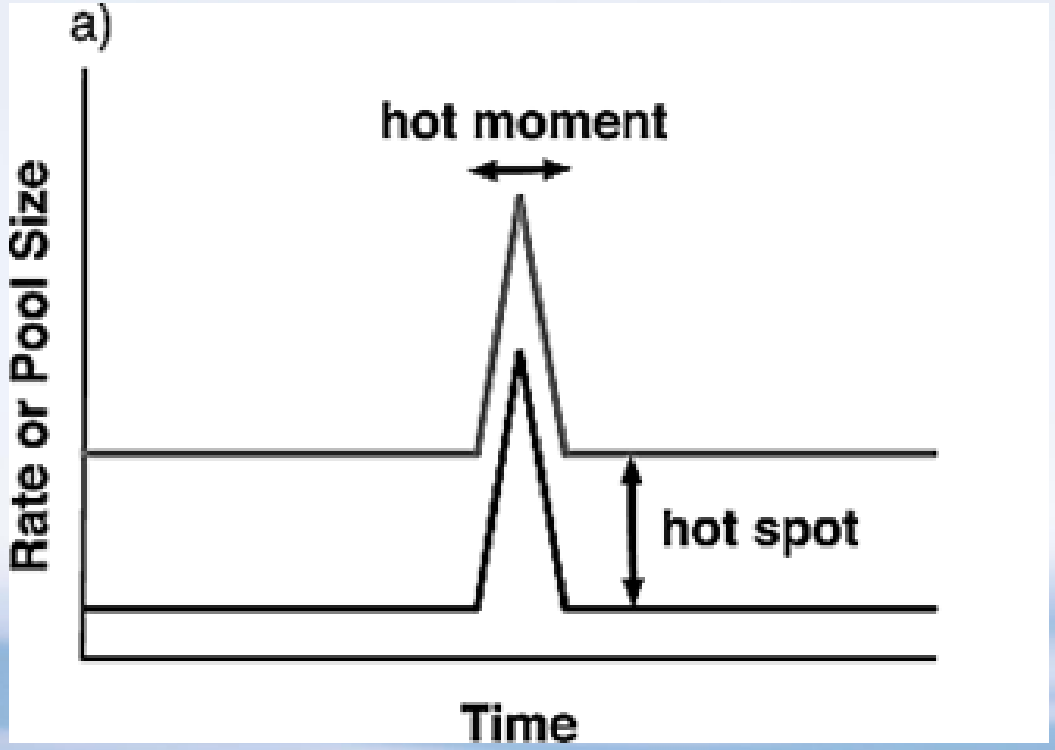
Overview of NEWnet Sensor Group Activities

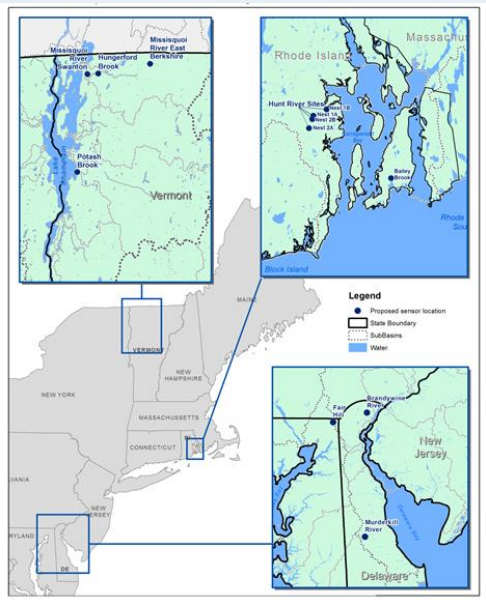
RII – Track -2 IIA 1330446

Regional Research Question

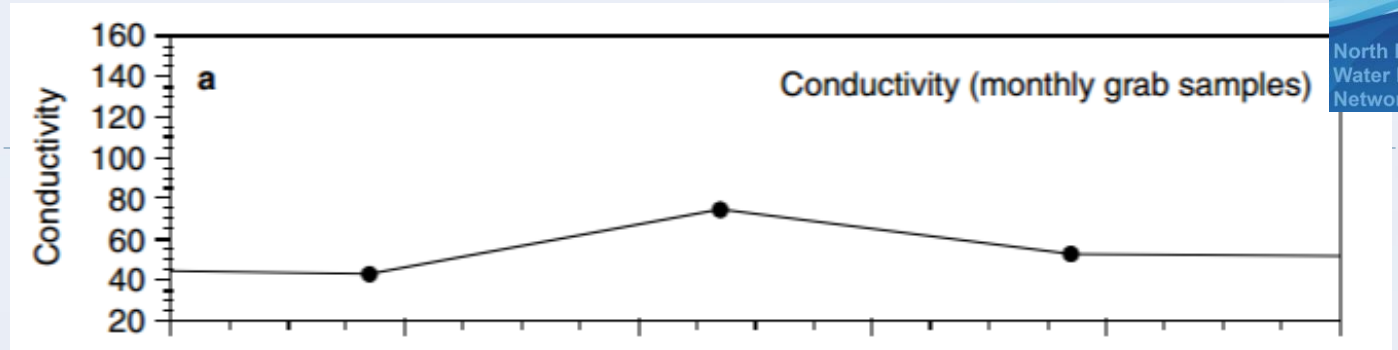
What is the impact of climate variability and extreme events on water quality for watersheds with different land uses extending across the N-S gradient (VT to DE)?



