Biogeosciences Discuss., 10, C1784–C1792, 2013
www.biogeosciences-discuss.net/10/C1784/2013/

Biogeosciences
Discussions
Open Access

BGD
10, C1784–C1792, 2013

Interactive comment on "Enhancement of photosynthetic carbon assimilation efficiency of phytoplankton assemblage in the future coastal ocean" *by* J.-H. Kim et al.

J.-H. Kim et al.

kykim@chonnam.ac.kr

Received and published: 12 May 2013

We would like to thank to anonymous Referee #1 and his valuable comments. Find the detail responses to comments in below.

Comment 1) The authors missed to express the novelty of their study. After having read the paper I could not figure out what to learn from this study. This is nicely reflected in the last sentence of the abstract. Here, the authors mention that "more research is required to suggest that some factors such as grazing activity could be important for regulating phytoplankton bloom in the future ocean (p. 4612 L. 23- 25)". First of all, it is totally unclear at this point how grazing is related to the topic as it comes out of nowhere. Secondly, the authors should use the last sentence of the abstract (which is one of the most important parts of the manuscript) to underline their own findings. It is more than obvious that "more research is required".

Response 1) We agree on the review and originality did not have enough emphasized in our manuscript because some of our mesocosm data were already published. We added more results such as experimental conditions (Figs S1, S2), grazing activity (Fig. S4) as well as taxonomic composition (Fig. S3) on supplementary materials. Also, abstract will be changed entirely in revised version, and we are sure it will be more improved than previous version.

Comment 2) The authors mention relative changes in some photophysiological parameters in the abstract. It is unclear to me how these differences were calculated. This is not explained in the main text. The numbers also do not re-occur in the text. Is it the means of all days within one treatment compared to another treatment?

Response 2) Data investigated in this study are too extensive, thus we think enumerate and simple comparisons among the experimental treatments are not meaningful in the abstract. We will change most part of abstract with simple and universal expressions based on the tendency of experimental parameters among the treatment.

Comment 3) PAM fluorometry is a very complex technique. The authors do very little in order to explain what the different parameters they measured with the Phyto PAM tell us. It would be very helpful to explain what the different parameters (e.g. alpha_LC) actually show so that readers, which have no experience with PAM fluorometry can easily understand what has been measured here and why.

Response 3) We will add more detailed methods and photosynthetic parameters in Material & Method. Most previous PAM studies utilized rapid light responses curves (RLCs) to evaluate physiological states, but we used LCs (steady-state light response curves) because this result includes more ecological responses of phytoplankton. We will describe more about the ecophysiological meaning of LCs and LCs parameters, and this will be inserted at first paragraph of Discussion.

Comment 4) This experiment deals with ocean acidification. Although a detailed presentation of the carbonate chemistry may not be absolutely necessary in case the results were already published elsewhere, it is obligatory to mention the most important facts on the development of the carbonate chemistry in the course of the bloom. Especially in this experiment where massive amounts of nutrients were added to the mesocosms. This must have led to a strong draw-down in dissolved inorganic carbon (DIC) and consequently to pronounced shifts in pCO2 and pH. The high pCO2 atmosphere put into the headspace of the mesocosms could most likely not compensate the biotic activity of the autotrophic community.

Response 4) We added basic data about pCO2 and pH on supplementary materials (Fig. S1). As mentioned by reviewer, drawdown of pCO2 (also DIC) was observed insensitively with active biomass increases of autotrophic organisms during the experimental period. We recognize this massive chemical changes also appeared in future coastal ocean with massive phytoplankton bloom, but fluctuation of carbon chemistry was neglected in the laboratory studies. This is one of distinction between laboratory and mesocosm studies.

Comment 5) How were cells kept in suspension? Were mesocosms mixed? Was there pronounced accumulation of sedimenting material on the ground or settling of a benthic community? The basic experimental setup should be described with more detail.

Response 5) Normally, seawater is mixed by wave reaction in the pelagic system, but seawater was mixed more actively by seawater mixing unit (bubbling by targeted gas concentration) for 20 min for creating a homogeneous condition (include particulate and dissolved organic matter). Mixing efficiency was reported in previous method paper (Kim et al. 2008, L&O method), and we will explain this system in the Material & Methods.

Comment 6) “The key physiological finding of this study” (p.4621 L. 6) that “phytoplankton could assimilate more organic carbon for photosynthesis [: : :]" is not supported by the data provided in this study. 14C measurements for gross community production indicate a very similar organic carbon assimilation in all treatments.

Response 6) The meaning of that sentence is "(1) Phytoplankton utilize less light energy under acidification but it could assimilate similar amount of carbon as the control (present). (2) Phytoplankton utilize the same light energy under greenhouse, but it could assimilate carbon more than the control". From the consideration of these two results, we conclude that CO2 had positive affect on photosynthetic carbon assimilation efficiency. We inserted the simple diagram in below (Fig. 1.). However, gross community production did not change along the experimental treatment as mentioned referee #1. We solve this paradox by grazing activity (Fig. S4), and it was significantly enhanced under acidification and greenhouse than ambient. Also, total biomass (Chl a in this study) significantly depressed under greenhouse. According to these results, we conclude that gross community production did not change. We will add one more graph (see Fig. 2., it will be inserted in revised manuscript), which is chl a normalized GCP, and it was significantly higher under greenhouse than ambient and acidification. This result is represent that GCP could be increased when grazing effect is eliminated under greenhouse condition.

Comment 7) The dataset cannot be fully interpreted without detailed investigation on the phytoplankton species composition in the mesocosms. I agree with Gustaaf Hellegraeff that species shifts can pretty much explain all observed differences between treatments. Species composition should therefore be taken more into consideration. Being able to investigate changes in species composition is actually the big advantage of mesocosm studies and the authors should make use of that.

Response 7) Although several data were published in series papers, we added results of taxonomic groups in supplementary materials (Fig. S3), and we will add paragraph about species composition on the manuscript (in Discussion) because it is difficult to understand mesocosm condition without these data. In the supplementary materials, taxonomic groups' changes (micro-, nano-, pico-flagellate, and diatom) were included. From the species-level identification, Skeletonema costatum, Chaetoceros spp. and Eucampia zodiacus responded positively or negatively to experimental treatments in the diatom group (published in Kim et al. 2010, ES&T, see Fig. 3). Also, Gyrodinium spp., Akashiwo sanguinea and Nematodinium armatum showed different responses among the dinoflagellate group under experimental treatment (unpublished data). Among the taxonomic groups, diatom occupied most of phytoplanktonic biomass, but dinoflagellate occupied small biomass during the experiment period (see supplementary materials, Fig. S3). Thus, dinoflagellate contributes very little to photosynthesis and community production among the taxonomic groups.

General comments) The manuscript by Kim et al. needs to be restructured. A lot of paragraphs (e.g. the whole "ecological implications" section in the discussion) have no clear argumentation. It is no pleasure to read the manuscript in its current form but hard work. The authors should also have a critical look on the logic of their sentences. For example, the sentence: "These results indicate that phytoplankton required less light energy without depressed photosynthetic activity under acidification condition, and maximizes photosynthetic carbon assimilation efficiency using same light energy under greenhouse condition. (p.4621 L. 13-15)" is hard to understand. The reader has to spend a lot of time thinking about this sentence before it is clear what the authors want to express. And there are many more such examples. Thus, the authors should put a particular focus on improving clarity in the whole text.

Responses to general comments) We will check the manuscript, and ambiguous sentences and expression will be modified.

References

Kim, J.-M., Shin, K., Lee, K., and Park, B.-K.: In situ ecosystem-based carbon dioxide perturbation experiments: Design and performance evaluation of a mesocosm facility, Limnol Oceanogr. Methods, 6, 208-217, 2008.

BGD

10, C1784–C1792, 2013

Kim, J.-M., Lee, K., Yang, E.J., Shin, K., Noh, J.H., Park, K.T., Hyun, B., Jeong, H.-J., Kim, J-.H., Kim, K.Y., Kim, M., Kim, H.-C., Jang, P.G., and Jang, M.C.: Enhanced production of oceanic dimethylsulfide resulting from CO2-induced grazing activity in a high CO2 world, Environ. Sci. Technol., 44(21), 8140-8143, 2010.

Figure 1.Diagram to explain enhancement of photosynthetic carbon assimilation efficiency of phytoplankton.

Figure 2. Chlorophyll a normalized community production during the experimental period in the present (green), acidification (blue) and greenhouse (red) conditions. Colored shading represents the standard deviation from the mean of replicate enclosures.

Figure 3. Abundance of diatom during the study period (b) Skeletomema costatum (c) Chaetoceros spp., (d) Eucampia zodiacus. The green, blue, and red symbols and lines represent the control, acidification, and greenhouse conditions, respectively. (Source: Kim et al. 2010, ES&T)

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/10/C1784/2013/bgd-10-C1784-2013-supplement.pdf

---

Interactive comment on Biogeosciences Discuss., 10, 4611, 2013.

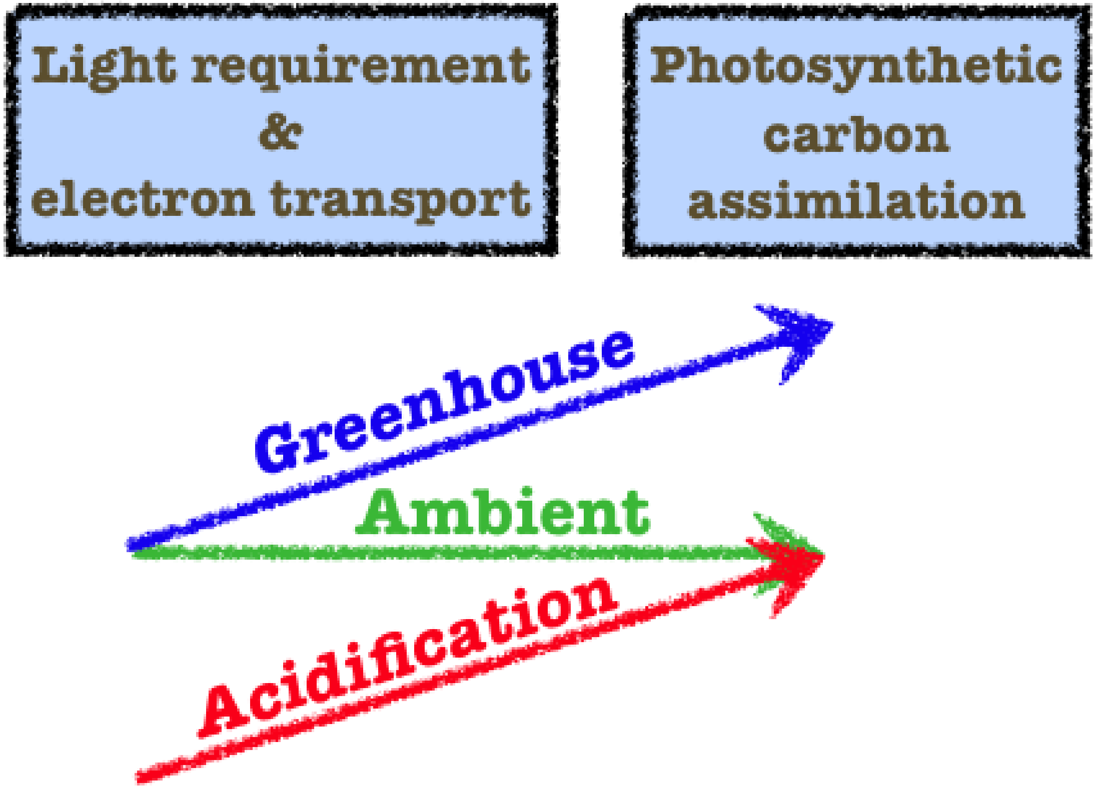

Fig. 1. Diagram to explain enhancement of photosynthetic carbon assimilation efficiency of phytoplankton.

