PermaMeteoCommunity:
Developing a permafrost and meteorological climate change response system to build resilience in Arctic communities

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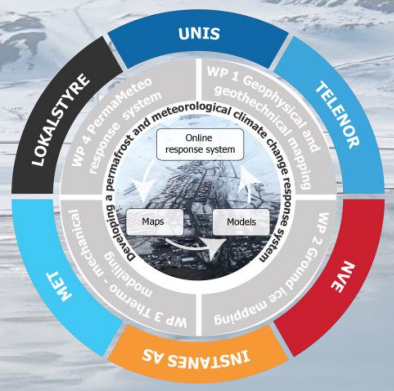
5: Instanes AS.

6: Telenor Svalbard.

7: Longyearbyen Lokalstyre.

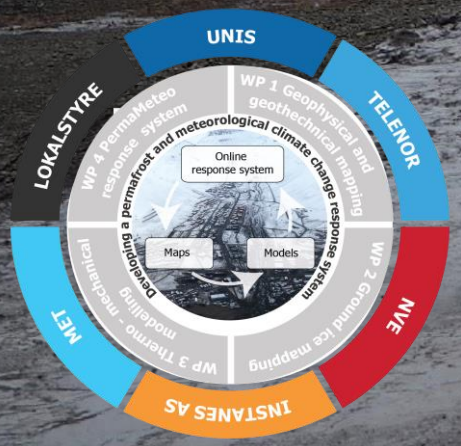


Why is this important ?

- Create interdisciplinary geoscientific knowledge about the impacts of permafrost degradation due to climate change on nature and society.
- Develop a climate change response system that can be adopted by high-Arctic communities to cope with changing climate and permafrost.

How to do this:

- Real-time observations of meteorology and permafrost conditions.
- Geotechnical modelling.
- Combining observations and modelling into an online response system.



UNIS Strategic Pilot Project 2021-2024

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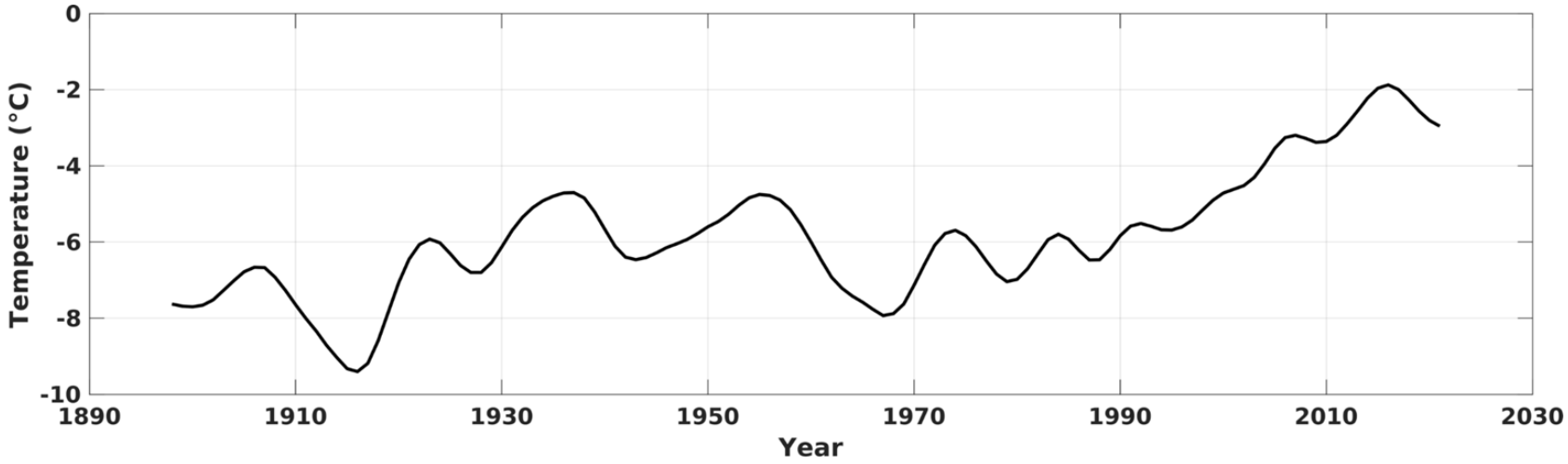
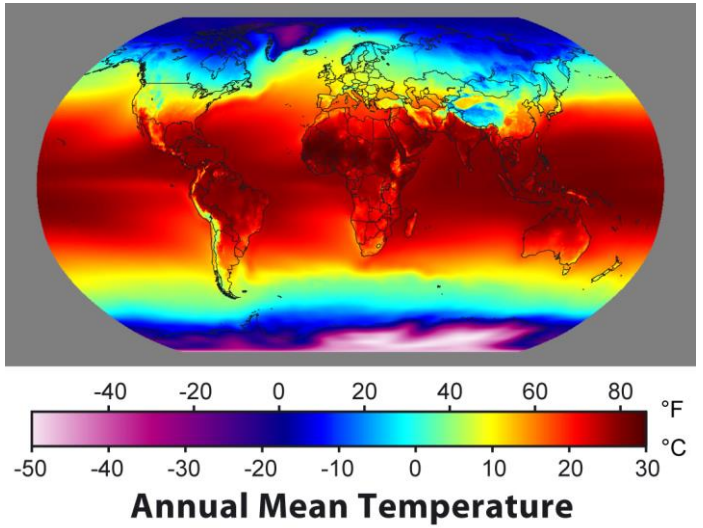
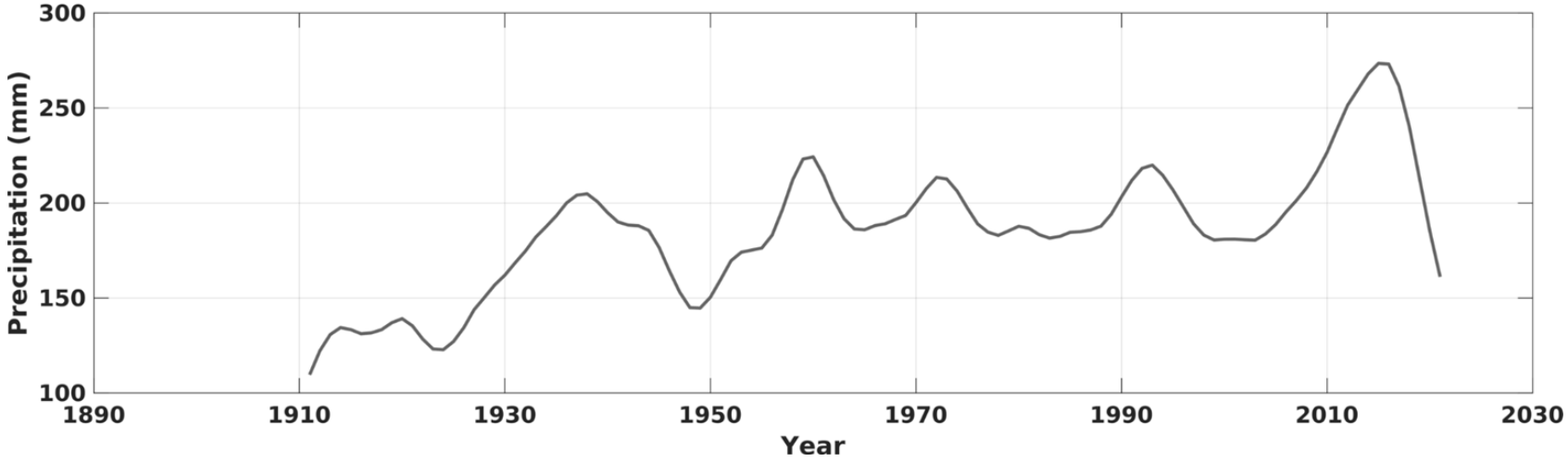
Climate change in Longyearbyen

Observations



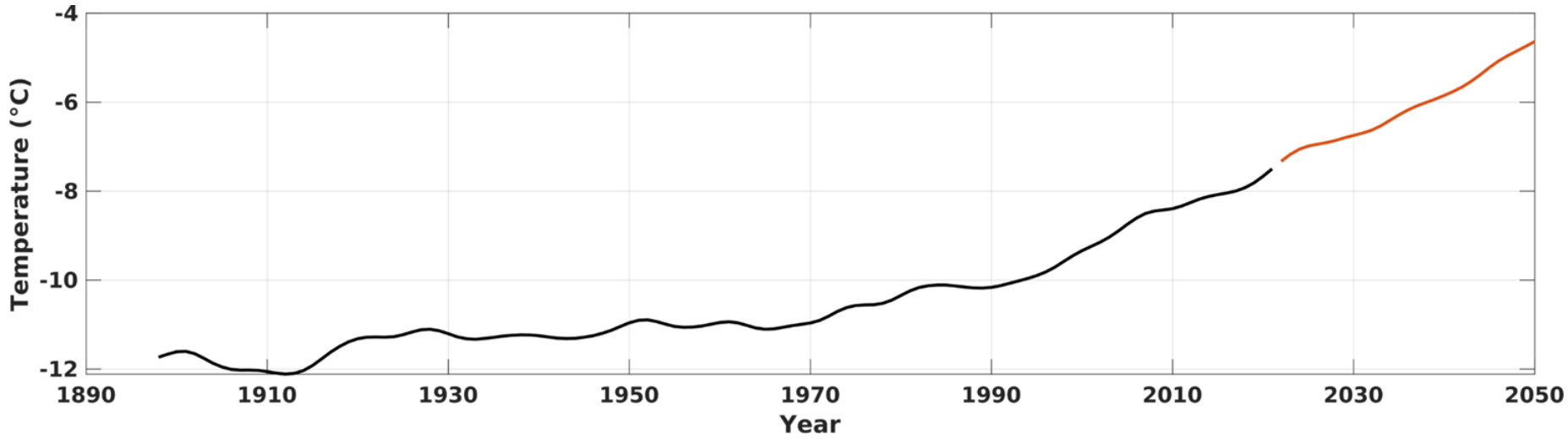


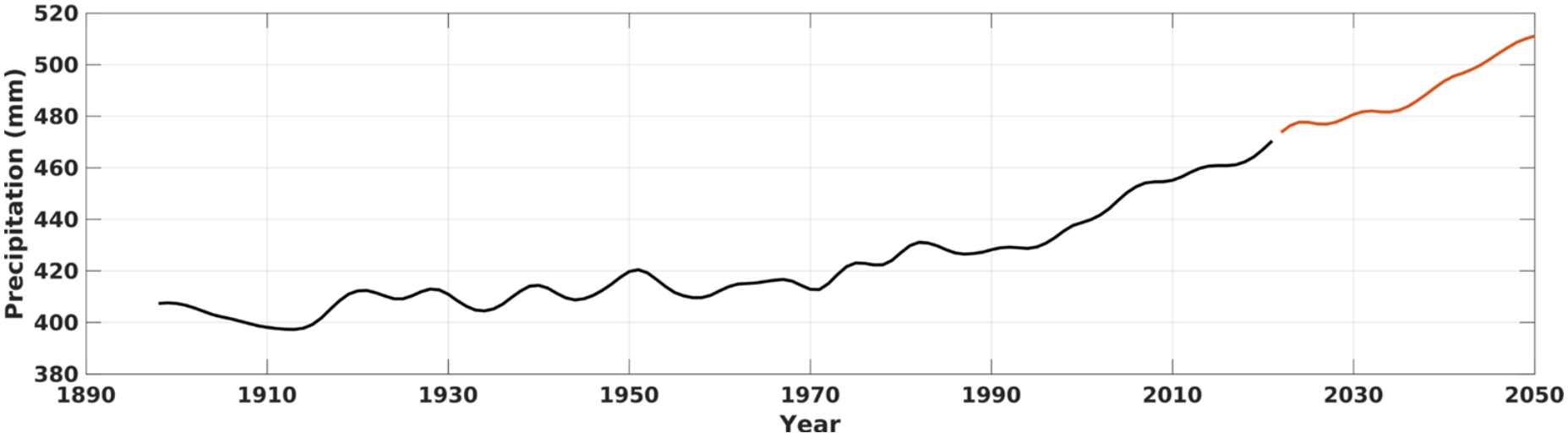


Data from MET Norway

Future climate change in Svalbard

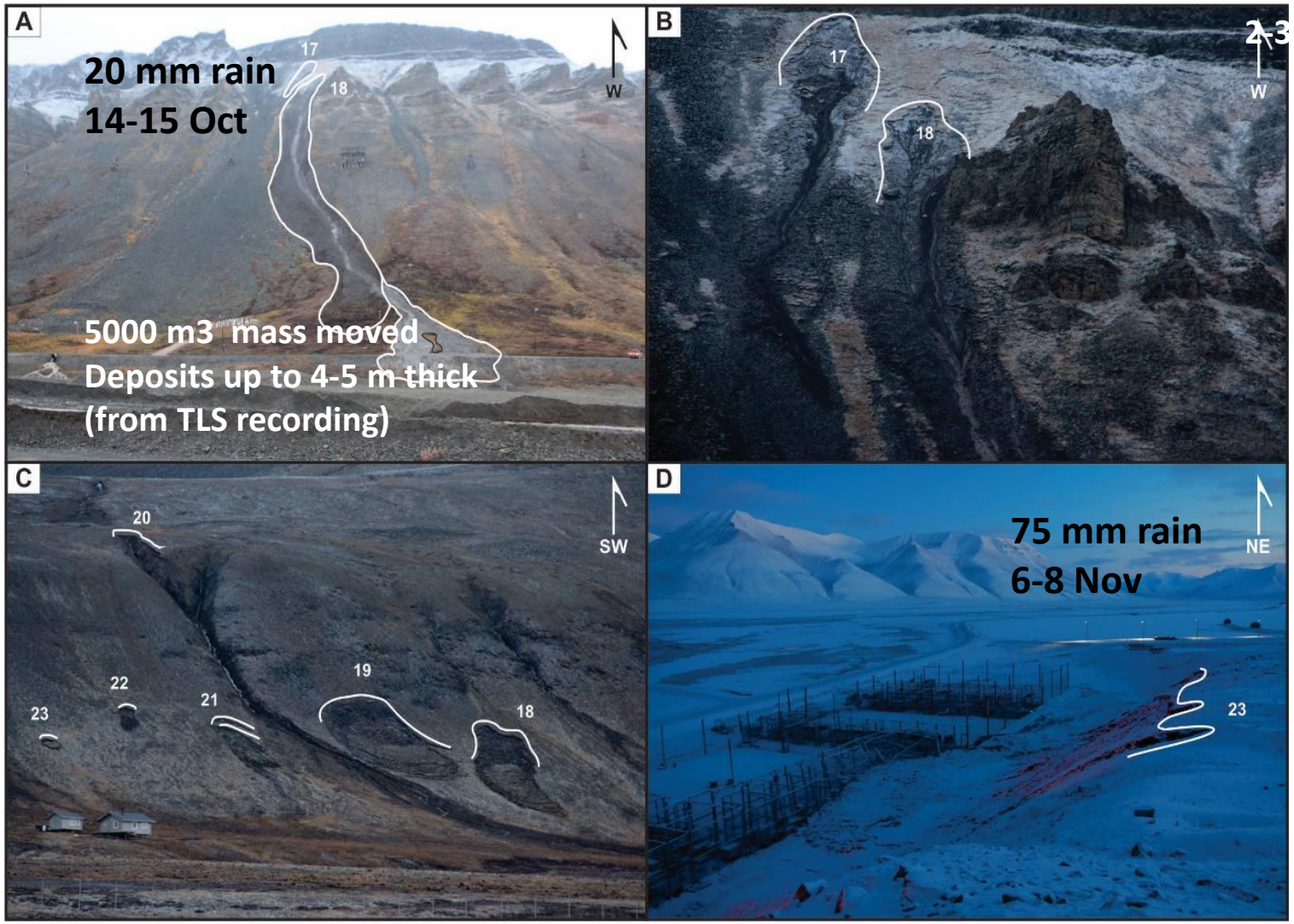
Model data

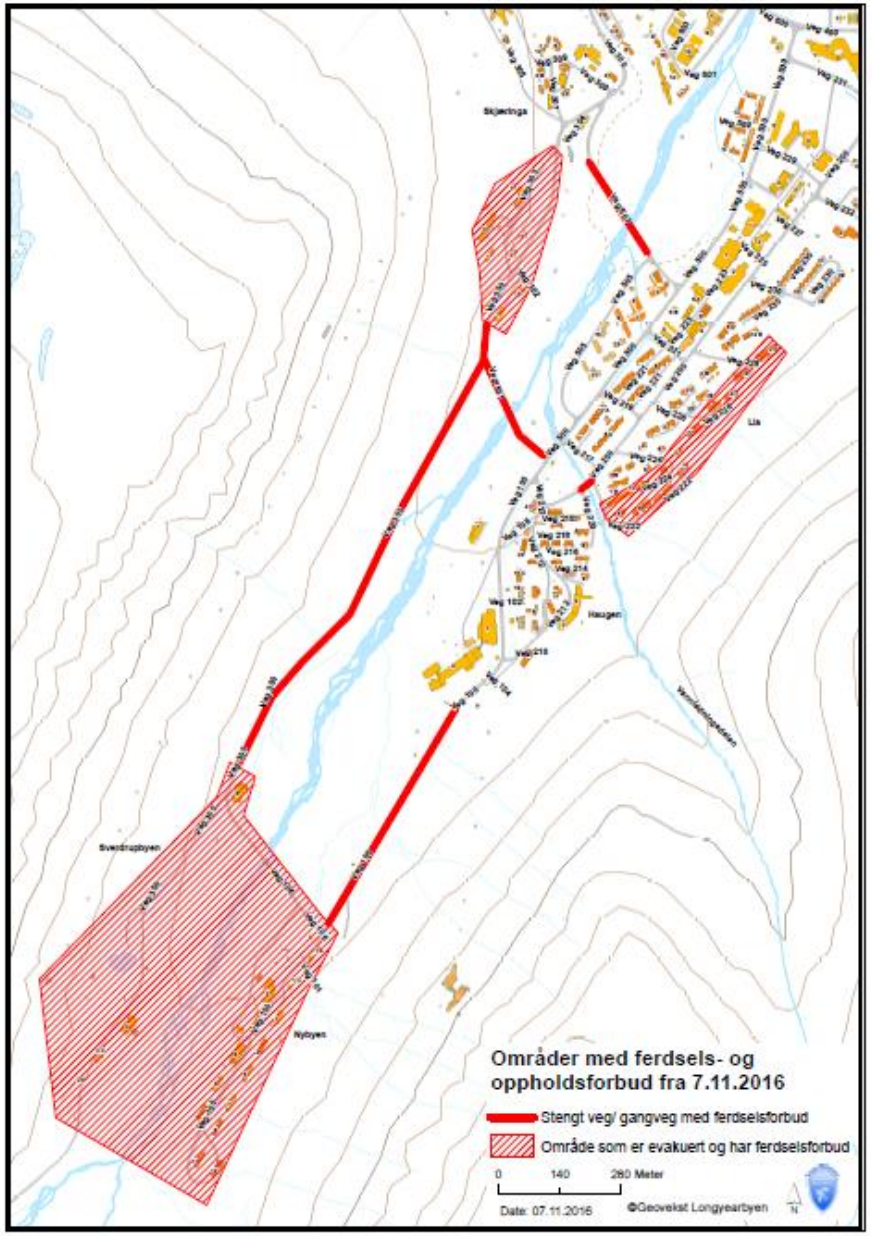




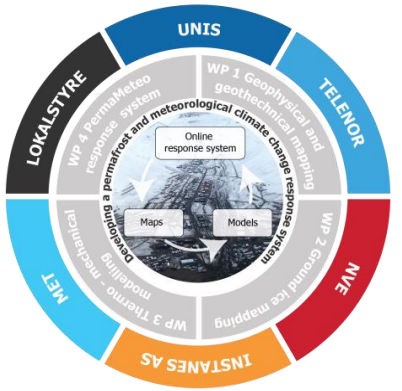
CMIP5 data obtained from www.climatereanalyzer.org

Autumn warming: 2016 rainstorms in October and November caused active layer sliding





Main research ambitions in the project



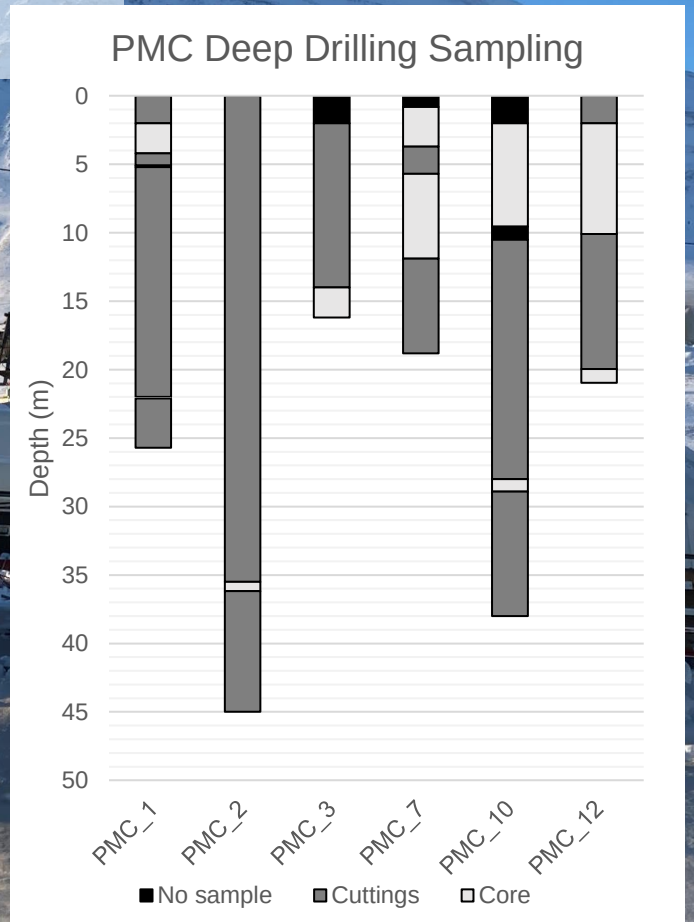
- ***What is the sedimentary infilling history of the Longyeardalen valley and how much ground ice is contained in the sediment*?**

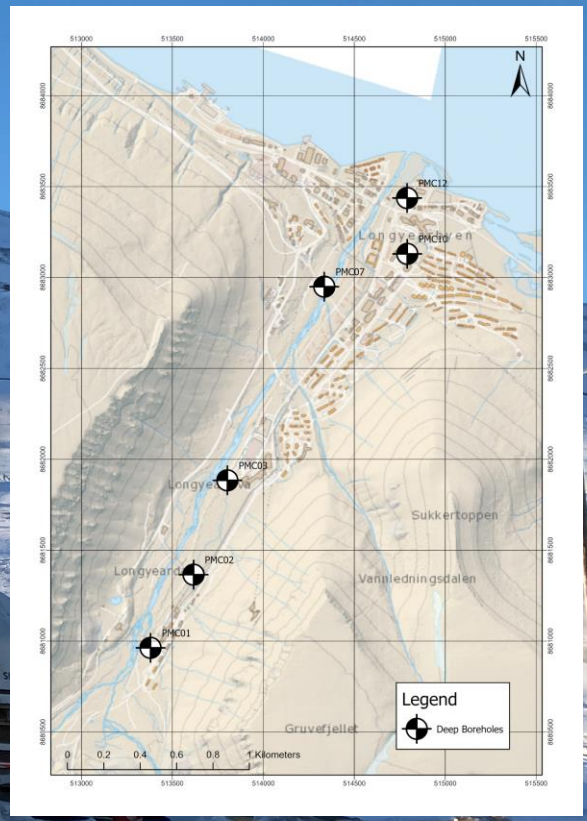
- ***What extent of Longyearbyen is underlain by saline soils, what are their engineering properties and how will sediment behaviour change with temperature increase?***

- ***How to build the best online permafrost and meteorological response system with both observations and model input for Longyearbyen?***

