Storm surge and wave extremes for present and future. Impact on the insurance losses for the North Sea coastal areas.

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Extreme Environmental Events, 13-17 December 2010, Cambridge

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CoastDat downscaling cascade

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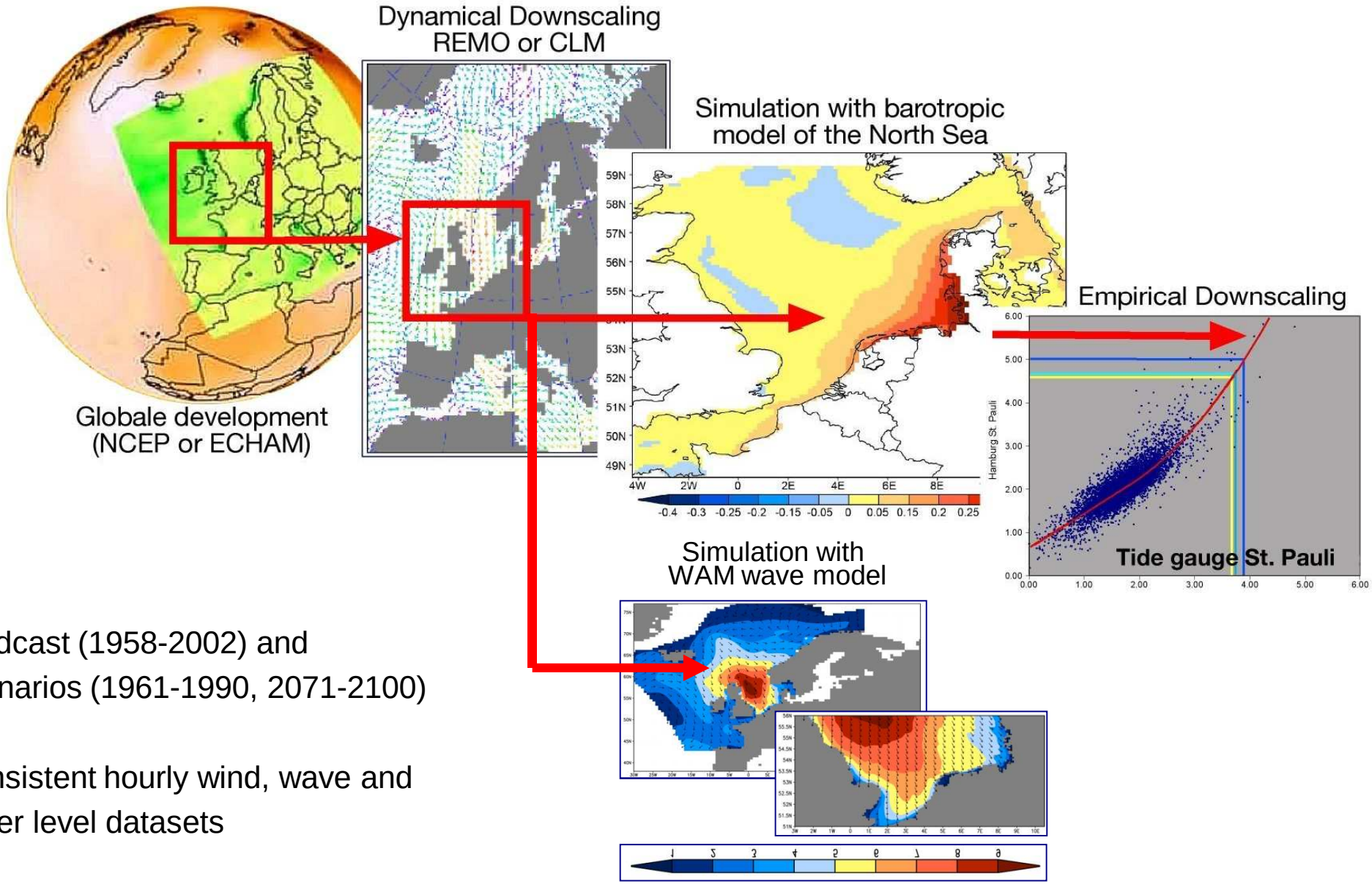

Hindcast (1958-2002) and scenarios (1961-1990, 2071-2100)

Consistent hourly wind, wave and water level datasets

Validation

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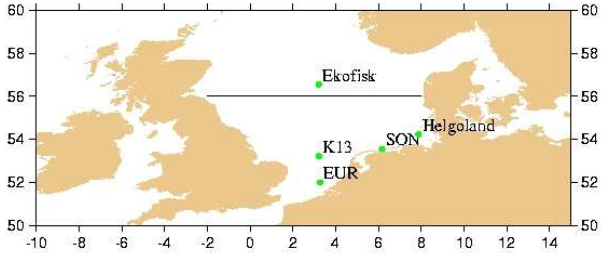

