



## Preparing Estuarial Cities for Extreme and Rare Events

*Peter Fröhle, Natasa Manojlovic*

Institute of River and Coastal Engineering, Hamburg University of Technology  
Hamburg, Germany.

### ABSTRACT

Estuarial cities are facing three main hydro-metrological threats:

- \* storm surges from the sea caused by storm events,
- \* fluvial flooding caused by extreme high river discharge, and,
- \* pluvial flooding caused by heavy precipitation

which is likely to increase with climate change and resulting sea level rise, amplification of storm systems and change of precipitation patterns.

The three hydro-metrological threads may be statistically independent in some areas (e.g. extratropical areas with comparatively large catchment areas), in other areas (e.g. tropical areas influenced by typhoons or hurricanes with small catchments) they are caused by much the same metrological weather system.

The Elbe estuary is located in the North Germany. The Elbe estuary is the approx. 100km long tidal-influenced section of the river Elbe and connects the metropolitan region of Hamburg with the North Sea. The river Elbe has its source at a height of 1.386 m above mean sea level in the Czech Republic and reaches its mouth in the North Sea. The catchment area of the Elbe 148.268 km<sup>2</sup>. Hence, the City of Hamburg is threatened by the above mentioned hydro-meteorological events, where the generating weather systems are largely independent of each other and, therefore, the co-occurrence of two or three extreme events forming an extraordinary extreme event is rare. Nevertheless, it is not physically impossible.

Within this research a platform for the assessment of the flood risk in Hamburg is developed and implemented, where :

The formation of vulnerability and risks and interactions between processes is being analysed based on historical and recent societal decisions influenced by sometimes catastrophic events.

The formation of hydro-meteorological hazards and the statistics of extreme hydro-meteorological events are being analysed as basis for holistic risk assessment.

Hydrodynamic–numerical models are being implemented to model the formation and the consequences of extreme hydro-meteorological events and to forecast storm surges in real time to improve preparedness.

Stakeholder involvement is analysed and the awareness and capacity of

the main stakeholder is being improved.

The research is carried out within the EC-funded research project PEARL([www.pearl-fp7.eu](http://www.pearl-fp7.eu)). PEARL aims at the development of the adaptive holistic risk assessment and management strategies for coastal communities, including estuarial cities. The main focus is laid on extreme hydro-metrological events. Within PEARL a multidisciplinary approach is used integrating social, environmental and technical knowledge and experiences.