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Interactive comment on "Stabilising Large Grains in Aggrading Steep Channels" *by* William H. Booker and Brett C. Eaton

Anonymous Referee #1

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Dear authors,

The study presented was pretty interesting and fascinating. After reading and analyzing it several times it seems to me that the role of GSD in an aggrading channel is evident and there is solid evidence to state that. I believe that the experiments are well designed and allow the reader to make comparisons between both GSD. Furthermore, these experiments allow one to compare different boundary conditions which makes them really valuable to the community.

After careful consideration, especially taking into account the results shown here, I believe that the article needs to be re-formulated and go through major revisions. The reasons are explained in detail in the following lines but in summary, it is because of the text structure and the way how the information was conveyed. The experiments are the

strong point of the article, however, it is difficult to understand all the ideas the authors are trying to express and also how the hypothesis and initial motivation are developed throughout the text. Some statements are also unclear and will be discussed below.

General comments: 1) This a personal opinion. The article's title could be changed to something more appropriate. When I received the article I thought that it was related to large chains in the sense of boulders or macro-roughness elements. Given that most steep channels do have boulders and other (actual) large grains, and those are neglected in this study, the title was misleading to me. Again, this is a personal opinion but please consider it if you think the same.

2) The article structure does not convey the information in a fluid manner. The introduction has little information about aggrading systems and it seems to me that it gives more importance to degrading systems. Although, I understand that the idea was to make clear that we know more about degrading systems more information and references to what we really know about aggrading systems is required. There are virtually no references to any study that may have discussed aggrading systems.

3) The article presents the study using Lane (1955) balance expression. Then, the assumptions of this expression are called into question and by doing so the hypothesis is formulated. The problem is that Lane 1955 did not consider a mixture of sediment and therefore does not intended to explain the responses of different GSD, even when they have the same D50. Only later in the paper, in the discussion (page 10, line 4), this is explained. So, as a reader, I had problems trying to understand why this is not explained right away. The major concern about this is how the information flows in the article.

4) The hypothesis needs to be reformulated. I understand the idea of the study is to compare responses to different GSD and boundary conditions. This was well developed in the text. However, if I just take the hypothesis, it doesn't say that. "We hypothesise that, like degrading systems, the presence of the large grains will result

in different transport regimes, as in MacKenzie and Eaton (2017), and thus different channel morphodynamics and depositional slope" It says that it is just the presence of large grains, what about boundary conditions? The article shows that is not just the presence of these large grains but discharge is a fundamental control.

5) A lot of information about bed structure, for example bars, is given by the end of the discussion. There is no data about this and only observations. This should be presented in a more formal way.

I belive that all these comments can be easily addressed by changing the text structure.

Specific Comments:

1) Abstract - line 2 - there is no need to say "shape", it is already included in the distribution. 2) Abstract - line 4 - Is it correct to talk about "fan" if we are in a 1D system? The fan part is where the system spreads and here it does not occur. 3) Introduction - line 11 - There is one problem when we use the discharge as a variable to explain a certain response. If we double (or 3X, 4X, ...) the channel width while holding the discharge we may have different geomorphological responses. Therefore, is not actually the discharge, but some other characteristic (e.g., unit discharge) what is better for comparisons. This may be discussed somewhere. 4) Intro - line 11 - There are several other references to this statement (sed supply and discharge controls) 5) Intro - Most of the Intro - Generally only one reference is given for a certain statement. More references are required. For example, when talking about armour layers (line 24) only Andrews and Parker, 1987 is cited. 6) Intro - Page 2 - Line 8 - References are needed for this statement. 7) Intro - Page 2 - Line 9 - Would it be better to start the discussion with something relatively newer than Lane (1955)? The experiments are really interesting, but starting the analysis based on this relatively old study (there is more information available related to stream power). It doesn't mean that this expression is not important, but, it does not fit what we know about sediment mixtures. 8) Intro - Page 2 - Line 21 - The text is confusing. However what? Please notice that the idea does

not flow starting with "however". There are some equations, definitions, and other text that makes this "however" confusing. 9) Intro - Page 2 - Line 23 - This is critical, Lane never said that this works for a sediment mixture, as you mentioned in the discussion. Therefore, up to this line, calling into question the assumption is not valid. please try to find another way to present the hypothesis. 10) Methods - general - This is the strong part of the article, it was really interesting. 11) Methods - general - It would be really interesting to analyze the evolution of the slope, that is, change of slope in time. I was wondering if the experiment came to a final equilibrium slope, or how do you decide to finish an experiment. Do we find the mean slope by the end of the experiment or by the middle of it. A simple plot would answer these interesting questions. 12) Results - page 6 - line 8 - This statement is only true for 0.1 ml sˆ-1. Notice that in panel a) for 0.2 ml sˆ-1, there is no "strong distinction". 13) Results - page 7 - line 3 - Notice that you need to reference Table 5 when you talk about the efficiency. 13) Results - General - It would be good to have more information about the properties of the bars that are mentioned at the end of the discussion. 14) Discussion - General - Some parts can be moved to the intro for a better motivation for the study. Also, it would help understand the hypothesis. 15) Discussion - General - Like in the intro, more references are needed. It is generally poor in important references. 16) Discussion - General - I'm not making a lot of detailed comments in the discussion because it seems to me that in the new version it will change significantly. Only the most important specific points are considered here. 17) Discussion - Page 9 - Line 30 - It seems that Church's relation can be a better way to motivate the study. 18) Discussion - Page 10 - Line 10 - It would be interesting to consider a little discussion about what may happen if we have the same D84 and different D50. 19) Discussion - Page 10 - Lines 12 to 17 - These lines are confusing. First, you mentioned that in low slopes sand plays an important role and that you can make the same inference. Then you said it is not actually sand what is the control in your experiments but the absence of large grains. Notice that your statement is correct (it is the absence of large grains), but relating it to Curran and Wilcock does not make any sense, because they attributed to sand. 20) Discussion - Page 10 -

Lines 20 to 32 - A lot of confusing statements are given here. a) One important aspect that you are considering is channel slope. The analysis made using Eq. 4 does not include channel slope, even though it is known that slope plays a role critical shear stress Lamb has published a number of studies related to this topic. b) Comparing a change in critical stress change for D84 to a change in slope is confusing. Why can we do that? The problem is that for a given discharge if we vary slope water depth changes as well, therefore changes in slope and not directly comparable to changes in shear stresses. Maybe I'm missing something but if you explain a little more about this rationale it would be clearer. 21) Discussion - Everything related to bars and beyond reach average - Most of the text is not clearly related to data or measurements. It need to be better justified. 22) Discussion - Page 12 - Line 6 - There are two more (more more mobile) 23) Conclusion - Page 12 - Line 34 - Change you in " as you increase". Also a period is missing.

Again, as I said before, the study is quite interesting. I hope you can address these comments and I hope that these observations and comment can improve the text.