# Scientific evidence on climate change in the Baltic Sea Region

Hans von Storch

Institut für Küstenforschung, Helmholtz Zentrum Geesthacht

Klimacampus, Universität Hamburg

Helmholtz-Zentrum Geesthacht

Zentrum für Material- und Küstenforschung

# Why care about regional climate change?

Global assessment done by IPCC (AR4 from 2007)

Climate changes NOT uniformly around the world

Impacts differ greatly around the world

Relevant political decisions are taken locally (adaptation)

Public and policy makers need scientific information

→ Regional assessments needed

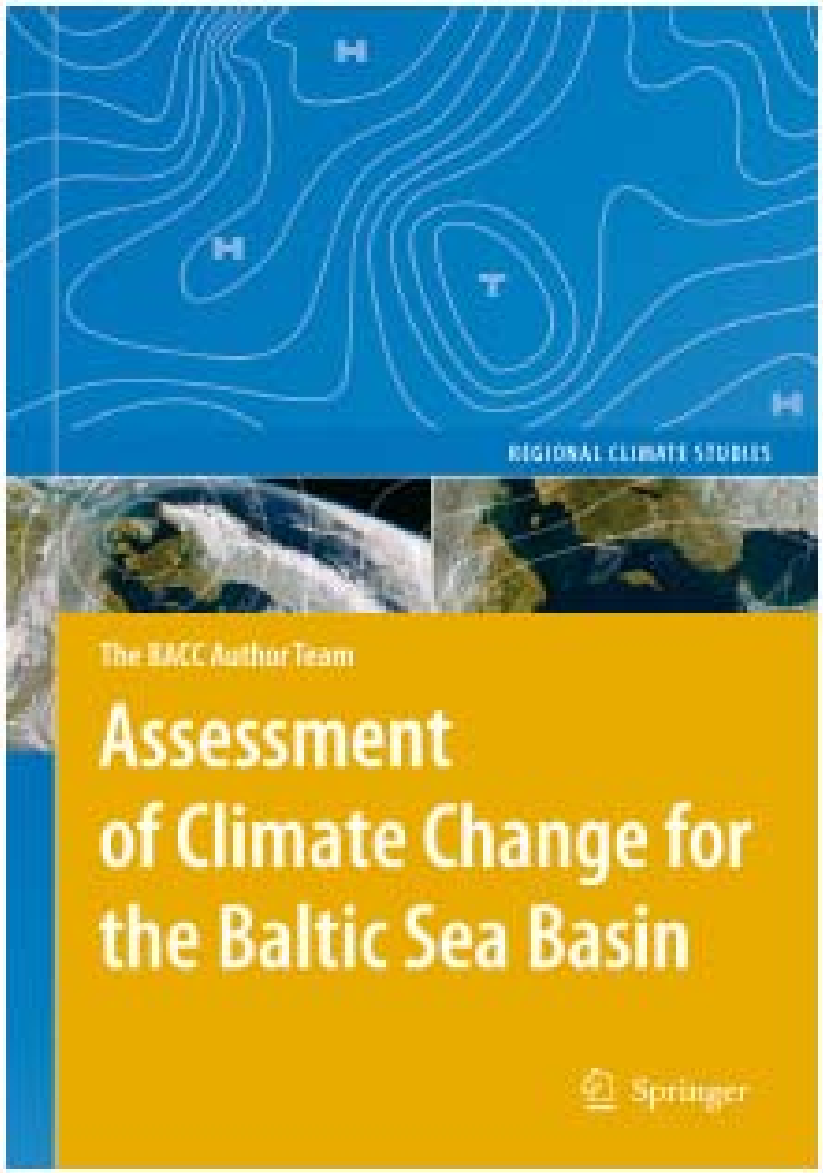
## What can we do?

**Mitigation** – Stop emitting greenhouse gases – **Globally**

**Adaptation** – Live with impacts as good as possible – **Regionally**

Scientifically sound information is needed in **comprehensive and accessible way**

**BACC** - Assessing scientifically legitimate knowledge claims about regional climate change



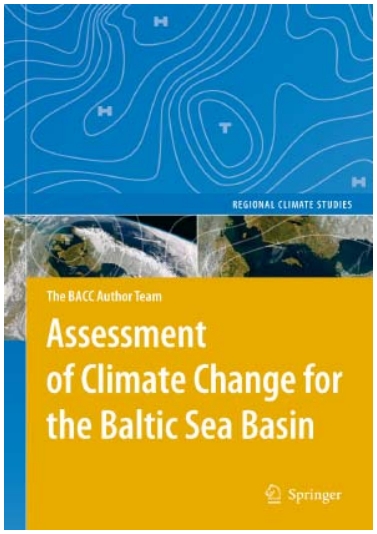
## BACC definition of the term **“climate change”**

BACC follows the IPCC definition and adds explicitly “anthropogenic” to the term “climate change” when human causes are attributable, but employs the term “climate variability” when referring to variations unrelated to anthropogenic influences.

- BACC is a working group of GEWEX program BALTEX.

- The BACC Project integrates available knowledge of historical, current and expected future climate change.

- The unique feature of the first BACC report is the combination of evidence on climate change and related impacts on marine, freshwater and terrestrial ecosystems in the Baltic Sea basin (catchment and water body).



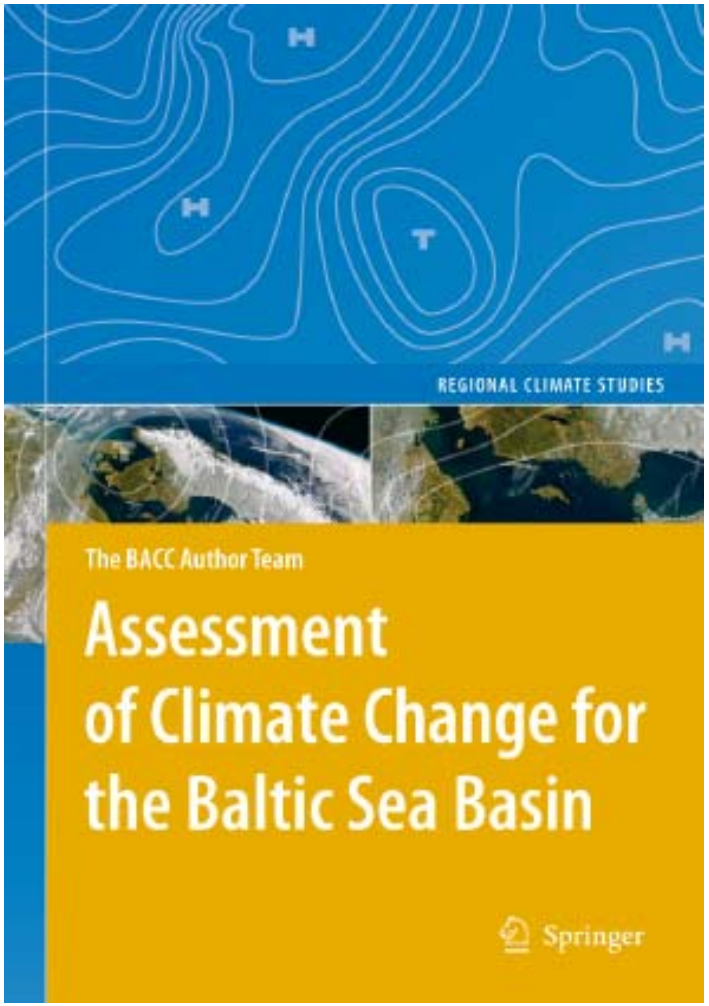

- The first BACC report was the first systematic scientific effort for assessing climate change in the Baltic Sea region.

