CHANGES IN THE AEROSOL SIZE DISTRIBUTION DEPENDING ON RAINDROP SIZE DISTRIBUTION IN LEÓN (NORTHWEST SPAIN)

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INTRODUCTION

The present study aims to characterize aerosol size distributions in León (whose main source of aerosol is traffic) and the effect of precipitation over the different modes of aerosol size distributions: nucleation, Aitken, accumulation and coarse particles. For that, both the raindrop and aerosol size distributions were studied with rain were studied, and percentage variations in aerosol particles were estimated. Later, scavenging coefficient (λ) across the size distribution before, during and after the rain events was obtained to study the evolution of the particle sizes with rain. Some studies show a more effective scavenging with low rainfall intensities and long duration for particles smaller than 50 nm.

STUDY AREA

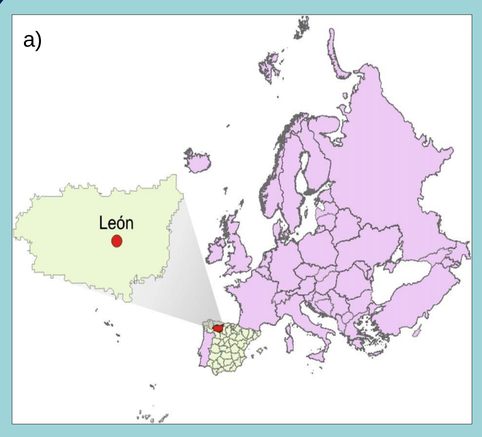


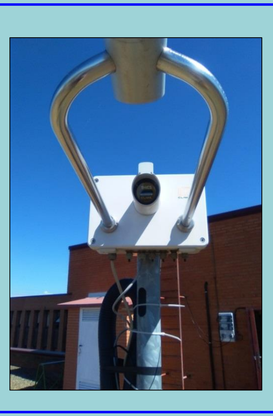
FIG. 1. a) Location of León, in Spain.
b) Location of the sampling point of aerosols and precipitation.

Data were collected from February 12th 2016 to April 30th 2016, at the university campus of León, Spain:
42° 36’ 50” N
5° 33’ 38” W
846 m asl

METHODOLOGY

SAMPLING

- Laser disdrometer Thies LPM



Registered drops with diameters between 0.125 and 8 mm in 20 channels.

- Optical particle counter (PCAS-X)

- High resolution nanoparticle sizer (SMPS Model 3938:DMA 3081 and CPC 3772)

0.1-10 µm 0.018-1 µm
Continuous monitoring of particle size distributions.

- Davis Weather Monitor II Station

Continuously registering temperature and humidity.

RESULTS and CONCLUSIONS

- 32 rain events were studied during the measurement campaign.
- Gamma and lognormal distributions were used for characterizing raindrop and aerosol size distributions, respectively.

TABLE. 1. Summary of 32 rain episode.

	INTENSITY (mm/h)	*DURATION* (min)	*PRECIPITATION* (mm)
MIN	0.22	50	0.56
MAX	7.23	941	66.4
MEAN	1.31	438	9.42

SMPS + PCASP

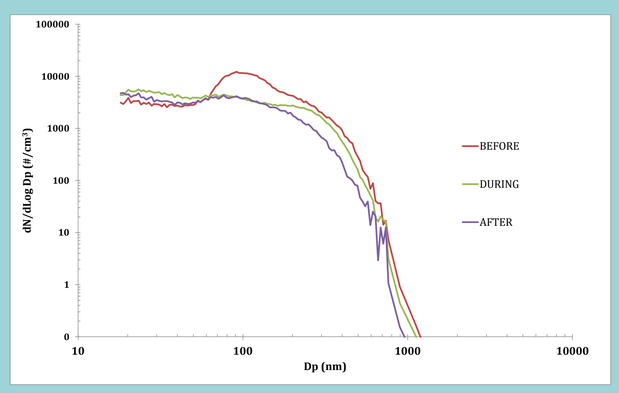


FIG. 1. Distribution of aerosol particles before precipitation (red), during rain (green) and after rain (purple) for a rain event that occurred on 24/02/2016.

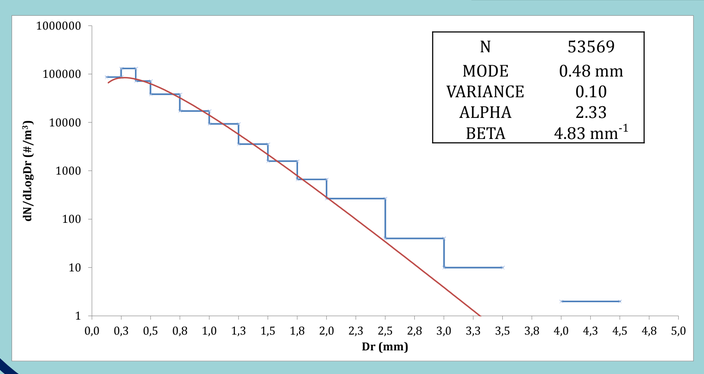
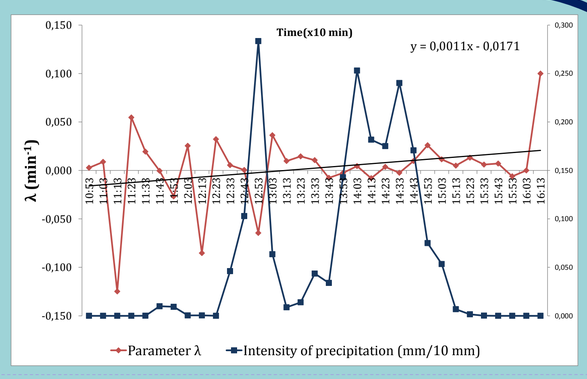


FIG. 2 Gamma distribution of drops for the rain event of 24/02/2016 with accumulated precipitation of 1.19 mm and duration of 266 min, with a low rain intensity of 0.43 mm/h.

FIG. 3. Minute by minute evolution of scavenging parameter (λ) (red line) and precipitation (line blue). In black the trend of λ.: positive values indicate effective washing in one rain event (24/02/2016).



- During rain, scavenging coefficient is, almost always, positive, indicating effective washing.

Nucleation mode (5-20 nm) → **Aitken mode (20-100 nm)** → **Accumulation mode (100-1000 nm)** → **Coarse mode (> 1000 nm)**

TABLE. 2. Summary of particle’s number, before, during and after rain.

	(part./ cm³) *BEFORE*	(part./ cm³) *DURING*	(part./ cm³) *AFTER*	*Variation BEFORE-DURING* (%)	*Variation DURING-AFTER* (%)	*Variation BEFORE-AFTER* (%)
PCASP (0.1-10 µm)	190±150	190±170	150±150	0	-17	-12
SMPS (0.018-1 µm)	3900±2300	4000±3000	3900±3100	11	4	20
NUCLEATION MODE	1100±900	1300±1100	1400±1400	42	10	38
AITKEN MODE	2000±1100	2100±1600	2000±1600	10	2	12
ACCUMULATION MODE	740±730	580±590	510±480	-13	-6	-16

- Nucleation mode and Aitken mode do not denote an effective scavenging of particles with low intensities of precipitation.
- Particles in PCASP range (0.1-10 µm) have an effective scavenging with decreases in number of 12% between before and after rain.
- Analyzing by modes, an effective washing of particles in the SMPS accumulation mode, for the size range measured by PCASP, was observed, although the results differ between measuring equipment.

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