

Improved understanding of the impacts of hydroclimate, land use and agricultural management on nitrate concentration dynamics using SWAT

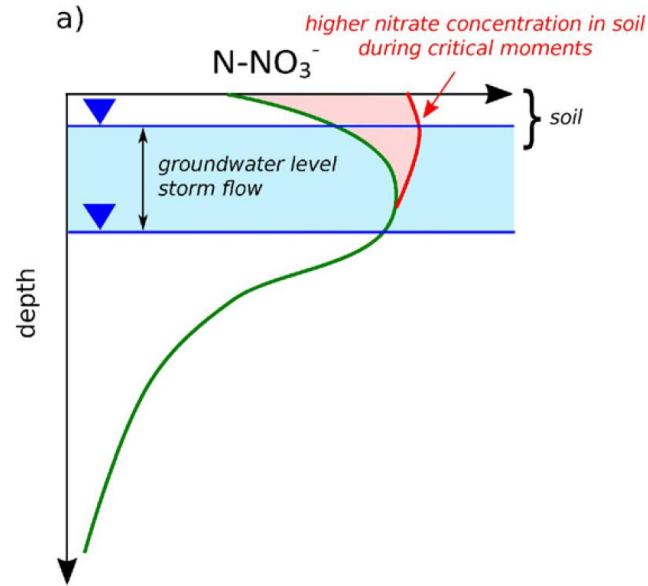
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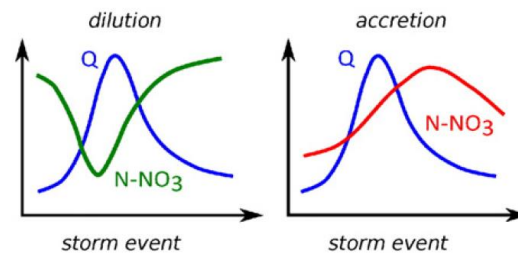
² Division of Agronomy

University of Natural Resources and Life Sciences, Vienna (BOKU)

From Dupas et al. (2016)



Storm flow C-Q patterns



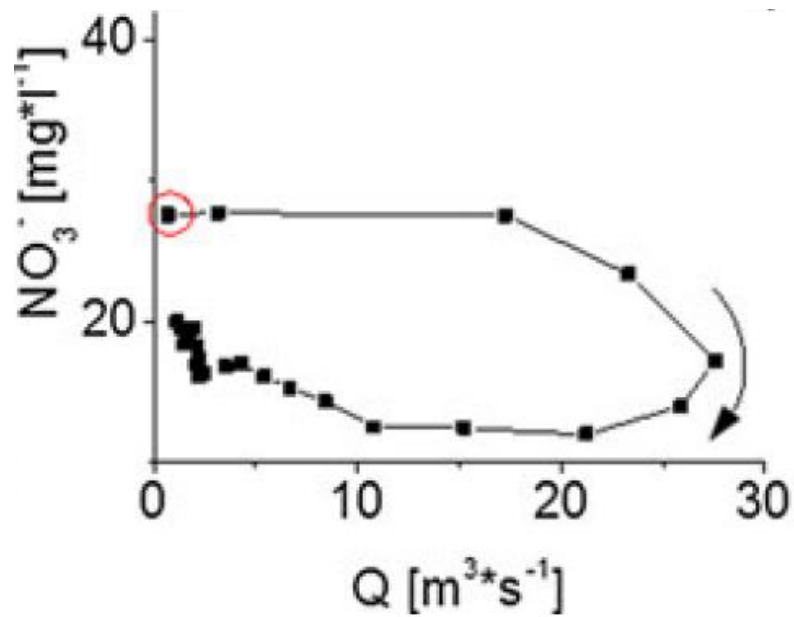
Source limited

Transport limited

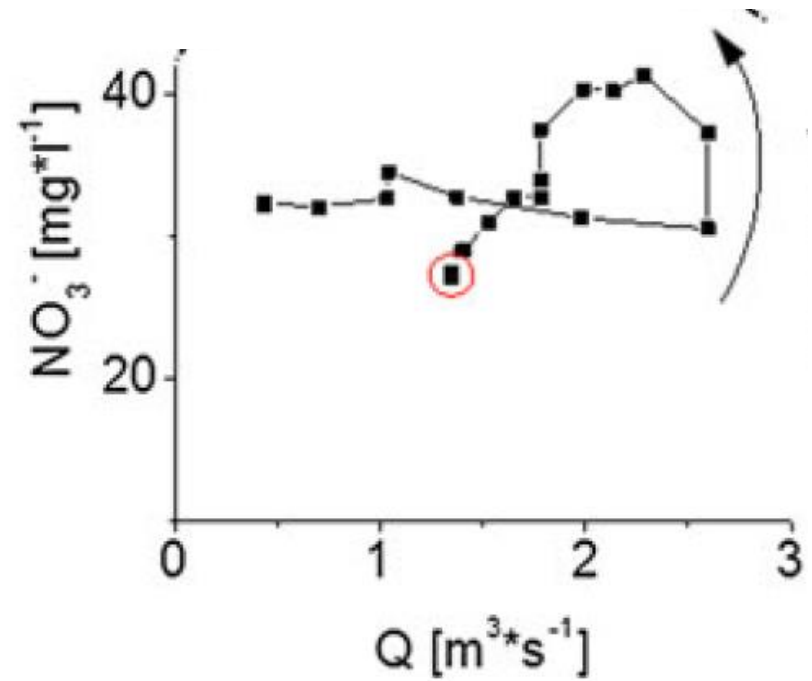
Dilution or accretion

From Schwientek et al. (2013)