- **The results have not been influenced by either political or special interests.**

# Publication in January 2008:

**More than 30 contributing institutions**
**More than 80 contributing authors from 13 countries**
**More than 475 pages**
**More than 2000 references (~150 non-English)**

Ch1: Introduction and summary
Ch2: Past and current climate change
Ch3: Projections of future climate change
Ch4: Climate-related change in terrestrial and freshwater ecosystems
Ch5: Climate-related change in marine ecosystems
Ch6: Annexes

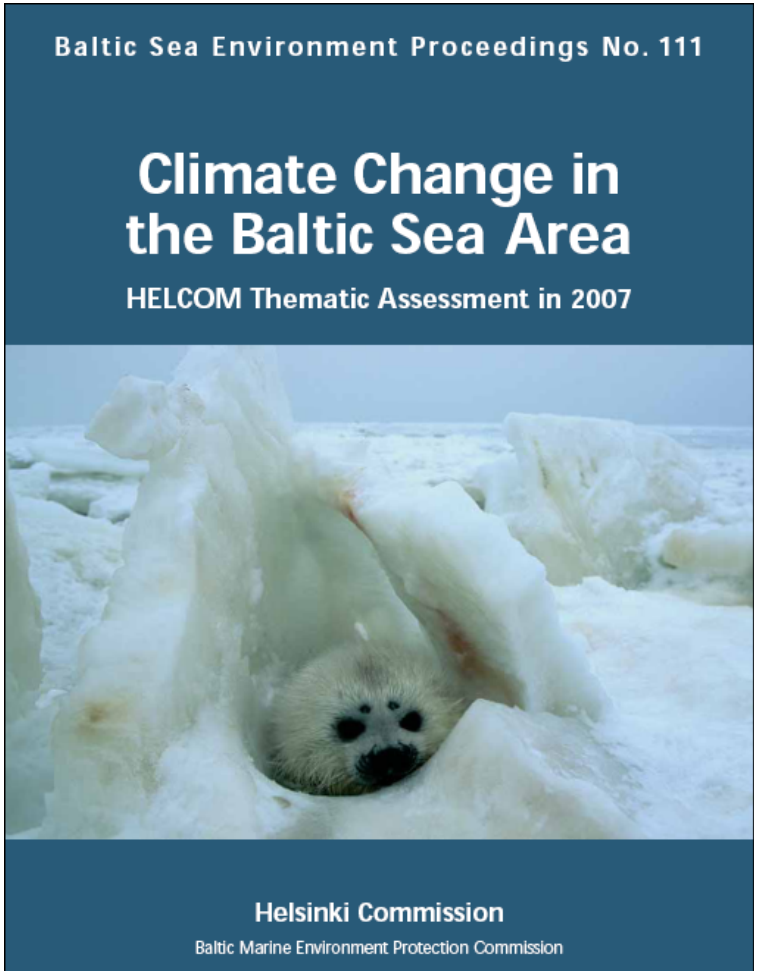



**www.baltex-research.eu/BACC**

# HELCOM Thematic Assessment published May 2007

The report is based on the BACC material but condensed to 59 pages with a focus of the marine environment of the Baltic Sea. It has been approved by the HELCOM contracting governments of 9 countries and the European Commission.

An unprecedented cooperation of a climate-related research program (BALTEX) and an intergovernmental body



# Follow-up: Climate assessment for the metropolitan region of Hamburg

HAMBURG Winner 2011 EUROPEAN GREEN CAPITAL

Similar to BACC, a climate assessment report about the scientifically documented knowledge of climate change in the region of Hamburg has been published in November 2010. This is an activity of the KlimaCampus and the Helmholtz Zentrum Geesthacht

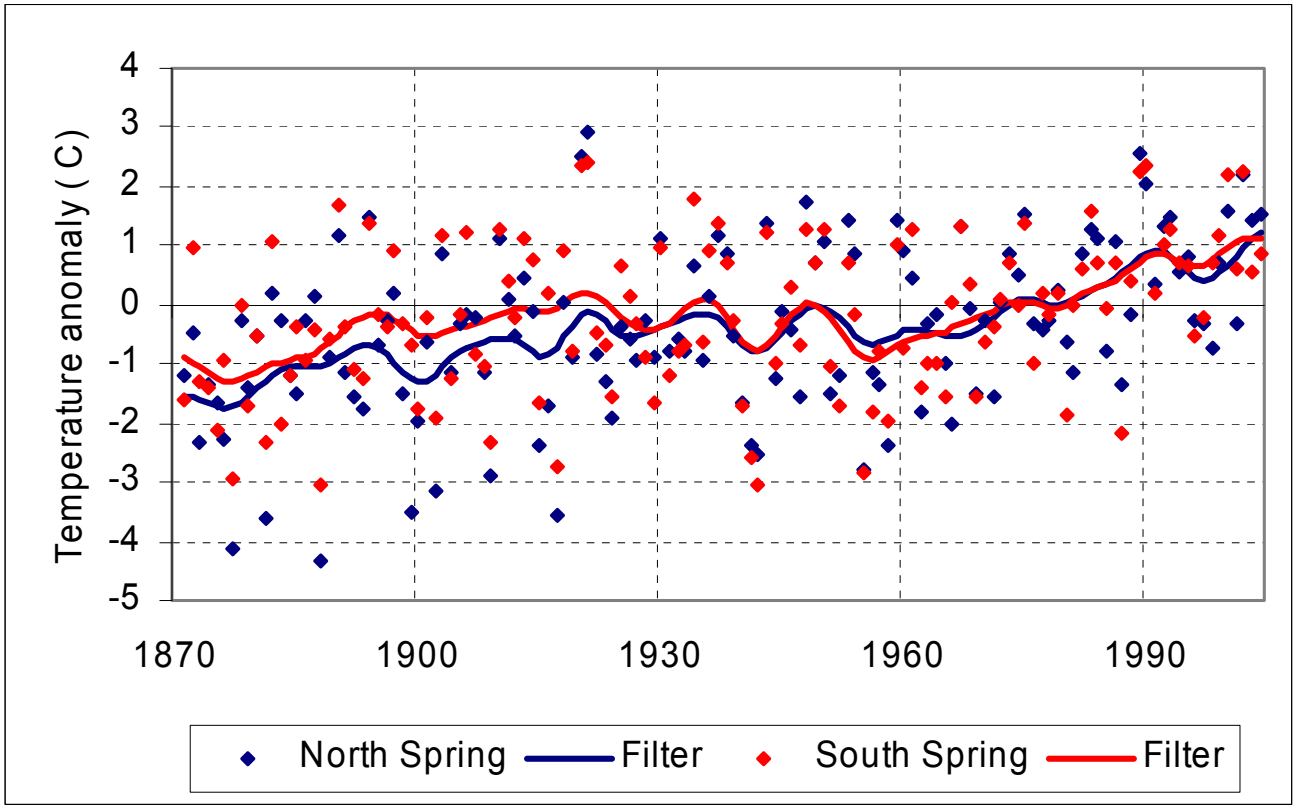

The effort is supported by the Senate of Hamburg and by the Environmental Ministry of Schleswig Holstein.

clisap

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

# BACC 1: Past and current climate change

- Air temperature increased by about 1.2 C since 1871 until 2004.
- Most pronounced warming in spring.
- Related observed changes in winter runoff, ice duration and snow.
- More precipitation in the 2nd half of the 20th century with major regional variations.
- No systematic change in windiness found.
- No clear long-term trends in Baltic Sea salinity.

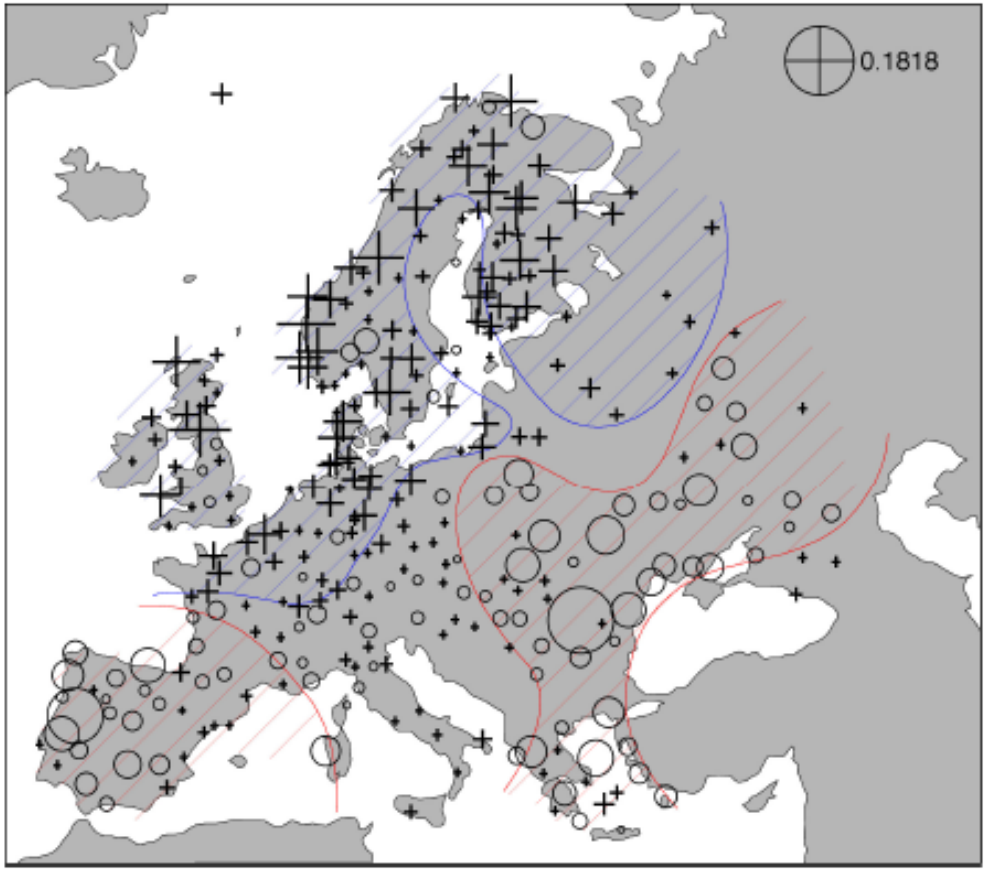



Baltic Sea basin land surface spring air temperature 1871-2004

| | Winter | Spring | Summer | Fall | Year | |
|---|---|---|---|---|---|---|
| North | 1,17 | **1,95** | **0,78** | **1,04** | **1,3** | **°C** |
| South | **1,30** | **1,43** | 0,40 | **0.80** | **1,01** | **°C** |

**Linear temperature trends 1871 – 2004** for the northern (latitude > 60 °N) and southern (latitude < 60 °N) Baltic Sea basin.

# Precipitation Extremes in Winter

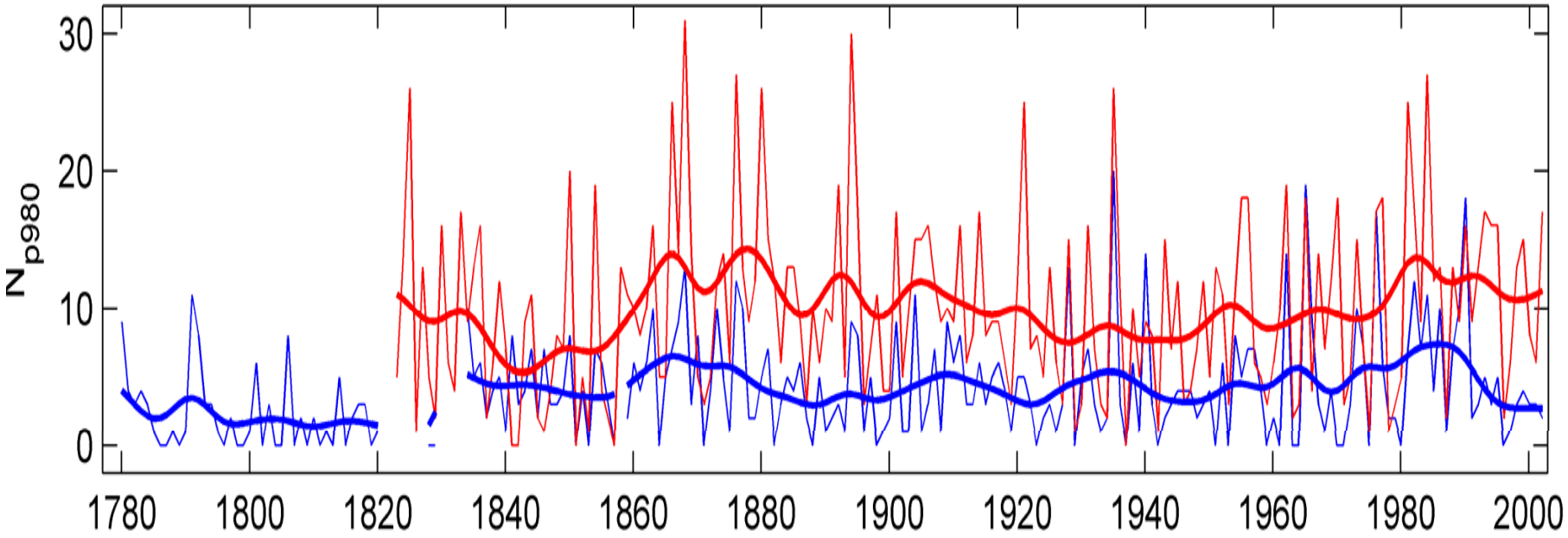



+ Increase in the number of extreme precipitation events

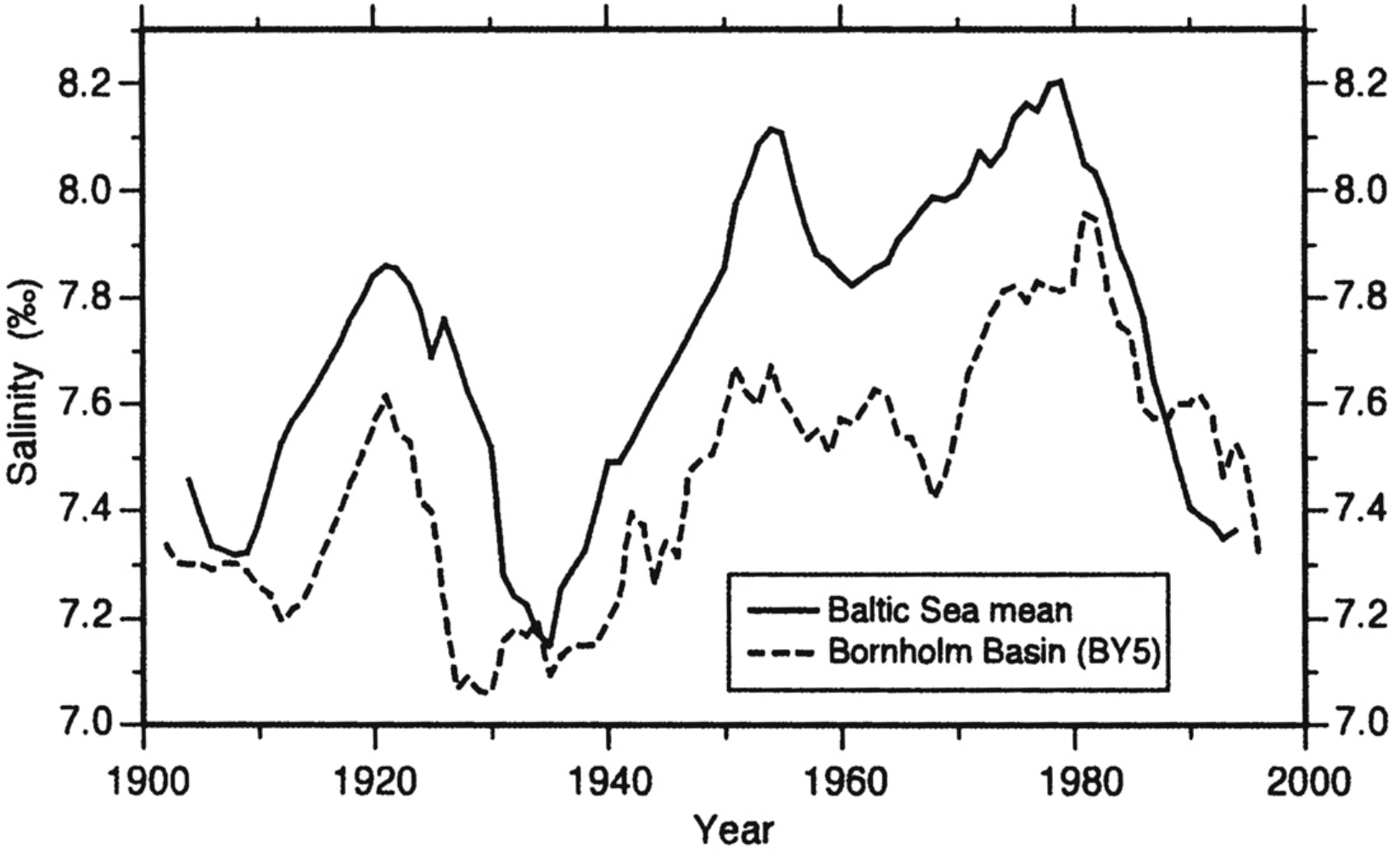
O Decrease in the number of extreme precipitation events

**Fig. 2.25**. The linear trend in number of precipitation events above the 90$^{th}$ percentile (R90N) during winter (December to February) for 1958–2000. A '+' signifies an increase and a '◯' shows a decrease. The size of the symbol is linearly proportional to the magnitude of the trend. Units are days/year and the maximum trend magnitude is shown in the top right (from Haylock and Goodess 2004)

# No changes in wind and storminess




Number of low pressure systems (p< 980 hPa) in Stockholm and Lund


Salinity (‰)
8.2
8.0
7.8
7.6
7.4
7.2
7.0
1900
1920
1940
1960
1980
2000
Year
Baltic Sea mean
Bornholm Basin (BY5)

salinity

# BACC 1: Ongoing changes in regional ecosystems

- Associated changes in terrestrial ecosystems include
  - earlier spring phenological phase,
  - northward species shift, and
  - increased growth and vigour of vegetation.
- Robust assessments of changes in marine ecosystems related to climate change are hardly possible at this time.
- Further research is needed to discriminate between climate change and other anthropogenic drivers such as over-fishing, euthrophication, air pollution and land use changes.

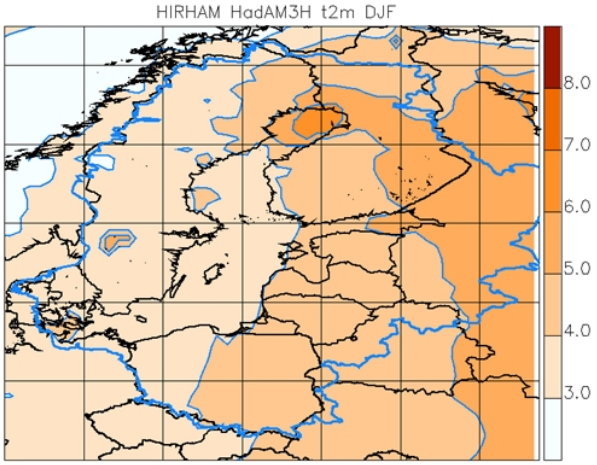
# BACC 1: Scenarios of future climate

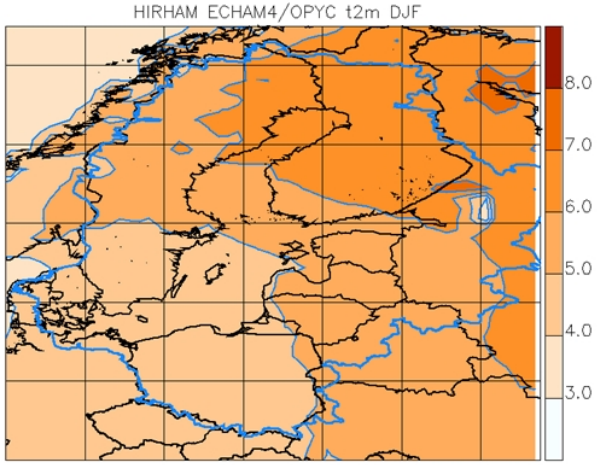
- … constructed by feeding assumed emissions of greenhouse gases and aerosols into quasi-realistic models of the climate system.
- Future emissions can not be predicted; only plausible and consistent visions of the future (i.e., scenarios) are possible.
- Scenarios provide a frame for decision makers to explore the range of policy options to deal with the reality of anthropogenic climate change.
- Scenarios are no predictions.

