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Earth Surface Dynamics Discussions

Interactive comment on "Morphology of the Kosi megafan channels" *by* K. Gaurav et al.

Anonymous Referee #1

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- General comments –

This paper shows a valuable set of measurements that is an important addition to remotely sensed data, which is often used to study large rivers. This data is valuable for determining river dynamics and evolution.

In this paper, the data is used to test theoretical predictions of channel properties. I have several concerns about the validity of the methods and the choose of location for the analysis, which I address below. One of the main things, and that is something the authors point out themselves, is that sediment load has been ignored, yet very important.

Similarly, the paper addresses a very theoretical issue and the conclusions are very abstract. In the introduction, the authors mention some of the important topics river research. In order for this paper to be relevant in the field of fluvial geomorphology, the

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authors need to address the geomorphological problems more specifically and provide tangible conclusions. This would require some 'translation' of the theoretical results to the broader field. I believe this is required for considering publication in Earth Surface Dynamics.

In addition, the structure of the paper needs improvement, detailed comments on the structure is addressed below.

Perhaps the authors should consider to combine their measurement with their ongoing campaign that does involve sediment transport measurements, as mentioned at the end of the paper. A paper based on these combined measurements could clear some of the main issues and provide a better link to fluvial processes and the resulting geomorphological evolution.

It might be best that the authors submit a 'new' paper instead of revising this paper, given the concerns that may require some major rewriting of pieces.

- Specific comments –

One main concept used in this paper is the threshold channel theory, which predicts the geometry of channels with no sediment supply. As you mention yourself, (page 1030, line 5) this theory does not hold for this case since there is a large amount of sediment influx. Subsequently, you simplify the threshold-equations for W,H and S and fit this to the actual data. The whole section on threshold channels seems redundant, as you prove yourself. Why don't you skip this section and start right away with dimensionless W, H and S? This is where all subsequent analyses are based on? Furthermore, what is the difference between your W*, H* and S*, and the dimensionless parameters of, for example, Gary Parker? Please prove some insight in why you need new equations and why previous dimensionless parameters are not useful here. So the threshold theory does not consider sediment load, but the 'fitted' equations doesn't do this either?

This paper is a bit top-heavy, there are quite some subjects mentioned in the intro-

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duction, there is a lot of methodology, but only limited actual results and hardly any discussion. I believe the paper would improve if many of the aspects discussed in the introduction are studied in the paper: is there an effect of vegetation, are there differences of different grain sizes, what is the added or combined value of these measurements and remotely-sensed data? Could your results add to recent advances in river remote sensing on large rivers in this region (e.g. Passalacqua et al, 2013, Marra et al, 2014). This potential set of data deserves to be studied more extensively!

The introduction needs to be rewritten. Parts of interesting information for in the introduction appear later in paper, in the results section (page 1028, lines 10-17). The paper misses a clear goal. I understand you seek for the similarities between channel segments of braided rivers and channels of single-threaded rivers, but it is unclear to my why this is valuable information. One thing I like is that you state that these measurements are valuable in addition to aerial images, but the paper does not elaborate on this matter. To make that claim, you need to provide detailed imagery and show the added value of your data. Furthermore, you need to explain the threshold channels theory in the introduction, this is now explained in the results section after the actual results (e.g. page 1030, line 5-8). And explain why this is important to use.

This paper needs to be restructured. Parts that are relevant for the introduction appear in the results section. Most of the results section contains methods. There is not really a discussion; the only real discussion is in the conclusions. And some results are mentioned for the first time in the conclusions.

I have some concerns about the relevance of the data from the residual channel that the authors refer to as 'seepage channels'. If these are residual channels, their shape and slope are probably dictated by the previous channel when it was still connected to the source of water and had a larger discharge and stronger seasonal variations. After it became abandoned, there was still water in there but I doubt if this has a discharge that has altered the channel such that the channel geometry and slope are related to the current flow regime. The authors should show evidence that this is not the case or

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address this concern and analyses what the effect is on their analyses.

Words like threads and channels seem to be used interchangeable. I suggest the authors check for consistency and provide a sentence of their definition in the introduction. I would stick to: braided channel and single-threaded channel. Avoid using 'braided thread'. If you want to be strict, you should use braided river (not channel) as such river is made up of individual channels. Anyway, be consistent.

I would change 'seepage channel' to 'residual channel', which is the proper geomorphological term (but do mention they are fed by groundwater).

- Miscellaneous comments –

The abstract misses a description of the results. In the abstract, you write what is measured, but not, for example, the main results shown in figures 3-5.

In the introduction, please elaborate on the governing processes of channel pattern. What are the effects of sediment and vegetation? Describe things as cohesion and describe the relation of stream-power on channel pattern (e.g. Van den Berg, 1995).

1024, 1-5. Write all methods in past tense (or be consistent).

1024, 5. 'both' is confusing next to 'channels', rephrase.

