What are the impacts of Global Change on water quality in the Elbe river system and how are these to valuate?

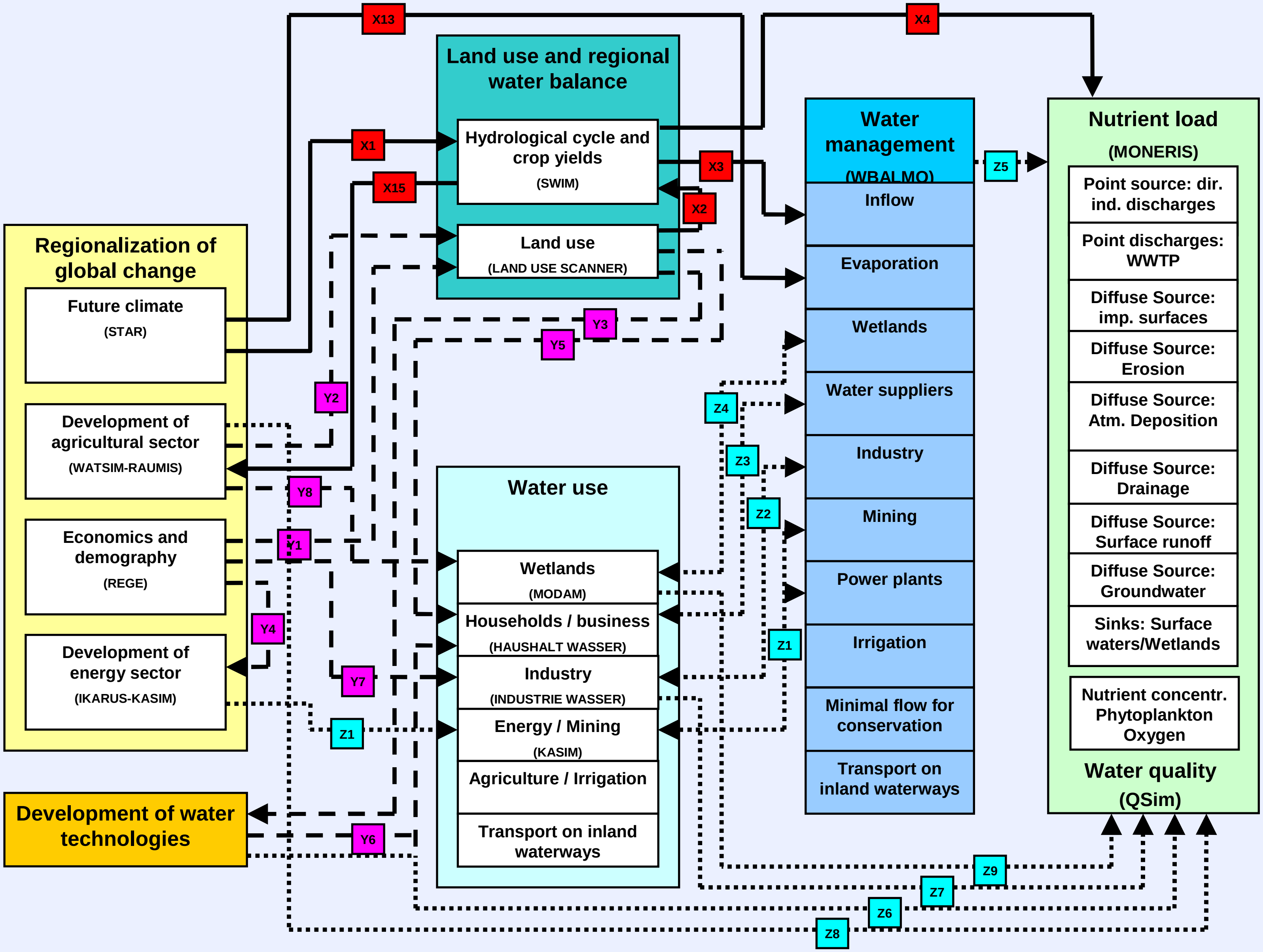
Welche mittelbaren und unmittelbaren Folgen hat der Globale Wandel auf die Gewässergüte und wie sind diese zu bewerten?

Horst Behrendt, Helmut Fischer & Malte Grossmann
Institute of Freshwater Ecology and Inland Fisheries,
Federal Institute of Hydrology,
Institute for Landscape Architecture and Environmental Planning (ILAUP), TU Berlin

