

Dear editor Hongkai Gao, Dear reviewers

We thank you again for the constructive and careful reviews. We have modified the manuscript according to the reviewers' requests and provide detailed answers to their issues below. Here, we summarize the most important changes:

- Added two figures (Figs. 3, 11) containing field photos of the measurement stake (as requested by referee #3)
- We made minor changes to the conclusions (as requested by referee #3) to increase the clarity of the message.

We hope that we could satisfactorily address the remaining issues.

Kind regards

Dominik Amschwand on behalf of all co-authors

In the following, we would like to reply to their comments from Anonymous referee #3 in detail (reviewer comment in blue, >our response in black):

General comments:

The manuscript “Seasonal ice storage changes and meltwater generation at Murtèl rock glacier (Engadine, eastern Swiss Alps): Estimates from measurements and energy budgets in the coarse blocky active layer” by Amschwand et al. presents a complete hydro-meteorological dataset to investigate the processes of the rock glacier store-release at Swiss Alps. Based on below-ground energy-flux measurements, ground-ice melt and hydrological measurements, the authors conclude that the rock glacier plays a crucial role in buffering seasonal runoff through active layer ice melt and thermal buffering. The active layer acts as a buffer, refreezing snowmelt in the winter and slowly releasing meltwater throughout the thaw season, which helps maintain baseflow. The findings highlight the importance of rock glaciers in regulating water flow. My major concerns are as follows:

1. Some key details are missing, especially the ablation measurements of the ground ice. Since the evolution of the ground-ice is an important part of this study, how to observe it determines whether the conclusions of the paper are reliable. It would be beneficial to provide supporting photos. >Yes, we agree and added two figures containing photos of the measurement stake.
2. Two or three years of observation is relatively short and should not be considered as long-term changes. The term 'long-term' is mentioned only twice in the entire paper. The first time is in the introduction of the article's research content, and the second time is in the conclusion. >Yes, we agree and deleted 'long-term'.
3. In this study, the focus seems to be on measuring direct runoff during summer. Is there surface runoff in the watershed in spring? Is some of the winter precipitation melting in the spring and forming runoff? >Yes, field observations and the discharge measurement show that there is surface runoff of snowmelt. We added the underlined part to the sentence in the conclusion to clarify that not all snowmelt is converted to ground ice: “A substantial part of the snowmelt is rapidly fixed as AL ice in winter--spring, but slowly released during the thaw season...”

Specific Comments:

Line 19: This expression (a few%) looks weird to me. >We have spelled out the “%” sign in words.

Line 43: cf. >We have deleted the cf and the unnecessary reference.

Line 47-49: Additional references needed. >We have added references.

Line 116: There is no need to cite this article here. >Yes, we have deleted it.

Line 124: the permafrost-groundwater connectivity. As far as I understand, the whole article is about the relationship between permafrost and surface runoff. > Yes indeed, and we also put forward the hypothesis that rock glaciers contribute to groundwater recharge. We extended the sentence (additions underlined): “This case study contributes to the question of the hydrological significance of rock glaciers by presenting a complete hydro-meteorological data set at the well-studied Murtèl rock glacier, investigates how the permafrost affects the surface runoff pattern, and explores implications for the permafrost-groundwater connectivity.”

Line 184: What does the question mark here mean? >We replaced “intra-permafrost?” by “likely intra-permafrost”.

Line 195-Line 199: Please give the full forms of these abbreviations >We spelled out “Swiss Permafrost Monitoring Network” (PERMOS). PERMA-XT is the project name.

Section 3.4.1: Adding a photo or two from the observations would make this more convincing.

>Yes, we have added photographs.

Figure 7: A small rainfall in August 2022 produced a large runoff, exceeding the runoff of many large rainfalls in 2021 (even > 25mm), and an explanation should be added. >The reason for the “excess” streamflow at relatively low rainfall is that this discharge compounded with discharge of previous rainfalls. We added an explanation to the figure caption: “Note that discharge is in cases compounded with discharge from previous rainfalls, introducing some scatter in the rainfall-streamflow relation”.

Line 675: old permafrost ice on long-term (over millennia). This is not the result of this article's research. It may have melted in decades of years. >Yes, we agree. We deleted the sentences because this is already explained in the introduction: “~~Rock glaciers store and release water and ice on different time scales with varying magnitudes and residence times: (1) Liquid water on short-term (sub-monthly) scale, (2) ground ice in the coarse-blocky AL on intermediate term (seasonal), and (3) old permafrost ice on long-term (over millennia).~~ We quantify supra-permafrost ice storage changes...”.