

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

**Laura Maritza Cardenas et al.**

[laura.cardenas@rothamsted.ac.uk](mailto:laura.cardenas@rothamsted.ac.uk)

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This is an interesting study that addresses the roles of soil compaction and water saturation levels on N<sub>2</sub>O production and the microbial origins of N<sub>2</sub>O. The results are not terribly profound but this is an important contribution to the literature as the precise causes of N<sub>2</sub>O hot spot production are still unresolved. Overall I found the writing to suffer from incorrect grammar and English writing style. Further, the manuscript is much longer than it needs to be. The manuscript would greatly benefit from a major rewrite and could be re-written as a short concise note rather than a full research paper. I've identified some issues with the writing below but there are numerous problems beyond what I have listed. R: the majority of the authors consist of native English speakers and the English has been revised by them, so we believe the quality of the English is good. We think that providing the current level of detail in this manuscript as

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a full research paper is required to give further evidence for the need to use isotopic signatures and modelling approaches of N<sub>2</sub>O in order to describe the driving source processes of this gas as emitted from soils. Line 26 to 29: As this sentence contains both a colon and a semi-colon it needs to be broken into at least two sentences. I do not understand the meaning of the portion after the colon (28-29). R: thanks for the suggestion, paragraph has been split.

Line 73 and 74: Please check with Coplen (2011) regarding the correct usage of “isotopologues” and “isotopomers”.

R: we have now modified the text according to Coplen’s definitions below and used isotopologue always if SP AND d<sup>18</sup>O are addressed, isotopomer if ONLY SP is addressed. According to Coplen: ‘The molecular species can be an isotopologue, an isotopomer, or neither. For example, the three molecular species <sup>15</sup>N<sub>2</sub> <sup>16</sup>O, <sup>14</sup>N<sup>15</sup>N<sup>16</sup>O, and <sup>15</sup>N<sup>14</sup>N<sup>16</sup>O are isotopologues, but they are neither isotopologues (because the latter two do not differ in isotopic composition) nor isotopomers (only the latter two are isotopomers). Isotopolog: Molecular species that differ only in isotopic composition (number of isotopic substitutions) and relative molecular Mass. Isotopomers: Molecular species having the same number of each isotopic atom (thus, the same relative molecular mass) but differing in their positions.’ We defined these in the introduction as: ‘Isotopologues of N<sub>2</sub>O represent the isotopic substitution of the O and/or the two N atoms within the N<sub>2</sub>O molecule. The isotopomers of N<sub>2</sub>O, are those differing in the peripheral ( $\beta$ ) and central N-positions ( $\alpha$ ) of the linear molecule’ which we believe agree with the definition given by Coplen.

Line 97-98: Why is “soil volume” the key control on the net isotope effect? This seems more like an experimental condition rather than a governing soil process. R: we changed the text for: “The results generally confirmed the range of values of  $\eta$  (net isotope effects) and  $\eta^{18}\text{O}/\eta^{15}\text{N}$  ratios reported by previous studies for N<sub>2</sub>O reduction for that part of the soil volume where denitrification was enhanced by the N+C amendment. This did not apply for the other part of the soil volume not reached by the N+C

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amendment.”

Line 111-112: Generally avoid one-sentence paragraphs. This statement belongs more appropriately in the Methods section and could be deleted here. R: text has been moved as suggested

Line 159: This paragraph is much longer and more detailed than it needs to be. R: section has been moved to a supplementary material.

Line 323-324: Use past tense here. R: all throughout this section (3.2) there is only past tense. I am not sure where the reviewer refers to.

Line 338: Delete “already”. R: deleted as suggested.

Line 351: Incorrect word use. SP values don’t “show”; rather they are obtained. Use past tense to describe trends in the experimental data throughout this paragraph. R: text has been amended.

Line 363: Don’t describe “the plot”; rather simply refer to the trends between the parameters. R: text amended.

Line 365: Regressions don’t suggest but simply describe a (presumably significant) relationship between two parameters. You can state that the intercept of the regression equation relating SP and the  $N_2O/(N_2O+N_2)$  was – 2 per mil. R: changes have been introduced.

Line 367-369: The writing is confusing here; I cannot follow the meaning of this sentence. R: These are the lines in the submitted pdf: “This is in juxtaposition with the situation when the N emissions are dominated by  $N_2$  or  $N_2O$  is low, where the SP values of soil emitted  $N_2O$  were much higher (Fig. 3), pointing to an overall product ratio related to an ‘isotopic shift’ of 10 to 12.5o/oo.” We modified to (including previous sentence): “The plot of the  $N_2O / (N_2O + N_2)$  ratio vs SP for all treatments in the first two days (when  $N_2O$  was increasing and the  $N_2O / (N_2O + N_2)$  ratio decreasing) shows a significant negative response of the SP when the ratio increased (Fig. 3).

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The regression suggests that when the emitted gaseous N is dominated by N<sub>2</sub>O (ratio close to 1) the SP values will be slightly negative with values around -2 (Fig. 3), i.e. within the range SP range of bacterial denitrification. With decreasing N<sub>2</sub>O / (N<sub>2</sub>O + N<sub>2</sub>) ratio the SP values of soil emitted N<sub>2</sub>O were increasing to values up to 8 per mil.”

Line 370: It is not helpful to refer to data in a figure of another paper. Describe the main significance to the similarity between these data sets. R: I think the reviewer here refers to line 389. We are not referring to a figure necessarily but to the data from Lewicka-Szczebak et al. (2014). The significance was explained in the discussion: ‘These results confirm from 2 independent studies Lewicka-Szczebak et al., 2014) that there is a relationship between the product ratios and isotopic signatures of the N<sub>2</sub>O emitted.’

Line 374: Again, don’t state what is plotted in Figure 4, describe the relationships between the variables and refer to the figure. R: This is in line 406. We have edited the text as suggested.

Line 383: The r<sup>2</sup> values by themselves are not very relevant. What is relevant is if the relationships are significant and their associated p values. R: R<sup>2</sup> are reported in lines 412 onwards. We have analysed the regressions and introduced the P values as suggested.

Line 389: See comment for line 374. R: I think reviewer refers to line 428. We have stated the new figure was done similarly to the previous one, so we have left the text as it was.

Tables 1, 4, 5 and 6: These tables could readily be placed in the Supplementary Documents. R: yes, it would be possible, but we would like to have the editor’s view before moving them.

Figure 5: These figures are not well organized. Put a box around the legends so that we know they are legends. Within the legend, the line should be placed through the

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data points rather than defining each line as “Linear”. The y-axis title should display delta not “d”. R: Legends have now been enclosed by a box. The ‘Linear’ word in the legend clarifies that a linear function was fitted so we have left this as it was. The reviewer refers to the X axis, delta has been changed.

Please also note the supplement to this comment:

<http://www.biogeosciences-discuss.net/bg-2016-556/bg-2016-556-AC1-supplement.pdf>

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