Interactive comment on "Morphometric properties of alternate bars and water discharge: a laboratory investigation" *by* Marco Redolfi et al.

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The paper is a straightforward, nicely presented, experimental and theoretical study of the effect on channel bars of systematically increasing water discharge. Because the experiments use a conventional vertical-wall flume, the increase in discharge translates to increasing depth and shear stress at constant width and slope. The result is a transition from emergent bars that lead to a rough meandering pattern through conventional alternate bars to a form of diagonal bar that seems to be a transition to dunes. The bars generally get lower and shorter, and move faster, as the discharge increases. The paper also shows that many of the changes are reasonably well predicted by the weakly nonlinear bar theory proposed in 1987 by Colombini and colleagues.

Apart from the direct scientific findings, two meta-contributions of the paper that I particularly like are, first, a nice demonstration of a mechanistic theory applying to conditions well outside those for which it was formulated; and second, an especially clear and teachable example of the application of Fourier modes in morphodynamic theory (Fig. 5). All in all, this is a paper that asks relatively little of its reviewers. So perhaps the most useful thing I can do, apart from minor technical suggestions, is to pose some questions that might provide a starting point for additional discussion of the paper's findings:

1. Are there any visible effects of the near-critical Froude numbers that characterize all of the runs (Fr values roughly 0.9 – 1.2, Table 1)?

2. Do any of the observed bars show flow separation, and if so, what effects do the authors think the separation, which is clearly not part of a weakly nonlinear theory, has on bar dynamics and sediment transport?

3. From the parameter values in Table 1, it appears that the experiments were all run for bedload-dominated conditions, and with a relatively high relative roughness based on the grain size. Overall, the experimental conditions are representative of gravel-bed rather than sand-bed rivers. In that context it's interesting to consider the transition to dunes hinted at in the higher-discharge runs, since most natural, alluvial gravel rivers do not have dunes, while dunes are the predominant bedform in sand-bed rivers, often superimposed on bars. The intermediate case, diagonal bars, in the high-discharge runs appears to be relatively unusual in natural channels. Yet they do not appear to require unusual conditions to form in the experiments. Do the authors have any thoughts as to what aspects of self-organization in natural channels might discourage diagonal bars or other transitional-dune forms from developing? Or have they been overlooked or misclassified? 4. On the same theme of diagonal bars, this set of experiments seems to beg for a follow-up in which the aspect ratio is varied over an even wider range, allowing the slope to vary also, so that one could observe the complete transition from emergent bars and an inset meandering channel (the lowest

discharge in this series) to a state of fully developed dunes with a height scaled to, but only a fraction of, the flow depth (the logical extension of the high-discharge end of this series). Do the authors think this would be useful, and/or have any other comments on the relation between bar and bedform dynamics?

Minor technical comments: I would like to see the following quantities added to Table 1 for each discharge: spatial mean shear stress; Shields parameter based on that stress; Rouse number. I believe that Esurf uses UK standard spelling, in which case 'center' should be changed to 'centre' throughout the paper. 29/30 'this kind of bedforms' should be 'this kind of bedform'. I would also suggest that, although not technically incorrect, many people use 'bedform' only for features like ripples and dunes whose vertical scale is small compared to the depth. A more neutral term like 'bed morphology' would be less likely to cause confusion. 49 'Fredsoe, 1978' It seems to me that Parker (1976) made this point clearly, though earlier, and should be added to the citation here. 57 'manly' to 'mainly' 122 'cross sections' This again is not technically incorrect but people may interpret 'cross' to imply 'transverse' so this might clarified to 'longitudinal sections' 151 'amplitude. . . provides' to 'amplitudes. . .provide' 157 'requires to specify' to 'requires that we specify'. Additionally, I assume that the authors mean that in the original Colombini et al. theory these closure relations were not specified, so that equations $6 - 8$ represent choices made by the authors of the current paper. If this is the case, it would be better not to use the past tense in describing these choices (e.g. in line 168 'was modeled'), since they are part of this paper. So for example, in line 168, change to something like 'We model the effect. . .' But it seems to me that Colombini et al. included a similar closure for the lateral slope effect, so it's not clear which aspects of equation 8 are different (only the value of r?) between this paper and the original theory. 184 'becomes' to 'become' 202 'Noteworthy,' to 'It is noteworthy that' 234 'to' to 'for' 250/1 'ensemble bar shape' Computation of these for each discharge is one of the more interesting data-analysis techniques used in the paper. It would be nice to have more details about how this was done, perhaps in a second Appendix. In particular, as the authors note elsewhere, the bar pattern varies quite a

bit along the flume. This is clear in Figure 2 and is strongest for the high discharges, where the wavelength seems to change as well. Were the bars ensemble-averaged over the whole channel length, or just the downstream part? If the whole length was used, how (if at all) were the varying bar shapes rectified relative to one another? 303 'firsts' to 'first' 304 'for calculating' to 'calculation of' or 'us to calculate' 382, 395 see 29 above 399 'from' to 'of' 416 'to' to 'with' 446 'tends' to 'tend' 448 'gives' to 'give' 491 'associate to' to 'associated with' 502ff 'Overall. . . history' This final statement is too vague to provide any useful information. The paper would be stronger if it ended with the seven clear, specific conclusions it has now. But if the authors want to end with something more general, it would be better to come up with a statement that has a memorable and useful message.