

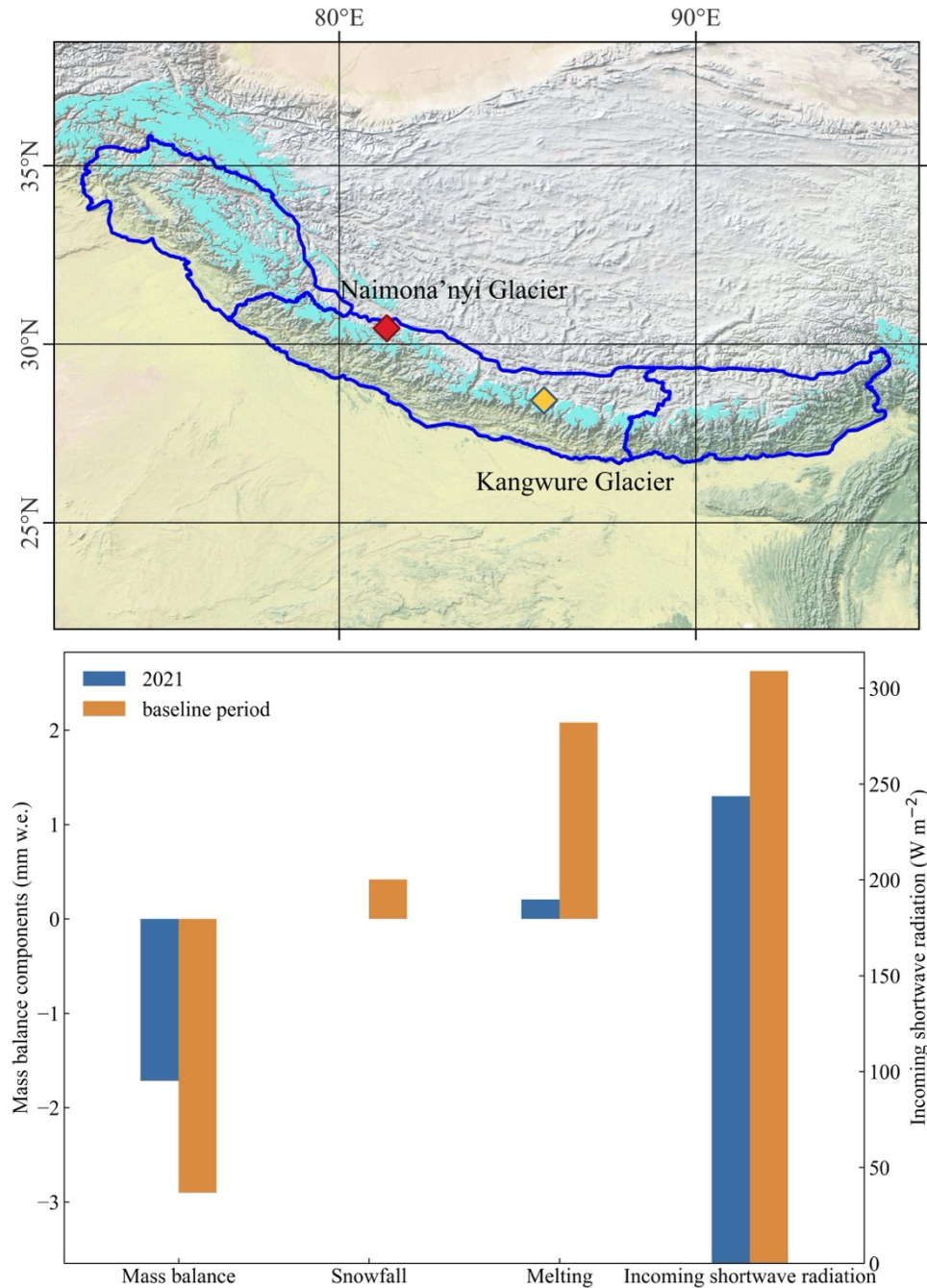
Reply to Reviewer 1

General Comment 1: My first comment is related to the title. When reading the title, the first impression is that this paper is about a study that investigates how tropical cyclones drive extreme positive glacier mass balance in the central-eastern Himalayas. However, while reading the manuscript the impression is that this paper is about a study that investigates the impact of a single tropical cyclone (Tauktae) on a single glacier (Naimona'nyi Glacier) solely as well as the regional atmospheric implications of TC Tauktae. The impacts of TC Tauktae on glacier mass balances in the central and eastern Himalayas have not been addressed and are neither supported by the findings presented in this study. Therefore, in my opinion, the title needs to be changed into something that fits well with the main findings presented in this study, i.e. the impacts of TC Tauktae on the glacier mass balance of Naimona'nyi glacier. In case the authors want to continue with the title, more evidence is needed to support this title. For example, by looking into the impacts of multiple TCs, such as TC Hudhud, TC Phailin, TC Yaas, and TC Hamoon on multiple glaciers distributed over the central and eastern Himalayas. That raises also the question, whether similar studies exist that looking into the impacts of TCs on other glaciers in the region and beyond? This kind of information could also be useful for the discussion.

Response: We sincerely thank the reviewer for the valuable comments regarding the consistency between the manuscript title and the scope of the study. This comment prompted us to reconsider the consistency with the title of the manuscript. The term “tropical cyclones” in the original title could lead readers to interpret the study as investigating the general impact of tropical cyclones on glacier mass balance across the central and eastern Himalayas. However, the present study mainly focuses on the impact of a single event, tropical cyclone Tauktae in 2021, on the mass balance of Naimona'nyi Glacier and the potential physical mechanisms involved. The reviewer's comment made us realize that different TC events can differ substantially in their timing,

tracks, intensity, and spatial extent of influence. Therefore, it would not be rigorous to generalize the results from a single TC event to represent the effects of tropical cyclones on glacier mass balance in general. Accordingly, we have revised the title by replacing the general term “tropical cyclones” with the specific event, “tropical cyclone Tauktae.”

We have carefully considered the reviewer’s concern regarding the geographical scope implied by the title. To assess the potential spatial extent of the positive glacier mass balance anomaly associated with TC Tauktae, we analyzed the changes in snowfall, albedo, cloud cover, and shortwave radiation, which are closely related to the positive mass balance anomaly of Naimona’nyi Glacier, during the TC period. We further calculated the anomalies of these variables relative to the same period during 2000–2024. The results show that during the TC period, snowfall, albedo, and cloud cover were generally higher and exhibited positive anomalies in the central Himalayas, whereas shortwave radiation was lower and exhibited negative anomalies. As the anomalous signals of these meteorological and energy-related variables associated with the positive mass balance anomaly of Naimona’nyi Glacier extended into the central Himalayas, we considered that the positive mass balance anomaly induced by TC Tauktae may also have extended into this region. To further examine this spatial response, we conducted a preliminary mass balance simulation for Kangwure Glacier (location shown in the figure below), which is located in the central Himalayas. The results show that Kangwure Glacier also exhibited a weak positive mass balance anomaly relative to the corresponding baseline period during May 18–19, 2021, mainly due to the reduction in incoming shortwave radiation. Meanwhile, ERA5 cloud cover and cloud-top brightness temperature data indicate that the cloud system associated with Tauktae covered the area around Kangwure Glacier during 18–21 May, accompanied by increased cloud cover and reduced shortwave radiation. Taken together, these results provide some evidence that the positive mass balance anomaly associated with TC Tauktae may have extended into the central Himalayas.



However, as pointed out by the reviewer in General Comment 3, different types of glaciers may respond differently to the same tropical cyclone. We therefore recognize that, even though both Naimona'nyi Glacier and Kangwure Glacier exhibited positive mass balance anomalies, this response cannot simply be generalized to all glaciers in the central Himalayas. To address this issue, we have added Section 5.3 to the Discussion, where we further discuss differences among glaciers in terms of elevation range, glacier surface characteristics, aspect, and other factors that may contribute to

different glacier responses. Considering these differences, we recognize that the term “extreme” in the original title may overemphasize the magnitude of the positive mass balance response and may not be applicable to different glacier types. We have therefore removed the term “extreme” from the revised title.

We also fully agree with the reviewer’s concern regarding the eastern Himalayas. In the eastern Himalayas, although ERA5-derived precipitation increased during the TC period, the increases in snowfall and albedo were not pronounced, and the anomalous reduction in shortwave radiation did not extend across the entire eastern Himalayas. Therefore, consistent with the reviewer’s other comments, we agree that there is currently insufficient evidence to support extending the conclusions regarding the positive mass balance anomaly to the eastern Himalayas. We have therefore removed “eastern Himalayas” from the title.

In addition, considering that this study focuses on the anomalous mass balance response during the influence period of TC Tauktae relative to the corresponding period during 2000–2024, and taking into account the reviewer’s comments as well as our reassessment of the scope, results, and applicability of our findings, we have revised the title accordingly. The revised title is: “How tropical cyclone Tauktae drives positive glacier mass balance anomalies in the central Himalayas”.

Based on the literature currently available to us, there remains a lack of studies directly investigating the impacts of tropical cyclones on high-mountain glacier mass balance and the associated physical processes. Existing studies have mainly focused on the impacts of tropical cyclones on snow cover over the Tibetan Plateau, the influence of tropical cyclones on precipitation over the Tibetan Plateau, and the transport of tropical cyclone-related moisture toward the Tibetan Plateau. These studies provide an important basis for understanding moisture sources and precipitation over high-elevation regions of the Tibetan Plateau affected by tropical cyclones, and also provide background and indirect evidence for the potential connection between tropical cyclones and high-mountain glaciers investigated in this study. Building on this

background, we further used the specific case of TC Tauktae to examine the connections among tropical cyclone activity, glacier climate, energy balance, and mass balance. We hope that this study can link tropical cyclone activity with high-mountain glacier responses, provide a new case study and reference for understanding the connection between tropical cyclones and mountain glaciers, and offer some insights for further research in the future.

General Comment 2: This brings me to my second comment that is related to the discussion. The discussion about the regional atmospheric implications of TC Tauktae is interesting to read, but I am doubting about the statement that TC Tauktae had an impact on the eastern Himalayas, as the region fell outside the main track of the TC. In my opinion, the authors need to investigate this more in-depth and revise their findings/statements based on what they find, also see later comments.

Response: We thank the reviewer for highlighting the applicability of our current findings to the eastern Himalayas. We fully agree with the reviewer's point that TC Tauktae may not have produced a positive mass-balance response in the eastern Himalayas. In Section 4.3, we further analyzed the main drivers of the positive mass balance during this event. The results show that the increase in mass balance was mainly attributable to increased snowfall and reduced glacier melt, while the reduction in melt was closely associated with changes in the energy balance resulting from increased albedo and reduced cloud cover. Based on this understanding of the underlying mechanisms, we further used ERA5 data to analyze the spatial variations in snowfall, albedo, and net shortwave radiation across the Himalayas during the influence of TC Tauktae, and assessed the potential spatial extent over which the event may have produced a positive mass balance impact. The results show that the central Himalayas experienced relatively pronounced increases in snowfall and albedo, together with reductions in net shortwave radiation during the influence of TC Tauktae. These changes are consistent with the key driving factors identified for the formation of the

positive mass balance at Naimona'nyi Glacier. In contrast, although the eastern Himalayas experienced increased precipitation, no pronounced increase in snowfall was observed, and albedo did not show a significant increase. This suggests that the influence of the TC may have extended to the eastern Himalayas in terms of precipitation, but this does not necessarily imply a similar positive mass-balance response. Therefore, based on the available results alone, we cannot confirm whether TC Tauktae could have produced an influence favorable to positive glacier mass balance in the eastern region. Based on this consideration, we fully agree with and have adopted the reviewer's suggestion to remove references to the "eastern Himalayas" from the title, abstract, Discussion, and Conclusions, thereby avoiding extending the influence of TC Tauktae beyond the areas supported by the current evidence.

