

# ***Interactive comment on “Measuring frequently during peak soil N<sub>2</sub>O emissions is more important than choosing the time of day to sample” by Jordi T. Francis Clar and Robert P. Anex***

## **Anonymous Referee #1**

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General comments: Authors state several times that this is the first study of N<sub>2</sub>O flux temporal variability that includes several hot moments. Which isn't really true, is it? There is Luo et al. 2012 (Decadal variability of soil CO<sub>2</sub>, NO, N<sub>2</sub>O, and CH<sub>4</sub> fluxes at the Hogwald Forest, Germany), and a lot of other studies from that same study site that show temporal variations in N<sub>2</sub>O. There are also numerous papers from Australia (e.g. Barton et al. 2007 Nitrous oxide emissions from a cropped soil in a semi-arid climate) – although, to be fair, the Barton paper did not really experience what could be called “hot moments”. And there is also the Machado et al. 2019 paper (as cited in the current manuscript) that also measured temporal variability during periods that included “hot moments”.

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Also, I don't agree that constraining sampling to particular times of the day provide little benefit. Generally, researchers will be sampling during regular working hours (i.e. between 9 am and 5 pm), during those hours, sampling before 10 am will underestimate fluxes (for 50% of annual flux – i.e. see figure 1c), while sampling after 2 pm will overestimate fluxes. So your preferred sampling time should be between 10:30 to 13:30. No? Even figure 1d makes a strong case for not sampling in the afternoon (between 15:00 and 18:00), because it will overestimate fluxes. That being said, I do agree with you that frequency of sampling during hot moments is more important than what time the sampling took place during those hot moments.

So, realistically, I don't think that your conclusions are actually substantiated by your own data. I think that your data still backs up previous research that suggests avoiding the afternoons when sampling for determination of N<sub>2</sub>O fluxes. Not the most novel conclusion, but I think it is still worthwhile.

Also, I would like to see a bit more in the discussion about why diurnal patterns are less relevant during periods of high emissions. There is very little on what mechanisms of processes actually drive this. In Figure 1c and 1d, there is much higher variability between 0 and 8h (compared with the rest of the day). Any ideas why this might be? Is there less production? Or is it related to climatic conditions at night?

Finally, try to avoid paragraphs that consist of 1 sentence (e.g. lines 159-161).

Specific comments:

Lines 36-38. The topic of sampling frequency and quantifying what it means in terms of uncertainty for your cumulative estimate has been covered well in the paper by Barton et al. 2015 (see your own citation list), and should probably be cited here.

Line 46: I think it would be worthwhile to cite your Table 1 here, because the table does a good job of summarizing some of the literature on timing and existence of diurnal patterns in N<sub>2</sub>O fluxes. Although, it doesn't seem like there is that much disagreement.

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Pretty much all of the studies summarized in Table 1 (11 of the 12 that suggest a PMT) suggest avoiding sampling during the afternoon. That is pretty good consensus in my opinion.

M&M section is very thorough. Nice.

Line 214: “Flux” not “Flus”.

Line 239: wouldn't it make more sense to report your MDF as a flux per hour? Rather than per day? You are measuring flux rates based on 20 min deployment times and are calculating your daily fluxes by integrating the individual flux measurements for that particular day. So it is possible to have some fluxes below the MDF and others above the MDF on the same day.

Line 240: I'm not sure why these were removed from the dataset. I would have retained them. Also, it is not clear what you did with these values. Whether you assigned them a value of 0 or just deleted them could create differences when calculating cumulative fluxes via integration.

Line 266: the “+0” is unnecessary.

Line 275: “percentage of the annual”.

Results:

Line 289: what happened during 2016-17? Having to throw out 48% of the fluxes is not good (or were these removed because they were below MDF?). I think it might be better to differentiate when fluxes were thrown out because of bad data and when they were thrown out because they were below MDF.

Discussion:

Line 318: Are you sure that this is the first? Doesn't the Machado et al. 2019 paper measure diurnal variability in a fertilized agronomic system with hot moments?

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Line 319-320: I am not sure what this sentence is trying to say. Diurnal patterns of N<sub>2</sub>O emissions vary due to flux intensity? Or something like that? It would be good to add a short discussion why that may be.

Line 334-337: a single sentence is not a paragraph. Also, I have read this a few times, and it is really hard to follow. Please re-phrase.

Line 345-347. I'm pretty sure that the Machado paper that you cite analyzes diurnal variability of N<sub>2</sub>O during hot moments from multiple years, under a range of weather conditions and following summer fertilization and spring thaw periods. So I don't think that this statement is correct.

Line 355: "did not exhibit", rather than "do not exhibited".

Line 356: this is partly true. While measuring during a PMT may not guarantee accurate estimation, measuring during the afternoon would almost certainly cause biased estimates (see figure 1d).

Conclusion:

Line 362: You keep saying that you are the first, and yet you have cited another manuscript that has also done this.

Line 372: In figure 1c (50% of flux), there is a pattern during daylight hours (underestimate during early morning and late evening, and overestimate during the afternoon), but not at night. So unless you plan on sampling at night, there are still PMTs. Also, any idea why there was so much more variability in flux measurements made at night?

Line 384: According to your data, there still seem to be periods that should be avoided (i.e. afternoons). This should be mentioned.

Figure 1: Looking at the number of points, I would guess that each point equals one hourly flux. So please change the Y axis to "g N<sub>2</sub>O-N ha<sup>-1</sup> hr<sup>-1</sup>" (or per m<sup>2</sup>) rather than per day.

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## References:

Please go through and check the formatting of the references. There are many where the formatting is incomplete.

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