Title: **Set up and optimization of an integrated multi-instrumental method for analysing Saharan dust in atmospheric PM filters from Sierra Nevada**

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This report is the union of some of the work and analyses carried out at the Laboratory of Dra. Laura Tositti, Bologna University. It is based on the analyses of Particulate Matter, one of the main atmospheric pollutants which is able to cause serious health and environmental problems. Specifically, the sampling of analysed filters has been done at Sierra Nevada, south of Spain, within the Spanish research project FRESA. This sampling station has the characteristic of being next to North Africa at a high altitude (2550 m a.s.l.). Because of this, Particulate Matter collected in these filters often includes Saharan Dust that comes from North Africa transported by the wind. This kind of Particulate Matter has a specific chemical and physical composition. It is made mostly of coarse particulate and its colour tends to be reddish because of its content in iron oxides such as hematite.

The aim of this report is to use a series of basic and widely available spectroscopic techniques to analyse these filters in order to characterise in detail the properties and composition of airborne particulate matter. Then the idea was to develop a quantitative analytical approach from spectroscopic techniques usually applied only in a qualitative way according to an approach partly experimental and partly chemometric recently introduced at Dra. Tositti's lab.

Portions of a series of 19 weekly filters from Sierra Nevada were analysed in triplicate. Experimental procedures and data analyses will be separated in 5 parts each. These parts are the 4 analyses of the filters that has been done: Homogeneity test, UV-VIS Diffuse Reflectance Spectroscopy (UV-VIS DRS), Fourier Transform Infrared Spectroscopy with attenuated total reflection (FT-IR ATR), and Chemiluminescence using a Luminol-based test for the detection of ROS (Reactive Oxygen Species).

Moreover, a parallel work of this thesis was the design and optimization of the resuspension system, a special assembly that was set up to produce solid calibration standards on filters in

order to quantify chemical compounds on the filters, (especially hematite). This work therefore enabled the acquisition of several properties of these environmental samples, i.e. the filters weight and their homogeneity, spectroscopic signal of hematite and colour information, and IR bands that mostly explain the quartz and hematite composition, along with others, and finally, chemiluminescence maximum peak.

All the data obtained in this thesis work was finally subjected to Spearman correlation analysis extending my dataset to data previously obtained at Bologna lab such as Ion Chromatography as well as meteorological data during the sampling period. A high correlation was found between hematite, PM_{10}, reddish colour of filters, and the IR absorption band, while chemiluminescence seems to be correlated with acetate and calcium cation.