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Interactive comment on "Experimental study of sediment traps permeable for frequent floods" *by* Sebastian Schwindt et al.

Author's response

F. Comiti (Referee)

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Dear Authors,

I think your experiments were very well conducted, the results are clearly explained, and your ms is nicely written. However, I believe some clarifications are necessary before publication. Please find below my comments.

Best wishes Francesco Comiti

Dear Francesco Comiti,

Thank you for your thorough and constructive review of our Manuscript. We adapted the text in response to your comments. We answer the particular remarks in detail below. The updated manuscript still requires the Editor's invitation that we hope to receive soon.

Best wishes,

the Authors.

Introduction

This section is too much focused on bedload transport issues, whereas little is presented about why check dams are used and how their implementation evolved over the past decades/centuries (see paper by Piton et al. ESPL). As the topic is very technical on check dam designing, I think the introduction should summarize the historical evolution of such structures

We improved the introduction by completing the reasoning for the construction of check dams, also applying on Piton et al. (2017).

Design approach for permeable sediment traps

The statement about the dominance of supercritical flows in mountain rivers is not true, as many lab and field investigations - also related to high flows - found out that critical flow conditions (Fr around 1) represent a sort of upper limit in mobile beds , for example see Grant (1997, WRR), Comiti et al. (2007, J. Hydrol, 2009, WRR), Yochum et al. (2012 J. Hydrol), Zimmermann (2012 WRR). Therefore I think you should modify your phrase, making explicit that only in the case of a smooth, stable bed (bedrock, artificial revetment) supercritical flow can onset in steep channels and thus a stable hydraulic jump can form in the retention basin downstream.

We adapted the text.

Also, the assumption that bankfull discharge corresponds to effective discharge for sediment transport does not hold for steep channels (see Lenzi et al., 2006 J. Hydrol.)

We completely agree with that and we clarify this differentiation now in the revised discussion Section 5.4 (Application and limits).

I would merge section 3 with section 2, as they are quite short

This is true. We merged sections 2 and 3 but we kept subsections because both titles are two different aspects that are crucial for the understanding of the paper. We want the reader to easily relocate both the design of check dams and the related sediment retention pattern through the section titles.

Methodology

This section is quite well written and complete. However, I'd suggest some minor changes/comments:
- the use of the term "torrential barrier": I would avoid the adjective torrential, it is not needed and in English it refers more to debris flow processes.

We removed the adjective "torrential" in front of "barrier" in the manuscript.

Actually, you should clarify also earlier in the ms that debris flows are not considered in your work.

We added this hint at the end of the introduction.

- driftwood: In English refers to wood drifting in lakes or ocean, not in rivers. I'd suggest use simply "large wood" or "wood material" –

Implemented.

Why did you choose a value of roughness n equal to 0.02 ? Please comment on its appropriateness relative to prototypes

The roughness originates from the bed grain size and it results from respecting the geometry scales that we observed in nature (e.g., ratio between channel width and grain size). We assessed the interpolated Manning's n in earlier studies using a shooting algorithm applied to the resolution of 1D Saint-Venant equations along the channel. We added this in the text.

Results

Also this section reads well and presents useful information. However, I find the number of figures a bit too high and I suggest to consider removing 2-3 figures to make the paper more concise and shorter.

The application of the motion-sensing device (Kinect V2) is interesting to know but not crucial for our manuscript. Therefore, we provide the former Figure 9 (Kinect application) and the error evaluation (Figure 10) as supplemental material now.

Discussion

Can you offer an explanation for the lack of incision and reshaping of the deposit, differently from previous studies? More in detail, is it possibly due to the relative size of sediments (with respect to flow discharges?)

Indeed, we used a larger grain mixture than what was used in previous studies and we added this hint in the text. However, given the small geometric scale (large size) of our model, the grain sizes are coherent with the set of field observations that we used.

Didn't previous studies obtain grain imbrication too?

This would be interesting to know but we cannot appropriately judge imbrication based on the reports from former studies.

Could there be a the role of test durations?

Sure, there is a role of duration. We tested longer durations in preliminary tests and we observed more pronounced sediment deposition and higher deposit volumes in these tests. Therefore, our *experiments are on the safe site regarding sediment retention. We added this in the discussion.*

Please comment on how this lack of reworking compares to real cases You argue that the guiding channel should be rough to favor fish passage, this is correct, but isn't this in contradiction with the Manning n=0.02 you tested? Also, the rougher the channel the less the flushing is effective.

The situation that we modeled corresponds to floods when, we assume, there is no fish migration. In the flood situation, the relative grain submergence is low, and therefore the flow smoothens. We added this aspect to the discussion of eco-morphological aspects in Section 5.3.

As to driftwood passage (but please call it large wood), this can be favored for frequent, low floods and for moderate log lengths, and thus relatively large bottom openings are good also to this respect. Wood should be trapped during large, infrequent events only, as for "excessive" bedload (Comiti et al., 2016, Geomorph)

We added this and the literature resource in the Manuscript.

The term torrential hazards again suggests debris flow-like processes in English, whereas here you mean intense bedload. I suggest to drop the term torrential

As earlier proposed, we dropped the term torrential with respect to our study but in the reference to Piton and Recking (2016a), we kept the term, as it applies to their study.

Conclusions

Although your experiments do provide very interesting insights on the de- position processes during a flood, I am left with a doubt: are we sure that the guiding channels are actually beneficial for bedload permeability in the long run? You state that after the deposition the receding flows were not able to rework the sediment deposit as the channel "attracted" the flow, leaving the deposit untouched, and then one has to intervene mechanically (with very high costs !) For ordinary floods, in a check dam without a guiding channel but with large openings the flushing could be similarly effective, I suspect.

The key point is that the sediment transfer is improved through the guiding channel up to small, non-hazardous floods. Mechanical interventions after an important flood event are inevitable. We adapted the conclusions to highlight this important aspect.

I have seen "very open" check dams which do not trap much bedload during ordinary floods, and very likely they are able to partially self-clean after a flood event through "wandering flows" over the deposit (if openings are located at different heights), apparently better than with a guiding channel (based on your experiments). The question is about how much sediment can be let pass during a flood, and this is very site specific depending on the conveyance of the downstream channel. Can you please try to "convince" more the reader on the real advantages of guiding channels?

The self-cleaning may be interesting but it can also be very dangerous. We added a paragraph in the discussion Section 5.2 (sediment flushing) to underline that (also according to a remark from Reviewer 3). With our sediment trap concept, we want to promote sediment continuity but only if the risk of uncontrolled self-cleaning can be avoided. We added the key word of self cleaning and we adapted the conclusions to stress the importance of avoiding unwanted sediment flushing.

Also, I think a big issue that you should highlight again in the conclusions is the very critical role of wood on clogging the openings, and how this should be contrasted (as discussed in the literature you already cite) or accounted for.

We added this for future work at the end of the conclusions.

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