Mapping the spread of particle-bound pollutants in the Elbe estuary

Introduction to the particle-bound pollution pressure in the Elbe estuary and its effects on sediment management

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Content

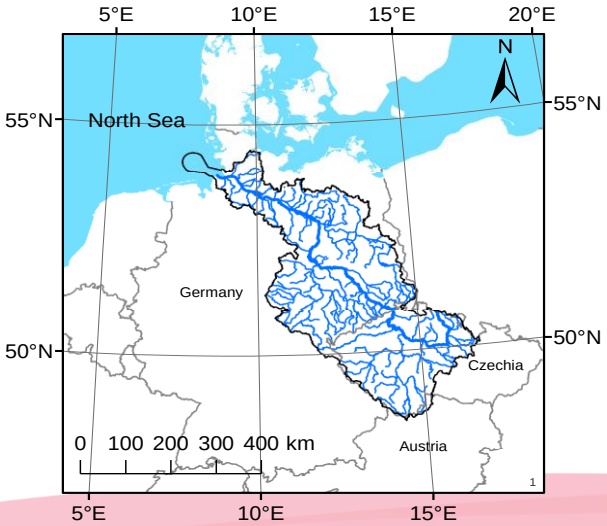
+ Background
+ Challenges modelling particle-bound pollutants
+ Exploring solutions in IMMERSE – Current work
+ Outlook

Background

Riverine sediments and SPM from the Elbe basin depict high levels of pollution

Elbe catchment

- It extends 1094 km from its source in the Giant mountains in the Czech Republic
- It collects sediments, nutrients and pollutants that determine the quality of the estuarine water and sediments



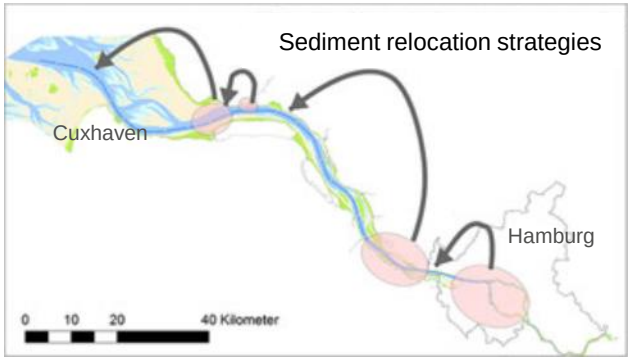
Organic and inorganic pollutants bound to sediment are transported into the estuary

- Heavy metals (e.g. Hg, Cd, Zn, Cu)
- POP's (e.g. HCB, DDx, PCB's)

Schwartz (2019), modified

Needs of quantitative estimates

Pathways and transport quantity of pollutants



BFG (2014), modified.

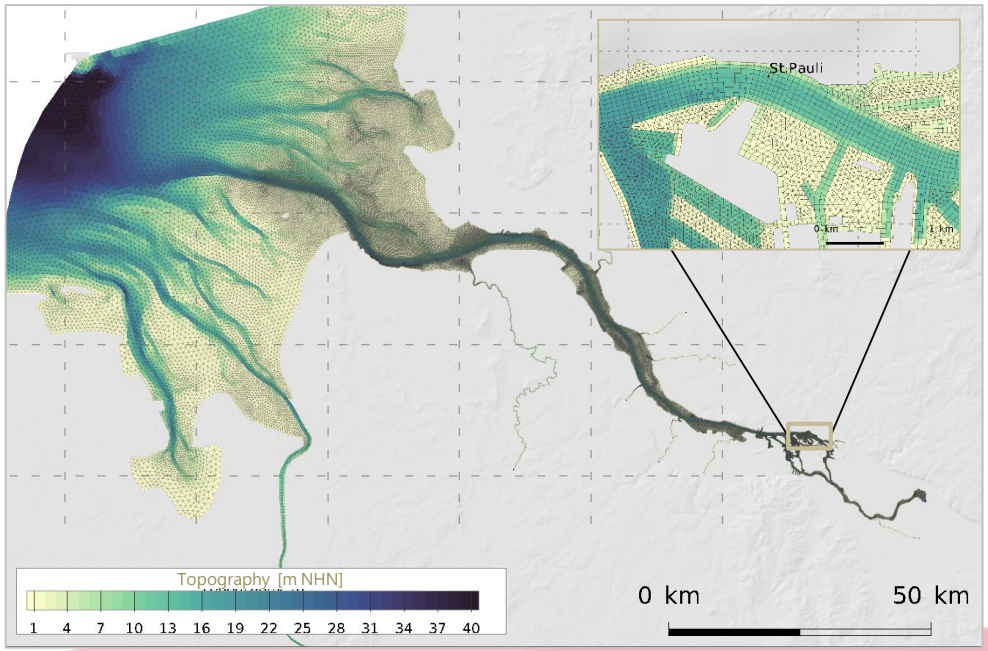
- The pollution of the riverine sediments restricts the estuary management in the tidal Elbe and **strategies for the reuse and relocation of sediments.**
- For the approval **of future relocation measures**, the forecast of the expected pollutant drift will play a greater role, especially for the implementation of the MSFD targets.
- Estimates of **the effect of remediation measures** in the Elbe (inland waters) or of climate change on future management measures

