ESCALATE

Extreme Storms and Coastal evolution under AccelerATEd sea level rise

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Introduction

Climate change is likely to affect the main hydrodynamic boundary conditions of many coasts. Attention has traditionally focused on accelerated sea level rise. The aim of our work is to quantify future coastal change at mid-latitudes under global warming, with an emphasis on dune erosion.

We are interested in the slow steady effect of sea level rise relative to the damaging coastal impact that changes in storm surge levels and storm wave characteristics may have. Our study area is the North Sea area.

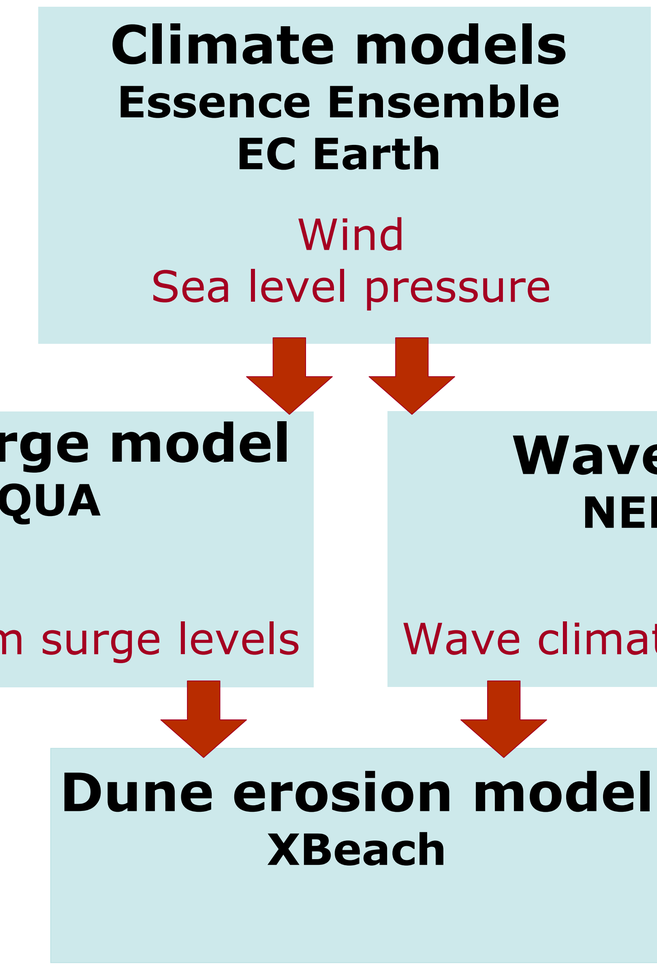
Methodology

Our work is based on a model cascade from a global climate model through a regional wave model, to a local coastal-impact model.

The wind fields and sea level pressure results of each climate model (Essence and EC Earth) are used as input for the storm surge model WAQUA and the North Sea wave model NEDWAM. Both are operational models used at the Royal Dutch Meteorological Institute.

Output of WAQUA and NEDWAM serves as input for the coastal-impact model XBeach [Roelvink et al 2009].

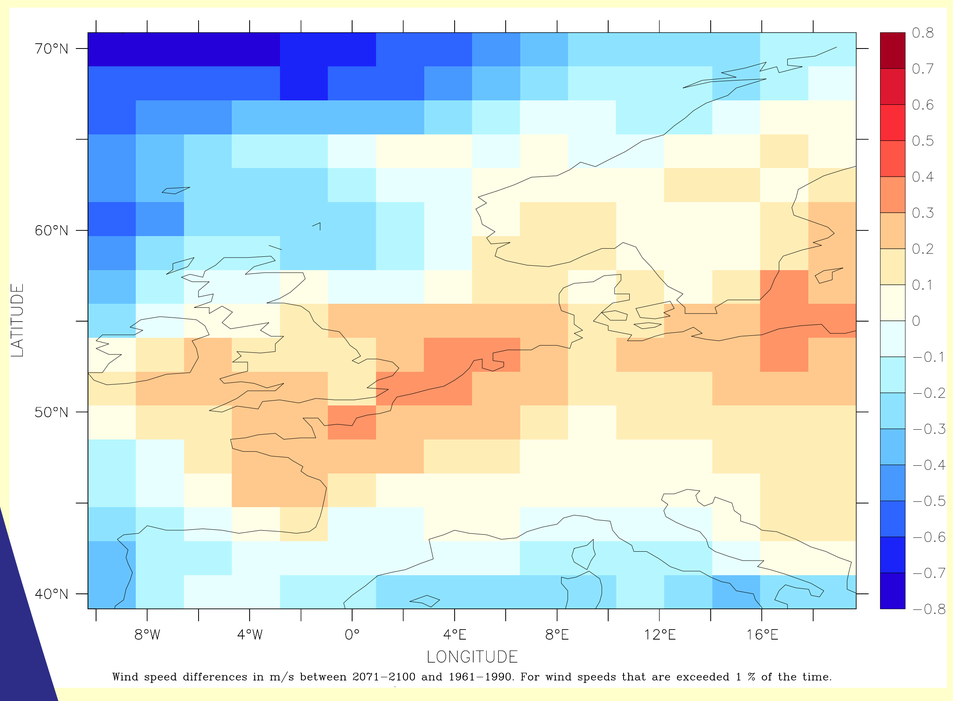
The 17 member Essence Ensemble allows to study the extreme storm events (100 - 1000 yr return period) that are responsible for dune erosion.



