

## ***Interactive comment on “Gravel threshold of motion: A state function of sediment transport disequilibrium?” by Joel P. L. Johnson***

**Anonymous Referee #2**

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Review of ‘Gravel threshold of motion: A state function of sediment transport disequilibrium’ Earth Surface Dynamics (esurf-2015-52) Joel P. L. Johnson

This paper uses flume experiments and a morphodynamic model to assess the impact that sediment supply has on the evolution of thresholds of motion. The topic of the paper is of interest to readers with some interesting findings that are applicable to the wider discipline. However at present the paper is quite, long, ‘dense’ and difficult to read in parts meaning that the novelty of the paper is somewhat lost in places.

The main comment I feel which needs addressing in this paper is the lack of emphasis on the physical underpinnings of how sediment supply affects the thresholds of motion. Whilst the author makes reference to the bed state conditions in the introduction he does not really follow those through in terms of the implications of his findings. This

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currently leaves the reader wanting more detail in this regard. There are many papers which talk about the effects of both bed state in terms of structure as well as sand content on entrainment thresholds. I think the latter is particularly important for this paper and the author could look at the following papers as a starting point.

Curran, J.C. and Wilcock, P.R. (2005). Effect of sand supply on transport rates in gravel bed channels. *Journal of Hydraulic Engineering*. 131:961-967 Ikeda, H. and Iseya, F. (1988). Experimental study of heterogeneous sediment transport. Environmental Research Centre Paper 12. University of Tsukuba; Japan. Jackson, W. L., and Beschta, R.L. (1984). Influences of increased sand delivery on the morphology of sand and gravel channels. *Journal of the American Water Resources Association*. 20; 527–533.

I also feel the paper could benefit from being shortened as it is currently quite long and loses focus in places. Detailed comments are also given below.

Line 83- I am not sure I agree with the statement that is still only believed to be controlled by grain parameters. There is an increasing recognition that, as the author alludes, bed state controls are also important. I think at the very least this should be recognised in the current text and references made to the large body of work relating to the impact of structure on bed stability. How does this also link to the concept of mobile armours? You go on to mention this in lines 153-157 so this section could be reorganised?

Line 93- comma missing after vertical position

Lines 123- 131- this section is clumsy and needs re-writing

Line 141- 143- does this not assume that the bed state does not change? You could have the same overall flux of sediment but the surface structure may change and hence the distribution of threshold stress will thus change as the bed is more stable?

Line 155- consider revision of little additional decrease

Lines 158 – 167 – I think if you are using the terms interchangeably throughout the

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paper then there is no need for this paragraph at all.

Line 185- should be dimensional not dimensionally

Line 189 – move 'Ar is an optional dimensionless armouring parameter, described further below' to line 198 where you talk about Ar

Line 189- I think the Ar should be defined as it can have different definitions

Line 202- this sentence does not make sense- do you mean large grains rather than large range?

Line 205- although this paper is concentrating on step pool sequences perhaps something to consider later on in the paper is how applicable these results are to gravel bed rivers more broadly e.g. at lower slopes?

Line 207 – unit missing after flume length

Line 226- can you be more specific- how much erosion?

Line 227 – what does 'very low' mean? Can you quantify?

Line 228 – why was this feed rate chosen? What was this rate in comparison to the initial transport rates?

Lines 243- consider deleting to GSDs compared

Lines 237- why was the Wilcock and Crowe model specifically used?

Lines 237- 265- can this section be shortened? Why not just reference the W&CM highlighting the changes you made to it?(lines 262-263)

Lines 313 -316 – what was your GSD? This is important if you are beginning to discuss sand content and the mechanisms by which sediment feed rate affects initiation of motion? Also in line 313 you mention that the % of grains smaller than 2mm was very small but in lines 316 you say 2.8mm was your smallest grain fraction?

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Lines 332 – define RMSD

Lines 336 – 344 – this is an interesting finding but what are the implications of this in terms of bed state?

Line 352 – need full reference to Parker

Line 473- change stresses to stress

Line 474- I am not sure they are comparable are they? Again thinking in terms of the relative effects of bed structure and implications of grain size, structure and thresholds of motion would D50 and D84 be expected to behave the same?

Line 475- what do you mean by 'fairly comparable'?

Lines 503-506- I think this is one of the places where a better physical explanation behind the findings would be useful

Lines 530 – this section is supposed to be linked to system memory but I find it hard to distinguish this and a much more explicit link needs to be made.

Lines 545-546 – I would re-write to avoid asking a rhetorical question

Lines 576 – whilst I find this section an interesting concept I think it could be shortened a lot given the paper is already quite long.

Line 584- expand upon the work of Phillips (2007)

Line 625 - I would re-write to avoid asking a rhetorical question

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