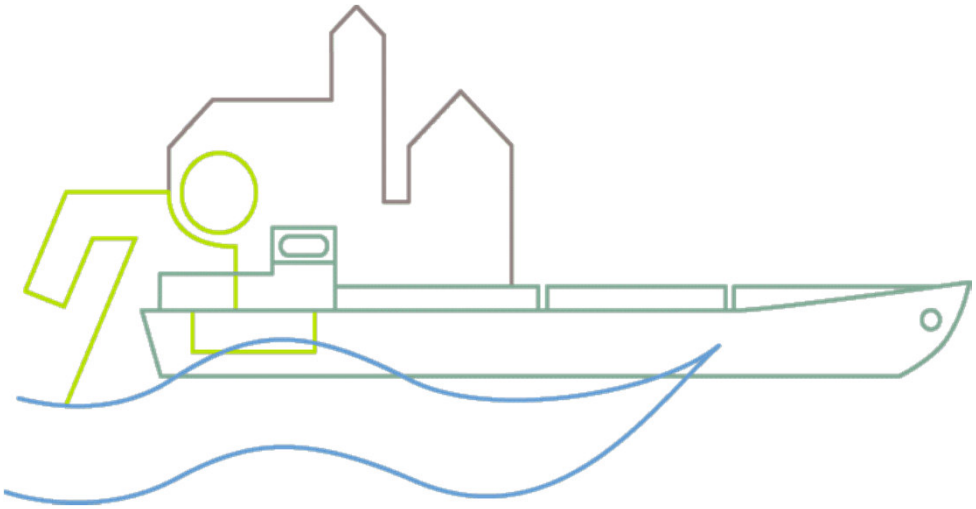

The Imperative of Sediment Management Concepts in River Basin Management Plans

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Introduction – river basin management plans

River basins are the preferred management or planning unit for management plans

River basin management plans (RBMPs) set out how organisations, stakeholders and communities will work together to improve the river system; at the same time these are facing the **challenge of multipurpose uses** (nature protection, flood damage prevention, housing, navigation …. to be continued) and **cross-border situations**

RBMPs are key instruments for the implementation of Water Framework Directive (these plans also provide synergy for the implementation of Marine Strategy Framework & FFH - Directive)

RBMPs guide a multibillion-Euro industry stream restoration industry in Europe

Introduction – river basin management plans

Discussion

Do RBMP‘s adress the central issues and challenges that are specific for each river basin in Europe?

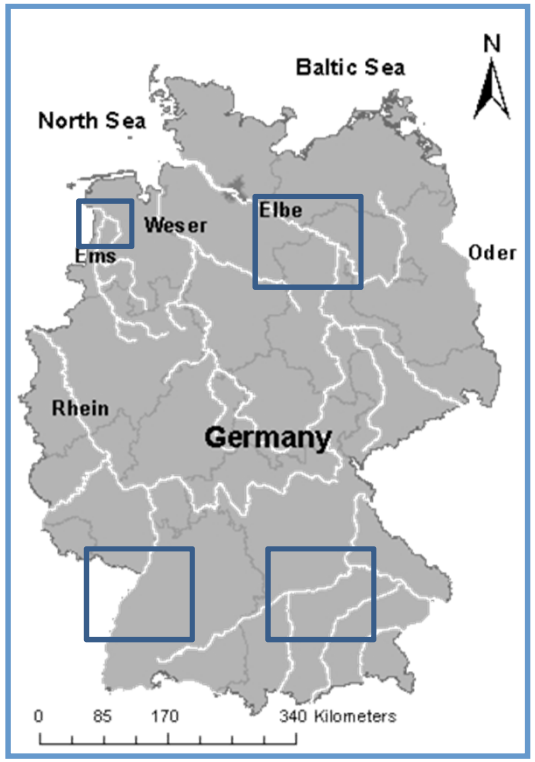
Do RBMP‘s include measures that can effectively support the achievement of a good ecological status/potential?

Is there sufficient knowledge about the system and its dynamics to decide on the most effective measures? And is it taken into accout when deciding on the plan (and on measures included)?

Introduction – river basin management plans

Two major challenges to achive a good ecological status/potential

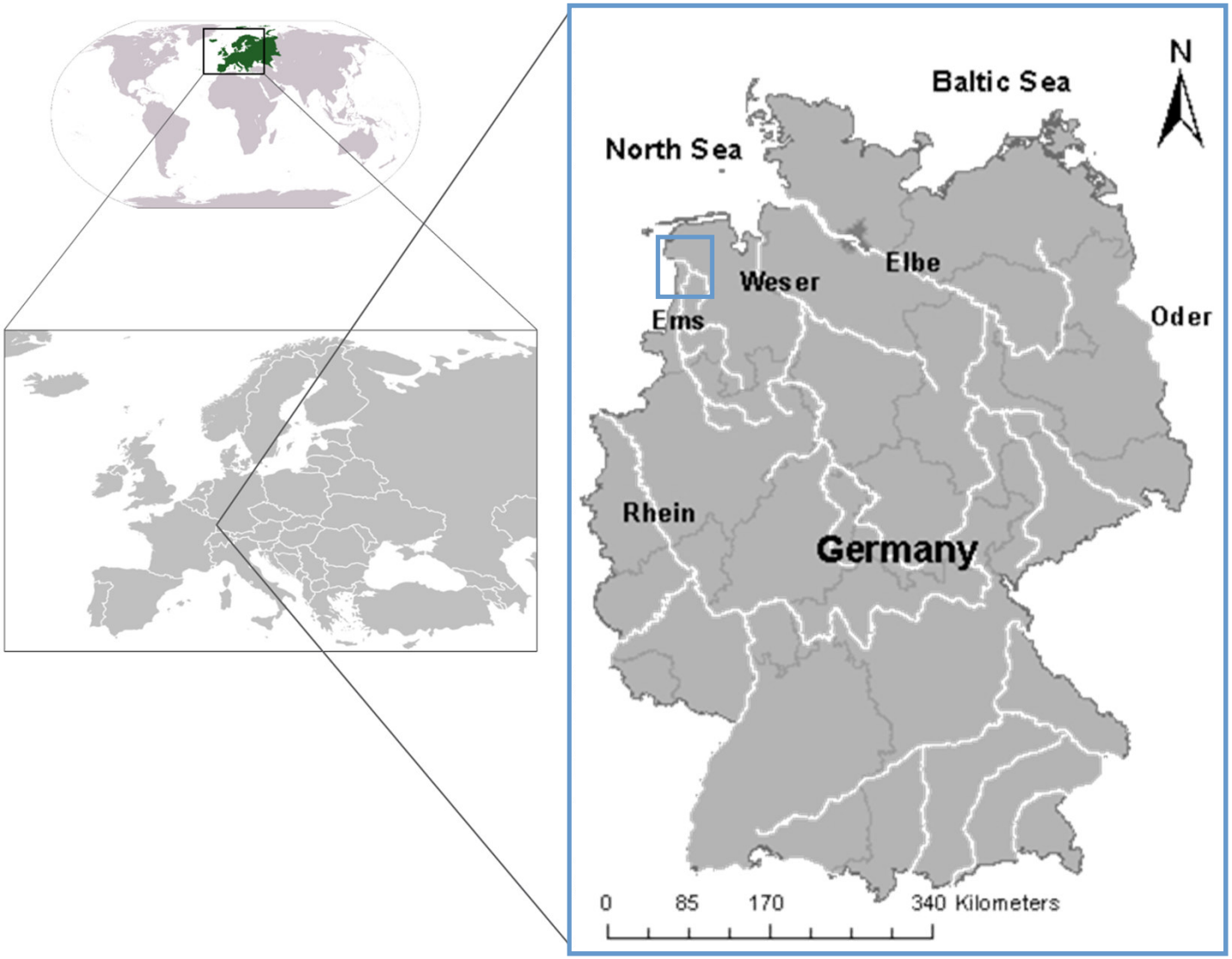
- hydromorphological degradation -> lack/surplus of sediment
- input of nutrients and pollutants -> sediment associated transport



