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UNECE Group of Experts on Assessment of Climate Change Impacts and Adaptation for Inland Transport

Stress tests: A methodology to assess the impact of extreme events on traffic streams

Suez Canal was blocked for six days after the accidential grounding of Ever Given

Traffic jam of more than 300 ships

Delays, detours via the Cape of Good Hope in Africa, which adds about 3,500 miles to the journey and up to 12 days

Losses
$9.6 billions (value of goods moved through the canal each day)

BBC-News

This time: man-made failure – accident

Next time?

Climate induced failure | low water, mass movement or else

Stress test

Construction of an **extreme scenario** that assumes a failure or restriction of a traffic node or section for several weeks du to an extreme (weather) event.

Simulation of consequences via traffic modelling. Assessment of the direct transports effects/costs

Extreme situations can be

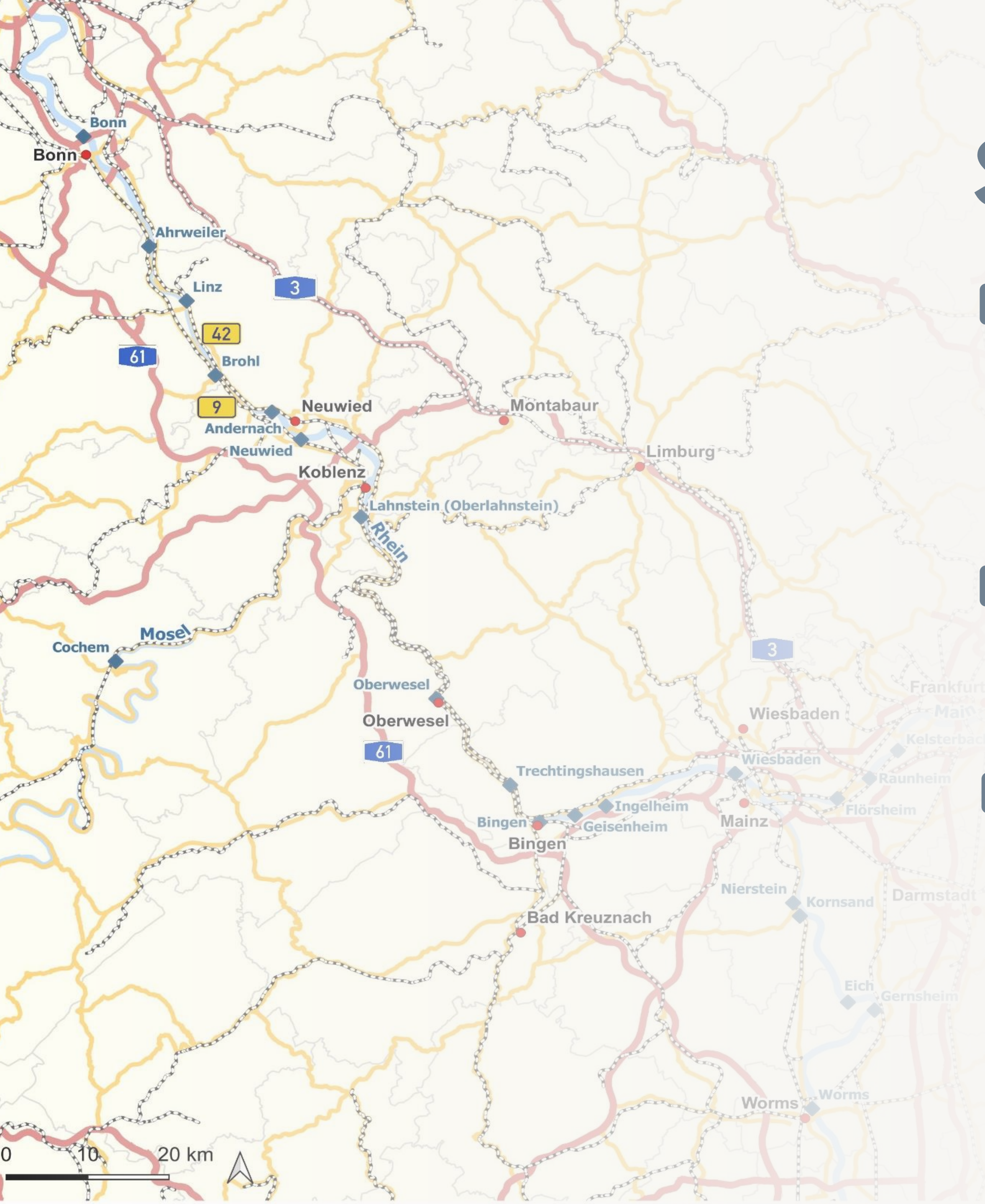
Man-made hazards / accidents

Track lowering at Rastatt

high-water situation (21 days)

low-water situation (180-days)

