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 (Conca, 2019).

This study investigated the inorganic composition of PM_{10} samples collected in a polar environment (Ny-Ålesund, Norwegian Arctic) in spring and summer 2010-2016. The purposes were the identification of the PM sources and the understanding of the short- and long-range transport processes taking place in the area, their possible future evolution and their effects on the radiative balance of the atmosphere.

The calculation of crustal and marine enrichment factors allowed a first subdivision of analytes according to their primary source (crustal, marine or anthropogenic). Principal Component Analysis, Hierarchical Cluster Analysis and Factor Analysis allowed the identification of specific sources and the study of the seasonal variability of samples.

The results evidence a remarkable seasonal trend for most of the investigated elements. This was particularly evident for 2012 samples, as shown in Figure 1. For both geogenic and anthropogenic elements, concentrations are generally higher in March and April. In this period 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 (Becagli, 2017).

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.

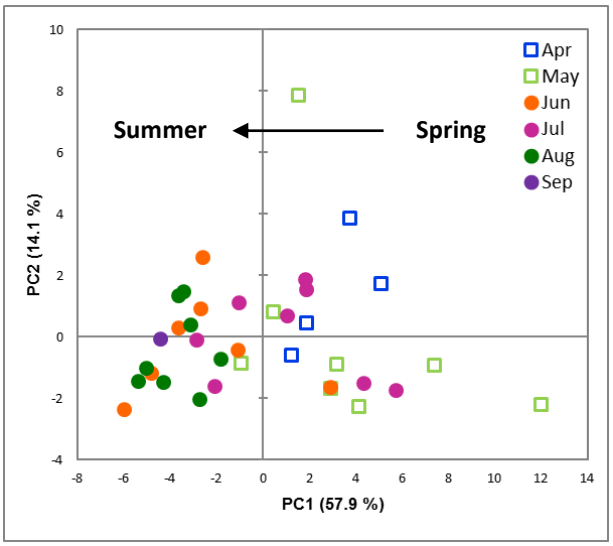

Figure 1. Score plot for 2012 samples.

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