

The Adaptation at Altitude Knowledge Network 'Solution Showcase': the cryosphere edition



Swiss Agency for Development
and Cooperation SDC

Rosie Witton and
Kate Williamson

29th October 2024



Agenda:

Welcome (5 minutes)

Solution Showcase and Q&A (20 minutes)

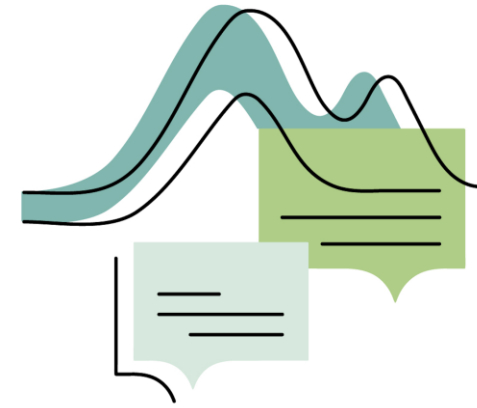
- Zhanar Raimbekova – GLOF Protection Measures in Kazakhstan

Global Mountain Safeguard Research (GLOMOS) and the cryosphere - Stefan Schneiderbauer (20 minutes)

COP29 & the International Year of Glaciers' Preservation (5 minutes)

AOB (5 minutes)

Welcome to the A@A Knowledge Network 'Solution Showcase' on the cryosphere!



ADAPTATION AT ALTITUDE

KNOWLEDGE
NETWORK

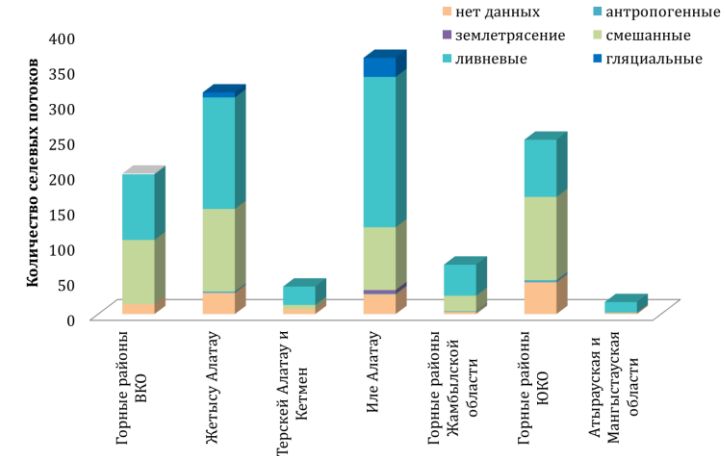
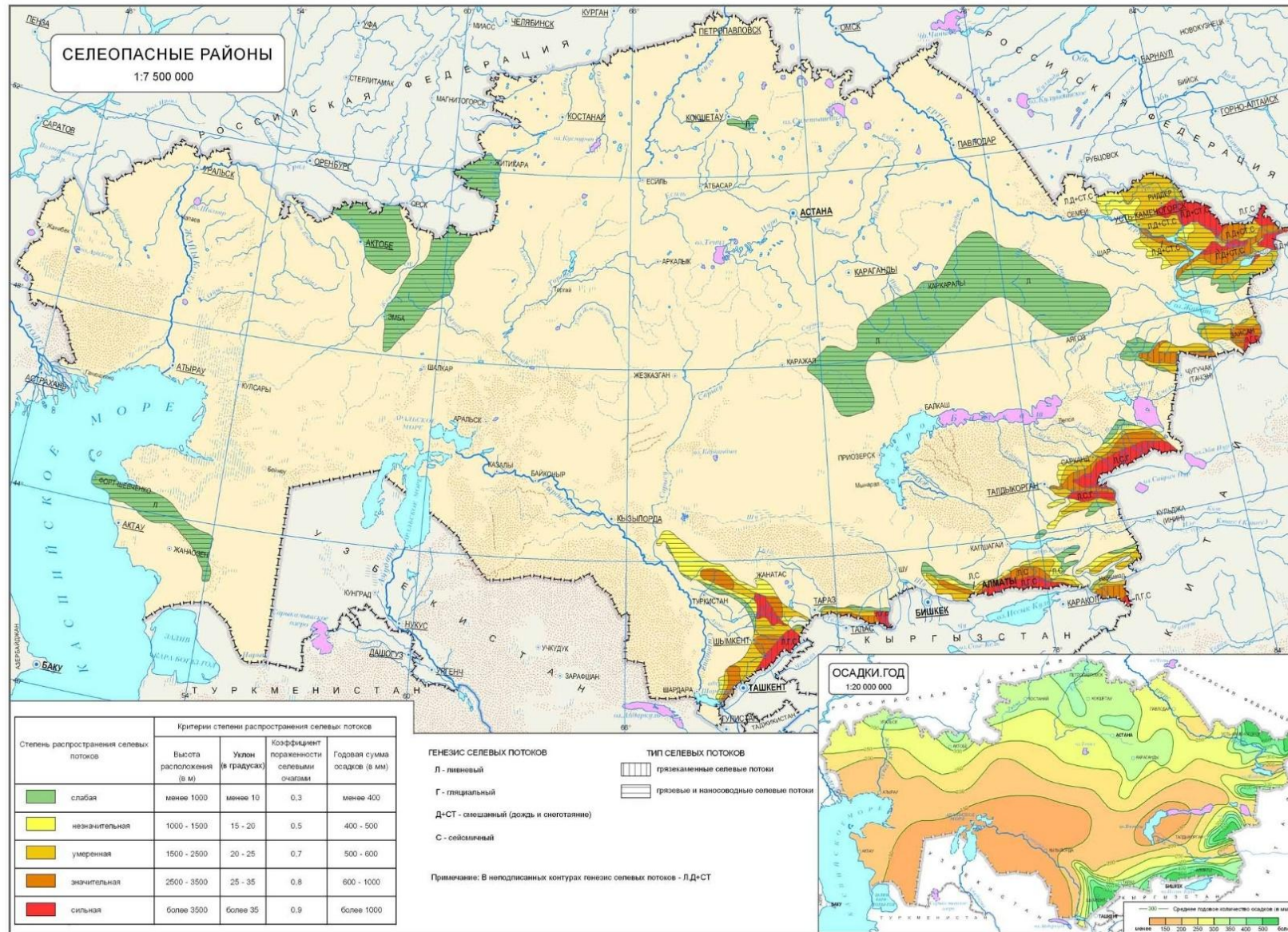
- Cryosphere = the regions across the globe that are covered in ice and snow.
- This can be in the form of ice sheets, sea ice, glaciers, snow, and permafrost, and together they make up more than 15% of the Earth's surface.
- The cryosphere – and the livelihoods and sectors that depend on its services – are being threatened by accelerating rates of warming, and changes in the volume and seasonality of snow and ice are contributing to increased risks posed by hazards, such as floods, erosion, and drought.
- Communities and sectors in mountain regions across the world are shifting practices and implementing technologies, processes, and tools to anticipate and build resilience against the impacts of climate change on the cryosphere.