dilution



accretion

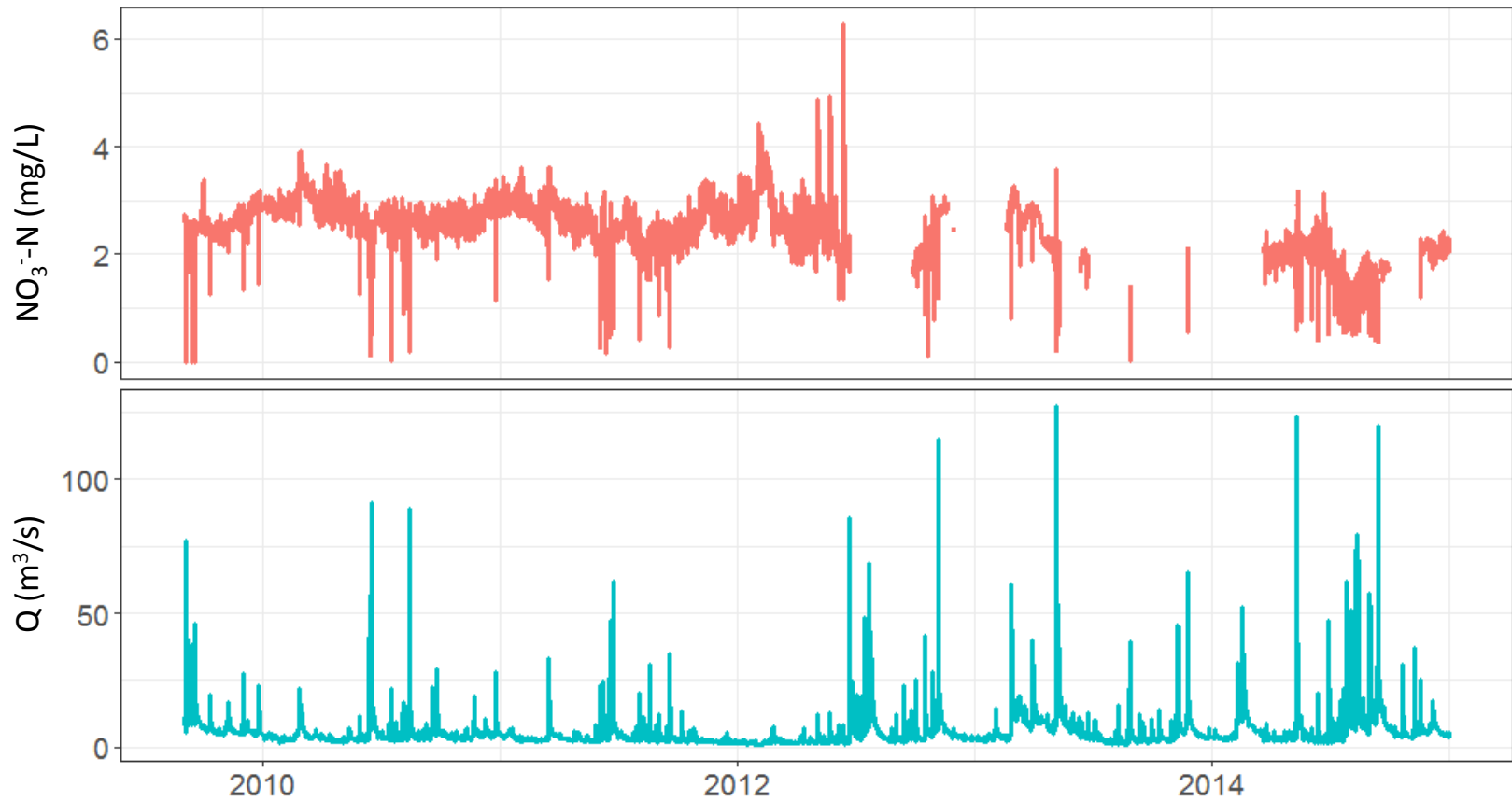


Research questions

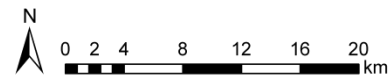
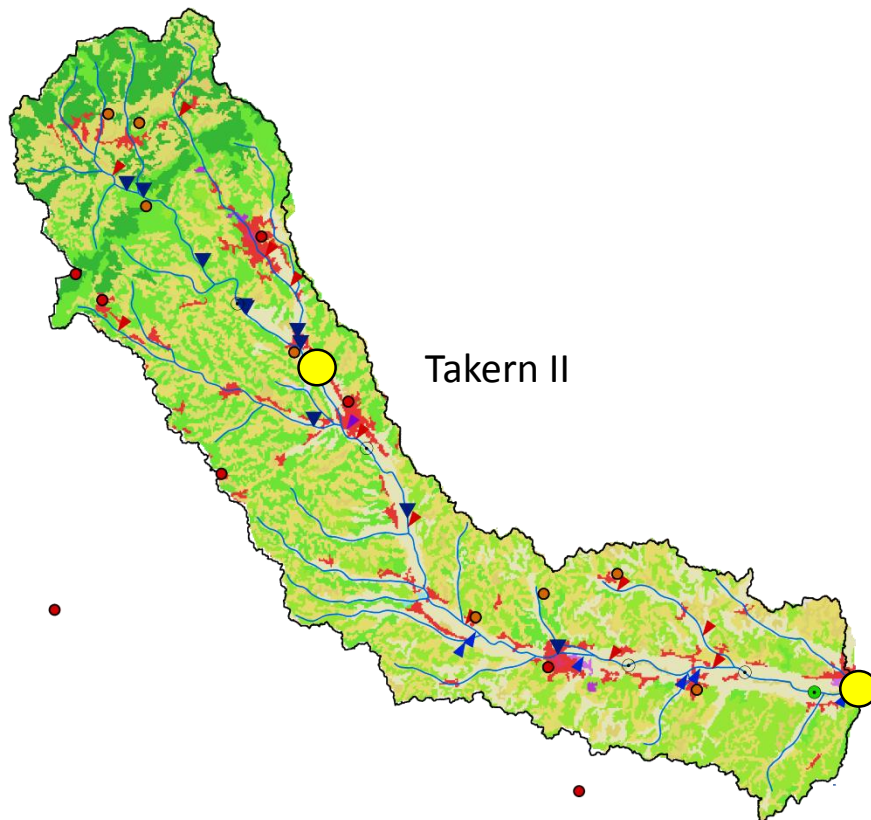
- Can SWAT reproduce the chemodynamics of NO_3^- -N concentrations observed in a watershed?
- Is it possible to use SWAT to determine if an event (a watershed) is transport-limited or source-limited?

Available observed data at Takern II

- 5 Minute NO_3^- -N (mg L^{-1}) samples



The Raab watershed (988 km²)



Measurement stations

- ▼ Discharge gauge, eHyd
- Weather station, ZAMG
- Precipitation gauge, eHyd
- Water quality online monitoring, IMW3, Raab mon.
- Water quality monitoring (in operation), GZÜV
- Water quality monitoring (not operating), GZÜV

Point sources

- ▲ Waste water treatment plant > 2000 PE (municipal)
- ▲ Waste water treatment plant (industrial)
