The MyLake model

- Inputs
  - Lake morphometry
  - Atmospheric forcing
    - Temperature, pressure, wind speed, humidity, precipitation, irradiance
  - Water, inorganic particle, and total nutrient loading

- Outputs
  - Temperature distribution
  - Snow/ice cover
  - Thermocline depth

  - Sediment heat exchange
  - Surface sediment P cycle

  - Simplified pelagic P cycle
  - Transport of suspended particles
  - Phase partitioning of P

MyLake—A multi-year lake simulation model code suitable for uncertainty and sensitivity analysis simulations

Tuomo M. Saloranta[a,*], Tom Andersen[b,a]

[a] Norwegian Institute for Water Research, Gaustadalléen 21, N-0349 Oslo, Norway
[b] Department of Biology, University of Oslo, P.O. Box 1066, Blindern, N-0316 Oslo, Norway

Minimum requirements

- Bathymetry (area vs. Depth)
- Meteorology (daily)
- Water budget
  - Water in/out (all sources) + water level
- Phosphorus & suspended particle loading
  - Link to watershed model & management options
- Non-particulate light attenuation (DOM)
- Calibration data
  - Water temperature + ice thickness
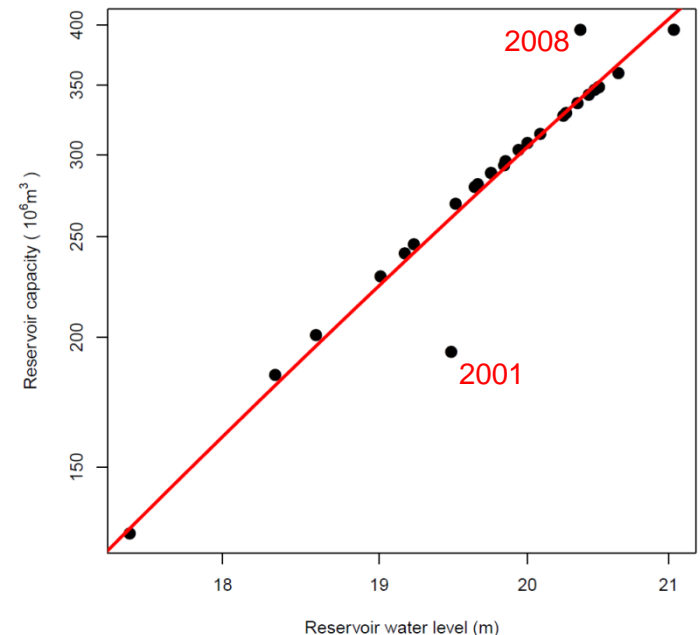 - Total P & chlorophyll in reservoir

Bathymetry

- No bathymetric map available

- Can partly be reconstructed from (annual) reservoir curve
  - Need deepest point as m.a.s.l.
  - Mysterious outliers (2001 & 2008)

