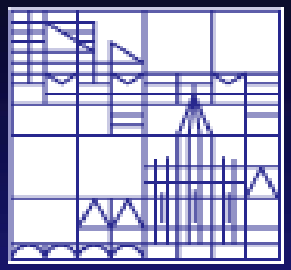

Frank Peeters & Dietmar Straile

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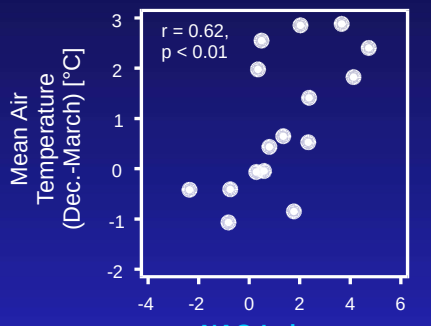
MOPPS

Modelling the impact of changes in the **p**hysical environment on **p**lankton **s**uccession with special emphasis on *Daphnia*-algae interactions

Influence of climate variability on plankton interactions



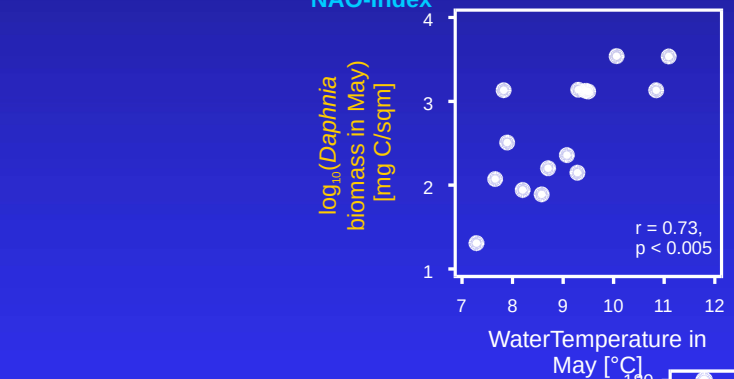
NAO

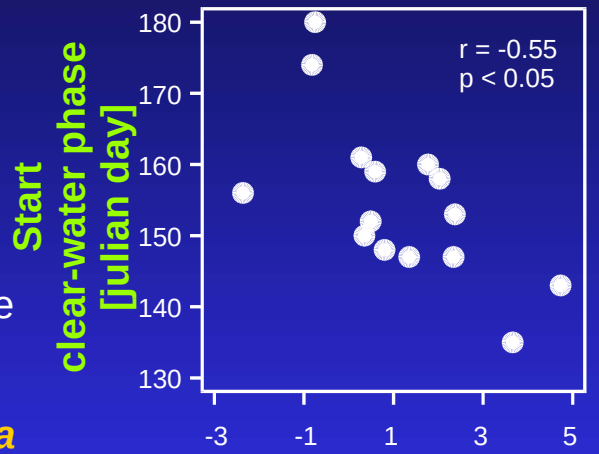
Local Meteorology

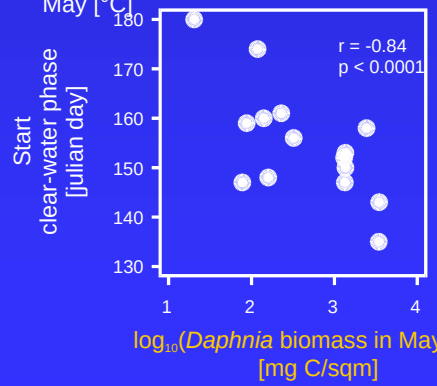
Water Temperature

Daphnia growth and biomass

Daphnia grazing



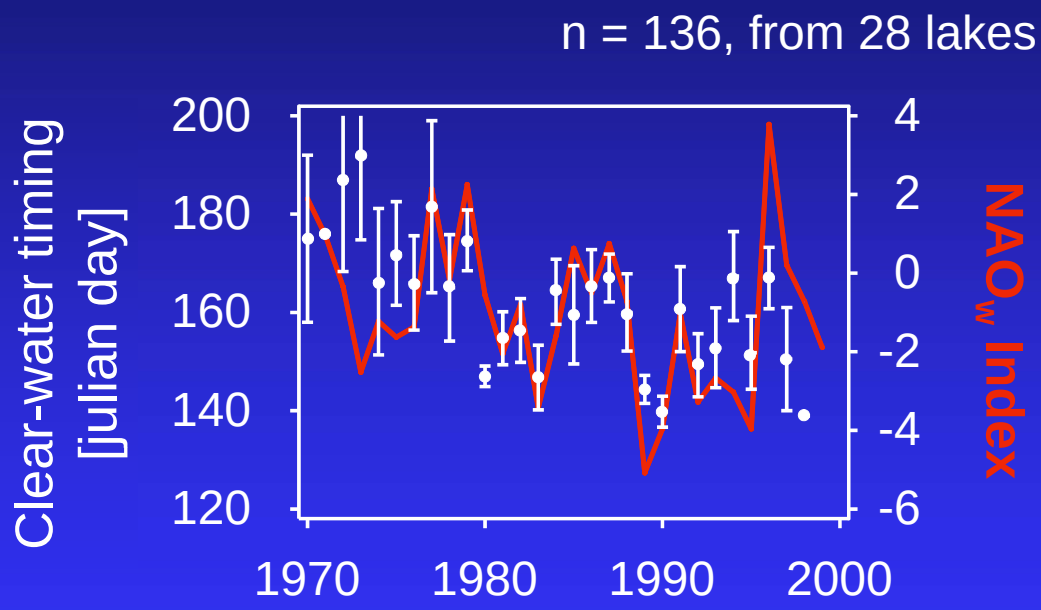




Timing of the clear-water phase

Straile et al. (2003)

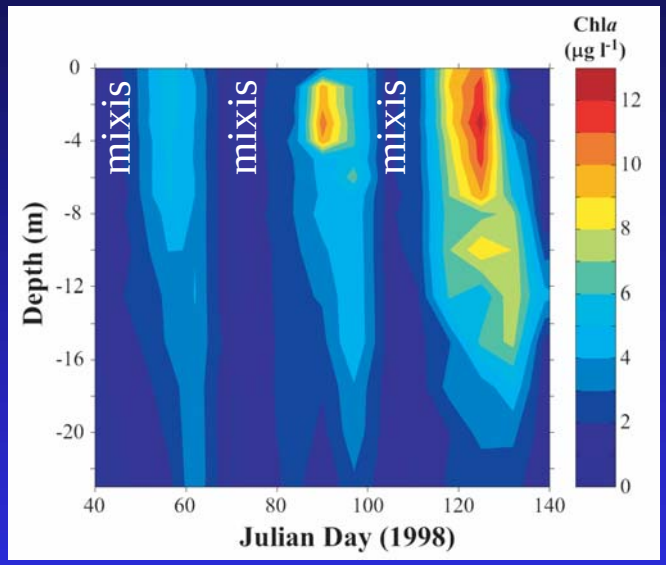
Clear-water timing in Central European lakes



