





Cascading Flood Risks in Mountain Regions

Early Warning, Governance and Resilience

7 October 2026

WORLD METEOROLOGICAL ORGANIZATION

GLOBAL WATER PARTNERSHIP ORGANISATION

ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

Webinar Agenda

Duration	Session
13:00-13:05	Welcome and opening • **Dr Hwirin Kim,** Chief, Hydrological Modelling and Forecasting, WMO • **Anjali Lohani,** Global Head, Water & Climate Resilience Investments, GWPO
13:05-13:50	Regional and National Perspectives: • **Bibhuti Pokharel**, Senior Divisional Meteorologist, Meteorological Forecasting Division, Department of Hydrology and Meteorology, Nepal • **Manish Shrestha**, Hydrologist, ICIMOD • **Daurbek Sakyev**, Director, National Meteorological and Hydrological Service, Kyrgyzstan • **Christophe Lienert**, Managing Director, Swiss Steering Committee on Intervention in Natural Hazards, Switzerland
13:50-14:10	Panel Discussion • **Narelle Van Der Wel**, Head, Cryosphere Monitoring, Predictions and Services, WMO • **Bibhuti Pokharel**, Senior Divisional Meteorologist, Meteorological Forecasting Division, Department of Hydrology and Meteorology, Nepal • **Daurbek Sakyev**, Director, National Meteorological and Hydrological Service, Kyrgyzstan • **Christophe Lienert**, Managing Director, Swiss Steering Committee on Intervention in Natural Hazards, Switzerland
14:10-14:20	Q&A
14:20-14:25	WMO activities on flood management - Ramesh Tripathi, Scientific Officer, WMO
14:25-14:30	Key messages and way forward

Speaker



Anjali Lohani

Global Head, Water & Climate Resilience Investments, GWPO

Speaker



Bibhuti Pokharel

Senior Meteorologist,
Department of Hydrology
and Meteorology (DHM),
Nepal

Beyond Early Warning

Investing in cascading flood-risk reduction in Nepal’s mountain region

Bibhuti Pokharel,
Senior Divisional Meteorologist
Nepal Meteorological Department

Introduction

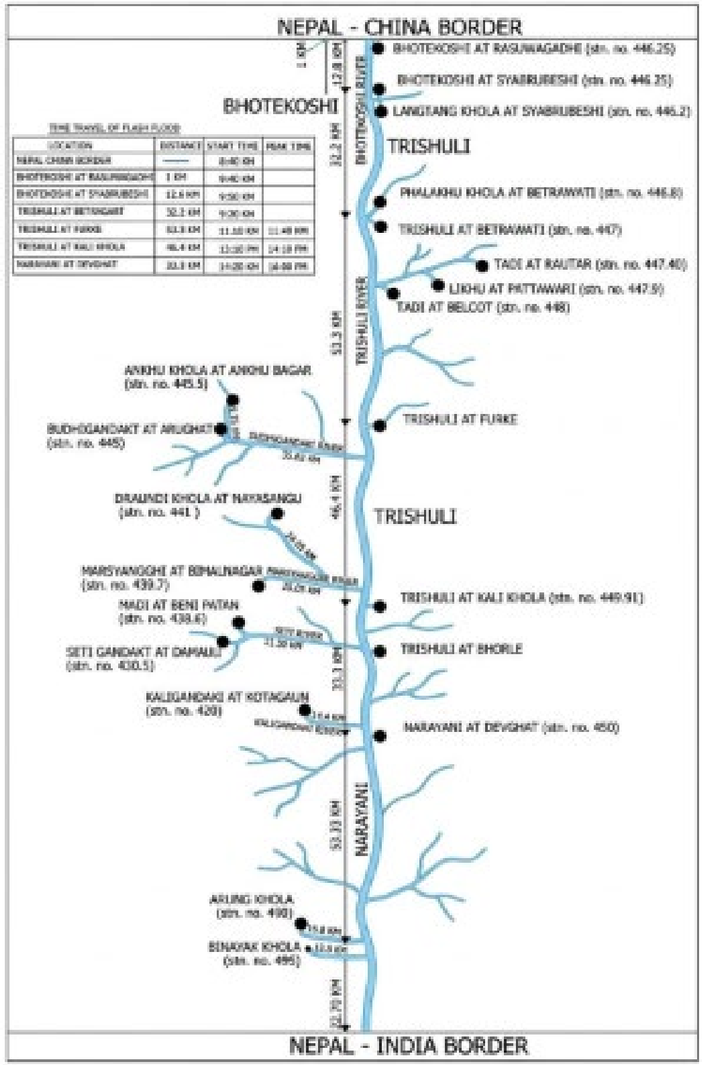
- Himalayas are highly prone to orographic rainfall and extreme weather events—such as cloudbursts, GLOFs—which frequently trigger flash floods, debris flows, and landslides.
- The complex and fragile topography provides cascading disastrous effects. Glaciers in Himalayas are melting and thining due to climate change which resulted in rapidly growing glacier lakes. These lakes are dammed by unstable moraines . Steep topography prone to landslides, earthquakes and intense monsoonal precipitation makes it more vulnerable and catastrophic to peoples living downstream.
- Due to the remoteness of the Bhotekoshi Rasuwa flood area, pinpointing the exact location of the incident was challenging. Furthermore, the lack of observation stations in such remote terrain complicated meteorological research into the event.

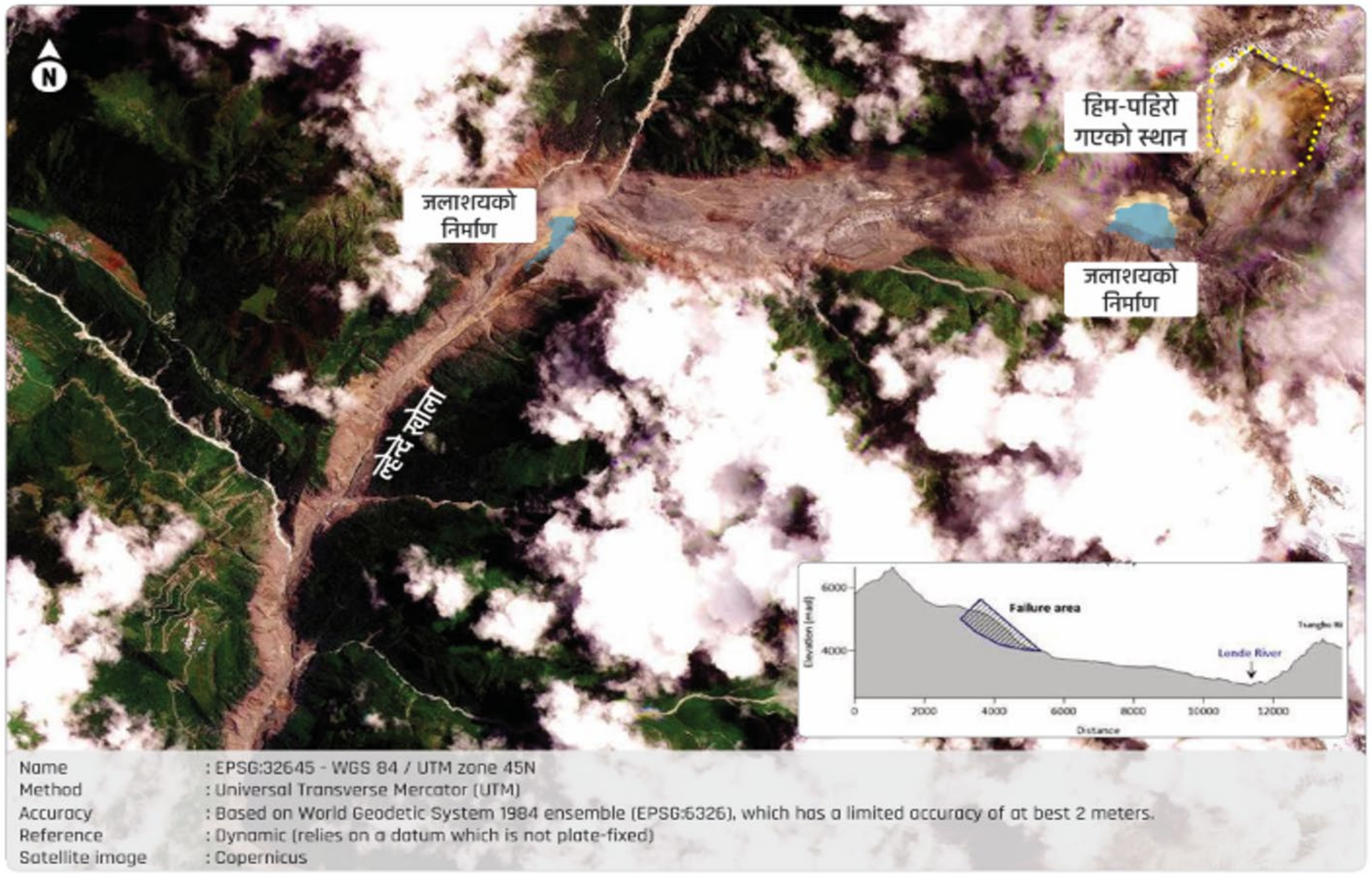
Introduction

- On 26 August 2026 a devastating flash flood occurred in the Lhende Khola–Bhotekoshi–Trishuli–Narayani river system. According to report from NDRRMA and CHWRR , it was triggered by an **ice-rock avalanche** originating from the northern part of the Langtang–Lirung Himal in Rasuwa District.
- A hanging glacier and rocky terrain covering an area of about **2.0 km²** at an elevation of approximately 5200m got detached and fell onto the Lhende glacier located at approximately **3,800 m elevation**, generating a massive outburst flood in the downstream Lhende River which produced a **seismic signal equivalent to a magnitude 5.2 earthquake**, recorded at approximately **08:37 AM**.

Source: Report from National Disaster risk reduction authority(NDRRMA) and Assessment Report II Rasuwa–Bhote Koshi Flood Event, 2026 (2083)from Centre for Hydrology and water Resource Research

Flood Travel path and location of place where incident happened





Source: Report from National Disaster risk reduction authority(NDRRMA) and Assessment Report II Rasuwa–Bhote Koshi Flood Event, 2026 (2083)from Centre for Hydrology and water

Unusual and increase in frequency and magnitude of extreme weather events

1. **First Recorded Tornado, 31 Mar, 2019 (Unusual)**
2. **Extreme Weather Events of 2021**
   - ***Heavy monsoon rain induced flashflood in Manang District (Northern fragile mountains- rain shadow, low rainfall and desert area), 14-15 Jun, 2021 (Unusual and frequent)***
   - ***Melamchi Climate induced Disaster, June 15 and subsequent July 31 and August 1, 2021 (Unusual and frequent)***
   - ***Post-monsoon Heavy Rainfall Event in Western Nepal (17-21 Oct, 2021) (Unusual and frequent)***
3. **Extreme Weather Events of 2023**
   - ***flash flood in Muktinath, Mustang District, (Northern fragile mountains- rain shadow and desert area), August 2023 (Unusual and frequent)***
4. **Extreme Events of 2024**
   - ***Record Breaking Heavy Downpour in Kanchanpur District of Nepal- 7-8 July 2024 (Unusual and frequent)***
   - ***GLOF at Pashanglahmu Rural Municipality-5, Thame Solukhumbu district-14 August 2024 (frequent)***
   - Extreme Rainfall (record breaking rainfall events) and Flooding Event Kathmandu Valley and in its vicinity districts, 27-29 September 2024 (Unusual and frequent)
5. **Extreme events of 2025**
   - ***GLOF in Tilagaun, Humla, May 2025 (Frequent)***
   - ***GLOF in upstream of Lhende Khola impacting Rasuwa (Frequent)***
6. **Extreme Events in 2026**
   - ***Rasuwa (Bhotekoshi-Trishuli) Himalayan Tsunami, August 26, 2026 (Unusual and frequent)***

Observed seasonal temperature trends for 1971-2024 period (°C/Year)

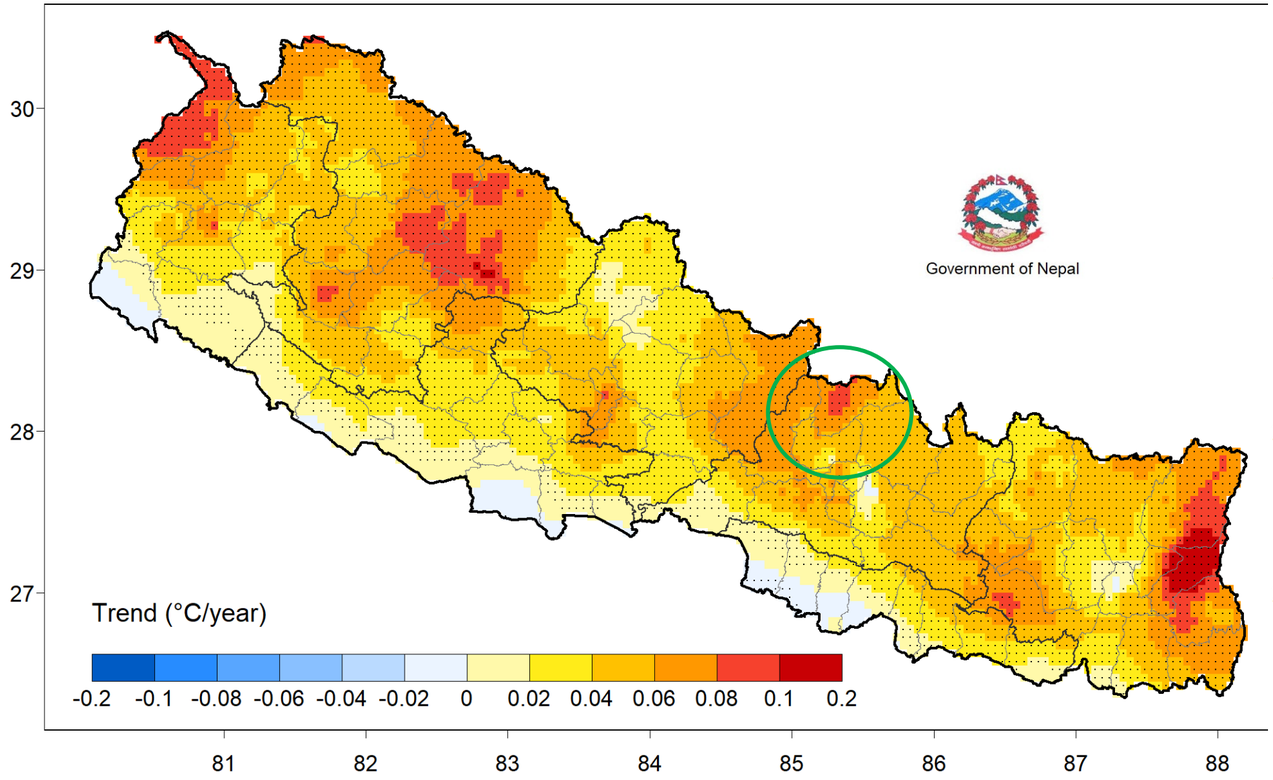
Parameter	Region	Winter		Pre-Monsoon		Monsoon		Post Monsoon		Annual	
		α	Trend	α	Trend	α	Trend	α	Trend	α	Trend
Max Temp	**Nepal**	**	0.043	**	0.033	**	0.049	**	0.048	**	0.045
	High-Himalaya	**	0.061	**	0.034	**	0.055	**	0.054	**	0.051
	High-Mountain	**	0.059	**	0.045	**	0.054	**	0.054	**	0.055
	Mid-mountain	**	0.052	**	0.041	**	0.053	**	0.052	**	0.051
	Siwalik	**	0.018	*	0.021	**	0.04	**	0.037	**	0.029
	Terai	ns	-0.002	ns	0.012	**	0.034	**	0.029	**	0.017
Min Temp	**Nepal**	*	0.013	*	0.013	**	0.026	**	0.02	**	0.019
	High-Himalaya	ns	0.006	**	0.027	ns	0.011	ns	0.013	**	0.017
	High-Mountain	ns	0.011	**	0.029	*	0.013	**	0.022	**	0.021
	Mid-mountain	**	0.015	**	0.023	*	0.012	**	0.02	**	0.02
	Siwalik	**	0.017	**	0.022	**	0.017	**	0.023	**	0.02
	Terai	**	0.022	**	0.023	**	0.015	**	0.018	**	0.02

*Note: α – Significance, Significant: * - 95% CL, ** - 99% CL, not significant - ns*

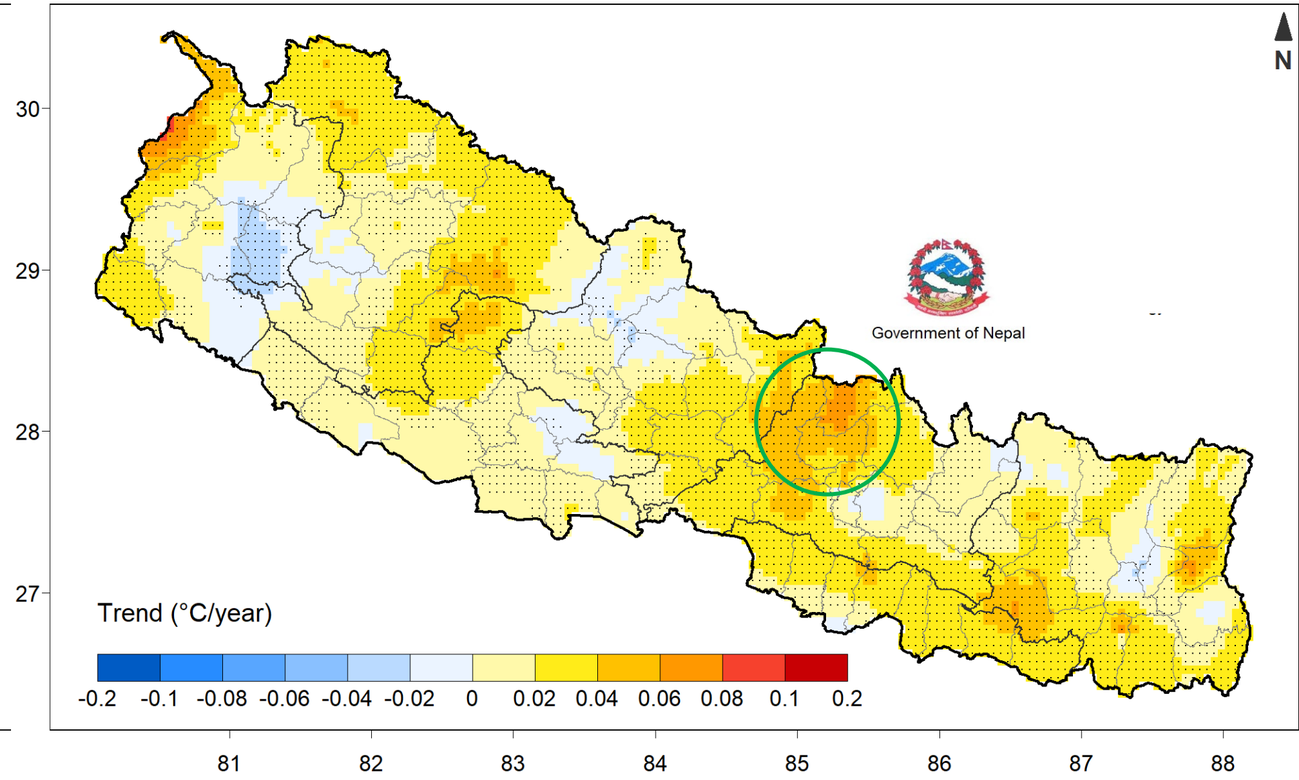
- **Annual Daytime Warming Rate:** High-elevation annual Max Temp warming (**+0.051 to +0.055 °C/yr**) exceeds the national average (**+0.045 °C/yr**) by ~18% and is over **3× faster** than the Terai (**+0.017 °C/yr**).
- **Monsoon & Post-Monsoon Highs:** High elevations maintain elevated rates (**0.054–0.055 °C/yr**), surpassing All Nepal (**0.048–0.049 °C/yr**) and lowlands (**0.033–0.037 °C/yr**). **Specially this trend is important for Monsoon, because during summer, temperature tendency is to remain above 0oC.**

Spatial Variability of Observed Temperature Trends for 1971-2024 Period (°C/Year)

Annual Maximum Temperature Trend

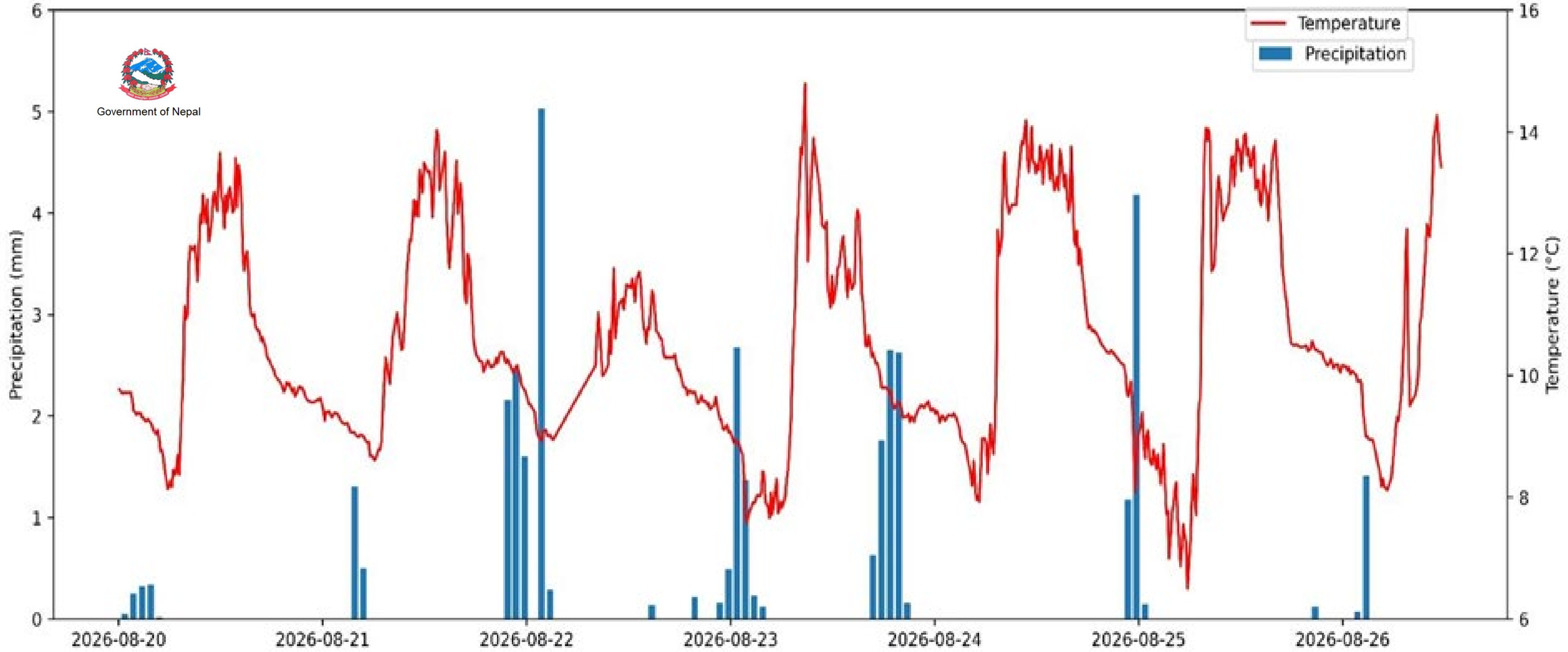


Annual Minimum Temperature Trend



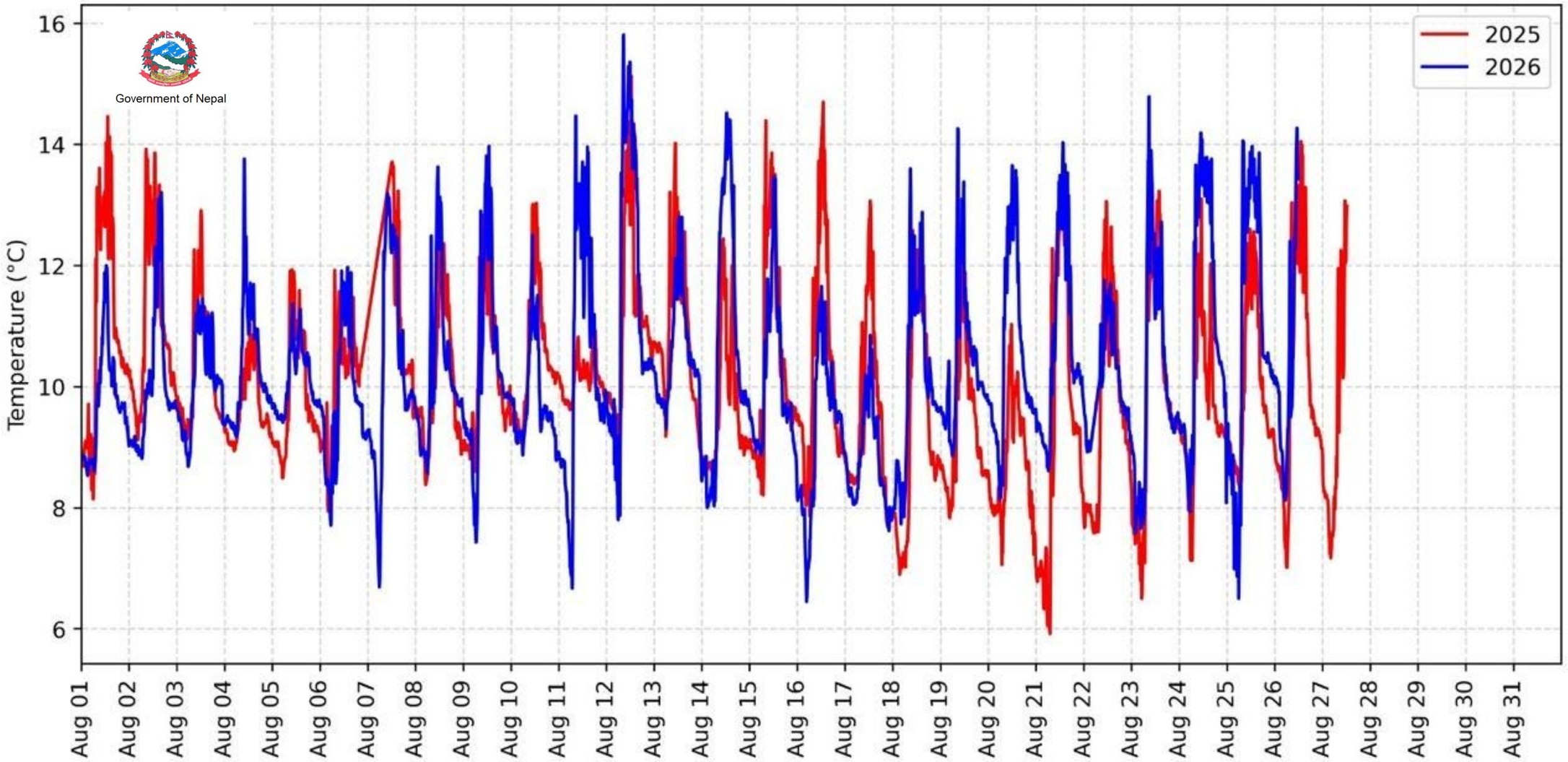
- **Spatial Hotspots:** The spatial maps reveal pronounced warming hotspots (orange to red shades, reaching **0.06 to 0.1 °C/yr**) across the high-altitude northern belt and specific central/eastern mountain pockets (green circles), In Rasuwa and its vicinity districts and ner

