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Biogeosciences Discussions

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.

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The POC concentration in percent is calculated as POC concentration (μg/L) divided by TSM (total suspended matter in the water, in mg/L), the unit is %.

The amino acids carbon proportion in bulk POC : This proportion is calculated based on the THPAA data set (in μM). First we calculated the carbon concentration (in μM) of every specific amino acid compound according to the stoichiometry of that amino acid compound (in this study there is totally 34 amino acids compound concerned, though

some of which were usually zero in concentration), and then we added all amino acid carbon concentrations together, and that was the amino acids carbon concentration (in this work it was called POCAAs). So amino acids carbon proportion in bulk POC (in %) is calculated as POCAAs (μM) divided by bulk POC (μM). Similar calculation can be done for nitrogen.

As for pigments, the idea is that phytoplankton-carbon is highly related to its biomass (e.g., Chla). And in Svalbard, previous work has given a conversion factor of 50 (i.e., phytoplankton-carbon: Chla ratio = 50) (Hop et al., 2002). With our measured Chla concentration, by multiplying the factor of 50, we then got the phytoplankton carbon (in μM). Phytoplankton carbon divided by bulk POC is the phytoplankton carbon proportion in bulk POC (in %).

With respect to the question for 'pigment POC (Abstract)', we checked the abstract and it said '. . .and phytoplankton pigments accounted for $\sim$10% of the POM. . .' in the abstract. Here we meant to say that amino acids carbon and phytoplankton carbon together accounted for $\sim$10% of the POC. The original sentence seems misleading and confusing, and we will change the word 'pigments' to 'carbon'. Thanks for reminding this mistake.

Detail for the estimate of flux of Svalbard:

For the Bayelva river OC flux:

Based on the data in Table 1, we calculate the mean of POC, DOC and TSM. The discharge is calculated based on the instrumental discharge monitoring data set in 2012. In 2012 the discharge was 29 $\times$106 m3 (or exactly 29847888 m3). So the river flux is estimated as mean concentration multiplied by discharge.

For the whole Svalbard OC flux:

According to the Bayelva River monitoring result (Table1), we obtained the POC in percentage as 0.35% , and the published total TSM flux of the whole Svalbard is 16 $\times$

106 t/yr (Hasholt et al., 2006). So the whole POC flux for Svalbard is 0.35% $\times$ 16 $\times$ 106 t/yr = 0.056 $\times$ 106 t/yr

Similarly, the DOC concentration in the Bayelva river was used to calculate for the total DOC flux for whole Svalbard. According to Table 1, the DOC concentration was 73 μM and the glacier meltwater runoff is 25 km3/year (Hagen et al., 2003). So the total DOC flux is 73 μM multiplied by 25 km3.

The NVE station, based on which the flux was estimated, located a few hundred meters upstream the river mouth and is free of tidal influence. Critically, there will be some modification of OC in the river section between NVE station and river mouth, partly due to tidal effect, but the tide effect was not considered in the flux estimate. We will mention this point in the revised version to remind the reader.

Though no previous report on continuous POC concentration in this region can be found so far, TSM concentration varies during the whole ablation season, implying that there should be some variations in POC concentration. By a comparison to other glacier meltwaters in Svalbard (Kuliński et al., 2014; Stibal et al., 2008; Tye and Heaton, 2007), our OC content range is at the lower end, but still within the same order (for the representativeness discussion please see our another reply to comment with page C6768). So it is likely that our flux estimates will not be deviated from the true value too much. Further, as was stated in the text, the fluxes in this work are just estimates, it is preliminary and further work is needed. On another aspect, we still think the whole Svalbard OC flux estimate is one of the necessary parts in our work. As we wrote in the previous reply, there is a need for the Svalbard OC flux estimate, due to the global warming and glacier retreat background, and for Svalbard, its bulk OC flux is unknown (Dittmar and Kattner, 2003; Hernes et al., 2014). In this work, we estimate the Svalbard OC flux for the first time, and the interesting point is that the area-weighted OC fluxes and discharge-weighted OC fluxes of Svalbard are all comparable to other glacier systems (like Greenland ice sheet and glaciers in gulf of Alaska), or it is even higher. Given that Svalbard locates right near the ocean current pathway which flows

into the arctic ocean, the non-decomposed OC part (mainly DOC) from Svalbard will enter arctic ocean and/or finally the ocean interior. So Svalbard is very important in organic carbon flux/budget study. This is one of the messages that we would like to bring to the readers, which may also advance our understanding of C.

References

Dittmar, T. and Kattner, G.: The biogeochemistry of the river and shelf ecosystem of the Arctic Ocean: a review, Marine Chemistry, 83, 103-120, 2003.

Hagen, J. O., Kohler, J., Melvold, K., and Winther, J.-G.: Glaciers in Svalbard: mass balance, runoff and freshwater flux, Polar Research, 22, 145-159, 2003.

Hasholt, B., Bobrovitskaya, N., Bogen, J., McNamara, J., Mernild, S. H., Milburn, D., and Walling, D. E.: Sediment transport to the Arctic Ocean and adjoining cold oceans, Nordic Hydrology, 37, 413-432, 2006.

Hernes, P. J., Holmes, R. W., Raymond, P. A., Spencer, R. G. M., and Tank, S. E.: Fluxes, processing, and fate of riverine organic and inorganic carbon in the Arctic Ocean. In: Biogeochemical dynamics at major river-coastal interfaces: Linkages with global change, Bianchi, T., Allison, M., and Cai, W. J. (Eds.), Cambridge University Press, New York, 2014.

Hop, H., Pearson, T., Hegseth, E. N., Kovacs, K. M., Wiencke, C., Kwasniewski, S., Eiane, K., Mehlum, F., Gulliksen, B., Wlodarska-Kowalczuk, M., Lydersen, C., Weslawski, J. M., Cochrane, S., Gabrielsen, G. W., Leakey, R. J. G., Lønne, O. J., Zajaczkowski, M., Falk-Petersen, S., Kendall, M., Wängberg, S.-Å., Bischof, K., Voronkov, A. Y., Kovaltchouk, N. A., Wiktor, J., Poltermann, M., di Prisco, G., Papucci, C., and Gerland, S.: The marine ecosystem of Kongsfjorden, Svalbard, Polar Research, 21, 167-208, 2002.

Kuliński, K., KÄŹdra, M., LegeÅijyńska, J., Gluchowska, M., and Zaborska, A.: Particulate organic matter sinks and sources in high Arctic fjord, Journal of Marine Systems,

139, 27-37, 2014.

Stibal, M., Tranter, M., Benning, L. G., and ÅŸehák, J.: Microbial primary production on an Arctic glacier is insignificant in comparison with allochthonous organic carbon input, Environmental Microbiology, 10, 2172-2178, 2008.

Tye, A. M. and Heaton, T. H. E.: Chemical and isotopic characteristics of weathering and nitrogen release in non-glacial drainage waters on Arctic tundra, Geochimica et Cosmochimica Acta, 71, 4188-4205, 2007.

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