GLOF Protection Measures in Kazakhstan: Insights from the **GLOFCA Project** and their impact on cryosphere-linked hazards



Zhanar Raimbekova
GLOFCA Project Researcher,
Senior Lecturer, PhD in Hydrology
Al-Farabi Kazakh National University
Zhanar.Raimbekova@kaznu.edu.kz

Cryosphere-Linked Hazards in Kazakhstan



13

Mountainous areas in Kazakhstan, %

70

Mud (debris) flow hazardous areas, %

Approaches to GLOF Protection in Kazakhstan

- In Kazakhstan, GLOF protection measures are implemented through both active and passive approaches, depending on the area's susceptibility to mudflow floods.
- Active measures typically involve engineering structures like mudflow dams and retention basins designed to directly mitigate the impact of GLOFs and floods.
- Passive approaches focus on monitoring, early warning systems, and land-use planning to minimize potential damage in vulnerable regions.



Types of hydraulic protective structures include:





The mudflow hazard period in Kazakhstan usually occurs during the months of May-September, but for GLOF hazards we work more actively in the hot months of June-August.

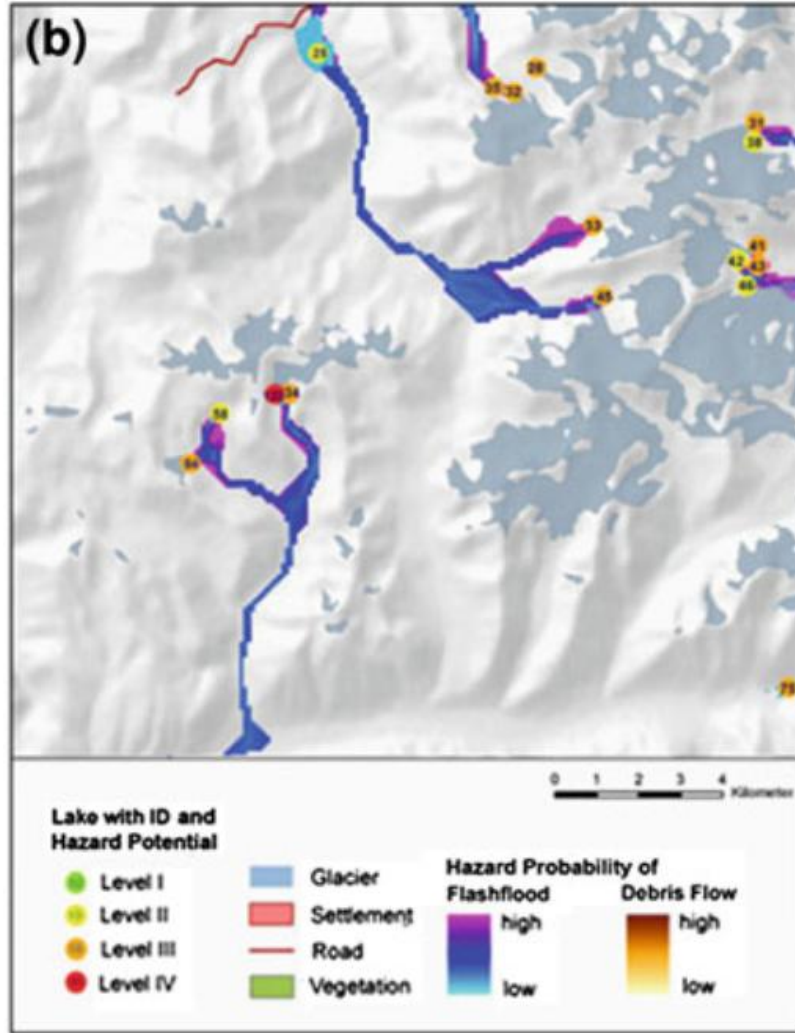
Preventive work is carried out manually, explosively and using special small-sized and construction equipment, expanding and deepening evacuation channels, installing and launching siphons with a diameter of 200 to 300 mm, pumping water from lakes with motor pumps.



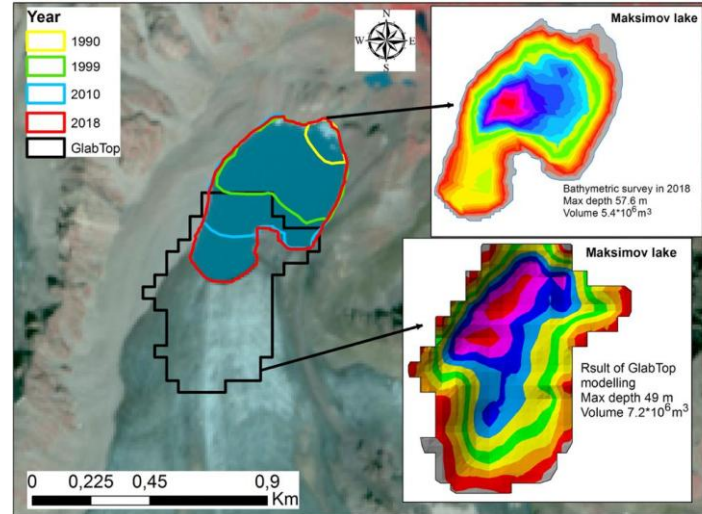
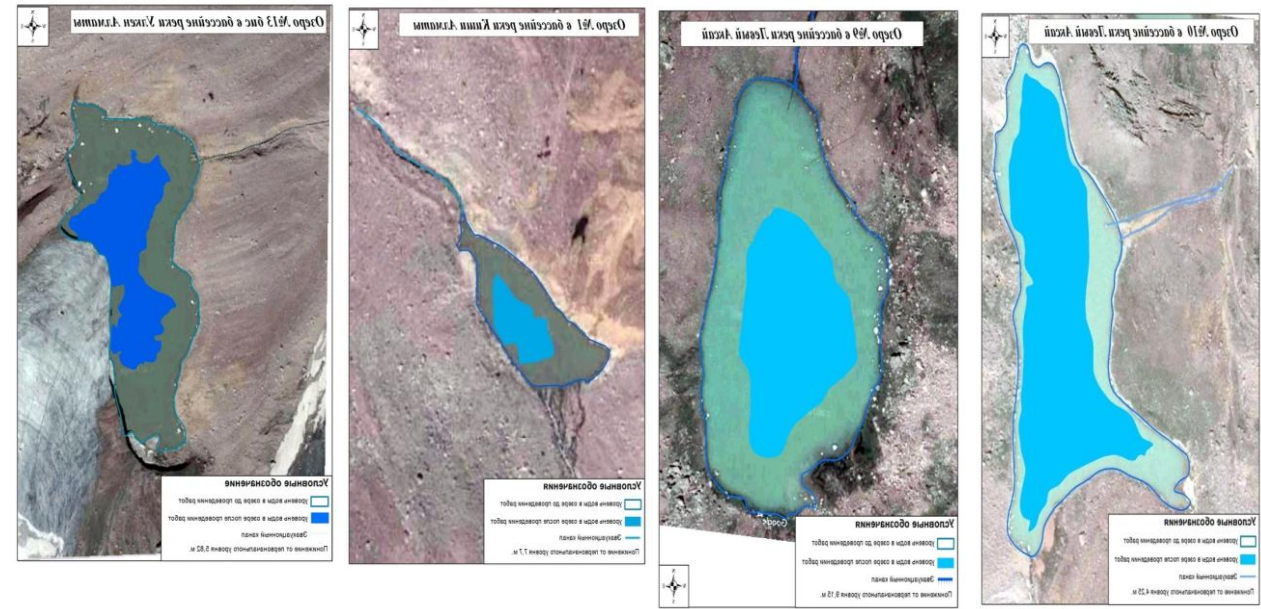


