Comment on esurf-2021-74
Anonymous Referee #1


The authors investigate the interplay between overland flow and seepage in the development of channels network by erosion. They perform dedicated laboratory experiments, by imposing controlled water rainfall on a granular bed inside a cylindrical container. A variable gate enables the discharge of sediment and channelization. The originality of this work, consists in changing the balance between overland flow and seepage, by adding few percent of clay in the sand forming the granular bed. This addition provides cohesion and reduces the seepage. The authors compare mainly four cases, (low cohesion, low rainfall), (low cohesion, high rainfall), (high cohesion, low rainfall), (high cohesion, high rainfall), each case correspond to an experiment of dozen hours. The granular surface is accurately measured using a 3D scanner providing digital elevation models.

The first crucial step determines the non-contributing area, the regions which are internally drained, by analysis of the topography. Then, the authors analyze the evolution of the distribution between contributing and non-contributing area, the incision rate and the average erosion rate. The contributing area grows with time, showing the network development. Overland flows transport more sediment than the seepage erosion. But this last has a higher incision rate and occurs by discrete strong events (mass wasting). Finally, the authors try to apply their results to chosen field examples.

The general idea is very interesting and the experiments appear to have been performed and analyzed rigorously. However, several important points are not sufficiently explained and difficult to follow. The captions of the figures are not complete. Ideally, a figure should be understandable (at least the main point) just by reading the caption. Often the reader does not which run is tested on each figure.

The method to determine the contributing and non-contributing area is not clear for me. A graphical explanation may be useful.
I do not understand also, what is the quantitative criterion to attribute a channel to overland flow or seepage. The numeration should be used consistently.
Moreover, some of the conclusions are not really supported by the data. Which curve does demonstrate each conclusion point? Some behavior occurs for only one run, so it may be incidental. As the number of runs is small, all should be shown with the same kind of plot found in Fig.6, maybe in appendix.

The run 1 is closer to the previous experiments of the literature. Do the authors find the amphitheater-headed channels in this run? I would say, that the elevation of the watertable is significantly smaller than the total bed, which produces mass wasting under the form of slumping or sapping events. At least one example of mass wasting should be shown and illustrated.

I do not understand also the discussion of the field examples. In Fig. 13 and 14, in which case seepage erosion is dominant (likely right and left). The morphological indicators must be indicated in the caption. I note, also there is no discussion about the scaling between laboratory experiments and the field. Can we deduce the relevant time and space scales using the laboratory results? Are the shapes similar?

This issue is related to the lack of modeling of the underlying hydraulic mechanism. This study is not necessary for publication, but will definitively improve the work. Without model or measure of the watertable, the reader does not what are the time scales for the watertable to form and possibly emerges to trigger seepage erosion. The affirmation that seepage erosion occurs once overflow erosion has sufficiently modified the surface is maybe not general and could be related with the dynamics of the watertable.

Specific comments:

1) The uplift process is not sufficiently described and discussed. Can the authors show in the schema of Fig. 2, how this uplift is applied? Consequently, does the main slope evolve with time.

2) Is Table 3, obtained for a specific run? If not, are the channels head similar for all parameter values? A graphical example would be worthwhile, to understand the procedure.

3) How the NCA integration rate is defined and then computed from experimental data? Same question for the incision rate?