General Comment 3: Also, I missed a discussion on the limitations and uncertainties of the methods applied in this study. What are the main limitations and uncertainties? What can be said about the significance of the findings presented? Are the findings presented representative for the entire region? Naimona'nyi Glacier is a rather small northward-oriented glacier located at high altitude, which means during TC events or other similar extreme precipitation events I would expect that ablation is limited and accumulation is large as most precipitation will fall in the form of snow, eventually resulting in positive daily glacier mass balances. As the authors claim (based on the title) that TCs drive extreme positive glacier mass balances in the central and eastern Himalayas, I am wondering how the physical mechanisms look like to larger clean ice or debris covered glaciers, such as Rongbuk Glacier or Khumbu Glacier, which have glacier tongues located at a lower altitude than Naimona'nyi Glacier. Also, are there differences in the physical mechanisms between northward-oriented glaciers (generally on the Tibetan Plateau) and southward-oriented glaciers?

Response: We sincerely thank the reviewer for this important and constructive comment. As the reviewer pointed out, the original manuscript did not provide a sufficiently

detailed discussion of the limitations and uncertainties of the methods, or the regional representativeness of the findings. We have carefully considered these issues and added information on model uncertainty, differences among glaciers and their effects on positive mass-balance anomalies, and the uncertainty in the spatial extent of positive mass-balance anomalies in the revised manuscript. First, we described the uncertainties associated with the model in the Methods section, and the relevant details have been added to Text S2 in the Supporting Material.

Regarding the reviewer's concern that different types of glaciers may exhibit different responses to TC Tauktae, we further considered the potential effects of elevation, glacier surface type, aspect, and local environmental conditions. Rongbuk Glacier is located on the northern slope of Mount Everest, with an elevation range of approximately 5300–6300 m, while Khumbu Glacier is located on the southern slope of Mount Everest, with an elevation range of approximately 4900–7600 m. Compared with Naimona'nyi Glacier (5400–7400 m), both glaciers have glacier tongues extending to lower elevations. At lower elevations, the relatively higher air temperature may result in a lower proportion of precipitation associated with TC Tauktae falling as snow, thereby reducing snow accumulation. However, the proportion of lower-elevation areas is relatively small, while the increase in cloud cover and the resulting reduction in incoming shortwave radiation during the TC period may still suppress ablation. Therefore, we consider that differences in elevation may mainly regulate the magnitude and spatial distribution of positive mass balance anomalies.

Debris-covered and debris-free glaciers differ in their energy-balance processes, and debris thickness can further influence ice ablation (Fugger et al., 2022; Rounce et al., 2021). However, during the influence of TC Tauktae, the increase in cloud cover led to a reduction in incoming shortwave radiation, placing glaciers under a relatively low-energy-input background. Under this common background, differences in debris cover and debris thickness may mainly affect the strength of the positive mass-balance response.

For glaciers with different aspects, we compared snowfall and related meteorological conditions on the southern and northern slopes of the Himalayas during the influence of TC Tauktae based on ERA5. The results show that the northern slope experienced a relatively pronounced increase in snowfall and a positive snowfall anomaly, whereas no obvious increase in snowfall was observed on the southern slope. Therefore, the northern slope may have received greater solid precipitation input. Meanwhile, both the northern and southern slopes experienced increased cloud cover and reduced incoming shortwave radiation, resulting in relatively low energy input over both aspects. Under these conditions, the combined effects of increased snowfall and reduced shortwave radiation may produce a more pronounced positive mass-balance anomaly on the northern slope, whereas the southern slope may still exhibit a positive mass-balance response mainly through the reduction in shortwave radiation and its suppression of ablation. Therefore, we consider that differences in aspect may mainly regulate the magnitude of positive mass-balance anomalies.

However, based on the reviewer's suggestion, we further recognized that not all glaciers would necessarily be effectively affected by TC Tauktae. Due to regional topographic and climatic conditions, some glaciers may not receive the moisture transport or cloud systems associated with the TC, or may experience weaker and shorter-lasting TC influences. Under such conditions, changes in snowfall, cloud cover, and shortwave radiation may be relatively small, while local weather processes and other large-scale circulation systems may play a more important role in glacier mass balance. Therefore, whether different glaciers exhibit positive mass-balance anomalies, as well as the magnitude of such anomalies, may be subject to spatial uncertainty.

Based on these considerations and the reviewer's suggestion, we added Section 5.3, "Spatial uncertainty in the glacier mass balance response to tropical cyclone Tauktae," to the Discussion of the revised manuscript. This section discusses the effects of elevation, glacier surface type, and aspect on glacier responses to TC Tauktae, as well as the associated spatial uncertainties.

Revised text:

5.3 Spatial uncertainty in the glacier mass balance response to tropical cyclone Tauktae

Increased snowfall and surface albedo, together with the reduction in S_{in} associated with increased cloud cover, are major contributors to the positive mass balance anomaly at Naimona'nyi Glacier during the influence of TC Tauktae. Further analysis of ERA5 data shows that the anomalous signals associated with the positive mass balance anomaly, including increased snowfall, higher surface albedo, increased cloud cover, and reduced S_{net} , extend into the central Himalayas. We therefore suggest that the positive mass balance anomaly associated with TC Tauktae may have extended into the central Himalayas. However, differences in elevation distribution, surface properties, aspect, and local climatic conditions among glaciers may lead to different mass balance responses even under similar meteorological forcing (Yu et al., 2013; Zhu et al., 2018). For example, for glaciers with different elevation ranges, elevation differences may regulate the mass balance response mainly by affecting precipitation phase, rather than directly determining changes in cloud amount during the TC period. In lower-elevation glacier areas, T_a is generally higher, so precipitation associated with TC Tauktae is more likely to fall as rain, thereby reducing solid precipitation accumulation. However, increased cloud cover and the associated reduction in S_{in} radiation may still occur, thereby suppressing ablation in these areas. Considering that low-elevation areas account for a relatively small proportion of the total glacier area, the glacier as a whole may still exhibit a positive mass balance anomaly, although the spatial distribution and magnitude of the anomaly may differ.

Glacier surface properties may further modulate this mass balance response. Debris-covered and debris-free glaciers differ in their surface energy balance and ablation processes, and debris thickness can also affect ice ablation rates. Under certain conditions, thin debris layers may enhance energy absorption at the ice surface and increase ablation, whereas thicker debris can provide greater insulation and suppress ice melt (Fugger et al., 2022; Rounce et al., 2021). However, during the influence of

TC Tauktae, increase cloud cover reduced S_{in} at the glacier surface, resulting in lower energy input to the glacier overall. Therefore, regardless of the presence or absence of debris at the glacier surface, the reduction in S_{in} associated with increased cloud cover during the TC period could reduce energy input and suppress ablation. Under this common low-energy background, differences in debris cover and thickness are likely to influence the magnitude of the positive mass balance anomaly.

Glacier aspect and topographic conditions may also modulate the mass balance response to TC Tauktae (Olson and Rupper, 2019; Zhang et al., 2024). ERA5 analysis shows that the snowfall responses differed between the southern and northern slopes during the TC period. The northern slopes experienced increased snowfall and positive snowfall anomalies, whereas the southern slopes showed neither a clear increase in snowfall nor positive snowfall anomalies. Thus, the northern slopes may have received greater mass input from increased solid precipitation. Meanwhile, ERA5 indicates that both slopes experienced increased cloud cover and associated reductions in S_{in} , resulting in relatively low energy input on both slopes. Under these conditions, the combination of increased snowfall and reduced S_{in} may have produced a stronger positive mass balance anomaly on the northern slopes. Although the southern slopes showed no clear increase in snowfall, they may still have exhibited a positive mass balance anomaly through reduced S_{in} . Therefore, differences in glacier aspect may partly account for differences in the magnitude of the positive mass balance anomaly.

However, some uncertainties should be acknowledged in interpreting these results. First, not all glaciers may be affected by TC Tauktae. Regional topographic and climatic conditions may prevent some glaciers from receiving the moisture transported by TC Tauktae and its associated cloud systems, and therefore snowfall, cloud cover, and radiation conditions may show little or no significant change. In addition, among glaciers that are affected by the TC, the intensity and duration of the TC-related perturbations may also differ. These differences may be related to the distance between the glaciers and the areas of TC-related moisture transport and cloud activity, and may

also be modulated by local topographic and climatic conditions. When the TC influence is weak or short-lived, changes in snowfall, albedo, and shortwave radiation over glacier areas may be limited and may even be manifested mainly as an increase in cloud cover. Under such conditions, local weather processes and other large-scale circulation systems may dominate glacier mass balance, making it uncertain whether these glaciers exhibit positive mass balance anomalies and how large these anomalies may be. This indicates that the positive mass balance anomaly and associated mechanisms identified at Naimona'nyi Glacier under the influence of TC Tauktae may have some regional relevance, but their magnitude and specific expression may vary depending on the environmental conditions of individual glaciers. Future studies should combine field observations, remote sensing data, and energy and mass balance models across glaciers with different elevations, surface types, and geographic settings to further assess the spatial variability and regional representativeness of glacier mass balance anomalies associated with TC events.

Specific Comments 1: L86-89 and Fig.1: I have a few remarks regarding Figure 1 and the text in the manuscript. For Fig. 1a, could the authors add more geographical information (e.g. Himalayas, Tibetan Plateau) and a grid over the panel to make it easier for the reader to recognize where the Naimona'nyi Glacier is located? Also, what is the source of the background map? If known, please add this information to the caption. As for Fig. 1b, I suggest adding a color bar showing the meaning of the colors in the figure and I recommend adding an additional panel that shows the regional setting of the glacier (more zoomed in compared to Fig 1a. and zoomed out compared to Fig 1b.), including a river network. That helps to guide the reader better through the regional descriptions given by the authors and gives the opportunity to indicate the location of Lake Manasarovar. Further, I suggest adding more information by including the outlines of the glacier branches surrounding the glacier of interest, as the authors describe there is also a southern branch. As for the description of the southern branch, I am wondering

whether this is not supposed to be the western branch? Looking at outlines of the glacier from RGI as well as satellite imagery I notice there is only a western branch and not a southern one.

