

**Review of ‘Spatio-temporal evolution of glacial lakes in the Tibetan Plateau over the past 30 years’
by Dou and co-authors, 2022**

The study by Dou and co-authors presents a new dataset of glacial lakes across all of High Mountain Asia (HMA) for three different study periods (1990-2019), mapped using Landsat 5 and Landsat 8 data in Google Earth Engine. The study highlights a general increase of glacial lake number and area, except for the most Western ranges of HMA.

This is a topical line of research, which tackles a very relevant question for the monitoring of hazards related to growing glacial lakes. However, I have a number of (very) major comments related to the soundness of the methods and results analysis, as well as to the novelty and relevance of the findings, that would need to be addressed for further consideration of this work.

I have also included a number of minor comments that can hopefully help the authors in revising their manuscript. These are however far from complete given the considerable revisions needed.

Major comments

Introduction: I do not find the discussion about the minimum lake threshold to be of much relevance in the introduction. The corresponding paragraph could be shortened considerably. Especially as the minimum size is not the only parameter that needs to be considered for the mapping – a (much) more important one would be the NDWI threshold (McFeeters et al., 1998), or even simply the method used for the mapping. The minimum lake threshold will indeed depend on the resolution of the images considered and is a basic threshold to post-process the mapping.

Study focus: The main aim of this study seems to have been the production of this glacial lake dataset for 3 distinct time periods. As such, the manuscript currently reads like a ‘data’ paper, with no clear research question or objective (the methods themselves as I understand from their limited descriptions, are also fairly basic). It is mentioned that there are some ‘problems’ related to lakes but it is unclear what these are and what this study does to address them.

Methods: The methods are very vague, preventing any assessment of their soundness. For example:

- There is only one sentence about the validation of the mapping with NDWI/MNDWI, with no quantitative information.
- The threshold selection is very obscure.
- Another critical aspect would be to specify how the aggregation was made for each period. Indeed, some lakes (the supraglacial ones especially) vary considerably in time (even seasonally). It is not clear how this is accounted for.

Discussion:

The discussion consists of a comparison of the dataset with other studies and considerations on the uncertainties. Interpretations (backed up with a sound statistical analysis) of the actual evolution patterns are clearly missing, and the added-value from this new inventory is not even mentioned.

Figures: In general not very informative and a few of them of poor quality.

Minor comments

Title & Abstract

L10: I do not think that the 'Tibetan Plateau' is the correct terminology here. This study spans most mountain ranges of High Mountain Asia (except the Tien Shan and the Altai), including the Tibetan Plateau, which is here referred to as 'Tibetan Interior Mountains' (Fig. 1). In the current scientific consensus, the terminology in the Title and in all following text should therefore be 'High Mountain Asia (HMA)'.

L16: It would be useful to also indicate the relative values

Introduction

L29: references missing to support this statement.

L31: The term 'glacial lake' should be explicitly defined in the introduction.

L36: revise 'great important'

L40-43: references missing

L41-42: 'of computers' not necessary (repetition)

L55-60: A key missing reference here would be the work by Shugar et al., 2020

L57: Also Linear Spectral Unmixing (Kneib et al., 2020; Racoviteanu et al., 2021)

L79-80: last part of the sentence could be removed (self-explanatory)

Study area

L89-95: These are common facts, not particularly relevant for this study. Here it would on the contrary be useful to mention which area this study covers.

L96-100: So what? How is this related to this particular study?

L101-106: Here again, the link with the topic of the study is missing, and the text is very vague – it would need to be complemented with actual values.

Data and methods

L121: what do you mean by 'mainly'? Which images were used other than L5 TM and L8 OLI?

L124: In my experience a lot of ponds/lakes are already frozen in many regions of HMA in October/November. Can this be accounted for in the uncertainty estimation?

L124-125: I don't understand what you want to say here?

L132: what are the actual values? Here the authors are just mentioning a range?

L134: How was this used to remove shadows?

L140: In all the methods there is an approximation made between glacier and glacier terminus. It would be useful to better explain when either are used, and how the glacier terminus is defined. Here for example, it is not clear why the glacier terminus is used instead of the whole glacier outlines.

L144: glacier terminus or glacier?

L146: specify RGI version used – it would make sense to use different versions depending on the period considered.

L151: what is meant by 'updated time'?

