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Soil aggregate stability and rainfall-induced sediment transport on field plots as affected by amendment with organic matter inputs

Pu Shi (1), Christian Arter (1), Xingyu Liu (2), Martin Keller (1), and Rainer Schulin ()

(1) Institute of Terrestrial Ecosystems, ETH Zurich, Switzerland (pu.shi@usys.ethz.ch), (2) Institute of Environmental Engineering, ETH Zurich, Switzerland

Aggregate stability is an important factor in soil resistance against erosion, and, by influencing the extent of sediment transport associated with surface runoff, it is thus also one of the key factors which determine on- and off-site effects of water erosion. As it strongly depends on soil organic matter, many studies have explored how aggregate stability can be improved by organic matter inputs into the soil. However, the focus of these studies has been on the relationship between aggregate stability and soil organic matter dynamics. How the effects of organic matter inputs on aggregate stability translate into soil erodibility under rainfall impacts has received much less attention.

In this study, we performed field plot experiments to examine how organic matter inputs affect aggregate breakdown and surface sediment transport under field conditions in artificial rainfall events. Three pairs of plots were prepared by adding a mixture of grass and wheat straw to one of plots in each pair but not to the other, while all plots were treated in the same way otherwise. The rainfall events were applied some weeks later so that the applied organic residues had sufficient time for decomposition and incorporation into the soil.

Surface runoff rate and sediment concentration showed substantial differences between the treatments with and without organic matter inputs. The plots with organic inputs had coarser and more stable aggregates and a rougher surface than the control plots without organic inputs, resulting in a higher infiltration rate and lower transport capacity of the surface runoff. Consequently, sediments exported from the amended plots were less concentrated but more enriched in suspended particles (<20 μm) than from the un-amended plots, indicating a more size-selective sediment transport. In contrast to the amended plots, there was an increase in the coarse particle fraction (> 250 μm) in the runoff from the plots with no organic matter inputs towards the end of the rainfall events due to emerging bed-load transport.

The results show that a single application of organic matter can already cause a large difference in aggregate breakdown, surface sealing, and lateral sediment-associated matter transfer under rainfall impact. Furthermore, we will present terrestrial laser scanning data showing the treatment effects on soil surface structure, as well as data on carbon, phosphorus and heavy metal export associated with the translocation of the sediments.