

## ***Interactive comment on “On the deep convection events and Antarctic Bottom Water formation in ocean reanalysis products” by Wilton Aguiar et al.***

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Following the discovery of spurious open ocean deep convection in the Weddell Sea in the ECCO reanalysis two-three years ago, this manuscript investigates whether this behaviour is also found in other reanalysis products, and if so, which mechanism generates it. Reanalyses are often used instead of observations, in data-poor areas such as the Southern Ocean, yet are pretty much models. Such a study is hence vital both for the observational and modelling community.

The manuscript in its present form however does not really answer the questions announced in the abstract. The analysis concentrates on one reanalysis product only, and the explanations lack evidence to back them. The results that are shown are interesting and encouraging, but a substantial amount of rewriting is required. Please

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pay attention to the English language as well, and consider asking a native speaker to correct future versions of the manuscript.

Major comment

Section 3 needs to be majorly rewritten so that you properly comment on all three reanalyses and actually demonstrate the mechanisms that you discuss. Try re-organising your section (especially sections 3.2 and 3.3) following this structure:

1. Show a first figure;
2. Comment on it, for all three reanalyses. If they diverge (e.g. SoSe and ECCO are different from UR), start demonstrating the mechanism by showing the next figure; then
  - 2.1 Comment on that next figure for the reanalyses that agree with each other;
  - 2.2 “In contrast, UR. . .” – Comment on the different reanalysis.
3. Reiterate as many times as necessary until the full process has been demonstrated for all three reanalyses.

Also, make sure that your figures actually show what you are discussing. For example on page 6 from line 28, you use a figure showing year 2004 yet comment on the reanalyses in other years.

Other comments

Throughout the text: Why are some water mass names in italics?

The figures are not consistent. For example, Figs. 1 and 3 feature maps of sea ice concentration, but the third map (Fig. 4) is of sea ice thickness.

Fig. 2 has black lines for “observations”, but not Fig. 5 and subsequent figures. Observational water mass distribution/volume should be provided, using the world ocean atlas for example.

P2, line 32: there are more than 15 models in CMIP5 – rephrase as “. . . found that most

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models of the Coupled. . ." or ". . . found that all 15 models they studied. . ."

P3, line 29: this sentence is confusing, what do you mean by "those distinct patterns"? Please rephrase.

P4, lines 17-24: you should summarise the water masses and their densities in a table, that would be clearer.

P5, line 2: are sea ice and ocean currents velocities directly provided, or are they calculated? if so, how?

P6, line 4: where do you show the neutral density layers?

P6, line 20: give the value of the high heat content.

P6, last sentence: that is not true, there is a small region with WSDW in 2004 on Figure 4d.

P7, line 25: "unrealistic percentage" – that joins my previous comment, the reader does not know what would be a realistic value unless you show these in observations too.

Throughout section 3.2: how do you define a significant change? How many percent?

P11, line 26: Thanks for the citation, but that is not really relevant here. Cite rather Kjellsson et al. (2015), doi: 10.1016/j.ocemod.2015.08.003, or Heuzé et al. (2015), doi:10.5194/gmd-8-3119-2015

Figure 8: caption does not say which reanalysis you are showing.

Figs 5,6,7,9,10: present all results for similar water masses with the same vertical range (i.e. same range for all subpanels of surface water, same range for all subpanels with AABW etc)

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