

Interactive comment on “Assessment of the ECCO2 reanalysis on the representation of Antarctic Bottom Water properties” by M. Azaneu et al.

Anonymous Referee #2

Received and published: 2 May 2014

The manuscript aims at providing the science community with an assessment of a new reanalysis product. It focuses on the areas where the lack of observations is dramatic and where previous reanalyses did not perform well. It is important for an accurate modeling of the Southern Ocean that such products are made available, but also that their biases are identified.

I agree with Reviewer 1: the manuscript in its current form is too long, quite messy, and contains too much information going in too many directions. It fails at answering the simple questions raised by the abstract, so that in the end we still don't know how good ECCO2 is at simulating AABW. It seems to me that there are two different stories in your manuscript: the assessment of ECCO2 during the reliable period, and the polynya

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times and their associated issues. It is particularly confusing, as you described the polynya times as “unreliable”, yet anyway comment on how close the results after 2004 are to the observations.

I would suggest turning the current manuscript into two papers. The first one would be a skimmed version of the present manuscript, dealing only with the representation of AABW in ECCO2 in the “reliable period” (until 2004). The second one would talk about the complex issue of the polynya opening in ECCO2, trying to identify the reasons for this opening (you mention a few in your analysis) as well as the impacts of the polynya on the representation of AABW. You would target a wider audience with two distinct papers, and each paper would be far clearer than the current one.

I agree with Reviewer 1 that your figures are too small, but for most of them it does not matter too much. Figures 2 (in particular its inserted panels), 5 and 6 are the only ones that really need to be larger in the revised text. See below for more comments about all the figures. I also agree that you are too vague in your assessments: you need to give actual values rather than saying that something is “close” or “relatively good”.

1 Comments on the science/ideas

p1027, last paragraph: you're going in circles. You're actually saying that you have no observations, hence you need models, but you can't trust models so you need to evaluate them against observations...

p1032: you say you are defining AABW with a neutral density criterion. Why do you show the temperature and salinity fields in the results then? It seems like you are only highlighting more biases by doing so.

p1032 (again): why don't you consider the depths 600-3000 m? I am not saying you should study them, but explain why you decided not to show them.

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p1033: your explanation of Taylor diagrams seems very long and tedious.

p1039: what do you mean by “unusual feature” (line 4)? There is no clear anomaly compared with the observations, so it does not seem unusual. Is it unexpected because normally models struggle to represent it?

p1039: line 24, is it denser because of the temperature or salinity biases? line 29, the density cannot be overestimated because the layer is fresher, it's only because it's colder.

p1040: line 1, why is the density underestimated in BA and circumpolar shelves?

P1040, and later in the text: you just spent several pages commenting on the inaccuracies of ECCO2, you can't really say now that it has “a good representation”!

p1041: That is too long for something you don't show. As I said at the beginning of the review, I think you should show it, but in a different paper.

p1042 and throughout the result section: as each subsection is quite distinct, you should finish them with a brief conclusion, a sort of “bring home message” for what was just tested.

p1043: line 13, the current colorscale won't allow the reader to see that. I am also puzzled by the subsurface dense bias – is it at the same depth as the warm bias?!

p1044: end of the page, you do not comment on the process leading to colder WDW (that you mention line 25).

p1047: the fact that the 0°C isotherm corresponds to your isopycnal seems like a lucky coincidence, at least in the way you phrase it. Maybe rephrase this sentence so that it feels less like you tried any possible diagnostic to get something coherent.

p1048: lines 6-7, the observed signal is actually drowned in its internal variability, you can't expect to have better results unless you get a longer observational timeseries.

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p1048: line 24, are your correlations significant? M2 in particular seems too short for correlation tests

p1051: these findings seem counter-intuitive, the unreliable period should not be a better estimate, unless the representation of processes in ECCO2 is completely wrong. Maybe have a look at Latif et al. (2013) and their hypothesis that polynyas/deep convection are a normal feature of the Southern Ocean that we're simply not observing currently + studies showing that deep convection –at least in models- is the most effective way to form and modify AABW.

p1053, line 19 onwards: you should average only over the reliable period.

p1055: you again conclude that what you looked at is “well represented”... not really! In particular, that is disturbing that twice you actually found a good match between ECCO2 and the observations, but only if you consider the unreliable period.

p1059: if you decide to keep the paper as a whole rather than separate it, you will need to talk about the polynya far earlier than here. It was quite frustrating seeing all the hints you've dropped through the text and having to wait until the end of the results to have the answer.

p1061: your comments on figure 16 are too short, you don't even mention all the panels.

