SCAVENGING OF AEROSOL PARTICLES BY RAIN IN LEON (SPAIN)

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INTRODUCTION

Wet scavenging is usually divided into swept into the cloud (in-cloud scavenging, ICS) and swept under the cloud (below-cloud scavenging, BCS). In this study only considers BCS. In general, to evaluate BCS used λ parameter. BCS is not as efficient in all sizes of aerosol particles, for example in the "Greenfield Gap" (0.3-1 mm) washing usually less. Therefore, it is analyzed the evolution of λ parameter in " Greenfield Gap" and it were to analyze the variation in the concentration of particles as a function of rain.

STUDY AREA

Data were collected from July to the end of October 2015 , at the university campus of León, Spain (42° 36' 50" N, 5° 33' 38" W, 846 m asl).

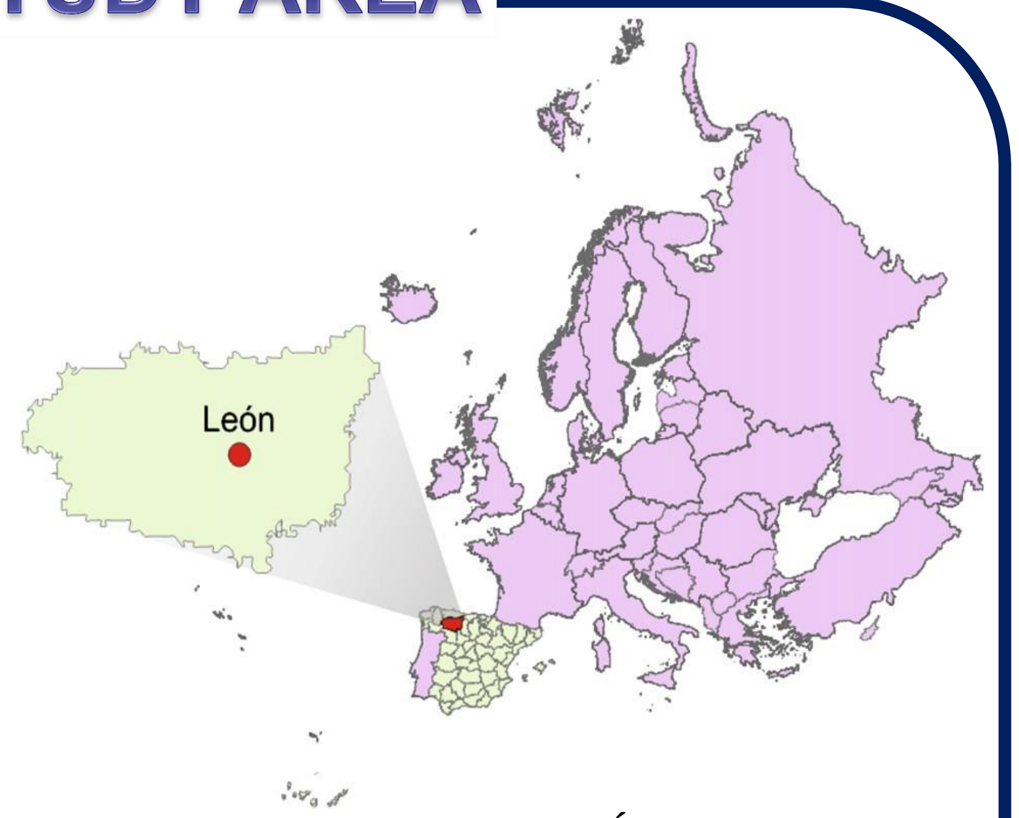
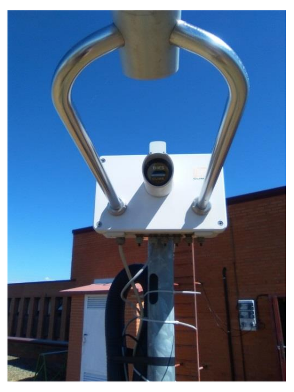


FIG. 1. LOCATION OF LEÓN, IN SPAIN.

