ECCONET: climate change and adaptation for inland waterway transport

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Outline presentation

- The ECCONET project
- Methodological issues
- Effect of climate change on IWW (Rhine and Danube)
- Economic assessment
- Adaptation measures

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- Effects of Climate Change on the inland waterway network

- FP7, European Commission, 2010-2012 (ongoing)
- 10 partners, 5 countries, 5 disciplines:
  - Meteorology
  - Hydrology
  - Infrastructure Management
  - Shipbuilding
  - Economics/Logistics

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Methodology

Complete impact chain

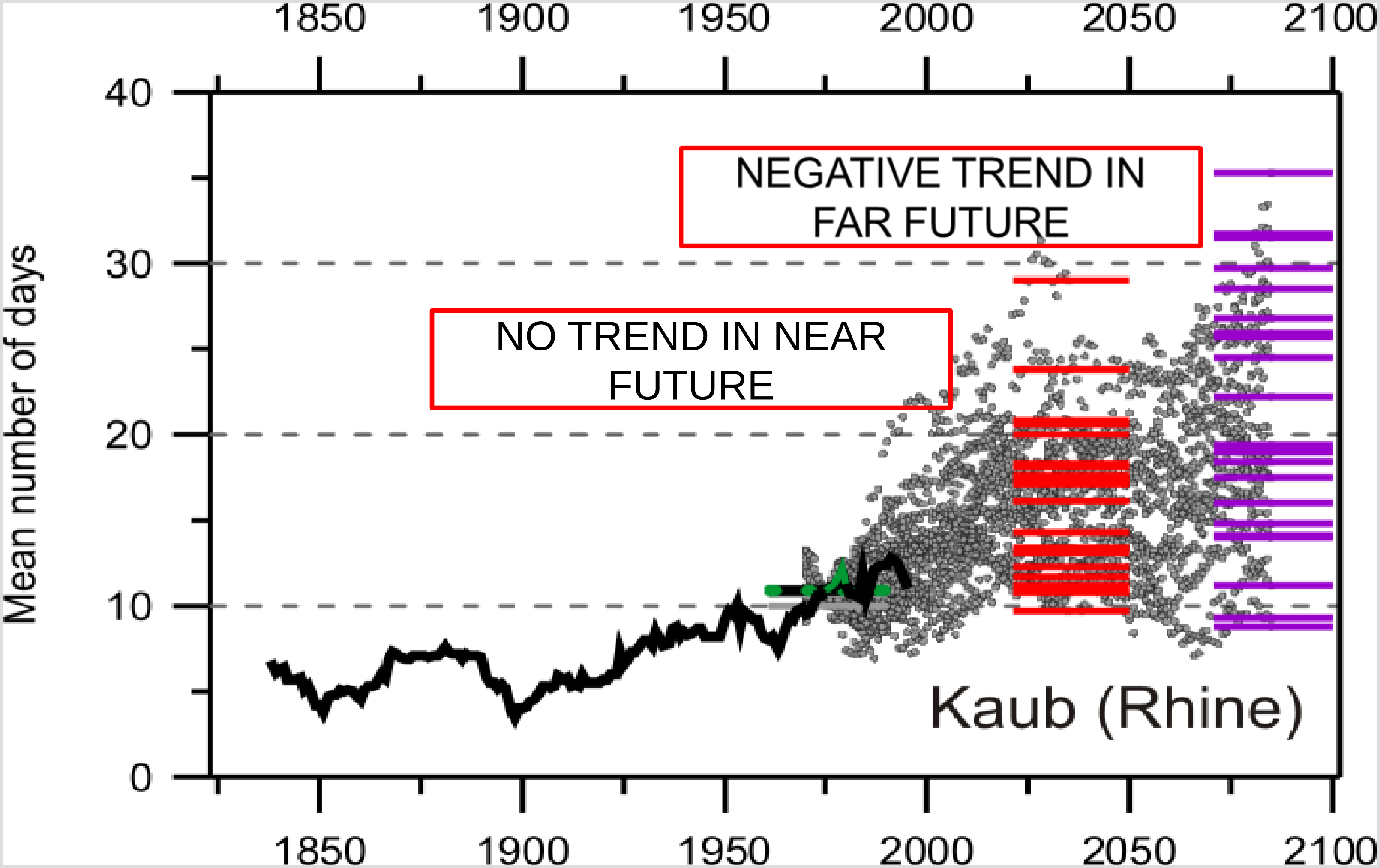
1. Climate change
2. Weather and precipitation
3. Hydrology: waterlevels on Rhine and Danube
4. Costs of Inland Waterway Transport (IWT)
   - with and without adaptation measures
5. Transport Volumes
6. Assessment of adaptation options
7. Policy advice

