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SOIL Discussions

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Interactive comment

Interactive comment on "Greater soil carbon stocks and faster turnover rates with increasing agricultural productivity" *by* Jonathan Sanderman et al.

Jonathan Sanderman et al.

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The manuscript is well-written and describes an Australian long-term (at least 40 years) field trial with a gradient in productivity. The authors discuss the paradox between an increased turnover in the treatment with the highest productivity leading to the largest SOM accumulation. The turnover rates of 14C demonstrates a factor of three between the decomposition rates of the different treatments. Overall, decomposition rates or the ones used in multi-pool C dynamic models are not able to reflect this difference in decomposition rate between the treatments. It is suggested that the most productive system (with the highest turnover) produces the largest amount of microbial necromass that is stabilized in the soil and compensates the turnover of plant residues. As a gen-

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eral remark, I appreciate the model efforts and the demonstration of large differences in turnover rates based on the 14C analysis. However, the conclusion that microbial necromass compensates differences in residue input remains speculative. The authors hardly suggest ways forward to demonstrate this difference in necromass using analytical techniques nor do they refer to other field trials that show similar or contrasted behaviour. I would have liked to see this addressed in the discussion.

Response: The authors appreciate the overall positive assessment of the manuscript. The main critique contained within this comment from reviewer #2 can perhaps be best paraphrased as "the authors speculate too much about the importance of microbial necromass." We feel the reviewer has mischaracterized the intent of this discussion – we have never suggested that microbial necromass compensates for differences in residue input. In fact we are arguing the opposite: that increasing residue inputs leads to greater microbial biomass and therefore necromass. Higher microbial biomass increases microbial activity, which results in a greater than expected (relative to inputs) increase in C cycling rates. Upon re-reading, we re-worded the last sentence of the discussion, removing the phrase "the production and stabilization of microbial residues is" with "concurrent increases in plant inputs, microbial activity, and microbial-derived C are...". We feel the prior sentences in this last discussion paragraph are putting our results in the context of other results from the literature, and not speculating. We hope that re-phrasing this last sentences makes clear that we are not attributing the increase in soil C to microbial residue production alone, but rather to the response to increased inputs.

Moreover, we have included three sets of analytical data which support, either directly or indirectly, the notion of greater microbial biomass/necromass: 1) NMR data showing greater contribution of Alkyl and N-alkyl C, both C functional types that are in high abundance in microbial biomass but not in plant residues (indirect data because the interpretation is a bit ambiguous due to potential contribution in these NMR chemical shift regions from plant-derived compounds); 2) amino sugar data which are products

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of microbial synthesis (direct data); and 3) exactable OC and basal respiration rates (indirect data).

In support of our argument we discuss at some length the findings of Lange et al (2015) paper which, to our knowledge, is one of a the only other publications to demonstrate the importance microbial biomass/necromass in building SOC in a field trial study.

Specific remarks Page 9 line 25 Please specify in brackets the corresponding components of Fig. 3.5 related to the different pools.

Response: This sentence has been revised to refer to specific portions of the NMR spectrum as suggested by the reviewer.

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