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Towards a Regional Assessment of Coastal Flood Risk: A review of Methods Applied in Norway, Sweden, Finland, Denmark, and Germany

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Towards a Regional Assessment of Coastal Flood Risk

A review of Methods Applied in Norway, Sweden, Finland, Denmark, and Germany

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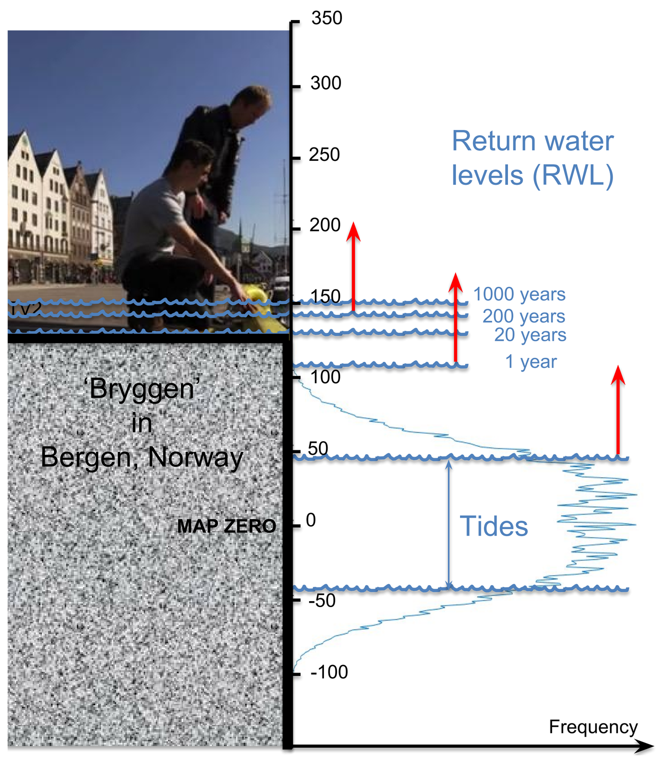
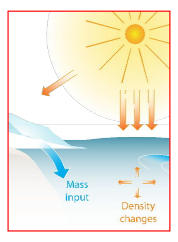
Flood risk – a combination of tidal-regime, extreme values, and sea level rise



Sea level rise gives higher return heights and flooding more often

Projected 50 cm sea level rise by 2100 (ensemble mean)



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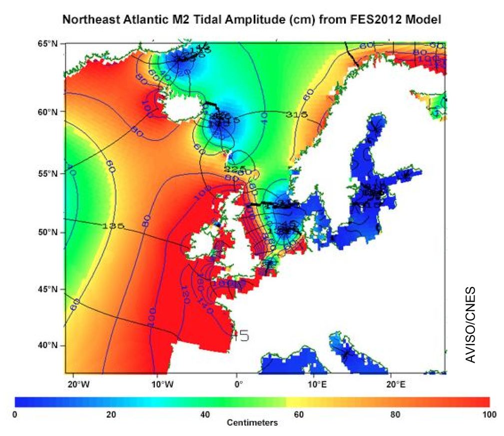
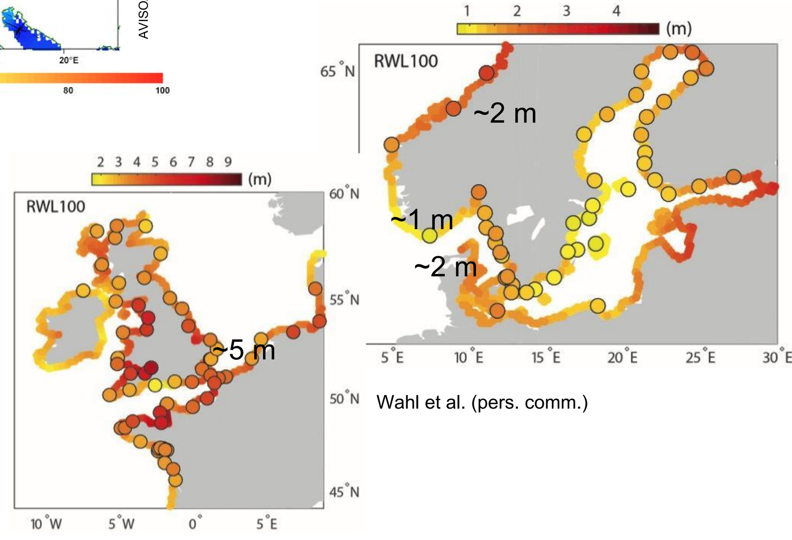
PHYSICAL DIFFERENCES

