



**Government of Nepal**  
**Ministry of Energy, Water Resources and Irrigation**  
**Department of Hydrology and Meteorology**

# Feedback on GLOF monitoring training including GLOF events in Nepal, 2025

*12 February 2026*

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# Outline



- Overview: Brief Introduction of DHM
- Overview: Growing Hazards and GLOFs
- GLOF events in Nepal in 2025
- Sentinel Asia- DHM Collaboration
- Summary of EORs activated in 2025

# Overview



## Department of Hydrology and Meteorology

### Mandate

- To monitor all hydrological and meteorological activities in Nepal

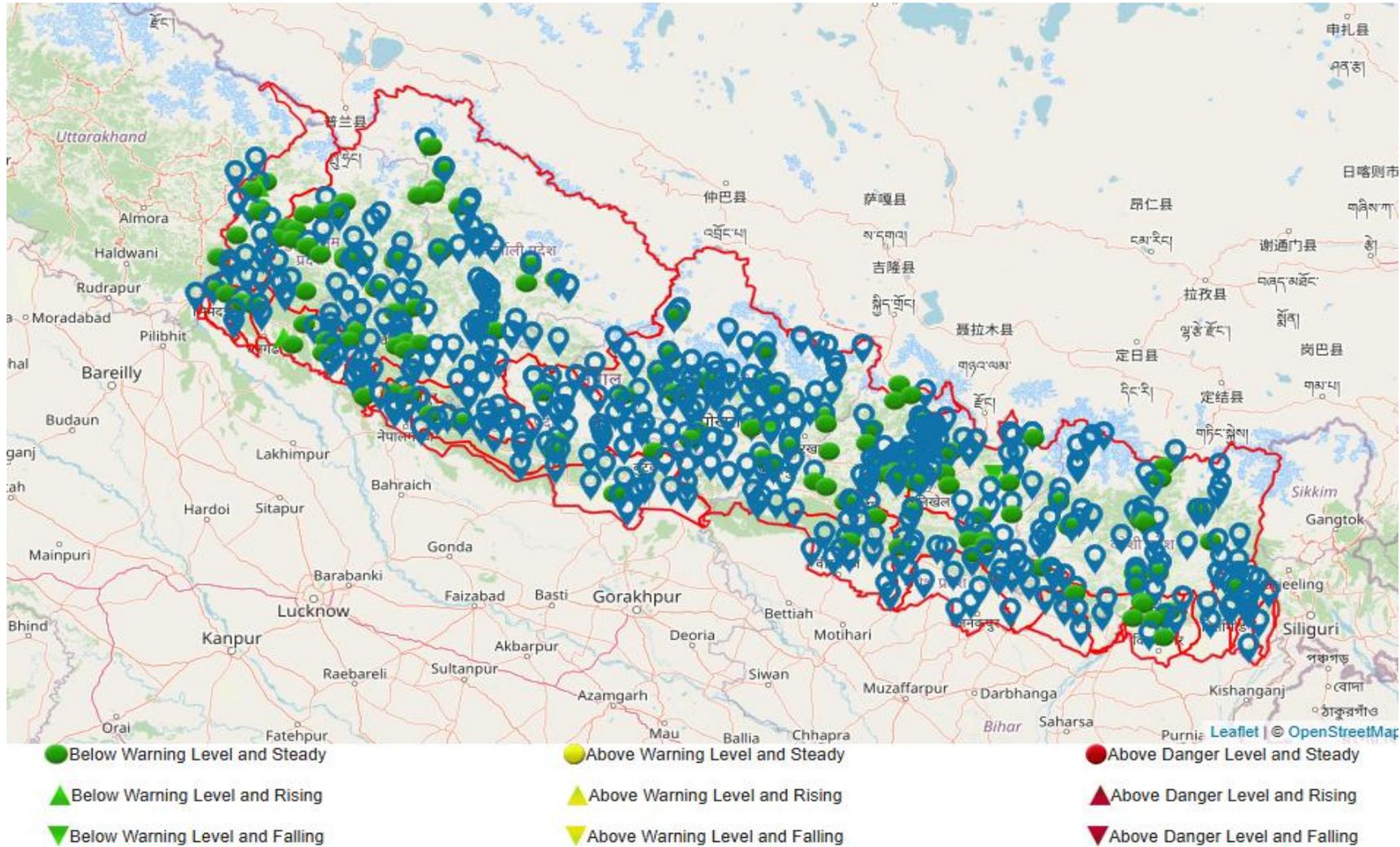
### Principle Activities

- Collect and disseminate hydrological and meteorological information
- Issue hydrological and meteorological forecasts for public, mountaineering expedition, civil aviation, and for the mitigation of natural disasters.
- Mitigate weather, flood and drought induced disaster by providing early warning services to the concerned communities.
- Promote relationships with national and international organizations



# Overview

## Hydro- meteorological Observation Network

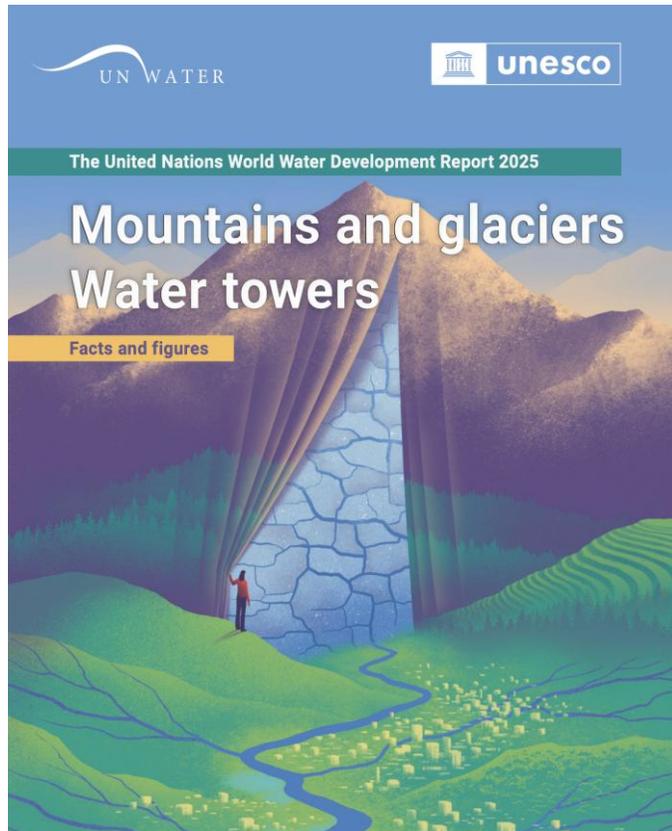


More than 325 Rainfall monitoring stations

More than 200 Water level monitoring stations

More than 10 snow stations (both meteorological and hydrological stations)

# Growing Hazards and GLOFs



- Frequency of **glacial lake outburst floods (GLOFs)** has **significantly increased** since 1900. **More than 60 GLOF events were recorded in the Hindu Kush over 2010-20**
- Over **12,000 deaths in the past 200 years** from GLOFs, with severe damage to infrastructure.

RESEARCH REPORT  
**Inventory of glacial lakes and identification of potentially dangerous glacial lakes in the Koshi, Gandaki, and Karnali river basins of Nepal, the Tibet Autonomous Region of China, and India**

- **47 Potentially Dangerous Glacial Lakes** within the river basins of Nepal
- 25 in China, 21 in Nepal and 1 in India

