Future sea level rise on the Finnish coast and its implications

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Outline

Sea level rise

Local projections

Results

Applications

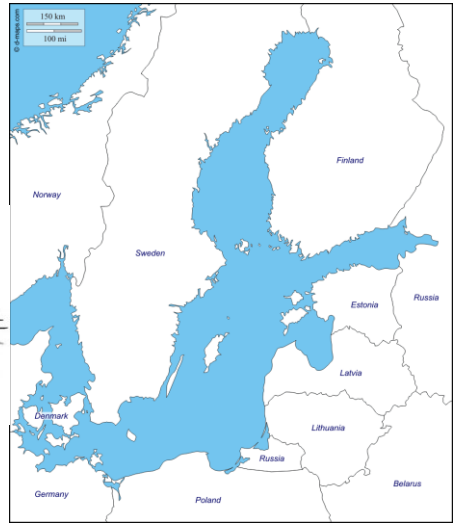
Factors vel in Finland

1. Postglacial land uplift

2. Regional sea level rise
3. Wind-induced component (Baltic Sea water balance)

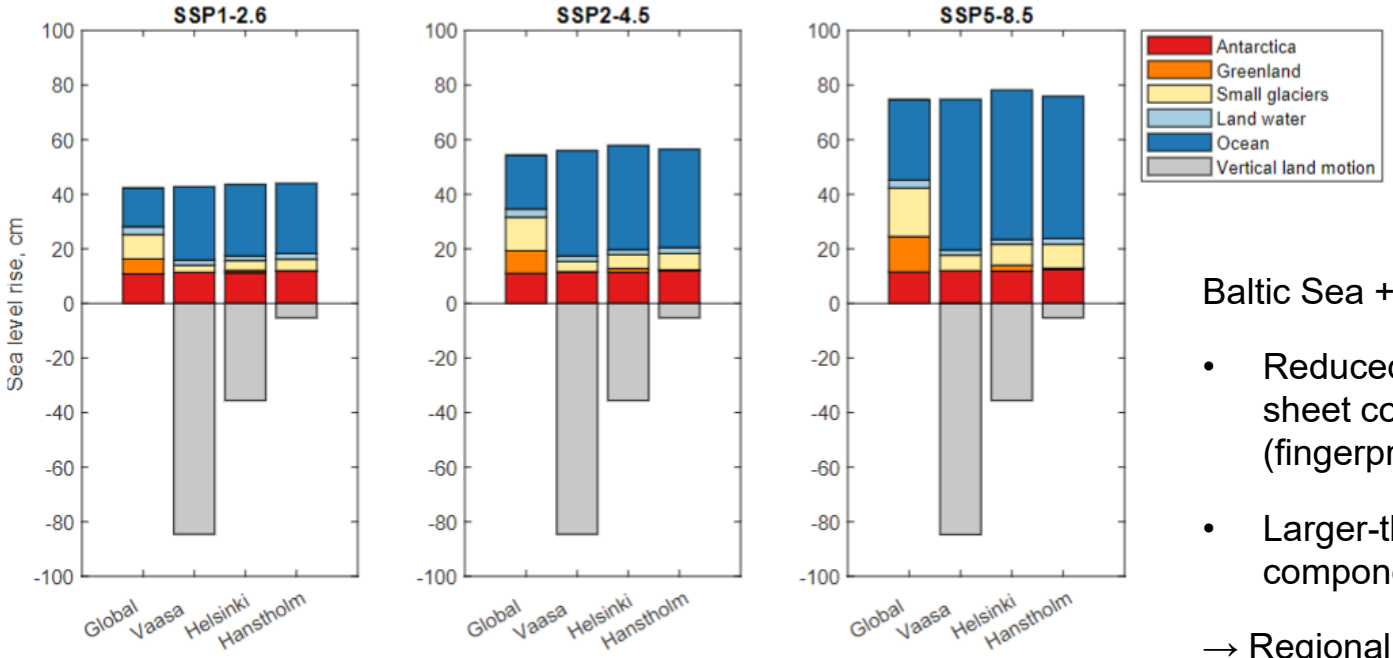
- 3–9 mm/yr depending on location (NKG2016LU)

