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Cluster analysis applied to the synoptic patterns of lightning wildfire days in Castile and León (Spain)

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Wildfires are the main disruptive and destructive agent in the natural environment of Castile and León region (Spain). Covering a total of 94225 km^2, and with a forest area of nearly 50000 km^2, Castile and León is one of the regions with the greatest forest mass in all of Europe. 8% of the fires that occur in this region are due to lightning strikes during thunderstorms, although in some years they represent more than 20% of the total burnt surface. During the period from 1985 to 2006, there were 376 wildfire days (WD) with 976 wildfires caused by lightning, covering more than 1 hectare.

The formation of storms requires the interaction of several dynamic and thermodynamic mechanisms on different scales. Convective systems depend primarily on large-scale processes that develop an adequate thermodynamic structure, whereas processes on a mesoscale act basically at the beginning of the convective phenomenon. The synoptic scale atmospheric patterns and their relationship with local weather play an important role in the occurrence of hailstorms, through its controlling effect on the formation of local thermodynamic regimes.

In this study we have made a classification at synoptic scale of the conditions of the atmosphere on the 376 WD that affected different areas in Castile and León. As a first step, a Principal Component Analysis in T-mode was carried out on the initial ensemble of meteorological fields, followed by a Cluster Analysis of the days, based on the retained principal component loadings. Days participating with similar loadings on the extracted components were clustered together. The seven atmospheric fields selected at low and mid-levels were the 850 and 500 hPa geopotential height and temperature and the 850 hPa relative humidity and horizontal components of wind.

The non-hierarchical CA was applied to a total matrix of 64 loadings of the 376 events. Four cluster elements were retained. The results make it possible to establish the atmospheric conditions which, at synoptic scale, favour the formation of convective events that lead to wildfires in the different zones of a region as extensive as Castile and León.