

Anonymous Referee #1

The main objective of the manuscript is to measure four different precipitation indices, their tendencies over Northern Chile and their statistical link to geographical variables. In my opinion, there is a strong need in literature for articles assessing observed local precipitation climate change at specific networks of stations, since many current studies focus on coarser spatial scales derived from regional or global models, which are prone to large bias, particularly in case of rainfall. Thus, the aim of this work is certainly of interest for the readers of HESS.

The authors would like to thank the reviewer for his work regarding the comments on this manuscript and his nice words.

The topics presented are covered with a good amount of material, and the network employed is of particular interest due to the high altitudes of many stations and the scarcity of dataset covering arid regions. The manuscript is written in an understandable way, even if a revision from a native English speaker is recommended. Results are novel and interesting, exploiting a recently recovered large station network of particular geographical and climate relevance, and are well presented and explained. Therefore, I highly recommend the publication of the manuscript. Some steps of the analysis might not be easy to reproduce, given that three of the precipitation indices considered (Concentration Index, Entropy, Fractal dimension) are not straightforward to measure. However, even if their methodology could be further described, I think it is not in the scope of this paper, which already references the original articles describing these indices in detail.

The authors appreciate the comments regarding the language. We hope that after the comments made by the author, it will be better understood. A more precise description of each index was not included for the same reason that the reviewer points.

In Section 2.1 ("Observed rainfall data"), authors describe the quality controls and homogenization employed. No station of the 161 employed was discarded; however, they specified that missing data were present for some stations. To better understand the degree of quality of the dataset, the authors could specify which was the maximum % of missing data measured in their stations during the study period.

Section 2.1 has been rewritten, defining the values of missing data and doing a better explanation of the filling method applied in this case.

In the Discussion Section, the authors compare their findings with those provided for other geographical areas already available in literature. In the case of the Concentration Index, the authors might also consider to include a comparison with the recently published work of Sangüesa et al. (2018)* for Southern Chile. It is interesting to notice that the range of annual values of the Concentration Index in Northern Chile [0.42-0.67] is quite smaller than the range observed in Europe at annual scale [0.51-0.72] in the paper of Cortesi et al. (2012)**, who employed exactly the same methodology to define the index, albeit with a slightly shorter period (1971-2010). At a first glance, such a range difference seems to be quite unlikely, due to the much more arid nature of Northern Chile compared to Europe, which should determine higher values of the Concentration Index. However, the lower values measured in Northern Chile might arise from a severely different gamma distribution of precipitation in desert climates; in fact, a lack of days with small or very small precipitation amount in the desert should determine an important change of the exponential curve of the Concentration Index, basically pushing the left part of the curve closer to the Equidistribution line, and explaining why in Northern Chile the values are lower than in Europe. I suggest the authors to introduce the comparison with Europe in the Discussion section, explaining why, in their opinion; the observed range in Northern Chile is smaller than the European one. To further improve the manuscript, the authors might want to include a similar comparison of the ranges of the values of the Entropy and Fractal dimension indices, particularly if important differences with the ranges measured in other continents are detected. Unfortunately, I'm not proficient with these two indices, so I can't give any more suggestions to the authors.

The reviewer points one key concept about these indices, and such differences showed here may have both climatological and geographical explanations, but also statistical ones. Some appointments have also been made for the other indices. The Discussion section has been developed as it follows:

"The range of annual values of the Concentration Index in Northern Chile (0.42-0.67) is quite smaller than the range observed in Europe at annual scale (0.51-0.72) in the work of Cortesi et al. (2012), who employed exactly the same methodology to define the index, albeit with a slightly shorter period (1971-2010). Such a range difference seems to be quite unlikely, due to the much more arid nature of Northern Chile compared to Europe, which should determine higher values of the Concentration Index. However, the lower values measured in Northern Chile might arise from a severely different gamma distribution of precipitation in desert climates. In fact, a lack of days with small or very small precipitation amount in the desert should

determine an important change of the exponential curve of the Concentration Index, basically pushing the left part of the curve closer to the equidistribution line, and explaining why in Northern Chile the values are lower than in Europe. The geographical and climatological reason of the reported differences could be the presence of the Mediterranean, which rises high sea surface temperatures during the autumn and triggers convective processes, leading to higher Concentration Index values.”

