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Landslide-GLOF cascade at the expanding Jinwuco in Tibet, 2020: a clear consequence of anthropogenic climate change

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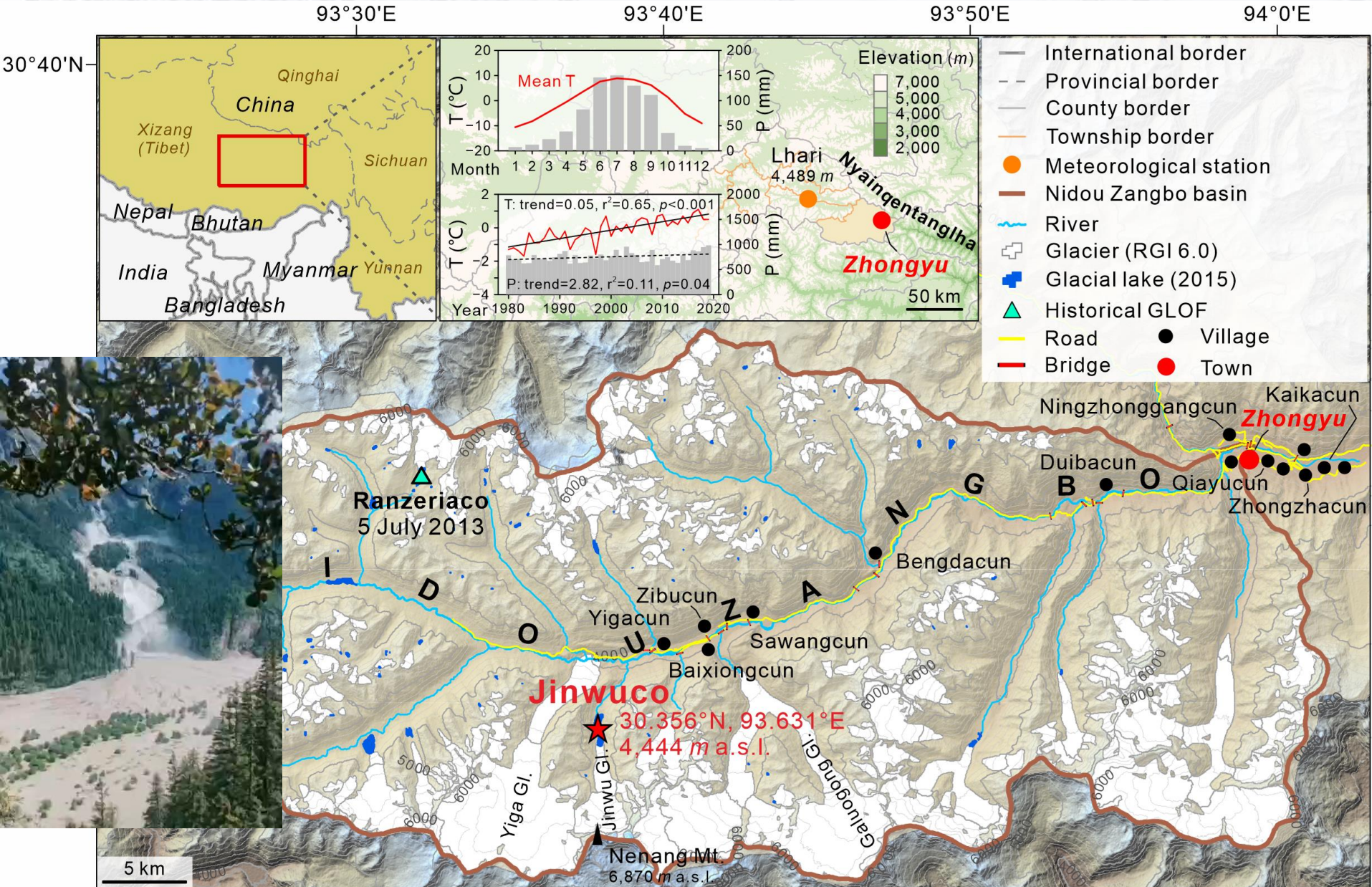
Photo courtesy: H. Li (26 June 2020)

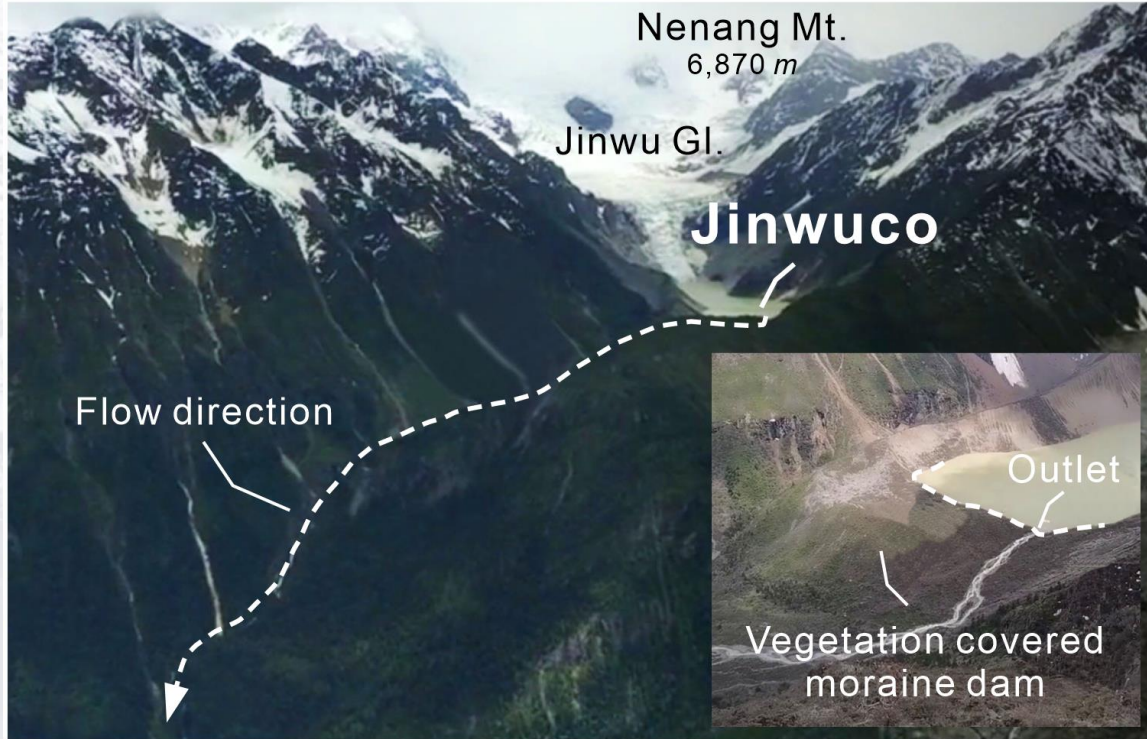
Summary

1. Overview
2. Causes and impacts
3. Implications

Overview

Location: Tibet, China; **Date:** 26 June 2020; **Source:** Jinwuco (30.356°N, 93.631°E);

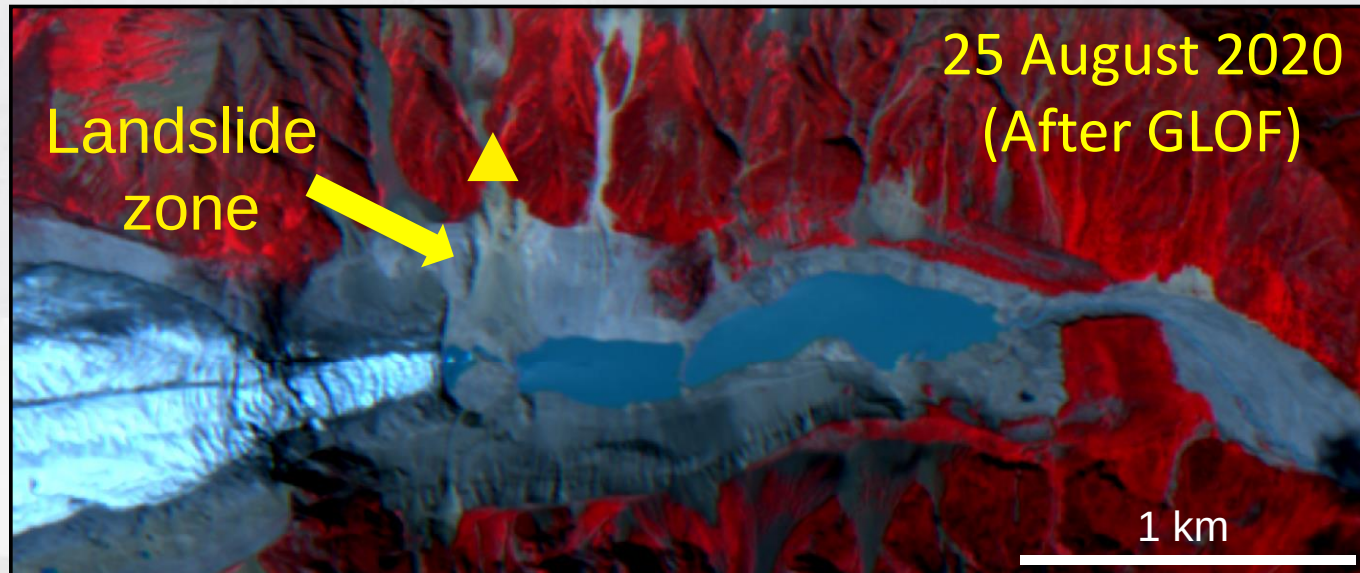
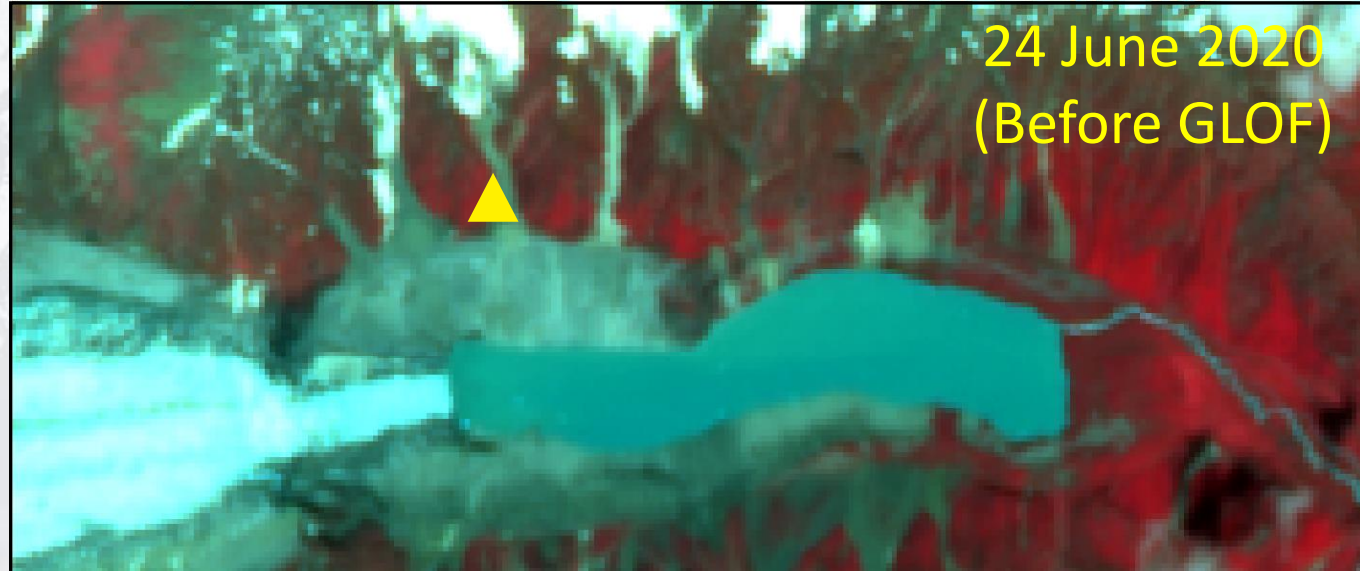




What caused this event?



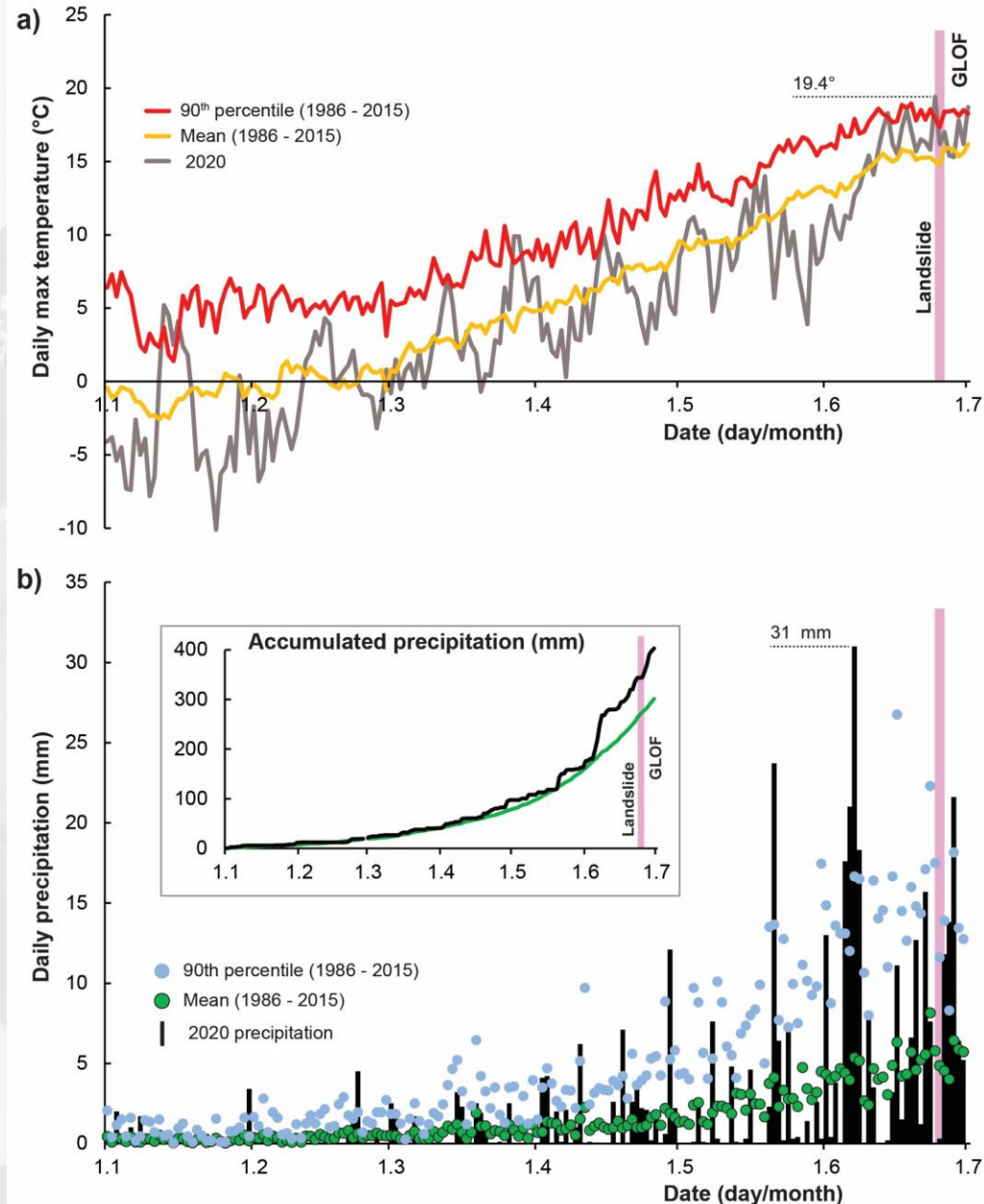
Based on high-resolution satellite images before and after the event, we found that **the landslide from the western lateral moraine was the direct cause of this flood.**



What caused this event?



When compared to the longer-term climatology it becomes immediately obvious that the landslide and GLOF process chain at Jinwuco occurred following a period of **above average temperatures and unusually wet weather** that most likely triggered the landslide.



