Extreme sea levels and the assessment of future coastal flood risk

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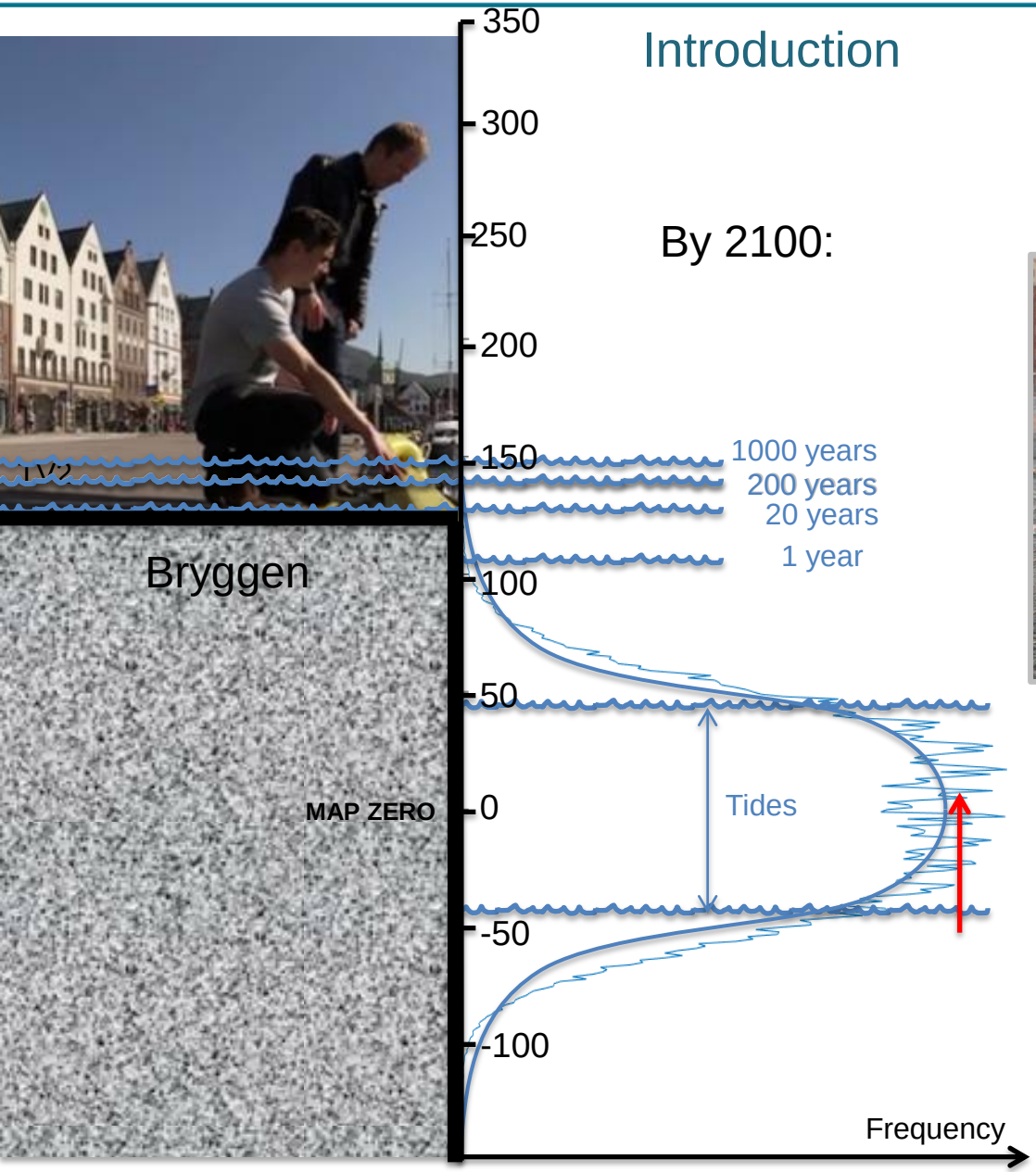
SEPTEMBER 19–20 2016 OSLO

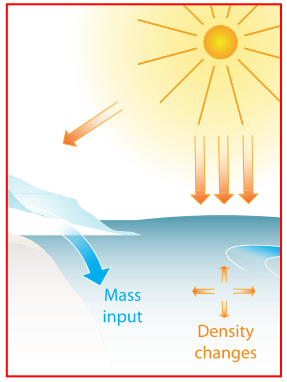
Introduction



By 2100:

Higher return heights
Flooding more often

50 cm sea level rise



kartverket.no/sehavniva ; www.kyst.dk

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Rationale: The need for trans-Nordic collaboration