CLIMATE CHANGE

Effects of Climate change

- Low water levels
  – Most important
  – Can impede or block navigation for weeks
- High water levels/floods
  – Blocks navigation, but shorter periods
- Ice
  – Significant decrase
- Fog
  – Significant decrease

Low flow projections



Differences between Rhine and Danube

- Rhine: snow/rain regime
  - Wet winters, dry summers
    - Summers get dryer, winters get wetter: problem can get worse!
- Danube: snow regime
  - Dry winters, wet summers (snowmelt)
    - Summers get dryer, winters get wetter: problems can improve

Hydrological modelling: low water levels

- Determination of representative years:
  - D2: median year
  - D5: once every 5 years
  - D10: once every 10 years

Kaub	2005 reference (Simulated reference)			2050 Dry scenario (2020-2050 Model)		
Water depth	Median	D5	D10	Median	D5	D10
>4.3m	13	10	18	77	42	19
3.6<x<=4.3	80	58	94	70	87	38
3.1<x<=3.6	181	170	119	95	54	136
2.8<x<=3.1	90	73	30	100	46	91
2.5<x<=2.8	1	37	65	23	63	14
2.2<x<=2.5	0	17	28	0	53	29
x<=2.2	0	0	11	0	20	38

Economic assessment

Effect of low water on transport costs

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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									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%**		

Costs rise quickly under low water conditions
Below 1.6 meter, most inland waterway transport becomes impossible

Methodology

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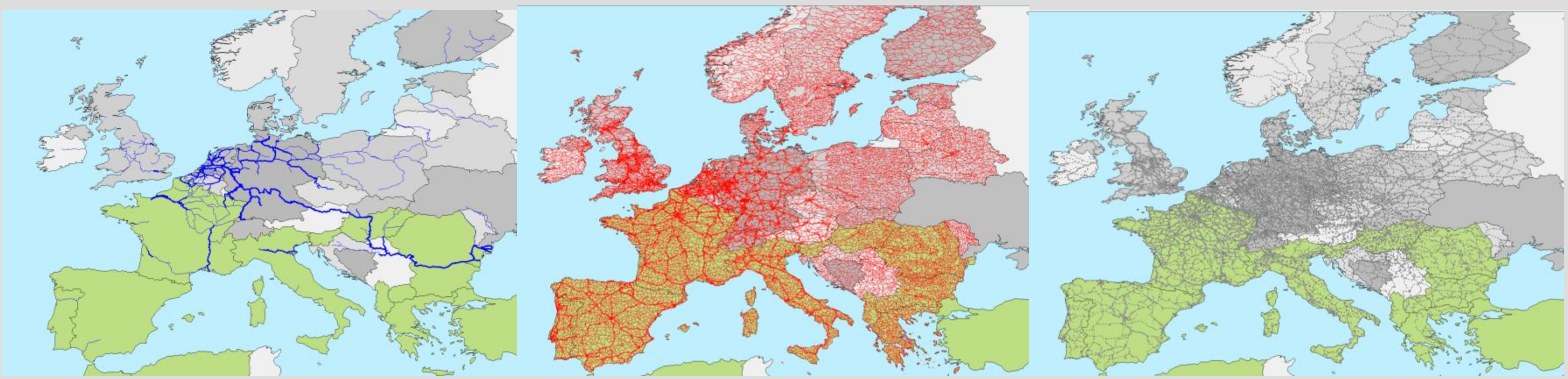
- Transport network model NODUS



