

## ***Interactive comment on “Coupling threshold theory and satellite image derived channel width to estimate the formative discharge of Himalayan Foreland rivers” by Kumar Gaurav et al.***

### **Anonymous Referee #2**

Received and published: 29 September 2020

**Summary.** The authors utilize hydrograph records and satellite imagery to develop algorithms where discharge can be predicted based on the formative width of the river channel.

**General comments.** Overall, I have few comments as the paper is well written and conveys its results in a straightforward manner. I believe with very minor revisions this manuscript would be suitable for publication within Earth Surface Dynamics. The details provided on additional data and the methodology within the appendix are welcome.

There are a few points throughout that may not be well established. Namely, that the

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extracted width during the wet season is a good proxy for the formative discharge. The idea that the formative discharge occurs at annual timescales has always felt like a misinterpretation of Leopold and Maddock and Wolman and Miller. It occurs at annual to multiple year timescales in temperate regions based on the frequency of events. Arid regions flood considerably less. The reasonable match between discharge from Equation 4 & 6 suggests that the flow is likely close to the formative value, but some discussion on the recurrence of formative flows within this system would be welcome.

Another point of concern, though fairly noted by the authors, that could use more discussion is the non overlapping satellite images and discharge records. For some rivers they are fairly close, but others like the Chenab and Teesta have discharge records from the 1970s and images from 2014 and 2018, respectively. It is not clear that averages taken from the 1970s should be compared with measurements from current times without significant effort to establish that the underlying timeseries is non-stationary. The acknowledgement of the changes to flow due to anthropogenic modification is a step in this direction, however the step from width to discharge relies on the idea that the river is self-forming, which may not be the case in many managed and modified large rivers. If the timescale of river adjustment is relatively quick then the formative discharge always matches the width, however if adjustment to modification of the flow or climate change is slow the formative width concept estimates will lag the actual discharge. I would greatly appreciate the authors providing more insight into these issues within the discussion.

A note on timeseries here. Is the monthly mean value representative of the actual hydrograph? The rivers are relatively large and that may be the case, however I would feel more at ease with the methodology if I knew that the hydrographs were not being under sampled to a degree that they may not adequately represent the flow in the system anymore.

To better understand the utility of this method relative to other existing methods the authors should consider a comparison with the data available from Allen and Pavelsky

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which presumably covers many of the same rivers. Their method and the authors have similar data limitations and therefore would inspire more confidence in the current assessment and indicate potential broader applicability of the methods developed here.

Specific Comments.

Ln. 65 - A few lines explaining what the 'threshold theory' entails would be welcome here. What does the threshold theory say about rivers that allows this method to progress?

Table A2 - Could you add a column listing the years of satellite images on the right. These data are in table A1 as a list, but a summary would be welcome here.

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Interactive comment on Earth Surf. Dynam. Discuss., <https://doi.org/10.5194/esurf-2020-60>, 2020.