## Response to Reviewer 1.

*Our responses are in blue italics, embedded into the reviewer's comments.*

The authors introduce 6 years of meteorological, soil and, snow data collected at a tundra site in the Canadian high Arctic. The observed polygonal tundra environment located on Bylot Island, Nunavut is described as well-drained, void of standing vegetation, and typical of permafrost landscape. A thorough review of instrumentation, datasets, and validation at the site are presented prior to an assessment of data quality and correction of the temporal data where necessary. The authors highlight a lack of data available to drive snow physics models in herb (graminoid) tundra environments as motivation. Thin Arctic snowpack common to this area, and greater Arctic regions, consist of contrasting high density winds slab and lower-density depth hoar elements. The predominate drivers of this composition, wind compaction and upward flux of water vapour, are clearly identified by the authors as a gap in the current generation snow physics models requiring new datasets to evaluate against and improve from.

The described work is a valuable contribution and should be published in ESSD. Public release of this dataset and its associated validation are a service to the snow, climate and meteorological communities where significant effort has been required to initiate and sustain these remote measurements. I have noted instances below where I felt minor clarifications were needed on corrections applied but in general, I felt the dataset was well documented. Where internet data resources were accessed, for example the ECCC station data, date of access should be noted in the references in case of future revision. Useful lessons and anecdotes on sensor deployment, calibration and adaptation punctuate the paper and I felt it could be more impactful if these were summarized in a concise discussion near the end. A discrete guide on how to setup an Arctic site is clearly beyond scope, but some of the more significant choices, for example the use of ERA5 over the CNR4 data, warrant clear recommendations. I would hope such as summary would be a catalyst for development of similar sites, amplifying the efforts here.

*We thank Joshua King for his overall positive recommendation and carefully consider his minor recommendations below.*

Minor comments with line numbers provided:

Lines 47, 68,73 and others – Where the authors are part of the narrative should the citations not be in-line instead of in parenthesis?

*Yes indeed. This is how endnote works and it will be fixed in the final version or at type setting.*

Line 149: What does significant mean in the contact of the spatial variability described here? It would be helpful to place this in the context of another study or even a metric of the locally observed variability to constrain the use of the word significant.

*We will specify "As reported in Figure S3 for our very site, and as also observed at other spots in the valley, the thermal conductivity at a given soil level can vary by a factor up to 3 within a few meters"'*

Line 165 Superscript is missing for ^3

*Thank you. This will be fixed.*

Line 167: Add the total number of pits completed in the sentence or point towards a table to summarize.

*Pit data are detailed in the results section and are shown in Figure S7 and S8. We will state here that "Depending on the year, 2 to 7 snowpits were studied on herb tundra".*

Line 181: It is not clear if the correction applied was a constant or varied over time.

*Thanks for having us look into this. In fact, we did not use the CNR4 sensor, but the datalogger sensor. We will correct our text and mention that for the correction was a function of incident solar radiation. It is therefore not a constant over the year when it was used. This will be specified.*

Line 198: This internet resource needs to be cited with the data of access.

*We will mention that it was accessed on 5 February 2021.*

Line 213: The gas station equation does not have its variables introduced in text with units.

*Indeed, this will be added, we apologize for the omission.*

Line 271 The Pond Inlet airport station has an observer. Were the observer comments ever used to evaluate selected precipitation phase threshold at +0.05C?

*It is in fact 0.5°C. Thank for pointing this out. We did not use this information in our data set. However, we plotted the air temperature during the rain events and also during the snow events, as indicated by the Pond Inlet airport data, and +0.5°C really seems like the most sensible boundary.*

Line 279: The use of time lapses appears to be key here. Was this approach contrasted against an automated or empirical approach?

*In fact, the camera was installed in summer 2015 so that we used the automatic snow gauge and satellite data to determine snow cover dates for 2013 and 2014. The procedure has been detailed in (Domine et al., 2018). For the other years, since we had a camera, we did not seek satellite data. The snow gauge gave the same snow-in and meltout dates as the camera, within one day. We will mention our method for 2013 and 2014. We feel there is no need to compare gauge and camera result since we never relied on the snow gauge only.*

Line 307: It was previous stated that there was no small-scale relief at the tundra site in the context of hummock-tussock formations. Is this related to the wedge structures?

*Indeed, we stated line 125 that "There is no small-scale topography within the polygon (Figure 1) and in particular no hummock or tussock." Now in line 306 we state "However, snow depth is highly spatially variable because of the small-scale relief in the ice-wedge polygon terrain." We realize this may be confusing and we will specify that the scales are different. The hummock-tussock relief is at the 50 cm scale. The relief in polygonal terrain is indeed due to the ice wedges and is at the 10 to 20 m scale. Thanks for spotting this problem.*

Line 395: This reference appears to be incomplete. Please expand on what type of correction was applied.

*There is in fact no citation possible because the relevant work by Fourteau et al. has been submitted to J. Glaciol. and submitted papers cannot be cited. We explain lines 395-396 that "the amount of correction decreases with increasing snow density and is about 1.1 for dense wind slabs and 1.5 for soft depth hoar." Fourteau et al. propose density-based corrections. In any case, the fact that we cannot detail this now has no impact on our current paper because we state line 396 "Data presented are uncorrected." We believe that no change on this point is warranted until the paper by Fourteau et al. is accepted.*

*Finally, we wish to point out that we have solved the issue concerning our long-wave (LW) downwelling data, which we did not trust, so that we used ERA5 data instead. This was due to an error in the program supplied by Campbell scientific during 2012-*

*2013 to run the CNR4. That program applied the sensitivity coefficient of the downwelling SW sensor to all four sensors. This has been corrected. However, we also noticed that frost built up on both CNR4 upper sensors and that the 5 minutes of hourly heating were often not sufficient to remove the frost. We therefore built a hybrid downwelling LW data set, where periods impacted by frost were replaced by ERA5 data corrected using a correlation between valid CNR4 winter data and ERA5. In the revised version, we will therefore include a hybrid downwelling LW data set. The upwelling SW will also be corrected for the error in the Campbell program.*

## Reference

Domine, F., Gauthier, G., Vionnet, V., Fauteux, D., Dumont, M., and Barrere, M.: Snow physical properties may be a significant determinant of lemming population dynamics in the high Arctic, Arctic Science, 4, 813-826, 2018.