

Interactive comment on “Recent accumulation rates of an alpine glacier derived from firn cores and repeated helicopter-borne GPR” by L. Sold et al.

M. Pelto

mauri.pelto@nichols.edu

Received and published: 25 October 2014

Sold et al (2014) provide a new approach using GPR to assess accumulation distribution. The key advance in this airborne system is that it can observe multiple accumulation layers over a region assessing the retained accumulation of previous years. The system is validated using just two firn cores. The snowpits are of little value since the most recent years accumulation is not assessed. The approach is sound and the results interesting. The main issue is better illustrating the spatial distribution of accumulation and the poor validation. Better spatial validation is needed going forward, but cannot be expected of the current study.

C2148

4433-5: The statement of limited accumulation zone measurements versus ablation stakes is sometimes the reverse and cannot be categorically made. For example on Storglaciaren, Sweden, Brewster Glacier, New Zealand, Columbia Glacier, Easton Glacier, Rainbow Glacier and Sholes Glacier, United States probing densities of accumulation are much higher than ablation measurement (WGMS, 2011; Pelto and Brown, 2012)

4436-2: The GPR was flown in April and May and is focused on assessment of firn from previous melt seasons not the most recent accumulation season that is just ending. This point should be emphasized here.

4445-20: A citation that arrives at a similar finding of the percent of retained firn being from refrozen meltwater on a temperate glacier is: Miller and Pelto (1999) who found on Lemon Creek Glacier 10% refrozen meltwater. “To determine how much meltwater is retained in diagenetic ice, the walls of each test-pit have been continually surveyed. In our records from the two field seasons of 1982 and 1984, an average of 10% of the firn stratigraphy comprised this secondary ice at a density of 0.90.”

4444-25: Wadham et al (2006) in Svalbard found a higher ratio of retained meltwater, but did note that this thick layer did represent the annual layer. The higher percent is expected in a more polar setting. The key item is that it was the annual layer where the main refrozen layer formed.

4447-4 or 4449-10: Detailed mass balance can provide more than a plausibility check, it is the best means of validation on this particular glacier. Going forward a simple means of better spatial validation would be to utilize an extensive network of probing at the end of the balance year. That could be contrasted the next spring to the GPR mapping of the second annual layer down. On Storglaciaren the network allows this. On Lemon Creek Glacier we used over 300 probing measurements in 1998 and 2014 to validate our snowpits (Miller and Pelto, 1999). This could be done to validate GPR too.

C2149

Figure 6: An additional figure of the distribution of accumulation from a single year is needed, to better see the details of spatial variation.

Miller, M. M. and Pelto, M.: Mass balance measurements on the Lemon Creek Glacier, Juneau Icefield, AK 1953–1998, *Geografiska. Annaler*, 81A, 671–681, 1999.

Pelto, M.S. and Brown, C.: Mass balance loss of Mount Baker, Washington glaciers 1990–2010". *Hydrological Process.* 26(17), 2601–2607, 2012.

Wadham, J., Kohler, J., Hubbard, A., Nuttall, A. and Rippin, D.: Superimposed ice regime of a high Arctic glacier inferred using ground-penetrating radar, flow modeling, and ice cores, *J. Geophys. Res.*, 111, F01007, doi:10.1029/2004JF000144, 2006.

WGMS, 2011: Glacier Mass Balance Bulletin No. 11 (2008–2009). Zemp, M., Nussbaumer, S. U., GärtnerRoer, I., Hoelzle, M., Paul, F., and Haeberli, W. (eds.), ICSU(WDS)/IUGG(IACS)/UNEP/UNESCO/WMO, WMO, World Glacier Monitoring Service, Zurich, Switzerland, 2011.

Interactive comment on *The Cryosphere Discuss.*, 8, 4431, 2014.