Periodicities of hail precipitation in France

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The wavelet analysis is a powerful tool appropriated for studying multiscale and non-stationary processes that occur in finite spatial and temporal domains. Its development began with Morlet and, since then, the wavelet transform (WT) has had better applications in Geophysics.

However, the characterization of hail precipitation is not exempt from difficulty, since it deals with phenomenon on a small scale, with elevated spatial and temporal variation. The extreme variability of the frequency and distribution of hail is attributed, among other things, to the same process of its formation. The conditions that influence hail formation span from air masses climatology to lower-scale factors such as orography, wind fields, concentration of ice nuclei or temperature. This last factor is important both from a point of view of convective activity as well as its influence in the height of the freezing point. Thus, it would be possible to do comparative analysis between time series of temperature and diverse hail variables; or, rather, to try to establish a relationship between periodicities found and phenomenon such as ENSO (El Niño, Southern Oscillation) or NAO (North-Atlantic Oscillation).

France is one of the European countries that is most affected by hail precipitation. Previous climatic studies have been done with the objective of characterizing the long-term variability of distinct variables of this hydrometeor that is present in the time series. These measurements are obtained using networks of hailpads distributed in French territory and managed by ANELFA. Berthet et al. (2011) observed the annual hail frequency in France, finding successions of three years with high values followed by three years of low values; this being calculated as the number of hailfalls per year divided by the number of hailpad stations that were in use during said year.

In the present paper, a wavelet analysis was carried out with the objective of detecting the possible existence of oscillations in the number of impacts of hailstones and to know the period in which they occur. In order to do so, the Continuous Wavelet Transform (CWT) was applied. A non-orthogonal wavelet function was chosen, which is useful for the analysis of temporal series in which slight and continuous variations are expected in the amplitude of the wavelet. The mother wavelet used is the Morlet wavelet, which consists of a plane wave modified by a Gaussian envelope.

The results show how, both in the Atlantic area and in the Midi-Pyrenees area, climatic periodicities are observed.