Convection-induced severe winds over Menorca Island 28th October 2018. Under the watch of a forecaster.

Catalina Estarellas*, David Esteban, Bernat Amengual, Miquel A. Gili, M. Ángeles Picornell

D.T. Illes Balears – AEMET *cestarellasm@aemet.es

ABSTRACT

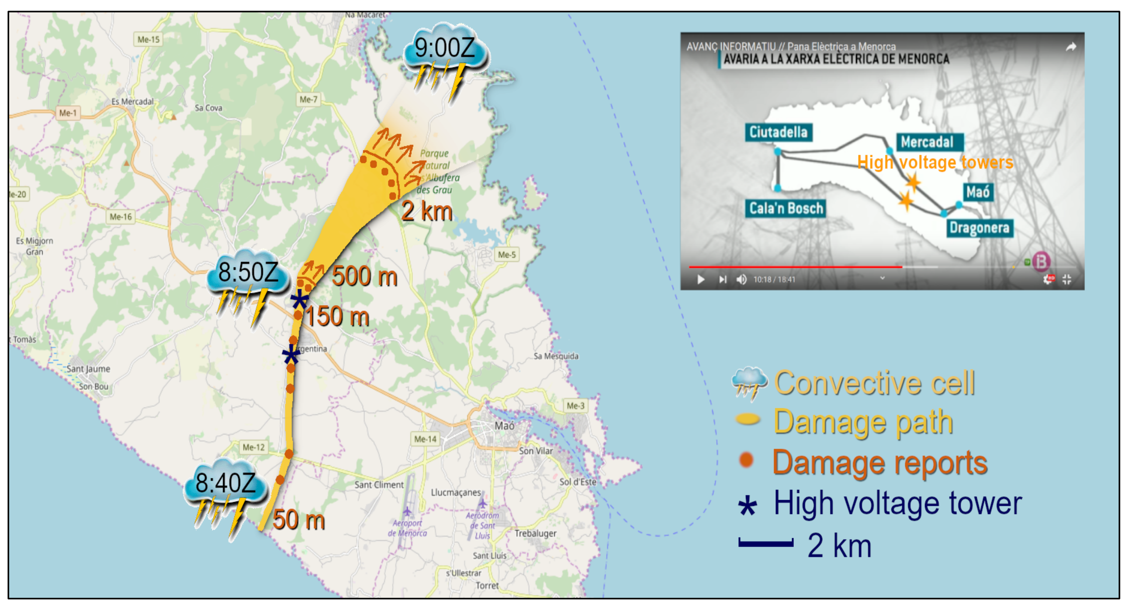
In the morning of 28 October 2019 a severe thunderstorm crossed Menorca Island from south to north producing very strong winds and tornado-strength damage including the collapse of four high voltage towers and a subsequent wide blackout which last for 72 hours. Wind gusts up to 140 km/h were estimated through a comprehensive field study, which concluded that both microburst and tornado phenomena could be responsible for the observed damage.

The present study explores this event of severe weather under the perspective of an operational forecaster, from diagnosis and synoptic analysis to monitoring current conditions and nowcasting.

The event of violent winds occurred during a strong cold outbreak that took place over western Europe from 26th October. Heavy rain and thunderstorms occurred within several instability lines associated with the passing of the cold front. We discuss the nature of the thunderstorm that produced high-impact winds, which exhibit characteristics in common with supercells and multicells structures, and analyse the predictability of such a phenomenon with the current nowcasting tools.

