Dear Editor,

We thank the reviewers for a constructive set of reviews that will improve the manuscript. We have responded in detail to them in the attached document, and included text that we would include in the revised manuscript.

Thanks,

Luke Wedmore (on behalf of co-authors).

Our responses to the reviewer 3's comments are shown in blue text. **Specific changes that we will make to the text are in bold font.** The line numbers quoted refer to the revised version of the manuscript that we will resubmit if invited.

RC3

You may consider also the work by Delvaux et al. (2012) on the segmentation and scarp height of the Kanda fault in the Rukwa rift.

- **Delvaux, D.**, Kervyn, F., Macheyeki, A.S., Temu, E.B. (2012). Geodynamic significance of the TRM segment in the East African Rift (W-Tanzania): active tectonics and paleostress in the Ufipa plateau and Rukwa basin. Journal of Structural Geology, 37, 161-180. DOI: 10.1016/j.jsg.2012.01.008.

In this work, we stress the importance of field measurement of the scarp height. We found that the local fault morphology might influence the calculated scrap height. This means that the selection of the site for performing the fault scarp profile is important and difficult to perform on the basis of remote sensing only. The question is thus how did you selected the sites for extracting scarp profiles and how did you took into consideration the local geomorphology associated to the fault?

We completely agree with the reviewer. Careful field observations to select a site to measure the scarp height is ***always*** the best method to use. Such an approach was not possibly over the past few years due to covid, yet it was important to conduct this study as the area is rapidly developing so it is vital that constraints are placed on seismic hazard before this happens.

There are some benefits to the approach we have taken (ie using remote sensing only). Remote sensing allows a larger geographic area to be covered than field studies – it would be difficult, expensive, and very time consuming to measure the height of the ~200 km long Chipola fault using field studies alone. It also allows us to take measurements in areas that would be very difficult to access in the field.

We will amend the text to make it clear that fieldwork is required to select the best sites for scarp height measurements and cite the paper suggested by the reviewer:

"Selecting sites for measuring displacement caused by earthquakes across faults is best performed by careful assessment of local geomorphology in the field (Delvaux et al. 2012, Bubeck et al. 2015). This was not possible in this study as the Covid19 pandemic restricted travel. Instead, we used SRTM data to measure the displacement across the faults, which enabled us to take multiple measurements across a large geographic area in a national park that is not always accessible for fieldwork." [Line 215-219; Section 3.2.3]

As a consequence of using sub-optimal remote sensing methods, we implemented a range of technical measures to ensure our scarp height calculations are as accurate as possible:

- We selected the sites for extracting the scarp profiles on a systematic basis, sampling the digital elevation model every 30m, but then stacking these profiles together at intervals of 120 m.
- Individual profile samples were extracted perpendicular to the *local* strike of the fault.
- The purpose of the stacking is to remove the effects of localised changes in fault morphology, or other sources of random noise in the digital elevation model. However, this does not always successfully remove local variations in fault morphology, and thus when measuring the height of the stacked profiles, we are careful to only measure profiles that show a clear fault offset. For example, we would look for a clear scarp, and upper and lower surfaces of a similar angle, with no significant disturbances to the slope. Hence, although we were not able to use field observations to find the best sites to measure scarp heights, by instead using multiple scarp height measurements (and far more than could be practically measured in the field) to help smooth out random noise, we have in part negated this challenge.
- The code that we use to measure the height of the fault scarp in the profile (an adapted version of the code published in Hodge et al., 2019, Solid Earth) has additional quality checks to ensure the measured profile is not influenced by local morphological changes:
    - The code takes a Monte-Carlo approach to sampling the upper and lower slopes, and selects 10,000 random subsets of the points on each slope, so that any small-scale morphological disturbance shouldn't be reflected in the final measurement.
    - If more than one maximum in the gradient of the slope across the scarp itself is detected, then our code does not make a measurement in that location.

This approach has been successfully implemented, and verified with field measurements, in southern Malawi (e.g. Wedmore et al., 2020, Tectonics). Thus, we are confident that it has been successful in Zambia, despite not being able to do the verification in the field.

We will amend the text to the following text to make this clear and add the reference suggestion from the review as follows:

"We extracted topographic profiles every 30 m oriented perpendicular the local strike of the fault. As local fault morphology can influence the calculated scarp height (Delvaux et al., 2012) we stacked the profiles at 120 m intervals along strike to filter short-wavelength topographic features such as vegetation or human structures that are unrelated to active faulting. Profiles were then visually inspected, for a clear scarp, with footwall and hanging wall slopes above and below the scarp of approximately the same angle. The scarp height of profiles that passed our visual inspection were measured following the approach of

Wedmore et al. (2020b), which includes inbuilt Monte Carlo sampling of random subsets of the footwall and hanging wall slopes to prevent small scale local morphological disturbances affecting the calculated scarp height. Verification with detailed field measurements was not possible during this study because of travel restrictions during the Covid19 pandemic, but these methods have previously been used and verified in southern Malawi, which has a similar tectonic setting and terrain (Wedmore et al., 2020a, b)" **[lines 219-229; Section 3.2.3]**