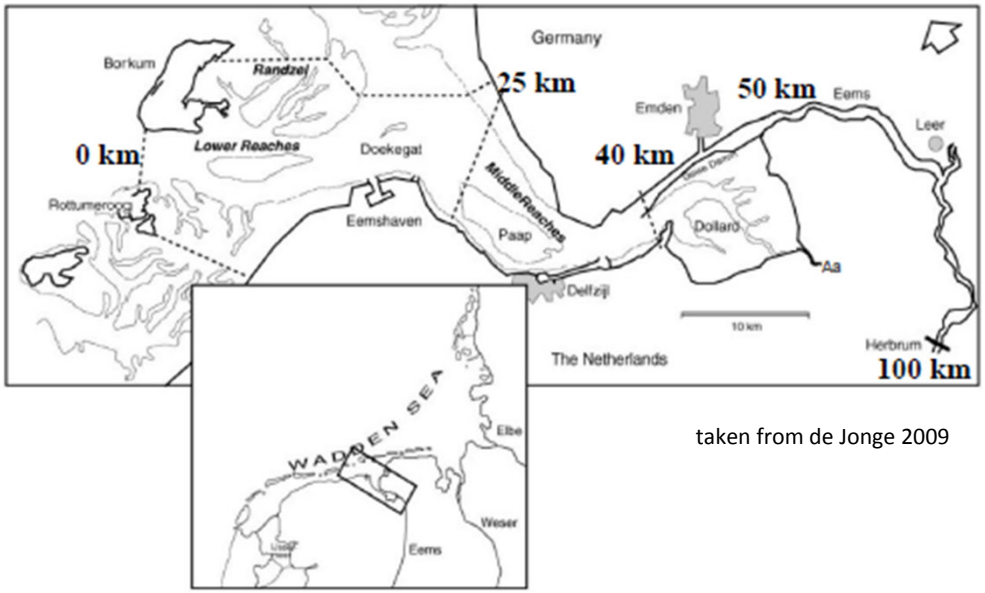
and four case studies

- Ems estuary -> amplification of hyper-turbidity
- Elbe and Danube -> decoupling of floodplains
- Upper Rhine -> flux of contaminated sediments

Ems - amplification of hyper-turbidity

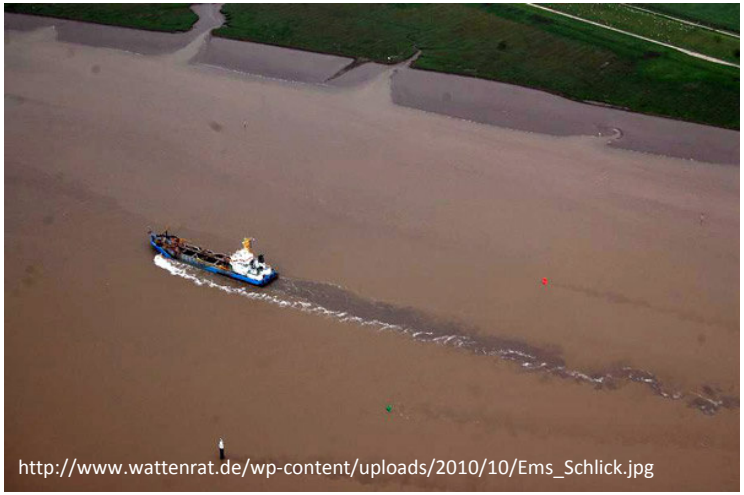


Ems - amplification of hyper-turbidity



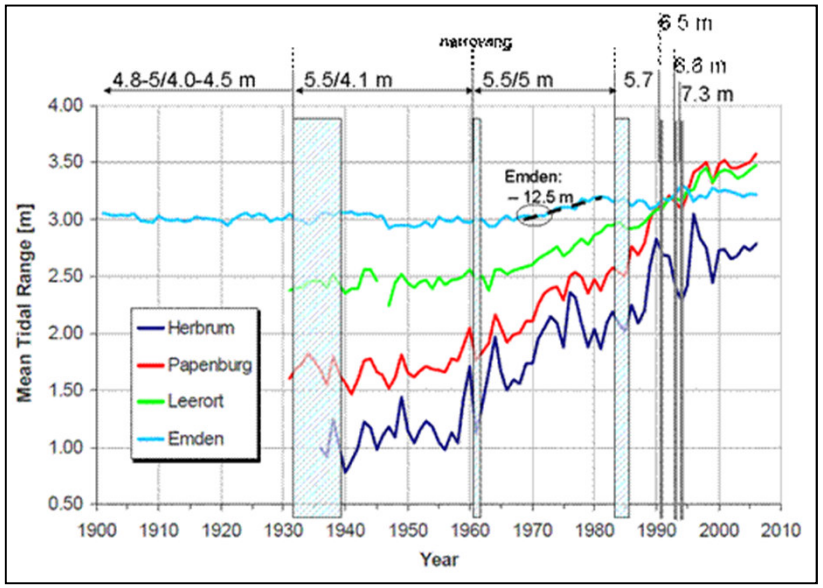
taken from de Jonge 2009


http://www.seglerkameradschaft.de/wp-content/uploads/2013/GEDC1145.JPG

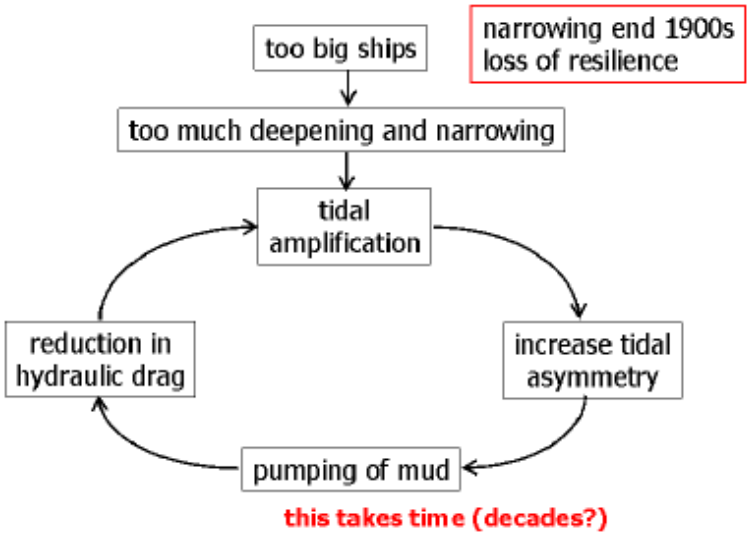

http://www.wattenrat.de/wp-content/uploads/2010/10/Ems_Schlick.jpg

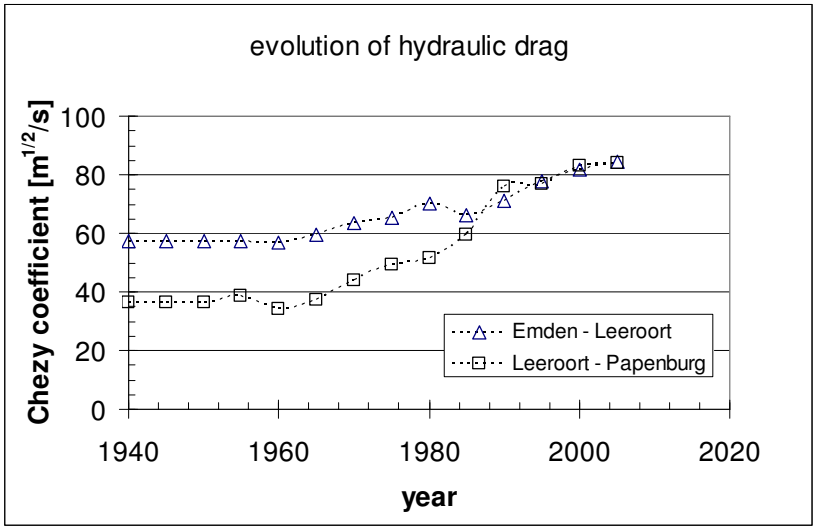

http://www.spiegel.de/fotostrecke/schwieriges-manoever-kreuzfahrtriese-auf-dem-weg-ueber-die-ems-fotostrecke-77661.htm

