

# Consequence of climate change for inland shipping

Midterm results by consortium Water and Transport  
Knowledge for Climate



SYSTEM BOUNDARIES AND PROBLEM DEFINITION

A strong selling point of the port of Rotterdam is not only a free entrance to the sea, but also the good hinterland connections by the rivers Rhine and Meuse. Although much attention is given to the consequences of climate change with respect to sea level rise and adequate storm defense systems, there may be consequences for inland shipping too.

## SEA LEVEL RISE



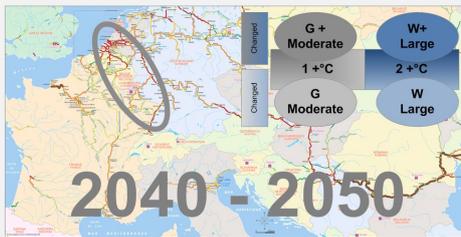
With climate change the sea level rises and therefore it is likely that there will be a more frequent occurrence and longer durations of closed storm surge barriers, that may disconnect the free entrance for inland and seagoing vessels to the seaport.

## LOW WATER LEVELS



The Rhine is traditionally a so called combined rain-snow river but may change into a more unpredictable rain oriented river because of changing temperature and precipitation patterns. This may sometimes lead to higher water levels, which may give problems for the passage of bridges by (to) high inland (container) vessels. But what is more undesired are relative long periods (in the order of 10 -30 days) of low discharges, which may allow only shipping with strongly restricted shallow draught.

## HIGH WATER LEVELS



## SYSTEM BOUNDARIES

### GEOGRAPHIC

This project focuses mainly on the transport of goods by inland navigation along the river Rhine from the Port of Rotterdam to the German hinterland till Koblenz and vice versa.

### CLIMATE SCENARIO

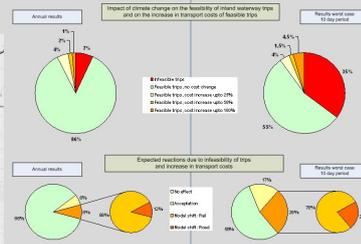
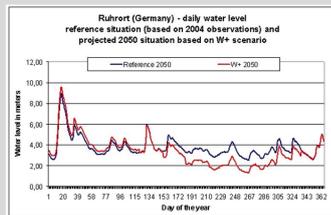
As climate scenario's the W+ (KNMI) is taken into account and for the economic scenario the high economic growth of Global Economy (WLO) is chosen as a basis.

### TIME HORIZON

Because the time horizon of the climate scenario's is much larger than the economic scenario's, the time horizon of 2050 is chosen in this project (the high economic growth for the gap period 2040 - 2050 will be taken as small).

EFFECTS ON DUTCH SEA PORTS

In the second half of the year lower **water levels** cause less **draught** and lower **ship capacities**. This leads to higher transport **prices**, lower **reliability** and an incentive for **modal shift**. As a result, the **share** of inland waterway transport decreases



In 2050 the closing frequency of the Maeslantkering is estimated to be 1:5 years instead of 1:10 years. After 2050, the impact may be larger: up to 30 closures a year.

The German seaports Hamburg and Bremen do have good railway services and connections: depending on transport costs and capacity, up to 4% of total volume of inland waterway transport could shift from Dutch seaports to these German ports

## How can we reduce the impact of climate change on the barge transport through the Dutch seaports ?

SOLUTIONS AND THEIR IMPACT

### Information Management

Up to date on line information about present and expected water depth along the route, local stream patterns and water velocities, real-time draught and trim of the vessel, etc



### River Management

Dredging, movable weirs, adjustable groins, reservoirs and retention basins, etc



### Logistic management.

Extra stock or storage capacity, alternative routes, other transport modalities, extra handling facilities in harbors or at points of modal shifts, etc



### Fleet management.

Inland navigation with vessels of smaller draught, so broader, longer, build of light weight materials, extra (temporary) buoyancy, etc



Solutions will be assessed on their:

Technical feasibility

Cost - Benefit ratio

Implementation term

Impact on environment