

Review of Hunter et al. 2019 revised manuscript

The revised version of the manuscript is notably improved from the first version and is ready for publication after minor corrections.

Note: Line numbers in the manuscript from page 5 onwards are botched. Please keep this in mind when reading my comments.

1. Page 2, line 8: “the atmosphere mode layers ~~drapes~~ ~~drape~~ over the topography”
2. Page 2, Line 26: “... was used or ~~only~~ specific regional”
3. Page 3, Lines 8–9: remove “the 2nd” and “the 5th” prefixes for the project names in favour of the suffixes “Phase 2” and “Phase 5”
4. Page 2, Line 29: Change the section header to “Atmosphere and land models” since you are discussing both those components in the section.
5. Page 3, Line 10: “... with previous work ~~but~~ ~~and the authors~~ acknowledge that space borne measurements ~~indicate that of~~ TSI ~~have~~ ~~has~~ decreased from 1371 Wm² in 1978 to 1362 Wm² ~~from 1978 to~~ in 2013”
6. Page 3, Line 12: “We ~~therefore~~ examine”
7. Page 3, Line 15: “TSI may depend upon ~~if whether or not~~ the group is a participant of CMIP6”
8. Page 3, Line 28: I didn’t understand the context in which the word “resilience” is used here with regards to the forests. I think that the vegetation is static so you are not using it to mean that the forest fractional area can change in response to temperature.
9. Page 4, Line 1: Change the section header to “Ocean and sea ice models”
10. Page 5, Line 21: “We ~~also~~ explore two sets of non-protocol ~~sensitivities~~ — ~~experiments to assess sensitivities to the~~ Pliocene orbital configuration and ~~the~~ TSI”
11. Page 6, Line 8: There should only be ~~orb~~ Eoi^{400} in the list in the section header
12. Page 6, Lines 13–14: “anomaly if PRISM4 Pliocene minus ~~PRISM4~~ modern”
13. Page 7, Lines 7–9: Figure 1 does not show the island as part of the Antarctic stream function configuration.
14. Page 9, Line 14: “Very high differences in MASAT differences of up to 31.3C are reached over regions of Greenland and Antarctica where the elevation of Pliocene ice sheets have been changed with respect to the present.”
15. Page 9, Line 26: (Kamae et al. 2016)
16. Page 10, Line 31: “regions that are ~~subaerial~~ ~~exposed~~”
17. Page 10, Line 33: “~~subaerial~~ ~~exposed~~” Both Baltic Sea and Hudson Bay are exposed in Pliocene, not subaerial.
18. Page 10, Line 8: The values 1.8C and 1.1C are reversed
19. Page 10, Lines 16–18: “It must be noted, however, that ~~this calculation~~ ~~such a comparison of CS to ESS is only meaningful and revealing when one~~ assumes that the PlioMIP2 enhanced boundary condition ~~represents~~ ~~approximates~~ the, ~~which is a reasonable position since the hence neglecting~~ non-glacial elements of the PRISM4 retroacted paleogeography ~~are relatively small~~ (Dowsett et al. 2016).”
20. Page 11, Line 6: “meridional mass ~~transport~~ stream function”

21. Page 11, Lines 7–8. The meaning of the sentence spanning these lines is unclear to me.
22. Page 12, Line 4: “levels of CO_2 , regional”
23. Page 12, Line 5: What does ‘This warming’ refer to?
24. Page 12, Line 7: “we find a cooling during DJF and MAM (not shown)” Note: although I’d recommend the authors to put this in supplement.
25. Page 12, Line 8: Can the authors re-check the text in the parentheses?
26. Page 12, Line 10: Gulf Stream should be capitalized. Also I don’t follow the sentence and it’s substance as it is currently written.
27. Page 12, Line 17: “but this effect diminishes with increased CO_2 ” I don’t follow, the GWP area in all *Eoi* configurations are larger than in *E280*, and that area grows larger with CO_2 .
28. Page 12, Line 18: “As expected, increased CO_2 drives warm pool expansion under both modern and Pliocene geographic conditions.”
29. Page 12, Line 27: “becomes more asymmetric” in what way? I don’t see what is becoming asymmetric.
30. Page 13, Line 15: It would be good to show the AMOC time series in supplement.
31. Page 14, Lines 28–29: Here, in reference to the deep convection around Antarctica the authors say that the increased deep convection here “would explain the strengthened AMOC within the Pliocene”, but this is not correct. The measure of Pliocene MOC in the preceding section is based on the max of the NADW which originates from the North Atlantic, whereas the deep waters from Antarctica constitute the AABW. It’s a different cell from the NADW, so it doesn’t directly contribute to the top cell. Additionally, various studies have shown a compensation between the two cells such that a stronger NADW reduces AABW and vice versa. So a larger deep water formation around Antarctica would reduce the strength of the top cell, not strengthen it. Furthermore, this compensation is exactly seen in Fig 12. In *Eoi400* with a stronger top cell, the bottom cell constituting waters from Antarctica is reduced in strength and northward penetration.
32. Page 15, Line 5: “statistically significant”
33. Page 15, Line 5: “and AMOC_{max} at 26.5N”
34. Page 16, Line 3: “Comparing Compared surface warming ... high-latitudes in a similar and whose spatial distribution is similar to that obtained with HadCM3 within for PlioMIP1 under ...”
35. Page 16, Line 32: “... 3.5C and 2.9C per doubling of CO_2 ”
36. Page 16, Line 33: “which again are also similar to results of from PlioMIP1 wherein they were estimated to be of 3.3C and 3.1C respectively”
37. Page 16, Line 34: “We derive an approximation of estimate the Earth System Sensitivity of at ~5.6C leading to implying an ESS/CS”
38. Page 16, Line 7: “... vegetation models by other PlioMIP2 participating groups ...”
39. Page 16, Lines 9–10: The sentence about precipitation change is too short and ends abruptly.
40. Page 17, Line 7–8: Why do the authors say that the geographic changes along the Antarctic Peninsula in the Pliocene are not analogous to those that can be expected in the future? The West Antarctic Ice Sheet is marine grounded and the disintegration of that ice sheet under warmer conditions would lead to geographic conditions that are entirely like the Pliocene. One would have the main large islands that are seen in the PRISM4 version along with several smaller (and below climate model resolution) islands. This is well established from ice modelling studies and from GIA modelling following the removal of the ice load. And these changes are not

something that one would have to wait very long for – ice sheet modelling studies (Pollard and DeConto, Nature 2016) show that the WAIS can completely collapse in as little as a few hundred years.

41. Figure 7: “meridional mass **transport** stream function”
42. Table 2: “Summary of equilibrium **parameters** **metrics** for seven ...”
43. Table 3: “Global mean annual surface air temperature (MASAT) **decomposed into** and the mean **surface air temperatures in** polar”
44. Table 3: “North Pole” and “South Pole” make it look at first glance that you are talking about exactly at the pole. Maybe change these to something like “NH polar” or something else?
45. Table 5: “**Integrated mean** Climatological zonal mean”
46. Table 6: “... and **defining characteristics** various metrics for the spatial extent of the equatorial...”