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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Open check dams and large wood: head losses and release conditions" *by* Guillaume Piton et al.

Guillaume Piton et al.

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Reviewer Comment: 1. The comments of Reviewer #1 are written after "Reviewer Comment" The responses by the authors follow in normal style.

Reviewer Comment: 2. General comments:

Reviewer Comment: 3. I carefully read the manuscript titled "Open check dams and large wood: head losses and release conditions" submitted by Piton and co-authors to the Journal Natural Hazards and Earth System Sciences and currently undergoing a thorough open discussion process. The authors tackle a subject of utmost interest describing the behavior of large wood (LW) at variously designed open check dams, assessing quantitatively the increase of energy dissipation and thus the flow level at

the structure due to accumulating of LW in various fashions and attempting to decipher the LW release mechanisms which may trigger subsequent hazard processes potentially resulting into severe damages at farther downstream located risk hotspots. In investigating these topics, the authors applied an experimental approach and conducted an extensive research program. This enabled them on the one hand to gain important insights into the physical processes of LW entrapment and overtopping and to provide for estimates of the relative overtopping flow depths which may prove useful in engineering design endeavors. In light of these preliminary considerations the covered contents fit into the range of scopes of the Journal further contributing to improve our understanding of both the interplay of LW with instream structures and the potent hazard triggers which may result from this interaction.

We thank very much Reviwer #2 for his time and comments.

Reviewer Comment: 4. As clearly emerges from the previous paragraphs I value the proposed research and the experimental approach which underpins it, I also contend that the employed experimental setup (i.e. inclined channel featuring constant width with an "insertion" of instream structures of different geometries and designs) might not reflect the entire variety of topographic settings real retention basins and check dam structures are inserted in. If the width of the channel was variable and if, in particular, the available retention volume for all constituents of wood laden flows increased behind the interfering instream structure, LW could be accommodated differently in space due to a more variable spectrum of flow patterns. Different longitudinal profiles (i.e. milder slopes in proximity to the check dam if compared with possibly steeper feeding channels) could also influence the LW accumulation upstream of the considered instream structure. Hence, I motivate the authors to comment of these issues, since the interested reader needs to clearly understand the limits of knowledge transfer related to your findings.

We agree that the pattern of accumulation and development of the LW carpet would change depending on the basin width rather than just the open check dam width. Regarding the effect of basin slope, the key question is how long is the dam backwater area? This is already discussed in the responses to the comments of Reviewer #1. Regarding the basin width we will add the following elements about this question: “The flume was 6.0 m long, 0.4 m wide and 0.4 m deep. Our flume modelled a basin 8-24 m wide (assuming scale ratio of 1:20-1:60) which is not extremely wide but consistent with many structures observed in the field (Piton et al., 2015, p. 22). The eventual widened basin located upstream of open check dam was thus not modelled. Experiments recently performed on an open check dam with a wide basin demonstrated that LW naturally floats spanning the whole basin width and accumulates in the close vicinity of the open check dam (Roth et al., in press). This was also observed in our relatively narrow flume. We hypothesize that using a wider basin would simply enable the LW to accumulate more widely rather than longitudinally along the flume. More complicated basin shape would likely trigger recirculation pattern that might modify the floating carpet behaviour far from the dams (see e.g., Tamagni et al. 2010). This work clearly focuses on the interaction between LW and open check dam in the close vicinity of the barrier. “

Reviewer Comment: 5. I also argue that the way how LW is approaching the interfering instream structure may co-determine the blockage behaviour. It could have been insightful to explicitly consider the peculiarities of LW influenced flow regimes rather than trying to supply LW to make the jam “supply unlimited” as is stated by the authors. To reiterate on this point, I think that the LW pieces arrival scenario may play a relevant role. The LW congestion (sensu Braudrick et al., 1997) or more recently described hyperconcentrated LW flow regimes (Ruiz-Villanueva et al., 2019) might play a crucial role in determining the blockage mechanisms, rightly due, as the authors point out, to both drag forces and buoyancy, to particular entanglement mechanisms between LW pieces and to friction forces between LW and exposed structure surface. I think that in their discussion the authors should deal with these issues and based on their findings provide hints for specific future research. Reviewer Comment: 6. More generally I’m also convinced that the experimentally simulated discharge vs time relation (i.e. flow

hydrograph) could indirectly exert an influence on the LW blockage and overtopping behavior. Falling limb scenarios seem not to be considered in the applied experimental protocol.