Diurnal Temperature and Precipitation since 20 August, 2026 in Kyanjing Station (3850masl), Rasuwa District, near the Snow Avalanche Site



- Temperature remained above 8 degrees,
- temperature remained above 13oC for longer hours on 24 and 25 Aug
- Continuous rainfall and possibilities of convective activities

August Temperature Comparison in 2025 and 2026 in Kyanjing Station (3850masl), Rasuwa District near the snow avalanche site



- 2026 August Temperature is higher than the 2025 August temperature

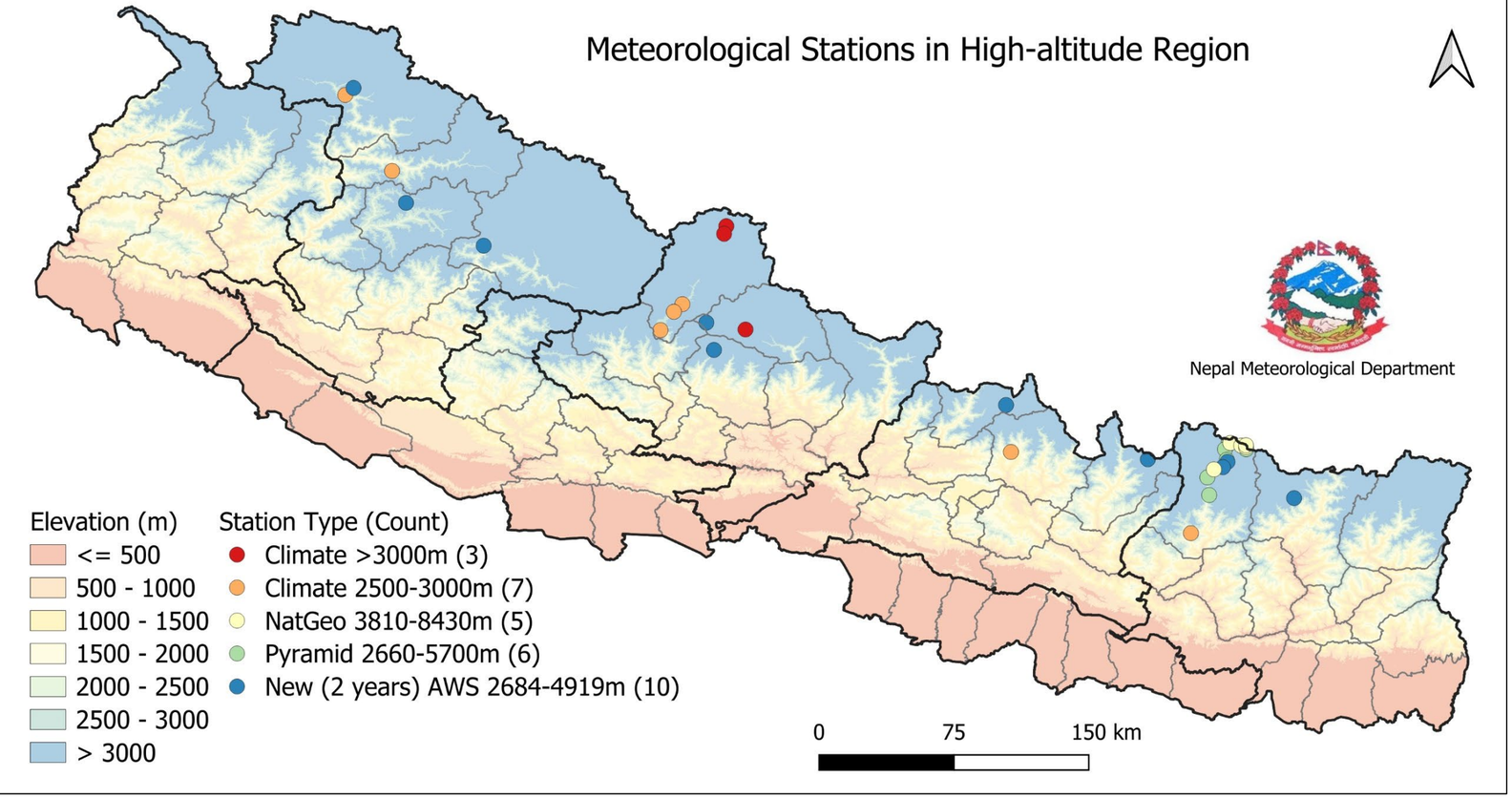
Station Temperature Trend in High Himalayas: Higher than Nepal Average Trend (°C/Year)

Annual and Seasonal Average Temerature (Tmean) Trend (1971-2024) of Stations in elevation >2500m

Stations	Elevation (m)	Data availability (no. of year)	Winter		Pre-monsoon		Monsoon		Post-monsoon		Annual	
			α	Trend	α	Trend	α	Trend	α	Trend	α	Trend
Changri_Nup_Pyramid	5700	6	ns	0.078	ns	0.019	**	0.081	**	0.081	**	0.060
Chhoser	3884	20	ns	0.055	ns	0.006	**	0.083	*	0.060	**	0.047
Chialsa	2770	27	**	0.154	**	0.092	**	0.100	**	0.161	**	0.131
Humde	3401	10	*	0.066	ns	0.010	**	0.094	**	0.056	**	0.059
Kala_Patthar_pyramid	5600	14	*	0.113	ns	0.006	**	0.085	**	0.091	**	0.062
Lete	2617	27	ns	0.057	ns	0.017	**	0.088	**	0.071	**	0.060
Lomangthang	3705	22	**	0.114	*	0.067	**	0.093	**	0.112	**	0.100
Lukla_pyramid	2660	15	**	0.122	*	0.065	**	0.106	**	0.120	**	0.102
Namche_pyramid	3570	17	**	0.094	ns	0.016	**	0.090	**	0.095	**	0.062
Pheriche_pyramid	4260	21	ns	0.072	ns	0.023	**	0.076	**	0.084	**	0.049
Pyramid_AWS_1	5035	23	**	0.122	ns	0.011	**	0.075	**	0.083	**	0.062
Rara	2989	38	ns	0.046	ns	0.034	**	0.071	ns	0.059	ns	0.039
Sarmathang	2574	17	**	0.138	**	0.126	**	0.119	**	0.130	**	0.132
Simikot	2993	27	**	0.167	ns	0.060	**	0.087	**	0.141	**	0.099

Note: α – Significance, Significant: * - 95% CL, ** - 99% CL, not significant - ns

- Station above 5000m with long term data closest to Rasuwa district I kalapathar and Namche pyramid stations. These stations shows 0.085 to 0.90 oC/year increase in monsoon
- Sarmathang, Sindhupalchok, at elevation 2900m is closest station with long term data. This shows 0.119°C/y
- Khadka et al 2023 shows Langtang Region glacier is more sensitive to temperature increase than other glaciers of Nepal



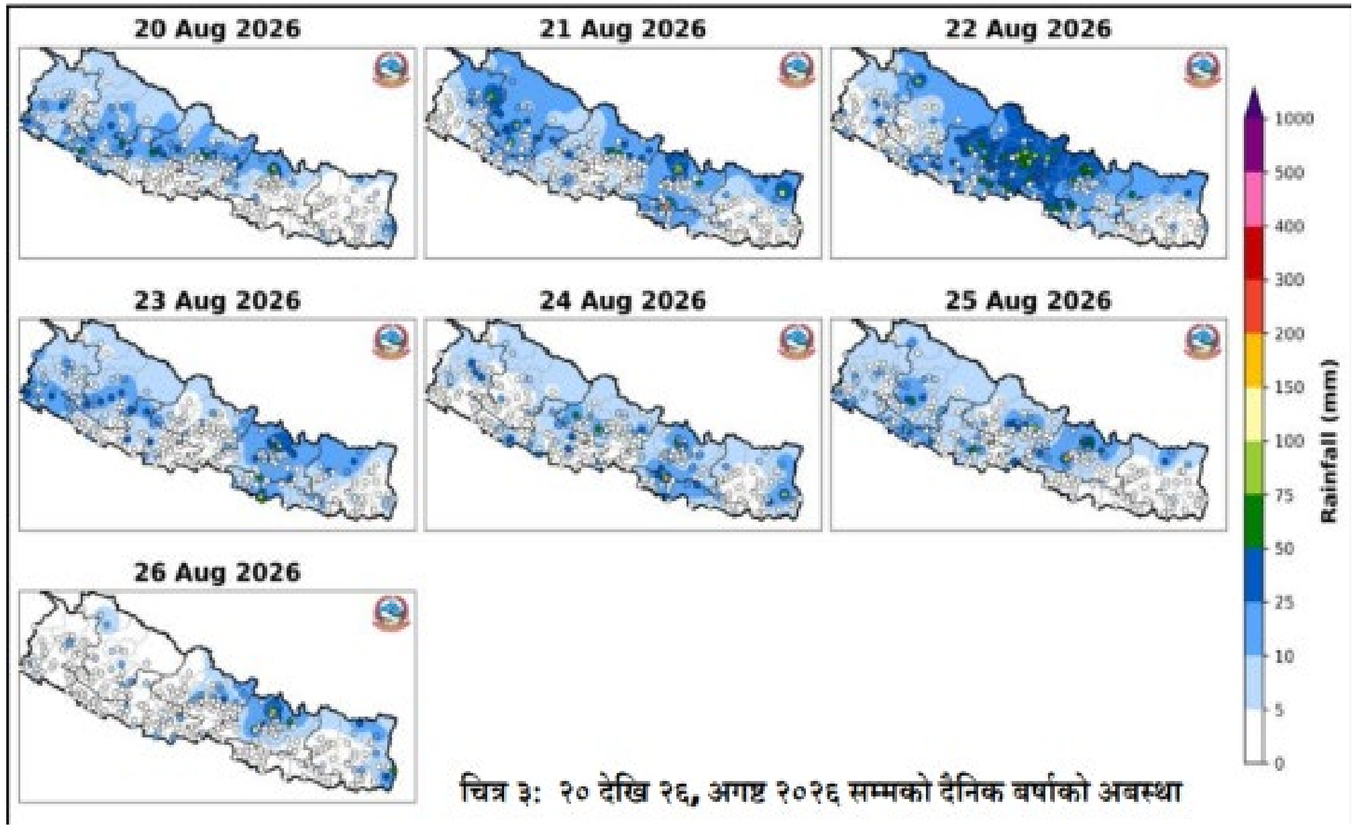
S.No.	Name	Elevation (m)	type
1	Changri_Nup	5700	Pyramid Program, Solukhumbu
2	Kala_Patthar	5600	
3	Pyramid_AWS	5035	
4	Pheriche	4260	
5	Namche	3570	
6	Lukla	2660	

S.No.	Name	Elevation (m)	type
1	Phortse	3810	National Geographic Society
2	Everest Base Camp	5315	
3	Everest Camp II	6464	
4	Everest South Col	7945	
5	Everest Balcony	8430	

S.No.	Name	District	Elevation (m)	type
1	Chhoser	Mustang	3884	Climate (>3000)
2	Lomangthang	Mustang	3705	
3	Humde	Manang	3401	
4	Simikot	Humla	2993	Climate (2500-3000)
5	Rara	Mugu	2989	
6	Chialsa	Solukhumbu	2770	
7	Jomsom	Mustang	2741	
8	Thakmarpha	Mustang	2655	
9	Lete	Mustang	2617	
10	Sarmathang	Sindhupalchok	2574	

S.No.	Name	District	Elevation (m)	type
1	Dingboche	Solukhumbu	4339	AWS New
2	MachhapuchhreBaseCamp	Kaski	3700	
3	Kyangjing	Rasuwa	3850	
4	Hurikot	Dolpa	2684	
5	DanpheLek	Jumla	>3500	
6	Beding	Dolkha	3704	
7	Pangboche	Solukhumbu	4002	
8	Panchamukhi	Humla	3933	
9	Siptan La Pass	Solukhumbu	4259	
10	Tilicho	Manang	4919	

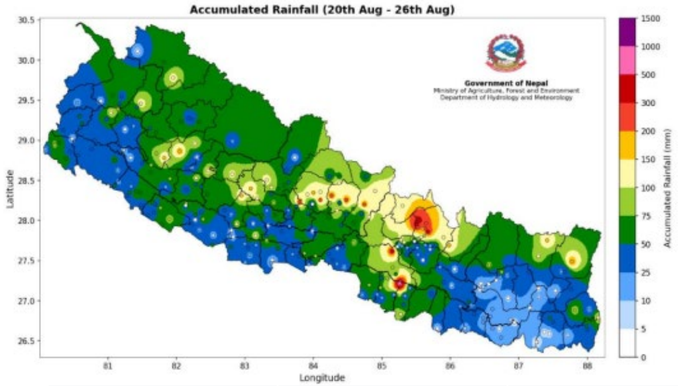
Observed rainfall from 20 Aug -26 August, 2026



चित्र ३: २० देखि २६, अगष्ट २०२६ सम्मको दैनिक वर्षाको अवस्था

Many locations in the Himalayan and hilly areas of Bagmati Province received approximately 100–500+ mm during 20–26 August. At Dhunche, the highest daily rainfall during 20–26 August was approximately 68.1 mm on 22 August; Thamachit recorded about 32 mm.26 August rainfall at Dhunche was 29.8 mm and at Thamachit was 6.8 mm.

Kyanging (≈3,850 m) recorded 21.6 mm on 22 August but only 1 mm on 26 August.Kyanging temperature during the week ranged from 6.2°C to 14.5°C.



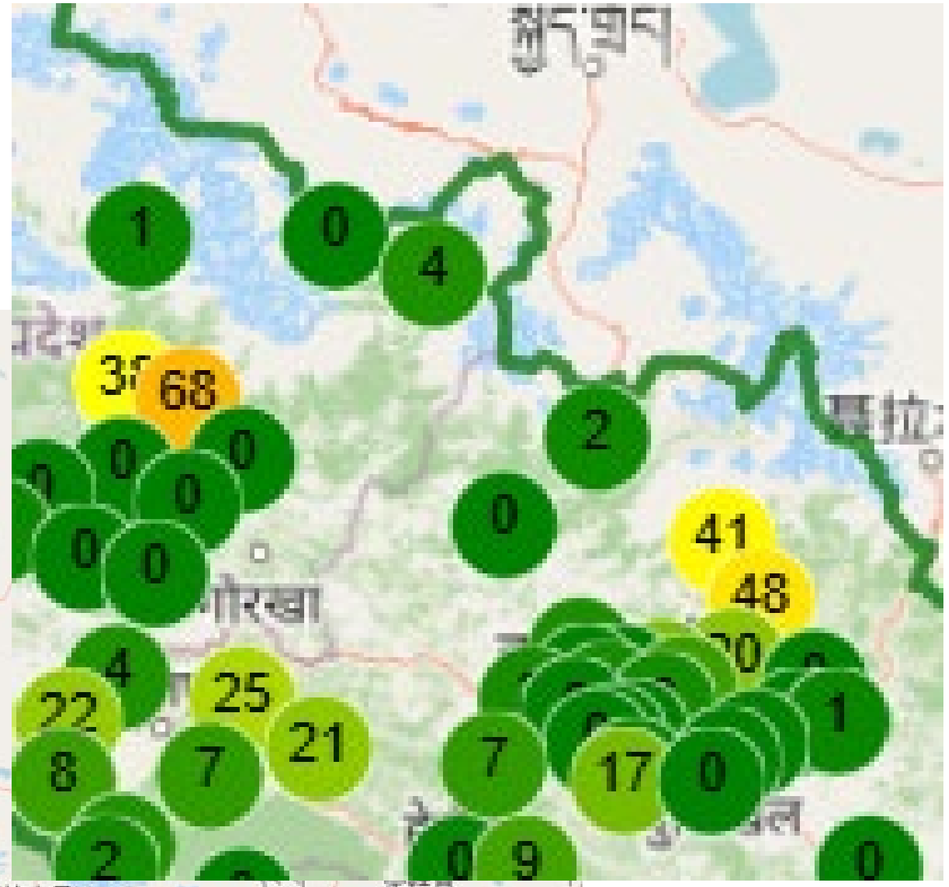
Station	District	Rainfall (mm)
Dhunge	Sindhupalchok	114.6
Take Ghyang	Sindhupalchok	83.6
Chandan	Sindhupalchok	63.4
Barhabise	Sindhupalchok	51.6
Bhotang	Sindhupalchok	27.6
Duwachaur	Sindhupalchok	16.0
Nawalpur	Sindhupalchok	6.0
Kakani	Nuwakot	6.2
Dhunche	Rasuwa	29.8
Thamachit	Rasuwa	6.8
Kyanging	Rasuwa	2.2

24-hour rainfall observations at approximately 8:45 AM, 26 August 2026

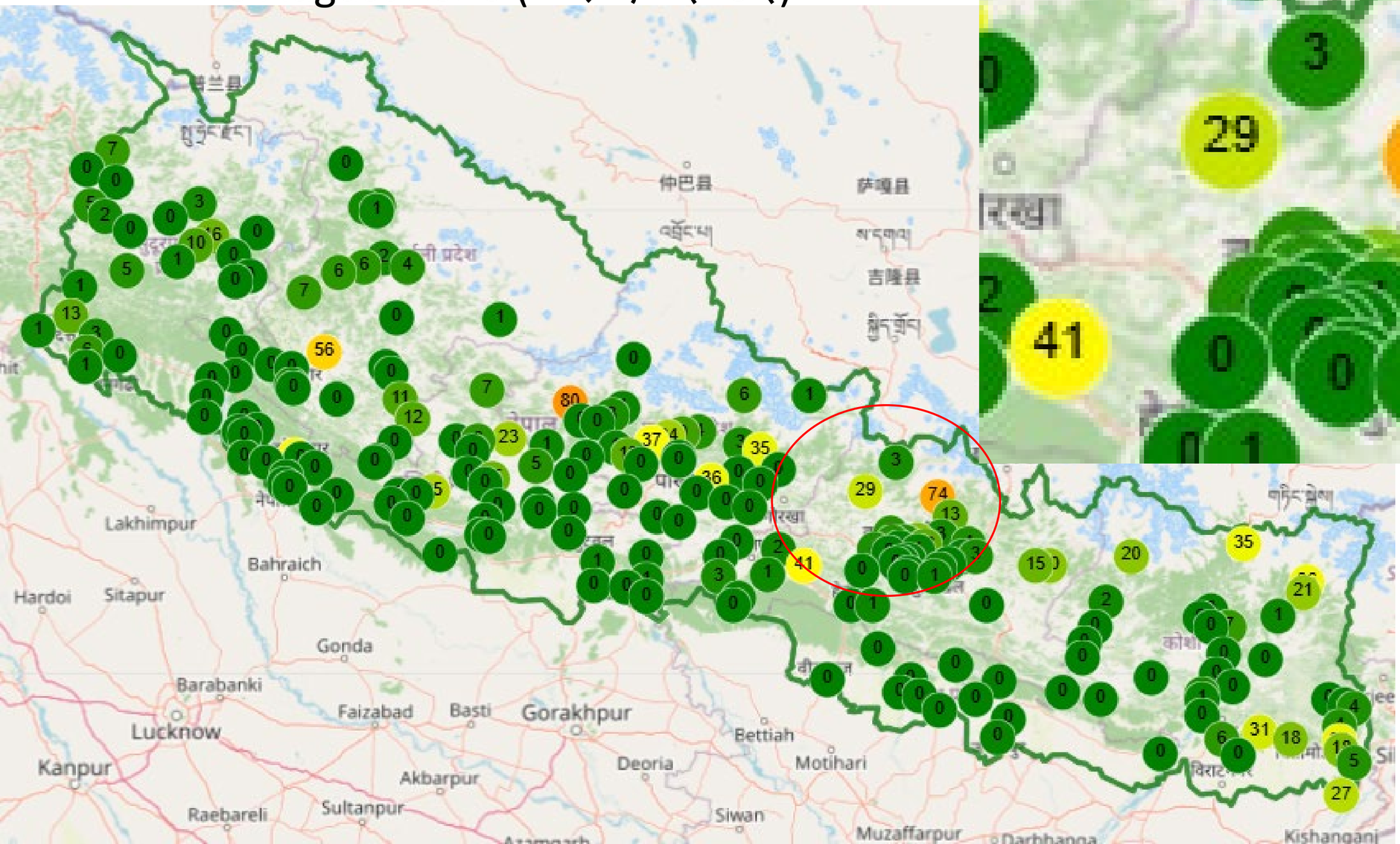
Bhotekoshi Flood Event

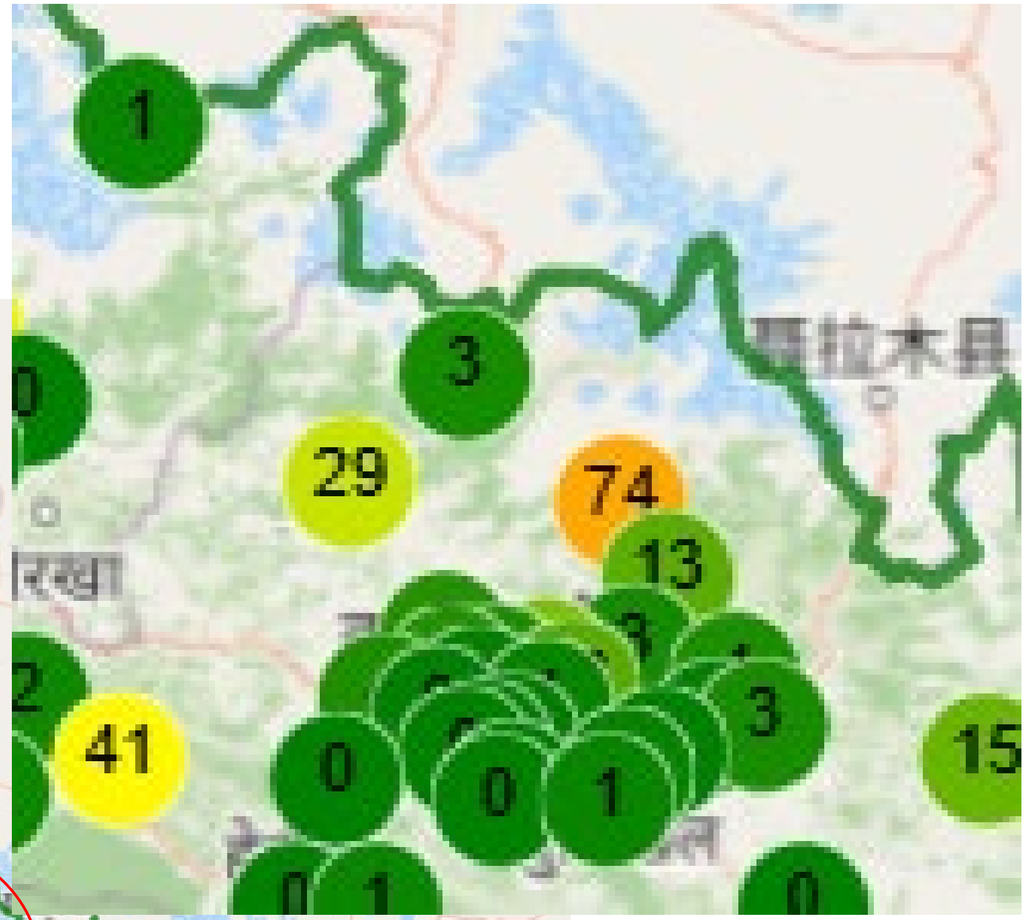
25 August 2026 (भदौ ९ २०८३)





26 August 2026 (भदौ १० २०८३)





Synoptic Conditions and Satellite image Analaysis

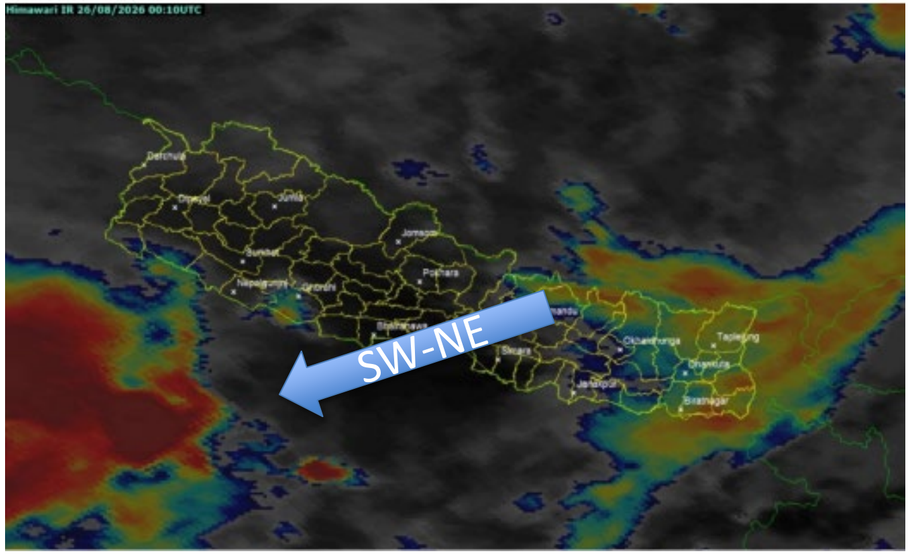
Monsoon Trough was in its normal position.

On the morning of 26 August, a Low-Pressure Area was located around northern Odisha, Jharkhand and West Bengal, India.

An upper-atmospheric Western Disturbance was located around 70°E and 28°N.

These conditions indicated a possibility of isolated heavy rainfall, particularly during nighttime and morning hours.

Active monsoon conditions, widespread antecedent rainfall and relevant synoptic-scale systems were observed.

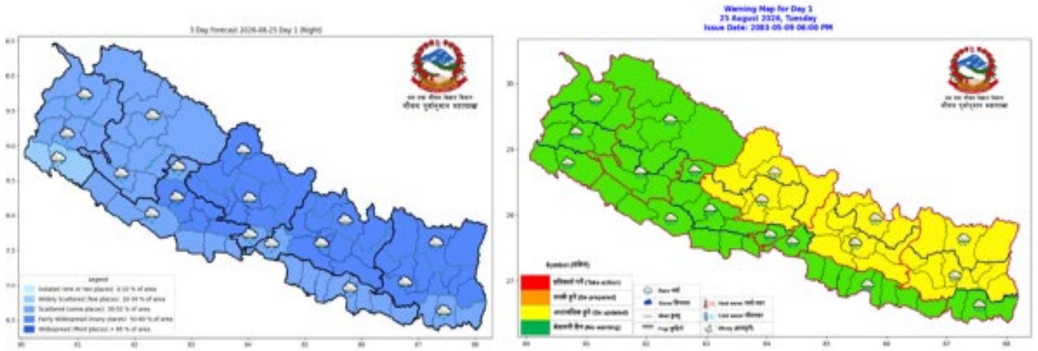


Himawari observation at 5:55 AM, 26 August 2026

Image analysis shows generally cloudy condition throughout the country and cb cloud movement was from northeast to southwest in morning hour .The sky gradually became clearer, with partly cloudy conditions at afternoon.

Weather Forecast Issued by NMD with rainfall and warning m

Forecast time	Forecast
25 Aug, 6:00 PM	Moderate rainfall with thunderstorms/lightning with at few hilly areas of Koshi Province, Bagmati Province, Gandaki Province and Lumbini Province; chances of heavy rainfall at one or two locations of hilly and mountainous region of Koshi Province, Bagmati Province and Gandaki Province.
26 Aug, 6:00 AM	Moderate rainfall with thunderstorms/lightning with at few hilly areas of Koshi Province, Bagmati Province, chances of heavy rainfall at one or two locations of hilly and mountainous region of Bagmati Province and Gandaki Province.