- **Preventive works** are conducted using various methods, including manual operations, blasting techniques, specialized compact and construction machinery, expanding and deepening evacuation channels, installing and activating siphons with diameters from 200 to 300 mm, and pumping water from lakes using high-capacity motor pumps.
- Each year, preventive measures are promptly carried out across the Almaty region and the city of Almaty to reduce breakthrough risks **at 15-18 moraine lakes.**

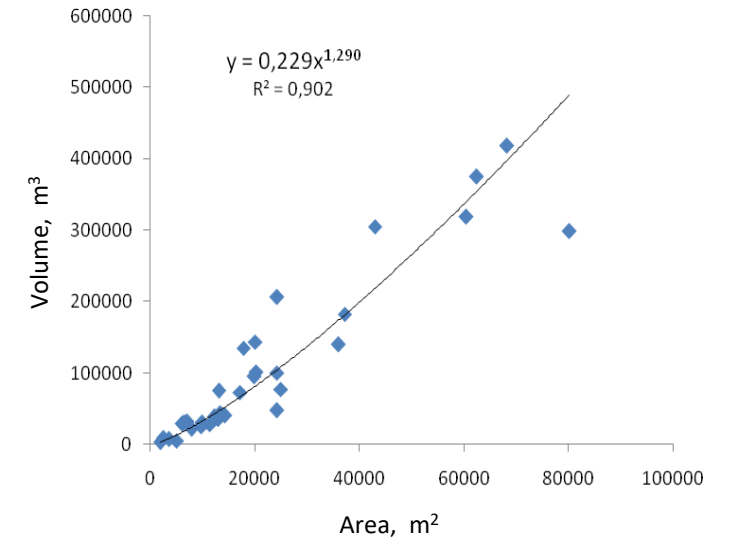
Glacier Lake volume before and after preventive works



Probability of an area affected by flash floods and mudflows ([Bolch et al, 2012](#))



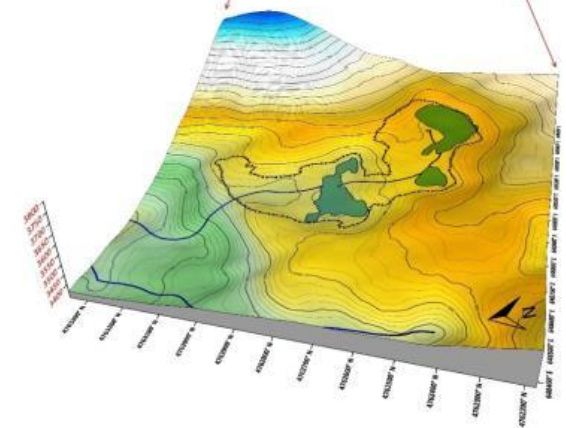
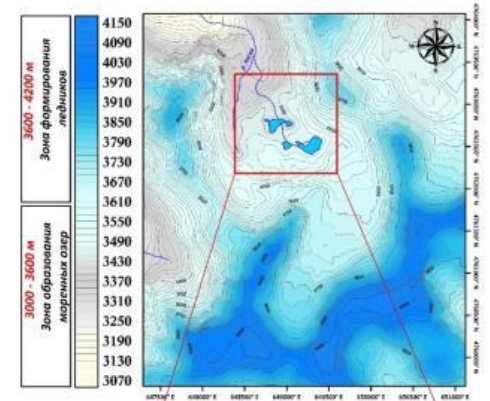
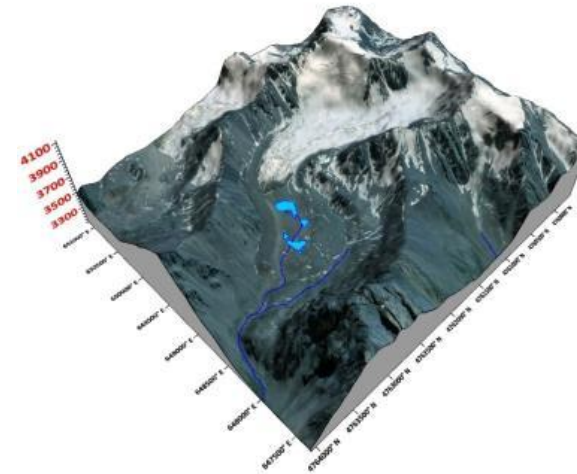
Comparison of bathymetry with results of GlabTop



Relationship between the volume and areas of lakes in the Ile Alatau



Existing Monitoring & Early Warning System



Aerial visual inspection of the moraine-glacier complex

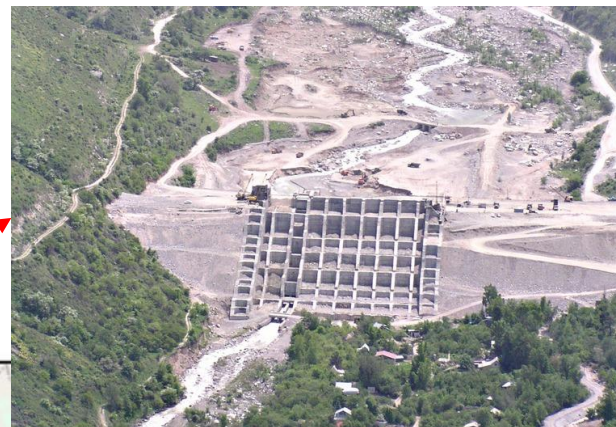
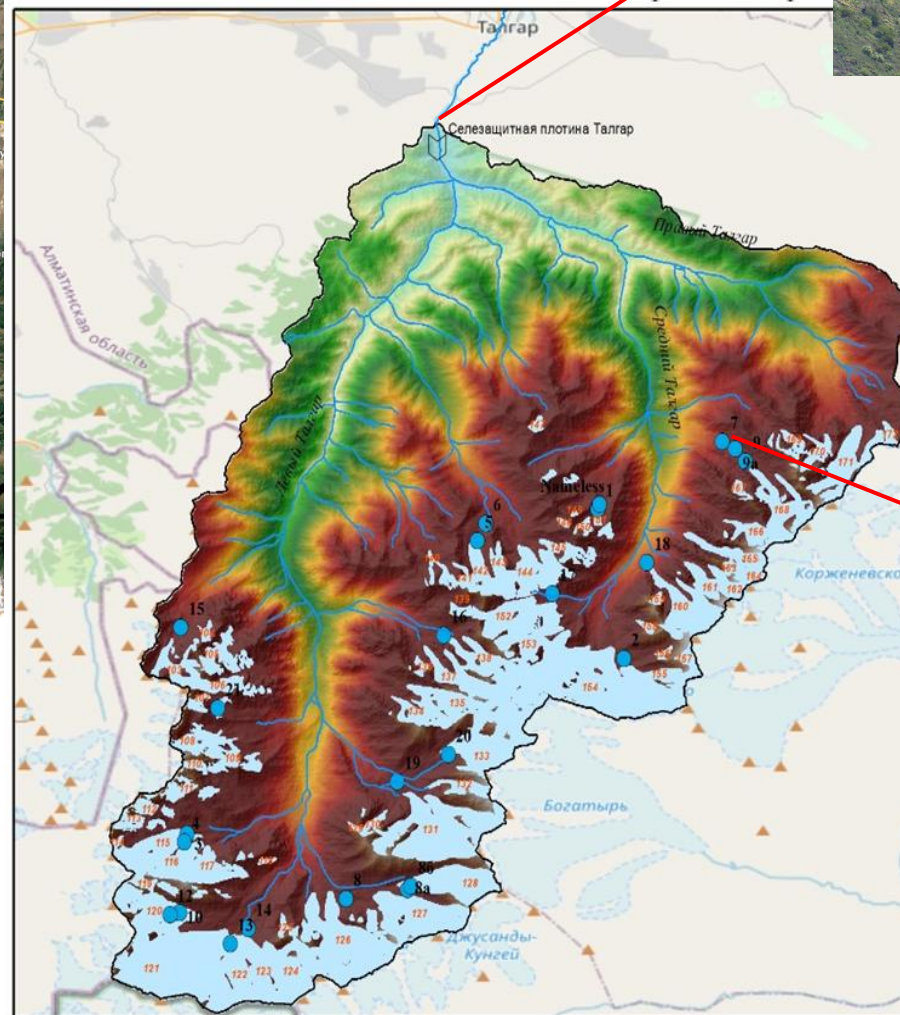