- Differences for the coastlines of Norway, Denmark, Sweden, and Germany
  - impacts and vulnerability
  - tide levels, storm surges, future sea level change
  - methodologies for climate change projections
  - methodologies for extreme events
  - approaches for dealing with coastal flood risks and climate change
  - governance adaptation schemes
- Need for enhanced trans-national collaboration
  - Provide more robust measures for mitigation and adaptation
  - Wider dissemination across levels of governance and between the northern European countries
- A starting point

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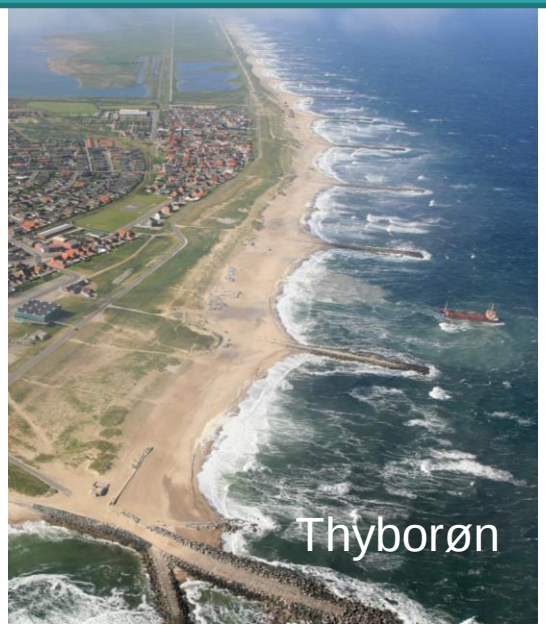
Physical differences: urban and geo-morphology

Different impacts



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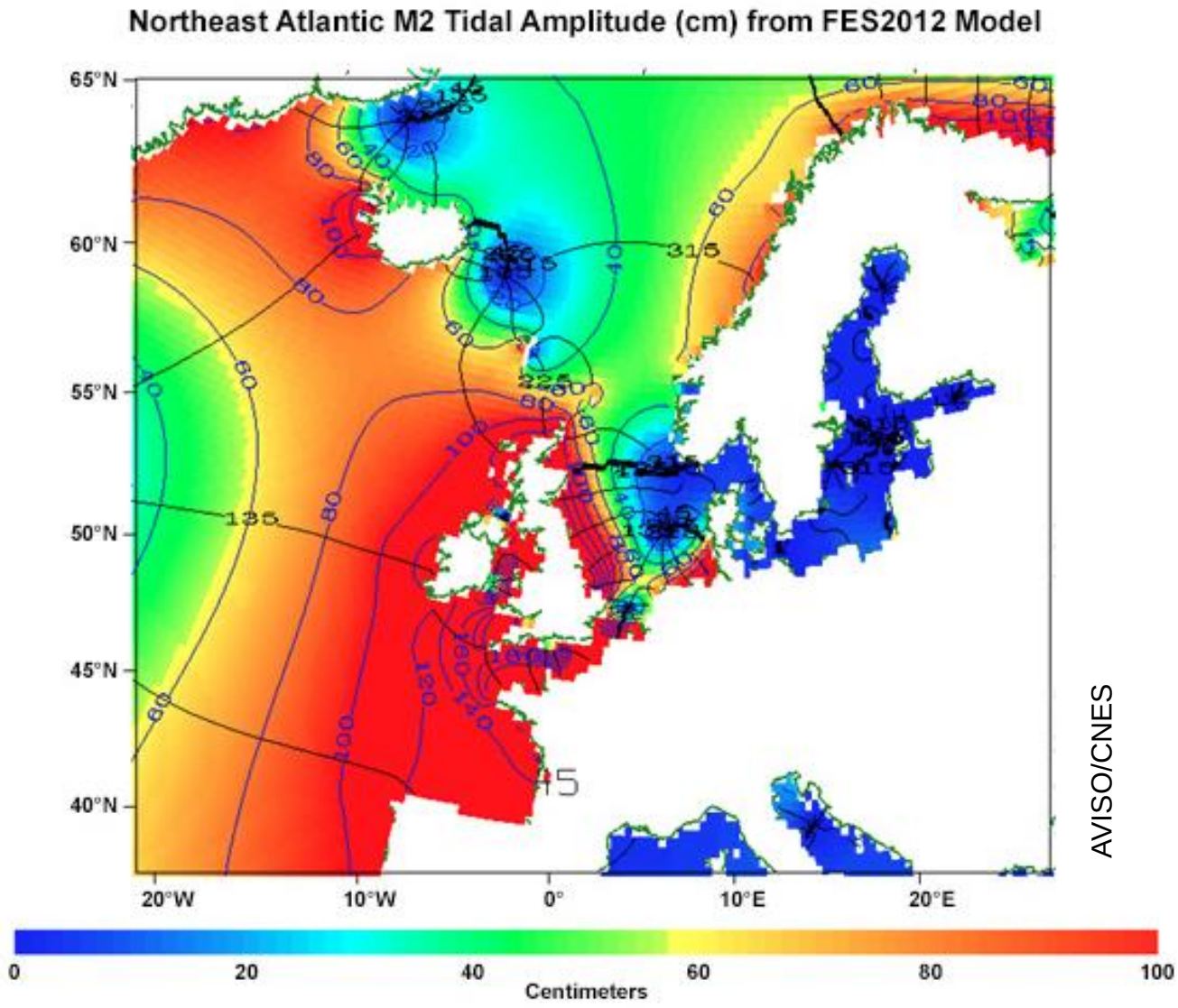
Physical differences: Tidal ranges



