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Macrophyte growth module for the SWAT model

Impact of multi-stressors on stream ecology

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WHY

Multiple pressures on water & ecology:

- Management, land use, climate change
- Model for catchment response

Macrophyte

- Ecological indicator
- Change river physical & chemical condition

Macrophyte for SWAT

- Modified INCA-P for macrophyte growth
- Benthic sediment

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Modified INCA-P

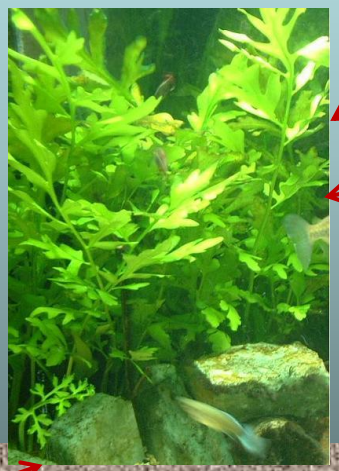
Growth

Death

Well mixed water column

Temperature

Light



Flow rate

Respiration

Sediment

Nutrient N/P

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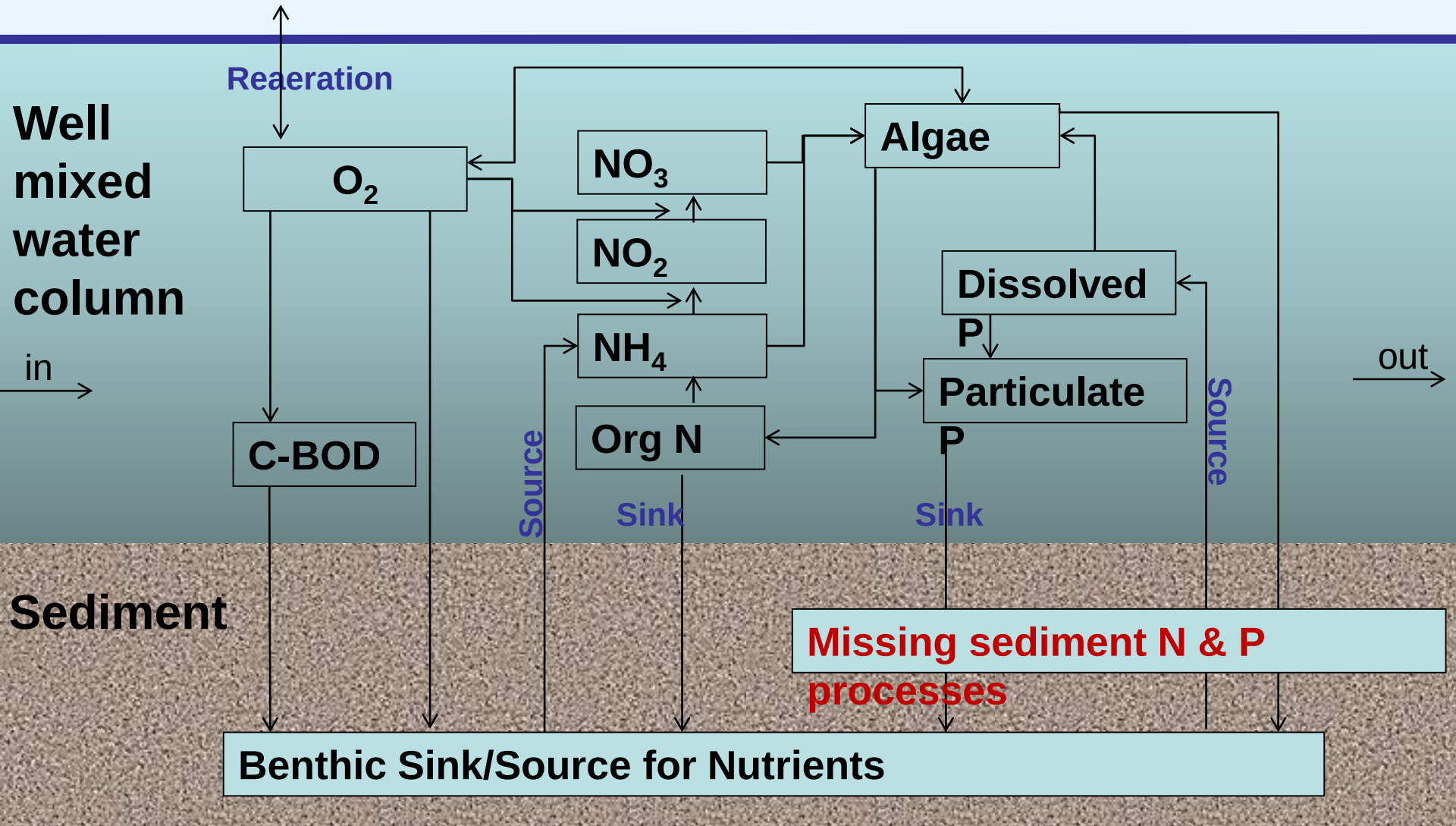
SWAT in-stream model QUAL2E



