THE USE OF A HAILPAD NETWORK IN A METEOROLOGICAL SERVICE. A COMPARATIVE STUDY WITH OBSERVATIONAL DATA: 17TH SEPTEMBER 2007.

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I. INTRODUCTION

One of the biggest arable lands in Catalonia (northeast of Spain) is the plain of Lleida (fig. 1) with about 200.000 hectares of crops. At 17th September 2009, a storm heavily affected 889 hectares of fruit trees, the main production of the area. From 1990 the Associació de Defensa Vegetal - Terres de Ponent (ADV-TP), a local organisation for crop protection, is working to collect information of hail events and damages. In 2001 they built a hailpad network in this arable land with 170 hailpads distributed every each 16 square kilometres (Fraile et al. 1992). Thanks to this network different studies have been carried out (Aran and Peña, 2009; Mateo et al., 2009) at the Meteorological Service of Catalonia (SMC).

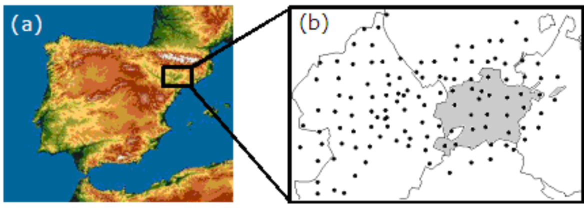

FIG. 1: (a) Iberian Peninsula (b) Hailpad network in the plain of Lleida. The area affected by the hail storm, El Pla d'Urgell, shaded.

In this study, some advantages and limitations of using a hailpad network for the analysis of the spatial distribution of hail fall and its characteristics are presented. The analysis is based on the 17th September 2007 hailstorm. The synoptic and mesoscale characteristics of this event are analysed by Pineda et al. (2009). The second section shows a summary of the climatology of the last years of the hailpad database in the plain of Lleida and the main characteristics of the hail fall for this event. In the third section, some details of the planning for the ground survey carried out only few days after the hailstorm and the result derived from are presented. In the fourth section, there is the comparative study between the ground survey and the hailpad information of this event. In the fifth section, it is shown the usefulness of using radar product to analyse hail storm such as probability of hail (POH) and also its limitations. Finally, the last section includes the main conclusions.

II. HAILPAD DATA

The hailpad database used is from 2001 to 2007 with a total of 82 hail events. According to this data, April is the month with bigger areas affected by hail however the diameter is lower than 2 cm. In May, June and July the diameter can achieve 4 cm. September is a month characterised by a lower number of hail events and by hail with a diameter lower than 2 cm. According to this, the 17th September of 2007 was an extraordinary episode, the hail surpassed 5 cm and the number of hailpads affected were 81 when the average is 10 hailpads per event.

It can be seen in figure 2 the area with higher diameter is in south, whereas the maximum intensity is displaced to the north. This dissociation was also found by Fraile et al. (1992).

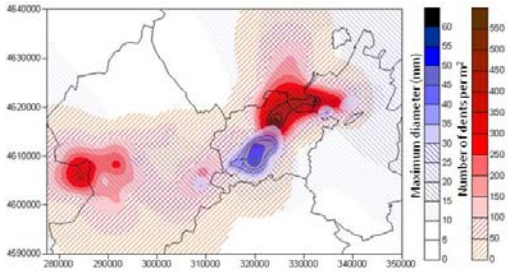

FIG. 2: Maximum diameter (blue scale) and number of dents per square metres (in red) in the plain of Lleida in the 17th of September of 2007 hail episode.

III. GROUND SURVEY

To obtain observational data from spotters or witnesses of the heavy storm, a ground survey was done. The proceeding followed was: (i) Identifying the affected area by means of mass media. (ii) Contacting to the affected people by telephone to have a previous report. (iii) Planning the visit starting from the inner part with big damages and ending to the external areas where the impact was low. (iv) Visiting the area and carrying out some interviews to obtain more detailed information (evolution of the storm, type of precipitation, size and intensity of the hail, other phenomena, description of the damages) and in some cases taking photos or collecting useful debris. In total, 11 interviews were done. From this information, a map with 5 zones defined according to a degree of affectation was elaborated, ranged from 0, no damages, to 5, big diameter or high intensity with important damages (Fig. 3).