METHODOLOGY

SAMPLING

Laser disdrometer Thies LPM

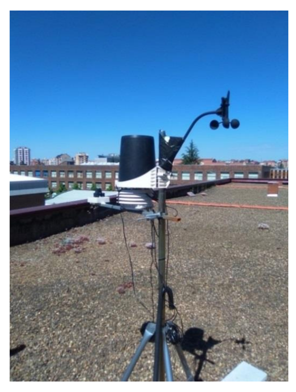


Registered drops with diameters between 0.125 and 8 mm in 20 channels

Optical particle counter (PCASP-X)

Registered aerosol particles with diameters between 0.1-10 µm in 31 channels

Davis Weather Monitor II Station



Continuously registering the temperature and humidity

RESULTS and CONCLUSIONS

- Gamma and lognormal distributions were used for characterising raindrop and aerosol size distributions, respectively.

TABLE. 1. SUMMARY OF RAIN'S EPISODES OCCURRING.

	INTENSITY (mm/h)	DURATION (min)	PRECIPITATION (mm)
MIN	0.20	28	0.4
MAX	5.75	1232	32.7
MEAN	1.31	231	4.1

TABLE. 2. SUMMARY OF EVOLUTION OF PARTICLE'S NUMBER, BEFORE, DURING AND AFTER RAIN.

	(part./cm^3) BEFORE	(part./cm^3) DURING	(part./cm^3) AFTER	Variation BEFORE-DURING (%)	Variation DURING-AFTER (%)	Variation BEFORE-AFTER (%)
MIN	31 ± 13	32 ± 7	10 ± 4	25	31	30
MAX	406 ± 20	370 ± 35	393 ± 76	-58	-76	-70
MEAN	174 ± 18	146 ± 25	130 ± 14	**-16**	**-15**	**-25**

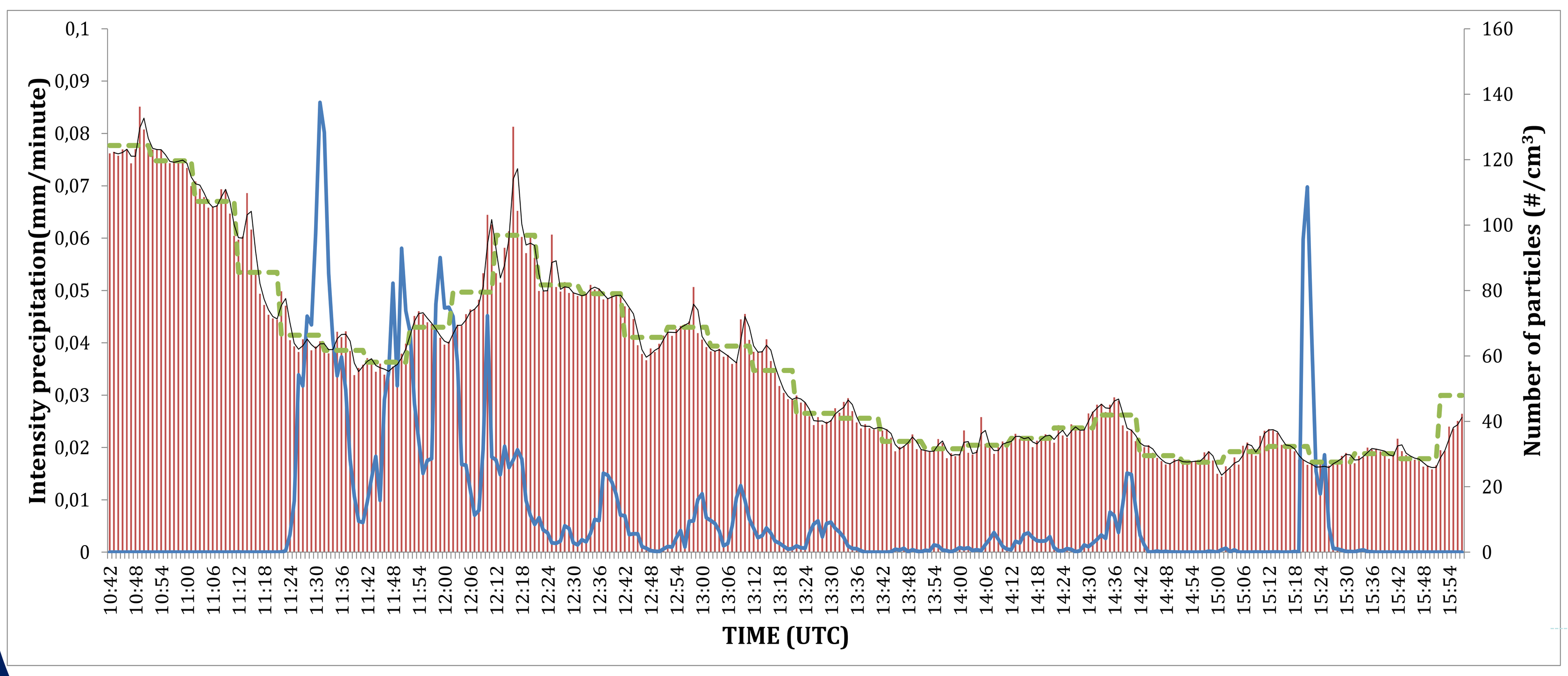
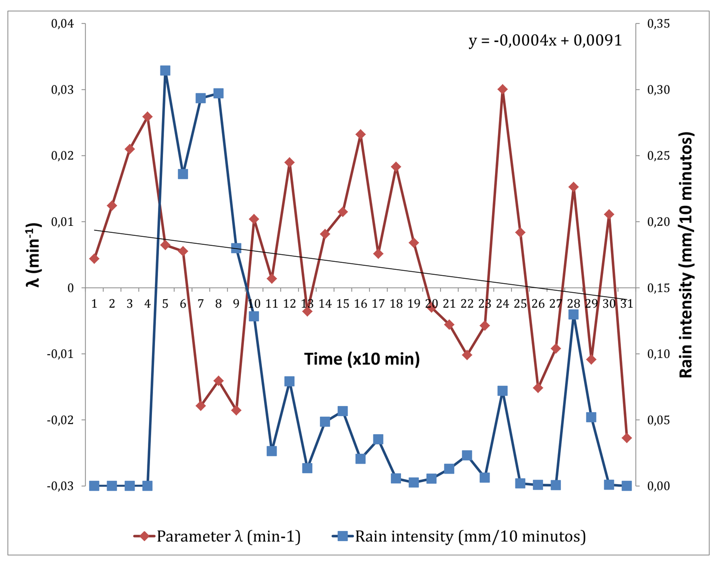


