Comments from Referee #1, followed by the authors' responses

C: In this study, the authors identified gaps in glacier mapping on the southeastern Tibetan Plateau due to high cloud and snow coverage in this region. They developed an ensemble learning-based random forest classifier using Landsat, Sentinel-1, Sentinel-2 and NASA DEM data to automatically delineate glacier extents from 2016 to 2022. They then extended this inventory to 2000 by combining the manually mapped glacier outlines in 2000, 2005, 2010 and 2015. They also provided glacier mass balance information based on satellite altimetry data. Overall, the glacier outlines provided in this study for the southeastern Tibetan Plateau form a useful baseline dataset. The methods developed in this study can also be extended to other regions with high cloud and snow coverage. This manuscript is suitable for publication in The Cryosphere. I recommend making the following improvements:

R: We sincerely thank you for your thorough review and constructive feedback. In response, we have revised the manuscript to improve clarity, rigor, and presentation. Specifically, we updated the title and terminology for consistency, standardized units, specified spatial resolution and data sources, reorganized sections for better readability, expanded the results, enhanced figure clarity, and refined references and citations. These revisions strengthen the manuscript and better highlight the significance of our study. A detailed point-by-point response to your comments is provided below.

C: Title: How about to change "Tibet" to "Tibetan Plateau" in Title and other places?

R: We appreciate your suggestion. We agree that "Tibetan Plateau" is more precise and commonly used in the scientific literature than "Tibet." Accordingly, we have revised the title and all relevant occurrences in the manuscript to "Tibetan Plateau."

C: "achieving the first annual-resolution glacier inventory in the region", suggest adding the spatial resolution here.

R: We appreciate your suggestion. We have added the spatial resolution to the text. The revised sentence now reads: *"…producing the first multi-temporal glacier inventory in this region at a spatial resolution of 30 m."* (Line14)

C: “constructed glacier inventories for 2000, 2005, 2010, and 2015”, it is possible to find the available data for so dense time interval?

R: Thanks for your comment. We fully agree that obtaining consistent, high-quality remote sensing data in the southeastern Tibetan Plateau is a long-standing challenge due to persistent cloud cover and complex terrain. To address this issue, we incorporated all available satellite observations (Landsat-5 TM, Landsat-7 ETM+, Landsat-8 OLI, and Sentinel-2 MSI) and applied a unified processing workflow, including strict cloud/snow masking, multi-temporal compositing, and uniform classifier training. This strategy ensures cross-sensor consistency and minimizes temporal gaps. Based on these harmonized datasets, we successfully produced glacier inventories at 5-year intervals for 2000, 2005, 2010, 2015, 2020, and 2025.

C: How about the comparison of mapped glacier area and mass balance with other existing datasets and performance of your datasets?

R: Thanks for your suggestion. We added a comparison of our mapped glacier areas and mass balance with existing datasets at the end of the manuscript (Table 1). While some differences exist due to methods, data sources, and study environments, the comparison shows that our estimates fall within reasonable and expected ranges.

Table 1 Comparison of our results with previous studies.

Study	Data	Period	Regions similar to this study	Mass change rate (Gt yr^{-1})
(Brun et al., 2017)	ASTER stereo images	2000-2016	Nyainqentanglha	-4.0 ± 1.5
(Shean et al., 2020)	WorldView/GeoEye DEMs, ASTER DEMs, and TanDEM-X Global DEM	2000-2018	Nyainqentanglha Hengduanshan	-3.15± 0.93 -0.96 ± 0.23
(Yi et al., 2020)	GRACE and ICESat	2002-2017	Nyainqentanglha	-6.5 ± 0.80
(Wang et al., 2021)	ICESat-1,2 and GRACE/GRACE-FO	2003-2019	Nyainqentanglha	-6 ± 1.0
(Jakob et al., 2021)	CryoSat-2 SARIn L1b	2010-2019	S AND E Tibetan Plateau Hengduanshan	-3.38 ± 1.21 -4.30 ± 0.98
(Hugonnet et al., 2021)	ASTER DEMs, ArcticDEM, REMA and TanDEM-X	2000-2020	South Asia East	-6.87
(Zhao et al., 2022)	ASTER stereo images, CryoSat-2 SARIn L2I, ICESat-1/2, and GRACE/GRACE-FO	2000-2019 2003-2020 2011-2020	SETP	-4.72 ±1.18 -4.86 -5.80 ± 0.8（mean seasonal） -5.53 ± 0.2（mean annual）
This study	CryoSat-2, ICESat-1/2, Landsat-5/7/8, Sentinel-1/2	2003-2022	*	6.51 ± 1.22

