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Discriminating downburst-producing and hail-bearing thunderstorms using total lightning and weather radar observations

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Different sources of information related to severe weather are available in Catalonia (NE Iberian Peninsula), giving actual observations (e.g wind gusts) or indirect data potentially useful as proxy data. The 170 Automatic Weather Stations network of the Meteorological Service of Catalonia (SMC) provide local observations of strong wind gusts A network of 50 hailpads covers an agricultural area in central Catalonia, giving information about hail size. Besides, social media has become a prolific source of information of severe weather events, providing geo-located pictures and comments. Finally, the information submitted by the net of meteorological observers spread around Catalonia and trained by the SMC is a trustful source of severe weather observations. Thus, by combining all the previous sources, it is possible to accurately select those episodes of severe weather in which moderate or large hail (more than 2 cm of diameter) or downbursts had affected Catalonia. Metzger and Nuss (2013) had developed a method to categorize hail-producing and downburst-producing thunderstorms by means of different type of data: radar parameters, sounding derived indices, and, mainly, the presence of “lightning jumps”, i.e. sudden increases in lightning flash observations, either in cloud-to-ground or intra-cloud data. The SMC operates a Total Lightning Location System that allows monitoring those lightning jumps, mainly associated to intra-cloud lightning.

A data base of severe events for Catalonia has been created and maintained by the SMC. This work presents the analysis of some relevant episodes of the database. Firstly, an evaluation of the sounding data has been carried out for each case study. Secondly, the remote sensing analysis has focused in the search for key elements in the radar products and in the satellite imagery, as well as in the categorization of the lightning jump, if present. First results are presented for some of the main events occurred in the region in the last years: July 2012 (severe hailstorm), September 2014 (one case with various downbursts and another with large hail), October 2013 (downburst), September 2007 (hail event), October 2006 (downburst), and August 2008 (downburst)

Metzger, E.L., and W. A. Nuss, 2013: The relationship between total cloud lightning behavior and radar-derived thunderstorm structure. Weather and Forecasting, 28, 237-253