Geophysical Research Abstracts
Vol. 17, EGU2015-7505, 2015
EGU General Assembly 2015

Characterization of drought events in the Iberian Peninsula 1931-2009

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There are many definitions of drought due to an imbalance between water availability and its use. In general, when there is an extended period of time in which the rainfall remains below their mean values, drought incurred. It is important to assess the severity, duration and frequency with which these phenomena occur, because its influence in the evolution of ecosystems, agriculture and livestock. In this work we use the Standardized Precipitation Index computed in a 3-month and 12-month time scale (SPI3 and SPI12) in two periods: 1931-1969 and 1970-2009, applied to synthetic series generated by Luna and Balairón (AEMET). These daily rainfall series cover a squared region of the Iberian Peninsula regularly.

We have fitted loglinear models to drought class transitions derived from Standardized Precipitation Index. Each period is analyzed independently and we obtain separated squared contingency tables. Each cell in these tables have two classification criterions (A,B) with levels i,j, respectively, and two identifiers of the table (p and k) where level i is the drought class at month $t-1$, j is the drought class at month t, p is the period of time and k identifies a short region inside the Iberian Peninsula. Then, the elements of these tables can be represented by $n_{i,j,p,k}$. The model selected to explain the differences in the contingency tables for all the stations is the quasi association loglinear model, where different parameters for different periods and regions (p and k) are fitted.

$$\log\left(E^k_{ijp}\right) = \lambda + \lambda^A_i + \lambda^B_j + \alpha u_i v_j + \delta_{1i}(i=j)$$

When adjusting these models, it is assumed that the values in the cells of the contingency tables were taken by independent Poisson distributed variables. To validate the adjustment of the model, we use the residual deviance G^2 which is asymptotically distributed as a Chi-Square for each contingency table.

$$G^2 = 2\sum_l n_l \log\left(\frac{n_l}{\hat{n}_l}\right)$$

We have examined if there are differences in the expected number of transitions between all drought classes by ANOVA linear model with fixed effects for the periods.

The main conclusion is that agricultural droughts become more frequent, the duration of each event does not increase, but the droughts intensity is growing. The probability of consecutive raining days has decreased, especially in autumn and in winter.