A combined raindrop aggregate destruction test-settling tube (RADT-ST) approach to identify the settling velocity of sediment

JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

ID 3265183
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Year 2015
Title A combined raindrop aggregate destruction test-settling tube (RADT-ST) approach to identify the settling velocity of sediment
Journal Hydrology
Volume 2
Number 4
Pages / Article-Number 176-192
Keywords raindrop impact, aggregate breakdown, settling tube, settling velocity, modelling
The use of sediment settling velocity based on mineral grain size distribution in erosion models ignores the effects of aggregation on settling velocity. The alternative approach, wet-sieved aggregate size distribution, on the other hand, cannot represent all destructive processes that eroded soils may experience under impacting raindrops. Therefore, without considering raindrop impact, both methods may lead to biased predictions of the redistribution of sediment and associated substances across landscapes. Rainfall simulation is an effective way to simulate natural raindrop impact under controlled laboratory conditions. However, very few methods have been developed to integrate rainfall simulation with the settling velocity of eroded sediment. This study aims to develop a new proxy, based on rainfall simulation, in order to identify the actual settling velocity distribution of aggregated sediment. A combined Raindrop Aggregate Destruction Test-Settling Tube (RADT-ST) approach was developed to (1) simulate aggregate destruction under a series of simulated rainfalls; and (2) measure the actual settling velocity distribution of destroyed aggregates. Mean Weight Settling Velocity (MWSV) of aggregates was used to investigate settling behaviors of different soils as rainfall kinetic energy increased. The results show the settling velocity of silt-rich raindrop impacted aggregates is likely to be underestimated by at least six times if based on mineral grain size distribution. The RADT-ST designed in this study effectively captures the effects of aggregation on settling behavior. The settling velocity distribution should be regarded as an evolving, rather than steady state parameter during erosion events. The combined RADT-ST approach is able to generate the quasi-natural sediment under controlled simulated rainfall conditions and is adequately sensitive to measure actual settling velocities of differently aggregated soils. This combined approach provides an effective tool to improve the parameterization of settling velocity input for erosion models.
Publisher MDPI
ISSN/ISBN 2306-5338
edoc-URL http://edoc.unibas.ch/39513/
Full Text on edoc No;
Digital Object Identifier DOI 10.3390/hydrology2040176