Harms and Grimm, 2008



Sensors are a useful tool for capturing hot moments!

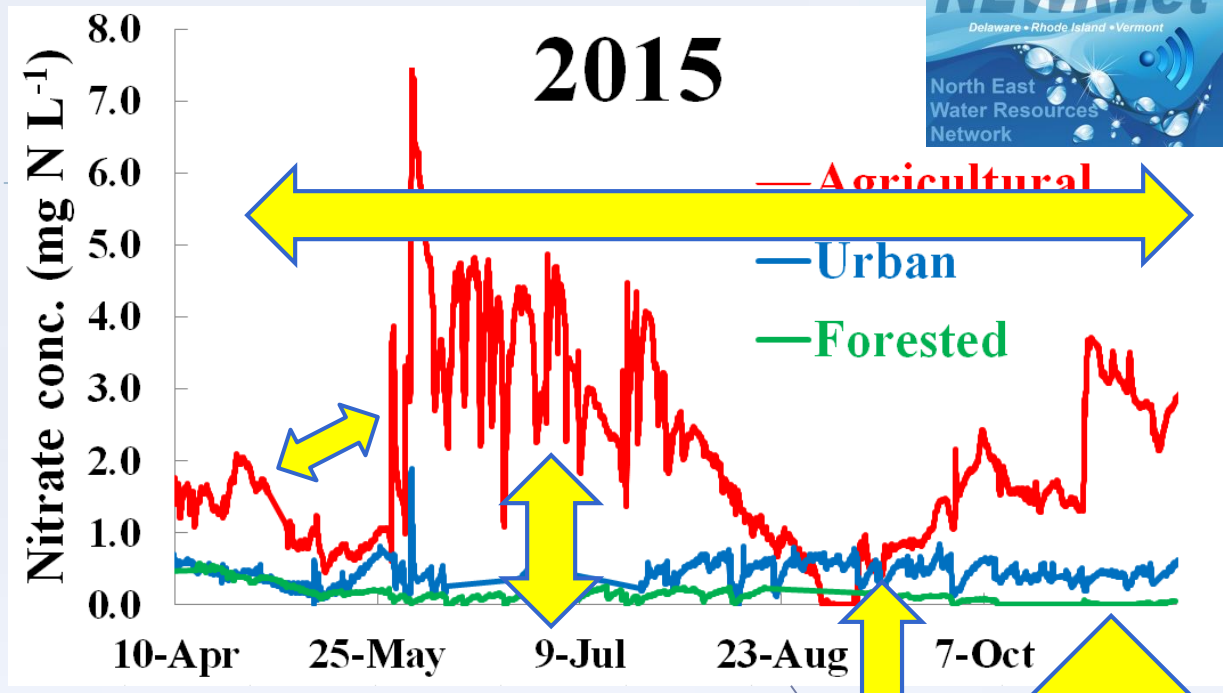


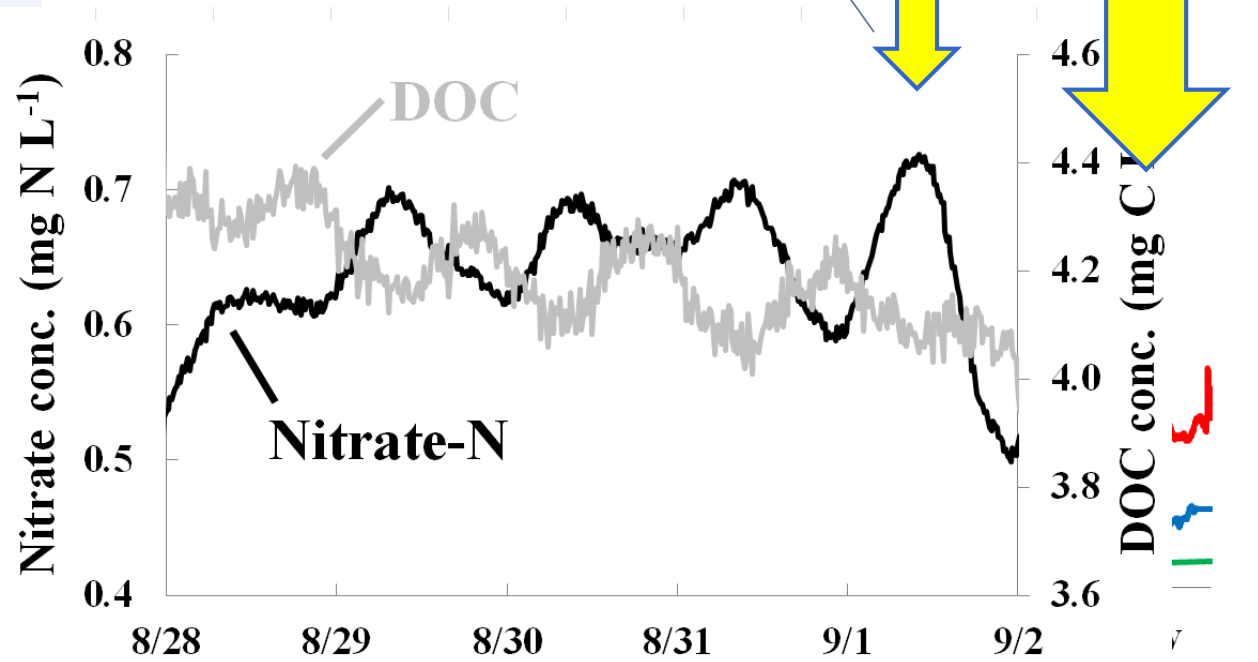
Kirchner et al. (2004)

