

Modeling Contaminated Sediment in the Elbe River Basin: Integrating Field Data & Observations

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Introduction: WFD & Elbe River Basin

Elbe River Basin: Substances of Concern

Groyne Fields: Sediment Traps

Field Data: Interpreting Groyne Fields

Conclusions



WFD and the Elbe River Basin

■ Water Framework Directive

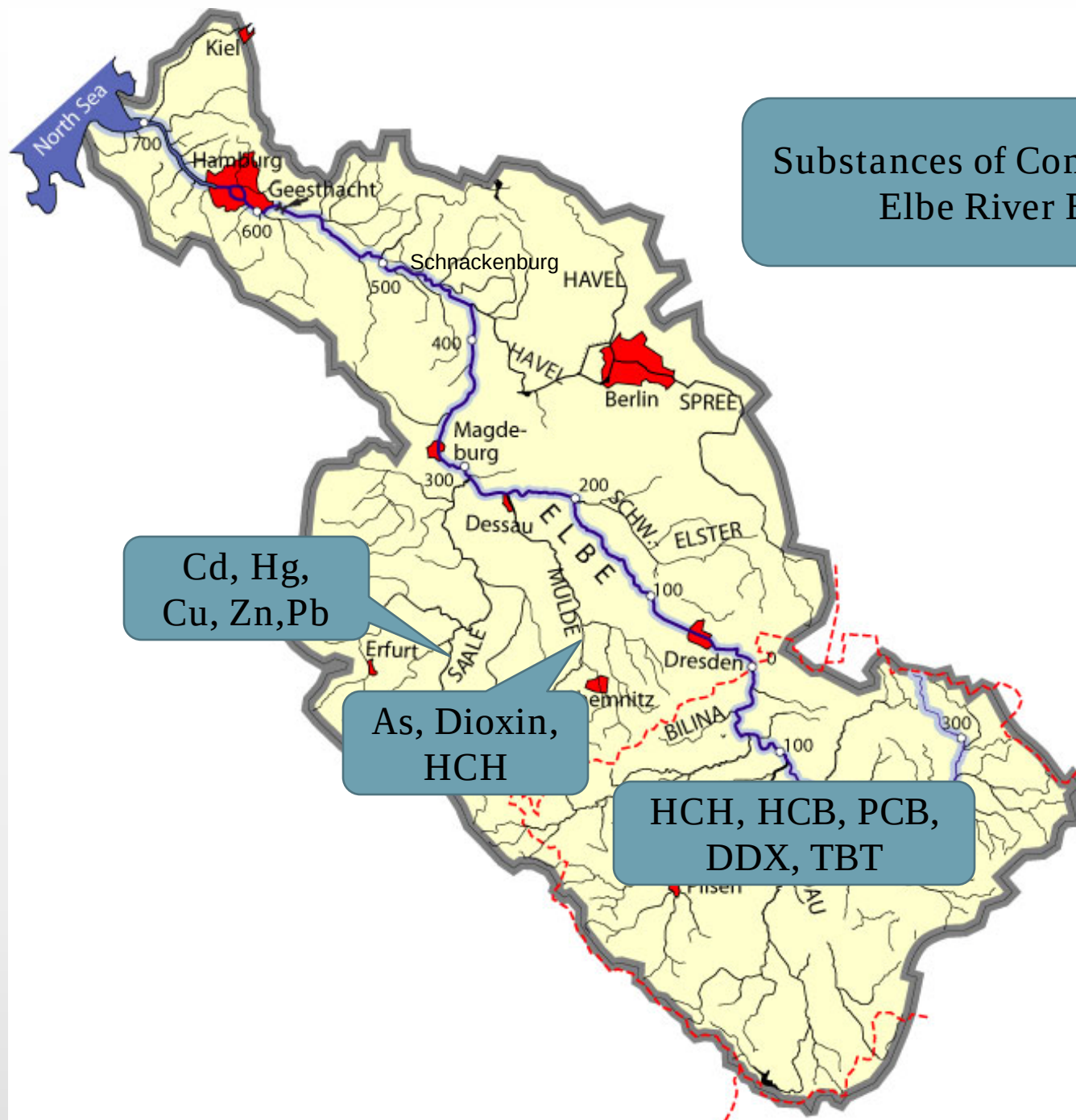
- EU Water bodies: Good chemical & ecological status by 2015
- Some sections of the Elbe will likely fail WFD goals