Recorded of glacier collapse moment



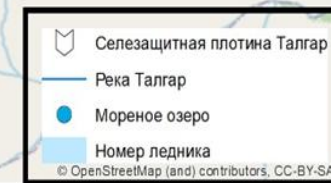
GLOFCA Pilot Site in Kazakhstan: Talgar River Basin



Talgar Dam



Moraine Lake No. 7

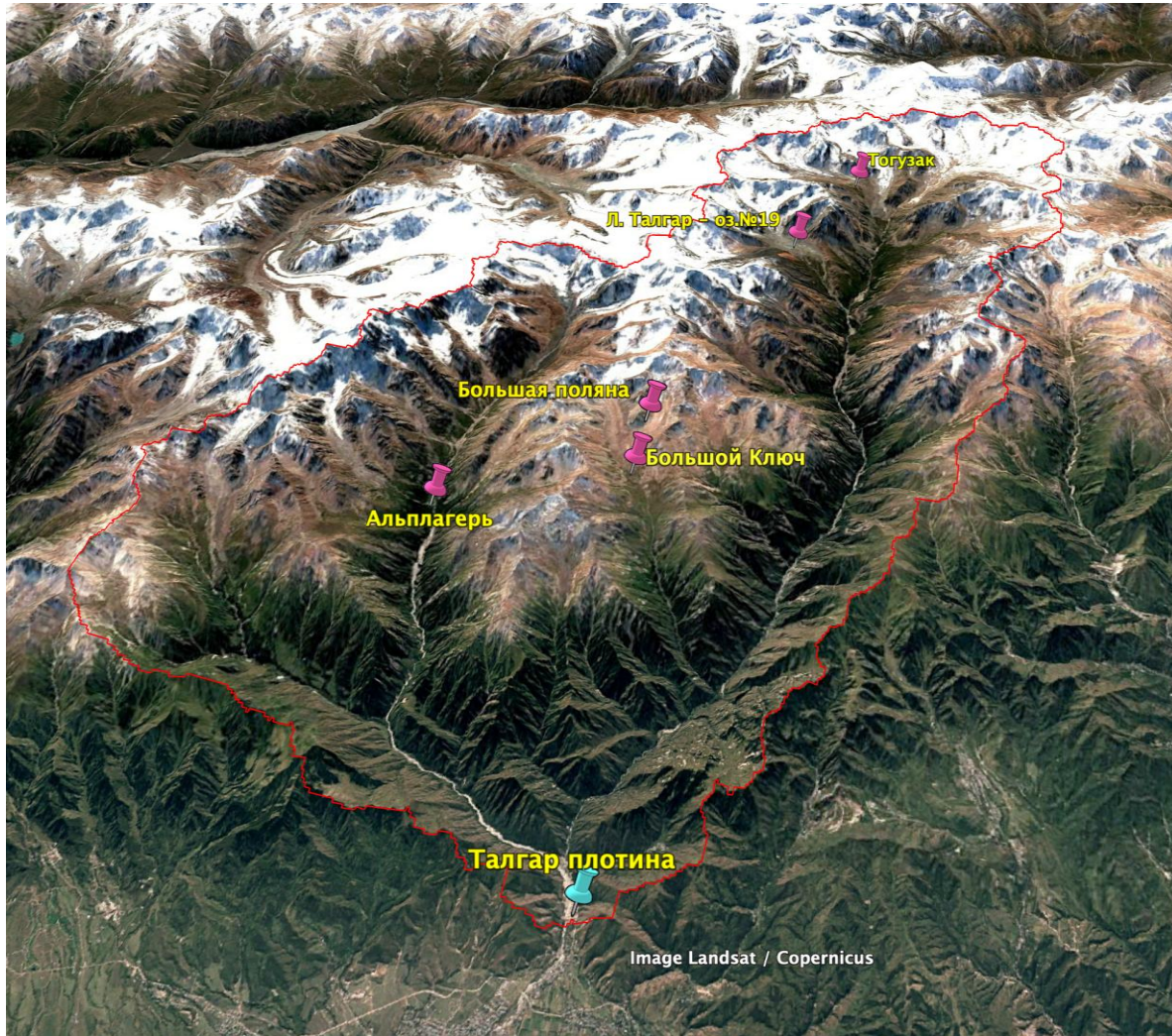


Number of moraine dammed glacier lakes - 24



№	Name / Number of the lake	Coordinates		Elevation, masl	Volume, m ³	Date of bathymetry	Hazard degree
1	Lake №1	43°8'24.84"	77°16'29.37"	3415			developing
2	Lake №2	43°5'23.37"	77°17'5.97"	3632			developing
3	Lake №3	43°1'51.28"	77°6'48.93"	3591	78 800	21.08.2019	potentially dangerous
4	Lake №4	43°1'41.60"	77°6'44.49"	3613	3 740	21.08.2019	potentially dangerous
5	Lake №5	43°7'46.30"	77°13'39.04"	3422			developing
6	Lake №6	43°8'7.23"	77°13'50.61"	3347			developing
7	Lake №7	43°9'46.53"	77°19'25.17"	3223			potentially dangerous
8	Lake №8	43°0'32.58"	77°10'33.40"	3479			potentially dangerous
9	Lake №8a	43°0'43.07"	77°12'0.07"	3743	26 500	12.07.2019	dangerous
10	Lake №8b	43°0'47.57"	77°12'4.63"	3758			developing
11	Lake №9	43°9'23.04"	77°19'57.56"	3391			dangerous
12	Lake №9a	43°9'37.85"	77°19'42.94"	3326			dangerous
13	Lake №10	43°0'15.77"	77°6'38.22"	3772			potentially dangerous
14	Lake №12	43°0'12.83"	77°6'24.49"	3793			developing
15	Lake №13	42°59'37.67"	77°7'49.85"	3597			potentially dangerous
16	Lake №14	42°59'56.47"	77° 8'15.56"	3507			not dangerous
17	Lake №15	43°6'1.64"	77° 6'40.18"	3371			potentially dangerous
18	Lake №16	43°5'51.72"	77°12'51.33"	3466			dangerous
19	Lake №17	43°6'42.31"	77°15'24.80"	3550			potentially dangerous
20	Lake №18	43°7'20.03"	77°17'38.35"	3111			not dangerous
21	Lake №19	43°2'54.60"	77°11'45.91"	3410	113 048	21.08.2019	potentially dangerous
					112 905	31.08.2020	
22	Lake №20	43°3'27.12"	77°12'58.12"	3753	21 200	21.08.2019	potentially dangerous
23	Lake №21	43°4'23.30"	77°7'32.32"	3661			developing
24	Lake "Безымянное" (unnamed)	43°8'30.86"	77°16'31.70"	3400			highly dangerous

Existing Monitoring System in the Talgar



Catchment area: 444 km²

Tributaries: Right, Middle and Left Talgar

There are **560 objects** and **20,000 people** in the GLOF risk zone.