Hot Moments Across Time and Space

Sensor team studies:

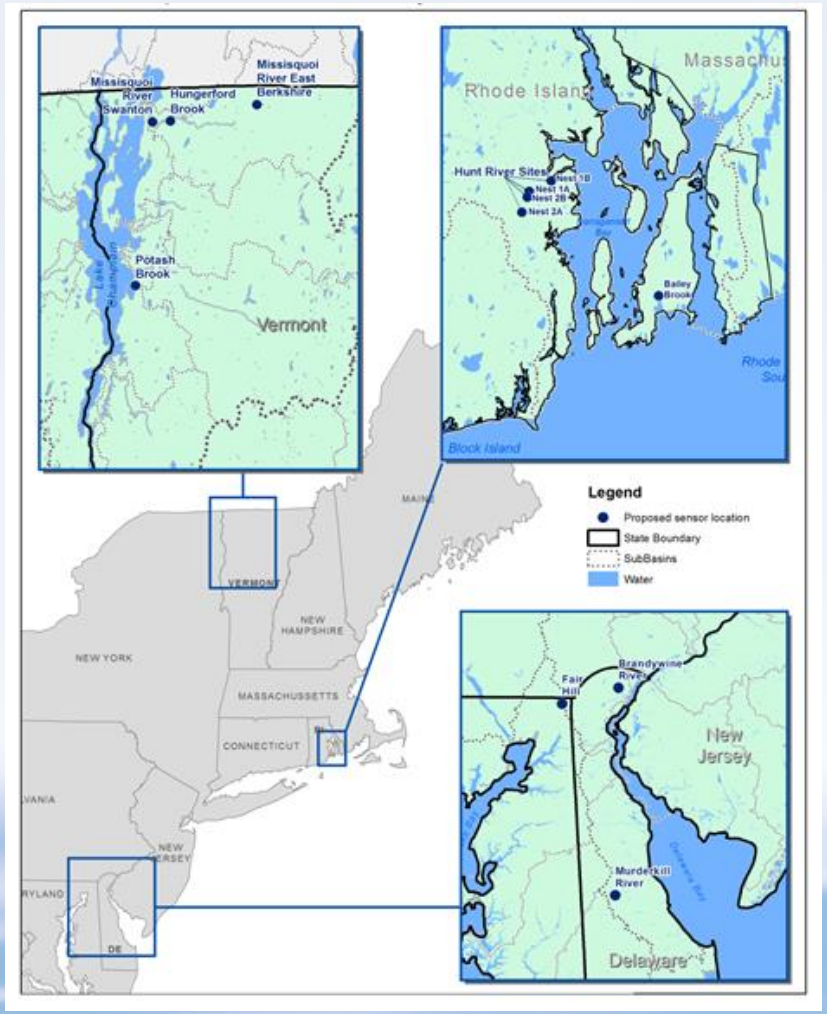
- Landcover Effects
- Seasonal Dynamics
- Event Variability
- Inter-Annual Variability (in all of the above)
- Diurnal Cycling





Talk Overview

- Collective Motivation
- Sensors
- Site Descriptions
- Deployment
- Sensor Performance
- Examples of Detected Hot Moments Across Time and Space

