Coupling of primary production and diel nitrate dynamics in the eutrophic lowland river system Bode

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Magdeburg

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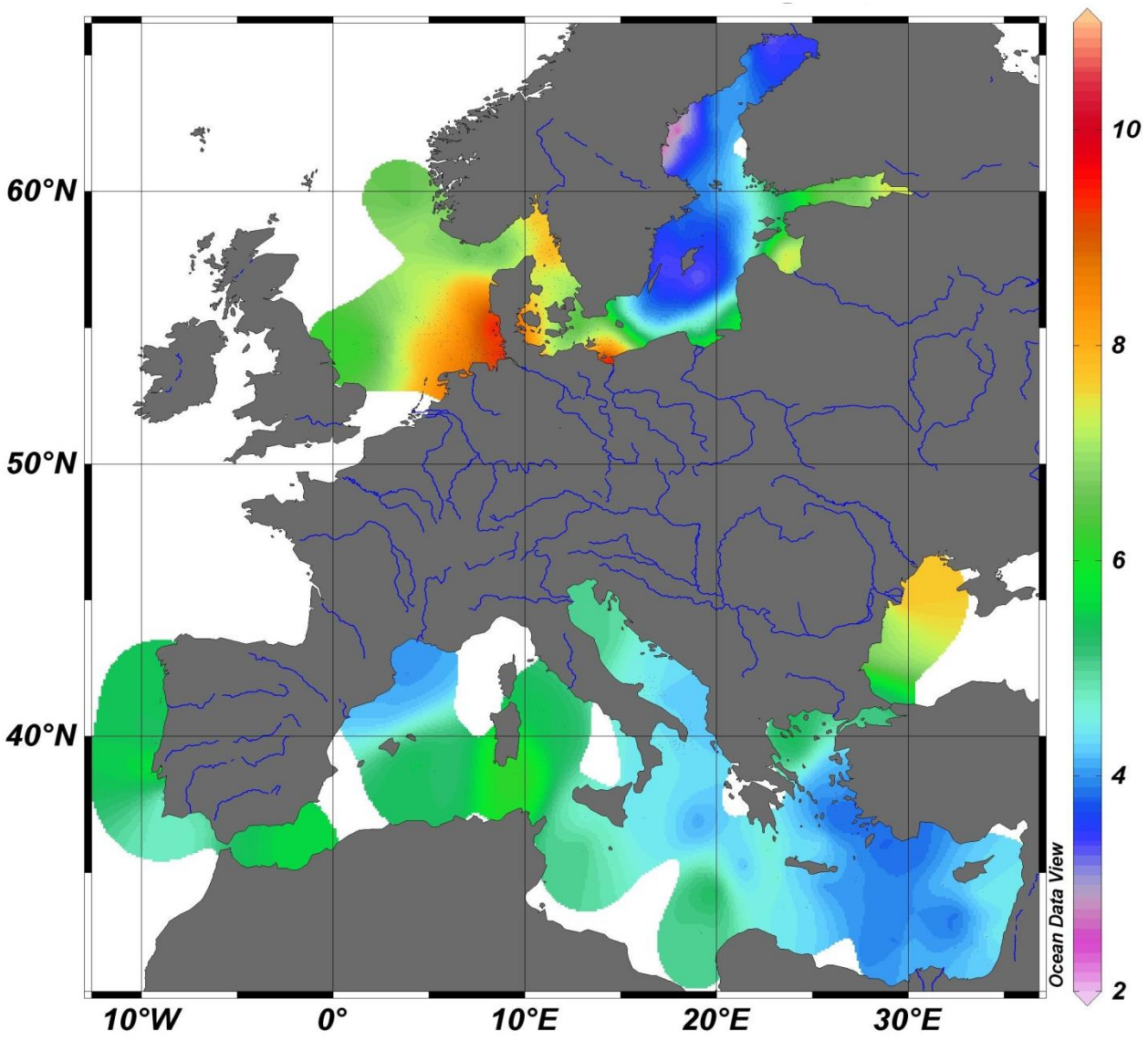
Eutrophication of coastal zones



(Sorce: Emeis et al. 2011)

$\delta^{15}N$
(‰ vs. air N_2)
in top layer
sediments
(0-1 cm)

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Motivation

- Nitrate uptake studies focus primarily on small streams
- Continues measurements of N uptake are missing
- Studies on nitrogen retention in highly impacted streams and rivers are rare
- New high temporal resolution data of water quality

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Objectives

- Ecosystem metabolism
  - Impact of environmental factors on Gross Primary Production
  - Stream size
- Nitrate retention due to GPP
- Assess the value of new UV sensors

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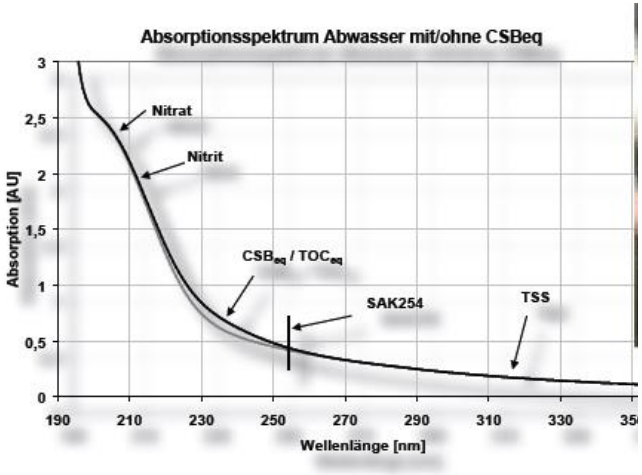
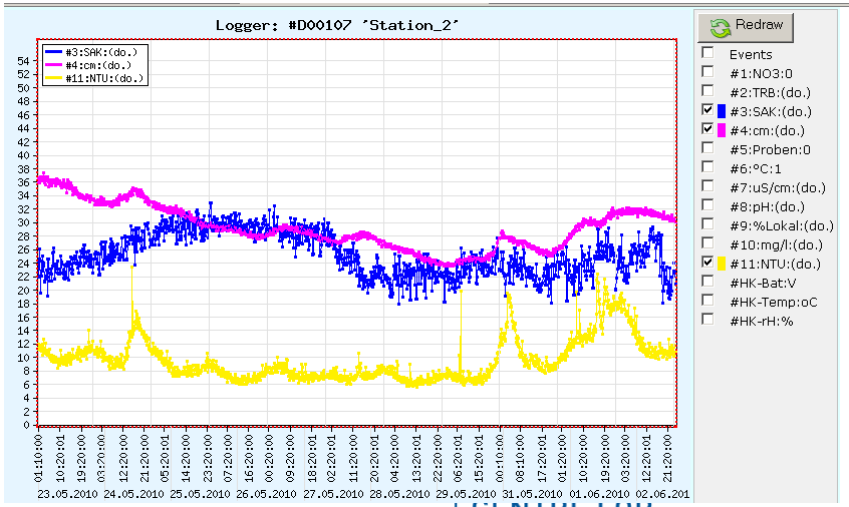
Measurement Sensors and Automatic Samplers

Sensors



- TRIOS UV sensors
- YSI Sensors

Online-Data



Automatic Sampler

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Ecosystem metabolism

- **Evaluating Gross Primary production**

- **Continues oxygen measurements**
  - **GPP calculation using one station dial DO method and energy dissipation method**
  - **Evaluation of controlling factors light, temperature and discharge**

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Study sites

Forest stream, Selke
Station Meisdorf

- mean discharge = 1,5 m³/s
- mean NO_3-N=1,5 mg/l
- reparian vegetation

Agricultural stream, Selke
Station Hausneindorf

- mean discharge = 1,7 m³/s
- mean NO_3-N = 3,3 mg/l
- spars reparian vegetation

Lowland river, Bode
Station Stassfurt

- mean discharge = 12,5 m³/s
- mean NO_3-N = 3,2 mg/l
- spars reparian vegetation

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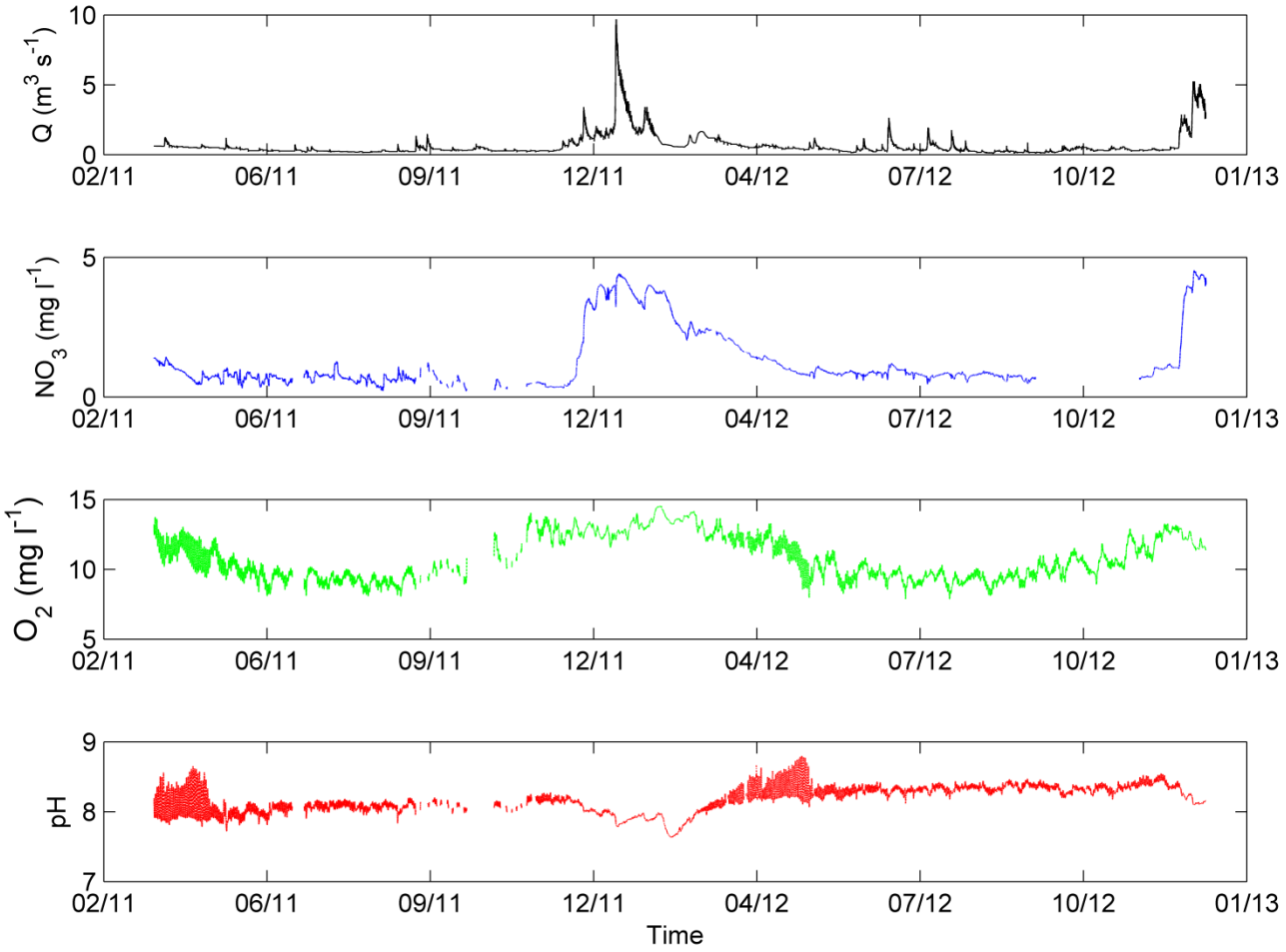
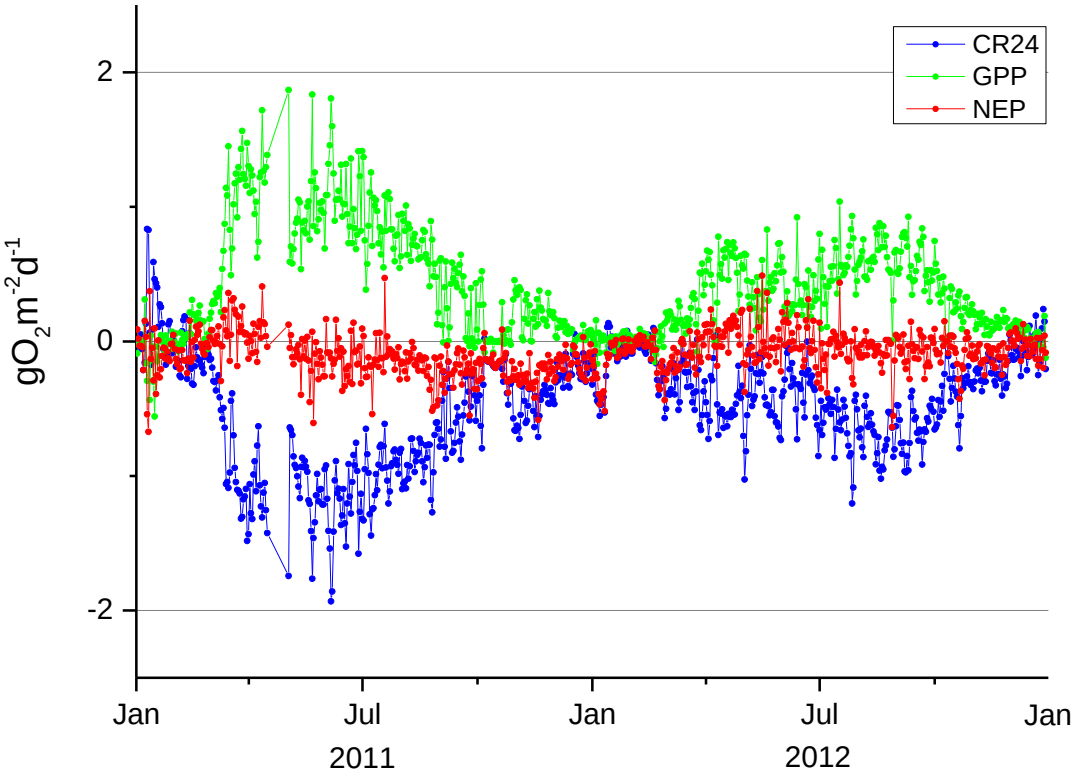
Continues sensor data offer new insights into Ecosystem metabolism (Selke river)