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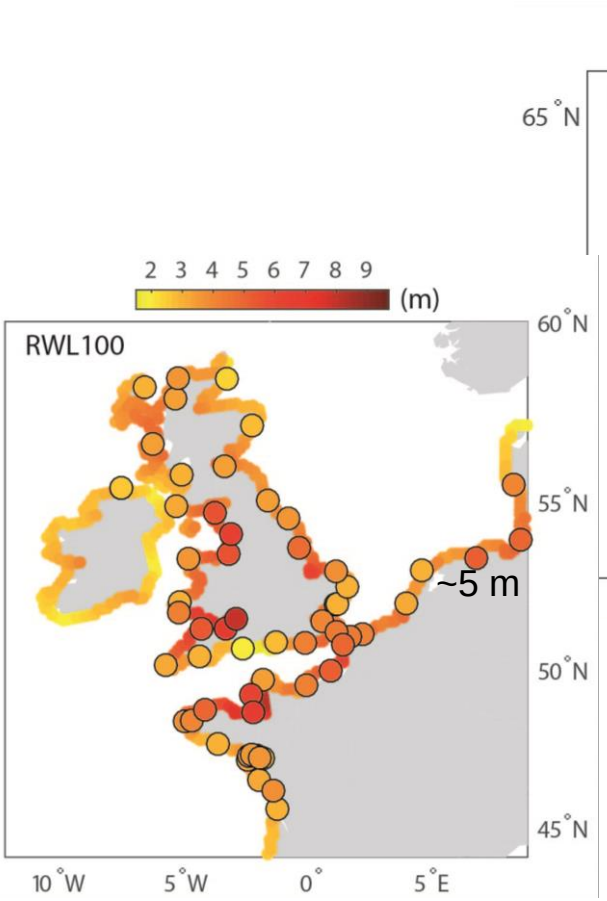
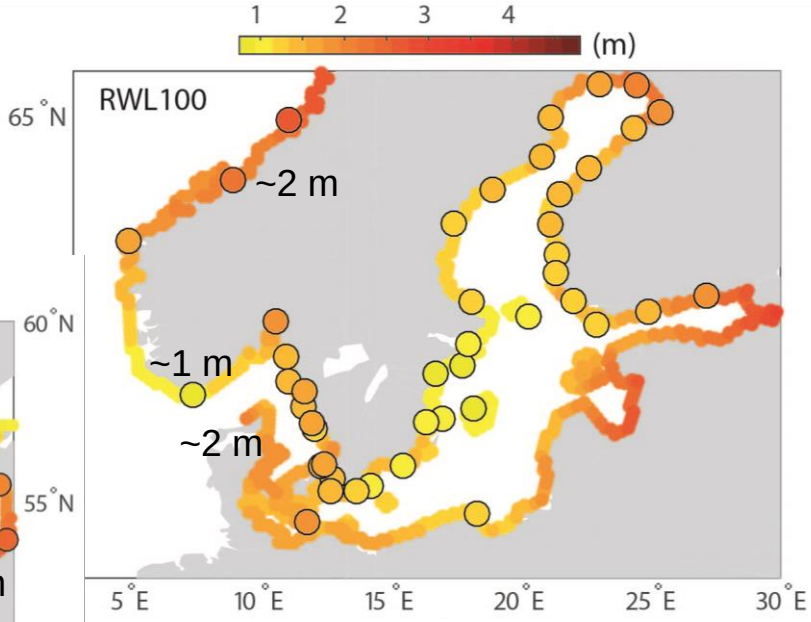
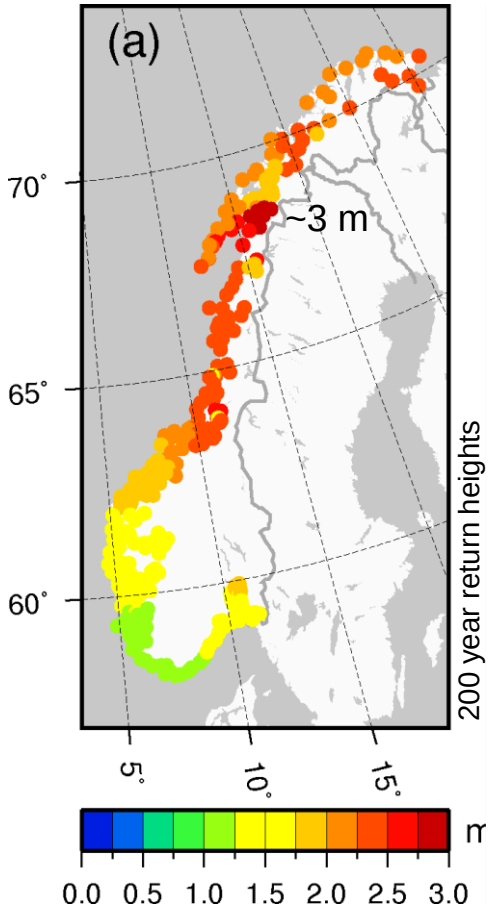
Physical differences: Storm surge heights