- Some GPS-located echosound depths
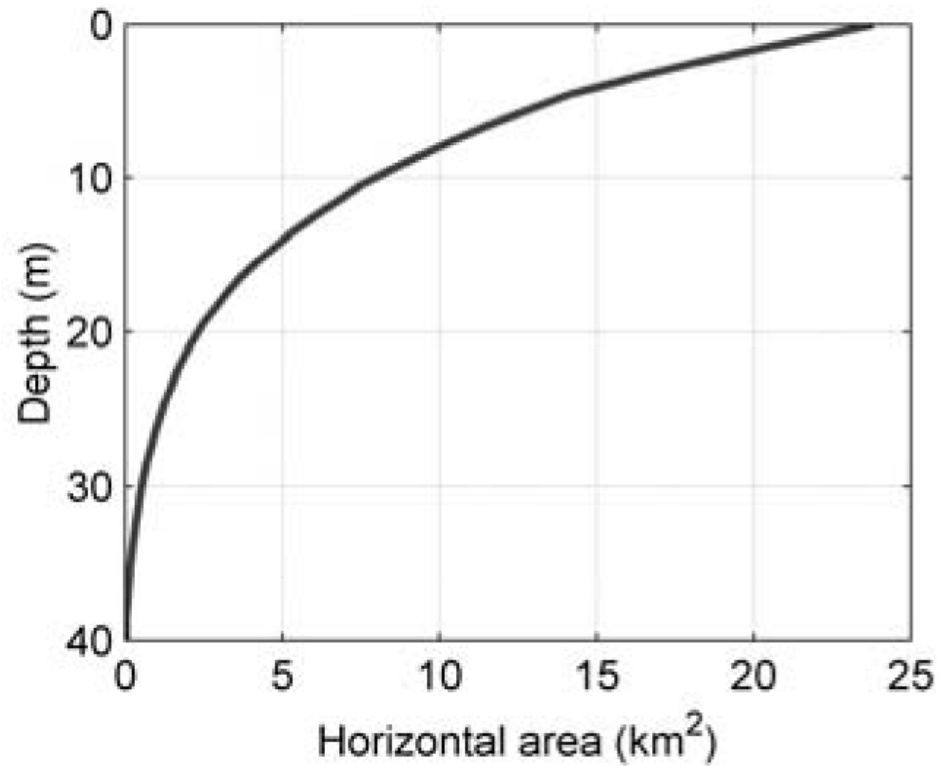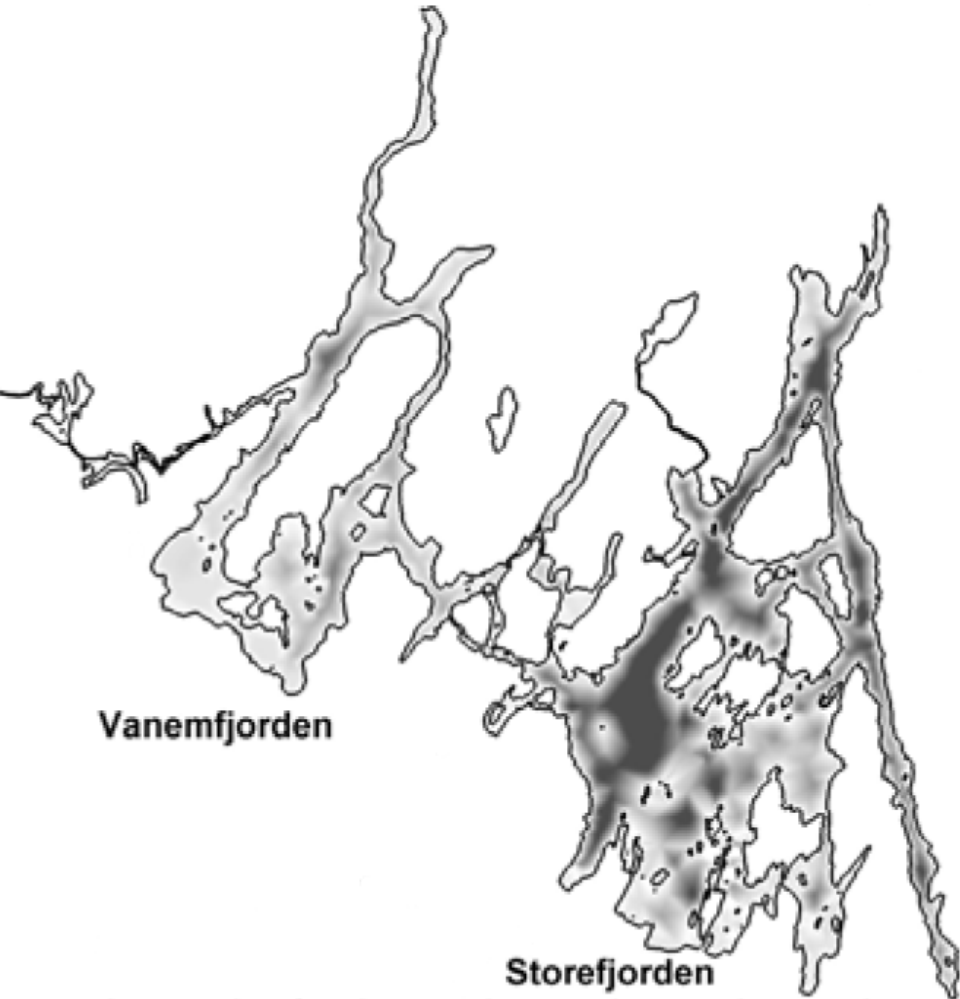 - More can be collected
  - Need shoreline contour
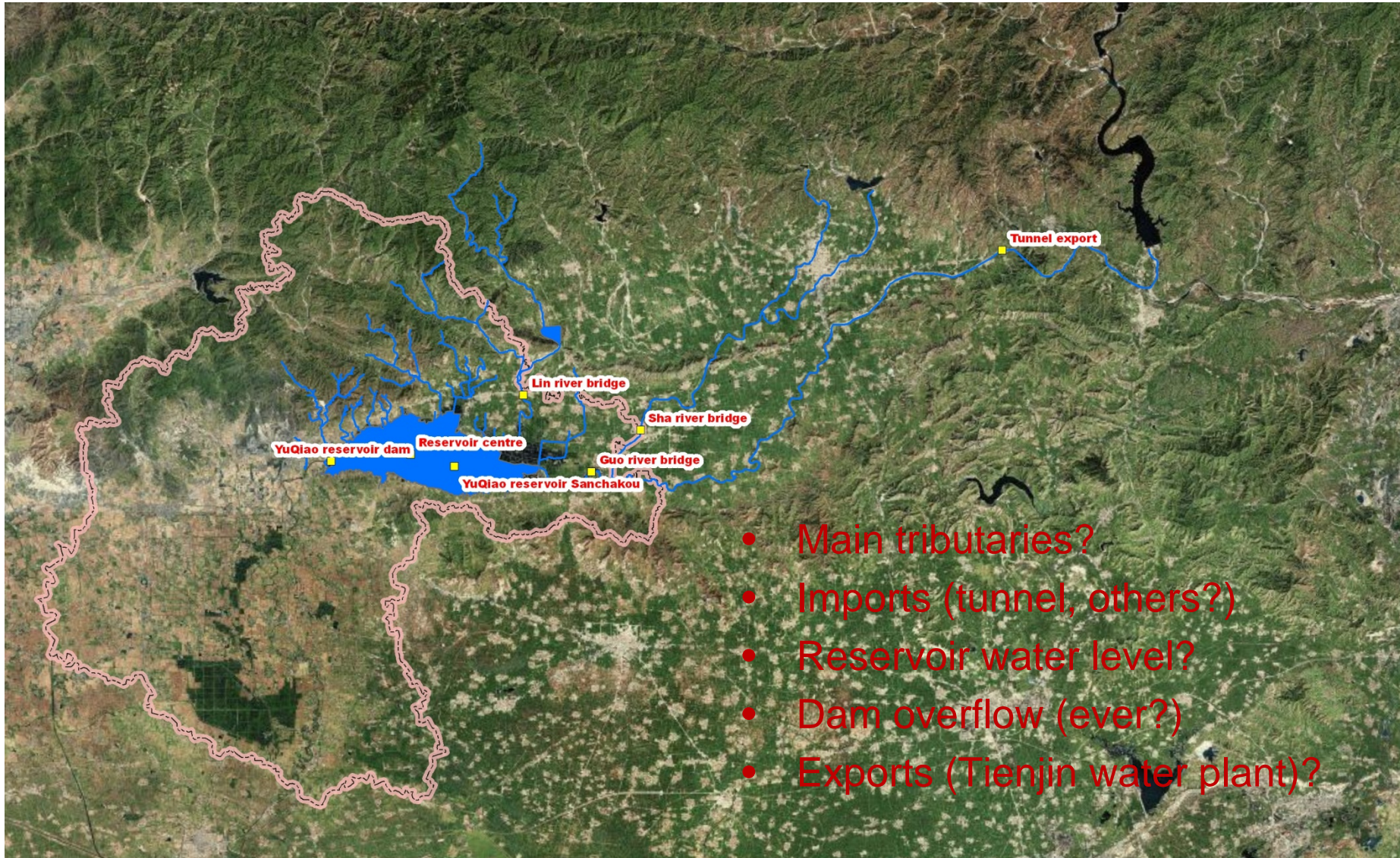
Yuqiao Reservoir

