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Atmospheric Measurement Techniques Discussions

Interactive comment on "Estimation of nocturnal CO_2 and N_2O soil emissions using changes in surface boundary layer mass storage" *by* Richard H. Grant and Rex A. Omonode

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Specific Comments: -Page 1, line 24. The use of the concentration change within the stable surface layer is also a "micrometeorological" technique. Your method is one of the micromet tools available. Yes. Not meant to indicate otherwise. Just was stating some of the methods that typically do not work under nocturnal conditions.

-Page 1, line 26. The community usually uses "eddy covariance" instead of "eddy correlation". My mistake. Corrected. That was the 'incorrect' term first used for the method.

-Page 2, line 21. I couldn't find that SBL was defined. Added here

-Page 2, line 22. Molecular diffusion rates are closer to 10ËĘ-5. Yes. Corrected

-Page 2, line 22. Qualify that you mean typical turbulent diffusion coefficients during daytime. We can argue a wide range before we get to molecular diffusivity at night. Yes, so the estimated value has been removed.

-Page 3, line 26. I think you mean that the N2O MDL is 0.3 nL/L, not ul/L? yes, corrected.

-Page 3, line 28. The manual for this instrument suggests better than 1 uL/L; is your value related to precision or accuracy? Precision as measured.

-Page 4, line 5. The van de Wiel reference is quite recent, whereas similarity theory has been developed much earlier. Please give original references. van de Wiel reference refers to the local similarity scale, not general similarity.

-Check typographical (spelling) errors: e.g., Page 4 line 19 and line 26. Corrected line 19, could not find line 26 error.

-Page 4, line 27. Why were the chamber measurements made during the day? Can you give the audience an indication about how the chamber measurements would cycle diurnally? Recall that your comparison is with the night. Measurements were made routinely during the day. It was too expensive to hire students to work the night as well.

-Page 5, line 6. You use 30-minute chamber measurements for a relatively short period on each day. It would seem more reasonable to report the measurements on a reasonable time unit; typically umol/m2/s is used. It is misleading to scale this to units of "per day" with such a small, biased sample. I agree, however this was done to provide framework for most researchers that conduct chamber measurements- they typically report for daily flux based on one 30-min measurement during the day. Based on this and comments below, I have changed all units to umol/m2/s or nmol/m2/s.

-Page 6, line 1. Be consistent; use friction velocity instead of shear velocity here. Also, in several places, variance is used when you define standard deviation (sigma w). Be specific. Corrected in text. Standard deviation is used in the description of the flow conditions in Table 2 because of prior use in other papers. Variance is used more generally since it is a TKE component.

-Page 6, line 2. The term “z-less” tends to be a very specific term used with stable atmospheres. Please define this if you think the word is needed. Same issue on Page 8, line 8. I have removed the first reference to z-less flow and rephrased but retained the second usage as the diffusion across the 6.3m ‘cap’ is based on a exchange coefficient calculated assuming z-controlled flow..

-Page 6, line 9. It would help the audience to use consistent units. In this paper, most readers would really prefer that you use units such as umol/m2/s throughout. The fertilizer community often uses mass of N, but mass units really don’t help this paper (and you use mass of N_2O, not N). In this particular line, we are given a concentration in uL/L and then you switch to gradient of mg mËĘ-4. I have changed all flux units to umol/m2/s, nmol/m2/s, and equivalent accumulation units.

-Page 6, line 24. Should not say w’; this would mean the variance of the deviation. Ok. Changed

-Page 8, line 26. The literature reported in Table 1 is quite selective. Please tell us why you chose these specific papers. Including every paper would be pointless since this is not a review paper. I sought out representative studies (similar crop conditions and soils) that used good techniques.

-Page 9, line 11. You say “generally lower”. Please quantify that it was about a factor of 2 to 5 less. Since some measurements are in the same range, it is hard to specify. I have included a table comparison as suggested by referee #3.

Given this magnitude, what can you say about the possibilities of the technique? Also,

most researchers gap-fill night periods using various techniques. Is your stable atmosphere measurement better than gapfilling these periods? No. The study shows only that there is similarity between the chamber method and this method. The method needs improved profiles above the 8m measured here to identify the ‘cap’ well and hence the volume of accumulation. More work is needed to actually say it is a night-time gapfilling method.

-Page 9, line 30. I am confused why you think that advection of N_2O from soybean would necessarily have a lower concentration at this time of year. The fertilizer applied to the corn field was much prior to your measurement period. This actually resulted in very low N_2O fluxes through your measurement period, typically about 10% of the peak measurements that most researchers measure following fertilizer application. Yes, the N applications discussed did not strongly influence the emissions but the study was late in the season when little N was still available. Discussion on relative soybean emissions was based on Table 1. Fluxes were similar to maize with no N applied (Fig. 8). I have expanded on this topic.

-Page 10, line 9 and 12. It looks like the accumulation method was a factor of 2 to 5 less than the chambers. These statements appear to mislead that they were close. I have added a table (Table 5) illustrating the differences and changed the text to clarify.