Response: Thank you for the reviewer's detailed and helpful comments on Figure 1. We agree that the original Figure 1 did not provide sufficient geographical context for the study area and did not clearly show the spatial relationship between Naimona'nyi Glacier, the Himalayas, the Tibetan Plateau, and the surrounding areas. Following the reviewer's suggestions, we have revised Figure 1. In Figure 1a, we added the spatial extents of the Himalayas and the Tibetan Plateau and included latitude and longitude grids to help readers better identify the location of the study area. We also added the source of the background map to the figure caption. In addition, we added a new Figure 1b showing the main rivers and lakes surrounding Naimona'nyi Glacier, providing a clearer connection with the geographical description in the main text. In Figure 1c, we added a complete legend and displayed the entire Naimona'nyi Glacier. Regarding the naming of the glacier branch, the glacier generally extends in a north–south direction and is divided into southern and northern branches, while the area investigated in this study is located in the northern part of the glacier. Therefore, to accurately reflect the spatial location of the study area, we consistently refer to it as the “northern branch” throughout the manuscript. The revised Figure 1 and its caption are provided below. The corresponding changes have been updated in the revised manuscript.

Revised Figure 1:

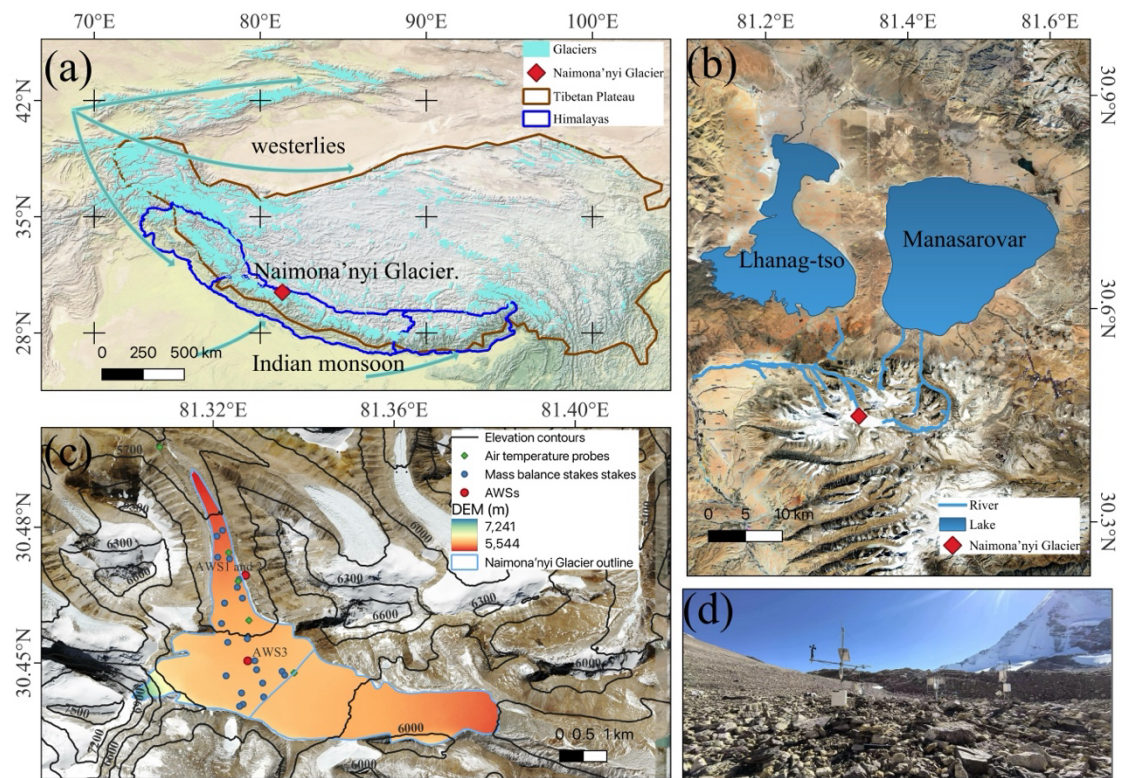


Figure 1. (a) Location of Naimona'nyi Glacier. The background map was obtained from Natural Earth. (b) Rivers and lakes surrounding Naimona'nyi Glacier. (c) Contour map showing mass balance stakes (blue circles), air temperature probes (green diamonds), and AWSs (red circles). The background imagery in (b) and (c) was obtained from Google Satellite imagery. (d) Photograph of AWS1.

Specific Comments 2: L95: I have some doubts about the correctness of the annual mean air temperature stated by the authors. For a location at almost 6000 m a.s.l. a mean air temperature of 6.0 °C seems to be rather high to me. Is this not supposed to be the annual maximum air temperature? Also looking at Fig. S1 most of the observed temperature data are below 0 °C.

Response: Thank you for pointing out this issue. The annual mean air temperature here is −6.0 °C. In the original manuscript, the minus sign appeared at the end of the previous line, and the line break separated it from the temperature value, which caused ambiguity. We apologize for this oversight. We have reformatted this part to ensure that the minus sign remains together with the temperature value. We also checked and corrected other

similar formatting issues throughout the manuscript to avoid any potential misunderstanding. The revised text is shown below, and the corresponding change has been made in L94f of the revised manuscript.

Revised tex (L94f): Meteorological records from an automatic weather station (AWS) at 5,910 m a.s.l. on the slopes north of the glacier indicate a mean annual air temperature of -6.0°C , with the highest monthly temperatures occurring in July. Annual precipitation averages 292.5 mm and exhibits a bimodal distribution.

Specific Comments 3: L140: Please add a reference to ERA5 (Hersbach et al., 2020; <https://doi.org/10.1002/qj.3803>).

Response: We appreciate this reminder. Following your recommendation, we have added the relevant reference for the ERA5 dataset (Hersbach et al., 2020) at Line 140 and included the full reference in the reference list. The revised paragraph is provided below, and the corresponding change has been made in L140f of the revised manuscript.

Revised text (L140f): We additionally used the fifth-generation reanalysis data from the European Centre for Medium-Range Weather Forecasts (ERA5), including T_a , RH (derived from dew point temperature and air temperature), WS, precipitation, and S_{in} , to reconstruct a continuous hourly meteorological dataset covering the period from July 1, 1994, to September 30, 2024 (Hersbach, H. et al., 2023).

Specific Comments 4: L153: Melt and sublimation/evaporation are loss terms but are summed up in equation 1. Does that mean that the model produces negative values of sublimation/evaporation and melt?

Response: Thank you for pointing out this issue. In this model, melt and sublimation/evaporation represent mass loss and are therefore defined as negative values, whereas snowfall and refreezing represent mass gain and are defined as positive values. Accordingly, in the mass balance equation, melt and sublimation/evaporation are included as negative terms and combined directly with the positive terms, such as

snowfall and refreezing, to obtain the net glacier mass balance. To avoid ambiguity, we have added a description of the sign convention for the mass balance terms in the main text and revised the relevant statements to clarify the mass balance equation and the meaning of its individual terms. The added text is provided below, and the corresponding changes have been made in L163f of the revised manuscript.

Revised text (L163f): Refreezing and P_{snow} are accumulation terms and are therefore defined as positive values, whereas M_{water} and E_v represent glacier mass loss and are therefore defined as negative values. Glacier mass balance is calculated as the sum of all mass balance components.

Specific Comments 5: L164-166: Why did the authors choose to work with two different temperature lapse rates and precipitation gradients, how did the authors derive these lapse rates/gradients, and do the authors have an explanation for the rather large difference between the higher and lower temperature lapse rates? Is that based (for the lapse rates) on the difference in temperature/elevation between AWS1 and the lowest and highest loggers? Also, if the authors had access to AWS and logger data, why did the authors choose for a fixed lapse rates/gradients over time and not for monthly varying lapse rates/gradients?

Response: We thank the reviewer for the comments regarding the temperature lapse rates and precipitation gradients used in the study.

Temperature lapse rate:

We used two temperature lapse rates because the observed temperature data showed clear differences in the vertical temperature variations across different elevation ranges. The study area has five temperature probes and one AWS1, located at 5477, 5822, 5910, 5912, 5979, and 6074 m a.s.l. Based on the concurrent observations, we found a clear change in the vertical temperature lapse rate around 5910–5912 m. We therefore used 5910 m as the boundary between the two elevation ranges in the model. For elevations below 5910 m, the temperature lapse rate was derived by fitting the observations at

5477, 5822, and 5910 m and was $-0.84\text{ }^{\circ}\text{C}/100\text{ m}$. For elevations above 5910 m, the temperature lapse rate was determined from the observations at 5912, 5979, and 6074 m. The two lapse rates therefore better represent the observed vertical temperature variations across different elevation ranges in the study area.

We also tested the effect of using monthly varying temperature lapse rates on the simulation results. The results showed that the simulations using monthly varying lapse rates differed only slightly from those using fixed lapse rates. Therefore, to avoid introducing unnecessary temporal variability and to maintain a simple model configuration, we did not further introduce monthly varying temperature lapse rates. Instead, fixed lapse rates were applied separately to the two elevation ranges.

Precipitation gradient:

Unlike air temperature, precipitation observations in the study area were available only near AWS1. Therefore, we lacked concurrent precipitation observations at different elevations, making it difficult to directly derive the precipitation gradient or reliably determine its monthly variations. We therefore first referred to the precipitation gradient determined by Zhu et al. However, when using a single precipitation gradient, we found that the simulated results were generally underestimated below 5800 m. Considering that the spatial distribution of precipitation below 5800 m may be affected by local topographic conditions, a single precipitation gradient may not adequately represent the spatial variation in precipitation across different elevation ranges in the study area. Based on this consideration, we used 5800 m as the elevation boundary and applied two precipitation gradients to the two elevation ranges. We also evaluated the simulation results under different precipitation gradient settings against the available point mass-balance observations. The results showed that the use of two precipitation gradients provided a better representation of the observed spatial variation in mass balance. Therefore, we ultimately adopted these two fixed precipitation gradients in the model simulations.

Specific Comments 6: Fig. S1: S1a and S1c show the reconstructed vs observed wind speed and air temperature, respectively, but are listed vice versa in the caption. Please check.