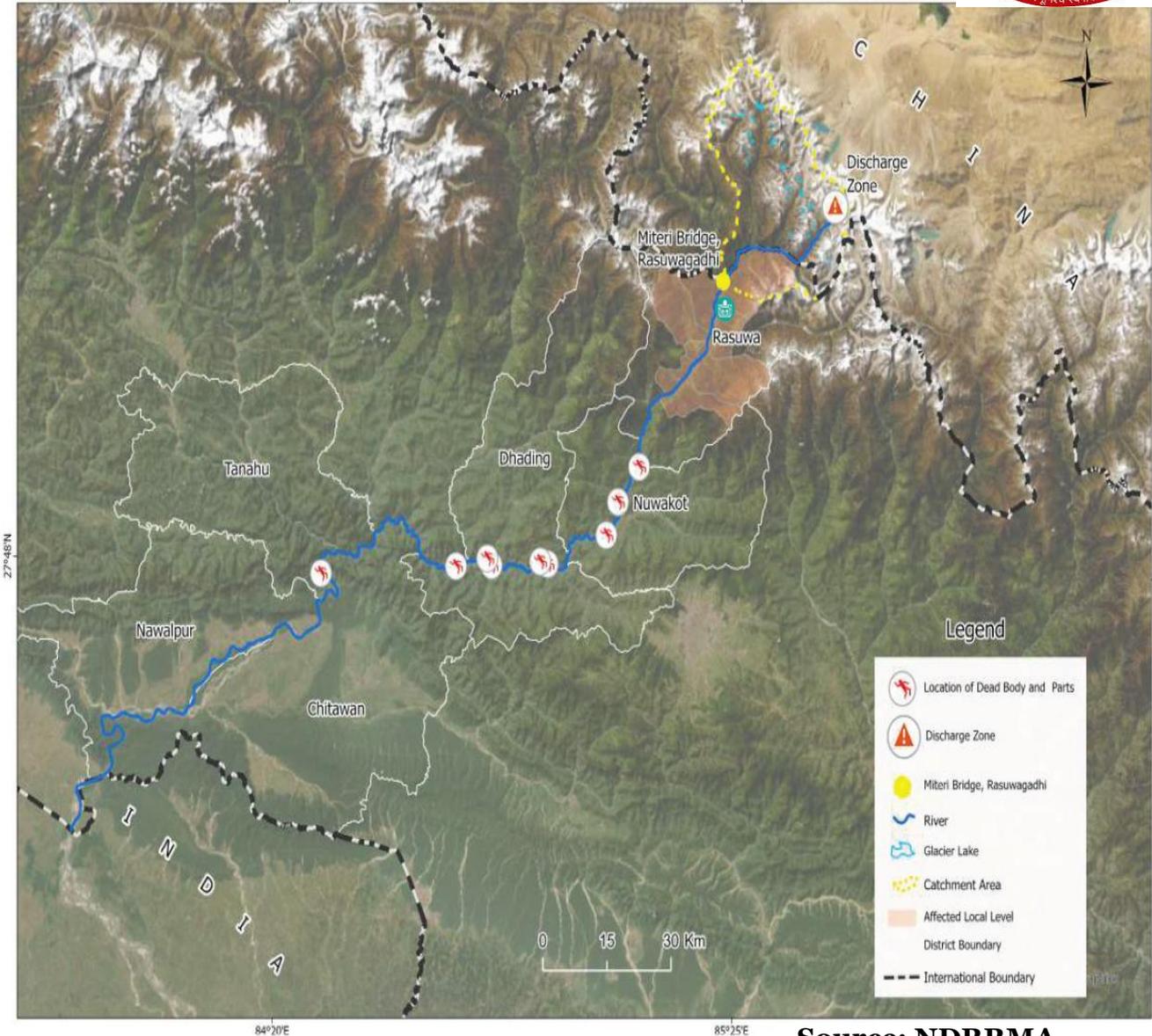
- **3 GLOF event recorded in 2025 only**



# Rasuwa GLOF



- On July 8, 2025 early morning, a massive flash flood originating from China caused an unprecedented surge into the Bhotekoshi River
  - The Miteri (Friendship) Bridge near the Rasuwagadhi border crossing was washed away.
  - significant damage at the dry port, customs office, hydropower projects
  - vehicles and goods swept away
  - reports confirmed fatalities and missing persons
- caused by GLOF from a supraglacial lake on the Purepu Galcier- approx. 36 km u/s of Nepal-China border
- Lake area decreased from approx. 0.75 km<sup>2</sup> to 0.6 km<sup>2</sup>



Source: NDRRMA

# Rasuwa GLOF

रसुवामा बाढीले नेपाल-चीन मितेरी पुल बगायो, सुक्खा बन्दरगाह



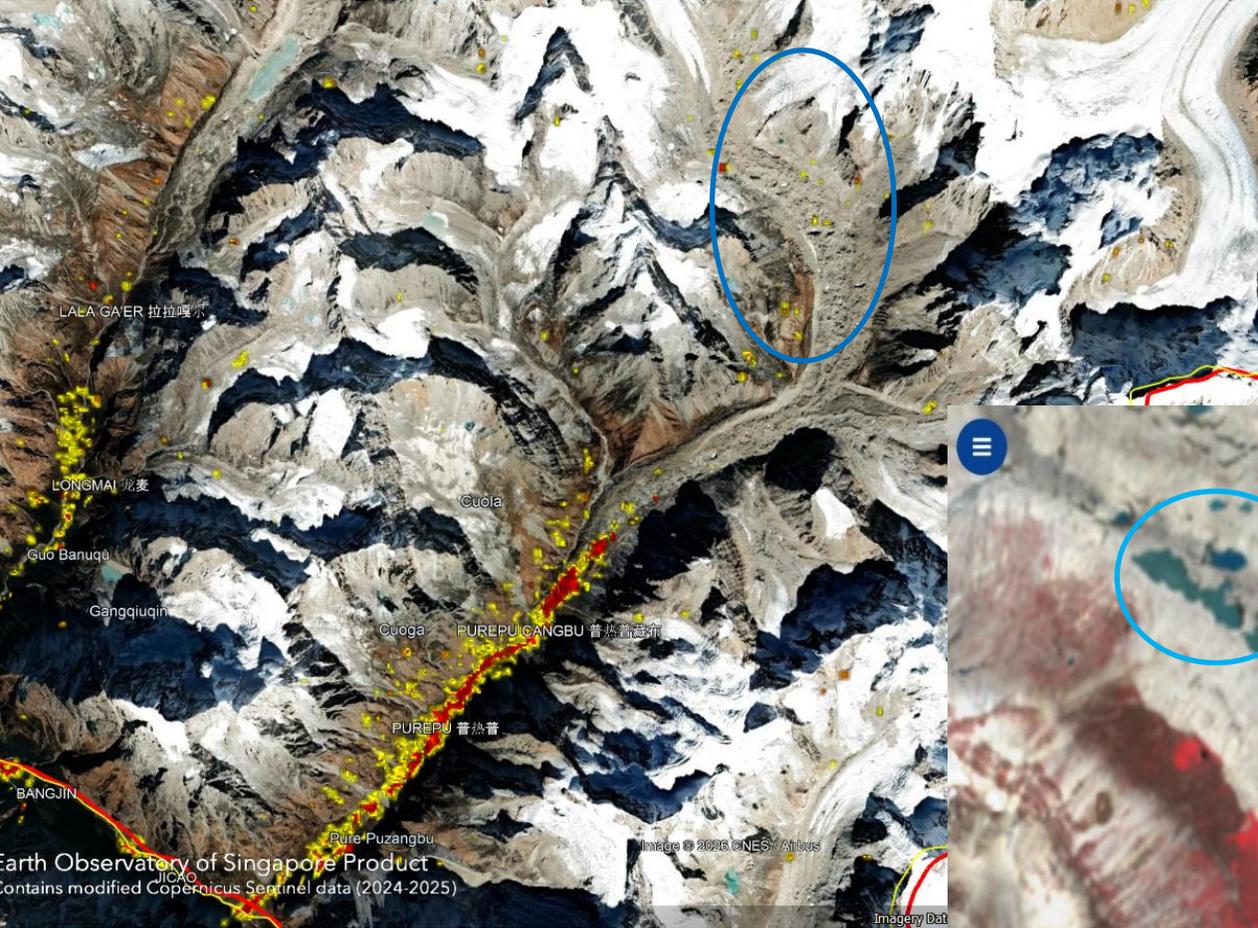
स्याफ्रुबसाका बाढा मापन उपकरण बग्या, टिमुरका चलका थिएन