Return water levels (RWL)





Wahl et al. (pers. comm.)



Simpson et al. (2015)

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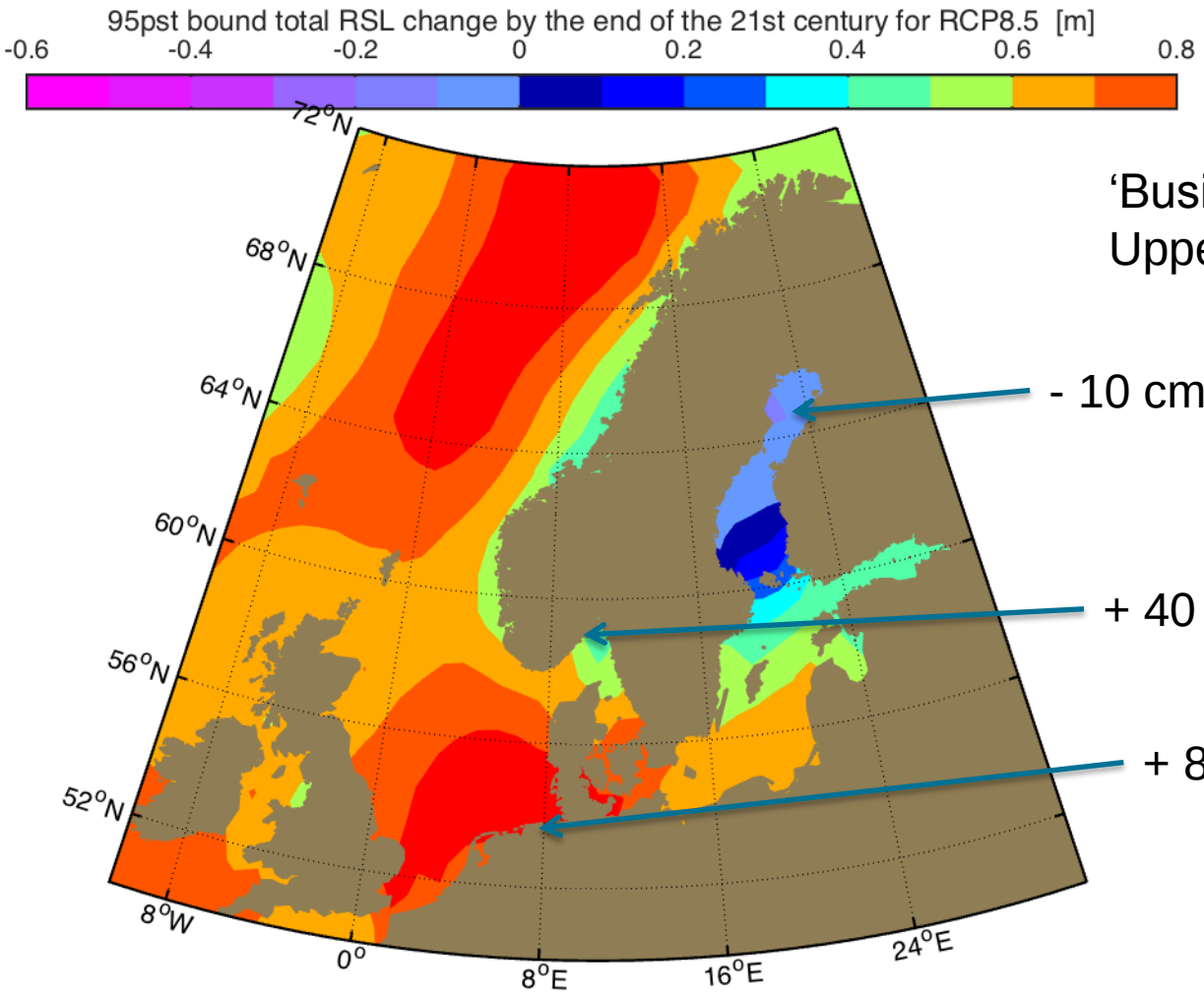
Physical differences: Projected Sea Level Changes



‘Business as usual’
Upper range (66% likely)

- 10 cm

+ 40 cm

+ 80 cm

Ref: IPCC AR5 Chapter 13. Data: http://icdc.zmaw.de/ar5_slr.html

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Climate change reports: National, … , and IPCC AR5

- Different foci
- Different expertise
- Different methods used
- Different parameters presented
- Nothing official on common Nordic/North European scale?