-Table 2. The superscripts on the column labels look like powers; please just label the columns to avoid this. Also note that sigma w is standard deviation, not variance. Corrected

-Table 3. Same issue with superscripts. The gradients are written as differential equations. In fact, you do not know this information; you have estimated this from finite difference measurements between heights. Please label appropriately. Corrected

-Figure 3 (a). Is this the absolute value of the difference in wind direction? It is always positive. Yes, it is absolute. Now indicated in caption.

-Figure 3 (b) and (c). In other parts of the paper, you plot sigma w. But here you show variance; why? As part of the TKE.

-Figure 4 (a). Variance is indicated on the right axis, but the units don't match. Fixed

-Figure 6. If this is an accumulation starting at 1900, why don't the accumulations start at zero? Axis label fixed

-Figure 8. "h" is used for hour in most places, but now rainfall uses "hr". Fixed

Note also that the reported values of mass accumulation CO2 fluxes are less due to a correction in the plotting criteria

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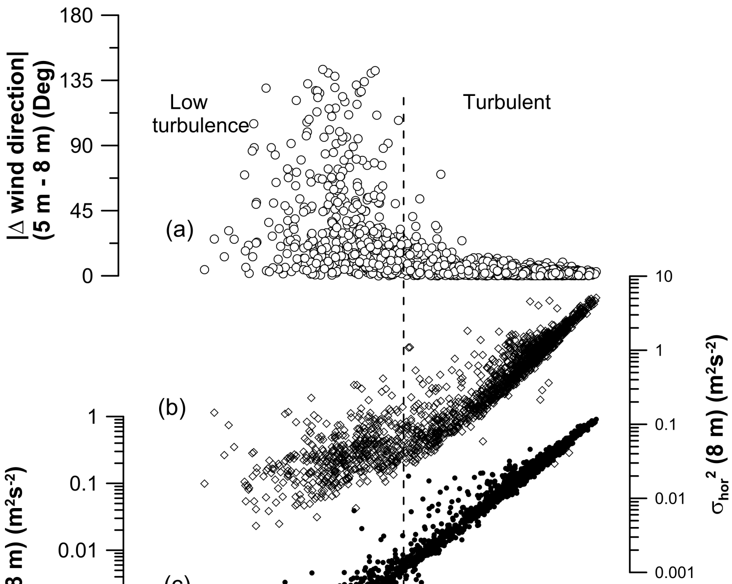


Fig. 1.

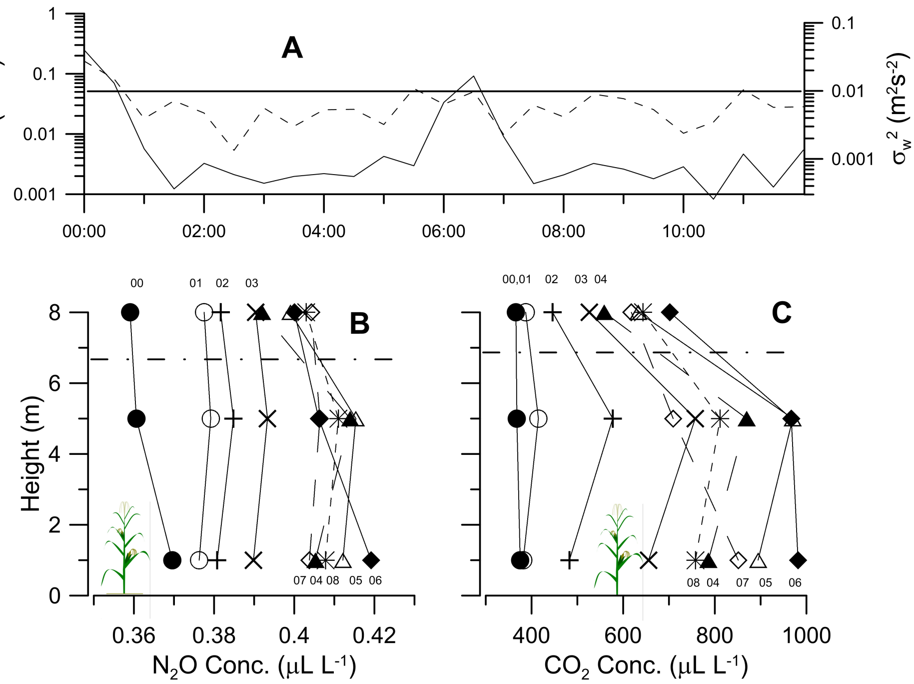

A
B
C
u* (ms-1)
σw2 (m2s-2)
Height (m)
N2O Conc. (μL L-1)
CO2 Conc. (μL L-1)
00:00
02:00
04:00
06:00
08:00
10:00

Fig. 2.

