Anonymous Referee #3

Which global reanalysis dataset represents better in snow cover on the Tibetan Plateau? This study comprehensively evaluated the snow cover fraction (SCF) of eight reanalysis datasets over the Tibetan Plateau based on selected remote sensing products. The authors found that each dataset demonstrates distinct characteristics in describing the SCF. Combining interpolation of atmosphere variables and parameterizations, the authors systematically investigate potential causes of SCF disagreements among these datasets. Additionally, an ensemble algorithm was developed to optimize SCF. In addition to being appropriate for The Cryosphere, this article offers significant implications for future research on data guidance. I could recommend publishing the manuscript in The Cryosphere after essential revisions.

R: We greatly appreciate your positive evaluation and constructive suggestions. These feedbacks have significantly contributed to improving the quality of the manuscript. We carefully read each comment and made corresponding adjustments and enhancements to the manuscript. Here, we would like to note that all results in the manuscript have been reprocessed according to the comments of you and other two anonymous referees, with a unified time range of the Water Years 2001–2017 and consistent spatial resolution of 0.5°×0.5°. Meanwhile, descriptions of the results have also been adjusted accordingly. Below are our specific responses to each comment, prefaced with "R:".

Major comments:

1) Language

I strongly agree with reviewer #1 that the language needs to be significantly improved. I'm not a native speaker, so I leave the work to the authors.

R: According to the suggestions of anonymous referee #1 and #2, we have made

substantial revisions to the manuscript language. These revisions encompass improvements in word usage, methodological implications, and the logical presentation of results.

2) Reference datasets

The data assessment and manuscript quality are largely based on the SPIReS dataset. It would be helpful if the authors could provide further clarification regarding this dataset's representativeness. Why is SPIReS chosen as a reference here? At the very least, a summary review of RS products is needed.

R: Remote sensing methods are continuously evolving, from traditional MODIS SCF band ratio methods to spectral mixture methods, and further to more advanced spectral unmixing methods. In a comprehensive evaluation conducted by Stillinger et al. (2023) utilizing airborne lidar datasets for subcanopy snow mapping performance over mountain areas in the western United States, spectral unmixing-derived data (including SPIReS and MODIS Snow-Covered Area and Grain Size, abbreviated as MODSCAG) exhibited lower bias and Root Mean Square Error (RMSE) compared to data derived from band ratio methods and spectral mixture methods. Moreover, unlike MODSCAG, SPIReS incorporates the influence of light-absorbing particles on snow, leading to more accurate SCF data. Therefore, we have used SPIReS SCF data as the reference dataset for the manuscript. Furthermore, we have added more descriptions of this data in section 2.1.1.

It would also be nice to add SPIReS (and TPMFD) to Table 1.

R: The SPIReS SCF data is derived using remote sensing methods, while TPMFD is a multi-data merged dataset. The production processes of these two datasets differ significantly from those of reanalysis datasets. As a result, we are only able to provide information on the temporal coverage and spatial resolution of SPIReS and TPMFD in Table 1, rather than covering extensive details in the table. Therefore, we have added

substantial descriptive details about these two datasets in sections 2.1.1 and 2.1.3 to enhance readers' understanding.

3) Manuscipt structure

Sec. 3 Results

Please make the results sharp and use numbers to promote your results. Generally, the results section lacks qualitative descriptions and remains subjective. Please leave the discussion to the discussion section and present only results here.

R: We have increased the frequency of using numerical descriptions to present the results as suggestion. By employing this approach, we aim to present the manuscript results in a more quantitative manner, thereby avoiding subjective judgments. Since we cannot quantify the impact of snow data assimilation on the accuracy of the SCF simulation in reanalysis datasets, we attempt to understand its influence on the analysis of SCF errors through separate paragraphs of discussion. There is no interspersed analysis with the impact of meteorological forcing during the analysis of SCF errors.

