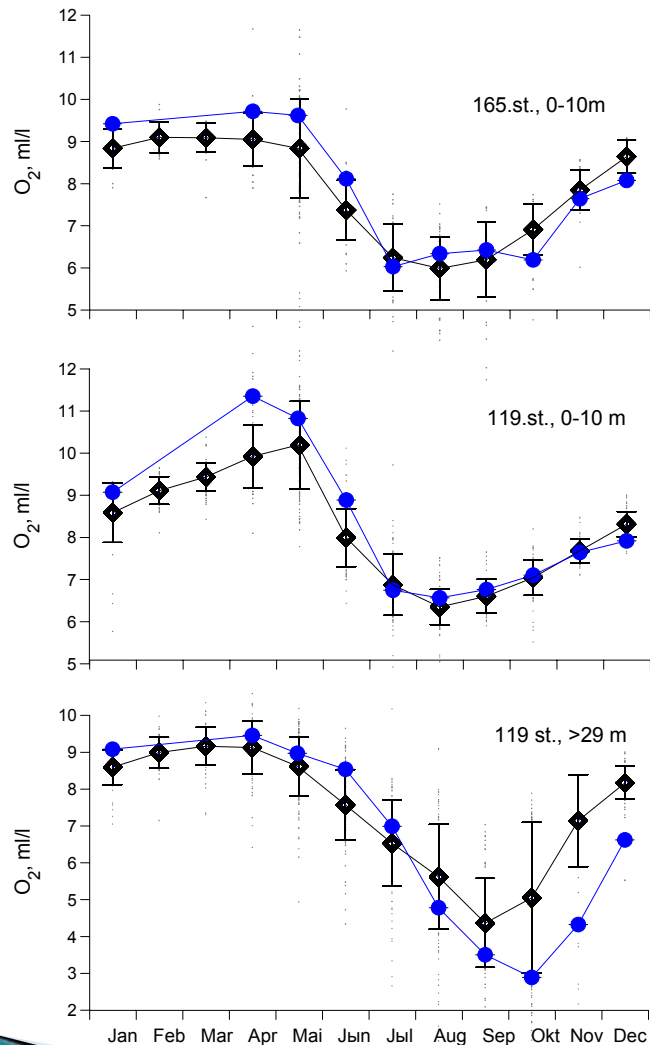


Progress report of SRP KALME (WP 5) for 2007

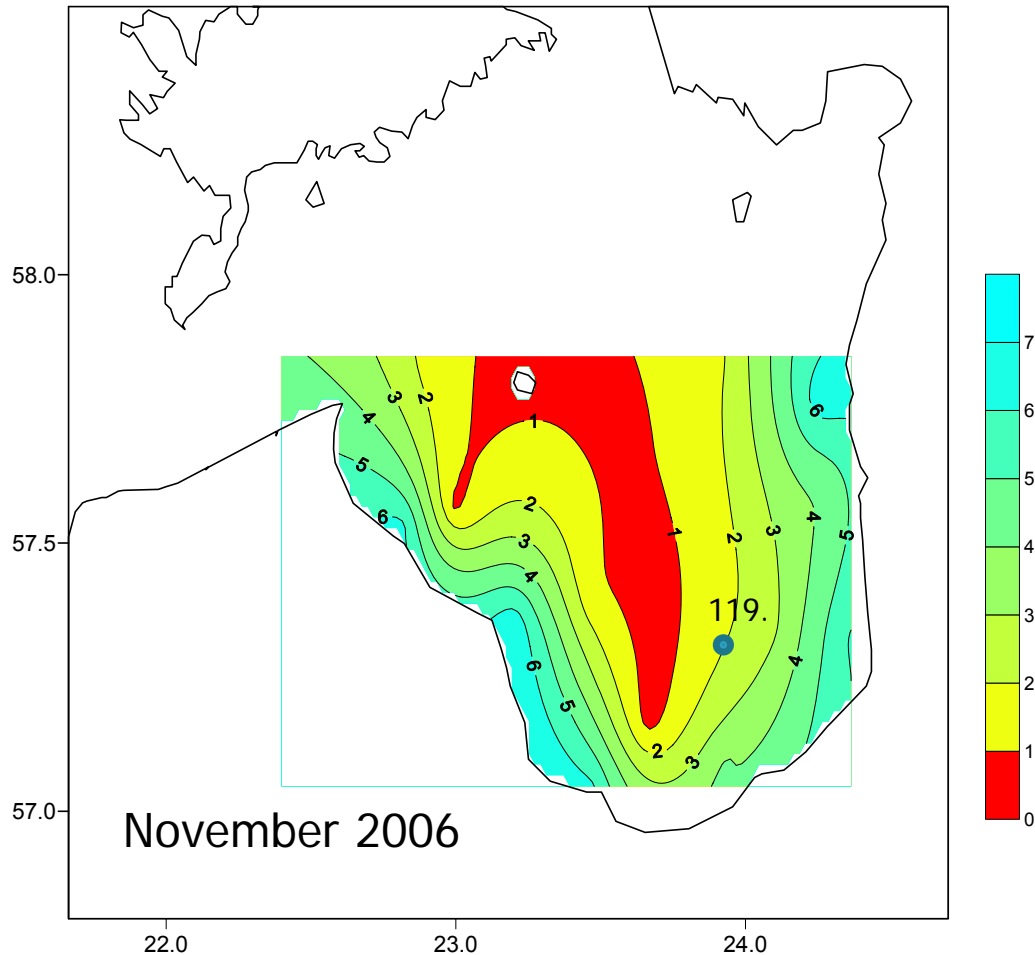
Juris Aigars, Bärbel Müller–Karulis, Mintauts
Jansons and team

WP 5 rationale



- ▶ It is quite unlikely that climate change will result in significant increase of Baltic sea temperature, but it might result in more frequent summers like summer of 2006, when warm and calm weather prevailed 1–2 months longer than on long term average.
- ▶ For such basins as the Gulf of Riga that means longer periods of seasonal stagnation

