A basin-wide analysis
identifying areas of risk in the Elbe watershed

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Background of this talk

Heise et al. 2008

Report on

Evaluation of risks from particle-bound contaminants in the Elbe Basin

on behalf of the Hamburg Port Authority (HPA)

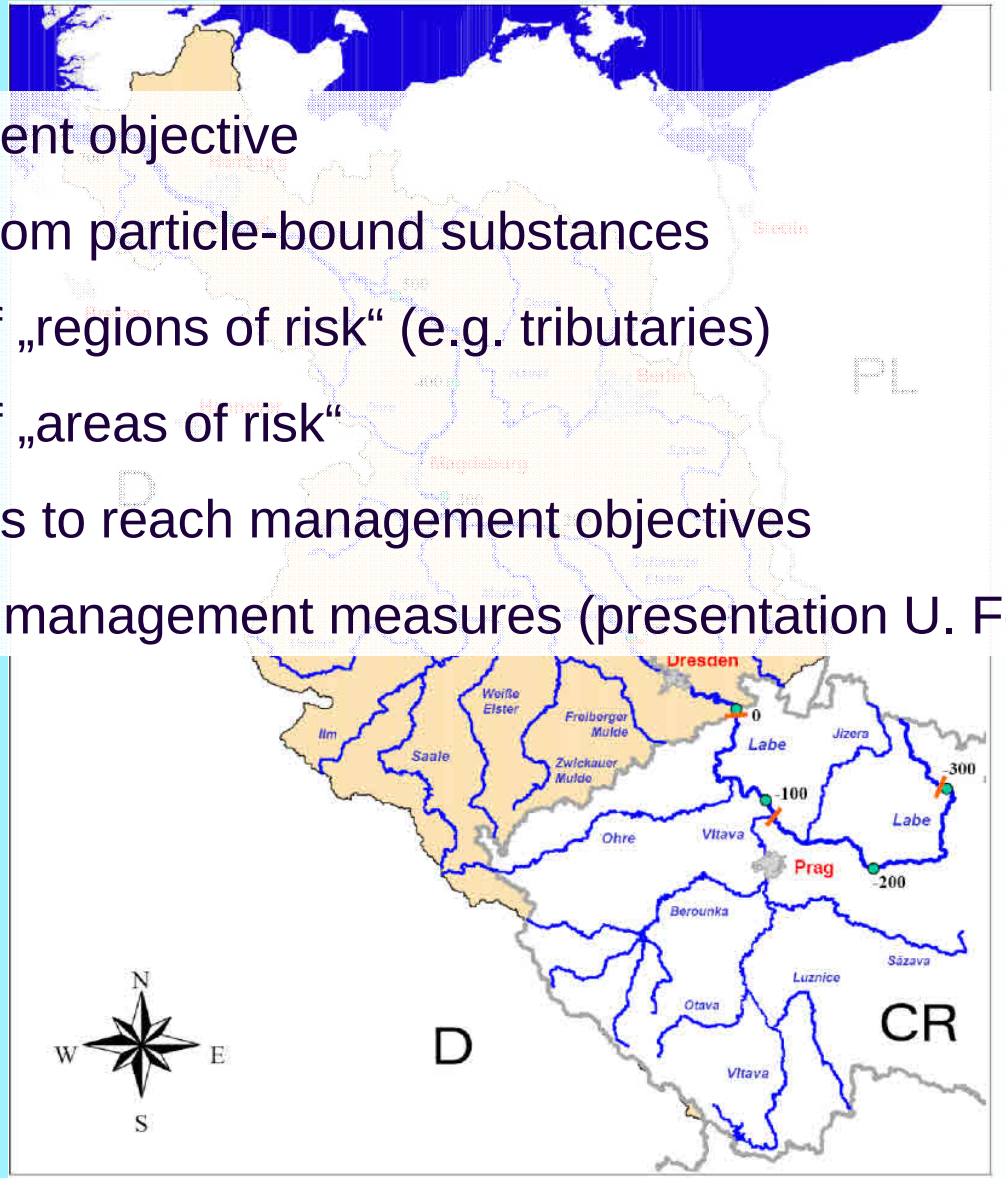
← co-financed by the Elbe River Community

Problem formulation (HPA, FGG)

Historically contaminated sediments in the Elbe watershed continue to impair ecosystem services. Due to the diversity and wide distribution of sources those that pose the main risk to the watershed are to be identified and potential measures suggested.

Steps of the risk evaluation in the Elbe

1) Risk management objective
2) Extent of risk from particle-bound substances
3) Identification of „regions of risk“ (e.g. tributaries)
4) Identification of „areas of risk“
5) Reduction goals to reach management objectives
6) Suggestion for management measures (presentation U. Förstner)



Risk Management Objectives

1) Risk management objective(s):

to guarantee the quality of the ecosystem,

its function and services to the society

1) Risk management objectives:

Compliance with the WFD

healthy aquatic ecosystem

value of life & human health

Prevention of food chain impact

Navigable waterways

agricultural use of flood plains

2) Extent of risk from particle bound substances

Extent of risk

„RISK“ =

The management objectives can not be guaranteed (with high safety).