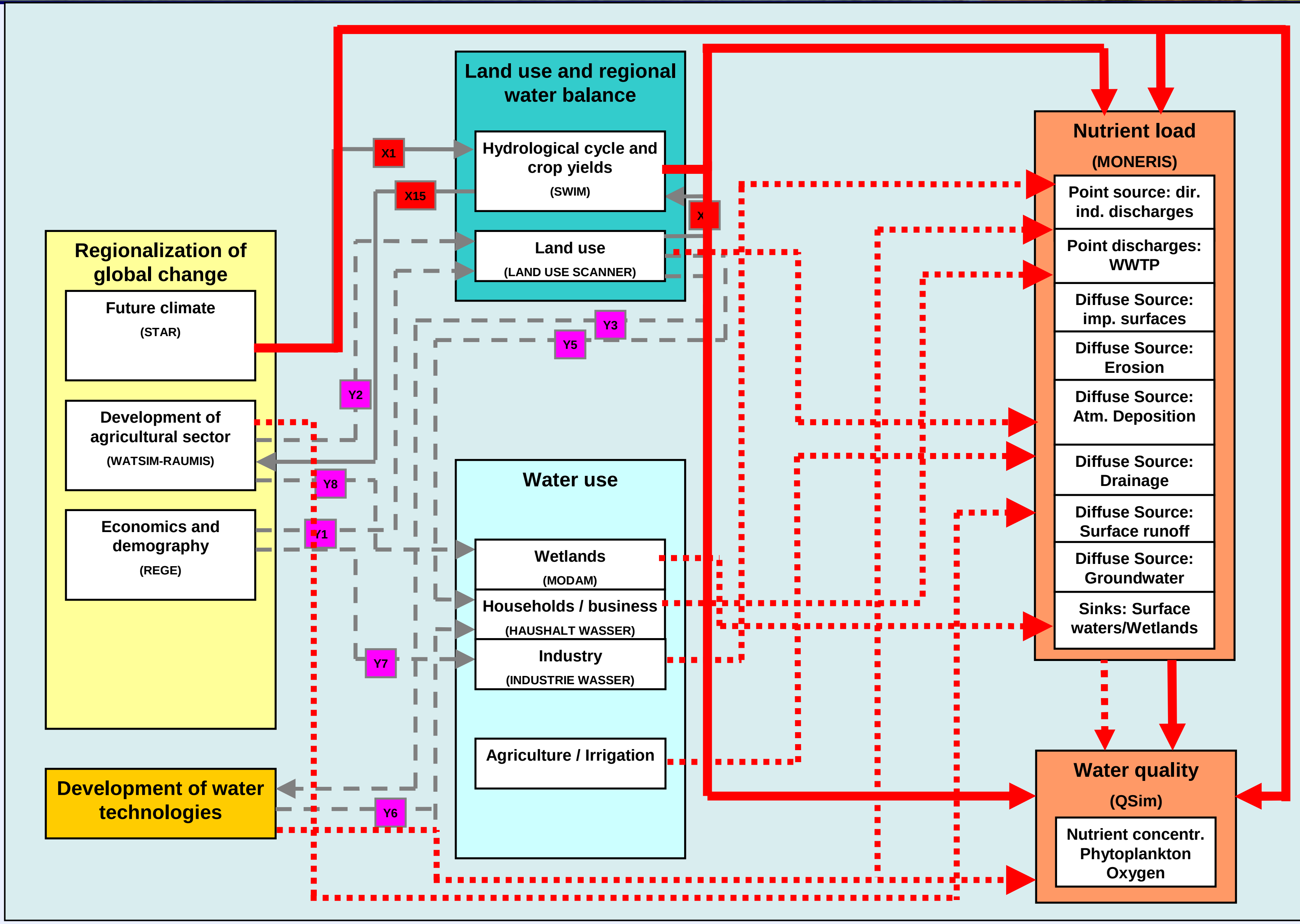
Content

1. Water quality in GLOWA Elbe
2. Applied Tools and Linkages
3. Influence of global change on nutrient loads in the Elbe catchment
   (presented by Horst Behrendt)
4. Influence of global change on the water quality of the Elbe River
   (presented by Helmut Fischer)
5. Economic assessment of basin-scale strategies to achieve water quality goals
   (presented by Malte Grossmann)
6. Problems and Outlook

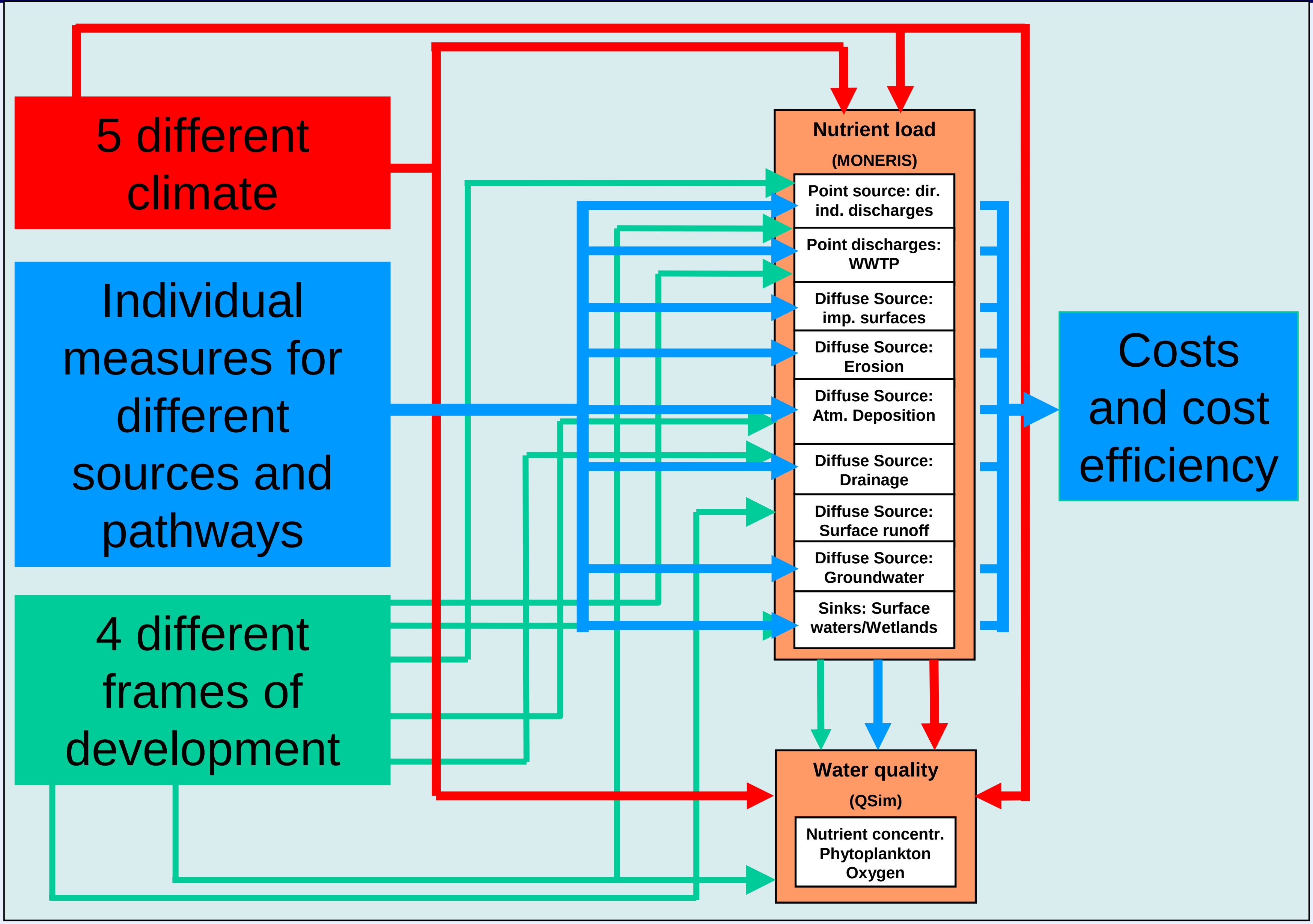
1. Water quality in GLOWA Elbe



2. Applied Tools and Linkages



2. Applied Tools and Linkages



Influence of global change on nutrient loads and concentrations in the Elbe catchment

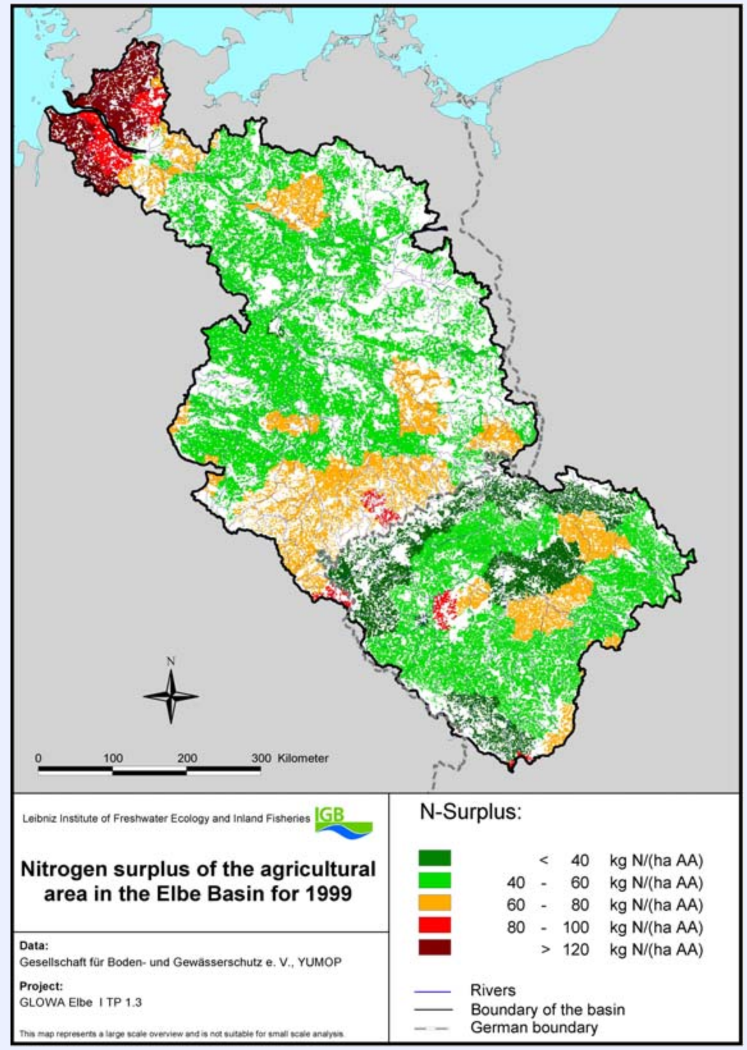
3.1 Data base
3.2 Influence of changing discharges on nutrient loads
3.3 WFD – good ecological state and needed measures