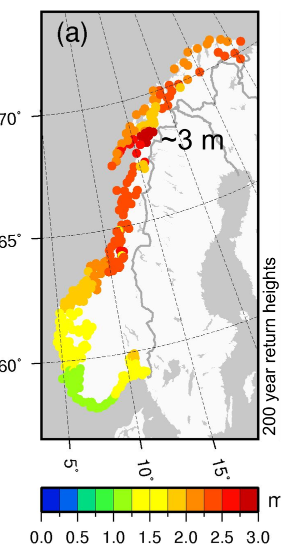
Tidal ranges



Return Water Levels

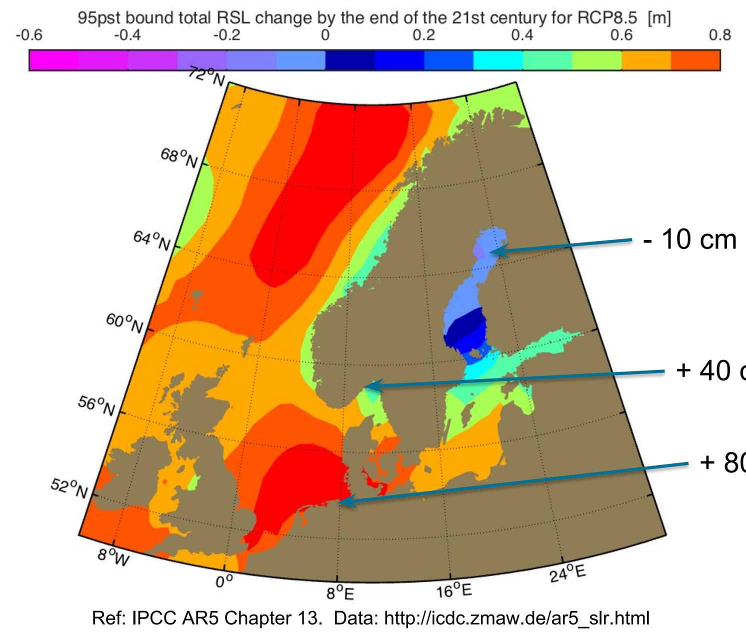


Wahl et al. (pers. comm.)



Simpson et al. (2015)

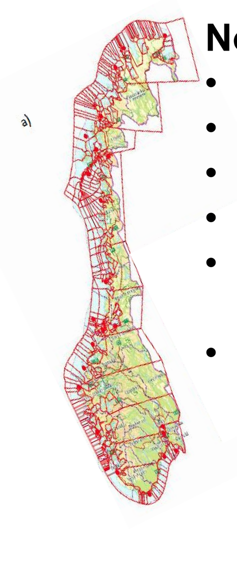
Projected Sea Level Changes



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

METHODOLOGICAL DIFFERENCES

Extreme Value Analyses and return water levels used



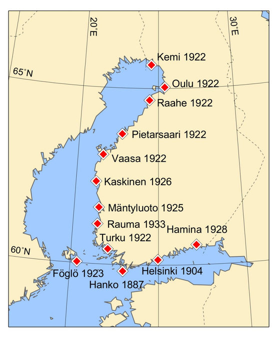
Ravndal & Sande (2016)

Norway:
- 23 tide gauges
- 25–100 year series
- Detrended
- ACER-method
- 20, 200, 1000 years RWL
- analysis between tide gauge stations done using local tide and nearest observed weather effect

Sweden:
- 23 tide gauges
- 40–130 year series
- Detrended
- GEV-method
- 100, 200 years RWL
- Regional recommendations for lowest allowed building (RWL+safety)
- Tides partially included in EVA

Nerheim et al. (2013)

