



## **Integration of historical, present and future coastal flood protection in densely populated metropolitan areas at the example of the Niederhafen in Hamburg**

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Rising sea levels are increasingly threatening coastal regions. Especially cities which are located in estuaries and river deltas are highly vulnerable to coastal flooding. A common adaptation strategy of the people living in these areas is to heighten the flood protection structures like sea dikes and barriers. This way of creating safety against flooding often causes problems in city areas due to a limited availability of space. In order to face the challenges of rising sea levels, adaptation strategies are needed that provide a high safety standard on the one hand and a small demand of space on the other hand.

With its 1.7 million inhabitants of Hamburg is the second largest city in Germany. Both, the number of people living in the city and the economic values are continuously increasing. In order to protect lives and goods against flood damage caused by storm surges in the Elbe estuary where Hamburg is located, engineers, scientists and urban planners have to find design solutions which combine a high safety level with demands of modern city infrastructure and urban planning.

At the example of the historical development of the Niederhafen in Hamburg, which is one of the most touristic places in the city, it will be shown how changing demands on urban development and the results of ongoing scientific research on the water levels of possible storm surges in future lead to a continuously changing design of this part of the city.

The presentation will give an overview how the different demands of recreation, urban planning and infrastructure of streets, public transport and waterways around the Niederhafen area developed in history and in how they are going to develop in future. It will be focused on the question how these changes can be realized in combination with the ongoing strengthening and heightening of the flood protection structures, which have to be carried out to face the challenges caused by climate change and rising sea levels. Furthermore it will be demonstrated in which way opportunities can be taken in order to guarantee a high level of safety against flooding in a densely populated metropolitan region like Hamburg without building one big storm surge barrier in the estuary.