Mauri Pelto (Referee)

Specific Comments:


72: “..of an extensive glacier monitoring effort/program/network”.

73: reword “To date mass balance measurements have been performed on more than 60 individual glaciers, most are short time series with 20 glaciers having been monitored for at least three decades.”

127: Is it worth explaining how potential errors can be avoided/identified? “Beginning from a point of known depth such as the snowline or from a snowpit. Measuring at a consistent interval and using the average of 2 or 3 probes within 25 m (Pelto et al, 2013).
140: Is it worth noting here, or just near line 250, that both end of the winter snowpack and end of summer snowpack density vary from point to point but have a relatively limited mean range.

168: How many of these were along consistent transects where the general route is known?

250: I agree with your approach to documenting and reporting density observations as well as examination of their variation in Figure 4. In terms of the broader import of not having a density observation, is this worth more context? You note the variation in density, does this apply to just point or the mean for a glacier? For most glaciers where detailed observations exist the variation in end of winter and end of summer snowpack density is limited. Fausto et al (2018) found that on the GIS snow density within 0.1 m of the surface had an average value of 315 kg m$^{-3}$ + 44 kg m$^{-3}$. Further they found insignificant annual air temperature dependency and suggested using a constant density was likely more appropriate for modelling than modelling surface density. On alpine glaciers density measurements for snow during the accumulation season have limited relation to elevation or snow depth (Machguth et al. 2006; McGrath et al. 2015; Sold et al. 2016). By mid-summer on temperate glaciers the density of retained accumulation has a similar behavior approaching a consistent mean value for specific glaciers and icefields that are between 550 and 600 kgm$^{-3}$ across western North America (Bidlake et al. 2010; Pelto et al. 2013; Beedle et al. 2014; Pelto, et al. 2019).

326: How many measurements were complemented or corrected for missing information?

330: Do you have a specific example where the intermediate measurements are valuable, such as many on a specific glacier or during a specific time interval?

370: Figure 6 is incredibly valuable. I would encourage using a mechanism to expand the lateral and vertical extent for glaciers with more than 10 years of record. Is a landscape mode for a page allowed usable in ESSD to accommodate a particularly wide figure?

408: Indicate the timing of this transition from accumulation to ablation at these two sites.

410: For visualization of the trends in winter and summer I suggest adding a figure or panel with all of the summer record and winter records of the glaciers in Figure 7 on the same plot. This allows seeing how similar trends are.

429: That summer balance changes are the key has been noted in many alpine regions
around the world, is that worth noting here? WGMS GGCB #4 (2021) illustrates seasonal balance for the regions with long balance records from more than a couple glaciers 3.1 (Alaska), 3.2 (Western North America), 3.7 (Scandinavia) and 3.8 (Central Europe), all show this declining summer balance trend and limited winter balance trend.

452: Not sure why this would be expected in a snowpack that is at 0 C. There is certainly a documented evolution of density to a through mid-summer, but after that it is more about removable of thickness than any densification/refreezing processes. No need to address unless you see value in addressing based on local observations.

492: The lack of temporal change in density and limited EOS and EOW density all argue that applying a standard density would be appropriate to substitute for in-situ observations. Could reference Sold et al. (2016) here since they had a similar result with no trends in density spatially or with altitude.

References:


