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Influence of Wood Density on Backwater Rise due to Wood Accumulations upstream of a Retention Rack

Mallqui et al.

Editor handling the paper: Isabella Schalko

Round 1, Reviewer A

ITEM	REVIEWER A	ANSWER	LOCATION
1	Title is too generic and not really descriptive of the work carried out. What is the backwater rise for? Bridges? Dams? Hydraulic structures?	Thanks for the observation. The backwater increment is located upstream of a retention rack.	Title and throughout the document.
2	I can't really see much novelty in the manuscript. Schalko et al. (2019) did consider	Thanks for the observation. The range of wood density values was expanded (400 to 950 kg/m3), the effect of density on the dimensions of the accumulation was evaluated, especially on the height, which for values of Fo=0.2, 0.3 was much less than the height of the water.	Introduction, line 9, page 3
3	References are grossly insufficient. A lot of similar work from colleagues around the world is missing (some of which also studied the importance of density in large wood accumulations!), such as: De Cicco et al. (2020), Livers et al. (2020), Panici and de Almeida (2018); Follett et al. (2021); Muller et al. (2022), Gschnitzer et al. (2017) and many more.	Thanks for the observation. - An analysis of the influence of the retention grid on the amount of logs retained was carried out, making a comparison with Cicco, 2020 - The method to calculate the solid volume was that of the cylinder (Livers, 2020) - Rise of height accumulation was compared with the results of Panici and Almeida (2018) - The space between the channel bottom and the accumulation height was compared with the gap studied by Follet (2021) - The study of Gschnitzer (2017) was cited in the introduction.	- Discussion, line 11, page 13. - Test Procedure, line 16, page 6. - Discussion, line 27, page 13. - Discussion, line 24, page 13. - Introduction, line 10, page 2.

ITEM	REVIEWER A	ANSWER	LOCATION
4	There is plenty of work that has been done on racks, but only Schalko et al. (2019) is reported. How does the authors' work compare to the others in the literature and the backwater rise? For example: Hartlieb (2017), Lyn et al. (2003), Lange and Bezzola (2006), Schmocker and Weitbrecht (2013), Panici and Kripakaran (2021), but there's more. Some of these works proposed their own equation for backwater rise estimation: how does that compare to what the authors have developed here?	Thanks for the observation. Results of backwater rise of the present study and other authors were compared in Figure 11.	Figure 11, page 11.
5	Methods are also insufficient. There is little description of the test procedure and how data will be analyzed. There's no mention of the instruments used and their accuracy. The choice of parameters is unjustified. Also, very importantly, a dimensional analysis has not been included	Thanks for the observation. The accuracy of instruments is shown on Model Configuration section. Another section for Dimensional Analysis was generated (Section 2).	- Model Configuration section, line 12, page 4. - Dimensional analysis, page 3.
6	The results and discussion sections are very meagre and lacking substance in the description of the observed processes	Thanks for the observation. We added the results of the evaluation of the influence of log density on the geometry accumulation. In the discussion, we compared the results of this with other authors.	- Discussion, page 13.
7	There's no future outlook or description of "what's next" in the discussion	Thanks for the observation. A proposal for future research was added in the last paragraph of the conclusions.	- Conclusions, line 35, page 14.

Round 1, Reviewer B

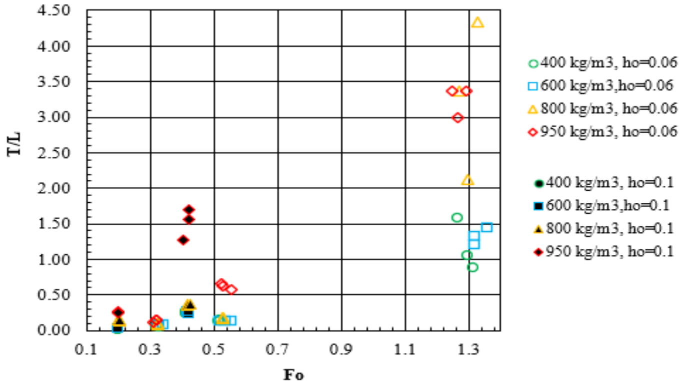
ITEM	REVIEWER B	ANSWER	LOCATION
1	1. Literature review. Further publications in the context could be included, the review is so far rather short.	Thanks for the observation. We included other authors in the analysis: De Cicco (2020), Follet (2021), Gshtnitzer (2017), Kramer (2017), Lange, Bezzola (2016), Livers (2020) Panici and Almeida (2018), Panici and Kripakaran (2023).	Throughout the document.
2	1. Scale and model effects (lines 110 et al.) should be discussed in the section 2.1 more detailed than in the present version. Particularly the wall effects (trunks have to orient parallel to the wall instead of being parallel to the rack) are interesting, since the model is relatively narrow.	Thanks for the observation. The log groups were added in the center of the channel, trying to orient them parallel to the sides of the channel.	-Model Configuration, Line 21, page 4.
3	1. "Percentage" of retained logs: Relative to their supplied number (and not the volume), right?	Thanks for the observation. It's correct, the percentage is relative to the supplied number of logs.	--
4	1. The rack includes eight bars. They probably influence the result (obstruction of the section): Seven or nine bars would leave a different flow section open. If the Reviewer's hypothesis is correct, then please discuss this briefly in the manuscript.	Thanks for the observation. We discuss the variation of the number of bars in the first paragraph of the discussion.	- Discussion, line 11, page 13.
5	1. Is ho the flow depth with rack but without driftwood, or the downstream flow depth of the blocked rack?	Thanks for the observation. ho is the depth of the flow without driftwood, 0.30 meters upstream the rack.	- Test procedure, line 12, page 6.

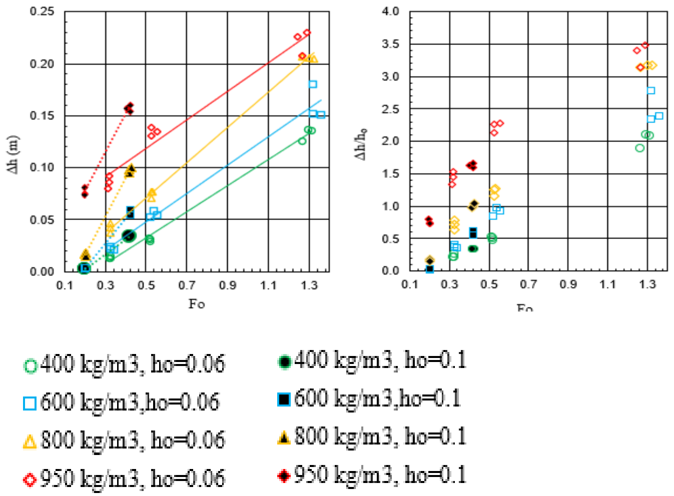
ITEM	REVIEWER B	ANSWER	LOCATION
6	1. Test repetition: Are the errors mentioned coming from the test repetitions or within the groups of same Fo? Is it possible to compare the outcome with the recommendations of Furlan?	Thanks for the observation. The errors mentioned come from the test repetitions. Please can you. Could you please specify which recommendation you are referring to?	--
7	1. Use SI units (no cm).	Thanks for the observation. This point was corrected throughout the document.	Throughout the document.
8	1. Were the trunks added to the model begin and then arranged autonomously at the rack, or did you position them directly there?	Thanks for the observation. First case: The logs were added to the flow, 4.7 m upstream the rack, and then they arranged autonomously at the rack.	- Model Configuration, line 6, page 4.
9	1. The information of Fig. 4 is included in Figs. 5 and 6. If this is the case, then Fig. 4 could be removed.	Thanks for the observation. Figure 4 includes a comparation of backwater results with Schmocker (2013).	Figure 11, page 11.