The rest of the revision mainly addresses the readability of the text, asks a few simple questions and provide grammatical corrections.

The comments have been considered to improve the manuscript. We thank the reviewer for its effort.

* Sanguesa et al. (2018) Spatial and Temporal Analysis of Rainfall Concentration Using the Gini Index and PCI. *Water* 10(2), 112; <https://doi.org/10.3390/w10020112>

** Cortesi et al. (2012) Daily precipitation concentration across Europe 1971–2010. *Nat. Hazards Earth Syst. Sci.*, 12, 2799-2810, 2012; <https://doi.org/10.5194/nhess-12-2799-2012>

Page 1, line 11: replace sentence with this one: "Northern Chile is one of the most arid regions in the world, as it includes the Atacama Desert. At high latitudes, most of precipitation is observed only in a short period of the year, from December to March. This makes water availability one of the main concerns for policymakers".

The text was corrected.

Page 1, line 14: replace "and this makes that" with "for this reason,".

The text was corrected.

Page 1, line 18: replace the second "determined" in the sentence with a synonymous, e.g: "caused".

The text was corrected.

Page 1, line 24: replace the second "these" of the sentence with "this".

The text was corrected.

Page 2, line 1: the summer season mentioned is the Boreal or Austral one?

The text was corrected.

Page 2, line 3: replace the sentence with "Such a configuration of the upper levels is known as Bolivian High (250 hPa). it activates the South American monsoon, (...). As a consequence, the dry or wet characterisation (...).

The text was corrected.

Page 2, line 19: replace "prior" with "main".

The text was corrected.

Page 2, line 22: correct the sentence: (...) they show a particular degree (...). Such patterns increase at high latitudes and in wet regions (...).

The text was corrected.

Page 2, line 25: add an "s" after "work".

The text was corrected.

Page 2, line 28: remove "or even smaller".

The text was corrected.

Page 2, line 29: replace "This exposes that" with "Thus,".

The text was corrected.

Page 2, line 40: replace "study" with "studied".

The text was corrected.

Page 3, line 4: replace "face characterization of precipitation" with "characterize precipitation".

The text was corrected.

Page 3, line 6: replace "this" with "the".

The text was corrected.

Page 3, line 20: replace "this" with "these studies".

The text was corrected.

Page 4, lines 1-5: redundant, can be removed.

We believe that this sentence concludes the identification of the problems previously identified.

Page 5, line 21: replace "are" with "is" or remove "every".

The text was corrected.

Page 8, line 10: take advantage of this line to introduce in the text between parenthesis the symbols used at page 9 for referring to variables elevation, curvature, orientation and distance to the Amazon basin (they are still not defined in the paper).

The text was corrected. Despite this, the variables are characterized in Table 1 located in page 22.

Page 8, line 22: replace "significance" with "robustness".

The text was corrected.

Page 8, line 18: I can't find neither Table 1 neither Table 2 in the manuscript. Were they included?

Both tables appear after the reference list, in pages 22 and 23.

Page 9, line 17: replace "(17) to (20)" with "(16) to (19)".

The text was corrected.

Page 12, line 10: replace "in" with "at".

The text was corrected.

Page 15, line 25: replace the first sentence with "In this work, the spatial distribution of specific irregularity indices applied to precipitation temporal behaviour has been presented, as it represent a good tool to carry on studies in arid and semiarid areas. In case of annual and monthly accumulated rainfall, the high degree of interannual variability determines a similar high degree of uncertainty of climate p projections. It is more interesting to consider (...) This allows to interpolate and measure (...).

The text was corrected.

Page 15, line 34: replace "very constricted" with "short".

The text was corrected.

Page 15, line 35: replace "C is increasing" with "C increases".

The text was corrected.

Page 16, line 1: expand the results: "The P11 index is mostly homogeneous in all the study region, with only a slight increase at the centre and south, (...)".

The text was corrected.