

Author's response

We would like to thank Martin Mergili for careful reading the manuscript and for his input that helped us to clarify ideas and figures. Below is a point-by-point response to his reviews.

The authors present an interesting study on the characteristics of failed lakes in Patagonia and, on this basis, on the susceptibility of glacial lakes in the Baker Basin, to GLOFs. Most of the manuscript is concise, well-written and well-structured. I can recommend the work for publication after the authors have included some **minor-moderate revisions** specified in detail below.

The authors are welcome to contact me at martin.mergili@boku.ac.at in case they disagree with my comments or if they wish to further discuss the one or the other issue.

General Comments

1. The quality of the figures is generally very good. It might be useful for the reader to have an overview map of the Baker Basin presented early in the paper (a map of the basin is only shown in Fig. 12 where the results are presented). In contrast, Fig. 8 could be omitted – in my opinion, it does not carry a lot of additional information.

-We agree with the referee comment and will incorporate an overview map of the Baker Basin early in the paper (see the figure at the end of this response). We considered also removing the figure 8, however, we think that it has a value as a graphical synthesis of failed moraine-dammed lake settings in Patagonia and we prefer to keep it.

2. Grammar and style need some final polishing, I have addressed some (but probably not all) issues in the specific comments below.

-We modified the paper according to the referee grammar and style suggestions.

Specific comments

4767, 6 and 4772, 21: "Schuster" would be correct instead of "Shuster". [Done](#)

4769, 1: Remove "are". [Done](#)

4769, 4: Better: "... in the southernmost part ...". [Done](#)

4770, 25ff: Were the angles of reach measured in a straight line or along the flow path?.

-Along the flow path, the text now reads as follows " GLOFs angle of reach were measured along the flow path, from..."

4771, 16: On data from how many lakes is the equation based, and could you provide a measure of error/uncertainty?.

-The number of lakes is now incorporated in the text as follows "Thus, we collected data from literature of a large number of moraine dammed lakes worldwide (38 measurements of lake area and volume from 25 lakes; Fig.3)..."

-The error/uncertainty was indicated in the original manuscript in the page number 4771, lines 18, 19 and 20 and reads as follows "We compared the measured volume of 38 data of moraine dammed

lakes with the volume estimated with the derived empirical formula. The mean error of the volume estimates was $\pm 71\%$." Thus, we leave the text as it is.

4772, 10: "... conditioning factors ...".Done

4772, 23: Better: "... larger amounts of water ...".Done

4773, 12: You talk about growing and stable lakes – are there also shrinking lakes observed?.

-Yes, although these lakes have presented just minor area reduction over dozens of years. We added the following sentence to clarify this point: "...remain stable or shrink (examples of minor moraine dammed lake area reduction, not related to GLOFs, have been observed in Patagonia; see figure 5d in Loriaux and Casassa 2013), since the potential area exposed to mass movements or ice avalanches may increase and the dams may be subject to higher hydrostatic pressures."

4775, 18f: "... including very large moraine-dammed lakes ...".Done

4776, 11f: "... that of rock avalanches ...".Done

4776, 20: Probably better: "Lake outlet slope measurement" or "Dam slope measurement".

-We use now "Lake outlet slope measurement".

4776, 23: "... maximum flow accumulation in the lake ...".Done

4777, 4: "... steepest descent ...".Done

4777, 7ff: In my opinion, this procedure needs to be explained more clearly: (i) It should be explained what is the purpose of the pairwise comparison (Table 3) as this is hard to understand for anyone not familiar with this method. (ii) It should be mentioned in the text that in Table 4, the sum of the weights of all factors – i.e., the highest possible score – is 100.

- (i) The following sentence was added to clarify this point (page 4777, line 14). "The aim of the pairwise comparison is to assess the significance of one factor compared to another. Values from 1 to 9 can be assigned to each factor, where a value of 1 means that both factors have equal importance and a value of 9 means that a factor has an extreme prevalence over another.

- (ii) The following sentence was included in the text (page 4777, line 23) "... six factor scores. **The highest possible score is 100.**"

4777, 9: "We chose this method ...".Done

4777, 10 and 17: "... judgements ...". Done

4779, 2: "... with higher peak discharges ...".Done

4779, 15: ... "outburst floods in Patagonia ...".Done

4780, 8: In contrast to ice, rock fall material cannot "cover" the lake's surface – please reformulate.

-We replaced "covered the lake's surface" for "covered the lake's area".

4780, 13: I am not sure whether the term "overtopped" is suitable here.

-The phrase was reformulated as follows “Reconnaissance flights carried out few days after the Río Engaño outburst indicate that the lake was impacted by glacier ice (this might correspond to an ice avalanche or calving) **that probably caused waves** which overtopped the dam and started the lake drainage”.

4781, 10: Please refer to Fig. 5 here. [Done](#)

4781, 22f: Please make clearer that the peak discharge you refer to is a computed (and therefore hypothetical) and not a measured one.

-The text now reads as follows “The computed (hypothetical) peak discharge of GLOFs from...”

