Influence of global change on the water quality of the Elbe/Labe

Einfluss des globalen Wandels auf die Gewässergüte der Elbe

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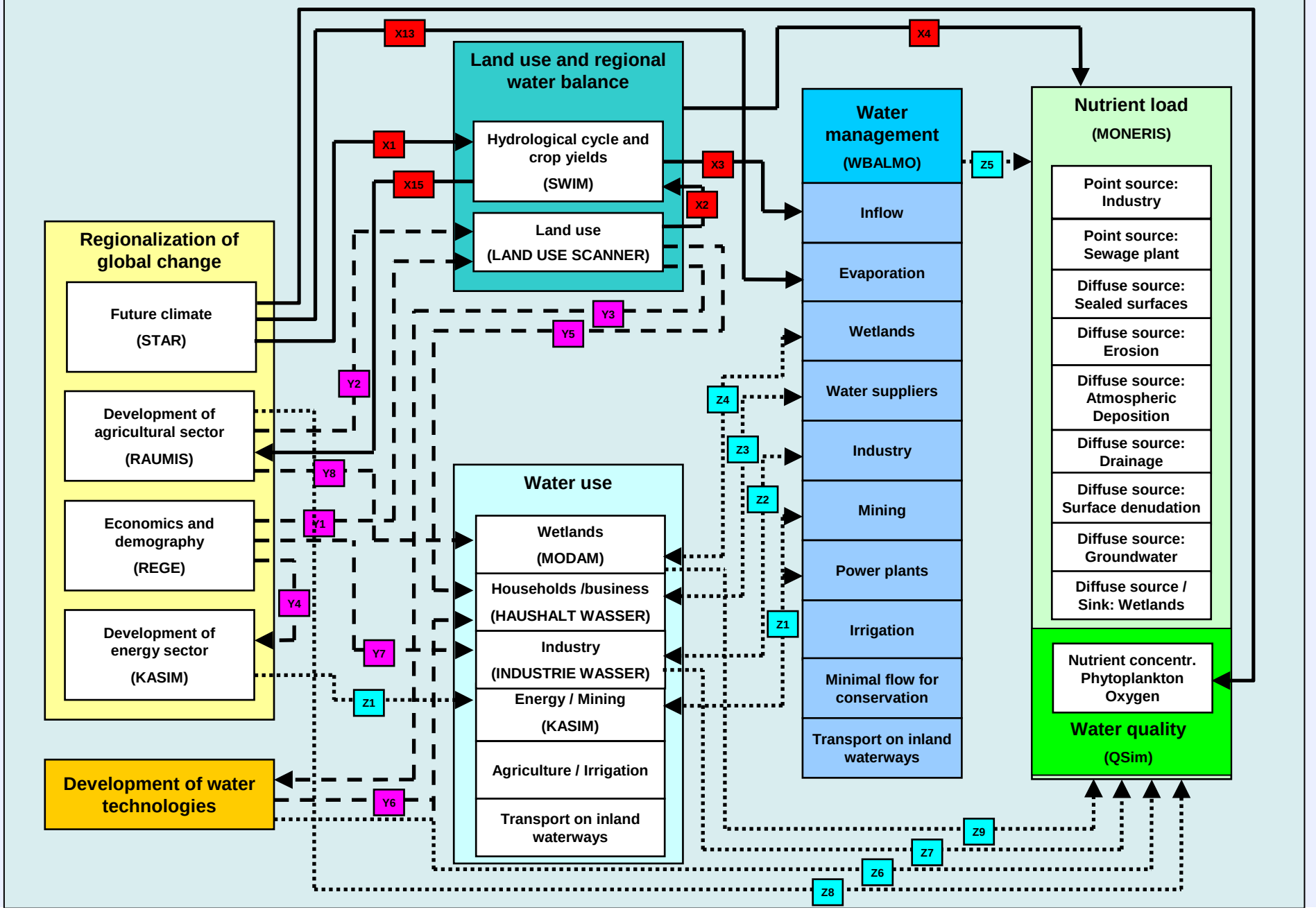
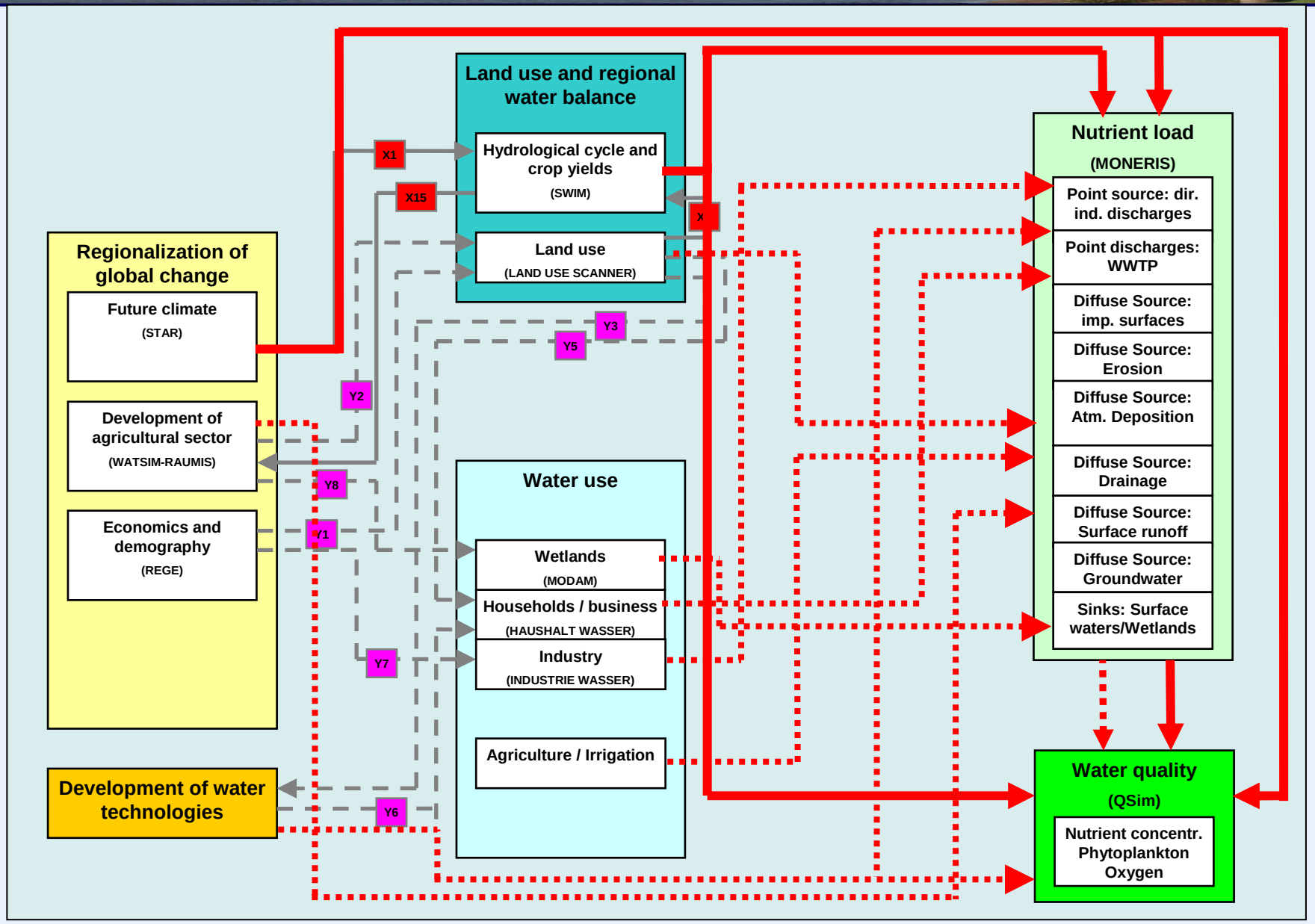
Introduction - position of the project in the model network