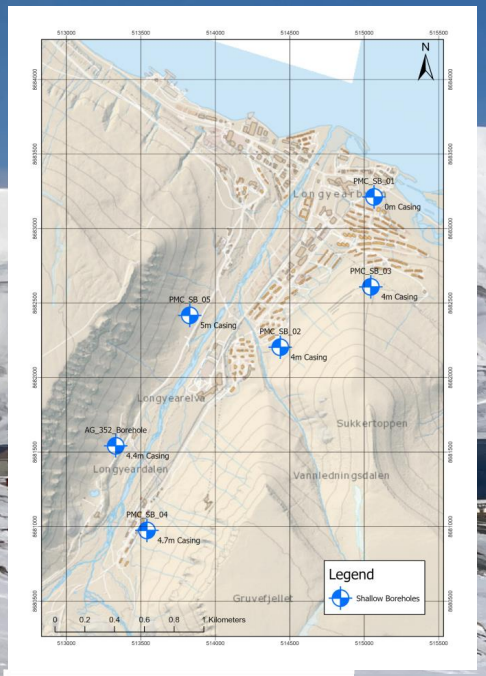
Deep drilling to map the permafrost and sediments filling Longyeardalen

Longyearbyen Drilling campaign autumn 2021 + March 2022:
Boreholes drilled: 6
Meters drilled: 177
Meters of core: 29.1
Meters of bag samples: 127 (82 samples)

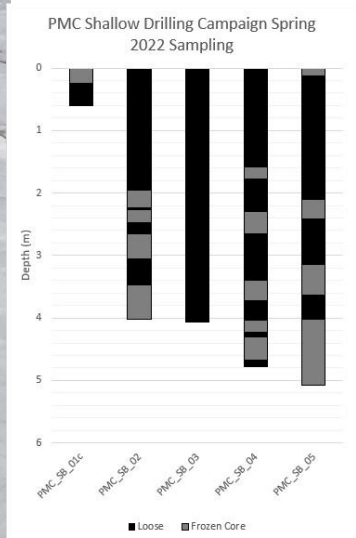




Shallow drilling to map ground ice and sediments in the lower slopes of Longyearbyen

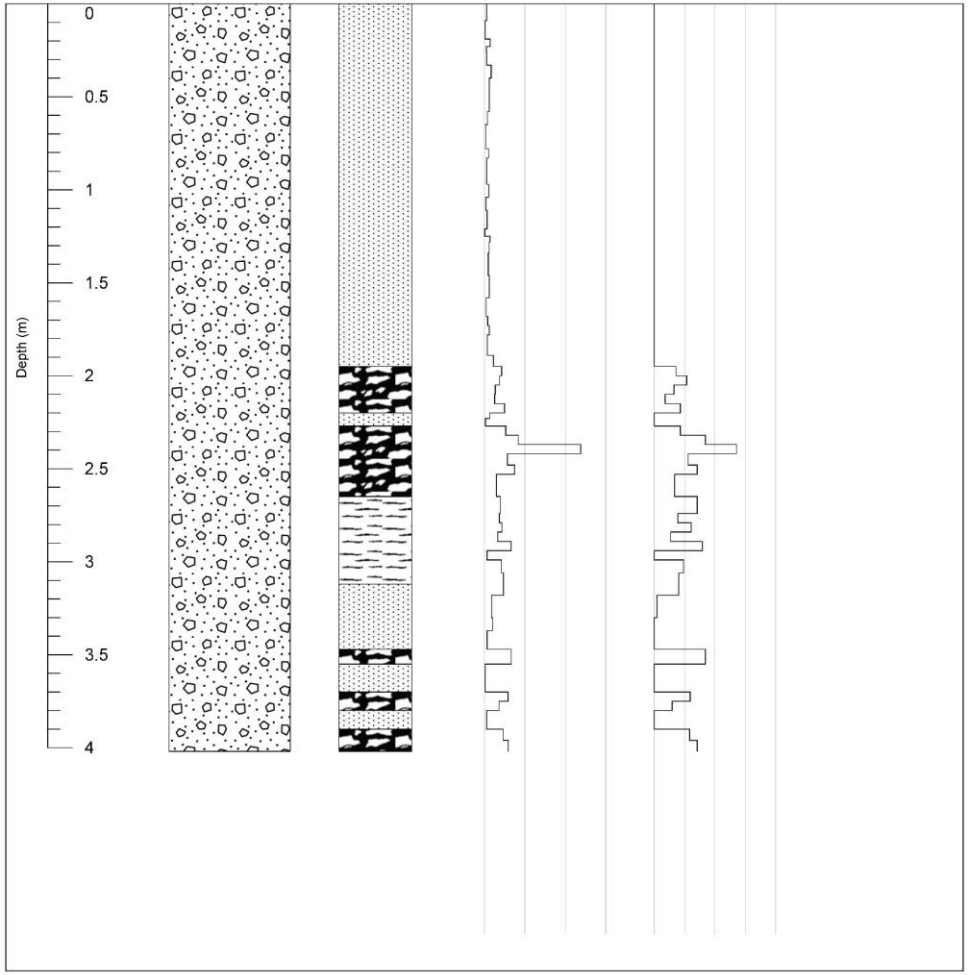


Drilling campaign spring 2022:
Days of drilling: 9
Boreholes drilled: 5
Meters drilled: 18.53
Meters of core: 18.53