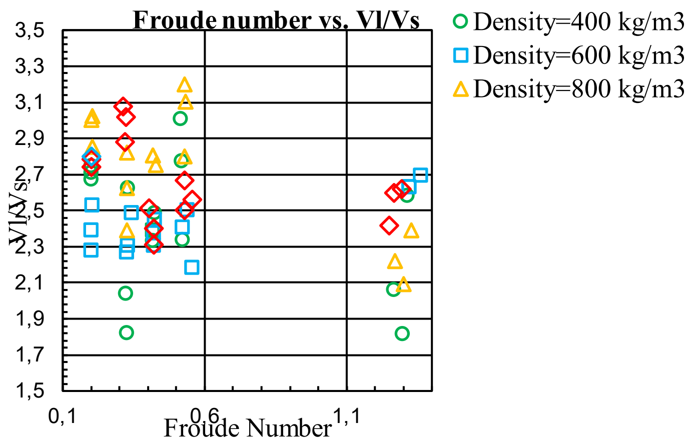
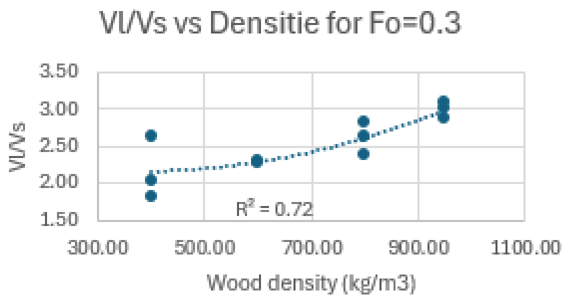
Round 2, Reviewer A

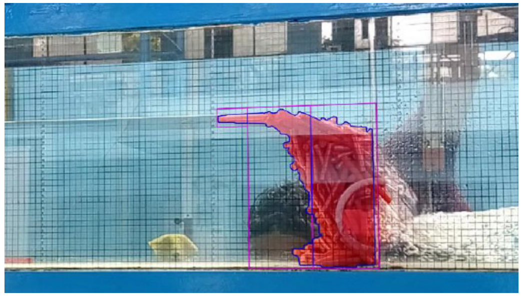
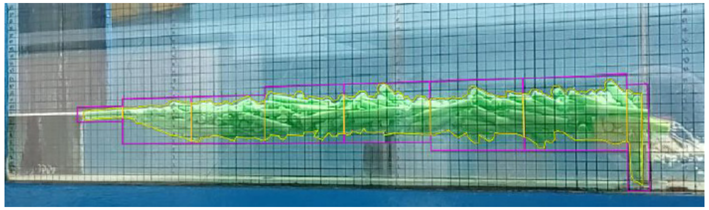
Number	Topic	Observation	Answer	Location
1	*Introduction: references and research gap*	The introduction discusses existing literature. Specific literature on effects of LW density, so the main topic of this paper, is quite brief. Please add more on previous *findings* on LW density here (focus on what exactly previous sources found, not only their topics). Note: Hartlieb (2015) has more detailed results, in addition to those available in the (Hartlieb, 2017) article already used. (It's in German, but his Fig. 3.32, Table 3.13 should give a good start.) And please have a look at what kind of structure Hartlieb studied, I think it was a weir instead of debris rack? Also see Al-Zawada et al. (2021)	We added some findings from Hartlieb (2015): Hartlieb (2015) developed a risk analysis on the transport of wood in rivers, including a study of consequences of blockages in the structures. Based on this, experiments on the effects of wood density on the headwater level upstream of a spillway were carried out. The results showed an increased headwater level and reduced discharge flow through the structure due to the increase of wood density. And Al-Zawaidah (2021): Al-Zawaidah et al. (2021) investigated the geomorphic changes caused by accumulation of different densities of wood and plastics at a vertical rack. Results showed that maximum scour depth was observed in the presence of light accumulations (density < 1000 kg/m3) and minimum scour depth was observed for dense accumulations (density > 1000 kg/m3). The study highlighted the importance of considering the density of accumulation as a critical factor in the prediction of geomorphic changes within the riverine system.	Lines 8 - 11, p. 3 Lines 15-19, p. 3
		The research gap is missing between line 8 and 9 of page 3, which in turn makes the novelty of this study unclear. Please be explicit what knowledge is currently missing, why further study is needed. The more detailed description of previous studies (above) should help making the step to what new knowledge you are adding.	We highlighted the importance of using artificial logs with a large range of densities in the study: Recent research has addressed the influence of the density of the floating material on the increase in backwater for different steady flow conditions, including natural wood, plastic waste and artificial wood. However, it was deemed necessary to extend the study to accumulations with a wider range of wood densities.	Lines 25 - 27, p. 3
		For line 9-12 of p3, a clearer split between aim and methods would be useful. E.g. this study aims to determine the influence of relative log density on… rack. Hereto flume experiments were conducted, taking into account.	Grammar signs were considered when we ordered the paragraph: Therefore, the aim of this research was to evaluate the influence of wood density on the backwater rise and shape accumulation upstream of a retention rack. For this purpose, flume experiments were conducted with artificial logs of a wide range of wood density values.	Lines 27 - 29, p. 3

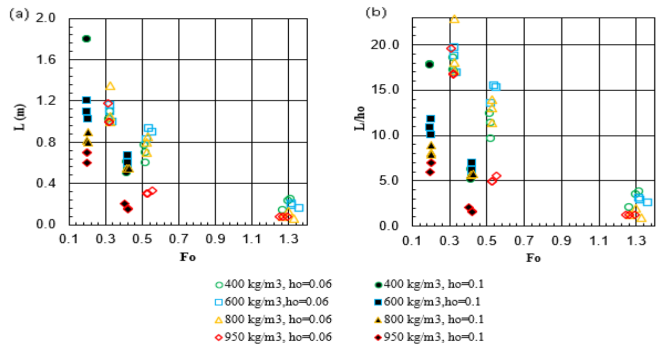
Number	Topic	Observation	Answer	Location
2	*Effect initial water depth*	Using a titling flume, the five tested Froude numbers are split over two different initial depths. This should be mentioned in the text. E.g. p4, line 33: 'To establish the test scenarios, 4 different log densities and 5 different Froude numbers were predefined, split over two initial depths and obtained by adjusting the flow rate, channel slope and downstream weir.' [NB: please also mention the weir here.]	We mentioned the use of two initial depths in the following paragraphs: A program of 60 tests was carried out in 20 different scenarios, varying the density of the wood, the Froude number and the initial height of the flow. To establish the 20 test scenarios, 4 different log densities and 5 different Froude numbers were predefined split over two initial depths and obtained by adjusting the flow rate, channel slope and downstream weir.	Lines 11-12, p. 4 Lines 26-27, p. 5
		More importantly, implications/results of the different initial water levels should be investigated, discussed in text and indicated in figures where relevant (use for example different marker styles).	We referred to the findings of another author and those of the current research: Some findings give a direction about the influence of different initial depths on backwater rise. For a given Fo, the approach flow depth ho has no effect on Δh/ho (Schalko et al., 2018b). In this case, it was observed that different initial depths have an influence also on the dimensions of wood accumulation (Sections 4.2 and 4.3).	Lines 4-6, p.6

Number	Topic	Observation	Answer	Location
		For accumulation geometry, it makes sense that a lower water depth leaves less space for LW, resulting in thinner and longer accumulations for a given LW volume. For accumulation thickness (Fig 5), this effect is likely compensated for by scaling using T/h_0. But not for accumulation length: using L/B it is ignored, and L/h_0 would exacerbate the effect further. Indeed, Fig. 7a shows that the Froude numbers of 0.3 and 0.5 (which had lower h_0) create relatively long accumulations. It makes sense this in turn messes up the scaling in Figure 7b, but this explanation is missing. And how about effects on accumulation compactness (fig. 9)?	We explain the use of initial depth to dimensionless accumulation height and length:To make the length and height of the accumulation dimensionless, the initial depth was used (h_0). In the case of the height accumulation, the relation T/h_0 compensates for the variation of initial depth because (T) covered almost the whole flow depth (h). In the case of the length accumulation, L/h_0, initial depth exacerbates the reduction in length with respect to the initial depth since a lower h_0 generates a greater L.And the effect of ho on compactness (T/L):It has been observed that L decreases with initial heigh (h_0) and T increases with h_0, while, in Figure 11 it can be seen that T/L takes higher values for h_0 = 0.10 m (F_0 ≈ 0.2, 0.4) compared to the same density data (same color), however, it's no possible to stablish a relation between T/L and h_0 considering the data of the present investigation, rather, it has been seen that compactness is influenced to a greater extent by wood density and Froude number.  	Lines 3-6, p.12 Lines 12-17, p.13

Number	Topic	Observation	Answer	Location
		Maybe you could even say something about initial depth and backwater rise? For backwater rise, eq. 5 by Schalko takes initial depth into account, and tries to scale the absolute LW volume using the initial depth. Potentially you could use your results as an indication of how well the predicted and measured results line up for different initial depths?	We explain the influence of initial depth on backwater rise: First, the influence of the two different initial depth on the relative backwater rise was analyzed in Figure 17. As can be seen, backwater rise increases linearly with increasing Froude number (Figure 17a) and data for both initial depths follow the same trend line when plotted against relative backwater rise (Figure 17b). 	Lines 10-12, p.15

Number	Topic	Observation	Answer	Location
3	*Consistency in driving variables*	The accumulation geometry results (section 4.2) use accumulation thickness and length (T/h_0, L/ho) to describe accumulation geometry. Section 4.3, on accumulation compactness, continues using thickness and length, i.e. T/L. Section 4.4 on backwater rise uses porosity (bulk factor a) and factor Vs/h_0BdT based on Schalko's work. a) Is it possible to use more of the same factors throughout the sections? For instance by describing effects of LW density on bulk factor a?	We calculated bulk factors for all cases but didn't find a specific relation between bulk factors and the main parameters, so we didn´t add the analysis of this parameter independently. As a general observation, we can see that bulk factor reduces with increasing Froude number, except for Density= 600kg/m3. Also, bulk factor increases with wood density for Fo=0.3 specifically.   	This is not on paper. It's only explained here.

