Response to Reviewer's comments (RC#2)

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

18 May 2023
Referee Comment #2
Citation: https://doi.org/10.5194/essd-2023-116-RC2

General:

This paper presents approximately eight years of quality-controlled datasets of two automatic weather stations (AWS) on the ice in NW Greenland, one situated on the contiguous ice sheet and one on a detached coastal ice cap. This region is climatologically very interesting as well as rapidly changing, as described in numerous recent publications. These AWS data are highly valuable for process understanding, climate monitoring, and model evaluation/satellite validation, and deserve to be published. The data have been extensively quality controlled as described in this paper. The resulting dataset appears clean and robust and useful for users. My main problem is the non-concise and often unclear writing style in this paper, which makes the paper hard to digest and, more seriously, in places leads to confusion. Although it is a relatively minor remark, it will require a significant effort by the authors to remedy this.

Thank you for your comments; in accordance with the Major comment and the comments on Section 4.1, we have revised the text to reduce its length and improve readability. In addition, we will correct the unclear explanations in accordance with your comments.

Major comments:

I would like to encourage the authors to critically go through the MS text again to improve the readability and accuracy of the text. The writing can be more concise and precise. Some examples (not exhaustive) are listed below as minor comments. And in the process please aim for a shorter paper.

We will revise and improve the readability of this manuscript by following the reviewer's comments as

> *Section 4.1: I suggest listing all range values in Table 3 and not to repeat these in the text, to improve readability. Instead, for each correction it would be nice to mention the % data affected.*

and reducing the amount of text by deleting the text and figures in the sections on PDD (Fig. 5) and

air temperature lapse rate (Fig. 7b).

Table 2 would be better placed at the very beginning or end of the text.

We have modified Table 2 to be placed at the front of the main text.

This paper presents an observational dataset, so it is more logical to start the introduction with the history and importance of in situ observations in Greenland.

We thought I included an explanation in the second paragraph of the Introduction, but it seems it was insufficient, so we will add a few more sentences about the AWS network of GC-Net, K-transect, and PROMICE, citing their references and the position of SIGMA AWSs.

Section 5 also discusses derived data, such as positive degree days, lapse rates but also average seasonal cycles, etc. Not sure such (admittedly basic) analysis has a place in a data journal.

Following the comment, we will delete the following parts

- Figure 5 and the second paragraph of section 5.1 (both related to PDD)
- Figure 7b and the second paragraph of Section 5.2 (discussion on the rate of temperature decrease between the two locations)

Minor comments:

l. 17: an -> the

We will revise following the comment.

l. 25: ""snow height degradation", unclear, do you mean snow height decrease or snow metamorphism?

We will correct to "snow height decrease" since it means "snow height decrease".

l. 37: "however, the existing in situ meteorological data are insufficient for these purposes", unclear, do you mean that current observational coverage is insufficient? It is quite good in Greenland when compared to e.g., Antarctica.

“Insufficient" is an overstatement in some cases, so we will rephrase as "continuous accumulation of measured data will be more valuable”.

l. 51: "analytical values of various numerical models", unclear, do you mean "output of numerical models"?

We will correct to "output of numerical models" as the reviewer's comment is correct.

l. 54: please explain 'sensor noise' and 'natural factors'.

Sensor noise mainly refers to a few watts of radiation that occurs at night. Currently, we use the terms "electric pulse," "electric noise," or "sensor noise" to refer to this error, but this was not appropriate. This phenomenon and its errors are generally referred to as "Zero Offset" (Behrens, 2021), so we will modify the terminology to use that terminology.

Natural factors include riming, ice accretion, snow accumulation on sensors, etc. Since this expression is indeed abstract, we will modify this part of the initial publication to add the following explanation:

“natural factors”

-> “natural factors (e.g., riming, ice accretion, snow accumulation on sensors)”

l. 56: please explain QC or better simply write out throughout.

Since QC was first mentioned here, we will add an explanation that QC is a process to improve the quality of data by removing outliers and modify the notation to Quality Control (QC).

l. 76: " It is considered" the fact that the surface consists of accumulating snow/firn proves that this is the accumulation area.

We will rephrase “It is considered to be” to “This site is”.

Fig. 1a: I suggest including the GC-Net stations as well.

We will consider adding GC-Net and K-transect observation sites.

l. 78: "is supposed to be", unclear, was it intended to be at the equilibrium line, or is it thought to be there?

We intended that the SIGMA-B site is thought to be located at near the equilibrium line.

We will modify to mean that the SIGMA-B site is considered to be located at near the equilibrium line.

l. 80: " The surface condition at this site varies (see Fig. 2), and surface melting has occurred in warm years". Obviously, surface melting occurs at the equilibrium line. Did you perhaps mean "net ablation"?

Surface melting here was intended to mean "significant surface height decreasing," so “surface melting” will be changed to " significant surface height decreasing”.

l. 97, Figure 2: mainmast -> main mast (also elsewhere in text).

We will correct following the comment.

Figure 2: why is date given only in lower plots?

