

ECCONET: climate change and adaptation to inland waterways

Transport & Mobility Leuven

Christophe Heyndrickx

Tim Breemersch

Outline presentation



- Project plan and objectives ECCONET
- Methodological issues
- Effect of climate change on Rhine and Danube
- Adaptation measures

- Effects of Climate Change on the inland waterway network
- 7th Framework Program, European Commission
- 10 partners, 5 countries, 5 disciplines:
 - Meteorology
 - Hydrology
 - Infrastructure Management
 - Shipbuilding
 - Economics/Logistics

Methodology and modeling

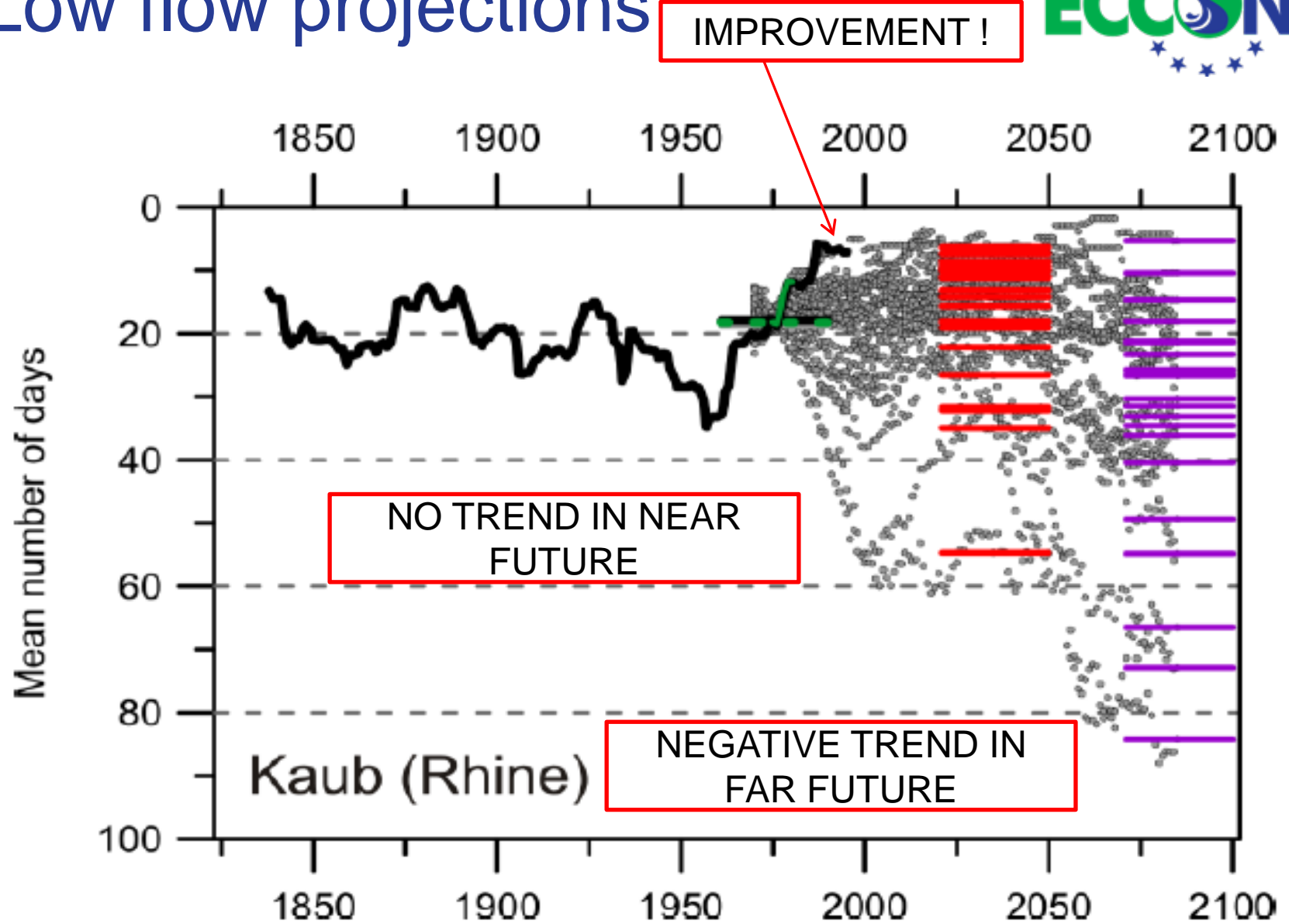


	Time span	Important variables	output	Complications
Climatological models	30 year-averages for example: 1960-1990, 1991-2021, 2021-2050, 2040-2070, etc.	precipitation, temperature		Bias-prediction, regional climate scenarios, large set of model chains (ensembles), uncertainty
Hydrological modelling	Daily and even hourly variations for all modelled years (30 years)	water levels/water depths on different river stretches based on nature of river		Added uncertainty due to regional variance and anthropogenic factors. Large running time
Transport-economic modelling	Based on an OD-matrix for 1 year. Predictions should be based on averages or should be composed of different characteristic situations	Flow of goods by transport mode (inland waterways are 1 of the modes) Costs of transport (minimized by model)		Difficult to handle sub-annual information (for example seasonal variance) Uncertainty in OD matrix. Only a limited set of model runs is possible

