

Nat. Hazards Earth Syst. Sci. Discuss., referee comment RC1  
<https://doi.org/10.5194/nhess-2021-160-RC1>, 2021  
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## Comment on nhess-2021-160

Anonymous Referee #1

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Referee comment on "How is avalanche danger described in textual descriptions in avalanche forecasts in Switzerland? Consistency between forecasters and avalanche danger" by Veronika Hutter et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-160-RC1>, 2021

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### How is avalanche danger described in public avalanche forecasts? Analyzing textual descriptions of avalanche forecasts in Switzerland

#### Overview

This manuscript presents the results of a study that examines the text-based descriptions of avalanche danger in public avalanche forecasts. The study analyzed the text descriptions published in more than 1,000 avalanche forecasts by the national avalanche warning service in Switzerland over eight forecast seasons.

I applaud the authors for recognizing the value of text-based analysis in research of avalanche forecast quality, as this approach has the potential to expand ways to think about and examine the topic. While the study offers valuable insights, it is my opinion that several weaknesses need to be addressed before the manuscript should be considered for publication. Due to my comments about the research objective and the approach of the analysis, I believe that the manuscript requires major revisions. However, I hope that my comments below offer meaningful starting points for improving the manuscript. In my opinion, the suggested changes will make the paper a much stronger and, therefore, a more impactful contribution.

#### Major Comments

##### *Link between theoretical background and analytic approach*

- I appreciate the introduction of the semiotic triangle as a conceptual framework for the task of avalanche forecast production. As the authors point out (lines 41-44), the semiotic triangle is helpful in that it tracks the process from an avalanche situation to forecaster interpretation to a communication. However, I am not able to see the connection from this conceptual framework to the methodological approach. To make this connection stronger, I recommend that the authors revise their introduction to present their research questions and objective in a more accurate way.

### *Clarifying the stated objective*

- To add more detail to the comment above, the stated objective of this study requires further clarification. If the objective of the research is to demonstrate the value of text-based analysis to avalanche forecast research (lines 54 and 66-68), the authors need better situate and justify their rationale for the study design and analysis within the body of literature on text-based methodologies. As the methods section does not include any citations to support the methodological approach beyond validating the inter-rater agreement rate (lines 169-170), the authors need to provide more adequate support to ensure that the study is well-grounded and that the reader can see how it makes a contribution to the stated objective.
- If this extends beyond the possibilities of the current analysis, I recommend that the authors reword the objective to make it clear that the goal is to contribute to an official translation of terms characterizing key factors of avalanche hazard rather than to demonstrate the value of text-based analysis in avalanche research.

### *RQ1: An analysis of forecaster agreement may not represent language use*

- While important insights emerge from the analysis of RQ1, the task does not replicate the forecasting workflow and the implications to the avalanche forecasting process require re-examination. There is a crucial difference between the analytic exercise designed to examine RQ1 (lines 26-29) and the forecasting process outlined in the semiotic triangle. In contrast to the semiotic triangle, the analytic exercise does not replicate the forecasting task of moving from an avalanche situation to an interpretation and subsequent communication symbol. Rather, it orders this process in reverse, whereby the forecaster is tasked with matching a communication symbol to a corresponding key factor in an avalanche situation. Thus, the analytic approach does not examine how language is used by forecasters in the context of how forecasts are produced, which is what RQ1 might suggest given its current wording (i.e., "how do forecasters use language...") (lines 75-76). A more precise wording of RQ1 might read, "how well do forecasters agree on the meaning of key phrases...."

### *RQ2: Establishing a hypothesis*

- Research question 2 (lines 133-135) involves analyzing how the classified text descriptions correlate across differences in avalanche danger. The authors distinguish avalanche danger according to the different levels of severity as classified by the European Avalanche Danger Scale and according to dry-snow versus wet-snow conditions. The analysis examines a measure of the completeness of trigger, likelihood, and size information across differences in avalanche danger as well as examines their content distinguished by natural and additional load triggers; few, several, or any triggering locations; and sizes 1, 2, 3, 4, and 5.
- To establish a starting point for expected outcomes, the authors need to provide a reference to the full European Avalanche Danger Scale in the main body of the manuscript. Based on the formal definitions of the various levels, what differences in completeness and content, if any, would be reasonable to expect? Providing this background and hypotheses would better situate the results in terms of how they confirm or contrast existing expectations. This would help to expand the discussion of

the value of the danger description and the potential reasons for the observed variabilities.