BGD
10, C1784–C1792, 2013

Interactive Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

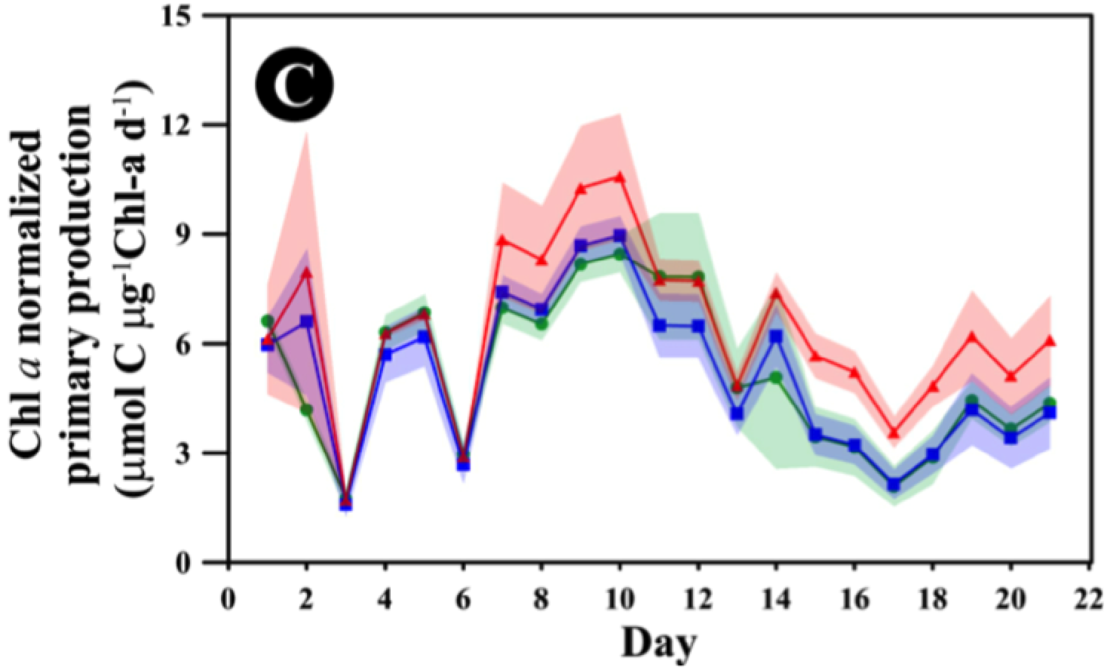

Fig. 2. Chlorophyll a normalized community production during the experimental period in the present (green), acidification (blue) and greenhouse (red) conditions.

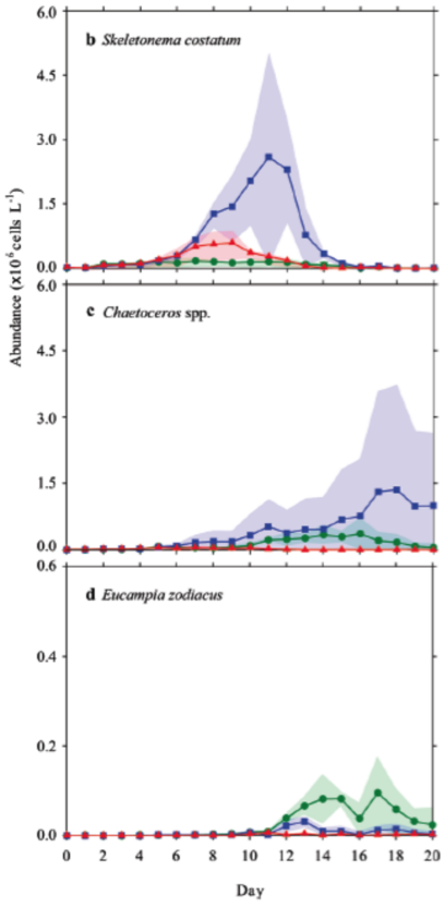

Fig. 3. Abundance of diatom during the study period (b) Skeletomema costatum (c) Chaetoceros spp., (d) Eucampia zodiacus. (Source: Kim et al. 2010, ES&T)