In this manuscript, a set of long time series microwave radiation snow observation experiment data obtained in Altay region of Xinjiang during the 2015/2016 snow season were described and discussed in detail, including the test area overview, measurement methods, data arrangement and preliminary result analysis of measurements. This is a very comprehensive and unique measured dataset, these datasets including: microwave brightness temperature data with dual polarization in three bands, snow characteristics data, four-component radiation observation data and meteorological observation data, etc. According to the preliminary result analysis of the measured data, this set of data has very high measurement quality, which is of great value for the better input of snow model development, the verification of simulation results and related snow application. The full text is written in standard English, logical and fluent, with good readability.

Thanks for these constructive suggestions. We have revised the manuscript according to your comments. Please see following point-to-point response.

However, there are the following related issues need to clarify or modify:

1. The standards or specifications for this experimental implementation can be supplemented;

   Re: Thanks for the suggestion. Another reviewer also pointed out unclear description of the experiment, and suggest merging section 2.2 and 2.3. based on your suggestions, we reorganized section 2.2 and 2.3. In measurement of every parameter, we described the instrument, instrument precision, observation frequency, time and observation protocols.

   We do not list out all change. Please see detailed revision in “section 2.2 measurement methods” in the revised manuscript.

2. Please describe and supplement the measurement error analysis and data quality control method of the datasets in detail;

   Re: The data is in situ observation. For the snow pit observation, multiple repeat observation was conducted to decrease the error. For example, the snow density observation was conducted three times. If one of the three value is abnormal, the fourth observation would be performed. The final density is the average value of the three normal values. For the automated observation, the temporal curves were drawn to remove the abnormal values. However, we believe there is more or less errors caused by instruments or manual operations. Moreover, we adopted another reviewer’s suggestion to consolidate data into NetCDF files.

   1) In section 3 Description of released IMCS data

“The ground-based brightness temperatures layered snow temperatures, and 4-component radiation were automatically collected in uniform format” was revised to

L298-305: “The time series of automated layered snow temperature and 4-component radiation data were firstly processed with removal of abnormal values and gap fill, and then were consolidated into a NetCDF file “ten-minute 4 component radiation and snow temperature.nc”. The ground-based brightness temperatures and the formatted weather and soil data requested from ANRMS were provided ‘as is’. Brightness temperature data were divided into time series of brightness temperature and multi-angle brightness temperatures, and separately stored in two NetCDF files, and the weather and soil data were consolidated into a NetCDF file “hourly meteorological and soil data.nc”. Table 3 describes the contents of the provided dataset.”

In section 5 Discussion, we added the uncertainties of the dataset.

2) we added a paragraph in section 5.1:

L450-455: Although the dataset is just for one season observation, the daily snow pit observation with coincident microwave and optical radiation data in a full snow season provide the most detailed variation of snow parameters which allow researchers to find more details in snow characteristics and their relationship with remote sensing signatures. The dataset also fills the snow observation gap in mid-low snow depth area with relative short snow cover duration.

3) we added section 5.2 Uncertainties to present the short observation of L band, no subsurface soil moisture, and the subjectivity of grain size measurement. (L492-509)

5.2 Uncertainties

During the experiment, some uncertainties were produced due to irresistible factors. It is reported that the sampling depth of the L-band microwave emission under frozen and thawed soil conditions is determined at 2.5 cm (Zheng et al., 2019). We did not collect subsurface soil moisture, and the L band radiometer observation began on January 30, 2016. Therefore, it is difficult to obtain the ground emissivity in the full snow season based on the data. The soil moisture data at 10 and 20 cm under soil/snow interface cannot be directly used to validate and develop soil moisture retrieval from L band brightness temperature. We hope detailed soil moisture profile will be observed to estimate the subsurface soil moisture to fill the gap.

The grain size data were collected through taking photos. When measuring the length of grains, the grain selection has subjectivity, and the released data are average values. Although the general variation trend can be reflected by the time series of average grain size, some details might be missed. Therefore, the original grain photos could be provided through requesting for authors. In snow melt period, large liquid water content would influence the measurement results of snow fork. So, it is suggested to use small-size snow shovel or cutter to observe layered snow density in future experiments.

One season observation is quite valuable for developing and validate remote sensing method or snow model, although the representativeness of this observation remains unknown. We need more years of observation to endorse or confirm the evolution of snow characteristics.

3. If possible, some practical application cases study related to this dataset can be added.

Re: Thanks for this suggestion.

We published a paper "Improving the snow volume scattering algorithm in a microwave forward model by using ground-based remote sensing snow observations" in "IEEE Transactions on Geoscience and Remote Sensing", based on this dataset. We used the data to develop a new volume scatter algorithm. The reviewers encouraged us to publish a summary paper to describe this dataset. So we did not describe specific cases, but described the existing application and discussed the possible applications.

