SPATIAL AND TEMPORAL VARIABILITY OF GLACIER SURFACE VELOCITY IN THE PARLUNG ZANGBO BASIN, TIBETAN PLATEAU.

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1. Introduction

Monitoring glacier surface velocity is important to understand the response of mountain glaciers to environmental forcing under climate change. The variability of surface velocity in the temperate glaciers of the Parlung Zangbo Basin (PZB) has attracted wide attention [1]. This study investigated in detail the spatial pattern and the temporal variability of surface velocity of glaciers in the PZB. We used the Sentinel-2A/B MSI data form October 2016 to December 2019 and Landsat-8 OLI data from June, 2013 to June 2020 to generate velocity maps. Based on the satellite images acquired from 2013 to 2020, we present a map of the annual and of time-averaged glacier surface velocity and examined four typical glaciers (Yanong, Parlung No.4, Xueyougu, and Azha) in the PZB.

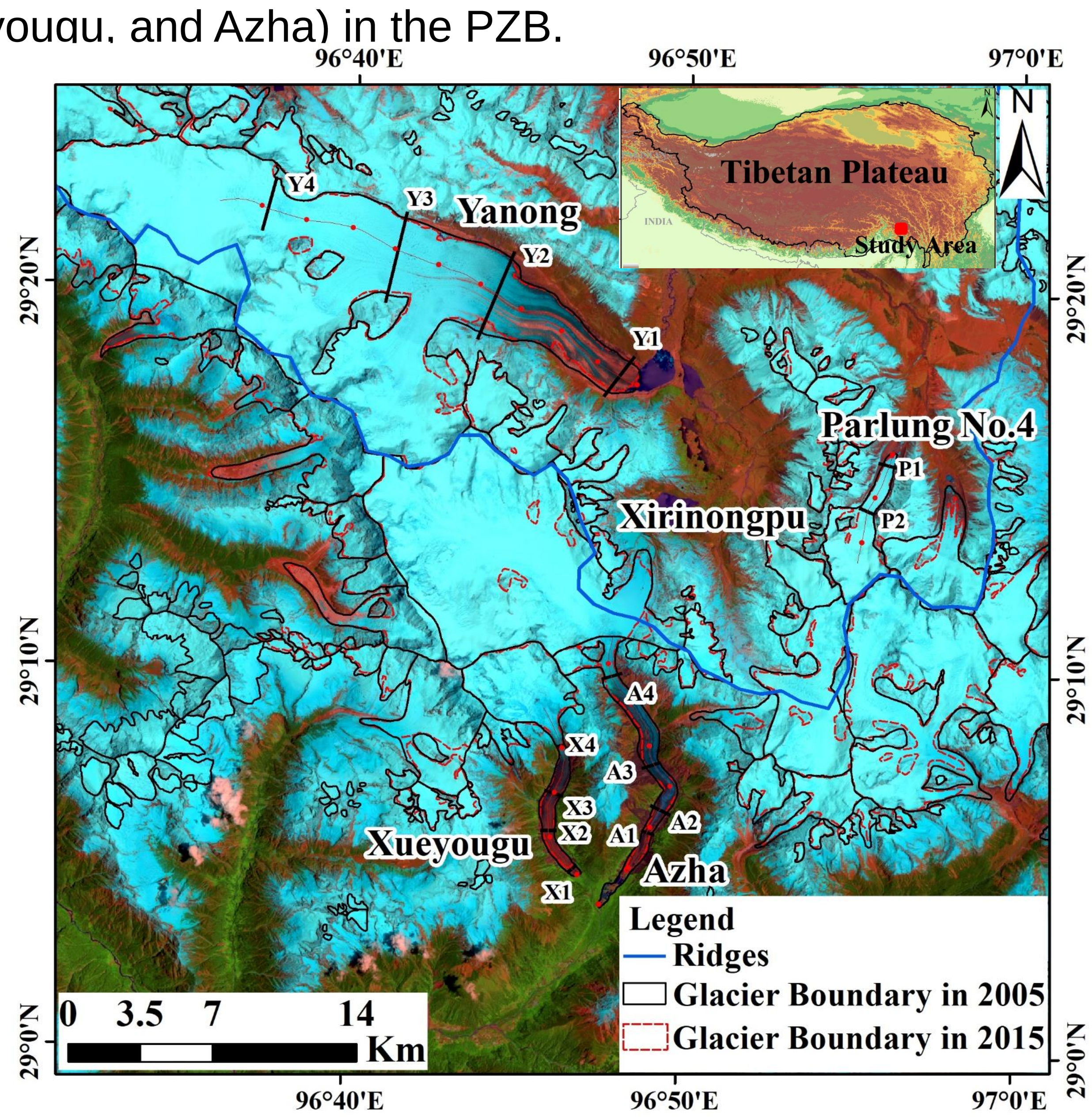


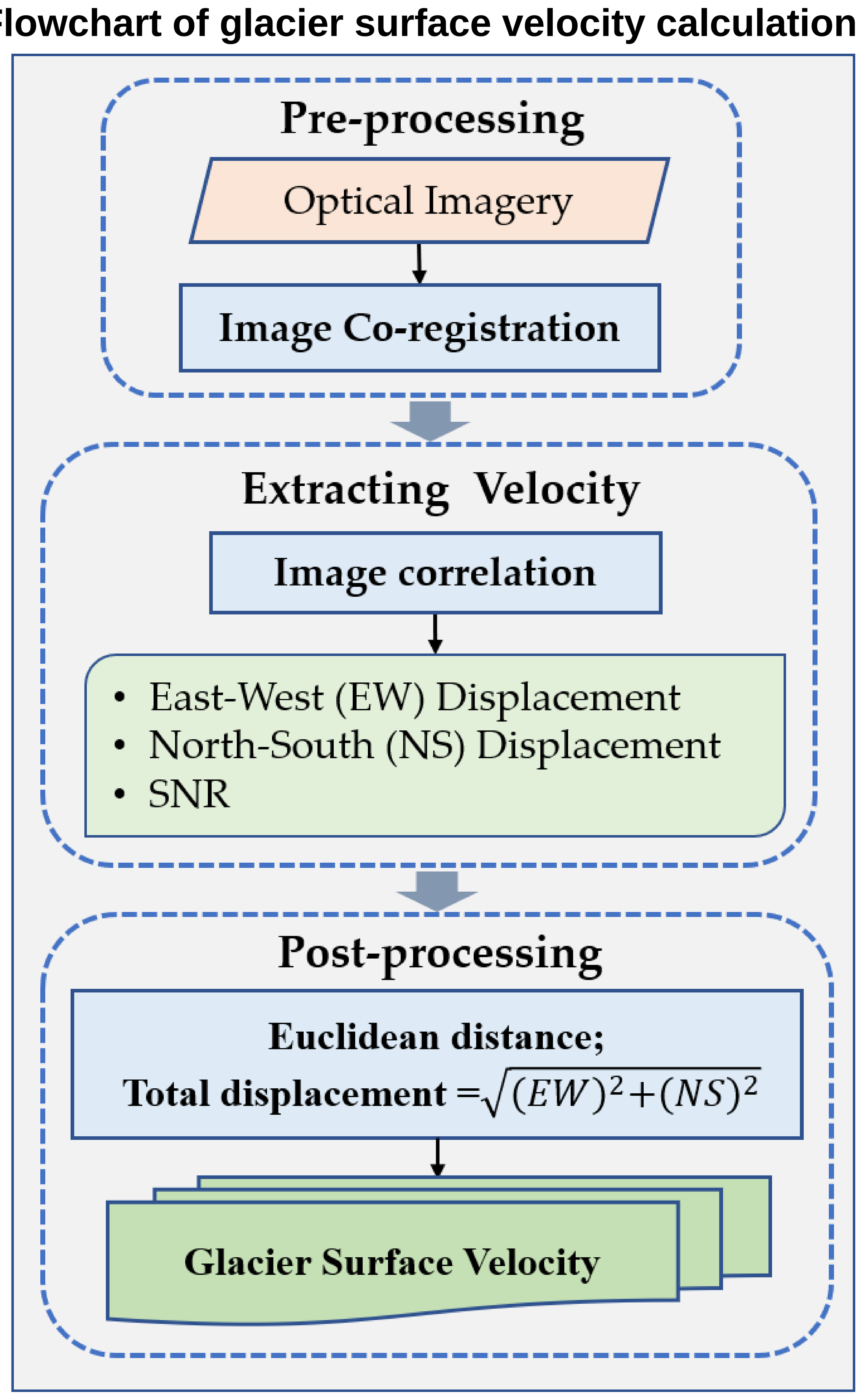
Figure 1. Location of the study area (Parlung Zangbo Basin). The red line is the centerline of Yanong Glacier. The black line is the glacier boundary from the Chinese Second Glacier Inventory.

