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Interactive comment on "Representation of the Denmark Strait Overflow in a z-coordinate eddying configuration of the NEMO (v3.6) ocean model: Resolution and parameter impacts" *by* Pedro Colombo et al.

Anonymous Referee #1

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General comments:

This paper investigates the sensitivity of the Denmark Strait Overflow to horizontal model resolution and number of vertical levels in a regional ocean model based on a global ORCA12 configuration using NEMO. The horizontal resolution varies between 1/12, 1/36 and 1/60 degree using a two-way nesting scheme for 1/36 and 1/60. Vertical levels vary between 46, 75, 150 and 300. It has been found that if the slope of the model grid is smaller than of the actual ocean topography the overflow water entrains too much surrounding water and gets more diluted. Increasing the number of

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vertical levels is therefore not always a good choice to improve overflows. This is paper presents a timely topic and a comprehensive modelling study. My comments are only of minor nature to improve the flow of the paper and figures.

Specific comments Introduction:

2-7 High salinity shelf water which is a source for Antarctic Bottom Water is an overflow too and could/should be mentioned here. Around Antarctica most models struggle to get the dense water from the shelf into the abyssal ocean without entraining too much surrounding water.

Methods:

Figure 1. As far as I can tell, only section 29, 24, 20, 16 and Denmark Strait have been used. I do not see much value showing all the other sections. I suggest reducing them to the once which are being shown. I am aware that they are meant to show DSOW core. Please see my comment how alternatively the DSOW could be tracked, which would not require individual sections. Figure 2. It is hard to compare those fields. I would suggest showing the mean from the global configuration and anomalies to the regional setup. In this case it becomes clearer where the differences are. Since both models use the same grid calculating anomalies should be easy. All the subsequent figures have a lot of white spaces between the subplots. If there is any chance to move subplot labels into the figures that would allow to reduce the white spaces and improve the visibility/readability of the figures. 8-14. It appears that the DSOW has a seasonal cycle, which is not present in observations in the Denmark Strait (Jochumsen et al. 2012). Although this is not too critical for this study it shows that likely the formation regions of DSOW in the Nordic Seas are not captured correctly (Våge et al. 2013). That could explain why the transport variability is so low. The seasonal signal usually originates from the EGC and Fram Strait. Figure 4. I would swop (a) and (b) so you can avoid starting in line 8-16 with Figure 4b and later going back to Figure 4a. Figure 5-6. Is there the chance to include observational values here (CTD casts) along some of

these sections? That would help to illustrate how the solution should look like. Maybe just adding density contours would/could already help. 9-1 It remains unclear where this statement is based on, as far as I can tell observations along these sections are not shown or provided. I recommend a re-write of section 8-29 until the results section. The main point is not clear to me. Is it that in the control simulation the temperature in the DSOW layer are more diluted than in the other simulation? If so, this should go in the results section and would also help avoid talking about Figure 7 twice.

Results:

Figure 7. Is it necessary to show the "warm" >3.6°C waters? It distracts from the cold DSOW in the Irminger Sea and would allow to get a bit more structure in these plots. Have you tried using anomalies plots here, to make the point clear that with more vertical levels the bottom water gets eroded? Figure 7,10,11 I think it would help to overlay the DSOW path in these simulations. As the authors stated the DSOW is characterised by a temperature minimum, so the path in these simulations could be also defined by the zonal minimum in the regional for each latitude, an alternative way to what the authors use at present. 22-14 I am not convinced that reducing the model bias in the source waters will help. Results in Figure 16 show that even if modelled temperature would agree with observations, temperatures downstream would end up being warmer than the observations.

Technical corrections:

I could not spot any typos but hope a native speaker might help.

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