

# Sensitivity Study of the Storm Surge of 1<sup>st</sup> November 2006 in the Ems Estuary

Elisabeth Rudolph, Bundesanstalt für Wasserbau, Hamburg, Germany  
Annkathrin Schüßler, Rheinische Friedrich - Wilhelms - Universität Bonn, Germany

**Departmental Research Programme**

- National Meteorological Service of Germany (DWD)
- German Maritime and Hydrographic Agency (BSH)
- German Federal Institute of Hydrology (BfG)
- German Federal Waterways Engineering and Research Institute (BAW)

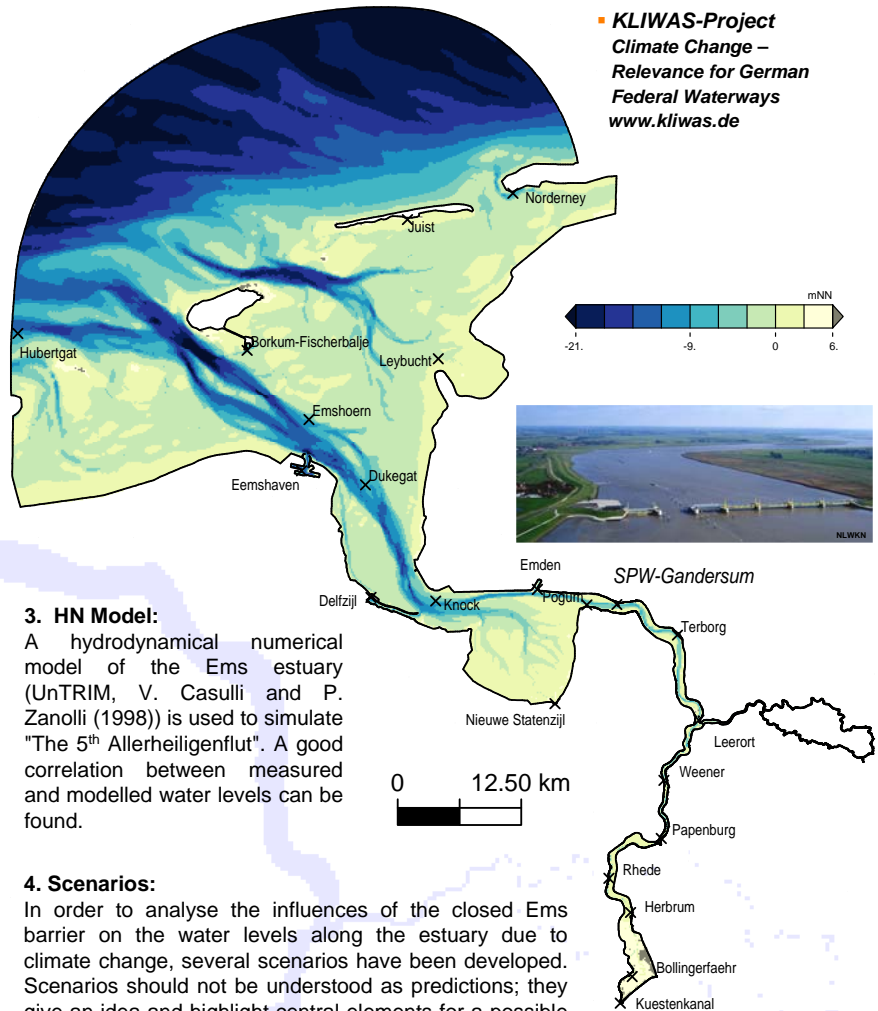
**KLIWAS-Project Climate Change – Relevance for German Federal Waterways**  
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## 1. Motivation:

As climate will change in the next century and beyond, the German Ministry of Transport (BMVBS) is interested in the effect of climate change on waterways. In order to find a strategy for adapting to climate change, it is important to understand the current situation and then analyse the future situation under the influence of climate change. This concept will be presented by looking into a storm surge in the Ems estuary which hosts the waterway from the North Sea to Emden and Papenburg. These investigations are embedded in the scientific joint venture programme KLIWAS.

## 2. Storm surge of 1<sup>st</sup> November 2006:

On 1<sup>st</sup> November 2006 a severe north - western storm caused extreme high water levels in the German Bight and the mouth of the Ems. In parts of the Ems estuary, during the occurrence of "The 5<sup>th</sup> Allerheiligenflut" the highest water levels since 1906 were observed. As a consequence, the storm surge barrier Ems near Gandersum was used for the first time during a high storm surge.



## 3. HN Model:

A hydrodynamical numerical model of the Ems estuary (UnTRIM, V. Casulli and P. Zanoli (1998)) is used to simulate "The 5<sup>th</sup> Allerheiligenflut". A good correlation between measured and modelled water levels can be found.

## 4. Scenarios:

In order to analyse the influences of the closed Ems barrier on the water levels along the estuary due to climate change, several scenarios have been developed. Scenarios should not be understood as predictions; they give an idea and highlight central elements for a possible future.

The development and intensity of a storm surge in the Ems estuary is determined by the water level at the boundary to the North Sea, the river discharge into the estuary and the wind over the estuary. Scenarios have been developed which vary the

- increase in river discharge into the estuary, using values already measured (fig 1),
- operation of the storm surge barrier (fig 1 + 2),
- sea level changes in the North Sea for 2100 (fig 2 + 3).

## 5. Results:

Considering all scenarios the dikes and the storm surge barrier will provide full protection. Areas have been identified where the varied parameters have the most influence. The sea level is the strongest component over the river discharge and the local wind. While the storm surge barrier gates are closed, the sea level and the wind will have the most influence on the area downstream of the barrier while the river discharge has the biggest influence on the area upstream of the barrier. This investigation will give the KLIWAS programme the chance to work on adaptation and mitigation of problems caused by climate change.

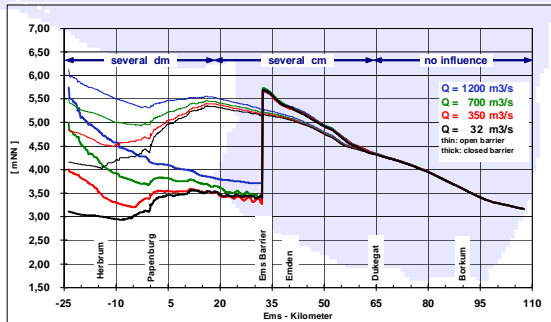


Fig 1: Influence of fresh water discharge on the highest water level during storm surge along the Ems estuary

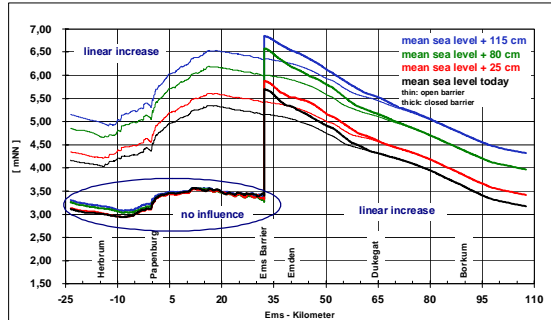


Fig 2: Influence of sea level rise on the highest water levels during storm surge along the Ems estuary

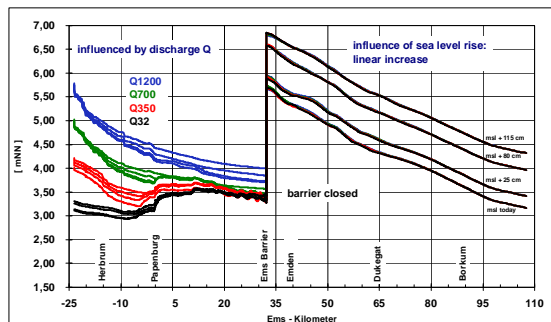


Fig 3: Influence of sea level rise and river discharge on the highest water level during storm surge along the Ems estuary

HN - Model: UnTRIM  
Wind: forecast LM of DWD  
Discharge: measurement  
Topography: 2005  
Open boundary to the North Sea: North Sea Model BAW

Authors:

Elisabeth Rudolph  
[elisabeth.rudolph@baw.de](mailto:elisabeth.rudolph@baw.de)

Annkathrin Schüßler  
[a.schuessler@uni-bonn.de](mailto:a.schuessler@uni-bonn.de)

German Federal Waterways Engineering and Research Institute  
Referat K3 - Hydraulic Engineering in Coastal Areas  
Wedeler Landstraße 157  
22559 Hamburg

Tel.: +49 (0) 40/81908-0  
Fax: +49 (0) 40/81908-373  
Email: [mail@baw.de](mailto:mail@baw.de)  
[www.baw.de](http://www.baw.de)

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