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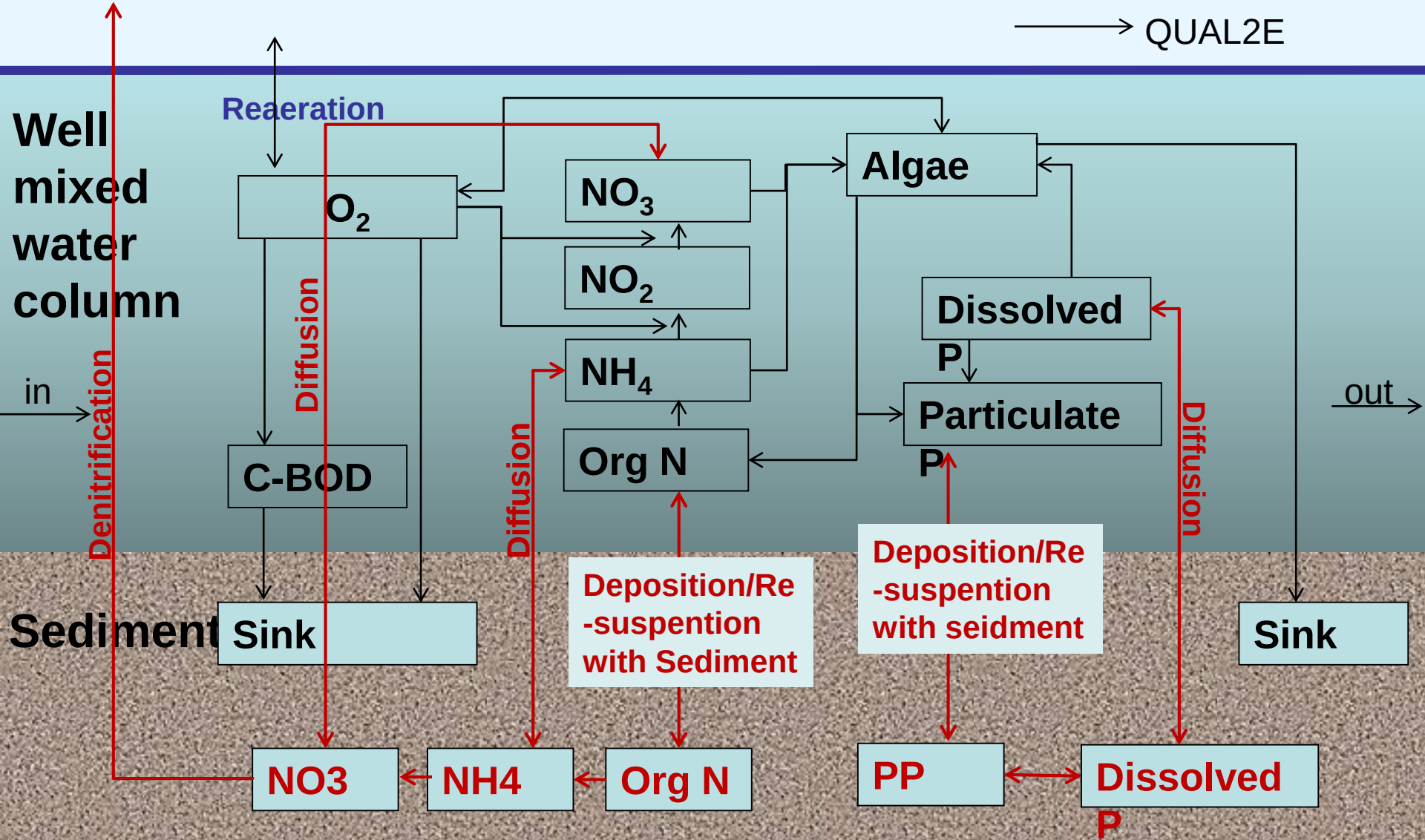
SWAT + Benthic sediment



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SWAT+ Macrophyte

New processes

QUAL2E

Well mixed water column

Temperature

Light

Flow rate

Respiration

Sediment

Sink

Deposition/Re-suspention with Sediment

Deposition/Re-suspention with seidment

Sink

NO3

NH4

Org N

PP

Dissolved P

Denitrification

Diffusion

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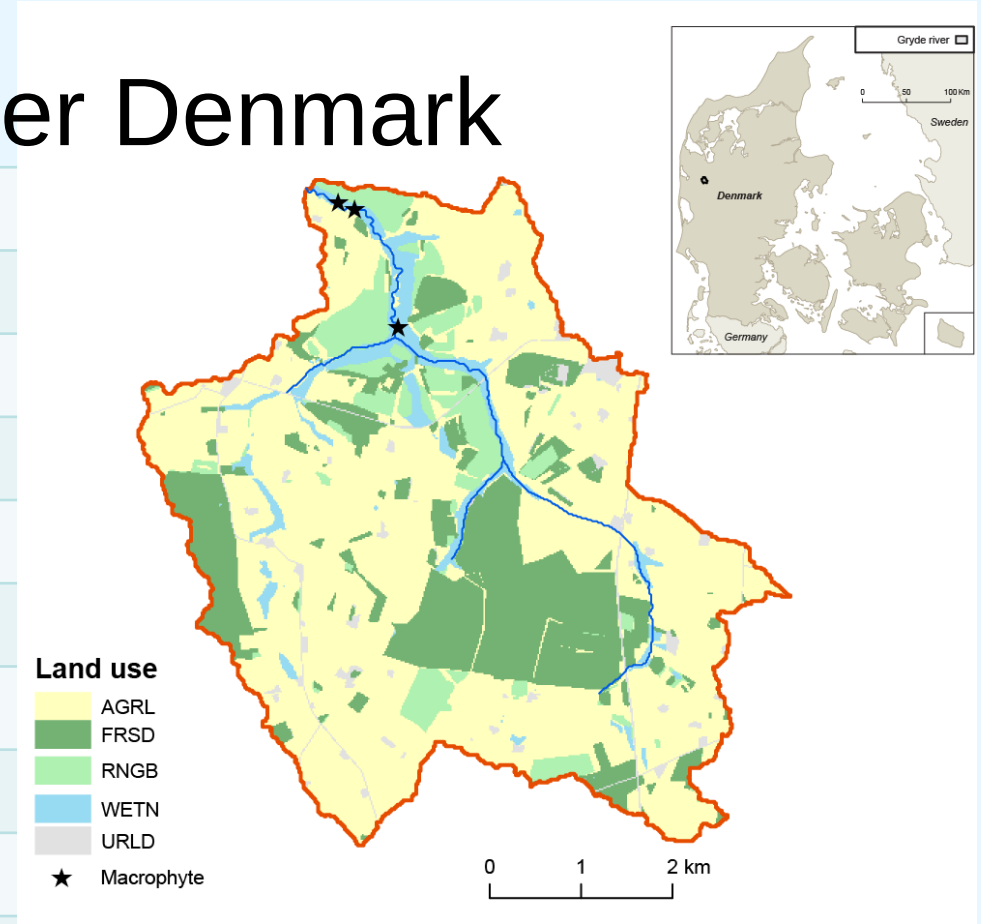
Study site: Gryde river Denmark

