

## ***Interactive comment on “Reconstructions of Droughts in Germany since 1500” by Rüdiger Glaser and Michael Kahle***

**Rüdiger Glaser and Michael Kahle**

ruediger.glaser@geographie.uni-freiburg.de

Received and published: 17 December 2019

The manuscript “Reconstructions of droughts in Germany since 1500” focuses on the calculation of various indicators for droughts since 1500 based on the historical climate and environmental database [tambora.org](http://tambora.org). Specifically a Historical Precipitation Index (HPI) is calculated and correlated with the SPI index. Additionally, a Historical Drought Index (HDI) and a Historical Wet index (HWI) are derived. Information on the long term development and dynamics of droughts is scarce and consistent long time-series are hardly available. However, the analyses of drought time series is highly relevant and important in the context of climate change and its impacts. For the development of sustainable risk management strategies for droughts it is important to know how droughts developed over time, and which drivers influenced their temporal dynam-

C1

ics to draw conclusions for the future. Thus, the research question dealt with and the objective of manuscript are innovative and highly relevant. However, I see the following major problems which require substantial re-writing of large parts of the manuscript as well as additional analyses during the revision. Thus, I suggest major revision (or even reject with an invitation to re-submit):

Answer: The authors thank rev1 for the general statements and comments! In the meantime, we revised the whole article along the suggestions; we also added a new conceptual viewgraph to highlight the analytical work-flow and reorganized the whole article along this concept.

1) The development, i.e. calculation of all presented indicators is not provided. It therefore remains rather unclear what their specific meaning and their advantages and disadvantages are.

Answer: We added a new view graph to highlight the whole workflow and especially to present the calculation of all presented indicators precisely (see Figure 2 in the revised MS). We reorganized the relevant paragraph and added the meaning and advantages of the used indicators. We referred to the well introduced modern indices (SPI, Drought Classes of the DWD), which are widely known and used. The historical derived Indices are related to these to get the opportunity to calibrate, connect and compare these.

It would be interesting to know, if all indicators are based on the seven-level monthly indicators for temperature and precipitation, which are included in the [tambora.org](http://tambora.org) database from 1500 onwards, or if additional data and information included in the database has been used.

Answer: We used the seven class hygric index from [tambora.org](http://tambora.org), but also the given information (written evidence) of the impacts on agriculture, forestry, water balance, ecology and socio-economic effects.

The development of the Historical Precipitation Index seems to be the key result of

C2

the manuscript, however, its development is described in one sentence only (lines 161-163). More detailed information is necessary here. The advantages and disadvantages of the developed indicators should be discussed.

Answer: We see the HPI, which is equivalent to the modern SPI, as a key issue, but also as a stepping stone for the derivation of the HSPI (Historical SPIs). This is now much clearer in the new introduced concept figure. The whole structure of the workflow, which is described in the sub-paragraphs 3.1 to 3.9 is much clearer now and more informative.

2) I don't think that the droughts always affected whole of Germany in the same way. Thus, I doubt, that the indicators are continuously representative for whole of Germany. However, no information is given on spatial situation, how many stations are included in the calculation of the SPI, how are these distributed, how was the spatial aggregation undertaken? How representative for Germany is the HPI? How was spatial distributed information dealt with?

Answer: Figure 1 describes the spatial distribution of the historical information. The distribution of the given historical information covers large parts of modern Germany and neighboring regions very well. The modern reference data are taken from the official integrated DWD data for Germany. There were no separate or additional calculations done at this stage.

3) It is additionally unclear for what the presented drought indicators can be used and what analyses can be based on the developed time series.

Answer: The presented drought reconstruction is the attempt to connect the historically derived with the modern indices and categories. Their use is the same as the modern ones, an evaluation of drought in the long-term development.

The calculation of these indicators should be complemented with analyses of the time series and their interpretation. It is quite strange, that the results and discussion section

### C3

is rather a review and quite descriptive text only loosely connected with the indicators described in the methods section. I suggest to rewrite the results section completely. It should present analyses of the developed indicators and time-series and their interpretation.

Answer: We see that this was obviously not clear in the given MS. For this we followed the suggestion and we completely re-wrote this paragraph and re-organized it.

