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Discussions

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Interactive comment on "Heat waves in Africa 1981–2015, observations and reanalysis" *by* G. Ceccherini et al.

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General comments

This paper examines the presence of heat waves in Africa using two different data sources and a novel and robust descriptive metric. Although heat waves are of great importance for human society, the results are unfortunately not sufficiently embedded in a theoretical/practical context. Neither the materials nor the methods are described in sufficient detail to reproduce the results. The findings are salient but very cursory and explained only very curtly, using subjective evaluations to draw conclusions that are not necessarily made apparent to the reader. As such, the paper has the potential of making a relevant contribution to the research community, but I regrettably cannot recommend it for publication in this form.

Specific comments

Overview

All in all, the paper feels very data driven. This might not have been a problem if it were presented in a journal geared toward presenting data sets, and if the data were made available to the general research community, but neither is the case here. The subject matter and results are presented with a very minimalistic embedding in a wider context.

Reproducibility is another issue. The data produced in this study are not made available to the community - it would be a great improvement if this were published somewhere and referenced in the paper. Additionally, the materials used for the paper are not described with enough detail to reproduce the results. ERA-Interim is a large data set. What components were used to compute the maximum and minimum temperature for each day? The assimilation runs? Was absolute temperature at a certain time step or one of the derived temperature variables used? Multiple variables come into question and could arguably make sense, but as this is not explained the methodology is ambiguous.

Also, the conclusions presented in the paper are fairly subjective. In the absence of data, at least tables would be convenient. Instead, the reader is asked to "eyeball" figures. When discussing the findings, the authors mention trends. However, these are not quantified in any way. Quantification of the trends and their significance would provide a necessary measure of objectivity.

Specifics

This is not an exhaustive list.

Page 1, line 10: "The purpose of this article is to show the. . . regime of heat waves. . ." The paper does little to characterize the regime of heat waves. Intra-year variability receives no real mention, and all data is aggregated onto five yearly time scales.

Page 2, lines 7-10: It would be helpful if the relevance of the analyses were explained in greater detail. The authors mention that Africa is vulnerable, but they do not really describe how this study specifically sheds light on Africa's weather in a useful fashion. This is addressed in the conclusions, but in very broad strokes. More concreteness earlier would be better to motivate the reader to invest time in the paper.

Page 3, lines 8-12: If this paper were referring to data found elsewhere, it would not need to be very specific about how the data was computed. However, as the data was computed specifically for the paper, the methodology should be described precisely. The citations are okay, but it would still be nice to see the equations behind the HWMI. The text does not really explain what HMWI measures, and the equations would hopefully make that clear.

Page 3, lines 20-23: These are essential details that allow the reader to understand the meaning of all the numbers discussed later in the paper. What does the classification mean? In which events might one expect to see a heat wave classified as a certain number? Without this information it is very difficult to interpret the results. Sadly, the information is left out.

Page 3, lines 24-28: This leaves the tropics out of consideration. It's understandable that it's hard to touch on every issue when doing a study that compares tropics and two hemispheres but it would be nice to see that mentioned here.

Page 3, line 29: The time shift to compensate for the different seasonal regimes between hemispheres definitely does cause a temporal inconsistency. This is referred to later on in the paper as a possible reason why the northern and southern hemispheres have slightly different results. Therefore "might" is definitely incorrect. It would be better to address this inconsistency in the paper than to simply mention it.

Page 4, lines 8-10: It's not clear what this means.

Page 4, line 13: When describing a trend it would be helpful to include information

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from a trend analysis - a visual analysis is very subjective.

Page 4, line 19: This isn't clear from the figure. Also, if the anomaly might be due to the differing length of the analyzed time series, surely it would be better to correct for this rather than to use it as a possible but unconfirmed reason for the inconsistency. Normalization or truncation of the data are two straightforward, but certainly not the only ways of doing this.

Page 4, line 26: A visual comparison of maps by putting them side by side is difficult. This information should be reduced - for example by providing histograms or change maps. Also, it is unclear what is being compared here. The intensity? Frequency? Spatial distribution? The trend over time?

Page 4, lines 27-28: What is the meaning of the gridded HMWI product? Five years are aggregated to a single map with only the spatial distribution of heat waves of a certain intensity. Does each map signify the highest HMWI computed at a given point over the five year period? Are frequently reoccurring heat events captured on these maps? I suspect not, and that would be interesting information. Regardless of whether or not this is the case, it's not clear and should be. Occurrence, intensity and frequency are all separate attributes of the heat wave phenomenon and would be a good addition to the paper. In general, referring to the percent of land affected by high HMWI is ambiguous. How long does a given HMWI class have to be reached in order for it to be considered affected over the five year period?