Result – a non-usual botom water oxygen conditions



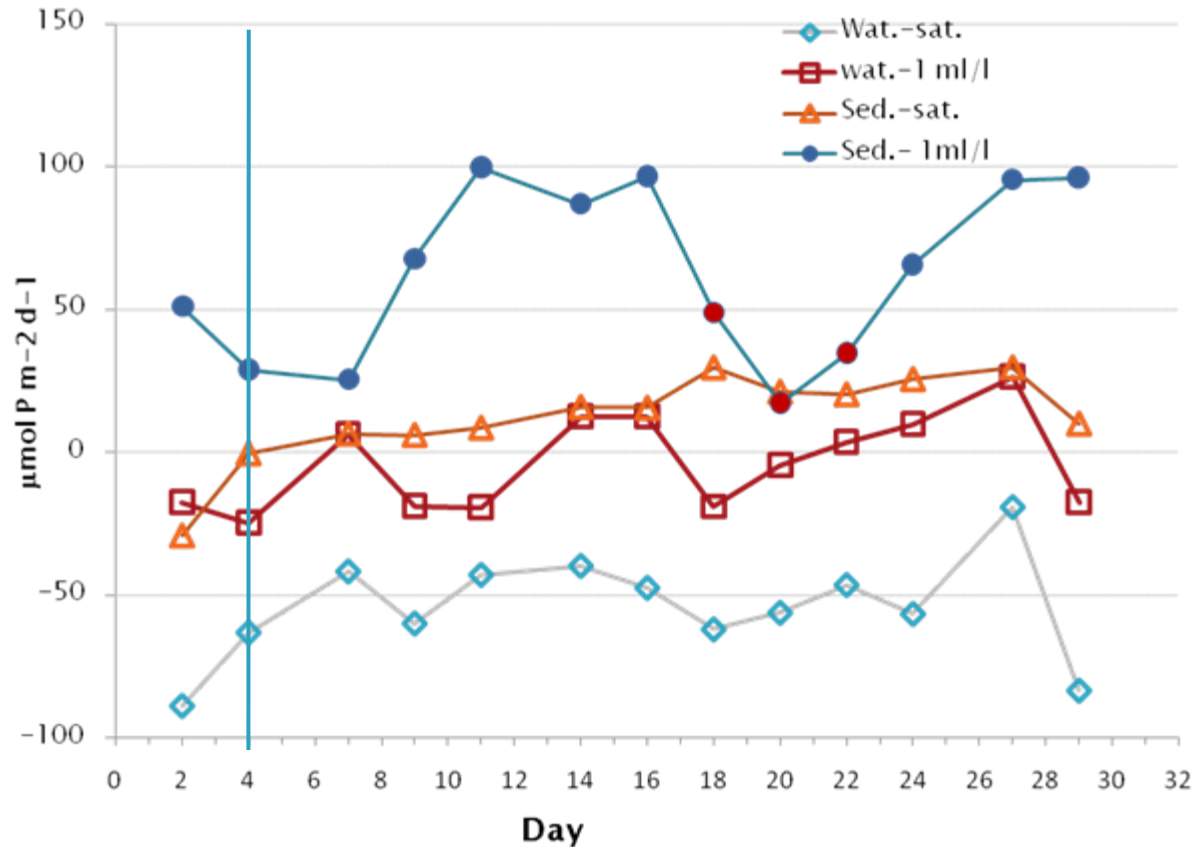
Eksperiments in frame of WP – 5a

- ▶ Although conditions of very low oxygen conditions have been observed in deep basin of the Gulf of Riga, the sediments overlying water has never been anoxic, therefore previous studies simulating anoxic conditions in Baltic are not applicable
- ▶ The WP–5a work task is to run several simulations of oxygen conditions range (nutrient flux experiments)
- ▶ It was planned to run two experiments during 2007, however, due to technical problems only one was performed, simulating 1 ml/l of oxygen concentration and temperature 4–5 °C in sediments overlying water

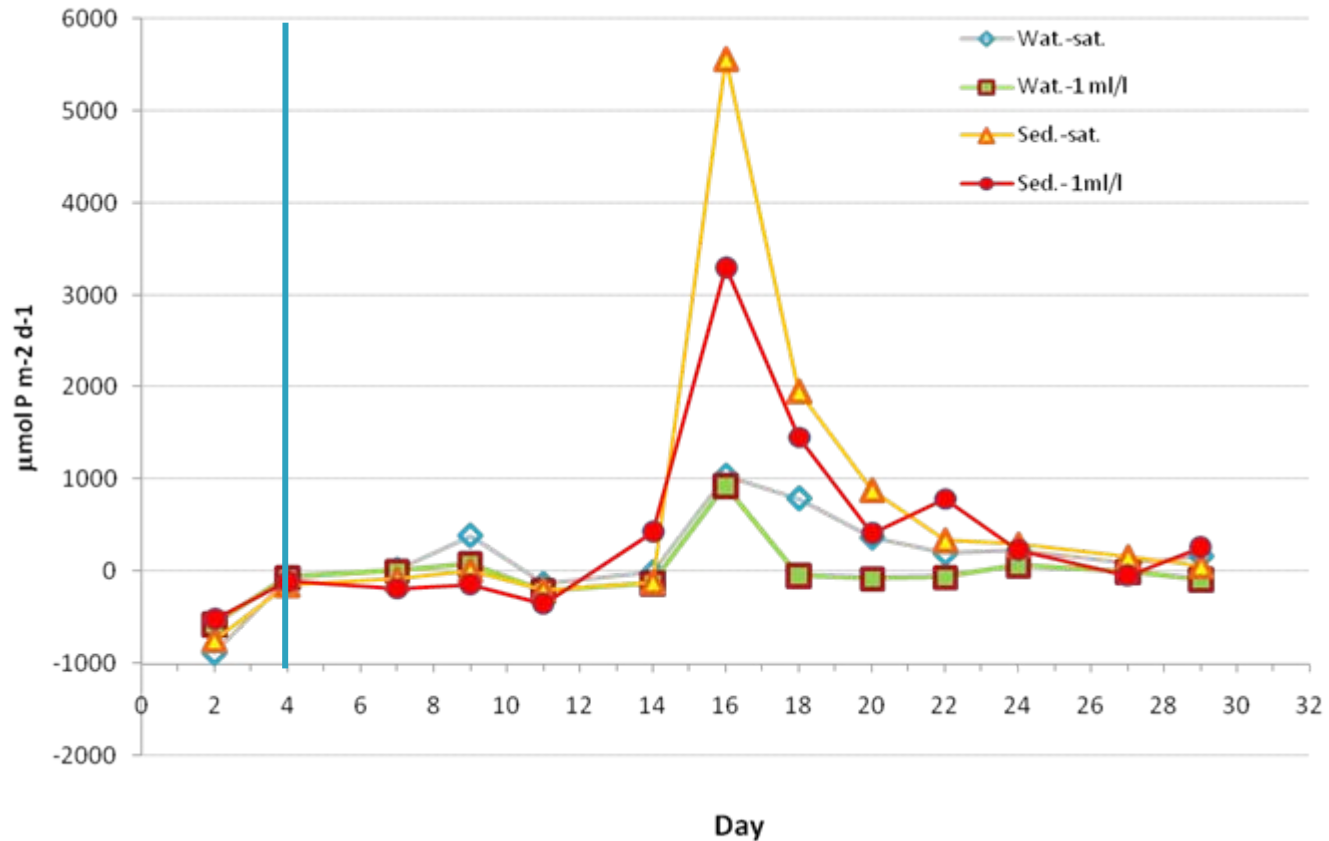
Experimental setup



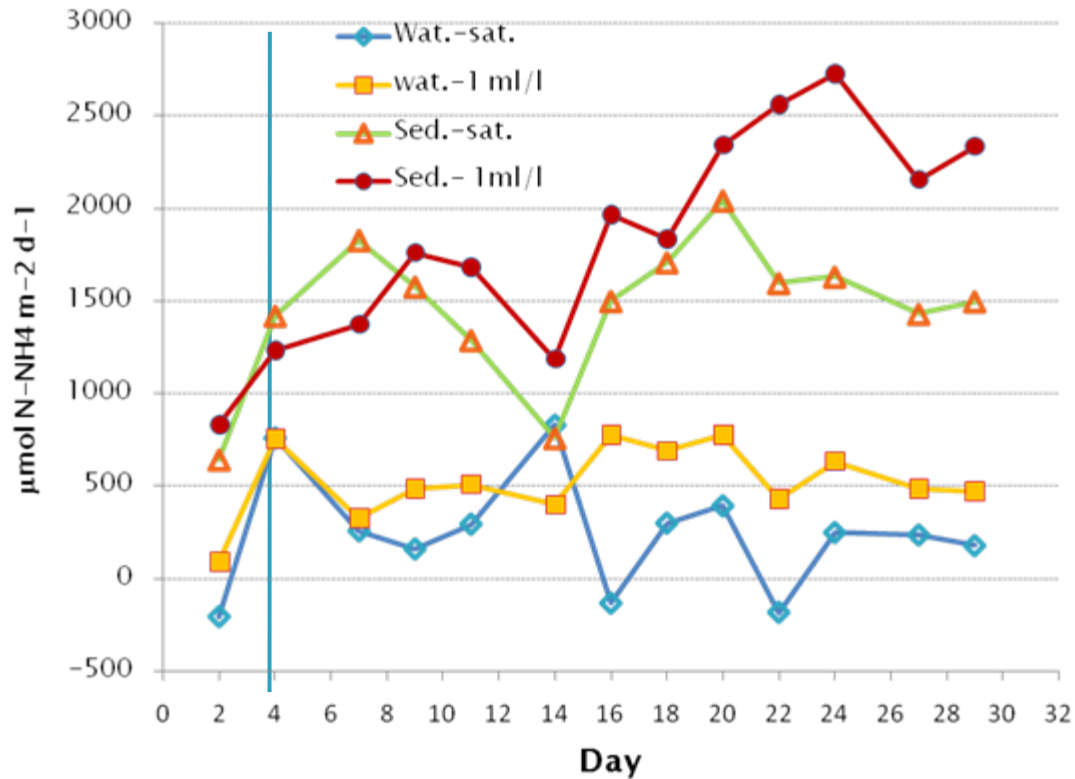
First results phosphorus



First results nitrate



First results ammonia



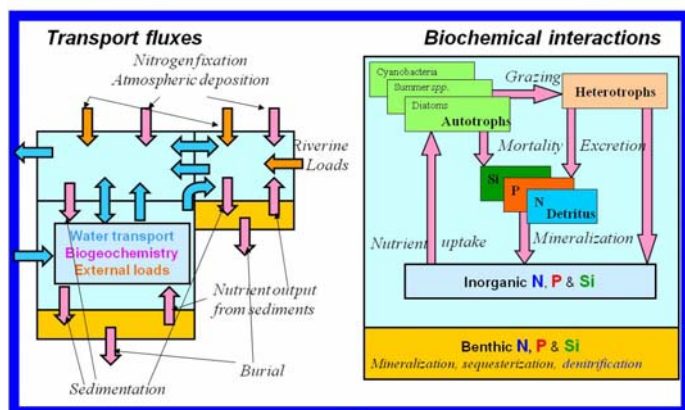
Some words about WP 5b



- ▶ Main task of DP 5b is deployment of sediment-multitrap and measurement of settling particle sedimentation rate
- ▶ To safeguard sediment-multitrap from unvelcome interventions from passers by we decided to deploy navigation buoy first to mark region and only then to deploy sediment trap
- ▶ The activity is delayed (multitrap is purchased, but navigation buoy so far is not).
- ▶ It is estimated that deployment will be done late May or early June.

