*Loading of heavy cargo, port of Lübeck, © Rolf Klein*

## Climate Change in the Baltic Sea Region: The Vulnerability of German Ports

As a gateway between ground and sea transportation, and as a business location for service and industry, ports are of great significance for the regional and national economy. At the same time, port structures are located in regions threatened by storms and rising sea levels. Due to highly interdependent value chains, weather related disruptions in port operation can cause serious economic damage. Thus, adaptation to possible climate impacts seems like an obvious task for port authorities. What can be said about the climate vulnerability for German Baltic port locations?

### Regional Economic Importance of German Baltic Sea Ports

In 2010, the ports along the German Baltic Sea coast moved goods with a volume of 54.6 million tons. This volume corresponds to 6% of the entire international trade in Germany. Although the contribution of Baltic Sea ports to the total international trade is comparatively small, these ports play an essential role for the German economy as a hub for goods transported to and from north-eastern Europe.

As opposed to the container oriented North Sea ports, the German Baltic Sea ports are predominantly characterised by ferry and Ro/Ro services, and by the transportation of mass goods. In 2010, 51% of the total cargo handling was allotted to the transportation of vehicles and 36% related to mass goods. Transportation of containers in German Baltic Sea ports is at 4% only of minor significance. The most important types of goods are agricultural and silvicultural goods, petroleum products, and construction materials.

In 2010, the two most important ports along the German Baltic Sea coast were Rostock and Lübeck with 19.5 million tons and 17.8 million tons (excl. tare weight) handled, respectively. Regarding passenger transportation, with 11.4 million passengers, 40% of all passengers leaving and arriving at German sea ports travelled via German Baltic Sea ports in 2010. Especially Puttgarden, Rostock, and Kiel are important Baltic Sea passenger ports. As major hubs for transportation of passengers and goods, as well as central locations for industry and service providers, the German Baltic Sea ports contribute significantly to the security and strengthening of employment, income, and tax revenue in the coastal region. According to a study on the regional economic importance of the ports in Lübeck by UNICONSULT 2012, approximately 8,200 jobs in this city depend directly on its ports. For the city of Lübeck, the gross value associated with the port related economy is estimated at 542 million Euros.

### Requirements and Potential for Adaptation

In a recent survey on the vulnerability of German Baltic Sea ports due to climate change within the frame of the German research project RADOST, the Institute for Ecological Economy Research (IÖW) has questioned port operators and port-based businesses (for details on this survey see page 8). The survey results on the ports' current readiness for a rise in sea level show that a majority of participating ports will be required to adapt by 2050 if the sea level rises faster than predicted by the IPCC. Especially older and low laying port areas will have to be elevated to avoid flooding. This opportunity of modernisation and reconstruction should be utilised to implement other adaptation measures.

The rise in sea level also increases the baseline level for storm high tides. Therefore, the occurrence probability of high water levels also increases. With regards to these aspects, the survey has shown that storm high tides with peak levels beyond 2m, such as it occurred twice during the last century, will cause severe disruptions and damages for two-thirds of participating ports. Because such events may take place at any time, the corresponding ports are advised to evaluate possible modifications and implement these measures. Furthermore, the possible intensification of westward winds may increase the net transport of sediments in exposed ports (e.g. Rostock). Therefore, dredging may have to be done in shorter intervals, especially to maintain the ships' passage way.

A more difficult manoeuvrability for ships due to heavy swell and more frequent storms may provide additional challenges. In order to avoid delays and accidents, the manoeuvre areas leading into the port should be widened. In many ports these areas are not available for these purposes or their extension may pose a severe intrusion into the marine ecosystem. Therefore, the use of towboats will have to increase.

The possible increase and intensification of heavy rainfall events may pose the risk of exhausted drainage systems in the ports. This problem already caused disruptions and damages in the past. Port operators should react by incorporating larger pipe diameters for new drainage systems.

In a workshop in September 2012, representatives of port infrastructure companies evaluated the need for adaption in German Baltic Sea ports as low. In reference to the model based predictions up to the middle of the 21st century, the workshop participants claimed that the German Baltic Sea ports are well prepared. During the last decades, new and replacement investments in infrastructure accounted for climate change, especially the rise in sea level, by including higher safety margins. The operators of port infrastructure assume that any further adaptation requirements can be met technologically and organisationally. Because the economic and technological development requires adaptation measures in much smaller intervals, an adjustment to changing climatic conditions can be considered accordingly.

**Outlook**

In continuation of the work done, possibilities for adaptation will be evaluated, and components for an adaptation strategy for German Baltic Sea ports will be developed. For this purpose, it will be essential that

1. the actors of port economy are supplied with precise and robust information regarding climate change at the German Baltic Sea coast,
2. operators of port infrastructure are provided with an instrument to estimate the port's climate vulnerability with little utilisation of resources, and
3. the already identified adaptation needs are defined in detail and transformed into actions, including the identification of responsibility, time line, and required resources for implementation.

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*Road improvements, port of Lübeck, © Rolf Klein*


*Loading of paper, port of Lübeck, © Rolf Klein*

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