Horst Behrendt, Dieter Opitz, Thorsten Strube, Markus Venohr

Institute of Freshwater Ecology and Inland Fisheries

Data base for the modeling of the Elbe catchment

- ***The modeling of the diffuse emissions into the total Elbe river system was the main topic of GLOWA-Elbe I.***
- ***The spatial resolution of subcatchments was about 500-2000 km².***

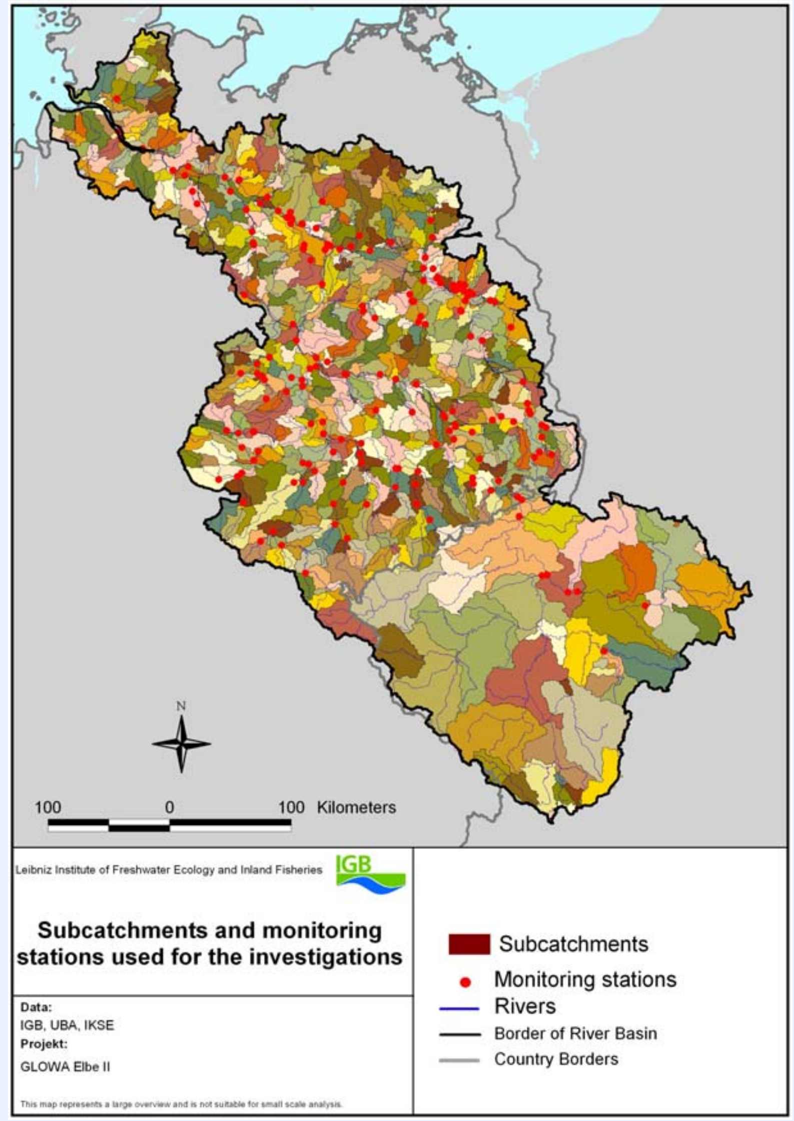


3.1 Database

- ***Wthin GLOWA-Elbe II a database for point sources was established and the total nutrient loads are calculated for a new subdivision of the basin.***

- ***Present state DE:***
  645 subcatcments (150km²);
  180 stations;
  CZ:
  55 subcatchments (920km²);
  7 station

  Unfortunatley the spatial distinguish of the basin is not the same as for the WFD



3.1 Database

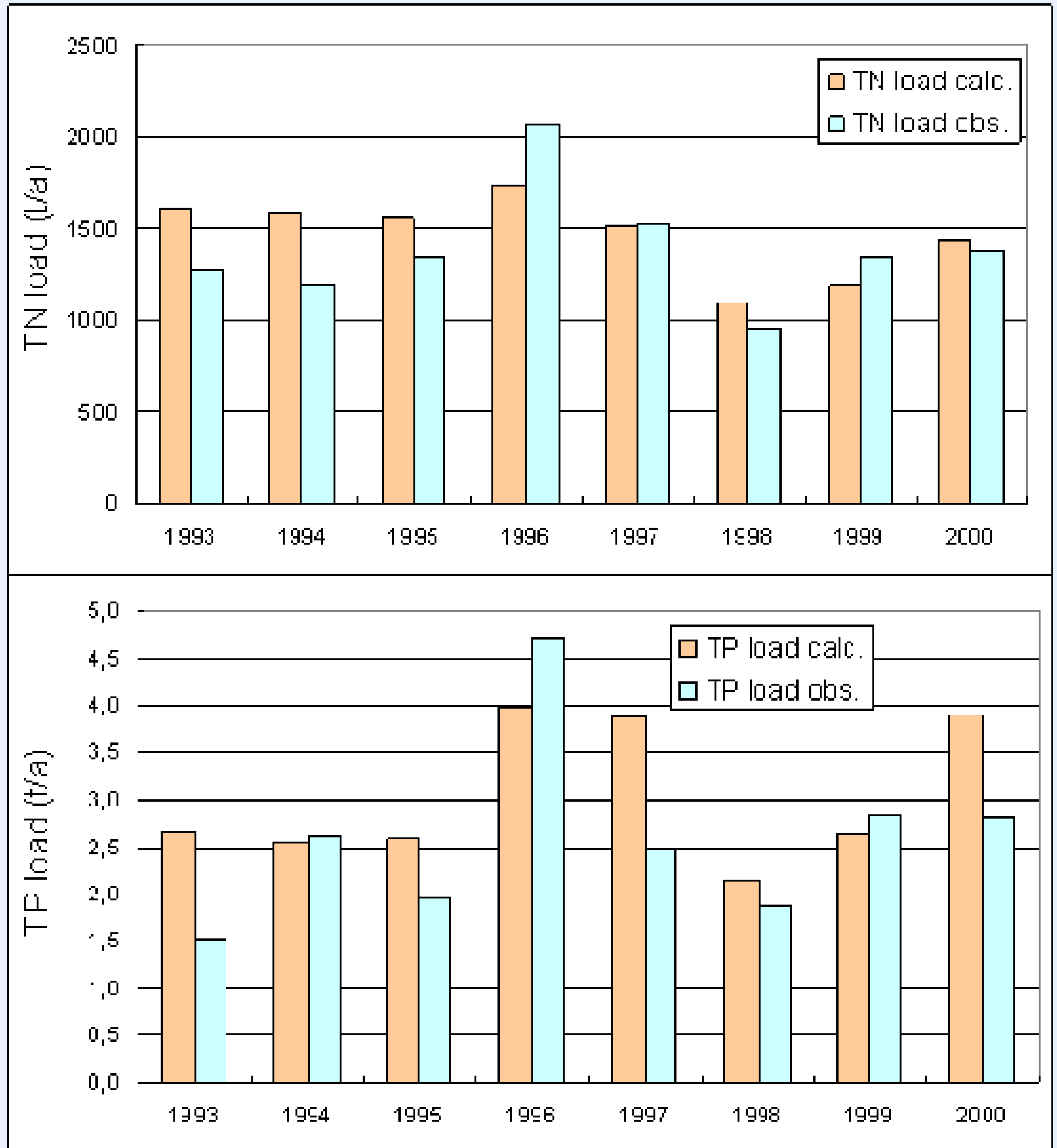
- ***Experience from Glowa-Elbe I and the EUROHARP-project:***

