Facilitating adaptation planning in sub-Arctic Sweden: researcher-stakeholder interactions to identify appropriate tools and information.

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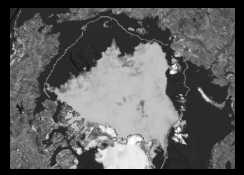
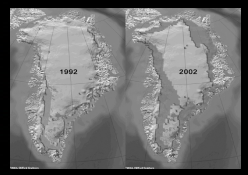




Why has the Arctic become so important recently?

It has cooled the planet for more than 100,000 years, *but this could change*

It has re-distributed the planet's warmth, cooling the tropics and warming the North, *but this could change*

Climate change is happening there twice as fast as anywhere else and we can learn from it

What happens there affects the local residents and the rest of the world

Background

Climate change is now generally accepted

It is particularly evident in the North

People of the North can contribute little to mitigation: they must adapt

Adaptation is a local process

Projections of future climates and their impacts at a local scale are poor and need to be improved

Researchers know insufficient about what stakeholders need to know about likely local changes.

Stakeholders know insufficient about what science can and cannot provide

Researchers and stakeholders need to develop local adaptation strategies together

Specific aims

To understand past and predict future climate changes at a scale of 10´s of m.

To use predicted climate to develop predictions of changes in ecology, natural resources (ecosystem services), land, permafrost and water.

To calculate how these changes in turn affect future climate.

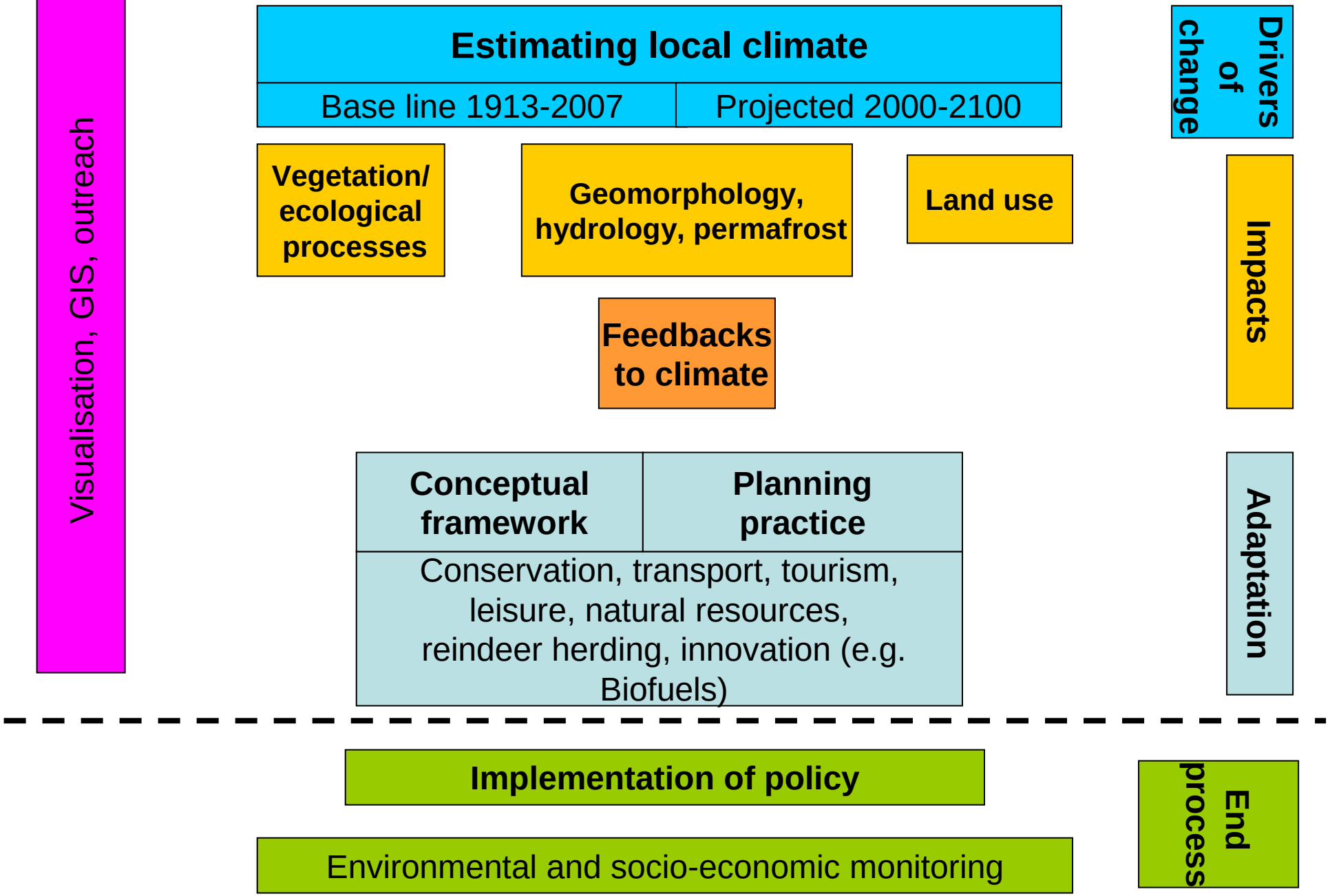
To project changes in land-use based on changes in ecosystem resource availability

To develop ways of adapting to all these predicted changes

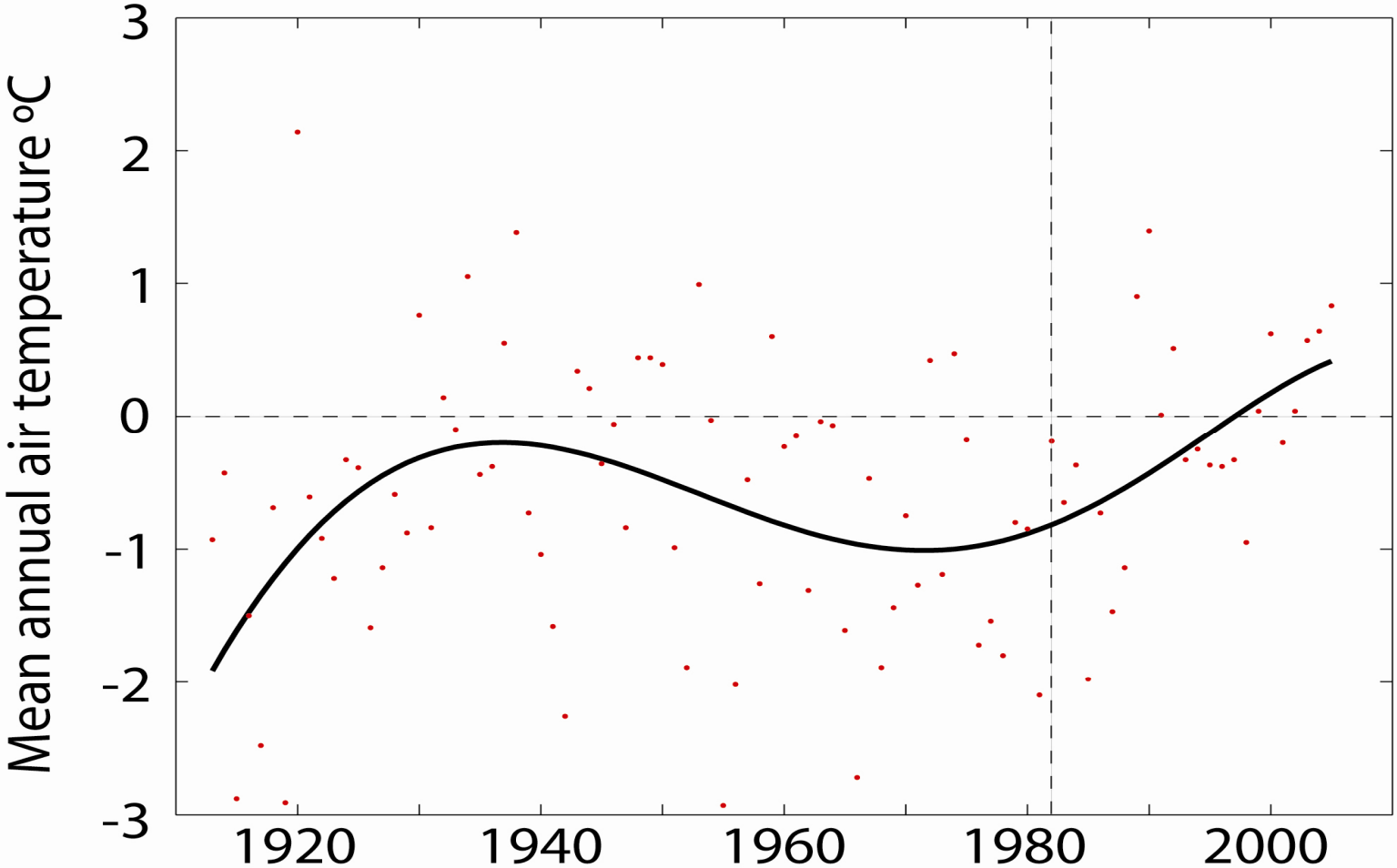
Time frame: 2030 and 2050 – for the children and grandchildren!

Picture: Johannes Förster

ADAPTATION PROJECT



The need to adapt. There are multiple accelerating environmental changes - overall warming and loss of cold winters



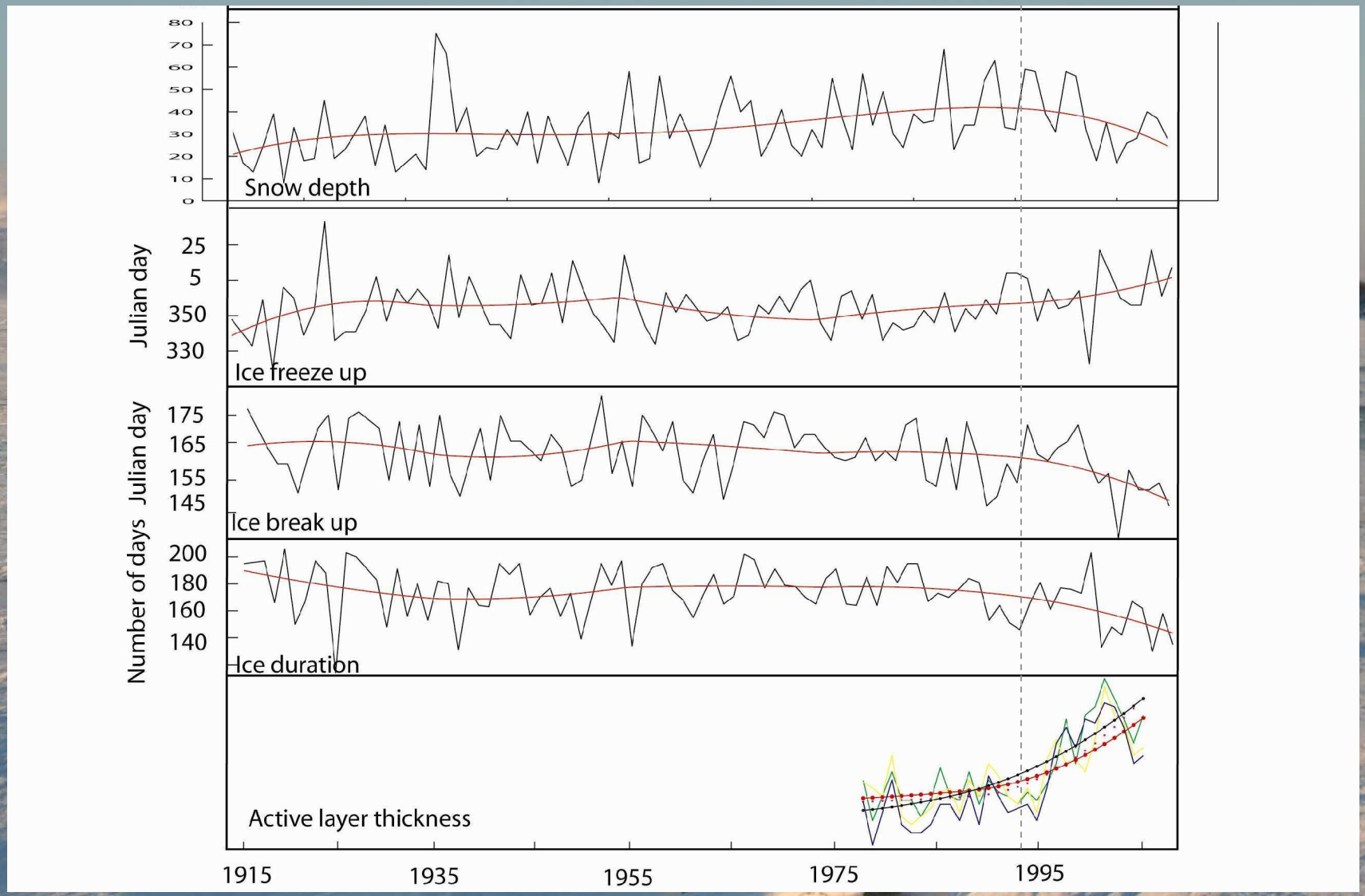
Callaghan et al., in prep.; Kohler et al., 2006

A new climate era for the sub-Arctic?

Variable (temp ^{o}C)	**Period of comparison**			
	1913-early 20th Century maxima	Mid 20th Century *minima* to 2006	Early 20th Century maxima to 2006	1913 to 2006
All year	**1.62 ± 0.36**	**1.48± 0.38**	**0.88 ± 0.27**	**2.5**
Spring	**1.60 ± 0.53**	**1.45 ± 0.55**	**1.25 ± 0.40**	**2.85**
Summer	0.90*	1.8*	0.87 ± 0.66	1.77
Autumn	**1.16 ± 0.45**	**1.08 ± 0.46**	**0.40 ± 0.18**	**1.56**
Winter	**3.30 ± 1.16**	1.85 ± 1.23	-0.40 ± 1.00	**2.9**

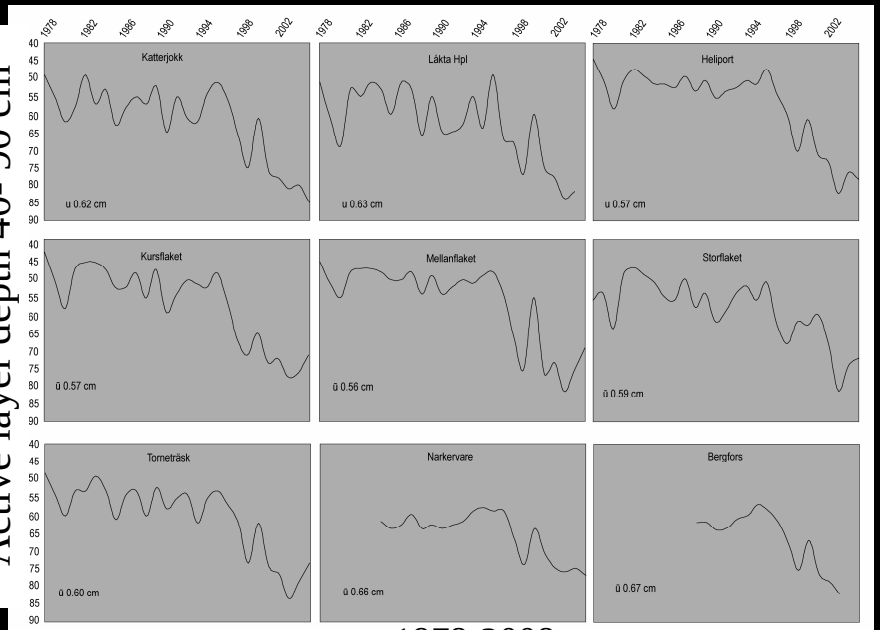
* Standard errors not applicable

Changes to the cryosphere (snow and ice) are rapid and are accelerating

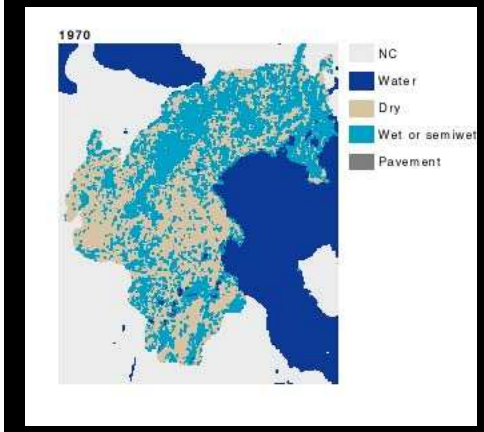


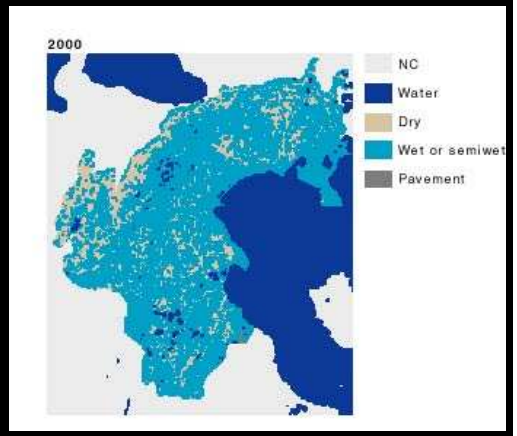
Callaghan et al., submitted; Kohler et al., 2006; Johansson and Åkerman, 2008

In sub Arctic Sweden, thawing permafrost = waterlogging, changing vegetation and increased methane emissions

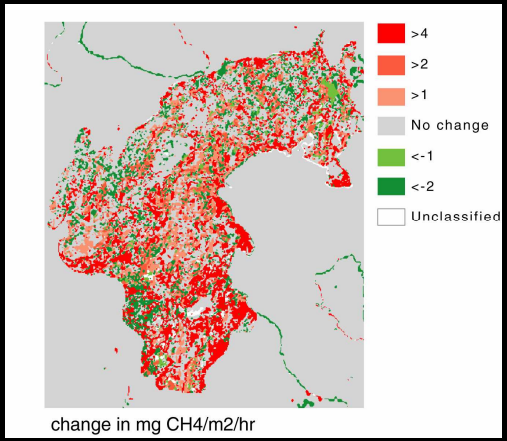


vegetation is changing: wetland communities and ponds are increasing in extent……..





……..and methane emissions have increased.



Conservation and other ecosysem services: forest structure and treeline are changing, but for complex reasons: climate acts on the trees via their herbivores. Prediction is difficult.

Use of traditional Ecological Knowledge – pioneered in ACIA, featured in IPCC 2007

Simple assessment by Huntington et al., 2004

Science accepts/knows – TEK accepts/knows	→	Greater confidence in knowedge
Science accepts/knows – TEK disagrees	→	Exploration of causes of disagreement gives new knowledge
TEK knows – Science does not know	→	A new focal point for research
Science knows – TEK does not know	→	Failure of outreach by scientists

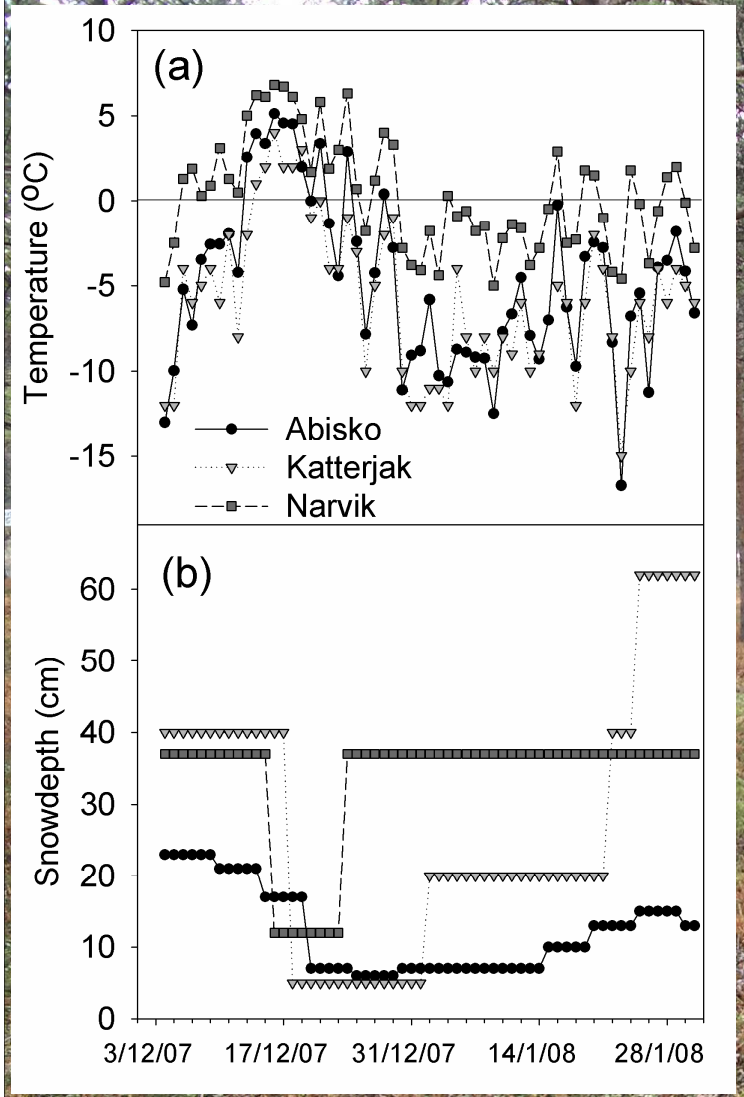
Challenge: Science accepts and calculates uncertainty levels, TEK does not (*yet*)

