The influence of synoptic weather patterns in supercell formation in Spain

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1. INTRODUCTION AND GOALS
✓ Supercells are the most organized and complex type of thunderstorms.
✓ Large-scale circulation weather types (WTs) is one of the basics to understand the synoptic climatology and have been associated to local weather conditions (i.e. severe weather).
✓ This study aims to provide a full picture of the effect of different WTs in supercell formation and their spatiotemporal patterns in Spain.

2. DATA AND METHODOLOGY

Observed Supercells (Tiempo.com Network):
✓ Database developed by a supervised citizen science project (Martín et al., 2020).
✓ More than 100 confirmed supercells and more than 600 medium-high confidence supercells.
✓ Continuous records between 2014-2018.
✓ To confirm supercells: Doppler wind images or pictures/videos of the event.

Atmospheric data (NCEP/NCAR: Reanalysis 2):
✓ Period 1987-2018, 2.5 degree coverage, 6-hour to transform to daily average.
✓ 500 hPa Geopotential height (Z500).
✓ The data covered a wide area: 25ºN to 55ºN and 20ºW to 25ºE.

PCA Classification (daily timestep):
✓ Automated objective based classification (Lemus et al., 2019).
✓ Firstly a PC Analysis in S-mode and then a Cluster Analysis (CA), based to retain the principal component loadings.
✓ PCA transformed to six principal components, explaining >90% variance.
✓ PCA rotation Varimax and K-means clustering to Z500 data.
✓ Twelve different WTs (Figure 1).

3. RESULTS
✓ WT3, WT7 and WT10 are the most frequent circulation weather types for supercell formation (Figure 2).
✓ Supercells are less common in other WTs. However, WT1 is related to tornadic supercells in southwest of Spain, particularly during the cold semester.
✓ WT3, WT7 and WT10 are common summer synoptic patterns characterized by high-pressure systems.
✓ Supercell formation is related with short-wave troughs over Iberian Peninsula, particularly from May to September.
✓ Each WT has a different temporal pattern: WT3 is more frequent in June, WT7 in July and WT10 in August.
✓ The spatial distribution of supercell formation under these three WTs mainly concentrates in north-eastern Spain (Figure 3).

4. CONCLUSIONS
✓ A Circulation Weather Types classification was applied for providing a global picture of the influence of synoptic weather patterns in supercell formation in Spain.
✓ Caution is advised in the interpretation of the results, as the supercell data only covers five years (not representative for climatology).
✓ Three WTs outstanding above all: WT3, WT7 and WT10.
✓ The north-eastern of the Iberian Peninsula is the area with the highest supercell frequency, particularly, the Middle Ebro Valley (MEV) and the eastern most part of the Iberian System.

References: