

Interactive comment on “Impacts of a decadal drainage disturbance on surface–atmosphere fluxes of carbon dioxide in a permafrost ecosystem” by F. Kittler et al.

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We thank Anonymous Referee #1 for the constructive feedback and the helpful comments/suggestions that helped improving the manuscript. Below comments from the referee followed by our responses can be found.

Line 16: clarify if you mean ‘net CO₂ uptake’ or GPP Net CO₂ uptake was meant here, and it was clarified in the manuscript by using the term sink strength.

Line 22: it wasn’t clear until I read the paper, what you meant by ‘intensified’, may want to clarify There was a sub sentence added to describe ‘intensified’.

Line 30: I suggest updating to Hugelius (2014) and updated permafrost C numbers
C1

The citation was updated as suggested.

Line 55: I don’t think you mean methanotrophic here, which can occur under aerobic and anaerobic conditions. Change to methanogenic, if that’s what you meant. We used the term ‘microbial decomposition of methane’ instead.

Line 60: There are quite a few long-term studies from Toolik lake e.g., Mack et al (2004), Sistla et al (2013) The study from Mack et al (2004) was integrated. We refer to Sistla et al (2013) in more detail a few sentences later, and skipped it here to avoid revisions.

Line 116: I’m confused by ‘during the first nine months’ since the measurements only occur during the growing season. To avoid misunderstandings we corrected the statements since open-path data were used during the first growing season only.

Line 128: change ‘data are collected’ to data ‘were’. Throughout methods, change to past tense. We changed all sentences to past tense in Section 2 of the manuscript.

Methods: Are missing a lot of information about gapfilling and partitioning the fluxes. But then I see this information is in the Discussion, which is a distraction from the discussion section and gap in the Methods. Most of that text in Section 4.3 should be moved to the Methods, the remaining could go in the Supplement. We rearranged parts of the text paragraphs as the reviewer suggested. More information about the gapfilling and flux partitioning method can be found in Section 2.4 now. Furthermore the remaining text of Section 4.3 is used as supplement material.

Line 160: Change ‘presented’ to ‘present’ It was corrected as the reviewer suggested.

Line 180: not sure what is meant by ‘missing release’ It was clarified in the section. We referred to the fact that the expected release with dominating positive fluxes at the beginning of the growing season after the snowmelt is completely missing in these time series.

Methods: Add in information about statistical design and analysis. We added some

information on the statistical analysis covering the ANOVA as a new paragraph at the end of section 2.4.

Line 207: I suggest to change 'evolving' to 'greening' or 'changing' It was changed to 'greening' as the reviewer suggested.

Line 215: change 'higher cumulative' to 'higher net cumulative' It was corrected as the reviewer suggested.

Line 255-266: Given that there was only one historical year of data from the disturbed site, and given the level of inter-annual variability, I don't think the data support such a strong statement. I would change 'demonstrates' to 'suggests' and 'strongly rebounded' to 'may have rebounded' It was corrected as the reviewer suggested.

Figures 7–9: Would be easier to see trends if you changed the line style for either the decadal or recent data so that one set is solid line and the other is dashed. The style of the graphs was changed as suggested with dashed lines for the historic dataset.

Line 190: ANOVA not mentioned in methods; as noted above, need to add in a statistical analysis section to the methods See comment for Methods above.

Line 306-307: How was the effect of soil temperature, moisture, etc. analyzed? Results presented in companion studies (Kwon et al, BGD 2016; Goeckede et al., in prep.), based on small scale flux observations (flux chambers) and associated observations of environmental conditions; clearly demonstrate the influence of soil moisture on soil temperature conditions. Here, drier soils promoted warmer conditions near the soil surface, and colder conditions at deeper soil layers. The warmer top soils promoted microbial respiration of recently assimilated carbon (Kwon et al., BGD 2016). With the focus on eddy-covariance observations in the present manuscript, such relationships are harder to establish, since the eddy covariance footprint always covers a mixture of wet and dry microsites, respectively, and observations of soil temperature/moisture are only available for very few spots. Therefore, we added a link to Kwon et al. (2016) as a

C3

reference for more process-based analyses of the carbon cycle at this study site.

Line 317: manuscript doesn't present organic matter decomposition results. Change to 'decomposition of soil organic matter' to 'ecosystem respiration' It was corrected as the reviewer suggested.

Line 323-33: The APEX peatland drainage experiment (Alaska) has been running since ~2005. Some of these pubs aren't long-term but they are water drainage studies in the permafrost regions, and their results may inform your discussion: Turetsky (2008, APEX), McConnell et al (2013, APEX), Natali et al (2015, not APEX) We decided not to include the proposed literature since none of the studies is matching our targets. Either the focus is on methane in combination with the drainage experiment, the measurement technique is different or the manipulation is focusing on warming, which is in our case a secondary effect of the drainage but not the primary disturbance. To make clear what focus area we are targeting, we changed 'carbon fluxes' to the more specific term 'summertime CO₂ fluxes'.

Line 343: change 'annual' to 'growing season' It was corrected as the reviewer suggested.

Line 378-379 Any long-term changes in snow-depth? Or winter soil temps? Measurements were carried out during the growing season only. No data on soil temperature or snow depth were collected during the off-seasons, e.g. winter. Therefore no information can be given for this period. BEST-data indicate that wintertime air temperatures have not changed significantly over the last decade but can be highly variable from year to year.

Line 485: What do you mean exactly by adaptations? The sentence was restructured to avoid misunderstandings.