Ecosystem metabolism in the Selke River
(agricultural stream, Selke)



- One station diel DO method (Roberts et al. 2007) and energy dissipation method
- Gross Primary Production (GPP) clearly follows seasonal variation
- NEP was mostly positive during vegetation period
- Clear regression between CR24 and GPP
  >strong contribution of autotrophic respirtion on CR

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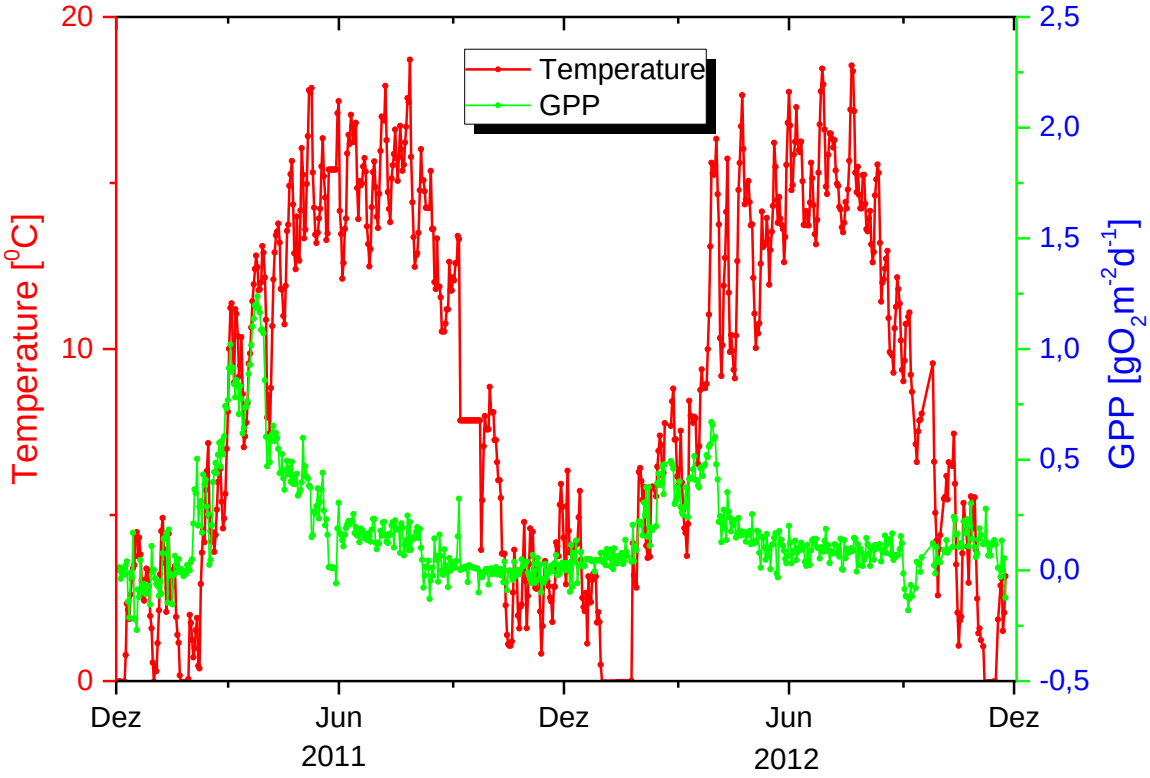
Impact of temperature on GPP
(forest stream reach, Meisdorf)