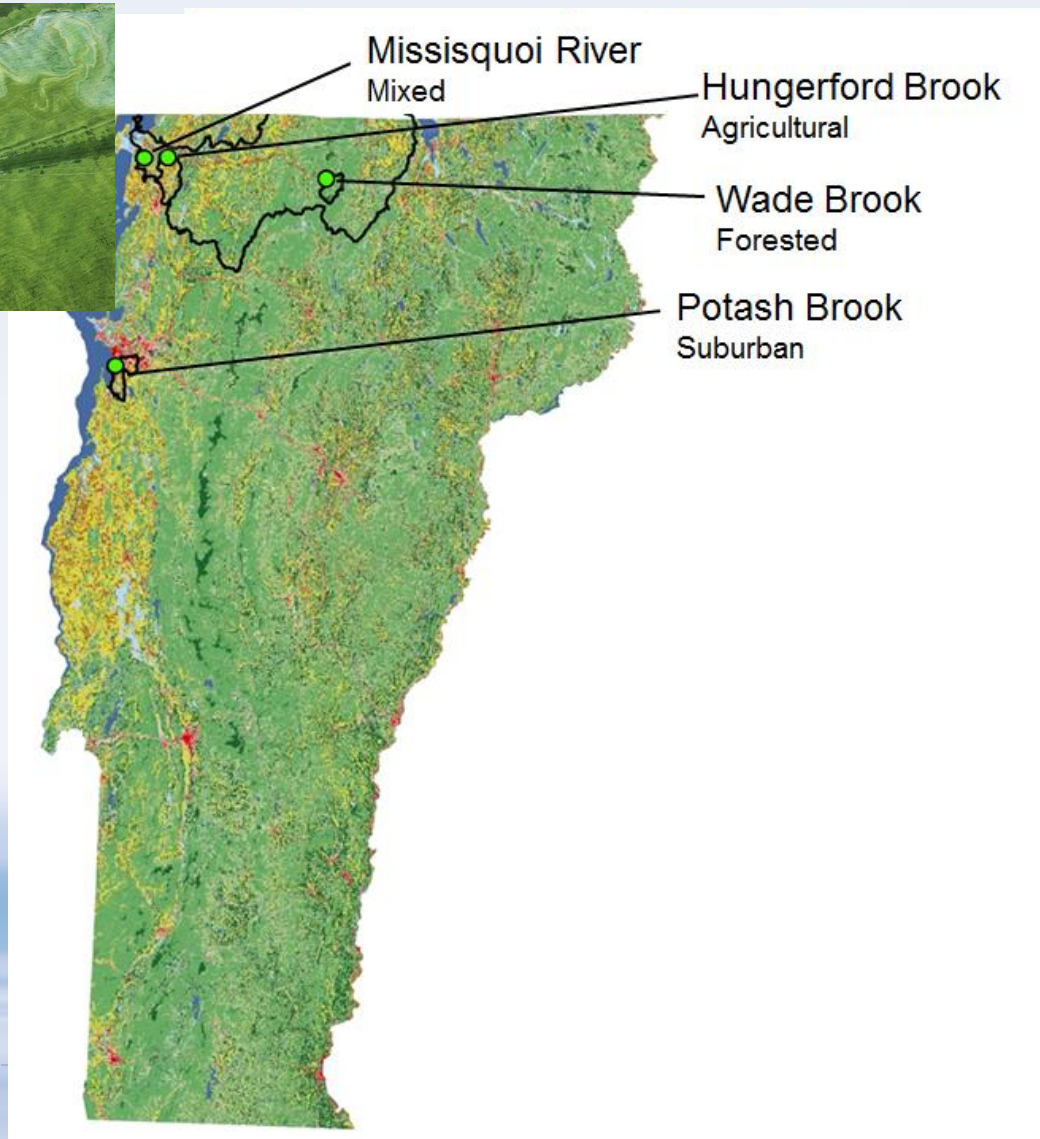


Sensor Selections
(15-30 minute measurement frequency)

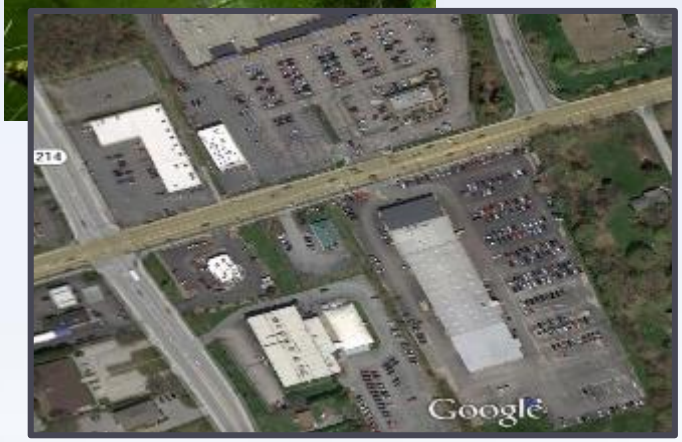
- YSI EXO2
  - Temperature/Conductivity
  - Dissolved Oxygen
  - pH
  - Turbidity
  - Fluorescent Dissolved Organic Matter(fDOM)
  - BGA/Chlorophyll
- s::can Spectrolyser
  - Nitrate-N
  - Dissolved Organic Carbon
  - Particulate Organic Carbon
  - Turbidity
  - Full UV/Visible ‘Fingerprint’ scan

Vermont NEWRnet Sensor Network:

Schroth, Bowden, Vaughan, Sleeper (UVM), Shanley (USGS), Vermilyea (Castleton)



RI Sensor Sites: Gold, Addy, Pradhanang (URI), Chace (Salve Regina) :



- **Forested Watershed (Pristine Reference)**
  - Cork Brook, Scituate, RI
  - 4.7 km^2 watershed
  - Providence Water (600,000 customers)
- **Urban Watershed: Bailey's Brook**
  - Middletown, RI
  - 8.3 km^2 watershed
  - Newport Water (50,000 customers)
- **Agricultural Watershed, Maidford River**
  - Middletown, RI
  - 8.0 km^2 watershed
  - Newport Water(50,000 customers)

Delaware Study Sites:
Inamdar, Levia, Leathers, Andres, Ullman, Rowland, Winters, Hudson (UDE)

- Sensor Site locations in Delaware & Maryland – 3 sites

- Brandywine Creek at Wilmington

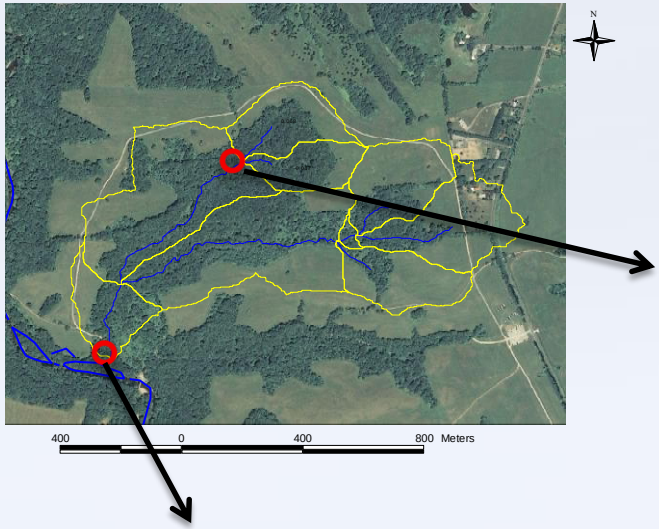
- Urban site
- Drainage area ~ 314 sq. miles
- Sensor near the water intake for Porter & Wills Water treatment plants in Wilmington