Increasing westerly winds: small additional sea level rise in Finland



AR6: Regional sea level rise

IPCC AR6 median projections, 2100 relative to 1995–2014, medium confidence



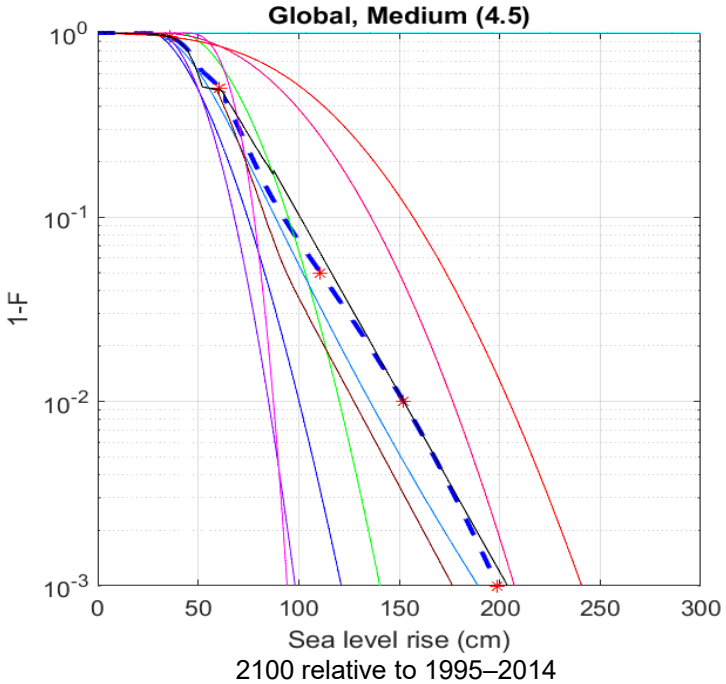
Baltic Sea + North Sea:

- Reduced glacier and ice sheet contribution (fingerprints)
- Larger-than average ocean component

→ Regional sea level rise ~ same as globally (excluding land uplift)

Probability distribution of sea level rise

- Before AR6, IPCC's sea level projections have not included low-confidence information (marine ice sheet instability)
- Therefore, Finnish national assessments have been based on an ensemble of projections: probability distribution fitted to each projection
- Mixture distribution of 10 global mean sea level projections, including medium and low confidence projections from IPCC AR6



Red dots

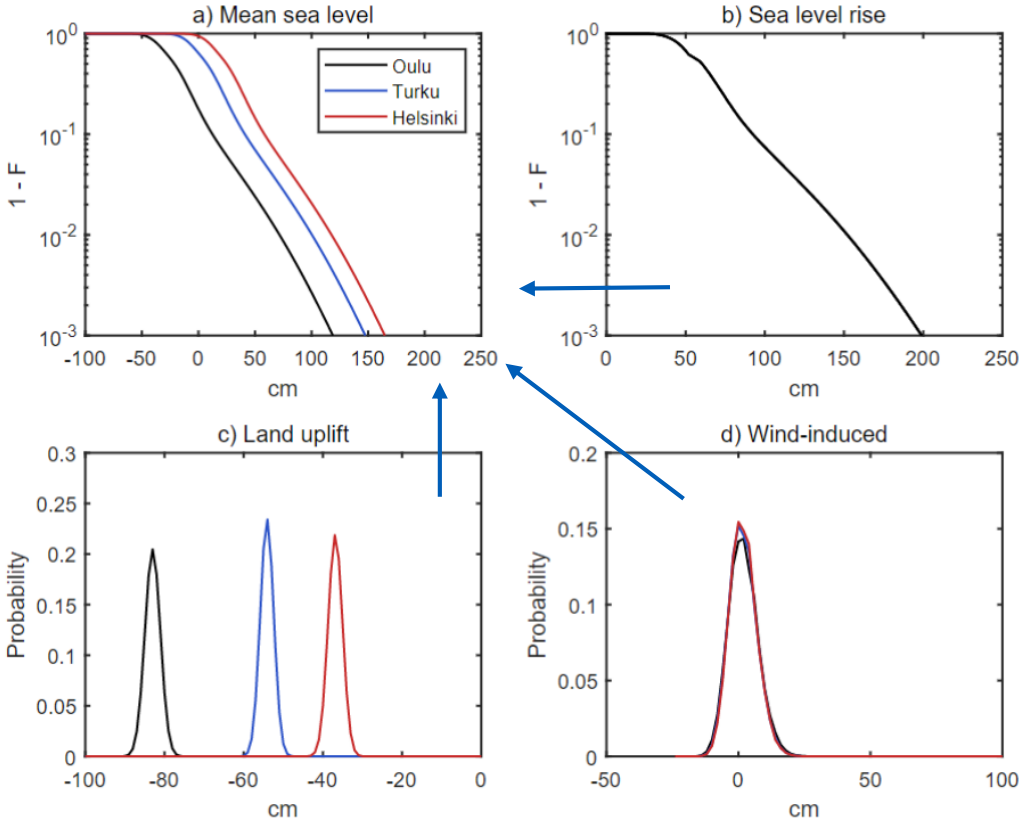
5%	50%	95%	99%	99.9%
36.0	60.4	110.8	152.1	199.0

Local mean sea level projections

RCP/SSP2-4.5: 2100 relative to 1995–2014

Local mean sea level projection

a = b + c + d



Land uplift (NKG2016LU)

- Mixture distribution incorporating 10 global sea level rise projections
- Same (global) distribution used for all locations

Based on

- correlation between zonal geostrophic wind in the Danish Straits and mean sea level in Finland
- climate model projections of geostrophic wind

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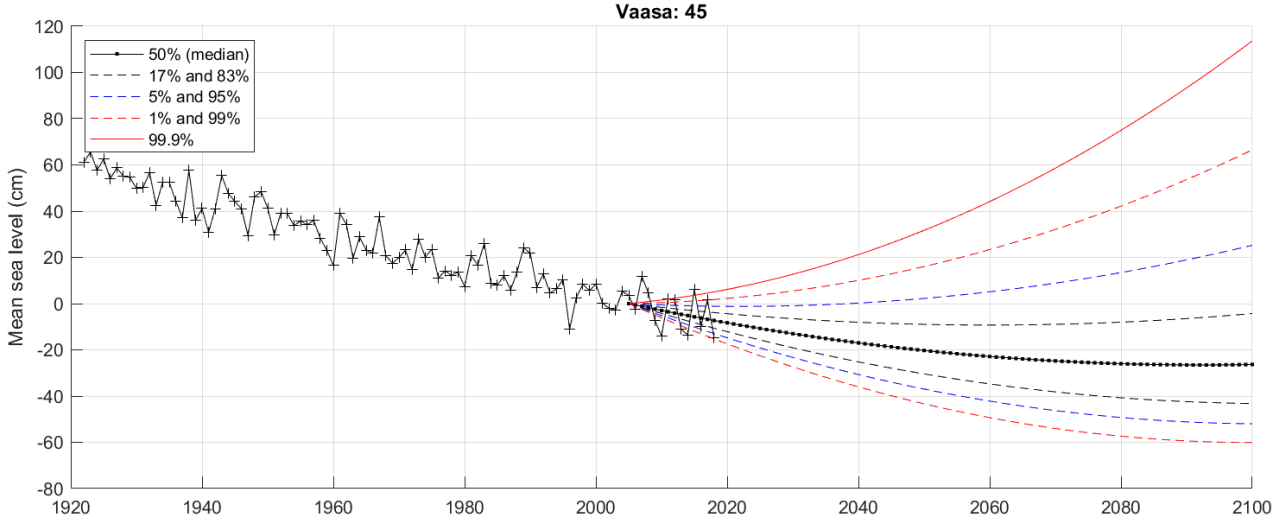
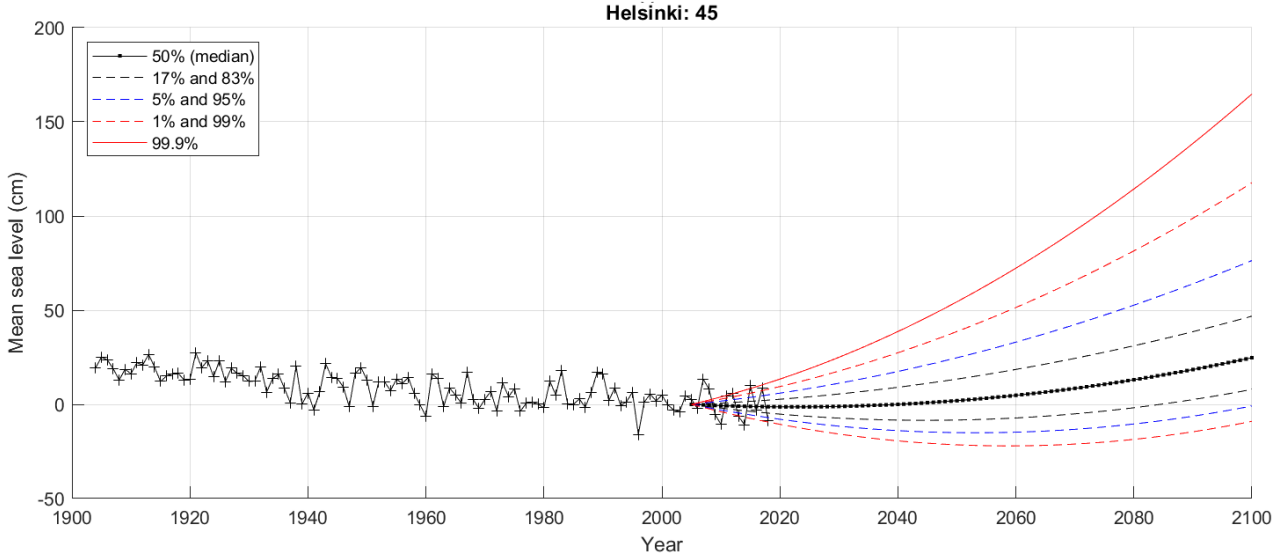
Results

