Response to Reviewer 1

Yang et al. Introduced the structure and performance of an Early Warning System installed for monitoring ice collapses and river blockages in the southeastern Tibetan Plateau. The EWS has successfully warn three collapse-river blockage events and seven small-scale collapses. They also found that the volume and location of the collapse and the percentage of ice content contribute the different velocity of debris flow and magnitude of rive blockages. Such work represents an important contribution to the cryosphere disasters monitoring and warning on the Tibetan Plateau. Although the manuscript provided good descriptions of EWS and their performance, there are a number of issues below that need to be addressed prior to publication.

Reply: We would like to thank Dr. Zhuang Yu for reviewing and editing this study. We greatly appreciate your insightful comments and respond to each of them below. Responses to the comments of the reviewer are written in blue.

General Comments：

The introduction needs more background on the ground-based early warning systems that have already been installed around the world. The author states that few successful warnings have been reported. Could the authors provide some description about the question of EWS performance? In line 51, the author states that there are no EWS for ice collapse on the Tibetan Plateau. Are specific instruments and structure of EWS needed for ice collapse? More explanation should be added to the manuscript.

Reply: Thank you for these insightful comments. The reported EWSs (e.g. Huggel et al., 2020；Wang et al., 2022) were designed for warning the GOLF. However, the occurrence of GOLF is rare. That is the main reason why few successful warnings have been reported (Massey et al., 2010). In fact, most of EWS are equipped with similar sensors such camera, water level gauge, geophone, and AWS. Therefore, in the revised manuscript, the relevant description on the specification of ice collapse would be removed. We added the sentence to address the challenges of EWS installation and maintenance in high-altitude region. "*In reality, the installation and maintenance of EWS in sparsely populated regions generally faces many difficulties such as the instrument transport and logistics in high altitude mountainous areas, the harsh extreme weather conditions, the power supply and data transmission in cloudy and rugged regions, the reliability and compatibility of different sensors, the sustainable funding.*".

The reported successful early warning was also cited (Massey et al., 2010).

Massey, C. I., Manville, V., Hancox, G. H., Keys, H. J., Lawrence, C., and McSaveney, M.: Out-burst flood (lahar) triggered by retrogressive landsliding, 18 March 2007 at Mt Ruapehu, New Zealand—a successful early warning, Landslides, 7, 303-315, 2010.

Section 2 "Study region" and Section 3 "Historical ice-rock collapse around ......" could be merged as Section 2. Study region and historical ice-rock collapses.

Reply: Both reviewers have pointed this out. In the revised manuscript, we will move it to the study area section. The title of Section 2 will be changed as "Study region and historical ice-rock collapses".

Figure 7 and the supplementary, the seismic waveform of two abnormal waveform (showed by green arrows) need to be displayed in the supplementary. Are these waveforms typically different with the normal waveform introduced by ice-rock avalanche? Maybe the small-scale rock avalanches without debris flow formation.

Reply: Thank you for your suggestions. We will provide the seismic waveform of these two abnormal waveforms in the supplementary as followings. The waveforms on 2 June and 1 October 2022 are completely different from the typical avalanche-induced waveform. Although the amplitude of waveform is above 20, the duration and characteristics of waveform is different. The typical avalanche-induced waveform usually lasts several minutes and displays the gradually decreasing amplitude with the collapses. However, the two abnormal waveforms are very short, indicating the possible waveform noise. This is the reason why no debris-flow could be verified in the outlet of the Sedongpu valley.