Flash Flood Disasters Occur in Northern Nepal

Updated 26 Aug 2026 10:05 UTC Views: 80

Global Disaster Weather Monitoring and Forecast News
Producer: Huo Da Bao Yuanyuan Checker: Dai Kan **2026** 年 **08** 月 **26** 日 **18** 时

Flash Flood Disasters Occur in Northern Nepal

Influenced by the southwest monsoon and orographic lifting along the southern foothills of the Himalayas, Nepal has experienced per the past 10 days, with accumulated precipitation reaching heavy rain to intense rain levels (Figure 1). Additionally, driven by a plateau trou China (upstream of Nepal) has seen moderate to heavy rain, with localized heavy to intense downpours. As a result of both local and disasters such as flash floods and debris flows struck northern Nepal on August 26. Over the next three days, a monsoon depression loc India (Figure 2) is expected to continue bringing moderate to heavy rain to Nepal, with heavy to intense downpours in the south (Fig advised against potential secondary disasters—including flash floods, landslides, and debris flows—that may be triggered again by th precipitation.

累计降水

Factors That may have Triggered

- 2015 earthquake shaking may have weakened the underlying rock mass over the long term,
- Warming and permafrost degradation likely weakened the source rock wall by increasing bedrock temperatures and thawing ice within fractures
- Glaciers in the region have been losing mass for decades at a rate equivalent to more than half a metre of thinning per year. Since 2010 the rate of recession of the Langtang-Lirung glacier extent has accelerated, increasing from 0.5% per annum over the previous two centuries to 1-2.3% per annum in the past 16 years.
- Precipitation can provide an additional short-timescale forcing. Intense or prolonged rainfall can therefore rapidly increase water supply to fractures and potentially increase fracture-water pressure.
- Unusually warm conditions before the failure, supporting enhanced snow and ice melt and more precipitation falling as rain rather than snow.



Source: https://www.worldweatherattribution.org/rapid-warming-in-the-himalaya-exacerbates-geohazard-cascades-beyond-adaptation-limits

Information Dissemination, Inter Agency Coordination and Operational Response

440
Phone calls received (Toll-Free 1155)

52
Media interviews / briefings

2
Video presentations (Facebook Live)

16
Social media posts (Facebook/Twitter)

Special monitoring of weather conditions in affected and surrounding districts began after information about the event was received.

Forecasts, warnings and other information were disseminated through social media and other communication channels.

Coordination with NDRRMA and participation in high-level disaster-response meetings.

Weather briefings for the Civil Aviation Authority of Nepal, helicopter operators and other aviation stakeholders at the Rescue Coordination Centre.

Participation in meetings chaired by the Ministers for Home Affairs and Agriculture, Forestry and Environment.

Coordination with the Ministry of Foreign Affairs concerning information communication with the Government of China.

Coordination with the Ministry of Home Affairs, Ministry of Energy, Water Resources and Irrigation, and the Office of the Prime Minister and Council of Ministers.

Discussion between DHM and Chinese Meteorological Administration (CMA)

Impact of Bhotekoshi Flood event

The flood flowed through the Bhotekoshi River and caused significant loss of life and property and different sectors in Rasuwa, Nuwakot and Dhading districts.

- Energy & Hydropower Sector
- Commercial, Business & Industry Sector
- Tourism
- Transportation & Cross-Border Links and Trade
- Agriculture, Livestock & Fisheries
- Land & Crop Degradation:
- Livelihood Loss
- Social Infrastructure (Education & Public Facilities)

Cascading mountain risk

UPSTREAM TRIGGER

- Extreme rainfall
- Cloudbursts
- Glacial lake / ice or rock failure
- Landslide / debris flow

CASCADING PROCESS

- Slope failure
- River blockage / sudden release
- Sediment + debris transport
- Channel avulsion

DOWNSTREAM CONSEQUEN

- Bridge / road failure
- Hydropower disruption
- Settlement flooding
- Isolation of communities

SYSTEMIC IMPACT

- Loss of access
- Service interruption
- Livelihood losses
- Long recovery

Impact of Bhotekoshi Flood event

Rasuwa Flood: Search, Rescue, and Relief Update

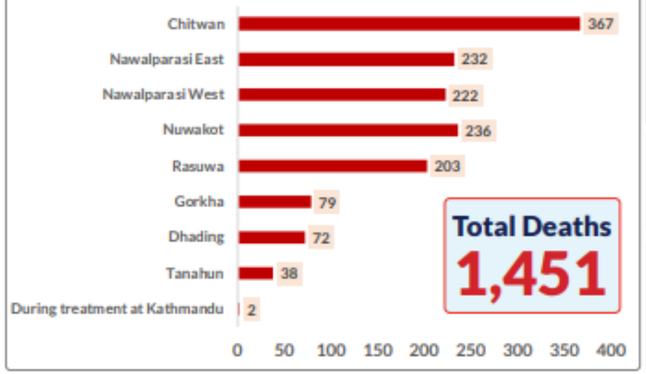
Date: 21 September 2026 Time: 07:00PM

This data has been prepared based on the information received from the District Administration Offices and National Emergency Operation Centers.

Government of Nepal
Ministry of Home Affairs
National Disaster Risk Reduction and Management Authority
Singhadurbar, Kathmandu

Human Casualties

including various unidentified human remains



Total Deaths 1,451

Treated

- Currently, **12** people are undergoing treatment at **4** different hospitals.
- Medical treatment provided by various security forces: **10,365**

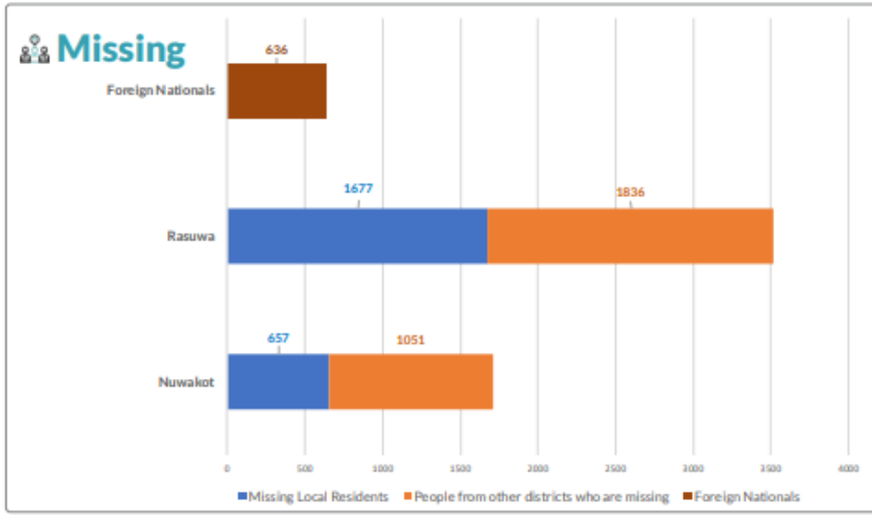
Nepal Army Helicopter Flights **11** flights conduct to affected areas today

Total Rescued 13,784

DNA samples collected 1,286 Deaths **1,997** Relatives

Details of the deceased **336** Female **585** Male **530** Human body remains

Missing

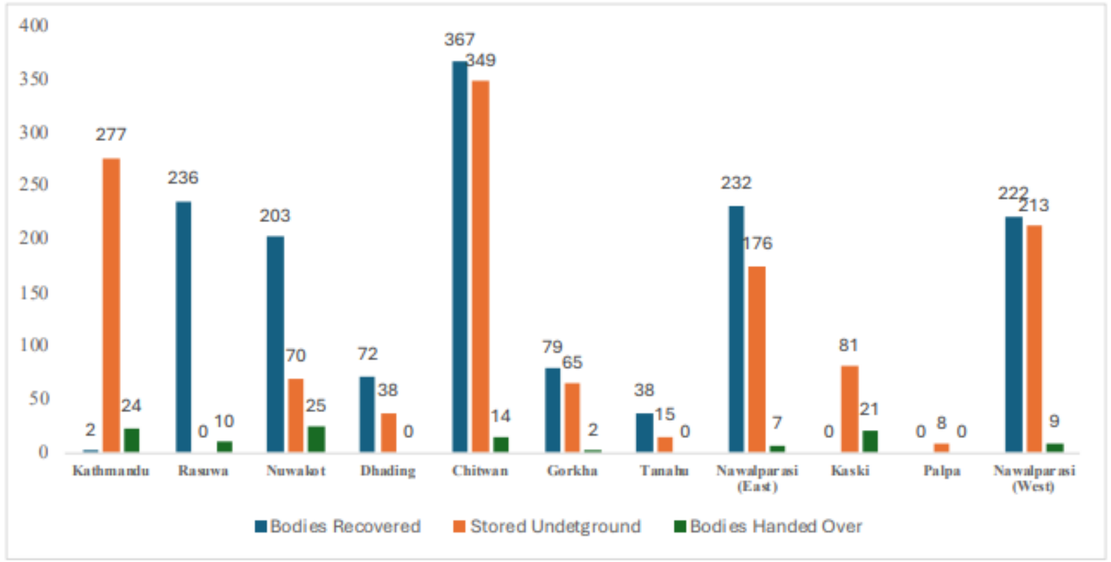


Total Missing 5,745

** The no. of dead body handover i.e 112 has been deducted from the total count of missing persons*

District-wise rescue and dead bodies management

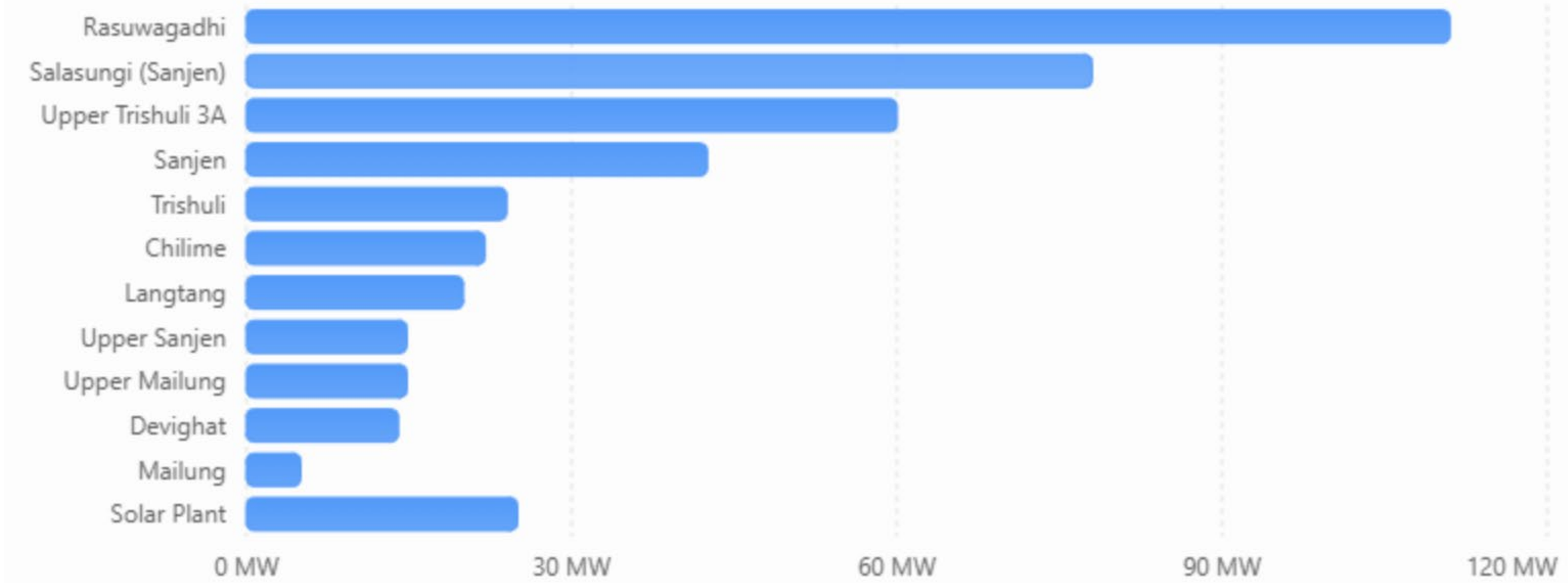
- Total Recovered/Rescued Bodies: 1,451
- Safely Stored Underground: 1,292
- Handed Over to Families: 112



Comparison of District-wise Recovered Bodies and Underground Safe Storage

Hydropower and Solar Projects Affected by Flood

Installed capacity of affected projects in MW.



Why early warning alone is not enough

- Saving lives and property requires joint effort from every sector, coordination among disaster focused authorities,agencies, local governments and general public.
- Forecasts and early warning provided must be reliable accurate to increase trustworthiness in general public and with sufficient time period for general public to take action.
- It must be disseminated through reliable sources as information may come through different sources and coordination within concerned officials are must.
- Unverified information from multiple sources can cause panic among people during a disaster.
- During the Bhote Koshi flood, SMS warnings were sent out, but many people doubted the severe flood level as they had never experienced one like it. Some went to flood-prone areas to record photos and videos, which led to higher casualties..
- Public responsiveness to weather warnings is essential, as individuals must take immediate action

Risk-sensitive land-use planning and Ecosystem-based risk reduction

- Maping risks of multi-hazards like flood, landslide, debris flow, river blockage, GLOF paths.
- Site-specific hazard assessment for major and critical infrastructures required.
- Linking municipal land-use plans, building permits and infrastructure budgets to the same risk maps and standards.
- Protecting Forests, wetlands, floodplains and natural river corridors can reduce runoff, erosion and sediment deliverythat temporarily store water and sediment.
- Restoring degraded slopes using locally appropriate vegetation, contour measures, check structures and bioengineering.

Impact Based Forecasting and Community preparedness

- Combined rainfall, river level, radar/satellite, terrain, landslide susceptibility, GLOF inventories, infrastructure and exposure data, with updated thresholds, susceptibility maps and infrastructure vulnerability and develop impact-based thresholds: not only “how much rain?” but “what will this rainfall likely do to roads, bridges, rivers and settlements?”
- Not only Warnings but also prepared communities with actions evacuation maps, safe routes, shelters.
- Trained disaster volunteers with priority to women, older people, persons with disabilities, children.















Summary

1. Global warming induced climate change already affecting Nepal.
    1. Rainfall intensity increase over the northern Nepal (Himalayas, with fragile geomorphology)
    2. Glacier melt in the Himalayas and decreasing snow cover
2. Investment in Himalayan Climate Monitoring and Analysis System (Quality Data)
    - Multi-hazard early waning system
    - Mountain climate research to understand climate systems and their changes
3. **Climate-Resilient Infrastructure Engineering and Sustainable Development of Nepal:**
    1. Implement National Framework for Climate Services (realtime data to short term forecast to seasonal prediction and Climate Projection)
        a. Energy
        b. Water Resources
        c. Agriculture
        d. Disaster Mitigation
        e. Health
    2. Co-Production and collaboration with these thematic stakeholders
4. Upcoming very strong El-Nino event
5. Glacier monitoring (in situ, remote sensing and AI) Glaciologist with climate science background)

Thank You

Speaker



Manish Shrestha

Hydrologist,ICIMOD



Changing Scenario of Disaster Risks in the Hindu Kush Himalaya

Cascading Flood Risks in Mountain Regions: Early Warning, Governance and Resilience

Manish Shrestha

Date: October 2026

Headlines

THE KATHMANDU POST

Flood washes away Nepal-China border bridge at Rasuwagadhi

AP

Heavy rain and flooding kill at least 62 in northern India

The Bhutan Live

Over 70 Families Displ… Reuters …ods Ravage Phuentshoglin…

BY THE BHUTAN LIVE · JUNE 30, 2026 · 2 MINUTE READ

Nepali Times

Death toll rises in Nepal flood

Children among the most affected, with at least 102 orphaned

Reuters

Floods, landslides kill 56 in India and 14 in Nepal

…lake drainage triggered Nepal, climate body says

ThePrint

At least 34 dead in India's north… September 27, 2026 …ods

REUTERS 02 June, 2025 01:00 pm IST

REUTERS Follow

Heavy rain and flooding kills 82 across India, Pakistan and Afghanistan

Reuters
Thu, July 23, 2026 at 1:37 PM GMT+3:45

Bangladesh floods leave 23 dead, 5.7 million people affected

BBC

People 'jump from roof to roof' as floods kill 148 in Nepal

ALJAZEERA

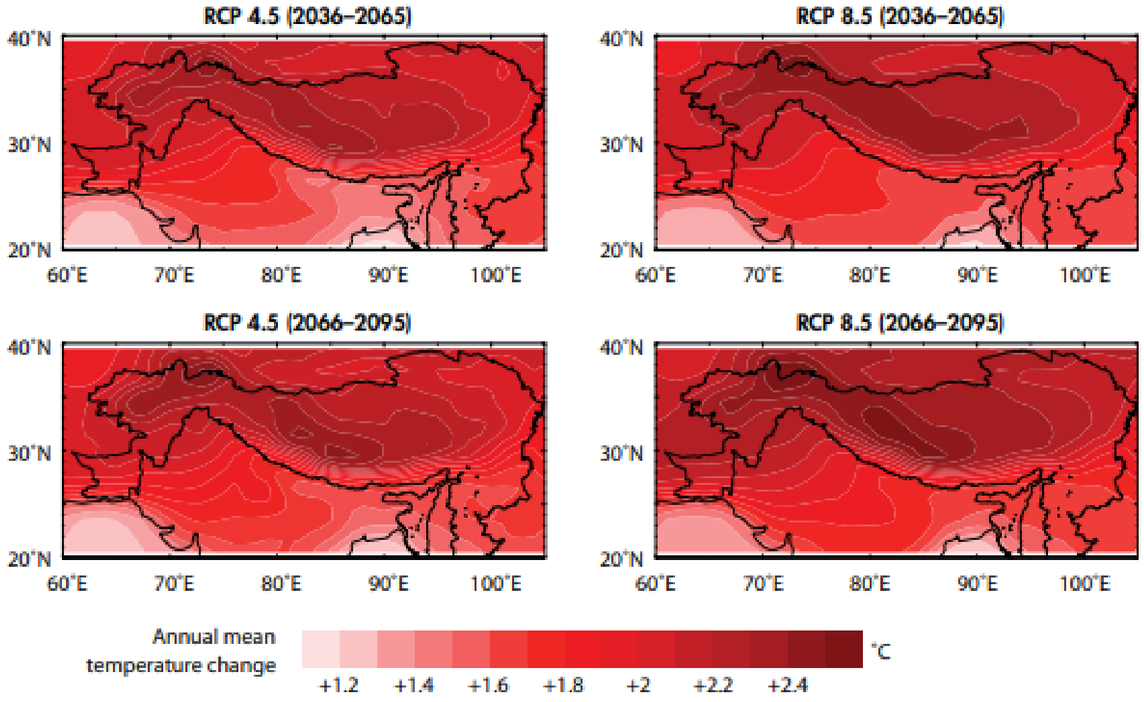
Two million impacted as Pakistan's Punjab faces worst floods in its history

World

Floods in Bangladesh kill 44, leave over a million stranded

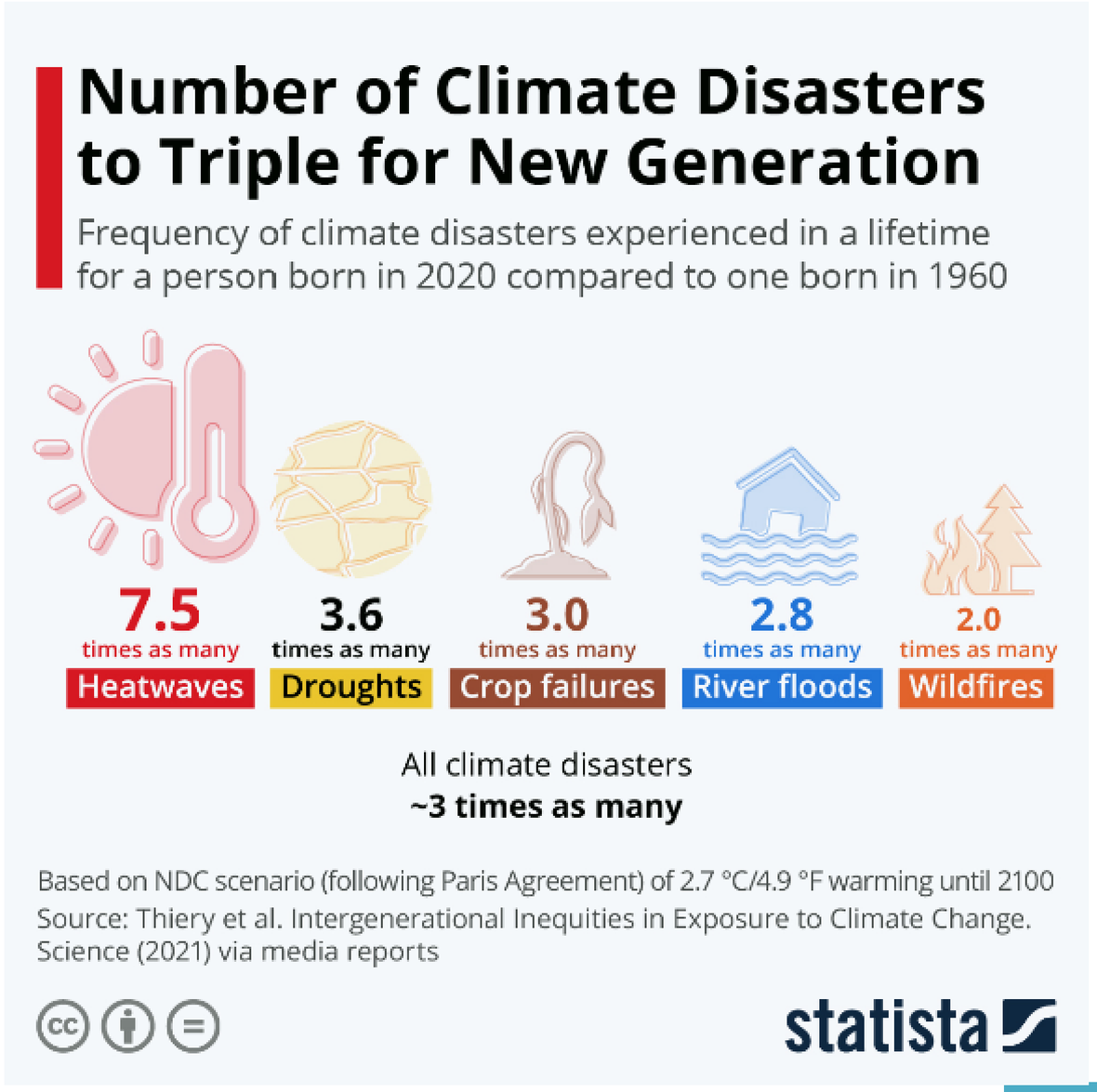
REUTERS 11 July, 2026 07:30 pm IST

What future behold for HKH?



THE HKH WILL WARM MORE THAN THE GLOBAL MEAN AND MORE RAPIDLY AT HIGHER ELEVATIONS

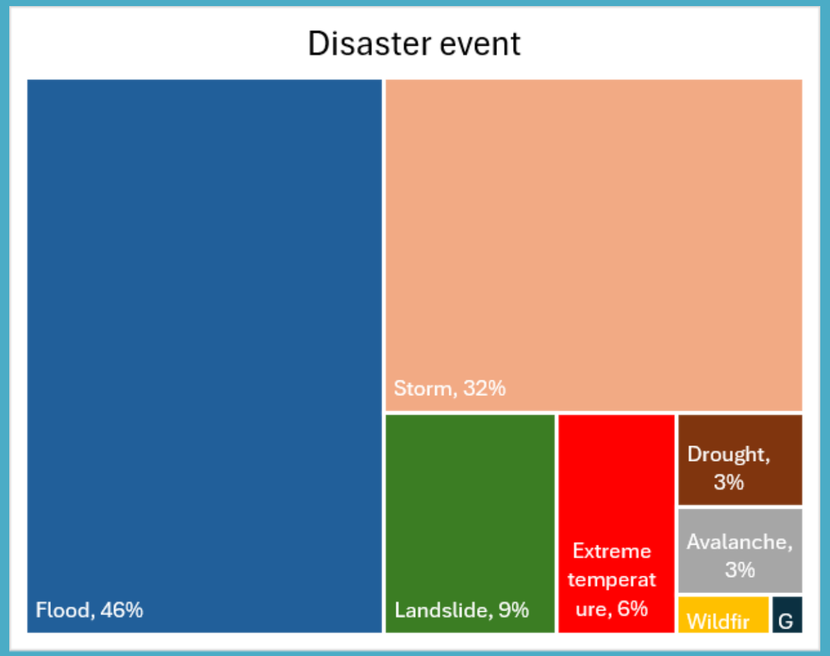
Even if global warming is limited to 1.5°C by the end of the century, the Hindu Kush Himalaya will warm by around 1.80°C.

