



The Bayelva high Arctic permafrost long-term observation site: an opportunity for joint international research on permafrost, atmosphere, ecology and snow

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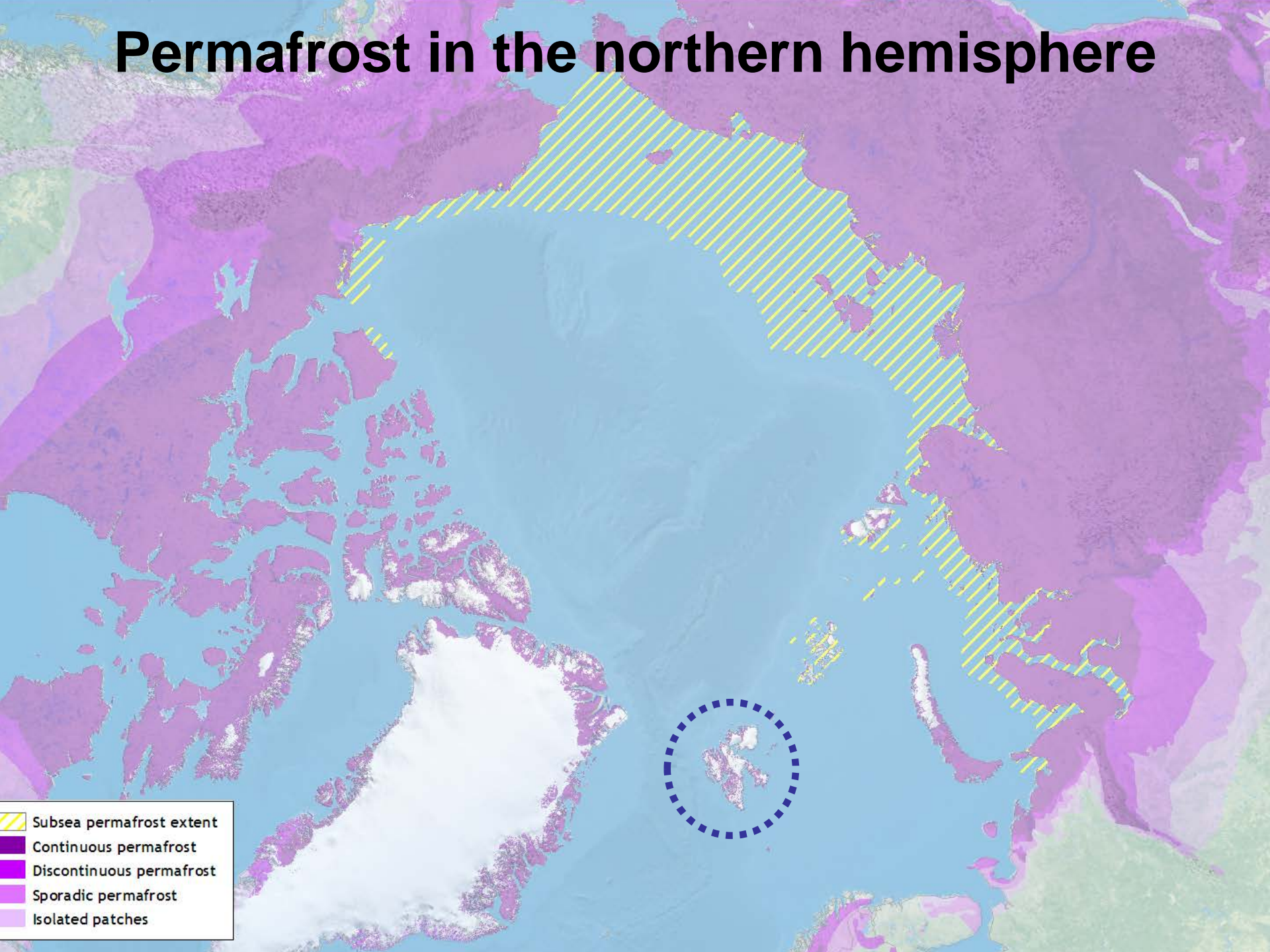
Nicoletta Cannone, Università degli Studi dell'Insubria, Italy

Alex Schulz, Boris Biskaborn, Marion Maturilli, Alex Schulz, AWI, Germany

Masaki Uchida, National Institute of Polar Research, Japan

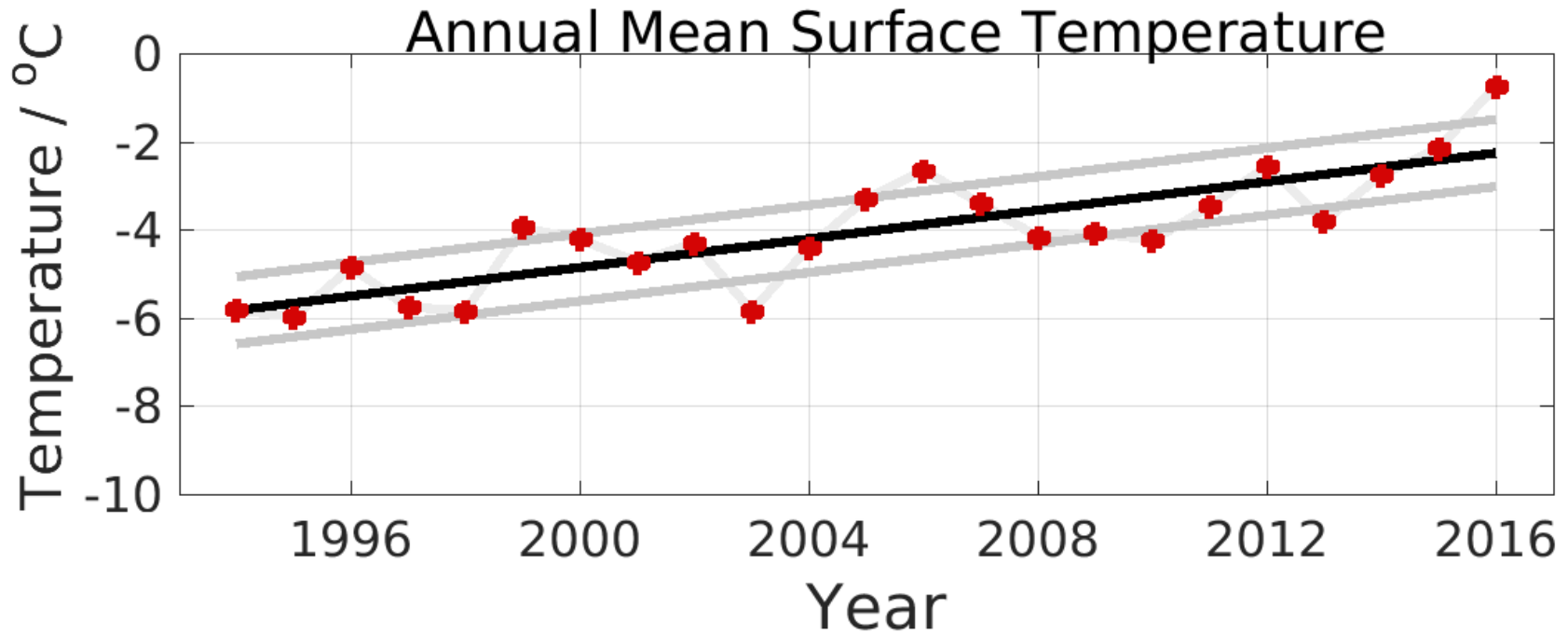
Sebastian Westermann, University of Oslo, Norway

Permafrost in the northern hemisphere



- Subsea permafrost extent
- Continuous permafrost
- Discontinuous permafrost
- Sporadic permafrost
- Isolated patches

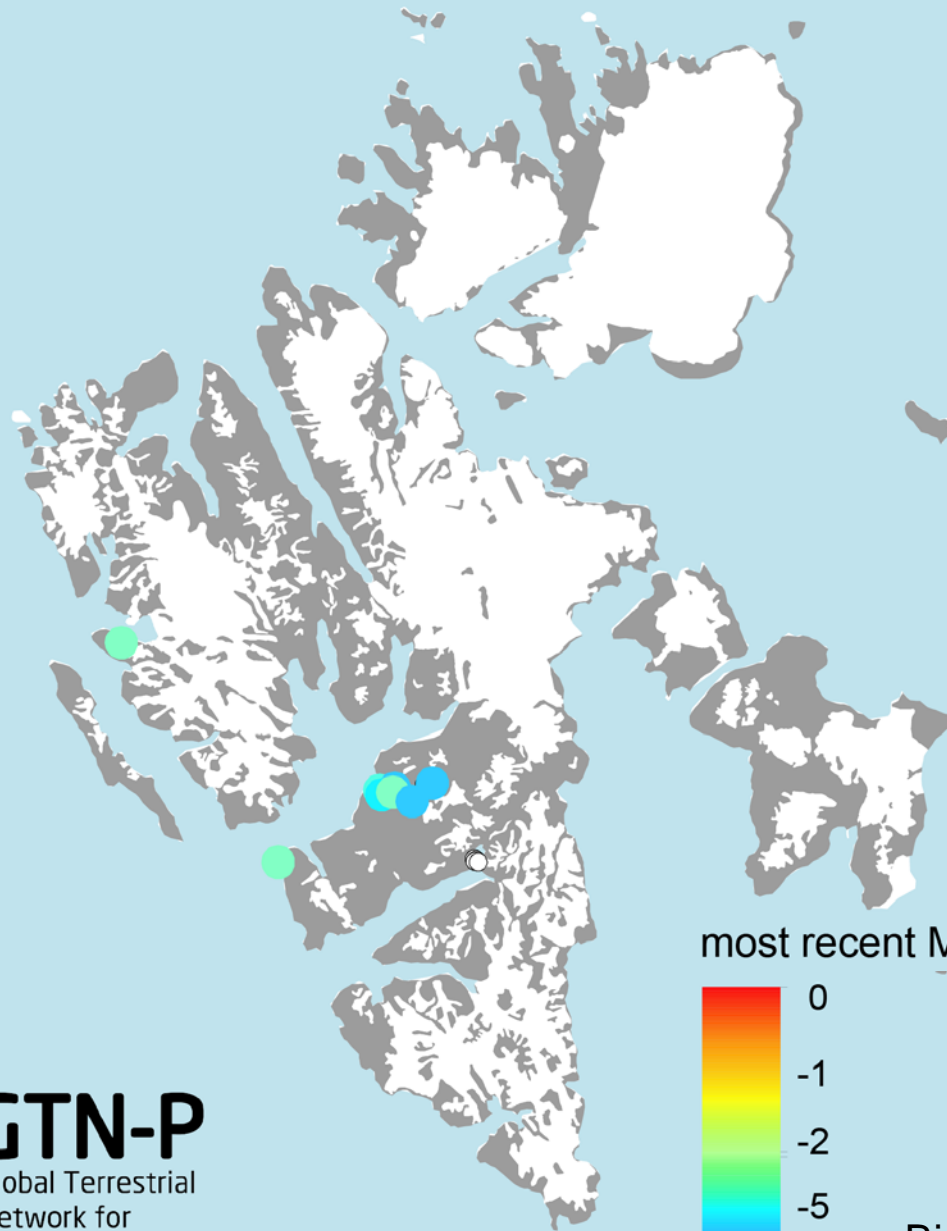
Warming in recent 2 decades, Ny-Ålesund



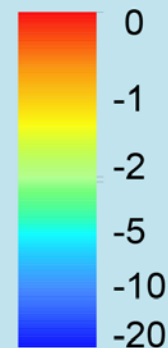
Mean warming : $+1.6$ (± 0.7) °C/decade

Strongest signal in winter: $+3.2$ (± 0.7) °C/winter

Svalbard



most recent MAGT near ZAA (°C)

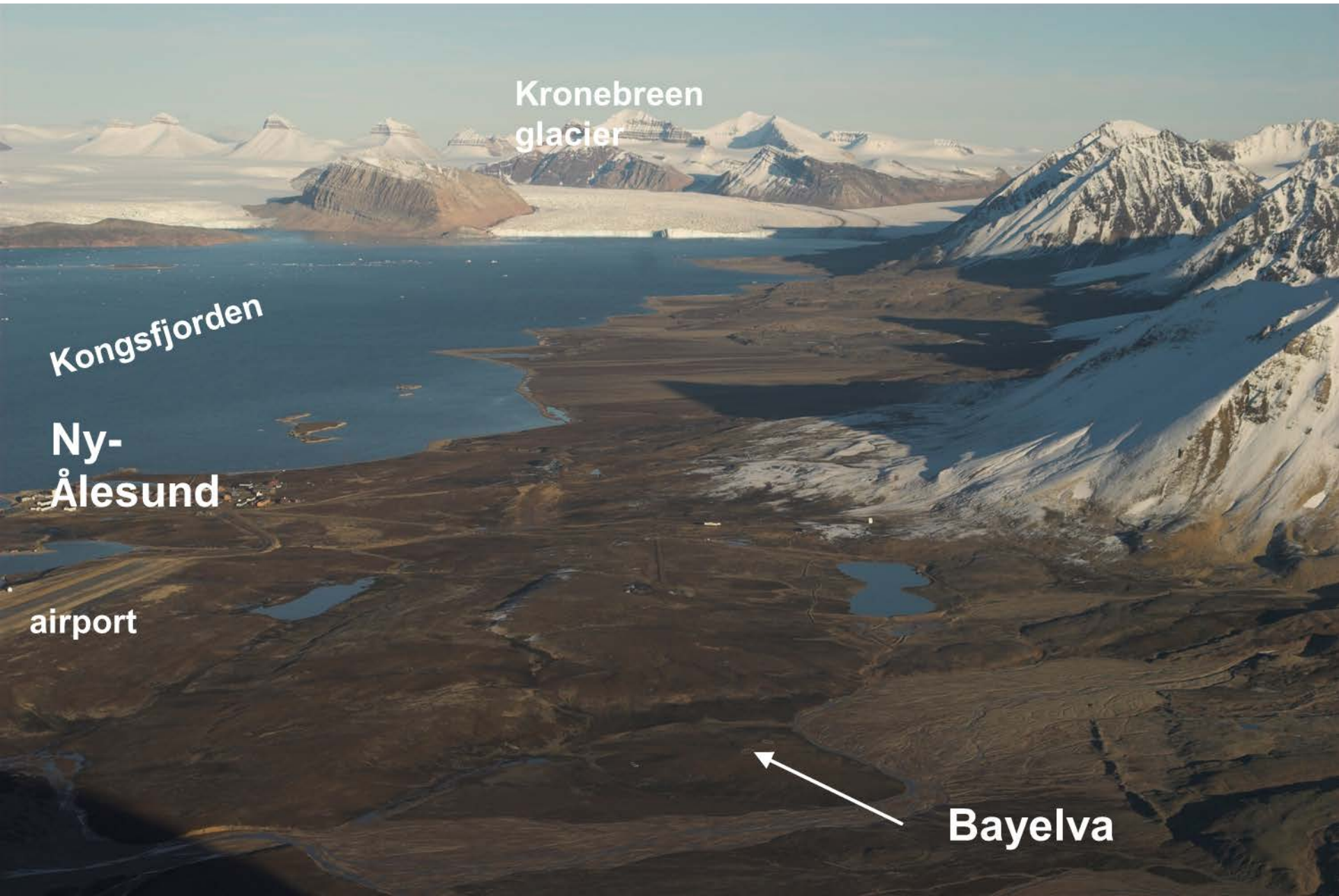


GTN-P

Global Terrestrial
Network for
Permafrost

Biskaborn et al. 2015.
& in prep.

The Bayelva site



Kronebreen
glacier

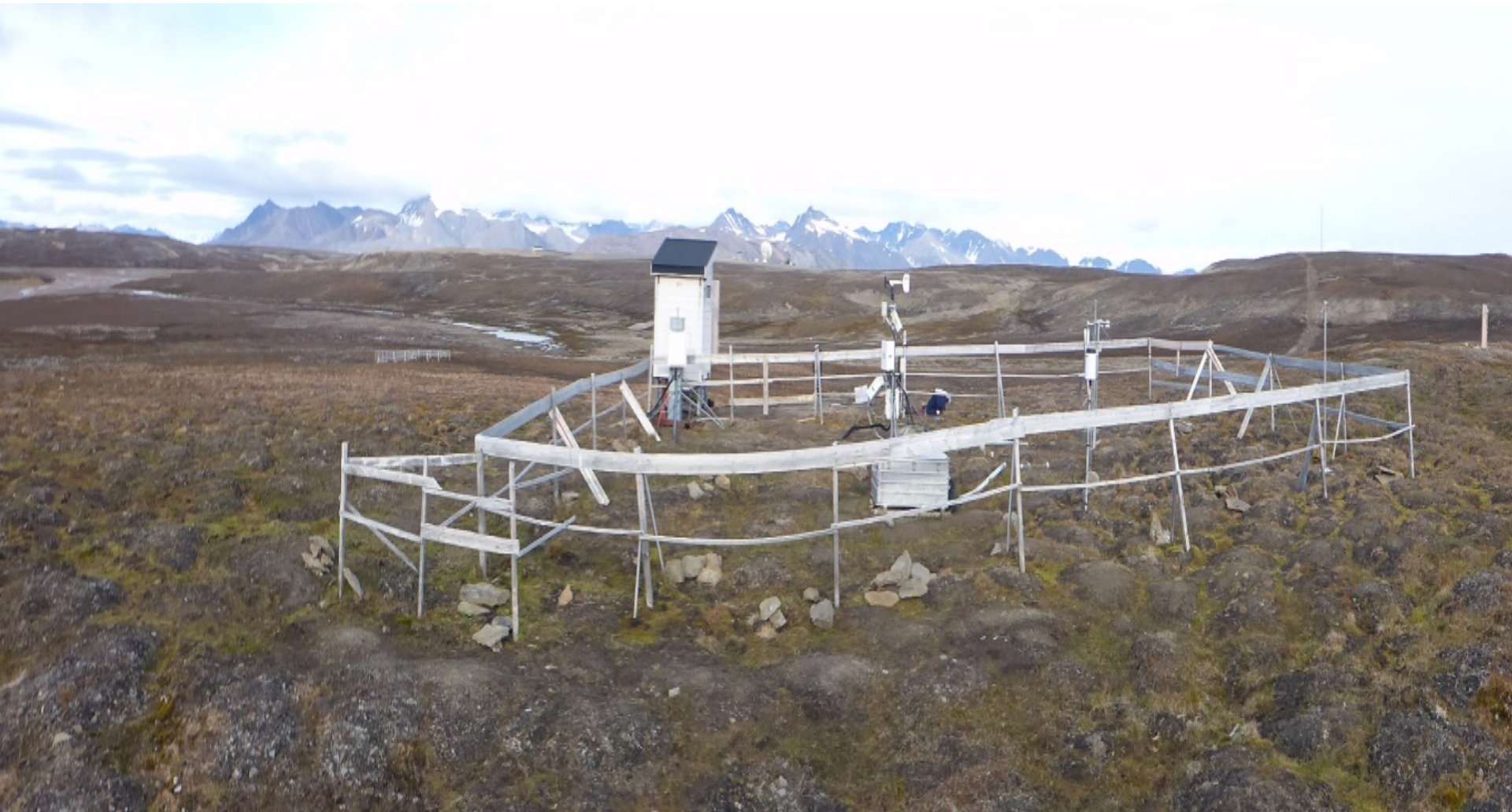
Kongsfjorden

Ny-
Ålesund

airport

Bayelva

The Bayelva site

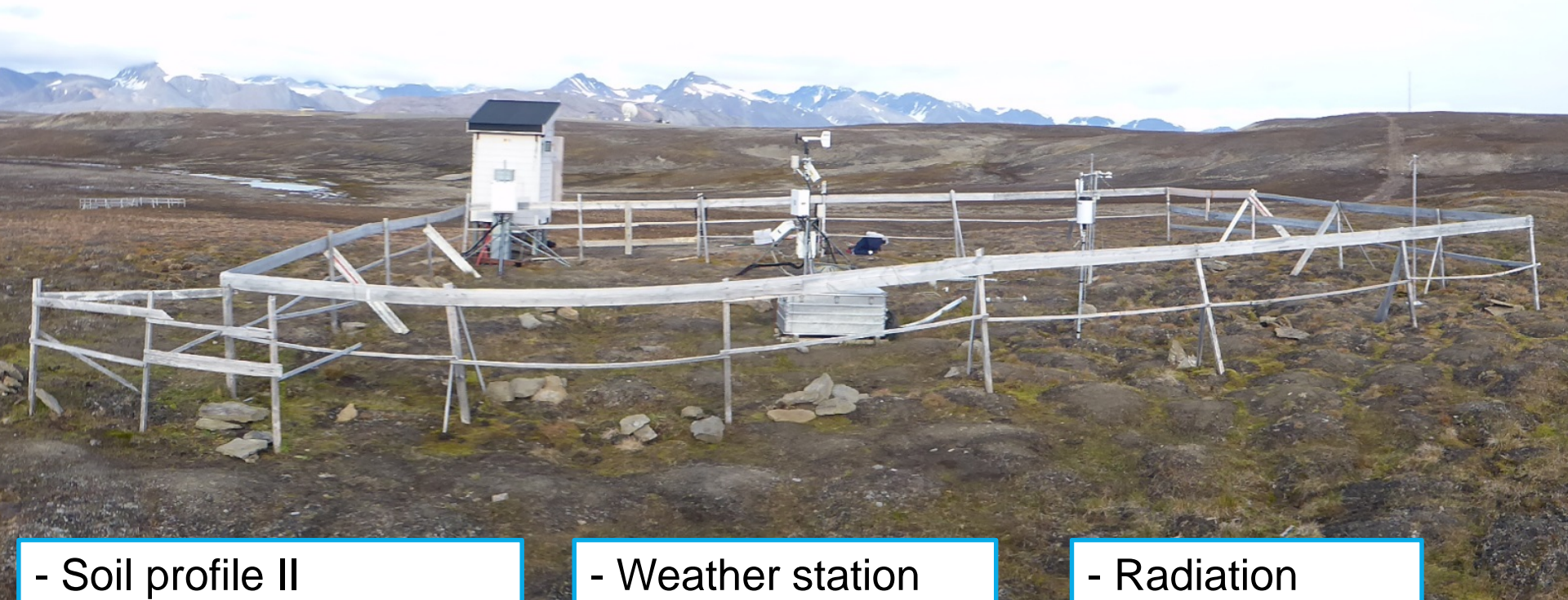


The Bayelva site

- Electronics and data hub
- Camera

- Soil profile I
(temperature, moisture)

- Permafrost borehole
(9 m)

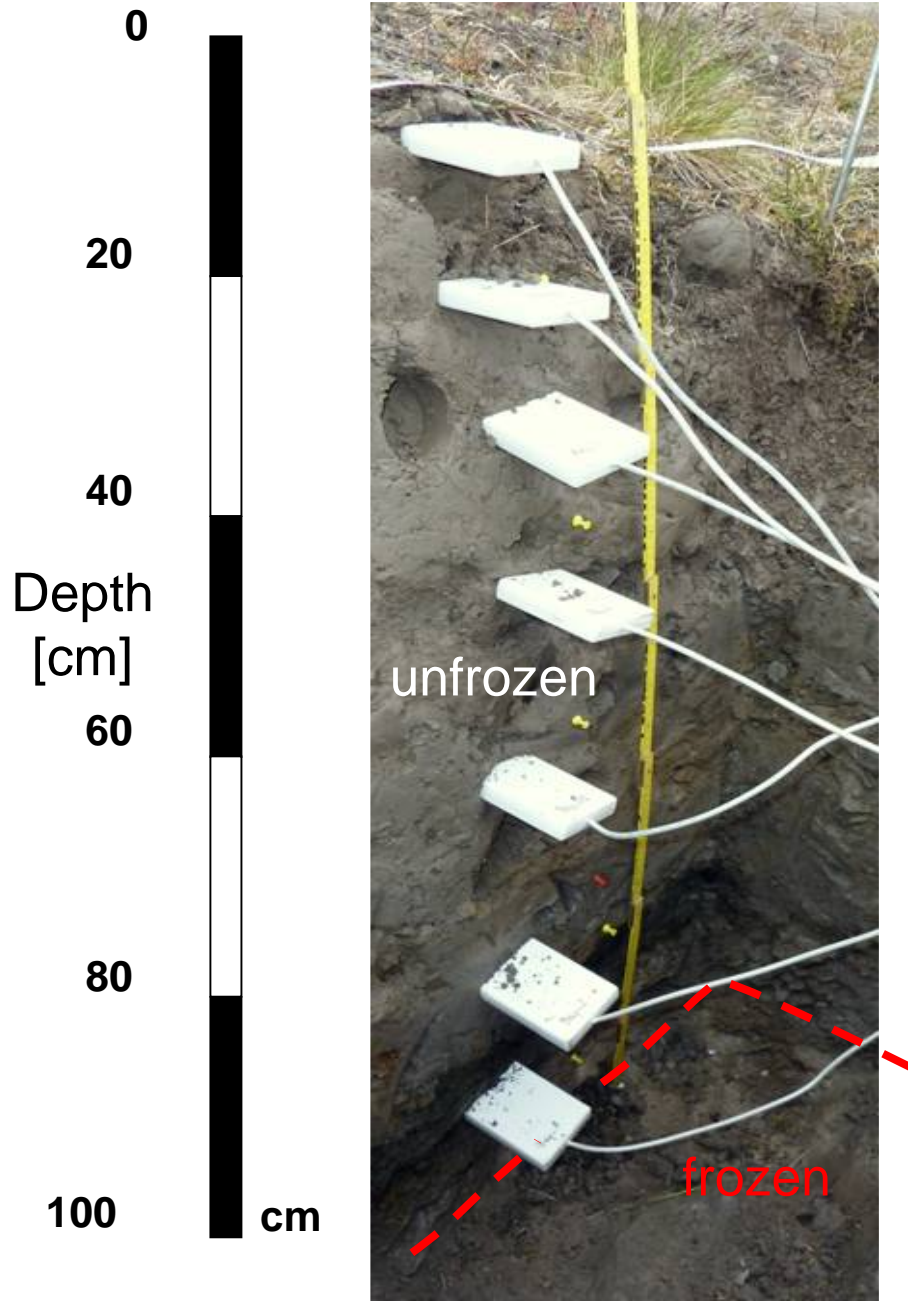


- Soil profile II
(temperature, moisture)

- Weather station
- Snow profile

- Radiation
- Snow height II
- Rain

Soil characteristics



Active layer

- Surface energy balance
- Biogeochemical processes
- Organic carbon storage/exchange

State variables

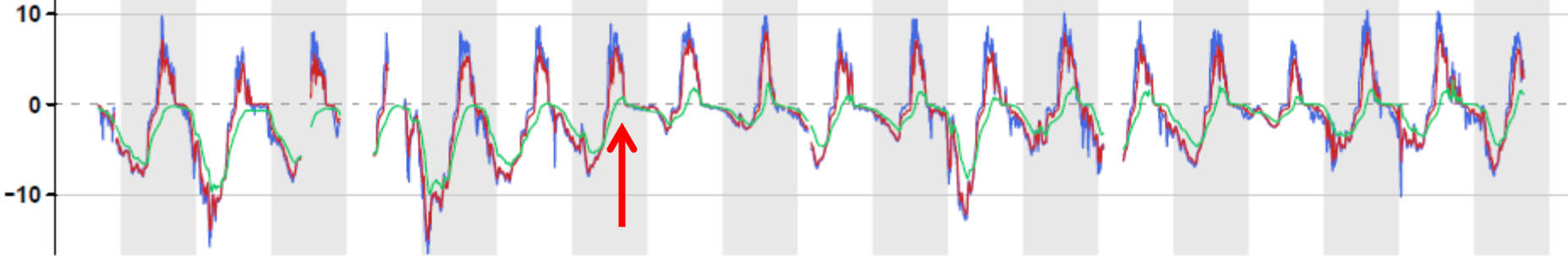
- Temperature and water content

Temperature, water content, snow



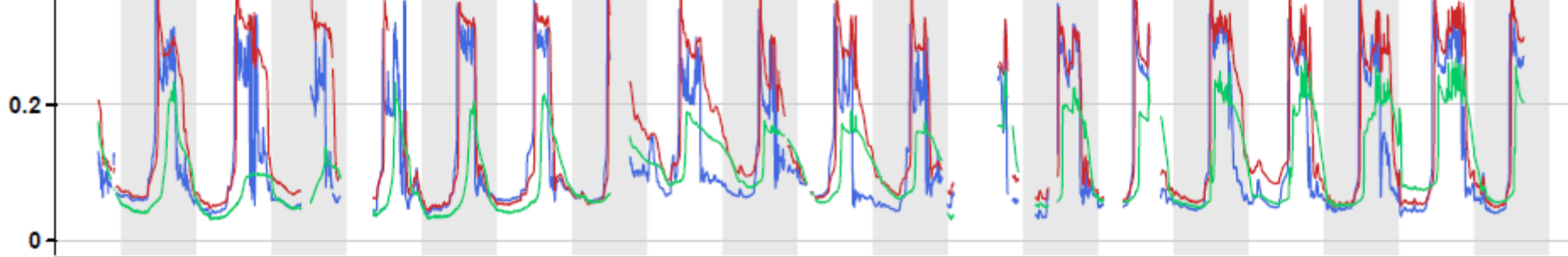
1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

Soil temperature [°C]

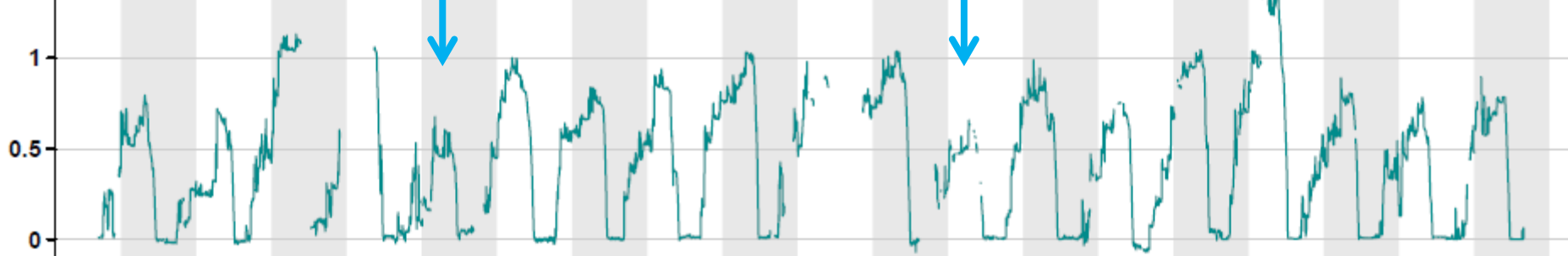


— -9cm — -40cm — -120cm

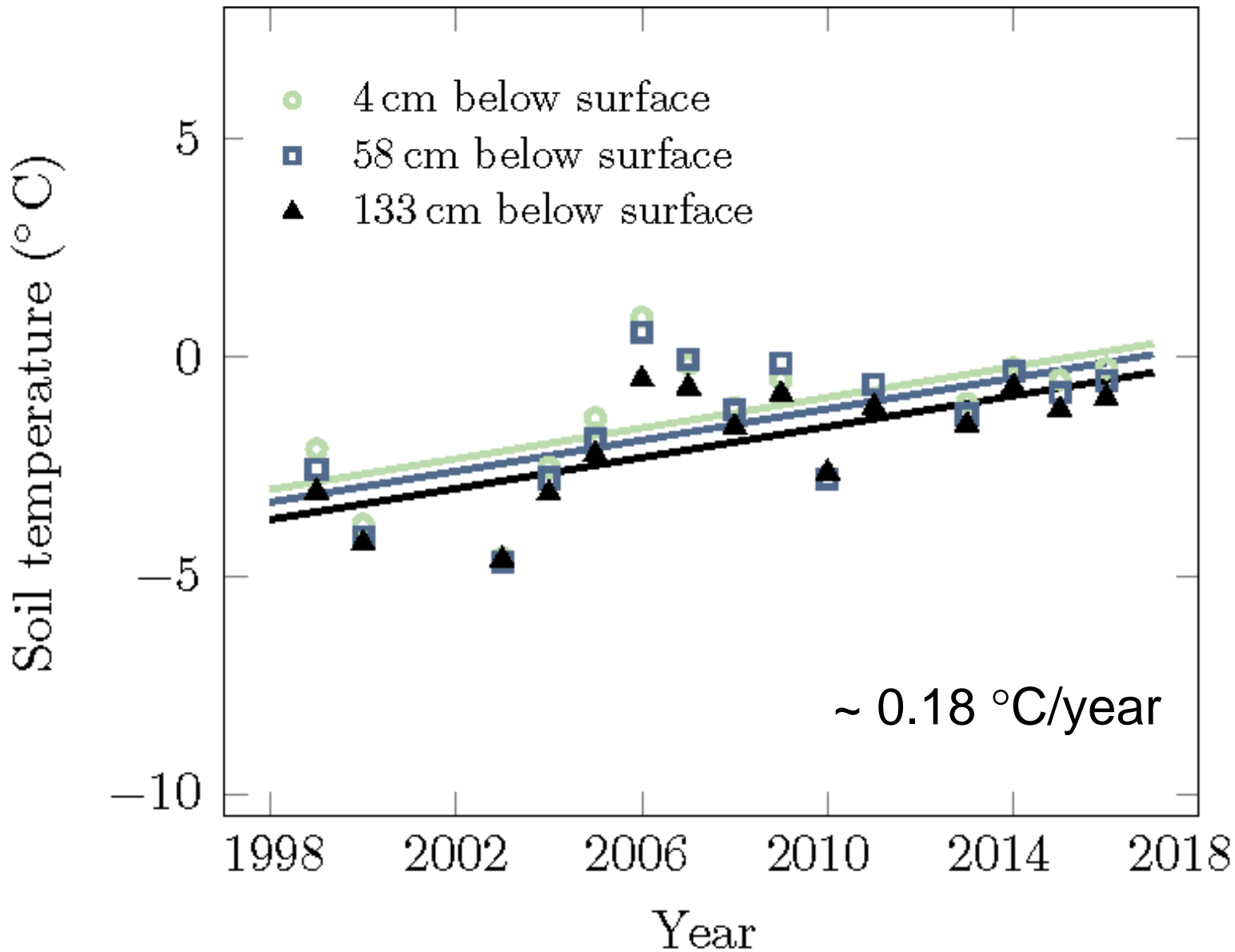
Soil volumetric liquid water content [-]



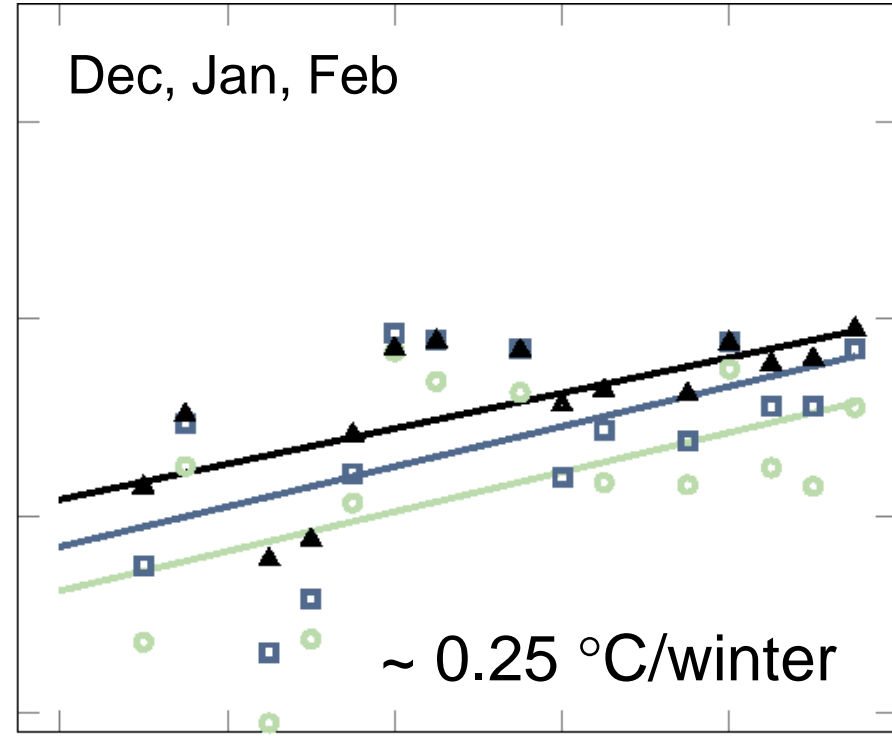
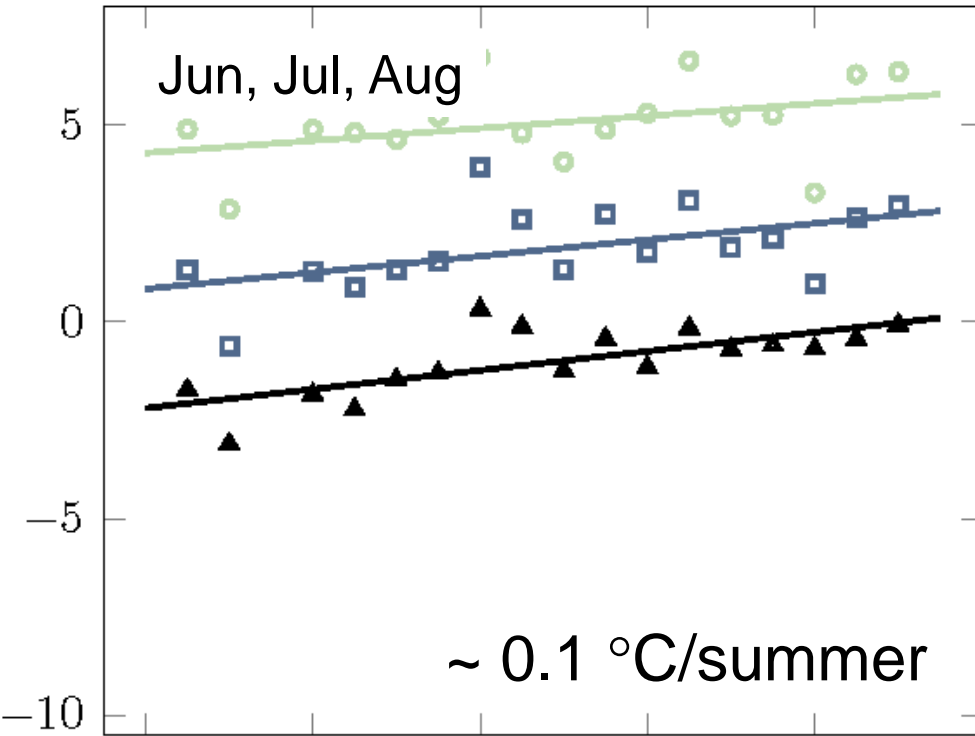
Snow depth [m]



Yearly trends: degrading permafrost



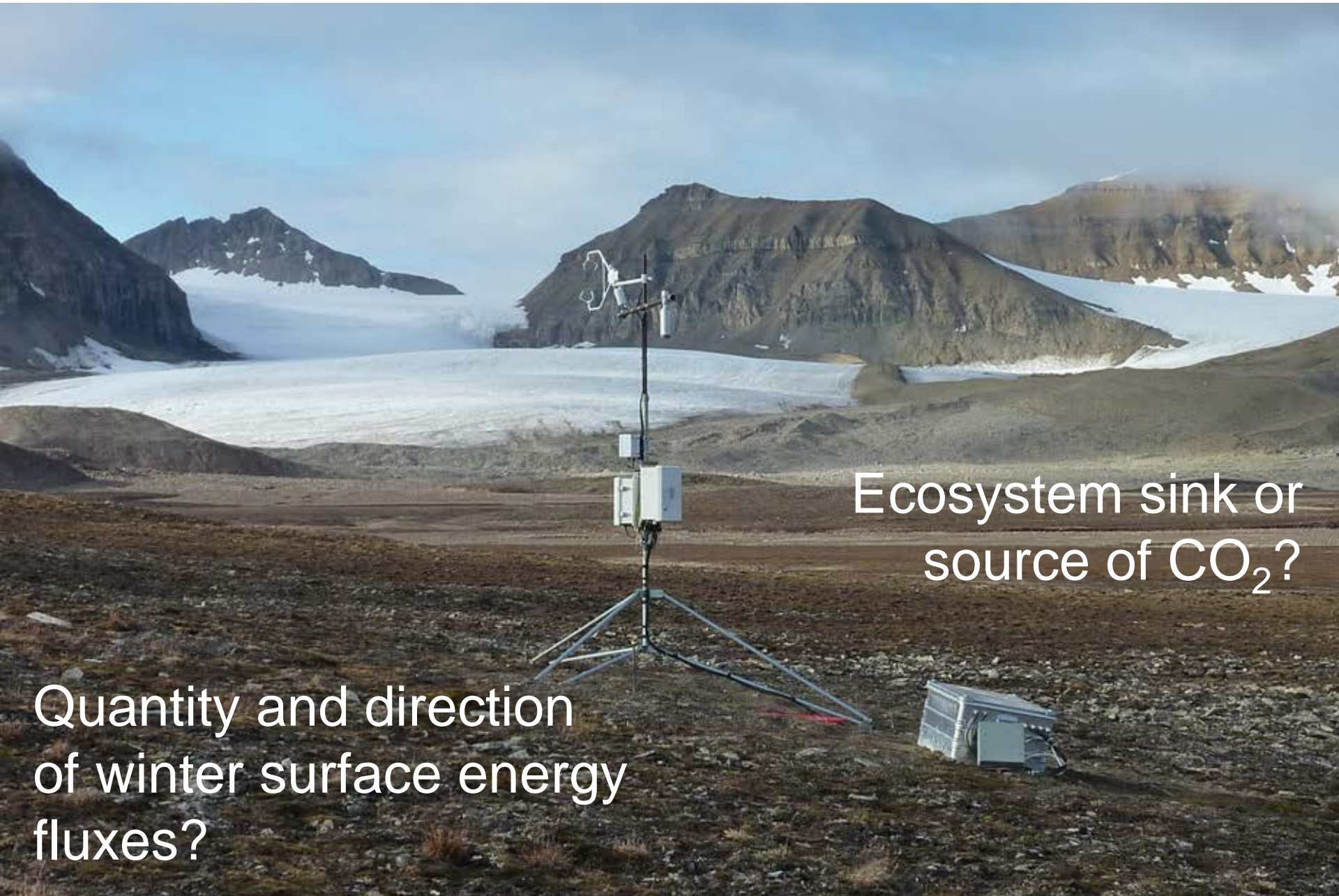
Seasonal trends: degrading permafrost



- 4 cm below surface
- 58 cm below surface
- ▲ 133 cm below surface

- Winter trend 3x summer trend for 1998-2017

Annual net exchange of water, heat, CO₂



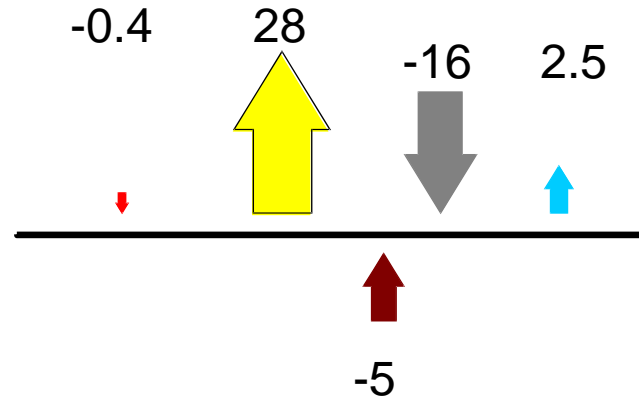
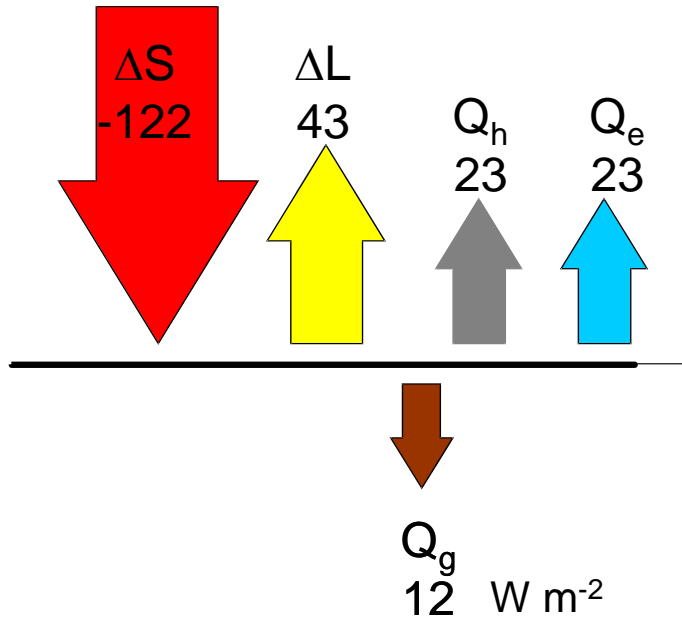
Ecosystem sink or
source of CO₂?

Quantity and direction
of winter surface energy
fluxes?

Surface energy budget 2008-09

Jul-Aug
Snow free

Oct – mid Mar
Snow covered

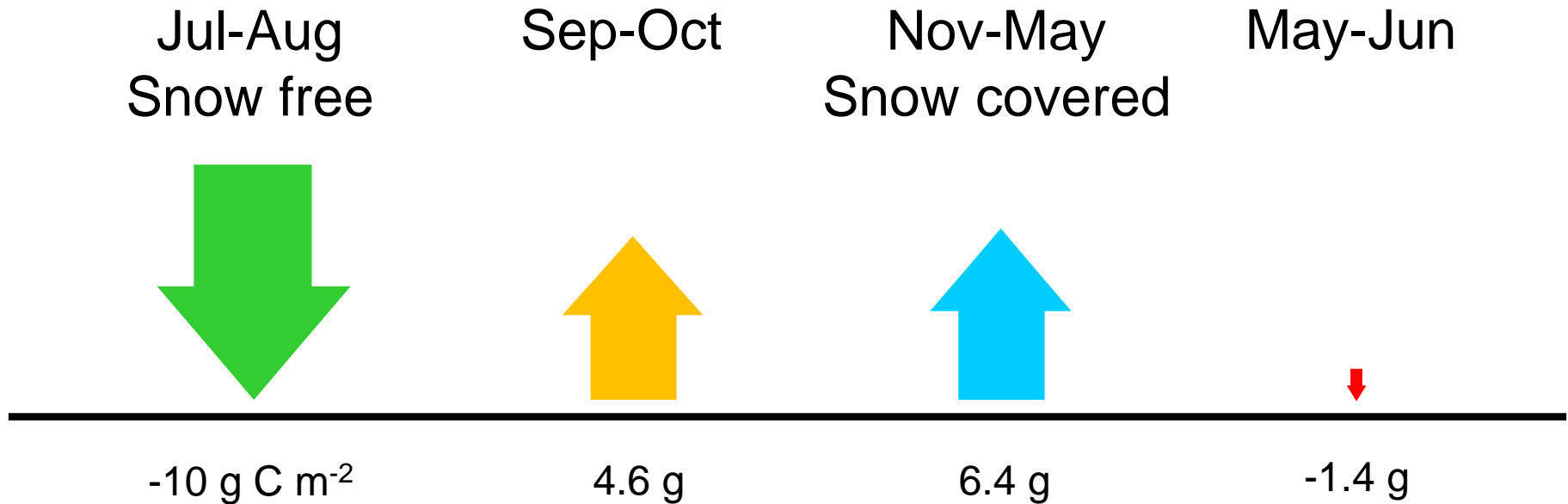


- Most energy in summer lost to atmosphere
- Permafrost cooling in winter dominated by ΔL and Q_h

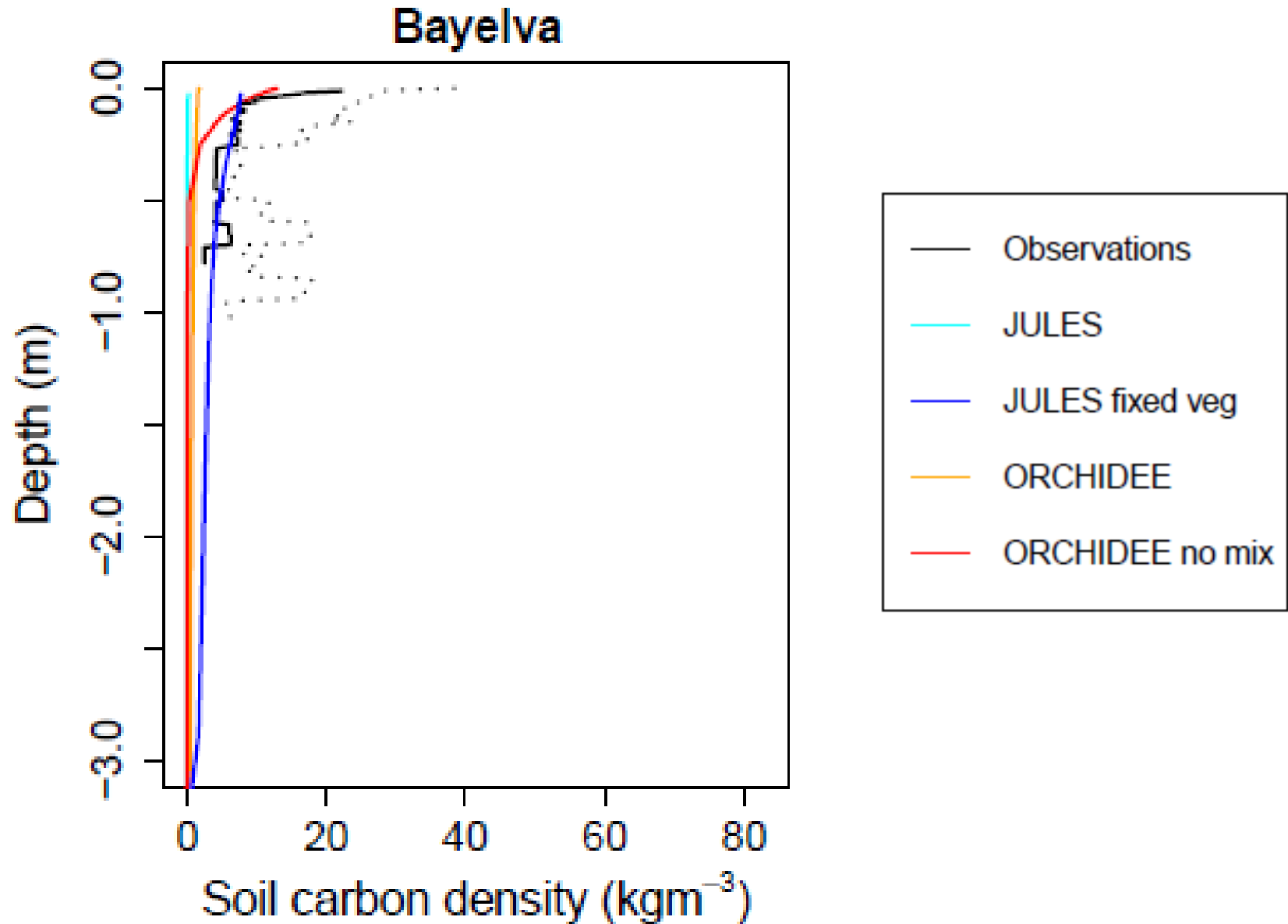
Westermann et al. 2009, Boike et al. 2012.

Data archived in FLUXNET, European fluxes database cluster, PANGAEA

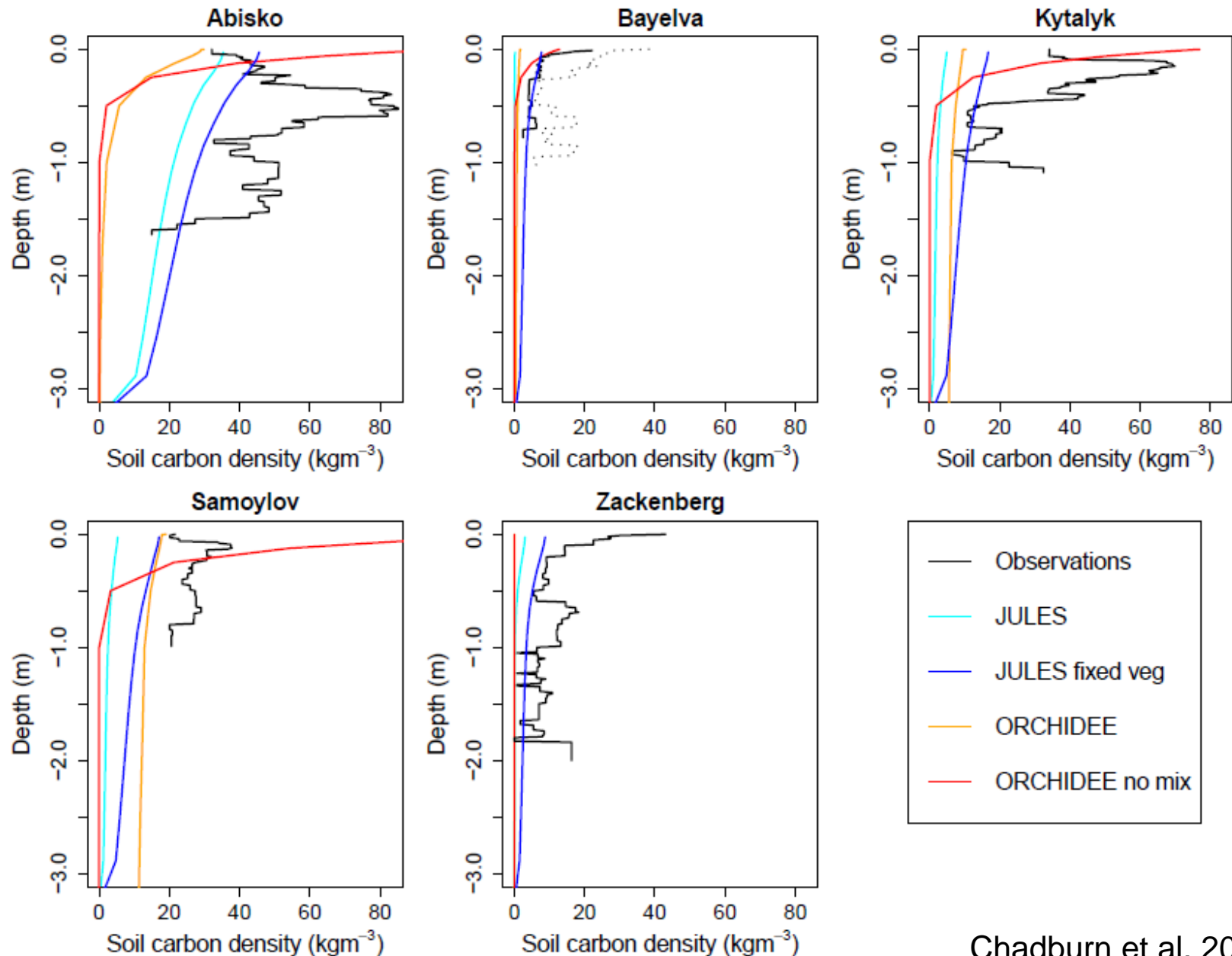
Annual CO₂ budget



- At this site, uptake = emission (2008-2009)
- Shoulder and winter seasons are the unknowns!



ESM model validation: SOCC



Combine your data & Share and archive your data so that they can be used for process and model evaluations!