EFFECT OF CLIMATE CHANGE

- Rhine
- Danube

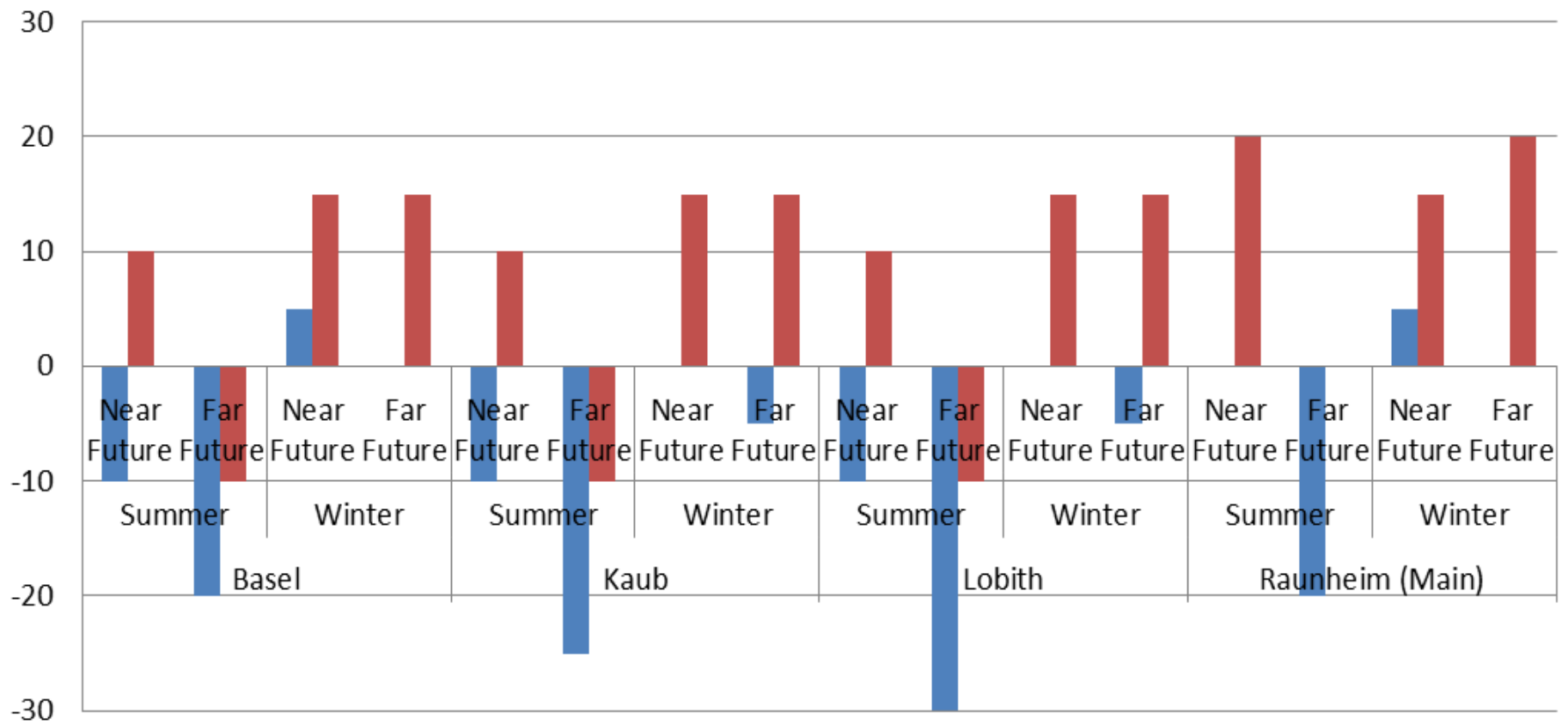
Low flow projections



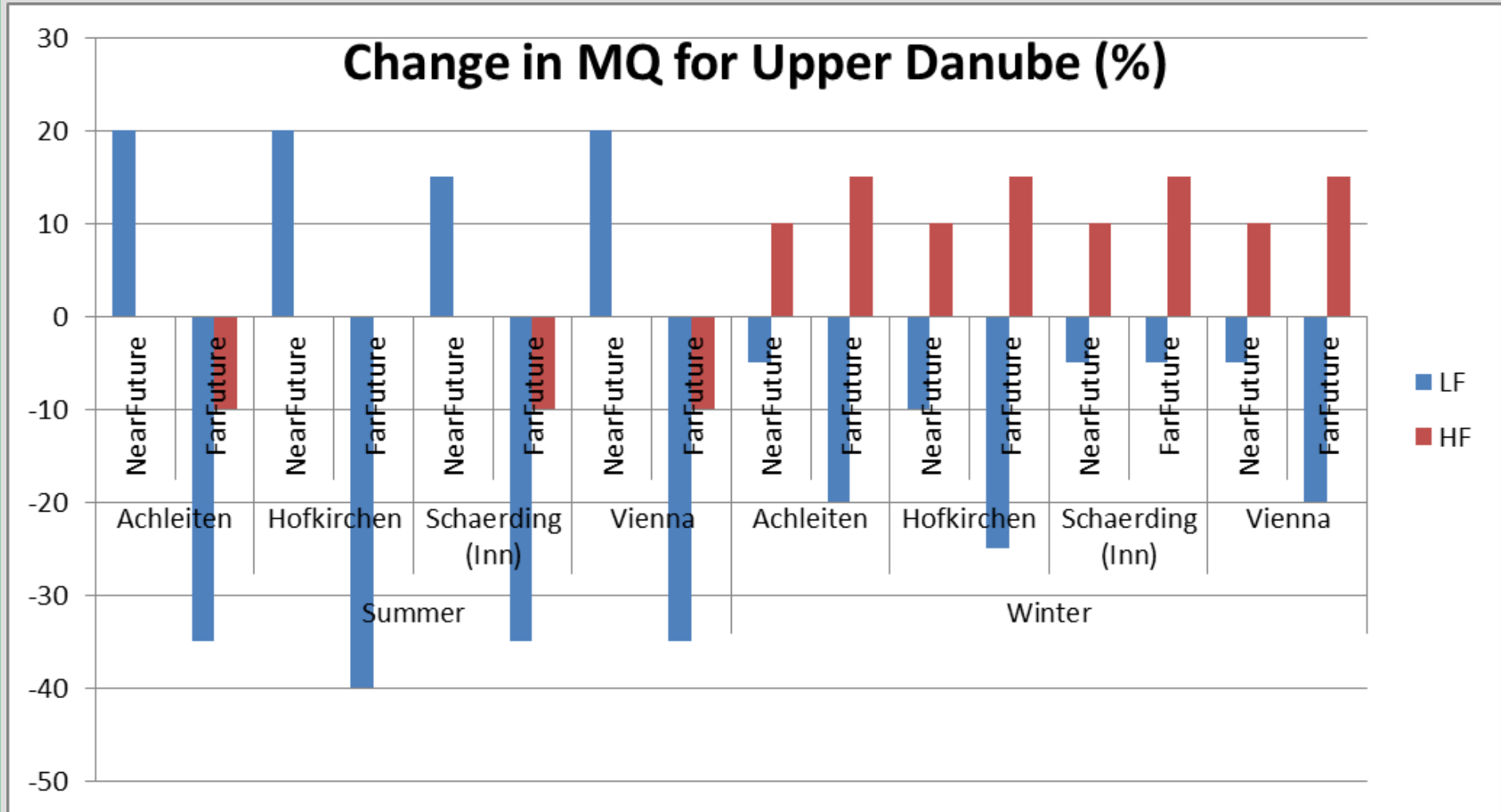
Effect of climate change on hydrology (1)



Relative change in NMQ7 on Rhine (%)



Effect of climate change on hydrology (2)



Impact of climate change



Phenomenon	Period	Middle Rhine	RMD canal	Upper Danube
Low flow	1950-2005	positive effect	no effect*	positive effect
	Middle of 21 st century	no effect	unknown	negative effect*
	End of 21 st century	negative effect	negative effect*	negative effect*
High flow	1950-2005	no effect	no effect	no effect
	Middle of 21 st century	negative effect	no effect*	no effect*
	End of 21 st century	negative effect	no effect*	unknown
River ice	1950-2005	positive effect	positive effect	positive effect
	Middle of 21 st century	no effect*	positive effect*	positive effect*
	End of 21 st century	no effect*	positive effect*	positive effect*
Visibility (fog)	1950-2005	positive effect	positive effect	positive effect
	Middle of 21 st century	unknown	unknown	unknown
	End of 21 st century	unknown	unknown	unknown

Representative years



	2005 'reference'			Near future 'dry' scenario		
Water depth	Median	D5	D10	Median	D5	D10
1.6	0	0	0	0	4	24
1.8	0	20	36	5.5	55	74
2	14	61	86	28.5	79.5	121.5
2.4	133	192	221	135.5	203.5	234.5
2.6	182	260	273	216	259.5	307.5
3.25	301	334	344	324	365	365
3.55	328	351	352	344	365	365

