Assessment of adaptation strategies

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- Discussion / validation on findings

Objectives and problem

- Overall objective: is to mitigate or compensate the possible additional transport costs for IWT and loss of reliability due to climate change by means of adaptation measures.

- Primary goal is to offset the (threat of) increased occurrence of (extreme) **low water periods**.

- Secondly also high water can occur more frequently, resulting in problems for container transports (bridge clearance) and in case of extreme high water levels, a temporary ban of navigation.

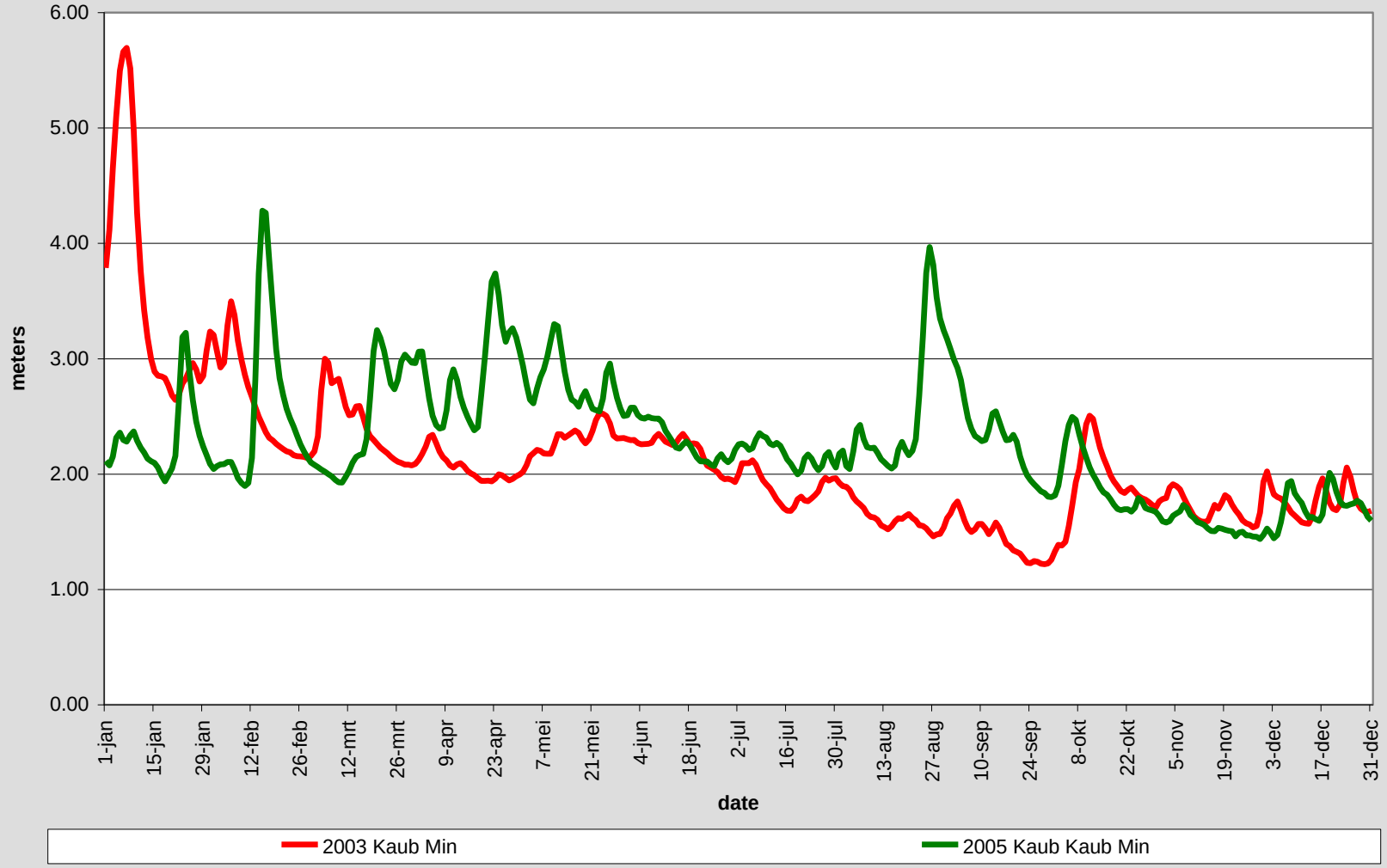
ECCONET Research questions

- What measures are sustainable and effective both from public and private viewpoints?
- Focus on cost-effectiveness of the measure:
  What is financially needed to compensate for increased low water periods or decrease water levels (high water) at critical locations in Rhine and Danube?
- What are the critical locations and what is the target to reach to compensate climate effects (minimum and maximum scenario)?
- What can be done? What is the most cost-effective measure or combination of measures to reach the targets (package)?
- What are the positive and/or negative impacts of adaptation measures on other aspects, such as environment, nature, employment?
- What is the overall score on the different appraisal criteria?

ECCONET Research questions

- What are the impacts of climate change?
  - Impact on low water situations
  - Impact on high water situations
- Into what extent shall measures reach an impact?
- A quite pessimistic scenario could set the maximum required impact of a measure:
  - Extreme (low) water level situations observed on Rhine in 2003 could become the average situation
- What was the difference in waterlevels compared to ‘normal’ years and what would the be a ‘target’ for the impact of adaptation measures?

Target: example Rhine at Kaub 2003 (red) vs 2005 (green)



Target: example Kaub

Possible draft of passing vessel at Kaub	Number of days in year **2003** and % of year		Number of days in year **2005** and % of year	
Over 4m	9	2%	2	1%
Below 4m	356	98%	363	99%
Below 3.5m	354	97%	354	97%
Below 3m	344	94%	324	89%
Below 2.5m	305	84%	263	72%
Below 2m	185	**51%**	103	**28%**
Below 1.5m	25	7%	12	3%

Target: example Kaub

Possible draft of passing vessel	Year 2003	Year 2005	Adapted Year 2003* **(+0.25m waterlevel)**
Over 4m	2%	1%	3%
Below 4m	98%	99%	97%
Below 3.5m	97%	97%	96%
Below 3m	94%	**89%**	**88%**
Below 2.5m	84%	72%	68%
Below 2m	**51%**	**28%**	**28%**
Below 1.5m	7%	3%	2%

=> 2003 + 25 centimeter of draft each day (or less draft at the same payload) would have resulted in transport situation similar to 2005

* Similar approach can be used to determine the target for 2050 climate scenario's/water levels

Assessment methodology

- Multi-criteria approach to allow comparison on costs and effects
- Pragmatic and consistent methodology developed by NEA and VU to identify costs and impact on (high and low) water levels
- Understanding amongst partners of data collection requirements for alternatives

Assessment of alternatives

- Four different types of measures:
  - Operational and technical changes
  - Infrastructure and maintenance
  - Prediction procedures
  - Storekeeping/production processes

- Different in nature with different costs and effects

Criteria for analyses (MCA) (1/2)

- **Transport benefits / savings,** e.g.
  - 1) resulting from higher payload on critical locations (vessel, infrastructure adaptations)
  - 2) avoiding transport during events with problematic water conditions (multimodal cooperation, storekeeping, prediction).

- Additional investment and maintenance or (additional) exploitation costs (discounted) of the measure compared to 'doing nothing'
  - Costs for private parties (e.g. barge operators, shippers)
  - Costs for public parties (e.g. waterway manager, Ministry of Transport);

- Environmental impacts (positive and negative):
  - Global warming (CO2 emission);
  - Energy consumption (e.g. reduction of fossil fuel consumption)
  - Air quality (SO2, PM10, NOx emissions);
  - Noise;
  - Nature conservation (Natura 2000);
  - Use of space (m2)
  - Water pollution;

Criteria for analyses (MCA) (2/2)

- Transport safety
- Direct employment from investments
- Indirect effects such as regional economic effects (employment)
- Other aspects:
  - Legal feasibility
  - Public acceptance
  - Financing opportunities

IWT fleet and operation: assessment conclusions

- Quantitative information available: investment costs and additional draft (centimetres)
- Cost-efficiency: adjustable tunnels>side blisters>lightweight structure
- Considerable investments required but there is uncertainty about actual impact of climate change.
- Will operators already invest in such measures?
- Multimodal cooperation in particular for time critical / high value goods (containers, chemicals): use rail and road in case of water level problems.

=> What do you think about these results?

IWW infrastructure: assessment conclusions

- Focus on Austrian Danube case for maintenance works with transferable results to Rhine waterway
- Large infrastructure works (locks, dams) are out of scope for climate change
- Daily maintenance/dredging can be intensified which brings (limited) additional costs.

=> What do you think about these results?

Improved forecasting: assessment conclusions

- Difficult to assess future impact on water levels and inland shipping industry
- Impossible to assess costs for improved forecasting

=> Do you consider this as an important adaptation measure to climate change relative to the other measures?

What does this imply for assessment?

- Most feasible action in the short run is **optimisation of maintenance works of the fairways.**
- Sector investments in **new ship technology** are only feasible when water levels change significantly (whether or not due to climate change) and as soon as the actual impact of climate change is more clear.
- Multimodal cooperation is an option for specific cargo types such as containerised goods and chemical cargo but has limits (lack of capacity, high price).
- We should not expect much impact from improved forecasting and storekeeping

How to continue within Ecconet

- Estimate costs and effects for most promising (and validated) adaptation measures:
  - Adapted infrastructure
  - Adapted fleet

- Determine impact on water levels and draft of vessels and their impact on transport costs for inland waterway transport.

- Evaluation of alternatives with the NODUS transport model providing results on modal share of IWT as result of measures.