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Interactive comment on "Aggregates reduce transport distance of soil organic carbon: are our balances correct?" *by* Y. Hu and N. J. Kuhn

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Dear Referee: Thank you very much for your time and comments. Your suggestions are appreciated and helpful to improve the manuscript. Below are our replies to the individual questions. (1) Results observed from one soil cannot represent all other soil types Answer: We agree with your comments. This study serves merely to identify the potential error introduced by the effects of aggregation on SOC redistribution, rather than quantitatively determining the significance of such an error. In the future, more experiments with soils of different aggregation and various SOC contents need to be carried out to examine the aggregation effects on the silty loam studied here to a wider range of soils. Long-term monitoring is also required to determine the mineralization potential of different SOC fractions. Further research should also focus on the effects of preferential deposition of eroded aggregates, and the fate of SOC in these aggregates, whilst in-transit towards downslope during multiple rainfall events. Effects of varying rainfall characteristics as well as a range of crust and moisture conditions of soil surface as well as soil management (e.g., Wang et al., 2008; Hu et al., 2013a) onto SOC transport should also be investigated. (2) Transport process & aggregate breakdown Answer: We agree with your concerns that further breakdown of aggregates into fine particles during transport process can potentially increase the transport distance of eroded SOC and thus increase the likelihood of eroded SOC to be transferred into rivers. However, in slope scale, previous research has pointed out that sediment delivery ratios are up to 90% smaller than soil erosion rates, even in catchments with soils of fine texture where all soil particles should move as suspended load (Walling, 1983; Beuselinck et al., 1999b, 1999c; Parsons et al., 2006). This demonstrates that most of the eroded sediments are re-deposited during transport processes (Beuselinck et al., 2000). There could be two possible explanations: 1) sediment is not eroded and transported as mineral particles, but in form of aggregates (Beuselinck et al., 1999c). Aggregates do not move that far as individual mineral particles, due to the accelerated settling velocity of aggregates by the greater masses and larger sizes. 2) Runoff is not always continuous, but of certain transport capacity. Preferential deposition occurs along the transport pathway, once sediment fractions are out of the transport capacity of runoff. These re-deposited fractions would then likely to be subjected to repeated erosion processes (Starr et al., 2000; Jacinthe et al., 2002; Lal et al., 2004; Lal and Pimentel, 2008). In addition, we assume that the aggregate size distribution during prolonged transport processes would not change significantly. The proportional composition of the six EQS classes in each sediment collection interval did not significantly differ over rainfall time (ANOVA, single factor, $P > 0.05$, n=18). Experiments from another study (Xiao et al., in preparation) also show that increasing raindrop impact to aggregates, within a certain extent, does not reduce aggregate size distribution much more. (3) Rainfall intensity, duration & aggregate size Answer: As discussed in previous question, this study is merely the first step to investigate the en-

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tire erosion-transport-deposition process. Further research should, therefore, focus on the effects of preferential deposition of eroded aggregates, and the fate of SOC in these aggregates, whilst in-transit towards downslope after multiple rainfall events. Effects of varying rainfall characteristics as well as a range of crust and moisture conditions of soil surface as well as soil management (e.g., Wang et al., 2008; Hu et al., 2013a) onto SOC transport should also be investigated in the future. (4) Erosion size (interrill or rill erosion) & sediment load Answer: We agree that the splash or interrill erosion is more likely to selectively erode soil fractions and thus form various sediment compositions. But regardless of selective splash and interrill erosion, or non-selective rill erosion, sediment fractions are all likely to experience preferential deposition. Therefore, the SOC redistribution by either selective or non-selective erosion, is strongly depending on the transport distance of eroded aggregates. (5) Calibration and efficiency of ultrasound dispersion Answer: It is true that the calibration and efficiency of ultrasound dispersion are controversial (Beuselinck et al., 1999a; Kaiser et al., 2012). But, the application of ultrasound dispersion in this study aims at the comparison of size distributions between aggregated fractions and non-aggregated fractions. Although the ultrasound energy used in Hu et al. (2013b) was not enough to thoroughly disperse the original soil into real mineral particles (Kaiser et al., 2012), such extent of dispersion was notable enough to demonstrate the potential under-estimation of applying mineral particle size distribution to predict the settling velocity of eroded SOC. In addition, complete dispersion, if so difficult to thoroughly carry out, is probably not feasible to apply in any other erosion models, either. (6) Aggregate specific SOC distribution vs. mineral SOC distribution Answer: We agree with you that, in the silty loam used in this study, SOC may not play an important role in forming and stabilizing coarse aggregates, which would be immediately re-deposited. But, according to our results (Table 1, Figure 2 and Figure 3), the aggregation effects were very pronounced in forming medium size fractions, such as EQS of 32 to 125 μm. (7) Particle size classification Answer: We agree with you that the EROSION 3D model and LiSEM model are very powerful in representing many particle classes. But for aggregated soils, settling velocities are affected by the

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actual size, irregular shape, porosity of soil fractions and their incorporation with SOC of light-density (Kinnell and McLachlan, 1988; Loch, 2001; Hu et al., 2013b). Hence, the mineral particle size classes, no matter how efficiently applicable in erosion models, are not the decisive factor to determine the actual settling behavior or movement of aggregates. In addition, the upper limits of the mineral particle size classes used in current erosion models are often smaller than the sizes of coarse EQS applied in this study. Such limits may also skew the estimation on settling velocity of eroded sediment. (8) Separation of clay Answer: It is definitely possible to separate clay from other fractions by settling velocity. However, in this study, a long settling tube is required to sufficiently fractionate coarse aggregates that have fast settling velocities. If using the 1.8 m long settling tube as in this study, it will cost a clay particle (size of 2 μm) about 140 hours to settle from the top to the bottom. Such a long time is simply not practical for a laboratory experiment. In addition, fine suspended fractions are considered as one group "exported" out of the terrestrial system as suspended sediment. Hence, with the current settling tube (length of 1.8 m), any fractions finer than 20 μm (settling time longer than 1.5 h) were not further fractionated to save time.

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