

Summer winds over the Iberian Peninsula related to thermal low conditions from COSMO-REA6 (1995-2018) high-resolution reanalysis

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Introduction

Regional winds are those generated by short-scale processes, both spatial (in the range of hundreds of kilometers or less) and temporal (from seconds to days) [1]. Due to its complex topography, the **Iberian Peninsula** presents numerous regional winds [2]. There is little literature about regional winds in the Iberian Peninsula, and most of it is written in Spanish.

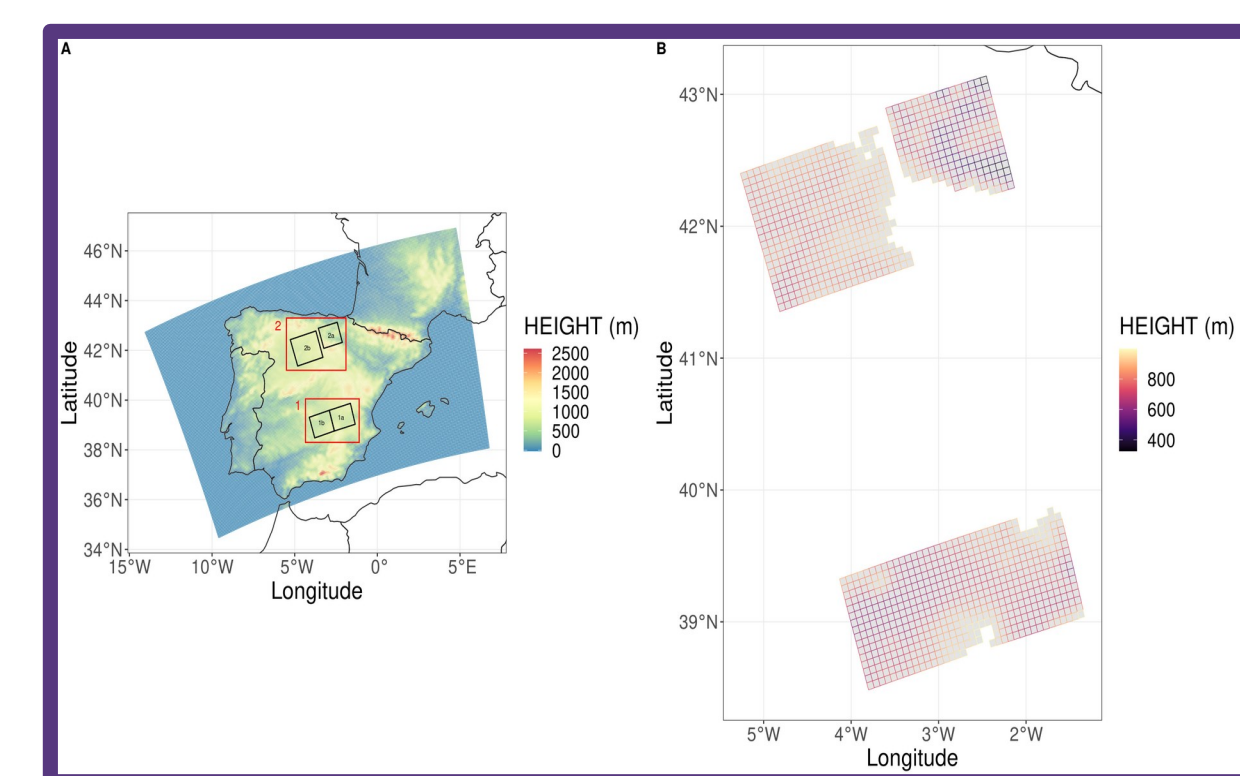
Among them, the **Solano** wind is defined in the *Dictionary of the Spanish language* as "the wind that blows from where the sun rises", that is, from the east; "solano" means "sunny" in Spanish. Broadly speaking, it is considered an **easterly wind**, sometimes from the southeast, that appears in various regions from the Iberian Peninsula. More specific information can be found in local articles and books, where Solano is commonly defined as an **east-southeast wind system that occurs in summer** in the central Iberian Peninsula, specifically **Castilla-La Mancha and Extremadura** [3, 4].

A **thermal low** is a warm, superficial and non-frontal depression that forms over continental regions. These lows appear during summer months due to intense surface heating in arid or semi-arid areas with little surface evaporation. It is clear that the **Iberian thermal low** causes warm and humid air flows to enter the Peninsula inland, producing **winds from the east, the southeast and the north** [5, 6]. These are very close characteristics to those of the Solano wind, which appears in the **same months, areas and directions and with the same daily cycle**.

