Assessment of nitrogen retention in the Seine river basin by different approaches

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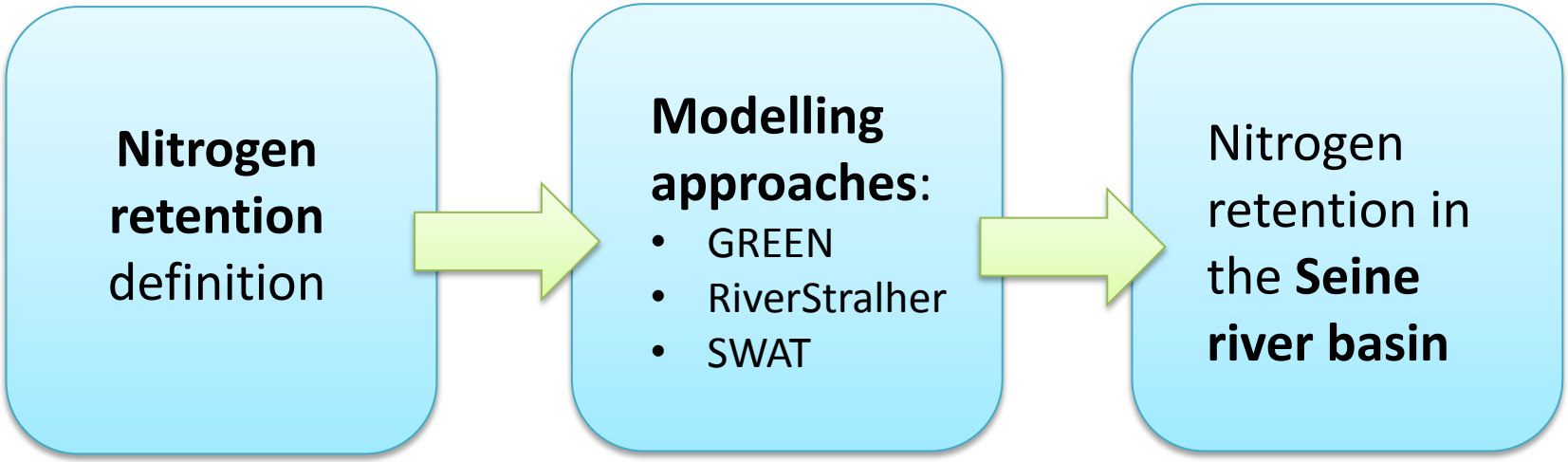
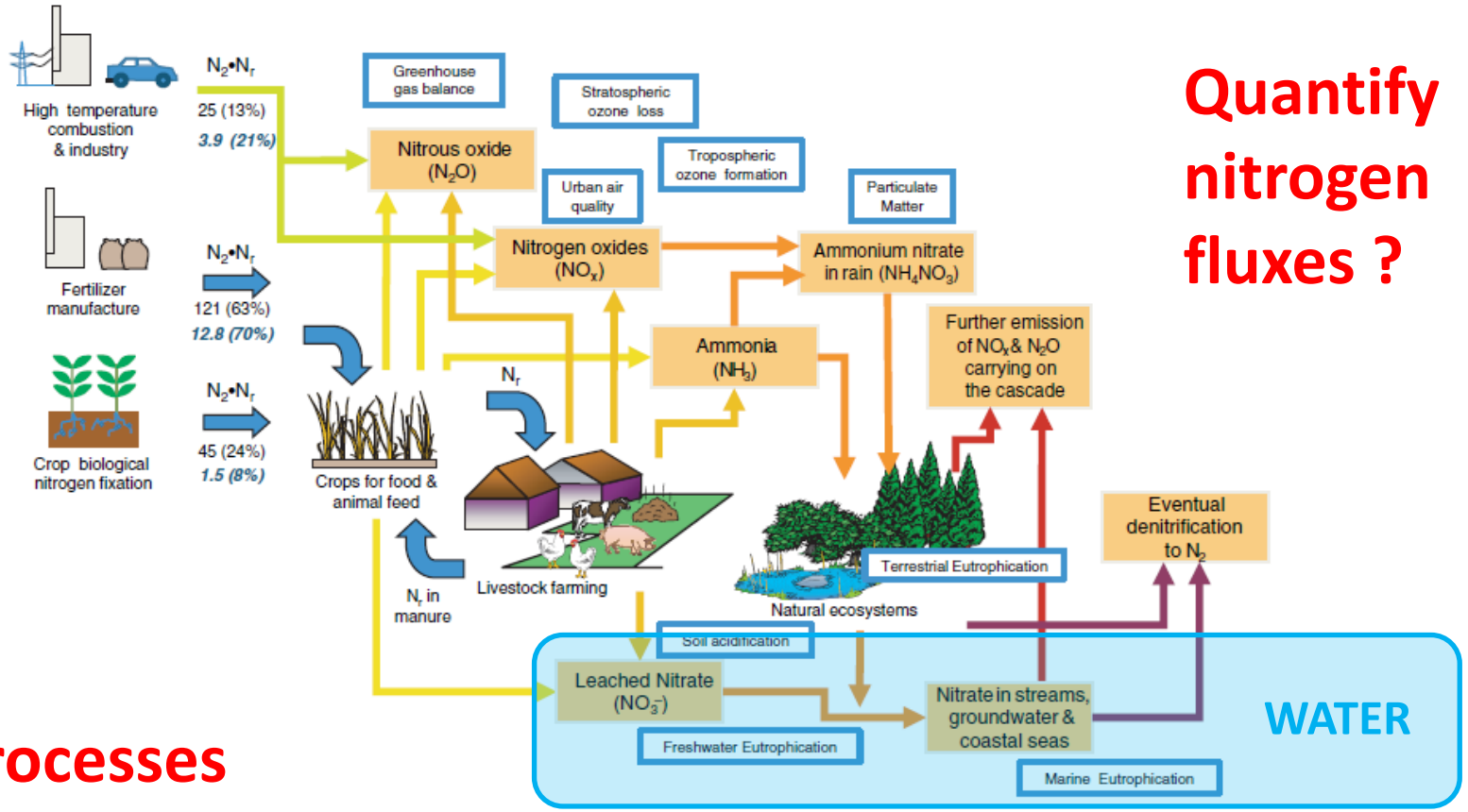
Objective

Assess the nitrogen retention in the Seine river basin (~70 000 km^2, France) by three models : GREEN, RiverStralher and SWAT

→ *Reflect on nitrogen retention in the river basin and its modelling representation*



Nitrogen cascade



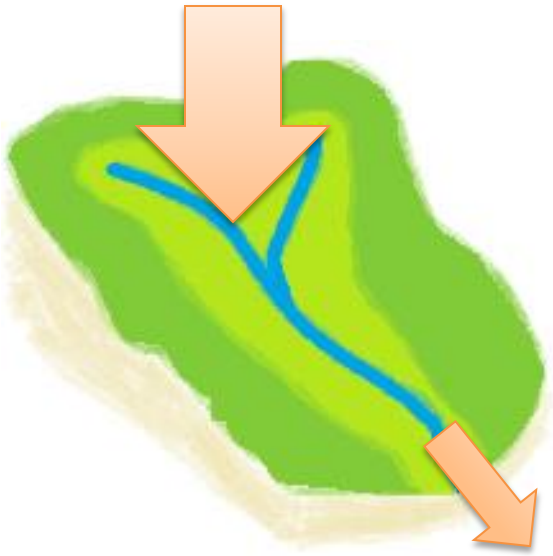
Quantify nitrogen fluxes ?

