Response to **Referee #2**：

Dear Referee:

Many thanks for your review of our paper. The paper has been carefully revised according to your comments, and detailed point-by-point responses to the comments are given below. In our letter, the comments from the reviewer are highlighted in bold font and our responses listed below are in black font.

General Comments

1）The authors investigated the spatiotemporal features of glacier elevation changes over the southeastern Tibetan Plateau using multisource satellite data, it is an interesting work.

R. Thank you for your comment. The point-by-point responses to your specific comments are given below.

2） While the current work is not sufficient. The authors introduced that glacier in the SETP experienced accelerated melting in recent decades in the Introduction. However, based on multisource satellite date investigation and comparison with previous studies, they got the same result, and then the research is over. There have no novel findings, even though they did a lot of work.

R. Thank you for your comments. The previous studies and our study both demonstrate that the SETP are experiencing accelerated melting in recent decades, however, the obtained glacier elevation changes and the estimation uncertainties are varying. In our study, the multi-source satellite data including the new released data such as ICESat-2 ALT06 data and CryoSat-2 CryoTEMPO EOLIS data, are integrated for the glacier elevation measurement, which significantly improve the estimation of glacier elevation change by compared with the previous study.

For the contributions of our study, 1) we introduced a new method for yearly glacier elevation change estimation by integrating ASTER stereo image, ICESat,

ICESat-2, and CryoSat-2 CryoTEMP-EOLIS altimetry data, and our estimation result achieved finer spatiotemporal resolution and smaller uncertainty compared with the existing estimation results. Due to the effective integration of the multisource satellite data in our study, the improved estimation result for the glacier elevation change has been obtained. We think the new proposed method also provide a valuable reference for the future glacier study in the other region of the earth. 2) We carried out extensive analysis for the multisource satellite measurements. In particular, we compared the ICESat-2 measurements by the strong beam with the weak beam, and we revealed that the ICESat-2 strong beam and weak beam had no significant differences in glacier elevation measurements. We also compare the CryoSat-2 CryoTEMP-EOLIS data with the commonly used CryoSat-2 L2 data in our study, and we found the CryoSat-2 CryoTEMP-EOLIS data achieves significant improvement over the CryoSat-2 L2 data in glacier elevation measurement. 3) We derived the glacier elevation change for the overall SETP region at a fine spatiotemporal resolution. Accordingly, we analyzed the spatiotemporal variability of the glacier elevation change in SETP region, and we found the SETP region not only contains the melting glaciers but also contains the accumulated glaciers. 4) We further analyze the anomalous glaciers (accumulating glaciers) in term of glacier altitude, glacier aspect, glacier number, glacier slope and glacier length, respectively. Generally, the glacier accumulation occurs in 38 glaciers that account for 12.62% of the selected 301 glaciers. We compared the characteristics of the accumulating glaciers with the melting glaciers in our study. We found that most of the accumulating glaciers are facing the southwestern side and the melting glaciers are mainly facing the northern and eastern sides (North, Northeast, East, Southeast), and the accumulating glaciers characterized in general by steeper glacier slope, shorter glacier length, and slight lager altitude compared with the melting glaciers.

More details have been added to the Section 4.2 of the revised manuscript. We think these findings could further improve our knowledge and understanding for the glacier elevation change in the SETP region. The related description has been added to Section 4.2 and Section 5.1 of the revised manuscript.

SPECIFIC COMMENTS

1) In addition, there have many confusions in the Introduction. For example, in the second paragraph, the authors introduced that glaciers in the HMA are greatly retreating, and then list several research and numbers, there have no summarize. And then the authors said that glacier elevation changes in the SETP have not been well quantified by existing studies due to inconsistent results and give some examples. I know the authors want to emphasize the importance of glacier elevation change in the SETP and it should have drawn more attention. However, more research and numbers were given to emphasize the inconsistence of previous studies in the end of this paragraph. It is a confusion to me.

R. Thank you for your comments. To make a clearer expression for the second paragraph of the Introduction section, we have reorganized this paragraph. Specifically, 1) we firstly introduce the rapid glacier melting trend in HMA region, then 2) we illustrate that the glacier elevation changes show large spatial variability in HMA based on specific studies on different subregions. 3) We mentioned that among the subregions the glaciers in the SETP region have experienced the strongest recession in HMA since 2000. Finally, 4) we demonstrate that the current estimates for the glacier elevation changes in SETP region is still limited in accuracy, and then show the inconsistent results derived from the previous studies. The revised paragraph has been added to the Introduction section in our revised manuscript.