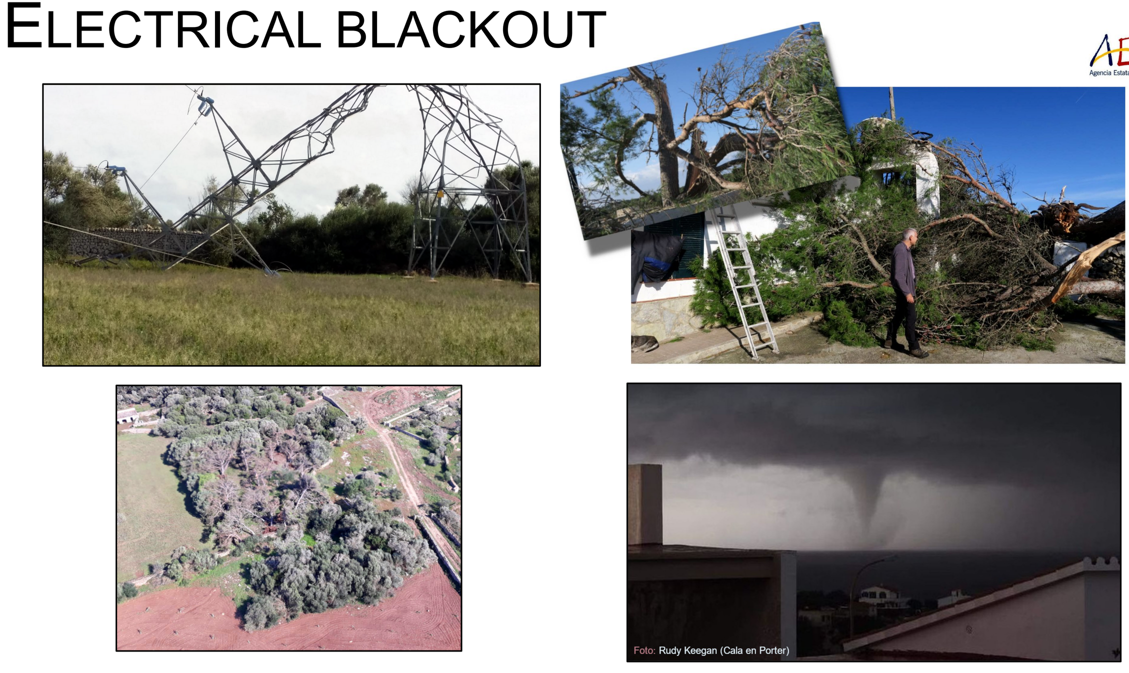
IMPACT

DAMAGE PATH



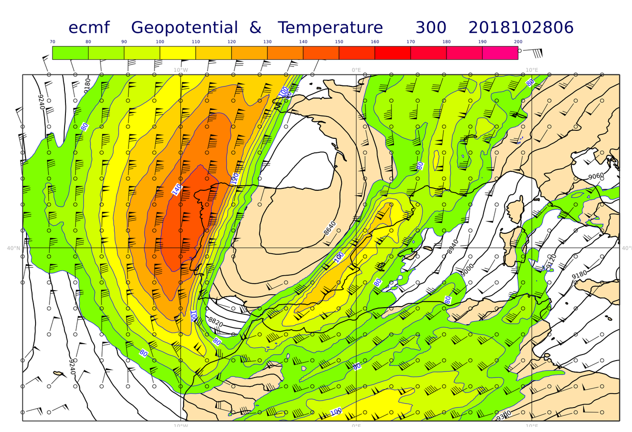
140 km/h Estimated maximum wind gusts (**F0 – F1** Fujita enhanced scale)