Processes

(Sutton et al. 2011; Galloway et al. 2003; 2008)

Nitrogen retention

River basin

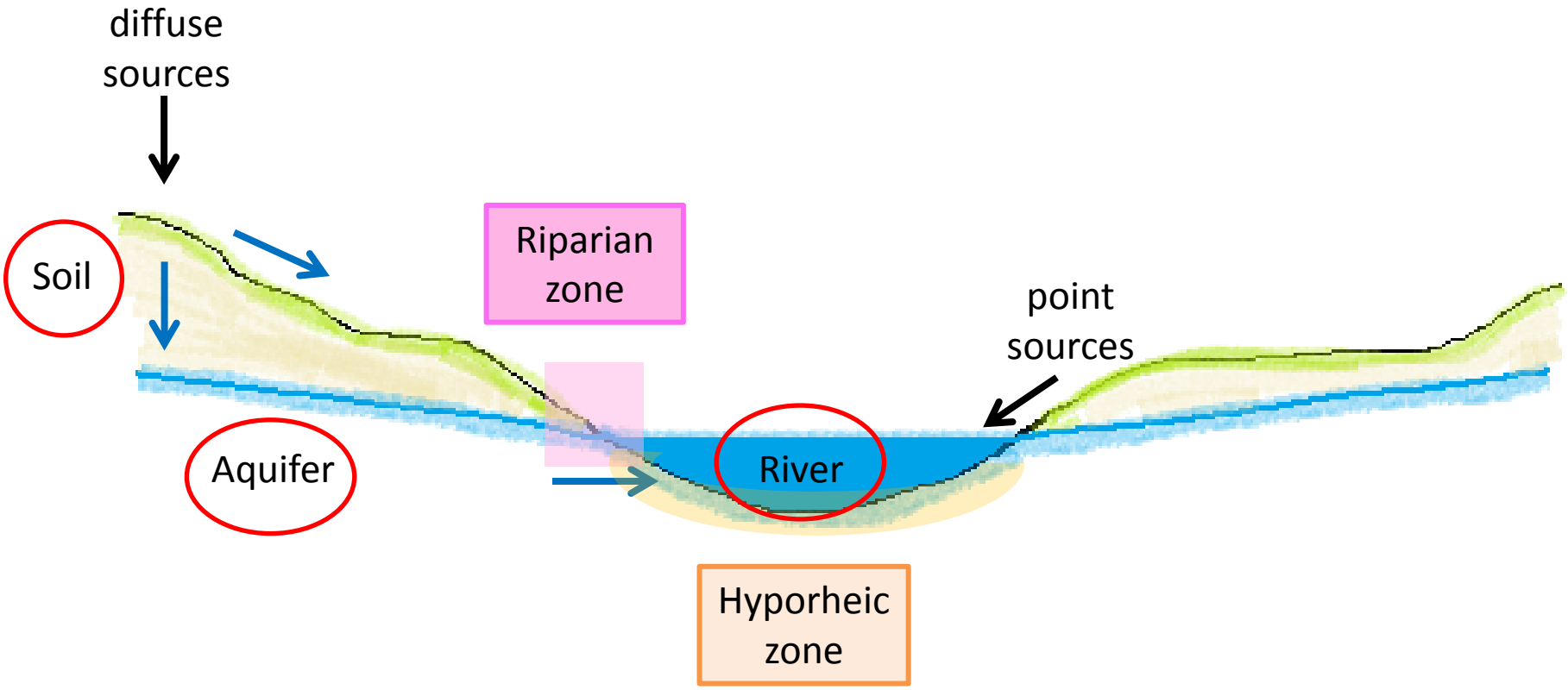


Nitrogen retention: permanent or temporary removal of nitrogen in the river basin

Aquatic continuum from land to ocean *(Billen et al. 1991)*

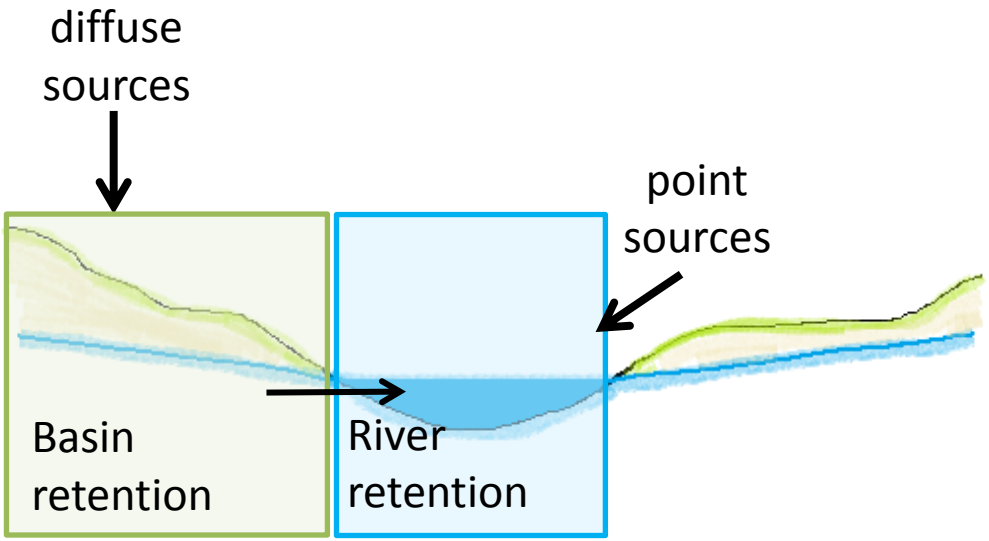
Soils→groundwaters→riparian zones, floodplains→Rivers→estuaries

Nitrogen retention in the aquatic continuum



Model GREEN

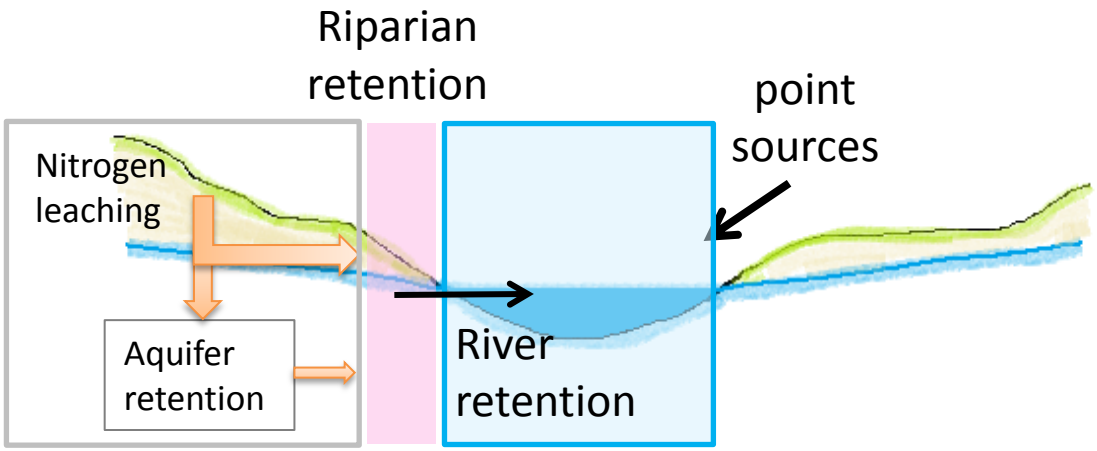
Grizzetti et al. (2008; 2013)



- Conceptual statistical regression model
- Sub-catchments ~170 km2
- Annual nitrogen load
- Application at the European scale

