

# Palsa mire research in Sweden

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Mires and wetlands of the North Calotte

Vadsø, Norway

2-4 October 2019





Palsa



Peat plateau



Thermokarst pond



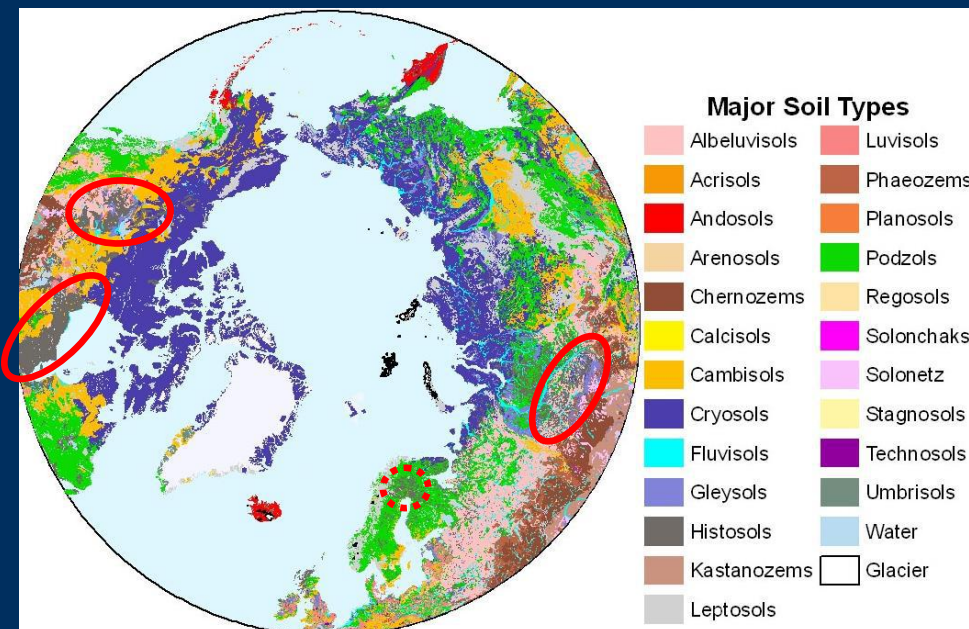
Fen

# Why care about Arctic peatlands?

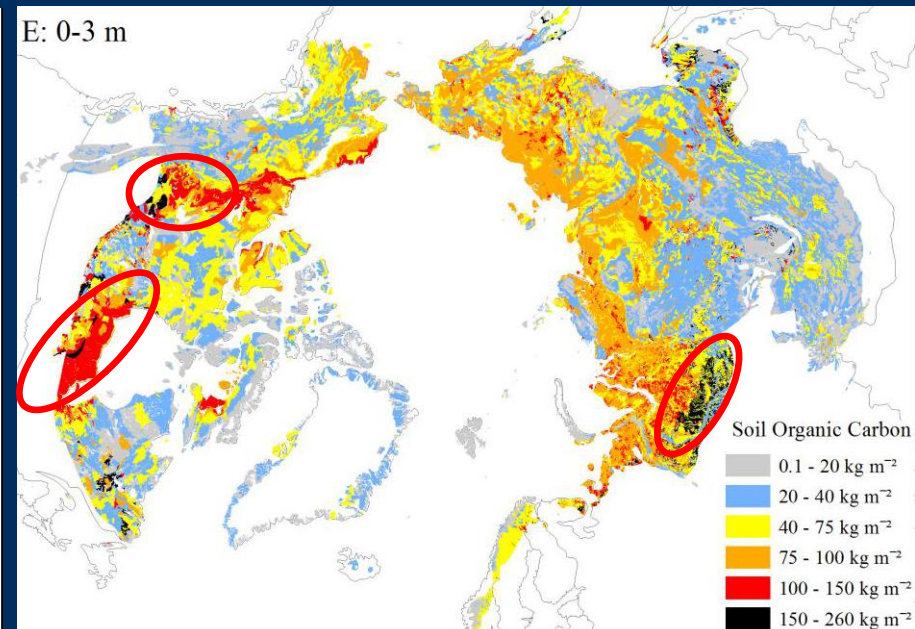
Peatlands provide habitats for specialized biodiversity

They provide flood control and capacity for water purification

Peatlands contain  $\sim 1/4$  of the soil organic carbon pool in the permafrost region ( $\sim 300$  out of  $\sim 1300$  Pg C – Hugelius *et al.*, 2014)



Jones *et al.*, 2010

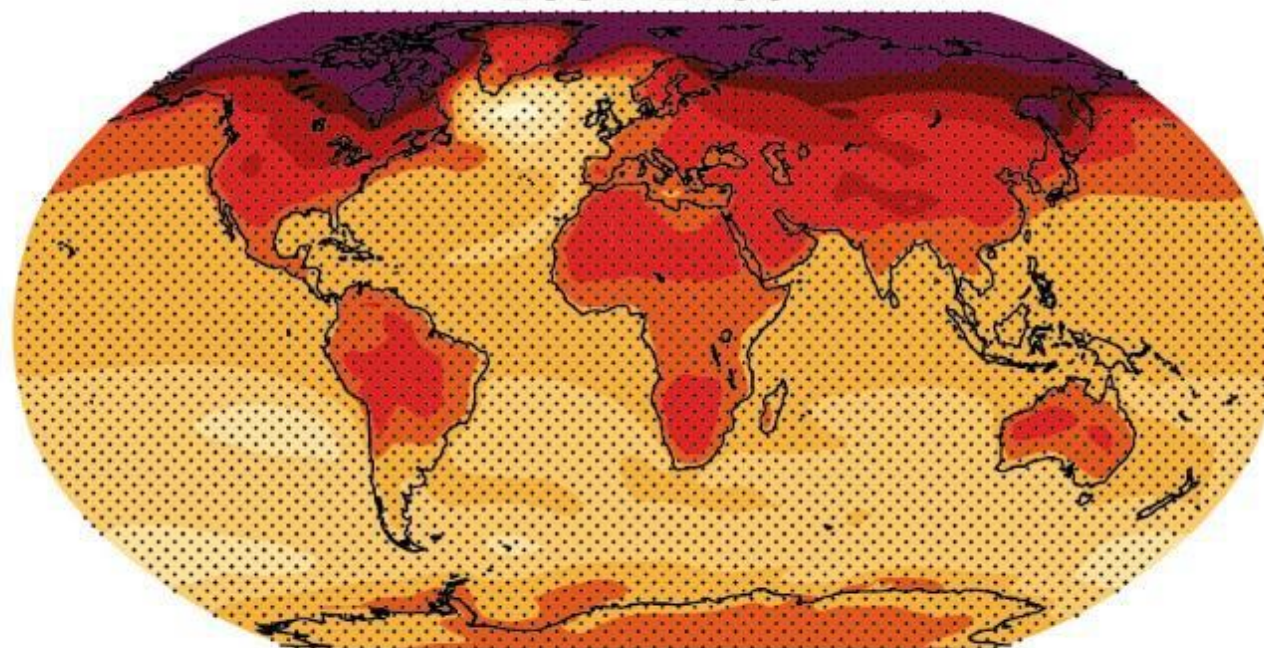


Hugelius *et al.*, 2014

# Projected changes in MAAT by 2100

Temperature scaled by global T ( $^{\circ}\text{C}$  per  $^{\circ}\text{C}$ )

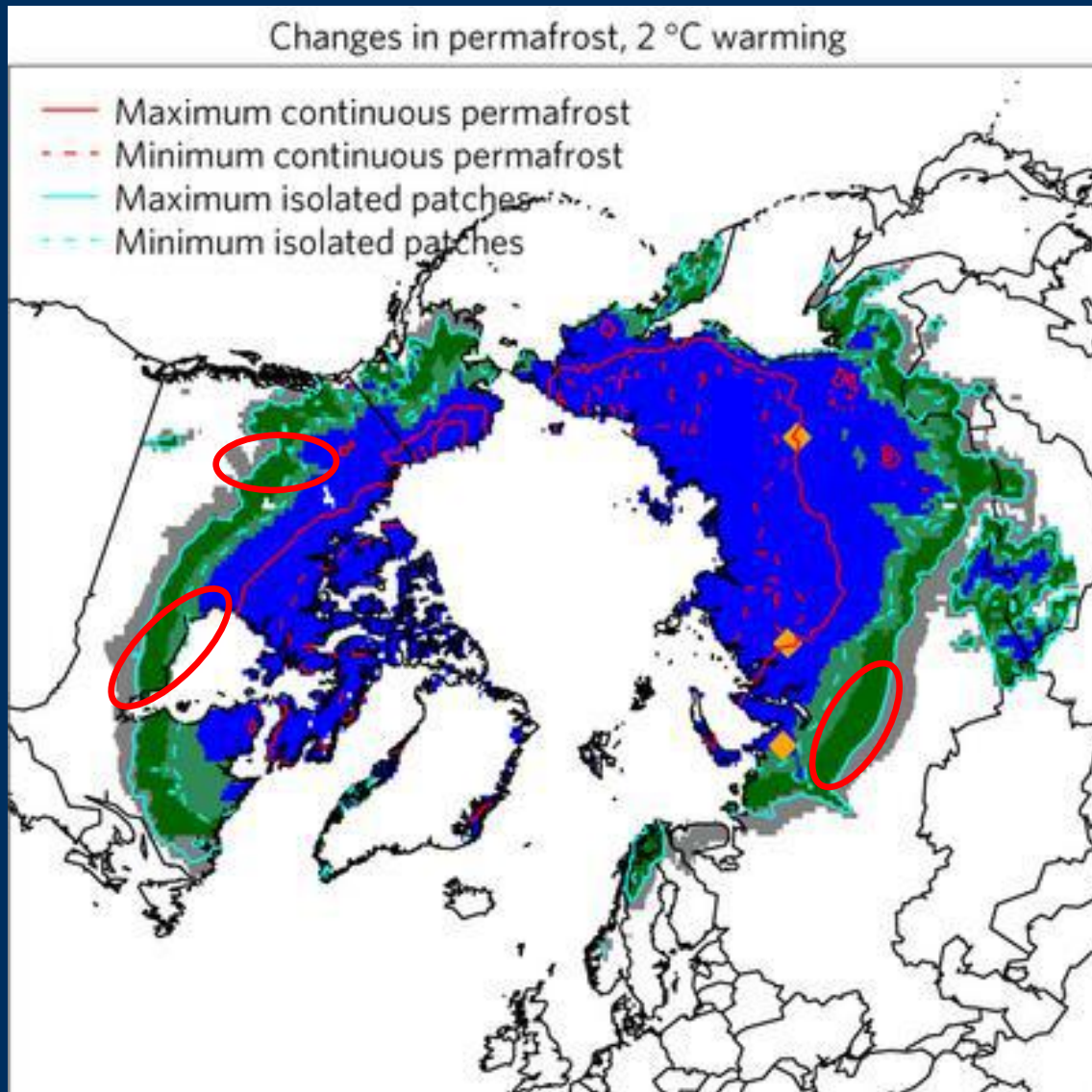
2081-2100



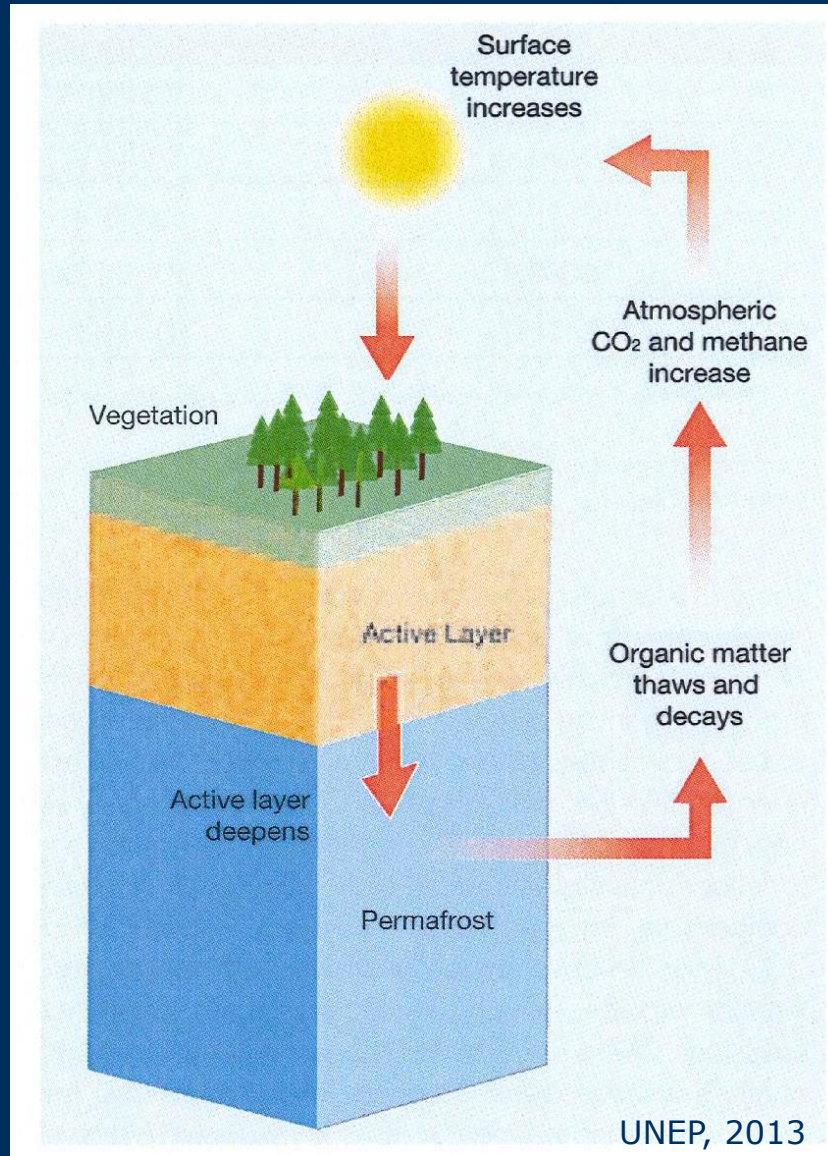
( $^{\circ}\text{C}$  per  $^{\circ}\text{C}$  global mean change)



# Projected changes in permafrost distribution

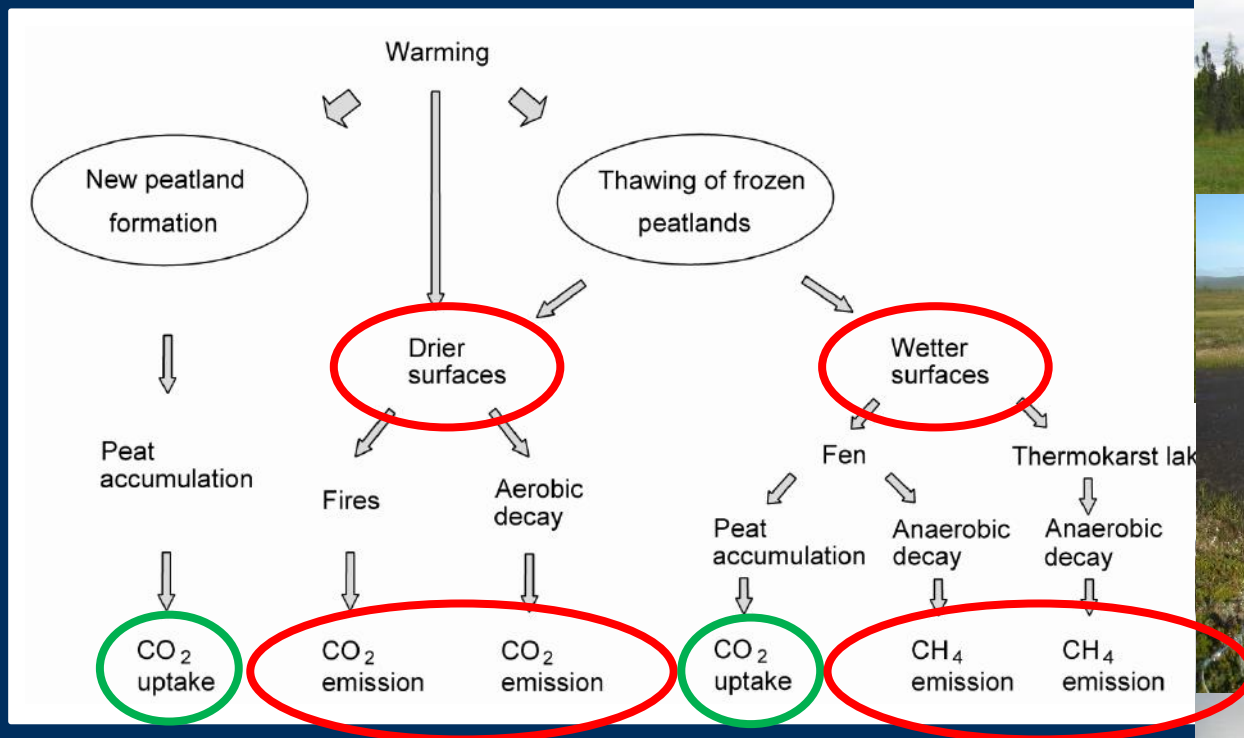


# The permafrost carbon feedback



This feedback mechanism is identified as a key uncertainty in the IPCC Assessment Report (2013) - but not yet quantified!

