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Biogeosciences Discussions

Interactive comment on "Carbon allocation and carbon isotope fluxes in the plant-soil-atmosphere continuum: a review" *by* N. Brüggemann et al.

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General comments This review manuscript sums up a wide field of knowledge in the area of the biogeochemical C-cycling, in particular it addresses three different aspects: 1. Carbon allocation and C fluxes: Different C pools - such as plant and soil pools - are addressed, as well as changes within these pools. The fluxes include plant→soil, plant→atmosphere, atmosphere→plant, soil→atmosphere, soil→plant 2. Natural fractionation processes between 13C and 12C during C fluxes 3. Labelling experiments with 13C or 14C, intending to explain C fluxes The paper is in general very well written and explanatory and certainly deserves publishing. It is at the same time demanding to read, and some parts leave the reader a bit at a loss on what really can be learned from the huge amount of research papers accumulated on the topic. For instance it is

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not absolutely clear, whether it is the aim of this paper to describe and explain C-fluxes by isotopic signatures (as stated in the abstract and introduction) or whether the paper focuses on explaining measured isotopic signatures by a range of possible underlying processes (large parts of the paper and conclusions). These two approaches should be distinguished more clearly. It would also help if the three aspects mentioned above would be addressed right at the beginning to avoid confusion amongst readers from other scientific areas. A separate methods chapter could help during reading and at the same time highlight new promising techniques. This section could also be critical about some fields of application: e.g. maybe there are some parts of the plant-soil-atmosphere continuum, where natural abundance measurements are difficult to interpret and will not help our understanding in the future, as there always are too many incoming and outgoing processes affecting the signal of a certain pool . . .and possible ways out of this dilemma (inhibitors?, GMOs?). Alternatively there could be a subject index of methodologies with short definitions and an indication of advantages and possible limitations. Some longer chapters of the paper could gain from subheadings. At least it should be clear from the first sentence, or even the first words of a paragraph what this paragraph is going to deal with. A simple rearrangement of words could help. (See specific comments) The figures are very good but they should be explained in more detail in the text, especially Fig. 4. More references to Fig. 4 should be made in the chapters where the respective components are described. Fig. 1 is especially useful and clear, a similar figure for soil-related processes would be very instructive. Specific comments: Ad 2 Carbon isotope fractionation in plants This chapter is especially good and informative and it reads very well. P3627 line 8-25. This section is overlapping with section 3.4 and 3.5. If you decide to leave the order please make clear the difference. Ad 3.2 Carbon transfer to soil biota P3636 line 16-17 please reword, this sentence is difficult to understand. P3637 line 15-16 please specify (how do earthworms access plant exudates?) Ad 3.3. Carbon losses via plant and rhizosphere respiration and BVOC emissions The knowledge presented in this chapter is strongly compressed and it demands considerable expertise in the field to follow the

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somewhat jumpy explanations. I suggest separately treating the VOC part and to include more general information in order to help the reader following the red thread of the chapter. I also suggest to move rhizsphere and especially mycorrhizal respiration to Chapter 4 (belowground C turnover). Ad 3.4 Temporal C allocation patterns I suggest rearranging the words, which puts the main topic of each paragraph in the front, eg: P 3641 line 1: Diel variations in soil repiration are temperature (and moisture) independent. . .. . Correlation-based studies in separate sentence Line 16: Initial growth and respiration are supplied from storage C in seeds. . ...in both annual and perennial plants. . .. . Chapter 4.1 Heterotrophic soil respiration This chapter is very short concerning the wealth of knowledge, the importance of the process in the global C cycle and the fractionation effects. If you include such a chapter (in spite of the self-limitation mentioned above) mechanisms such as a biotic/abiotic "regulatory gate hypothesis" of C mineralization, the effects of nutrients and nutrient stoichiometry on Rh, and effects of different microbial "carbon use efficiency" of fungi versus bacteria, should be mentioned. Chaper 4.3 Fractionation due to microbial metabolism Here the studies of E.A. Hobbie on mycorrhizal fractionation should be included, e.g. Hobbie, E.A. 2005. Using isotopic tracers to follow carbon and nitrogen cycling of fungi. in J. Dighton, P. Oudemans and J. White, eds. The Fungal Community: Its Organization and Role in the Ecosystem. Marcel Dekker. pp 361-381. Scandellari, F., E.A. Hobbie, A.P. Ouimette, and V.P. Stucker. 2009. Tracing metabolic pathways of lipid biosynthesis in ectomycorrhizal fungi from position-specific 13C labeling in glucose. Environmental Microbiology 11:3087-95. DOI: 10.1111/j.1462-2920.2009.02013.x Hobbie, E.A., and K.C. Boyce. 2010. Carbon sources for the ancient giant fungus Prototaxites inferred from modern analogues. in press, Proceedings of the Royal Society B. Hobbie, E.A., P.T. Rygiewicz, M.G. Johnson, and A.R. Moldenke. 2007. 13C and 15N in microarthropods reveal little response of Douglas-fir ecosystems to climate change. Global Change Biology 13:1-12. Hobbie, E.A., and T.R. Horton. 2007. Evidence that saprotrophic fungi mobilize carbon and ectomycorrhizal fungi mobilize nitrogen during litter decomposition. New Phytologist 173:447-449 Hobbie, E.A. 2006. Carbon allo-

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cation to ectomycorrhizal fungi correlates with total belowground allocation in culture studies. Ecology 87:563-569. Hobbie, E.A., F.S. Sánchez, and P.T. Rygiewicz. 2004. Carbon use, nitrogen use, and isotopic fractionation of ectomycorrhizal and saprotrophic fungi in natural abundance and 13C-labeled cultures. Mycological Research 108:725-736.

Chaper 4.5 Transfer of C from leaf litter and DOC to soil and microbes P 3656 line 15 What do you mean by “unrecognizable organic matter”, do you mean “completely humified organic matter”? 6 Conclusions and outlook P 3663 line 1: meshwork? P 3663 line 19: do you mean “secondary” ion mass spectrometry?

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/8/C2372/2011/bgd-8-C2372-2011-supplement.pdf

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Interactive comment on Biogeosciences Discuss., 8, 3619, 2011.