Indigenous knowledge on snow and extreme events

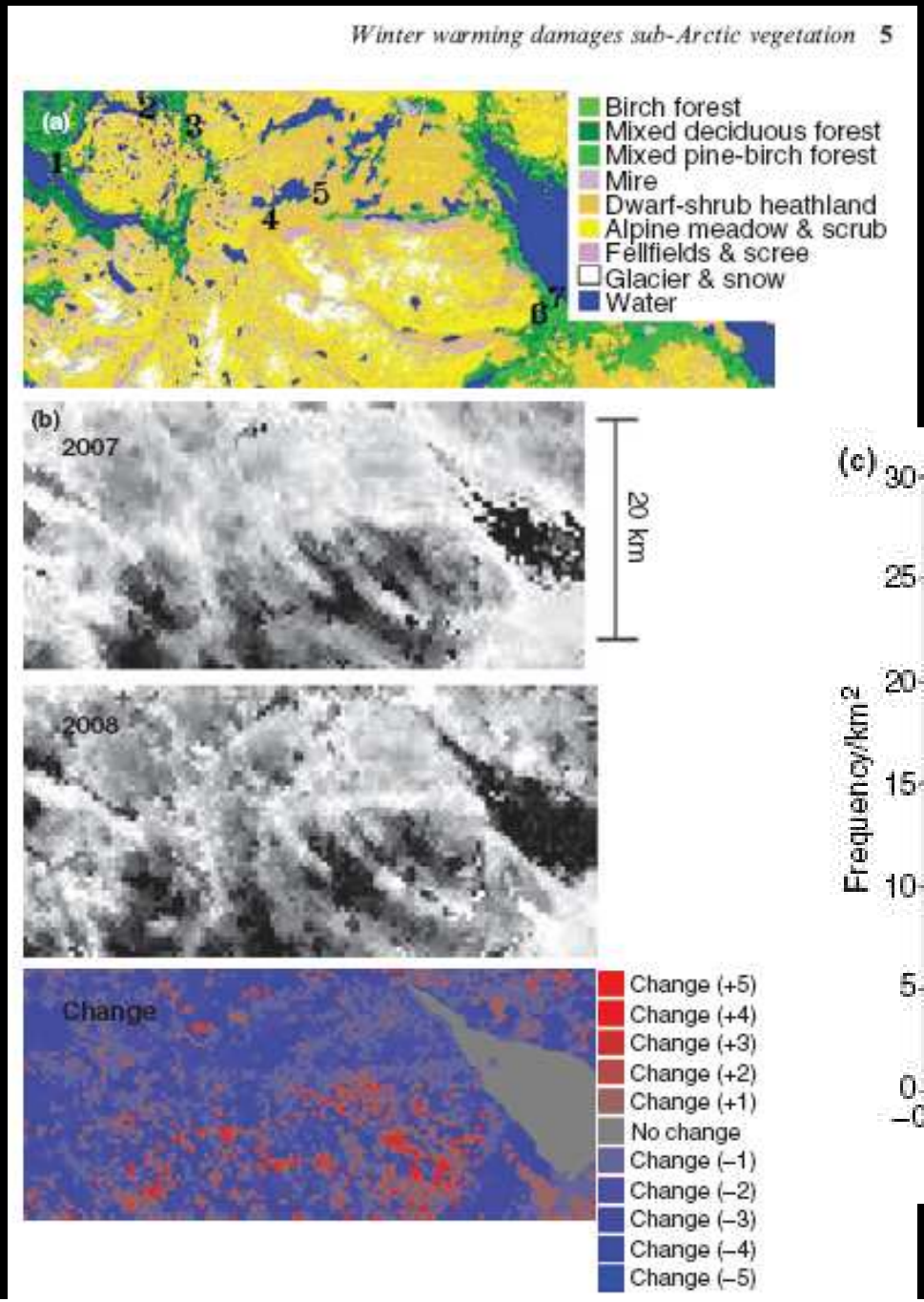
Reindeer feeding after a heavy snowfall.
Photo: Inger Marie Gaup Eira/www.ealat.org

Extreme events - experiments

Bokhorst et al., 2008; in press

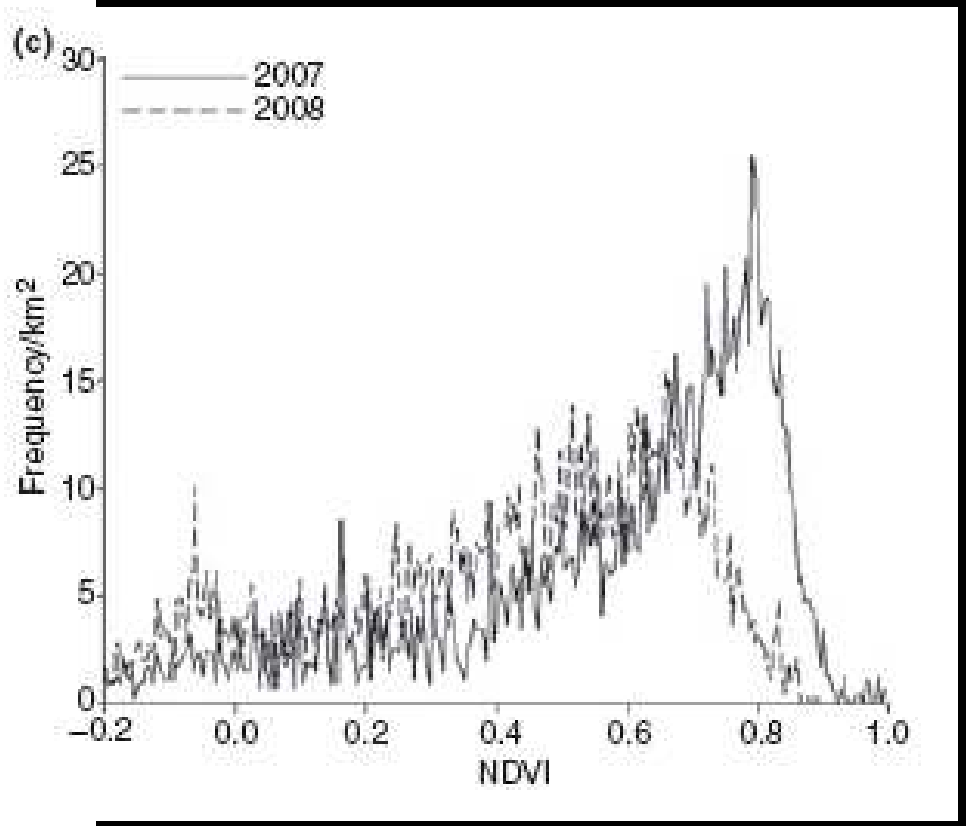


A natural event was identified in May 2008: a few warm days in winter 2007 had long-lasting effects.



MODIS-derived NDVI values at 0.25 km^2 resolution:

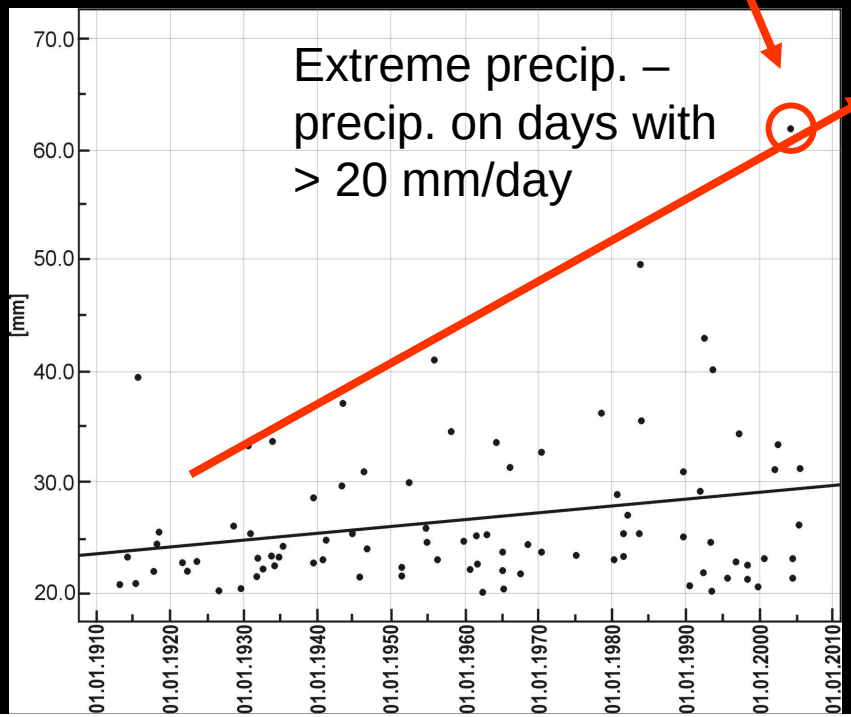
26% reduction in NDVI over an area 0f 1424 km2



Bokhorst et al., in press

Extreme summer precipitation *events* cause infrastructure damage and geomorphological changes: make planning difficult – responses are to past changes, not future

Bridge on E10 destroyed



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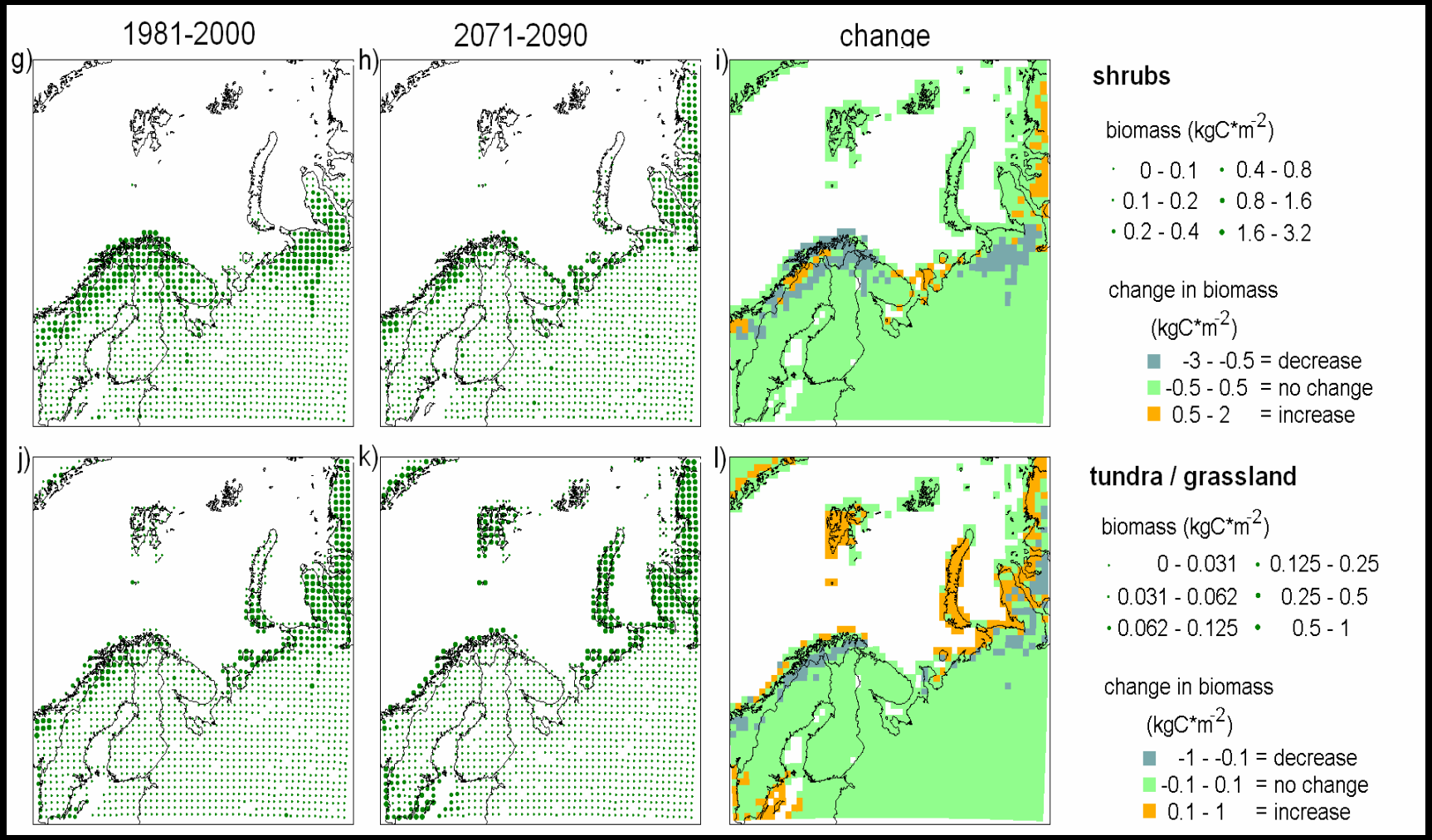
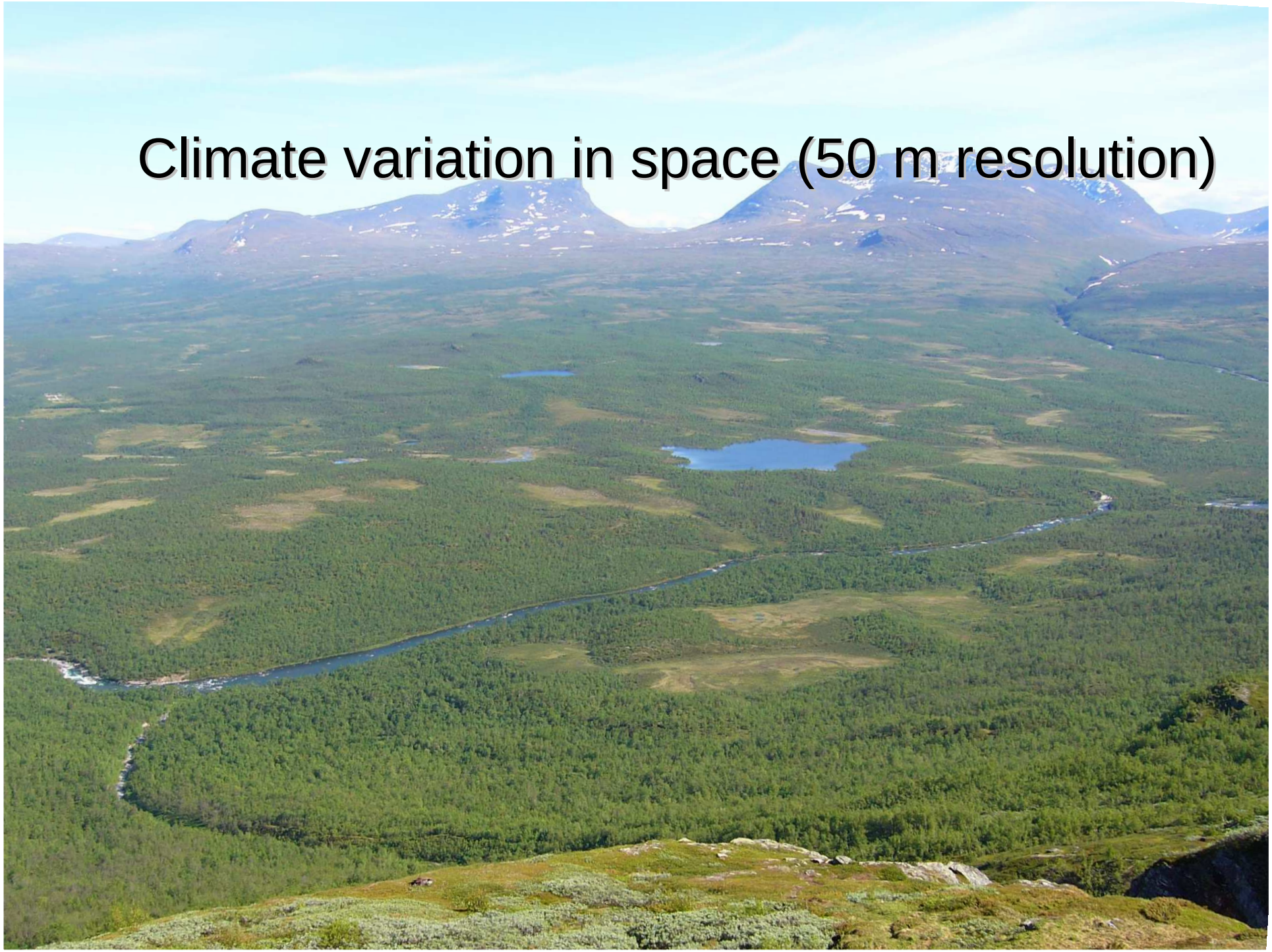
Models predict future ecosystem changes responding to changes in climate, but generally at large scales, and events are excluded. The Barents region will see increases in forests and productivity but increased insect pest damage and feedbacks that result in further warming. However, in summer, there will be cooling.



