Comment on gmd-2021-309
Anonymous Referee #1

Referee comment on "Nonparametric estimation method for river cross-sections with point cloud data from UAV photography URiver-X version 1.0 -methodology development" by Taesam Lee et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-309-RC1, 2022

Apologies for the brief response here, but I had everything typed, and the system deleted my response. I will try to summarize what I am able to remember.

Overall:

The goal is worthy, but the methodology, reproducibility, validation, and results are questionable. I recommend rejecting the paper.

- No discussion of UAV type used (sensor, height flown, date flown, resolution), which is essential to place this work within the vase literature devoted to UAV-based survey.
- UAV cannot penetrate water depth, unless using bathymetric technology (which was not discussed here). Therefore, the significant matching of the point cloud data with the engineered surveying data in the Figures is questionable.
- Why is the focus of this paper on channel cross-sections when no hydrological conditions are described, modeled, or assessed in terms of stream flow? In essence, the approach mentioned here can be used for any form of landscape survey analysis, and in fact, since the lack of UAV's ability to penetrate water surface is a limitation that was not adequately addressed in this study, the overall paper study should probably focus on general landscape patterns or dry streams for comparison.

Specific Comments:

Lines 62-63 - This is based on UAV of wet versus dry pixels and not stream cross-section. Flood inundation from UAV is a well-established field. Stream cross-sections are not
commonly used with UAV, as the sensors cannot penetrate the water depth and gather data of the full wetted perimeter. Traditional surveying is essential to supplement UAV or LiDAR-based point clouds for purposes of hydraulic modeling.

Lines 81-85 - A DEM, similarly, cannot penetrate water depth. In most DEM approaches, the depth of the stream still must be “burned” into the digital model, which requires knowing the depth a priori.

Lines 87-88 - Where do you demonstrate the strengths of higher-resolution points, compared to DEM resolutions from satellites, for purposes of hydraulic modeling? Generally, a very rough depiction of channel top width, bottom width, side slope, and Manning’s n roughness is adequate for catchment-scale modeling in software such as HEC-RAS, since the water conservation equations are not highly sensitive to small changes in channel geometry.

Lines 90-93 - Natural river cross-sections do not typically form a trapezoidal shape, but rather a U-shape, due to erosion and sediment redeposition throughout the channel. Manmade channels are typically trapezoidal. It is unclear throughout the study if the sample stream is manmade or natural. I believe it is manmade, due to having engineered plans and appearing trapezoidal and straightened in the aerial figures, but little background information on this stream is able to be found online. Moreover, having UAV produce reliable riverine cross-sections in ungauged and natural areas is most useful for modeling hydrology in remote systems, as engineered systems have plans and field surveys available. This paper claims to address this gap but then, it appears, uses a man-made channel for validation.

Section 2 - This section is very confusing. A more thorough discussion of how the different variables and equations relate to a stream and the UAV points would be helpful. There is no discussion of how the UAV was classified - how does the software know what is vegetation, water, concrete? What is the density? What kind of software is necessary for this? Section 2 could be transferred largely to an SI and explained in more hydrological and data gathering terms, here, for readability.

Lines 151-153 - These assumptions defeat the entire point of using raw UAV data and comparing its applicability to derive cross-sections. In a natural channel, one would not know this geometry before-hand. Moreover, over a large watershed, it would change many times over, and must be extractable from the UAV data alone to be useful.

Lines 254 - Here is further discussion of a natural channel, but the model stream appears to be engineered.

Section 4.2 - Why is a random line being used to re-project the data instead of the
coordinate system used in the 2004 engineering study?

Note: The 2004 engineering study referenced is not able to be found online. For reproducibility, please host this study or the datasets using an URL, and preferably, a DOI.

Section 4.3.1 - Interesting rationale for why you chose these two sites, but where, then, is this compared (a site with many overlapping panels versus one on the edge of the survey area)? Pros/cons? Limitations? Where do you compare to traditional DEM or LiDAR? Moreover, I think having only two sites for comparison when you had thousands of data points is not ideal. It is not immediately clear how long this stream is, but in the event that it is substantially long, more than two cross-sections will be required.

