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Comment on bg-2021-228

Anonymous Referee #2

Referee comment on "Sources of nitrous oxide and the fate of mineral nitrogen in subarctic permafrost peat soils" by Jenie Gil et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-228-RC2, 2021

The manuscript 'Sources of nitrous oxide and fate of mineral nitrogen in sub-Arctic permafrost peat soils' by Gil and co-authors is an interesting study on nitrogen cycling in vegetated and bare soils of the Russian sub-arctic. The authors used an isotope pulse-labelling approach to identify the microbial pathways responsible for N2O emissions at their study sites and concluded that emitted N2O mainly originated from microbial denitrification. However, also nitrification was an essential process for N2O production since it produced the nitrate required for denitrification.

The formation and release of N2O from arctic and subarctic soils has not yet gained the attention it deserves. It is crucial to understand how N2O fluxes will respond to future environmental and climatic changes in particular in the high northern latitudes, since there the changes will be most severe. The presented study adds important information on the formation and release of the important greenhouse gas N2O in a remote area of this world. The study is well designed and the conclusions are supported by the presented data. I have only few comments, which hopefully are helpful to improve the manuscript.

The title of the study indicates that these soils are affected by permafrost, but in the description of the study site and the soil characteristics I did not find any information on permafrost, except that the sites are situated in the zone of discontinuous permafrost. Are the sites still affected by permafrost? If yes, please give more information e.g. on active layer depths, if not, the title should probably be adapted.

Specific comments:

P2, L1-4: Which processes do you mean? Could you be here more specific and start with the explanation of the processes you mean?

P2, L9-10: This sentence is hard to understand.

P5 L35-P6 L2: What are the results of the comparison between the two methods? In Fig. 1 I only see the results of the current approach. I would expect that inserting the collars only 1h before measurement would disturb the system and affect the outcome of the measurement. Furthermore, a one point measurement introduces uncertainty in comparison to multi-point measurements and it would be good to comment on this uncertainty.

P6 L16: Do you mean Herrman et al., 2005?

P7 L16: If I get this right the 15N in the soil was only considered until a depth of 6 cm, since this is the sampling depth of the soil cores. It was not described how deep the 15N tracer solution was injected into the soil but I can imagine that the label diffuses relatively quickly below this depth. Would N2O production from the 15N label below the sampled soil depth introduce a bias into their mass balance calculations?

P9 L13: Please explain how WFPS was calculated.

P9 L24: Figure 3

P10 l3: 'no'

P14 L8-10: This was yet said in the introduction.

P14 L 13ff: I would admit in this paragraph that addition of label likely increased N2O fluxes. At least that is what the data show. I am sure the heterogeneity is high but the authors do not present these data.

P15 L14: Sx?

P16 L2: What do you mean by 'evolutionary advantage'?

P17 L28: When was the 'exceptionally dry year'? 2010 is the year of the current study.

Figure 2: The y-axis label is misleading. It seems that not the total recovery is presented but the relative proportion of the different pools in the recovered 15N. It might be more informative to present the absolute 15N recovery in the different pools, which would than not always sum up to 100%. Please add error bars.

Figure 3: Could the authors comment on the large differences in 15NH4-N and 15NO3-N concentrations in the different plots. In particular the 15NH4-N concentrations steeply decrease during the first days, but the increase of 15NO3-N concentrations or 15-N2O-N fluxes seems much lower. Where is the label gone?

Figure 4: Could you add error bars to the average values presented.