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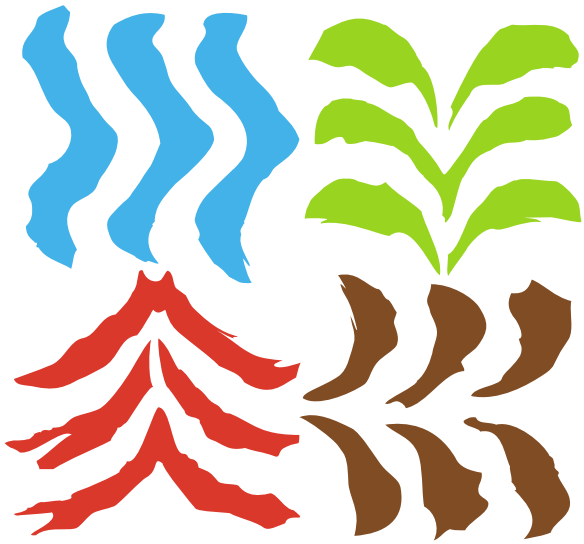

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O84-6

[C3.2-1] B: Soil Erosion and Degradation on Agriculture Land

A Sound Measurement of Splash Detachment Rates for Erosion and Eluviation Modelling

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Splash is well recognised as a key process of interrill erosion and soil surface degradation. Splash has more recently been pointed out as a mechanism of colloid mobilisation suggesting the role of this process in controlling colloid-facilitated transfer and lessivage. Measured splash detachment rates are used to parameterise interrill erodibility in soil erosion and landscape evolution models as well as eluviation in pedogenesis models. However, the available measurements of splash detachment rate are biased and experiment-specific. Firstly, splash detachment is often considered as a single process whereas, depending on the measurement conditions (e.g. soil aggregation, surface water content, rainfall kinetic energy), raindrop impact on soil can trigger different physical mechanisms. Secondly, the interaction between the measurement device and the redistribution pattern of splashed particles produces bias that are generally not taken into account when interpreting the experimental data. Thirdly, the size selectivity is mostly disregarded whereas several authors have already pointed to its preeminence. The objectives of this communication are thus 1) to propose a measurement framework that is physically and experimentally sound to determine splash detachment rate, 2) to quantify reliable detachment rates for different soils and size fractions, 3) to analyse the way splash detachment is represented and parametrised in different soil erosion and pedogenesis models, and 4) to suggest a new approach to model splash detachment.

The experimental framework we designed enabled to: 1) distinguish the consequences on soil aggregates of aggregate breakdown, and transport by splash; 2) propose an invertible mathematical model for a non-biased interpretation of the measurements. This model was obtained from a numerically integrated point-equation by first conducting a sensitivity analysis to determine the significant parameters and then finding a simplified form by meta-modeling.

Two laboratory devices were set up to sample the soil fragments produced by aggregate breakdown and transported by splash, respectively. Each device has a central circular 18-cm2 source. Sieved air-dried soil (3-to-5-mm size fraction) was exposed to simulated rainfall at 29 mm.h-1 and with a time specific kinetic energy of 250 J.m-2.h-1. Those conditions are representative of a storm on a dry seedbed. Three cultivated soil surface materials, with various sensitivities to erosion, were tested: a silt loam, a clay loam and a silty clay loam. The size distributions (16 size fractions from 0.05 to > 2000 μm) of the broken down and splashed soil fragments were determined by combining sieving and laser diffraction. These size measurements were performed in ethanol in order to preserve aggregation.

The results show that the splash rate depends mainly on the size fraction of the aggregates available at the soil surface. The rates are higher for the middle-sized fractions (50 to 1000 μm) and, contrarily to what is generally thought, splash of colloidal-sized soil fragments is not significant. The physical mechanism generating colloidal-sized soil fragments under rainfall impact is breakdown and it occurs only on aggregated soils. In the literature, splash detachment refers to various physical processes: in soil erosion and landscape models, it encompasses both aggregate breakdown and splash sensu stricto, and, in eluviation and colloidal-particles transport models, it actually relates to aggregate breakdown only. Thus splash detachment in soil erosion and landscape models should be parametrised by combining aggregate stability tests (representative of aggregate breakdown) and splash cup measurements. Eluvation and colloidal-particles transport models should be parametrised by aggregate stability tests only.

Keywords：*aggregate breakdown, soil erosion model, pedogenesis model*