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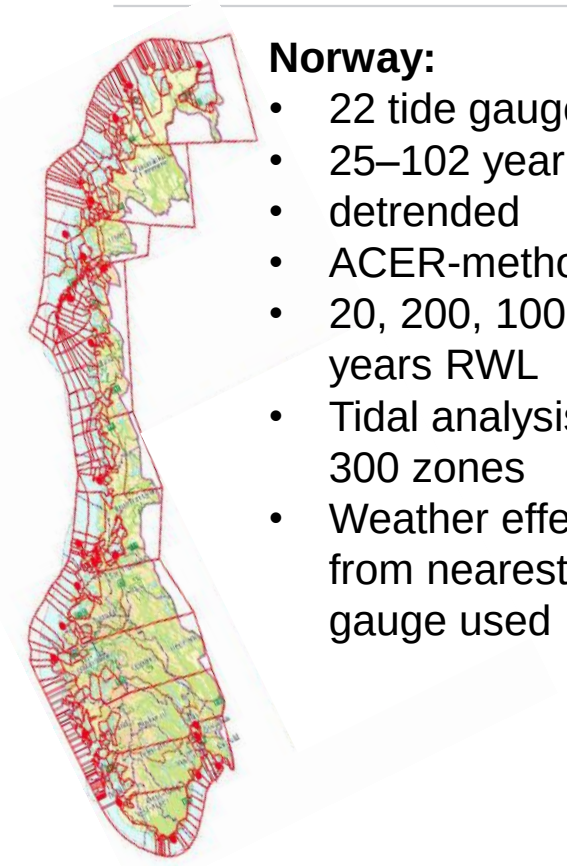
Methodological differences: Extreme Value Analyses



Roaldsdotter & Sande (2016)

Norway:

- 22 tide gauges
- 25–102 year series
- detrended
- ACER-method
- 20, 200, 1000 years RWL
- Tidal analysis in 300 zones
- Weather effect from nearest tid gauge used

Denmark:

- 68 tide gauges
- 15–125 year series
- detrended
- POT-method (mostly)
- 20, 50, 100 years RWL
- Interpolation between tide gauge stations

Sørensen et al. (2012)

Sweden:

- 23 tide gauges
- 40–130 year series
- GEV-method
- 100 years RWL (lowest allowed building)
- + safety 50–100 cm
- Tides ignored

Nerheim et al. (2013)

