



THE STATE OF ART OF THE DROUGHT STUDIES IN SPAIN



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WCRP Spanish Committee

1. Introduction: Drought in Spain

Drought is one of the most important natural hazards in Spain in terms of frequency, severity and economical losses. The drought as a climatic phenomenon has a slow implementation but it spreads throughout vast territories. The longest dry spells (dry day <0.1 mm) lasted more than 150 days in the south of Iberian Peninsula over 40-years periods. The persistence of the dry days is so high in southern Iberia than the phenomena can not be considered as Markovian, even using Markov-chains of orders higher than 2. That kind of spells occurs in the warm part of the year, but long droughts are recorded also in other seasons. The consequences of this water deficit are alternated by heavy rainfall events, and its harmful impact on society becomes more noticeable by the increasing demands of agriculture with support irrigation and the recent urban development.

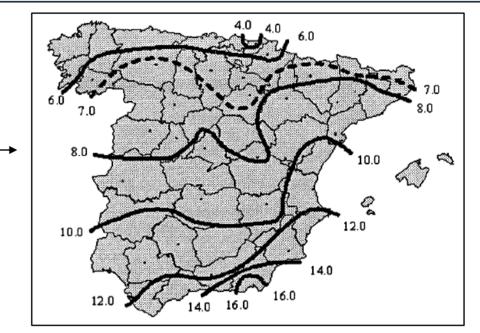
2. Studies on droughts in Spain

A like-bibliometric analysis over a wide collection of studies on drought in Spain has been made. The studies deal with analysis on drought indices, persistence of dry periods, socio-economical impacts, regional characteristics, synoptic genesis, influence of low-frequency variability patterns, spring precipitation variability, etc. Therefore, we must test the drought indices and times scales in order to achieve a good modelling of the different droughts types under extreme environmental conditions and increasing water demands.

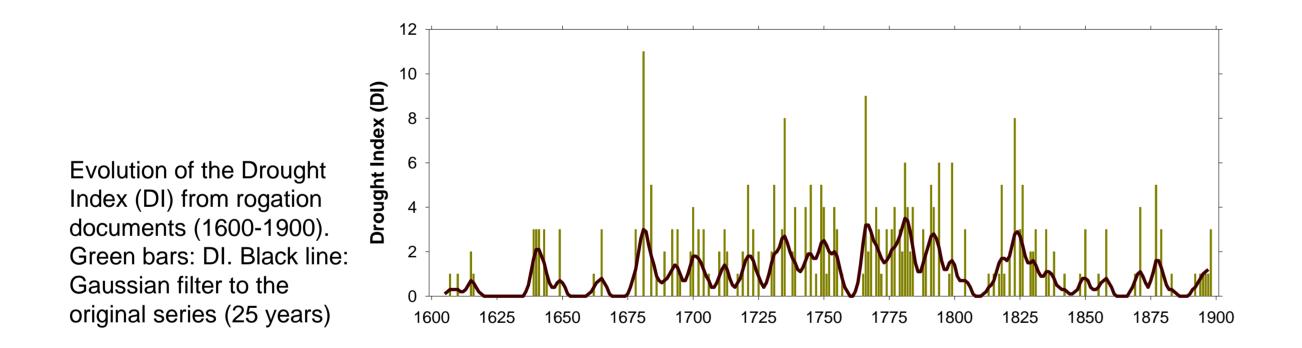
Some examples of several studies on droughts in Spain are shown: Cuadrat (a), Martin-Vide and Gomez (1999) (b), Estrela et al. (2000) (c) and García-Haro et al. (2010) (d). Some perspectives in the improvement of drought studies are also shown: Guijarro (e) and Valero et al. (f).

