ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

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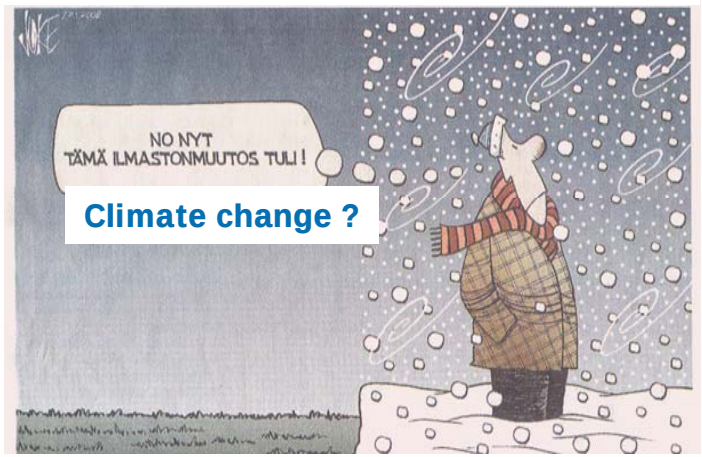
# Recent snow cover changes
## in Northern Europe

*Introduction*

*Snow-project (INTAS)*
*...its data and results*

*Snow in N-Europe;*
*(BACC) and up*

*Future ?*



# IPCC 2007

(Separate chapter)


## Observations:
## Changes in Snow, Ice and Frozen Ground

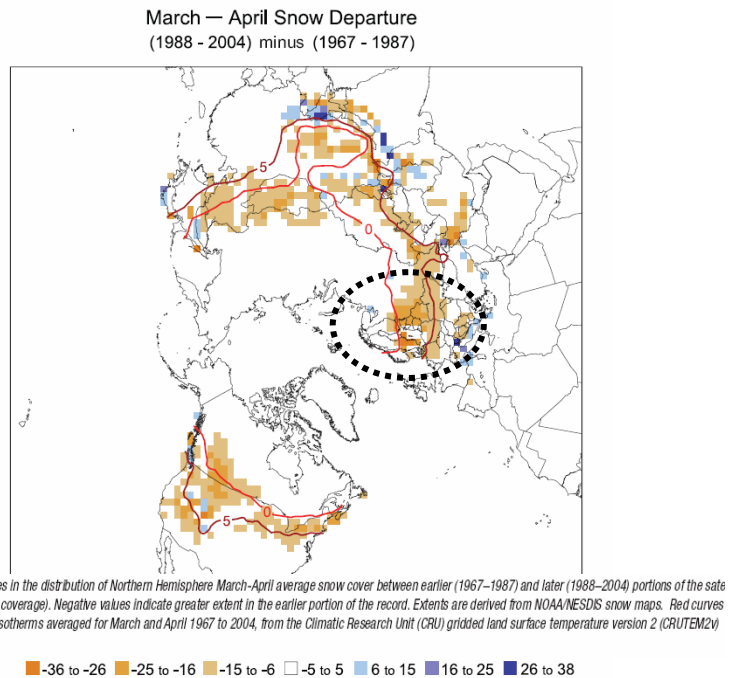



**Figure 4.3.** *Differences in the distribution of Northern Hemisphere March-April average snow cover between earlier (1967–1987) and later (1988–2004) portions of the satellite era (expressed in % coverage). Negative values indicate greater extent in the earlier portion of the record. Extents are derived from NOAA/NESDIS snow maps. Red curves show the 0°C and 5°C isotherms averaged for March and April 1967 to 2004, from the Climatic Research Unit (CRU) gridded land surface temperature version 2 (CRUTEM2v) data.*

## (Synthesis Report -> SPM)

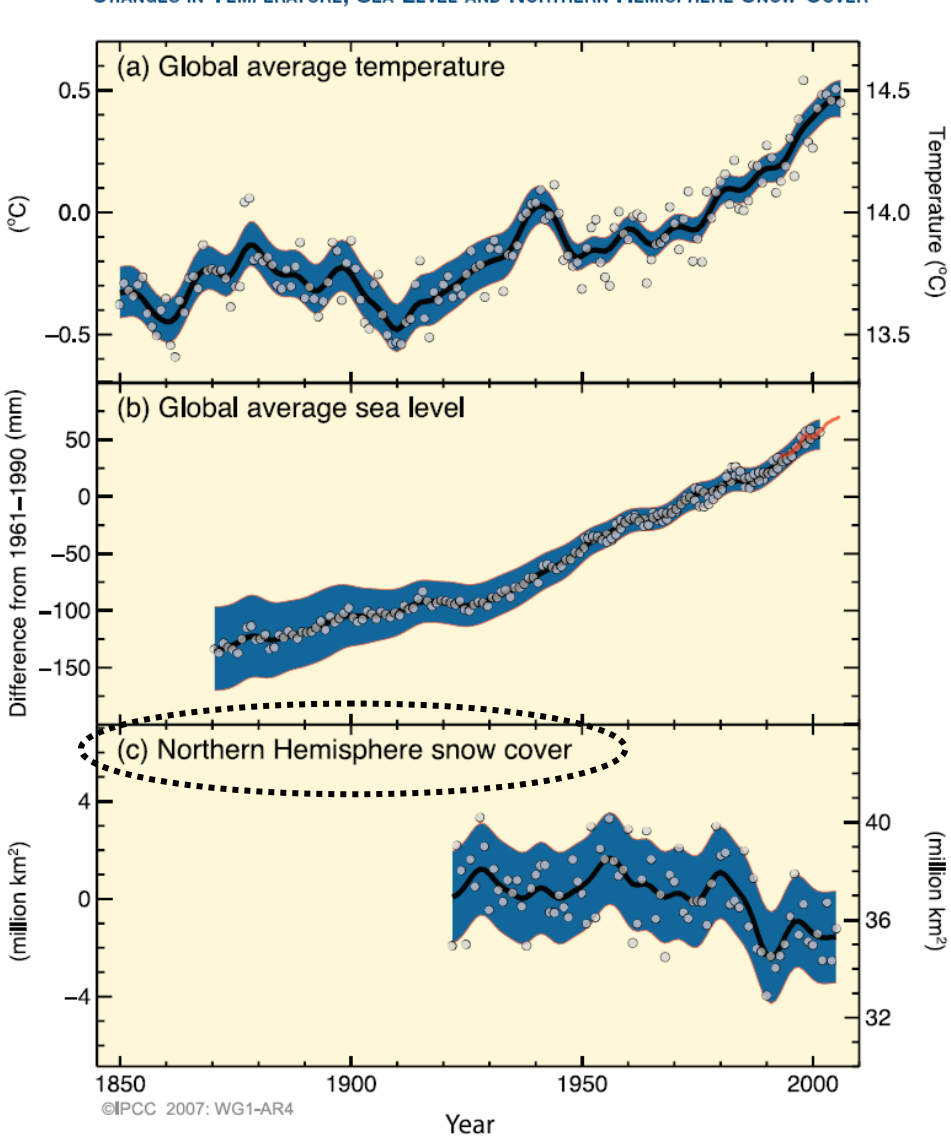
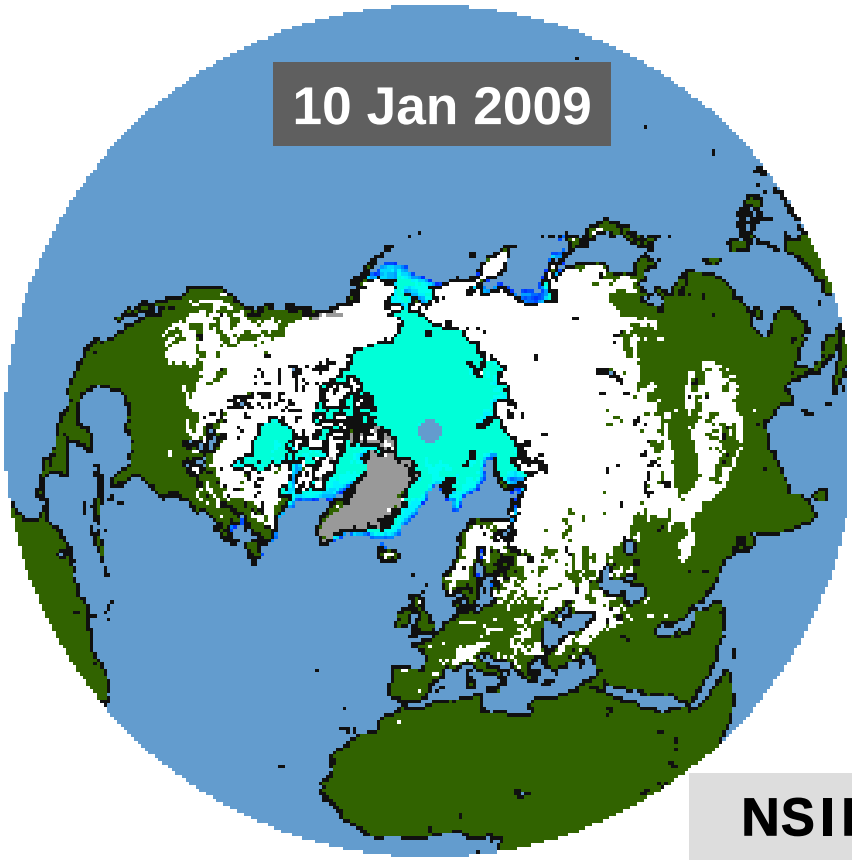
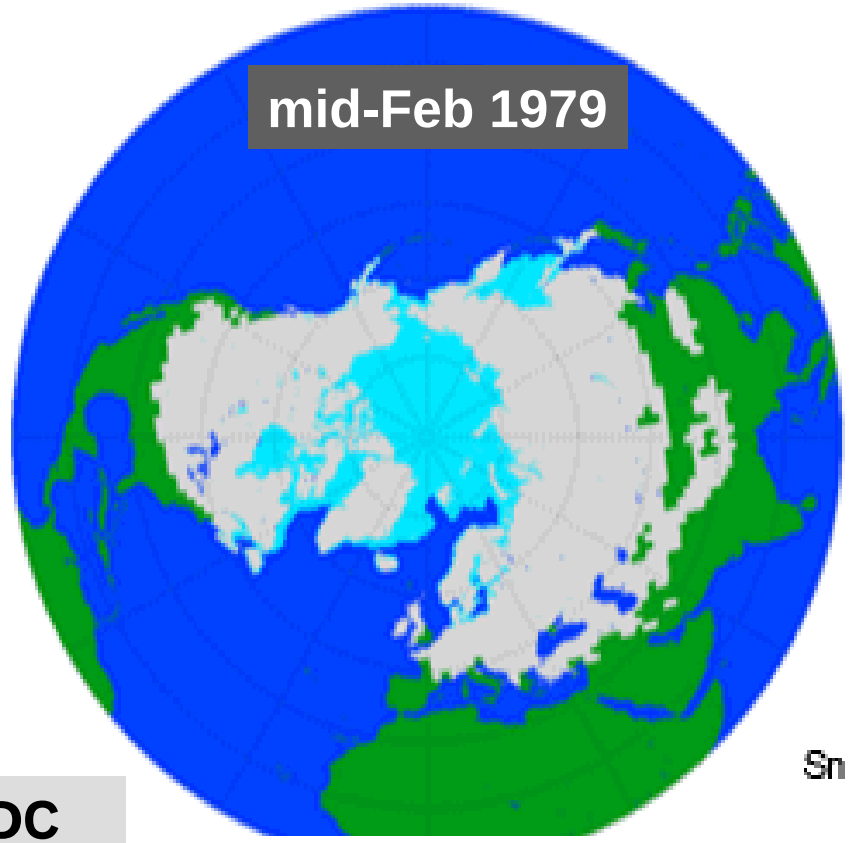



