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### **3. Recent (mainly 200 years) and current climate change**

**Suggested new title:**

### **3. Climate change during the last 200 years**

3.2 Atmosphere  
(Anna Rutgersson)



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## Author team

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## State of the Chapter

54 pages, including 22 figures and 17 pages of references

Text is mainly done, editing needed.

Comments from internal review includes changing structure, additions/rewriting needed for some parts.



## 3.2 Atmosphere (Anna Rutgersson)

### 3.2.1 Large-scale circulation patterns

3.2.1.1 decadal- to century scale climate variability

3.2.1.2 Impact of the NAO circulation patterns

3.2.1.3 Impact of the NAO on the Baltic Sea water basin

3.2.1.4 NAO and blocking

3.2.1.5 Open questions

3.2.1.6 Implications of circulation changes

### 3.2.2 Surface pressure and winds

3.2.2.1 The wind climate of recent decades

3.2.2.2 The long-term wind climate

3.2.2.3 How unusual were recent decades with respect to

wind clim.

### 3.2.3 Surface air temperature

3.2.3.1 mean temperature

3.2.3.2 Daily cycle and seasonality

3.2.3.3 temperature extremes

### 3.2.4 Precipitation

3.2.4.1 mean precipitation

3.2.4.2 precipitation extremes

### 3.2.5 Cloudiness and solar radiation

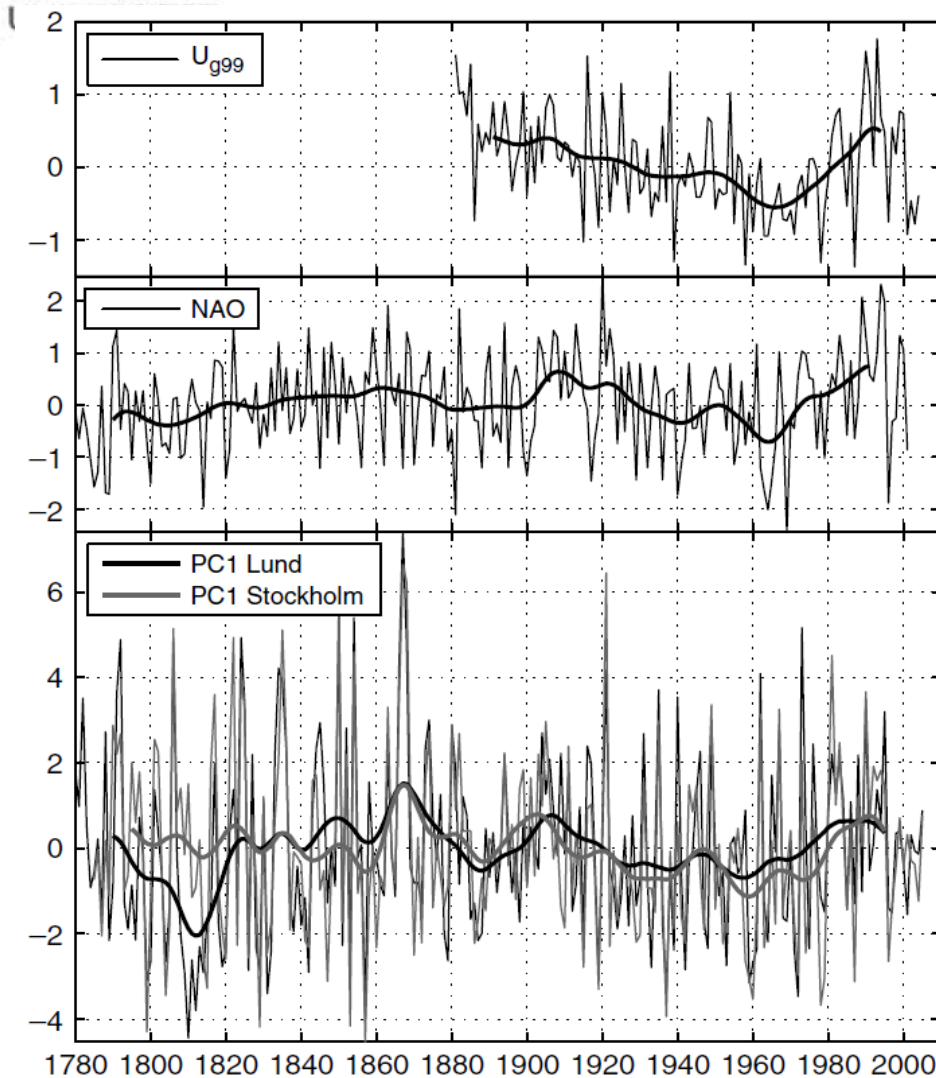
3.2.5.1 Cloudiness

3.2.5.2 Sunshine duration and solar radiation



# Large scale circulation patterns, examples

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Positive – more zonal circulation, mild wet winters and increased storminess

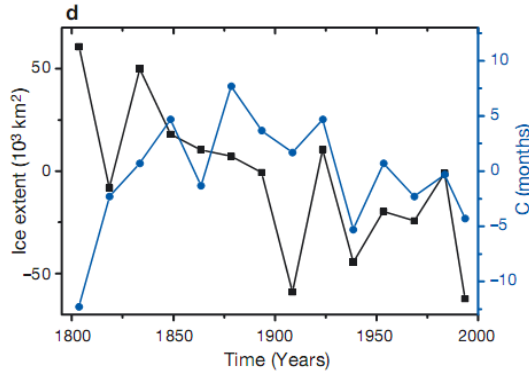
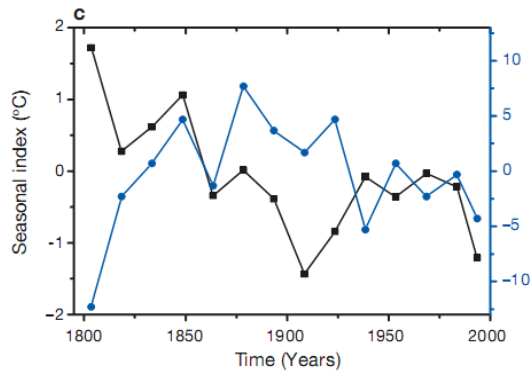
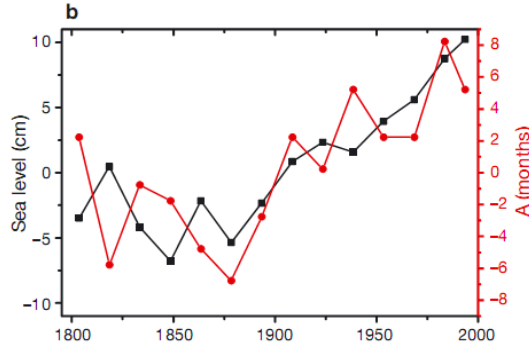
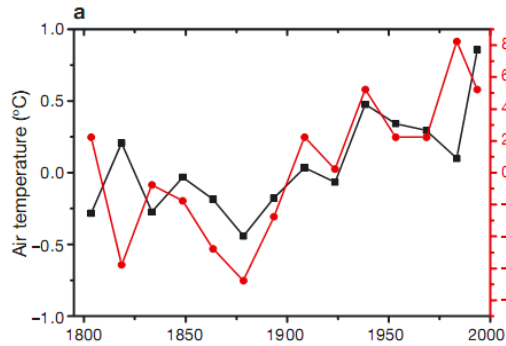
Negative – meridional circulation

NAO index



# Large scale circulation patterns

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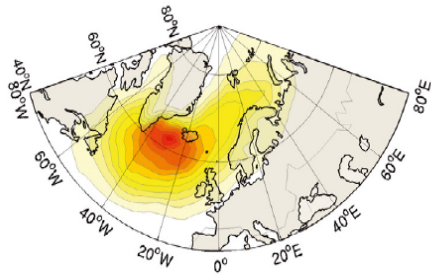


