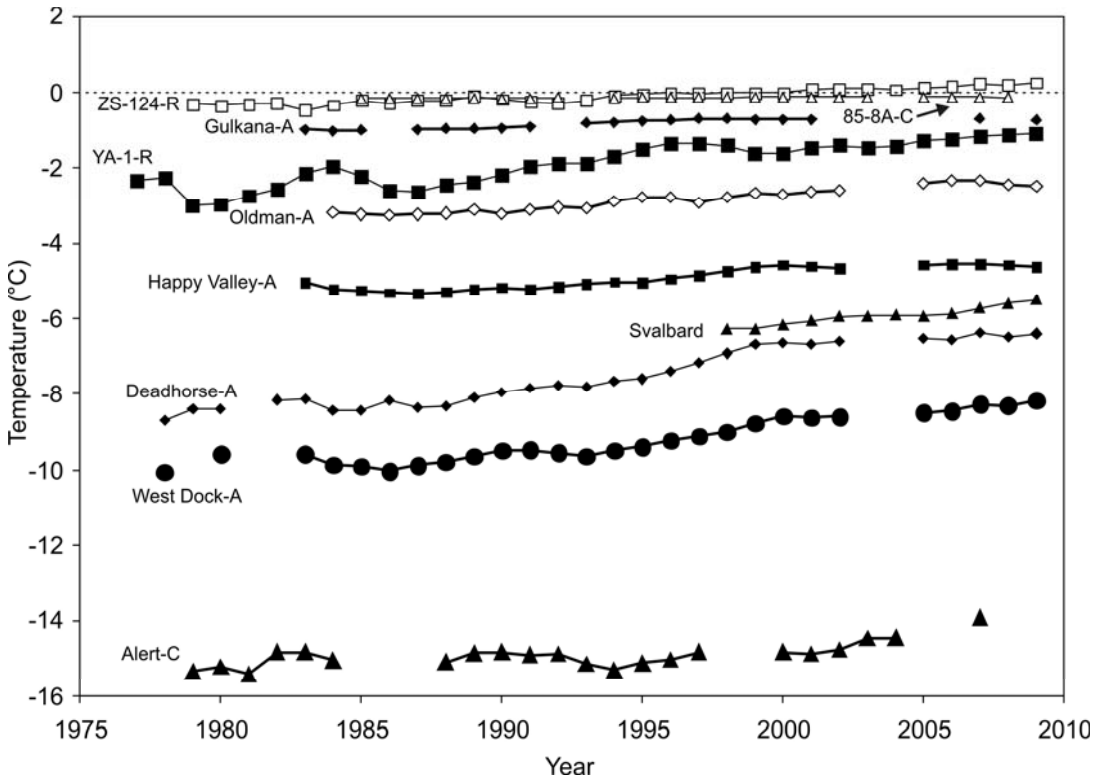
Ground temperatures

Current trends

Future predictions

Why do we care?



