Particulate matter in the northwest of the Iberian Peninsula: A one-year study

Fernanda Oduber, Carlos Blanco-Alegre, Ana Isabel Calvo, Amaya Castro, Roberto Fraile, Teresa Nunes, CÉLIA ALVES, *University of Aveiro*

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Abstract

Humans and the environment are exposed to a complex mixture of several atmospheric contaminants, including particulate matter (PM). The study of the PM composition and its temporal variation allows determining the potential emission sources and, therefore, to establish mitigation measures. Researches on the spatial and temporal variation of chemical characteristics of PM in the northwest of the Iberian Peninsula are scarce.

The present study was carried out in León city, located in the northwest of the Iberian Peninsula (42° 36′ N, 05º 35′ W and 838 m above sea level), between 9th March 2016 and 14th March 2017. PM_{10} sampling was carried out on the roof of the Faculty of Veterinary (University of León). Two different devices were used: a) a low volume sampler (TECORA, ECHOPM) operated with 47 mm diameter teflon filters and b) a high volume sampler (CAV-A/Mb) equipped with 150 mm diameter quartz filters. Quartz filters were used to determine PM_{10} by gravimetry, and organic and elemental carbon (OC and EC) by a thermo-optical method. Teflon filters were used for the analysis of water soluble ions (ionic chromatography). Furthermore, an automatic weather station located in the sampling site recorded temperature, wind speed and direction, relative humidity and precipitation data. Likely due to the seasonality of sources and meteorological processes, well-defined temporal differences were observed in PM_{10} concentrations and chemical composition. Monthly and seasonal variations were studied in detail. During the sampling period, the mean temperature and relative humidity were 12 ºC and 64%, respectively. Summer (July-September) was the season with less precipitation and higher mean temperature (21.3 mm and 20 ºC, respectively), whereas spring (April-June) was the rainiest season (223.2 mm). The PM_{10} daily limit value (50 µg/m^3, Directive 2008/50/EC) was only exceeded on 23rd February 2017 (60.4 µg/m^3), coinciding with a Saharan dust intrusion episode. The lowest PM_{10} value (2.0 µg/m^3) was observed in summer, after a precipitation event. Winter (January-March) was characterized by high PM_{10}, OC, EC and NO_3^- mean concentrations (20.6 ± 9.3, 3.0 ± 1.5, 1.0 ± 0.5, and 1.7 ± 1.8 µg/m^3, respectively). These results may be due to the contribution of fossil fuel-based heating systems. The lowest PM_{10} and OC mean concentrations were observed in spring (11.8 ± 6.1, 1.8 ± 1.0 µg/m^3, respectively). The decrease in the particulate matter levels during spring can be associated with the intense precipitation in this period. Summer was characterized by low EC and NO_3^- concentrations (0.6 ± 0.3 and 0.5 ± 0.3 µg/m^3, respectively) and high Ca^{2+} and SO_4^{2-} mean values (0.3 ± 0.2 and 1.6 ± 1.1 µg/m^3, respectively). The presence of high levels of ions, such as Ca^{2+} and SO_4^{2-}, can be attributed to different episodes of African dust intrusions that reached the Peninsula [1, 2].

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