Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2019-203-RC1, 2019

Biogeosciences
Discussions
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Interactive comment on "Seasonal and spatial patterns of primary production in a high-latitude fjord affected by Greenland Ice Sheet run-off" *by* Johnna M. Holding et al.

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Received and published: 30 June 2019

The manuscript presents carbon rates of phytoplankton assemblages (total and size-fractionated) at several stations in a land-terminating arctic fjord duirng summer and fall months. This arctic fjord system is experiencing rapid environmental changes (climatic, hydrological), thus affecting oceanographic features such as halyne-driven stratification from ongoing freshening. Major results were: low primary production (PP, 14C) and autotrophic biomass (chl-a) were observed at inner stations associated to melting runnoff during summer months: during that period, an interplay between light and nutrient limitation (caused by particles and nitrogen, respectively) were raised as main factors for

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Discussion paper

the low PP estimates. This study provide an excellent base-line of carbon estimates dataset to understand the role of drivers (i.e., freshening process) at a global scale in fjord systems.

Specific comments - This study is focused in total and size-fractionated PP as well as chlorophyll-a. Major changes of variability could be at the taxa/species level instead: do the authors have phytoplankton abundance, richness or taxonomical analyses? It would be great to have some feeling of what kind of groups (at least) are dominating at the different study seasons and stations. The taxonomical analyses could fit very nicely to phytoplankton size classes.

- Regarding the above, could the authors explain what was the criteria for the phytoplankton size fractionation protocol; according to Sieburth et al, phytoplankton community can be splitted in three different size classes which match taxonomical groups: for example: picoplankton (mainly cyanobacteria: <2.0 um); nanoplankton (mainly flagellates: 2 – 20 um), microphytoplankton (a mix of diatoms and dinoflagellates species > 20 um). Is there any previous evidence on the size classes dominating the systems such as components of the microbial loop?

- In line 178 "in three different size fractions: >10 μm, GF/F (nominal pore size: 0.7 μm) to 10 μm and < 0.7 μm" . . . I was confused with the definition of the last size fraction: What group was collect in the filter? If water is passing through 0.7 um, what is the next filter to collect phytoplankton cells less tan 0.7 um? - In figure 4, in terms of chlorophyll-a in stations 3 and 4, diatoms or nanoflagellates dominated the system? whereas, nanoflagellates or picoplankton dominated at inner stations? The same for PP size fractionation. - Inorganic nutrients: Do authors have a knowledge of environment N:P:Si ratio for the fjord area during their sampling to search for spatial/temporal gradients on nutrients ratios other than actual concentrations? The manuscript present data on N:P ratio less than 16 (according to Redfield ratio) to infer PP "limitation"; N:Si (1:1) is another interesting ratio to explore in the near surface layer, especially for diatoms, a groups that needs silicic acid for the frustule. Again, species/functional groups could respond more to ratios than concentrations; for example nanoflagellates respond better to N sources (ammonia), whereas diatoms could respond better to silicic acid concentrations

- Do the authors performed a nutrient limited experiment to infer “limitation”?. I would suggest to use “nutrient deficiency” instead.

- Since Young Sound is affected by sea-ice in the spring and run-off (river and or glacier) in summer, is there any information on the supply of inorganic nutrients from theses sources to the inner area of the fjord? Are sea-ice and run-off rich in any dissolved (micro-macro) nutrients?

- the first effect of increasing freshwater run-off is the vertical stratification of the water column; however, run-off could also explain density gradient circulation along the fjord, thus increasing its “ventilation” and probably generating internal waves traveling along/across the fjords that could be important to “break” the picnocline and bring inorganic nutrients to the surface “brackish” layer. Is there any possibility for this mechanism that could act fueling PP in this fjord in the near future?

- Role of wind: at the end of the period strong winds were evident; however there was no differences in the stratification index between seasons; according to literature, strong winds deepen the mixed layer and then lowering PP through the photic layer; it means that phytoplankton cells are spending more time below the photic layer. Any chance to use another SI that take mixed layer in consideration? I guess all CTD casts and PP incubations sampling were taking before and after stormy conditions.

- Figures and relationships: in figure 3, would be nice to have the PP sampling dates incorporates in the figure to see wind and run-off conditions. - in figure 4, I suggest a relationship with mean (±SD) integrated PP estimates to strengthen figure 6 conceptual model. - Any possibility to give some estimates of the assimilation index (integrated carbon uptake rates to integrated chl-a concentrations, mg C (mg chl-a)-1 day-1) which could provide a useful indicator of the potential physiological status of phytoplankton (by size classes) along the freshwater influence gradient of the fjord.

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