General comments

The authors present an interesting paper on the effect of large wood (LW) at various open check dams on hydraulic conditions. Based on an extensive data set, the authors describe resulting backwater rise due to LW blockage at check dams and analyze the process of LW overtopping the dam structure. From a flood hazard perspective, it is very important to determine when LW may pass the retention structure as this can increase flooding downstream. The authors introduce dimensionless parameters to 1) describe the physical process of LW overtopping and 2) inform engineers what relative overtopping flow depth results in LW overtopping. The paper fits very well to the scope of the Journal and provides new insights regarding the interaction between LW and hydraulic infrastructures.

My general comments concern the description of the physical experiments, analysis of effect of LW characteristics, workflow to apply the "non-dimensional parameter describing the formation of a LW carpet", and the form (language) of the paper:

1. The description of the experimental procedure should be improved. It is not clear to me how the authors added LW (L180 ff). A table of the test program should be added. In addition, the authors refer to Piton et al. 2019b regarding the experiments. Please clarify the difference between the reference and this present study.
2. The proposed computational steps to determine the effect of LW on stage-discharge relationship (beta1 and beta2) are easy to follow, but the resulting values exhibit large variations. The authors do propose that engineers calculate upper and lower boundaries, but recommendations on how to select a final value or how to proceed are missing.
3. The experiments were conducted for various LW dimensions. However, the effect of LW mixture or presence of organic fine material is not discussed. Due to the presence of organic fine material, the resulting backwater rise increases, as depicted in Figures 6-9. The paper would benefit from a short discussion on the effect of FM on backwater rise, as it also enables the comparison to previous studies with branches and leaves.
4. The authors introduce a dimensionless parameter describing when a LW carpet forms or when a more compact LW accumulation can be expected. I agree with the authors that the ratio of buoyancy to drag force has not been presented in that form yet. However, Schalko et al. (2019, Water Resources Research) state that "The initiation of a LW carpet formation corresponds to the state, where the buoyancy force is higher than the downward drag force." The reference is included in this paper but the concept of the "characteristic LW volume generating the primary backwater rise prior to the formation of a LW carpet" is not discussed and no reference added when the ratio of the forces are presented. I recommend adding this reference, as it provides a great opportunity to compare the present analysis with other approaches. In addition, it should be added that the application of this concept (to identify how LW accumulates), required first to determine the resulting backwater rise and then insert this value to U in F_D; it would be interesting to discuss the limitations, as beta1 and beta2 exhibit large variations.
5. The authors include a section regarding comparison to previous work with an interesting table. However, in the text the authors compare their results only to Schmocker and Hager. I recommend to either include more quantitative comparison or shorten the section.
6. The paper is well-structured, and the majority of the figures are very informative. However, the paper is very difficult to read. I strongly recommend that the revised paper is proofread by a native speaker. Please also check consistency of terminology (see technical comments).

Based on these general comments, I propose the paper needs **major revision in content and form**. I added more detailed comments below.

Specific comments

Keywords

- Recommendation: add driftwood (or replace woody debris using driftwood)
- Hyper-congested LW transport is defined as LW transport at the very front of a flood wave, where the amount of transported LW significantly exceeds the amount of water. As the type of transport is not discussed in this paper, I would recommend writing congested LW transport and also add this term in the text.

Abstract

- The authors use the term “energy dissipation” in the abstract and also in the entire ms. I would recommend replacing this term with hydraulic losses, as energy dissipation in this context is very confusing.

Introduction

- L82/84: The experiments were conducted without sediment. I recommend to either remove the sentences regarding sediment transport or add information on how to derive effect on sediment transport and elaborate more in detail how flow above the structure affects sediment transport.

Computing open check dam discharge capacity

- L95: The terminology of flow energy in m is not correct; please use “energy head” (energy is confusing with [m] as units); in addition vertical height above datum is missing.
- L98: The authors state a range of flow Froude number F between 0.01 and 0.3. F = 0.01 this is very small; is this a common value at check dams - in particular when the authors stated in L80 that the flow Froude number is expected to be larger at check-dams compared to reservoir dams. Please discuss.

Materials and Methods

- Add more details on the experimental setup. Why did you choose the respective slope, what is the accuracy of the measurement devices? Regarding flow depth measurement: what if LW accumulated 20 cm upstream of the dam - how did you account for that?
- Add here or in a subsequent section information regarding tested discharge, to what flood they correspond and why you tested those values.
- L157: How did you choose the respective LW dimensions; please add quantitative information to the text instead of "twofold greater number of elements".
- L161: Regarding the fine material: how much organic fine material did you add, why did you choose pine needles, I assume this is very difficult to collect at the end; if you upscale pine needles using a scale factor of 30 it represents rather twigs.
- L167: In addition to the authors' experience, please include references to clogged LW volume at structures during previous floods or refer to previous flume experiments.
- L189: See general comment regarding reference to Piton et al. 2019b

Results:

- L213ff: please also comment on the effect of flow condition on this process; please see description of LW accumulation process at racks by Schalko et al. 2019 WRR - it is very similar and worthwhile to compare
- L290: Regarding the surface waves: Why did you not add a floater or flow straightener to suppress surface waves - how can this test be included if the initial conditions cannot be compared to the other tests?
- L292: How was this problem fixed for the measurements with LW?

- L324: See general comment on Schalko et al. (2019, Water Resources Research) stating that “The initiation of a LW carpet formation corresponds to the state, where the buoyancy force is higher than the downward drag force.” Please add reference
- How did the authors account for the effect of organic fine material? Did you include the dimensions of the pine needles in an average “equivalent log diameter”?
- Figure 11: I agree that the data provide information that h* decreases with increase T/Fd ratio, but the variations are extremely high; please discuss.

