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The role of high intensity rainfall events on erosion patterns and sediment connectivity – a laboratory experiment

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Climate change is expected to result in rainfall events with higher intensities and volumes, influencing soil erosion rates and patterns. Earlier research has shown that the order in which events occur in a sequence affects (total) erosion and sediment yield. High intensity events occurring as start of an event seem to result in more erosion for following lower intensity events, compared to sequences with the reverse. A possible explanation for the influence of event sequencing is the system connectivity; the degree of coupling between sediment sources and sinks. This hypothesis was investigated through execution of a series of experiments in the large-scale rainfall simulation laboratory at the University of Hull (UK).

Two catchments were created, each measuring 4m wide by 4m long, with a tapering to a 1.5m wide outlet across the final 1m of the catchment. The initial conditions consisted of a smoothed central valley with sloping side gradient of 1 in 25, superimposed on an along-axis plot gradient of 1 in 10. A different substrate grain size was used in the two separate plots (215 and 458 μm, respectively). Five rainfall events settings were used in the experimental runs, each having a different intensity and/or duration. These were run in a randomly ordered sequence across in nine different experimental runs. To ensure differences in erosion were the result of running the events in a different sequence, the same initial landscape was reconstructed before every sequence. Sediment yield and runoff were measured at the outlet and laser scans were taken after each rainfall event to record the morphological evolution of the catchment. Results show that the same rainfall event resulted in different sediment yields when placed in the different sequences of runs. Connectivity values, derived from the DEMs (see connected poster for the details on the derivation of these values), indicate that high intensity events are dominant. When high intensity events follow lower intensity events, connectivity values increase significantly. On the other hand, when lower intensity events follow high intensity events, connectivity values show almost no change. This indicates that high intensity events create a better connection between hillslope and outlet. This improved connection creates favorable flow paths, that can subsequently be utilised by lower intensity events, thus generating a relatively higher sediment yield.