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Interactive comment on "Influence of snow depth distribution on surface roughness in alpine terrain: a multi-scale approach" *by* J. Veitinger et al.

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GENERAL COMMENTS

The paper of Veitinger et al. addresses the topic of snow cover distribution focusing in particular on its effect on summer terrain. To this aim the authors introduce the concept of the roughness of the snow covered winter surfaces and analyze it, at different scales, with respect to the roughness of the summer terrain. As the authors, I also think this variable is very powerful in giving insight in the spatial distribution of the snow cover, being able to distinguish even from uneven areas and therefore also to better recognize potential avalanche release areas.

My main concern is related to the generalization of the results starting from the three study cases, where the data are poor for statistics: 7 TLS in ST and 3 ALS in CB1 and CB2. Therefore, I would not stress much the consequences of the findings but more describe the methodology and highlight its potentiality, which I found very high. In conclusion, I think the manuscript is suitable to be published in The Cryosphere after the authors will have considered the following specific points. Of course, I am available for further discussion in The Cryosphere discussion process.

SPECIFIC COMMENTS

Pag. 4637, line 16: are the three basins potential avalanche release areas? I guess so; better to say it explicitly, otherwise it is not clear why you choose these areas for your study.

Pag. 4638, line 5: "...as the z value of the upper left, upper central...". A specific figure, associated to Fig. 2 could be helpful. As description of the method in the text is so detailed, I would add such a figure. Otherwise, you could also delete all this part of the text and just refer to the literature. I personally prefer the first solution.

Pag. 4639, eq. (7) and (8): the equations should be: x = xy * cos(beta) e y = xy * sin(beta). Check it.

Pag. 4640, line 17-20: I guess this roughness is of the summer terrain; better to say it. But actually, the most relevant comment on this paragraph is that especially lines 19-20 show already the results of the application of the method you describe in Sec 2. Moreover, what do you mean with larger scales? Is it here referred only to the size of the three basins? Or is it referred, as later in the manuscript, to the scale of the analysis (5-25 m)? This paragraph needs to be clarified.

Pag. 4641, line 4-6: The sentence is not clear. It is not clear how you determine the precision of each single scan. By the difference of two consecutive scans of the same snow surface? Does this mean that in each campaign of TLS you scan twice the same

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snow surface? I am not an expert of the laser scan technique, but I know that at the Seehore test site in Italy a TLS campaign implies a single scan of the area, as doing it twice would be too expensive and time consuming.

Pag. 4641, line 15: Even if an increase is visible, due to the low number of data, I would put the sentence in a less statement way: "it might thus be a potential good indicator for the increasing. . .".

Pag. 4642, line 2: here you speak of accuracy while at pag. 4641, line 4 of precision. Could you not write here also the precision for the ALS at Vallée de la Sionne, instead of the accuracy? Anyway (see comment at pag. 4641, line 4-6) precision and accuracy must be better clarified.

Pag. 4642, line 25: you write here 3 to 25 m, but later in fig. 6 it seems that the first x value is 1 m. If the scale in the manuscript corresponds to the size of the moving window (Pag. 4642, line 26), I would expect the first value on the x axis in fig. 6 to be 3. Am I right?

Pag. 4644, line 1: what do you mean with initial roughness? Is it the roughness of the summer terrain at 1 m resolution? If so, I would add a reference to Fig. 3 (b) and (d).

Pag. 4645, line 10: why do not simply say: "A better fit is given by a power function, of the form.."

Pag. 4645, line 19: check the order of appearance of the Tables and the numbering.

Pag. 4645, line 19: why only for basin ST? I guess it is related to the low (only 3) number of data for CB1 and CB2. Therefore, as this problem occur throughout the whole work, I would, at the beginning of the section, clearly state that some analysis can be done only for ST as more data are available.

Pag. 4648, lines 18-25: For CB1 and CB2, with only three data, I would not do the analysis (see previous comment). Moreover, 25 January 2009 is not really at the end of the accumulation season, as later more snowfalls occurred (fig. 4. (d)). Therefore

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your explanation is questionable.

Pag. 4649, line 18: on which basis you select a reference winter surface roughness? Did you chose the one where some features are correctly represented by your experience? But, do not the most representative features come exactly from the analysis you are going to present, don't they? Why do not test all surfaces versus all surfaces, without making this choice? Also for this I would not do the analysis for CB1 and CB2, or, if so, stress again the poorness of the database.

Pag. 4650, line 2: for a snow covered surface, the correct expression is Digital Surface Model (DSM) and not Digital Terrain Model (DTM). Check throughout the whole manuscript.

Pag. 4651, line 27: if you want you could add a reference to "Maggioni M., Bovet, E., Dreier, L., Buehler, Y., Godone, D., Bartelt, P., Freppaz M., Chiaia, B.2, Segor V., 2013. Influence of summer and winter surface topography on numerical avalanche simulations. ISSW 2013, Grenoble, 7-11 October 2013", where this topic is addressed and also winter and summer roughness considered.

Table 1 and 2: The units are missing. Table 3. Put the complete dates. (if you decide to keep this table in the manuscript) Table 5. Put the complete dates. Fig. 4. Larger fonts would be better. Fig. 8. Thicker line for the fitting The figures of the snow depth distributions in the basins CB1 and CB2 are missing in the appendix.

TECHNICAL CORRECTIONS (maybe not complete)

Pag. 4634, line 7: "..and their corresponding..." Pag. 4635, line 11: "...change the friction between the avalanche flow and the underlying terrain, thus has an impact on the avalanche dynamics, ..." Pag. 4635, line 20: "Changing snow deposition patterns.." Pag. 4642, line8: "is situated about 300 meters away from ..." Pag. 4645, line 19: "shows characteristics..." Pag. 4647, line 4: "...can be observed.." Fig. 1. "...field sites .." and "...marked the exact ..." Fig. 6. "...snow surface ..." Fig. 10. "... snow

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glide cracks.”

Interactive comment on The Cryosphere Discuss., 7, 4633, 2013.