

Intensified paraglacial slope failures due to accelerating downwasting of a temperate glacier in Mt. Gongga, Southeastern Tibet Plateau



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1. Background and Objectives

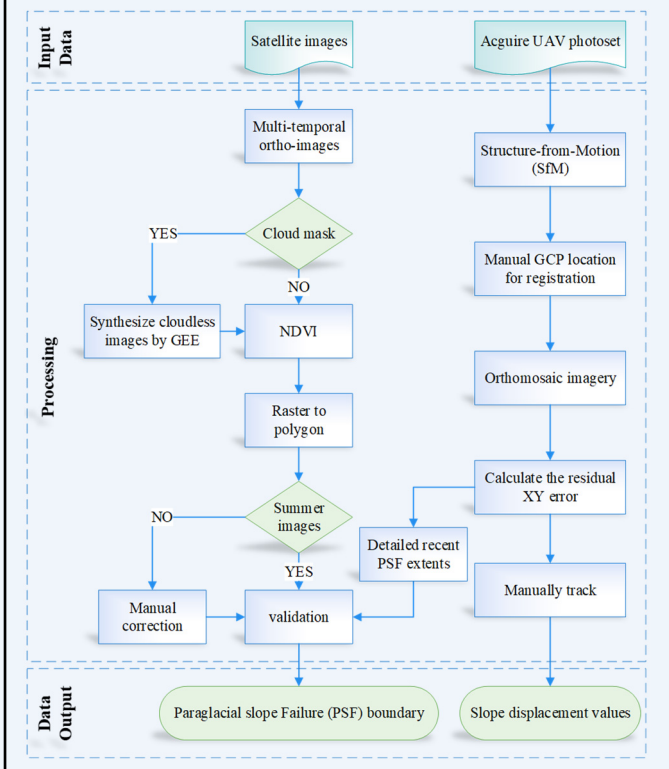
Topographic development via paraglacial slope failure (PSF) represents a complex interplay between geological structure, climate, and glacial denudation. Where debris generated by PSFs is deposited on the surface of a glacier, this debris can increase the extent or thickness of a supraglacial debris-cover, in turn modifying glacier ablation and affecting meltwater generation. To date, little attention has been paid to intensity and frequency of PSFs in glacierised, monsoon temperate regions of Southeast Tibet.

The objectives of this research are to:

- map and quantify slope failures and topographic change around Hailougou Glacier through time series image comparison;
- describe and discuss the spatial distribution, spatiotemporal evolution, and possible forcing mechanism of different types of PSFs;
- discuss the geomorphic and environmental effects of these slope processes, and further discuss possible linkages between PSFs, climate change, and glacier downwasting.

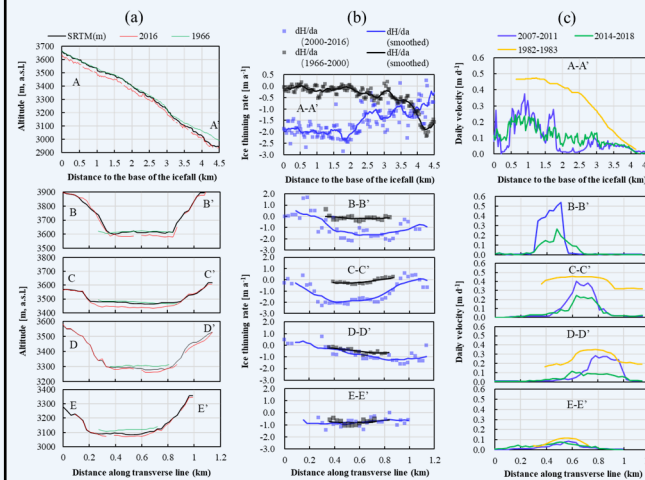
2. Methodology

We used repeat UAV and satellite remote sensing imagery as the basis for identifying and analyzing the evolution of three styles of paraglacial slope failure (PSF) at Hailougou Glacier (29°58.4'N, 101°91.6'E) between 1990 and 2020, and manually tracked the displacement of each PSF.