Monitoring System:

1 year-round monitoring station;

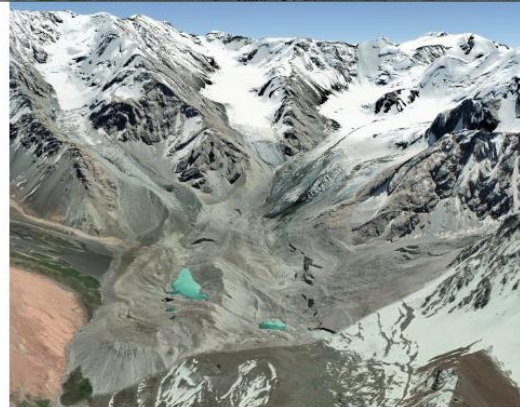
4 seasonal monitoring stations;

1-3 additional stations

Talgar debris-flow protection dam



Glacier lake A (lake number 8)
Measures water level and visual check on the process
Monitoring camera (1 s/d) or video when triggered
Trigger lines in the river bed
Communication with radio.
This location is already served by a hydro-post.



Glacier lake B (lake number 19)
Measures water level and visual check on the process
Monitoring camera (1 s/d) or video when triggered
Trigger lines in the river bed
Communication with radio.
This location is currently not monitored.



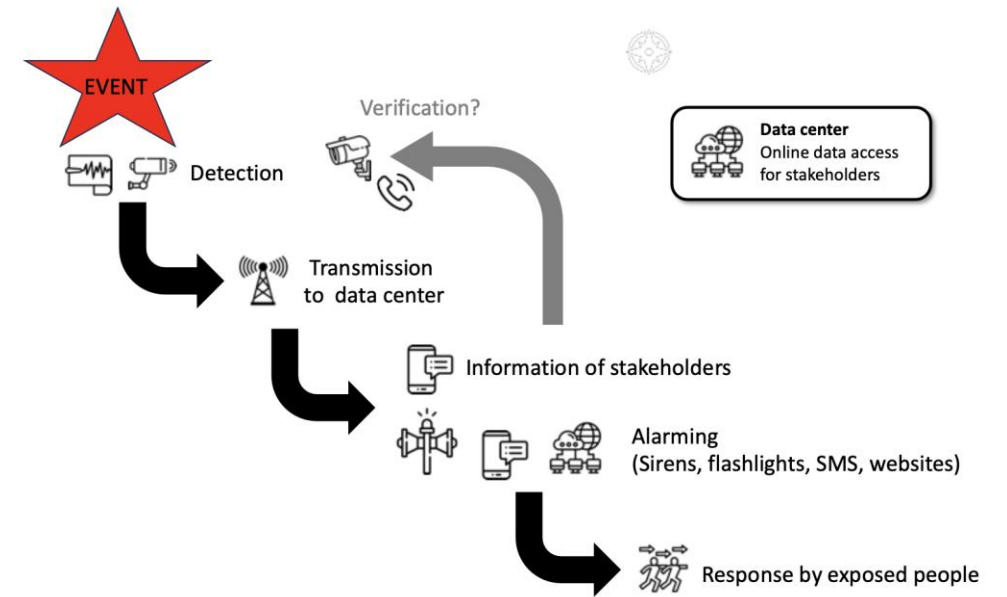
Valley sensor left (Left Talgar)
Measures water pressure and seismic signal of large boulders
Piezometers on large boulder(s)
Geophones for passive seismic
Includes multiple catchments
Monitoring camera (1 s/d) or video when triggered (automatically switch on|off)



Valley sensor right (Mid Talgar)
Measures water pressure and seismic signal of large boulders
Piezometers on large boulder(s)
Geophones for passive seismic
Includes multiple catchments
Monitoring camera (1 s/d) or video when triggered (automatically switch on|off)



Allarming at Talgar protection dam
Check for permission and feasibility.
Probably not automatic alarming, but manual control of data and alarm (check already existing protocols). The local natural hazard experts should get a message.