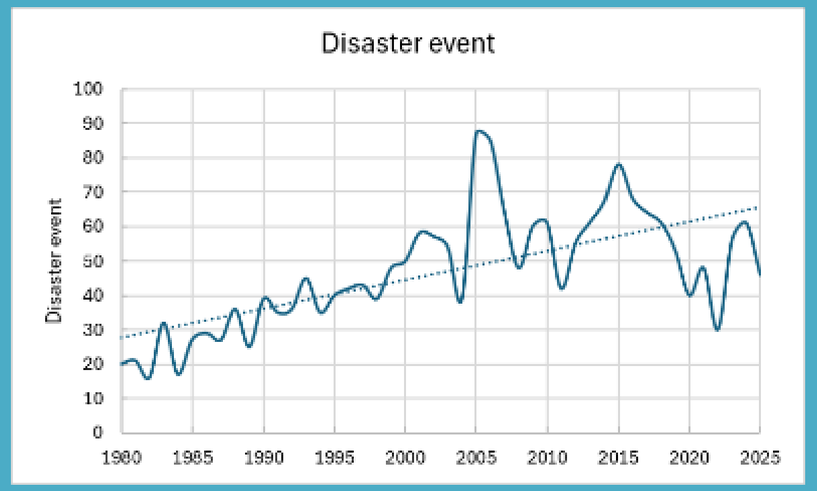


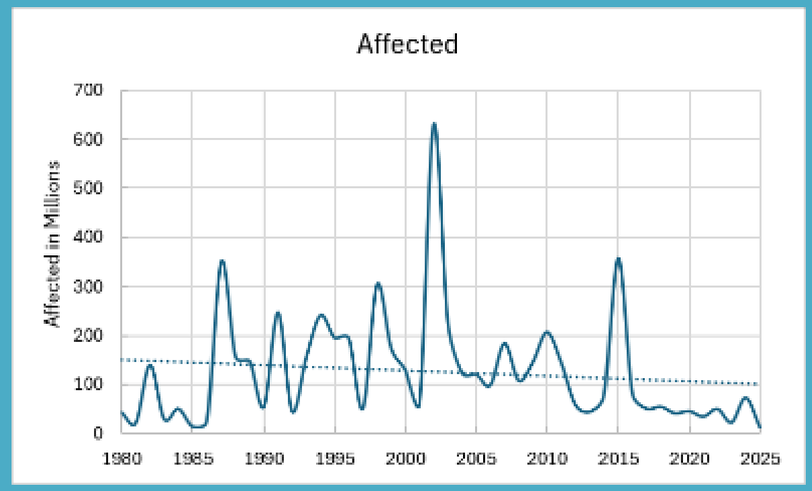
Disaster trend in the HKH member countries



	Event	Death	Injured	Affected	Damage
1986-2005	864	272085	1.17 M	3.63 B	B$ 447.6
2006-2025	1148	231470	0.21 M	1.88 B	B$ 684.8





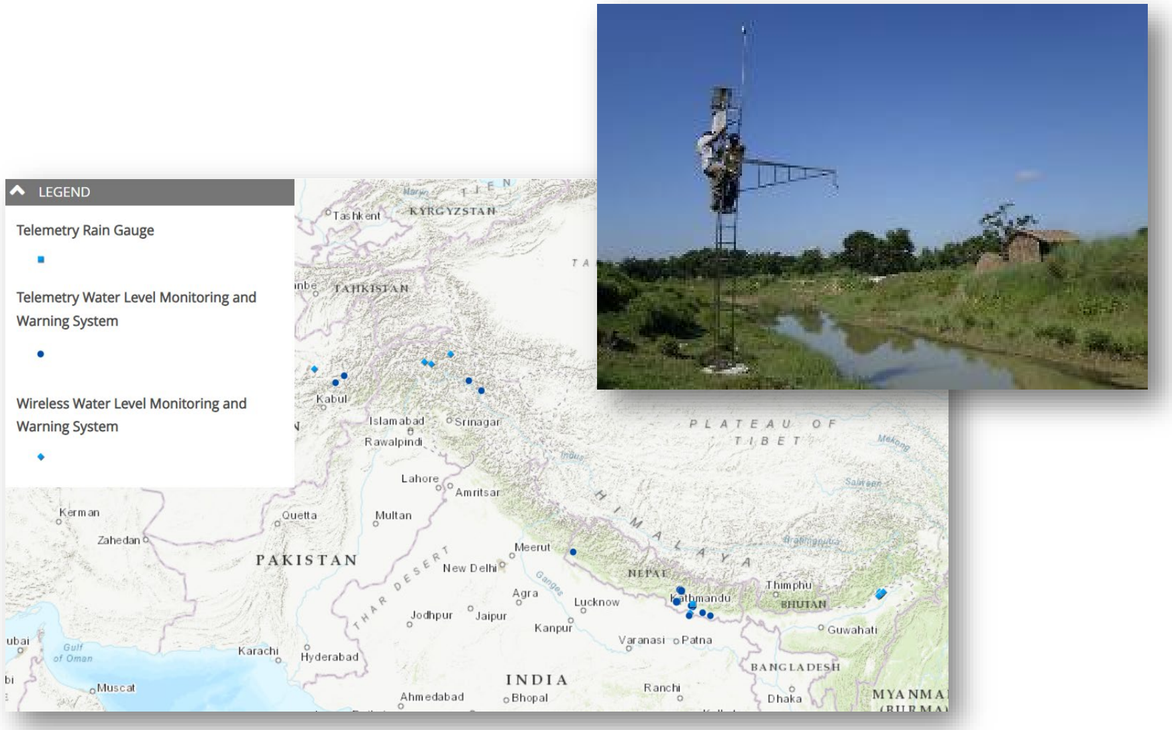


Data source: EM-DAT

ICIMOD’s Experience in flood management

Community based flood early warning system (CBFEWS)

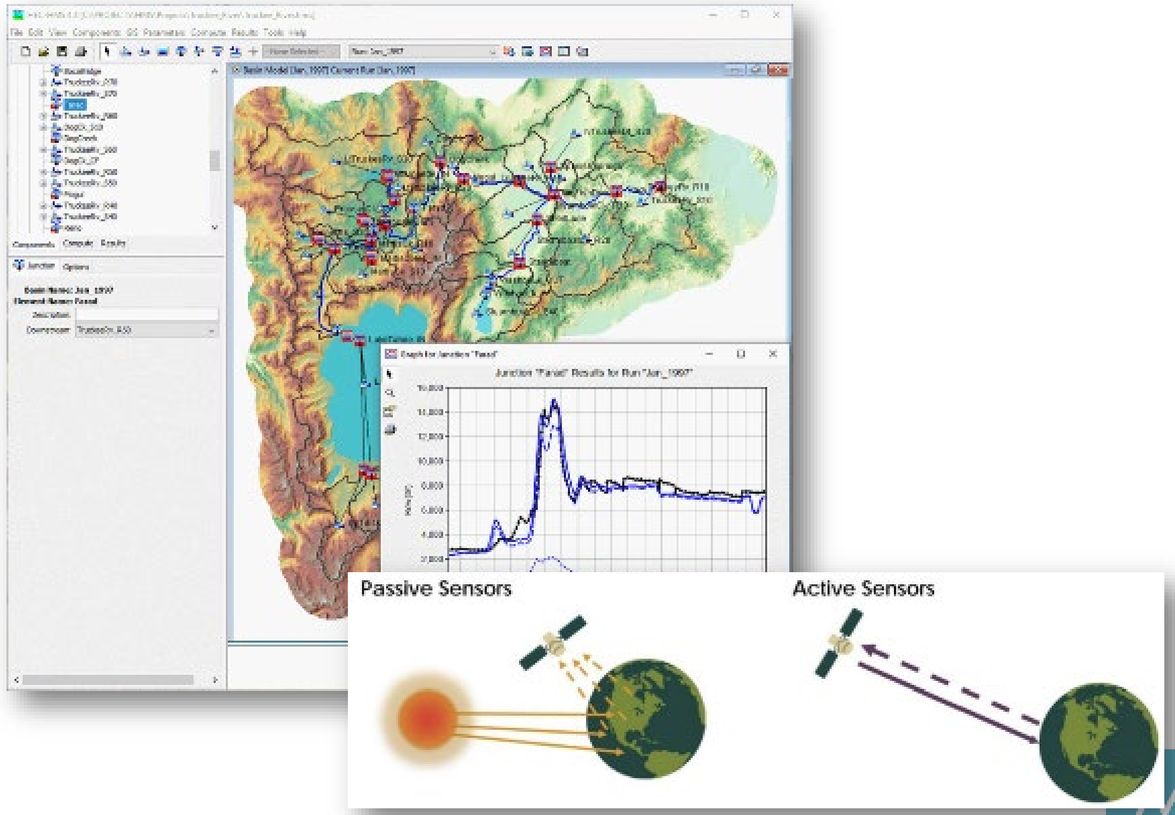
US/DS community linkages



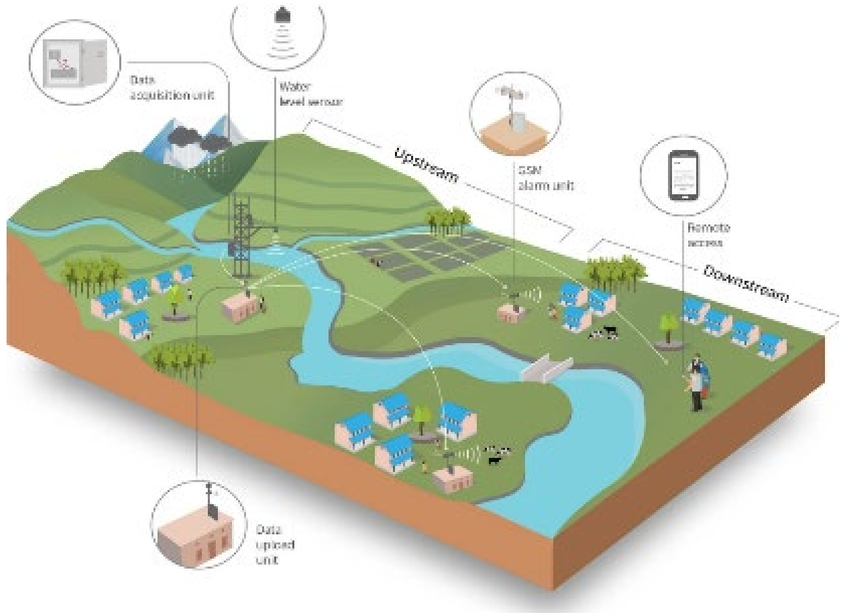
Modeling based

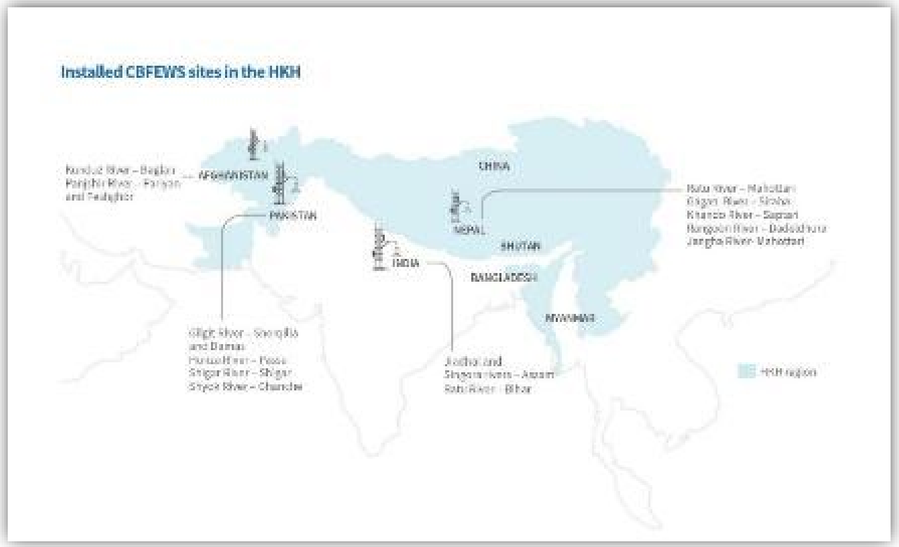
Hydrological model

Earth observation, RS and ML



Community Based Flood Early Warning System (CBFEWS)





Three components:

Water level sensor unit at the riverbank upstream

Data upload unit at a caretaker's house

GSM alarm unit downstream for the communities.

The lead time - ranges from 30 minutes to a few hours

Success stories

Pakistan Government
Credits CBFEWS for Zero Loss of Human and Animal Lives in Sherqilla Floods





Nepal - India data sharing
An example of local level cross border cooperation



Thousand of lives saves at Khando river



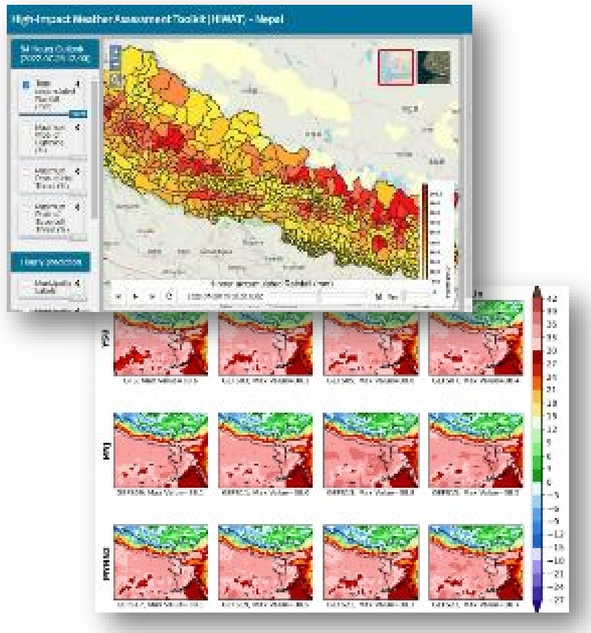


Karonga, Malawi



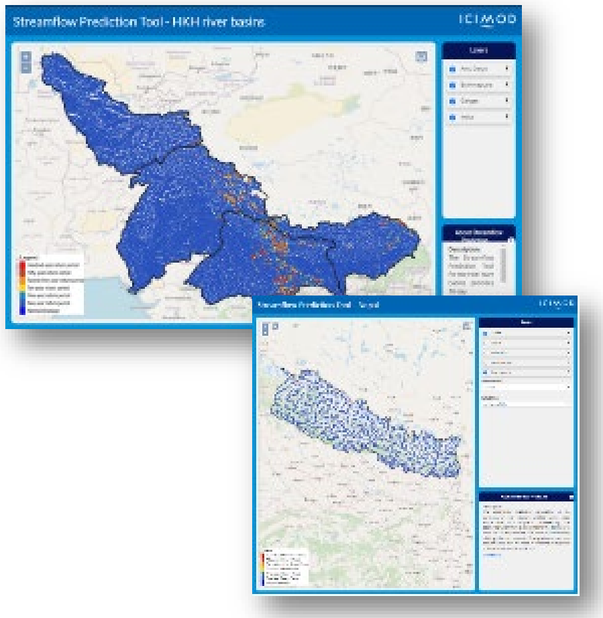
Modeling based flood management services

HIWAT



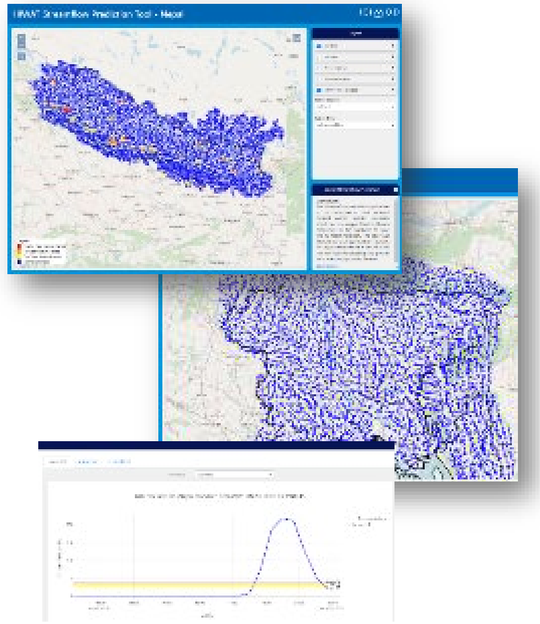
- Weather forecast – 2 days
- Rainfall, temp, lighting etc.
- 12 ensemble

Streamflow Prediction Tool



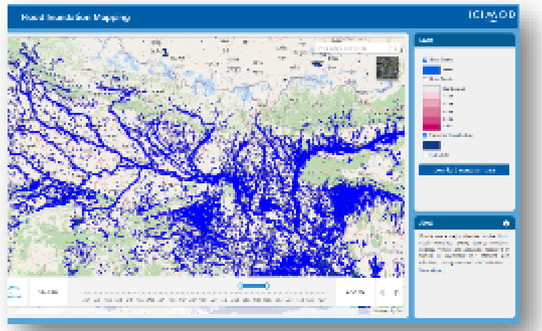
- 10 days lead time
- ECMWF rainfall and runoff
- 52 ensemble

Flash Flood Prediction Tool



- 2 days lead time
- HIWAT rainfall
- Localized flood

Flood Inundation Mapping



- Flooded and non flooded area
- SAR data- penetrate cloud
- Machine Learning algorithm

Seasonal outlook





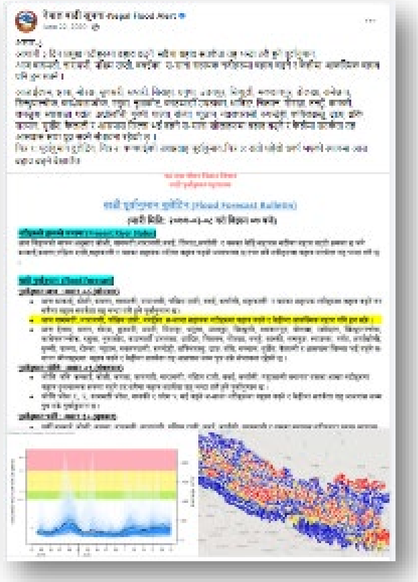
Use cases

ICIMOD

National Level
BMD, DHM, FFWC, PMD, NCHM, NDRRMA

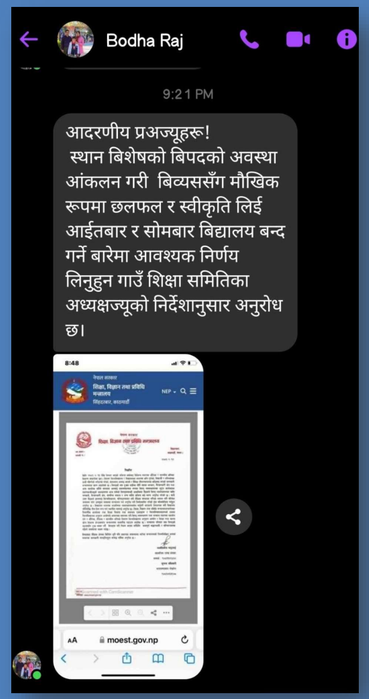
Community Level
DRR Focal person, Red cross, Start fund Nepal, School, Communities





Chief Education Officer Mr. Bodh Raj Pathak, used the *SERVIR app* to notify school principals about closures. He directed schools to remain closed on Sunday and Monday.

"During last August's flooding, I monitored ICIMOD's HIWAT, Streamflow Prediction Tool, and data from national agencies to decide on activation [distributing cash aid]," - Laxmi Awasthi DRR advisor for the Mercy Corps





Integrate into local curriculum

- Nepal’s Local Government Operation Act, 2017 empowers municipalities to design and implement their own school curricula.
- Benighat Rorang Rural Municipality - a chapter on EWS for Disaster Preparedness for grade 8 students.
- ToT for schoolteachers | 20–21 September 2024

Curriculum for Grade 8

कक्षा ८ को लागि पाठ्यक्रम

For children of age 12-13 year.

१२ - १३ वर्ष को बच्चाहरु को लागी

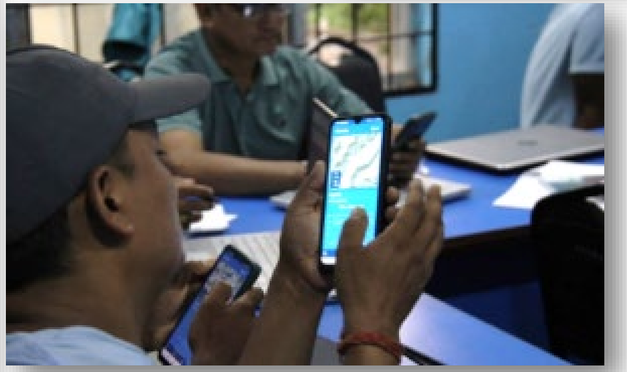
Early Warning System (EWS) for Disaster Preparedness

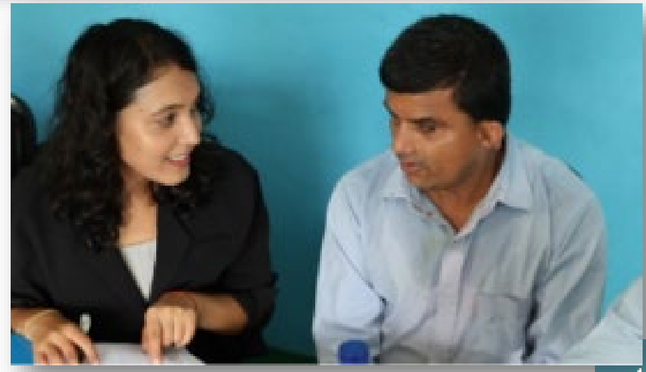
विपद् तयारीको लागि पूर्वचेतावनी प्रणाली

Natural disasters are powerful events in nature that can happen suddenly and can be very dangerous. They can disrupt our lives and the world around us. Disasters like floods, storms, wildfire, or earthquakes happen because of natural processes. For example, floods occur when water overflows on land that is usually dry, often due to heavy rainfalls, dam failures, or melting snow; and wildfires occur due to dry conditions and strong winds in forests or grasslands that can spread quickly.

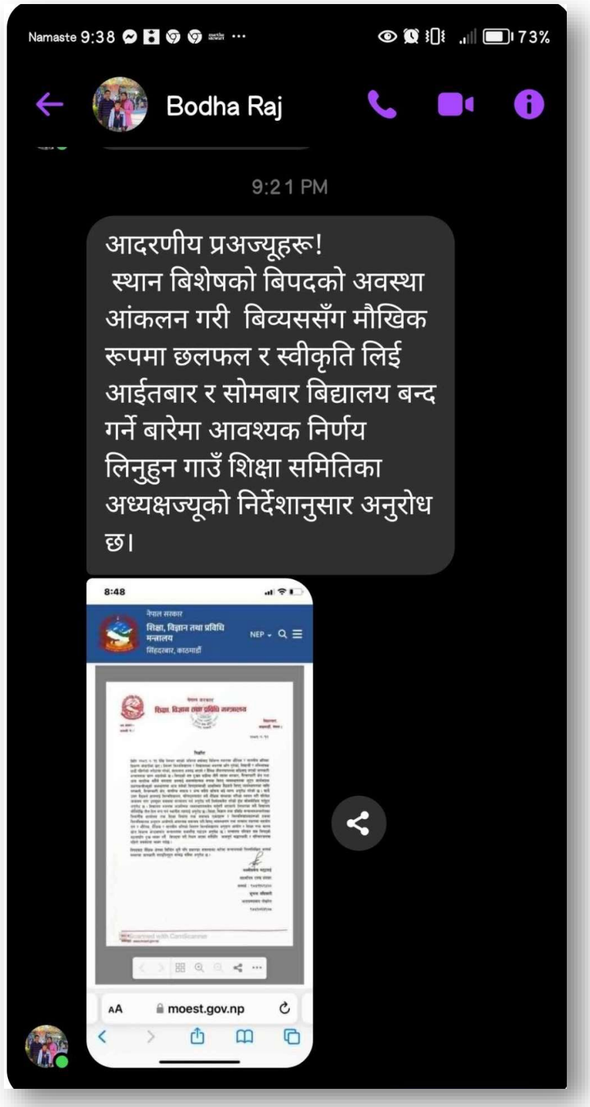
प्राय: प्राकृतिक विपदहरू शक्तिशाली स्वाभावका घटनाहरू हुन्छन् । जुन अचानक हुन सक्छन् र धेरै खतरनाक हुन सक्छन् । तिनीहरूले हाम्रो जीवन र हाम्रो वरपरको वातावरणमा बाधा पुऱ्याउन सक्छन् । बाढी, आँधी, वन डढेलो वा भूकम्पजस्ता प्रकोपहरू प्राकृतिक प्रक्रियाका कारण हुने गर्छन् । उदाहरणका लागि, भारी वर्षा, बाँध भत्किनु वा हिउँ पग्लनु कारणले गर्दा सामान्यतया सुख्खा जमिनमा अधिक पानी बग्न गई बाढी आउँछ । त्यस्ते जङ्गल वा घाँसे मैदानहरूमा सुख्खा अवस्था र बलियो हावाको कारणले डढेलो लाग्ने गर्दछ, जुन छिट्टै फैलिन सक्छन् ।







Theory to Action | September 2024



Municipality ordered school closer – 17000 benefited





Ward Chairperson evacuated staff and property after getting EW

Theory to Action | September 2024



Mr. Suraj Pandey, teacher relayed EW saving lives and properties along the Trisuli River



82-year-old Hemnath Thapaliya regularly uses the 'Prokop Alert' app and share information with his community.



Rajendra Tripathi
Schoolteacher/farmer used app for farming activities



Out scaling to other municipality

- ICIMOD received several request for developing similar curriculum from different municipalities.
- Chattar Jorpati RM, Dhankuta M, Dhunibensi RM, and Tilathi Koiladi RM.
- Scoping visit completed in 3 municipalities.



"धनकुटा नगर: स्वच्छ सुन्दर समुन्नत शहर"

धनकुटा नगरपालिका
DHANKUTA MUNICIPALITY
धनकुटा, कोशी प्रदेश, नेपाल
Dhankuta, Koshi Province, Nepal
नगर प्रमुखको कार्यालय

Date: 22 December 2024

Dr. Pema Gyamtsho
Director General
ICIMOD, Khumaltar, Nepal

Subject: Request for ICIMOD's Expertise: Local Curriculum Development for Disaster Preparedness in Dhankuta Municipality

Dear Dr. Gyamtsho,

I hope this letter finds you well. I am reaching out to seek ICIMOD's valuable support and collaboration in developing a locally relevant curriculum focused on disaster early warning systems for Dhankuta Municipality.

As you are aware, the increasing frequency and intensity of disasters in Nepal necessitate educational frameworks tailored to the unique needs of local communities. Technological advancements and capacity-building efforts are essential to mitigate these challenges effectively. We were inspired by the success story of Benighat Rorang Rural Municipality in Dhading District, where ICIMOD's SERVIR-HKH team supported the development of a disaster preparedness curriculum for high school students. The program's inclusion of teacher training (TOT) and the integration of early warning systems (EWS) as a compulsory subject has demonstrated remarkable local impact.

Given this success, we envision scaling similar initiatives to Dhankuta Municipality, where 20 secondary schools stand to benefit from a curriculum addressing disaster preparedness, climate change adaptation, and sustainable resource management. By empowering students with the knowledge and skills to address these pressing challenges, we aim to build a resilient and informed community.

In this regard, we kindly request ICIMOD's support in the following areas:

- Technical Expertise: Guidance in curriculum design and content development.
- Training and Capacity Building: ToT programs for school teachers & relevant stakeholders.
- Material Support: Resources to facilitate the integration of disaster preparedness into the local curriculum.

We would greatly appreciate the opportunity to engage with your team who supported the Dhading initiative, to learn from their experiences and explore potential collaborations. Your expertise in integrated mountain development and sustainable practices would be invaluable in enhancing the quality and relevance of our educational efforts.

We look forward to your positive response and the opportunity to work together to create a meaningful and lasting impact on the students and communities of Dhankuta Municipality.

Thank you for considering our request.

Chintap Tamang
Mayor

Mayor

Website: www.dhankutamun.gov.np *E-mail: mundkt@gmail.com*



मुनिवेणी नगरपालिका
नगर कार्यपालिकाको कार्यालय

Ref: 1482

M/S ICIMOD
Khumaltar, Lalitpur, Nepal

Subject: Request for Curriculum Design and Teacher Training on EWS for Disaster Preparedness

Dear Sir,

We were honored to participate in the Consultative Workshop on EWS Local Curriculum for Disaster Preparedness held on September 24, 2024, in Benighat Rorang Rural Municipality, Dhading, organized by ICIMOD in collaboration with the District Co-ordination Unit, Dhading.

During the workshop, we learned that ICIMOD has already developed an EWS for Disaster Preparedness curriculum for Grade 9, which has been implemented in schools in Benighat Rorang Rural Municipality. The Training of Trainers (ToT) on Early Warning Systems, conducted on September 18–22, 2024, has enabled teachers to effectively apply the curriculum, helping safeguard students and communities during the September 15 Gulmi earthquake disaster.

Recognizing the critical importance of disaster preparedness in our municipality, which is also prone to landslides, we have decided to adopt the EWS curriculum and to roll it out in our schools from the upcoming academic session 2081 (2024).

We kindly request ICIMOD's support in distributing the curriculum and providing ToT on EWS for Disaster Preparedness to our teachers to achieve the same success as in the previous year.

