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Interactive comment on "The Indian summer monsoon climate during the Last Millennium, as simulated by the PMIP3" *by* Charan Teja Tejavath et al.

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Dear authors, and dear editor,

Regarding your manuscript titled "The Indian summer monsoon climate during the Last Millennium, as simulated by the PMIP3" (cp2017-24), I see a number of problems which you have to resolve. I'll detail these below. I am not quite sure whether I should recommend rejection or whether these concerns can be addressed in a substantial revision.

Let me first state, that a thorough analysis of the Indian Summer monsoon in the PMIP3-past1000-ensemble would be a valuable contribution to our understanding of

the climate of the past millennium.

Note to editor and authors: Please crosscheck the data mentioned on page 5 line 8 with the data-availability-requirements of CP.

Main concerns:

You present a set of simple correlation analyses, the frequency of ENSO-events for different periods, and the velocity potential over these periods for the PMIP3 multi-model ensemble. I am not sure whether this set of analyses is substantial enough to warrant publication.

Not least if I understand your analyses correctly - but you obviously can prove me wrong - parts of them are inappropriate or wrong which has implications for the results.

First, you diagnose differences in correlation coefficients between two periods. However, Gershunov et al. (2001, http://dx.doi.org/10.1175/1520-0442(2001)014<2486:LFMOTE>2.0.CO;2) and others discuss how correlation coefficients can change over time without a change in the underlying relation. My impression is, that maybe one if any correlation-difference may be significant in your analyses.

Secondly, if I understand your analyses of the ENSO-frequencies correctly, you do not identify differences in La Nina and El Nino frequencies but just diagnose differences in the mean background state.

This implies, I am sorry to say, If I am correct, that two of your three main results are incorrect.

Further concerns:

I am not sure your use of the Multi-Model-mean is appropriate. I think for most of your analyses the spread and the differences between the models are of interest and the multi-model-mean analysis is not necessary. For example correlating the MMM-ISMR- and MMM-NINO3.4-indices seems not very meaningful. As another example, I am not

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sure, the premise of the paragraph on Page 6 Line 8ff is valid.

You often refer to proxies but don't show any comparisons at all. For example on page 12 line 3, it would help to be able to make the comparison directly or at least in an appendix.

P7L14 and L16: I do not see the decreasing precipitation trend. If it is there, please quantify it more clearly.

P12L7: I'd like to repeat, that I don't think these correlations mean much for the multi-model-ensemble-mean, as you don't identify the relation between ENSO and Indian climate by this, but just the common long term relation between the global mean and both the ENSO-region and India.
Additionally, the correlation coefficients are generally rather small, which to me also indicates that, at least for temperature, you just capture the concurrent relation between TG and TI and TG and NINO34.

Furthermore, you make some additional inferences which I would call wrong or at least your analyses do not warrant them, e.g.:

P11L25: "All this suggests a better agreement among the models in simulating the long term trend in rainfall over India relative to the variability during the MWP and that during the LIA."
I don't think your analyses allow to infer this.

P13L10ff: "we surmise that Indian Sub-continent was warmer (relatively cooler) during the CE 1000-1199 (CE 1550-1749) than the many other regions of the globe".
I don't understand how you come to this assumption, but I don't think you can infer this from comparing one regional series with the global mean.

P14L3: "More importantly, these results suggest that any long term weakening between the ENSO-Indian summer monsoon (e.g. Kumar et al., 1999; Ashok et al., 2001) is not necessarily due to anthropogenic climate change."

It's not that this isn't a possibility but from my point of view your data and your analyses do not give any indication of this, they in my opinion don't tell you anything at all about this.

P14L21: "It is known that the El Niños (La Niñas) cause anomalous increase (decrease) in global temperature. Therefore, a predominant presence of higher number of simulated El Niños as compared to La Niñas in almost all the models is the reason why the simulated MWP is warmer as compared to the LIA. Given this agreement across the models, we can surmise that, in real world too, the MWP is likely due to the occurrence of a relatively higher frequency of El Niños as compared to the La Niñas"
a) Can you give references for "It is known . . ."
b) You do not identify a change in frequency of El Ninos but just describe the temperature change in the background state.
c) That is, the MWP in the models isn't warmer and LIA isn't colder because of ENSO. Rather your analysis just describes the warmer MWP and the colder LIA.
d) Thus your inference is circular and in this context very likely wrong.