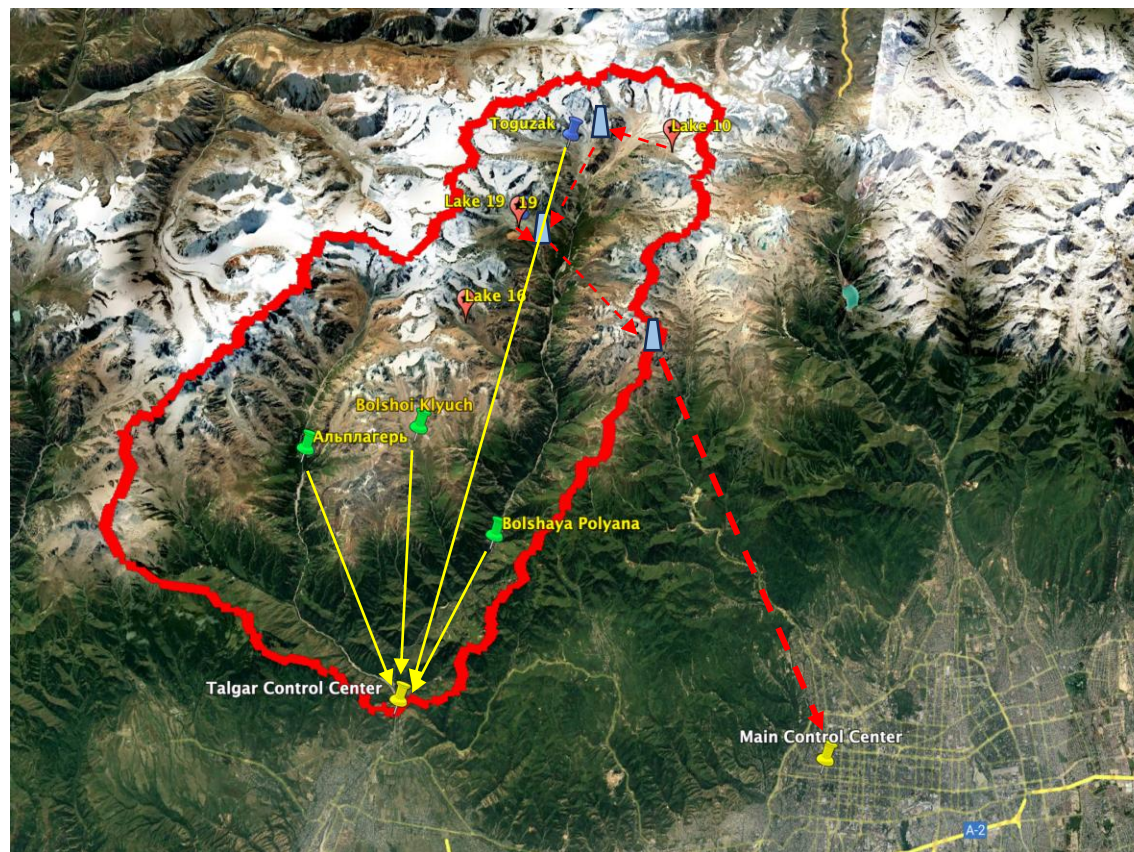
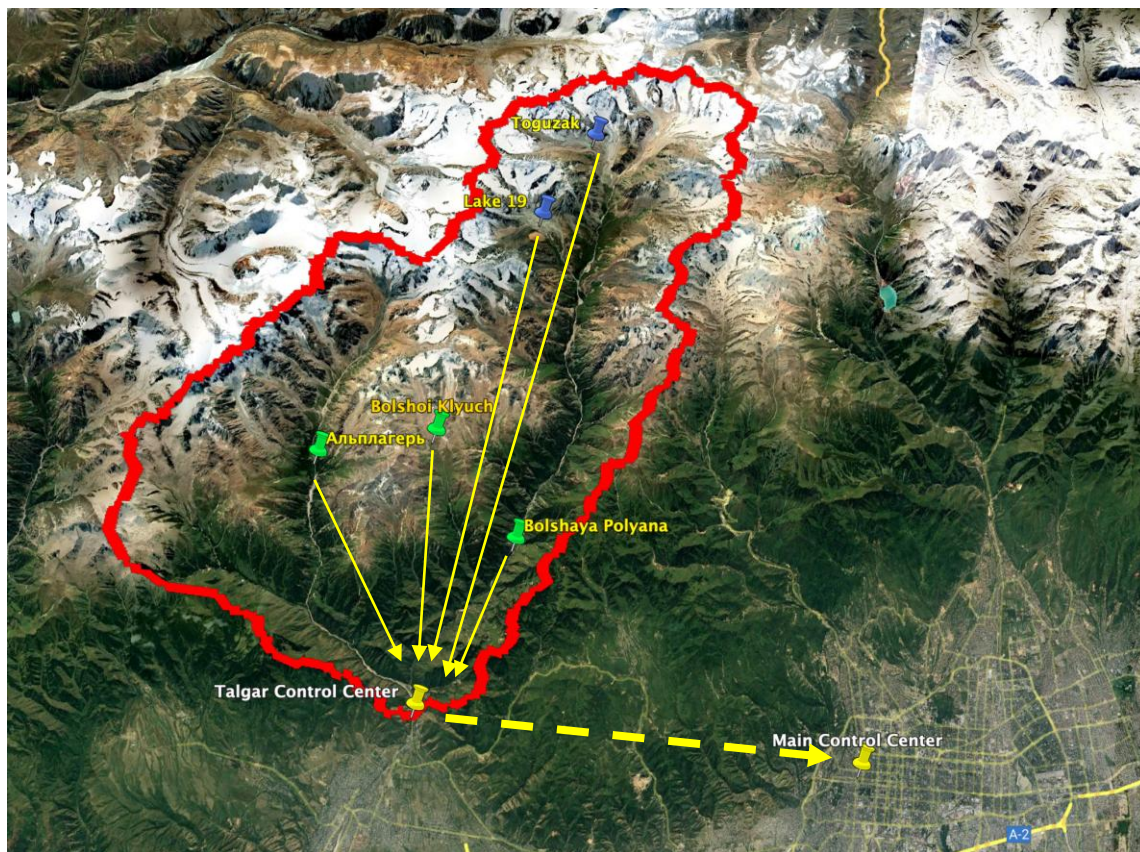


Planned Monitoring and alarming

- 2 valley sensor
- 3 lake station
- 2 retranslators



GLOFCA Implementation in Kazakhstan



Situation center

The situation center for collecting, storing, processing and visualizing incoming information in real time is a control center, on the video wall of which information about the state of moraine lakes is displayed, and also based on modeling the situation with specialized software, information is provided on predicting possible situations, such as the possibility of landslides, mudflows and so on.

- A single center for collecting, displaying and analyzing data coming from various sources;
- Organizing the interaction of relevant services for rapid response;
- Main screen - a multi-screen system for displaying various types of data and reports;
- Auxiliary equipment, electronic means of input and display of graphic data;
- Monitoring the condition of moraine lakes and riverbeds;
- Possibility of timely warning of relevant services about the possibility of an emergency.



Thank you for your attention!

QUESTIONS?

Zhanar Raimbekova

Zhanar.Raimbekova@kaznu.edu.kz

October 29, 2024



UNU
EHS



Turning science into action!

eurac
research

Global Mountain Safeguard Research (GLOMOS)

29 October 2024



Stefan Schneiderbauer & the GLOMOS team



UNU
EHS

eurac
research

GLOMOS
GLOBAL MOUNTAIN SAFEGUARD RESEARCH

A joint research programme for
the sustainable development of
global mountain regions

eurac headquarter – Bolzano / Italy



UNU Institute for Environment and Human
Security – UN Campus Bonn / Germany



GLOMOS

a joint programme of
UNU-EHS (Bonn / Germany) and
Eurac Research (Bolzano / Italy)
for sustainable development of global mountain
regions.

goals and vision

- Provide **knowledge in & for mountain regions** as well as the interconnected lowlands at all levels (local to international)
- To increase the **resilience** of mountain communities towards natural and anthropogenic **hazards and disaster risks**
- To support **adaptation solutions and sustainable transformation processes** within mountain **social-ecological systems**