Sincerely,

Chief Administrative Officer
Muni Kot Municipality, Tagadi, Dhading





Changing scenario

Multi-hazard scenario

- One hazard triggering another
- Multiple hazard within short timeframe
- Impacts overlapping before recovery

Thame GLOF 2024

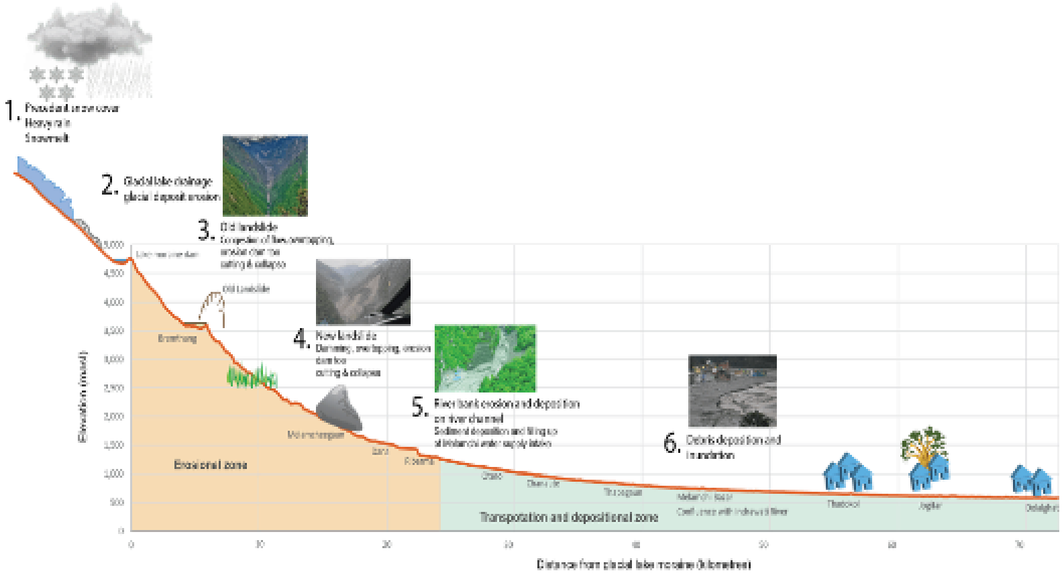
Expanding glacier lake → Rock avalanche 200m fall (trigger) → Breach GL-5 → 120m vertical drop → Breach GL-4 → Combined GLOF downstream → impact

Rasuwa flood 2026

Ice–rock avalanche → Debris flow → Flash flood → impacts

Melamchi 2021

Extreme rainfall → GLOF → debris flow → landslide → river blockage → landslide dam break → flash flood → impact



Kathmandu 10 Action Points

Regional workshop by ICIMOD), NDRRMA Nepal, and the Embassy of Switzerland in Kathmandu from 15 to 17 September

To strengthen disaster preparedness, early warning systems, emergency response and recovery

- Re-design EWS for sudden hazard and sacrificial infrastructure for cascading hazards and rapid response.
- Map multi-hazard hotspots using satellite monitoring and impact-based forecasting.
- Shift transboundary cooperation from raw data sharing to decision-ready information.
- Assess regional response capacity across ICIMOD's Regional Member Countries (RMCs).
- Review and strengthen communication protocols for faster disaster information sharing.
- Establish a regional technical working group across RMCs, ICIMOD, ADPC and CDRI.
- Create a regional disaster response fund with member and development partners.
- Develop a shared data portal to overcome institutional data silos.
- Promote people-centred recovery using gender-disaggregated data.
- Develop phased recovery plans with short-, medium- and long-term financing.

Thank you

Manish Shrestha
Shrestha.Manish@icimod.org

Speaker



Daurbek Sakyev

Director, National Meteorological and Hydrological Service, Kyrgyzstan

Ministry of Emergency Situations of the Kyrgyz Republic

Cryospheric Hazards in the Kyrgyz Republic

Forecasting emergencies caused by glacier and permafrost degradation, scenario modelling and risk reduction measures — taking into account lessons from the tragedy in Nepal



Scale of the threat: outburst-prone lakes of Kyrgyzstan

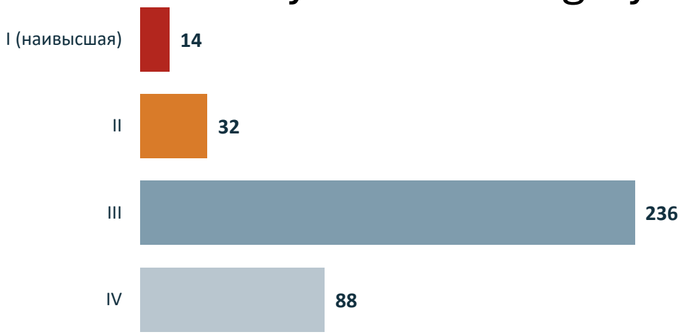
> 2 000

high-altitude lakes in the country

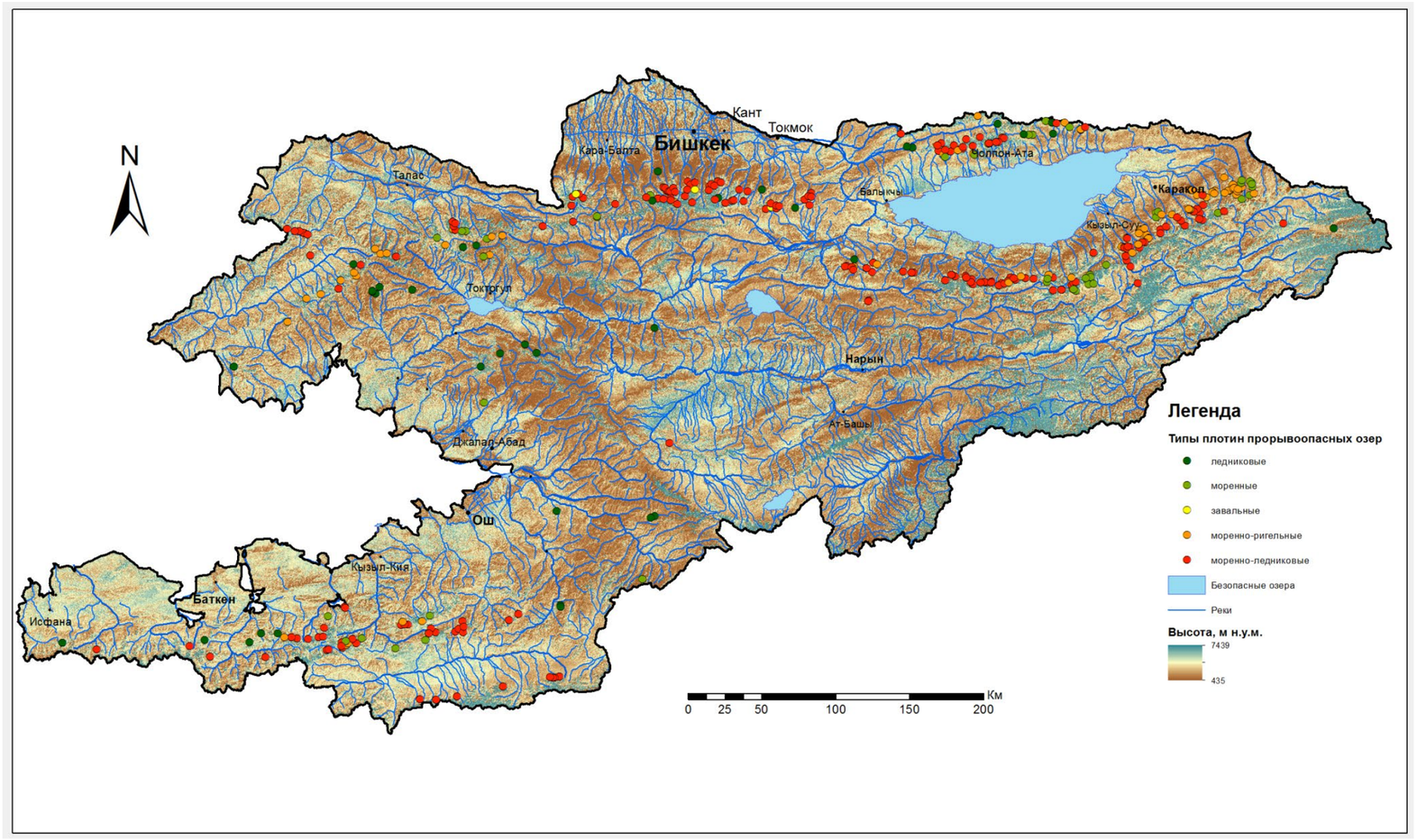
370

lakes in the outburst-prone lake catalogue

Distribution by hazard category



Catalogue as of September 2026;
60 lakes surveyed in 2026



Types of dams of outburst-prone lakes

Key point: the greatest danger is posed by unstable moraine-glacial lakes — they can form within one season and drain through underground channels.

Cryospheric hazards are not limited to lake outbursts

The tragedy in Nepal showed that climate warming can trigger cascading processes in the cryosphere. For Kyrgyzstan, the full range of cryospheric risks must be considered.

1

High-altitude lake outbursts

Moraine-glacial, thermokarst and landslide-dammed lakes

Example in the Kyrgyz Republic: Orto- Kayndy (2026), Takyrtor (2025)

2

Cryogenic landslides and earthflows

Permafrost thaw reduces slope stability

Example in the Kyrgyz Republic: Kashkasuu (2019), Shamshy (2025)

3

Glacier collapses

Ice-rock avalanches caused by degradation of hanging glaciers

4

Glacial debris flows

Debris flows and mudflows originating from glaciers and moraines

Example in the Kyrgyz Republic: Ala-Archa, Aksai, Adygene

5

Degradation of moraine dams

Melting of buried ice and thermokarst within the dam

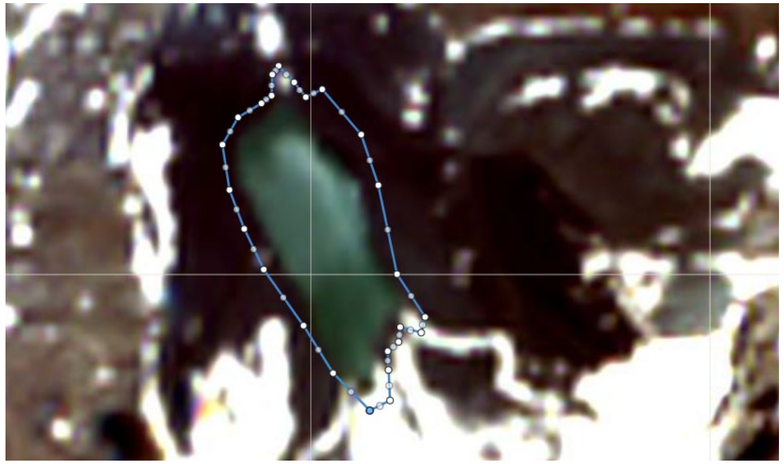
Example in the Kyrgyz Republic: Lake Petrov

The common trigger is cryosphere degradation: glacier retreat and permafrost thaw. These processes develop rapidly — new hazardous sites can emerge within a single season.

Orto-Kaindy-West, outburst on 13 July 2026



Sentinel-2, natural colours, 10.07.2026

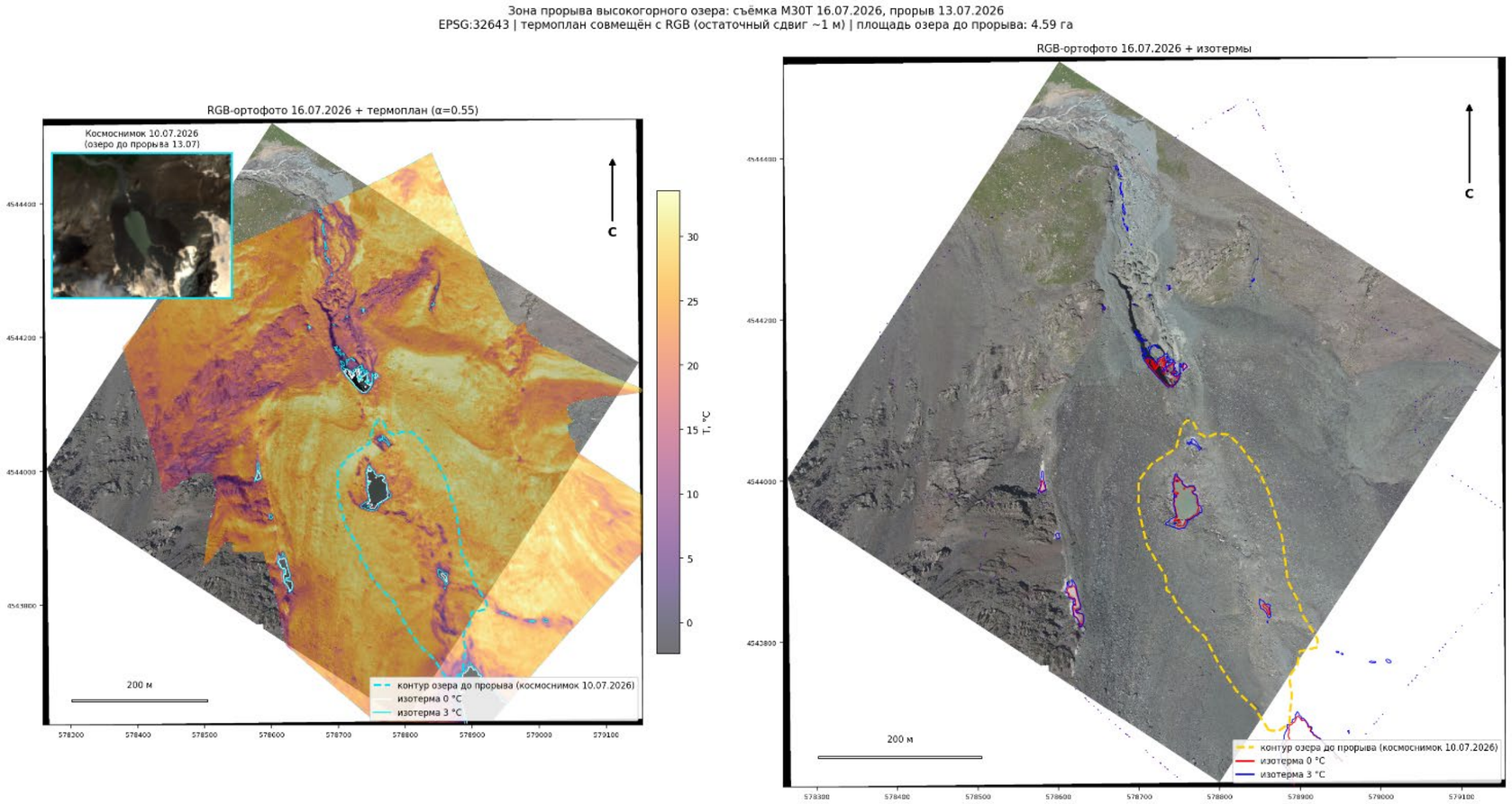


28.06.2026, Sentinel-2

At-Bashy District, Naryn Region
N 41.042951° E 75.937287°
3698 m
above sea level
Type
Unstable moraine-glacial water body at a retreating glacier
Area before outburst
≈ 48 тыс. m^2 (Sentinel-2)
increase in area over two weeks: 29 282 → 48 327 m^2 +65 %
466 211 m^3 estimated

What happened: the lake drained almost completely through several underground channels near the bottom, generating a debris flow. Temporary structures and apiaries were affected, and agricultural land in the lower part of the valley was within the debris-flow transit and deposition zone.

Orto-Kaindy, estimate of lake drainage time



Analysis of thermal orthophoto (survey on 16 July 2026)

Суммарный расход Q, м³/с	Время опорожнения t = W/Q
60 (40 + 20 по двум каналам)	≈ 2 ч 10 мин
40	≈ 3 ч 14 мин
20	≈ 6 ч 29 мин

The calculation assumes a steady-flow regime with a volume of W = 466,211 m^3.
The values should be considered a lower estimate: the calculation does not account for the decrease in discharge as the water level falls; taking this into account, the actual duration may exceed the calculated value by 1.5–2 times.
As thermal and hydraulic erosion enlarges the channel cross-sections, discharge increases and drainage time decreases,

Kashka-Suu (Alamudun District), landslide caused by permafrost thaw



General view: the mass moved 950 m down the valley



Head scarp up to 100 m high



Earthflow toe: cones formed by melting frozen blocks

≈ 900 тыс. m^3

volume of displaced mass

≈ 41 тыс. m^2

source area on the slope

3170 → 2600 m

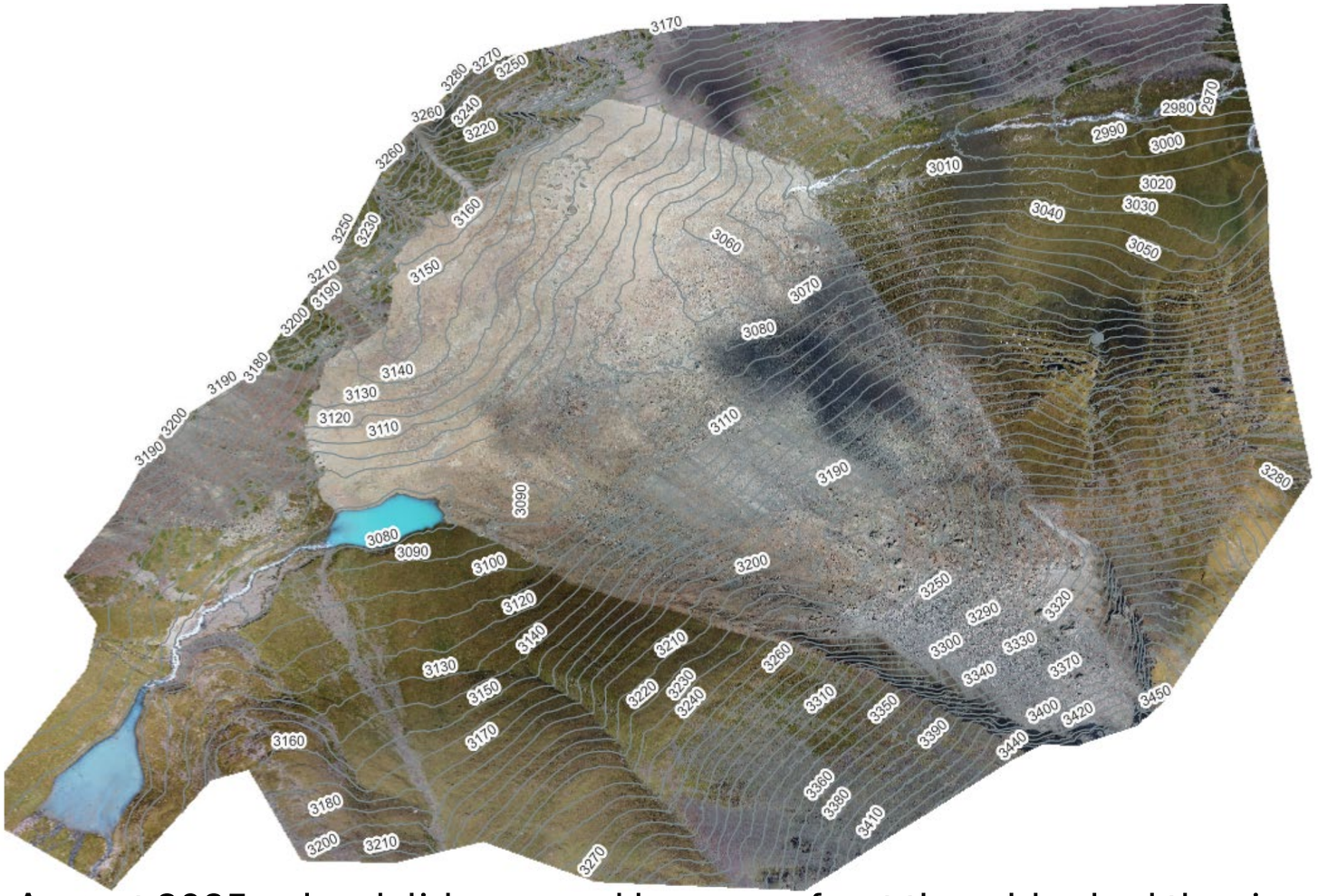
elevation difference, 950 m travel distance

10–14 %

ground ice content; buried ice layer 1–1.5 m

24 June 2019, upper Kashka-Suu River (tributary of the Ala-Archa River), elevation >3,000 m. Causes: deep permafrost thaw due to climate warming and a tectonic step that impeded water drainage in fractured rocks. A distinctive feature: ≈85% of the mass consisted of weathered bedrock, not only loose cover.

Shamshy, landslide-dammed lake after a landslide in frozen ground







August 2025: a landslide caused by permafrost thaw blocked the river channel. The lake was included in the outburst-prone lake catalogue; its category will be determined based on monitoring results in May–August 2027.

Lake Petrov, moraine dam stability

Dam stability
Indicator — thermokarst lakes on the moraine dam

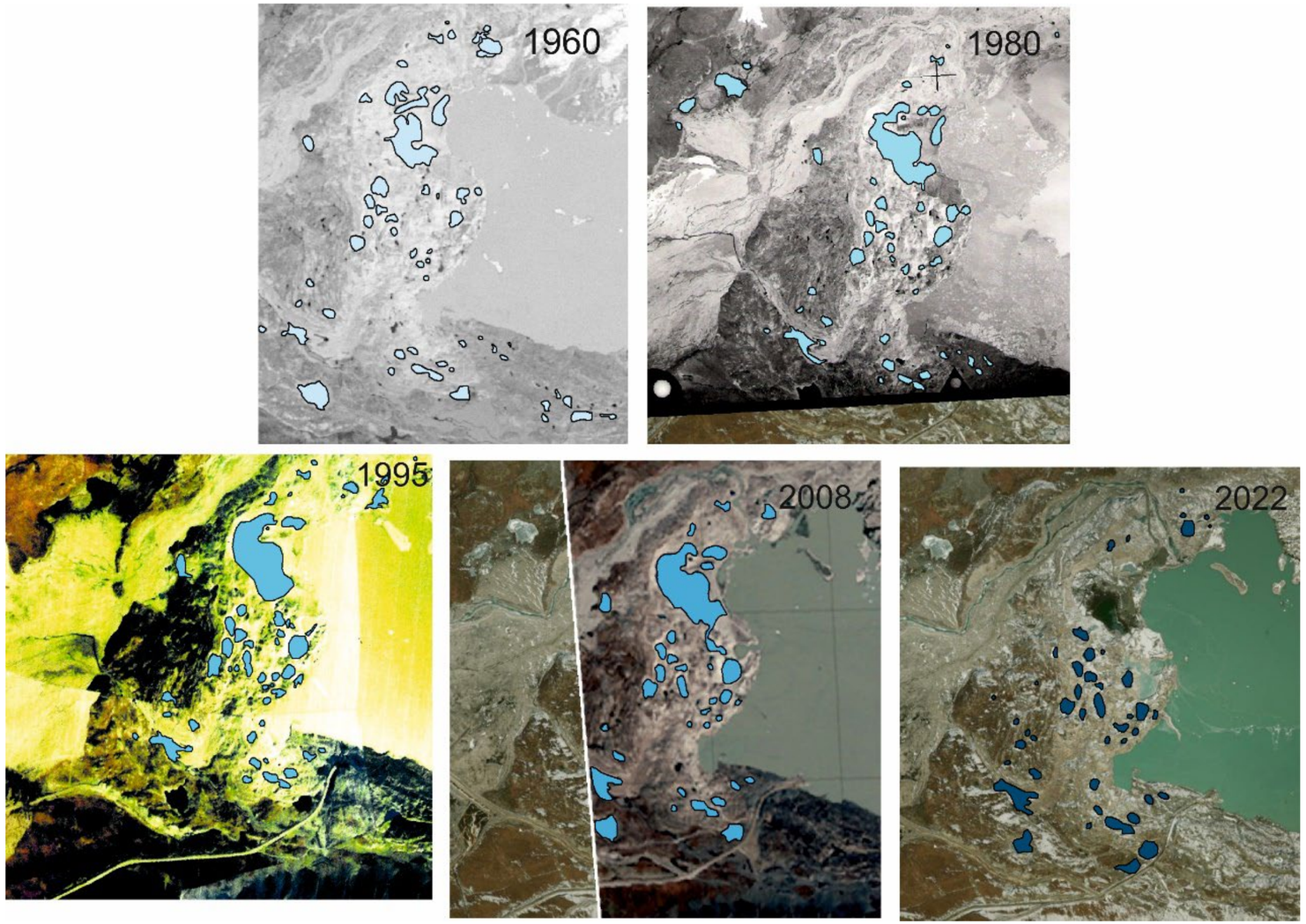
14 → 18

number of thermokarst lakes over the last 50 years

0,5–1,5 m

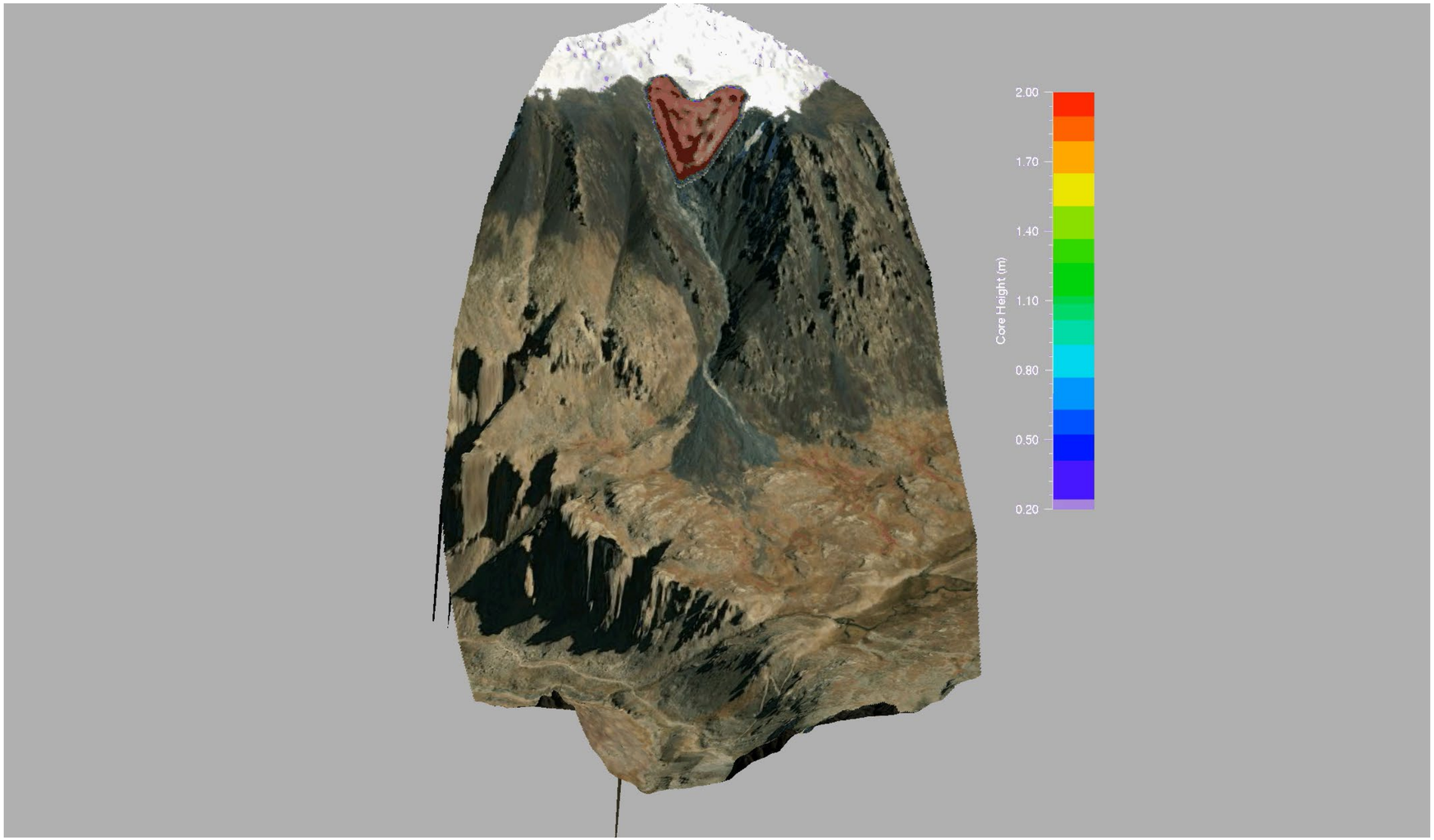
average lake depth (Deeper Pro echo sounder)

No sharp increase in the number or size of the lakes has been observed



Thermokarst lakes on the dam of Lake Petrov, 1960–2022

Modelling of the glacier collapse in Juu-Ku, 8 July 2022



What is shown
3D model of the slope: glacier detachment, trajectory and stopping zone of the ice-rock mass.
Шкала
Flow core height, m (0.2–2.0).
Significance
The model was calibrated against a real event and can be used to forecast collapses of other glaciers in Kyrgyzstan.