Biogeochemical model -> start from long-term adaptation of Savchuk 2002

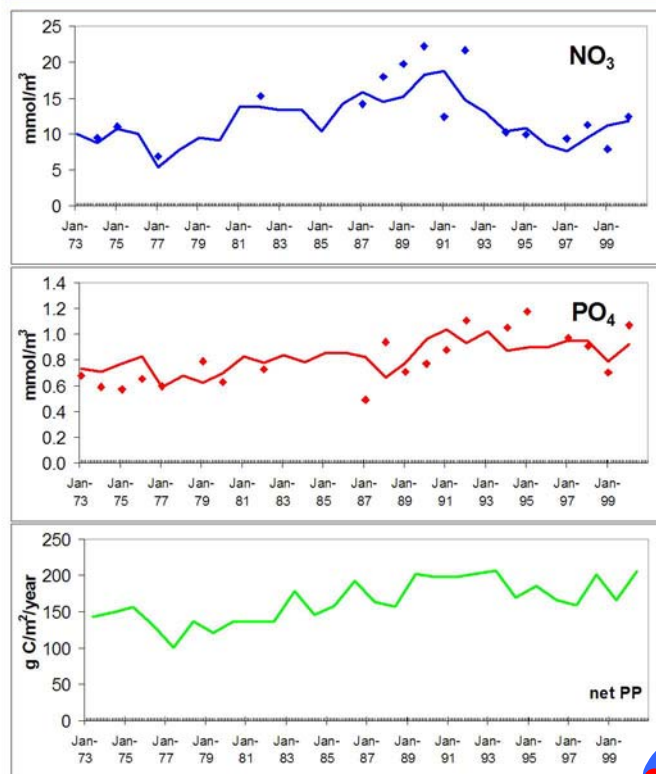
3-box model of the Gulf of Riga



1973 – 2000 Marine monitoring data
External N, P, Si inputs

Numerical routine (simulated annealing)
for parameter calibration

Simulated trends in winter nutrient concentrations and net primary production

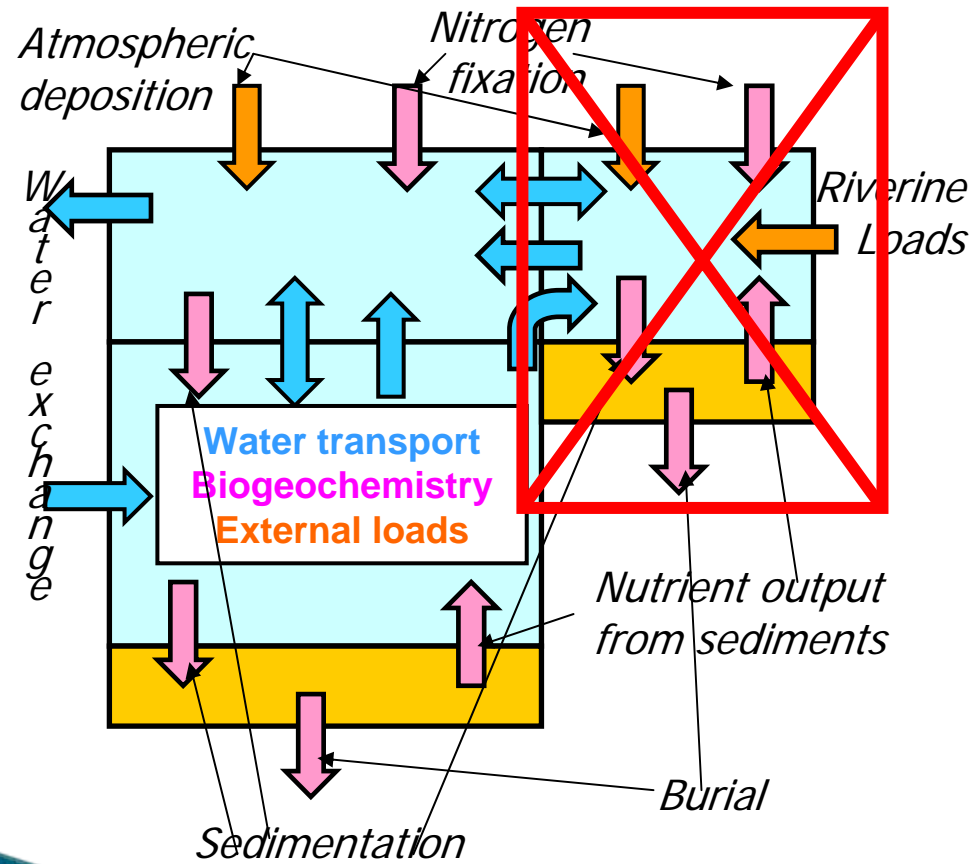


Model reformulation

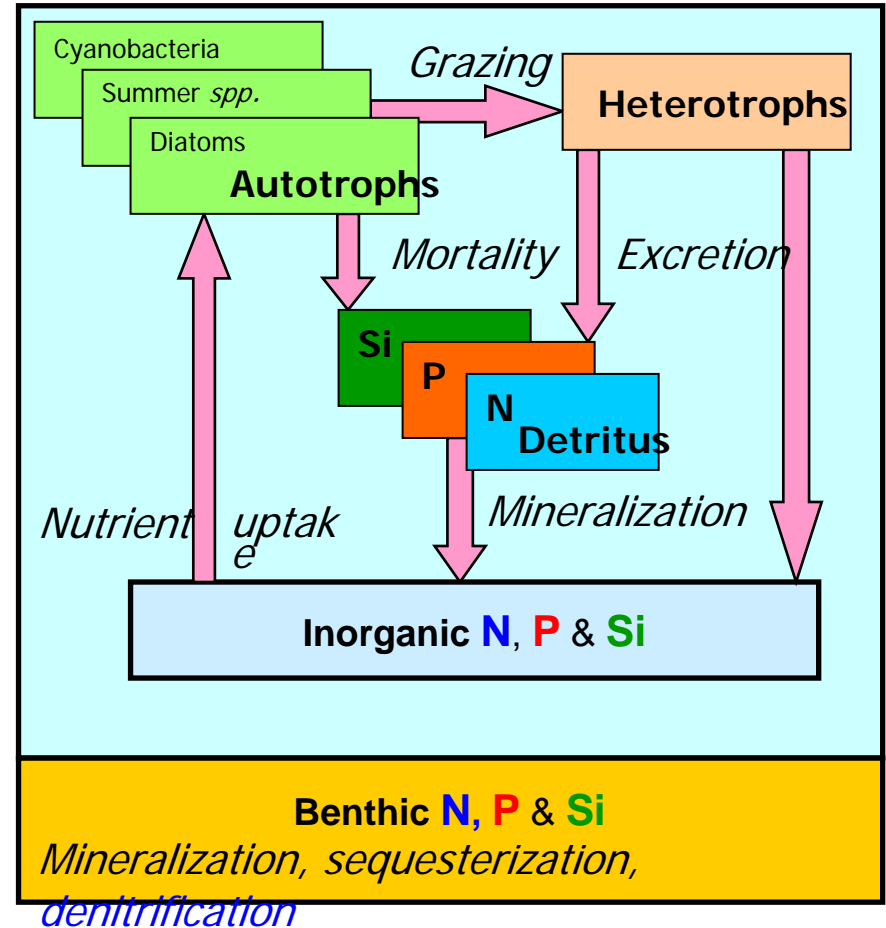
- ▶ Software update: biogeochemical model was coded with Visual Basic 6, which Microsoft will no longer support
- ▶ Upgrade to Vb.net 2008 → large changes in code structure (object oriented, arrays reference types)
- ▶ Change of model calibration algorithm (simulated annealing, Wah et al. 2007) → larger degree of randomness in parameter search
- ▶ Removal of overparameterized processes, model simplification
 - Two box structure, Si excluded
 - Modified phytoplankton description, better coexistence of phytoplankton groups, especially for cyanobacteria
 - Sediment biogeochemistry optimized for box model structure (optimized for relatively high average oxygen content in demersal model box)
 - Explicit temperature dependence of rates limited to heterotroph organisms

