Hydrology and Earth System Sciences Discussions

Interactive comment on "Study of frequency pattern of coherent turbulent flow over ripples using image processing with implication in river restoration" *by* A. Keshavarzi et al.

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Interactive comment on "Study of frequency pattern of turbulent flow structure over ripples using image processing with implication in river restoration" by A. Keshavarzi et al.

Anonymous Referee #2

Already the title is problematic. Turbulent flow is turbulent. It cannot be particularly more or less coherent. If anything, it can host structures, which require precise definition that may be spatially or temporally coherent in some way.

Response:The title of the paper can be revised to highlight the message.

The language is hard to follow and at times even incomprehensible. The introduction is not giving an informative overview and then a precise description of the investigated research question. It rather lists rather common and known facts.

Response:The reviewer does not provide advice regarding missing information. Hence, it is difficult to comment as the introductory section of any paper will not include all possible information but rather that information the authors consider important to the focal point of the paper. Furthermore the last paragraph of the introduction details the information not currently available in the literature that is to be presented in this paper.

The experimental setup and reasoning is not well described. How are the artificial ripples produced? How is the sand deposited? How is it made sure that the ripples are always covered with a layer of sand? How is it argued that the experimental setup is relevant for any other situation in the laboratory or in nature (the plots of figure 6 show a different behavior for first and second ripple, so the results cannot be of general nature)?

Response:The experimental tests were performed over artificial ripples with fixed and mobile bed. Two different types of ripple including sinusoidal and triangular shapes were tested (See Figure 3). The wavelengths of sinusoidal and triangular ripples were 200, 250 and 300mm. The height and length of each ripple was 0.03 and 0.20 m, respectively with no topographic variation in cross-stream direction. The stoss side of the triangular ripples was inclined at 11 degrees from the horizontal, while inclination of the lee side was set to 31 degrees (according to the angel of repose). The ripples were made from bent galvanized plate produced a stable bed, necessary for measuring the velocity profile and study the flow structure. The galvanized plate was covered with uniform sand particles glued on the plate for fixed bed experiments. To make a mobile bed, the bottom of the flume was covered with a movable bed material layer consisting of sand particles with d_{50} of 0.62 mm. The galvanized plate was also covered with

some layers of similar particle sand size. As sediment particles entrainment was at the initiation of motion, a limited number of entrained particles did not change the bed condition over ripples.

How can a Kolmogorov scale be given? If so, for what location, (eta=(nuËĘ3/epsilon)ËĘ0.25, and the rate of dissipation=epsilon is a function of distance to wall)?

Response:The authors acknowledge the issues associated with the estimation of the Kolmogorov scale. This parameter was included in Table 1 at the request of a pre-publication reviewers. It can be deleted from the table with no loss of information.

Why is the coordinate system not chosen to follow the terrain? How is it actually chosen? Rather than telling me that a code is written in C++, I would like to know on what principal it works. How are depositions discriminated from entrainment events? Why should black and white be an indication? It just does not make sense.

Response:The image processing technique has been described in detail by Keshavarzi, A. R. and Ball, J. E.: An application of image processing in the study of sediment motion, J Hydraul. Res., 37(2), 559–576, 1999.

As an example of the presented reasoning, which in my view is questionable, I mention the last 5 lines of section 2 on Material and Methods: It is written that in order to minimize the lateral wall effects, measurements are taken only in the middle. In my view however, it is mandatory to show how the profile varies over the later direction to justify why measurements from the middle are representative for a lateral homogeneous flow. The last three lines of the same paragraph are simply wrong, it is not enough to understand turbulence in 2D. Turbulence IS 3D and so are the associated structures. Such stream-wise structures are known to have a lateral distribution.

Response:The reviewer's comment is noted but reflects more on the clarity of expression used rather than the reviewer's claim of error. The inclusion was to highlight

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the need to understand 2-D characteristics of turbulent prior to investigating the 3-D characteristics of turbulence. This approach is necessary due to the need to develop appropriate analysis with experimental methodologies and secondly is consistent with previous studies on quadrant analysis of bursting process in following studies by Kline et al. (1967), Grass (1971), Nakagawa and Nezu (1977, 1978), bridge and Bennett (1992), Nelson et al. (1995), Nezu and Nakagawa(1993) and Ojha and Mazumder (2008).

Bridge, J. S. and Bennett, S. J.: A model for entrainment and transport of sediment grains of mixed sizes, shapes and densities, Water Resources Res., 28(2), 337–363, 1992.

Grass, A. J.: Structural features of turbulent flow over smooth and rough boundaries, J. Fluid Mech., 50(2), 233–255, 1971.

Kline, S. J., Reynolds, W. C., Schraub, F. A., and Runstadler, P. W.: The structure of turbulent boundary layers, J. Fluid Mech., 30(2), 741–773, 1967.

Nakagwa, H. and Nezu, I. Prediction of the contribution to the Reynolds stress from bursting events in open channel flows. J. Fluid Mech., 80(1), 99–128, 1977.

Nakagwa, H. and Nezu, I. Bursting phenomenon near the wall in open channel flow and its simple mathematical model, Fac Eng Kyoto University, Japan XL 40(2), 213–240, 1978.

Nezu, I. and Nakagawa, H. Turbulence in open channel flows, IAHR Monograph, Balkema, Rotterdam, 1993.

Nelson, J. M., Shreve, R. L., McLean, S. R., and Drake, T. G. Role of near bed turbulence structure in bed load transport and bed form mechanics, Water Resources Res., 31(8), 2071– 2086, 1995.

Ojha, S.P. and Mazumder, B.S. Turbulence characteristics of flow region over a series of 2-D dune shaped structures, Adv. Water Res., 31, 561–576, 2008.

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In the results section I actually do not see many results that are also novel. Yes, the burst event probabilities are seeing the bed form. On the contrary it is hard to imagine hoe this should not be the case. But what is learned from this? I am afraid that I fail to understand.

Response:Can the reviewer point to previous publications where this result has been published. It is our view that, while the result is obvious, we have shown that the data supports the expectation.

The image analysis is not described, but it seems little more than subtracting one image from another and claiming that white spots are deposition and black spots are entrainment events. Why? Many scenarios are possible for each gray tone change, as it is not clear which color particular grains have. Or is it a monolayer of sand? If so, how is it maintained?

Response:The image processing technique has been described in detail by Keshavarzi, A. R. and Ball, J. E.: An application of image processing in the study of sediment motion, J Hydraul. Res., 37(2), 559–576, 1999.

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