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Aggregation-induced reversal of transport distances of soil organic matter: are our balances correct?

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The effect of soil erosion on global carbon cycling, especially as a source or sink of green-house gases (GHGs), is the subject of intense debate. The controversy arises mostly from the lack of information on the fate of eroded soil organic carbon (SOC) as it moves from the site of erosion to the site of longer-term deposition. This requires improved understanding the transport distances of eroded SOC, which is principally related to the settling velocities of sediment fractions that carry the eroded SOC. For aggregated soils, settling velocities are affected by their actual aggregate size rather than the mineral grain size distribution. Aggregate stability is, in turn, strongly influenced by soil organic matter. This study aims at identifying the effect of aggregation on the transport distances of eroded SOC and its susceptibility to mineralization after transport and deposition.

A rainfall simulation was carried out on a silty loam soil. The eroded sediments were fractionated by a settling tube apparatus into six different size classes according to their settling velocities and likely transport distances. Weight, SOC concentration and instantaneous respiration rates of the fractions of the six classes were measured. Our results show that: 1) 41% of the eroded SOC was transported with coarse aggregates that would be likely re-distributed across landscapes; 2) erosion was prone to accelerate the mineralization of eroded organic carbon immediately after erosion, compared to undisturbed aggregates; 3) erosion might make a higher contribution to atmospheric CO_2 than the estimation made without considering the effects of aggregation and extra SOC mineralization during transport.