

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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Received and published: 28 August 2014

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.

Comment: I do not think it is needed to provide some big numbers that are probably irrelevant due to their uncertainty and from which it is hard to learn something. However, this comment does not call for removing the discussion around weaknesses existing in erosion models. It is an important matter per se and this does not need a very uncertain global estimate to be justified.

Answer: We highly appreciate your understanding. We also understand your concerns

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in terms of extrapolating data from a single soil type under certain simulated rainfalls to global scales. As stated in our manuscript, the potentially significant deposition of eroded SOC within the terrestrial system inferred from this study aims at illustrating the risk of overestimating the erosion-induced CO₂ sink strength, rather than quantitatively determining the significance of such biased estimation. Similar concerns have also been raised by several other referees on the way the risk was calculated in this paper. However, Referee 9 also acknowledges that the estimation in this study is put in a proper perspective. Therefore, we would prefer to still draw attention to the comparison in the paper, but without too specific numbers to justify the uncertainty. In order to accurately deliver our statement, the relevant section will be changed in the revised manuscript:

A 15.5% SOC enrichment of sediment re-deposited in the terrestrial system would imply a corresponding reduction in lateral SOC transfer between eroding and all colluvial depositional sites. The percentage of such enrichment corresponds to the proportion of eroded SOC estimated to be deposited in permanent sinks (e.g., 0.12 Pg yr⁻¹ by van Oost et al. 2007). While the effects of aggregation on SOC redistribution and subsequent fate cannot be assessed based on one experiment, most sediment is transported in form of aggregates (Walling, 1988; Walling and Webb, 1990). Ignoring the effect of aggregation on erosion and redistribution of SOC, therefore, bears the risk of overestimating the erosion-induced carbon sink effect. As a consequence, the behavior of aggregated sediment requires a reconsideration of existing approaches. Further study of different soil types, their aggregation and aggregate breakdown while moving through landscapes of varying topography during rainfall events of different intensity, frequency and duration, is required to assess the relevance of aggregation for SOC movement and fate identified in this study.

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Interactive comment on Biogeosciences Discuss., 11, 8829, 2014.

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