Impacts





Nidou Zangbo

Zhongyucun

Gagring Qu



Ningzhonggan

Yi'ong Zangbo

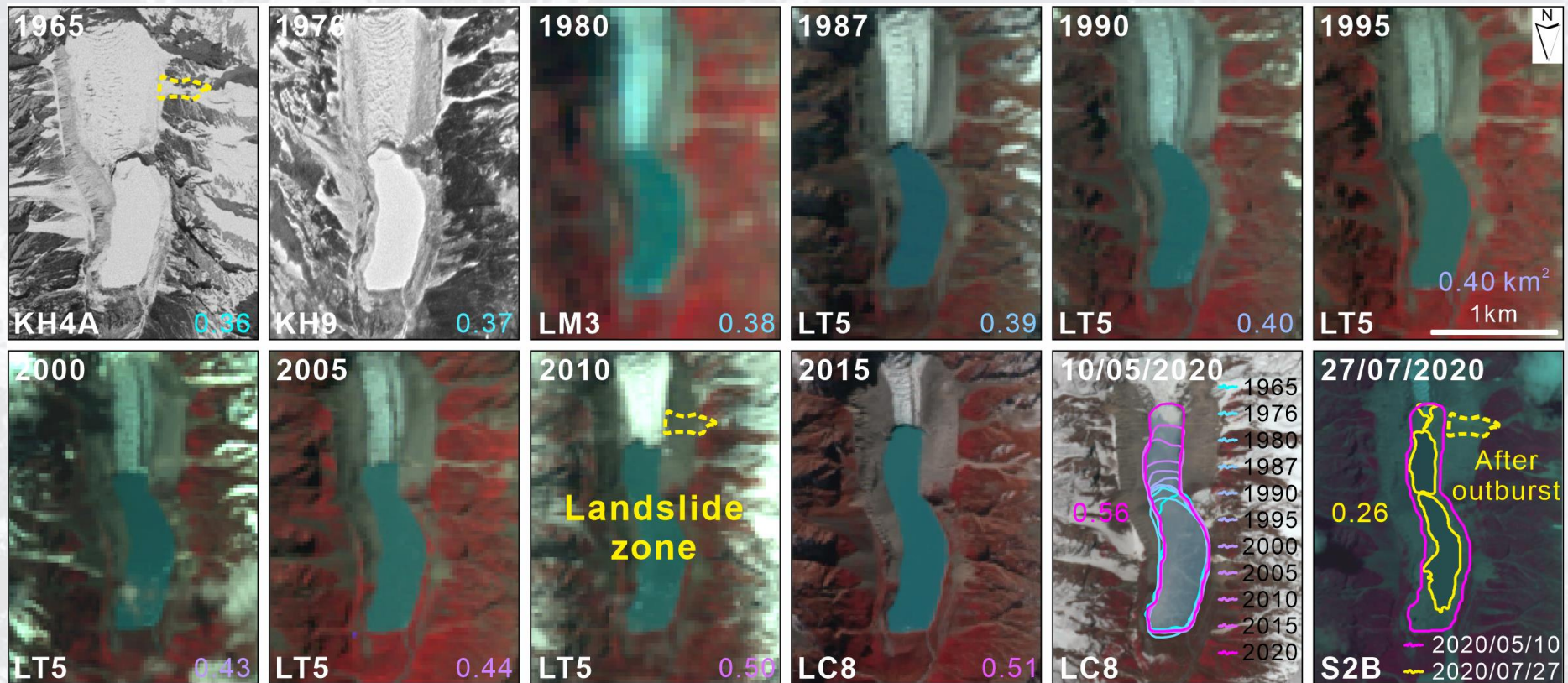
Impacts

Details of the damages and losses caused by the GLOF of 26 June 2020

Item	Description
Casualties	No casualties caused in this GLOF.
Buildings	10 residential houses destroyed and 1 damaged.
Roads	43.9 km of road connecting from Zhongyu township government seat to Yigacun was almost washed away.
Bridges	6 steel bridges, 1 suspension bridge and 1 concrete covered culvert were washed away.
Farmlands	Flooded farmland 19.98 hectare (including 2.58 hectares of rapeseed fields); destroyed farmland 6.24 hectare (including 0.55 hectares of rapeseed fields); destroyed farmland fence 8,517 m.
Grasslands and forage lands	Destroyed artificial grassland area 3.15 hectare; flooded forage land 2.58 hectare.
Forests	Destroyed 9.07 hectare of forests for soil and water conservation project.
Flood control levee	Breach of 7.7 km of flood control levee.
Others	The total CNY 8.4 million 45% completed Yiga view project is completely flooded; 25 corrugated pipes, 3 culvert access bridges, and 7 simple bridges for humans and livestock leading to summer pasture were washed out.

Implications

- This case provides **a strong basis for assessing the role of anthropogenic climate change** as a direct contributor to a GLOF-related disaster.
- This case further shows that **lateral moraine instabilities can also produce large outburst flood hazards**. Such process chains may become of increasing importance in the future, given further glacial retreat or downwasting, leading to higher moraine walls being precariously positioned above expanding proglacial lakes.



Concluding remarks

- We identified the **slope failure from a steep lateral moraine as the cause of this GLOF**. Analysis of meteorological conditions before the GLOF suggests that, most likely, **the extremely heavy rainfall and above-average air temperatures in June were essential drivers of this process chain**.
- The long-term evolution of Jinwuco and its relationship to the likely landslide trigger, as revealed by a time series of satellite images, **provide strong evidence that this event is directly related to anthropogenic climate change**.

For more information, please refer to the following article:

Zheng, G., Mergili, M., Emmer, A., Allen, S., Bao, A., Guo, H., and Stoffel, M.: The 2020 glacial lake outburst flood at Jinwuco, Tibet: causes, impacts, and implications for hazard and risk assessment, *The Cryosphere Discuss.* [preprint], doi:10.5194/tc-2020-379, in review, 2021.



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Thank you for your attention!

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