Extreme Events (wind and waves) from GEV

	Years	Wind [m/s]						Waves [m]					
		CoastDat			*Observed*			*CoastDat*			*Observed*		
		χ_r^{90}	χ_r	χ_r^{90}	χ_r^{90}	χ_r	χ_r^{90}	χ_r^{90}	χ_r	χ_r^{90}	χ_r^{90}	χ_r	χ_r^{90}
K13	**2**	24.38	25.17	25.96	24.05	25.21	26.37	7.12	7.49	7.86	6.41	6.77	7.13
	5	25.86	27.28	28.7	25.75	27.64	29.53	7.84	8.44	9.04	6.93	7.54	8.15
	25	28.44	31.33	34.22	28.09	32.77	37.45	8.99	10.35	11.71	7.52	9.21	10.9
EUR	**2**	22.5	23.16	23.82	23.16	24.03	24.9	5.89	6.15	6.41	5.52	5.84	6.16
	5	23.76	24.82	25.88	24.33	25.94	27.55	6.34	6.83	7.32	5.89	6.46	7.03
	25	25.67	28	30.33	26.43	29.75	33.07	6.9	8.2	9.5	5.99	7.88	9.77
SON	**2**	23.29	24.15	25.01	23.11	24.03	24.95	6.78	7.06	7.34	5.6	5.84	6.08
	5	24.89	26.32	27.75	24.15	25.94	27.73	7.37	7.79	8.21	5.97	6.46	6.95
	25	26.68	30.7	34.72	26.42	29.75	33.08	8.04	9.03	10.02	6.34	7.88	9.42

2, 5, and 25-year return values with 90% confidence limits based on 10.000 Monte Carlo simulations each.

(Weisse and Günther 2007)

SON - Schiermonnikoog

Applications: Long-term changes

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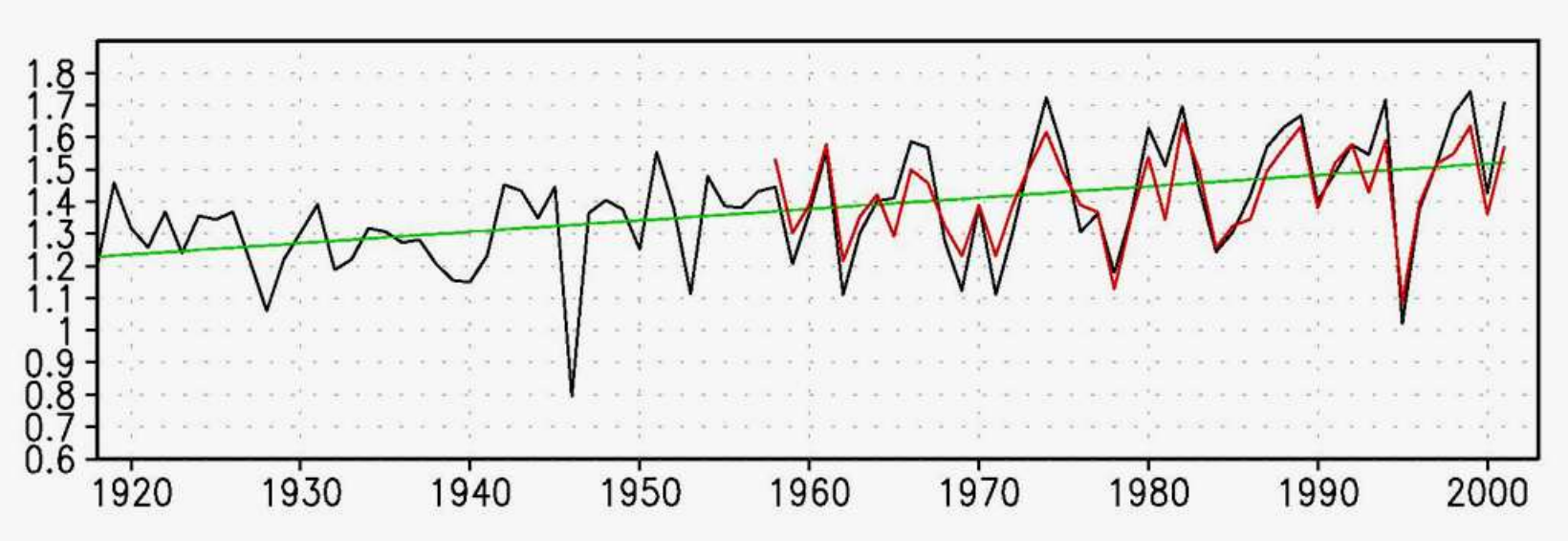
Annual mean winter high waters at Cuxhaven (German Bight)



red – modelled data, black – observations

(Weisse and Plüß 2006)

