

## Review of the article

"The role of thermokarst evolution in debris flow initiation (Huttekarak Rock Glacier, Austrian Alps)"  
by Simon Kainz et al.

This study analyses the possibility of a gravitational event occurring as a result of a cascade of rapid events, namely the rupture of a thermokarst lake, the rupture of a rock glacier front, the development of a debris flow and the blockage of a river impacting the Radurschl valley (Ötztal Alps, Tyrol) on 13 August 2019. The analysis of the overflow risk of an artificial lake created during such events is a topical issue with important societal challenges.

This article proposes an interesting methodology based on multi-criteria analysis that is of interest to the scientific community. It is an interesting article well-argued and can be published in your journal

## From a formal point of view

The bibliographical references are numerous. These citations support the scientific demonstration but sometimes make the reading more difficult. For example, is it necessary to cite references from 1984 to 2010 (see line 231) or between 1990 and 2010 in line 235. It is not a question of ignoring previous work but of finding the right balance between citations.

Also, there are many examples where authors are quoted twice in two consecutive sentences (line 137 and 138 for Glade and Crozier et al., lines 183 and 185 for Patton et al. to name just two examples). Is this necessary? Why not choose the most striking points of the work without wanting to refer to everything that is said in the article. I think the readability would be improved by reworking the citations. But this is a side remark that does not detract from the quality of the work.

## On the content

The article is well constructed, and the argument is well presented.

In the introduction why not mention the study site in the last paragraph?

Line 63 the authors underline the fact that the assessment of the hazard potential of rock glaciers requires an integrated approach combining hydrogeological, meteorological, thermal, geomorphological, and mechanical aspects in a coherent framework. As these aspects are well identified in the introduction, why not go into more detail later? The hydrogeological descriptions are described succinctly from line 104 onwards. What arguments do you have to say that the cirque is drained only by subsurface water? Do you have any idea of the mineralization of the water from your various sources? Is it possible to indicate them on your figure 2 or 3. What arguments do you have for saying that the water flows along distinct channels eroded into the ice core?

Line 105 you refer to a considerable catchment area when the only indication given of the size of the catchment area is 2.8km<sup>2</sup>. Can you provide additional information to clarify this point?

Meteorology part: Line 88 can you clarify what you mean by "moderate annual precipitation"?

Table 1 the legend of your table shows a chronicle of data from 1976 to 2019 which is based on references from 2016 and 2018, there is a problem in your dates

2019 does seem to be a special year from a meteorological point of view, with more snow and precipitation than the previous 4 years. Since 1976, have there been similar rain and snow conditions as those that caused the disaster, i.e. have you analysed all your weather data by year with the same finesse to see if there were similar weather conditions without necessarily reaching the 2019 disaster?

The particle size analysis was done on 8 samples. Is this enough to cover the whole surface?

Discussion part

The discussion is really interesting and poses the problem in the long term, especially the effect of climate change which accelerates the degradation of permafrost and favours the creation of a thermokarst and the possible consequences.

Finally, the authors point out that debris flows are initiated by the destabilisation of rocky glacier fronts and most often occur in response to heavy rainfall. They also state that intense snowmelt or rain-on-snow events and exceptionally warm periods have also been identified as triggering factors. My question is, does climate change mean less snow and less rain? If so, what is the real impact of climate change on the risk? Can the authors elaborate on how they pro climate change: more snowmelt because more heat with less rain? less snow so a lower snowline and fewer glaciers? What is their scenario?

In conclusion, this article sheds important light on the risks involved weather conditions. The proposed retrospective analysis is interesting and deserves to be published in your journal