# BACC 1: Projections of future **regional** climate change

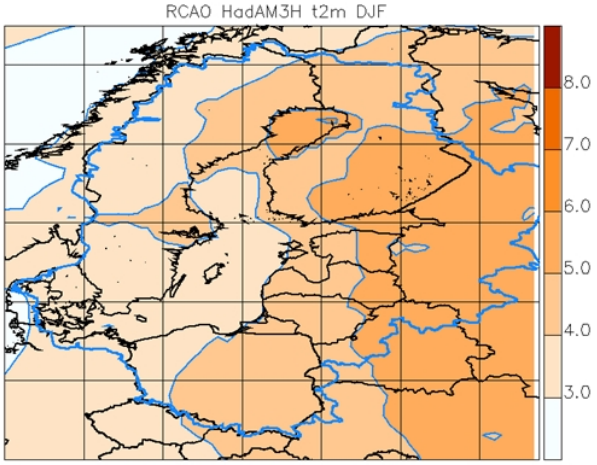
- Increasing temperatures very likely during the entire 21st century, but size of the trend depends considerably on model.
- Projected mean precipitation increases, largest increase in winter throughout the basin and decrease in summer in the southern basin.
- No clear projection for wind speed and storms.

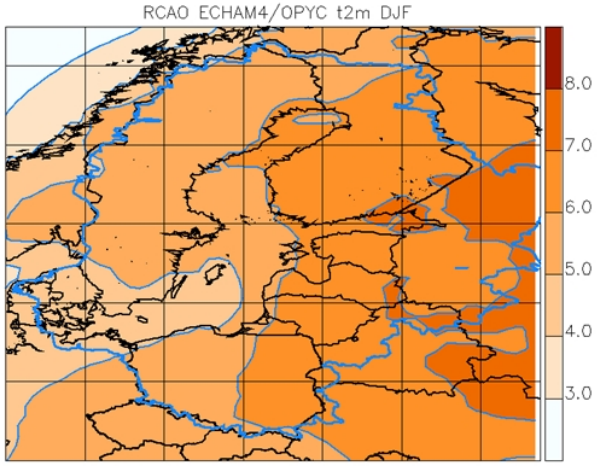
# RCM projections for 2071-2100 relative to 1961-1990 (A2 scenario): Winter Air Temperature




RCM: HIRHAM



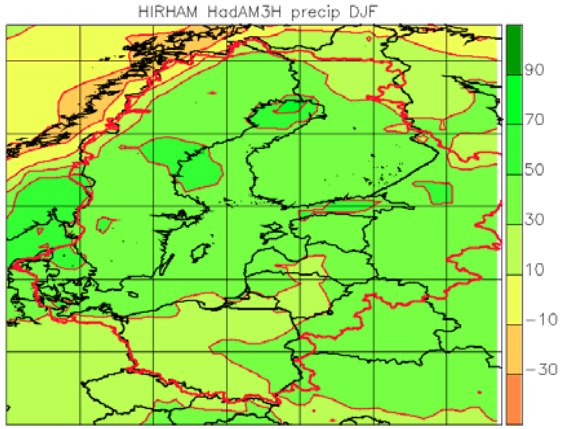



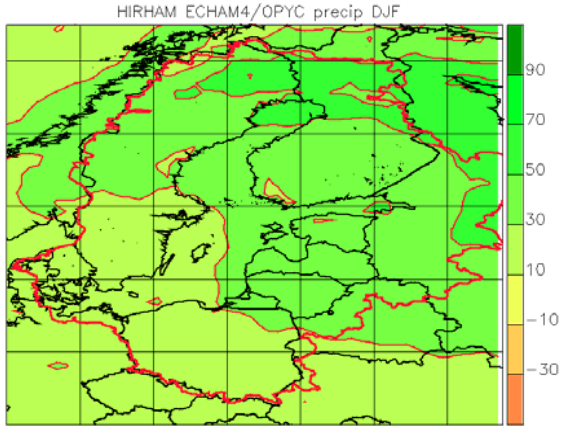

RCM: RCAO

GCM: HadAM3H

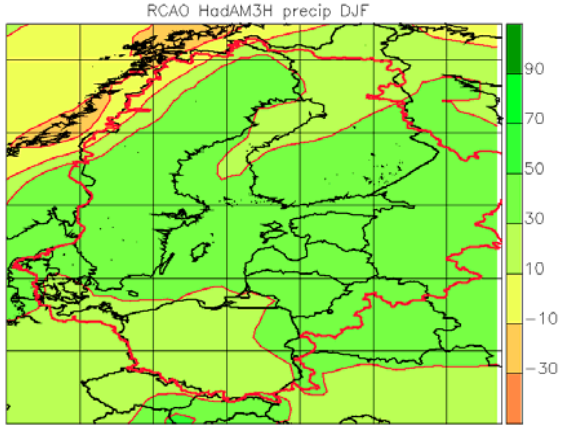
GCM: ECHAM4/OPYC

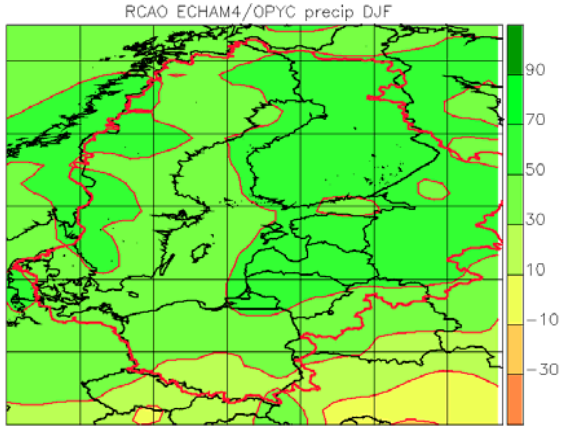
# RCM projections for 2071-2100 relative to 1961-1990 (A2 scenario): Winter Precipitation




