# WINTER SAHARAN DUST INTRUSION AT LEON (SPAIN): BIOGENIC AND NON-BIOGENIC AEROSOL TRANSPORT

**A.I. Calvo[1*], A. Castro[1], D. Fernández-González[2,3], C. Blanco-Alegre[1], A.M. Vega-Maray[2], R.M. Valencia-Barrera[2], E. Alonso-Blanco[4], M. Sorribas[5] and R. Fraile[1]**

[1]Department of Physics, IMARENAB University of León, 24071 León, Spain; [2] Biodiversity and Environmental Management, University of León, Spain

[3]Institute of Atmospheric Sciences and Climate-CNR, Bologna, Italy; [4]Centre for Energy, Environment and Technology Research (CIEMAT), Department of Environment, 28040 Madrid, Spain

[5]Remote Sensing and Atmosphere Department, Atmospheric Sounding Station 'El Arenosillo', 21130, Huelva, Spain

*aicalg@unileon.es

## INTRODUCTION

Due to its proximity to the African continent, Spain is a country exposed to frequent Saharan dust intrusions, mainly in summer, associated to the presence of an anticyclone in the North of Africa. In spring and autumn, these intrusions are mainly due to a depression located in the W or SW of Portugal. Less usual are those intrusions occurred in winter. Dust plays an important role in processes affecting climate, biogeochemistry and air quality.

This study aims to analyse the transport of biogenic and non-biogenic aerosols during a winter Saharan dust intrusion at León (Spain) occurred in February 21 and 22, 2016.

## STUDY AREA

Data were collected from 15 to 28 February 2016, at the university campus of León, Spain (42° 36' 50" N, 5° 33' 38" W, 846 m asl).


Fig. 1. Location of León, in Spain.

## METHODOLOGY

**Sampling**

| Hirst-type volumetric trap VPPS2000 (Lanzoni©) | Optical particle counter (PCASP-X) | High resolution nanoparticle sizer (SMPS Model 3938) | CIMEL CE318 Sun Sky photometer |
|---|---|---|---|
|  |  |  |  |
| Collection of pollen grains | 0.1-10 µm | 0.018-1 µm | Quantification and physical-optical characterization of aerosols |

Continuous monitoring of particle size distributions

- A Davis Weather Station: continuously registering the temperature and humidity
- Regional air quality network data (http://www.medioambiente.jcyl.es/)

## RESULTS and CONCLUSIONS

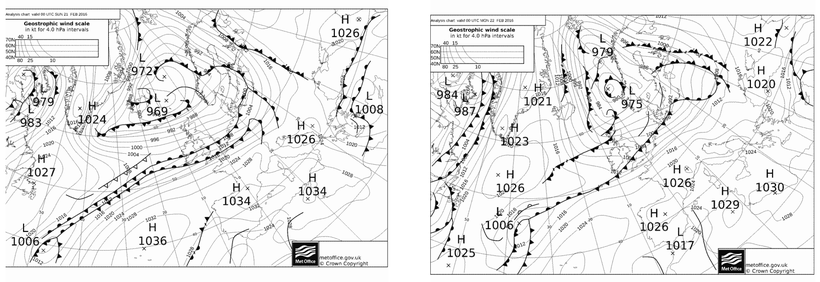



Fig. 2. Synoptic charts (surface pressure) for 21 and 22 February 2016.

- **21 February 2016**: very high pressures (up to 1034 hPa) on the Iberian Peninsula. Actually, it is an extension of the Azores anticyclone over the Mediterranean.
- **22 February 2016**: the situation remains similar but the pressure tends to decrease and a center of relative low pressure appears on the Strait of Gibraltar, which generates southerly winds in the Southeast.

- The arrival of the air mass from North Africa triggered a situation of atmospheric stability over the city preventing dispersion of pollutants in surface. A marked increase in the submicrometer particle number was observed, exceeding for some moments the amount of $20x10^3$ particles $cm^{-3}$. The daily legal limit for $PM_{10}$ was not exceeded. However, maximum 1 h $PM_{10}$ value of 50 µg $cm^{-3}$ was reached.

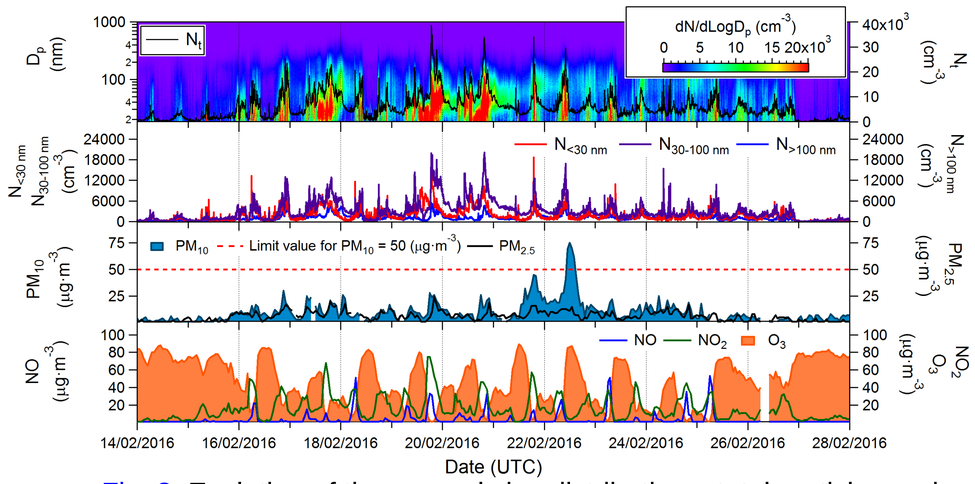
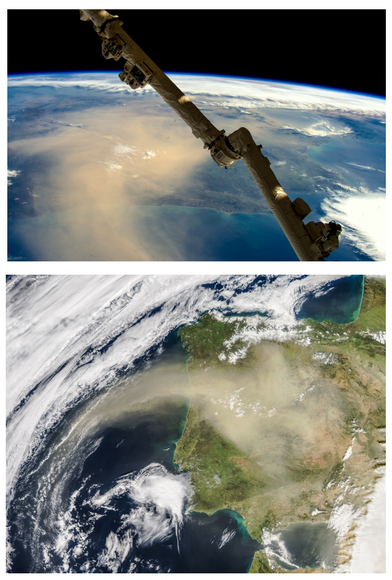


