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Biogeosciences Discussions

Interactive comment on "Availability of phosphate for phytoplankton and bacteria and of labile organic carbon for bacteria at different pCO_2 levels in a mesocosm study" *by* T. Tanaka et al.

Anonymous Referee #4

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General comments:

The authors aim to investigate the effects of increasing pCO_2, on the availability of phosphate and dissolved organic carbon (DOC) to natural phytoplankton and bacterial communities. Earlier studies addressing these questions have produced conflicting results. Given the current trajectory of atmospheric CO_2 concentrations there is a clear urgency to gain a better understanding of the effects of higher pCO_2 in the oceans and how potential changes in nutrient partitioning may cascade through different trophic levels as well as affecting the biological pump.

This study was conducted in mesocosm enclosures of natural fjord waters at post-

bloom condition, bubbled with high CO_2 containing air and amended with inorganic N and P to induce a phytoplankton bloom. The enclosures were sealed with gas tight tents to maintain the different pCO_2 levels throughout the experiment. The mesocosms were sampled over several weeks for alkaline phosphatase activity (APA), particulate phosphorus and inorganic nutrients. Phosphate uptake rates and turnover times by ^{33}P-PO_4 incorporation and DOC uptake rates and pool turnover by ^{14}C-glucose incorporation were also tested, as well as the specific affinity of phosphate and glucose.

The results showed no statistically significant differences among the three pCO_2 treatments with respect to P or DOC availability, however, it appeared as if higher pCO2 enhanced P-uptake in the larger size fractions. The authors conclude that the lack of significant effects on P and DOC availability in response to increasing pCO_2 implies that the planktonic community can buffer such changes, at least during short term events.

This is an interesting paper that addresses timely issues with regards to the changing global environment driven by increases in atmospheric CO_2 content. Overall this study represents a small portion of a much larger, very encompassing, mesocosm experiment, and as such feels slightly disconnected by itself. Although this paper focus on the P and DOC availability and describes the materials and methods used for these particular assays, the authors draw data from other publications/manuscripts from the same experiment without mentioning this in the methods section. I think it would benefit this paper to add a line or two on SRP, HPLC etc., even if these are published elsewhere.

I also believe that some minor reconstruction of certain passages and sentences would improve the readability of this paper (see below) as well as breaking the results and discussion sections into their own separate entities. As it stands now, the results section is unevenly weighted with results sometimes being discussed in conjunction to the data presented, and sometimes lacking any discussion.

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Other comments:

Materials and methods –

2.1 What was the sampling frequency? Were the samplings carried out at the same time of day each time? Could diel patterns influence the results?

What were your hypothesized results to the different treatments?

The reason for sampling out of one each of the treatments instead of all nine mesocosms can be stated here rather than in the results and discussion section.

2.4 – calculations

This is a well developed section and welcomed.

However, why did the P-biomass have to be derived from cell counts and chlorophyll data since there were direct measurements of size fractionated particulate P throughout these experiments (e.g. Fig 1)? Are these data not representative for the osmotrophs in question?

Results and discussion –

P 3947, ln 29, Was the grouping of phytoplankton taxa from HPLC diagnostic pigments during the 5 phases identified by P turnover times the same as if analyzed by any other parameter? e.i. was the strongest correlation found between changes in community composition and P turnover time?

Minor points:

Abstract –

ln 4: 750 μatm should be 700 μatm (2x350 = 700, which is also what is found in materials and methods.

Introduction –

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Interactive Comment

p 3938, ln 26, ". . . increasing **the** dissolved CO2 concentration.."

p 3939, ln 3, change "until the year 2100" to "by the year 2100"

p 3939, ln 10, suggest add "both" in "..enhances **both** photosynthetic carbon . . . and release of..". Also, split sentence in two. Ln 12 ". . . by phytoplankton (Engel et al. 2004). It also modifies.."

p 3940, ln 2-3, suggest change "not necessarily easy to be examined especially for.." to "not necessarily **readily** examined **in**.."

The sentence following is also somewhat heavy and could be rewritten to improve reading.

Ln 10, suggest changing " ..can be useful to examine.." to "can be useful **for** examin**ing**.."

Ln 12, suggest change "the objective..is to examine how..for bacteria changes at different pCO_2levels.." to "..for bacteria, **is affected by** different pCO_2 levels.."

Results and discussion –

P 2946, ln 4. From Fig one it appears as if the change is largest and smallest size fraction in the 3x and in the 10 μm only in the two other treatments.

So I suggest change from "accompanied by an increase in the $>$10 μm fraction.." to "driven by an increase in the $>$ 10 μm fraction.."

P 3947, ln 7, "nmol-P L^{-1}" should be nmol-P L^{-1} $\mathbf{h}^{-1}$

P 3948, ln 24, "..P deficiency. . . supply for phytoplankton and bacteria community." Suggest change to " P deficiency..supply for **the** phytoplankton and bacteria**l** communit**ies**."

P 3951, ln 9 and 19, Change "between" to "among"

P 3951, ln 19 suggest change from "..the availability of glucose and of phosphate availability was.." to " the availability of glucose and phosphate was.."

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Figures 1 and 2:

The raster choice was poorly reproduced and looked different in the graphs than in the squares representing the size classes. You may want to consider a different pattern option or even colors for a clearer impression.

There looks like there is an nice anti correlation between P turnover time and APA. Could SRP data also be included here?

Interactive comment on Biogeosciences Discuss., 4, 3937, 2007.