

GEO Mountains General Meeting 2025 #2



26 November 2025

www.geomountains.org

© Margarita Marushevska



Schweizerische Eidgenossenschaft
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Swiss Agency for Development
and Cooperation SDC

Housekeeping



- ☐ Please **raise your hand** to request the floor
- ☐ Any comments can be made / questions asked **in the chat**
- ☐ **The meeting is being recorded** – if you have any concerns about this, please let me know;
the recording may be made available upon request
- ☐ **The slides will be circulated** to registered participants afterwards

Agenda



- | | |
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| 14:05 – 14:35 | 3. Recent and ongoing GEO Mountains activities |
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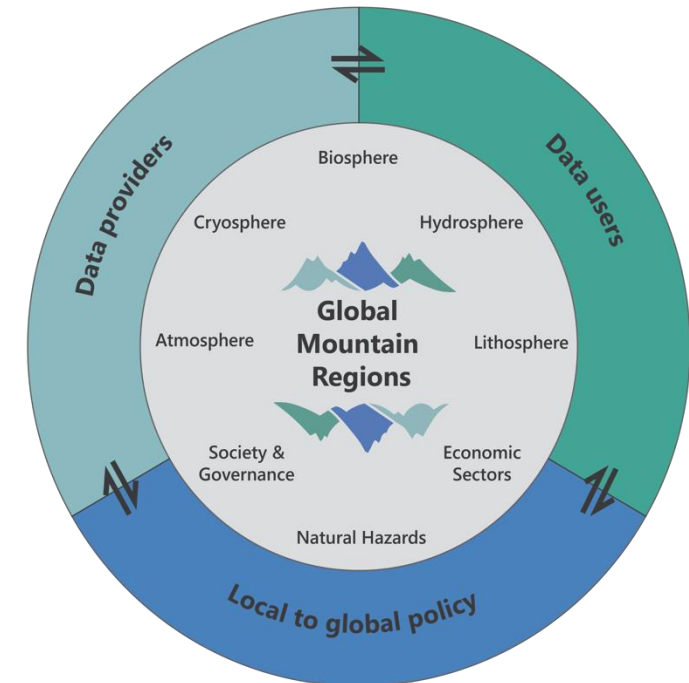


GEO Mountains

The Global Network for Observations and Information in Mountain Environments

A Group on Earth Observations (GEO) Work Programme Initiative, co-led by the Mountain Research Initiative (MRI) & the National Research Council of Italy (CNR), since 2016

- ❑ To **increase** the **discoverability**, **accessibility**, and **usability** of a wide range of **data and information** pertaining to **mountains globally**
- ❑ To **integrate** and **apply** such data and information for **scientific**, **policy**, and **practical impact**
- ❑ To **build**, **connect**, **coordinate**, and **share capacity** across a **community** of mountain researchers, practitioners, and policy makers



Adaptation at Altitude

- ❑ The **Swiss Agency for Development and Cooperation (SDC)** continues to support the GEO Mountains Secretariat and network activities (via the Mountain Research Initiative) under the Adaptation at Altitude Programme from **2024 – 2027**
- ❑ Under Outcome 1, GEO Mountains works to support bridging data & information gaps in Andes, East Africa, HKH, Caucasus and Central Asia

Climate Change
Vulnerability &
Mountain Areas



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and Cooperation SDC**

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and Cooperation SDC



CONDESAN
Consortio para el Desarrollo Sostenible
de la Ecorregión Andina

ICIMOD

UN
environment
programme

SEI Stockholm
Environment
Institute

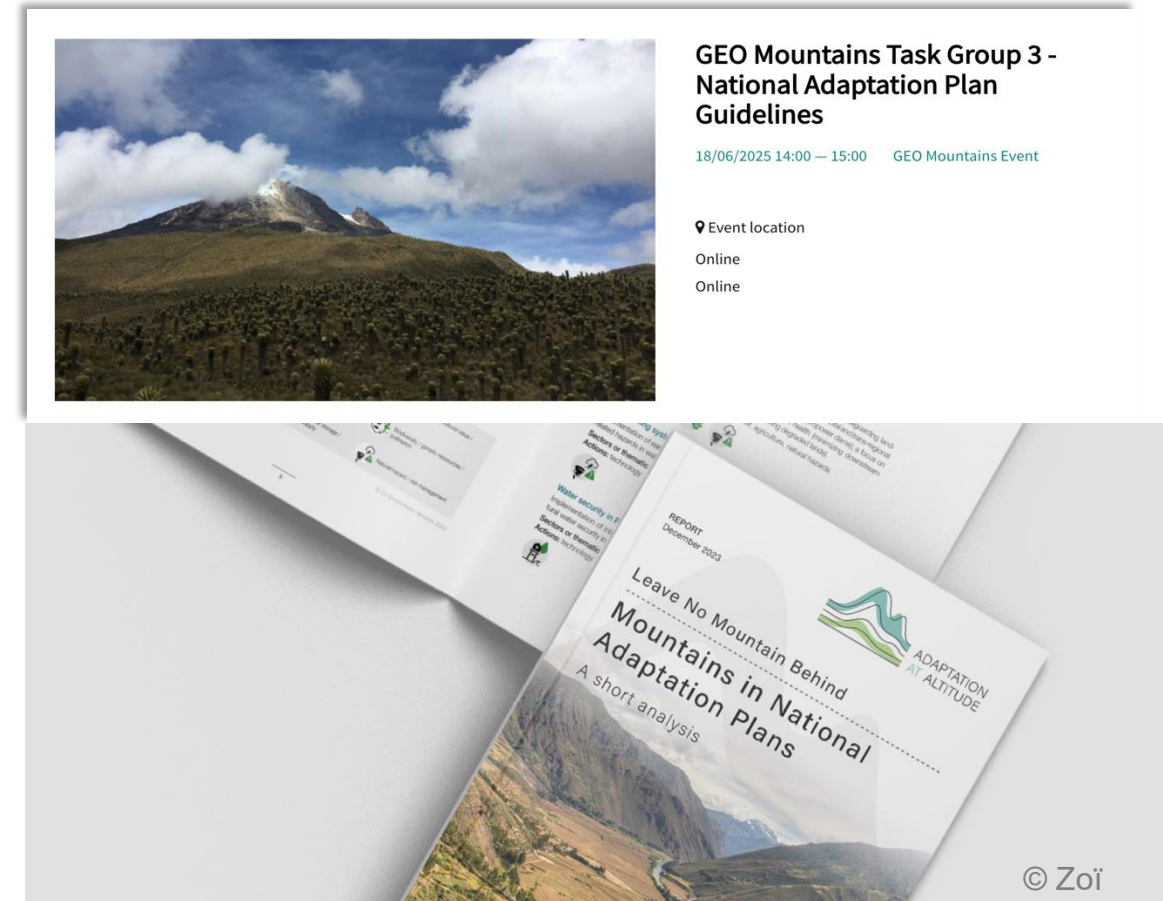


**UNIVERSITÉ
DE GENÈVE**



Task Group 3 – Global Policy Outreach

- ❑ GEO Mountains plans to develop a Technical Supplemental to the UNFCCC National Adaptation Plans (NAP) on the topic of "**Earth Observation for Monitoring Adaptation in Mountains**"
- ❑ The first TG3 meeting took place in June 2025, launching the work on the NAP Technical Supplement, outlining the potential structure of the document and seeking interest from participants.
- ❑ A preliminary analysis of NAP coverage with respect to mountains was conducted by the Zoï Environment Network in 2023, and presented during the June 2025 meeting.
- ❑ Further work with the TG will continue in 2026, with new updates based on UNFCCC COP30 outcomes.