FIG. 2. Evolution minute to minute of total number of particles per unit volume (vertical red lines) and evolution of precipitation (line blue) in one rain event.



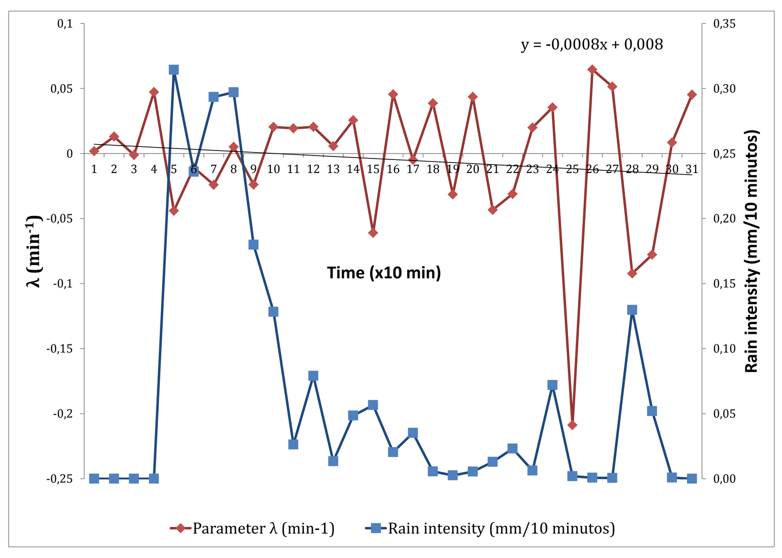


FIG. 2. Evolution minute to minute of scavenging parameter (λ) (red line) and evolution of precipitation (line blue). In black the trend of λ. Positive values indicate effective washing in one rain event.. A) Particles under 0,3 µm. B) Particles between 0,3-1 µm ("Greenfield Gap").