Applications: Climate change signal

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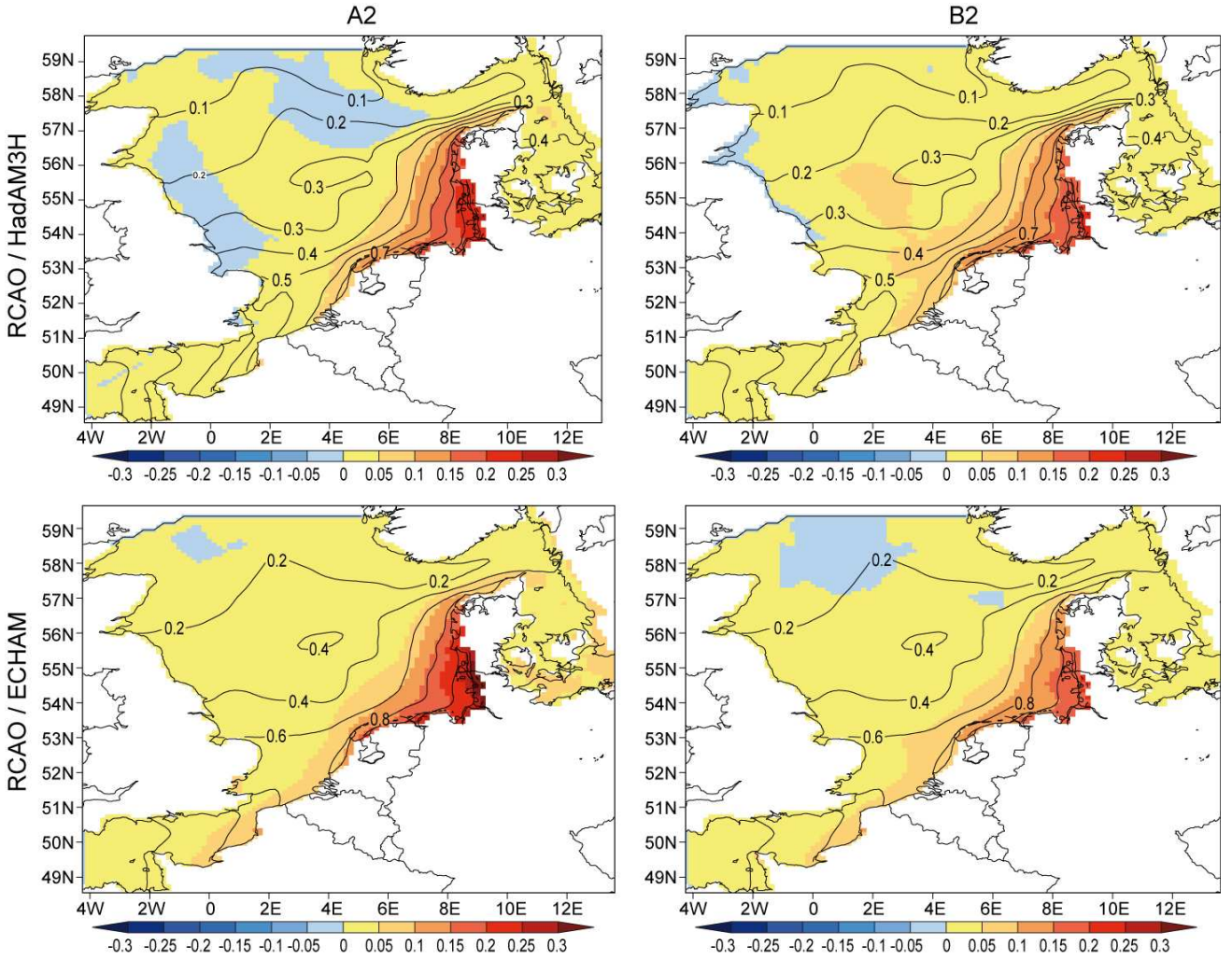
Change of annual 99.5% storm surge (2071-2100 to 1961-1990)



(Woth 2005, Woth et al. 2005)