Model RiverStralher

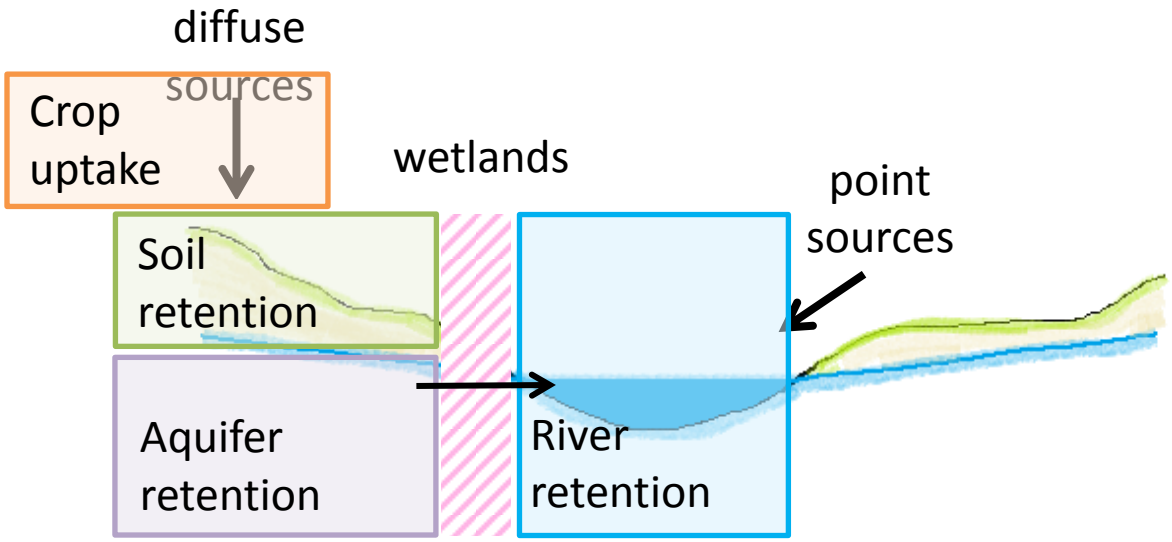
Billen and Garnier (2000)



- Physically based model of stream processes plus conceptual model of nitrogen diffuse emissions from soils
- River axes (1km resolution), sub-basins (stream segments lumped by Stralher order)
- Daily nitrogen concentration
- Application in river basins

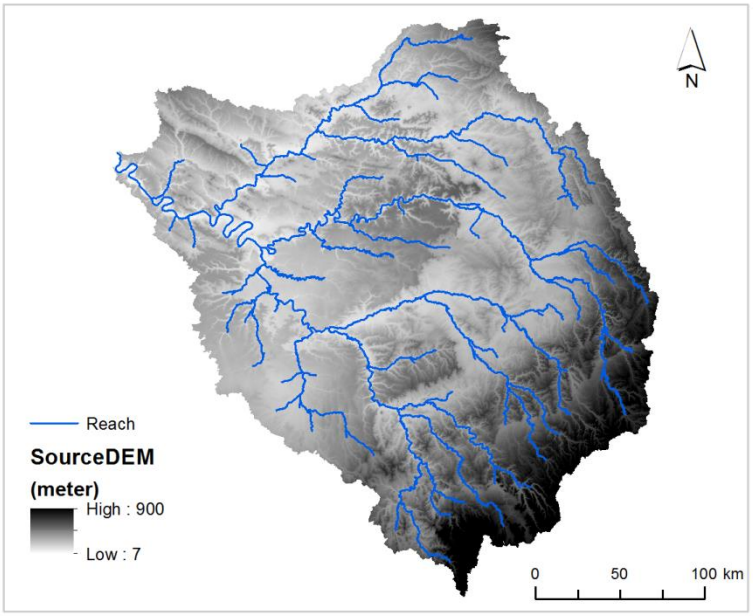
Model SWAT

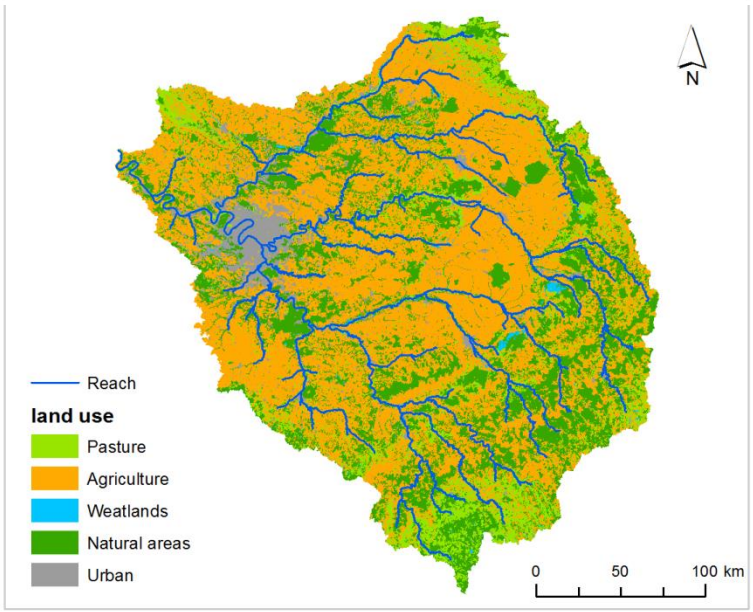
Arnold et al. (1998)



- Physically based model of water and nutrient processes in the river basin
- Sub-basins and Hydrological Response Unit (HRUs)
- Daily water flow and nitrogen concentration
- Application in river basins