Effect of low water



Table 2: The Kaub case in 2005

Water depth	Days frequency								Average cost per ton/km Boat Va Upstream Dry bulk	% Payload Boat Va
	1993		1989		1985		2005			
	Nbr	%	Nbr	%	Nbr	%	Nbr	%		
> 4.3 m	<p>Costs rise quickly under low water conditions Below 1.6 meter, most inland waterway transport becomes impossible</p>								0.0122	100.00%
at 4 m									0.0122	100.00%
at 3.4 m									0.0136	84.00%
at 3 m									0.0157	68.00%
at 2.70 m									0.0180	56.00%
at 2.40 m									0.0221	44.00%
at 2 m	0	0,00%	0	0,00%	11	3,01%	0	0,00%	0.0333	28.00%
Total	365	100,00%	365	100,00%	365	100,00%	365	100,00%		

ADAPTATION MEASURES

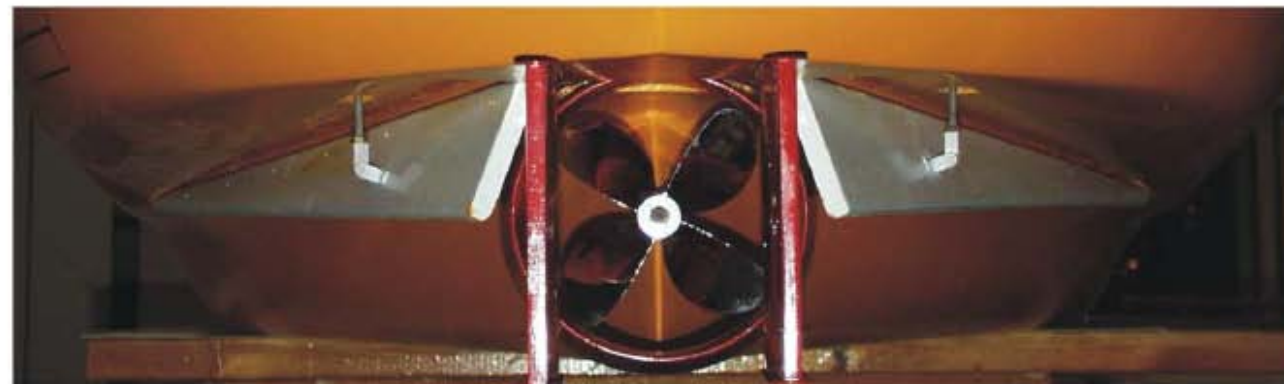
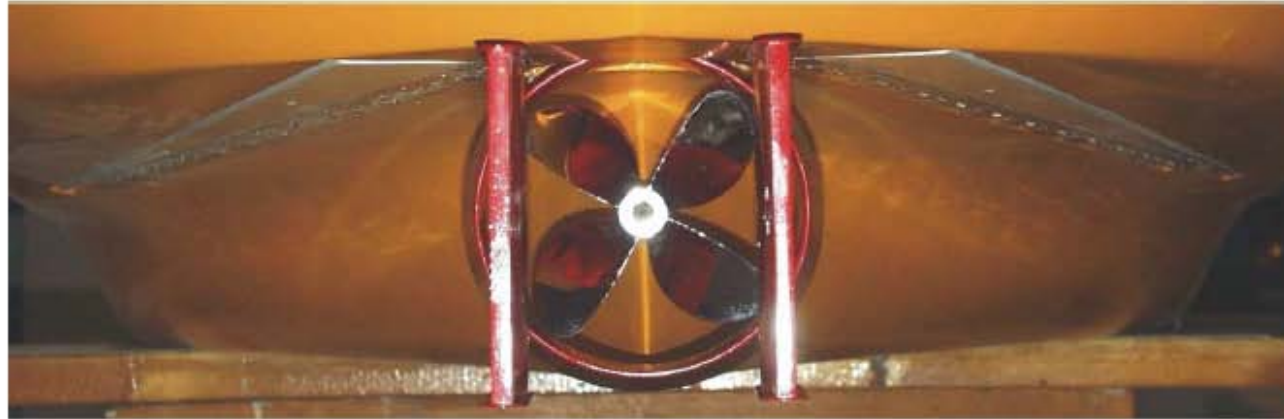
- Fleet adaptation
- Infrastructure
- Prediction
- Logistics

