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Biogeosciences Discussions

Interactive comment on "Growth and specific P-uptake rates of bacterial and phytoplanktonic communities in the Southeast Pacific (BIOSOPE cruise)" *by* S. Duhamel et al.

Anonymous Referee #1

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General comments

In this study, Duhamel and co-authors present estimates of specific growth rates for different size-fractions in the plankton (heterotrophic bacteria and pico and nano-microphytoplankton) along a transect extending from the upwelling region off Chile through the Southeastern Pacific Gyre. Specific growth rates were estimated using a unique combination of C and P incorporation methods and C and P standing stocks estimates. This study presents results from an oceanic province were such data is lacking (Southeastern Pacific Gyre) combined with a promising methodological approach (growth rate estimates derived from P-based measurements) to better under-

stand plankton dynamics and biogeochemistry in the ocean. I, therefore, recommend publication in this special issue of Biogeosciences. I have several comments concerning the manuscript that should be addressed before publications.

Specific comments

Introduction. The authors refer to a parameter μ that is not clearly defined. This leads to some confusion (at least for the reader) between specific growth rates (which I assume is what the authors mean by μ) related to cell division rates and cell specific or biomass specific uptake of C, N or P (specific uptake rates). These two parameters can be related to each other but are not equal (as an example specific C uptake does not directly reflect specific growth rates as some C is respired by the cells and not incorporated into cell biomass). A clear definition of these too parameters and how they relate to each other for the different elements would be helpful.

1) Abstract, line 8: μ has dimension 1/time nothing to do with carbon units. Be more precise. What is meant is that estimates of μ are based on C incorporation and C biomass measurements?

2) Introduction, § 1: The introduction begins with the symbol μ without mentioning what μ really stands for. I would suggest first explaining what is meant by μ (specific growth rate I suppose).

3) Introduction, § 1: " The determination of heterotrophic bacterial ...". This seems to be a repetition of the first sentence in the introduction. It is not clear what the additional message is here. Be more precise or leave this sentence out.

4) Introduction, § 2, lines 10-13: "and is an expression of μ as it is modified by ..." μ is not modified but rather determined by environmental conditions.

5) Introduction, § 4, line 6: "Contrary to C and N, P is more quickly liberated from dead material...". Should be rather "In contrast to C and N, P is quickly released from decaying material...". Can the authors give a time scale for that?

BGD

4, S1149–S1153, 2007

6) Introduction, § 5, line 6-9. Should be rather something like this "This area presents a gradient in trophic conditions from the extremely oligotrophic South East Pacific gyre, the largest and most poorly investigated province of the world’s ocean, to the high productivity Chilean upwelling region"

Materials and methods

7) M&M, section 2.1, lines4-8: rephrase: "Temperature, conductivity, salinity, oxygen and fluorescence high resolution profiles were obtained using a CTDO profiler (Seabird 911 Plus) between 0 and 500 m depth...Seawater samples were collected at 6 different depths corresponding to levels of 50, 25, 15, 7, 3 and 1% surface irradiance, respectively."

8) Why is the max. irradiance for measurements 50% of surface values and not higher?

9) M&M, section 2.4, lines 1-6: rephrase " Specific uptake rates (Vsp) have been calculated by dividing heterotrophic bacterial production (HBP), C uptake rates (VDIC) or P uptake rates (VDIP) by bacterial biomass (HBB), phytoplankton biomass (AB) and particulate P (PartP), respectively."

10) M&M, section 2.4: It would be more elegant if HBB was expressed as VLeuC or something similar.

Results

11) Results, section 3.1, lines 8-11: rephrase "Flow cytometry measurements showed that over the whole transect...cells had an average size of 0.68ś0.08 μm, 0.86ś0.1 μm and 1.74ś0.13 μm, respectively. Average cells size of Synechococcus in the upwelling stations was 1.16ś0.2μm."

12) Results, section 3.2: In order to evaluate the methods comparisons between Chla, PartP and POC measurements are presented (figures 2 and 3), but no mention is made of biomass estimates based on cell counts. Why is that? It seems to me that biomass estimates based on cell counts is still the most reliable method to separate detritus

BGD

4, S1149–S1153, 2007

from living organisms as well as to estimate biomass of different living groups (even if one has to use conversion factors to estimate C), instead only "proxy" measurements (POC, Chla, and even PartP) are considered.

13) Results, section 3.2, §2, lines 10-12: rephrase "This indicates that 69% and 14% of the PartP variability is unrelated to Chla variability in the ..."

14) Results, section 3.2, §3: The differences between C and P uptake ratios (57 which incidentally is much lower than Redfield: 106/1) and particulate matter ratios (349) is used to derive differences in residence times. I am not sure how that works. Residence times can also be roughly estimated (assuming no vertical or horizontal export) from the measurements as the ratio between the concentration in particulates (nmol l-1)/Uptake (nmol l-1 d-1). What is the residence times using this formula for C and P? Does it vary depending on region and depth?

15) Results, section 3.2, §3: I understand that data from high productivity (a few high values) will significantly influence the regression. I find it, therefore, commendable that the authors show results for the oligotrophic regions separately. It would be, however, relevant to this study that an analysis including all the data is also shown (additional figures maybe).

16) Results, section 3.3: rephrase "Vsp DIP$<$0.6 values were 1.2 to ... HBP:HBB values in the productive areas (MAR-STB6 and STB15-UPX, respectively)..."

17) Results, section 3.3: From the cell counts and Chla measurements what would the C:Chla ratio be as compared to the values from Veldhuis and Kraay (2004). Why not use conversion factors derived from data in this study? If the biomass estimates from cell counts are too high, how do they compare with measured POC values? And since the C:cell convertion factors are so variable (Table 1) why not simply try using a better one and then compare with the P-based estimates?

18) Discussion, §1: It is growth-mortality that controls population dynamics or assem-

BGD
4, S1149–S1153, 2007

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blage composition, not growth alone.

19) Discussion, §1: rephrase "We measured DIP ... in order to asses in-situ specific growth rates of bacteria and two size classes of phytoplankton".

20) Discussion, Section 4.1,§1: There seems to be a mix-up between Table 1 and Table 2. Also, from the text Table 1 should be Table 2 and vice-versa. I am also not sure that Table 2 is very useful. Since variability in C:Chla ratios is well known, couldn't the authors simply give the range of C:Chla variability with relevant references? I would also remove the large parenthesis describing variability in C cellular content since they are given in Table 1.

21) Discussion, section 4.1, §1: rephrase "So although the use of a single conversion factor is the rule in field studies, it probably leads to significant errors in biomass estimates. Conversely, using appropriate cell or Chla to carbon conversion factors would demand complex data analysis"

22) Discussion, section 4.1, §2: rephrase "It is found in a variety of molecules with different cellular roles, ranging from...If the contribution of detrital P to PartP standing stocks is small enough, than PartP can be considered to reflect standing stock of living material."

23) Discussion, section 4.2: Is there no measurements of DOP in these or similar regions. I was under the impression that DOP could be an important P source and sink in oligotrophic regions.

24) Discussion, section 4.3, §1: Why aren't the results of Perry and Eppley (1981) and of Thingstad et al. (1996) given in Table 3? How can the detrital proportion of PartP be estimated?

25) Discussion, section 4.3, §2: replace "rich areas"; with "productive areas".

Interactive comment on Biogeosciences Discuss., 4, 2027, 2007.