



## **Multilinear approach to the precipitation-lightning relationship: a case of study in the northern part of Spain during local summer electrical storms of 2002-2009 period**

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In this work we analyse the precipitation-lightning relationships in electrical storms of the Spanish Basque region occurring under local atmospheric flows during 91 summer days in the 2002-2009 period, and develop a new method that consists in a multilinear approach to estimate daily total rain in a rain gauge network using lightning measurements. Local data related to 22 different observatories of a rain gauge network, corresponding to daily rainfall depths and cloud to ground lightning counts 10 km around, permitted to analyse the spatial variations of those relationships. We found a general mean tendency of the precipitation/lightning ratio for the whole period but also observed the existence of different rain yields values in different days and observatories. We analysed the difference between the collected rain depth and the value given by the general tendency that relates lightning and rain, using PCA method. PCA results showed a first axe explaining 50% of the variability that related all local rainfall differences observed each day in the whole network. According to that, we could estimate daily differences between observed rain and expected value from lightning counts in the whole network using only a representative observatory. This permitted to develop a multilinear expression to estimate daily rain depth measured in every observatory, based on the main precipitation/lightning tendency and rain measured in a representative observatory. In particular, we found that rain depths estimations obtained this way accurately fit total rain cumulated in the whole network. Hydrological applications of this method are obvious, since it permits to estimate total precipitation during strong convective events based on a unique rain observatory and the lightning counts around.