SASI-104

Surface Area	250 km^2
Volume	1.56 km^3
Maximum Depth	12 m
Mean Depth	4.6 m
Shoreline Length	65 km

Vansjø bathymetry

Water budget

Labels on map:
- Tunnel export
- Lin river bridge
- Sha river bridge
- Guo river bridge
- Reservoir centre
- YuQiao reservoir dam
- YuQiao reservoir Sanchakou
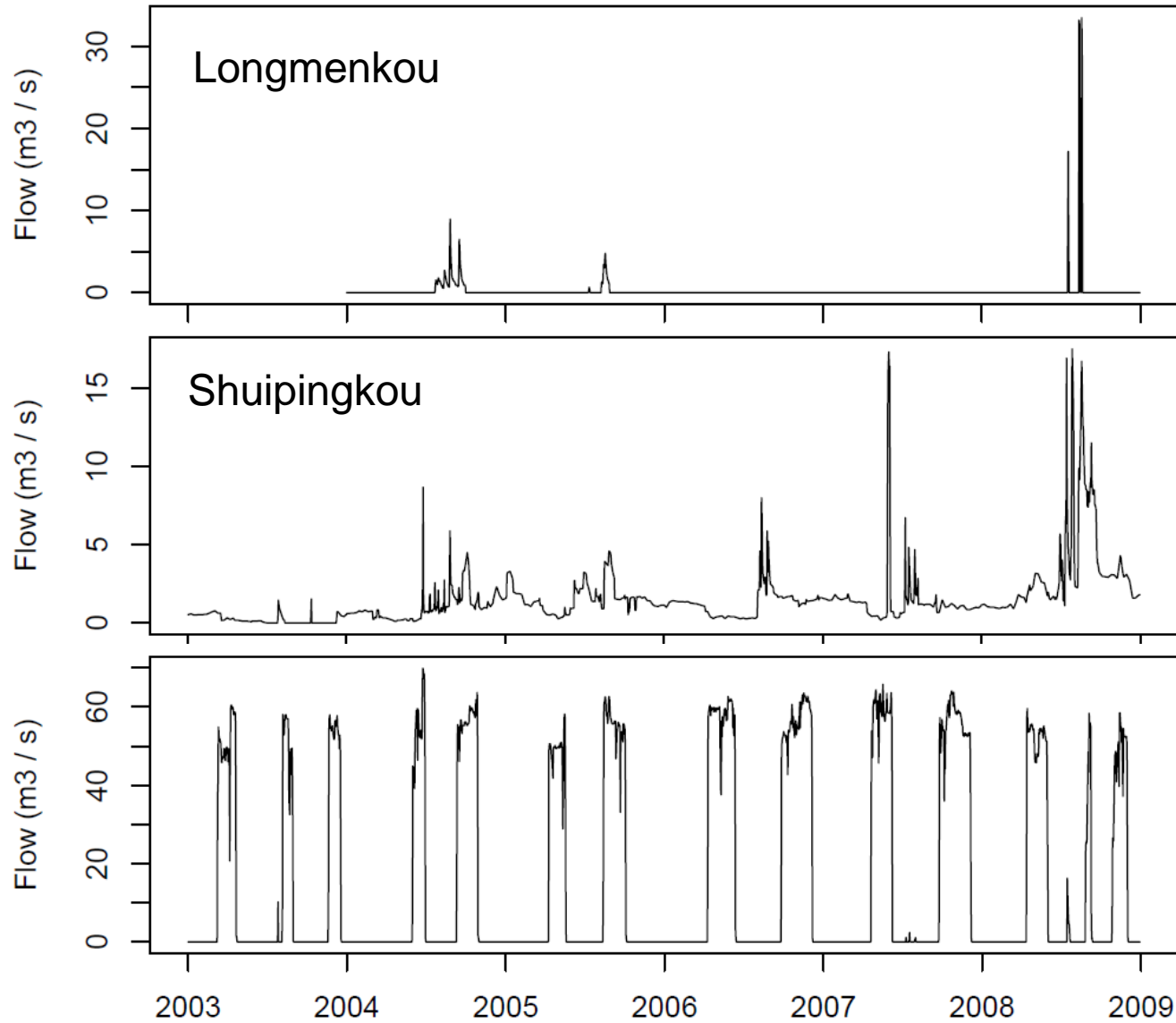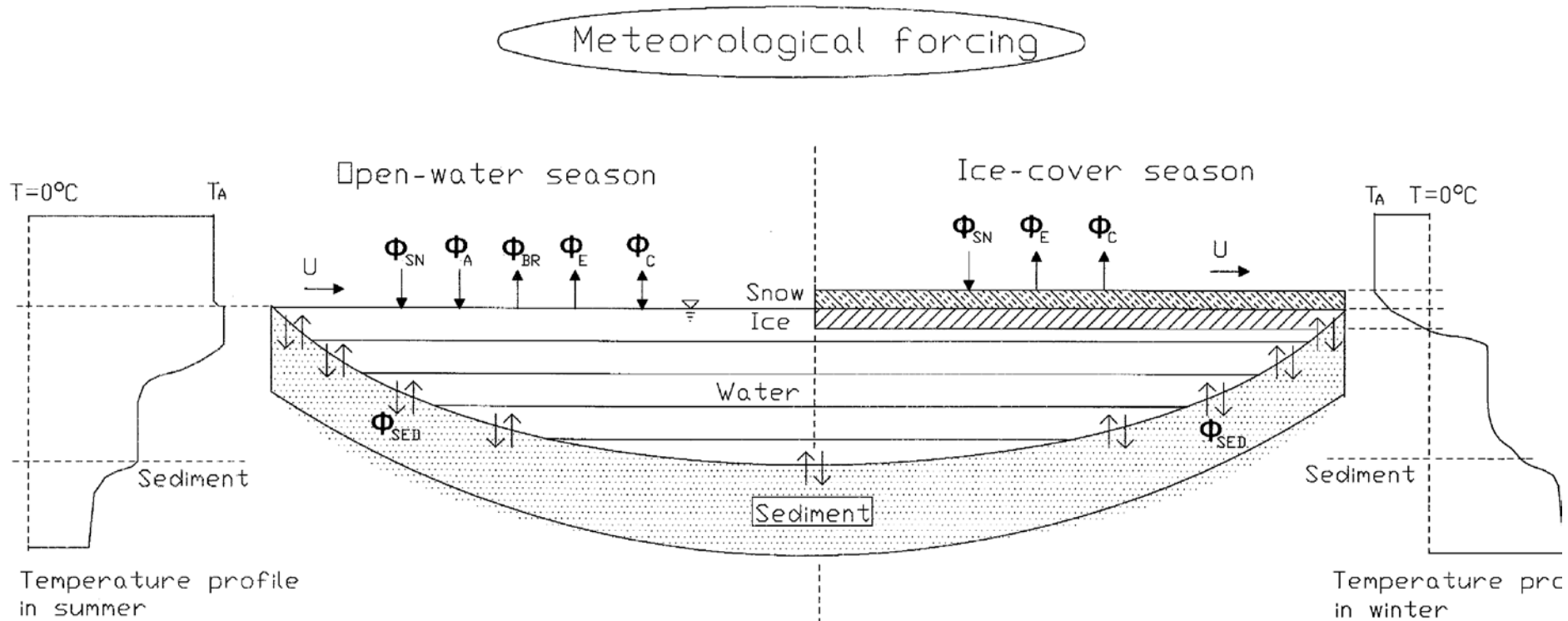
- Main tributaries?
- Imports (tunnel, others?)
- Reservoir water level?
- Dam overflow (ever?)
- Exports (Tienjin water plant)?

