Responses to referee and editor

Dear referee and editor，

We sincerely thank you again for your careful reading and helpful comments that improved the quality of this paper. We apologize for the problems in our manuscript, and we have fixed them in the revised version. Our point-by-point responses to your comments are given as follows. The sentences in italic and underline are the comments.

✧ **Comment 1:**

There is an abbreviation in the abstract (IoU) which is not defined (L17). Please do.

Respond：

Thank you for your suggestion. In the abstract, we use the abbreviation IoU (Intersection over Union) but do not give the full name. We will clarify this in the revised paper. Thanks again for your feedback. And table 4 provides a detailed explanation of IoU.

Re-edit:

1) With Google Earth images of 0.52 m resolution in the study area, the Recall, Precision, F1 Score, and Intersection Over Union (IoU) of glacial lake extraction based on the proposed method are 96.52%, 92.49%, 94.46%, and 90.69%, respectively.

✧ **Comment 2:**

L27: Please can it be clarified in the text what the 'strong relationship' is between glacial lakes and ongoing climate warming? This is just a statement. Is there a relationship between warming and lake size, and frequency? Clarify in text.

Respond：

Thank you for your suggestion. Climate warming, continuous glacier retreat and ablation of differences in the debris cover have led to the formation of a large number of glacial lakes and the continuous expansion of glacial lake areas. Climate change affects both size and number of glacial lakes. In the revised version, we added some literature to support this point of view.

Re-edit:

Climate warming, continuous glacier retreat and ablation of differences in the debris cover have led to the formation of a large number of glacial lakes and the continuous expansion of glacial lake areas (Nie et al. 2017, Chen et al. 2021a). In the past 30 years, the number of glacial lakes in High Asia has increased by 17.4%, the total area has increased by 17.3%, and the glacial lake area in the whole region expanded by 0.58%/a (Zhang et al.2022a). The rapid change of glacial lakes may increase the possibility of the occurrence of glacial lake outburst floods (GLOFs) (Zhong et al. 2021). The risk of GLOFs in High Asia is the highest (Taylor et al.2023). This may threaten the lives and property of 30 surrounding residents, and downstream infrastructures (Song et al. 2016; Begam et al. 2018; Nie et al. 2023). Such as, the GLOF in Tibet on June 26,2020, led to the destruction of 43.9 kilometers of roads and 8 bridges, and the flooding of 19.98 hectares of farmland (Zheng et al. 2021). Therefore, continuous dynamic monitoring of glacial lakes is essential to studies on climate change, water resource distribution, and disaster warnings. However, many small and unevenly distributed glacial lakes are ignored, these glacial lakes usually have a high risk of outburst (Zhang et al. 2022b).

✧ **Comment 3:**

Don't think 'on the other hand' is needed on L27 or L34 - the following statements are not contradicting.

Respond：

Thanks again for your advice. We will re-examine the wording in these two places and make appropriate adjustments in the revised paper. Thanks again for your feedback.

Re-edit:

Climate warming, continuous glacier retreat and ablation of differences in the debris cover have led to the formation of a large number of glacial lakes and the continuous expansion of glacial lake areas (Nie et al. 2017, Chen et al. 2021a). In the past 30 years, the number of glacial lakes in High Asia has increased by 17.4%, the total area has increased by 17.3%, and the glacial lake area in the whole region expanded by 0.58%/a (Zhang et al.2022a). The rapid change of glacial lakes may increase the possibility of the occurrence of glacial lake outburst floods (GLOFs) (Zhong et al. 2021). The risk of GLOFs in High Asia is the highest (Taylor et al.2023). This may threaten the lives and property of 30 surrounding residents, and downstream infrastructures (Song et al. 2016; Begam et al. 2018; Nie et al. 2023). Such as, the GLOF in Tibet on June 26,2020, led to the destruction of 43.9 kilometers of roads and 8 bridges, and the flooding of 19.98 hectares of farmland (Zheng et al. 2021). Therefore, continuous dynamic monitoring of glacial lakes is essential to studies on climate change, water resource distribution, and disaster warnings. However, many small and unevenly distributed glacial lakes are ignored, these glacial lakes usually have a high risk of outburst (Zhang et al. 2022b).

✧ **Comment 4:**

Newly inserted text needs a reference (L28 to L30) - would also suggest rephrasing as increasing glacial lake sizes does not necessarily mean it will increase the occurrence of GLOFs. I would rephrase to

suggest that the magnitude of GLOFs could increase as glacial lakes expand. Also needs citations.

Respond：

Thank you for your help. Increased glacial lakes do not necessarily lead to increased GLOFs, but they can increase the likelihood of GLOFs occurring. We will elaborate on this in the revised version and add corresponding citations.