GLOMOS team

Bolzano



Stefan Schneiderbauer
Head Bolzano office



Lina Rodriguez
Research Associate



Paola Fontanella Pisa
Programme Associate



Federica Romagnoli
Researcher



Miriam Recchi
Team Assistant for Bolzano

Bonn



Joerg Szarzynski
Head Bonn office



Navneet Kumar
Senior Research Associate



Dipesh Chapagain
Senior Research Associate



Dustin Wenzel
Team Assistant for Bonn

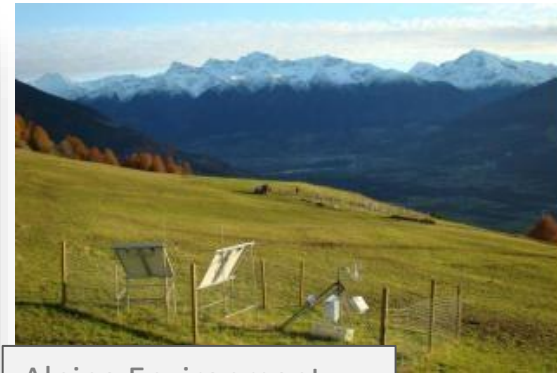


Alok Panray Beeharry
Student Assistant

→ > 600 staff

→ Yearly budget of > 100 Mio €

→ 16 Institutes / Research Centres



Alpine Environment



Regional Development



Mountain Emergency Medicine



Renewable Energies

Earth Observation



Big Data - Machine Learning



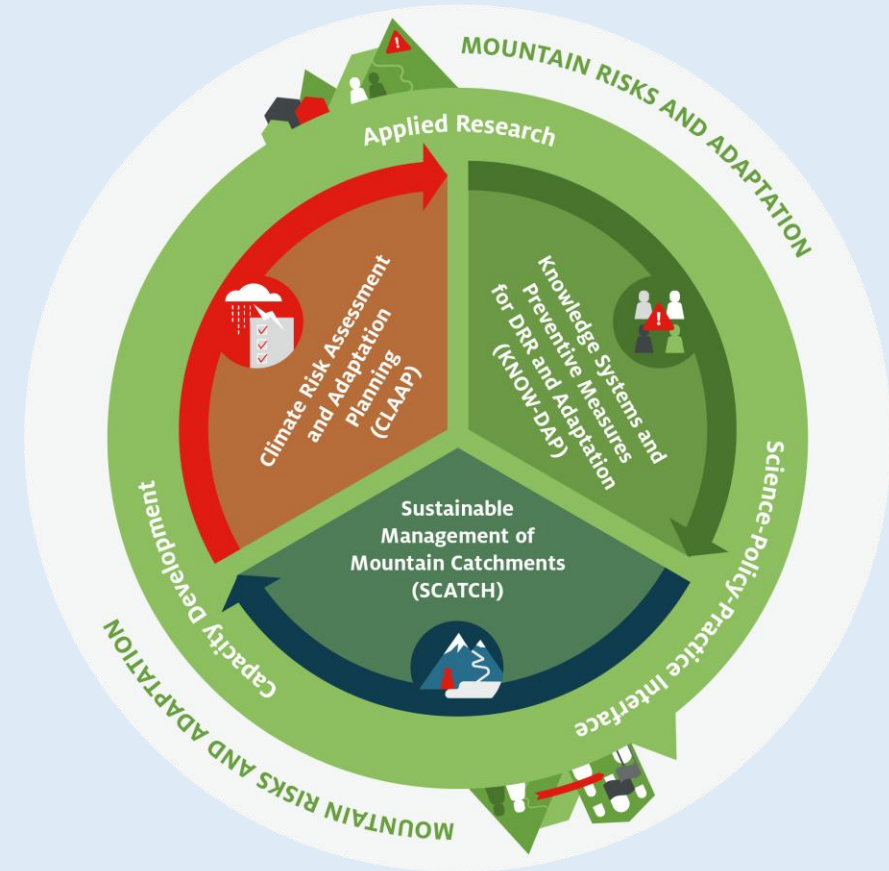
terraXcube – climate chamber

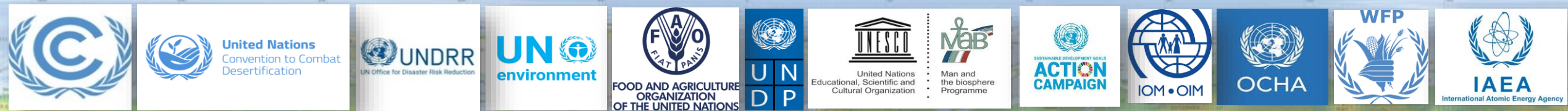
GLOMOS

related UN framework



main topics of applied research





LAC
Ecuador, Peru,
Mexico



Morocco,
Burundi



HKH
Nepal, India



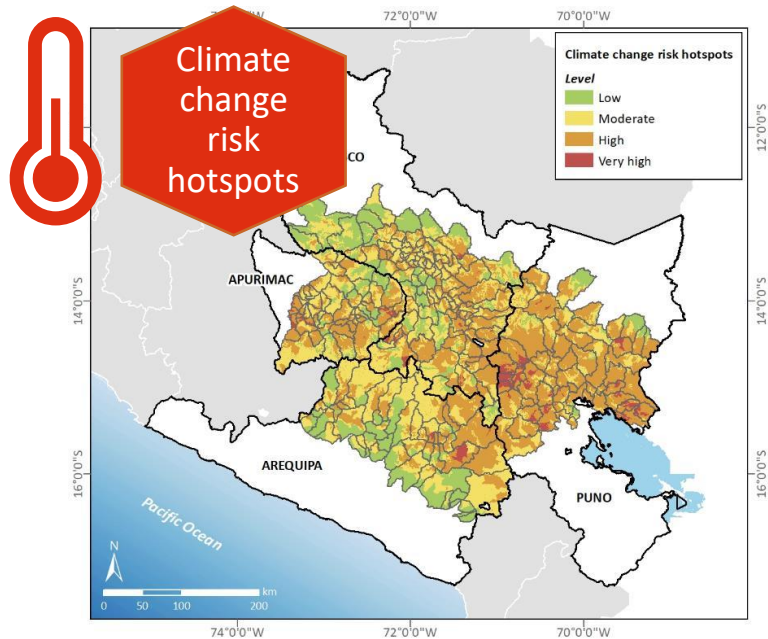
SADC
South Africa
Lesotho



Global networks, target regions and focal country network

GLOMOS Activities

Peru



Japan



Upcoming: Nepal & India

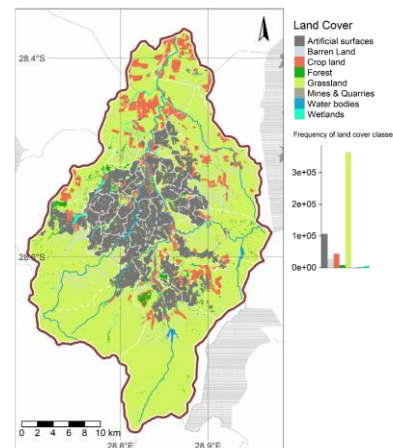
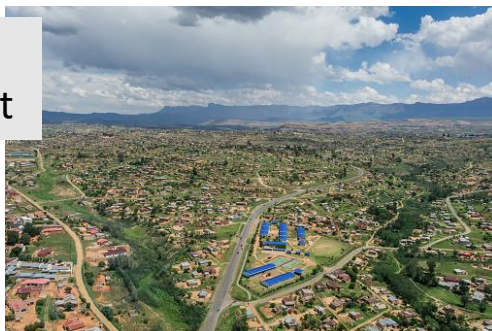


sustainable forest management for reducing disaster risk



Lesotho / South Africa

Water management



Land degradation & siltation processes



GLOMOS research: multidimensional risk in mountains

SAFEGUARDING MOUNTAIN SOCIAL-ECOLOGICAL SYSTEMS, A GLOBAL CHALLENGE

Facing emerging risks and adapting to changing environments
Volume 1 of 2

Edited by
Stefan Schneiderbauer
Paola Fontanella Pisa
John F. Shroder, Jr.
Joerg Szarzynski



Safeguarding Mountain Social-Ecological Systems, vol. 1

A Global Challenge: Facing Emerging Risks and Adapting to Changing Environments

1st Edition - December 1, 2023

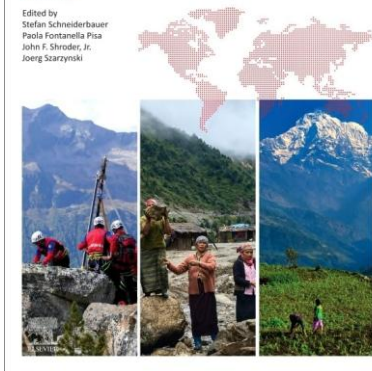
Editors: Stefan Schneiderbauer, Paola Fontanella Pisa, John F. Shroder, Jorg Szarzynski

