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 (on the range of hundreds of kilometers or less) and temporal (from seconds to days) [2]. 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. 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 [2, 4].

A high-resolution reanalysis, such as COSMO-REA6 (0.055°) [7], could describe regional winds previously as seen in [2] and [3]. The main objective of this work is to characterize for the first time the Solano wind in the central and northern Iberian Peninsula and relates 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 five sub-zones and hourly ranges: in the central Iberian Peninsula, the Basque Country (12-17 UTC) and northwestern Castilla-La Mancha (15-18 UTC) with negative in the east wind direction cells have been considered. In the Basque Country subzone, 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 Latin subzone, 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 [8].

Results

SOLANO CASE STUDY (AUGUST 3, 2005)

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 60% of the summer days, while in the northern Iberian Peninsula only 10%.

It has been described as a very heterogeneous wind, with great temporal variability and marked daily cycles; although these are also different between areas.

The distribution is distinct for the sub-zones, which may be attributable to their geographic characteristics. In the North, there is a thermal low channeling in the mountains of the Basque Country, and then the flow disperses to the east in Castile and Latin. 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 or on a place of origin.

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 wind changes when obtained in the flow. A thermal low appears in La Mancha, but the opposite when it appears only in the North.

References


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