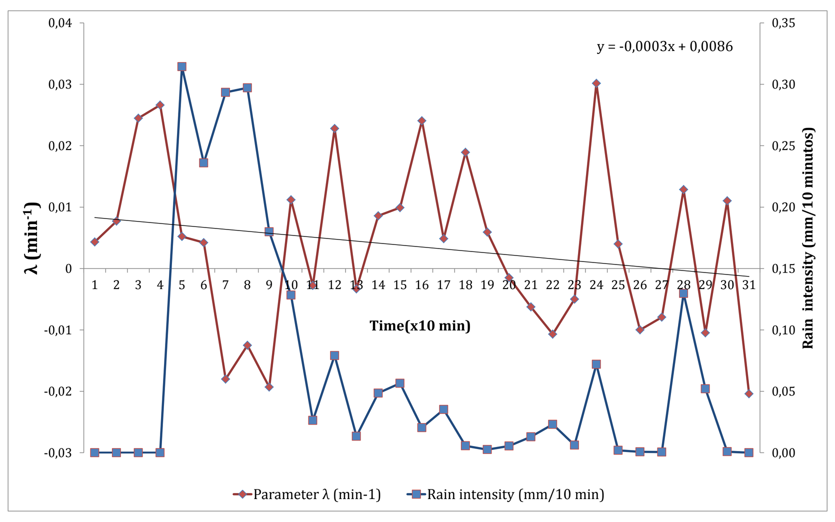


FIG. 3. Evolution minute to minute of scavenging parameter (λ) (red line) and evolution of precipitation (line blue). In black the trend of λ. Positive values indicate effective washing in one rain event.

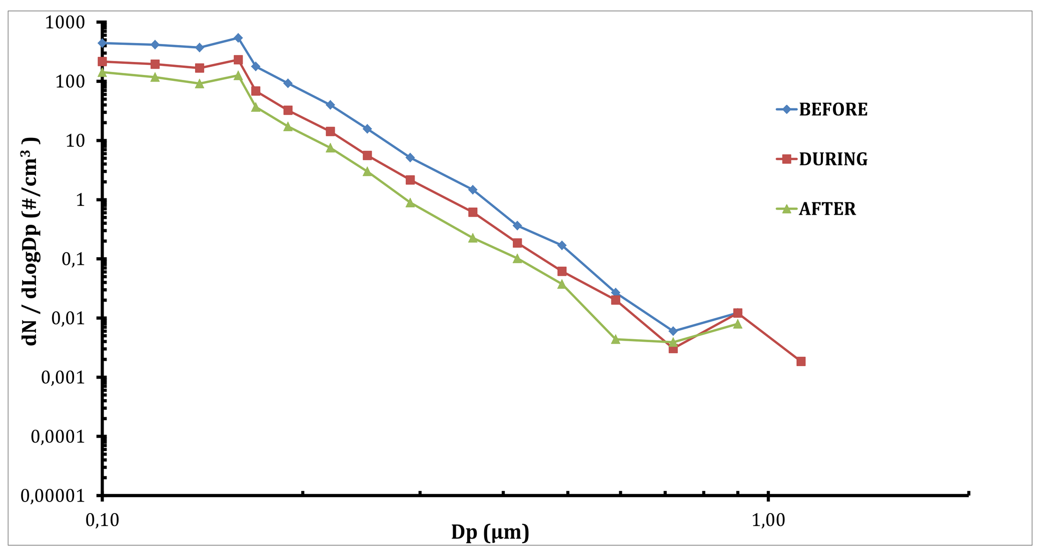


FIG. 4. Distribution of aerosol particles before precipitation (blue), during rain (red) and after rain (green).

- Pearson correlations statistically significant negative between:
  - Precipitation and total particles number (r=-0.53; p>0.001).
  - Precipitation and total particles mass (r=-0.54; p>0.001)
  - Drops (between 0.125 and 2.5 mm) and particles number (between 0.1 ad 0.42 µm)(p>0.001)

- Precipitation produce effective washing effect on aerosol particles in the atmosphere, with decreases in the number of particles present before and during rain of 15%, and before and after rain 25%.

BIBLIOGRAPHY

- Chate, D. M., Murugavel, P., Ali, K., Tiwari, S. & Beig, G., 2011. Below-cloud rain scavenging of atmospheric aerosols for aerosol deposition models. *Atmospheric Research*, 99(3-4), 528-536.
- Greenfield, S.M., 1957. Rain scavenging of radioactive particulate matter from the atmosphere. *Journal of Meteorology*.
- Sportisse, B., 2007. A review of parameterizations for modeling dry deposition and scavenging of radionuclides, 41, 2683-2698.

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