SWISS POLAR INSTITUTE

Open Forum

Part 2

SWISS POLAR INSTITUTE

PAMIR

SPI Flagship Initiative

Martina Barandun

PAMIR

"From ice to microorganisms and humans: Toward an interdisciplinary understanding of climate change impacts on the Third Pole"

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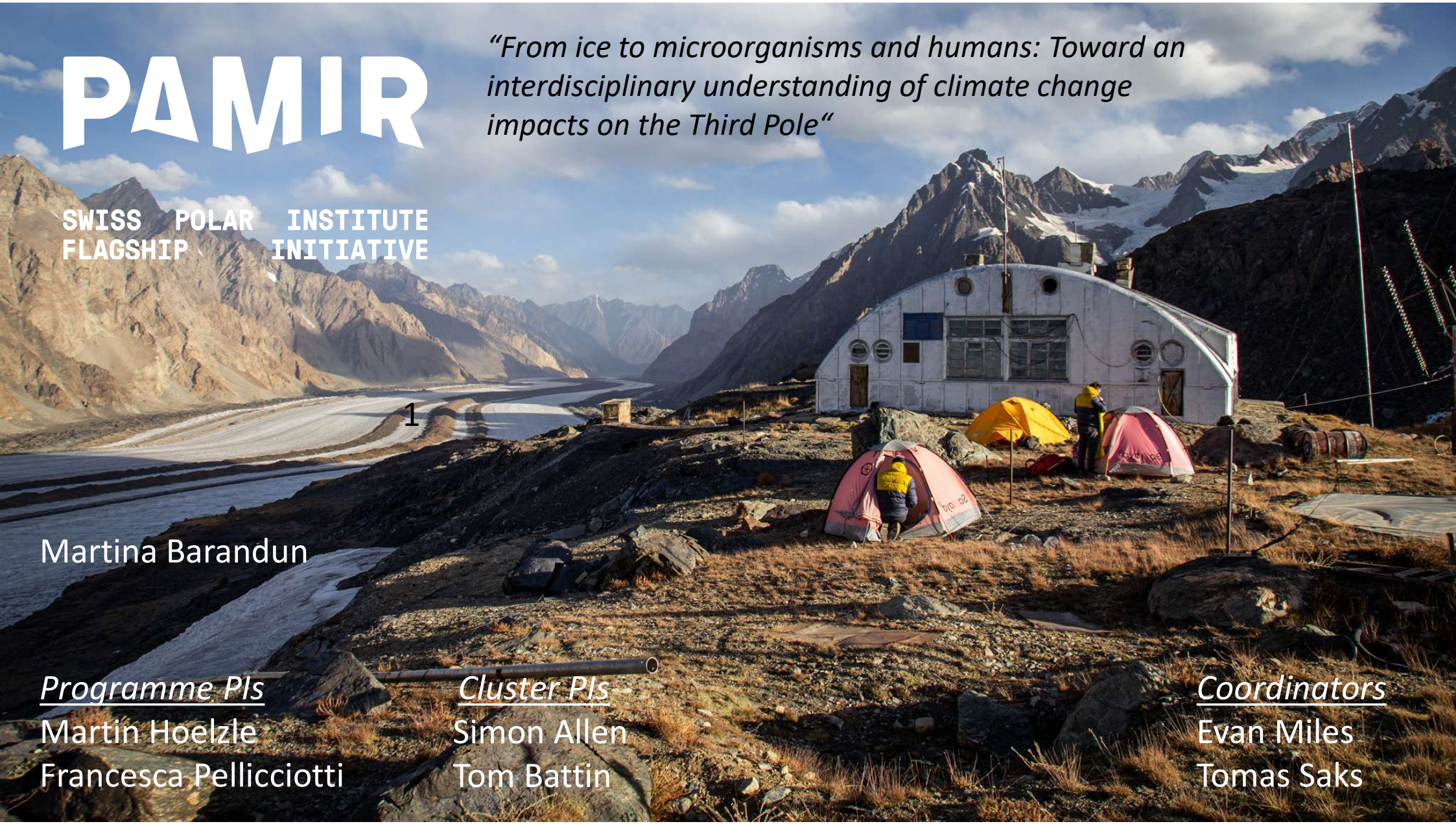

Martina Barandun

Programme PIs
Martin Hoelzle
Francesca Pellicciotti

Cluster PIs
Simon Allen
Tom Battin

Coordinators
Evan Miles
Tomas Saks

What is the state of the Pamir cryosphere?

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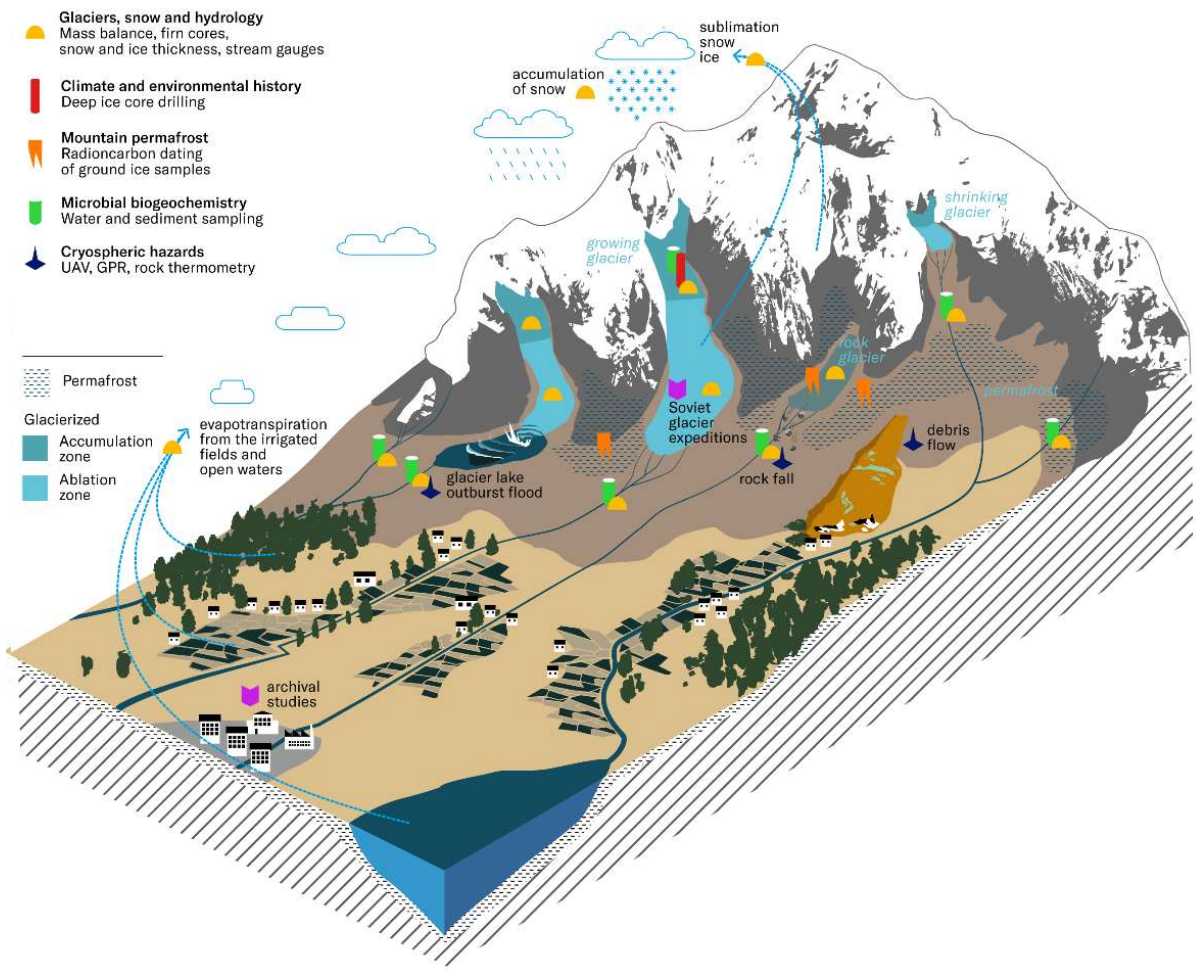
How is the changing cryosphere impacting ecosystems, hazards and water resources?

→ Systematic measurements
→ New fundamental observations



<u>Implementation</u>
Five research clusters across disciplines
Outreach and training activities
Mar 2022- Feb 2026
Hosted at WSL → UniFr

Where are we?