	Gryde river	
Location	Northwest Jutland	
Area	30 km^2	
Land use	Agriculture	67%
	Forest	31%
	Wetland	2%
Hydrology	Precipitation	1023mm
	ET	547 mm
	Discharge	249 mm
	Groundwater	> 70%
Observation	Discharge	1977-93
	Macrophyte	1977-87



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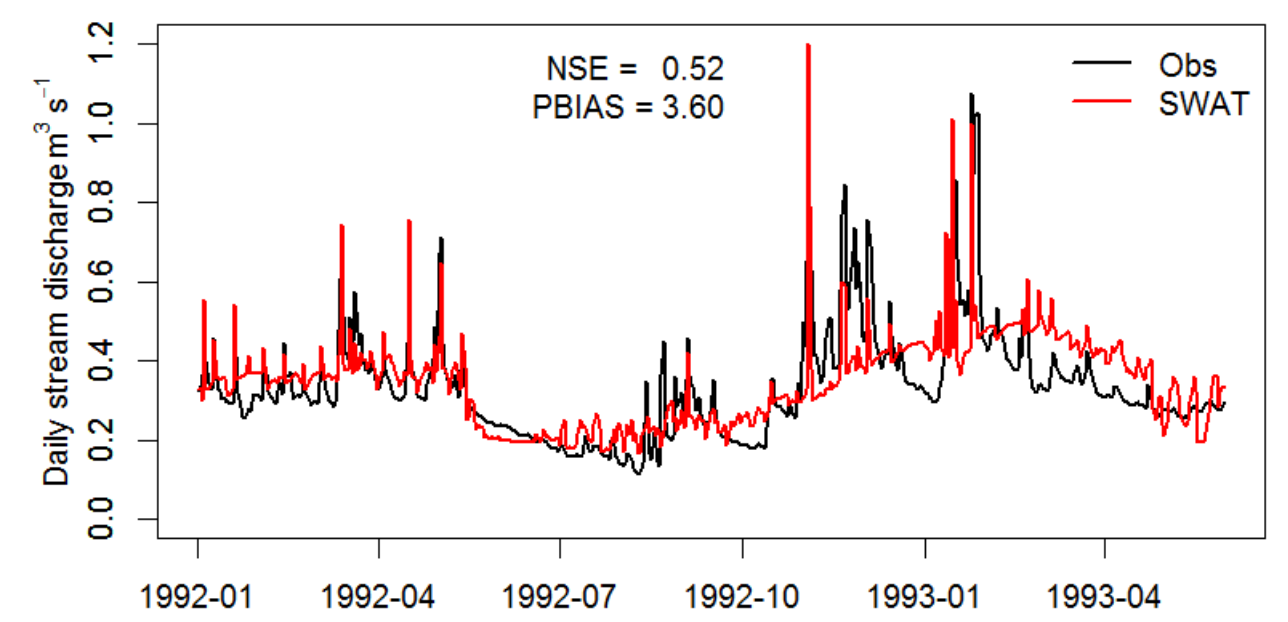
Discharge

- **Not satisfying**
  - **Small variation in observation**
  - **Different surface / ground water domain**