- ▲ PRTR plant (Pollutant Release and Transfer Register)

— Water course □ Basin boundary

Land use

- | | |
|-----------------------------|---------------------|
| ■ Settlement, dense | ■ Pasture |
| ■ Settlement, light | ■ Complex patterns |
| ■ Industry, Infrastructure | ■ Deciduous forest |
| ■ Mining | ■ Coniferous forest |
| ■ Urban green areas | ■ Mixed forest |
| ■ Non irrigated Agriculture | ■ Natural grassland |
| ■ Viniculture | ■ Water bodies |

Neumarkt/Raab

Calibration at daily time step

- Multicriteria sensitivity analysis. 16 parameters selected for calibration



- LHS with 100 000 parameter combinations

- Statistical criteria for calibration

Q daily: KGE > 0.6, RSR (FDC) < 1

NO₃⁻ daily: KGE > 0.4, |pbias| < 0.5, RSR (FDC) < 2

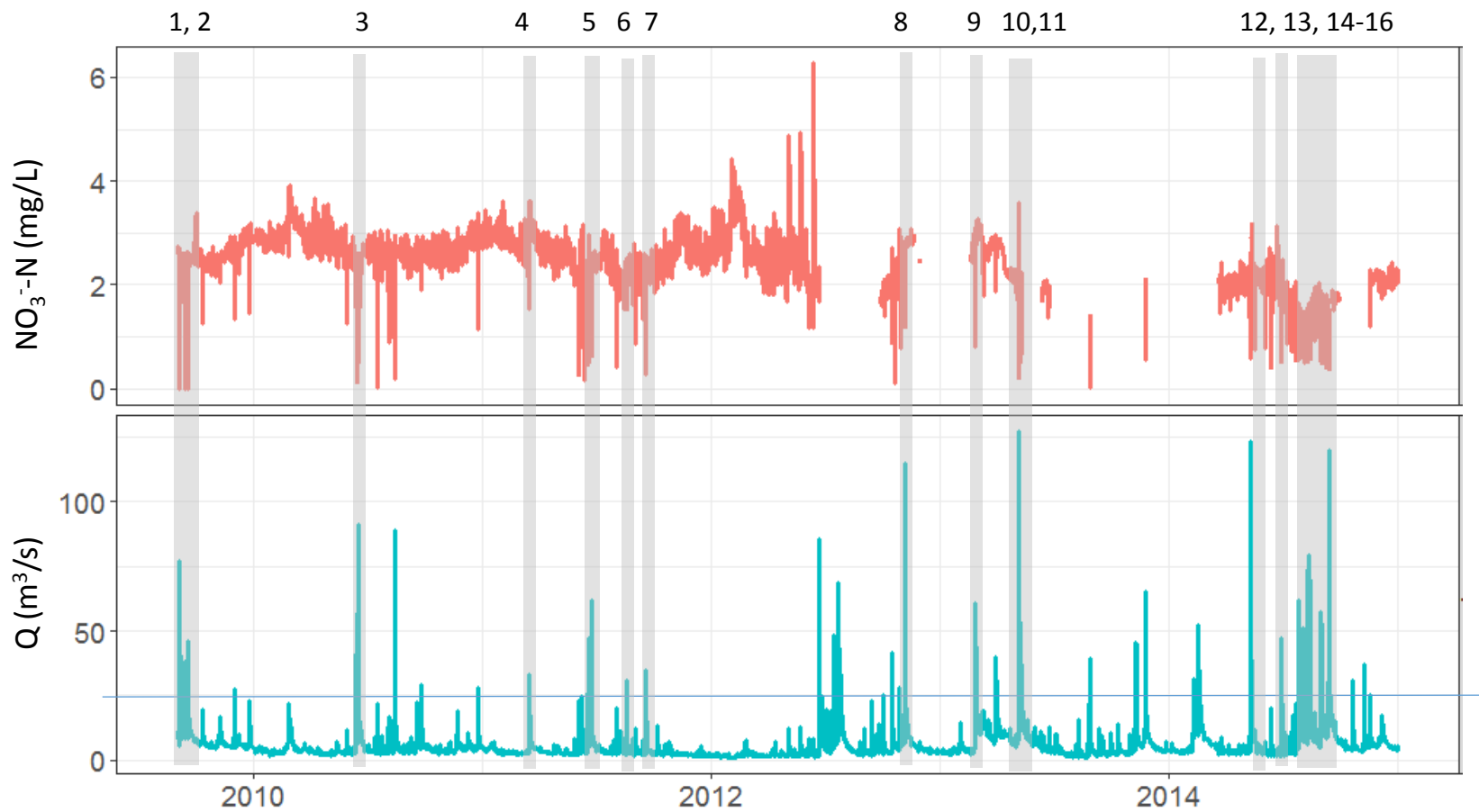
- Results for NO₃⁻-N calibration:

		Index of
NSE	KGE	Agreement
0.42	0.62	0.63

```
v__SFTMP.bsn  
v__SNOCOVMX.bsn  
v__SURLAG.bsn  
v__GW_DELAY.gw  
v__GW_REVAP.gw  
v__GWQMN.gw  
v__RCHRG_DP.gw  
r__SOL_K...sol  
r__SOL_AWC...sol  
v__SLSOIL.hru  
v__ESCO.hru  
v__LAT_TTIME.hru  
a__OV_N.hru  
r__CNOP...6..mgt  
v__RCN.bsn  
v__NPERCO.bsn
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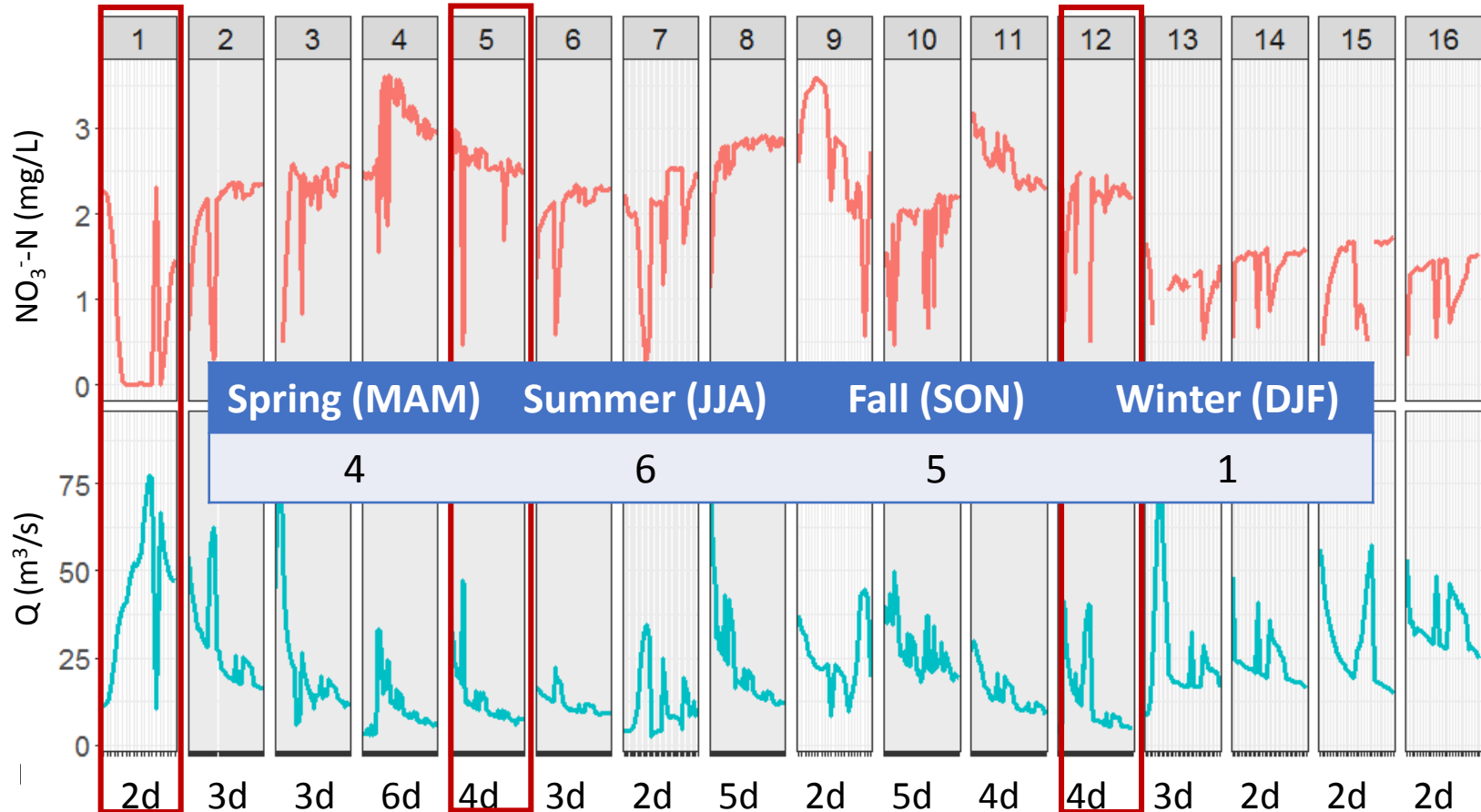
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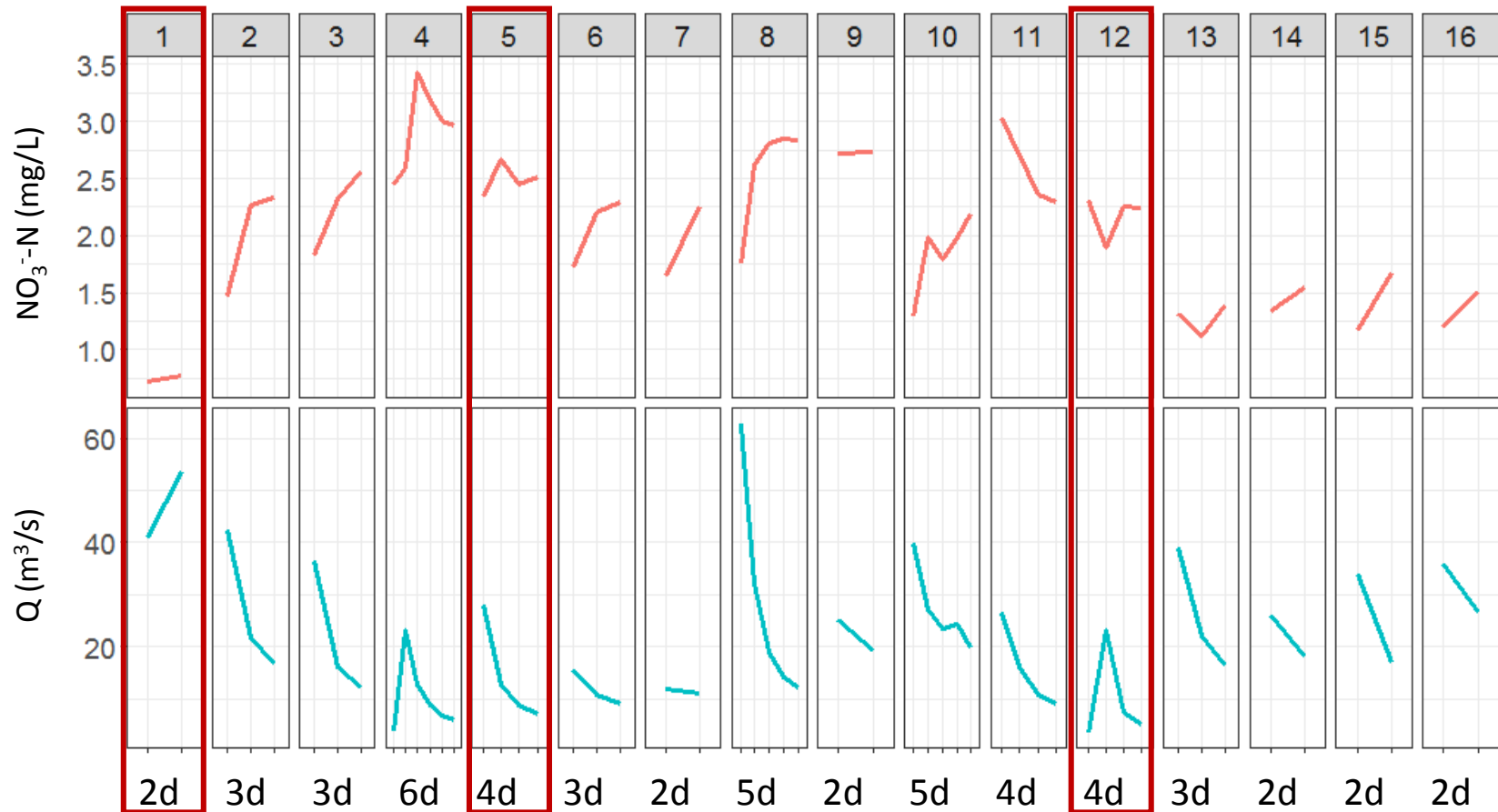
Observed NO_3^- -N and discharge for 16 events

- 16 peak discharge events were selected, hourly resolution.



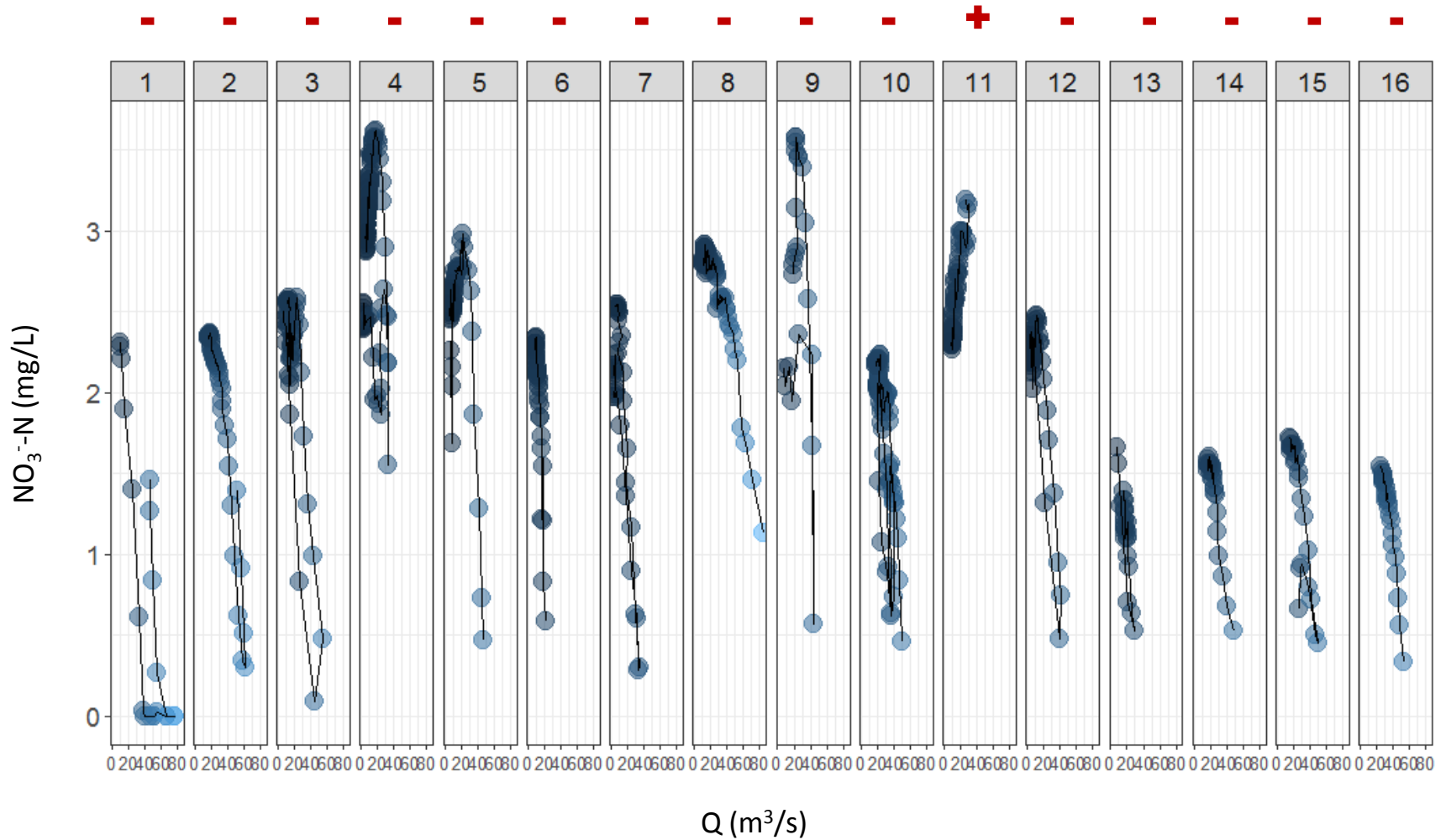
Observed NO_3^- -N and discharge for 16 events

