Air pollution in León during a set of forest fires in the NW of the Iberian Peninsula: a post-fires rain event

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Introduction

In the Mediterranean area, forest fires have increased in number and surface over the last 50 years, becoming a health, environmental and social problem (Chen et al., 2017).

An example is the recently set of fires occurred in Galicia, Asturias, León and North of Portugal, in October 2017. In total, more than 100,000 ha were burned between 14 and 16 October, being the majority arsons. The plumes from wildfires reached the most populated cities of the NW Iberian Peninsula and even central Europe (Fig.1), causing dark skies in the cities with a high ash content.

The aim of this study was to analyze the main air pollutants during this event and the scavenging effect of a post-fire rain event.

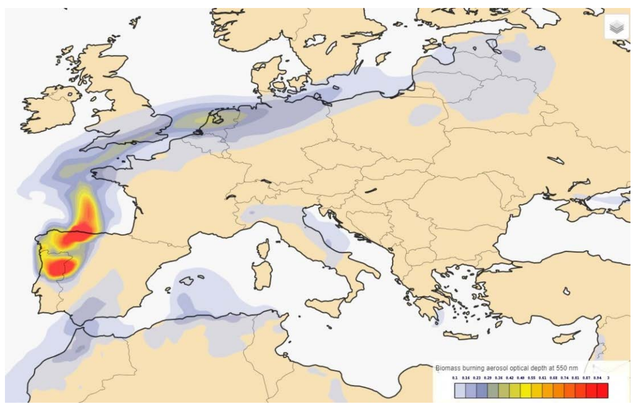


Figure 1. Biomass aerosol optical depth at 550 nm forecast at 17/10/2017 from the Copernicus Atmosphere Monitoring Service.

LEÓN (NW SPAIN)

Sampling: 16 - 18 October 2017

During wildfire

After rainfall

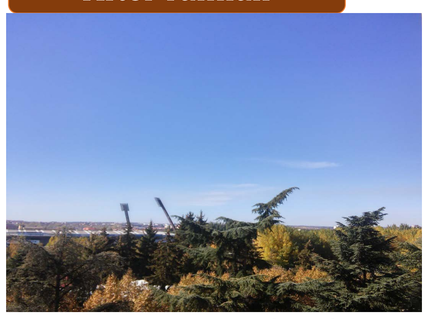
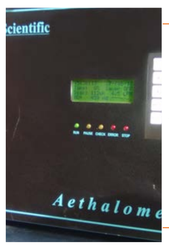


Figure 2. Images of León city during the fire and the day after.

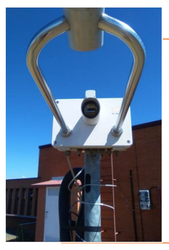
Sampling instruments

Optical spectrometer PCASP-X. Particles with diameters between 0.1 and 26.8 μm in 31 channels were measured.

High resolution nanoparticle sizer (SMPS Model 3938). Particles with diameters between 7.6 and 310.6 nm in 104 channels were sampled.



An AE31 Aethalometer for measuring Black Carbon (BC) concentration



A laser disdrometer Thies LPM (raindrops between 0.125 and 8 mm size in 22 channels)

A Davis Weather Station to monitor some meteorological variables

Data provided by the regional air quality network related to PM_{10}, O_3, SO_2 and NO_X concentrations

Results

Previous wildfires occurred near the sampling area (Fig. 3).