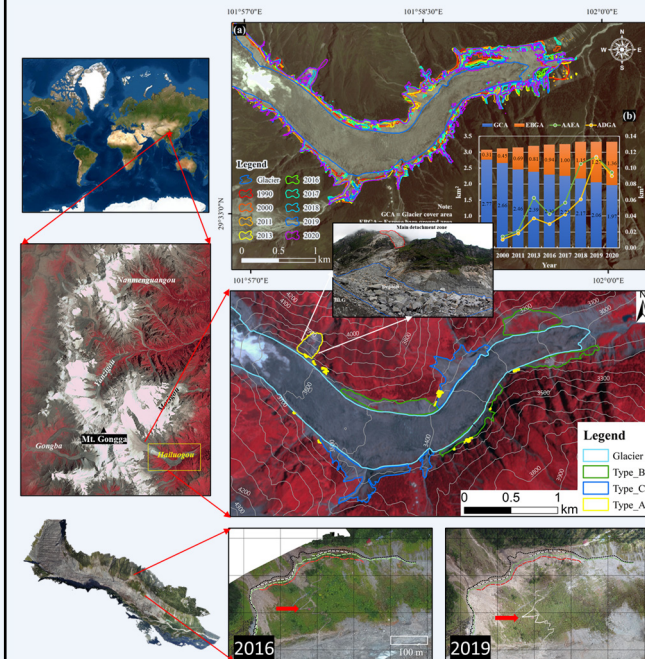
3. Results

- HLG retreated and thinned remarkably between 1966 and 2020.



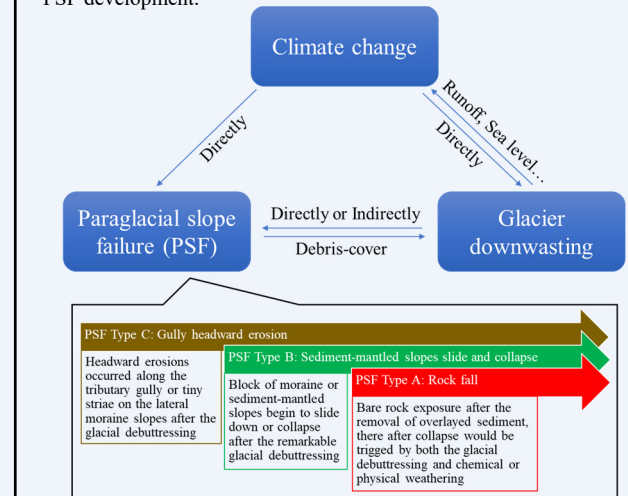
- Rapid downwasting of the glacier surface has exposed oversteepened ice-marginal slope topography, which show evidence of widespread instability in the form of

- rock fall,
- sediment-mantled slopes slide and collapse, and
- gully headwards erosion.



4. Discussion

- Relationships between climate, glacier evolution, local topography and PSF development.



5. Conclusion

- In HLG, non-ice-contact rock falls in deglaciating catchments are a well-established, short- to long-term response of paraglacial slopes following glacier downwasting and rock slope exposure, however, analysis of antecedent meteorological conditions suggests that an abnormally long monsoon and low temperature may have served to prepare, and perhaps trigger this rock slope failure.
- Deformation of sediment-mantled moraine slopes and an increase in erosion activity in ice-marginal tributary valleys caused by a drop in local base level have occurred in tandem with recent glacier downwasting.
- Field evidence indicates that the glacier ice body adjacent to unstable rock and sediment-mantled slopes has narrowed, or 'squeezed', and we hypothesize that this may be the result of ice deformation caused by ice-marginal slope displacement and loading.
- The accelerating downwasting of glacier are used as a preparatory or triggering factor, which could directly or indirectly cause the PSFs.

Reference

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- Cody, E., Anderson, B. M., McColl, S. T., Fuller, I. C., and Purdie, H. L.: Paraglacial adjustment of sediment slopes during and immediately after glacial debuitressing, *Geomorphology*, 371, 107411, doi:10.1016/j.geomorph.2020.107411, 2020.

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