Indicator of Risk:

Risk based sediment quality guidelines (SQG) for ecosystem functions

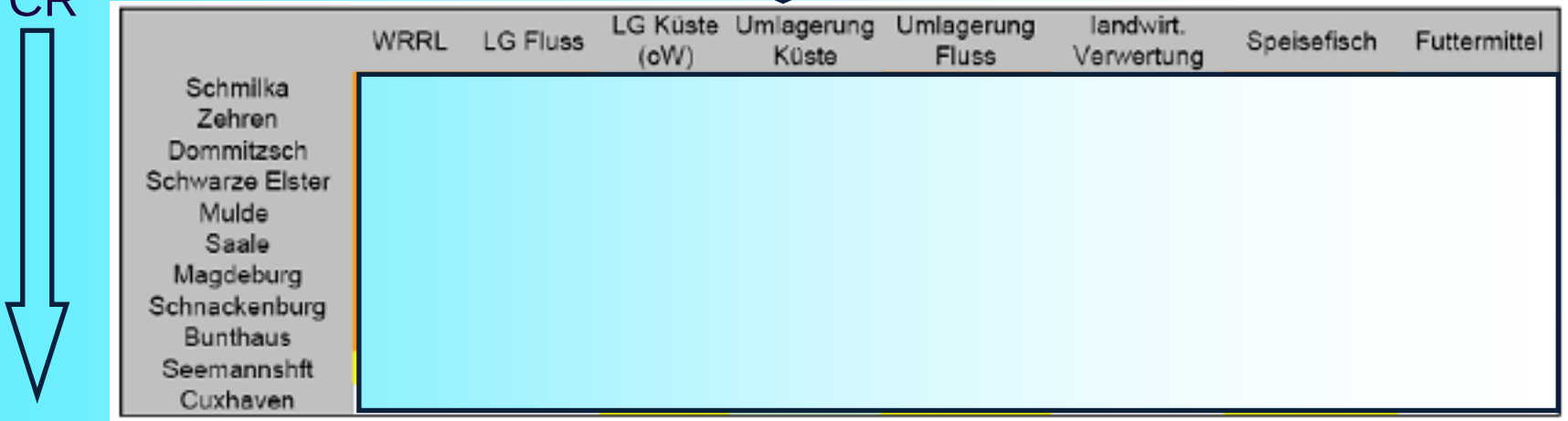
[$Cont_{SPM}$] < SQG: a risk is unlikely

[$Cont_{SPM}$] > SQG: a risk towards uses and ecosystem functions can not be excluded

2) Extent of risk from particle bound substances

Ecosystem uses

CR



North Sea

Extent of risk

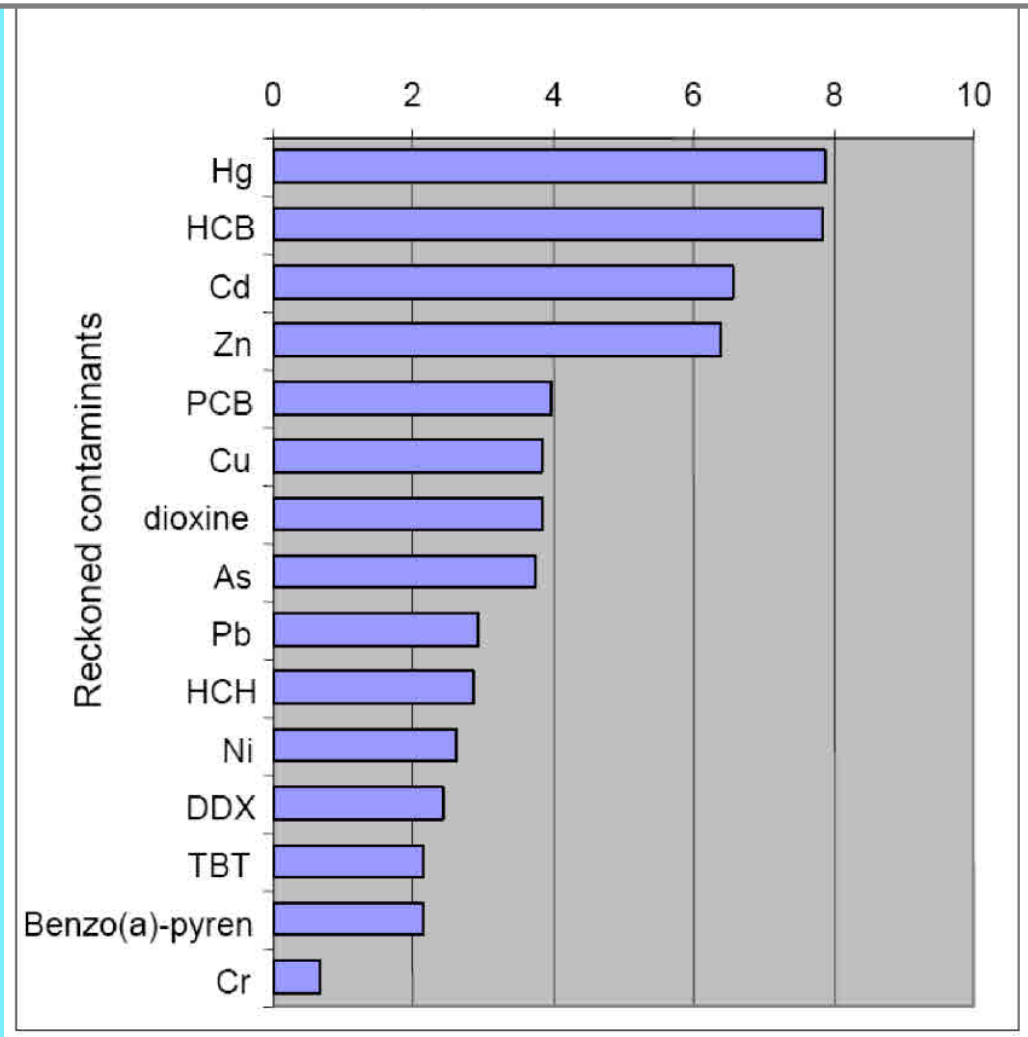
Orange: significant risk for the ecosystem use at the indicated site