- Coursey Pond on Murderkill, Kent County, DE

- Agricultural site
- Drainage area = 9500 ha (at sensor)
- Landuse = 52% Ag, 23% forest

Delaware Study Sites

- Big Elk Creek nested subwatersheds



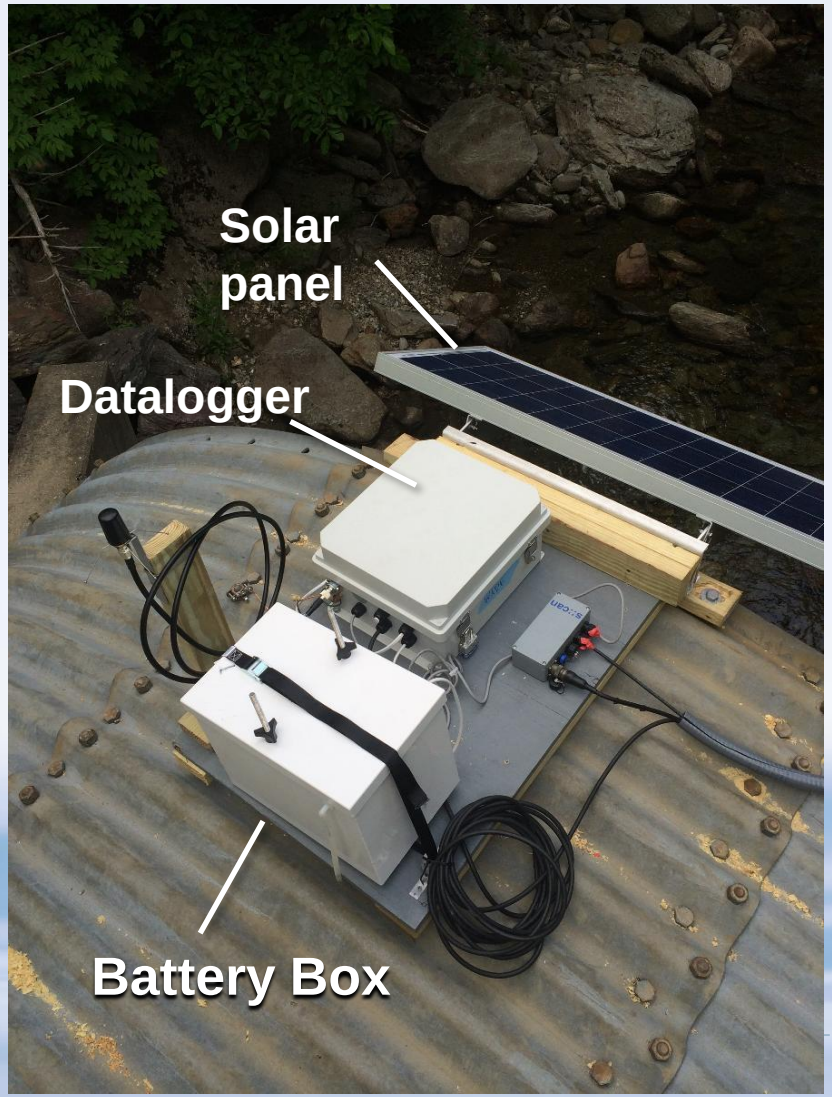
12 ha stream

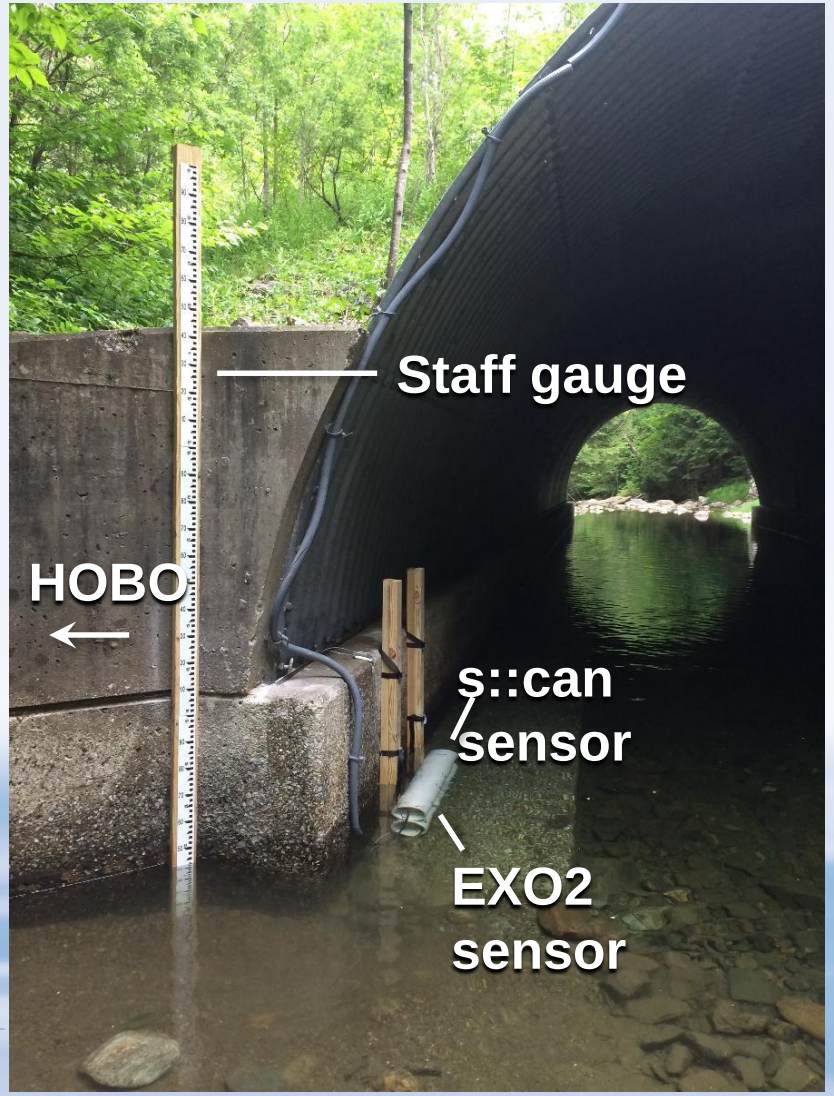
Big Elk Creek

79 ha stream