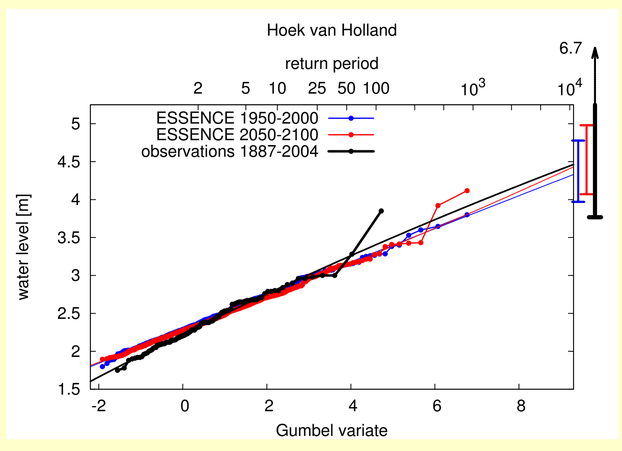
Preliminary results

Wind results from 17 member Essence Ensemble

Wind speed that is exceeded 1% of the time, difference between period 2071-2100 – 1961-1990. The Essence ensemble shows a slight increase of high wind speeds in the southern North Sea area.



Wind speed differences in m/s between 2071–2100 and 1961–1990. For wind speeds that are exceeded 1 % of the time.

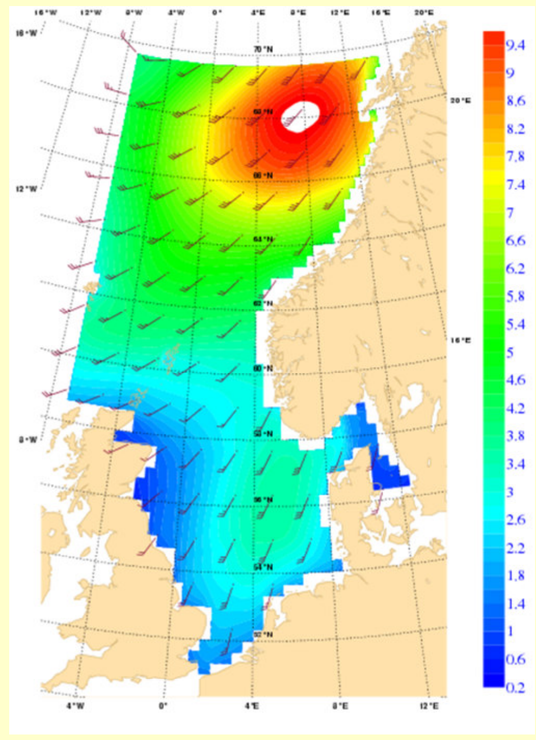


Storm surge levels at Hoek van Holland

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). 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] See poster Sterl for more information.

Impression of the wave results by NEDWAM

This figure gives an impression of the kind of results NEDWAM can generate. The wave height is indicated by the colour bar, the wind speed are shown by wind flags.



Roelvink. D., A. Reiniers, A van Dongeren, J. van Thiel de Vries, J. Lescinski, R. McCall, 2009, XBeach Model Description and Manual
*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*