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Interactive comment on "Drought lacunarity around the world and its classification" *by* Robert Monjo et al.

Robert Monjo et al.

dominic.roye@usc.es

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Dear Hasan, Thank you very much for the comments. They have been very useful to improve the paper. You can find the changes below.

Abstract ÂńThe first sentence can be written more literally because it does not feel goodÂż This sentence have been changed to: (Changes in manuscript: Page 1, line 1): "The measure of drought duration strongly depends on the definition considered" ÂńIn the "Abstract", the authors were supposed to give a few main conclusionsÂż Additionally, a conclusion have been added to the Abstract. (Changes in manuscript: Page 1, line 8): "To conclude, outcomes provide ability to determine when droughts start and finish"

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Discussion paper

1. Introduction. ÂńThe lacunarity pertains to both gaps and heterogeneity of the attractor the related dynamical system. The term of “lacunarity” should be explained in the "Introduction" section with examples from the literature. It also needs to be explained how it is associated with drought. Because drought is not only related to a dynamic system (time interval or spell), but to the interaction of many meteorological variablesÂż In our context, drought is used to refer large patterns of dryness in rainfall sequences. To improve the explanation of the ÂńlacunarityÂż concept, we have introduced some sentences : (Changes in manuscript: Page 1, line 20) [...] in the same manner that the Cantor set alternates points with gaps; this is also known as lacunarity. (Changes in manuscript: Page 2, line 43) [...] ÂńIn this sense, dry pauses of the rainfall can be compared with the gap distribution of fractal objects, which is also known as \textit{lacunarity} \citep{Martinez2007,Lucena2018}. The lacunarity analysis is used to characterise ’spatial’ patterns (such as invariance, density and heterogeneity) of fractal objects, which represent \textit{attractor} solutions of nonlinear dynamical systems \citep{Plotnick1996,Wilkinson2019}. If a time series of precipitation is solution of the climatic system in a given point, the dryness distribution informs about (climate) average features of the system (e.g. surface convergences/divergences of moisture flows and latent energy fluxes or speed of the hydrological cycle).Âż Plotnick R.E, Gardner R.H., Hargrove W., Prestegaard K., Perlmutter M.A. (1996). Lacunarity analysis: A general technique for the analysis of spatial patterns. Physical review E, Statistical physics, plasmas, fluids, and related interdisciplinary topics 53(5):5461-5468. DOI: 10.1103/PhysRevE.53.5461 Wilkinson M., Pradas M., Huber G., Pumir A. (2019): Lacunarity exponents. Journal of Physics A Mathematical and Theoretical 52(11). DOI: 10.1088/1751-8121/ab0349

2. Methods ÂńThis section with its subsections should be rewritten in a way that is understandable to an average readerÂż Thank you very much for the suggestion. We have rewritten the subsections to reinforce conceptual pathway. The changes are: (page 3, line 64): “The main fractal measure was estimated for dry-spell density by means of the n-index. In a similar way as n-index describes the decrease rate (power

law) of the maximum average intensities of rainfall over time (within a particular meteorological event), it also can be applied to analyse how dry-spell lengths decrease around a maximum value. For this propose, each spell duration... [...]" In a similar way as for precipitation, Following the same method as in precipitation, the maximum accumulated (page 4, line 83): "Statistical analysis" (page 5, line 122): "Data availability considered" [Note: To distinguish with the section "6. Code and data availability"] Additionally, lines 89-96 where moved to the end of the methodology section.

1. Results ÂńThis section can be written much more appropriate. Maybe a few minor corrections can be added. For example, hydro-climatological interpretations were expected instead of statistical interpretations. This is not a statistical study. In that case, it would be much more meaningful if the hydrological point of view came to the forefront. In addition, the scope of this journal allows the subject of this work.Âż Thank you very much for the suggestions. We would like to emphasize that the paper has a clear methodological and non-hydrological orientation. The key of the article is the consideration and utility of the Cantor set, combined of other commonly used methods, for the objective statistical analysis of the dry/wet sequences. We think that considering the Cantor set as a model of the temporary behaviour of droughts is a new conceptual contribution to the analysis of consecutive dry day sequences. Remember that the Cantor set has a null measure and, on the other hand, is not empty, or even not countable. This reinforces the fact that although the number of rainy days can be very large in some regions, always its temporary representation against dry days is much lower in any climate. In future works we can relate the temporary behaviour of droughts with the atmospheric causes that produce them. In anticipation, we have added a brief sentence about a (general) meteorological interpretation of the results: (pag. 8, line 167): "This classification is consistent with the main atmospheric circulation belts. For instance, Lℓ is strongly linked to the extreme air flow regimes (inland areas of the equatorial calms and most intense areas of the polar jet streams), which involve most frequent rainy days due to continuous moisture convergence (see, e.g., spatial distribution of 10-meter wind regimes in \citet{Possner2017})." Possner,

A., Caldeira, K. (2017): Geophysical potential for wind energy over the open oceans. In: Proceedings of the National Academy of Sciences of the United States of America, 114: 11338-11343.

Please also note the supplement to this comment:
https://www.earth-syst-sci-data-discuss.net/essd-2019-115/essd-2019-115-AC1-supplement.pdf

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