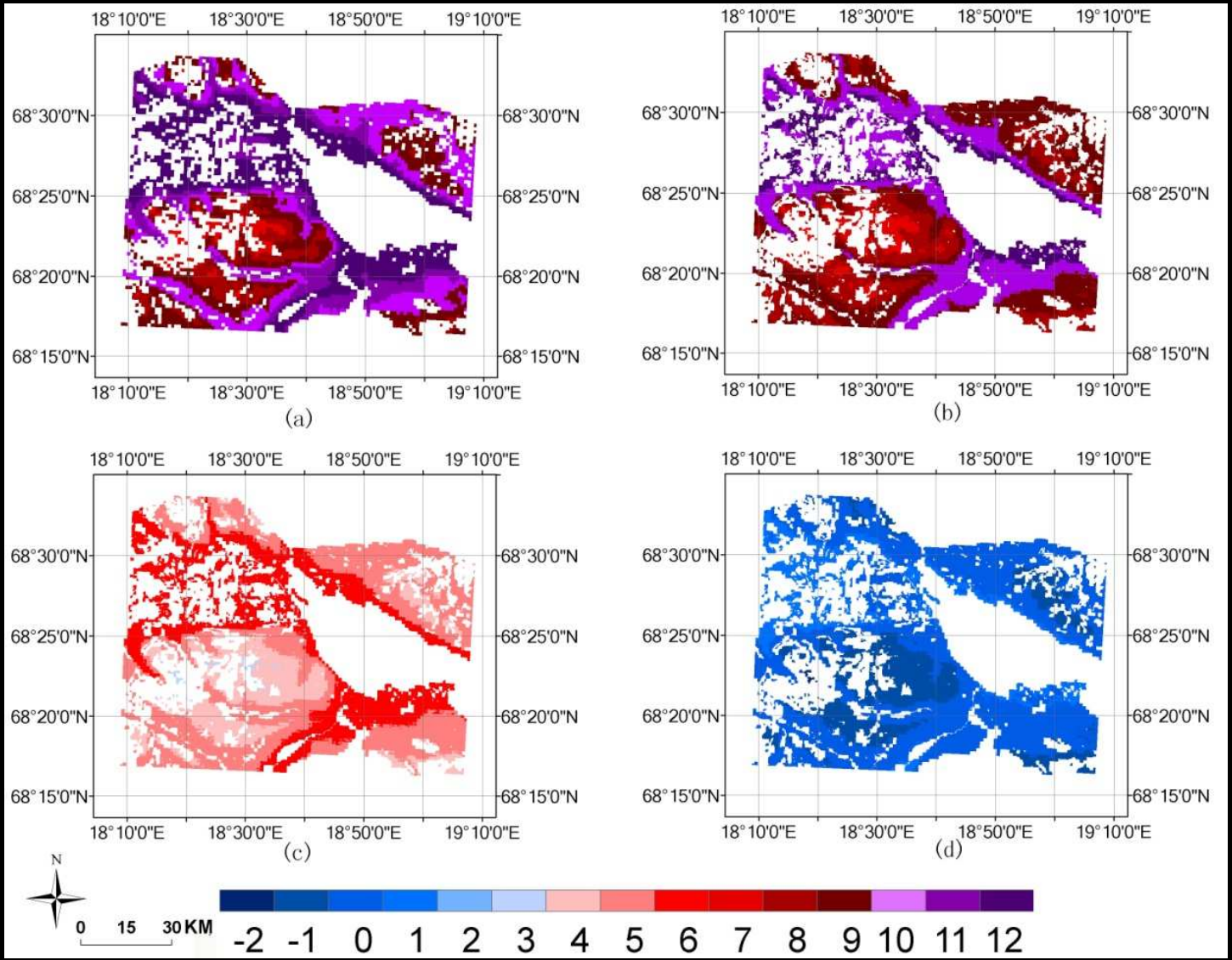
Wolf et al., 2008

Climate variation in space (50 m resolution)



Monthly temperature patterns at Abisko, 1913-2006

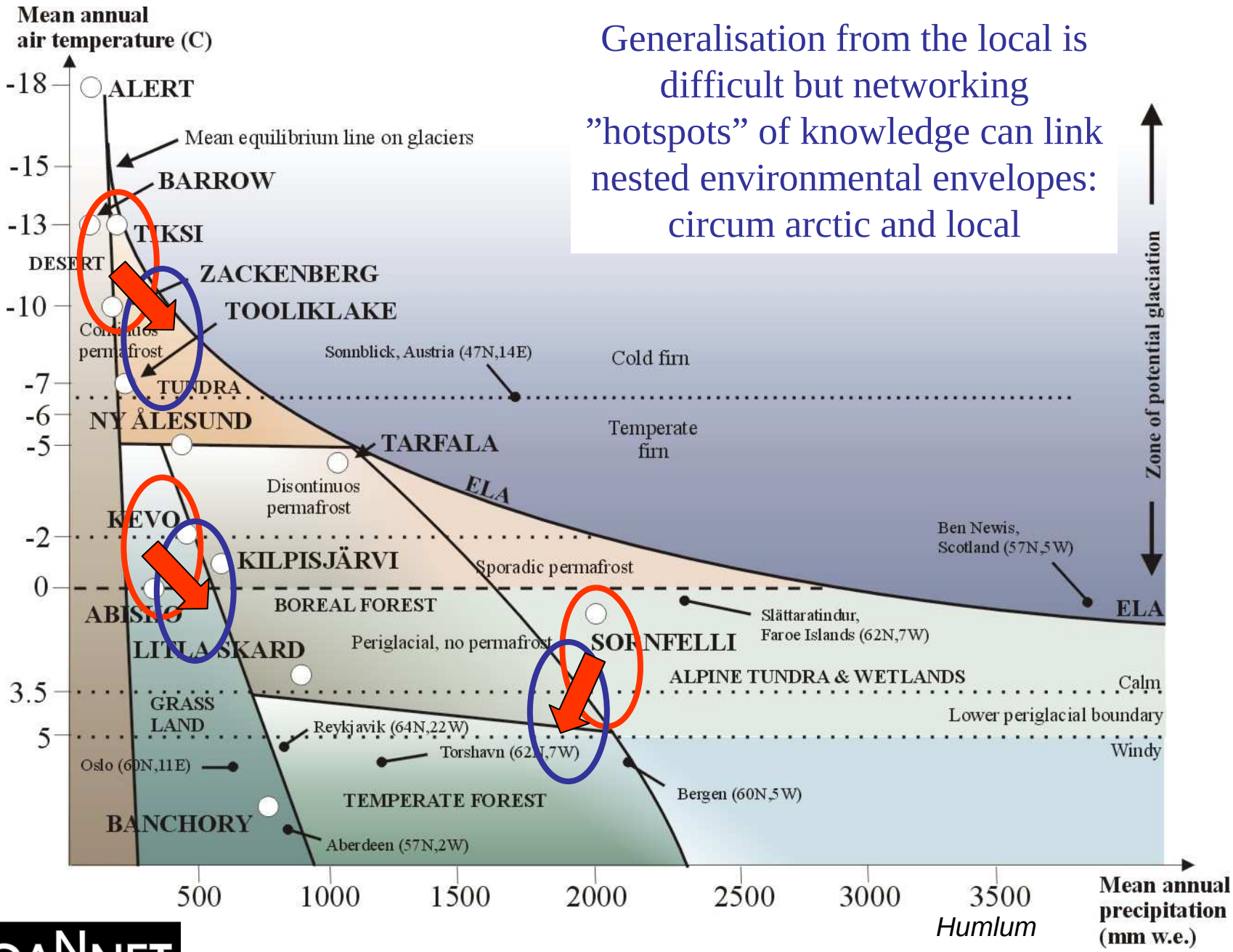
One tool is to model local temperature variation (50 m resolution) (1913-2008)



Measuring feedbacks from ecosystem change

Monitoring of methane emissions at Zackenberg and carbon dioxide at Abisko

Generalisation from the local is difficult but networking ”hotspots” of knowledge can link nested environmental envelopes: circum arctic and local



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Bottom lines:

a) It is clear from our first meeting that stakeholders are adapting ON THE BASIS OF CURRENT CHANGES

b) Adaptation needs to be PLANNED FURTHER AHEAD IN TIME using climate change and impacts projections at the local scale.

c) We need to FOCUS ON GRADUAL, CONTINUOUS CHANGE AND STEP CHANGES after thresholds have been crossed or after extreme events

d) Collaboration is the way forward: networking in the local area and then between ”hotspots”

e) A change in science attitude is required: generality is useful for science and mitigation but local aspects are fundamental to residents