A SYNOPTIC AND MESOSCALE DIAGNOSIS OF A TORNADO IN CASTELLCIR, CATALONIA, ON 18TH OCTOBER 2006

M. Aran[1], J. Amaro[1], J. Arús[2], J. Bech[1], F. Figuerola[1], M. Gayà[3], E. Vilaclara[1]

1 Servei Meteorològic de Catalunya, Spain, maran@meteocat.com
2 Instituto Nacional de Meteorología, Centre Meteorològic a Catalunya, Spain
3 Instituto Nacional de Meteorología, Centre Meteorològic a les Illes Balears, Spain

(Dated: September 12, 2007)

I. INTRODUCTION

On 18th October at 11 UTC a mesoscale convective system grew in the south part of Catalonia (north-east of Iberian Peninsula) and crossed it from south-west to north-east. It wasn't until two hours later that a squall line developed. At that time, a tornado was reported in the village of Castellcir (about 50 km North from Barcelona city). Although witnesses were very close to it there wasn't personal damage. The site survey indicated a track about 5 km long in a forest area. After the tornado, further to the north-east, a downburst caused some damage in farms and greenhouses.

Tornado events are quite frequent in Catalonia (more than 25 were observed from 1991). Some studies have been carried out by other authors near this area (Homar et al. 2003; Gayà et al. 2001; Martín et al. 1997; Bech et al. 2007). The aim of this study is to characterize this event to provide a potential useful input for forecasting similar situations. To achieve it, firstly, a synoptic study is done using ECMWF analysis and water vapour satellite images. Afterwards, mesoscale features are detailed using satellite and radar images, rawinsonde data and automatic weather stations.

II. SYNOPTIC AND MESOSCALE ANALYSIS

The synoptic environment in this area was similar to other cases studied, such as the one presented by Homar et al (2001). A deep low was situated over the west part of the Iberian Peninsula. Over Balearic Islands, there was a negative tilted ridge and over Catalonia the wind field was diffluent (figure 1).

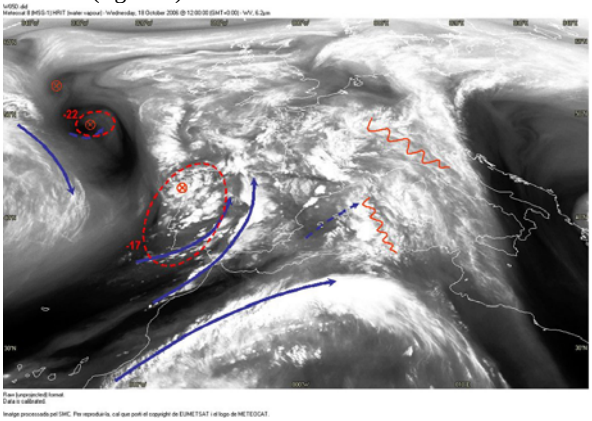

FIG. 1: Reanalysis using water vapour image at 12 UTC of 18th October 2006. Jet streak (solid blue line) and relative winds (dashed blue line), temperature at 500 hPa (dashed red line), vorticity centre (red circles) and ridge axis (orange)

At mid and low levels, a thermal ridge was centered over the Western Mediterranean area as it can be seen at 850 hPa (figure 2). At surface, the low was over north-west Spain, and only a relative low appeared at the Tunisia coast. Easterly winds were flowing in the affected area and, as a result, moist and relative warm air was impinged over the southern part of the Catalonia coast.

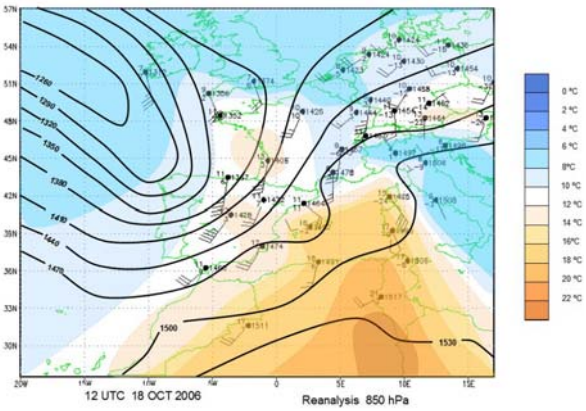

FIG. 2 Reanalysis of the geopotential (black lines) and temperature (colour scale) at 850 hPa

The mesoscale study should allow to determining where and when convection developed. First, instability indices obtained with rawinsonde data (see table I) yielded expected values for this kind of events in Catalonia (Romero R. et al, 2007).

	CAPE (J/kg)	LR7050 (ºC/km)	PRW85 (mm)
Barcelona 00	97	4,8	19,1
Barcelona 12	868	6,3	16,2
UIB Climatology	100-200	6,4-6,6	13-14

TABLE I: CAPE (J/kg), Lapse Rate 700/500 hPa (LR7050 in ºC/km), Precipitation Water sfc-850 hPa (PRW85 in mm) for rawinsonde data of Barcelona at 00 and 12 UTC of 18th October 2006 and climatology data from UIB (Romero et al. 2007).

The analysis of operational radar observations didn't indicate clearly supercell features. However, a comma shape was observed in the PPI radar product in the same area and time where the tornado was reported. Doppler data showed wind shear but not evident signs indicating a clear mid-level mesocyclone vortex.

In the area of this study, there isn't any automatic weather station closer than 10 km. The distribution of

surface temperature shows the warm advection. However, because of the complex topography, no thermal boundary was found in the area of interest. Half and hour before the tornado event and 30 km far west, the convective cells associated to the squall line produced westerly gusts.

III. CONCLUSIONS

Although the synoptic ingredients weren't the most appropriate for triggering deep convection, some mesoscale factors allowed the development of a convective cell that produced a tornado.

The complex topography and the lack of nearby surface observational data didn't allow determining for sure the local triggering mechanism. Unfortunately, two operational radar located at 40 km from the studied area suffered attenuation due to the rainfall. However, they provided some details of the echo and wind field structure, indicating a comma shape and evident signs of wind shear. Further analysis of the data available will complete the present study of this tornado event.

IV. ACKNOWLEDGMENTS

The authors would like to thank N. Pineda, L. Trapero and T. Rigo of the SMC for their help in providing lightning and radar data.

V. REFERENCES

Bech J, Gayà M., Aran M., Figuerola F., Amaro J., Arus J., 2007: Tornado damage analysis of a forest area using site survey observations, radar data, and a simple analytical vortex model. (presented in this meeting).

Gayà M., Homar V., Romero R., 2001: Tornadoes and waterspouts in the Balearic Islands phenomena and enviroment characterization. *Atmos. Res.*, 56 253-267.

Homar V., Gayà M., Romero R., Ramis C., 2001: A synoptic and mesoscale diagnosis of a tornado outbreak in the Balearic Islands. *Atmos. Res.*, 56 31-55.

Homar V., Gayà M., Romero R., Ramis C., Alonso S., 2003: Tornadoes over complex terrrain: an analysis of the 28th August 1999 tornadic event in eastern Spain. *Atmos. Res.*, 67-68 301-318.

Martín F., Riosalido R., de Estevan L., 1997: The Sigüenza tornado: a case study based on convective ingredients concept and conceptual models. *Met. Appl.*, 4 191-206.

Romero R., Gayà M., Doswell C. A, 2007: European climatology of severe convective storm environmental parameters: A test for significant tornado events. *Atmos. Res.*, 83 389-404