We agree that the question of how LW transported in various regimes approach open check dams is of interest. As pointed by Review #2 in his previous comment, the upstream channel features and shape as well as the basin features might also influence and modify the way LW approach structures. It is a complex question. In the material and method, we will introduce the following comment: “The mixtures were progressively introduced to the flow from the first step. Logs were introduced manually at the upstream end of the flume, by groups of 5-15 logs, in a semi-congested mode (sensu Ruiz-Villanueva et al. 2019). Indeed, D’Agostino et al. (2000) reported that congested LW clusters tend to be laminated by the hydraulic jump that might appear where the channel flows enter the dam backwater area. In addition, congested LW clusters might also be reorganized by the recirculations that appear in the dam backwater area (see e.g., Tamagni et al., 2000). Consequently, although this is a simplification, we neglected the upstream, in-channel LW flow regime and forced a semi-congested supply regime.” And in the discussion we will add the following elements : “This work modelled the rising limb of hydrographs until overtopping of LW or maximum pump capacity. Hydrograph recession or eventual flood hydrograph with several peaks were not modelled. LW jams tend to remain in place when discharge decreases according to our experience (see also Roth et al., in press). If LW jam are not cleaned, we consider, consistently with Schalko et al. (2019a), that large head losses are to be expected at structures already jammed by LW. Similarly, it is worth mentioning that if LW hypercongested flows (sensu Ruiz Villanueva et al. 2019) occur and enter the dam backwater area as a floating carpet comprising several layers of logs; it could reach the dam en masse and immediately form a 3D dense jam even though the flow remains in the floating carpet regime. In such a case, we hypothesize that the jam would be more stable than a single-layer floating carpet (i.e., would be released for higher overflowing depth) but this is to be verified in further works. The eventual effect of basin shape or presence of sediment deposit on the LW supply regime would also be worthy of investigation. “

Reviewer Comment: 7. To conclude this general comments section, I also share most of the concerns raised by the other anonymous reviewer. So without any further redundancy, I suggest a major revision focusing on the aforementioned both content and form related issues.

See responses to Reviewer #1.

Reviewer Comment: 8. Additional specific comments: Reviewer Comment: 9. Abstract: L11: It would be better to rephrase “Large wood (LW) tends to accumulate against such structures” to “Large wood (LW) tends to accumulate at such structures”.

Ok, done.

Reviewer Comment: 10. L14: It would be advisable to rephrase “to estimate how high is the overflowing depth atop the structure” to “to estimate the overflowing depth at the structure”.

Ok, done.

Reviewer Comment: 11. L19: “is about 3-5 the mean log diameter”. I’d write “is about 3-5 times (or D) the mean log diameter”.

Ok, done.

Reviewer Comment: 12. L23-25: Please check this last sentence and enhance its readability.

We will certaintly try something.

Reviewer Comment: 13. L26 Keywords: I’d put Large Wood instead of Woody Debris.

We used LW throughout the paper but wanted to use another key word for people calling it woody debris to find the paper. The term is still widely used by some communities.

Reviewer Comment: 14. 1 Introduction: Reviewer Comment: 15. L70: Please refor-

mulate the entire sentence to improve its readability.

Ok, done.

Reviewer Comment: 16. 2 Computing open check dam discharge capacity Reviewer Comment: 17. L102: Check the font of z2 in the figure caption. It seems not to be consistent with other mathematical symbols.