- ***Quality and resolution of data allows a modeling with high spatial resolution.***

Case study Zelivka: about 265 subcatchments (average size 4,5 km²)

Model efficiency for Zelivka:

DIN: 0.72
TP: 0.69



3.2 Influence of changing discharges on nutrient loads

Input:

SWIM calculations for discharge; STAR calculations for precipitation

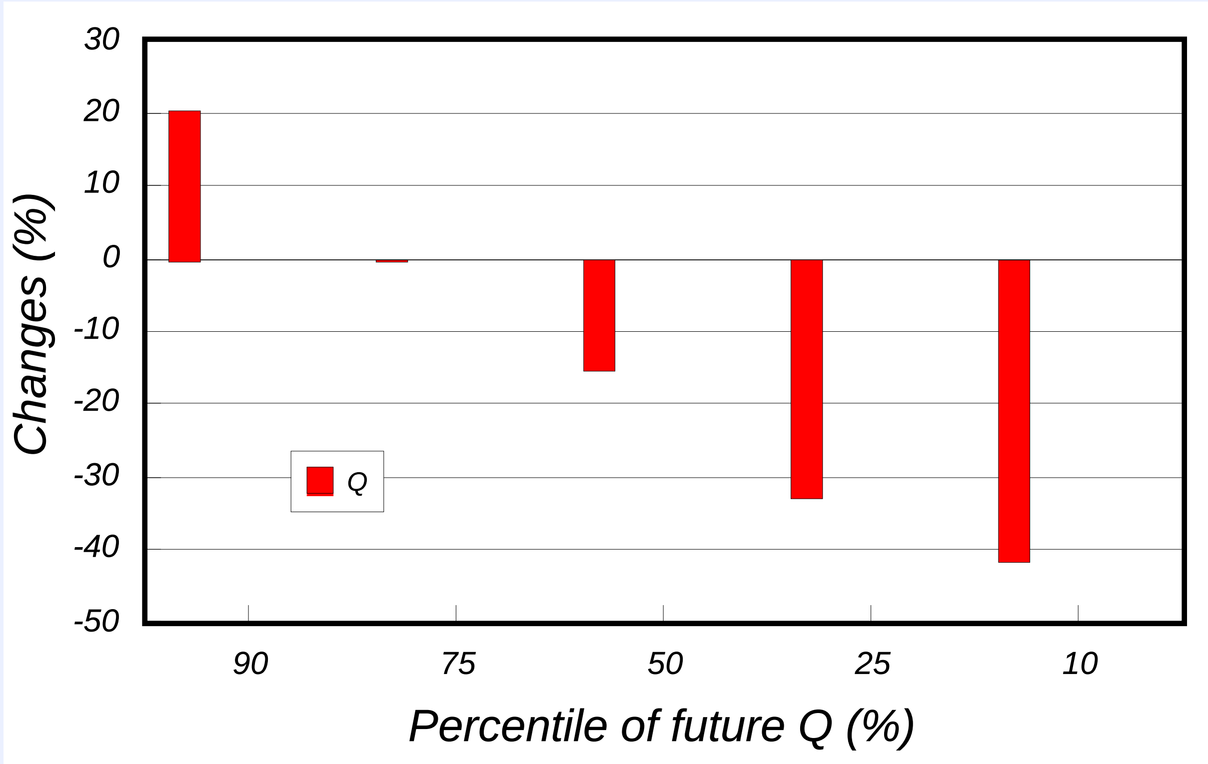
Assumptions:

None further changes of human inputs; N-surplus constant for next 40 years

Results for total Elbe:

Q is changing in a range of + 20% to – 40%.

Q of 1998-2000 corresponds to a 75% percentile for the future



Q (m³/s) 815 676 575 457 398

3.2 Influence of changing discharges on nutrient loads

Results for Elbe and large tributaries – Q:

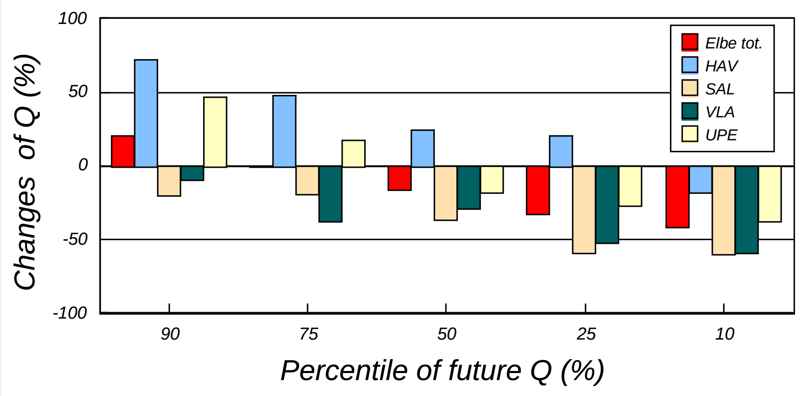
The variation in the individual tributaries is much higher than for the total Elbe.

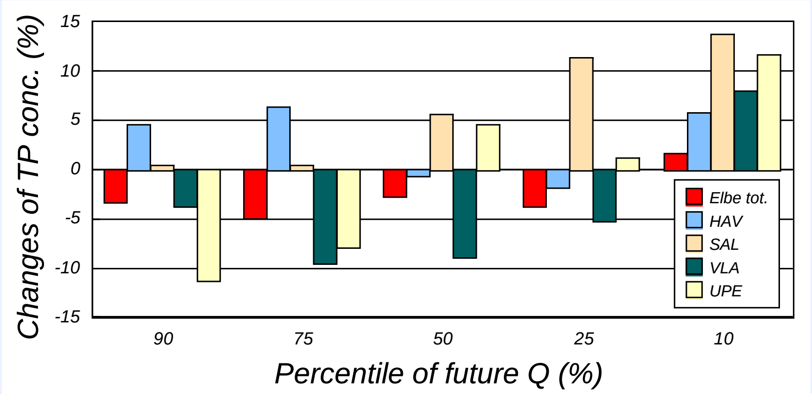
The variation differs for the individual tributaries due to the selection of only one year as corresponding to a certain percentile for Q.