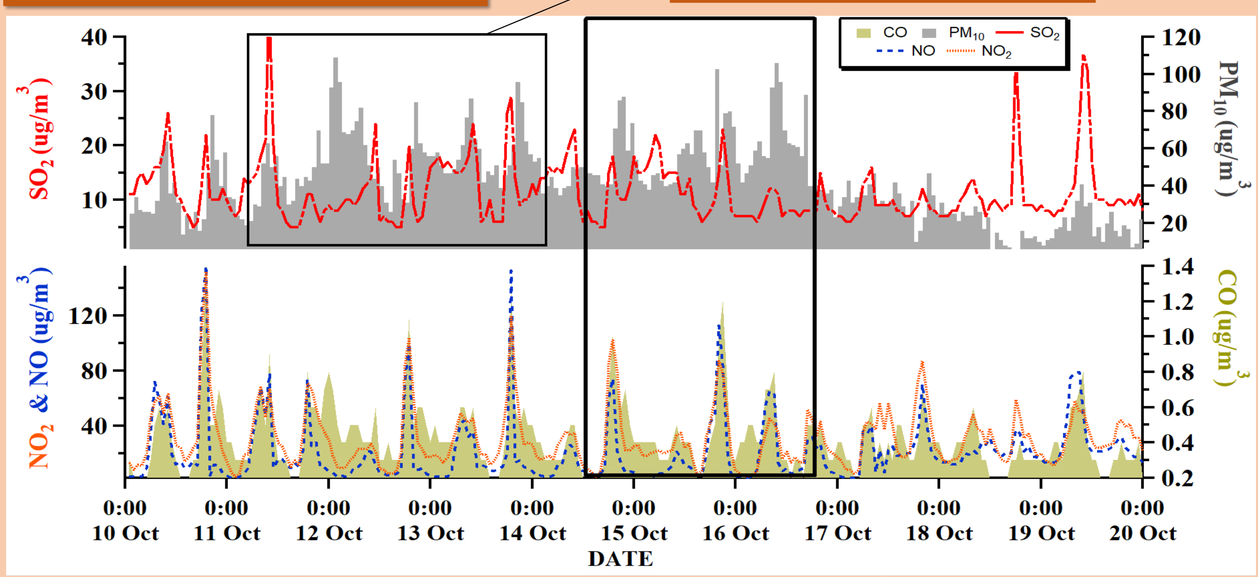


Figure 3. Evolution of PM_{10}, NOx, CO and SO_2 concentration in León between 10 and 20 October (data source: Regional Air Quality Network).

High concentration of air pollutants were registered in León during wildfires days. Higher hourly PM_{10} values, with 106 μg m^{-3}, were recorded at 0900 UTC of 16 October (Fig. 3). Rain produced a clear scavenging, with a PM_{10} decreased of 42.5%.

