

Interactive comment on “Carbon fluxes in the Canadian Arctic: patterns and drivers of bacterial abundance, production and respiration on the Beaufort Sea margin” by E. Ortega-Retuerta et al.

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Interactive comment on “Carbon fluxes in the Canadian Arctic: patterns and drivers of bacterial abundance, production and respiration on the Beaufort Sea margin” by E. Ortega-Retuerta et al. Response Letter Anonymous Referee #1

General comments

This manuscript presents new measurements of bacterial abundance, production and respiration in the coastal Beaufort Sea during August. These data are used together with primary production and dissolved organic carbon measurements to compare bacterial carbon utilization with carbon standing stocks. The results show the region was

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mostly net heterotrophic, the measured bacterial carbon demand exceeding primary production by 3 to 22 times. Using the average BGE measured at 6 stations, the bacterial C demand was calculated at all stations and compared to depth-integrated primary production. Surprisingly, the only net autotrophic stations were found in the Mackenzie River mouth, a region previously found to be strongly net heterotrophic. The manuscript is well written. The numerous methods utilized are valid, complementary and properly integrated. The results are very well put in perspective and offer new insights into the controlling factors of bacterial production and whether the Arctic Ocean is acting as a sink or a source of CO₂.

We appreciate very much the reviewer's comments. All specific questions and comments have been addressed in the revised version of the MS and are detailed below

SPECIFIC COMMENTS p. 6019, line 15 - A scale bar would be useful in Fig 1. The 50-m isobaths could also be added.

We have included the bathymetry and scale bar in the revised version

p. 6019, line 23 - The stations sampled with the zodiac correspond to the southern portion of Transects 600 and 300?

Correct, the stations sampled with the zodiac are the southern portion of transects 600 and 300 (7 and 8 stations, respectively)

p. 6020, line 11 - The same regions (gates) were ascribed to LNA and HNA for all samples? The two populations were clearly discernible at all stations and depths?

Because we regularly observe shifts of DNA fluorescence after staining with SYBR Green, it has not been possible to ascribe the same gates for LNA and HNA bacteria for all samples. Nevertheless, for the majority of the samples, the two populations were clearly distinguishable.

p. 6020, line 25 - 10-20 nM of 3H-leucine was saturating even at river stations? Vallières et al. (2008) have found 10 nM to be below saturation.

At River Stations, 20 nM of leucine was used. This was observed to be saturant at coastal station 390. 10 nM final concentration was used in the more oligotrophic stations (e.g. offshore station 220)

p. 6021, line 12 - Based on the bacterial biovolume measurements made using DAPI, could you estimate what fraction of the total bacterial population would pass a 1 μm filter?

Assuming spherical cell shape, the mean cell diameter would be 0.42 μm . However, we believe that separation of bacterial populations in those passing the 1 μm filters from those retained would discriminate particle-attached from free-living bacteria, so not discernible by mean cell size. We estimated average free-living bacterial production to be 32% using 3 μm filters as a cut-off

p. 6021, line 24 - What is the approximate limit of detection of the TCR and BR measurements? This information would be relevant given that 6 out of 19 respiration experiments showed no significant O₂ decrease.

Based on standard error calculations of the standards, the approximate limit of detection would be less than 1 μM . We have included this in the text (page 8, line 148) "BGE and BCD were calculated using total community respiration measurements assuming that a substantial portion of bacterial respiration is due to particle-attached bacteria (i.e. bacteria retained by the 1 μm filter)"

p. 6021, line 28 - It would be appropriate to state here why TCR was used instead of BR in the bacterial carbon demand calculations (the explanation appears only at p. 6030).

We have included the information also in this section (page 8 lines 152-154). Likewise, we have included BGE estimations using free-living BR in Table 2

p. 6022, section 2.2.4 - Detailed PP results will be presented elsewhere?

Detailed PP results will be presented elsewhere in a paper concerning nitrogen uptake
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and regeneration. This paper is in progress.

p. 6026, line 21 - In Table 2, "na" refers to the samples where no significant O₂ decrease was measured?

It refers to samples that were not analyzed: At the station 135, respiration measurements were only determined using 1 μm filtered samples. The abbreviation is given below the table.

p. 6026, line 29 - It would be appropriate to point that only one BGE measurement was made at the CHLa maxima depth, lessening the significance of the comparison with surface values.