Area of study – Seine river basin





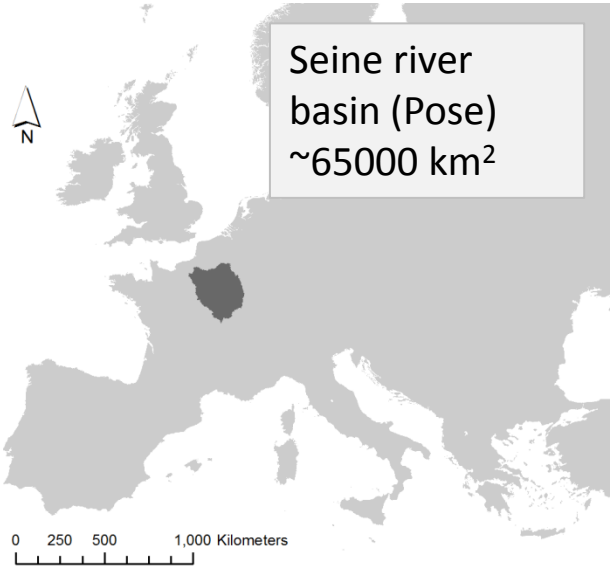
Altitude: 0-900 m

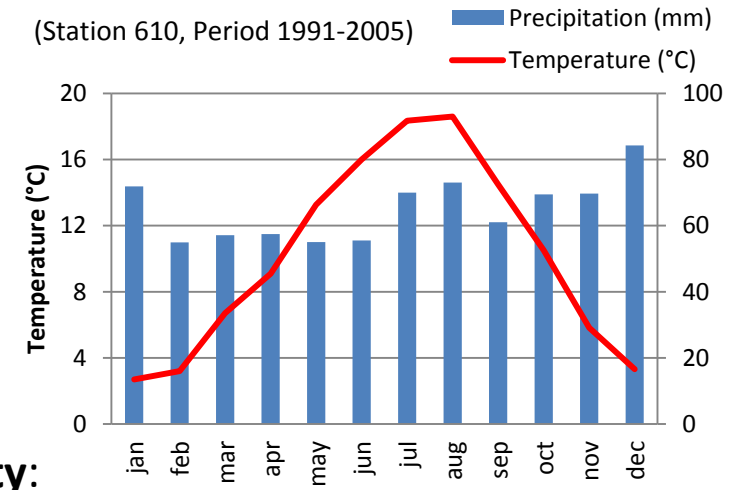
Geology: limestone, clays & chalk

Soils: fertile agricultural soils

Land use:
53% arable land
26% forest
13% grassland
7% urban
1% water

Population density:
215 inh/km^2

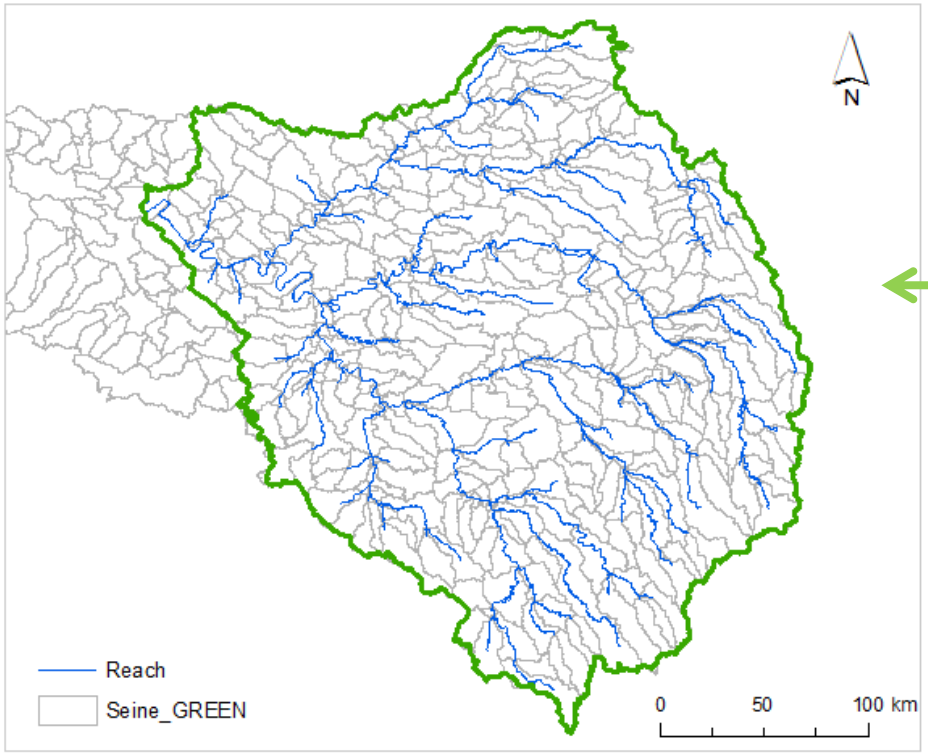


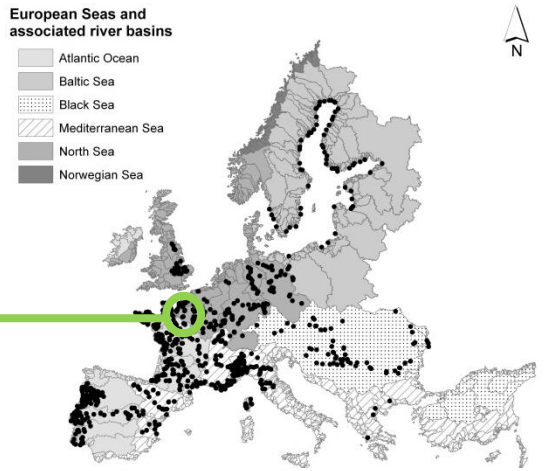


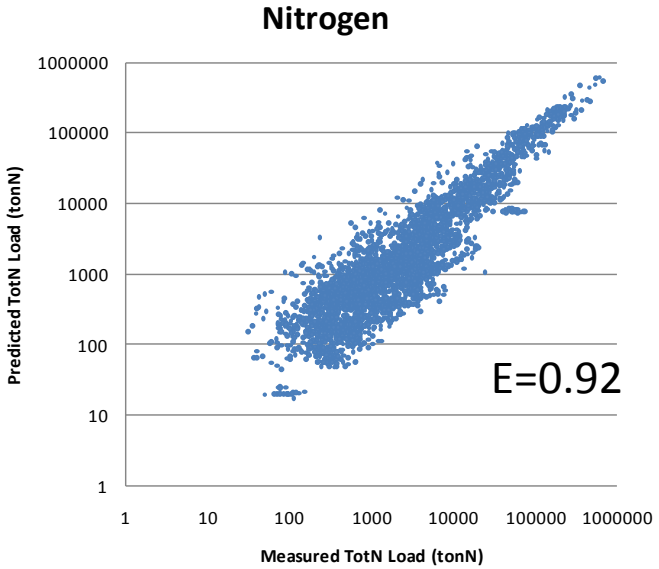
Results – GREEN

Grizzetti et al. (2013)