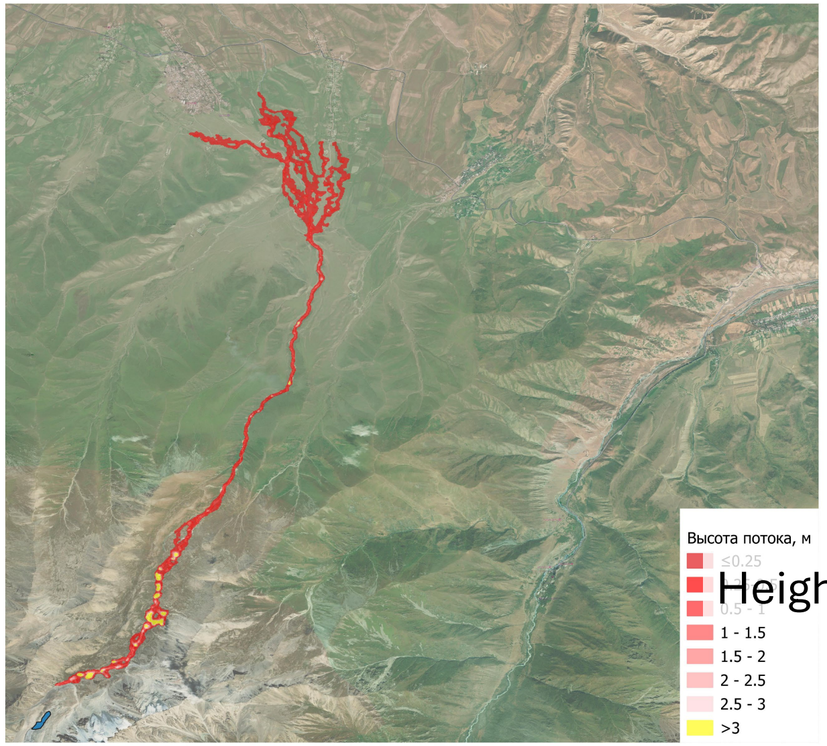
Ala-Archa, debris-flow flood hazard modelling



What is shown
Path of the debris-flow flood through the valley to populated areas; average flow height — 2.3 m.
Category I lakes in the basin
Ак-Сай (Ч-40),
Тезторские (Ч-8)
5–10 minutes
available for evacuation in the event of an outburst in Ala-Archa Park
CAIIZ is installing an early warning system; clear action and evacuation protocols are required.

Takyrtor, 27 June 2025: a forecast that worked

1. Modelling



IMPACT ZONE

2. Identification of vulnerable zones



3. Protective measures

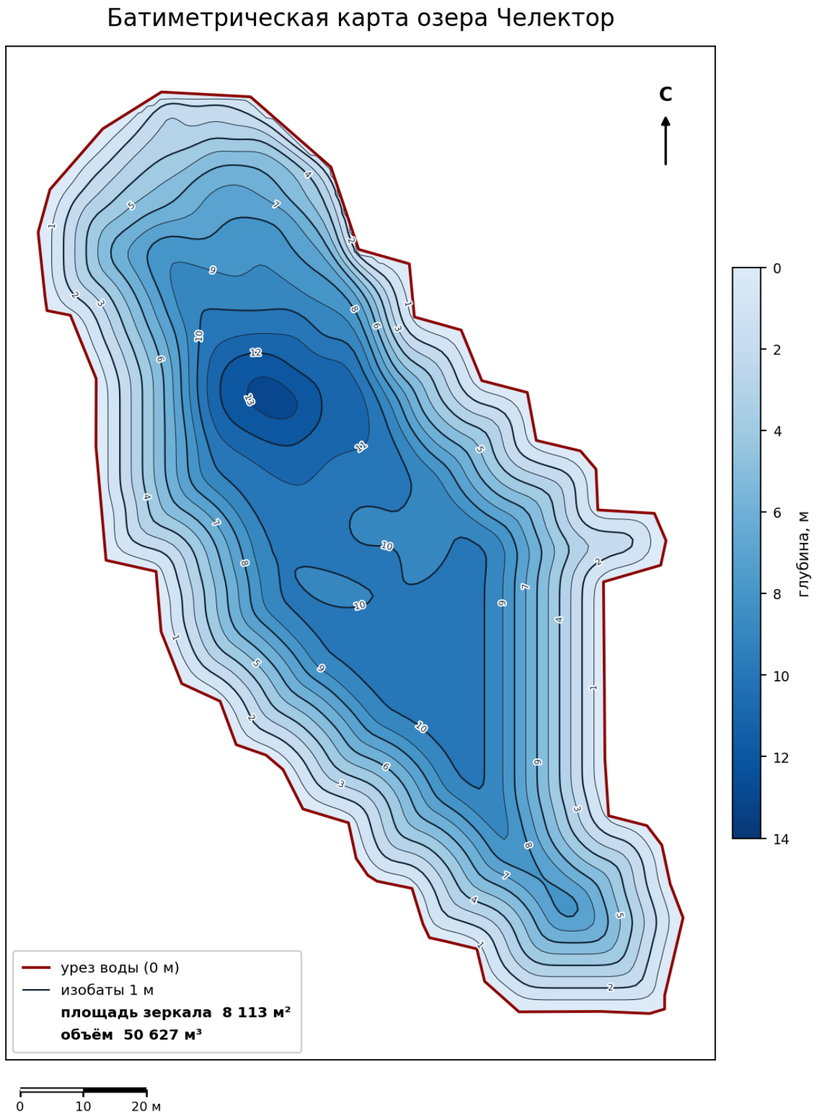


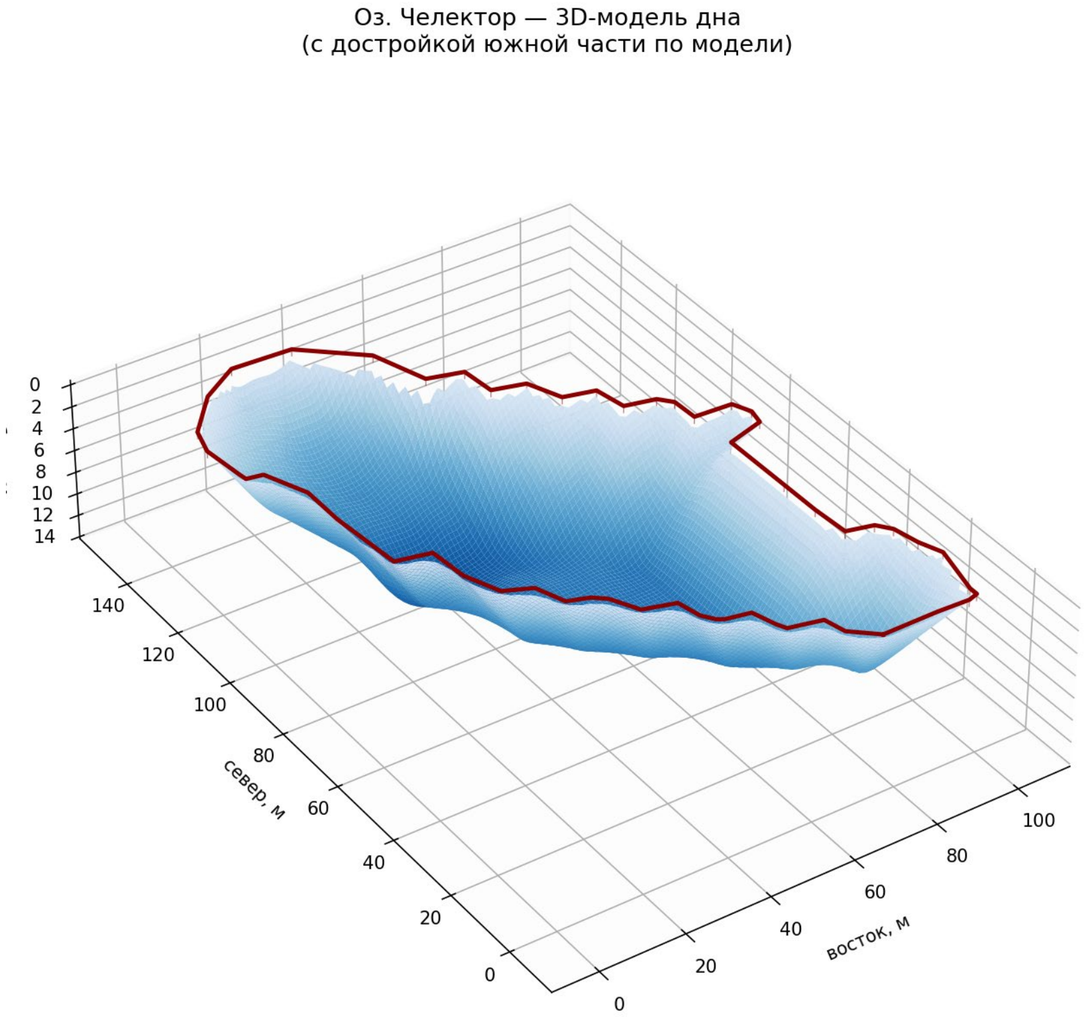
4. Consequences



Result: based on recommendations developed jointly with scientific experts, the Kyrgyz Ministry of Emergency Situations constructed a 4 m-high diversion dam one day before the outburst — overtopping was prevented and Verkhnyaya Serafimovka village was protected.

Chelektor Lake (Category I), bathymetry and 3D bottom model





I category
Ч-53, heighst 3880 m
8 113 m^2
surface area
50 627 m^3
water volume
Within the impact zone Bishkek – Koi-Tash – Ysyk-Ata,

The 3D lake model, basin shape, location of underground channels and volume determine the maximum outburst discharge and flow reach.

Recommendation. Include cryospheric hazards in the Emergency Classification

Amend Resolution No. 21 of the Cabinet of Ministers of the Kyrgyz Republic dated 17 January 2025 “On Approval of the Classification of Emergencies and Criteria for Their Assessment in the Kyrgyz Republic” — establish a group “Cryospheric Hazards (Geocryogenic Risks).”

Proposed definition

Cryospheric (geocryogenic) hazards are dangerous natural processes and phenomena resulting from degradation of the cryosphere: glaciers, permafrost and buried ice. The main trigger is degradation and thawing of permafrost, which reduces the stability of slopes, bedrock and glaciers.

Proposed assessment criteria

- volume of unstable mountain mass capable of moving;
- population and infrastructure in the impact zone;
- rate of process development and flow arrival time;
- potential for cascading development (landslide → lake → debris flow).

Processes included in the group

1. Cryogenic landslides, earthflows and rockfalls caused by permafrost thaw
2. Glacier collapses and ice-rock avalanches
3. Subsidence caused by permafrost thaw
4. Ground heave

Recommendations on monitoring and modelling

2 Radar satellite monitoring

SAR imagery: monitoring under cloud cover and at night, automated processing; detection of slope displacement in permafrost zones.

3 National risk assessment methodology

Moraine dam stability criteria, scenario-based consequence modelling, and approved response protocols.

4 Digital elevation models from UAVs

High-precision DEMs for Category I lakes — the basis for modelling impact zones.

5 Licensed modelling software

Annual subscriptions to RAMMS and FLO-2D for modelling outbursts, debris flows and collapses.

6 Warning and evacuation protocols

First and foremost for Ala-Archa, where only 5–10 minutes remain for evacuation; exercises with the population.

Additionally: continue international cooperation and mobilize donor funding.

Key conclusions

1

The threat is growing

Glacier and permafrost degradation can create new hazardous sites within one season: 370 outburst-prone lakes and landslides in frozen ground (Kashka-Suu, Shamshy).

2

Forecasting works

Takyrtor, 2025: a protective dam built on the recommendations one day before the outburst protected Verkhnyaya Serafimovka village.

3

Solutions are needed

Include cryospheric hazards in the Emergency Classification (Resolution No. 21 dated 17 January 2025) and strengthen monitoring, modelling and the human-resource capacity of the Ministry of Emergency Situations.

Thank you for your attention

Speaker



Christophe Lienert

Managing Director, Swiss Steering Committee on Intervention in Natural Hazards, Switzerland

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Lenkungsausschuss Intervention Naturgefahren LAINAT
Comité de direction Intervention dangers naturels
Comitato direttivo Intervento pericoli naturali
Steering Committee Intervention in Natural Hazards

Secretariat



Early Warning and Disaster Risk Management in Switzerland

Thoughts on trends and experiences with governance

7.10.2026, Geneva, WMO & GWP online seminar on High Mountain Flood Risks

Author: Dr. Christophe Lienert

Managing Director, Swiss Steering Committee on Intervention in Natural Hazards LAINAT

Natural hazards in Switzerland

Earthquakes



Dynamic flooding



Static flooding



Drainage



Erosion



Debris flows



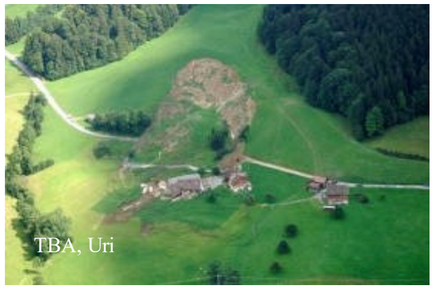
Hail



Storms



Landslides



Rockfalls



Avalanches



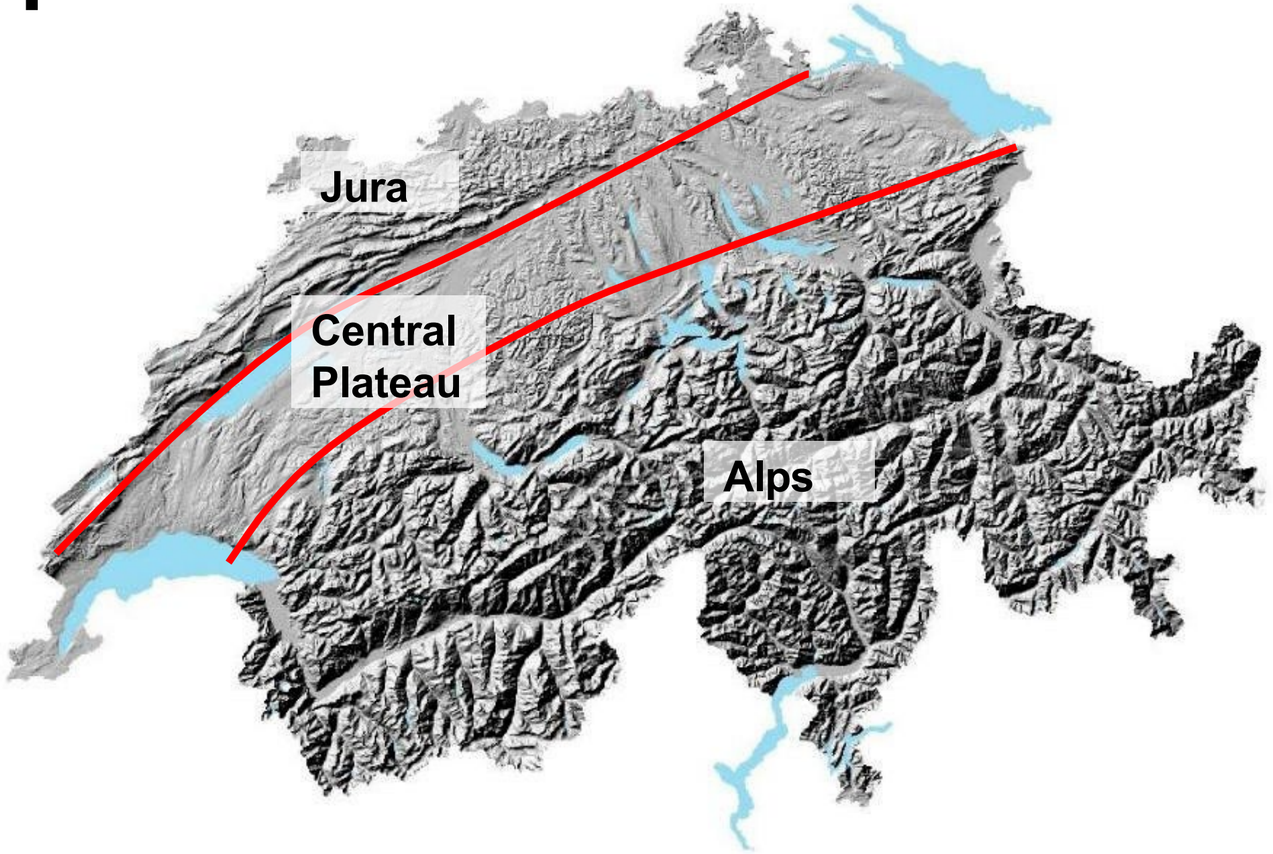
Forest fires



Geographical overview of Switzerland



Jura:
Earthquakes, floods, rockfalls, landslides





Alps:
Earthquakes, avalanches, rockfalls, landslides, debris flows, floods, storms, fire



Central Plateau:
Earthquakes, floods, landslides, storms

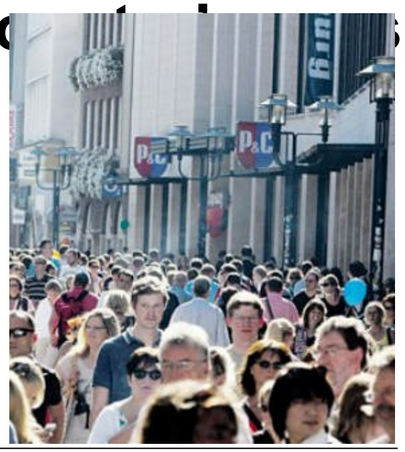
Area: 41,000 km^2,
Inhabitants: 9 Million, 219 inhabitants per km^2
Geomorphology: 60% Alps, 30% Plateau, 10% Jura

Source: BAFU

Natural hazards and socio-economics in Switzerland

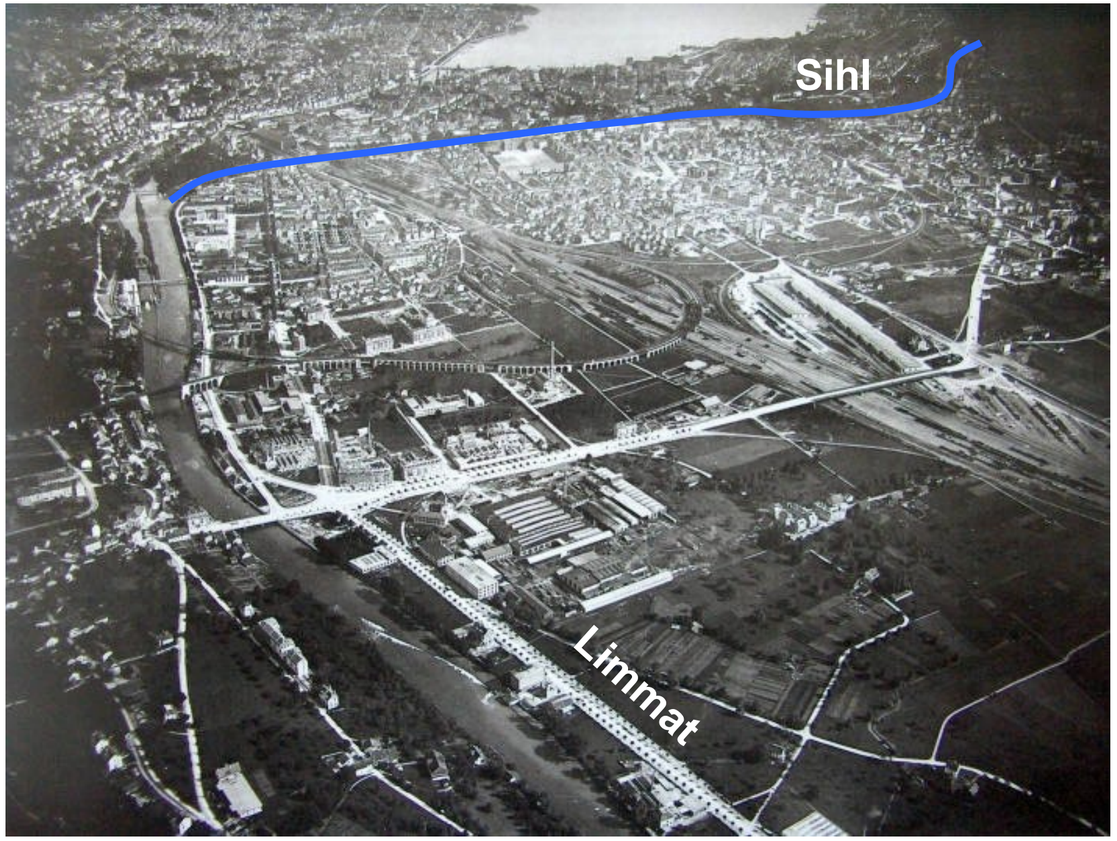
- past 50 years: population almost doubled
- housing, transport **infrastructure grew** rapidly, so did the **damage poten**
- Industries and workplaces are affected, thus the **country's value creatio**



Challenges: Increasing damage potential by urbanisation

City of Zurich: Damage potential of CHF 6.8 billion





Source: Spelterini 1906, AWEL Kt. ZH

Challenges: climate change and the climate signal

- higher frequencies: not just value concentration, but visible climate signals
- summers to become drier, precipitation to become stronger, more intense
- more surface runoff, more droughts, less snow days, thawing of permafros

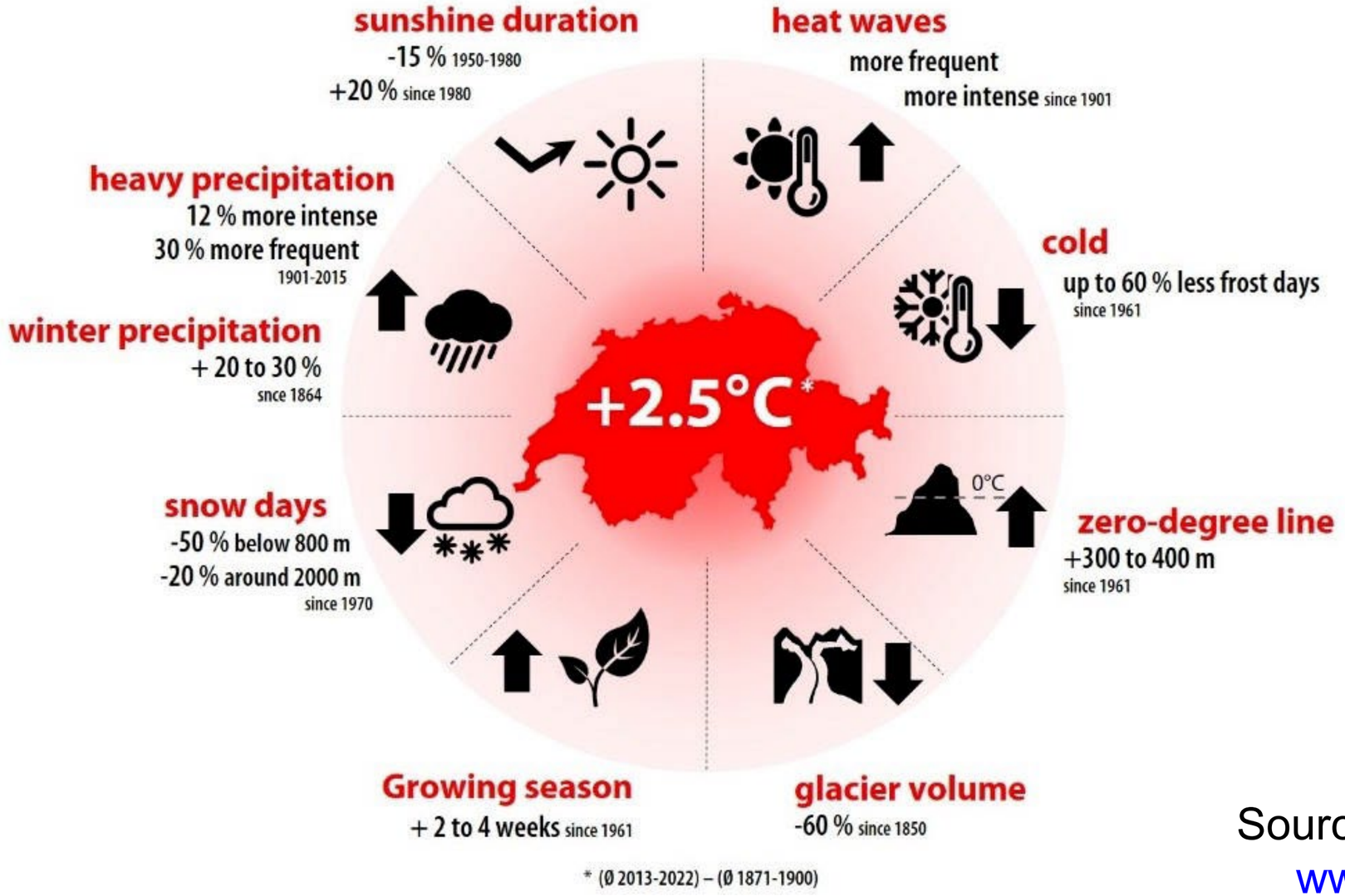






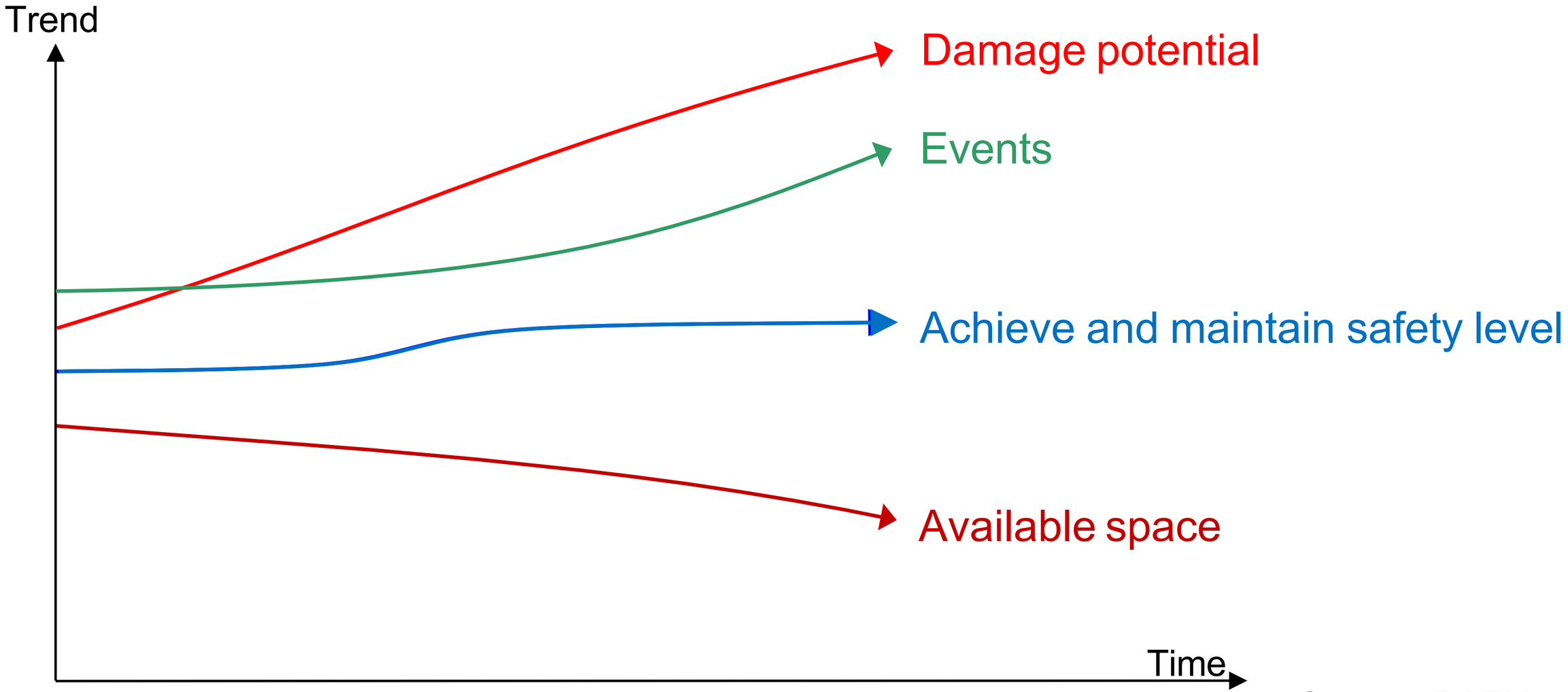
Source: own internet search

Challenges: climate change and scenarios



Sources: BAFU, MeteoSwiss
www.climate-scenarios.ch

General trends



Source: BAFU

Current example: rockslide Slatten, Swiss Alps, 28.5.2025



Sources:
Swissinfo, WSL, RTSI, Guardian

Slatten, an exemplary compounding event

- geological hazard (rock fall) >
  - glacial hazard (rocks on glacier lead to glacier rupture) >
    - mass movement hazard (rock and glacier slip off, wood and soil mix
    - [illegible]cal hazard (damming up river in valley bottom)