- Similarly, the authors need to include their rationale for including and differentiating dry-snow versus wet-snow avalanche types. Why do they make this distinction? Are any avalanche conditions excluded from this distinction? And finally, how is information completeness and content expected to differ across these conditions? Providing this background and hypotheses would better situate the results in terms of how they confirm or contrast existing expectations.

### *Communicating Uncertainty*

- As the authors detail in their explanation of the semiotic triangle (line 40), a key aspect of the cognitive task in avalanche forecasting is that forecasters may work through the semiotic triangle with incomplete information, which produces various levels and sources of uncertainty. Is it possible that situations of extreme danger might have different levels or sources of uncertainty than situations of moderate danger and might explain some of the resulting patterns in the analysis?
- The authors do highlight this possibility in the discussion section (lines 338-339). However, as the element of incomplete information was pre-defined in the semiotic triangle, this very limited mention of it in the discussion seems underdeveloped and incomplete. The manuscript would benefit from elaborating on the role of incomplete information as it currently leaves a lot of questions open.

### *RQ2: The inclusion and exclusion of phrases*

- Through the analysis of RQ1, text phrases that did not produce high levels of agreement among forecasters regarding key factors were subsequently excluded from additional analyses. This begs the question: what themes were encompassed by these ambiguous phrases? Could these phrases also offer valuable insight into avalanche forecast quality? I recommend that the authors consider conducting further analysis of the excluded phrases. The results could then be incorporated into the analysis of RQ2 for a more robust analysis. Is it possible that the themes encompassed by the ambiguous phrases might correlate with specific hazard conditions and might provide insights into what forecasters deem important to danger descriptions beyond key phrases?
- Additionally, does it make sense to include phrases in the analysis that were never used in a bulletin? This should be addressed in the limitations section.

### *Implications for users of avalanche forecasts*

- Line 338: "Leaving out information, for example the likely triggers or size classes of avalanches expected for danger level 2-Moderate, may, for forecasters, actually convey information about the situation." Please elaborate on this. Maybe provide an example.
- There are various papers, such as Lazar et al. (2016), Statham et al. (2018), and Clark (2018 and 2019) that shed light on consistencies or inconsistencies among avalanche forecasters. I think it would be useful for this paper to include these ISSW papers in the discussion.

- The discussion does not include any recommendation for avalanche forecasters or the Swiss avalanche bulletin system (e.g., use of phrase catalogue). While there is a brief mentioning of the graphic display of avalanche hazard information in Canadian avalanche bulletins, a critical discussion of how the graphical approach and/or the conceptual model of avalanche hazard (Statham et al., 2018) can address the identified challenges is missing. I believe that a broader discussion would make this a more useful paper for the global avalanche safety community.

### *Limitations*

- Given that the use of the sentence catalogue seems to be very specific to the production of the Swiss avalanche bulletin, I don't think it is realistic to expect that the results would be transferable to other warning services. I believe that the focus on Switzerland should be clearly stated in the research objectives. This means that this aspect likely does not need to be mentioned in the limitations section.
- Per my earlier comment on the the inclusion and exclusion of phrases in the analysis, I believe that this should be addressed in the limitation section.

### **Minor Comments**

#### *Triggering terminology*

- I find the terms used to describe the key factors related to triggering avalanches to be wordy and confusing (i.e. triggering leve, triggering spots frequency, and triggering spots location). I think the following terms from the Conceptual Model of Avalanche Hazard (Statham et al., 2018) offer a clearer delineation of these key elements: trigger type, sensitivity, and spatial distribution. These elements are then combined to form the likelihood of avalanches, whereas the size classifications offer an ordinal representation of consequence. I recommend the use of these terms as it strengthens the connection to well-established definitions of key factors within risk science.

