

Interactive comment on “Impacts of Changing Hydrology on Ravine Growth: Experimental Results” by Stephanie S. Day et al.

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Comments on Impacts of Changing Hydrology on Ravine Growth: Experimental Results Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2017-567>

Dear authors, dear reviewers, dear editors,

I read the experiments with interest. I consider it as an interesting contribution to erosion science. I have a main comment to assess about the interpretation. The total sediment removal volume (V_s) is shown to be not dependent of the flow rate (discharge) (fig 5a). This implies the presented linear relation between the mean water discharge and the mean sediment discharge (fig 5b), as the total volume of water (V_w) is constant, and the total experiment duration (T) is used to calculate both sediment

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discharge (Q_s) and water discharge (Q_w): $Q_s = V_s/T$ and $Q_w = V_w/T$.

It is also presented that the sediment discharge is not constant during the experiment, at the beginning of each experiment the sediment discharge is high and increases to reach a maximum during the ravine formation, then decreasing to get a significantly lower value (fig 4 and 5). If the water discharge increases during the experiment, a second peak of sediment discharge is observed following the liquid discharge increase. This is clearly shown on the graphs and explained in the text.

For the longest runs (ie, low water discharge as the water volume is constant in the experiment design) the sediment flux at the end of the experiment seems to have reached a relatively constant value, drastically lower as during the ravine formation (run 6 and first stage of run 11 for example). Thus the total removal volume would roughly corresponds to the volume exported during the ravine formation, with a negligible contribution of the flux existing during a following relatively steady state. Indeed if the experiments would be conducted with a higher volume of water delivered at the same discharges, we could expect a quite unchanged removal volume.

Thus it seems confusing to present measured erosion as solid discharge (averaged during the experiment time) and it would be more clear to present it as total removal volume (both in the graph and in the text).

We could consider a first stage during which the ravine forms and adjusts to the constant discharge, with a removal volume not dependent on the discharge, and a second stage where the ravine is in steady state with this discharge. During ravine formation and adjustment to the discharge, the eroded volume would not be dependent on the discharge. During the second stage, the solid discharge is drastically lower and could follow the dependence between solid and liquid discharges known in river systems.

As a second sediment load peak is observed when the discharge is increased (in the experiment conducted with larger water volume – runs 10-12 and 18-20), the total eroded load in a ravine could be function of water discharge fluctuation and temporar-

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ily. Note that the total eroded load is higher for experiments conducted with increasing water discharge (and higher water volume) (figure 3a), which could support this hypothesis. Nevertheless, in those experiments the final steady state (if existing) has not been reached (fig 5 c and 5d) mitigating any interpretation.

Considering the previous comments, I put into question the discussion about the independence between liquid discharge and sediment discharge, it also put into question part of the discussion on the implication of the presented study results for natural systems.

Finally I assess some specific comments:

As on the precise measurement, the sediment flux is not null at the beginning of the experiment (figure 4), there are no reason to link the first point of the data sets to figure 5 to the origin. Moreover, erosion may begin as soon as the notch outlet is open, with no tend to a null flux when the time from the opening tends to zero.

Some modification I propose in the conclusion :

paragraph 1 (p.11 l. 2-5) The experiments here suggest that water volume, rather than discharge, [-(remove) controls the total volume of erosion in ravines because sediment discharge rates are linearly related to water discharge rates,] [+(add in place) controls the total volume of erosion during the ravine formation.] This result holds true for both transport-limited and detachment-limited systems.

paragraph 2 (p.11 l. 5-7) As long as slope is a free parameter in these rapidly-evolving systems, [-(remove) each] [+(add in place) changes in] flow rate can be accommodated through [-(remove) changes] [+(add in place) an adjustment] in both cross-sectional and longitudinal channel geometry. Wider channels were typically shorter and thus steeper.

paragraph 3 (p.11 l. 8). "well known" is an unnecessary precision, I would delete it.

I hope those comments could help to improve this article and make a great publication.

C3

Yours sincerely, Dr Valentin Wendling

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