

## ***Interactive comment on “Autotrophic and heterotrophic metabolism of microbial planktonic communities in an oligotrophic coastal marine ecosystem: seasonal dynamics and episodic events” by O. Bonilla-Findji et al.***

**O. Bonilla-Findji et al.**

wein@obs-vlfr.fr

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Comment by authors: we thank the referee#3 for the thorough comments, which have strongly improved the manuscript.

Anonymous Referee #3

This manuscript presents seasonal changes in trophic balance (i.e., autotrophy versus heterotrophy) in the Bay of Villefranche. Although trophic balance is very important, data are still few for the coastal waters, especially for its temporal variation. The data

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in this manuscript contains important episodic events, e.g., forest fire, local upwelling and wet deposition of Sahara dust. Thus, I highly evaluate the data and support the publication after revision. I give many suggestions, but I think all of them are easy to be revised or considered. General comments

1. Purpose of this study is not clearly presented.

ANSWER: We have tried to describe the purpose of the study more clearly.

2. Threshold GPP is given as  $2.8 \mu\text{mol O}_2 \text{ l}^{-1} \text{ d}^{-1}$  (P2042, L19), but it should be a mistake. Substitute 1 for GPP:R in the equation (P3042, L17), the obtained GPP, that is threshold GPP, is 1.12. The leaner regression line in Fig. 7 also shows that threshold GPP should be around 1 (i.e.,  $\log \text{GPP} = 0$ ) not 2.8 (i.e.,  $\log \text{GPP} = 0.45$ ). I strongly recommend to check the calculation again, because the estimate of threshold GPP should affect your conclusion.

ANSWER: We have done this recalculation and indeed the threshold calculation was wrong. Thanks for finding this error!!

3. What is “Total DOC consumption”? Is it BCD or DOC consumption by all biota? For the latter case, how did you measure it? Community respiration (R) is not total DOC consumption. State the meaning clearly. Anyway, BCD is only given in text (P2043, L29-31), but I suggest to show it in figure, considering its importance.

ANSWER: This misleading sentence has been removed.

Specific comments P2035, L19: What is “these processes”?

ANSWER: Corrected

P2036, L13-14: How often did you take the seawater samples for routine analyses?

ANSWER: Weekly for nutrients and Chla. Sampling points are shown in the contour plots.

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L20: Add "Net community production" before NCP and put NCP in brackets.

ANSWER: Corrected

Replace "CR" by "R", because you designated community production as "R" in P2035.

ANSWER: Corrected

P2037, L6: ". . .due to the low particle concentration" How much is the contribution of particulate organic carbon to TOC in general?

ANSWER: In the samples from Point B collected before this study, POC was <10% of TOC and usually DOC and TOC data were not different, i.e. three measurements showed overlapping SD. This is not unusual for oligotrophic low particle environments. Thus, taking TOC for DOC is a typical option in oligotrophic waters, which reduces contamination risk.

P2038, L10-13: Prefiltration may change bacterial community structure and their activities. How much is the recovery of bacteria in the filtrate? And I suggest to describe the possible effects of prefiltration on the results in Discussion.

ANSWER: For Point B water, it is >80% and most of the time even >90%. It is known for a long time that prefiltration can be a problem. We have mentioned in the discussion that the parameters GPP, R, BP and BR are error-prone. This is well known and we feel that there is no need to describe that in detail in every paper.

P2039, L5-6: "Bacterial carbon demand (BCD) was calculated as BP + BR" Give the assumption about bacterial respiration quotient.

ANSWER: This information is already given in P2039,L4-5.

P2040, L9: "The summer period of 2003 was characterized by a high frequency of forest fires. . ." State the months when forest fire was most frequently occurred.

ANSWER: The forest fires occurred almost exclusively in July/August. This information

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has been added to the figure legend.

L23-24: I think " $\mu\text{M}$ " should be " $\mu\text{mol m}^{-2}$ " for time and depth integrated value. P2041, L22-24: I think " $\mu\text{mol O}_2 \text{ l}^{-1} \text{ d}^{-1}$ " should be " $\mu\text{mol O}_2 \text{ m}^{-2}$ " for time and depth integrated value.

