Review on: Impact of dust addition on the metabolism of Mediterranean plankton communities and carbon export under present and future conditions of pH and temperature

General comments

The presented work provides valuable insights into the short-term response (within 72h or 96h) of the plankton community to dust input in oligotrophic low nutrient, low chlorophyll waters of the Mediterranean sea under present-day and future conditions. The authors show the time-evolution of the response leading to i) either a shift towards even stronger net-heterotrophy or, with a time lag of 2 days, ii) to a shift towards net-autotrophy of the plankton community.

In general, the authors present a rich dataset which was part of an even bigger effort, the PEACETIME project, to shed light on the role of dust input into Mediterranean waters.

The manuscript is well structured. However, I believe, the material could be further condensed and the readability and clarity increased. For example, often 'this' and 'that' are used. I suggest to be explicit to what you refer to make it easier for the reader. I tried to highlight some cases, where such clarification is needed in the specific comments - but please consider to go though the whole text.

I have two major concerns with the presented material:

1. While being aware about the enormous amount of work and the limited ship time to gain such dataset, the limited number of replicates of the experiments (using only duplicates instead of e.g. triplicates) makes it hard to draw statistically meaningful conclusions. This limits the value of the otherwise valuable experimental setup and study. I believe, this should be considered in potential follow up experiments.

2. The title promises to provide insights into the response of carbon export to dust input. First, a time evolution of export fluxes would have been certainly of value, which should be considered in a future application of the experimental design. Second, a few more information and discussion on the tank design and its (potential) effect on particulate fluxes would be helpful (e.g. is the energy input comparable to typical dust event situations, how does the circulation affect aggregation dynamics, do you account for ongoing grazing and remineralization in the 'sediment trap' of the tank, do you expect TEP to collect at the surface - away from your sampling valve - if so, in how far does it matter for export?). Third, I miss data and discussion on observables mentioned in the methods part, i.e. total carbon, lithogenic and biogenic silicates and calcium in the exported material. Further, I would have expected a stronger discussion on the aspect of export, e.g. also with regards to the ratio between POC and TEP-C production and export flux. It also seems as if there could be a relation between the community state and export flux.

Further, a discussion on questions related to the following points could be of value:

- In how far can be the present plankton community (and thus its response to dust input) regarded as adapted to future climate conditions (after a short period of adjustment time)?
- What are the potential consequences of the response within the studied time frame on longer time periods?
- What are the consequences of your findings on future modeling strategies?

Please find more specific comments below.

Specific comments on the text

p.2, l.42-44 A bit more explanation is needed on DOM as precursors for TEPs and thus aggregation of minerals - the connection between DOM and aggregation of dust particles is not immediately clear

p.3, l.48 What is 'This potential...' referring to? - be explicit.

p.4,l.56-57 ...(Longhurst et al. 1995). Although phytoplankton production in LNLC areas is limited ...

p.4,l.60 ...in LNLC regions and as such ...

p.5,l.85 ...Ridame and Guieu, 2020). However, no clear ...

p.6,l.108 Since you refer to biological remineralization processes being affected by ocean warming, write '...weaken the ocean biological CO_2 sink in the future ...' (to not confuse it with physical effects on CO_2 uptake).

p.6,l.117-120 ...trophic levels. Their study was conducted under nutrient-depleted conditions (Maugendre et al.., 2017b). Hence, there is still a need ...nutrient availability.

p.6,l.151 I have a number of questions regarding the setup of the tanks:

1. How efficient is sedimented material transported to the sediment trap? Or got material stuck to the tilted side walls and wasn't captured?
2. Was the sediment trap somehow poisoned to avoid remineralization and grazing on settled material? Or do you underestimate POC sedimentation fluxes?
3. How large (its area) was the propeller used, which direction of flow field was induced and how much energy was put in - how does the induced mixing rates compare to in situ conditions (also under wet dust input conditions)? And to phrase it broader: What is the propeller effect on the sedimentation flux?

p.9,l.169 Can you briefly mention the mean/median grain size?

p.12,l.239 ...regimes as in the ...

p.13,l.264 We followed the time evolution ...

p.14,l.275 ... frequency as for ...

p.14,l.284 Ref. for standard needed

p.18,l.357 Which stoichiometry are you assuming to calculate the factor two? Or provide a reference.

p.20,l.387 I think, a brief description of the general environmental settings in which the experiments were carried out, would help, before going into the details of experimental results. Particularly such information of a pre-occured dust input event at TYR would aid the reader to understand the state of the plankton community.

p.21.l.422 I suspect you mean 'general positive trend' (as opposed to acceleration via an increasing trend)

p.21,l.423 Here and throughout the text: when speaking about variability, you seem to refer to differences between experiments and not to variability in the statistical sense as deviation from the mean. I suggest to move either to 'differences' or to define variability at the first occurrence as difference between the experiments.