Tributaries
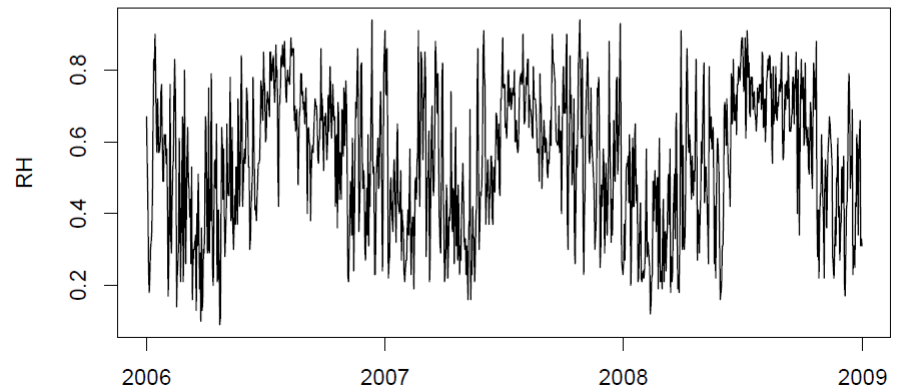
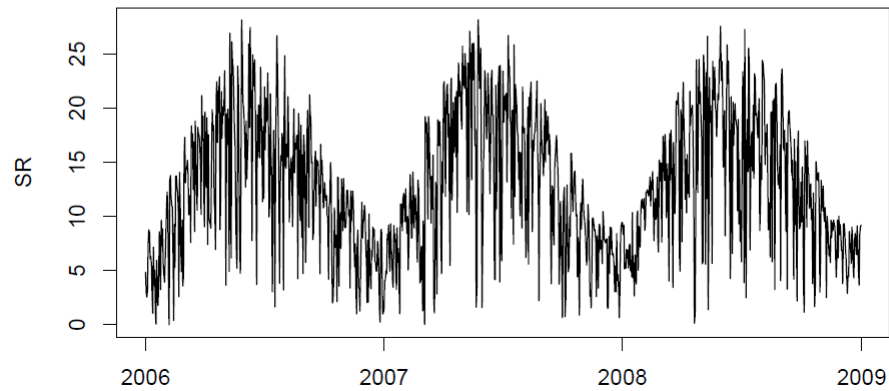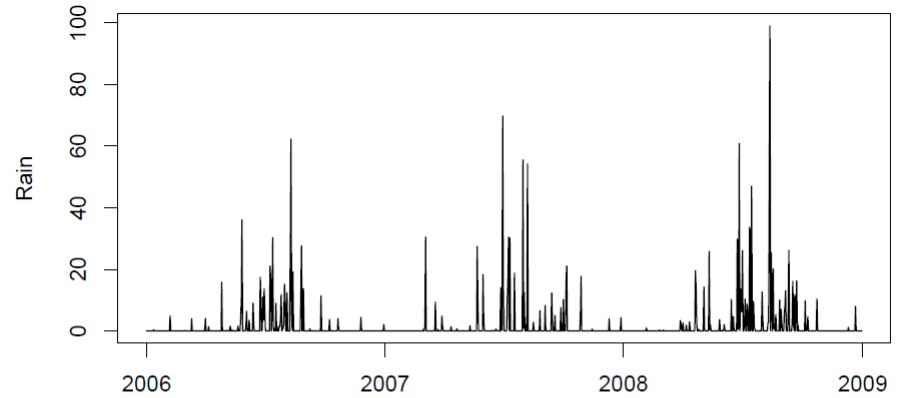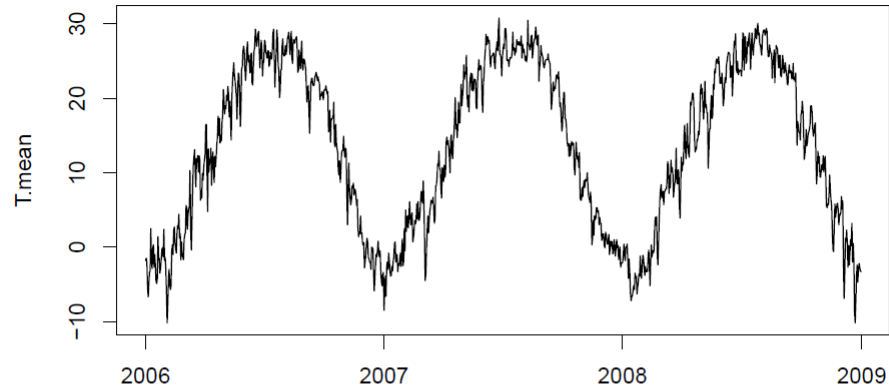