Because we decided to focus on total respiration measurements, then only one data point is shown at the Chl Max. We actually have two respiration measurements at the Chl Max when using filtered water, but for simplicity we have decided to remove that sentence.

p. 6027, line 13 - In Fig. 4, it would be good to change the scale so that values <1 are more clearly visible (this can be done by changing the median and non-linearity of the ODV color mapping).

We have changed the scale in the revised version of the Figure

p. 6028, section 3.4 - What are the DOC and DN concentrations of these two samples? What increases were caused by the river water addition?

We have included this information in the text (page 20, line 435-441) "While riverine DOC added (228 μM) involved substantial (i.e. >20%) DOC increases over ambient DOC in both surface (65 μM) and Chl Max (73 μM) concentrations, river additions led to 10% increases of total dissolved nitrate (0.13 μM), over ambient concentrations (0.01 μM) in the surface, explaining the observed stimulation in BP. Conversely, at the Chl-a max, the addition yielded a decrease in nitrate of 8% over ambient concentrations (0.62 μM), resulting in a lack of stimulation, or even a slight inhibition of BP (Fig. 6)"

p. 6030, line 8 - The size fractionated BP data are not shown. How many samples were used to derive that 36% of total BP was due to bacteria attached to particles? Stations near the river were similar to offshore stations in that respect? Garneau et al. (2006) and Vallières et al. (2008) have found a much larger contribution of the particle-attached bacteria in the Mackenzie River and the region influenced by the river.

The sample size of these measurements is 121 (included in the text). Although the proportion is highly variable over the sampling region, we observed particle-attached bacterial production to be highest in River stations (salinity = 0), being particle-attached BP higher than 98%. Since those riverine stations were not used to make direct respiration measurements, those data are not presented in the manuscript

p. 6033, line 8 - The "concentration of added C" is not discussed, but it should be.

We have included this in the text

p. 6034, line 3 - The statement: "the experiment results suggested that organic matter coming from the river could partially stimulate bacterial in surface waters. . ." seems in contradiction with line 5-13 of page 6033 where the stimulation of BP was attributed to dissolved N. Dissolved N is mostly organic in the region?

We have changed this sentence by "Mackenzie River waters could partially alleviate substrate limitations (organic and/or inorganic)"

Technical corrections: p. 6018 line 22 - "Microbial food web" would be more appropriate than "microbial loop". p. 6024, line 17 - What is considered as the "top layer"?

We have reworded it

p. 6028, line 23 - To facilitate comparisons, the values observed in the present study could be added to Table 4. C2404

We have included them

p. 6029, line 27 - Please add that "free-living bacteria" refer to those passing a 1 μm

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filter.

Done

p. 6034, line 4 - "Bering Sea"??

Changed by "Beaufort"

END OF REVIEW

Interactive comment on Biogeosciences Discuss., 9, 6015, 2012.

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Fig. 1. Ortega-Retuerta et al

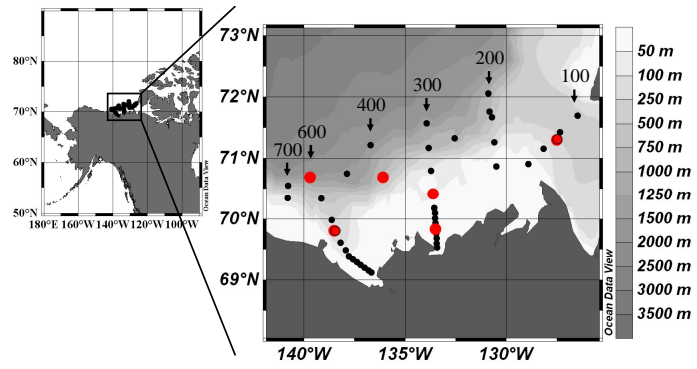


Fig. 1.

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Fig 4. Ortega-Retuerta et al.

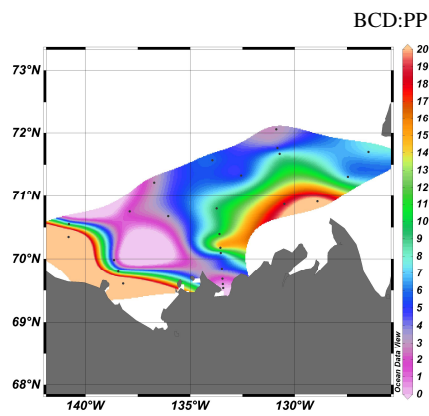


Fig. 2.

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