Anonymous Referee #1

Which global reanalysis dataset represents better in snow cover on the Tibetan Plateau?

Yan et al. analyze snow cover fraction from various global reanalyses and one specific snow reanalyses for High Mountain Asia, and relate this to remotely sensed snow cover fraction and a regional meteorological dataset. The study has some potential, however, in the current stage of the manuscript I am not willing to do a full detailed review until basic scientific principles are adhered to (see major points).

R: Thank you very much for your feedback and constructive suggestions. They will significantly enhance the scientific quality and language expression of our manuscript. We have carefully read through each comment and made numerous revisions to the language and methods. We look forward to the revised manuscript meeting your standards and eagerly await your further review. The followings are our point-by-point responses to the comments. Our responses start with "R:".

Major points:

Introduction has many inaccuracies, and I stopped at around L70 (see also minor points below).

R: We have made great revisions to the language and expressions throughout the manuscript, including refining imprecise terminologies in the introduction, correcting scientifically inaccurate viewpoints, and rectifying citation errors. We hope that these modifications meet your standards.

Methods are incomplete to evaluate the manuscript: study area, hydrological basins, temporal period, how was snowfall derived from TPMFD, how were the datasets on different resolutions merged, definition of hydrological year (if any), and more.

R: Following your suggestions, we have added a section on the study area in section 2.2. This section primarily introduces the methods and data used to define the TP region, including the methods and data for defining the nine hydrological basins within TP. In the data section, we have reprocessed all results in the manuscript, standardizing the time range to Water Years (WYs) 2001–2017 and spatial resolution to 0.5°. Corresponding adjustments have been made to the description of the results. Additionally, when describing the TPMFD dataset, we have added the process of converting its total precipitation into snowfall. In the methods section, following the suggestion of anonymous referee #2, we have added details on data evaluation methods. Furthermore, we have organized the methods used for error source analysis and optimization of reanalysis datasets into section 2.3.2.

I'm not sure about the research aims. If HMASR is the only reanalysis from all studied that assimilates MODIS observations, and MODIS is used for evaluation, then the expected results are rather obvious.

R: The aim of this manuscript is to assess the SCF performance of multiple reanalysis datasets over the TP. However, it goes beyond mere assessment. Our manuscript also aims to explore the main factors contributing to SCF biases in different reanalysis datasets and to optimize SCF accuracy through the combination of multiple reanalysis datasets. Of particular interest is HMASR, which stands out among reanalysis datasets as it is specifically made for TP snowpack (Liu et al., 2021). Hence, it does a lot of careful design, including the assimilation of accurate snow data. HMASR assimilates SCF data from MODIS and Landsat obtained by spectral unmixing methods, but it is still influenced by errors in meteorological forcing inputs and land surface models during the reanalysis process. The quantitative assessment results remain to be determined. As expected, quantitative analysis reveals that HMASR emerges as the top performer in spatial simulation among reanalysis datasets, with significant improvements attributed to its snow data assimilation. However, in terms of annual trends, HMASR is more affected by meteorological forcing inputs, resulting in only moderate CI values. Furthermore, combining HMASR with the GLDAS yields even more accurate SCF spatial simulations.

Minor points:

L50: I would assume glaciers are more sensitive to long-term climate changes. Snow cover is extremely sensitive to year-to-year variability. And because of this strong interannual variability, less to long-term changes.

R: We agree with your viewpoint. Additionally, variation in snow cover over the TP is a key component of climate change and variability, and critical for many hydrological and biological processes (You et al., 2020). We have revised the relevant statement in L65 of change-tracked manuscript.

L54: Beniston et al. 2018 deals with European cryosphere, not TP.

R: Thank you for suggestion. We have replaced "Beniston et al., 2018" with "Yang et al., 2019", which also guides us to be more rigorous in future research work.

L60: SPIReS is not a product, but a spectral unmixing method. And Stillinger et al. 2023 recommend spectral unmixing in general, not SPIReS in particular.

R: We have removed the word "product" and revised the statement to: "The Snow Property Inversion from Remote Sensing (SPIReS) then uses a more advanced spectral unmixing technique that provides improvements to SCF estimates (Bair et al., 2021)". Additionally, we have removed the relevant description of Stillinger et al. (2023) from the introduction and incorporated it into the description of SPIReS in Section 2.1.1 in a more rigorous manner.

L69: There are no "global" meteorological agencies. Just regional, at best supranational, which produce the reanalyses.

R: I would like to explain that there was an error in our English expression here. What we meant was the major meteorological agencies around the world, not "global" meteorological agencies. We have made the correction in the manuscript.

At this point I grew tired of the introduction: Please check the accuracy of your statements. And in particular against the references you cite.

R: We have not only worked out the issues you pointed out, but have also checked the entire manuscript for relevant errors. We look forward to your further review.

Table 1 and related text: Please explain why you defined the SCF parametrization for ERA5, ERA5L, MERRA and JRA as you did.

R: We have added references to all publicly available reanalysis datasets' SCF parameterization methods in Section 2.1.2 as suggestions.

L255: Taylor diagrams do not evaluate spatial correlation.

R: We have removed the term "spatial" when describing correlation coefficients in both the methods and results sections. Additionally, in the Methods section 2.3.1, we have added the calculation methods for the three Taylor diagram indicators to enhance reader comprehension of the results.

Data and methods: Missing study area and period of analysis.

R: As explained above, we have added details about the study area and time range in the Data and Methods section.

L265: Unclear how you applied the CI, since it requires a common grid, and all your datasets come with different resolutions.

R: Once we standardized the spatial resolution of all datasets, this issue was easily resolved.

Results: Where do the basins come from? Please introduce in methods.

R: Thank you for suggestion. We have added the definition of the basins in Section 2.2.

HMASR covers only partly of the 2001-2020 period you used for the other datasets. Why not make a common period? As it is, you introduce artifacts with different periods.

R: We have standardized the study period to WYs2001–2017 based on the time coverage of all datasets as suggestions.

References

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