A high-resolution reanalysis, such as **COSMO-REA6 (0.055°)** [7], could describe regional winds precisely, as seen in [8] and [9]. The main objective of this work is to characterize for the first time the Solano wind in the central and northern Iberian Peninsula and relate it to the thermal low process that occurs in this area during the summer months.

Methodology

DATA: There are no wind sub-daily datasets for the Iberian Peninsula central region with adequate temporal and spatial frequency. However, high-resolution **COSMO-REA6 reanalysis** [7] is capable of describing regional winds in the Iberian Peninsula [9]. **Zonal and meridional wind components at 10 meters** to calculate wind speed and direction as well as **specific humidity at 2 meters** and **mean sea level pressure** have been obtained for the 1995-2018 period.



STUDY DOMAINS: Each area has been divided into two sub-zones and hourly ranges: in the **central Iberian Peninsula, eastern Castilla-La Mancha (7-12 UTC) and western Castilla-La Mancha (13-18 UTC);** in the **northern Iberian Peninsula, the Basque Country (7-12 UTC) and northern Castile and León (13-18 UTC).**

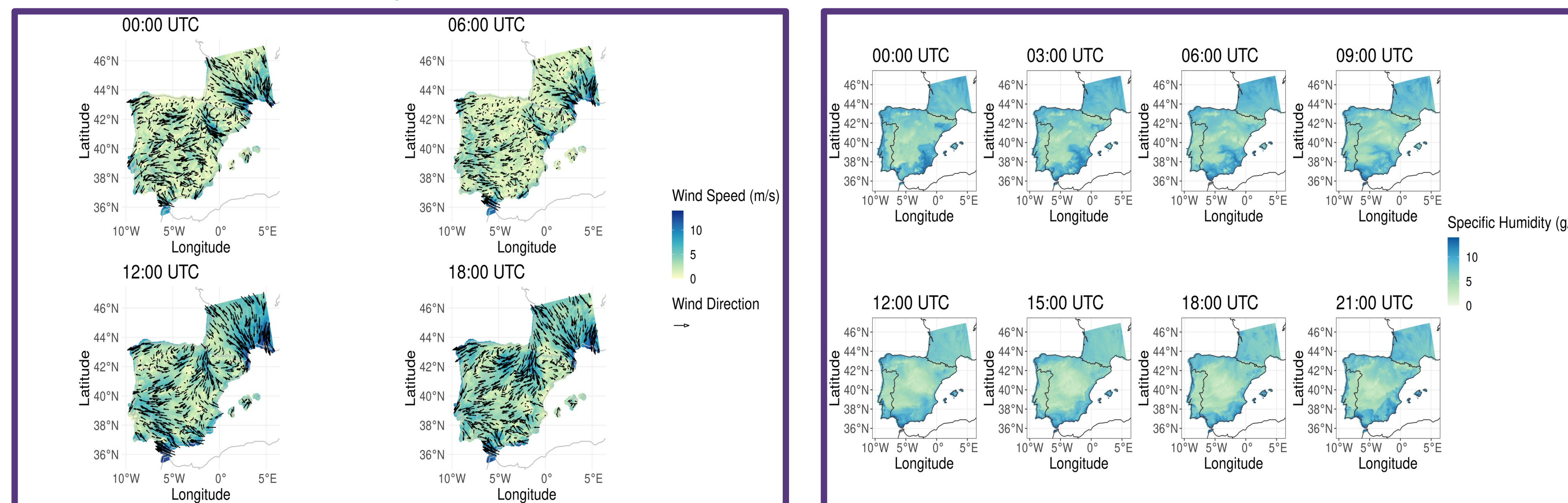
SOLANO DEFINITION:

- **Hourly wind speed restriction.** To examine that there is a considerable wind flow, its speed must always be greater than 3 m/s.
- **Hourly wind direction restriction.** In both sub-zones of the central area only east wind direction cells have been considered. In the Basque Country sub-zone, the wind is channeled from the north in the Cantabrian Mountains, so only the cells that present northerly wind have been taken into account. In the Castile and León sub-zone, only those cells with an easterly wind have been considered.
- **Daily specific humidity variation restriction.** Only those cells in which there is a specific humidity variation of at least 3 g/kg throughout the day have been considered.

