The influence of climate change at high altitude and high latitude

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- Background and sources
- Climate changes (past and future)
- .... and their impacts
- ....... at high latitudes/ altitudes
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References

Intergovernmental Panel on Climate Change (IPCC) 2007

Impacts of Europe’s changing climate (EEA)
Arctic Climate Impact Assessment (ACIA)

etc…

WMO
- CCI (Commission for Climatology)
- IPY (International Polar Year)
- CliC (Climate and Cryosphere)

- BALTEX Assessment of Climate Change
tetc…

Springer, 500p
The Intergovernmental Panel on Climate Change (IPCC) was established by WMO and UNEP in 1988 to assess scientific, technical and socio-economic information relevant for the understanding of climate change, its impacts and options for adaptation and mitigation.

Main activities and products -→ [http://www.ipcc.ch](http://www.ipcc.ch)

IPCC Working Groups /4 major assessment reports
- **WG I** …scientific aspects of climate change
- **WG II** …impacts of climate change…
- **WG III** …mitigating of climate change…

**IPCC ja Nobel (2007)**

**WHY IPCC ?**

... policymakers need an objective source of information about the causes of climate change, its potential environmental and socio-economic consequences and the adaptation and mitigation options to respond to it.

UNFCCC

-> Copenhagen 2009

IPCC 1990   IPCC 1996   IPCC 2007   .....IPCC 2050
Past climate: data sources?
Global Temperature Changes

......in different time-scales.......
NORDIC ANNUAL MEAN TEMPERATURES

Stockholm

Helsinki

Spitsbergen Norway

Stykkisholmur Iceland

Tasillaq Greenland
Warming in the Arctic is **double** that for the globe from 19th to 21st century and from late 1960s to present.

Warmth 1925 to 1950 in Arctic was not as widespread as recent global warmth.
**BACC:** The Baltic area has become warmer...

- spring, growing season and summer start earlier
- autumn, frost season and winter start later

**Annual trends (days/year)**

*ECA dataset 1951-2000*

**Duration of the ice cover in some Finnish lakes**

**High precipitation**

**Linear trend in the DJF number of events above 90th percentile during the period 1958–2000.**
Interannual variability in water inflow is considerable, but no statistically significant trend is found in the annual time series for the period 1921-2005.
Large Flood Events 1985-2007

http://www.dartmouth.edu/~floods/Archives
UNTIL NOW

- No change in heat content and salinity

- Accelerated rise of the sea level

- Less ice...

No long-term trends in storminess?

However, it is possible to attribute parts of the observed regional changes to changes in the large-scale circulation!

(BALTEX Assessment of Climate Change....BACC)
IPCC: Past and future?

Variations of the Earth's surface temperature: 1000 to 2100

Departures in temperature in °C (from the 1990 value)

Observations, Northern Hemisphere, proxy data

Global instrumental observations

Projections

Several models all SRES envelope

Bars show the range in 2100 produced by several models

Scenarios

- A1B
- A1T
- A1FI
- A2
- B1
- B2
- IS92a
Projected warming in 21st century expected to be

- greatest over land and at most high northern latitudes

- and least over the Southern Ocean and parts of the North Atlantic Ocean
Projections of future precipitation changes

- Increases very likely in high latitudes
- Decreases likely in most subtropical land regions
Implications (... of climate changes) -> IPCC WG2

Arctic ice and snow ..as well as permafrost ..and vegetation zones
Ice cover of the Arctic Sea...is disappearing?
Linear trend coefficients in the time series of mean snow depths for the permanent snow-cover period 1936-2000
Increased glacier retreat since the early 1990s

Area of seasonally frozen ground has decreased...
Biological influences

The Earth is "greening" (from satellites)

Köppen climatic zones

Dry climates
- Steppe
- Desert
- Mild winters*
- Dry summers
- Wet all seasons
- Cold winters*
- Dry summers
- Wet all seasons
- Polar climates
  - Tundra
  - Ice cap

Flying into climate change

Climate threat to coral reefs

Now in 2100

Pine

Spruce

Birch

Desert Steppe Dry summers Wet all seasons Cold winters* Dry summers Wet all seasons Polar climates Tundra Ice cap

Pine Spruce Birch

1-20 % 21-40 % 41-60 % 61-80 % 81-100 %

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Now in 2100

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Pine Spruce Birch
Temp. & Prec. -> 2100

1990s

2020s

2050s

2080s
Rising sea levels...

IPCC 2007

60 cm

20 cm

Sea level change (mm)

Year

1800 1850 1900 1950 2000 2050 2100

Estimates of the past

Instrumental record

Projections of the future

Relative sea level over the last 300 years

Summit GISP 2, 72.6N, 36.6W (elev. 3207m)

GUESS YA GRANDPAPA, GOT IT ALL WRONG!!
Concluding remarks

Climate change will not be gradual, but...

If the Golf stream would not exist!
EU’s 2°C target and implications for global emission reductions
Arctic Climate Impact Assessment (ACIA, 2004)

- http://www.acia.uaf.edu

BALTEX Assessment of Climate Change -> BACC (2007)

The overall format is similar to the IPCC
- author groups for the individual chapters
- overall policymakers-summary
- review process.

- http://www.baltex-research.eu
ARCTIC:
Present and future temperature
Natural + anthropogenic causes

NAO etc?

Natural causes