Source: Canton Valais, ETH

Slatten, a brief summary

- Monitoring in place *years, months before* the event (cooperation with research)
- detailed onsite measurements (GPS, drones, etc.) *weeks before* the event
- 300+ people evacuated by municipal authorities, through order by Cantonal auth.
- continuous hazard assessment (e.g., uncertainties how to handle dammed lake).
- **Novel pressing questions** arise:
  - Mountain areas, permafrost thawing and climate change
  - Re-assessment of hazard zones, build-back
  - Societal questions (abandonment vs. re-settlement, national cohesion)
  - Financing and sustainability
  - New precedent cases

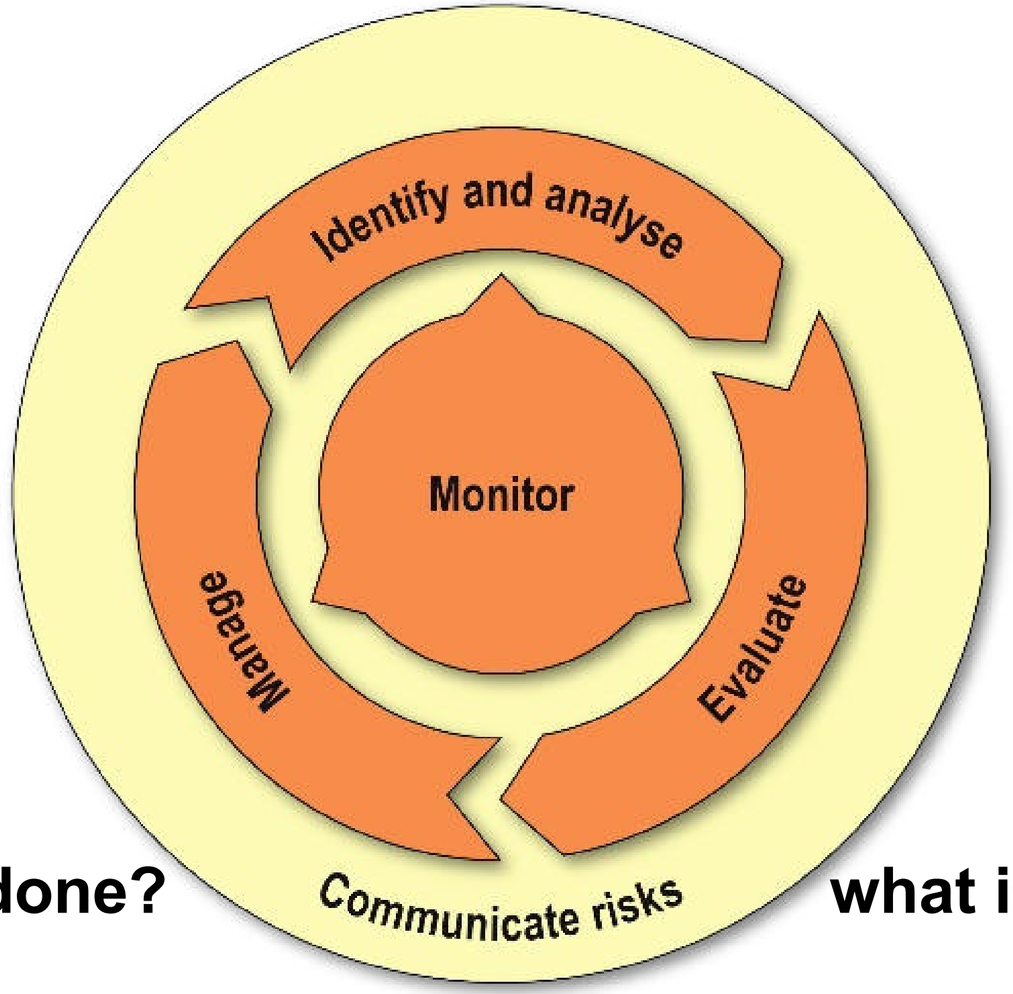
Integral Risk Management IRM (more details here)



Model *Integrated Risk Management*
Federal Office for Civil Protection
2019

Integral Risk Management IRM

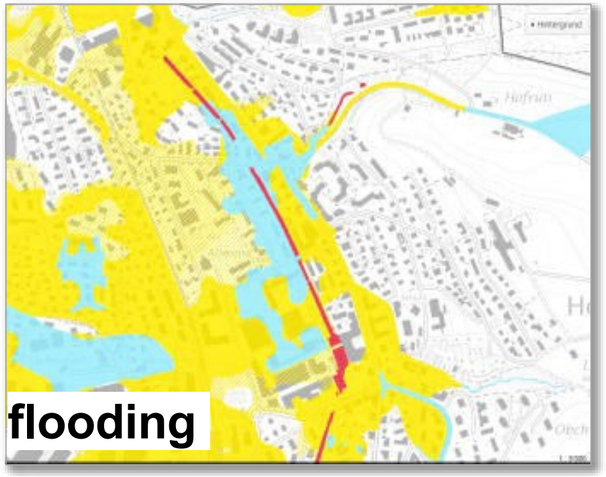
what can happen?

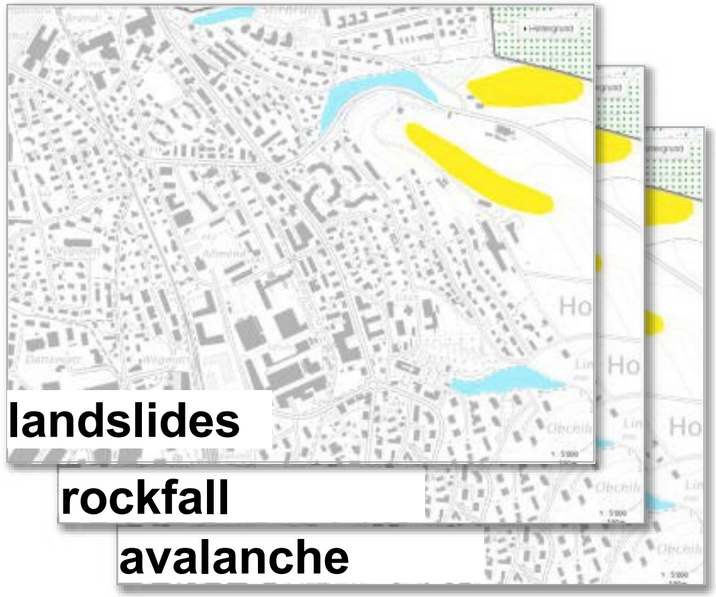


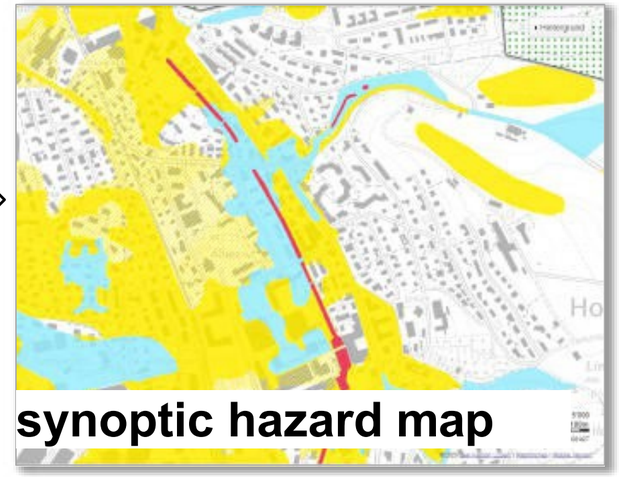
what has to to be done?

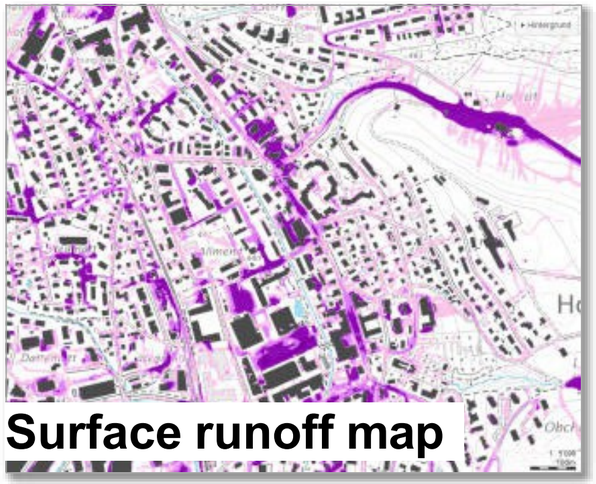
what is allowed to happen?

hazard maps: an instrument for “what can happen”









“What has to be done?” > Four types of measures

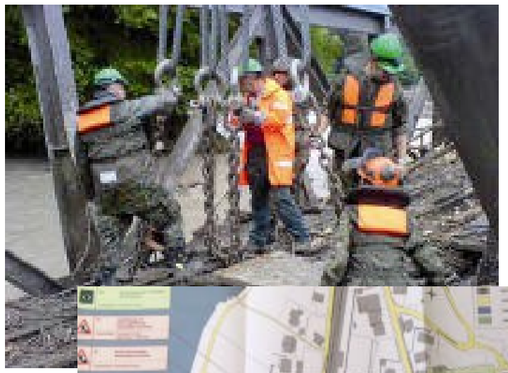
Planning





- land use planning
- land use restrictions
- object protection

Organizational

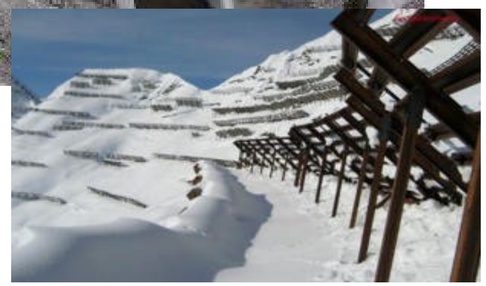




- forecasts
- early warning
- preparedness, emerg. planning

Techn./structural

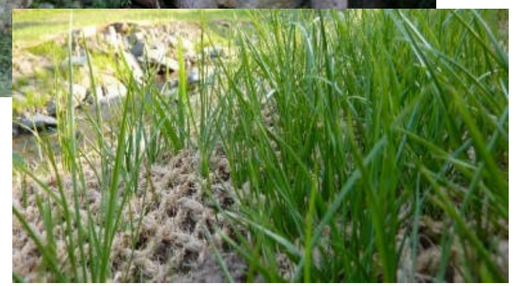




- avalanche barriers
- flood prot. dams
- rockfall prot. nets

Sio-engineering





- protection forests
- bank protection

“What has to be done?” > Four types of measures

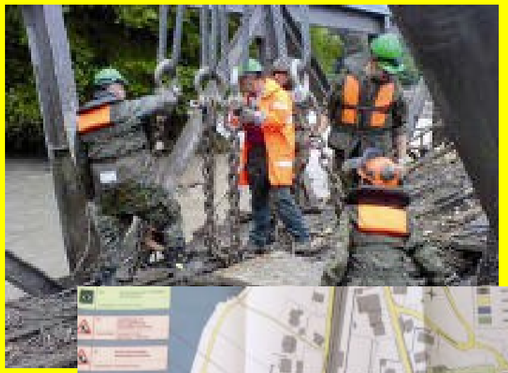
Planning





- land use planning
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Organizational

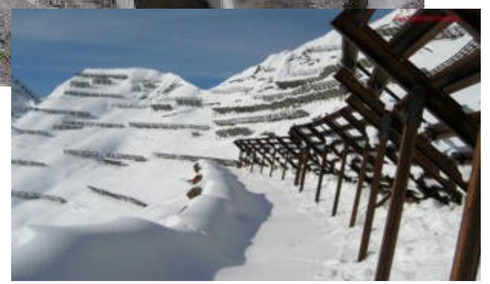




- forecasts
- **early warning**
- preparedness, emerg. planning

Techn./structural

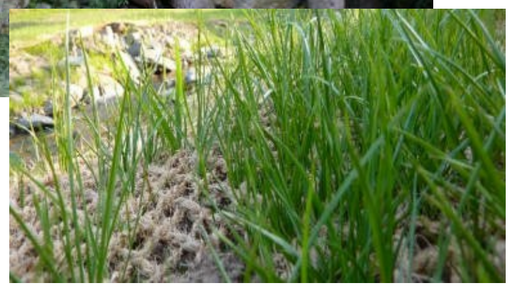




- avalanche barriers
- flood prot. dams
- rockfall prot. nets

Sio-engineering





- protection forests
- bank protection

Various disasters in recent times (e.g. 1987, 1999)

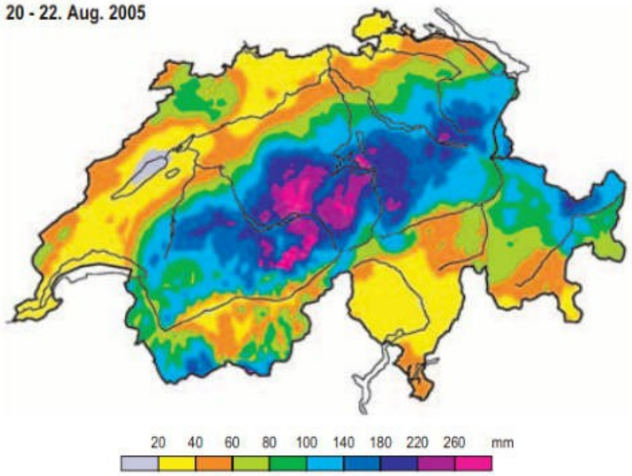


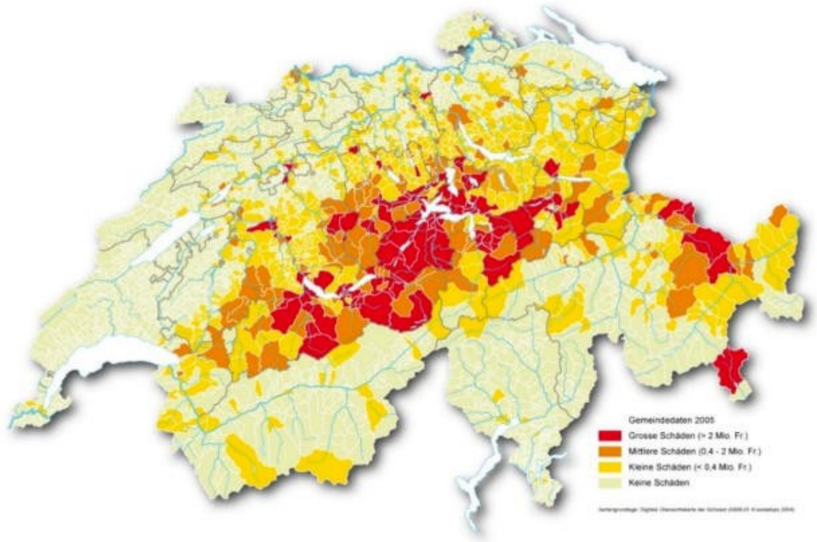
Sources:
BAFU, WSL

“Game changer” > national floods of 2005











#DYK

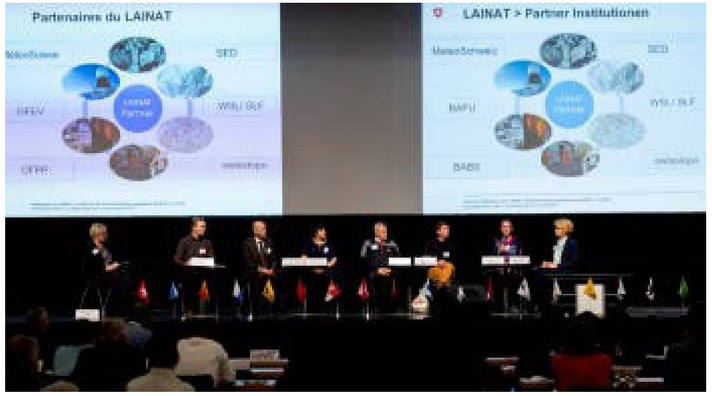
The 2005 event led to 6 fatalities and damages > CHF 3 billion. Analysis showed that proper warning systems could have saved ~20% of the costs

OWARNA «Optimization of Warnings and Alerting»

- Federal Council adopts resolution **OWARNA** 2007 → **strong political basis**
- **fostering cooperation** among Swiss Federal Dept., joint Crisis Committee
- **increased investments** in forecasting, transfer knowledge to the local level
- starting point for developments of **operational data and warning platforms**
- founding of Steering Committee on Intervention in Natural Hazards **LAINAT**

LAINAT: Steering Committee on Intervention in Natural Hazards

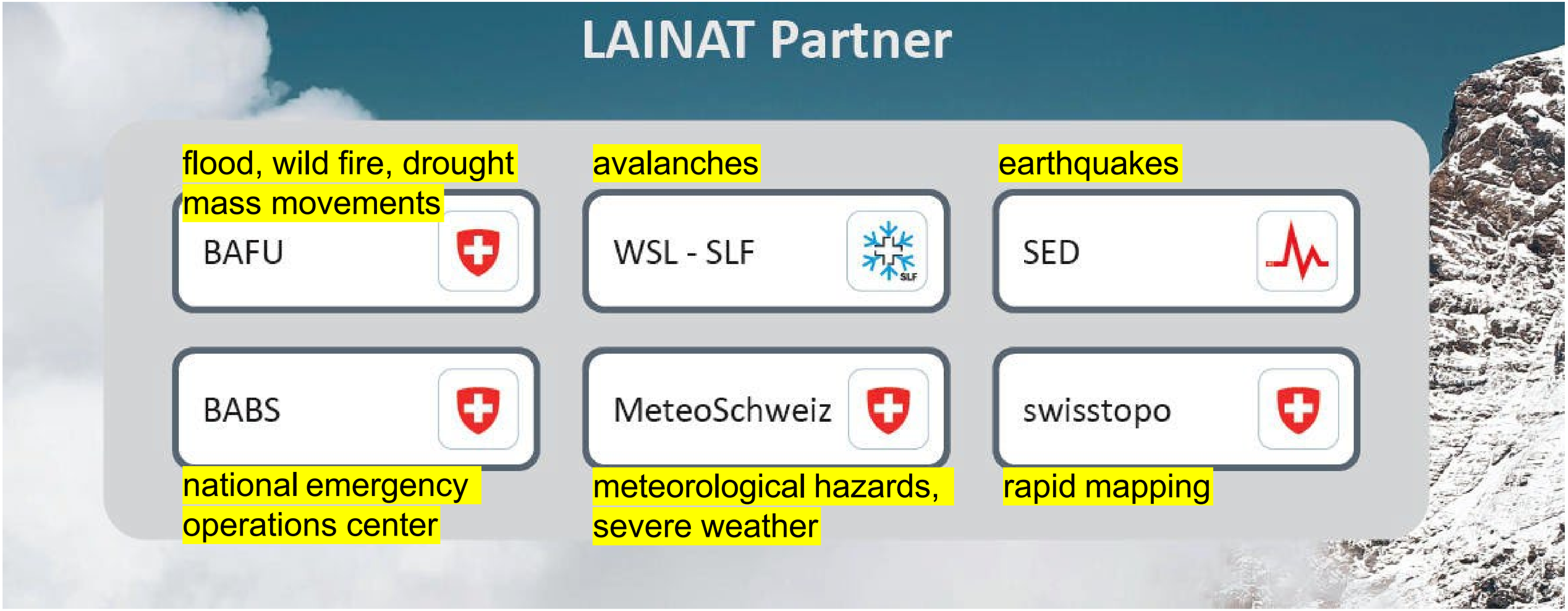
- **coordination body** for natural hazard warnings on the **Swiss Federal level**
- **streamlines warning activities** and **warning product development**
- strong **political linkage** to ministries; legal basis **Civil protection Act**, Art.3



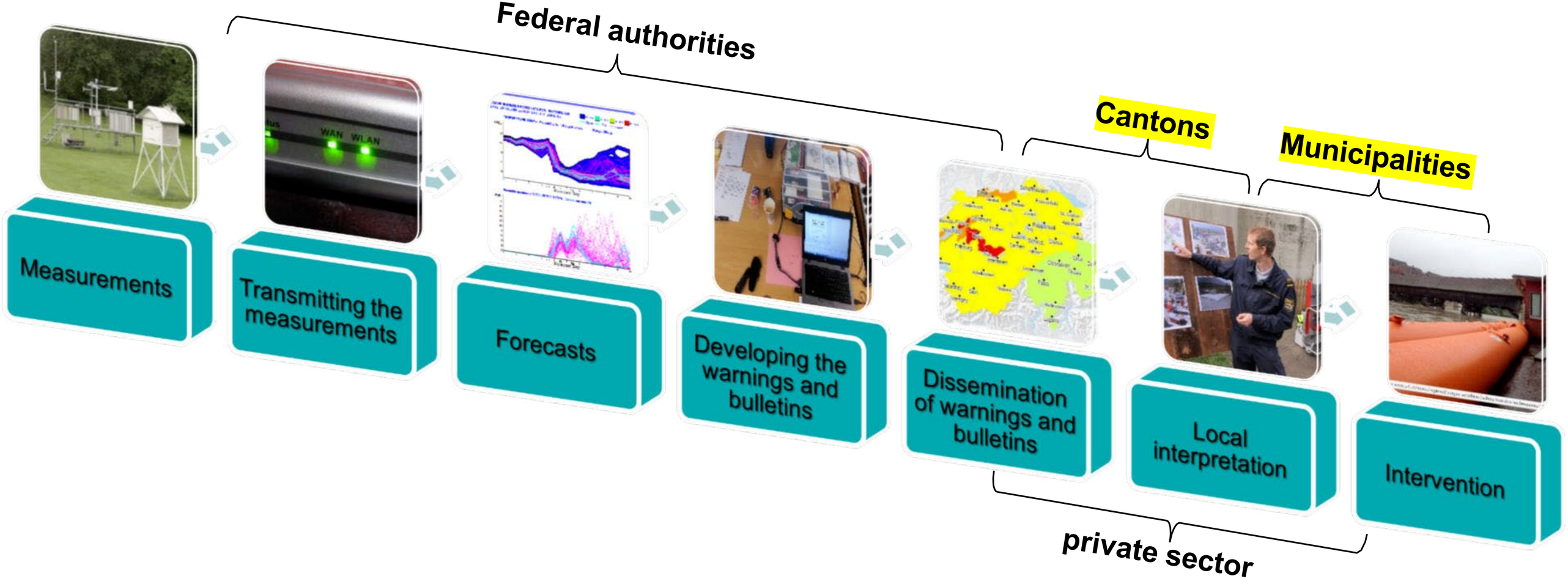




LAINAT: Steering Committee on Intervention in Natural Hazards



The warning chain in the Swiss Federal system



The warning chain: responsibilities and subsidiaritv

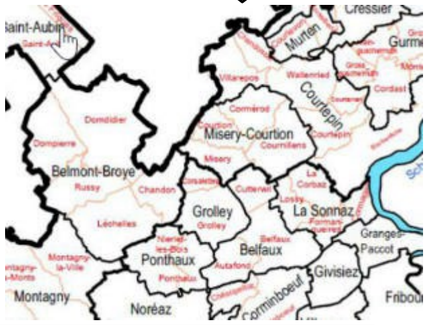
- **Federation:** issues nationwide information and warnings



- **Cantons:** (re-)issue, enrich warnings; take counter-measures



- **Communes**: receive warnings; take counter-measures

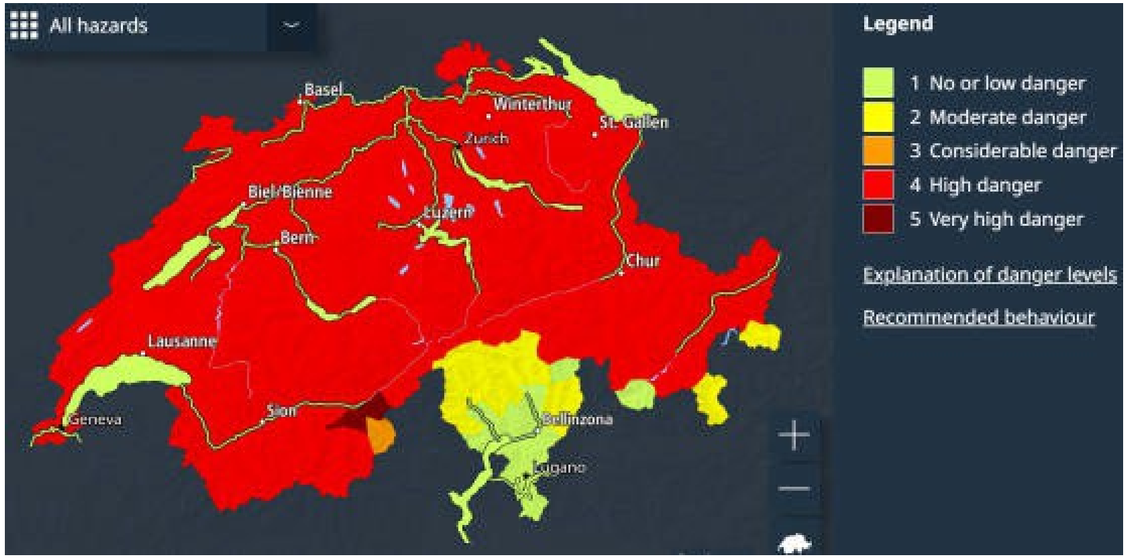


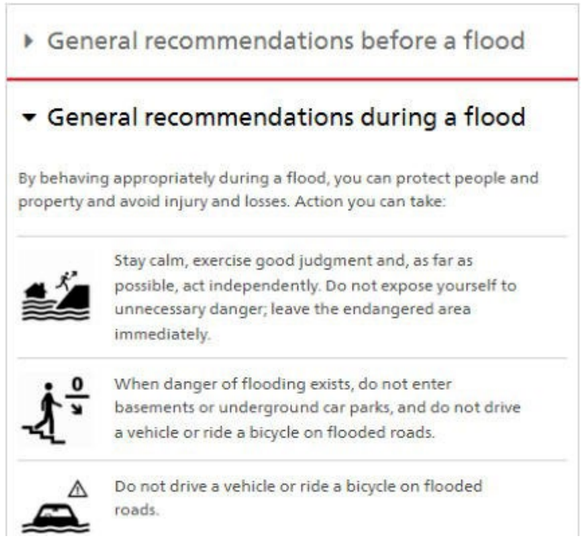
Public Natural Hazard Portal NHP

www.natural-hazards.ch

A public platform for **natural hazard warnings for the Swiss population**

- Information and warnings, real-time, 24/7, multi-lingual, embeddability
- Multi-hazard warning maps and single-hazard warning maps
- Behavioural recommendations, bulletins, press releases



