

***Interactive comment on* “Spatial-temporal changes in flow hydraulic characteristics and soil loss during gully headcut erosion” by Mingming Guo et al.**

Anonymous Referee #1

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The manuscript entitled “Spatial-temporal changes in flow hydraulic characteristics 1 and soil loss during gully headcut erosion” is a study of gully head evolution under controlled conditions belonging to a set of papers presented by the authors in the last years on this subject. Since the authors aim in this manuscript is to investigate the hydraulics changes in the flow through the gully and its impact on energy consumption it fits into the journal scope. My general comments on the manuscript are that it covers a topic of interest, and it is well structured with clear Tables and Figures. Not been a native English speaker I find hard to suggest specific changes in the English usage, but there are sections that are hard to follow and expressions that does not seem the most appropriate (e.g. line 146 “artificially planted forest. . .”). In my opinion the most

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valuable part of the manuscript is the experimental dataset presented by the authors, which are scarce in gully erosion studies. However, the results are mostly a confirmation of the previous knowledge, some hardly novel like the transition in hydraulic regime through the gully headcut, which limits the significance of the manuscript. This might be compensated with a more critical discussion of the results, which currently is mostly a comparison of previous papers. The analysis and discussion of the issue of energy dissipation (consumption in the authors wording), which might be the most innovative part of the manuscript is not deep enough, and does not try to link with previous studies on optimization of energy dissipation in drainage networks which might be enlightening.

Some specific comments that might be of help to the authors for improving the manuscript are:

1- Better description in material and methods of the flume conditions in the gully bed section. It is apparent in Figure 3e that this is a short section with lateral walls, and so it is a situation far off from which might appear on gully in real world conditions, where gully walls will expand at a different rate and energy dissipation might take place for a longer section. Although this does not invalidate the experiment performed by the authors, it clearly conditions the expected results and the conditions to which we could extrapolate the results. This should be considered in the discussion. 2- The discussion of results seems to be mostly a comparison of results for previous papers, with little additional insight. A deeper discussion, which might include, for instance, implications for modelling gully erosion, scale effects (for larger or smaller gullies), or restoration efforts might be included. 3- The analysis of energy dissipation does not seem in depth enough. Firstly, there is no attempt to provide an overall energy analysis of the system, there are energy losses in the water depth which are not mentioned (like the one dissipated as heat and noise) and it is not clear how much of the original energy available to the flow (which I guess is the potential energy at the reservoir located at the top of the upstream section) is dissipated and how much remains at the end of the flume. The authors do not try to analyze the results to seek if some kind of optimization

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of energy dissipation (as suggested by previous papers on river and rill network development) is apparent. For instance calculating the energy losses by wetted section or by unit flow or sediment discharge, like previous studies. These are ideas, among others in that line, that the authors may want to explore to take advantage of the very detailed dataset that they have developed.

4- Data availability. Although in this case it is beyond the authors' responsibility to decide on data availability, it is a good practice to provide at least the ancillary data from which the graphs have been developed. For this I mean the values of the data plotted in the graphs. In this way you facilitate use to other colleagues of the information that might be retrieved scanning and plotting the graphs. I recommend the authors to seek permission for this.

Some other minor technical corrections that I might add are:

1- Title. Perhaps "Spatial-temporal changes in flow hydraulic characteristics and soil loss during gully headcut erosion under controlled conditions" might be more descriptive of the manuscript.

2- Lines 62-64. Not very clear, please edit for clarity.

3- Lines 85-86. Reduces soil losses as and headcut retreat as compare to what, bare soil? Please clarify
 4- Lines 133-134. You probably do not need two references to indicate elevation range in the area.
 5- Check English usage in line 145-146.
 6- Line 215. Please provide a bit more information on the LS300-A measuring principle.
 7- section 2.2.2.. Could you indicate the corresponding upslope area for the different flow discharge used, according to the runoff coefficient, and storm intensity used?
 8- Lines 241-241. Error in X-Y dimension or in Z dimension? Please clarify.
 9- Discussion on soil losses. A mention of the sediment concentration measured in the upstream and flume outlet might be quite helpful to understand the erosion/deposition processes.

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