

We would like to thank the reviewers for the additional effort they put into reviewing the manuscript. We have now addressed the edits/comments in the revised version of the manuscript and provided a point-to-point reply below.

Report # 1 by Eleanor Bash

Page 1, line 27: This is a vague term, please be more specific

RESPONSE: Thank you. Values (in %) are now provided. Changes precipitation and rainfall ratio are also presented in % in the Result section [3.1 - 3.4].

Page 1, lines 27-28: Include the time frame for the changes earlier in the abstract

RESPONSE: moved up before two sentences [now in page 1, lines23-24].

Page 1, line 29 [1]: Assigning causal relation is hard, I suggest using a different wording.

RESPONSE: 'caused' is reworded to 'influenced'.

Page 1, line 29 [2]: This is only true in one basin, be specific.

RESPONSE: It is now specified Peyto Glacier basin.

Page 2, line 2: Perhaps you mean glacier runoff? Or mountain streamflow affects these things in prairies downstream? Streamflow is the quantity and seasonal variation.

RESPONSE: We meant mountain streamflow and that is the correct use here. Its meaning is clear. We have edited the sentence for more clarity.

Page 2, lines 6-11: These three sentences should link to each other better, they read like unrelated statements.

RESPONSE: The connecting word 'similarly' has been added to link them. The second sentence has been rephrased accordingly.

Page 2, line 31: This sentence is not adding anything to the paragraph.

RESPONSE: The sentence is removed.

Page 2, lines 35-36: Not sure what you are trying to say here, please rephrase.

RESPONSE: The word "can" has been eliminated for clarity. It now reads "and sometimes changes in hydrological processes can have compensating effects on streamflow generation"

Page 4, line 8: comma should go after respectively, not before.

RESPONSE: Edited.

Page 4, lines 14-15: An uncalibrated model usually means the parameters are not tuned to local observations. What do you mean by "selected primarily from"?

RESPONSE: In hydrology uncalibrated means not tuned to streamflow prediction. Text has been edited and an example has been added for clarity. "(e.g., temperature and precipitation lapse rates)".

Page 4, line 20: You give actual dates below, better to include those here than this more vague description.

RESPONSE: These are replaced by: “past” corresponding to 1966 (PGRB) and 1983-1984 (AGRB) and “present” to 2014 (PGRB) and 2011-2014 (AGRB).

Page 4, line 25: What do you mean here?

RESPONSE: replaced this by 'from available DEM'.

Page 4, lines 31-39: suggest splitting this into two paragraphs for each basin and describe the data with equal detail for each.

RESPONSE: This paragraph has been split into two paragraphs, one for each basin. Dates of satellite images are specified. Details are also added for AGRB.

Page 5, lines 1-5: The description of these scenarios is much improved over the previous version, make sure to rely on these throughout the text rather than referring to past-present descriptions which get confusing for the reader.

RESPONSE: Thank you. They are now consistently used in Section 3, Results.

Page 5, lines 22-23: The function is not necessary if the language and associated package are named.

RESPONSE: Thank you. They are now removed.

Page 5, line 34: Better to move this to the end of the sentence.

RESPONSE: Edited. The sentence now reads as: Annual and seasonal average temperatures generally increased in the present decade compared to the past except for the summer maximum at AGRB.

Page 6, line 4: If this is the amount of increase, move to the end of the sentence.

RESPONSE: Edited. Changes in % are also added.

Page 6, line 11 [1]: How do you define this?

RESPONSE: The definition (rainfall divided by the total precipitation) has been added.

Page 6, line 11 [2]: Related to the previous comment, use the labels you defined here A-D or C1.

RESPONSE: Edited. They are now explicitly defined using the model comparison scenario (C1). Table ST5 now includes rainfall ratios for the five comparisons (C1-C5). They are now cited in the following sentences in the paragraph in line with comparisons of the other variables.

Page 6, lines 13-14: Are these changes significant?

RESPONSE: Yes, for the comparison C1 (both basins), C3 & C4 (AGRB). They are now mentioned and included with statistical tests (Table ST5), and therefore, Table 2 has been removed to avoid duplication.

Page 6, line 40: Isn't the negative annual balance a result of both decreased accum and increased melt?

RESPONSE: There was a significant increase of icemelt from 265mm to 667mm. Though statistically insignificant, snowfall decreased from 1135mm to 919mm and both firnmelt and snowmelt decreased. The three sentences (lines 1 - 3, page 7) explained that the fixed climate (C2 and C5 to see the impact of glacier change) and the fixed glacier (C3 and C4 to see the impact of changing climate) compressions show that changes in climate (with past and present glaciers) have caused more negative mass balance than changing glacier configuration. This is due to both decreased accumulation and increased ice melt.

Page 7, lines 4-5: This is misleading I think, presumably the past configuration has more snow accumulation on the glacier because it is larger?

RESPONSE: Winter snow accumulations were greater in the past glacier configurations than in the present glacier configurations for both present and past climates. These could be due to glaciers' elevation (higher in the past) and area which was larger in the pasts. These values (snow accumulation) are presented in depths (mm) per basin area.

Page 7, line 11: You've already stated the significance level you use in the methods it is not necessary here.

RESPONSE: Thank you, it is now removed. The significance level has been removed also in the line 15, page 7 with edited text.