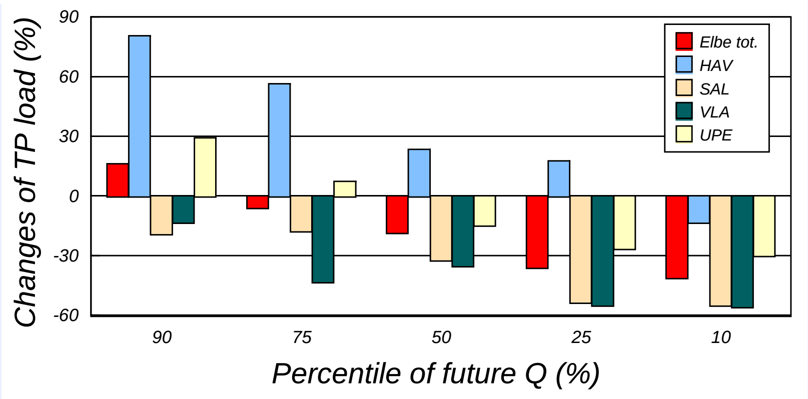
Results for Elbe and large tributaries – TP:

The changes of TP conc. is low but different for total Elbe and for the individual tributaries.

The changes of TP load are similar to the changes of the discharge.







3.2 Influence of changing discharges on nutrient loads

Results for Elbe and large tributaries – TN:

The changes of TN conc. is larger than for TP especially for low flow conditions for Saale and Vlatava.

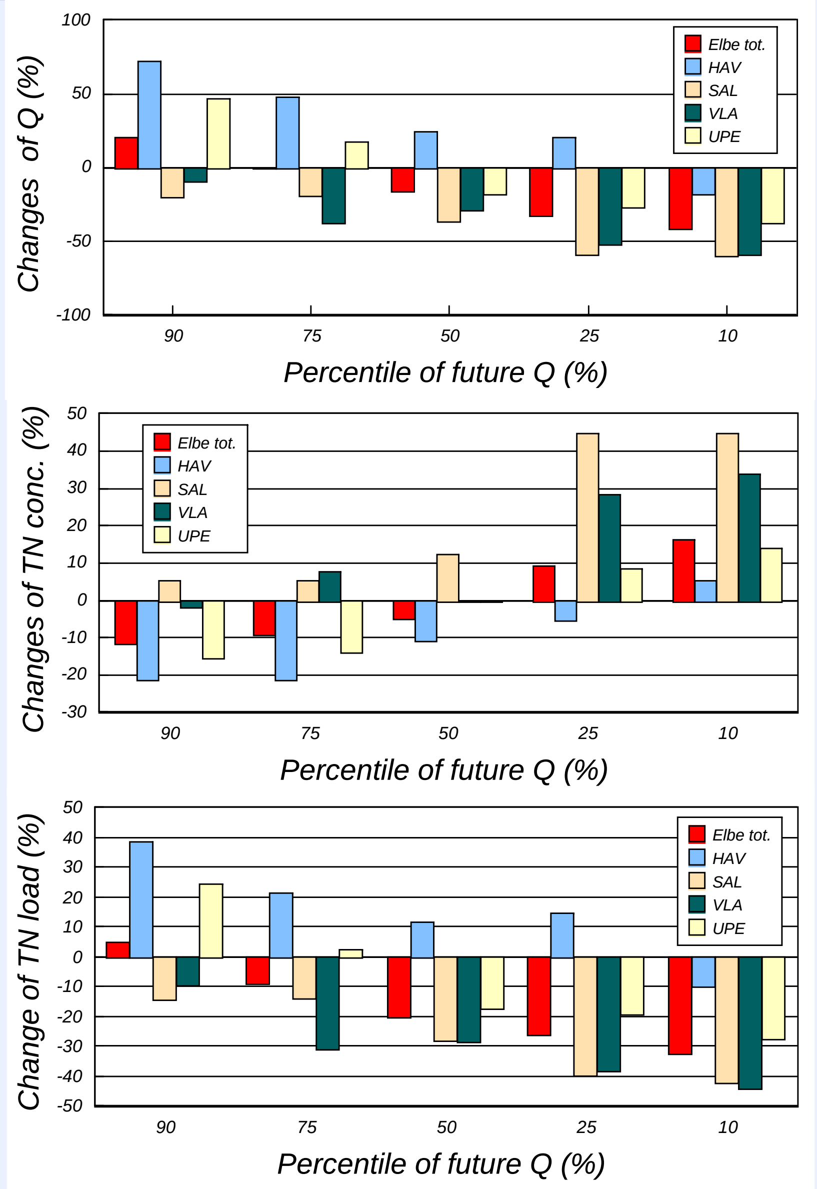
The changes of TN load are also similar to the changes of the discharge.

Results in general

If the future is characterised by lower discharges the tendency for the nutrients is:

Increasing concentrations – bad for state of freshwater systems.

Decreasing loads – good for state of coastal zone

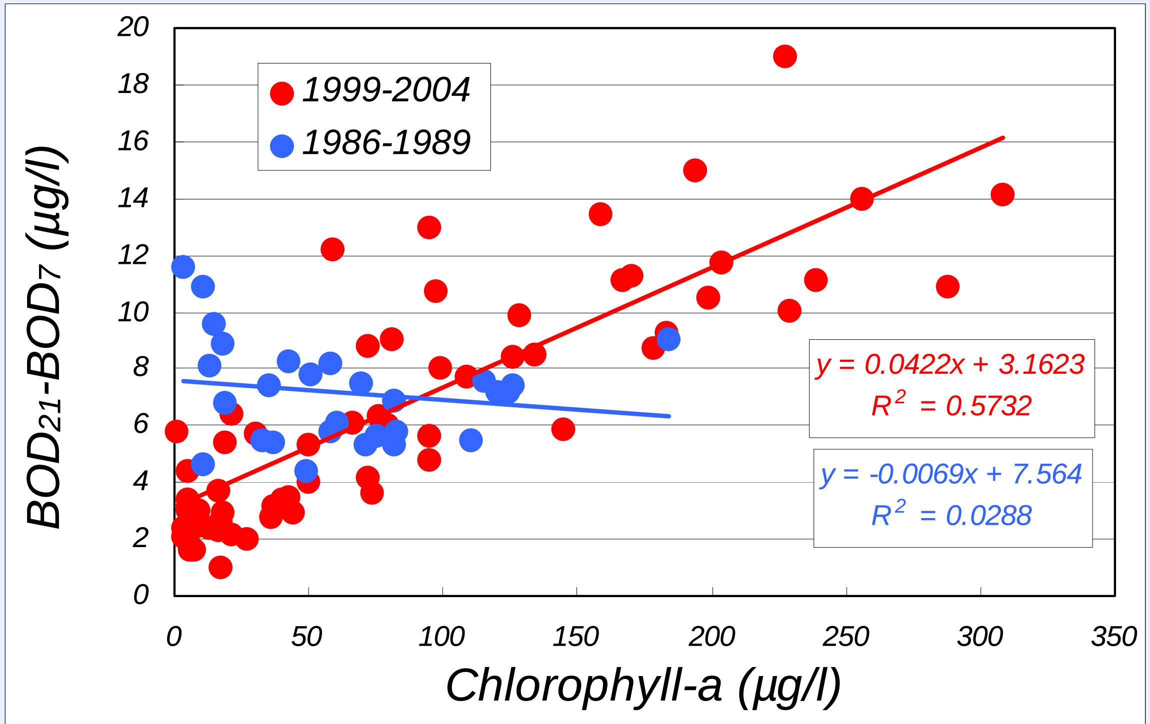


The behaviour of the ecosystem is changing

Dependency of the BOD increase between the first and the third week on the chlorophyll-a concentration in the Elbe for the time period 1986-1989 and 1999-2004.

