

Earth Syst. Sci. Data Discuss., referee comment RC1
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Comment on essd-2021-279

Anonymous Referee #1

Referee comment on "A temporally consistent 8-day 0.05° gap-free snow cover extent dataset over the Northern Hemisphere from 1981–2019" by Xiaona Chen et al., Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2021-279-RC1>, 2022

General Comments:

Chen et al., 2021 derive a spatio-temporally complete 5km NH snow cover extent dataset through an aggregation of multiple remote sensing-based gridded products and ancillary datasets. Through their data generation methodology and decision-tree approach to snow classification, the authors derive the GLASS SCE dataset which is then compared with in situ GHCN station observations, the MOD10C2 gridded SCF product and the CLARA-A2-SAL surface albedo dataset. While GLASS SCE demonstrated some skill in capturing climatological SCE when compared to gridded products, there remains a strong spatial bias across much of the NH (especially when compared with in situ observations). While the paper provides a clear narrative, with excellent sources and a promising resulting dataset, I would recommend the authors make some changes to the main Figures and consider a temporal bias analysis before I can fully recommend the paper for publication.

Major Comments:

- While I appreciate the amount of work done comparing the spatial biases of your product, I feel the paper should also include a temporal analysis. Since you have a data product spanning some 39 years, I would expect the SCE biases to change as a function of time. It is already clear that spatial biases exist and this may provide additional insight into where these biases come from and why they exist. Specifically, I would strongly recommend the authors produce an annual and monthly climatological analysis between CLASS SCE, GHCN and MOD10C2 as a new section in the results.

- While on the topic of biases, it is slightly concerning to me that the product has such extreme biases (over 50% of the SCF differences are > 5%) with the majority positive, when compared to in situ. While the authors briefly explain this error as "reasonable in snow-related studies", and an expected consequence of "the coarse spatial resolution of the GLASS SCE" (ie. the grid to point comparison problem), I am not convinced by these claims/arguments (both of which lack references FYI). I would like to see the same comparison done between GLASS SCE and GHCN data done between MOD10C2 and GHCN to provide a baseline of what to expect with an established product. I think it would also be worthwhile to perform this analysis using a subset of the products/steps described in Fig. 2. Is there a way in which you could leave certain products out to help better identify where the bias may be coming from? Or what about performing a sensitivity analysis of the thresholds used in Fig. 3? I think additional analysis along these lines needs to be completed before the authors can make the claims they make about strong skill and overall product accuracy.

- Finally, while the paper is actually quite coherent, the figures need some work (and a bump in resolution, they are all fairly low quality which makes it hard to note visual details in the maps) I have compiled all of my thoughts on figures here.

- Fig 1: Shrink the size of the station dots, or perform plotting which shrinks dots that are tightly clustered (ie. near the Canada/USA border and Norway/Sweden)
- Fig 3: What do the colors represent? Why are some nodes green and blue?
- Fig 4: Why are many of the GHCN stations now missing here? Ie. Eureka, Alert in the CAA and much of Europe? Are we still talking about 562 stations with these results? Additionally, the dots are too big here, refer to my comment on Fig 1.
- Fig 5: Dots again too large in 5a; Why are you applying a linear fit to the data in 5b? It certainly appears nonlinear; Also, what are the pixels with 100% SCF in 5b?; Can you increase the number of bins in 5c? I'd like to see the histogram with more detail; I'd also like to see a figure showing the mean bias as a function of latitude to help support your claims about a latitudinal bias.
- Fig 6: This should be removed as you really only need Fig 7a. The differences are too hard to note at this resolution for such a wide scale.
- Fig 7: Titles. Can you add figure titles? It is annoying to constantly jump to the text or description to read what I am looking at; 7b; What do the colors represent? Are they the grid-cell biases? Also I feel these axes should be reversed with GLASS on the X. 7a, why does Greenland have horizontal banding on the interior?
- Fig. 8: Titles again please. 8a a red-green color scheme is changing for people with colorblindness, just use a white -> red color scheme or something. 8b., why are you saturating values between -0.5 and 0.5 when you are talking about correlations near 80 percent in the text? You should have this set to -1/1.

Minor Comments:

- The introduction is a bit verbose. Lines 40-55 and 80-100 could likely be summarized in a sentence or moved to a reference

- Line 120 "has calibrates different"?

- Section 2.1.3, where/how is the elevation dataset used? It is briefly mentioned here but then no where else really?

- Lines 180-185. Do you consider the impacts of ablative processes in this portion of the analysis? While a simple temperature-index approach like what you are using may work, are you missing impacts from sublimation, redistribution etc.?

- Line 209. "we used cubic-spline in the resampling process". What do you mean by this? You are performing a resolution upscaling of data products with this method correct? This is an entire field of study and a very challenging problem with many uncertainties. You should provide further details/references here and likely dedicate a portion of the discussion to uncertainties/errors around some of your data processing decisions.

- Line 215. Could you provide additional details into how these values were derived in the text? I am curious as these will have a large impact on your final SCE values.

- Line 292. "form" -> "from"?

- Line 297. I just want to confirm you are still using all 562 GHCN stations, correct? As stations are missing in your Figures as previously mentioned.. Also is the confidence interval 1 or 2 SD?

- Line 303. Again, I don't know if a linear relationship is really appropriate for this data. To me it seems to follow more of a logarithmic distribution. You may need to do a log-norm of the data first before comparison.

- Line 310. Have you considered that most of the low bias stations are along the Canada/US border? Are these differences due to different measurement techniques from different institutions as this may bias your results? A few additional details of the GHCN dataset may be necessary. Perhaps you could separate by agency and preform comparisons on an agency-basis to see if there are differences.

- I think this manuscript would really benefit from a discussion on uncertainty/error in the data being used, station differences, your aggregation methodology etc. GLASS certainly displays a positive bias as you have shown and I'd like more explanation into where/why this bias is coming from.

