



## **Objective assignment of precipitation and fronts to cyclones: application to extreme events on the Iberian Peninsula**

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Variability and predictability of extreme weather events are research topics for which significant advances are strongly demanded by the scientific community. The socio-economic impacts of these events as fatalities, properties damages, rebuilding and reinsurance costs are becoming critical in the context of ongoing climate change. Within this framework, precipitation extremes associated with extra-tropical cyclones that affect the Iberian Peninsula are considered in this study. The aim of this research is to provide for an automated methodology to objectively assign precipitation and atmospheric fronts to the corresponding cyclones in order to study the characteristics of winter storms associated with extreme precipitation in the Iberian Peninsula.

Firstly, a method to objectively assign the amount of precipitation to mid-latitude fronts at sub-daily basis is used (Hénin et al., 2018a). The method relies on the co-location of 6-hourly accumulated precipitation and fronts (both warm and cold fronts) inside a search box of predefined dimension. Results for the period 1979-2016 show that wintertime frontal precipitation accounts for up to 70% of total precipitation over the western European extremities. Secondly, an automated procedure is developed to objectively assign, at sub-daily basis, the fronts to the center of the parent cyclone. The approach is similar to the one used to relate precipitation and fronts: a search box is used to look for the cyclone center in the neighborhood of a frontal feature. A catalog of storms is obtained for the Northern Hemisphere from 1979 to date, based on mean sea level minima for cyclones' center's detection and on the nearest neighbor search for cyclones tracking (Trigo, 2006).

Results show that the assignment of fronts to cyclones is not always straightforward and it strongly depends on the different mechanisms driving the overall weather pattern. For example, local pressure minima may form in the edge of a pre-existing cyclone making ambiguous to state which cyclone each front is attending. Therefore, a subset of extreme events in Iberia is analyzed taking into account three different situations: precipitation extremes, wind extremes and compound events due to extreme precipitation and wind. Different precipitation sources, including the new ERA5 reanalysis product by the European Centre for Medium-Range Weather Forecasts (ECMWF) currently available from 2000 to date, are considered, according to the assessment of satellite-based estimates and high-resolution precipitation datasets over Iberia presented in Hénin et al. (2018b).

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