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Comment

## ***Interactive comment on “Effect of CO<sub>2</sub> enrichment on bacterial production and respiration and on bacterial carbon metabolism in Arctic waters” by C. Motegi et al.***

### **Anonymous Referee #4**

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Review of the submitted manuscript “Effect of CO<sub>2</sub> enrichment on bacterial production and respiration and on bacterial carbon metabolism in Arctic waters” to Biogeosciences

General comments:

This study addresses the potential impact of ocean acidification on bacterial activity and carbon metabolism in the future Arctic Ocean. In the framework of the EPOCA (European Project on Ocean Acidification) coastal mesocosm experiment in the Kongsfjord (Svalbard) in 2010, the authors obtained experimental data on bacterial produc-

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tion and respiration rates, and estimated the bacterial carbon metabolism (demand and growth efficiency) with increasing CO<sub>2</sub> concentrations. Overall the authors focussed on a very interesting topic in the field of microbial processes within biogeochemical cycles in cold, aquatic ecosystems. The relevance to investigate whether and how bacterial communities potentially change their dynamics and activities has been increased, since it's known that microbes play a very dominant role in the cycling of organic matter within the microbial loop. Thus this topic is and will be of great interest to readers of BG. However the here presented and rather descriptive manuscript needs major improvements (mainly in the data presentation, the statistical proof of data and the discussion).

The authors present their experimental data in a day to day comparison of real pCO<sub>2</sub> and BPTdR, Leu:TdR ratio, BGE and BCD obtained from nine different mesocosms, and conclude that the response to elevated pCO<sub>2</sub> have a strong temporal variation, which is potentially linked to the nutrient status. This conclusion seems to be speculative since no nutrient data (inorganic and organic matter) are provided by the authors, just as much as this relationship has not been statistically tested in this manuscript. The potential responses to increased CO<sub>2</sub> or decreased pH are influenced by complex interactions of autotrophic and heterotrophic processes, including changes in substrate quality and bottom-up or top-down control within the food web. Since no clear direct effect on BP and BR could be investigated, the authors should include data which refer to potential indirect effects (phytoplankton development, substrate availability, food web structure, . . .). Although other results of this mesocosm study are and will be presented in this special issue of BG, I have concerns regarding the ability of interpretation due to the lack of background information in this manuscript. As a reader it is hard to understand how the ecosystem reacts to the induced environmental changes within the mesocosms from the data presented here. For a research paper I would expect to read a kind of a stand-alone manuscript. I recommend including some of the data the authors referring to in the discussion section (including more statistical verification). Furthermore the data obtained in this study do not allow calculating BGE and BCD,

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since the factions of BP and BR seem to be not the same. It is not clear whether BGE and BCD were calculated for total or only for free-living bacteria. Please clarify in the material and method section.

Despite the fact that this manuscript needs some major changes and that these kind of data is still very difficult to interpret in the context of future environmental changes, I would like to emphasize that the scientific community has also the need for datasets which shows no or only small effects regarding ocean acidification. So far a large variability of increased pCO<sub>2</sub> effects on bacterioplankton dynamics and activities has been shown, which reflects the importance of studies dealing with these complex interactions of the ecosystem's community and their indirect effects, especially in cases where no significant direct effects can be determined. Nevertheless taken as a whole I can not recommend publishing this version of the manuscript in BG without a comprehensive improvement (major revision).

Specific comments:

Title (1) The title is very long and could be more precise. (i.e. the study was investigated in an arctic environment, in the Kongsfjord and not in general in "Arctic waters".)

Abstract (1) Please add one sentence about the scientific context of your study (introduction to topic).

Introduction (1) Please provide a clear objective/hyphthesis of this study. p. 15215 l. 21-23: in contrast to p. 15215 l. 7-13. p. 15215 l. 27ff : please state a clear objective/hypothesis.

Material and methods p. 15216 l. 15 & 16: be consistent with your abbreviation ("... pCO<sub>2</sub> levels..." vs "...levels of CO<sub>2</sub>..."). p. 15216 l. 21: Nalgene p. 15217 2.2 BP: Separate more clearly between BPLeu and BPTdR. The method you describe here can be easily mixed up with the method Piontek et al. (2012) used. Furthermore 1h of incubation time is rather short for a cold environment! Did you test the bacterial

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incorporation of 3H-thymidine by means of a time kinetic? p. 15217 2.3 BR: Did you only determine the bacterial respiration rates from the free-living fraction ( $<0.8\mu\text{m}$ )? p. 15218 2.4 BGE and BCD: Which BP rate did you use for this estimation?

Discussion (1) In general the discussion section is too speculative, along with a lack of statistical verification of the relationships discussed. p. 15223 l. 9-15: belongs to the result section

Figures (1) Please provide legends and refer to treatments. (2) The caption of a figure should have enough information to allow it to be understood in isolation. (3) It would be helpful to distinguish in which phase the experiment was at which time point. (4) Do you show mean values?

Fig. 3: Why did you choose different tick label for the x-axes? (Figures on the left hand side) Fig. 4: Please give more information about the figure (i.e. colour bar, etc. ...)

Technical corrections: Please check for language and style. I recommend to ask a native-English speaker or to use professional help to improve the English in this manuscript.

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**BGD**

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