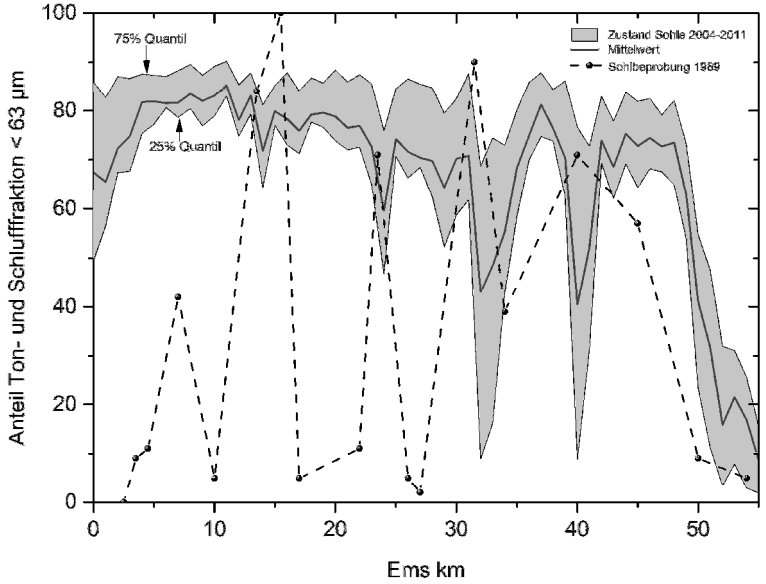
Ems - amplification of hyper-turbidity



Winterwerp (2013): Response of tidal rivers to deepening and narrowing







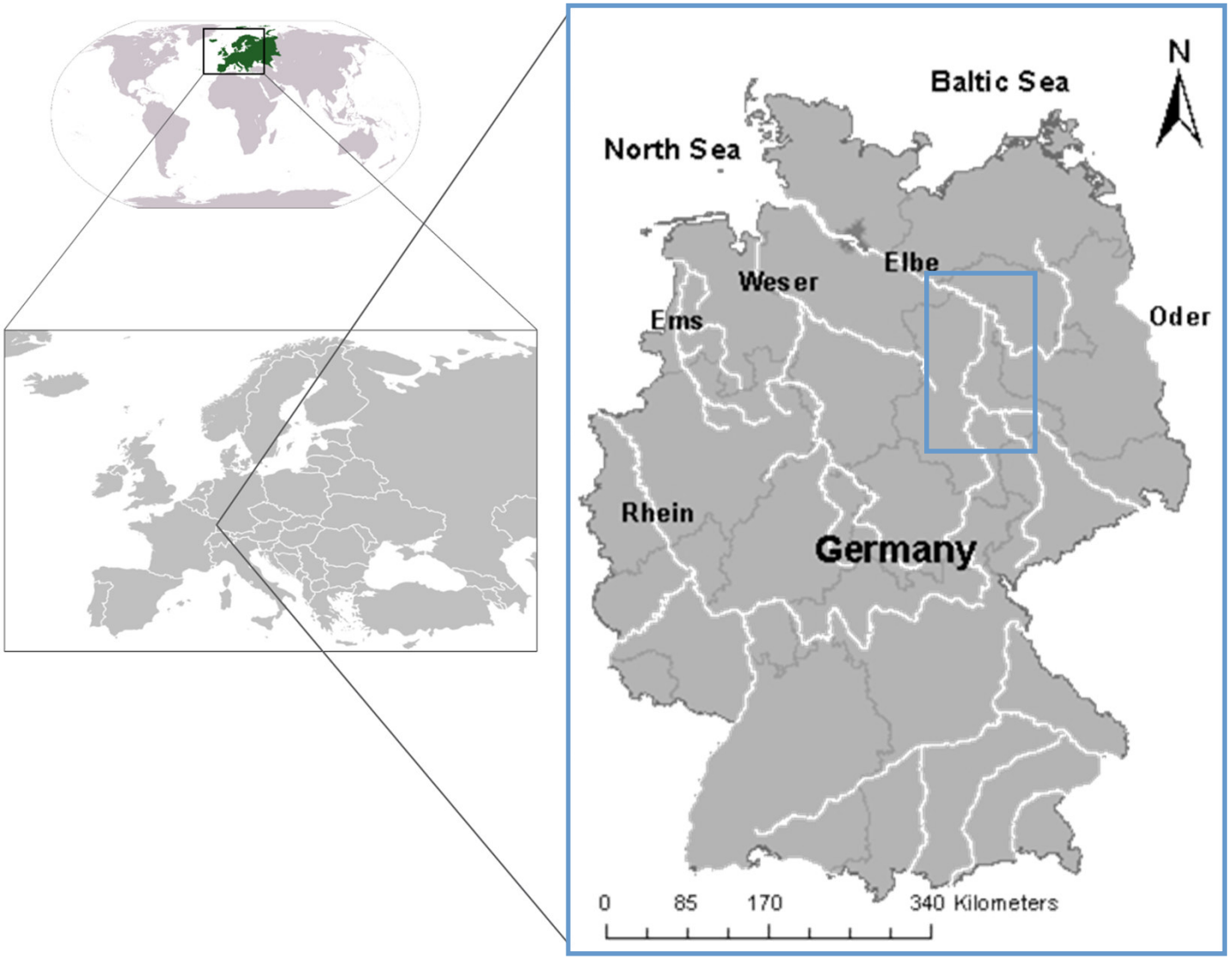
Ems - amplification of hyper-turbidity

ecological potential exhibits destinct shortcomings (in particular Lower Ems): high SPM concentrations directly associated with low oxygen concentrations and permanent existance of fluid mud layers.

Masterplan 2050
-> one objective: resolving silt problem
-> tidal control with the gates of the Ems barrier
-> tidal polders and backward relocation of dykes
-> Reconnection of ^distributaries and old river loops to the ebb and flow by penetrating barriers

WSV-Sediment management concept (to be published in 2017)
-> since 2009 integral part of the WFD management plan for the Ems
-> focus on WSV-maintenance activities (potential for optimization)
-> joint German-Dutch concept to be developed
-> maintenance activities subject to changes due to concurrent activities: Masterplan 2050, deepening of the maritime access to Eemshaven (NL/outer Ems)

Elbe – decoupling of floodplains



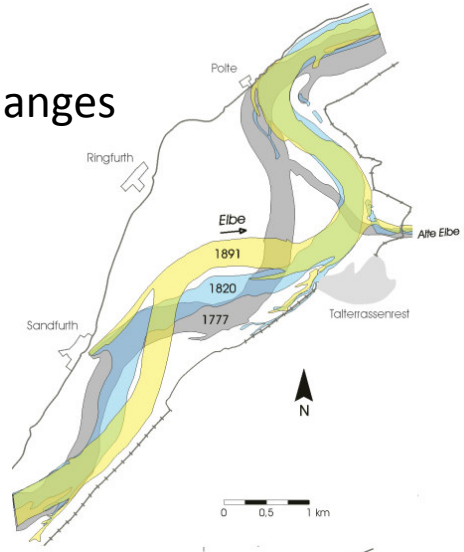
Elbe – decoupling of floodplains

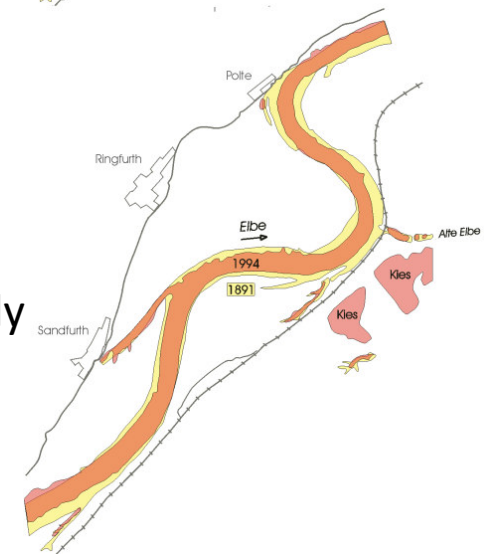
first morphological and hydraulic changes dated back to the 12th century

first river regulations conducted in the 18th century

in 1844 establishment of a large river training program to improve navigation

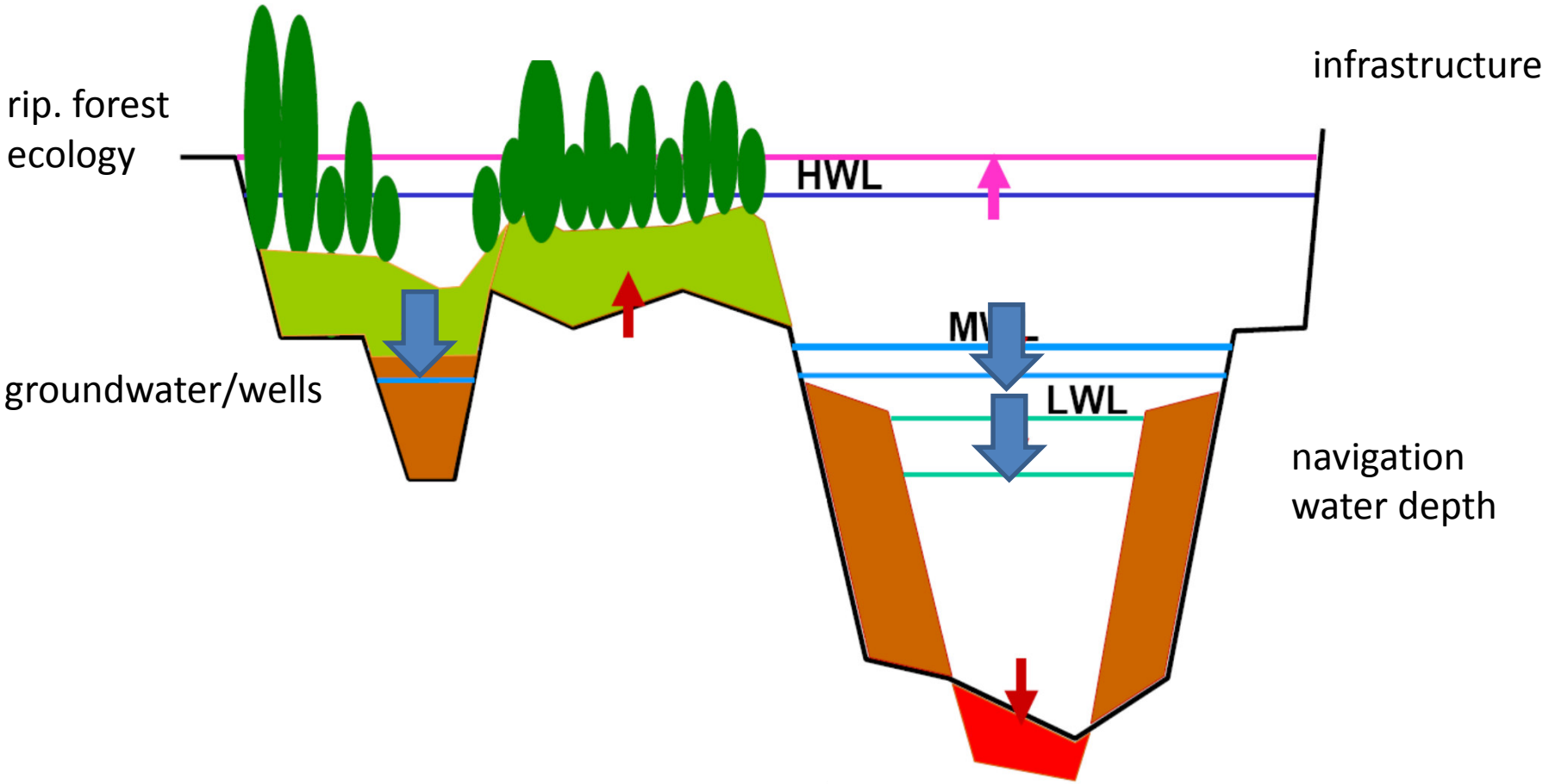
since 1911 low flow regulation
since 1902 construction of barrages in the Czech part
since 1996 artificial sediment supply