Number	Topic	Observation	Answer	Location
		b) On that note, how did you determine a? It is needed for eq. 5 and 8, and hence for Figure 12, 13, 14 and 15. But the paper doesn't mention how you determine it. Did you measure it? Calculate it? How? Also, the porosity used seems constant with Froude number, judging from the straight lines in 12 and 13. E.g. Schalko et al. (2019) found a dependency of a on Froude number. And I expect you may also find a dependency on wood density?	We determined bulk factors (Vl/Vs) estimating Vs as the sum of the volume of all retained logs, and Vl as the product of the lateral area of the accumulation by the channel width. The lateral area was estimated by videometric analysis. We can see an example here: (Areas: blue and yellow respectively).  	Lines 15-17, p. 8

Number	Topic	Observation	Answer	Location
		c) Figure 7 non-dimensionalizes accumulation length L with the flume width B. Why L/B? Physically the flume width should not matter. Also, in the dimensional analysis L/h_0 is used, not L/B.	We uniformized the dimensionless L as L/ho in all the analysis: $\frac{\Delta h}{h_0} = g\left(F_o, \frac{T}{h_0}, \frac{L}{h_0}, \frac{\rho_T}{\rho_w}\right) = 0$ (2)  Figure 8: (a) Froude number vs. accumulation length L (m), (b) Froude number vs. dimensionless L, for different log densities.	Lines 3-8, p. 11
4	*Dimensional analysis*	- Form Backwater rise (or whatever you are interested in) is a function of the mentioned variables. But not equal to zero. So the following forms of eq. 1 and 2 make more sense: Δh=f(h_0,v,g,T,L,ρ_T,ρ_w) Δh/h_0 =f(F_0,T/h_0 ,L/h_0 ,ρ_T/ρ_w) Please note: Δh resp. $\Delta h/h_0$ are now in front of the equal sign, so the number of variables mentioned in line 27 decreases by 1	The equations and explanation were corrected considering the suggestions (see equations 1 and 2) $\frac{\Delta h}{h_0} = g\left(F_o, \frac{T}{h_0}, \frac{L}{h_0}, \frac{\rho_T}{\rho_w}\right)$	Line 5, p.4

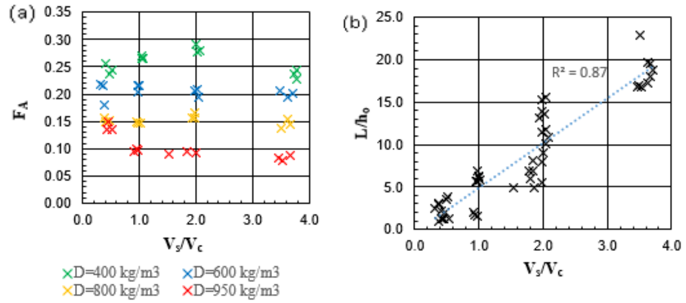
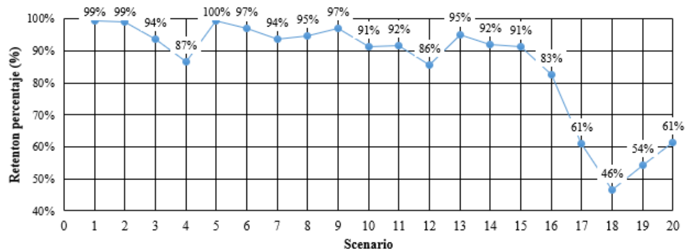
Number	Topic	Observation	Answer	Location
		-Content Normally the dimensionless analysis is used to identify which variables should be used to predict your variable of interest. In this analysis you kind of build up toward using T/h0 and L/h0 as predictive variables. So further changes, apart from the notation above, may be helpful.	ho remained within the dimensionless variable L/ho in all the analysis.	Line 5, p.4
5	*Methodology: scale*	p4, line 18-30: I understand that the experiments are not based on a specific prototype situation and associated scale. But please give an example to give the reader direction. For instance 1:100 for 6m long logs. Or …	We added an example: The model studied in the present investigation is not related to a particular prototype or case study; however, the length of the artificial logs was carefully selected to allow the formation of jam that resembles the actual ones. However, if a scale of 1:30 is considered, the length of the prototype log would be 1.8 m and the diameter 0.30 m.	Lines 4-6, p.5
6	*Methodology: repetitions*	Please mention how often you repeated every test as part of the test program (section 3.2). Variability is discussed at various places in the manuscript, but the number of test repetitions is never mentioned.	We mention this in the paragraph:Each scenario was repeated three times to evaluate the reproducibility of the test, making a total of 60 simulations.	Lines 28-29, p.5

<table>
<tr><th>Number</th><th>Topic</th><th>Observation</th><th>Answer</th><th>Location</th></tr>
<tr><td>7</td><td>Methodology: variability and precision</td><td>Table 1 mentions the flume slope in %, with depending on the scenario a slope of 0% ; 0.02%; 0.15% or 0.8%. The 0.02% slope amounts to an angle of 0.01°, or 2mm of elevation difference over a flume of 10 m. Can you really make such precise adjustments?</td><td>We use a graduated bar to adjust the channel slope. Each line represents 0.2 % according to the fabricant (see figure below), and this is approximately 0.5 inches that we divided in ten parts to obtain a slope that gives us the required initial conditions. According to that, we can define a precision of 0.02%.
</td><td>This is not in the paper. It's only explained here.</td></tr>
<tr><td></td><td></td><td>Directly under table 1, relative standard errors are discussed, so (I suppose) e*=σ_n/(x¯√n), using average x¯and standard deviation σ_n over n samples. For experimental parameters within a Froude group, e* is stated to be smaller than 1% in all cases, with reference to Table 2. It is unclear whether numbers in table 2 are given in percentage (according to the caption), or in the units indicated in the top line of the table.
For example, the first relative standard error is 0.00019. If the unit is m³/s, then 0.00019 m³/s is 4% of the desired discharge, so more than the 1% mentioned in text. If the unit is %, the</td><td>The table of relative errors was corrected and uniformized the units. Also, we added the formula used. The unit for relative standard error is %.
$$e * (\%) = \frac{\sigma_n}{\bar{x} * \sqrt{n}} * 100 \quad (3)$$
Table 2: Relative standard error of initial parameters (%)
<table><tr><th></th><th>e * (%)</th><th></th><th></th></tr><tr><td>Scenario</td><td>Q</td><td>h_o</td><td>F_o</td></tr><tr><td>1 - 4</td><td>0.19</td><td>0.09</td><td>0.25</td></tr><tr><td>5 - 8</td><td>0.26</td><td>0.31</td><td>0.62</td></tr><tr><td>9 - 12</td><td>0.38</td><td>0.19</td><td>0.42</td></tr><tr><td>13 - 16</td><td>0.14</td><td>0.49</td><td>0.70</td></tr><tr><td>17 - 20</td><td>0.26</td><td>0.40</td><td>0.72</td></tr></table>
The relative standard errors for slope were removed because we</td><td>Lines 7-13, p. 6</td></tr>
</table>

Number	Topic	Observation	Answer	Location
		precision is impossibly good (0.00019% of 0.005 m³/s, so 10 microliter/s on a discharge of 5 L/s. Also, for the second column, how do you calculate relative errors of a flat slope? That gives division by 0.	consider flat slope in scenarios 5-8 and the values were kept constant in the other groups.	
8	*Methodology: artificial logs*	Please mention explicitly if your 3D-printed logs can absorb any water. I assume they cannot, this would be a large advantage compared to using wooden logs in tests.	  We analized 03 samples from each density group. First, we weighed the dry samples. Then, the samples were submerged for one hour and weighed again (see figures below). The results (see table below) show that the absorption percentage varies from 0 % to 3.23 %, with the highest percentages being found in the lightweight logs.We select Then, the samples were submerged for one hour and weighed again (see figures below). The results (see table below) show	Lines 12-17, p. 7

