Dear Reviewers,

Thank you for reviewing our manuscript. We have found your comments to be constructive and useful in amending sections of the original manuscript submission. Please find the reviewer's comments and the corresponding changes made to the manuscript below.

Anonymous Referee #1

" (1) The context of section 3.3 about N_2O fluxes from drainage stream should be rewritten concisely because of its less importance."

Section 3.3 will be shortened to address this.

"(2) The authors have discussed more about the correlations between soil properties and N_2O fluxes, and also indicated that the soil conditions is more conducive for the occurrence of nitrification and thus higher concentrations of NO_3^-. However, the authors suggested that denitrification may be the primary process for N_2O emissions solely according to the lack of correlation between NH4+ and N2O fluxes, this conclusion assumed seems to be speculative and misleading. The process of nitrifier denitrification as a significant source of N_2O production under certain soil environmental conditions is increasingly highlighted in various soils, and should be incorporated into the discussion of the current manuscript."

The potential pathway of nitrifier denitrification has been added to the discussion section with two relevant references.

"Another possibility is that conditions are favourable for the conversion of NH_4^+ to N_2O via microbial nitrifier denitrification. In certain conditions the nitrifier denitrification process can be responsible for the majority of N_2O released from soils (Kool et al., 2010; Zhu et al., 2013)".

"P15330 L14-16, what is the exact time for gas measurement?"

Not entirely sure what is meant by "time" in the question. Measurements were made during the day between 10:00 am and 4:00 pm. Hopefully this is what is asked for.

Changed text to include sentence "Measurements were made continuously between 10:00 to 16:00 on these days".

"P15333 L18, the unit for KCl should be 1 mol L-1."

The reviewers statement is correct, text unit has been changed to "mol L^{-1}"

"P15334 L11, "Fifty measurements were. . .", this should be checked again throughout the manuscript."

Numbers were converted to text throughout the document where necessary.

"P15334 L10-13, this section is in contrast to the first paragraph in the later 3.5 section, and should be rewritten."

I am unsure where the contrast is. The first section which the reviewer refers to is about the location of flux measurements. Section 3.5 refers to which locations the soil measurements were made from. Although the soils were made from flux measurement locations the locations differ as is explained in the text. No changes have been made to the text to address this.

"P15334 L17, ", respectively", as well as in other places in this manuscript."

Various changes made throughout text to include commas.

P15337 L5, "between the height. . .".

Typo corrected.

P15338 L21-22, this sentence is unclear.

P15338 L22-23, the range of soil bulk density needs to be clear.

Both sentences re-written as:

"WFPS % values across all measurement locations in the field ranged between 9 to 50 % with a mean value of 26.5 %. The bulk density of the soil in the field with the exception of the manure heap perimeter ranged between 0.6 to 1.1 g cm^{-3} with a mean value of 0.8 g cm^{-3}. Due to the heterogeneous nature of soils there were several outliers for each of the soil properties measured across the field (Table 1)".

P15339 L13-14, concentrations of NO3- should also be correlated strongly with both total nitrogen and WFPS%.

Correlation between NO_3^- with NH_4^+ and TOC was a lot stronger than that of total nitrogen and WFPS, but we include them both for completeness.

Anonymous Referee #2

Page 15344 L12: There are many publications on the relationship between soil properties and N_2O fluxes that could be discussed before highlighting the need for more research and better measurement approaches.

We have added further references to address this.

"Many studies have identified similar soil properties which affect the rate of N_2O emissions from agricultural soils (Butterbach-Bahl et al., 2013; Dobbie and Smith, 2003): however, due to the multiple simultaneous microbial processes which produce N_2O it is difficult to identify a clear relationship between soil properties and flux. Relationships between N_2O flux with temperature, WFPS % and nitrogen content in soils are often observed; yet a consistent method for predicting N_2O from agricultural soils based on soil measurements still eludes researchers (Flechard et al., 2007; Smith et al., 2003). "

Page 15344 L24: I understand that the confidence interval (table 3) for aggregated fluxes was derived from the range of N_2O fluxes what would represent uncertainty if aggregated fluxes would be based on just one sample otherwise the uncertainty of aggregated fluxes would be smaller.

The reviewer is correct in their comment; however, propagation of the uncertainty in the cumulative flux estimate could be done several different ways. We have chosen to use the method used in IPCC reports which is to present the sum of the minimum and maximum of each source as in the IPCC 2007 and 2013 physical science basis sections.

Page 15346 L25: It is mentioned that not covering the full variability of a field could cause an underestimation of derived emission factors and related N_2O budgets. In fact, N_2O emission budgets are derived from the amount of reactive N multiplied with an emission factor. So far, reactive nitrogen is uneven distributed at the test site and therefore also N_2O fluxes are uneven distributed. However, it is not (clear enough) shown that the response of N_2O fluxes on reactive N (nitrate) differ between measured features. The number of soil property measurements on soil features (shaded area, manure heap perimeter,..) is probably too small, but it could be interesting to see how the slope of N_2O versus NO_3 differs between soil features and grazed area and how this relationships can be explained by difference in wfps, soil porosity and ph between features and grazed grassland.

We agree with the reviewer that the different relationships between soil and flux measurements at different features would be interesting, however as the soil analysis was not done on a 1:1 ratio, we have too few points for further analysis of this data.

Figure 6c does highlight the relationship between flux and nitrogen content to an extent. The linear regression in this plot is dominated by the relationship between NO_3^- and N_2O. There does not appear to be any bias in the plot in the relationship between the regression fitting and the samples taken from the features of the field, although the number of points is too few to be certain.