DTU Library

Extreme sea levels and the assessment of future coastal flood risk

Nilsen, J. E. Ø. ; Sørensen, Carlo Sass; Dangendore, S. ; Andersson, H. ; Arns, A. ; Jensen, J.; Jönsson, A.; Nerheim, S.; Ravndal, O.; Sande, H.

Total number of authors:
12

Publication date:
2016

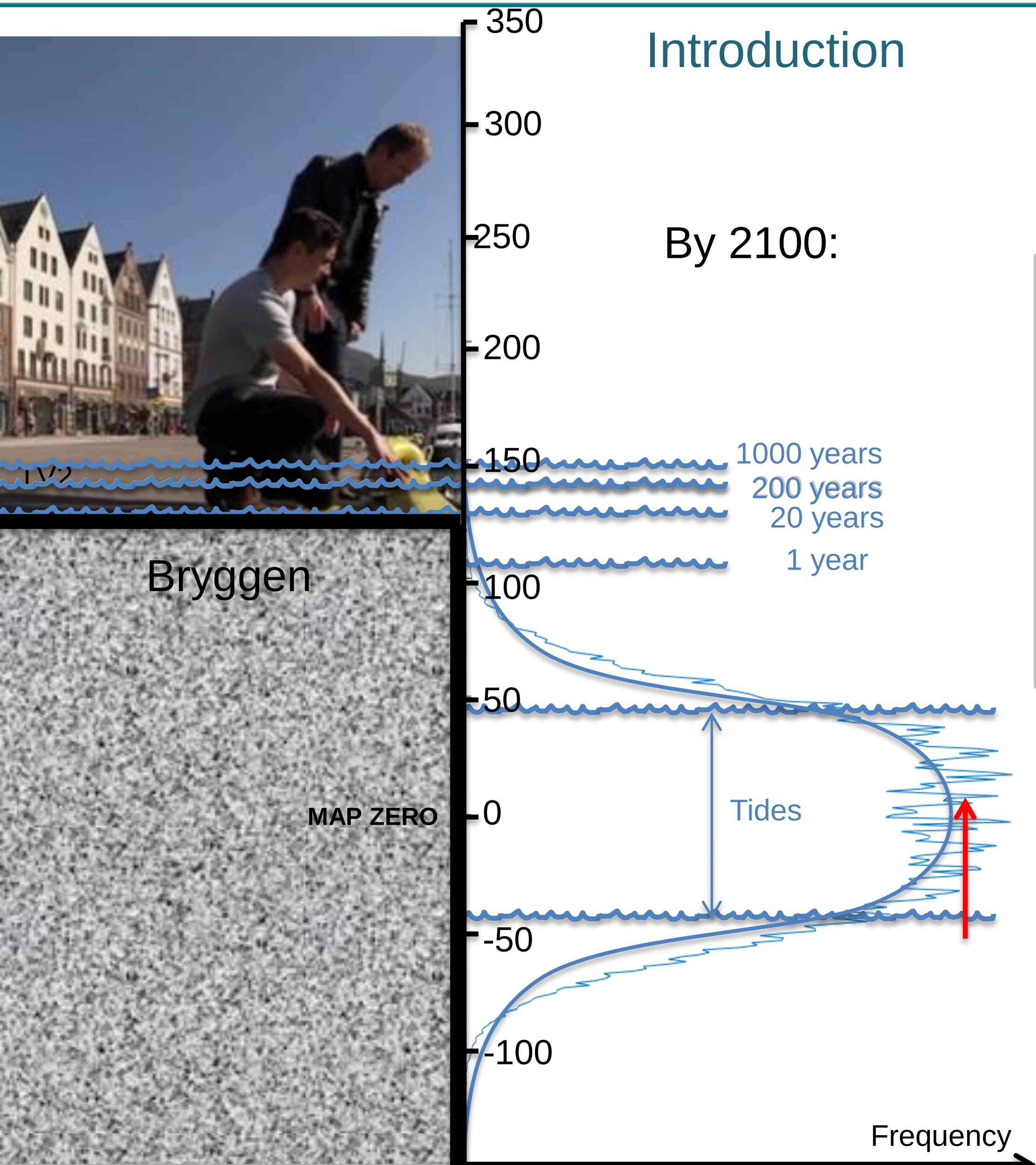
Document Version
Peer reviewed version

J.E.Ø. NILSEN, C.S. SØRENSEN, S. DANGENDORF, H. ANDERSSON, A. ARNS, J. JENSEN,
A. JÖNSSON, P. KNUDSEN, S. NERHEIM, O. RAVNDAL, H. SANDE, M.J.R. SIMPSON, P. SØRENSEN,