Fleet adaptation



Measure		Primary effect	Preliminary assessment
A1	Lightweight structure	Reduction of own weight causing lower draught	Further research necessary on technical solutions
A2	Adjustable tunnel	Navigation in lower water levels	In combination with A1
A3	Side blisters	Payload gain between 115 and 260 tonnes	Theoretical approach, handling provides to be difficult
A4	Flat hulls (multiple screw push boats)	Draught reduction from 1.7 to 1.4 meter	Promising approach especially for push boat technology, even at increased construction cost
B1	Small instead of large vessels	Small vessels are less water sensitive	Goes contrary to scale effect
B2	Upgrade of small vessels to continuous operation	Increased performance	Promising approach
B3	Coupling convoys	Redistribution of load	Promising due to increased scale effect
C1	Strategic alliance between IWT and other modes	Co-operation with other modes	Capacity limits of rail and high prices make this difficult

Adjustable tunnels



Source: DST

Fig. 4: Adjustable tunnel aprons (in functional model scale)
- to be retracted into the hull if the ship utilizes its full draught in deep water (above)
- to be extended when the ship operates with small draught in low water (below)

Side blisters

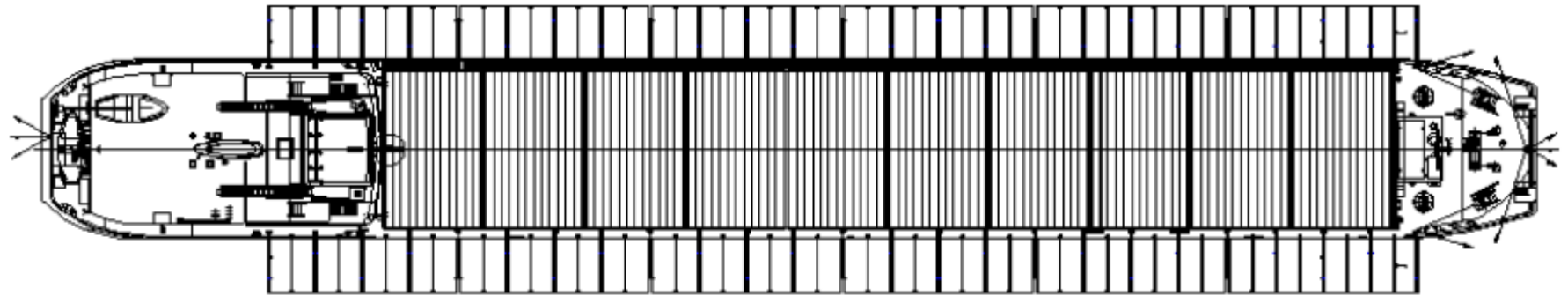


Fig. 7: *General arrangement plan of a ship with laterally extractable buoyancy elements*