Discussion

- See general comment regarding comparison with other studies
- L375: Please clarify; Given the same approach flow depth, resulting backwater rise under supercritical conditions is higher because of the increased flow velocity and hence increased energy head.
- L377: What are “average LW volumes”, these classifications are based on previous flume experiments and do not correspond to measured LW volumes in the field. I advise to use specific volume numbers or base such categories on field observations.
- L379: If you use the term kinetic energy then please use "potential energy" and not height; but I would recommend to use terminology that reflects your equation. In addition, this is not only the case for supercritical flow, but also for subcritical flow. Also, in L98 you state that F varied between 0.01 and 0.3, which is subcritical. Please revise.
- L391: The authors observed that the LW accumulation piled up? Would you not say that the initial logs block the open flow cross-section, and logs are pulled downward along the dam?
- L415: Due to the characteristics of LW it should not be recommended to use 1D models when simulation the interaction between LW and infrastructures. Since the paper is very long, I would recommend deleting this section and add the application of the approach in the Conclusions section.
- L435: See general comment regarding uncertainty – to apply the ratio between buoyancy and drag force, the backwater rise or resulting flow velocity is required. This depends on beta1 and beta2, which exhibit large fluctuations. Please comment.

Conclusions

- L458: The increase in flow depth includes a wide range - how should this then be considered by engineers?

Technical comments

Abstract

- What is a piedmont river?

Introduction

- L30: “LW might actually play a significant role…”; please revise as several previous floods demonstrated the destructive power of LW accumulation at river infrastructures.
- L35: Replace “disturbing” with affecting
- L55: Revise the two research questions, as they are very difficult to read in the present form. As described above, I advise that the authors use “hydraulic losses” instead of “energy dissipation”. In addition, I would recommend replacing “bridge jamming hazards” with a more generic term as “flood related and structural hazards”
- L62: Recommend using “poles” or simply “racks” instead of piles as these terms were also used in the cited papers.

Computing open check dam discharge capacity

- L96: Add flow depth to h and energy head to H
- L105: Add reference
- L107: Add h1 to Fig. 1
- L126: Revise sentence and refer to section instead of “see later”.

Materials and Methods

- L132: Either state one model scale factor or the range; in addition, please replace ”to the authors’ opinion” with a reference or remove it.
- L144: than instead of that
- L150: figure? Not clear
- L158: Check document regarding “error”
- L161: The authors use the term “large wood” in the title and ms; I advise to only use this term and replace “debris” and “coarse debris”.
- L177: “to the flow” instead of “in the flow”
- L177ff: Revise description on how the LW was added to the flow. “The LW jam could thus always grow up if flow conditions allowed it.” This is not clear.
- Figure 4: The scheme is very helpful; the data points are very informative, but to improve readability I recommend to only plot data of e.g., 2 LW mixtures and data without LW.
- L196: Add “data” to point transparency

Results:

- L200: Include section numbers or delete this summary
- L203: what are “most runs”?
- L204: “LW accumulation at check-dam” not against
- L205ff: Specify orientation and location of log (e.g.: in a horizontal position to the flow direction” or simply horizontal to the flow direction). In addition, revise: “They get stuck against and often parallel to the dam.”
- L210: Please specify “in the LW jamming”
- L219: Revise “overflowing on the spillway” and check used prepositions in entire ms

- L222: “few LW pieces finding a way over the spillway”, please revise, e.g. “few logs were transported over the spillway”
- L234: Delete “Nonetheless” or combine the subsections and make it clear to what “nonetheless” refers to.
- L239: If this was not tested or observed, please revise this sentence. e.g. it can be hypothesized and not "without any doubt".
- Figure 5: Please add flow direction arrows, and specify “most runs”
- Figure 6-9 and related text sections: See comment regarding “debris” and general comment regarding effect of LW dimensions on backwater rise.
- L270: delete “really”
- L276: close to each other not from
- L276: not clear what is meant by “current lines”
- L303: three instead of some
- Equation 5: please add definition of z2 again
- L312: maximum instead of max
- Figure 10: The different sizes of data points corresponding to release of LW are very helpful in Figure 11, but I would use same size for this Figure since the parameter corresponds to the x-axis.
- L322: Please revise, difficult to follow (LW submerged in number and tightly entangled?)
- L327: differentiate instead of “discriminate”
- Equation 7: I recommend using rho_LW instead of rho_s to avoid confusion with sediment density
- L332: Recommend using V instead of u in Equation for consistency; based on the number of symbols a “Notation” section would be very helpful.
- L341: Delete “sucked” or replace
- L352: Close to the threshold

Discussion

- L363: I agree but it is somewhat strange to write this sentence in the section "comparison"; you may want to move it to “Conclusions”
- L365: represents instead of “encapsulates”
- L367 ff: exhibit instead of experience
- L374: approaching instead of incoming flow
- L383: dams
- 398: Revise “thus flow power to stuck LW against the dam”
- Table 2: What is meant by “marginal release”; definition of LW volume categories not clear; 540 dm^3 were added in Schalko et al. compared to 75 dm^3 in Schmocker and Hager
- L403: Please revise, not clear.
- L430: Revise “fruit”
- L444: differentiate instead of discriminate

Conclusions

- L450: Please revise; what is “the other hand”; what are “transported element sizes” – logs?
- L451: affect instead of “trouble”
- L465: What is meant by “without calibration” – see general comment on this transition