

Response to Reviewer's comments (RC#3)

Responses to the reviewer's comments is provided below. Reviewer comments are in black gothic type, and responses are in blue type.

09 Jun 2023

Referee Comment #3

Citation: <https://doi.org/10.5194/essd-2023-116-RC3>

General:

The article describes the valuable meteorological data collected by two weather stations in northwest Greenland and the processing thereof. The article is clearly written, the key elements of the AWS systems are thoroughly described and the figures are of very good quality. I only have minor comments on the manuscript. It is great that this data is being published and distributed freely. Nevertheless I am concerned that many data users will wonder why there is only data up to 2020. Adding recent data will certainly increase reuse and citations. If this is not possible for some reason, then it should be stated clearly in the article. I am also strongly encouraging (and I think ESSD does as well) the publication of the scripts that are behind the data processing. This is key to making this dataset and article fully reproducible. After addressing these two points and the minor comments listed below, the article will be a great asset for ESSD.

Since July 2020, SIGMA-A observation data has been continuously showing erroneous and missing values due to some kind of malfunction. Due to the global pandemic of the COVID-19, field work has not been possible, and this situation continues to this day. Therefore, in this paper, we intend to publish the data set up to August 2020, when we can obtain the data reliably and when the mass balance year is well delimited.

As your comment, we are considering the possibility of releasing the processing code, as we believe it would benefit the scientific community. However, more time is needed to prepare for the release of the code, as more testing and code organization are needed.

We are working on those tasks now, but due to the large amount of work, we think it may be difficult to complete those tasks by the deadline of this revision, and we hope to complete the work and release the code by the time of publication.

Comments on the article:

- abstract: ESSD requires that the dataset DOI appears in the abstract. Please add the two DOIs of the two level 1.3 datasets.

We will add the dois of Level 1.3 datasets to abstract.

- I.22: "snow height increased" by how much? The use of "snow height" is misleading in the accumulation area. In many studies, snow more than one year old is not referred to as snow anymore but firn, so I first misunderstood this statement as the "annual snowfall is increasing". If the author do not distinguish snow and firn, then the total snow (+firn) thickness, and thickness change, are actually not measured. I recommend changing to "surface height" or "snow surface height". For Sigma-B, it would be nice to state clearly if it is standing on bare glacial ice. In that case "snow height" can be used.

We agree with the intention of the comment. The first installation was on bare ice in July 2012, but it is possible that refreezing ice (when it formed is unknown) is now forming above the bare ice surface in 2012. Therefore, "snow height" in the manuscript will be changed to "surface height" because a location higher than the surface height at the time of installation is not necessarily snow.

- I.24: "decrease" by how much? Again, for snow height, do you mean that the annual maximum snow height is decreasing or that the surface height is generally decreasing? "decrease" means the surface is lowering. We will rephrase "snow height" to "surface height".

- I.26: "notable snow height degradation" Not clear why it is notable or with regards to which normal it is a degradation. Please rephrase.

We will rephrase "notable" to "apparent".

- I.97: "mainmast" two words?

We will rephrase "mainmast" to "main mast".

- I.123: "cm" line 104-105 you use m for instrument depth, now cm for height. Please be consistent. Potentially use only SI units.

We will change the "m" notation of the depth of snow temperature sensor installation to "cm" notation.

- table 1: It should be stated whether RH is provided with regards to water or with regards to ice (in subfreezing conditions). Some sensors do the conversion automatically, some don't. If it is with regards to water, then a corrected RH could be provided accounting for the different saturation point in subfreezing conditions. Or at least potential correction methods should be listed.

Since this sensor calculates relative humidity based on the saturated water vapor pressure for liquid water, we will add a note to that in the table. The intent of this paper is to describe the QC method of

the observed data and the observed values themselves, and it is our policy not to make any corrections or process the data including such a way that the intention of the implementer may intervene. Including further data processing methods in this paper would be redundant and would obscure the point of the discussion. We understand that accurate data analysis may require correction for shelter heating effects of air temperature and humidity in freezing environments, so we will discuss those treatments when we publish such a paper. However, We will revise the text to add a note to that effect, for alerting readers to this issue.

- Section 3: I am missing a discussion of the sensors' known limitations, it could be either included under the AWS system description subsections or in a section of its own at the end of the manuscript. It should estimate how often those problems may occur and point at potential way to remediate them. Some of these limitations are:

It may be necessary to describe the errors that the observed values contain, and we will add a subsection in Chapter 3 to explain this. The response to the correction and limitation of individual observations is described in detail below.

However, as noted in the response to the comment on Table 1, the intention of this paper is to publish the observed values themselves, without any correction or data processing that might involve the intervention of the implementer's intention. Therefore, we will note that the data published in this paper possibly contain some errors only and will not conduct any additional analysis or corrections that would show the corrected values.

- RH sensor clogging up with rime (<https://doi.org/10.1007/s10546-004-7955-y>)

The temperature and humidity sensors used at both sites may be affected by icing and riming as you have indicated. We will revise the text to cite this paper and add a note to that effect, for alerting readers to this issue.