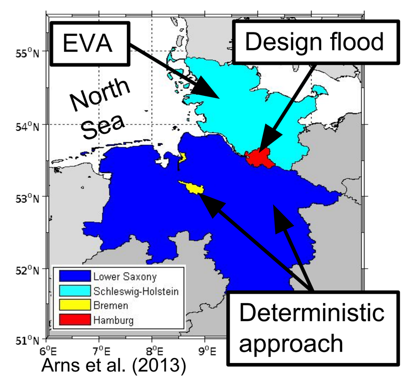
Finland:
- 14 tide gauges
- 84–130 year series
- Detrended
- Exponential distribution fitted to monthly maxima of the last 30 years
- 20, 50, 100, 250,1000 years RWL
- Lowest recommended building heights based on 1/250 events/year in 2100 + wave margin
- Interpolation between tide gauge stations



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)

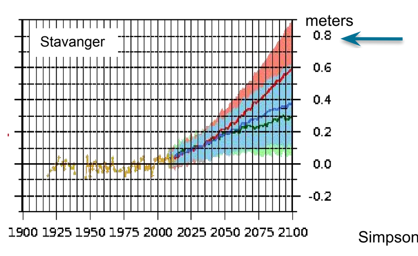
Germany:
- Different methods between states
- Both 100 and 200 years RWL used as design levels
- + some safety



Arns et al. (2013)

Sea level projections used

Norway:
- IPCC AR5 based
- Land uplift based on observations
- National recommendation RCP8.5 & 95% bound

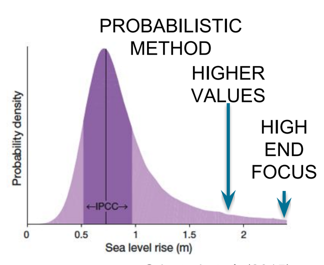


Simpson et al. (2015)

Sweden:
- IPCC AR5 based
- Land uplift based on updated modelling
- Recommendation RCP8.5 & 95% bound from regional authorities

Finland:
- An ensemble of several recent GMSL predictions, including IPCC AR5 (details in Johansson et al. 2014)
- Land uplift, uneven distribution of GMSL rise, and changes in the Baltic Sea water balance accounted for.

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

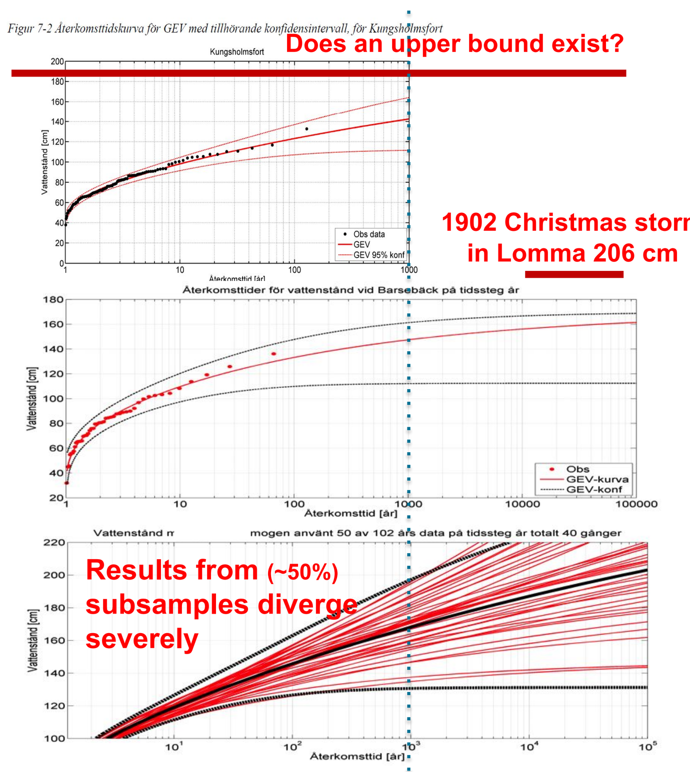


Grinsted et al. (2015)

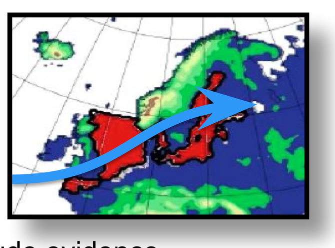
Germany:
- IPCC AR5 based
- Coastal protection climate change surcharge depends on federal state (e.g., 50 cm in Schleswig-Holstein)

In general no political decided number to use …

What about the more rare extremes?