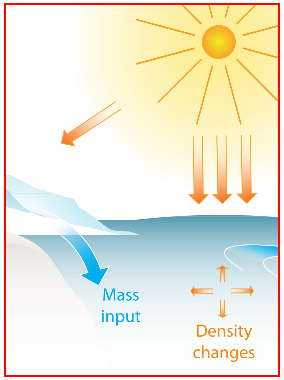
Extreme sea levels and the assessment of future coastal flood risk

Introduction

Higher return heights
Flooding more often



50 cm sea level rise



kartverket.no/sehavniva ; www.kyst.dk

J. Even Ø. Nilsen - even@nersc.no

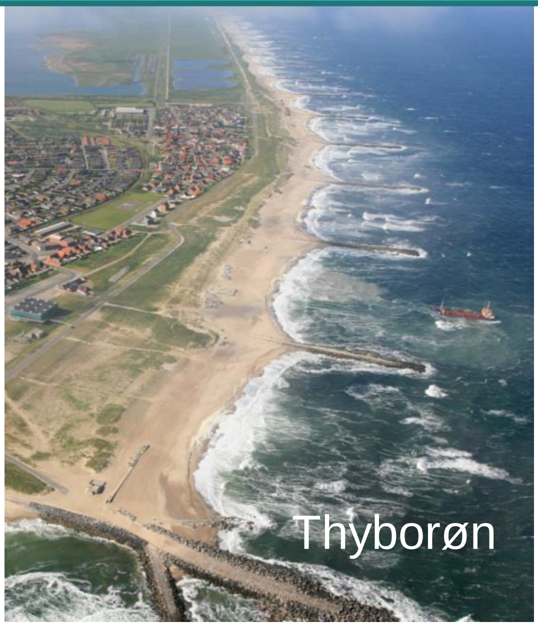
Rationale: The need for trans-Nordic collaboration