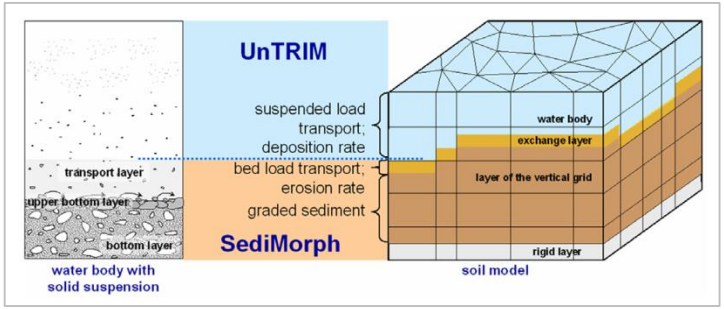
Elbe estuary, Satellite image from the tidal Elbe. Source: Brockmann Consult & Wattenmeersekretariat, provided by HPA

3D- HN-model-based investigations

Morphodynamic modelling

Numerical simulations are currently the principal technique to compute the spread and distribution of pollutants in the water-sediment compartment and thus, to create a quantitative **basis for the risk assessment of sediment management** measures.

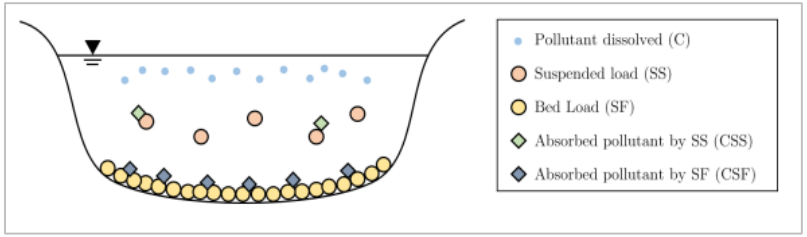




Challenges

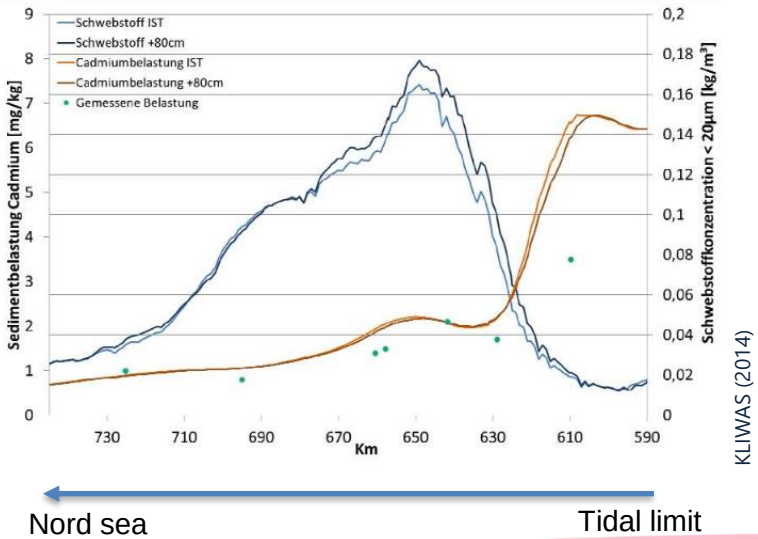
Modelling the transport of pollutants in tidal rivers

+ Pollutant concentration in the two-phase system water-particle **varies** along the river **in dependency on physicochemical conditions** like pH, Temperature, salinity and organic content (sorption tendency varies).