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- >3000 cumulative field person-days
  Expecting >1000 in 2025

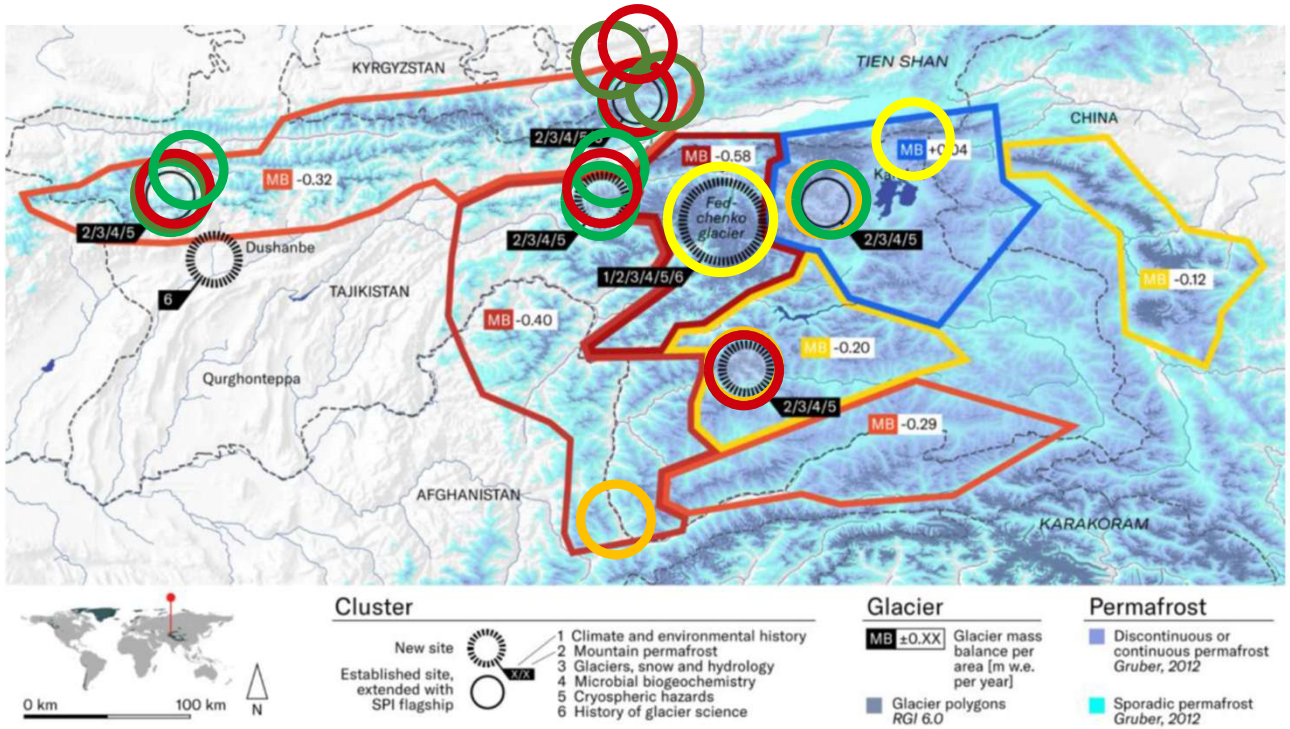
- 4 years of *systematic* measurements (meteo- glacio- hydro-) at 7 sites
- *New* fundamental observations
  - Permafrost phys. → SDSC collab
  - Ice thickness, mass balance
  - Microbial genomes
  - 2-300 year dendrochonologies

- Collaborations with organizations in Tajikistan, Kyrgyzstan, Japan, France

...A lot of headaches...

→ **Most measurement objectives met!**

C1 C2 C3 C4 C5



Final objectives (2025)

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High mountain meteostation network

- A new network of modern Automatic Weather Stations (AWS): 8 stations
- Covering a elevation range from 3600 m asl. to 4900 m asl.

PAMIR has helped to build a dense in high mountain network of AWS through out the Pamir areas.

Data has been collected successfully on all AWSs this summer 2025

[Barandun et al., accepted]

→ Re-establishing Gorbunov meteostation

- Oldest high-elevation record in Asia, 1936-1994 (abandoned)
- Efforts to reestablish in 2000 and 2015

The current station has never been visited by a Tajik scientist, downloaded, or maintained

PAMIR aims to make this site functional again:
→ Collaboration with Tajik Hydromet and ISTA
→ Now: data download and sensor replacement

The team goes into the field soon (11 Sep - 23 Sep)

Gorbunov heritage meteostations
[C. Gras]

Final objectives (2025)

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A first Pamir ice core

Kon Chukurbashi ice cap (5800m): the edge of the KK Anomaly
2024 visit: Feasible, accessible, coring conditions

PAMIR is trying to take the first deep ice core from the region
→ New collaborations with Japan and Ice Memory Foundation
→ Technical support from UniBe, PSI

The team is currently in the field (3 Sep - 11 Oct)

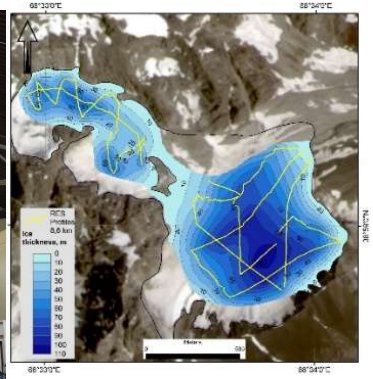
ICE MEMORY

Kon Chukurbashi ice cap
[Ivan Lavrentiev]

Helicopter GPR surveys

- 10 glaciers with ice thickness measurements
  [8 of which surveyed by **PAMIR**]
- Slow on foot, limited coverage
- After years of helicopter discussions...
  ...We can fly!!
- VIRL-7 20MHz radar slung under Mi-8

First 20 flight hours right now!



Yakarcha (2023)

VIRL-7 heli GPR *[I. Lavrentiev]*

Englacial temperatures

- First(?) observation of subsurface temperatures in the region
- Four contrasting sites
  Kon Chukurbashi [E Pamir, 5800m]
  Nissai [W Pamir, 4400m]
  Yakarcha [Pamir Alay, 4200m]
  Zulmart [C Pamir, 4800m, 2024]

...Installation ongoing

Thermistor installation at Yakartsha in 2025 *[S. Fugger]*

Final objectives (2025)

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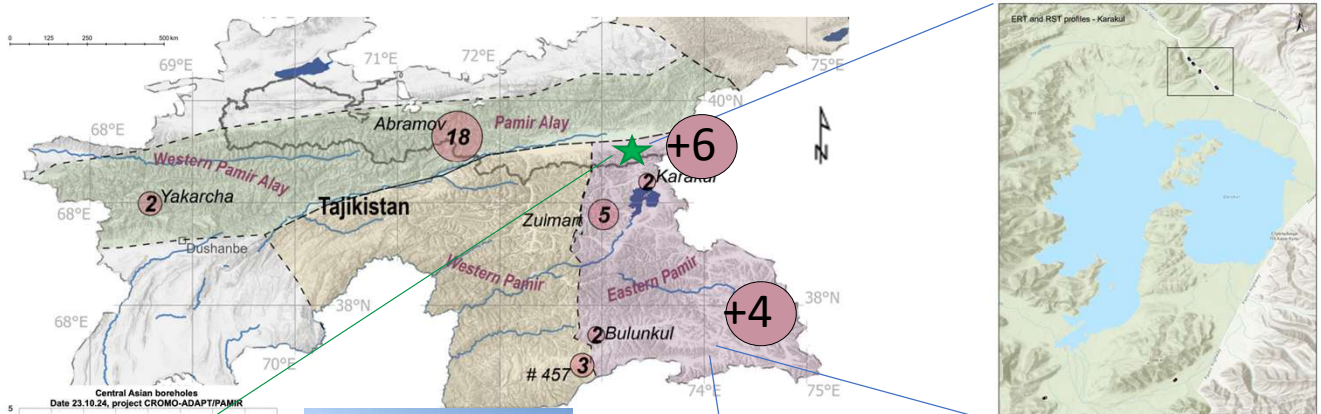
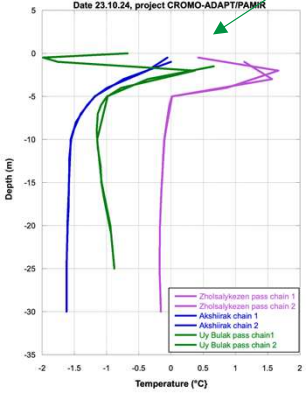
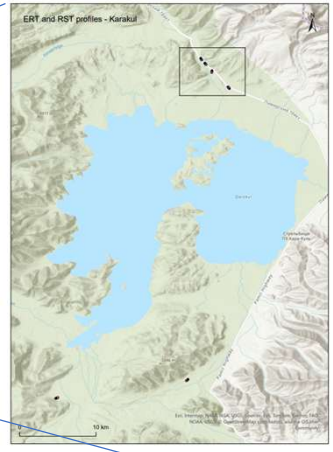
Network of permafrost observations across the Pamir

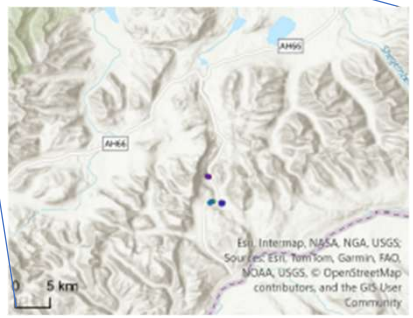
- Over 32 ERT and RST measurements across the PAMIR
- First Pamir permafrost borehole installed in 2024
- **PAMIR** increased the coverage of the geophysical surveys in the Eastern Pamir significantly



