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Mapping future flooding hazards from sea extremes and subsidence

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The management of flooding hazards in low- lying coastal areas calls for an integrated approach to the water loading from various sources. Furthermore, local subsidence in landfill areas and organic soils in many coastal towns must also be taken into account in order to evaluate current and future flooding hazards and management options. Water loading from all directions due to river discharge, precipitation, groundwater and the sea state (i.e. mean and extreme water levels) need to be carefully considered when dealing with flooding hazards at the coast. Flooding hazard and risk mapping are major topics in low-lying coastal areas before even considering the adverse effects of climate change and sea level rise (SLR). IPCC have yet again stated that mean sea level is rising and will continue to do so over the coming centuries, and that the rise very likely will contribute to an upward trend in extreme coastal high water levels. While permanent inundation due to SLR may be a prevalent issue, more often floods related to extreme events (storm surges) have the largest damage potential. Challenges are amplified in some areas, however, as a result of subsidence due to natural and/or anthropogenic causes. Subsidence rates of even a few mm/y may over time greatly impair the safety against flooding of coastal communities and must be accounted for in order to accomplish the economically most viable protection and management options now and in the future. Here, case studies are presented from Thyborøn and Aarhus (DK) to show how potential flooding extent and flooding depth during storm surges will increase in the future due to the combined effects of SLR and subsidence. By modelling the vertical land movement in a Digital Elevation Model (DEM), this gives a better spatial-temporal representation of the land surface and of the challenges ahead in relation both to flooding hazards and to groundwater and sewer systems? management issues. Based on the results from the two study sites, a practice-oriented methodology for detecting local subsidence areas and combining land movement and sea extremes in coastal flooding hazard mapping is being developed for Denmark. In addition to projections of SLR and re-evaluation of extreme statistics from tide gauge data series, this includes repeated high- precision levelling and various historical, geophysical and geotechnical data and modelling efforts. Here, the broad research focus is on developing methods based mainly on existing data and knowledge and on the synergies in bringing this knowledge together. This will generate results of great social value in relation to the climate change adaptation efforts across levels of government and the methods developed are believed to be of great commercial interest as a basis for the development of concrete solutions. The presented case studies show that it is both relevant and feasible to include local subsidence in flooding hazard mapping and climate change adaptation schemes. Geotechnical and geophysical data and knowledge to a large extent already exist and currently an effort is being made in order to bring this knowledge together to enable a practice- oriented methodology that combines the effects of local subsidence and future sea extremes in hazard mapping and climate change adaptation schemes in Denmark.

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