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Discussions

Interactive comment on "Quantifying river form variations in the Mississippi Basin using remotely sensed imagery" *by* Z. F. Miller et al.

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General comments:

This paper describes a spatial analysis of river widths in the Mississippi River basin, utilizing automated analysis of remote sensing data. The study is one of a progression of studies by the authors and others to characterize river forms in a more spatially-explicit, automated manner, in order to yield both mean and spatially-varying metrics of fluvial form. Given the large spatial area and the computational challenges associated with a large basin, I believe the authors have done a fine job in building the form relationships and extracting useful information from such an enormous dataset. The underdescription of width variability has been discussed in the past by many authors.

Without massive data such as those developed in this article, it has been difficult to grapple directly with the problem of variability. Clearly, the main goal of the article is to describe the methods necessary to expose empirical form functions. However, the results highlight some interesting deeper questions to me, such as why various sub-basins have such a difference in terms of their width equations. It is possible these are bound up with the geomorphic history of the basin. What time-scales are of historical importance is an important question. Another area for which this article is important is in the approaches to dealing with massive spatial river data that may soon be available to scientists, such as those from the proposed SWOT satellite mission. Overall, I am pleased with these results and, while I have minor questions here and there (explained in the "specific issues" points below), I think quite highly of this work.

Specific comments:

(1)It isn't clear how reservoirs along the rivers were handled in the extraction and computation of the widths.

(2) P. 3600, line 5: strictly speaking, it isn't really correct to say that these relationships were "derived". Derivation implies deduction, whereas these relationships are developed through empirical induction.

(3) P. 3600, line 15: Assumptions don't really "characterize" variability; the DHG estimates do.

(4) P. 3601, line 11: Actually, description of the DHG goes all the way back to da Vinci in the early 1500s.

(5) P. 3601, line 20: There are some versions of these equations that have physically derived DHG relations, mostly their exponents.

(6) P. 3603 and 3604, multiple places: the issue of return period influencing the coefficients and/or exponents in the DHG formulations has been handled here with an assumption of the width being representative of "mean growing season streamflow".

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While this is a reasonable starting point, it should be made clear that understanding the problem of return period on these relationships is very important to better interpreting these river systems and the methods to analyze them.

(7) P. 3606, lines 16 – 18: it would be useful to know if the authors split their data prior to calibration, in order to save some data for validation, or whether all the data were used for both calibration and validation.

(8) P. 3607, equation 2: What quantity does "n" refer to? Is it the number of river pixels with a corresponding width, or some other metric?

(9) P. 3607, line 8 and figure 2: Widths below 100 meters are almost certainly drastically under-represented, because small river widths are clearly going to be mixed in with land signal or covered by vegetation. I'm not sure of the utility of even having the bars below 100m. Fractal river theory would suggest these bars should continue their exponential count upwards with decreasing width until a much smaller length scale is reached than 100m.

(10) P. 3609, lines 3-5: What about "error" due to USGS widths at unusually narrow "stable" locations where gauges are often placed? A source of systematic bias?

(11) P. 3609 and 3610: Equations 3 – 6 would benefit from having standard error of the estimates (or similar metrics) included.

(12) P. 3613, line 25: This point raises an important physical question. Why would having width help in reducing uncertainty?

(13) P. 3613 and 3614: Cross-correlation of W and D, as well as autocorrelation in W would be interesting and useful metrics at some future stage, and they may influence some of the statistical tests already described.

(14) Alternate river-centered coordinate approaches, such as Legleiter and Kyriakidis, have also discussed these issues.

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