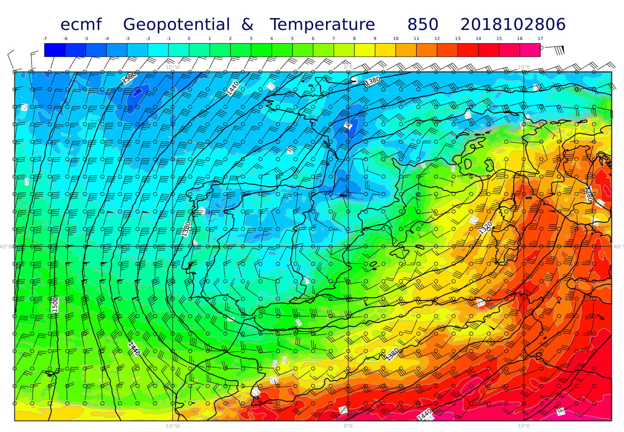
ELECTRICAL BLACKOUT



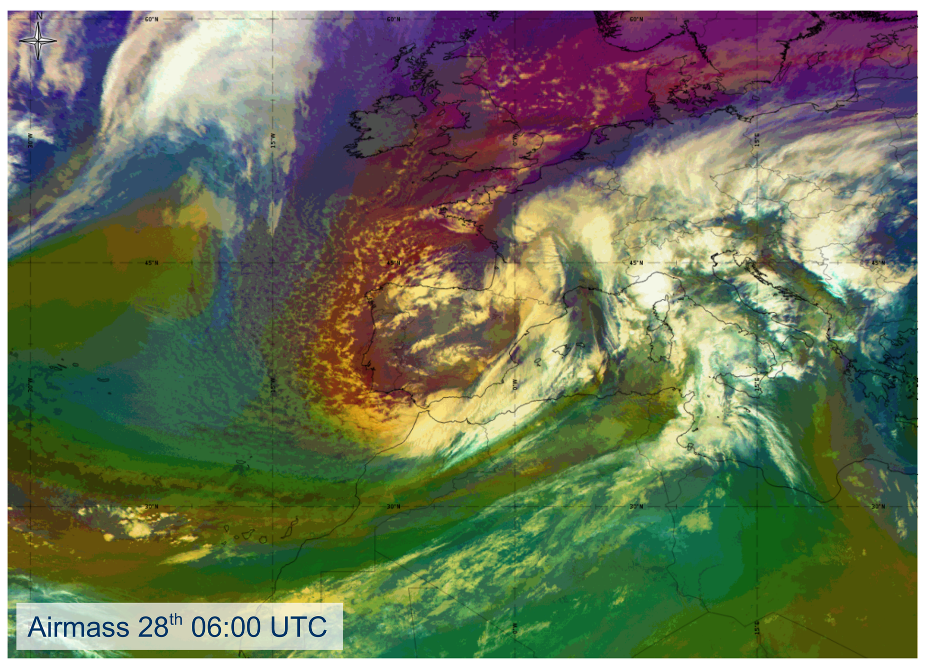
38.000 users without power suply and **thousands** felled trees by the strong winds

DYNAMIC and ENVIRONMENTAL CONDITIONS

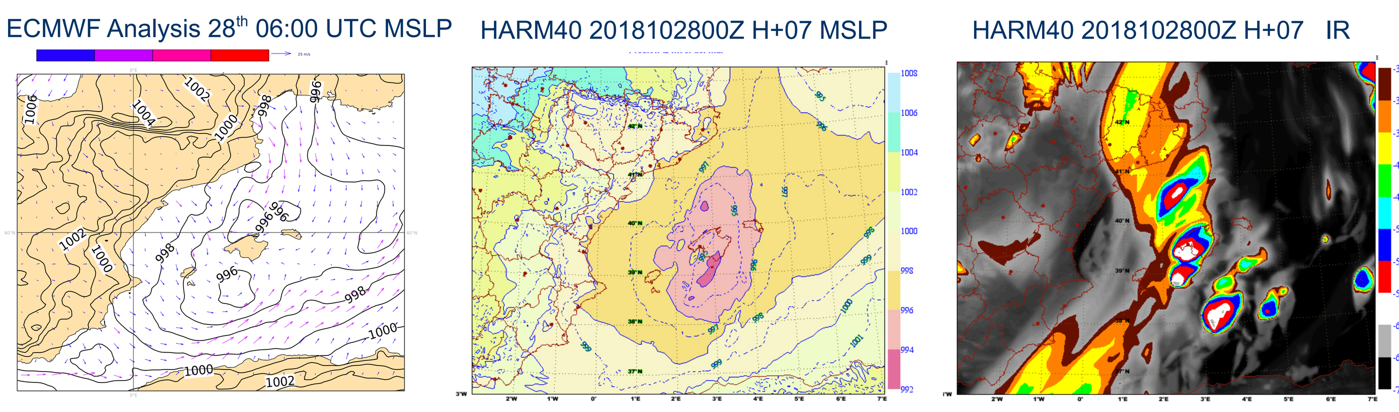




- Short wave trought with a cold core of -30ºC pushed by a 150 kt N-S oriented jet streak.
- Active cold front reaches the Mediterranean, were interaction of the incoming arctic air mass and subtropical one causes heavy rain and thunderstorms, at times organized.
- Severe wind event occurrs while the cold front passing.
- Jet streaks played a major role in steering cloud bands of deep convection.

