

Interactive comment on “Ocean acidification state in western Antarctic surface waters: drivers and interannual variability” by M. Mattsdotter Björk et al.

Anonymous Referee #1

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Review of "Ocean acidification state in western Antarctic surface waters: drivers and interannual variability" by Mattsdotter Björk et al. for publication in Biogeosciences

This study presents carbonate data of four cruises into the Amundsen and Ross Seas and analyzes the acidification state. Interesting data is presented but the manuscript is not convincing; this can best be seen in the Conclusions section which only states some general contentions.

The data should be treated and inspected in much more detail. The description of the hydrography and the results is flawed and should be restructured and much improved. The Discussion gives the impression that some incidental observations are treated.

C2082

There is no structure in it.

I think the data is very interesting and should be published. However, the manuscript can only be accepted when the manuscript will be completely worked over and the analysis be much improved.

Below are some suggestions for the revised manuscript. Please note that the manuscript needs extensive rewriting.

In the Introduction the potential adverse effects of OA are treated comprehensively. This ignores the fact that there is also accumulating evidence that for many organisms OA does not really constitute a threat. Thus the Introduction is rather one-sided. I think some text and references should be added which will put the OA discussion into perspective. Generally, I think the Introduction is too long, too detailed with issues that are hardly relevant to the investigation and it can thus be shortened.

In the text geographical names are mentioned, but for the reader it is not clear where that is. Please add all

Title

To me the term "drivers" looks strange. I would suggest something different, maybe like "driving force".

Methods Section

During the 2006 cruise the CO₂ system was over-determined. From this, relevant information can be gathered, which would be highly interesting to the reader. I urge the authors to give quantitative info on the match or mismatch of the measurements. This will be important to assess the uncertainty of the derived parameters for the following cruises.

How much time was there between the sampling on board and the measurements of CT in the home laboratory? Please provide the info in the text.

C2083

In line 16 it is written that the accuracy of CT and AT were “controlled” using CRM. Please provide more info on this. Was the CRM used as reference only? In that case, how far off were the measured data from the nominal value of the CRMs? Or were the CRMs used to set the accuracy of the measured values, i.e., by applying a correction factor based on the measured CRM value?

Please provide a reference for the Ca to salinity relationship.

The Hydrography section needs extensive rewriting. The observed changes of SST and salinity allow a detailed description.

The definition of the Polar Front should be given. In the text it is said to be at 60°S with the contention that there is a “sharp temperature gradient and salinity decrease”. However, there is a sharp temperature gradient all through the Southern Ocean from north to south. The strongest gradients are in most years seen at about 58-59°S. A salinity decrease (relative to what?) can neither be seen at 60°S.

Line 17 SST and salinity varied to a large extent due to different cruise tracks.

Line 18 Delete the first part as this is too general.

Line 20 This only holds for the cruise in 2008/2009.

Line 21-22 Your sentence: “In 2006, the PFZ was reached further south due to the more northwesterly cruise track.” This should be rephrased. Apparently, the PF was situated further to the south going in westerly direction. As such, the cruise track is no explanation.

Line 22-24 This could be described much more carefully and in more detail. As it is now, this is too general. Salinity shows structures where values much higher are observed in 2007/2008.

Line 26 Why are there two temperatures mentioned? -1.2°C is in such a context not considered to be just above the freezing point.

C2084

In Fig. 2 the changes of SST and salinity upon entering the AmP and RSP are not clearly visible. Please modify the figure accordingly.

Section Sea ice extent

How has the sea ice boundary been defined?

Section Results

This section needs a full restructuring. The results should be written down much more carefully and with more detail. The numbers mentioned in the text to be visible in the Figures are not useful and sometimes wrong. In the following some suggestions are given.

P7890 line 18-19 It is not useful to give the numbers here as the spreading at the ice edge is quite large.

P7890 line 19-20 AT dropped clearly before the ice edge at about 66-67°S. The salinity decrease is also clearly before the ice edge.

P7890 line 23 I cannot recognize these numbers in Fig 6.

P7891 line 1 CT did not decrease in 2008

I think Table 3 is not useful. It would be much more revealing to calculate mean values for the different ocean provinces in the region. The mean value over such a large range of the ACC will irrevocably lead to averages with no great meaning and a huge spread.

P7891 line 10 “. . . CT increased . . .” Against what did CT increase?

Section Discussion

At the beginning, the large winter ice extent (which remained until December) in 2010 is thought to be responsible for much melt water. However, the fact that the ice extent is lower in the other years may also be interpreted that much melting has occurred already, which would lower the salinity. Thus the explanation given in the manuscript

C2085

does not appear convincing.

Several contentions in the Discussion are phrased rather unsecure with many “may”s and “perhaps”. And they are rather uncertain indeed. There is no real evidence for them. I think the analysis should be made more robust and additional information should be brought.

P7893 line 15-21 This is rather speculative, the more so as at the end it is mentioned that the results are statistically not significant.

P7893 line 28 Omega <1 is mentioned. Is this meant to be the annually mean omega? Or the summer omega? Does this hold for the whole region? Or will only at that point in time the omega <1 be reached? Or in 50% or 15% of the region? The definition of when and what is very important for omega and even more so with the contention of a change of only 20 years.

The cruise dates in Table 1 and in Figure 1 are incompatible. So when have the samples been taken? The following figures also say data to be originating from August, Sept. and Nov., whereas Table 1 and the text say only data from December. Moreover, in Fig. 2 data is starting at 57°S, while Fig. 1 only shows a map south of 60°S.

Technical comments

P7880 line 18 outflowing (one word)

P7880 line 19 In that year we . . .

P7880 line 25 years (full)

P7881 line 10 have (not has)

P7881 line 12 steady state (words separated)

P7882 line 4 delete: the

P7882 line 21 . . . the floating (insert: the)

C2086

P7883 line 3 have (not has) ; . . . of the carbonate (insert: the)

P7883 line 16 the mineral will tend to dissolve.

P7883 line 17 delete: the

P7883 line 27 organisms (add –s) Modify the sentence like this: . . . calcareous organisms; they are important . . .

P7884 line 1-2 Modify to: . . . high CO₂ levels (Bednarsek et al., 2012). (i.e., delete the text on line 2)

P7885 line 6 insert comma after “functioning” ; delete comma after “such as”

P7885 line 7 delete comma after “functioning”

P7885 line 15 delete commas after “water” and after “Sea”

P7886 line 20-22 Please change the sentence to: The information is given in two plots: score and loading. The score plot summarizes the observations and observes patterns, trends and clusters.

P7886 line 22 summarizes ; explains (add –s)

P7887 line 6 delete: western

P7887 line 13-14 Change to: . . . summarizes the expedition info. (Everything else can be read in the Table)

P7887 line 24 delete: in

P7888 line 1 Circumpolar Deep Water is the right name of the water mass.

P7888 line 1 delete: in

P7888 line 2 . . . but we did not enter (insert: we, or : it)

P7889 line 4 AmS should be Amundsen Sea or AmP, right?

C2087

P7889 line 8 determined (not: investigated)

P7889 line 9 delete comma

P7889 line 19-20 I suggest: Generally, the December sea-ice concentration was at its maximum in 2010 and at its minimum in 2007.

P7890 line 6 delete first comma

P7890 line 26 were (not: was)

P7891 line 2 In that year, (not: this year)

P7892 line 8 shows

P7892 line 9 identifies

Interactive comment on Biogeosciences Discuss., 10, 7879, 2013.

C2088