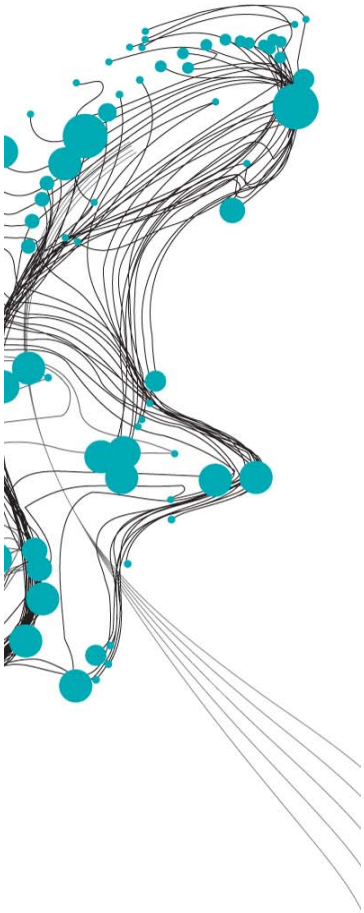
THE NORTH SEA STORM SURGE ATLAS

PERFORMANCE ASSESSMENT AND UNCERTAINTY ANALYSIS



Current storm surge forecasting is often carried out with detailed real-time computer modelling. These models are accurate, but also computer intensive with long calculation times. Also, the forecast horizon is short and the possibilities for scenario assessment are limited. In 2013, a North Sea Storm Surge Atlas was developed by Royal HaskoningDHV, KNMI and Deltares, which uses a new and innovative method to predict storm surges in the North Sea area to provide quick insight of storm surges for five to ten days ahead. This research focuses on the validation and uncertainty identification of two possible algorithms for the Storm Surge Atlas.

The Storm Surge Atlas uses a weather forecast consisting of pressure fields. A large database of predefined storms with precalculated storm surges is used for the forecasting of storm surges rather than performing all calculations real-time. There are two possible algorithms to use this database for prediction of storm surges. The first method (A) is based on finding a best matching pressure field in the database and using the precalculated surge as surge prediction. The second method (B) uses a linear regression model. The direct correlation between spatial patterns in the pressure fields in the database and the precalculated surges are used to calculate the predicted surge from the forecasted pressure fields.

To assess the performance of both Storm Atlas methods, 33 historical storms have been selected and hindcasted. The performance assessment is done for 11 locations, of which 5 are located at the North Sea coast of the United Kingdom and 6 at the Dutch coast. A comparison between method A and B is then made for the performance on peak water level, duration of the storm water level and timing of the peak. Furthermore, sources of uncertainty are identified and classified in order to focus the improvement of the Storm Surge Atlas.

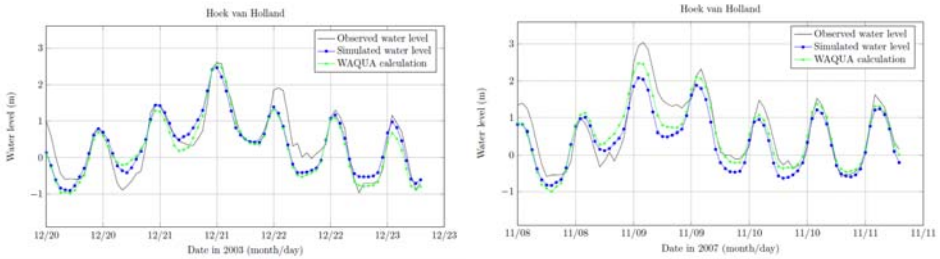


Figure 1: Example of two simulated historical storms. The blue dotted line shows the simulated waterlevels by the Storm Surge Atlas. The black line shows observed water levels.

Table 1 shows an overview of the performance of both Storm Atlas methods. In general, the results show that method A performs slightly better. When looking more in-depth to the results of peak water levels, we see that method A has a more structural underestimation with less variability, whereas method B has a larger variability in under- and overestimation.

Table 1: Root mean squared errors of the simulated and observed water levels

	Method A	Method B
Peak water level [m]	0.46	0.50
Duration [hours]	1.10	1.70
Timing [hours]	9.87	10.07

The size of the database and the quality of the pressure fields as input data have been identified as major sources of uncertainty and therefore as focus points for improvement of the Storm Surge Atlas.

It can be concluded that the North Sea Storm Surge Atlas is a tool which is able to reproduce historical storm surges quite well, with large time savings compared to real-time modelling. The North Sea Storm Surge Atlas can be a valuable addition in the field of storm surge forecasting, e.g. for scenario analysis, quick assessments of possible developments of a storm. It is recommended to work further with the Storm Atlas method A, based on finding a matching pressure field.

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