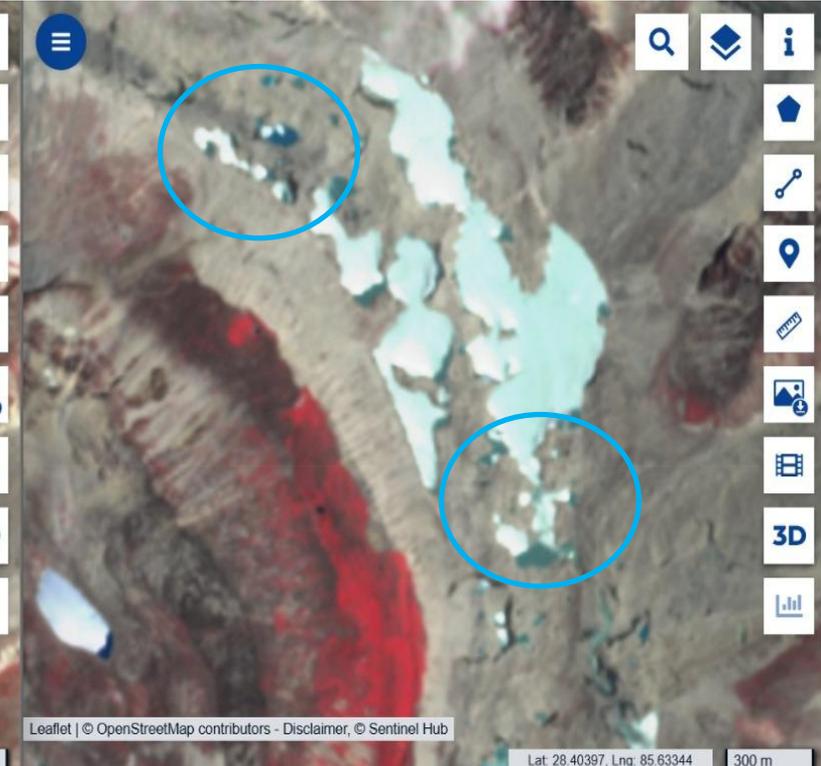
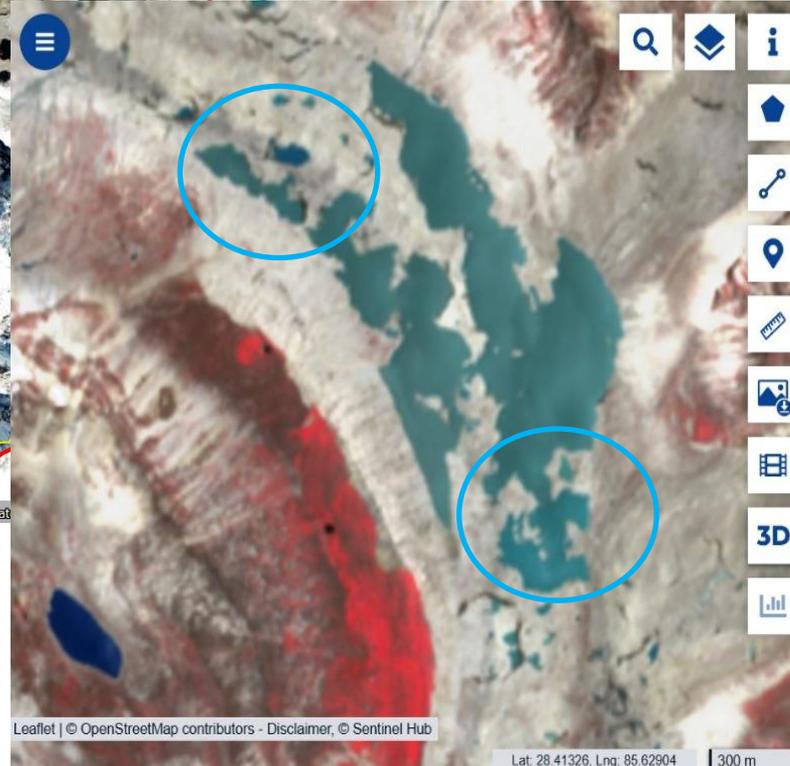
Photo Credit : रेडियो लाइटाइड



# Rasuwa GLOF



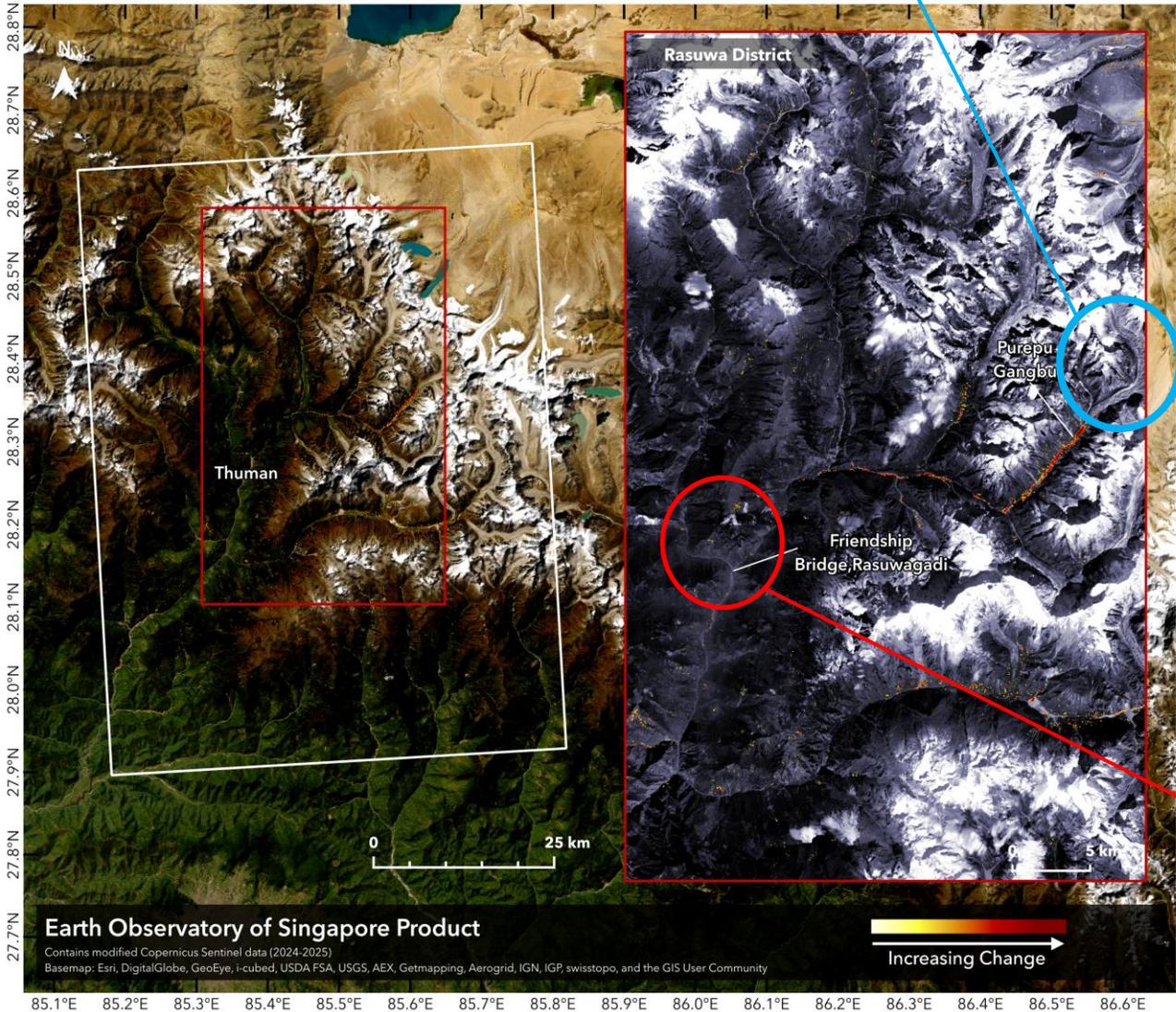
**Damage proxy map overlaid over google earth image from 2021 (no lake visible. Possibly originated in 2024)**