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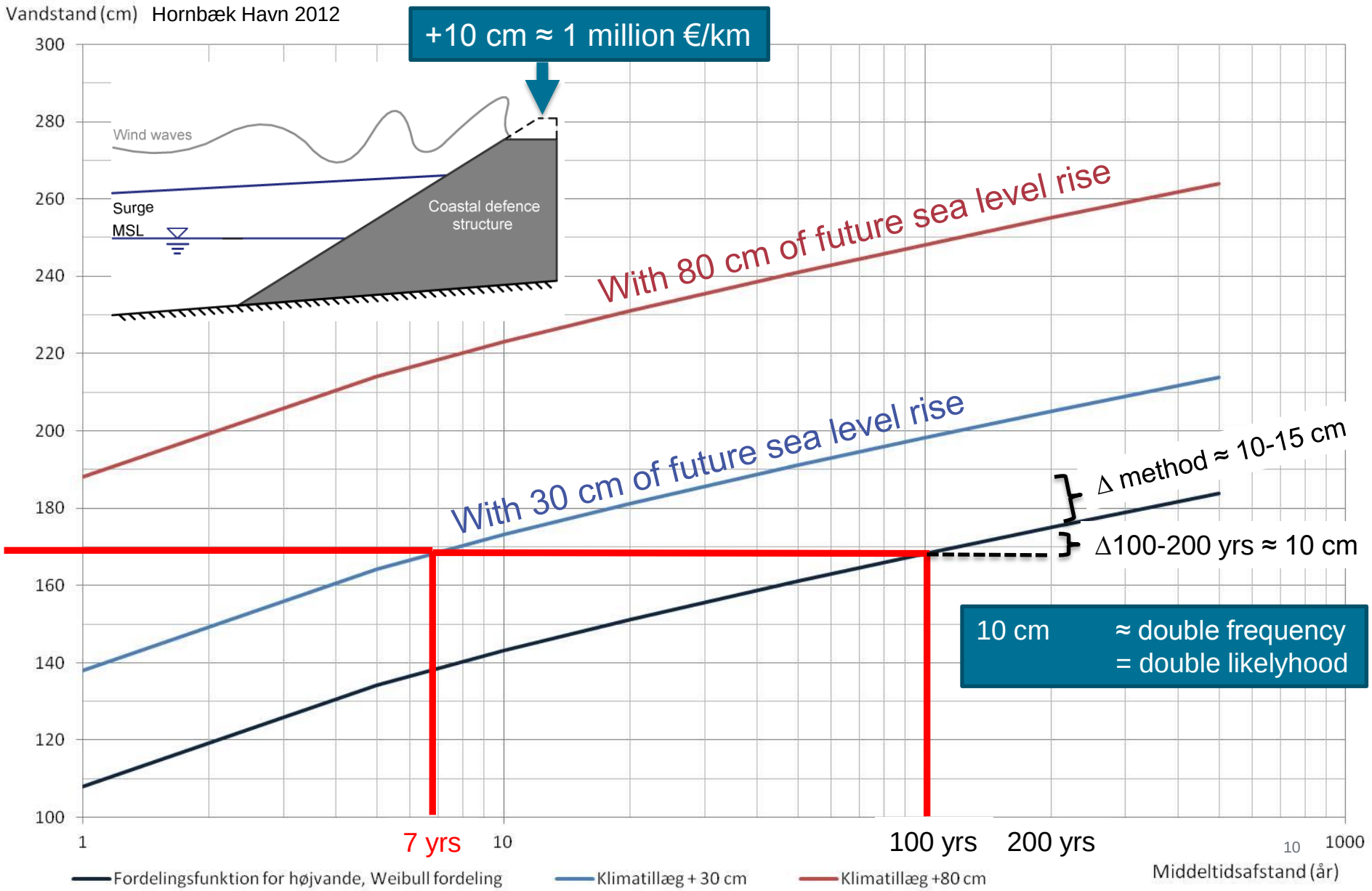
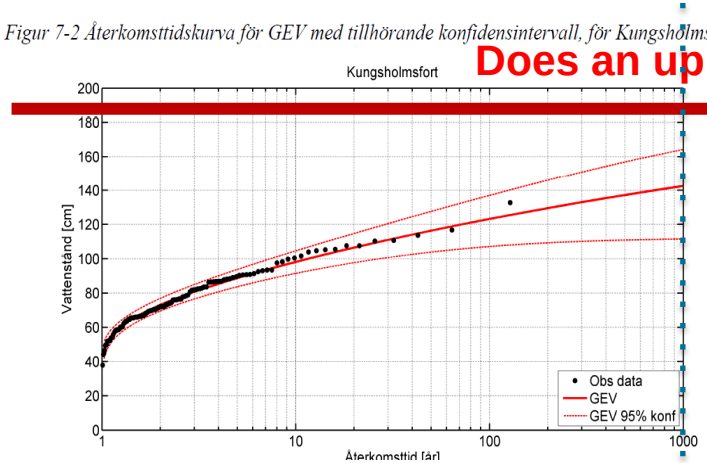
Methodological differences: Are they important?

