

Interactive comment on “Predicting climate extremes – a complex network approach” by M. Weimer et al.

Anonymous Referee #1

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Dear Authors,

Thank you for putting forward a new complex network approach to detecting heat waves and for the proposal to use this approach for decadal predictions of heat waves. I think that your paper does convey interesting ideas on both topics but I think that the paper's quality needs to be strongly improved before publication.

1 General comments

First, you should make clearer the intention of your paper. Is your main goal to promote a new heat wave detection method or is it an improved prediction of heat waves? You

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do both in your paper but you do not clearly distinguish these two aspects of your work. Please make your presentation clearer in this respect and note also the last of my specific comments in Sec. 2.1, which is connected to this issue. Following the suggestions in this comment would also have the advantage of enriching your results section, which currently, I think, is a bit thin.

My second general comment pertains to the practical value of your network approach to detecting heat waves for the actual prediction of heat waves. This point is not properly addressed in the current version of your manuscript and I have to admit that, as yet, you have not convinced me of the advantage of your network approach over what you call the standard approach. Let me be more precise and propose a potential solution: In Fig. 4 you show that in the observations there is a relationship between the rescaled (I assume) numbers of heat waves (o) and the rescaled (I assume) correlation thresholds of your temperature networks (W_T). Based on this relationship, please sketch (in words and formulas) how you can forecast the number of heat events with your network approach. I would like to see a plot showing those numbers (not some rescaled or some other strange quantity such as W_T) as obtained with the standard method and with the network method in comparison to the observations.

2 Specific and technical comments

I suggest you make the title more specific because the general problem of predicting climate extremes is not really addressed in your paper. For example, you could change it to “Predicting heat waves - a complex network approach.”

In the following, I will first give comments on the text referring to the respective locations in the format p????l?? (page, line). I will then give comments on the figures.

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2.1 Comments on the text

p1482l10 Please briefly explain the “standard approach”.

p1482l10 The way you word it I get the impression that nowhere the network approach works worse than the standard approach while, in fact, Fig. 7 shows that this is not the case; so please reword.

p1482l22 “have been also followed” → have followed?

p1483l5ff The abbreviations should be in brackets and the explanation in front of those brackets (here and everywhere else in the manuscript).

p1483l23 Do you mean on a time scale/lead time of five years?

p1484l1 “On the other hand”: What is on the one hand?

p1484l19ff Think about where in the manuscript you want to explain why you think your network approach to heat wave detection works. Explain it well in this one place and refer to this explanation from other places if necessary. Right now, you address the explanation in several places scattered accross the manuscript, in part just repeating things, in part adding new aspects; that makes it hard to comprehend.

1486l8–10 Explain the standard approach better please: standard approach to doing what? Are you talking about detecting heat periods or about evaluating a model w.r.t. its ability to detect heat periods?

p1486l13 “the correlation threshold between time series”: I understand what you mean, but you can write this better; please rephrase.

p1486l17 Make clear here an important difference between Ludescher and colleagues’ (2013) approach and yours: They make predictions based on observational data

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alone, i.e. they really use the NETWORK to forecast something while you actually use a CLIMATE MODEL to forecast something and then analyze those forecasts using networks.

p1486l20ff This sounds as if the main reason for a model to under- or overestimate the number of heat waves is a bad simulation of the magnitude of heat waves. Yet later (1488l9-19) you detect simulated heat waves based on the daily maximum temperature percentile corresponding to a 3 K anomaly in the observations, which implies that you correct for a possible bias in heat wave magnitudes prior to detecting simulated heat waves. Thus, your main argument as to why the network approach can be expected to work better than the standard approach (to detecting simulated heat waves) does not apply to the application case presented below...

p1487l5 networks → networks’

1487l7–14 You will get the same relationship between the number of events and the mean correlation if you don’t include heat but cold waves in those gaussian noise time series. So, how can you be sure that when applied to real data, your method detects heat waves and not also cold waves or some other form of spatially and temporally extended temperature anomalies?

p1487l29 I am pretty sure you don’t want to remove the variabilities from the time series.

p1488l19 Why did you expect this?

p1488l22 I assume you mean “simple graph”?

p1489l8 “acceptable results”: What do you mean by that?

p1489l20 You construct one network per JJAS season with roughly 120 days. That are pretty short time series. What about the uncertainty of your estimated correlation coefficients?

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p1489I21 You give an uncertainty here but talk about a constant edge density in the same breath. Please clarify.

p1490I9 The filter is applied to which data?? To W_τ or to the temperature data? And why?? I don't understand.

p1490I11 You apply a 10-year moving average filter to 10 years of data. What do you do at the ends of the time series?

p1490I13 What is the "absolute mean difference"?

p1490I14 "heat periods o ": Do you mean the number of heat periods?

p1490I18 Please use different symbols for (or somehow indicate the difference between) the original and the rescaled m , and similarly for o and W_τ .

p1490I21 Is this the usual way the simulated number of heat waves is evaluated (using the rescaled quantities)?? Does CCLM perform better with respect to the rescaled o 's and m 's than with respect to the unrescaled quantities?

p1490I23 So the rescaled o is compared to the rescaled W_τ here?

p1491I12 Well, the lines in Fig. 4 do not fully match, so the two estimators are obviously not "equivalent". Moreover, is Fig. 4 your "best" example, i.e., how does this figure look like in the other regions?

p1491I26 "based on normalized time series": Which time series were normalized how?

p1492I5–7 It would be interesting to see where the error of the network approach to heat wave detection comes from in the different (r, d) cases. There are two possibilities, as far as I can see:

1. the network approach to heat wave detection does simply not work

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2. the network approach to heat wave detection does work but the CCLM simulations are bad

You can check which possibility applies to which case by comparing $M_d^r(W)$ with W_τ based on CCLM data (let me call this M_{CCLM}) to $M_d^r(W)$ with W_τ based on E-OBS data (as in Fig. 4; let me call this M_{EOBS}). If M_{CCLM} is similar to M_{EOBS} we have possibility 1 while if $M_{CCLM} \gg M_{EOBS}$ we have possibility 2, right?! Please do this analysis and discuss your findings.

2.2 Comments on the figures

Fig. 2 The difference between subplots a) and c) is not well visible. I'd recommend you make the difference more pronounced.

Fig. 4 Explain in the caption what the $M = \dots$ are.

Figs. 4–6 Why do the o time series jump between decades?

Fig. 5 Are these the original or the rescaled o 's and m 's? (See my comment on p1490I18; introduce new symbols for the rescaled quantities and use them where applicable.) Why do you use different scales for o and m ?

Figs. 4, 6 Same question as for Fig. 5 (with W_τ in place of m).

Fig. 7 Could you please make this comparison more quantitative, e.g., by writing the values of $M_d^r(m)$ and $M_d^r(W)$ into the respective (r, d) boxes.