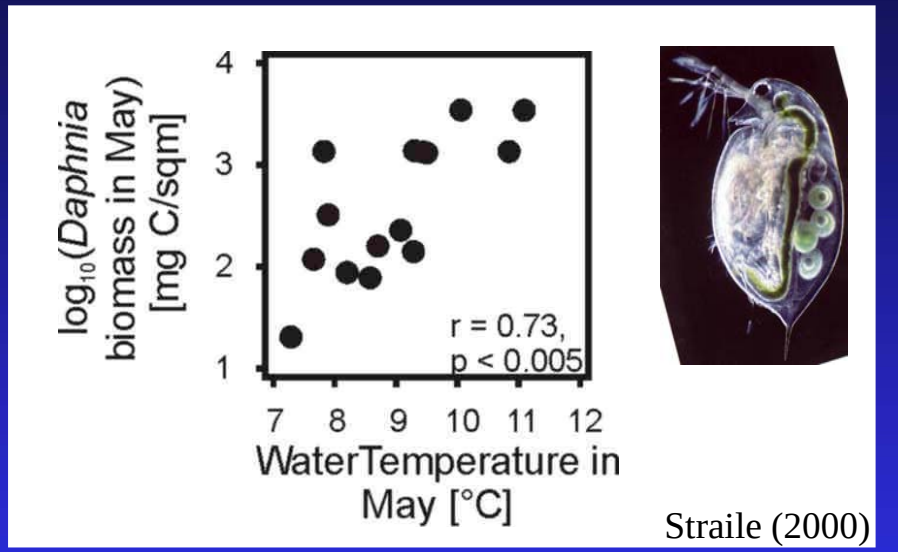
Straile (2002)

Impact of climatic change

Phytoplankton growth in spring
sensitive to light (mixing) conditions



***Daphnia* growth**
sensitive to water temperature



Straile (2000)