Model formulations

Transport fluxes

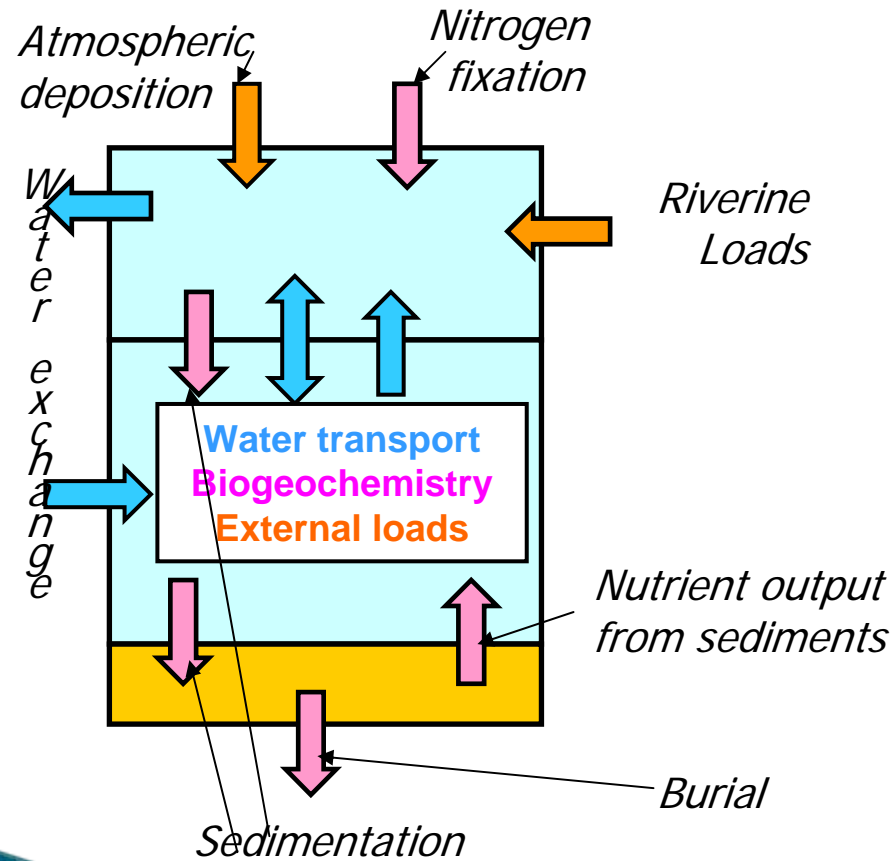


Biochemical interactions

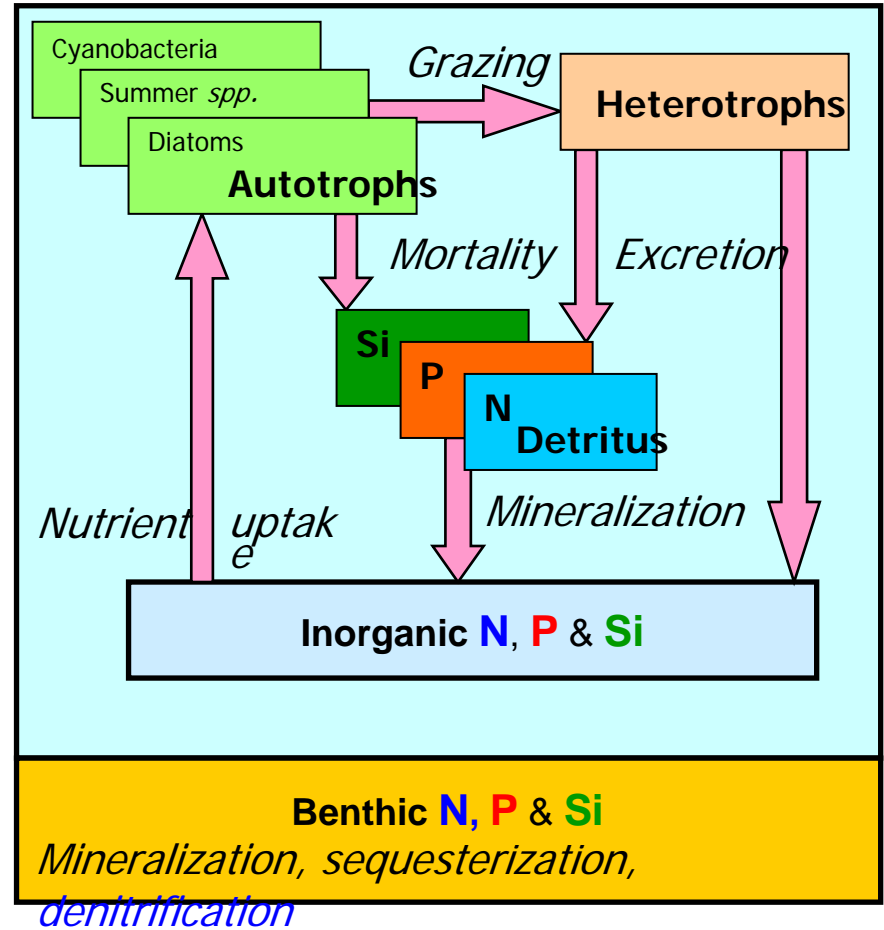


Model formulations

Transport fluxes

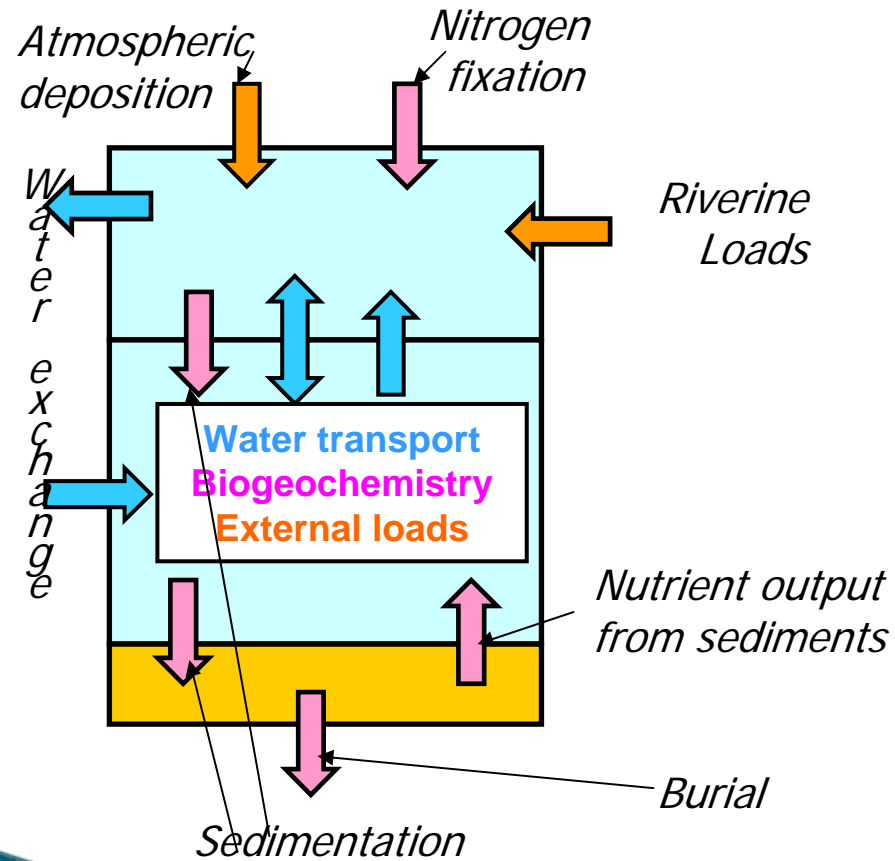


