Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC2
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Reply on RC1

Anonymous Referee #2

Referee comment on "Impact of increased resolution on long-standing biases in HighResMIP-PRIMAVERA climate models" by Eduardo Moreno-Chamarro et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-209-RC2, 2021

Review Moreno-Chamarro et al. "Impact of increased resolution on long-standing biases in

HighResMIP-PRIMAVERA climate models"

This is a nice study than analyses and compares important biases in PRIMAVERA models for high and low resolution. The ensemble is small but the authors spend sufficient time to discuss the differences between the models. Another issue is the separation between the impact of ocean and atmosphere resolution. The biases are often the result of coupled interactions and the present set of simulations make it difficult to sperate the role of ocean and atmosphere resolution. I have sometimes the feeling that regarding the role of atmosphere or ocean resolution the authors jump too quickly to conclusions, thereby relying on other literature. I would prefer that the are a bit more cautious, if their conclusions cannot be without doubt supported by their own analyses. For instance I am not fully convinced that increasing atmosphere resolution is the main reason for the reduction of the warm bias in the upwelling regions as stated in the abstract. No clear analyses for that are provided.

One of my main concerns is the abstract which to my opinion does not reflect very well the main conclusions of is even in contradiction. In the conclusions it is written:

"On average (i.e., in the ensemble mean), the warm eastern tropical ocean, the double ITCZ, and the cold North Atlantic improve at higher resolutions, while the SO warm bias worsens or persists in some models, and a new warm bias emerges in the Labrador Sea in all the models as a result of excessive Atlantic ocean heat transport (Roberts M.J. et al., 2020b) and excessive ocean deep mixing in the Labrador Sea in NEMO models at a 0.25° resolution (Koenigk et al., 2021)."

This is a fair summary of the results. I do not see this reflected in the abstract, instead it speculates too much about the role of the atmosphere or ocean and the need of eddy rich ocean modelling. This can be discussed in the discussion section, but the abstract should be mainly limited to the results obtained from the analyses. I urge the authors to modify the abstract and makes it more coherent with the main text.

Specific comments:

- L55. Here it is clear which biases are analyzed. This was not clear from the abstract.
- For the upwelling regions, I miss a discussion about the role of ocean mixing. For the Atlantic upwelling region see for instance: https://doi.org/10.1175/JCLI-D-19-0608.1
- L 180. I was surprised that ERA-Interim analyses were used and not the more recent ERA5.
- L 230. I do not think that on the basis of one eddy rich model and no dedicated analyses between increase of ocean and atmosphere resolution, you can make that statement.
- L 376. Why not mention this in the abstract?
- L 420. This statement seems to contradict for instance with L364 and L376. The reduction of the cold bias in the sub-polar gyre in the North Atlantic is one of the strongest signals between LR and HR. Also, the reduction of the double ITCZ bias in the Pacific is a clear signal that the authors partly attribute to the increase in the ocean model resolution (L290). So, this statement is not backed up by the authors own analyses. This statement is then lifted to the abstract, where it should be removed. It can be discussed in the discussion section with a reference to the statement at L370 where eddy-rich ocean models improve the Gulfstream separation and reduce the warm bias near the coast.

Typo’s

- L216: … small impact… The structure of the sentence suggest positive is missing between small and impact.
- L303: Referring only to Fig. 1 and not also to Fig. S2 reads strange in the first sentence.
- L348: *... compared* to...
- L425 ..helps *to* reduce..