

Review for the paper by Shangguan “Mass changes of the Southern and Northern Inylchek Glacier, Central Tian Shan, Kyrgyzstan during ~1975 and 2007 derived from remote sensing data”, The Cryosphere Discuss

The paper has undergone some revisions and improvements since the last submission, but still shows considerable deficiencies. Not all points of critics have appropriately been addressed (e.g. quality of the figures). The error bars for the extent mapping and velocities are not yet well explained. The assumption of zero-penetration of the x-band SAR signal in dry snow for the SRTM is not correct in my view and needs revision of text and computations. References in the intervals of volume and mass changes are not consistent throughout the manuscript and this makes reading and verification what actually has been done very difficult (e.g. has DEM2007 been subtracted from DEM1999 or vice versa. This does not become clear due to completely opposite labeling in text and fig.4. This matters in regard to the sign and direction of changes observed as well as the interpretation presented!). The figure numbering is not according to the appearance in the text and needs to be adjusted. Most of the figures are still in an unacceptable state and partly labels referred to in the description cannot be identified. This has been addressed in the previous review and only partly been changed by the authors. Final proof-reading by a native speaker would omit missing or incomplete phrases as present at various locations in the manuscript.

My judgment is between major revisions and rejection since the authors failed to provide a proper revised manuscript that at least adheres to basic, technical and formal standards. There can of course still be small issues and one might see things different. However, for a paper in the state of revisions I would expect that at least such formal criteria like clear figures, figure sequence and reasonable correct grammar and language are met. I leave it to the editor to decide if he want to proceed with revisions or reject. In any case, the manuscript needs considerable rework.

Specific comments:

- L24: this sentence reads like you analyzed a long time series, but in fact it was a bi-temporal comparison. So please reword
- L25: ... SIG tongue/terminus ...???
- L26: “likely” ==> what does this mean – did you measure the velocities or not? Are they outside of the error bars, then why likely, when inside, it's not a major result to be stated in the abstract. Knowing this, what's about the directions which often are even less reliable when the velocity is already difficult to measure. So perhaps better delete L25?
- L27: Better write “Geodetic glacier mass balances” instead of “Glacier mass balances”
- L35/36: This last sentence is strange and without connection. It needs more explanation.
A phrase of conclusions is missing in the abstract as do 1-2 sentences of the critical discussion. So perhaps really delete the uncertain velocities of the glacier front and put 2 phrases on discussion and conclusions.
- L45/46: I think this sentence “On average, ...” is somehow misplaced here as it has no real connection to the phrases before or after. So move it somewhere appropriate (e.g. L51).

- L46/47: "The runoff .. has increased during the last decreased" ==> I do not understand this sentence nor do I believe the cited authors have written it as such. Please verify.
- L53-62: Is this not standard textbook information that might be omitted to make the manuscript more concise?
- L70: Insert a paragraph break before "SIG, the ..."
- L79: Delete "also" in this phrase
- L98: ... the glacier flow at the terminus is mainly directed towards ...
- L120ff: Please do not repeat information in the text that is also given in Tab.1 (e.g. spatial resolution, ground coverage).
- L138ff: Please do not repeat statements given in Tab.1 like B/H ratio of SPOT. I suggest to concentrate all information on the data (incl. incident angles) in Tab.1 and only refer to general info in the text. This makes Tab.1 the one and only point to find the information and not spread over text and table. Similar for ALOS.
- L148: reference to Fig.4 does not follow the order of appearance in the text. This is confusing and I suppose automatic referencing during the type setting will mess this up. So please decide on order and when you refer to figures.
- L158: again order of figure reference is not correct
- L165: now fig.2 appears...
- L170ff: I still do not agree on the detection accuracy of half a Landsat pixel, although the authors outline their point in the response to the reviewers. This might be true in some cases, but not overall. Their own statement in the present manuscript relates to difficulties with debris cover and they use a hillshade based on the 90m SRTM DEM to improve the detection. Hence, I doubt that the detection accuracy can be 15m (half a Landsat pixel) or something is misstated or I misunderstood the procedure completely.
- L175ff: The error terms for absolute image registration are not stated or is this included in the percentage value given? It cannot be known from the write-up. Perhaps it would be easier to read when the errors are given in a short table rather than in the text.
It appears that error bars are kept smaller than they really are. Actually larger error bars wouldn't be any problem in my view but perhaps be more realistic?
- L182: What are glacier velocity rates? Do you mean displacement rates – that would be the velocity or not?
- L185/186: This sentence is incomplete (point) and doubles the statement in L184. Please revise this section or delete this sentence.
- L188: In the data section you mention that SRTM 4 was gap filled and you also use SRTM3 plus the unfilled finished-B SRTM. It now becomes confusing to the reader what SRTM DEM you use for what purpose and why. Please make this clear – best already in the data section/Table!
- L190: I think the grammar is not right here, do you mean "Dependent on an expected image ..."
- L200: There is a blank behind "SIG, " and before the comma. What data is used to

compute the RMSE and how are observations taken into account?

- L201ff: The following 2 phrases are unclear – e.g. “..., the survey compasses...”. Please reformulate.
- L204/205: How are these uncertainties estimated? Could you please provide a similar error estimate/propagation as for the area changes.
- L230: This might better read “The accuracies of the final DEM differences were evaluated ...”
- L249ff: The assumption of negligible X-band penetration in dry snow is wrong. It does not help to give a reference here that also relies on other references or comes from optical remote sensing. Please provide information on original surveys of X-band penetration studies of snow (e.g. by Mätzler) or to standard text books. Check also the observation principle of the former ESA CoreH2O Earth explorer candidate mission (X- and Ku-band to measure SWE of dry snow) or observations from the TanDEM-X mission of snow and glacier areas e.g. in regard to laser scanning also laser altimetry. The X-band penetration is just different/less to C-band, but not zero or close to zero under dry snow conditions (different when wet of course)! This section and computations require revision.
- L268: The time difference between the survey and the DEMs is partly really considerable and the errors resulting from ablation cannot be evaluated. I suggest to give not only the deviations of the SPOT model but also the values for the used SRTM, ALOS and KH-9 DEMs in Tab.3.
- L296: Again check the order of figures as they appear in the text.
- L311ff: However, Fig.3 shows also flow vectors into the glacier tongue although the magnitude is higher towards lake Merzbacher. But does this mean that the main flow direction is towards the lake? In Fig.3b, there is an obvious low flow section exactly at point b, upstream of the turn to lake Merzbacher. This is not addressed in the text, can this feature be explained or is it a tracking error?
- L321: Perhaps better replace “shrank” by “retreated”
- L321ff: The number given here could perhaps also be given as mean annual retreat rates since this allows a better comparison between the different long observation periods. The numbers are also given in Tab.4 – so either specify them in the text or in the table but not double the information, and even with different signs in the text and table – this is confusing!
- L332ff: It would be nice to give the original value of volume loss per elevation zone, since there might be other conversions of volume to mass coming up and the current data provided does not really allow subsequent utilization with different conversion factors. Again the values given in Tab.5 are also stated in the text – so either/or. The signs of the values are again different in table and text. I understand that the authors want to avoid writing about a negative mass loss, but it somehow is confusing when mass loss is attributed as loss of 0.3 m w.e a-1 and on the other hand a possible positive or balanced budget is given with -0.1 (L336).
- L337: What does the expression elevation thinning mean? Is this different from thinning or elevation decrease?
- L339/340: This is interpretation and should be left/moved to the discussion

- L341: Please verify grammar
- L345: Should read “which are”
- L341ff: The labeling of the figure and terminology in the text are not consistent. In the text the authors speak of surface lowering between 1975-1999 while the figure shows this as 1999-1974. This makes it unclear and very confusing what is shown and what has been subtracted from what and even the years are different! It influences the sign of the observations and hence all the description. Please be consistent throughout the manuscript in regard to terminology/labeling and signs including the figures. Figure 5 caption depicts 1975-1999 while the legend shows SPOT-KH9 – so what is right? Please clarify.**
- L347/348: “... while a slight decrease with small amplitudes ...”. Is there also the option for a slight decrease with high amplitude?
- L350: Do not start a sentence with “and” please ==> rephrase
- L352: “...where the velocity was faster measured ...” I suppose you mean high velocities were measured, not that your activity of measuring was faster.
- L353: “It looks like a tributary surge”. You are still presenting results, but start speculating. This is clearly a sentence that needs to be moved to the discussion.
- L359: Again, assumptions should not be presented in the result section but might be part of your discussion and interpretation of the results.
- L368: “... the elevation of the SIG was thinning under ...” - this reads as if the altitude was actively thinning. Please rephrase.
- L362: Wouldn't it be more comprehensive to start the description with the earliest time interval and then go to more recent one or the overall period. This approach is not consistent in the manuscript, but would ease reading and help following the authors argumentations quite a bit.
- L378f: It might be worth starting with an interpretation and discussion of your results rather than presenting numbers of other observations over several lines that have already been mentioned in the introduction. So rearrange the text – mention your observations and if/how they are in line or contrast to previous work.
- L390ff: The observations and temporal variability of glacier surface velocities has also been identified by high-resolution TerraSAR-X imagery. I think it is mandatory to refer to the work by Neelmeijer et al. (2014) – actually on the the authors has co-authored the work by Neelmeijer et al. - so even more astonishing that this is not mentioned.
- L396: “huge” - this is not a good expression here as the relations do not become clear – better address like XX m/yr or XX% of the overall mass loss ...
- L397/398: “flow velocities at the middle part of the SIG tongue were higher that at parts” ==> please verify grammar, wording and sense of this phrase.
- L399: “High velocities transports ...” check grammar
- L400: Do you mean water from the Lake Merzbacher lubricates the glacier bed? One might doubt this and any proof of that is missing nor reference to comparable situations. Could this not also just be enhanced melt at the front? Actually also change the expression “glacier base bed”. Please check also the paper of

Neelmeijer et al. (2014) where high-resolution flow fields are provided over entire melt periods.