Other updates

- ❑ The MRI and GEO Mountains participated in a "network of networks" meeting for the Andes region, held between 1-3 July 2025 in Lima, Peru. A valuable opportunity to take stock of research and monitoring network activities in the Andes, with a view to strengthen coordination efforts among activities: <https://cloc.condesan.org/redes-que-se-encuentran-taller-de-articulacion-cientifica-en-los-andes/>
- ❑ GEO Mountains was represented at the EuroGEO workshop, 13-15 October 2025, The Hague, The Netherlands. The workshop was a key event to coordinate and connect European efforts within the GEO Post-2025 phase: <https://eurogeosec.eu/egw2025/>
- ❑ MRI (GEO Mountains) invited to participate in an European Commission Horizon Europe-funded project **iClimateAction**, a collaboration between the WMO, GCOS, and GEO. The MRI is facilitating the expert consultations on ECVs in mountain regions: <https://cordis.europa.eu/project/id/101216980>
- ❑ **Outlook:** Preparation for the GEO Post-2025 Work Programme, with an updated GEO Mountains Implementation Plan for 2026-2028.



Meeting of Networks, 1-3 July 2025. Lima, Peru.
Photo:©CLOC Conectate A+ Secretariat



EuroGEO Workshop, 13-15 October 2025. The Hague, The Netherlands.
Photo:©EuroGEO Secretariat.

International Mountain Conference (IMC): updates



- ❑ 2 GEO Mountains sessions at IMC, September 2025: (1) focus session on socio-economic monitoring; and (2) workshop exploring challenges & opportunities in interdisciplinary monitoring and bridging science and policy.
- ❑ The workshop highlighted key data gaps, particularly in socio-economic and local-scale information.
- ❑ Emphasis on participatory, ethical, and standardized approaches to improve data sharing and policy relevance.
- ❑ Calls for stronger interdisciplinary collaboration, long-term monitoring support, and sustained science–policy dialogue in mountain regions.

In Situ Inventory: new version 3.2 released!

This latest update introduces several major developments:

- ❑ Expanded coverage: more stations and networks
- ❑ Network associations: Each station is now explicitly linked to the wider network or compilation it belongs to.
- ❑ Mountain range attribution: All stations are now associated with the mountain range in which they are located, based on the GMBA Mountain Inventory v2.

Published September 9, 2025 | Version v3.2

GEO Mountains In Situ Inventory v3.2

Thornton, James M. (Data curator)¹ ; GEO Mountains Network Members 

The GEO Mountains Inventory of In Situ Observational Infrastructure v3.2.

See README.md for further information.

The inventory is presented as a web map [here](#).

We specifically thank the following individuals, who directly contributed data to this release:

- Kaleb Goff (GLORIA Great Basin)
- Clara Hickman (African Mountain Research Foundation)
- Jorge Andres Huenante Gutierrez (DGA Chile)
- Sam Koehler (University of Vermont)
- Sabine Kraushaar (TUM)
- Waldo Sven Lavado Casimiro (SENAMHI)
- Norbert Lanzasato (Amt der Tiroler Landesregierung, Abteilung Krisen- und Gefahrenmanagement, Lawinenwarndienst)
- Luis Daniel Liambi (Condesan)
- Carlo Marin (EURAC Research)
- Mariano Masiokas (INIGLA)
- Victor Omoit (TAHMO)
- Nick Pepin (University of Portsmouth)
- Jingyao Zheng (Chinese Academy of Sciences)

[Dataset](#) [Open](#)

117
VIEWS

165
DOWNLOADS

Show more details

Show affiliations

Versions

Version v3.2	Sep 9, 2025
10.5281/zenodo.17086383	
Version v3.1	Sep 2, 2025
10.5281/zenodo.17036766	
Version v3.0	Sep 1, 2025
10.5281/zenodo.17020536	

[View all 3 versions](#)

Cite all versions? You can cite all versions by using the DOI [10.5281/zenodo.17020535](https://doi.org/10.5281/zenodo.17020535). This DOI represents all versions, and will always resolve to the latest one. [Read more](#).

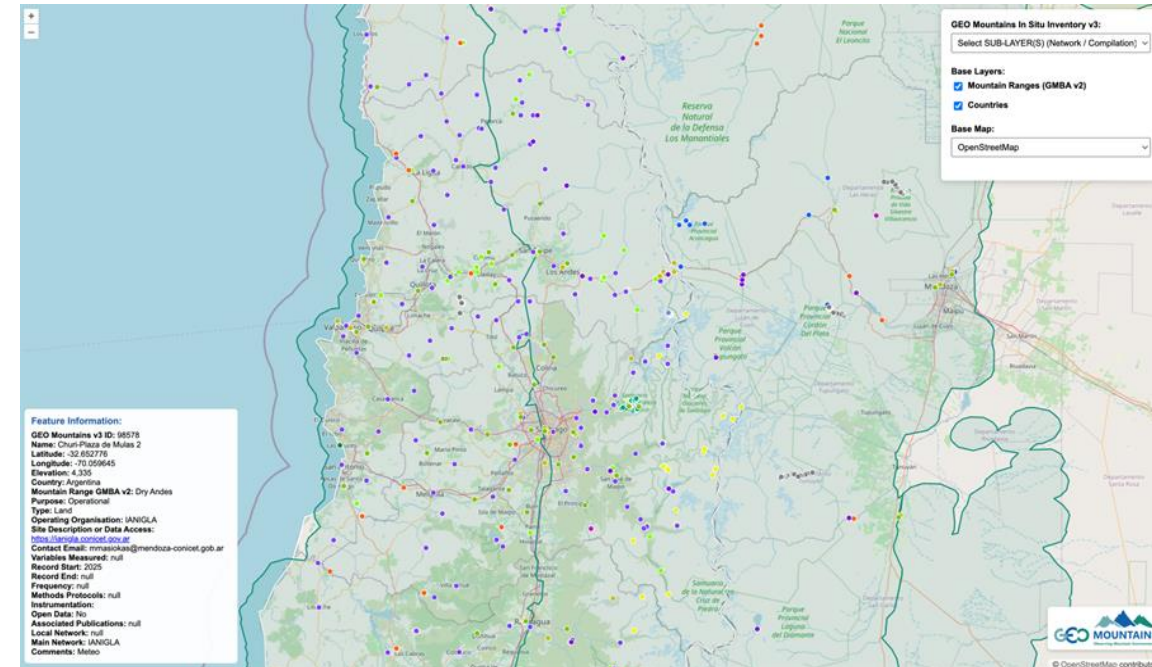


Figure 1 (left). Screenshot of the inventory page, available on Zenodo.

Figure 2 (right). Screenshot of the inventory web map interface showing all stations in region of Santiago, Chile (Andes).

<https://geomountains.org/geo-mountains-releases-a-new-version-of-its-in-situ-inventory/>

New website just launched!

- ❑ Enhanced functionality and features
- ❑ Improved project explorer – filter & search GEO Mountains activities
- ❑ Dedicated publication section: new GEO Mountains publications hub brings outputs from activities together
- ❑ Expand history section: the history page has been developed and offers a comprehensive overview of GEO Mountains' development over time
- ❑ Fresh new design and mobile-friendly layout
- ❑ <https://geomountains.org/>

