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Potential fate of SOC eroded from natural crusted soil surface under simulated wind driven storm

Liangang Xiao, Wolfgang Fister, Philip Greenwood, Yaxian Hu, and Nikolaus J. Kuhn
University of Basel, Physical Geography, Environmental Sciences, Basel, Switzerland (liangang.xiao@unibas.ch)

Improving the assessment of the impact of soil erosion on carbon (C) cycling requires a better understanding of the redistribution of eroded sediment and associated soil organic carbon (SOC) across agricultural landscapes. Recent studies conducted on dry-sieved aggregates in the laboratory demonstrated that aggregation can profoundly skew SOC redistribution and its subsequent fate by accelerating settling velocities of aggregated sediment compared to mineral grains, which in turn can increase SOC mineralization into greenhouse gases. However, the erodibility of the soil in the field is more variable than in the laboratory due to tillage, crus formation, drying-wetting and freeze-thaw cycles, and biological effects.

This study aimed to investigate the potential fate of the SOC eroded from naturally developed soil surface and to compare the observations with those made in the laboratory. Simulated, short, high intensity wind driven storms were conducted on a crusted loam in the field. The sediments were fractionated with a settling tube according to their potential transport distances. The soil mass, SOC concentration and cumulative 80-day CO_2 emission of each fraction were identified. The results show: 1) 53% of eroded sediment and 62% of eroded SOC from the natural surface in the field would be deposited across landscapes, which is six times and three times higher compared to that implied by mineral grains, respectively; 2) the preferential deposition of SOC-rich fast-settling sediment potentially releases approximately 50% more CO_2 than the same layer of the non-eroded soil; 3) the respiration of the slow-settling fraction that is potentially transported to the aquatic systems was much more active compared to the other fractions and the bulk soil.

Our results confirm in general the conclusions drawn from laboratory and thus demonstrate that aggregation can affect the redistribution of sediment associated SOC under field conditions, including an increase in emissions compared to bulk soil. Overall, this confirms that terrestrial SOC redistribution and the mineralization play an important role in erosion induced C cycling, with major uncertainties to be addressed.