- High GPP during spring
- Much lower GPP than in agricultural stream
- Clear temperature effect only in spring
- Light is the controling factor of GPP
- Autumn peak during leave litter fall

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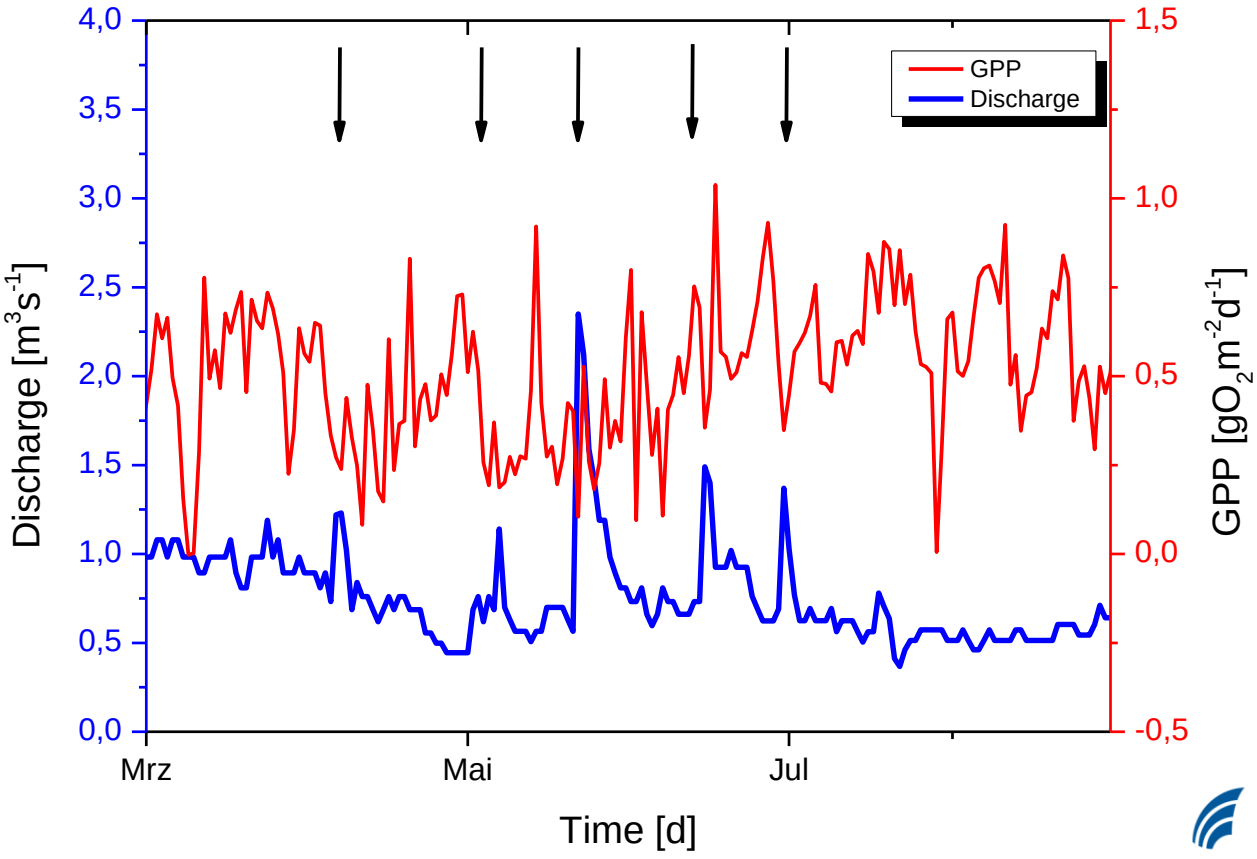
Impact of discharge on Gross Primary Production
(agricultural stream, Hausneindorf)