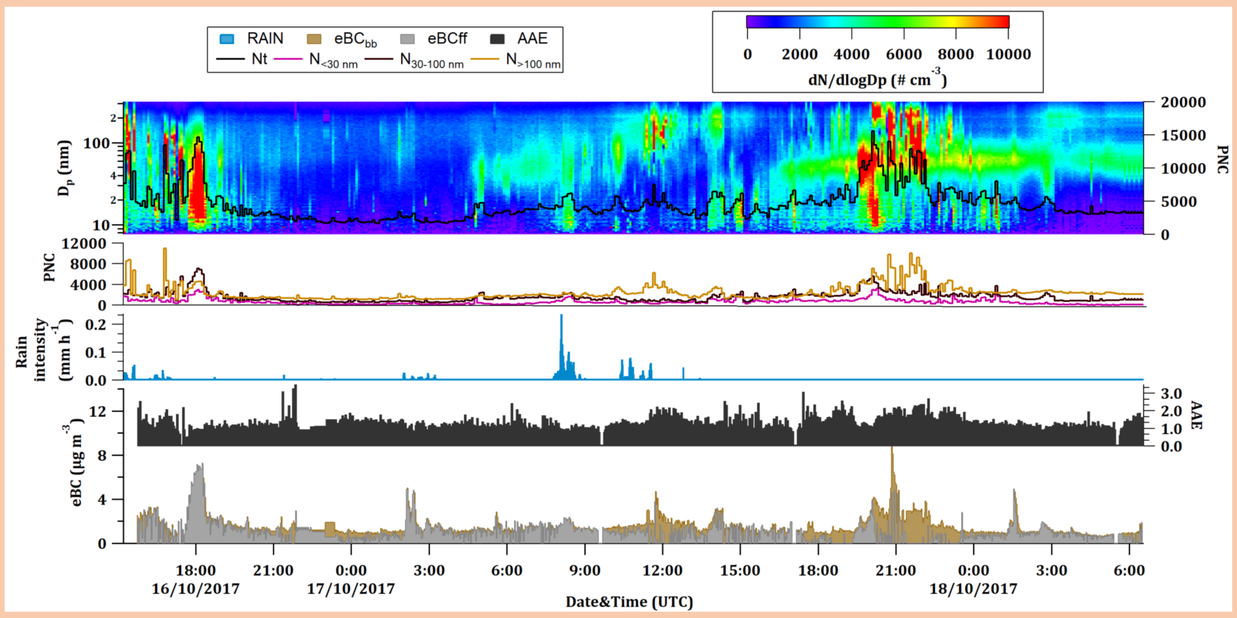
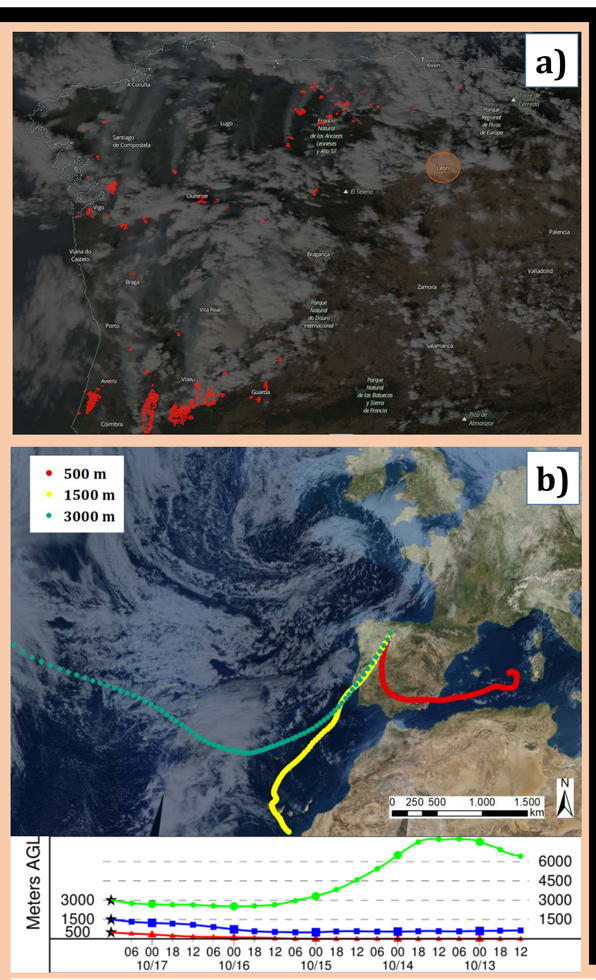


Figure 4. Evolution of nucleation, Aitken and accumulation modes (Particle Number Concentration –PNC-) (# cm^{-3}), equivalent Black carbon (eBC) (fossil fuel and biomass burning), Absorption Ångström Exponent (AAE) and rain intensity during and after wildfires.

- Two rainfall events occurred in León with an accumulated rainfall of 5.7 mm.
- eBC maximum concentration was reached on 16 October, at 1806 UTC with 7.94 μg m^{-3}.
- At the same hour, the nucleation, Aitken and accumulation maximum particle concentrations was reached with 3,000, 7,156 and 4,555 # cm^{-3}, respectively.



Hysplit back-trajectories show that air masses arriving at León on 17/10/2017 could transport ash from wildfires (Fig. 5b).

Figure 5. a) Image of Satellite Aqua and Terra /MODIS (Fires and thermal anomalies) the 15/10/2017; b) HYSPLIT back trajectories at 500, 1500 and 3000 m the 17/10/2017; c) NAAPs dust and smoke concentration the 16/10/2017.

CONCLUSIONS

- A plague of wildfires produced a high burden of pollutants in León, reaching high concentrations and a decrease of visibility. Mainly, the aerosol particles in accumulation mode and black carbon increased its concentrations.
- The rainfall after wildfires produce a clear scavenging (PM_{10} decreased of 42.5%).

References

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