Referee #2

This manuscript describes short- and long-wave surface radiation data obtained at the Thule High Arctic Observatory in Northern Greenland over several years. The data are a useful contribution to surface energy budget studies in the Arctic, where according observations are scarce. The data will gain importance with the progression of the observation period.

Regarding the measurements, the authors apply very thorough corrections with regard to different sources of offsets (e.g. thermal offset due to the lack of shielding; cosine correction). The applied procedures are described in detail and easy to understand. Also, the comparison of the applied pyranometers to instruments that are calibrated at PMOD is explained, pointing to the relation of the instruments to corresponding reference devices. The manuscript is an important basis for understanding the data quality of the data set and moreover for the listing of metadata like e.g. instrument model and serial numbers. As the metadata are not included in the downloadable data set, I recommend to include the link to the manuscript on the data download page, so data users are aware of it.

I thank the reviewer for this very useful suggestion. A link to the publication has been added to the THAAO web pages for data access. See, for example, https://www.thuleatmos-it.it/dataaccess/DLI/

In the manuscript, time series of daily and monthly irradiances are shown, and single case studies presented in relation to meteorological conditions.

Overall, the manuscript is comprehensive and well written, and I recommend publication in ESSD upon addressing the comments listed below.

Comments:

L26: DSI is absent (solar zenith angle≥90°) from 29 October to 13 February. Yet, the data files partly contain data before 13 Feb, showing negative radiation values. I suggest to flag these or discard them.

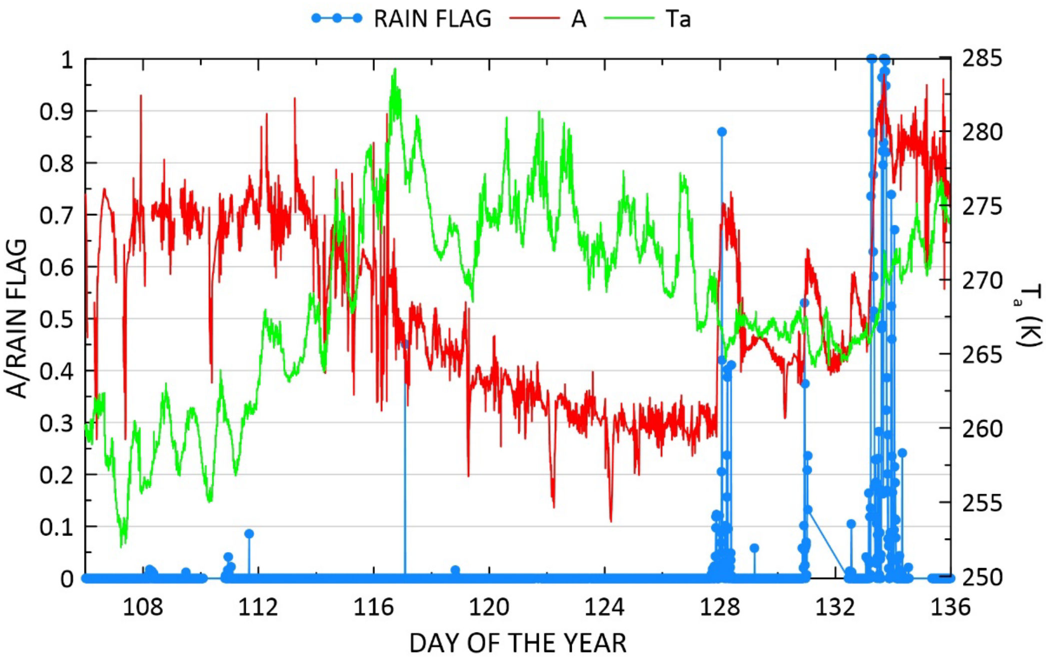
Although negative DSI values are not physically possible, negative DSI values can be observed during nighttime (either among two diurnal periods and during the long polar night), due to the infrared loss of the pyranometers. Most of this effect is reduced via ventilation systems or correcting nighttime measurements with co-located pyrgeometers (as explained in Section 2.1.3 of the manuscript); nonetheless, some small negative values may still occur. The recommendation from BSRN is to keep the nighttime negatives in the archived files, “so that each individual BSRN customer can then decide how to treat the data depending on the scope and aim of their work” (Driemel et al., ESSDD, https://doi.org/10.5194/essd-2018-8). Similarly, we prefer to keep the data all year long and to advise the reader/user that the negative DSI values are artifacts due to the pyranometer’s characteristics.

L118: in the 1990s

Done.

L 493: Could the the lower A values in 2021 be related to liquid precipitation with consequent solid ice formation on the ground, being darker than snow?

Liquid precipitation is one of the possible causes for the decrease in surface albedo in 2021. Other possible causes are snow melting due to rising temperature, or snow removal by wind. At that time, we did not have measurements of precipitation, but we have the "rain flag" data on the HATPRO microwave radiometer, indicating that some kind of precipitation (solid or liquid) may hit the rain sensor. The rain flag value is 0 without precipitation and becomes 1 in case of precipitation. Data are collected at about 1 minute time step. The figure shows the time series of the 5-minute averaged rain flag and A values from 15 April (day of the year 106) and 15 May (DOY 135), and the air temperature.



In the period of A decrease from 23 April to 6 May (DOY 113-126) , no rain/snow is flagged, so we can hypothesize that the snow removal is due to the melting caused by high temperatures, associated with high DLI values, as explained in the text. The rain flag is on again on 7-8 May (DOY 127-128), when A value rises above 0.70, because of snow precipitation. Finally, A reaches 1 on 13 May (DOY 133), after snowfall.

The pictures taken from the webcam on building 1971 showing the ground around the upward SW and LW irradiances measurement site are very useful in identifying variations on the surface cover. Unfortunately, such pictures are not available for some days. However, the picture of 4 May (DOY 124) shows some patches of snow-free ground, which are responsible for the A decrease. On the contrary, the picture of 14 May (DOY 134), captured after the end of the snowfall, shows a homogeneous snow cover.

Picture of 4 May 2021. The red circle shows the position of the radiometers facing the surface

Picture of 14 May 2023

Figure 10: the relation between T anomalies and albedo isn't obvious: preferably, the upper panel should show the absolute temperature (with indication of 0°C). The same applies to Line 663, where this event is discussed. "11 K higher than unusal" doesn't mean a lot here if no baseline is provided.

We agree with the reviewer, and we added a panel with absolute temperatures, indicating also the x axis corresponding to the melting point (273.15 K). The panel shows that the reduction in A starting by mid April 2021 is triggered by a steep increase in air temperature, which reaches values above the melting point (up to 278.8 K on 26 April, corresponding to an anomaly of 11.4 K). This represents a record for the month, compared to the other years in the 2016-2022 interval.

Similarly, air temperature remains above the melting point for six days by the end of September 2019, with a peak in air temperature of 280 K, corresponding to an anomaly value near 9 K, so again the extraordinarily warm temperature is presumably the factor causing the delay in the snow season.

Some comments have been added in Section 3.2.2 and in the Conclusions.

Figure 14: unnecessary figure, the basic information is included in Figure 16.

Figure 14 has been removed.