Response to reviewers

Line numbers mentioned in this reply refer to our clean version of the revised manuscript.

Reviewer #1

The QScat data set was tried to download, but failed. The web page display "403 Forbidden". Whether this data can be downloaded publicly now or not

Reply: We tried to download our data set immediately after receiving this comment, and we confirm that the dataset is downloadable. We then contacted the figshare team, and they also confirmed it.

The 403 error is a user-end error. When it occurs, all datasets (not just ours) deposited on figshare become unavailable for downloading possibly due to the user's internet issue.

Our data have been downloaded for more than 130 times by readers worldwide since we submitted to ESSD (shown on the our figshare website).

We are therefore led to conclude that the dataset is public.

It is suggested authors to draw the spatial distribution maps of CScat, ERS/ASCAT, QSCAT data and compare their spatial distribution difference.

Reply: We very much appreciate this suggestion but would like to exchange more with referee #1 on which kind of "spatial distribution difference" is needed here. The main difficulty we encountered when addressing this comment is that we are dealing with time series radar signals, thus not sure how to effectively compare the spatial distributions of time series signals.

Maybe referee #1 means that we should draw the spatial map of the merged CScat (now named as LHScat) in a certain month, and check it against the ERS, ASCAT, or QSCAT data from the same month. This can be done. However, CScat was created by merging ERS, ASCAT, QSCAT data. If we show the spatial distribution of CScat in e.g., 1993.06, it will be exactly the same as ERS in 1993.06.

Maybe referee #1 means we should average all the monthly images, then compare the averaged images among ASCAT, QSCAT, etc. This can be done too. However, as stated earlier, we are dealing with time series signals that are changing through time (as shown in Fig. 5 in the main text). ASCAT values are obtained during 2007-2022, and QSCAT between 1999-2009. As time changes, there will be certainly some differences in the values per se.

Maybe referee #1 wanted a map of the spatial distribution of the data merging quality? However, this has been shown in Fig. S3.

We would also like to clarify that the aim of our research is to merge temporal signals. We have therefore put an utmost emphasize on validating the inner temporal consistency of the signals (as shown in Figs. 5, 6, 7, and 9). We have demonstrated strictly that the merged radar signals do not have a sensor shift, and this apparently has been recognized by the other two reviewers.

Due to these reasons, we will be glad to add additional figures if further information can be provided by referee #1.

Comparing with radar backscatter dataset with monthly scale, the radar backscatter dataset with daily scale will be more useful for applications of vegetation, soil et al,. It is suggested that authors publish dataset with daily scale first, then the dataset with monthly will be synthesized.
Reply: Thank you. Maybe we didn't make it clear enough in the last round of revision, but there are several reasons we chose the monthly temporal resolution:

First, there is a balance between spatial and temporal resolution. As you know, most microwave dataset has a ~25km resolution, and the low resolution limits their utility. Here, CScat has a resolution of ~8.9km, an almost three-fold increase. This is achieved by using the BYUdeveloped Scatterometer Image Reconstruction (SIR) with Filtering (SIRF) algorithm (https://www.scp.byu.edu/docs/EnhancedFAQ.html). SIRF combined multiple-orbit passes from multiple days to get a fine spatial resolution. As a result, daily images are not possible except for the polar regions.

In short, between daily images with a sparse spatial coverage, and monthly images with a largely enhanced spatial resolution and a full global coverage, we chose the latter. This point has been added into the main text (lines 41, 115-122).

Second, daily images do not have a full global coverage. This point has been stated in the previous round of revision.

Third, we are not sure daily images are always more useful than monthly ones: it all depends on the purpose of a research. Monthly images have been frequently used by existing global-scale studies. This point has also been stated in the previous round of revision.

We hope the clarifications make sense to referee#1, and will be glad to exchange more if referee#1 is willing to.

Reviewer #3

Thank you for addressing my comments and your effort to improve the article! I have only minor comments and suggestions.

Response: Thank you for reviewing again our manuscript, and for providing very positive evaluations. We have addressed the minor suggestions. Please see below for a point-by-point response.

Minor comments:

1. Spatial sampling vs spatial resolution - please clarify

- p2 - l43 and p2 - l68: 8.9/4.45 km is the spatial sampling distance and not the spatial resolution, right?

- p4 - l127: spatial sampling or spatial resolution?

- p4 - l129: 8.9 km - spatial sampling or spatial resolution?

- p17 - l536/l542: 8.9/4.45 km - spatial sampling or spatial resolution?

Response: Thank you for this insightful comment. There is indeed large difference between sampling and resolution for radar data. Normally scatterometers do not get images directly. Instead, they sample signals from the swath which can be several hundred kilometers wide. Then from the sampled signals images can be produced with a resolution. The BYU version scatterometer data were created using the Scatterometer Image Reconstruction (SIR) with Filtering (SIRF) algorithm, which works on the samples but downscales the signals to a higher resolution (please check https://www.scp.byu.edu/docs/pdf/QscatReport6.pdf especially Figs. 3 & 9 in it). We therefore tend to call it "resolution" to be consistent the BYU data center.

2. Decision tree regression

- p9 - l270: I like the graphical example, can you gain any insights by looking at the structure of the decision tree model globally (besides the predictor-importance in Figure 8)?

Response: Indeed, we also found the structure of the tree interesting. We now calculated whether the first branch node of the tree coincident with the most important variable as calculated by "predictorImportance". We found almost the same results, which have been shown in Fig. S4 and mentioned in lines 265-268, 337-340.

- p10 - l306: "equivalent" sounds quite strong, maybe use 'into a "substitute" C-band signal'

Response: Thanks. We changed as suggested.

3. Editorial/typo

- unit/dB missing: p11 - l351, p12 - l367/l368/l369

Response: We have corrected this issue here and throughout the manuscript, thanks!

- p17 - l556: blank "and__efforts"

Response: We have corrected it, thanks!

Suggestions:

1. The new title is better, maybe more catchy:

- A Global Satellite Radar Backscatter Data Record (1992-2022+): Merging C-band ERS/ASCAT and Ku-band QSCAT

Response: Thank you for the very helpful suggestion. We have adopted the title suggested by you after adding "long-term, high-resolution" to it. Most microwave datasets have a 25 km resolution, and the low resolution limits their utility. Here, our dataset is ~8.9km. This was achieved with the cost of a reduced temporal resolution, which is also one of the reasons why we merge the signals at the monthly temporal resolution. We have taken this chance to further clarify this point in the revised manuscript (lines 114-122).

2. Probably the CScat dataset name is already well established, but in case you want to reconsider focus on long-term or merged radar backscatter instead of C-band only

- Long-term Scattermeter data - LTScat

- Long-term Radar Backscatter data - LTRB

- Merged Radar Backscatter – MRB

Response: All the three are good. We slightly modified the first one by emphasizing the high resolution of our dataset, as explained above. Thus, we now call it "LHScat", which stands for Long-term, High-resolution Scatterometer data. We changed the associated sentences and Figs. 2 & 9.

Again, thank you very much for the very helpful suggestions!