Sec. 5 Conclusions

Generally, the conclusions are very specific and lack an overall assessment of the performance of state-of-the-art reanalyses. Furthermore, the conclusion and summary are largely similar to the abstract.

R: We have revised the descriptions in the conclusion and abstract. In the conclusion section, we provide specific descriptions of the performance of each reanalysis dataset in terms of the spatial distribution and annual trends of SCF, as well as the dominant factors influencing their biases. Additionally, detailed descriptions of the optimization results for the datasets are provided. Following your suggestion, we have also included an overall assessment of the optimal performance dataset in simulating SCF in the conclusion section. In the abstract section, we focus more on looking at all the reanalyzed datasets as a whole to describe their situation on the simulated TP SCF.

Specific comments:

L22: Please define ERA5L

R: After revising the language in the abstract, we think that providing the abbreviations of the reanalysis datasets may be appropriate.

L71: Please add relvelent reference here.

R: We have added three additional references to support the statements of manuscript, namely Lin and Wu (2011), Thackeray et al. (2016), and Wegmann et al. (2017).

L109: from 2 to 26 cm

R: We have revised as suggestion.

L173: HTESSE"L"

R: The abbreviation error has been corrected.

L225: Please provide the full name of the CRA-Land dataset, similar to the other reanalysis datasets mentioned in the manuscript.

R: Thank you for suggestion. This was an oversight on our part. We have now included the full name of CRAL.

L240: Important infomration of TPMFD dataset is not availbale. What variables are used in this data, what is the resolution and temporal coverage, how is snowfall derived, etc. This could be easily done by adding TPMFD to table 1.

R: As mentioned earlier, we have added details describing the temporal coverage and spatial resolution of the TPMFD dataset in section 2.1.3. To acquire snowfall data, we employed a dynamic threshold parameterization scheme to convert precipitation data from TPMFD into snowfall data (Ding et al., 2014). These additions have also been

incorporated into section 2.1.3.

L372: Jiang et al., 2020 reported to the significant simulation biases for SCF over the TP. Please consider citing here.

R: Due to the significant structural changes made to section 3.1.2, we have cited the reference at L504 of change-tracked manuscript in accordance with your suggestion.

L404: Remove "This suggests the presence of another significant factor that is responsible for the overestimation of SCF in JRA55"

R: We have removed this sentence as suggestion.

L413: change "the important role of" to "the importantance"

R: The analysis of the primary factors influencing the spatial distribution bias of SCF in the JRA55 simulation has been relocated to L558-574 of change-tracked manuscript. We have changed the statement at L573 in change-tracked manuscript accordingly.

Table 1: Please also add the reference dataset here.

R: We have added a column for references in Table 1 as suggestion.

Figure 2: "Tibetan Plateau region" is used in many figure captions. Please remove the "region" and revise throughout the manuscript.

R: We have removed the "region" from all figure captions in the manuscript.

Figure 4: Instead of using both, I suggest using Autumn/Winter/Spring/Summer or SON/DJF/MAM/JJA.

R: Thank you for suggestion. We have standardized the seasonal labels in Figure 4 to SON/DJF/MAM/JJA.

Figure 6: To improve the compariability, I would suggest changing the y-axis range of subpolt b the same.

R: We have replaced the original form of Figure 6b with a consistency index plot of reanalysis datasets and SPIReS annual trends. In this new figure, there is no longer an issue of Y-axis range affecting comparability. However, following your suggestion, we have made the Y-axis range consistent in Figure 2c which is Taylor Skill Scores (SS) plot for each basin overlain on a map of the TP.

Figure 10: the abbreviation for the reanalyzed dataset is not given.

R: We have added the abbreviations of the reanalysis datasets in the caption of Figure 10.

References

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Lin, H., Wu, Z., 2011. Contribution of the autumn Tibetan Plateau snow cover to seasonal prediction of North American winter temperature. Journal of Climate 24, 2801–2813. https://doi.org/10.1175/2010JCLI3889.1

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