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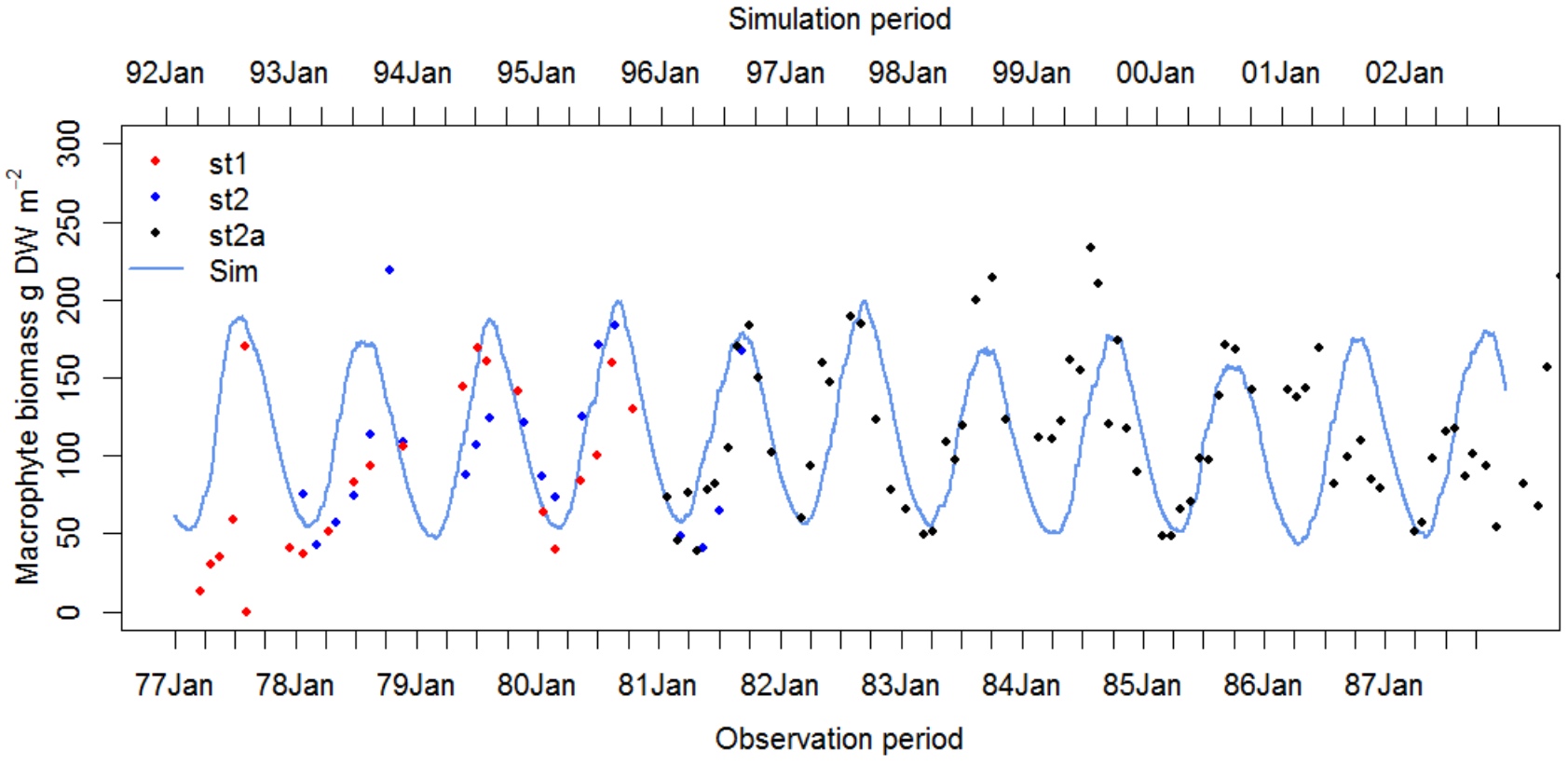
Macrophyte: 10 year daily biomass

- **Observation/simulation period not same**
- **Seasonal dynamic match**



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Macrophyte & Stream flow

- **Macrophyte growth in streams**
  - **Increase roughness**
  - **Slow down flow velocity**
  - **Reduce sediment erosion & increase deposition**
- **SWAT manning's N static**
- **Manning's N related with macrophyte biomass**