Introduction - position of the project in the model network



Introduction

Factors influencing algal biomass and nutrient budget and Models providing input data for QSim

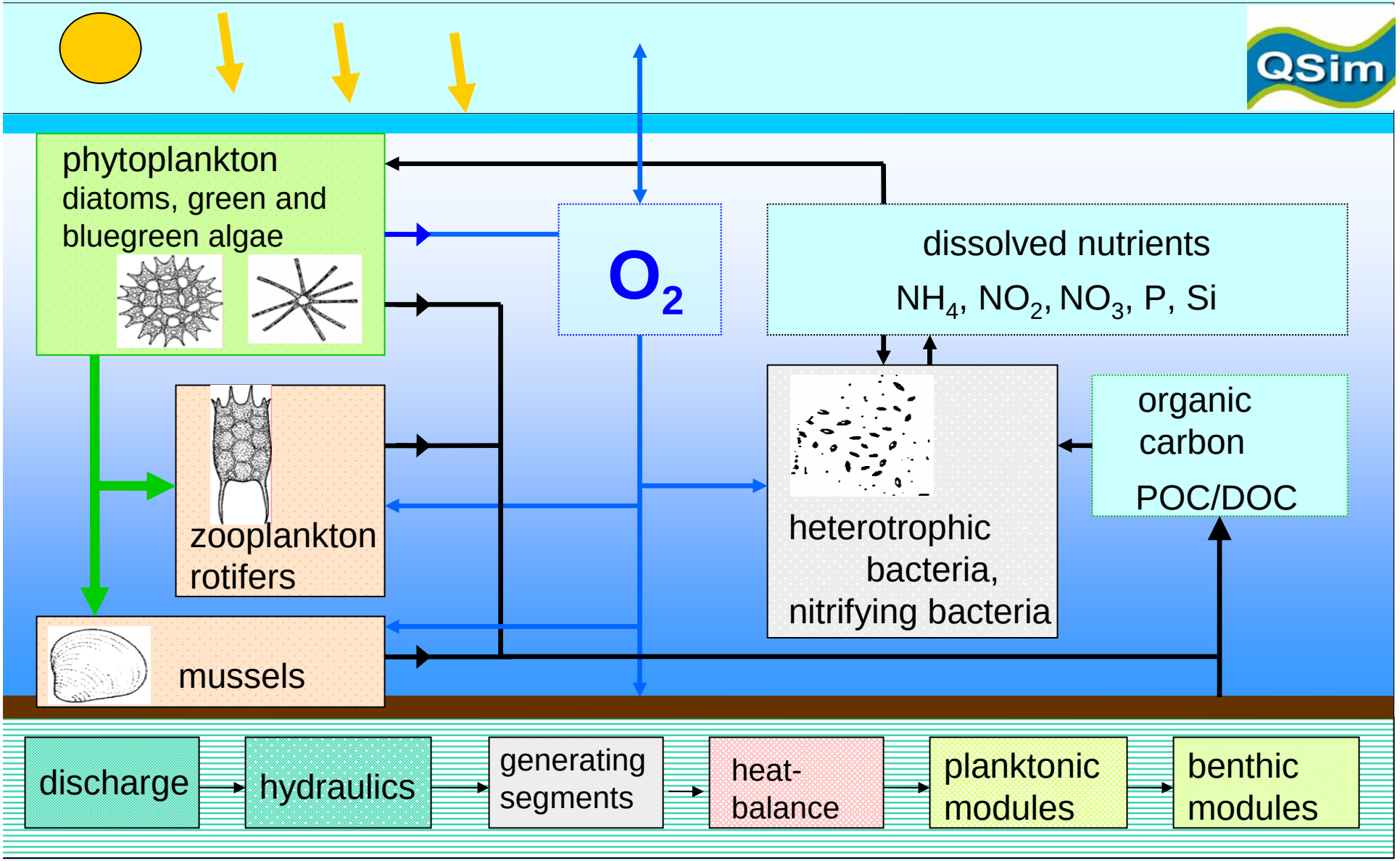
→ **Climate** (temperature, light regime, precipitation) → model "STAR", PIK

→ **Discharge** (water depth, retention times) → model "SWIM", PIK

→ **Nutrients** (inputs, concentrations) → model "MONERIS", IGB

nutrient budget ←→ Algal growth and biomass

Introduction – the model QSim



Schöl et al. 1999, 2002

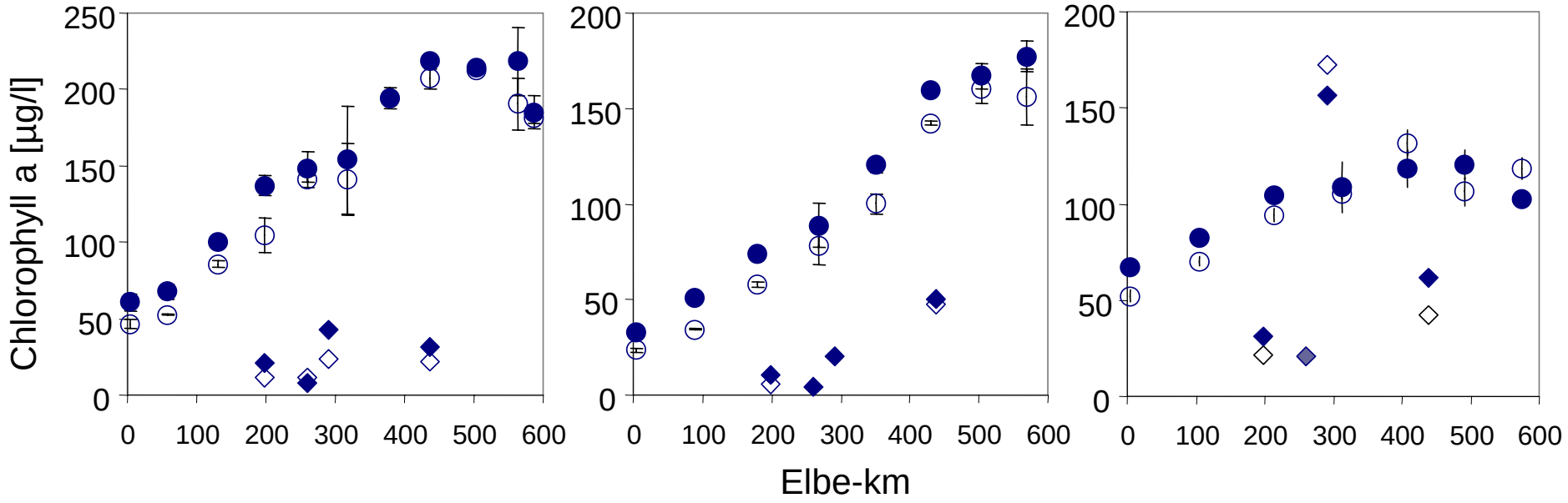
Results

Longitudinal („Lagrangian“) sampling campaigns: **chlorophyll *a***

Summer 2000
26.6. – 5.7. (9 days)
low discharge

Summer 2005
24.7. – 1.8. (7 days)
medium discharge

Spring 2006
8.5. – 15.5. (6 days)
high discharge



n = 3

- ● 18:00
- ○ 6:00

Elbe

- ◆ 18:00
- ◇ 6:00

tributaries

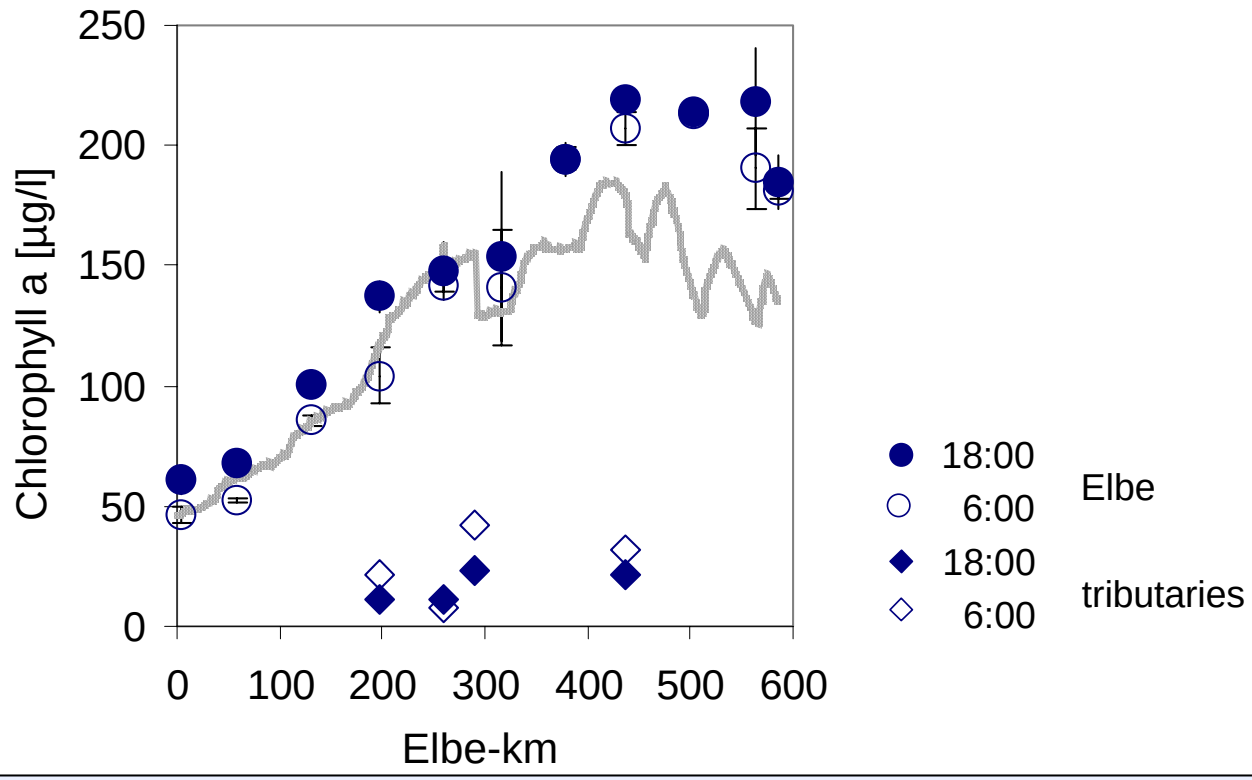
High phytoplankton biomass leads to oxygen supersaturation in the Middle Elbe (up to 200% in summer) and and heavy loads of organic matter in the tidal area.

