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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 #2

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The manuscript presents an inventory of supraglacial lakes in the Khan Tengri-Tomur Tianshan Mountains, with particular focus on 2 glaciers; Toumar Glacier and South Inylcheck Glacier. The work is based on a series of 9 Landsat images acquired over a 21 year period, 1990 – 2011. Analysis includes lake area in relation to slope gradient, elevation and debris cover extent. The manuscript addresses a current and relevant topic, adding significant information to a relatively sparely investigated geographical area. The results are interesting but there are a number of issues.

General comments

The paper is long and contains too much background information for the data pre-

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sented. The background should focus on supraglacial lake development on debris-covered glaciers; analogies to lake development on the Greenland Ice Sheet are not relevant or helpful in introducing this work. There is also a lot of background information the discussion section which is not related to the results of this manuscript.

The time series of imagery used is discontinuous, making regular multi-annual comparisons problematic; this is largely glossed over in the results and discussion. There are many factors influencing the development of surpraglacial lakes and, as the authors seem to find, 9 images may be too few to investigate any temporal pattern in development over a large area. I am also a little unsure of the lake classification technique; figure 4 seems to suggest significant 'visual modification' was needed. There is no real discussion of the performance of the method or explanation as to why it was chosen. Were a number of approaches assessed (e.g. NDWI)?

My main concern with the manuscript is the comparison of lake area with short-term climatic variation; they serve little purpose in explaining any of the variability in lake area. Lakes are more common during periods of downwasting, associated with a warming climate but it is often argued that they are a result of a longer term climatic signal. It is well documented that supraglacial lakes form and develop in relation to many interconnected and complex processes and while the local climatic conditions may induce some variation, the effect is likely to be over ridden by larger scale expansion and drainage. For example, the transition of a lake from melting to calving processes could significantly increase the area in a single season. In addition, supraglacial lakes are ephemeral and may only persist if they are underlain by un-fractured ice. As expansion occurs and the perimeter intercepts a structural weakness, the lake will rapidly drain. A more useful approach may be to investigate the life cycle of some of the lakes; do lakes persist? Of the area change what % is due to the expansion or shrinkage of existing lakes and what % is the formation of new lakes or complete drainage of existing lakes? Do previously drained lakes re-fill? I am aware that some of the questions may be hampered by the discontinuous time series but I feel more analysis could be carried

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out.

Page/line comments

P 4546 Ln 12 remove ‘are’.

P 4547 The first paragraph of the introduction (l 1-26) is very general and could be removed.

P 4548 L 6-8 not relevant to this work. L 20-21 could this be re-worded. L 22-25 a distinction should be made between ephemeral lakes, disconnected from the glacial hydrological system and base-level lakes, formed at the hydrological base-level. The former only persist while underlain by un-fractured ice (2-3 year life cycle observed in the Himalayas) but the latter, while initially controlled by many of the same processes, can persist and attain potentially hazard volumes.

P 4549 L 3-16 this section contain a lot of information, could it be reduced to something along the lines of ‘research in the region has focused on the moraine dammed Petrov Lake and the ice dammed Lake Merzbacher but, supraglacial lakes have received little attention’? L 20-21 could this be re-worded.

P 4550 There is a lot of information about the area that is not really used in the later discussions and so not relevant.

P 4552 L22 why where the 8 glaciers selected? Are all supraglacial lakes in the region found on these glaciers? Are they the only debris covered glaciers in the region? Do they have any similarities/differences for which they were chosen? L23 They are spanning - They span.

P 4553 L 5-7 even though the majority of lakes are found on these two glacier I am not sure that focusing the analysis on them adds to the manuscript. There is no interpretation/discussion of the differences found. L 10-15 do not need to give more information about the Merzbacher Lake. L 20 remove in numbers. L 25 how representative is the mean value? L 27-29 a bit confusing, are you saying the ice is debris free above

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4750 m a.s.l., has a continuous mantle below 3750 m a.s.l. with a transitional zone in between?

P4554 L 4-8 still confusing. L 14 change with to within. L 15 can the authors comment on how variable lakes level may be during this time window? A similar period in winter season is likely to have little variability but this may not be the case close to the peak of the ablation season. L 25 it is possible to fit an expanding, shrinking and no change trend within the error bars of figure 6.

P 4555 L6 change closed to close. L 22-27 this section could have more impact if it discussed the year on year variability rather than the means.

P4557 L 4 remove it's. L 5-14 this section could be better discussed with an idea how long lakes persist. L 29 this depends on where the maximum melt is occurring on the ice face. E.G. on south facing ice faces, it is usually due to solar radiation and towards the top of the face. As the face melts the gradient is reduced and surface debris builds up on the face reducing ablation.

P 4558 L 15-20 surface velocity data would be useful and very interesting if there is significant variation. A feature of many debris covered glaciers is the reduction of surface gradient (lower ablation rates occur towards the terminus where debris is thick and continuous and higher ablation rates are measured upglacier, at the transition from clean ice to debris cover) and, associated reduction of surface velocity. L 25-29 Analogies to the GIS not really useful.

P 4559 L 11-18 many moraine-dammed lakes in the Himalayas have formed from the coalescence of supraglacial ponds and lakes with a lake forming at the hydrological base-level of the glacier (usually the lowest point on the moraine rampart).

Figures F 2 – not sure that this provides any more information to that discussed in the text, it could be removed.

F 3 – a good figure but it would be a little clear if the glacier outline was a different

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colour or if the clean ice areas could be coloured.

F 6 – this figure would be clearer if the connecting lines between years were removed. They serve little purpose at the time series is discontinuous.

F 8, 11, 12 – do not really add anything to the manuscript.

F 13, 14 – not sure they are useful in light of earlier comments.

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