Simulating extreme sea levels at the Baltic Sea coast from synthetic cyclones

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Baltic Sea



- Sea level affected by wind, air pressure and seiches
- Mean sea level from water flow through the Danish Straits
- Negligible tides
- Mean depth 54 m
- Highest maxima in the ends of bays
- Finnish tide gauges (shown on the map) have 100-year time series
- Highest observed maxima at Hamina (197 cm) and Kemi (201 cm)

Method to simulate sea level extremes

- Aim is to study coastal sea level maxima due to wind and air pressure
- How severe coastal flooding could occur in the present climate, if the weather conditions are optimal?
- Looking for the cyclone tracks that cause the highest storm surges
- Generate an ensemble of synthetic cyclones (moving pressure fields)
- · Calculate the surface winds from the pressure field
- Sea levels are simulated with a barotropic numerical model, having surface wind and pressure as forcing
- Large ensemble of cyclones with varying tracks is used as forcing to sea level model





Cyclone generation



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- Pressure distribution has Gaussian shape
- Cyclone moves with constant velocity from given point
- The maximum depth of the pressure distribution is constant
- Surface winds obtained from corrected geostrofic winds
- Correction based on reanalysis data

Preliminary results and future studies

- Storm surge maxima 200 cm at Kemi, 240 cm at Hamina
- Mean water level of the Baltic Sea (up to 100 cm) should be added to storm surge
- Over 300 cm sea levels are possible when storm surge coincides with high mean sea level
- Probabilities of maxima are not assessed with this method (no weighting for the cyclone tracks)
- Further simulations will be made based on an ensemble of cyclones
- The high sea level extremes for different locations at the coast are identified
- The effects of low pressure intensity, speed, direction and point of origin on the sea level extremes on the coast are studied





Ilmatieteen laitos

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