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Interactive comment on "Underestimation of denitrification rates from field application of the ^{15}N gas flux method and its correction by gas diffusion modelling" *by* Reinhard Well et al.

Anonymous Referee #2

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Overall the paper is quite relevant to researchers who have used or are planning to use the 15N labelling method to quantify identification rates in-situ. The researchers convincingly show through modelling and field data that the impact of subsoil diffusion and storage fluxes have a significant impact on the estimated denitrification rates and thus have likely caused under reporting in the current literature.
General comments
- My main reservation is regarding the applicability of the modelling more broadly for correction of field results. Parameters like diffusivity are notoriously difficult to estimate in the field, and therefore the discrepancy between model and measured as reported here may never be reconcilable.

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- While i appreciate the difficulty of including water phase gas transport in a model, especially one with such a complicated isotopologue structure, I feel it should at least be discussed in the paper as another important factor. It would both contribute to pore space storage as well as isotopic fractionation although the latter may not be important given the label strength.
- The model results are somewhat dense and difficult to digest - my concern is that someone who is not a modeller/gas diffusion specialist would get lost in the current brief narrative. Suggest being more verbose but for the benefit on enhanced clarity.
- Section 3.1.2 requires significantly more explanation. I would have expected to see a more normal flux calculation as a proxy for production as is done with CO2 or CH4, however the fitting approach is applied here. Why did the authors not use a linear or exponential flux model as is commonly used for other gases. What do the parameters alpha and delta signify or what is their physical manifestation - are they related to chamber volume and surface area, cylinder depth, etc? Is this approach/equation commonly applied outside of this paper?
- Discussion and conclusions - If the modelling approach cannot be applied quite yet to correct the values, perhaps there should be a small table or histogram or similar of "likely errors" that may have been incurred in past experiments using this method. This would at least allow the community to make an educated guess on how far off our current estimates are from reality (and may allow some reconciliation across methods as well).
- Overall the flow of the paper could be improved, this is partly due to sections with poor sentence structure or run-on thoughts mostly in the introduction and discussion portion of the paper.

Specific Comments Page 2
- Line 9 - "to measure" should be "in measuring" or similar. - Line 14 - gastight should be gas tight unless this is a brand of container - Line 25 - suggest inserting several sentences explaining to the reader why in-situ measurements are important. Is there

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literature to cite comparing in-situ to lab incubations or similar? Page 3
- Line 8 - some more detail around why we don't just measure these parameters instead of modelling them Page 4
- Line 14 - change amount to concentration - Lines 18-29 - consider separating into bullets. -Consider annotating figures with some of the details contained in lines 18-29 Page 6
- Figure 2b - What is the origin of the oscillation in the flux data Page 7
Line 1- is the chamber here fully/homogeneously mixed? Line 18 - Is the atmosphere multi-layer? This isn't clear Line 22 (and elsewhere) - NO3 is often used, but are there any chemical or biological processes modelled that convert NO3 to other species? If not then perhaps its best to clarify that gases are produced independent of NO3 transformation. Page 8
Line 10 - Is production constant with depth over the length of the collar? Page 11
- Line 11 - Clarify that these initial results are from the bottom open scenario

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