Applications: Climate change signal

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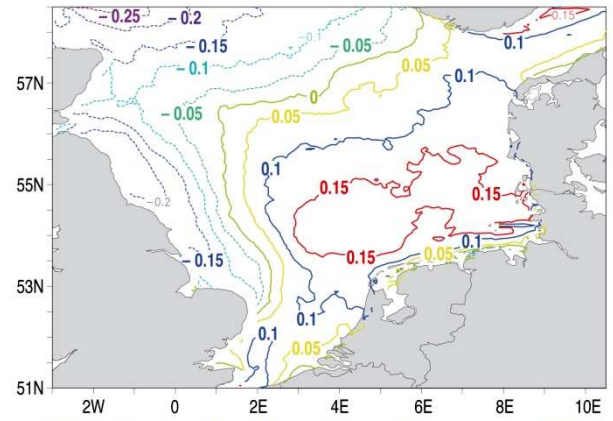
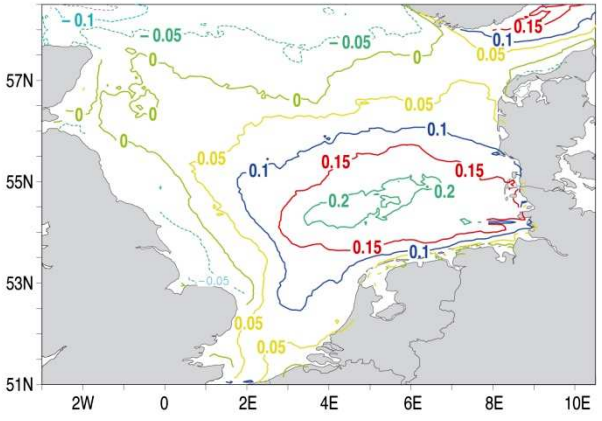
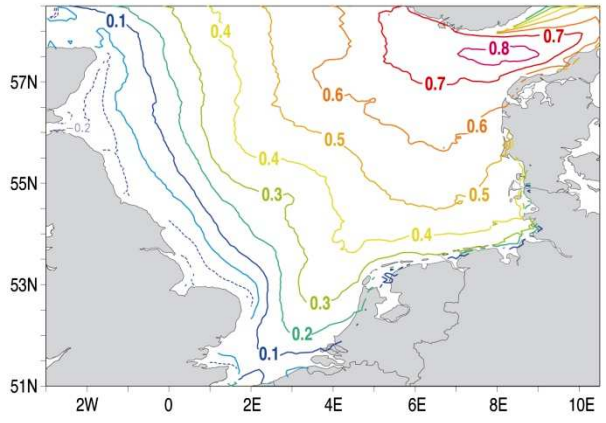
A2 **B2**

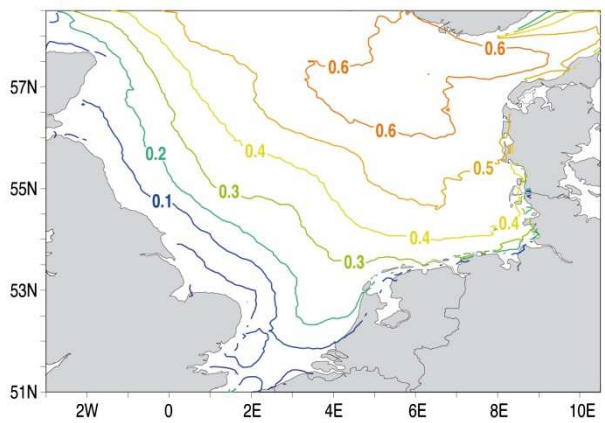
RCAO/HadAM3H





RCAO/ECHAM

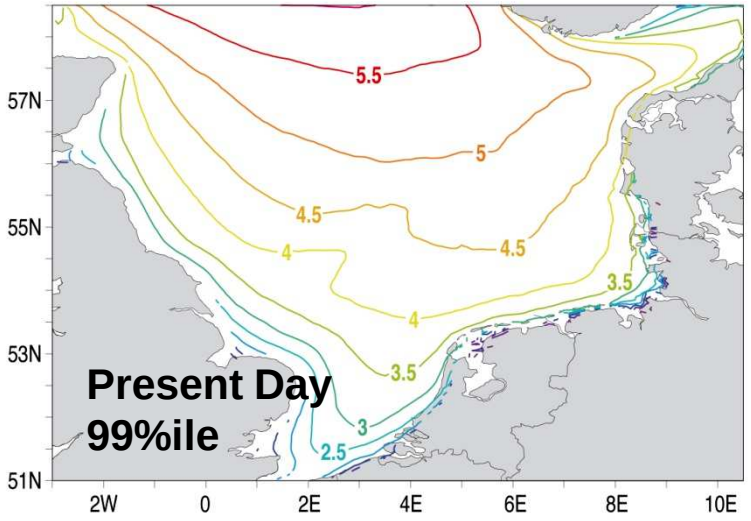




(Grabemann and Weisse, 2008)

