

Response to referee #2

We appreciate the referee for the comments on our manuscript. All these comments are very important guides to improve the quality of our manuscripts. We will discuss and attempt to answer the points you raised in the following (replies are in blue):

General comments:

This paper explores the use of deep learning algorithms to map debris-free glaciers in Gaofen-6 PMS (pan/multispectral) imagery, which has 2-meter spatial resolution and lacks short-wave infrared (SWIR) bands. Previously employed glacier-mapping methods frequently rely on SWIR bands in instruments such as ASTER, Landsat, and Sentinel-2, because the reflectance of snow and ice is very low in that part of the spectrum. High-resolution (meter-scale) instruments tend not to have SWIR bands, as the authors point out, so if one needs to map (e.g. smaller) glaciers at high resolution, this method could be of great use.

Thanks a lot for your approval.

A limitation of this method is that it is designed to work on clean (debris-free) glaciers. Since debris cover is present on 44% of Earth's glaciers (<https://www.nature.com/articles/s41561-020-0615-0>), this method is currently limited to regional studies where glaciers are largely clean. However, the authors point out that in the future, the method could use more diverse input data and be made to work on debris-covered glaciers. The method described in this paper does appear to be a solid building block for future expansion.

Thanks for your valuable suggestions. Due to the region restriction of Gaofen-6 PMS imagery, we did not acquire those images where there are debris-covered glaciers, such as the Karakoram Range, Pamirs, southern Tien Shan, Himalayas, etc. Therefore, we did not test the debris-covered glaciers in this study because of the absence of sample. The differences between clean glaciers and debris-covered glaciers are relatively large, so it is essential to make a new sample of debris-covered glacier and to develop an optimized strategy. As you said, this method has a potential on debris-covered glaciers by expanding the dataset. I will be devoted to this solution in the coming time, which is also an important component of my dissertation.

While the authors provide a generally good overview of previous work, one closely related paper that was not cited is from Xie, et al. (2020), entitled "GlacierNet: A Deep-Learning Approach for Debris-Covered Glacier Mapping". The application space is a bit different for this approach, but this paper seems important to mention when discussing prior work.

Thanks for your valuable suggestion. This paper is cited in the revised manuscript.

This paper makes extensive use of deep-learning jargon, and it should be better described for this journal's audience. The first time the "attention mechanism" is mentioned in the main text (line 58), for example, it should be better introduced, or pointed out that it will be described in the next section. But even after that, the method is not adequately described. I think it would be good to briefly describe the concepts behind the jargon at first mention, for example, something like "ASPP is used to obtain multi-scale context information from the imagery." Otherwise, understanding of the gist of the article will be too reliant on the reader finding outside resources.

Thanks for your suggestions. We introduce some of the deep-learning jargon in more detail, such as DeepLab V3+, Convolutional Block Attention Module and Atrous Spatial Pyramid Pooling in the revised manuscript.

In summary, this paper describes a method that achieves good results in its currently limited domain, and appears to be a good building block for future extension of the method to other input data sets. I recommend publishing after significant revisions for 1) readability, and 2) adequate explanation of the concepts behind the algorithms.

Thanks a lot for your suggestion. For readability, we sought a native English-speaking scientific editor to polish our manuscript. For adequate explanation of the concepts behind the algorithms, we explain the deep-learning jargon in more detail.

Some specific comments:

I think for most people, longitude/latitude coordinates given in decimal degrees are more useful than degrees-minutes-seconds.

Thanks for your suggestion. We replaced the degrees-minutes-seconds to decimal degrees.

The paper would benefit from a go-through by a native (or near-native) speaker of English to correct usage of articles, plurals, etc.

Thanks for your suggestion. A native English-speaking scientific editor is polishing our manuscript to avoid these grammatic mistakes and inappropriate sentences.