At present the heavily biodegradable material in the Elbe is mostly attributed to the phytoplankton in the river.

In the 1980‘s this behaviour was covered completely by BOD from other sources.



Elbe at Zollenspieker

Conclusion:

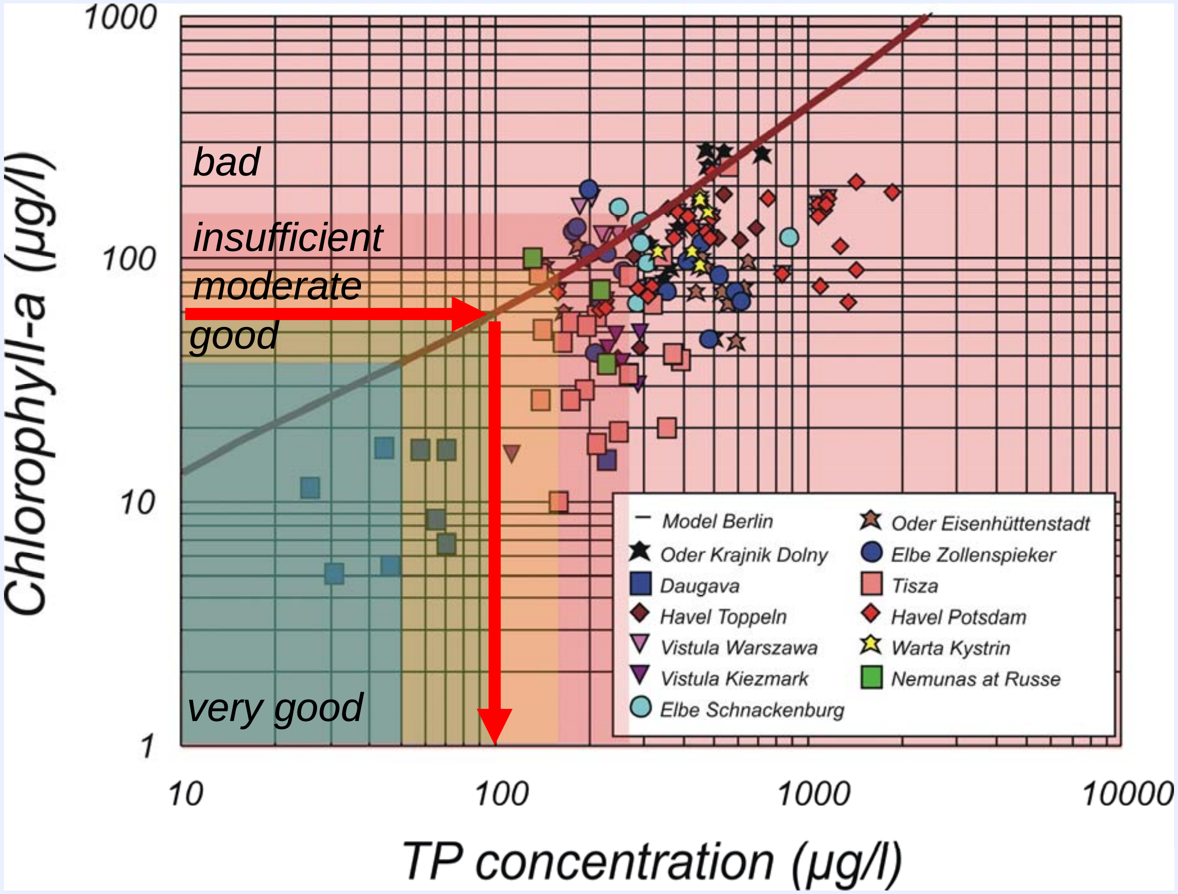
The oxygen budget of Elbe has been changed from an allochthonous dominated to an autochthonus dominated budget.

Classification of phytoplankton in rivers & phosphorus state

A good state of large rivers (with low flow and high potential of P-use; Typ 10.2 and 20.2) can be achieved for seasonal averages of Chlorophyll-a concentrations below 50 µg/l.

This corresponds to a seasonal average for total P lower than 100 µg/l.

At TP-conc. < 100µg/l the SRP-conc. is in the limiting range at least for periods of the year.

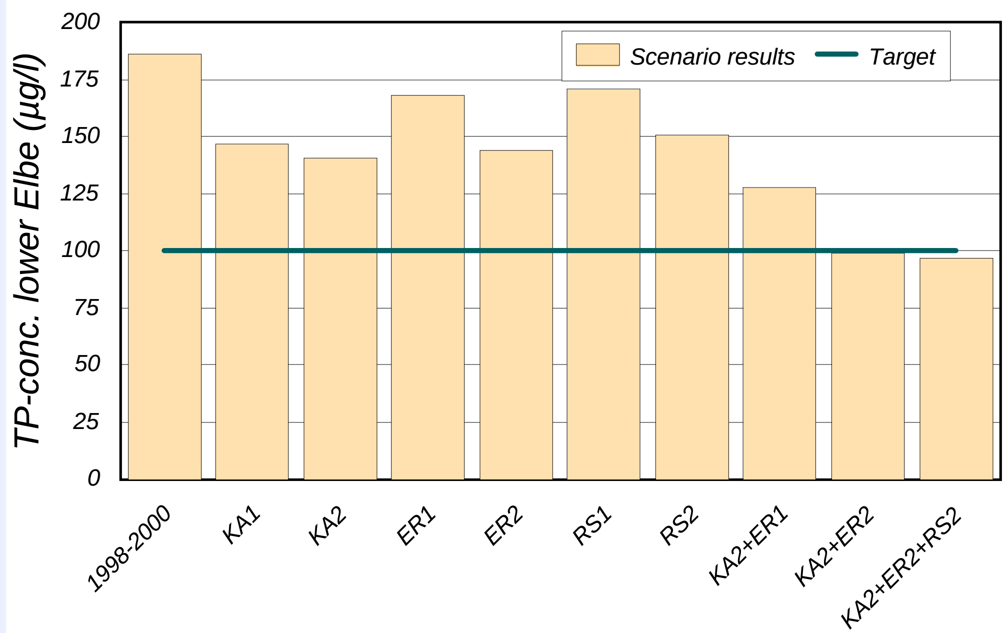


Are TP concentrations below 100 µg/l possible?

Scenario	Measure
KA1	MWWTP of 10000-100000 PE = 1mg/l P; MWWTP > 100000 PE = 0.5 mg/l P
KA2	MWWTP of 10000-100000 PE = 1mg/l P; MWWTP > 100000 PE = 0.05 mg/l P
ER1	40 % of arable land will be managed without plough
ER2	80 % of arable land will be managed without plough
RS1	Reduction of connection between arable land and surface waters (40% of arable land)
RS2	Reduction of connection between arable land and surface waters (80% of arable land)

The good ecological state of the lower Elbe can not be achieved with a single measure.

For the combination of strong measures in relation to large WWTP's and erosion prevention a good state could be achieved.