Re-edit:

The rapid change of glacial lakes may increase the possibility of the occurrence of glacial lake outburst floods (GLOFs) (Zhong et al. 2021). The risk of GLOFs in High Asia is the highest (Taylor et al.2023). This may threaten the lives and property of 30 surrounding residents, and downstream infrastructures (Song et al. 2016; Begam et al. 2018; Nie et al. 2023). Such as, the GLOF in Tibet on June 26,2020, led to the destruction of 43.9 kilometers of roads and 8 bridges, and the flooding of 19.98 hectares of farmland (Zheng et al. 2021).

✧ **Comment 5:**

L32 to L33: Check tenses, 'to be' does not seem to fit

Respond：

Thank you for your suggestion. We will revisit our wording and make appropriate adjustments in the revised version to ensure grammatical accuracy.

Re-edit:

Such as, the GLOF in Tibet on June 26,2020, led to the destruction of 43.9 kilometers of roads and 8 bridges, and the flooding of 19.98 hectares of farmland (Zheng et al. 2021).

✧ **Comment 6:**

L35: Why are glacial lakes on the of sensitive indicators to 'global changes'? Please clarify in the text

Respond：

Thank you for your suggestion. Under the background of climate change, the area and number of glacial lakes show a trend of rapid change. In the revised version we respecify such relationships.

Re-edit:

Climate warming, continuous glacier retreat and ablation of differences in the debris cover have led to the formation of a large number of glacial lakes and the continuous expansion of glacial lake areas (Nie et al. 2017, Chen et al. 2021a). In the past 30 years, the number of glacial lakes in High Asia has increased

by 17.4%, the total area has increased by 17.3%, and the glacial lake area in the whole region expanded by 0.58%/a (Zhang et al.2022a).

✧ **Comment 7:**

L56: Please reference glacial lake colours.

Respond：

Thank you for your suggestion. We do not directly cite any specific reference regarding the color of glacial lakes. The colors we observe are based on the image data we downloaded. However, it is undeniable that due to the influence of the development environment of glacial lakes, the colors of glacial lakes in different regions are different in remote sensing images.

Re-edit:

Due to different development environments, the morphology of glacial lakes may differ in remote sensing images (Zhao et al. 2018). Collecting more samples of different types is of great help to enhance the stability and universality of the model (He et al. 2021). For the sake of increasing the diversity of the training dataset, except for the high Asia region, this study also collected some glacial lake samples from other continents.

✧ **Comment 8:**

L123: Easy freezing? What does this mean? Clarify in text

Respond：

Thank you for your suggestion. What we want to express here is that from the images we collected, we found that the water on the surface of the glacial lake in this place is easy to freeze. Of course, this may also be due to the image collection time. In order to avoid misunderstanding, we have removed this inaccurate statement.

✧ **Comment 9:**

L144: Please can the authors clarify all the data in the Google Earth imagery? Readers may not have used this so can it please be clarified in the text rather than 'and other data'

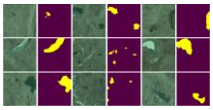
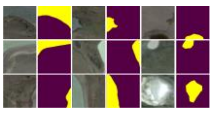
Respond：

Thank you for your suggestion. Google Image, also known as Google Earth, is a virtual globe software developed by Google. This software provides a wealth of satellite images, aerial images and GIS data. We provide the image source and imaging time in the modified version.

Re-edit:

Google Earth Images is a composite of a vast array of satellite and aerial photographs. These images are sourced from a variety of providers and platforms that are responsible for satellite launches. The primary contributors of high-resolution imagery include Maxar Technologies, the Centre National d'Etudes Spatiales (CNES) and Airbus. They provide IKONOS, QuickBird, Geoeye, WorldView, SPOT and Pleiades imagery.

Table 1. Details of the glacial lake training dataset based on Google Earth images in this study. All copyrights Image ©Google Earth 2020.

Area	Image source	Image time	Data level	Number	Sample examples
Himalaya, Northern Tibet Plateau, Asia	Pleiades 1,2; SPOT 5,6,7	2010-2020	Level14-18 (4.45-0.28m)	5494	
Buenos Aires Mountains, South America	Pleiades 1,2; QuickBird	2004-2016	Level 17,18 (0.79m, 0.4m)	3397	
Alaska Mountains, North America	WorldView 3	2013-2017	Level 18,19 (0.28m, 0.14m)	5519	
the Alps, Europe	Geoeye 1; WorldView 3	2015-2020	Level 18,19 (0.41m, 0.21m)	966