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Experimental investigation of spatial patterns of soil erosion and deposition using multiple tracers

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In this paper we present the methodology and results from experiments on the TRACE (Test Rig for Advancing Connectivity Experiments) facility. We have carried out experiments to quantify sediment transport and deposition and assess the resulting patterns of sediment redistribution across the boundary between hillslope and floodplain during a single rainfall event. TRACE is a dual axis, dual container soil slope measuring 2.5 m wide $\times$ 6 m long $\times$ 0.3 m deep with a folding action about the centre axis of the width dimension, and is accompanied by a rainfall simulator. The two slope elements can be moved independently and therefore allow the set-up of hillslope- and floodplain-type elements. We have applied a combination of sediment-tracer methods simultaneously in order to monitor sediment sources and travel distances and spatial patterns of sediment transport and deposition at the interface between hillslope and floodplain elements. Prior to the experiments we use 10 rare earth elements (REE) as well as radioactive ^{134}Cs to 'tag' soil in known initial locations across the slope, the interface zone and the floodplain zone. We also trace the coarse fraction using painted gravel. At the end of the experiment we measure concentrations of the REE and ^{134}Cs in soil samples at 160 locations throughout the slope and floodplain elements to assess the travel distance, origin and spatial patterns in sediment transport and deposition of the fine fraction. We also monitor the spatial pattern of the coarse fraction to determine the sources and travel distances of gravel both within each element and from the slope towards the floodplain element. Results indicate high soil-erosion rates on the

slope with abrupt sediment deposition at the slope-floodplain interface and lowered sediment transport rates on the floodplain element with preferential transport of fine sediment. The results also demonstrate the usefulness of REE as a technique in the assessment of spatial patterns of erosion and the sources of sediment transported to different locations on the slope. The REE and ^{134}Cs gave comparable results in terms of quantities of soil transported and deposited.