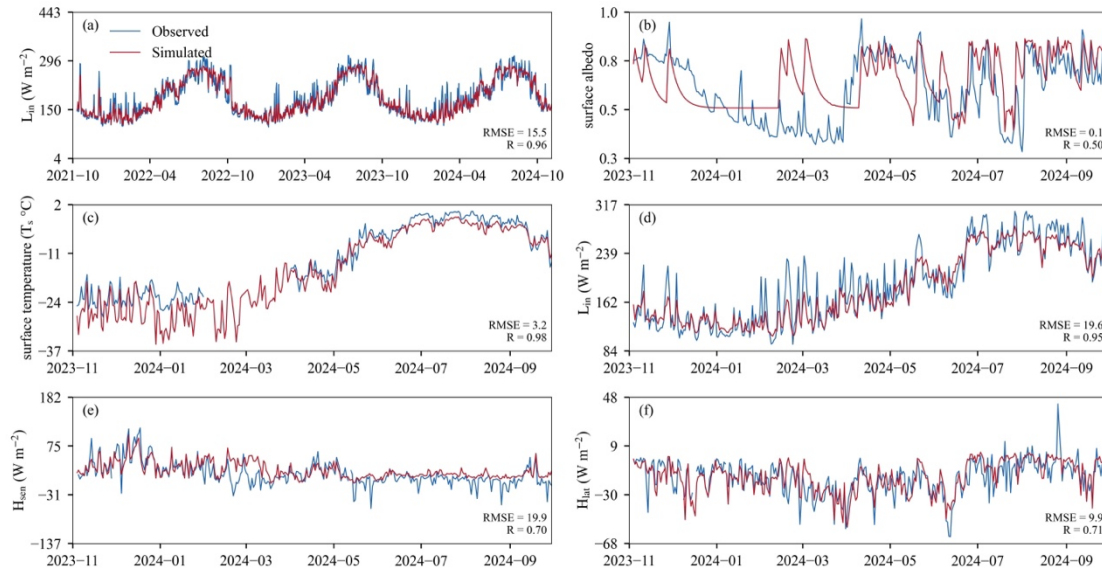
Response: Thank you for pointing out this error. We added two new figures to the Supporting Material, so the original Fig. S1 has been renumbered as Fig. S3. We have revised the figure caption accordingly and corrected the descriptions of S2a and S2c. The revised figure caption is provided below, and the corresponding changes have been made in L185f of the Supporting Material.

Revised text: Supplementary Figure. 3. Comparisons between reconstructed and observed meteorological variables at AWS1. (a) wind speed (WS, m s^{-1}), (b) relative humidity (RH, %), (c) air temperature (T_a , $^{\circ}\text{C}$), and (d) incoming shortwave radiation (S_{in} , W m^{-2}).

Specific Comments 7: Fig. 2: According to the caption and y-axis label, surface temperature (2c) is shown in degrees Celsius, but the values are presented in degrees Kelvin. Please check.

Response: Thank you for pointing out this issue. Because several new figures were added to the main text, we moved the model validation and uncertainty analysis to the Supporting Material. Therefore, the original Fig. 2 is now presented as Fig. S1. In Fig. S1c were originally expressed in Kelvin (K), whereas the y-axis label and figure caption of the original figure were incorrectly indicated as degrees Celsius ($^{\circ}\text{C}$). We have converted the surface temperature data in Fig. S1c to $^{\circ}\text{C}$ to ensure consistency with the units used in the subsequent text. The revised Fig. S1 is provided below, and the corresponding changes have been updated in the Supporting Material.

Revised Figure S1:



Supplementary Figure. 1: In situ measurements and model results for energy balance components. (a) Comparison between observed and simulated incoming longwave radiation (L_{in} , $W m^{-2}$) at AWS2 during 2021–2024. (b–f) Comparison between observed and simulated surface energy balance variables at AWS3 from December 2023 to September 2024, including (b) surface albedo, (c) surface temperature (T_s , $^{\circ}C$), (d) incoming longwave radiation (L_{in} , $W m^{-2}$), (e) sensible heat flux (H_{sen} , $W m^{-2}$), and (f) latent heat flux (H_{lat} , $W m^{-2}$).

Specific Comments 8: L205 and Fig. S2: Which definition was used for precipitation occurrence? Is it defined similar to wet-day frequency, where an occurrence is counted as 1 when daily precipitation exceeds 1 mm/day? Further I noticed that the y-axis labels of Fig. S2a and S2b are swapped. I guess Fig. S2a shows the cumulative precipitation amount and Fig. S2b shows the cumulative precipitation occurrence. Please check.

Response: Thank you for pointing out this issue. The definition of precipitation occurrence was not clearly described in the original manuscript. In this study, a precipitation event was defined at an hourly timescale, with hourly precipitation greater than 0 mm counted as one precipitation event. We considered that the use of “occurrence” in the original manuscript may have caused some ambiguity. Therefore, we replaced this expression with “cumulative numbers of precipitation events”

throughout the revised manuscript to clearly indicate the cumulative number of precipitation events.

Because several new figures have been added to the Supporting Material, the original Fig. S2 is now numbered as Fig. S4. We also rechecked the precipitation data and Fig. S4. Fig. S4a shows the cumulative number of precipitation events, whereas Fig. S4b shows the cumulative precipitation. The time period shown in Fig. S4b is from October 2013 to October 2024, during which the cumulative precipitation is close to 3500 mm. Considering that the mean annual precipitation in the study area is approximately 292 mm, this cumulative precipitation is generally consistent with the length of the study period and the precipitation characteristics of the study area.

Following the reviewer's suggestion, we have further clarified the definition of precipitation events in the main text and provided a clearer description of the method used to extend the precipitation data. The corresponding changes have been made in L217f of the revised manuscript. The revised text is provided below.

Revised text (L217f): Precipitation was reconstructed by adjusting ERA5 precipitation to match the cumulative numbers of precipitation events and cumulative precipitation observed by AWS1 (Zhu et al., 2021). First, precipitation events were identified separately in the AWS1 observations and ERA5 data at an hourly timescale. Hourly precipitation greater than 0 mm was defined as a precipitation event. Because ERA5 may detect more precipitation events than observed at AWS1, a series of precipitation thresholds was tested for the ERA5 data. For each threshold, ERA5 hourly precipitation below the threshold was set to zero, and the cumulative numbers of precipitation events was recalculated. The threshold was progressively adjusted until the cumulative numbers of precipitation events in the processed ERA5 data most closely matched that observed by AWS1. After determining the optimal threshold, a scaling factor was calculated as the ratio of cumulative precipitation observed by AWS1 to cumulative precipitation in the threshold-adjusted ERA5 data. This scaling factor was then applied to the threshold-adjusted ERA5 precipitation to obtain the reconstructed precipitation

time series. The reconstructed precipitation showed good agreement with AWS1 observations in terms of the cumulative numbers of precipitation events, cumulative precipitation, and monthly precipitation (Fig. S4).

Specific Comments 9: Fig. S3 (here and throughout the manuscript where this applies): The units of daily precipitation are supposed to be (mm/day) instead of (mm)?

Response: Response: Thank you for pointing out this issue regarding the precipitation units. The precipitation shown in Fig. S5 (formerly Fig. S3) represents daily accumulated precipitation and is expressed in “mm”. However, the results presented in the original manuscript refer to mean daily precipitation, for which the appropriate unit is “mm d⁻¹”. We have therefore corrected the relevant units accordingly in the revised manuscript, as shown at L316 and L334.

Specific Comments 10: L244-245: In my opinion it is better to phrase the sentence as “...anomalous low snowfall frequency and amount...” instead of “...anomalous snowfall frequency and amount...”.

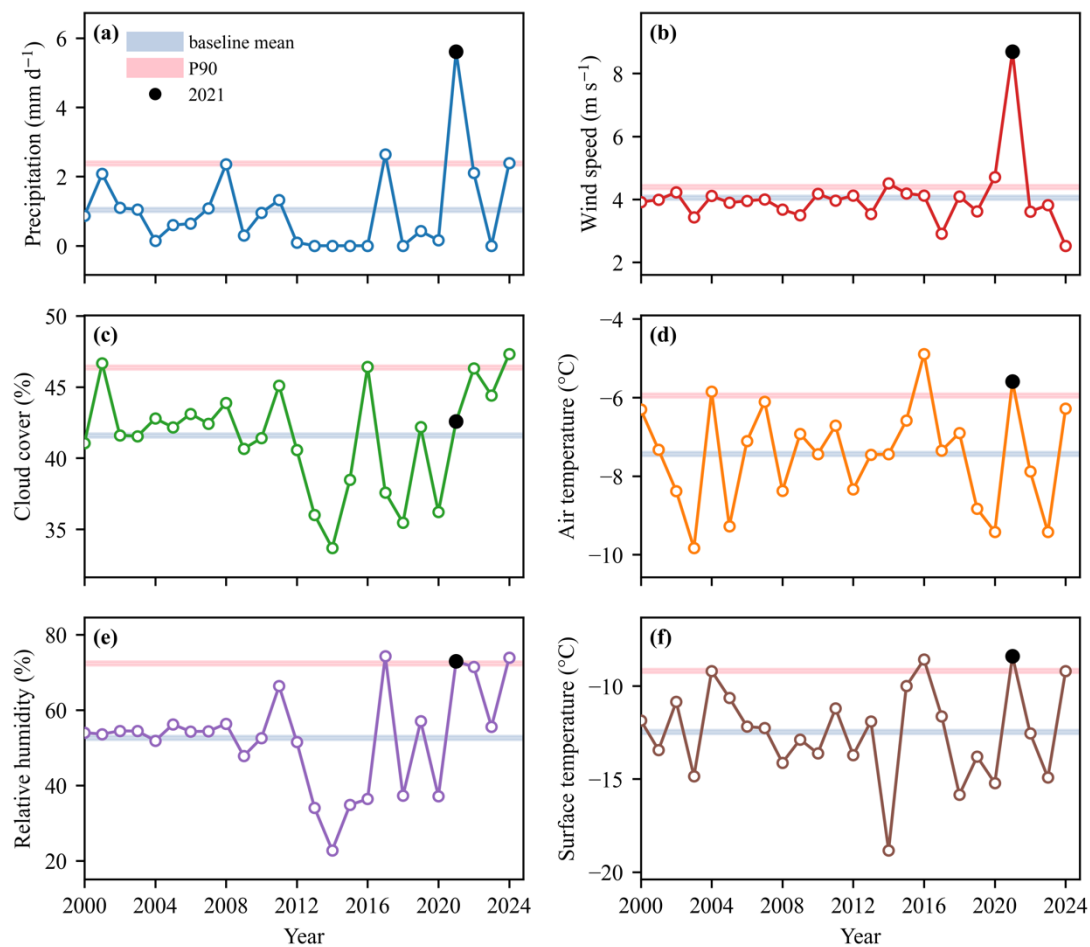
Response: Thank you for the reviewer’s suggestion. We agree that the revised wording is more accurate and clearly indicates that both snowfall frequency and snowfall amount were anomalously low during this period. Following the reviewer’s suggestion, we have changed “...anomalous snowfall frequency and amount...” to “...anomalously low snowfall frequency and amount...” to make the statement more precise. The corresponding changes have been made in L163f of the revised Supporting Material, as shown below.

Revised text (L163f): This underestimation may be related to anomalous low snowfall frequency and amount, which led to lower albedo and consequently higher melt.

Specific Comments 11: Fig. 4: The dashed black line representing the mean of the baseline period is missing here.

Response: Thank you for checking Fig. 4 and for your helpful suggestion. Due to the addition of new figures in the revised manuscript, the original Fig. 4 has been renumbered as Fig. 5. The original figure did not include the black dashed line representing the baseline mean. Following the reviewer's suggestion, we have added the baseline mean line to the revised figure, making the results clearer and easier to interpret. The revised Fig. 5 is provided below.

Revised Figure 5:



Specific Comments 12: Section 4.2: Are the mass balance and flux values presented here area-averages over the glacier?