1024, 7. Remove 'also'.

1024, 9. 'threshold channel theory' requires more elaboration here.

1024, 16. I don't think a river 'selects' a pattern, the pattern is a result of the fluid mechanics.

1024, 22. A reference to Leopold et al. 1957 would suffice here.

1024, 17. There governing parameters are not 'Possible'.

1024, 21. 'multiple-threads channel', multi-threaded channel, or braided channel.

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1024, 24-25. ‘within the same channel’ is confusing, could be deleted. And are you sure all these references are relevant and needed?

1025, 1. You state that experiments agree with this observation. But only one reference is given. There are many more experiments on braided rivers (e.g. Van Dijk, Vande Lageweg, Kleinhans, Tal, Bertoldi). Do these experiments show similar results?

1025, 2. ‘is collection’ -> ‘is a collection’.

1025, 12. You state that the fan consists of homogeneous material. This is a very important assumption and I doubt this is true. Do you have measurements or references that support this claim? Actually, later (line 22-23), you show that there is a strong gradient in grain sizes which will have an effect when comparing different reaches of the channel. Please show that this is not an issue, or account for grain size differences in your analysis.

1025, 17. Large is better. You indeed measure a lot, but it requires much more effort to measure. Earlier you cite and base your research aims on flume experiments, which are very small (yet very useful). Please elaborate and specify why large is useful here. Keep in mind that large rivers tend to show different behavior (e.g. Ashworth and Lewin 2012 and the work of Latrubesse), this claim is somewhat controversial, but you could contribute to this discussion.

1026, 3. Can you shortly explain from the literature why the river changes to meandering here? What factors are important here?

1026, 6. Can you put the channels in the earlier mentioned diagram of van den Bergh, to show if you can explain why some are straight and some are braiding?

1026, 11. I think it is the other way around: the fan is mad by fluvial deposits. The composition of the fan is the result of the river.

For the entire methods section, please use past tense of things done in the past.

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1026, 19. I think this device measures velocity not discharge. You calculated the discharge.

1025, 24. Sentence subject: The device does not compute this, you did. (I assume).

1026, I have a feeling you cite literature here that uses the same equipment as you. But this is not relevant here. Please only cite technical documents or studies that digs into stuff like calibration, processing techniques, or comparison with other data and not studies that just happen to use this equipment.

1027, 10. Methods here are presented chronologically (we did a, then we did b, etc,). It should be clear to the reader how your measurements relate to the research questions and then show what you measured and shortly how. Also, the analyses are missing from the methods. I suggest you restructure the methods and add the methodology that is now part of the results section.

1027, 16. Where does this 11% come from?

1027, 26. Figure 3 does not show aspect ratio.

1027, 28. You state the maximum flow is in the center of the channel. Figure 3a and c show a different pattern.

1028, 5-6. This a bit of an awkward description of the well-known morphology of a braided river. Rephrase.

1028, 11. Wetted area depends on river stage / water height (which is a result of discharge).

1028, 12. This may be relevant to explain in the introduction.

1028, 16. Objectives should go in the introduction. You can shortly remind the reader of your objectives at specific places in a paper to boost the readability, but I don't think that that is necessary in a paper of this length.

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1028, 18. You manually detect bars (which would go to methods). But, you could also do this analysis automatically and explore the effect of different choices in bar definition.

1028, 23-27. This should be in methods.

1029, 20. Where is the chezy factor based on? The grain size, derived from flow measurements?

1029, 6-end. This should be in methods. Also, as you prove later, this method is not valid for this case (see my main comments above).

1029, 23. Should this be median grain size?

1030, 2. Factor 2: you could add these factors in the figure to guide the reader.

1030, 12. You state that the relation accord with the observations. Yes, but isn't this te result of fitting the curve to the data?

1031, 1-9. Please explain better what this means.

1031, 19. I don't think you can conclude statistically equivalence based on an overlap in mean +/- standard deviations. It seems they are, but there are proper tests for that.

1031, 24-27. This is very interesting. As you say, there is little data on this. But apart from that, are there mechanisms that may explain this difference?

1032. The conclusions contain new results and a lot of discussion.

1032, 15-16. You say the braided channels have a higher aspect ratio. And you mention that this data has very large scatter. In section 4.4 you reject similar differences with less scatter (I think).

1032, 19-25. You make a very bold conclusion that the (very small and based on scattery data) difference in aspect ratio is caused by different sediment loads. Since you do not consider sediment load in your equations, this idea (or as you put it: 'guess')

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should be in the conclusion.

Figure 1. Make this bigger and make clear which locations are part of the next figures (e.g. number the locations?)

Figure 3. State in the caption what type of data this is (ADCP I guess, and what for bed measurement?)

Figures 3 and 4. Consider plotting the channel sections at the same scale and with the same colorbar so the differences between them are more clear. You can combine figure 3 and 4.

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