

The Cryosphere Discuss., author comment AC2  
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## Reply on RC2

Elisabeth D. Hafner et al.

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Author comment on "Automated avalanche mapping from SPOT 6/7 satellite imagery with deep learning: results, evaluation, potential and limitations" by Elisabeth D. Hafner et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2022-80-AC2>, 2022

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Dear Ron Simenhois,

please find below the answers to your more specific comments:

Line 125: We will add a sentence properly introducing the patch size we utilize for our model in the revised version of our manuscript.

Line 127-133: You understood the methodology of our data sampling correctly. We will revise the corresponding section to make it easier for the reader to understand.

Line 129: The "Second" must have gone lost in the editing process, we will correct this in the revised version.

Line 146: We chose to use weighted BCE because weighting the outlines according to their perceived visibility (manual mapping) was our main intention. Given the class imbalance IoU loss would have been a valid choice. We did not try it, as we chose not to extensively focus on varying all model parameters, but agree that for future work it would be interesting to (for example) run the model with IoU loss. However, as our model metrics are about as good as human experts (section 4.3), we do not expect a huge change in metrics by using a different loss.

Line 150-151: As already mentioned, varying all possible model parameters would be beyond the scope of this paper. Additionally, due to the format we have chosen to not include metrics for all variations that we have played with. In this specific case, the transformation of the shadow pixels increases model performance, though not by a large margin (metrics without transformation: POD: 0.618, PPV: 0.593, F1- score: 0.618).

4.1: We will revisit this section and attempt to bring more clarity in the revised version by reorganizing.

Table 2: The bold fonts signify the model parameters that were varied compared to our "initial" model. We will add this information to the legend in the revised manuscript.

Figure 6: We will replace "avalanche score" with "model confidence" in the revised version

of our manuscript

Line 232: We know that the data quality from expert mapping is lower in shaded areas (for more details see comment to section 4.4). As our model cannot know more about avalanches in shaded areas than it has been taught, the model will have lower performance in shaded than in illuminated areas.

Table 4: As the experts mapping did not follow exactly the borders of pixels in the SPOT imagery this is an area-wise comparison of the mapped avalanche polygons. Which in terms of results is comparable to a pixel-wise comparison. To make this clear we will add this information to the revised version of our manuscript.

Figure 8: The color scale of our heat map represents the number of experts who have agreed. We will change the title of the color scale to “number of experts” in the revised version to make this clearer.

4.4 Generally, we have decided to limit the content of this section to the specific limitations of the model and only briefly mention the limitations we have already dealt with in previous work. Concerning the reliability of manual mapping from SPOT6/7 data, we have in Hafner et al. (2021) compared the POD in shaded and illuminated terrain. We know that avalanches are more likely to be missed in the shade (POD: 0.15 shade, 0.86 illuminated, 0.74 overall). We have also mentioned that in line 232. In order to make this clearer to the reader unfamiliar with previous work we will expand this section a bit in the revised manuscript.

Line 285: These numbers are correct and may also be found in Table 2. They are lower than for the whole model as the training data is significantly reduced by using only release areas or only deposits. But even though the metrics are not satisfying with the reduced amount of training data, we were able to show that the model learns more from the deposits. We will make this clearer in the revised version of our manuscript.

#### References:

Hafner, E. D., Techel, F., Leinss, S., and Bühler, Y.: Mapping avalanches with satellites – evaluation of performance and completeness, *The Cryosphere*, 15, 983–1004, <https://doi.org/10.5194/tc-15-983-2021>, 2021.