- 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

J. Even Ø. Nilsen - even@nersc.no

Physical differences: urban and geo-morphology

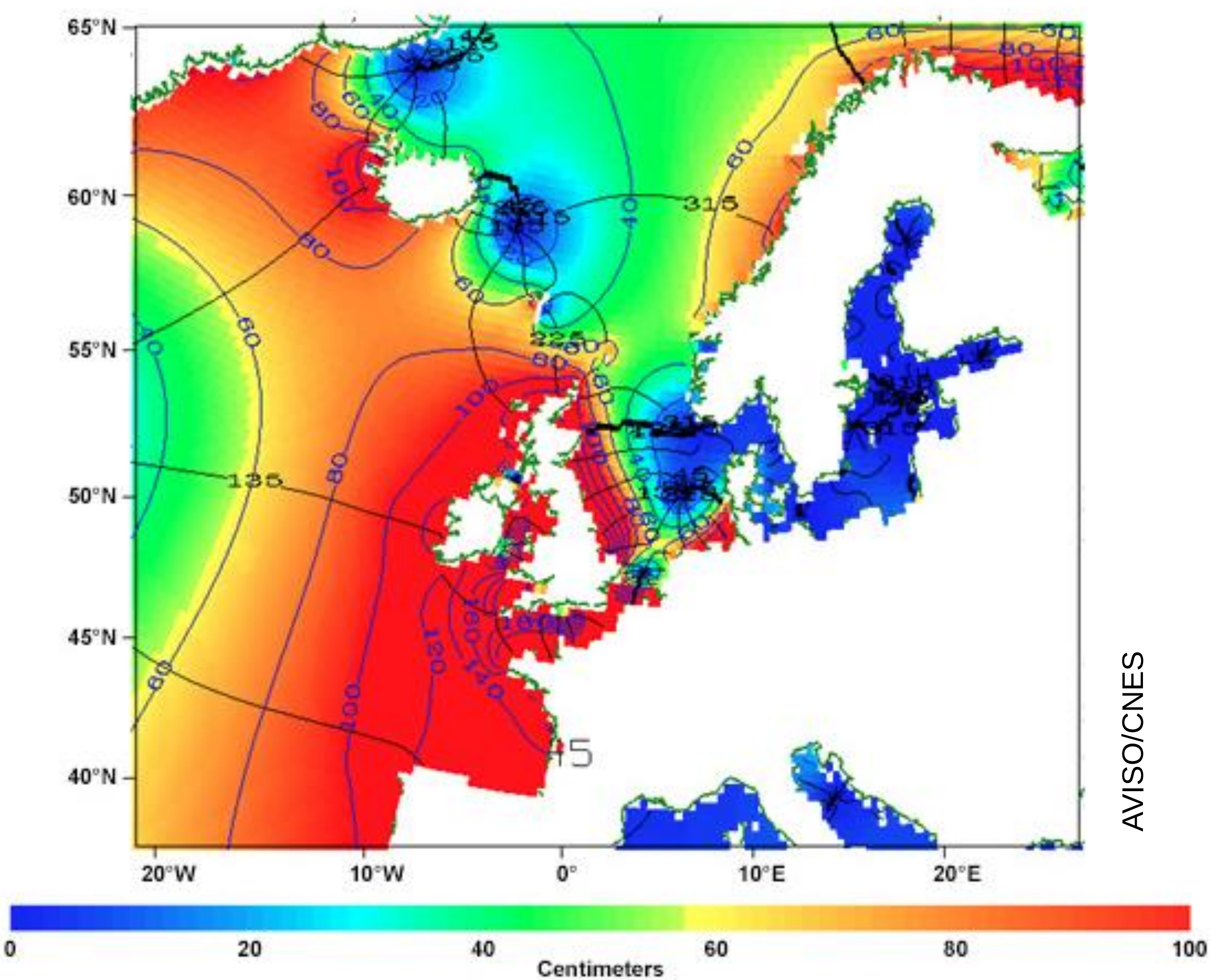
Different impacts



J. Even Ø. Nilsen - even@nersc.no

Physical differences: Tidal ranges

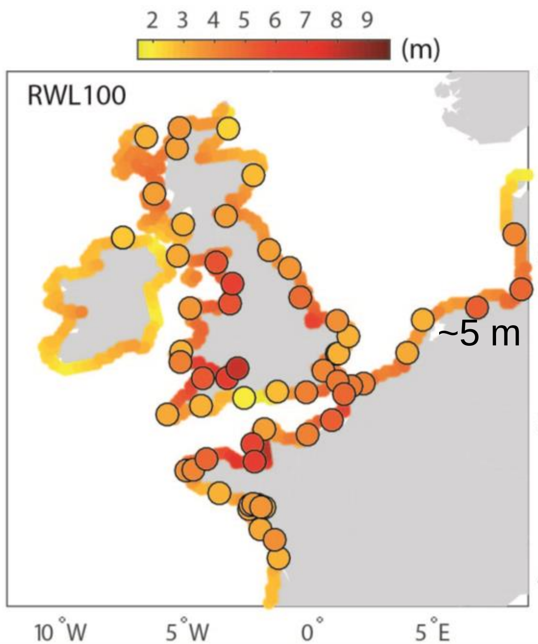
Northeast Atlantic M2 Tidal Amplitude (cm) from FES2012 Model