Response: Thank you for raising this issue. Due to the addition of a new section in the revised manuscript, the original Section 4.2 is now Section 4.3. The mass balance and its components presented in Section 4.3 are all area-averaged values over the entire

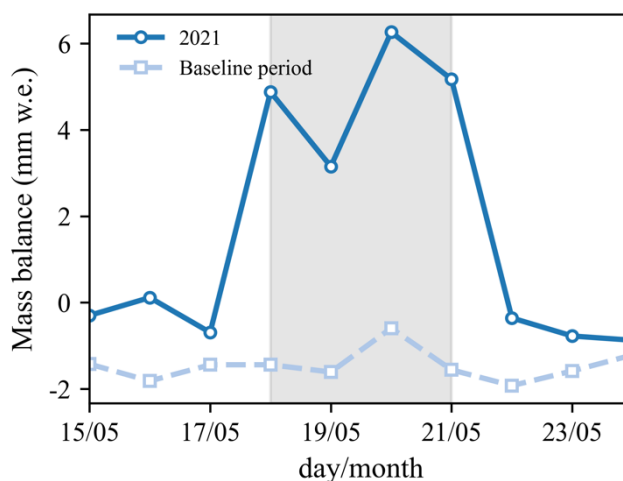
Naimona'nyi Glacier. We have added a statement in Section 4.3 (L342) to clarify that these values are area-averaged over the entire glacier. The revised text is provided below.

Revised text (L342): Figure 6a shows the glacier-wide mean values of mass balance and its components during the TC period and the baseline period, including snowfall, refreezing, sublimation, and melting.

Specific Comments 13: L322: Please check, as Fig. S4a does not show glacier mass balance values but precipitation.

Response: We sincerely thank the reviewer for identifying this issue. After reviewing the figure, we confirmed that the original Fig. S4a actually shows precipitation. This was because a mass balance figure was inadvertently omitted when we compiled the Supporting Material, resulting in inconsistencies between the figures in the Supporting Material and the corresponding figure citations in the main text. In the revised Supporting Material, we have added the missing mass balance figure as Fig. S9 and have accordingly revised the relevant figure numbers in both the Supporting Material and the main text.

Revised Figure S9:

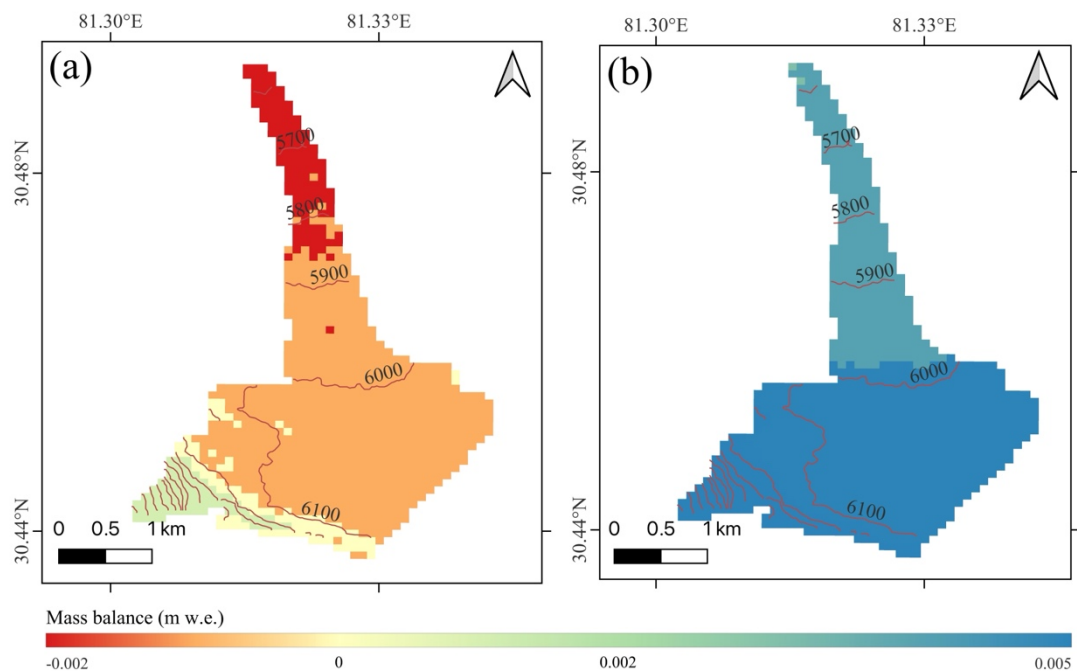


Supplementary Figure. 9. Daily mass balance variations during the TC period and the baseline period.

Specific Comments 14: L329-334, Fig. 6: I recommend exchanging the panels a) and b), which means the glacier mass balance for the baseline period is presented first, followed by the glacier mass balance for the TC period.

Response: Thank you for this helpful suggestion. We agree that presenting the results in the order of the baseline period followed by the TC period provides a clearer comparison of glacier mass balance. In addition, we have moved this figure to the Supporting Material, where it is now numbered as Fig. S11. Accordingly, we have exchanged panels (a) and (b) in Fig. S11, with the baseline-period glacier mass balance now presented in panel (a) and the glacier mass balance during the TC period presented in panel (b). The revised figure is provided below.

Revised Figure S11:



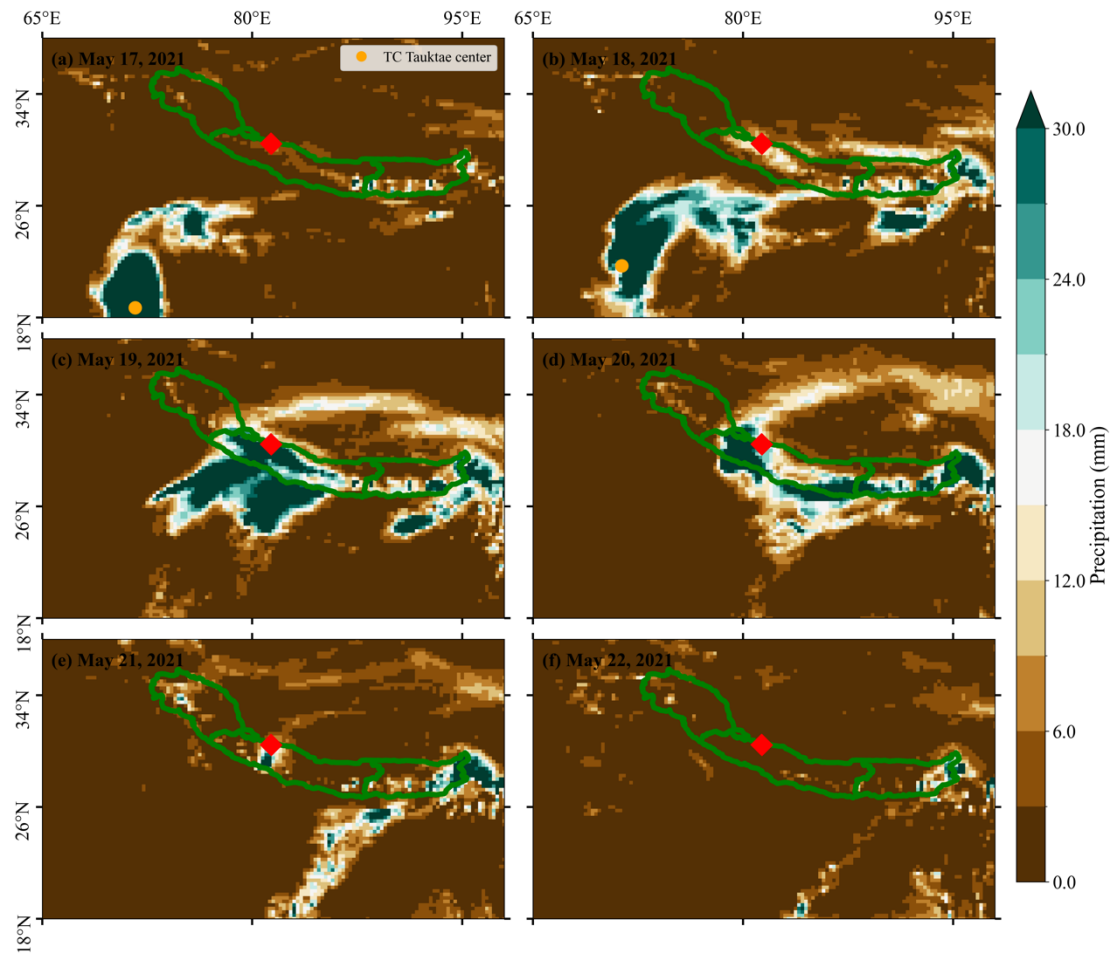
Supplementary Figure. 11. Spatial distribution of daily mean glacier mass balance during (a) the baseline period, and (b) the TC period.

Specific Comments 15: Figs.8-10, and Figs. S8-S13: These figures are hard to read/interpret due to dark or light blobs that are present, which is basically caused by

the scaling and the color schemes implemented in these figures. I strongly recommend that the authors check all these figures, change the color schemes and/or change the scaling. For example, for Figs 8 and 9 and other similar figures I recommend 1) to change the colormap (Blues) to a colormap with multiple colors such as BrBG (Matplotlib colormap), MPL_BrBG (NCL color table) or a color scheme comparable with the one used in Fig. S9 instead, and 2) change the scaling by applying less color classes, changing the levels used for plotting data, e.g. [0,1,2,5,10,15,20,30,40,50] or increasing the max. value that can be displayed. Also, I recommend increasing the size of the red diamond marker and to include the black dashed and green solid lines in Figure 1 as well.

Response: Thank you for this very helpful suggestion. In the original manuscript, the color schemes and data classification used in Figs. 8–10 and Figs. S8–S13 resulted in relatively prominent dark or light patches in some areas, which reduced the readability of the figures and made it difficult to identify the spatial distribution of the data. Following the reviewer's suggestion, we have revised the color schemes and data ranges of these figures to reduce the influence of extreme values on the overall color representation and to make the spatial differences among regions clearer. We have also increased the size of the red diamond markers to make the location of the study glacier more readily identifiable. In addition, we increased the size of the red diamond markers to make the location of the study glacier more readily identifiable. Following the reviewer's suggestion, we also added the boundaries of the Tibetan Plateau and the Himalayas to Figure 1 to more clearly indicate the location of the study area. The revised figures are now numbered as Figs. S6, Fig. 8, and Fig .9, respectively, and are provided below. The corresponding figures and citations in the manuscript have also been updated accordingly.

Revised Figure S6:



Supplementary Figure. 6. Spatial distribution of daily precipitation from ERA5 data from May 17 to 22, 2021. The green solid line represents the extent and subdivision of the Himalayas. The red diamond markers indicate the location of Naimona'nyi Glacier. Panels (a)–(f) correspond to May 17–22, 2021, respectively.