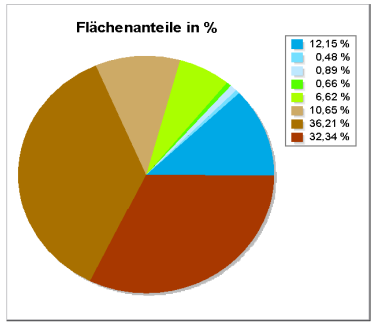


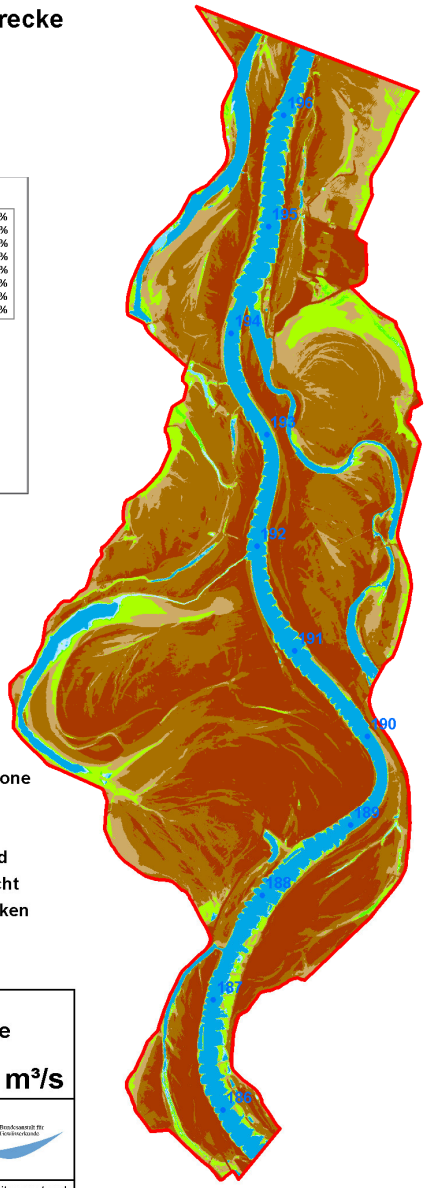
Elbe – decoupling of floodplains

Impacts of water level changes



Modellierung des Standortpotenzials für Vegetation in der Pilotstrecke Klöden / Elbe





Überflutungstage	Einheit
365 - 300	Wasserfläche
299 - 220	Wasserwechselzone
219 - 160	Röhricht
159 - 140	Weidengebüsch
139 - 80	Silberweidenwald
79 - 50	Hartholzaue feucht
49 - 5	Hartholzaue trocken
5 - 0	Zonaler Wald

Grundlage: KLIWAS-Projektionen

MQ der Zeitreihe 1961-1990 für die Ensemble-Rechnungen - 15% **Q= 292 m³/s**

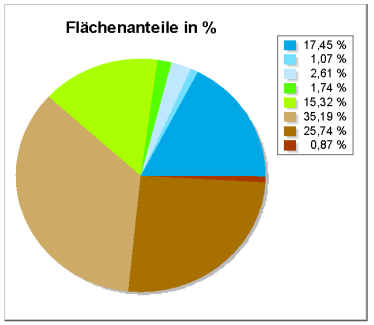
Bundesanstalt für Gewässerkunde
Referat U2
Kartografie und GIS: S. Rosenzweig

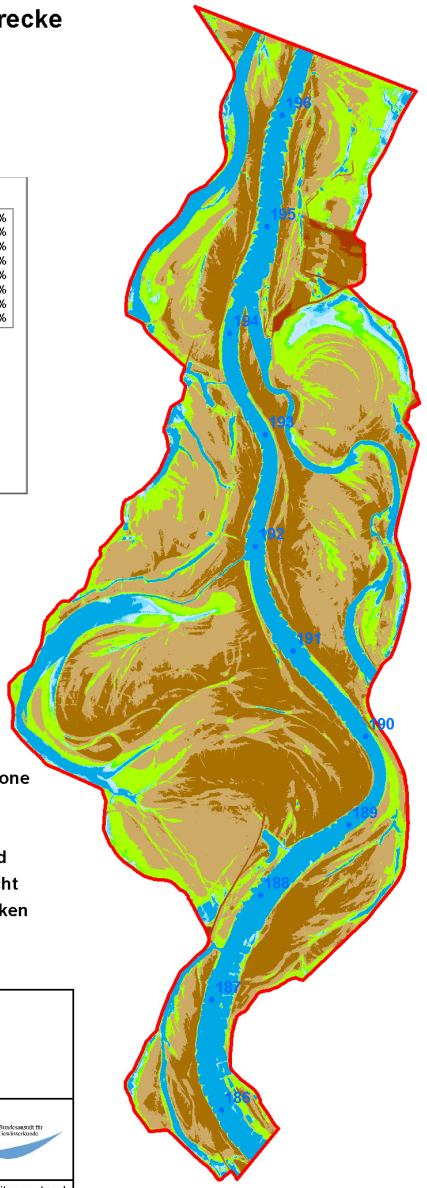
0 0,5 1 2 Km

N

Bearbeitungsstand: 15.04.2013

Modellierung des Standortpotenzials für Vegetation in der Pilotstrecke Klöden / Elbe





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Grundlage: FLYS

Erosion zurückgerechnet

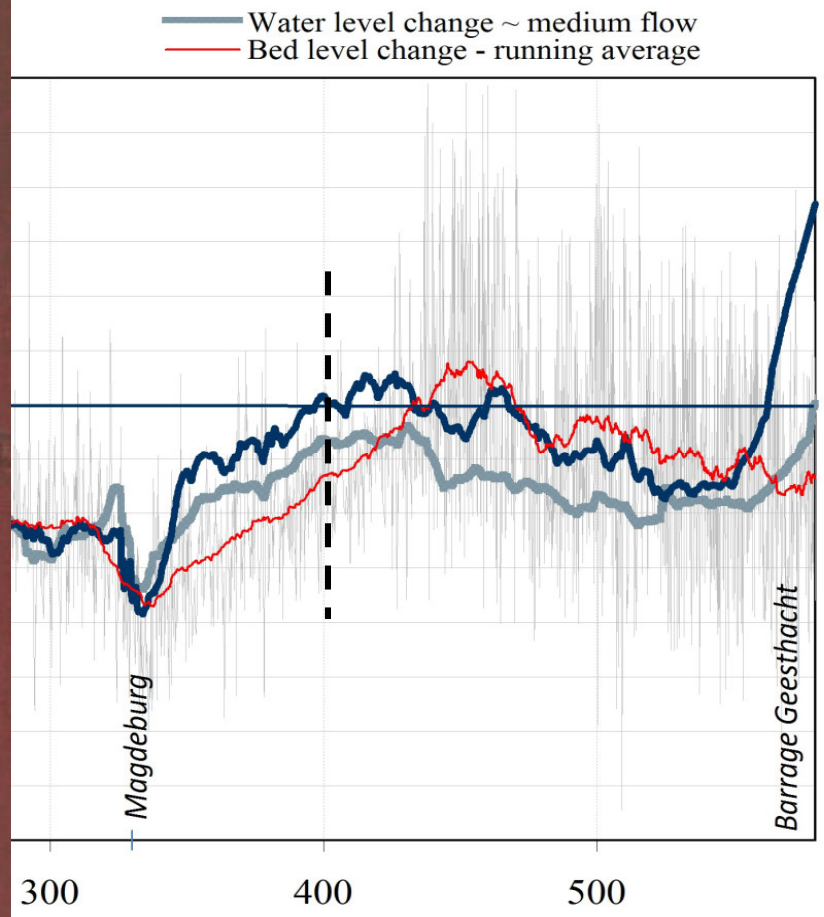
Bundesanstalt für Gewässerkunde
Referat U2
Kartografie und GIS: S. Rosenzweig

