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Interactive comment on "Coarse bedload routing and dispersion through tributary confluences" *by* K. S. Imhoff and A. C. Wilcox

Anonymous Referee #1

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The authors use passive-integrated transponder and radio-frequency identification technology to study how confluences influence the routing of coarse-sediments in a gravel bed mountain-river (East Fork Bitterroot River basin, Montana, USA). They observe that coarse sediment entering confluences experience reduced depositional probabilities, in contrast to the size-selective transport observed in a control reach. The results also suggest that transport distance and variance growth rate are enhanced through confluences for a given flow strength. Based on these data, the authors propose a conceptual model according to which equilibrium headwater confluences promote enhanced dispersion and greater downstream transport distances than otherwise expected.

This paper reports the first field study of coarse-sediment routing through mountain-

river confluences. As such, the field data are interesting for the community. As a matter of fact, making the raw data available for the community as a supplementary material would greatly improve the impact of the paper. I have, however, a certain number of reservations, listed below, that prevent me to recommend publication of the manuscript at this stage.

1. As discussed in the introduction (p 1512), in section 4 (p 1526) and exemplified by figure 1, the sudden increase of discharge at the confluence is likely to be a important control parameter of sediment dispersion and transport distances. It is therefore regrettable that the sites being ungauged, the entire analysis relies on water stage measurements. This weakens the conclusions of the paper.

2. Abstract, page 1520, line 14-15. The authors mention the existence of "finer-grained experiments" in which efficient transport corridors are also observed. Unless I'm wrong, these "finer-grained experiments" are discussed nowhere in the manuscript.

3. page 1514, line 5. What exactly do you call a "disturbance"? Please be more explicit.

4. page 1515, lines 25-30. What is the bed D50? What is the D50 of the tracer particles ?

5. page 1516, lines 16-19. How exactly did you make sure that the tracer particles were deposited randomly ? Why would randomly distributed particles be more likely to move to natural positions ? How long does it take ? And what do you mean by "natural position" ? I understand that your objective is to minimize the possible influence of the initial condition. But your statements need to be supported by observations or reasoning. For my part, I would be encline to believe that it is very difficult to ensure a random distribution on the field so that starting

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from a regular grid is the most reproducible initial condition even though it is not the most “natural ” one (as in Phillips et al. 2013).

6. The authors chose to organise the discussion of the results in three separated sections: 1) short presentation of a few sediment dispersion models in section 2.3, 2) test of these different models against the field data in section 3, 3) discussion in section 4. I don’t like this organization which prevents from conveying a clear message.

   First of all, the reader looses track of the central idea of the manuscript. The accumulation of sentences starting with “We also ...” (at least 3 or 4 in sections 2.3.2 and 2.3.3) participates to this feeling and leaves the reader under the (false) impression that the authors are randomly testing theoretical models.

   Secondly, many notions are defined long before being actually used. E.g. the normalized transport distance defined page 1518 is plotted and discussed page 1524. Similarly, equation (2) or the dimensionless impulse are introduced page 1519 and used page 1525. Again, this does not facilitate the reading of the manuscript.

   The authors should therefore reorganize the manuscript. It is particularly important to explain 1) what motivates the choice of a given model instead of another, 2) what are the differences between the different models (assumptions, physical mechanisms, ...).

7. page 1519, L1. D50 instead of L50

8. page 1519, equation (2). I imagine that the coefficients involved in equation (2) (0.232, 1.35, ...) are empirically fitted coefficients and not fundamental constants. If so, these coefficients probably depend on the field site where equation (2) is applied. The authors should comment on this.

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9. Page 1521 : What motivates the choice of equations (5) and (6) to compute the critical Shields stress ? To what extent do the values calculated from equations (5) and (6) differ from each other ? From the empirical Shields curve ?

10. Many paragraphs address several different ideas and should therefore be split. See, for example, the very long paragraph of the introduction extending from page 1511, line 7 to page 1512, line 5. The paragraph starting p 1524, line 16 and ending page 1515, line 4 is another example.

11. The phrasing of some sentences is rather unclear. I have listed some of them below. This list is not exhaustive and the authors might want to check the whole manuscript.

    (a) page 1510, Line 18-19 : "We suggest that confluences absent of disturbances enhance sediment transport..."

    (b) page 1513, Line 7-9 : "Sediment transport through equilibrium confluences, however, is poorly understood (Best and Rhoads, 2008), in turn constraining understanding of confluence influences on local and network-scale patterns of sediment routing."

    (c) p. 1514, l. 21-22 "Between the study confluences is a plane-bed-morphology control reach."

    (d) p 1528, l. 6-7 " Despite this, observed tracer transport suggests that confluences enact an enhanced dispersive regime through increased travel distances and reduced depositional probabilities."

12. Figure 3. The caption mentions " photographs of the (b) upper confluence, (c) control reach, and (d) lower confluence" which are not on the figure.

13. Figure 5. Describe a, b and c in the caption.

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14. The aspect ratio of figures 9, 10 and 11 should be increased so as to make them more readable.

15. Figure 11. Modify the axis limits so as to zoom on the data.

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