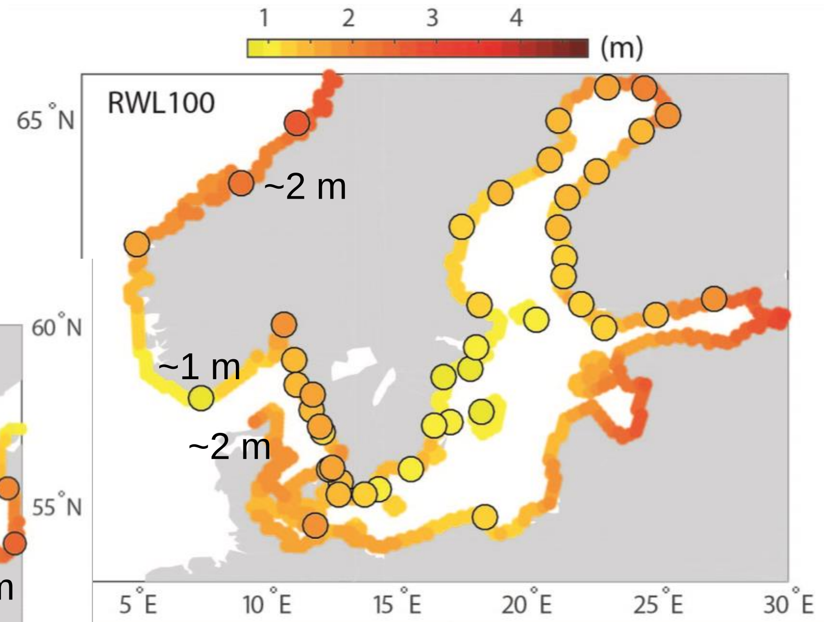


J. Even Ø. Nilsen - even@nersc.no

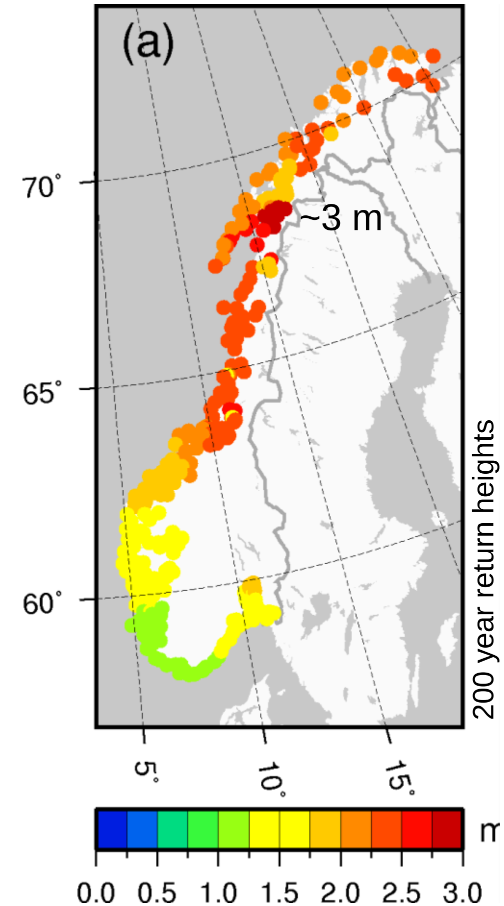
Physical differences: Storm surge heights

Return water levels (RWL)





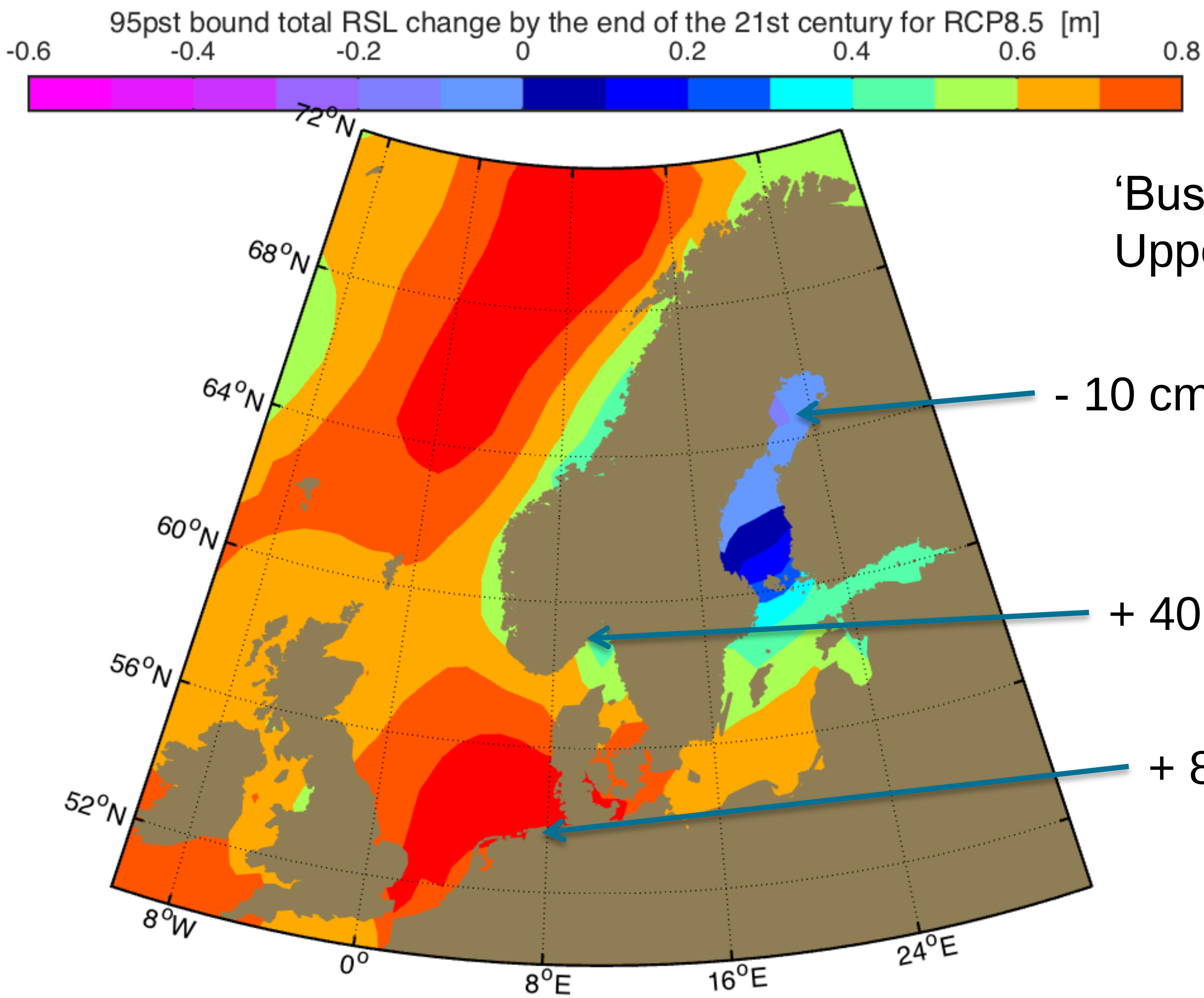
Wahl et al. (pers. comm.)