4782, 15f: Unless they have completely drained, those 16 lakes “are” located [Done](#)

4783, 12: “... lake level ...”.[Done](#)

4784, 5: Better: “... show quick responses ...”.[Done](#)

4784, 12: In the case of General Carrera Lake, was it really the LIA when it was formed, or was it the ice age?.

-The text now reads as follows “were formed during or before the LIA”.

4784, 21: “analyses”. [Done](#)

4786, 2: “... glacier and lake changes ...”.[Done](#)

4786, 8f: “... faced by Patagonian settlements ...”.[Done](#)

4786, 12: “... stable lakes ...”.[Done](#)

4786, 22: “Our analysis shows ...”.[Done](#)

4786, 24: “... on the lake outburst susceptibility ...”.[Done](#)

4787, 2: Remove “one”. [Done](#)

4787, 16: “... which has to include data ...”.[Done](#)

4791, 21ff: This paper is not cited in the text (at least, I did not find it).

-It was mistakenly omitted in the original manuscript. The reference is mentioned in the text now (4768, line 1). “ Using these method, hazardous lakes can be identified, and subsequently, if they are found to pose a potential risk to lives or infrastructure, more detailed local studies (e.g. GLOF modelling) might be developed (**Mergili and Schneider 2011**) (e.g. Bajracharya et al., 2007; Worni et al., 2012).”

Table 4: Glacier steepness above lake is classified into *Yes* and *No* – why not into classes of slope angles?.

-We replaced *Yes* and *No* for $\geq 25^\circ$ and $< 25^\circ$ respectively.

Fig. 1: In the legends of A and B, the class thresholds are not clear – e.g., an elevation of 250 m is assigned to two classes at the same time - better write: ≤ 250 m, $>250 - 500$ m, $>500 - 1000$ m, etc. Further, please replace “Altitude” by “Elevation”.

We will incorporate the changes suggested by the referee.

Fig. 2: Replace “glacier angle of terminus” with “slope of glacier terminus”; “Verification of outburst factors into the lakes”: “into” seems not the correct word here; “Classification of lake outburst susceptibility”. Into the lakes was replaced by “in the lakes”. The rest of the changes were done according to the referee suggestions.

Fig. 3, line 5 of caption: “... fewer data are available.”. Further, the green line appears strange to me: if it is derived from the black points, it should be much higher up in the right part of the diagram – please clarify.

-The caption was modified according to the referee comment

-We checked the data and the form of the 4 curves and all are correct. However, the end of the green line was marking the last value of the area/volume relationship in the database. It was extended now to show the area/volume relationship from zero to $20 \text{ m}^2 \times 10^6$, as the rest of the curves. Thus, now the green curve is higher up on the right side.

Fig. 6, line 2 of caption: “... (where debris flows often occur) ...”. Done

Fig. 7, caption, first line: “Types of moraine dams ...”. Done

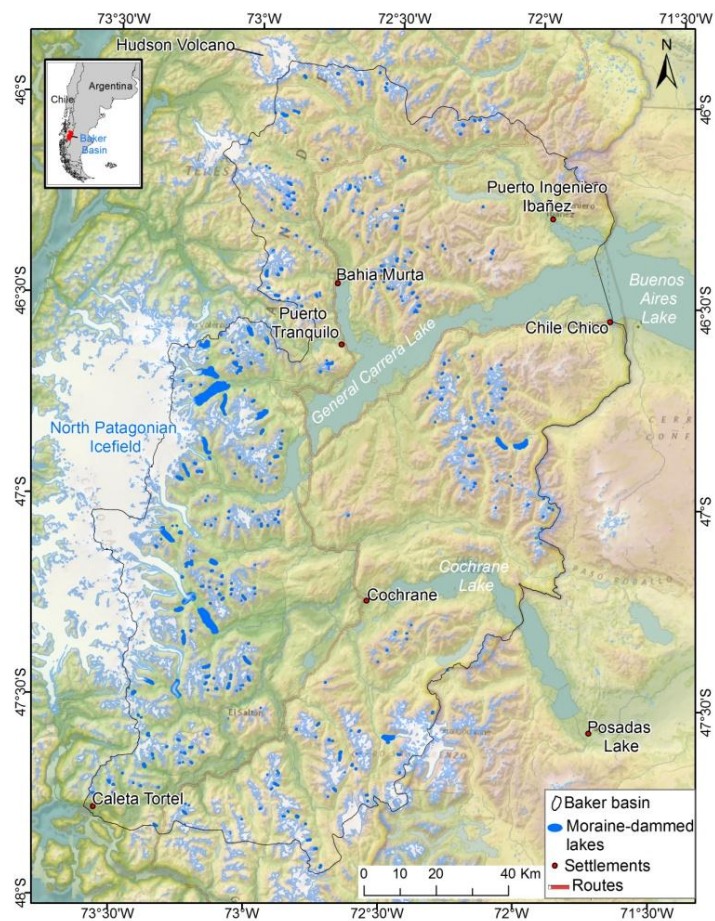


Figure 2. Location of moraine-dammed lakes and settlements in the Baker Basin.