[Mathys et al., 2025]







→ Permafrost borehole n2

- **PAMIR** found a second great site

...Installation in Oct '25

Permafrost borehole installation at Uy-Bulak pass in 2024 *[E. Miles]*

Non-science Impacts and outcomes

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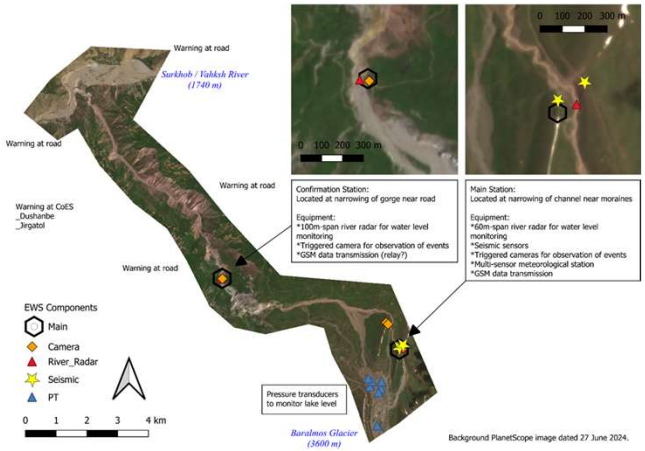
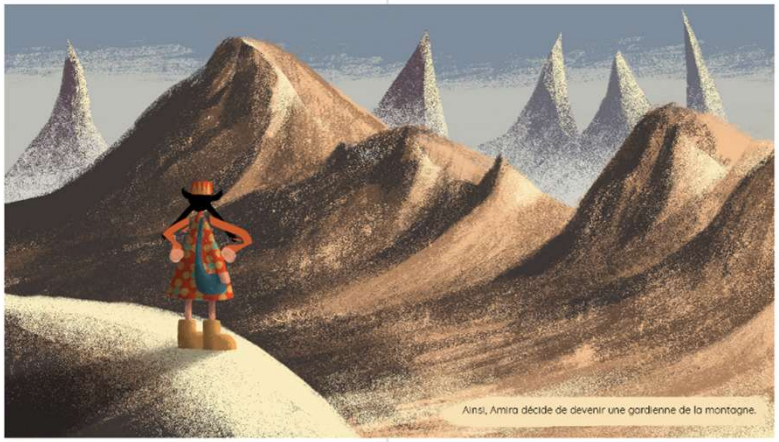
Policy and Adaptation

- PAMIR had key roles in High Level International Conference of Glaciers' Preservation (Dushanbe 2025) *keynote, convener, panelist, presenter*
- Important support of SCO, EDA office in TJ, for intl collaboration
- Hazards assessment at Baralmos Glacier leading to implementation of glacial lake outburst flood Early Warning System



UNESCO GLOFCA EWS concept



Amira and the gurdians of the mountain

Outreach

- Children's book production (soon)
- Swiss Polar Class modules on Pamir mountain environments and change
- Support of Adventure of Science program and its outreach activities
- x2 SPI PolArts pairs -> exhibitions
- Participation in Ice Memory film

Training

PAMIR workshops on:

- Health and Safety (CH + CA)
- Glacier travel (CH + CA)
- FELICS ice c<orer operation (CH)
- Stream hydrology (CA)
- Lake bathymetry (CA)

Figure 12: Experiment demonstrating the amount of water brough by glaciers in Central Asian rivers at the exhibition stand "Meltwater"

Several training workshops and outreach activties in Dushanbe

Thank you very much

PAMIR

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CRYOSPHERE PROJECT | in Central Asia

CAIAG

UNI FR UNIVERSITÉ DE FRIBOURG UNIVERSITÄT FREIBURG

Universität Zürich[UZH]

EPFL

ISTA

PAUL SCHERRER INSTITUT PSI

WSL SLF

GLOFCA | GLACIER LAKE OUTBURST FLOODS IN CENTRAL ASIA

CROMO-ADAPT

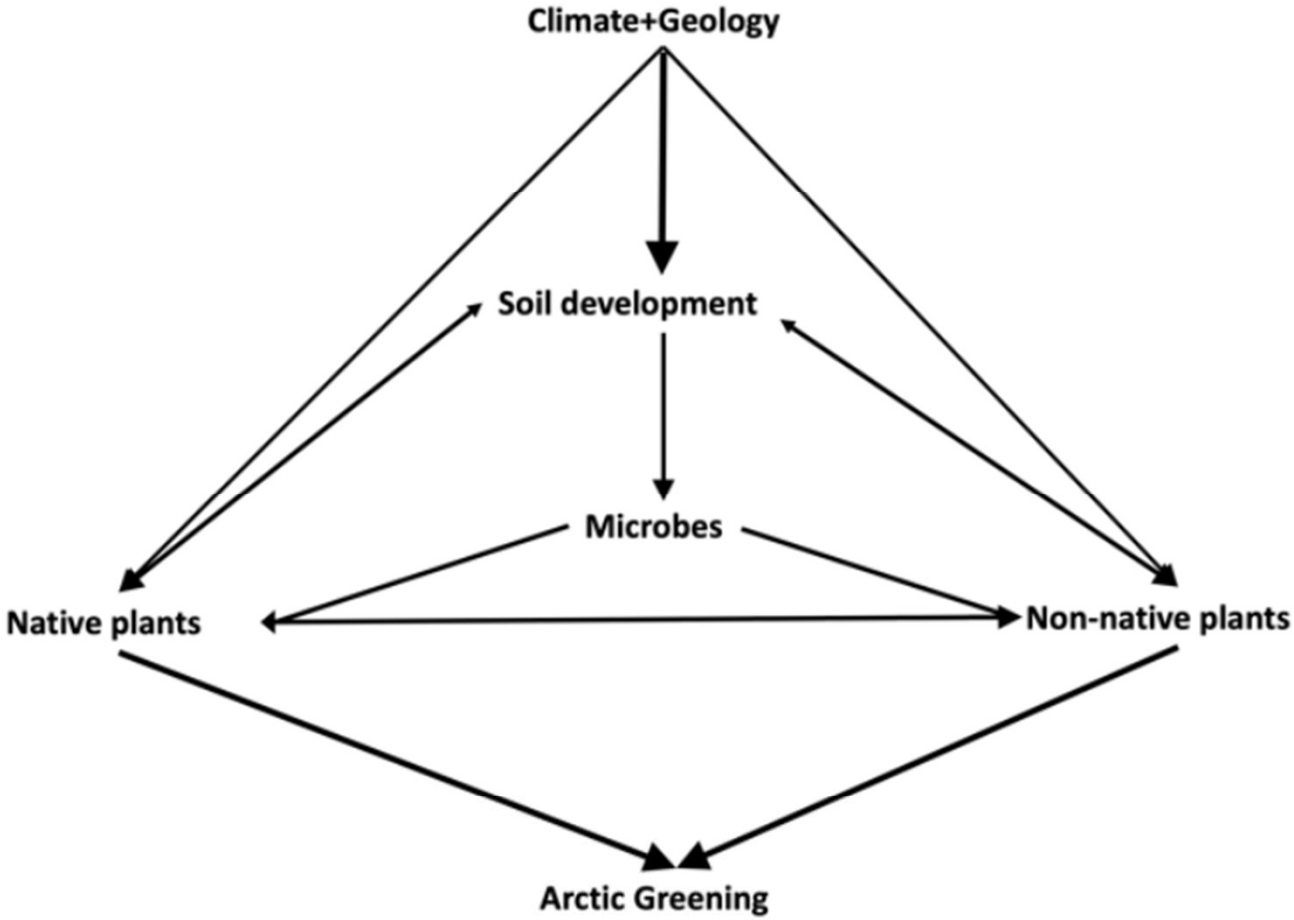
Cryospheric Observation and Modelling for improved Adaptation in Central Asia

