

Interactive comment on “PlioMIP2 simulation with NorESM-L and NorESM1-F” by Xiangyu Li et al.

Anonymous Referee #2

Received and published: 2 November 2019

Review of "PlioMIP2 simulations with NorESM-L and NorESM1-F" by Xiangyu Li, Chun Cheng Guo, Zhongshi Zhang, Odd Helge Ottera, and Ran Zhang

This manuscript presents initial results from the Nor-ESM modeling group for two simulations of the mid-Pliocene Warm Period experiment (Eoi400 of Haywood et al., 2016b), the core paleoclimate experiment of the Pliocene Model Intercomparison Project (PlioMIP) Phase 2, as a contribution to CMIP6. The simulations were run with the older NorESM-L (also used in PlioMIP1) and the more recent NorESM1-F. Six key diagnostic variables were examined, and the NorESM-L PlioMIP2 run was also compared to the group's earlier efforts for PlioMIP Phase 1. This is a solid contribution to the PlioMIP2 effort, and I recommend publication of this paper, subject to minor modifications to address the comments raised here.

General comments:

C1

Of note is the authors' finding that the NorESM1-F mid-Pliocene simulation actually warms less (+1.7 degC global mean SAT, +1.2 degC global mean annual SST compared to PI control) than the equivalent simulation with the older NorESM-L model (+2.1 degC global mean SAT, +1.5 degC global mean annual SST). This relative cooling of higher resolution model compared to the lower resolution model is not entirely expected, nor is both model versions' relative cooling of the Pliocene simulation compared to PI control; it is also not consistent with some of the other PlioMIP2 experiments already reported (MRI-CGCM2.3, CCSM4, IPSL-CM5A). Furthermore, the NorESM1-F Eoi400 simulation is itself cooler than the equivalent PlioMIP1 simulation (-1.1 degC global mean SAT). The authors attribute this primarily to the change in paleogeographic boundary conditions from PlioMIP1 to PlioMIP2. While this is certainly possible for NorESM-L, paleogeography alone cannot address why the newer NorESM1-F is generally not as warm as the older NorESM-L under PlioMIP2 boundary conditions.

It would be helpful to know how the equilibrium climate sensitivity differs between the two model versions. It would also be useful to know whether the authors have previously documented any differences in run results owing the horizontal grid resolution differences between the coarser grid NorESM-L and finer grid NorESM1-F.

Specific comments:

Page 3, lines 17-19 – Can the authors be more specific about the additional improvements to the MICOM ocean component of NorESM? Also, the authors note that NorESM1-F was run without the CAM4-Oslo advanced scheme for interactions between aerosols and clouds. Is there a CMIP6 PI control run available for NorESM1-F with the CAM4-Oslo scheme enabled, to compare with the NorESM1-F described here? I wonder whether the absence of this scheme with the newer model might also contribute to the lower magnitude of warming in the mid-Pliocene run described here.

Page 4, lines 10-15 – It is unclear why NorESM-L was run with different PI greenhouse gas values (280 ppmv, 270 ppbv, 760 ppbv of CO₂, N₂O and CH₄ respectively) com-

C2

pared to NorESM1-F (284.7 ppmv, 275.68 ppbv, 791.6 ppbv of CO₂, N₂O and CH₄ respectively) for the PI control run. If this was done so that the only key difference between PlioMIP1 and PlioMIP2 simulations with NorESM-L was the new paleogeographic reconstruction for PlioMIP2, it would be helpful to clarify that. If, however, the code for NorESM-L has been updated since 2012, it would be necessary to provide more detail on what has changed.

Section 4.5 Sea Ice, pages 6-7 – The sea ice differences between NorESM-L and NorESM1-F merit some additional discussion, especially for the Southern Ocean around Antarctica. Can the authors elaborate on why NorESM1-F is producing so much more ice in this region?

Technical comments:

Page 2, line 21 – There is a reference here to Zhang, R. et al 2013. Elsewhere, there are cites for Zhang, R. et al 2013a and Zhang, R. et al 2013b, but there are a total of three Zhang, R. et al 2013 references in the reference list. These should be renumbered to avoid confusion.

Page 4, line 4 – How many ocean layers for NorESM1-F?

Page 5, lines 15-17 – The description of the regional temperature highs is not consistent with Table 3 – perhaps because Table 3 lists regions from SH pole to NH pole, which is a little non-intuitive.

Page 5, line 21 – Should read “circum-Arctic” rather than “circus-Arctic”

Page 9, lines 6-7 – Perhaps say “In contrast,” rather than “On the contrary,”

Table 3 and Table 5 – listing regions starting with the NH polar region at the top would be a more intuitive way to present this information

Interactive comment on Clim. Past Discuss., <https://doi.org/10.5194/cp-2019-102>, 2019.