D1969

The influence of synoptic weather patterns in supercell formation in Spain

Carlos Calvo-Sancho (1), Yago Martín (2)

(1) University of Barcelona, Department of Applied Physics, Spain (ccalvosancho@gmail.com)
(2) School of Public Administration, University of Central Florida, USA (ym@ucf.edu)

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: 25°N to 55°N and 20°W to 25°E.

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).

Supercell Spatiotemporal distribution for 2014-2018 period

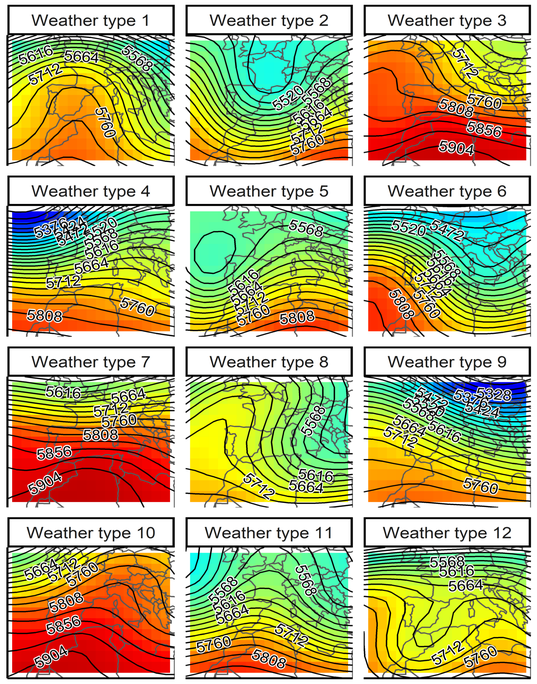

Figure 1: Circulation Weather Types Classification. Dashed: Z500 interpolation; contours: Z500 values.

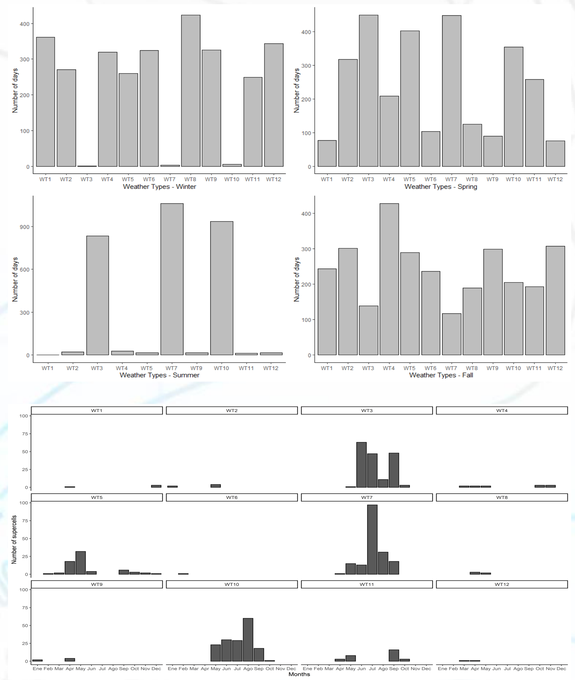

Figure 2: (above) Seasonal frequency of WTs; (below) SP vs WTs frequency.

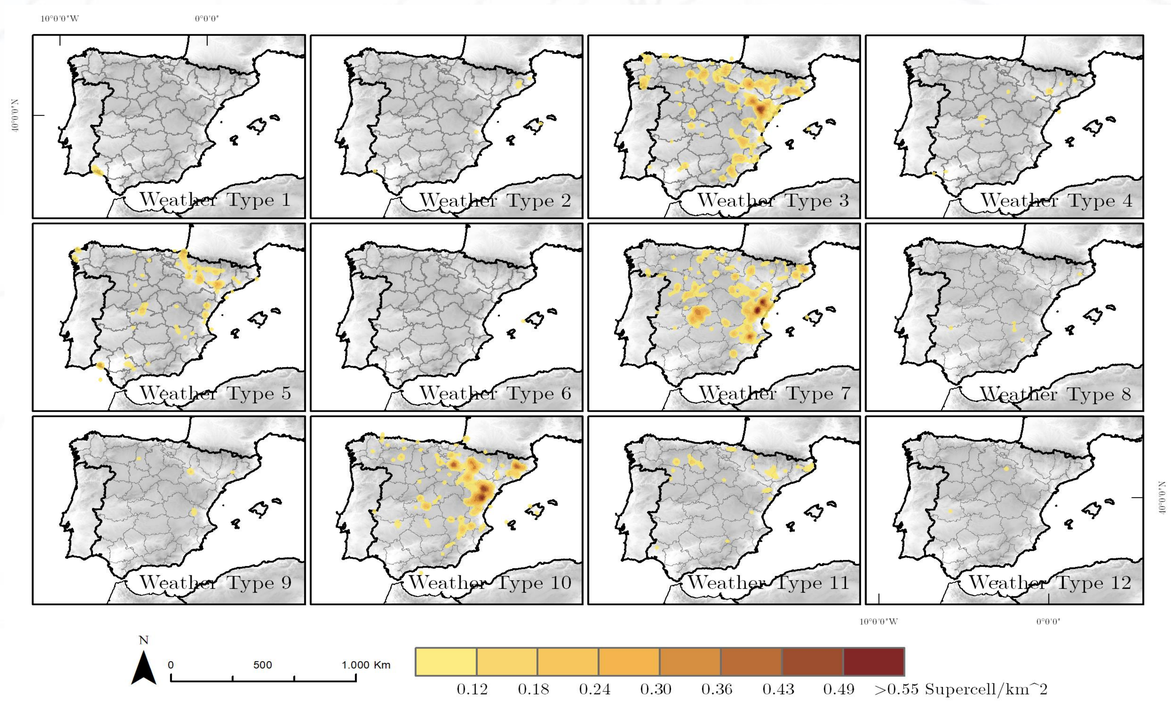

Figure 3: Supercell spatial distribution for individual weather type.

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 WT7 is the most frequent WT for supercell formation.
- ✓ 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:

Martín, Y., Cívica, M., and Pham, E. 2020. Constructing a database of supercells in Spain using publicly available PPI radar and citizen science. UNDER REVIEW in *Annals of the American Association of Geographers.*

Lemus-Canovas, M., Lopez-Bustins, J. A., Martin-Vide, J., & Royé, D. (2019). synoptReg: An R package for computing a synoptic climate classification and a spatial regionalization of environmental data. *Environmental Modelling and Software*, *118*(April), 114–119. https://doi.org/10.1016/j.envsoft.2019.04.006