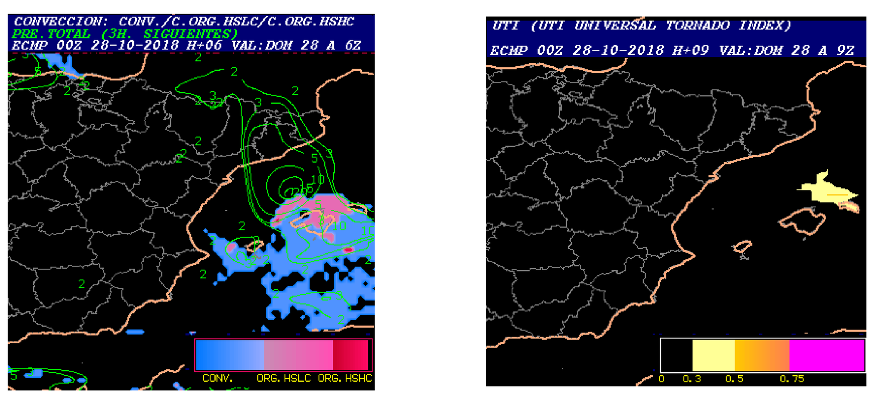

Airmass 28th 06:00 UTC

MESOSCALE



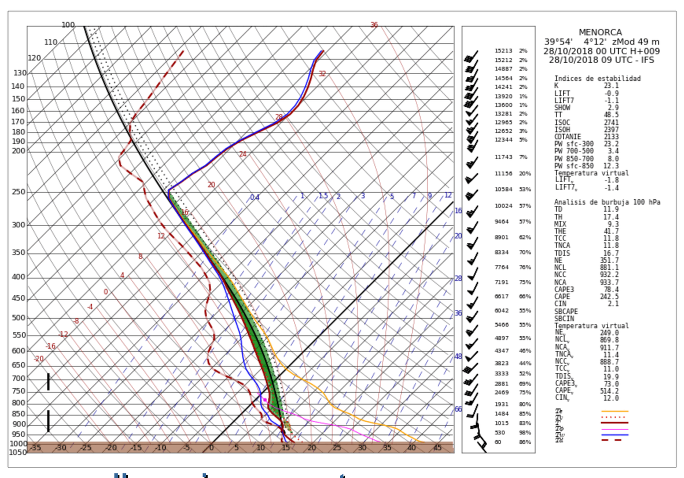
ECMWF analysis (left) showed a **mesoscale low** located just at the position where the convective system was first observed (S Mallorca). This structure was well captured by Harmonie-Arome forecasts (mslp in center and IR pseudo-image on the right). Meso-low and MCS moved together to the French coast in the next 6 h.

CONVECTIVE PARAMETERS



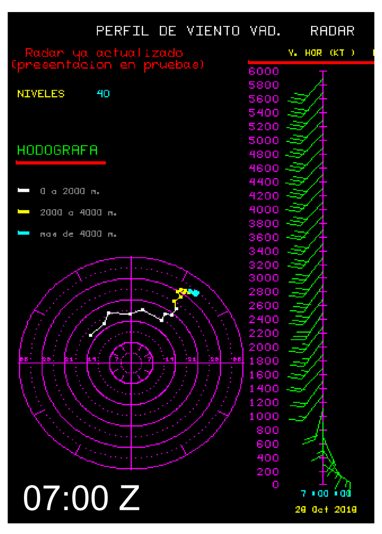
Convection indexes computed on the ECMWF forecasts showed favourable environments for organized convection and chance of tornadoes and supercells.

SOUNDING

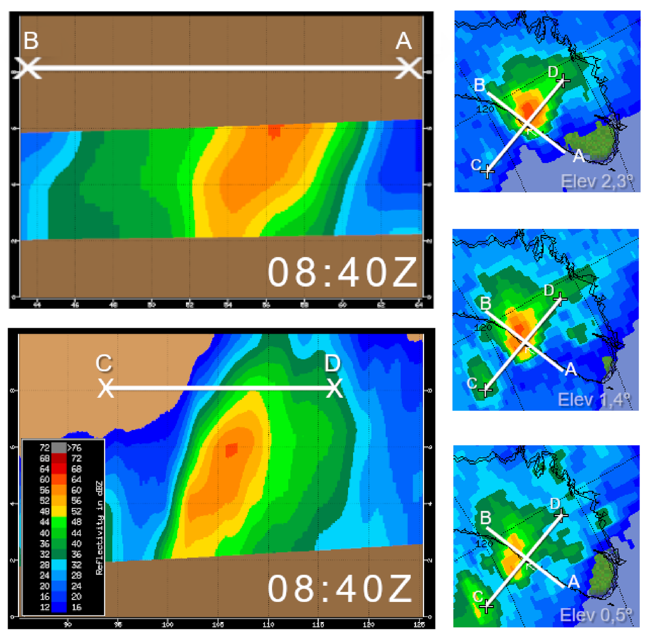


Supercell environment Spain (Quirantes et al. 2014)	ECMWF forecast
SBCAPE 200 J/kg	SBCAPE > 200 J/kg
CIZ6 9 m/s	CIZ6 31 m/s
SRH3 100 m²/s²	SRH3 170 m²/s²