Revised Figure 8:

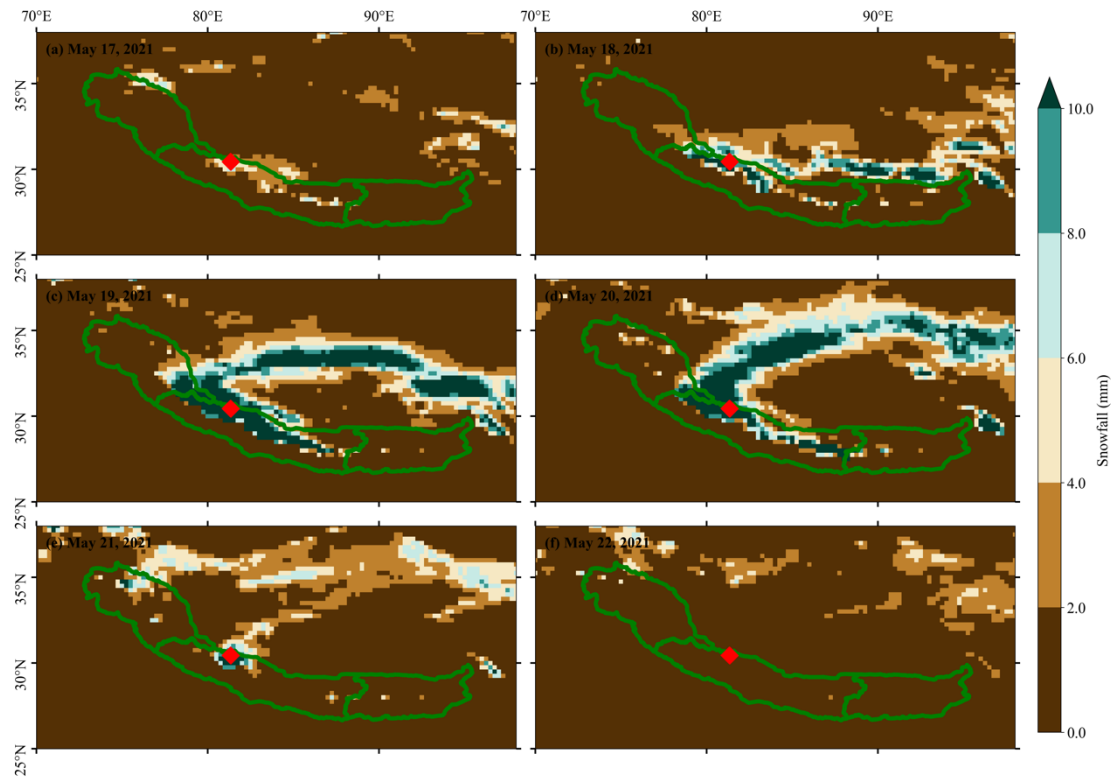


Figure 8: Spatial distribution of daily snowfall from ERA5 data o from May 17 to 22, 2021. The green solid line represents the extent and subdivision of the Himalayas. The red diamond markers indicate the location of Naimona'nyi Glacier. Panels (a)–(f) correspond to May 17–22, 2021, respectively.

Revised Figure 9:

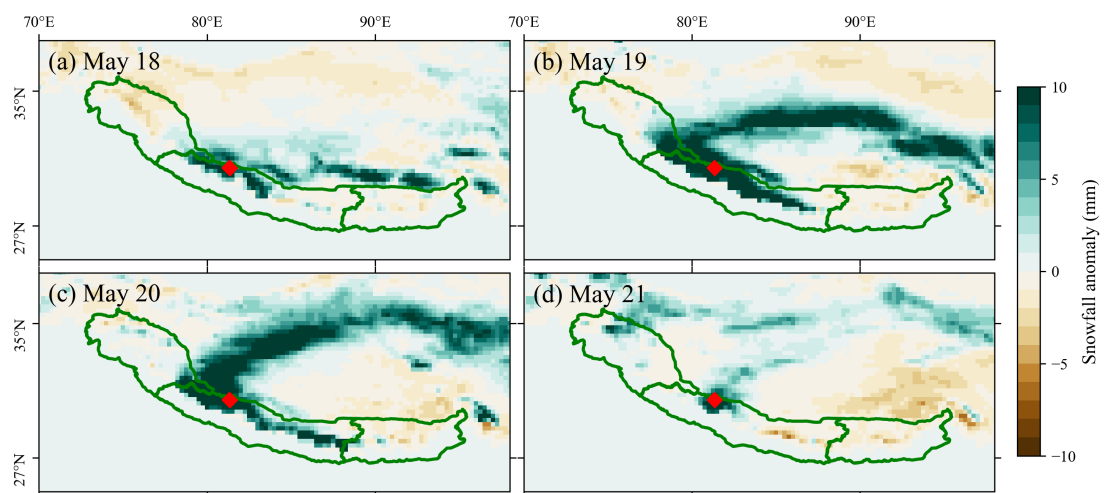


Figure 9: Daily snowfall anomalies on (a) May 18, (b) May 19, (c) May 20, and (d) May 21, 2021. Anomalies are calculated relative to the 2000–2024 climatological mean for the corresponding day of the year. The green outline denotes the Himalaya region,

and the red diamond marks the location of Naimona'nyi Glacier.

Specific Comments 16: Further I suggest adding the track of TC Tauktae to these figures. By adding the track, it is better to see whether precipitation falling in a certain area is associated with the TC or another synoptic system. Also, I am wondering (counts for here and previous figures 8 and 9) why the authors show the fields for the entire TP region and not zoom in on the region of interest, i.e. the Himalayas?

Response: Thank you very much for this very helpful suggestion. We recognize that adding the track of TC Tauktae to the figures provides a more direct way to assess the relationship between TC Tauktae and the spatial distribution of precipitation over and around the study area. Therefore, following the reviewer's suggestion, we have added the track of TC Tauktae to the relevant figures (Figs. 2, 3, and S6). These figures have been incorporated into the newly added Section 4.1, "Identification of the influence period of tropical cyclone Tauktae on Naimona'nyi Glacier," to further assess whether the influence of TC Tauktae reached the Naimona'nyi Glacier region. Since the new Section 4.1 and the corresponding figures are presented in full in our response to Specific Comment 20, we do not repeat them here to avoid unnecessary duplication. We kindly refer the reviewer to our response to Specific Comment 20 for the details.

Regarding the spatial extent, the original manuscript showed the entire Tibetan Plateau mainly to illustrate the atmospheric and precipitation fields associated with TC Tauktae from a broader spatial perspective. However, we agree that, given the focus of this study on Naimona'nyi Glacier and the surrounding Himalayan region, an overly large spatial extent reduces the spatial detail and readability of the study area. Therefore, following the reviewer's suggestion, we have adjusted Figs. 8–10 and the corresponding supplementary figures by narrowing the map extent to the Himalayas and the surrounding study area, while retaining sufficient surrounding areas to show the track of TC Tauktae and its associated atmospheric and precipitation patterns. This adjustment provides a clearer representation of the spatial relationship between TC Tauktae and the precipitation and climatic anomalies over the study area. Some of the revised figures are shown below, and the corresponding figures in the manuscript have

been updated accordingly.

Revised Figure 10:

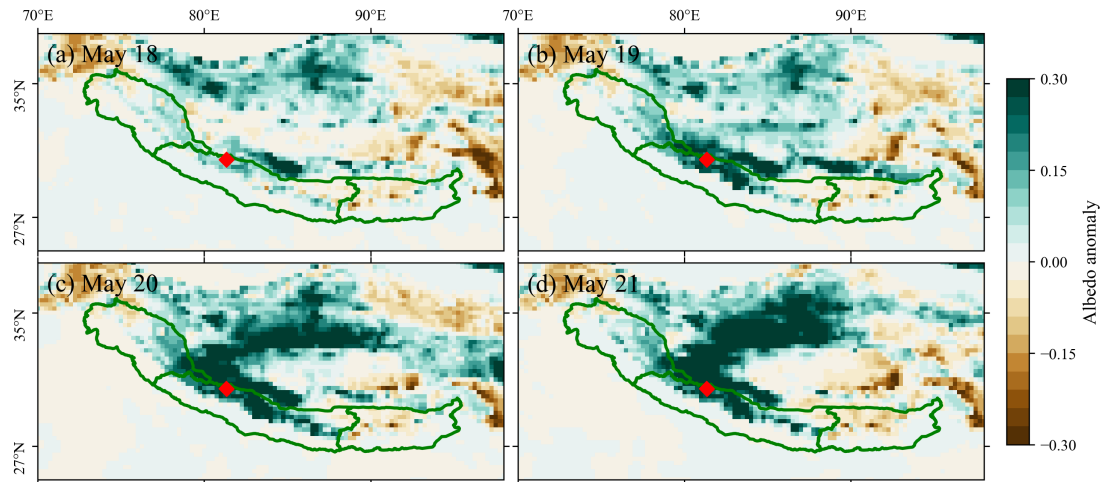


Figure 10: Daily surface albedo anomalies on (a) May 18, (b) May 19, (c) May 20, and (d) May 21, 2021. Anomalies are calculated relative to the 2000–2024 climatological mean for the corresponding day of the year. The green outline denotes the Himalaya region, and the red diamond marks the location of Naimona'nyi Glacier.

Specific Comments 17: L436-437: I notice that looking at the precipitation fields in Fig. 8, the TC comes from the southwest on May 17 and arrives in the central Himalayas at May 18/19. It looks like that the TC had a significant impact in this area, but that the eastern Himalayas was barely affected.

Response: Thank you for pointing out the spatial differences in precipitation responses across different regions in Fig. 8. We agree that Fig. 8 shows that TC Tauktae moved from the southwest toward the Himalayan region on May 17 and mainly affected the central Himalayas during May 18–19, while the precipitation response in the eastern Himalayas was relatively weak. To further verify the influence of TC Tauktae on Naimona'nyi Glacier, we added a new Section 4.1 in the revised manuscript and analyzed the spatiotemporal variations in integrated water vapor transport using ERA5 data. The results show that the water vapor transport was mainly concentrated over the central Himalayas and the area surrounding Naimona'nyi Glacier. Meanwhile, the spatiotemporal evolution of cloud-top brightness temperature indicates that the TC Tauktae-related cloud system mainly affected the central Himalayas as it moved toward

the Himalayan region, while its influence on the eastern Himalayas was relatively weak. Therefore, we fully agree with the reviewer's comment and have removed the relevant statements regarding the impact of TC Tauktae on glaciers in the eastern Himalayas from the original manuscript

Specific Comments 18: L445-446: I think that the absence of the increase in albedo in the eastern Himalayas is related to the absence of snowfall and therefore already hints that what happens in the eastern Himalayas, during May 17-21, 2021, is not related to TC Tauktae.

Response: Thank you for this important comment. Based on the changes and anomalies in snowfall and albedo during May 17–21, 2021, we found no clear increase in snowfall or albedo, nor any pronounced positive anomalies, over the eastern Himalayas. Therefore, we agree with the reviewer's assessment and have removed the statements regarding the influence of TC Tauktae on the eastern Himalayas from the Abstract, Discussion, and Conclusions of the revised manuscript.

Specific Comments 19: L470-471: Could the authors elaborate more on how the moisture transport by large-scale circulation is related to the limited snow cover in the eastern Himalayas? What do the isotope-based studies show?

