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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Permafrost Nitrous Oxide Emissions Observed on a Landscape Scale Using Airborne Eddy Covariance Method" *by* Jordan Wilkerson et al.

Anonymous Referee #2

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This manuscript presents an airborne Eddy Covariance technique to measure N2O emissions from permafrost regions. A summer flight campaign was performed in August 2013 above North Slope, Alaska. The measurements from this airborne laboratory gave an average N2O flux of 3.8 mg N2O m-2 d-1, higher than the expected range for permafrost regions. The authors speculate that increasing thermokarst under climate change (a hotspot of N2O emission in permafrost) could have resulted in such high N2O emissions. Overall, the analytical technique and estimation of N2O flux based on EC Method are well described with plenty of details. The analytical precision of N2O mixing ratios seems satisfying for airborne measurement, and uncertainty in flux estimations has been also discussed. However, given the unexpectedly high N2O flux,

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Discussion paper

it remains a question to us how realistic flux data we could obtain based on these airborne measurements within limited time scales. Although this approach has been tested for CH4/H2O with a near-by EC tower (Sayres et al., 2017), spatial variabilities in N2O fluxes could largely differ. Therefore, more ground-based fluxes data in the near region by EC tower or chamber measurements are necessary to confirm the applicability of this technique. Alternatively, if N2O emission factors or edaphic parameters are available in this or other similar regions, a ground-based model estimation of N2O fluxes separating landscape elements may strengthen the whole manuscript.

Detailed comments:

Abstract: Some explanation of the high N2O fluxes needs to be implemented. Also, please indicate the site location in the abstract.

Page 2, Line 10-16: The authors argued that chamber measurement or lab studies cover small spatial scales. However, the airborne measurements cover only short time periods. Perhaps a little more background on spatio-temporal variabilities in N2O fluxes from permafrost?

Page 2, Line: 17-20: Much of the detailed information on flight campaign could be put in M&M.

Page 5, Line 1, equation (3): I think that running flux method (RFM, Sayres et al. 2017) was used for N2O flux estimations in this manuscript. However, Sayres et al. (2017) suggested advantage of flux fragment method (FFM) against RFM in their airborne EC CH4 study. Also, they claimed that FFM can isolate flux contributions from individual surface land classes. Please explain it.

Page 7, Line 29 and Line 32: Could you give a more quantitative description of land classes (in % or area size) for Table 1?

Page 8: Line 27-30: Gene abundance does not directly refer to denitrification and N2O reduction rates. It still needs to be expressed so that N2O can be reduced. Better

focus on the O2 inhibition effect on N2O reductase.

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