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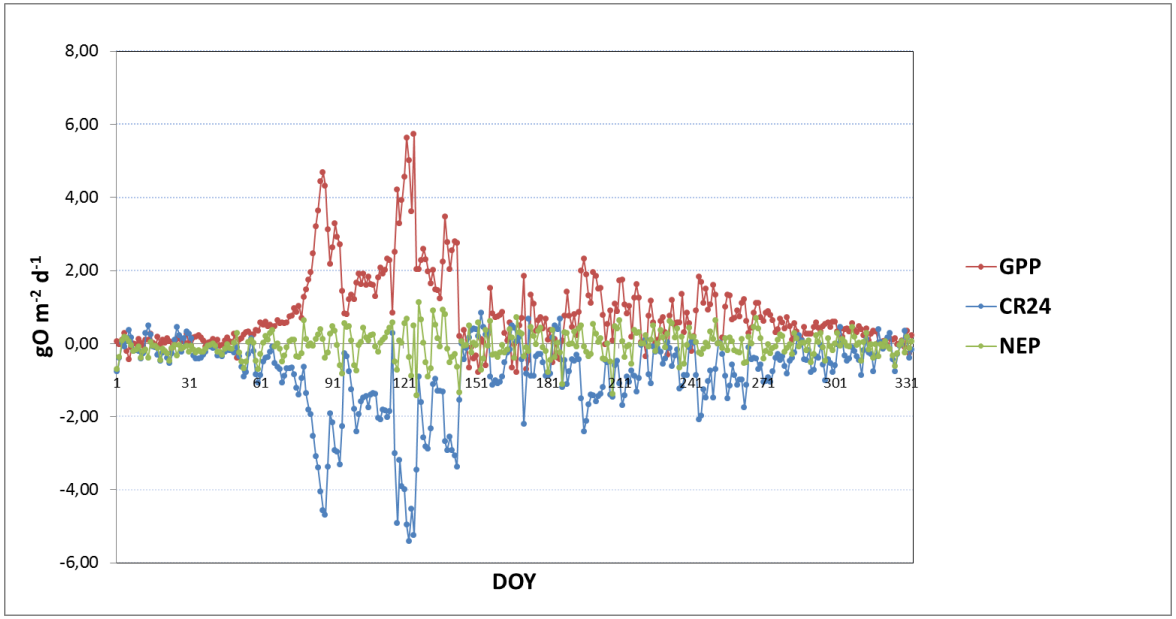
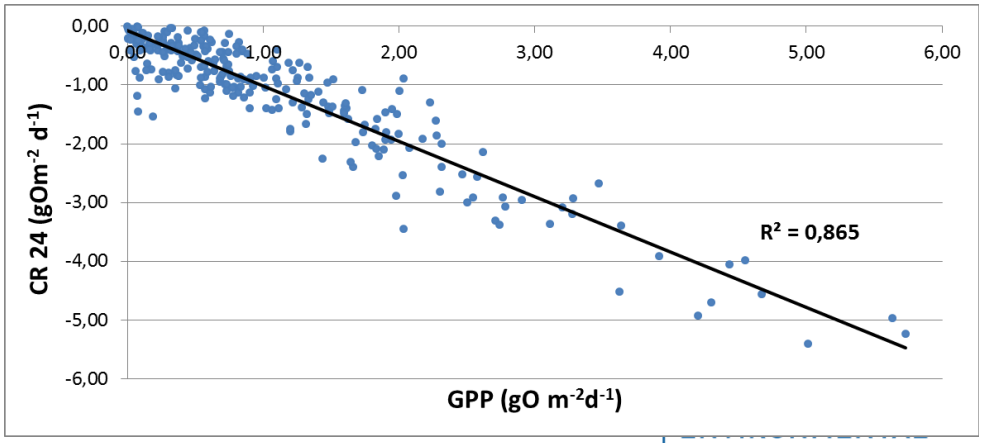
Ecosystem metabolism in the Bode
(lowland river)



- two GPP peaks in spring are caused by algae blooms
- Another slight increase of GPP in automn (litter fall)

- Community respiration mirrores GPP
- GPP was a strong predictor of CR24-> autotrophic respiration is dominating



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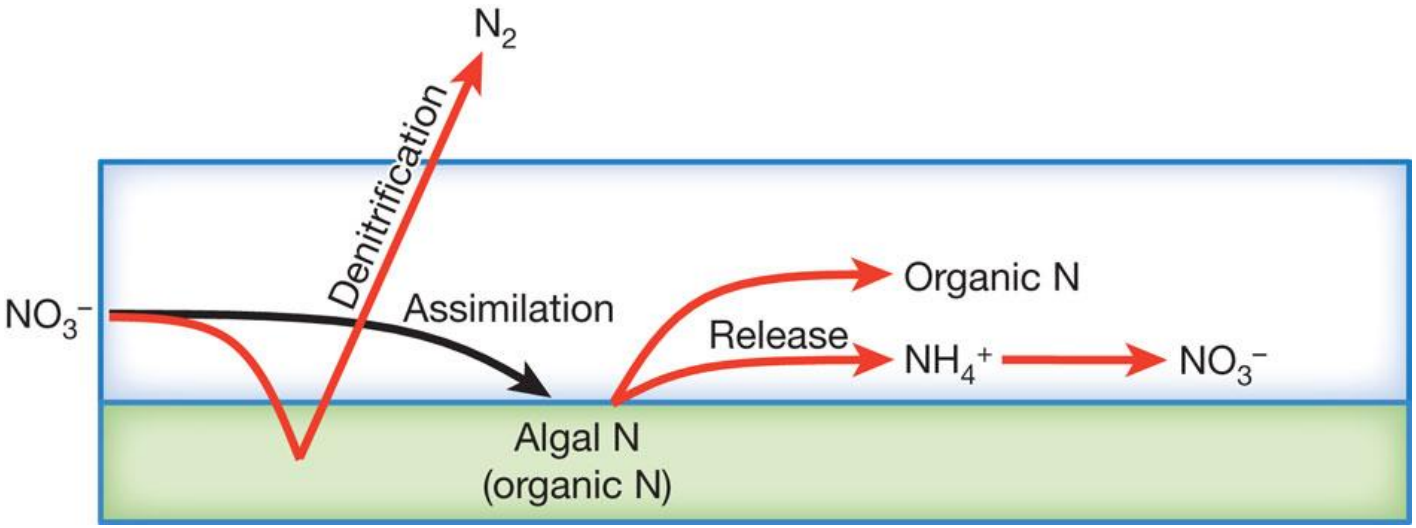
Nitrogen cycling in streams.



