RAIN EVENT ON 22 OCTOBER 2006 IN LEÓN (SPAIN): DROP SIZE SPECTRA

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I. INTRODUCTION

Size spectra of hydrometeors such as raindrops or hailstones are essential in many research projects. Remote detection of rain by radar, for example, is parametrized by the reflectivity factor, which depends on the number of raindrops and their size distribution (Berenguer et al., 2005). Soil erosion through the impact of rain depends on the kinetic energy of the drops, which is also a function of their size (Cerro et al., 1998).

This study describes the physical characteristics of precipitation on the wettest day of the year 2006 in León, Spain. The aim is to analyze the atmospheric situation during 24 hours by means of various techniques (synoptic situation, satellite imagery, radio sounding, rain gauge and disdrometer), and finding relationships between the most representative variables.

This is one single instance that continuous previous studies (Fraile et al., 2005) on the temporal sequencing of precipitation processes, and this study presents the methodology followed to identify patterns in the evolution of the precipitation.

II. METEOROLOGICAL SITUATION

Fig. 1 shows the synoptic map on the surface and at 500 hPa. It can be seen that around the Iberian Peninsula the meteorological situation is characterized by the presence of a large trough whose leaving zone is located right over the Iberian Peninsula. These are ideal conditions for instability. 24 hours later the trough deepened still further and came closer to the study zone.

Nevertheless, the radio soundings carried out near the study zone show a low level of instability (CAPE was nearly zero). The radar imagery shows the cloud layer over León that day causing the highest daily precipitation registered in 2006.

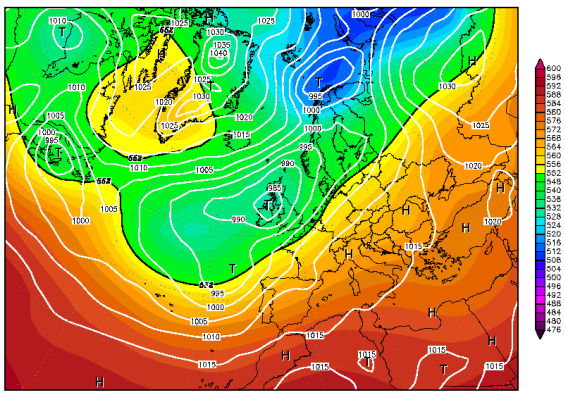

FIG. 1: Meteorological situation on 22nd October 2006 at 0000 GMT on the surface and at 500 hPa (courtesy of Wetterzentrale).

The Spanish Instituto Nacional de Meteorología provided images from a radar located at approximately 80 km from the study zone. The images show different cloud formations constantly crossing the sky over León, although at moderate reflectivity factors.

The result of this meteorological situation is summarized in Fig 2, which represents the total precipitation registered minute by minute in the city of León from 0000 GMT on the 22nd until 0000 GMT on the 23rd. Rain fell continually during the whole day, with two moments of particular intensity (from 1100 to 1140, and from 2225 to 2350 GMT).

III. RESULTS AND CONCLUSIONS

The optical disdrometer used in the city of León uses data on drop size and integrates them in intervals of one minute each. We have employed the transformations found by Brandes et al. (2002) and Park et al. (2005) to calculate the volume of a rain drop from its maximum diameter on the horizontal. It is thus possible to represent the intensity of the precipitation in each minute (it is similar to the derivative of the curve in Fig. 2). This intensity (with a better resolution than the curve in Fig. 2) is represented in Fig 3. In Fig. 3 we can see the two most intense precipitation events: the first, from 1100 GMT on, exceeded 25 mm/h; the second, around 2300 GMT nearly reached 40 mm/h.

Fig. 4 shows the size histogram of the rain drops registered during the whole day. The disdrometer registered nearly 10^6 drops in these 24 hours. The distribution can be seen to be approximately exponential, with very many small drops and very few large drops (only 3 drops of over 5 mm were registered, and they are not included in Fig 4). The parameter of the exponential is 2.75 mm^{-1}.

