The Cryosphere Discuss., 5, C621–C626, 2011
www.the-cryosphere-discuss.net/5/C621/2011/

The Cryosphere Discussions

Interactive comment on "Utility of late summer transient snowline migration rate on Taku Glacier, Alaska" *by* M. Pelto

Anonymous Referee #3

Received and published: 27 June 2011

Review of Pelto, M. Utility of late summer transient snowline migration rate The Cryosphere Discussions 5,1-18,2011

Summary In this paper, ground observations from snow pits and probing are used to determine snow water equivalent (SWE) and balance gradient for the Taku Glacier, a large and well-studied glacier in southeastern Alaska. This is a key area and a key dataset, so it is really important that these observations and relationships are published. These observations are compared to satellite-derived (TM and MODIS) observations of transient snowline position (altitude) over most of the melt season in order to develop a tool to use the rate of snowline rise to infer mass balance without ground data or in the absence of satellite observations at the very end of the season. The period of observation is 1998-2010, with some observations limited to 2004-2010. Making the

relationship between ground based observations and satellite observations for the purposes of mass balance determination are significant, especially when they can help us extend the record in space or time, as ground mass balance measurements are difficult to achieve in a comprehensive way.

Overall recommendation: Clarify significance, broader applications and wider satellite use, fix details. Acceptable with revisions.

- It would be good to put the mass balance results in context (even though this is more of a methods paper)

- The author mentions applicability to other glaciers. It would be nice to see the relationships of TSL change rate and any other mass balance or proxy data. This would increase the significance of the technique and result. For applicability to other glaciers to be a strong point, the author needs to address the question of consistent rate of rise for various glaciers and years. The method seems to hinge on this.

- I would like to see the author articulate the importance of the paper more explicitly

- Why not use MODIS for all years (and all glaciers) since it is more likely to get coverage throughout season (all clear days) instead of the clear day every 16 days of TM repeat.? It would be nice if MODIS-TM comparison could evaluate whether this could be done, as it sets the stage for using the TSL migration more widely.

Text comments P2. Line 6. Don't probing transects measure depth, rather than SWE? You need to assume a density to get SWE, so this assumption/measurement is necessary to determine the SWE. Explain the approach used.

P2. Line 10-12. Why are all details for 2010 and no other years included here? This seems more detailed than necessary for abstract. Or, if necessary, clarify what is special about 2010.

p.2.line26: need colon after facies; also consider specifying alpine glacier? There are actually other facies such as "dry snow", "superimposed ice", and "firn" to consider and

the statement in this line needs to be more carefully written in order to be true.

P3.line13-15. This sentence is not clear. In particular, I am confused about “reliable multiple annual observations late in the ablation season”. Does multiple refer to across years or within years?

p.3 line 15. Add a sentence about significance of this approach and the improvement with MODIS? Significance is implied in lines 9-15 but could be stronger.

p.3 line19. Include latitude and longitude of glacier or icefield. Clarify whether you mean 200 vertical meters of ELA.

p.4 line 4. Define AAR upon first use

p.4 line13. After describing consistent density of snowpack, include the value that you are using here.

p.4 line 14, 16 Be consistent about I/we throughout paper; also specify which are the important snowpits in fig 1 because you label all of them.

p. 5. Line 12. How was transient snowline “readily identified”? – were images classified or snow and ice characteristics mapped carefully? Description of methodology here suggests it was a bit ad hoc.

p. 5 line 25. Here again, it would be nice to know the density if it is very consistent, if not, perhaps in a data table or supplement.

p.6 line 9-11. Consider writing out the explanation of balance gradient calculation in generic terms. (Reference to Furbish and Andrews, 1984)

p. 6 line 15-20. Why are the balance gradients in mm/m in the text but displayed as SWE in figure 3? It would be easier to make the interpretation from SWE to balance gradient if units were shown more consistently.

p. 7 line 2. How do you handle the fact that the glacier surface topography is changing,

yet you overlay your images on a 2000 DEM every year? This may be the best/only way to do it, but consider/assess the impact on your results. ASTER DEMs may also be another way to quantify surface elevation for this period (or the survey data could be used, but seems not to be in the paper).

p. 7 line 5-10 Explain in methods why the 2-week intervals of rates of rise are so important to quanify individually.

p. 7 line 15 There is still a “please check” in text

p. 8 line 15 Change “ the simutaneously” to “simultaneous intervals” (or similar – it doesn’t make sense as written)

p. 8 line 15 revise sentence starting “The MODIS imagery …. “ so that it is more succinct

p.8 line21. “If there is consistency …” – does this method sometimes give consistent rates and sometimes not? It seems as if the relationship would be much more robust if it was regularly consistent, and then you would need fewer intermediate images to make assessments.

p.9.line 15. Acknowledgements: change “individual” to individuals. Consider including the scientists/technicians who collected the key data as coauthors (McGee, Beedle, McNeil)

Comments on Tables and Figures T1. Table should specify which images come from which sensor, differentiating among the Landsat 4-7. Justifications of dates are different in the two columns. Separate by year? It would be easier to read if it was one taller column (with some kind of year breaks) rather than two unseparated columns. The caption should be revised to say Date (MM/DD/YYYY)and Altitude (m) of transient snowline for Taku Glacier … Also, consider putting in bold the highest for each year or the last for each year

T2. This table is hard to follow. The top part makes sense, although Rate of rise

needs units (m/d?). Why not include the intermediate pairs (July – Aug, July – Sept., but not Aug – Sept)? The lower part of the chart "Lower Elevations" is less easy to follow – the column heading should be repeated, and the importance of separating these indicated? Perhaps because rate is very different lower/earlier in season? The connection is not made very clearly in the text. Double check significant figures on the Rate of Rise – I think there maybe an extra one in table values.

Fig. 1 Need to reference source map used as background in figure and references. What is scale shown? Include Latitude, Longitude, and scale. If possible also include an Alaska inset Map for general location. Consider adding a table with snowpit ID and Lat, Lon, Elevation

Figure 2. Are these snowpits or probes along 1 or 2 transects? I am confused about why the caption sounds like there is one or two snowpits but the elevation varies and says it is at 1000. This is either wrong or confusing. Only one transect is shown in Figure 1. Make caption (SWE) agree with axes (Accumulation).

Figure 3. Is this the SWE or the balance gradient? If it was from 98, 04, and 05 then why are 1998 through 2010 all shown?

Figure 4. Specify and approximate location or elevation for this "between the snowpits and the transient snowline"? It is quite vague.

Figure 5. Zoom in to show TSL better? If only mapping on Taku Glacier, then most of this figure is unnecessary. Can the results from Taku be useful in m.b. on other glaciers? If so, then make that case with this figure. Otherwise zoom in. Alternately a direct comparison of Figure 5 and Figure 6 (Fig 5 A and B?) would be a nice comparison of the TM and MODIS results separated by only a week at the end of the ablation season.

References Cited Furbish, D. J. and Andrews, J.T. (1984) The use of hypsometry to indicate long-term stability and response of valley glaciers to changes in mass transfer.

Journal of Glaciology 30, 199-211.

Interactive comment on The Cryosphere Discuss., 5, 1365, 2011.