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www.indrastra.com | ISSN 2381-3652

Decades of Warning Preceded Sikkim Glacial Lake Outburst Flood

IG indrastra.com/2023/10/decades-of-warning-preceded-sikkim.html

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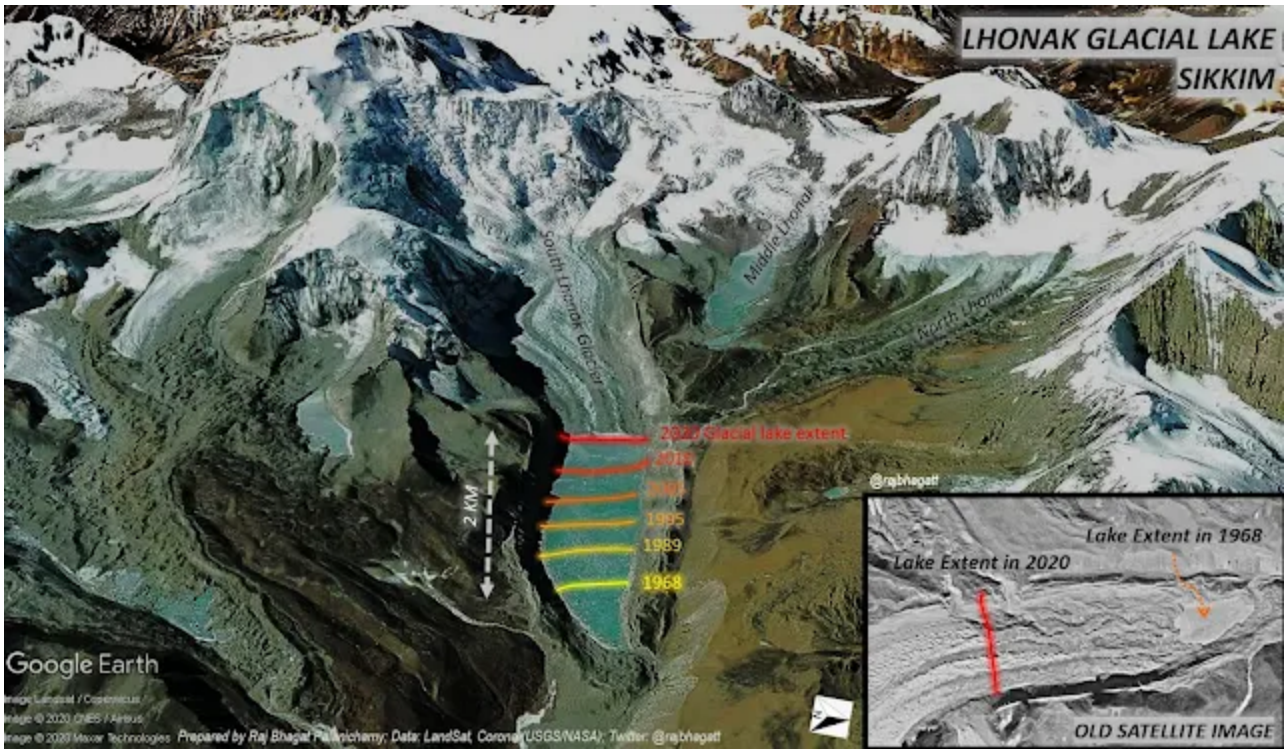
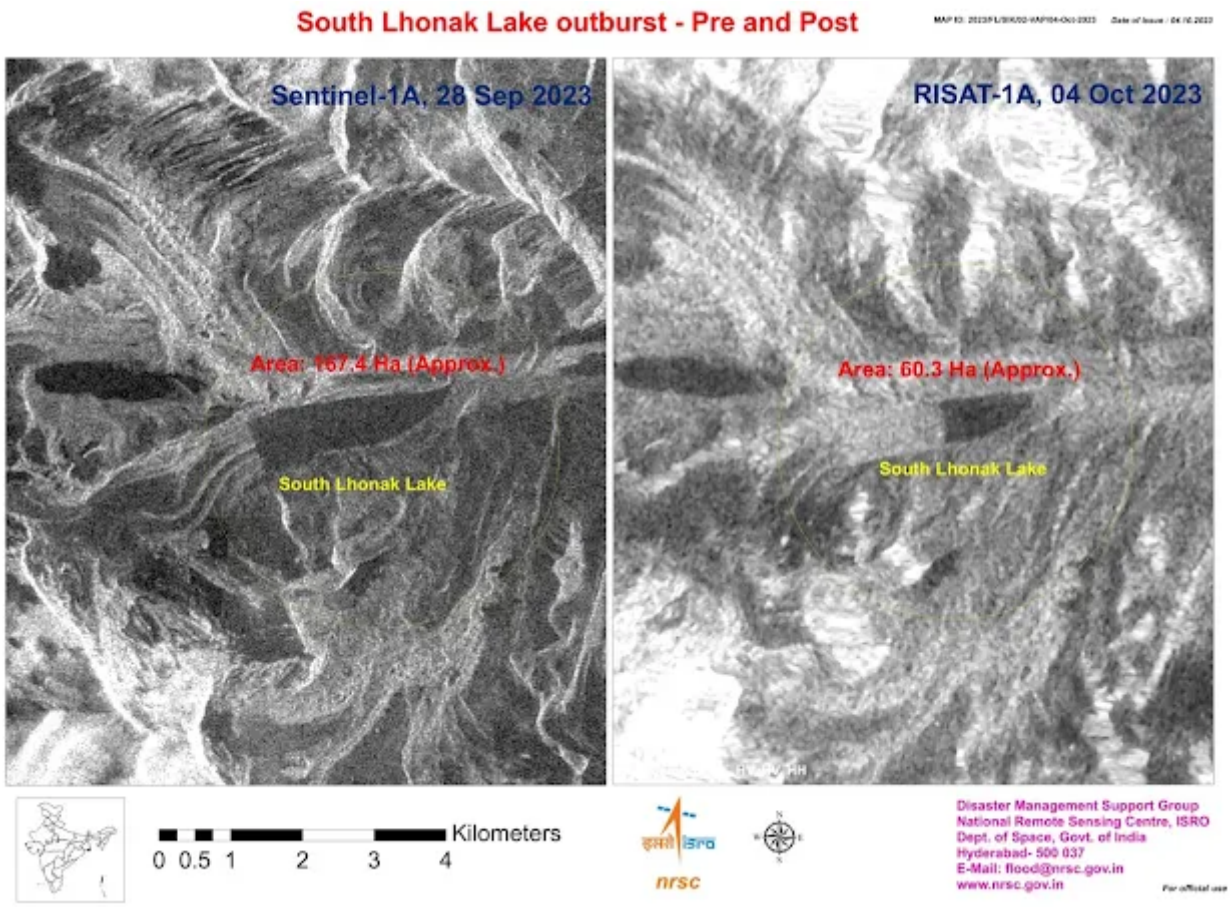