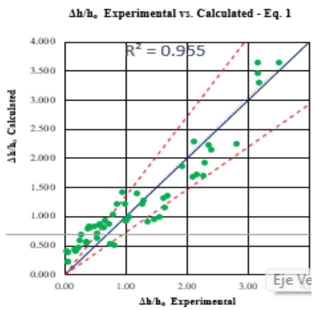
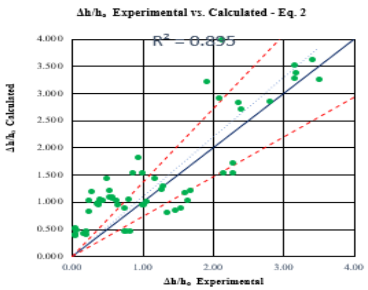
<table>
<tr><th>Number</th><th>Topic</th><th>Observation</th><th>Answer</th><th>Location</th></tr>
<tr><td></td><td></td><td></td><td>that the absorption percentage varies from 0 % to 3.23 %, with the highest percentages being found in the lightweight logs.We select 1 hour because it is the maximum time that logs were submerged for one day.</td><td></td></tr>
<tr><td></td><td></td><td>Please describe how you printed logs of different densities. This would be useful for people interested in conducting similar experiments. Are they hollow, with different sized air gaps in the center? Or are they solid, made from different materials? If so, which ones?</td><td>The description was made as follows:

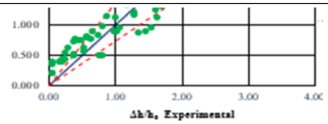
Table 5: Slice information
<table>
<tr><th>Information</th><th>400 kg/m^3</th><th>600 kg/m^3</th><th>800 kg/m^3</th><th>950 kg/m^3</th></tr>
<tr><td>Machine type</td><td>Finder</td><td>Finder</td><td>FlashForge Guder II</td><td>FlashForge Finder</td></tr>
<tr><td>Material type</td><td colspan="4">PLA (Polylactic acid)</td></tr>
<tr><td>Layer height</td><td>0.12 mm</td><td>0.12 mm</td><td>0.12 mm</td><td>0.12 mm</td></tr>
<tr><td>Perimeter structures</td><td>1</td><td>3</td><td>4</td><td>4</td></tr>
<tr><td>Fill density</td><td>5 %</td><td>15 %</td><td>20 %</td><td>25 %</td></tr>
<tr><td>Approximate printing time</td><td>33 minutes</td><td>21 minutes</td><td>44 minutes</td><td>46 minutes</td></tr>
</table>
Four printers were used due the number of logs (2 800 logs approx.). As can be seen in Table 5, the elements with the lowest density have the thinnest layer, which may explain the higher percentage of absorption.</td><td>Lines 22-25, p.7</td></tr>
</table>

<table>
<tr><th>Number</th><th>Topic</th><th>Observation</th><th>Answer</th><th>Location</th></tr>
<tr><td></td><td></td><td>The absolute log volume is mentioned. Please also compare it non-dimensionally to earlier experiments. For instance using Schalko's characteristic volume VC. This would tell to what degree you are in a regime with a long floating carpet or not.</td><td>We added the relation between Vs/Vc and FA and the relation between Vs/Vc and L/ho.
</td><td></td></tr>
<tr><td>9</td><td>Methodology: test procedure</td><td>Packets of artificial logs are gradually added. Where? (how far upstream?). How? And how much time is there between adding packets?</td><td>Manual addition of packets of artificial logs of 8 % - 10 % of the total solid volume (between 60 and 70 pieces) every 15 seconds, 4.7 m upstream of the retention rack. The number of artificial logs collected in the outlet basket is counted to determine the retention percentage and were not reincorporated into the flow.</td><td>Lines 9-11, p.8</td></tr>
<tr><td></td><td></td><td>The test procedure mentions the aim was to retain more than 50% of the logs in front of the racks. Please report in greater detail
- Did you re-add the logs that passed the rack, or not?
- If not re-added, how much variation was there in retained log volume? 50% passage gives a a factor 2 difference in log volume, creating substantial difference in accumulation dimensions and backwater rise.
And did you actually succeed in the 50% passage aim? Or are there even test results with more passage?</td><td>Figure 4 shows the percentage of logs retention by scenario.
</td><td>Lines 11-12, p. 5</td></tr>
</table>

Number	Topic	Observation	Answer	Location
10	*Figure 5*	There is something wrong with this figure. Are the ax labels in Fig. 5b switched around? Accumulation thickness T should be about equal to water depth h, according to the text and photos. But at $\Delta h/h_0=2$ (i.e. $h/h_0=3$), $T/h_0=1$. You could consider plotting h/h_0 instead of $\Delta h/h_0$, if the aim is to show that thickness approximately equals water depth.	This has been corrected.	Lines 4-5, p. 10
11	*Backwater rise: eq. 5 and 6 (50%)*	Please correct the literature references of eq. 5 and 6, they currently give errors.	This has been corrected.	Lines 4-7, p. 15
		Please be aware that eq. 5 from Schalko is a general equation, designed to be used in different circumstances. Eq. 6 from Schmocker and Hager is fitted to a specific experiment, with a specific LW volume, rack design, initial depth, etc, that are not included in the equation. Other situations/LW volumes/… will not result in same backwater rise, so its value is mainly the expectation of linear scaling with Froude number, given otherwise constant conditions. Please mention when introducing the equations and use them appropriately in later discussions.	As can be seen, the results obtained by the equation of Schmocker (2013) seem to be in the zone of backwater rise for ρ_T=800 kg/m^3, considering that these results are applicable to other values of volume and initial water depth. In the other hand, the results obtained by the formula of Schalko (2019) seem to be near the zone of ρ_T=950 kg/m^3, if the original factor 0.55 is replaced in equation 9, the result will be ρ_T=900 kg/m^3, according to the methodology description of Schalko (2019) the average density of their accumulation was ρ_T=600 kg/m^3, that can reflect the results of backwater rise for the present study might are underestimated with respect to the results of Schalko (2019).	Lines 3-9, p.19 Lines 30-37, p. 20

Number	Topic	Observation	Answer	Location
		Please mention applicability limits of the equations. (for which Froude numbers etc. were they derived? How does that compare with your conditions?)	We mention these differences in the results (Paragraph 4.4):Schalko et al., (2019b) proposed the equation (7) to obtain the relative backwater rise, that was defined from the equation of Schalko et al. (2018b) for Fo= 0.2 – 1.4 with R2 = 0.97. On the other hand, Schmocker & Hager (2013a) proposed the linear equation (8) that relates relative backwater rise and Froude number for Fo= 0.5 – 1.5 with R2 = 0.98.And in the discussion:The influence of wood density was included in the formula of Schalko et al. (2019b) and the results were compared with those obtained by the original equation of Schalko (2019) and by Schmocker and Hager (2013). The relationship between the relative backwater rise obtained in the present study and the Froude number shows a relatively linear trend for each density, similar to the consideration of Schmocker and Hager (2013), whose equation for determining backwater rise depends only on the Froude number but keeps the other parameters constant, such as the accumulation volume of 50 dm3 compared to 3.3 dm3 in the present study and the initial water depth of 0.04 m compared to 0.06 m and 0.1 m considered in the present study. On the other hand, the formula of Schalko (2019) is a general equation, designed to be used in different circumstances.	Lines 4-6, p. 15 Lines 30-37, p. 20
		P10, line 13: please also explain parameter a, it's currently missing.	It was submitted in observation 3-a	-
		P10, line 15: please explain how you determined bulk factor a for your calculations (see also comment 3)	It was submitted in observation 3-a	-
		P10, line 18: results are not exactly linear, especially around zero. E.g. Fig. 12b, results seem to form more a 'square root line' from (0.2;0) than a linear line through (0;0). Suggestion: e.g. 'relatively linear trend' or add more explanation	We use a linear trend to make calculation easier and we use the term: relatively linear trend.	Line 4, p.16