**Figure SPM.3.** *Observed changes in (a) global average surface temperature, (b) global average sea level from tide gauge (blue) and satellite (red) data and (c) Northern Hemisphere snow cover for March-April. All changes are relative to corresponding averages for the period 1961–1990. Smoothed curves represent decadal average values while circles show yearly values. The shaded areas are the uncertainty intervals estimated from a comprehensive analysis of known uncertainties (a and b) and from the time series (c). {FAQ 3.1, Figure 1, Figure 4.2, Figure 5.13}*

# Satellite observations 1966-

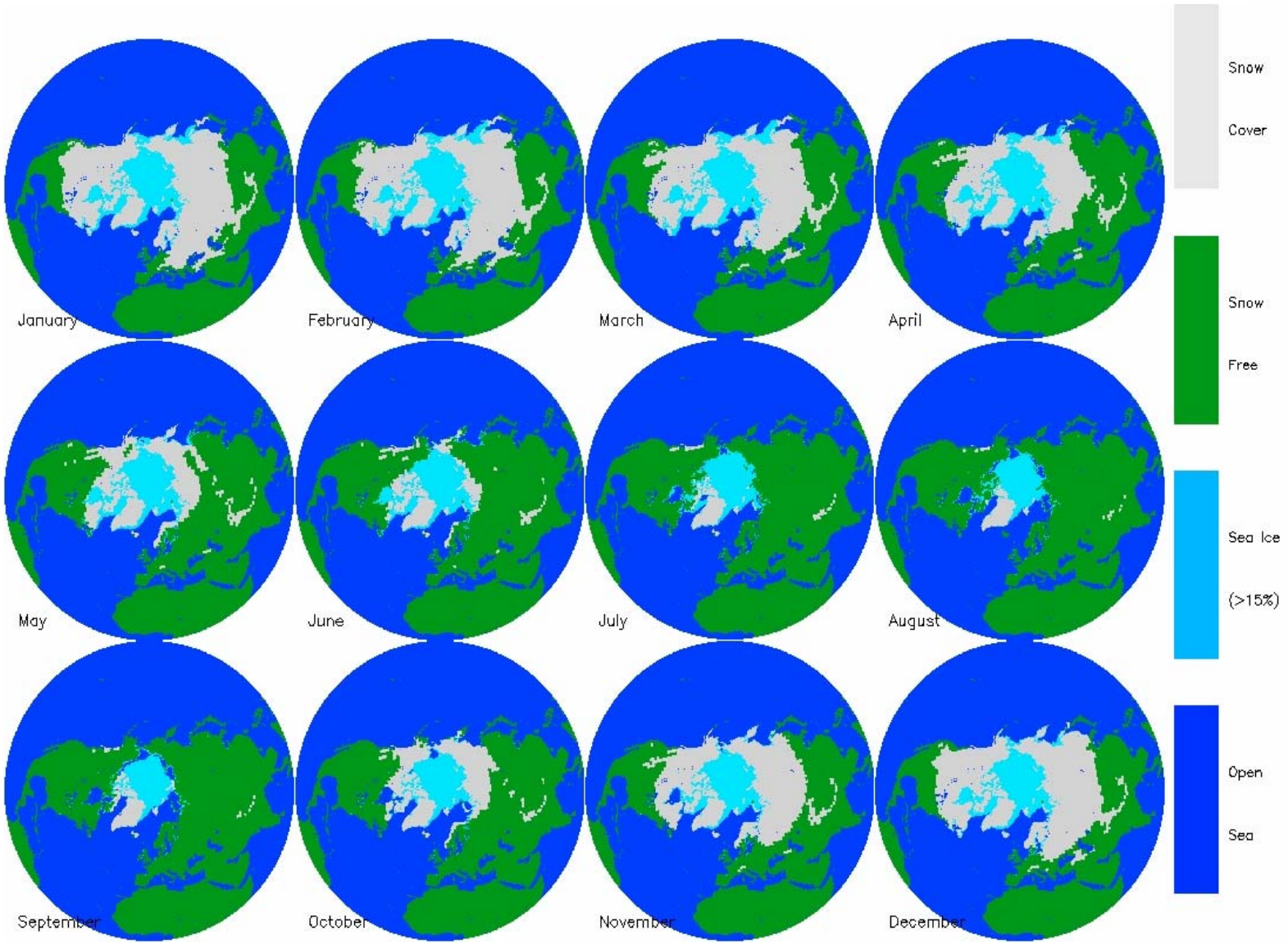


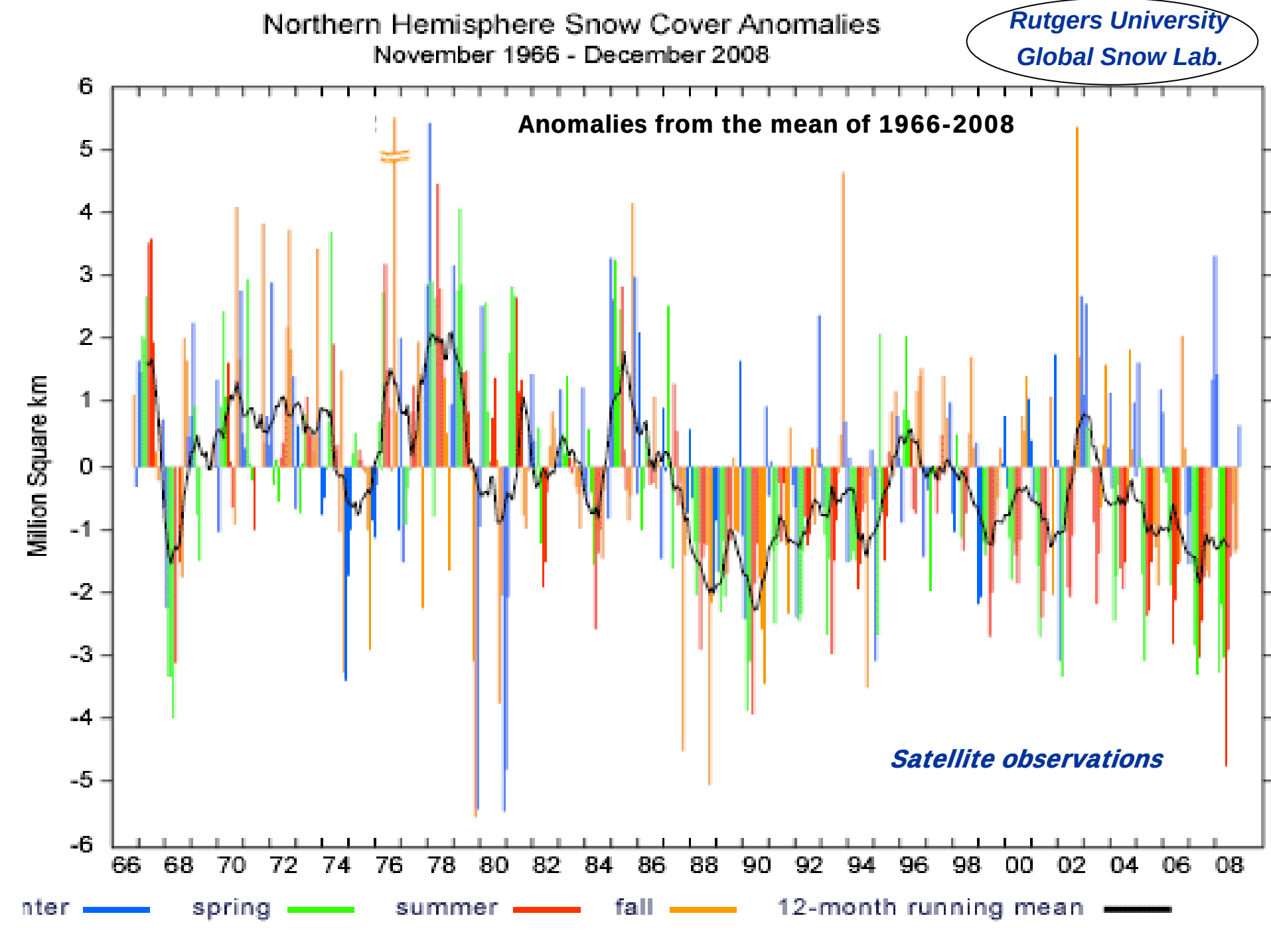



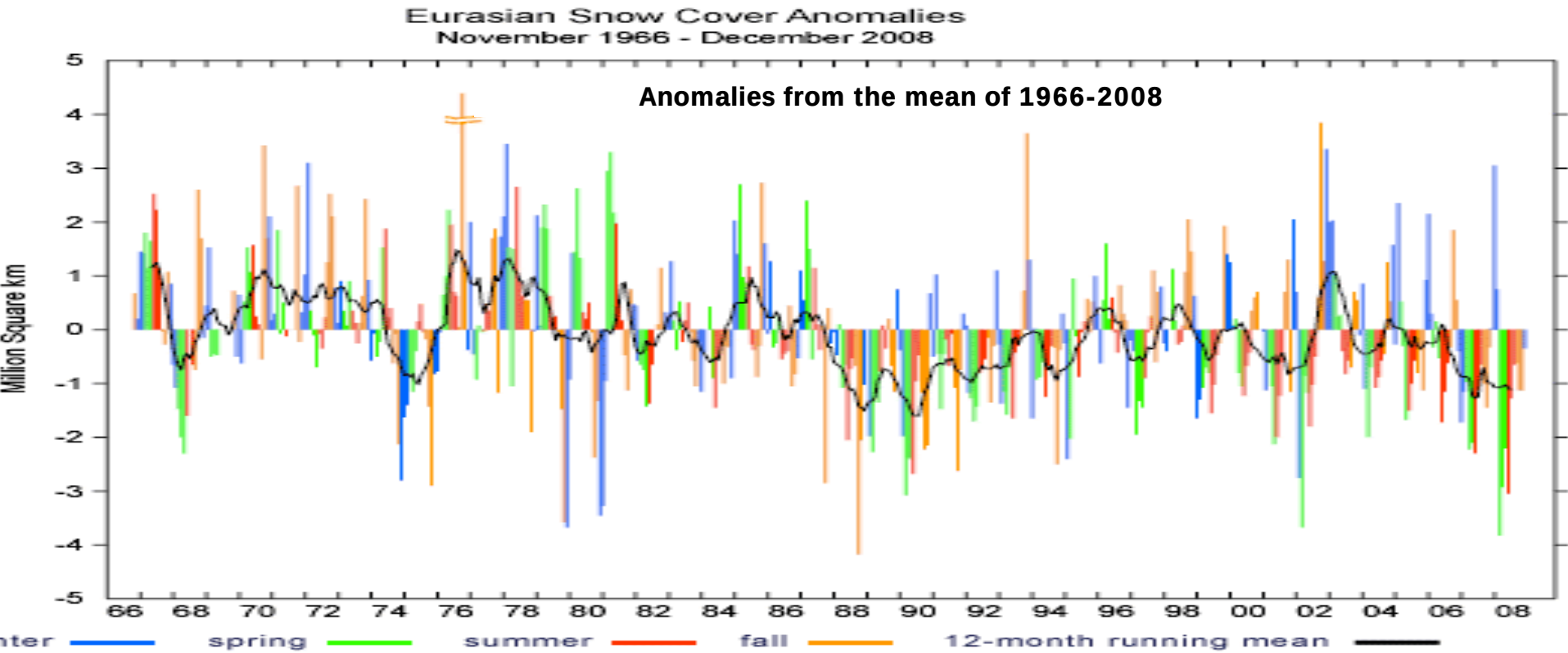

**NSIDC Boulder**

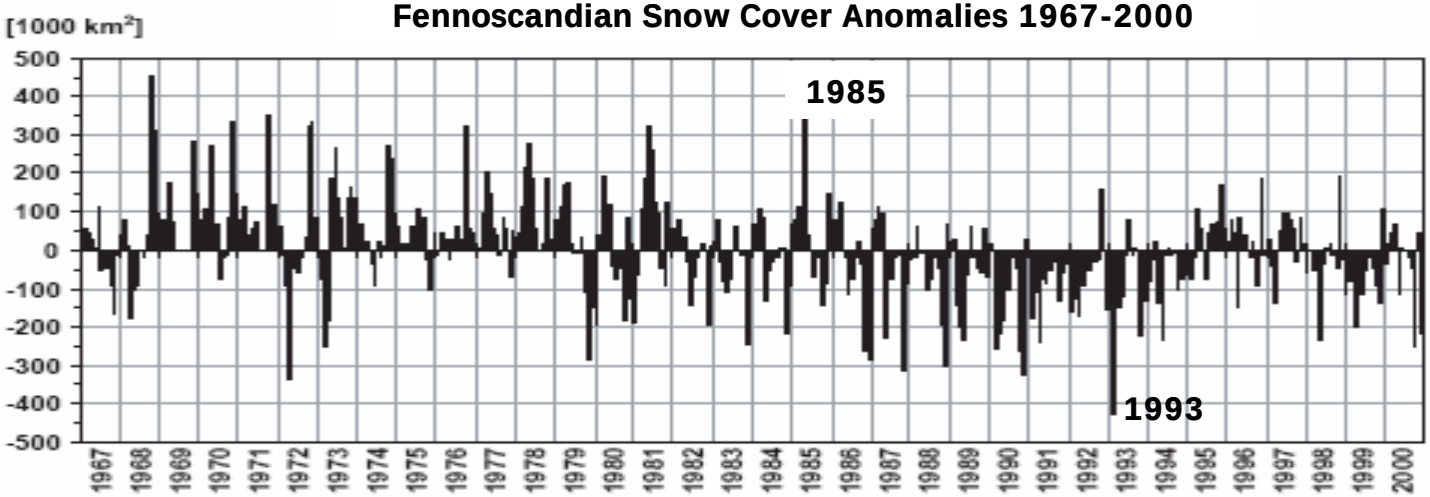
**Max. since 1966**

# Average snow cover & Sea ice extent (1966...)




Northern Hemisphere Snow Cover Anomalies
November 1966 - December 2008
Rutgers University
Global Snow Lab.
Anomalies from the mean of 1966-2008
Million Square km
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
66
68
70
72
74
76
78
80
82
84
86
88
90
92
94
96
98
00
02
04
06
08
Satellite observations
nter
spring
summer
fall
12-month running mean




***Rutgers University***

***Global Snow Lab.***



## INTAS project SCCONE (2002-2006)

**"Snow Cover Changes Over Northern Eurasia during the last century: circulation consideration and hydrological consequences"**

**15 fSU scientists + FIN/** NOR/ GER

***The specific objectives (Tasks) were*:**

**- to identify the main snow cover regions of Northern Eurasia;**

**- to quantify the trends in snow cover and depth;**

**- to investigate the relation between snow cover variability and variations in atmospheric circulation patterns;**

**-to investigate the impact of snow cover changes on basin-scale run-off.**

**http://www.intas0077snowchanges.narod.ru**

# Data

a) Daily snow depth (~ 1936-2000)

Russia & Kazakhstan ~ 200 stations

Nordic countries ~ 20 stations

b) 10-day snow surveys (1966-2000)

c) Monthly data (~ 1936-2000)

Russia - 1300 stations

Nordic countries ~ 100 stations

-> (NORDKLIM- web-site)

d) Remote sensing data (MPI)

e) Circulation data

f) Runoff data

Updates?