3. Examples

Droughts over the last 400 year in the North-East Spain

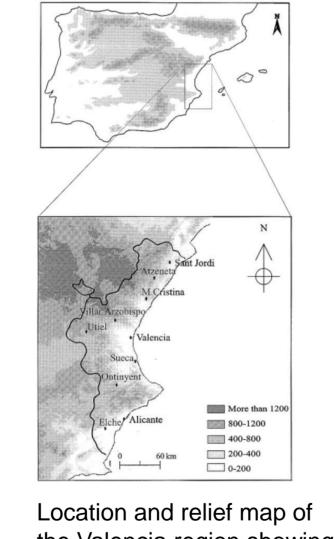


A continuous Drought Index (DI) from 1600 to 1900, in a semi-arid region of North-East Spain (the middle Ebro valley), was created from the historical documentary sources (rogation ceremonies). Drought evolution during the past four centuries often coincides in time with the evolution recorded in other Mediterranean areas. Between the sixteenth and nineteenth centuries the most important droughts were recorded in the last quarter of the eighteenth century, which coincided with a period of high climatic variability known as the "Maldà" anomaly. In general, the eighteenth century was drier than the seventeenth and nineteenth centuries.

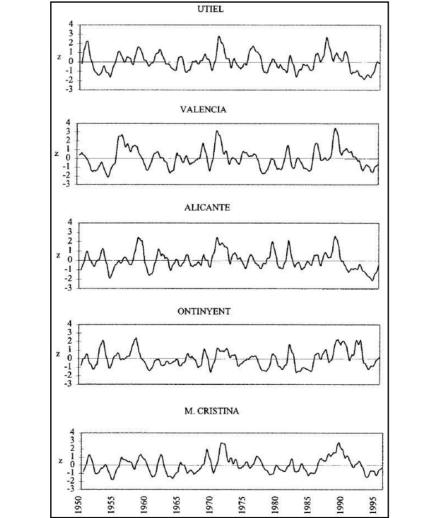


Multi-annual drought episodes in the Mediterranean (Valencia Region) from 1950-1996. A spatio-temporal analysis

Analysis of recurrence probabilities reveals that the precipitation regime of the Valencia region is characterized by tremendous variability. This is typical of a Mediterranean climate. Drought periods affect the area frequently and can be very persistent. This is evident in all of the recurrence graphs, where values can vary from maximum to minimum peaks within 1 or 2 months at any of the observatories. This is due to the fact that precipitation tends to be concentrated in torrential rainfall events that usually occur in the autumn or first half of winter. For the Valencia region, they represent the main feature of its precipitation regime and the principal contribution to the hydrological system.



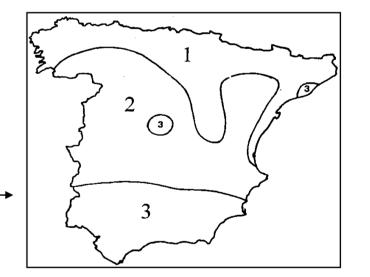
the Valencia region showing meteorological observatories



Probabilities of recurrence (12 months) for the 1950–1960 period b based on the length of dry spells

> Mean duration (days) of the dry spells (dry days >1.0 mm for the 1951-1990 study period)

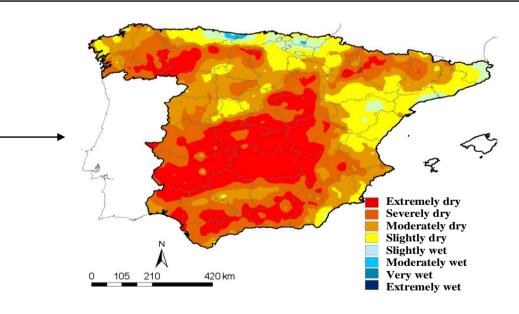
The adjustment of the general distribution of the dry spells according to their length and the adjustment of the longest spells, those that exceed 1,2 or 3 months duration, have been considered. The goodness (or not) of the adjustments permits regionalization of the country, showing up three types of behaviour: (1) a Markovian in which the adjustments are acceptable, in the north of Spain; (2) with good general adjustment, but with notable discrepancies between the empirical values and those estimated for the longest spells, in a central area; and (3), in which both adjustments have to be rejected, and so drought can not be considered a Markovian phenomenon, in the south.

