Review of Ibraim et al 2018

The paper by Ibraim and co-authors presents a novel technique to measure a suite of isotopic fingerprints of N_2O using a field-deployable device. Since N_2O emissions and their isotopic ratios vary spatially and temporally to a large degree, such an instrument is very useful to allow extent our knowledge on the processes driving these N_2O emissions. The measurements presented in the paper demonstrate that the QCLAS instrumentation works well under field conditions and allows its implementation in further studies. This successful field deployment is certainly a central step after a year-long construction and test phase in the laboratory and I congratulate the team for this effort. Likewise it is clear to the authors of this study that measuring the isotopic information of N_2O is just one step, and to interpret and exploit the data requires extensive other knowledge, ranging from meteorological boundary conditions, soil analyses, to interpreting the application of manure on the sampling site. As further outlined below, some of these non-measurement aspects of the paper should be improved to gain more clarity for the readers. Since the current measurement set up was not perfect, i.e. only night-time measurements provide robust results, a lot can be learned from this measurement campaign for future field applications. At some places the authors already suggested how these limitations could be overcome with a better design etc. I have the impression that these “lesson learned statements” could be extended to guide future measurement campaigns in this area. In general, the paper is clearly structured, the figures are mostly instructive and the text is written nicely. I therefore welcome this paper for final publication after my and the other reviewers comments are included in the final version.

General observations and detailed comments:

In section 4.4.6 (page 13) you discuss the influence of the manure application (12^{th} July) on the calculated source signatures of the emitted N_2O. A causal link between excessive nitrogen addition on subsequent N_2O emissions from the soil is to be expected and might be the case. However, looking at the flux time series in Fig. 3 it is equally clear that N_2O fluxes rise after intense rainfall events and this also fulfils expectation. The highest N_2O emissions within the entire study follow the strong rainfall event end of July - here without a manure application. However, the manure application on the 12^{th} July is almost synchronous with the rainfall event; the farmer apparently waited for rain to apply the manure. My feeling is that the discussion in section 4.4.6 focusses too strongly on the manure application, while the more likely driver behind the rising N_2O emissions (intense rainfall) is not really discussed equally. A second argument for the “heavy rain hypothesis” is also the wide footprint of the isotope measurements. From Fig. 7 I get the impression that the largest fraction of the emissions stems from outside of the dashed rectangle where the site is located. Only 15 to 30% of the N_2O emissions came from the local field where the manure was applied, while the largest fraction comes from an area of a few km distance. It might be that the other fields in the surroundings were also fertilized at the same time by the farmers and thus the De-Fen site is representative, but this information is missing. I might be wrong, but you might gain additional insight to view the N_2O flux data and the isotopic signatures also from this heavy rainfall point of view (likewise WFPS) and a wider, more realistic regional footprint. In this respect you might also put less weight on the NH_4 and NO3 soil extracted solute data because these data might be too local for the footprint of the measured N_2O isotope signatures. As suggested in your conclusions, it will be valuable in future measurement campaigns to also sample air from chambers that are more representative of the site. In other words, the precious isotope measurement time during the day or for meteorological situations that do not lead to sufficient N_2O accumulation in the boundary layer could be better invested.

Please mention the footprint shown in Fig. 7 earlier in the paper. It would be helpful for some readers (including me) to be aware that the actual footprint of the N_2O isotope data is more extended than what is visualized in Fig. 1.

Page 1, Lines 33 and 37: Mentioning the sink term ”while N_2O reduction acted as a major sink” may not clear to all readers. Does this refer to a consumption of N_2O produced in the soil itself or also for ambient atmospheric N_2O, i.e. a net sink to the atmosphere?. “N2O reduction to N2 largely dictated the isotopic composition of measured N_2O. “ Does this statement refer to all measured isotope ratios; this statement seems very general.

Page 3, Lines 35: stick to one name for the management “cutting” vs moving (caption Fig. 4)

Page 3, Line 30: Site name: Could you use just Fendt as the site name in your paper rather than the awkward De-Fen (I know the acronym De-Fen is the more official in terms of the European Flux Database cluster).

Page 3, Lines 37: I am not a specialist for agricultural manures, but my understanding is that manure usually refers to animal feces (with the N mostly in form of urea) so I am confused by the ammonium N and referring to the Raiffeisen Laborservice; Do you mean inorganic fertiliser e.g. pure Ammonium sulfate? I any case please specify this. Further, I wonder if it would have been worthwhile to obtain also the bulk N-isotopic composition of the two different kinds of fertilizers/manure. You put a lot of effort into measuring the spatial and temporal distribution of the $\delta^{15}N$ of soil-extracted nitrate while a value for the manure might be valuable as well for the input signature of d15N of soil NH_4.

Page 4, Line 14: This measurement-specific information seems not necessary here (“While…) and could be deleted.

Page 5, Line 2: sentence could be shortened: “Then the gas was dried using a Nafion dryer…()….also, delete: overpressured (the 4.5 bar already indicate that)

Page 5, Line 36: Given the complexity of the pathways, this correlation criterion is not a sound argument for a valid measurement as it discards 18 out of 30 values while accepting 12 only leading to a bias in the results.

Page 8, Line 32. You could end the sentence after the Toyoda citation and delete after “, but…” as this does not add much.

On page 8, line 35 you write: “At night, within a stable nocturnal boundary layer, vertical wind speeds and hence tracer transport are low, while lateral wind speeds can be high and constituents like N2O can be transported over larger distances. As a result, N2O emissions from other land uses or land cover **may** have contributed to the observed N2O isotopic composition. To assess the **possible** influence of other land use / land cover. Please omit **may** and **possible** in these occasions where you actually know that more distant emission contribute.

Table 1:

unit for bulk density is not % but rather g/cm3; pH is dimensionless;

Table: 2:

to prevent confusion with the units, provide all values for the mole fraction in ppm, i.e. for T 0.329 ppm.

Table 3:

Event no (a.u)? did not get that

for the three columns with SPKeeling and $\delta^{15}N$ and $\delta^{18}O$: one digit seems enough for the +- values, i.e. 1.9 instead of 1.91 for SP.

Table 4:

caption: better: Characterization of the lower and upper range for…

first column header “Source signature” should read parameter or signature

Figure 3:

Note, the x axis label for Fig. 3 and 4 and 5, 6 are all different (Date vs Datum in). Please select one for all, e.g. Date in 2016.

panel c with precipitation: 80 mm per hour seems a very high value, please check.

please rewrite sentence to omit, respectively: “Blue and red dashed lines refer to a cutting event and to a manure application, respectively.” to: The blue dashed line indicates a cutting event and the red line manure application. (similar as you write in caption Fig. 4).

Figure 4:

please explain the values given on the right side of the histograms

zoom panel a: at around 20.7. there is a weird magenta dot within the background values (black dot) caption: please replace y-axis with axes (plural)

general observation at Fig. 4: In Fig. 3 it becomes apparent that the heavy precipitation events (around 12.7. and 22.7.) that lead to a progressive reduction of the WFPS are strongly connected with two prominent N_2O fluxes. While the first heavy rain event (around 12.7.) is connected with the manure application, the second rainfall event happens without manure application. It would be worthwhile to add these heavy rainfall events also in Fig. 4 with lines or other markers.

Figure 7:

If possible adjust the colour legend to rounded numbers rather than 3.16e+02, e.g. 0.5; 1; 5; …300. Also, if possible, add the numbers (15, 30, 45 %) of the source sensitivities onto the isolines of figure itself (this is quicker than having this written in the caption.