H. Fischer, BfG Koblenz

Results

Chlorophyll a – measured and modelled data

Sommer 2000
26.6. – 5.7.
low discharge



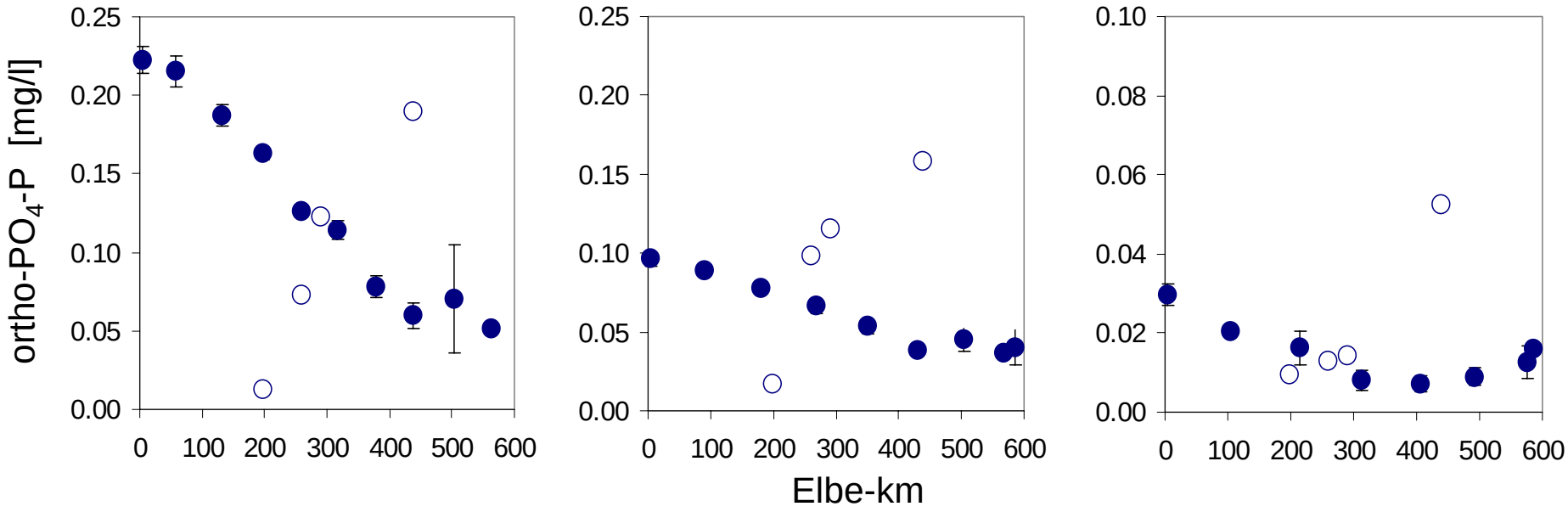
Results

Longitudinal sampling campaigns: **dissolved phosphorus (ortho-phosphate)**

Summer 2000
26.6. – 5.7. (9 days)
low discharge

Summer 2005
24.7. – 1.8. (7 days)
medium discharge

Spring 2006
8.5. – 15.5. (6 days)
high discharge



n = 6

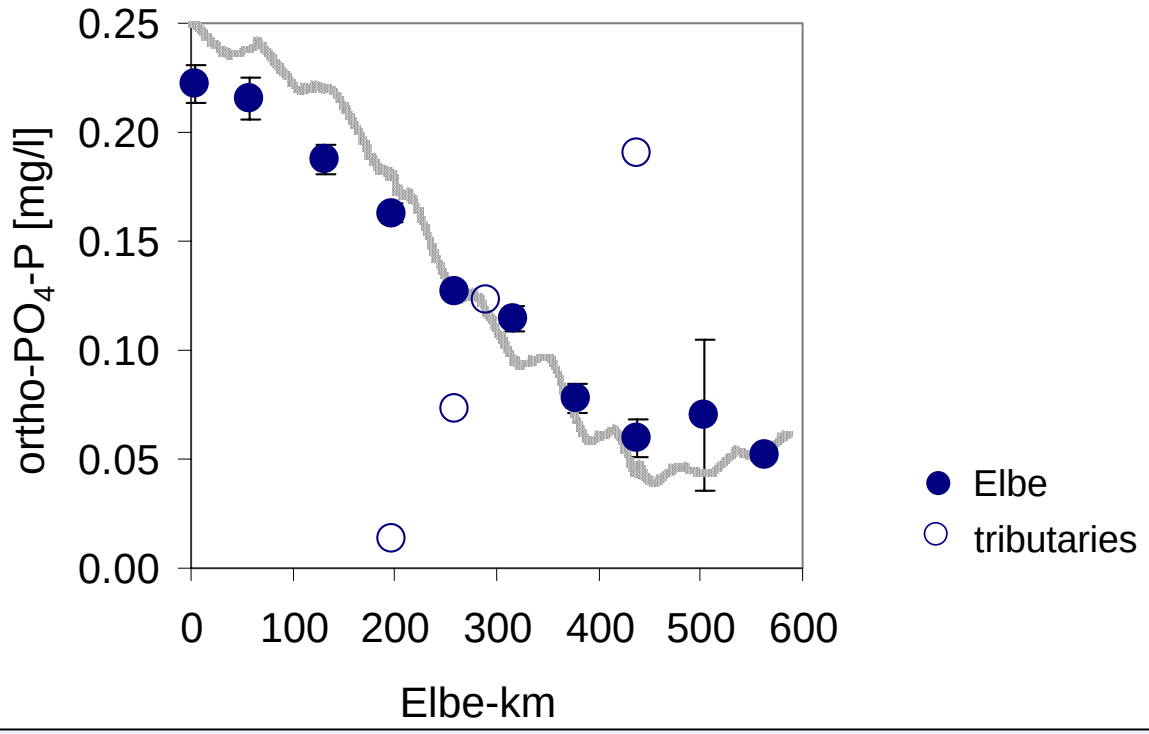
● Elbe

○ Tributaries

Results

Phosphate – measured and modelled data