■ Elbe Basin Sediments

- Areas of low sediment quality due to historical contamination.
- Effect management measures (fishing, dredging)

■ Elbe Sediment Modeling: Hydrodynamics, suspended sediment, and particle-bound contaminants

- Describe erosion and deposition along and between groyne fields
- Estimate transport of particle-bound contaminants – particularly from tributaries



Groyne Fields: Alter the Elbe's Hydraulics

- **History:** Built in 17th century for flood prevention, land acquisition & customs collection
- **Today:** Improve navigability in low water
 - KM 0-~125: No groynes
 - KM >~125: 6900 groynes (**92% of banks**)
- **Assumptions:**
 - Groynes trap fine sediment
 - High water: mobilize fines & sorbed contaminants



Role of Groyne Fields in Sediment Transport?

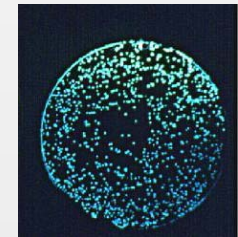
- **Field** : Very little fine sediment in groyne fields (upstream of Magdeburg)
- **Modeling**: Groynes fill quickly with fine sediments



- **Data**:
 - Field Summer 2010: Toxicity & Chemistry data
 - Wittenberg (km 214) –Magdeburg (km 327)
 - Ongoing: Suspended sediment loads

Sediment Sampling: Targeting Sinks/Sources

- Sources/Sinks
 - Tributaries (Saale, Mulde)
 - Side-structures
- Sampling Program (n=25)
 - Sediment Chemistry
 - Toxicity:



V. fischeri

(Bioluminescent Bacteria)

