



Increasing extreme events in the central Himalayas

Third Pole Climate Forum

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Mountain hazards- From compound events to cascading disasters

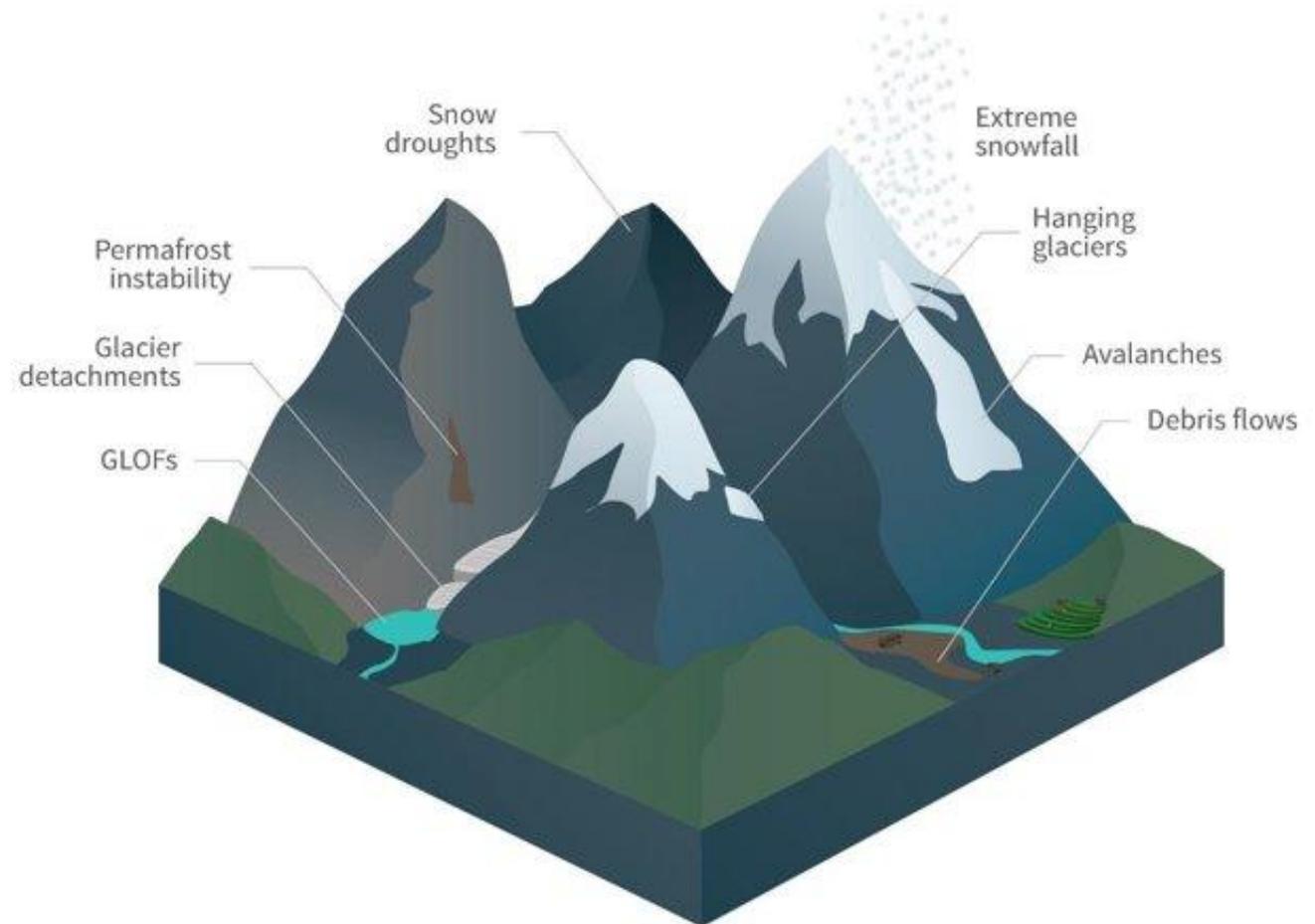
Single hazard and **multi hazards**

Due to compound drivers, hazards have become **cascading in nature** (primary hazard triggering secondary hazard)