Mass movement causing damages at the infrastructure



Study site

- Rhine river – most important inland waterway in Germany
  2 railway lines along the Rhine and Mosel
  2 Highways and several Federal roads
- Important passage for passenger and freight transport → part of the TEN-T core network (Rhine-Alpine corridor)
- In the past, the study region was affected by weather induced traffic limitations.
  - Steep slopes in the Rhine valley → mass movements
  - Low-water situation in 2018
  - High-Water situations in 1995 and 1998

Definition of a scenario (exemplarily)

	High water situation	Low water situation
Type of limitation	Closure	Limited capacity
Affected modes	Rail, road, waterway	waterway
Affected sections	Road B9, railway 2630, waterway Rhine at Oberwesel	Waterway Rhine at Oberwesel
Duration of limitation	21 days	180 days

.... Input data and methods

Traffic (network) data

- Traffic matrices of passenger and freight transports including information on start-/end relationships
- High-resolution data on infrastructure networks
- Assumptions on traffic relocations and modal shifts for specific situations via traffic assignment

Studied period of time

- 2010: description of the current situation
- 2030: projected traffic network

Evaluating transport related effects

- Comparison: situation with/ without limitation
- Traffic assignment for impacted traffic
- Alternative routes within the affected mode?
- Transfer to other modes?
- Consideration of typical adaptation reactions of economic entities

Attributes of the road and rail network model

Quality indicator
Separation of traffic flows
Number of lanes
Speed limits, no overtaking
Route curviness and gradient
Tunnel position
City model component

Number of tracks
Maximum train length and weight
Maximum target speed
Route gradient
Geometry and structure gauge
Type of transport & track prizes
Network operator …

Assumptions of the traffic modelling

Unlimited availability of vehicles and operates

Immediate replacement bus service for rail passenger transportation

Alternative road and railway routes are used directly after an interruption

Modal shifts with a few days delay

- Rail/Waterway → road starts at day 3
- Waterway → rail starts at day 10

Comparison of the normal state with the extreme scenario

- Additional travel time
- Additional kilometres
- Percentage of Modal shifts
- Additional transport costs

High-water situation (2030)

Impact		Losses in 1.000 t/day	Additional travel time (min per journey)
	**10.100** vehicles/day	**0**	**2/3** for passenger/ freight transport
	**253** trains/day	**15**	**25/45** for local/ long-distance transport
			Modal shift in 1.000 t/day
	**176** 1.000 t/day	**176**	**100/76** shifted to rail/road

Additional transport costs: 2.46 Mio €/day (52 Mio/event)

Low-water situation (2030)

