

The Cryosphere Discuss., referee comment RC2
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Comment on tc-2021-354

Anonymous Referee #2

Referee comment on "Comparison of manual snow water equivalent (SWE) measurements: seeking the reference for a true SWE value in a boreal biome" by Maxime Beaudoin-Galaise and Sylvain Jutras, The Cryosphere Discuss.,
<https://doi.org/10.5194/tc-2021-354-RC2>, 2022

Manuscript presents comparison between three different snow samplers and a density cutter which are used for SWE measurements. Uncertainties and errors are presented and evaluated for the methods. The study results that the large samplers should be used as reference for SWE measurements.

Topic of the study is scientifically relevant, and results are supported by other existing studies. Data set is novel, comprehensive and collected with stable manner ensuring quality. The results are interesting for groups starting SWE measurements and choosing instruments for that, in addition to groups using already one of the instruments or similar ones, or groups, such as modelers, using data from the instruments. However, I would like to see more novelty and progress beyond current understanding in the study.

Snowpack structure and snow properties should be presented to be able to evaluate for which snow conditions the presented results could be applicable. The reference for the true SWE is highly related to experienced snow conditions. For example, large and short samplers are not suitable for very deep and hard snow. It could be stated already in the title that which type of the snowpack is the comparison made for.

As stated in lines 365-367, it is possible to study methods in several snow conditions with the data set. I would like to see these results, how samplers are working in accumulation period and melting period, and what could create additional errors in those conditions, such as increasing amount of ice layers in melting period or crust layers during melt-freeze events in accumulation period.

It would be interesting addition to density sampler comparison if results for different layer properties (e.g. hardness and grain shape classes) would be presented, similarly as for

different density ranges. However, a problem with wedge cutter is that the sample includes more snow from the bottom of the sample location than top of it due to shape of the cutter. When samples are taken inside a layer, related error should be small, but layers are still naturally changing gradually. Related uncertainty could be checked. For thin layers, problem with using density from the same grain type is that it may also vary depending on snowpack structure. At least, analysis and description on how densities of the same grain types vary should be added. You could consider also average density from the closest measurements above and below instead of averaging the whole snowpack.

I think that novelty and impact of the study are not strong enough for publishing in The Cryosphere at present. However, I recommend improving the manuscript and publishing in another journal. In the case of significant improvements on the manuscript, resubmission to The Cryosphere could be considered.

Specific comments:

It would be nice to have map and figures from the sampling locations.

Lines 28-29, 32: The first documentations about SWE samplers and snow courses have been published a bit earlier in 1920's in Europe, but those are quite not possible to find since written in German and not available online. I recommend rephrasing such as "On our knowledge, the first documentation in English..."

Line 29: add $1\frac{3}{4}$ inch also in cm

Lines 139 and 240: I would recommend using uniformly unit of mm when writing about SWE instead of cm, then it will not mix with snow depth that easily. Now, both units are used which is confusing.

Line 204: "...is the total thickness of all snow layers (other than ice layers) (cm)"
Otherwise it might look like thickness also includes ice layers, even though it is written in the next sentence.

Line 379: Also "under similar snow conditions" would require better description earlier on what kind of snow conditions you had.

Line 404: "sections. Although"

Line 408: Chapter 4.2 could be simplified and main points better clarified

Line 455: "drier snow" - newly fallen snow can be also wet (defined by liquid water content). Replace with "This lighter snow".

Line 520: Replace "in the methods section" with "in the Section 2 Material and methods"

Lines 560-565: Mention that using large samplers as "true" SWE is also environment related, like in deep snow conditions it is more reasonable to use extendable samplers.