

Response to reviewer RC3 (K. Birkeland)

Frank Techel et al.

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We greatly thank Karl Birkeland for his detailed review and the helpful comments.
Our response is shown in blue, *intended changes to the manuscript in italics.*

5 This is an interesting paper that highlights the differences both within and between avalanche warning services in the Euro-
pean Alps by comparing the avalanche danger ratings issued. The authors collected an interesting dataset and, in my opinion,
they used appropriate methods for their analyses. I found some parts of the paper difficult to follow, but that might be a com-
bination of my unfamiliarity with some of the regions discussed and also the difficulty in describing all the different warning
services and how they produce their products. From my perspective there are no major flaws with their paper and I recommend
publication with mostly minor revisions.

10 **1 General comments**

In the Introduction the research questions are listed. However, the first two listed research questions are not – in my opinion
– research questions. The first question regarding the “operational constraints” of the various warning services is really just
background information that the reader (and the researcher) needs to understand to better understand the source of the data for
the paper. The second question is really more of a methodological question and not a typical research question. To me the three
15 research questions addressed by this paper are: 1) Does bias exist within and between warning centers?, 2) (the currently listed
research question nr 3) and 3) (the currently listed nr 4).

*We will take up this suggestion. We will highlight that we not only address the three research questions (as suggested), but
that we also provide an in-depth review on avalanche forecast products in the Alps and the concepts used to communicate the
avalanche hazard.*

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I found all the avalanche warning service abbreviations a little awkward and difficult to follow. I suggest writing out the
avalanche warning service names in the text rather than using the abbreviations throughout the majority of the paper. I think
doing so would be especially helpful for readers like myself who might not be familiar with the names of the various warning
services. The abbreviations would still be useful for the maps.

25 Likewise, in some places the authors spell out a country (Switzerland), while in others they will use one of two different
abbreviations (SWI or CH). I suggest writing out the countries for consistency and for those not familiar with some of the
abbreviations.

We will take up this recommendation and spell out the name of the forecast center/country and provide the abbreviation in brackets (for instance Vorarlberg (VOR)).

5 It was not clear to me why the authors used the 1700 forecast for Switzerland rather than the 0800 updated forecast (p. 14, line 29). Why was this done? Would using the 0800 forecasts have changed the results?

We used the 1700 forecast, as this is the main forecast in Switzerland. Furthermore, at the beginning and end of the forecasting season no update is published in the morning. However, we would not expect major changes in our results using the 0800 updated forecast, as the forecast danger level changes only in about 2.7% of the days and regions from evening to morning forecast, with an almost equal share of adjustments towards a higher or lower danger level (1.7% up, 1% down) (Techel and Schweizer, 2017)). According to Techel and Schweizer, the »forecast accuracy«, measured as the agreement between local danger level estimates and the forecast danger level remained the same, regardless which forecast was used.

10 *We will explain why we used the 1700 forecast.*

Section 5 is called “Results and Interpretation”, which is an unusual title for a section of a scientific paper. Normally “interpretation” would be considered part of the Discussion. I guess the paper works this way, but the authors could consider either changing this section to “Results and Discussion” and then bringing in the Discussion to this section, or they could have a “Results” section and move their interpretations to the Discussion section.

We are aware that the section title differs from what is common standard. The main argument for this title was that we not only provide results, but also immediate interpretation/explanation, without going into a more detailed discussion at this stage.

20 *We will change the section title to Results, but rather keep the immediate explanations in this section as we believe this will aid the reader in understanding the results.*

On Figure 5 it is difficult to see the two highest agreement borders. Could all the borders be black, but just very thin? Again, this isn’t a big point, but perhaps something the authors could look at and see if it could be improved.

25 *We will find alternative options to better visualize the disagreement rates.*

In Figure 6 the area of Italy that is below the main map should be in a box or something to show that it is an inset and not physically located south of the main map.

This is a good point. We will show this in a box to make it more obvious.

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Finally, the authors are in a unique position for a further, in depth, discussion of their results. First, how might they propose to increase the consistency across Europe? With the “matrix” that they allude to but do not describe? Or, with a conceptual model such as presented by (Statham et al., 2017) that proposes a workflow that is now currently in use in many avalanche forecasting operations in North America? Or, do they have other solutions or ideas? Second, do they have any insights into why the different biases exist? Are there certain practices in certain countries or at different avalanche warning services that can

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help explain the biases presented? These would be interesting discussions for the reader if the authors can provide additional insights.

We will address the first point - proposition and current direction to increase consistency across Europe - in our discussion. However, we will only be able to provide a very rough indication on the current / future developments within the working group of the European Avalanche Warning Services, as this is work in progress. We envision that the use of the EAWS-Matrix (Müller et al., 2016), including future developments, by all the AWS will increase consistency. Furthermore, consistency might be increased by cross-border collaboration as in the current project ALBINA, where three warning services (Austria: Tirol/TIR, Italy: Bolzano-Alto Adige - Südtirol/BOL and Trentino/TRE) develop a joint forecasting platform (Mitterer et al., 2018). Concerning the second question: no, we cannot say with certainty why biases exist. We indicated one potential reason on page 28 (lines 1-5). But in the end, we do not have this information and will therefore not be able to go into detail in that respect. In this study, it is our aim to show that differences exist, which will hopefully stimulate the discussion in the EAWS about the «Why?», and about how consistency can be increased.

References

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