ГидроМет Кыргызстан

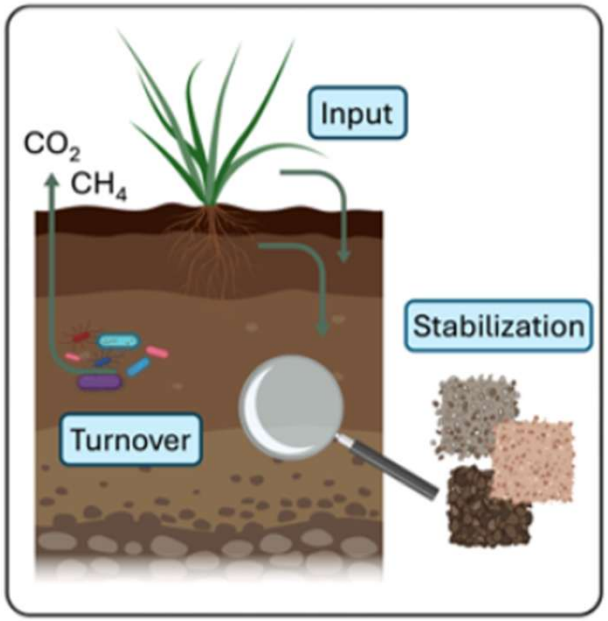
SWISS POLAR INSTITUTE

Jana Rüthers

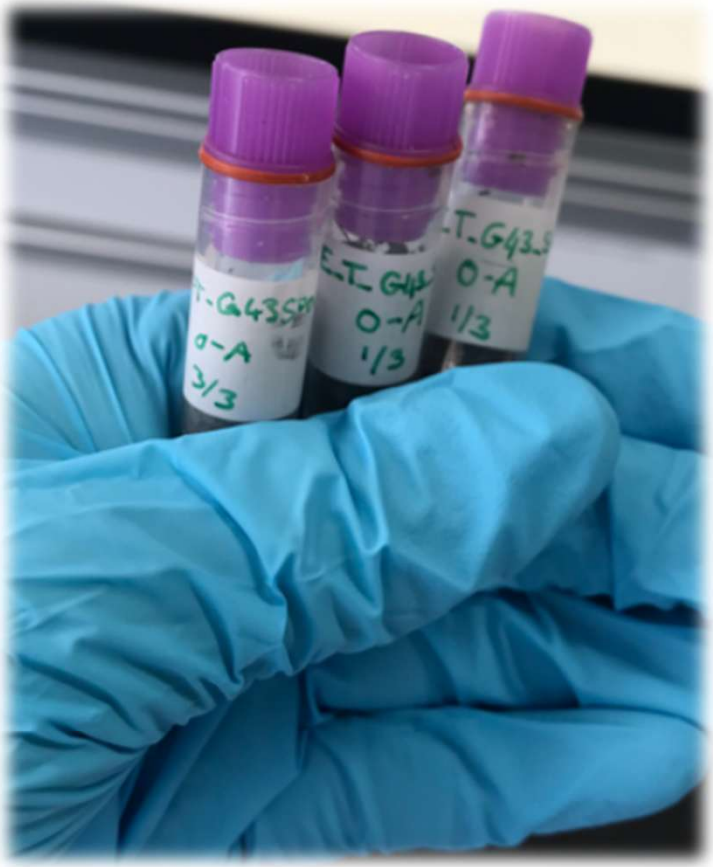
ETH Zurich


Climate+Geology
Soil development
Microbes
Native plants
Non-native plants
Arctic Greening

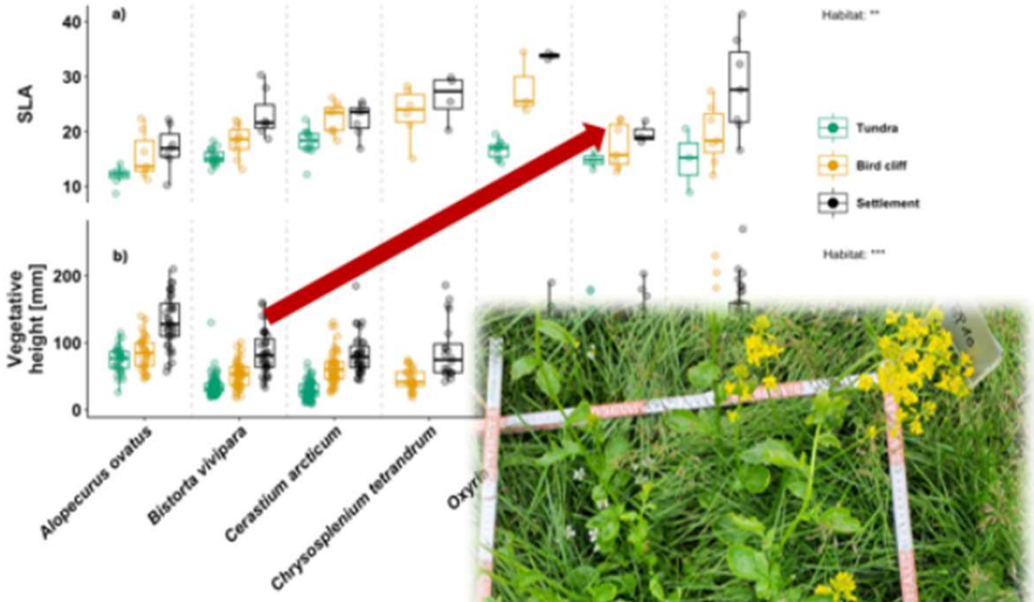
Carbon cycle



Soil development



Soil fungi are linked to CO_2 emissions and environmental changes



Greening can occur through trait expressions of generalist species

Rising introduction of non-native species

Changing plant competition patterns

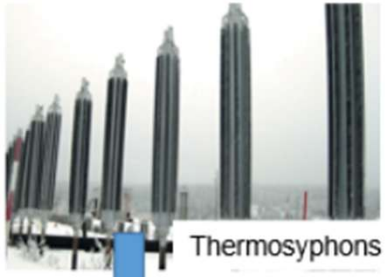
SWISS POLAR INSTITUTE

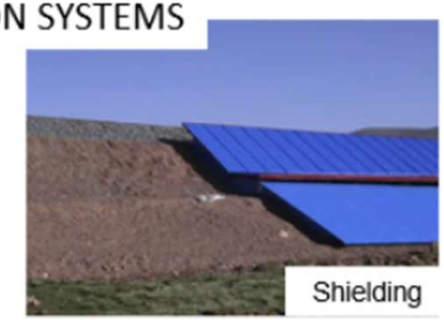
Elizaveta Sharaborova

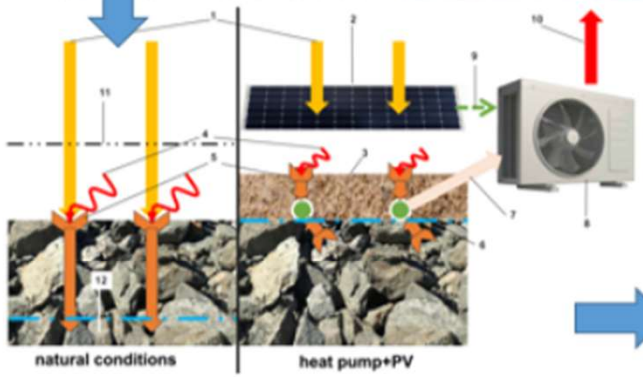
EPFL

SITUATION, PROCESSES, CONSEQUENCES

THERMAL STABILIZATION SYSTEMS

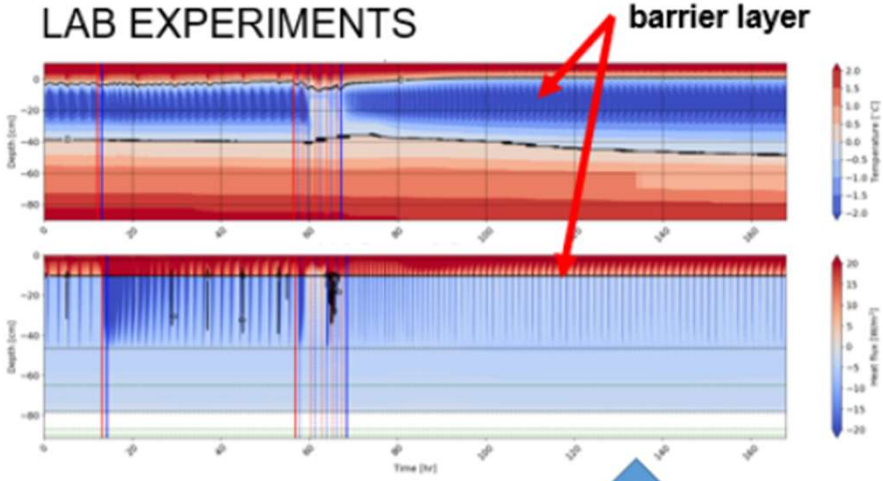




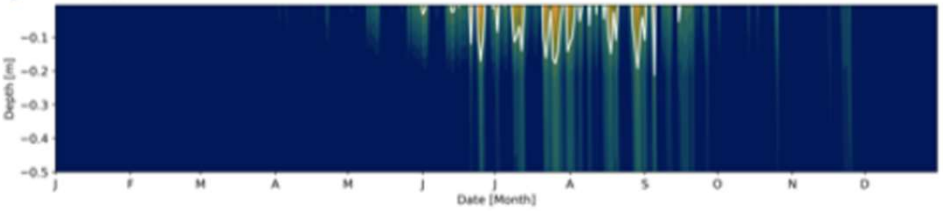


1 - solar radiation, 2 - energy converter, 3 – sand or gravel, 4 - convection, 5 - heat conduction, 6 - cooling tubes, 7 - heat transfer fluid, 8 - heat exchanger, 9 - converted solar energy, 10 - heat sink, 11 - snow level, 12 - active layer depth