- L409: "... it could be brought uncertainty though we ..." ==> please check grammar and wording
- L422: Please check wording and grammar
- L424: "However, it is disagreement on the mass balance of ..." ==> please check grammar
- L443: "... mass displacement down-glacier is an important signal that occurs before a glacier surge" ==> The mechanism stated here remains unclear to me since flow speeds are generally highest during a surge (e.g. Quincey et al. 2011) and one would expect considerable mass relocated during the surge event. So what causes a significant mass transport BEFORE the surge without increased ice dynamics and how would that drive a surge afterwards?
- L445: Cuffey & Paterson (2010) is a textbook. Are you sure that they present there original own results or rather cite work? ==> in case rephrase
- L449/450: Please check logic in this sentence. I also do not understand how low flow velocities are necessarily linked with high ablation/melt down rates. Couldn't there be high ablation rates and high velocities?
- L455: Please verify wording "below Lake Merzbacher" ==> You probably mean downstream of Lake Merzbacher
- L463: "... was also found ..." ==> before you wrote increasing temp and decrease in precipitation. Until 1996, not its a decrease in precipitation and decrease in temp ==> you cannot write "also" as the signals/observations are different
- L464ff: "It is disagreement on climate ..." ==> please verify grammar
- L474: "... space-borne datasets sources" ==> either datasets or data sources
- L475/476: "... SIG has a velocity of about 100m/yr for large parts of the tongue ..." ==> you obviously have an internal definition of glacier tongue and glacier terminus that you do not explain before to the reader. For me the tongue would be the end of the glacier, so lowest point as would be the terminus. ==> I do not see that in Fig.3; in fact velocities at the tongue (not at Lake Merzbacher) are close to zero!
- L479-481: You are contradicting your own statement in the same sentence. The area in general decreased but due to the surge it increased in the same period by 2 km² ????
- L483-485: "The results showed that the mass balance of SIG and NIG was negative from 1975 to2007 despite the surge of NIG." This statement somehow implies that a surge would be triggered or only be possible by previous positive mass balances or have any other positive effect on mass balance. We know that there are various mechanisms and theories on causes for surges. So reformulate this sentence.
- L486ff: Within these 2 sentences the problem of signs becomes really obvious. I suggest to either write about mass loss all the time and keep the signs positive or talk about mass balance and keep the sign negative.
- L491ff: "... elevation thinning ... to be quicker ..." ==> please check wording and if expressions are appropriate

Figure captions:

- L722: "... tongue changes ..." ==> please check expression and revise to e.g. changes in glacier front positions
- L724: I suppose you mean: "Mean annual flow direction and velocity of SIG in the time intervals 2002-2003 (a) and 201 to 2011 (b)." ==> because what you state reads different!
- L725: See comments below and consistency in regard to labels KH9-SRTM/SPOT and time intervals
- L734: ALOS has various sensors, so please be precise and write ALOS PRISM
- L736: This is the "mean annual elevation difference in the period 1975-99" NOT the annual elevation difference

Figures:

- Figure 1:** This figure requires revision. The legend matches with the map frame border. The elevation range is quite strange/unique with 1526-7439. Better use round values like 1500 to 7450. It is unclear if the stretch is linear or e.g. logarithmic ==> provide interim values. There should be some buffer around the elevation scale and scale bar. Show the ASTER scene extent, when it is used – the label is unclear (also in Fig. 4). Label of SIG and Khan Tengri cannot be read.
- Figure 2:** The scale bar and north arrow need a white buffer and why grey color behind the legend?
- Figure 3:** Points a, b, c cannot be seen well – please change color. Similar numbers for region 1 and 2 cannot be identified.
- Figure 4:** The lake dam label can not clearly be identified. Point (e) is partly difficult to see and at different locations in the panels.
- Figure 5:** Labels of points a-f cannot be read. Please magnify the labels.
- Figure 6:** Same critics for labels. Either by time consistent interval or by sensors
- In general a joint layout of the figures would help and make the manuscript much nicer.

References:

- Julia Neelmeijer, Mahdi Motagh and Hans-Ulrich Wetzel (2014): Estimating Spatial and Temporal Variability in Surface Kinematics of the Inylchek Glacier, Central Asia, using TerraSAR-X Data. Remote Sensing 6(10), 9239-9259; doi:10.3390/rs6109239, <http://www.mdpi.com/2072-4292/6/10/9239>
- Quincey, D.J., Braun, M., Bishop, M.P., Hewitt, K., Luckman, A. (2011): Karakoram glacier surge dynamics. Geophysical Research Letters 38(L18504), doi:10.1029/2011GL049004.