Num ber	Topic	Observation	Answer	Location
12	*Backwater rise: figure 12, 13*	Please combine figure 12 and 13 in a single figure with subplot a-d. No need to have 2 separate captions, 4 legends and 4 times the same figure title.	This has been corrected.	Lines 1-3, p. 17
		Please discuss the figure content in text. P11, line 3-4 just say you made figures. (At least, I suppose the reference to Fig. 11, 12 should be to Fig. 12, 13.) What do the figures show? What do we learn from them?	We included more parameters and expanded the explanation of the figures.	Lines 10-17, p. 15 Lines 3-10, p. 16
13	*Backwater rise: figure 13 and design equations*	Basically, you seem to be first calculating a 'compensation factor' for eq. 5 per density group (crosses in Fig. 14), resulting in a density-dependent compensation factor (f_A', eq. 7) which is then incorporated into eq. 5, giving eq. 8. I would suggest directly fitting the constants in an adapted eq. 5 using all your tests. That seems both more direct and easier to follow. Ideally with a simple form, fitting C1 in eq. 1: Δh/h_0 =C_1*ρ_T/ρ_w *(F_0 V_S/(h_0 Bd_T)(9FM+1))/aEq. 1Alternatively, with a more complicated form, fitting both C1 and C2: Δh/h_0 =C_1*(ρ_T/ρ_w)^(C_2)*(F_0 V_S/(h_0 Bd_T)(9FM+1))/aEq. 2OrΔh/h_0 =C_1*(ρ_T/ρ_w -C_2)*(F_0 V_S/(h_0 Bd_T)(9FM+1))/aEq. 3	After a comparison of the 03 forms proposed for eq. 10 (linear with 01 coefficient - 1, potential - 2 and linear with 02 coefficients - 3), we considered linear relation with 01 coefficient between density and type factor, because this provided the same correlation with the measured data with respect to the 3rd form and because of its ease of application. The following figures show the correlation for each case and the simplified equation is also shown.   	Lines 5-14, p. 18

Number	Topic	Observation	Answer	Location
				
		On equation forms: please note eq. 8 in the manuscript can be simplified to the form of eq. 3 above: 5.4(1.17(ρ_T/ρ_w)-0.046)=6.33(ρ_t/ρ_w -0.040), making it easier to read and apply. However, given the small value of 0.040 (the line in Figure 14 almost goes through the origin), I would suggest trying the simpler form of eq. 1 above, the end result may be quite similar?	It's important to mention that in the last version the factor 0.55 was omitted, but in the present equation it was included. $$\frac{\Delta h}{h_o} = 3.48\left(\frac{\rho_T}{\rho_W}\right)\frac{F_o\left(\frac{V_S}{h_o B d_T}\right)^{\frac{1}{3}}(9FM+1)}{a} \quad (10)$$	Lines 5-6, p. 18
		How do your results, and hence your eq. 8, compare to the results from Schalko her experiments? In other words, if you use the same LW density as in Schalko et al. (2019), do you get the same backwater rise? In Schalko's equation (eq. 5), f_A=0.55 for naturally evolving accumulations. Figure 14 suggests that	As it can be seen, the results obtained by the equation of Schmocker seems to be in the zone of backwater rise for ρ_T=800 kg/m^3, considering that these results are applicable to other values of volume and initial water depth. In the other hand, the results obtained by the formula of Schalko (2019) seem to be near the zone of ρ_T=950 kg/m^3, if the original factor 0.55 is replaced in equation 9, the result will be ρ_T=900 kg/m^3, according to the methodology description of Schalko (2019) the	Lines 3-9, p. 19

Number	Topic	Observation	Answer	Location
		your f_A^'=0.55 at ρT/ρw=0.5, i.e. ρT=500 kg/m³. Is this the density Schalko et al. used?	average density of their accumulation was ρ_T=600 kg/m^3, that reflects that the results of backwater rise for the present study show lower relative backwater rise with respect to the results of Schalko et al. (2019).	
14	*Discussion: novelty and relevance*	P14, line 5-8 says you used permeable material, and talks about absorbtion and density variation overtime. Please clarify. I suppose in your case only the accumulation is permeable, the individual plastic logs don't absorb water? This methodological improvement bears mentioning.	The absorption capacity of log was analyzed in section 3.3 and a maximum weight increase of 1.8 % was found for the pieces of 400 kg/m3 of density after one hour of immersion. Considering equation 10, this represents a 1.8 % increase in the relative backwater rise, which is less than the average relative standard error of 3.4 % for scenarios where the log density is 400 kg/m3.	Lines 28-29, p. 19Lines 1-4, p. 20
		Please also emphasize other novel aspects of your study more (density range studied? Type of structure studied? Density included in design equaltion for backwater rise? …?).	The novel aspects are included in the discussion.	Lines 12-15, p. 19
		Please add some discussion on the relevance of your work. How can results be used for practice? In designing debris racks or bridges, predicting floods, hydrodynamic modelling, …? Why is density relevant here? (locations with many waterlogged logs? Or very dense manmade debris?).	The study of parameters that influence the increase in backwater rise, including wood density, is important to understand the process of wood accumulations formation in rivers. The experiments in this study focus on accumulations upstream of a vertical retention rack, common in hydroelectric power plants. Here it was shown that wood density influences the shape of the accumulation, an accumulation of light logs forms a longer carpet than an accumulation of heavy logs and these in turn generate greater backwater rise. Therefore, it is important to highlight that an accumulation of heavy logs can increase the risk of flooding in unplanned areas. The constant maintenance of reservoirs and retention structures is key to prevent accumulations from absorbing water and increasing their weight, as well as taking more appropriate retention measures in forests with dense trunk species.	Lines 18-26, p.21

Number	Topic	Observation	Answer	Location
15	*Abstract*	Please check what you consider as your main findings, and whether they are present in the abstract. I would expect the fact that the new design equation (eq. 8) now includes density effects is important, but it is not mentioned. Conversely, is the variability that the last paragraph starts with so important? If so, mention explicitly that you had a very low variability. If not, leave it out.	The modified equation was included in the abstract.	Lines 31-32, p. 1
16	*Cross references*	Please check references to figures, equations and literature, there are some error messages in them.	This and the last observations have been corrected.	-

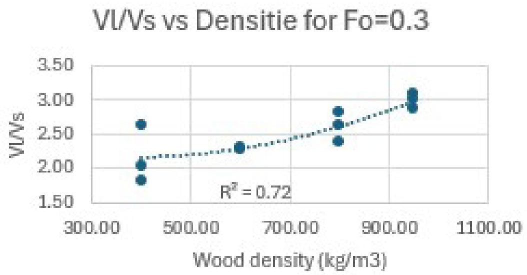
Round 3, Reviewer A

	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
PART 1					
1			Please add a section on data availability. Is the data available in an online repository? If so, where?	The Data Access Statement was added and contains the link to an online repository https://shorturl.at/GFZFy	
2			Please check your paper storyline and changes to the content from a holistic viewpoint. What is important, what is not? You do not need to present every little thing you did, the new version has 21 figures! (Reviewer comments are only suggestions. Sometimes a short sentence in the paper instead of a new figure is enough, or even just in the rebuttal if you find it distracts from the main message).	The storyline of the document was reviewed, and the number of figures was reduced to 15.	
3			Keywords: keywords help your paper be found. The tile is already indexed by search machines. Usually the abstract is as well. So it is more helpful to add keywords that are not yet present in your title, and if possible, not in the abstract. E.g. alternative terms for what you did. So instead of wood density, wood accumulation and flume experiments, I would	keywords were replaced in the following paragraph: Backwater increase, large wood, driftwood, debris rack, scale experiments	

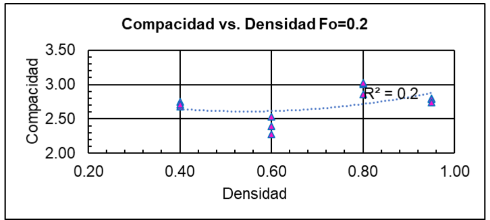
	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
			suggest for example Large Wood, driftwood, debris rack or scale experiments		
4			The abstract contained symbols TL and LL where TA and LA where meant. Please check the rest of the paper for this issue	The symbology was corrected throughout the document.	
5			I suggest to move figure 15 and the accompanying text (p14, line 6-9) to the start of section 4.2 This photo plus description is a good general intro to density effects on geometry.	The figure and its description were moved to the beginning of Section 4.2.1 as Figure 5.	
6			Figure 8 presents the accumulation thickness vs backwater rise. It does so in two subplots, with TA/h_o vs h/h_o, and TA/h_o vs $\Delta h/h_o$. Please include only one of these subplots: the data is exactly the same, just shifted down with the y-values 1 lower in the second subplot. ($\Delta h/h_o=h/h_o-1$).	Now, the figure only includes accumulation thickness vs. relative backwater rise as the Figure 8.	
7			The discussion starts with a discussion on how pile shape affects flow patterns and blocking probability. The effect from the number of rack bars on blockage is likely directly from bar spacing, not the bar shape and flow patterns that it is attributed to (p19: "4 bars	The paragraph was omitted.	