Feedback is welcome!
geomountains@mountainresearchinitiative.org

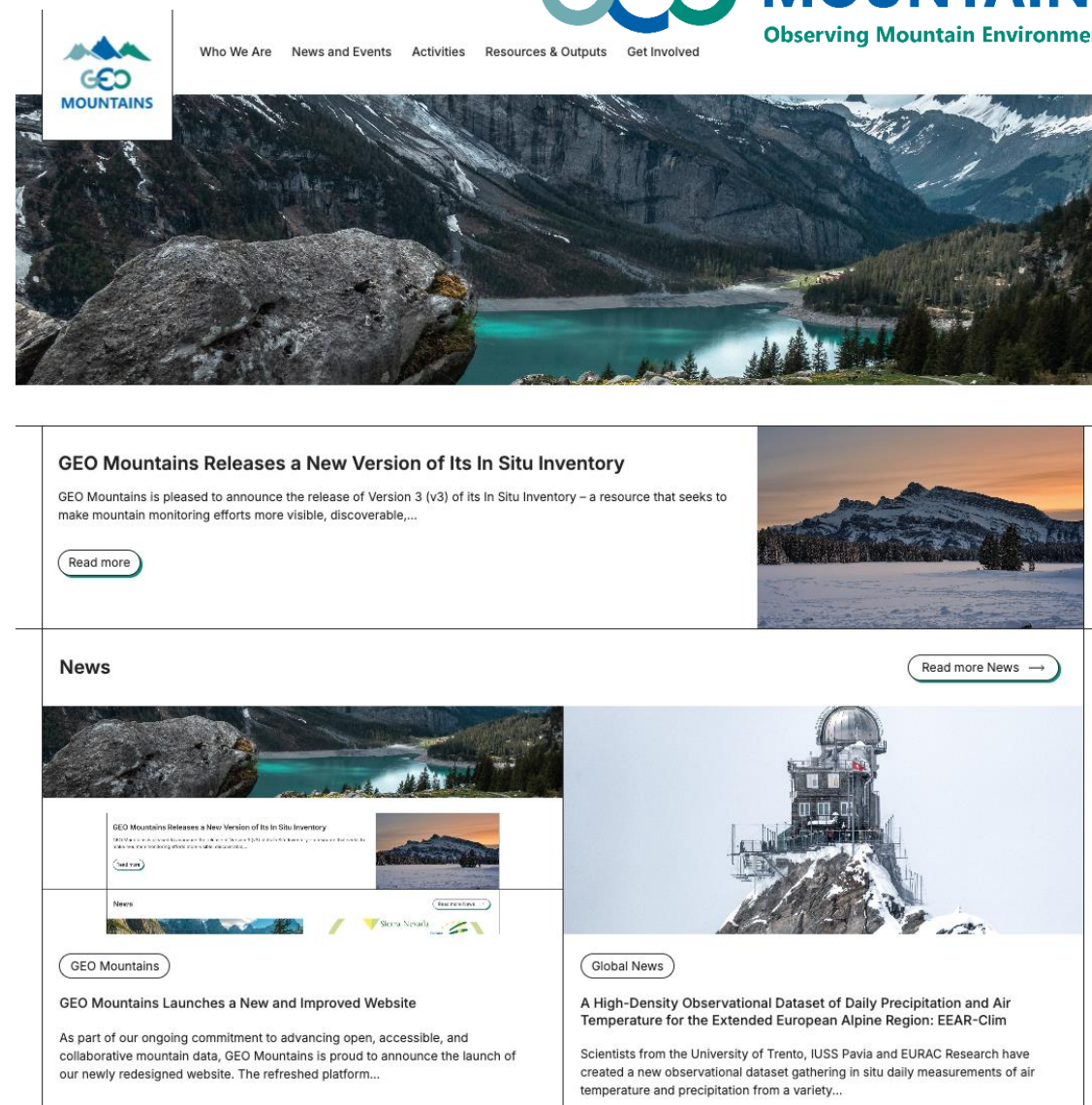


Figure 1. Screenshot of GEO Mountains brand new website.

Small Grants 2024 – 2025 & new call

- ❑ Final reports are being compiled & added to our website under the Projects page
- ❑ You can find summaries & main results on their dedicated pages
- ❑ The results will be added to the GEO Mountains inventories
- ❑ A Small Grants Campaign showcasing the results on social media & newsletter will be done in the course of 2026
- ❑ If anyone interested in presenting their work & main results at the next GEO Mountains GM, contact us.

Next Small Grants 2026-2027 Call: Call launch, 27 Nov. 2025.
See announcement and call details in the MRI Newsletter,
out tomorrow!
Deadline for submission: 20 February 2026.






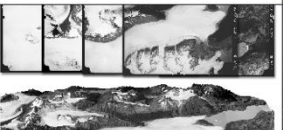


Projects

Here you'll find an overview of GEO Mountains' projects, both past and ongoing. Our work is organized into three main project types:

- 1. Secretariat-Led Projects (GEO Mountains Projects):** Those projects led by or, heavily involving, GEO Mountains Secretariat staff, often in conjunction with the GEO Mountains Task Group members and MRI Working Groups
- 2. Small Grants Projects:** Those projects funded via the GEO Mountains Small Grants Programme under Adaptation at Altitude
- 3. Community Projects:** Projects funded and/or initiated independently of GEO Mountains, but which nevertheless contribute substantially to the aims of GEO Mountains, and which the project team has agreed to list here

Small Grants Project 2024-25 Region Status Filter by Year 2015 — 2025 RESET FILTER

Search

 <p>Small Grants Project 2024-25</p> <p>Risk Assessment for Hydropower Projects from Rock and/or Ice Avalanches in High Mountain Asia (REACH)</p> <p>This project assessed the exposure of hydropower infrastructure in High Mountain Asia to cascading ro...</p>	 <p>Small Grants Project 2024-25</p> <p>Armenian (South Caucasus) Small Alpine Lakes Geoportal</p> <p>This project studied 21 small alpine lakes in Armenia to understand their hydroecology and make historical...</p>	 <p>Small Grants Project 2024-25</p> <p>Elevation Dependent Climate Change on the Slopes of Kilimanjaro and its Impacts on Water Supply</p> <p>This project used 20 years of climate data from a transect of 22 stations across Mount Kilimanjaro to...</p>
 <p>Small Grants Project 2024-25</p> <p>Unlocking Airborne Historical Stereo-Image Archives for Glacier Elevation Change Assessment in the Chilean Andes</p> <p>This project digitised and processed a unique archive of historical airborne stereo images to reconstruct...</p>	 <p>Small Grants Project 2024-25</p> <p>Long-Term Monitoring of Snow Accumulation and Related Climate Variables at a High-Altitude Cryospheric Research Site in Bhutan</p> <p>This project addresses the need for reliable in-situ data in Bhutan's remote high mountain regions by...</p>	 <p>Small Grants Project 2024-25</p> <p>Monitoring of Glaciers in the Karakoram With Special Emphasis on Water Demand and Management</p> <p>Regional Centre for Mapping of Resources for Development (RCMRD) (Kenya) & NASA (USA)</p>

<https://geomountains.org/projects-impact-stories/>

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Monitoring Mountain Meteorology and Snow Across Elevational Gradients in the Northeast Appalachians and Adirondacks in North America



Joshua Beneš (1) Mark Beauharnois (2), Arne Bomblies (1), Jay Broccolo (3), Elizabeth Burakowski (4), Paul Casson (2), Jordan Clayton (5), Patrick J. Clemens (1), Alix Contosta (4), Vamsi Dondeti (1), Keith Garret (3), Anna Grunes (1), Heather Hoffman (5), Sara Lance (2), Braedon Lineman (6), Cara McCarthy (5), Scott McKim (2), Justin Minder (2), Colby Morris (3), Georgia Murray (6), Chris Nadeau (7), Sarah Nelson (6), Kyler Phillips (6), Melissa Webb (5)

(1) University of Vermont, Farrell Hall - 210 Colchester Ave, 05465 Burlington, VT USA

(2) Whiteface Mountain Field Station and SUNY-Albany, Wilmington, NY USA

(3) Mount Washington Observatory, North Conway, NH USA

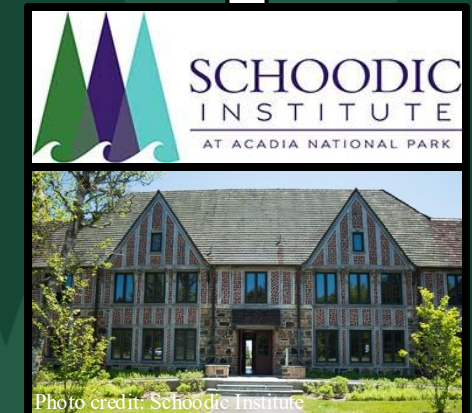
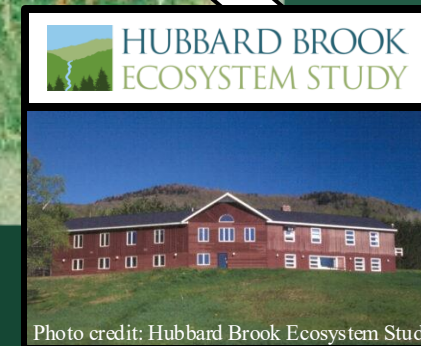
(4) University of New Hampshire, Durham, NH USA