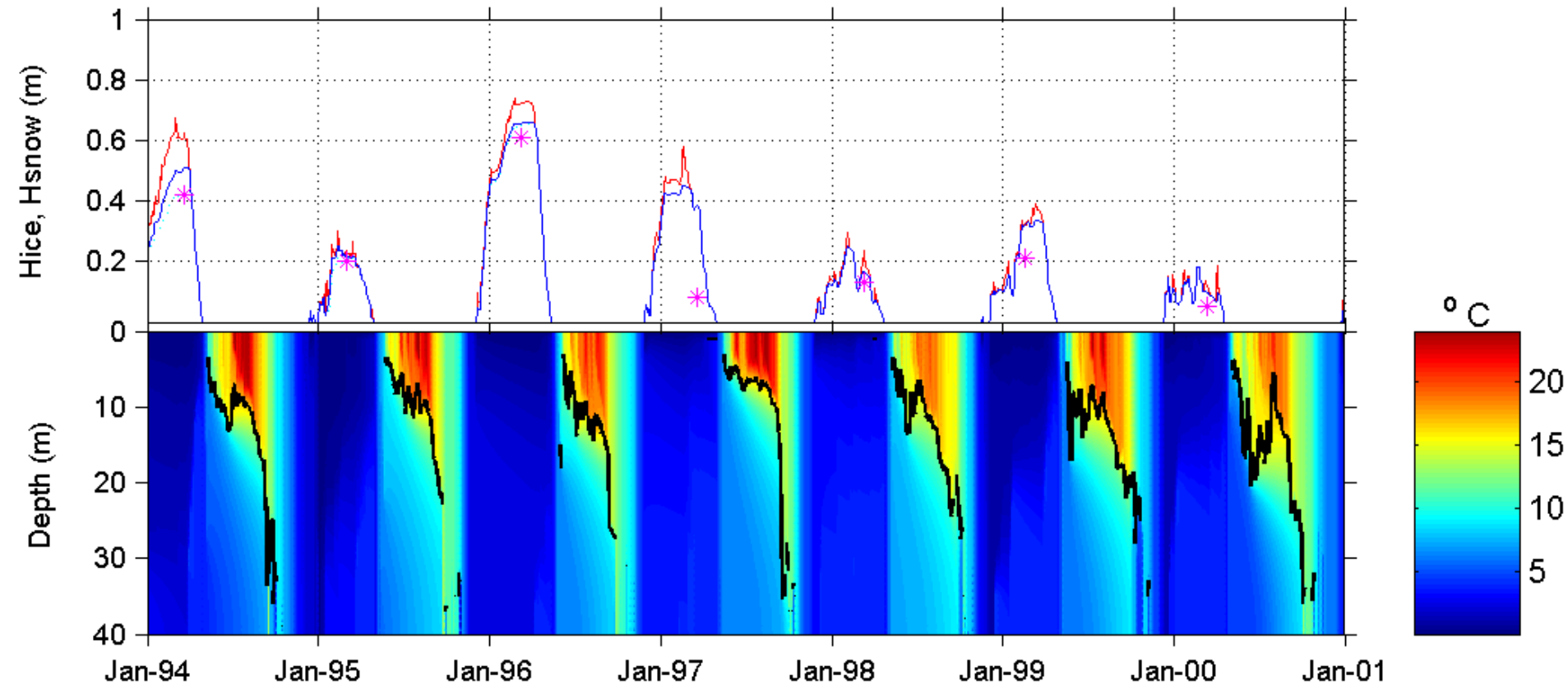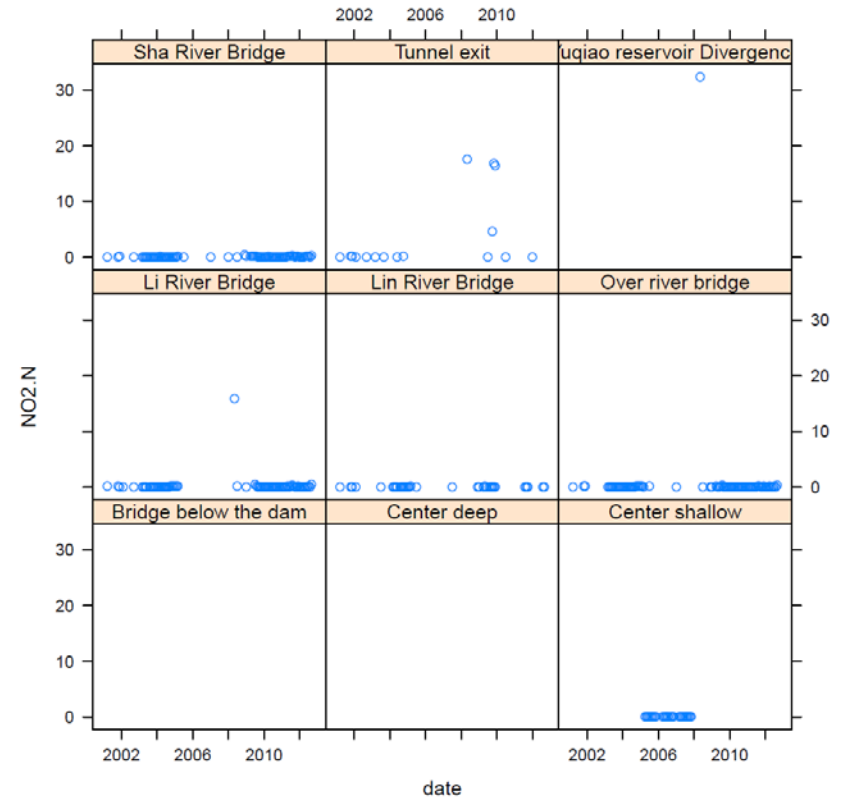# MyLake: Global energy balance
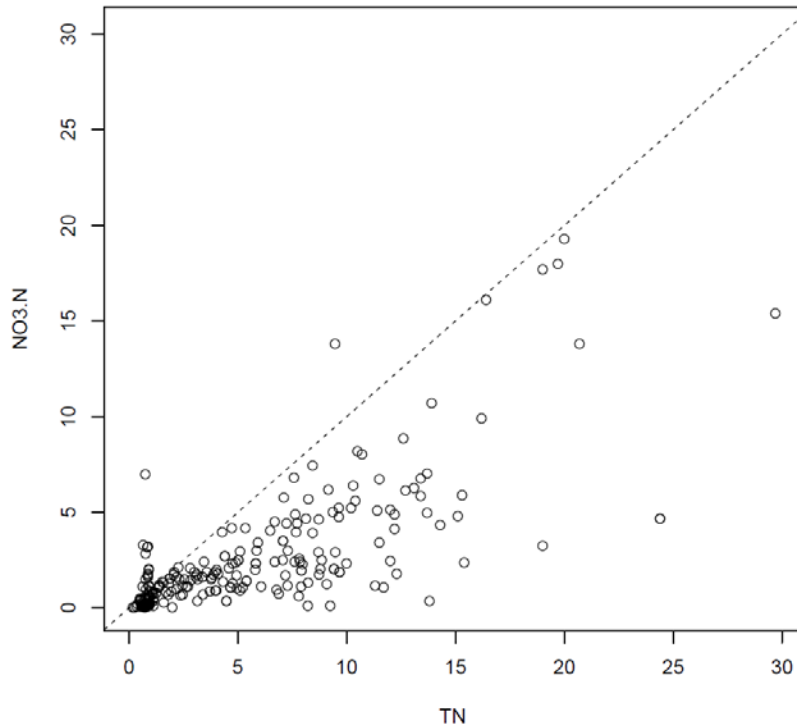
Meteorology