**Left Pre-event (July 5, 2025) and Right Post-event (July 8, 2025) Sentinel 2 images**

# Rasuwa GLOF

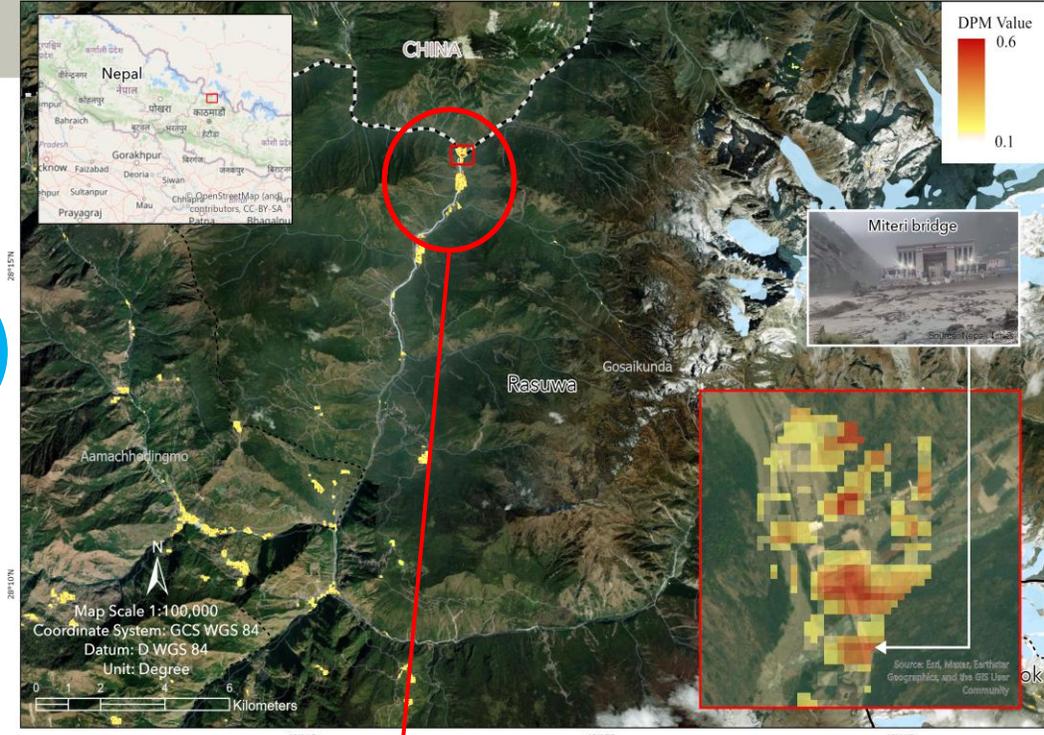
## Glacial lake location



## DAMAGE PROXY MAP IN RASUWA DISTRICT, BAGMATI PROVINCE

# NEPAL

As observed by Sentinel-1 images on 9 July 2025



20 MISSING PER

This map serves as a guideline for potentially damaged areas within human settlements. However, accuracy may be limited, especially in over vegetated or mountainous terrain where some damage might not be detected by satellite imagery.

- Province Boundary
- District Boundary
- Municipality Boundary
- Waterbody
- Waterway
- Road

Satellite Image:  
 Pre-disaster : Sentinel-1, 15 and 27 June 2025  
 Post-disaster : Sentinel-1, 9 July 2025

Contains modified Copernicus Sentinel data (2025)

GIS Data:  
 Road © OSM (2025)  
 Administrative Boundary © GADM (2025)

Map product made by GIC-AIT

Disclaimer: The accuracy of this map is not validated.

**Sentinel 1 Damage Proxy Map Pre event: 15 & 27 June 2025 and Post: July 09 2025 (Source: GIC-AIT)**

**Friendship Bridge, Nepal-China Border**

# Rasuwa GLOF

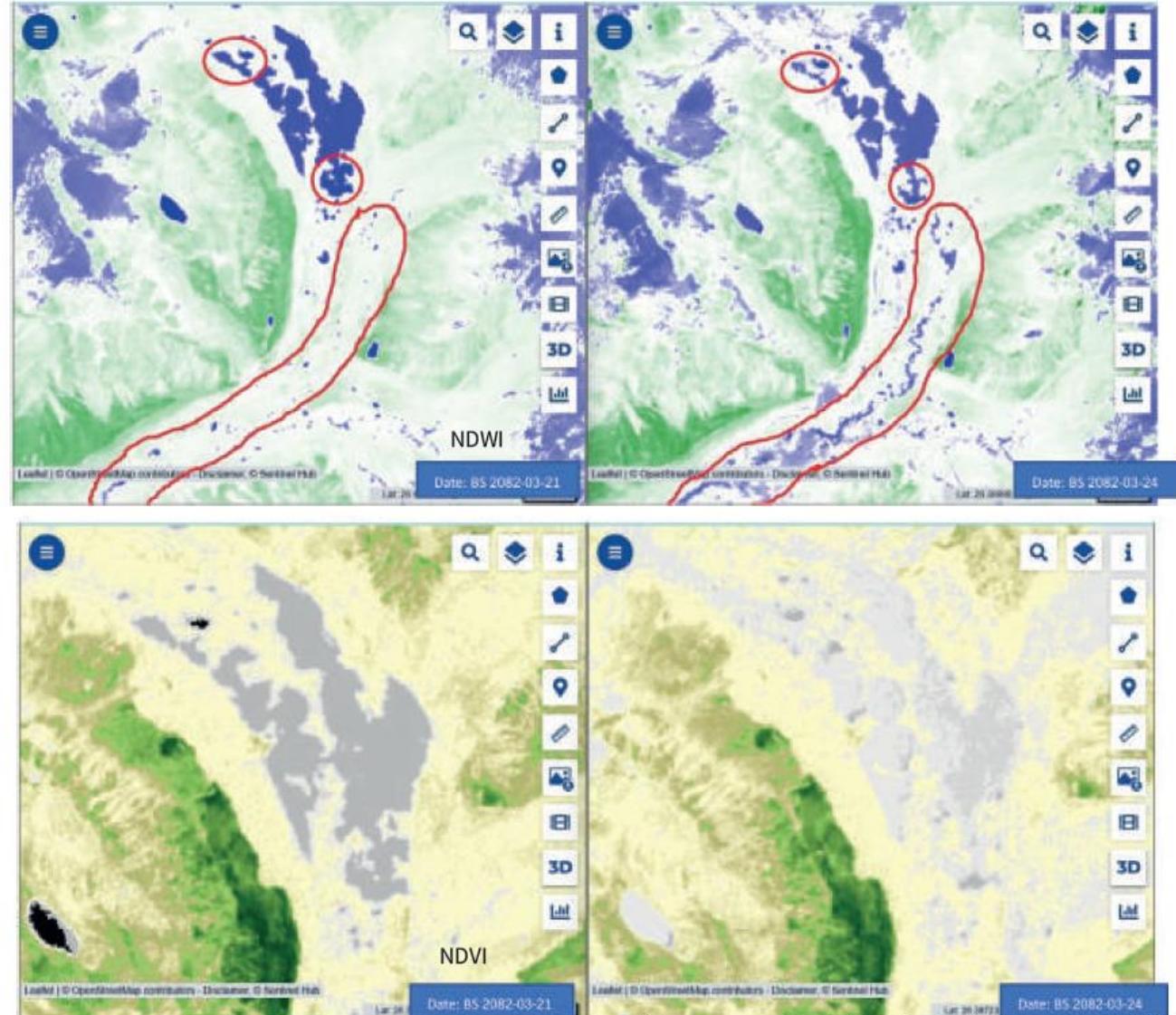


## Remote Sensing Analysis of Flood Causation

Sentinel-2 imagery reveals the rapid development and subsequent discharge of a supraglacial lake on the Purepu Glacier, located approximately 35 km upstream from the Nepal–China border post.

Beginning in March 2025, supraglacial ponds started to form and gradually expanded through mid-May. From that point onward, a sharp increase in surface water was observed, culminating in a lake area of approximately **0.525 km<sup>2</sup>** by 28 June (source:ICIMOD). Continued coalescence and expansion led to the formation of supraglacial lake measuring around **0.75 km<sup>2</sup>** by 07 July (source :DHM).

On 08 July, the lake had undergone a rapid decline in area, shrinking to approximately **0.6 km<sup>2</sup>** (source :DHM). Drainage features visible on the glacier surface that day indicate that at least part of the outburst occurred supraglacially, suggesting a complex drainage pathway contributing to the downstream flash flood.

