A winter Saharan dust intrusion at León: air quality and health impacts

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Saharan dust is one of the natural causing exceedances of the PM_{10} daily limit mass concentration (*DLV*, 50 µg/m^3) in southern Europe (Querol et al., 2004). Due to its geographical location, Spain is frequently affected by Saharan dust outbreaks. Most of these events occur in Spain between May and September, when the dust transport is governed by anticyclonic conditions over the East or Southeast of Iberian Peninsula. Winter African dust intrusions are less frequent but also give rise to PM_{10} exceedances. During winter and spring, the Saharan dust intrusions are scarce and do not usually reach the northwest of the Peninsula. This dust transport is mainly due to the cyclonic activities over the West or South of Portugal (Rodríguez et al., 2001). Particulate matter from this source consists mainly of clay minerals, quartz, Ca and Mg carbonates.

This study aims to characterise the winter Saharan dust outbreak that affected León (Spain) on February 23 and 24, 2017. Sampling was carried out at the university campus of León, Spain (42° 36' 50" N, 5° 33' 38" W, 846 m asl), between February 19 and 27, 2017. Different instruments were used: *i*) a Hirst-type volumetric trap VPPS2000 (Lanzoni©) for hourly collection of pollen grains; *ii*) an optical particle counter (PCASP-X); *iii*) a high resolution nanoparticle sizer (SMPS Model 3938) for the continuous monitoring of particle size distributions *iv*) a low volume sampler (TECORA, ECHOPM) operated with 47 mm diameter teflon filters and *v*) a high volume sampler (CAV-A/Mb) equipped with 150 mm diameter quartz filters. Quartz filters were used for determining PM_{10} (by the gravimetric method), and organic and elemental carbon (OC and EC, by a thermo-optical method). Teflon filters were used for the analysis of water soluble ions (by ionic chromatography) and trace elements (PIXE). Additional data provided by the regional air quality network (www.medioambiente.jcyl.es) related to O_3, NO_X were also taken into account. Furthermore, an automatic weather station located in the sampling site recorded temperature, wind speed and direction, relative humidity and precipitation data. The synoptic situation was analysed in detail. In order to identify the weather type, a Circulation Weather Types classification (CWTs) was carried out (Lamb, 1972). Air masses were also analysed using back trajectories from HYSPLIT model.

The back trajectories confirm that there was an air mass from North Africa that arrived at the Iberian Peninsula on February 23, 2017. In February 2017, the mean temperature and the relative humidity in León were 6.1 ºC and 73%, respectively. However, during the Saharan dust intrusion episode, the mean temperature and the relative humidity were 9 ºC and 52 %, respectively, and the circulation weather type was cyclonic.

The hourly evolution of the aerosol size distribution was obtained and the inhalable, thoracic, tracheobronchial and respirable fractions were evaluated for healthy adults and high risk groups, following the Spanish standard UNE 77213.

On February 23, 2017, an increase in the concentrations of some air pollutants were detected. Thus, the PM_{10} daily value reached 60.4 µg/m^3, exceeding the *DLV* (the mean for the sampling period was 20 ± 10 µg/m^3). The NO_2 and OC concentrations had a slight increase, reaching 49 and 4.24 µg/m^3, respectively (means for the sampling period were 35 ± 8 and 2 ± 1 µg/m^3, respectively). Also, an important increase of the concentrations of crustal elements (Al, Mg, Ti, Si, Ca, K and Fe) was observed. These elements are major constituents of African dust. The presence of pollen in the atmosphere was scarce, however pollen types non characteristic of this area in this period of the year were identified.

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