Rainfall characteristics at León in 2016 and 2017

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INTRODUCTION

Nowadays, air pollution is one of the principal risk to human health and rain is the main sink of aerosol particles in the atmosphere, since it is the main process to mitigate pollution. On this basis, the study of rainfall characteristics is crucial because it can provide information about present and future risks in an area, related to rain amount or intensity.

The use of models is critical to prevent damages by rain, hence the correlation between synoptic situation and rainfall characteristics can provide information to be used in future models.

Thus, the aim of this study is to analyze the rainfall characteristics in León in the last two years, related to the daily synoptic situation.

STUDY AREA

LEÓN (NW SPAIN)

- Population: 200,000 people including metropolitan area
- Mediterranean climate (normalized values with last 35 years of AEMET data):

- rain events irregularly scattered over the year with an annual mean precipitation of 515 mm
- temperatures are cool, with an annual mean of 11.1 °C
- the winter is cold with frequent frosts, 71 per year
- the summer is tempered by the altitude with maximum temperatures around 27 °C

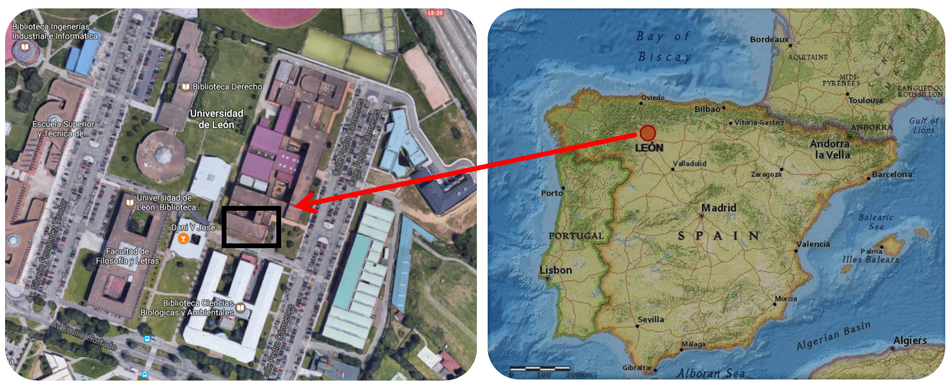

Fig. 1. Sampling point in León.

MATERIAL

***LASER PRECIPITATION MONITOR* (LMP)**

- Rain was sampled during 2016 and 2017 using a laser disdrometer
- Registered **drops** between **0.125-8 mm** in 22 channels.
- Rainfall variables were obtained every minute:

Precipitation intensity

Accumulated precipitation

Number of drops in 22 channels

Mean and SD of raindrop sizes

Fig. 2. *Laser Precipitation Monitor* (LPM) of *Thies Clima* used during the sampling campaign in León between January 2016 and December 2017.

RESULTS

- 203 rainfall days (129 in 2016 and 74 in 2017) with a total of 949.6 mm accumulated (611.6 mm in 2016 and 338.0 mm in 2017).
- The day with more rain amount was 15/02/2016 with 66.4 mm, a mean raindrop diameter of 0.35±0.29 mm and a total of 6.2 10^7 raindrops/m^2.
- In 2016 the maximum rain intensity was recorded on 15/02/2016 at 0700 UTC (19.9 mm/h).
- In 2017 the maximum rain intensity was recorded on 05/02/2017 at 0700 UTC (12.8 mm/h).

Table 1.- The 26 weather types from Lamb classification (Trigo and DaCamara, 2000)

Directional types	Non-directional types	Hybrid types	
Northerly (N)	Anticyclonic (A)	AN	CN
Southerly (S)	Cyclonic (C)	ANW	CNW
Easterly (E)		AW	CW
Westerly (W)		ASW	CSW
Northwesterly (NW)		AS	CS
Southwesterly (SW)		ASE	CSE
Southeasterly (SE)		AE	CE
Northeasterly (NE)		ANE	CNE

Table 2.- Summary of rain characteristics during the sampling campaign in León (2016 and 2017) and PM_{10} concentration in Station 1 (traffic) of Air Quality Network of Castilla y León data in León city.

Year	Sum of raindrop (#/m^2)	Number of rain days	Rain (mm)	Mean raindrop diameter (mm)	PM_{10} concentration (µg/m^3)
2016	3.23 10^9	123	611.6	0.36±0.20	20.0
2017	1.06 10^9	80	338.0	0.35±0.19	24.0
Total	4.29 10^9	203	949.6	0.36±0.19	22.0

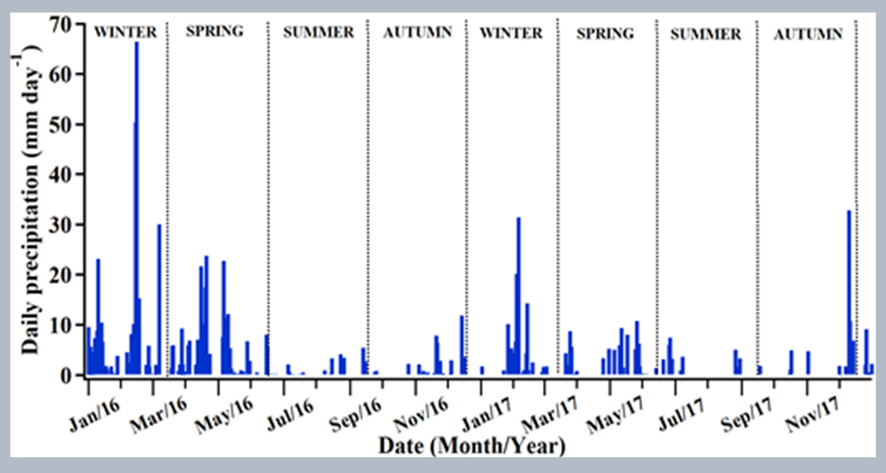

Fig. 3. Daily rainfall time series recorded in León between January 2016 and December 2017.