RADAR FURTHER ANALYSIS



VAD WIND
High clockwise shear



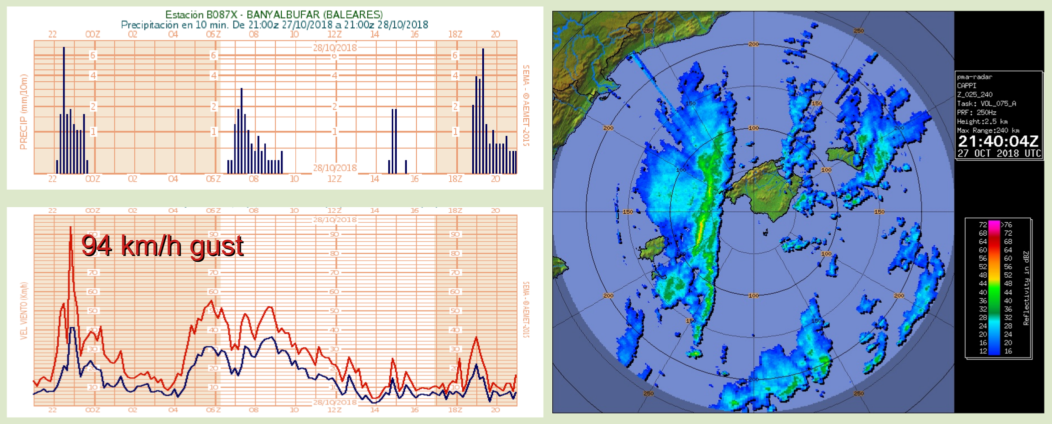
- Low level weak echo region (WER)
- Strong reflectivity gradient at the low-level inflow
- Maximum reflectivity located at mid-levels, over the WER
- Hook echo and bounded weak echo region difficult to identify

CONCLUSIONS

1. Categorizing a storm allows a forecaster to anticipate potentially hazardous weather, however, real convective structures are not always easy to classify and still have great potential to produce severe weather.
2. The following features were found to be related to the event of thunderstorm violent winds and hence can be used to anticipate severe weather:
   - IR images from satellite: mesoscale convective systems. V-shaped clouds.
   - Interaction of convective systems leading to enhancement.
   - Radar images: rapid ascending and descending reflectivity cores. Sudden echotop rising.
   - Radar Doppler images: cyclonic signatures in the velocity field are precursor indicators of the severity of thunderstorms.
3. Proposal for development in nowcasting techniques: since thunderstorm mesocyclones and downbursts can be detected in radar Doppler (as high shear in azimutal and radial directions, respectively), an automatic detection algorithm of such structures would help in anticipating severe weather (ATAP-AEMET used to have projects in that sense).

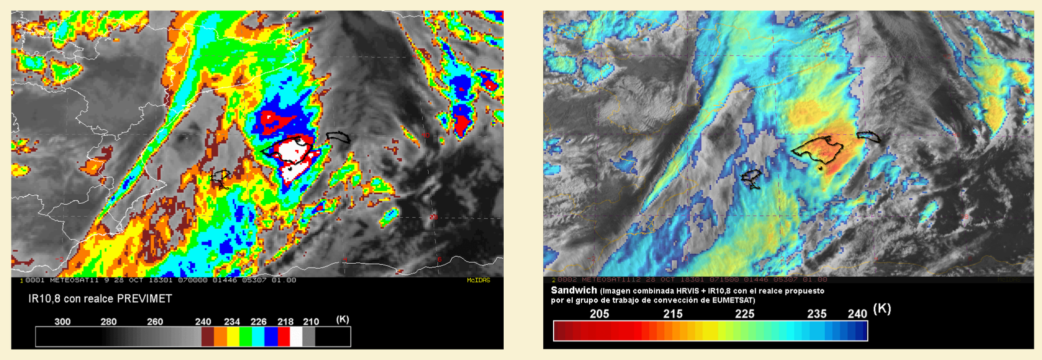
MONITORING & NOWCASTING

10 h before — Squall line over Mallorca: Gusts 94 km/h



Recordings of precipitation and wind of the Automatic weather station of Banyalbufar (NW Mallorca) (left images) and radar image of CAPPI0 on the right.

