



Widespread extreme drought events in Iberia and their relationship with North Atlantic moisture flux deficit

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Droughts represent one of the most frequent climatic extreme events on the Iberian Peninsula, often with widespread negative ecological and environmental impacts, resulting in major socio-economic damages such as large decreases in hydroelectricity and agricultural productions or increasing forest fire risk.

Unlike other weather driven extreme events, droughts duration could be from few months to several years. Here we employ a recently developed climatic drought index, the Standardized Precipitation Evapotranspiration Index (SPEI; Vicente-Serrano et al. 2010a), based on the simultaneous use of precipitation and temperature fields. This index holds the advantage of combining a multi-scalar character with the capacity to include the effects of temperature variability on drought assessment (Vicente-Serrano et al., 2010a).

In this study the SPEI was computed using the Climatic Research Unit (CRU) TS3.21 High Resolution Gridded Data (0.5°) for the period 1901-2012. At this resolution the study region of Iberian Peninsula corresponds to a square of 30x30 grid pixels. The CRU Potential Evapotranspiration (PET) was used, through the Penman-Monteith equation and the log-logistic probability distribution. This formulation allows a very good fit to the series of differences between precipitation and PET (Vicente-Serrano et al., 2010b), using monthly averages of daily maximum and minimum temperature data and also monthly precipitation records. The parameters were estimated by means of the L-moment method. The application of multi-scalar indices to the high-resolution datasets allows identifying whether the Iberian Peninsula is in hydric stress and also whether drought is installed.

Based on the gridded SPEI datasets, spanning from 1901 to 2012, obtained for timescales 6, 12, 18 and 24 months, an objective method is applied for ranking the most extensive extreme drought events that occurred on the Iberian Peninsula. This objective method is based on the evaluation of the drought's magnitude, which is obtained after considering the area affected – defined by SPEI values over a certain threshold (in this case $\text{SPEI} < -1.28$) – as well as its intensity in each grid point. Different rankings are presented for the different timescales considering both the entire Iberian Peninsula and Portugal.

Furthermore we used the NCEP/NCAR reanalysis in the 1948-2012 period, namely, the geopotential height, temperature, wind and specific humidity fields at all pressure levels and mean sea level pressure (MSLP) and total column water vapour (TCWV) for the Euro-Atlantic sector (60° W to 40° E, 20° N to 70° N) at full temporal (six hourly) and spatial (2.5° regular horizontal grid) resolutions available as well as the globally gridded monthly precipitation products of the Global Precipitation Climatology Centre (GPCC), to analyse the large-scale conditions associated with the most extreme droughts in Iberia. Results show that during these drought periods there is a clear moisture deficit over the region, with permanent negative anomalies of TCWV. Additionally, in these occasions, the zonal moisture transport is more intense over the northern Atlantic and less intense on the subtropics while the meridional moisture transport is intensified, in accordance with the barotropic structure of HGT anomalies.

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Vicente-Serrano, S.M., Beguería, S., López-Moreno, J.I., Angulo, M., and El Kenawy, A. (2010b). A new global 0.5° gridded dataset (1901-2006) of a multiscalar drought index: comparison with current drought index datasets based on the Palmer Drought Severity Index. *Journal of Hydrometeorology*, 11, 1033–1043

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