Reduced Luminescence:
Evidence of Contamination

30-Min Elutriate Test

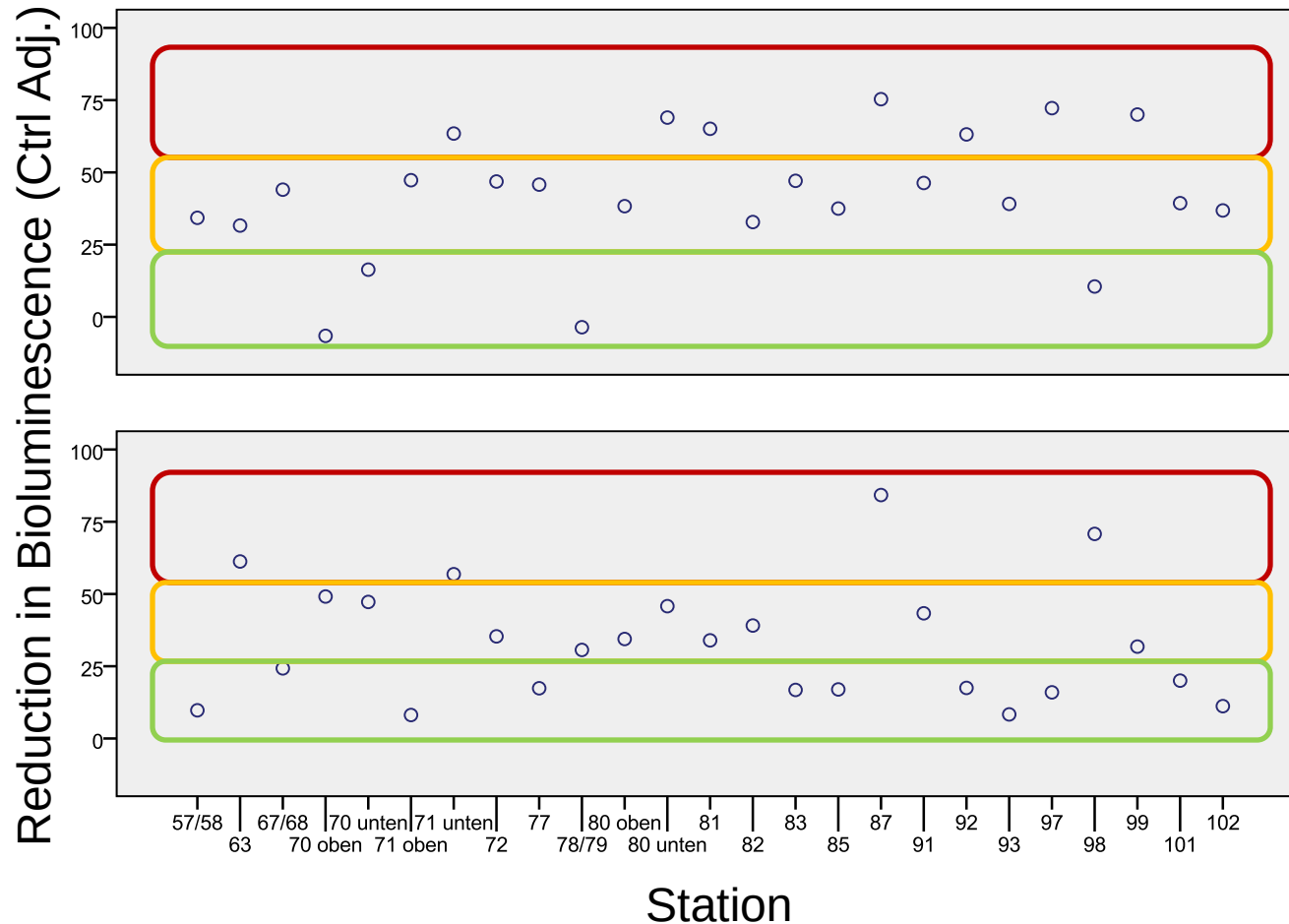
A. globiformis

(Soil Bacteria)

Reduced Respiration: Evidence of
Contamination

2-Hour Contact Test

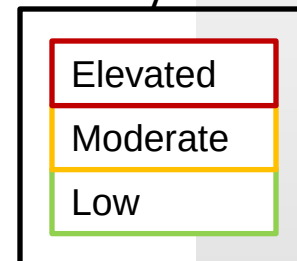
Sediment Toxicity: Groynes & Small Harbors



