

Interactive comment on “Microbial carbon recycling: an underestimated process controlling soil carbon dynamics” by A. Basler et al.

A. Basler et al.

abasler@gwdg.de

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Answer to Anonymous Referee #4

We would like to thank the reviewer for their helpful comments and suggestions, which have greatly improved our manuscript. We hope that our response answers all their concerns.

Interactive comment on “Microbial carbon recycling: an underestimated process controlling soil carbon dynamics” by A. Basler et al.

Anonymous Referee #4

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For the editor/authors, This is a review of the manuscript titled “Microbial carbon recycling: an underestimated process controlling soil carbon dynamics”. The work presented in this paper nicely compares mean residence time (MRT) and the chemical composition of different fractions of soil organic matter (SOM). The authors present a useful framework for thinking about SOM turnover in terms of stabilization versus recycling processes occurring soils. They demonstrate this framework using sugars. I think this manuscript is ready for publication pending some minor revisions. My comments mainly revolve around how the authors frame their study (in the introduction), and how they synthesize their results (in the discussion).

I would like to see more information in the Introduction that compares and contrasts the authors’ stabilization/recycling dynamics with other work that talks about physical protection, microbial access, and chemical recalcitrance as processes controlling SOM turnover.

Answer: To our knowledge, there is no attempt to quantify the importance of stabilization or recycling to soil C turnover (and we do not see how it could be done). The basic studies reviewing the mechanisms of C stabilization (von Luetzow et al., 2006; Sollins et al., 1996) do not mention the fact that recycling may affect many studies on stabilization mechanisms and can hardly be distinguished from stabilization of “unmodified” molecules. In addition, most of the work about physical protection focuses on the mechanisms but this is not the scope of our manuscript. Literature proving the relevance of recycling is – to our knowledge - only available from sediment investigations (e.g. Takano et al. (2010)), which we now cited in the introduction. However, any transfer of these results gained from intact polar lipids in marine sediments on sugar dynamic in topsoils is hardly possible and soil literature on that topic is still absent.

I think the authors’ framework dovetails nicely with existing literature, but this is not clear the way it is written. Second, I think the authors could do a better job synthesizing their results in both the context of their stated hypotheses, as well as existing theory. I have more detailed comments below.

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Abstract Page 9730, lines 9-11: First word of sentence needs to be capitalized. Also, perhaps I'm missing something here but it seems like this reason doesn't follow if it's a cycle? After reading the rest of the abstract I get what you are saying, but this sentence was rather confusing the first time through.

Answer: We rephrased the sentence.

Page 9730, Line 15: Be more specific here, what kinds of sugars?

Answer: We specified the sugars as "neutral".

Introduction I do like casting this issue in terms of stabilization versus recycling of OSM. However, there are lots of hypotheses out there that use different language/words but are in essential agreement. I feel like you could do little more to put stabilization/recycling in context. Talking about physical protection, chemical recalcitrance, and accessibility is good start, but I think you need to expand on this topic a bit.

Answer: We added some more details to the first paragraph in the introduction as suggested by the referee.

Page 9731, Lines 1-2: You need some literature references here if you are going to establish this as a paradigm in your narrative.

Answer: We added a respective reference.

In the last paragraph of the introduction it seems like you are defining a system where plant-derived sugars are not subject to recycling. Therefore, by definition almost, microbial-derived sugars will be more affected by recycling processes. You need to clarify what, if any pathways exist for recycling of plant-derived sugars. My apologies if this information is there and I just missed it.

Answer: We use the term plant derived sugar in the sense that these sugars are synthesized by plants. This is opposed to microbial sugars that are synthesized by the microbial biomass. If microbial biomass takes up plant sugars and reuses these (al-

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tered or unaltered) they would be counted as microbial sugars.

Results Page 9737, Lines 9-11: These data on sugar-C related to total C in oPOM seem to figure prominently in the abstract, they should be presented explicitly, in some fashion, in this section (putting data not shown is not acceptable)

Answer: In the abstract we primarily focus on the MRT of sugars and bulk carbon in the oPOM fractions and these data are shown in Table 2. The contribution of sugar C to total C in the respective fractions is of lesser interest, therefore we decided not to shown the data in detail.

Page 9737, Lines 14-18: I'm not an expert on sugars in plants and soils, so it's not clear to me that there is a standard set of sugars that are only found in plants and not microbes. Could you add some information on what sugars are typically used to differentiate between plant and microbial inputs, as well as how you determined, in your system, which sugars were plant-derived and vice-versa?

Answer: Soil sugars are commonly divided in plant and microbial derived sugars; we mentioned that point in the second paragraph in our introduction. In general, arabinose and xylose are plant derived and fucose, rhamnose, galactose and mannose are microbial derived sugars. However, this classification should be considered with caution, as our results indicate. Several studies (Basler et al., 2015; Cheshire, 1976; Coelho et al., 1988; Muramaya, 1988) show that arabinose and xylose could be synthesized by microorganism. In addition, this point is also part of our discussion.

Page 9738, Lines 25-27: I don't see the data on the contribution of maize to the extractable C anywhere in the paper. Perhaps I missed it? Answer: We apologize; we missed to add a reference to Figure 2. We changed this, to facilitate a better traceability of our data.

Discussion

Restructure the discussion so that you are synthesizing, not just repeating, results.

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This happens throughout this section, but is particularly evident in the first part of the first paragraph of this section. Also, simply stating that your findings agree with those of others is not adequate synthesis.

Answer: We fully agree that pure repetition is not nice writing style for the discussion. However, we think it is helpful to repeat the data, especially if putting them into context with other studies. Showing concordance with results of other studies may convince the reader that this work is no singularity and will enable to bring our data into a larger context. Therefore, we restructured and shortened these sentences, but did not delete the data comparison with literature. . There seems to be differences in how sugars are referred to throughout the paper. In some places abbreviations are used, but not in others. For those not familiar with the abbreviated names of these sugars, using the full name would reduce confusion.

Answer: We apologize for the inconsistency. We now use the abbreviations throughout the paper, which are first explained in the introduction.

Page 9740: I would like to see more discussion on how SOM fraction quantity and MRT support existing aggregate hierarchy hypothesis. You present these two findings separately in the discussion, but they actually complement one another quite well, and if discussed together would present a nice synthesis.

Answer: We do agree with the reviewer that the data on SOM fraction quantity supports the aggregate hierarchy hypothesis. This is also made clear in the discussion, however we would prefer not to dwell on this too much as it has been shown before (e.g. John et al. (2005) and we cannot add any novel information to this. Our novel contribution is the fact that the sugar and microbial biomass dynamics also are in concordance with this concept and therefore we prefer to focus on this.

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