0 0,5 1 2 Km

N

Bearbeitungsstand: 15.05.2013

Elbe – decoupling of floodplains



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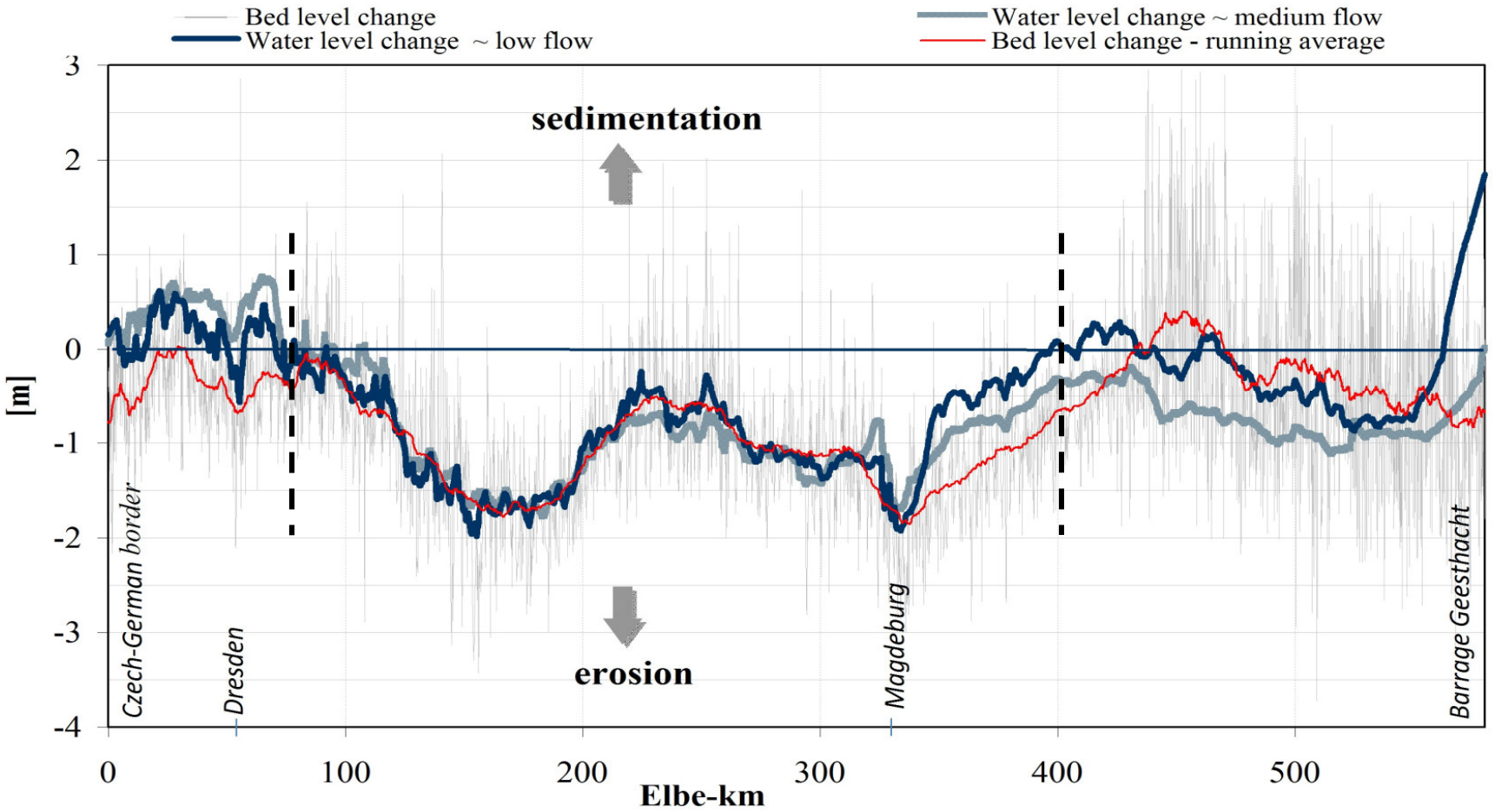

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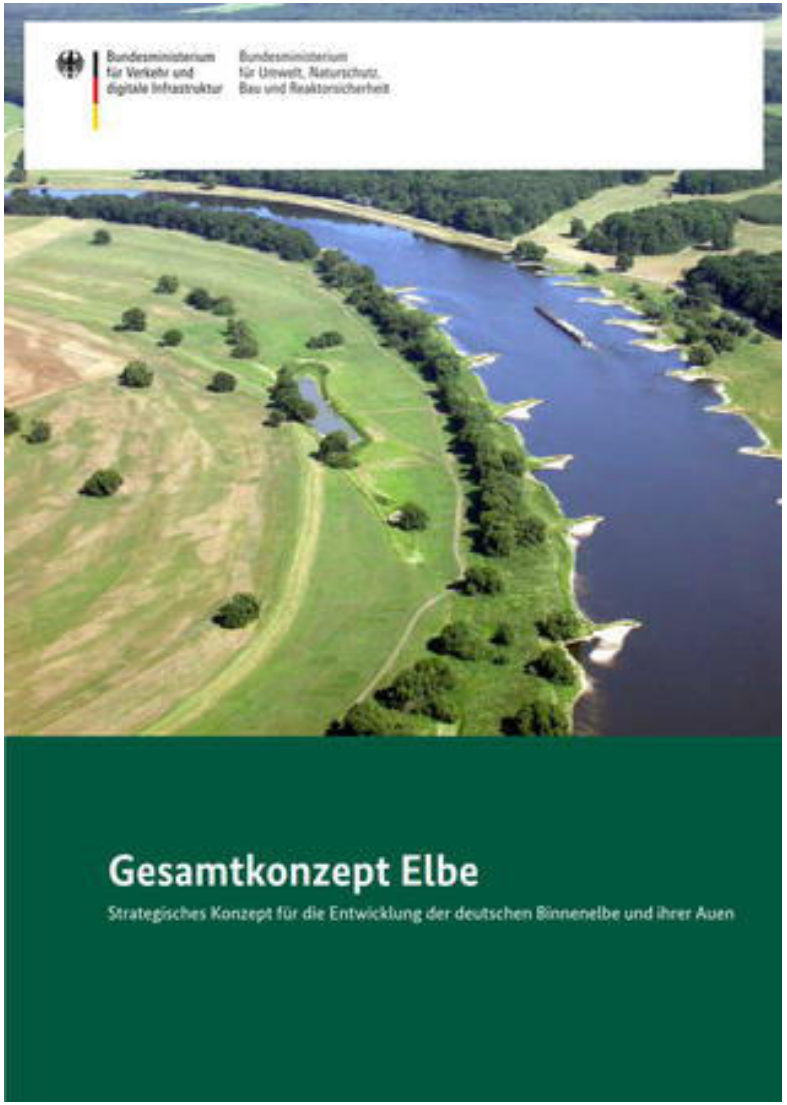
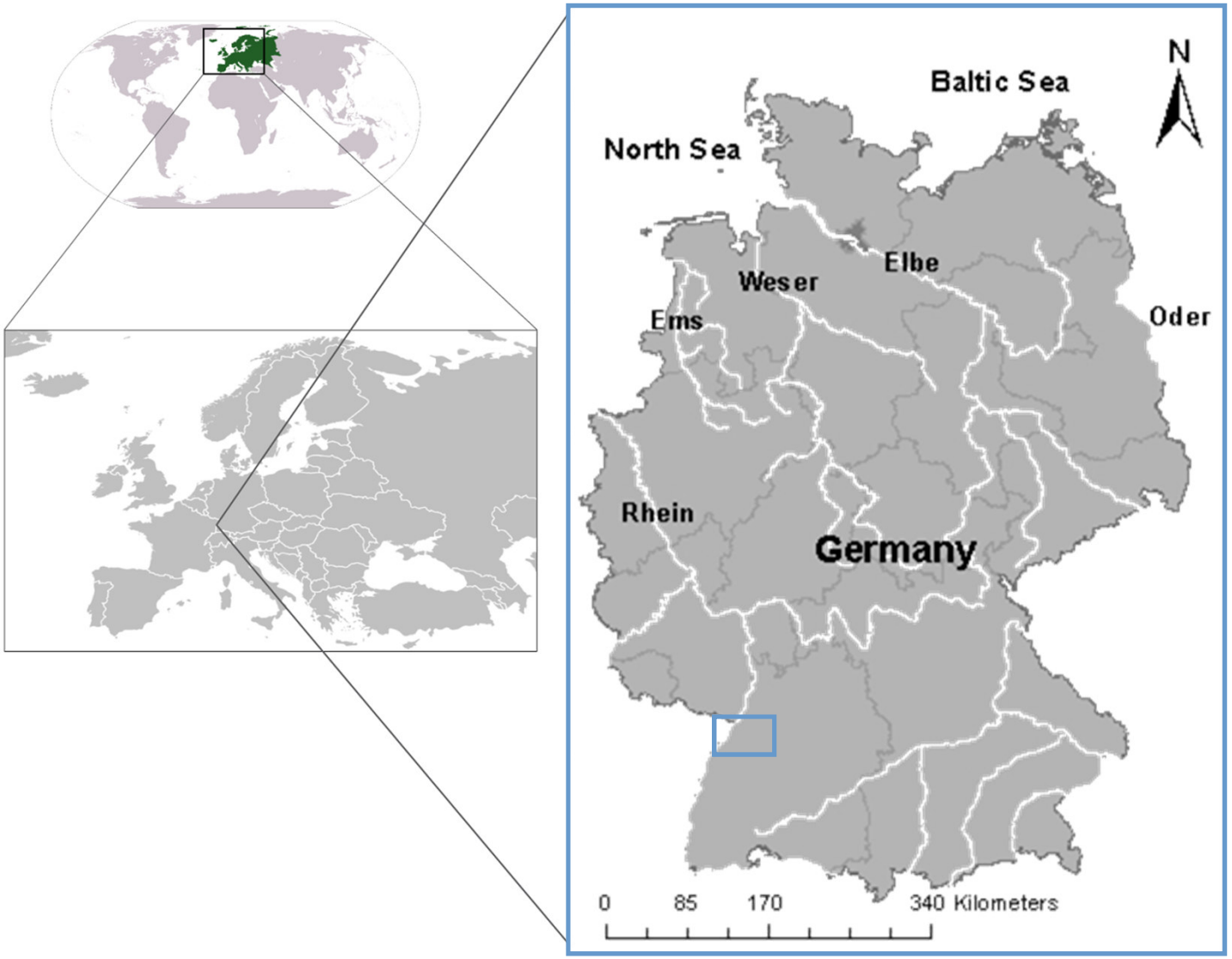


Development of a master plan that takes into account the needs of the varied user demands

…… e.g. to maintain safety and ease of navigation while developing & improving the natural regime.

central specific issues and challenge to stop the ongoing erosive trend and turn the sediment balance into a stable state

Upper Rhine – flux of contaminents

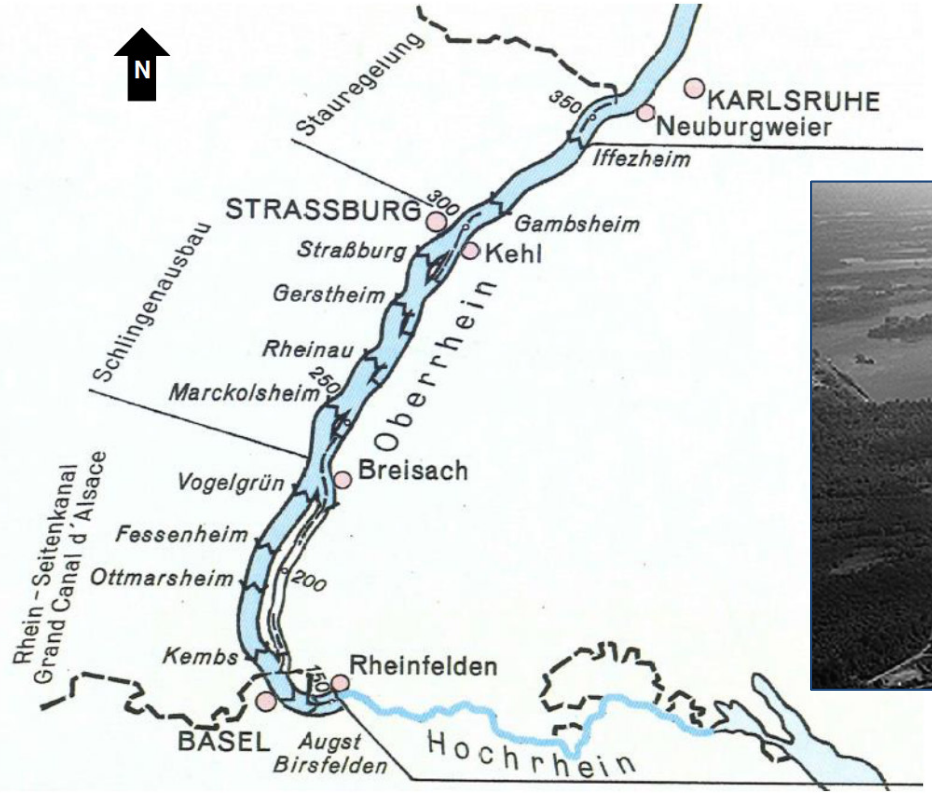


Upper Rhine – flux of contaminents

Construction of 10 dams in the southern Upper Rhine…

… to control water level and improve navigation

… for hydropower purposes



Figures: Frings (2014)

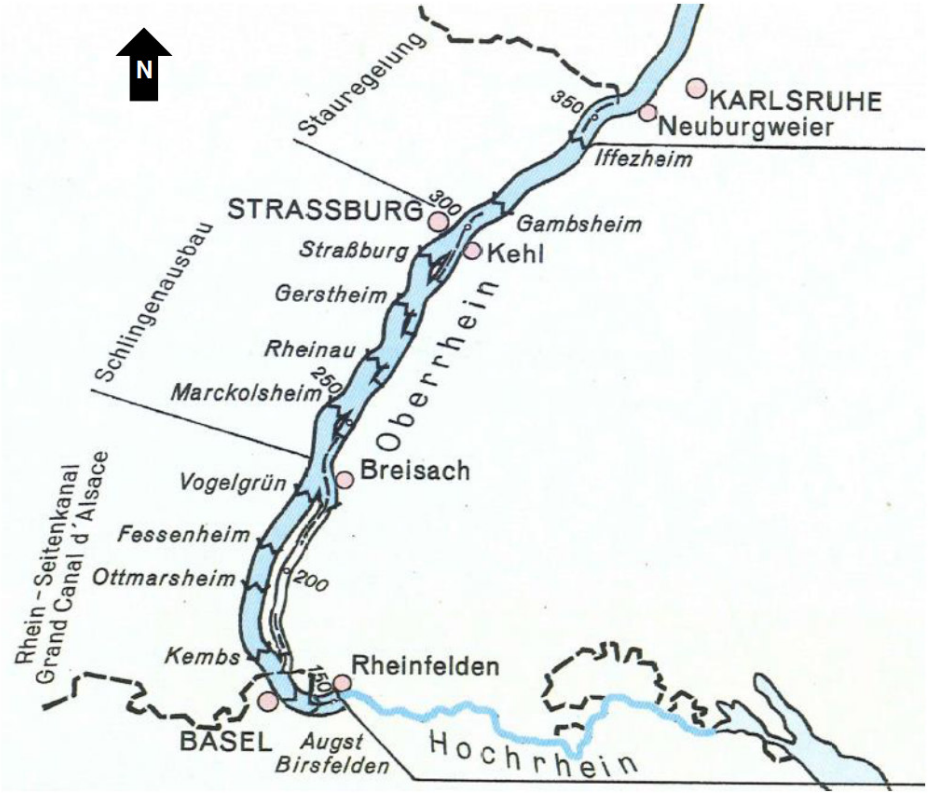
Upper Rhine – flux of contaminents

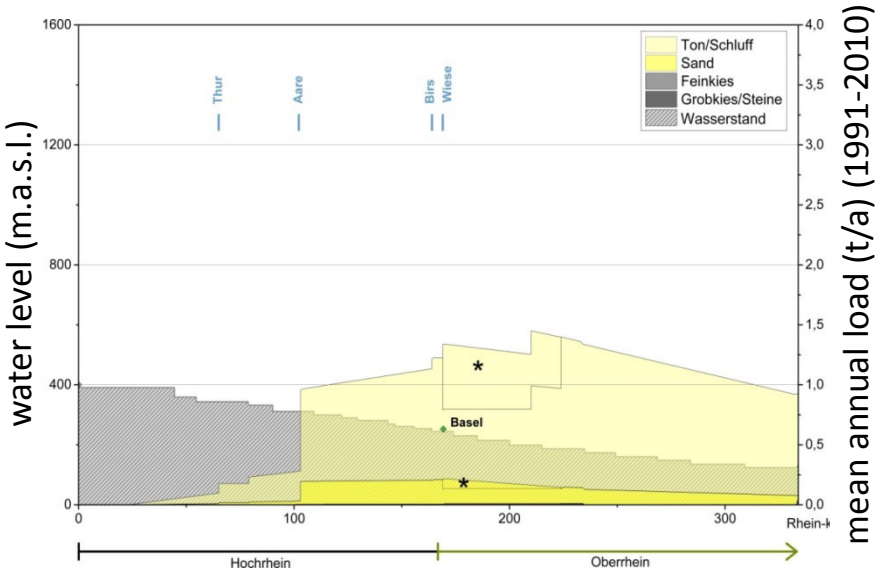
Construction of 10 dams in the southern Upper Rhine…