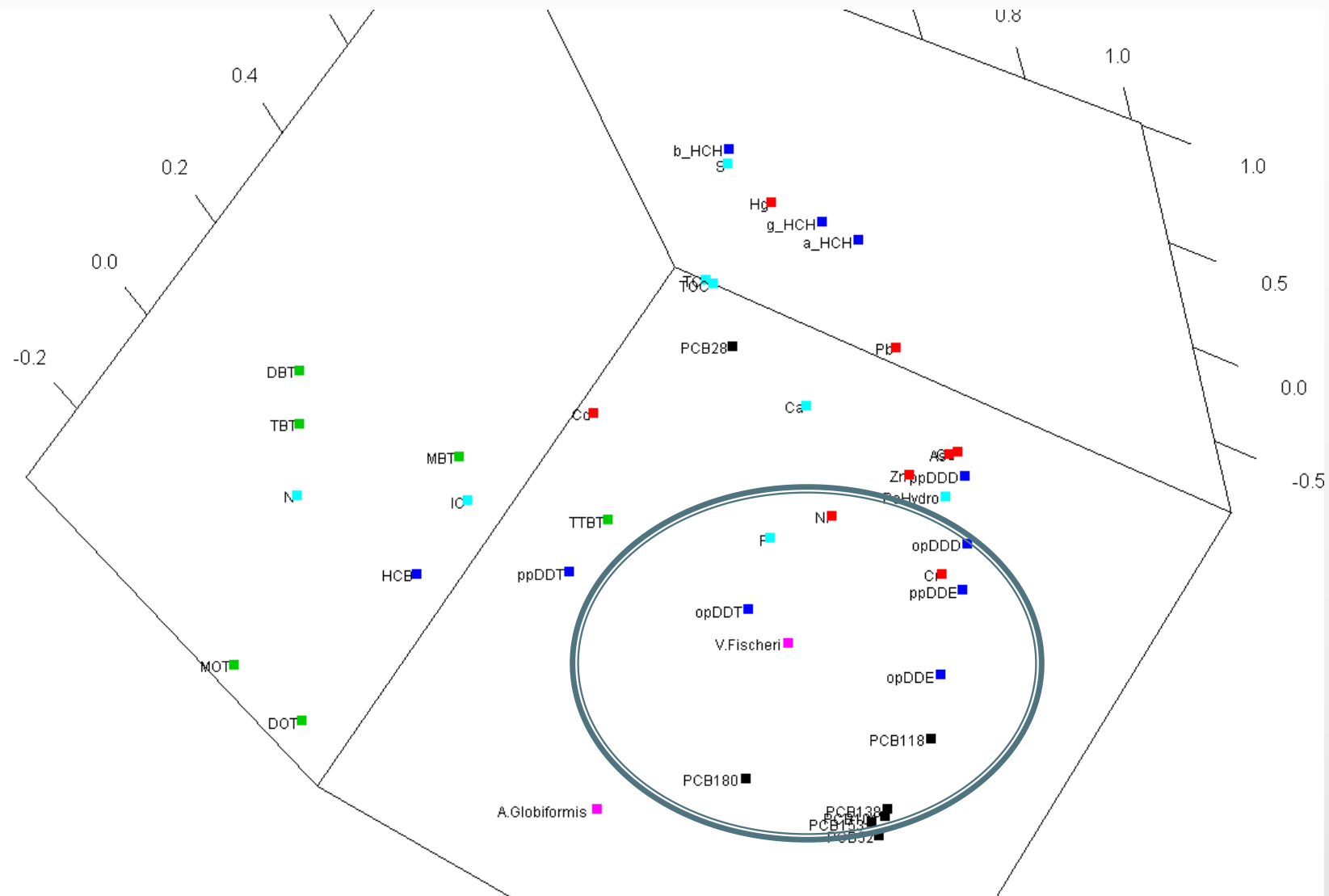
A. globiformis

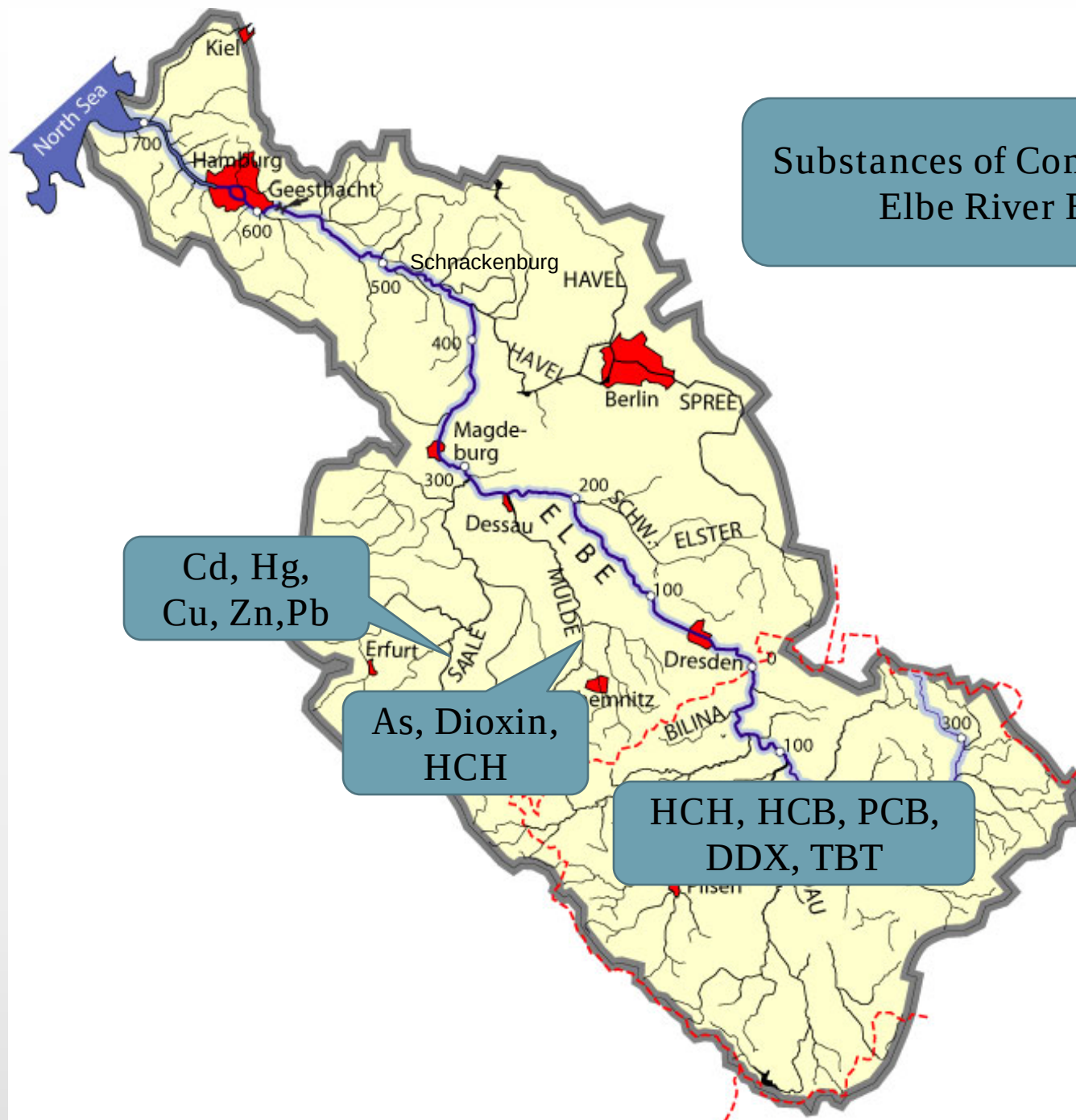
V. fischeri

Toxicity

