A WINTER SAHARAN DUST INTRUSION AT LEÓN: AIR QUALITY AND HEALTH IMPACTS

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INTRODUCTION

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 occurs 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 characterize the winter Saharan dust outbreak that affected León (Spain) on February 23 and 24, 2017.

STUDY AREA

León city, belonging to the Province of León, is located in the northwest of the Iberian Peninsula. 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 (Fig. 1).

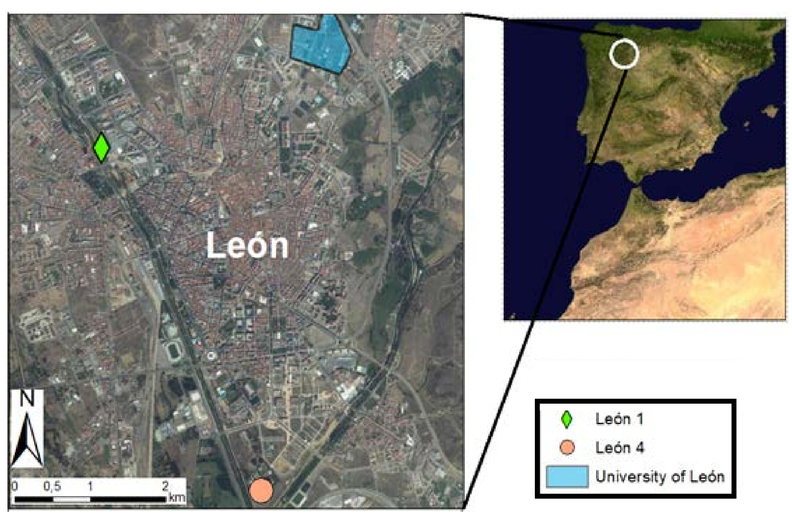

Fig. 1. Location of the sampling site.

SAMPLING

Hirst-type volumetric trap VPPS2000 (Lanzoni©): Collection of pollen grains

Low volume sampler (TECORA, ECHOPM): Collection of PM_{10} (47 mm diameter teflon filters)

Optical particle counter (PCASP-X): Continuous monitoring of particle size distribution (0.1-10 µm)

High resolution nanoparticle sizer (SMPS): Continuous monitoring of particle size distributions (0.018-1 µm)

High volume sampler (CAV-A/Mb): Collection of PM_{10} (150 mm diameter quartz filters)

Fig. 2. Sampling instrumentation.

Besides, additional data from following sources were used:

- Regional air quality network (www.medioambiente.jcyl.es).
- Automatic weather station recorded temperature, wind speed and direction, relative humidity data.

RESULTS AND CONCLUSIONS

- There was an air mass from North Africa that arrived at the Iberian Peninsula on February 23 (Fig. 3).

