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Conference on European Tornadoes and Severe Storms

Relationships between surface hail observations and lightning activity in the upper part of the Ebro Valley (Spain) during the 1998 year.

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Studies on hail and lightning activity relationships show that many storms that produce relatively high flash rates and densities of positive ground flashes usually produce severe weather, with large production of hail, but more evidence is needed to establish this assertion. In this way, the work we present here is focused on the study of those relationships in the upper part of the Ebro Valley (Spain), where a cloud seeding campaign to suppress hail is carried out every summer involving 514 locations where hail occurrence is reported. Data used here correspond to the observations during the 1998 year.

A primary data base was created with the following information: day and hailstreaks observations number for different diameters, along with cloud to ground lightning counts (positives and negatives) detected by the spanish meteorological service (INM) in a window of 185 x 200 km^2 that includes the surveyed area. Also, for the 169 locations that reported at least one hailstreak during the campaign a second data base was created with the followings: day, size of the hail reported and lightning counts (positives and negatives) observed in a surrounding square window of 20 km side. Due to the size of windows used, first data base corresponds to a general analysis of the hailstorms and the second one to a local analysis.

Concerning the first data base we can report that lightning activity was measured in 33 days of 122 days of campaign with a mean density of 0.02 flashes km^{-2} day^{-1}. Hail was observed only in 9 days in which lightning mean density increased to a value of 0.05 flashes km^{-2} day^{-1}. Analysis of this data base suggest that there exists a minimum CG flash density for hail to be possible equal to 0.02 flashes km^{-2} day^{-1}. Moreover, in the four days when larger hail is reported (mean diameter $\geq$30 mm) this minimum increases to 0.04 flashes km^{-2} day^{-1}.

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When considering the positive lightning, we notice that there are days with hail and no positive CG flashes, but severe thunderstorm days (having hail observations with diameters $\geq$ 1.9 cm.) always do have them, being the minimum percentage measured 4%. Also, in the 9 days when hail was reported in the area mean percentage of positive flashes is 8.6%, while for severe hailstorm days this mean reaches 12%.

Finally, when focusing on the local analysis, we found similar results. Data show that hail occurrence probability increases with CG lightning counts, and this probability reaches 20% at 0.2 flashes km^{-2} day^{-1}. Concerning positive flashes, again, an increase in hail occurrence probability has been detected when the percentage of positive lightning increases. In particular, for windows that exhibit at least 0.2 flashes km^{-2} day^{-1} (in which average of positive lightning percentage is 8.2%), hail occurrence probability increases from 19% to 27% if percentage of positive flashes considered is under and above the average respectively.