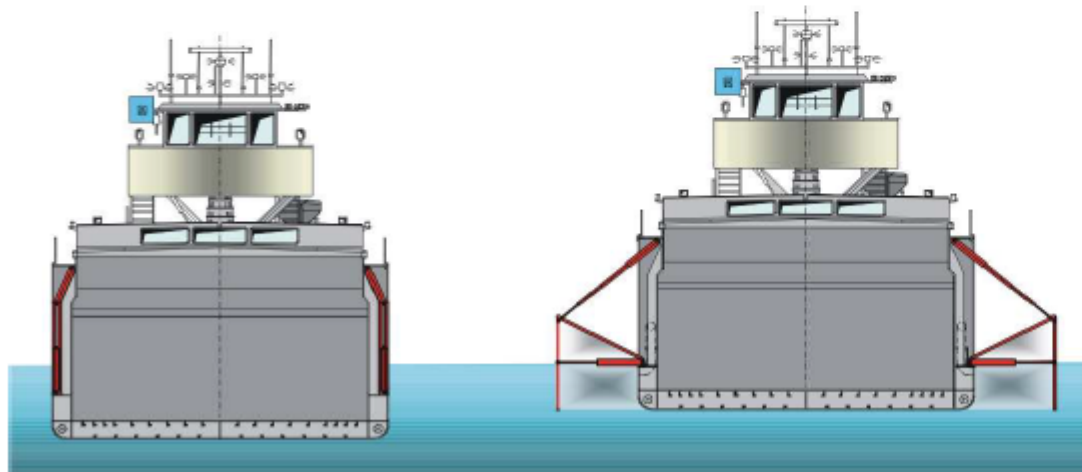
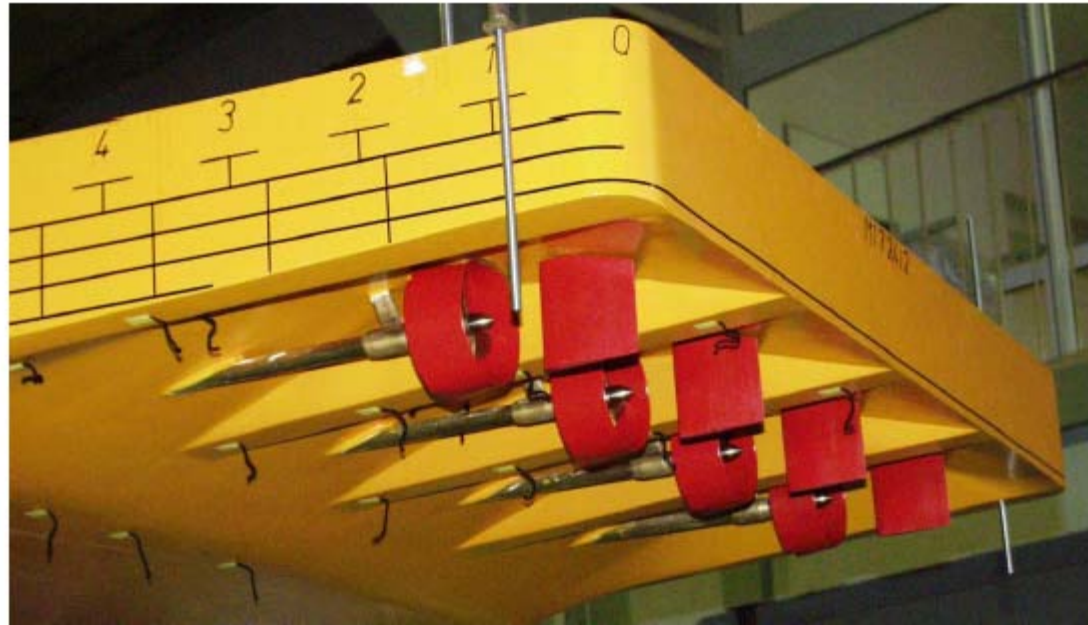
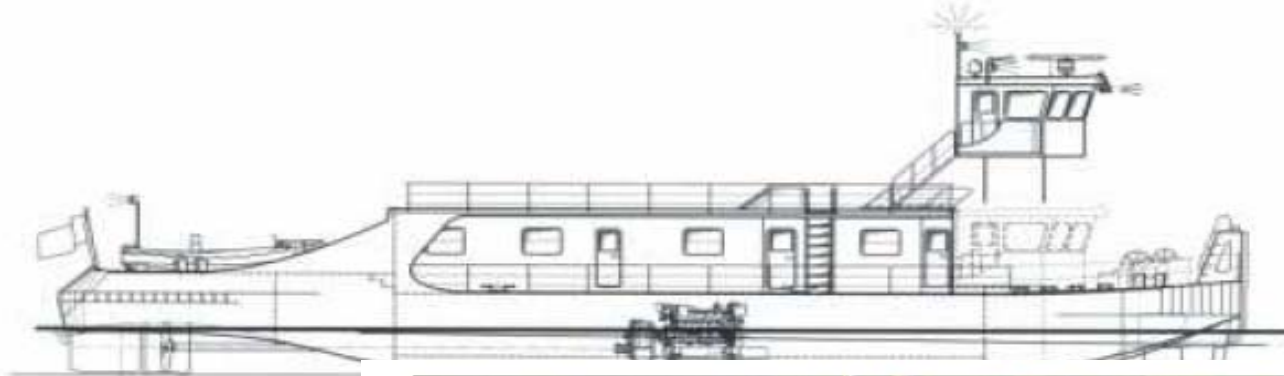
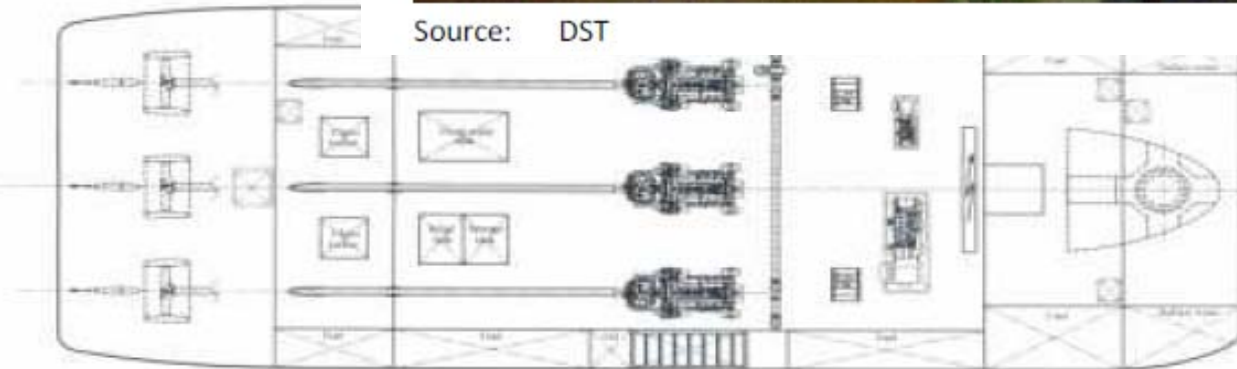