# Impacts of global warming on Arctic peatlands, and C feedbacks

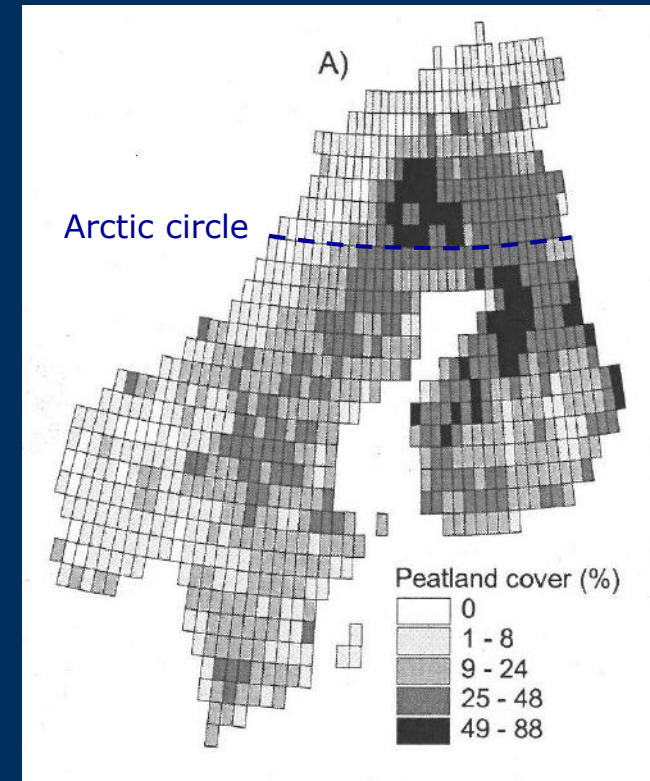
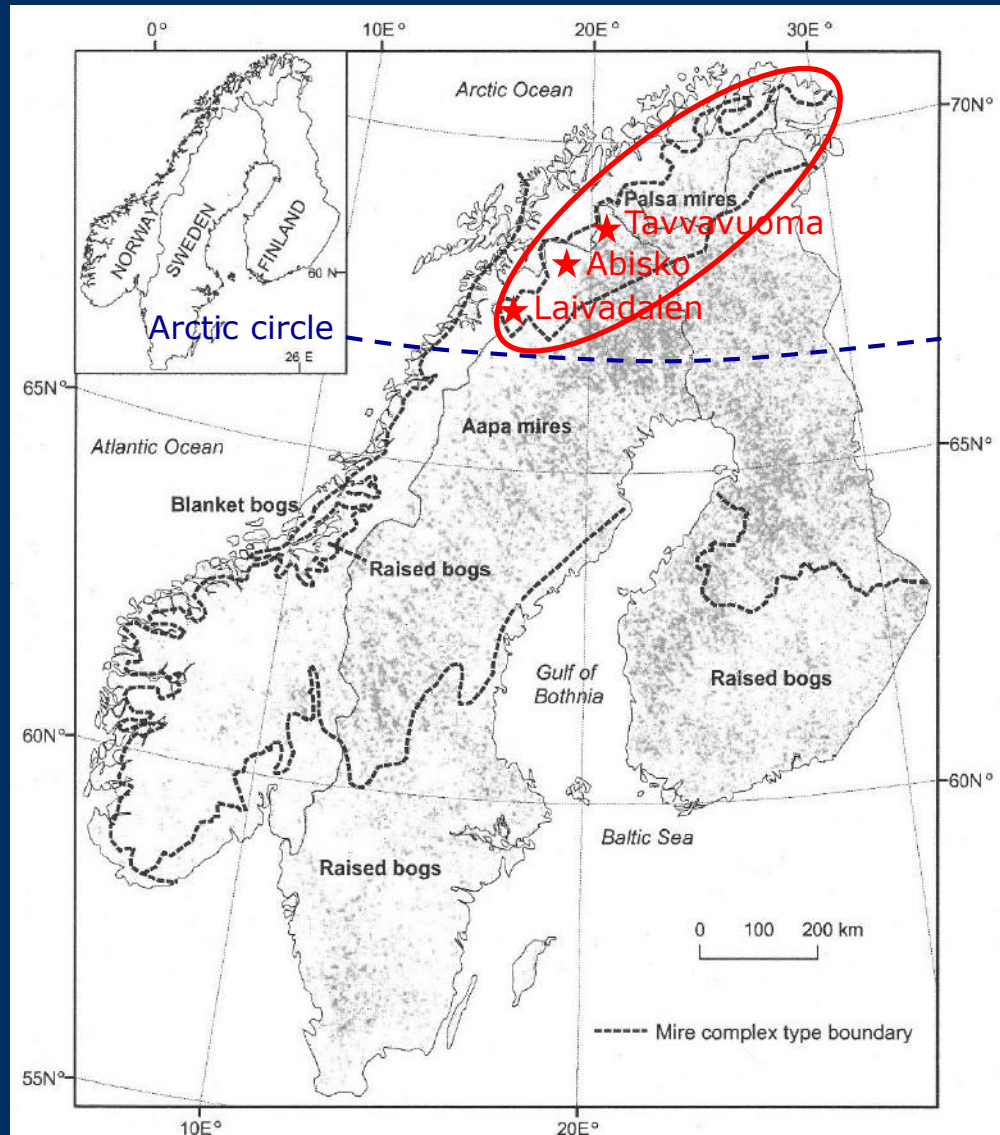


Adapted from Tarnocai, 2006

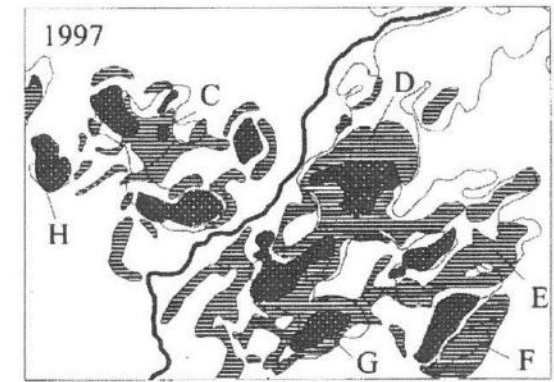
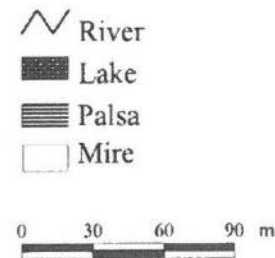
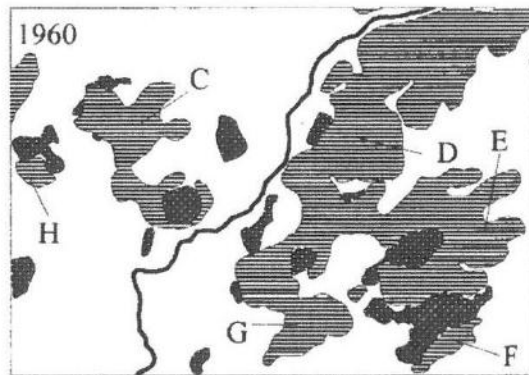
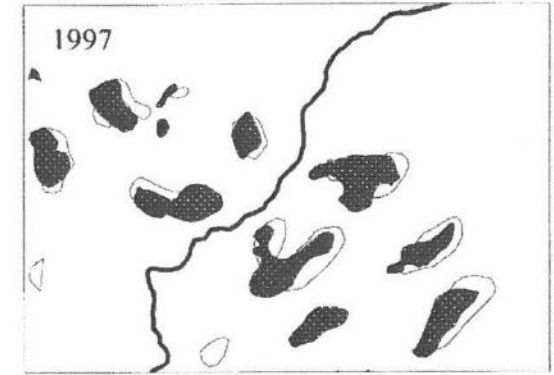
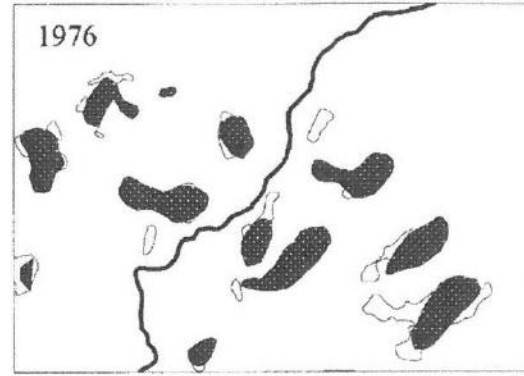