Anomalies in the climate records together with the circulation types that describe the vorticity of the atmospheric Circulation. Blue, cyclonic (positive NAO, red anticyclonic – negative NAO)



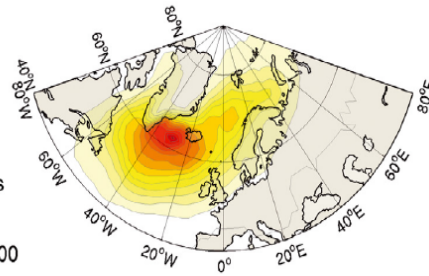
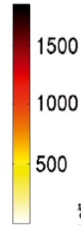
# Large scale circulation patterns, examples

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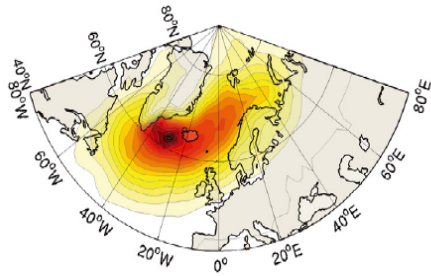


P1: 1958/59-1977/78

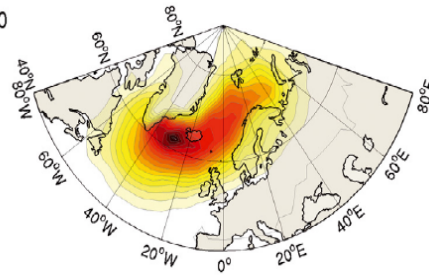
No. of deep  
cyclones



P2: 1968/69-1987/88



P3: 1978/79-1997/98



P4: 1988/89-2007/08

Increase in Number of deep  
Cyclones (stronger westerlies for the  
later decades)



# Large scale circulation patterns, concl

Poleward shift in storm tracks

Weather types are more persistent than in earlier decades (increase in 2-4 days) from 70s to 90s, can explain increase in extreme events.

Variability in other parameters can (to a large extent) be explained by variability of NAO.

A part of the recent warming in the area can be explained by increase in NAO, not all of it.

Response of NAO to additional forcings like loss of sea ice in the Arctic. Less ice in barents and Kara seas might give decreasing winter temperatures in Northern Europe.





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# Large scale circulation patterns, overlaps

3.2.1.3 Impact of the NAO on the Baltic Sea water basin  
(potential overlaps with 3.4)

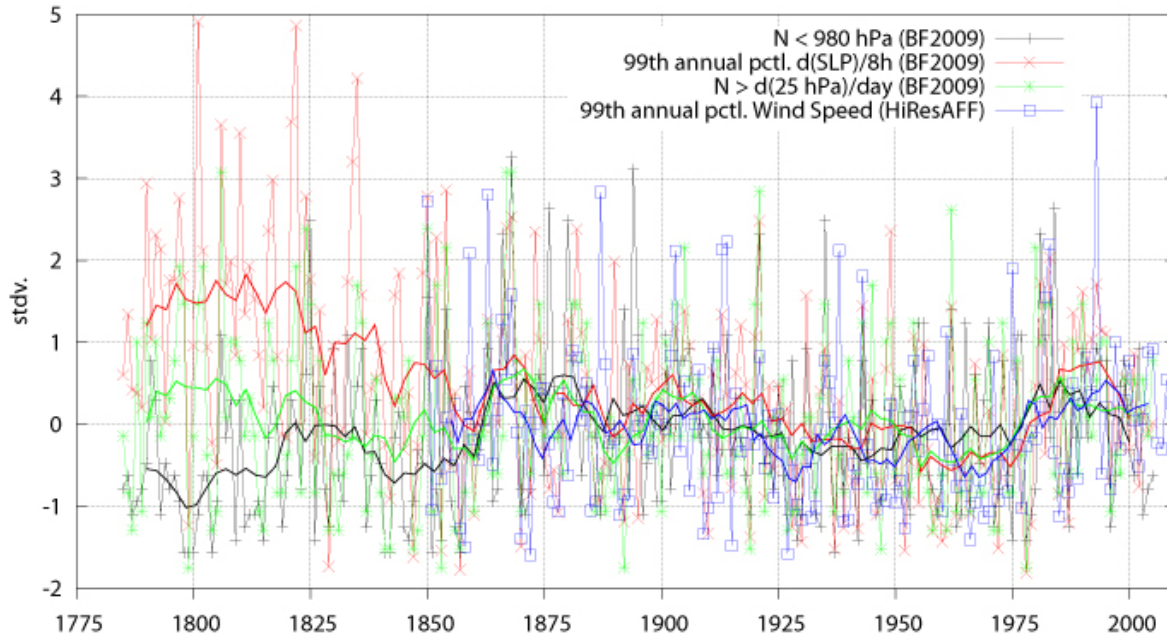
3.2.1.6 Implications of circulation changes

