Positive Matrix Factorization of suburban aerosols: a first time approach in NW Spain

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Introduction

Aerosols are important components of the atmosphere and their physical, chemical and optical characteristics depend largely on their sources and formation processes. In a specific location, aerosol concentrations are related to several factors (meteorological conditions, regional background, local and regional sources, etc.). Aiming to create mitigation strategies for improving air quality, the source identification and apportionment is essential. The goal of this study is the identification of the main aerosol sources, using Positive Matrix Factorization (PMF), by means of the chemical composition of the samples collected in a one-year campaign carried out between March 2016 and March 2017 in León city, Spain. This is the first time that such a study has been performed in León.

Methods

The sampling campaign was carried out in the Campus of the University of León, at NE of León city, Spain (42º 36′ N, 05º 35′ W and 838 m asl). PM_{10} sampling was carried out using a low volume sampler (TECORA, ECHOPM) equipped with 47 mm diameter teflon filters, and using a high-volume sampler (CAV-Mb) equipped with 150 mm diameter quartz filters. Quartz filters were used for the determination of organic (OC) and elemental (EC) carbon (thermo-optical technique), and levoglucosan (ionic chromatography). Teflon filters were used for the determination of water-soluble ions (ionic chromatography) and major trace elements (PIXE). Furthermore, temperature, wind speed and direction, relative humidity and precipitation data were recorded in an automatic weather station (located in the same sampling site).

Conclusions

The best fit was provided by a 6-factor solution, allowing the identifications of the following sources in the city of León: mineral, marine, traffic, secondary aerosols, biomass burning and aged sea salt. Summer showed the highest mineral factor contribution, with 23%, mainly due to the high occurrence of African dust intrusions, which reached the NW of Spain. The marine factor has the highest contribution in winter (14%), due to the high frequency of westerly weather types, which are characterized by humid air masses loaded with marine salts from the Atlantic Ocean. Traffic is the prevailing aerosol source in León city in the entire year, accounting for 29% of PM_{10} mass. Secondary aerosol contributes to 16% of the PM_{10} mass and remains constant in all seasons, while biomass burning contribution increase in winter up to 4%, due to the emissions from heating devices. Aged sea salt is the second most important factor contributing to the annual PM_{10} loads (26%). Summer and spring are the seasons with the highest representativeness of this source. This factor is characterized by a deficit of Cl^-, mixed with the contribution of dust particles. Authors such as Hsu et al. (2007), observed a Cl^- deficit only in polluted summer and not in the clean winter, revealing that it is strongly related to air pollution. Daily source contributions of particulate matter as a function of wind speed and direction were also analysed. In general, PM_{10} mass concentrations decrease with increasing wind speeds.

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