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Biogeosciences Discussions

Interactive comment on "Long-term bare fallow soil fractions reveal thermo-chemical properties controlling soil organic carbon dynamics" *by* Mathieu Chassé et al.

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The paper evaluated the MRT and SOC storage in different sized fraction along a] gradient of different years of bare fallow. They found that the majority of centennially persistent OC was in sand and clay fractions, which was more stable than C in silt fraction. The reason is large amounts of PyOC were in sand and clay fractions. Therefore, they concluded that thermo-chemical properties controlling soil organic carbon dynamics among different size fractions. The paper is generally good written and the data is convinced and supports the conclusion. I have some comments as follow: 1. I understand the results of most persistent organic carbon is associated with sand- and

clay-sized fractions, and sand fraction seems more stable than silt and clay fractions in this paper. However, this is contrasting with most previous studies (such as Ding et al. 2014 and Ding et al., 2018) that reported that C in silt and clay is stable compared to sand fraction. The authors acknowledged that physical or physico-chemical protection controls organic carbon dynamics in ïňĄne fractions but chemical recalcitrance controls organic carbon persistence in sand-sized fractions. It is more and more recognized that the role of physical or physico-chemical protection surpass the role chemical recalcitrance on soil carbon stability among soil scientists. Biochar (ie., PyOC) may be an exception that have high stability only due to its chemical recalcitrance. I recommend authors to improve discussion on this knowledge and cite the related articles if needed. 2. Please see other detailed comments in the attachment.

References: Fan Ding, Huang Yao, Sun Wenjuan, Jiang Guang-Fu, Chen Yue. 2014. Decomposition of organic carbon in fine soil particles is likely more sensitive to warming than in coarse particles: An incubation study with temperate grassland and forest soils in Northern China. PLoS ONE 9(4): e95348. doi:10.1371/journal.pone.0095348. Fan Ding, Wenjuan Sun, Yao Huang, Xunyu Hu. 2018. Larger Q10 of carbon decomposition in finer soil particles does not bring long-lasting dependence of Q10 on soil texture. European Journal of Soil Science. 69 (2): 336–347

Please also note the supplement to this comment:
https://bg.copernicus.org/preprints/bg-2020-176/bg-2020-176-RC1-supplement.pdf

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