RCM: HIRHAM



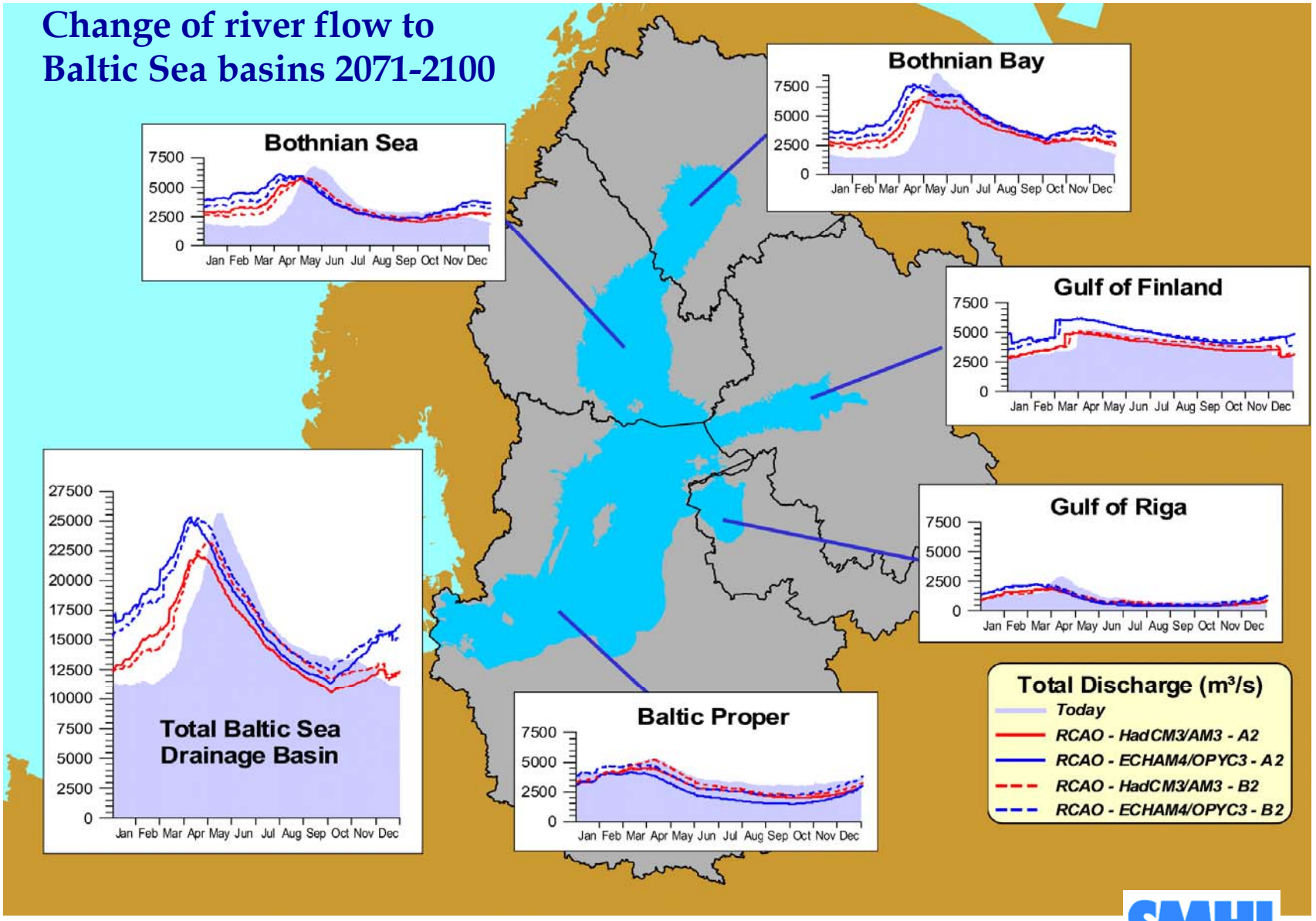




RCM: RCAO

GCM: HadAM3H

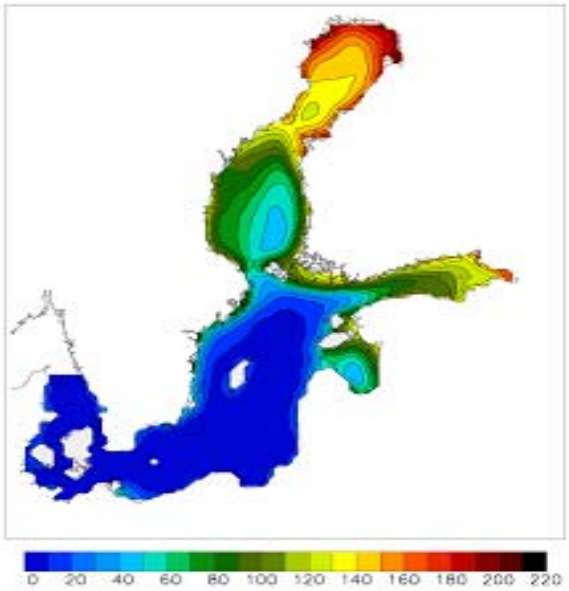
GCM: ECHAM4/OPYC

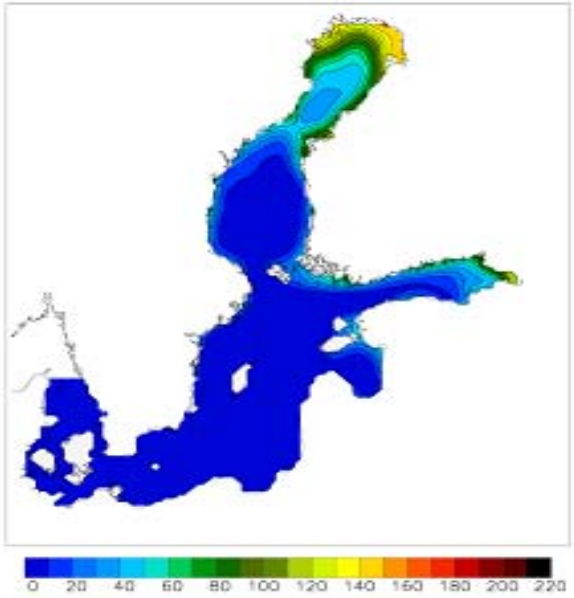
# Change of river flow to Baltic Sea basins 2071-2100

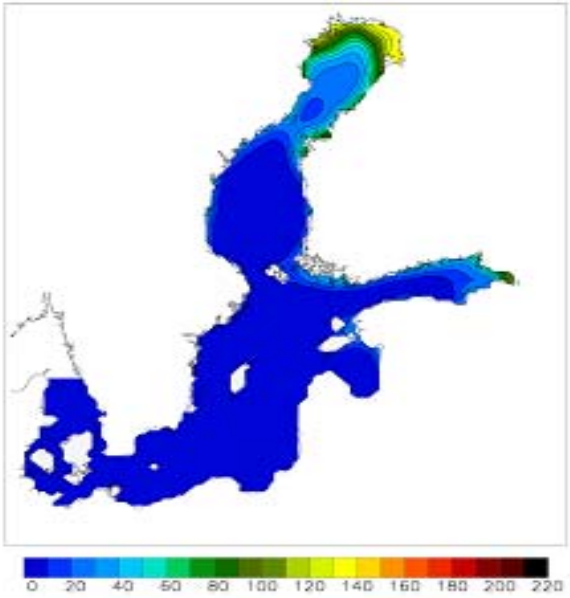



SMHI

Mean number of ice days in a present day simulation (right) and two scenarios for 2070-2100 (bottom)



# BACC 1: Projections of future climate impacts on terrestrial ecosystems

The expected future warming is likely associated to an accelerated continuation of the present trends in
- earlier spring phenological  phases,
- northward species shifts
- increased growth and vigour of vegetation

# BACC 1: Projections of future climate impacts on marine ecosystems

- No detailed, comprehensive analysis available – projections are more ad-hoc and uncertain.
- Effect of other changing influences hardly predictable.
- Possible Baltic Sea salinity decrease would have major effect on marine fauna.
- Expected changes in precipitation and river runoff may have additional detrimental effects on the problem of eutrophication.