2. Data and Method

2.1 Data

We used the Sentinel-2A/B data form October 2016 to December 2019 and Landsat-8 data from June, 2013 to June 2020 to generate velocity maps.

2.2 Flowchart of glacier surface velocity calculation [2].



3. Results and Analysis

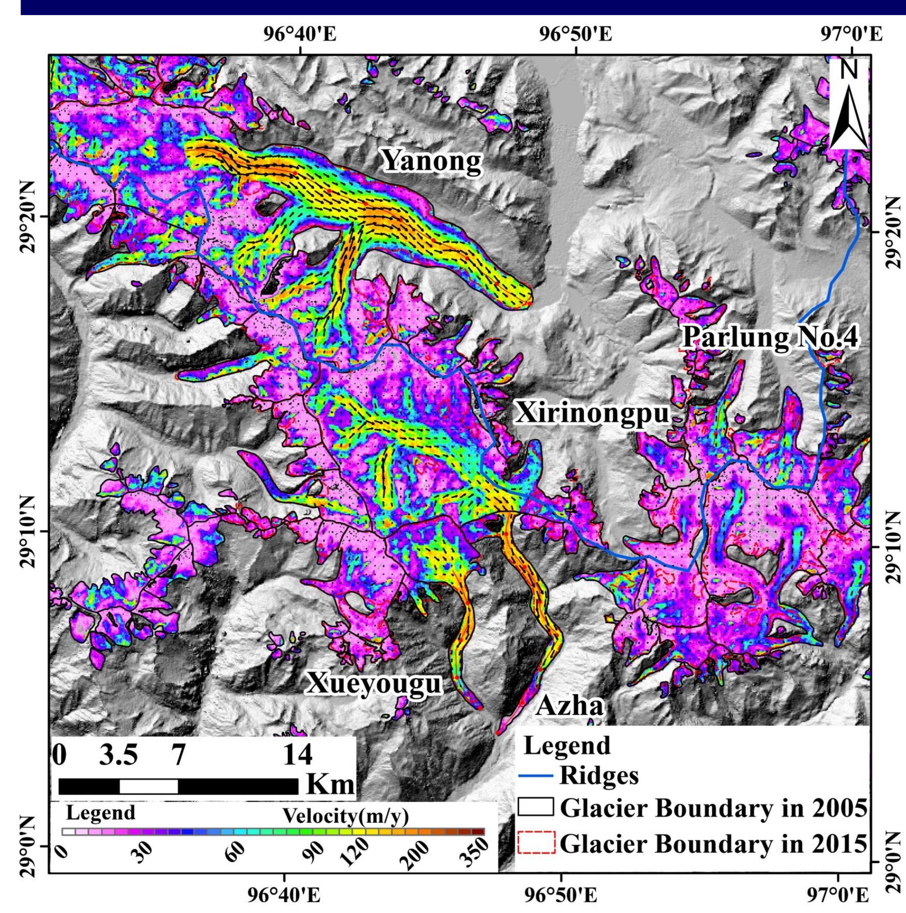


Figure 2. Mean annual glacier velocity in the Parlung Zangbo Basin during 2013–2020. The velocity map overlays the grey-shade void-filled SRTM DEM. The blue lines are mountain ridges, and the black lines are glacier boundaries in 2005 (SCGI). The red dashed lines are glacier boundaries in 2015. Red lines with dots in some glaciers show the flow centerline.

