

Interactive comment on “¹⁵N gas-flux method to determine N₂ emission and N₂O pathways: a comparison of different tracer addition approaches” by Dominika Lewicka-Szczebak and Reinhard Well

Anonymous Referee #1

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This is an informative and relevant study, the experiments are well planned and conclusions are sound. Prior to publication, a few clarifications are needed. The paper would also benefit from language editing (e.g. past and present tense are mixed).

General comments: Both, the introduction and discussion could benefit from including references that support your statements. There are quite a few statements, which are unsupported by references and/or your results. Although this might be the first paper on the effect of ¹⁵N tracer approach on the N gas source partitioning, some other papers have investigated the effects of tracer addition on the soil N cycle (Davidson et al.,

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1991; Gütlein et al., 2016; Kaur et al., 2010). It might be worth looking at those (you do not need to cite those necessarily, but they might contribute to your discussion). The tracer addition (with a ¹⁵N fraction of 73 %), resulted in an initial ¹⁵N fraction of soil NO₃⁻ of 42.5 % (line 51). This means that soil NO₃⁻ content was more than doubled, which is much above common recommendations of tracer addition (10 – 25 % of native soil N). What was the motivation for such a high addition of tracer and what are the consequences for your results? I would like to see a discussion on this. Your comparison of the ¹⁵N fraction of NO₃⁻ (a_{NO3}) with the calculated a_p values (line 127) makes only sense if NO₃⁻ was the sole source of N₂O and n₂, i.e. all gases were produced via denitrification. What supports this assumption? You speculate yourself later about the possibility for hybrid N₂ (line 148). And N₂O production from nitrification is also possible.

Specific comments: Abbreviations should be introduced at first use and then used consequently Do not start sentences with abbreviation or chemical symbols (e.g. line 8) Line 11: please be more specific what kind of results. Line 13: “wider range” is unclear, be more specific. Line 40: I suggest you first describe the soil, before describing the treatments, i.e. start this paragraph with text from line 47. Line 49: this is an unusual unit for soil density; maybe use the more common cm⁻³? Line 51: what is “initial condition”? Is this prior to trace addition or immediately after? Please clarify. Line 66: the a_p values, are those calculated or measured? I think this part would benefit from showing all equations rather than referring solely to other papers. Line 102: This sentence needs rephrasing; “we may deal with” is unclear. Line 110 (&114): The phrase “column heterogeneity” is unclear and might be confusing. As I understand you mean the heterogeneity between different columns, but it sounds like the within column heterogeneity. The latter, you actually cannot conclude about. Line 115: Suggest adding “(Table 2)” at the end of sentence. Line 116: “Very” is imprecise. Avoid such qualitative statements. Line 117: For me it is unclear why the initial NO₃⁻ content should differ between the treatments. After all, it is the same soil. Alternatively, it might be due to stimulated nitrification in the mixed soil (see e.g. Kaur et al., 2010). Line

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119-123: This sounds somewhat unlikely to me. If less ^{15}N was injected, you certainly should have noted that during the injections. Line 129 (& 136): Suggest moving the text in parentheses (after colon) to the Methods. Line 131 & 144: The “differences” you refer to, is this the cumulative or mean? Line 171: should rather be “tracer addition”
Line 172: here you use for the first time “content” of inorganic N, while otherwise you use concentration. In fact, content is the correct term.

Figure 1, caption: “black dots” Figure 1, caption: Last sentence not needed (as there are no statistical differences) Table 2: Unclear what is compared statistically, within treatment of between? Also, what is the “mean” referring to, mean of what? The “Injection point”, is this for both layers? Table 3: Suggest moving the equations (with additional explanations) to the method section.

Cited references: Davidson, E.A., Hart, S.C., Shanks, C.A., Firestone, M.K., 1991. Measuring gross nitrogen mineralization, immobilization, and nitrification by ^{15}N isotopic pool dilution in intact soil cores. *Journal of Soil Science* 42, 335-349. Gütlein, A., Dannenmann, M., Kiese, R., 2016. Gross nitrogen turnover rates of a tropical lower montane forest soil: Impacts of sample preparation and storage. *Soil Biology and Biochemistry* 95, 8-10. Kaur, A.J., Ross, D.S., Fredriksen, G., 2010. Effect of soil mixing on nitrification rates in soils of two deciduous forests of Vermont, USA. *Plant and Soil* 331, 289-298.

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