

# Exploring the relationship between avalanche hazard and large-scale terrain choices at a helicopter skiing operation – Insight from run list ratings

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## Response to Anonymous Referee #1

Reto Sterchi, Pascal Haegeli

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We would like to thank the reviewer for taking the time to read our manuscript in detail and provide constructive feedback. The following sections describe our response to the comments raised by the referee and outline the changes we made to the manuscript to address these concerns.

### 1 Title

**Review** (Reviewer #3 made the same comment)

*[...] The tile uses the expression “large-scale”; I recommend the use of “regional” here so that it becomes clear that a large scale (1:10,000 or so) is meant, or “detailed assessment” if this should be the focus, but not – as this expression is quite often also used in NHESS – a nation-wide assessment. [...]*

#### **Response to the review and changes made to the manuscript**

We agree that the expression “large-scale” is not sufficiently specific for describing the spatial scale of our analysis. However, we feel that the proposed “region” is ambiguous as well. Since the scale of the guides’ process refers to individual runs, we believe that replacing the expression “large-scale terrain choices” with “run list terrain choices” is most appropriate. To address the reviewer’s concern, we made the following changes (highlighted in green):

*Title*

“Exploring the relationship between avalanche hazard conditions and run-list terrain choices at a helicopter skiing operation”

### 2 Acceptable risk level

**Review**

*[...] In the abstract as well as in the main text body the authors repeatedly address the term “acceptable risk level”, from the overall scientific discussion and concept behind risk and vulnerability, I am wondering what exactly is meant by “acceptable” (death rates below a certain percentage? Number of ski runs without avalanche accident?) and if some explanatory sentences could help here to avoid confusion. [...]*

#### **Response to the review and changes made to the manuscript**

Whereas acceptable avalanche risk levels have explicitly been defined in land use planning (e.g., 1 in 30 years, 1 in 100 years, and 1 in 300 years avalanche risk maps), they have not been defined in backcountry and mechanized skiing. We intended to use the term “acceptable” in a more qualitative way to express that operations do their best to avoid avalanche incidents while acknowledging that the activity is inherently risk and not all of the risk can be eliminated. However, considering this review, we

changed the following instances, where we describe terrain choices intended to reduce the risk to an acceptable level as “appropriate terrain choices” (changes highlighted).

Page 1, line 10ff:

*[...] Using a large data set of over 25 000 operational run list codes from a mechanized skiing operation, we applied a general linear mixed effects model to explore the relationship between ~~acceptable~~ skiing terrain that is deemed appropriate (i.e., status open) and avalanche hazard conditions. [...]*

Page 3, line 3ff:

*[...] The objective of our study is to advance our understanding of the professional avalanche risk management process by quantitatively examining the relationship between ~~acceptable~~ skiing terrain appropriate (i.e., open or closed for guiding) and avalanche hazard conditions at the run scale using historic avalanche hazard assessments and run list ratings from a commercial helicopter skiing operation. [...]*

Page 20, line 1ff:

*[...] For example, explicitly including the likelihood of avalanches and destructive size parameters of the existing avalanche problems in the run list model has the potential to extract more detailed information about the relationship between the avalanche hazard situation and characteristics of runs with ~~acceptable~~ appropriate skiing terrain. [...]*

Page 20, line 11ff:

*[...] Using a large, multi-seasonal dataset of operational run list choices from a mechanized skiing operation, we applied a general linear mixed effects model to quantitatively explore the relationship between avalanche hazard conditions and ~~acceptable~~ appropriate skiing terrain numerically for the first time. [...]*

Page 20, line 29ff:

*[...] For the first time, the effect of avalanche hazard has been isolated from the influence of other factors such as the run list code the day before and the effect of recent skiing. Properly isolating these effects is critical for describing the relationship between avalanche hazard and ~~acceptable~~ appropriate terrain in a meaningful fashion. [...]*

### 3 Operation vs. Operator

#### **Review**

*[...] The authors address multiple times the “mechanised skiing operation” but are using data from one operator; maybe the wording could be “mechanised skiing operator” to avoid confusion (e.g., page 1, line 11; page 20, line 11). [...]*

#### **Response to the review and changes made to the manuscript**

The term “operator” usually refers to the actual person that operates (and potentially owns) a mechanized skiing operation. We believe that keeping the term “operation” is more appropriate since our study analyses the run list risk management decisions of an entire organization. We did not make changes to the manuscript.