Sommer 2000
26.6. – 5.7.
low discharge



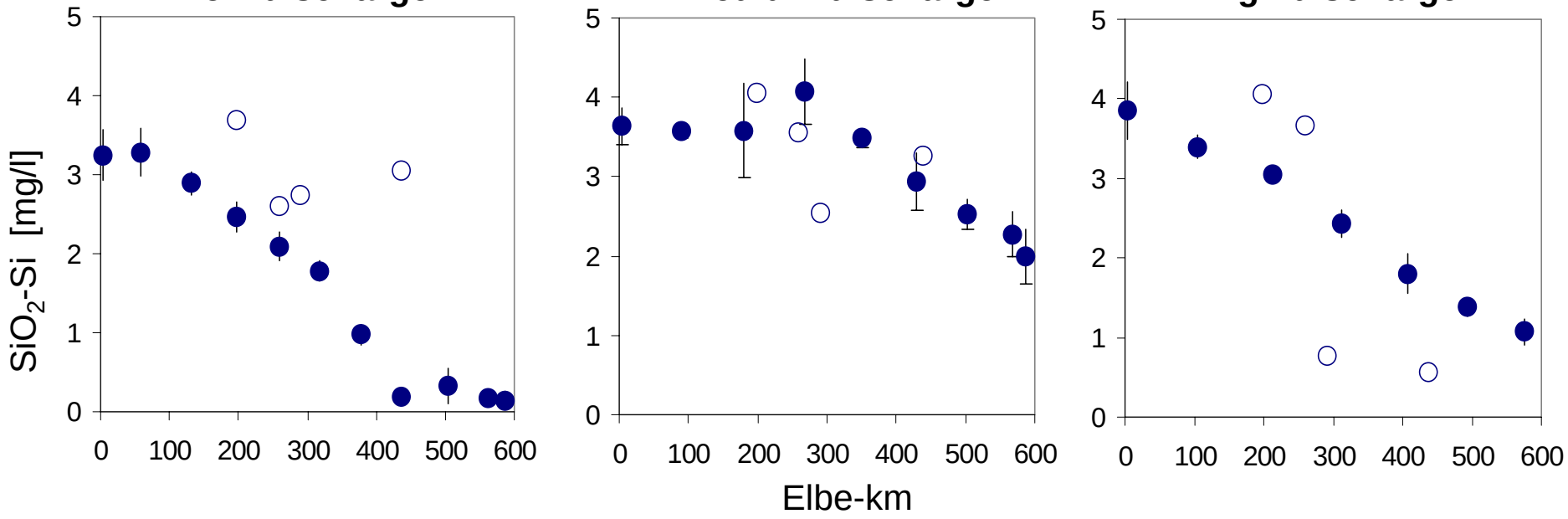
Results

Longitudinal sampling campaigns: **silica**

Summer 2000
26.6. – 5.7. (9 days)
low discharge

Summer 2005
24.7. – 1.8. (7 days)
medium discharge

Spring 2006
8.5. – 15.5. (6 days)
high discharge



n = 6

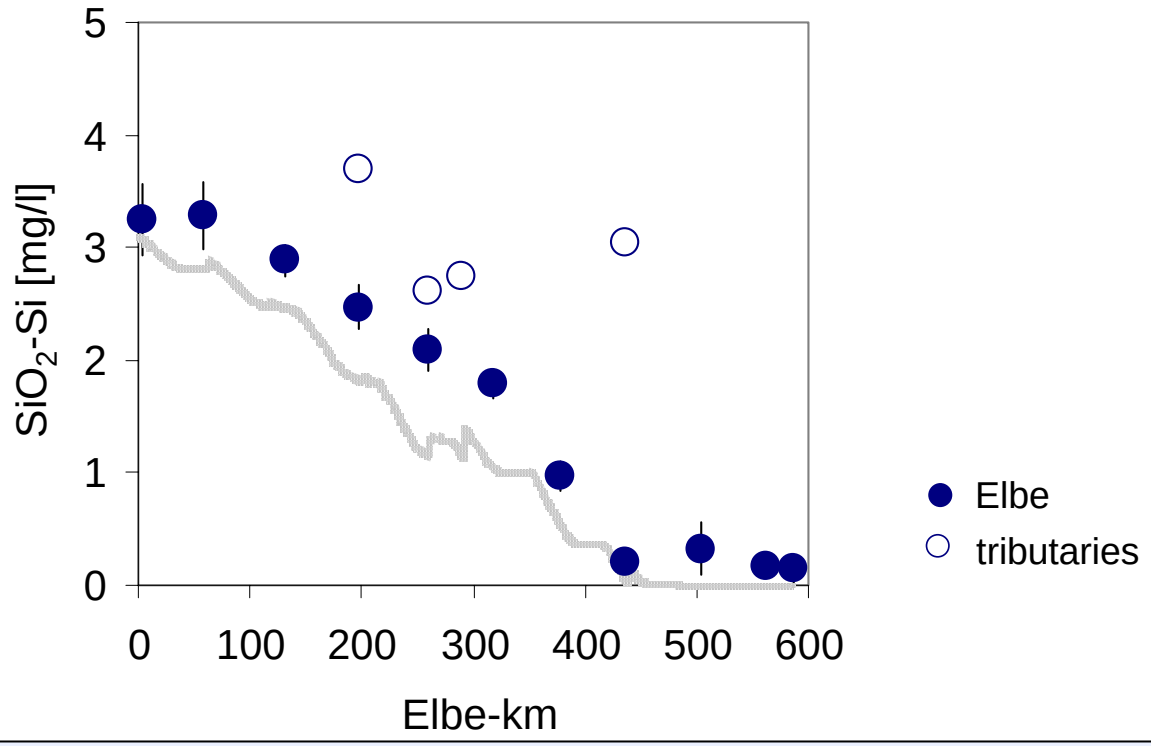
● Elbe

○ Tributaries

Results

Silica – measured and modelled data

Sommer 2000
26.6. – 5.7.
low discharge



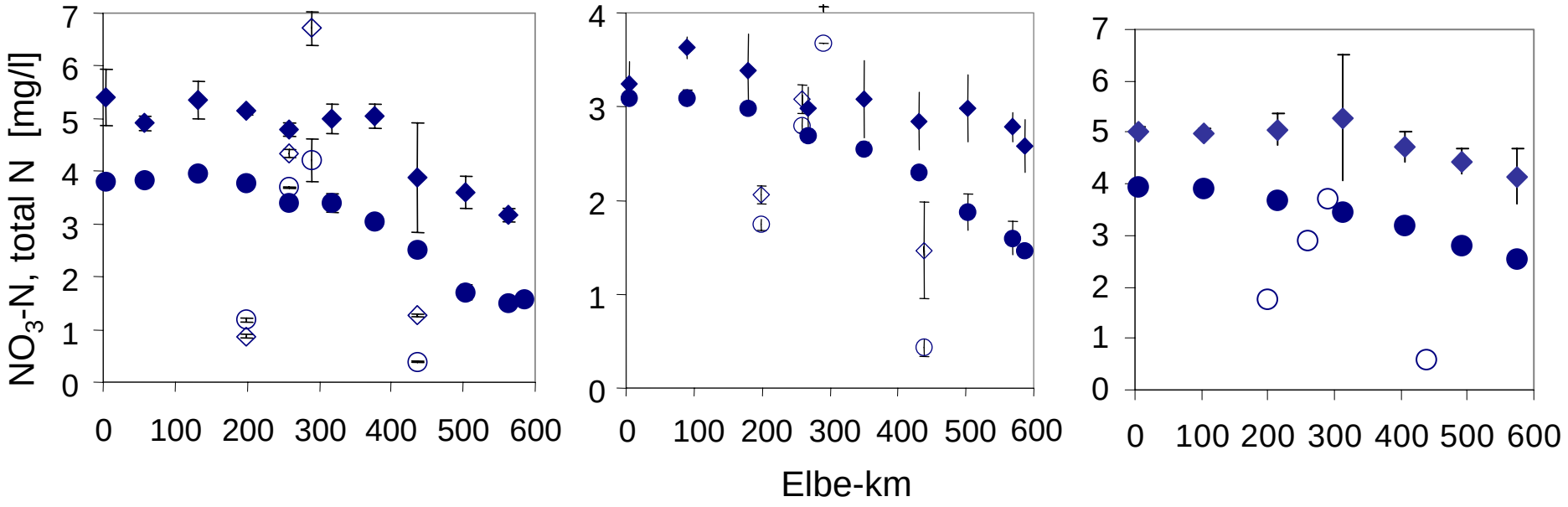
Results