P19L2: "Our analysis of the PMIP3 datasets suggests that the Indian region was likely warmer than the global temperature during the MWP."
I don't think your analysis suggests this.

Minor points:

Is the title appropriate? I would say, you discuss more the ISM-ENSO relation than the general state of the ISM.

I would suggest to drop the MIROC-simulation completely from the paper. It is enough to mention from the start that you don't use it, because of the known problems with the simulation. There are a number of references available, I think.

I found the manuscript in parts hard to read, thus I would suggest to check where things could be rewritten to make the manuscript more clearly readable.

Page 1 Line 24: The models can't confirm the proxy-data, they can only be consistent with them or, if you insist, can agree with the proxies.

P2L11: What do you mean by "there is no apparently significant change in the external climate forcing from the first half of 20th century"?

P3L5: Is this full paragraph relevant for this paper?

P3L33: Please give a reference for PMIP3.

P4L19ff: I don't think you validate the models

P4L33: The correct references for the PMIP3-past1000 simulation-setup are Schmidt et al. (2011, doi:10.5194/gmd-4-33-2011) and Schmidt et al. (2012, doi:10.5194/gmd-5-185-2012)

P5L6: I don't think ERA-Interim goes from 1900 to 2010?
P5L8: Can you please provide a reference for the IMD-data? And is this data publically available? If yes, please provide a URL, if not please provide contact details where the data can be obtained. [Dear editor, please crosscheck this with the data-availability-requirements.]

P6L33ff: Is this relevant? What does this imply?

P7L11: You do not plot events but just the 11-running means which possibly masks the higher frequent ENSO-variability.

P8L18: You shortly write about standard deviations here and elsewhere. From my point of view, it does not become clear, what's the point of these discussions.

P10L16: Which models are these outliers, what is the bias because of which you call them outliers, where do you show this?

P11L2: Much of what you describe here for the global temperature is in the IPCC and other publications.

P11L18: I do not see these decreasing ISMR-trends, please clarify.

P11L20ff: I cannot really follow the premise of this sentence.
P11L22: Why would we "expect" this?

P12L11: I think you mean "1000-year".

P13L1ff: Maybe I miss something why are these statistics of interest/relevant?

P13L17: What do you mean by "realistic"?

P13L19: GOALS should read FGOALS.

Your Figure 7 does not show the ensemble but only one model, as far as I can see.

P15L4: What do you mean by this "discrepancy".
P15L5: What kind of "factor" is this "discrepancy" meant to be?

P17L7: Maybe you should discuss the different models first before writing about the composite.

P19L29: Can you provide a reference for this cautionary note.

P20L8: Maybe I missed it in your results-section but I think you should discuss these contrasts between the LM-relations and the modern relations in more detail and possibly show them in Figures or at least supplementary materials.

The Figures produced with GrADS are sometimes of suboptimal quality. Furthermore I recommend to change the color scale which is rather easy in GrADS if I recall correctly. The reason for this is, e.g., https://www.climate-lab-book.ac.uk/2014/end-of-the-rainbow/.

It is often unclear whether MMM refers to the multi-model-mean or to the multi-model-ensemble, its members, or its spread. One example is on page 8 in line 11.

Please do not insert tables as pictures into the manuscript.

You quite often put words or sentences in italics to emphasize them. I think this is unnecessary.

Please be sure that you refer in the text to the correct figures and tables.

I think you have to cite Rehfeld and Laepple (https://doi.org/10.1016/j.epsl.2015.12.020) in your paper.

I won't detail typos etc., as I think the CP-copy-editor is going to deal with them - but there are a number of them.

In conclusion, I recommend you concentrate on the dynamical differences between a/the warmer period/s and a/the colder period/s of the last millennium and their implications for the Indian Summer Monsoon, as this would fill a gap in our studies on the last millennium in simulations.

Best regards

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