In section "5.1 Discussion", we presented existing and possible applications:

"5.1 Applications

Although the dataset is just for one season observation, the daily snow pit observation with coincident microwave and optical radiation data in a full snow season provide the most detailed variation of snow parameters which allow researchers to find more details in snow characteristics and their relationship with remote sensing signatures. The dataset also fills the snow observation gap in mid-low snow depth area with relative short snow cover duration.

The snow pit data and microwave brightness temperatures have proven useful for evaluating and updating a microwave emission transfer model of snowpack (Dai et al., 2022). This dataset reflected the general fact that brightness temperature at higher frequencies presented stronger volume scattering of snow grains, and were more sensitive to snow characteristics. This experiment revealed that the dominant control for the variation of brightness temperature was the variation of grain size but not the snow depth. The largest snow depth or SWE did not correspond to the largest brightness temperature difference between 18 and 36 GHz in the condition of dry snowpack. Due to the growth of grain size, the maximum difference occurred before melting for stable snow cover. Therefore, the daily snow depth variations curve derived from passive microwave remote sensing datasets tend to exhibit a temporal offset from those of in situ observation.

During the snow season, brightness temperatures for both polarizations presented similar variations, but they behaved different in some time periods. The horizontal polarization was more sensitive to environment and was less stable than vertical polarization. Besides, the polarization difference at 18 GHz and 36 GHz showed increase and decrease trends, respectively during the experimental period. The results for 18 GHz were opposite to the simulation results (Dai et al., 2022). The different polarization behavior at 18 and 36 GHz might be related to the environmental conditions, snow characteristics and soil conditions. However, the subsurface soil moisture was not observed, the dynamic ground emissivity could not be estimated. L band has strong penetrability, and the brightness temperature variations were predominantly related to subsurface soil conditions, except when the liquid water content within snowpack was high. Therefore, in the condition of soil moisture data absence, L band brightness temperatures were expected to reflect soil moisture variation which influence the soil transmissivity (Babaeian et al., 2019; Naderpour et al., 2017; Hirahara et al., 2020).

Snow surface albedo significantly influences the incoming solar radiation, playing an important role in the climate system. The factors altering snow surface albedo contains the snow characteristics (grain size, SWE, liquid water content, impurities, surface temperature etc), external atmospheric condition and solar zenith angle (Aoki et al., 2003). Snow albedo was estimated based on snow surface temperatures in some models (Roesch et al., 1999), while others considered snow surface albedo to depend mainly on snow aging (Mabuchi et al., 1997). In this experiment, we obtained the 4-component radiation, snow pit and meteorological data. These data provide nearly all observations of possible influence factors, and could be utilized to discuss and analyze shortwave radiation process of snowpack, and validate or improve multiple-snow-layer albedo models.

Snow grain sizes and snow densities within different layers presented different growth rates during different time periods. Generally, the growth rates are related to the air temperature, pressure and snow depth (Chen et al., 2020; Essery, 2015; Vionnet et al., 2012; Lehning et al., 2002); therefore, this dataset can be used to analyze the evolution process of snow characteristics, as well as validation data for snow models."

4. Page 1: "Involution Processes" should it be "evolution processes"?

   Re: We corrected it.

5. The literature of Dai et al., 2021 is mentioned in the paper, but only the literature of Dai et al., 2020 is found in the reference at the end of the paper, please check.

   Re: We added the reference. Dai et a., 2021 was revised to Dai et al., 2022

   Dai, L., Che, T., Xiao, L., Akynbekkyzy, M., Zhao, K., and Leppanen, L.: Improving the Snow Volume Scattering Algorithm in a Microwave Forward Model by Using Ground-Based Remote Sensing Snow Observations. IEEE Transactions on Geoscience and Remote Sensing, 60: 4300617. doi:10.1109/TGRS.2021.3064309, 2022.

6. In Line 186-189, there are two brightness temperature values in the two polarization of 1.4ghz, and only one value in the two polarization of the other two bands. Please check whether they are correct.

   Re: For 18 and 36 GHz, the sky brightness temperatures for vertical and horizontal polarizations were close to each other.

   To make the meaning clear, we revised this sentence:

   "those were approximately 29.7$\pm$0.3 K and 29.3$\pm$0.9 K at 18.7GHz and 36.5 GHz, respectively."

   was revised to

   L179-180: "the sky brightness temperatures were approximately 29.7±0.3 K at 18.7 GHz for both polarizations and 29.3±0.9 K at 36.5 GHz for both polarizations."

7. Section 4 "Overview of collected Data from IMCS", could it be "Overview and preliminary analysis of collected data from IMCS"?

   Re: We revised the title according your suggestion.

   4 Overview and preliminary analysis of collected data from IMCS

   Based on above comments, this manuscript can be accepted after minor revision.