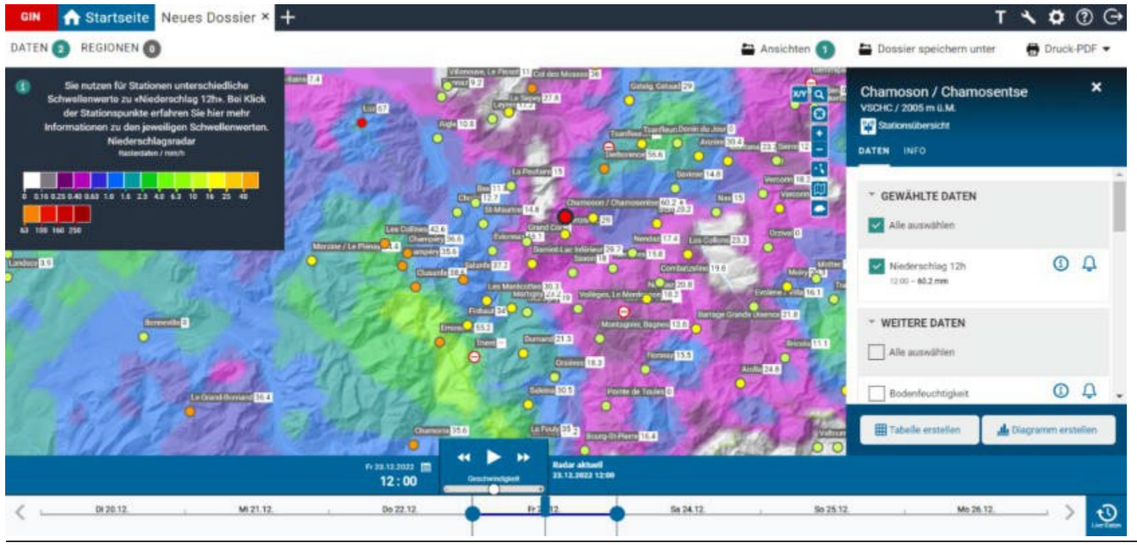


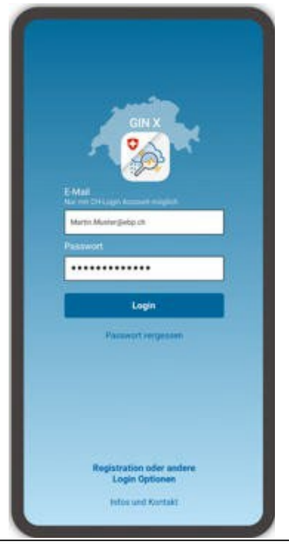
Joint Information Platform Natural Hazard GIN

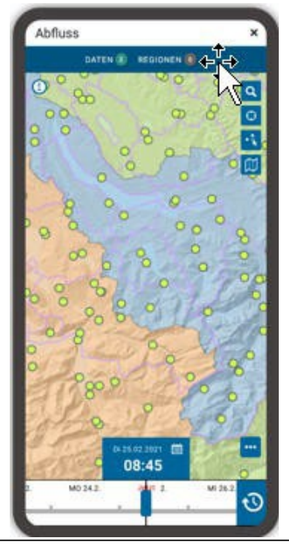
www.gin.admin.ch

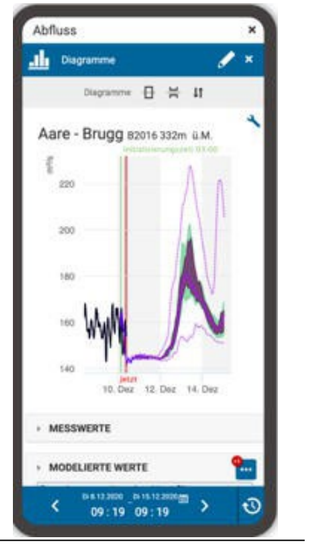
A data and **information distribution channel for authorities**

- data provided by LAINAT-partners; real-time sensor-/model data
- Users: Federation, Cantons, municipalities; password-protected
- desktop and mobile access, customizable and warning pushes







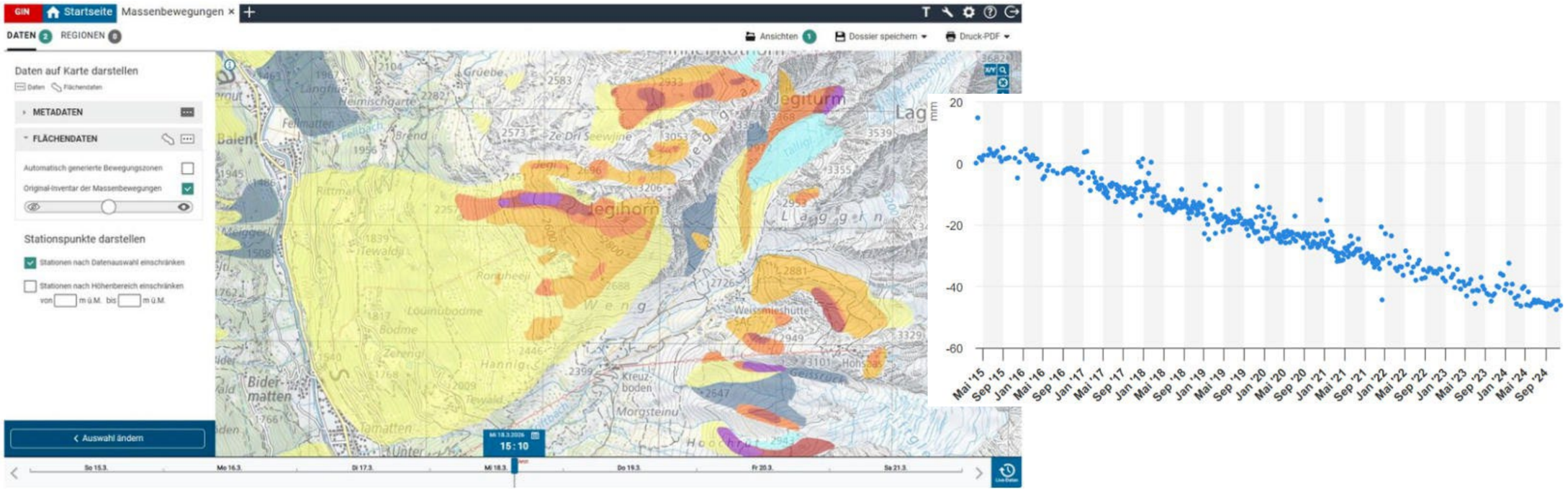


Joint Information Platform Natural Hazard GIN

www.gin.admin.ch

NEW on GIN

- Interferometric Synthetic Aperture Radar **(InSAR) data products**
- Detect displacement hot spot areas
- Source: satellite data which are regularly updated and processed



Joint online «remote briefings»

- coordinated and provided by LAINAT-experts on Federal level
- for cantonal authorities, well ahead of events
- Integral process view: (snow >) meteo > hydrology > mass movement
- «experts advise experts», clarify questions and minimize uncertainties
- rapidly set up and scaleable







International roles and contributions

- Swiss Consultative Group Disaster Risk Reduction DRR (DEZA/SDC)
- WMO Standing Committee DRR, Early Warning for All initiative
- UNDRR and UN Sendai Framework, Swiss Reporting of Target G



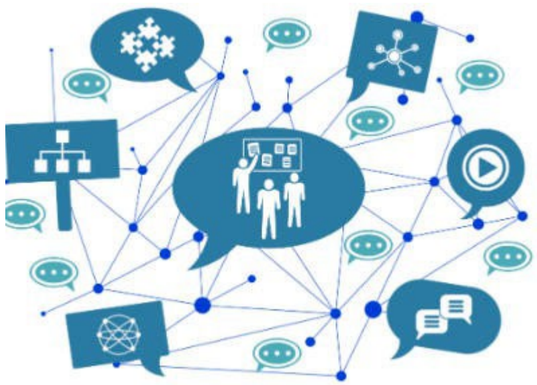
Conclusions: is Switzerland prepared?

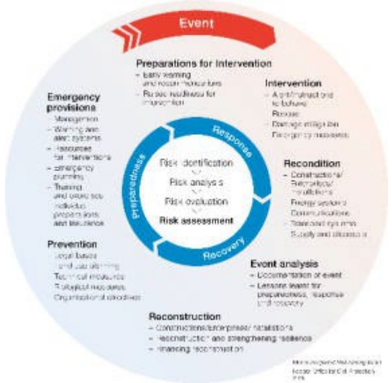
YES

- integral risk management (IRM) and risk developments caused by climate change and land use are **well anchored in Swiss legislation**
- we deliver effective **multi-hazard, cross-sectoral** warnings, we are **proactive** and refine warning **products, optimized** for different use
- we foster organizational **frameworks for collaboration** among stakeholders
- we ensure involvement of all actors in **data collection, forecasting** and **early warning,** speak as **one single voice** («whole-of-government service»)







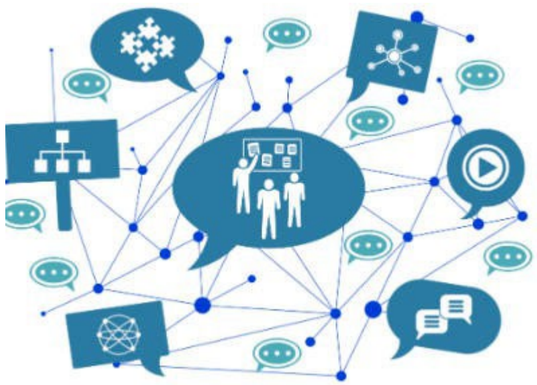
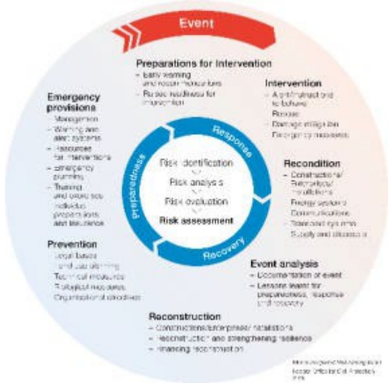


Conclusions: is Switzerland prepared?

SUT

- we have to **avoid new risks** and deal with **residual risks**
- we have to acknowledge intertwined, compound, cascading multi-hazards that may intensify with **climate change**
- we must keep pace with **new technologies,** increasing **societal demands**
- we have to ensure (existing) **business continuity**
- we need to make the most out of **limited resources**



Need for action on new measures

- Improved early warning of extreme precipitation
- next generation weather radar
- consolidation and strengthening of the warning chain
- early warning of alpine mass movements
  - merge existing monitoring data on national scale
  - advance methodology for early detection of instabilities
  - establish regular exchange betw. Federal and Cantonal authorities

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Lenkungsausschuss Intervention Naturgefahren LAINAT
Comité de direction Intervention dangers naturels
Comitato direttivo Intervento pericoli naturali
Steering Committee Intervention in Natural Hazards

Secretariat

Thank you for your attention

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@lienert

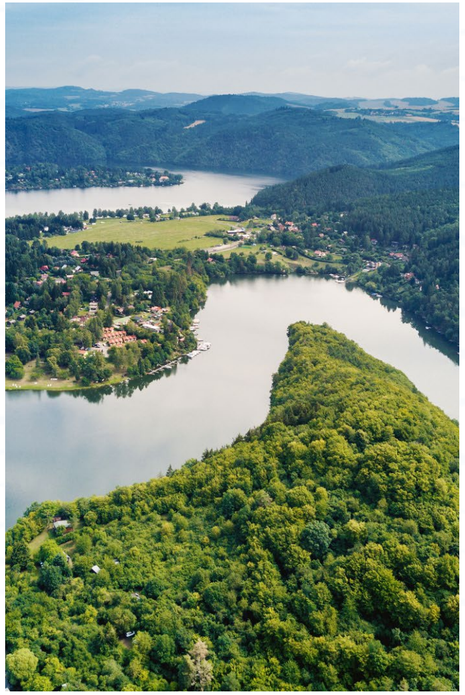
lienert

christophe.lienert@bafu.admin.ch

References, further reading (selection)

- **Websites Federal Offices**: Mit Warnungen vor Überschwemmungen schützen (admin.ch); Gefahren - MeteoSchweiz (admin.ch); Warnung bei Naturgefahren (admin.ch); SED I Earthquake Early Warning (ethz.ch); White Risk
- **Swiss Agency for Development and Cooperation SDC**. Newsletter N°1/2023 – Digitalization in CC, DRR and Environment Interview_LAINAT.pdf (weaver.ch), accessed September 2026.
- **Lienert, C.** (2025). Early warning – international collaboration using map-based and user-centered approaches. *International Journal of Cartography*, *11*(2), 235–245. https://doi.org/10.1080/23729333.2025.2479429
- **Lienert C., Angly F., Neversil S., Meier D. (2021)**. The public Swiss natural hazard portal for warnings and recommended behaviour. https://doi.org/10.5194/ica-abs-3-180-2021, accessed September 2026
- **Switzerland: Voluntary National Report of the** Midterm Review of the Sendai Framework (undrr.org), accessed September 2026.

Panel Discussion







Q&A

WMO activities on flood management

Ramesh Tripathi, WMO

07 October 2026

Tranboundary Flood Risk Management (TFRM)

- **Practical guide on ‘Transboundary Flood Risk Management’**
- Experts from WMO Members, WMO, UNECE, and others
- **Practical/Operational guide with case studies** rather than theoretical or research documents
- Possibly available in 2027
- Draft publication will be shared with experts for review and feedback

Table of Contents

Practical Guide (A primer) on Transboundary Floods Risk Management
(40–50 pages)

0 Scope of Practical Guide

1 Fundamentals and Issues of Transboundary Floods
(state-of-the-art, problem definition)

1.1 Preliminary problem definitions on hydrological extremes
(Using as trigger ‘Nature pleads not guilty’ ideas, R. García 1972)
- 1.1.1 Hydrological Extremes, hazards and risks
- 1.1.2 Transboundary Floods
- 1.1.3 E2E Value chain for Flood Management

1.2 Transboundary floods management issues: territorial, cultural and technological constraints
(Using as trigger geographical asymmetries/stressors/ conflicts)
- 1.2.1 Upstream-downstream geographical problem
- 1.2.2 Cultural constraints
- 1.2.3 Technological constraints
- 1.2.4 Institutional constraints (Political)
- 1.2.5 Sustainability

1.3 Best practices and Limitations on integrated flood risk management in transboundary basins
- 1.3.1 E2E Transboundary Flood Alert Systems
- 1.3.2 E2E Transboundary Flood Risk Profiles
- 1.3.3 Flood Risk and Hazard Integrated Decision Support Systems

2 Flood Monitoring and Forecasting on transboundary basins

2.1 Flood monitoring and forecasting products
- 2.1.1 Type of mechanisms, spatial and temporal scales
- 2.1.2 User segments and requirements (Thresholds defining)
- 2.1.3 Impact-based flood forecasting products (provide examples)

2.2 Data infrastructure and data policies
- 2.2.1 Data infrastructure requirements: data types and exchange media
- 2.2.2 Data policies and data exchange formal arrangements

2.3 Dissemination and communication
- 2.3.1 Efficient dissemination and effective communication principles
- 2.3.2 Multicultural/plurinational problems on joint services

2.4 Case descriptions
- 2.4.1 Africa (Nile Basin)
- 2.4.2 Asia (Mekong Basin)
- 2.4.3 South America (La Plata/Amazonas)
- 2.4.4 North America, Central America and the Caribbean (Lempa & others)
- 2.4.5 South West Pacific ()
- 2.4.6 Europe ()

3 Flood risk management on transboundary basins: planning and implementation

3.1 Elements and scope of hydrological risk management planning
- 3.1.2 Corrective Disaster Risk Management
- 3.1.3 Compensatory Disaster Risk Management
- 3.1.4 Prospective Disaster Risk Management

3.2 Roles of National Hydrological Services and Transboundary basins organizations *(provide examples)*
- 3.2.1 Policy, plans, and governance framework
- 3.2.2 Institutional and legal frameworks for cooperation

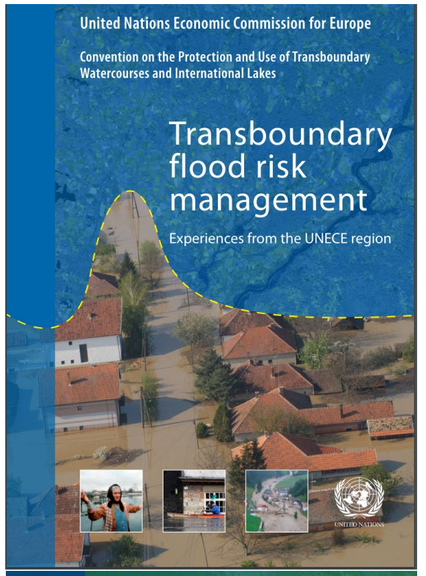
3.3 Flood Prevention and Mitigation Measures
- 3.3.1 Structural measures: dams, levees, retention basins, flood diversion channels
- 3.3.2 Non-structural measures: zoning, land-use planning, ecosystem-based solutions
- 3.3.3 Integrated watershed management approaches
- 3.3.4 Cost-benefit analysis of mitigation options in a transboundary context

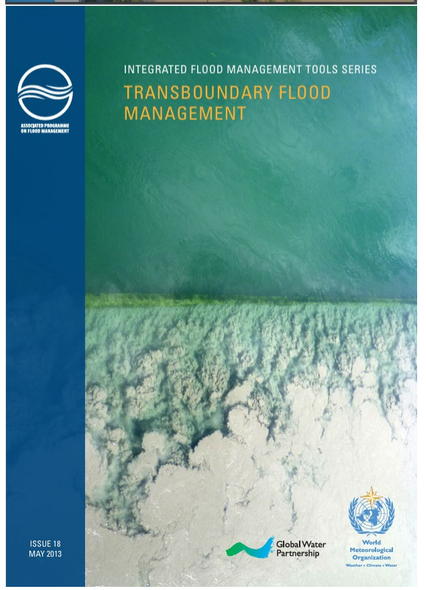
3.4 Flood risk community intervention strategies

4 UN initiatives related to transboundary flood risk management
- 4.1.1 Data infrastructure: WIGOS/WHOS
- 4.1.2 Hydrometric networks and novel techniques: HydroHub
- 4.1.3 Flood Forecasting Framework: FFF
- 4.1.4 S2S Status and Outlooks: HydroSOS
- 4.1.5 Flood management projects such as Volta Flood and Drought Management, Water at the Heart of Climate Action
- 4.1.6 UNECE
- 4.1.7 UNESCO

5 Wrap-up and Recommendations

Annex
- Checklist
- Decision Tree Diagram

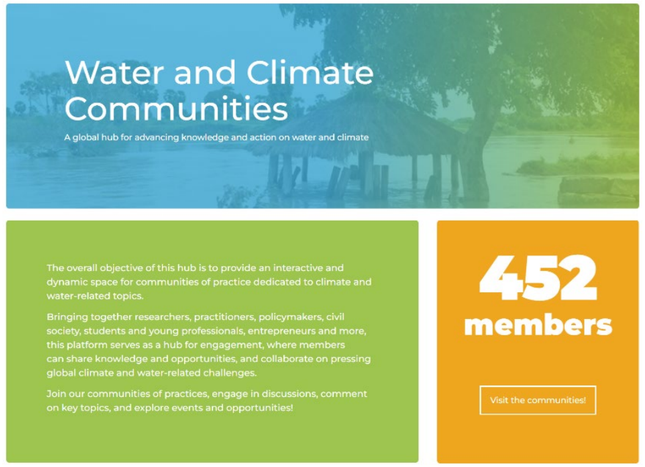




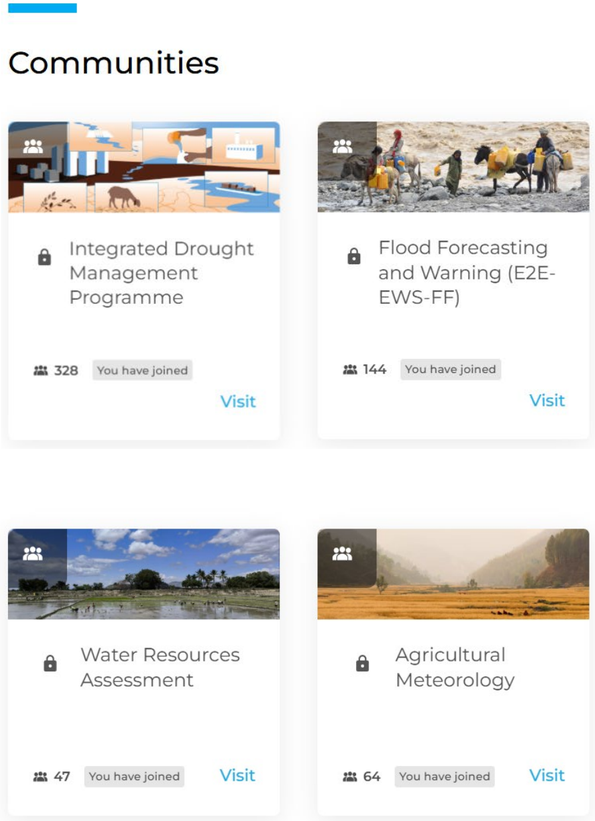
Community of Practice (CoP) on E2E - EWS for Floods Forecasting and ServiceDesk

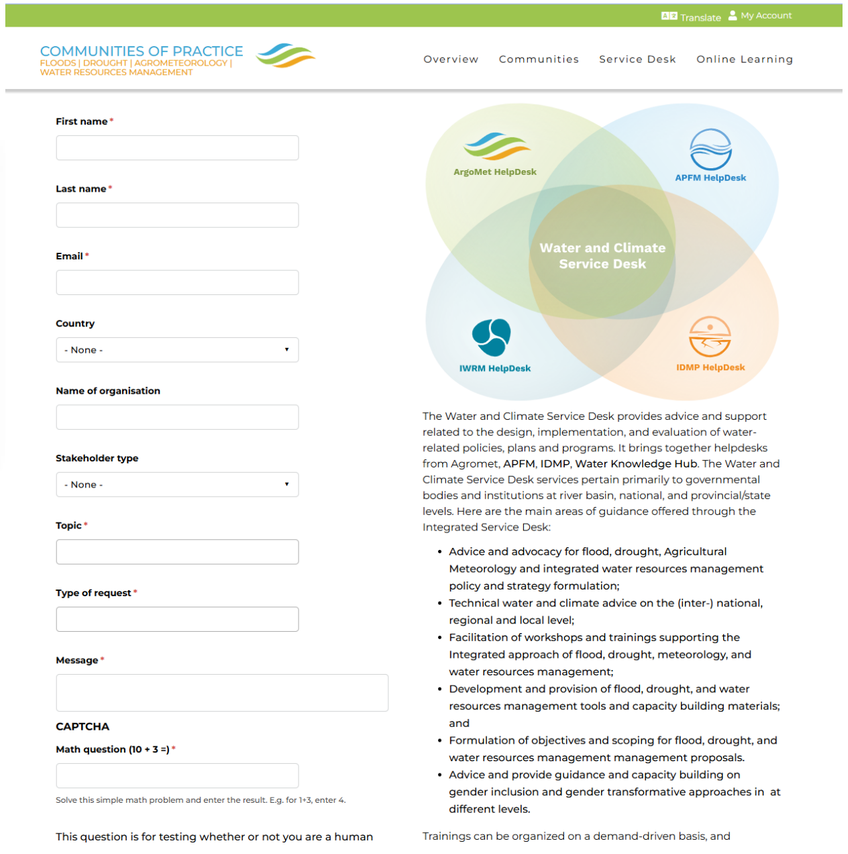
It facilitates expert discussions, webinars, training sessions and case studies to improve technical capacity and operational readiness in E2E-EWS for floods, contributing directly to global efforts such as WMO's Early Warnings for All initiative linking with COPs on integrating drought management, agricultural meteorology and water resources assessment.

Community of Practice (CoP) on End-to-End Early Warning Systems for Flood Forecasting (E2E-EWS-FF) (presently active with 140 plus experts) and the Water and Climate ServiceDesk.



Scan here to join CoP and use ServiceDesks





Associated Programme on Flood Management (A PFM)

25 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

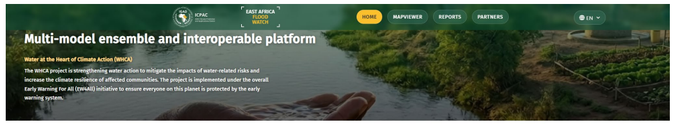


IFM integrates **land use** and **water resources** in a river basin, in accordance with Integrated Water Resources Management, with the objective of **maximizing net benefits** derived from the use of floodplains and **minimizing loss of life** due to flooding. IFM keeps in consideration environmental preservation, balancing development needs with **flood risk** towards **sustainable development**.

Activities of the APFM

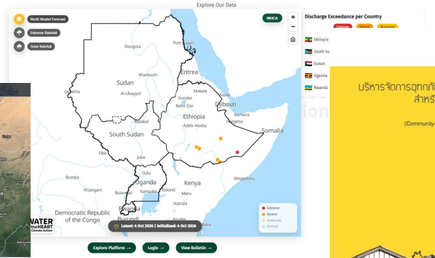
- Development of IFM guidance and advisory tools
- Developing training materials and Capacity building
- Strategic advice on flood management through the IFM HelpDesk
- Implementing Regional, National and Community-based IFM projects













Integrated Flood Management HelpDesk

A facility to provide guidance on flood-related issues to countries that seek to adopt the IFM concept.

BENEFICIARIES

Government agencies on various levels, CBOs, RBOs, Voluntary Organizations, Bi- and multilateral Organizations, Universities

Request for **assistance**: preparation of project proposal, supervision of technical implementation **capacity building,** training and advocacy material

HelpDesk For Integrated Flood Management

http://www.floodmanagement.info/ifm-helpdesk/

Looking for stronger collaboration

Technical input

30 plus SUPPORT BASE PARTNERS

Institutes specialized in various disciplines relevant for IFM

WORLD METEOROLOGICAL ORGANIZATION

Global Water Partnership

30 Support Base Partners (SBPs)

Specialized institutes in various disciplines relevant for IFM

adpc · ALTERRA WAGENINGEN UR · anteagroup · Australian Government Bureau of Meteorology · bfg Bundesanstalt für Gewässerkunde · Cap-Net · Centre for Ecology & Hydrology · crealp · ČHMÚ · cimaresearch · Deltares · DHI · EUROAQUAE · HKV · JICE · CARITAS · CAWR Center for Advanced Water Research · IUCN · IAHS AISH · ICHARM · K&I Conoscenza e Innovazione · PROHIMET · RIVERS WITHOUT BOUNDARIES · IRHA International Rainwater Harvesting Alliance · TUHH Technische Universität Hamburg-Harburg · UNECE · UNESCO-IHE Institute for Water Education · UNU-FLORES · People in Need · WWF · esepia · the bright initiative by Bright Data · WATER YOUTH NETWORK · VORTEX-IO · WATER FRAMES · SMHI

http://www.floodmanagement.into

Closing & Key Messages

THANK YOU.

WORLD METEOROLOGICAL ORGANIZATION

GLOBAL WATER PARTNERSHIP ORGANISATION

ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT