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Title: Quality-controlled meteorological datasets from SIGMA automatic weather stations in northwest Greenland, 2012–2020

Author(s): Motoshi Nishimura et al.

MS type: Data description paper

Thank you for sending the specific and valuable revision comment on the revised manuscript. Considering the comments, we have revised our manuscript as shown below. The given referee comments are written in gothic font. Each comment's responses and correction details are in blue type. Revised sentences and context are highlighted using the text's track changes in MS Word.

We also added our thanks to the reviewers and editors for their help in the peer review process.

20 Sep. 2023

Referee Comment #4

General

As all previous reviewers, I want to honor the authors for their high efforts in maintaining weather stations in a harsh environment and for providing the data to the scientific community. I also acknowledge their attempts to increase the quality of the dataset by removing erroneous measurement values and discussing the time series.

While I have the impression that the authors spent substantial work in making use of the already available reviewers' and editor's comments, I found a few points that might be considered/revised before the paper is being published.

Best wishes

Wolfgang Gurgiser

Comments:

On section 3.2

- Do you correct SW_d (incoming shortwave radiation?) at SIGMA-B for the 4° slope angle? If yes, does this mean that your station/CNR4 is not mounted horizontally but in parallel to the slope?

SW_d is the observed value of the horizontally installed shortwave radiation sensor (CNR4) itself. SW_{d_slope} is the physical quantity obtained by correcting the observed SW_d as the amount of radiation for a slope inclined by 4° .

- I'm not sure if you use the corrected data (SW_d/u_{slope}) for calculating the surface albedo because in equation ix, there is no "slope" subscript

Since there is no need to correct for slope at the SIGMA-A site, we use this general notation. However, because of the possibility of such misunderstanding, we added the explanation in L170 in the revised manuscript that " SW_{d_slope} is used for SW_d when calculating a_{sw} at the SIGMA-B site".

- Might the lower sensors of the CNR4 at SIGMA-B be markedly influenced by the station, also by the solar panels? If yes, you should also mention this influence at the end of the section

We did not identify the significant influence of AWS including solar panels during the process of examining the QC procedure. However, the possibility of such an effect cannot be completely ruled out, and an explanation is added at the end of section 3.2.

By line(s), figures or tables

Line 24: "A proxy of cloud formation frequency" – I would just write a "A proxy of cloudiness" because incoming longwave radiation just indicates if clouds are there or not

We have corrected it as you indicated.

The corrected part is L24 in the revised manuscript.

Lines 24-29: While I find a comparison per-se interesting, it's in my opinion not necessarily needed in the abstract of this paper. If you keep it, I would recommend revisions because in its current form, it's hard to understand.

The policy is to maintain a comparison of the climates of two sites that are relatively close to Northwest Greenland, and the text has been revised to make it clearer.

The revised part is L24–29 in the revised manuscript.

Line 65: Maybe change to "...support the evaluation and development of numerical models"

We have corrected it as you indicated.

The corrected part is L55 in the revised manuscript.

Line 66: I suggest to delete the second part of the sentence starting with "and..."

We have deleted the relevant part as you indicated.

The revised part is L55 in the revised manuscript.

Line 69: I suggest to change the text as follows "...or technical issues (e.g. Zero Offsets, faulty sensors)"

We have revised it as you indicated.

The revised part is L58–59 in the revised manuscript.

Line 70: “quality” instead of “accuracy”?

We have corrected it as you indicated.

The corrected part is L60 in the revised manuscript.

Line 71: I would remove “which is a process ...” because e.g. detecting a drift in a sensor or detecting unrealistic constant values over time would for me also be part of quality control

The points you indicated are also intended to show that what QC is intended to do in this paper.

Therefore, if this sentence is deleted, the definition of QC in this paper will become ambiguous.

Although we can understand the intent of the comment, we will not change this section for the reasons stated above.

Line 88: “...and the sensor...”

We have corrected it as you indicated.

The corrected part is L78 in the revised manuscript.

Lines 88-90: Please split the sentence in two.

We have corrected it as you indicated.

The corrected part is L79 in the revised manuscript.

Line 93: “...an accumulation area of the ice sheet...”

We have corrected it as you indicated.

The corrected part is L83 in the revised manuscript.

Line 95: “...located near...”

We have corrected it as you indicated.

The corrected part is L85 in the revised manuscript.

Line 98: “...vary”

We are sorry, but we did not understand the intent of this comment. Grammatically, the verb in this passage is “varies”, so we did not make the correction.

If you have some other intents, please let me know.

Line 98-99: e.g. “...surface lowering...” (surface height decreasing is not a good expression)

We have corrected it as you indicated.

The corrected part is L88 in the revised manuscript.

Line 99: "...is located..."

We have corrected it as you indicated.

The corrected part is L89 in the revised manuscript.

Line 135: "...below..."

We have corrected it as you indicated.

The corrected part is L119 in the revised manuscript.

Line 206: "... and when the..."

We have corrected it as you indicated.

The corrected part is L182 in the revised manuscript.

Line 244: Maybe change to "...of simple statistics based on maximum, minimum, and mean values derived from ..."

We have corrected it as you indicated.

The corrected part is L218 in the revised manuscript.

Lines 249-251: Sorry, but I don't get the meaning of the added text.

We revised the text in the relevant section.

The revised part is L L224–226 in the revised manuscript.

Line 270: "...from the entire (???) observation..."

As you pointed out, we are referring to the entire period. It was indeed a confusing expression, so we have rewritten it in a concise manner as you suggested.

The corrected part is L236 in the revised manuscript.

Equation 1.4.3: I wonder if there could be conditions (e.g. fog) where LW_d and LW_u could be very similar in your environment? Then, maybe not all time steps with LW_d very close to LW_u should be flagged.

As you point out, LW_{net} could be smaller in weather conditions such as fog. And certainly in such cases that data should not be masked.

We tried to determine if there was fog or frost using temperature and humidity data. For example, when the humidity is very high (e.g., 90-100%), if the temperature is negative, it is frost, if positive, it is fog, and so on. However, fog may occur in a freezing condition, the separation of those conditions is difficult, and the optimal algorithm cannot be determined. Therefore, we were led to the conclusion

that more careful consideration is needed to determine an effective masking algorithm.

Therefore, this is an issue for future improvement, and for now, the algorithm will not be changed with the policy of broadly masking suspect data. Thank you for your helpful comments.

Line 359: "...of correct values..."

We have corrected it as you indicated.

The corrected part is L305 in the revised manuscript.

Table 5: % SWu is higher in Level 1.3 than in Level 1.2? This might be an error.

Thank you for pointing this out. I checked the algorithm and found a minor bug. We have fixed the bug and replaced Table 5.

In the process of making this correction, we also found an error in the text of the "anonymous test" described in section 4.2.3, so we have corrected the part in L343–344 in the revised manuscript as well.

Line 394: "...is shown..."

We have corrected it as you indicated.

The corrected part is L338 in the revised manuscript.

Line 398: "...calculated only from the..."

We have corrected it as you indicated.

The corrected part is L342 in the revised manuscript.

Line 403-404: Wouldn't riming or icing cause shading of the sensor and thus, rather an underestimation of the SW values?

We believe it depends on the intensity of liming and icing. If a thin ice film is formed on the dome, it may cause multiple reflections within the dome, resulting in the overestimation of radiation. If the thick one is formed, we identified that using LW_{net} (Equation 1.4.3). In this case, the radiation data have been masked.

Line 421-422: Do you mean "...that passed the second control"?

That is exactly how I understand it. It seems that it was difficult to understand, so the text has been revised.

The revised part is L358 in the revised manuscript.

Table 4: Might it be that you do not show the threshold values but the min/max values that

you use to determine the threshold values? In other words, is e.g. the threshold of wind speed at U2A 25.5+15 m/s? If yes, I would add the real thresholds in the table.

You are correct, the values used only to determine the Range test expression threshold are listed in this table. The threshold values used in the Range test themselves are summarized in Table 3, so we do not list them in this table.