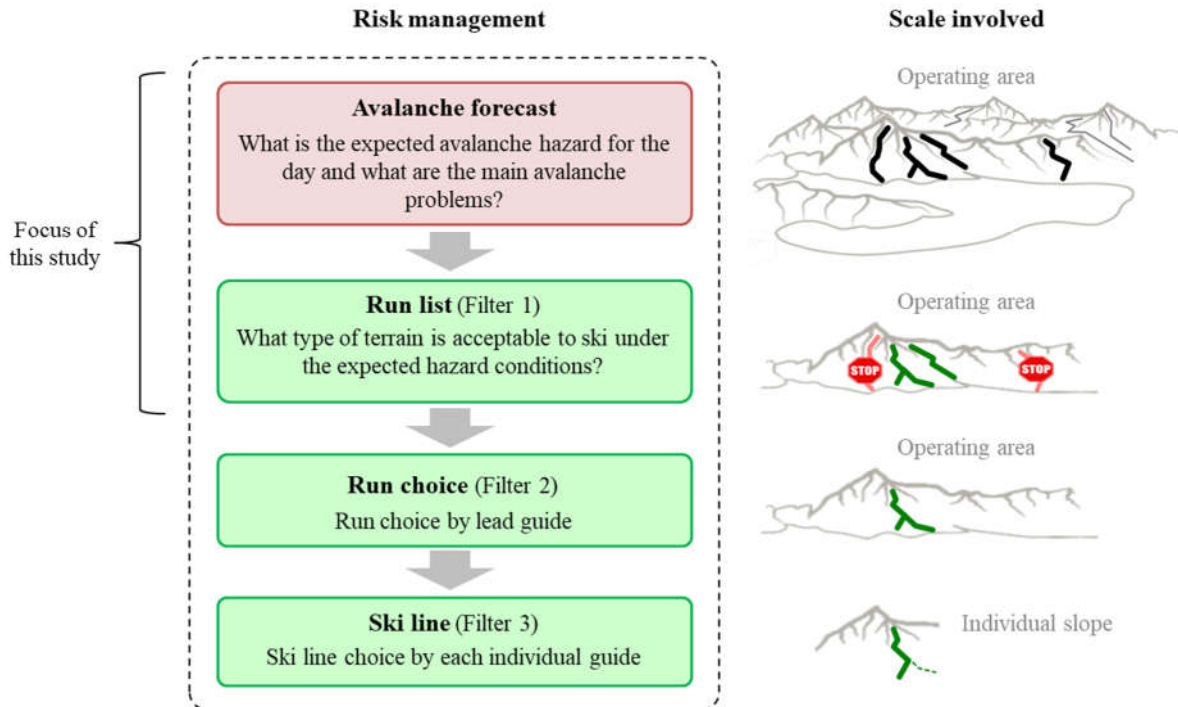
## 4 Illustration of risk management process

### Review

[...] On page 2, lines 1-22 the author describe the procedure of assessing avalanche hazard and establishing the run list, it would be useful to underpin this by a Figure showing the different steps by e.g., boxes and arrows in between. [...]

### Response to the review and changes made to the manuscript

Thank you for highlighting this issue. We believe that a figure will help illustrating the entire process as well as the focus of our study and propose the following figure.



*Caption: Risk management process with terrain selection in mechanized skiing in Canada.*

## 5 References

### Review (Reviewer #3 made the same comment)

[...] Please check references for updates, and provide a doi for those references that are in press. [...]

### Response to the review and changes made to the manuscript

Thank you for highlighting this. The paper is in press and should have a DOI shortly (expected in approximately 2 weeks).

*Walcher, M., Haegeli, P., and Fuchs, S.: Risk of death and major injury from natural winter hazards in mechanized backcountry skiing in Canada, Wild. Environ. Med., [in press](#).*