Geophysical Research Abstracts
Vol. 12, EGU2010-14148, 2010
EGU General Assembly 2010

A probabilistic storm surge risk model for the German North Sea and Baltic Sea coast

Jan-Henrik Grabbert (1), Andreas Reiner (2), Jan Deepen (2), Harvey Rodda (3), Stephan Mai (4), and Dietmar Pfeifer (5)

(1) Aon Benfield Reinsurance Brokers, Impact Forecasting, Hamburg, Germany (jan-henrik.grabbert@aonbenfield.de), (2) Aon Benfield Reinsurance Brokers, Analytics, Hamburg, Germany, (3) Hydro-GIS Ltd, Chalgrove, UK, (4) Coastal Engineer, Loxstedt, (5) University of Oldenburg, Institute of Mathematics, Oldenburg, Germany

The German North Sea coast is highly exposed to storm surges. Due to its concave bay-like shape mainly orientated to the North-West, cyclones from Western, North-Western and Northern directions together with astronomical tide cause storm surges accumulating the water in the German bight. Due to the existence of widespread low-lying areas (below 5m above mean sea level) behind the defenses, large areas including large economic values are exposed to coastal flooding including cities like Hamburg or Bremen.
The occurrence of extreme storm surges in the past like e.g. in 1962 taking about 300 lives and causing widespread flooding and 1976 raised the awareness and led to a redesign of the coastal defenses which provide a good level of protection for today's conditions. Never the less the risk of flooding exists. Moreover an amplification of storm surge risk can be expected under the influence of climate change.
The Baltic Sea coast is also exposed to storm surges, which are caused by other meteorological patterns. The influence of the astronomical tide is quite low instead high water levels are induced by strong winds only. Since the exceptional extreme event in 1872 storm surge hazard has been more or less forgotten. Although such an event is very unlikely to happen, it is not impossible.

Storm surge risk is currently (almost) non-insurable in Germany. The potential risk is difficult to quantify as there are almost no historical losses available. Also premiums are difficult to assess.
Therefore a new storm surge risk model is being developed to provide a basis for a probabilistic quantification of potential losses from coastal inundation. The model is funded by the GDV (German Insurance Association) and is planned to be used within the German insurance sector. Results might be used for a discussion of insurance cover for storm surge.

The model consists of a probabilistic event driven hazard and a vulnerability module, furthermore an exposure interface and a financial module to account for specific (re-) insurance conditions. This contribution will mainly concentrate on the hazard module.
The hazard is covered by an event simulation engine enabling Monte Carlo simulations. The event generation is done on-the-fly. A classification of historical storm surges is used based on observed sea water levels at gauging stations and extended literature research. To characterize the origin of storm events and storm surges caused by those, also meteorological parameters like wind speed and wind direction are being used. If high water levels along the coast are mainly caused by strong wind from particular directions as observed at the North Sea, there is a clear empirical relationship between wind and surge (where surge is defined as the wind-driven component of the sea water level) which can be described by the ATWS (Average Transformed Wind speed).

The parameters forming the load at the coastal defense elements are water level and wave parameters like significant wave height, wave period and wave direction. To assess the wave characteristics at the coast the numerical model SWAN (Simulating Waves Near Shore) from TU Delft has been used.
To account for different probabilities of failure and inundation the coast is split into segments with similar defense characteristics like type of defense, height, width, orientation and others.
The chosen approach covers the most relevant failure mechanisms for coastal dikes induced by wave overtopping

and overflow. Dune failure is also considered in the model.
Inundation of the hinterland after defense failure is modeled using a simple dynamical 2d-approach resulting in distributed water depths and flood outlines for each segment.

Losses can be estimated depending on the input exposure data either coordinate based for single buildings or aggregated on postal code level using a set of depths-damage functions.