

## ***Interactive comment on “Quantifying seasonal cornice dynamics using a terrestrial laser scanner in Svalbard, Norway” by Holt Hancock et al.***

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General Comments: I appreciate the opportunity to review this well-written manuscript presenting an intriguing use of terrestrial laser scanning (TLS) technology. The authors worked in Longyearbyen, Svalbard where an important body of prior work has focused on cornice fall avalanches. The innovative addition here is the TLS, which allowed more accurate volume estimations to be made for cornice on slopes facing two different aspects, over parts of two consecutive winters. Sustained winter darkness at this latitude complicates conventional methods like visual observation or time-lapse photography, but the TLS overcomes limitations of daylight. The long-range scanner employed here also allows slopes to be repeatedly measured from a safe distance, while the use of snow-free, bedrock surfaces as reference points improves the accuracy of the snow

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volume calculations. Cornice fall avalanches are important hazards in this and other mountainous regions, but considerable uncertainty remains about the processes and triggers responsible for these events. As such, this work has important ramifications for planning and hazard management. I have no doubt that the international snow science community will be interested in this application of TLS. I also expect that this work will evolve rapidly in future years, likely incorporating greater automation to allow cornice growth/fail to be tracked over much finer temporal scales. I find the manuscript to be well organized and clearly written. By working carefully over two winters, on two different slopes, the authors were able to identify consistencies with implications for understanding the processes involved in cornice formation. The title is accurate. The methods are clearly explained. The literature review and introduction are concise, but adequately present the motivation for the study. The overall presentation is clearly and logically structured, and the paper is an appropriate length. I recommend acceptance after a few minor changes (noted below).

Specific Comments: All of the figures are relevant and helpful to the reader, but I think a few of them should be changed. Specifically, Figure 5 and 7 are difficult to read because the colors used to represent the snow surface at the different times are too similar. Both of these figures are really important – they nicely present the data and allow clear visual distinctions to be made between scans, between slopes, and between the two winters. Improving their readability with more contrasting colors is a necessary step that will greatly help comprehension of the reader. I found Figures 9 and 12 difficult for a similar reason. While one might think that the bright red and dark blue colors representing the extremes of the change spectrum would be visible against the grayscale hillshade, the differences are actually really subtle. The figures are both important because they illustrate just how sensitive the TLS method is to even small changes in the snow surface. Unfortunately, the areas that changed are just really hard to see – even with the arrows drawing attention to specific regions in the images. I'm not sure what to recommend here. It is possible that a different color scheme would work better. Another possibility would be to keep a large figure representing the overview

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of the slope, and having a series of enlargements of small areas (keyed back to boxes in the overview figure) that show the detected changes in a more obvious, zoomed-in way. Just as in my comment above, these figures are critical to presenting your data and supporting the following discussion – it would be great if they could be made even more compelling.

Technical Corrections: After reading through the manuscript, I also offer the following minor editorial suggestions: Line 30 – “... projections of snow that form due to...” Line 40 – “... Cornice hazards.” Line 76 – Would “designing” be a better word than “planning” here? Line 90 – I usually capitalize “U-shaped valley” Line 90 – “... oriented axis running...” Line 95 – Is there any information about the thickness of the continuous permafrost? Line 101 – “... consists of a 50-70-m, near-vertical bedrock cliff situated under the plateau margin and above...” Line 115 – “The climate of Svalbard prohibits...” Line 139 – by “reliable” snow depth data do you mean the start of seasonal snow accumulation? Or is this the date at which the snowpack exceeded a certain minimum thickness necessary for accurate measurement? Line 154 – “... we used to georeference individual...” Line 225 – I’m not sure what “(Size D2, R3)” means. Line 370-372 – I would include reference to Figure 7 and Figure 5 here. Line 380 – “... to suggest that specific interactions...” Line 387 – “... cornices we investigated, and also failed completely both seasons.” Line 439 – “... also favorable for the development of more...” Line 629 – “... was taken is indicated by POV in...”

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