Romanovsky et al., 2010

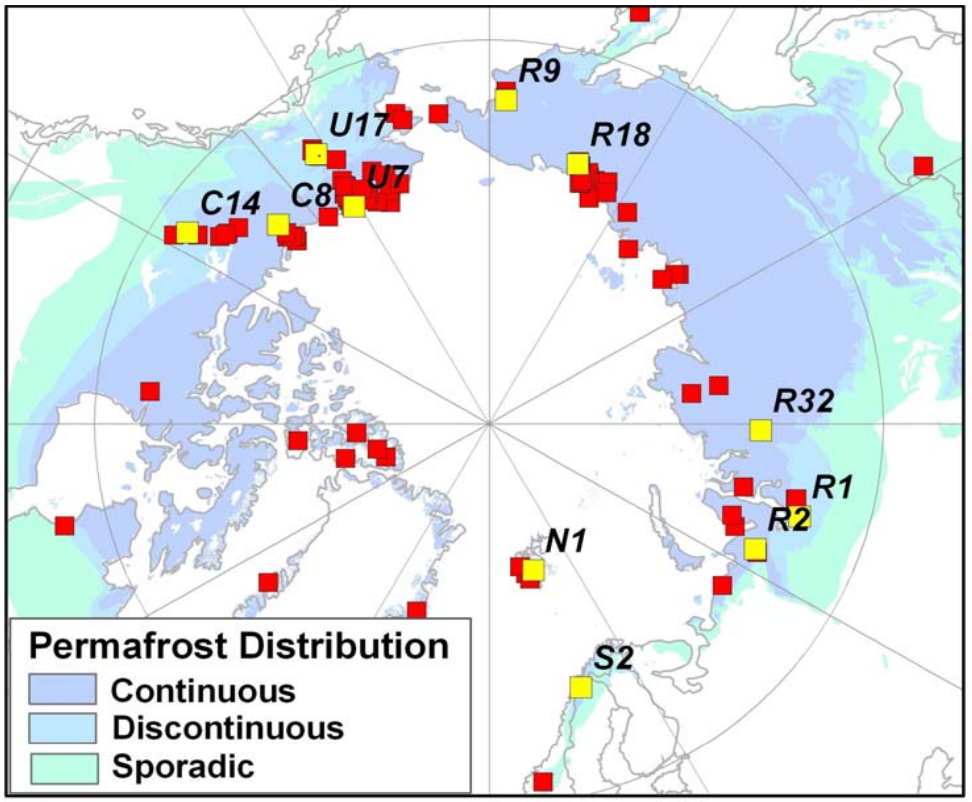
Warming typically between 0.5 to 2 °C

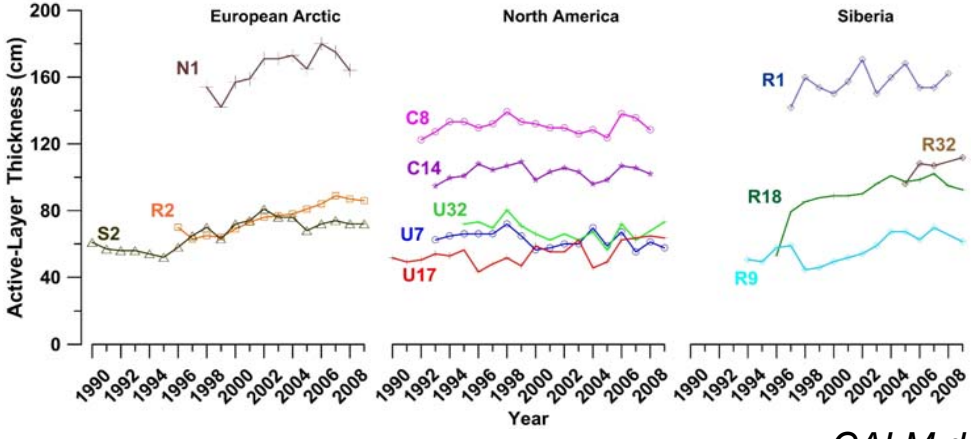
Active Layer Thickness (ALT)

Current trends

Future predictions

Why do we care?





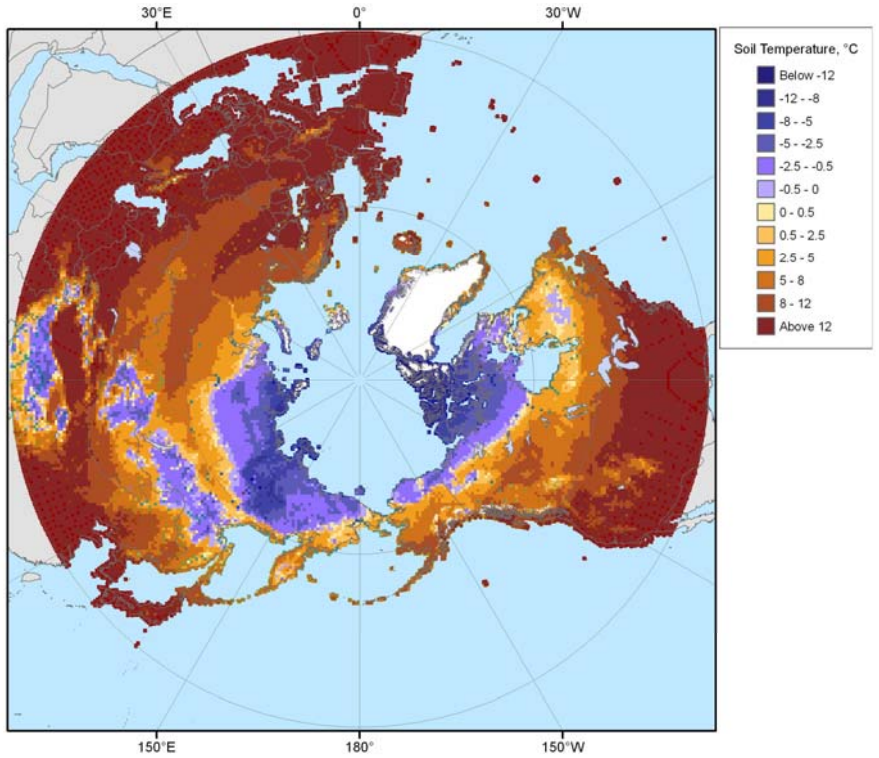
CALM data archieve

Projections for year 2090

Current trends

Future predictions

Why do we care?



Extensive thawing in the southern boundary of permafrost region

Changes in hydrology

Current trends

Future predictions

Why do we care?

Drying of ponds

1970

2009

Callaghan et al., in press

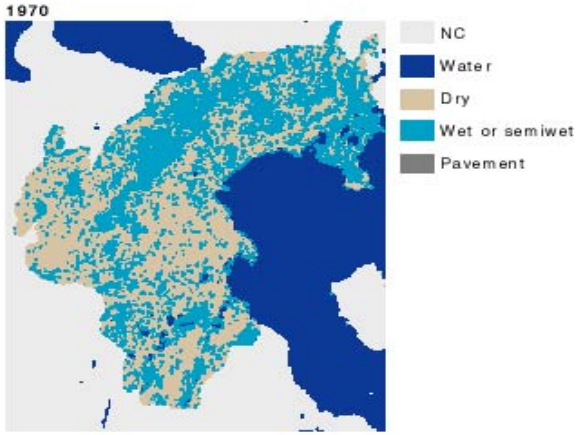
Changes in hydrology

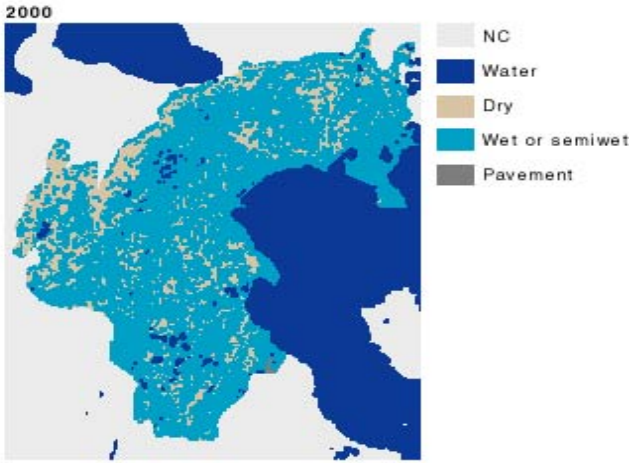
Current trends

Future predictions

Why do we care?