In a tragic turn of events, Sikkim, a picturesque Indian state nestled in the Himalayas, experienced a devastating glacial lake outburst flood (GLOF) on the early morning of October 4th, causing widespread destruction in its wake. The incident has once again brought to light the long-standing warnings issued by government agencies and research studies about the looming threat of GLOFs in the region, highlighting the urgent need for proactive measures to mitigate such disasters.

The GLOF, which originated from Lhonak Lake, unleashed a sudden and massive surge of water downstream along the Teesta River Basin, wreaking havoc on its path. The affected districts of Mangan, Gangtok, Pakyong, and Namchi bore the brunt of the catastrophe, leaving a trail of devastation in its wake.



Map Attribute: Indian Space Research Organisation (ISRO)

According to the Sikkim State Disaster Management Authority (SSDMA), the toll in the aftermath of the GLOF stands at 14 lives lost, with 102 individuals, including 22 army personnel, reported missing. Additionally, the disaster resulted in the breach of the Chungthang dam, a critical component of the 1,200-megawatt (MW) Teesta Stage III Hydro Electric Project, Sikkim's largest hydropower venture.

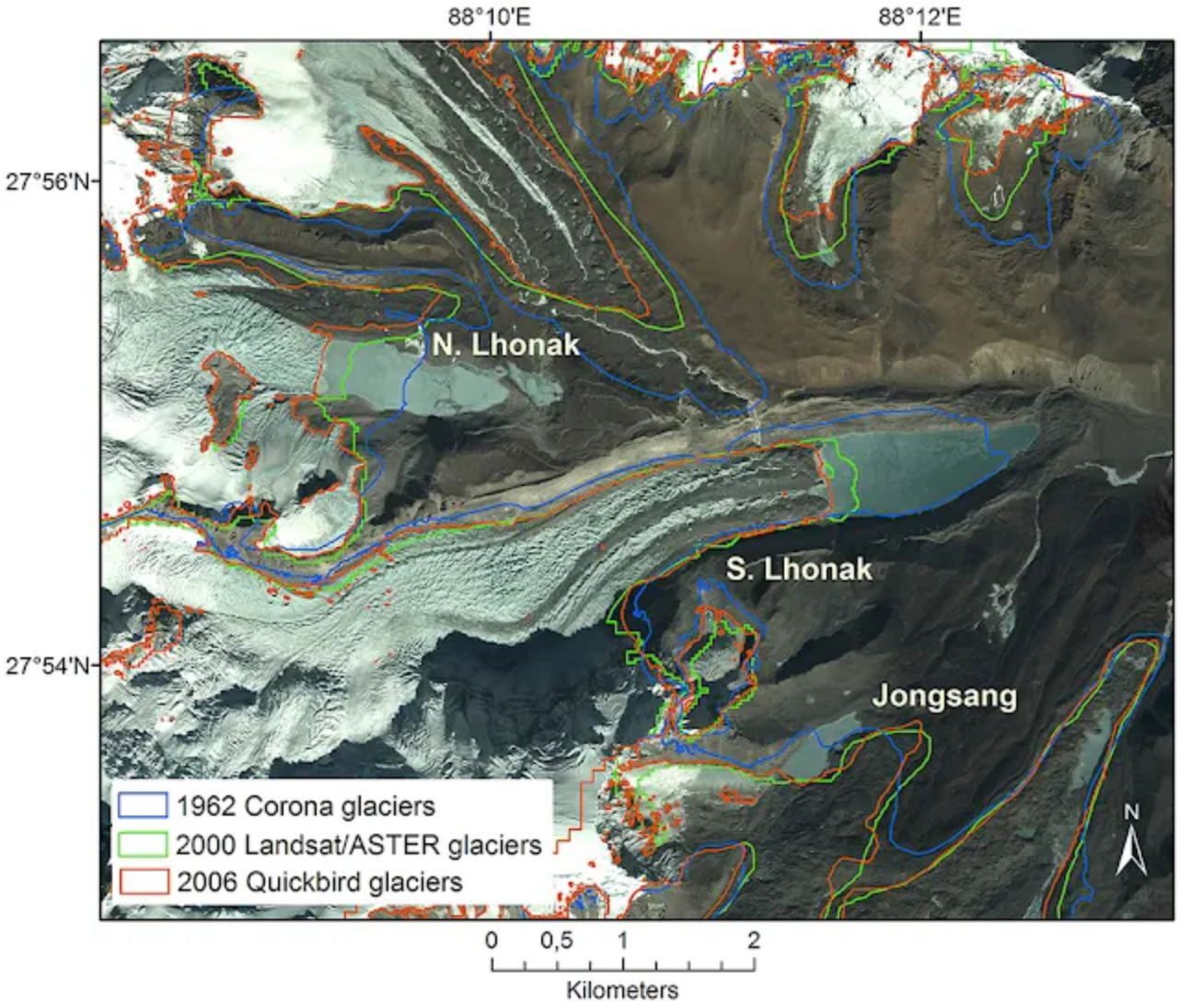
GLOFs, as a natural phenomenon, occur when glacial lakes formed by melting glaciers suddenly burst open, unleashing a torrent of water with tremendous force. The reasons behind these catastrophic events can vary, from excessive water accumulation in the lake to triggers like earthquakes. Such incidents can lead to flash floods downstream, posing grave risks to both human lives and the environment in the affected areas.