Cascading disaster creates bigger impact than a single hazard

Increasing number of disasters is primarily due to increased exposure

Frequency of such disasters may increase due to climate change



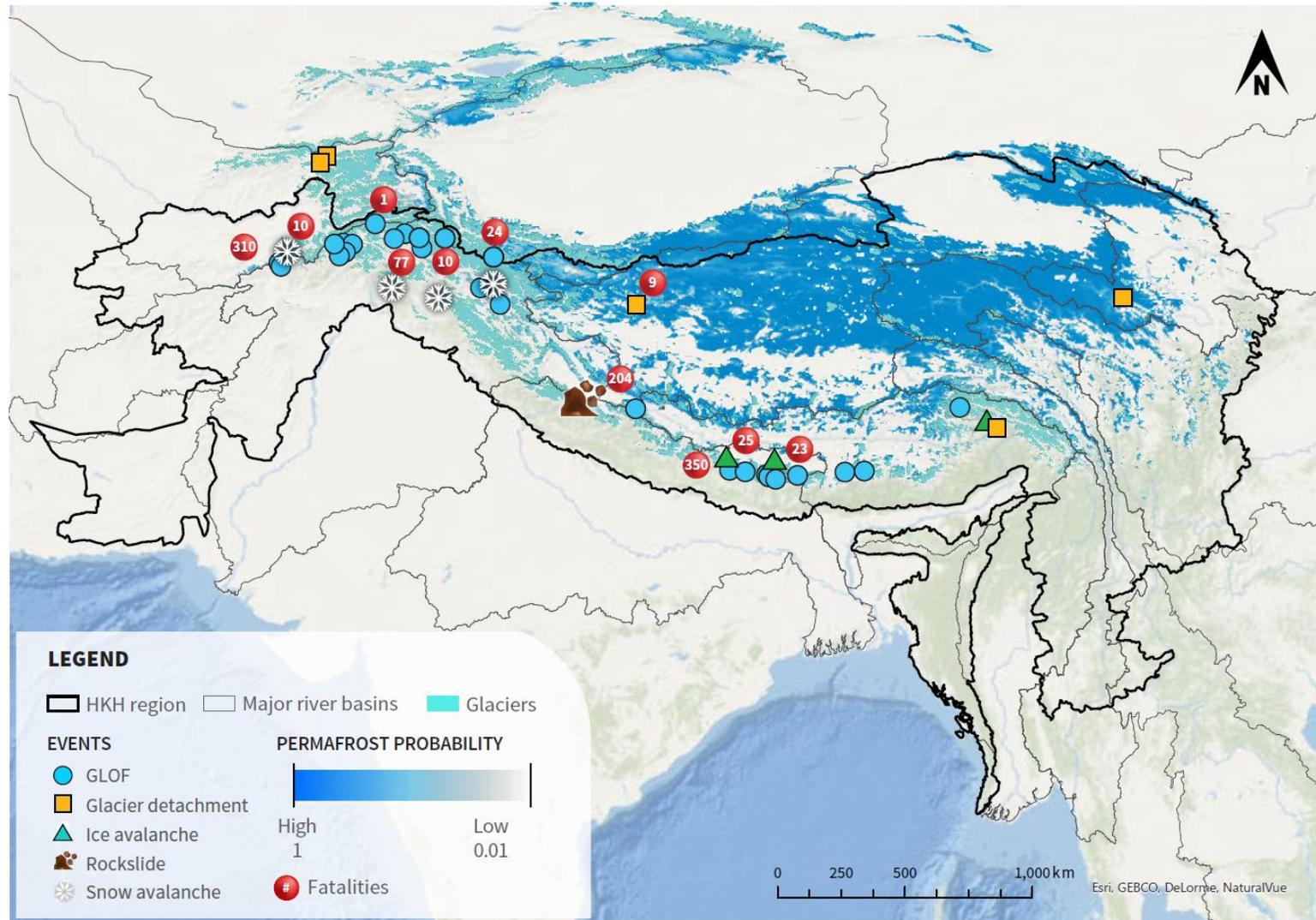
Cryosphere-related events since 2015

Many recent disasters related to cryospheric changes documented

- GLOF
- Glacier detachment
- Ice avalanche
- Rockslides
- Snow avalanche

Casualties and infrastructure damages are recorded

Source: HIWISE report, ICIMOD



Extreme events 2016-2025

Description	Date	Location	Impact
Bhote Koshi GLOF	August 2016	Tibet, China, Nepal	Infrastructure, Roads and agriculture land
Melamchi GLOF	June 2021	Sindhupalchowk, Nepal	
Tamakoshi floods	June 2022	Tibet, China, Nepal	
Manang Floods	June 2021	Manang, Nepal	
Gorkha floods – Birendra Tal	2023		
Barun river flood	2017	Barun Tal, Nepal	
Thame GLOF	August 2024	Solokhumbu, Nepal	
Central Nepal floods	Sept 2024	Central Nepal	
Dodhara Chandani rainfall	July 2024	Farwest Province, Nepal	
Limi GLOF	May 2025	Humla, Nepal	
Kagbeni floods	2023	Mustang, Nepal	

Bhote Koshi GLOF: Nepal 2016

Bhote Koshi – 45 MW Hydroelectric project

Transboundary - 6 km d/s from border between China and Nepal

Poiqu (China)/Bhote Koshi drainage basin extends to more than 6,000 m



Event: July 2016 GLOF- moraine-dammed lake 24 km u/s burst in the Zhangzangbo River basin

Impact: Significant damage to the headworks and powerhouse - large boulders, up to 8 m diameter, desanding basin, erosion of the abutment walls and the highway > US\$ 10 million

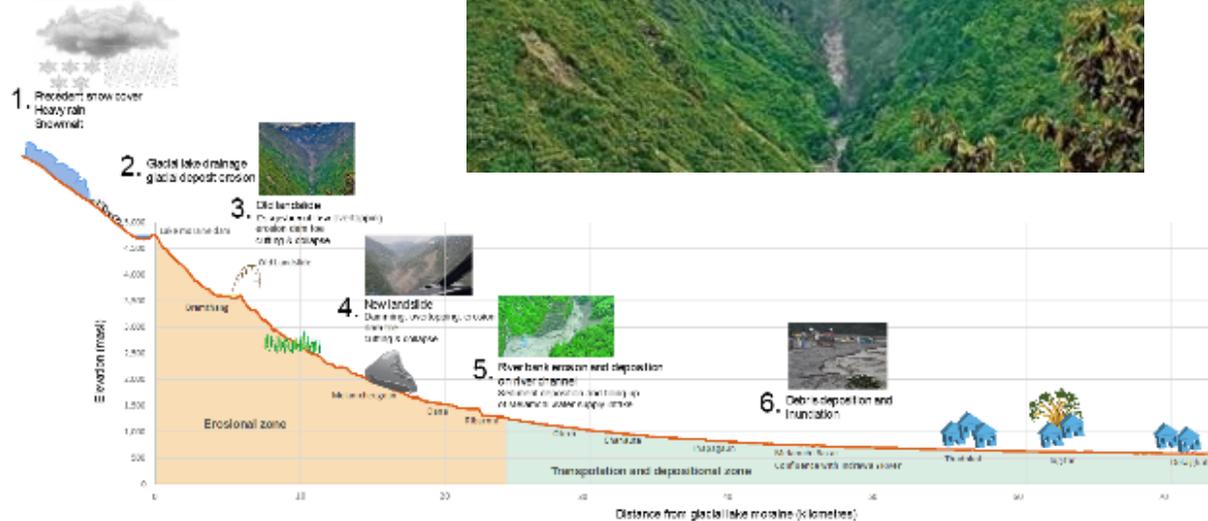


<https://www.hydroreview.com/world-regions/surviving-three-natural-disasters-lessons-learned-at-upper-bhote-koshi-in-nepal/#gref>

Melamchi GLOF: Nepal

Melamchi - 320 km² basin – 5200 m

Cascading hazards with GLOF, landslides, LDOF and impacts



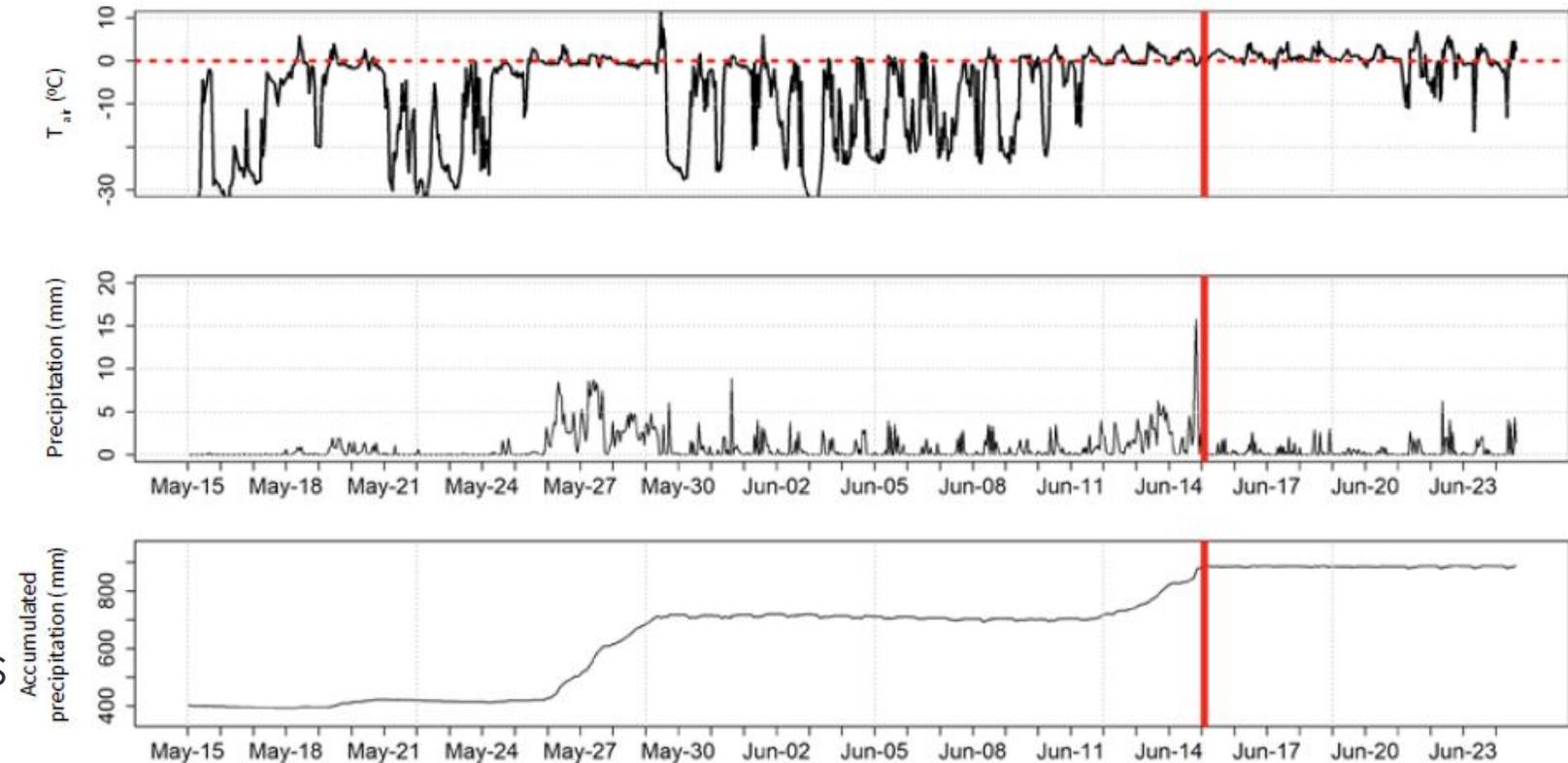
Event: June 2021 GLOF- Pemdang Khola a tributary of Melamchi

Impact: 25 people killed, Significant damage to d/s settlements, 6 bridges washed away, 15 meters of accretation



Melamchi GLOF: Nepal

- Data from the automatic weather station (AWS) in the upper part of the Melamchi watershed at an elevation of 4962 masl
- Provided evidence of the possible cause of the GLOF and subsequent disasters
- However, the station networks in higher elevations is very thin



Source: ICIMOD (data from AWS operated by ICIMOD at Ganja La in the upper Yangri Khola), Maharjan et al (2021)

Tamakoshi floods: Nepal 2021

Tamakoshi – 456 MW Hydroelectric project

Transboundary - 6 km d/s from border between China and Nepal

Event: Heavy rainfall in the upstream in the Rongxar area causing floods and temporary damming



Manang floods: Nepal 2021

Marshyangdi river flooding in the mountain district in Gandaki Province

Impact: Five houses, including the postal office, were swept away by flood

Event: June 2021 – Heavy rainfall leading to floods

Significant damage to the roads and bridges - Around 200 people from more than 50 families have been displaced from Naso Rural Municipality



THE KATHMANDU POST

<https://www.hydroreview.com/world-regions/surviving-three-natural-disasters-lessons-learned-at-upper-bhote-koshi-in-nepal/#gref>

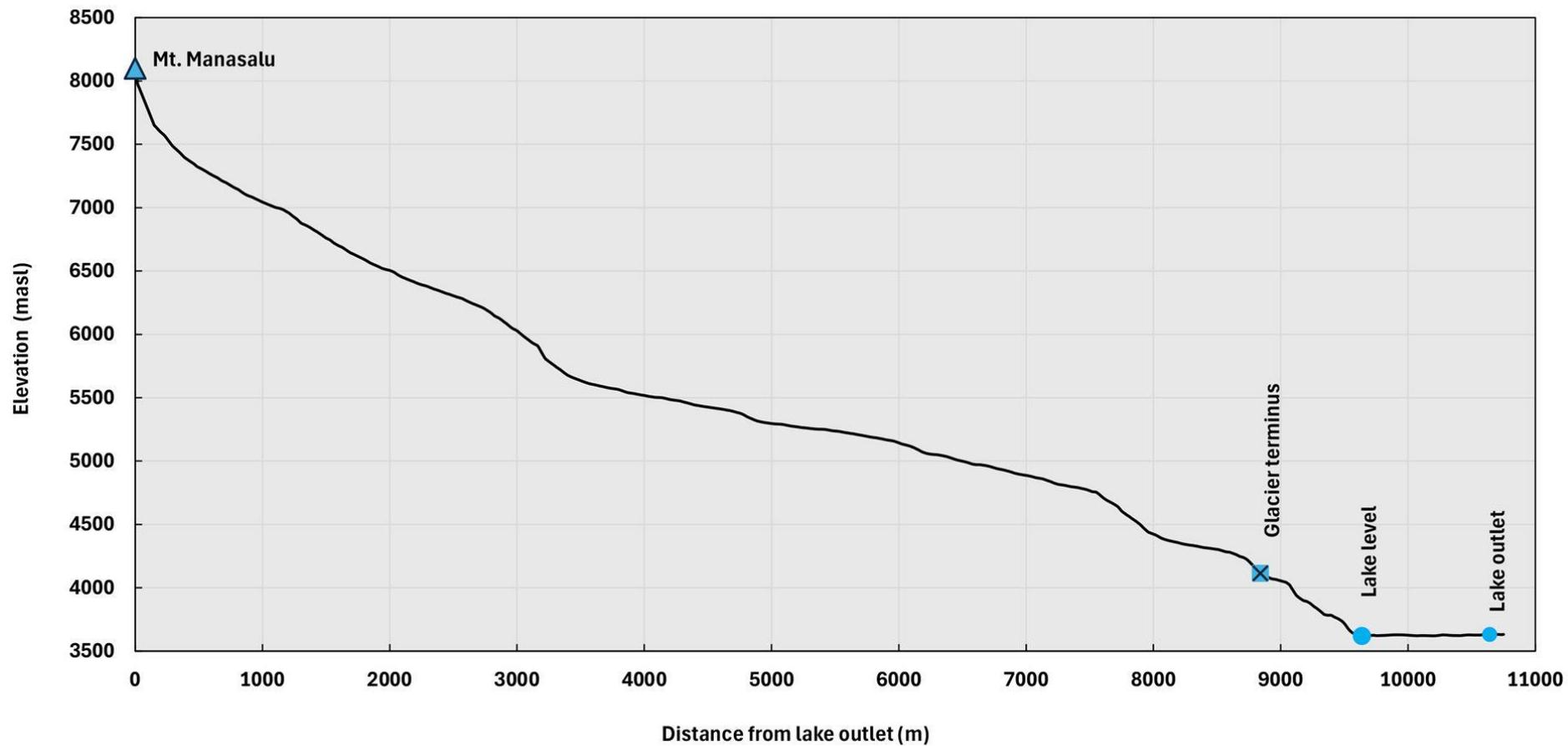
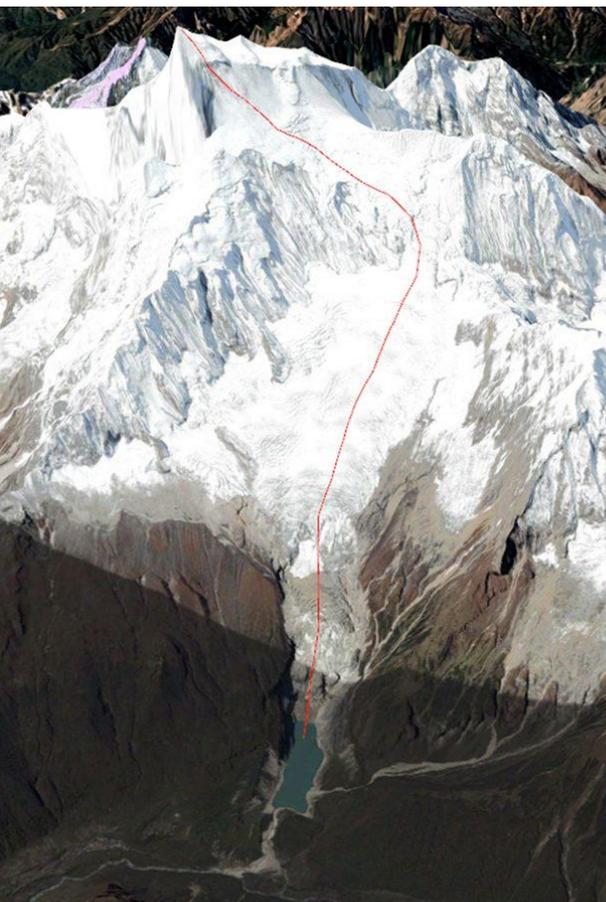
Birendra Tal: Nepal 2023

Birendra Tal, a glacial lake (3600 m) at Samagaun, Chumanubri rural municipality-1, Gorkha

Event: The lake was destabilized after a huge avalanche originating in the Mt Manaslu

Authorities raised alarms over the potential for a flood in the Budhigandaki, emphasizing the **substantial risk posed to settlements downstream.**

Impact: Significant damage to the roads and bridges - Around 200 people from more than 50 families have been displaced from Naso Rural Municipality



Dodhare Chandani: Nepal 2023

On July 7 and July 8, Dodhara in Kanchanpur recorded the heaviest rainfall

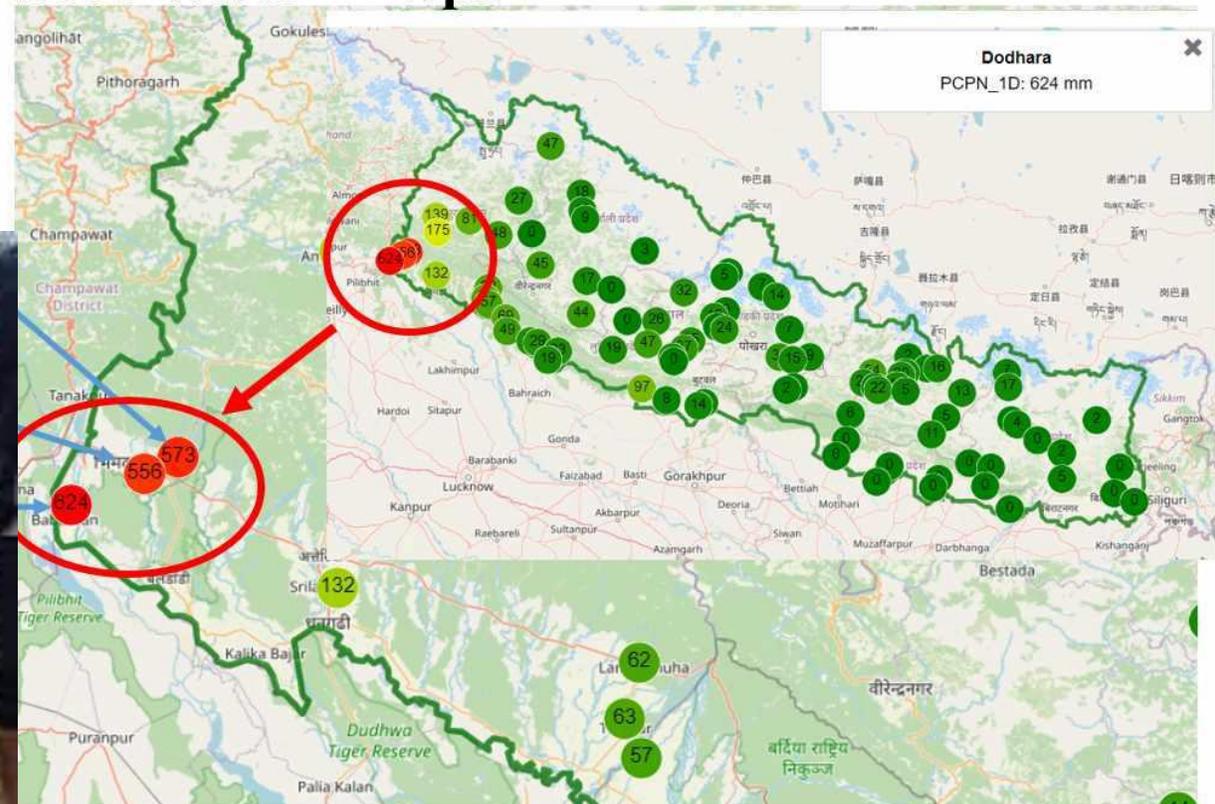
624.0 mm of rain fell in Dodhara, 573.6 mm in Hanumannagar, and 556.4 mm in Sundarpur within a 24-hour period.

Located at banks of Mahakali river in Kanchanpur district

Impact based forecast delivered by DHM through SMS

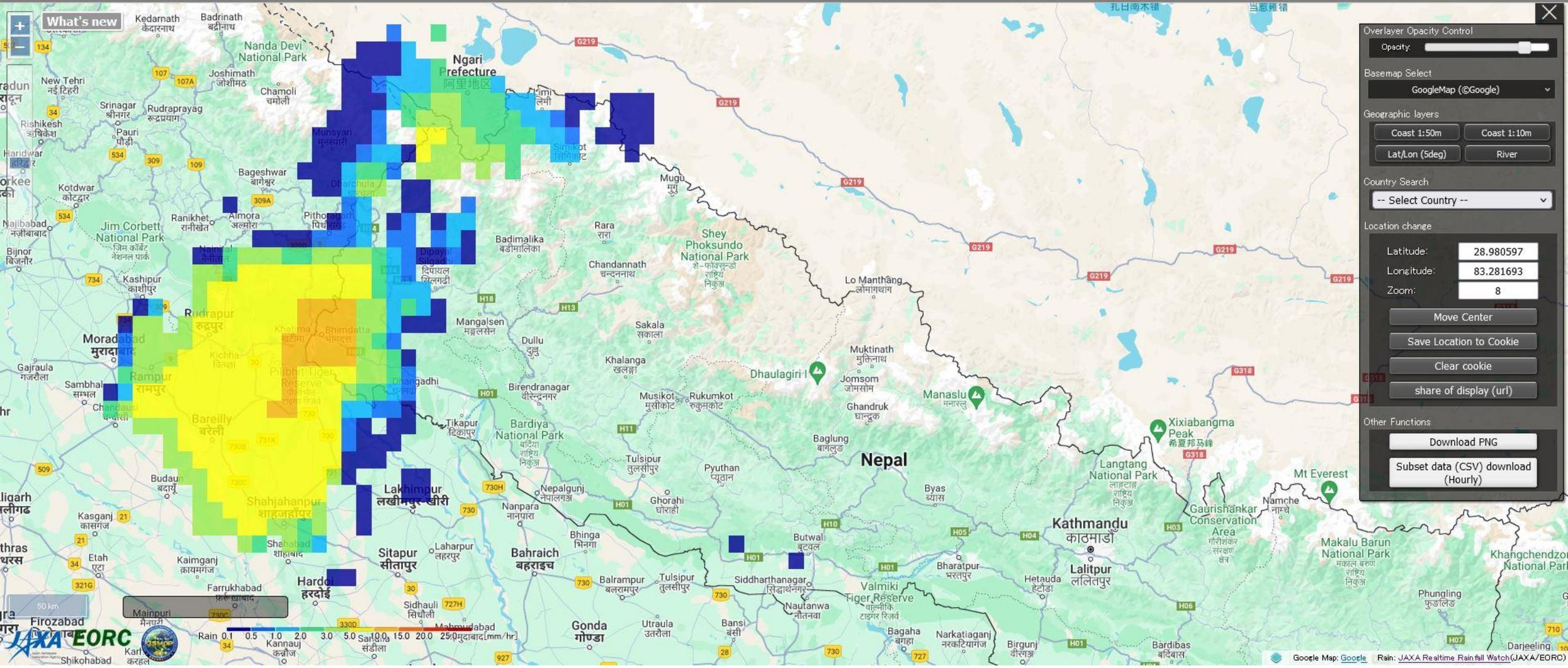
No human lives lost

Extreme Precipitation in 7th to 8th July 2024 in Southwestern Nepal



Date: **2024** / **7** / **7** **19:00-19:59** **UTC**

GSMaP_STD



Overlay Opacity Control

Opacity:

Basemap Select

GoogleMap (©Google)

Geographic layers

Country Search

-- Select Country --

Location change

Latitude:

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Zoom:

Other Functions

Thame GLOF

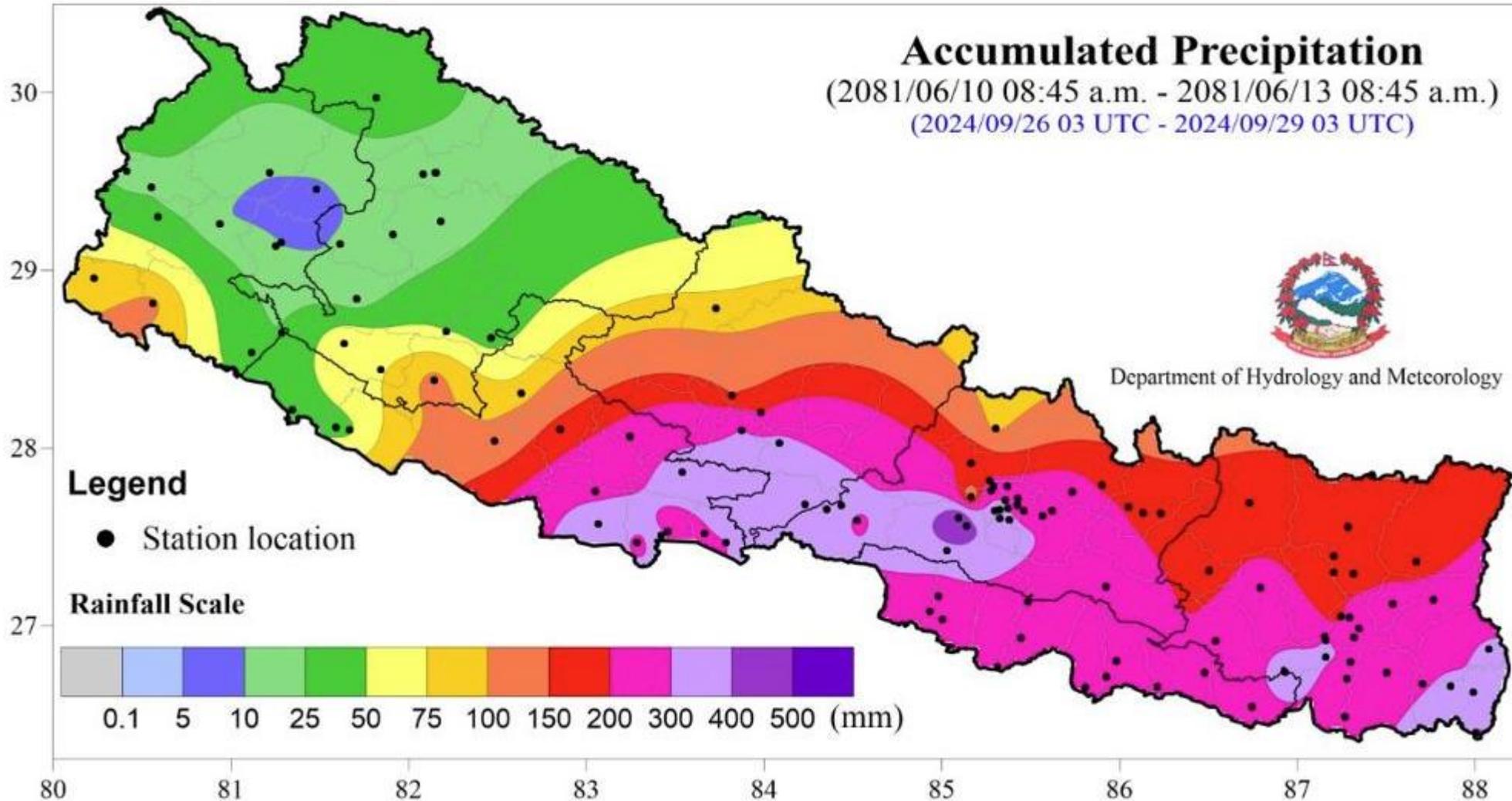
GLOF struck Thame, a village (3800 m) in the Everest region in Solukhumbu District of Nepal on 16 August 2024

GLOF occurred from the outburst of Thyanbo glacial lake (4750 m).

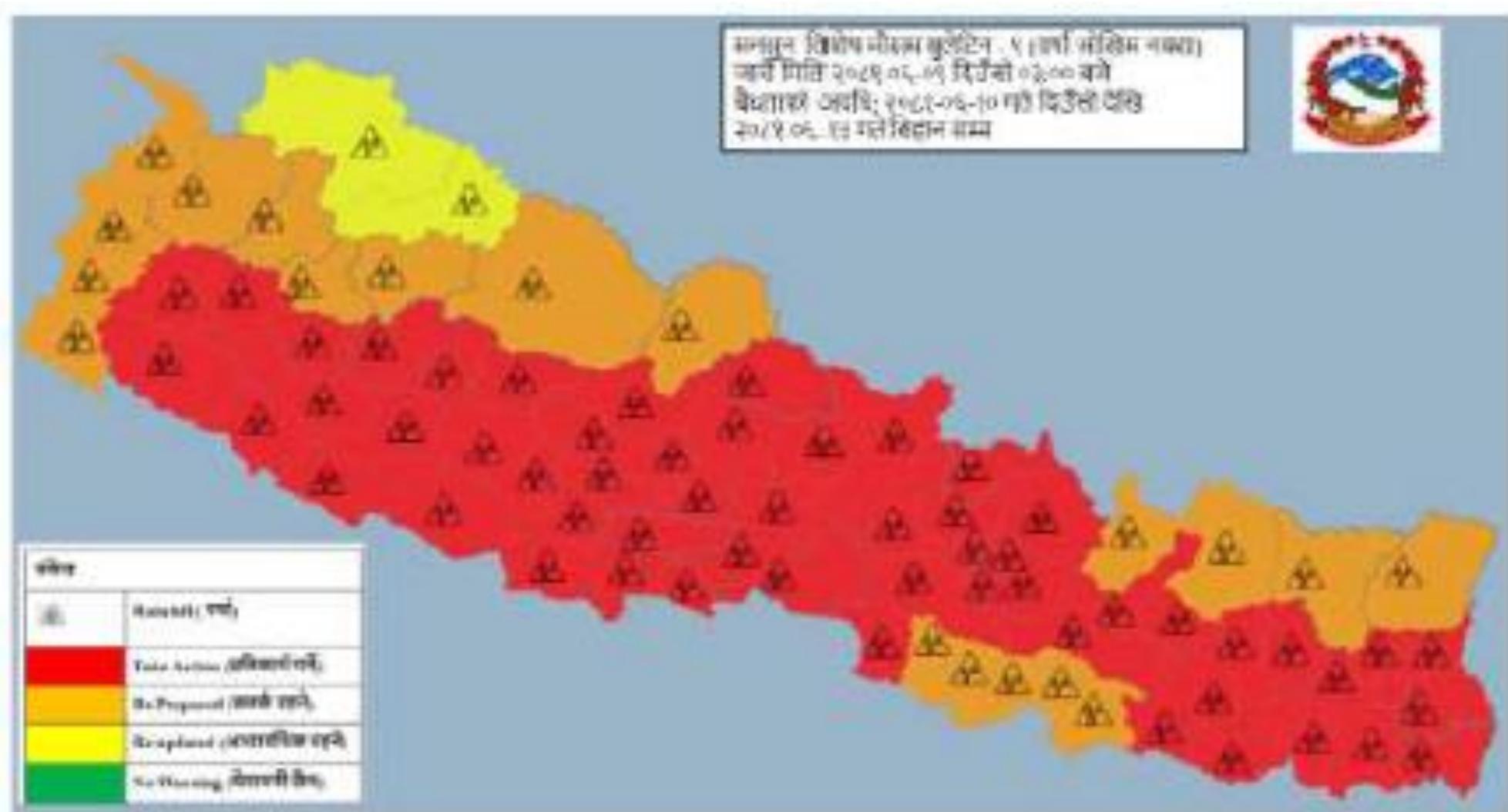
Source: NDRRMA



3-day accumulated ppt in Nepal: September 2024



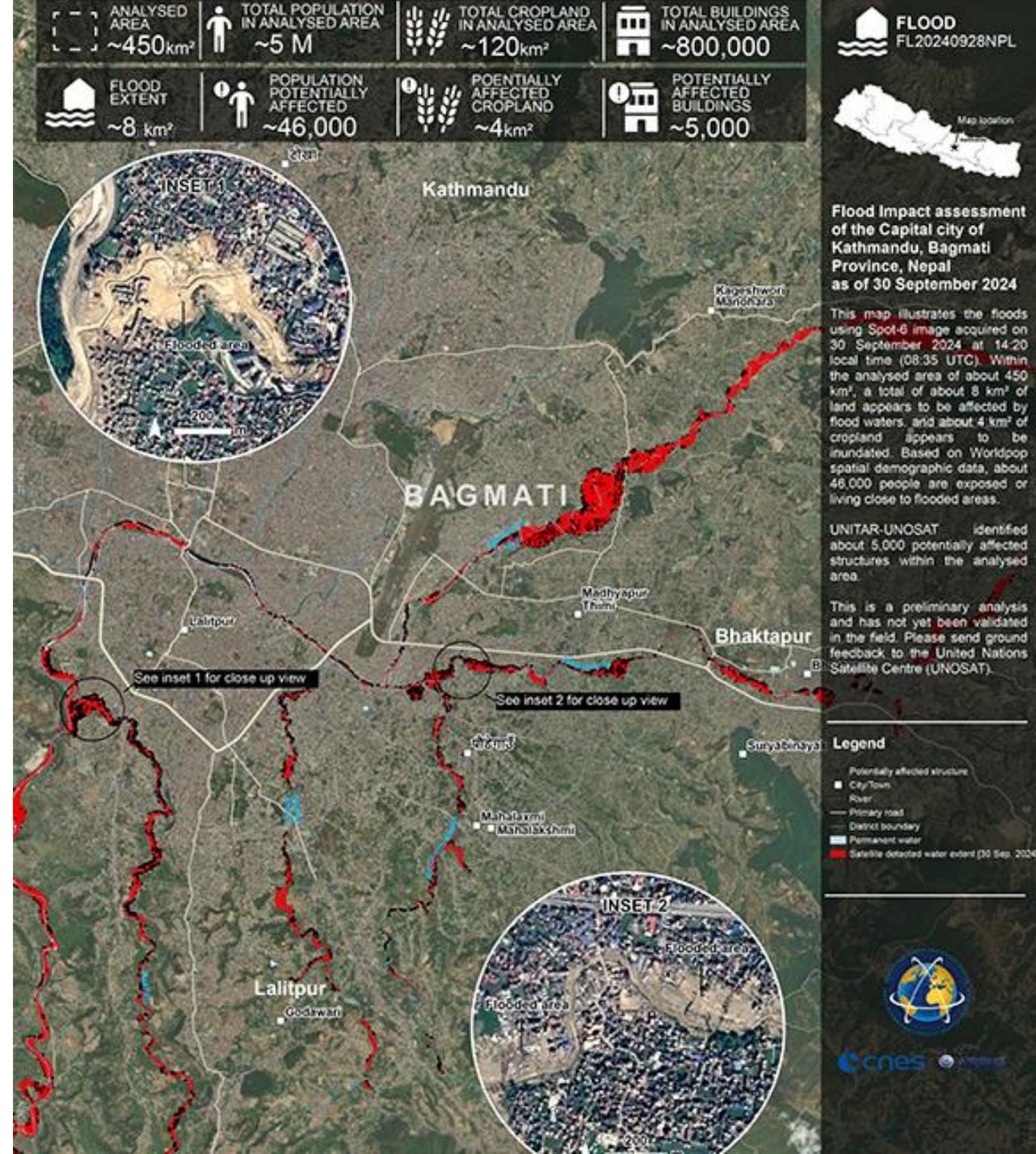
Special bulletin: 25 September



Nepal activated the international charter

Rapid assessment of the floods in the Bagmati river in Kathmandu Valley

Impact: 250 fatalities, 18 missing persons, and 178 injured. initial damage and loss to major infrastructure is estimated at NPR 12.85 billion.



Nakhu khola



Kagbeni Floods: Nepal 2023

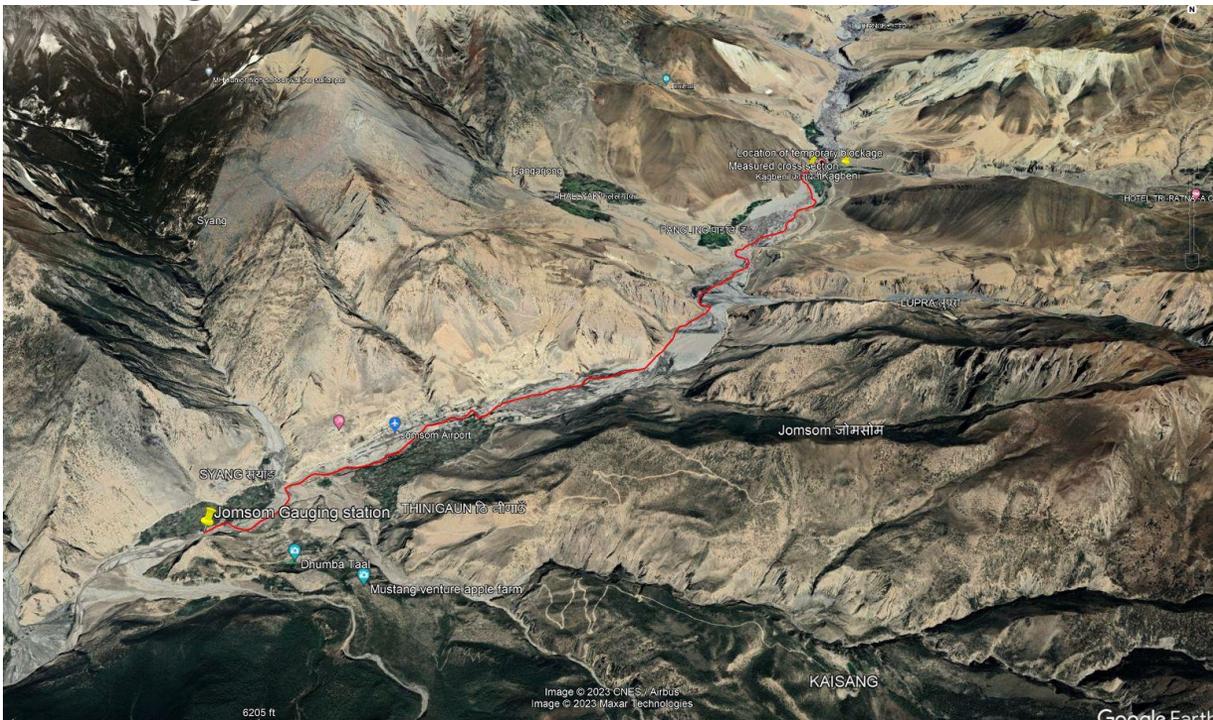
On Aug 13, village of Kagbeni, Mustang district is struck by a flood

The Kag khola, dammed upstream by a landslide, burst flooding the lower reaches.

Originated from above 3600 m.

Impact: washed away 29 houses and displaced more than 150 people

One motorable bridge, 1 steel truss bridge and 3 temporary bridges were destroyed



Limi Floods: Nepal 2025

On May 15, village of Til, Limi valley in the remote Humla district is struck by a flood (4100 m elevation)

A similar flood occurred in May 2011

“If the cryosphere is a barometer of the planet, then Limi is the siren. And the alarm is blaring” - Tashi Lhazom

Impact: lost critical infrastructure - primary drinking water source, a recently constructed hydropower plant, 25 agricultural fields, four irrigation canals, a water mill, the main road to the local monastery, and the community water tank.



Extremes in the future

RCP 4.5

RCP 8.5

Average Q

(m^3s^{-1})

0

>4000

Mean Relative Change [%]

0

100

200

300

Extremes will increase strongly during the 21st century, almost doubling in magnitude by the end of the century

Source: Wijngaard et al. (2017)



TRAINING ON

Spatial and temporal analysis of climate change indices using the Climate Data Analytical Tool and CORDEX datasets over South Asia

21–24 June 2022 | Dhulikhel and Kathmandu, Nepal

Organised by

International Centre for Integrated Mountain Development (ICIMOD)
and Met Office (MO)



Key messages

Frequency and intensity of extreme events in higher elevations are increasing

Co-develop and co-design solutions/ EWS with new innovative techniques and approaches as cascading disasters are on the rise for resilient infrastructure development and climate resilience

Science-based evidence at local level and **tailored climate services** that is actionable is critical for decision making

Governments must invest in glacial lake monitoring, transnational EWS and open data-sharing to improve preparedness. The focus of adaptation strategies should integrate long-term perspectives and emphasize socioeconomic impact assessments.



Thank you