Watterlogging





Christensen et al., 2004

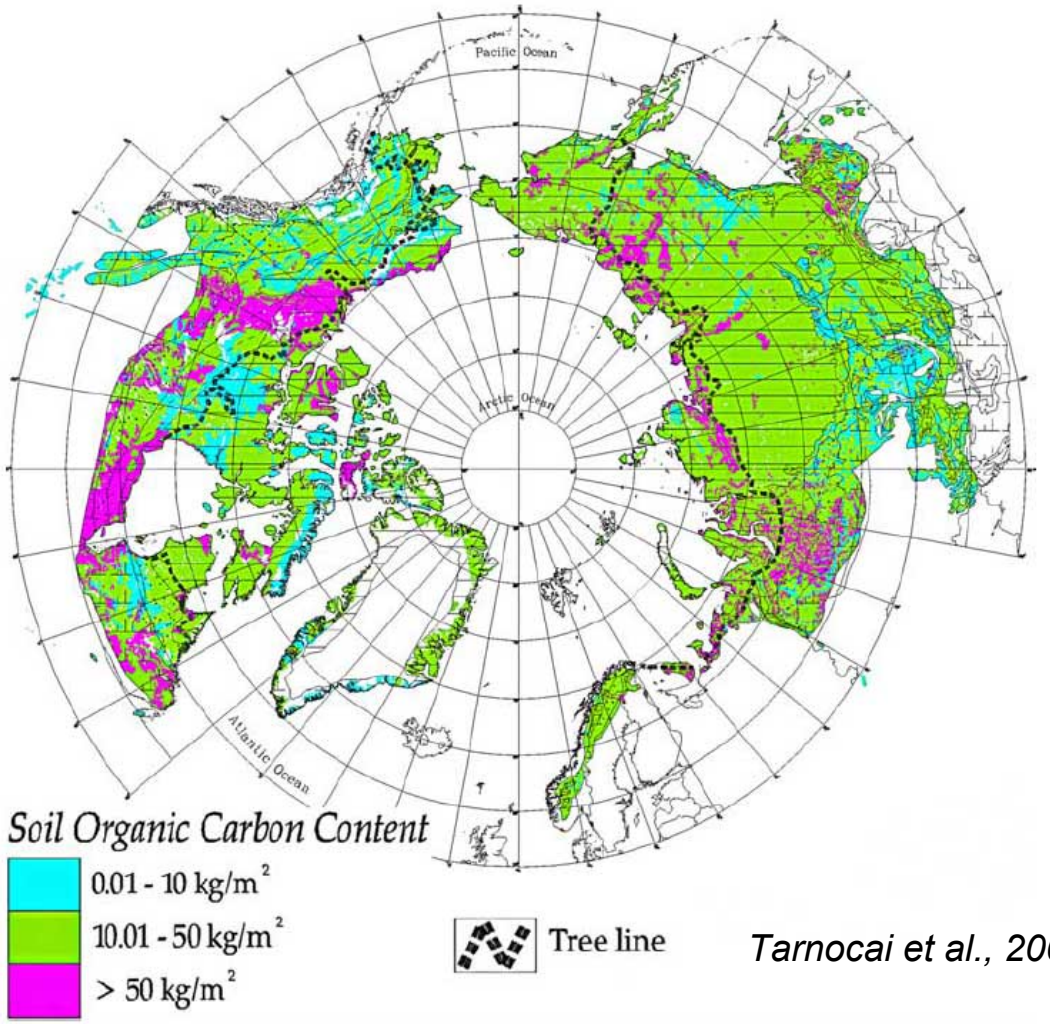
Carbon storage

Twice as much carbon stored in the ground than is in the atmosphere today

Current trends

Future predictions

Why do we care?



Tarnocai et al., 2009

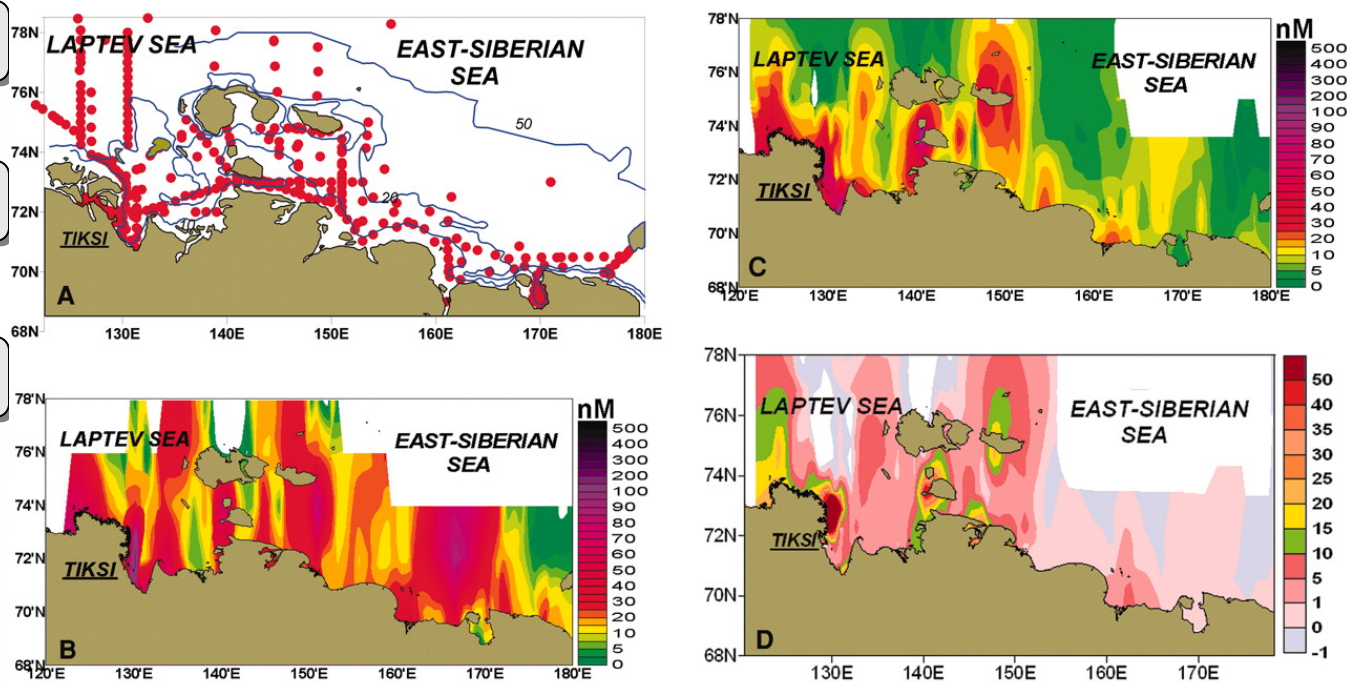
Dissolved CH_4 in the East Siberian Arctic Shelf in summer

Arctic shelves can contain 1300 Gt of C

Current trends

Future predictions

Why do we care?

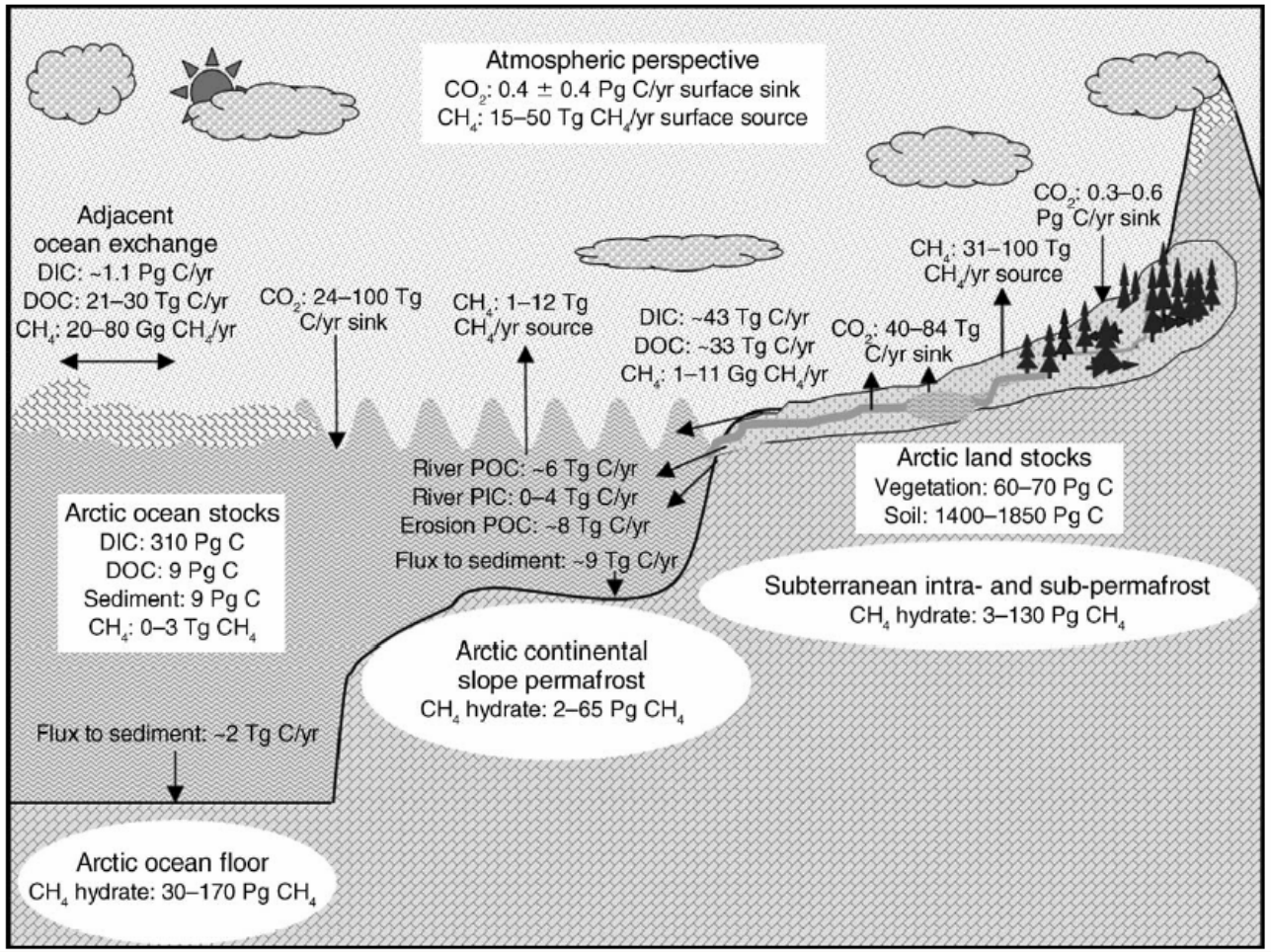


Shakhova et al., 2010

Million dollar question!

Will the Arctic be a sink or a source of carbon in the future?

- Current trends
- Future predictions
- Why do we care?



Mcguire et al., 2009

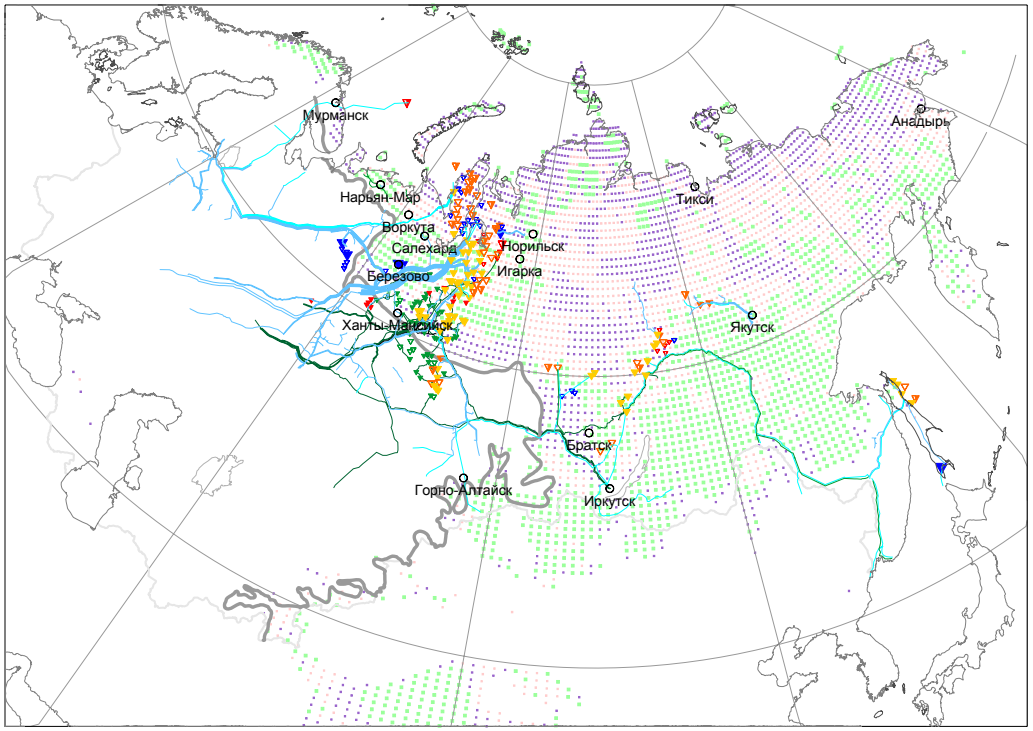
Infrastructure susceptibility to permafrost thaw in Russia

Current trends

Future predictions

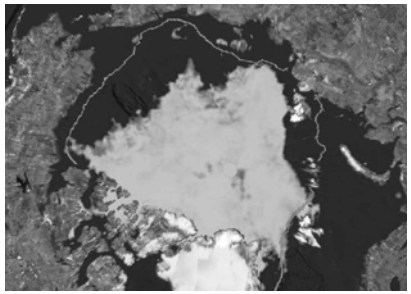
Why do we care?

Susceptibility of buildings and engineered structures to ongoing climatic and permafrost changes



Updated from Instanes and Anisimov, 2008

Snow is a dominant feature of the Arctic
Affects all the other cryospheric components

