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

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CoastDat downscaling cascade

- Dynamical Downscaling
  - REMO or CLM
  - Simulation with barotropic model of the North Sea

- Empirical Downscaling
  - Tide gauge St. Pauli


Consistent hourly wind, wave and water level datasets
Validation

Extreme Events (wind and waves) from GEV

<table>
<thead>
<tr>
<th>Years</th>
<th>Wind [m/s]</th>
<th>Waves [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CoastDat</td>
<td>Observed</td>
</tr>
<tr>
<td></td>
<td>$X_r^{90}$</td>
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<td>25</td>
<td>26.68</td>
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</tbody>
</table>

2, 5, and 25-year return values with 90% confidence limits based on 10,000 Monte Carlo simulations each.

(Weisse and Günther 2007)
Applications: Long-term changes

Annual mean winter high waters at Cuxhaven (German Bight)

red – modelled data, black – observations

(Weisse and Plüß 2006)
Applications: Climate change signal

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

(Woth 2005, Woth et al. 2005)
Applications: Climate change signal

Annual 99%-ile Significant Wave height
Climate Change Signals [m]
2071-2100 relative to 1961-1990

(Grabemann and Weisse, 2008)
Applications: Offshore wind

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)
Applications: Safety of navigation

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

- 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

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

parameters:

\( t_{\text{win}} \) – length of time window (120h)
\( \text{th}(i) \) – threshold (ann. 99.99%)
\( \text{exc} \) – necessary number of exceedances to consider time-window as event (10)
Applications: Re-insurance for coastal areas

Differences between annual expected losses from scenarios and present day conditions

UK

Belgium

Netherlands

Germany

Denmark

All countries

Scen/Cti in %

Scen, Scen+0.5m, Scen+1m

Ct, B2, A2
Thank you for your attention

References:


