General comments:

This paper reports in situ measurements conducted during the Finnish Antarctic Research Programme (FINNARP) 2022 expedition at the Finnish Aboa station in the Dronning Maud Land, Western Antarctica. Measured physical properties of the surface atmosphere and near-surface snow are listed together with specifications of the employed instruments. Some example data are also presented. These contents are generally well-documented, although I have identified some issues that should be addressed (see below). Therefore, I have confirmed that this paper can provide valuable insights into major national field campaigns and observational research programs in Antarctica, where performing a field campaign is always challenging. These imply that this paper can fit well with the scope of the journal GI.

However, my overall impression is that this paper is something like a field report, because the data, methods, and results are presented in the same section (Sect. 2), which is not a typical composition of a scientific paper. Since I usually don't follow this journal, I investigated some previous papers published in GI and found that the composition of the authors' previous paper, published in GI (Leppänen et al., 2016, cited in this paper), is almost identical to the present paper. Therefore, I understand that the current composition is permissible for GI.

Based on the above, I suggest that this paper may be considered for potential publication in GI once the authors attend to the following points.

Thank you for the positive feedback and detailed comments which helped us to improve the manuscript.

Specific comments (major)

L. 26 ~ L. 37: The content of the first paragraph of the introduction section is almost the same as that of the abstract, which gives a redundant impression. I recommend writing more general information related to the argument "Understanding the seasonal evolution of Antarctic snow is essential for interpreting satellite observations and quantifying surface mass balance in Antarctica." in the abstract (L. 12 ~ L. 13) here.

Sentence moved to the introduction.

L. 118 ~ 120: Reviews of the previous studies (L. 47 ~ L. 116) are OK. So, why did the authors decide to conduct the FINNARP 2022 expedition? The motivation behind the FINNARP 2022 expedition and the scientific relationship between previous expeditions and FINNARP 2022 are unclear. Please consider describing them.

Related text added ".Aim of the expedition was to characterize and quantify the impact of surface roughness on surface albedo and altimetry-based retrieval of snow elevation over Antarctica. The objective was gathering a unique data set to be analysed for surface roughness scale dependence and directionality." and "Main purpose of the field campaign during the FINNARP 2022 expedition was to collect innovative combination of drone-based data on snow surface roughness and albedo together with in-situ observations of physical snow properties. Drone-based observations on surface roughness have not been made before in the area and drone-based albedo observations were also more extent than existing ones. Spatial coverage was also wide due to measurements at the satellite overpass locations.".

L. 282 ~ 285 and Fig. 12: In some liquid water content measurements for the surface snow, the measured values are positive although the simultaneously measured surface temperature is negative. How can we believe the measured liquid water content is accurate? Please explain.

Temperature was measured typically from the shadow and liquid water content measurement was exposed to solar radiation, which might cause positive liquid water content values. In addition, snow surface temperature was measured on top of the snow and vertical measurement of liquid water content contains snow from topmost ~7 cm, where snow can be more wet due to earlier air temperature fluctuations. However, accuracy of the SnowFork instrument needs consideration, which is noticed earlier by comparing SnowFork density measurements with density cutter measurements in unpublished study.

L 287 ~ 289 and Fig. 13: The purpose of this part is unclear. If the authors want to retain the content, the discussion should be much more in-depth.

We agree that the discussion was not deep enough, and we decided to remove this part.

L. 329 ~ 340: Although snow surface roughness is highlighted in the conclusion section, I could not find a figure showing measured snow surface roughness quantitatively. Please reformulate the conclusion section.

Conclusion is modified, information on surface roughness derivation from laser scanner data is added.

Specific comments (minor)

L. 51 ~ L. 54: The quantitative information here can be more informative if the authors indicate the study period of Reijmer and Broeke (2003).

Time period of used AWS5 observations is added, 1998-2001.

L. 71: What do the authors mean by "fine layer structure"? A complementary explanation is needed.

Changed to "detailed layer structure"

L. 76: For "grain size", it is necessary to specify whether it is geometric grain size or optically equivalent (optical) grain size.

Added "traditional grain size" which means largest extent of an average grain

L. 143, "12 m/s wind speed": What is the measurement level for this wind speed value? Please indicate here.

Wind speed is measured on ground level, related text added.

L. 187 ~ L. 194: Please indicate whether the radiation sensors are ventilated or not.

The radiation sensors were not ventilated due to the power demand being too large for the battery-operated station. The field crew revisited the AWS5 site typically once a week, with a longer break around Christmas and New Year, and ensured that the domes were rime-free. Beyond that, however, it is possible that intermittent riming particularly at dawn/dusk conditions and nighttime is possible. Limiting SZA in analyzable data (e.g. Figure 6) effectively removes most potentially contaminated observations; the few remaining cases are now analyzed in detail (see below). Text is revised to note the lack of ventilation and the regularity of maintenance visits.

L. 189 ~ L. 190, “shortwave and longwave radiation wavelengths”: Please indicate the wavelength range quantitatively.

Revised to “shortwave (280-2800 nm) and longwave (4-50 µm)”.

Figure 6: Albedo data contains some obvious outliers (albedo > 1.0). These outliers and simultaneous downward and upward shortwave radiations should be masked. Another option is to lower the threshold value for the solar zenith angle (currently set at 80°).

In our analysis, these cases correspond to broken-cloud conditions where concurrent enhancement or inhibition of incoming solar flux by cloud shadowing of the direct radiation path and e.g. cloud side reflections combine with alteration of reflected flux by moving cloud shadows in the pyranometer FOV, creating conditions where the measured apparent albedo of fine-grained dry snow may variably exceed 1.0 or be suppressed to 0.8.

The measurement itself is thus intact. But, as this is an effect of the measurement conditions and flux aggregation across the pyranometer FOV’s rather than any material change in the snow, we propose to revise the figure 6 and text so that the cases (Dec 18 and Jan 1) are filtered, but their presence and effect is explained in the associated text as above. For the reviewer’s interest, we enclose a zoomed-in figure of the case on Dec 18 – the high variability in both fluxes is apparent, and being temporally located around mid-day, the possibility of the effect ensuing from e.g. dome riming may be excluded (also note the absence of same effect on the following day). The highly variable effects of broken clouds on the radiation field at ground level are established in the literature. See e.g. Mol, W. and van Heerwaarden, C.: Mechanisms of surface solar irradiance variability under broken clouds, Atmos. Chem. Phys., 25, 4419–4441, https://doi.org/10.5194/acp-25-4419-2025, 2025.

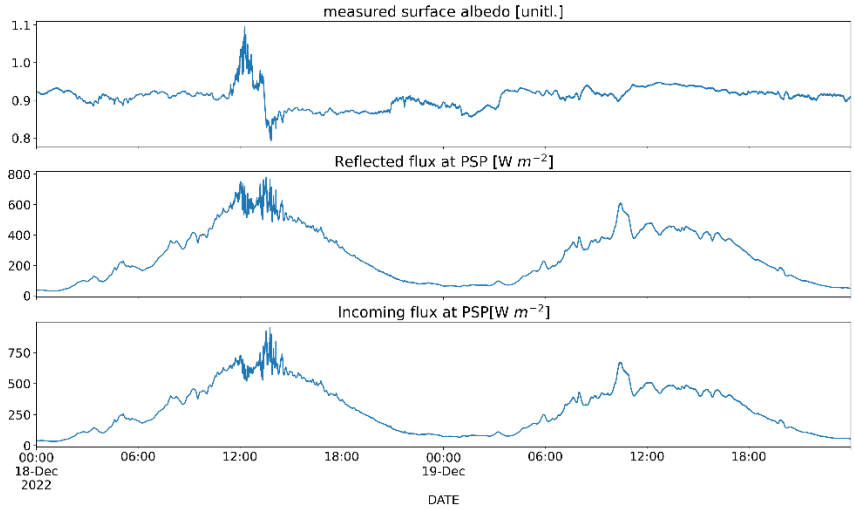

Figure 11: Levels (depths) of the snow density profile measurements should be indicated in the caption.

Interval of the density measurements is added to the caption.

Figure 14: Like the case for albedo (Fig. 6), the presented surface meteorological data contains some obvious errors (spikes), which should be masked in my humble opinion.

If sensor distance from snow surface values has difference to the average of an hour is more than 15 cm, values are now filtered out. Related text added.

Technical corrections

L. 65: It seems to me that Table 1 is not mentioned in the running text.

Correct, added

L. 69 ~ L. 70: Is the description “from the topmost 50 m of the snowpack” correct?

Yes, radar penetration depth was 50m according to the authors.

L. 89: “found” is better than “resulted”?

Changed

Figure 1: An explanation of the red square in the map for the entire Antarctic ice sheet is needed. Also, please describe the satellite data used to show background topography in this figure.

Explanation about the red square is added. Background is combined from optical satellite photos provided by USGS, which information is now better visible in the figure bottom left corner.

Figure 2: Please consider indicating the date when this picture was taken.

Picture was taken 23.11.2022, which is now added to the caption.

Table 2: When Table 2 is first referred to in the running text (L. 127), CM11 has not yet been introduced. Therefore, in the caption, a detailed description of CM11 should be provided.

“CM11 pyranometer” added to the table

L. 150, “(Fig. 3b)”: It is better to indicate it at the end of this sentence, in my humble opinion.

Changed

Figure 5a: Same as the comment on Table 2. Figure 5 is referred to in the running text before the explanation of CM11 is provided.

“CM11 pyranometer” added

L. 227: “Fig. 5d” -> “Fig. 5a”?

Changed

Figure 6: “shortwave” must be indicated in the caption.

Added

Figure 7: Time zone should be indicated in the upper panel of Fig. 7b.

Time zone is UTC time and it is added to the caption.

L. 235: “(Fig. 5c)” -> “(Fig. 5d)”

Changed

Figure 8g: It seems to me that the cross section of the snow sample in the density cutter is not flat (this is an example of measurement failure). I recommend replacing the figure if possible.

Figure changed to better one

L. 252, “grain size”: Please specify whether it is geometric snow grain size or optical snow grain size.

Added “traditional grain size”

L. 254, “SEAR”: It seems to me that its definition is missing in the running text.

SEAR is manufacturer and therefore moved to the parenthesis.

Figure 12 caption: “snow surface temperature (red) and air temperature (light red)” -> something like “snow surface temperature (red circles) and air temperature (light red solid line)”

Changed