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Interactive comment on “Investigating microbial transformations of soil organic matter: synthesizing knowledge from disparate fields to guide new experimentation” by S. A. Billings et al.

Anonymous Referee #2

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This is review of the article titled “Investigating microbial transformations of soil organic matter: synthesizing knowledge from disparate fields to guide new experimentation”. Briefly, the authors show how information from experiments in aquatic systems and chemostats may be used to better understand soil organic matter transformations. They follow this with an example of how this knowledge may be applied to the question of SOM dynamics at depth. This article is highly thought provoking and poses connections that many researches in soil and terrestrial ecosystem science may not have considered. It seems to be highly relevant and worthy of publication. My biggest concern with this manuscript is its length. Perhaps some condensation and distilling

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of the main concepts/points would improve the paper. If at all possible, I recommend shortening the discussion on each topic. That being said, I have some suggestions for things that might be missing (contradictory I know). I really only have minor comments.

Page 1099, lines 4-8: This sentence sounds way too similar to the first sentence of the abstract. I suggest changing one or the other.

Page 1100, lines 8-16: This is all one sentence, and is very long and confusing. Also, maybe backup and summarize the C quality hypothesis?

Section 2, pages 1102-3: If I read this correctly, you suggest that natural aquatic and chemostat environments help to identify baseline microbe-substrate relationships that may be present in soil. This is mostly due to relief of diffusional constraints. But what if diffusional constraints are the defining characteristic shaping microbe-substrate interactions in soil? I think this may be an important point that, even if addressed later on, should probably be introduced here as well. You could also be more clear about what you mean by 'varying environment' and 'changing conditions'.

Page 1105, lines 21-24: The last sentence of this paragraph seems like the main point of this whole section. Might want to move it up closer to the beginning?

Page 1116, lines 19-23: Might to add Manzoni et al. 2014 in this sentence? It's already in the reference list.

Page 1119, last paragraph: Kind of lost me here. Can this be stated more simply as averaging over space or time? Given that you can identify the critical thresholds over which each, or both, vary?

I may have missed it, but do you discuss what kinds of stresses can be imposed using chemostats? I recall something about osmotic stress earlier. It's often by observing systems under stress that we learn the most about their function. Also, chemostats seem good for interrogating equilibrium systems, but what about disequilibrium conditions? Any options there?

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I found section 5 to be fascinating and very informative. However, this is the section I'd single out for significant reductions in length. The focus seems to drift here, away from the main points of the paper which are: utility of using aquatic and chemostat systems to understand SOM dynamics.

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