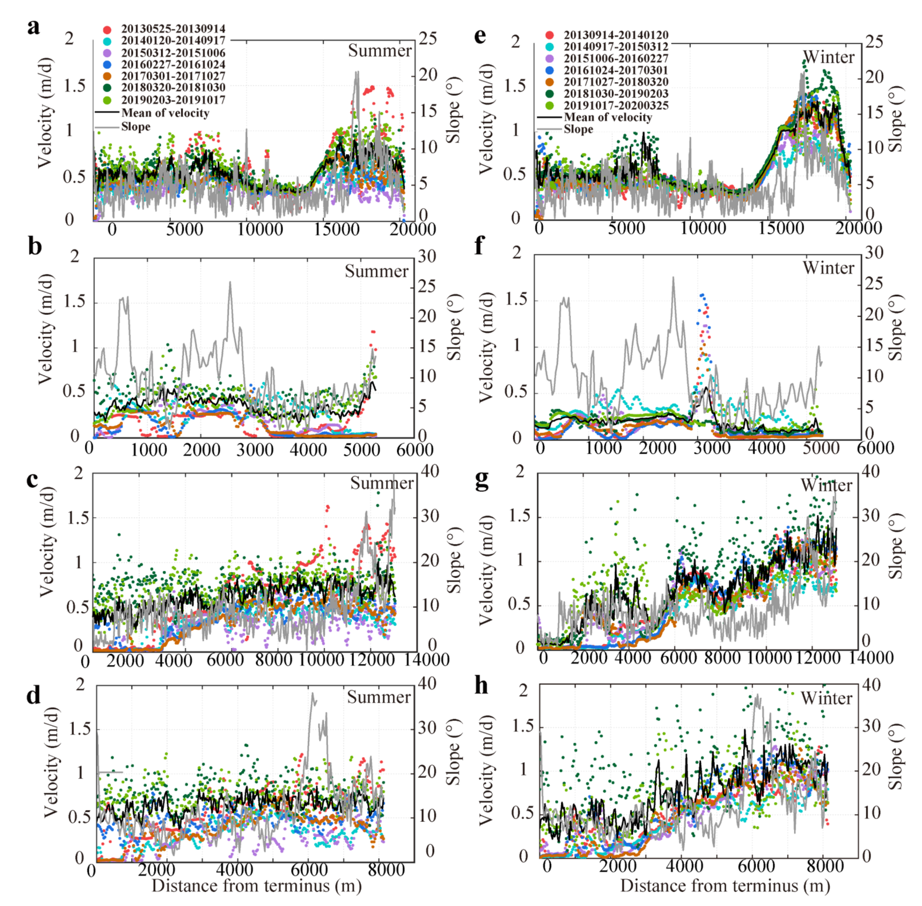


Figure 3. Summer (left, 2013–2019) and winter (right, 2013–2020) center flowline velocities vs. distance from terminus: Yanong Glacier (a and e) (GLIMS ID G096657E29334N); Parlung No.4 Glacier (b and f) (GLIMS ID G096920E29228N); Azha (c and g) (GLIMS ID G096818E29132N) and Xueyougu Glacier (d and h) (GLIMS ID G096758E29147N); mean of velocity (black solid line).