Annual 99%-ile Significant Wave height

Climate Change Signals [m]
2071-2100 relative to1961-1990



Applications: Offshore wind

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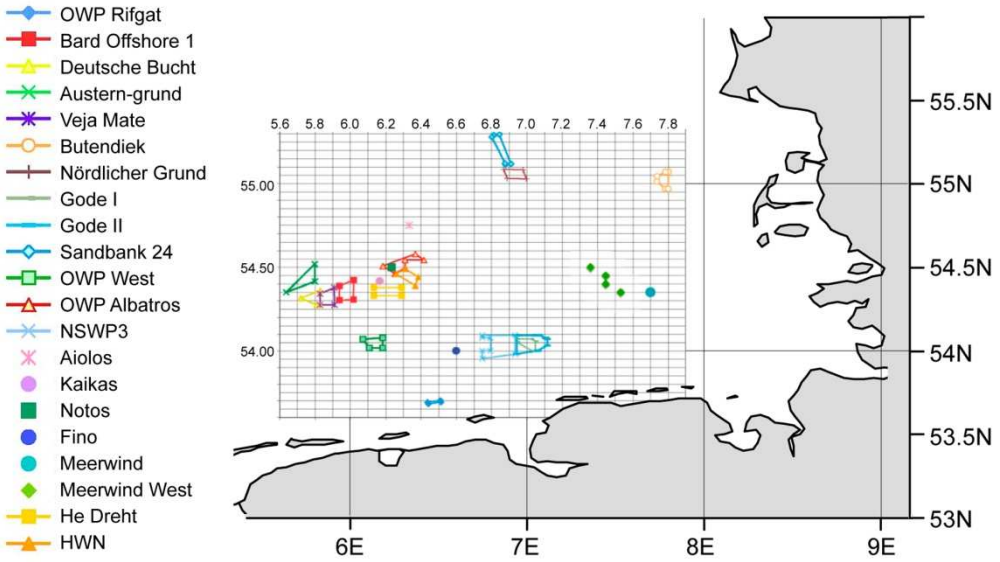
Wind and sea state statistics

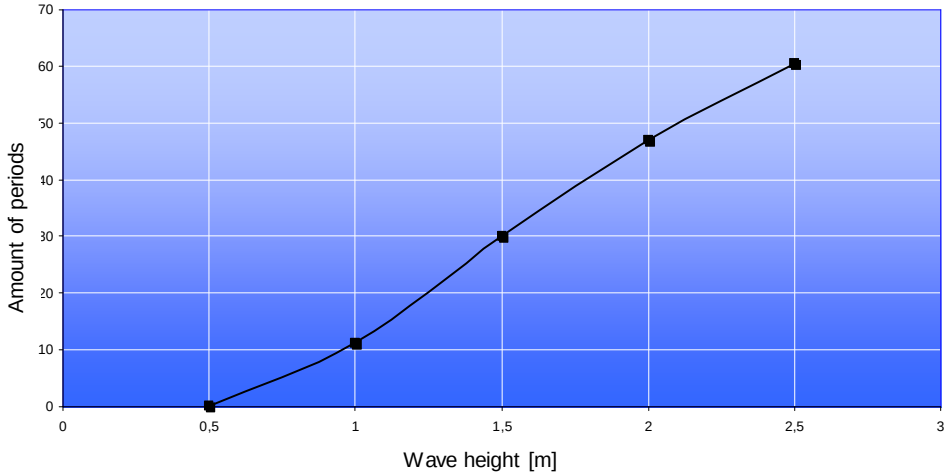
- Wind power availability
(wind speed and direction)

- Design of structures
(joint wind and wave extremes)

- Planning of installation / maintenance
(weather windows)



Mean amount of 4-day periods depending on the wave height



Applications: Safety of navigation

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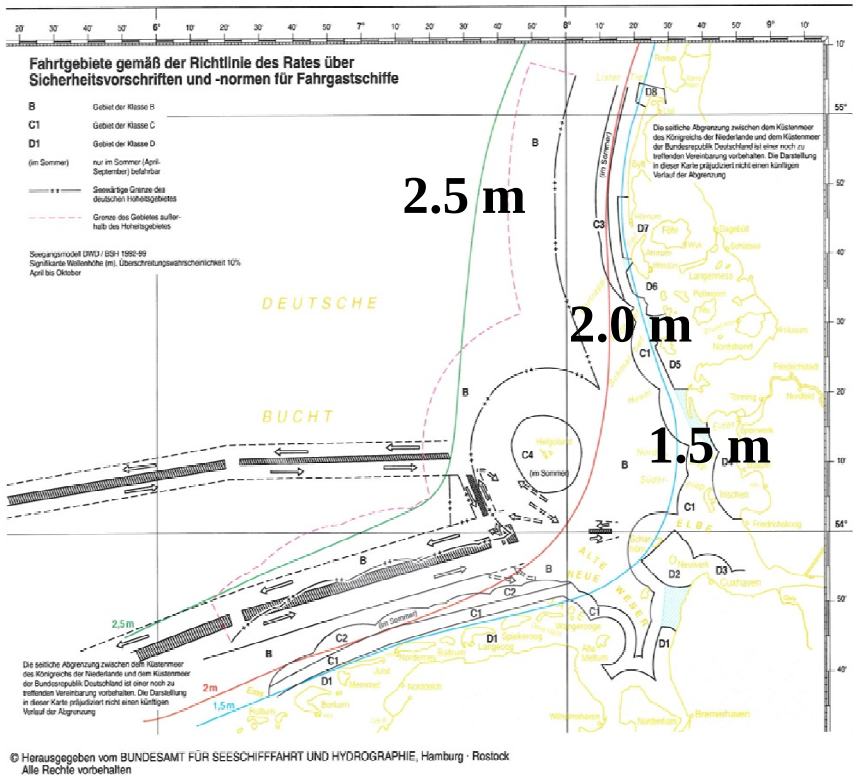
Background:

EU safety regulations for RoRo passenger vessels

Criteria:

- Sig. wave height of 1.5, 2.5, 4.0 m exceeded in less than 10% of time (according to ship specifications)
- Distance to next harbor



(Source: BSH)

Applications: Re-insurance for coastal areas

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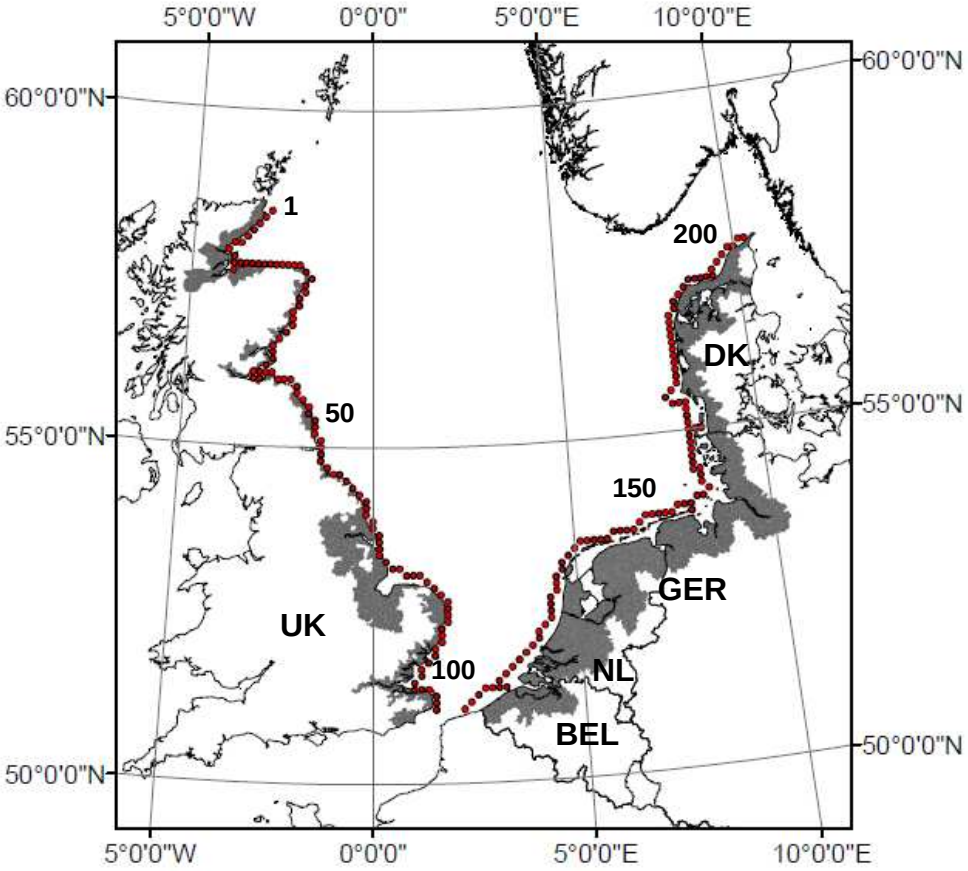
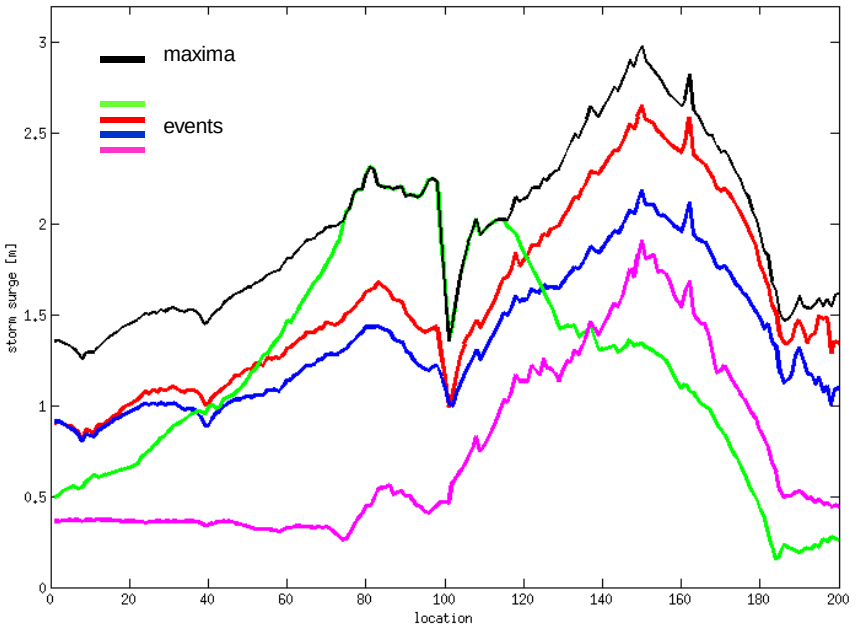
- Risk of coastal flooding due to storm surges. Possible loss changes for future climate.
- Large area (5 countries)
- Dependent time-series
- Need for realistic spatial patterns and separate events rather than spatial distribution of extremes
- Not enough high water events in the existing datasets