Simpson et al. (2015)

J. Even Ø. Nilsen - even@nersc.no

Physical differences: Projected Sea Level Changes



'Business as usual'
Upper range (66% likely)

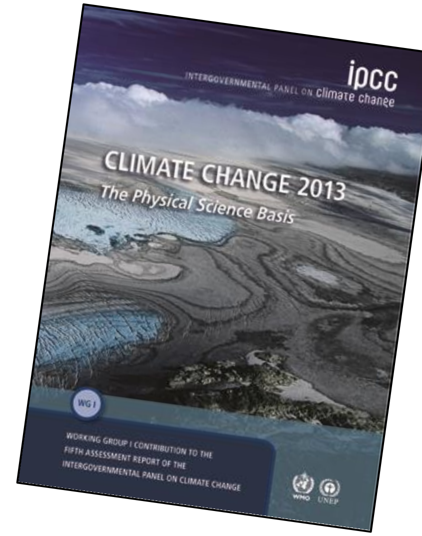
- 10 cm

+ 40 cm

+ 80 cm

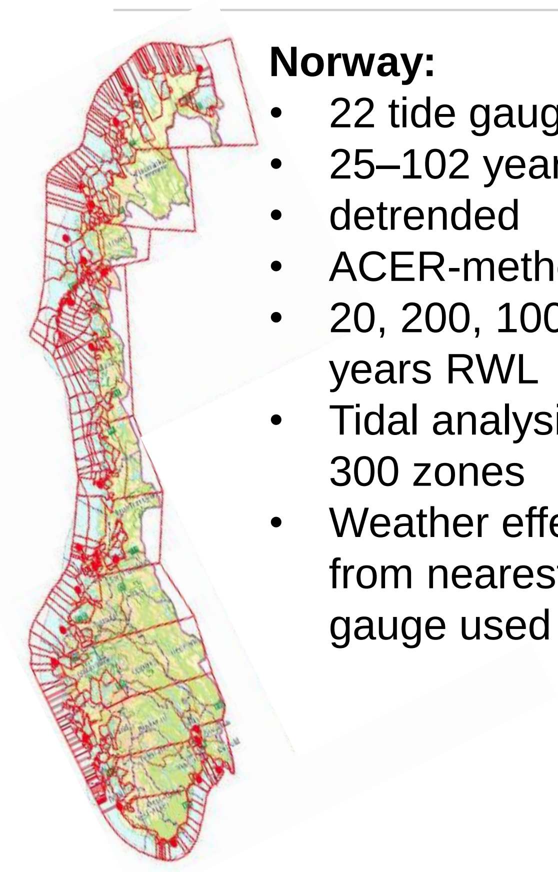
Ref: IPCC AR5 Chapter 13. Data: http://icdc.zmaw.de/ar5_slr.html

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?

