Nat. Hazards Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/nhess-2018-289-AC2, 2019

Natural Hazards and Earth System Sciences
Open Access
Discussions

Interactive comment on "High-spatial resolution probability maps of drought duration and magnitude across Spain" *by* Fernando Domínguez-Castro et al.

Fernando Domínguez-Castro et al.

f.dominguez.castro@gmail.com

Received and published: 14 February 2019

Anonymous Referee #2

The paper presents a methodology to characterize drought duration and intensity over Spain using two climatic indices: SPI and SPEI. The work uses a gridded dataset of SPI and SPEI values calculated weekly at high spatial resolution over Spain. From this dataset and using SPEI and SPI at four different time scales, the authors obtain a peak-over-threshold empirical series of drought duration and magnitude on which they fit a Pareto distribution. The fitted probability distribution is then used to produce maps of the maximum drought duration and magnitude of different time scales. The work differs

from previous drought characterization efforts in the high spatial and temporal resolution at which the study is conducted, and the use of a GP distribution to capture the probability distribution of extreme anomalies, which is critical for correct drought characterization. I found the study valuable from the methodological point of view and from the insight it provides on drought patterns. The paper provides important methodological guidance on the most adequate probability distribution to characterize exceedance thresholds through a thorough analysis of different candidate probability distributions that could represent the POT series. It also shows that the spatial patterns of drought can be very different when droughts are characterized at different time scales. I do not have major methodological concerns, however, the paper is written such that some methodological and conceptual aspects are not clear.

Many thanks for your positive comment.

Part of the problem is that the paper needs to be heavily edited for language and style. The text has been polished by a professional English speaker to improve the language style and text flow.

Also, the authors need to pay attention to details. For instance, some of the symbols used in the equations are not defined in the main text or the symbols used in the text and the equation are different (e.g. x0, w_j). The symbols corresponding to each equation are described in the new version of the manuscript, and we have systematized the symbols in the text and equations

The labels of Figure 1, 2 and 3 cannot be read and their general quality need to be improved. We have improved the quality of these figures.

There are many awkwardly written sentences throughout the paper that are distracting and detract from the quality of the study. The paper, as currently written, is not ready for publication. The text has been polished by a professional English speaker to improve the language style and text flow.

Section 2.2. discusses the arbitrary nature of selecting thresholds in the indices to define drought, and how these thresholds are different for different activities or processes impacted by drought. Then in Page 4 line 6 says that the studies uses an 'arbitrary' threshold of zero and define drought as an event with an index below zero. Isn't it the standard way of applying these indices to define drought? In that case, zero represents the long term average climatology and therefore it could be argued it is not an arbitrary threshold. The way the paragraph is written makes me doubt whether I am actually interpreting this correctly. I suggest that paragraph is edited to be more specific or clear about what the authors actually mean. Globally, there is no standard definition of drought. Likewise, there are different procedures/methods to define a drought event, with no standard threshold. All negative SPI or SPEI values characterize drought conditions, regardless of the magnitude or severity. Some studies applies a threshold of -0.8 or -1 z-unit to define a drought event. We have clarified the rationale behind our selection of zero unit, as a threshold, as follows. "There are several criteria (thresholds) to identify independent drought events (e.g. Fleig et al., 2006; Lee et al., 1986). These thresholds are generally arbitrary, with no clear objective metrics to relate a certain value of a drought index with specific sectorial impacts. Indeed, this is a challenging task, given the large number of economic sectors and environmental systems impacted by droughts (Pérez and Barreiro-Hurlé, 2009). Furthermore, regions and sectors can respond differently to various drought timescales (Lorenzo-Lacruz et al., 2013; Pasho et al., 2012). In this work, we obtained the series of drought events from the weekly gridded series of SPEI and SPI at four selected time scales (1-, 3-, 6- and 12-months). We used zero threshold to define drought events. Although this threshold allows for inclusion of less severe drought events, it can secure a sufficient sampling size to conduct the probabilistic analysis. Importantly, the retention of drought events in this manner will not bias the obtained results, given that high values of the series will be retained following the peak-over-threshold approach". Fleig, A. K., Tallaksen, L. M., Hisdal, H. and Demuth, S.: A global evaluation of streamflow drought characteristics, Hydrol. Earth Syst. Sci., 10(4), 535–552, doi:10.5194/hess-10-535-2006, 2006

Lee, K. S., Sadeghipour, J. and Dracup, J. A.: An Approach for Frequency Analysis of Multiyear Drought Durations, Water Resour. Res., 22(5), 655–662, doi:10.1029/WR022i005p00655, 1986

Lorenzo-Lacruz, J., MoÅŢan-Tejeda, E., Vicente-Serrano, S. M. and Äźopez-Moreno, J. I.: Streamflow droughts in the Iberian Peninsula between 1945 and 2005: Spatial and temporal patterns, Hydrol. Earth Syst. Sci., 17(1), 119–134, doi:10.5194/hess-17-119-2013, 2013.

Pasho, E., Camarero, J. J. and Vicente-Serrano, S. M.: Climatic impacts and drought control of radial growth and seasonal wood formation in Pinus halepensis, Trees - Struct. Funct., 26(6), 1875–1886, doi:10.1007/s00468-012-0756-x, 2012.

Pérez, L. and Barreiro-Hurlé, J.: Assessing the socio-economic impacts of drought in the Ebro River Basin | Análisis de los efectos socioeconómicos de la sequía en la cuenca del Ebro, Spanish J. Agric. Res., 7(2), 269–280, 2009.

Also, a few additional details in the methodology, such as how were the climatic inputs used to produce the indices gridded, may help interpret the results. We have included a more detailed description of how the gridded indices were produced. "Based on gridded datasets of maximum and minimum air temperatures (1304 observatories), precipitation (2269 observatories), wind speed (82 observatories), relative humidity (179 observatories) and sunshine duration (112 observatories), Vicente-Serrano et al. (2017) developed a high-resolution spatial (1.21 km2) and temporal (weekly) drought dataset for Spain (412178 pixels). This dataset spans the period from 1961 to 2014. Importantly, this drought dataset was developed after a rigorous procedure to check the quality and homogeneity of the input climatic data. The grid of each variable was computed by universal kriging method (Borrough and McDonnell 1998; Pebesma, 2004), using latitude, longitude and elevation of each grid cell as auxiliary variables. The grid layers were validated with a jackknife resampling procedure (Phillips et al., 1992) and difference between the predicted and observed values for each observatory was low (see Vicente-Serrano et al., 2017 for details). Overall, the gridded climatic data were employed to compute the Standardized Precipitation Index (SPI) (McKee et al., 1993) and the Standardized Precipitation Evapotranspiration Index (SPEI) (Vicente-Serrano et al., 2010) at different timescales ranging from 1- to 48-month (http://monitordesequia.csic.es). While the SPI accounts only for precipitation data, the SPEI is based on normalization of the difference between precipitation and atmospheric evaporative demand (AED). In this study, we employed these two drought indices to assess the possible impacts of the AED on drought hazard probability in Spain. The SPI and SPEI were used at time scales of 1-, 3-, 6- and 12-months for the period 1961-2014".

Borrough, P. A., & McDonnell, R. A. (1998). Principles of Geographical Information Systems. UK, Oxford University Press.

Pebesma, E. J. (2004). Multivariable geostatistics in S: The gstat package. Comput. Geosci., 30, 683–691.

Phillips, D. L., Dolph, J., & Marks, D. (1992). A comparison of geostatistical procedures for spatial analysis of precipitation in mountainous terrain. Agric. Meteorol. 58, 119–141.

Vicente-Serrano, S. M., Tomas-Burguera, M., Beguería, S., Reig, F., Latorre, B., Peña-Gallardo, M., Luna, M. Y., Morata, A. and González-Hidalgo, J. C.: A High Resolution Dataset of Drought Indices for Spain, Data, 2(3), 22, doi:10.3390/data2030022, 2017.

McKee, T. B., Doesken, N. J. and Kleist, J.: The relationship of drought frequency and duration to time scales, Eighth Conf. Appl. Climatol., 179–184, 1993.

Vicente-Serrano, S. M., Beguería, S. and López-Moreno, J. I.: A multiscalar drought index sensitive to global warming: The standardized precipitation evapotranspiration index, J. Clim., 23(7), 1696–1718, doi:10.1175/2009JCLI2909.1, 2010.

I have a few additional questions: why does the paper use the word centile instead of

percentile? Does it have a specific meaning, like the percentile from the empirical cdf? In the whole manuscript, we have replaced "centile" with "percentile".

Page 4 line 21: does the 0th percentile actually exist? Does it refer to the minimum value in the record? Indeed, the 0th percentile considers all the serie.

Page 7 line 9-10: I am not sure you should expect that low model observation agreement is caused by the lower sampling size at long time scales. Why would that be? Goodness of fit and robustness are different things. At longer scales there are less events, so we have lower sampling size. This clearly affects the accuaracy of the estiamtions. The extreme cases are the pixels that have no solution for the GP parameters, which also increase for longer scales (see Table 2).

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2018-289, 2018.