**General comments**

In this paper, the authors investigate the effect of horizontal resolution on the North Atlantic mixed layer depth and its link to the AMOC. Their analysis is based on three simulations performed with the EC-Earth3 climate model.

Overall, the paper is well-structured and well-written. The analysis is sound, and results are mainly descriptive. The paper could benefit from a more thorough discussion of the broader implications of the findings.

> We have added the following paragraph just after listing the conclusions:
>
> "These results show different behaviour for the ocean circulation and its driving processes in the North Atlantic across resolutions. Therefore, further research is needed to confirm if similar differences are identified in other climate models, to thus determine if eddy-resolving models consistently bring new regimes of variability that could challenge our current understanding of the future changes to be experienced by the AMOC, which predominantly come from models with eddy-parameterized oceans."

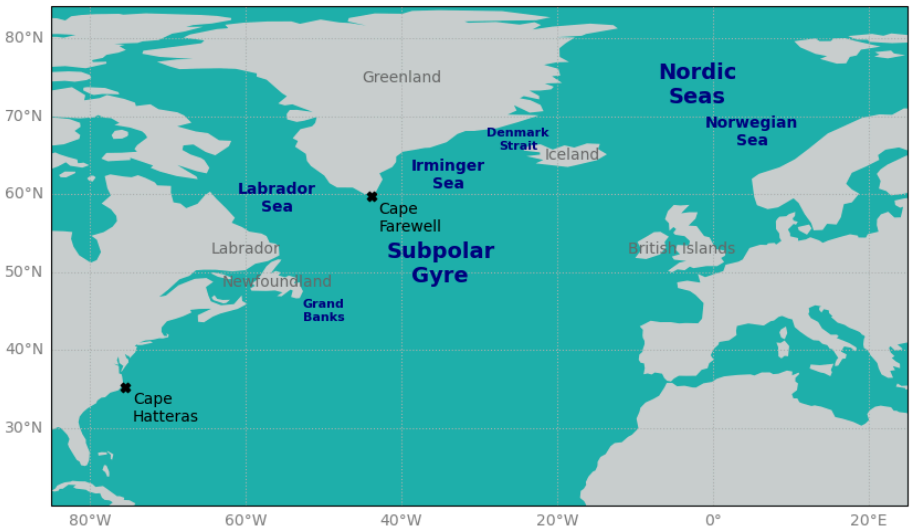
My comments are mainly orientated to improve the presentation of the results, particularly the figures along with a few minor suggestions to improve the text.

> We thank the Referee for dedicating time to review our paper and for the constructive feedback. The suggested changes help for a better understanding of the work improving its scientific quality. Answers to each comment can be found below.

**Specific comments on figures**

The manuscript includes several geographical references. While some (e.g., Labrador Sea, Irminger Sea, Nordic Seas) are familiar, others (e.g., Cape Farewell, Cape Hatteras) may not be as well-known to all readers. I recommend adding these locations to one of the maps.