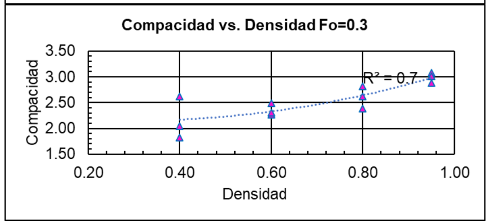
	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
			with of 6 mm in diameter, which significantly influenced the flow currents upstream and downstream of the grid, making the retention percentage null in most cases”). I believe that with four bars, bars were simply too far apart to block logs effectively. With 8 or more bars, they were close enough to stop driftwood. Moreover, the text here seems also to mix up pier shape (first sentence) and pier diameter (subsequent sentences. Please remove this paragraph or correct it.		
8			Discussion: Your results show amazingly low variation in backwater rise between tests. You may be proud of this. Frame it not only as a problem (‘uncertainty and randomness’), but also as an achievement. Maybe link to it being made possible by having 3d-printed logs with uniform properties and less absorption?	Thanks for the comment. The results show low variations in backwater rise between tests and this was possible thanks to the 3D- printed logs that have uniform properties and less absorption. This was mentioned in lines 22 – 24 of p. 14 (Discussion – Methodology)	
9			For figures that mention the initial depth (for instance in legends): please add a unit. Eg h_o=0.1 m	The figures 6, 9 and 13 were corrected.	

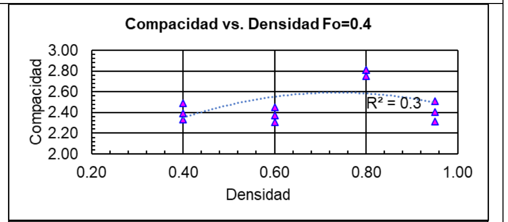
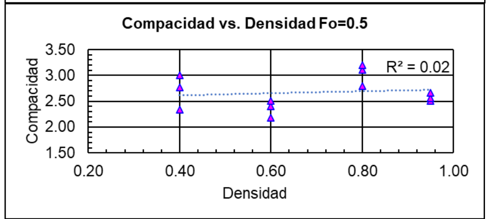
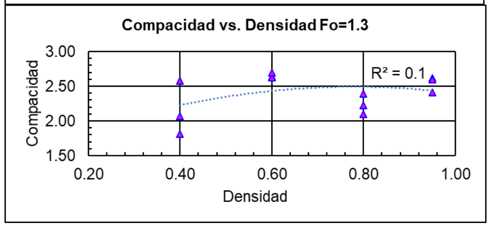
	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
10			Figure 15: I'd put labels for log densities in the subplots themselves, e.g. behind the subplot numbers. This is easier for the reader than in the caption.	Labels with log densities were added to the figure as figure 5.	
11			For table 1, you could use the following format for brevity:	Table 1 was reduced.	
PART 2					
12	2b	Effect initial water depth	implications/results of the different initial water levels should be investigated, discussed in text and indicated in figures where relevant.	We referred to the findings of another author … "Some findings give a direction about the influence of different initial depths on backwater rise. For a given F_O, the approach flow depth h_o has no effect on $\Delta h/h_o$ (Schalko et al., 2018). In this case, it was observed that different initial depths have an influence also on the dimensions of wood accumulation (see sections 4.2 and 4.3)."	a) Please clarify what Schalko said. Is this for a given F_o and VS? Or for a given dimensionless wood volume? I suspect the latter, looking at your Eq. 7. This is important, as your tests has a fixed absolute volume (ignoring retained percentage) b) The cited text is added to your methodology section. They describe your results. Please move it to a relevant part of the results (or discussion). Response: We added the second condition and moved to lines 18-20 of p.15 (Discussion – Results) Some findings gave directions about the influence of different initial depths on backwater rise. For a given F_O and dimensionless wood volume, the approach flow depth h_o has no effect on Δh/h_o (Schalko et al., 2018). This could be verified with the data measured in the present investigation.
13	2c	Effect initial water depth	For accumulation geometry, it makes sense that a lower water depth leaves less space for LW, resulting in thinner and	We explain the use of initial depth to dimensionless accumulation height and length: "To make the length and thickness of the accumulation dimensionless, the initial depth was used (h_0). In the case of the accumulation thickness, the relation T_A/h_0	I suggest to emphasize the more general conceptual point here: tested conditions were not the same: if you increase initial depth for a fixed wood volume, there is simply more space for the wood. E.g. add something like

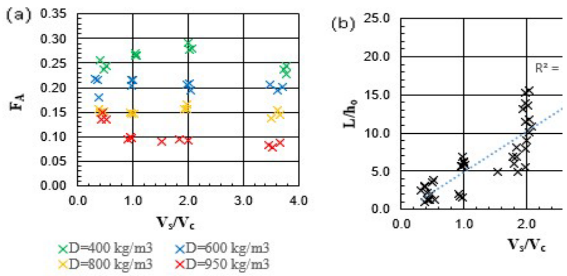
	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
			longer accumulations for a given LW volume. For accumulation thickness (Fig 5), this effect is likely compensated for by scaling using T/h_0. But notfor accumulation length: using L/B it is ignored, and L/h_0 would exacerbate the effect further. […] this explanation is missing. […]	compensates the variation of initial depth because T_A covered almost the whole flow depth (h). In the case of the length accumulation, L_A/h_0, initial depth exacerbates the reduction in length with respect to the initial depth since a lower h_0 generates a greater L_A." […]	"Effectively, the fixed wood volume between tests, conducted at two different initial depths, implies the tests were conducted with different dimensionless wood volumes, leading to two populations in the graphs." Response: It was added to lines 3-4 of p. 11 (Results – Effects of wood density on the accumulation characteristics – thickness and length accumulation): To sum up, test performed with fixed volumes for two initial water heights generate two populations of dimensionless volumes, which can be seen in Figure 6a and in Figure 9a. We also used "total solid volume" and "fixed wood volume" to refer to the initial volume added before the retention.
14	3a	Consistency in driving variables	The accumulation geometry results (section 4.2) use accumulation thickness and length (T/h_0, L/ho) to describe accumulation geometry. Section 4.3, on accumulation compactness, continues using thickness and length, i.e. T/L. Section 4.4 on backwater rise uses porosity (bulk factor a) and factor V_s/h_0BdT based on Schalko's work. Is it possible to use more of the same factors throughout the sections? For instance by describing effects of LW density on bulk factor *a*?	We calculated bulk factor for all cases but didn't find a specific relation between bulk factor and the main parameters, so we didn't add the analysis of this parameter independently. As a general observation, we can see that bulk factor reduces with increasing Froude number. [,,,] 	What do you mean with no specific relation? Your reply says that bulk factor increases with wood density. This is interesting to add to the paper (in text or figure). More importantly: please bring the different paper sections more in line with each other. Currently, • The dimensional analysis hypothesizes an effect of F_o, ρ, T_A and L_A on Δh. • Result section 4.2 presents results of ρ on T_A and L_A • Result section 4.3 presents results of ρ on T_A/L_A. • Results section 4.4 presents results of ρ, *a* and V on Δh. So effects of T_A and L_A on Δh are hypothesized, but never presented. Conversely,

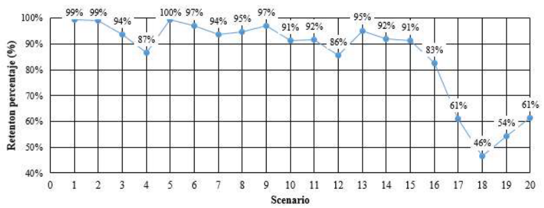
	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
					effects of bulk factor *α* and (indirectly) volume V are presented, but not part of your hypothesis. My suggestion is to present the effect of wood density on bulk factor, and additionally either A) remove the dimensional analysis B) adapt the dimensional analysis in terms of F0, ρ, *α* and V, as used in section 4.4 or C) study the effect of T_A and L_A on Δh and then bring your dimensional analysis in line with the results. Response: 1. Sorry, we didn't complete the idea. Only for Fo=0.3, we found a relation between Vl/Vs and ρ with R^2 greater than 0.5. For the rest of cases R^2 is less than 0.2.