- Cost functions per (sub)mode
  – Operational costs
  – Time costs
  – Equipment costs
- Calibration

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Modal split effects: Rhine

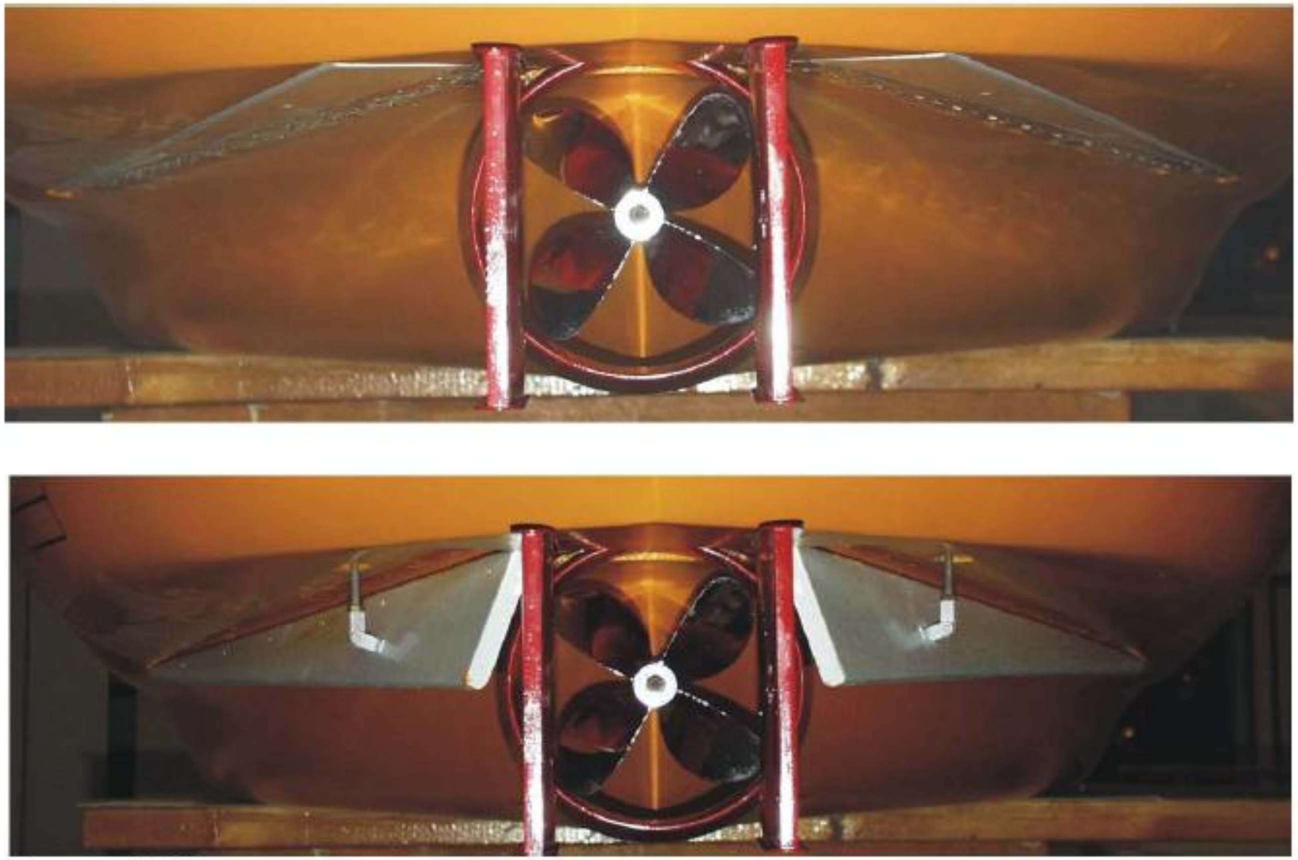
Scenario	Mode	Observations	Model 2020-2050		Model 2020-2050	
		2005 Data	2005 Data		2050 Data	
			Dry	Wet	Dry	Wet
D2	IWW	10,85%	10,83%	10,83%	9,44%	9,43%
	Rail	16,65%	16,66%	16,67%	11,50%	11,51%
	Road	72,49%	72,51%	72,51%	79,07%	79,06%
D5	IWW	10,78%	10,61%	10,83%	9,19%	9,44%
	Rail	16,67%	16,73%	16,66%	11,59%	11,50%
	Road	72,54%	72,65%	72,51%	79,22%	79,06%
D10	IWW	10,71%	10,63%	10,78%	9,21%	9,38%
	Rail	16,70%	16,73%	16,67%	11,58%	11,52%
	Road	72,59%	72,65%	72,54%	79,21%	79,10%
Average	IWW	10,82%	10,78%	10,84%	9,38%	9,45%
	Rail	16,67%	16,68%	16,66%	11,52%	11,50%
	Road	72,51%	72,54%	72,50%	79,10%	79,05%