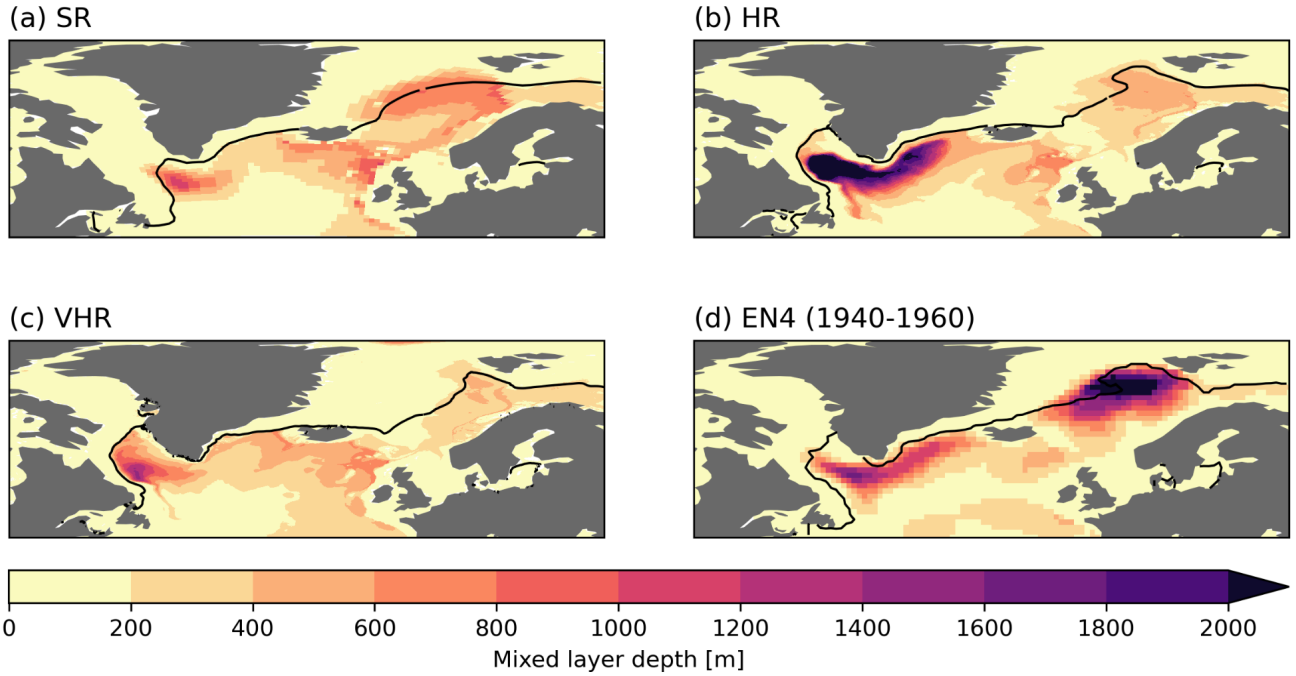
> Thank you for the suggestion. We have added a new figure to the appendix with all these locations. We have also added a reference to the figure at the end of the Methods section.



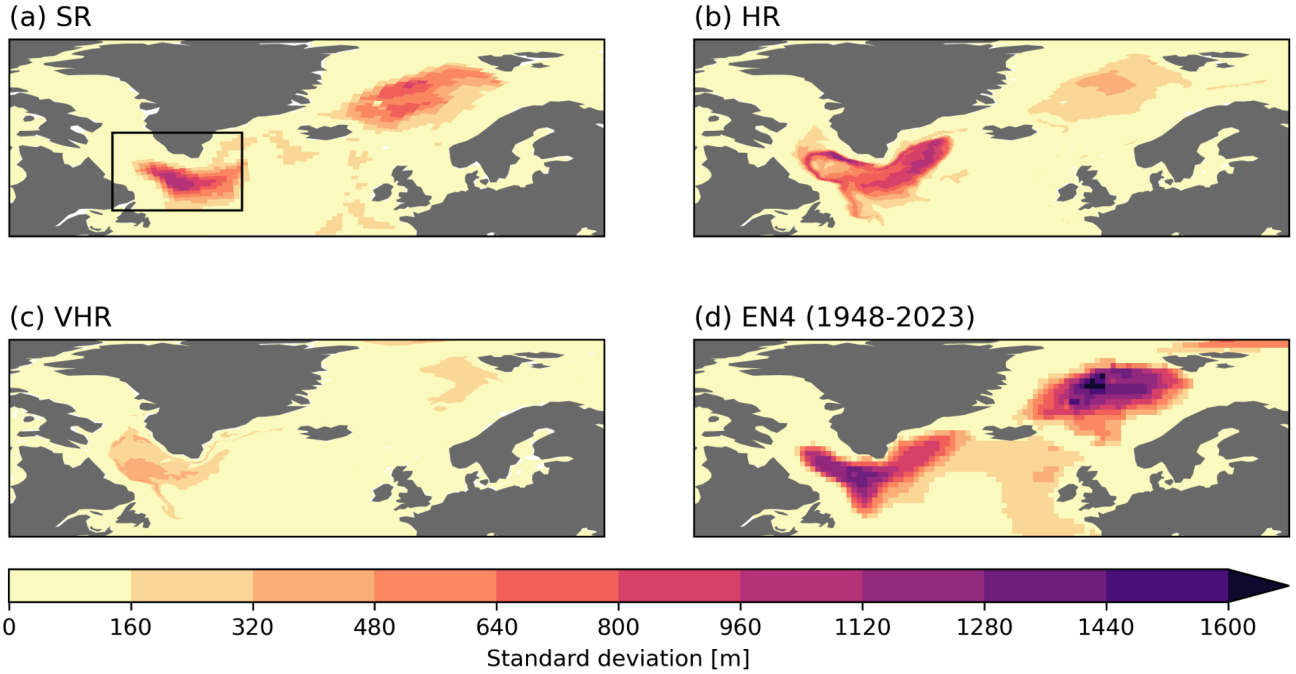

*Supporting Figure 1 (added as Fig A1): Map including geographical references that are relevant for the article.*

F1, F2, FA3. I suggest changing the colorbar of these figures because it is difficult to distinguish the differences, particularly for values below 1000m. Besides, it is hard to see the black line of the climatological sea ice superimposed to the dark contours.

