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Interactive comment on "N_2O isotope approaches for source partitioning of N_2O production and estimation of N_2O reduction – validation with ^{15}N gas-flux method in laboratory and field studies" *by* Dominika Lewicka-Szczebak et al.

Anonymous Referee #2

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The manuscript by Lewicka-Szczebak et al. touches on an important topic developing within the efforts to more comprehensively understand the use of bulk and site specific N2O isotopes in delineating the extent of N2O reduction in order to more accurately apportion N2O production pathways. More importantly, the natural abundance N2O isotopes method is cross-checked with an independent approach (i.e. 15N-enriched experiment) - a combined study which is still generally lacking. The authors are commended for their meticulous and systematic considerations of the approaches used in their study. The extensive discussion on the suitability of the different approaches

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(i.e. mapping versus model incorporating all three SP, d18O and d15N values) in both lab and field studies will definitely provide useful guidelines for similar studies in the future. As such, this study is topical, relevant and certainly fits the remit of BG. Generally the manuscript is well written and well-presented except in some places, more explanations/justifications are required (which I detail below):

Line 61: It would be helpful to provide the actual value of sensitivity increase here so that a direct comparison can be made.

Line 68: 'budget' is a more appropriate word here rather than emission. It is probably much easier to measure N2O fluxes directly if emission is intended.

Line 76: Should diffusion of N2O be taken into account as one of the processes determining the final N2O isotopes? Either here or in discussion, why the fractionation factor of diffusion is not considered in this study should be briefly mentioned.

Line 98: What was the non-identical treatment here? Suggest briefly describe to give the readers some idea on the treatment differences which should be avoided

Line 117: Suggest the authors indicate their reference method here

Line 159: Should also briefly mention what is the same treatment strategy employed in this study.

Line 178: Why 20 mg N/kg of soil in lab incubation compared to 10 mg N/kg soil in field fertilisation?

Line 141: This is confusing. Why the dates for 'next field campaigns' do not correspond to what is written earlier?

Line 217: How was N2O converted to N2? In-line conversion?

Line 298: nD is not included here. Why? Understand that the isotopic ranges are not very different between bD and nD but authors should briefly mention why this is not included here to avoid confusion. Also to show that the authors have considered the

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nD pathway as well.

Line 310: Why higher fungal DN compared to nitrification in this instance? The data in Table S2 can be used to briefly justify this?

Line 379: Some of the N2 fluxes are above the detection limit but the values written here are below the detection limit mentioned in line 373.

Line 421 - 423: Don't quite get what you mean here. Consider rephrasing. You mean corrected precursor ranges based on different fractionation factors?

Line 434: The minimum reduction line is not described in Fig. 1. The dotted lines and the mixing should be clearly described in the legend/caption.

Line 461: There was relatively large discrepancy between lab and field NO3- and NH4+ values. In fact, the d15N-NH4+ is very heavy and the possible factors driving these values should be discussed.

Line 490: The authors mentioned that the high d15N-NH4+ has shifted the location of the nD and Ni in the end member mixing plot. What is the author comparing the shift to?

Line 551: Amplitude for 3D1 model, case 1 is not always lower than the reference – at the start and towards the end of sampling, the amplitude is higher than the reference method. Any explanation on why this is the case?

Line 670: I agree with the authors that recalculation of the literature mixing endmember values is important but my question is what fractionation factors should be considered when correcting these values and how to evaluate that these corrected ranges are justified?

Line 686: Be specific of what shift is meant here? Temporal?

Line 820: This sentence is rather subjective. Is it possible to provide a more definitive range here? Can the authors make use of a sensitivity analysis to show the extent of

substrate isotopic variations effects on the accuracy of the mapping approach?

Line 825: Can the author suggest the lowest N2O fluxes without compromising the precision of isotope maps and the 2DI model? This will be helpful as a guideline for future studies wanting to use these approaches.

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