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Earth Surface Dynamics Discussions

Interactive comment on "Analysis of glacial and periglacial processes using structure from motion" *by* L. Piermattei et al.

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GENERAL COMMENTS This paper presents an application of the automatic photogrammetry technique known as Structure-from-Motion to investigate glacial and periglacial processes in the Italian Alps. Authors assess the accuracy of datasets acquired during field surveys using ALS datasets as benchmark. These techniques are of growing interest for Geoscientists and, in my opinion, the paper deserves for the definitive publication in Earth Surface Dynamics. The structure is correct, the methods are properly executed and described and results are, in my opinion, interesting for the scientific community. I include below some minor suggestions or comments that could be of interest for the authors to be incorporated in the final version of the manuscript.

SPECIFIC COMMENTS 1) THE TITLE: In my opinion, the title does not describe exactly the content of the paper because currently the title "Analysis of glacial and periglacial processes using SfM" focus on the processes. The processes are addressed in the paper, but the focus is set on the factors influencing the accuracy of the SfM models. The time devoted to understand the global and spatial distribution of the accuracies is longer than the time used to explain the glacial and peri-glacial processes. I suggest that this aspect should be included in a new title for the paper. Something like "Analyzing the suitability-accuracy of SfM to monitor glacial and periglacial processes. . ." would be more adequate in my opinion.

2) REAL LEVEL OF GEOMORPHIC CHANGE AND LEGEND INTERVALS: In some figures (for example figure 6 or 19) present a different number of decimal places in the legend, I recommend you to be consistent and the use of the same number of decimal places for the intervals. On the other hand, the use of intervals or classes smaller than 1 m in the legend, in my opinion, is not supported by your results. I mean, if you are getting accuracies of around 1 m, using intervals from -0.05 to 0.05 (i.e. 10 cm) is below your real level of detection. I recommend fitting the legend of these figures to the real accuracy of you datasets.

3) 3D SURFACE CHANGES: The estimated changes among the different DTMs are assumed to happen in a predominant way in the vertical direction, i.e. the vector of change is normal to the horizontal plane, which is not very often the case in mountainous and glacier landscapes. It is well known that DTMs are not real 3D records of the landscape. In my opinion, the use of an analysis based on 2.5D datasets (DTMs) instead of 3D actual approaches should be justified and discussed on the manuscript. In your case it is quite a simple issue because the most interesting area for you is the glacier that presents low slopes and changes tend to happened in the vertical direction (which is the one that you assume when you use a DoD approach).

4) LINE OF SIGHT ANALYSIS: The analysis of the relationship between the line of sight and the elevation difference is limited to the line of sight for a specific camera

(five camera locations); however, I guess that from a methodological viewpoint it would be logical to investigate the average incidence angle for a cell (estimating the average angle using every camera) and the Z difference. Additionally, the number of times every pixel is visible from a camera can explain a part of the variance in Z differences. This analysis would be interesting, otherwise you could justify that the selected camera is representative of a number of camera poses.

5) DTM, DEM and DSM: Along the paper, the DTM term is used to describe the gridded model resulting from the processing of the point clouds. The term DTM is widely used to describe models representing different topographic attributes (i.e. elevation, slope gradient, curvature, etc.). In this line, the term DEM is specifically used to describe the DTM that represents the altitude and the term DSM is specifically used to describe the Digital Surface Model. I recommend to use the specific acronyms in the text to avoid misunderstandings.

TECHNICAL CORRECTIONS L5-P4, I suggest the use of uppercases for "lidar". L9-P4, I suggest the use of consumer-grade or conventional instead "common". L10-P4, I suggest the use of uppercases for "lidar", please extend this to rest of the manuscript. L22-L26-P4, In general and along the manuscript, I suggest the use of the passive voice instead of the first person style. For example, L6-P13 (1357) "the accuracy of the photogrammetric reconstruction for the different substrata was investigated" instead of "WE ...". FIGURE 1: I recommend a thicker line to delineate the glaciers. L23-P5, I suggest the use of "repeated" instead of "repeat" L17-P7, You refer to Figure 4, however, in the list of figures, this figure presents the workflow instead the location of the camera, and I guess you refer to figure 5, please check. P11-L29, I suggest leaving out the last sentence about the unfavourable line of sight because later, you will state that there is not significant relationship between the incidence angle (line of sight to normal vector) and Z differences. I suggest trying to explain this 0.41 m mean value for 0-10 degrees of slope areas using the visual and physical properties of the materials. Probably differences in texture or any other aspect are causing this value to be higher

than expected. TABLE 5: please check caption: "... stable are off..." FIGURE 5: I understand that you are using the same north arrow and scale bar for the a) and b) maps and I recommend you to include these between the two maps and not inside b). FIGURE 6: please use the same number of significant decimal places in the legend. On the other hand, and according to your methods I think is not justified the use of intervals in the legend smaller than 1 m, you are using a DTM of 1 m pixel size and your estimations of the vertical accuracy of the SFM-DTMs clearly point out to a level of detection of geomorphic change > 1 m. FIGURE 7: For me it is very difficult to understand figure 7 in its present form. The lines of the profile are superimposed and even in the zoom window, it is difficult. I do not understand how you include camera locations in a 2 dimensional plot. FIGURE 8: the legend of figure 8b could be located on the bottom-right part of the graph for a better visibility of the columns. The mean and the standard deviation are good parameters but I miss in your manuscript the use of an absolute value of the differences that probably would correlate with slope. The mean value is not very rich unless you have systematics errors in your data. This is the case of high slopes in bare ground, any explanation? FIGURE 9: an interesting approach here would be the analysis of the relationship between the number of times an object is visible from a different camera and the Z differences. FIGURE 19: please use the same number of significant decimal places in the legend. On the other hand, and according to your methods I think is not justified the use of intervals in the legend smaller than 1 m, you are using a DTM of 1 m pixel size and your estimations of the vertical accuracy of the SFM-DTMs clearly point out to a level of detection of geomorphic change > 1 m. P17-L15 longer than what? I sugget the use of "long"

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