Anticipated effect of climatic warming for deep monimictic lakes in spring

light conditions (mixing) remain unchanged

water temperatures increase

algae growth rate unchanged

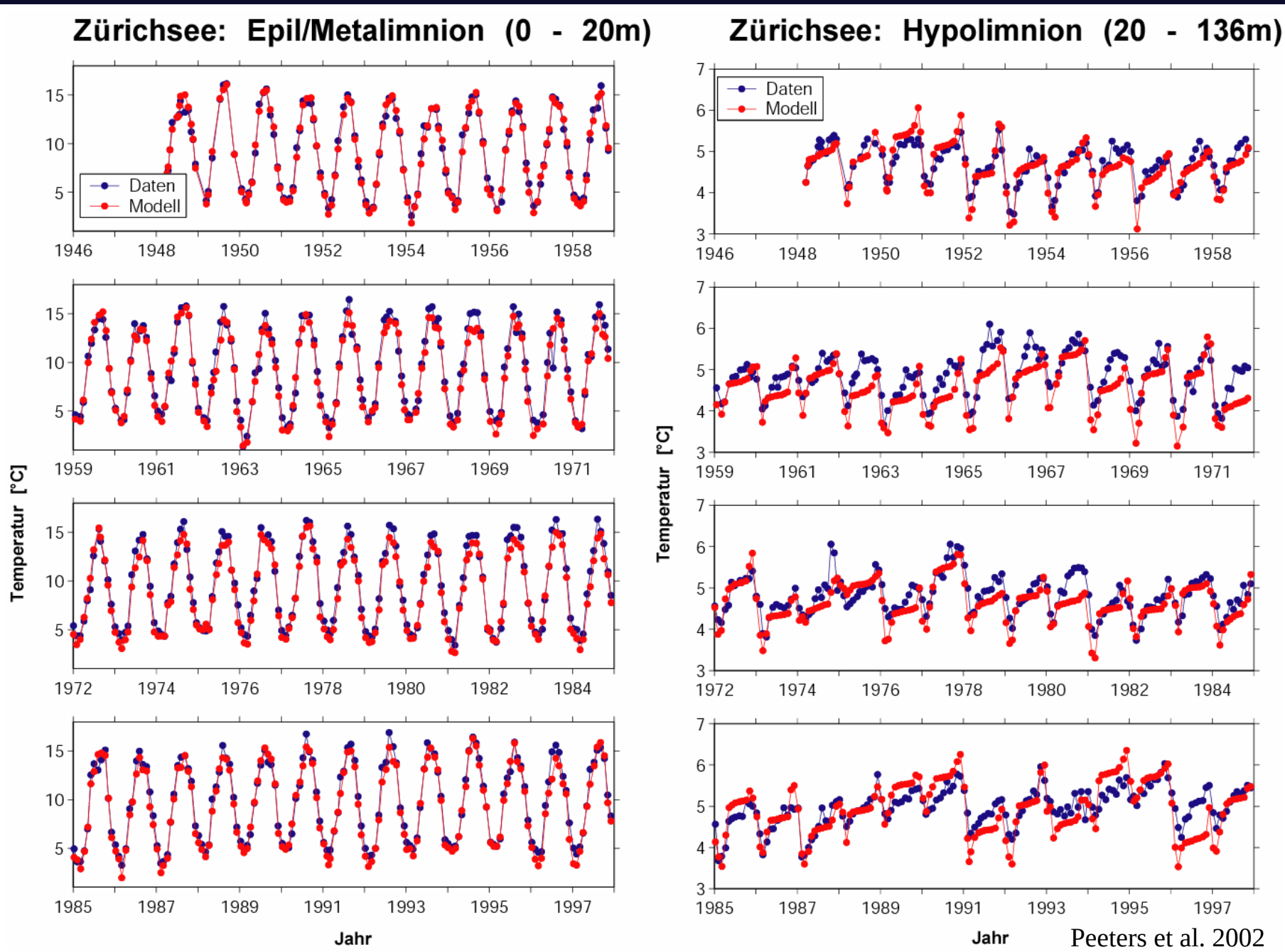
Daphnia growth occurs earlier

Shift in ecosystem interactions

Models

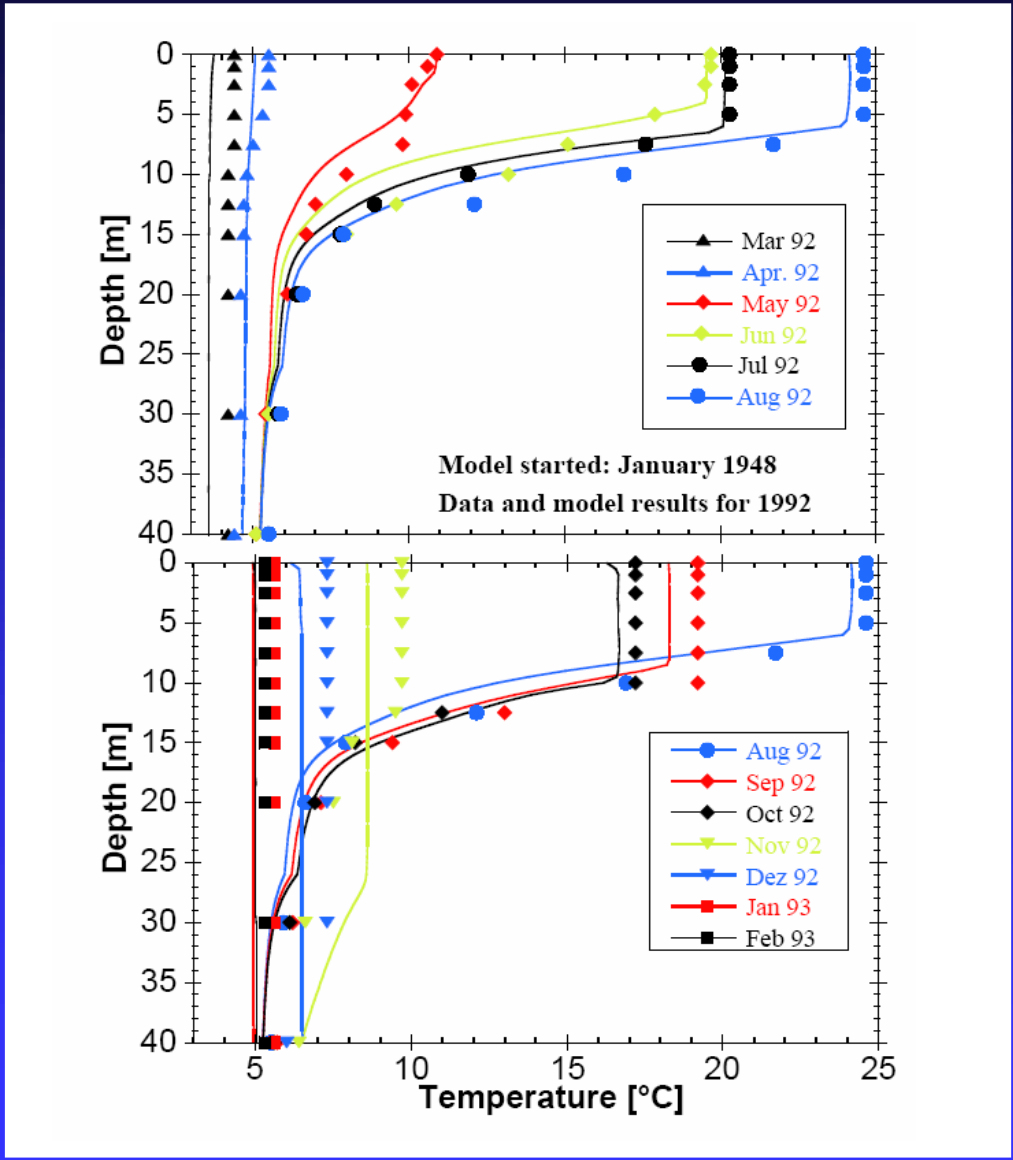
1) 1-dimensional vertical mixing model

Comparison of simulated and measured temperatures



Peeters et al. 2002

Comparison of simulated and measured temperatures