Conceptual representation of the distribution of micropollutants

+ Many pollutants relevant in the Elbe are transported by water and SPM dynamically, which means that their pathway follows the water movement and sediment drift.

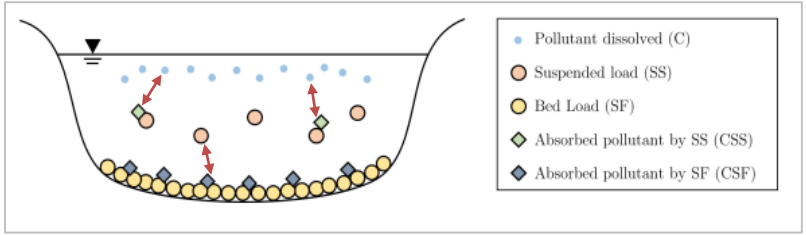


Exploring solutions

Modelling the transport of pollutants in tidal rivers

Research questions

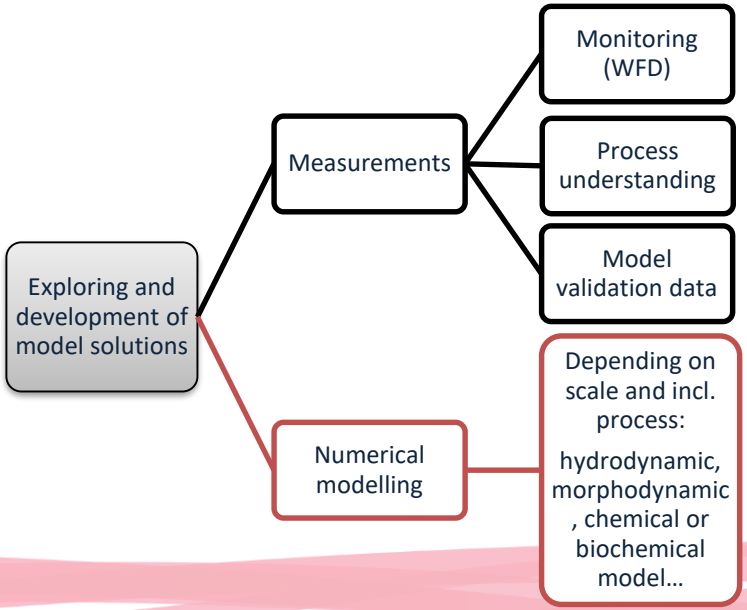
+ Which dependencies/mechanisms are crucial to calculate the spread of particle-bound pollutants in estuaries (Elbe) by means of numerical modelling?
+ How are particle-bound pollutants coming from inland waters spatially and temporally distributed/trapped along the estuary and adjacent North Sea?



