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Ecosystem Risk Assessment in Integrated Risk Analysis (XtremRisK Project)

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Introduction

The joint research project XtremRisK is aiming to improve the understanding of extreme storm surges and related risks which may result from expected climate change. XtremRisK involves three universities (Braunschweig, Hamburg, Siegen) and the Agency of Roads, Bridges and Water in Hamburg (LSBG), and works in close collaboration with responsible coastal and harbour authorities. The project commenced in 2008 and is to be completed by 2013 (Oumeraci et al., 2009). The overall aim of the project is to enhance the knowledge with respect to the uncertainties of extreme storm surge predictions as well as to quantify the overall flood risks for two pilot sites selected to represent an open coast and an estuarine area.

Hereby, flood risk is defined as the combination of the probability of a storm surge and expected consequences. Integrated risk analysis comprises storm surge predictions (risk sources), coastal and estuarine defence failure probabilities (risk pathways) and the determination of subsequent losses (risk receptors) (Oumeraci, 2004).

XtremRisK consists of four subprojects (SP), from which subproject 4 aims at performing integrated risk analysis by merging results achieved in SP1 (determination of most unfortunate, physically possible storm surges), SP2 (estimation of defence failure probabilities) and SP3 (modelling of inundation and estimation of consequences) (Burzel et al., 2010).

Sylt Island was selected as a representative pilot site for an open coast. There, risk analysis focuses on ecosystems, where risks due to storm surges will be determined and mitigation measures will be developed and discussed. In addition, future risks under consideration of the effect of climate change will be also estimated. Hence, this paper describes the results obtained within SP4 of XtremRisK with a clear focus on risk assessment for ecosystems.

Methods and Results

Within SP4, methods for estimating social and ecological vulnerability are investigated using socio-economic methods. It became obvious that different strategies for each type of vulnerability are required.

Risk analysis for the ecosystem on Sylt Island has been performed based on the ecosystem service approach. Ecosystem services are benefits that people obtain from ecosystems such as food production, freshwater provision, and recreation (World Resources Institute, 2003). For this purpose, an assumed unaffected condition has to be compared with a possible future condition affected by extreme storm surges (Millennium Ecosystem Assessment, 2005).

Changes in ecosystem services due to storm surges are used as indicators for ecosystem's vulnerability. Inundation modelling, dune and dike breach simulation as well as micro scale ecosystem damage estimation have to be considered. For example, ecosystem services like storm surge protection by dunes, groundwater provision and biological diversity have been identified to be vulnerable to storm surges on Sylt Island.

Integrating ecological vulnerability is usually not considered in present risk analysis and therefore, the integration of ecosystem's vulnerability is urgently needed. In the long term, it is believed that this will ensure a sustainable protection and development of Sylt Island.

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