Strom surge events and total maxima for each location



Applications: Re-insurance for coastal areas

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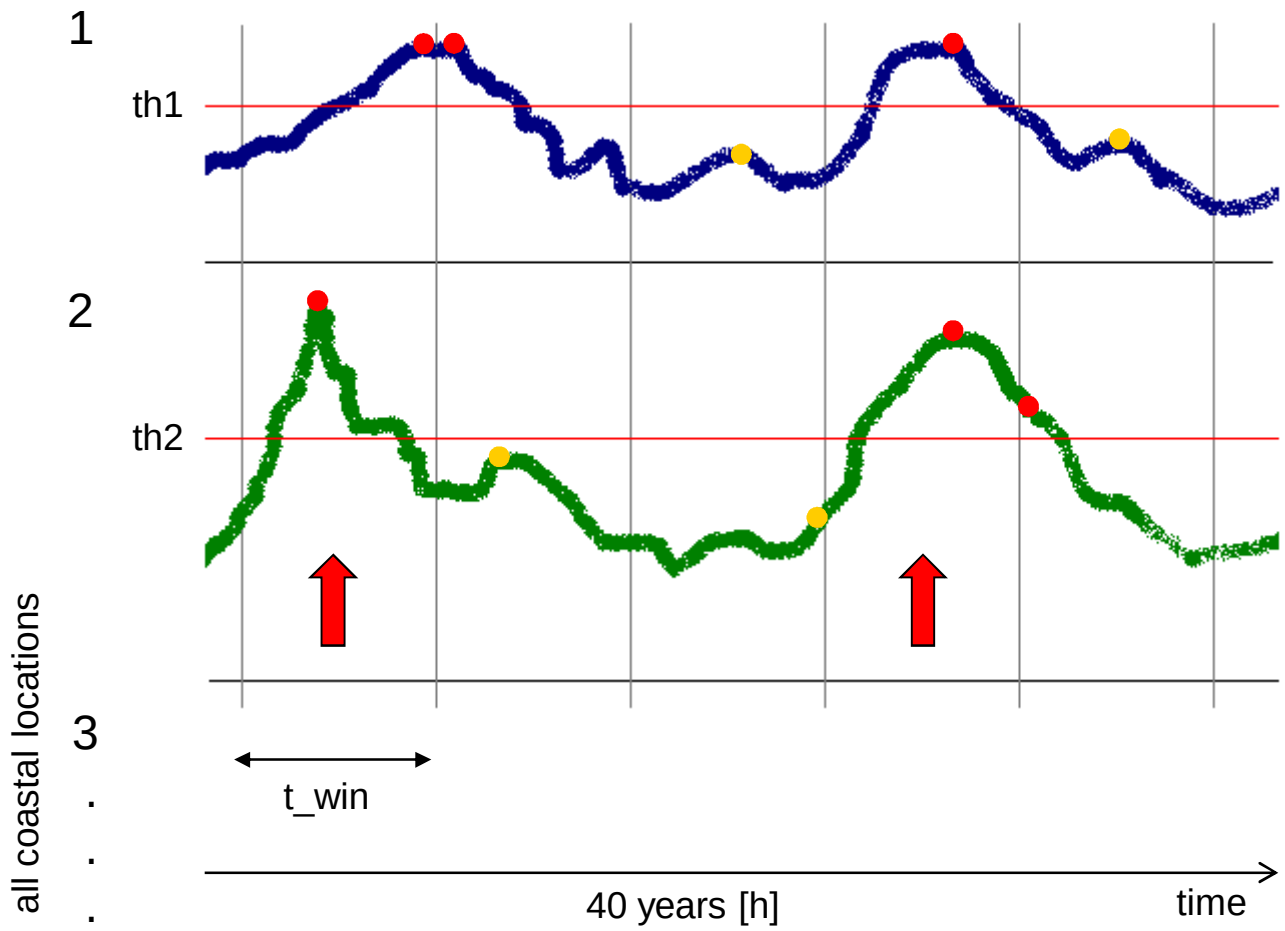
probabilistic event set