World Data Center-B
Moscow (Obninsk)

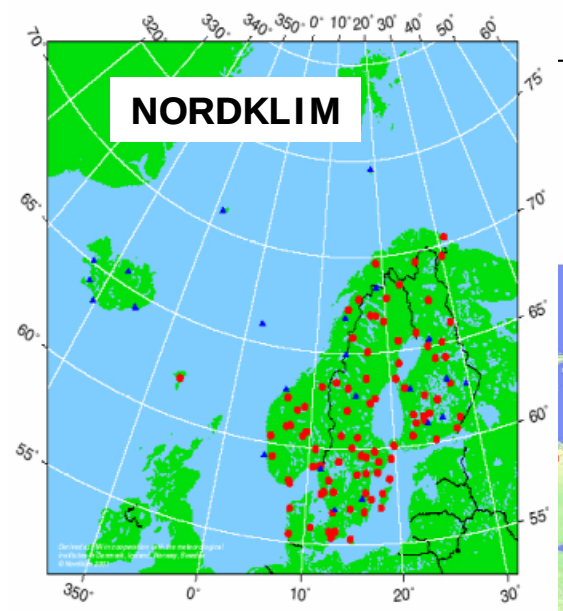
# Publications (>30)


Research Article

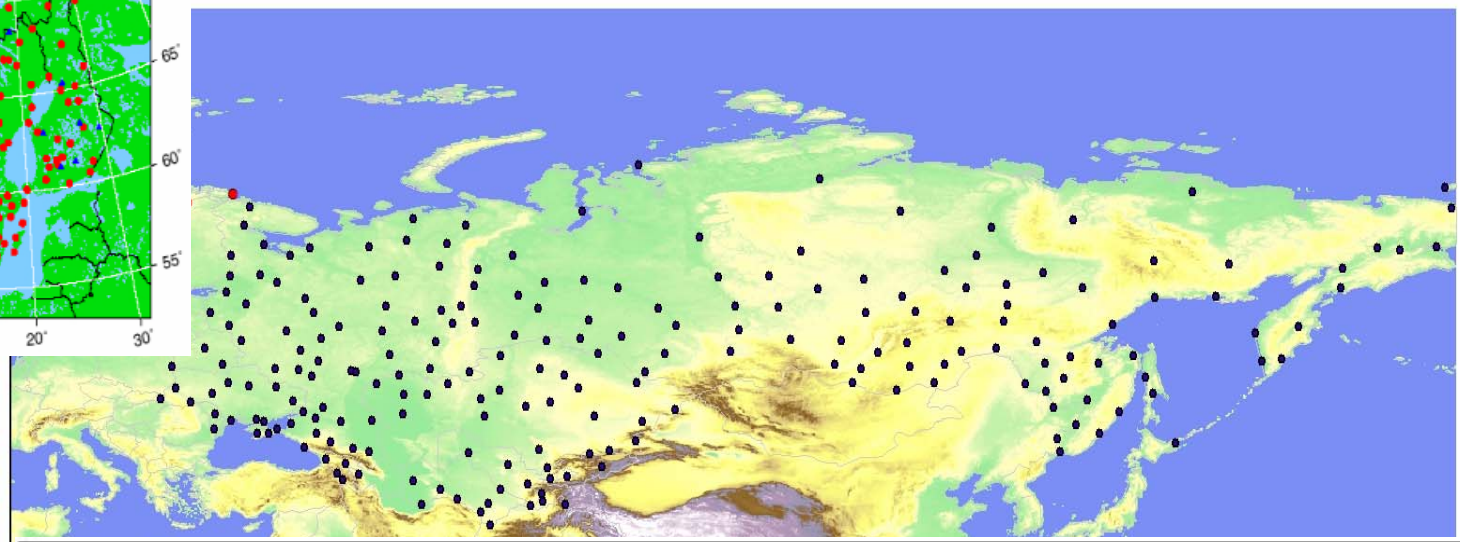
**Winter snow depth variability over northern Eurasia in relation to recent atmospheric circulation changes**

V. Popova*
Institute of Geography, Russian Academy of Sciences
**email:** V. Popova (valeria_popova@mail.ru)
*Correspondence to V. Popova, Institute of Geography, Russian Academy of Sciences, Russia.

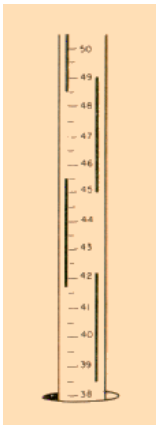
**Funded by:**
- INTAS V. POPOVA; Grant Number: 00-77 and 03-51-5296
- Russian Foundation for Basic Research; Grant Number: 06-05-64349