Boreholes to be used for observations feeding data into the response system

Stratigraphic Log PMC_SB_02



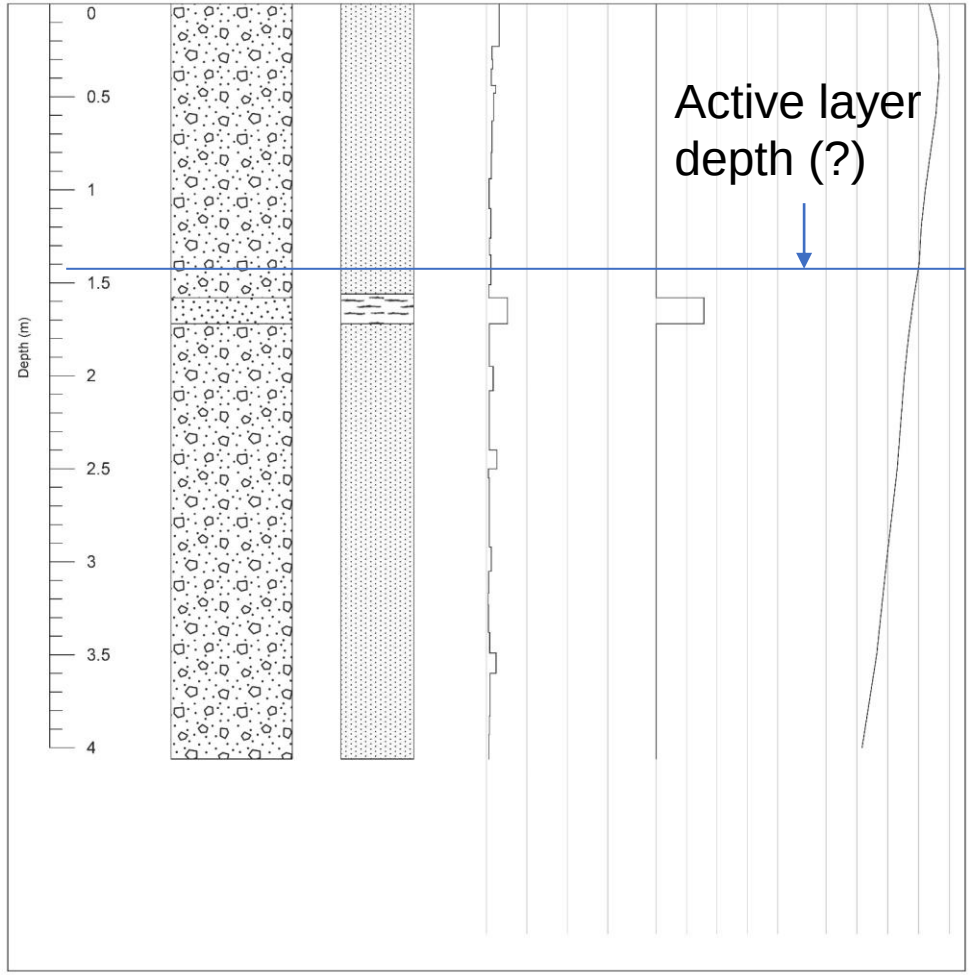
Sediment
- Diamicton

Cryostructures
- Lenticular
- Suspended
- Structureless

Gravimetric water content (%)
0 100 200 300

Excess ice (%)
0 25 50 75 100

Stratigraphic Log PMC_SB_03



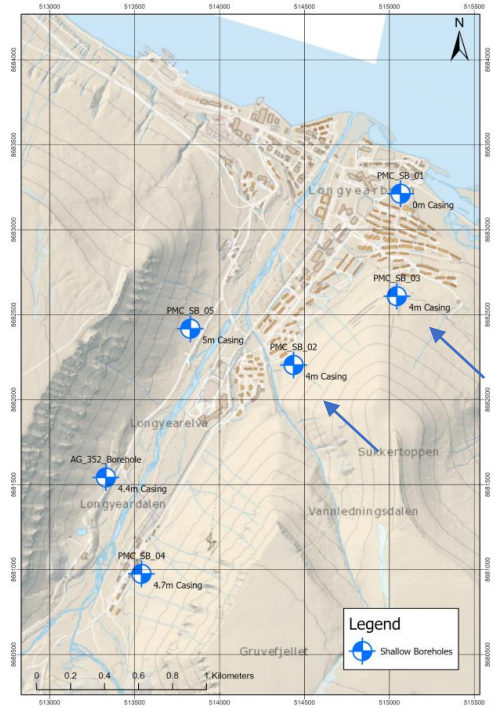
Sediment
- Diamicton
- Muddy sand

Cryostructures
- Lenticular
- Structureless

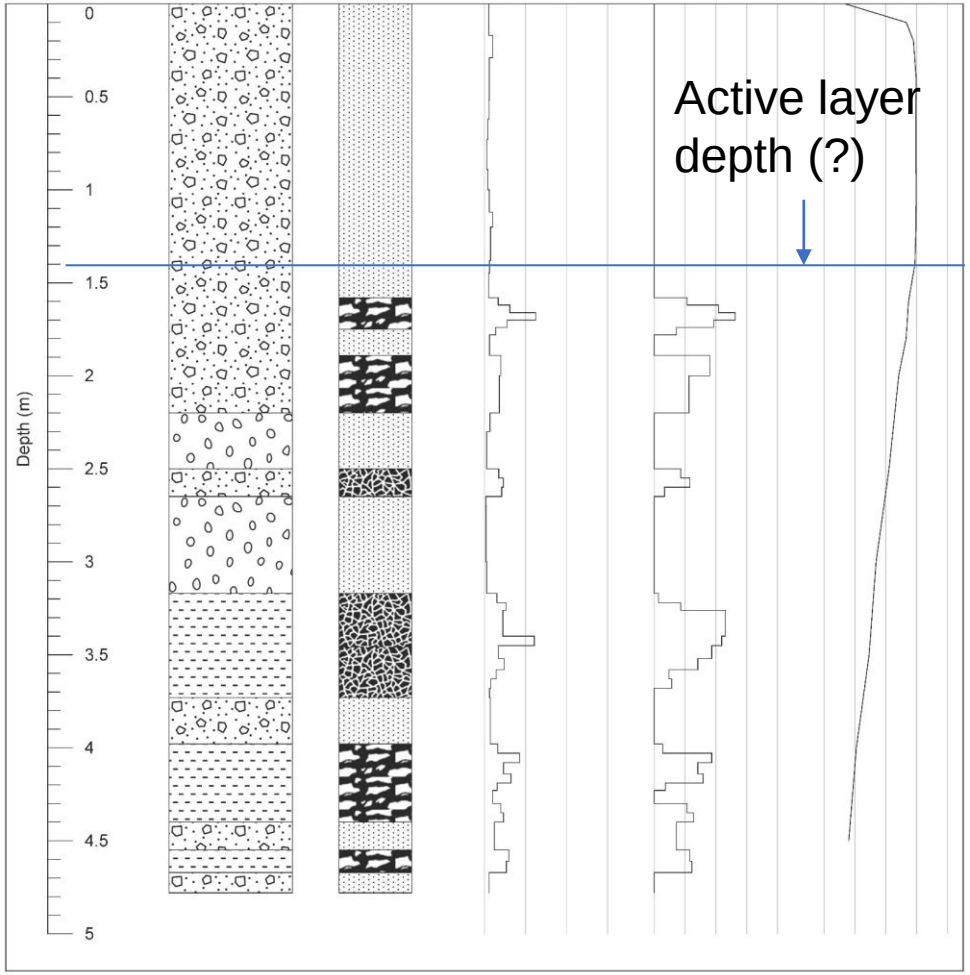
Gravimetric water content (%)
0 100 200 300

Excess ice (%)
0 25 50 75 100

Temperatures 10.10.2022 14:00 (°C)
-3 -2 -1 0 1



Stratigraphic Log PMC_SB_04



Sediment
- Diamicton
- Gravel
- Mud

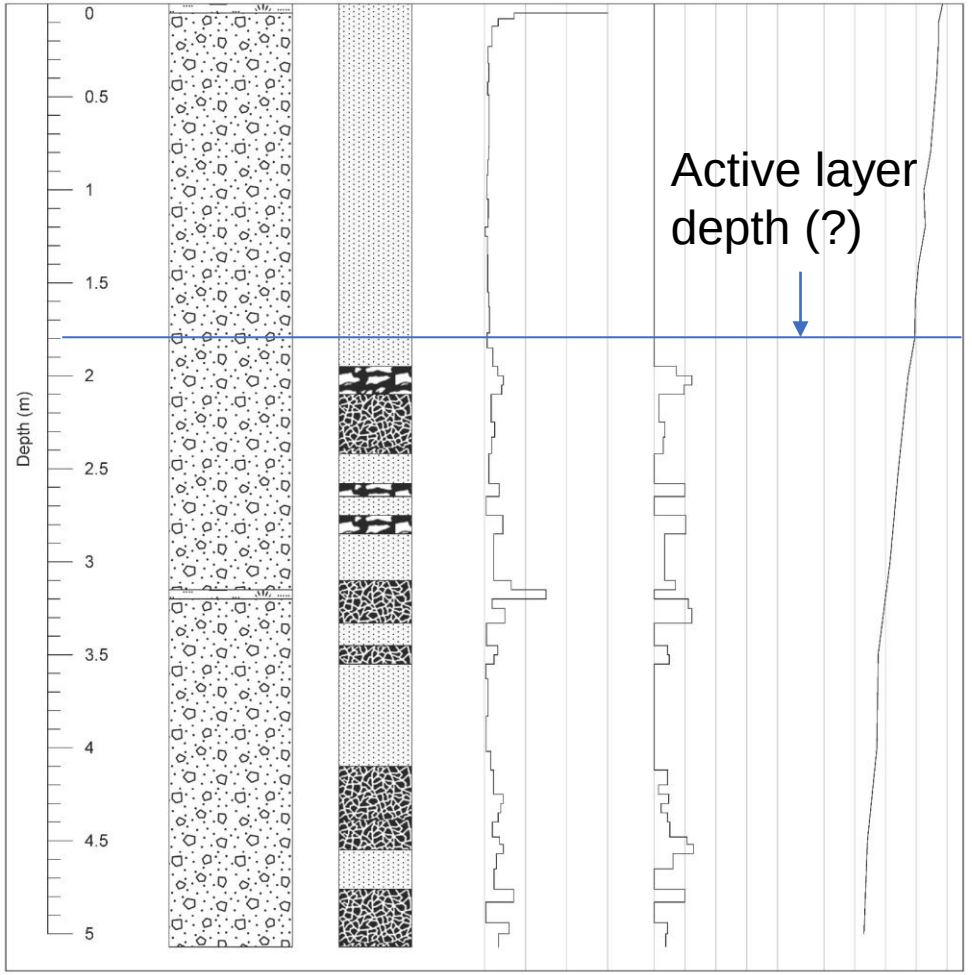
Cryostructures
- Irregular reticulate
- Structureless
- Suspended

Gravimetric water content (%)

Excess ice (%)

Temperatures 13.10.2022 20:00 (°C)