LAB EXPERIMENTS

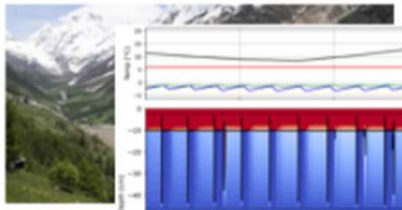


COOLING AFTER 16 YEARS

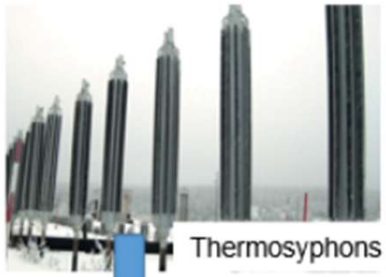


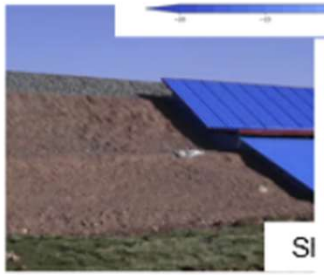
PROTOTYPE

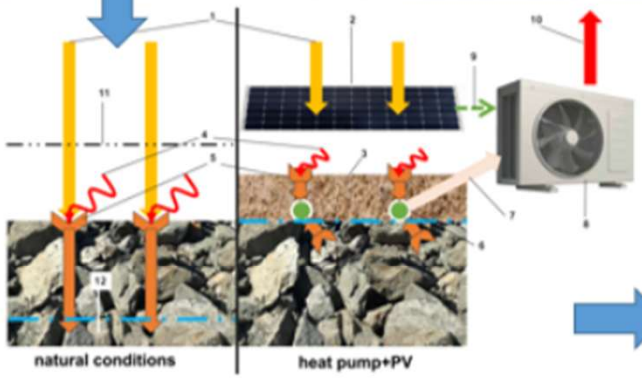
SITUATION, PROCESSES, CONSEQUENCES



THERMAL STABILIZATION SYSTE







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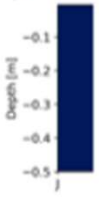
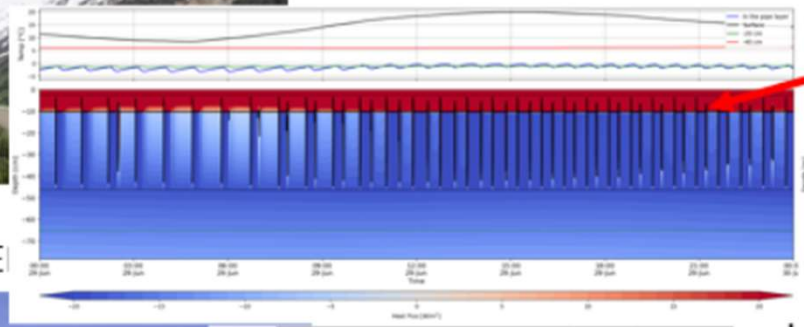
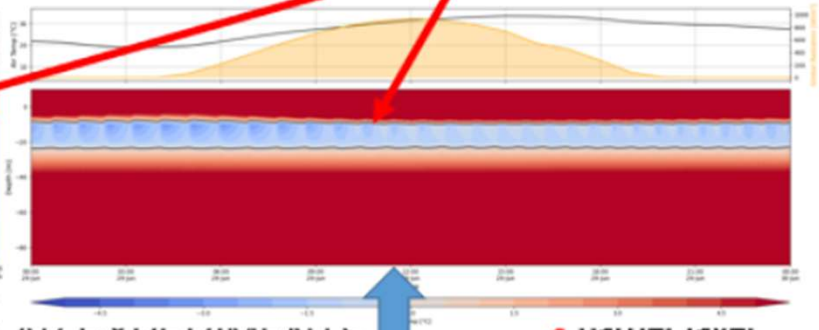
CC



