

Earth Surf. Dynam. Discuss., referee comment RC1
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Comment on esurf-2021-14

Anonymous Referee #1

Referee comment on "Landslide-lake outburst floods accelerate downstream hillslope slippage" by Wentao Yang et al., Earth Surf. Dynam. Discuss.,
<https://doi.org/10.5194/esurf-2021-14-RC1>, 2021

Review of 'Landslide-lake outburst floods accelerate downstream slope slippage' by Wentao Yang et al., submitted to *Earth surface Dynamics*

Summary

'Landslide-lake outburst floods accelerate downstream slope slippage' by Wentao Yang et al. documents the initial and ongoing impact of a couple of landslide-lake outburst floods along the Jinsha River. Using Sentinel-2 image pairs from before and after the outburst floods, the manuscript identifies hillslopes that adjoin the river channel that (i) fail instantaneously after the floods and (ii) where rates of displacement are accelerated in the two years afterwards, over a reach of up 100 km downstream from the initial landslide-dam failure location near the village of Baige. The authors identify that the undermining of the hillslopes is driven by lateral erosion of the river channel, induced by the very high discharges during the outburst flood, and suggest that there is an ongoing feedback cycle of landslide-landslide-dam-failure-landslide hazards that is often overlooked in studies of landscape evolution and mountainous hazards. In general, the topic of the manuscript is appropriate for *Earth Surface Dynamics*, however I believe there are several revisions that are required before it is suitable for publication. These are detailed in more below line-by-line, but in general these include the manuscript structure and ordering of the sections, further placing of the work in the broader context through the use of literature and implications for other landscapes beyond this case study, further statement of the methods and uncertainty.

Line-by-line comments

Line 18-27: The opening of the manuscript gives general context for the study area. A similar section is found at the beginning of the Material and Methods section (lines 48-53). I'd recommend combining these sections, it is a little strange why further study area

context information is provided in the Materials and Methods section.

Line 28: 'extremely large flux' – it's not clear if this refers to sediment flux or water flux. Please clarify

Line 28: 'significant social impacts' – such as? Can you give specific examples from these references? It will help justify your study

Line 30: 'from failed dams and along its routes' is poor English – rephrase to something like 'many large boulders are often entrained by LLFs, sourced from the landslide dam themselves and along the course of flood route.'

Line 32: I'm not sure these references are correctly used. The Baynes study explores primarily the impact of extreme flood events (triggered by glacial outbursts, not landslide dams) on bedrock erosion in Iceland, and doesn't mention a comparison with monsoon flood events. There is assumption here that monsoon-flood events do not have high sediment loads of coarse material, and I'm not sure the references cited support this claim. I'd recommend further engagement and appropriate use of literature throughout the manuscript to help support your claims.

Line 40: 'ongoing' may be a better word to use than 'persistent'

Line 41: This sentence doesn't quite follow on from the previous one – I'd recommend moving the part about not having the direct and ongoing observations of LLF impacts on hillslope instability to after the statement saying they may also disturb upper hillslopes adjacent to the collapsed banks over longer periods. This part of the introduction is crucial for justifying the work, as you're identifying a knowledge gap that we don't have ongoing observations of hillslope displacement after the initial post-flood assessment. This is what makes your study interesting, but I think you could do a clearer job of justifying this knowledge gap as it's a little unclear at present.

Line 45: Give the exact dates of the floods, not just 'late October' and 'late November'.

Line 45: add 'ongoing' to 'the impacts of LLF hillslope stability', as this emphasises the novelty of your study

Line 49-74: Material and Methods section. I note that the first part of your Material and Methods section neither mentions either materials or methods. All of this first section is

more context material that should be moved to the introduction section.

Line 76-91: More detail is required here about the measurements that you actually made. Can you explain some more of the method behind the COSI-Corr method? Is this a pixel-matching method, or some other form of image analysis? Additionally, how was the active channel width measured? Manually? Automatically? Can you give an estimation of the uncertainty associated with these measurements? This is important information that is required to support your conclusions.

