This paper presents an important work to not only fill in the gaps of the ICESat/ICESat-2 observations on the Antarctica sea ice thickness, but also provide a continuous ice thickness time series showing obvious seasonal cycle characteristics with CryoSat-2 from 2010 to 2021. The authors utilize a physical model and a waveform fitting method that they developed in their previous work to get snow depth and total freeboard, then the sea ice thickness and volume. This work provides a sea ice thickness dataset that could be merged with that derived with ICESat/ICESat-2 to produce a longer-term observations of circum-Antarctica sea ice, which would greatly promote global climate change studies. However, there are some concerns that need to be clarified by the authors before publication.

Major:

It is not clear at which step what parameters are estimated. Generally, there are several parameters involved here: total freeboard (air-snow interface elevation-derived), ice freeboard (snow-ice freeboard elevation-derived), snow depth, and ice thickness. L181 states the ice freeboard and snow depth are output parameters produced directly by CS4WFA? However, L292-293 shows the snow depth are derived from subtracting snow-ice freeboard elevation from air-snow interface elevation. So, my question is what is the input and output between each step in this study? At which step comparing with what reference dataset? I suggest supplementing a flow chart to make it clearer.

In Section 4, authors compare snow depth and thickness with other datasets. why not snow freeboard included in comparison?

L179. About the statement 'Fit parameters are discarded if the result is a "poor fit"', how much data have been discarded and what kind of data are discarded?

The similar question for L213, for what types of waveform, there is no good fit? This is important because it may better inspect the proposed method.

Minor:

L1." a physical waveform model and a waveform-fitting method to estimate the snow depth and snow freeboard" is misleading. What is the relationship between the physical waveform model and the waveform-fitting method and are they used for snow depth and snow freeboard respectively or as a whole? Are they the comprehensive method called CS4WFA?
The sentence is ambiguous.

L3. Is the thickness in "snow depth and thickness" snow or sea ice thickness?

L9-10. Some findings are expected after the sentence. For example, "…, showing the interannual differences between the two kinds of satellites". Or add "Results show that" before "Reconciling…"

L80-82. There may be misstatements on those literatures:

The approach "Worby" in Kern 2016 is a static ratio between sea ice thickness and snow depth, which are seasonal empirical values from ASPeCt, which are ship-based observations.

Li 2018 is a dynamic ratio between snow depth and sea ice thickness, which are initial guess from empirical equations between the total freeboard and snow/ice thickness by Ozsoy-Cicek Burcu, et al; Sea ice thickness retrieval algorithms based on in situ surface elevation and thickness values for application to

altimetry;*Journal of Geophysical Research: Oceans;*2013, 118 (8):3807-3822.

Xu 2022 is an improved version of Li 2018 with a similar strategy.

Wang 2022 uses the same 'Worby' method, i.e., the static ratio, in Kern 2016 for ICESat, while uses snow depth from AMSR-E/AMSR-2 for Envisat-based sea ice thickness retrieval.

So, I suggest the sentences to be rewritten. For example:

"With some empirical parameters, sea ice thickness can be estimated with ICESat/ICESat-2 alone. Regarding sea ice as a single ice/snow layer, the Worby method (Kern et al., 2016) uses a static ice-snow ratio which are seasonal empirical values from the ASPeCt program (Worby et al., 2008). The one-layer method (OLM, Li et al., 2018) and its improved model (OLMi, Xu et al., 2021) are proposed with a dynamic ice-snow ratio for each footprint measurement based on an initial guess from the empirical relationship between snow depth/ice thickness and snow freeboard (Burcu, et al., 2013)."

P18. Figure 7. What caused the uncertainty difference between different sea sectors?
How is the pan-Antarctic uncertainty computed?

L156. Add Ψ after "a physically-modeled waveform" for Eq.2

L158. What is h_{sd} in eq.4? If it is snow depth, should it be h_s according to Eq.1 and Table 1?

L187 R_n should be R_0 here?

Title of Figure 2. For "the daily linear interpolation", to avoid misunderstanding that the dashed lines are derived with daily data, it may be better written as "the linearly interpolated dashed lines between the midpoint dates are used as daily density estimates for the thickness calculation."

L262, h_{fs} should be h_{fs}. Is there system uncertainty for snow freeboard in Eq.7?

L290. Section 4.4 missed in this sentence.

P15. Figure 4. Are the vertical dashed lines mean values? Can the mean, std, and model values in each season/month be put on the map? The same with Figure 5.
The position of figure 4 is better to be close to the text in Section 4.1. The position of Figure 8 can also be adjusted.

L366. The exception is not only Ross Sea. Am-Bel is 4 cm thicker in spring than summer.

L384. The last word "that" is 'than'?
L395. "thinner that" to "thinner than"

P21. Figure 9. Use different colors to differentiate decreasing and increasing regions instead of the uniform grey?

L476. About the discussion of the radar-laser difference in this section, another possible reason may be the high spatial resolution of ICESat/ICESat-2 than the grid/segment-averaged coarse resolution CryoSat-2. The

lower resolution may smooth higher or lower signals values.

P25. The legend in Figure 10 is "Sea ice thickness derived with CryoSat-2 snow depth" instead of "CryoSat-2 snow depth"?

L701-703. The citation of Meredith 2019 can be improved according to their suggestions: https://www.cambridge.org/core/books/ocean-and-cryosphere-in-a-changing-climate/polar-regions/8D76B8865B796C16991F7A9FB6271C2D