All ecosystem uses are at risk due to particle bound contaminants!
Exception: estuary.

2) Extent of risk from particle bound substances

Extent of risk

Relative importance of contaminants for the basin risks



3) Identification of regions of risk

What regions contribute how much to the risk at downstream sites?

Mulde-confluence (foto: ARGE-Elbe)

Contribution of regions to the risk depend on

- SPM-Load of the area

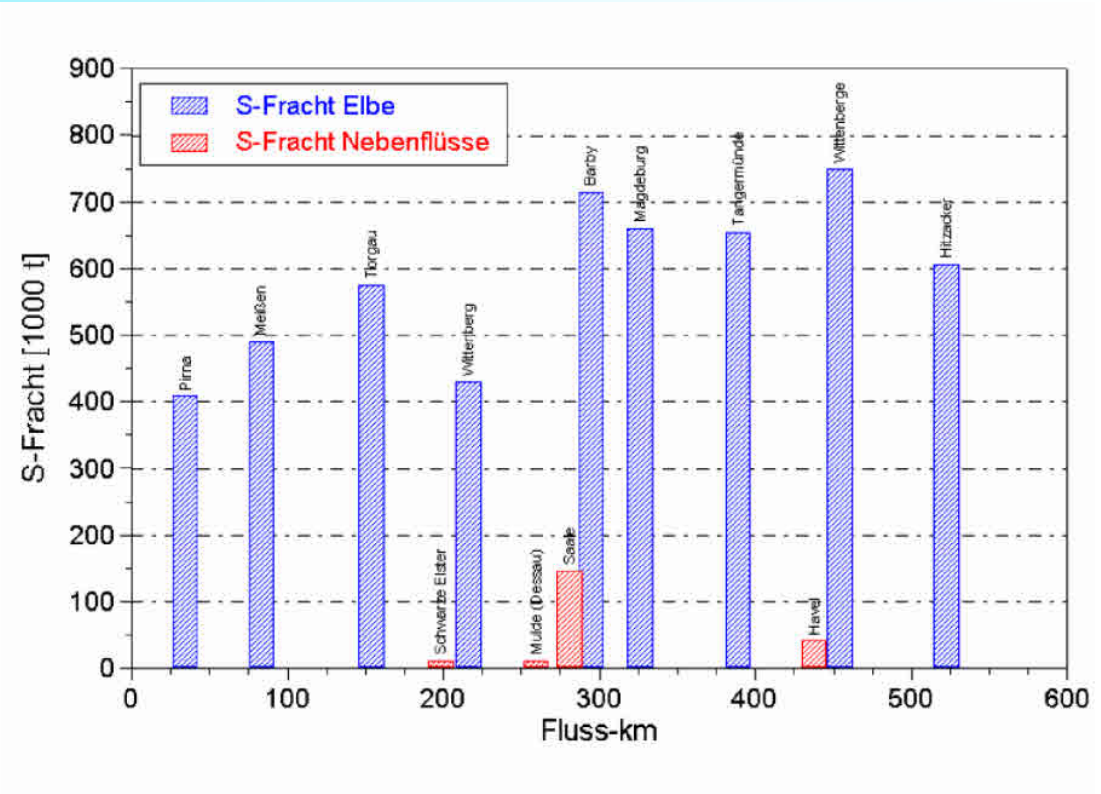
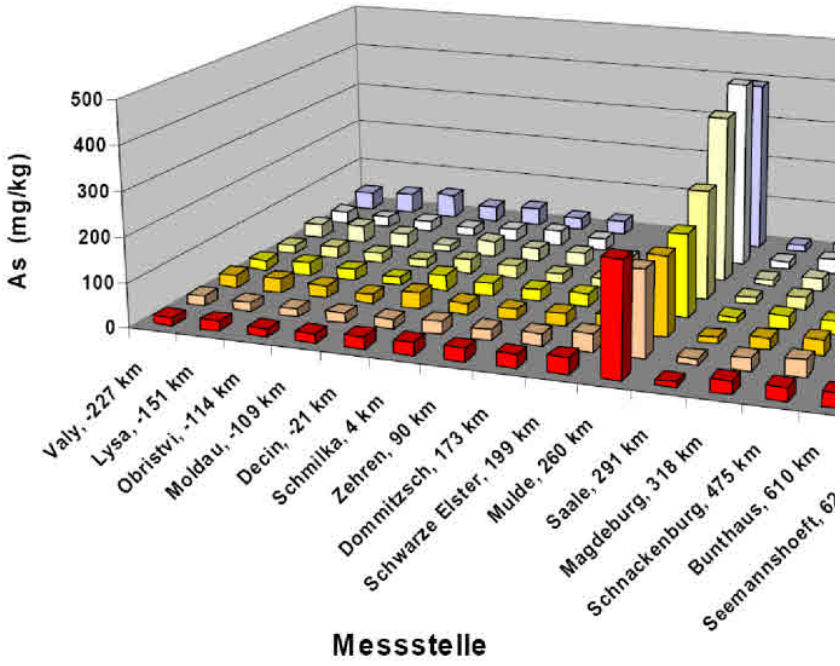