- The events were aggregated to daily resolution.



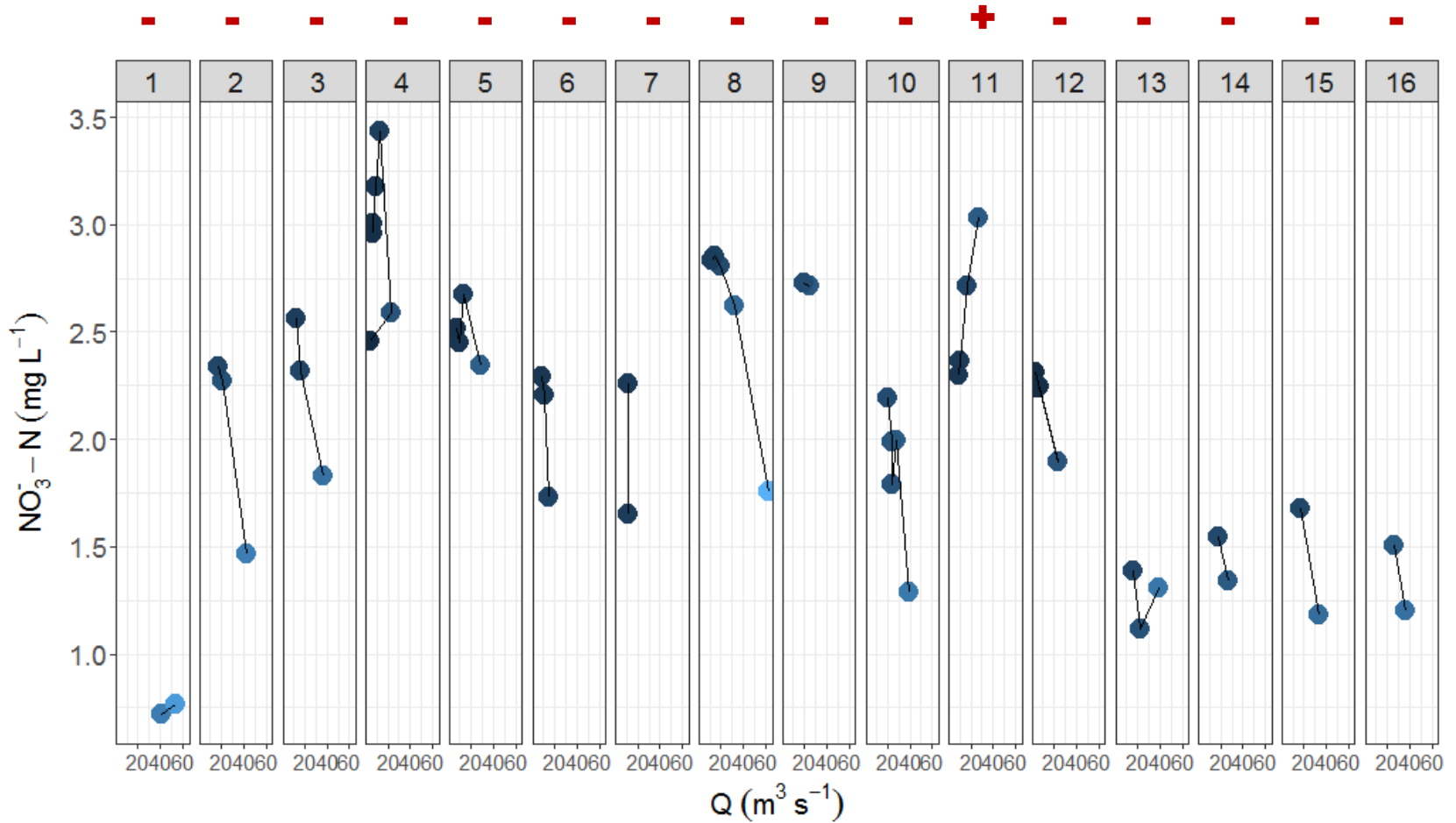
Observed patterns of hysteresis with hourly data

- Positive slopes (accretion) occurred for one event in May 2013



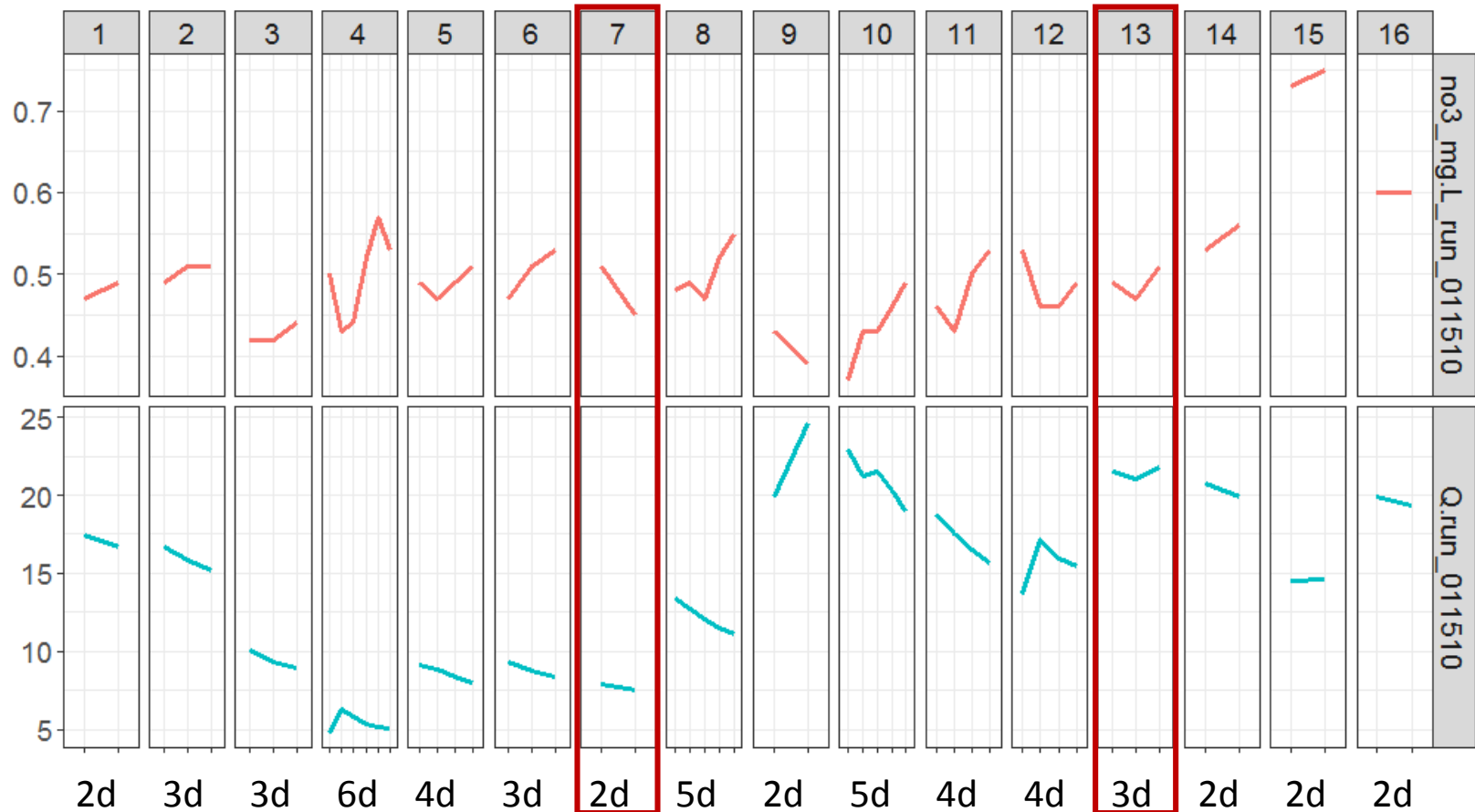
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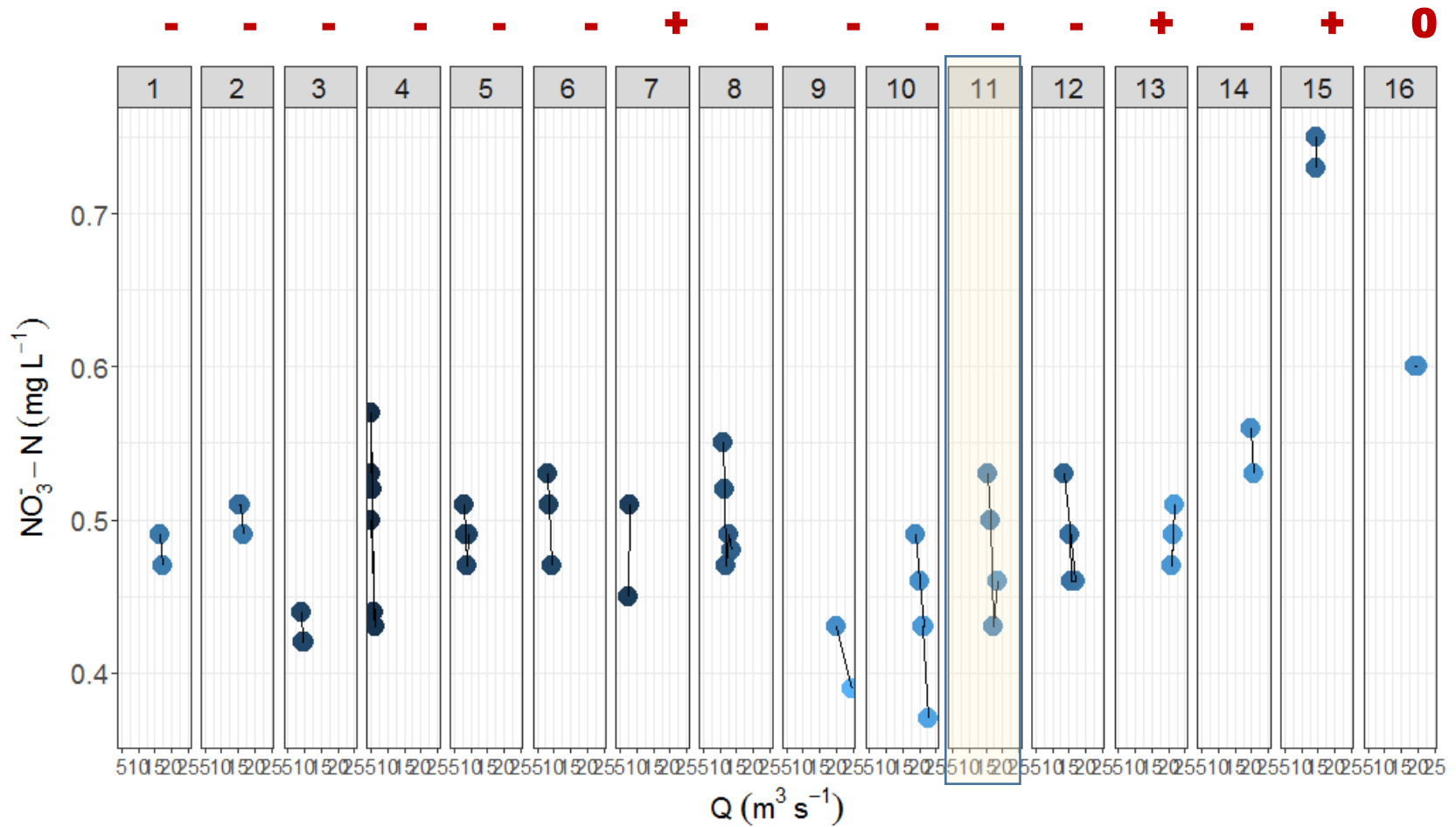
- SWAT Results

SWAT simulated $\text{NO}_3\text{-N}$ and discharge for the same events



Simulated daily hysteresis

- Positive slopes occurred in Sept. 2007, July and August 2014



- Chemodynamics of observations at daily aggregation were different than SWAT simulated daily
- Are processes not being represented in SWAT?
- Simulated nitrate concentrations are affected by errors in loads and errors in discharge

- Undertake an improved calibration
- Examine seasonality of hysteresis
- Relationship to timing of management (fertilizer) practices
- Examine SWAT NO_3^- processes closer

Thank you

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Uncertainty of nitrate parameters?