Response: Thank you for raising this important point. The wording in the original manuscript was not sufficiently clear and may have caused some misunderstanding. Our analysis was not intended to establish a causal relationship in which moisture transported by large-scale circulation led to limited snow cover in the eastern Himalayas. Rather, based on the ERA5 analysis, the weaker snow response in the eastern Himalayas was described as a spatial characteristic of the results. The isotope-based study cited immediately afterward was intended mainly to demonstrate that moisture associated with TCs can be transported to the Tibetan Plateau through large-scale atmospheric circulation. we placed this in the Discussion section, which inadvertently linked the moisture transport with the weaker snow response in the eastern Himalayas and caused the misunderstanding. Therefore, we deleted the

discussion related to the isotope-based study from the original manuscript to avoid creating an unintended association.

Specific Comments 20: L471-473: Based on the outcomes presented in this study, evidence that the meteorological and energy perturbations associated with TC Tauktae has affected the eastern Himalayas is lacking in my opinion. Optionally, the authors could perform moisture tracking analyses to trace moisture sources associated with precipitation falling in the central or eastern Himalayas during the May 18-19, 2021 period?

Response: Thank you for raising this important point. We agree with the reviewer's assessment that, based on the results presented in the original manuscript, there was insufficient evidence to demonstrate a clear meteorological and energy influence of TC Tauktae on the eastern Himalayas. Therefore, we have removed the relevant statements regarding the influence of TC Tauktae on the eastern Himalayas from the revised manuscript.

Meanwhile, to further clarify whether TC Tauktae affected Naimona'nyi Glacier, we added a new Section 4.1, in which we conducted a combined analysis of integrated water vapor transport, moisture flux divergence, cloud-top brightness temperature, ERA5 precipitation, and glacier-wide meteorological conditions during May 13–25, 2021. The results indicate that the influence of TC Tauktae on Naimona'nyi Glacier began to emerge on May 17 and became more pronounced during May 18–21. Therefore, we define May 18–21, 2021 as the main period of TC Tauktae influence on Naimona'nyi Glacier. The relevant analysis has been added to Section 4.1 of the revised manuscript, and the statements regarding the influence of TC Tauktae on the eastern Himalayas have been removed throughout the manuscript.

Revised text:

4.1 Identification of the influence period of tropical cyclone Tauktae on Naimona'nyi Glacier

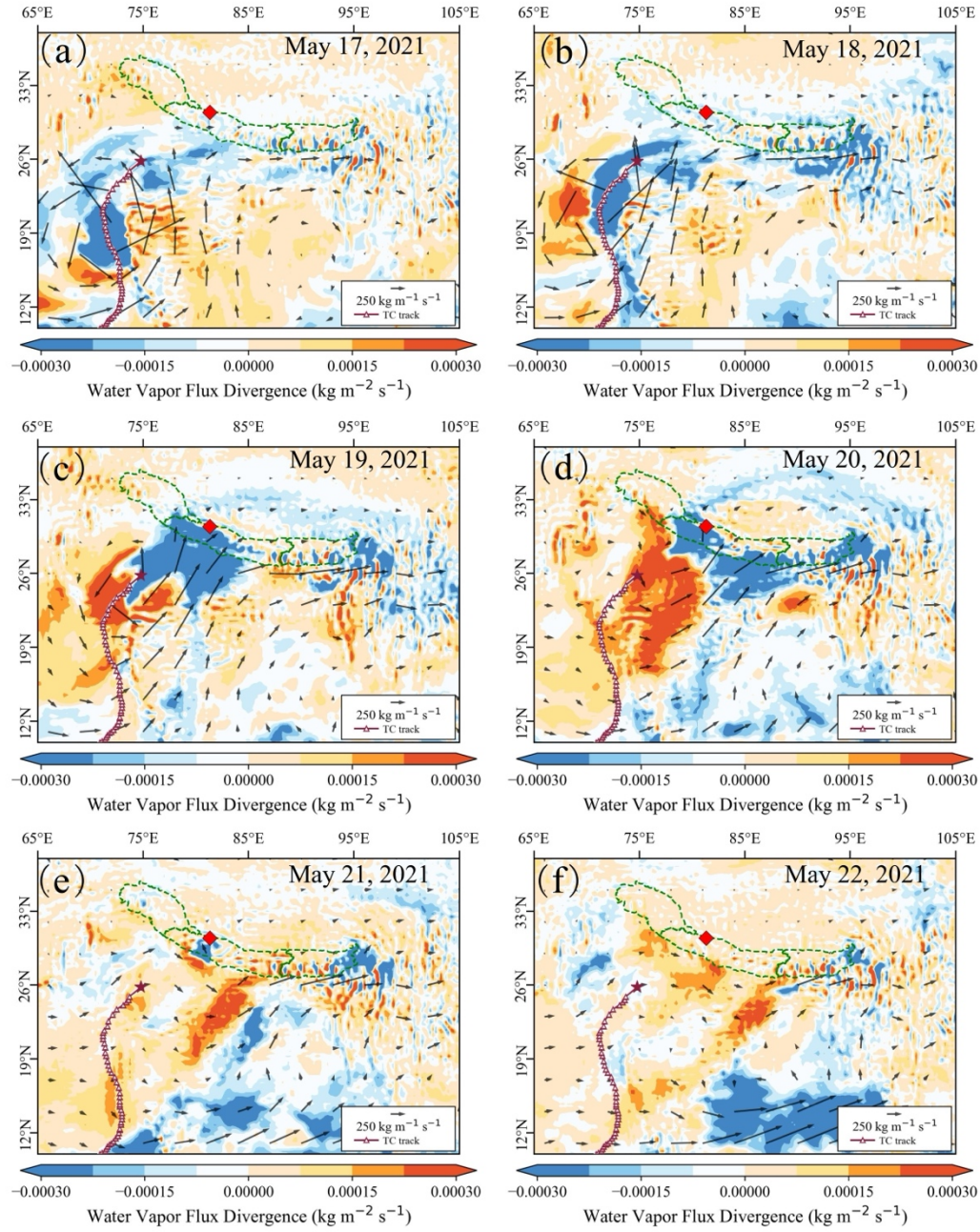


Figure 2: Daily changes in vertically integrated water vapor transport and moisture flux divergence from 17 to 22 May 2021. (a) May 17, 2021; (b) May 18, 2021; (c) May 19, 2021; (d) May 20, 2021; (e) May 21, 2021; (f) May 22, 2021. Shading indicates the integrated water vapor flux divergence ($\text{kg m}^{-2} \text{s}^{-1}$), and black arrows indicate the integrated water vapor transport (IVT), with arrow direction and length representing the direction and magnitude of IVT, respectively. The magenta curve indicates the tropical cyclone track, triangles indicate the cyclone positions along the track, and the star indicates the final position of the track. The red diamond indicates the location of

the study glacier, and the green dashed line indicates the extent of the Himalayas.

To determine whether Tauktae affected Naimona'nyi Glacier, we conducted a combined analysis of vertically integrated water vapor transport (IVT), moisture flux divergence, BT, glacier-wide reconstructed meteorological conditions, and ERA5 precipitation during May 13–25, 2021. The variations in these variables were pronounced during May 18–21. Therefore, the spatial evolution of IVT, moisture flux divergence, BT and ERA5 precipitation was examined for May 17–22, while glacier-wide meteorological conditions were presented as a complete time series for May 13–25. On May 17, 2021, TC Tauktae was located southwest of Naimona'nyi Glacier, and the IVT field showed the onset of weak moisture transport from the southwest toward the glacier. However, moisture flux divergence remained weakly negative, indicating that moisture convergence over the glacier was still weak (Fig. 2a). On May 18, IVT from the southwest toward the glacier strengthened, consistent with the location of TC Tauktae southwest of the glacier, and was accompanied by enhanced moisture convergence (Fig. 2b). During May 19–20, IVT from the southwest toward the glacier continued to intensify, while a continuous zone of moisture convergence gradually developed over and around the glacier, reaching its maximum during this period. Meanwhile, the IVT direction remained consistent with the position of TC Tauktae southwest of the glacier (Fig. 2c–d). On May 21, both the intensity of IVT and the spatial extent of moisture convergence began to decrease, although moisture convergence remained evident near the glacier (Fig. 2e). By May 22, IVT from the southwest had largely diminished, and the moisture convergence over and around the glacier had also weakened (Fig. 2f). These results suggest a possible influence of southwestward moisture transport associated with TC Tauktae on Naimona'nyi Glacier, accompanied by moisture convergence over and around the glacier.

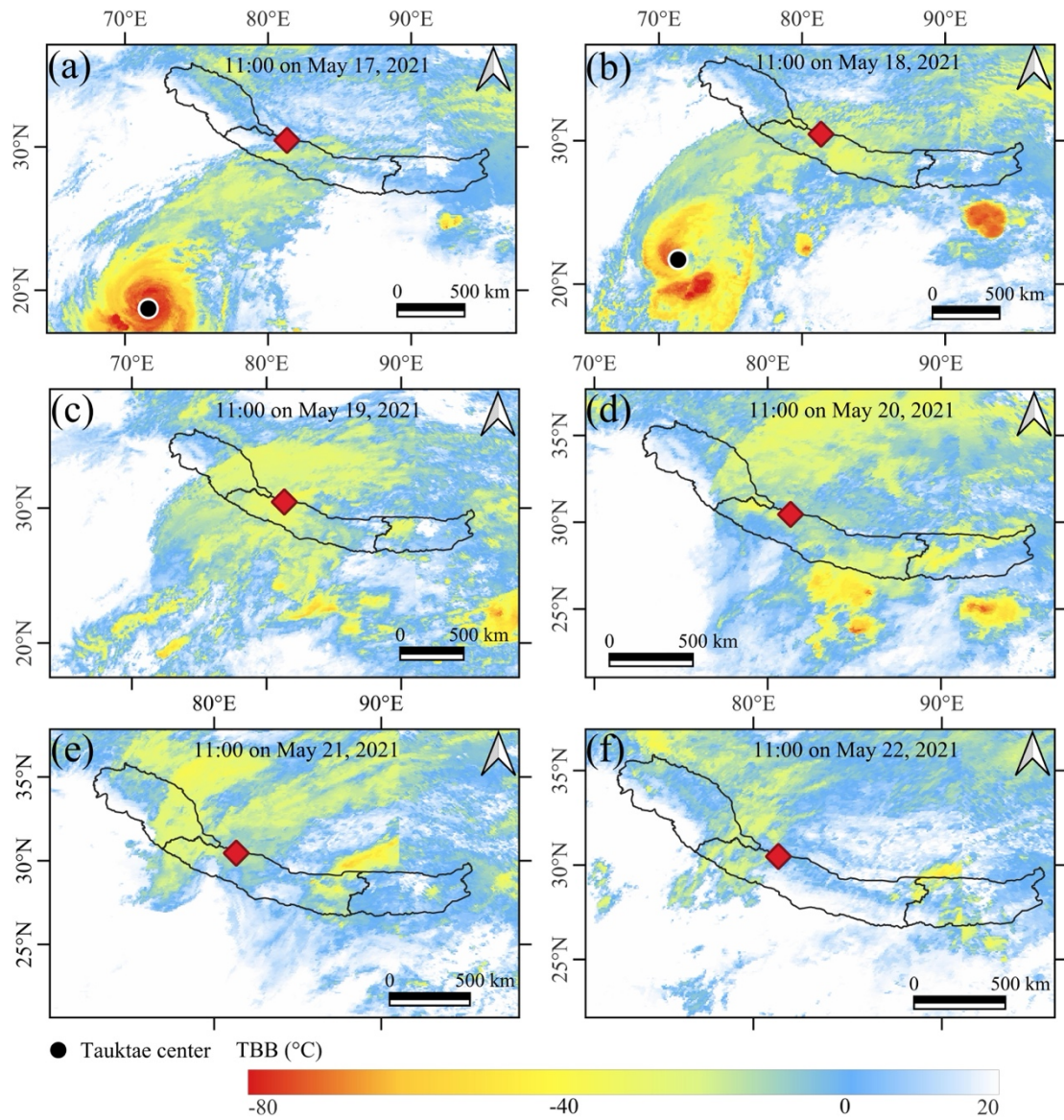


Figure 3: Cloud-top brightness temperature (BT) at 11:00 from May 17 to May 22, 2021. (a) May 17; (b) May 18; (c) May 19; (d) May 20; (e) May 21; (f) May 22. Shading indicates BT, black dots indicate the center position of TC Tauktae, black lines indicate the Himalayan region, and red diamonds indicate the location of Naimona'nyi Glacier.