# BACC 1: In short …

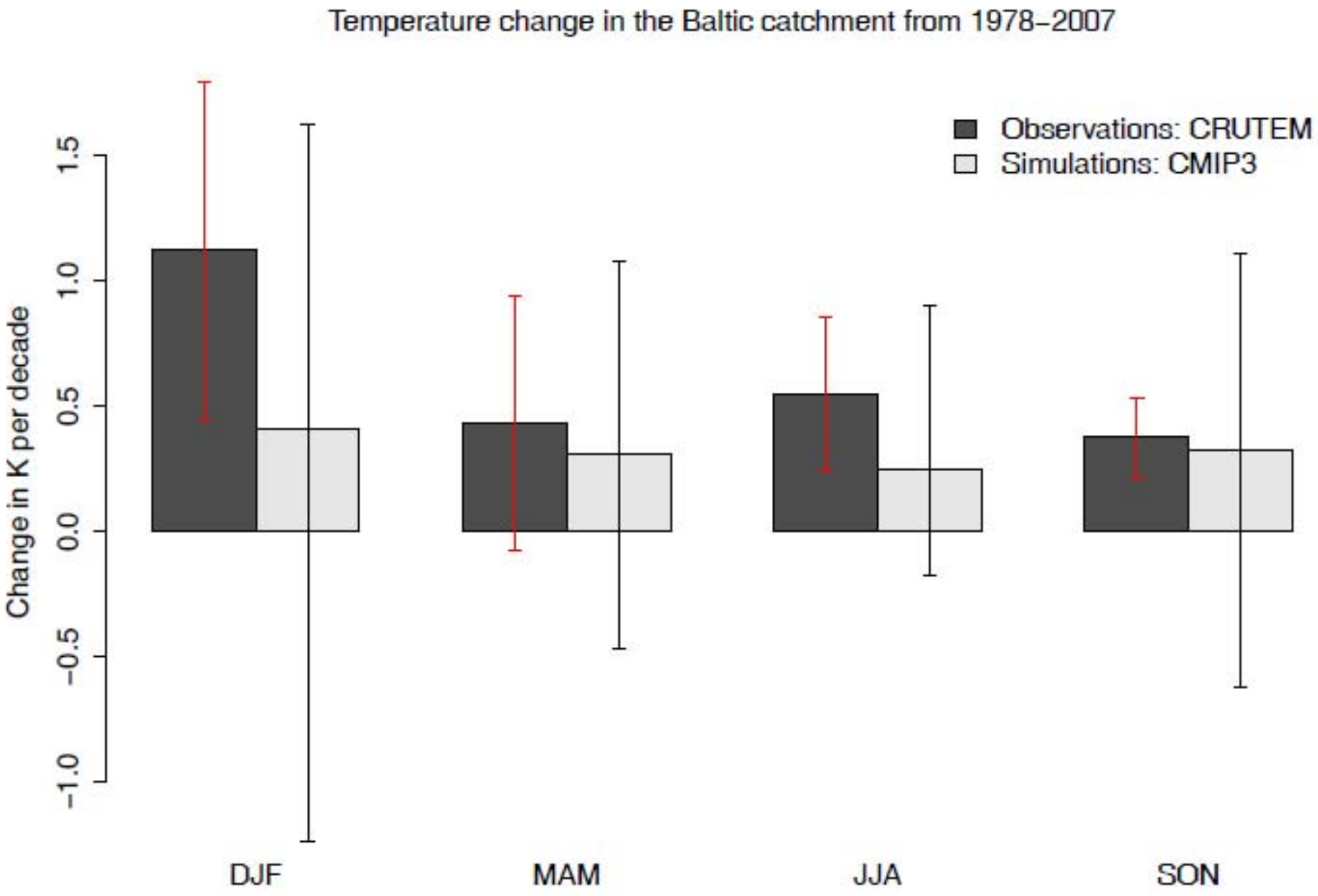
- Presently a warming is going on in the Baltic Sea region, and will continue throughout the 21st century.
- BACC considers it plausible that this warming is at least partly related to anthropogenic factors.
- So far, and in the next few decades, the signal is limited to temperature and directly related variables, such as ice conditions.
- Later, changes in the water cycle are expected to become obvious.
- This regional warming will have a variety of effects on terrestrial and marine ecosystems – some predictable such as the changes in the phenology others so far hardly predictable.

# Consistency analysis: of ongoing and expected change

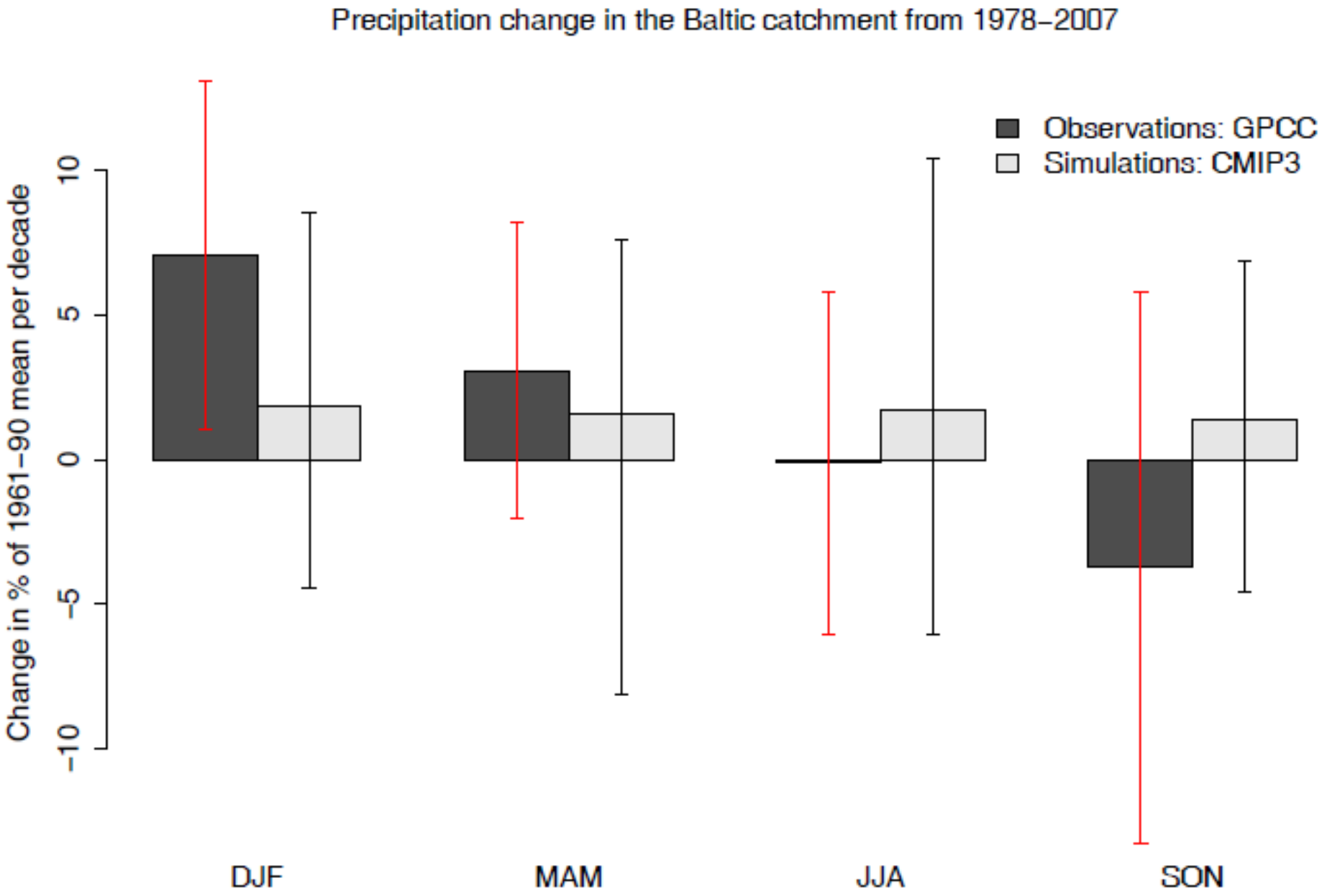
To check of consistency of recent and ongoing trends with expected scenarios, driver-related changes as described by model scenarios are compared with the recent trend.