Stratigraphic Log PMC_SB_05



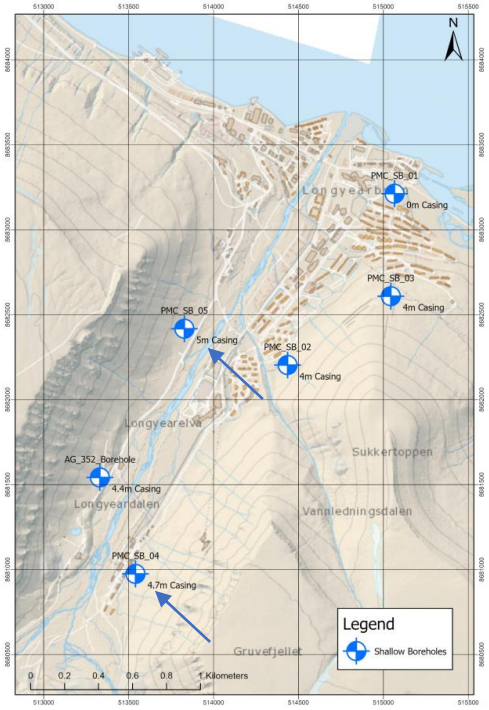
Sediment
- Diamicton
- Organic rich mud

Cryostructures
- Irregular reticulate
- Suspended
- Structureless

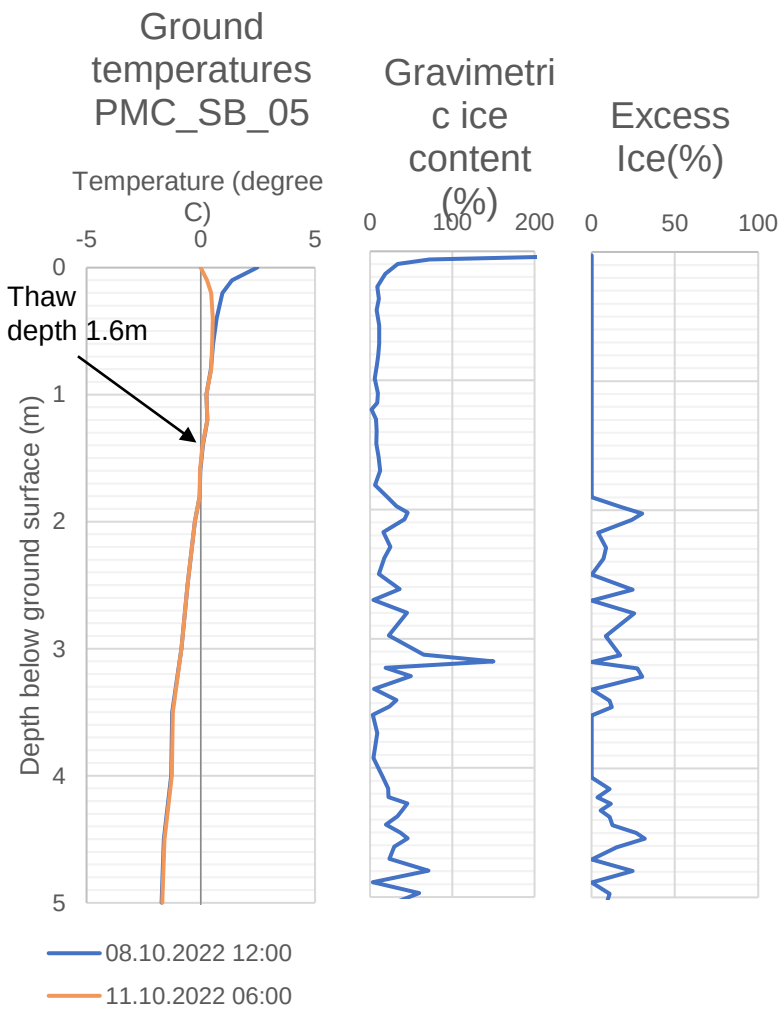
Gravimetric water content (%)

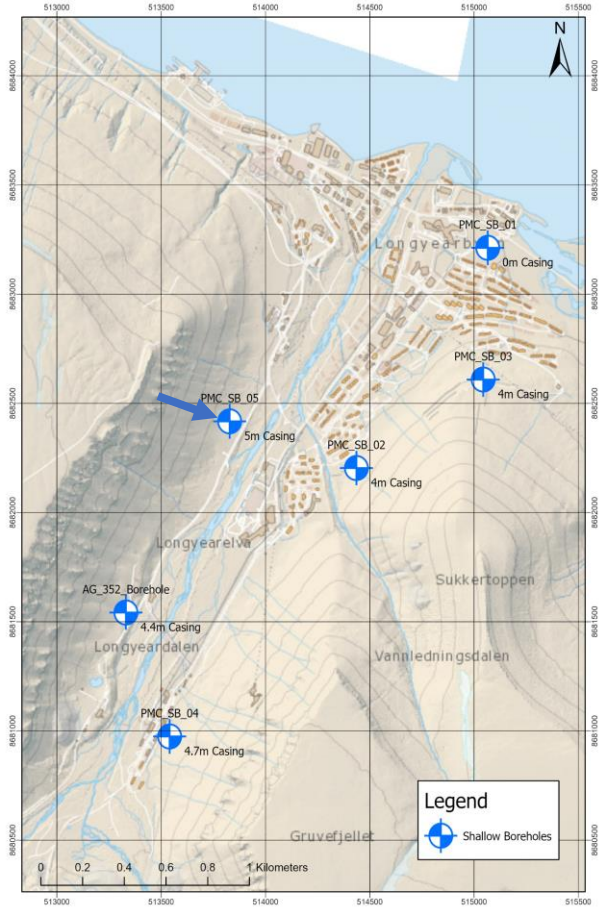
Excess ice (%)

Temperatures 10.10.2022 14:00 (°C)



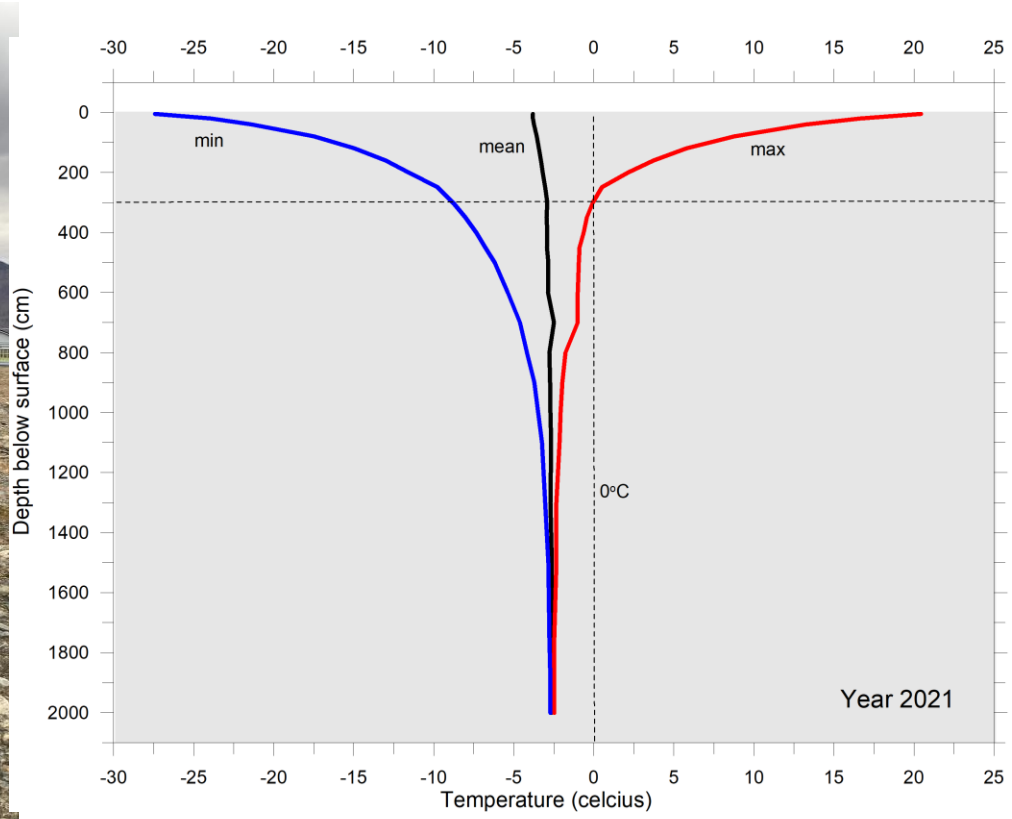
Response system taking form – observations installed this autumn – data flowing





Permafrost borehole temperatures will be feeding directly into the response system

