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

### **Anonymous Referee #1**

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Kim et al., used a mesocosm setup to investigate if ocean acidification and/or ocean warming affects primary production and photophysiology of a coastal phytoplankton community. Although the results potentially contain interesting aspects, I cannot recommend publication of the manuscript in its current form in Biogeosciences. I will explain in the following why I think that this manuscript seriously needs to undergo major revisions.

Major problems: 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

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“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”.

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?

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.

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  $pCO_2$  and pH. The high  $pCO_2$  atmosphere put into the headspace of the mesocosms could most likely not compensate the biotic activity of the autotrophic community.

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.

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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.  $^{14}\text{C}$  measurements for gross community production indicate a very similar organic carbon assimilation in all treatments.

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.

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.

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