p.22,l.446 positive trends (see above)

p.22,l.448-449 what are you referring to? Which final values and 3 % of what?

p.23,l.455 'this parameter' → 'DOC concentration' (if I am not mistaken, otherwise please fill with the right parameter name)

p.24,l.476-477 why is it an important discrepancy? - do you somewhere come back to this statement to explain it? In the figure, to my eye, I see two times the same green color, so it's not straight forward to see, which is G1 and G2 (I assume the order matters, but it could be clearer)

p.24,l.482-485 I am a bit confused here by increasing versus decreasing values. So the ratio between DOM and POM production shifted towards POM production and therefore the %PER was decreasing?! I guess, the sentence could be written in a clearer manner.

p.24,l.484 at this station → at station ION (please re-check)

p.24,l.486 at this station → at station ION (please re-check)

p.24,l.489 at this station → at station ION (please re-check)

p.24,l.495 Start with: In contrast to station ION, at station FAST was much less ...

p.25,l.509 incorporation into

p.25,l.511 At station TYR,

p.25,l.512 under present-day environmental conditions

p.26,l.520-521 maybe add a gray line in FAST at 72h to make comparison easier

p.27,l.560 refer again to Tab. 2 at end of sentence.

p.28,l.571 instead of a continuous increase

p.28 Sec 2.4: I am missing information of how much of the dust was recovered from the 'sediment trap'. Additionally, you were mentioning the measurements of BSi etc. in the methods part and don't show it here (or anywhere else in the manuscript). I wonder why? See also my general comment.

p.28 No mentioning and summary of Fig.9 in the results part?

p.29,l.599-602 A rough back-of-the-envelope calculation for the flux induced by the loss of POC at TYR between t-12h and t0 (using an initial POC difference of about $15\,\mu\mathrm{mol\,C\,L^{-1}}$ from Fig. 3) under the assumption of a homogeneous water body:

$$\begin{aligned} F &= 280\,\mathrm{L} \cdot 15\,\mu\mathrm{mol\,C\,L^{-1}} \cdot \frac{1\,\mathrm{mol}}{10^6\,\mu\mathrm{mol}} \cdot 12\,\mathrm{g\,mol^{-1}} \cdot \frac{1000\,\mathrm{mg}}{1\,\mathrm{g}} \cdot \frac{1}{0.36\,\mathrm{m^2} \cdot 3\,\mathrm{d}} \\ &= 46.7\,\mathrm{mg\,C\,m^{-2}\,d^{-1}} \end{aligned}$$

provides a very different picture from what has been found in the 'sediment trap' of the control tanks, particularly, when also considering the stoichiometry for the POM/POC ratio (which would make a factor of 2 according to your methods part 2.3). This is already of the order of sedimentation fluxes or even higher than in the dust addition experiments. I am a bit concerned about the results related to the export of particulate matter. As already pointed out in the general comments part, a few more checks and a deeper discussion might help.

p.29,l.604-606 A higher TEP-C content is not really visible in Fig. 3. Given the higher POC content at t0 at TYR for C1/C2, you could potentially even come to the opposite conclusion (i.e. higher TEP-C/POC ratio at FAST).

p.30,l.629 Provided that dust input happened, it seems as if dust input frequency might play a role in determining the evolution of the plankton community. Is there anything know about it (frequency of events, expected changes in future, etc.)?

p.31,l.635 'optimal' or 'favorable conditions'? Looking at the dust input experiments, it seems to me that BP was not at its maximum.

p.31,l.642 at station FAST, as shown...

p.32,l.664 under present-day environmental conditions

p.32,l.670 here and throughout the manuscript, specify the main limiting nutrient - not everyone is familiar with the biogeochemistry of the Mediterranean sea

p.33,l.678,679,687 instead of 'this station' specify the station explicitly.

p.34,l.702-704 Please explain a bit more detailed.

p.35,l.723-725 Why is it higher under future conditions?

p.35,l.733 simply 'more in a steady state and less stressed' or maybe ' more in balance and less stressed'?

p.36,l.754 I suspect the reference needs to moved to '... new nutrients (e.g. ...) and ' - since the study of Moutin took place before your studies

p.37,l.777 more important → higher (or, in which sense more important?)

p.38,l.790 why don't you refer to the decreasing TEP-C as shown in Fig. 3?

p.38,l.799-804 The reference in line 801 cannot really refer to your experiments, so I would suggest to reformulate this part in terms of what Bressac and Guieu 2013 found and how that relates to your study.

p.39,l.822 this treatment → future conditions (or treatment G compared to ...)

p.42,l.899 weakening of the CO_2...

Specific comments on figures and tables

Fig.4 I cannot distinguish between the individual tanks. I suspect the order matters. Since you refer to individual tanks in the text, it would be helpful to be able to distinguish between the tanks.