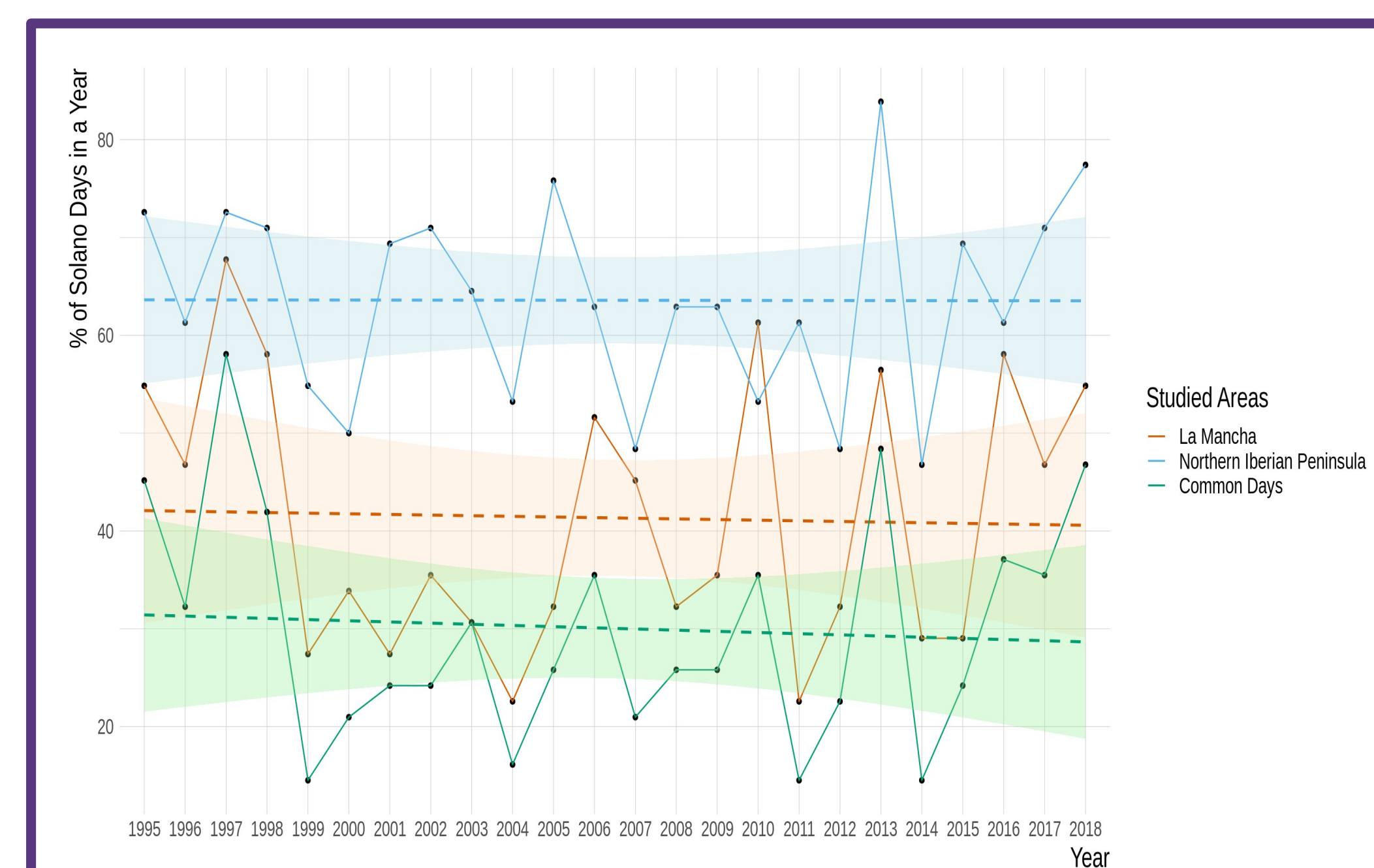
DATA ANALYSIS: Total percentage of Solano appearance, daily cycles, temporal descriptions and trends, variability and extension distributions, the non-parametric Mann-Whitney-Wilcoxon (MWW) test and mean sea level pressure anomalies were calculated using R software [10].