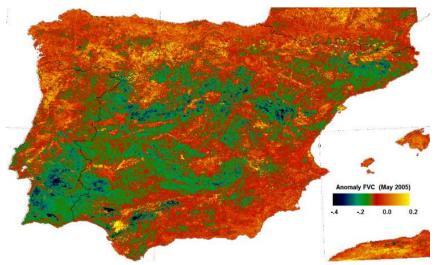


C Influence of the 2005 drought on vegetation cover

The 12-month Standard Precipitation Index (SPI) in December 2005 reflects long-term precipitation patterns, corresponding to the severe drought suffered by the Iberian Peninsula during 2005. 12-month SPI values for Spain in December 2005 stratified into 8 intervals: extremely wet (>2.0), very wet (1.5 to 1.99), moderately wet (1.0 to 1.49), slightly wet (-0.99 to 0.0), slightly dry (0 to 0.99), moderately dry (-1.49 to 1.0), severely dry (-1.99 to 1.5), and extremely dry (<−2.0).

FVC Anomaly (May 2005), illustrating the influence of the severe drought in Spain during the 2004-2006 period on vegetation cover. A severe disturbance in vegetation cover can be observed across Spain during the growing season.

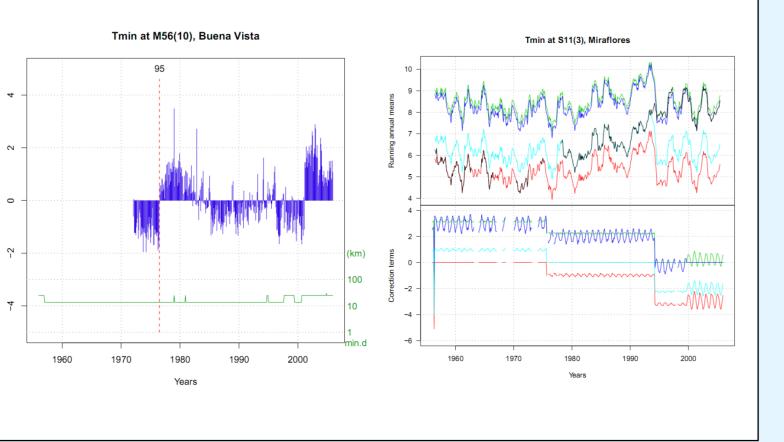




4. Perspectives

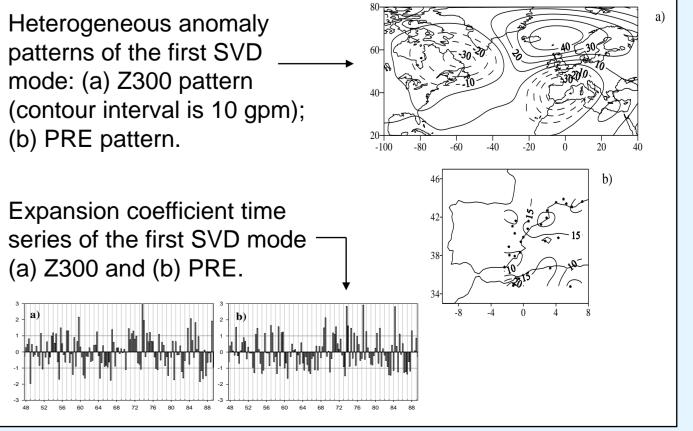
e CLIMATOL

As a last contribution we can mention the recent update of the R contributed package 'climatol', which in this version (2.0) introduces a function for a completely automatic homogenisation of climatological series, including missing data filling and detection/correction of outliers and shifts in the mean of the series. This is not a work specifically addressed to droughts, but it is clear that the first step to endeavour a drought study begins by procuring a good quality precipitation data-set, and this package may be a useful tool for that.



Low frequency variability patterns

Concerning to the studies on the influence of lowfrequency variability patterns on the precipitation, the springtime precipitation is analyzed in the western Mediterranean area. The main purpose is to identify atmospheric circulation patterns occurring simultaneously with precipitation anomaly configurations in springtime using observational data. The singular value decomposition (SVD) statistical technique is applied to the western Mediterranean spring precipitation and the 300-hPa geopotential height field. This level is selected because baroclinicity and depression development (cyclogenesis) are intimately related to the strength of the 300-hPa flow.



References:

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