OUTDOORS EXPERIMENTS

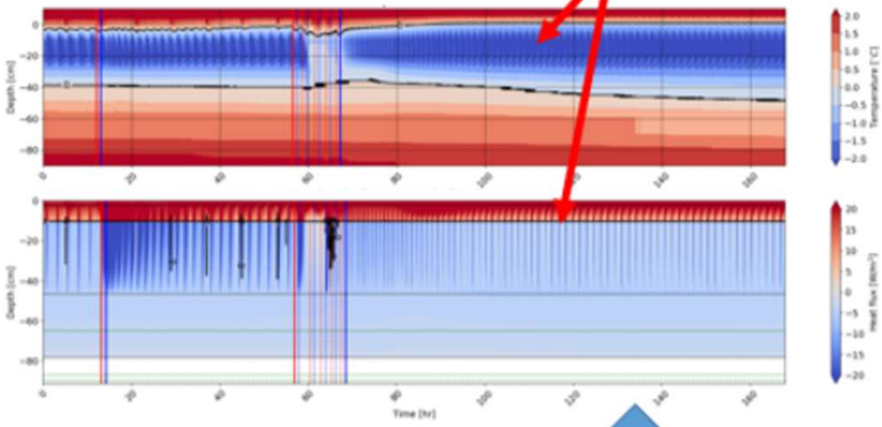
barrier layer

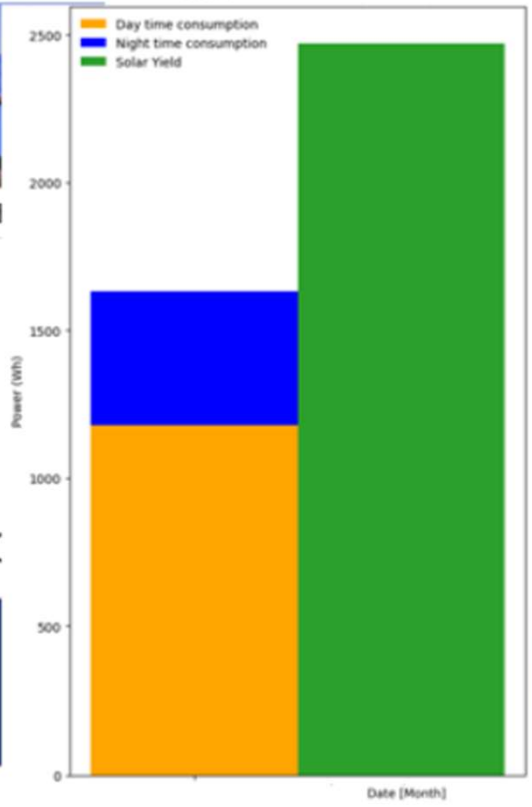


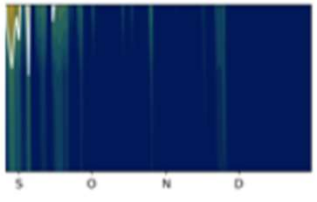


LAB EXPERIMENTS

barrier layer







PROTOTYPE

SWISS POLAR INSTITUTE

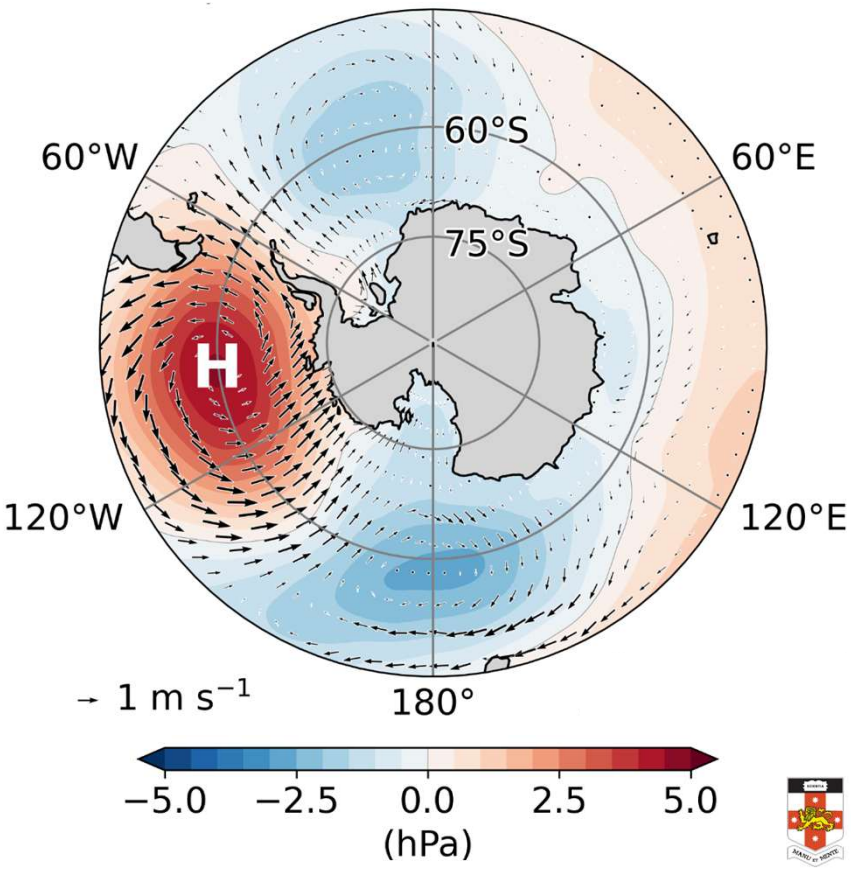
Maurice Huguenin

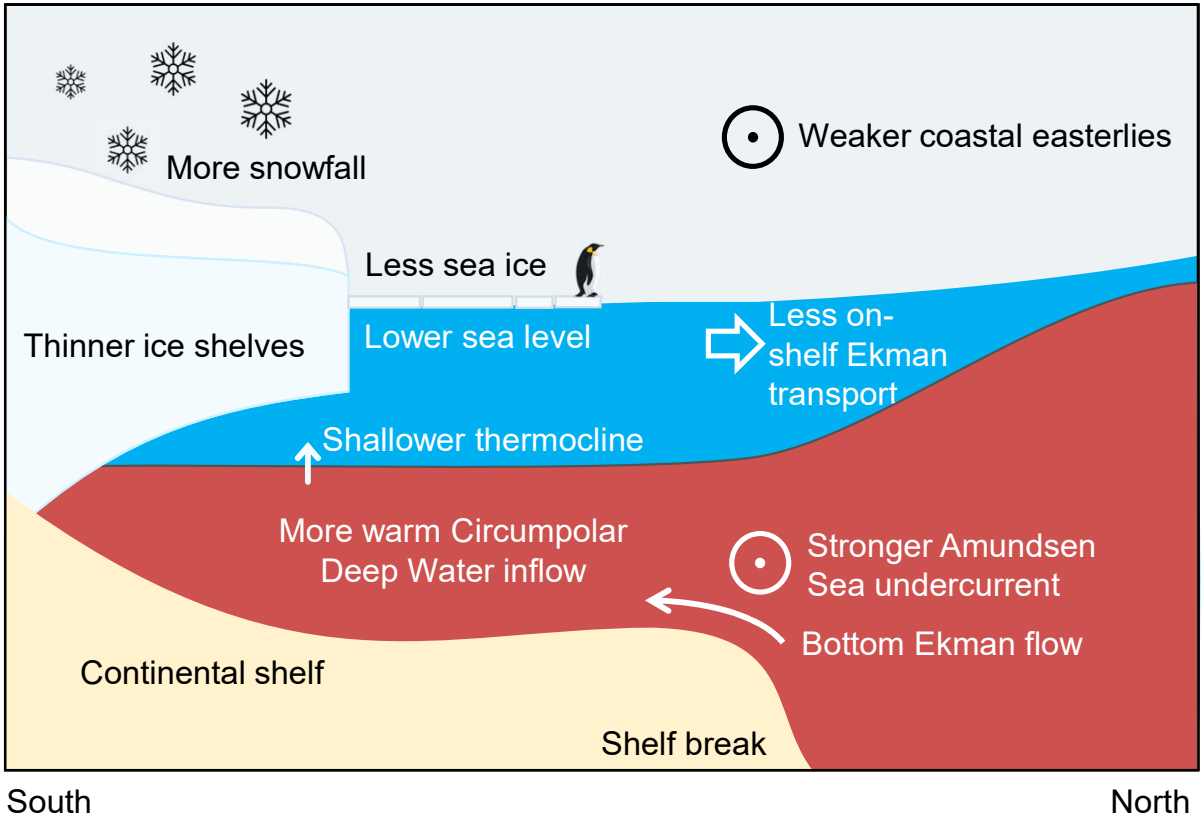
UNSW Sydney,
visiting scientist ETH Zurich

Subsurface warming in West Antarctica during El Niño

Huguenin et al. (2024, GRL)

Sea level pressure & surface winds





Maurice F. Huguenin

SWISS POLAR INSTITUTE

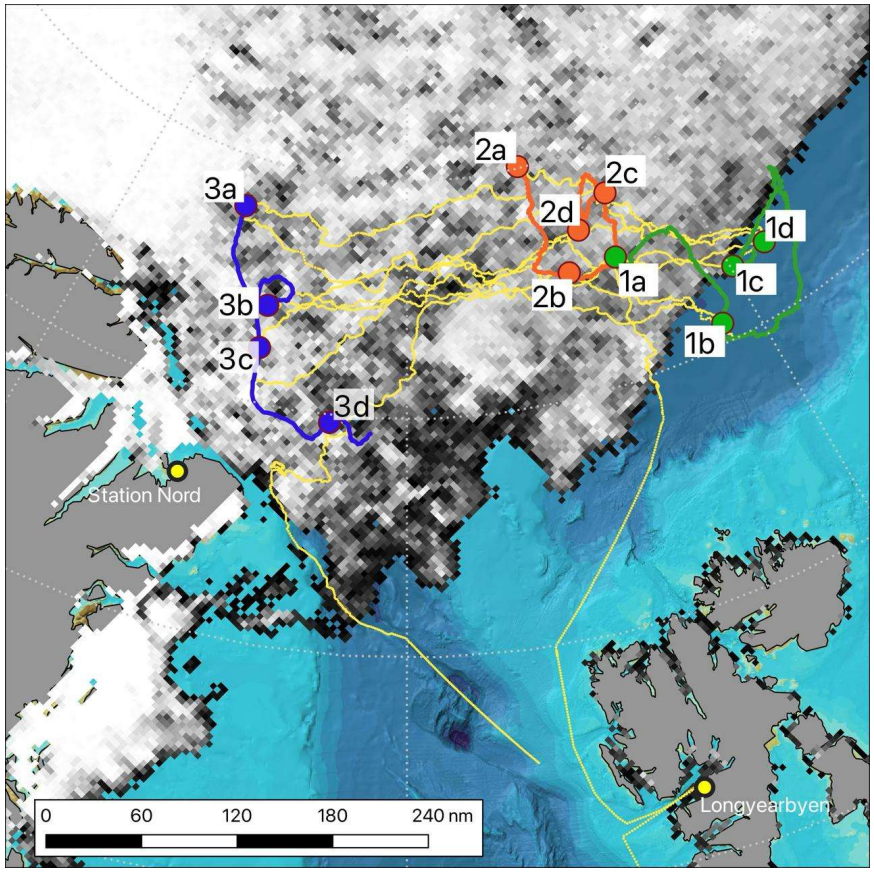
Ruzica Dadic

SLF/WSL

CONTRASTS of sea ice regimes in the Arctic Ocean during melt season

R. Dadic, M. Haugeneder, M. Jaggi, M. Lehning, R. Mott, R. Pirazzini

Pictures by R. Dadic, M. Jaggi, A. Lauren, M. Nicolaus, E. Salganik



SLF WSL CONTRASTS CRYOS EPFL FINNISH METEOROLOGICAL INSTITUTE AWI SWISS POLAR INSTITUTE FONDATION BNP PARIBAS

SWISS POLAR INSTITUTE

Monika Maślikowska

University of Zurich

Boundary Spanning for Sustainability in Extreme Antarctic Teams

King George Island (Antarctica)

Jan/Feb 2025 (~1 Month)

7 Research Stations: Arctowski, Escudero, Ferraz, Machu Picchu, Copacabana, Great Wall, Artigas

~96 Interviews (~90 Participants), Observations, Journals, Pictures, Videos

7 Supporting Organisations: SPI, UZH, Arctowski (IBB PAN), Escudero (INACH), PROPOLAR, EURAM, SCAR

MONIKA MAŚLIKOWSKA (PI), ANDRES KAOSÄR, JAN SCHMUTZ, PERDO MARQUES-QUINTEIRO, LILLY CHARLOTTE LEHMEYER

SWISS POLAR INSTITUTE

FONDATION BNP PARIBAS

SWISS POLAR INSTITUTE

Marius Banica

ZHAW Zurich University of Applied Sciences

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Sirin Orbital Systems AG
Dr. Matteo Madi
madi@sirin-os.com

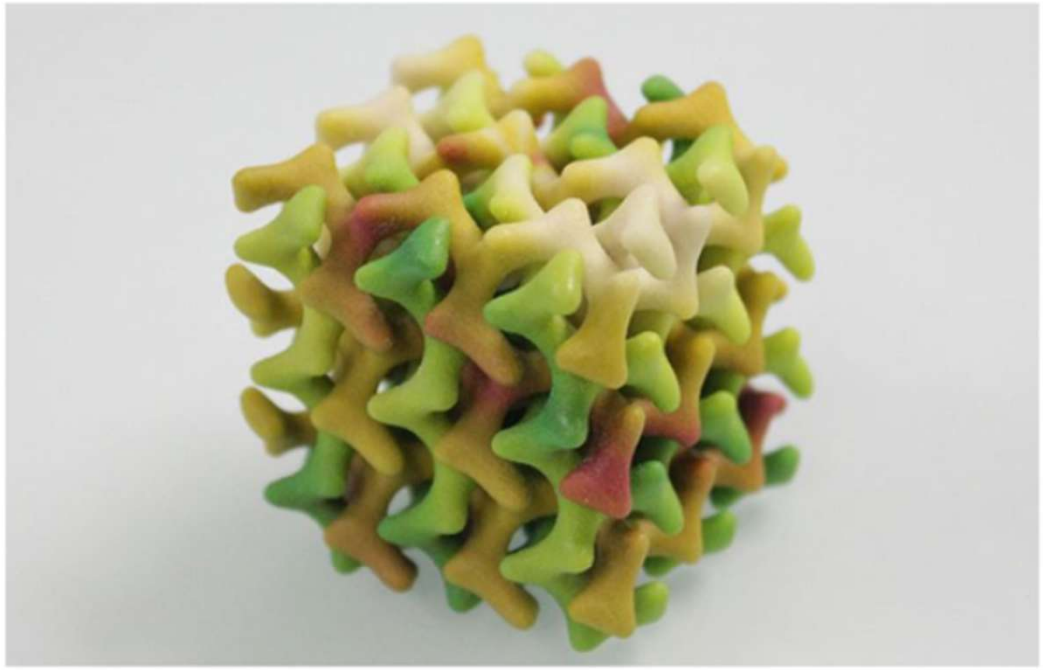
Water + phytantriol remains liquid down to -120°C (ETHZ)

Pumping/hydraulic networks possible. No heating req'd for storage.