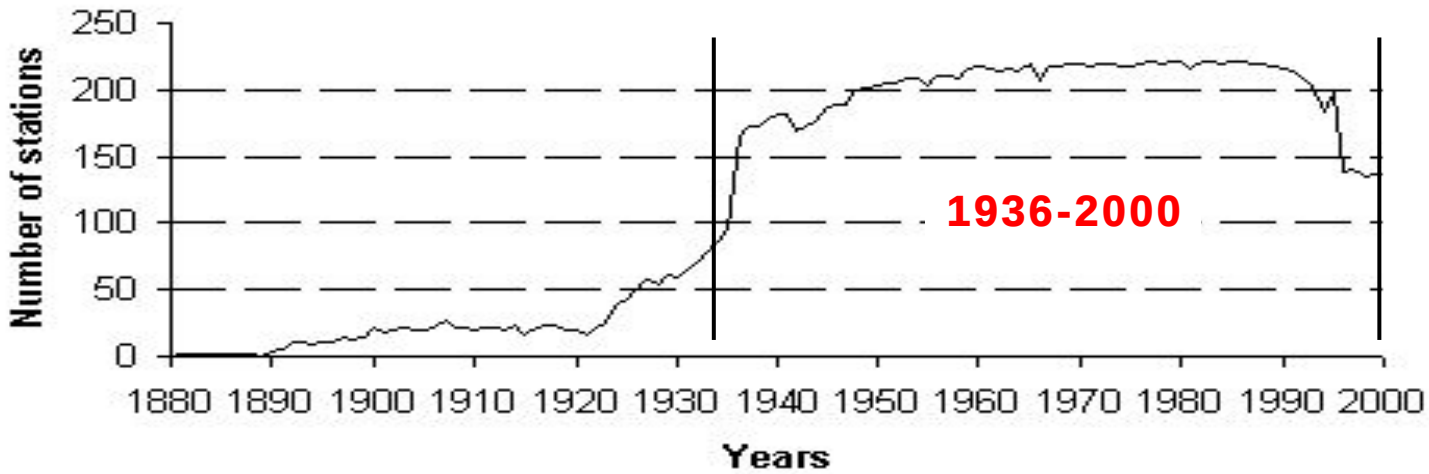

## Station network of fixed (snow depth) stations



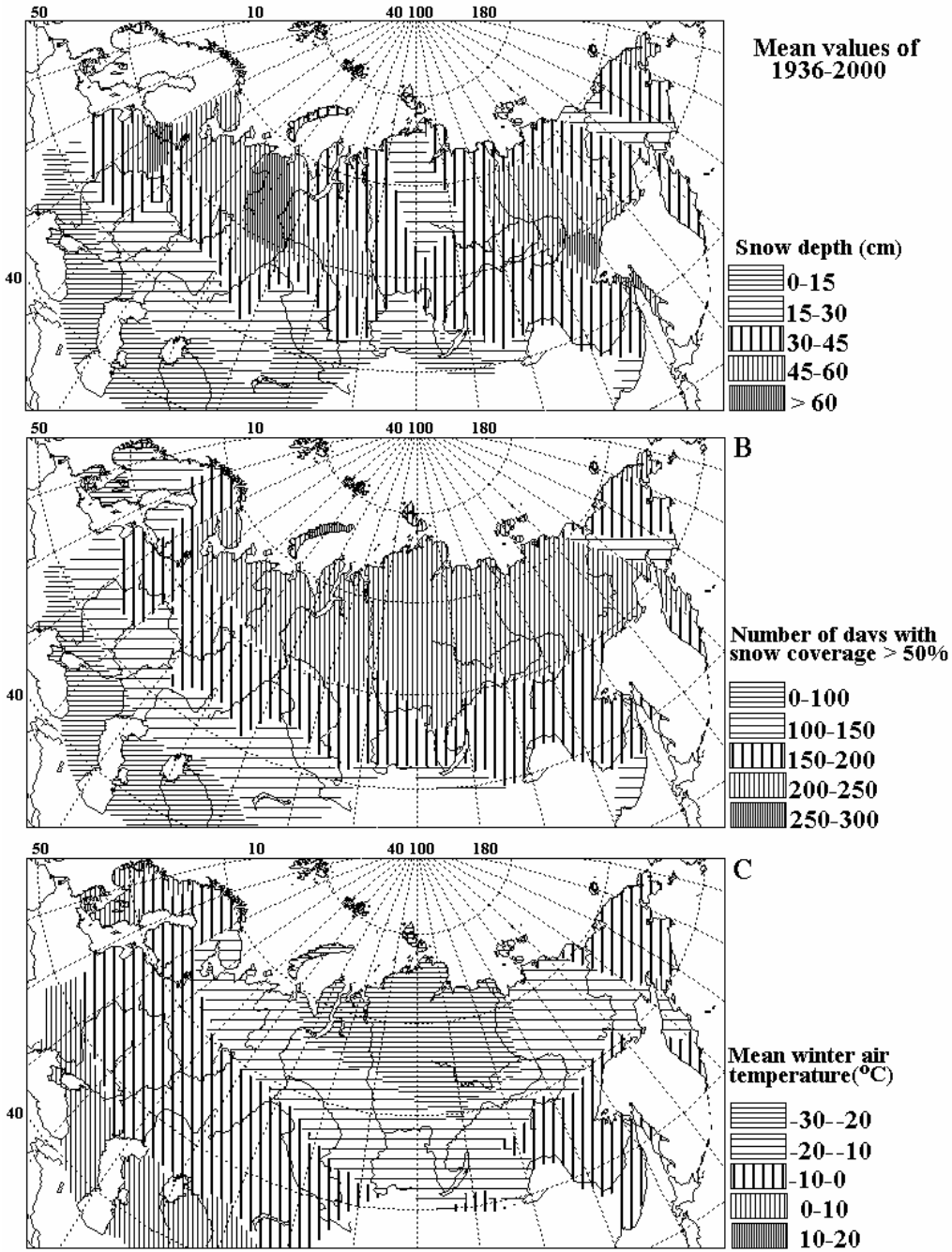
Snow Depth

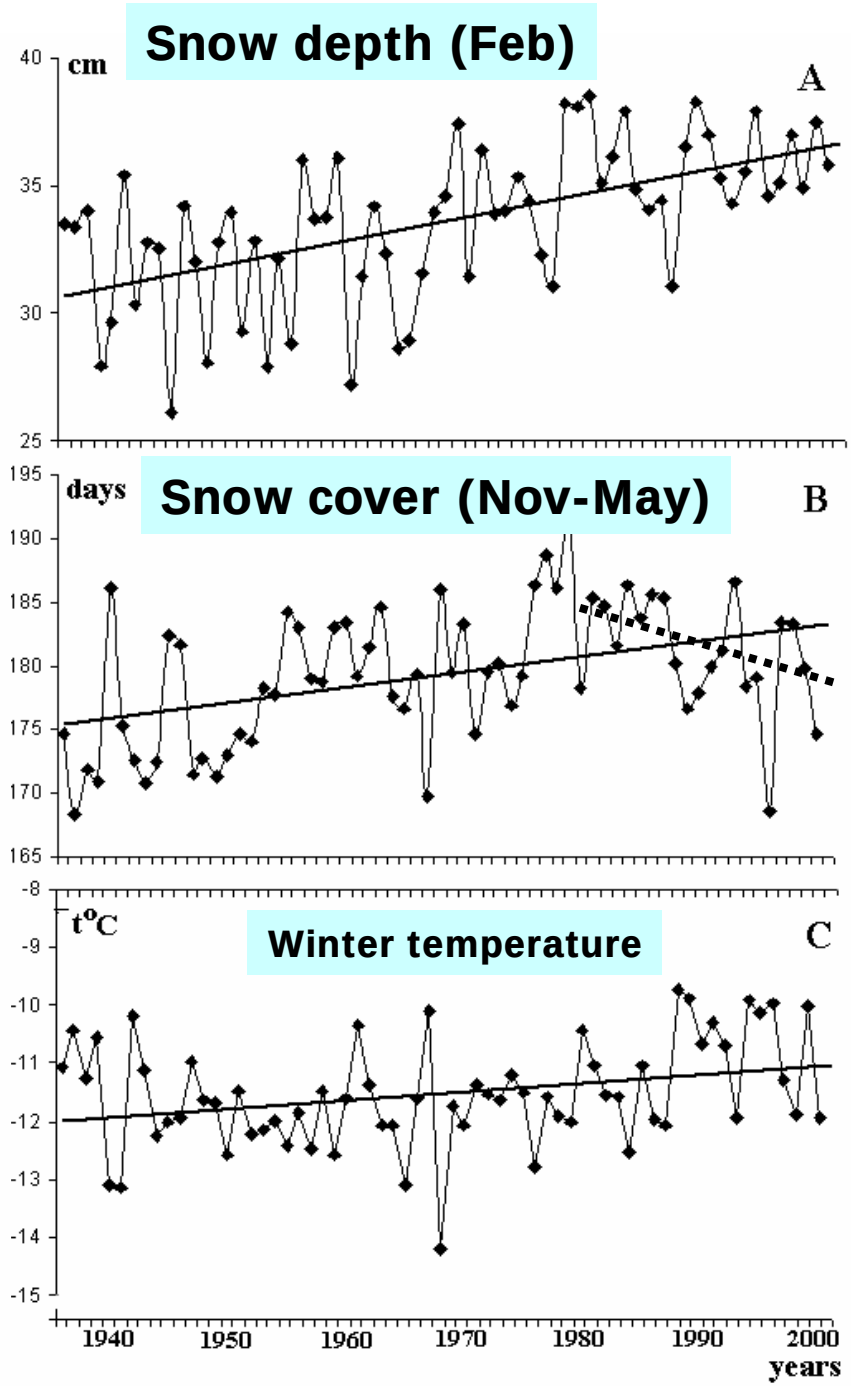


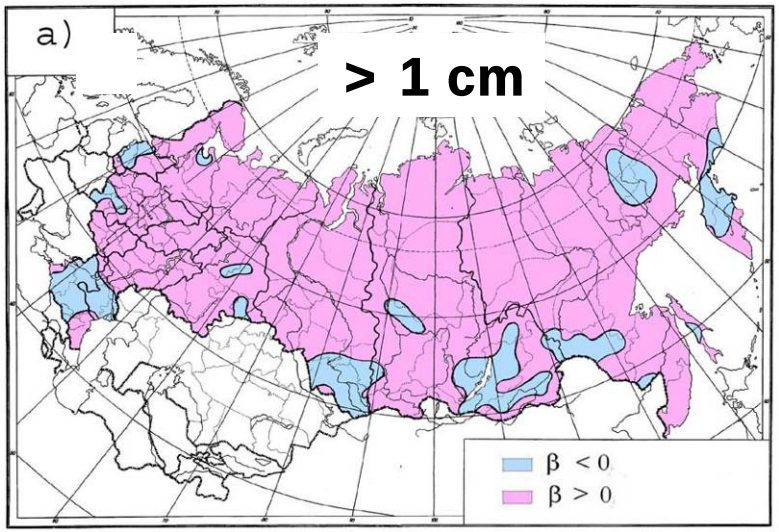
## Number of stations in snow depth data set (fSU)



# 1936-2000

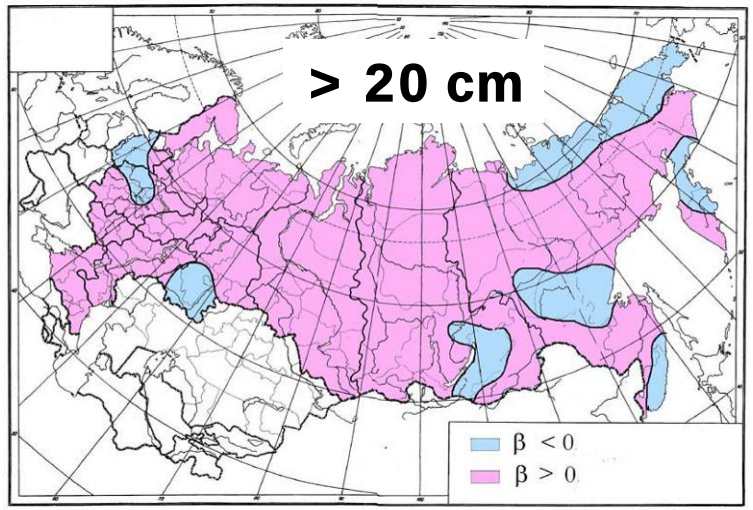

50
10
40 100
180
40
Mean values of 1936-2000
Snow depth (cm)
0-15
15-30
30-45
45-60
> 60
B
Number of days with snow coverage > 50%
0-100
100-150
150-200
200-250
250-300
C
Mean winter air temperature(°C)
-30--20
-20--10
-10-0
0-10
10-20

