Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2020-111-RC1, 2020

Geoscientific Model Development Discussions
Open Access
EGU

Interactive comment on "Introducing LAB60: A 1/60° NEMO 3.6 numerical simulation of the Labrador Sea" *by* Clark Pennelly and Paul G. Myers

Anonymous Referee #1

Received and published: 8 June 2020

1 General comments

This study presents first results of a 10-year long nested high-resolution (∼1 km) ocean hindcast run focused on deep convection in the Labrador Sea and the associated mixed layer depth (MLD) restratification and water mass composition. The authors find that small-scale eddies transport buoyant water masses of different origin into the Labrador Sea interior which increase stratification. A marginally coarser horizontal resolution (∼5 km) leads to a significant reduction of these effects and yield too dense waters and too deep MLDs compared to observations.

Printer-friendly version

Discussion paper

This model experiment description paper highlights the importance of the ocean model resolution to adequately represent the interplay of small-scale dynamics and the large-scale water mass composition and is hence of interest for the climate community. I consider the overall quality good and suggest this paper accepted with minor revisions.

2 Specific comments

62-66: In this sentence, I find it difficult that you 1) use model results only to explain a real world phenomenon and 2) cite yourself only.

73-77: There are other model studies showing the opposite, see e.g. Cael and Jansen (2020) and references therein.

130: It is not discussed at all why a factor of 5 is used to obtain the 1/60° horizontal resolution. Please add this.

Fig. 3 and 4: The LAB60 North Atlantic Current seems to be less vivid and eddy-rich compared to both ANHA12 and AVISO. Can you discuss this?

The "Discussion" section is rather a summary than a discussion. A discussion section is not explicitly required (https://www.geoscientific-model-development.net/for_authors/manuscript_preparation.html → Manuscript composition), so either rename the section or add a discussion. Personally, I would like to see a discussion. For instance, the videos indicate that the LAB60 setup exhibits a model drift and is far from equilibrium (drag the slider of the video player with the mouse from start to end rather fast and you can see a large-scale accumulation of the runoff and Irminger Water tracers in the respective videos). Would a potential model drift influence the LSW time series or the described eddy dynamics? In addition, the shown model data is particularly suited to discuss ongoing questions about meso- and submesoscale energy transfers during convective/unstable situations. Furthermore, your results indicate that

even if an ocean model performs under a high spatial resolution, buoyant water needs to be provided by e.g. the boundary current in the first place to be available for eddies. If this is the case, a nested model configuration like the presented one would have a severe handicap given the coarser resolutions of the parents which provide the boundary current.

3 Technical corrections

- sections are not numbered
- its de Steur et al. 2009 (not 2018), Treguier (not Trequier) and Yashayaev (not Yashauaev); Fi* references not in alphabetical order
- 125 & 130: Please specify “temporal refinement”.
- Table 2: Please reference LIM2 and CORE as you did for other settings.
- Table 2: Please add the atmospheric forcings (CGRF and DFS) and their respective time periods
- 160-185: LAB60 was forced by CGRF from 2002-2006 (5 years) and by DFS from 2007-2011 (5 years). If this is correct, I find it difficult to plot one LAB60 time series in Fig. 9. Can you at least indicate the two different forcing data sets in the plot/caption?
- 189 & 329: Please specify which sigma/density is used.
- 202: Did the simulation length really increase or rather decrease when the number of CPUs increased?
- 225: configuration”s”?

- 232: Please define how you computed the eddy components (e.g. u') in the model and AVISO data.
- Fig. 5 and Video 1: It is more informative to show relative vorticity normalized by the planetary vorticity, ζ/f, to learn about the transition from meso- to sub-mesoscales.
- 250 & 265: Please define meso- and sub-mesoscales in the introduction and how you separate them.
- 256: Please define convective energy (CE) including the mixing depth to which you refer to in Fig. 6 b. On this snapshot, all CE values are >= 500 J m^{-3}. However, a winter situation is shown (17 January 2003) and I would expect CE values < 0 J m^{-3} indicating unstable situations. Is this a misunderstanding?
- 295: First, you find the LSW with σ_Θ > 27.68 kg m^{-3} (line 189; I assume you used σ_Θ in this step). Then, you calculate σ_1 of this water mass. Then, I don't understand why you define the "yearly maximum density of this water mass as the thickest depth where the density changes by 0.001 kg m^{-3}". I don't understand how a "depth" can be "thick" and to which density the 0.001 kg m^{-3} change refers to. Can you reformulate this here and in the caption of Fig. 9? Formulated as it is, I would have problems reproducing this quantity.
- Videos: Adding the sea ice edge and some MLD contours would make the videos even more helpful.

4 References

Cael, B. B, and M. F. Jansen (2020): On freshwater fluxes and the Atlantic meridional overturning circulation. Limnology and Oceanography Letters 5, 2020, 185–192, https://aslopubs.onlinelibrary.wiley.com/doi/full/10.1002/lol2.10125

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2020-111, 2020.

Printer-friendly version

Discussion paper