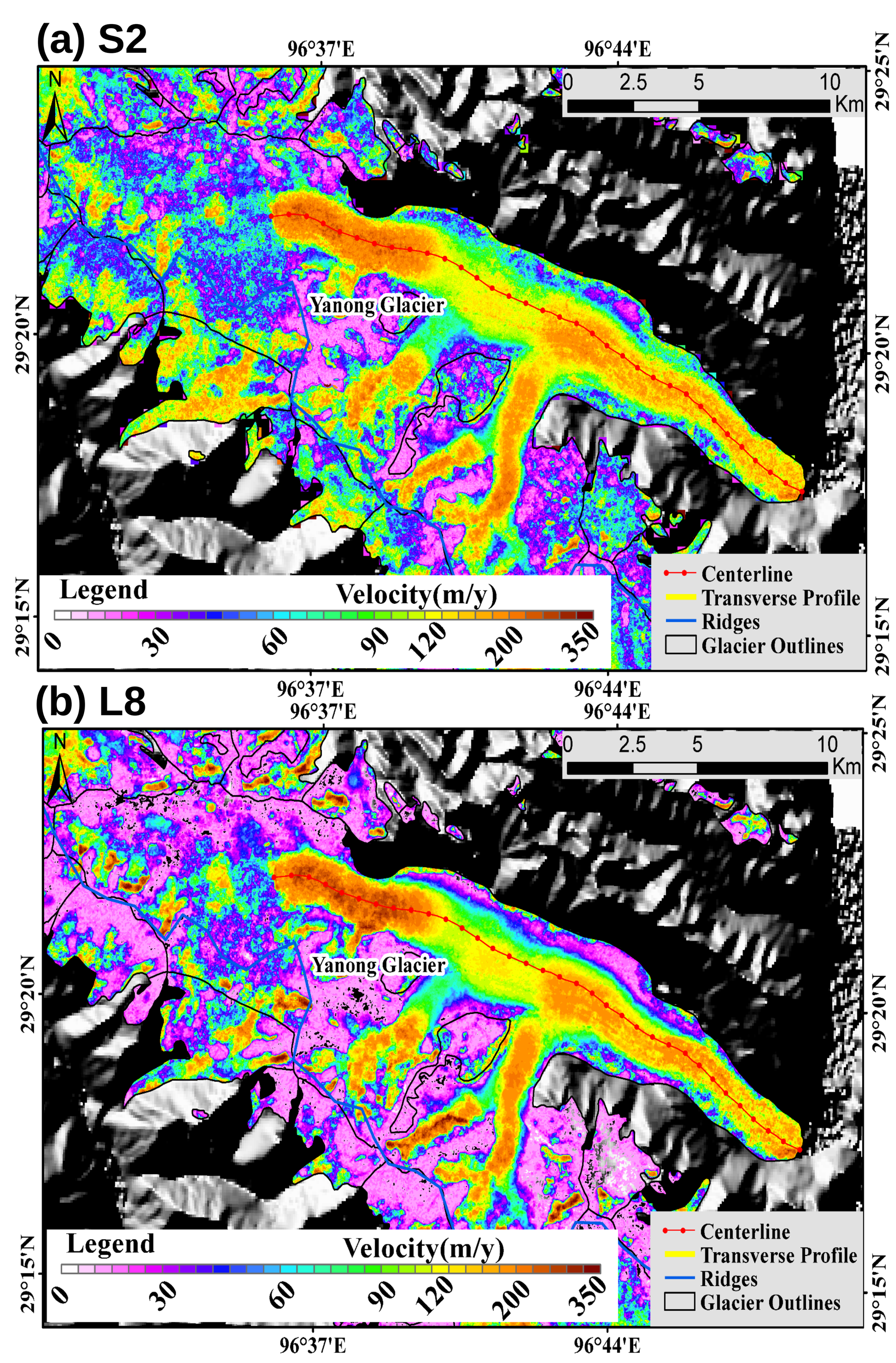


Figure 4. Comparison of glacier surface velocity field in Yanong glacier generated from (a) Sentinel-2 MSI (b) Landsat-8 OLI respectively during 2016-2017.