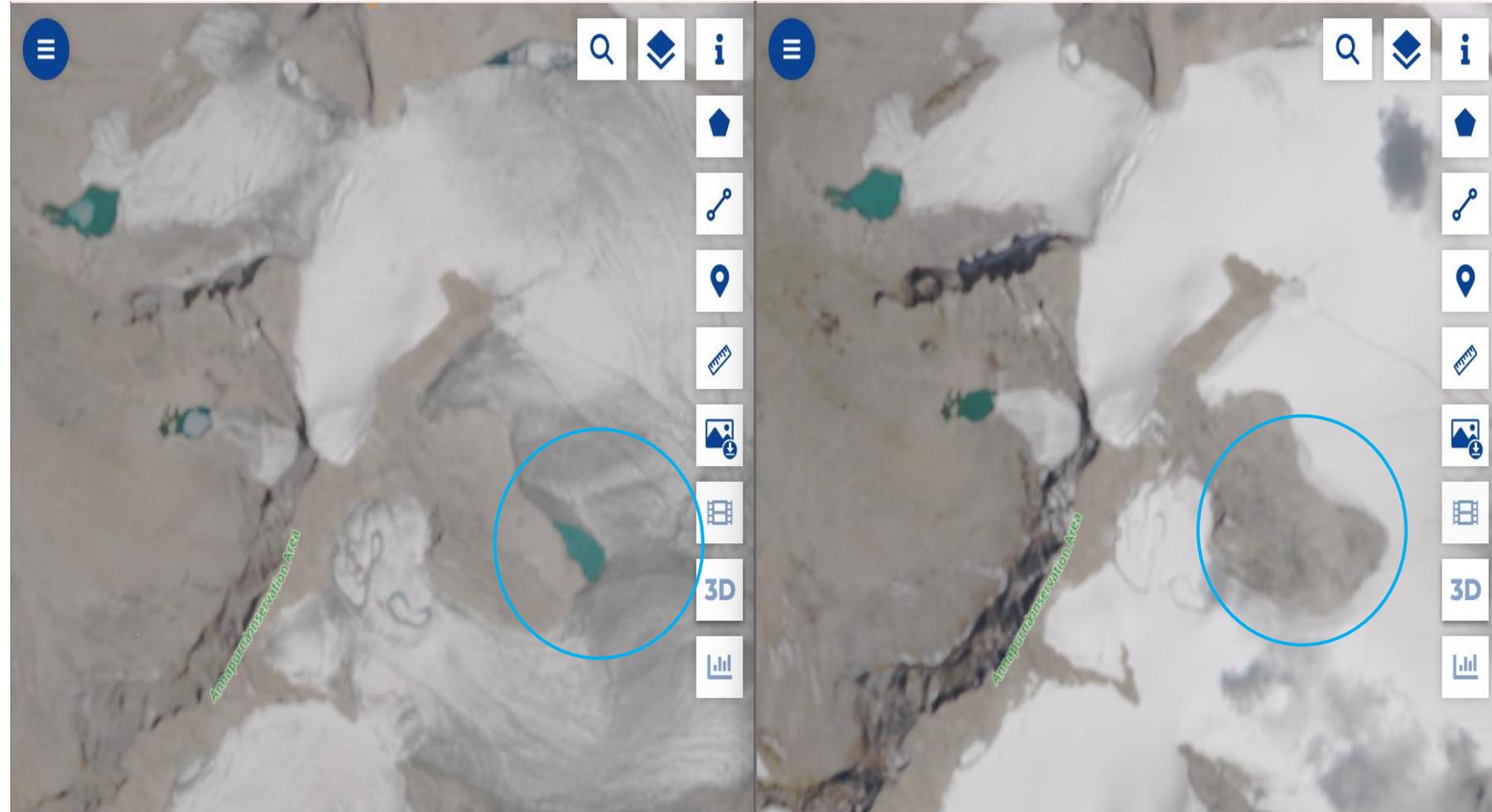


(Source : Sentinel - 2 Imagery, DHM)

# Mustang GLOF

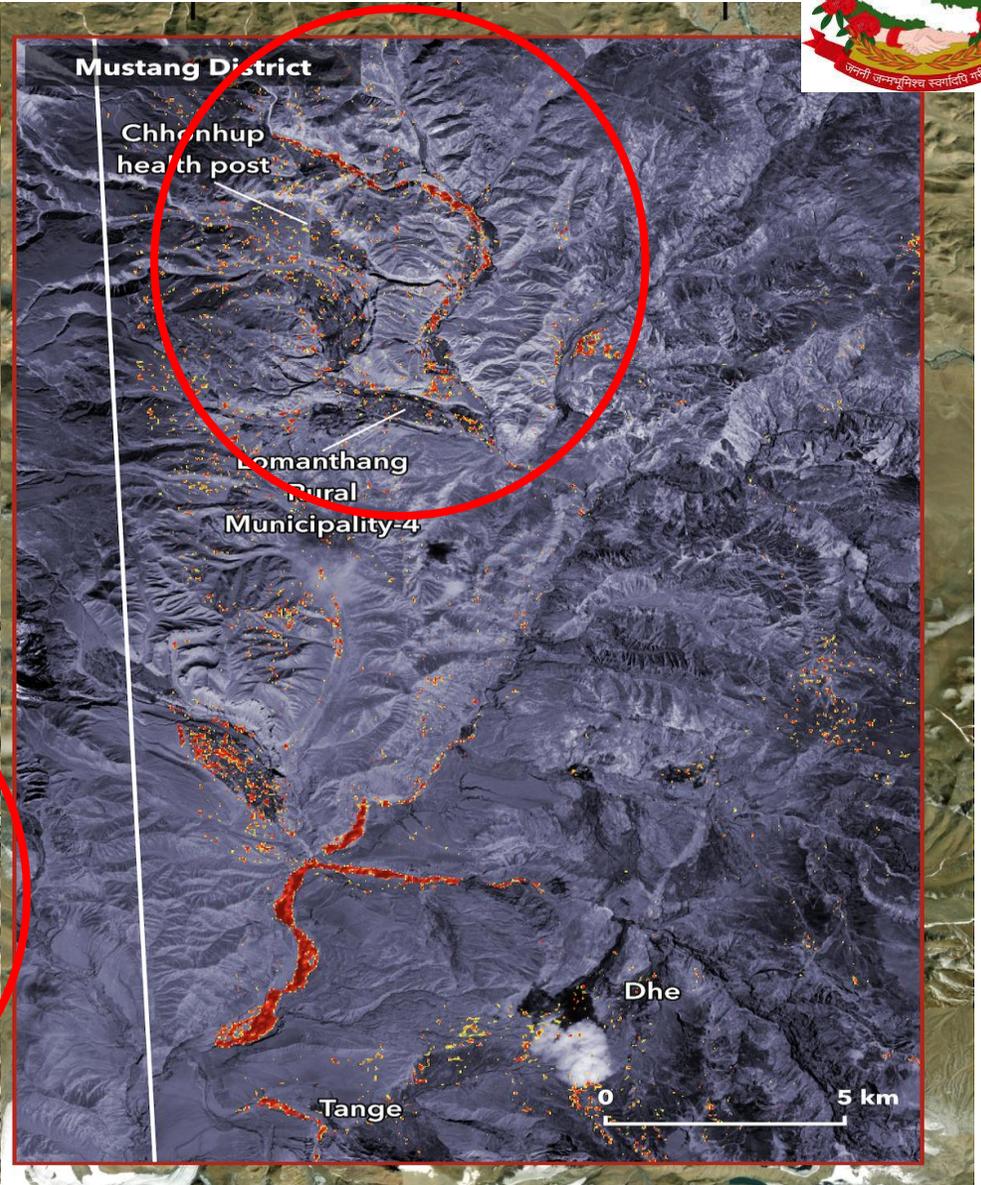
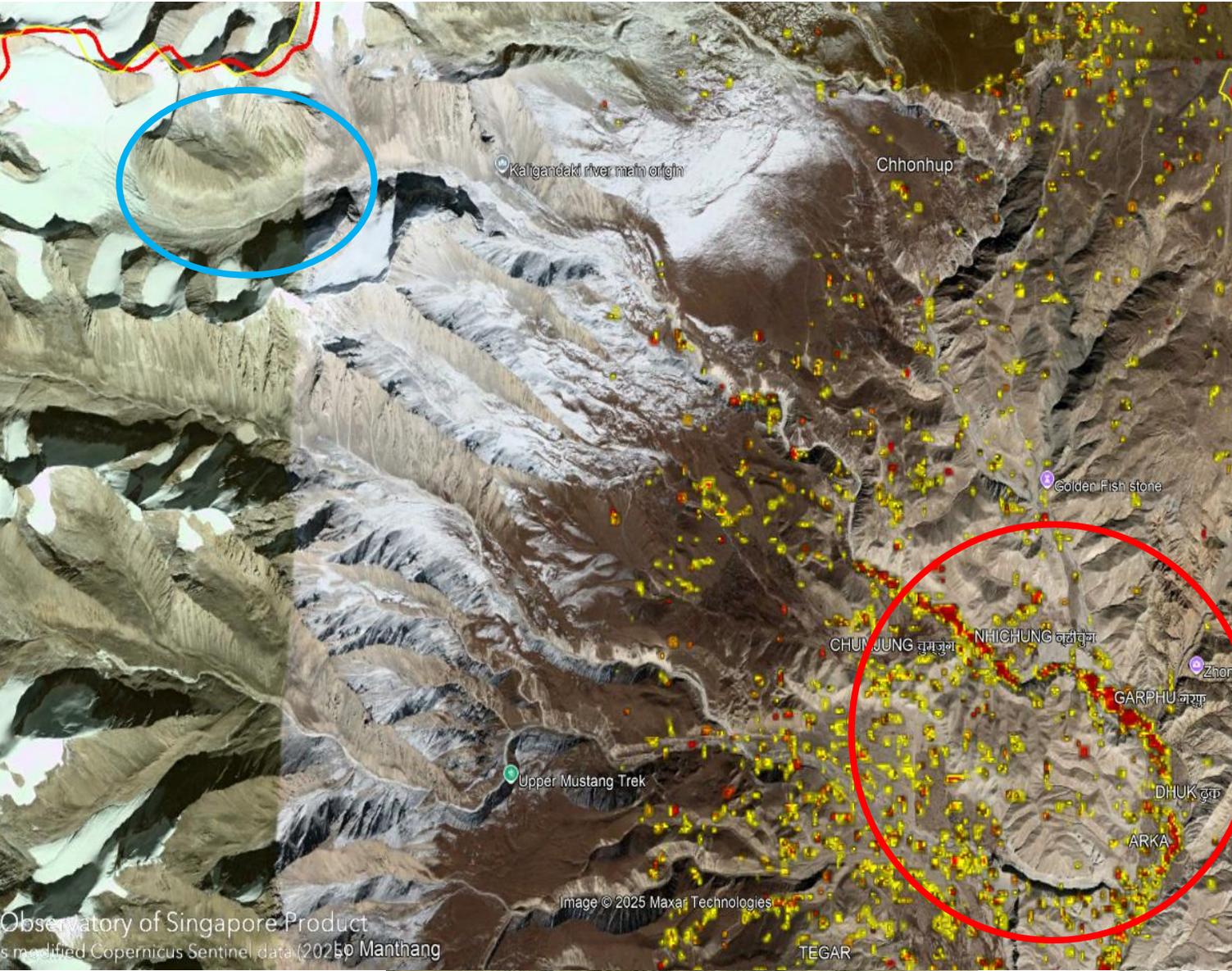