Page 7, line 16: Why is this the case?

RESPONSE: The rainfall ratio and snow melt were smaller in the past glacier configuration compared to the present glacier. The present climate increased icemelt, whereas the present glacier configuration decreased icemelt due to reduced glacier size in the AGRB.

Page 8, line 1: You haven't mentioned this previously

RESPONSE: Change in glacier surface slope was mentioned in line 29, page 6 (Section 3.2) as "..., and glacier surface have become steeper from the past to present...". This is now supplemented with values of change in glacier surface slopes.

Page 8, lines 4-5: This seems out of place in this paragraph.

RESPONSE: Moved to the next paragraph, where changes in climate (air temperature and precipitation) have been discussed.

Page 8, lines 17-28: This paragraph belongs in results.

RESPONSE: This paragraph has been moved to section 3.4.

Page 9, line 9: I'd love to see one more paragraph here discussing the new insights from this unique modeling approach. You provide so many detailed values in the different scenarios, try to summarize these to lead the reader to the implications more clearly.

RESPONSE: One paragraph has been added here to explain the use of the modeling approach to segregate the impacts of climate and glacier configurations on glacier hydrology.

Page 9, line 20: You looked at climate changes and glacier changes, not really snow itself

RESPONSE: Edited.

Page 9, line 25: Wasn't this ratio change also due to decreased snow pack as a result of smaller glacier area?

RESPONSE: Here the rainfall ratio refers to rainfall divided by total precipitation. It is defined in the line 12, page 6. Rainfall ratio refers only to change in precipitation phase, and this is only influenced by climate, not snowpack.

Page 9, line 28: You haven't described observations of mass balance.

RESPONSE: 'observations' has been replaced by 'studies' to reflect the literature review in section 2.1.

Page 9, lines 32-33: This is restating what you have already said.

RESPONSE: This sentence has been removed.

Page 9, line 40: In which scenario?

RESPONSE: C1, from past climate and glacier to present climate and glacier. The text has now been edited.

Page 10, line 2: This is a leap, since you have only looked at two snapshots in time.

RESPONSE: The sentence has been revised as: ".. streamflow from the glaciers increased in the present climate...".

Figure 1: You mention two stations at each basin, include both here.

RESPONSE: They are very close and showing ice stations within the small basins (in the present scale of the map) will not be possible to show discernably at this scale. And we have used only the moraine stations data for this study to bias correct reanalysis data (ERA-Interim). The locations of ice stations are shown in the model paper:

Pradhananga D, Pomeroy JW. 2022. Diagnosing changes in glacier hydrology from physical principles using a hydrological model with snow redistribution, sublimation, firnification and energy balance ablation algorithms. *Journal of Hydrology* 608 (127545) DOI: <https://doi.org/10.1016/j.jhydrol.2022.127545>.

Figure 7: Use the same colors as Fig 6 to represent the scenarios.

RESPONSE: Thank you. Fig 6 has been updated accordingly. Now red has been used for past climate - past glacier and purple has been used for present climate - present glacier.

Report # 2 by Anonymous referee #1

The authors have improved this paper in revision. I only have a few more corrections to point out.

[RESPONSE: Thank you for the corrections. We have addressed them.](#)

page 2, line 35

“and sometimes changes”

[RESPONSE: Edited.](#)

page 3, lines 22-23

“These ERA global reanalyses”

[RESPONSE: Edited.](#)

page3, lines 28-34

I still find this description of the bias correction confusing. It sound like the same thing is done for both glaciers, so why is it described twice? Here is what I understand it to be:

biases in ERA-Interim are identified by comparison with observations (2013-2018 or 2014-2018)

biases in ERA-40 are identified by comparison with bias-corrected ERA-Interim (1979-2002)

bias-corrected ERA-40 is used for Past Climate (1965-1975)

bias-corrected ERA-Interim is used for Present Climate (2008-2018)

[RESPONSE: Thank you for your clarification and re-phrasing them. These have helped us to improve the text one more time.](#)

[For PGRB, biases in both ERA-Interim and ERA-40 were identified by comparison with observations 2013-2018 and 1992-2001 at Peyto Main Station. For AGRB, biases for ERA-Interim were identified by comparison with observation 2014-2018 at Athabasca Moraine Station. Only for AGRB, biases in ERA-40 were identified by comparison with bias-corrected ERA-Interim \(1979-2002\). The text is now revised for clarity on these approaches.](#)

page 5, line 29

The analysis is described as being over PGRB and AGRB, but is it actually over the glaciated areas of the basins? Comparison using C1 makes no sense otherwise.

[RESPONSE: Thank you. Yes, both glacierized and glaciated areas of the basins were considered.](#)

page 8, line 2

“albedo feedback of glacier surfaces”

[RESPONSE: Edited](#)

page 8, line 3

Previously stated that Athabasca Glacier mean elevation has increased.

[RESPONSE: Edited](#)

page 9, line 5

“decrease thereafter”

[RESPONSE: Edited](#)

Figure 1 caption

The station symbols are pentagons, not circles.

RESPONSE: Edited

Figure 2

Titles AGRB and PGRB at the tops of the columns would make this figure a little easier to read at a glance.

RESPONSE: Added the titles at the tops of the columns