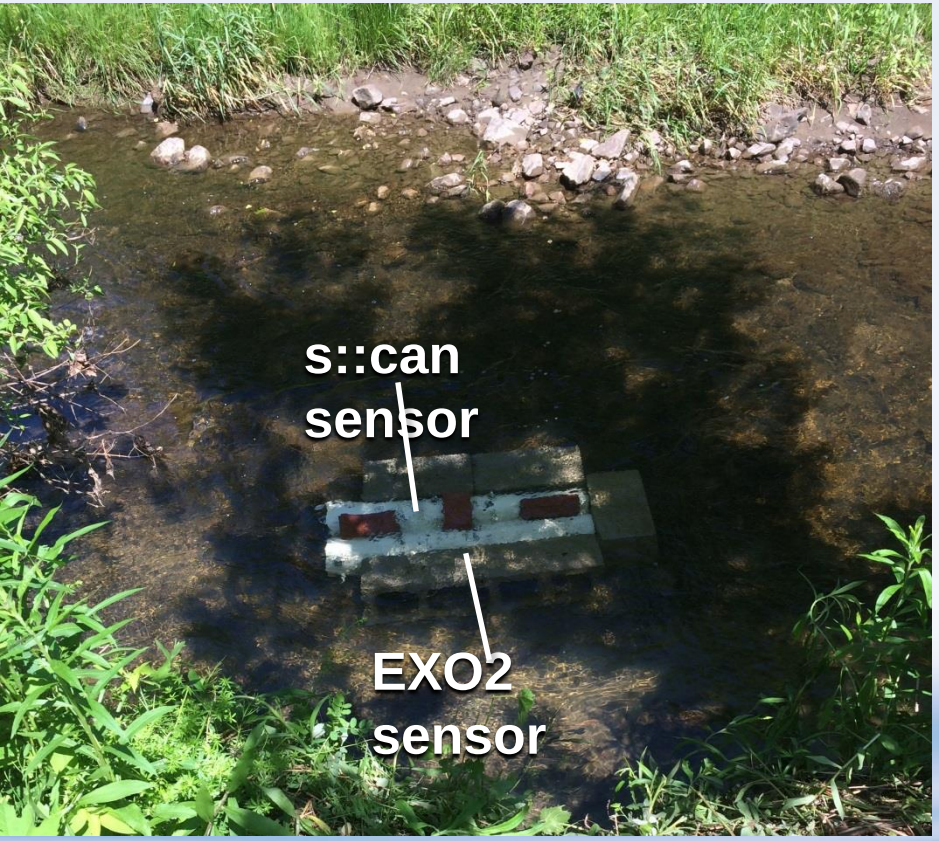
- Forested, “reference” sensor site
- Small, nested, subwatersheds = 79, 12 ha
- Long history of water chemistry (8 years)
- Good understanding of watershed behavior with numerous publications
- Drain into Big Elk Creek – water supply source for the town of Elkton, MD (pop. ~ 15,000)