- It should be highlighted W, C, N and NW types, with a rain amount of 198.5, 177.4, 152.6 and 123.1 mm, respectively and 27, 28, 18 and 17 rain days.
- ANW type registered the maximum rain intensity.
- The larger mean raindrop diameter was reached in the NE type (0.43±0.25 mm).
- The number of rain days for the A type was very high (22) but the rain amount was only 15 mm.
- The most rainy type was the CNW, with almost 30 mm in only two rain days.

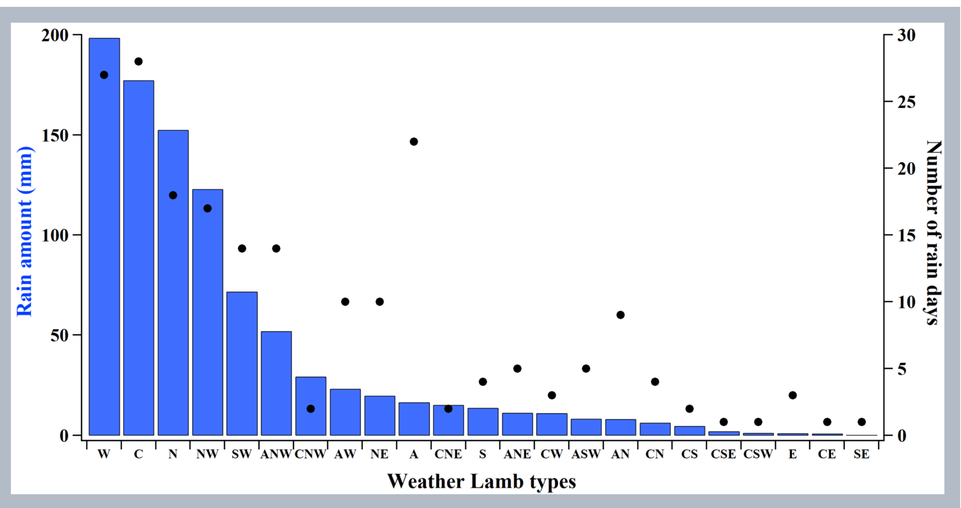

Fig. 4. Volume recorded and number of rain days for each of the Lamb Weather Types during the campaign in León 2016-2017.

- The lower volume of rain in 2017 was an important factor to explain the more polluted atmosphere in 2017 than in 2016, like in other studies (Zikova and Zdimal, 2016).

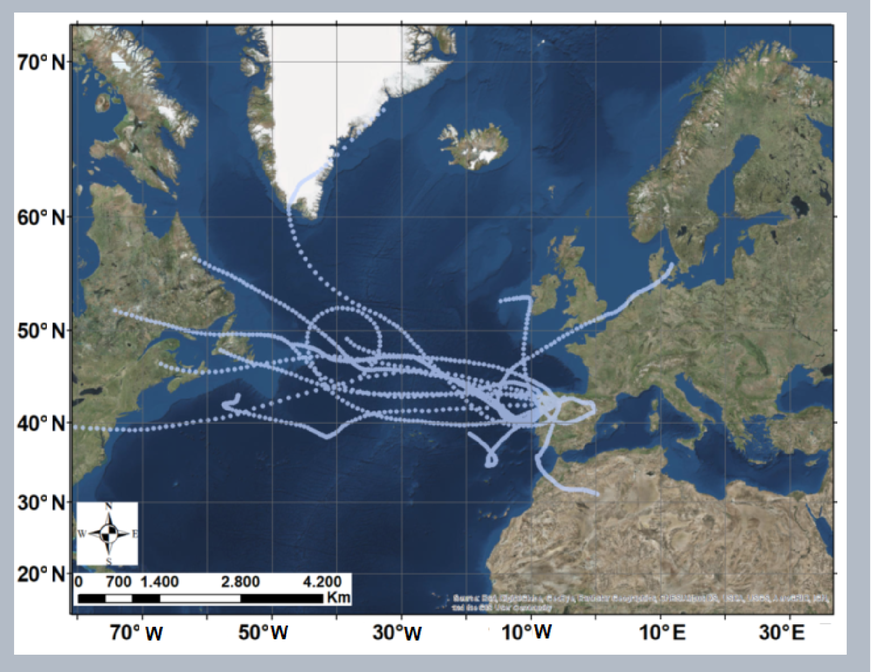

Fig. 5. Example of four days back trajectories arriving at 1000 m a.s.l. during rain events in León in winter 2017 from HYSPLIT data (Calvo et al., 2012).

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