We have corrected the caption of the table to avoid possible misinterpretation.

The corrected part is L292 in the revised manuscript.

Lines 467-468: What differences between LWstd and the measured LW values is allowed for not flagging a value?

The coefficients used in the Anomaly test (see Eq. 2.0.1) are listed in the second paragraph of Section 4.2.5. This coefficient will give you an idea of the Anomaly range. Also, specific median and standard deviation values are not included because it would be redundant to include them in the paper. If necessary, they can be found in the published program. By adding a note in the revised manuscript (L303–304) that those statistical values can be referenced in the program as needed, we thought that the intent of the anomaly test for LW could be understood by this explanation.

Equation 2.7.1: Please add the unit (cm?).

All equations describing QC procedures, including Eq. 2.7.1, omit the units. Therefore, we have added the units in the text, not in the equations.

We also thought it would be better to use cm as the unit of *st_depth* in Table 2, so we have revised that part as well.

The corrected parts are Table 2 and L424 in the revised manuscript.

Line 528: This text sounds very subjective, maybe you can explain more about potential valid records that would be masked.

It is understandable that this process involves subjectivity. However, in the case of a data where there is very little erroneous data set such as atmospheric pressure, it is difficult to determine the ranges of the range and anomaly tests based on statistical values, and this is the reason why this process was conducted.

It is clear from the Level 1.2 dataset that the data that seem to be anomalies clearly deviate from the fluctuations of the atmospheric pressure. We checked the data after processing and confirmed that the erroneous data were masked appropriately and that other correct values were not masked. We have added an explanation to the extent that it is not redundant, just to be sure.

The revised part is L441–443 in the revised manuscript.

Line 536: “The maximum was slightly positive at SIGMA-A site”- which maximum? In case you refer to the +7.2°C, I would not write “slightly positive” but just provide a number.

Thank you for pointing this out. I certainly did not explain it well enough. This discussion part was regarding the annual maximum monthly mean temperature. Including other parts of the text besides the part you pointed out, we have revised the text to make the interpretation of the data more accurate. The revised part is L449–454 in the revised manuscript.

Fig. 4: In the legend, please replace snow height with surface height.

They should have been corrected to surface height in the last revision. Therefore, this section will not be revised.

Fig. 7: The subplot showing the lapse rate is not described in the figure caption any more. Please correct.

The part of Fig. 7 showing the rate of temperature diminishing was removed in the previous revision. The caption has been removed accordingly, and the explanation related to the section has been removed from the caption as well.

Line 630: I'm not familiar with “occurrence frequency” but rather “frequency distribution” – you may check again.

We thought the frequency distribution was more prenatal as you pointed out, so I modified it accordingly.

The modified part is L522 in the revised manuscript.

Lines 639-642: This text could be shortened.

We have revised the sentences following the comment.

The revised part is L532–535 in the revised manuscript.

Line 653: “...indicates a higher frequency of clear....”

We have corrected it as you indicated.

The corrected part is L546–547 in the revised manuscript.

Line 655: Isn't the sentence starting in this line replicating the information in lines 649-650?

You are correct. Since the repetitive parts cannot be deleted due to context, we have reorganized the information and revised the text to avoid redundancy.

The revised part is L548–551 in the revised manuscript.

Lines 689-691: Please revise the description of (1)

The relevant part has been rewritten in a concise manner.

The revised part is L583–585 in the revised manuscript.

Line 691: Maybe you find a better description instead of “dramatic”

We have rewritten “dramatic” to “apparent”.

The revised part is L586 in the revised manuscript.

Line 693: Maybe change to “(3) Observed atmospheric conditions in JJA...”

We have corrected it as you indicated.

The corrected part is L587 in the revised manuscript.

Line 694: “(4) Frequent clear-sky...” or even “(4) Low cloudiness” which might be a more accurate description than “clear-sky” throughout the paper

We think your point is valid. We have revised the part you pointed out and the abstract to describe "frequency of clear skies" instead of "clear-sky".

The corrected part is L26 and 588 in the revised manuscript.