(5) USDA NRCS National Water and Climate Center, Portland, OR USA

(6) Appalachian Mountain Club, Gorham, NH USA

(7) Schoodic Institute, Winter Harbor, ME USA

NorthEast Network of Mountain Observatories



NENMO Environmental Network Project



University
of Vermont

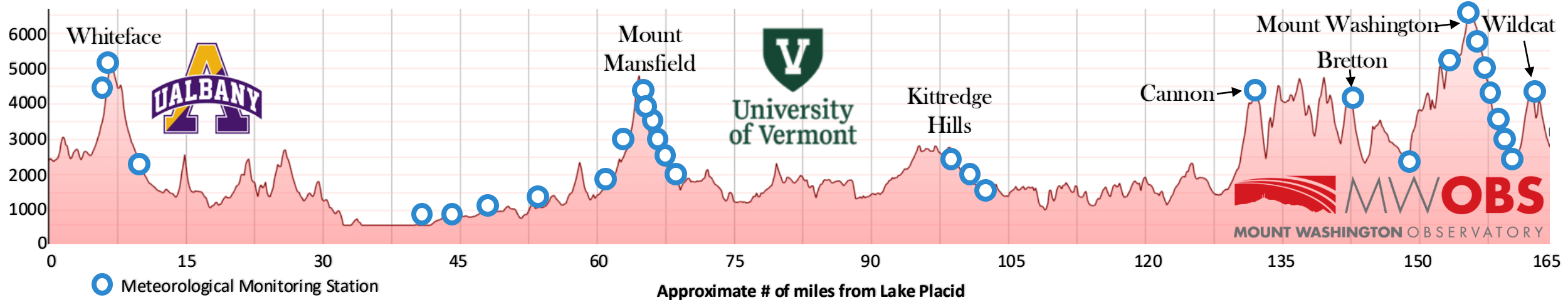


MW**OBS**
MOUNT WASHINGTON
OBSERVATORY



Data Driven Regional Resilience

- **Standardize Data:** Ensure mountain observatories use common formats for data and metadata.
- **Enhance Forecasts:** Partner with stakeholders to improve flood and snowmelt forecasting.
- **Align with International Methodologies:** Update monitoring practices to meet national and global objectives.
- **Share Data Publicly:** Create a public portal to make data FAIR (Findable, Accessible, Interoperable, Reusable).



← New York → ← Vermont → ← New Hampshire →

Northeast Snow Survey (NESS) Feasibility Study



- **Purpose:** The NESS project aims to create an automated snow and weather monitoring network in the Eastern US to fill a significant data gap in the region.
- **Goal:** The primary objective is to gain a better understanding of how climate change is impacting snowfall, runoff, and mountain ecology in the Northeast.
- **Model:** The project is a feasibility study modeled after the successful Snow Telemetry (SNOTEL) network that operates in the Western US.

Mesonet Development

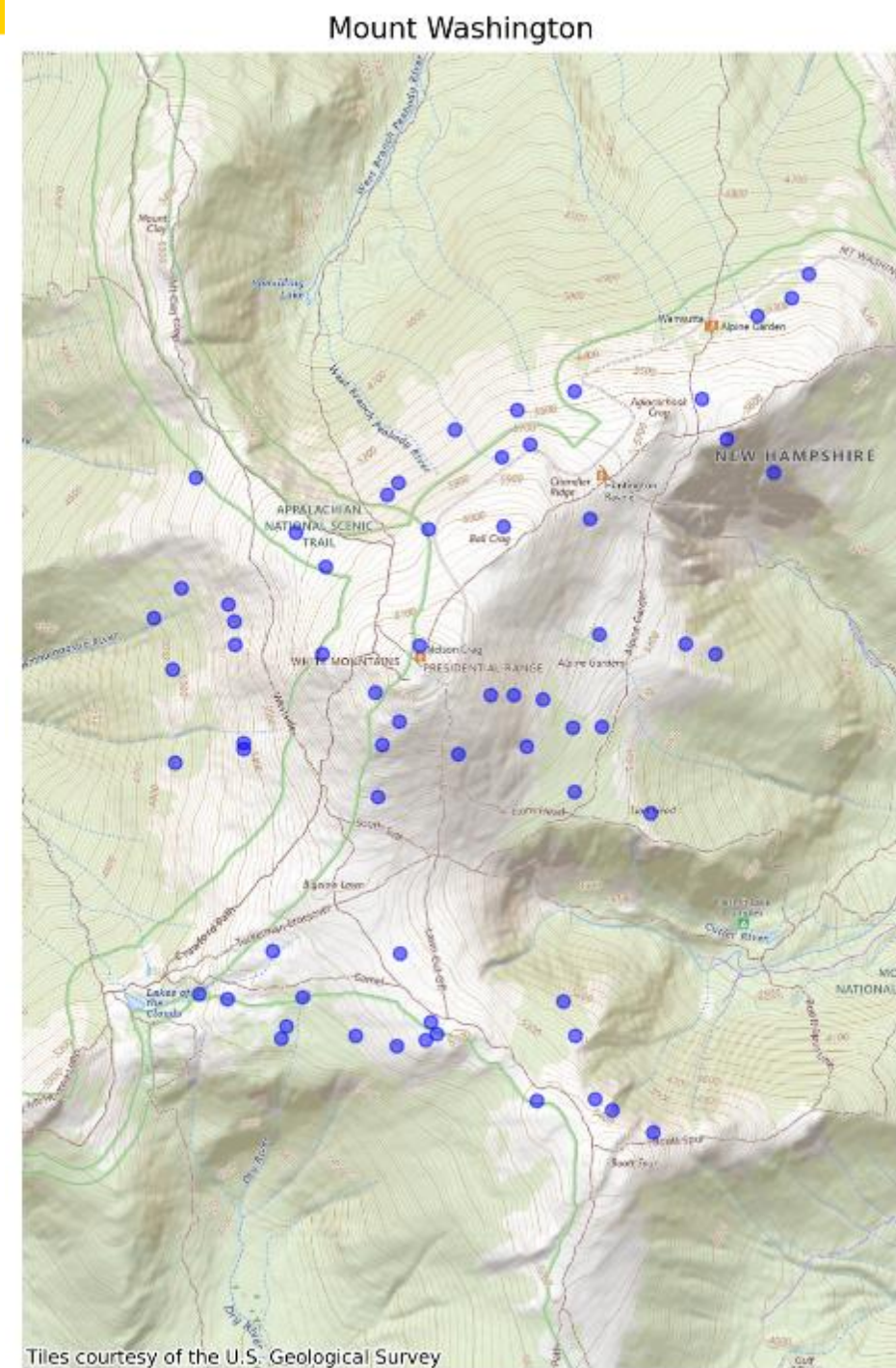
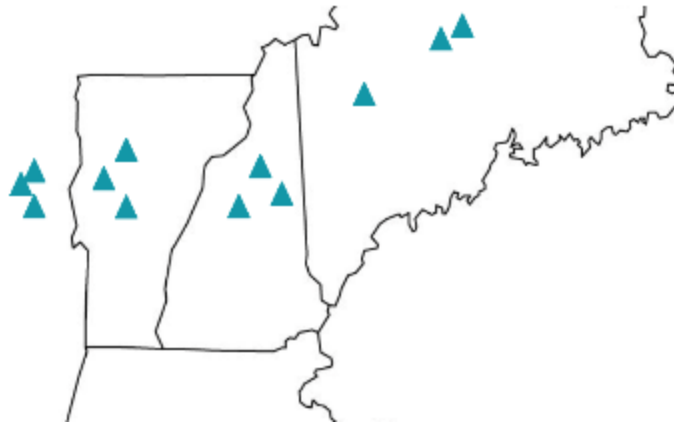