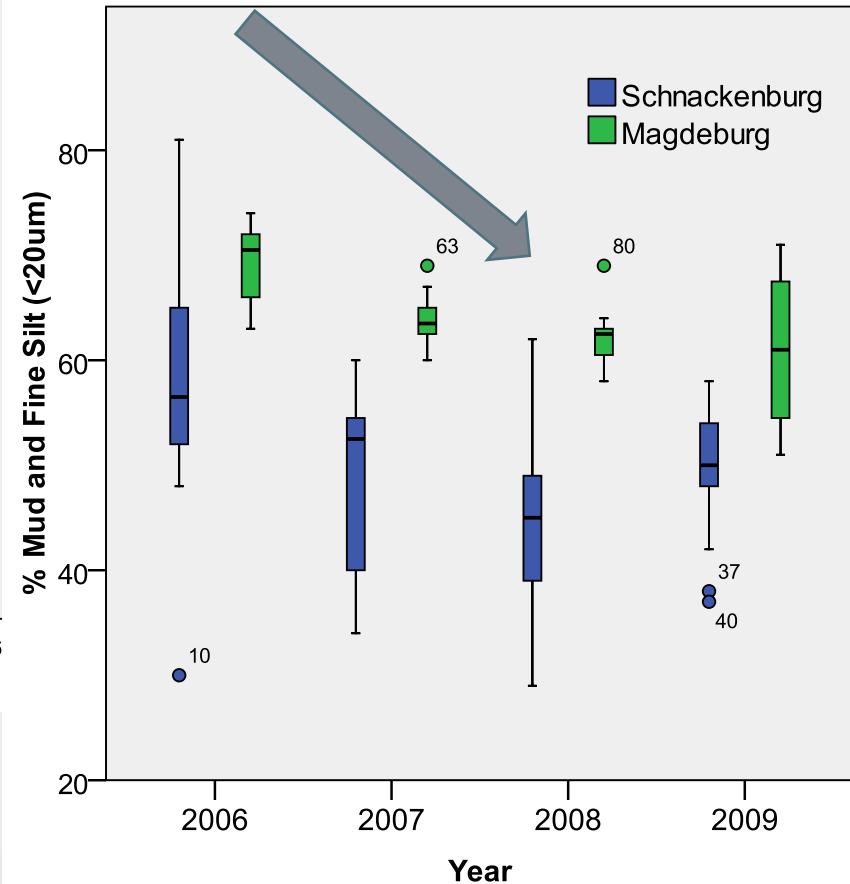
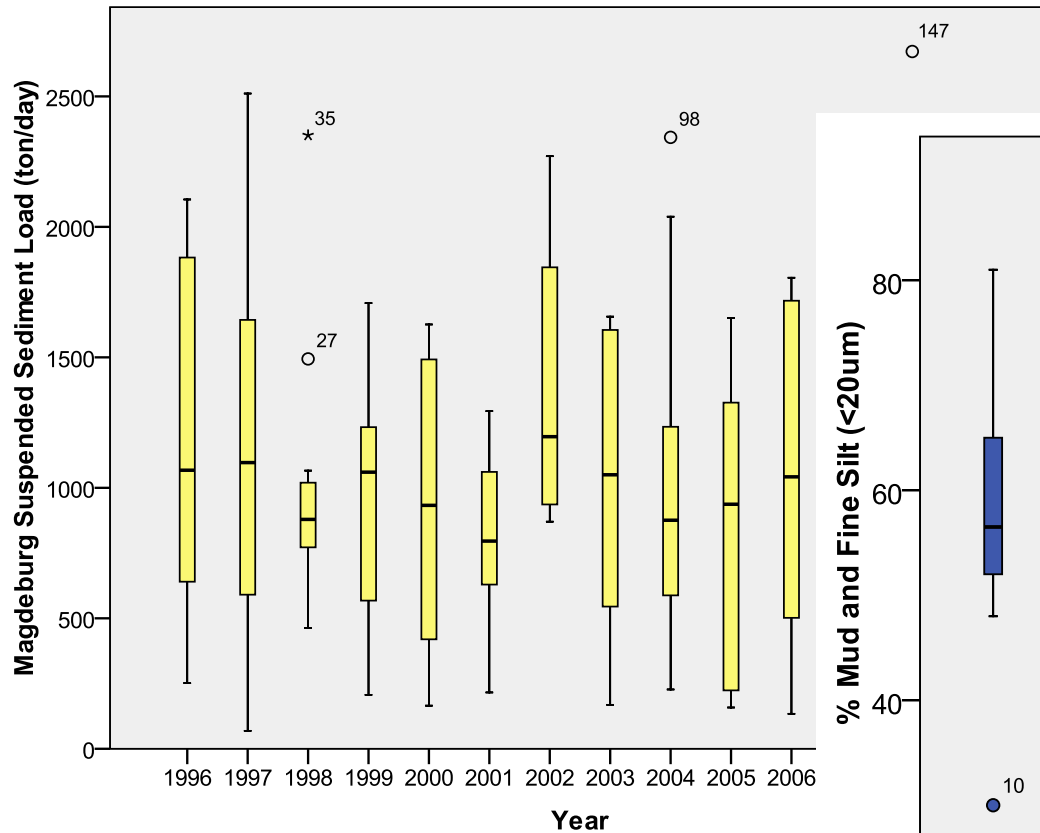