Section 342 - "natural bumps" at the bottom are probably sediment deposition. It is uncertain why this approach was compared to 2004 field data (is the 2004 study "as-builts" or engineered plans? Which can vary significantly. Or actual raw survey data?). This is of the utmost importance to understand in order to verify if the results are believable.

Line 348 - Why is there a gap in a large swatch of Site-2's cross-section? Was there a shadow here in flying the UAV? What does this mean for the reliability of such an approach? Could you have gathered a cross-section slightly upstream and downstream of this location for more robust survey results? Was this an issue with post-processing?

Section 4.3.3 - I do not believe you can accurately estimate wetted perimeter without surveying below the water surface. Moreover, what is the point of calculating this? There was no hydraulic modeling done to compare how the UAV-derived \( A(H) \) and \( P(H) \) compared to stream flow analysis from traditionally-derived surveying and/or satellite data. It is also unclear how you gathered this data when only comparing for two "sites" or cross-sections along the length of the stream.

Results Section: There is no discussion here of the LOWESS method results and how it compared to the proposed KLR model. How does your proposed approach benefit us in comparing to how UAV-based survey is typically interpolated? Comparing both the KLR & LOWESS to field survey (that was gathered recently) would be the most interesting and useful results.

Line 396-397 - From the aerial image, it does not appear this channel has much vegetation (mowed). This is an unnecessary discussion.

Line 398 - I think the proposed method here is actually more useful for buildings or
natural landscapes and not for streams, given the questionability of how the camera obtained survey points below the water surface. Therefore, it is unclear why the paper focuses on channel cross-sections and not UAV-smoothing in general. There were no hydrologic models performed, no climate discussed, no stream flow gauges, etc.

Line 400-402 - Why discuss LOWESS here (or anywhere in the paper) if it was not actually used? Although, the figures seem to suggest it was indeed used, but not robustly compared and discussed? There seems to be a discrepancy here.

Figure 1 - How did the UAV (red points) capture data below the sub-surface of the channel ground? Does the 4x6x6m geometry apply throughout the stream reach? If so, how is this actually surveyed data of a natural channel, rather than a very rough simplification of an engineering design? The elevation of the bottom channel being 18m is *the* most important discrepancy here. I do not believe this is the actual flowline elevation, and I cannot check the original plans referenced to verify. UAV cannot penetrate water, therefore, the red dots are likely the surface of the water, and the RMSE comparisons would all be different if the blue line dipped much lower than is shown in the Figure.

Figure 2 - Why are there so many more red points here? Is this the other Site? It is not clear from the captions, which should be self-explanatory.

Figure 3 - RMSE here does not match RMSE in Figure 4. Optimal RMSE is 0.2-0.5, which is not achieved here, although from the looks of the figures, it should have been. How do you explain this variance between the figures and these plots of RMSE?

Figure 5 - Ensure legend texts are full words, not "PolyFit2/PolyFit4", which are not described in the text. LOWESS is plotted here but not described in the text. How does your approach improve LOWESS? LOWESS appears to be quite close to the blue "measured" line.

Figure 7 - What is Unsam Bridge? (Remove underscore). It is not described in the text. Showing some major cities would be helpful. I do not think zooming so far out in the top panel is essential. Rather, the lat/lon coordinates should be made more clear and placed on all geospatial map panels in the figures. Where does Hapcheon flow? It looks like where Migok-cheon enters Hapcheon, the stream suddenly ends? What is the lake I am looking at in the Hapcheon panel? What is the background of Migok-cheon? Was this stream engineered to, for example, capture additional flow back in 2004? From a brief look at the aerial in Figure 9, it does not appear to be fully-natural.

Figure 9 - What is (a), (b), and (c) in the caption? Coordinates, scale, and N-arrow are essential to locate in space. Improve legibility. The stream looks engineered to meander along the neighborhood/road and also is full of water. The UAV points along the bottom of
the channel area are all white, which suggests to me they are capturing the water elevation.

Figure 10 - Here you state the surveying was done in 2005, yet the engineering study was 2004. This is not typical. Please confirm how and when the data was obtained for validation and provide public access for reproducibility of results. This site appears natural, whereas Figures 2, 5, and 6 seem to showcase a trapezoidal/man-made channel. Did you study two separate streams? If so, where, how, why? I am confused about the case study matching the figures.