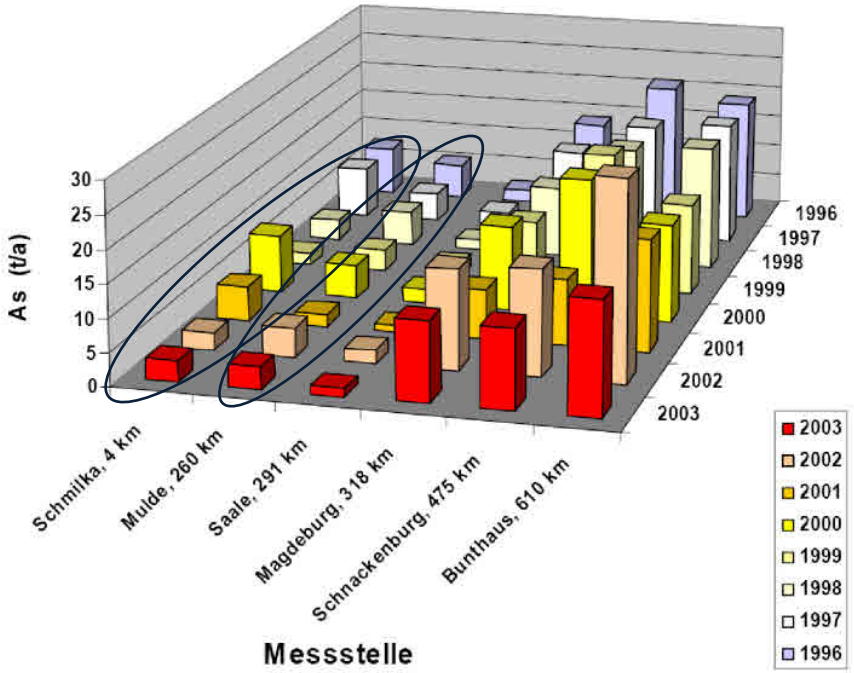
Abb. 1.1: Schwebstofffrachten der Elbe an ausgewählten Bilanzprofilen und von Hauptnebenflüssen (Daten BfG)

Identification of regions of risk

Contribution of regions to the risk depend on

- SPM-load from the area (e.g. sub-catchment)
- Contaminant concentration in SPM
- SPM-Loads, diluting the contaminant concentration





Contribution of regions to the risk depend on

- Contaminant concentration in SPM
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- Impact of high/low water discharges

