**Climate
of the Past**

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Discussions

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Interactive comment on "The ENSO teleconnections to the Indian summer monsoon climate through the Last Millennium as simulated by the PMIP3" *by* Charan Teja Tejavath et al.

O. Bothe (Referee)

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Dear authors,

In your manuscript "The ENSO teleconnections to the Indian summer monsoon climate through the Last Millennium as simulated by the PMIP3" you present results on the relation between the El Niño Southern Oscillation (ENSO) and the climate on the Indian subcontinent during the Indian Summer Monsoon (ISM) season in simulations over the last millennium. You find differences in the occurrence of El Niños and La Niñas between warmer and colder periods during the last millennium, i.e., between your definition of the Medieval Warm Period and the Little Ice Age. You find differences

in ISM rainfall (ISMR) between these two periods. You find different efficiencies of El Niño and La Niña in influencing Indian climate between both periods. You analyse the velocity potential between both periods and identify changes in the Walker Circulation.

As for the two previous versions of the manuscript there are various small issues which in parts have already been identified by the editor in his initial evaluation of your manuscript.

I ask you to also address all the editor's comments in an upcoming revision.

Further, I see one larger problem with the manuscript, which I assume to require a major revision before your work may be considered for final publication.

My comments are:

1   Major:

You still use all events larger zero in the analyses leading to Table 4 and related results (see Page 11 Line 6ff). This still incorrectly puts neutral ENSO events in one of the categories of El Niño or La Niña. Please redo this with your latter classification using an 0.5 standard deviation criterion. Relatedly it is unclear what you mean by all El Niños or all La Niñas later in the manuscript thus making it impossible to evaluate whether the description of your results is correct.

2   Minor:

Your focus on anthropogenic forcings (e.g., Page 2 Line 8) appears as if you are ignoring natural forcings. Overall this is not the case, but by already starting the introduction this way it gives the reader this impression.

P3 L32: As in previous versions, it remains unclear which modelling studies you mean here.

P4 L1: You do not really reconcile simulations and proxies.

P6 L12: As your bootstrapping procedure still remains unclear, I think the reader needs more details.

Please ensure that Figures which are essential for your argument are part of the general manuscript while those only of supporting relevance are in the appendix. For example, is Figure A1 correctly placed in the Appendix or should part of it be in the main manuscript. Similarly, is Figure A2 essential or not? Please check this for all Figures.

P6 L21ff: I don't understand the reference in this sentence. If I understand it correctly, you refer to the Figures of Stocker et al. (2013) and IPCC (2013). Then you should put them as, e.g., Stocker et al. (2013, their Figures ....).

P6 21ff (and elsewhere): I still don't get the point of most of your discussions of standard deviations. This is especially the case here, where I don't see whether this is your result or an IPCC-result or a result of Stocker et al.

P6 L28: One cannot really identify the trends from this Figure.

P7 L1: This is hardly visible in the Figure.

P7 L17: I cannot follow your writing of "seven (five) models". Figure 1 shows 6 significant models - though it's unclear at which level.

The legend for Figure 1 and its caption contradict each other with respect to which significance level is shown.

P7 L30: Maybe it would help to state your criteria earlier.

P8 L5: I think the formulation "of the corresponding statistic" is ambiguous. Maybe try

to clarify.

P8 L10: I'd like to note again as for the previous version: If I see it correctly, you use the GISS data uncorrected (compare https://www.clim-past-discuss.net/8/C393/2012/cpd-8-C393-2012.pdf), I don't think that's too much of a problem, but you may note this somewhere. Sorry, that I didn't note this in my first review.

Paragraph: P8 L17ff:
Calculating anomalies is a standard procedure. You don't tease out the signal with it. You just visualize the evolution more clearly.
The reference to seasonal prediction is unnecessary.
If there are outliers, then there are two outliers viewed globally. However, I don't think you validly can call them outliers especially considering that the models' 20th century evolution are much closer to each other than the past millennium data suggest. I also wouldn't speak of bias here.

P8 L25: You do not show this agreement with (paleo-)observations.

Paragraph P8 L29ff: The discussion of the climatology-temperatures are interesting, but don't serve a purpose. We learn something about the models, but not about your topic. Further, line 32, it is not "interestingly", but obviously that the anomalies align better - you removed the climatological mean from the series.

P9 L1: We know which volcanic eruption it likely was. See https://doi.org/10.1073/pnas.1307520110, https://www.nature.com/articles/srep34868, doi:10.1038/ngeo2875. We also know that other volcanic eruptions resulted in potentially decades long cooling episodes. One example of a potential reference is doi:10.1038/nature14565.

