Answer to reviewer 3

February 5, 2016

Note: Bold text indicates the reviewer's comments.

This paper focuses upon associations between channel morphology and discharge for 92 sites along single-thread meandering and braided gravel-bed channels in the Bayanbulak grassland, China. There are well established associations published in the literature between morphology (width, depth, slope) and discharge, that identify thresholds between the two morphological states. For example Leopold and Wolman (1957) identify a threshold condition between meandering and braided channels in the relationship between slope and discharge. The authors in this study compare their data with Parker et al. (2007), Church and Rood (1983) and King et al. (2004). Comparison could be made with a wider selection of studies, including Leopold and Wolman's (1957) original work on the topic. We are aware of all these studies (Metivier and Barrier, 2012). We would be happy to include all datasets used from previous work, but the data used by Leopold and Wolman (1957), for instance, is not available.

Overall the numerical formulation and statistical treatment of the data look fine, however the methodology needs more detail, some clarification, and possibly some further justification. It appears that the authors were analyzing the morphological and discharge characteristics of threads (anabranches) from the braided channel and comparing these with single-thread meandering reaches. Surely the main conclusions concerning morphology are therefore unsurprising e.g. no major width differences in channel width. Why did the authors not survey the full active width of the braided channel; including multiple channels and bar tops? The authors need to present further rationale for concentrating on discrete threads of channel. As discussed here and in Gaurav et al. (2015), most studies to date focus on what is called the "active width" of braided rivers, whereas we propose to focus on individual threads. There are several reasons for this.

w_i is the width of the i^{th} thread of a braided channel (N threads in total). As shown here the hydraulic geometry of braided threads is identical for each individual thread:

$$w_i = \alpha Q_i^{\beta} \tag{1}$$

where α, β are to constants and $\beta < 1$. Summing the threads together leads to

$$W = \sum_{i=1}^{i=N} w_i = \alpha \sum_{i=1}^{i=N} Q_i^{\beta} \neq \alpha \left(\sum_{i=1}^{i=N} Q_i \right)^{\beta}. \tag{2}$$

The original hydraulic geometry of the threads is therefore lost through the scale integration process.

The study of active widths of braided streams is inherited from stability analyses that consider an originally wide channel, destabilized by growing bars (Engelund, 1970; Parker, 1976; Devauchelle et al., 2010; Zolezzi et al., 2012). In contrast, we propose that the physics of individual threads is of specific interest. It is a step towards understanding their collective behavior.

From inspection of the aerial images in Fig 3, it appears that meandering, wandering and braided channels may all exist within the study area, yet there is no mention of wandering. Why are the authors just working on braided and meandering channels? Are some of the sites sampled actually wandering in nature? The authors must offer a correct classification of their channel types. We agree but the purpose of this work is not to establish a detailed classification. Wandering channels are an intermediate planform between braided and meandering rivers. Their definition is somewhat arbitrary (Church, 1983; Brierley, 1989). Here we propose to compare threads of single and multi-thread rivers. It turns out that the single-thread rivers of the Bayanbulak grassland are mostly meandering rivers (average sinuosity of 1.5) whereas multi-thread rivers are mostly braided (total braiding index larger than 3.3).

Why are the morphological characteristics of braided and meandering rivers worthy of study; bearing in mind the immense volume of research already conducted in these channel types? The key finding of this study appears to be the lack of morphological differences between braided and meandering streams. The authors must make it clear what the significance of these conclusions are. The lack of significant difference between meandering and braided threads suggests that a fully-developped braided river can be considered as a collection of individual threads. The physics of single-thread rivers thus probably applies to braided rivers. We also show that the scaling relationships of braided and meandering threads is, to leading order, controlled by the threshold of motion. Our observations show that the aspect ratio of a thread, because it does not depend on discharge, is an important quantity to understand the influence of variables such as the sediment discharge on the geometry of threads.

Page 1291: Line 18, simply splitting alluvial channel types into two end members is far to simplistic, and not very helpful for future understanding. What of the wide variety of other channel typologies e.g. Montgomery and Buffington (1997), or Rosgen (1994)? In this paper we are interested in the comparison of threads of single-thread and multi-thread rivers. Because of their high sinuosity, the single-thread rivers we study are meandering but this point is not critical to our analysis.

