

Interactive comment on “Consequences of respiration in the light on the determination of production in pelagic systems” by O. Pringault et al.

Anonymous Referee #2

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In this study an alternative method for the quantification of light intensity-related respiration in oceanic water samples is presented. The method is based on the determination of oxygen concentration changes in water samples during light/dark shifts using a fast-responding microsensor. In order to estimate community gross production, both net production and respiration need to be determined accurately. As the latter two can be derived from oxygen concentration changes in time, the first can be calculated assuming:

Net production = Gross production - Respiration

However, as dark respiration in dark incubated samples can directly be quantified by

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this method, light respiration can not, as the change in oxygen concentration in time in illuminated samples reflect Net production rates.

To overcome this problem, it is proposed in this study to derive the light respiration rate from the initial change in oxygen concentration directly after switching from light to dark incubation, assuming that during this short initial period, respiration still equals light respiration.

As is stressed several times in the manuscript, it is indeed of major importance to correctly quantify prevailing (light/dark) respiration rates in order to quantify gross production rates of oceanic water samples, as is in the past often largely ignored. Therefore the topic of this study is important.

Although the presented method seems rather simple and straightforward, the authors go into a lengthy and sometimes puzzling description to explain this. However, or maybe due to this, several of their argumentations or statements are rather puzzling. For example:

Introduction:

P 1369, L 9: 'Although, the strength of this coupling between autotrophic and heterotrophic compartments will vary as a function of the organic matter and nutrient concentration, it cannot be considered as negligible'

1) What does this mean?

Results:

P:1372, L21: 'When NP (in absolute values) was greater than Rdark, resulting in physiologically impossible negative values of P, we consider that Rlight needs to be greater than NP in order to get a positive value for P'.

2) Not clear and rather confusing. Why does respiration (light or dark) need to be greater than the net production? It seems to me that part of the confusion has to do with

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the different types of communities one can theoretically encounter in an oceanic water sample, e.g. When oxygenic phototrophs are absent, respiration will be >0 , Gross production = 0, and Net production <0 . When oxygenic phototrophs (e.g. cyanobacteria) are virtually only present, light respiration will be very close to 0, but dark respiration significantly higher, and both Net and Gross production >0 . The community composition can thus not be ignored and in many cases light respiration can thus very well be significantly lower than dark respiration. Please comment on this.

3) However, what is of much more importance and largely not discussed, is the question whether their based assumption holds, i.e. if light respiration can theoretically be determined during (the initial) dark period! This seems highly unlikely, and if indeed not possible, it would mean that determined values in this study do not represent light respiration rates. Against their assumption it can be argued that directly after switching off the light, community metabolic processes will abruptly change. E.g. as mentioned above, cyanobacteria but also algae and even oxygen-respiring anoxygenic phototrophs (can make up a significant part of the community in oceanic samples) will switch immediately to aerobic respiration when deprived of light, in order to sustain energy generation. These combined processes will result in a significant but only apparent light respiration. Please comment on this, and include in the discussion section.

Further questions:

4) This microsensor based method needs to be compared with existing techniques, such as stable isotope ^{18}O techniques, which in fact can effectively quantify light respiration rates in light incubated samples. As the stable isotope technique allows direct quantification of light respiration during the light period, but the proposed microsensor method can not, the former seems by far the most preferred method. Please comment on this and include in the discussion section.

Further questions:

5) One presented data set jumps out as it shows a highly unexpected result but is not

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discussed, i.e. the data presented in Fig 2b: higher absolute oxygen consumption rate during illumination compared to dark rates, how can this phenomenon be explained? Light dependent activity of present grazers?

6) Can it be that respiration rates are not so much light dependent, but rather oxygen concentration dependent? After an illumination period the oxygen concentration is significantly increased, what thus may result in a significantly higher respiration in the subsequent dark period.

7) Is a fast-responding microsensors really needed to obtain the presented data, or would a mini- (often more stable) sensor suffice?

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