South Lhonak Lake, the epicenter of the recent GLOF, is classified as one of the 14 potentially dangerous lakes susceptible to such outbursts. Situated at a dizzying altitude of 5,200 meters (17,100 feet) above sea level, the lake owes its existence to melting of the Lhonak glacier. The rapid expansion of the lake is attributed to the melting of the associated

South Lhonak glacier, as well as additional meltwater from the adjacent North Lhonak and main Lhonak glaciers.

Satellite imagery from the Hyderabad-based National Remote Sensing Centre corroborated the dramatic reduction in the area of South Lhonak Lake, plummeting from 167.4 hectares on September 28th to a mere 60.3 hectares on October 4th, confirming the occurrence of a GLOF event that inflicted massive damage in the Teesta River basin.

In a comprehensive study conducted by the National Remote Sensing Centre and the Indian Space Research Organisation in 2012-2013, the formation of a moraine-dammed glacial lake at the snout of the South Lhonak glacier was discussed in detail, along with the associated risks. The study underscored the high probability of a GLOF event for South Lhonak Lake, with an estimated peak discharge of 586 m³/s.



Map Attribute: Close-up view of glacier area changes around the North and South Lhonak glaciers from 1962 to 2006, showing changes in the pro-glacial lakes. | A. E. Racoviteanu, Y. Arnaud, M. W. Williams, W. F. Manley - A. E. Racoviteanu et. al. "Spatial patterns in glacier characteristics and area changes from 1962 to 2006 in the Kanchenjunga–Sikkim area, eastern Himalaya", The Cryosphere doi:10.5194/tc-9-505-2015

In 2016, an expedition led by Sonam Wangchuk of the Ladakh-based NGO Students' Educational and Cultural Movement of Ladakh, organized by the Sikkim government's Department of Science and Technology, sounded a warning about the impending threat of a GLOF event. As a precautionary measure, high-density polyethylene pipes were installed to channel water away from the glacial lake.

This year, in September, officials from the Department of Science and Technology (DST), SSDMA, and the Land and Revenue Department conducted another inspection at the lake site, aiming to install an early warning system and an automatic weather station.

A **study published** in the IEEE International Geoscience and Remote Sensing Symposium in 2021 classified South Lhonak Lake as potentially dangerous due to its high outburst probability. It highlighted the alarming retreat of the South Lhonak glacier, which, from 1962 to 2008, receded approximately 2 kilometers, with an additional 400-meter retreat from 2008 to 2019. This raised serious concerns about the hazard potential of the lake, given the heavily populated downstream valley with numerous settlements and critical infrastructure.

Warnings about the looming threat of GLOFs in Sikkim are not new. The Sikkim Human Development Report of 2001 cautioned about a 'serious potential hazard' from such events, emphasizing the need for vigilance in a state dotted with numerous glaciers.

As Sikkim grapples with the aftermath of this devastating GLOF, it serves as a grim reminder of the importance of heeding early warnings and implementing proactive measures to safeguard lives and property in regions vulnerable to such natural disasters. The tragic event underscores the urgency for governments and researchers to work together to develop robust strategies for managing the risks posed by glacial lakes in high-altitude regions.