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Temporal variation of enrichment ratio of SOC in eroded sediment from interrill erosion over prolonged rainfall events

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Interrill erosion is commonly associated with selective erosion of fine and light particles, including soil organic matter. Most studies confirm that the eroded sediment is generally enriched in organic Carbon (OC) compared to the source soil. Yet the reported OC enrichment ratios (ERsoc) vary largely. The discrepancies of ERsoc are caused by soils inherent properties such as texture, but also aggregation, initial OC content and surface roughness or cover, as well as rainfall of different intensities, kinetic energy and duration. The data reported in the literature so far have also recognized the effect of crusting on C erosion, but no systematic study on the effect of rainfall duration, and thus prolonged crust formation and its variability, has been conducted so far. It is also noteworthy that most studies reported SOC enrichment, while conservation of mass dictates that ERsoc must be balanced by a decline of C in the source area material. Over time, this should also lead to a reduced or even negative ERsoc in sediment, questioning a quasi-constant average (annual) positive value for ERsoc to estimate the C soil erosion for a prolonged erosion time.

To capture the effects of prolonged rainfall time and crust development on the variation of ERsoc of eroded sediment, two loamy soils were exposed to a rainfall simulation of 30 mm h-1 for 6 hrs. Runoff, infiltration and sediment discharge were recorded in intervals of 30 min and OC of eroded sediment was determined. ERsoc varied over time: increased at first, peaked at the point when steady state runoff was achieved and declined afterwards. “Negative” OC enrichment compared to the original soil was observed at the end of the rainfall events. These results confirm that the conservation of mass applies to ERsoc as a consequence of crusting. Therefore, they clearly point out that the duration of a given rainfall event and the associated extent of crusting affects ERsoc. A “constant” positive ERsoc is therefore possibly biased leading to an overestimation of OC erosion, especially on rapidly crusting soils in environments with relatively high rainfall volume and intensity.