How far does detached sediment travel?

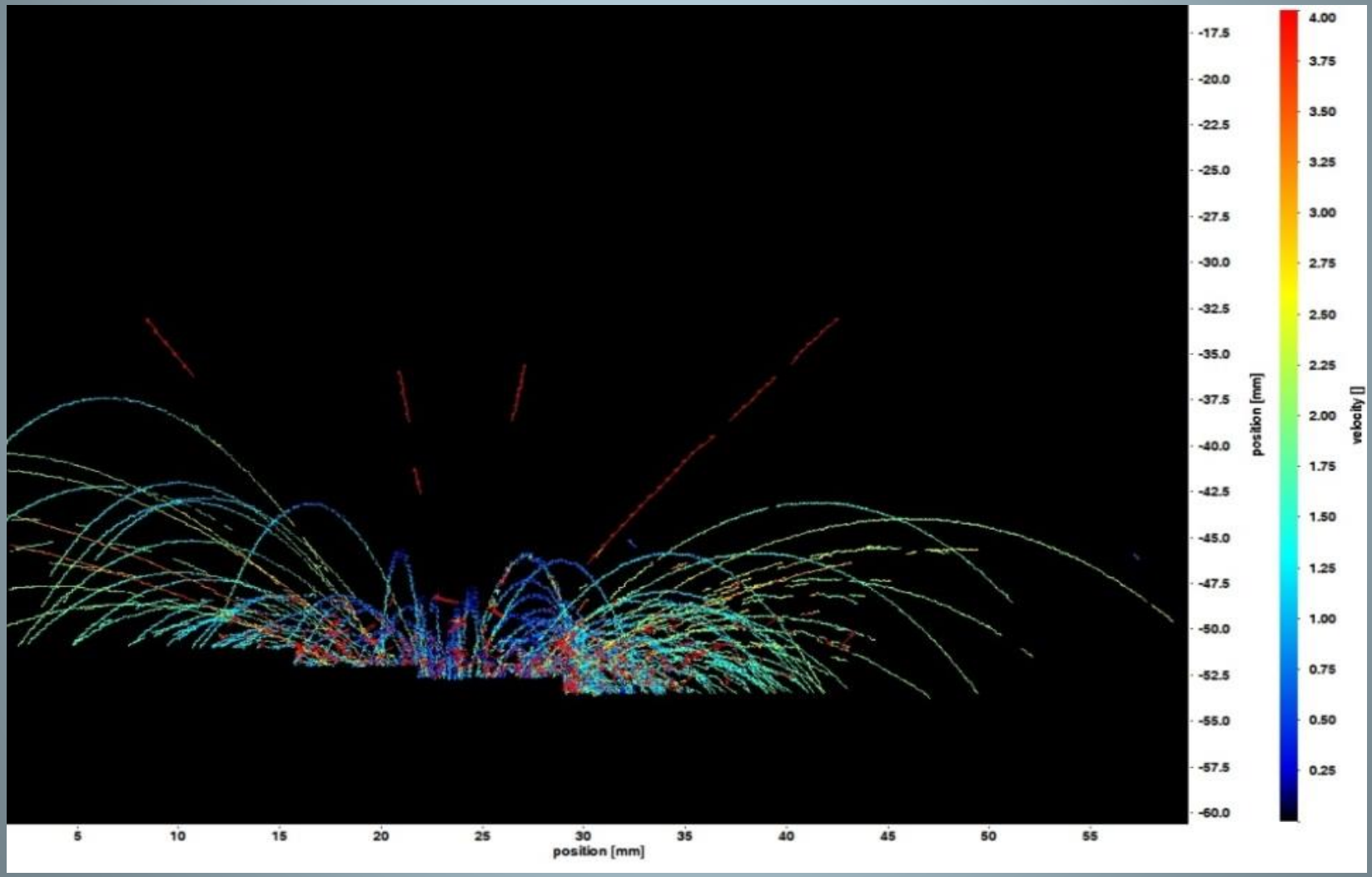
All processes of sediment detachment lift particles from the ground surface.

