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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

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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