Biogeosciences Discuss., 10, C2203–C2208, 2013
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Interactive comment on "Synergism between elevated pCO_2 and temperature on the Antarctic sea ice diatom *Nitzschia lecointei*" *by* A. Torstensson et al.

Anonymous Referee #3

Received and published: 23 May 2013

General comment

The manuscript "Synergism between elevated pCO2 and temperature on the Antarctic sea ice diatom Nitzschia lecointei" is an interesting piece of research that contributes to a better understanding of the possible effects of warming and ocean acidification in the physiology and performance of a primary producer from an environment sensitive to climate change. The manuscript is well written and clear, the methods used are straightforward, the data presented is novel and the conclusions are supported by the observations and bibliography. However there are some points that have to be addressed to improve the overall quality of the manuscript.

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Specific comments

Summary

P(age) 6638-L(ine) 13. “Polyunsaturated fatty acids (PUFA) comprised up to 98% of the total acyl lipid fatty acid pool at −1.8 âŮęC. However, the total content of fatty acids was reduced by 39% at elevated pCO2, but only at the control temperature. PUFAs were reduced by 30% at high pCO2.” This paragraph is not clear.

Introduction

P 6639- L 7. NSDIC Arctic Sea Ice News and Analysis can be supported/change by paper of Parkinson et al. (2013) noted in the bibliography below.

P 6639-L 9. Can a time frame for the stability of climate in the Antarctica be provided?

P 6640-L 26. Yang and Gao (2012) manuscript refers to a single specie in their experiments, either reword to (Line 25) “in a marine diatom”, add more references (eg.Wu et al. 2010) or refer to the citation provided within Yang and Gao (2012) manuscript.

P 6641-L 6. Hopkinson et al., (2011) refers in general terms to the CCM as being an evolutionary response to the change of atmospheric gases and then cite other manuscripts, however a more detailed explanation about this process is given by Giordano et al. (2005) on page 118.

Material and Methods

P 6646-L 5. Specify if during the Fatty Acid (FA) extraction 1 ml of Chloroform:Methanol:Water (1:2:0.8) was added after the submersion in 2-propanol to ensure the total FA extraction.

P 6646-L 6. Specify the type of detector used in the Agilent 7820 GC (FID or other).

P 6646-L 13. Specify the number, type and origin of the lipid standards.

P 6646-L 21. Specify the statistical software used.

BGD

10, C2203–C2208, 2013

Results

Introduce all the statistical results where they are mention, going back and forth to Table 1 difficult the manuscript's readability.

P 6647-L4. "Growth rate increased significantly at 960 μatm compared to the 390 μatm pCO2 at 2.5 °C". Give the actual difference once again (even if already mentioned in the summary), this would be helpful for a better appreciation of the real magnitude of the increase in growth rate.

P 6647-L12. "At −1.8 âŮęC, total FA content was reduced by 39% in the 960 μatm treatment" Give the standard error of the FA percentages mentioned here and elsewhere.

P6647-L 15. "FA contents decreased with 65–76% at 2.5 âŮęC compared to −1.8 °C" Is not clear to which pCO2 each percentage refers to.

P 6647-L 18. "Cellular PUFA content also decreased significantly with increasing pCO2" This is only true for the -1.8°C treatment, please clarify.

Figure 4. Was the molarity of each specific FA take in to account when calculating its concentration? Consider presenting the data in milligrams cell-1 or other gravimetric unit as for example Riebesell et al. (2000) Rossoll et al. (2012) or Mayzaud et al. (2013).

P 6648-L 10. Give a more elaborate explanation of the reasons for using ANOVA in spite of the heterogeneity of variance in instead of non parametric statistics; Underwood's citation alone do not explain the rationale of that decision.

Discussion

P 6649-L 15. "Choosing a temperature close to the optimum growth temperature, rather than at ambient conditions, might paradoxically both over- and underestimate the effect of carbon enrichment." Add a few more words clarifying how this happen.

BGD
10, C2203–C2208, 2013

P 6650-L 1. “Since growth was faster in the warmer treatment, the number of generations exceeded the numbers in the colder treatment. There is a possibility that more generations of N. lecointei acclimated to high pCO2 in the high temperature treatment, hence the promoted growth rate.” This is a circular reference, is not clear which factor is actually pointed as the promoter of growth or if it is a synergistic effect of both.

P 6650-L 6 to 25. The paragraph have no clear point and does not lead to any conclusion related with the study.

P 6650-L 14. A similar observation to Engel et al. (2013) have been done earlier by Riebesell et al. (2007).

P 6654-L 14. Why is the statement by Hopkinson et al. (2011) contrary to Raven (1991)? Both actually mean the same in terms of CCM down regulation and energy utilization.

P 6654-L 22. Wu et al. (2010) Show a positive growth rate and enhanced photosynthetic carbon fixation rates of high CO2 grown cells in the diatom Phaeodactylum tricornutum. Pointing this out may help to emphasize the relevance of the specie specific effect.

P 6654-L 26. “However, down-regulation of CCMs has more recently been suggested to occur at high pCO2 (Wu et al., 2008; Hopkinson et al., 2011).” This line seems to be redundant as this was already mention above.

P 6656-L 1. “Hence, the physiological effects of pCO2 may be more pronounced closer to the optimal temperature of the species, although this temperature is generally higher than ambient conditions” This statement somehow sound contradictory to the results that show no effect of pCO2 in the FAs at +2.5°C (closer to the optimal +5.1°C) (Fig. 4).

Technical corrections

P 6638-L 26. the reference Steinarche et al., 2009 is missing in the bibliography. P

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10, C2203–C2208, 2013

6640-L 21. L 23, the correct term is Psychrophilic. P 6642-L 9 and L 22. Add salinity units. P 6660-L 1. Name of second author in Rossoll et al. (2012) is misspelled.

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Interactive comment on Biogeosciences Discuss., 10, 6637, 2013.