ESCALATE

Extreme Storms and Coastal evolution under AccelerATEd sea level rise

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Aim of ESCALATE

The aim of the ESCALATE project is to quantify future coastal change at mid-latitudes under global warming, with an emphasis on dune erosion. Climate change may influence surge levels and storm-wave characteristics and is expected to lead to accelerated sea-level rise.

Our working hypothesis is that the future behaviour of mid-latitudinal coasts is determined primarily by changes in the storm climate, with associated changes in surge levels and wave characteristics and that, in contrast to common believe, sea-level rise is a secondary climate driver only. We are using a chain of models to test this hypothesis.

Climate models

Essence

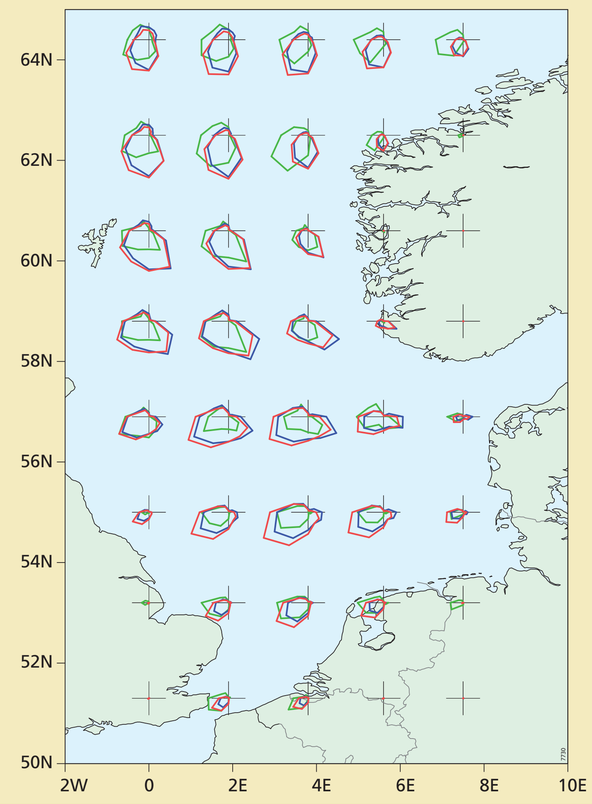
- Based on ECHAM5/MPI-OM climate model
- greenhouse gas concentrations follow IPCC SRES A1b scenario
- 150 year (1950-2100)
- 17 ensemble runs
- the large number of members allows to calculate storm surge levels and wave characteristics with low probability of occurrence (1:100-1:10 000 years)

EC Earth

- Climate model originally developed for weather prediction
- Using more than one climate model provides the possibility to study model uncertainties
- climate runs with high spatial resolution and possibly different scenarios compared to Essence

Preliminary wind results (Essence)

Distribution of 6-hourly winds exceeding 8 Bf (17 m/s) per 30- degree sector for all grid points in the North Sea. Means over all ESSENCE members for the present (1950-2000, blue) and future (2050-2100, red) climates. For comparison, ERA-40 is added in green. Along rows at 53°N and 55°N an increase in strong south-westerly winds can be seen. [Sterl et al 2009]



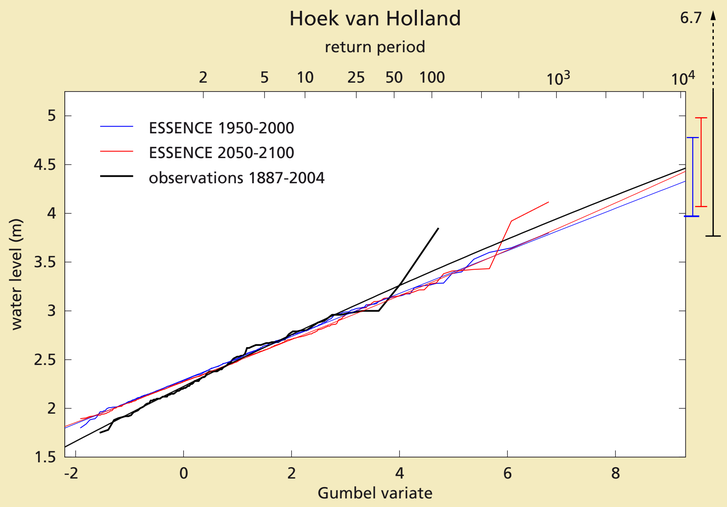
Wind
Sea level pressure

Storm surge model

WAQUA

- operational storm surge model of KNMI
- grid on the northwest European shelf region (approximately 8 x 8 km)
- The astronomical tide is prescribed at the open boundaries and propagates from there into the model domain

Storm surge results at Hoek van Holland



Gumbel plot for water levels at Hoek van Holland from the ESSENCE-WAQUA/DCSM98 ensemble. Black: observations, blue: present-day climate (1950-2000), red: future climate (2050-2100). The thin lines are the fits to a GEV, and the bars in the right margin indicate the 95% confidence interval of the 10 000-year return value. Within the limits of natural variability there is no change in the height of the water levels due to global warming along the Dutch coast. [Sterl et al 2009]