Longitudinal sampling campaigns: **nitrogen (nitrate and total nitrogen)**

Summer 2000
26.6. – 5.7. (9 days)
low discharge

Summer 2005
24.7. – 1.8. (7 days)
medium discharge

Spring 2006
8.5. – 15.5. (6 days)
high discharge



n = 6

- ◆ Total-N
- ● NO_3-N

Elbe

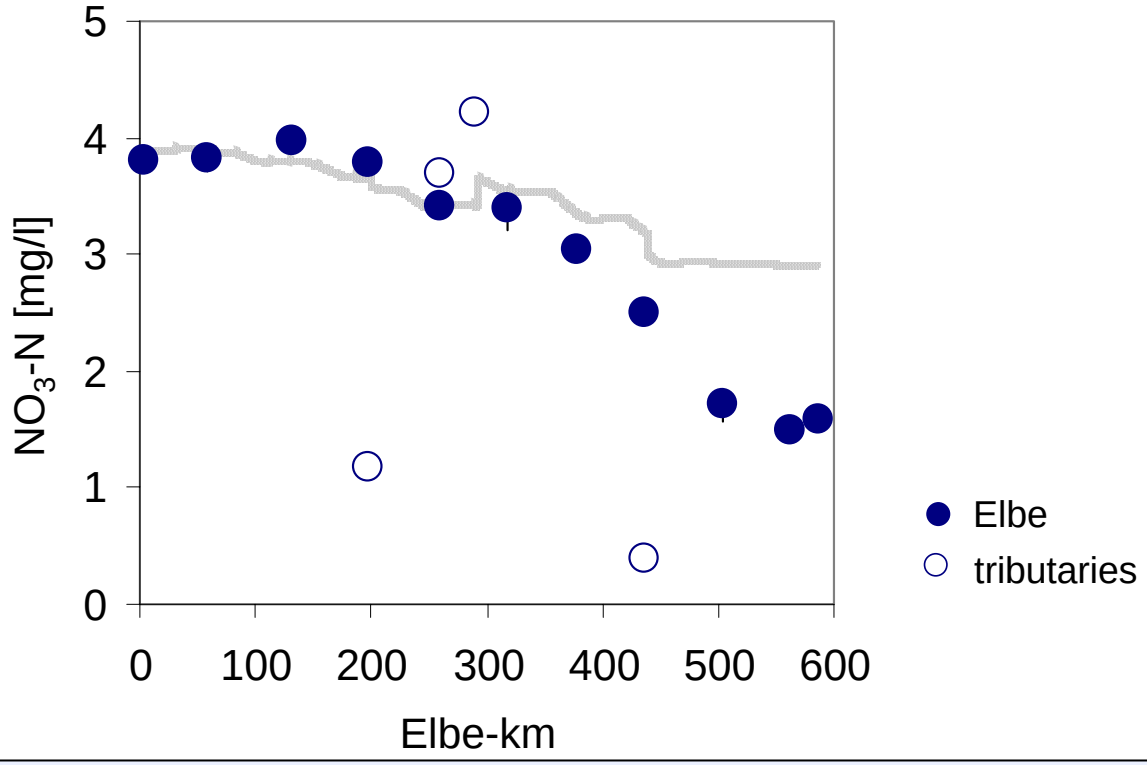
- ◇ Total-N
- ○ NO_3-N

Tributaries

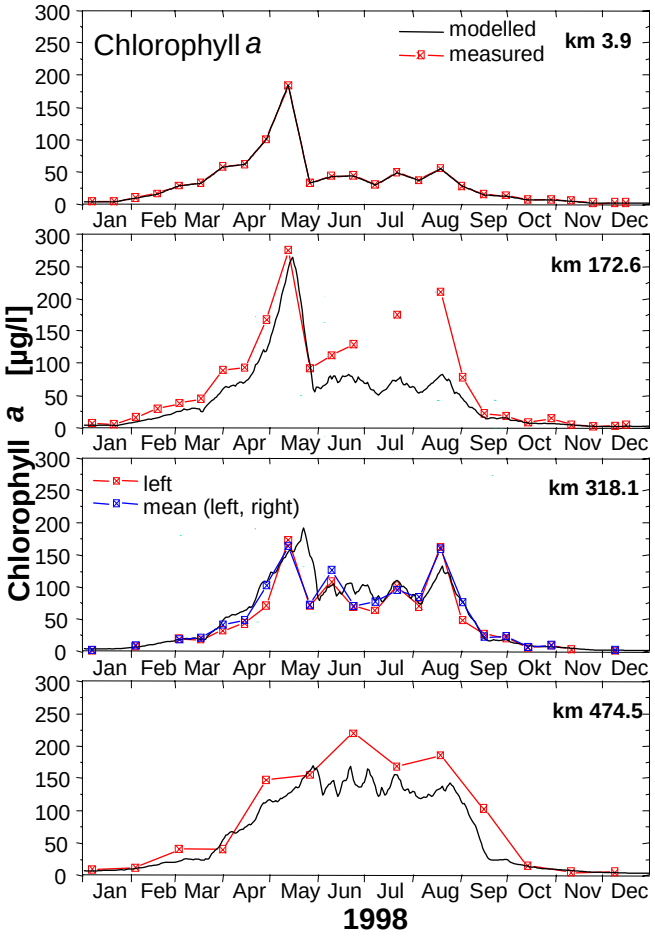
Results

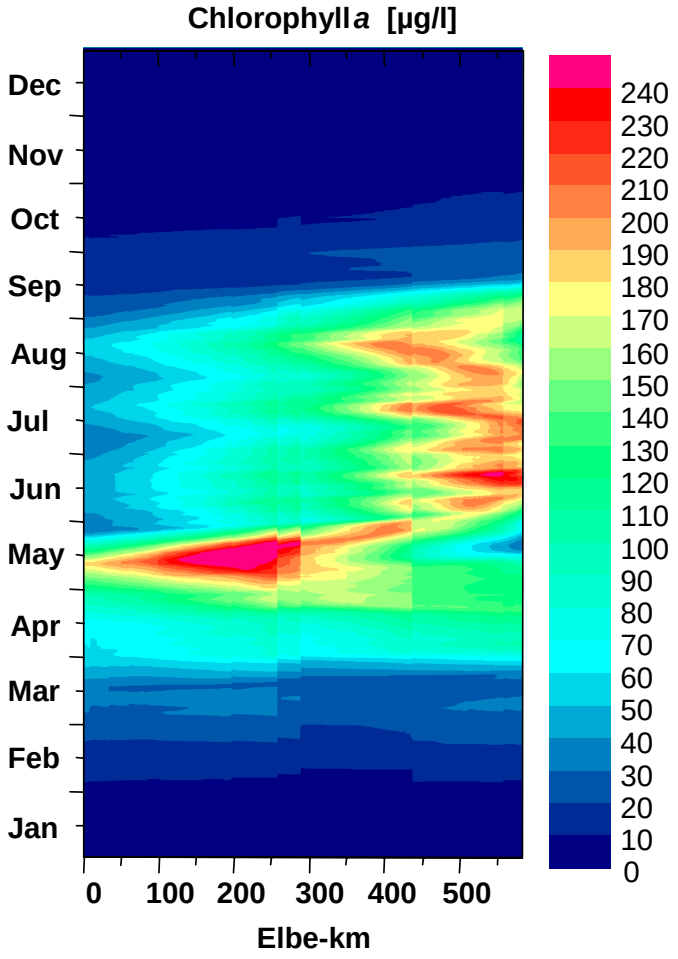
Nitrate – measured and modelled data

Sommer 2000
26.6. – 5.7.
low discharge



Chlorophyll *a* (1998)