Seine river basin (Pose): 351 sub-basins



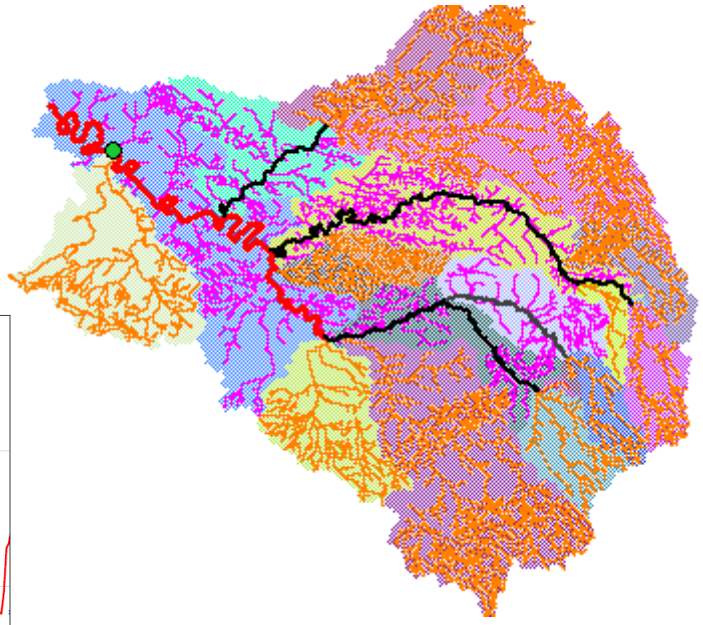


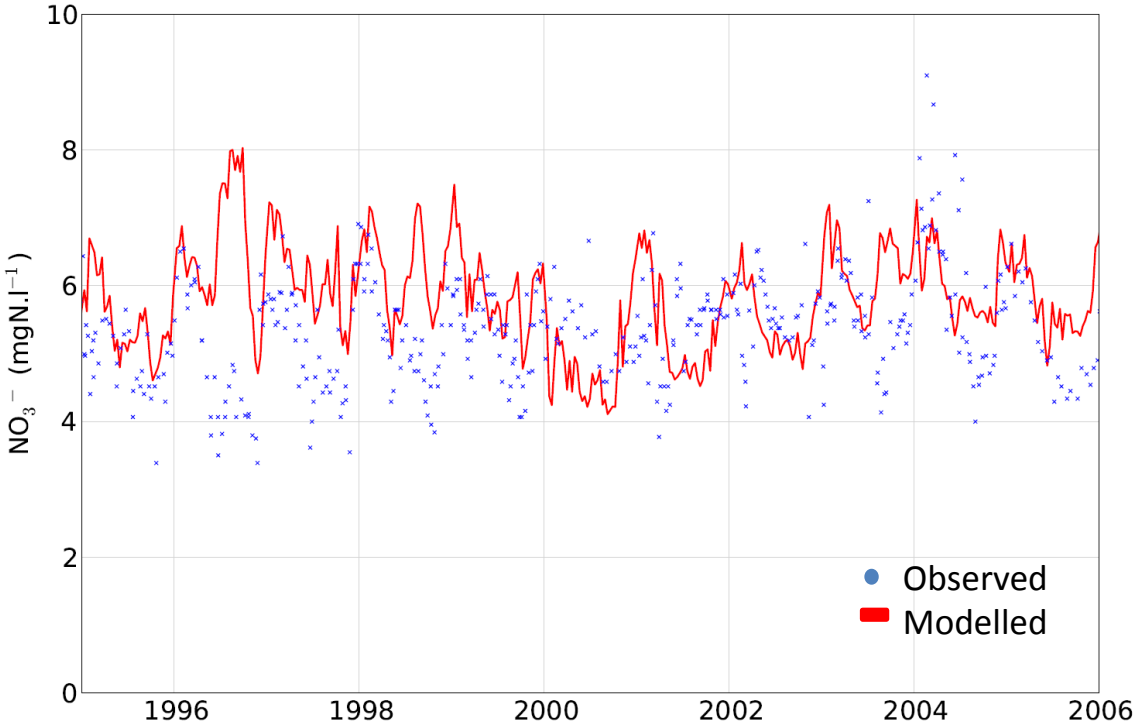


The model GREEN was calibrated against monitored data for years 1985 – 2005 for total N and total P (sub-catchment average area ~170 km^2)

Results – RiverStralher

Passy et al. (2013)

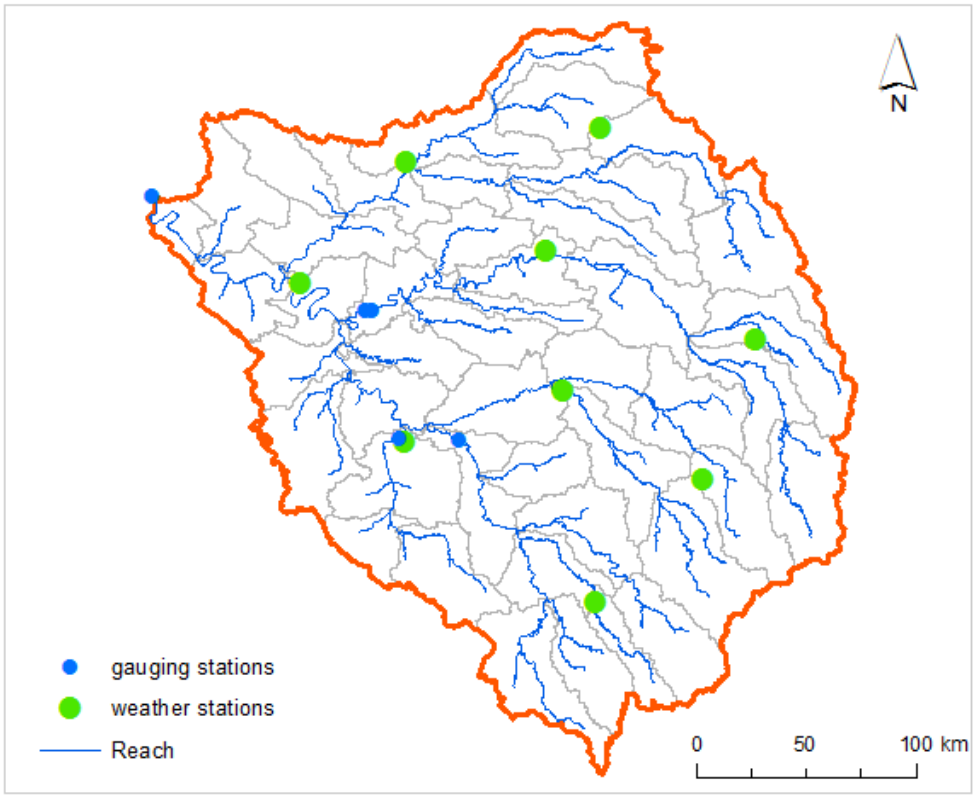




Spatial discretisation:

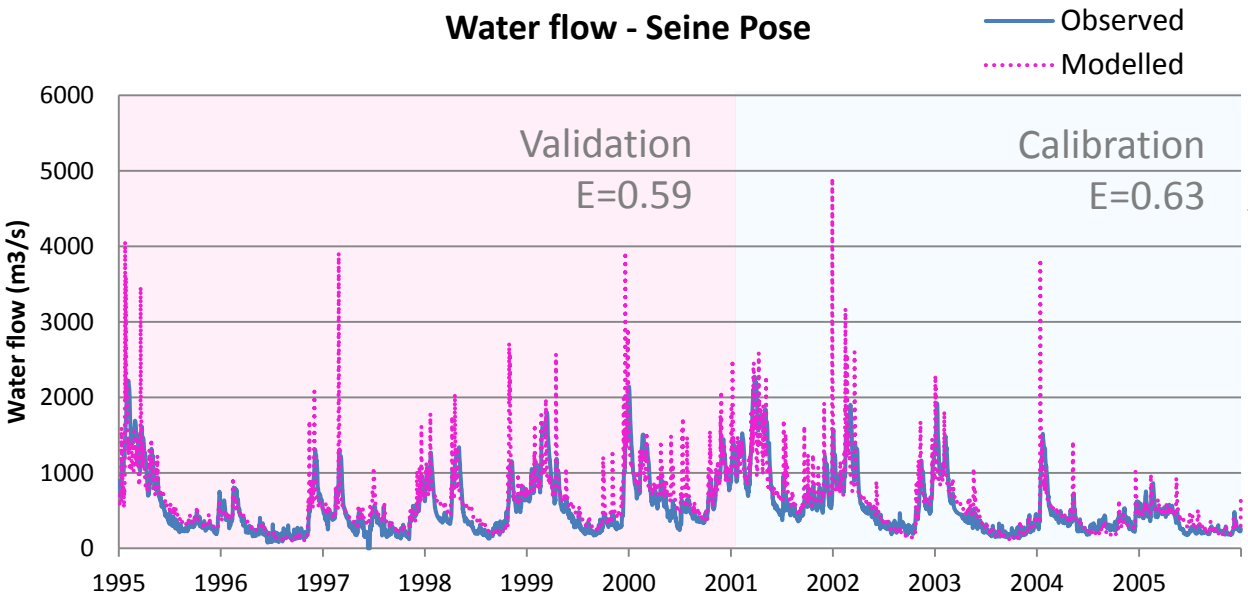
- 5 main river axes
- 21 sub-basins
- ~3000 stream segments

