

Review: *High-resolution mapping of glacial lake expansion in Kyrgyzstan (2016–2024) using Sentinel-2 imagery*
(Manuscript ID: egosphere-2026-1442)

We sincerely thank both reviewers for their careful evaluation of our manuscript and for their constructive comments, which have helped us identify several aspects that would benefit from further clarification and improvement. In response to the comments received, we propose several modifications intended to strengthen the manuscript. The principal planned revisions include:

- Clarification of the inventory scope, terminology, and the use of the 3000 m elevation threshold to delineate high-mountain glacierized and recently deglaciated environments;
- Revision of statements implying direct glacier retreat–lake evolution relationships that were not explicitly evaluated in this study, including the moderation or removal of several causal interpretations in the Abstract, Discussion, and Conclusions;
- Revision of the definition of glacier-detached lakes to better distinguish physical glacier contact from potential hydrological connectivity;
- Addition of supplementary glacier-related contextual information and references, including glacier coverage statistics, glacier–lake distance metrics, and a glacier distribution map derived from RGI v7.0;
- Clarification and restructuring of several methodological aspects, including the distinction between the inventories used throughout the workflow and the introduction of a summary table;
- Clarification of several methodological and statistical aspects, together with revisions to selected figures, captions, and associated discussions to improve readability and facilitate interpretation of the results;
- Addition of references and supporting literature where further context or justification was requested by the reviewers;
- Consideration of a slight revision of the manuscript title to better reflect the inventory-based nature of the study and avoid overstating glacier–lake process relationships.

Detailed responses to each comment are provided below. For clarity, all proposed modifications to the manuscript text are shown in italics.

On behalf of the co-authors,
Valentine Piroton

Referees' Comments to Author:

Reviewing 1

L6 Abstract. I don't disagree that lakes are sensitive indicators of glacier change, but glaciers themselves are sensitive indicators of glacier change. You don't need to look at the lakes necessarily. And also, glacial lakes are not important for hydrological and hazard assessments – they are important considerations or to be considered. This first line needs to say something useful and meaningful and I don't think it's quite there yet.

We appreciate this comment and agree that the opening sentence could be formulated more precisely. Our intention was to emphasize the importance of glacial lakes as components of rapidly changing high-mountain environments rather than to imply that they are the primary indicators of glacier change.

Abstract: The opening sentence will be reformulated as follows: *“Glacial lakes are dynamic components of glacierized mountain environments, and their distribution and evolution provide valuable information for hydrological and hazard-related studies.”*

L11-12. Where it starts “mostly small” feels like it should be worked into a separate sentence or after a semi-colon. Extra words needed – something like, “Most of these lakes are relatively small...”

Abstract: As requested, the sentence will be reformulated as follows: *“The 2024 inventory includes 2 592 lakes covering 77.6 km². Most of these lakes are relatively small (<0.05 km²) and are located between 3 500 and 3 800 m elevation.”*

L35-36. The statistics here on the number of glacial lakes in Kyrgyzstan and their susceptibility to GLOFs is based on a paper from 2010 (so the actual date likely earlier than that). So these stats are at least 16 years old, and yet you use the present tense (“are”) when discussing them. Would it not be better for you to make that clearer.

The reviewer raises a valid point regarding the temporal context of these estimates.

Sect. 1: The sentence will be revised as follows: *“According to Janský et al. (2010), more than 80 % of Kyrgyzstan is mountainous, hosting over 2 000 glacial lakes, at least 300 of which were considered at risk of outburst.”*

Figure 1- I see the urban areas feature in the legend, but can't see any on the actual map and the colour is too similar anyway to the low elevation shading. Seems to me that red dots were used to mark urban areas anyway.

The reviewer is correct that the urban areas are shown as red dots on the map, whereas the legend currently displays a pale-yellow polygon symbol.

Fig. 1: *The legend will be revised accordingly by replacing the current “Urban areas” symbol with a red point symbol consistent with the map representation.*

L95-98 – it would be good to see some citations to back up the claims about changing snow cover, GLOFs, landslides, etc.

We agree that these statements would benefit from additional supporting references. Relevant literature on changing snow cover, glacier retreat, glacial lake development, and associated slope hazards in Central Asia will be incorporated. In addition, the wording will be slightly

revised to better reflect the complexity of the relationships between glacier change, glacial lake development, and associated hazards.

Sect. 2: *“Seasonal snow and glacier melt is the primary water source for rivers and lakes, making the region highly sensitive to climatic changes (Shahgedanova et al., 2020). Rising temperatures and declining snow cover in recent decades have accelerated glacial melt, contributing to glacial lake expansion and increasing exposure to GLOF hazards (Narama et al., 2009; Sorg et al., 2012; Akzharkynova et al., 2026). The steep and rugged terrain further shapes local microclimates and contributes to hazards such as landslides, avalanches, and rockfalls, particularly in areas experiencing active glacial retreat (Bolch et al., 2011; Huggel et al., 2012).”*

L102 – again, would be good to see a citation to substantiate this point about rural livelihoods. Additional supporting references will be incorporated to substantiate the relationship between meltwater availability, rural livelihoods, and agricultural activities in Kyrgyzstan.

Sect. 2: *“Rural livelihoods and national agriculture depend heavily on meltwater availability (Sorg et al., 2012; Shahgedanova et al., 2020), making the stability of glaciers and glacial lakes a central concern for both environmental and socio-economic resilience.”*

Fig 10 – I didn’t really understand the legend in part b “Area change to 2016 (%)”. Should this be since 2016?

Thank you for identifying this mistake.

Fig. 10: The legend label will be changed from “Area change to 2016 (%)” to “Area change since 2016 (%)”.

We thank the reviewer again for these constructive comments, which will help improve the clarity and precision of the manuscript.