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Interactive comment on "Interactions between deforestation, landscape rejuvenation, and shallow landslides in the North Tanganyika – Kivu Rift region, Africa" *by* Arthur Depicker et al.

Anonymous Referee #1

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General comments: This study examined landslide activities in response to deforestation in tectonically-rejuvenated and relict landscapes in the North Tanganyika-Kivu rift region, Africa. The authors mapped landslides from Google Earth imagery using a new method to correct for biases in imagery inventories. They found more abundant but smaller landslides after deforestation in rejuvenated landscapes compared to relict landscapes, which were possibly caused by differences in seismicity and regolith stock. This work tackles an interesting and important topic of how land-use changes affect landslide activities in different geomorphic settings, and has potential to make a contribution to Earth Surface Dynamics. However, the current manuscript could be strengthened with improved data presentation and analyses, and clarification of several key

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technical details (detailed below).

Specific comments: Major comments: 1. Landslide definition and data presentation This manuscript termed the mapped landslides as ‘shallow landslides’ – I don’t get what the authors meant /why the authors emphasized ‘shallow’? Do the authors refer to shallow soil landslides that are distinct from bedrock landslides, or have no intention to separate soil versus bedrock landslides? Do the authors exclude deep-seated bedrock landslides?

If the mapped landslides are all soil landslides, I can see that landslide size is limited by regolith stock – a recent publication, Prancevic et al. (2020), had a nice dataset illustrating this, which could be a useful reference. If the authors do want to highlight those landslides as ‘soil’ landslides, some discussions are needed then regarding the possible existence of bedrock landslides in the dataset.

Meanwhile, it would be helpful to display and discuss the areal size distributions (e.g. Malamud et al., 2004) of the landslide inventories in rejuvenated and relict landscapes, which would be a more effective presentation than just mean landslide source area.

2. Ambiguity in the method for correcting image biases The description of the method developed to correct for biases in satellite imagery was confusing, and I could not judge whether this method was correct or not. Specifically, in L165-L170, why is Eq. 6 equivalent to Eq. 7? For example, in Eq. 6, assuming A = 1, N = 3, and n1 = r1 = 3, n2 = r2 = 4, n3 = r3 = 5, I would calculate a LSF of 3. In Eq. 7, if A = 1 and ri > 1, I didn’t get how Eq. 7 can give the same result of 3.

I’d suggest add a general paragraph discussing the principles of this correction at the beginning of section 2.2.2, and give some specific examples when doing the derivation. Based on the current description and information, I could not validate this method.

3. Point of ksn analysis I didn’t get why the authors introduced a new function relationship between slope and ksn and conducted the analysis in Figure 7 – this seems to be

irrelevant to the characteristics of landslides in rejuvenated vs. relict landscapes, which are the key points of this study. The ksn analysis seems to be isolated from the remaining discussion of landslide activities as well. I'd suggest either removing this part (or moving to supplement) or linking landslide activities to ksn to enrich discussions.

Besides, the classification in Figure 7 was also not convincing – for example, panels a) and f) seem to have similar trends, and do not indicate clearly the existence of a threshold slope (TA).

4. Add analysis of seismicity and rainfall data as controls The authors speculated on the roles of rainfall and seismicity in setting landslide abundance and sizes (section 4.1), but did not conduct any thorough analysis. The authors already presented rainfall data in the region (Figure 2c) which could be analyzed in more details to examine the role of rainfall in landslide occurrence. It'd help as well if more seismicity data could be compiled and analyzed to show the differences in rejuvenated versus relict regions. So I'd suggest more quantitative analysis examining the relationships between rainfall (annual rainfall and rainfall variability or extreme events), seismicity (patterns, numbers of small-magnitude events, etc), and landslide occurrence in the rejuvenated and relict landscapes.

Minor: L1: briefly explain why deforestation increases landslide activity

L6: 'a longer timescale' – over what timescales? Thousands of years?

L7-8: would be useful to define 'rejuvenated' here

L11-L13: too long, consider rewrite as two shorter sentences?

L20: not consistent with discussions and results? Mentioned the role of regolith stock in the discussions and results but didn't mention them here.

L25: clarify what is 'shallow'?

Figure 1: possible to add the spatial extent of landslide mapping? Or the whole area –

would be helpful to indicate.

Figure 2: might help to add a 2-D cross-section plot of the Rift zone and illustrate key parts such as 'shoulders'

L73: is the percentage of tree coverage reported as for each one arc-second grid?

L98: you didn't show the relationships between rainfall metrics and landslide activities in the discussions. . ., also define what is 'sufficiently large'?

L109: modal slope angle?

L125: the introduction of this new function seems somewhat arbitrary, and I really didn't see how this new function adds to the paper. . .

L135-140: do you mean you excluded some really large landslides here? If so, why you want to exclude the large ones? what's the criteria to exclude large ones?

Could expand and add more data to show the results of relative depth? Is there a correlation between landslide area and depth so you can estimate landslide volume?

L140: 'a point of initiation' – is this the centroid point of the source area?

L148: Figure 8a came too late – suggest to move it earlier to Figure 2.

L150: how did you tell landslides from mining and quarrying?

L154: change the title to 'correct for biases in satellite imagery'?

L155: as mentioned earlier, suggest to add an introductory paragraph illustrating the principals of the correction method

L159: the definition of r is not clear. . .maybe give an example to illustrate

L165-170: didn't get why Eq. 6 is equivalent to Eq. 7.

L174: poor definition and explanation of d, again, might help to give an example

L198: in order ‘to’ link. . .

L216: define what is ‘tolerance value of 100 m’ here

Figure 7: make it clear in the caption what are the points? Values for each individual catchment?

L233: briefly explain how the classification in Hungr et al. (2014) works?

L253-254: refer to Prancevic et al. (2020)

L266: suggest to make sub-sections in section 4.1 to discuss in each the role of seismicity, rainfall, and regolith stock. . .

Figure 10: in panels g and h, it seems like landslides are centered around similar angles ($\sim$35 degrees) for both rejuvenated and relict landscapes? Why? Similar threshold angles in both landscapes?

L279: what do you mean by ‘landslide-triggering earthquakes’? did you mean no earthquakes greater than a specific magnitude? Can make it clear here.

L317: expand and explain what do you mean ‘the smaller size is likely due to a smaller minimum critical landslide area linked to the absence of tree cover’?

L322: where does the landslide depth of 2.5 m come from?

L328: how does this ‘conservative value of 0.2 mm year-1’ relate to Montgomery and Brandon, 2002? Explain.

L341-343: sentence too long and reads confusing. Rewrite to shorter sentences?

References: Prancevic, J. P., M. P. Lamb, B. W. McArdell, C. Rickli, and J. W. Kirchner (2020), Decreasing landslide erosion on steeper slopes in soil-mantled landscapes, Geophysical Research Letters, 47(10), e2020GL087505.

Malamud, B., D. Turcotte, F. Guzzetti, and P. Reichenbach (2004), Landslide inventories and their statistical properties, Earth Surf. Processes Landforms, 29, 687-711.

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