Mean sea level projections for Vaasa and Helsinki by 2100

- Middle emission scenario: RCP4.5/SSP2-4.5





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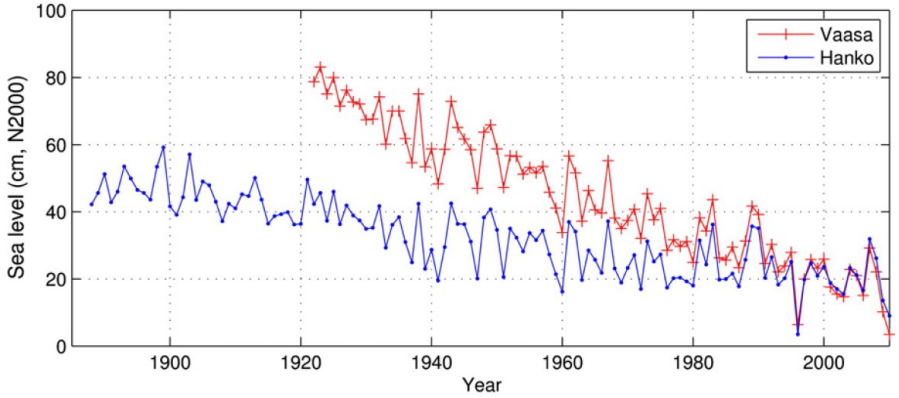
Past trends of absolute sea level rise

Trends of local sea level rise can be calculated from observed (relative) mean sea levels, when land uplift rates and the wind-induced component over the 20th century are known



