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Interactive comment on "Short-and long-term temperature responses of soil denitrifier net N_2O efflux rates, inter-profile N_2O dynamics, and microbial genetic potentials" *by* Kate M. Buckeridge et al.

Anonymous Referee #2

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The study is important, since emissions from terrestrial systems dominate N2O fluxes which may be further enhanced by warming climate leading also to warming of the soil.

In this study, the key studied function was denitrification, both producing and consuming N2O. The N2O flux potentials were measured from boreal ecosystem soils where mean annual temperature spans from 0 – 5.2 C. Furthermore, incubations by adding 15N-KNO3 were done in temperature range from 5 to 25 C in order to see the effect of warming to fluxes.

Both short-term warming and a long-term warmer climate enhance net N2O production, and N2O production was bigger than N2O reduction during the incubation. There was reduction of N2O by mineral soil, not by organic soil. Combining horizons of mineral soil and organic soil decreased the combined net N2O flux by up to 200% of the expected, combined net production rate from separate horizons. There was decoupling between gene abundances and biogeochemical outcomes.

Generalization of the results was done and may be enough from the potentials made on anaerobic conditions and with added NO3-. Possibly name would already indicate, that this was a laboratory experiment.

MS is well written and figures are clear. Methodology is mostly the same as used earlier by Billings and Tiemann, 2014, except that δ 15N is measured from N2O but not from produced N2 gas. There is some points needing further clarification.

Results are expressed as ng N2O-N g-1 h-1. It is unclear to me is this dry weight or fresh weight and same used in all soil weight (gen copies, added 15N etc.) based measurements? Soil samples in half-pint jars (240 ml) were 40 g mineral and 50 g of organic soil, and in combined experiment 20 g for mineral and 25 g for organic soil. Their bulk density (supposedly dry BD?) is $\sim$0.1 for organic and $\sim$0.7 g cm-3 for mineral soil. is there wet bulk density also available in order to compare thinks based on volume of the soil. This may explain why actual soil volumes in jars are different, it is not explained further. Or how close volumes are, when in both WHC is adjusted to 80% (which is of course a big difference in water content). Knowing actual volumes is especially important in combined setting, where volumes probably have an effect to ratios of produced and consumed N2O. Also, in methods (r: 252) the 0.25 g added soil (ww,fresh weight, dw) for functional gene analyses is unclear, and was this wet weight of soil straight from incubation flasks, and thus about 80% WHC? And the result based on this added amount of fresh (WHC 80%) or dry weight of added soil. It may also be worth to mention this and possible volume differences in discussion regarding functional gene abundances. I have difficulties to understand

this tracing method (could be also my lack of knowledge), so maybe you explain it a bit more carefully. Why not adding 15N-N2O in the beginning and measuring 15N2 would not work? When you add 15N-NO3-, you assume that it will first produce enough big amount of 15N-N2O in three initial hours. From this concentration increases in 15N-N2O (production > consumption) or decreases (production < consumption) are visible in the incubation time 60h. In this method you also assume, that 14N N2O released from soil own N stores is not diluting 15N + 14N -N2O. In equation at row 238, it would be easier to reader to show the real times (initial 3 h and final 60 h). Also jump from added δ15N 3000 ‰ first to ng 15N- N2O g-1 soil (dw,ww, fresh?) maybe needs to be explained more clearer. It would be nice to see (or have a reference) how you get from headspace N2O ppm:s and δ15N values to ng g-1 15N-N2O in headspace, since there is also lot of 14N-N2O added. In any case recovery of 15N as N2O is big, almost 75% at the warmest experiment at the time point 60 h. Would be nice to see also course of N2O concentration increase with time – and d15N-N2O for the time points used. Maybe as supplement.

Some typos (or not) and just asking: r, 226 : there is range of ppm, but what was the range of d15N-N2O standards, 0.1 ‰ precision looks for me extremely good in highly enriched N2O. r. 347 and elsewhere. " g-1 $\pm$" between standard deviation (or error?) or after that. r. 246, r. 252: is 0.25 g also based on fresh weights? reference list: many typos in subscripts N2O, spaces N 2 O and letters, like "Dur??n"

Good luck with MS!

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