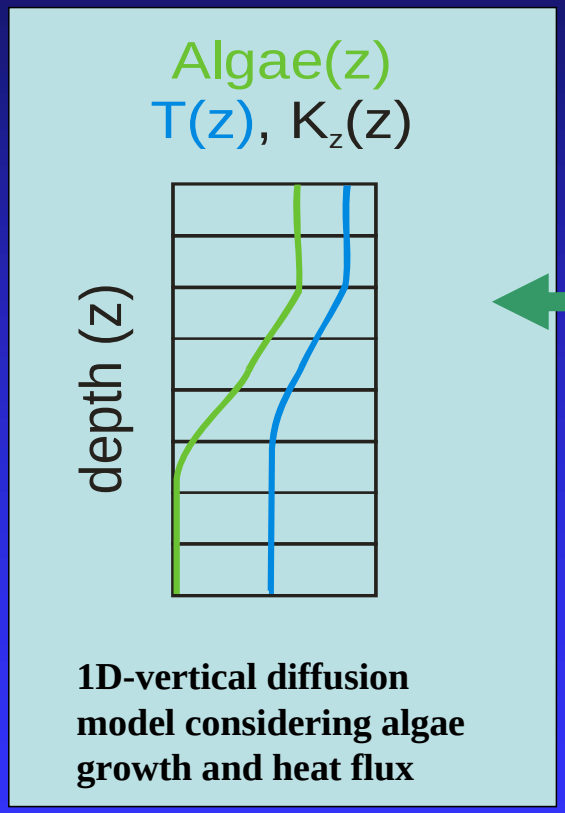
Peeters et al. 2002

Models

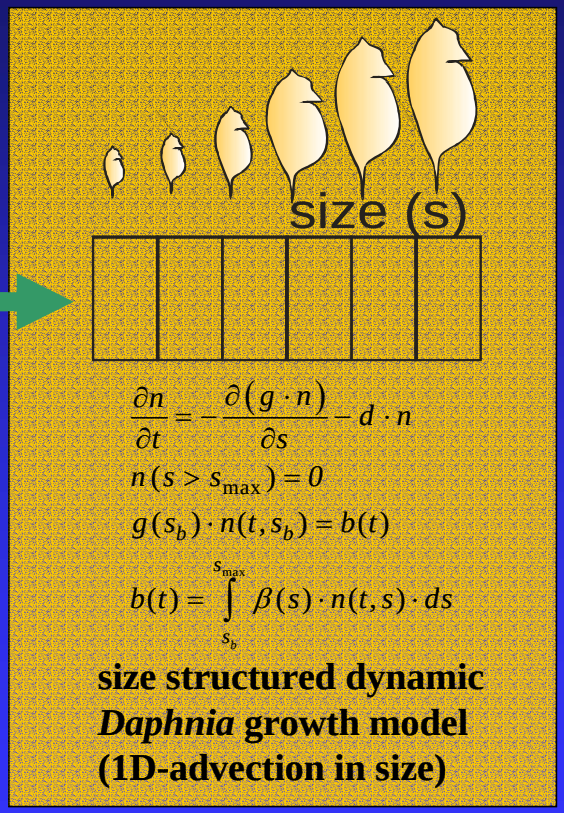
1) **1-dimensional mixing model (✓)**
2) **Algae-growth model**
   (dependent on solar radiation, diffusivities and water temperatures)
3) **D*aphnia* – model**
   (different complexities)
   a. biomass model
   b. size-structured dynamic model
   c. different parameterizations of growth and reproduction rates

Modelling the impact of environmental conditions on plankton succession