ADAPTATION MEASURES

Fleet adaptation & logistics

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 extracted when the ship operates with small draught in low water (below)

Side blisters

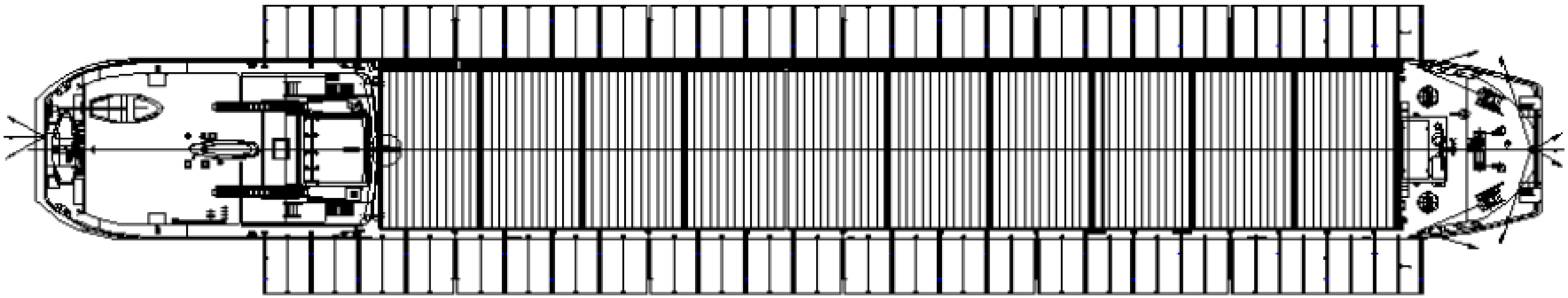


Fig. 7: General arrangement plan of a ship with laterally extractable buoyancy elements

