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PM_{10} and heavy metal measurements in an industrial area of southern Italy

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Abstract

Atmospheric particulate concentrations and heavy metal content are measured from March to July 2001 at an industrial site located in a rural zone of the southern Italy. PM_{10} samples are collected by a low-volume sampler and each sample is analysed by AAS techniques for its content of Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn. We measure also temperature, atmospheric pressure and relative humidity, and we collect anemometric data. The study purpose is the investigation of pollutant levels in an industrial area located in a rather unpolluted region and the characterization of the correlation structure among particulate concentrations, heavy metal content and local meteorological parameters. Data analysis is carried out by means of univariate and multivariate statistical methods. In the investigated period, the average value of PM_{10} daily concentrations (24 μg Nm^{-3}) does not exceed the national standard of 40 μg Nm^{-3} and only nine values are higher than the European daily limit value of 50 μg Nm^{-3}. Particularly, the occurrence of two anomalous values (183 μg Nm^{-3} in 3 March and 94 μg Nm^{-3} in 22 June) seems to be related to no-local events as confirmed both by in situ data measured in the AQM network of Potenza city (about 10 km far from the study area) and by remote measurements performed in the same days. Regarding the heavy metal levels, we observe high levels of Cr (34 ng Nm^{-3}), Ni (85 ng Nm^{-3}) and Zn (214 ng Nm^{-3}) in agreement with the local industrial source pattern. The

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multivariate analysis, carried out using meteorological parameters as exogenous variables, allow to evaluate the role of the different variables as driving factors of the correlation structure among the metals.

Keywords: Atmospheric pollutants; Meteorological parameters; Multivariate analysis

1. Introduction

Many studies deal with different aspects of atmospheric particulate (Dordevic et al., 2004; Esposito et al., 2004; Fang et al., 2004; Hinz et al., 2005). The characterization of the fine fractions (PM_{10} and $PM_{2.5}$) represents an interesting field of investigation (Harrison et al., 1997; Lenschow et al., 2001; Artinano et al., 2003; Bogo et al., 2003; Querol et al., 2004). Particularly, at local scale, the increase of atmospheric particle emissions is one of the most important problems of atmospheric pollution in urban and industrial areas. Epidemiological studies have shown associations among ambient concentration of particulate, its chemical composition and health dangerous effects. Moreover, many efforts are devoted both to the description of their spatial-temporal behaviour (Chow et al., 1999; Gehrig and Buchmann, 2003; Viana et al., 2003; Rodriguez et al., 2004) and to the analysis of their chemical composition (Beceiro-Gonzalez et al., 1997; Janssen et al., 1997; Querol et al., 2001; Röösli et al., 2001; Kim et al., 2002; Cyrys et al., 2003; D'Alessandro et al., 2003; Tsai et al., 2003; Quiterio et al., 2004; Al-Momani et al., 2005).

In situ concentration of atmospheric particulate, its size distribution and its chemical characteristics depend on emission sources, local meteorology and geographical features. For this reason, it is important to study the behaviour of particulate in strongly polluted sites, in suburban/rural areas and in zones with specific geomorphologic or anthropogenic characteristics where only few data are available (Rizzio et al., 1999; Röösli et al., 2001; Gehrig and Buchmann, 2003; Fang et al., 2004; Rodriguez et al., 2004).

In this context, the industrial area of Tito Scalo (Basilicata region, southern Italy) is an optimal test site because it is located in a rather unpolluted zone, it is surrounded by low hills and it shows a well-defined source emission pattern. Moreover, in a previous paper, we already discussed the TSP levels and source profiles of heavy metals in this area on the basis of data collected from 1997 to 1999. Particularly, the multivariate statistical procedure allowed us to identify three profiles: two of them related to industrial sources and one related to other sources (natural and/or anthropogenic). Moreover, taking into account the effect of different meteorological conditions, we were able to distinguish the contribution of different fractions of the same metal in the detected source profiles (Ragosta et al., 2002).

In this paper, we present data collected during a field survey, starting from 1 March to 28 July 2001, aimed to characterize pollutant levels and to analyze the relationships among particulate concentrations, heavy metal content and meteorological parameters. Particularly, on daily scale, we measure PM_{10} concentrations, Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn concentrations and local meteorological parameters such as temperature, atmospheric pressure, relative humidity and anemometric data. The data analysis is carried out by means of univariate and multivariate statistical methods in which the meteorological parameters are used as exogenous variables for highlighting the data correlation structure (Ragosta et al., 2002; Quiterio et al., 2004). Moreover, data coming from air quality monitoring network of Potenza city (the most important urban site of the Basilicata region, 10 km far from Tito Scalo) and data measured with remote techniques are