Reply to reviewer comments by Bret Shandro

Frank Techel

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Dear Bret

thank you very much for your review of our manuscript and the helpful comments.

Please find below our reply (in blue) to your comments *(in italics)*.

General comments

This manuscript presents a novel method for interpreting snowpack tests for evaluating snow avalanche hazard and is appropriate for the NHESS. Overall, the quality of the manuscript is good to excellent.- Thank you for this very positive feedback.

The presentation of a 4-class stability interpretation scheme is beneficial beyond academic purposes, as some avalanche practitioners assess an avalanche problem's sensitivity on a 4-class scale (Statham et al., 2018).

Below I proved minor comments for the authors and editor and recommend publication of the manuscript.

As the NHESS audience includes readers beyond snow avalanche hazard, I suggest a title that communicates the relevant natural hazard, for example, «On the snowpack stability interpretation of extended column test results.» - We intend to change the title as suggested.

Specific comments

- *Line 105 – Regarding the minimal depth criteria, Techel and Pielmeier (2014) appear to use a 15 cm. What is the benefit of distinguishing between a weak layer 6-10 cm and 5 cm or less? Why not classify all tests class 4 if the weak layer less than 10 cm?* - The idea was a less discrete influence of the weak layer depth on the classification. However, comparing the results using a simpler approach as you suggest with the approach we used in the manuscript, showed only very marginal changes in the results. As keeping it simple has some benefit too, we will adjust the weak layer criteria to a single criteria: a depth less than 10 cm will be classified as stability class 4. Using this simpler depth criteria will have no impact on the overall findings or conclusions drawn (despite some minor changes in proportion values in parts of the manuscript, which we will address in the revised mansuscript).

- *Line 146 – For the dataset sampling to cluster stability classes, were any precautions taken to avoid the algorithm producing results that were overfitted to the sampled data, i.e. how was a 90-10 ratio selected?* - Although not shown in the manuscript, we also explored a sampling approach using an 80-20 ratio. The resulting splits were very similar as can be seen in Fig. 1. The most notable difference in the splitting criteria were noted for the class threshold between classes 3 and 4. Here, the first splits differed (ECTN$\leq$10 vs. ECTN$\leq$3). However, the second most frequent split obtained with 80% of the data (ECTN$\leq$10) was the same as the most frequent split obtained with 90% of the data. - Note there is a mistake in the manuscript on line 260 which should read: *ECTP$\leq$14 (48%), ECTP$\leq$13 (36%)* rather than *ECTP$\leq$15 (48%), ECTP$\leq$14 (36%)*.

- *Figure 3 – The reader may benefit from the proportion values included in the figure. I believe this would allow the reader to better interpret the results section.* - Good suggestion. We will add these.

Technical corrections

- *Line 168 – There appears to be a formatting issue with the list, (i) (ii).*

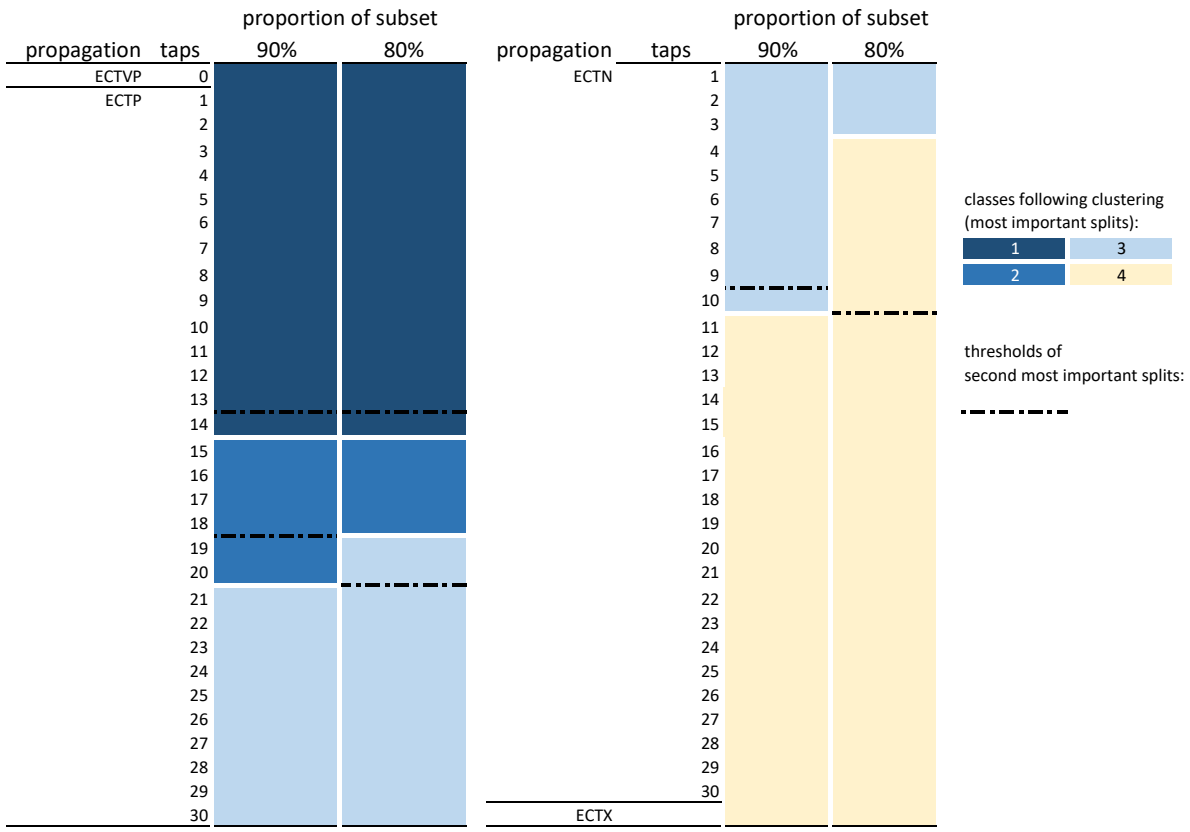

Figure 1. Clustering thresholds obtained, when using either 90% (currently used in the manuscript) or 80% of the data for each of the 100 repetitions. Colours represent the four classes based on the most frequently indicated splitting criteria. The dotted-dashed lines indicate the second most frequent splitting criteria. In general, the splitting criteria were rather similar.

References

Statham, G., Haegeli, P., Greene, E., Birkeland, K., Israelson, C., Tremper, B., Stethem, C., McMahon, B., White, B., and Kelly, J.: A conceptual model of avalanche hazard, Natural Hazards, 90, 663 – 691, doi:10.1007/s11069-017-3070-5, 2018.

Techel, F. and Pielmeier, C.: Automatic classification of manual snow profiles by snow structure, Nat. Hazards Earth Syst. Sci., 14, 779–787, doi:10.5194/nhess-14-779-2014, 2014.