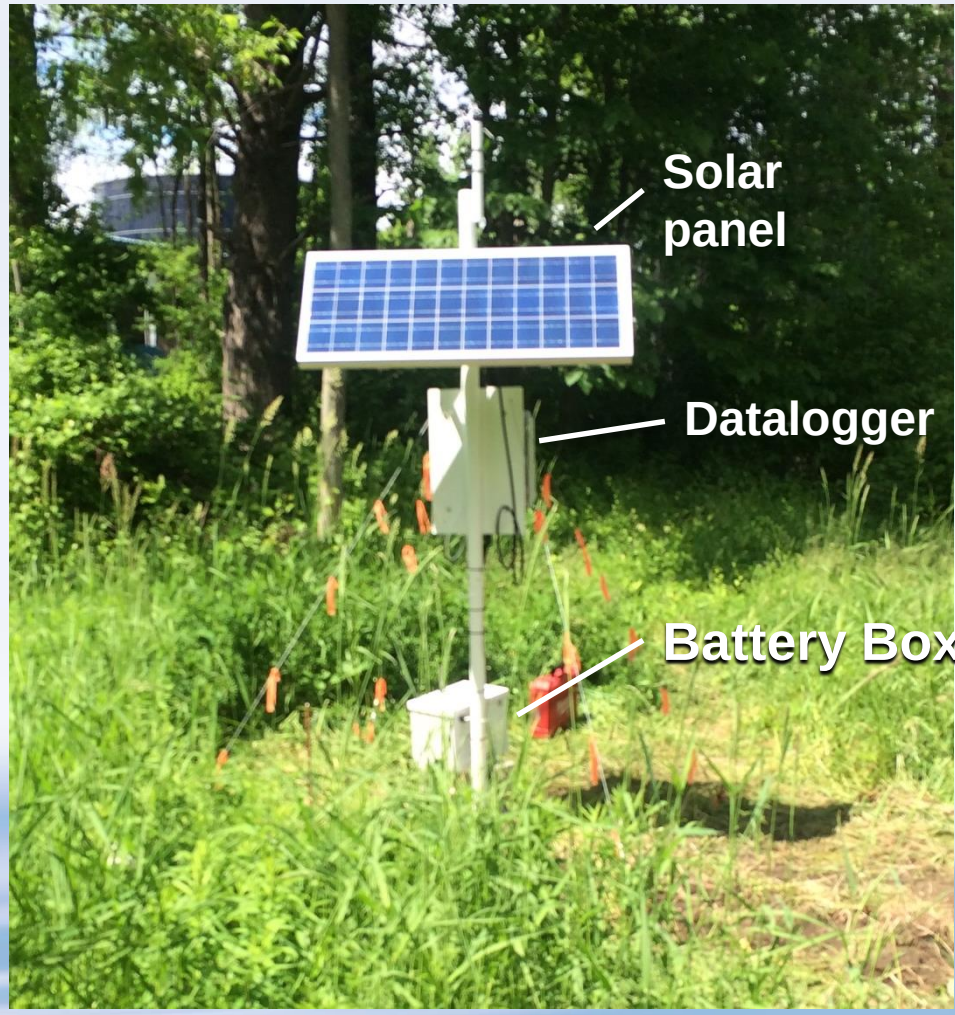
Field Installations





Field Installations





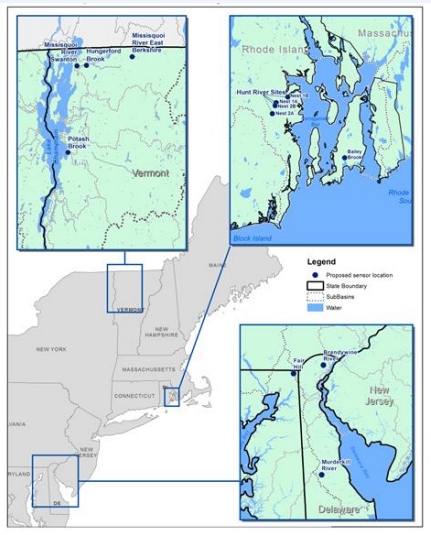
Synoptic Water Sampling

- 1) Samples collected periodically at all sites across range of conditions to asses sensor data accuracy and develop local calibrations or corrections if necessary and possible (grab and automated)
  - Consistent sampling protocols, standard suite of analyses for each sampling event
- 2) Additional synoptic sampling events and detailed analyses for particular research questions.