Water that never freezes

Link to article

24 APR 2019



Three-dimensional model of the novel lipid mesophase (Photo: Peter Rüegg/ETH Zürich)

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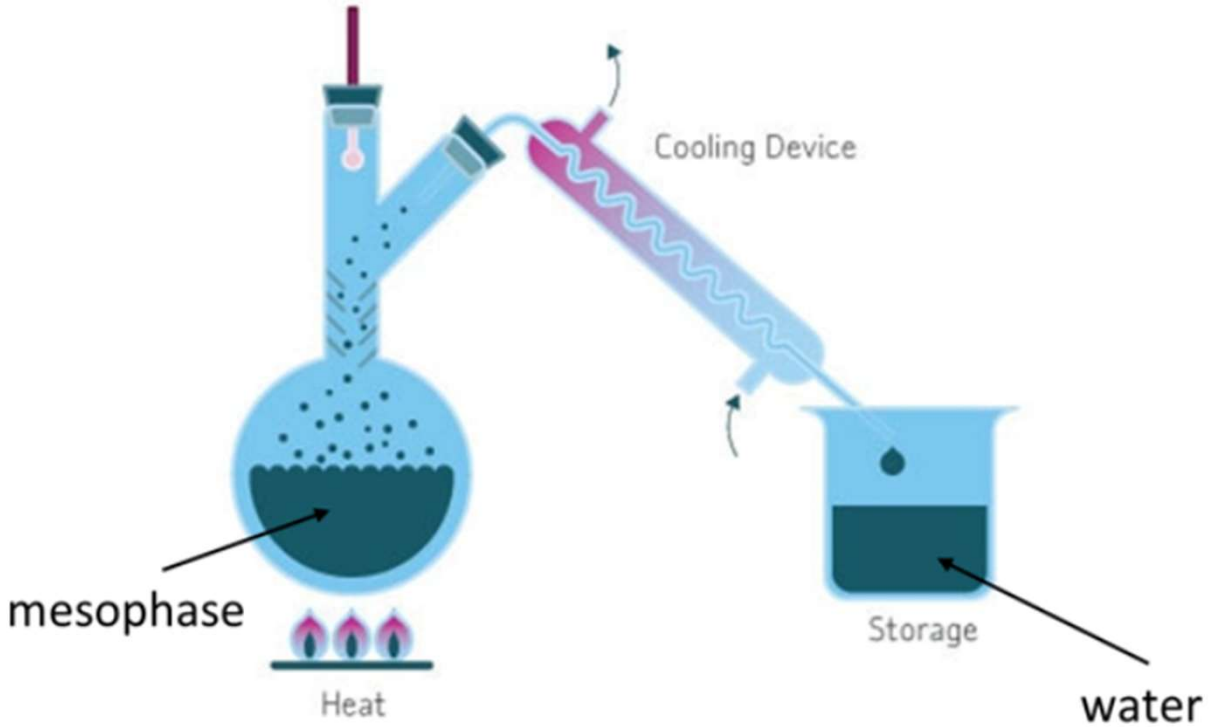
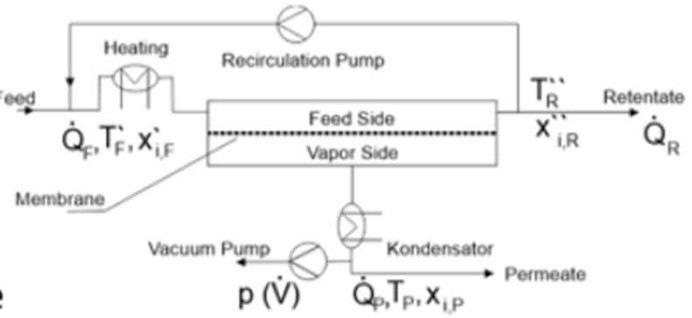
Problem: Separation.
Distillation was successful,
but is energetically expensive.

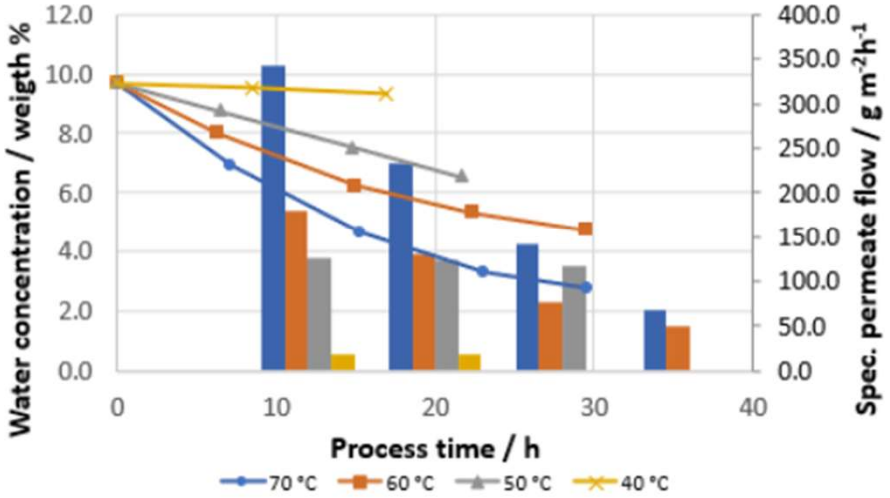
Technogrant TEG-2024-002:
Identify energy efficient separation method.



Pervaporation

- Pervaporation is a method to separate a compound from a liquid mixture
  - It diffuses selectively through a membrane
  - The evaporated permeate is condensed
- Physical drivers are:
  - Pressure difference over the membrane
  - Specific characteristics of the membrane to let the compound pass





Next steps

- Compare energetical input of pervaporation with rectification
- Separate water from phytantriol via liquid phase (nano filtration)

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SWISS POLAR INSTITUTE

Laureen Ahlers

EPFL

Microbes in the Mountains: Hidden drivers of CO_2 and CH_4 fluxes

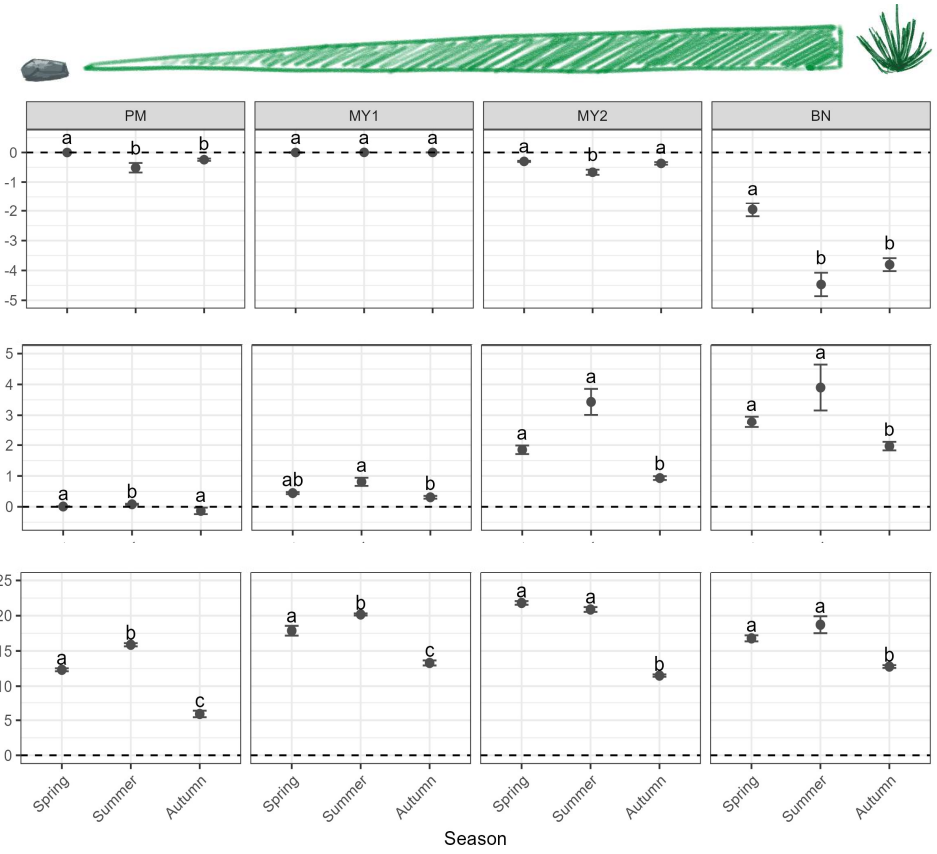
Laureen Ahlers
MACE laboratory, EPFL Valais-Wallis

Soil microbes can release CO_2 to the atmosphere and remove CH_4

Warming might amplify CO_2 emissions from soil – CH_4 response?