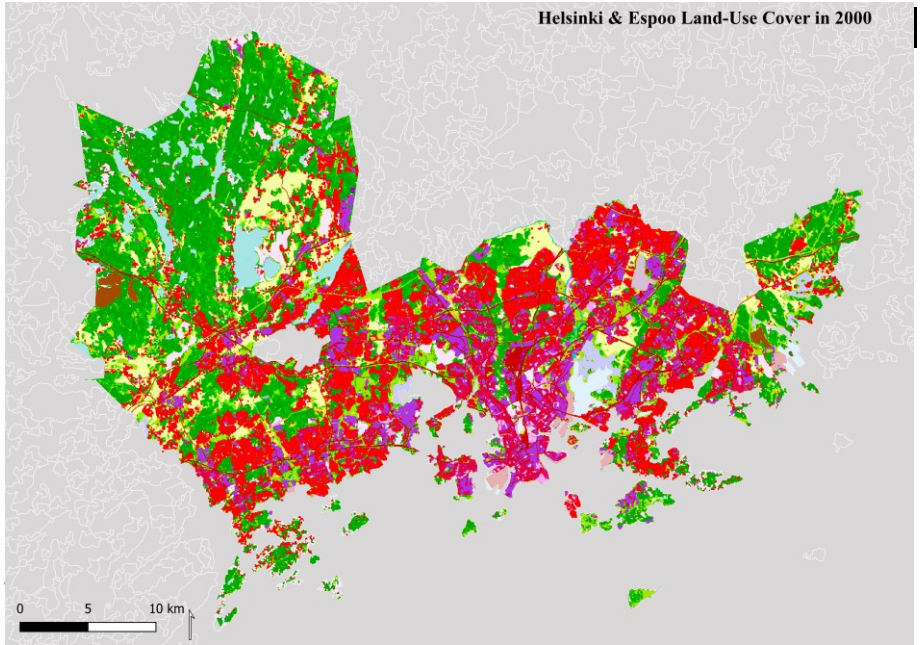
Trends of relative mean sea level (h_m), land uplift (d), absolute local sea level rise (r) and the wind-induced component (w) in Helsinki, Turku and Vaasa (mm/a)

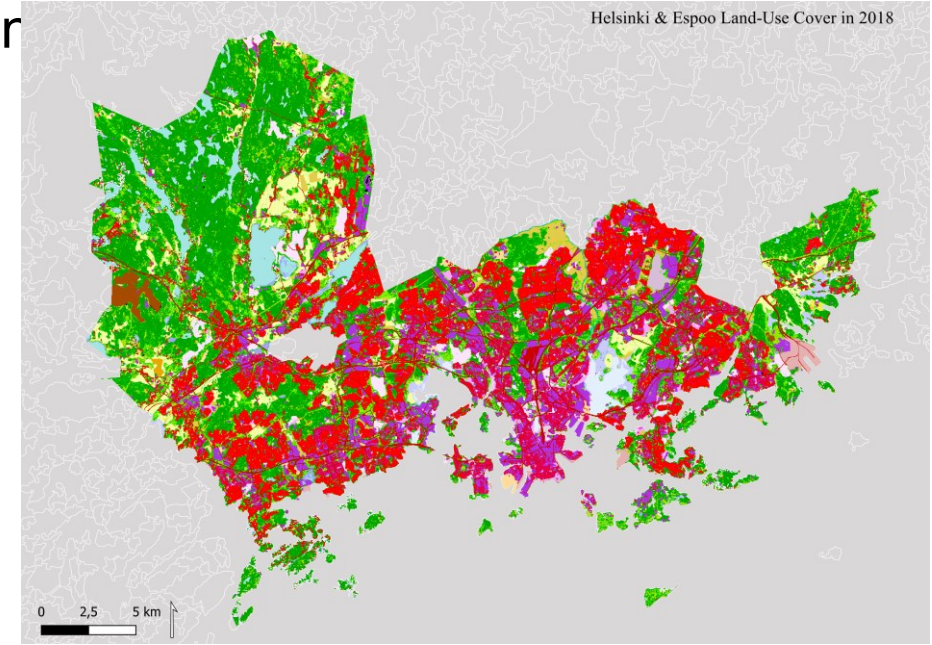
	Years	$\dot{h}_m$	$\dot{d}$	$\dot{w}$	$\dot{r}$
Helsinki	1901–2018	–1.88 ± 0.19	–3.69 ± 0.18	0.49 ± 0.19	1.32 ± 0.08
Turku	1922–2018	–3.56 ± 0.24	–5.41 ± 0.17	0.59 ± 0.25	1.29 ± 0.11
Vaasa	1922–2018	–6.97 ± 0.25	–8.79 ± 0.16	0.60 ± 0.25	1.23 ± 0.11
Helsinki	1993–2018	–0.37 ± 1.89	–3.69 ± 0.18	0.17 ± 2.11	3.15 ± 0.85
Turku	1993–2018	–2.07 ± 1.81	–5.41 ± 0.17	0.16 ± 2.01	3.18 ± 0.80
Vaasa	1993–2018	–5.10 ± 1.87	–8.79 ± 0.16	0.16 ± 2.02	3.54 ± 0.76

