

Interactive comment on “Distribution and recent variations of supraglacial lakes on dendritic-type glaciers in the Khan Tengri-Tomur Mountains, Central Asia” by Q. Liu et al.

Anonymous Referee #1

Received and published: 9 December 2013

This paper by Liu and others presents an inventory of supraglacial lakes on glaciers of the Tian Shan region over a 21 year period, extracted from nine landsat images. Special focus is given to those on two glaciers, Tomur Glacier and South Inylcheck Glacier. Lake occurrence and area is compared with elevation and debris cover. While I genuinely found it an interesting read I have some issues with the manuscript which I shall detail below, first with general observations about the work, and then with line-by-line comments.

General comments.

1) I found the paper very long considering the amount of results included. This was true

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of both the introduction (long) and the discussion which contained considerable review of the literature without it being related back to the work of this paper. Several figures were also extraneous. I feel the length of the paper should be substantially reduced to bring it into line with the magnitude of the original work presented.

2) I have concerns over the temporal aliasing of the observations. The total lake area on a glacier and in a region will vary considerably throughout a year. By taking only one observation in a year the authors do not know whether they have chosen the peak of the lake extent (the date of which will vary substantially interannually). As a result interannual comparisons are meaningless as we cannot tell if the authors are comparing maximum extent with another maximum extent or some middle ground. The same problem occurs when taking the mean of several years for investigating the role of elevation in lake area, we don't know if the mean is taken from the annual maximum lake extent.

Data is scarce due to cloud and snow cover, but I'm confident that more data exists than is presented here (I've had a quick look in the Landsat archive), perhaps other sensors should be considered (ASTER etc). If the data doesn't exist then I don't feel these internannual comparisons can be supported, and without them there is little data left in this paper. We already know from the literature to expect a relationship between slope and lake size/occurrence, and that these glaciers are steeper in their upper sections.

3) The variability in the data presented is not fully explored. Selecting only two glaciers for much of the analysis doesn't help with this. Much of the interannual variability in the KTTM lake extent isn't explained by that from the two glaciers the authors focus on. Likewise the lake area anomaly in 2010 on Tomur Glacier is not explained.

4) I am a bit worried about the methodology for lake detection. It would seem from Fig. 4. that large area of false positives needed manually deleting, and I would encourage experimenting with an alternative method, or if this has been done some indication of the relative performance.

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Line by line comments

P4546

L12 “lake predominantly occurred”

P4547

L12 “act as a porous-medium”

The whole of the study area section to me seems unnecessarily long.

P4550

L3 Very wordy. Try “There are 1375 glaciers in this region”

Methods section: Do you have a measure of how initially successful the classification was? What percentage of the output of the feature extraction module proved to be false positives?

Did you compare the feature extraction module results with those from a more commonly used water detection method such as ratioing Landsat bands 1 and 3? If so what were the results?

P4552

L25 While I have no reason to doubt this 17% cover figure, it really doesn't look like this on Figure 3, in fact it looks far higher. If this percentage is correct then I think some effort is needed to make Fig 3 clearer. Are all the black lines glacier outlines? If so they look generous. How are the upper limits of the glacier defined? Perhaps shading clean ice and snow in different colours would help.

P4552

L15 The Merzbacher lake is described in your introduction, no need to replicate this information. The section also makes it sound like the Merzbacher lake is supraglacial. Is it? I understood it was proglacial.

C2138

TCD

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L18 from “Total area” to “...respectively” would maybe be better placed on L5 associated with the sentence “since we observed the majority of supraglacial lakes...”

L25 It would be useful to see the range or variance associated with these means so the reader can assess if the use of interannual means is appropriate.

P4554

L5-8 I found this very hard to read, could it be re-written?

L14 With one → within one

L14-15 “The images...early autumn.” This whole sentence makes no sense to me, sorry.

L16 the table 3 → table 3

L25-27 Is the trend from 2005-2011 statistically significant? If I look at the rising trend from 2006-2011 I can draw a horizontal, or even slightly negative line through the error bars!

P4555

L6 closed → close

L5-8 This sentence needs some tidying up to clarify that both glaciers had the same value, and the larger region had a different one.

L12 Perhaps a new paragraph at “During the 9 year...”

L20 onwards: This paragraph starts with a statement about year-by-year variations, this paragraph includes very little discussion of interannual variation. The last two sentences are the exception which I think needs some work. To my eye, Fig 7 shows that small lakes are just as important. I think this statement needs to be proven statistically. At least show us the trend with the large lakes removed.

P4557

L3 remove “it’s”

L14 Naturally → natural

L15 → P4558/L13 I don’t really see how this is relevant to this paper. It reads more like a literature review and would be more appropriate in the (already rather long) introduction. In fact some of the material overlaps with that of the introduction.

P4558

L22 lake’s → lakes’

P4560

L14 How are these lakes draining? I’m unconvinced that the change in the subglacial system is triggering drainage. If the lakes are draining through hydrofracture then access to the bed is the restriction, not the state of the basal hydrology. We know from the velocity response of ice from lake drainage that lakes can drain into subglacial systems that are not efficient enough to discharge such a large volume of water at low pressure.

Figures.

Fig. 1. I think this figure is useful and appropriate.

Fig. 2. I don’t really think this adds anything to the manuscript, I suggest removal.

Fig. 3. I liked this figure, though please see my earlier comments about making the glacier area more obvious.

Fig. 4. Useful, but made me concerned about the classification method.

Fig. 5. I really like figure 5, I’d like to see the scale on the y axes use more conventional elevation divisions (5000,5500,6000 etc for example).

Fig. 6. I don’t like the apparently continuous x axis, when in fact there is a large break in the timeline. I think this needs to be made more obvious.

C2140

TCD

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Figures 8, 11, and 12. These are very pretty, but I don't think they're important or useful for this paper.

Fig. 9. I think this is a nice figure, but with figures 3 and 10 it is a bit superfluous.

Interactive comment on The Cryosphere Discuss., 7, 4545, 2013.

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