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Micro-scale analysis of flood risk at the German Bight Coast

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Coastal lowlands in the North Sea Region are highly susceptible to be flooded in the course of extreme storm surges. In upcoming decades climate change and related sea level rise will strongly modify hydrodynamics and morphodynamics in coastal environments, forward saltwater intrusion into groundwater and soils and aggravate coastal hazards for many cities and societies. A clear understanding of the likely risks and impacts of flooding is therefore compulsory. In the framework of the EU-project FLOOD*site* new approaches are developed for hazard analysis, vulnerability assessment, and risk management. In order to apply some of these new methodologies a pilot site application was conducted for the community of St. Peter-Ording at the German North-Sea Coast.

Detailed risk analysis has been performed for this area. This analysis incorporated a probabilistic hazard analysis, a micro-scale vulnerability analysis, and the determination of flooding scenarios based on the hazard analysis. Finally, it has been developed into a GIS-based risk analysis tool merging the various categories of the economic, social and ecological vulnerability with scenario-based probabilities of flooding on a micro-scale level.

Within the hazard analysis, the annual probability of flooding of the hinterland was determined for each section of the flood defence system protecting the coastal area of St. Peter-Ording. Based on the results of the hazard analysis for the flood defence system, the numerical SOBEK model was used to perform the flood inundation simulation for different flooding scenarios. Flood inundation simulations were then performed, also

taking into account the uncertainties of the input parameters and different water levels during a storm surge. Results comprise inundation maps, water depths, and flow velocities.

In addition to hazard analysis, the estimation of the expected damages is crucial to assess the flood risk and its spatial distribution. This investigation aimed at improving two major deficits in vulnerability assessment, which are 1) the costs and efforts of detailed, object-based vulnerability studies and 2) the lack of social and ecological risk criteria.

Earlier vulnerability assessment studies have shown that only a micro-scale approach can deliver data, which are detailed enough to properly assess the flood risk, though it is rather time- and cost-intensive. Seeking for a minimisation of the effort for future damage potential analysis and damage estimations, a quick, economically feasible instrument for the precise evaluation of assets at risk and the damages has been developed.

In order to understand the interrelations of socio-economic and ecological dynamics as well as the intangible impacts of floods, an integrative methodology for vulnerability assessment has been applied. Following a multi-criteria risk assessment approach, the spatial distribution of economic, social, and ecological risk was investigated at the pilot site to identify specific risk zones. To assess the overall vulnerability, several risk criteria were assessed in St. Peter-Ording for each vulnerability category: (a) economic: buildings, private inventory, stock value, gross value added; (b) social: population at risk (& risk to life), vulnerable people, social hotspots, (c) ecological: coastal biotopes.

The multi-criteria risk assessment resulted in a comparative risk rating system for the economic, social and ecological damage categories constrained by different flooding scenarios. A GIS-based map output was considered the appropriate tool for a spatial analysis of the associated flood risk. The results will be presented and discussed in greater detail during the conference.