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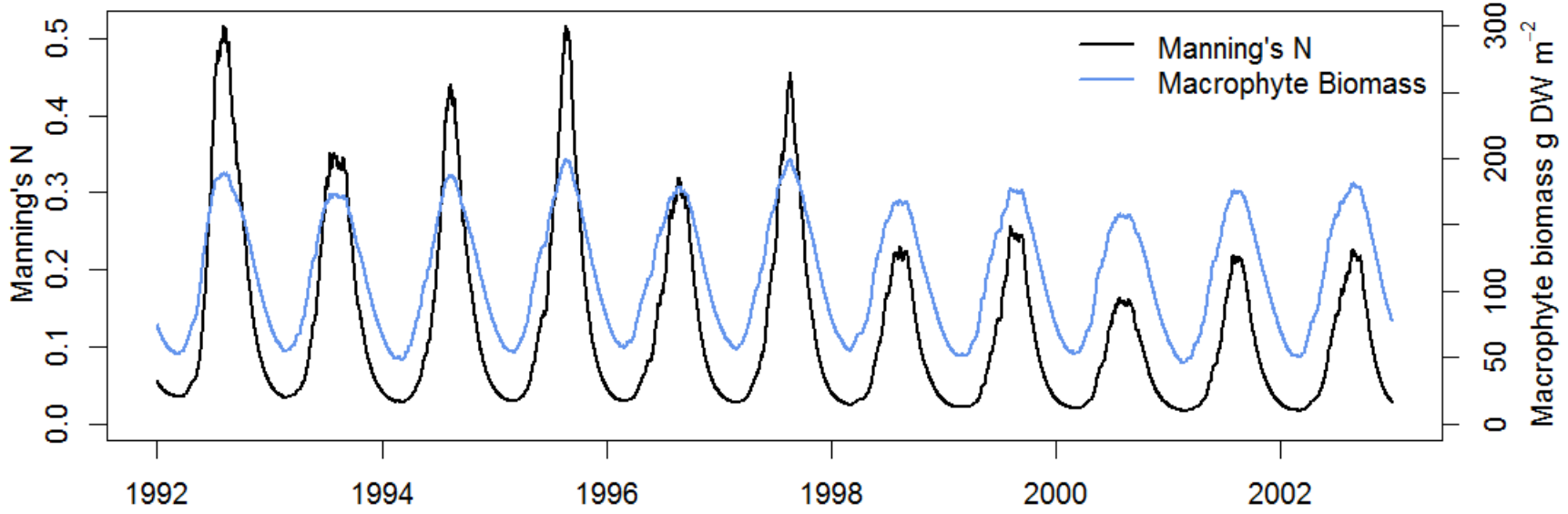
Dynamic Manning's N

- **Change with macrophyte biomass**
- **Seasonal dynamic & magnitude**
- **Improve relationship with macrophyte biomass**
  - **Fix magnitude**



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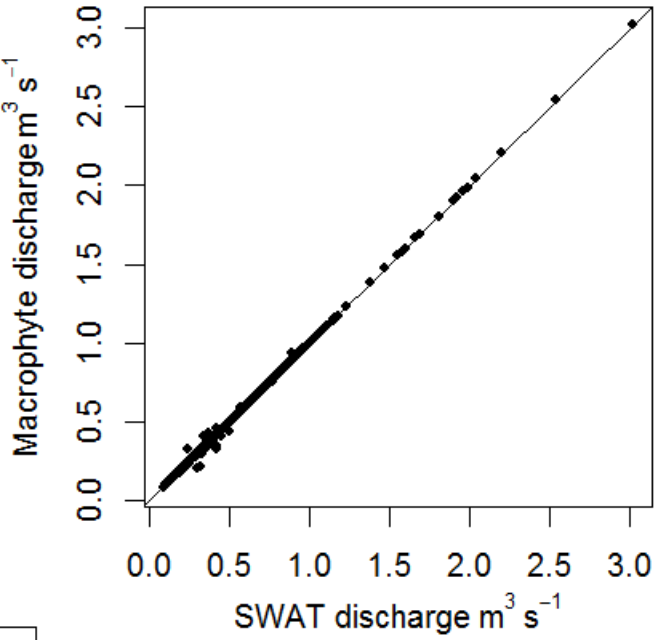
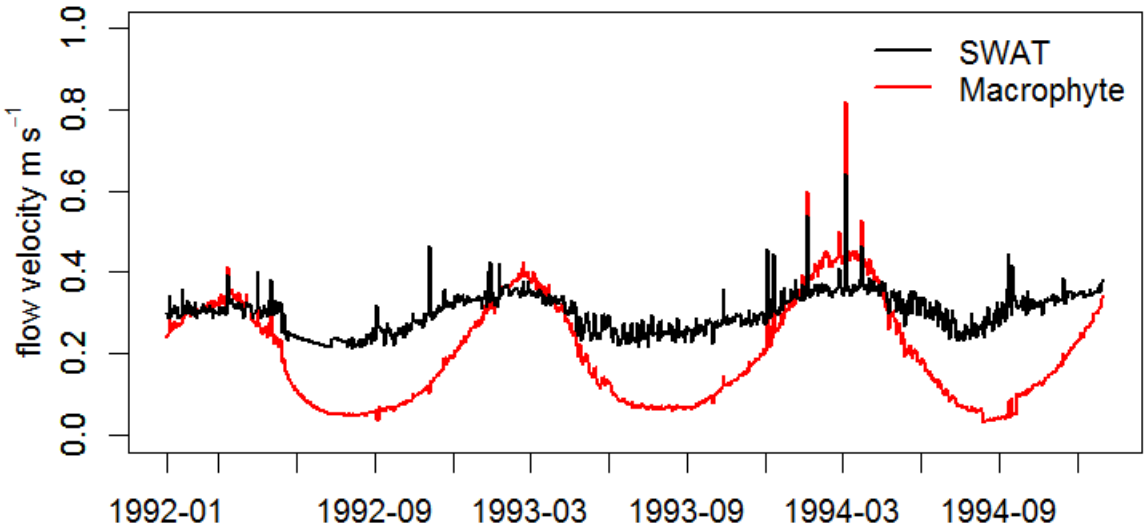
Impact on Flow

