

Interactive comment on “A field-based method for simultaneous measurements of the ^{18}O and ^{13}C of soil CO_2 efflux” by B. Mortazavi et al.

Anonymous Referee #0

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A field-based method for simultaneous measurements of the ^{18}O and ^{13}C of soil CO_2 efflux

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General comments

This paper presents a comparison between three different methods to determine the stable isotopic composition of ^{13}C and ^{18}O of the soil CO_2 efflux. Comparisons between different methods in this field are rare. A reliable method to determine the ^{18}O signature of soil respiration is needed and the presented method using mini-towers looks promising. The same method is novel for the determination of ^{13}C of soil respiration. This speaks for an acceptance of this paper for publication. However, I am not convinced of the applicability of a Keeling plot approach without corrections for the isotopic fractionation during diffusion for the estimate of the $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ using the mini-towers (see specific comments below).

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Interactive Discussion

Discussion Paper

I find it fairly well written and it is easy to follow. However, I find a contradiction in the Results and Discussion section compared to in the Conclusions and Abstract (see specific comments below).

It is difficult for the reader to evaluate if there are significant differences between the estimates of the different methods since no statistical tests are applied.

Specific comments

Methods

Was soil CO₂ from the soil probe sampled directly after the sampling from the chamber or did you wait a certain time? There is a risk that the CO₂ gradient in the upper part of the soil profile was disturbed by the chamber. This could possibly affect the Keeling plots of the soil CO₂ samples!

I am not convinced that it is possible to simply apply a Keeling plot approach to the mini-tower data! After installing the mini-towers the CO₂ concentration is building up and there is CO₂-diffusion within the pipe and out of the top of the pipe with an isotopic fractionation going on. For ¹³C, at steady state a 4.40/00 fractionation factor should be applied, similar to the soil CO₂ data. But after two minutes, which was the time for the start of the sampling, steady state is quite likely not reached yet. Thus, your measured $\delta^{13}\text{C}$ values for the mini-tower samples are not simply the result of a mixing of two CO₂ sources but also the result of an ongoing isotopic fractionation. This is a very important point and should be addressed!

P5 Consider to provide more information about the site. Field and bottom layer vegetation and soil texture would be valuable.

P6L4 Sampling from the mini-towers started at 2 min after installation. When did it end?

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Results and discussion

P11L14 and last paragraph on P11. The stated differences were not statistically significant (I tested with 95%CI).

P11 last two lines. "The mini-tower approach provides an effective way to measure the ^{18}O of soil respired CO_2 ". However, the SDs of the estimates are quite large and many samples are needed to get a good estimate of the isotopic signature of ^{18}O and ^{13}C using the mini-towers.

Last line on P12 and upper paragraph on P13. It is stated that there are differences between the $\delta^{13}\text{C}$ determined with different methods. However, I made 95% confidence intervals for the estimated means and found no significant differences between the Mini-towers and the other two methods. See comment on statistical tests above.

Conclusions

P14L5 The statement "there were close agreements in the ^{13}C of soil CO_2 efflux measured with the different techniques" Do not fit with the text in the first paragraph on P13. As most of the stated differences were not statistically different (see above), the text on P13 should be changed.

References

Most of the relevant literature is cited. However, the paper that, to my knowledge was the first to use static chambers to determine the $\delta^{13}\text{C}$ of soil respiration was the one by Högberg and Ekblad (1996). This method was further tested in the papers by Ekblad and Högberg (2000) and Ekblad et al. (2002).

Technical corrections

Introduction

P4L7 "...from the soil to the atmosphere is to".consider "...atmosphere is too"

P4L10 ..Consider to add a comma after "In the field,"

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Methods

P6L2 "...placed into the soil surface." To what depth?

P6L15 Is "65 by 65 cm" the size of the chamber at the base? What is the height?

P7 Was the soil probe inserted directly before or after the CO₂ sampling from the chamber?

P8L27 To clarify the authors may consider to write- "...relative to PDB for 13C and SMOW for 18O."

Results and Discussion

P12L3 The mini towers were installed on the 2 or 3 June? Both dates occur at different places in the manuscript.

P12L24 "slight enrichment". should be "slight depletion"

P13L25 (Ekbald) should be.(Ekblad)

References

P15L16 Ekbald should be .Ekblad

Tables 1 and 3

The errors for each Mini-tower and for Mean Mini-tower corresponds to what, SD or SE?

Table 1 L1. "18O of soil CO₂ (0/00) efflux...". I suggest. " $\delta^{18}\text{O}$ (0/00) of soil CO₂ efflux".

Table 3 L1. "13C of soil CO₂ (0/00) efflux...". I suggest. " $\delta^{13}\text{C}$ (0/00) of soil CO₂

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efflux".

L2. "A 4.20/00 fractionation factor..." Should it be 4.40/00 ? This is at least stated on P9L3.

L3. "**An outlier...". should be? "***An outlier..."

Fig. 3. The upper two graphs show $\delta^{18}\text{O}$ but should show CO_2 (ppm) according to the legend.

Possible additional references

Högberg P Ekblad A 1996. Substrate-induced respiration measured in situ in a C3-plant ecosystem using additions of C4-sucrose. Accelerated paper. Soil Biology and Biochemistry 28: 1131-38.

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