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# *Interactive comment on* "Criteria for the optimal selection of remote sensing images to map event landslides" *by* Federica Fiorucci et al.

**Anonymous Referee #1**

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The authors present a study focussing on an expert-based interpretation of imagery data with the aim of mapping landslide features of a single landslide. Various data are tested and the mapping results are compared to reference data and field mappings. The authors then give recommendations regarding the feasibility of the different mapping techniques and imagery data for landslide mapping.

The employed methods are standard methods (dGPS, heuristic landslide mapping techniques), so there is no methodical innovation. The used software are commercial products. The results are difficult to reproduce, since only one expert did all the mapping. It would be interesting to see, how the landslide would have been mapped by further experts (>10). Furthermore, it remains unclear if the results are transferable to the relevant scale of event landslide inventories or to other types of landslides.



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Discussion paper

The text is generally well written, but there are some minor mistakes of grammar and style. Some of them are addressed below, but it would be out of scope to raise every issue. Therefore I recommend careful copy editing. Below, I focus on issues concerning the scientific content of the manuscript. Where numbers are given in the specific comments they refer to the manuscript page and line. A major revision carefully addressing the raised issues below is required, before the paper can be considered for publication.

Specific comments:

Throughout the manuscript: Unless you conducted statistical hypothesis tests, avoid the term ‘significant’ or ‘significantly’ and replace it by other attributes (e.g. distinct).

Section 1

Consider introducing the principle of heuristic, visual mapping of landslide features based on the interpretation of landslide signs (‘geometric signature’; Pike, 1988). This is well explained in Section 4.2. However, an introductory description of the procedure would benefit the understanding of the reader. In this context, also explain the advantage of stereoscopic over monoscopic interpretation techniques.

Comment on the positional accuracy of landslide mapping, which depends on the data it is based on. UAV-based imagery theoretically allows for mapping with sub-decimetre details and accuracy. But is that even necessary? On the contrary, landslide mapping based on satellite imagery will result in less detailed features with less positional accuracy. Consider addressing the necessary positional accuracy of the mapped landslide features with respect to the intended use/scale of the compiled landslide inventory. For an overview map of landslides triggered by a specific event the positional accuracy will not play a great role. If the inventory should serve as input data for landslide modelling however, the positional accuracy of the mapped landslides is of great importance.

Consider adding a sentence addressing the potential of UAV-based imagery for efficiently analysing changes over time (e.g. Turner et al., 2015).

Section 2

Describe the landslide in much more detail. Which type of landslide is it, what type of material is involved (since the area seems to be not very steep) and what are the causes and failure mechanism? Have there been changes during the winter months (e.g. retrogressive failure, erosion)? Is the area cultivated/what is the land cover/land use?

Section 4

Add a figure with examples of each imagery data considered for landslide mapping showing each time (without the mapped features) (i) the whole landslide and (ii) a detailed view (e.g. one of the areas specified in Fig. 1). Also add the map used for the field mappings and the positions of the seven ground control points.

Add a table specifying what was done by whom and when. Also include the abbreviations of the persons.

When were the DGPS measurements conducted? Was the landslide deposition area clearly discernible in the field? If not, this data cannot be used as reference for the other datasets. Were there any changes in the period between the triggering of the landslide and the acquisition of the UAV- and satellite-images (e.g. vegetation ingrowth)?

Describe the 2.5D pseudo-stereoscopic data in more detail. Why was the landslide mapping based on the orthorectified UAV-imagery done in Google Earth and not using a more suited GIS software? Did you use the DEM included in Google Earth for aiding the mapping procedure? Why didn't you consider a DEM based on the UAV-point cloud? Since in most of the scene there is no high vegetation (trees), the landslide's morphology should be represented well. Also other derivatives of the resulting UAV-

based DEM (e.g. shaded reliefs, e.g. Niethammer et al., 2010) could be used for landslide mapping. Then, also the morphometric features could have been mapped better using the UAV data.

Describe the transfer of mapped landslide features from Google Earth to the GIS. Which GIS software was used? Which coordinate system/projection was used for the individual datasets (can Google Earth handle ETRF-2000)?

Mention that you mapped the source/transportation area and the deposition area as separate landslide features. How did you discern the source/transportation area from the deposition area? Are there indicators beyond subjective visual recognition? How did you treat shadows during landslide mapping?

Section 5

Are the length, width and area measurements planimetric (projected) measures?

Section 6

Comment on the comparability of landslide features mapped on different scales (1:1.000 to 1:6.000).

P10, L10-14: This statement only applies for the used data (UAV-based orthorectified image supported by the DEM of Google Earth). If another DEM was used (e.g. based on the point cloud derived from the UAV-data), the mapping results may improve.

Technical comments:

Abstract:

L18: change Goggle to Google

Do not use abbreviations (GPS, GIS)

P1, L7: change to: through field surveys. . .

P2, L26: explain VHR here (now on P3, L29)

P3, L3-L6: Consistently use either abbreviations or the written out form of the slope direction.

P3, L19: change to: ©GoPro camera.

P3, L31: consistently specify the spatial resolution of the satellite imagery data (either 1.84 or 1.85 m) throughout the paper, also in Table 1.

P4, L1: change to: For the satellite imagery,. . .

P4, L5: mention that 432 are the considered bands

P4, L14: in case of the UAV-based imagery, landslide mapping is based on the generated orthorectified image, right? Change to: . . .visual interpretation of the orthorectified image derived from the images taken by the UAV (or something similar). Also on P6, L12 and the caption of Fig. 2.

P4, L27: Was the satellite imagery resampled to 2 m? Otherwise state the original spatial resolution of 1.84 m (or 1.85 m).

P5, L6: change to: before the landslide occurred.

P5, L7: change filed to field

P5, L13: use RMSE as abbreviation

P5, L24: change to: For this purpose,. . .

P7, L32: change ($0.38<E<0.15$) to ($0.38 \geq E \geq 0.15$)

P8, L7-8: there is a verb missing in the sentence. E.g. begin with 'This is particularly true for. . .'

P9, L30: change to: the mismatch is. . .

P11, L3: change to: and typically have a limited. . .

P11, L12: change to: large areas

P11, L13: change to: sub-metre

P11, L18: change to: morphological signature

P11, L19: change to: selecting

P11, L21: what do you mean by geographic accuracy? Positional accuracy?

Figures and Tables

Figure 1: add information on the shown datasets in Fig. 1A (also add a reference to Google Earth), also specifying the source of the polygons and -lines.

Figure 2: Add a north arrow. Change DGPC to DGPS in the caption.

Table 1: change meter to metre in the caption

Consider the following papers:

Niethammer, U., S. Rothmund, M. R. James, J. Travelletti, and M. Joswig 2010: UAV-based remote sensing of landslides, Int. Arch. Photogram. Remote Sensing Spatial Info. Sci., 38(5), 496-501.

Petschko, H.; Bell, R. Glade, T. 2016: Effectiveness of visually analyzing LiDAR DTM derivatives for earth and debris slide inventory mapping for statistical susceptibility modeling, Landslides 13(5), 857-872.

Turner, D.; Lucieer, A. de Jong, S. M. 2015: Time Series Analysis of Landslide Dynamics Using an Unmanned Aerial Vehicle (UAV), Remote Sensing 7(2), 1736-1757.

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