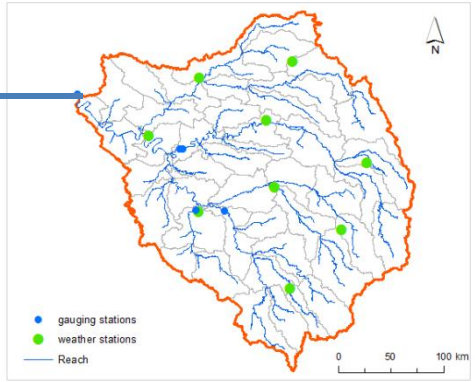
Results – SWAT



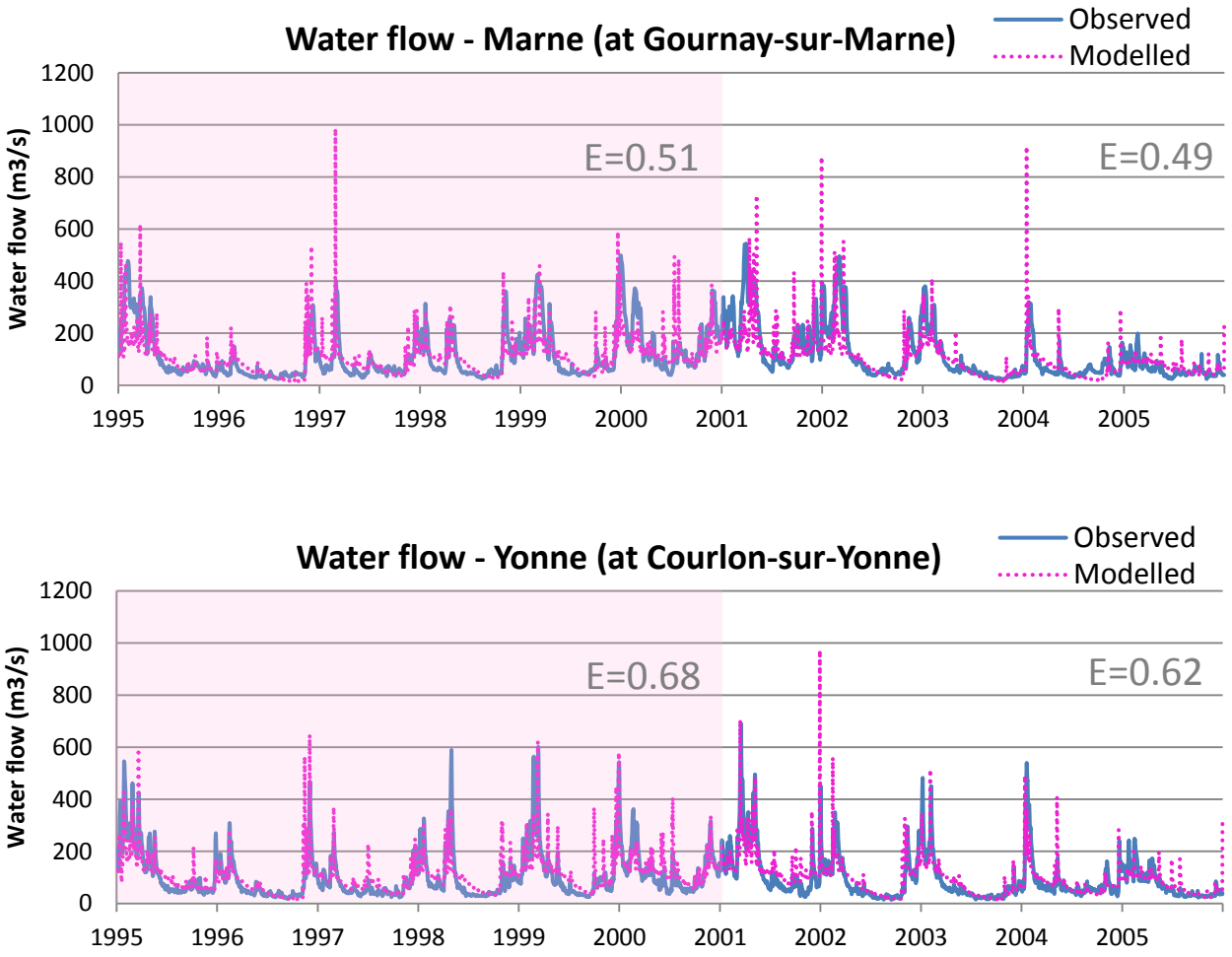
45 sub-basins
373 HRUs

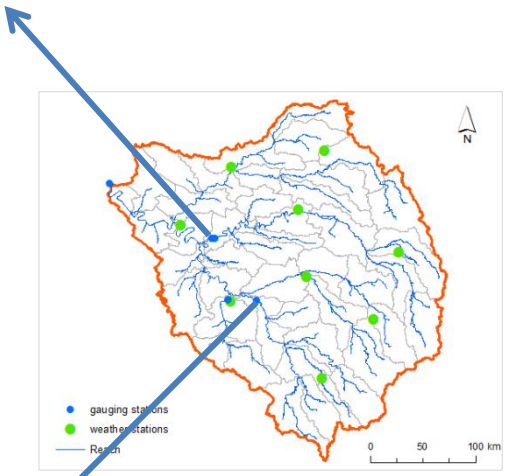
Results SWAT - water flow



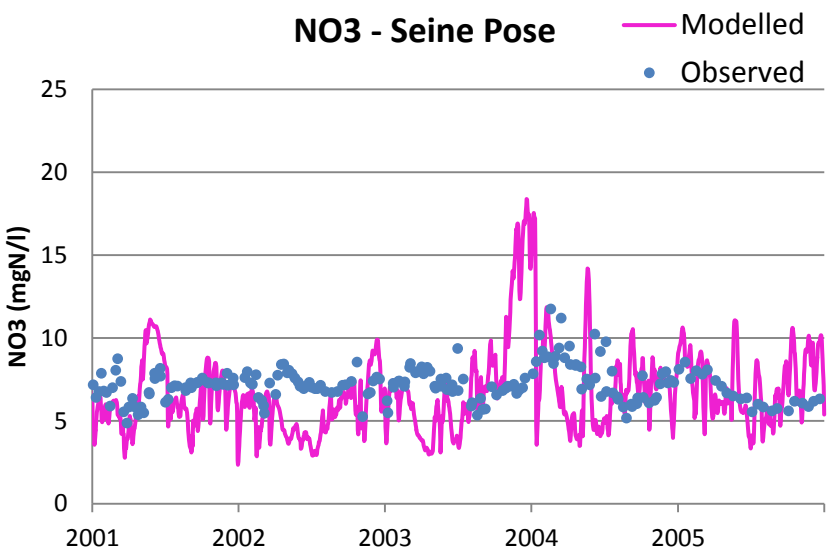


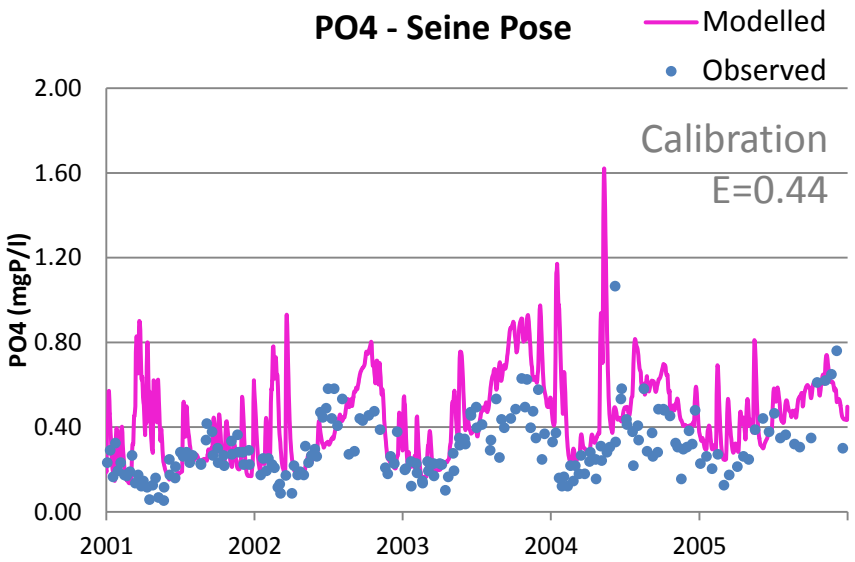
Results SWAT - water flow



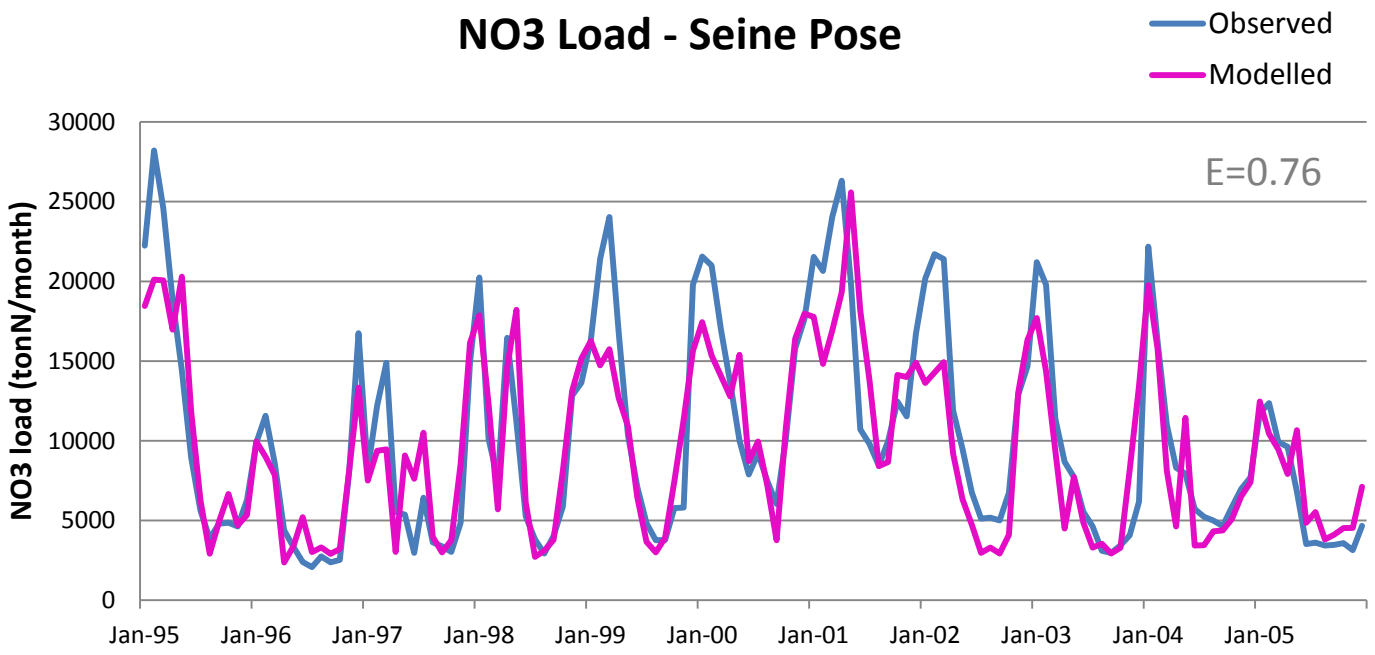


Results SWAT - water quality

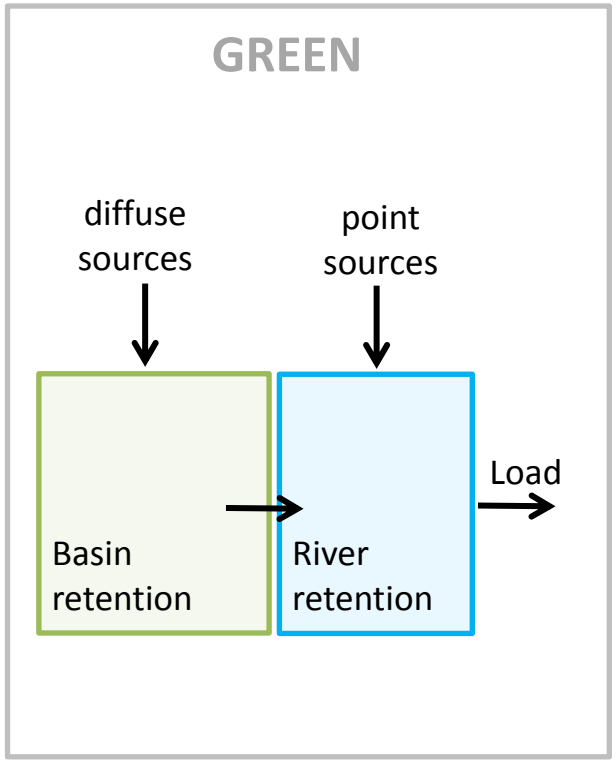


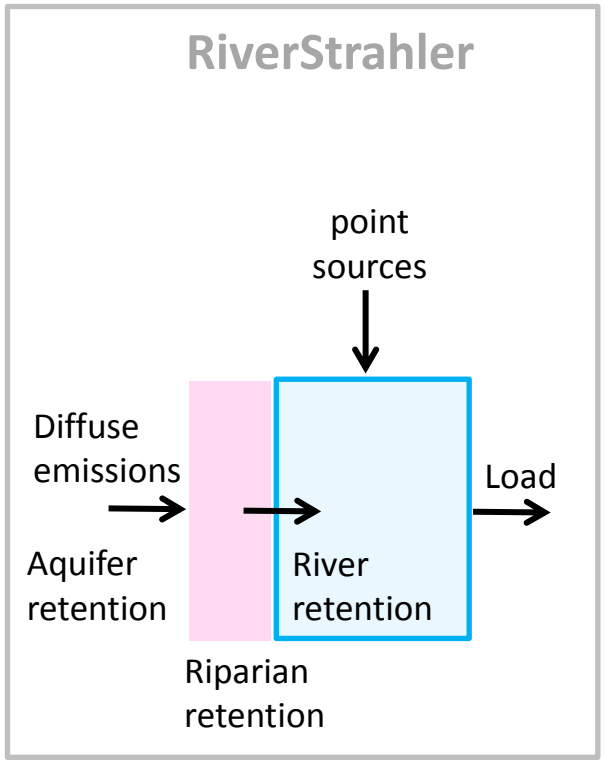