- Unventilated thermometer overheating in low wind and clear sky conditions.

As noted in the response to the comments on Table 1, this paper does not include any correction or data processing that might include the possibility of intervening intentions of the implementer, and the intention is to publish the observed values themselves, so I will not discuss such issues. However, We will note the shelter heating effect, which has been pointed out in many previous studies, in Chapter 3.

- Radiation sensors and anemometers being shadowed/sheltered by the station mast (<https://doi.org/10.1029/2010JD015507>)

At least radiation sensors of SIGMA-A is placed far enough away from the AWS main mast, and the

pole of the radiometric sensor is placed in such a way that it does not affect the sensor. So we think that the station mast has almost no influence to those sensors. If SIGMA-B is affected, it would be by the shadow of the satellite communication antenna mounted at the top of the main mast of AWS. I cannot make a quantitative assessment of the presence or absence of this effect, but a detailed review of the hourly data showed that the effect was not pronounced. According to this, it is highly unlikely that the antenna's shadow is affecting the radiation, and if it is, it is likely to be slight. Therefore, we think no specific treatment is required. Nevertheless, your point is a valid one, and I will add a brief summary of the above explanation to Chapter 3.

- I.218: if RH is given with regards to ice, then supersaturation is not uncommon on the ice sheet up to ~110% and this filter may be too strict. If RH is given with regards to water then values >100 are unlikely.

Since the humidity sensor measurement is based on relative humidity relative to liquid water, we would leave the upper threshold at 100%.

- I.226: "lower" higher?

The indication is correct, we will correct it to "higher".

- I.243: Please avoid this use of brackets in equations to indicate interchangeable variables. Brackets have a defined meaning in equations. Either spell out two equations or use a subscript "i" in the equation and define it in the text like: "i being either u or d"

We will correct as per the comment with some subscripts.

- Section 4.1.5: Do you use the same filters for "sensor_height" as for "sh"? It should be mentioned in the text.

Since the sensor height is calculated after the QC of the snow height was completed, we do not set any no filter for the sensor height. I will add an explanation to the text about this.

- I.317: "weak electric pulse" where does that pulse come from, why is it weak and how does this relates to the radiation measurements?

"weak electric pulse" mainly refers to a few watts of radiation that occurs at night. The radiation amount is an observation error caused by the specifications of the instrument, and the error is caused by the slight temperature difference between the two detectors (inside of the dome shelter and sensor body), which occurs when there is a large temperature difference between the outside air temperature and the temperature inside the sensor body.

This radiometric error may cause the shortwave radiation to be recorded as an observed value at night.

However, since the value is an observation error, the observed value may be different from the original radiation balance.

- l.331: same comment as line 243

We will correct as per the comment with some subscripts.

- l.409: since the snow temperature sensors' installation depths were given in meter, I misunderstood the "-1" as meter. Please be consistent with the units.

We will correct the notation of depth for snow temperature sensor installation to "cm".

- l.445: please give mean annual PDD and its standard deviation to support this statement.

In accordance with RC2, we are going to reduce the text, so we will delete the part about the analysis of the PDD. Therefore, the relevant part of this comment will also be deleted, so I will not respond to it.

-l.454: Is there any net ablation years? Does the station allow to measure the ice ablation? Is there any measurement (e.g. stakes) of the ice ablation? Please elaborate on this.

Since no ice thickness changes or stake observations were made, it is not possible to discuss the mass balance. Since this discussion is based on observations at AWS, the discussion is based on meteorological observation data.

Incidentally, Sugiyama et al. (2021) reported the result of stake observations of the SMB for the years 2012/13-2018/19. The result showed that the SMB at the same elevation zone, the clearly negative SMB year is 2014/15. 2015/16 and 2018/19 are ± 0 , and the rest are POSITIVE. However, since this is not an observation at the SIGMA-B site and we did not observe it at the same elevation as the SIGMA-B site, we do not know if its SMB is the same at the SIGMA-B site. This verification is beyond the scope of this paper and will not be done in this paper.

- l.472: shouldn't the lapse rates be negative?

The point is correct, but I will delete this section and will skip responding to your comment.

Comments on the data files:

- Commercial formats like Microsoft Word should be avoided. Please replace by a text file.

The temporary Dropbox data link may have included MS word files, but the official dataset data and doc do not include MS word, so please check the doi link page.

- The station coordinates (potentially through time?) and a table giving the meaning of each

variable (as they are named in the data files) should be provided at least in the readme file, or even better: in separate, machine-readable files (e.g. csv, tsv).

We will change information published as pdf files to text format, etc.

- The date format used is non-standard. ESSD encourages ISO 8601 (or alike). Please specify if time stamp is local time or UTC.

We will correct the time data format.

Reference:

Sugiyama, S., Kanna, N., Sakakibara, D., Ando, T., Asaji, I., Kondo, K., ... Oshima, T.: Rapidly changing glaciers, ocean and coastal environments, and their impact on human society in the Qaanaaq region, northwestern Greenland. *Polar Science*, 27. <https://doi.org/10.1016/j.polar.2020.100632>, 2021.