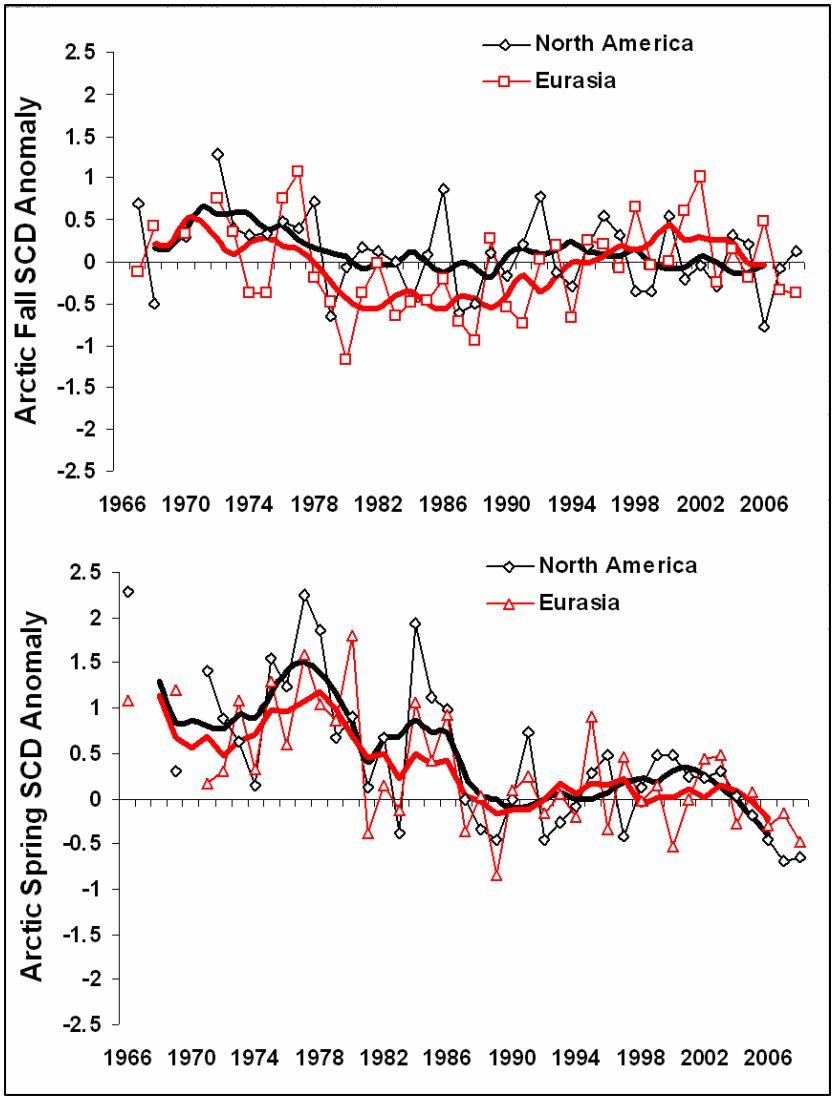


Sea Ice and River and Lake Ice

Glaciers and Ice caps

Permafrost

Snow cover duration



Derksen et al., 2009

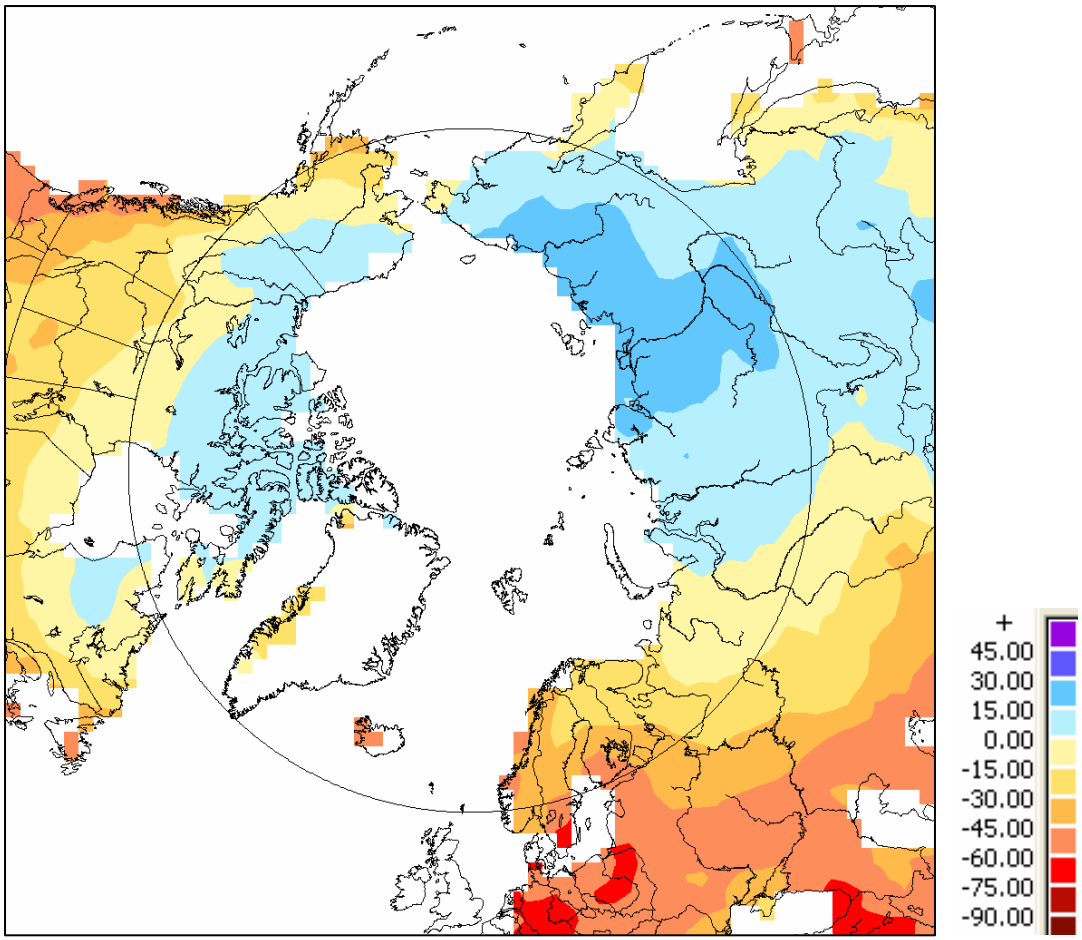
Current trends

Future predictions

Why do we care?