	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
					   2. We decided to reference the dimensional analysis of Schalko (2018) and add ρ as an independent variable, therefore we don't show a dimensional analysis which hypothesize an effect of F_o, ρ, T_A and L_A on Δh. However, as a part of the objectives mentioned in lines 16-18 of p. 3 (Introduction), we present the qualitative results of the influence of ρL on accumulation characteristics.
15	8b	Methodology: artificial logs	Please describe how you printed logs of different densities. This would be useful for people interested in conducting similar experiments. Are they hollow, with different sized air gaps in the center? Or	Info added in table 5, Figure 5 and surrounding text.	Thank you for the detailed explanation. I am not sure the average reader needs this much. Given the large number of figures and tables in your manuscript, I would suggest simply stating that all logs were 3D-printed with PLA, with variations in the wall thickness and fill density (i.e. fill percentage) to obtain different densities.

	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
			are they solid, made from different materials? If so, which ones?		If you publish your data in an online repository or somewhere else, that might be a suitable place to also give this detailed information. Response: We removed the figure and table and added the suggested text. Printing information will be displayed as an attachment in the online repository (Data Access Statement).
16	8c	Methodology: artificial logs	The absolute log volume is mentioned. Please also compare it nondimensionally to earlier experiments. For instance using Schalko's characteristic volume VC. This would tell to what degree you are in a regime with a long floating carpet or not.	We added the relation between Vs/Vc and FA and the relation between Vs/Vc and L/ho.  	a) Very interesting result in Fig 12a! Interesting to see results presented in terms of final Froude number instead of initial one. That suddenly gives the insight that the upstream Froude number of all tests is independent of hydraulic conditions but clearly dependent on wood density. In other words, irrespective of the initial hydraulic conditions, if enough driftwood is added, backwater rise continues until the same upstream Froude number is reached, where this final Froude number depends on the wood density. This matches nicely with the two phases of driftwood accumulation, with wood first being pulled down, followed by pure carpet growth. Please emphasize this in text, here and in the discussion (for novelty and implications). This could be used to calculate the backwater rise needed to obtain these upstream Froude numbers, i.e. for backwater rise predictions Response: The influence of wood density on final Froude number was mentioned in lines 17,18 of p. 11 and lines 1-3 of p.12 (Section 4.2.1). b) I wonder if Fig 12b is needed. Indeed, in your results, accumulation length scales almost linearly with Vs/Vc. But this is not simply a result where the wood volume is

	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
					varied between tests. Instead, the solid volume Vs remains (approximately) constant, but tests are conducted under different hydraulic conditions, indirectly changing the characteristic volume Vc. Either it should be explained that is figure is a different way of looking at how hydraulic conditions change L_a, or the figure can be left out. Response: Figure was removed. c) I assume Vs in these figures is the *actual* accumulated volume, compensated for the percentage of logs retained in the accumulation (i.e. Fig. 4)? This is important, as $V_{S,added}$ and $V_{s,blocked}$ can differ by a factor 2. Please add a general sentence to say so. I.e. at p5, after line 10, something like ”Solid wood volumes (Vs) presented in the results refer to actual blocked volumes, taking into account the log retention volume per test.” Response: Solid volume represents the space occupied by the retained logs and it is mentioned in lines 6-10 of p.5 (Section 3.2).
17	9	Methodology: test procedure	The test procedure mentions the aim was to retain more than 50% of the logs in front of the racks. Please report in greater detail […] How much variation was there in retained log volume? 50% passage gives a factor 2 difference in log volume, creating substantial difference in	Figure 4 shows the percentage of logs retention by scenario. 	Thank you for adding this. So basically most tests have a similar accumulation volume. But for the 4 tests with the highest Froude number, the accumulation is only half as big. a) Please reflect in your article (at the results or discussion) on this difference, and how it affects your results. Response: We mentioned the difference of retained logs between flow regimes and its influence in lines 17-21 of p.14 (Discussion of the Results). b) Please confirm if the actual blocked volumes are included in the calculations, and not the total added volumes? So for figure 18, 20 and

	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
			accumulation dimensions and backwater rise.		21? This is important! If not, please include it in new calculations. I made a suggestion where to explain it in-text in the attached manuscript. Response: Yes and this is mentioned in lines 6-10 of p.5 (Section 3.2). c), Regarding the figure: please make this a bar graph. Or just plot the markers without line in between (like Fig. 13). A line implies meaningful results between markers/scenarios, with some continuous ordering along the x-axis. Response: Figure 3 was corrected.
18	11a	Backwater rise: eq. 5 and 6	Be aware that eq. 5 from Schalko is a general equation, designed to be used in different circumstances. Eq. 6 from Schmocker and Hager is fitted to a specific experiment, with a specific LW volume, rack design, initial depth, etc, that are not included in the equation. Other situations/LW volumes/… will not result in same backwater rise, so its value is mainly the expectation of linear scaling with Froude number, given otherwise constant conditions. Please mention when introducing the equations and use them appropriately in later discussions.	As it can be seen, the results obtained by the equation of Schmocker (2013) seems to be in the zone of backwater rise for ρ_T=800 kg/m^3, considering that these results are applicable to other values of volume and initial water depth. In the other hand, the results obtained by the formula of Schalko (2019) […]	Good that you compare your and Schalko's results. But the more general point that Schmocker and Hager's equation is not a general design equation is only mentioned in the discussion. It is important for the casual reader to mention this earlier. Also: because it not a design equation, but specifically obtained for their conditions (their flume, their driftwood volume, their …), while you have different (dimensionless) wood volumes, direct comparison to their results is meaningless. So: a) Please leave out the comparison with Schmocker and Hager from figure 21 and from the text below. It is useless to frame the difference between their results and yours in terms of wood density. It may as well have been completely different wood volumes. (if you repeated your experiment with 4 times less wood, your result would completely change, and this figure/text would change with it.) Response: Comparation with Schmocker's equation was removed of Figure 20, for the following paragraph and the Discussion.

	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
					b) Please adapt the introduction of the Schmocker and Hager's equation (p15: eq. 8 and line 4-6) for this issue. Either simply leave the equation out. Or explain that while the calculated magnitudes only apply to their specific experiments, it gives useful information on the shape of the Froude scaling. Response: Schmocker's equation was omitted.
19	11d	Backwater rise: eq. 5 and 6	P10, line 13: please also explain parameter a, it's currently missing.	It was explained in our answer to review question 3-a.	yes, but that doesn't help the reader. Eq 5 (eq 7 in the new version) contains parameter *a*. You already tell the reader there the meaning of the other symbols, but not of *a*. Please see the text suggestion on page 15, directly under Eq. 8. Response: The estimation of "a" was explained in line 26 of p. 3 (Dimensional Analysis)
20	13a	Backwater rise: figure 13 and design equations	Basically, you seem to be first calculating a 'compensation factor'for eq. 5 per density group (crosses in Fig. 14), resulting in a density-dependent compensation factor (f_A', eq. 7) which is then incorporated into eq. 5, giving eq. 8. I would suggest directly fitting the constants in an adapted eq. 5 using all your tests. That seems both more direct and easier to follow. [several options…]	± After a comparison of the 3 forms proposed, we went with the simpler linear equation […]	I'm glad that you choose the simpler formula. That makes everything easier to understand and to apply in practice lateron. Still, I think your story would become more straightforward if you directly go for the end result. Currently, you first compare results from your experiments with Schalko's equation per wood density (fig 18), then use the difference between these to calculate fA per log density (fig 19), subsequently present the performance of this equation (fig 20) and finally compare results to Schalko (fig 21). Instead, I would simply directly state that you fit C1 (or however you call it) in the equation below. $$\frac{\Delta h}{h_o} = C_1 f_A \frac{\rho_L}{\rho_W} \frac{F_O\left(\frac{V_S}{h_o B d_L}\right)^{\frac{1}{3}}(9FM+1)}{a}$$

	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
					Next, you can show your current Figure 20 and mention the correlation coefficient. (To emphasize the linearity of the density effect, as the current figure 19 does, you could state in text that fitting the power of $(\rho/\rho)^{C2}$ only improves the result by XXX, supporting the chosen linear dependency on log density. Such a statement can be given in-text, without requiring additional plots) Response: We mentioned the coefficient C1 and added exponents to explain the estimation of them in Section 2 and Section 4.3) In this Fig. 20, you could indicate densities by color (like everywhere else) and make a second subplot with Schalko's original predictions (Eq. 7), to emphasize that the included density really collapses the different densities onto the same line. Response: We classified the results of Figure 15 in colours and added figure 15b showing results of relative backwater rise collapsed. This way, you can skip figure 18, 19, 21 and a lot of the surrounding text, making your message clearer. Response: We skipped the 3 figures. --- If you nonetheless still want to keep all the in-between steps and figures, then please A) Clarify the explanation before Fig. 18 (p16, see the comment there) and B) show the linear correlation without intercept (y=ax instead of y=ax+b) in Fig.19 and eq. 9, so that you can use exactly the same relation to obtain Eq. 10.
21	14a	Discussion: novelty and relevance	P14, line 5-8 says you used permeable material, and talks about absorption and	The absorption capacity of log was analyzed in section 3.3 and a maximum weight increase of 1.8 % was found for the pieces of 400 kg/m3 of density after one hour of	Great result. Please help the reader, explicitly say why this is such an improvement. See the text suggestion.