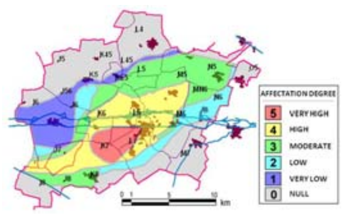

FIG. 3: Map of the degree of affection according to the information obtained from the ground survey in El Pla d'Urgell .

IV. COMPARATIVE ANALYSIS WITH HAILPAD NETWORK

In order to compare the quantitative information given by hailpads with the qualitative information of the ground survey it was used the ANELFA scale (Dessens et al., 2007) to categorize the qualitative information of the 5 zones (Fig. 3). Also, for each of the 5 zones it was chosen two of the closest hailpads. In figure 4, it is shown as an example, the comparison of the range of diameters observed with the ones marked in a hailpad.

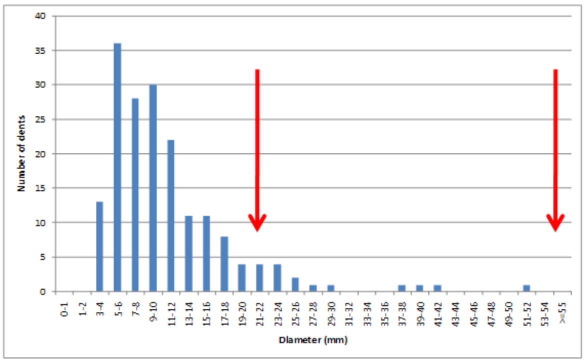

FIG. 4: Representation of the number of dents per diameter (mm) for the hailpad K6. The red arrows point at the maximum and minimum diameter observed by a witness of that area.

To evaluate the goodness of the visual observation with the closest hailpad, for each zone it was build a table of 3 factors (maximum size, range of diameters and intensity): 1-very good coincidence, 2-not bad and 3-low coincidence.

Variable	**Zone 1**	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**
Maximum diameter	2	1	1	1	1
Range of diameter	3	2	1	3	1
Intensity	3	2	1	1	2

TABLE I: Degree of coincidence (1-very good coincidence, 2-not bad and 3-low coincidence) for the observed maximum diameter, range of them and intensity of the hail fall in each area.

It can be seen in table I how spotters seem to put more attention when the event is important and the information given is closer to the obtained by a hailpad. In some hailpads, the maximum diameter recorded doesn't correspond to the observed one.

V. PROBABILITY OF HAIL

At the SMC since 2004 it is operating a probability of hail (POH) radar product (Aran et al., 2007). In the analyzed event the area with a probability of hail greater than 30% totally coincides with the area of the heaviest hail fall in El Pla d'Urgell (Fig. 5). The area of maximum diameter and higher intensity agrees with the maximum probability (higher than 90%). Although, the POH product is useful to determine the area affected by hail it doesn't give clear information about the size and intensity of the hail fall.

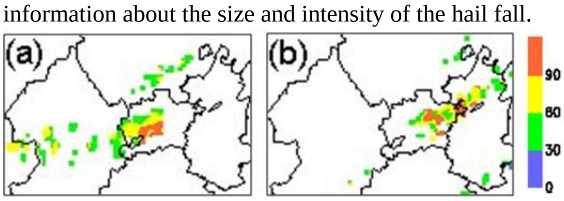

FIG. 5: Hourly composite map of the probability of hail radar product for the 17th September 2009: (a) 14 UTC and (b) 15 UTC.

VI. CONCLUSIONS

From the comparative analysis it can be concluded that the ground observers tend to perceive only the bigger hail stones in detriment of smaller ones even if the intensity is high. Also, it is important to point out a hailpad network doesn't give all the information about the hailstorm: bigger diameters are likely not to be recorded or in some events different storms can contribute to dent the same hailpad in the same day.

The main advantage of using POH product in surveillance is that it shows the probability of hail fall in a vast region. The cost of support a hailpad network with a high density of hailpad like the ADV-TP one is high and it cannot cover big extensions like the ones covered by a radar network. Another advantage of using POH product is that this information is available every 6 minutes with a delay of 15 minutes for processing the product. The main limitation of using POH is that no information about size and density intensity can be inferred.

The information given by spotters is very useful if it is taken following some basic recommendations such as to use common objects as references to describe it or taking photos, timing of the event, reporting other characteristic of the storm ... It is necessary to train spotters or give them some advise if not their information will be useless.

VII. ACKNOWLEDGMENTS

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