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SAFEGUARDING MOUNTAIN SOCIAL-ECOLOGICAL SYSTEMS

Building Transformative Resilience in Mountain Regions Worldwide
Volume 2 of 2

Edited by
Stefan Schneiderbauer
Paola Fontanella Pisa
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Joerg Szarzynski



Safeguarding Mountain Social-Ecological Systems, Vol 2

Building Transformative Resilience in Mountain Regions Worldwide

1st Edition - June 28, 2024 • Language: English

Paperback ISBN: 9780443328244 • eBook ISBN: 9780443328251



Stefan Schneiderbauer, Paola Fontanella Pisa, Jessica Lucy Delves, Jörg Szarzynski, A Bustillos Ardaya, Stefano Terzi, Lydia Pedoth, S Mandira Singh, C Adler, I Alcántara-Ayala, ... [Show details for 12 authors](#)

UNU-EHS Policy briefs, Mountain Partnership

13/10/2023

Handle: <https://hdl.handle.net/10863/37207>

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Abstract

Mountains are multi-risk areas due to complex interactions between natural and socioeconomic factors. These multiple risks can manifest locally but can also have severe impacts in distant lowland areas, thus requiring coordinated approaches across sectors and regions. Moreover, mountain risks are embedded in the specific natural, cultural, social and economic contexts of mountains, which call for local knowledge and livelihood options that can adapt to and reduce exposure to these risks.

GLOMOS activities related to the cryosphere

- Mountain agenda in the UN flagship reports (UNEP AGR, UN WWDR)
- GLOMOS in IYGP 2025 task forces
- GLOF risk and adaptation strategies in the HKH region
- Adaptation in the national reports of mountainous countries
- eurac research working on global snow cover monitoring

Nature.com

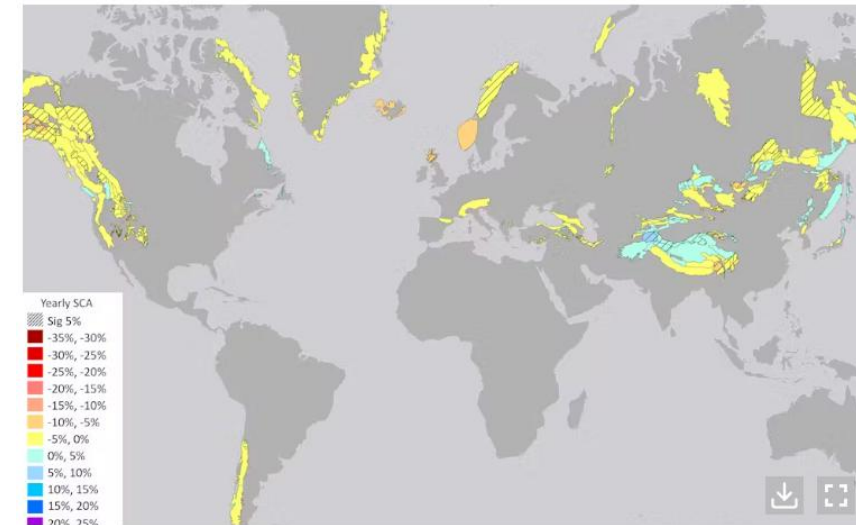


Figure 2. The extent of snow cover.
Variation is shown in percent.
Credit: Eurac Research / Claudia Notarnicola

Overall negative trends for snow cover extent and duration in global mountain regions over 1982–2020

[C. Notarnicola](#)

[Scientific Reports](#) 12, Article number: 13731 (2022) | [Cite this article](#)

7898 Accesses | 30 Citations | 488 Altmetric | [Metrics](#)

Mountain Agenda in UN Flagship Reports

Adaptation Gap Report 2024:

UNEP's annual report to assesses global progress in planning, financing, and implementing adaptation actions.

- Lead author of the adaptation finance gap chapter.
- Mountainous region highlighted for the first time: The adaptation finance requirements for mountainous developing countries (MDCs) are estimated to be USD 187 billion per year, or 1.3% of their combined GDP.
- International public adaptation finance flows to MDCs reached only USD 13.8 billion in 2022.

UN World Water Development Report 2025:

UNESCO's annual assessment of the overall state, use and management of the world's freshwater resources.

- Thematic Focus of UN WWDR 2025: "Water Towers: Mountains and Glaciers."
- Contributing author for Chapter 4 on human settlements and DRR.



GLOMOS in IYGP 2025

- In December 2022, the UN General Assembly adopted a resolution declaring 2025 as the International Year of Glacier Preservation (IYGP).
- UNESCO and WMO are co-leading the celebration of IYGP 2025, and coordinating four task forces (TFs).
- The initiative aims to raise global awareness of the critical role glaciers, snow, and ice play in the climate system and the hydrological cycle, as well as the economic, social, and environmental impacts of changes in the Earth's cryosphere.
- GLOMOS is a member of two task forces:
 - TF2: International conferences, regional workshops, and capacity building
 - TF3: Research and monitoring initiatives.



2025

**International Year of
Glaciers' Preservation**



Adaptation in the national reports of mountainous countries.

- GLOMOS contributed to the first high level expert dialogue on mountains during the UNFCCC 60th session of the Subsidiary Body for Scientific and Technological Advice (SBSTA) in June 2024 in Bonn.
- Follow-up action: we are analysing the adaptation information database for mountainous countries, based on national reports, to produce scientific insights aimed at advancing adaptation in mountain regions.





Thank you for your attention!

The International Year of Glaciers' Preservation

Do you have a climate change adaptation project/initiative in mountains that:

- Explores and applies technologies, approaches, and/or processes to adapt to the actual or expected **impacts on and risks posed by glacial retreat, snow and ice melt, and/or permafrost thaw?**
- Harnesses benefits to livelihoods, economies, and the environment?
- Demonstrates financial, economic, and environmental sustainability and have the potential to be feasibly scaled-up and replicated in other mountain regions?

If so, we want to hear from you!

We will be featuring your project/initiatives on our **Adaptation at Altitude Solutions Portal** and showcasing a selection in a **visual output** for the 2025 UN International Year of Glaciers' Preservation. If this is of interest, please reach out to adaptationataltitude@zoinet.org



#MountainsMatter

#COP29



SAVE THE DATE

COP29 Side Event

18 November 2024

10:00-11:00 (Baku time, GMT+4)
Cryosphere Pavilion & online

Glacial Lake Outburst Floods and Flows: Responding to Climate Change Risks Related to the World's Glaciers

This event, organized by the Adaptation at Altitude programme, will showcase the dangerous and deadly impacts of Glacial Lake Outburst Floods (GLOFs) in different glaciated mountain ranges and underline the importance of GLOF disaster risk management, while bringing forward solutions to reduce multi-hazard risks.





AOB

- Explore a review of recently implemented or ongoing adaptation solutions collected from the [Adaptation at Altitude Solutions Portal](#) (A@A Solution Portal) in this recently published journal paper: [Trends in climate adaptation solutions for mountain regions](#).