ANSWER: All data are volumetric. Please see also comment below on depth integration, a term which has caused confusion.

p2042, L2: ". . .was generally lower at the deeper stations" I suppose "station" should be "depths".

ANSWER: Corrected

L14: If you really calculate the volumetric ratio for GPP:R, please state the unit in Fig. 7.

ANSWER: Corrected

L15: Figure 7b should be Fig. 7a.

ANSWER: Corrected

L16: Replace "GRR" by "GPP".

ANSWER: Corrected

L17: Replace "R2" by "R<sup>2</sup>". If you show R<sup>2</sup>, you should show a linear regression model (i.e., regression equation between log GPP:R and log GPP) not a power equation.

ANSWER: Corrected

L20: How much is the average measured GPP?

ANSWER: It is  $1.19 \mu\text{mol O}_2 \text{ l}^{-1} \text{ d}^{-1}$ . We do not give average data for other parameters and therefore also not for GPP.

L23: Add "Fig. 8a" at the end of the first sentence. "Overall, the lowest abundance

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occurred in winter, . . ." I think the lowest BA was obtained not in winter but in Sep-Oct.

ANSWER: The lowest abundance was in some winter month, although sometimes higher values for specific samples occurred.

L25-27: "In February 2004, . . . associated with heavy rains". I suggest to move this sentence before the second sentence in P2041, L6.

ANSWER: Corrected

P2043, L2-3: "Low rates were measured in autumn and winter, i.e. during the downwelling and forest fire period . . ." I think forest fire period is Jul-Aug and it is not autumn or winter.

ANSWER: Corrected

L6-7: "In July-August, the depth-integrated value was ca. 60% higher than in June. . ." Because the ratio of (BP in Jul-Aug):(BP in Jun) is less than 1 (Fig. 4), I think "higher" should be mistake.

ANSWER: No, BP was higher in Jul-Aug. The ratio was calculated in a way that a value of 0 means no stimulation. This has been changed (no stimulation is now the value 1) and better explained in the figure legend of Fig. 4 in the revised version.

L11-13: Give the assumption about photosynthetic quotient for the calculation of BP:GPP ratio.

ANSWER: Done

L21-22: "No consistent effects were found following dust deposition event" What is your hypothesis about the relationship between dust deposition and BR?

ANSWER: As stated in the discussion, DOC in the dust could be readily available thus, increasing BGE. An alternative is that DOM was concentrated on dust particles along with bacteria and then better used.

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P2044, L5: "co-variations were considered with correlation coefficients larger than 0.5" I think the number of data set is different among parameters. Why did you choose constant R for all the test of significance?

ANSWER: We have changed that in table and text.

L7: "Positive correlations were found among Chl a concentrations, particle concentration and bacterial abundance" Because particle concentration didn't collate to bacterial abundance, I suggest to revise this sentence.

ANSWER: Corrected

L10: Replace "GGP" by "GPP".

ANSWER: Corrected

L13: ". . .to access GPP, CR, BR and BR". I think either of two "BR" should be "BP" or "BA".

ANSWER: Corrected

L16-17: "However, less problems should be expected, when data are used in a comparative way as in this study". Why can you say that? It is appeared that community composition varies among season and it affects the estimates of all biological rates given in this study.

ANSWER: For our statement it is not relevant whether the community changes. The problem is that there are inherent problems (which are known for 30 years) with the approaches. Therefore, we do not have rate measurements with a desirable biogeochemical resolution. However, the results from the last 30 years indicate that these methods have been proven very useful in a comparative way. If rates change with community composition, this is just one (natural) parameter influencing the rates.

P2045, L4-5: "total DOC consumption exceeded production rates" Which figure (or result) shows it?

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ANSWER: This is a misleading sentence, which has been corrected.

L9-12: "During the autotrophic period. . .with R remaining stable compared to strong increases observed in GPP. . .changes in primary production were mainly driving the GPP:R ratio" Ratio of GPP:R was relatively constant during the autotrophic period (Fig. 7a). Do the changes in primary production really relate to the variation in GPP:R ratio?

ANSWER: yes, as stated for the autotrophic period (P:R »1).

L14-21: What do you suggest by comparing threshold GPP among the studies?

ANSWER: Corrected

P2046, L11: When is "the second part of the study period"?

ANSWER: Corrected. The heterotrophic part.

P2048, L5-6: ". . .forest fires contains inorganic nutrient. . ." I think fire doesn't contain nutrients but ash contains them.

ANSWER: Corrected

L14-15: ". . .although the forest fires should have supplied additional organic carbon (e.g. in the form of black carbon). . ." To my knowledge, black carbon is not organic carbon, and, at least, it doesn't contribute to your DOC result. I suggest to delete this part.

ANSWER: Black carbon is the incomplete combustion of fossil fuels or biomass and can be part of DOC/TOC.

L22-23: ". . .some organic P has likely imported by atmospheric deposition originating from forest fires" Cite the reference.

ANSWER: We do not have a citation for that but fly ash is P-rich and at one occasion we have seen the deposition of fly ash from forest fire into the bay.

P2048, L14-15: "Such an import is likely too small to be detectable against background C2661

values." But the previous studies could detect the increase in SRP or DOC. State the difference between your study and the previous ones.

ANSWER: Assuming that this is page 2049: The previous study on Sahara dust input was done in summer, when phosphate is low. Also, calculations on inputs were not only derived from in situ but also from experiments in this previous study.

L17-19: ". . .nutrients are regenerated in February." Of course, regeneration is occurred though the year, but its degree should be temporally varied. Which is more effective for nutrients input in February 2004, regeneration or water mixing?

ANSWER: We we want to say here is that in February nutrients stock have been replenished (regeneration and mixing).

L21-23: "Bacterial abundance and production were . . . higher than at the next sampling, when the phytoplankton bloom had already started." Because BA and BP usually increase with progress of primary production, which is more significant for stimulation of bacteria in February 2004, phytoplankton bloom or wet deposition? I know this is a difficult question, but I think the time-lag cannot fully support your idea.

ANSWER: The point here is that we do NOT see an increase in GPP a few days after dust deposition. But BP and BA are elevated. Therefore the dust input is much more likely the cause.

Table and Figures Table 1: "r" should be absolute value of r. But I suggest to reconsider the r values for test of significance (see above).

ANSWER: It is unclear what the reviewer means with absolute r values.

Fig. 1: Unit of y-axis in Fig. 1a should be " $\mu\text{mol photons m}^{-2} \text{s}^{-1}$ ". I suggest to change the unit of y-axis in Fig. 1b from "knots" to " $\text{m s}^{-1}$ ", because the unit used in text is " $\text{m s}^{-1}$ ". Add year in ticks of x-axis and wind direction in figure legend.

ANSWER: Corrected. Giving the wind direction was not be useful, since the resolution

is too small for the scale of the graphs.

Fig 2. I ask to show the periods of upwelling, forest fire and wet deposition of Sahara by arrows for Figs 2, 6 and 8. I know it is a hard work, but it must be convenient for your potential readers. Put the unit in bracket for title of Fig. 2a and add (T) after "Temperature" in Figure legend of Fig. 2a. For the unit of Fig 2d, " $\mu\text{mol C L}^{-1}$ " is better than " $\mu\text{M}$ ", considering the unit used for inorganic nutrients.

ANSWER: Corrected

Fig. 3: The values for y-axis present the frequency of forest fire, but time-scale is not shown. I strongly suggest to show the number (or area) of forest fire occurred in Jul-Aug only. Add the definition of large fires in Figure legend.

ANSWER: Corrected. Forest fires occurred basically only in July-August.

Fig. 4: Add the definition of "stimulation" in Figure legend and show the actual period (Jul-Aug, 2003?) after "forest fire period".

ANSWER: Corrected

Fig. 5: Units of particle and bacterial abundance should be better to replaced by "particles  $\text{ml}^{-1}$ " and "cells  $\text{ml}^{-1}$ ", respectively. Add the actual period of Sahara dust event in Figure legend. I suggest to use the ticks of 0, 10, 20, 30 for y-axis, because they are the actual sampling depths.

ANSWER: Corrected

Fig. 7: Add the explanation of the solid line in Figure legend.

ANSWER: Which line?

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