We added trend evaluations and discussed the main long-term, mid-term and yearly variations. We also added the seasonal shifts and discussed it.

4) Also the outlook section is only very loosely connected to the rest of the manuscript. I suggest to completely re-write this chapter. It should rather contain ideas of how to further analyze the developed indicators and/or how these can be analyzed in combination with other drought information. Maybe, a conclusions section would be more relevant.

Answer: We re-wrote and re-organised also the whole section.

Further comments:

Introduction Lines 20-23: These statements should be underpinned with references.

Answer: We added references

Lines 28-30: Statements could be more specific. Long-term reconstructions of what? Why are long term reconstructions necessary from comprehensive risk assessments? Century long time-series are not really necessary for comprehensive risk assessments, rather for temporally dynamic risk assessments.

Answer: We deleted this paragraph, as risk assessment is not in the focus of this article.

Lines 41-46: the statements should be underpinned with references.

### C4

Answer: We added (and moved) the relevant references.

Lines 47-53: It would be interesting to know, which drought indices are characterizing which drought type. If this is introduced in the introduction, this could be picked up later on for the new indices presented in the study, so that it becomes clearer for what the different indicators can be used.

Answer: We refer to different indices as usual in this context. But we decided to use the SPI, because this can be derived with the historical information. We added a short comment on this.

Line 65: Please clarify to which phases you refer here. This is rather unclear. Data is not fully clear to me, if all information/data described in this section is used for the analyses of the manuscript, maybe some more information which data/information has been used for what might be helpful.

Answer: As now outlined in the text and the conceptual view graph, the modern period refers to 1881-2018 while the term historical is related to 1500-1996.

Lines 98-101 This paragraph fits better into the introduction.

Answer: We followed the kind advice.

Lines 117-118. The equation for the calculation of the SPI should be provided or more detail how it has been calculated and on which data specifically. "Official precipitation values for Germany" is not specific. How many stations? Daily values? Spatial aggregation etc. Or was the SPI calculated already and available in the database. This becomes not fully clear here.

Answer: We used the already existing SPI values and drought categories as provided by the DWD. The spatial aggregation etc. was done by the DWD. We think more specification is not needed here, because the references are given.

Line 182-183: It remains unclear how the monthly PIs were summed up to the HPIs

C5

and how these were transformed into SPIs. Is the MDI available in the database tambora.org?

Answer: We described it more clearly in the re-written MS. The code is also available on the Copernicus Homepage under "Assets".

Lines 188-190 it is not clear to me how the HDI was calculated on basis of the HPI. Please elaborate on this and explain better.

Answer: We added a more specific description. Together with the conceptual view graph it should be clear now.

---

Interactive comment on Clim. Past Discuss., <https://doi.org/10.5194/cp-2019-104>, 2019.

C6

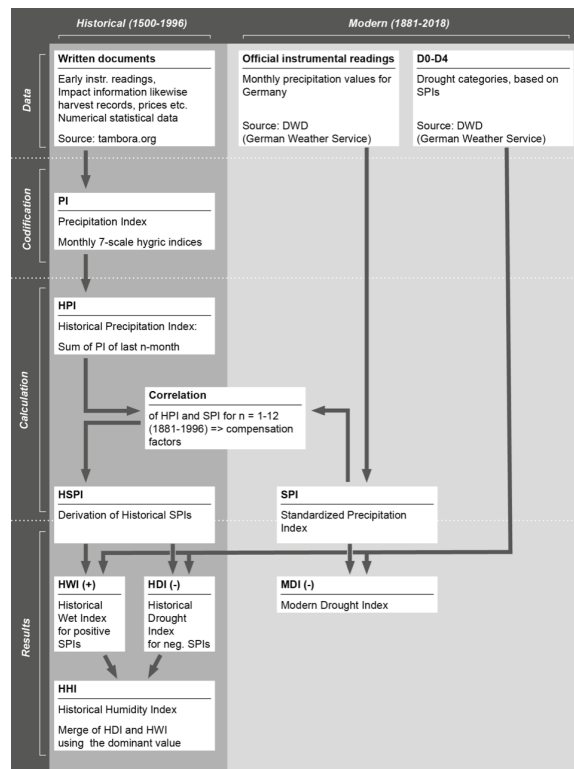


Fig. 1. conceptual design