Page 5, line 1: The temporal resolution of the reanalysis data should be stated somewhere. This would make it clearer for those interested in reproducing the paper's results, particularly because several options are open.

Page 5, lines 8-10: Again, if a trend is described, it should be described objectively, i.e. with an actual trend analysis.

Page 5, lines 13-14: This is not clear from the figure.

Page 5, lines 14-16: This should be quantified.

Page 5, lines 16-19: This means little without more clarity, either through better explanations or quantification, or in the best case both.

Page 5, lines 20-33: This would have been a very interesting line of investigation to pursue, if some objectivity was provided. There are classic measures for verification that would shed much light on the ability of HMWI to describe heat events observed using other methods - one example is a confusion matrix, but many are available. The passage here falls far short of a true verification. Objectivity and quantifiable conclusions would be a large improvement.

Page 6, line 20: This simply is not the case, no sociological aspects are mentioned.

Page 6, lines 22-23: This would fit better in the introduction to catch the reader's interest and demonstrate the relevance of the study.

Page 6, lines 27-31: Many applications of the data produced in this study are mentioned here, but they are not mentioned in the paper as such. A theoretical section would be helpful and appropriate, otherwise the applications mentioned appear out of context.

Technical corrections

General: The description of the variables is nonuniform. Sometimes it's HMWId_tx, sometimes HMWIdtx, sometimes HMWId TX. This needs to be harmonized.

General: why is the word "reanalysis" always italicized?

Page 1, line 15: "... an increasing numbers..." -> "an increasing number"

Page 1, lines 28-29: This sentence is like many others in the document: grammatically correct but they feel backwards because they begin with a qualifier that describes the action in the sentence. You could consider turning these around.

Page 3, lines 12, 14: Here "according to the methodology described in. . ." might be clearer than "for further details. . ."

Page 3, line 24: here "in" would be more accurate than "between".

Page 5, lines 16-17: This sentence is unnecessary. Figures should be self-explaining where possible with any necessary descriptions in their captions. That way the reader is not required to page back and forth between the figures and the text in order to interpret them.

Page 6, line 28: " improve the observation constrain" - the wording is unclear.

Figure 2: The borders between the classes are ambiguous. 3-6, 6-9, etc. overlap. This should be e.g. 3-<6, 6-<9, if that if correct.

Also, the maps are difficult to compare. Most people have difficulties transferring the information from one map to another for comparison. If you are requiring the reader to overlay the maps in their mind, it is probably better to reduce the cognitive overhead by overlaying the maps in the figure so that they can more quickly recognize what you want to say. Admittedly, by the number of maps here that might be difficult but it's possible.

The histograms are easier to compare, but they are so small that the reader can only draw very basic conclusions from them. Since the histograms are repeated in figure 4, it would be better to leave them off and have a less crowded figure.

Figure 3: See figure 2. Additionally, a much more in-depth analysis would be possible - and it wouldn't need to be difficult! For example, scatterplots of the frequency of different classes of heat events for each station over time would be intuitive to interpret for most readers. They would also present a good opportunity to overlay trend lines produced with regressions, etc.

Figure 4: These plots could be reduced and it would make them much easier to interpret. It is more intuitive to put time on the x-axis than magnitude classes. Differentiating

the magnitude classes through the legend would also be more intuitive.

However, also here a scatterplot would be most helpful, in part because it would allow the visualization of trend lines and also because it would condense the information. Suggestion: Use the x-axis for time. Differentiate TX and TN by color. Use differing symbols for each time period and plot them next to each other with trend lines for each group.

Figure 6: See comments for figures 2, 3. Also, the plot's meaning is unclear. Does each grid point show the maximum HMWId reached in the given time period? What happens with multiple hits?

A more interesting analysis would be to show the likelihood that a given HMWI will be reached across the map, as well as change maps that show how this has changed time. The results could also be used to evaluate the likelihood of heat incidents occurring in major African population centers, etc.

Figure 7: The meaning of "% of Land Area" is unclear. Is this the percent of land area in which a certain HMWI class was reached? The percent that was reached in that class consistently in all years? Etc.

Also note that if you are using the native coordinate system of the ERA-Interim data, these numbers will not be correct, as the grid cells refer to unprojected coordinates whose areas change according to their proximity to the equator.

Figure 8: See other comments for other map figures. Again, a confusion matrix or something similar would be much better than a subjective "eyeballing" of the data.