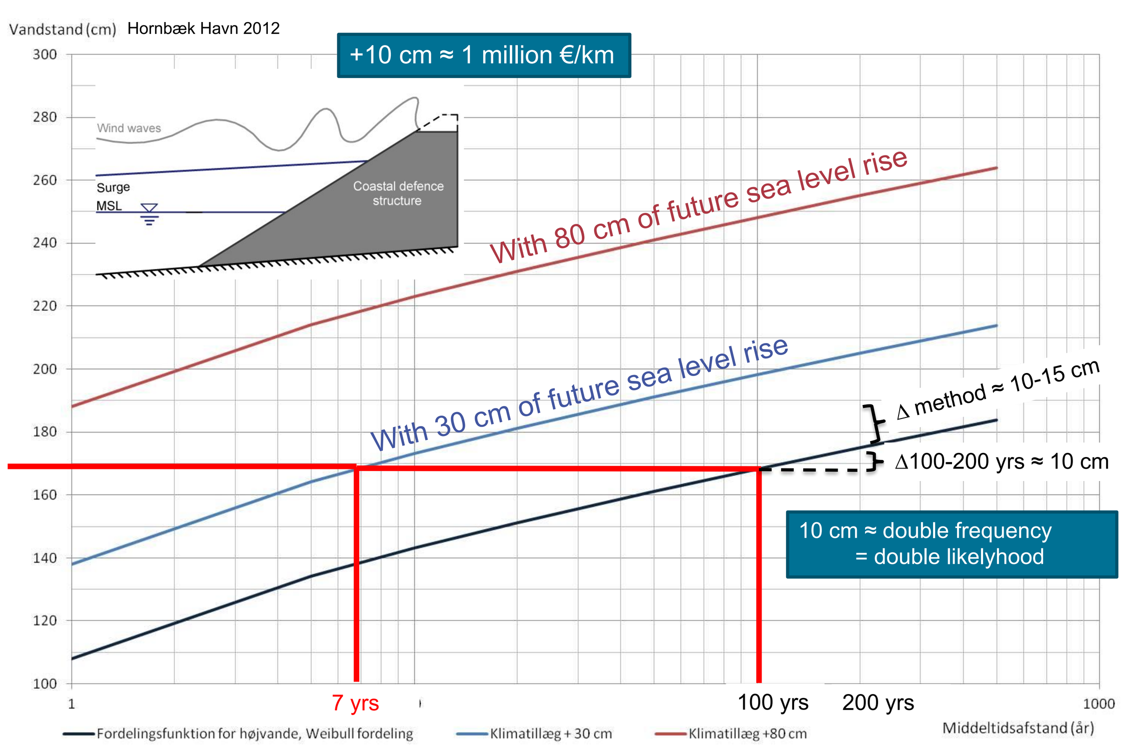
- Study in Sweden
- Demand for upper bound, for design values
- Worst storm in present climate is unknown
- Statistical EVA is problematic for return periods longer than the time series
  - Most countries have at best 100 or some years time series
- Modelling deemed more suitable for design values
  - 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



Nerheim et al. (2013)

An alternative method to assess rare extremes is to include evidence of historic events. See also poster 45 today by Madsen et al.

Are methodological differences important?



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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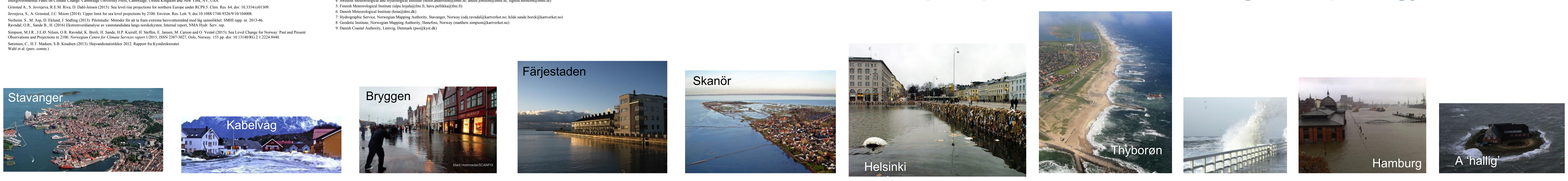
Different impact potentials: urban- and geomorphology



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