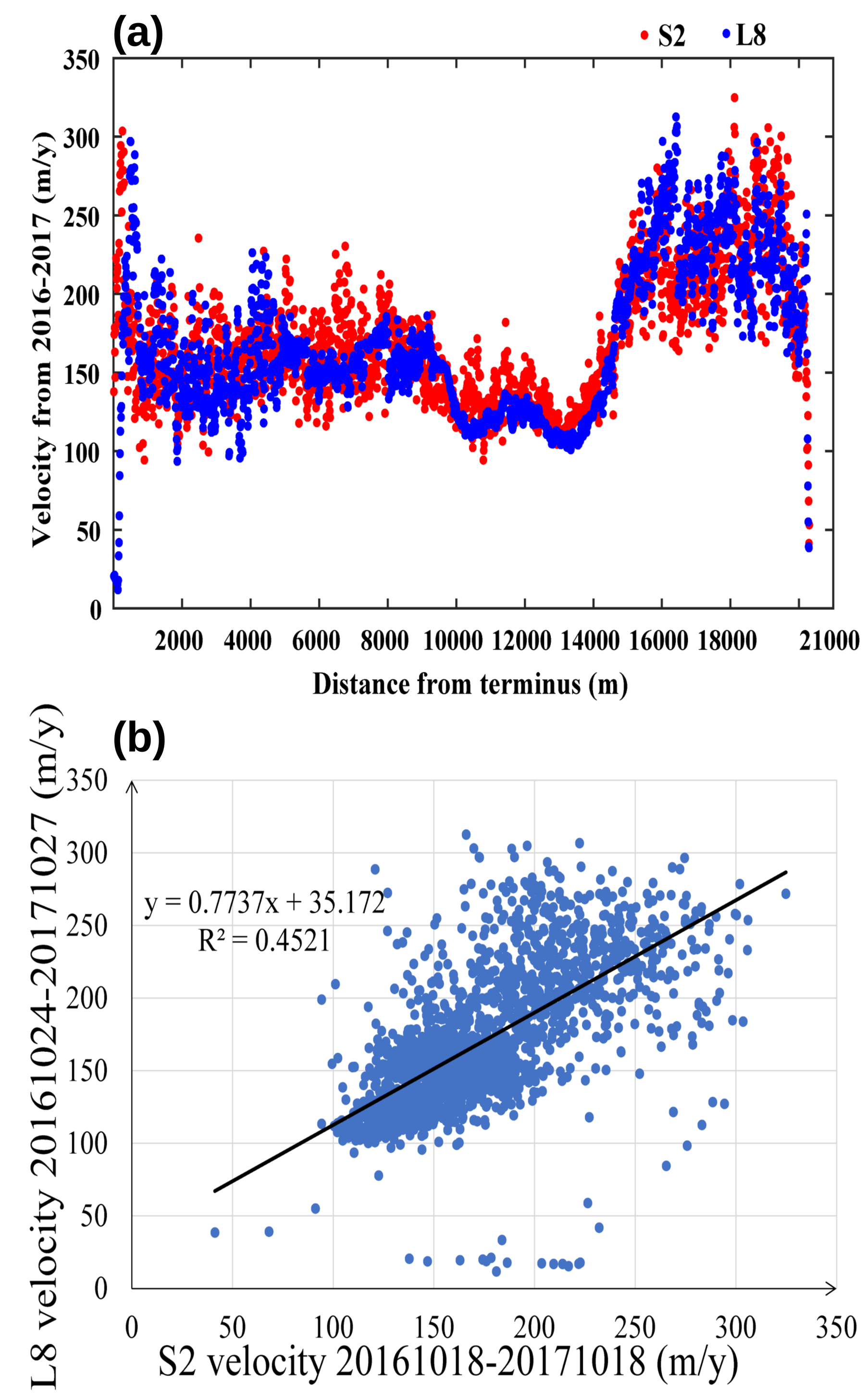


Figure 5. (a) Center-line profiles of Landsat 8 OLI and Sentinel-2 MSI results during 2016-2017.
(b) Scatter plot of Sentinel-2 MSI vs. Landsat-8 OLI glacier surface velocity during 2016-2017.

4. Conclusions

Results of the L8 / OLI and S2 / MSI datasets were compared to evaluate their accuracy, and assess the reliability of cross correlation for ice flow monitoring. The r^2 is 0.4521. The seasonal and interannual variability of surface velocity was captured by the transverse velocity profiles in the four selected glaciers. The observed spatial pattern and seasonal variability in glacier surface velocity suggests that the winter-spring snow might be a driver of glacier flow in the central and upper portions of glaciers. The findings on glacier velocity suggest that the transfer of winter-spring accumulated ice triggered by mass conservation seems to be the main driver of changes in glacier velocity. The interannual and seasonal glacier velocity result would contribute to modelling glacier dynamics in the future.

5.Reference

[1] W. Yang, T. Yao, B. Xu, G. Wu, L. Ma, and X. Xin, "Quick ice mass loss and abrupt retreat of the maritime glaciers in the Kangri Karpo Mountains, southeast Tibetan Plateau," Science Bulletin, vol. 53, no. 16, pp. 2547-2551, 2008.
[2] S. Leprince, "Co-Registration of Optically Sensed Images and Correlation (COSI-Corr): an Operational Methodology for Ground Deformation Measurements," IEEE International Geoscience & Remote Sensing Symposium IEEE, 2008.