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Extreme storm surges. A method to calculate extreme events at the North Sea coast

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The North Sea coast is, as well as many coastal regions, a preferred settlement and industrial area. At the same time the North Sea coast is seriously threatened by storm surges. Climate change and resulting consequences as sea level rise will have serious effects on the safety in coastal areas. The Project XtremRisK – Extreme Storm Surges at Open Coasts and Estuarine Areas, Risk Assessment and Mitigation under Climate Change Aspects, funded by the German Federal Government, will help facing this challenge. The „Source-Pathway-Receptor"-Concept will be used as a basis for risk analysis and development of new risk management strategies.

Within the XtremRisK project, a method to assess extreme events under present climate conditions is developed. Starting from there, extreme events will be assessed using conditions which reflect the climate change scenarios. A couple of methods to calculate an extreme storm surge exist, which are often statistical methods. Here, a deterministic method is used which takes the physics of storm surges into account. The most relevant contributions to a storm surge are spring tide, wind surge and sometimes an external surge that enters the North Sea from the Atlantic. With the developed method, these three components are analysed and their development and interaction over the last 100 years is assessed.

The presentation will give an overview about findings of the conducted analyses and the developed method to calculate extreme storm surge events. The study focuses on analysing (i) the highest event of each component and (ii) the interaction between tide and surge as well as the interaction between surge and external surge. This detailed analysis is needed because the components do not interact linearly. With this knowledge, an extreme event based on the observed extremes of the components can be calculated by adding them to the mean tide level. Investigation on the hydrodynamics and physics of storm surges show that the components have to be added non-linearly, which leads to a lower water level than in case of linear superposition. With this approach, an extreme event under present climate conditions can be calculated in accordance with natural law.

A long consistent time series of water level records is very important for the characterisation of storm surges. Consequently the extreme storm surge for the city of Hamburg is determined at tidal gauge Cuxhaven and its propagation upstream to Hamburg subsequently calculated by numerical modeling. The storm surge for Sylt is determined at tidal gauge Hörnum.

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