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1 Introduction

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The High Mountain Asia (HMA) region hosts the largest glacier concentration outside the polar regions, and these glaciers prominently contribute to streamflow in one of the most populated areas of the world (Brun et al., 2017). Current studies have revealed that the glaciers in HMA are greatly retreating (Brun et al., 2017; Gardner et al., 2013; Yao et al., 2012). For example, Brun et al. (2017) illustrated that the glacier elevation change rate for the total HMA region was -0.21 ± 0.05 m/yr during 2000-2016, and

Shean et al. (2020) revealed that the total HMA glacier mass change rate during 2000-2018 was −0.19 ± 0.03 m w.e./yr. Glacier elevation change shows large spatial variability in HMA. Specifically, a positive glacier elevation change rate of 0.047 ± 0.06 m/yr was reported in Kunlun by Shean et al. (2020), a slight negative glacier elevation change rate of -0.1± 0.06 m/yr was observed in Karakoram by Kääb et al. (2015), and the most negative elevation change rate of -0.73 ± 0.27 m/yr was found in Nyainqentanglha by Brun et al. (2017). Among the subregions the glaciers in the SETP region have experienced the strongest recession in HMA since the 2000s, and this recession in the SETP accounts for approximately one-quarter to one-third of the total glacier mass loss in HMA (Brun et al., 2017; Kääb et al., 2015; Neckel et al., 2014). Glacier elevation changes in the SETP have drawn the most attention from glaciologists, climatologists, and geoscientists, and great efforts have been made to improve elevation change estimations (Brun et al., 2017; Gardner et al., 2013; Shean et al., 2020). However, estimates of glacier elevation changes are still limited in accuracy and are inconsistent with each other for the SETP region. For example, different estimates of − 0.40 ± 0.41 m/yr for 2003–2009 (Gardner et al., 2013), − 0.81 ± 0.32 m/yr for 2003–2008 (Neckel et al., 2014), − 0.68 ± 0.22 m/yr for 2000–2016 (Brun et al., 2017), − 1.11 ± 0.11 m/yr for 2010–2019 (Jakob et al., 2021), − 0.54 ± 0.16 m/yr for 2000–2018 (Shean et al., 2020), − 0.69 ± 0.35 m/yr for 2000–2019 (Hugonnet et al., 2021), and − 0.73 ± 0.18 m/yr for 2003–2020 (Zhao et al., 2022) were reported in existing studies.
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2) In the third paragraph, the authors summarized the approaches for glacier observation through spaceborne remote sensing. The first approach is satellite images, including glacier outlines delineation from Landsat, Sentinel, and glacier elevation determination from satellite-based optical stereo images. The second approach is geodetic digital elevation model differencing, including InSAR and optical stereo images. That is a repeat.

R. Thank you for your comments. We have rephrased the literatures review about the glacier observation approaches in the third paragraph. Specifically, we modified the first type ‘satellite image’ to ‘Nadir optical and SAR satellite images’, thus the optical stereo image-based method is removed from this type. The related modification has been added to the revised manuscript.

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1 Introduction

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Glacier observations are mainly obtained through spaceborne remote sensing. There are four major approaches for observing glaciers: 1) Nadir optical and SAR Satellite images: These images have long been used for glacier observation and have provided abundant historical glacier change information along with climate change information (Ke et al., 2015). Mountain glaciers can typically be automatically or semiautomatically delineated with satellite images, such as Landsat, Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), Sentinel-2, or Sentinel-1 images (Pope and Rees, 2014, Robson et al., 2020; Zhou and Zhen, 2017; Peng et al., 2023). 2) Geodetic digital elevation model (DEM) differencing: DEM differencing is the most common approach for calculating the elevation change in an entire glacier area and enables the estimation of glacier mass change over time (Cogley et al., 2011; Robson et al., 2022). Generally, spaceborne optical and radar sensors are two main sources for producing DEMs for calculating elevation changes in large-scale glacierized regions. Spaceborne radar DEMs, such as those from the Shuttle Rader Topography Mission (SRTM) C-band data and TanDEM X-band data (Ke et al., 2020; Guan et al., 2022), are generated using interferometric synthetic aperture radar (InSAR). The radar signal penetrates snow and ice, and the penetration depth is a matter of debate and leads to uncertainty in glacier elevation estimation (Barundun et al., 2015; Kääb et al., 2015). Spaceborne optical digital models (DEMs) are generated using stereo images (Bhushan et al., 2021; King et al., 2023;); the generated DEMs are free of ice/snow penetration, while optical stereo images are unavailable in cloudy regions.