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

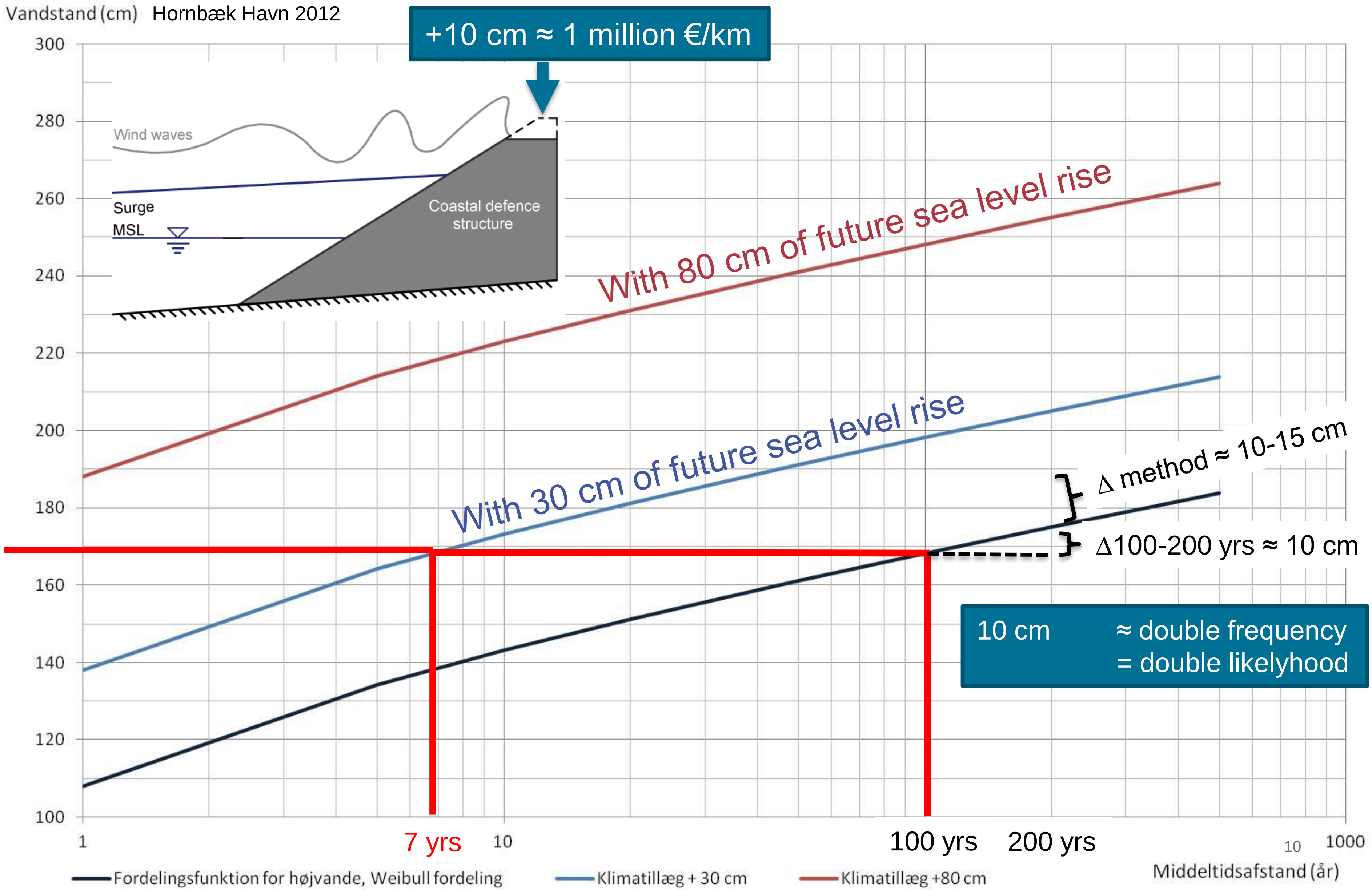
Sørensen et al. (2012)

Sweden:

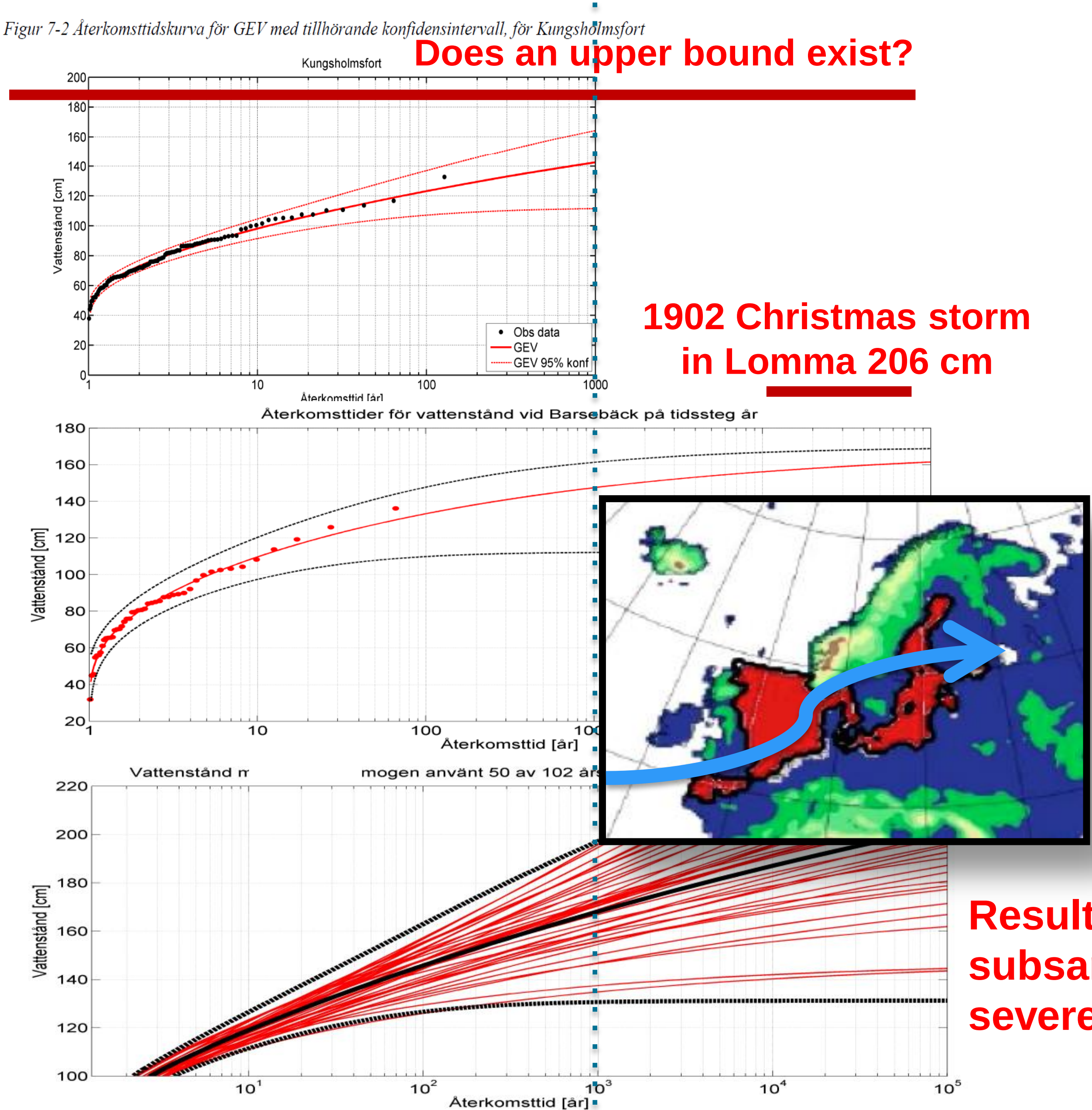
- 23 tide gauges
- 40–130 year series
- GEV-method
- 100 years RWL (lowest allowed building)
- + safety 50–100 cm
- Tides ignored

