

Earth Surf. Dynam. Discuss., referee comment RC1  
<https://doi.org/10.5194/esurf-2021-48-RC1>, 2021  
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## Comment on esurf-2021-48

Wolfgang Schwanghart (Referee)

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Referee comment on "Rapid Holocene bedrock canyon incision of Beida River, North Qilian Shan, China" by Yiran Wang et al., Earth Surf. Dynam. Discuss.,  
<https://doi.org/10.5194/esurf-2021-48-RC1>, 2021

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This is an interesting paper about the Beida River, North Qilian Shan. Based on geomorphometric analysis and the geochronology of fluvial terraces, the authors infer a climatic origin of phases of fluvial incision and knickzone formation. Overall, the authors offer convincing arguments for their interpretation. Yet, I have a few questions and comments that should be addressed in a revised version of the manuscript.

1. The three rivers shown in Fig. 2 have in common that they have a prominent knickzone as well as that they incise into the foreland-basin. The along-river distance of the knickzone to the mountain front is in all cases similar. According to the stream power incision model, however, slope patches should move upstream at a velocity dictated by upstream area. Hence, the three rivers should have similar upstream areas. However, looking at the map, the three sites seem to have very different areas. A way to address the effect of variable drainage areas is to calculate  $\chi$  as a horizontal along-river distance. This might be very helpful because it would provide additional evidence for (or against) a common base level drop, if all three knickzones should have similar  $\chi$  values measured from the mountain front.

2. It is interesting to note that some of the rivers draining the North Qilian Shan have steeply incised in the foreland while others have not, at least those that seem to have smaller drainage areas (I have not investigated this in detail, though, so this may be a bit speculative). Looking at GEarth, it seems that in particular those rivers with small catchments upstream the hanging wall are rather accumulating and form large fans with no (at least to me) obvious trend towards incision. Where these rivers drain into the gorges carved by the Beida river (and the other larger rivers), these smaller rivers are fluvial hanging valleys and show signs of headward erosion. How is it possible that under a general increase in precipitation, there are such different patterns in river incision? Or are there other processes responsible for the incision? For example, could a lack of sediment connectivity and increased sediment storage behind terminal moraines in the higher areas drained by the major rivers be a possible explanation for sediment starvation of the main

ivers and thus incision? At least, this explanation would not be at odds with the data as well as your interpretation of the other terraces, as well.

3. As noted in the previous comment, I think that the paper could benefit from some more geomorphometric analysis. So far, the authors mainly looked at the trunk streams of the rivers, and focussed this analysis on the Baida River. In order to generalize their findings, however, some additional work is required that shows that the findings are consistent with the other drainage basins having these knickzones. One interesting observation that could shed additional light on these river systems is the analysis of the tributaries to these rivers. Looking at the DEM in Google Earth reveals numerous fluvial hanging valleys tributary to the river downstream of the knickzone while they are missing upstream of the knickzone. Finally, comparison with incision rates measured elsewhere would help to judge the plausibility of the incision rates which are extremely high.

4. A short comment on the supplements: The quality of the pictures in the supplements is relatively bad. Consider storing the pdf with images in higher resolution.

5. A short comment on the figures: I partly found it difficult to read these figures. Perhaps I am getting old, but some of these figures (in particular photos) are very small.

All in all, I think that the paper should be considered for publication in ESURF after moderate revisions. I hope that my comments are helpful to improve the manuscript.

Wolfgang Schwanghart