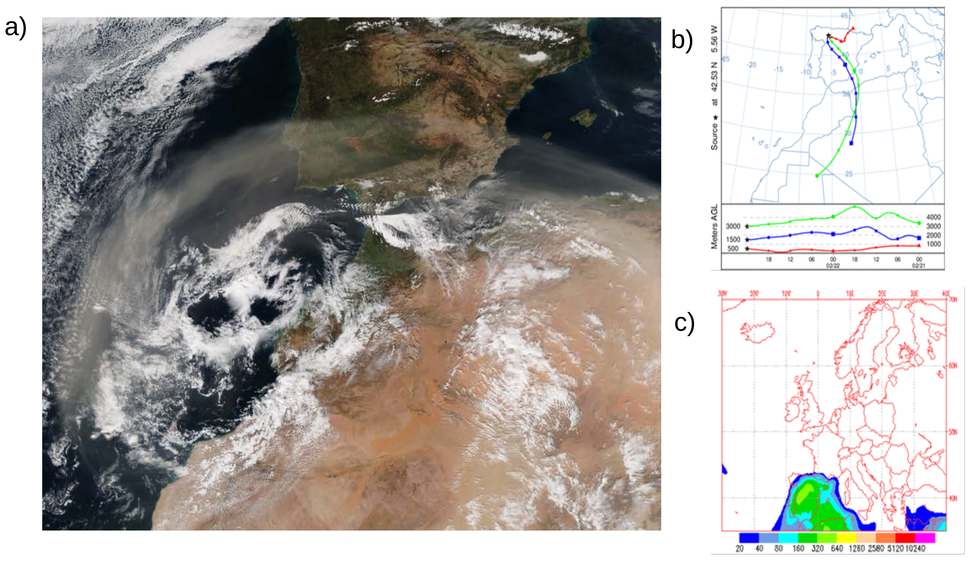

Fig. 3. a) NASA images showing the Saharan dust event, b) Hysplit back trajectories at 500, 1500 and 3000 m, c) NAAPs dust surface concentration the 23/02/2017**.**

- During the Saharan dust intrusion episode, the mean temperature and the relative humidity were 9ºC and 52 %, respectively.

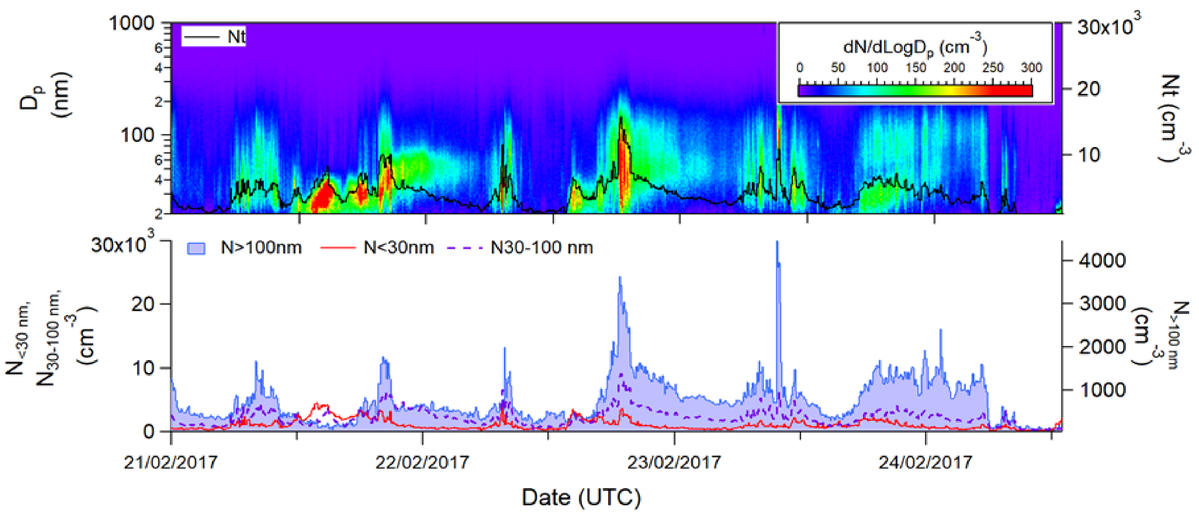

Fig. 4. Evolution of the aerosol size distributions, total particle number concentration (N_t) and particle concentration for each of the three modes: nucleation ($N_{<30nm}$), Aitken ($N_{30\text{-}100nm}$) and accumulation ($N_{>100nm}$).

- There was an important increase of particles with aerodynamic diameters > 100 nm, reaching the maximum of 4456 particles cm^{-3} (23 February at 0900 UTC) (Fig. 4).
- Mass concentrations show an increase during the dust outbreak, mainly due to the particles with aerodynamic diameters between 5 and 7 µm, evidencing dust as the main source of particles.

a) February 23, 2017. University of León

b) February 24, 2017. University of León

Fig. 5. Images of a) Saharan dust intrusion day and b) day after Saharan dust intrusion