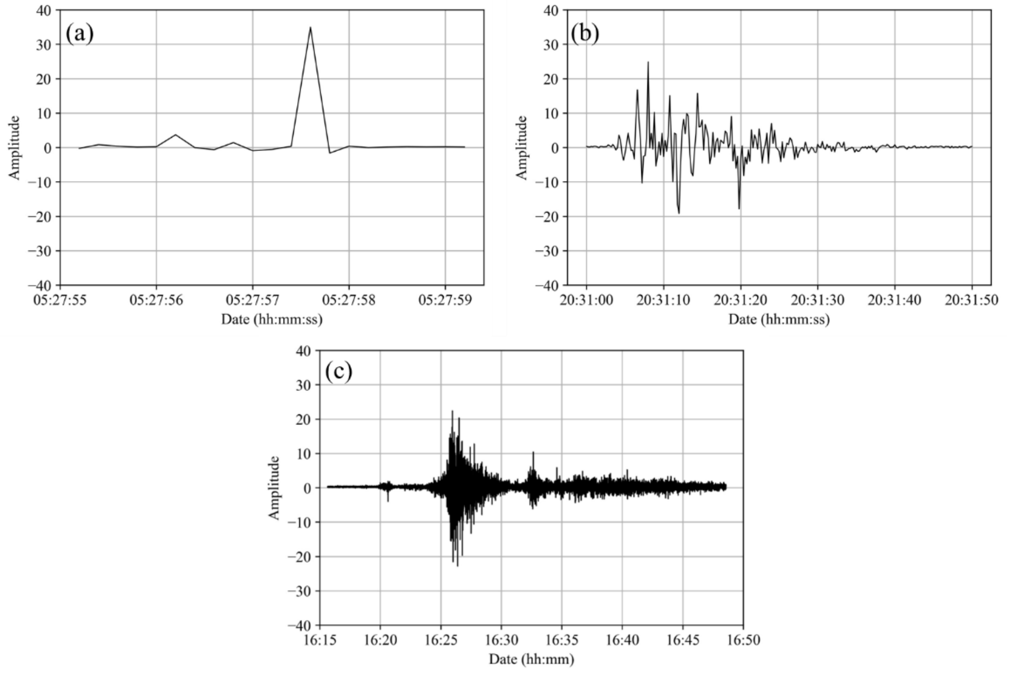

Figure S1: The two abnormal waveforms occurred on 2 June 2022 (a) and 1 October 2022 (b) and the collapse-induced waveforms occurred on 11 August 2022 (c), showing the different waveform and duration.

Line 276-278, the author claimed that both the maximum amplitude and the duration of seismic waveform are useful information for early warning the ice-rock collapse. Did the EWS incorporate this information in the system? In Line 174-175, the warning system seem to only consider the thresholds as the only warning information. More explains should be added for introduce the automatic warning system in the manuscript.

Reply: In the current stage of the warning system, we used the threshold of the waveform amplitude as the automatic warning path. If the amplitude is over 20, the warning message is sent to the two experts in the office of the Second Tibetan Plateau Scientific Expedition and Research Program. The experts will check the multi-parameters including real-time photos, videos, water level and waveform characters to determine the status of the glacier and river and inform the local government. We will add this information at the beginning of section 4.

Line 295-Line 300. The author provided the values of anomalous glacier thickening on three risking glaciers in the ablation zone. The boundary of this ablation zone should be delineated in Figure 9.

Reply: Following your suggestions, we have added the boundary of the ablation zones in the revised Figure 9.

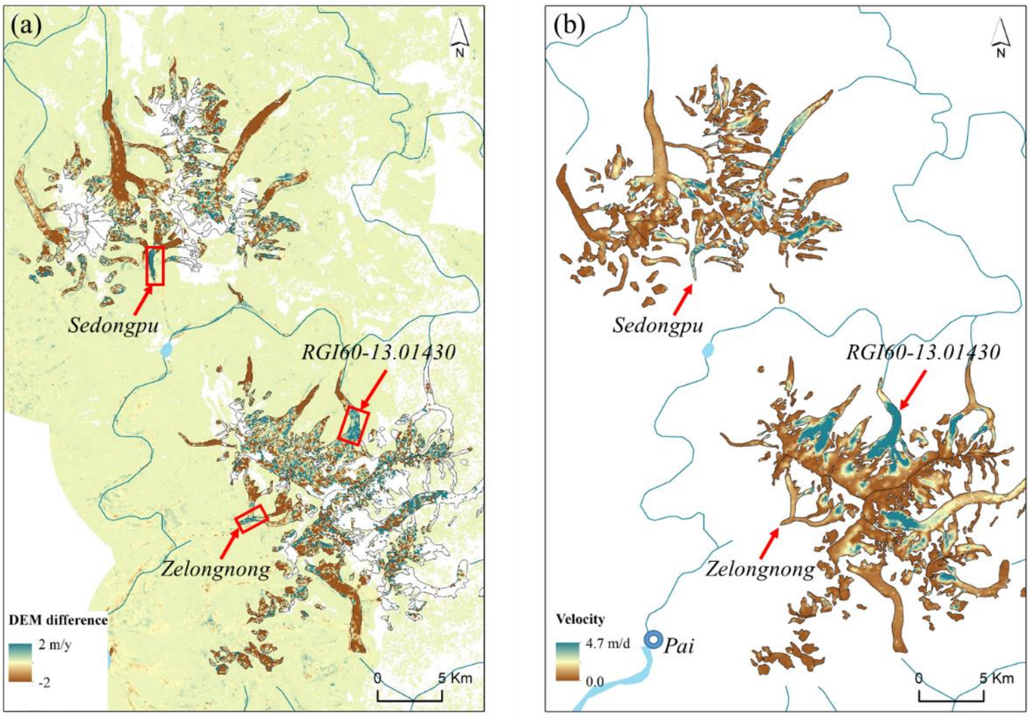

Figure 9: Spatial distribution of mean surface elevation change (m/y) during 2010-2020 (Hugonnet et al., 2021) and annual surface velocity (m/day) in 2017 (Millan et al., 2022), and the locations of the three glaciers with abnormal surface thickening (the red rectangles) and the tower of Pai.

The EWS in this manuscript did not include the GNSS for monitoring glacier displacement, which is the direct indicator of glacier abnormal change and the popular way for disaster monitoring (landslide and rock avalanche). Could the GNSS be used on the glacier surface, in particular for the risking glaciers such as the Zelongnong Glacier and the other glacier RGI60-13.01430 for early warning their abnormal dynamic changes?