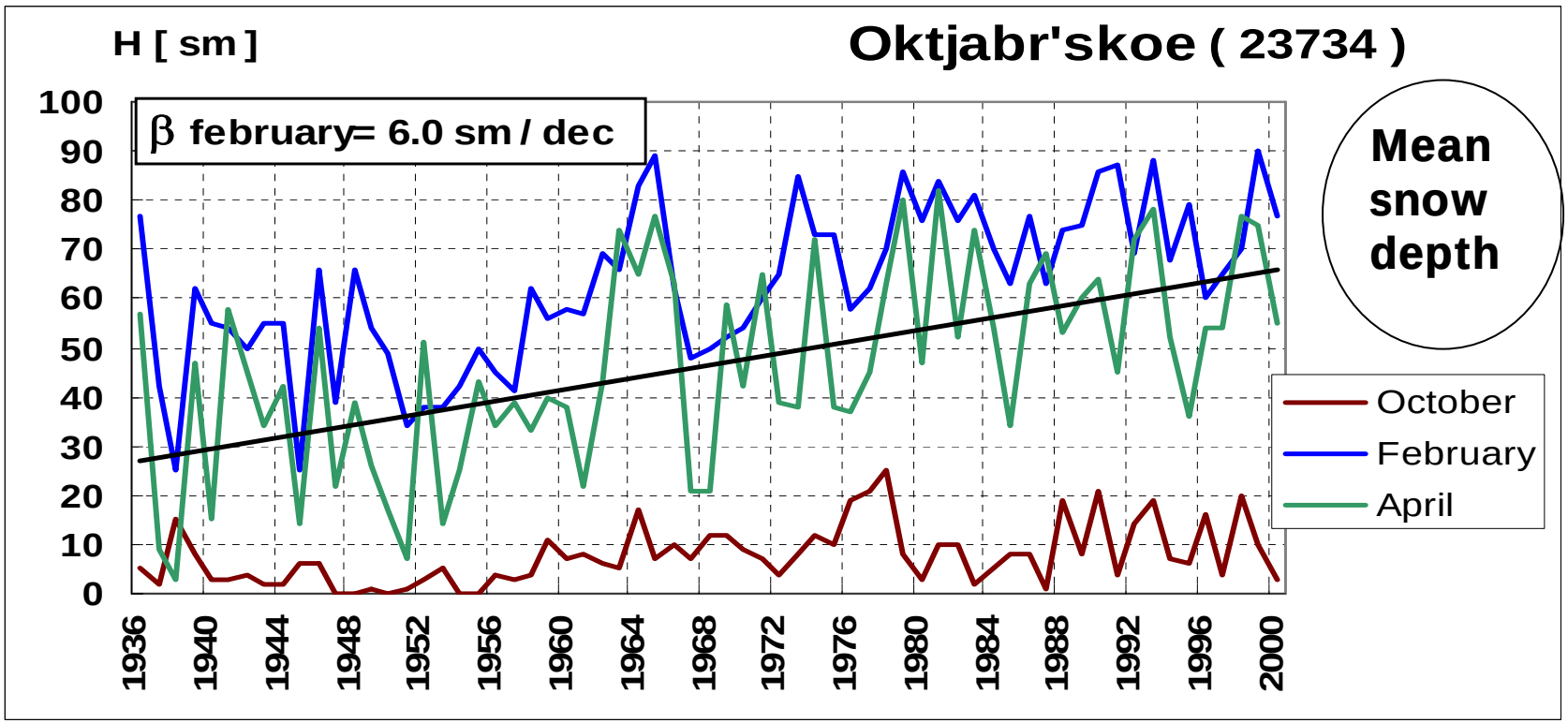

Snow depth (Feb)
cm
A
40
35
30
25
Snow cover (Nov-May)
days
B
195
190
185
180
175
170
165
Winter temperature
t°C
C
-8
-9
-10
-11
-12
-13
-14
-15
1940
1950
1960
1970
1980
1990
2000
years




**Linear trend of the number of days with snow cover**

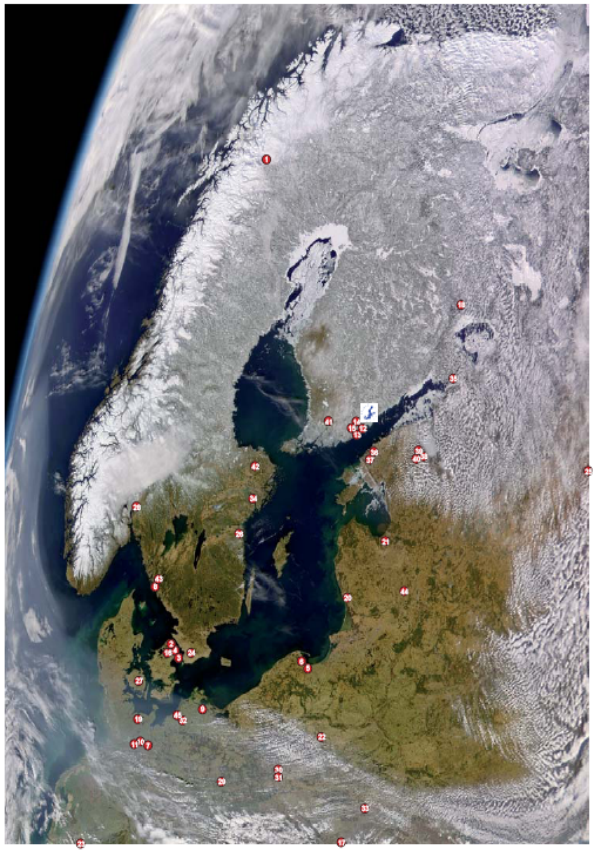
**(1936-2000)**



# Assessment of Climate Change for the Baltic Sea Basin - The BACC Project - 22-23 May 2006, Göteborg, Sweden

## Institutions contributing to BACC



The Baltic Sea Basin on 1 April 2004, as seen from the SeaWIFS satellite (NASA/Goddard Space Flight Center, GeoEye).

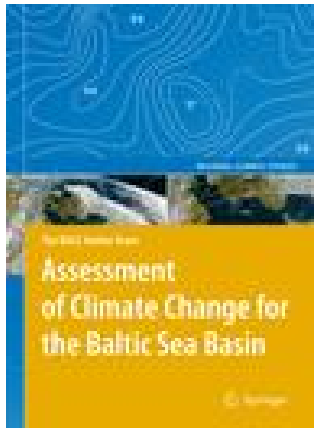
The north of the Bothnian Bay and the eastern Gulf of Finland are still covered with ice, while spring has already started in the southern part of the basin. Note the sediment plumes in the Gulf of Riga and the Bay of Gdansk, and the phytoplankton spring blooms in the Curonian Lagoon south of Klaipeda, along the Lithuanian and Estonian Coasts, in the Pomeranian Bay, in the Baltic Proper and in the North Sea west of Denmark.

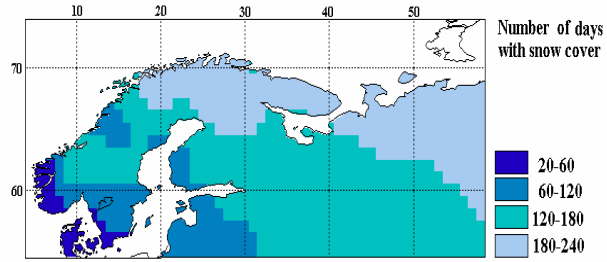
1 KVA Abisko Scientific Research Station, Abisko, Sweden
2 Danish Institute for Fisheries Research, Charlottenlund, Denmark
3 Danish Meteorological Institute, Copenhagen, Denmark
4 University of Copenhagen, Denmark
5 Institute of Hydroengieneering, PAS, Gdansk, Poland
6 Institute of Meteorology and Water Management, Gdynia, Poland
7 GKSS Research Centre, Geesthacht, Germany
8 Göteborg University, Sweden
9 University of Greifswald, Germany
10 Bundesamt für Schifffahrt und Hydrographie, Hamburg, Germany
11 University of Hamburg, Germany
12 Finnish Environment Agency, Helsinki, Finland
13 Finnish Institute of Marine Research, Helsinki, Finland
14 Finnish Meteorological Institute, Helsinki, Finland
15 University of Helsinki, Finland
16 Danish Hydrological Institute, Horsholm, Denmark
17 EC Joint Research Centre, Ispra, Italy (not on image)
18 University of Joensuu, Finland
19 University of Kiel, Germany
20 Klaipeda University, Lithuania
21 University of Latvia, Riga, Latvia
22 University of Lodz, Poland
23 Catholic University of Louvain-la-Nouvelle, Belgium (not on image)
24 Lund University, Sweden
25 Institute of Geography, RAS, Moscow, Russia (not on image)
26 Swedish Meteorological and Hydrological Institute, Norrkoping, Sweden
27 University of Southern Denmark, Odense, Denmark
28 Norwegian Meteorological Institute, Oslo, Norway
29 Potsdam Institute for Climate Impact Research, Potsdam,Germany
30 Adam Mickiewicz University, Poznan, Poland
31 R.C. of Agriculture and Forest Environment, Poznan, Poland
32 University of Rostock, Germany
33 University of Silesia, Sosnowiec, Poland
34 Stockholm University, Sweden
35 Russian State Hydrological Institute, St. Petersburg, Russia
36 Merin Ltd., Tallinn, Estonia
37 Tallinn University, Estonia
38 Estonian University of Life Sciences, Tartu, Estonia
39 Tartu Observatory, Estonia
40 University of Tartu, Estonia
41 University of Turku, Finland
42 Uppsala University, Sweden
43 Swedish Meteorological and Hydrological Institute, Vastra Frolunda, Sweden
44 University of Vilnius, Lithuania
45 Baltic Sea Research Institute, Warnemünde, Germany