Essentially same as global mean rates

Application of the results

- **The results are applied in national adaptation planning and impact studies**
  - Interactive flood risk maps
  - Land use changes in the flood risk zone of Helsinki





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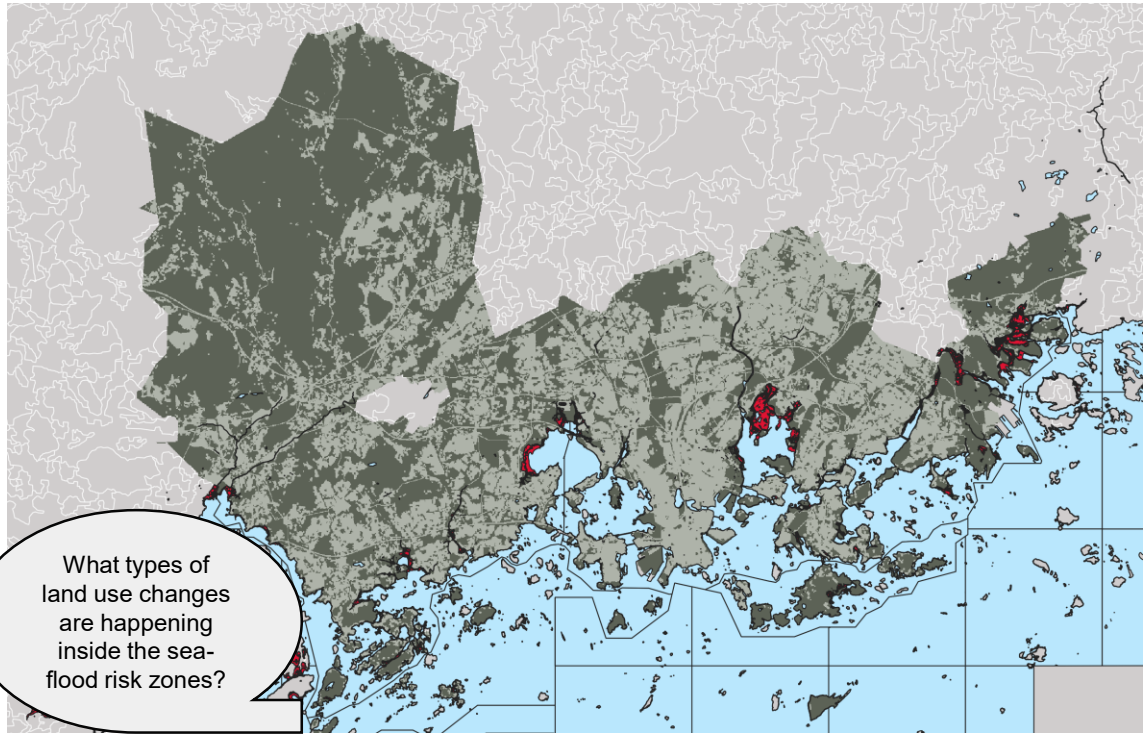

Land Use Types	Areas at risk in 2000 (ha)	Areas at risk in 2018 (ha)
Agricultural areas	256	275
Artificial Surfaces	723	605
Natural Areas	888	904
Wetlands	302	81

There are more agricultural areas and natural areas inside the risk zones, while fewer artificial surfaces and wetlands fall into the risk zones in 2018.

Note:

- Sea-flood risk zones represent the least probability (1/1000a) of occurrence in coastal regions of Helsinki and Espoo.
- This study assumes that the sea-flood hazard data is the same as in 2018 because no reliable data was found about sea-flood risks in 2000.

Take home messages

AR6 projections capture the uncertainty quite well.

Sea level rise on the southern Finnish coast will be faster than land uplift by the end of this century.

Adaptation and impact studies need this type of input.

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Thank you