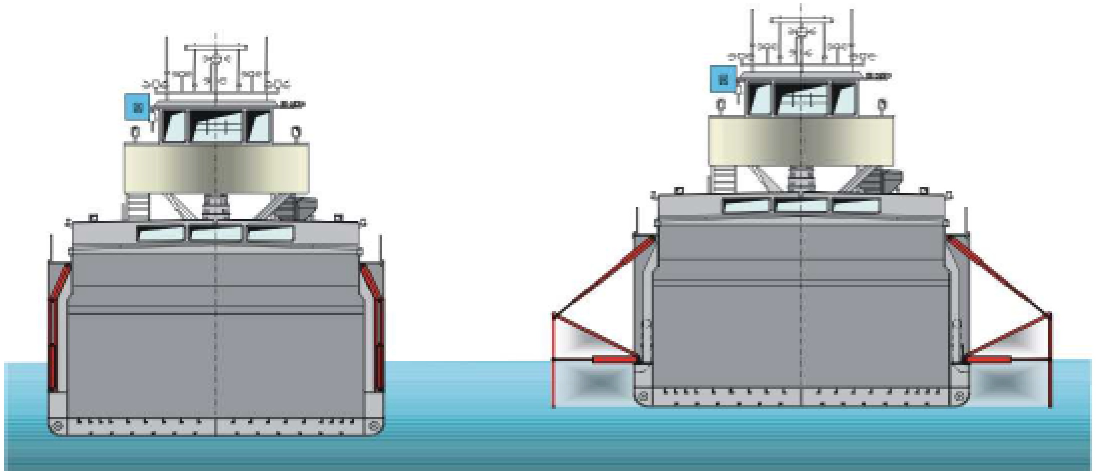
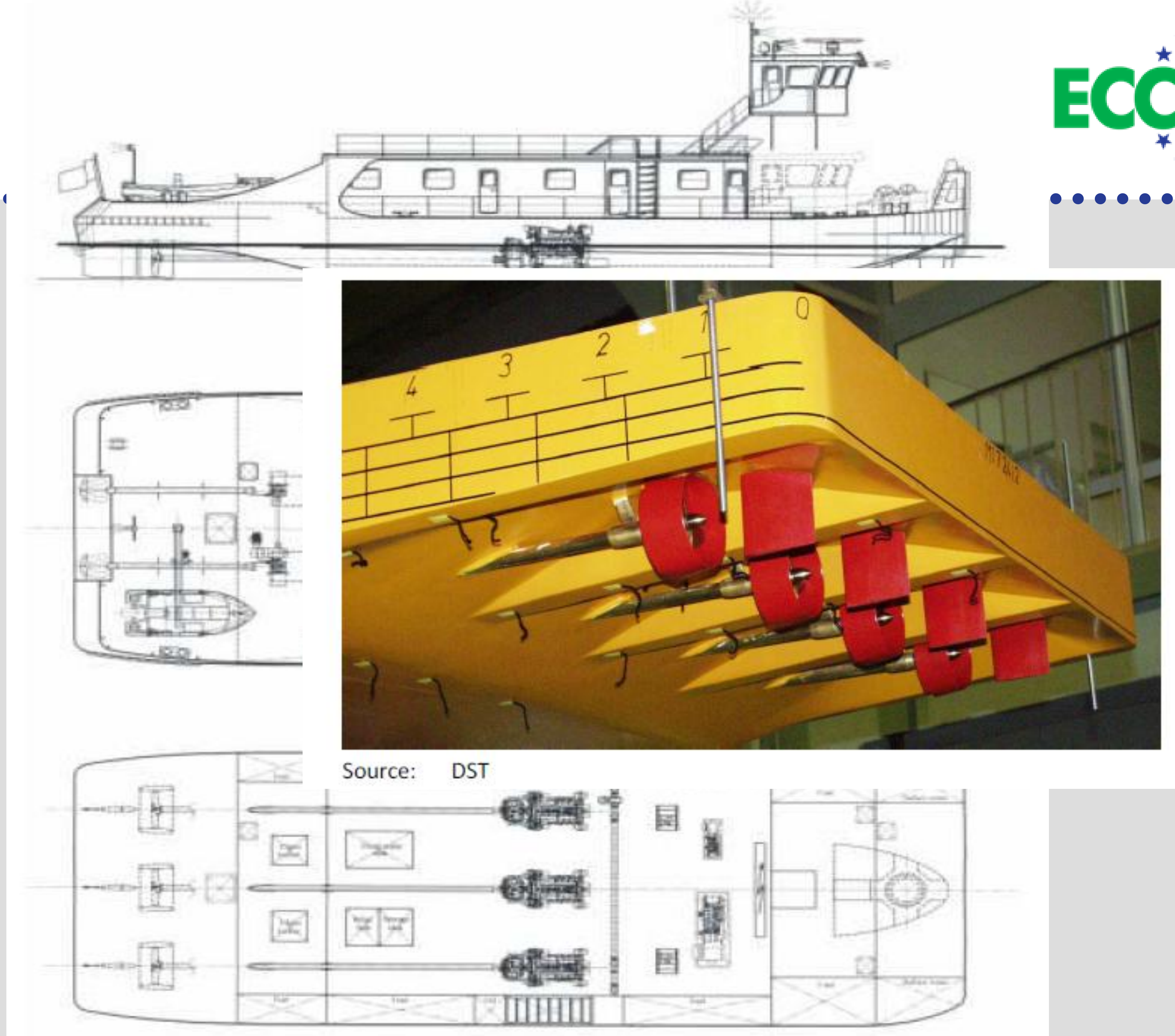