C: “Global changes significantly affect regional climate, rivers and lakes evolution, and the formation of geological hazards”, suggested refs (https://doi.org/10.1038/s41558-020-0855-4, https://doi.org/10.1038/s43017-024-00554-w)

R: Thanks for your suggestion. We added the suggested references in the revised version.

C: “Keshri et al. (2009) (Keshri et al., 2009)” style correction

C: “Y. Lu et al. (Lu et al., 2021)” style correction, I suggest that authors check the citation style throughout this manuscript

C: “Ye et al (Qinghua, 2020)..” correction

R: We appreciate your comment. In the revised manuscript, we reviewed and updated all references to ensure consistent and correct citation formatting throughout the text.

C: "including K-nearest neighbors (KNN), support vector machines (SVM), gradient-boosting decision trees (GBDT), decision trees (DT), random forests (RF), and multilayer perceptron (MLP)." Please check if all these abbreviations are necessary, and appear multiple times.

R: Thanks for your comment. After checking, only "random forests (RF)" appears multiple times in the manuscript. We kept the abbreviation for RF, while all other models (K-nearest neighbors, support vector machines, gradient-boosting decision trees, decision trees, and multilayer perceptron) are written in full for clarity. The modified sentence now reads: *"including K-nearest neighbors, support vector machines, gradient-boosting decision trees, decision trees, multilayer perceptron, and random forests (RF)."* (Line53)

C: Introduction: The authors reviewed a broadly studies, and I suggest the authors have a summary of gaps from these existing studies and then proposed the objective s of this study.

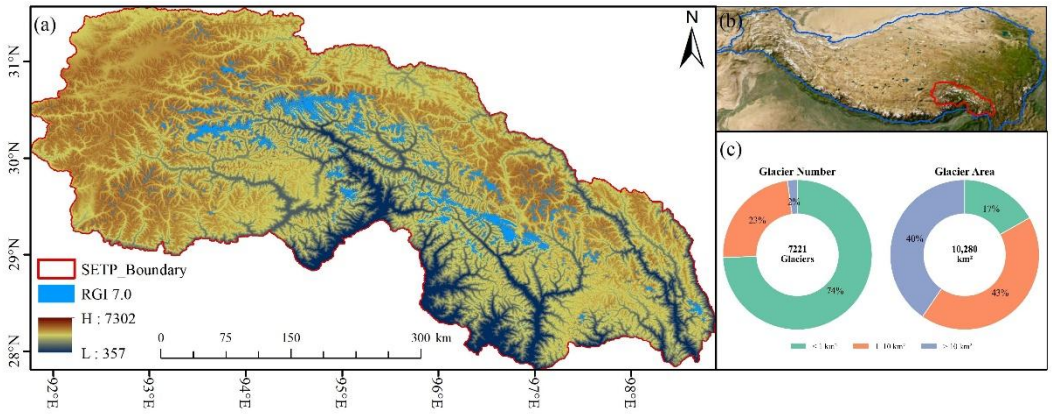
R: Thanks for your suggestion. We added a concise summary of the research gaps in existing glacier studies right before our study objectives. Specifically, we highlighted the lack of standardized methods to quantify the contribution of dynamic glacier area to mass balance and the limitation of cloud-free summer imagery for repeat monitoring. The modified sentence reads: *"Moreover, current studies often lack a standardized methodology to quantify the contribution of dynamic glacier area to mass balance, while the limited availability of cloud-free summer imagery hinders reliable repeat monitoring."* (Line111-112)

C: Figure 1: I suggest the authors add a inset to show the location of study area in the Tibetan Plateau.