Meanwhile, the spatiotemporal evolution of BT reveals the development of the cloud system associated with TC Tauktae and its expansion toward the study area. On May 17, 2021, TC Tauktae was located southwest of Naimona'nyi Glacier. On May 18, the cyclone moved further northward, while its peripheral cloud system expanded northeastward and covered Naimona'nyi Glacier. During May 19–21, as the cyclone

weakened and continued to move northward, its cloud system became increasingly fragmented and diffuse, while parts of the cold-cloud region continued to cover Naimona'nyi Glacier and its surrounding areas. By May 22, the low-BT signal over Naimona'nyi Glacier and its surrounding areas had substantially weakened (Fig 3f). ERA5 precipitation results show that on May 17, 2021, relatively heavy precipitation was mainly concentrated around TC Tauktae, with daily precipitation exceeding 30 mm, while no apparent precipitation impact was observed near Naimona'nyi Glacier (Fig S6a). On May 18, relatively heavy precipitation remained concentrated around the center of TC Tauktae, while precipitation over and around Naimona'nyi Glacier increased as the cyclone moved northward (Fig S6b). During May 19–20, the precipitation area expanded further, with relatively heavy precipitation occurring over the central and parts of eastern Himalayas (Fig S6). On May 21, the precipitation area contracted, with relatively heavy precipitation concentrated mainly near Naimona'nyi Glacier (Fig S6e). By May 22, precipitation over and around Naimona'nyi Glacier had largely dissipated (Fig. S6f).

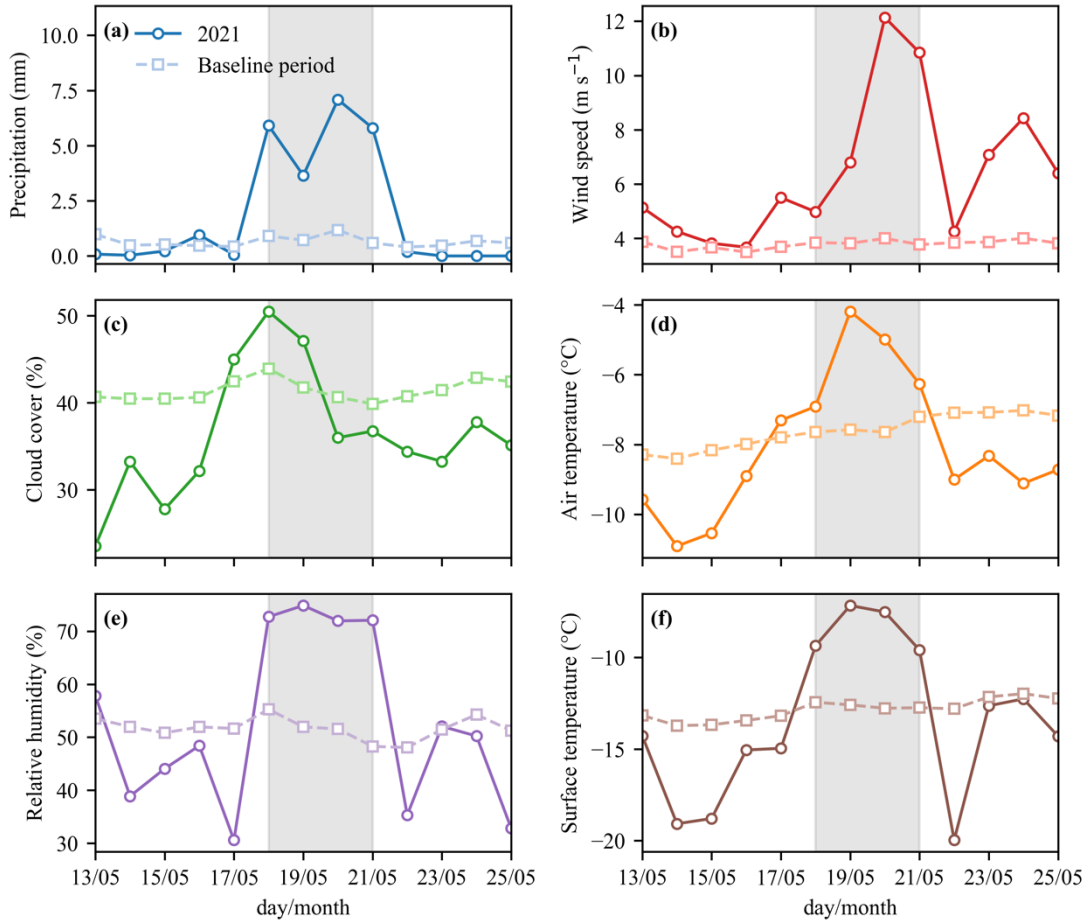


Figure 4: Daily variations in meteorological variables over Naimona'nyi Glacier from May 13 to May 25, 2021, compared with the baseline period. (a) Precipitation (mm); (b) wind speed (W s^{-1}); (c) cloud cover (%); (d) air temperature ($^{\circ}\text{C}$); (e) relative humidity (%); and (f) surface temperature ($^{\circ}\text{C}$). Solid lines with circles represent the daily variations in 2021, while dashed lines with squares represent the multi-year mean values for the corresponding days during the baseline period (2000–2024, excluding 2021). The gray shading indicates the main period of influence of Tropical Cyclone Tauktae from May 18 to May 21, 2021.

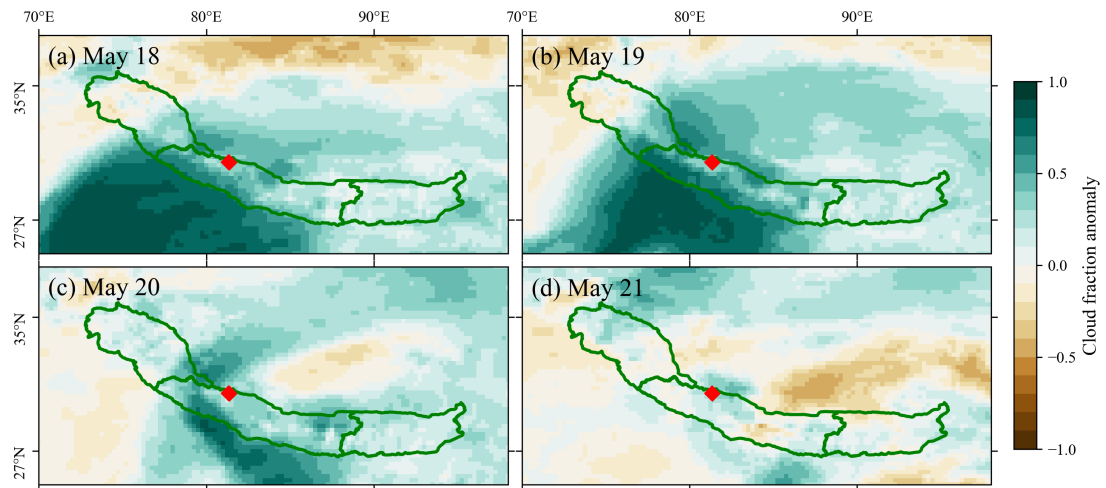
Finally, the glacier-wide reconstructed meteorological data indicate that some meteorological variables over Naimona'nyi Glacier began to deviate from the corresponding means for the same dates from 2000 to 2024 (baseline period) on May 17, 2021, with WS, cloud cover, and Ta slightly higher than the corresponding means during the baseline period (Fig. 4). During May 18–20, 2021, precipitation, Ta, RH, and

cloud cover were higher than during the baseline period (Fig 4). On May 21, 2021, although cloud cover was lower than during the baseline period, precipitation, T_a , RH, and WS remained higher than during the baseline period (Fig 4). The combined changes in IVT, moisture convergence, TC-related cloud systems, ERA5 precipitation, and glacier-wide meteorological conditions indicate that anomalous conditions over Naimona'nyi Glacier began to emerge on May 17, 2021 and became most pronounced during May 18–21, 2021. These changes were temporally and spatially consistent with the northward movement of TC Tauktae and the expansion of its associated cloud system toward the glacier. Therefore, we define May 18–21, 2021 as the main period associated with the influence of TC Tauktae (TC period) on Naimona'nyi Glacier and use this period for the subsequent analysis of its impacts.

Specific Comments 21: Fig. 10: This figure is hard to read as the (tick) labels are quite small and 6 separate figures seems to have merged into one, which is suboptimal. Therefore, I recommend splitting up Fig. 10 into 6 separate figures (Fig. 10- Fig. 15), and to address these one by one.

Response: We appreciate the reviewer's constructive suggestion regarding the presentation of Fig. 10. The original Fig. 10 contained six subplots, resulting in relatively small tick labels and a crowded layout that reduced the overall readability of the figure. Following the reviewer's suggestion, we have reorganized the original Fig. 10 into separate figures. Since this study mainly focuses on the variables related to the positive mass balance response, we removed precipitation from the original figure and retained snowfall, albedo, cloud cover, incoming shortwave radiation, and net shortwave radiation. Among these variables, snowfall and albedo, are retained in the main text (Figs. 9 and 10), while the other variables have been moved to the Supplementary Material (Figs. S17–S19). In addition, we no longer display the entire Tibetan Plateau, allowing each figure to present the spatial variations of the corresponding variables more clearly. Some of the revised figures are shown below, and the corresponding figures in the manuscript have been updated accordingly.

Revised Figure S17:



Supplementary Figure. 17. Daily cloud fraction anomalies on (a) May 18, (b) May 19, (c) May 20, and (d) May 21, 2021. Anomalies are calculated relative to the 2000–2024 climatological mean for the corresponding day of the year. The green outline denotes the Himalaya region, and the red diamond marks the location of Naimona'nyi Glacier.