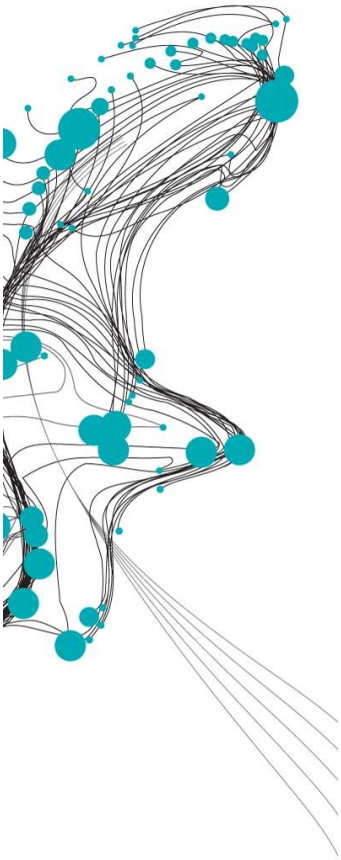
TRENDS IN STORM SURGES ALONG THE DUTCH COAST

DERIVED FROM AN ENSEMBLE OF REGIONAL CLIMATE MODEL SIMULATIONS FOR THE PERIOD 1951-2100



The implications of climate change, such as mean-sea-level rise due to global warming, nowadays are a hot topic. Besides mean-sea-level rise, flood safety is also affected by sea water level extremes. One of the main contributors to these extremes are storm surge conditions, when the sea water level is pushed up by storms above the seas. In the past, storm surges have proven to be a major threat to low-lying countries in particular. For example, the North Sea flood of 1953 in The Netherlands. The magnitude of future storm surges and the role of storm surge clusters herein still are relatively uncertain.

This research investigates storm surge trends in the period 1951-2100 along the Dutch coast for two locations, namely Hoek van Holland and Harlingen. For this purpose, the output data from the WAQUA/DCSMv5 storm surge model forced by RACMO2.2, a Regional Atmospheric Climate Model, were used. To simulate the impact of climate change, RACMO2.2 was forced with the RCP8.5 (Representative Concentration Pathway), which is the most severe defined greenhouse gas emission pathway.

The accuracy of the RACMO and WAQUA model combination was determined by calculating water level exceedance frequencies and comparing these to the exceedance frequencies based on measurement data. It was found that for the entire range of assessed exceedance frequencies (i.e. 1/0.2 till 1/4000 per year) the model predictions resulted in systematically lower water level extremes. The water level differences between the model and measurement data based exceedance frequencies became larger for smaller exceedance frequencies, especially at Hoek van Holland. Therefore, further research is needed to investigate whether the model combination is able to simulate the most extreme storm surge events.

Storm surge trends in the ensemble model predictions were assessed for three criteria: frequency, intensity and duration of storm surge (cluster) events. For Hoek van Holland, no significant increasing trends were obtained. Only a significant decrease of the frequency of storm surge events of approximately 0-3 events per 30 years resulted from the trend assessment for Hoek van Holland for the full simulation period. For Harlingen mainly an increase in the duration (above the 0.5 meter surge height) of storm surge events by approximately 2-6 hours was observed during the full simulation period. However, the obtained trends are much smaller than the decadal and inter-decadal variability of storm surge activity, leading to the conclusion that the trends cannot be directly attributed to climate change.

Table 1. Overall trend assessment results of the frequency, intensity, and duration of storm surge for Hoek van Holland and Harlingen. Shown is whether a clear trend is found, and if so, the approximate increase/decrease during the full simulation period is given as a range. For storm surge cluster events only the frequency is assessed.

Location	Frequency [events/30yr]	Intensity: surge height [m]	Intensity: total water level [m]	Duration [hr]
Storm surge (events)				
Hoek van Holland	0 to -3	No clear trend	No clear trend	No clear trend
Harlingen	0 to +1	+0.4 to +0.5 for extremes, but no clear overall trend	0.0 to -0.1	+2 to +6
Storm surge cluster events				
Hoek van Holland	No clear trend	-	-	-
Harlingen	No clear trend	-	-	-

Sten Aardoom

Graduation Date:
18 May 2020

Graduation committee:
University of Twente
Prof.dr. S.J.M.H. Hulscher
Dr. J.J. Warmink
Dr.ir. E.M. Horstman

KNMI
Dr. H. de Vries

UNIVERSITY OF TWENTE.