Author's response point-by-point on revised version of *Impact of mesoscale eddy parameterization on Arctic Atlantic Water circulation and heat transport in the eddy-permitting grey zone*

Below we first present a response (in blue text) to the reviewer´s comments and then a point-by-point response on the changes introduced in the second revision of the manuscript as produced by a latex-diff with the first revision.

Response on reviewer comments

Abstract and conclusions: I am surprised to find no mention of the use of the GEOMETRIC parameterization in both the abstract and conclusions, both because it is central to one of the experiments presented, and because it appears to result in somewhat improved distributions of eddy diffusivity in comparison with observations (Figure 3).

We have now added some text in the conclusions describing the similarities and main differences between the experiments with the standard and GEOMETRIC scalings.

Equation 2: You should not be using density here, unless density is defined to be a neutral density variable (or potential density, if that is what is used in the model simulations).

Since we at this point haven't started talking about model specifics we have now denoted it \tilde{\rho} and added ".. **the dynamically relevant** density .." following conventions from e.g Mak et al (2023) and Ruan et al (2024).

Line 102: idealistic - I think you mean idealized?

Yes, we have changed accordingly.

Equation 4: Is there any point in the addition of the second equality? I don't see V defined in the main text.

Yes, it is also used on the left-hand side of equation 5 describing the barotropic meridional transport.

Equation 8: Firstly, I don't believe rho(S,T,z) has been defined previously. Secondly, it is unconventional to write rho(S,T,z) rather than rho(T,S,z). Thirdly, I think you should state that you are using z as a proxy for pressure. Finally, I don't like the use of values without units in this equation. It might be clearer to define reference temperatures, salinities as symbols and state the values following the equation?

Ok, we have now changed the text according to your suggestions.

Line 256: where rho_0 = ... is a reference density ...

Changed accordingly.

Line 345: reduces

Changed accordingly.

Lines 375, 376: across the GSR (even better, get rid of the acronym)
Changed accordingly.

Section 3.5.1: This should be titled "Eddy heat flux divergence" (a flux of temperature does not make sense). I also suggest changing "was" to "is" in the first sentence of this section.
Changed accordingly.

Figures 12 and 13: These are harder to read than earlier figures due to relatively small and feint fonts.

The fonts have now been increased in Figures 12 and 13.

Acronyms: I feel that there are far too many acronyms in general. Some such as GM, EKE, MKE are fairly standard and fine to use. However, TKE is used in two different ways (turbulent and total kinetic energy). And the acronyms for the various currents, gateways, basins etc, make the manuscript hard to follow for a reader not expert in Arctic oceanography. Can I make a plea to review the use of all acronyms and, wherever possible, remove these? I suspect the length of the manuscript will increase by a modest amount, for a significant gain in readability.

We have now replaced the acronyms: GSR, PSW, AW, WSC, BSO, EGC, TKE with their full names.

Point-by-point changes (based on latex-diff line numbers)

1 Introduction

L20: Grammatical correction.

L33-L75: Replaced acronyms AW, PSW, GSR with full names.

Equation 2 and L91: changed density variable and added ”dynamical relevant density” according to reviewer comment.

L105: Changed according to reviewer recommendation.

L108-L118: Replaced acronym AW with full name.

L123: Hyphenated preexisting.

L128: Replaced acronym AW with full name.

2 Methods and data

L161: Removed acronym TKE.

L181: Replaced acronym AW with full name.

L193: Grammatical correction.

L212: Replaced acronym AW with full name.

L222: Replaced acronym GSR with full name.

Equation 3 and L230: Removed acronym TKE and MKE.

Equation 8 and L251-L255: Changes according to reviewer suggestions and replace acronyms AW an GSR.

L255: Replaced acronym GSR with full name.

L265: Changes according to reviewer suggestion.

3 Results

L284-L304: Replaced acronyms TKE and AW with full names.

Figure 4 text: replace acronym AW with full name.

L320-L353: Replaces acronyms AW and PSW with full names.

L355: Grammatical correction.

L360-L371: replaced acronym AW with full name

Table 2: Replaced acronym GSR with full name.

L378-L426: Replaced acronyms GSR, AW with full names.

Table 3: Replaced acronym GSR with full name.

L431-L451: Replaced acronyms GSR and BSO with full names.

L465-L498: Replace acronym AW, PSW, EGC and WSC with full names.

Figure 10 text: Replaced acronym AW with full name.

L515-L516: Changed sub-section title and tense according to reviewer suggestion.

L525-L526: Corrected spelling errors.

Figure 11 text: Replaced acronym AW with full name.

L563-L574: Replaced acronym AW with full name.

4. Summary and Conclusions

L578: Added ”currents” that was missing.

Figure 12: increased the font size.

L598: Corrected spelling error.

Figure 13: increased the font size.

L607: Added the missing ”to”.

L643-L646: Added text describing the similarities and main differences between the experiments with the standard and GEOMETRIC scalings, according to suggestion by the reviewer.

Appendix A

Figure A1 and A2 text: Replaced acronym AW with full name.

Appendix B

Figure B1 and B2: Increased the font size.

Per Pemberton,

On behalf of the other co-authors