L157: this is very vague – how many regions were selected, how large were they? A quantitative evaluation of this comparison would be required here, as well as for the choice of glacier outlines.

L160: The spatial and spectral properties of the 2 different sensors need to be actually compared (perhaps in a table?). Which products are used? Were they atmospherically corrected?

L161: English needs to be corrected.

L164: Is this implying that the threshold was chosen manually for every single of the ~43000 Landsat scenes? I find it hard to believe. How extensive are these checks.

L167: Either missing reference or missing explanation about these ‘multiple attempts in different regions of TP’

L173-175: How is the ‘front of the glacier’ actually defined? What are the parameters used for the classification?

L176-177: How do you deal with the large interannual/seasonal variability (e.g. Miles et al., 2017) of these lakes? What does the value for each study period correspond to?

L179: This statement does not appear to be based on any scientific fact (the references mentioned do not refer to the Tibetan Plateau). Furthermore, how were these lakes differentiated from the proglacial lakes in this study?

L190: References? How many interpreters worked on this?

L196: based on the formula Aer is not proportional to the sensor resolution.

Results

L202: How were the lake extents aggregated from these 40000+ images?

L205: there should be the same number of significant digits for the mean and STD

L208: Why the shape? Where does it appear in Eq. 2?

L210: already stated in the methods.

L216: Are the lake acronyms really necessary? I feel that giving the names would simplify the text.

L216: What about the other types?

L219-220: what is the difference between an apparent and sharp increase? Actual values would be welcome here. Also for what follows.

L224: I had understood that these lakes had been removed? If yes, then they should not be considered in the results?

L225: This part belongs to the discussion. I anyways do not see how the authors get to this conclusion. A more thorough demonstration would be highly welcome.

L228: Missing reference to figure.

L231: Maybe the relative changes are, but one cannot see anything in figure 7.

L241: Administrative?

L244: significant digits.

L245: How is this significant?

L246: Move to discussion.

L248: Can you give actual values?

L251: left -> west

L263-264: Discussion.

Discussion

L281-282: This should be in the methods. More details about this aggregation would be welcome.

L286: check English.

L291: If the geographical extents of the different inventories are not the same, how did you account for this?

L295: remove 'but'

L300: This is not a 'proof'. These examples could be biased?

L302: English - examining.

L305: Vague. What 'other inventories'?

L308-309: Does aggregating over a full 10-year period really improve the mapping? Is there not on the contrary a risk to remove all the interannual variability?

L310: these time periods are actually really similar.

L314: It could make sense to make a comparison with the Shugar et al. (2020) dataset here.

L320: There is a correlation, but also a clear overestimation...

L322: Quite subjective statement. If the datasets are so consistent, what is the added-value of this new dataset?

Figures

Figure 1:

Why do the glacier lakes appear so big, covering entire mountains? Have they been buffered? I do not think it is the best way to represent them.

What is the source of the glacier outlines?

L109: Mention actual reference (Bolch et al., 2012)

L110: Mention resolution of basemap

Figure 3:

Missing scale, coordinates, lake and glacier outlines. In (b) the snow makes it hard to see anything. Why Google Earth instead of Landsat? This is not consistent with the study.

Figure 4:

(a) Should be in log scale. Ylabel of (b) is wrong.

Figure 5:

What about the other lake categories? Do (b) and (c) show all the lakes or only one category? This representation is likely biased by the hypsometry of the regions, it would be good to account for it one way or the other. It would also be interesting to compare the different regions.

Figure 6:

Missing region name, scale, lake and glacier outlines.

Figure 7:

I can't see anything for the IMLs and SGLs. What is the scale? It would be interesting to show the evolution here.

Figure 8:

Where does this rate come from? A linear trend? Would be good to show the actual values in each region. The term 'mountain-wide' does not make sense.

Figure 9:

Check English in the caption. I am somewhat skeptical about the relatively low area of supraglacial lakes, can you comment on this in your discussion?

Figure 10:

As for figure 8 the color scale is so large that it is hard to get a sense of the actual values. Suggest bounding it to 100%. As for figure 8, how is the rate of change calculated? Is the middle period not taken into account? What is the background? And the background outlines? Source?

Table 2:

Are the spatial extents of each dataset accounted for?

Figure 11:

'Correlationship' is not English.