Biogeosciences Discussions

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Comment on bg-2022-26

Anonymous Referee #2

Referee comment on "The dominant role of sunlight in degrading winter dissolved organic matter from a thermokarst lake in a subarctic peatland" by Flora Mazoyer et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-26-RC2, 2022

This manuscript describes an experimental manipulation of DOM-rich water collected from a Canadian thermokarst lake. Filtered lake water was subjected to treatments designed to investigate the presence or absence of sunlight and the presence or absence of bacteria. Treatments were incubated for up to 18 days and changes in DOM properties and bacterial communities were characterized. Results showed that DOC loss was greatest in light-exposed treatments. Light-exposure combined with bacterial inoculation produced the greatest overall DOC loss. The authors note a large mass balance gap between DOC loss and concomitant increases in DIC and microbial biomass. They attribute flocculation as the mechanism responsible for the missing DOC.

Overall, the results from this study represent a potentially important contribution to our understanding of carbon dynamics in Northern thermokarst landscapes. There are some experimental design challenges that require additional treatment when interpreting results from this study:

Time between sample collection and initiation of the incubation. Over four months elapsed between initial sample collection and the beginning of the incubation study. While the authors point out that the sample was stored in the dark at 4 °C, this still represents a dramatic shift from the sampling environment (0.5 °C just below the ice). Even under refrigerated conditions, four months is a long time for aquatic microbes to make use of the most labile portions of the aquatic DOM. It is likely that comparatively low microbial

activity observed during the incubation may be at least partially due to the fact that this sample essentially underwent a four month microbial incubation prior to the beginning of the official experiment. This needs to be explored and results need to considered within this context.

On a related note: it appears from Matveev et al., 2019 that the sample from SAS2A was collected on 19 March while the present paper states it was collected on 24 March. Please verify that the reported sampling date is correct.

Incoming Solar Energy: If the Teflon bottles are light diffusers, then solar radiation measured outside the bottles is not representative of the energy experienced by the samples. You may be able to apply a simple correction by placing a pendant or pyranometer inside a Teflon bottle (or cut a bottle to make a Teflon cover) – this will be a more useful measure of the solar radiation that reached the sample.

Challenges with sample filtration. (lines 120-131) It is unclear why different filtration schemes were used when preparing water for the experiment (e.g., 0.2µm Tuffryn vs a two-step process with a 0.7 µm glass fiber filter and 0.2 µm cellulose acetate filter.) Please explain the sample preparation more clearly, perhaps with a flow chart.

Closing the DOC mass balance. The authors observed a large mismatch (58 to 1214%) between DOC lost and the concomitant gain in DIC and bacterial production. They attribute this to DOM flocculation which was noted, but unfortunately not quantified. In the absence of supporting measurements, the authors probably don't need to spend so much time discussing flocculation and simply admit they don't know.

Additional considerations could include:

- DIC outgassing to CO_2 during the incubation. It is possible that some DIC was out of solution in the form of an air bubble in the bottle. This DIC would not have been accounted for. Was this observed or checked?
- CO_2 loss during the two-month period of sample storage between sampling and analysis. While sample storage in exetainer vials has generally been reported as stable, it has been demonstrated that CO_2 concentrations were up to 14% lower than expected in vials that had been stored for 84 days.

Faust, D. R., & Liebig, M. A. (2018). Effects of storage time and temperature on

greenhouse gas samples in Exetainer vials with chlorobutyl septa caps. *MethodsX*, *5*, 857-864.

Other references that should be included in this work:

Frey, K. E., & Smith, L. C. (2005). Amplified carbon release from vast West Siberian peatlands by 2100. *Geophysical research letters*, *32*(9).

Bertilsson, S., & Tranvik, L. J. (2000). Photochemical transformation of dissolved organic matter in lakes. *Limnology and Oceanography*, *45*(4), 753-762.

Tranvik, L. J., & Bertilsson, S. (2001). Contrasting effects of solar UV radiation on dissolved organic sources for bacterial growth. *Ecology Letters*, *4*(5), 458-463.

Minor comments / edits:

Line 8 (and elsewhere): suggest rewording “retroaction loop” with “positive feedback loop”

Line 18: “full mineralization to CO2” implies that the entire DOC pool has mineralized; this is not consistent with your data.

Line 22: replace “undirect” with “indirect”

Line 23: “outstanding boosting factor” is awkward wording, please find alternative wording.

Line 84: you refer to Fig. 7 of Vincent et al. (2017); perhaps you can include this figure in the supplemental information.

Line 86: Field sampling – just refer to the date the sample was actually collected (was it 19 March or 24 March?)

Lines 144-145: provide a reference for the light-filtering properties of Teflon.

Lines 211-213: Why include the unpublished data in the PARAFAC analysis?

Line 248: replace “unfrozen” with “thawed”

Lines 294-303: Please provide more supporting references in your discussion of the fluorescence results.

Figure 6: Please show the DIC and Biomass as separate portions of the bar chart (stacked to show the total).

Line 427: “… carbon canalized to bacterial production…” I think you mean to say “… carbon allocated to bacterial production…”

Lines 540-541: These details about filter preparation and problems with cracking need to be presented in the methods section.

Lines 577-580: This material about the DNA content of cells should be excluded from this paper.