1. INTRODUCTION

Lightning activity and convective precipitation are two related characteristics of thunderstorms, and their relationship can be used as a quantitative indicator of the rainfall regime.

The Rainfall-Lightning ratio (RLR) is the usual parameter for the estimation of the convective rainfall volume per cloud-to-ground (CG) lightning flash. Intense storms tend to produce lower RLR values than moderate storms, even if the RLR depends on the thunderstorm type and local climatology.

The objective of this paper is to analyze the relationship between precipitation and lightning in the North Western Mediterranean coastal region (see Fig. 1). The present study is a case-by-case study, using daily rainfall accumulations and total lightning information (intra-cloud and cloud-to-ground flashes).

According to the reviewed studies, the RLR is isolated thunderstorms take precipitation values between 35 and 72 10^3 m^3 per CG flash.

2. DATA SOURCES

2.1 Lightning and Radar Data

Lightning information was collected by the SMC SAFIR lightning detection system (hereafter XDDE). The network is composed by three sensors, covering the region of Catalonia, and its contiguous area (see Fig. 1). The XDDE stations combine an interferometric sensor to detect intra-cloud (IC) flashes in the VHF with a LP sensor to detect the return-strokes of CG flashes. The XDDE spatial accuracy is around 2-3 kilometers, and its efficiency around the 90%.

The weather radar network of the SMC is made up of three C-Band Doppler radar systems operating in a highly complex topography environment (see Fig. 1). The radar quantitative precipitation estimations (QPE) used in this study were originated from a volumetric short range scan updated every six minutes. A composite product was built by selecting the most intense reflectivity (Z) value available for each pixel.

2.2 Selected Days

In the studied region thunderstorms may take place the whole year, but the main lightning activity occurs from June to September. For this study 34 days were selected. These days contains more of the 75% of the CG flashes registered in 2005 over the study region. The final sample included days of May 3, June 6, July 4, August 11, September 5 and October 3.

3. RESULTS AND DISCUSSION

The results found applying the 4 different thresholds for the selection of the convective cells are shown in Table 2. It can be observed that the elimination in the comparison of the cells with a daily rainfall average of less than 2 mm reduces the convective cells in a 17%, while the reduction of CG flashes is only a 4%. When applying a threshold of 5 mm, convective cells were reduced in a 6%, and the rainfall volume is only reduced in a 4%. When applying a threshold of 10 mm reduces the convective cells in a 17%, while the reduction of CG flashes is only of the 34%.

Table 3. Coefficients of correlation (r) for a linear fitting between rainfall volume with different thresholds and lightning (intra-cloud, cloud-to-ground, positive CG and total flashes).

<table>
<thead>
<tr>
<th>Threshold</th>
<th>IC</th>
<th>CG</th>
<th>CG+IC</th>
<th>IC+CG</th>
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<tbody>
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<td>T1</td>
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</table>

5. SUMMARY AND FUTURE WORK

This study analyzes the relationship between lightning and precipitation in 34 days of the 2005 thunderstorm season in Catalonia (NE Spain) and its coastal area, in the NW Mediterranean Sea.

The Rainfall Lightning Ratio found in the studied region has a mean value of 58.9 10^3 m^3 per flash. These results agree in magnitude with other case studies in other regions.

The daily rainfall volume has been compared with different types of lightning available, being the best fitting with total lightning (IC+CG), followed by IC flashes, CG flashes and positive CG flashes.

From this analysis, it is clear that lightning data can be useful for estimating the locations and amounts of convective rainfall, when only lightning data is available. Meanwhile, rainwater volume per CG flash can vary much more from one day to another, and the RLR depends on factors like the season of the year, the convective regime, the storm intensity, etc. A good identification of the convective area of the storms would help to reduce such variability. In this sense, rainfall intensities could be calculated in the hourly rainfall estimations, and use such information afterwards to delineate the convective areas in the daily accumulations, more than using a daily volume threshold, which is mixing convective and stratiform rainfall.