Thanks, this will be corrected.

Reviewer Comment: 18. L104: The caption of Figure 1 should end with a full stop.

Ok, done.

Reviewer Comment: 19. L111: $\sqrt{2g}$ is a common factor and it may be brought outside the bracket. The same suggestion applies to the second term in equation 4.3

Good suggesiton. Done.

Reviewer Comment: 20. Materials and Methods Reviewer Comment: 21. L134: Instead of referring the reader to the research report of Piton et al. (2019b) please provide a sketch of the flume. Instead, please try make the difference of this work with respect to the cited research report explicit.

We will make clear that this report is in French and was not peer-reviewed. The flume is a simple flume and does not, to our opinion, deserve to the sketched. The paper has already many figures and it would be probably useless.

Reviewer Comment: 22. 3.3. LW mixtures Reviewer Comment: 23. It would be an added value to provide more background on reasons for the selection of these specific mixtures.

Some more elements will be presented about the way we designed the mixture.

Reviewer Comment: 24. L158: There seems to be an inconsistent link to the figures in the supplementary material: (Figure 3 and Erreur ! Source du renvoi introuvable.-3 in supplementary material). Please fix it.

Yes, sorry for that. We will fix this point.

Reviewer Comment: 25. 3.4. Experimental protocol Reviewer Comment: 26. L174-175: Is there a deeper logic for the choice of the number of runs. Are these numbers sufficient to capture the randomness of the LW jam formation?

Good question. Who knows? We think it sufficient to capture a first approximation of the randomness of the processes. And 3-4 repetitions are better than none. We will however add the following comment: "This is less than the high number of repetitions required to capture behaviour of single logs at reservoir dam spillways (Furlan et al., 2019, 2020) but we assume it sufficient to capture the random variation of the process of large amount of logs piling up at dam. This should be validated in later works."

Reviewer Comment: 27. L190: h0 seems to be in the wrong format. Homogenize with the other employed mathematical symbols.

Thanks, corrected.

Reviewer Comment: 28. Caption of Figure 4: The caption of this figure should be expanded to explain how to interpret the wealth of information displayed in the figure.

The new caption will be: "Computation steps for $\beta 1$ and $\beta 2$. Step 0: fit of the pure water equation. Step 1: computation of $\beta 1$. Step 2: computation of bounding values of $\beta 1$. Step 3: computation of $\beta 2$. Step 4: computation of bounding values of $\beta 2$. "

Reviewer Comment: 29. L204: I'd change "accumulation against: : :" into "accumulation at: : :". Maybe even more rigorously "accumulation upstream of.."

We replaced "against" by "at" throughout all the paper where relevant.

Reviewer Comment: 30. L247: 4.2 LW-related head losses and stage –discharge relationships. Insert a space after –

Thanks, corrected.

Reviewer Comment: 31. L268: Change "both coefficient" into "both coefficients"

Thanks, corrected.

Reviewer Comment: 32. 4.3. Release conditions Reviewer Comment: 33. L307-308: Furlan (2019) also studied the effect of log density that was ignored in this study. I think this should be explained. Is density unimportant? If yes, why?

Very relevant remark. We will add the following comment : "Furlan (2019) also studied the effect of log density that was ignored in this study. While the density is key to determine the submerged part of a single log floating and eventually passing over a dam reservoir spillway, as soon as several logs piles up and eventually slide or rotate over the open check dam crest, we assume that their respective density has only a side effect. It is however taken into account in the second dimensionless number introduced below."

Reviewer Comment: 34. Figure 10: Personally, I find the figure a bit cryptic. On the horizontal axis "the fraction of large wood released is considered. In the legend the % released with circles of different sizes in displayed. Is there a redundancy here? Please explain.

The figure will be redrawn without the size and transparency dependency. It was redundant.

We thank very much reviewer #2 for his/her constructive comments and time spent in helping us to improve this work. It is really valuable.

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