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3) About the data source, the specific time of DEM acquired from ASTER images is not clear, and Fig 2(a) showed the glacier elevation changes from ICESat, ICESat2, CryoSat and ASTER DEM, the ICESat2 measurements (the purple dots) covered from 2002 to 2020, how it could be?

R. Thank you for your comments. The ICEsat-2 data acquired from 2018 to 2022 and the ASTER data acquired from 2000-2022 are used in our study. It is a mistake for the legend color in our previous manuscript, specifically, the ICESat-2 measurements should be blue dots, and the ASTER DEM measurements should purple dots. The Fig 2 (a) have been revised in our revised manuscript as follows.

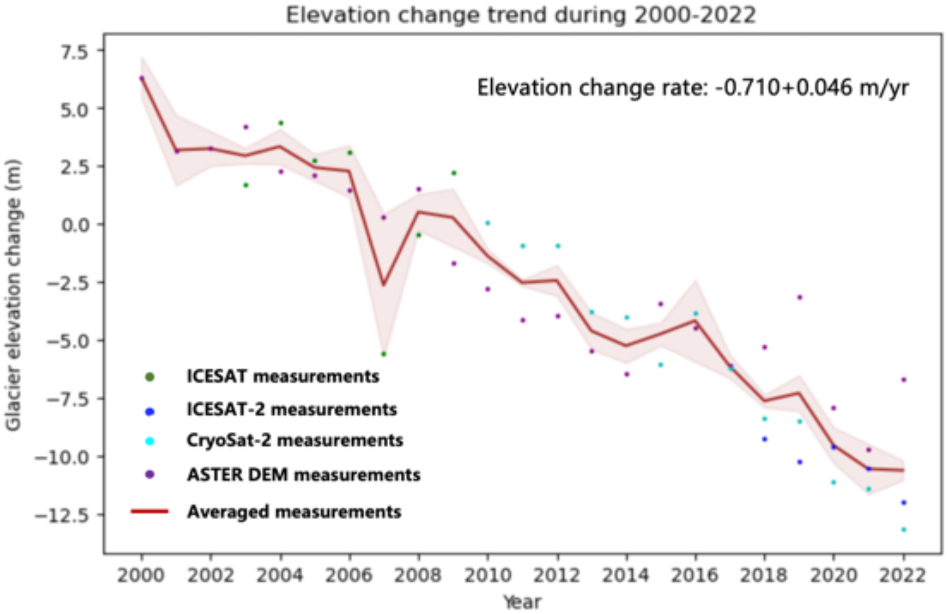

Figure 2 (a): The spatial distribution of glacier elevation change rate during 2000-2022

To leverage ASTER images as much as possible, all the ASTER stereo images with cloud coverage less than 60% are acquired for ASTER DEMs generation in our study. And in total 1671 pair-wise ASTER stereo images are eventually acquired for the time-series DEM generation in our study. To avoid seasonal effects in the analysis of annual glacier elevation changes, we make the priority of the generated ASTER DEMs which are acquired near July (glacier ablation season) for the glacier elevation measurement of the year. Specifically, the specific times of DEM acquired from ASTER images corresponding to different years are shown below.