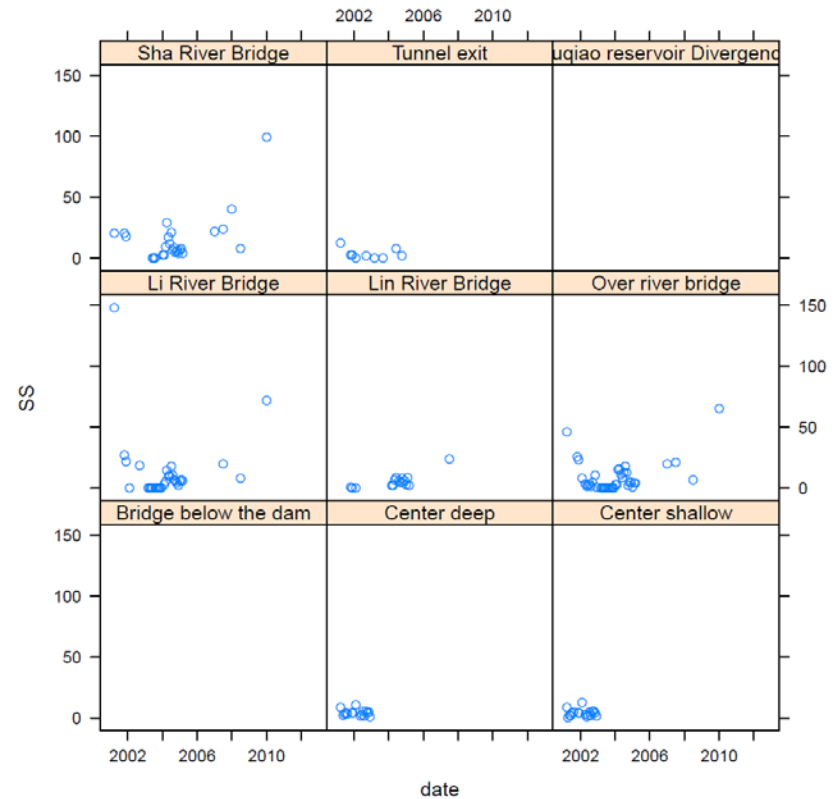# Vansjø: Temperature, ice cover

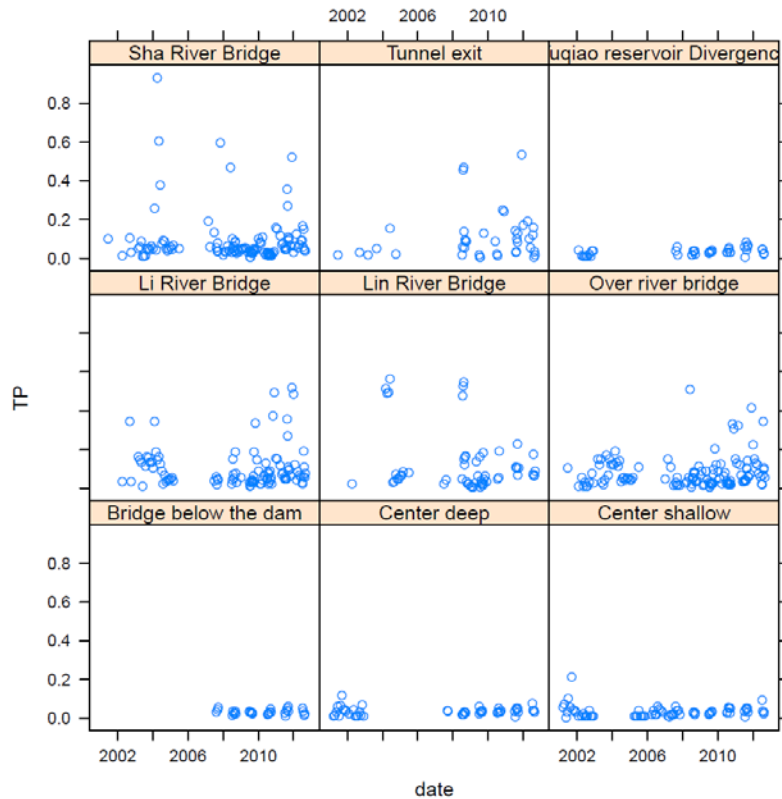10 years = 134 cpu seconds (1.7 GHz Pentium)

Monitoring data quality

Calibration data?