SIOS
SVALBARD INTEGRATED ARCTIC EARTH OBSERVING SYSTEM

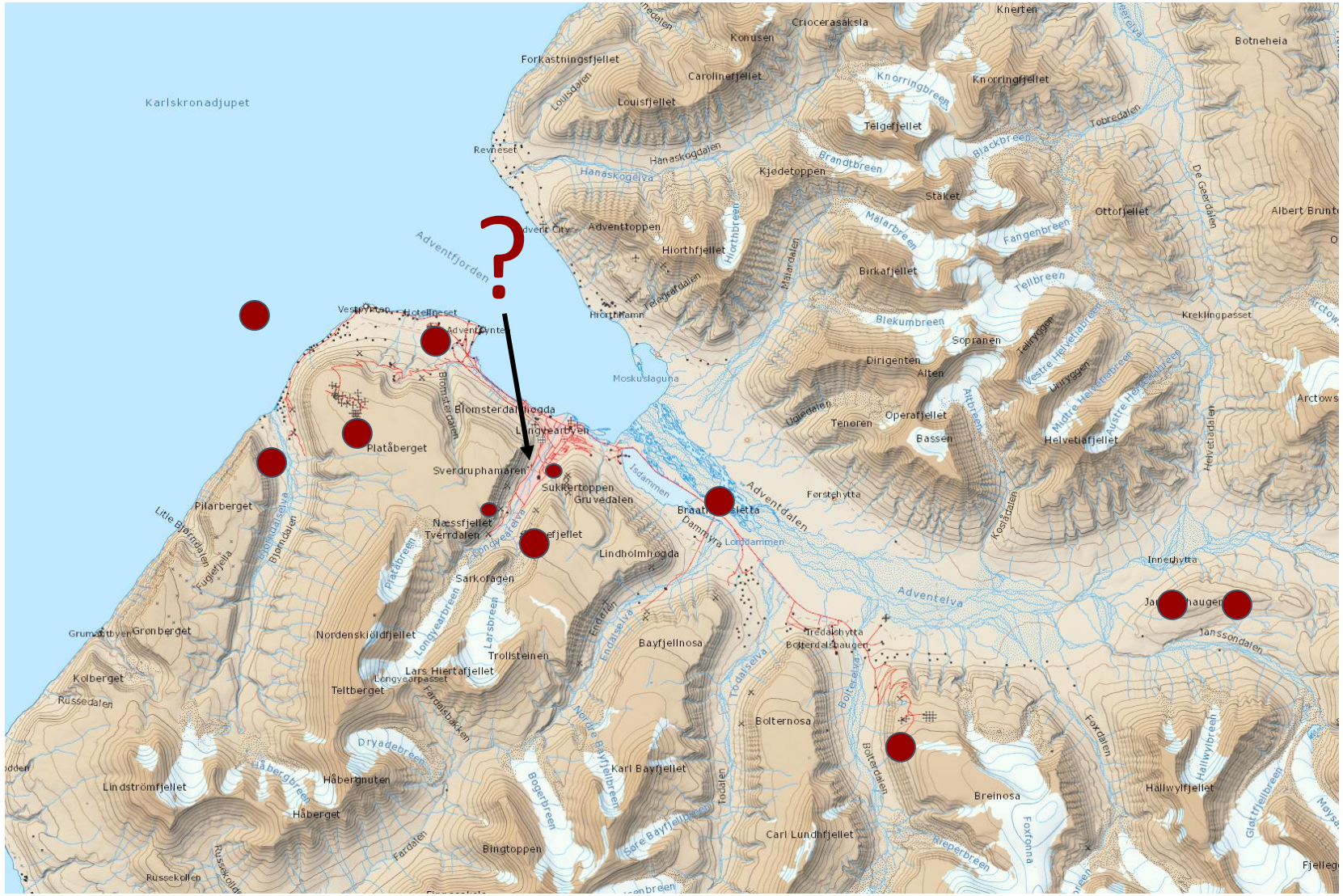


The response system will include also existing ground temperature observations in Longyearbyen made for other purposes

Established permafrost observation under large infrastructure

Two 45° boreholes reaches 17 m below the Kulturhuset building for ground thermal observations with 23 m long boreholes.