Alpine Micro-climate monitoring



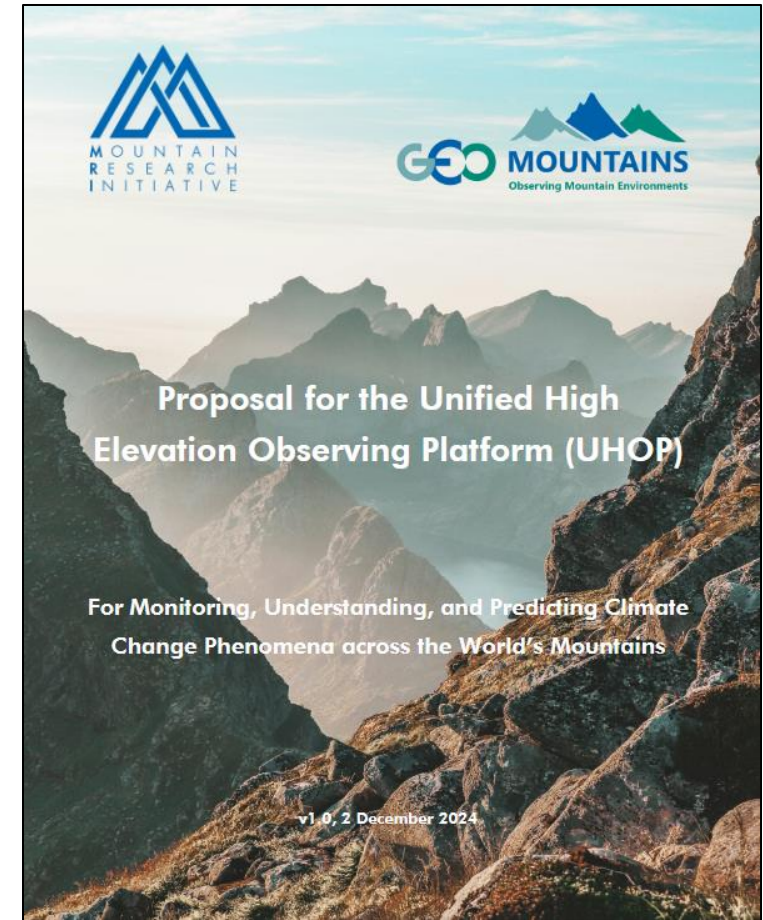
Caitlin McDonough MacKenzie
cmcdonoughmackenzie@bennington.edu

Stephen Keller
Stephen.Keller@uvm.edu



Unified High Elevation Observing Platform (UHOP)

- A global initiative for consistent mountain climate and weather monitoring.
- **Goal:** To fill data gaps, improve forecasting, and enhance community resilience.
- **Method:** A multi-tiered network of stations along elevation gradients.
 - **Tiers:** Gold, Silver, and Bronze accreditation based on station density and quality.
 - **Station Types:**
 - **Anchor:** High-quality, long-term stations for baseline data.
 - **Intermediate:** Moderate-quality stations to fill data gaps.
 - **Float:** Low-cost stations for high-resolution spatial data.



Pepin, N.C., Beneš, J., Masiokas, M., Steiner, J., Thornton, J.M. & Williamson, S. (2024).



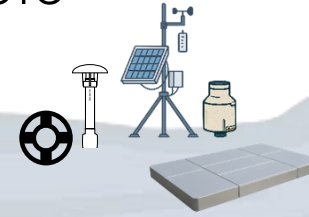
June 2023: Unified High Elevation Observing Platform (UHOP) Workshop – Bern, Switzerland

UHOP in the Northeast USA

NESS Stations



- WMO (as far as practicable) with complete radiation balance.
- SWE



Float Stations



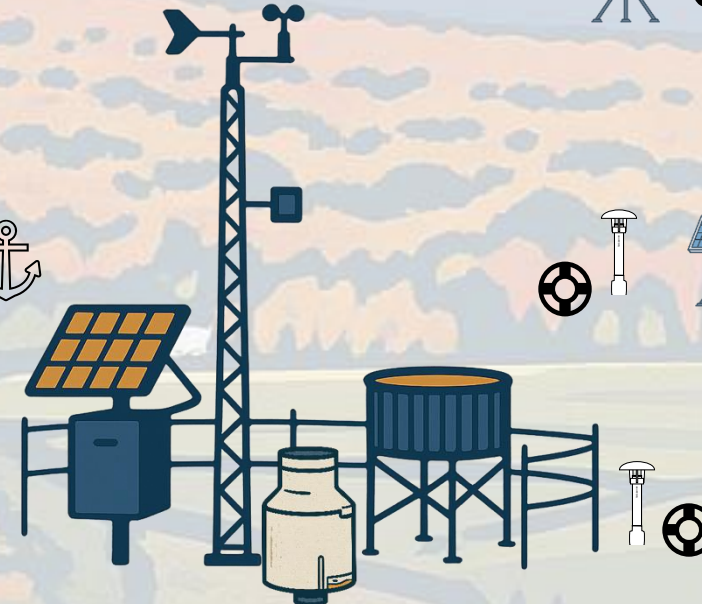
Intermediate Stations



Mesonet Stations



- WMO-certified meteorological observation in valleys



A model for the world

- **Prototype for UHOP:** Our networks serve as a successful example for UHOP.
- **Regional Network:** We are establishing a regional network of high-elevation observatories that can serve as a model for other networks.
- **Collaboration:** Our project is a prime example of multi-institutional collaboration.
- **Enhanced Data Sharing for Resilience:** We provide an example of enhanced data sharing for researchers, forecasters, and emergency personnel.

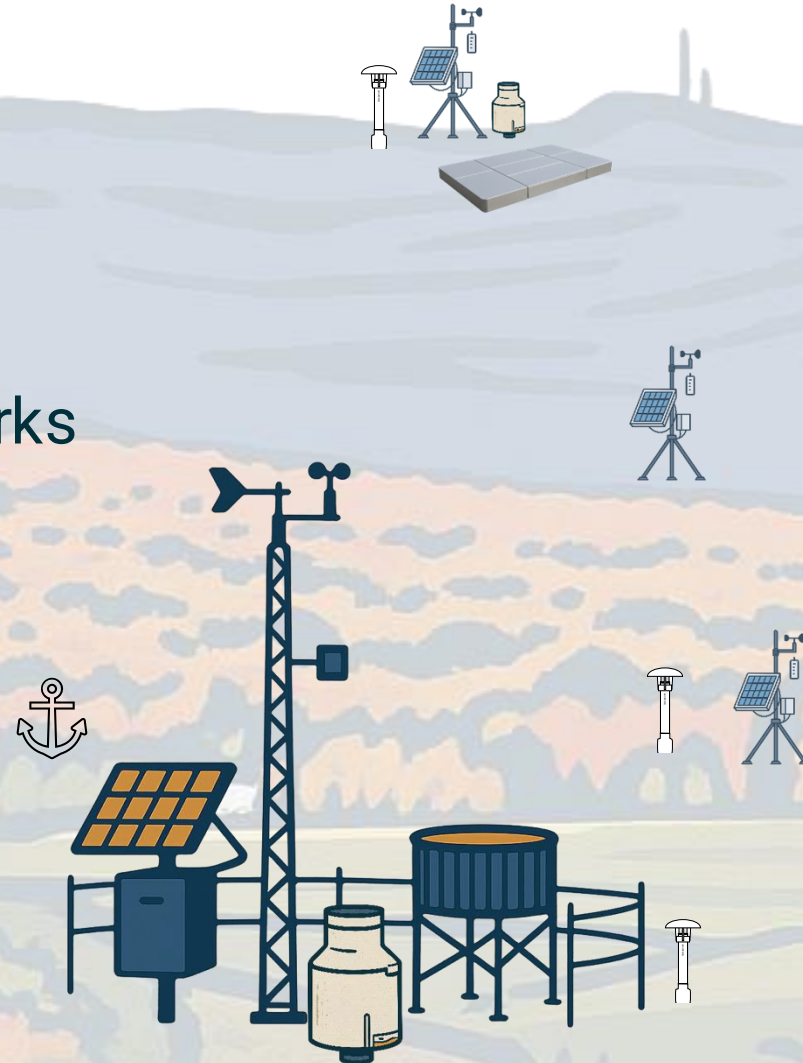


Questions?



