Comment on tc-2021-381

Anonymous Referee #3

Referee comment on "First results of Antarctic sea ice type retrieval from active and passive microwave remote sensing data" by Christian Melsheimer et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-381-RC3, 2022

Review of "Antarctic sea ice types from active and passive microwave remote sensing" by Melsheimer et al.

Summary

 This manuscript describes a method to retrieve three Antarctic sea ice types from passive microwave and scatterometer data: young ice, first-year ice, and multiyear ice. The approach adapts the ECICE method originally developed for the Arctic. Corrections are made for temperature and ice motion to improve performance. Comparisons are made with SAR data and ice chart stage of development fields. The ECICE fields generally compare well, but there are some discrepancies, notably the "formation" of MYI in July in the outer Ross Sea. The authors hypothesize that this is due to snow metamorphosis on FYI that results in a MYI-like signal. Other errors occur due to motion tracking errors.

General Comment

An Antarctic MYI data product is a great contribution. As the authors note, it is challenging to create such a product. The general approach here is a good one. The authors adapt the ECICE method that has been successful in the Arctic. The method appears to work well based on initial comparison with SAR and stage of development ice charts. The comparisons are generally qualitative in nature. I think that at this point, introducing a new method, this is okay. It is hoped that the authors will follow up this work with more quantitative comparisons to develop statistical error estimates. And it is hoped that the data set is expanded to a longer time series in future work. One thing that would help with the qualitative comparisons is if the SoD images could be custom made with a color scale indicating only the three ECICE ice types. This is discussed further in the comments below. But I'm not sure how feasible or easy this would be with the SoD fields. So, I don't think this is essential, though it would make the results easier to interpret. The other issues are all quite minor. The writing is good and the figures are otherwise well done. I recommend acceptance after minor revisions.

Specific Comments (by line number):

51: One reason why most MYI is in the Weddell Sea is that the gyre that transports MYI away from the coast to the north and northwest also transports in ice from the north and northeast. This is seasonal ice that gets transport into the Weddell, where it compacts along the ice shelve and Antarctic Peninsula and, along with less solar insolation and colder temperatures, allows that FYI to survive into MYI. This seems a salient point to make here as it is the mechanism to form MYI.

90-92: No SSMIS sensor data are used?

174: How is the "beginning of the cold season" defined? Is it the minimum total extent? But at the minimum, there may be regional gains and regional ice losses occurring (the minimum marks when the gains start to outpace the losses). Ideally, you would use the minimum at given grid cell or at least regionally.

187: How accurate are the ECMWF 2 m temperatures over the sea ice? There are several coastal stations that I assume provide observations, but over the sea ice, the observations are quite sparse, with few buoys (compared to the Arctic). It is reasonable to use ECMWF as that is what is available and better than nothing. But I think a mention on potential uncertainty is worthwhile here.

188-189: And likewise for the ice motions. Antarctic motions typically have higher errors because of the variability of the ice (flooding ice, etc.) and lack of buoy validation. Again, don't need to go into great detail, but a comment on the uncertainty would be helpful.

234-235: In what format are the SoD charts provided? It seems they are used here merely qualitatively. If they are just images, that makes sense. But if they are in some sort of data format (e.g., GeoTIFF), they could be used to do some quantitative comparison with the ECICE. And also, as noted below, they could be manipulated to consolidate the different ice classes into the main three with a clear color scale to more easily visually compare with ECICE.

236, Figure 2: This figure seems a bit odd and confusing to me. It seems like there are two SAR images overlaid on the ECICE image. But they overlay, so block the ECICE. Once can see some continuity, so the performance looks reasonable, but it seems odd to show only one figure with one or the other (SAR or ECICE). The ECICE color scale seems to have several more gradations than the 5 indicated in the legend. The legend color scale should match the colors plotted. It seems like creating a two-panel image – one with the ECICE and one with the SAR images and then overlay the contours on both – would be clearer?

239, Figure 3: I guess it is okay to have the SoD color scale in the Appendix – at least the authors acknowledge that it isn't legible in the figure. But ideally, a better color scale

would be included/added to the figure. And it's clear that the SoD figure has more categories than the ECICE, so it is a bit hard to directly compare, though the overall patterns are clear. It would be more work, but if it were possible to actually take the SoD and create a custom plot with the SoD categories combined into the three ECICE categories, that would be quite helpful.

267, Figure 5: As for Figure 3, it would be nice to have SoD in a simplified form with all types consolidated into the three ECICE types and with a color scale legend provided with the figure.

Minor Comments (by line number):

45: I've seen "snow-ice" with a dash to connect the two nouns and denote a unique type. But this is perhaps simply more of an editorial/style decision.

114: Typo, "cost" not "coast"

174: Not sure why the ASI reference is given as a footnote? If that is The Cryosphere style guideline, I guess that's okay, but in my view, datasets should generally be cited as regular references.

346: It seems like the chart color legend (Table A1) should be after the beginning of the Appendix text? But as noted, it would be helpful to create a new legend that combines the relevant classes into the three main types for the figures in the main text of the manuscript.