Results

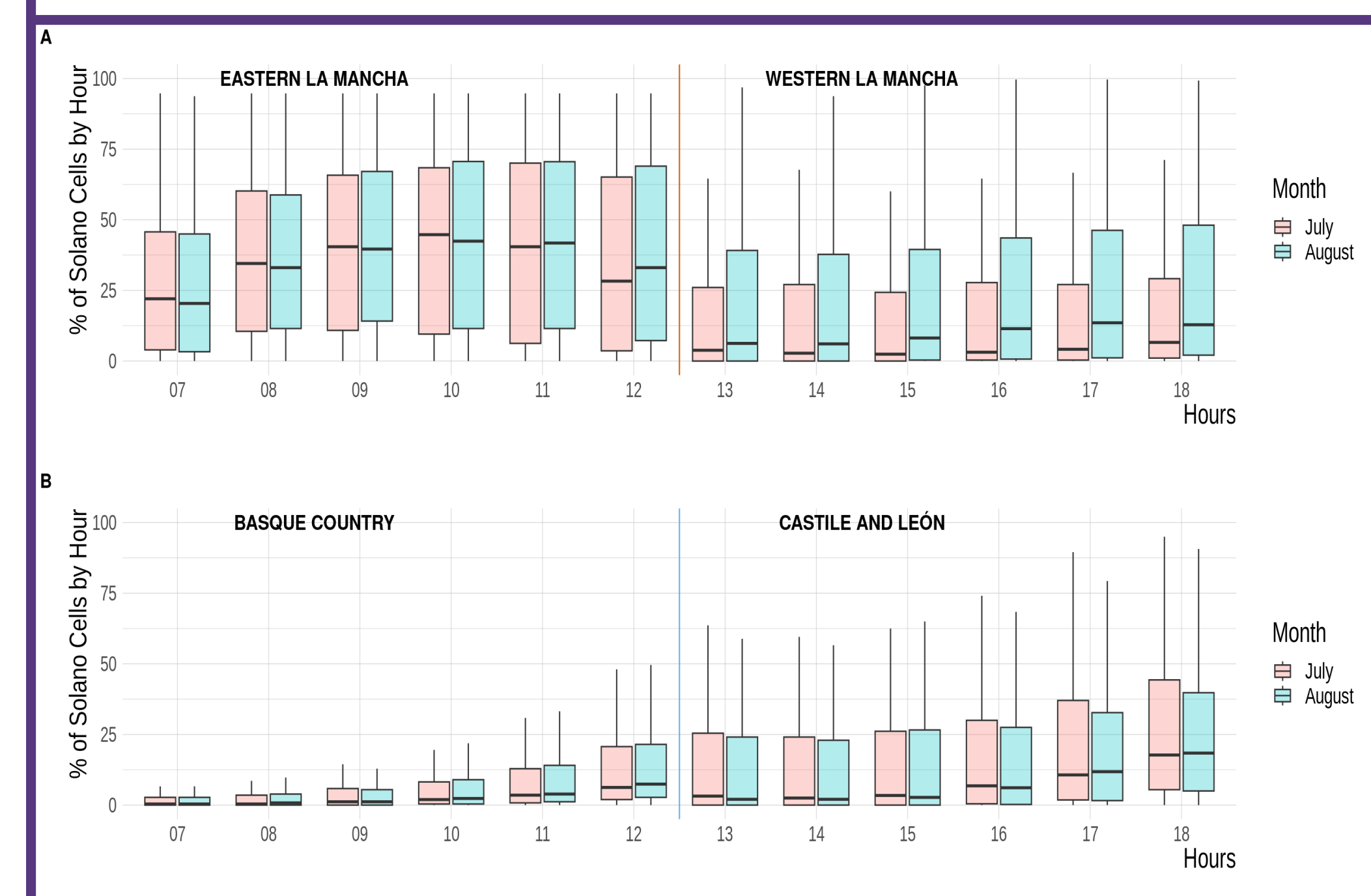
