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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.

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We would like to thank to anonymous Referee #3 and his valuable comments. Find the detail responses to comments in below.

Comment 1) The authors have photosynthetic parameters from both fluorescence-based rETR rapid light curves, and from PI curves using 14C. I see that the measures were conducted on different days, for logistical reasons. But could they actually plot the data extracted from the two different approaches? I am not sure how to handle the time offsets, but perhaps a plot of the key parameters vs. time, with a curve fit to see if the patterns differ?

Response 1) Our PAM data are representing the steady-state light response curves (LCs), not rapid light curves (RLCs). The differences between the two curves are related to the light history for photochemical responses. RLCs are usually measured after short-term light acclimated condition (normally 10 sec acclimated to actinic light), but LCs are measured after the full acclimation to light conditions (under ambient light acclimated in this study). We will be adding this explanation on the manuscript (in discussion). The results were re-plotted as photosynthetic parameters vs. time, which were suggested by referee #3 (result add in Supplementary materials). We will choose the curves with the better expression, and reflect it in the revised manuscript.

Comment 2) More substantively:"The relative electron transport rate (rETR) was calculated as rETR =phiPSII X irradiance. The absorption factor and relative fraction of PSII were not applied to the ETR calculation to avoid ambiguous problems (Ryan et al., 2009)." Although widely used, the rETR = phiPSII X irradiance is not calibrated. The Pmax values from this estimator are a (rough) proxy for electron transport from PSII centres. The measure is not calibrated for the number of PSII centres, nor for the fraction of incident irradiance allocated to PSII. There is no cross section (sigmaPSII) factor in the estimation, and no factor for the number of PSII centres present. Therefore, the Pmax values from these curves are not useful for comparisons across treatments, because sigmaPSII and the number of PSII could change, with or without corresponding changes in phiPSII. So the comparison to the PI curves from 14C measures needs to be more cautious. Discussions of light use efficiency can possibly be based upon the 14C measures, but the only generally comparable parameter that is extractable from the rETR curves is Ek, which is the boundary light between light limitation of PSII electron transport, and light saturation of PSII electron transport. So I would like to see plots of Ek from the rETR and from the 14C curves, to see how they differ. Any discussion of Pmax derived from rETR must be very cautious. It is not calibrated, and is relevant only on a basis of electron transport per PSII, and even then, the units are relative, not absolute.

Response 2) We recognized the technical problem of PAM measurement, suggested by referee #3, which was brought on by optical cross section. We did not consider the relative fraction of PSII (often assumed to be 0.5) to calculate ETR, and the results were represented in relative value (relative ETR). Relative fraction of PSII could be calibrated, but this process was not well developed for the field study until now. In addition, relative fraction of PSII could be altered by varied environmental condition such as temperature and irradiance as well as CO2, thus it is harder to calibrate this factor in the field. Our PAM data were constructed after measuring the effective quantum yield in the field mesocosm more than 70 times during the daytime. Indeed, many previous PAM researches did not apply this factor to calculate the ETR. Moreover, some studies used PAM data to estimate the community production. To avoid these of problems, we ignored this factor and measured photosynthetic rate with 14C incorporation measurement. Photosynthetic parameters were also calculated by rETR (LCs) and 14C incorporation (P-I curves) data independently. We suppose that difference in rETR and 14C refer to the relative fraction of PSII, which could change under high CO2 conditions. In addition, we can argue the light utilization is decreased under acidification conditions based on ΦPSII and LCs, even though our PAM data were not calibrated, these will not be a problem. We will add this point in Discussion.

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