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

DYNAMIC and ENVIRONMENTAL CONDITIONS
- Short wave trough 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 occurs while the cold front passing.
- Jet streaks played a major role in steering cloud bands of deep convection.

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 (right). Convection indexes computed on the ECMWF forecasts showed favorable environments for organized convection and chance of tornadoes and supercells.

SOUNDING

ECMWF forecast

Radar further analysis

- 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

Meso-scale and MCS moved together to the French coast in the next 6 h.

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 azimuthal 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 CAPPI on the right.
- CIZ6

2 h before
- V-Shape convective system
- Overshooting tops
- Mixing NE (Jardine Development Thunderstorm algorithm not shown)
- Long lived (more than 6 h).

1.5 h before
- Cycnlic signature in radar Doppler
- It isn’t a tornado guarantee but reflects thunderstorm organization (90% of supercells are related to severe weather)

0.5 h before
- Merging of structures and rapid intensification
- Social Media issues
- Tweets from AEMET and 112
- Rapid elevation and collapse
- After interaction:
  - Echo top: 10 km
  - Zmax: 48 59 dB
  - VIL: dorsally reaches 30 kg/m²
  - Cell displacement towards Minorca

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