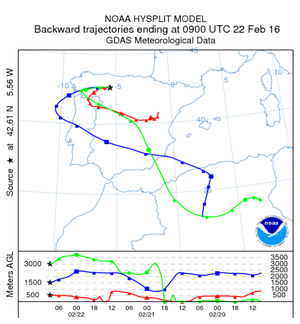

Fig. 3. Evolution of the aerosol size distributions, total particle number concentration ($N_t$) and particle concentration for each of the three modes: nucleation ($N_{<30nm}$), Aitken ($N_{30\text{-}100nm}$) and accumulation ($N_{>100nm}$). $PM_{10}$, $PM_{2.5}$, NO, $NO_2$ and $O_3$ concentrations corresponding to the urban background air quality monitoring station LEO 4 (05º33'53" W, 42º36'32" N and 838 msl) are also represented.



http://visibleearth.nasa.gov/

Fig. 4. NASA images shown the Saharan dust event in February 2016.

a)




b)

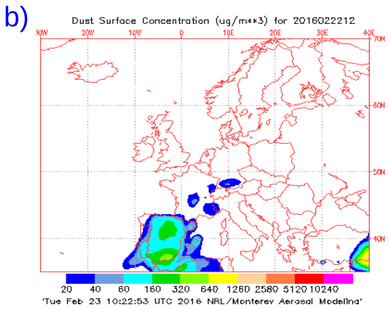



Fig. 5. *a)* Hysplit back trajectories at 500, 1500 and 3000 m and *b)* NAAPs dust surface concentration the 22/02/2016.

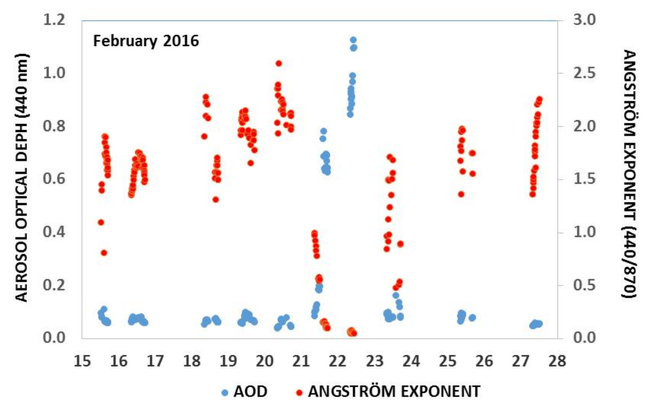



Fig. 6. Time series of AOD (440 nm) and Angström exponent (440/870) at León.

- The quick arrival of desert dust plume is observed thanks to the increase of AOD and the decrease of Angström exponent during the early morning of 21 February. The highest AOD was registered on the second day of the episode with a value of 1.1.
- The desert dust aerosol quickly moved away, which dropped back to background levels on 23 February.

- During the Saharan dust intrusion studied, sand particles and pollen grains not typical of flowering plants in this period of the year in the province of León or Castile and León were identified: *Artemisia* (17-28 µm; Fig. 7b I) and *Daphne* (18-23 µm; Fig. 7c II).
- Before and after the intrusion, a low concentration of pollen was detected with a predominance of *Corylus (*19-21 µm), *Alnus* (13-18 µm; Fig. 7d III), *Cupressaceae (*18-33 µm) and *Poaceae* (graminaceus) (16-47 µm), frequent in February in this city.

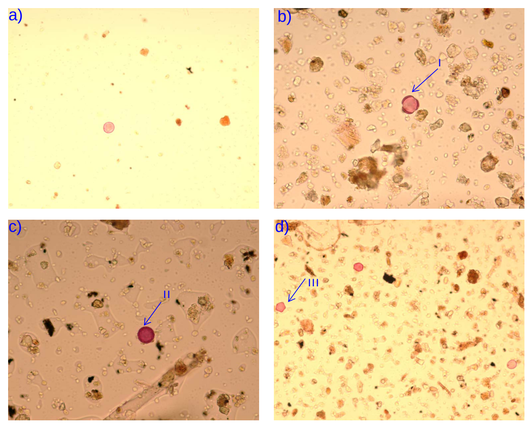



Fig. 7. Optical microscope images (*a* and *d*: 40x; *b* and *c*: 20x) of samples collected by the Hirst-type volumetric trap (Lanzoni VPPS 2000) corresponding to days without -20/02/2016- (*a*) and under Sahara dust intrusion -21 and 22/02/2016- (*b*, *c* and *d*).

**ACKNOWLEDGEMENTS**

This work was partially supported by the Spanish Ministry of Economy and Competitiveness (Grant TEC2014-57821-R), the University of León (Programa Propio 2015/00054/001) and AERORAIN project (Ministry of Economy and Competitiveness, Grant CGL2014-52556-R, co-financed with FEDER funds). The authors gratefully acknowledge the NOAA Air Resources Laboratory (ARL) for the provision of the HYSPLIT transport and dispersion model and/or READY website (http://www.ready.noaa.gov) used in this study. The authors would also like to express their gratitude to the Naval Research Laboratory for providing the NAAP aerosol map and NASA for the images.