Earth Syst. Sci. Data Discuss., 6, C102–C105, 2013
www.earth-syst-sci-data-discuss.net/6/C102/2013/

Open Access Earth System Science Data Discussions

Interactive comment on "Juneau Icefield Mass Balance Program 1946–2011" *by* M. Pelto et al.

M. Pelto et al.

mauri.pelto@nichols.edu

Received and published: 3 September 2013

We appreciate the detailed reading given this paper by the two reviewers and the resulting very specific comments. All of the comments are pertinent, the majority of the comments are minor yet important and will be quickly and readily addressed. There are five issues that will be more difficult to address and we can do so only with greater clarity in our descriptions.

1) A series of comments from Reviewer #2 on density from page 124. The most important observation on density was made initially by LaChapelle (1954) that the density of the previous winter's snowpack is uniform and consistent by July on the icefield. This has been supported by several more recent studies, including Ramage et al., (2000), who found that surface wetness, grains size and density were all uniform across the icefield and did not explain changes in radar backscatter with elevation on the icefield.

Nevertheless JIRP has consistently made density measurements and direct measurement of the water equivalent through the entire snowpack column for the entire period of record. The methods have not been standardized for the entire period, and the various approaches are not discussed as this would not add clarity to the issue. It is worth noting that one outcome of this paper is a mass balance manual that JIRP is now using that will continue the standard practices that have been adopted and consistently applied since 2003.

2) Reviewer #2 (126 Ln17) on ablation measurements. The balance gradient for the glacier in the ablation zone is not based on accumulation measurements. It is based solely on ablation measurements that were used to construct a mean gradient for the ablation zone. The gradient is adjusted to zero at the observed ELA. Annual observations of ablation are not a standard method because of costs and logistics, which does add uncertainty in the mass balance assessment. The balance gradient in the ablation zone has been published by Miller and Pelto (1990) for Taku Glacier and has been verified by independent work by Motyka et al (2003) on Taku Glacier and on neighboring Mendenhall Glacier (Boyce et al. 2007).

It is acknowledged that the lack of ablation zone measurements is the single largest source of error on Lemon Creek and Taku Glacier. This is why going forward we will be looking to use additional techniques including TSL observations to define ablation. The duration of the bare ice exposed at the surface maybe a key variable to observe for ablation determination, the exposure period can be observed using satellite imagery. We further began in 2013 to assess snow depth in the ablation zone at the end of accumulation season using GPR. This can provide an understanding of ablation rates change with elevation before bare ice is exposed as the snowpack melts off. These are future endeavors that may or may not prove useful in better validation of the surface mass balance record.

It is important to put the record in perspective, the methods used for determining mass balance have been consistent, and hence the mass balance record is consistent. Further that two different means of geodetic mass balance assessment have confirmed the cumulative mass balance record from both glaciers. This strongly suggests that the approach used for surface mass balance assessment is reasonable. This is in contrast to the UGS Benchmark glaciers where geodetic measurements did not support the surface mass balance record for Wolverine Glacier (Van Besusekom et al, 2010). We are beginning the process of subjecting the mass balance records for both glaciers to the same type of analysis used on Wolverine and Gulkana Glacier (Van Besusekom et al, 2010). This will require using additional field techniques and use of degree day models. We cannot at this time provide a well constrained estimate of error resulting from the lack of ablation zone measurements.

3) In Table 1 we did not provide the dates marking the end of the annual surface mass balance measurement season for every year, as they are not available for every year. To have the record reported consistently I would argue we should not include dates, but they could be added. Dates are available for every year since 1998.

4) Reviewer #2 (128 Ln 16-26): The details on the TSL methods and errors will be added with further reference to the original methods presentation by Pelto (2011) and Mernild et al., (2013)

5) Reviewer #1 (132 Ln2) The Taku Glacier has a very large surface area in the vicinity of the ELA, this makes the glacier sensitive to not only small changes in the ELA, but changes in the balance gradient near the ELA. This is likely the main issue with the lower correlation with the ELA on Taku Glacier. Utilizing direct observations of the balance gradient and TSL variations should help better identify not only the ELA, but adjust the annual balance gradient in this critical interval (Mernild et al, 2013)

Boyce, E.S., Motyka, R.J. and Truffer M.: Flotation and retreatof a lake-calving terminus, Mendenhall Glacier, southeast Alaska, USA. J. Glaciol., 53(181), 211–224 (doi: 10.3189/172756507782202928), 2007.

LaChapelle, E. R.: Snow studies on the Juneau Icefield, in: 1589: Variability of glacier mass American Geographical Society, edited by: Walters, R. A. and Meier, M. F., JIRP Report no. 9, 1954.

Mernild, S., Pelto, M., Malmros, J., Yde, J., Knudsen, N., and Hanna, E.: Identification of snow ablation rate, ELA, AAR and net mass balance using transient snowline variations on two Arctic glaciers. J. Glaciol., 59(216), 649-659, doi:10.3189/2013JoG12J221, 2013.

Motyka, R. J. and Echelmeyer, K. A.: Taku Glacier (Alaska, U.S.A.) on the move again: active deformation of proglacial sediments, J. Glaciol., 49, 50–59, 2003.

Ramage, J. M., Isacks, B.L. and Miller M.M.: Radar Glacier Zones in Southeast Alaska : Field and Satellite Observations. Journal of Glaciology, 46(153), 287-296, 2000.

Van Beusekom, A.E., O'Neel, S.R., March, R.S., Sass, L.C., and Cox, L.H.: Reanalysis of Alaskan benchmark glacier mass-balance data using the index method: U.S. Geological Survey Scientific Investigations Report 2010–5247, 2010.

Interactive comment on Earth Syst. Sci. Data Discuss., 6, 119, 2013.