In the case of raindrop detachment, rebound of the (fragmented) raindrop on hitting the surface transports sediment with it

In the case of shallow flow particles are lifted into higher velocity layers by turbulent eddies

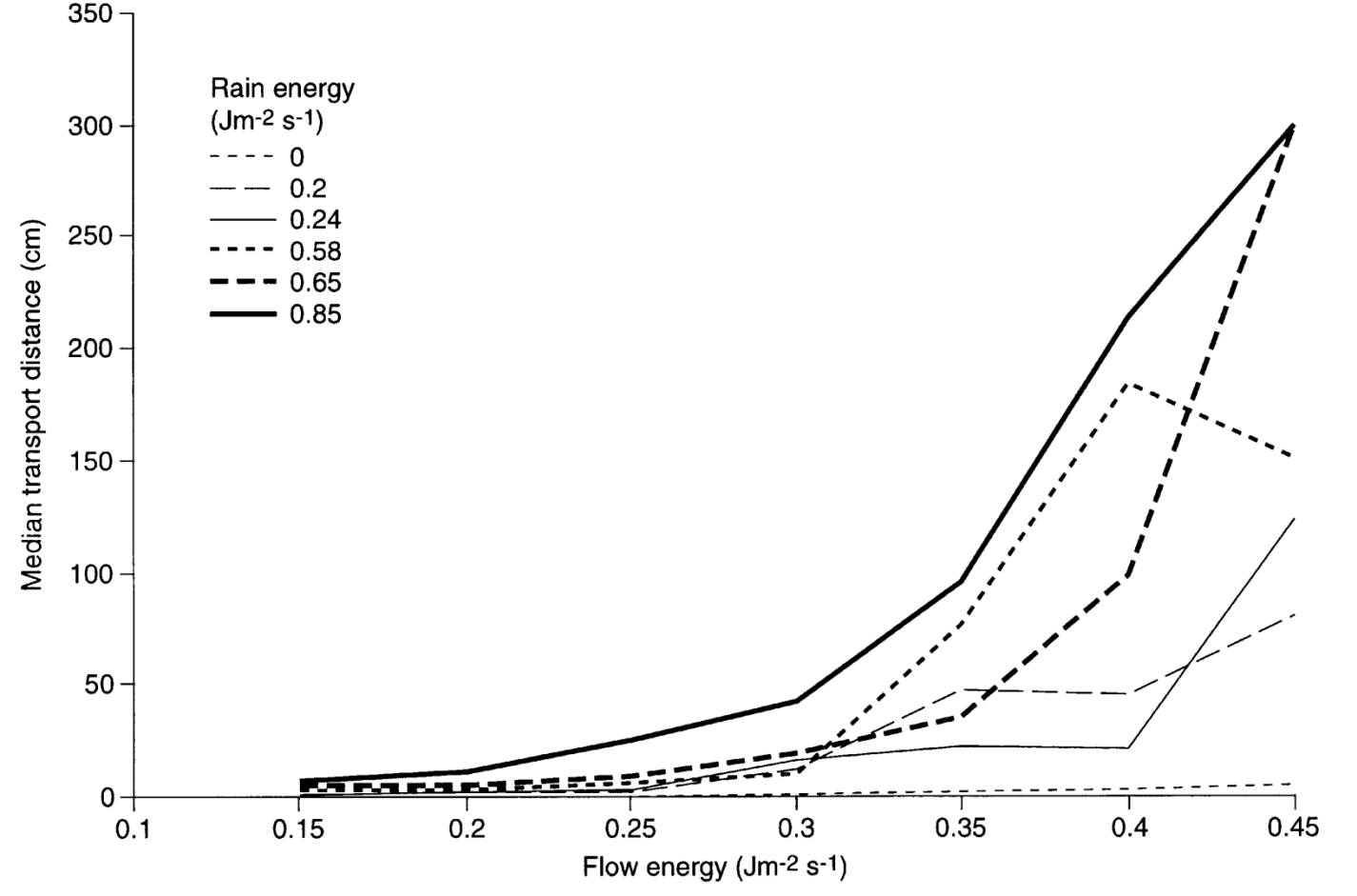