We have tried to improve the visibility of the figures reducing the binning and using magma color gradient instead of viridis. We did not find many additional options of perceptually uniform sequential colormaps, which we prefer as they are colorblind friendly. We note that F1 and F2 have been expanded to occupy the full text width for better visualization (mainly affects the font size from the preprint version). See examples below for the resulting F1 and F2:




*Supporting Figure 2 (replaces Fig 1): March MLD climatology for SR (a), HR (b), VHR (c), and EN4 1940-1960 (d). The black contour line shows the climatological March sea-ice concentration at 15 \%, for the same dataset in (a-c), and HadISST2 1940-1960 in (d).*



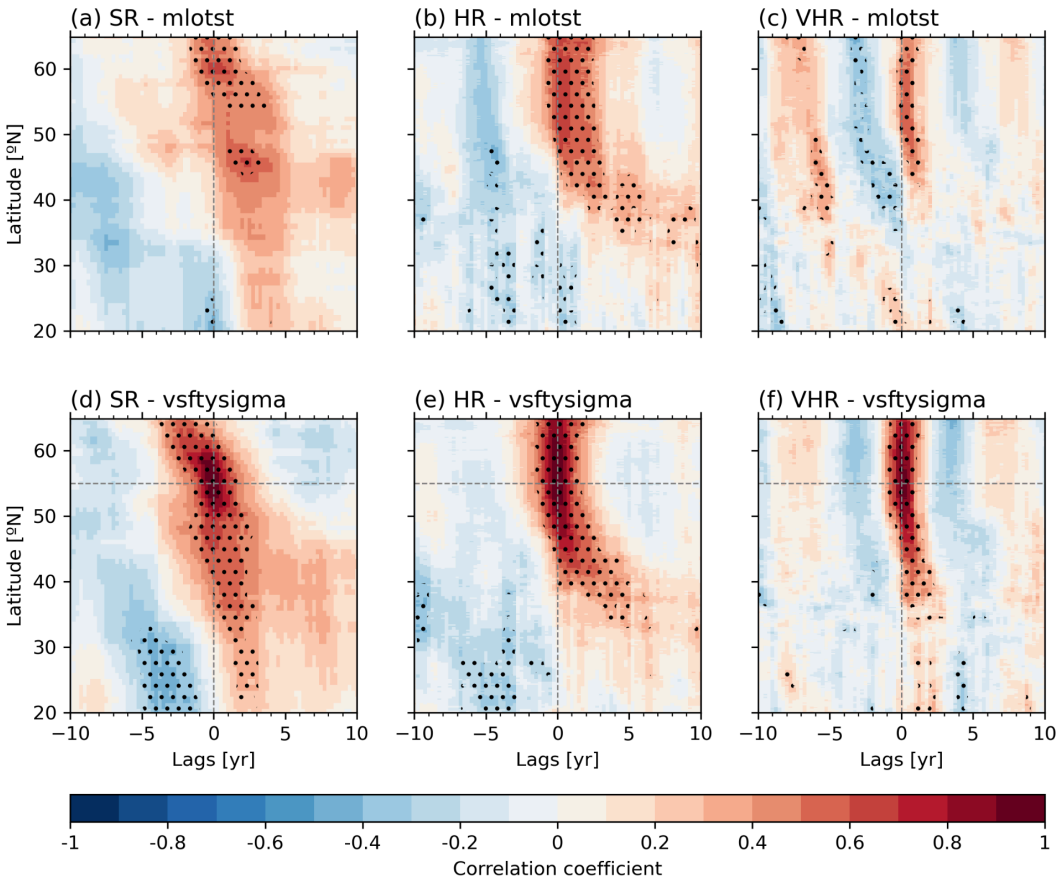
*Supporting Figure 3 (replaces Fig 2): March standard deviation of MLD for SR (a), HR (b), VHR (c), and EN4 1948-2023 (d). The box used to compute MLD time-series and vertical profiles is shown in (a).*

Table 2. I am a bit confused with the information that T2 provides. What exactly does the correlation represent? If it shows the correlation of vertical profiles (model vs. observations), the high values may not be surprising, as they primarily reflect the expected stratification (densest waters at the bottom, lightest at the surface). For instance, the 0.987 correlation for VHR is only a slight improvement over 0.976 for SR. Moreover, visually, Fig. 3a suggests that SR may outperform HR and VHR in some aspects.