For *temperature* change, this comparison leads to the assessment that model scenarios and recent changes are indeed consistent.

For *precipitation* this is not really the case.




Jonas Bhend, pers. comm.




Jonas Bhend, pers. comm.

# BACC II

# Principles

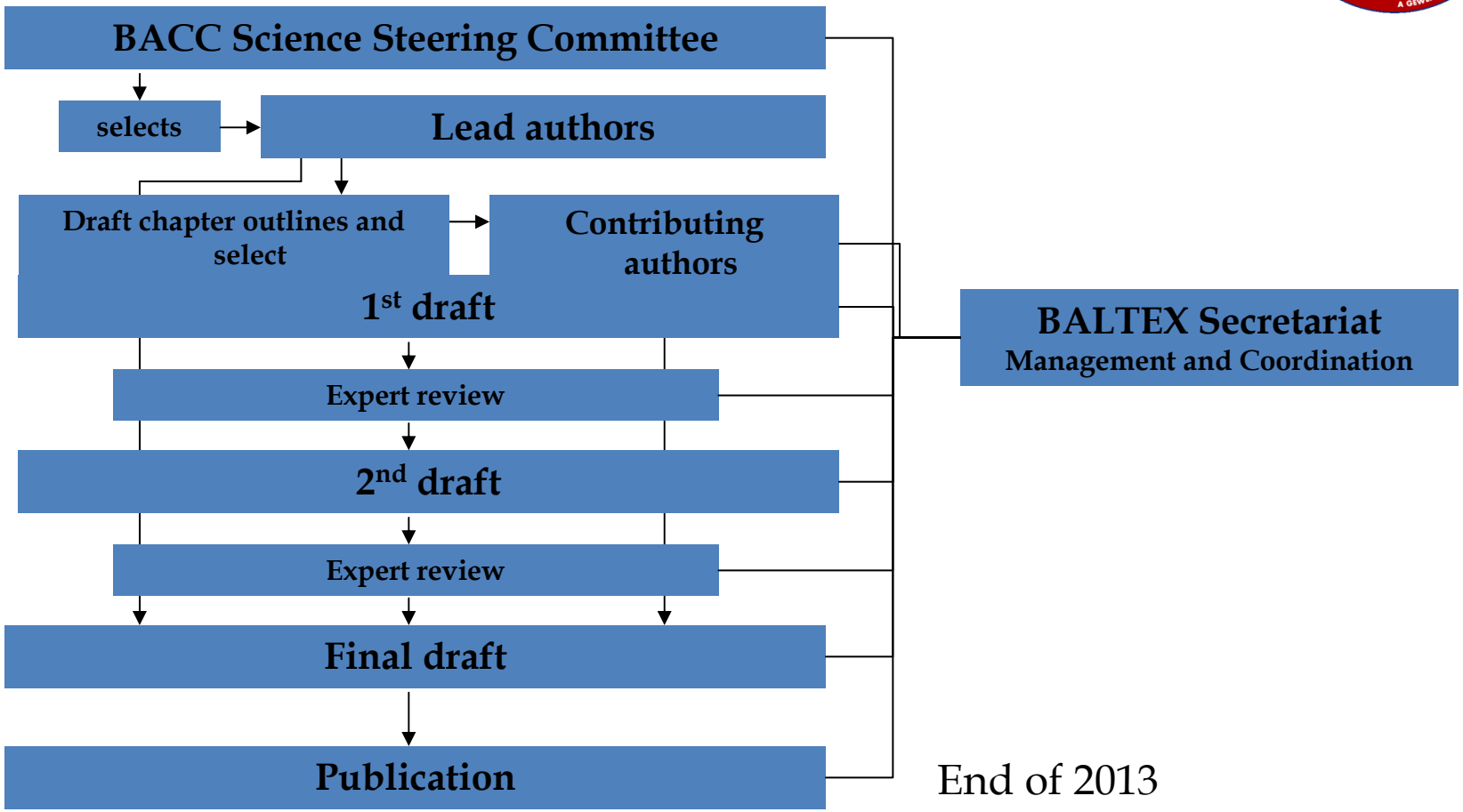
- **BACC assesses** NOT the state of the climate, its change and impact in the Baltic Sea Catchment, BUT the **scientific knowledge about the climate, its change and impact in the Baltic Sea Catchment.**
- For doing so, **questions** from political, economic or ideological groups are welcome.
- The **assessment** considers only legitimately scientific material, i.e. material available from libraries.
- Scientific contributions are welcomed only from scientifically accepted institutions, not from groups with a political, economic or ideological agenda.

# Principles

- The opinion of the lead authors, and their institutions, shall not have a greater weight in the body of knowledge than that of other contributors.
- Purpose is the presentation of **consensus about knowledge and lack thereof**.
- The assessment will be evaluated by **independent scientific reviewers**. The review process will be organized by the Scientific Steering Committee of BACC-2
- No financing by third parties.
- The Scientific Steering Committee has no influence on the substance of the assessment report (other than supervising the review process).

**The term "assessment"** in this context refers to a review of the available knowledge about climate change and related issues, and not to an evaluation of climate change itself. The assessment is the synthesis of material drawn comprehensively from the available scientifically legitimate literature (e.g. peer reviewed literature, conference proceedings, reports of scientific institutes) and should encompass the knowledge about what scientists agree on but also identify cases of disagreement or knowledge gaps.

# The BACC Process




**Difference to IPCC process: No political review, strictly scientific**