BUT ALL PROCESSES OF DETACHMENT AND LIFT ARE OPPOSED BY GRAVITY

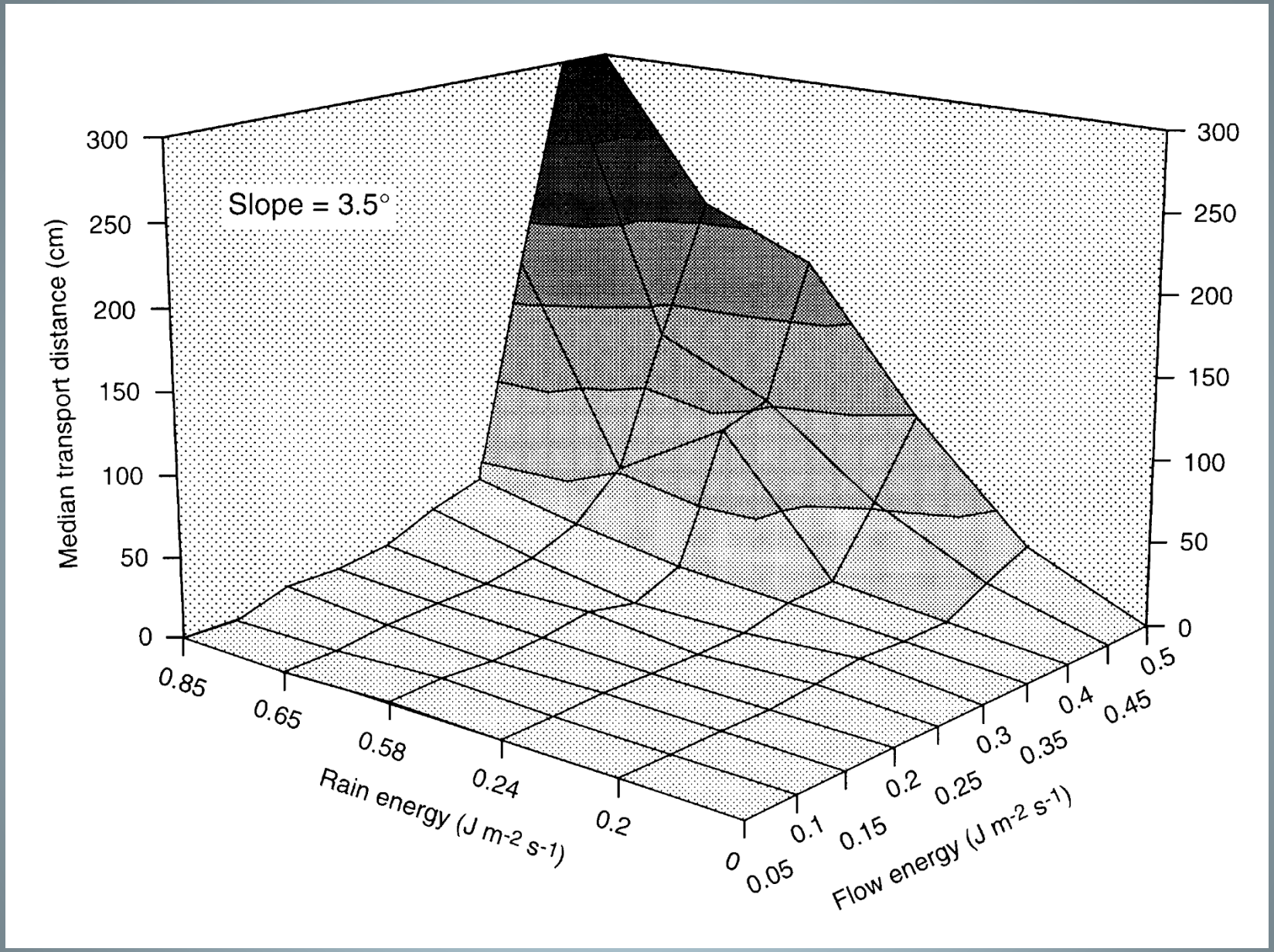
In the case of the raindrop



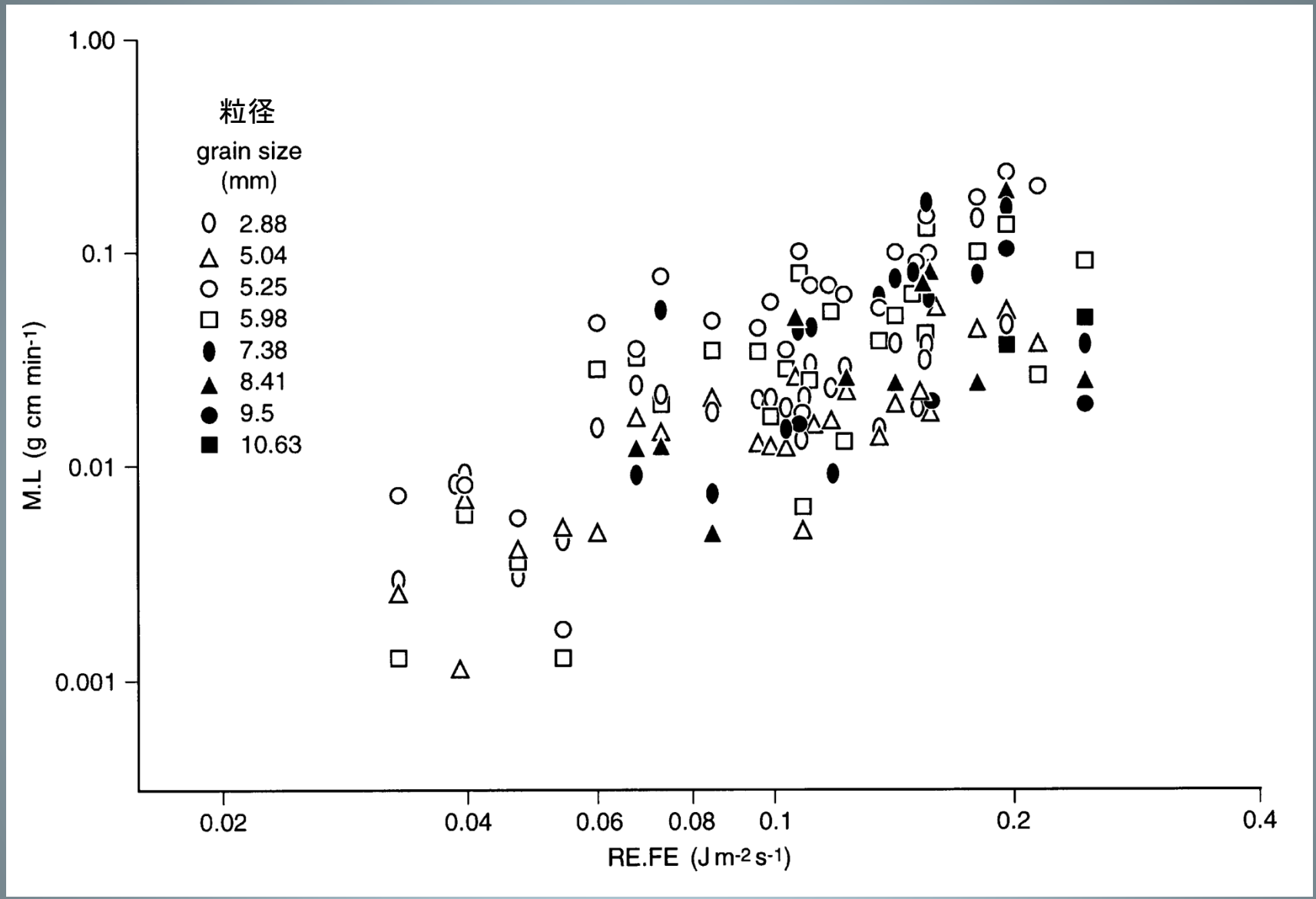
A common situation is where there is shallow flow that cannot detach particles but transport those detached by raindrops

Here:





Three-dimensional plot of median transport distances for a 3mm diameter particle on a 3·5° slope under rainfall energy varying from 0 to 0·85 Jm-2 s-1 and flow energy varying from 0·05 to 0·50 Jm-2 s-1

