HEAVY RAIN AND A TORNADO OUTBREAK DURING THE PASS OF A SQUALL LINE OVER CATALONIA

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I. INTRODUCTION

During the 13th of September of 2006 a squall line crossed the coastal regions of Catalonia (NE of Spain) causing heavy rainfalls and a tornado outbreak. In the central coast of Catalonia some waterspouts and tornadoes were observed. There was damage on roofs, walls and cars. Some cars were observed totally overturned and almost two trucks were displaced of their path.

The aim of this work is to characterize these types of situations and improve the forecast of convergence lines and their link with tornado outbreaks.

II. PRESENTATION OF RESEARCH

For the study of this episode were used satellite and radar images, rawinsonde data and automatic weather stations of the Catalan Meteorological Service.

On the 13th of September, from the images of water vapour, it can be seen a trough situated on the south part of Catalonia that crossed it from SE to NW. It was associated to a low with its curvature vorticity centre centered in the SE of the Iberian Peninsula (figure 1).

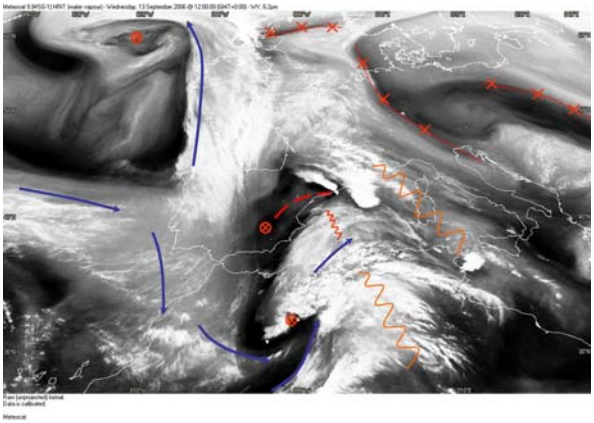

FIG. 1: Reanalysis using water vapour image at 12 UTC of 13th September 2006. Jet streak (solid blue line) and relative winds (narrow blue line), temperature at 500 hPa (dashed red line), vorticity centre (red circles) and ridge axis (orange).

From the objective analysis this short wave can be observed at all levels. The main flow was from east in the previous hours and reinforced and baked to southerly during the pass of the trough. This SW wind led the translation of the squall line.

At surface level, there was an important contribution of humidity during the previous hours of the episode. Between 00 UTC and 06 UTC, a low formed in front of Catalonia's south coast. Due to its position and the peculiar topography of the zone a line of wind convergence was generated. Along this line grew the first convective cells that later moved from SW to NE.

When the squall line arrives to the delta of Llobregat river (Catalonia's central coast), a tornado outbreak took place. There is only 10 km from that area to rawinsonde station of Barcelona. Although the event was about 10:30 UTC, rawinsonde data at 00 are more representative to carry out the instability indices analysis (figure 2). Instability indices has been compared with other tornado events near the area of study (Gayà M. et al 2001).

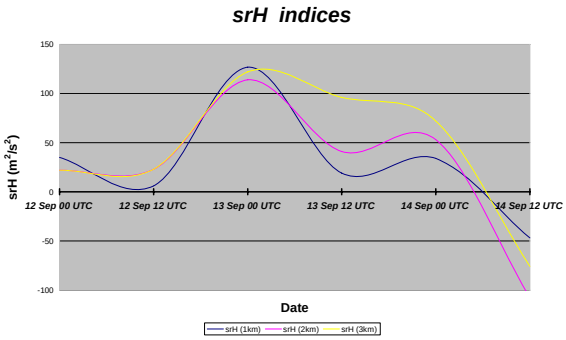

FIG. 2: Evolution of srH indices (1 km, 2 km and 3km) during the 12th, 13th and 14th of September of 2006.

It has been emphasized the importance of the presence of horizontal shear of winds around the squall line in the development of the episode (Caruso J. M. et al 2005) and the importance of the topography of the area in the process of generation of the tornado outbreak; a tornado outbreak was observed on the same place in 2005 (Bech J. et al 2006).

Radar data was analyzed to study the structure and movement of the convective cells (figure 3).

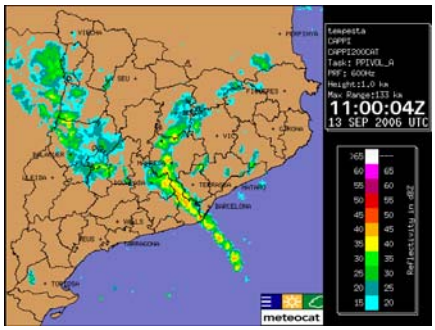

FIG. 3: Radar image at 11:00 UTC of the 13th September of 2006.

III. RESULTS AND CONCLUSIONS

The formation of a low in front of Catalonia's south coast was the cause of the generation of a line of convergence winds due to the peculiar topography of the zone.

On the subject of the formation of the tornado outbreak, it is important to emphasize that the level LFC was relatively low and CAPE in the first 3 kms was high, consequently the updrafts were important in the lowest levels. The vertical shear of the wind before the arrival of the squall line reached values of srH (0-3 km) of 122 m^2/s^2.

IV. AKNOWLEDGMENTS

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V. REFERENCES

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