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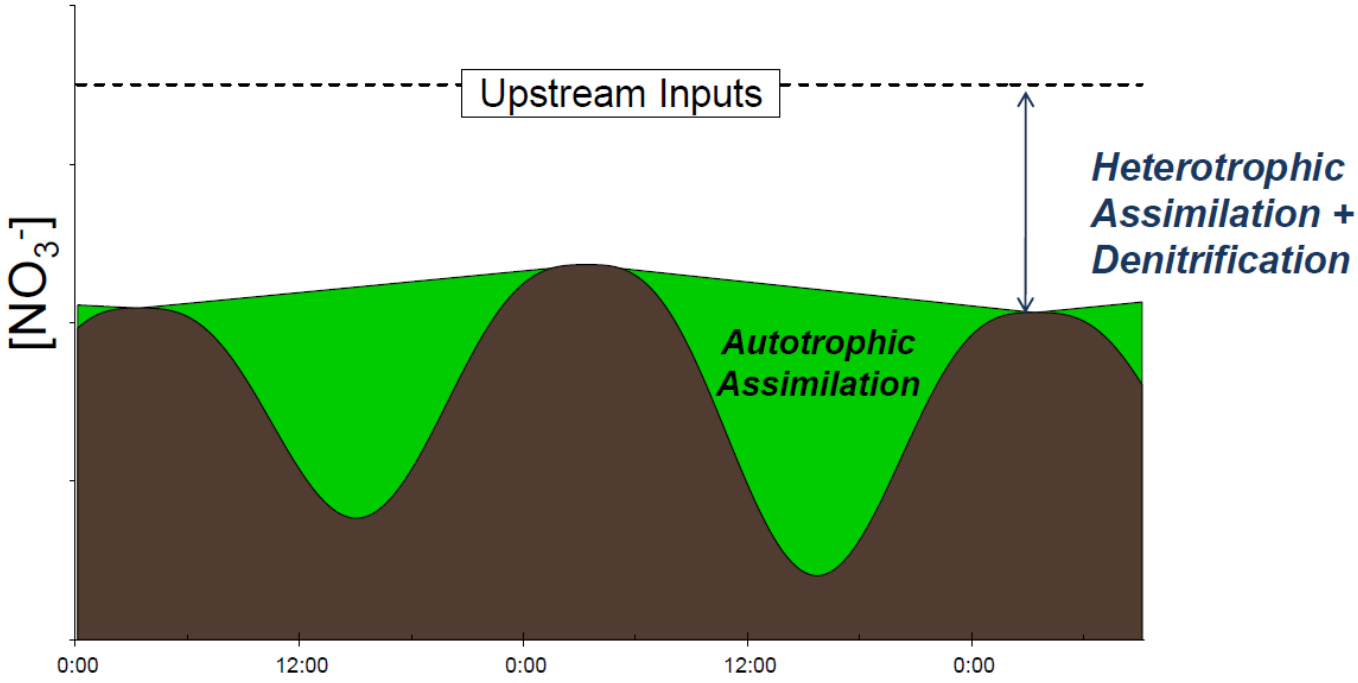
Diel Method for Inferring Nitrogen Retention Mechanisms



Heffernan and Cohen 2010

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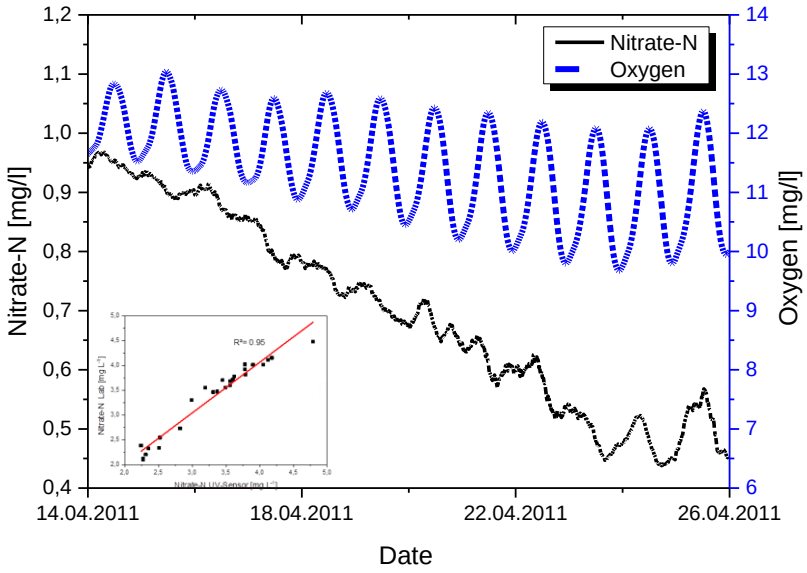
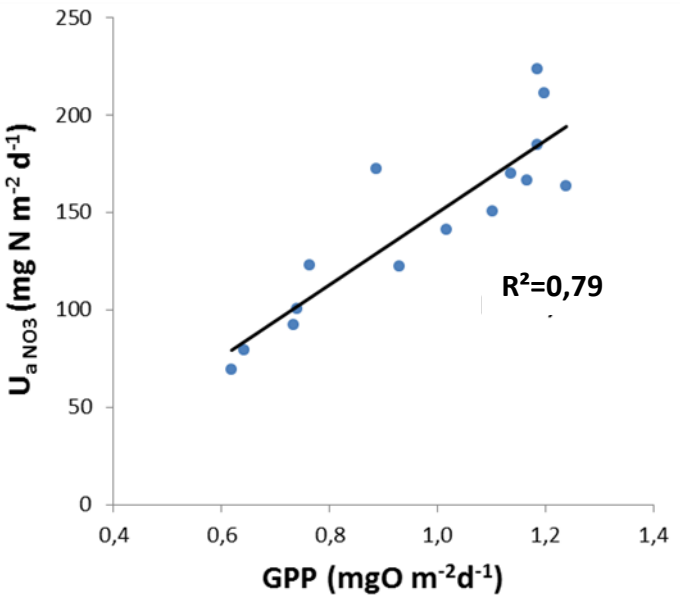
N uptake rate related to GPP