3.4 days per decade 1972-2009

Projected changes in snow water equivalent between 1970-1999 and 2049-2060



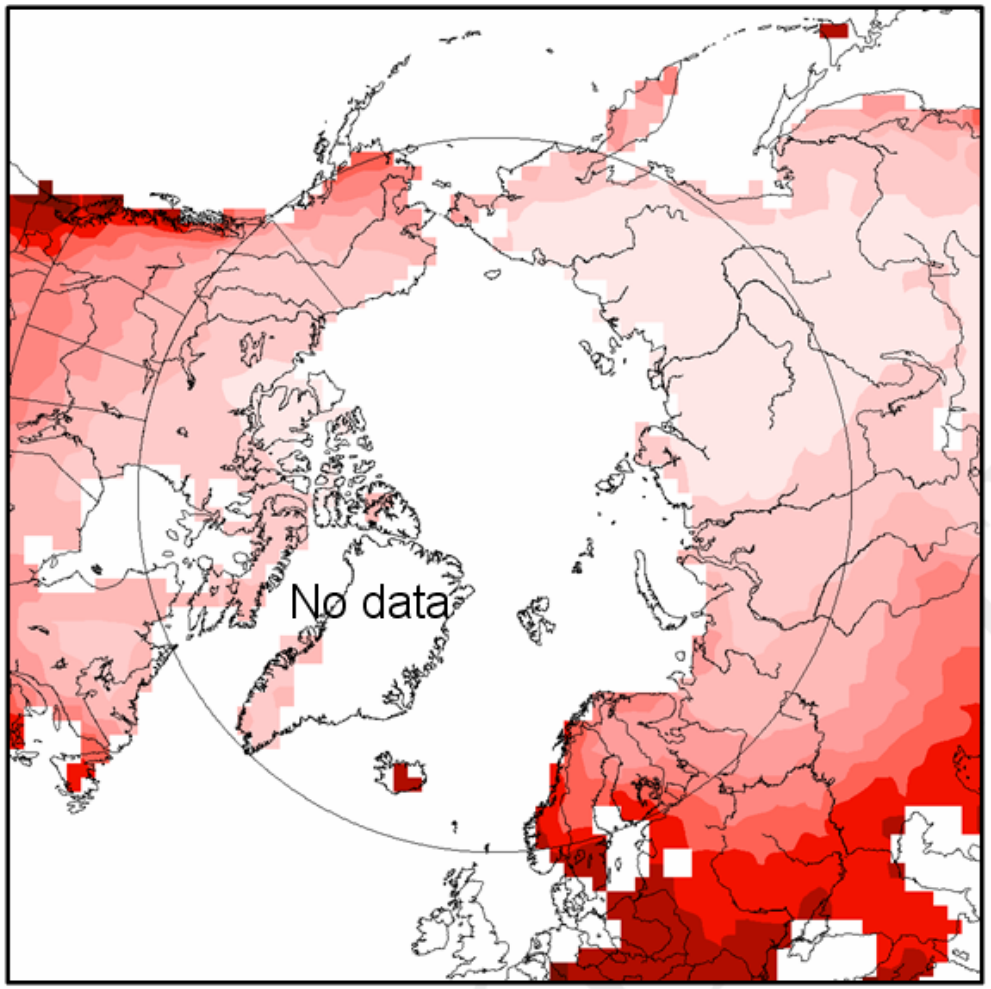
Brown and Mote, 2009

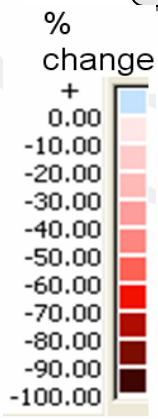
Current trends

Future predictions

Why do we care?

Projected changes in snow cover duration between 1970-1999 and 2049-2060





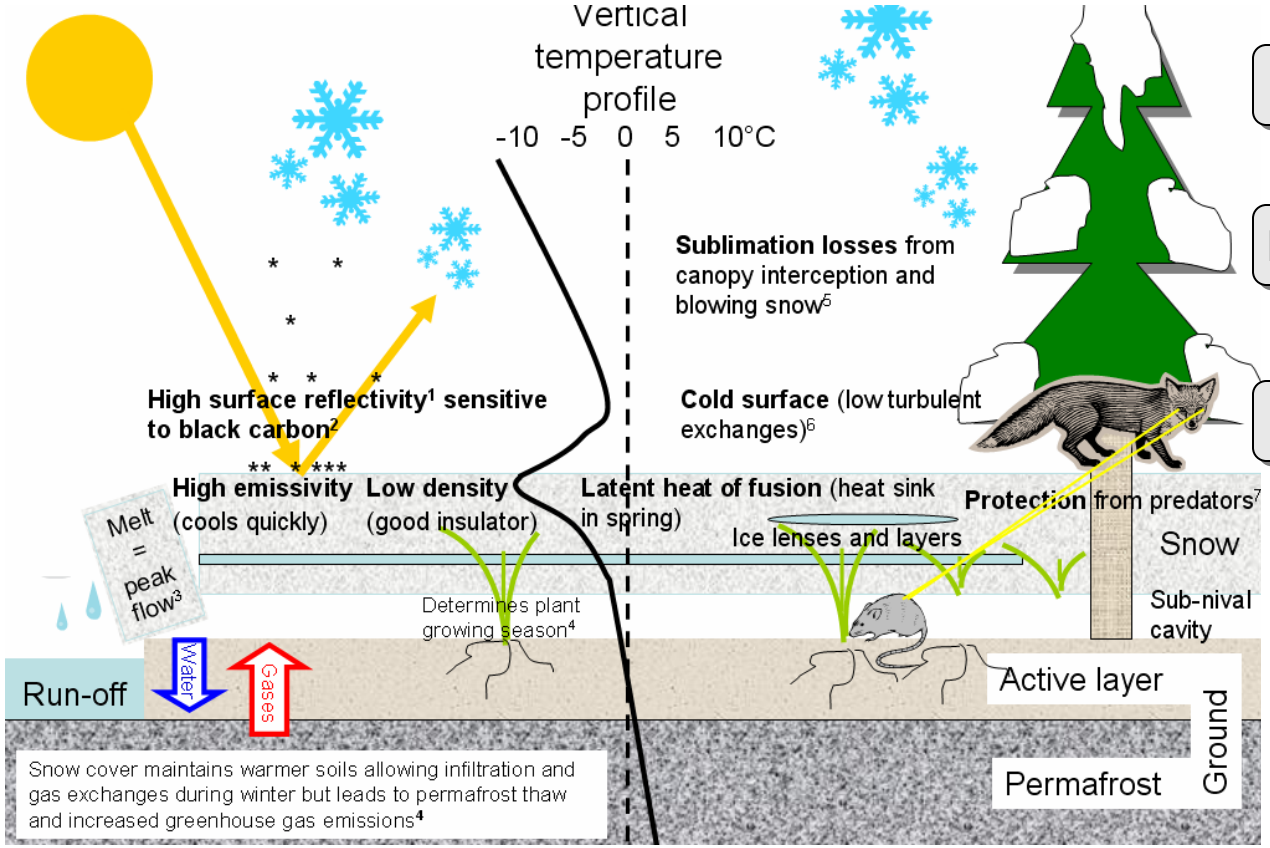
Brown and Mote, 2009

Current trends

Future predictions

Why do we care?

