

## **Response Letter**

### REVIEW

Nonlocal and local wind forcing dependence of the Atlantic meridional overturning circulation and its depth scale

Minor revision by reviewer 2; accepted by reviewer 1  
This response letter addresses the comments by reviewer 2

### COMMENT

#### REPLY

Dear reviewers, dear editor, first of all we would like to thank you for your effort. We were happy to address the minor comments. Thank you that you believe that the paper is publishable. We were disappointed that the second draft was not accepted but we believe that we have made a valuable publication with the final version.

I appreciate the effort made to improve the introduction and motivation (and discussion section); the science here is sound and this paper is a nice contribution to the field.

Thank you for your comment. We believe it does not make sense to list all improvements as it is minor revision with many small improvements at various occasions. Instead, we created a file that gives the difference between the latest draft and the final manuscript which is submitted with this report. Please review this file to get an overview of the changes made.

However my remaining issue is mainly difficulties in understanding due to writing style. Some of my comments below are repeated from previous round of reviews; I would strongly encourage the author take another pass at some improvement, particularly in regard to discussion of Fig 6 and Fig 8, which I think are fairly important to the story. These plots are unfamiliar and need to be carefully explained. As general advice, I think it is better to first explain what is plotted, then go into details about the calculations, rather than finally explain what's plotted buried several sentences after discussing details.

We changed the sections as well as the overall writing style accordingly.

Also, section 4 (5) is new and apparently in response to comments from both reviewers. I personally was satisfied without this additional analysis (i.e. author's changes made regarding Luschow reference are sufficient), but would not remove the new material. However, I don't think this new material adds to the main result and should be in an appendix or supplementary material section. And, although I did suggest the low-res run, my thought was an idealized efficient setup (ie not coupled) that could be easily run out for 1000-3000 years (or at least a few hundred). I'm not sure the (100-yr) low-res runs do more than muddy the water here, again arguing why this new material is really more appropriate for a supplemental section.

After having explored different possibilities we believe it is good to have the section on the low-resolution model runs within the main body of the manuscript. It provides an indication for the robustness of the results. We present a new way to understand the AMOC and excite subsequent discussions.

We addressed the list of the minor comments below. To get an overview of the changes made, please review the file which gives the difference between the latest draft and the final manuscript which is submitted with this response letter. We did further improvements on the manuscript which go beyond the comments of the reviewer.

l. 35 form -> from. But I would argue the sentence “In this way, ...” is not necessary at all.

l. 42 the Cessi ref seems a contrary result – but is not mentioned again (in the discussion) to possibly explain her results

l.50 “is substantial” is subjective and vague, suggest being more specific

l. 205, l. 332 “later on” -- be explicit as to which section in the paper you refer

l. 307 “show the meridional averages...” of what? Readers will not immediately grasp what you are showing in Fig 6, explain up front

l. 307 “It is technical” what do you mean by this?

Fig 6 caption: first sentence: "level of no motion (as plotted on the y-axis), in the..." And rewrite the “We do not show” sentence as “Qualitative behavior if plotted instead using  $\eta_{\rho}$  (not shown) is similar except ...”

l. 310 “The latter is preparatory...” delete sentence, do not know what this means

l. 370 “which can be identified in Fig 7” - ???

l 374-394 difficult to follow. Again I’d start off with explaining what is plotted in fig 8, then explain details in calculations, then the science of the results. Complicating the science analyses here, in some sentences I was not sure if the author was comparing  $2X_{SH}$  vs.  $2X$  or  $2X\{SH\}$  vs.  $1x$ . E.g., In l. 388 are you explaining the difference between the red and red-dashed in Fig 8a? Again the imprecise, indirect writing style makes comprehension problematic.

l. 383 dotted -> dashed

l. 380 and numerous places “deep levels” or “deeper levels” (deeper than what?) Since the paper discusses processes at the surface, in the upper part of the water column, at depth but above the level of no motion, and below the level of no motion, it is not clear what “deep” means. There is no harm in being more specific; if you mean below the level of no motion, say so.

l. 403 “from a generic point of view” - ???

Fig 8 and 9 captions – “velocity shear held constant” this is a bit misleading description. What you

have done is, in your diagnostic, taken the shear from the 1X expt and used this value in computing the diagnostic for transport in the 2X experiment (right?). “Held constant” has a different connotation/expectation of what was done. As someone who has worked on this general problem, I realized immediately what the author was doing here, even appreciated it as clever thing to do. However for a more general reader, the explanation is murky. Never is it clearly posed “does the shear adjust in conjunction with changes in  $\eta_{\psi}$  (or  $\eta_{\rho}$ )? To address this, in our diagnostic we employ the shear ...”

Fig 8 caption “the time-mean vertical velocity” shouldn’t this connect to previous sentence with a semi-colon?

l. 510 puming -> pumping

l. 511 “It forces the flow thus horizontal upstream...” - ???

l. 514 suggest making the point in next sentence without invoking global warming (esp. given no refs provided; maybe link to the section 4 material?) and moreover, it is difficult to say much about temporal adjustment given the 30-yr run period. Or make it clear you are speculating a bit with this motivation? I would keep the point made in the next sentence however.