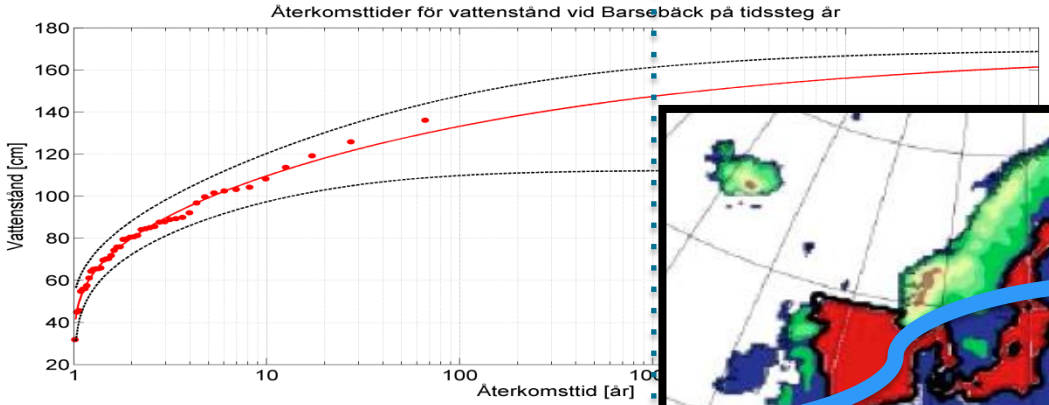


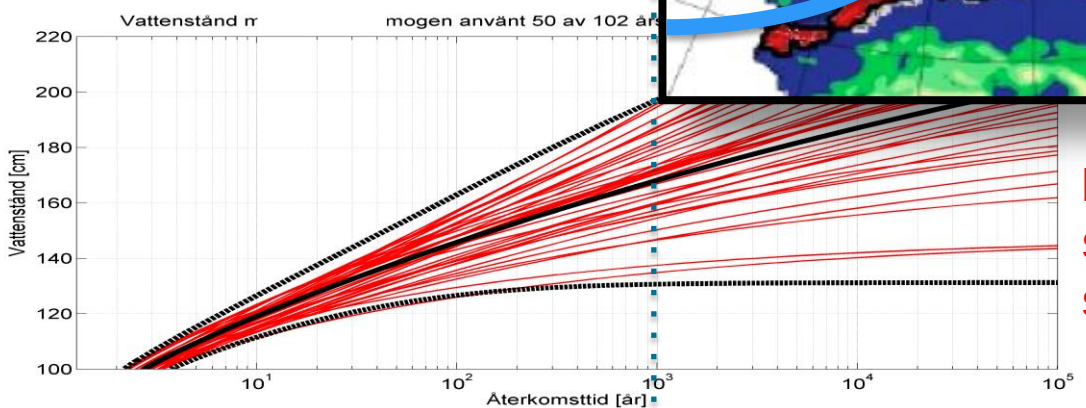
What about the more rare extremes?



Does an upper bound exist?

1902 Christmas storm in Lomma 206 cm





- Study in Sweden
- A growing demand for upper bound, for design values
- We do not know the worst storm in present climate
- Statistical EVA is problematic for return periods longer that twice the time series
  - Most countries have at best 100 or some years time series
- Modelling is deemed be more suitable for design values
  - Models need to preserve energy at all frequencies
  - Forcing at borders needs to have realistic extremes
  - But hard to assess what a worst possible low pressure system is

Results from (~50%) subsamples diverge severely

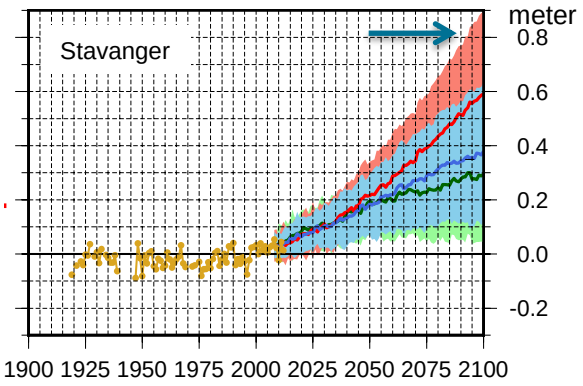
Nerheim et al. (2013)

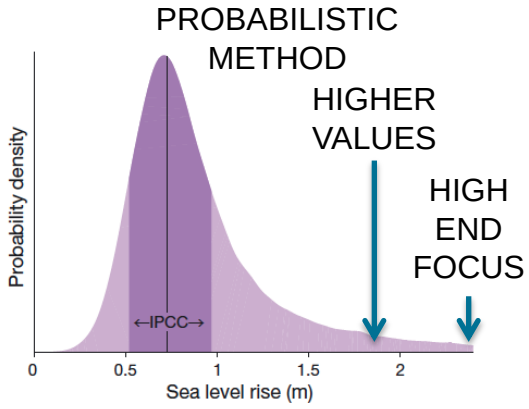
Methodological differences: Sea level projections

Norway:
- IPCC AR5 based
- Land uplift replaced
- Recommendation RCP8.5 & 95% bound

Denmark:
- IPCC AR5 based
- Grinsted et al. (2015)

Germany:
- IPCC AR5 based
- Coastal protection climate change surcharge depends on federal state (e.g., 50 cm in Schleswig-Holstein)





In general no political decided number to use …

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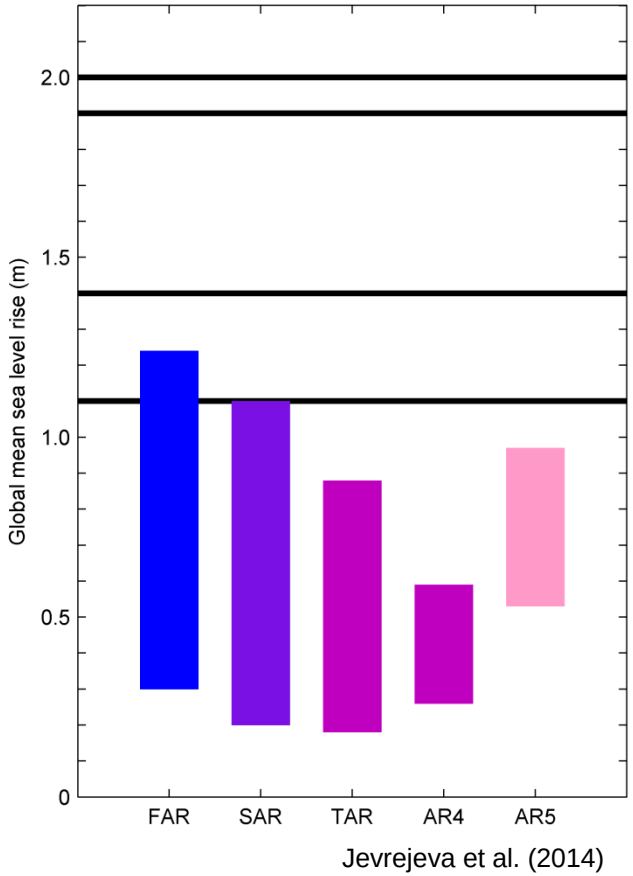
Governance decisions: Choice of projection output

