

## ***Interactive comment on “Particulate organic matter composition and organic carbon flux in Arctic valley glaciers: examples from the Bayelva River and adjacent Kongsfjorden” by Z.-Y. Zhu et al.***

**Anonymous Referee #1**

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### General comments

This manuscript reported biogeochemistry, in particular, organic and inorganic carbons in water corrected from a glacier-fed river and adjacent fjord in Svalbard and evaluated the impact of glacial melt water on biochemical process in the ocean. As an increase of glacial runoff has been apparent recently in Arctic regions as well as worldwide and is expected to be continued in future, evaluation of the impact of glacial melt water on biogeochemical processes in the ocean is important. The manuscript shows valuable chemical data of melt and seawater and suggest important carbon processes in the

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fjord, which would be worth to be published. However, I have some concerns indicated below and recommend amending the points before publication.

Major points:

1. There is a lack of discussion on the results of glacial meltwater with previous works. A number of studies on glacial meltwater hydrology and hydrochemistry has already been conducted in Bayelva River as well as other Svalbard glacier basins. For example, Hodson et al. (2002) suggested that ice marginal and proglacial environments are the most important zones of solute acquisition in melt water, thus, some part of the POC and DOC appeared to be derived from glacial forefield soils. It also implies that carbon flux in glacier-fed rivers is likely to differ between land-terminated glaciers (like Bayelva) and tidewater glaciers. Authors should discuss carefully that how the measurements of the meltwater chemistry are representative in glacier-fed rivers of Svalbard using previous works (please discuss carefully with the papers listed below at least).

Hodson, A., Tranter, M., Gurnell, A., Clark, M., & Hagen, J. O. (2002). The hydrochemistry of Bayelva, a high Arctic proglacial stream in Svalbard. *Journal of Hydrology*, 257(1), 91-114.

Hodson, A., Gurnell, A., Tranter, M., Bogen, J., Hagen, J. O., & Clark, M. (1998). Suspended sediment yield and transfer processes in a small High Arctic glacier basin, Svalbard. *Hydrological Processes*, 12(1), 73-86.

Wadham, J. L., Hodson, A. J., Tranter, M., & Dowdeswell, J. A. (1998). The hydrochemistry of meltwaters draining a polythermal-based, high Arctic glacier, south Svalbard: I. The ablation season. *Hydrological Processes*, 12(12), 1825-1849.

2. The difference in area-weighted carbon fluxes among glaciers is unlikely due to carbon process on the glaciers, but likely to thermal regimes in internal ice body of glaciers, which affect production of meltwater (e.g. Irvine-Fynn et al., 2011). Since the greater part of area of Greenland ice sheet is cold frozen ice, which doesn't con-

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tribute the fluxes of meltwater and carbon, thus it is obvious that area-weighted fluxes are greater for Svalbard than Greenland. Therefore, the simple comparison of the area-weighted carbon flux between Svalbard and Greenland is worthless. Discharge-weighted average of those carbons is more appropriate to discuss the difference between the two glacial systems.

Irvine-Fynn, T. D., Hodson, A. J., Moorman, B. J., Vatne, G., & Hubbard, A. L. (2011). Polythermal glacier hydrology: a review. *Reviews of Geophysics*, 49(4).

Minor comments:

P15657 L15 Please explain what the source of POC in glacial meltwater is. It would be worth to mention biogeochemical process of supraglacial microbial community (e.g. see papers below).

Anesio, A. M., Sattler, B., Foreman, C., Telling, J., Hodson, A., Tranter, M., & Psenner, R. (2010). Carbon fluxes through bacterial communities on glacier surfaces. *Annals of Glaciology*, 51(56), 32-40.

Irvine-Fynn, T. D. L., Edwards, A., Newton, S., Langford, H., Rassner, S. M., Telling, J., ... & Hodson, A. J. (2012). Microbial cell budgets of an Arctic glacier surface quantified using flow cytometry. *Environmental microbiology*, 14(11), 2998-3012.

P16657 L23-24 But, there is a number of papers published microbial process of glaciers in Svalbard.

P15670 L1 "glacier mass balance" is incorrect. "glacial meltwater production" would be more appropriate in this case.

P15670 L10-12 This is not convinced due to too small number and short period of the measurements.

P15670 L18-20 I disagree this conclusion. The difference is due to the area of meltwater production as mentioned above.

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Table 1 Indicate the time of collection since the concentrations of meltwater solutes usually change diurnally.

Table 2 Please indicate which sample were used for the data.

Figure 1a It would be worth to show all glaciers in the map to recognize the importance of glaciers in the fjord.

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