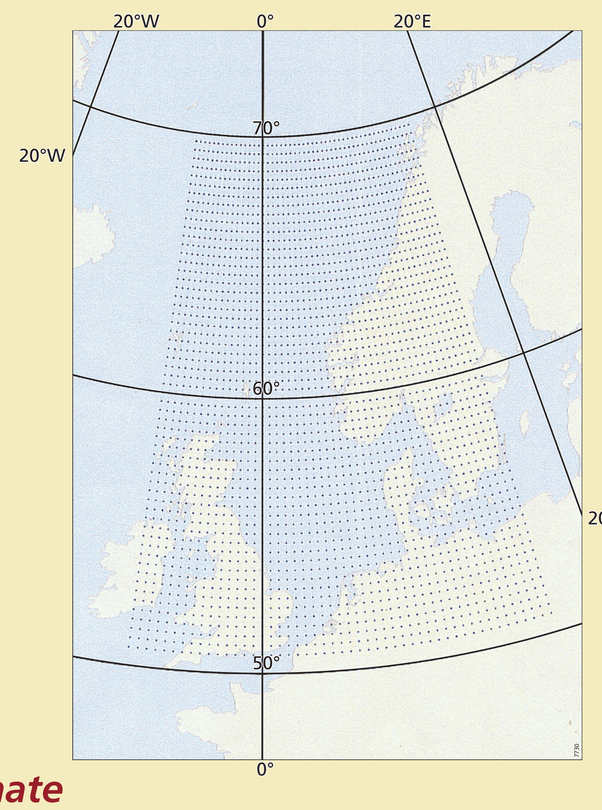
Sterl, A., H. van den Brink, H. de Vries, R. Haarsma and E. van Meijgaard,2009, An ensemble study of extreme North Sea storm surges in a changing climate Ocean Science, 5, 369-378

Storm surge levels

Wave model

NEDWAM

- operational wave model of KNMI
- domain includes the North Sea and the Norwegian sea
- swell is developed within the model grid



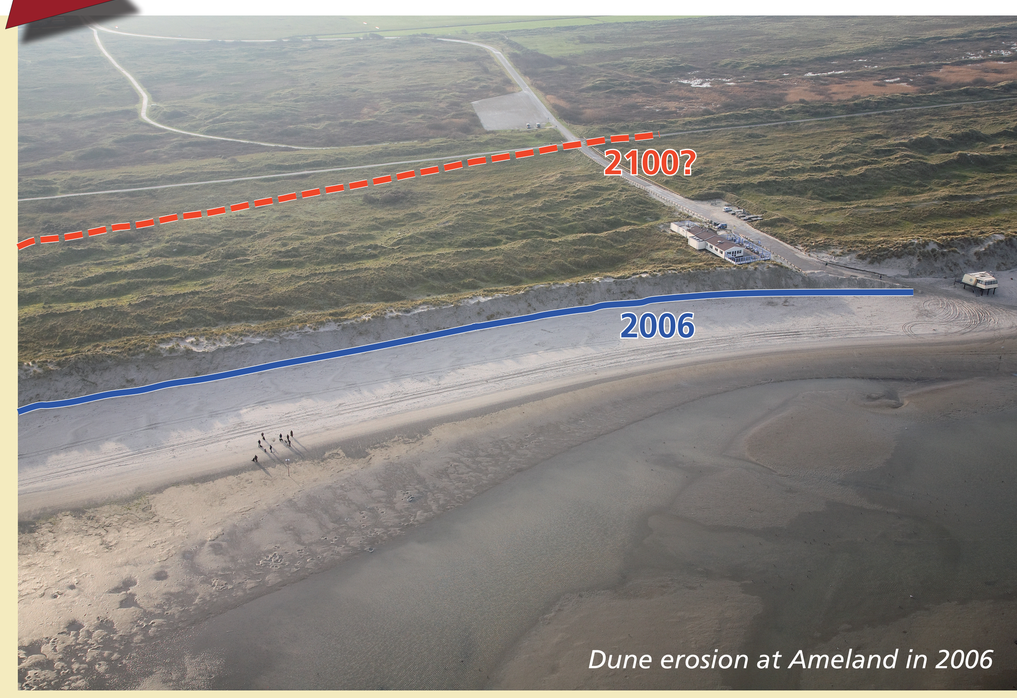
Wave climate

Dune erosion model

XBeach

With Xbeach we will focus on:

- What are the effects of changes in storm surge levels and storm-wave characteristics on dune erosion?
- Is it possible that dunes may breach during an extreme storm?
- What is the effect of extreme storms on dune erosion compared to sea level rise?
- How large is climate change-induced change in dune erosion relative to natural variation in dune erosion?



Dune erosion at Ameland in 2006

Geosciences

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