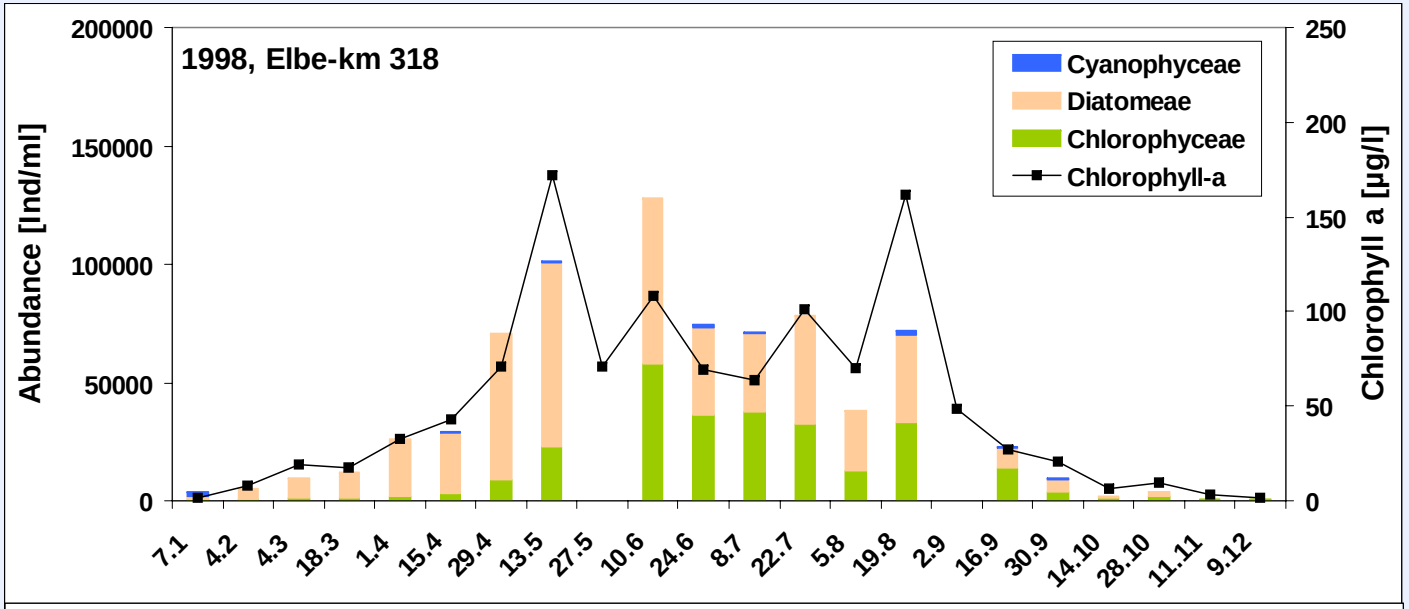
measured and modelled

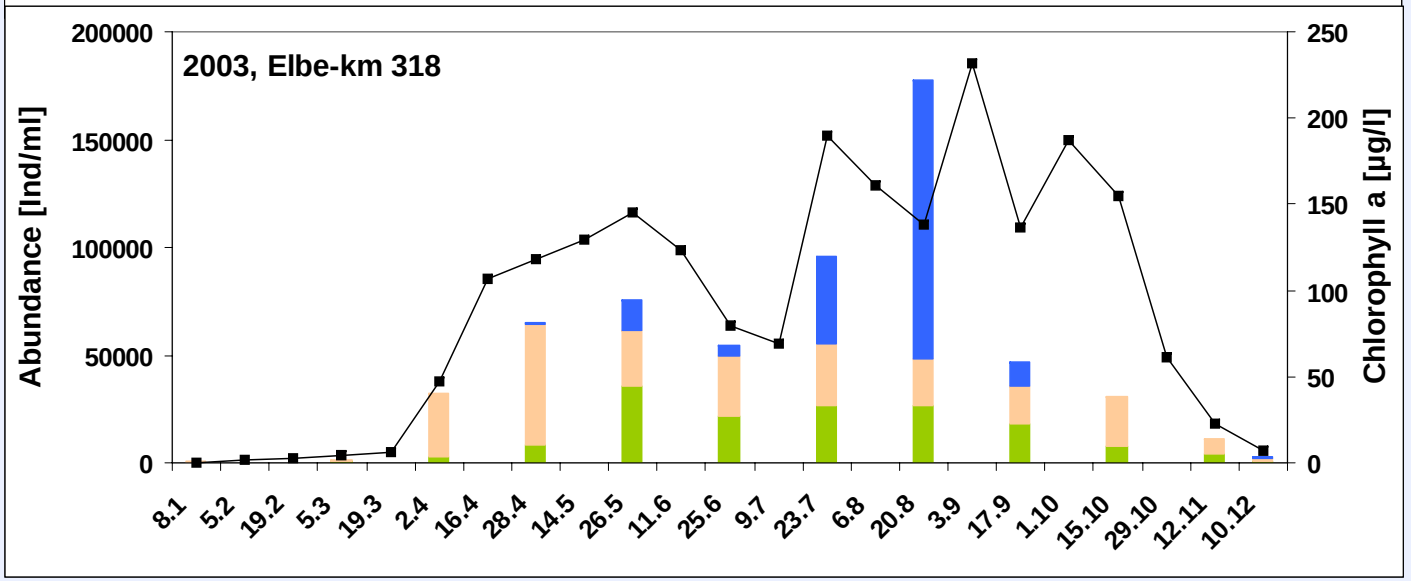
modelled

(Schöl et al. 2006; measured data by ARGE Elbe)