… to control water level and improve navigation

… for hydropower purposes

Reservoirs upstream of the dams retain 100 % of bed load (sand/gravel) and ~ 15 % of suspended load





Frings & Hillebrand (2017)

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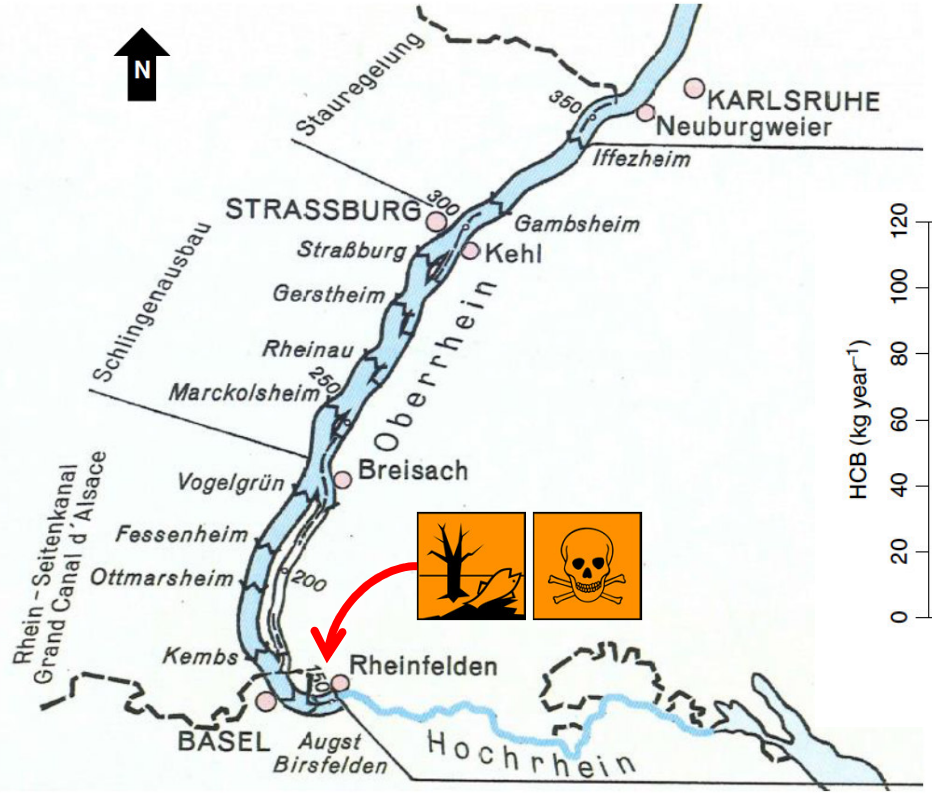
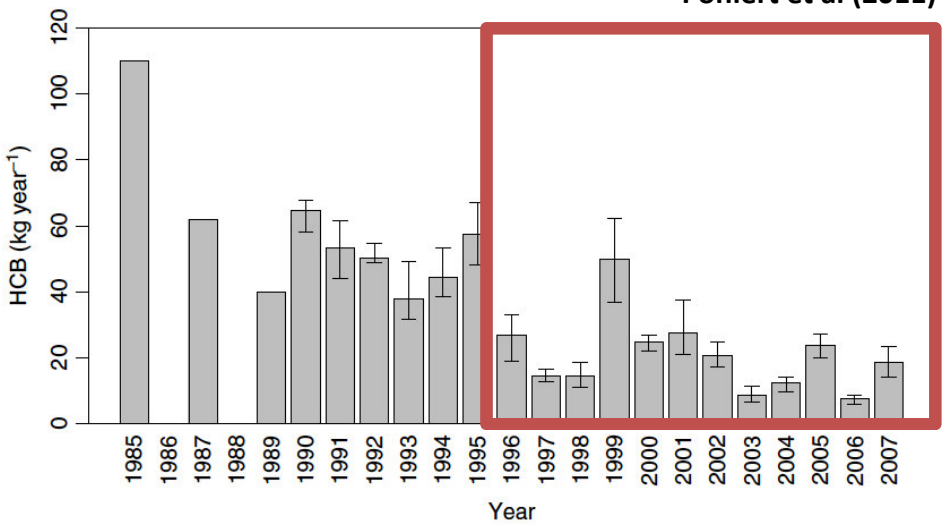


Hexachlorbenzene emission into the Upper Rhine (1970- 1990)

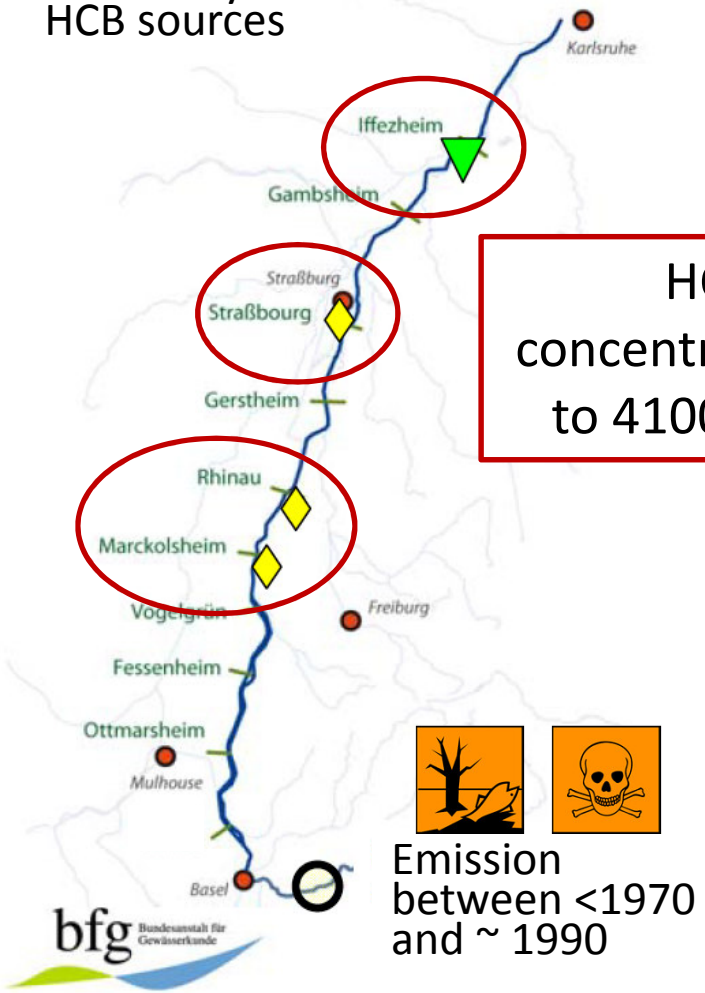
Highly toxic aromatic compound (dirty dozen) strongly associated to fine sediment

Pohlert et al (2011)



Upper Rhine – flux of contaminents

◆ Location of secondary HCB sources



HCB-concentrations up to 4100 µg kg^{-1}

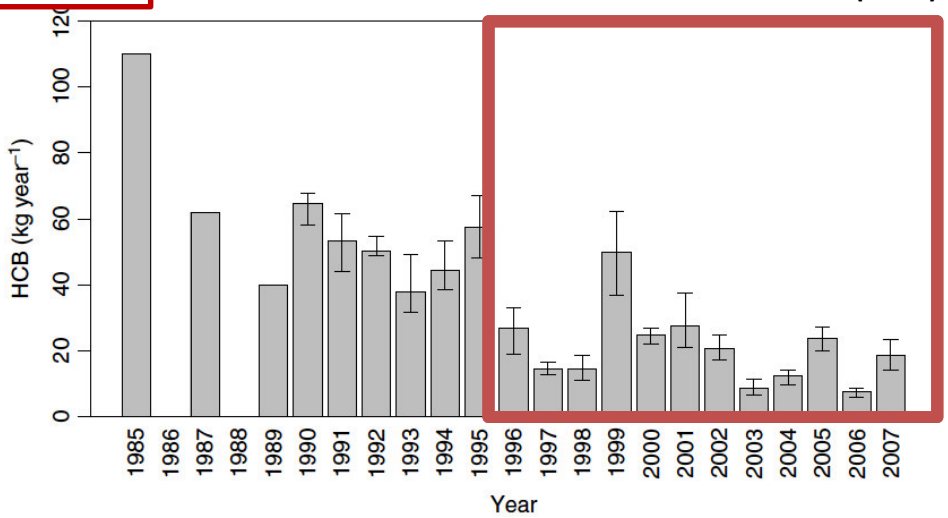
Emission between <1970 and ~ 1990

BfG (Report 1717 + 1787)