Biochemical interactions

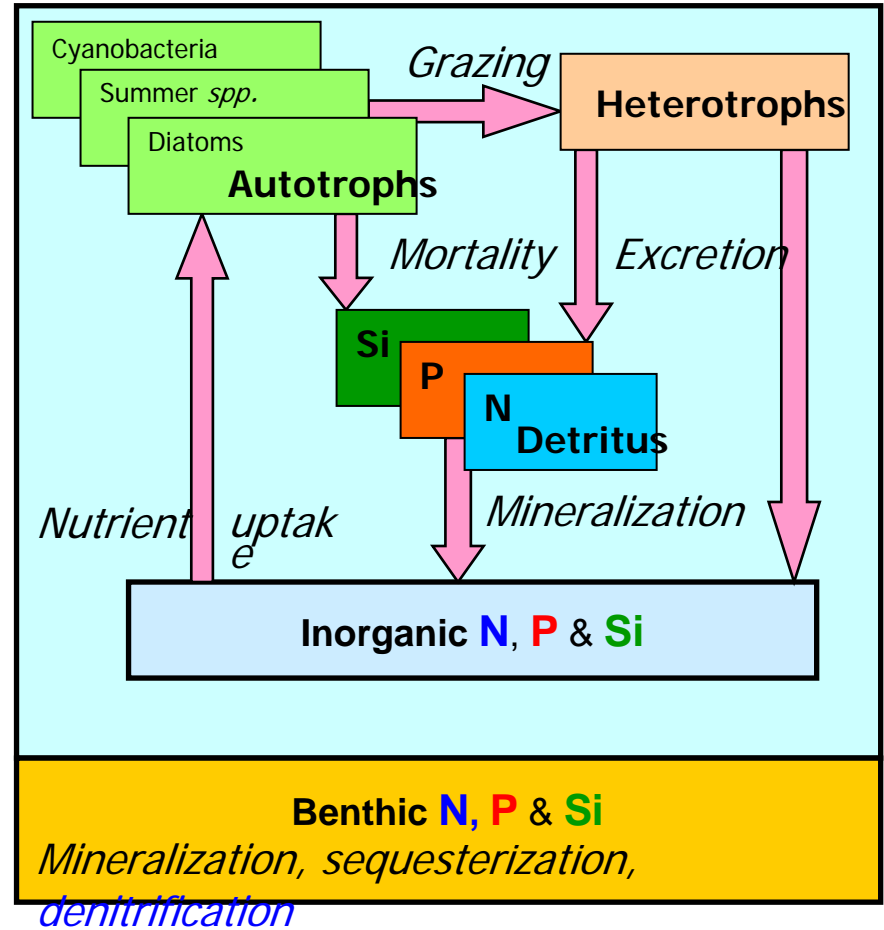


Model formulations

Transport fluxes

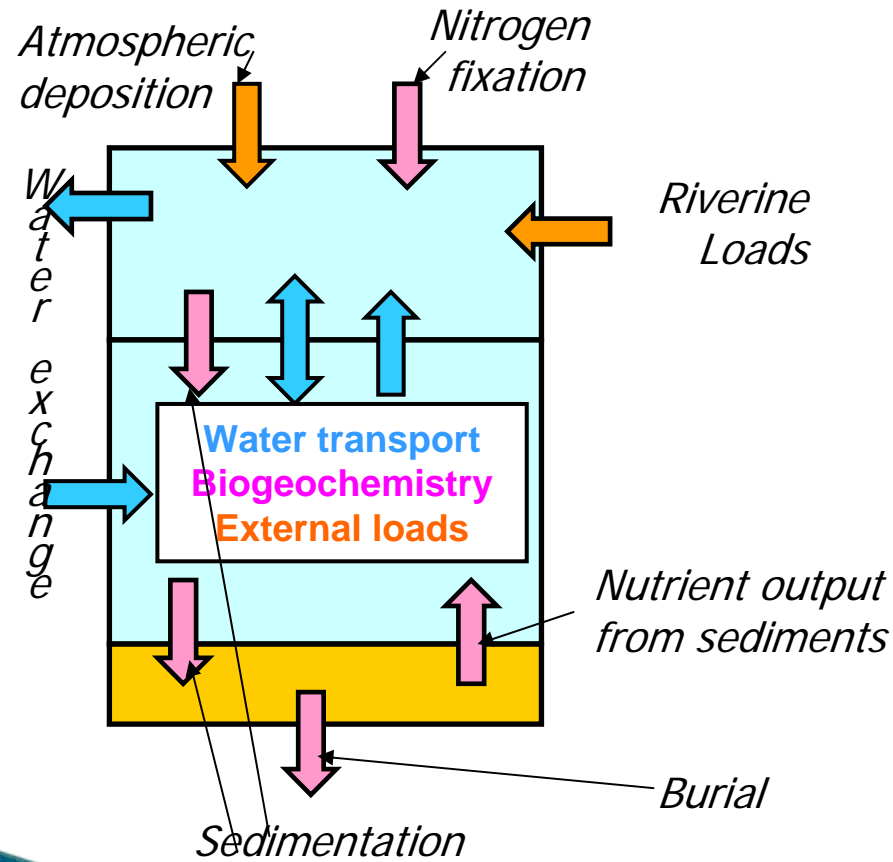


Biochemical interactions

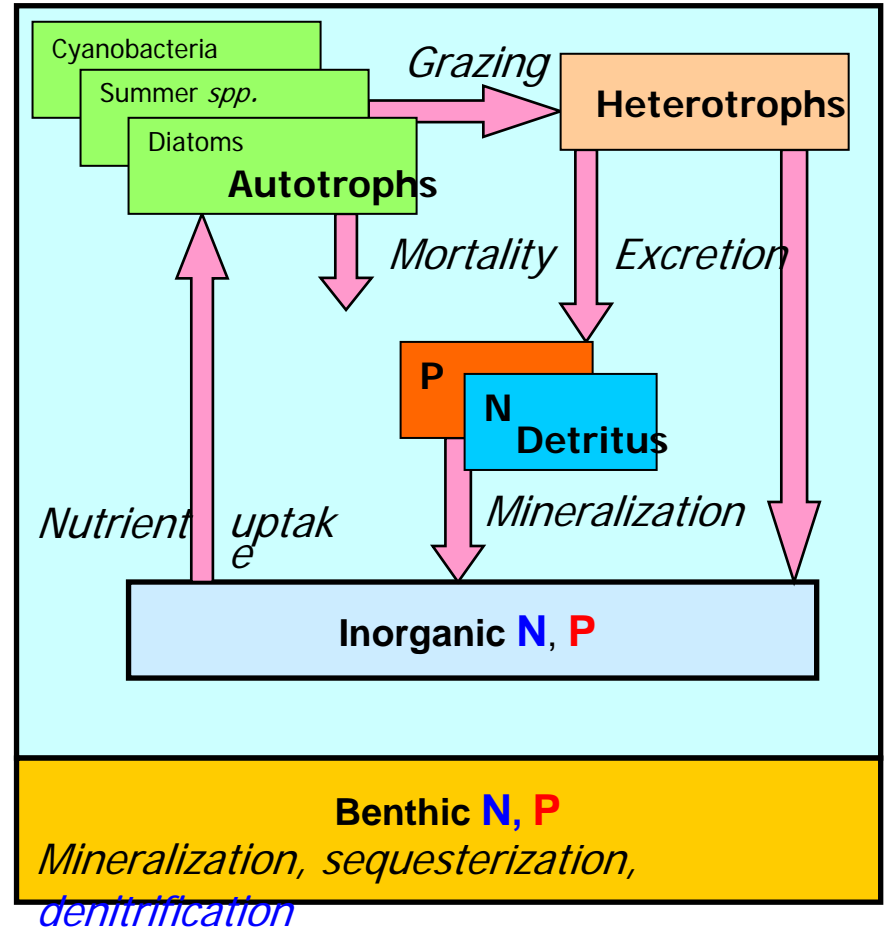