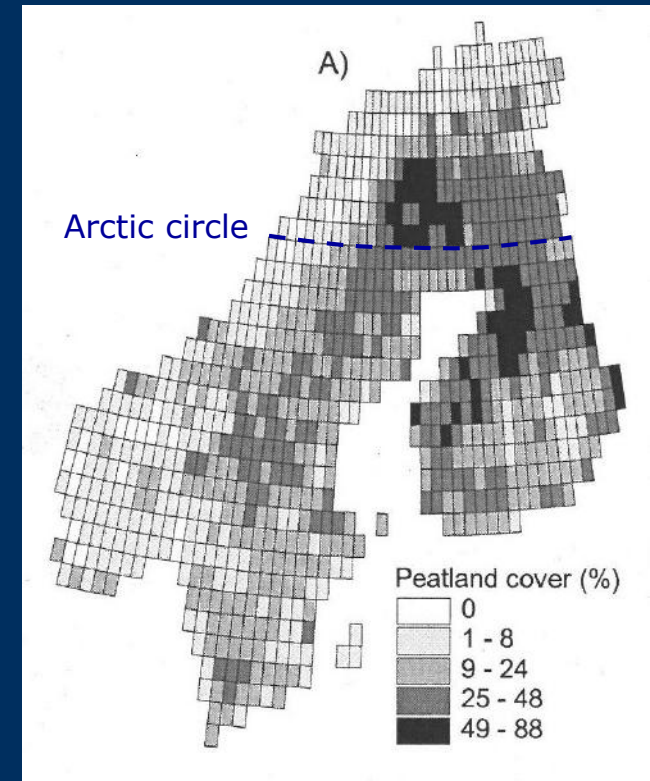
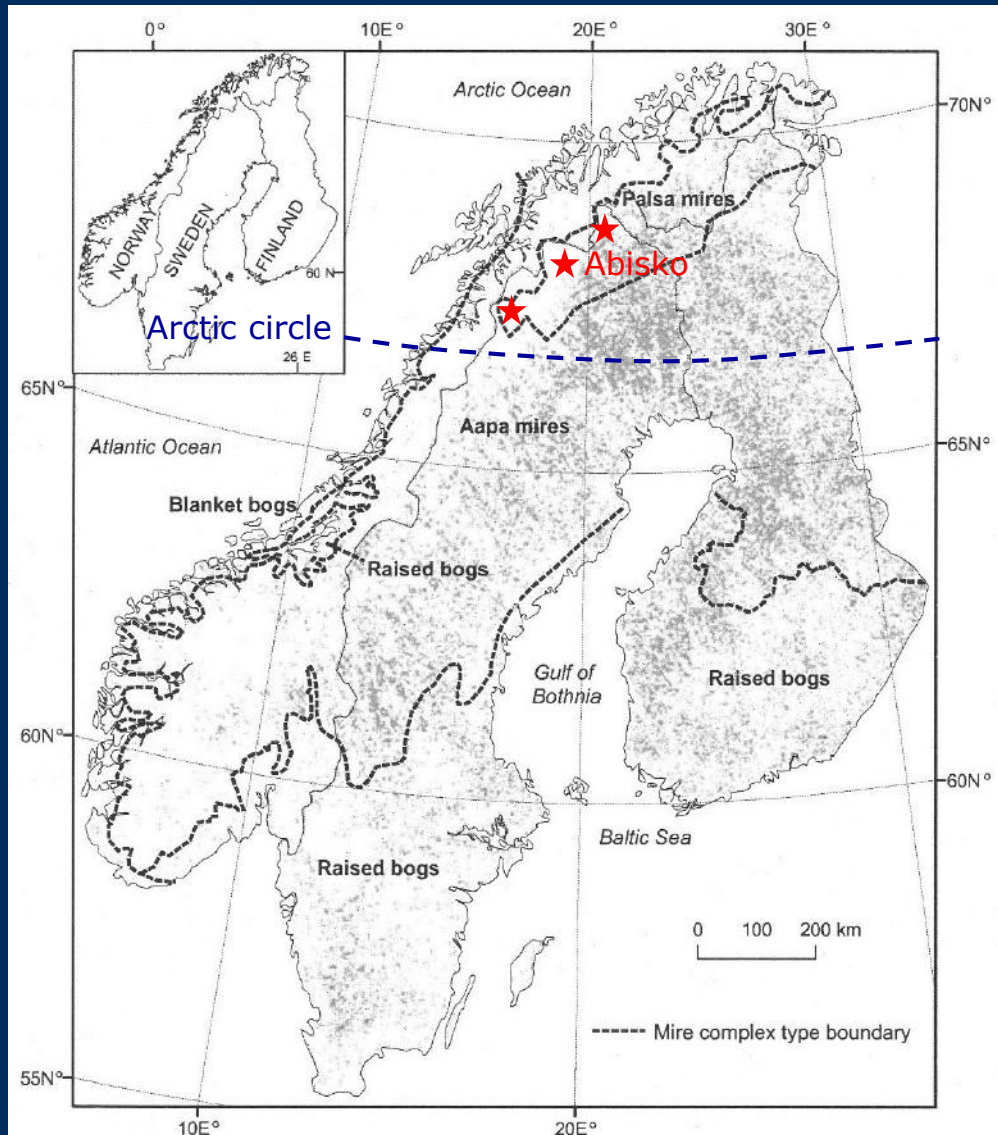
# Distribution of palsas in Fennoscandia



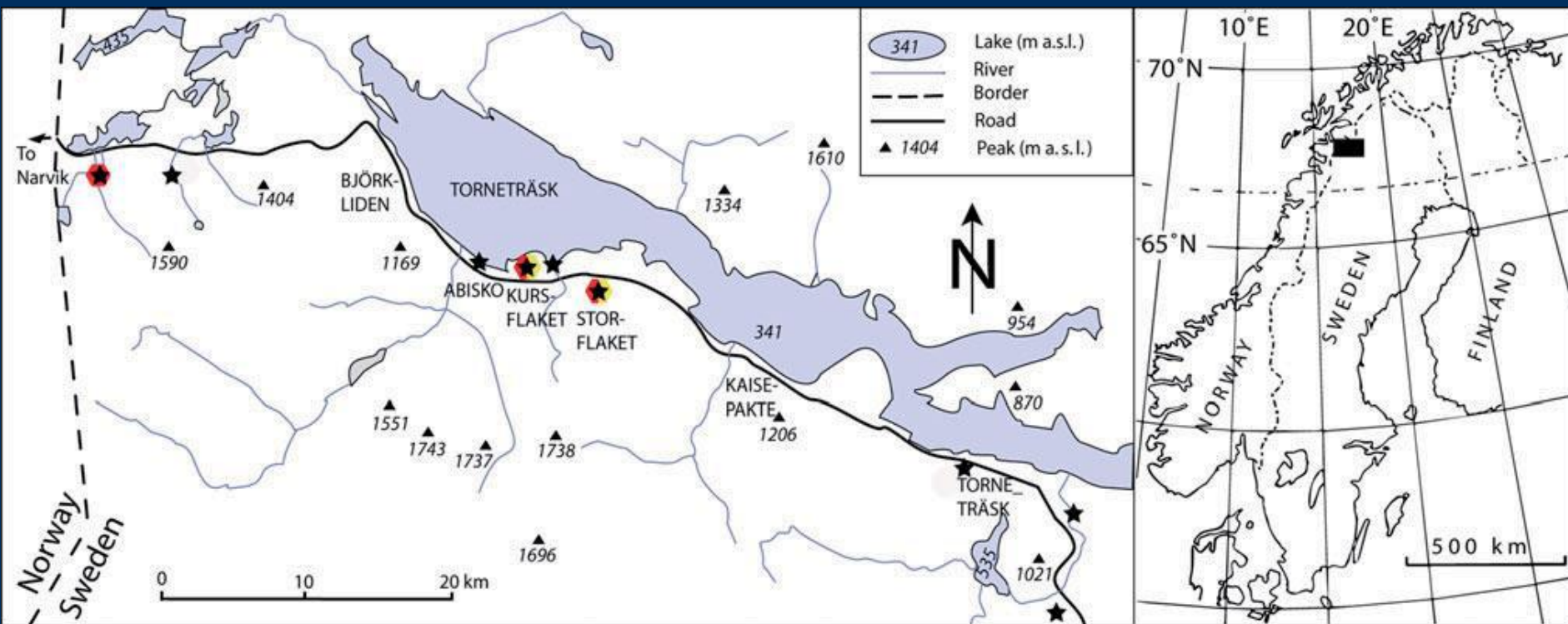
# Landscape changes in Laivadalen



# Distribution of palsas in Fennoscandia

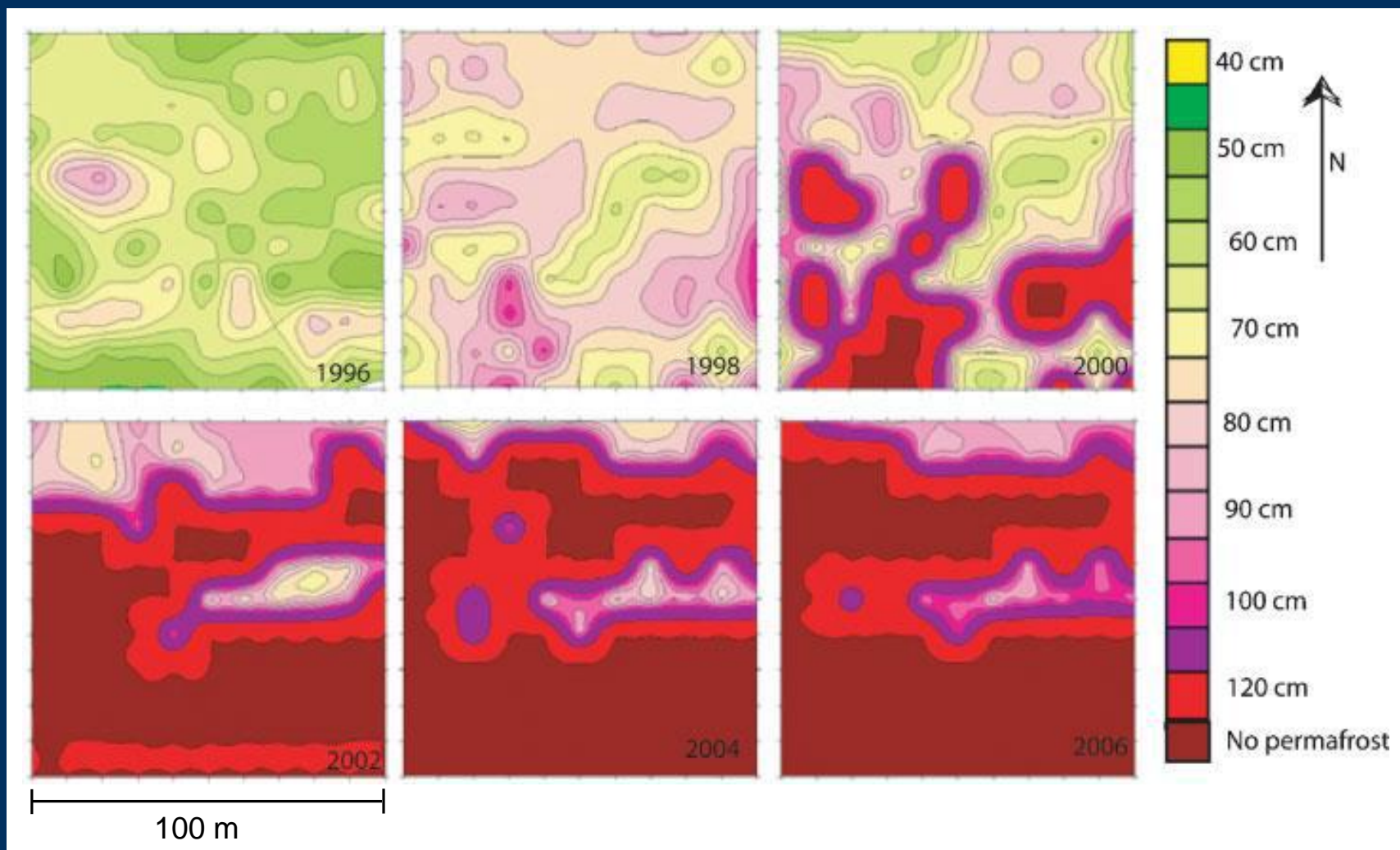


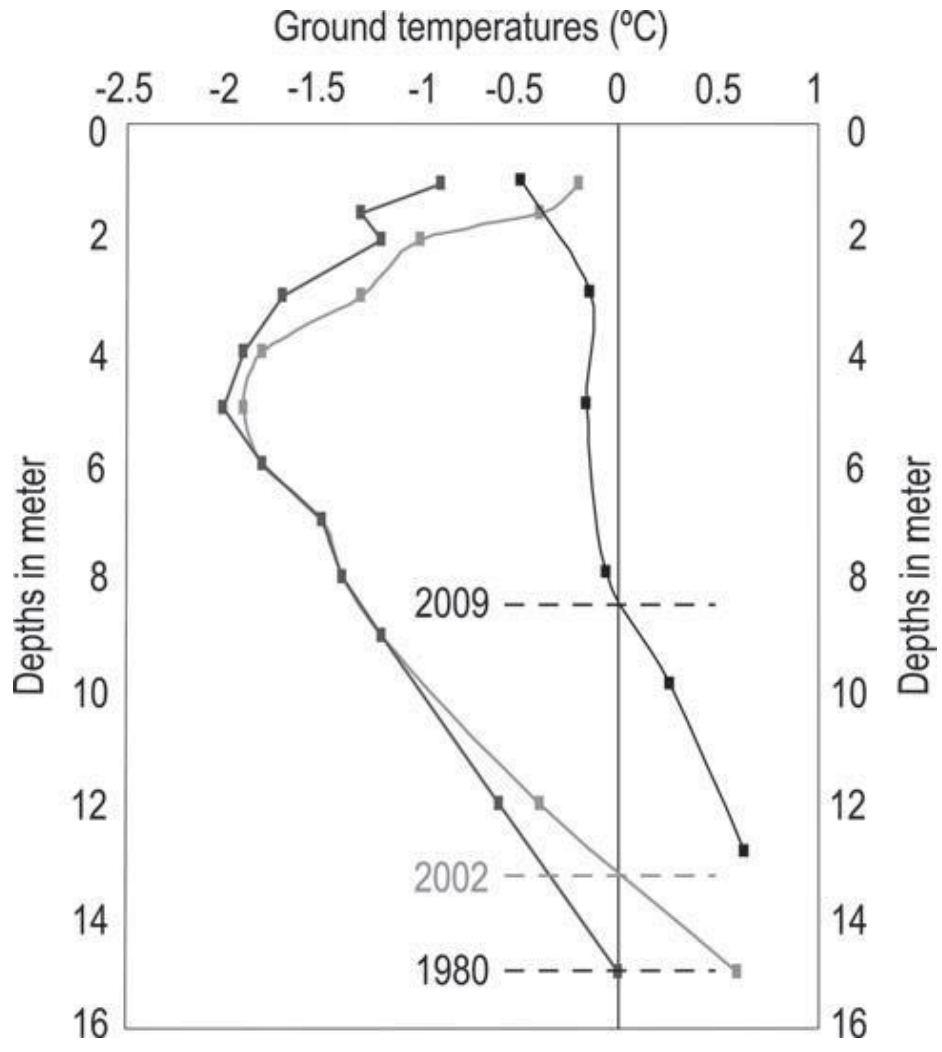
# Palsa monitoring near Abisko



- ★ Monitoring - Active layer thickness
- Monitoring - Ground temperatures Old boreholes
- Monitoring - Ground temperatures New boreholes

# Deepening of the active layer

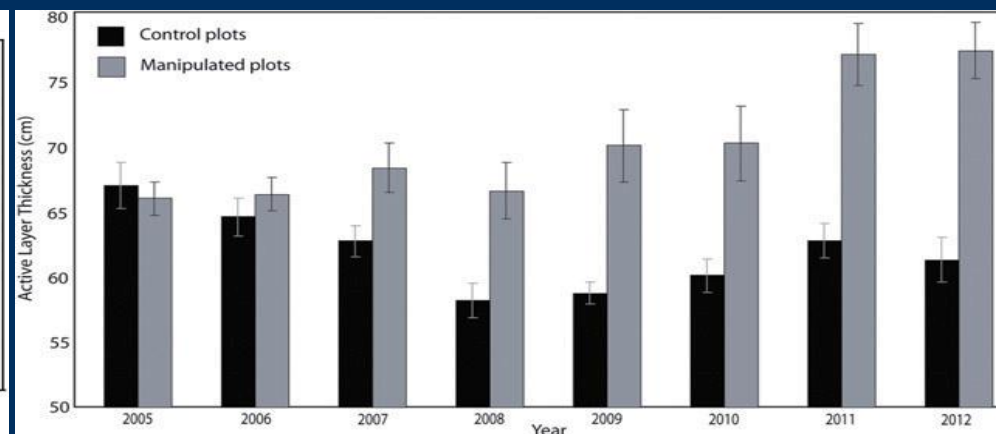
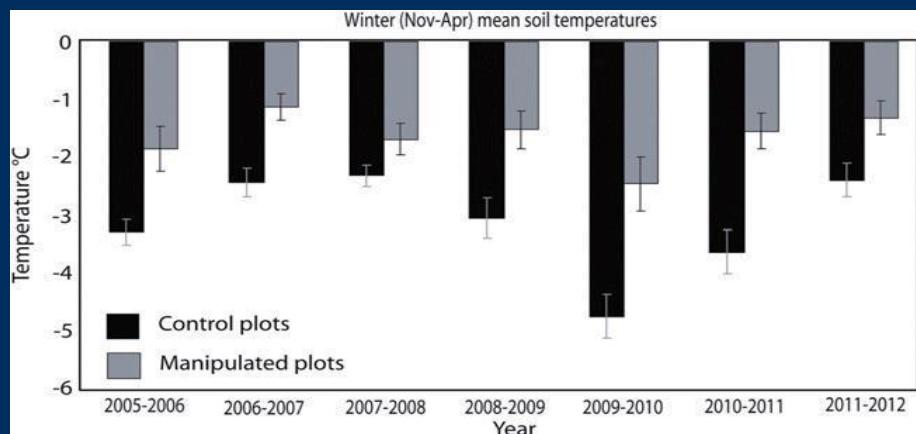




Johansson *et al.*, 2011

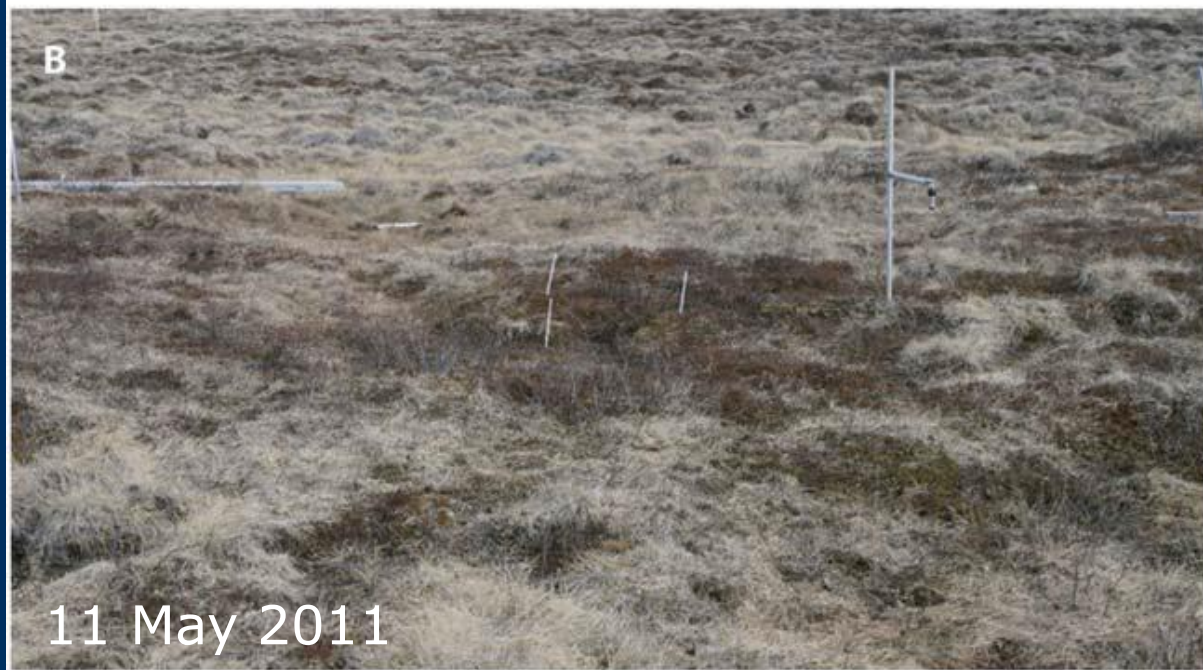


# Winter soil temperature, and active layer





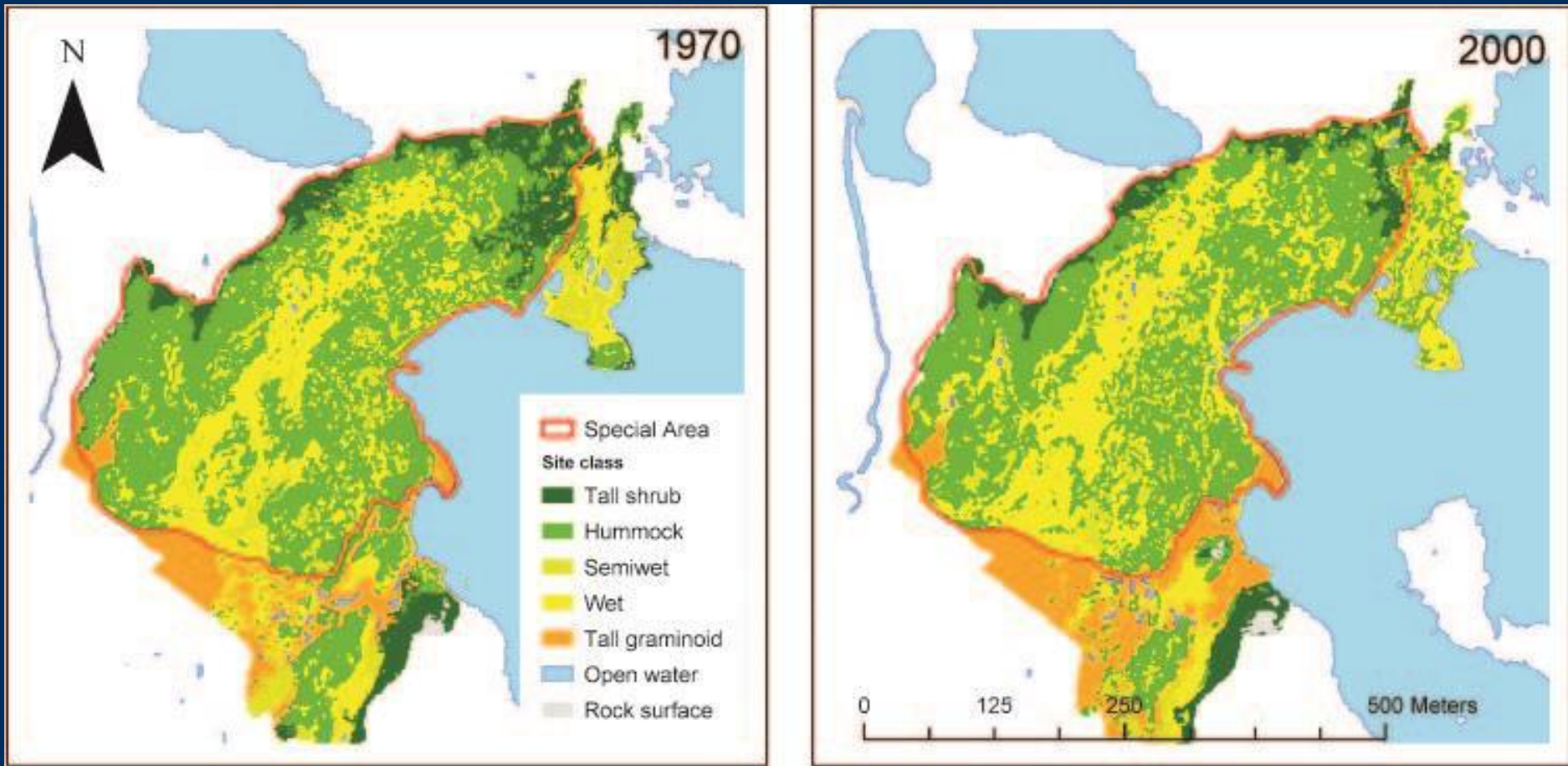
Manipulation plot



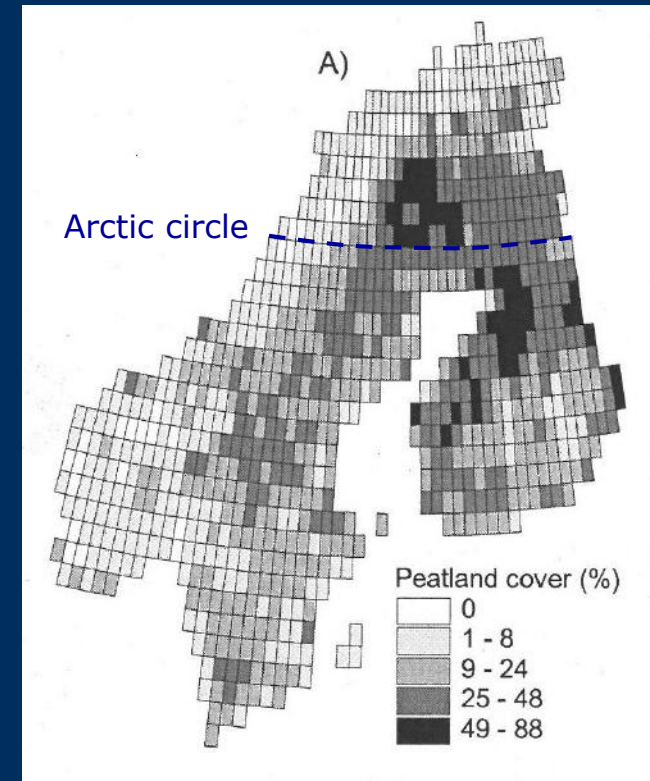
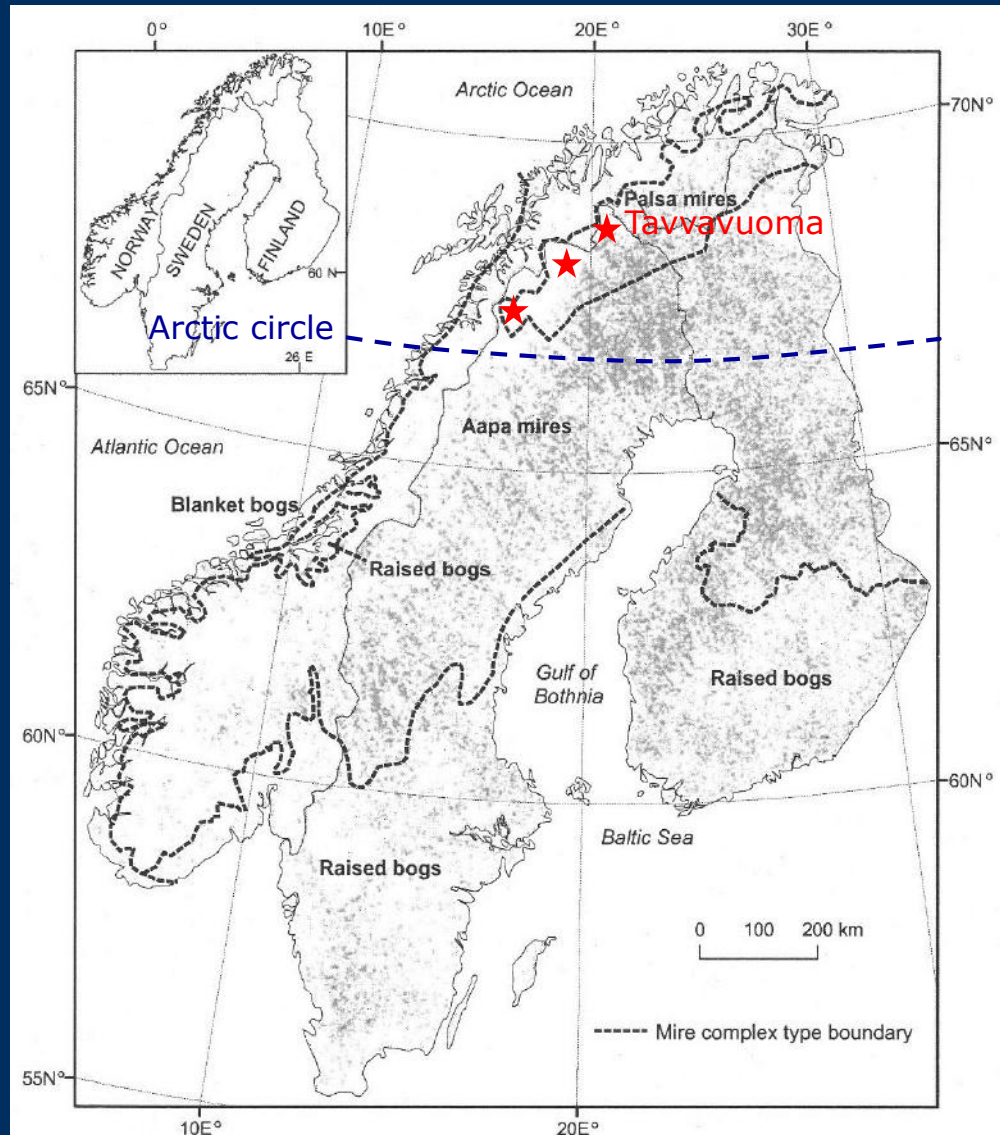
Control plot



# Vegetation changes in Stordalen



# Distribution of palsas in Fennoscandia



# Long-term carbon and permafrost dynamics

Peatland development started around 10100-9600 cal yr BP

Holocene net carbon accumulation rates are 8-17 gC/m<sup>2</sup>yr

Fen-bog transition and permafrost aggradation took place during the Little Ice Age (600-100 cal yr BP)

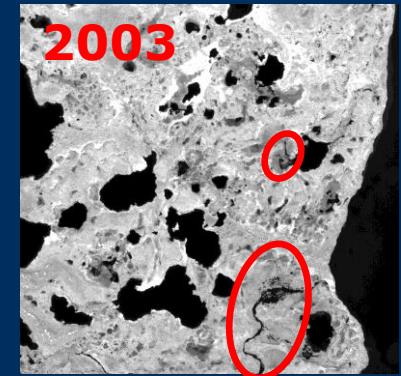
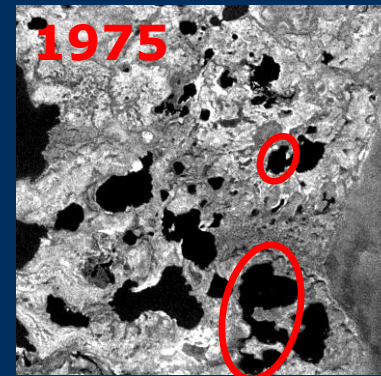
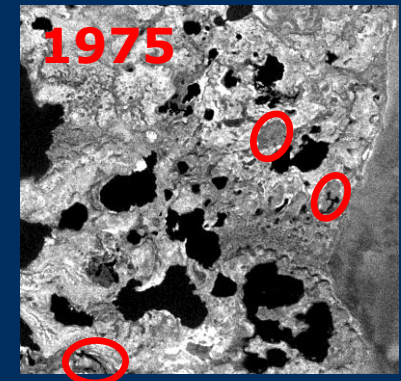
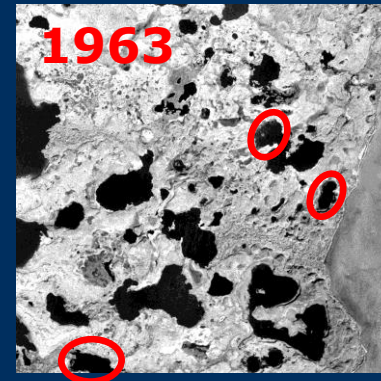
Sannel *et al.* 2018



# Formation and drainage of thaw lakes

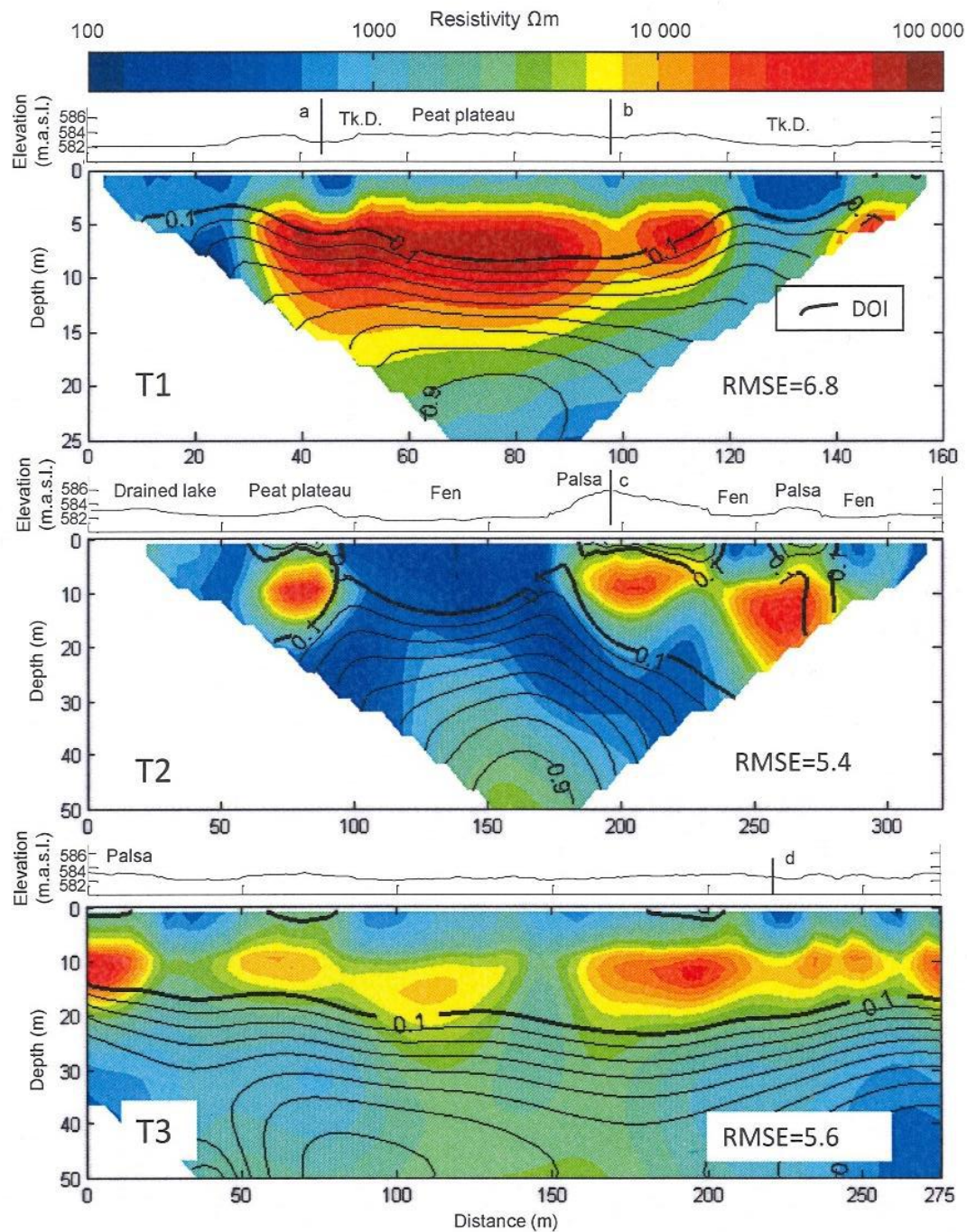
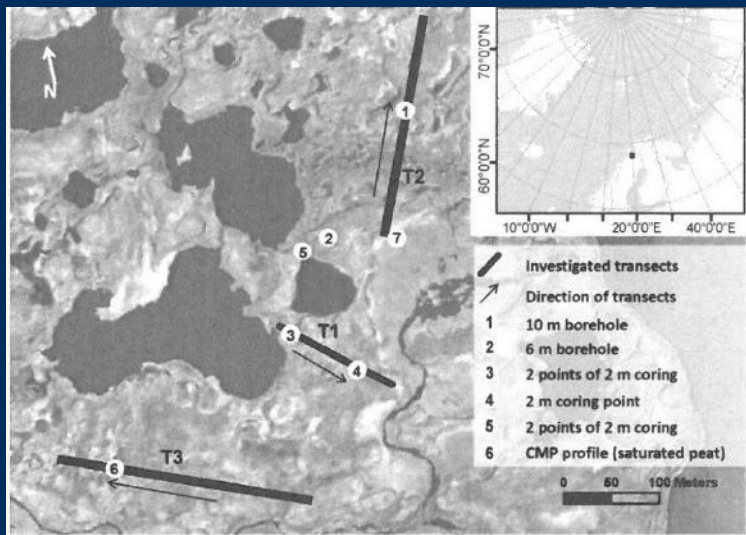
Extensive lake drainage  
and infilling with fen  
vegetation ( $\sim 8\%$ /decade)

