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Interactive comment on “The PMIP4 contribution to CMIP6 – Part 3: the Last Millennium, Scientific Objective and Experimental Design for the PMIP4 past1000 simulations” by Johann H. Jungclaus et al.

Anonymous Referee #2

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In this manuscript the authors describe the major goals of the last millennium experiments within the forth phase of PMIP, and the experimental protocol that have been proposed to address them. This is an important well-organised initiative that will shed new light on both the internally driven and externally forced contributions to the climate of the last millennium, and will complement other additional efforts by the paleoclimate community (e.g. PAGES2K).

Therefore, I find the article timely and worthy of publication in Geoscientific Model Development. The paper is well written and the experimental protocol is well justified

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and thoroughly explained. There are, however, some key choices of the experimental setup that could be better highlighted (see points below).

I thus recommend acceptance pending a few minor clarifications and comments that would need to be addressed.

Specific comments:

#1 I think that the article would benefit if the default forcings for the Tier1 experiments were more clearly synthesized, e.g. summarized in a Table and/or highlighted in the legends of the different figures. Otherwise, that key information is scattered throughout the text, and not always easy to find.

#2 This article describes the third part of the PMIP4 contribution to CMIP6, but there is no mention to the other parts (are there more than three?), and how they complement with each other. A brief explanation in the introduction would be helpful.

#3 I presume that the notation past1000 comes from the previous PMIP3 experimental protocol, and have been kept for coherence. I, however, think that the term is misleading, as it seems to suggest that the experiments cover the past millennium. But instead they target the "preindustrial" last millennium. I don't think that it's worth to change it now, but a more appropriate term could be considered in the future (e.g. preind1000).

#4 [Page 3, lines 7-10] I would recommend rephrasing this sentence for clarity. For example, to something of the sort of "...the relative contribution of internal variability and external forcing factors to natural fluctuations in the Earth's climate system...".

#5 [Page 4, line 15] Two other relevant articles that could be cited here are Lehner et al (2012) and Ortega et al (2015).

#6 [Page 4, line 37] As it is written, it seems to imply that the MCA-LIA transition is only explained by these clusters of eruptions. But changes in solar irradiance most probably played some (minor) role. I suggest rephrasing to "Clusters of eruptions have been identified as the major contribution to the transition..."

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#7 [Page 6, lines 10-12] Remove "a" from "a updated". The final part could also be slightly rephrased to "a new generation of climate models in which the different forcings will be better represented". Also, it is not clear to me if this sentence refers exclusively to the changes in land-use, or to all the forcings previously described. If it's to all forcings, it might work better at the end of the paragraph (as the next sentence refers only to land-use changes).

#8 [Page 5, line 13] Correct to "initiative".

#9 [Page 7, lines 4-8] It is not totally clear to me from this paragraph whether there are two different sets of historical CMIP6 simulations according to their initial conditions (are they taken from picontrol experiments, past1000 experiments, or both?). Is that why you say that it will be possible to assess the impact of initial conditions on the climate of the 19th and 20th centuries?

#10 [Page 13, line 21] Change to "impacted-related".

#11 [Page 14, line 17] I suggest specifying "new climate reconstructions", to distinguish from forcing (reconstructions) just mentioned before.

#12 [Page 14, first and second paragraph] These two collaborations with PAGES2K to investigate the past changes in the ocean circulation and hydroclimate are really important to bridge the existing gaps between models and paleo records. Will key variables for these model-data intercomparison studies, such as the AMOC and barotropic streamfunction and some drought severity indices, be consistently stored by the different modelling groups?

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