Review:

Hydrology and Earth System Sciences Discussions

Is sinuosity a function of slope and bankfull discharge? – A case study of the meandering rivers in the Pannonian Basin

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GENERAL COMMENTS

Amongst geomorphologists and hydrologists there has been a long-term fascination with trying to determine what controls the pattern of a river. This paper poses the question "Is sinuosity a function of slope and bankfull discharge?" It builds on seminal work by Leopold and Wolman (1957) and Schumm and Khan (1972), amongst others. The objective of the present paper appears to be to extend the previous work of Timár (2003) on the controls of channel sinuosity by incorporating the data reported in Petrovszki and Timár (2010) and Petrovszki et al. (2012) into a new analysis that attempts to fit a 3-D surface model describing the relationship between bankfull discharge, channel slope and sinuosity. The dataset considered is from meandering rivers in the Pannonian Basin, Hungary.

Although there is some merit in creating regional datasets to test the relationship between sinuosity, slope and bankfull discharge the underlying rationale of the paper is not very transparent. In particular there are several factors (outlined below) which need better clarification and further consideration if the value of this approach is to be fully understood.

SPECIFIC COMMENTS

1. The relationships between 'slope and sinuosity' and; 'slope, discharge and channel pattern' are described as background to the paper but this description is far from comprehensive and there is little coherence to the arguments which are developed. The introduction ends with a description of the quasi 3-D graph from Timár (2003) describing the relationship between bankfull discharge, slope and channel sinuosity. However, much of the preceding literature used as context describes the transition between channel patterns (straight, braided and meandering) rather than the range of sinuosity (meandering) per se – which appears to be the focus of the paper. It is noticeable that some of the classic literature relating sinuosity to these controlling variables and thresholds in channel pattern is not mentioned e.g.
   Chang, H.H. 1985. River morphology and thresholds. Journal of Hydraulic Engineering 111, 503-519.6
   Edgar, D.E. 1984. The role of geomorphic thresholds in determining alluvial channel morphology. In Elliot, C.M. (ed.) River meandering. New Orleans, American Society of Civil Engineers, 44-54.
   Parker, G. 1976. On the cause and characteristic scales of meandering and braiding. Journal of Fluid Mechanics, 76, 457-480.
   Schumm, S.A. 1967. Meander wavelength of alluvial rivers. Science, 157, 1549-50.

2. The basic data used in the analysis is described in a rather confused manner. It appears to be derived from historical maps (sinuosity), reconstructed from archival survey notes (slope) and derived from more recent discharge measurements (Lászlóffy, 1965). The compatibility

of this data and in particular the potential incommensurate nature of the age ranges of the data is not adequately described.

3. Calculating bankfull discharge using the van den Berg (1995) relationship and extrapolating this to the current study area is fraught with difficulties (Figure 1b). How is this justified?

4. In the results section it would useful if brief table was included showing the descriptive statistics of the three key variables: sinuosity, bankfull discharge and slope.

5. The rationale for fitting a surface of the form described in Figure 3 is not clearly articulated. In particular the transformation of the abscissa axis of Figure 2e to a linear scale (Figure 2f) and subsequent surface modelling is not convincingly justified. Furthermore it is not clear how the degree of fit as shown in Figure 3 provides a rigorous test of the modelled surface. It is important that the authors indicate which of the modelled surfaces is most appropriate – the parabola or quadratic? For example in the conclusion (12282, L23-25) it is stated three methods were used but there is no clear recommendation as to which one should be followed.

6. It is hypothesised that differences between the modelled surface (Figure 3c) and the original data are largely due to differences in the sediment discharge regime and bed material grain-size distribution. However, there is no real discussion of this or attempt to relate this back to the field setting.

7. The complex surface developed in Figure 3 bears some resemblance to the complex response threshold models used to describe channel pattern instability (Thornes, 1980). For example the cusp catastrophe model has been used to relate stream power and resistance to a responding variable like sinuosity e.g. Graf (1988) used this to describe the transformation between straight, meandering and wandering river patterns. Although this is not the same situation as reported here such a comparison is useful for context and possible extension.

8. Finally, a major issue with this paper is clarity of the text and Figures. The written style is not particularly strong and poor expression leads to ambiguity in many of the key paragraphs of the paper (which may be partly responsible for some of the issues outlined above). The paper requires a very careful proof editing to improve this aspect of the presentation and also correct some duplication and repetition which occurs in the text. Furthermore there are too many Figures. The paper would be more effective (many of the diagrams are too small) if only a few key diagrams were selected. Currently the written text is accompanied by three composite Figures which consist of 19 individual graphs and two data tables. I would encourage the authors to be more selective. An appropriate selection might be: 1a, 1d, 2b, 2e, 2f and <u>one</u> of the models in 3.

Graf, W. L. 1988. Applications of catastrophe theory in fluvial geomorphology, Modeling Geomorphologic Systems, John Wiley and Sons New York, 33–47.

Thornes, J. B. 1980. Structural instability and ephemeral channel behavior, Zeitschrift für Geomorphologie Supplement Band, 36, 233–244.

TECHNICAL CORRECTIONS AND MINOR QUERIES/COMMENTS

Note: The general comment on the standard of the written English should be noted. Some *examples* of the types of corrections are given here but more extensive rewording is required throughout.

P12272
L9-10, Avoid use of references in abstract. Abstract unclear needs re-drafting for clarity.
L19, The morphology of a river is affected by many …
P12274
L4-5, Think about the terms 'deeper' and 'dip' are these the correct terms to describe the geomorphology.
L9, Wolman
L10, By border-lines do you mean 'threshold'
L17-28, Define the terms in the equation immediately after you use them and be consistent with the notation ('s' and 'S')
12275
L1, Knighton and Nanson (1993) extended this original diagram to include anastomosing channels which occur at low slopes.
12276
L4, What is a '<u>real</u>' 3-D '<u>abstract</u>' surface'?
L11-12, Give the date of the 2nd military Survey maps?
L15, The explanation of the 10 different window sizes and resulting 50 m interval is not clearly explained. For example on P12277 (L9-10) it is not clear why the points near Jibou were deleted?
12277
L11-12, Multiple bedrock-controlled reaches occur along the River Olt, therefore no points were used from this river.
L15, However, the dataset assembled for this study used mean water ….
L16, Williams (1978) reported …
12278
L11, … their lengths shortened …
L22-23, Explain and justify the statement 'The effect of the slope correction is not so significant like the mean-bankfull discharge conversion'?
12279
L6, What is meant by 'best result'?
L11-14, How is this relevant?
L15, In natural rivers, sediment types vary together with sediment discharge regimes.
L22-27, Delete paragraph – the material is unnecessary.
12280
L-1-4, Delete paragraph – the material is unnecessary.
L23, Figure 2d shows a cross section through the maximum …
12284
The Appendix is not required. The methodology should briefly be described in the text.

References are complete.