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Experimental investigation of sediment sources and travel distances using multiple tracers

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In this paper we present the methodology and results from a series of experiments on the TRACE (Test Rig for Advancing Connectivity Experiments) facility. We have carried out experiments to quantify the controls on the process of sediment transport and deposition and assess the resulting patterns of sediment redistribution across the boundary between hillslope and floodplain in single rainfall events. 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 grain size-specific 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 ^{134}Cs to 'tag' soil in known initial locations across the slope, the interface zone and the floodplain zone. At the end of the experiment we measure concentrations of the REE and ^{134}Cs in soil samples at 80 locations throughout the slope and floodplain elements to assess the travel distance, origin and spatial patterns in sediment transport and deposition. Spatial monitoring of the flow hydraulics (depth and velocity) throughout the experiments allows various hydraulic parameters to be calculated for different areas of the slope and related back to patterns in sediment transport and deposition.