Coastal Flooding Hazards due to storm surges and subsidence

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Publication date:
2014

Document Version
Publisher's PDF, also known as Version of record

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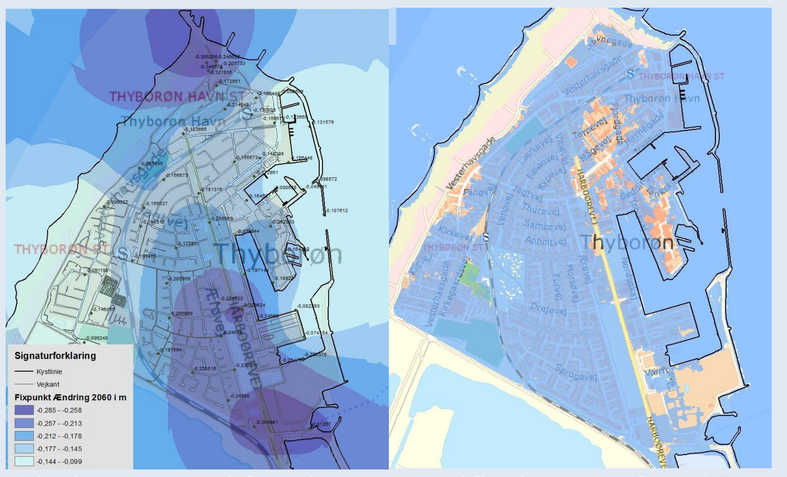
WATER NOT WANTED

Introduction

Flooding hazard and risk mapping are major topics in low-lying coastal areas before even considering the adverse effects of sea level rise (SLR) due to climate change. While permanent inundation 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 due to subsidence from natural and/or anthropogenic causes. Subsidence 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.



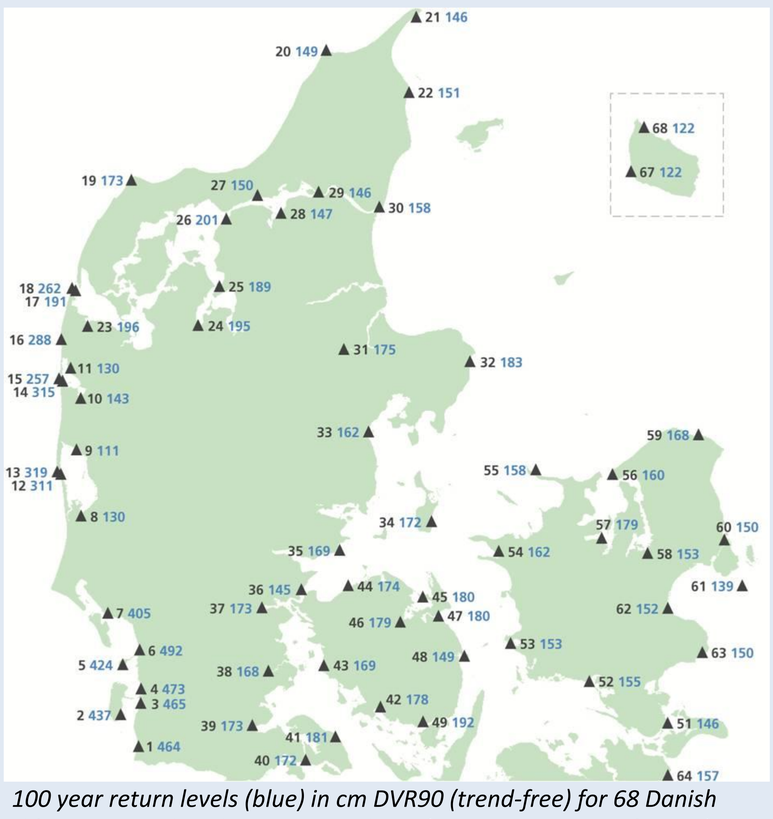
Subsidence pattern (left) and max potential flooding extent for a 100 yr event in 2060 in Thyborøn with uplift (1 mm/y), local subsidence and SLR (3 mm/y). Vertical reduction between MSL and land surface today is 4-10 mm/y (Preliminary results).

Research

The project (2014-2017) develops and tests a practice oriented method for combining extreme water level statistics and land movement in coastal flooding hazard mapping and in climate change adaptation schemes. From extreme value analysis of tide gauge records, statistics that allow also for projections of SLR, meteorological variability, and extremes with a very low probability of occurrence are provided.

Land movement is researched with a focus on short term surface height variability in the groundwater-ocean interface that, together with longer term processes, may cause substantial subsidence and impact future water management and adaptation strategies in flood prone coastal areas.

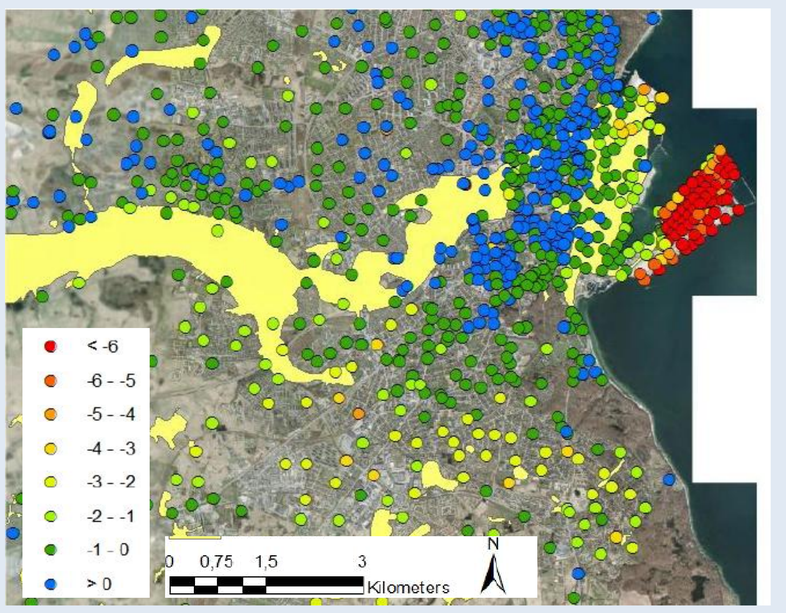
The town of Thyborøn on the Danish North Sea coast.



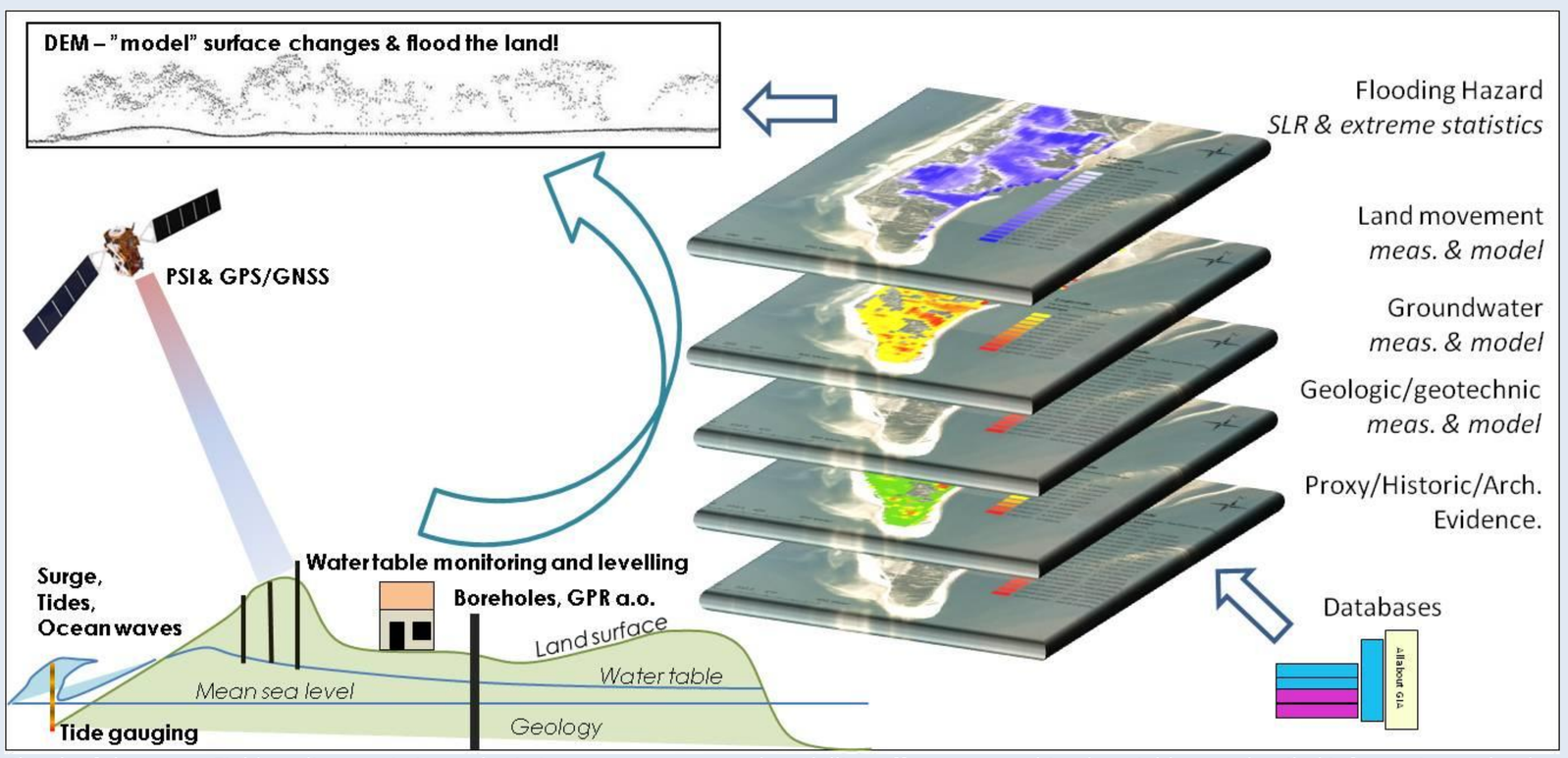
100 year return levels (blue) in cm DVR90 (trend-free) for 68 Danish tide gauge stations in current statistics (From Sorensen et al. 2013).

On location

Field studies' results from repeated precise levelling, GPS setups, and ocean and ground-water level monitoring in Thyborøn and Aarhus are integrated into geological and geophysical data and modelling work to explore the nature and causes of the subsidence encountered, and to explore new ways of utilizing data in relation to coastal flooding hazard mapping. Results may then e.g. be projected in a Digital Elevation Model (DEM) to give more realistic future surface and flooding level representations.



Local rates of land movement (mm/y) at Aarhus on the east Jutland Kattegat coast from repeated levelling. Yellow areas are below 3 m DVR90 (Preliminary results).



Sketch of the setup. Field studies, statistics and existing measurement and modelling efforts are combined to yield more detailed information on land subsidence and to improve flooding hazard assessments.

Outcome

The interdisciplinary research approach calls for collaboration across levels of research. Backed by research communities, public sector organisations and other stakeholders with a pronounced interest in planning tools, the project will draw attention to often overlooked factors in water research and climate change adaptation in Denmark.

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