New thermokarst lake  
formation



# Permafrost depth

## Electrical Resistivity Tomography (ERT)



# Air and ground temperature trends

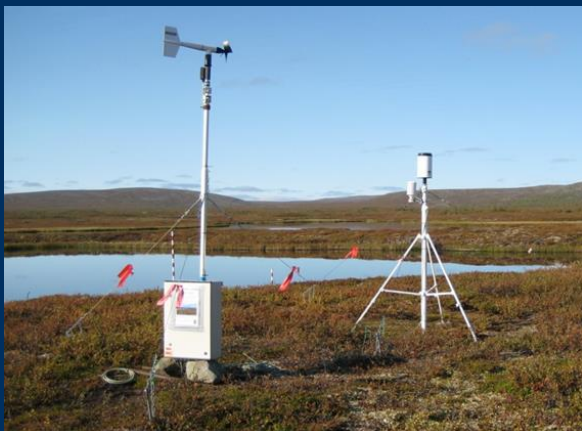
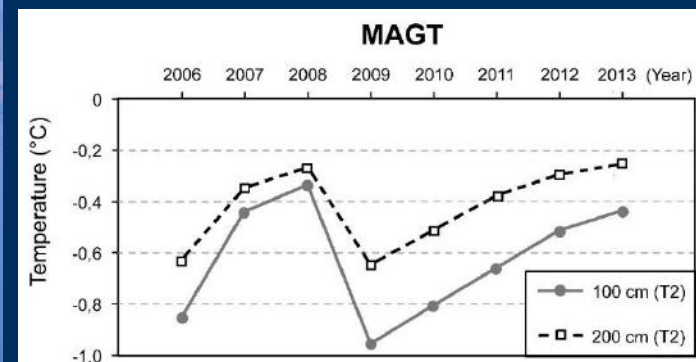
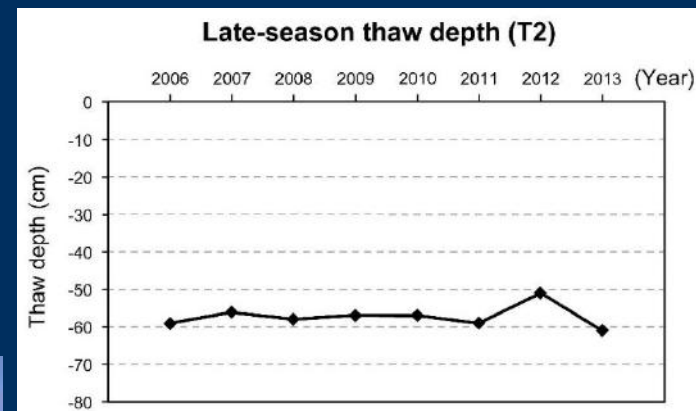
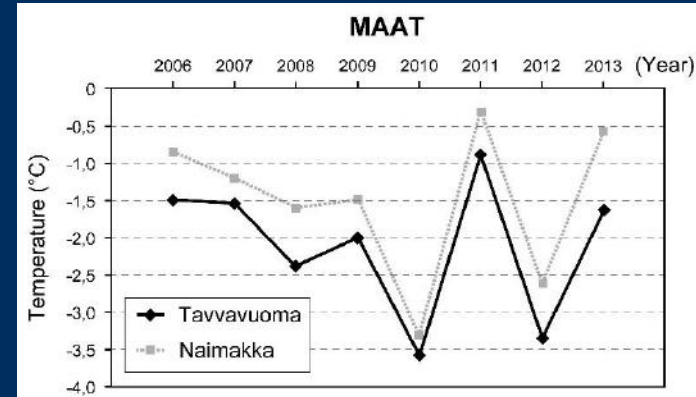
From 2006 to 2013 the:

Mean annual air temperatures have been variable, but not getting warmer

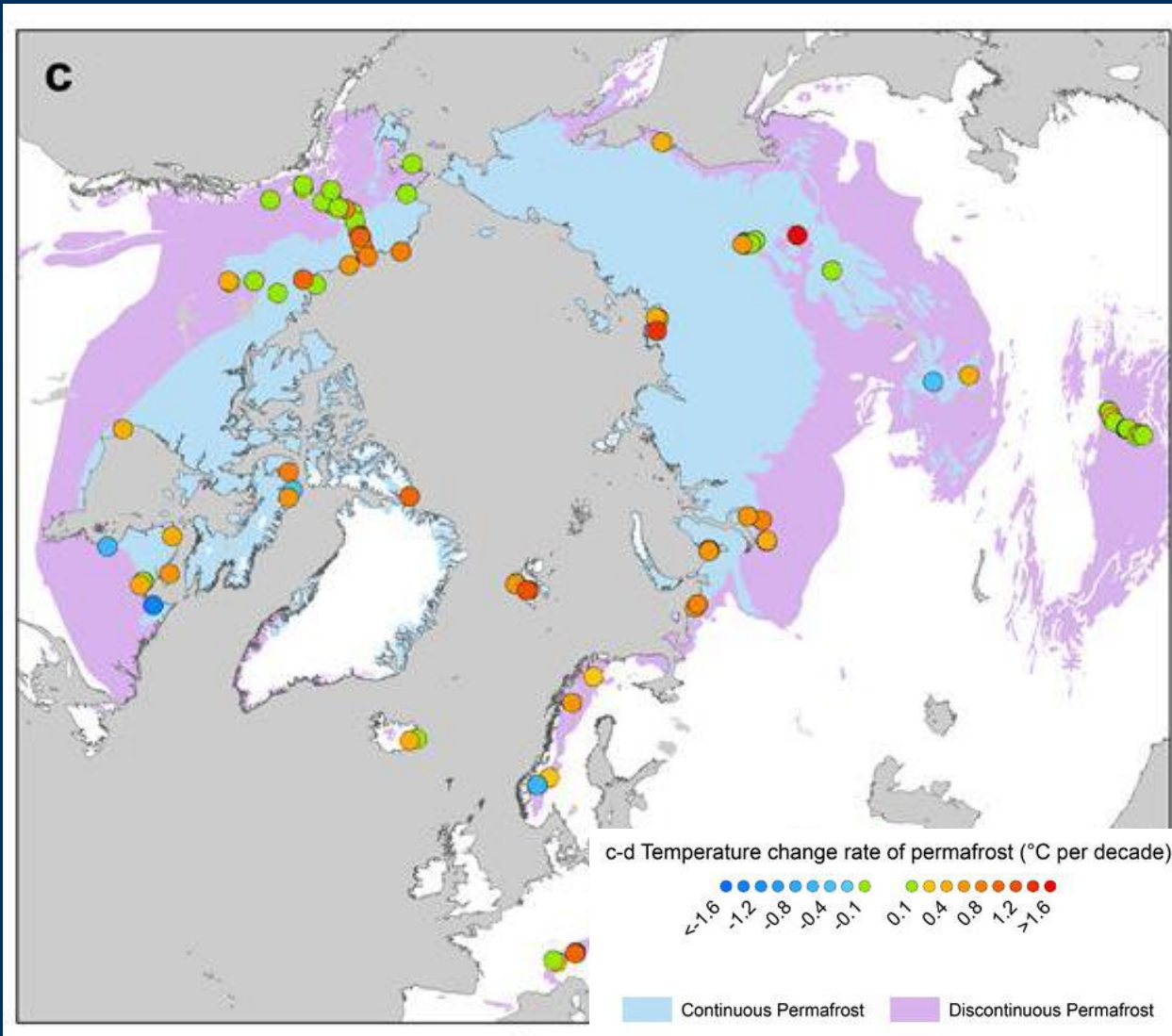
Late-season thaw depth has been relatively stable

Mean annual ground temperature has increased by  $0.06^{\circ}\text{C}/\text{year}$  at 1 m depth

Sannel *et al.*, 2016



# Permafrost warming 2007-2016



The increase in mean annual ground temperature has been  $+0,3^{\circ}\text{C}$

# Wetter or drier landscapes in the future?





*Thanks for your attention*

- and thanks to *Nordkalotträdet* for the invitation!



## A 3-year spearhead project between Stockholm and Helsinki Universities

### Aims at

- ✓ boosting strategic collaboration in the Arctic between the two universities
- ✓ combining the different strengths and expertise to enhance synergy
- ✓ increasing international visibility and impact of the Arctic research conducted

Funds small “start up” projects, workshops, annual meetings, visiting scientists