Joshua Beneš

Associate Director of
Research Facilities & Networks
University of Vermont
Water Resources Institute
jbenes@uvm.edu



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Elevational-Dependent Climate Change on the slopes of Kilimanjaro (from savannah to ice-fields) and its impacts on water supply



Nick Pepin, Yaping Mo, Ehsan Khalefa,
Simon Mtuy, Doug Hardy
School of Environment and Life Sciences,
University of Portsmouth
Presentation to GEO Mountains General
Meeting: 26 November 2025



Mountains are on average changing more rapidly than lower elevations



Elevation – dependent
climate change



- Water resources, glaciers/snowpack (Rasul & Molden 2019, Hugonnet et al. 2021, Kraaijenbrink et al. 2021)
- Extreme events: landslides/floods/GLOFs (Ding et al. 2021)
- Mountain ecosystems and human society (Palomo 2017)

EDCC Working Group

Part of Mountain Research
Initiative:

Lead: Nick Pepin

Contact:

Nicholas.pepin@port.ac.uk



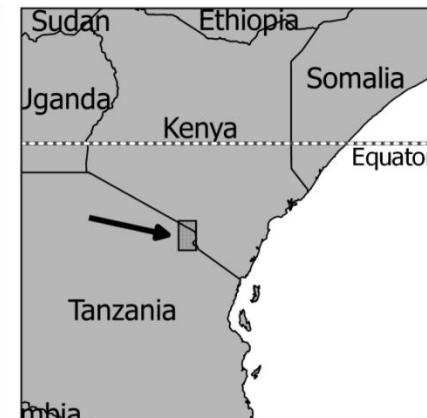
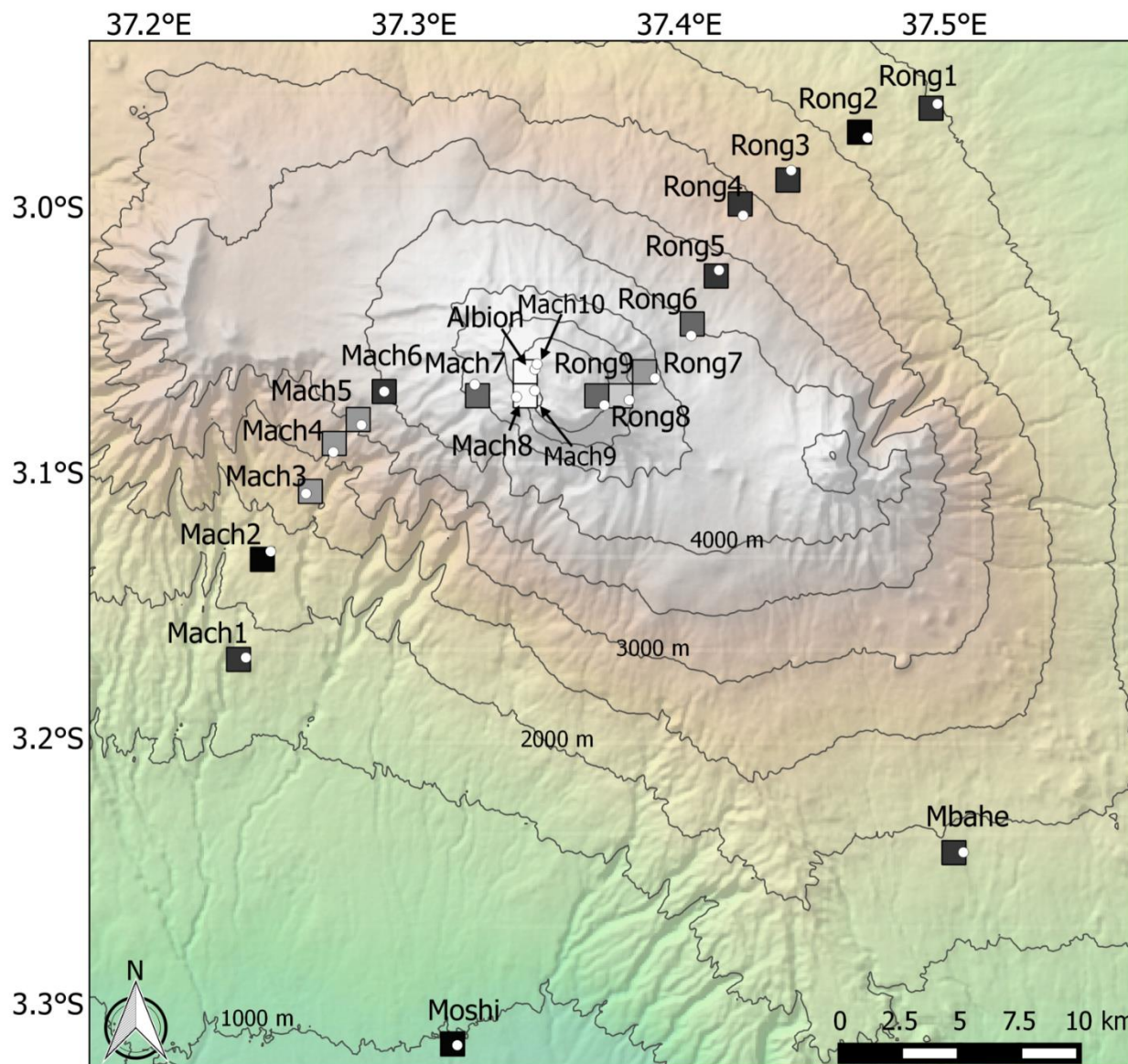
Many rapid changes
on upper slopes: Loss
of snow and ice:

On lower slopes as
well: Deforestation

Increasing population
pressure

The Kilimanjaro transect: 22 stations: 900 m to 5800 m

Started in 2004



Legend

Altitude variation inside 1km MODIS pixel

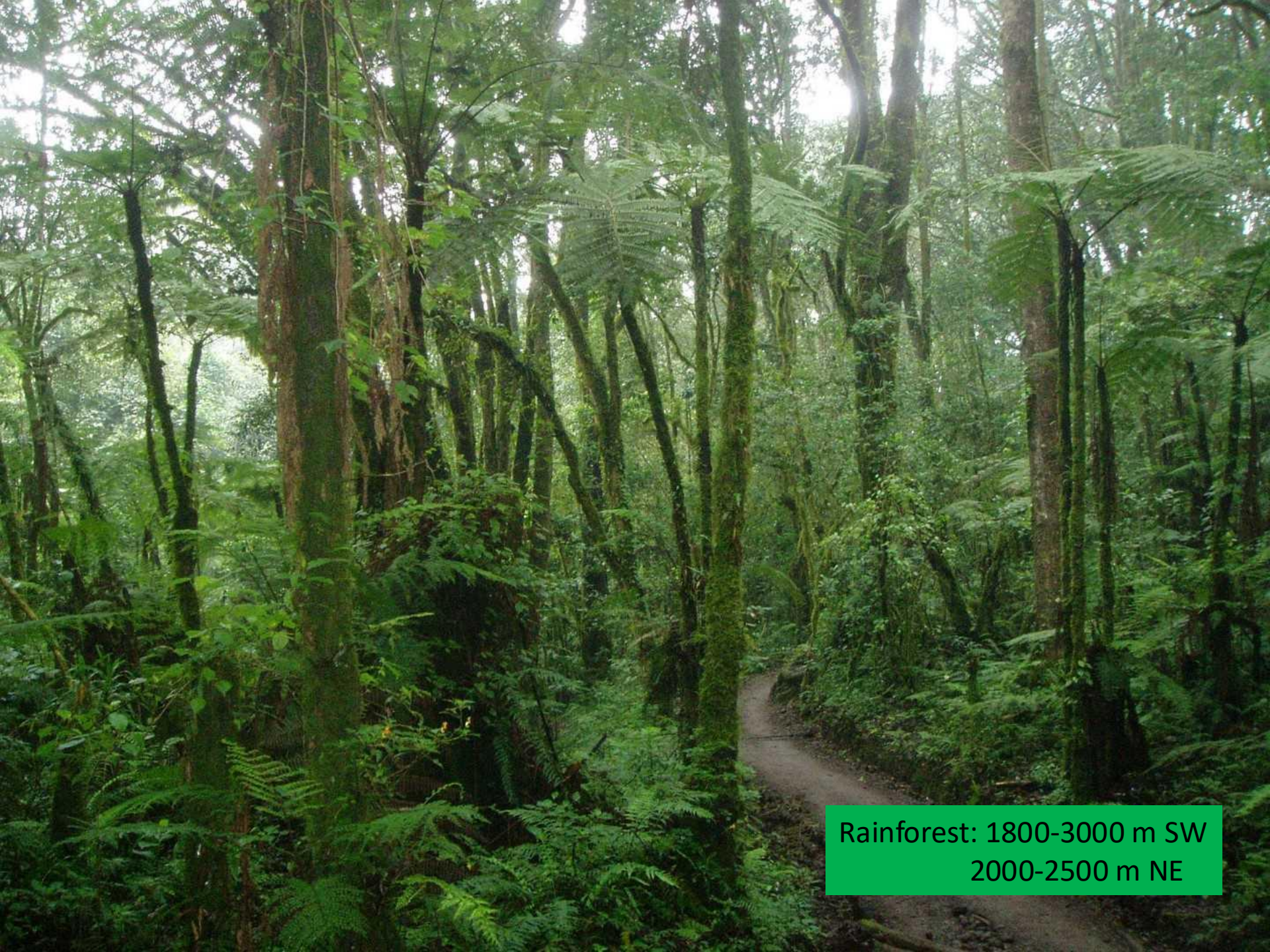
- 50 - 150
- 150 - 250
- 250 - 350
- 350 - 450
- 450 - 550
- 550 - 718

