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Using the raindrop size distribution to quantify the soil detachment rate at the laboratory scale

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Rainfall simulators are beneficial tools for studying soil erosion processes and sediment transport for different circumstances and scales. They are useful to better understand soil erosion mechanisms and, therefore, to develop and validate process-based erosion models. Simulators permit experimental replicates for both simple and complex configurations. The 2 m $\times$ 6 m EPFL erosion flume is equipped with a hydraulic slope control and a sprinkling system located on oscillating bars 3 m above the surface. It provides a near-uniform spatial rainfall distribution. The intensity of the precipitation can be adjusted by changing the oscillation interval. The flume is filled to a depth of 0.32 m with an agricultural loamy soil.

Raindrop detachment is an important process in interrill erosion, the latter varying with the soil properties as well as the raindrop size distribution and drop velocity. Since the soil detachment varies with the kinetic energy of raindrops, an accurate characterization of drop size distribution (DSD, measured, e.g., using a laser disdrometer) can potentially support erosion calculations. Here, a laser disdrometer was used at different rainfall intensities in the EPFL flume to quantify the rainfall event in terms of number of drops, diameter and velocity. At the same time, soil particle motion was measured locally using splash cups. These cups measured the detached material rates into upslope and downslope compartments. In contrast to previously reported splash cup experiments, the cups used in this study were equipped at the top with upside-down funnels, the upper part having the same diameter as the soil sampled at the bottom. This ensured that the soil detached and captured by the device was not re-exposed to rainfall. The experimental data were used to quantify the relationship between the raindrop distribution and the splash-driven sediment transport.