- Same afternoon of Rasuwa GLOF
- Date: July 8, 2025
- Location: Lomanthang, Mustang
- Damage: No casualties recorded



**Left Pre-event (July 8, 2025) and Right Post-event (August 7, 2025)  
Sentinel 2 images**

# Mustang GLOF



Observatory of Singapore Product  
Contains modified Copernicus Sentinel data (2025)  
Basemap: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

## Earth Observatory of Singapore Product

Contains modified Copernicus Sentinel data (2025)  
Basemap: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



# Humla (Tilgaun) GLOF

उत्तरी हुम्लाको तिलगाउँ पहिरोले क्षतविक्षत, नागरिक राहत र उद्धारको पर



<https://www.ratopati.com/cricket/nepal-premier-league-2025>



- First recorded GLOF of 2025
- Date: May 14, 2025
- Location: Tilgaon, Namkha–6, Humla
- Damage: Bridge, hydropower station, and irrigation canal
- Displacement: 32–33 people from 18–19 households
- Casualties: No casualties

# Humla (Tilgaun) GLOF



## Description

The Mohammed Bin Rashid Space Centre (MBRSC) created this map to support the post-disaster assessment of the Humla Glacial Lake Outburst Flood (GLOF) that occurred in Nepal on 15 May 2025.

## Area of Interest (AOI)

Longitude: 81.4341°E to 81.4856°E  
Latitude: 30.2056°N to 30.2407°N

## Methodology

Satellite Sensor Used: Copernicus Sentinel-1 (SAR)

Polarization: VH Band

## Methodology:

- Comparison of pre- and post-disaster SAR images
- Radar backscatter analysis to identify flood affected areas
- Preprocessing applied for accuracy

## Imagery Dates

Pre-Disaster: 26-04-2025  
Post-Disaster: 16-05-2025

## Impact Statistics

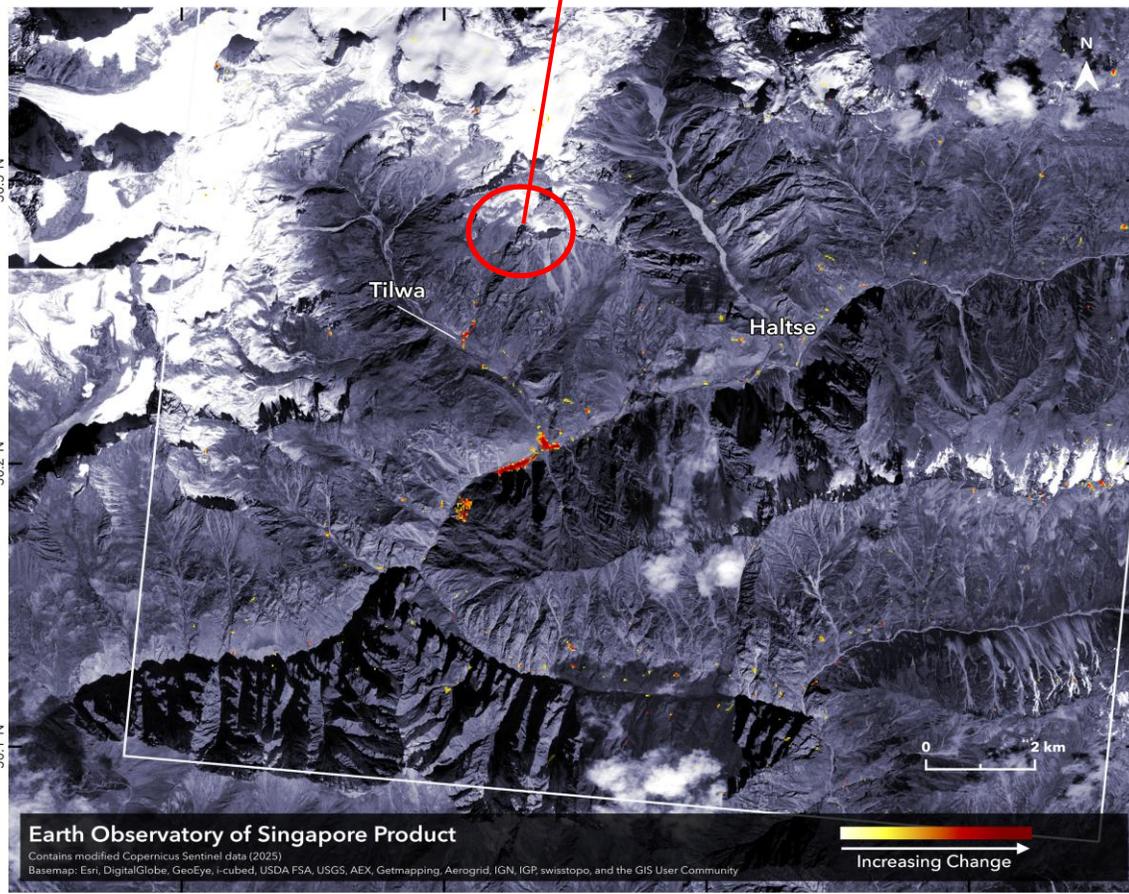
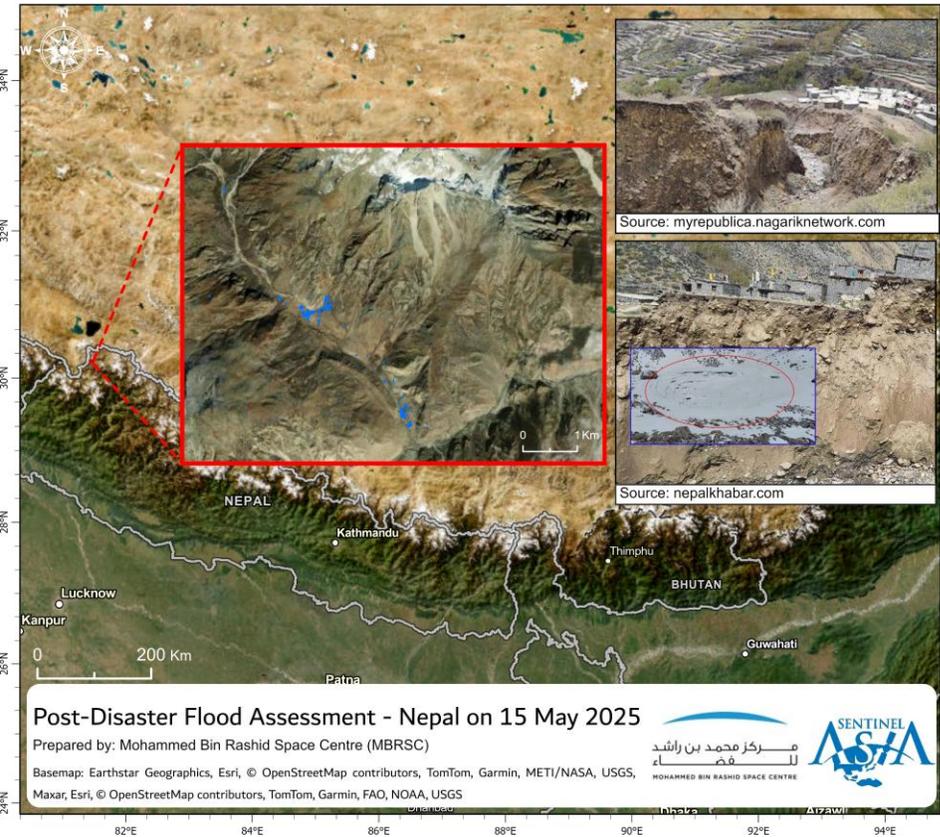
- 18 Damaged Houses
- 5 Bridges washed away by flash floods

