

Nat. Hazards Earth Syst. Sci. Discuss., referee comment RC3  
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## Comment on nhess-2021-32 Review

Anonymous Referee #3

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Referee comment on "GNSS and RPAS integration techniques for studying landslide dynamics: Application to the areas of Victoria and Colinas Lojanas, (Loja, Ecuador)" by Belizario A. Zárate Torres et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-32-RC3>, 2021

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### General comments:

The paper by Belizario et al. entitled "GNSS and RPAS integration techniques for studying landslide dynamics: Application to the areas of Victoria and Colinas Lojanas, (Loja, Ecuador)" presents the application of GNSS and RPAS techniques to study the landslide dynamics of two landslides that affected the Victoria and Colinas Lojanas sector of the city of Loja, Ecuador. The direction and velocity of landslide displacements were calculated by GNSS measurements, while orthophotos and DSMs were used to calculate horizontal and vertical displacements in a set of significant points throughout the study area.

Overall, this is an appropriate subject area for NHESS journal, and the amount of data collected is very important from a risk monitoring and prevention perspective. However, this work should try to better develop the application of topographic techniques to the case of study where some innovative aspects or tools are missing. In addition, the methodology used is not effectively illustrated and lacks some aspects related to an accurate assessment of errors. I believe that this paper has great potential and interesting aspects that could be improved to make it more appealing to a reader but in its current state is not ready now to be published. It requires a substantial upgrading (major review), maybe assessing the limits and errors associated with the used topographic techniques and the comparison with other technologies in terms of landslide dynamics estimation. The text is unclear in some sections (requires English revision and often the terminology used is incorrect, especially regarding the photogrammetric process), difficult to follow for a reader and the structure of the text must be revised because some parts are not in their optimal location (see specific comments below). With some important improvements, this work can be interesting and useful for the scientific community.

### Specific comments

- Abstract: I suggest rewriting it to make it more attractive to the reader perhaps emphasizing the innovative aspect of this work and the usefulness of these results in terms of the mitigation of natural hazard problems.
- Introduction: this part should be underlined the innovative aspects of the work, motivated the choice of technologies used for the surveys, and highlighted the usefulness of the data obtained.
- Methods:
  - A GoPro 3+ camera was used to carry out the SfM surveys, but it was not shown how the problems related to image distortion were solved given the use of a fisheye lens with a flight altitude very high.
  - The study areas are quite large (around 6 and 2 ha) and 6 and 5 GCPs were used respectively, by what criteria were this number and GCP/CP ratio chosen? Is this number sufficient? (look at this paper: <https://doi.org/10.3390/rs10101606> and <https://doi.org/10.1016/j.geomorph.2016.11.021>). Where are they located in the study area (a figure could be added about this)? Are the errors related to GCP and CP referred to the point cloud? and the errors related to DSM? Because for the displacements monitoring, the points are extracted from DSMs in stable areas so the interpolation error should also be considered.
  - Were the DoDs thresholded to account for the errors or do they represent raw differences? Line 180: why was a 3 m threshold chosen?
  - Has the problem of co-registration of point clouds been considered in making multi-temporal DSMs?
- Results: should be presented more effectively by trying not to repeat some of the data already summarised in the various tables.
- Discussion: This part is a kind of repetition of the results and is lacking in comparisons with other case studies or similar work, especially about the methodologies used. The discussion misses an in-depth analysis of the problems and errors caused by the technologies used, how to improve these aspects, and a comparison with other works using the same techniques. It would also be interesting to analyze how the results and the information obtained could be used and exploited for risk prevention purposes.

## Technical corrections

- Abstract: acronyms should always be made explicit here as well. In the first sentence, a verb is missing after the "to".
- UAV is more known than RPAS
- Line 41 and 409: "interpolated" is not the correct term to use, better generated or realized.
- Line 49-50: this sentence is unclear, and I suggest rewriting it.
- Line 181-182: this sentence is unclear, and I suggest rewriting it and explained which ArcGis tool was used, please.
- Figure 9 b and c: I think it is useful to improve the presentation of these figures since the legend covers the image itself.
- Line 333: what is meant by errors of the orientation process?
- Equations 1 and 2: should be moved to the methods section.
- Lines 332-333 and 338-341: should be moved to the methods section.