Reply: Installing high-resolution GNSS on the glacier surface is a good way to monitor the abnormal glacier dynamics with sufficient temporal resolution. However, for the Sedongpu Glacier and RGI60-13.01430, it is very difficult to install and maintain GNSS due to the logical problem. However, for the debris-covered Zelongnong Glacier, GNSS is the best way to monitor its dynamics. We will plan to install GNSS on this glacier in the near future. We will include this monitoring method in the revised manuscript. " *Enhanced monitoring, especially surface movement monitoring using Global Navigation Satellite System (GNSS), is critical for the Zelongnong Glacier, which is very close to the town of Pai with a population of more than 3000, and for the proposed large-scale hydropower project.*"

In section 6.2, the author stated that all-weather avalanche radar for real-time monitoring. Do the author know the similar instruments available for EWS?

Reply: The GEOPREVENT in Switzerland has developed the Avalanche Radar for real-time monitoring with a range of up to 5 km. Detailed information is available in https://www.geopraevent.ch/technologies/avalanche-radar/?lang=en

Minor comments:

Line 130. The video of the disaster process is retrieved remotely.

Reply: we will add “by commands” at the end.

Figure 1. Yarlung Tsangpo, Figure 4. Yarlungzangbo River. I suggest consistent use of Yarlung Tsangpo throughout.

Reply: Thanks. We have used the Yarlung Tsangpo in the whole manuscript.

The quality of Figure 5 should be improved to be more than 300Mdpi. The red arrow was not displayed fully in Figure 5a. and the major tick lines in X and Y axis should be added.

Reply: Thanks. We will improve the quality of Figure 5 and added/revised the relevant problems.

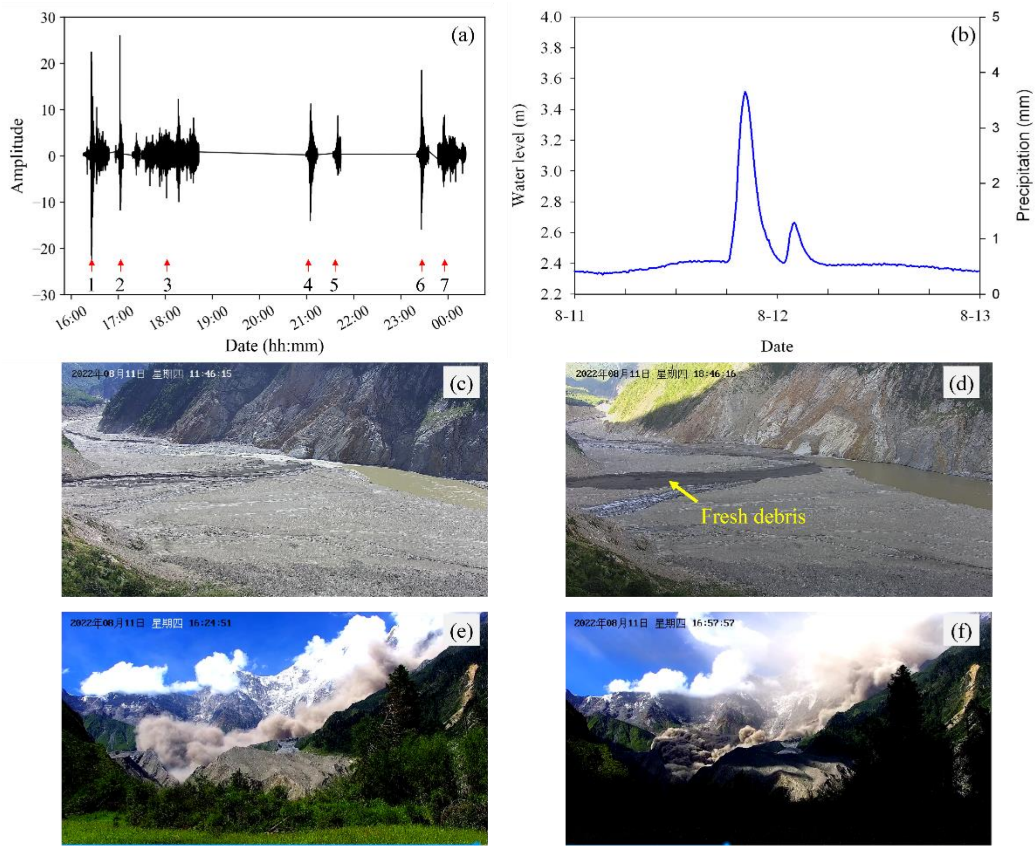

Figure 5: Recorded waveform of seven collapses on 11 August 2022 (a) and the water level rise due to small-scale debris flow (b), and the photos before and after the occurrence of fresh debris flow into the Yarlung Tsangpo River (c,d), and video screenshots of two rock collapses at 16:24 and 16:57 on 11 August 2022

Figure 9a, the units is m or m/year?

Reply: We have changed it as m/y. Thanks.