

Interactive comment on “Carbon uptake and biogeochemical change in the Southern Ocean, south of Tasmania” by Paula C. Pardo et al.

Anonymous Referee #1

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This is an important manuscript presenting data from repeat sections in the Southern Ocean south of Australia. The data analysis is comprehensive and the results are interesting and seem to be robust; they can be compared with other studies from the Southern Ocean, thus completing the view of this vital ocean region. Actually, I think there are even a few more studies that have recently appeared and addressing similar issues in other areas of the Southern Ocean, which the authors could incorporate in the discussion of the results.

The authors explain their results through the intensification of winds due to changes in the SAM. Their repeats cover the time period 1995 to 2011. However, they also write, almost at the beginning of the Discussion: “Several studies have reported a trend in the SAM toward its positive phase from the 1960s until the 2000s (Thompson and

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Solomon, 2002; Marshall, 2002, 2003; Lenton and Matear, 2007; Sallée et al., 2008).” During at least the second half of the time period, the SAM has not been in its positive phase anymore, and thus there will probably not be elevated winds anymore, which will not enhance upwelling. I encourage the authors to identify this and add comments to the manuscript.

Although all cruises used for the analysis were conducted around summer, they were not in the same month. Actually, data may be 3-4 months apart. Certainly, in the deeper water masses, this will not have a big effect on the results. However, for the surface and sub-surface layers the seasonal changes in biologically-mediated properties are large and thus this is likely to have an effect on the computed rates. I think this caveat should be treated in the manuscript. Please comment on this and analyze the possible and expected effects on the results.

P1, line 11: Is this the correct symbol for neutral density (also at other places in the manuscript)?

P2, line 6 “ . . . and ultimately upwell close to the Antarctic Shelf” I think this only holds for part of this water, and possibly not even the major part. Please change the wording to take that into account.

P2, line 11 I suggest a modified sentence: Within the eastward flow of the ACC major water exchange between the three ocean basins takes place.

P2, line 16 Because of twice the word “that” in this sentence I suggest: . . . water mass properties and this may complicate . . .

P2, line 19 I think it is fair to cite older work of observationalists here, which actually laid the basis for this knowledge.

P3, line 12-13 Change to . . . reported an increase in CANT uptake . . .

P3, line 16 delete “of the”

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P3, line 23 Change to . . . one of the most revisited sections in the Southern Ocean.

P3, line 23-25 This sentence is an anacoluthon. Please correct.

P3, line 31 This concerns surface waters, I presume. Please add that term.

P4, line 30 Is there a reference for this?

P5, line 13-15 You only give the precision for DIC and TA measurements. Please also supply the accuracy, which is much more important here. It should be less good than the precision.

P6, line 2 combined with and

P7, line 12 . . . defined by their I^{Sn} condition (Table 2).

P8, line 8-9 “Nevertheless, long-term trends in O₂ due to circulation and remineralization processes have not yet been reported.” This is not correct. See:

Matear, R. J., A. C. Hirst, and B. I. McNeil (2000), Changes in dissolved oxygen in the Southern Ocean with climate change, *Geochem. Geophys. Geosyst.*, 1, 1050, doi:10.1029/2000GC000086. (cited in the present manuscript)

van Heuven SMAC, Hoppema M, Jones EM, de Baar HJW, 2014. Rapid invasion of anthropogenic CO₂ into the deep circulation of the Weddell Gyre. *Phil. Trans. R. Soc. A* 372: 20130056. <http://dx.doi.org/10.1098/rsta.2013.0056>

The last paragraph of section 5 is clearly a conclusion, and should thus be moved to the Conclusions section.

P15, line 13 delete one “repeat”

P16, line 8 uses stepwise MLR (delete “and”)

P18, lines 16-17 This sentence is incomplete.

P23, line 8 When using data from GLODAPv2, please cite GLODAPv2 manuscript,

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Olsen et al 2016 ESSD.

P24, line 31 delete info near end of line

P25, line 24 Deep-Sea (hyphen)

P27, line 6 Deep-Sea (hyphen)

P27, line 22 add NCAR technical note

P27, line 26 Law et al. as shown here is the Discussions paper. There is also a final paper in Geosci. Model Dev. from 2017.

P32, line 11 Comptes Rendus Geoscience

P32, line 26 Mechanisms (typo)

Table 2 caption: references (typo)

PF is defined in the caption but does not occur in Table 2

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