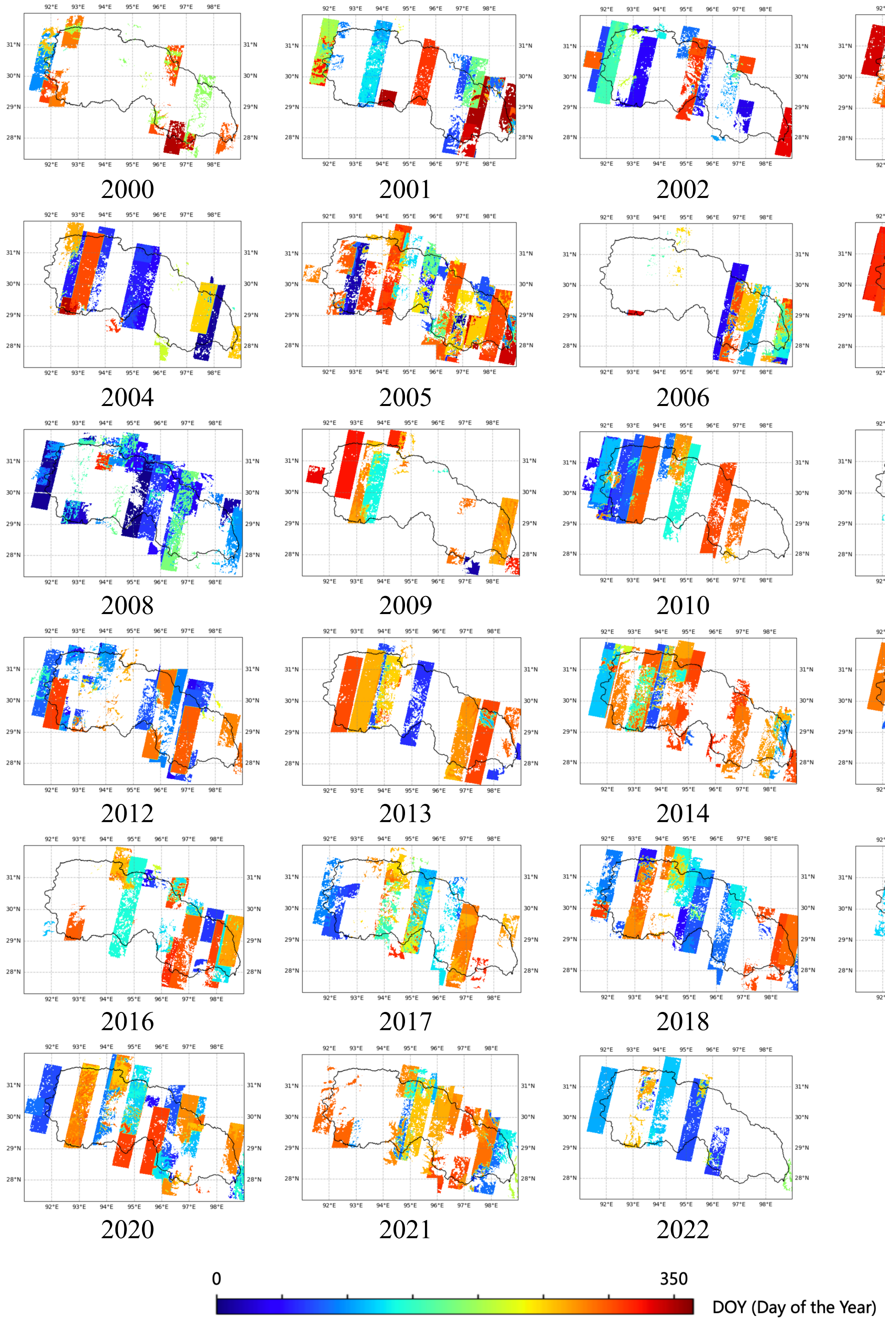

Figure.1: Specific time of DEMs derived by ASTER stereo images. The subtitle of each figure is the correspondng year of the generated DEM.

4) Therefore, the potential of this work is great, but considerable work is required before making it publishable.

R. Thank you for your comments. we have carefully revised our paper according to your constructive comments and suggestions. Generally, the Introduction section particularly for the literature review about the glacier elevation change in the HMA region and SETP region and the related methods has been thoroughly revised. In the

Section of Datasets used, the more detailed information about the used satellite data has been added to the revised manuscript. In the Methodology section, we have further descripted the detailed method about the multisource satellite data integration in glacier elevation change estimation. In the Results section, we changed the two periods of 2000-2012 and 2012-2022 to 2000-2011 and 2011-2022 to make the two periods the same years. In addition to illustrate that some anomalous accumulating glaciers appeared in the SETP region, we have further analyzed the accumulating glaciers features in terms of glacier altitude, glacier aspect, glacier number, glacier slope and glacier length, respectively. In the Discussion section, the bias among the satellite measurements and the comparison with the existing estimates have been presented with improved expression. In the last section of Conclusion, we conclude the works and related results of our study, and we also described the limitation of our study and our future study plan. Accordingly, we believe that the revised version of manuscript has been significantly improved.

Once again, thank you for your time reviewing this paper.

Best wishes,
The authors