Reviewed Manuscript: A comparison of 1D and 2D bedload transport functions under high excess shear stress conditions in laterally-constrained gravel-bed rivers: a laboratory study

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In this paper, the authors study the bedload transport under relatively high excess shear stress conditions in a laterally-constrained gravel-bed river. More specifically, the authors compare the 1D (based on the reach-averaged shear stress) and 2D (based on the local shear stress) approaches of bedload transport calculation using a Meyer-Peter and Muller type relation. For both approaches, the shear stress are calculated either with the depth-slope product or from a 2D hydraulic model (Nays2DH). Their study finds that under relatively high excess shear stress, both the 1D and 2D approaches (with either way of shear stress calculation) can predict well the bedload transport in the experiments, after some calibration. However, the critical shear stress shows marked difference in the 4 methods (1D vs. 2D, depth-slope product vs numerical modeling), reflecting differences in how these approaches conceptualize excess shear stress.

Results of this study can help deepening our understanding in a traditional topic in the earth surface science: how to calculate the bedload transport in a proper way. The topic is within the scope of *Earth Surface Dynamics*, and the contents are generally well organized. Therefore, I think that this paper could be published on *Esurf* after moderate revision. I list my comments below.

Main comments

1. Introduction

Since the topic of this manuscript is about the bedload transport under high excess shear stress conditions (as stated in the title), I think it would be helpful to cover the studies about sheet flow (i.e., bedload layers devolves into a sliding layer of grains that can be several grains thick) in the Introduction. It is likely that the flow condition in this study was not sufficient to induce sheet flow (which often requires a Shields number of 0.5~1.5), but it would still be beneficial to tell the readers what the bedload transport would be like under sufficiently large excess shear stress.

Some literatures about sheet flow are as follows:

Fredsoe, J. and Deigaard, R., 1994, Mechanics of Coastal Sediment Transport, World Scientific, ISBN 9810208405, 369 p.

Gao, P., 2003, Mechanics of bedload transport in the saltation and sheetflow regimes, Ph.D. thesis, Department of Geography, University of Buffalo, State University of New York

Horikawa, K., 1988, Nearshore Dynamics and Coastal Processes, University of Tokyo Press, 522 p.

Parker, G. (2004). 1D sediment transport morphodynamics with applications to rivers and

turbidity currents. (Chapter 7: Relations for 1D bedload transport) http://hydrolab.illinois.edu/people/parkerg//morphodynamics_e-book.htm
Wilson, K. C., 1966, Bed load transport at high shear stresses, *Journal of Hydraulic Engineering*, 92(6), 49-59.

2. Lines 116-118: How is the manning coefficient back-calculated? How do you determine the spatial distribution of manning coefficient? What is the formulation of the Ferguson (2007) relation? As the manning coefficient is one of the most import parameter that determine the flow hydraulics, I would suggest authors to explain in more detail about this content.

3. In the first paragraph of Section 2.2, the authors demonstrated that "Each experimental phase comprises an initial adjustment period during which morphology, hydraulics, and sediment transport are non-stationary. This adjustment period, which may vary from minutes to an hour, is followed by a steady-state period where these characteristics fluctuate around a mean value…In both examples, there is a brief adjustment period with less sediment transport, followed by fluctuations around a mean value."

However, when I looked at Figure 3, I do not clearly observe the two-stage characteristic in the temporal variation of sediment transport rate. I think it would be helpful to do some statistical analysis to justify your demonstration.

4. The experiments applied a widely-graded sediment mixtures, but the MPM type relation based on uniform sediment was applied for the calculation of sediment transport rate. I think that the authors should discuss the effect of multiple grain sizes on the calculation and analysis.

Specific comments

1. Line 18: Not only bedload material, but also suspended load, especially for lowland alluvial rivers.

2. Please plot the grain size distribution of the sediment used in the experiment.

3. Lines 87-88: I am not quite sure that I understand this. Maybe it is also not easy for the readers to understand. Please explain more about the measurement frequency.

4. Line 94: "slug" injection. Readers might meet difficulty in understanding the jargon.

5. Caption of Table 3: Are they experimental or model results? I am confused. Also, are they reach-averaged results or results of a certain location.

6. Figure 2: What does the error bar denote? Maximum/minimum or standard deviation?

What does the solid point denote? Mean or median value? Also, does the data in the figure reach-averaged value? Please explain in the caption.

7. Line 140: What do you mean by “second-order processes”?

8. Equation 3: Format problem. Following is what I see in the pdf file. I do not see the integration symbol.

Z

$$q_b \propto \quad (\tau_{(x)} - \tau_{c50})^{1.6} dx/A$$

9. Line 166: Why do you apply a constant slope for the 2D depth-slope method? You can calculate the local slope with the DEM data.

10. Line 174: Is 95 percent a small portion?

11. Lines 187-188: Figure 7a shows the regression of only shear stress, but not the flow depth.

12. Figure 6b: What does the τ_{c50} in panel b refers to, A1, A2, B1 or B2?

13. Caption of Figure 7b: Do you mean highest (Exp1c(4) and lowest Exp1c(1)? Exp1c(1) has a smaller discharge than Exp1c(4).

14. Conclusions: I suggest to put Conclusions as Section 5, rather than a subsection of Discussion.