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Earth System Dynamics Discussions

Interactive comment on "Refining multi-model projections of temperature extremes by evaluation against land–atmosphere coupling diagnostics" *by* Sebastian Sippel et al.

Anonymous Referee #1

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The paper "Refining multi-model projections of temperature extremes by evaluation against land-atmosphere coupling diagnostics" uses temperature and ET to explore the land-atmosphere interactions during heat waves in models. It then uses the derived coupling metric to constrain the CMIP-5 models and show that the constrained ensemble provides better representation of heat waves. Overall the paper is interesting and should be published, however it is poorly written in that there is insufficient justification of the methodology, overuse of supplementary figures and a lack of discussion and analysis. This makes the paper difficult to follow and understand. The authors present too much material and they need to trim it down to provide a strong and concise message. Therefore, I am recommending that the paper needs major revisions

before it is published. The specific comments that motivated this decision are given below.

Specific Comments:

Pg. 2, lines 3-7: This description makes sense but I cannot see the connection between this description and the and the "conceptual" Fig. 1a,b. It may be conceptual for the authors, but there needs to be more description about what each of the symbols in the figures means and how it connects to the description in the text. Specifically, what is the difference between a thick and thin arrow, curved versus straight, positive-negative sign, square, circle, rectangle and different colors. There is a lot going on in the figure and it is hard to know what is important and what is just there for aesthetic purposes.

Pg 4, line 12: Why use the old version of the NCEP reanalysis and not the CFSR? Why not use datasets with consistent temperature, evaporation datasets like MERRA and CFSR. These datasets have both temperature and evaporation. Why would you expect ET from one dataset to be correlated with T from another? There needs to be more discussion on this.

Pg 4, lines 19-20: Make sure to reemphasize this when discussing the results.

Pg 4, line 28: This is a good use of supplementary material as there is sufficient description to know that it contains a list of the 37 models used, but it is not necessary for understanding and interpreting the results of this paper.

Pg 4, lines 28-30: This is an important assumption for this study and the description is a bit vague. What does "tend" mean? It would be better to provide some sort of quantitative measure of the variability across ensembles. Is this true for all locations? Given the importance of this assumption there needs to be further analysis and discussion as to why you think this is a reasonable assumption.

Pg 6, line 2: I find this equation and description extremely confusing. It took me several times of reading the text to understand the metric. I am still have no idea of what is

represented in the equation particularly in the summation. Where does the 1 come from and why does it have a subscript? The equation is more confusing than the text and does not help at all with understanding the metric. From what I understand from the metric, the VACb gives the percent of the highest 30% of temperatures that correspond with highest 30% of ET, while VACc gives the percent of the highest 30% temperatures that correspond with the lowest 30% ET. It is difficult to remember which was VACb and VACc. It would be helpful if there was naming convention that is more descriptive instead of b and c.

Pg 6, line 10: I thought Fig 1a,b was just a conceptual example, how does this connect with the simple example of monthly time series referenced here? It seems to me that Fig 1a,b are completely unrelated with the rest of the figure, so why put them together? If they are related, then there needs to be more description as to how they are connected.

Pg 6, line 14-16: "Might" is not very reassuring and is an inherently weak argument. Correlation is also universally known and if you use a rank correlation it can also pick-up on the non-linearities.

Pg 6, lines 16-19: Not sure what this means. This needs more discussion. Also, this is an inappropriate use of supplementary information. There is no information about what is plotted in S1. Furthermore, this seems like an important justification of the methodology and should be included in the text.

Pg 6, lines 18-19: If it yields quantitatively similar results then why bother with the VAC? It is much easier to understand correlation. What about the significance level for the VAC? Is there any way to statistically quantify the significance of the VAC as to provide some level of confidence? If not, that is a major disadvantage over a traditional correlation metric and needs to be discussed. I am not against using the VAC, but as presented here the justification for using it is extremely weak. You need to convince the reader that this obscure metric is worth using.

Pg 6, line 20: This is a reasonable use of a supplementary figure because it provides more depth to the analysis, but is not directly necessary for understanding the paper. It could be improved by providing a better description. For example, "the model evaluation as shown in Fig X is presented for a 90th percentile threshold in Fig S2 and shows . . ." If this figure is completely different from any other figure presented in the text, then you need to include a more descriptive discussion about it in the text.

Pg 8, lines 4-5: A figure is not a reference, don't use it like one. There needs to be discussion about the figure and what it shows. Parts a and b need to be explained more. I am unsure as to what the different shapes represent and the colors.

Pg 8, line 10: Fig. 3b does not say Pearson correlation, make sure it is consistent with the other plots.

Pg 8, line 25: It is ok to reference a figure like this if you have already discussed it but since this is the first time that fig 4 has been mentioned you need to describe what is being plotted. Also, this is an inappropriate use of supplementary material. There needs to be explanation in the text. How does it differ from what is being plotted in fig 4a-b. Seems like the authors are using supplementary figures instead of actually discussing the important aspects of the analysis.

Pg 8, line 31: I think Fig. 4 is the best and most impactful figure in this paper. Make sure that you emphasize its importance.

Pg 9, line 2: What does "substantially" mean? Is it significant statistically speaking?

Pg 9, line 25: Again there is no information about what is plotted in the figure and the text makes it sound relevant for understanding and interpreting the results for this paper and therefore it should be included in the actual paper and not as supplementary material.

Pg 10, Line 3: Again, supplementary plots are not a reference. There needs to be an explanation of the figure.

Pg 10, Line 8: If you reference the same supplementary figure more than once, then that is a good indication that it should be included it in the text. There is more discussion in the text on S13 then on Fig. 5.

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