

Biogeosciences Discuss., referee comment RC1
<https://doi.org/10.5194/bg-2022-69-RC1>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on bg-2022-69

Anonymous Referee #1

Referee comment on "Meteorological responses of carbon dioxide and methane fluxes in the terrestrial and aquatic ecosystems of a subarctic landscape" by Lauri Heiskanen et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2022-69-RC1>, 2022

General comments:

The manuscript bg-2022-69 by Heiskanen et al. estimated the ecosystem- and landscape-scale CO₂ and CH₄ fluxes and their responses to meteorological parameters in a heterogeneous subarctic region, by measuring and upscaling the ecosystem-scale CO₂ and CH₄ fluxes of upland forest, pine bog, fen, and lake. The landscape-scale C balance and its regulating factors are very important topics, especially in the high-latitude regions where climate change is more rapid and severe than other regions of the globe. However, my major concern is the data coverage issue of this study. For their upland pine forest eddy covariance flux measurements, 86% and 91% of flux data are gaps over the two years respectively, which has extremely low temporal representativeness and inevitably introduced large uncertainty in the annual C estimate due to gap-filling. Moreover, only five-day flux measurements for each year (or only one year) over the lakes would also greatly challenge the accuracy of flux estimates for the lake ecosystems. In my opinion, the bottom-up approach of upscaling C fluxes from the ecosystem scale to the landscape scale itself has error propagation issues. Therefore, the low data coverage that existed in most of the ecosystem-scale flux measurements in this study would lead to a tremendous flux estimate uncertainty in the landscape-scale C balance estimate (or even at the ecosystem-level already), questionable data reliability, and probably misleading result analysis and conclusions.

Specific comments:

How was the upland forest CH₄ flux estimated as only eddy covariance CO₂ fluxes were measured there?

As the authors mentioned five major ecosystem types were investigated in this study and the fifth category is lake and stream, I wonder how to estimate the contribution from the connecting stream to the landscape-scale fluxes?

Could you please also provide the basal area, stand density, and LAI of the upland pine-dominated forest stands within the landscape?

How was the friction velocity threshold determined for each EC site? Or a citation from a previous study at this site if any?

Please make sure that the ustar correction should be done after the flux storage correction to avoid that the ustar correction might have been applied during the storage period (counted twice).

Section 2.2.2 is a bit confusing. So for the fen ecosystem, both EC and chamber data are available? EC measurements have both CO₂ and CH₄ fluxes, but chambers measure CO₂ flux only? For the treed pine bog and sparsely treed pine bog ecosystems, only chamber-based CO₂ flux data are available? Please clarify.

Gaps account for 86% and 91% of flux data over the two years. That's a lot! I wonder how the authors could justify the data quality and accuracy of the forest fluxes and thus the robustness of the landscape-scale carbon balance estimated in this study.

Only 30% of CH₄ flux data were left as the good-quality EC data. Please generally describe the CH₄ flux gap attributions as well.

Would the five-day flux measurements for each year represent the annual CO₂ and CH₄ fluxes of the lakes?