C: L115: This statistical information can be added in Figure 1 as an inset small figure.

R: We appreciate your comment. We added insets in Figure 1 showing the study area within the Tibetan Plateau and the distribution of glacier numbers and areas in the study

region.



C: “5,000 meters” to “5,000 m”

C: square kilometers to km^2

R: Thanks for your suggestion. We standardized the units throughout the manuscript.

C: 2.2 Data and 3 Methods, and other sections: Some subsections are very short in text, and can be combined together.

R: Thanks, we reorganized the relevant sections in the manuscript, combining some shorter subsections to improve the flow and readability.

C: Some sections such as Normalized Difference Water Index (NDWI) and Normalized Difference Snow Index (NDSI) are known well, can be cited only.

R: Thanks for your suggestion. We shortened the descriptions of well-known indices like NDWI and NDSI and replaced them with appropriate citations. The revised text now reads: *“To enhance the accurate classification of surface types, this study selects commonly used spectral indices, including the Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI), and Normalized Difference Snow Index (NDSI). From cloud-free pixel sets obtained after cloud filtering. Annual image sets were generated for five-year intervals from 2000 to 2025 (i.e., 2000, 2005, 2010, 2015, 2020, and 2025), with each image representing the composite result over the respective time window. NDVI is widely used for evaluating vegetation coverage on Earth's surface. The NDVI ranges from -1 to 1, with higher values indicating denser vegetation. NDWI is a common index for evaluating the distribution and extent of*

surface water bodies (Mcfeeters, 1996). Values close to -1 indicate pure water bodies, around 0 indicate moderate water presence, and near 1 indicate minimal or no surface water. NDSI is used for detecting snow cover on Earth's surface (Hall et al., 1995), Values near 1 indicate pure snow cover, around 0 minimal snow, and near -1 non-snow surfaces." (Line233-241)

C: Figure 3: I don't know if this figure is necessary, and the information provided is simple.

R: Thanks for your suggestion. We added Figure 3 to visually illustrate the image compositing method. We believe it helps readers understand the approach, even though the information is relatively simple.

C: Figure 5: Some keywords for these subfigures can be added on figures.

R: We appreciate your suggestion. We added descriptive keywords to the subfigures in Figure 5 to help readers interpret the information more easily.

C: Figure 6: can be merged with other figures as the information of this figure is simple.

R: Thanks for your suggestion. We kept Figure 6 separate because it shows images from different sample types, which is important for understanding sample variability. We also optimized the figure to improve clarity and presentation.

C: Figure 7: Caption: "at 2000" to "in 2000", and "Result2000" corrected to "Outline in 2000"

R: Thanks for your suggestion. We corrected the caption of Figure 7, changing "at 2000" to "in 2000" and updating "Result2000" to "Outline in 2000" as recommended.

C: Figure 8: This statistical of glacier area change between 2000 and 2022 is too simple and should be improved.

R: We appreciate your comment. We enhanced Figure 8, 9, 10 by showing both the absolute and relative changes in glacier area for each time interval, along with the spatial distribution of glacier retreat. These changes help readers better assess the magnitude and spatial variability of glacier changes over the study period.

C: Results and analysis: It is only one subsection: 4.1 Glacier extraction results and error analysis. The results section is too short, and the description in abstract that your study has more information. I suggest the authors extend the results section and should be consistent with your abstract.

R: Thanks for your suggestion. We substantially expanded the Results section to provide a more complete presentation of our findings. It now includes a detailed temporal analysis of glacier area changes from 2000 to 2025, highlighting annual and decadal trends, along with a comparison to existing glacier inventories. We also show spatial patterns of glacier retreat and mass balance through maps and summary statistics. Additionally, we included an error analysis and uncertainty assessment to provide transparent information on classification accuracy and potential limitations. (Line390-478)