

Interactive comment on “Antarctic Bottom Water and North Atlantic Deep Water in CMIP6 models” by Céline Heuzé

Anonymous Referee #2

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The paper presents a comparison of time mean fields between new, CMIP6 models and observations. The focus is the formation and distribution of deep water formed in the North Atlantic and Southern Ocean. The aim (I assume) is to document these biases as a basis for further study. In general, I did not feel that the paper presented much that was convincing in terms of new scientific interpretation. In particular many of the reported correlations seem small given that the many of the models are not very independent, which I don't think has been accounted for or even acknowledged. Nonetheless, the potential lack of new understanding is not necessarily a strong negative as documenting the models can be a useful exercise in and of itself.

A secondary issue I had with the paper was the overall style, which I found to be far too colloquial. Many examples are provided below, though this is not an exhaustive list.

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Scientific issues:

L77-78. Why is a different threshold used to the observations? How can you then fairly compare with the observations? Please explain this.

L224-226. So what can we actually determine or learn from this? Is there a relationship, particularly after controlling for the fact that several of the models are nearly identical (or assimilate observations, which I am surprised is included as it seems fundamentally different to the other models)

L250-251. This link surely only makes sense if the climate sensitivity is driving the DMV. But previously you suggest the logic is the other way around (i.e. larger DMV can sequester more heat and thus reduce climate sensitivity). If the DMV drives the climate sensitivity, why should DMV in the Weddel Sea and SPG themselves be linked? Isn't it more likely that the DMV in these two regions correlate due to some global model bias?

L364, L367. Are these correlations really robust given the real number of degrees of freedom is likely far fewer than the total number of models

Minor or style issues:

L1. "Deep water formation is the driver of the global ocean circulation" - on what timescale?

L5. Large majority - can you be more quantitative?

L5. "Pipe" - I'm not sure that quotation marks are useful here, just leave it as "overflow parameterisation"

L7, L8. Should be a "the" before AABW, NADW

L10. Who - replace with "that"

L11. Also are - are also

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L14. Don't start a sentence with "but"

L25. Quits - leaves

L28. These quotation marks and the equals sign are very colloquial.

L31. Is an accurate representation really needed for climate predictions? Over what timescales are you referring? Of what variable? Predictions in CMIP usually refers to initialised decadal simulations, whereas projections usually refer to century timescale uninitialised simulations.

L35. Occurring-too-often - overly frequent

L38. Too - overly

L41. Why are there ellipses here?

Table 1. The horizontal resolution here doesn't take into account any local grid refinement, which could also be noted.

L58. Is this the actual variable name or is it mlotst?

L58. For the models where you have MLD directly, can you show as a supplementary figure that your method and the online one are equivalent.

L72. Is the deboyer montegut MLD data just to 2004 or is it updated?

L77. Detected - diagnosed

L91. "Really" is not required

L104. "Hardly a third" is colloquial. Please be specific.

L109. Starting a sentence with "but"? Multiple other occurrences.

L164. Re-occurring too often - too frequent

L168. "... is but a..." - is just

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L173. "(Thin?)" - this made me a bit annoyed. If you want to hypothesize at the reason then please spell this out in a sentence rather than like this.

L182. "Thrice" - three times

L182. Erroneous period after "not"

L183. Does the pipe physically suck the water in the model physics? Could the description of this parameterization be described more formally?

L185. What is "the mystery remains" doing in a scientific paper?

L185. "Maybe it is formed..." Remove this and combine with the previous sentence.

L185. Conclusion needn't be pluralized

L205. Regionally varying biases perhaps?

L212. Biases as rmse... What does this sentence mean?

L228. "Tug of war" - this seems to anthropomorphize the models and its not clear what it is trying to convey. Perhaps "balance" would be better?

L233. Convects needn't be pluralized

L243. Here (and elsewhere) the referencing is a bit unclear. You've already cited this paper, and here it seems as if you're citing it as a reference showing a link between convection and climate sensitivity here.

L254. "Besides,..." - please make this sentence better

L257. Please define quantitatively what a "tolerable" bias is?

L265. Why is the word "grim" in a scientific paper?

L267. Don't start sentence with And

L286. Missing "the" before SPG

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L289. Is such a small correlation actually significant, especially when accounting for the limited degrees of freedom (i.e. many similar models)

L297. “The question remains”. What question? Please specify.

L298. “Convenient” seems to be assigning higher purpose to these correlations, which can’t be right.

L305-307. Missing “the” before SPG/GIN

L320. Don’t start sentence with “which”

L321. The AMOC can’t be said to be overestimated given the quoted uncertainty on both the model and observations.

L330. Why is there an exclamation mark?

L335. Remove “obviously”

L341. Missing “of”

L402. “This sentence is still valid” - “this is still the case”

L403. Why is there a floating question mark?

L427. Sentence starting with “which”

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