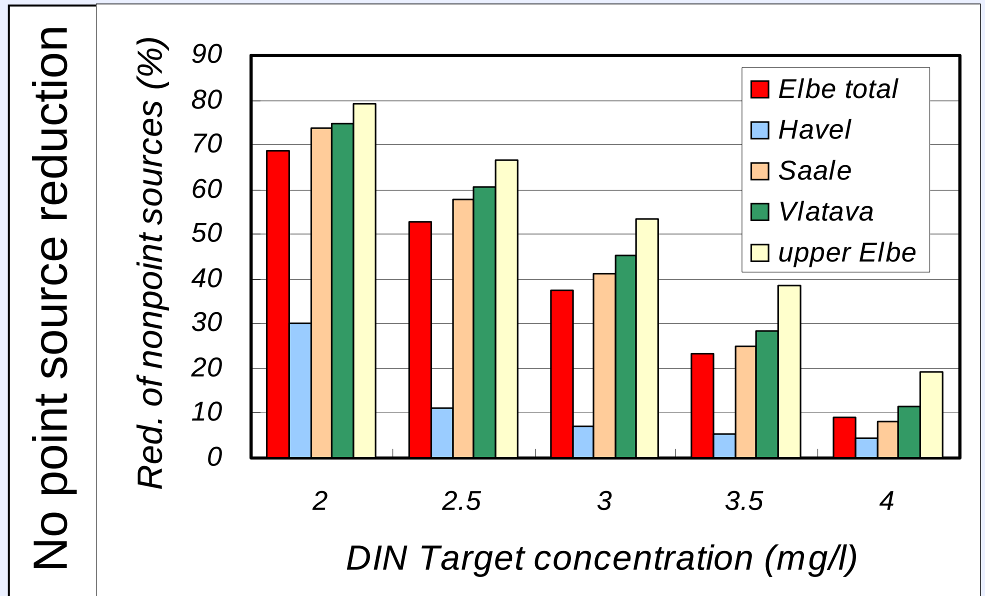


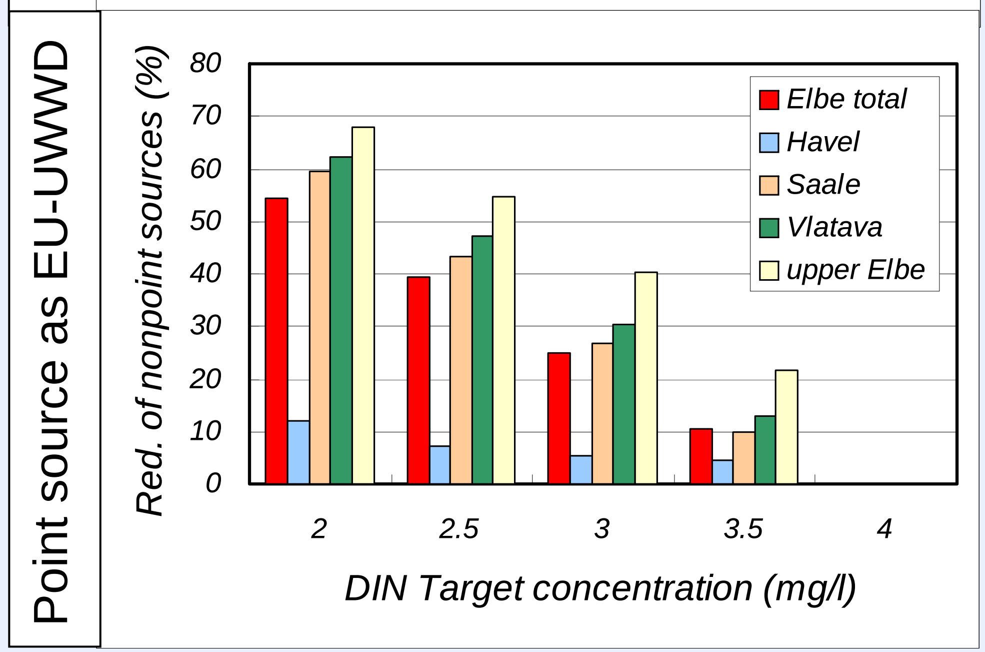
Which reduction of nitrogen losses is necessary to achieve a target concentration at the Elbe outlet?

For a target concentration of DIN for the Elbe of 3 mg/l a reduction of nonpoint sources of 38% is necessary, if point discharges will not be changed.

The demand for reduction is very different for the tributaries.

If all point sources fulfill the EU urban wastewater directive the needed reduction of nonpoint sources is approximately 13% lower as for unchanged point discharges.