500 meters contour lines

○ Stations



Cultivated Zone: 1000-1800 m SW
1000-2000 m NE



Rainforest: 1800-3000 m SW
2000-2500 m NE



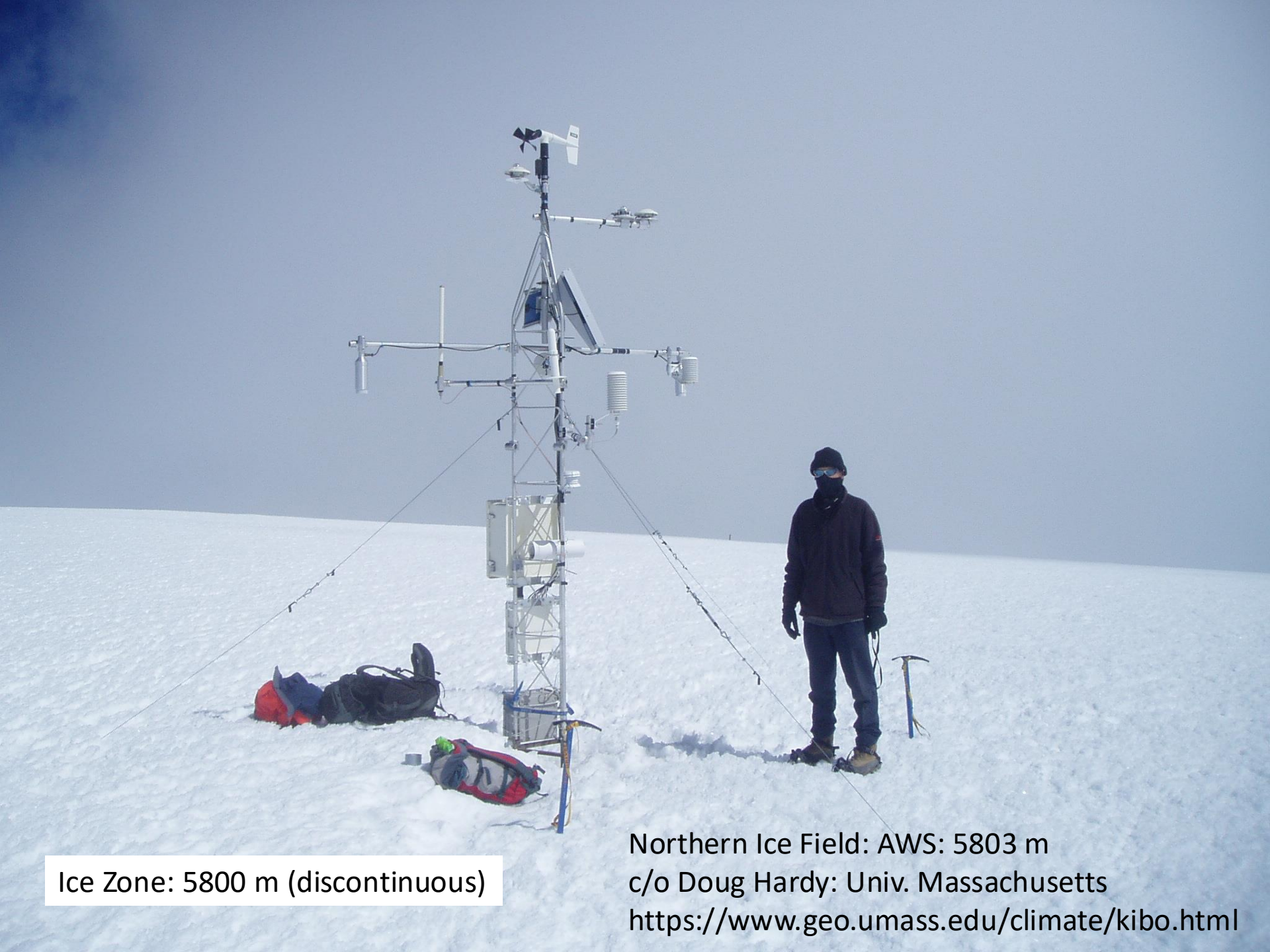
Giant Heather Zone: 3000-3800 m SW
2500-3500 m NE



Moorland Zone: 3800-4600 m SW
3500 – 4300 m NE



Desert: 4600 m-5800 m SW
4400 m-5800 m NE



Ice Zone: 5800 m (discontinuous)

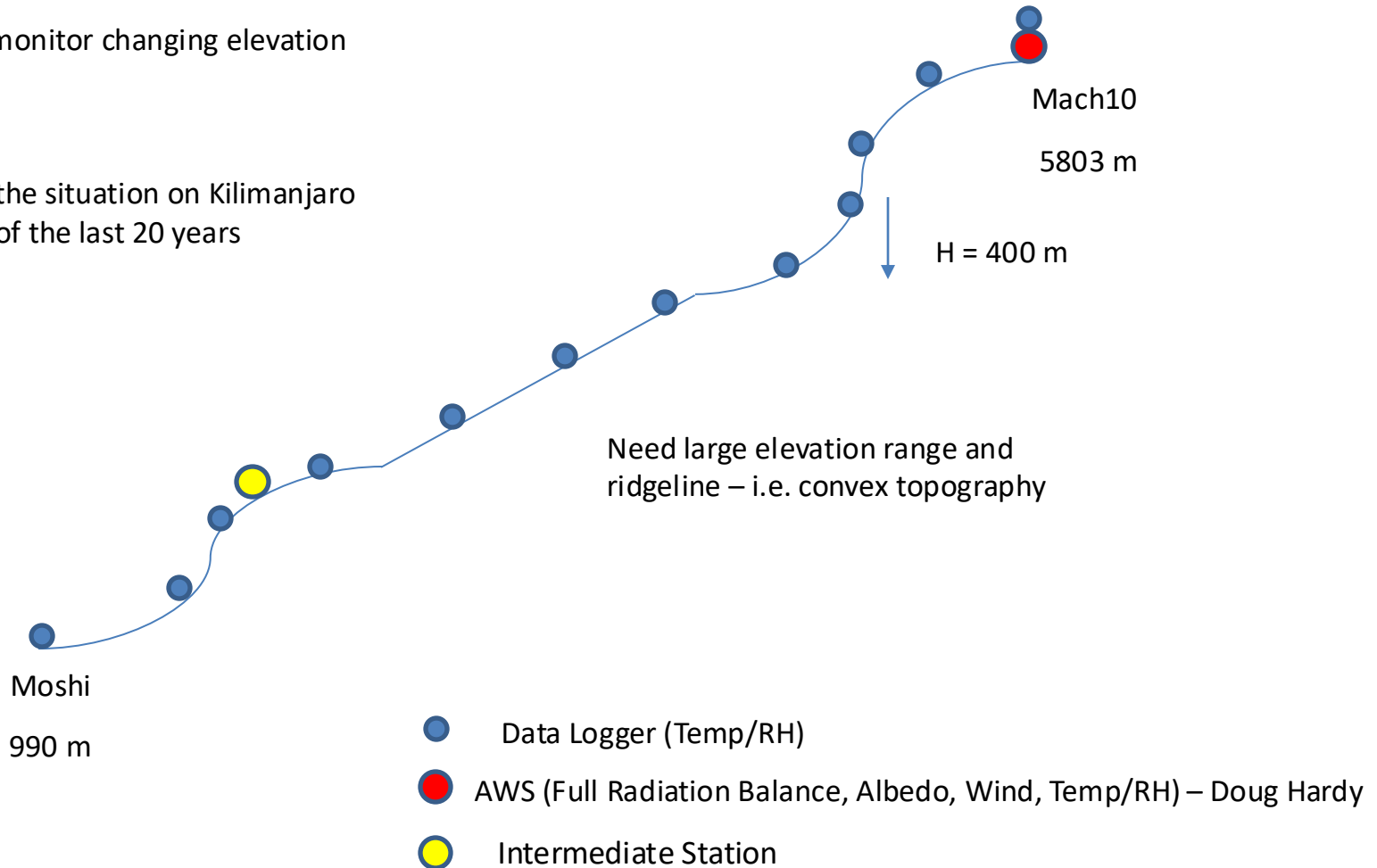
Northern Ice Field: AWS: 5803 m
c/o Doug Hardy: Univ. Massachusetts
<https://www.geo.umass.edu/climate/kibo.html>

Elevation Transect

Unified High Elevation Platform (UHOP)

Need to monitor changing elevation gradients

This was the situation on Kilimanjaro for most of the last 20 years





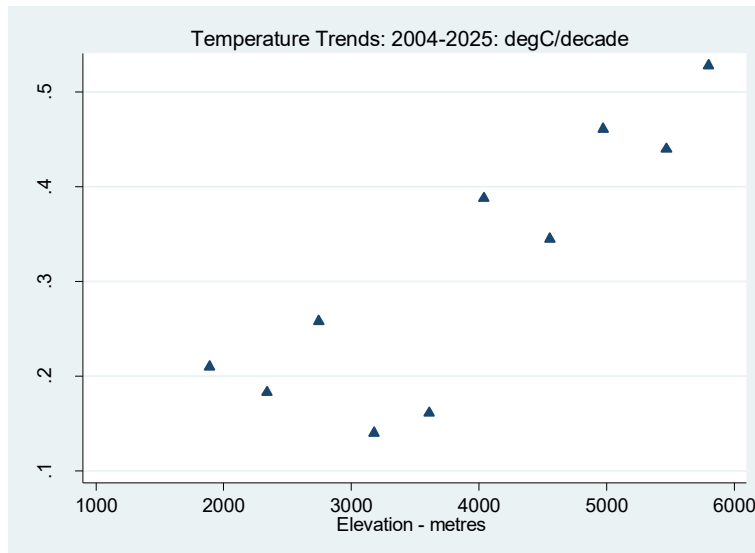
Variety of stations
on lower slopes

Some standard
screens – some
cheaper home
made tubes: this
shows a calibration
between two

This grant enabled
us to

- a) Start an upgrade
to standard screens
- b) Obtain 20 years
of data for the
transect to enable
analysis of EDCC
- c) Examine impact
of EDCC on water
supply on lower
slopes (interviews
with farmers)
- d) Enable outreach

Elevation Dependent Warming on Kilimanjaro



2010



2012



2015

This graph shows the warming rate for the 10 stations on the Machame (SW) side of the mountain over the last 20 years : The higher elevations are warming faster:

Up to 0.5degC/decade or **1degC over 20 years**

The bottom sites are around 0.2degC/decade or **0.4degC over 20 years**

To some extent the rainforests are stabilizing the climate on the mid-lower slopes

The trees also provide moisture for the whole mountain and have positive impacts on water supply

This has important consequences: see the above pictures (taken from the same point) of the decaying ice fields

OUTREACH



Lecture: why mountains matter and how to use Google Earth Pro's Historical Imagery to explore visible changes in the landscape.



Link to our website is [here](#).



Interactive session: younger pupils created drawings of the mountain-past, present, and imagined futures if climate change and human activities continue to affect it

Thank you for listening



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Acknowledgements

- Funding Support: NERC, NSF, RGS, Daphne Jackson, MRI
- *We acknowledge support from GEO Mountains under the Swiss Agency for Development and Cooperation (SDC)'s Adaptation at Altitude Programme (Project Number: 7F-10208.02.01).*
- Doug Hardy: Univ. Massachusetts – AWS Anchor Station and original transect installation
- Bill Duane, Gary Pike, Martin Schaefer (field assistance)
- Simon Mtuy and Summit Expeditions and Nomadic Experience (SENE) – trekking support on mountain
- Will Taylor (Geography) and other teachers at International School in Moshi

Agenda



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|---------------|---|
| 14:00 – 14:05 | 1. Welcome & Introduction (Alex Massot and Carolina Adler) |
| 14:05 – 14:35 | 3. Recent and ongoing GEO Mountains activities |
| 14:35 – 14:45 | 4. Community Input #1: Joshua Beneš, University of Vermont |
| 14:45 – 14:55 | 5. Community Input #2: Nick Pepin & Yaping Mo, University of Portsmouth |
| 14:55 – 15:05 | 6. Joint Q&A |
| 15:05 – 15:15 | 7. Future Activities |
| 15:15 – 15:30 | 8. General discussion & wrap-up |

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Mountains Connect

- ❑ Mountains Connect, 16 – 20 Feb. 2026, Kathmandu, Nepal
- ❑ Partners of the Adaptation @ Altitude Programme
- ❑ The MRI/GEO Mountains initiative will host a stand to share information on mountain data and monitoring, with a strong focus on how information can effectively support policy processes.
- ❑ We are also gathering **success stories** from our partner regions (Andes, HKH, Central Asia, South Caucasus, East Africa).
 - ❑ If you have a **project, dataset, or example** that you would like us to highlight during the February workshop, please feel free to contact us: geomountains@mountainresearchinitiative.org



GEO Mountains x GEO Youth Ideathon



- ❑ **Concept:** Bring together ~15–20 early-career researchers and young professionals (age ≤ 35) from the research community, practitioners and government to collaboratively design innovative, data-informed solutions to disaster risk reduction in mountain environments. The programme includes field visits, technical training, and a micro-ideathon where participants will co-develop actionable projects with mentorship from experts in EO, governance, and stakeholder engagement.
- ❑ **Format:** 2–3 days of technical and field engagement and ideathon-style challenge, followed by a conference, where participants can learn on ongoing initiatives, network and engage with stakeholders. 7-10 days in total.
- ❑ **Date:** 1/2 – 8/9 July 2026 (tbc)
- ❑ **Location:** Obergurgl, Austria

Stay updated via MRI Newsletter –
Registrations should open in February 2026



News from the network

- ❑ **Adaptation @ Altitude Knowledge Network** next event tomorrow, 27 November, 14:00 – 15:00 CET: Harnessing nature-based solutions for adaptation in mountains
- ❑ **GEO Work Programme Open House Webinar #1**, 3 December, 13:30 – 15:30: Weather, Hazard and Disaster Resilience focus area
- ❑ **Swiss Geoscience Meeting**, 5 – 6 December
 - ❑ MRI-hosted session 'Glaciers and Deglaciation: Multidisciplinary perspectives on their relevance for society' presented by Glenn Hunt (MRI Senior Project Coordinator), Iago Otero and Jeanne Fournier (Interdisciplinary Centre for Mountain Research), and Elisa Frank (Forum Landscape, Alps, Parks).
- ❑ **7th Global Meeting of the Mountain Partnership of the United Nations**, 26 – 28 March 2026, Andorra
- ❑ **GEO Symposium**, 26 – 28 May, Geneva
- ❑ **Regional Mountain Conference** (RMC2026): 5-8 July Obergurgl; Submission for workshop or focus session open until 17 December.



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Many thanks!

Please kindly provide some
feedback on this meeting:



geomountains@mountainresearchinitiative.org