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Biogeosciences Discussions

Interactive comment on "Microzooplankton grazing and phytoplankton growth in marine mesocosms with increased CO_2 levels" *by* K. Suffrian et al.

K. Suffrian et al.

Received and published: 25 April 2008

Final author comments on: Interactive comment on "Microzooplankton grazing and phytoplankton growth in marine mesocosms with increased CO2 levels" by K. Suffrian et al. Anonymous Referee #2 Received and published: 22 February 2008

Dear referee,

Thank you very much for the valuable comments and suggestions. Reworking the manuscript, in our opinion, lead to a much more focussed and readable version. The restructuring and reformulating turned into a major revision, and we hope, that you will appreciate this. We hope to convince you, that the manuscript has improved much.

Thank you for your effort, Kerstin Suffrian on behalf of all authors.

1. Unfortunately, the manuscript does not manage to set the own findings into a larger context, both with other findings from PeECE III as well as other ecological studies. Especially the discussion needs to be worked over, as does the language throughout the manuscript. The legibility of the manuscript suffers from partly very long sentences that could easily be divided into two or three single sentences.

We took your remark very serious and reworked the complete manuscript, tried to shorten sentences, and to set the discussion into a larger context. We think this really improved the manuscript.

2. Consider briefly describing the development of the planktonic community in the mesocosm over the course of PeECE III. That would help the reader seeing the result of the dilution experiments in the light of other findings within the mesocosm experiment. This also may make the discussion of the results easier later in the manuscript.

We inserted a brief statement of the algal development to the introduction.

3. Which response of phytoplankton growth and microzooplankton grazing in response to elevated pCO2 concentrations was expected by the authors?

As to our knowledge no research on this topic has yet been done, we were very open minded towards the possible results, Nevertheless we had our expectations, which were added in the introduction.

Methods: 4. Nutrients were added to the incubation water of the dilution series from day 13 on, to prohibit that nutrients limited the phytoplankton growth. This is a common routine. However, the so achieved phytoplankton growth data cannot directly be transferred to the natural, nutrient poor conditions. Landry 1993 writes: “In situations where excess nutrients are added to experimental bottles, the intercept of the regression ine with the growth rate axis may or may not represent the true specific growth rate of phytoplankton in nature. Thus it is essential…to also have incubated undiluted

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samples without added nutrients. The specific growth rate of phytoplankton, calculated from these samples as the sum of the estimated grazing mortality and the net growth of phytoplankton without added nutrients, is interpreted as the rate of phytoplankton growth under nutrient-limited field conditions.” I understand that sometimes logistical restrictions do not allow for conducting experiments ideally. However, this is an important point to take up in the discussion of your results, since this may have biased your estimates of k and g during the second half of the mesocosm experiment.

You have mentioned a very important point. It was indeed due to logistical restrictions, that we did not measure extra bottles, so we added this point to the discussion (4.1)

5. The incubation water was taken from the surface of the mesocosms. Do you have an idea about the vertical distribution of protists? Is the protist abundance of the surface water representative for the rest of the mesocosm?

The mesocosms were well mixed by an airlift system that recirculated the entire volume of the mixed surface layer ca. 5 times per day (ca. 40 l min-1) during the overall experiment (Jacobsen et al., 1995). Water for the dilution experiments was collected by submerging 25 l polycarbonate bottles approx. 30 cm from the water surface, so we avoided to have any impact of the surface. All physical parameters checked were distributed homogeneously, so the μZP is expected to be distributed evenly.

6. The incubation water was pre-screened on 200μm to exclude mesozooplankton. Did you check the incubation water for nauplii and small copepods like Oithona spp.?

Although we screened the experimental bottles optically for mesozooplankton, in 1 sample (2xd8) out of 19 μZP samples two larger nauplii (315 x 200μm) were found. As these larvae can flatten they thus pass through the 200μm filter. Compared to other experiments no significant differences were found. All other nauplii seen were smaller than 200 μm, and thus by definition μZP. We did not see any Oithona spp. or other copepods. We added this to the results.

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Discussion: 7. I found it unlucky to start the discussion with a paragraph on specific pigment markers. Without doubt, the choice of right markers is essential for the presented work; however they are not the focus of the manuscript. I suggest starting the discussion with the main finding that answers the working question/hypothesis stated in the introduction.

We do agree, and thus reshaped the structure of the whole discussion.

8. I found the whole paragraph 4.2 hard to read since other studies are referenced in a manner premising that the reader is familiar with the referenced publications. References are given 4-5 times throughout the manuscript with additional notes, such as “see discussion and references in …”. Especially in the manuscripts’ discussion, the authors could briefly describe some of the discussions that they refer to in this manner. This would give the reader, who is unfamiliar with the referenced literature, the chance to follow the authors’ train of thoughts and argumentation.

It is always hard to find the right balance between stating enough and repeating too much for an experienced reader. Still, this is a valid point, and we thus tried to insert the main topics of the referenced publications.

9. Explain the two possible mechanisms behind the studies results (page 422, line 8-13) more in detail. What did Riebesell et al. (2007) describe? As a reader I would like to understand your argumentation without first reading another publication.

See 8.

Technical comments text: 10. Page 412, line 10: Range given for the highest instantaneous growth rates is not consistent with Table 3 a-c. Abstract gives range of 0.02-0.99 d-1, while the table gives a range of 0.12-0.99 d-1

Thank you very much, this mistake was corrected. As we decided to take the first two days as a lag phase this value (for days 3-9) changed to 0.37-0.99 d-1.

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11. Page 412, line 17: Range given for the standing stock daily grazed of diatoms and prymnesiophytes during the bloom phase (day 7-9 according to definition page 414, line19) is not consistent with Table 3 a-c. Abstract gives range of 14-43 %, while table 3b gives 7% for diatoms on day 8 and Table 3c 2% on day 9.

See 10.

12. Page 413, line 16: Please include a reference for the statement #8220;…while other algal species…might benefit from an increase in the surface ocean CO2 concentration”

Refs were added: Barcelos e Ramos et al., 2007; Fu et al., 2007; Iglesias-Rodriguez et al., 2008; Riebesell, 2000; Rost et al., 2003

13. Page 414, line 4: There is no National Mesocosm Centre in Norway. You mean the Biological Station Espegrand.

Espeland Marine Biological Station has actually been: ...appointed as the National Mesocosm Centre by the Research Council of Norway. That is stated on the webpage given in the paper: http://www.bio.uib.no/pages/mbs.php.

14. Page 414, line 26: Please give the approximate in-situ temperature you incubated at, since this is important information for evaluating your growth and grazing rates. Please also include information on how long you incubated the dilution series.

The in-situ temperature (increase from ˜9°C to 11.5°C over the term of the experiment) was added to the general results. Incubations were for 24h, which was stated more clearly now.

15. Page 415, line 17: Please indicate that the light measurements are not shown. Page 416, line 1: Whatman GF/F filters have a particle retention of 0.7μm (http://no.vwr.com/app/catalog/Product?article_number=513-5242)

For sure this was corrected. I apologize for this.

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16. Page 416, line 20: Please specify whether the pure E. huxleyi samples from Bergen were a lab culture or cells isolated from the fjord/mesocosm.

Cells were isolated from the mesocosms and have been in culture at the IFM-GEOMAR since. This was also clarified.

17. Page 416, line 27: You write that you used 19-hex and partly also 4-keto-hex to identify prymnesiophytes, but you only show results from 19-hex. In which way are results from 4-keto-hex presented in this manuscript?

We did not make this point clear enough before. Results shown are either from 19-hex or from 4-keto-hex. To indicate these samples we invented 19-hex* as the combined pigment abbreviation, as it does not matter from which pigment the results are drawn. Clarified in paragraph 2.3

18. Page 417, line 15: Please check equation 3. According to Menden-Deuer 2000 p.575, Tab 4) the log pg C cell-1 is log a+b*log Vol (μm3). For protist plankton excluding diatoms the equation should be log pg C cell-1= -0.665+0.939*log Vol.

The equation is not wrong, but conventionally written in the way indicated by the referee. We thus changed it according to the referee's suggestion.

19. Page 419, line 19: You used two digits behind the comma in paragraph 3.2, so please give the range 2.1-2.5 μg l-1 in the same manner to be consistent.

I agree, settled.

20. Page 420, line 15: Write day 20-22

Done.

21. Page 422, line 20: Were the algae in the 3xCO2 treatment richer in carbon? Give reference!

Algal production of organic matter is increased, as pointed out by Riebesell et al., 2007:

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1) Increased CO2 uptake by plankton will accelerate the rate of ocean acidification in deeper layers, lead to 2) a decrease in oxygen concentrations in the deeper ocean, and will 3) negatively influence the nutritional quality of plankton. The latter development can have consequences for entire food webs in the ocean.

Technical comments tables and figures:

22. Table 1: Please add in the table text that nutrients were measured in the 100% ambient water and that nutrients were added from day 13 on. The table contains two times information on the day the experiment was conducted (under column DAY and EXP). You may consider taking out column DAY.

Done.

23. Table 3a-c: The table text in Table 3a includes all information needed for Table 3b+c. Thus the three tables could be fused into one. If you like to keep three single tables, you can delete the information on the three different treatments in table text of Table 3a.

We decided to fuse the tables into one.

24. Figure 1: Please explain in the figure text which of the graphs is representing which treatment (what stand 1xd1 for), so that a reader can understand the figure without having to read the manuscript. Please also write that the figure shows the biomass of heterotrophs in the 100% ambient water.

Done.

25. Figure 2: Please indicate clearly which figure column (or colour) presents which CO2 treatment. Take out panel a-d in the figure text if you do not label the figure accordingly.

Colour labelling was explained, panels were added by BGS discussions, and we will ask to remove them, as we don’t consider them essential.

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Interactive comment on Biogeosciences Discuss., 5, 411, 2008.

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