Yuqiao model choices

- Fluctuating volume
  - MyLake (-) vs. DYRESM/CAEDYM (+)

- Annual ice cover
  - MyLake (+) vs. DYRESM/Aquasim/Pclake/etc. (-)

- Shallow – unstratified(?)
  - MyLake (-) vs. Aquasim/Pclake/etc. (+)

- High alkalinity (calcite chemistry?)
  - MyLake (-), as well as most other models

MyLake: Local energy balance

$$A\frac{\partial T}{\partial t} = \frac{\partial}{\partial z}\left[KA\frac{\partial T}{\partial z}\right] + A\frac{Q^*}{\rho_w C_p}$$

Temperature
change

Diffusive
flux

Heat
flux

- 1-dimensional partial differential equation (PDE)
  - Implicit, finite-volume numerical solution scheme (daily time step)
- Boundary conditions: surface and sediment heat fluxes
  - Local weather station or WMO reanalysis data (daily averages)
- Freely available Matlab code
  - R version in development

MyLake: Plankton

Inorgaic P change

Diffusive flux

Net P uptake

$$A\frac{\partial P_D}{\partial t} = \frac{\partial}{\partial z}\left[KA\frac{\partial P_D}{\partial z}\right] - Ay_c^{-1}rP_{Chl}$$

$$A\frac{\partial P_{Chl}}{\partial t} = \frac{\partial}{\partial z}\left[KA\frac{\partial P_{Chl}}{\partial z}\right] - A\frac{\partial(wP_{Chl})}{\partial z} + A(rP_{Chl} + S_{Csed})$$
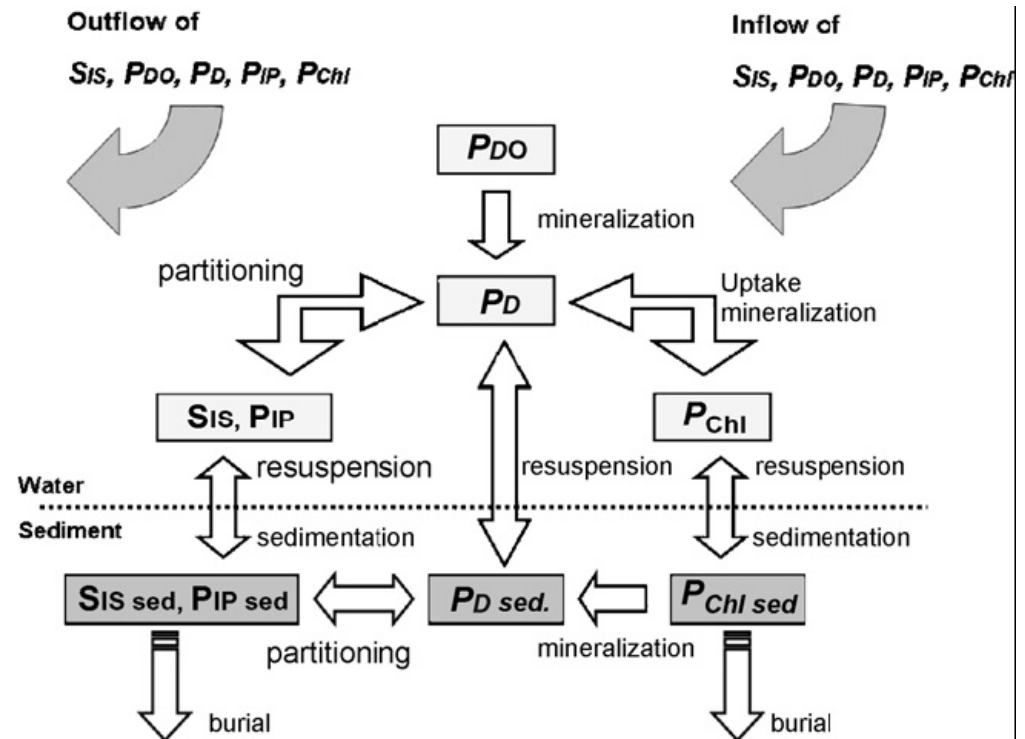
Chlorophyll change

Diffusive flux

Sedimentation flux

Local net growth

MyLake: P cycle

- **Biological processes**
  - Growth / uptake
  - Mineralization

- **Physical / Chemical**
  - Phase partitioning
  - Sedimentation
  - Resuspension
  - Burial

Vansjø (Storefjorden) calibration

- Sensitivity analysis → identify calibration parameters
- Calibration to monitoring data 1985-2000

- Calibration limited by missing winter data and low temporal frequency of loading data