3.2.2.3 How unusual were recent decades with respect to wind clim.  
(potential overlaps with chapter 6)



# Surface wind and pressure

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Storminess indices of the annual number of deep lows ( $N < 980$  hPa)

To conclude:

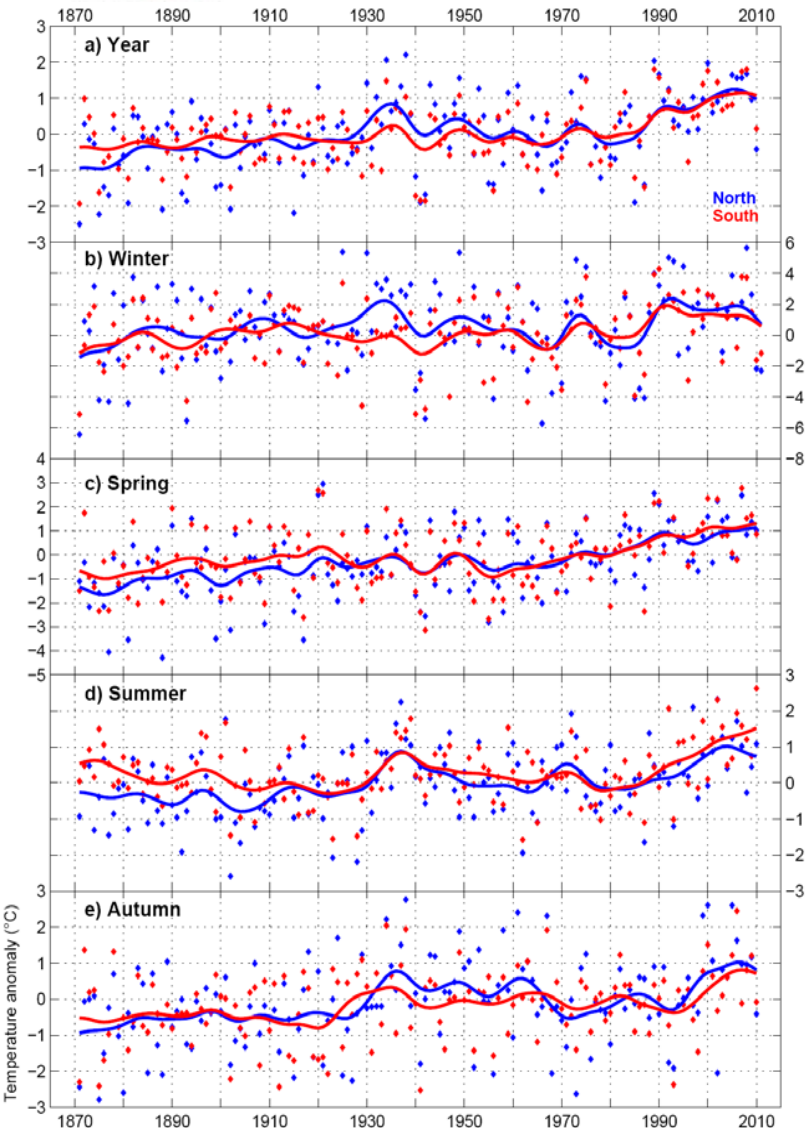
Increasing annual wind speeds  
In 1880s and 1990s. Calm around  
1960s-70s