Fig. 8: *Cross section of a ship with laterally extractable buoyancy elements*



Source: DST



Infrastructure: information & dredging

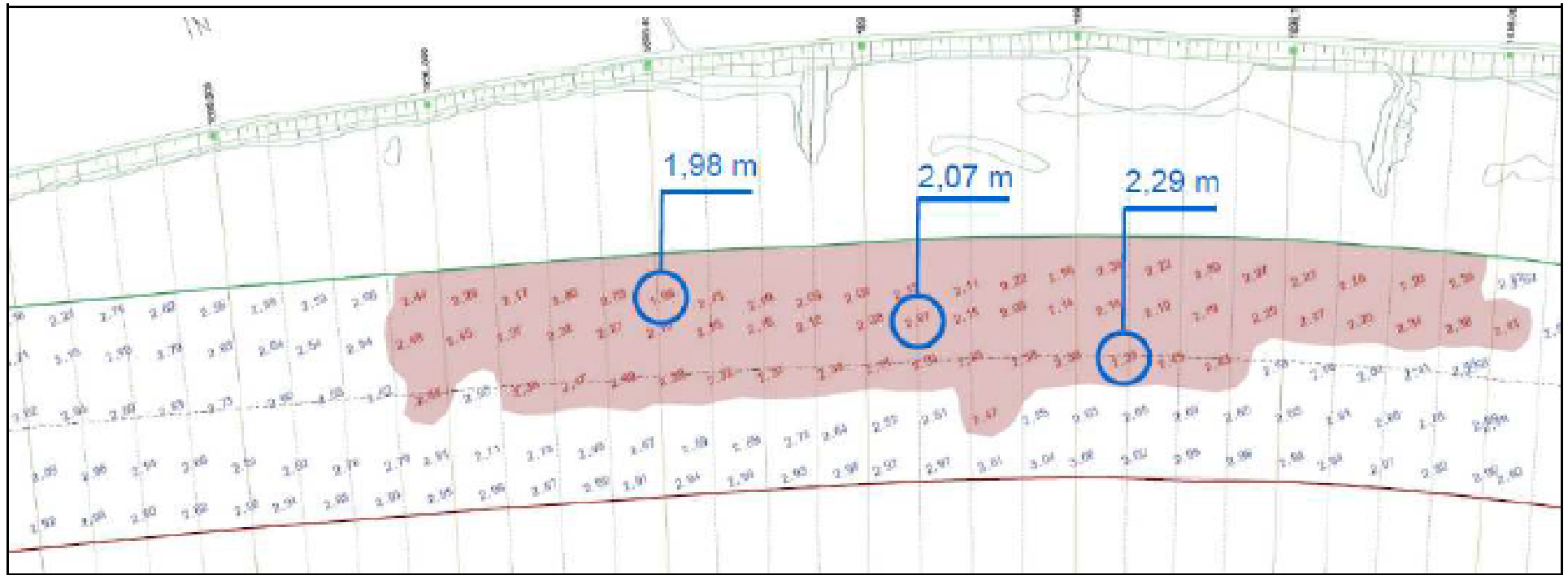


Figure 3.6: Track plot of fairway depth information of a shallow, available at the DoRIS website. Source: via donau.

Infrastructure adaptation: engineering



Figure 3.7: Measures within the Pilot Project Witzelsdorf. Source: via donau.

Seasonal prediction methods



- Improved prediction of water level situation (currently 3-5 days)
- Possibility of 1-3 months predictions and more was studied
- **Conclusion:** theoretically very appealing, also large interest from the sector..