Line 22, 23, there are two spelling errors; 'developed' and 'pattern'. Please can the authors check spelling throughout the manuscript Done.

Line 23, should Ashmore's (1991) fundamental laboratory work on braiding mechanisms be cited here? Yes we have included this reference earlier in the introduction.

Line 25, define 'aspect ratio' This is now done in the text.

Page 1292: Line 7, do braided rivers have banks? Yes indeed at least in the case of the Bayanbulak rivers. These banks limit the active channel from the braid plain and they are well defined. The picture below shows an example of such a bank. As this discussion is open and online we propose not to include this picture in the revised paper in order to keep terse.

Line 10, when the authors discuss single threads – are they referring to anabranches within the braided channel? Surely if morphological comparison are to be made between braided and meandering then it is the full channel (which may comprise multiple threads, and bar tops, along a braided reach), that needs to be considered rather than isolated threads. If isolated threads from braided reaches are being compared against single-thread meandering reaches, then it is unsurprising that their morphology is similar. Yes, we are indeed referring to anabranches and have answered this point in our answer to general comments.

Page 1294: Line 8, what were the length of the profiles used for channel slope measurement? Where these taken along the thalweg of the channels, and anabranches? Yes, the profiles where taken along the thalwegs and they are on average 1 km-long. We specify this point in the corrected manuscript.

Line 11, How many clasts were measured at each site? It is customary to use the 84th percentile of the cumulative grain size distribution in many bedload transport studies. Why is the 90th percentile used here? Between 200 and 500 clasts were measured depending on the exposure. We added this precision in the text. The 90th percentile is as common as the 84th percentile (see for example Garcia, 2008, for a review).

Line 19, why are only these three sources used for comparison? What of other fundamental work (e.g. Leopold and Wolman, 1957)? We agree that adding some other datasets would be useful. But in order to establish comparisons the data must be available (see Metivier and Barrier, 2012, for a discussion). The data of Leopold and Wolman (1957), like many other benchmark papers, are not available and can therefore not be used for comparison purposes.

Line 26, Individual threads suggests that dry bar tops are not included in the braided channel cross-section - however surely they are part of the active channel, and should be included in the analysis ? See the general discussion above.

Page 1295: Line 22, Could the others clarify their argument here, concerning the role of coarse particles in controlling morphology. It could equally be argued that very fine-grained cohesive sediments also strongly control morphology We agree that the representative grain-size of a gravel-bed river has always been the subject of debates, yet the influence of coarse particles on the channel

geometry has been discussed by many authors and seems well established. See for example Parker (1978) and Parker et al. (2008).

Page 1296: Line 2, Do the authors mean isolated 'meandering' threads? Please clarify We have modified the text to clarify this point.

Page 1299: Line 1, The 'means' of what? Please could the authors clarify. The means of the statistical distribution. We have clarified this in the text.

Page 1300: Line 1, surely the behavior between single-thread meandering (with well defined banks and more cohesive sediments), should be expected to differ to that of true braided with unrestricted movement? Could the authors clarify the statement here. We do not intend to claim that threads from meandering and braided rivers are equivalent. Our data show that if meandering threads are expected to differ from braided threads, this difference does not express itself in the variables studied in this paper (width, depth and slope).

Line 5, 10, There are a number of statements concerning the role of sediment transport/supply in controlling channel morphology made in the conclusions. Undoubtedly sediment supply plays an important role in controlling channel morphology, however the authors present no data on this. Rather than make comments concerning sediment transport, the authors should concentrate on the conclusions they can make from the data presented in the paper, and highlight the significance of these findings. We agree that this point, in our conclusions, on the influence of sediment transport is speculative. We have changed the text to make it clear.

Tables 3 and 4, There appears to be very little difference in some of the grain size metrics (D50 and D90 values) and slopes between some of the sites. In fact many are identical. However the channel dimension and hydraulic data differ markedly between the same sites. The two do not stack up! - Surely there must be differences between sites? Could the authors make some comments on this? This means that the channel dimensions are influenced by another parameter. We hypothethise that the sediment discharge may be at the origin of these differences.

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