Seasonality, decreasing wind in  
summer.

Some studies, show an  
increase in storminess (Donat et  
al) during the last 100 years.  
Probably due to inhomogeneous  
data.



# Surface air temperature



To conclude:

Mean, warming trend from BACCI (north 0.1 deg/dec, south 0.07 deg/dec) continued during spring and summer not for winter and autumn.

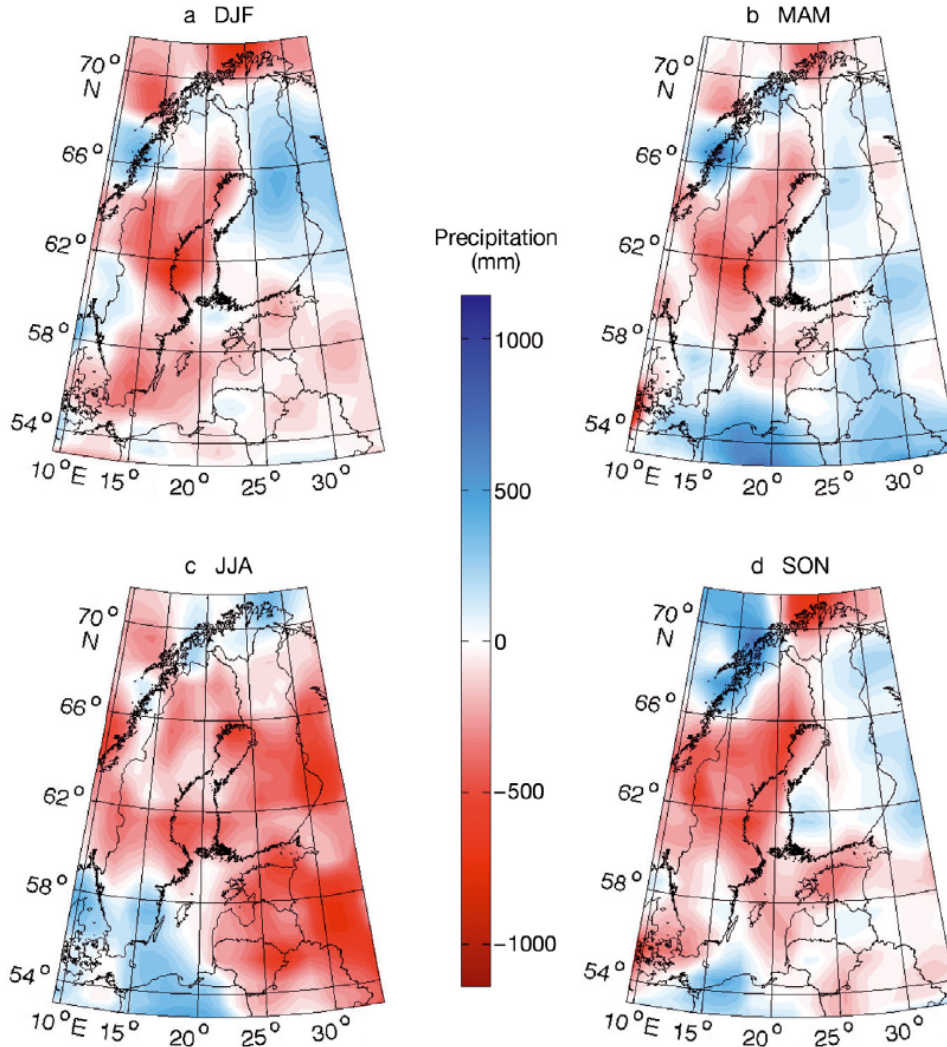
Extremes, increase in duration of mild periods in winter and hot summer periods

