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Hydrology and Earth System Sciences
Discussions

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

Anonymous Referee #1

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I enjoyed reading this paper. Nice to see some soil erosion experiments and some very interesting and thought provoking data.

The paper sets out to test the hypothesis that slopes evolve to a state of slope velocity equilibrium through the process of preferential erosion. I think the paper does succeed in doing this and the result that are present are really interesting, but the paper needs some work before it can published.

Infiltration seems to have been ignored in the introduction, but I remember some papers by Poesen and co-workers in the 90s that showed the importance of rock position for infiltration and maybe flow.

The authors describe mixing the soil in a heap before filling the soil flume. How did the team ensure that the rock fragment cover, soil bulk density, initial surface roughness was the same for each of the treatments? Table 1 gives us the conditions at the end of the experiment, but what was the condition at the beginning? We have the mean cover in figure 1, but this tells us nothing about the spatial variability, which may be high making figure 1 harder to interpret. Figure 2 shows us the change at the different slope positions, but we don't see the differences between the replicates. Figure 2 suggests that even at the top of the slope there was a significant change in rock fragment cover, given that we expect very little runoff at the top of the slope, what is the mechanism for this? Was the change in rock fragment cover solely due to fine removal or is there something else going on? Perhaps because the soil was repacked there was movement of the finer particles into the soil rather than their transport down the slope.

I think I would add some photographs to the paper which would help the reader visualise the experimental setup and the observed changes.

I may have missed it, but I couldn't find any mention of how Manning's n or Chezy 'c' was determined in the methods. Since there are some clear correlations between these parameters and roughness these needs to be defined.

The variable duration of the experiments P5 L3 needs some further explanation. Can you provide details of the rain application to the different treatments – maybe a table?

I wonder whether we should be surprised that we don't see shifts in rock fragment cover with slope in these experiments. After all Walnut gulch has been exposed to the action of water, wind, rain and animals for a very long time and these experiments took place over a short time period and on relatively short slopes.

Can you really conclude that you have reached maximum rock fragment cover (P7 L25) based on the findings of two other studies?

You don't mention erosion rate anywhere in the paper. While it isn't the subject of the

paper, it is a critical variable for explaining the generation of the rock covered slope. It might be expected that there is a correlation between erosion and the change in the rock fragment cover as finer material is removed to leave more rocks on the surface. If there isn't then does it suggest that another process is at work?

I would also like to know more about the characteristics of the flow. How deep was it compared to the roughness elements? Was the water submerging the rocks? Was it flowing in between them? Or was it flowing in the surface of the soil. I could imagine that at shallow flow depths relative to the roughness that surface roughness will dominate flow velocity, not only by adding 'friction' but also storage and tortuosity, but that as the flow depth increases the slope begins to take over. Would deeper flows have led you to draw different conclusions?

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