

The Cryosphere Discuss., referee comment RC1
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Comment on tc-2021-43

Anonymous Referee #1

Referee comment on "The Antarctic Coastal Current in the Bellingshausen Sea" by Ryan Schubert et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-43-RC1>, 2021

This paper uses an exciting data set of seal-borne observations collected over several years in the Bellingshausen Sea to characterise hydrographic conditions – and in particular to examine the development of the Antarctic Coastal Current as it transits the region. The authors describe key features of the flow, in particular how it varies from east to west, and quantify volume transport along its path.

I have a few comments about the methods and structure of the paper, but it is clearly of interest to the community and worthy of publication after minor revisions. I wonder, though, whether *The Cryosphere* is the best place for it: it's very much an oceanography paper – albeit one about the polar regions – and to my mind it would be a better fit in *Ocean Science*. I'm not sure how easy it is to shunt papers between the EGU journals, and going through peer review again would be too much like hard work. But ultimately, of course, that's a matter for the authors and the editor and I leave it to their judgement.

Overall structure

A good deal of figures in this paper are included in the appendix. I understand that many of these figures are repetitive and look very similar, but they are referenced a good deal in the text, and I cannot help but feel that they should somehow be included in the main body of the paper. Perhaps the authors could compile figures of, for instance, the annual-mean fields for each water mass for the main paper, and leave the summer and winter means for the appendix? Similarly with the section plots – I would prefer to see these plots in the main paper.

Secondly, I think that the description of the WW, transition layer and hydrography CDW

(ie Section 3.2) could be better focussed on the AACW. While the results in this section are interesting – and certainly don't need changing – the message of the paper would be much clearer if the relevance of the hydrographic results to the AACC were made more explicit. In particular, there are a few paragraphs where you have to get to the end before the AACC is even mentioned.

Methods

I am not convinced of the wisdom of changing the width over which the median is calculated when gridding the hydrographic sections (Section 2.3 and Table 1). Given that temperature and salinity are used to calculate geostrophic shear, couldn't changing the width of these bins have a small influence the description of the dynamics? I think it would be safer to use the same binning window for each section, and then to interpolate over any gaps.

Secondly, the authors use the 0% meltwater fraction contour to define the outer limit of the AACC when calculating transport. But they rightly note in the methods that the composite tracer method used to calculate meltwater fraction can't always be relied upon to give the most reliable results. Have the authors investigated the influence that uncertainty in the location of the 0% meltwater fraction contour has on transport estimates? Would the results be more reliable if they used a velocity contour as the outer limit of the AACC instead? By no means do I think big changes are needed, but at the least perhaps a few sentences of explanation would be welcome.

Thirdly, the authors use the 400 dbar as their level-of-no-motion when referencing geostrophic shear. My instinct, particularly on-shelf, would be to use the seafloor, but I understand that you sometimes have to choose a level and stick with it. Using 400 dbar, however, does make the velocity plots look a little odd – they all have a flow reversal at 400 dbar that doesn't look physical. Might it be an idea to plot the referenced velocity only above this level?

Line-by-line comments

Line 185 – Section 3.1 feels more like introduction than results – perhaps it would work better in the introduction if it doesn't present any new material?

Line 209 – Should Section 3.2.1 be entitled just “Winter Water”? The transition layer is dealt with later on.

Figure 5 – Would Figure 5 work better in the Methods section, when discussing how the sections were constructed? (And perhaps it could be combined with Figure 2 if the authors are worried about having too many figures?)

Line 281 – It feels a little odd to say that surface temperature is uniform, and then to quote its average temperature.

Line 282 – The authors say that “The uniformity of surface layer properties is a feature that is consistent across all sections in the Bellingshausen Sea”, then a couple of sentences later say that “surface salinity shows substantial lateral variations”, albeit in section three. This makes for a clunky paragraph that I’d recommend re-wording.

Line 321 – “This is thought to be due to continued entrainment” – is this this authors’ suggestion or does it need a reference?

Line 327 – In what way is salinity the “dominant change”? Does it have the biggest effect on density?

Line 334 – “The deeper change in the stratification is likely due to the outflow of glacially modified CDW and marks the base of the AACC”. Is there evidence for this, or is it a question of the definition of the AACC?

Line 381 – I initially thought that APCC was a typo, so maybe spell it out to avoid confusion? The acronym isn’t used all that often.