Online weather stations



Online weather stations

New full-scale station

10m wind speed
10m wind direction

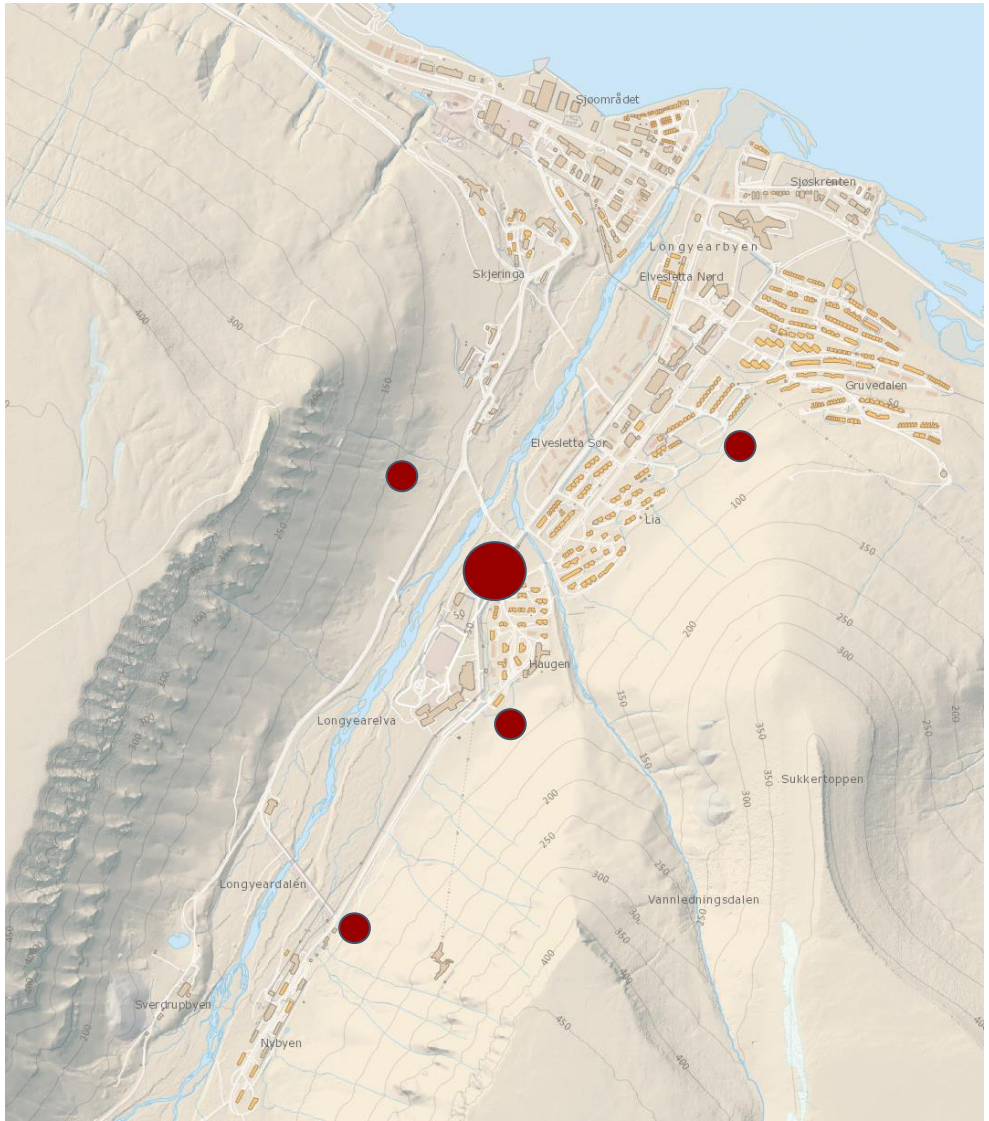
2m temperature
2m humidity

Pressure

Precipitation

Online small-scale weather stations over permafrost installations

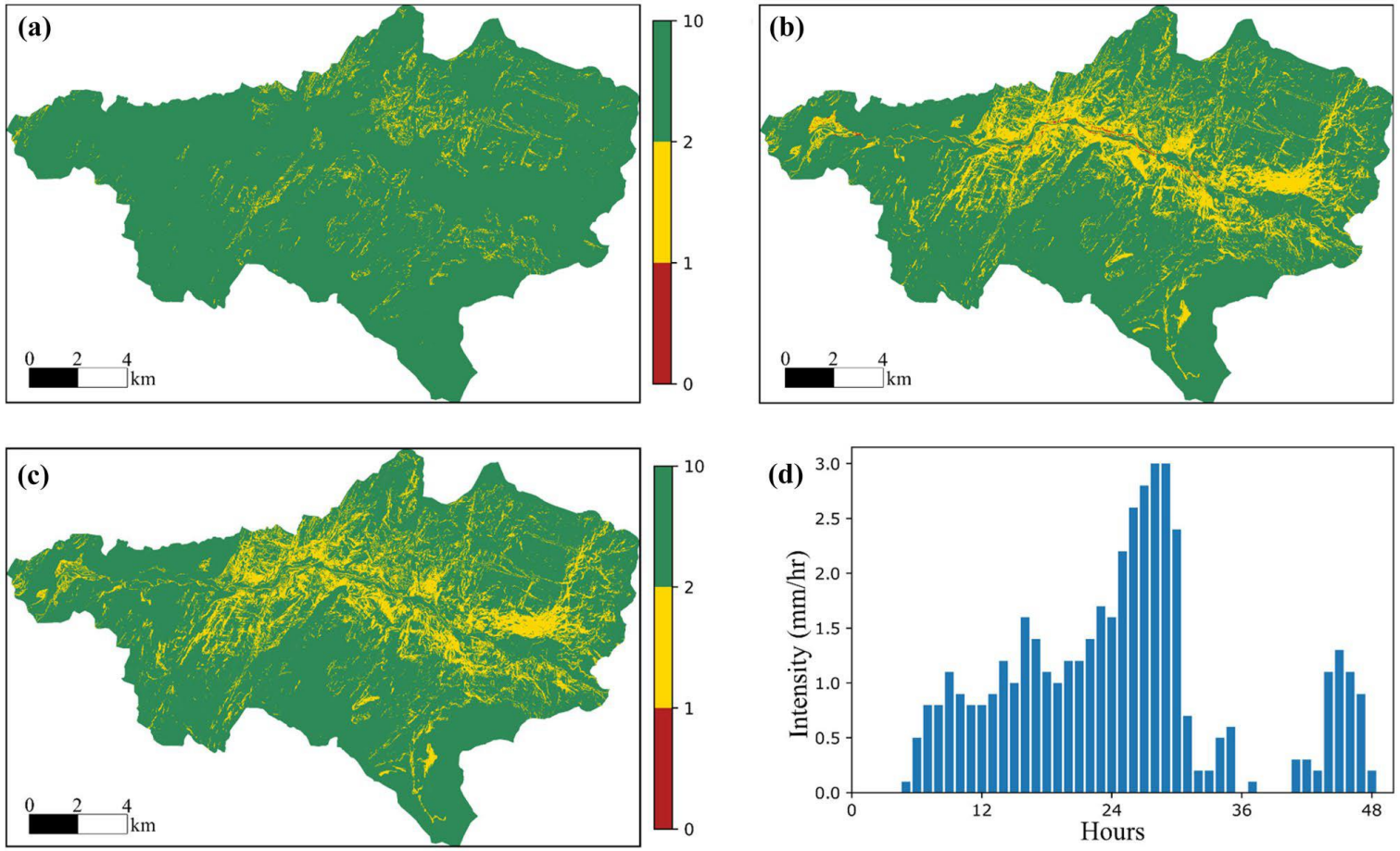
New compact stations



Wind speed + direction
Temperature
Humidity
Pressure
Precipitation

Geotechnical modelling

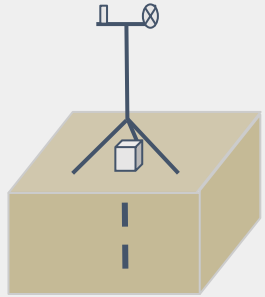
- ***Landslide susceptibility based on:***
  - ***Real-time meteorological and permafrost data: air and ground temperature, water content in active layer from the boreholes***
  - ***Meteorological forecast for coming days***

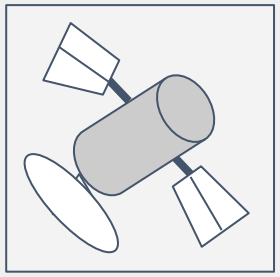


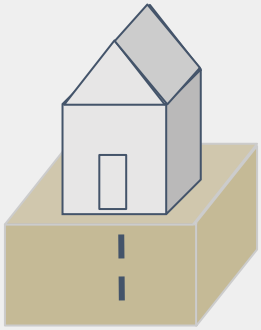
Oguz, E. A., Depina, I., Myhre, B., Devoli, G., Rustad, H., & Thakur, V. (2022). IoT-based hydrological monitoring of water-induced landslides: a case study in central Norway. *Bulletin of Engineering Geology and the Environment*, *81*(5), 1-20.

Permafrost and meteorological climate change response system

Data collection







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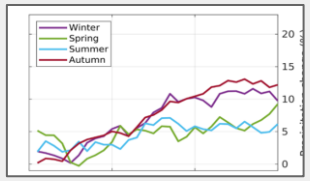
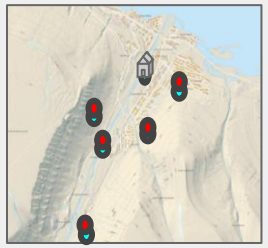
LONGYEARBYEN LOKALSTYRE

Online data portal





LONGYEARBYEN LOKALSTYRE

-> Better decision making by local authorities

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-> Valuable data for research and education

The permafrost and meteorological climate change system’s further development and use

The climate change response system shall be online and available in preparedness situations.

Will also be available for research, education and outreach use once established.

Potential for future development: early warning system trained with machine learning and artificial intelligence

The PermaMeteoCommunity Team !

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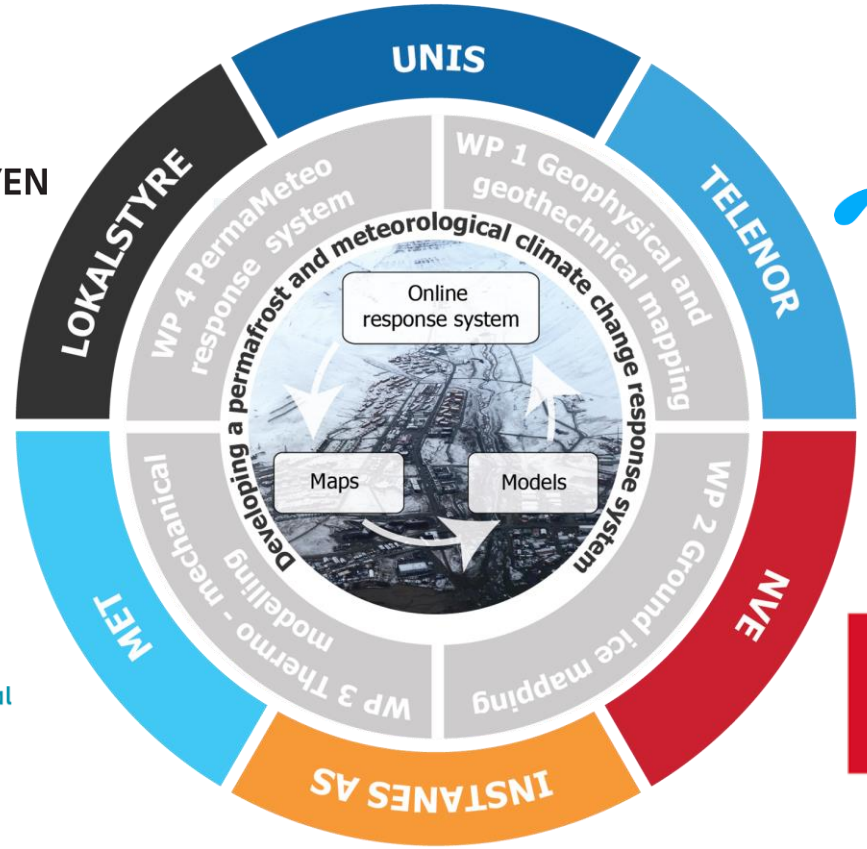

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Questions or comments?