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Interactive comment on "Overview of the Global Monsoons Model Inter-comparison Project (GMMIP)" *by* Tianjun Zhou et al.

Tianjun Zhou et al.

chenxl@lasg.iap.ac.cn

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Dear Annalisa,

Thank you for your constructive comments. For reading easily, we copied your comments in italic.

General comments:
1 - Why the term "global monsoons" is plural? The global monsoon represents the global hydrological cycle and it is very important/interesting to have metrics to consider it as a single phenomenon. Nevertheless it is composed by the regional monsoons. I think it is important to stress on the manuscript the need to have both, as this would help merging the contribution from the different communities dedicated to the regional monsoons (actually this is done in some parts, I would check it to be consistent in the

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Discussion paper

whole manuscript)

Response:
Here is a clarification for the terms “global monsoon” and “global monsoons”. In the revised manuscript, we use “global monsoon” to highlight the consistent changes of all regional monsoons at longer time scales, and the role of the monsoon system in the global hydrological cycle; whereas we use “global monsoons” to highlight the regional features of different monsoons and the contribution of regional monsoon systems to the global hydrological cycle **(P2, L14-17)**.

2 - In the Introduction the issue of the recent observed decrease in precipitation over India and the tendency of the coupled models to have increased precipitation when the atmospheric CO2 increases should be discussed (i.e. issues of thermodynamical versus dynamical changes in precipitation as discussed in Cherchi et al., 2011 and in Endo and Kitoh, 2014 for the different monsoon regions) - see references: Cherchi et al. (2011) Clim Dyn 37 83-101 doi:10.1007/s00382-010-0801-7; Endo and Kitoh (2014) GRL 41 1704-1710 doi:10.1002/2013GL059158.

Response:
Thanks. This has been revised as suggested and the relevant papers have been cited **(P3, L14-18, L25-27)**.

3 - Table 1: a useful information that should be added in this table and that should be mentioned in paragraphs 4.2 4.3 4.4 and 4.5 is the models involved in GMMIP that will be also involved in the other respective MIPs. This would help to know how many models (i.e. how large will be the sample) could be included in the comparison

Response:
This is a good idea, but other MIPs do not provide the model information in their papers or websites, except for HighResMIP. We hope we can provide this information on the GMMIP website, pending the publication of CMIP6 documentation papers.

4 - You should specify if you have specific requirements for the variables (and respective time-frequency) that should be saved as output from the GMMIP experiments (they should be listed in the manuscript)

Response:
The recommended variables and time frequency of model output are now listed in Appendix II **(P13-16)**.

5 - You should specify what specific criterion should be used for the TIP-NSH experiment (tier-3) to cut off the sensible heating from the selected regions

Response:
This has been clarified **(P7, L6-8; P25)**.

Some technical corrections:
Page 1, line 20: change "during" with "in"

Response:
Corrected **(P1, L20)**.

Page 1, line 23: remove the comma after the word "DECK"

Response:
In the CMIP6 framework, the “historical” simulation is not on the list of DECK experiments (see the overview paper of CMIP6, Eyring et al., 2016), so we have separated them with a comma.

Page 1, line 27: I would use "benefit monsoons prediction .." instead of "benefit monsoon prediction .."

Response:
Corrected **(P1, L27)**.

Page 2, lines 15-18: I think that in the Introduction the issue of internal feedback should be separated from that of external driven processes, and discussed in more detail

Response:
We have re-organized the paragraphs **(P2-3)**.

Page 6, sections 3.2 and 3.3: what are the initial conditions for these experiments? how long are these experiments? I would suggest including these information also in the text not only in the table

Response:
Added **(P6, L10-12)**.

Page 7, line 5: what do you mean by "standard CMIP6 horizontal and vertical resolutions"

Response:
This has been revised to “the same resolution as used in DECK” **(P7, L15)**.

Page 7, section 4.1: the chain of comparisons between different experiments is a bit confusing. Consider rewriting the paragraph. More for the comparison of Tier-2 experiments with pre-industrial and historical simulations, please consider that in the former (tier-2 experiments) you have prescribed SST in selected regions but you have also the contribution of anthropogenic GHG and aerosols

Response:
Related parts have been rewritten. The Tier-2 experiments are assumed to have “real” forcing signal and decadal drivers in the ocean. Thus comparing it with pre-industrial simulations would allow us to check the role of external forcings, while comparing it with historical run would allow us to check the roles of internal decadal modes, e.g., IPO and AMO **(P7, L22-28)**.

Page 7, lines 28-29: not clear, please rewrite. Why high resolution in the mid-latitudes?

Response:
This has been rewritten **(P8, L12)**.

Page 7-8, section 4.3: It should be mentioned in the manuscript that in HighResMIP the SST used to build the AMIP experiments will be used as daily mean, differently from the other AMIP protocol. This should be considered also for the kind of comparison that would result. Also in HighResMIP the aerosols would be sort of prescribed (mandatory use of MPI simple plume module for anthropogenic aerosols). This should also be mentioned and discussed in terms of possible comparisons with GMMIP experiments

Response:
These points have been clarified in the revision **(L8, P13-16)**.

Page 8, lines 24-26: this could also be a hard comparison because of the specificity of the HighResMIP experiments as mentioned in the comment just above. You should mention what kind of specific metrics/analysis could be used/you have in mind for this comparison?

Response:
Yes. The statement has been revised to "A comparison of CORDEX2 evaluation framework experiments forced with daily mean SST to HighResMIP Tier 1 runs over global monsoon domains will provide information on the similarities and differences of the added values derived respectively from high resolution global models and regional climate models." **(P9, L12)**

Page 9, line 7: "ACGM" should be "AGCM"

Response:
Corrected **(P9, L23)**.

Page 9, lines 7-9: both 20CR and ERA20C are global atmospheric reanalyses that assimilate only the surface pressure (and the SST are prescribed)

Response:
This has been revised **(P9, L23-24)**.

Page 9, line 7-8: you should include references for 20CR and ERA20C

Response:
References added **(P9, L24)**.

Page 9, line 15: "global monsoon" instead of "global monsoons"

Response:
As in the response to your first comment, here we use the term “global monsoons” to emphasize different monsoon domains.

Page 11: "Data availability" should be an appendix, I guess (see also general comment above for specific requirements on variables and related time frequency)

Response:
The location of “Data availability” is suggested by the CMIP6 special issue organizer. We added a part to show data requirements in the appendix II **(P13-16)**.

Page 11, line 25: insert "coupled" between "historical" and "simulation"

Response:
Done **(P12, L13)**.

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