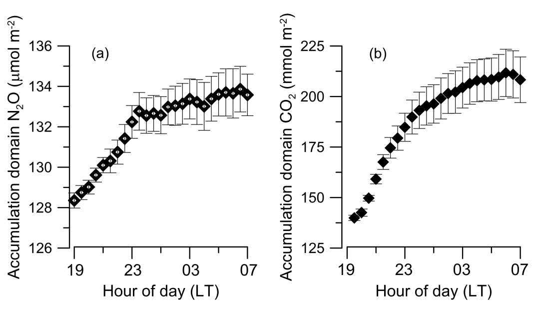
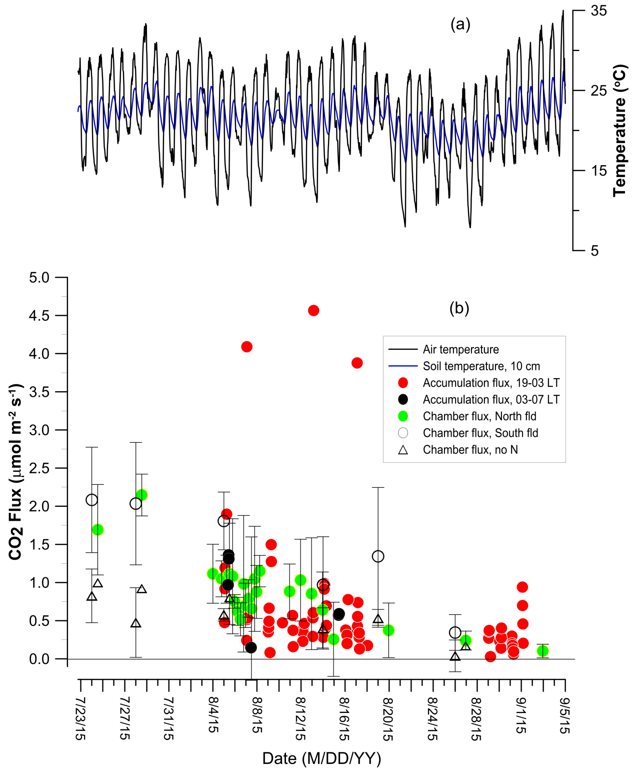
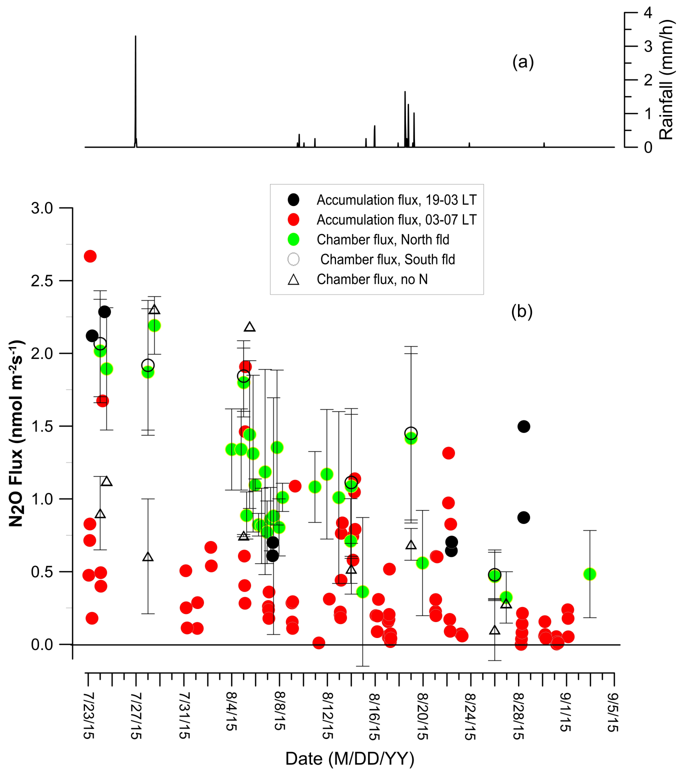

(a)
(b)
Accumulation domain N2O (μmol m-2)
Accumulation domain CO2 (mmol m-2)
Hour of day (LT)

Fig. 3.



(a)
Temperature (°C)
35
25
15
5
(b)
CO2 Flux (µmol m⁻² s⁻¹)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Air temperature
Soil temperature, 10 cm
Accumulation flux, 19-03 LT
Accumulation flux, 03-07 LT
Chamber flux, North fld
Chamber flux, South fld
Chamber flux, no N
7/23/15
7/27/15
7/31/15
8/4/15
8/8/15
8/12/15
8/16/15
8/20/15
8/24/15
8/28/15
9/1/15
9/5/15
Date (M/DD/YY)

Fig. 4.



(a)
Rainfall (mm/h)
4
3
2
1
0
Accumulation flux, 19-03 LT
Accumulation flux, 03-07 LT
Chamber flux, North fld
Chamber flux, South fld
Chamber flux, no N
(b)
N2O Flux (nmol m⁻²s⁻¹)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
7/23/15
7/27/15
7/31/15
8/4/15
8/8/15
8/12/15
8/16/15
8/20/15
8/24/15
8/28/15
9/1/15
9/5/15
Date (M/DD/YY)

Fig. 5.