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Biogeosciences Discussions

Interactive comment on "Long-term steady state ^{13}C labelling to investigate carbon turnover in plant soil systems" *by* K. Klumpp et al.

Anonymous Referee #3

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Review of the manuscript "Long-term steady state 13C labelling to investigate carbon turnover in plant soil systems" by Klumpp, Soussana and Falcimagne. Submitted for consideration for publication in Biogeosciences.

This manuscript reports on a two-year study of belowground C sequestration in grassland monoliths subject to contrasting grazing intensity. This issue has high actuality and may interest a wide forum in the scientific community. The work appears to have been carefully planned and carried out with a potential for some interesting and novel findings concerning belowground C-dynamics in grassland ecosystems. It is my conclusion that the work is suitable for publication in Biogeosciences, however, the present contribution needs substantial editing before publication can be recommended. In addition, the construction and test of a 13C labeling facility for soil monoliths that may be of

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interest to many research groups working on different aspects of soil-plant-atmosphere interactions.

Particularly the use and interpretation of data describing the C-flow between different soil OM fractions needs to be strengthened and improved. The flow of 13C between the different fractions is barely discussed although this was the main objective of the current study. Please, see specific comments in the following.

The title needs to be more specific referring to grassland. Certainly the described method could be applied to other soil-plant systems, but it has its limit not being useful for forest ecosystem studies.

The quality of the English writing should be checked by an English mother tongue. The text is readable, but could be improved in mere places. Also, check spelling. E.g. the inconsistent spelling of labeling / labelling.

The Materials and Methods section needs to be strengthened e.g. by avoiding too much repetition. One suggestion is to organize the text for Figure 1 in a more tabulated manner, for example listing the different compartments by succeeding order downstream in the air flow direction. Supplier names can be included in this list, and removed from the body text to facilitate reading.

Abstract Line 5, dot is missing between CO2 and The facility Line 23, Specify that it was SOM in particles larger than 0.2 mm Line 24, “reducing aboveground disturbance by cutting” Suppose it should say that aboveground disturbance is reduced by excluding or reducing cutting.

Materials and methods. Section 2.1.1 Line 8. In Figure 1 it appears that the air flow enters (IA) and leaves (OA) in close proximity on the same side of the enclosure. How was a complete mixing of air in the enclosure ensured. Was the ventilator actually a fan mixing the air inside? Please, specify.

Line 8. Was PAR only measured externally?

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Section 2.1.2 Line 4 and throughout. It would be very helpful if the dimensional numbers were supplemented by also the directions, i.e. W, L and H It is unclear how a 0.30 m3 belowground compartment can be subdivided into three 0.14 m3 units.

Line 15. What was the rationale for actively pumping air through the soil column? This is a rather artificial condition that may affect soil gas characteristics such as aeration significantly. This needs to be commented further in the text. Moreover, it is not clear whether the air pumped through the soil was mixed with effluent chamber air and thus included in the overall C- and 13C-massbalances or if the soil-air was analyzed separately. This also needs to be specified

Section 2.2 Line 3. The abbreviations H and L are defined for the treatments, but not used throughout the text. I recommend that the authors use these making the readability easier.

Line 15. Suppose it should read the CO2 in the vials was analyzed for d13C. How long time were the air samples stored prior to analysis? Please, provide this kind of information as it is well known that long-term storage of air samples in rubber sealed vials can be problematic causing changes in concentration and isotopic composition.

Section 2.4 Line 8. It should read size fractions were separatedĚ The organic matter fractions were not separated by the wet sieving.

Section 2.5 Suggest the header is changed to 13C determination and calculations

Section 3.1.1 It is mentioned that the quality and isotopic composition of influent and effluent air is measured as a control on a regular time scale. In addition to this, it is stated that the isotopic composition of influent air was checked on a temporal resolution of 30 minutes according to the mass balance calculations. However, these calculations were not accompanied by isotopic measurements but presumably based on IRGA determinations of the CO2 concentrations combined with assumptions about the 13C enrichment of the CO2. Thus, from a rational point of view this calculation can not

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provide a check on the labeling as stated (p 808, line 1) but rather provide interpolated values for the influent air quality as determined at the bi-monthly observations. This needs to be specified more clearly in the text. I also recommend that the calculations and equation on p 808 is moved to the Materials and Methods section.

Section 3.1.2 Line 12 (p 809). A fluctuation between -49.9 o/oo and -40.4 o/oo seems rather significant, perhaps more than a “small seasonal pattern” as stated in the text. However, a reasonable explanation for this observation is given. You refer to Fig. 2d apparently visualizing this pattern, but then it is stated in parenthesis that data are not shown (line 13). This is confusing. Nevertheless, the apparent winter depletion of -49.9 is not obvious from the Figure? Moreover, in this context it is not clear why the potted C4 plants were included in this study? It is stated that the C4 plants were included to check labeling quality (section 2.3.3), however, in this case C4 plants exposed to ambient air would also need to be included to serve as controls for labeling quality. The distinct isotopic discrimination in C3 and C4 photosynthesis is well known and not really important for this study, and I suggest these results are omitted.

Section 3.2 The first sentence in this section needs to be clarified. I suppose what is meant is that belowground carbon storage in monoliths with low disturbance was higher than carbon storage in monoliths with high disturbance.

The initial offset in d13C between the two treatments pictured in Fig. 3 is quite interesting, and the authors propose a couple of explanations for this observation. However, influences of previous as well as current dung and urine depositions by grazing animals and artificial urine on the distribution of 13C among various soil C-compartments is not mentioned at all. This should be considered also in the discussion of the results.

A draw back in the interpretations of the soil C dynamic is the apparent exclusion of the 13C data obtained in the different OM fractions. Apart from the graphical presentation of the AOM data in Fig. 3 it is basically only data from the SOM ($>$0.2 mm) fraction that is discussed. The authors suggest that Ěit is likely that a large part of the “new”

C which has deposited into the soil compartment vanished into smaller particle sizes (<0.2mm)Ě (p 812, line 25). But as the smaller fractions 13C was analyzed, why are the data not considered? Obviously a lot of effort has been put into these analyses, and this data material would improve the quality of the discussions strongly and should be included.

The sentence beginning p 810, line 24 is contradictory. ..monoliths adapted to high disturbance.. had higherĚthan monoliths adapted to high disturbance?

Concerning the between treatment offset in d13C in SOM and AOM, shown in Fig. 3 and discussed p 811, line7, I think the authors need to emphasize the temporal evolution in the data. As pictured, the two treatments were initially different, and it can be difficult to verify from the graphs only to which extent the discrepancy in d13C changed over time.

Section 4 I do not agree on the last conclusion. See comment above.

Interactive comment on Biogeosciences Discuss., 4, 797, 2007.