Upper limits:



Jevrejeva et al. (2014)

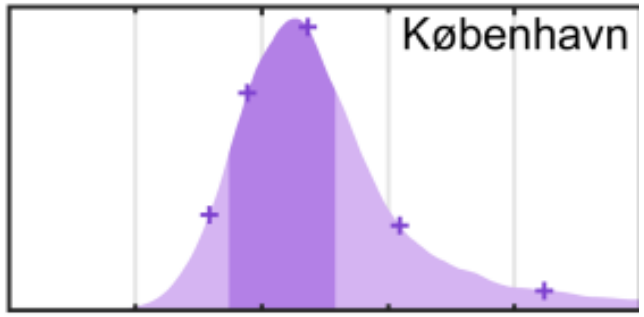
NOAA (2012)
UKCIP09

SCAR (2009)

Deltareport (2009)

IPCC

Likelyhood acceptance:



Grinsted et al. (2015)

83% = 1.05 m

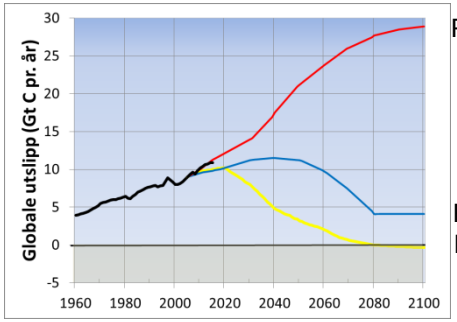
95% = 1.62 m

99% = 2.27 m

Emission scenario:

Not natural science

Social science



RCP8.5

RCP4.5

RCP2.6

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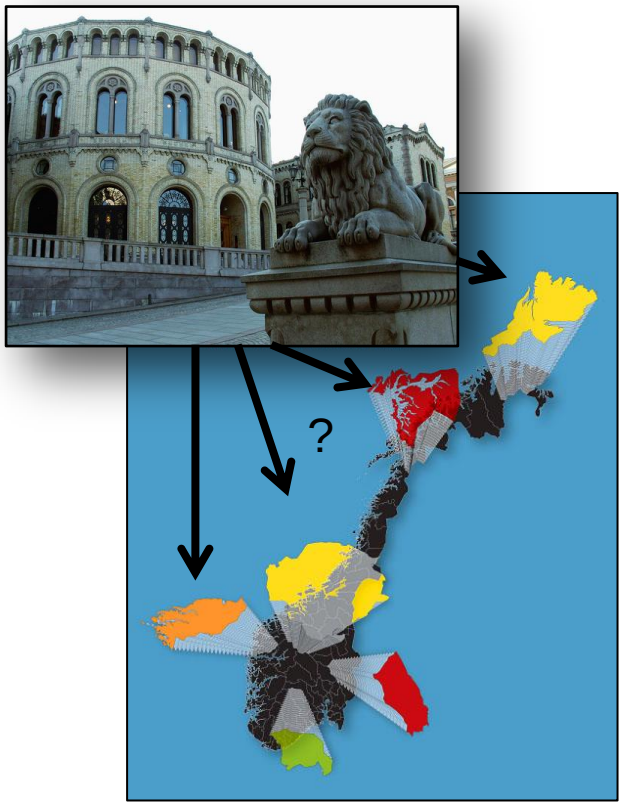
General governance challenges

- Choice of time span for adaptation planning (e.g. 2050, 2100, 2300?)
- Mean sea level change or extreme height changes
- Different responsibilities at different governance levels
- Communication and implementation is a challenge
  - Rules, standards, encouragement
- Two way (mis)communication
- Realistic view on uncertainties and (im)possibilities



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Conclusion

- Regional collaboration is needed
  - Share views and experiences
  - Learn from each other and develop relevant methods
  - Gain a deeper understanding of current and future physical processes governing extreme events
  - Discuss potential challenges in the work ahead
  - Foster cross-disciplinary research
  - Improve collaboration between science and governance

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Bjerknes Centre for Climate Research

Thank You!

NERSC DTU Danmarks Tekniske Universitet fwu UNIVERSITÄT SIEGEN Kartverket Miljø- og Fødevareministeriet Kystdirektoratet SMHI

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European Climate Research Alliance

ECRA Sea Level Change and Coastal Impacts Collaborative Programme

Sea level – Impacts – Risks – Adaptation

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