

## **Response to Referee #1 (in blue italics)**

This paper provides a first overview over temperature and precipitation projections from the ScenarioMIP simulations conducted for CMIP6. As such, it is more of a documentation than a cutting edge research paper, in part also because many of the CMIP6 results are very similar to CMIP5. However, I think this is ok given the clearly defined scope of the paper and the assumed goal to support the AR6 process.

*Thank you, indeed that is the nature of this overview paper, which also serves the purpose of involving and acknowledging the representatives of the modeling centers that participated in our MIP.*

The paper is well written with clear figures and sound methods.

*Thank you, we aim at providing all the scripts to reproduce the analysis and figures of the paper.*

I have a few minor comments that could be considered before publication.

Minor comments:

L130-: is there a reason these papers aren't cited in the classic style with "XYZ et al."?

*This was an oversight at least in part. A couple of links are meant to remain as such, because they are pointers to the ESGF inputs4mip downloadable data. The links to papers are indeed going to be substituted by citations according to the standard style in the final version, correcting the oversight.*

L147-: nothing wrong with this paragraph given the high level nature of the study, but I think it would still benefit the reader to end the introduction with a set of specific research questions that are being addressed in this paper.

*We agree and will reformulate the paragraph in the style suggested. It will read as: "In this study, we focus the analysis on the future evolution of average temperatures and precipitation. We address questions regarding the strength of the signal under the different scenarios and compared to similar CMIP5 scenarios, the identification of the time of separation between the temperature trajectories under the different scenarios, and the time at which they cross global warming thresholds. We also analyze spatial patterns of change addressing questions of robustness between the CMIP5 and CMIP6 multi-model ensembles, and within the CMIP6 ensemble among models and scenarios."*

L205: "likely conservative". I think I know what the authors are trying to say, but I still think it would be clearer to be explicit and say "underestimated" and maybe also briefly explain why.

*Agreed. We will rephrase as in: "likely underestimated, given that we are using only one run per model, while larger initial condition ensembles would better characterize each model's internal variability."*

Paragraph on L223: Possibly relevant paper, although conceptually similar to Tebaldi and Friedlingstein: Marotzke (2019).

*Thank you, we will add this citation.*

Generally, figure labels are too small. White space between panels could be decreased to make maps bigger and better readable.

*We plan to redraw all figures updating the content as a few more models have contributed their output to the ESGF in the intervening time since the paper was submitted. We will make use of this suggestion as well while doing that.*

Fig A5 is insightful and given its relatively detailed discussion in the text, I suggest to add it to Fig 2.

*It was actually like that in a previous version and we will be happy to reinstate it!*

L325: ok, but how about a simple difference maps of CMIP6-CMIP5?

*Good point. We will add the two difference plots under Fig3.*

Fig 4b: could the Tokarska constraint be applied to CMIP5 as well to show that it makes less of a difference in CMIP5 (as expected)?

*We have been remiss in a thorough discussion of this result and we plan to expand on it in the next version. Katarzyna Tokarska is now a co-author, and we will show the result of applying the constraints also to CMIP5, placing the corresponding brackets on the right-hand plot of Figure 4. These will show that the effects of applying observational constraints to CMIP5 is significantly less consequential. We will discuss this in the text, where appropriate.*

L465: Semantics, but technically if the reference period is 1995-2014 and thus its mid year is 2004, then the models have 16 years, not 5, to reach 1.5\_C.

*Good point. After reading that sentence again we decided to limit the parenthetical to pointing out the last year of the historical period, in order to avoid complications. We have however added some more caveats and discussion of these results, pointing at the possible discrepancies between observed and modeled trends in the years between 2014 and 2020, the tendency of some of the models to warm fast, and the differences between projected and observed forcings.*

L510: this is indeed new, to me at least. Doesn't look like there was such a coherent signal in CMIP5 models (Pendergrass et al. 2017). It is also a bit counterintuitive perhaps, but definitely plausible. A little more context on the history of this (why is the result new?) and maybe maps to indicate where this is most likely to originate from would be appreciated.

*We have found some work that discusses this type of outcome in models, and traces it back to the diminished gradient from equator to poles and other aspects of the warming planet, like reduced albedo variability in high latitudes resulting from melting snow and sea ice. We plan to expand on this paragraph by citing these papers and elaborating on the origins of this phenomenon. We won't be calling it 'new' anymore. Our understanding from the literature and the fact that the signal emerges strongly after time averaging makes us doubtful that we would see a spatial signal of temperature variability straightforwardly. We would submit that a thorough investigation of the sources of this behavior is beyond our scope here, and think it warrants a study of its own, focusing on processes and dynamics (and if possible involving more models).*

L520-: This recent paper could provide some more context here: Milinski et al. (2019)  
The discussion section is a bit light on references to other papers. I don't want to provide a list, but I trust the authors are able to do a better job at this given their collective expertise. One specific paper that is interesting but still relatively new: Parsons et al. (2020)

*Thank you, we will add these references and rally the co-authors to provide more.*