Warm temperatures cause higher CO_2 emissions and stronger CH_4 uptake

Experimental warming with OTC and microbial insights – ask me!



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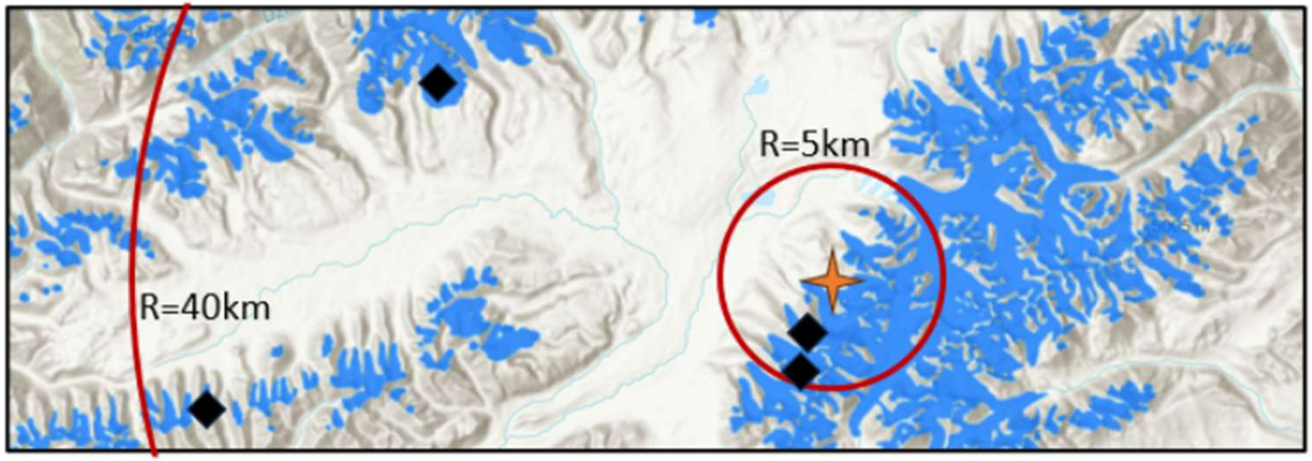
Valentin Künzler

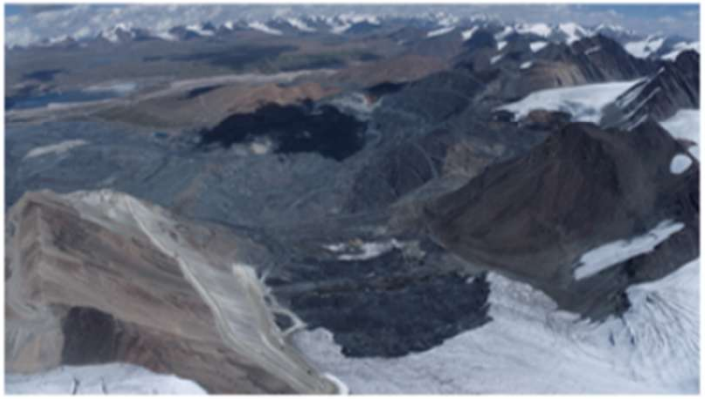
ETH Zurich

MITICA: Mining Impacts on Tien Shan Glaciers in Central Asia

SPI Polar Access Fund project – Vali Künzler in behalf of Lander Van Tricht – ETH Zürich



Open pit mine



Glaciers surveyed in August 2025

Data collected:

- DEM & orthomosaic (UAV-based, partly multispectral)
- Pointwise surface albedo
- Pointwise impurity material samples

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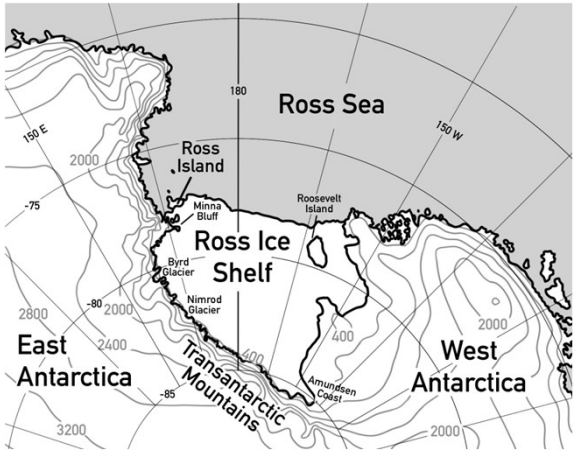
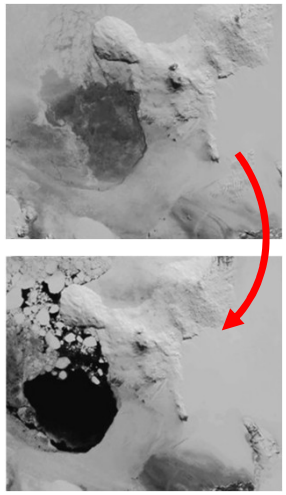
Melanie Fülster

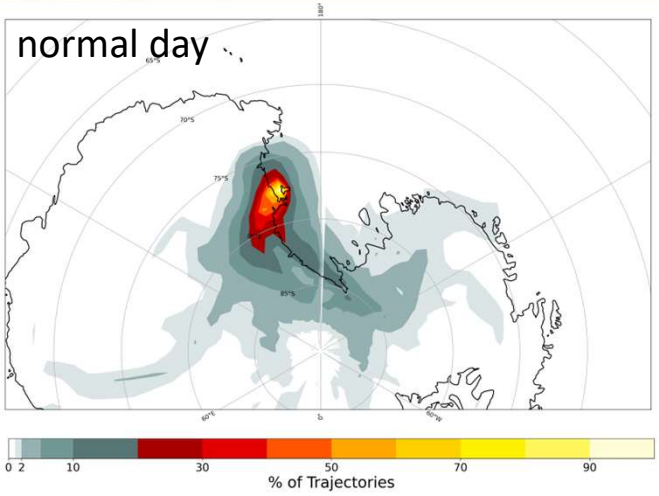
SLF/ETH Zurich

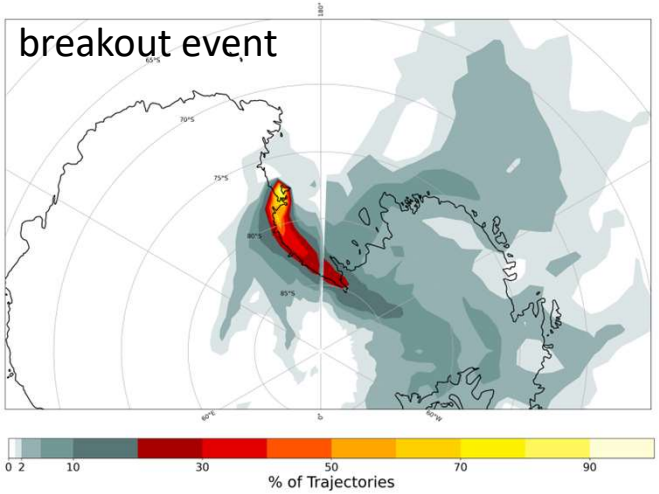
Atmospheric processes associated with fast ice breakout events in McMurdo Sound

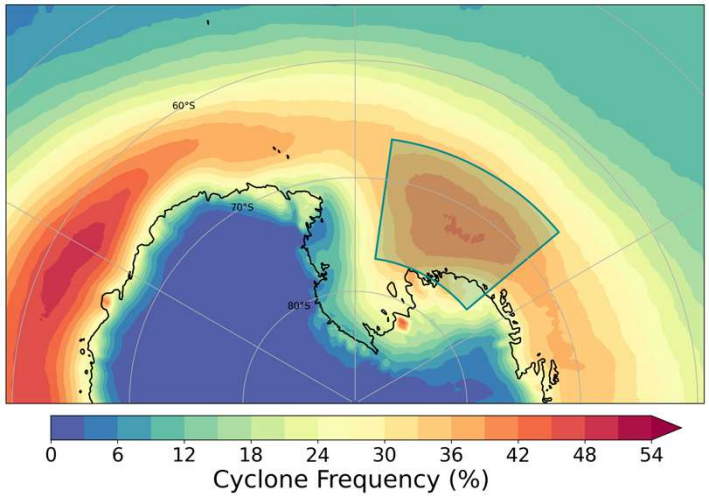
Melanie Fülster, Iris Thurnherr, Heini Wernli, Ruzica Dadic











Conclusion

- More cyclones → More breakout events
- 2013-2024: no significant trends

ETH zürich SLF