1) identify events from the original hourly dataset
2) fit the distribution (Gaussian)
3) generate artificial events



parameters:
t_win – length of time window (120h)
th(i) – threshold (ann. 99.99%)
exc – necessary number of exceedances to consider time-window as event (10)

Applications: Re-insurance for coastal areas

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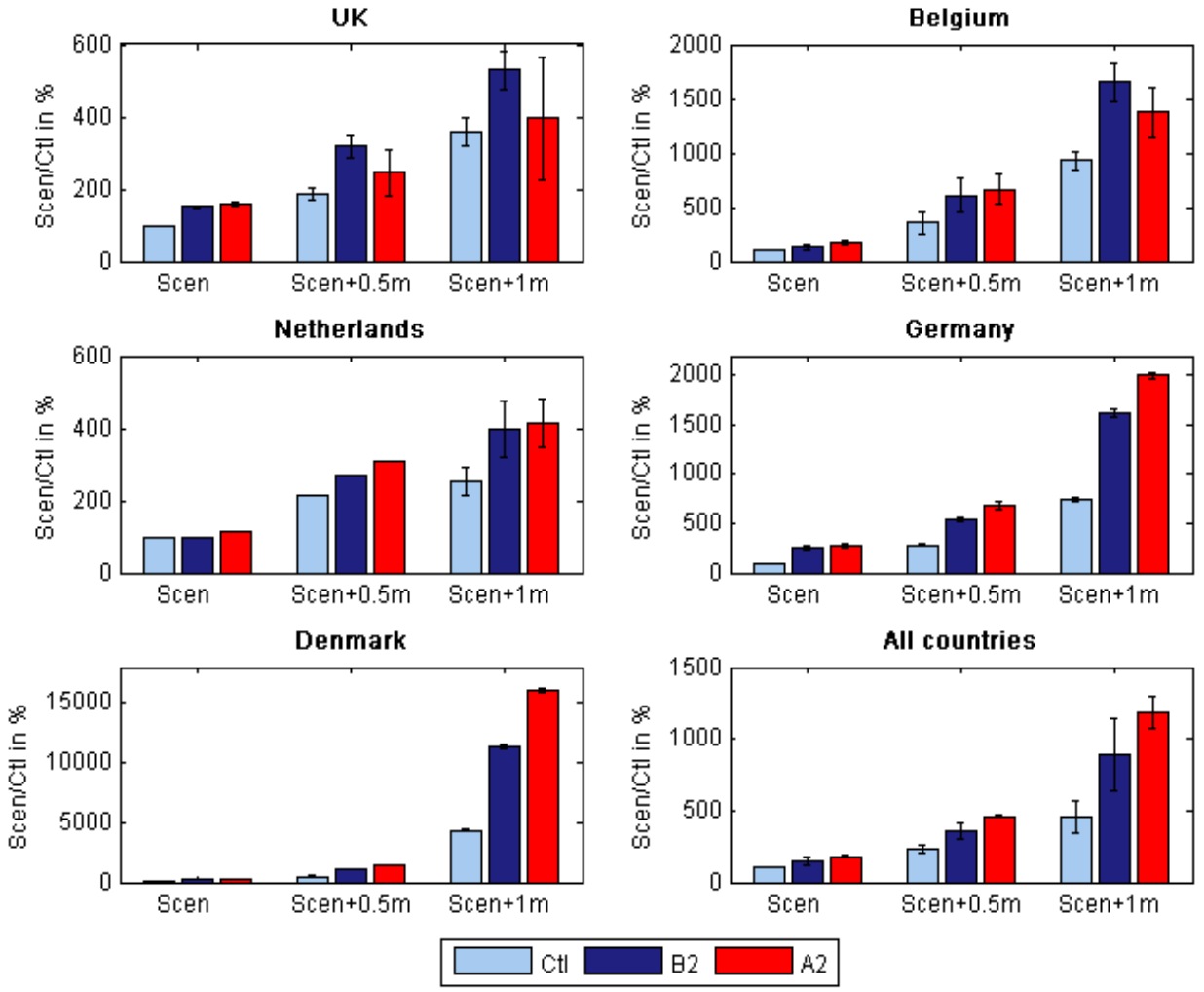
Differences between annual expected losses from scenarios and present day conditions



Thank you for your attention

References:

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