Biogeosciences Discuss., 4, S2664–S2671, 2008
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Biogeosciences Discussions

Interactive comment on "Build-up and decline of organic matter during PeECE III" *by* K. G. Schulz et al.

K. G. Schulz et al.

Received and published: 25 February 2008

General comments and suggestions:

1 There are also some apparent inconsistencies in data and interpretation. For example, while turbulence led to vertical mixing resulting in up to 58% dilution of the deeper layer ,... a similar decrease in oxygen concentrations is also expected to have occurred in the upper mesocosm. On the contrary, Riebesell et al. found an increase by up to 20 $\mu\mathrm{mol\,kg^{-1}}$ in dissolved oxygen under elevated p$\mathrm{CO_2}$, conditions.

Response We have clarified this point. The differences in upper surface water oxygen concentrations of about 20 $\mu\mathrm{mol\,kg^{-1}}$ between the 3x and 1x $\mathrm{CO_2}$ treatment as

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reported in Riebesell et al. (2007) was observed prior to the mixing event on day 12. In fact, enhanced mixing after day 12 significantly reduced oxygen concentrations in the upper surface layer of all mesocosms as expected if deep layer water would have reduced oxygen concentrations. Moreover, the reported difference of 20 $\mu\mathrm{mol\,kg^{-1}}$ before the storm event decreased to about 5 $\mu\mathrm{mol\,kg^{-1}}$, indicating enhanced deep layer oxygen consumption in the 3x compared to the 1x $\mathrm{CO_2}$, mesocosms. We have included this finding in the manuscript.

2 Rather than the effect on ammonium production, it is more likely that nitrification activity (i.e. ammonium consumption) was somehow affected by different treatments.

Response We have included a more thorough discussion on the origin of the observed differences in deep and surface layer ammonium concentrations. Briefly, we suspect rather ammonium regeneration than nitrification to be the main driver as increased nitrification at elevated $\mathrm{CO_2}$, would argue for higher deep layer water oxygen concentrations. However, all data available point to reduced oxygen concentrations in the 3x compared to the 1x $\mathrm{CO_2}$, treatments.

3 I find it hard to accept how the POC/PON ratio could remain relatively constant and close to the Redfield value both in the suspended matter in the upper mixed layer and in the sinking material collected by the traps in view of the proposed differences in the production and export of organic matter.

Response We have clarified our interpretation of the data collected by the sediment traps. Indeed, POC/PON is very similar in all mesocosms and only POC/POP and PON/POP seem to show treatment specific differences. However, we are extremely careful in our interpretation of the driving processes as 1) we do not have any data on the dissolved organic matter in the deep layer of the mesocosms and 2) the material collected in the sediment trap is most likely a mix of relatively young material, freshly settled from the upper surface layer and older material from the bottom of the

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mesocosms, already being subject to remineralization.

Specific comments

As for some reason the page and line numbering given by the referee differed in most cases from that we found on our printout, we hope to have identified all comments correctly.

1 P.2, l.3: Change “currently change”...

Response Done.

2 P.2, l. 3-4: Change “subsequent” to “consequently”

Response Done.

3 P.2, l.5: Delete “natural”

Response We have decided to keep natural in order to make a clear separation between experiments done with one specimen in comparison to a whole phytoplankton community in our mesocosms.

4 P.2, l.7: Change “deep waters” to “the deeper layer”

Response We have adopted this suggestion throughout the manuscript.

5 P.3, l.6: Change “21.” to “21st”

Response Done.

6 P.3, l.7: Change “drives global climate change” to “ is expected to drive”

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Response We have decided to keep our formulation as global climate change is an already ongoing process.

7 P.3, l.13: Change “do drop” to “to drop by”.

Response Done.

8 P.3, l.22: Change “carbonate saturation” to “the degree of carbonate saturation”

Response We couldn’t identify the sentence.

9 P.4,l. 3: Change “has” to “have”

Response Done.

10 P.4, l.9: Change “effected” to “affected”

Response Done.

11 P.4, l.11: Change “marine element cycling” to ..

Response Done.

12 P.4, l.14: Change “solid” to “good”

Response Done.

13 P.4., l.15: Change “are crucial” to “is crucial”

Response Done.

14 P.5., l.7-10: It will be better to describe briefly the nine experiments... The information should also be included in the caption to Fig. 2

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Response Done.. We have rephrased the sentence.

15 P.5, l.12: Is it 800 liters?

Response Yes.

16 P.5, l.18: Change “ensured the” to “ensured”

Response Done.

17 P.6, l.11: Change “final concentration” to “final DIC concentration”

Response Done.

18 P.6, l.16-19: How did you sample from a tube open at both ends?

Response We have added a more detailed description of the sampling procedure.

19 P.6, l.20: “Measurement” also includes chemical measurements (analyzes)

Response We have changed our wording to”Measurement procedures”

20 P.7, l.1: Is “In principle” needed here?

Response We have changed to “In most cases”

21 P.7, l.4-5: What is the need to include information about parameters not presented in this paper?

Response Table 1 is meant to give an overview on all parameters collected during PeECE III.

22 P.7, l.6-8: Change the sentence to “Nutrient analyses were performed...”

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Response Done.

23 P.8, l.1: Change “and stored” to “and the filters stored”

Response Done.

24 P.8, l.9-11: Change the sentence to “The dissolved compounds ...”

Response Done.

25 P.8, l. 19; Change “into depth” to “to the deeper, more saline layer”

Response Done.

26 P.9, l.2: Change “until” to “at”

Response We have decided to keep “until” as it includes temporal information

27 P.10, l. 8-11: The figure shows that ammonium accumulation decreased with increasing pCO_2.

Response We have adopted the referee’s suggestion

28 If the organic matter was indeed lost from the upper layer and remineralized in the lower layer, and given that appreciable mixing occurred across the pycnocline, why did the regenerated nutrients not sustain higher chlorophyll levels than the starting concentrations?

Response Ammonium which was mixed into the surface was at concentrations an order of magnitude lower than initial nitrate concentrations. Hence, regenerated nutrients brought into the upper surface waters could not significantly have fueled biomass production. However, ammonium could be responsible for the small increase in Chl$a$

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around day t_{20}.

29 P. 11, l. 18: Change “lead” to “led”

Response Done.

30 P.11, l.20: Change “Redfield” to “Redfield value of”

Response Done.

31 P.12, l.2: Change “Redfield” to ...

Response Done.

32 P. 12, l.5: Change “5x” to “6x”

Response Done.

33 P.12, l.8-9: Refer to Fig.11

Response There should already be a reference to Fig.11

34 P.12, l.16-17: Change the sentence to “The 2005 PeECE III mesocosm experiment differs...”

Response Done.

35 P.12, l.18: Change “pelagic key” to “key pelagic”

Response Done.

36 P.13, l.1-2: Change to “into the upper surface occurred probably by...”

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Response Done.

37 P.13, l.10: Change “Bellerby and et al” to...

Response We couldn’t find this citation

38 P.14, l.7-9: Why were the other nutrients not measured in these samples, and if they were, why are the data not presented?

Response We have incorporated the referee’s suggestion and now present all available deep layer nutrient data.

Interactive comment on Biogeosciences Discuss., 4, 4539, 2007.