Snow cover – an important component of climate, hydrological and ecological systems



Brown and Callaghan

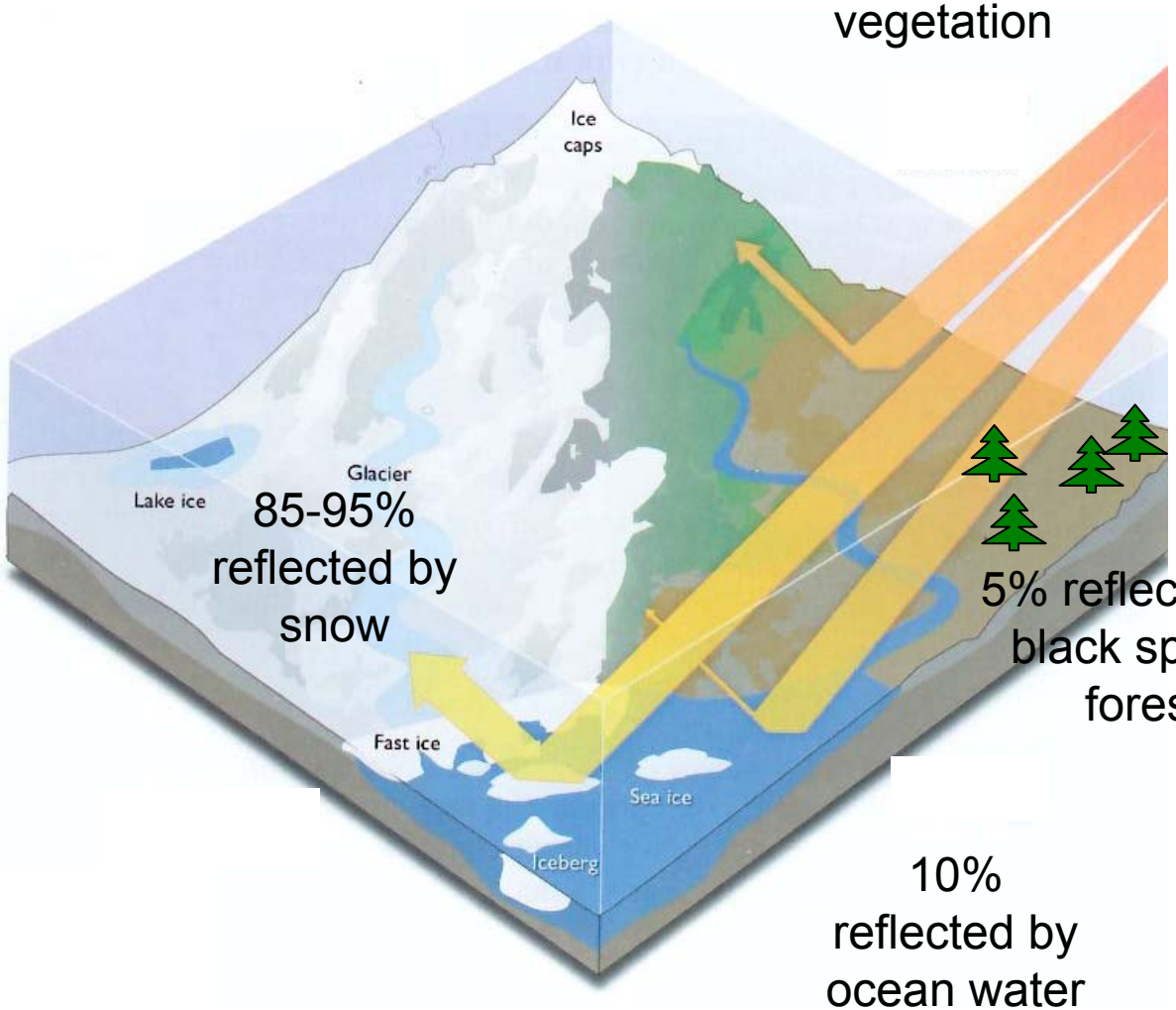
Current trends

Future predictions

Why do we care?

Albedo and insulation

20% reflected by tundra vegetation



85-95% reflected by snow

5% reflected by black spruce forest

10% reflected by ocean water

Current trends

Future predictions

Why do we care?

Hydropower industry

Current trends

Future predictions

Why do we care?

	Reference period 1960-1991			HadAM-B2 2071-2100			ECHAM-B2 2071-2100		
	W	S	A	W	S	A	W	S	A
Runoff (TWh)	12.5	53.5	66.0	21.5	49.9	71.3	30.4	51.2	81.6
Production (TWh)	34.2	28.1	62.3	34.8	31.5	66.3	39.4	35.1	74.5

Gode et al., 2007

Conclusions

- The Arctic cryosphere has changed dramatically during the last decade
- Natural variability is high and the system is complex but the rate of change has taken scientists by surprise
- Impacts of changes in the cryosphere change living conditions in the Arctic and have significant global implications
- Changes in the cryosphere provides challenges as well as opportunities

Thank you!