Model formulations

Transport fluxes

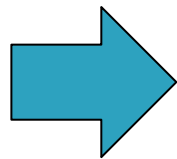


Biochemical interactions

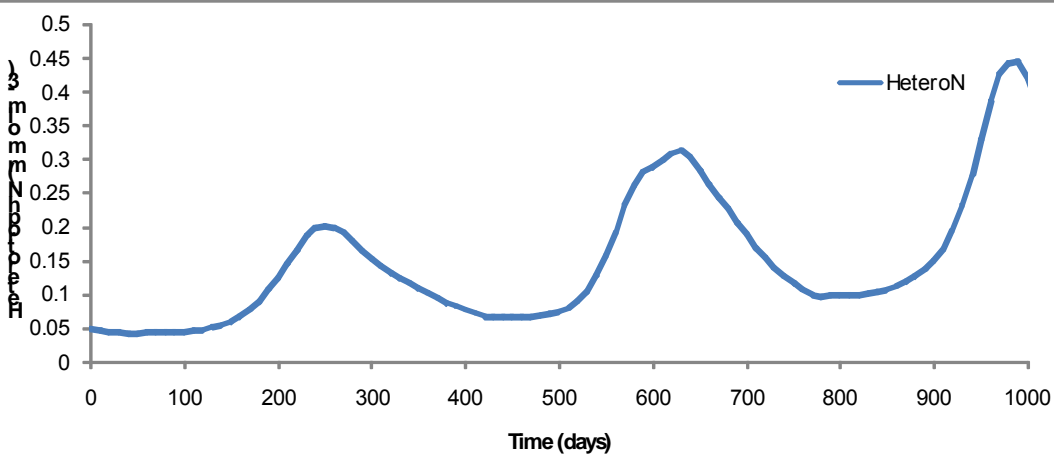
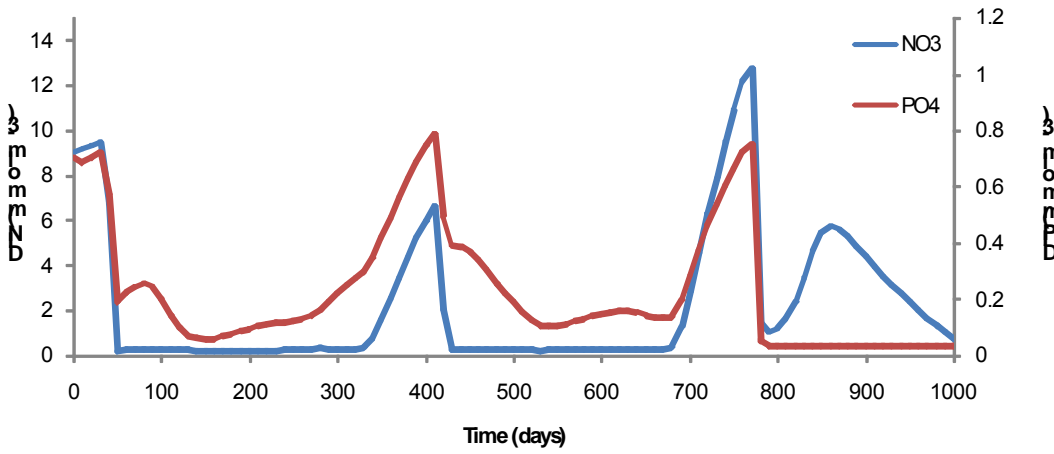
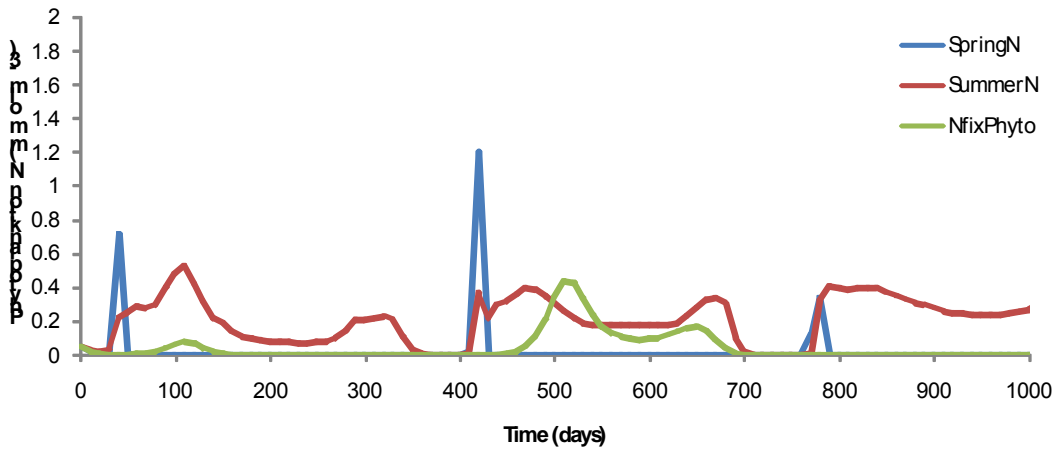