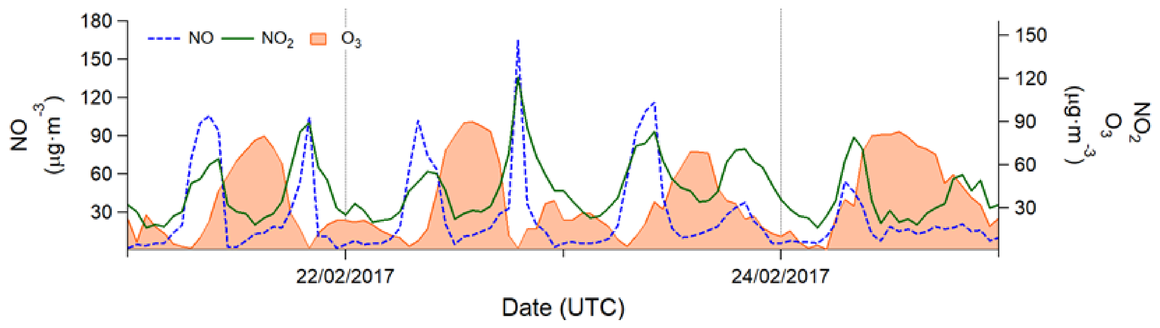

Fig. 6. NO, NO_2 and O_3 concentrations corresponding to the urban background air quality monitoring station LEON 4 (05º33'53" W, 42º36'32" N and 838 asl).

- An increase was observed in NO and NO_2 concentrations and a decrease in O_3 concentrations (+21, +69 and -28%, respectively), compared to the days without intrusion.
- The analysis of the 24 h filter, shows a PM_{10} concentration of 60 µg/m^3 on February 23, exceeding the DLV, while the mean PM_{10} concentration in *normal* days was 26 ± 14 µg/m^3.
- An important increase of the concentrations of crustal elements (Al, Mg, Ti, Si, Ca, K and Fe) was observed. The total mineral fraction reached 39% of the PM_{10} mass during the dust outbreak. Days before and after the dust intrusion the mineral fraction reached mean values of 18% and 9%, respectively.

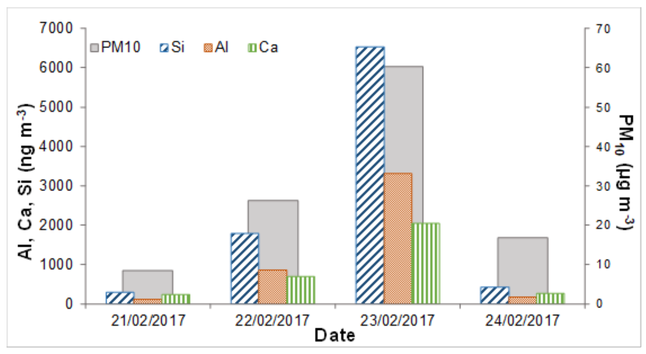

Fig. 7. Daily evolution of aluminum, calcium, silica and particulate matter concentrations during the intrusion of February 2017

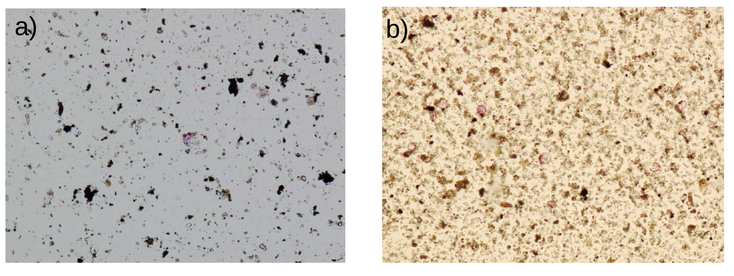

Fig. 8. Optical microscope images (40x) of samples collected by the Hirst-type volumetric trap corresponding to days a) without -21/02/2017 and b) under Sahara dust intrusion -23/02/2017

On February 23 when the dust plume reaches the north of the peninsula, the *Corylus* concentration was about six time higher (60 pollen m^{-3}) than the maximum value reached in previous days (10 pollen m^{-3}).

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