1. **Development of a dynamic algae-Daphnia model including physical transport**



1D-vertical diffusion model considering algae growth and heat flux



$$\frac{\partial n}{\partial t} = -\frac{\partial (g \cdot n)}{\partial s} - d \cdot n$$

$$n(s > s_{max}) = 0$$

$$g(s_b) \cdot n(t, s_b) = b(t)$$

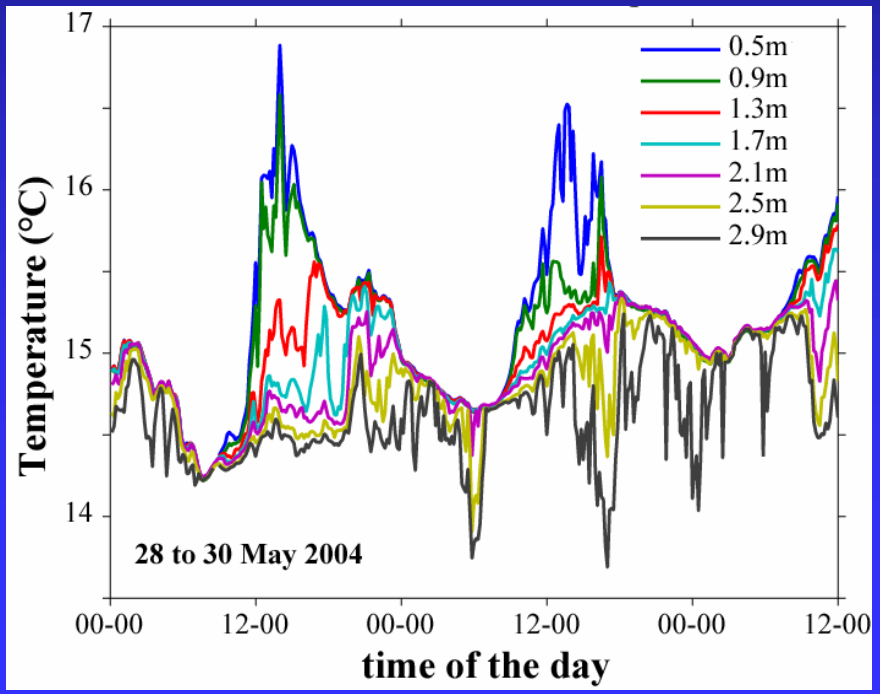
$$b(t) = \int_{s_b}^{s_{max}} \beta(s) \cdot n(t, s) \cdot ds$$

size structured dynamic *Daphnia* growth model (1D-advection in size)