- **Limited change on discharge**
- **Change flow velocity**
  - **Lower in summer**
  - **Higher in winter**





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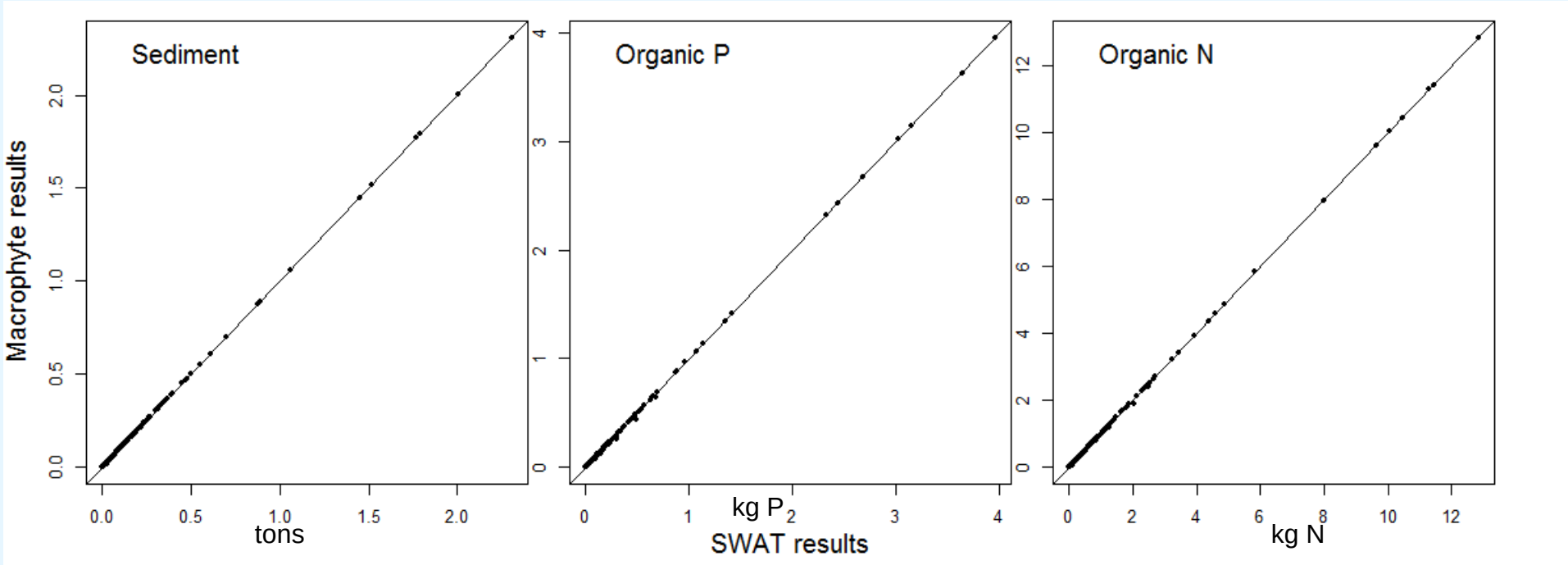
Impact on Transport: Default sediment routing