example forest stream, Selke

Dial nitrate and oxygen amplitudes



Nitrate uptake rate and GPP



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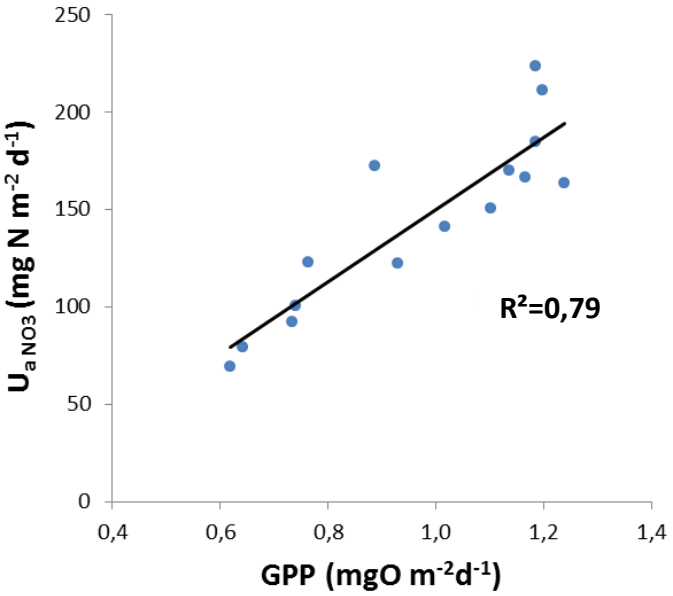
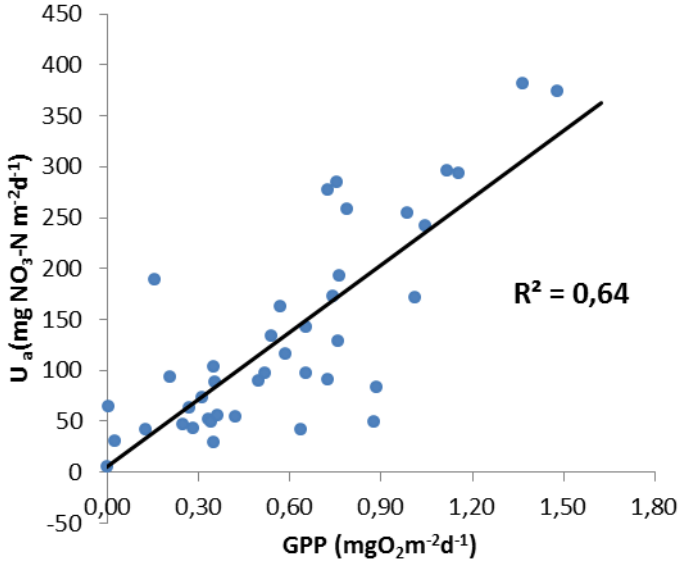
NO_3 uptake rate related to GPP, Selke River

Forest stream (Meisdorf), April 2011



Agricultural stream (Hausneindorf), 2011



- Low flow conditions
- Lower GPP in forest stream
- Similar slopes of regression functions

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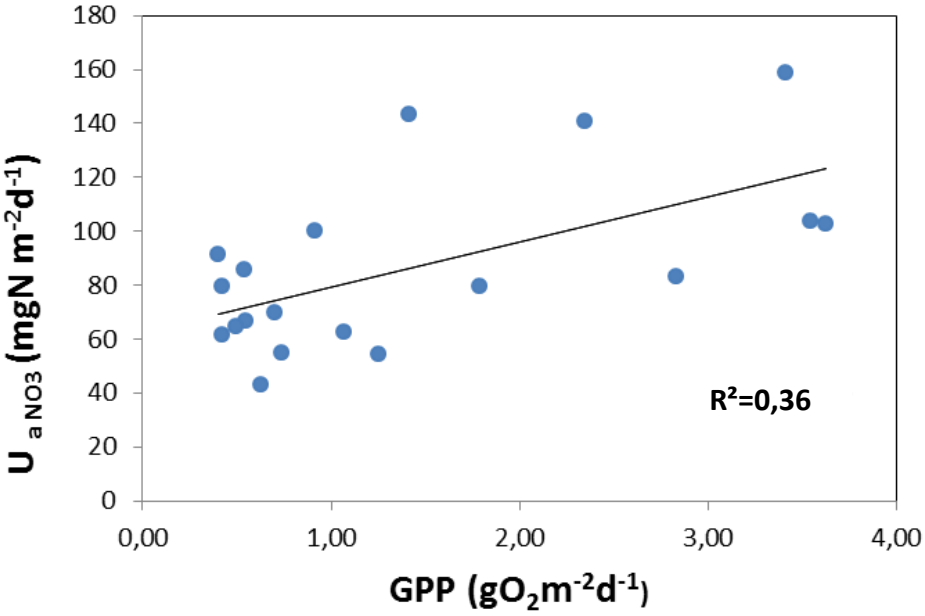
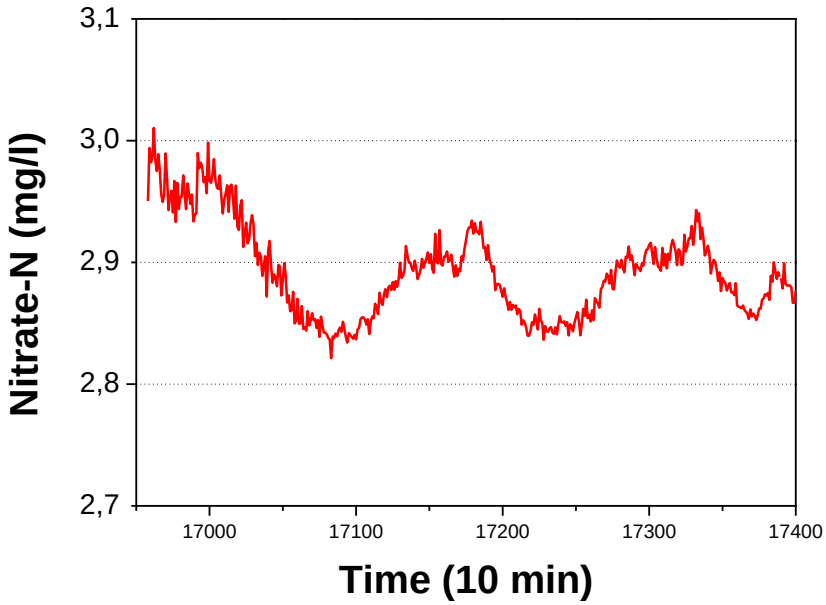
Primary Production and Nitrate Uptake at lowland river Bode, Gauge Station Stassfurt