Line 120: See last point, where do these error bars come from? Over what length reach are the channel width measurements taken? Is 96.33 ± 10 m the average width across the whole 100km study area? Can you break this down to reflect different reaches downstream of the initial landslide location?

Line 121: you state here that there may be a link between the lateral erosion (channel widening) and the ongoing hillslope displacement. At the locations where hillslopes are actively destabilising, it would be good to see a plot of the width increase for the channel at the corresponding location.

Line 125: So the areas are different, what about their displacement? Did the concurrent landslides move a larger distance than the ongoing landslides have done since the event? They may be inactive now, but how does the mobilisation of sediment compare between these two types of landslide?

Line 127: See previous point on Line 121 – make a figure showing width increase against landslide displacement (either concurrent or ongoing rate)

Line 133-145: Discussion section. This first section of the discussion section should be in the results section. There is nothing 'discussion' about this, it's more analysis providing new results that we haven't seen yet.

Line 136: Why are these estimates smaller than the flood discharges that we've already been told about on lines 62 and 67?

Line 143-144: This sentence is not required, it's a repeat of information in the previous sentence

Line 153: 'tens of hundreds of kilometres away' – I think this should be 'tens of kilometres

away'

Line 154: General point about the Discussion – I think you could do more to place your work in the wider context, to help show the implications of the work beyond this narrow case study. You make a speculative comment here about the feedback cycle of 'landslide-LLF-landslide' hazard chains, which needs to be supported with further reference to relevant literature (and data). How likely is that the ongoing hillslope displacements will lead to large landslides that will form dams? You don't present any evidence that this is likely to happen? Later on, you go on to discuss the seismic control on the hillslope stability – how important are the seismic controls for the 'landslide-LLF-landslide' hazard cycle? Can you have the landslide-LLF-landslide hazard cycle without an underlying seismic control? Further development of these implications, with reference to literature, is required to really help this manuscript make some robust and strong conclusions.

Line 156: This is the first time that you mention the implications for the infrastructure. You could mention this also in the introduction, to help justify your study – i.e., you need to understand the complete view of hazards associated with LLFs.

Line 165: Do you know when strong earthquakes (or extreme precipitation) may have occurred in this study area? I think this is important context for your results, and it helps to show whether the landslide-LFF-landslide hazard chain is an phenomenon that could occur in all landscapes, or is it just likely to occur in landscapes that have been weakened by a recent seismic event.

Line 174: 'our findings are proofs to the theory' is incorrect grammar. Rephrase to something like 'our findings support the theory...'

Line186-187: There are several references that you could highlight here to support this statement. See Lamb and Fonstad (2010; Nature Geoscience); Lamb et al. (2014; PNAS); Baynes et al. (2015; PNAS); Cook et al. 2018a (Science) and others. This is an example where further engagement with the literature will help to elevate your manuscript to place your work in the wider context of extreme events in landscape evolution

Figure 2: Can you change the colour scheme for the colour bar. A spectrum from red to green is hard for colour-blind readers to interpret, so I'd suggest using an alternative colour scheme. What does the small red circle inside the black square on the bottom of panels d1 and d2 indicate?

Figure 3: See previous point about the colour scheme. What happened to the eastern hillslope in January 06 2019? In this panel only, there is widespread displacement on the hillslope – do you have an explanation for this? Perhaps a rainfall event?

Figure 4: Why is the orange line not plotted between ~March 2019 and Jan 2020, when the blue line is plotted across this period?

Figure 5: I think it would be good to see an additional figure showing the width increase against the hillslope displacement. If the hillslopes that have higher displacement correspond to section of the channel that widened more extensively, this would help support your conclusions about the long term impact of LFFs on landscapes.

Also Figure 5: What does the y-axis represent? Would plotting actual channel width be easier to interpret?

Figure 7: In the caption, it would be good to explain why there are so many data gaps in the flow records. Were the gauging stations not operational? How likely is it that during these periods of missing data, there may have been floods of higher magnitude that have been missed?