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Ocean Science
Discussions

Interactive comment on "A modelling study of the hydrographic structure of the Ross Sea" *by* M. Tonelli et al.

K. Assmann (Referee)

kasm@bas.ac.uk

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Review of "A modelling study of the hydrographic structure of the Ross Sea" by M. Tonelli, I. Wainer, and E. Curchitser

General remarks

"A modelling study of the hydrographic structure of the Ross Sea" presents results from a state-of-the-art circumpolar sea ice-ice shelf-ocean model. It uses Optimum Parameter Analysis to assess the performance of the model in the Ross Sea at the end of a long spin-up run. The authors have obviously put a lot time and effort into getting this very nice tool for Southern Ocean modelling studies to run. The results that are presented look promising and because of that I feel the manuscript sells the

hard work that has gone into this rather short. In its present form the manuscript falls short of being a comprehensive model evaluation paper, but doesn't present any new insights into the oceanography of the Ross Sea either. While I think the OMP is a nice tool for model evaluation, more thought needs to go into how to apply it to Ross Sea water masses. A number of extra figures and analyses would turn this into a useful evaluation of a modelling tool that has a lot of potential to be useful in further studies. I would recommend re-submission at a later stage, possibly to a more modelling-oriented journal.

Specific comments

Introduction:

1) You motivate the work by pointing out the formation of AABW formation for global climate and its potential vulnerability under climate change, yet your manuscript doesn't really address either point. 2) Get rid of the "1.1 Ross Sea" heading. 3) The ACC does not flow East to West at any point, especially not along the Ross Sea continental shelf break. What flows along the Ross Sea continental shelf break is the southern limb of the Ross Gyre. 4) When talking about the different AABW sources, you need to mention the component formed along the Adelie Land coast as well, because it is as large as the Ross Sea. The thing about the Ross Sea BW is that it ventilates the entire deep Pacific. 5) There are various points here and in the rest of the manuscript where you get a bit confused about how HSSW and ISW interact and which paths they take before flowing off the shelf to become AABW.

Model description

1) Nice and comprehensive, but could potentially be shortened.

2) Define the variables you use in the equations in section 2.2.

3) I like the idea of using a technique like OMP on model results, but will make more specific comments on the results section.

4) Is the run stable?

Results

1) You don't check water column structure in a TS-diagram, but water mass characteristics. 2) The density lines you show in your TS-diagram look like surface referenced density $\sigma 0$ to me, not neutral density γn that Orsi and Wiederwohl (OW) use. That's why your densities are all out compared to theirs. Your two choices are either to calculate neutral density for the model, or to take the OW data and plot it in a manner comparable to your Fig. 3 with lines of $\sigma 0$ which is what I would suggest. 3) Why did you choose 165W? You should catch some of the ISW that way, but there isn't really that much HSSW left that far East and it's not the best place to see whether the model really does produce AABW or just retains it from the initialisation. 4) Regarding the water masses you define for your OMP: AASW is a hard water mass to define, because it is so variable in temperature and salinity both spatially and through a seasonal cycle which you alias by looking at an annual mean. I would leave it out in favour of MCDW or to split the shelf water into LSSW and HSSW. 5) As far as I can tell your definitions of SW and ISW are too close together for the OMP to tell them apart, which is why you end up with 100% ISW and 100% SW at the bottom on the shelf. This is where it would really help to see the actual temperature and salinity sections. Looking at a section along the ice shelf front would also help to work out how SW and ISW are distributed in the model. 6) The 50/50 mixture of AASW and CDW just off the shelf looks like there might be spurious deep convection. Again it would be helpful to see the actual temperature and salinity sections. Depending on which area is covered by your TS-diagram that would explain why your CDW is too cold. Does your sea ice have holes in that area? Working out why the CDW at the Ross Sea shelf break is too cold in your model is quite important, because it will impact the conclusions you can draw from further studies done with it. 7) You motivate the need to model the Ross Sea with AABW production and deep ocean ventilation, yet you only address this in a passing sentence and it remains unclear whether the model would be a good tool to address

questions related to AABW formation and changes in it. A section further West might be better to look at this.

Figure 1: It's a nice version of that sort of diagram, but available in many other incarnations in the literature. Use it more when describing your model water mass analysis or lose it.

Figure 2: Don't show the entire model area but zoom into the Ross Sea sector which you are interested in. Something like 150E to 130W South of 60 S should be enough for your purposes.

Figure 3: Consider adding a second panel with observations from the OW atlas. Define the area over which you are showing your simulated water mass results.

Figure 4: Show simulated temperature and salinity for the section and probably the observations as well. The fact that there is a shelf water-like component in the deep basin is hard to see with you colour scale, especially when printed out.

Interactive comment on Ocean Sci. Discuss., 9, 3431, 2012.