Conceptual representation of the distribution of micropollutants

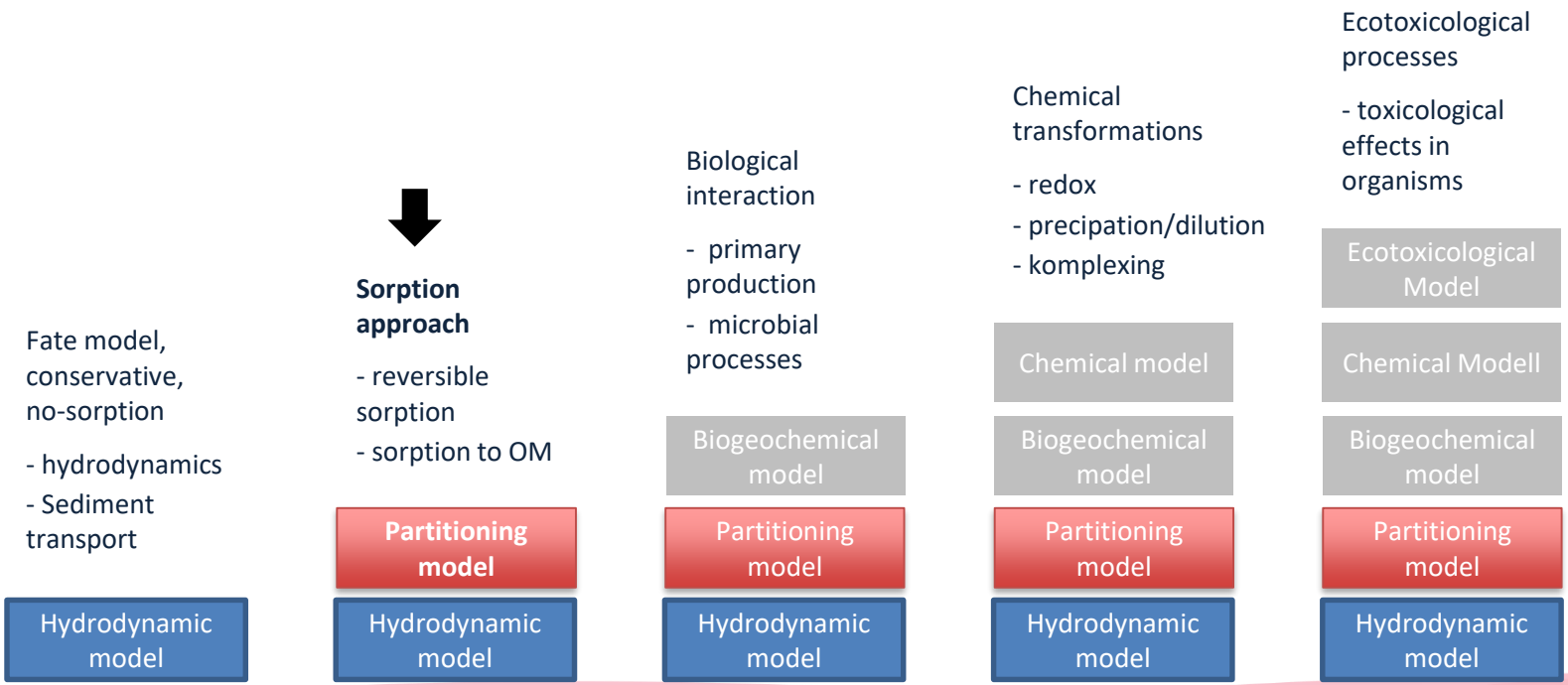
Enhancement of process understanding:

Particle reactivity to SPM of pollutants relevant for the sediment management of the Elbe (Cd, Hg, Cu, Zn, PCBs, DDx, HCB)



