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Interactive comment on "Technical note: Estimating light-use efficiency of benthic habitats using underwater O_2 eddy covariance" *by* Karl M. Attard and Ronnie N. Glud

Anonymous Referee #1

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This is a well-written, interesting technical note but the data analysis needs further explanations.

In this study, the authors use the underwater eddy covariance technique to measure oxygen flux in shallow coastal environments where light reaches the seafloor. From these fluxes, they compute hourly and daily light-use efficiency of the phototrophic benthic community. One of the key findings is that the hourly light-use efficiency may approach the maximum theoretical limit and that it decreases rapidly towards the middle of the day. These are nice results that are also supported by previous work by Berg and colleagues and should be of interest for the readers of biogeosciences. Light

use efficiency is a useful parameter for characterizing and comparing shallow benthic habitats and for assessing environmental change. In a time when coastal water quality is deteriorating globally, a technique allow evaluation of the activity of the phototrophic benthic community is very helpful.

I propose expanding the discussion of the calculations of GPP and R and their limitations. Gross primary production (GPP, here total oxygen produced through photosynthesis) was calculated as the sum of the daytime measured net oxygen production and the oxygen consumed through respiration (R) at night. As pointed out by the authors, daytime respiration typically exceeds nighttime respiration, but daytime respiration could not be measured directly in this study. Thus, four different daytime respiration rates were calculated, two static rates and two dynamic rates (linear or sigmoid increases) to determine the respiration behavior that would fit best with the measured data. The accuracy of the determination of R and GPP defines the quality of the light use efficiency estimates that are at the center of this study. In a tidal regime, the eddy covariance instrument may not interrogate the same area of the seafloor during day and night, and thereby produce nighttime R data that are not representative, even after some corrections, of the area producing the daytime flux data. The actual differences in R may be small, however, R then represents a best guess, not a known flux.

Another point that could be addressed in more detail are the other controlling factors of benthic photosynthesis besides light intensity, e.g. the spectral composition of the light, roles of grazers, nutrient availability, temperature and current strength.

In figure 1, the data could be interpreted differently, i.e. further increase of the light-saturation curves with increasing light. These are four consecutive days of measurements, and the curves of the third and fourth days increase until 300 PAR at least if not farther.

In figure 2, second panel, N1+N2 should be changed to be (N1+N2) average.

Although R is about 20% higher in plot 2 of figure 2, GPP is almost identical, and an explanation for this unexpected behavior would be helpful. Similarly, as R increases over time in fig. 2, c and c, one could expect that the curvature of the light-saturation curves would increase but it does the opposite. All four GPP plots in fig. 2 are nearly identical suggesting that magnitude and dynamics of R have little influence on GPP. This is counterintuitive as in many coastal environments R reaches similar magnitude as GPP (as also seen in figure 2) and also follows dynamics that may be similar to those of the GPP (as in fig. 2 d). This needs more detailed explanation.

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