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# Investigating the role of sediment type, rainfall event sequence and vegetation cover on surface water flow and erosion patterns using a physical model.

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It is anticipated that climate change will result in changes to both intensity and frequency of rainfall events, which in turn will affect soil erosion rates and patterns. Previous research has identified that erosion and sediment yield is influenced by the order in which rain events occur. This has been attributed to the connectivity of the system; defined as the physical transfer of water and sediment through a catchment. There are a number of different factors that interact to influence the connection across a catchment. The aim of the research presented here is to examine three of these factors; rainfall intensity and sequence, sediment type and vegetation cover using experiments carried out in the Total Environment Simulator (TES) at the University of Hull.

Two catchments were created, each measuring 4.0x4.0m, tapering to a 1.5m wide outlet. The catchments consisted of a central valley with 4% slope, superimposed on a long axis downward slope of 10%. To examine the impact of sediment size, the catchments were constructed from two varieties of sand ($\mu$=215microns and $\mu$=458microns). To examine the influence of rainfall, the TES rainfall generator was used, applying three rain intensities (low: 35 mm/h; medium: 92 mm/h and high: 125 mm/h) over both catchments. Low intensity events lasted 30 or 60 min, medium intensity events lasted 15 or 30min and high intensity events were applied with a duration of 15 min. These five different rainfall events were run in sequence across three days, totalling 15 rain events each. Initial experiments used bare catchment surfaces. Then to investigate the impact of vegetation cover, alfalfa seeds were planted, and allowed to grow for 10 days at two different densities across the catchments prior to the commencement of rainfall sequences. Water and sediment was collected at the outlet of the catchments allowing quantified comparisons. Terrestrial laser scans (TLS) of the evolved surfaces were also obtained such that the morphological evolution of the catchment under the range of scenarios could be tracked.

Analysis shows that the same rainfall event can result in different sediment yields depending on the preceding rain events. Overall, as the catchment developed and was subjected to more rainfall, the amount of sediment decreases on both catchments. However, it can be observed that when a high intensity events occurs first on the fine sediment, this produces a higher sediment output than when it occurs post other events, the opposite is the case on the coarser sediment. When we consider the vegetated catchments, the findings are different, with sediment yield remaining similar in all of the equivalent rain events despite their placement within the overall sequence. Evidence based on the TLS scans suggests these catchments form a more channelized structure immediately, so sediment is only being removed from these areas rather than across the whole of the catchment.