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Investigation of particle detachment and transport in raindrop impacted thin water flows under highly controlled conditions

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Small scale processes, such as splash, sheet, and interrill erosion mechanisms, can be studied with a very high degree of precision and accuracy. However, a major problem when performing investigations on raindrop impacted thin water flows is that accurate measurements of key erosion variables are difficult to obtain. In many investigations, important values are, therefore, not directly measured, but inferred from easier to determine parameters. For example rainfall intensity, plot dimension, and flow discharge are recorded during an experiment to rather crudely estimate velocity and depth of flow. Since water depth and flow velocity vary spatially and temporally during experiments with non-controlled flow conditions, this lack of measurement accuracy clearly reduces the explanatory power of the experimental data and could be a reason why it is still not possible to deduce exact physical formulas to precisely model soil erosion mechanisms. In order to be able to control and manipulate the key factors governing erosion processes in raindrop impacted thin surface flows, a special experimental setup and measurement protocol was designed. During the experiments, factors like rainfall (drop size, fall velocity, kinetic energy), flow velocity, and particle size were kept constant to reduce the complexity of the system and provide a better opportunity to precisely evaluate the effect of water depth, water discharge, and slope angle on erosion amounts. The used water depths ranged between 2.5 - 10 mm, water discharge between 100-700 l/h, and slope angle between 0-2°. The results of these preliminary tests show that this experimental setup and protocol is capable of producing reproducible, high quality datasets. In future, this device will be used to for example investigate varying sand-size mixtures, varying kinds of substrates, such as a biochar/sand/soil mixture, until natural soil monoliths will be analysed.