Fig. 8: Cross section of a ship with laterally extractable buoyancy elements



Source: DST

Infrastructure: information & dredging

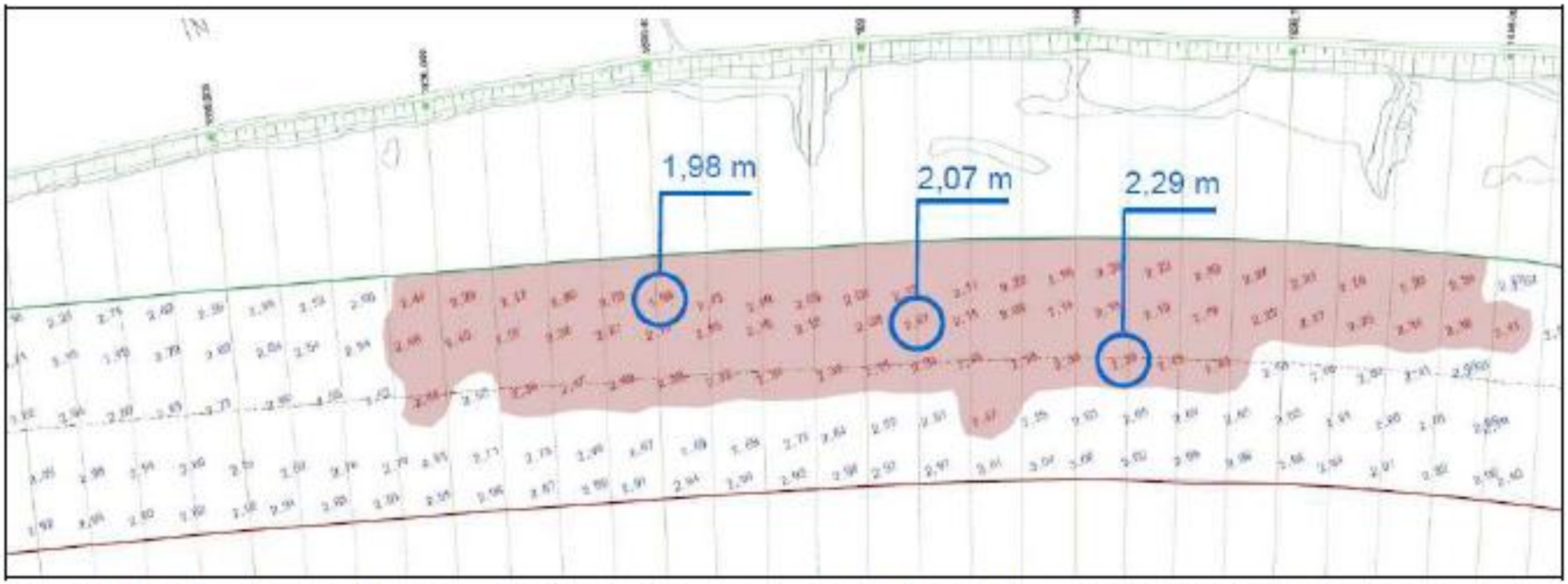


Figure 3.6: Track plot of fairway depth information of a shallow, available at the DoRIS website. Source: via donau.

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:

- Reliability of such a prediction?
- High R&D costs with no guarantee of results

Adaptation by industry

- **Survey method:** Very low response rate
  - **80 questionnaires were sent out, only 9 filled in. (+- 10 % response)**
- We have the impression that the issue of climate change is currently not alive in the sector.
- Our results show that the impact of climate change should not be **over**estimated, the impact is relatively low, especially compared to economic variables
- Additionally very large time spans -> potential negative side-effects only really apparent for 2100

Conclusions

- Climate change
  - Low water levels have biggest impact on navigation
  - Only minor changes in navigation conditions and transport volumes by 2050
- Adaptation
  - Options exist, but industry is not very interested at this moment
  - Dredging and coupled convoys are primary options

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