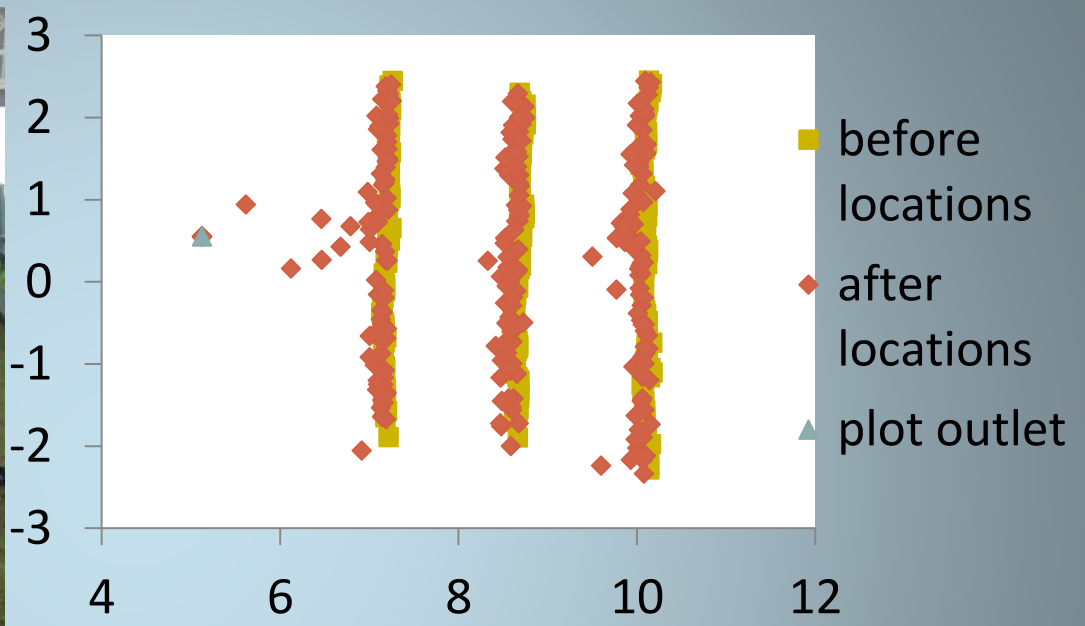


Particle transport (mass–distance/unit time) as a function of the product of rainfall and flow energy. Data are shown sorted by grain size

Any individual soil particle will be repeatedly entrained and deposited. In between entrainment events (for example being hit by a falling raindrop) the particle will sit on the hillslope, motionless.

It is possible to think of the periods of movement and the periods at rest, jointly, using the concept of *Virtual Velocity*

Single-event scale



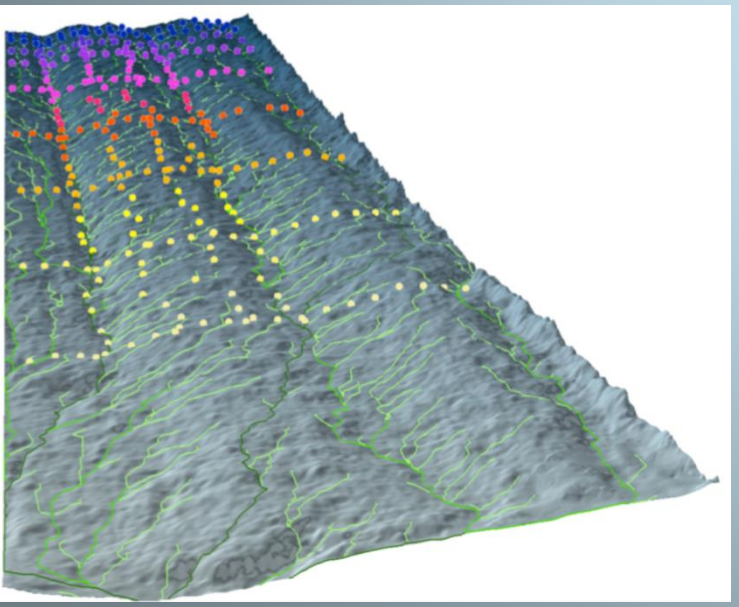
The data for the single-event scale come from RFIDs deployed in a rainfall simulation experiment, lasting 45 minutes at an intensity of 100 mm/hr

Median particle travel distance for the event is 73 mm yielding an event-based virtual velocity of 100 mm/hr

RFID：個別情報を無線通信で読み書きできる小型ICタグ

Seasonal scale

The data for the seasonal scale come from RFIDs deployed on a plot established following the Fukushima nuclear accident. Movement of RFID-tagged particles was measured after seven rainstorms in the period July to October 2012, during which time 470 mm rain fell.



Median particle travel distance for the season is 5523 mm yielding a seasonal virtual velocity of 41 mm/day

Decadal scale（10年単位の）

The data for the decadal scale come from magnetite particles deployed on a plot established at Walnut Gulch, Arizona, originally for a rainfall-simulation experiment. Movement of the magnetite particles was measured over the subsequent 16 years of natural rainfall during which time a maximum of 223 mm of runoff-producing rainfall occurred.

Median particle travel distance for the 16 years of record is 180 mm yielding a decadal virtual velocity of 11.25 mm/year.

Magnetite：磁鉄鉱

The data presented in these examples come from a variety of experiments, locations, and rainfall regimes such that they are not directly comparable in terms of scaling erosion rates. However, what they do show is that particle virtual velocity enables comparisons of rate of movement across scales so that rates of contaminant movement through the landscape can be estimated.