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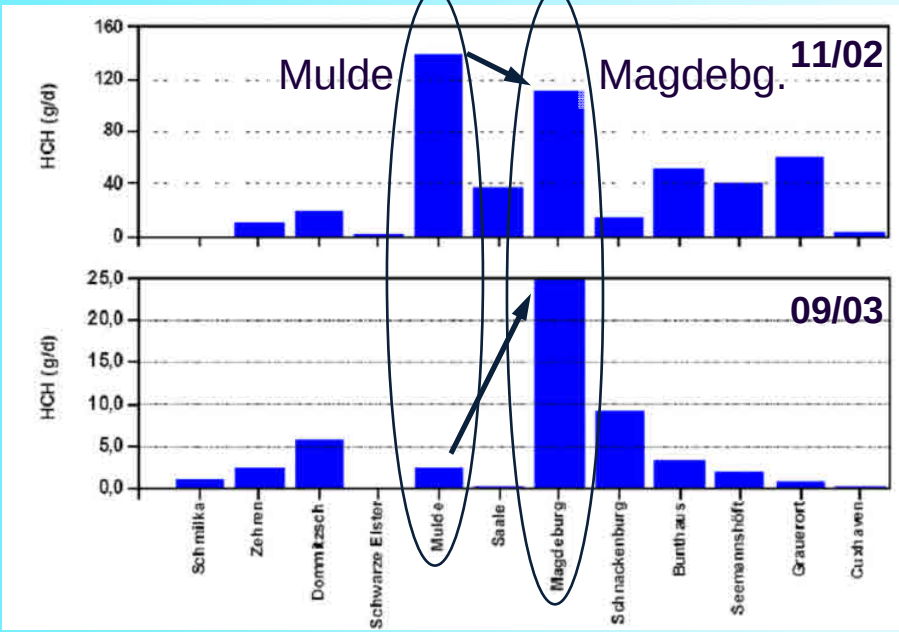

High water discharge

Low water discharge:

Hardly any HCH from Mulde

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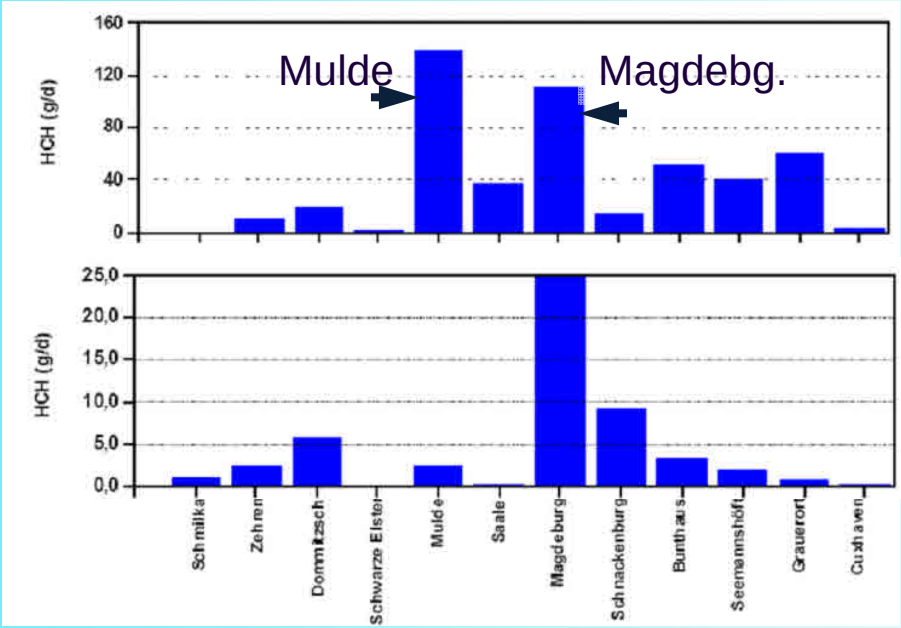