Reformulated box-model performance

- ▶ Model conserves mass for N and P
- ▶ Depicts reasonable seasonal dynamics of nutrients and biota
- ▶ Demersal nutrient and oxygen concentrations within plausible range



Reformulation and recoding successful



Performance examples:

- Phytoplankton

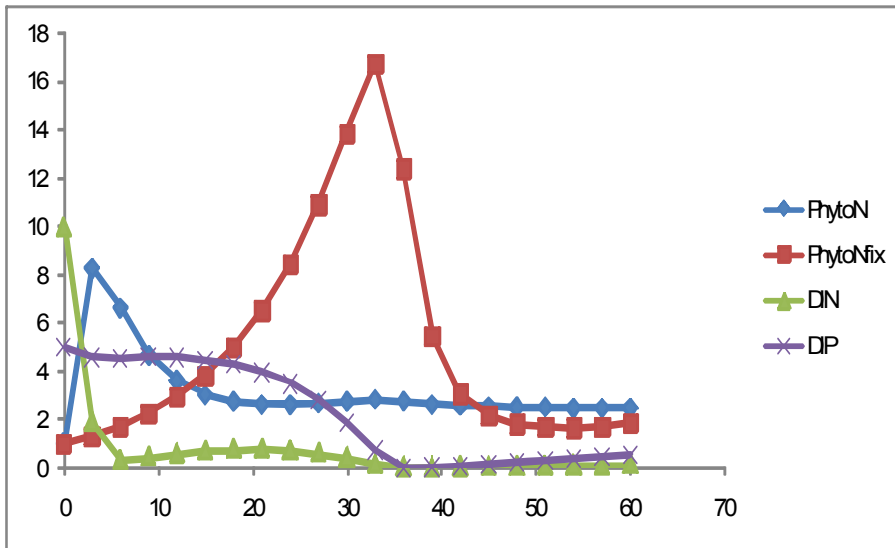
- Nutrients

- Heterotrophs

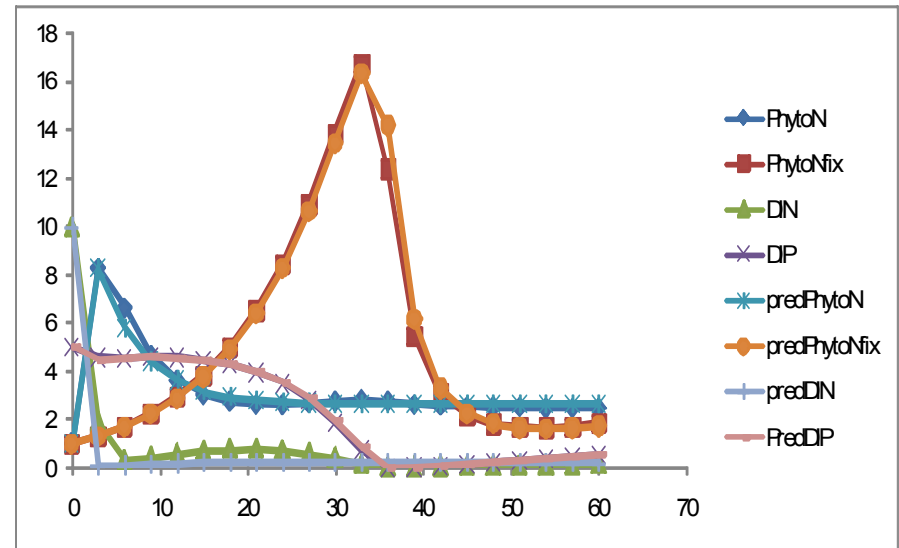


Calibration algorithm test

▶ Test data



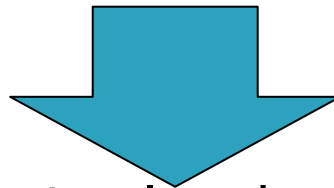
▶ Performance



-> simultaneous calibration of 7 growth parameters, good data fit -> calibration algorithm useful

Calibration of long-term biogeochemical dynamics

- ▶ Forcing data riverine, direct + atmospheric nutrient inputs, exchange with Baltic Proper, solar radiation, wind
- ▶ Calibration data
Nutrient, oxygen, phytoplankton and zooplankton concentrations
- ▶ Time-period included 1973 – 2000, data also available for 2001 – 2003 (planned verification period)
- ▶ 37 model parameters
- ▶ Initial parameter set simulating reasonable seasonal dynamics of nutrients and biota and plausible long-term dynamics



model calibration by simulated annealing (ongoing)

Plans for 2008

- ▶ Continue with experimental work. It is planned to conduct four experiment runs with varying oxygen conditions
 - ▶ Continue with modelling
 - ▶ Deploy navigation buoy in the Gulf of Riga and start sedimentation measurements
- 