Cite abstract as: Author(s) (2008), Title, European Aerosol Conference 2008, Thessaloniki, Abstract T06A212P

Seasonal variations and chemical characterization of PM_{10} in the Venice hinterland urban area

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Keywords: PM_{10}, particle characterization, PAH(s), trace elements, ions.

This study is part of a wider project to evaluate the impact on ambient air quality of a new highway in the Venice hinterland, characterized by the presence of several pollutant anthropogenic sources. The infrastructure has been projected to remove road traffic from the city of Venice-Mestre.

PM_{10} samples were collected on filters using low-volume samplers carrying out 24 campaigns in winter and summer periods during 20 months from November 2005 to August 2007. The aim was to investigate 18 monitoring sites along the future path of the new highway, in urban background areas and in construction sites.

PM_{10} chemical characterization involved PAHs (polycyclic aromatic hydrocarbons sampled on glass fibre filters) such as benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene and benzo(a)pyrene that have been analyzed using HPLC-fluorescence. Teflon filters were analyzed for water-soluble ions as sulphate, nitrate, ammonium, calcium, potassium, magnesium (ion chromatography). Trace elements as arsenic, cadmium, nickel, lead were also sampled on cellulose nitrate filters and quantified using ICP-MS.

Mean PM_{10} levels of each campaign were compared to a reference urban background station. Figure 1 shows a good correlation with reference to control sites data, whereas construction sites are characterized by higher concentration levels.

Principal components analysis was applied to ions and trace elements mean concentrations to find out possible clusters among different monitoring sites.

The load of the analytes (Figure 2) contributes to the setting of two significant principal components (70% of total variance explained). First component (PC1, Figure 3) distinguishes very well summer from winter sites ("s" and "w" as the second letter of labels), emphasizing the seasonal effect on PM_{10} annual trend. Summer sites are characterized by a relative low concentration of analytes and are generally very comparable. Summer construction sites (MsC and FsC), that have a significantly higher concentration of PM_{10} than other monitoring summer sites, are characterized by high levels of Ca^{2+} and Mg^{2+}, suggesting a raise of particulate due to important soil movement in building activities. Winter sites are all spread in the positive semi-axis of PC1, characterized by relative high levels of combustion pollutants (PAHs, Pb). Differences among these sites (PC2) can be related to local emission sources. In winter sites stable atmospheric conditions play a significant role in maintaining high levels of pollutants that seem to override the contribute of construction activities (TwC).

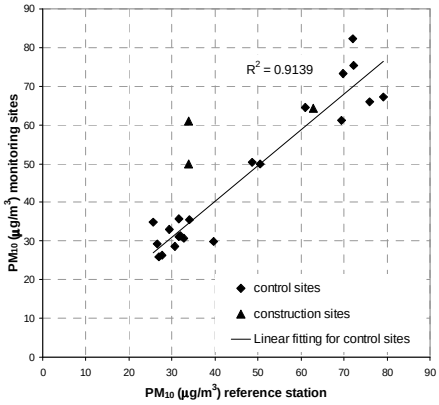

Fig. 1. PM_{10} data scatterplot.

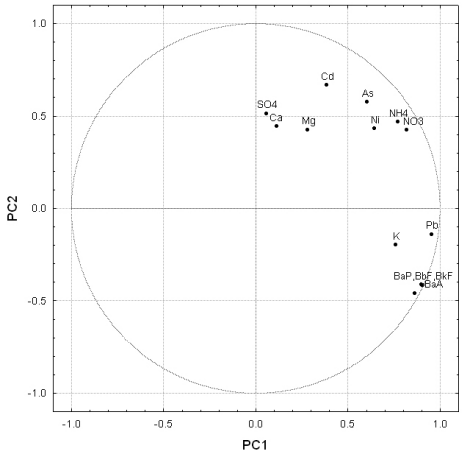

Fig. 2. Projection of variables on the PC1-PC2 plain.

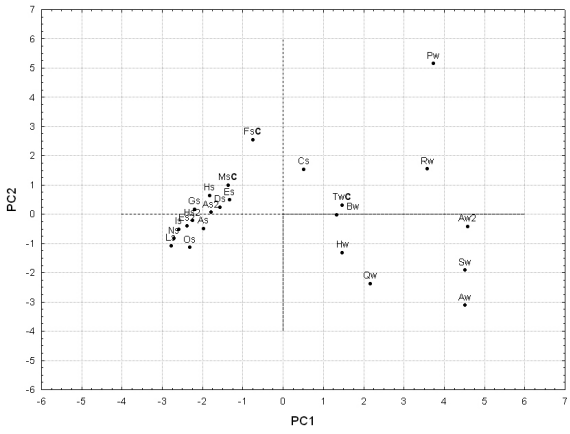

Figure 3. Projection of sites on the PC1-PC2 plain.