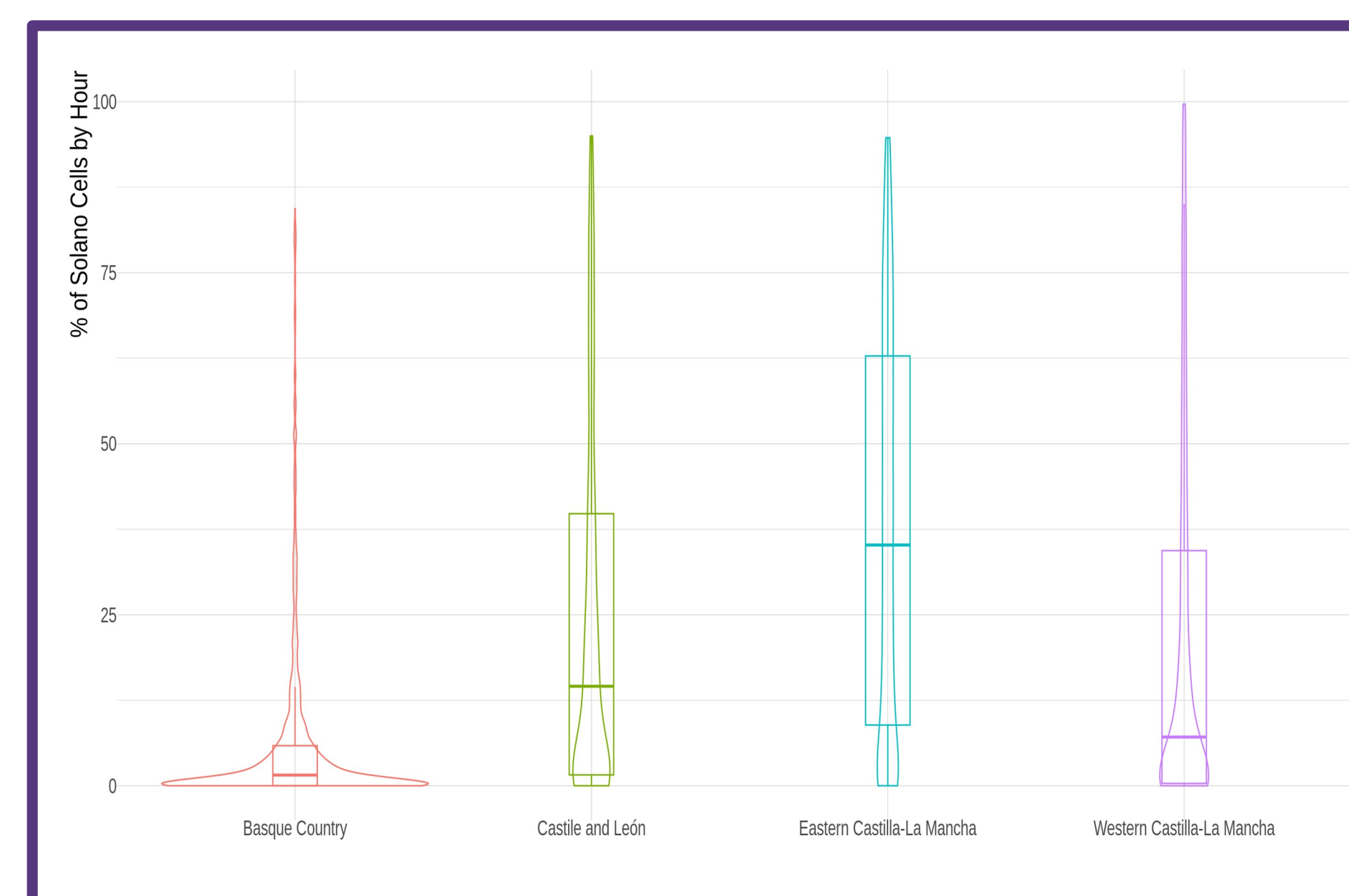
SOLANO CASE STUDY (AUGUST 3, 2005)