Results

Comparison of phytoplankton composition in the years 1998 and 2003



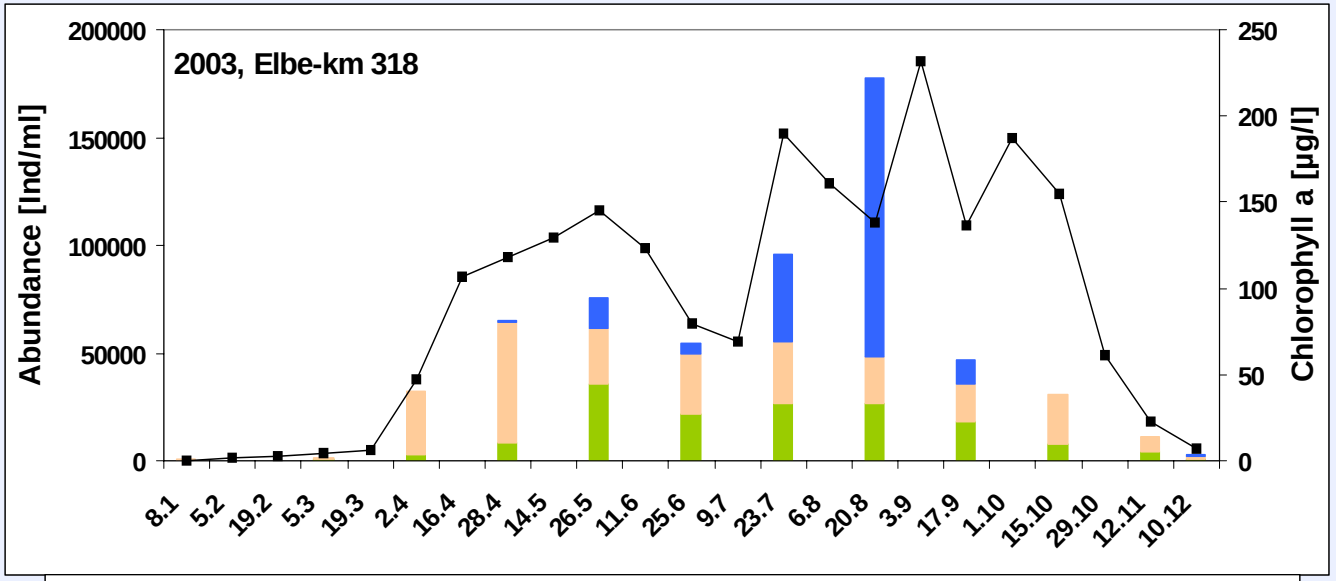


2003
a warm and dry summer

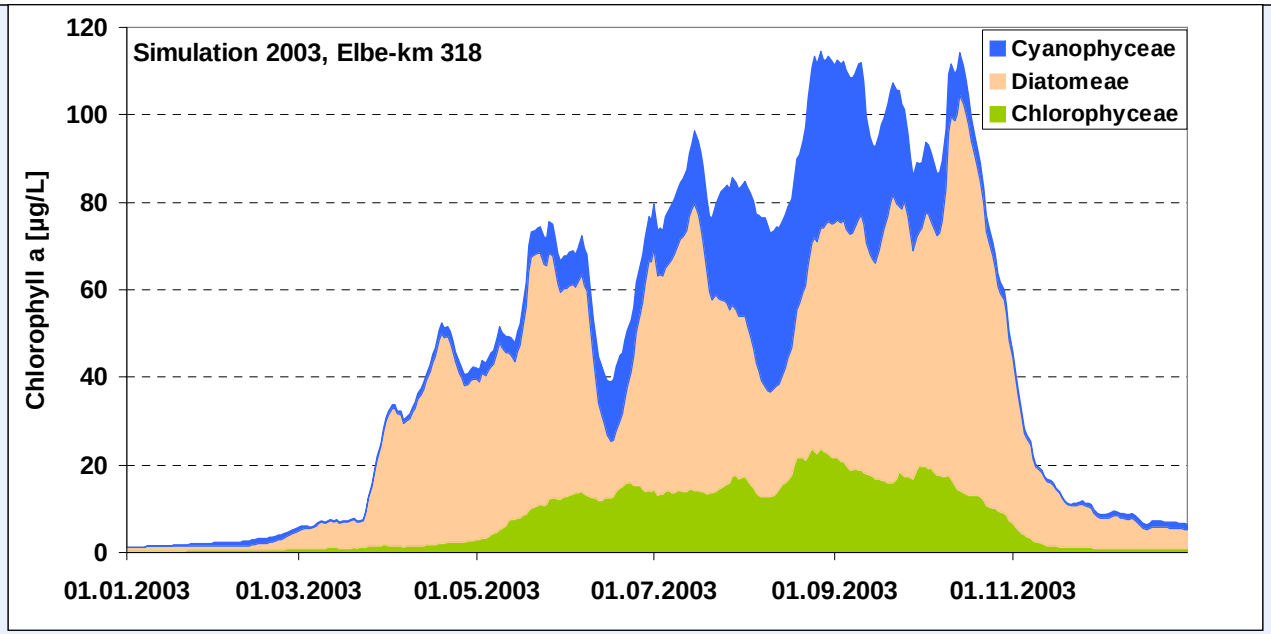
→ development of cyanobacteria

(data by ARGE Elbe)

2003
Measured
phytoplankton composition
(data ARGE Elbe)



2003
Modelled
phytoplankton composition



Results

In which direction will the system change if

- **temperature increases**
- **summer discharges decrease**

Model runs with database from years 1998 and 2003

Model results

→ **slightly more zooplankton**

→ **only minor change in algal biomass**

→ **change in phytoplankton composition**

(increase of cyanobacteria)

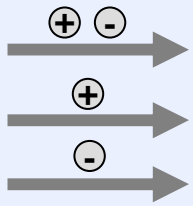
Conclusions and Outlook

Current state

- strong phytoplankton growth (factor ~4)
- intense turnover of nutrients (biologically controlled)
- heavy organic load („secondary pollution“) impairs the oxygen budget of the Elbe estuary
- high nutrient loads are problematic for coastal areas

Future state

- intensification of biological processes
- better growth conditions (light, temperature)
- stronger nutrient limitation is possible
- better conditions for cyanobacteria
- open system for invading species (e.g. mussels)



Phytoplankton development

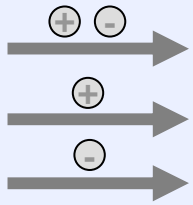
Conclusions and Outlook

Further work within GLOWA-Elbe II

- Modelling nutrient dynamics and phytoplankton growth in the Czech Elbe section (below Vltava/Moldau).
- Calculation of 5 climate scenarios x 4 socio-economic scenarios

Future state

- intensification of biological processes
- better growth conditions (light, temperature)
- stronger nutrient limitation is possible
- better conditions for cyanobacteria
- open system for invading species (e.g. mussels)



Phytoplankton development

Thank You

for your attention!

Longitudinal sampling campaigns: **(ortho-phosphate) and total phosphorus**

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low discharge

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24.7. – 1.8. (7 days)
medium discharge

Spring 2006
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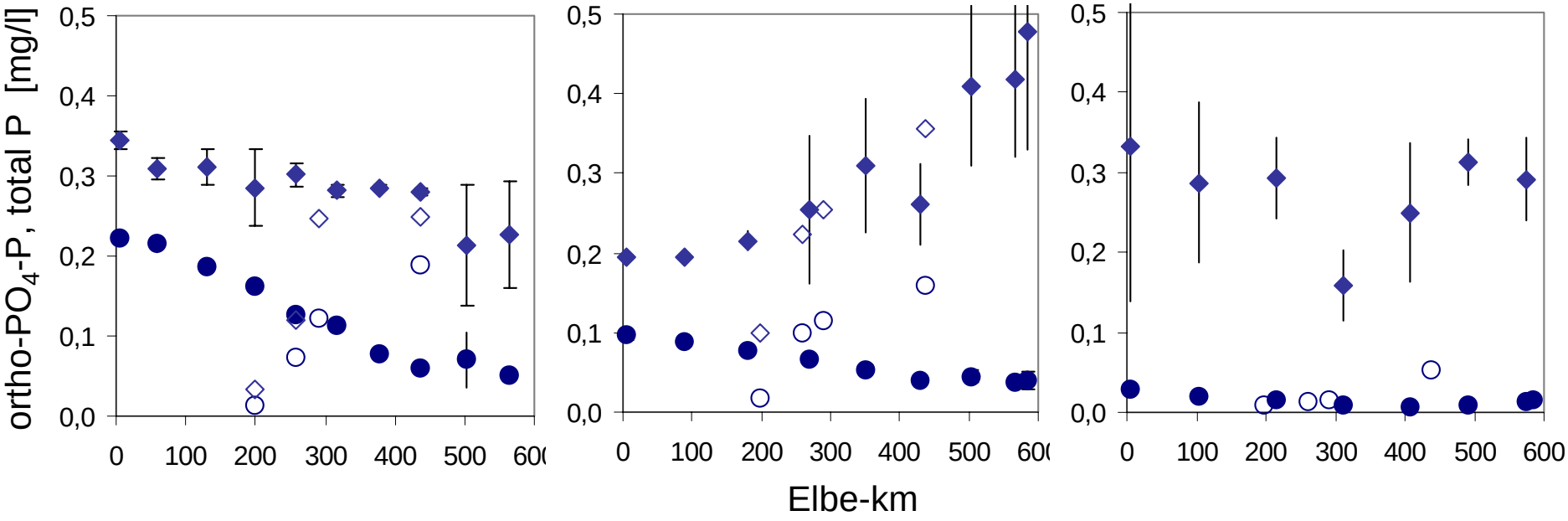
high discharge



n = 6
- ◆ Total-P
- ● ortho-PO_4-P

Elbe

- ◇ Total-P
- ○ ortho-PO_4-P

Tributaries