

Interactive comment on “Snow Avalanche Detection and Mapping in single, multitemporal, and multiorbital Radar Images from TerraSAR-X and Sentinel-1” by Silvan Leinss et al.

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Dear authors, dear editor! I am very pleased to see this manuscript and I am happy to review it (sorry that it took so long!). In recent years, my group were the only ones, publishing in the field of SAR-borne avalanche detection. We think that the method can assist in reducing uncertainty in public avalanche forecasting and deem the further development of this field very important. I am therefore happy that other groups also show and interest in SAR-borne avalanche detection! This contribution is therefore definitely worth publishing, however, I suggest that the authors consider my comments and questions. I suggest minor revision of the manuscript.

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Overall the manuscript is sound and very well written (I cant find any grammatical or spelling mistakes, however, I am not a native speaker). The figures are clear and easy to interpret. The structure of the paper is more or less fine (some comments on it). The biggest problems I see, actually, are that some of the content might not be relevant and the manuscript could potentially be shortened. 1) I do not see much value in presenting detection in single backscatter images and 2) although beautiful to look at, I do not see much value in the multiorbital composite, especially not for automatic detection.

Here are my detailed comments: Figure 1: there is no black rectangle Table 1: could you also indicate orbit number and geometry (asc/desc)? line 53: 55x35 km², that does not seem correct line 57: where did you download since you had to wait 24 h? line 59: same as line 53. why the square? Figure 2: could you add some more details on the AAI. if I understand it correctly, this is the AAI for entire SUI? from which observations is it calculated (no need to tell us how). what does mixed snow mean (dry high up, wet in the valleys, or due to aspect)? Figure 2: why are the dates of the multiorbital S1 images not shown in Table 1? ok see them in table A1 now! section 2.1: in case you feel like your article is too long, I think this section could be deleted or shortened substantially. you could refer to Yves paper or the SLF special report. line 85: dry slab avalanches at least have three different zones. in case of very wet slab avalanches the zones are more diffuse and in case of loose snow avalanches I would say they are absent. paragraphs 95 - 100: this section reads well but would benefit from some references to microwave scattering in undisturbed snow as well as avalanche debris. paragraph 105: this section reads like discussion. you have not done your analysis yet but conclude already which parts of an avalanche are detectable and why. if you leave this hear, you have to refer to work that tried to assess this at least qualitatively (eg Eckerstorfer et al 2015). line 131: was manual identification done only in TSX data? line 180: why do you use 4 db as a threshold? is that based on literature or on your data? paragraphs 185 - 200: I would consider these paragraphs also as method. please consider moving it there. and for clarification: how do you deal with the following situation: dataset A shows 2 separate avalanches which are overlapped by 1

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avalanche in dataset B? Figure 6: I am wondering if the readability could be improved by only showing the manually drawn outline, but delete the red lines inside? section 5.3: I am unsure why this exercise of comparing detection in single images and change detection images is of interest? I think it is well established that change detection is the only feasible way to reduce uncertainty in satellite avalanche detection. sections 5.4 and 5.5: this is a very interesting exercise that establishes the upper detection limit of SAR data. could you consider giving some more details here, about how avalanche size plays into detectability? section 5.6: that composite is great, very impressive. just to clarify: you did manual detections in entire Switzerland and found 7361 avalanches? line 290: the POD and FNR are calculated for the red or blue box in your study area? same question also when you compare manual detections. line 290: is the comparison pixel or also feature based? if feature based, how did you handle that for example the automatic detection algorithm split up an avalanche into two features and the manual detection indicates one avalanche? line 335: these statements read confusing. you have mapped an almost similiar number in TSX and Spot-6 images, however, only 68 % and 44 % of the detected avalanches overlap respectively? could you explain this a little bit better please! also, did the same person outline the avalanches in all data? section 6.3: this is a very important section in my view. could you say a little bit more about the size distribution of the avalanches and what the cut-off size is for avalanches not detectable in S1, but clearly visible in TSX. section 6.4: I feel like this is more a repetition of your methods than a discussion of the results. A agree that manual interpretability was improved by all the filtering and smoothing done. however, I somewhat question the use and need of these multiorbital composites, except for visual representation of an avalanche cycle. I cannot discern when all these visible avalanches released and which one came first in case of overlapping avalanche activity. this rather long section does not really add much to the overall good discussion of the results. section 6.5: the 4 dB threshold might be probematic and could maybe be replaced with more dynamic thresholding considering backscatter intensity change in individual change detection pairs. section 6.6: I am somewhat confused that you write about

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'avalanche differentiation' but I think you are discussing the detectability of avalanches in each of the data!?

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