Changes in the aerosol size distribution depending on raindrop size distribution in León (Northwest Spain)

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This study was carried out in the Spanish region of Castilla y León, which is surrounded by mountains that protect the area from the influence of the sea. The selected study zone is León, a city in the northwest of Castilla y León. León lies in a transition area between the two main climatic regions of Spain: the continental area and the Mediterranean area. The city of León (42º 46´ N, 5º 35´ W) lies on a terrace between two rivers in the northern plateau of Spain. The raindrops and aerosol distributions were registered at the university campus of León, at the premises of the University (about 840 m above sea level), to the northwest of the city.

The sampling was carried out during the period between February 12th 2016 and May 31th 2016.

An optical disdrometer THIES Laser Precipitation Monitor has been used for this study. This device measures hidrometeor velocity and size as they are intercepted in the sampling field, by the duration and the decrease in laser emission registered. The laser used is 780 nm wavelength and the sampling area is 228 × 20 mm². The raindrop sizes that may be detected have been grouped into 22 classes, and the number of drops per size is presented grouped per minute. For every minute, the average dropsize in each event has been calculated and also the evolution of precipitation, including rainfall intensity, total precipitation, raindrop mean size and the parameters of the gamma distribution.

In addition, the particle sizes were classified into 31 discrete channels (size ranges) between 0.1 to 10 µm, using a laser spectrometer probe (Passive Cavity Aerosol Spectrometer Probe, PMS Model PCASP-X). From the aerosol composition, the aerosol refractive index and density were estimated (Alves *et al*., 2014). The diameters corresponding to the different channels (particle bin sizes) were corrected using these refractive indices in a model based on the Mie Theory.

The particle size spectra were measured in 112 discrete channels (size ranges) between 0.18 nm to 1 µm, using a high resolution nanoparticle sizer (Scanning Mobility Particle Sizer Spectrometer, SMPS Model 3938).

Using the calculated density, the mass concentration was estimated, and the evolution of PM_1, $PM_{2.5}$ and PM_{10} was assessed. Likewise, the Total Number of Particles, Total Surface, Total Volume, Geometric Mean Diameter (CMD), Surface Mean Diameter (SMD), Volume Mean Diameter (VMD) and Geometric Standard Deviation (σ_g) of the number, surface and volume distributions have been obtained.

The present study aims to characterize aerosol size distributions in León and the effect of precipitation over the different modes of aerosol size distributions: Aitken, accumulation, and coarse particles. In order to evaluate the effect of rain on aerosols, the evolution of the particle sizes before, during and after the rain, and the scavenging coefficient (Λ) have been studied. The relationship between the studied variables (Zhao *et al*., 2015) was also analyzed.

The aerosol size fractions associated with health problems were evaluated following the Spanish standard UNE 77213, which is equivalent to the ISO 7708:1995. From the experimental size distributions, first the inhalable and thoracic fractions, and then the tracheobronchial and respirable fractions were assessed for healthy adults and high-risk groups (children, elderly or infirm people).

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