

Geosci. Model Dev. Discuss., referee comment RC2
<https://doi.org/10.5194/gmd-2022-277-RC2>, 2022
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Comment on gmd-2022-277

Anonymous Referee #2

Referee comment on "Understanding AMOC stability: the North Atlantic Hosing Model Intercomparison Project" by Laura C. Jackson et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2022-277-RC2>, 2022

Review of gmd-2022-277

The manuscript titled 'Understanding AMOC Stability: the North Atlantic Hosing Model Intercomparison Project' by Jackson and co-authors gives an introduction to the NAHosMIP experiments as well as some initial results. The manuscript investigates the responses of the AMOC in 8 climate models to freshwater hosing in two different setups, 1) uniform hosing North of 50N and the Arctic and 2) more realistic hosing around the coast of Greenland. The manuscript also compares what happens when the hosing stops at different points in the simulation. The results show that 4 of the 8 models can simulate a reduced AMOC once the freshwater hosing stops. Furthermore, the manuscript investigates common potential reasons for the AMOC to remain in a weakened state (i.e. salt advection, model resolution, subgridscale parameterization, etc.) and find no clear links with them and a model's ability to remain in a weak state. However, it was found that the model state just before hosing stops is indicative of whether the AMOC will recover, with models where the AMOC reaches a weaker state not recovering. I'm excited to see what other interesting studies NAHosMIP will bring.

The manuscript is very clearly written and serves as a great introduction to the NAHosMIP. I believe this manuscript is of scientific interest and should be published after a few minor clarifications are made to the text.

Detailed Minor Comments:

- Line 7 – ‘or’ should be ‘for’
- Lines 34-47 – it’s worth mentioning somewhere that Fov is sometimes referred to as Mov
- Section 2 – I’m assuming that the experiments are not only initialized from the piControl simulation but also use the piControl simulation external forcing and not historical or present day.
- Section 2.1 – The recovery run after 70 years is not mentioned. Also, it might be worth putting the acronyms in Table 1 into the text following the experiment description.
- Page 6 – line numbering seems off
- Page 6, top line – how is the upper layer defined? Is it the salinity in the top level of the model, average salinity over a specified depth, or something else?
- Section 2.3.4 – How is the compensation applied? Is it applied globally as a salinity trend at all grid points (including or excluding the hosing regions) at all times? It might also be worth mentioning how small this is relative to the freshwater hosing i.e. how much larger of an area/region -> much weaker flux?
- Line 141-142 – Not sure what is meant by ‘we also make use of results in other CMIP6 models...’. I cannot think of anything that isn’t included.
- Line 232 – Worth moving text from line 266 introduce HadGEM3-GC2 here
- Lines 236-239 – What is the motivation for using mixed layer depth for 26.5N AMOC and mixed volume for 45N AMOC comparisons? How are the MLD and mixed volume related, are they strongly correlated?
- Lines 246-247 – It is a bit unclear what is shown in the middle panels of Figure 8. Is this the annual minimum/maximum for each model in the last 10 years for Sr/Sw or the minimum of maximum of each grid point across all the models. Is the maximum just maximum summer temperatures and minimum winter temperatures?
- Lines 247-251 – it feels a bit unclear what the motivation is for showing the difference in the maximum and minimum. A bit more explanation of this comparison and their results would be useful.
- Line 251 – Do you mean the top panels of Figure 8?
- Lines 263-272 – how was Fov computed in this study? Monthly mean salinity and velocity or was it computed from $v \cdot S$ computed online during the model simulations? What is used as the reference salinity to convert from a salinity transport to a freshwater transport?
- Lines 303-306 – A remaining open question is why the different models reach different states before the hosing finishes...
- Line 310 – Also, in future scenarios you also have to take into account the impacts of warming... which these experiments do not include
- Figure 2 – The way the land is masked is inconstant across models. Also, it would be very helpful for the reader to have heading above the columns (i.e. picon, u03-hos, recovery)
- Figures 3&5 – a legend for the lines in the figure is missing
- Figure 7 – should bottom panel be 45N or 26.5N, this is missing in the caption
- Table 2 – the ensemble member should also be included, while it’s unusual for there to be multiple ensemble members for piControl, I know EC-Earth3 has 2 (r1i1p1f1 and r2i1p1f1)

