$PM_{2.5}$ and Water Soluble Inorganic Ions in the Venice area

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Keywords: $PM_{2.5}$, Aerosol characterization, Inorganic Ions

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Pollution from fine particles is an important environmental risk factor for both human health and the possible effects on climate and ecosystems. In polluted urban environments, it affects human health and deteriorates visibility. On a global and regional scale aerosol particles and trace gases have the potential to change weather patterns and the hydrological cycle. Venice area is affected by several emission sources: (i) the medium size urban area of Mestre; (ii) the industrial zone of Porto Marghera; (iii) a crowded road-network; (iv) the artistic glass-making area of Murano; (v) the shipping traffic and (vi) the Marco Polo airport. To better and deeper understand air pollution in the study area, in particular $PM_{2.5}$ and the secondary inorganic aerosol fraction, a collaboration between Università Ca' Foscari Venezia and Ente della Zona Industriale di Porto Marghera started in 2008.

This study is focused on the detailed characterization of Water Soluble Inorganic Ions (WSII) and Secondary Inorganic Aerosol (SIA) on $PM_{2.5}$ in the Venice area. Three sampling sites in different environmental conditions were chosen to evaluate spatial variations: (i) Punta Sabbioni (PS, semi-rural-background costal site); (ii) Mestre-Via Lissa (VL, urban background site); (iii) Malcontenta (MC, industrial site) (fig. 1).

Twenty four hours samples were collected onto quartz fiber filters in all the sampling locations simultaneously, with a flow of 2.3 m^3 h^{-1} according to EN 14907. The experimental campaign has been developed in 2009 and then four periods have been selected to evaluate seasonal differences: (i) spring, 26th February - 3rd April; (ii) summer, 11th June - 16th July; (iii) autumn, 20th September -31st October; (iv) winter, 22nd December - 31st January.

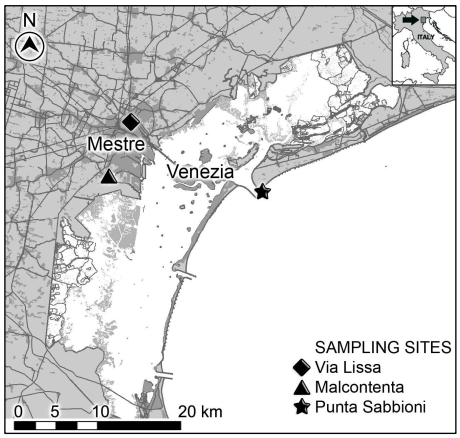

Figure 1. Sampling sites location.

Ultrasonic method was used to extract all filters for determination of inorganic ions by ion chromatography (Na^+, NH_4^+, K^+ Mg^{2+}, Ca^{2+}, F^-, Cl^-, NO_3^-, SO_4^{2-}).

Monthly average concentrations show a typical pattern with maximum values in cold season and minimum in warm season. Ammonium, nitrate and sulfate result to be major ions in $PM_{2.5}$ in all periods. Nitrate highest values have been detected in spring and winter. Sulfate presents maximum concentration in summer and autumn. On annual basis, results of the linear regression between NO_3^-+$nssSO_4^{2-}$ and NH_4^+ (expressed as neq m^{-3}) show a strong correlation (fig. 2). These results indicate that ammonium neutralizes almost completely sulfates and nitrates. Consequently, SIA fraction can be estimated as sum of NH_4^+, NO_3^- and $nssSO_4^{2-}$ masses. SIA mass shows similar values in the three sites but Punta Sabbioni presents the highest SIA% on $PM_{2.5}$ mass (36%).

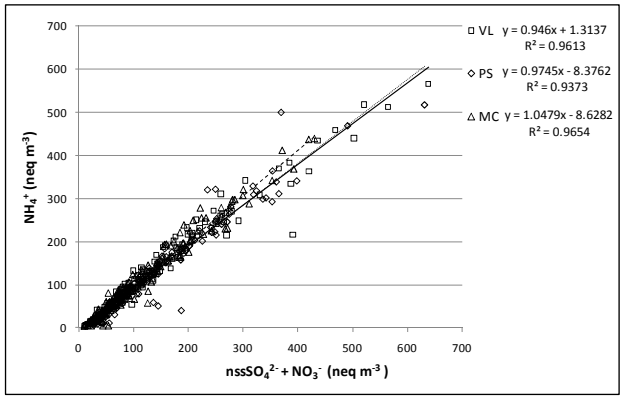

Figure 2. Regression between NO_3^-+$nssSO_4^{2-}$ and NH_4^+.

A Q-mode Hierarchical Cluster Analysis (qHCA, using Ward's method and the squared Euclidean distance measure) was performed to select groups of samples on the basis of their similar chemical composition. Then, each cluster has been interpreted according to local wind data. Preliminary results indicate that heavy pollution events were usually observed in days characterized by low wind speed and high % of wind calm hours.

This work was supported by Ente della Zona Industriale di Porto Marghera. The authors also express thanks to Environmental Protection Agency of Veneto Region (ARPAV) for the valuable support and logistics.