2. **Simulating the effects of temporal variation in environmental conditions from late winter/spring to early summer in Lake Constance**

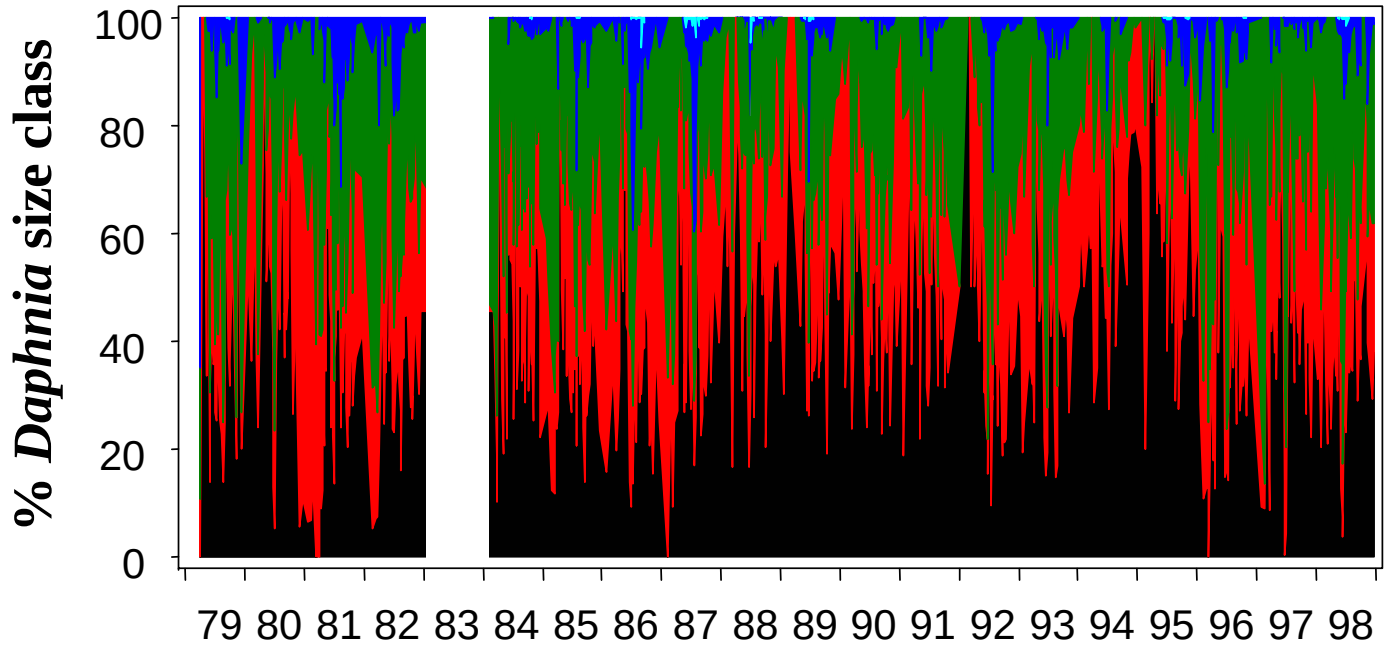
Calibration and validation of the models based on field data

Measurements of temperature and fluorescence with high temporal resolution



Calibration and validation of the models based on field data

… with long-term data of *Daphnia* abundances and size distributions



Measured size class distribution of *Daphnia* from 1979 - 1998

Tasks

1. **Development of the model(s)**
2. **Calibration and validation of the model based on field data (Lake Constance)**
   - existing long term data set
   - data collected specifically during this project (temporal resolution, data quality)
3. **Investigation of the effect of model refinement (Daphnia sub-models) on overall model performance**
4. **Assessment of the impact of changes in the physical environment on plankton succession in Lake Constance using hypothetical warming scenarios**