## Legend

Flooded Areas

## Remark(s)

The accuracy of this product has been validated



## EOS-RS Damage Proxy Map: Tilwa, Nepal, Glacial Lake Outburst Flood, 16 May 2025, v0.7

The Earth Observatory of Singapore - Remote Sensing Lab (EOS-RS) created this preliminary Damage Proxy Map (DPM) depicting areas that are likely damaged in Tilwa, Namkha Rural Municipality-6 of Humla, Nepal following a glacial lake outburst flood on 15 May 2025. This map was derived from synthetic aperture radar (SAR) images acquired by the Copernicus Sentinel-1 satellite operated by the European Space Agency (ESA) before (16 Jan 2025 to 4 May 2025) and after (16 May 2025) the event.

The map covers an area indicated by the white polygon. Damage is shown by colored pixels of 30m in size, where yellow to red indicates increasingly significant ground surface change before and after the event. Preliminary validation was conducted using news reports, with the cluster of red pixels validated using optical imagery to confirm the extent of the glacial lake outburst flood. This map should be used as a guidance to identify damaged areas, and may be less reliable over vegetated or mountainous areas. Scattered pixels over vegetated or mountainous areas may be false positives, and a lack of colored pixels over such areas may not mean no damage.

The product contains modified Copernicus Sentinel data (2025), processed by ESA and analyzed by the Earth Observatory of Singapore - Remote Sensing Lab (EOS-RS).

More map details and files at: [https://products.earthobservatory.sg/#/leaflet/EOS-RS\\_202505\\_Nepal\\_Tilwa\\_Glacial\\_Lake\\_Outburst\\_Flood](https://products.earthobservatory.sg/#/leaflet/EOS-RS_202505_Nepal_Tilwa_Glacial_Lake_Outburst_Flood)

Legal Disclaimer: <https://products.earthobservatory.sg/#/faq>

Credits: Earth Observatory of Singapore - Remote Sensing Lab (EOS-RS). Contains modified Copernicus Sentinel data (2025)

EOS Remote Sensing LinkedIn

**Sentinel 1 image showing Deformation change between Apr 26, 2025 and May 16 2025 (Source: MBRSC)**

**Sentinel 1 image showing Deformation change between May 4, 2025 and May 16 2025 (Source: Earth Observatory of Singapore)**

# Sentinel Asia- DHM collaboration



- Sentinel Asia Training on **Glacial Lake Outburst Flood (GLOF) Mapping using Earth Observation Satellite Data** was conducted from 29 – 31 July 2025, DHM collaboration with Sentinel Asia JAXA and AIT.



# Sentinel Asia- DHM collaboration



## Overall objectives:

- enhance the capacity of the participants to utilize earth observation data for GLOF mapping and contribute to more effective disaster preparedness and emergency response in Nepal.

## Topics covered:

- Introduction of Remote Sensing
- Obtaining and handling of satellite data
- Glacier Lake identification and mapping
- Glacier velocity and damage mapping
- GLOF damage proxy mapping

Attended by 18 participants from DHM and various Disaster related organizations and University students – NDRRMA, IOE, TU, KU.

# Sentinel Asia- DHM collaboration



**Department of Hydrology and Meteorology**  
 Babarmahal, Kathmandu, Government of Nepal



## Report on Flood and GLOF mapping

**Submitted to:**  
 Remote Sensing and Geo-Information Section  
 Department of Hydrology and Meteorology  
 Babarmahal, Kathmandu, Government of Nepal

### Processing using SNAP

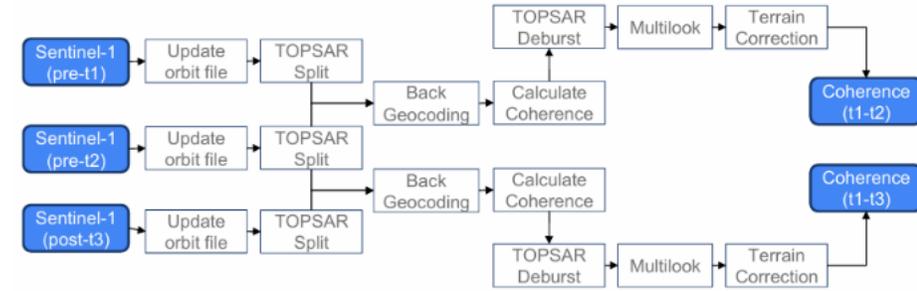
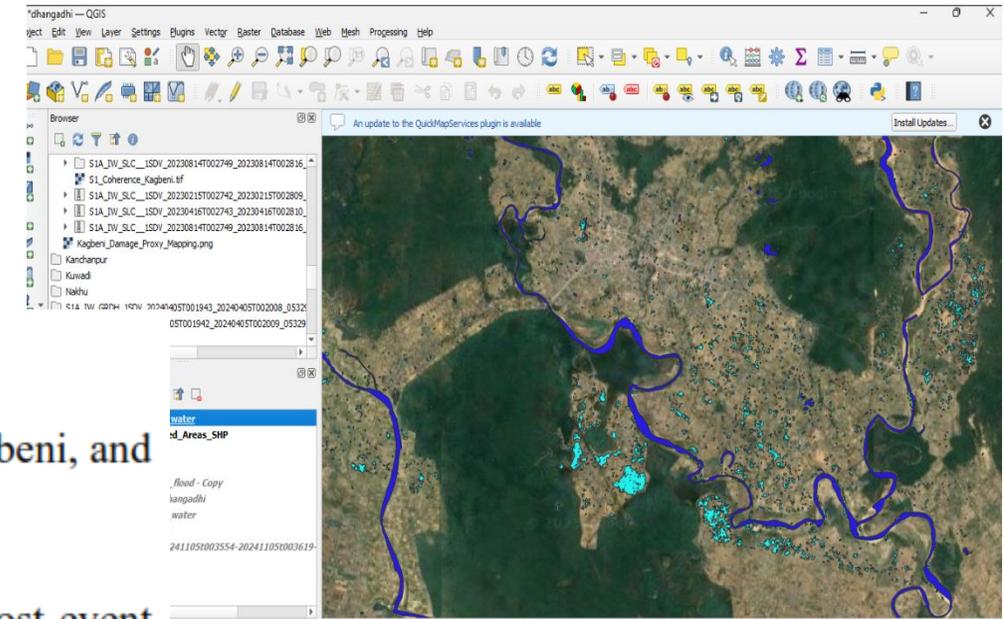


Fig. 1: Flowchart showing processing in SNAP.



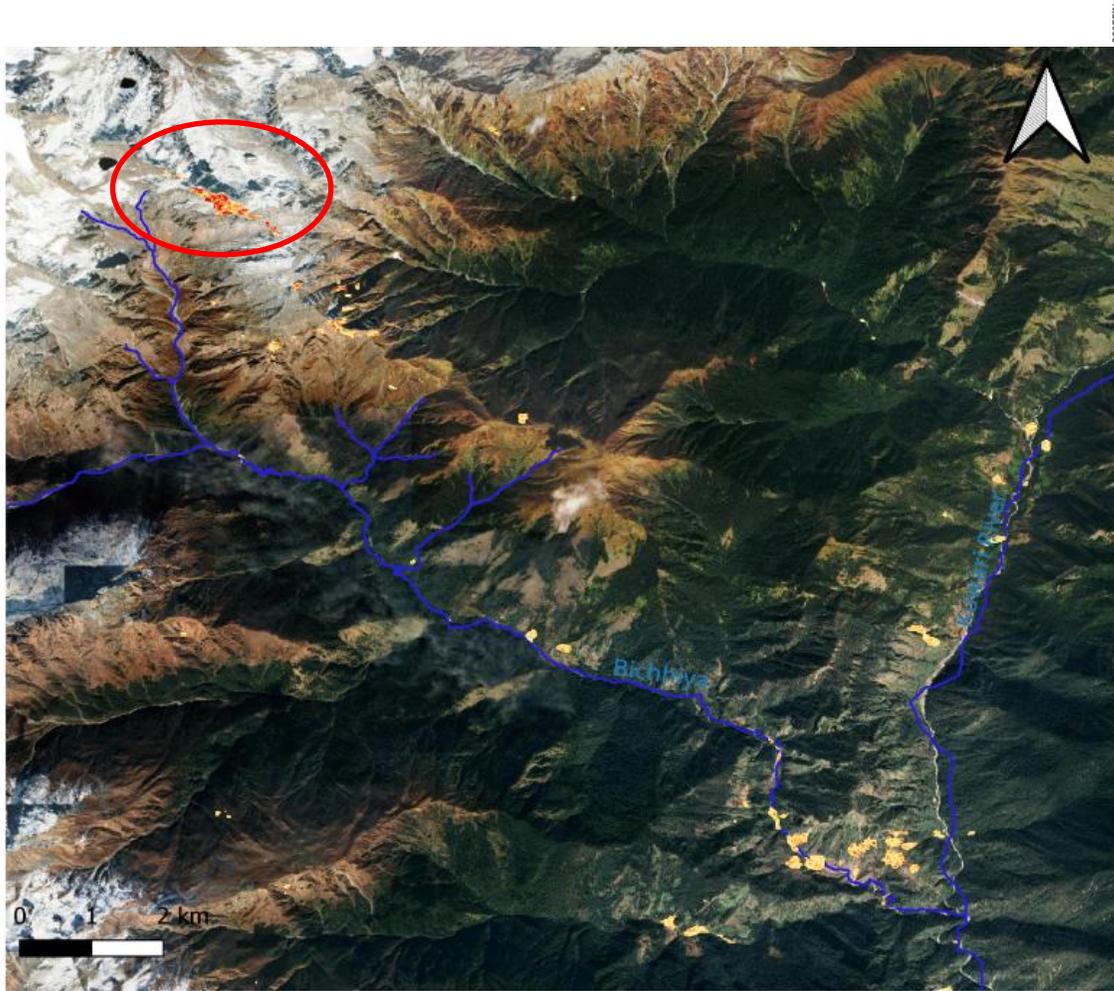
Showing the post-processing in QGIS for the Flood Inundation of Dhangadhi.

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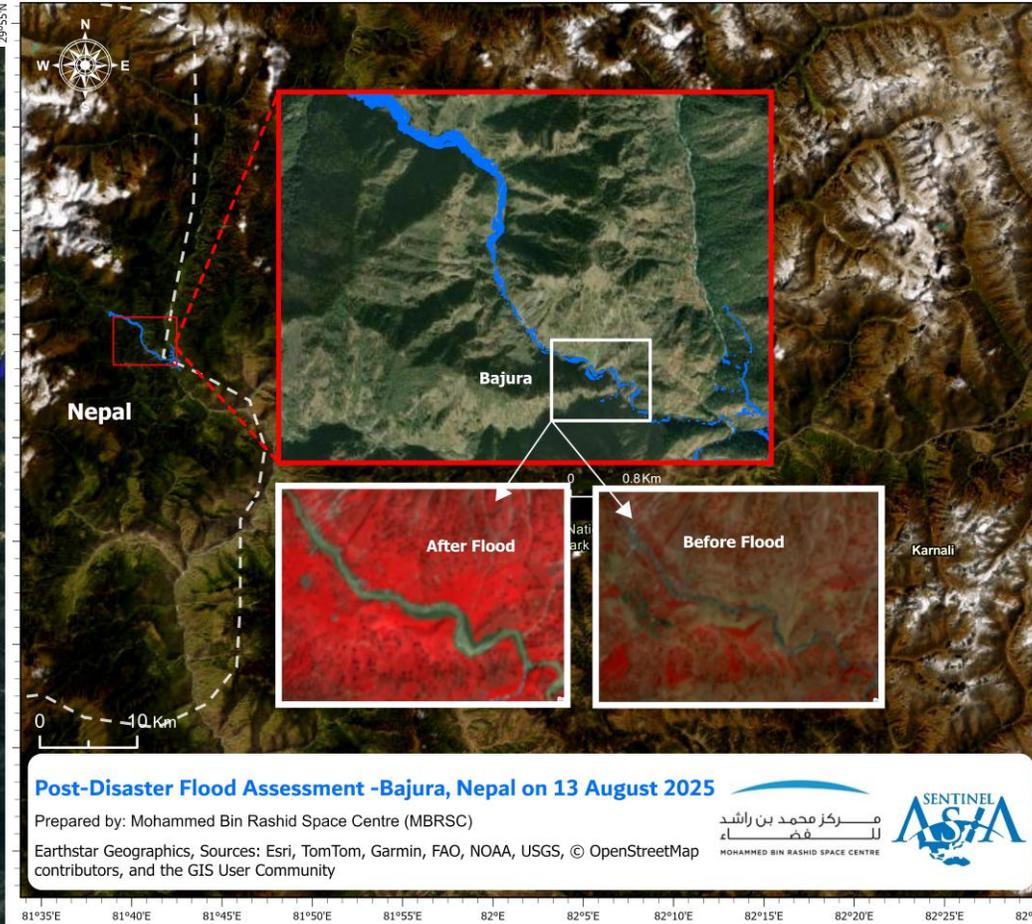
## Specific Objectives

- To perform Damage Proxy Mapping (DPM) in selected case areas (Nakhu, Kagbeni, and Kuwadi) using satellite data and geospatial analysis tools.
- To conduct flood mapping for Dhangadhi through the analysis of pre- and post-event satellite imagery for identifying inundated areas.

# Sentinel Asia- DHM collaboration



Damage proxy map from Sentinel 1 image showing Deformation change between July 15, 2025 and August 15 2025 (Source: DHM)



Post disaster assessment- Bajura (Source: MBRSC)

<b>Description</b>	The Mohammed Bin Rashid Space Centre (MBRSC) created this map to support post-disaster assessment efforts following the flood in Bajura District, Nepal, on 13 August 2025.
<b>Area of Interest (AOI)</b>	<b>Longitude:</b> 81.6469°E to 81.7089°E <b>Latitude:</b> 29.6838°N to 29.6380°N
<b>Methodology</b>	<b>Satellite Sensor Used:</b> Sentinel-2 (Multispectral imagery) <b>Methodology:</b> <ul style="list-style-type: none"> <li>• Comparison of pre- and post-disaster Sentinel 2 images</li> <li>• Change detection tool utilized based on NMDWI indices over both before and after image.</li> <li>• Flooded area extraction</li> </ul>
<b>Imagery Dates</b>	<b>Pre-Disaster:</b> 27-05-2025 <b>Post-Disaster:</b> 15-08-2025
<b>Impact Statistics</b>	Reference:  <b>11</b> Houses Swept Away
<b>Legend</b>	Flooded Areas 
<b>Remark(s)</b>	The accuracy of this product has not been validated

# Sentinel Asia- DHM collaboration



- Grateful to the organizers and trainers for their guidance, support and continued commitment to capacity-building
- Look forward to being a Sentinel Asia member, emphasizing on data-sharing for timely and accurate disaster monitoring and response.



# Summary of EORs activated in 2025

- 5 numbers of EORs activated in 2025 (GLOFs and Floods)

<b>Number</b>	<b>Disaster</b>	<b>Create date</b>	<b>AOI</b>	<b>Disaster charter activation</b>
<u>20251004-Nepal-Flood-00615</u>	Flood	05/10/2025	Kathmandu, Birgunj, Jhapa	No
<u>20250831-Nepal-Flood-00607</u>	Flood	01/09/2025	Kailali	No
<u>20250813-Nepal-Flood-00603</u>	Flood	15/08/2025	Bajhang	Yes
<u>20250630-Nepal-Flood-00588</u>	Flood-GLOF	01/07/2025	Rasuwa, Mustang	Yes
<u>20250515-Nepal-Flood-00579</u>	Flood-GLOF	18/05/2025	Humla	No

Thank you for your time and attention!!