Influence of global change on the water quality of the Elbe River

by Helmut Fischer

Economic assessment of basin-scale strategies to achieve water quality goals

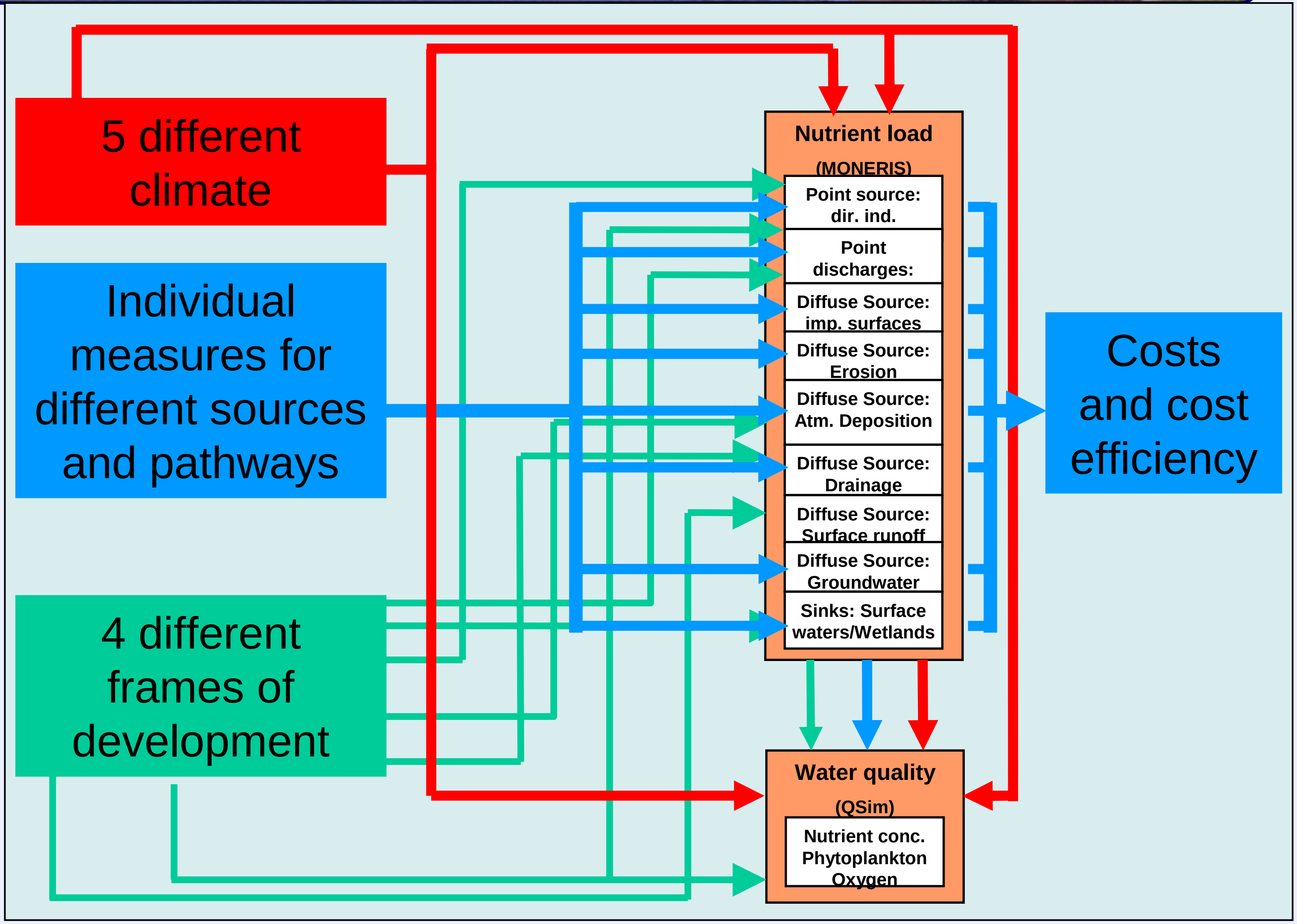
by Malte Grossmann

6. Problems and Outlook

realised but must be revised

mostly implemented but not tested completely

have to be implemented



For the direct use of the models for WFD a revision of the subcatchments is necessary

Tasks within GLOWA Elbe II:

- Revision of the selection of years representing certain percentiles of future climate
- Implementation of the 4 baseline scenarios for the frame of development and combination with the 5 climate scenarios
- Linkage to the wetland module of WBALMO
- Systematic comparison of potential strategies under conditions of different baseline scenarios
- Intensive sensitivity analysis
- Identify „least cost solutions“, cost-effective combinations of measures

Tasks in GLOWA Elbe III:

- Development of scientific models to tools for decision support.
- Improvement of economic approaches for Czech part of basin
- Modelling of further substances important for water quality of the Elbe (Si, heavy metals).

Offers/Interests:

- If German countries & Czech Republic are interested, we can do a revision of the spatial distinguish of the Elbe catchment according to your final state.
- We would like to go into a detailed dialog with IKSE, FGG & working groups of countries to achieve some level on agreement concerning specification of measures and cost assumptions (beginning early 2007).

One wish:

- We would like to get the present state of nutrient discharges for the individual WWTP for German and Czech part of Elbe for calculations of effects and costs of WWTP improvement.

The systems are more complex as assumed:

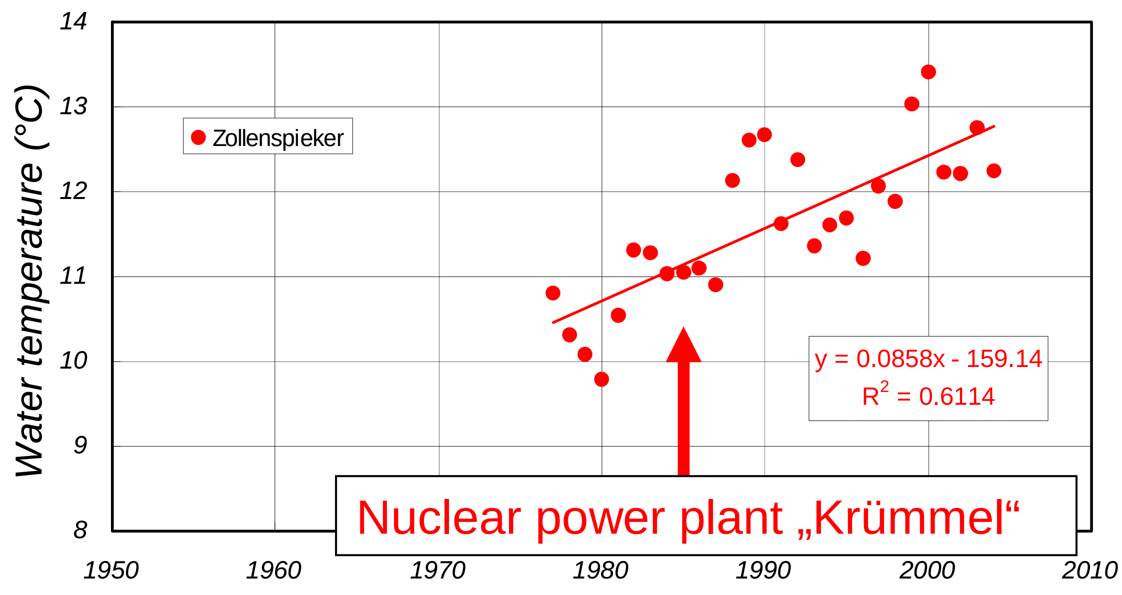
State of climate research:

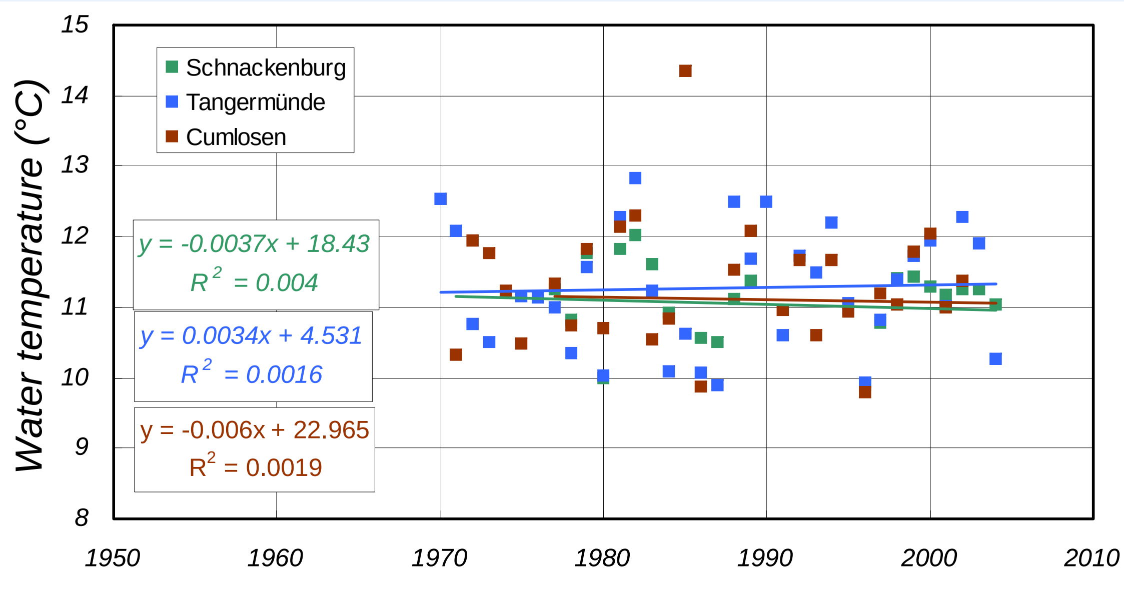
The increase in air temperature in Central Europe is significant (~0.5°C/decade).

Also water temperature is significantly increasing. But is this trend due to climate or power plants?

The stations without influences of power plants do not show a trend.

Why?





Thank You

for your attention!