

Interactive comment on “Comparison of past and future simulations of ENSO in CMIP5/PMIP3 and CMIP6/PMIP4 models” by Josephine R. Brown et al.

Anonymous Referee #1

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Paper Quality

This paper provides a comprehensive analysis of changes in ENSO from a variety of past to future climate scenarios from CMIP5/6 and PMIP3/4 models to determine insights into the sensitivity of ENSO to changes in seasonality, global average temperatures, and spatial patterns of sea surface temperature. The authors look at past time slices from the Last Interglacial, Last Glacial Maximum, and mid-Holocene and future projections from one percent per year CO₂ increase and an abrupt four times CO₂ increase. Their choices reflect a wide range of climates in order to constrain uncertainty, determine model agreement, and evaluate sensitivity of ENSO to different climate fac-

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tors. Their general findings illustrate consistent model agreement of weakened ENSO activity in the Last Interglacial and mid-Holocene, reduced variability in the western equatorial Pacific in the Last Glacial Maximum and enhanced precipitation response to ENSO in warmer CO₂ experiments.

Overall, the paper is well-written. The Introduction of the paper is a nice change in style from a typical climate modeling paper and was well welcomed. The authors nicely explained the historical context of ENSO, putting the Last Interglacial, Last Glacial Maximum and mid-Holocene, as well as future changes, into context of our prior knowledge from both proxies and modeling studies. Additionally, the authors produce a well-written description of the different simulations, providing clear enough detail on each of the simulations without bogging down the writing with too many technical details. The observations are clearly written out and synthesized in an easy to understand format and a thorough explanation on possible mechanisms is discussed.

Though the paper is well written, I think there are parts that need further clarification. Specifically, the authors should be clearer about the updated models compared to the previous models. At points, they suggest they will be comparing new simulations with previous generations models (I assume CMIP6/PMIP4 versus CMIP5/PMIP3?) but their results suggest that the models are more lumped together. The paper would be improved if the authors clarified when and how the newest generation models add to our understanding of changes in ENSO with respect to the simulations from previous generations models.

Scientific Questions/Issues

Lines 55-58 – There is an even newer reference from White et al., 2020 that can be added to this set of references (<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019GL085504>)

Lines 74-84 – This paragraph could benefit from updated references. For example, Cobb et al. 2013 is now superseded by Grothe et al. (in press at Geophysical Re-

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search Letters - <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2019GL083906>), which does show a strong reduction of ENSO variability during the mid-Holocene. Also, there's a paper by White et al. 2019 (<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017GL075433>) that shows a long-term trend in ENSO strength through the Holocene, contradicting some of the mid-Holocene ENSO reduction studies.

Section 2.1 Models – I think it would be useful to add just a few more sentences here about the models as not all readers of this journal will have that background. This can be brief and may only include one or two sentences, and then refer the reader to the website for more information. For example, what are the main differences/improvements in CMIP6, since this paper is really about using the new generation of coupled atmosphere-ocean climate models for both past and future climates. Or maybe just more broadly, what is it about CMIP6/PMIP4 that allows for an updated view of looking at changes in ENSO? I see that the authors add little bits of this specifically sprinkled throughout section 2.2, so I think just a more broad/general description to set up the context of this study would be beneficial.

In Sections 4-6, when talking about the model ensemble and trends, it is useful to mention the model agreement. The authors do this at times, for example, on lines 338-343, but I think it would strengthen the observations if this were done more consistently throughout these sections.

Figures – note what the stippled pattern indicates in the legend (as done in Figure 11 and 12)

Technical Issues

Line 223 should read “all available data are . . .”

Line 407 and 410 should be Niño

Line 414 – remove parentheses around Collins et al.

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Line 484 – Merryfield 2006 reference is not in the parentheses with the other references

Line 491 – Should read “This includes . . .”

Interactive comment on Clim. Past Discuss., <https://doi.org/10.5194/cp-2019-155>, 2020.

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