The reviewer is correct, T2 shows the correlation of time averaged vertical profiles across the vertical dimension of model vs observations. We agree that high correlation values are expected, because stratification has a smooth nature. We also acknowledge that correlation differences between configurations are small, so they need to be interpreted with caution, as not all features will be better captured by the same model. However, we note that visual inspection can be deceptive when drawing conclusions. That is why we use the metrics to evaluate which model configurations are better at representing stratification. The important aspect is that we used two different metrics (correlation and RMSE) and looked at three different key variables to assess if the same model configuration stands out in all cases. Interestingly, VHR consistently shows the best performance, showing the best metric for all cases but the RMSE value of the density profile, in which it's ranked second after SR. This gives us confidence to argue that VHR is still superior to SR, for which the temperature and salinity profiles are substantially worse, which indicates its density profile is well represented, but for the wrong reasons.. We now acknowledge in the text that for the particular case of correlation of density profiles, SR has similar peformane to VHR. For that we have updated the sentence in the manuscript to say: "VHR has the best agreement in terms of correlation, followed closely by SR"

F4, F5, F6, F7, F8, FA2, FA5. I suggest plotting dots when the values are significant instead of the other way around.

We understand that plotting the dots in the significant areas is the most common practice and what many readers will expect, which can lead to confusion.. However, we believe that masking the non-significant areas with the dots strongly improves the visibility of the significant values, which, in the end, is what we will analyse. In particular, adding dots over significant areas make them appear darker than they really are (i.e. with higher correlation), as we have illustrated in Supporting Figure 4 (equivalent to Fig. 7) below. For that reason, we prefer to keep the representation of significant areas as it was. We have now modified the Figure captions to say "Non-significant values are masked with dots to improve the visibility of the significant regions".




*Supporting Figure 4 (equivalent to Fig 7): Correlation of monthly volume overturning stream function without the Ekman transport at 36.73 kg m$^{-3}$ sigma2 density level with March Labrador Sea MLD (a, b, c) and with itself at 55º N (d, e, f), for SR (a, d), HR (b, e), VHR (c, f). When lag > 0 March Labrador Sea MLD (a, b, c) or AMOC at 55º N (d, e, f) leads. Significant values are masked with dots.*

FA4. The red line in these plots is not distinguishable.

We have made the line thicker so it can be seen better. We have also updated the colorbar to magma and line's color to black to be consistent with the other plots.

**Minor comments and typos**

In several places, the cited papers are not properly ordered eg. L48, L64, L65, L76, L194, L238

Solved.

L13. 'highest' instead of 'higher'

Changed.

L96-97. Should be: Haarsma et al. (2020) and Moreno Chamarro et al. (2024).

Changed.

L203. ‘less stratified resolution’ sounds strange to me. I suggest ‘the model version which represents the weakest vertical stratification’.There are other places in the manuscript referring to the model version as resolution alone that can be improved.

> Thank you. We have changed that to “the model configuration which represents the weakest vertical stratification”. We have made similar improvements in the manuscript when referring to SR, HR or VHR as resolution.

L330. ‘highest’ instead of ‘higher’.

> Changed.

L364. ‘partly due to a positive sea ice bias’. This is not actually demonstrated in the current study, but it is so far a hypothesis.

> We have modified the statement to say: “an underestimation that is connected to a negative sea ice bias in that model configuration”.

L371-372. ‘A positive NAO phase is found to drive an increase in MLD mixing and the response occurs for negative NAO phases.’ I don’t understand this sentence, please rephrase it.

> We have rephrased it the following way: “Positive NAO phases are found to enhance the Labrador Sea mixing, while negative NAO phases reduce the mixing there.”

L375-376. ‘Differences inter-model differences’. Please, delete the first ‘differences’.

> Deleted

L381. What does ‘an almost instantaneous AMOC to mixing, of limited latitudinal reach and persistence’ mean? I don’t understand this sentence.

> We have split it in two with the next sentence and rephrased it in the following way: “VHR shows an almost instantaneous response of the AMOC to the MLD changes in the Labrador Sea, a response that has limited latitudinal reach and persistence in time. Meanwhile, SR”.