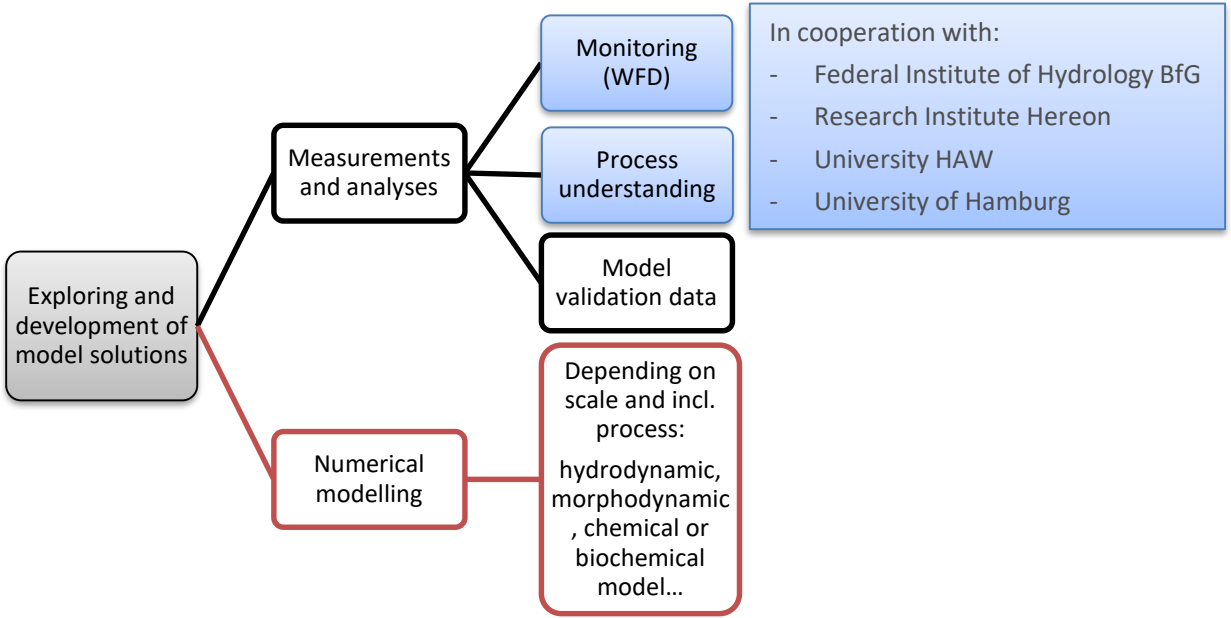
Exploring solutions

Complexity levels modelling pollutants in water bodies



Current work

Data collection and analysis

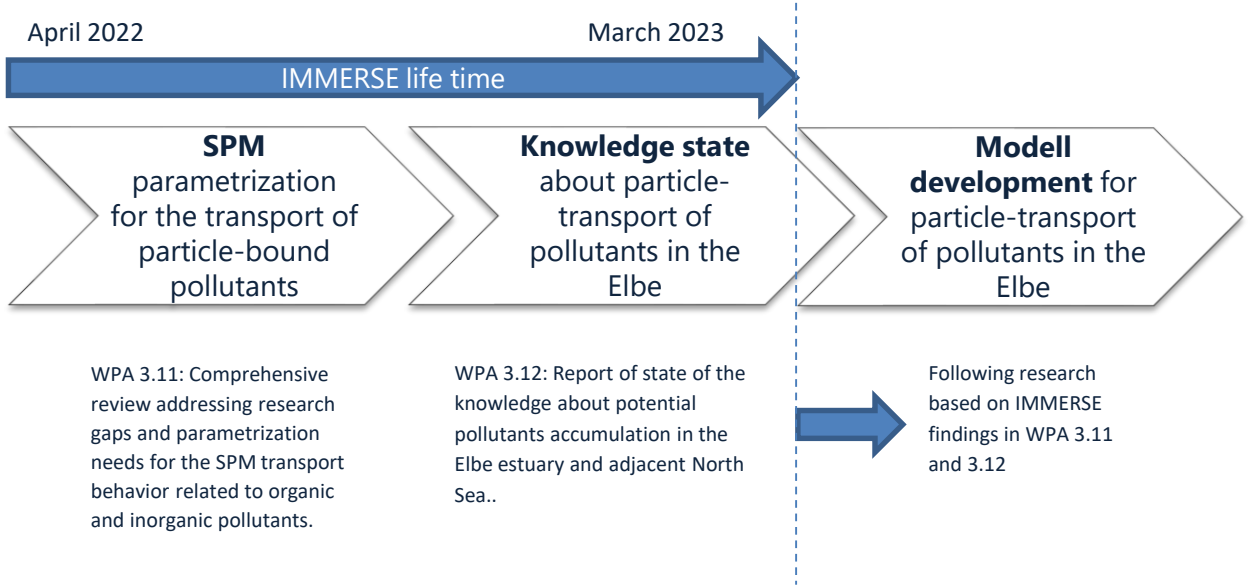


Field survey HAW, 2021. Source: BAW

Field survey BFG, 2021. Source: BfG

Outlook

Successive construction and calibration of the numerical model



Model-based development of measures:

+ Optimization of relocation strategies
+ Potential of dredged material to be re-used
+ Conception of remedation measures in abandoned hazardous-waste

Source: BAW

Thanks for your attention!

Questions?

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