Atmospheric circulation patterns associated with strong wind events in Catalonia

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Although the advance of powerful computers has improved the outputs of meteorological models, a good synoptic classification (SC) can be very useful for long-range forecasting. In this way, the Servei Meteorològic de Catalunya (SMC) is working on elaborating an accurate SC for extreme events. Catalonia is a region affected by high impact weather, mainly strong wind (SW) and heavy rain events. Not far from now, this last winter happened one of the worst wind events with high social impact. Within the framework of MEDEX project SMC has been collaborating in improving the knowledge of these events. Following this line of work, the aim of this study is to characterise the SW events in Catalonia.

According to the guidelines of MEDEX project we have used its strong wind event database for the period June 1995 to May 2004. The used methodology is based on principal component analysis (PCA) and clustering techniques. In this study it was applied the PCA technique based on S-mode for SLP, temperature 850 hPa and geopotential 500 hPa. The semi-objective classification was carried out using the NCEP-NCAR reanalysis. Furthermore, a wind velocity matrix was also used to take into account some mesoscale aspects. These data were obtained from the automatic weather stations of SMC network. Then, cluster analysis was applied to the component scores to obtain the atmospheric patterns. At the end, a discriminant analysis was applied to the clusters to improve the classification and to evaluate its goodness. This methodology was applied to two geographical domains: the MEDEX domain (30N-48N; 9W-15E) and a synoptic domain (30N-70N; 30W-20E). The obtained results showed that the small domain was not enough suitable to discern the main low and high centres. On the other hand, the synoptic domain resolved better the main situation for each season.

The results obtained working with the synoptic domain show seven patterns. The strongest event is related to the Alps cyclogenesis and an anticyclone ridge in the Iberian Peninsula during winter (cluster 7). This pattern can also be identified with weaker synoptic configurations for summer in cluster 6 and for autumn and spring in cluster 2. The second strongest event (cluster 1) corresponds to a deep low in the North Sea and an anticyclone in the Azores. The synoptic situation of cluster 1 might be correlated with the previous days of the pattern of cluster 7. The cluster 4, the third of intensity, classifies the events linked to the pass of a frontal system. The clusters 3 and 5 correspond to westerly circulation, the first for autumn and spring and the second for winter. Finally, we also obtained a geographical wind distribution for each cluster.