P9 L6: Well, some agreement. Are there further paleo-observations to show the agreement?

Figure A3: What is plotted here? Global or Indian temperature? Is panel (a) just copied

from the original publication or did you produce the Figure yourself. It looks strange. If you just adopt it, the publisher probably has to check the copyright?

P9 L12: Do you mean "MPI shows an insignificant weak decreasing trend"?

P9 L15: I wouldn't speak of a limitation in this context. A spread is expected, the difference in signal between different periods may be seen as a limitation.

P9 L22: I only count 5 simulations.

P9 L24: I don't think the comparison of absolute values between different time-periods between historical observations and the simulations is valid. If you also provided the difference between the historical simulations and the historical observations, one could evaluate it against the general precipitation bias.

P10 L7ff: I wonder under which circumstances the Indian subcontinent could have a colder absolute mean temperature than the globe as a whole. That is, I still don't see that this paragraph tells us anything of relevance.

Paragraph: P10 L11: If the standard deviations didn't change much, why is there a need to discuss them?

P10 L29ff: If I understand you correctly, you're saying that the bootstrapping shows that the difference between correlation coefficients is significant in a number of models. Are you saying that the 0.05 in Figure A7 is the significance level? If so, please highlight it more clearly. This is the interesting result of the bootstrapping. Maybe it's just the caption that is unclear.

My major concern implies that I don't think the sentences P11 L10 to L16 are valid as long as they relate to all events.

P11 L14ff: The sentence should qualify that this holds for some simulations. Anyway, I am not sure I can follow your argument or even what you are referring to. Let me summarise what I see from your table - if I counted correctly: In the MWP there are in

all models more El Niño (EN) than La Niña (LN). In the LIA five models have more or equal number of LN than EN. Two have more EN than LN. The absolute difference in numbers between both types of events is larger for six models in the MWP and for one model in the LIA.

P11 L16ff: Didn't you state the BCC result in line 12 already?

P11 L22: I am not sure whether the comparison between long term means and inter-annual variability is helpful.

P14 L16ff: Different resolutions and structures of the models imply that patterns of change are not exactly the same - especially for precipitation.

P14 L26: Your comparison is to the Last Millennium, isn't it? Thus, you cannot diagnose change relative to the historical period from this Figure, can you?

L14 L26ff: This equatorial Indian Ocean change is hard to identify. It may be helpful to elaborate what you are referring to.

P15 L3: A 0.2 level is rather uncommon.

P15 L8: Which negative correlations are you talking off? You don't show these, do you?

P15 L8: You mention the JJAS season, but do you show anything about the LSTG-ISMR-relationship then?

P16 L1: Well, there are more climate forcings than just the anthropogenic.

P16 L14ff: This sentence is still not relevant.

P16 L20: What do you mean by: "statistically significant . . . in comparison to the current day climate"?

P16 L24ff: You find this modulation in some simulations.

P16 L27: Does this refer to all events? If so, my major concern applies.

P16 L28: Why is it "despite" the occurrence?

P16 L28: Is this relatively high compared to the Last Millennium? Did you present this change relative to the full period?

P17 L5: What do mean by "the spatial distribution . . . is . . . higher"?

P17 L18: Does this relate to all events including neutral? See my major concern.

3 Technicalities:

Please improve the quality of the Figures. For example, produce them in the correct aspect ratio and do not rescale them in a graphics software.

Please be consistent in using Figure or Table AN or SN, i.e., please check that you always use the abbreviation A for Appendix.

There are a number of typos etc. but I leave those for the copy-editor. There are also further unclear formulations. Some of these appear to have survived from the last two revisions.

P6 L30: Remove "We revise the text accordingly"

P8 L25: I again think your reference is incorrectly formulated here. There are further instances of this.

P11 L23: This sentence is already in the beginning of the paragraph.

P12 L14: Please check that this paragraph, the captions, and the content of Figure 5 and Table 5 are correct.

Paragraph P13 L23ff. Shouldn't this come before the Paragraph P13 L10ff?

Figure A15: The second Figure A15 should be Figure A16, I guess.

P15 Footnote: This should be Figure A16.

P15 L27: I would write "such as volcanic eruptions" instead of "such as more volcanic eruptions during the LIA".

P17 all: You mix the results for Temperature and Precipitation in a way that may confuse the reader. Restructuring this section may help.

P17 L18: seven out of seven should possibly read all?

Best regards

Oliver Bothe