Nerheim et al. (2013)

Methodological differences: Are they important?



What about the more rare extremes?



- 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

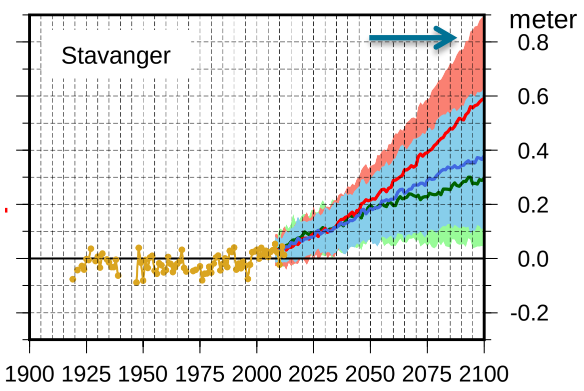
Nerheim et al. (2013)

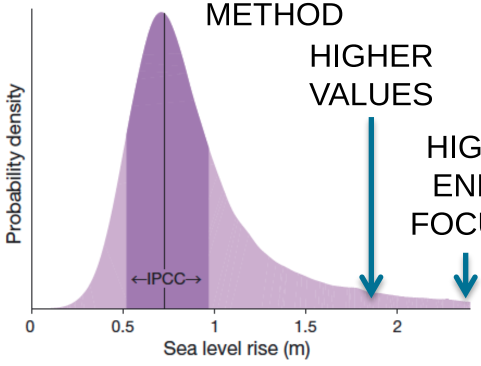
Methodological differences: Sea level projections

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)



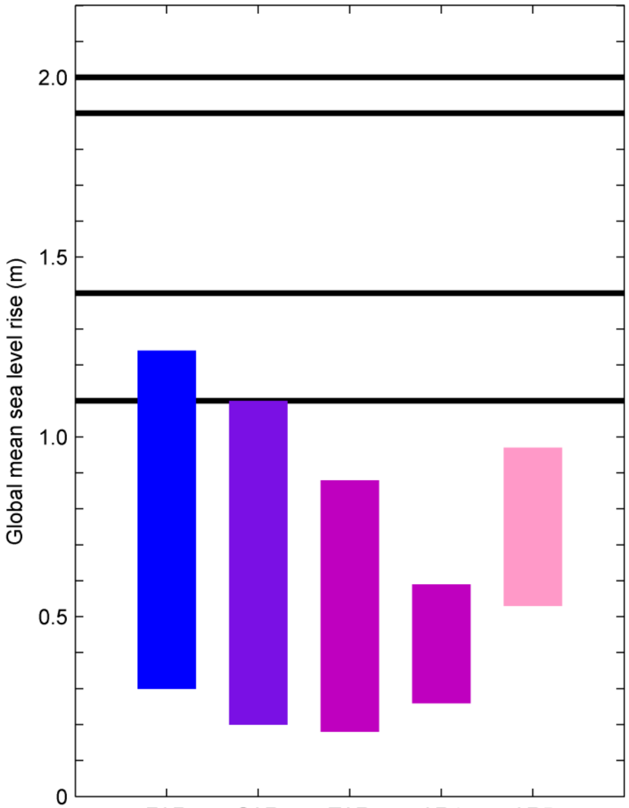


In general no political decided number to use …

J. Even Ø. Nilsen - even@nersc.no

Governance decisions: Choice of projection output

Upper limits:



Jevrejeva et al. (2014)

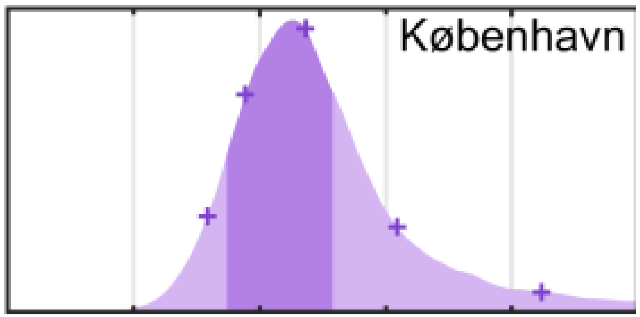
NOAA (2012)
UKCIP09

SCAR (2009)

Deltareport (2009)

IPCC

Likelyhood acceptance:



Grinsted et al. (2015)

83% = 1.05 m

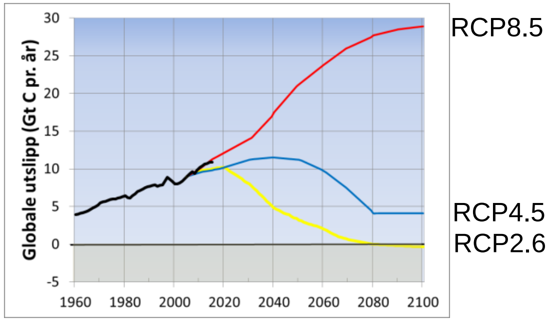
95% = 1.62 m

99% = 2.27 m

Emission scenario:

Not natural science

Social science

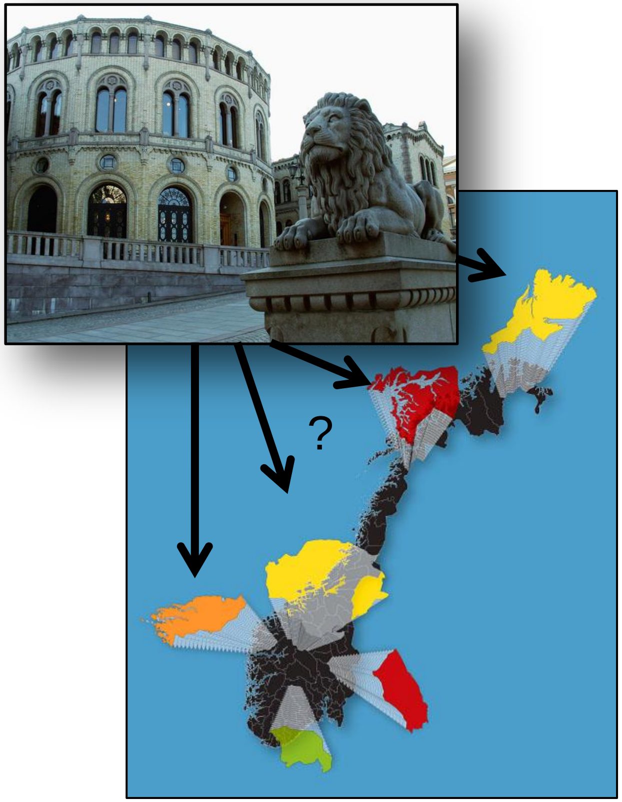


NERSC DTU Danmarks Tekniske Universitet fwu UNIVERSITÄT SIEGEN Kartverket Miljø- og Fødevareministeriet Kystdirektoratet SMHI

J. Even Ø. Nilsen - even@nersc.no

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



J. Even Ø. Nilsen - even@nersc.no

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

J. Even Ø. Nilsen - even@nersc.no

Thank You!

ECRA Sea Level Change and Coastal Impacts Collaborative Programme

Sea level – Impacts – Risks – Adaptation

Gianmaria Sannino (ENEA)

Italian National Agency for
New Technologies, Energy and
Sustainable Economic Development
(Rome, Italy)

Jan Even Øie Nilsen (NERSC/BCCR)

Nansen Environmental and
Remote Sensing Center
(Bergen, Norway)

www.ecra-climate.eu