

## ***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 N<sub>2</sub>O 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 N<sub>2</sub>O flux of 3.8 mg N<sub>2</sub>O m<sup>-2</sup> d<sup>-1</sup>, higher than the expected range for permafrost regions. The authors speculate that increasing thermokarst under climate change (a hotspot of N<sub>2</sub>O emission in permafrost) could have resulted in such high N<sub>2</sub>O emissions. Overall, the analytical technique and estimation of N<sub>2</sub>O flux based on EC Method are well described with plenty of details. The analytical precision of N<sub>2</sub>O mixing ratios seems satisfying for airborne measurement, and uncertainty in flux estimations has been also discussed. However, given the unexpectedly high N<sub>2</sub>O flux,

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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 CH<sub>4</sub>/H<sub>2</sub>O with a near-by EC tower (Sayres et al., 2017), spatial variabilities in N<sub>2</sub>O 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 N<sub>2</sub>O emission factors or edaphic parameters are available in this or other similar regions, a ground-based model estimation of N<sub>2</sub>O fluxes separating landscape elements may strengthen the whole manuscript.

Detailed comments:

Abstract: Some explanation of the high N<sub>2</sub>O 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 N<sub>2</sub>O 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 N<sub>2</sub>O flux estimations in this manuscript. However, Sayres et al. (2017) suggested advantage of flux fragment method (FFM) against RFM in their airborne EC CH<sub>4</sub> 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 N<sub>2</sub>O reduction rates. It still needs to be expressed so that N<sub>2</sub>O can be reduced. Better

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focus on the O<sub>2</sub> inhibition effect on N<sub>2</sub>O reductase.

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