Earth Syst. Sci. Data Discuss., referee comment RC2
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Comment on essd-2021-286

Anonymous Referee #2

Referee comment on "Snow depth product over Antarctic sea ice from 2002 to 2020 using multisource passive microwave radiometers" by Xiaoyi Shen et al., Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2021-286-RC2, 2021

General Comments:

This paper compared Gradient Ratios and selected the best 37/7 combination of passive microwave radiometer AMSR-E/2 to derive the snow depth over Antarctic sea ice with a linear regression equation based on the Operation IceBridge (OIB) airborne snow depth measurements. Then compared the proposed method with the Cosmic method proposed in 2003 and validated the derived snow depth with self-evaluation of OIB, a few in-situ measurements AADC, shipborne measurements ASPeCt, and the laser altimetry ICESat-2 derived snow depth. After that a daily snow depth data of Antarctic sea ice from 2002 to 2020 (with gap filled with SSMIS) was produced. This work is of great value to derive snow depth over the Antarctic sea ice for nearly 20 years. However, it can be greatly improved after a major revision. My detailed comments are as follows:

Specific Comments:

This work lacks specific month information for all data used throughout the paper, such as in the data description and validation sections.

About the growing and melting seasons, they should be clearly defined in the paper. I'm still doubt the suitability of the proposed method for both growing and melting seasons

since the Eq.1 was derived from the growing season and the evaluation for supporting the suitability was with Aspect and ICESat-2 data. Furthermore, the model values have a clear overestimation than ICESat-2 in Fig.6 and 7.

The scale effect needs to be considered, since the scale of AMSR-E/2 is 25 km grid, ASPeCt is 1 km around the icebreaker, while the footprint of OIB is within 10 meters, and the AADC is even smaller. How would the different scales influence this study?

L74. This part lacks the introduction of ICESat-2

L87.The overlapping tracks and inter-comparison time period of SSMIS and AMSR-E/2 is not clearly introduced. The similar problem in Eq.2 and Figure 2b was also not clearly stated.

L97. Since the sea ice is continuously drifting, which can be several kilometers per day, Section 2.2 should show the overlapping strategy of different datasets from spatial and temporal perspectives. For example, were the OIB snow depth measurements averaged in the overlapping AMSR-E/2 25 km grid in the same day? Generally, how much time difference between the two datasets in the same day?

L117. Why was the OIB data in 2011 not used? Is it because there is no overlapping with AMSR-E/2 in the year? How about the validation of SSMIS-derived snow depth with OIB? I didn’t see it in Section 4 accuracy evaluation.

L148. Does Section 3.1 used both AMSR-E and AMSR-2 GR to correlate with OIB snow depth measurements? Please make it clear.

L192. How about the uncertainty of intercept a and slope b over FYI and MYI respectively here?

L199. About “due to complex surface conditions here”, could you give some evidence to support this statement? Such as show the seasonal spatial distribution of GR.

L207-208. Why is it 6-year combination instead of 7 (2009, 2010, 2012-2014, 2016-2018, as stated in L117)? As we can see the data 2018 missing in Table 2, is it because the data in 2018 less than 80 matched points? I'm confused with the number of grid cells in Table 2. Is it the "matched points"? If it is, why were 2013 and 2017 included?

L217. About “the Comiso method”, please state the rationality to compare the proposed method with a paper published in 2003, nearly 20 years ago.

L243. About Figure 4, is this comparison of data in 2016? Please clearly state the time here. Is Figure 4c the mean snow depth in each year? Why does the year 2013 have an obvious valley? Based on the lower black dashed line in Figure 4c, I wonder why OIB cannot detect snow depth less than ~12 cm.

L293. We may see a clear overestimation for the proposed method in Figure 5, please explain it. We can also see this overestimation when comparing with ICESat-2 from Figures 6 and 7.

For Figures 6 (L316) and 7 (L321), I suggest to add grid information for each satellite and model values for column c.

L326. Figure 8a, please add model values for comparison. Figure 8b, I suggest to use grid-wise comparison instead of monthly mean scatter in order to show more details.

L334-336. There are several weird phenomena in Figure 9 as follows:

- Snow depth increased from spring to summer during a melting period.
- Snow depth in the Weddell West sector decreased from autumn to winter during a growing period.
- The thickest snow depth for the East Antarctic and Bell-Amundsen sea is in summer, the hottest time for the Antarctic.

These issues should be discussed.

In addition, how did you decide the spatial extent of sea ice in Figure 9?

L354. How did you decide the spatial extent of sea ice in Figure 10?

L372. How does the scattering intensity lead to the overestimation? Is this a possible reason for the Figure 9b overestimation of snow depth?

Technical Corrections:

L11. I suggest to add “passive” to “microwave radiometers”. Please check it throughout the paper.

L20. Please specify the “previous method”

L34. The citation “Giles et al., 2018” work mainly uses ERS-2 to retrieve ice elevation instead of snow depth. Another paper of Giles may be more appropriate to be cited here:

Giles, K. A., et al (2007), Combined airborne laser and radar altimeter measurements over the Fram Strait in May 2002, Remote Sens. Environ., 111, 182–194.

L35-36. “long times” to “a long time period”.

L44. It is better to use “in the Antarctic” than “in Antarctica” since we focus on sea ice. Please check the phrase throughout the paper.

L45. “uploading” to “upper”

L59. The citation “Kern et al., 2016” is a wrong one. The right one concentrating on the factor value is in “Kern, S., et al. (2011), An intercomparison between AMSR-E snow-depth and satellite C-and Ku-band radar backscatter data for Antarctic sea ice, Annals of glaciology, 52(57), 279-290”

L60. “successor” to “its successor”

L65. “reliable for estimating snow depth” to “suitable for retrieving Antarctic snow depth”

L79. “in the Arctic and in Antarctica” to “in Arctic and Antarctic.” Please check similar phrases throughout the paper.

L82. About “pre-processing, bias correction and quality control were all applied”, specifically how? Any introduction or citations here would be clearer.

L90 “(lower than or equal to 19 GHz)” to “than 19 GHz”

L93. “in” to “to”

L103-105. The reference “Schenk et al., 1999” for urban elevation DEM measurements should be cited to show the elevation accuracy, thus it should be placed after "1 m and 0.1 m"

L109. “misusing” to “subtracting”

L160-164. Please give the equation of GR here.

L163. What weightings? It is unclear.

L168-169. Is “the root mean square residual” RMSD? If it is, I see it is different from that in Table 1. What is the “standard deviations of the derived regression coefficients”?

L178. “…GR (37/19), which ranked next to GR (37/7), as shown in Table 1” is an inaccurate statement. GR (37/19) was next to 37/11 instead of 37/7. You can say GR (37/19) was the best combination among frequencies no less than 19 GHz.

L185-186. The statement is too simple. Here lacks more spatio-temporal information for data used.

L229. “a factor of 2”, it is 2.3 exactly.

L250. Please show, in average, how many AADC points are used to compute a 25 km grid mean values.

L259. Why the number of grid cells different between the two methods? Please clearly state if data used in this table all from the melting seasons.

L279. “in other seasons” to “in the other seasons”

L286. About “most of the multiyear ice is in the Weddell West”, “the Weddell West is dominated by multiyear sea ice” is more appropriate here.

L357. “method” to “methods”

L424. Delete “is”

L425. “at” to “to”

L446. Add “than the Comiso method” after “performance”

L476. The wrong doi should be https://doi.org/10.5194/tc-13-2421-2019