Since the surface condition of the SIGMA-B site varies greatly depending on the year and the time of year, we have included photographs of the different surface conditions at the site and the timing of each photograph in the figure as reference information. Specifically, in July in years with high temperatures, the entire snow layer may melt, exposing the bare ice surface, while in years with low temperatures, there may be almost no surface melting. This is a characteristic of the SIGMA-B site environment and is explained in the text.

l. 113: cyclone battery?

Since "cyclone battery" was a proper noun, we will change the term to "lead-acid battery".

Table 1 caption typo: observaion -> observation

The submitted version spells it correctly, so it may be some kind of mistake on Referee's part.

In any case, it should be correct in the revised manuscript.

Table 1: accuracy of wind direction, unclear what is meant here.

We will check and correct the sensor specifications.

Table 1: It appears that for the radiation measurement the sensitivity rather than the accuracy is listed?

We will check and correct the sensor specifications.

l. 131: some, not all?

I thought it would be easier to explain LW_{std} and others in the section explaining the QC process, and since they are not explained in the L131 section (section 3.2), I left them as some.

Since this is the intent, I will explain the intent and leave it as some instead of all.

l. 133: "Because the vertical radiant flux against the inclined surface needed to accurately calculate the surface albedo and surface energy balance is affected by the sloping surface at the SIGMA-B site, we calculated the slope-corrected downward shortwave radiation (SWd_slope) from the corresponding observations using the correction method in Jonsell et al. (2003) and Hock and Holmgren (2005)." This sentence is unclear.

We will revise this sentence to be more concise and clearer.

Table 2: in line 147, 'transmittance' is indicated by lowercase 't_r', in Table 2 we see an uppercase 'T_r' which is called 'transmissivity'. Are these the same things?

T_r in Table 2 is a constant (0.881; SIGMA-A, 0.872; SIGMA-B) defined to explain the QC of shortwave and near-infrared radiation in secondary control, and t_r in line 147 refers to the general atmospheric transmission coefficient used in the SW_{d_slope} calculation, which is a different parameter. It may be confusing, so we will change the variable names Tr to T_{rA} and T_{rB}, and t_r is left unchanged to make it easier to distinguish them.

Section 4.1: I suggest listing all range values in Table 3 and not to repeat these in the text, to improve readability. Instead, for each correction it would be nice to mention the % data affected.

We would like to reduce the amount of text by summarizing the range of the range test in a table or something. Also, it would be useful to know what percentage of the total data is masked, so we will add this information as a summary in a table or something.

l. 214: I do not understand this correction: why giving a clearly wrong measurement an arbitrary physical value?

Indeed, a negative wind direction is understood to mean that the sensor is making some kind of error, so we change the wind direction to be masked rather than set to 0 when the wind direction is negative.

l. 224 and 236: 'electrical noise', what is this? Earlier you used 'sensor noise', is this the same?

Since they mean the same thing, we will unify them with "Zero Offset" (See Reviewer#1 L.54 comment response).

l. 226: why can alfa_sw and alfa_nir not be lower than 0.95 and 0.90? Or do you mean 'higher'?

It was a "higher" typo. We will correct it as such.

l. 232: Are these the conditions for which the data are flagged as erroneous? It seems to be the other way around.

It seems that the notation was not clear. These parts will be changed from
"$SW_d < SW_{TOA\_max}$," to "$SW_d > SW_{TOA\_max} \rightarrow SW_d = -9999$,"
and modify the text a little to match this modification.

l. 237-240: You give the data a physical value (zero), would it not be better to not do that unless for instance when SW_TOA < 0?

The negative emission that occurs when the solar zenith angle is greater than 90°, which means SW_{TOA} =0, is considered to be Zero Offset, so the negative value itself has no meaning, and there is no emission in such a case, so setting the value to 0 is not a problem.

Therefore, we will not modify this part.

l. 249: the surface consists of snow or ice, so how can its temperature become positive?

Although the snow surface temperature is not higher than 0˚C, a threshold of upward longwave radiation equivalent to a snow surface temperature of +10˚C is set, taking into account the effect of radiation from AWS poles and other sources. This threshold does not imply that the snow surface temperature is positive.

l. 299: Six hours of calm weather is not impossible, why this arbitrary value? Why not use the wind speed at the other AWS to check this?

Since there are no other AWS nearby, we cannot confirm the validity of this process.

Although the 6-hour period has an arbitrary, it is possible to be in a calm weather environment with infinitesimally small wind speeds for several hours, so the 6-hour threshold was set to avoid accidentally masking such a situation.

l. 355: Why is wet snow treated differently at both sites?

The SIGMA-A site has a lower albedo limit of 0.3 because it is extremely unlikely that bare or dark ice will be exposed on the surface even if surface melting occurs, while the SIGMA-B site has a lower albedo limit of 0.1 because even dark ice may be exposed.

Figure 4, 6, 8: Consider reducing symbol size.

We will revise as following the comment.

Reference:

Behrens, K.: Radiation sensors, in: Springer handbook of atmospheric measurements, edited by: Foken, T., Springer International Publishing, pp. 297–357, https://doi.org/10.1007/978-3-030-52171-4_11, 2021.