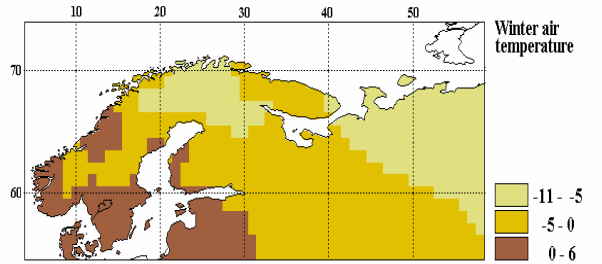
The HELCOM Secretariat in Helsinki

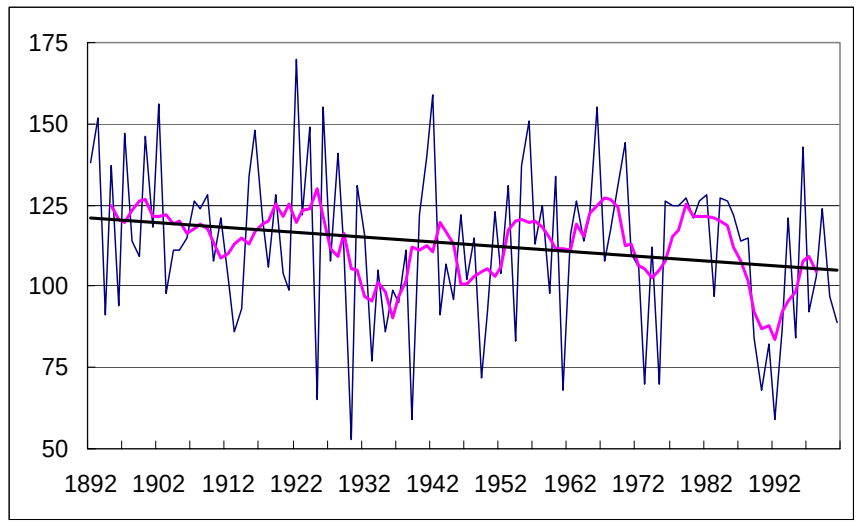
(Locations sorted and numbered alphabetically)