PCA Results : V. Fischeri & Organics

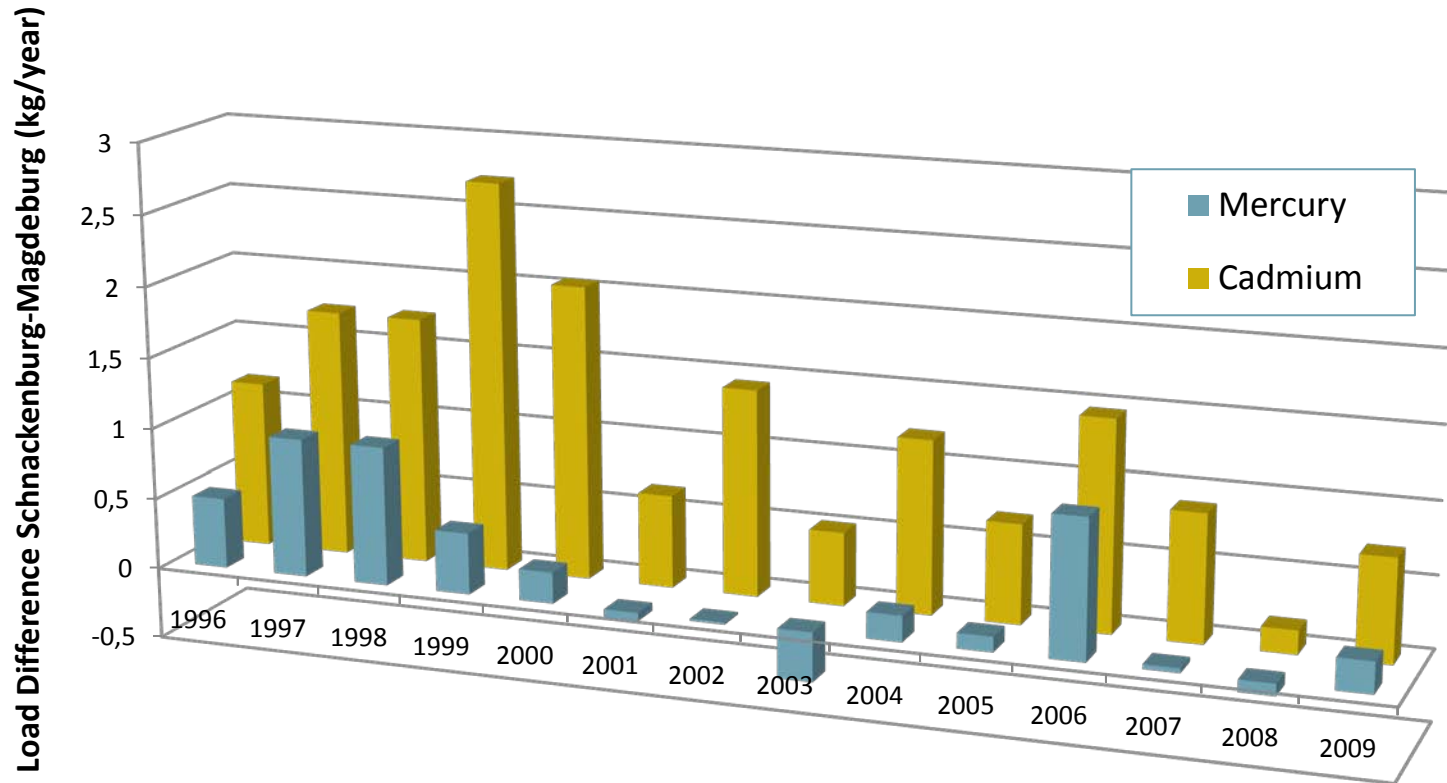




Suspended Sediment Characteristics

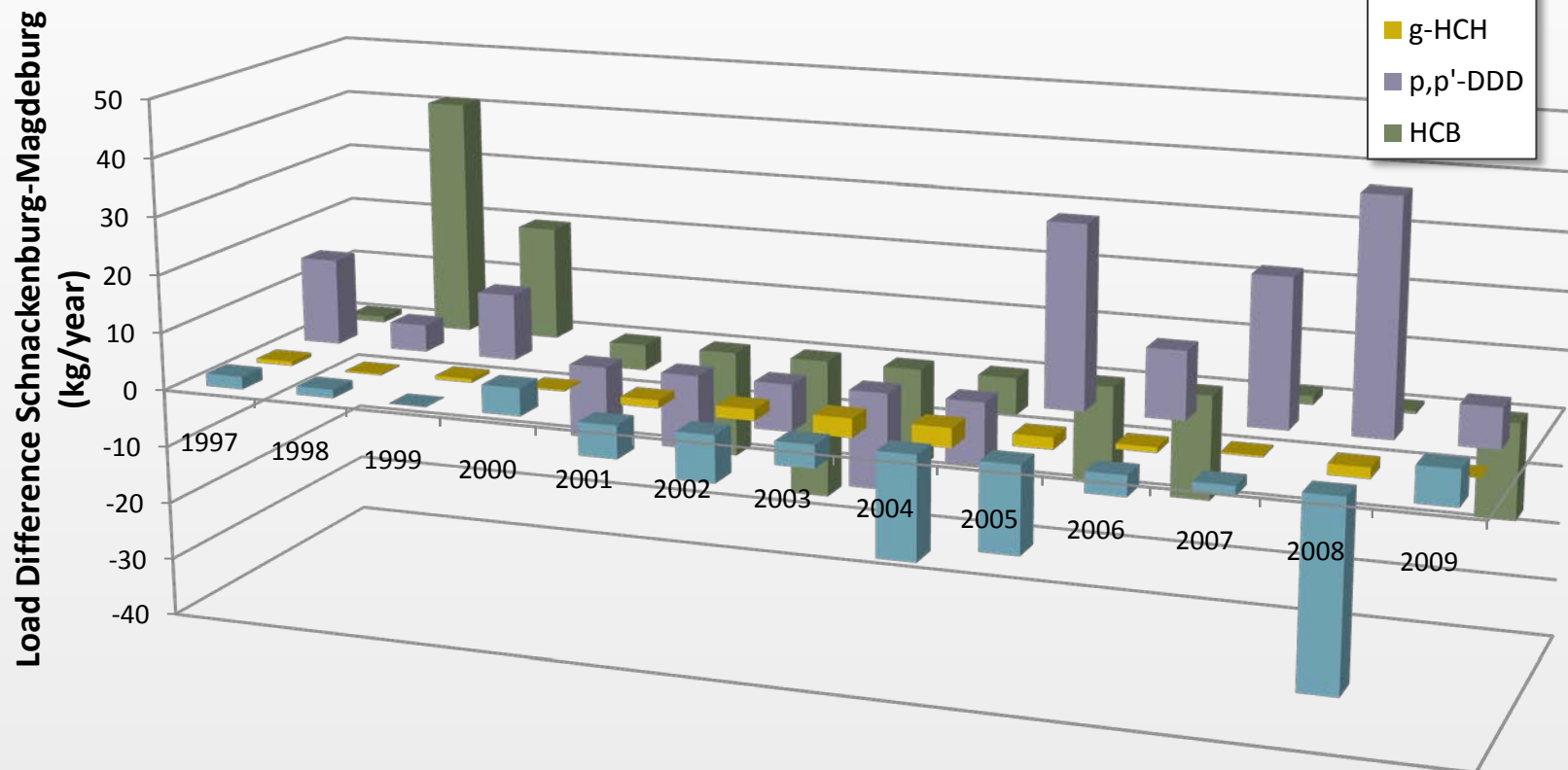


Groynes Likely a Secondary Source



Negative Values: Loads Decrease Downstream
Positive Values: Loads Increase Downstream

Different Sources, Different Processes



Conclusions

■ Coastal Area:

- Schnackenburg close to estuary - different contamination patterns

■ Groynes:

- Sediments & sorbed contaminants are likely resuspended during high water events (M'burg-S'burg)
- Sediments are bioavailable and can be toxic (Wittenberg-Magdeburg)
- Decreased Fines (2006-2008) likely related to coarsening observed in groynes

■ Information Gaps:

- More data needed on sediment grain size/density in groynes  To be collected this summer

Thanks for your Attention!



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Elbe

Model Elbe hydraulics and suspended sediment -
Czech border–Schnackenburg (km 474.6)

Describe erosion and deposition along and between groyne fields

Estimate transport of particle-bound contaminants –
particularly from tributaries

Evaluate multiple scenarios (remediation, floods)