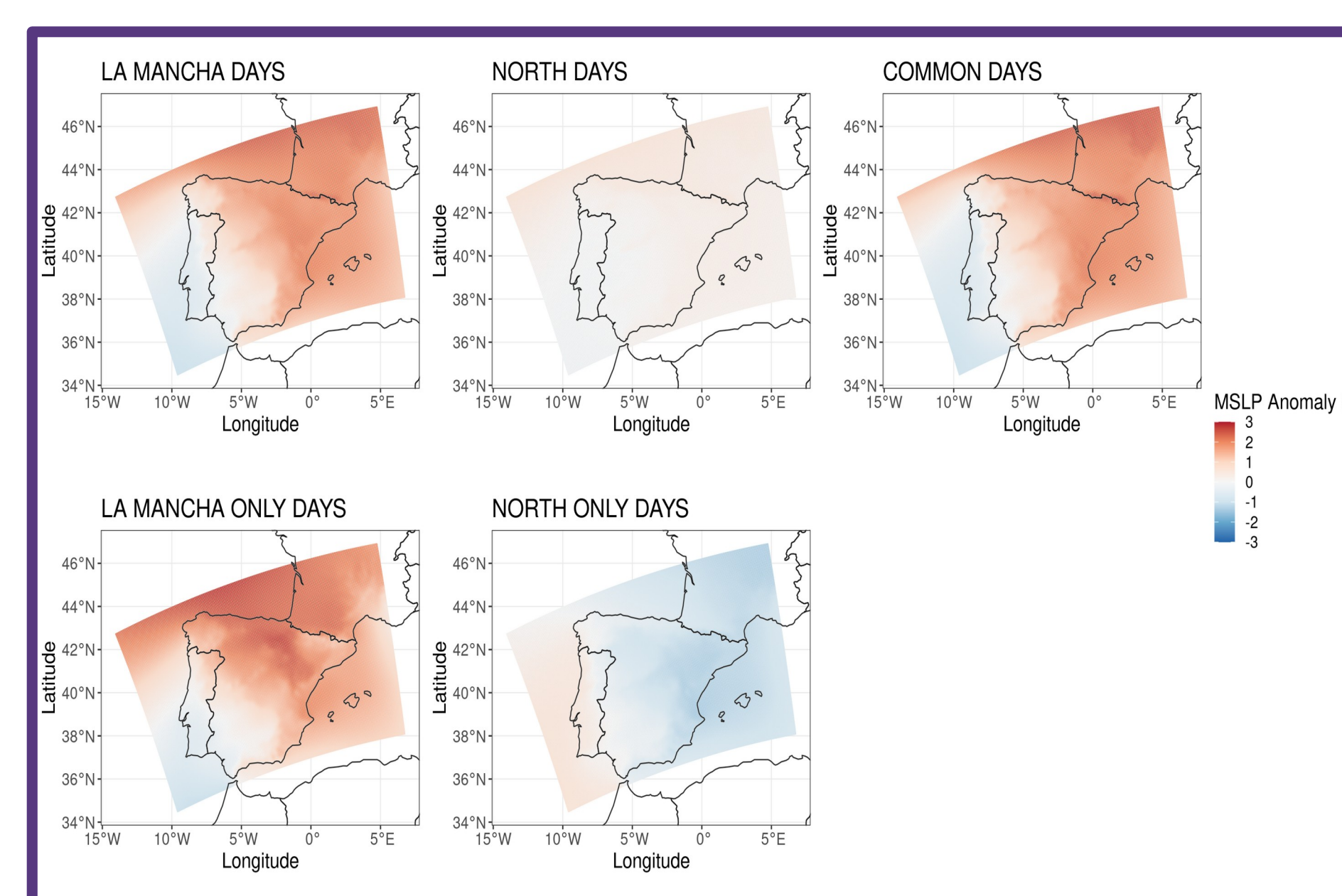
TEMPORAL EVOLUTION AND SUB-ZONE CELL DISTRIBUTION



SUB-ZONE CELL DISTRIBUTION IN COMMON SOLANO DAYS



MEAN SEA LEVEL PRESSURE ANOMALIES



Conclusions

- This work presents a **detailed description through a quantitative definition of the Solano** in the Iberian Peninsula, a **wind that has not been studied in depth until now**.
- The main statistics suggest that **the flows captured in La Mancha and in northern Iberian Peninsula present certain differences**. In **La Mancha**, Solano is obtained around **40%** of the summer days, while in the **North** it is obtained around **60%**.
- It has been described as a **very heterogeneous wind**, with **great temporal variability but marked daily cycles**, although these are also different between areas.
- The **distribution is distinct for the sub-zones**, which may be attributable to their orographic characteristics. In the North there is channeling in the mountains of the Basque Country, and then the flow disperses to the west in Castile and León. However, in La Mancha the flow appears on the plateau and then disperses to the west throughout the territory, reaching more or less size depending on the intensity of its characteristics on a given day.
- There are **no significant differences between July and August**, except for western La Mancha during the afternoon hours.
- Finally, the calculation of the pressure anomalies in these days has shown that in **La Mancha Solano always appears under positive anomalies in eastern and central Iberian Peninsula, but negative in the west; in the North the same situation is obtained when the flow also appears in La Mancha, but the opposite when it appears only in the North**.

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