Organised by: Support by: SMHI FIMR

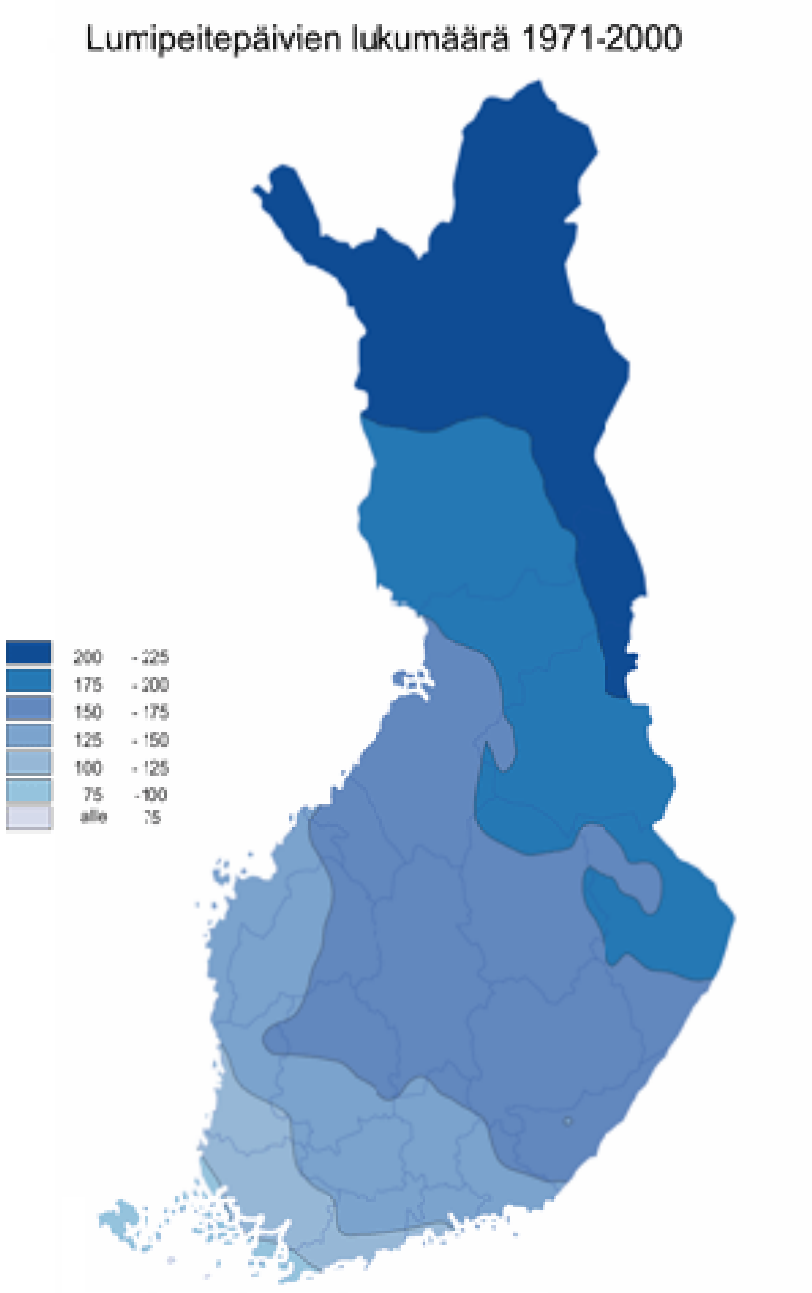


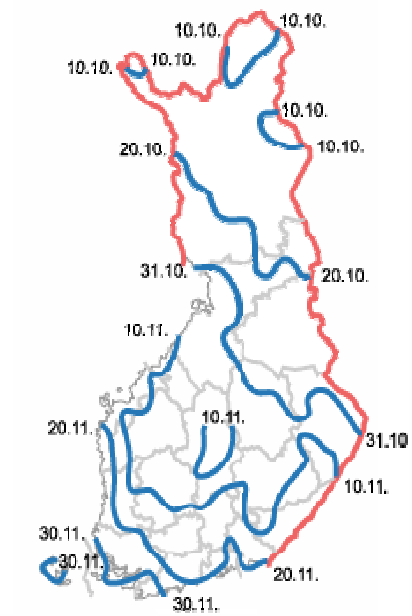



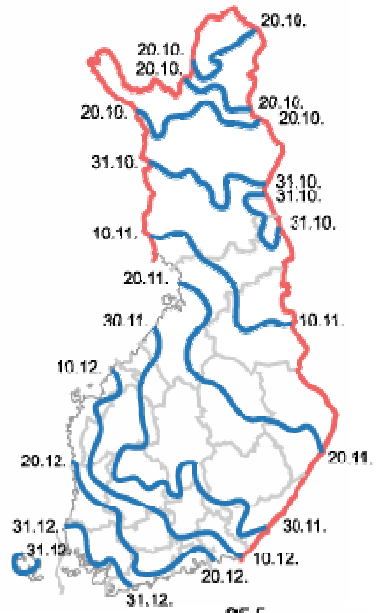



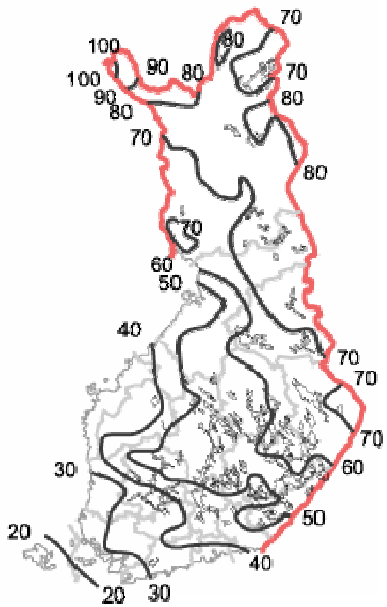

**Mean duration of snow cover in Estonia in 1891/92 - 2000/01, 5-year moving means and linear trend.**



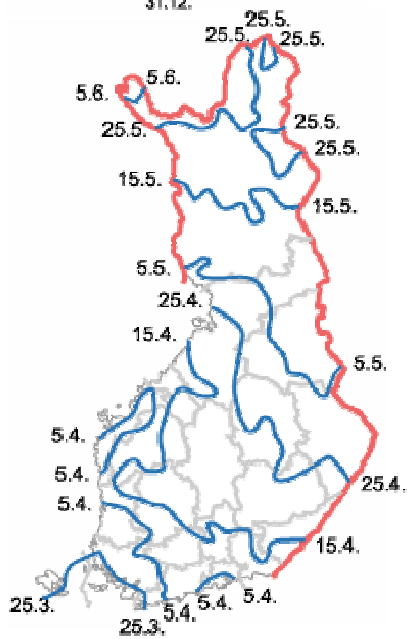

## Appearence and disappearence of snow cover and snow depth 15th March 1961-90



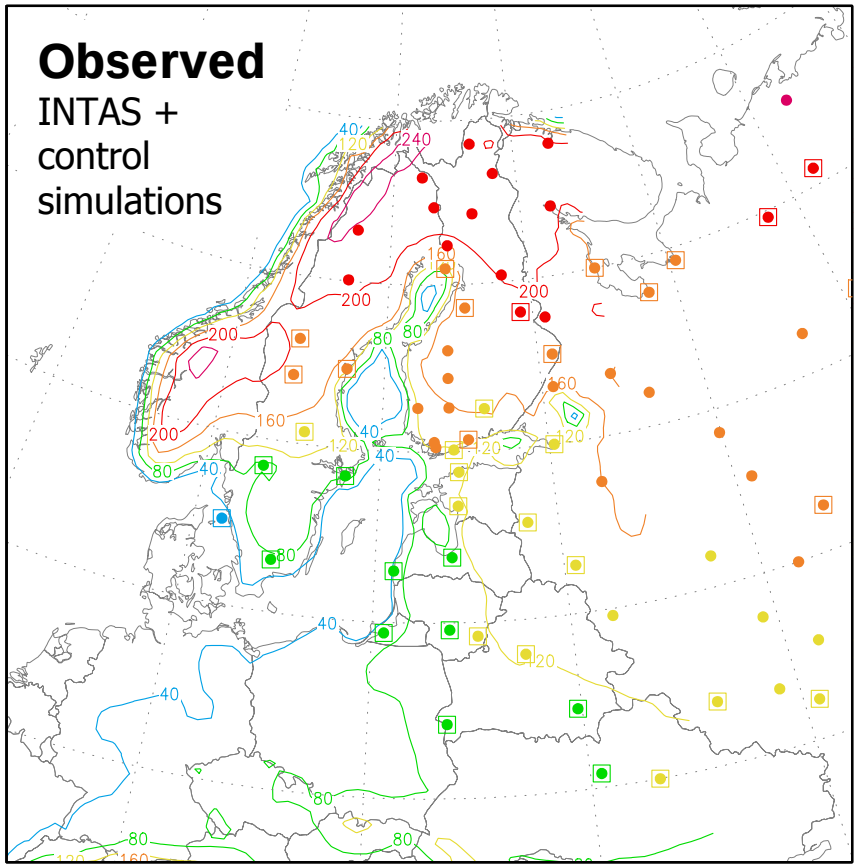



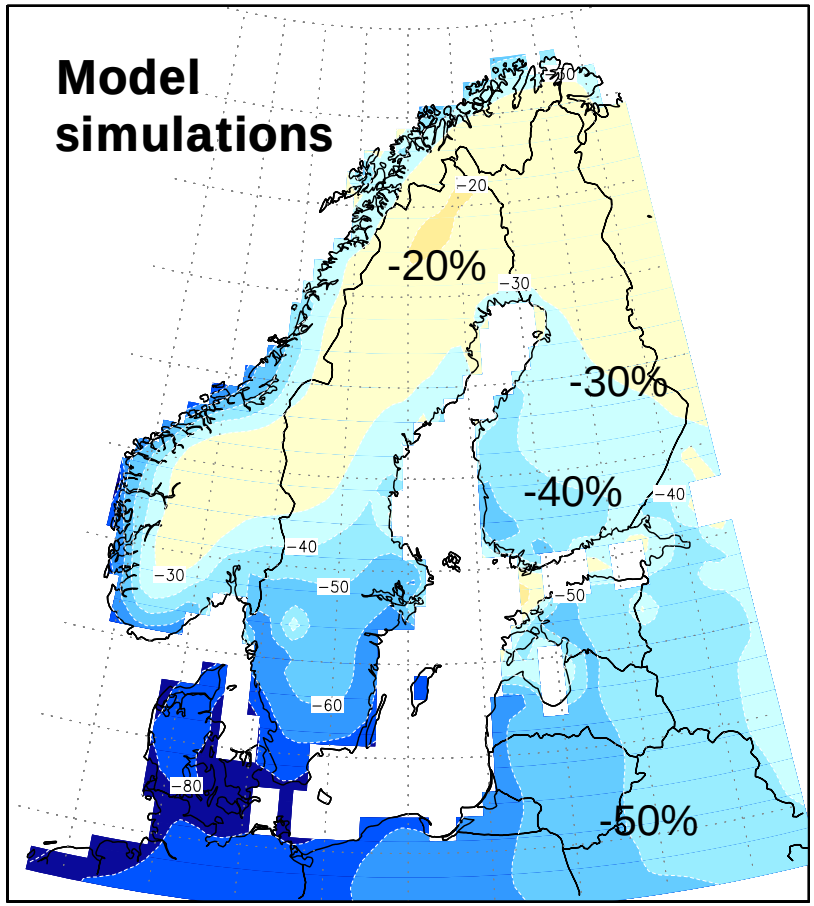




Lumipeite 15.3. 1961-90




Pysyvän lumen katoaminen



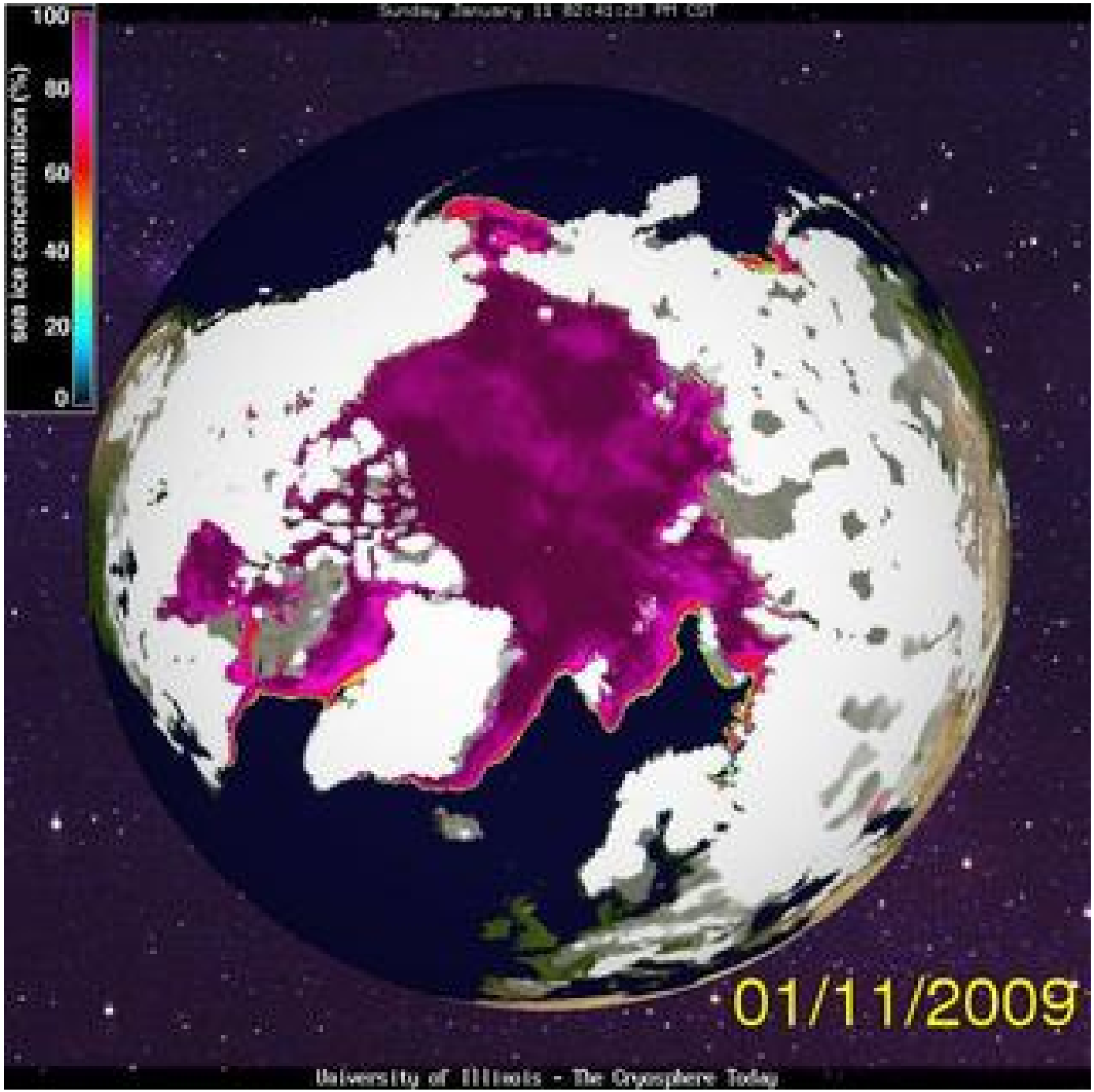




**Annual number of days with snow cover**

(a) Observed means in northern Europe, 1961-1990, based on the INTAS/SCCONE data (dots – see the colour scale) and a mean of seven RCM-H control simulations (contours). Stations with an observed inter-annual standard deviation ≥ 15 days are surrounded by open squares.

(b) (b) Projected multi-model mean changes for the period 2071-2100, relative to 1961-1990, based on seven RCM-H-A2 experiments (unit: days).

*Jylhä K., Fronzek S., Tuomenvirta H., Carter T.R. and Ruosteenoja K.,: Changes in frost and snow in Europe and Baltic sea ice by the end of the 21st century. Climatic Change, PRUDENCE special issue.*




University of Illinois