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Discussions

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Interactive comment on "Effect of soil saturation on denitrification in a grassland soil" *by* Laura Maritza Cardenas et al.

Anonymous Referee #2

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General remarks

This paper presents results from a sophisticated laboratory experiment in which an agricultural soil was compacted and adjusted to 4 different moisture conditions. Glucose and nitrate was added and the formation, isotopic and isoptomeric composition of gasesous N was measured over a period of 12 days. Using those data the authors try to determine the contribution of different processes to N gas formation. The paper is a good example how much information you can get from experimental data if you spend a lot of energy in calculations and data analysis. However, in my eyes the paper has three critical weaknesses:

1.) The results are not really new. It is known for a long time that addition of nitrate and glucose stimulates denitrification in soils and that denitrification is favored under wetter

conditions. All the points in the conclusions are not new. If there is new knowledge obtained from the study, it has to be elaborated more clearly.

2.) The paper is lacking a clear story. It is not really clear to me what was the final purpose of all those detailed analysis. There are some hypothesis mentioned at the end of the introduction but the rest of the manuscript is not tailored to address those hypotheses. The hypothesis that wetter conditions reduce heterogeneity could be answered from just looking at the error bars in figure 1 – you do not need sophisticated analysis to prove this point. Aiming to understand what is going on in one's own experiment (as stated in the last sentence of the introduction) is not a sufficient aim of a paper.

3.) There are some problems with the experimental approach which limit interpretation of the data. First, moisture conditions were not constant but changed a lot during the experiment. The second treatment, for example at the end of the experiment had the same water content as the third treatment in the beginning. They had changing substrate concentrations in parallel to changing moisture conditions. Thus, the interpretation of moisture effects during the course of the experiment is difficult. A way to minimize that effect would have been to moisten the supplied He/O2 gas. I would also expect that water loss was highest in the beginning, when the surface layer was drying. A way to get some information about temporal changes of water content would have been to weigh the incubation vessels during the incubation. Second, they measured gas emission – not gas production. They mention this problem in the paper but somehow ignore its consequences. The emitted gas probably originates from those sites which are physically linked to the atmosphere, while gas production, e.g. in the center of aggregates did probably contribute less to the emitted gas. So, the conclusions drawn from the analysis could be valid only for a part of the soil volume.

Detailed comments

l.17: remove "soils" l.40: What do you mean with "benign" for the environment. Do you mean the process is important because it closes the global N cycle because it reverses

N-fixation? l.64-73: I would move this paragraph to an earlier point, before talking about compactation. l.72: I would replace "powerful tool" by "basis". l.81: If there are several references for one statement, present them in chronological order. l.81-82: Remove sentence l.83: "…under the conditions…" l.92: Be more specific. What do you mean by "other steps of denitrification"? l.93: "reported here". l.100: Does that mean that those results are only relevant at elevated C and N? l.108: Why CO2? l.112: "controlled laboratory conditions" l.119: What do you mean by "heterogeneity in N emissions"? l.120: I am not a soil scientist, but is that really new? l.121: Aiming to understand what is going on in one′s own experiment is not a sufficient aim of a paper. l.137: Verb missing. "was applied"? l.228: "CO2 was measured…" l.230: replace "pulled together in one sample" by "pooled" l.232: Remove sentence. There is a similar sentence in the results section. l.268: Were the data normal distributed? l.275: "mixing model was then used" (use past tense) l.283: When did this occur and what is a possible explanation? Wrong fractionation factors? l.290: A TCD is an detector – not an analyzer. l.303 Why was the gas stream not bubbled through water to saturate it with water? l.305: I would expect the highest water loss right in the beginning. l.306. But they were similar between treatments in the end although different starting conditions. l.314-316: There was a high variability in the data. l.318: Remove "The results showed that" l.329: I do not see that in Figure 1. In Unsat/sat the N2O maximum was at 12 kg N/ha d, not around 7. l.348. Right. But what are the consequences of this for your experiment and its interpretation? l.354: You probably mean "CO2 fluxes". Why was CO2 measured? l.360: The carbon budget is interesting but complicated. Could you calculate recovery rates for the added glucose? It looks as if there are recoveries higher than 100%. Can this be interpreted as a priming effect? A problem with using CO2 for carbon budgeting is, that depending on pH you also have other IC species in the soil solution. Do you know the pH in your soils? l.370: Add article before "period" l.375: The SP data have a high standard deviation. Are the differencers discussed in this paragraph real? l.391: You may consider adding these data to the plot. l.394: Separate into two sentences. Start second one with "In our data, maximum …." l.404 So what is the message of

this paragraph with respect to the first sentence of the paragraph? l.405: Why was this done? l.428: Why was this plot done? l.441: I do not see data within those areas in the plots. l.456: "sat" page 19: It is difficult to detect the storyline on this page. L513: Could it be that there was C limitation in the dryer treatments because glucose was metabolized aerobically? l.534-537: The message of the CO_2 paragraph is not really clear. Are the CO_2 data helpful in this manuscript? l.539: How much is the unacounted N-loss in comparison to the accounted gasesous losses? l.541: NO: What are typical NO fluxes in the literature? Can the NO flux have a significant magnitude? The same applies to microbial biomass: Is the microbial biomass potentially formed from the unaccounted N-loss in a realistic order of magnitude? l.567: How should nitrification contribute to BDEN? Do you mean nitrifier-denitrification? l.636: I do not understand the content and purpose of this paragraph. l.719: Don't you have 4 periods in the figure? Table 3: Unit missing for Total emitted N. Tables 5 and 6: I wonder whether these data could be presented better in figures. Figure 5: the four sub-graphs are quite similar. Isn't a conclusion that the results were not much influenced by soil moisture? Do you really need 4 graphs?