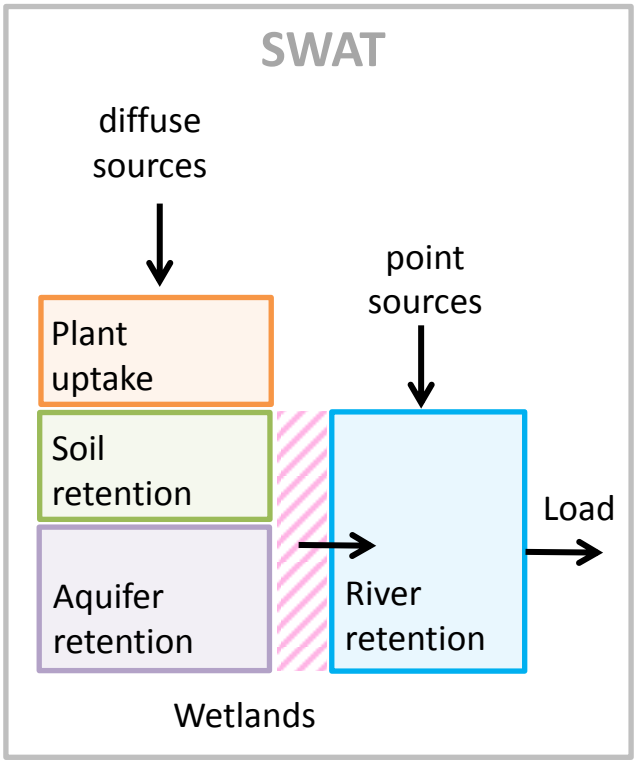
Results SWAT- water quality



Comparison modelling approaches





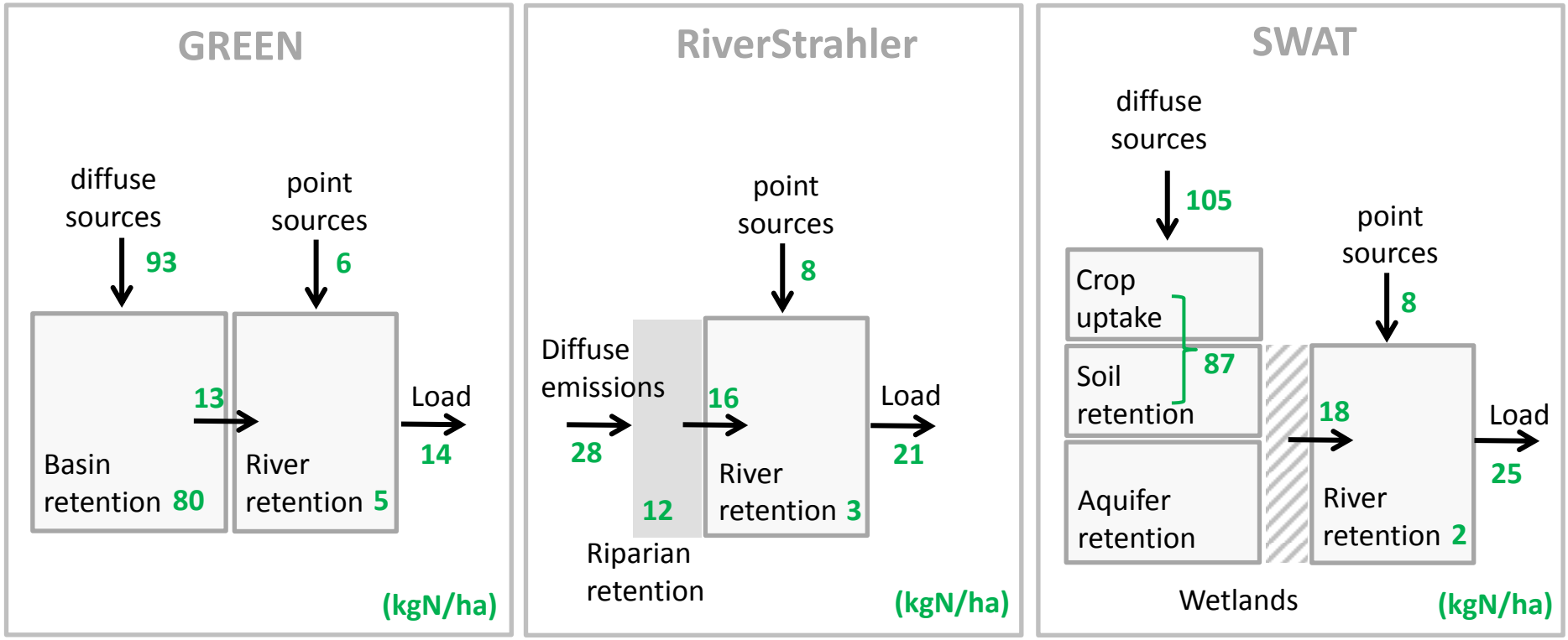


- Conceptual model
- Sub-catchments ~170 km^2
- Annual nitrogen load

- Conceptual & physically-based model
- 5 axes, 21 sub-basins
- 10 days nitrogen concentration

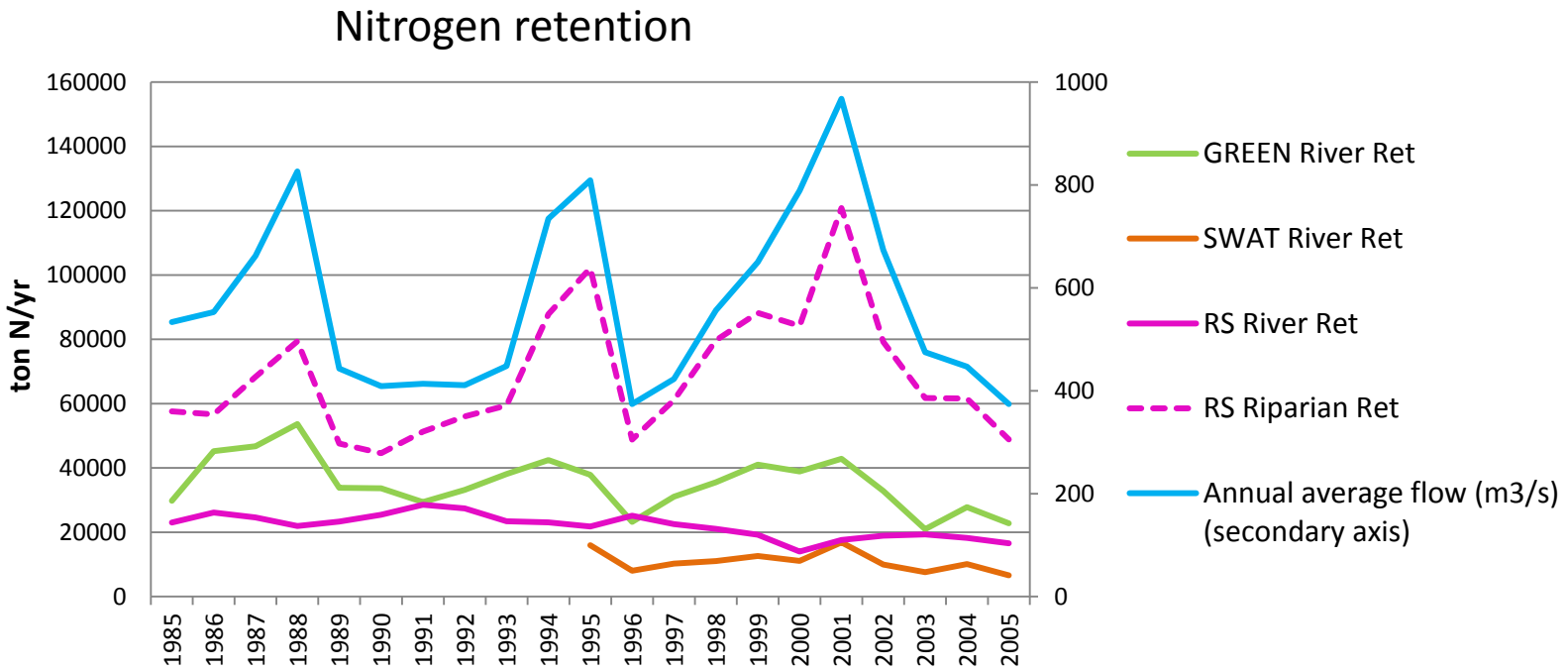
- Physically-based model
- HRUs (373)
- Daily water and nitrogen flow

Nitrogen budget



Annual values for the period: 1995-2005

Nitrogen river retention



Concluding thoughts

To better manage nitrogen we need to improve our understanding of the processes and our capacity of quantifying the fluxes

- **Comparing modelling approaches**→ understanding of processes and uncertainty of estimates
- **Models**→ GREEN, RiverStralher, SWAT
- **Processes**→ riparian areas, aquifer retention, delay of nitrogen pollution accumulated in aquifers

Thank you

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