Answers to Prof. Parsons

February 27, 2017

Overall comments: The paper draws together a range of previous studies on laboratory channels to explore the evolution o channel geometry data in order to assess examine the ability of threshold channel theory in explaining relationships between discharge and width. The paper is well written and presented and examines and explores why many laboratory channels evolve to braided rivers when physical or biological cohesive effects are not included. The work concludes that threshold channel theory can predict laboratory channel width when there is low sediment flux rates but that as flux rates increase a critical rate is reached when bar formation processes begin and the theory begins to break down at the onset of braiding. This is the main outcome from the paper and is an interesting and generally novel set of ideas, albeit a little speculative at times!

The discussion needs some attention in two main parts.

1) I think the paper would benefit from including a section that examines the interrelationships between width, depth, slope and shear stress. . .. as ultimately these have been shown to control alternate bar formation. . . inclusion of the work of Mosselman and Crossato, recent work by van der Lageweg would be valuable as well as the classic work of Parker on thresholds between braiding and meandering. Either this older theory is unnecessarily complex or the analysis herein too simple. . .a discussion of this would be welcome addition.

Following your suggestion we have added a discussion on that matter and a comparison to the stability analysis of Parker (1976), who was the first to examine the interrelationship between width, depth, slope and Froude number. Parker proposed that the limit between meandering and braiding channels occurs when the ratio (H/W) of a stream is of the same order of magnitude as the ratio of Slope of the channel to the Froude number of the flow (S/Fr). We compared our prediction with Parker's prediction using the same dataset and found that they are in good agreement. Comparison with more recent analyses, such as the one you mention, is difficult given the available data but the comparison with Parker's criterion undoubtedly shows that our empirical analysis is not in opposition with these theoretical analyses. We added a paragraph in the discussion and an appendix with a figure showing this comparison.

2) I would also welcome an additional element in the discussion on bank and substrate cohesion and its influence on geometry and sediment transport processes, including bedform and bar form development – with impacts on sediment transport rate and shear stress. Do more cohesive sediments inhibit bar formation and maintain single thread channels as some have argued. . . is this bank stability or bedform suppression (e.g. Schindler et al. 2016). Artificiality holding shear and depth higher? There is a wealth of additional work examining these elements that should be included and would result in a much more widely used paper.

Vegetation and bank cohesion indeed influence the geometry of the channel. Our analysis reveals that, at leading order, the geometry of experimental rivers accords with the threshold theory. Deviations of factors up to two can be seen from this scaling on figures 2 and 3. These deviations can be caused by the additional phenomena you mention. Tal and Paola (2007,2010), for example, have shown that vegetation could significantly lower the aspect ratio of a thread. The same has been done for cohesive sediments by Peakall et al. (2007) and Dijk et al. (2012). We have edited the manuscript to make this point clearer.

I have a few minor comments:

i) Rephrase sentence in abstract or break up sentence: "Using this finding to reinterpret experiments by Stebbings (1963), we suggest that sediment transport widens the channel until it reaches a limit width, beyond which it destabilizes into a braided river." Done

ii)

page 6, 20: "led". iii) Done

page 8, 12: "anymore" iv) Done
Page 8, 15: "influence" Done