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Relationship between convective precipitation and lightning activity using radar quantitative precipitation estimates and total lightning data

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Thunderstorms can be characterized by both rainfall and lightning. The relationship between convective precipitation and lightning activity may be used as an indicator of the rainfall regime. Besides, a better knowledge of local thunderstorm phenomenology can be very useful to assess weather surveillance tasks.

Two types of approach can be distinguished in the bibliography when analyzing the rainfall and lightning activity. On one hand, rain yields (ratio of rain mass to cloud-to-ground flash over a common area) calculated for long temporal and spatial domains and using rain-gauge records to estimate the amounts of precipitation. On the other hand, a case-by-case approach has been used in many studies to analyze the relationship between convective precipitation and lightning in individual storms, using weather radar data to estimate rainfall volumes.

Considering a local thunderstorm case study approach, the relation between rainfall and lightning is usually quantified as the Rainfall-Lightning ratio (RLR). This ratio estimates the convective rainfall volume per lightning flash. Intense storms tend to produce lower RLR values than moderate storms, but the range of RLR found in diverse studies is quite wide. This relationship depends on thunderstorm type, local climatology, convective regime, type of lightning flashes considered, oceanic and continental storms, etc.

The objective of this paper is to analyze the relationship between convective precipitation and lightning in a case-by-case approach, by means of daily radar-derived quantitative precipitation estimates (QPE) and total lightning data, obtained from observations of the Servei Meteorològic de Catalunya remote sensing systems, which covers an area of approximately 50000 km^2 in the NE of the Iberian Peninsula.

The analyzed dataset is composed by 45 thunderstorm days from April to October 2008. A good daily correlation has been found between the radar QPE and the CG flash counts (best linear fit with a R^2=0.74). The daily RLR found has a mean value of 86 10^3m^3 rainfall volume per CG flash. The daily range of variation is quite wide, as it goes from 19 to 222 10^3m^3 per CG flash. This variation has a seasonal component, related to changes in the convective regime. Summer days (July to middle September) had a mean RLR of 57 10^3m^3 rainfall volume per CG flash, while from middle September to the end of October the rainfall volume per CG flash doubles (mean of 125 10^3m^3 per CG flash).