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Climate of the Past Discussions

Interactive comment on "Mid-Pliocene Atlantic Meridional Overturning Circulation simulated in PlioMIP2" *by* Zhongshi Zhang et al.

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I think this is a useful contribution to the discussion around the climate of the mid-Pliocene. Whilst this paper does not present a new discovery, it is a helpful description and preliminary of the results of a new batch of climate model simulations. It explores the impact of the some boundary condition changes to explain the difference between these new simulations and the previous ones. I have one comment about the scientific results, and then a series of comments about the manuscript text and presentation.

Science:

- In your discussion, you show how changes in the Arctic gateways are responsible for the higher AMOC strength seen in PlioMIP2 w.r.t. PlioMIP1. However, there

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Discussion paper

is no comment about how strong that impact is. My own work (Brierley Fedorov, 2016, https://www.sciencedirect.com/science/article/pii/S0012821X16300978) suggests that the closure of the Bering Strait results in an increase of just over 2 Sv, which is a similar value to that seen by Otto-Bliesner et al (2017). Stepanek et al (2020) get a value of just under 2 Sv. Yet you shy away from providing any estimates of the magnitude of this effect. I would like you to go a bit further.

- I also feel that your statement that the impact of the gateways is "highly model dependent" needs more explanation. I suspect you might be correct, but you have presented no evidence for in the manuscript and (as I've stated) the 2 papers you currently cite, as well as Brierley Fedorov (2016) get similar values for it.

Stylistic:

- There are too many lists throughout this manuscript. If you feel that it is so important to identify each individual model showing a behaviour, then please consider highlighting this in the table in some way.
- Please use the ESGF controlled vocabulary where possible. The HadGEM model should be HadGEM3-GC31-LL.
- The very long sentence ranging from L67-74 feels like it has been written to inflate certain metrics by including a large amount of self-citations. Please only cite work that is relevant to the topic in question, and be selective.
- L80. This SST value is a difference in a difference, and you haven't given the readers relevant context to assess the magnitude of these yet. [compared with last numbers on L75, they may think models simulate Pliocene cooling in region]. Please rephrase.
- L87. Remove "in 2016", as citation makes this clear.

- L89. Please give dates of KM5c
- L93-95. This sentence reads like you are only assessing over the subset of models that have run both PlioMIP1 and PiloMIP2. Is this really the case?
- L98. Compare -> investigate
- L100. models that participated
- L107-112. This sentence just repeats the information provided by the aforementioned table. Please remove it
- L126-128. If the only some of the 6 models have extended their piControl runs, how come there are new control simulations for the other models?
- Please be consistent between the names of CCSM4-Utrecht and CCSM4-UoT throughout the manuscript.
- L137. Is Kanzow et al (2011) really an observational estimate of the AMOC maximum?
- L139. Is it really fair to consider 1
- L151. If you test the significance of the 1
- L159: ranged -> ranging
- L171: Why have you chosen to plot the median here? I don't object to it, but there was no explanation for the choice.
- L175: Fig. 5 does not support this.
- L179: please remove this list and others (see first point)

- L190: Please change “underestimate” to “appear to underestimate”. You are otherwise making an implicit statement about the source of error being in the models.
- L220: “the intensified” -> “an intensified”
- L223: I am not convinced about this statement. How can you exclude that the diffusivity has altered the preindustrial mean climate, which has then led to a different response through feedback processes?
- L231: carry -> carried
- L233-236: whilst I would agree with the statement, I am unsure how Hill et al and Feng et al evidence it.
- L239: Shouldn’t you rather be looking at the median than mean, given Fig 6. Although I do wonder why Fig 6 is the median, and how that has not lead to discontuities.
- L254. The Benguela upwelling is not in the North Atlantic – why mention here?
- L265-266: Both Federov et al and Foley Dowsett “reconstruct” SST not “show” it.
- L270-271. You have not mentioned the role of the overlying atmosphere resolution. This also matters – e.g. Gent et al (2010, Improvements in a half degree atmosphere/land version of the CCSM).
- L291. Why are you listing all 15 models here?
- Table 1. You may want to consider splitting this into 2 tables – a methods and results table.

- Table 1. Why does IPSL-CM5A have 2 lengths?
- Fig 6. PRSIM -> PRISM

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