Conclusions: you need to re-refer to the figures to help the reader follow, and you do not compare your work enough with the rest of the literature (in particular ECCO and other reanalyses).

p1061, you need to moderate your assessments or give more precise values: from what you said earlier, no it does not seem to me that ECCO2 “provides a good quality representation” (idem p1064, I would not say “high quality”)

p1062, mention that the temperature was better represented than the salinity and density in fig5. You also can't give a single message about the 4 case studies: in the result

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sections you do not study them looking at the same parameter and do not seem to follow a storyline from one to the other.

p1064: line 8, which parameterizations? lines 13-15, redo the trends with the “reliable period” only, and I’m afraid the patterns will disappear.

p1065: ARGO floats and seagliders do not go deep enough (yet) to be relevant for studying AABW.

2 Comments on the figures

Figure 1 contains a lot of information. Consider not indicating on the map the regions that you don’t talk about in the text.

Figure 2 really is too small. TS diagrams for the whole water column are OK, with the exception of the bottom right one whose legend cannot be read. The inserted panels are far too small. They don’t need to be as big as the full depth ones, but as you have plenty of space around your “big” panels you should easily find a way to make the 500m-bottom panels more visible.

Figure 3: the size of the figures is correct but the fonts would need to be bigger on the colorbar. You should also use a discrete colorscale for all the variables and not just the density. That would be easier to visualize, and would help follow your text in which you anyway mention specific values in temperature and salinity.

Figure 4: the coordinates are all over the place! Maybe you should omit (most of) them.

Figure 5 needs to be bigger. The worst one is the surface layer (a) where several region labels are on top of each others. If you do not want to use more space by turning it into three different figures, I guess you could use numbers for each regions, or even only put the points and draw arrows until the empty areas of the Taylor diagrams where you

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could put the labels.

Figure 6 needs to be bigger as well. The colorscale for the salinity is not really adapted to what you want to show us, too saturated in the red. You should saturate more in the blue, a bit like what you did for the temperature section in SR4 (fig 6b).

Figures 7 to 11 are fine.

Figure 12: you comment on c before you comment on b, so they should be reversed. Again, the colorscale for the density section does not seem very appropriate. The use of a discrete colorscale instead of the current continuous one may make the figure clearer.

Figure 13 is fine to me.

Figure 14 is a bit small, but that may be improved by rearranging into two columns of three lines each (having a next to b instead of on top of it).

Figure 15a: the dashed lines on the top panel are not easy to distinguish from the continuous lines. The fonts could be a bit bigger. Figure 15b, same comment about the coordinates as fig. 4.

Figure 16 is nice.

3 Quick comments on grammar etc.

As the text needs to be rewritten quite a lot I will not point out the individual typos. I anyway have a few general comments.

Avoid repetitions, examples from the introduction: “up to 80

Try sounding surer of what you write (e.g. p1040, too many “might”).

Be consistent: - call the longitude=0° meridian either the “Prime Meridian” or the

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“Greenwich Meridian”

- either say *case studies* or case studies, but not case *studies*. Use the same style throughout the text.

- p1038: either separate temperature and salinity for all layers, or put them both in the same paragraph for all the layers

- in the case studies and in table 2, if you say “Kerr et al. (2012), hereafter referred as K12”, then use K12.

Write shorter sentences. Long sentences with four different parts in the middle of a long and complex paragraph (e.g. p1044) are the best way to lose your reader. Try giving one, maximum two, facts per sentence. Also remove useless extra words (e.g. p1039, “regime”)

Avoid mentioning points which are not directly relevant to what you are saying (e.g. p1037, lines 18-19, p1043 lines 1-6) or that you already mentioned previously in the introduction or methods.

Mind the special characters. In the text and in your reference list, accents, umlauts and slashed o are regularly missing. Both LaTeX and Word can easily deal with them.

Interactive comment on Ocean Sci. Discuss., 11, 1023, 2014.