#### *Introduction*

- The introduction is fully focused on European avalanche bulletins. Since the authors refer to non-European avalanche bulletin formats in the discussion section, I think the manuscript would benefit from including a more in-depth description of how the information presentation in the Swiss bulletin compares to others. For example, the text information (avalanche activity, snowpack conditions, weather) included in Canadian and US bulletin offers more detailed insight about conditions than the text included in Swiss bulletins. Furthermore, a broader description of the context in the introduction will make the paper more relevant for a wider audience.
- Line 63: Clark (2019) examined the link between the likelihood and expected size of avalanches with the avalanche danger rating. The manuscript does not accurately describe this research.
- Line 106: At the core of the danger description "in Switzerland"...

## Discussion

- Line 346: I do not understand how the results of the analysis suggest that "communication of non-extreme situations is critical". This statement requires elaboration.

## Technical Comments

- Abstract is quite long.
- Replace "firstly" with "first", and "secondly" with "second" and so on (e.g., Line 8, but many others as well).
- Line 163: Extra ")" that is not necessary.
- Line 166: "More than 20 of the values ...". Please be precise?
- Line 164-171: In both cases, 53% of the groups were assigned the same by all participants. Is this correct or a typo?
- Figure 4: Given that the lowest value on this chart is 0.64, a different color scale would bring out differences more clearly. Given these details, can the authors explain the observed differences between the participating forecasters?
- Line 187-192: No need to repeat information that is already presented in Table 2.
- Line 195: Replace "All analysis was ..." with either "All analyses were ..." or "The entire analysis was ..."
- Line 201: "In the descriptionS ..." (missing s)
- Lines 201-206: The simultaneous description of the results and the example shown in Figure 5 makes the text quite convoluted. I recommend separating the two aspects to make the text more readable. Furthermore, I think that the description of the example should actually be included in the methods section, where there is already a reference to Figure 5 on Line 180.
- Line 207-208: The current statement does not state that the proportion of descriptions that include all three factors decrease with "decreasing" danger levels.
- Line 207-211: It seems to me that this description actually belongs to the next paragraph as it already discusses the danger description at different danger levels.
- Table 3: Tables cannot have shading. This makes them figures. Also note that some of the lines have been erased by the shading.
- Table 3: It would be best to use a consistent format for presenting the results. The authors currently use percentages in the text while using proportions in the tables and figures.
- Figure 6: Legends should not be plotted over top of stacked bars. In addition, labeling the individual charts with titles would make the figure easier to read.
- Line 278: Should be "classified" instead of "classed".
- Line 283: Should be Zooming "into" instead of "in to".
- Line 333: Why reasonably in brackets? It would be best if the authors quantified what they mean by "reasonable."
- Line 341: Avalanche warning services in Canada, the United States, and New Zealand are using graphical representations of the critical information.
- Table A3 indicates that not all phrases have been used during the study period. This is an important detail that is not mentioned in the text.

## References

Clark, T., & Haegeli, P. (2018). Establishing the link between the Conceptual Model of

Avalanche Hazard and the North American Public Avalanche Danger Scale: Initial Explorations from Canada. *Proceedings of the 2018 International Snow Science Workshop*, Innsbruck, Austria, 1116-1120. <https://arc.lib.montana.edu/snow-science/item.php?id=2718>

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Lazar, B., Trautman, S., Cooperstein, M., Greene, E., & Birkland, K. (2016). North American Danger Scale: Are Public Backcountry Forecasters Applying It Consistently? *Proceedings of the 2016 International Snow Science Workshop*. Breckenridge, CO, 457-465. <https://arc.lib.montana.edu/snow-science/item.php?id=2307>

Statham, G., Haegeli, P., Greene, E., Birkeland, K., Israelson, C., Tremper, B., & Kelly, J. (2018). A conceptual model of avalanche hazard. *Natural Hazards*, 90(2), 663-691. <https://doi.org/10.1007/s11069-017-3070-5>

Statham, G., Holeczi, S., & Shandro, B. (2018). Consistency and accuracy of public avalanche forecasts in Western Canada. *Proceedings of the 2018 International Snow Science Workshop*, Innsbruck, Austria, 1491-1495. <https://arc.lib.montana.edu/snow-science/item.php?id=2806>