Earth Surface Dynamics Discussions

Earth Surf. Dynam. Discuss., referee comment RC1
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Comment on esurf-2022-40

Anonymous Referee #1

Referee comment on "Coupling between downstream variations of channel width and local pool–riffle bed topography" by Shawn M. Chartrand et al., Earth Surf. Dynam. Discuss., https://doi.org/10.5194/esurf-2022-40-RC1, 2022

This paper presents results from a flume experiment with downstream variations in width, which are used along with field and experimental data in the literature to assess the relationship between width changes and bed slope and consequently riffle-pool morphology. The data are presented in the context of a scaling relationship relating slope and width changes, and results show that local width changes are an important control in bed morphology development.

This is a thoughtful, well-written paper. It does a service in compiling data from dozens of prior studies and synthesizing them in the context of the paper's scaling relationship. Most of my comments are relatively minor and aimed at making the paper easier to understand and interpret.

Substantial comments:

- The notion of 'changes in width' in the paper generally refers to downstream (spatial) changes in width, but there is some confusion with temporal changes in width (i.e., at-a-station widening or narrowing), in part because the flume experiment involved achieving quasi-steady-state, then changing the width of one section, and achieving a second quasi-steady state. So, there were places throughout the paper where as a reader I was not sure whether discussion of width changes meant spatial or temporal

changes. One suggestion may be to refer to temporal width changes as 'changes', but spatial variations in width as 'variations' or 'gradients'. This would provide some consistency with the scaling model, where the delta_w variable is actually a gradient, not a dimensional change. Replacing 'Δw' with '$\square_x w$' might help relieve some potential reader confusion, as would careful editing throughout the paper to ensure clarity about what type of width changes are at issue.

- It wasn't clear to me until about line 114 (the middle of section 3) that the paper would actually describe and present an experiments where the downstream pattern of width variation would be changed from one run to the next. That information should be explicitly described in the abstract, and potentially Introduction.
- I like Figure 3, but it's not clear how the lines showing the predicted values of eq. 1 are generated from the equation alone. I looked at the python notebook in the repository which provided some clarification, but some additional information in the paper itself would be helpful.
- The end of the Discussion (line 247 onward) provides some good context for how the scaling between width gradient and slope may be relevant for dam removal and sediment supply. I believe experiments have had difficulty replicating the field observations from the Elwha, however, where increased sediment supply led to a reversal in bed slope and temporarily filled in pools. Nelson et al. (2015) suggested that variable water discharge may have also played a role in that response, and the impact of time variations in flow may be worth including in the discussion here.

Additional comments by line number:

31: 'dynamic shifts' – does this refer to temporal or spatial changes?

39: 'local adjustments of bank position' – same question – at-a-station change in width, or downstream (spatial) change in width? Please check throughout the paper these types of issues – I won't point them all out in the review.

74: ΔU_x^* is a dimensionless velocity change, not a dimensionless velocity.

Eq. 4: why use ~ instead of = in this equation? Does the dimensionless velocity just scale like a Froude number, or is this actually how it's calculated?

Figure 2: I think the discussion would be easier to interpret if some data were added to this figure. Specifically, additional subplots showing (a) how width gradient changes in the downstream direction for both runs, (b) the downstream profile of the amplitude above/below the zero-crossing line for both runs, and (c) downstream profile of the local slope ($S_{local}(x)$).

Table 1: typo in footnote b: ‘supple’ should be ‘supply’.

128: My interpretation of Table 1 is that the times shown are when the flume was stopped, drained, and measurements were taken, but there is no information on this in the text. Please provide a bit more detail on the experimental procedure.

Figure 3: I think the figure legend and figure caption have a mistake – I suspect phi (the porosity) ranged from 0.3 to 0.5, not epsilon. If that was in fact epsilon, the porosity would be up to 70%. Also, mysterious “?” in the fourth line of the figure caption.

236: incomplete sentence ending in ‘including .’

Fig A.4 caption states units are meters, but figure appears to have values in feet.