Lightning is less frequent in winter, but is much more noticeable than in summer

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"Study of lightning rays in the Basque Country, and their relation to precipitation" is the title of the PhD thesis that physicist Joseba Areitio presented at the University of the Basque Country (UPV/EHU). In fact, since systems for the detection of these rays of lightning were developed in the 80s, the possibility of estimating the precipitation produced in a storm as a function of the rays generated therein has been an object of research.

With this known, it would suffice to know the distribution of rays of lightning in a geographical bowl or river basin in order to estimate the amount of rainfall they receive. Mr Areitio made his contribution to this line of research by gathering data from the Basque Country for which he made use of, amongst other resources, the Aemet (Spanish State Meteorology Agency) lightning ray detection network.

First of all, a study of the geographical distribution of rays in the Basque Country was carried out. Mr Areitio concluded that this is random, with an annual average value of one ray per square kilometre. Nevertheless, there is an exception: in the west of the Basque province of Bizkaia, annual value can be as much as two rays per square kilometre, and concretely in Greater Bilbao, the figure rises to three. This variation may be due to the effect of contaminants in the large urban areas. Moreover, the rays are more intense in the Bay of Biscay watershed (average of 35-40 kiloamperes) than in the Mediterranean one (25 kiloamperes). In any case, it is stressed that, generally, the number of rays and their geographical distribution show interannual and intermonthly variation,

resulting from the changes that take place in atmospheric circulation from one year to another.

Lightning and meteorological conditions

As regards the distribution of rays as a function of meteorological conditions, seasonal differences are remarkable. Concretely, storms in winter and at the end of autumn produce few but highly intense rays (70 kiloamperes), while the greatest number of rays in a year are concentrated in summer, but with much less intensity (25 kiloamperes). Also, during the winter period, the rays can fall at any time of the day. In summer, however, they concentrate predominantly in the afternoon, because the storms respond to the combination of intense daytime heating and cold air in the upper layers of the atmosphere.

On the other hand, in spring and at the beginning of the autumn the polarity and intensity of rays are half-way between those of winter and summer. Storms at these times occur regularly given the presence of isolated, high-altitude depressions, a phenomenon also known as the *cold drop*.

Precipitations by lightning

Finally, Mr Areitio studied the relationship between rays produced by storms and precipitation registered in the Basque Country. To this end, he used two types of techniques (subjective and objective) and compared his results to show that, effectively, the conclusions are similar. The data shows that, in winter, apart from the fact that the rays are more intense, each one of them corresponds to an amount of rainfall much greater than in summer.

Concretely, the thesis distinguishes between three fundamental types of

meteorological situations, as regards the relation between rays and precipitation. The first corresponds to winter-type storms, which also occur at the end of autumn and in spring. It is in this situation when the production of average precipitation per ray is at its maximum value in the Basque Country: seven million cubic metres per ray. At the other extreme are typically summer storms, associated with daytime heating and which are produced with weak winds. The production of precipitation per ray may reach values as low as 150,000 cubic metres per ray. The third and final type of situation, associated mainly with spring and the *cold drop* phenomenon, presents intermediate figures: one million and a half cubic metres of rainfall per ray for the whole of the Basque Country.

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