NO_3 uptake rates



Dial NO_3 amplitudes



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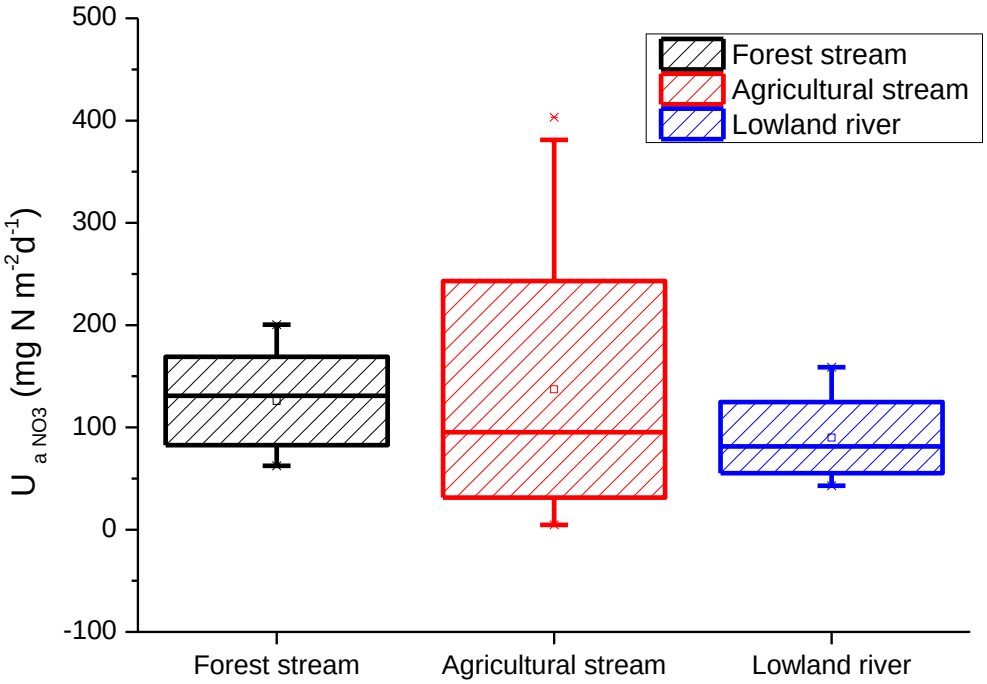
Ranges of NO_3 assimilatory uptake rates with high GPP

comparison of different stream systems



- Uptake rates based on short term dial NO_3 amplitudes
- Agricultural stream shows largest uptake ranges
- Uptake rates are in similar orders for all stream systems

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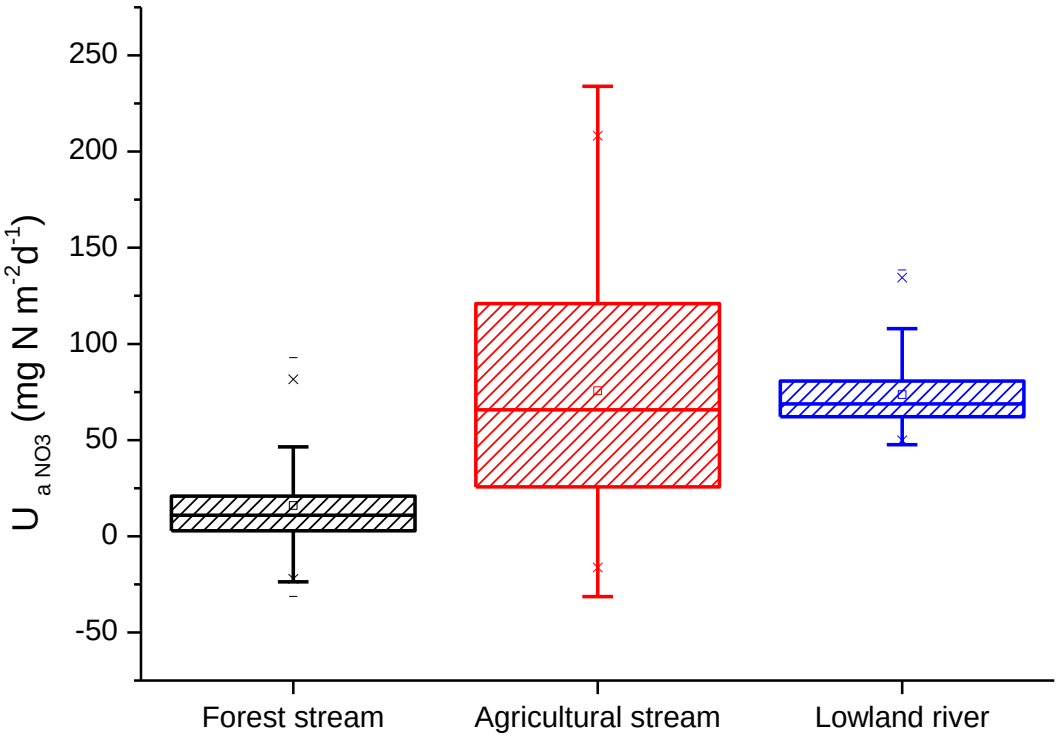
Ranges of NO_3 assimilatory uptake rates on a yearly basis (2012)

comparison of different stream systems



- Forest stream shows lowest assimilatory NO_3-N uptake
- Light availability controls areal NO_3-N uptake

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Conclusions

- Continues measurements allow new continues insights into stream ecosystem metabolism
- Discharge events can disturb GPP
- Assimilatory N uptake can be evaluated by continues nitrate measurements
- Nitrate concentrations and light availability control N uptake
- N uptake rates vary but were in a similar order for all stream systems

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