Earth Syst. Sci. Data Discuss.,
doi:10.5194/essd-2016-39-RC1, 2016

Open Access Earth System Science Data Discussions

Interactive comment on "Glaciological Measurements and Mass Balances from Sperry Glacier, Montana, USA Years 2005–2015" *by* Adam M. Clark et al.

M. Pelto (Referee)

mauri.pelto@nichols.edu

Received and published: 26 October 2016

Clark et al (2016) provide a valuable initial record of mass balance from Sperry Glacier. I congratulate the authors on their detailed report on both methods and results. The comments below are for further clarification of steps taken in achieving results. These are not suggestions to change approach, just to explain how something was accomplished more completely. The other main issue is that results were not placed in the regional context of other WGMS reference glaciers in the region, none are obviously in the same range, but several are close enough as to be valuable (WGMS, 2015, http://wgms.ch/latest-glacier-mass-balance-data/).

52: Reword sentence: "From 2005-2015, Sperry Glacier had a cumulative mean mass

Printer-friendly version

Discussion paper

balance loss of 4.37 m w.e. (water equivalent)."

57: New sentence "This data also allows determination of mass balance point values, and a time series of seasonal and annual glacier-wide mass balances for all eleven measurement years."

98: Must refer to other mass balance programs in the region including in Canada. Also the WGMS has 40 reference glaciers in the world, which are the benchmark glaciers for the global mass balance data set. the three USGS glaciers mentioned are part of this as are Columbia Glacier in the North Cascades, Lemon Creek Glacier in Southeast Alaska and Peyto Glacier in the Canadian Rockies. In this case the three most similar reference glaciers are Columbia, South Cascade and Peyto. Also could reference changes in Wind River Range Maloof et al (2014).

133-137: Expand on this discussion, what is the dominant weather source in the summer? Are the Pacific storms still important? What are some basic climate means from a nearby weather station? Reference any climate trends in the region already identified.

169: I cannot determine if an actual DEM is being used. More information is needed ie. 1.. Who developed the DEM from the images? 2. What methods/software and what information were used to take the aerial photographs from a raw image to DEMs? 3. What are the horizontal and vertical errors? The resolution of 5 m is noted but this is not error and does not denoted vertical vs horizontal. This can be very important as if you are off in position on a steep slope by a meter or few meters, then you are introducing large vertical errors, move a 5 m pixel a few pixels away on a steep slope and you've changed the elevation. These errors are best estimated by comparing off ice areas. 4. Were the DEMs co-registered?

187: Pelto (1996) has also noted the lack of superimposed ice in the North Cascades directly to the west.

246: Are all of these measurements made in the spring? What about snow density at

the end of the melt season, which is critical for mass balance. It has been noted in the North Cascades density of snowpack is consistent after Aug.1 (Pelto and Riedel, 2001: Krimmel, 2001). You give a maximum snow density of 600 kg m-3 is this the end of summer density assumed?

282: The most significant assumption made in this study is that each elevation bin has a representative mass balance value. On small glacier like Sperry this is usually not the case. There are zone of accumulation and ablation within the same bin, which is why AAR ends up being a more useful measure of mass balance than ELA. What is your evidence that particularly above 2500 m the measurements points used are representative of the bin? Figure 2 highlights this point with blue ice zone above the firn line and two disparate small retained snowpatches at different elevations. I have also included here Fig. 1 image of the Sperry Glacier in 2009 from Bob Sihler illustrating the same point. This does not mean the calculations of mass balance here need to be adjusted at this time. The issue needs greater acknowledgement, how will it be addressed going forward and any steps you are already taking to address it should be mentioned. For example, the higher density of probing in the spring maybe what you have used. The sections on seasonal variation noted at 350 and 382. Also suggest this is needed.

324: Figure 3 provides no additional value to the Table.

340: On this size of glacier with such a spatial variation of ba, how do you justify determining mass balance without knowing the AAR? The WGMS for its reference glaciers expect both ELA and/or AAR to be submitted (WGMS, 2015; Mernild et al 2013)

417: This similarity of ablation with elevation has also been noted at other alpine glaciers, provide a reference.

482: Should reference changes on other glaciers in the region to put this glacier in context. What was the cumulative mass balance of Peyto and Columbia Glacier, WA

during this period.? This could include a comparison of area loss rate versus other GNP glaciers.

484: How does this compare to area change from 1966-2005? Are there other GNP glaciers to compare this too?

Figure 5-6: Would be ideal to combine these on one figure with two y-axes.

Table 4-7: these provide excellent value.

Krimmel RM. 2001. Water, Ice, Meteorological and Speed Measurements at South Cascade Glacier, Washington, 1999 Balance Year. USGS WRI-00-4265.

Maloof, A.; Piburn, J.; Tootle, G.; Kerr, G.: Recent Alpine Glacier Variability: Wind River Range, Wyoming, USA. Geosciences 2014, 4, 191-201, 2014.

Mernild SH, Pelto MS, Malmros JK, Yde JC, Knudsen NT, Hanna E. in press. Identification of snow ablation rate, ELA, AAR, and net mass balance using transient snowline variations on two Arctic glaciers.

Pelto MS. 1996. Recent changes in glacier and alpine runoff in the North Cascades, Washington. Hydrological Processes 10: 1173–1180.

Pelto MS, Riedel JR. 2001. The spatial and temporal variation of mass balance on North Cascade glaciers. Hydrological Processes 15: 3461–3472.

Tennant, C. & B. Menounos (2013): Glacier change of the Columbia Icefield, Canadian Rocky Mountains, 1919–2009. J. Glaciol., 59 (216): 671–686 Journal of Glaciology 215.

WGMS. Global Glacier Change Bulletin No. 1 (2012-2013). Zemp, M., Gärtner-Roer, I., Nussbaumer, S. U., Hüsler, F., Machguth, H., Mölg, N., Paul, F., and Hoelzle, M. (eds.), ICSU(WDS)/IUGG(IACS)/ UNEP/UNESCO/WMO, World Glacier Monitoring Service, Zurich, Switzerland, 230 pp., 2015.

Interactive comment on Earth Syst. Sci. Data Discuss., doi:10.5194/essd-2016-39, 2016.

Printer-friendly version

Discussion paper

Fig. 1. Sperry Glacier in 2009, patchy accumulation zone.

Printer-friendly version

Discussion paper