- **Sediment & particulate N,P - very limited impact**
  - **Default sediment routing – use discharge not flow velocity**



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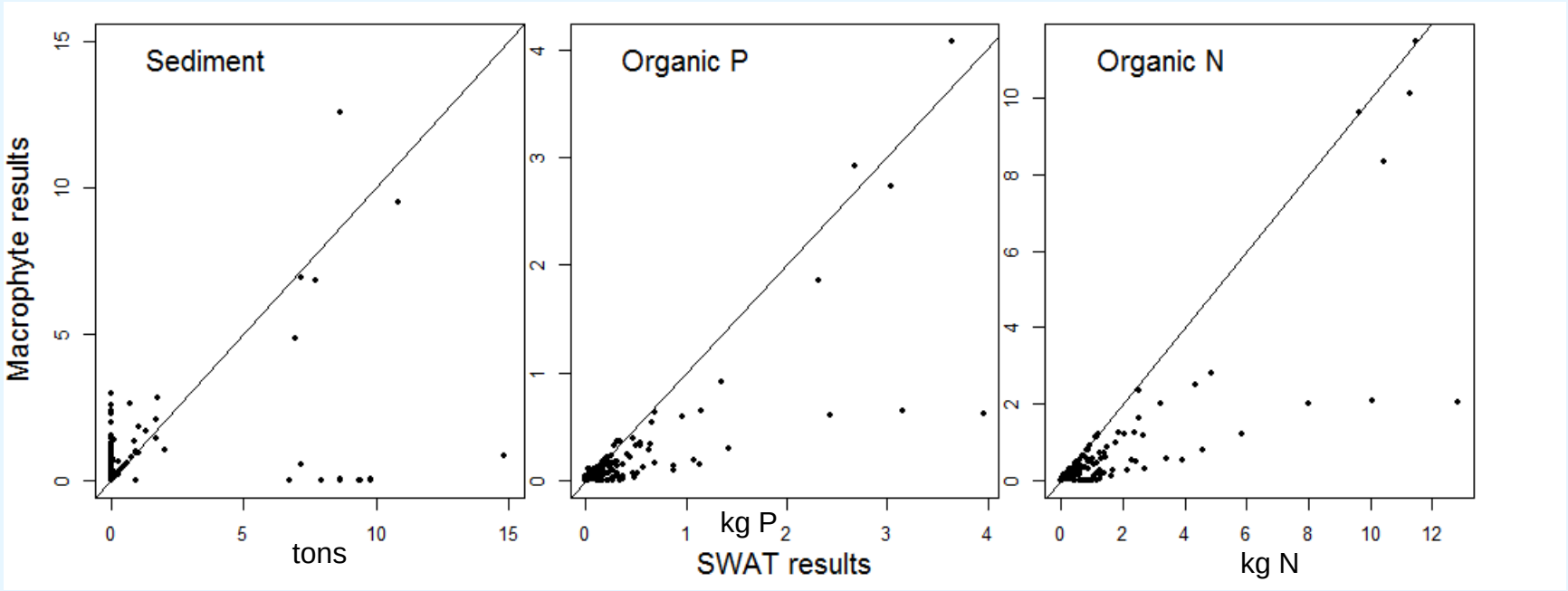
Impact on Transport: Physical sediment routing

- **Sediment: more erosion with macrophyte**
  - **Physical erosion use water depth, not flow velocity**
- **Organic N & P: less with macrophyte**
  - **Loss due to deposition units**



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Further work

- **Improve manning's N dynamic**
- **Sensitivity analysis / Climate change**
  - **Solar radiation**
  - **Temperature**
- **Epiphyte component**
- **Sediment erosion based on flow velocity**
  - **correct response to macrophyte growth**
- **Denitrification in benthic sediment**

Please come to our poster in the afternoon:
A SWAT model for Denmark