

**Interactive comment on “Brief communication: 4 Mm³ collapse of a cirque glacier in the Central Andes of Argentina” by Daniel Falaschi et al.
Anonymous Referee #3**

Summary

Falaschi and coauthors describe an apparent sudden collapse of a small cirque glacier in the central Andes, Argentina. They describe this event largely through the use of remote sensing and limited field surveys. Although largely documentary in nature, this brief report provides additional evidence for sudden failure of alpine glaciers – these events present an unusual type of mountain hazard that may occur with greater frequency in the years ahead. Overall, I found the evidence for the failure convincing, and the manuscript’s organization made their arguments mostly easy to follow. The paper will require moderate revisions to bring it up to the level required for publication in *The Cryosphere*, however. Below, I outline major points I have with the manuscript. I also include a marked up copy of the manuscript to help the coauthors revise their paper.

We thank the referee for the constructive comments. We have modified and corrected the manuscript following the comments and suggestions.

2. Major Points A) Remove or substantially trim speculative material - This manuscript represents a short note (Brief Communications) in *The Cryosphere*, and simply providing sound documentation for the event is sufficient for publication (largely because of the hazard implications associated with these events). In many places, however, the authors tend to go a bit too far in the interpretation of their data that leads to too much speculation (mostly about whether event was enhanced by fine-grained bed or whether events happened before). The authors point out, for example, that they have limited field observations, but then they go on to make claims that really require additional field observations or require modeling data that they currently do not have in hand (or report in the paper). I think a proper documentation of the event is enough. Simply state factors that caused the event to happen are currently uncertain. The logic of several statements are flawed at least in the way they are written. (e.g. towards the end of the paper ‘. . .no strong evidence, but can’t rule out past events. . .’)

*We agree that the nature of some statements is speculative when considering the available evidence and have thus shortened or removed them (e.g. the Tinguiririca avalanche). However, we think that it is allowed in the discussion section - if properly marked - to add some interpretation that is more speculative in nature. This should not only make clear that we have indeed recognized the geomorphological evidence of a probably larger previous collapse (to give one example), but should also identify open issues and point to interesting further studies. By presenting them here, there is a possibility to link potential future research proposals to such open issues and investigate them further. A pure observational report without reflecting about the lessons learned and open issues (i.e. the more speculative elements) would likely not warrant publication in *The Cryosphere*.*

Most importantly, we have considerably shorten/fully removed most of the speculative ideas that were originally included in the discussion chapter (namely the influence of the fine grained material of the glacier bed, the presence/absence of permafrost conditions below the avalanche deposit and the possibility of previous collapses), trying to stick to the main event (Leñas collapse). As far as the latter is concerned, we have also limited the discussion

regarding the Tinguiririca avalanche due to the even lesser amount of available remote sensing data, removing the corresponding figure as well.

B) Stick to the event described in the methods/study area – In the discussion section the authors (line 240+) describe methods used to study another glacier collapse, but this site really wasn't described except primarily in the introduction of the paper. A reader can't really evaluate the evidence for that event as it now stands since it's only briefly described in the introduction of the paper. I would recommend the paper be revised to either describe both events or simply to refer to the other one in passing (in the present version of the paper the authors start to tell us about their DEM differencing and uncertainties in the discussion section of the paper).

We agree with the referee that the Tinguiririca avalanche was half-heartedly discussed in the study, and that there is even less remote sensing data available (high resolution satellite imagery, DEMs) for this event. Hence, we have removed the Tinguiririca event more or less completely (incl. the figures). It is now only briefly presented in terms of avalanche volume and runout distance.

C) Check co-registration/uncertainty analysis – The authors co-registered their DEMs prior to differencing, but I would request that they check the quality of that coregistration (see artifacts near top of cirque in Figure 2a). It may simply be as good as they can get, but some explanation for this offset over steep terrain would be useful.

In steep terrain it is indeed possible that DEMs have artifacts that are much larger than the real changes. However, they have no impact on the general pattern of the elevation trends observed here. Moreover, the causes and problems of such artefacts have been discussed widely in the literature and we have thus only added a short explanation and some further references.

D) English needs to be improved –The paper includes many statements that are unclear or overly vague. I would suggest that the second and third authors spend some time with the text to improve the English. There are also many topographical errors in the manuscript. These errors really should have been cleaned up prior to submission.

We apologize for these errors (assuming you mean typographical?) and will give the ms a proper English check before re-submitting it. Also, all TC papers undergo language editing by the publisher after acceptance.

3. Figures and Tables Figure 1. Latitude/longitude (even two) needed so one can locate this glacier. Also, please state which bands (spectral range) were used for the color composite.

Figures 2 and 3. I found the order of these figures to be reversed. I would first report on Figure 2 as this shows when the event happened. Figure 3 really is a derivative product of stereo imagery, so DEM make more sense to show after you introduce Figure 2.

Figures 1 and 2 have been reorganized according to another reviewer's suggestion and are now including coordinates. Figures 1 and 2, show the Leñas glacier (February 12, 2007 and April 19 2007) before and after collapse and the DEM differencing-elevation change map. We thought that looking at the glaciers before/after collapse together with the elevation difference map would help the reader to better interpret the event. We have included a latitude/longitude grid in figures 1, and have added to the text the RGB composites used.

4. References I did not check the references for consistency, but this should be done on the revised paper.

Thank you for noting. We have double-checked and added some more reference to the revised manuscript.

5. Title – It's always awkward to start a title (or sentence) with a number. Why not just, 'Sudden collapse of

We agree and have now written: "Collapse of 4 Mm³ ice from a cirque glacier in the Central Andes of Argentina".