~ 65%

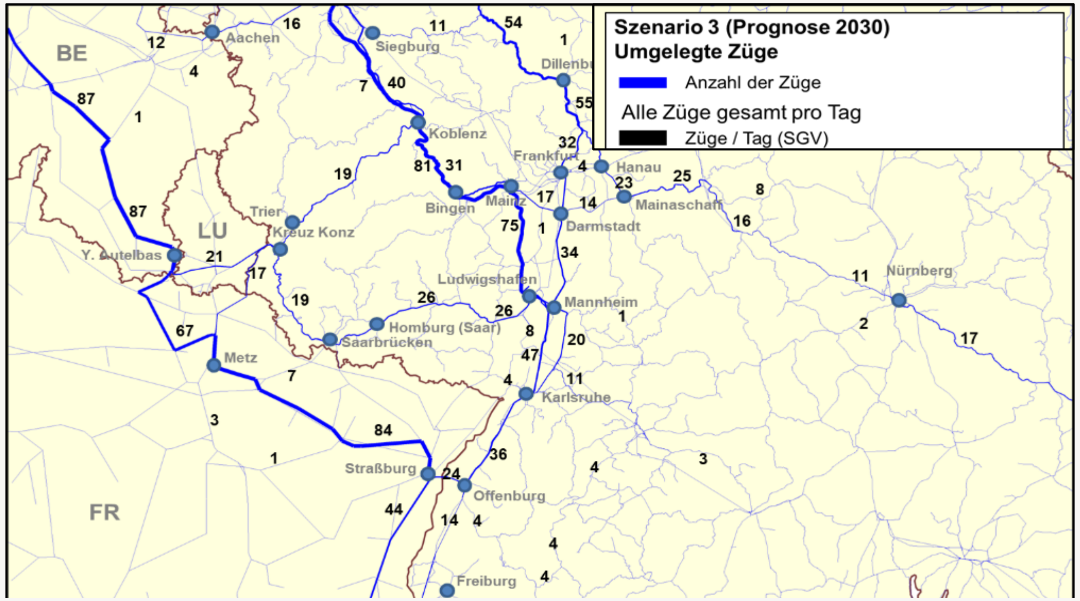
~ 29%

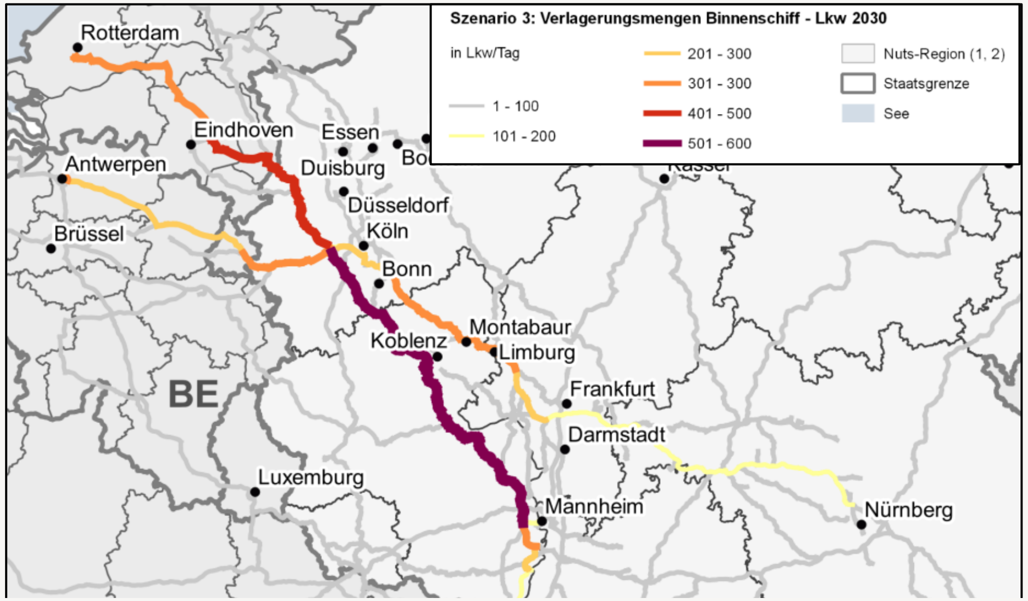
~ 6%

251.000 t/day

Duration: 180 days

Low water terms

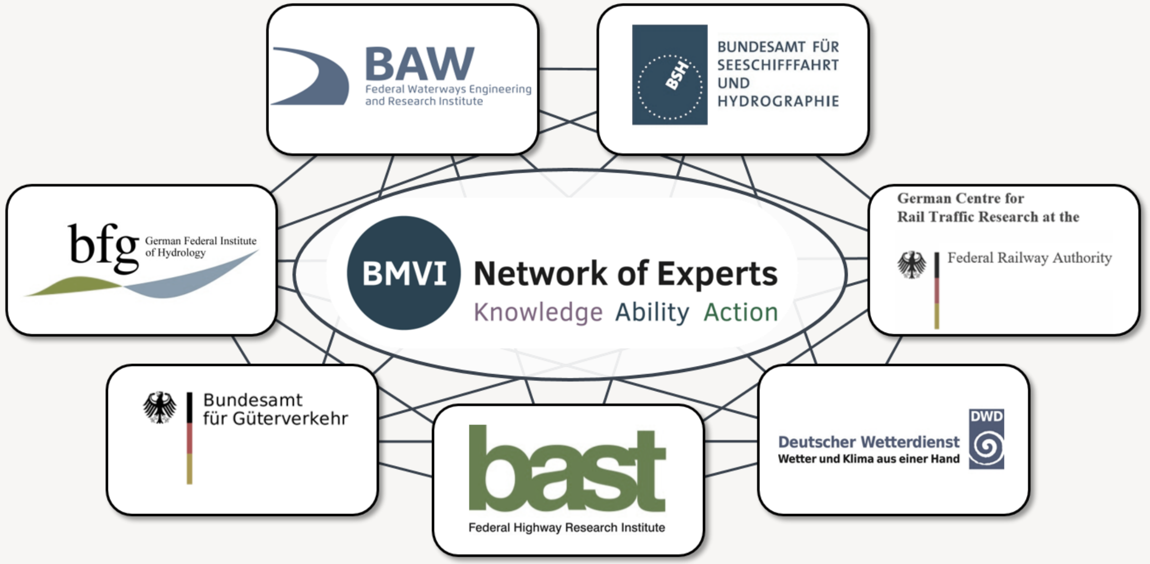




Additional transport costs: 1.4 Mio €/day (255 Mio/event)

Shortcomings → Needs for further improvement

- Simple model with several simplifications due to a limited data availability
- Important bottlenecks were not considered → Questionable assumptions (unlimited availability of vehicles, facilities and operates as well as unlimited capacity of foreign nets) lead to rather conservative estimates
- Only transportation costs which are directly related to the event were considered. Economic losses due to delayed deliveries and other disadvantages not considered.
- The additional modelled direct transportation costs for a 180-day low-water situation were between 250-300 Mio. Euro. The low-water situation from 2018 showed that real costs and impacts were much higher.



Thank you

Feedback, questions and comments are very welcome !

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