Hexachlorbenzene emission into the Upper Rhine (1970- 1990)

Highly toxic aromatic compound (dirty dozen) strongly associated to fine sediment

Pohlert et al (2011)



Upper Rhine – flux of contaminents

Setting up a sediment balance

- Define control volume and time period
- Balance input and output
- Size fractions:

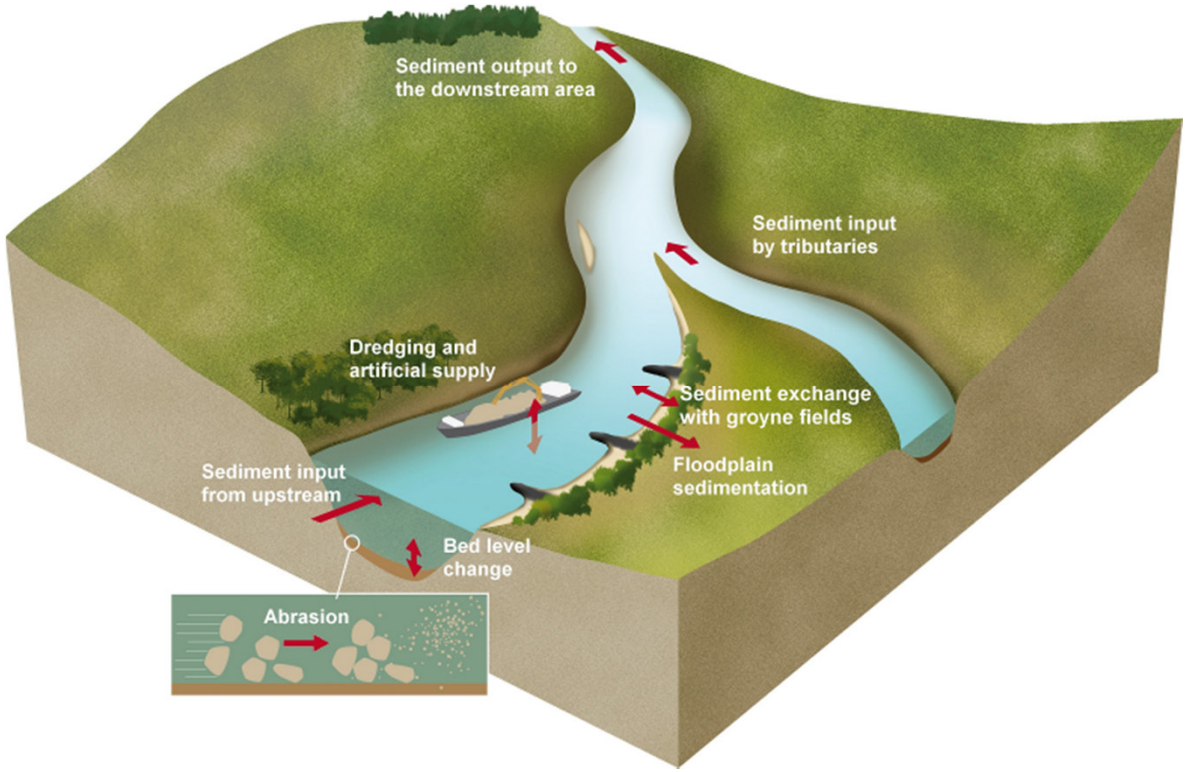
stones (> 63 mm)

coarse gravel (16 – 63 mm)

fine gravel (2 – 63 mm)

sand (0.063 – 2 mm)

silt/clay (< 63 µm)



$$I_{upstream} + I_{tributaries} + I_{artifical.supply}$$

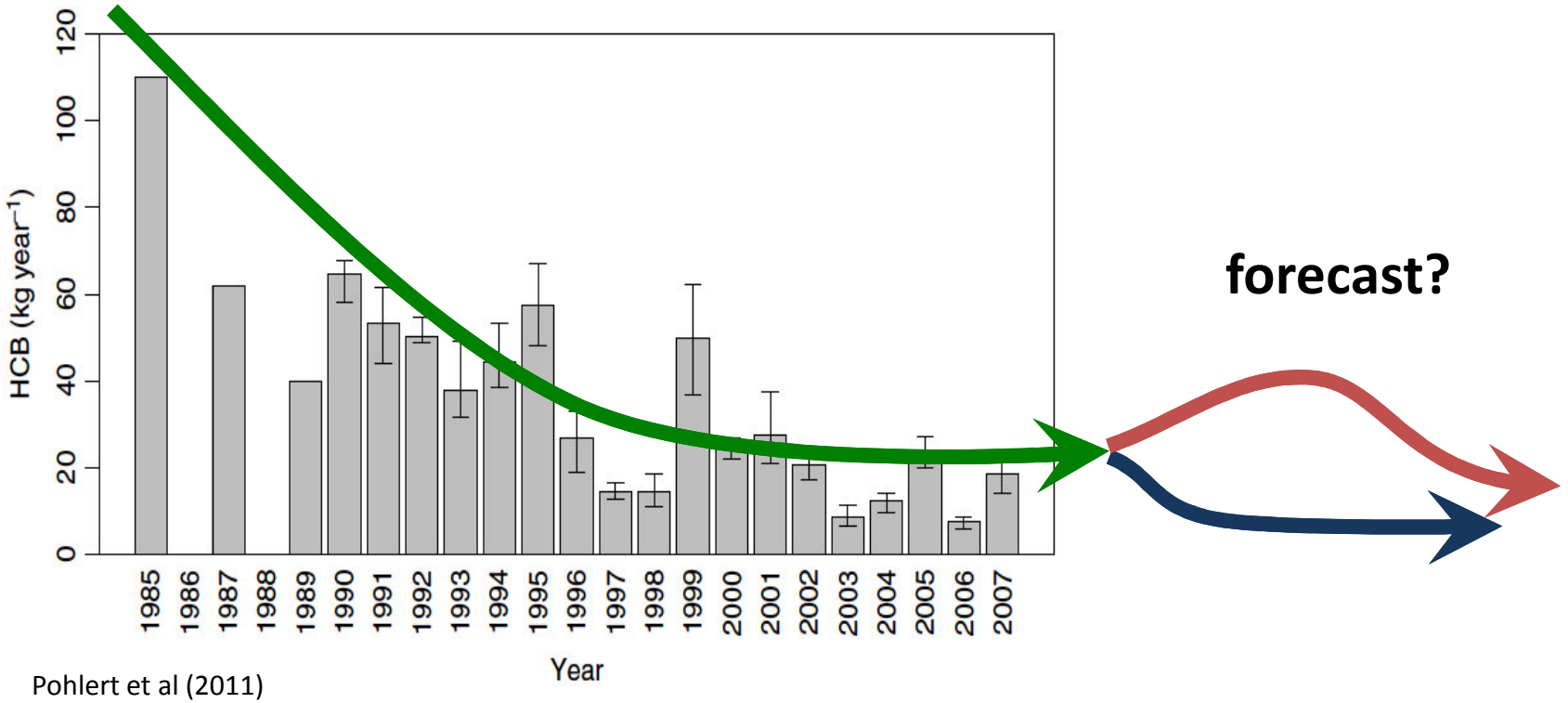
$$- O_{downstream} - O_{dredging} - O_{floodplains} - O_{abrasion} - O_{groyne.fields} = \Delta S$$

Upper Rhine – flux of contaminents

Mathematical models……

- of the sediment balance to predict the dynamics of geomorphological systems of the Anthropocen

- important tools to support the development of sediment-management concepts taking environmental changes into account



Pohlert et al (2011)

Results & Discussions

Statements derived from the presented (and other) case studies

Sediment managment should be an explicit component of RBMP‘s …. and requires basin-specific knowledge about sediment dynamics.

Healthy rivers require type-specific hydro-, sediment- and morphodynamics.

Hydromorphological and sedimentological conditions are closely linked and an essential basis for biological components.

Sediment balances provide an essential framework to study basin-specific sediment dynamics.