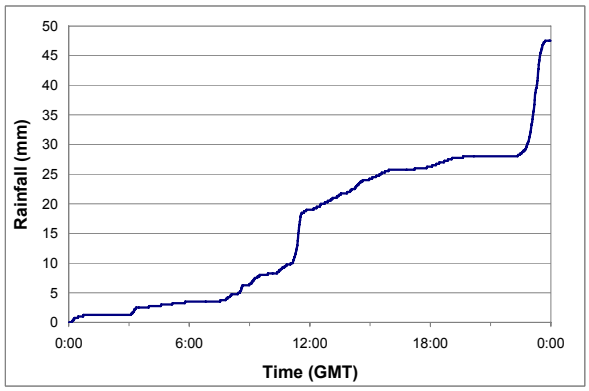

FIG. 2: Evolution of the total amount of precipitation registered.

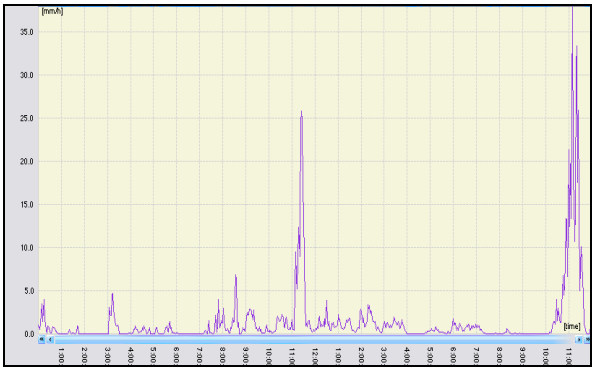

FIG. 3: Rain intensity during the 22nd October 2006.

The distribution does not remain constant during the day. Fig. 5 shows the temporal evolution (every five minutes) of the size spectrum in the two most intense moments mentioned above. There are variations in the total number of drops as well as in the size spectrum.

IV. ACKNOWLEDGMENTS

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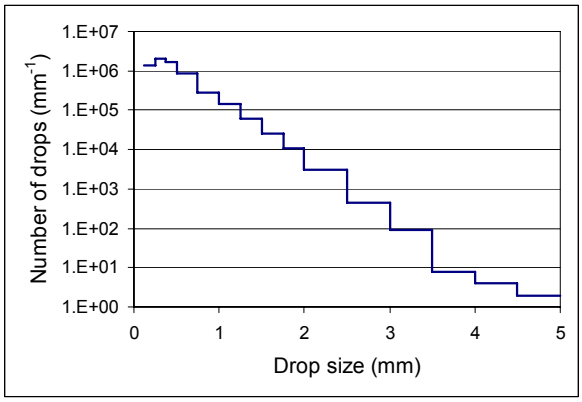

FIG. 4: Size spectrum of the drops registered during the whole day.

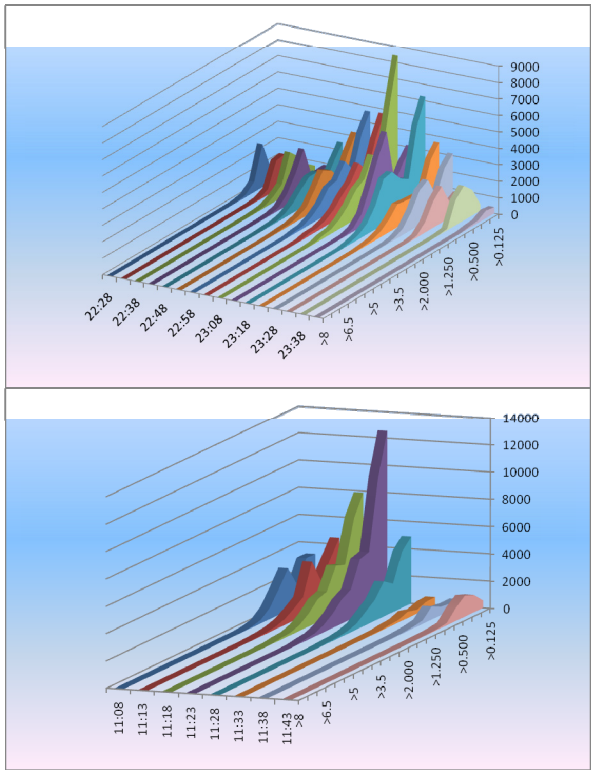

FIG. 5: Evolution of the size spectrum.

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