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Interactive comment

Interactive comment on "Slope–Velocity–Equilibrium and evolution of surface roughness on a stony hillslope" *by* Mark A. Nearing et al.

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Hi Mark, this is a very nice paper. Here some comments. It is not a discussion, as I guess we can have a better discussion once you read the suggested papers below: we discussed some of those together, years ago.

Regarding studies on flow velocity and discharge see: Hydrol. Process. 16, 1935 – 1953 (2002) where the authors refer:

In addition to the research carried out on rivers, Govers (1992) showed that an equation similar to Equation (3) can be used successfully to predict mean flow velocities for rills developing in loose non- layered materials (e.g. seedbed conditions). From an

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Discussion paper

analysis of 409 data points obtained for slopes ranging from 0.035 to 0.45 m/m and soil materials ranging from stony sands over silt loams to vertisols, Govers (1992) derived the following empirical relationship um = 3.52 Qˆ0.294 For studies where a fixed (i.e. non-erodible) rill surface was used (Foster et al., 1984; Abrahams et al., 1996), mean flow velocities appeared to depend on both flow discharge and slope of the rill. Yet, for situations where a rill is able to adjust freely its geometry to the flow conditions, Takken et al. (1998) reported that Equation (4) holds. Later, Gimenez and Govers (2001) have shown that the slope independency of flow velocity in eroding rills can be explained by an interaction between rill bed roughness and flow hydraulics. For rills, relationships of the form of Equation (1) have been reported by Lane and Foster (1980) and by Gilley et al. (1990). For a small number of data (n = 7) Lane and Foster (1980) obtained a coefficient a =4.48 and an exponent b =0.482.

In Catena 90 (2012) 76–86 the links between roughness and erosion intensity is explored in rills and gullies. In the introduction, the authors quote an interrill velocity-runoff relation (Abrahams and Parsons, 1990), and a similar equation for steep step-pool channels (Comiti et al., 2007) .

It seems to me that you should rewrite part of the introduction and the scientific background. I am sorry that I am suggesting two papers of which I co-authored but they are dealing with your subject and can really enhance your discussion and the validity of your findings. Furthermore, a proper discussion, which can follow after you have read the missing papers, can point to some aspects, such as the variation of the exponent of the velocity-runoff relationship. What does drive it from 0.3 to almost 0.7? is it the relative depth (i.e. the ratio between mean flow depth and D90 or D90/D10 . . . See about this: Andrews ED. 1984. Bed material entrainment and the hydraulic geometry of gravel-bed rivers in colorado. Geological Society of America Bulletin 95(3): 371–378. Or: Earth Surf. Process. Landforms, Vol. 34, 2023–2030 (2009).

If you prefer to ignore the above literature, then your paper is quite good. Nevertheless, you should check whether your data correspond always to the same boundary conditions, such as were the rock fragments always submerged? or vice versa? It is the problem of when we are exploring data which are fully turbulent, partly so, or even laminar (see the flow velocity profile and when the logarithm give room to the the parabolic lower part).

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