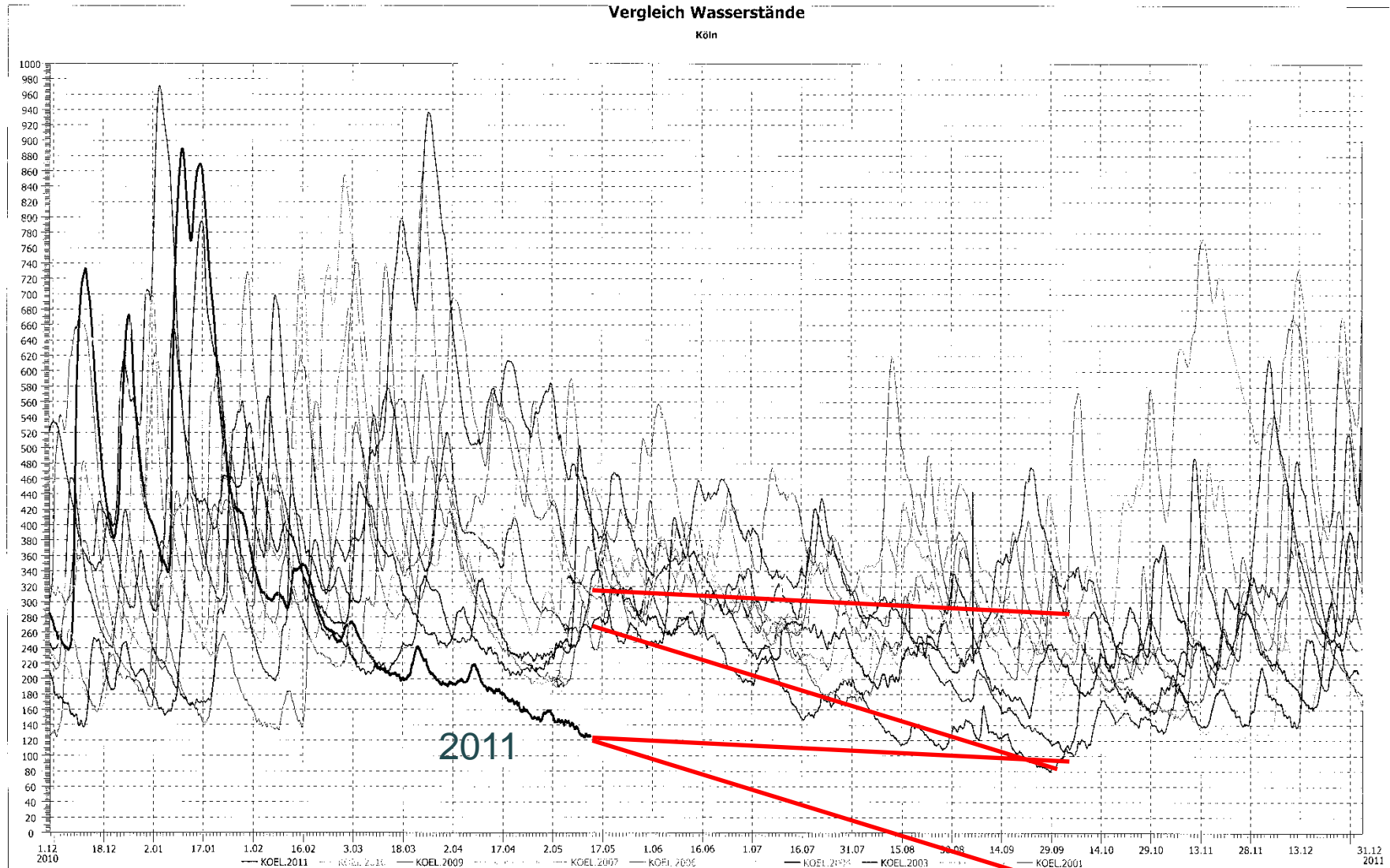
Unfortunately:

- High R&D costs with a relatively low success rate for actual 'trustworthy method'
- Possible: extraction of trends in seasonal forecast...
- From our data: 2011 could have been as bad as 2003 for inland waterway transport, if the summer had not been that 'wet'.

More knowledge than service for economic activity at this point



Datum: 13.05.2011 12:54:02



Adaptation by industry



Table 4.2: Preferred adaptation measures

	First best	Second best	Third best	<i>Total</i>
Smaller ship		1		1
Lighter ship	2	1		3
Storage capacity	1	2	3	6
Alternative transport	5	2	1	8
Shutdown production			1	1
Relocation production				
Koppverband		1		1
<i>Total</i>	8	7	5	20

INLAND WATERWAY TRANSPORT IS USED FOR ITS RELIABILITY

	Measure	Review method		
Dimension	Adaptation measure	Lit. review	Stakeholder view	Overall assessment
FLEET	Lightweight structure	Feasible	Ship owners	Feasible
	Adjustable tunnel	Feasible	Ship owners	Feasible, but costly
	Side blisters	Feasible	Ship owners	Feasible, but costly
	Flat hulls	Feasible	Ship owners	Feasible
OPERATION	Smaller vessel	Not realistic	Not realistic	Less feasible
	Continuous operation	Feasible	Feasible	Feasible
	Coupled convoys	Feasible	Feasible	In operation
	Rail and IWT alliance	Market dependent	Inflexible contracts	Feasible, but not for all goods
INFR	Maintenance	Necessary	Necessary	Feasible and necessary
	River engineering	Necessary	Necessary	Feasible and necessary
PREDICTION	Improved prediction	Reliability?	Important	Necessary if reliable
PROCESS	Storekeeping	Feasible	Costly	Short run solution
	Relocation of product	Less feasible	Very costly	Low feasibility



Christophe Heyndrickx
Tim Breemersch
Transport & Mobility Leuven
Diestsesteenweg 57

Tel: +32 (16) 74.51.21

Christophe.Heyndrickx@tmleuven.be

ECCONET website

www.ecconet.eu