Annual and seasonal mean surface air temperature anomalies for the Baltic Sea Basin 1871-2010



# Precipitation

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To conclude:

Mean: Increase in precip in Sweden and eastern coast of the Baltic Sea, decrease in southern Poland

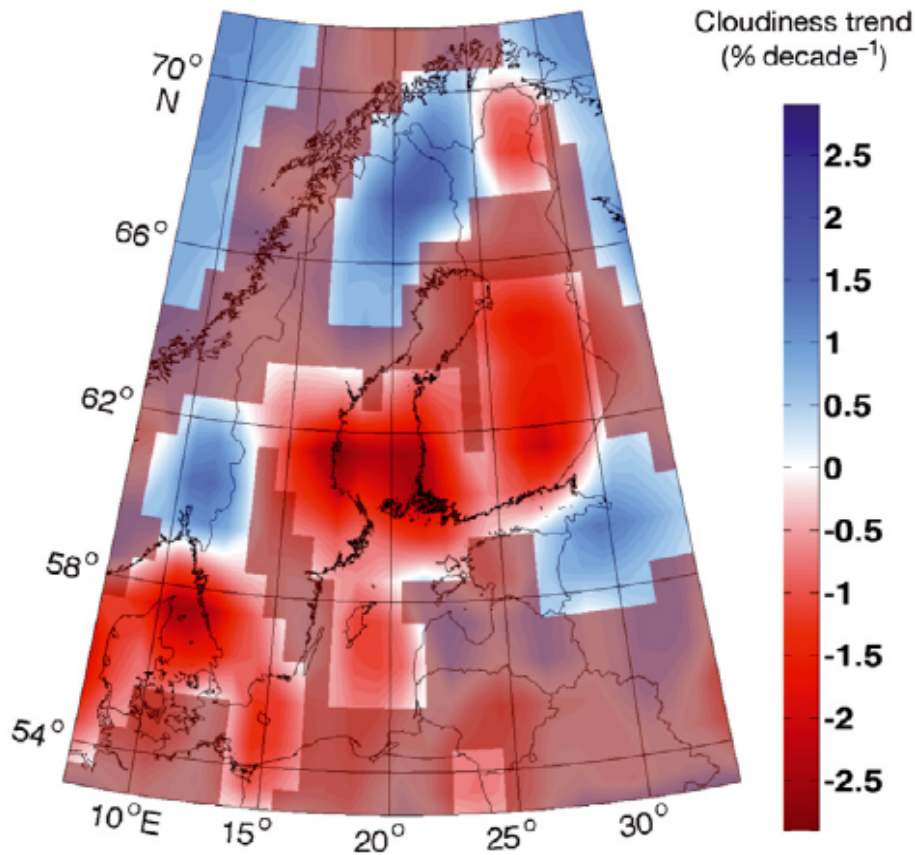
Longer wet periods (not more precip days). More frequent heavy precip.

Seasonal differences in 15-year totals of precipitation between 1979-1993 and 1994-2008



# Cloudiness and solar radiation

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To conclude:  
Decreasing cloud cover over the  
BS basin

(increase in low clouds, Poland,  
Estonia)

Linear trend of total cloud cover during  
1970-2008

## Open issues

Title section 3 (we suggest to change it).

Trends versus variability (can we have a trend over 20 years)

Data inhomogeneities

How do we relate to BACCI (comment from reviewer). If no new information is available – should we repeat BACC1?

Subsection ordering (temperature first?)

overlap problems (Section 2, Section 6, Section 4)

Appendix (should we have one for mean climate?) or glossary.