Biogeosciences Discussions

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Comment on bg-2022-94

Anonymous Referee #2

Referee comment on "Lateral carbon export has low impact on the net ecosystem carbon balance of a polygonal tundra catchment" by Lutz Beckebanze et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-94-RC2, 2022

This study by Beckebanze et al. seeks to improve estimates of soil organic carbon changes in permafrost-affected soils by estimating both vertical and lateral fluxes of carbon. They aim to achieve this with an extensive measurement campaign in a polygonal tundra ecosystem in Siberia, Russia. The study uses proven methods to estimate the carbon fluxes in a climatologically important area, where such measurements have not been done before. However, I find that the limited temporal coverage of the study (the growing season) puts into question the paper's main conclusions about the negligible importance of DIC and DOC export for the catchment NECB.

General comments

It is a bit puzzling to me why the carbon balance was computed for the growing season only. If the goal of the study is to improve estimates of soil carbon change in permafrost ecosystems, then an annual perspective including the highly dynamic spring and autumn seasons is required.

The majority of lateral transport will be in the snowmelt period in spring (65%-100% for dry tundra (palsa and bog habitats) in the study of Olefeldt et al., 2012). The authors state that the majority of the carbon export during the study period was accounted for by part of the spring flood in June, but that only part of the spring flood was covered by their measurements. This implies that the contribution of lateral DIC and DOC export to NECP may not be negligible on an annual basis, which appears to be one of the paper's main conclusions (see my comment about L10). Are there discharge measurements available for the spring season which would enable a rough estimation of the spring export of DOC and DIC? Or else, would it be possible to estimate spring discharge based on the annual water balance?

Similar to the previous comment, large methane emissions may occur in the autumn as the gas is expunged from the freezing soil (Mastepanov et al., 2013). It would be interesting to know if such emissions occur on Samoylov Island and if so, they should probably be included in the carbon balance.

Minor comments

L10: "annual fluxes": are annual totals of lateral fluxes compared to 93-day totals of vertical fluxes?

L25: greenhouse gases -> greenhouse gases (GHGs)

L34: NECB computations which include lateral transport are also available for the Stordalen Mire in subarctic Sweden (Lundin et al., 2016; Olefeldt and Roulet, 2012).

L32: "basic Arctic landscape C balance models" what models are being referred to?

L135: "quantify the impact carbon losses due to lateral transport have on the total carbon balance of Samoylov Island": please describe briefly how the EC fluxes were extrapolated from the EC footprint to the entire island. I wonder whether it wouldn't make more sense to compare the catchment vertical fluxes to the catchment lateral fluxes.

L159: "The 2014 spring flood of the Lena River flooded parts of the catchment." Where is this information coming from?

L205: a detailed discussion of Lundin et al., 2016 and Olefeldt & Roulet, 2012 would be relevant here.

Figure 1d: Considering the discussion of the representativeness of the tower footprint, it would be helpful to be shown the average tower footprint (i.e. of the 2014 measurement period) on the map.

Figure 5: this is a personal opinion, but I find the artificially coloured background images misleading. The water level and height of the vegetation would change over time.

References

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