	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
			density variation overtime. Please clarify. I suppose in your case only the accumulation is permeable, the individual plastic logs don't absorb water? This methodological improvement bears mentioning.	immersion. Considering equation 10, this represents 1.8 % increase in the relative backwater rise, which is less than the average relative standard error of 3.4 % for scenarios where the log density is 400 kg/m3.	Response: It was explained in lines 1-4 of p. 14 (Discussion – Methodology)
PART 3					
22		Abstract	'presents' for brevity?	The word was included in line 16 p.1	
23		Abstract	Text suggestion: e.g. quadrupling when log density is raised from 400 kg/m^3 to 950 kg/m^3, at F_o=0.5.	Text was replaced in lines 26, 27 p.1	
24		Abstract	Suggestion: The compactness of wood accumulations (T_A/L_A) increases with log density, with e.g. an increase of log density from 400 kg/m^3 to 950 kg/m^3 at F_o = 0.5 doubling the observed accumulation thickness while halving its length.	Text was replaced in lines 28-31 p.1.	
25		Abstract	I don't know if you really replaced fA, oradded a term. (Δh=C*ρ/ρ*…). Please consider rephrasing. e.g. "Finally, the equation of Schalko et al. (2019) was adapted to include the effect of wood density"	Text was replaced by the suggested in lines 31, 32 p.1.	
26		Methodology	Which national university? Maybe this is redacted for blind reviewing, but please	City and country were added in line 7 of p.4.	

	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
			mention a country in the final manuscript		
27		Results: Effects of wood density on the geometry of the wood accumulation	Suggestion to move this explanation a few sentences up, directly after "Accumulation length (La) … for scenario 1." For clarification, you could rephrase this to something like "Likely, the accumulation length decreases at larger initial depths (for a fixed wood volume) because logs tend to occupy the entire water column, so at larger initial depths the accumulation has more vertical space, leading to a smaller accumulation length."	Suggested text was added in lines 3-5 of p.10.	
28		General	Formatting: please check italics and subscript for variables throughout the paper. (also for my text suggestions)	Italics and subscripts were checked throughout the document.	
29		Results: Effects of wood density on the geometry of the wood accumulation	Please consider phrasing. I'd maybe say *upstream* Froude number, and either '… with the large wood accumulation present', '… after formation of the LW accumulation'	Final Froude number was replaced with upstream Froude number and Froude number with large wood accumulation present.	
30		Results: Effects of wood density on the compactness	Please split sentence and clarity. Suggestion: "As described in section 4.2, L_A decreases with initial depth (h_0) and T_A increases	The text was edited and improved in lines 12-16 p. 12.	

	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
		of woody material accumulation	with h_0. Consequently, the compactness (T_A/L_A) is higher at higher initial depths (see Figure 14, the compactness at h_o=0.1 m vs at h_o=0.06 m). Also, compactness strongly increases with Froude number. While it is not possible to stablish a relation between T_A/L_A and h_0 considering the data of the present investigation, it can be seen that compactness is influenced to a greater extent by wood density and Froude number."		
31		Results: Effects of wood density on the compactness of woody material accumulation	Repetition of line 1-3 on this page. Especially if figure 15+text are moved up. Please rephrase	The text was edited and improved in lines 1-4 p. 13.	
32		Results: Effects of wood density on backwater rise	Suggested text here serves to clarify the steps you took and split long sentence. Please check if the part about actual measured *a* and *Vs* is correct. Note: I actually suggest to skip these results and immediately fit your own equation, resulting in Fig. 20. In this case text becomes changed/removed. Still,	The estimation of "a" was explained in line 26 of p. 3 (Dimensional Analysis) Volumes corresponding retained logs were explained in lines 6-10 p. 5. (Methodology: Test programs)	

	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
			please explain the reader if actual measured values of *a* and Vs are used.		
33		Results: Effects of wood density on backwater rise	In Eq. 10 you only use the factor 0.65ρL/ρw from eq. 9, without the minus 0.026. Agreed with the simplification. But for consistency please fit the linear line accordingly without intercept. I expect you end up with something like y=0.63x in that case?	Figure of Relative density and accumulation type factor was removed.	
34		Results: Effects of wood density on backwater rise	I'd use 'predicted ', in caption and figure	Term "calculated" and "obtained" was changed by "predicted" when referring to the results of an equation.	
35		Discussion: Methodology	Your results show amazingly low variation. You may be proud of this. Frame it not only as a problem, but also as an achievement. (made possible by having 3d-printed logs with uniform properties and less absorption?) Short text suggestion here, but maybe add more?	Thank you. It was explained in lines 1-4 of p. 14 (Discussion – Methodology)	
36		Discussion: Results	Needlessly complicated. 'Accumulations become shorter and thicker for increasing wood density' ?	Lines 22, 23 of p.15 were edited and improved.	
37		Conclusions	Please rephrase sentence. Gramatically unclear if 'these' refers to light or heave logs	The lines were omitted.	

	Comment number	Topic	Observation reviewer	Reply authors	Remaining comment
38		Notations	Not used anymore, I believe?	The symbol f' was removed from notations.	

Round 4, Reviewer C

	Observation	
1	**Clarity and Framing**	**State**
	Please consider renaming **Section 2** to *"Background and Theory"*, as it currently does not reflect a dimensional analysis.	The observation was corrected.
	Make sure that all variables are introduced when first mentioned. For example, $\mathbf{F_0}$ is used in the abstract but not defined. Also note that the **Froude number** is a dimensionless parameter and is typically written in **non-italic** font.	The observation was corrected.
	Define **PLA** when it is first introduced.	The observation was corrected.
	I suggest updating the section titles in the **Discussion**: Section 5.1 → "Interpretation of Experimental Design and Materials" Section 5.2 → "Key Findings and Comparison with Literature	The observation was corrected.
2	**Standard Error and Figures**	
	Please add **standard error as error bars** to the relevant plots. This will allow you to: Remove Figure 12 and integrate those values into Figure 13. Optionally include reproducibility data (backwater rise) in Figures 8, 10, and 15 using error bars.	Figure 12 was deleted, and the errors were integrated into Figure 13. The errors of the relative backwater rise were also included in Figures 8 and 10, except in Figure 14 because it is necessary to show all data clearly.
3	**Equation 7**	
	Consider rounding coefficients to **1 or 2 significant digits** for clarity. For example: 2.5 * F_o^1.7 (rho_L/rho_W)^1.7	The observation was corrected.
4	**Tables and Figures**	
	You could **merge Tables 1 and 2** by including standard error in brackets. For example: "0.005 (0.19)" for Scenarios 1–4. The table caption could be: "Scenarios and test configurations. Values in brackets indicate relative standard error (%)".	The observation was corrected.
	Consider also **merging Tables 3 and 4**.	The observation was corrected.

	Figure 6a could be removed. You might place **Figure 6b** next to **Figure 8** and merge them for better comparison	Figures 6a and 9a are not recommended for removal because they show the effects of initial flow depth on the shape of the accumulation.
	Similarly, **Figure 9a** can be removed — **Figure 9b** alone shows the key result. Consider placing **Figure 9b** next to **Figure 10** and merging them as well	
5	Language and Proofreading	
	A careful proofreading pass is recommended to improve grammar, flow, and clarity. You may also consider a professional language editing service, if available.	The observation was corrected.
6	**Abstract and Conclusion**	
	The **abstract** covers the key elements but could benefit from improved flow and precision. Consider streamlining some parts, ensuring all variables are defined, and reducing repetition.	The observation was corrected.
	In the **conclusion**, the key findings and recommendations are somewhat mixed with methodological details. It would be helpful to structure it more clearly: summarize the main outcomes, then list recommendations separately. Ending with a brief forward-looking statement on practical implications would also strengthen it	The observation was corrected.