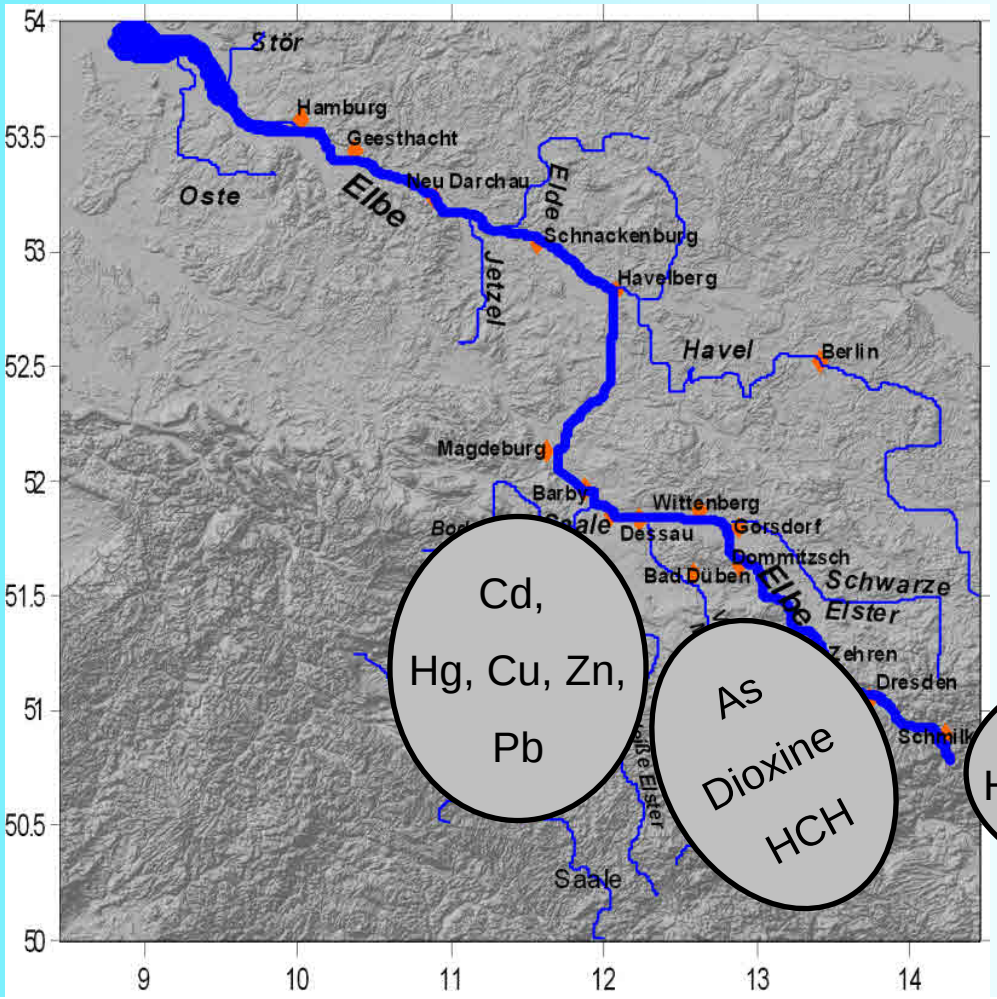
High water discharge

Low water discharge:

Hardly any HCH from Mulde

Identification of regions of risk

Regions at which contaminant load reductions are necessary in order to guarantee all (!) selected ecosystem services



Cd,
Hg, Cu, Zn,
Pb

As
Dioxine
HCH

CR
HCH, HCB, PCB, DDX
TBT

4) Identification of areas of risk

Areas of Risk

Detailed data from within regions of risk

- Contaminant depots
- Indication of mobility and transport of sediments

- Old mining sites (As, Cd in der Freiberger Mulde)
- Contaminated sediments in flood plains (e.g. Spittelwasser)
- Contaminated sediments in the rivers (Spittelwasser, Saale)
- Contaminated sediments in still water zones, reservoirs (easily resuspendible, z.B. Elsterbecken, Saalemündung)
- Groyne fields.

5) Hypothetical reduction goals and identified loads from sub-catchments

Reduction goals

Contaminant	Reduction goals to guarantee the management objectives	Sum of the loads from CR, Mulde, Saale, Schwarze Elster und Havel river
Cd	84 %	27 – 36 %
Hg	86 %	39 – 40 %
Cu	57 %	43 – 48 %
As	65 %	38 – 42 %
Zn	83 %	40 – 53 %
Pb	38%	46 – 57 %
Ni	42 %	40 – 51 %
TBT	99 %	54 %
HCH	77 %	100 %
HCB	97 %	100 %
PCB	72 %	100 %
Dioxins	94 %	70 – 82 %
pp'-DDE	92 %	100 %

Reasons:

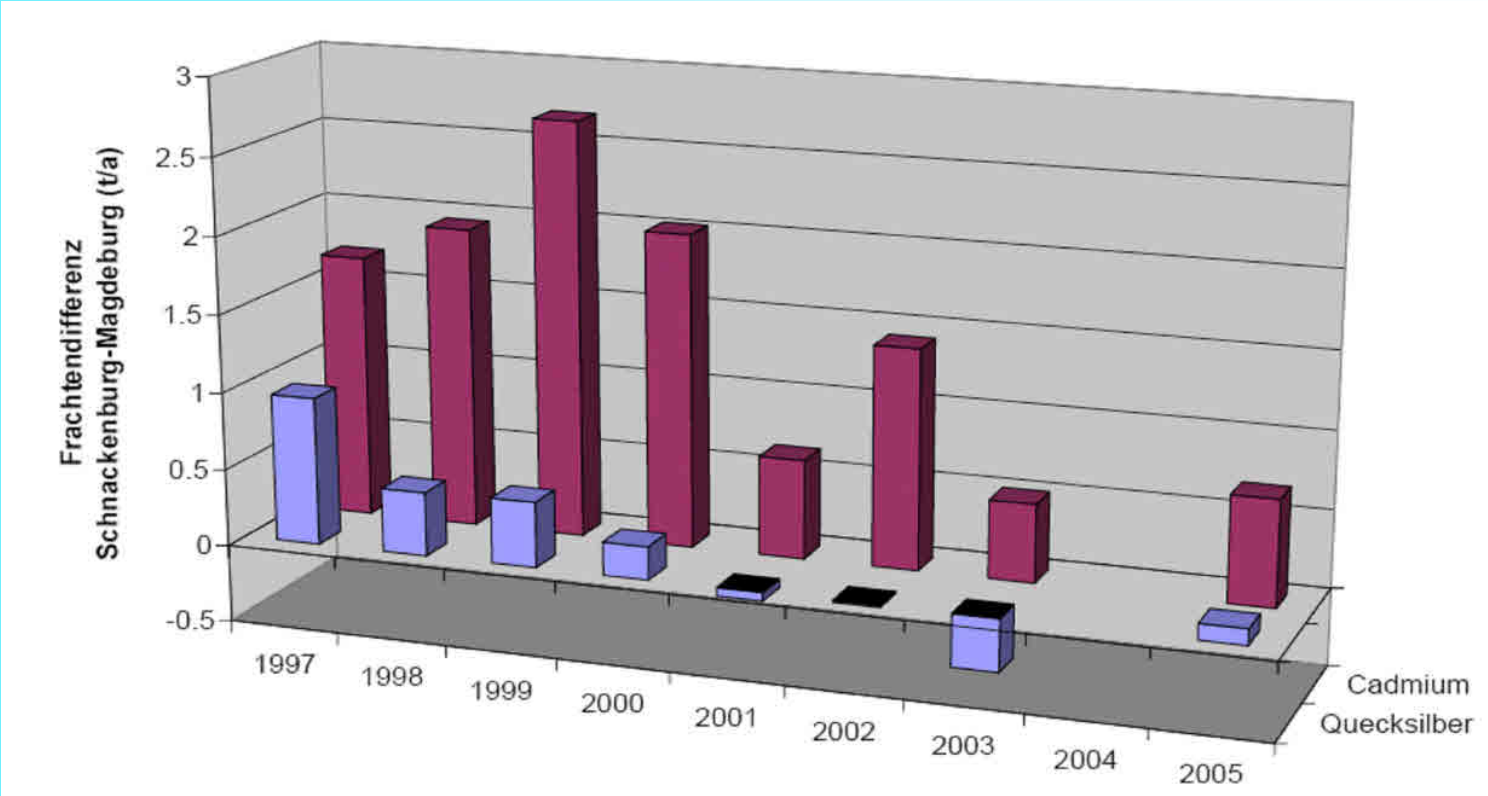
- Uncertainties in data basis and load calculations
- Unknown sources along the Elbe River basin
- Contaminated suspended matter within the main river, especially in groyne fields

Contaminants „on the move“

Emission from groyne fields seems to decrease since 2001

But for Cd and Hg it still exists.

Contaminants „on the move“



Emission from groyne fields seems to decrease since 2001

But for Cd and Hg it still exists.

Conclusions

- Evaluation of risk on river basin level is possible for the Elbe on the basis of existing data
- Long-term data on suspended matter are essential!
- Where uncertainties are high, detailed information has to be gathered (identification of gaps)
- Where certainty with regard to Areas of Risk is high, management measures should be considered
- The Czech stretch of the Elbe catchment needs to be tackled!

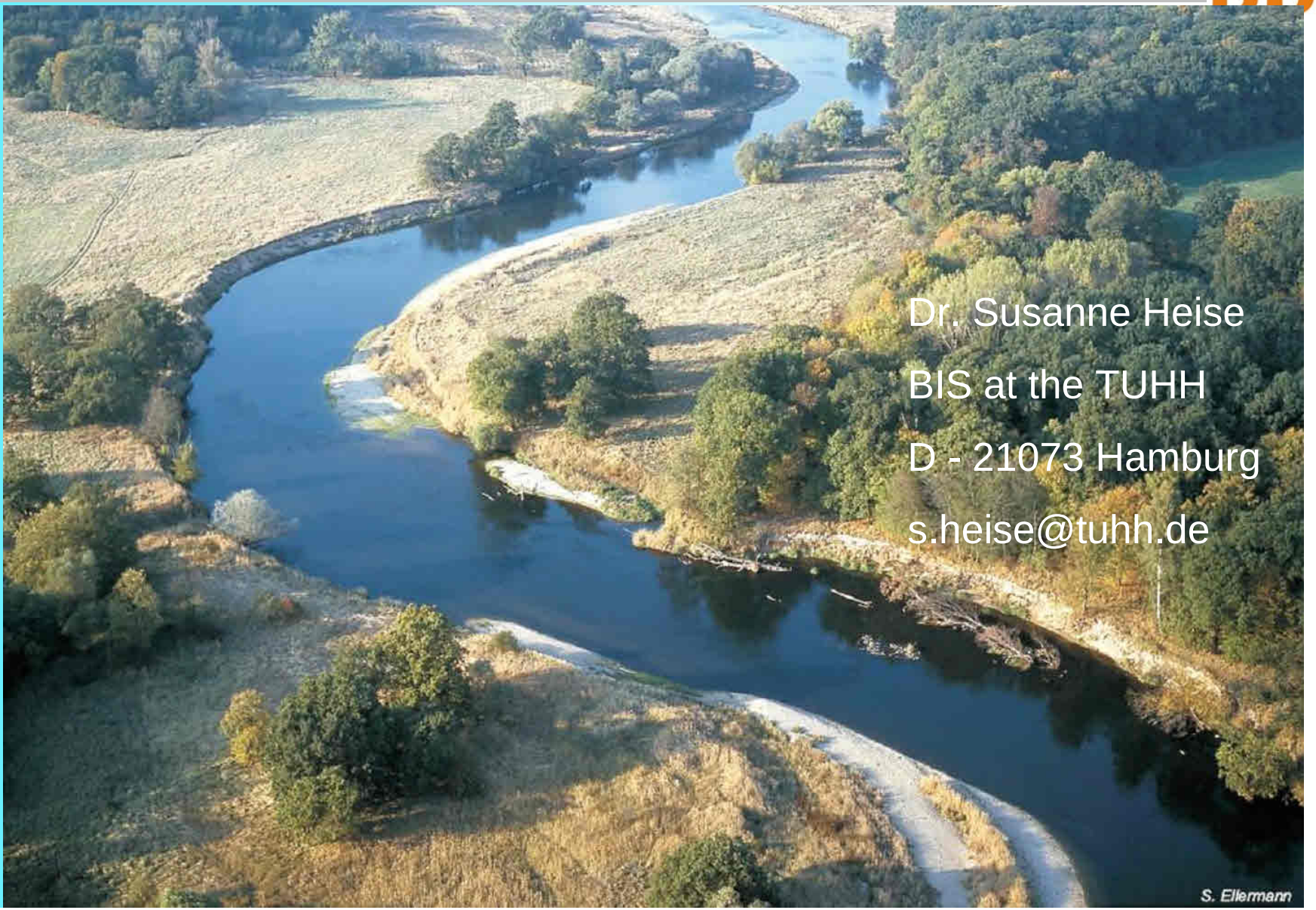
Acknowledgement

Peter Heininger (BfG) for communicating with the Elbe River Board (FGG)

Participants of the Ad-Hoc working group “contaminants” who shared the discussion on the approach

Hamburg Port Authority for funding this project and especially Axel Netzband

Thank you for your attention



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Achievable improvement of ecosystem services at Schnackenburg

Reduction goals

before:

		Median-Werte 2000-2005	WRRL (ökol)	UQRW (sed)	LG Küste	LG Fluss Umlagerung Fluss (ZW)	Landwirtschaftl. Verwertung	Speisefische	Futtermittel	Umlagerung Fluss	Umlagerung Küste
Cd	(mg/kg)	7.08		2.6	1	1.2	1.5	0.44	5	10	2.5
Hg	(mg/kg)	3.23		0.67	0.5	0.8	0.8	1	0.5	5	1
Cu	(mg/kg)	89.67	160		50	80	80			250	40
As	(mg/kg)	36.03	40		10	40	30		10	70	30
Zn	(mg/kg)	1194	800		500	400	200			1000	350
Pb	(mg/kg)	127		78.4	50	100	100	60	150	250	100
Ni	(mg/kg)	57.33		33.2	50	120	60			250	50
TBT	(µg Sn/kg)	15.7		0.02	0.05	25				150	20
HCH	(µg/kg)	9.91		10.3		30	10				
HCB	(µg/kg)	80.58		16.9		40	40	12.5	50	100	2
PCB	(µg/kg)	22.65			10						20
Dioxine	(µg/kg)	68				20		5.5	3.75		
ppDDE	(µg/kg)	8.62			5	40				200	1

after:

		WRRL (ökol)	UQRW (sed)	LG Küste	LG Fluss Umlagerung Fluss (ZW)	Landwirtschaftl. Verwertung	Speisefische	Futtermittel	Umlagerung Fluss	Umlagerung Küste
Cd	(mg/kg)		2.6	1	1.2	1.5	0.44	5	10	2.5
Hg	(mg/kg)		0.67	0.5	0.8	0.8	1	0.5	5	1
Cu	(mg/kg)	160		50	80	80			250	40
As	(mg/kg)	40		10	40	30		10	70	30
Zn	(mg/kg)	800		500	400	200			1000	350
Pb	(mg/kg)		78.4	50	100	100	60	150	250	100
Ni	(mg/kg)		33.20	50.00	120.00	60.00			250.00	50.00
TBT	(µg/kg)		0.02	0.05	25.00				150.00	20.00
HCH	(µg/kg)		10.30		30.00	10.00				
HCB	(µg/kg)		16.90		40.00	40.00	12.50	50.00	100.00	2.00
PCB	(µg/kg)			10.00						20.00
Dioxine	(µg TEQ/kg)				20.00		5.50	3.75		
ppDDE	(µg/kg)			5.00	40.00				200.00	1.00

Significant improvements would be achieved!