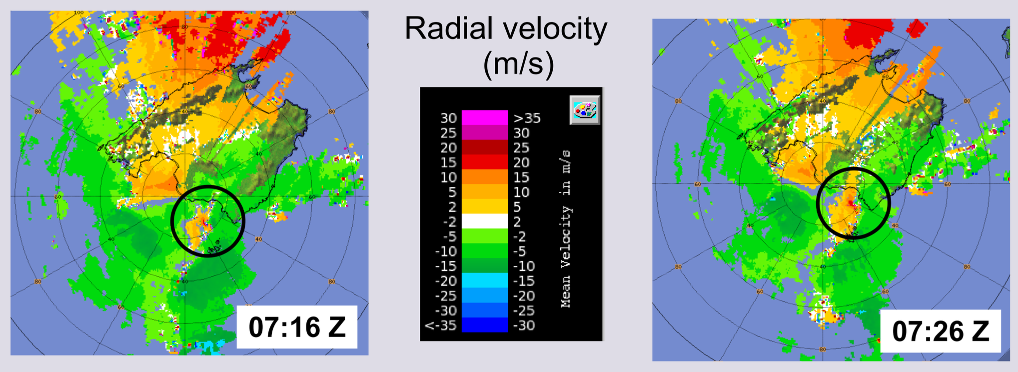
2 h before — V-Shape convective system



- Overshooting tops
- Moving NE (Rapid Development Thunderstorm algorithm not shown)
- Long lived (more than 6 h)

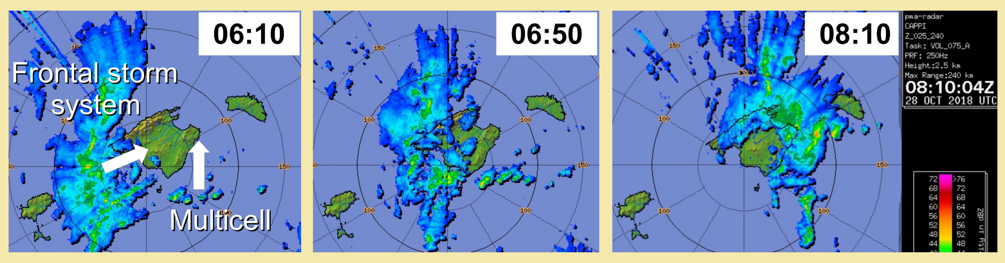
This cloud top temperature pattern is frequently seen in thunderstorms that produce tornadoes, hail, strong winds, and intense up and downdrafts.

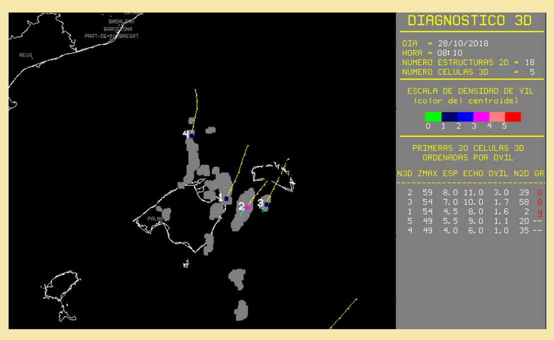
1.5 h before — Cyclonic signature in radar Doppler



- Prompt of a supercell mesocyclone
- It isn't a tornado guarantee but reflects thunderstorm organization (90% of supercells are related to severe weather)

30 min before — Merging of structures and rapid intensification



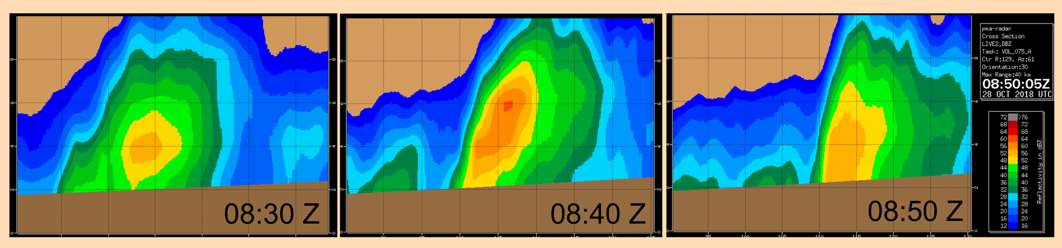


After interaction:
- **Echotop** 10 ⟶ 12 km
- **Zmax** 48 ⟶ 59 dB
- **VIL** density reaches 30kg/m²

Cell desplacement towards Minorca

Social Media issues — Tweets from AEMET and 112

08:40-09:00 UTC CONTACT — Rapid elevation and collapse



- Rapid elevation and collapse of maximum reflectivity
- Collapse occurs simultaneously with the observed downburst