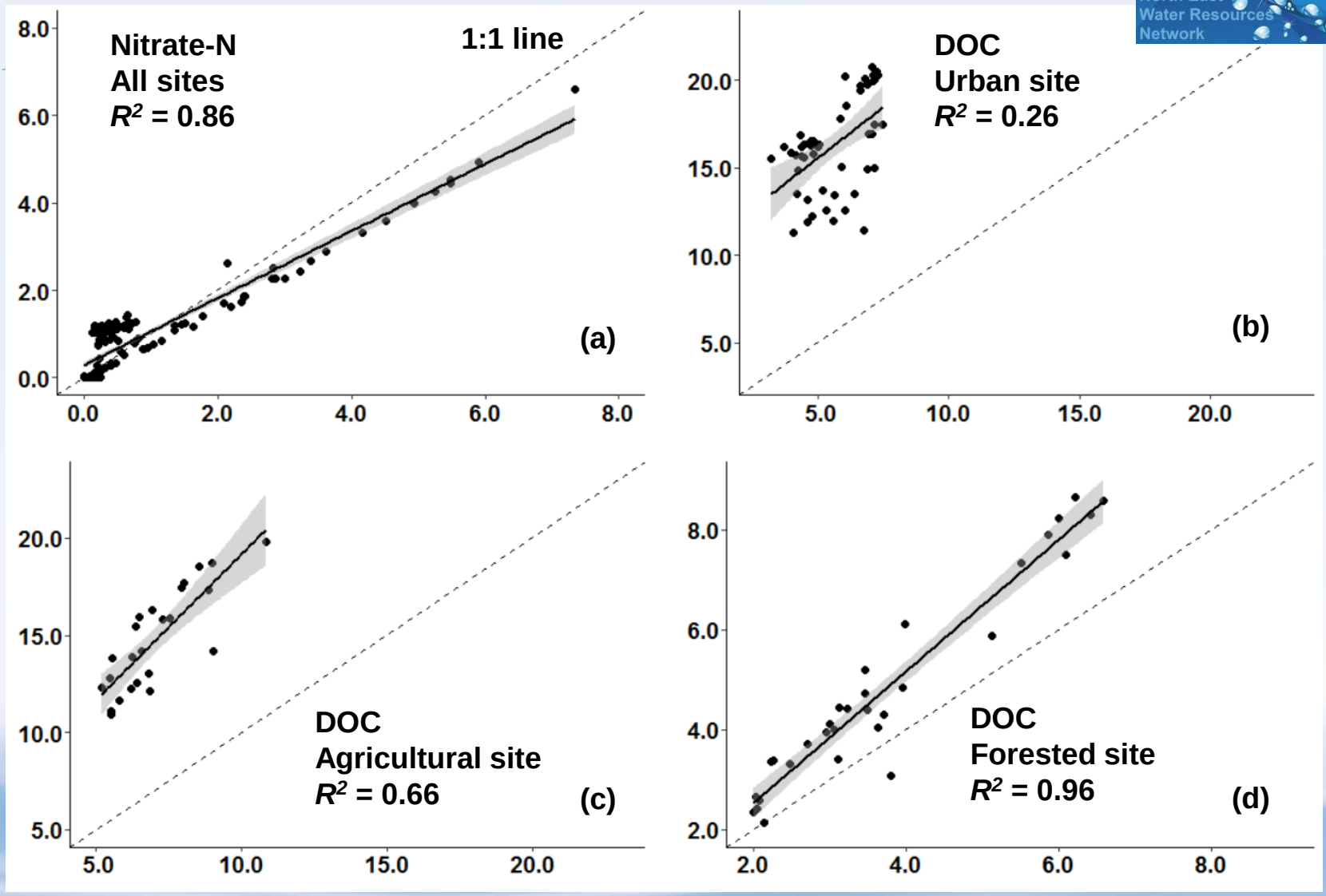
NEWRnet Results

Highlight different NEWRnet sensor applications across temporal and spatial scales.
Consider where might this approach/technology benefit your role in promoting/sustaining water quality?

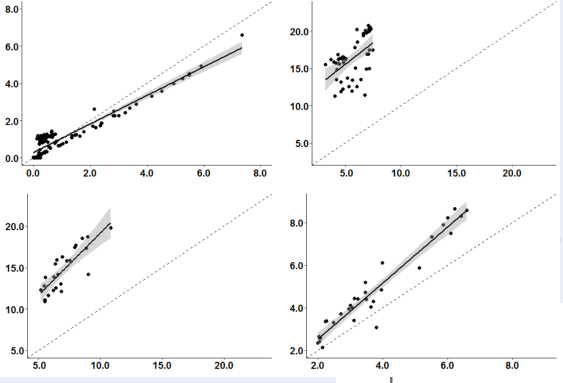
1. Key challenges and methodological issues with the sensors
2. Hot moment insight

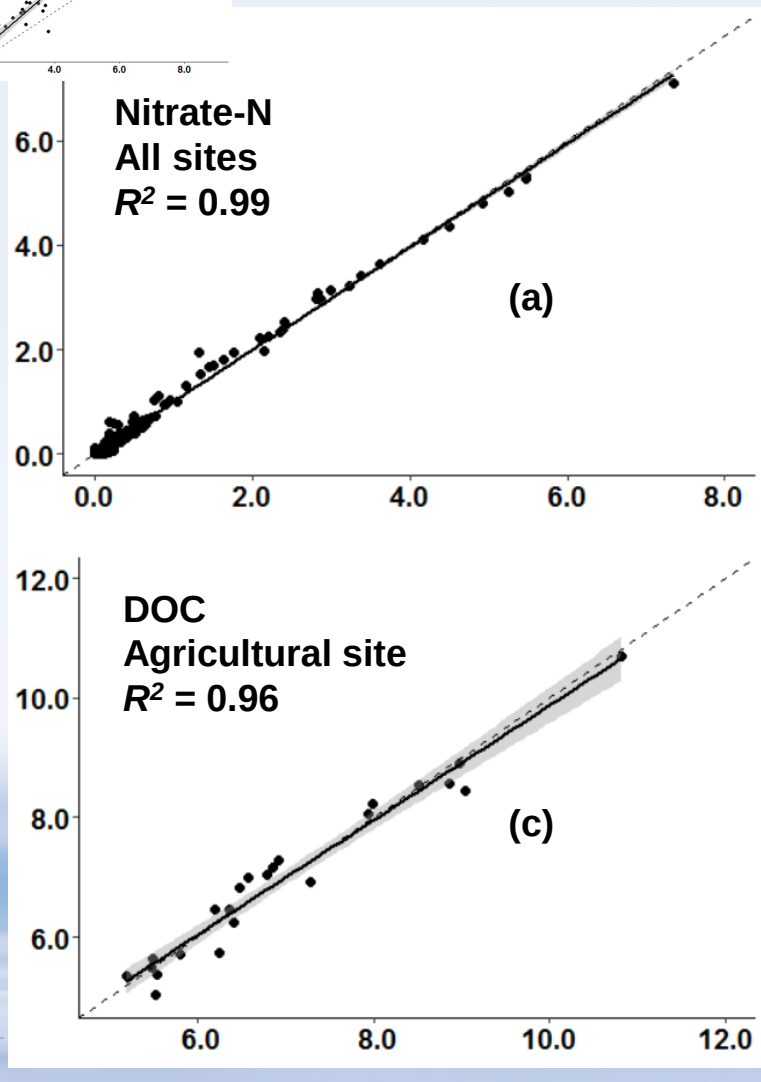


1. Sensor Calibration & Performance



1. Sensor Calibration & Performance





1. Sensor Calibration & Performance

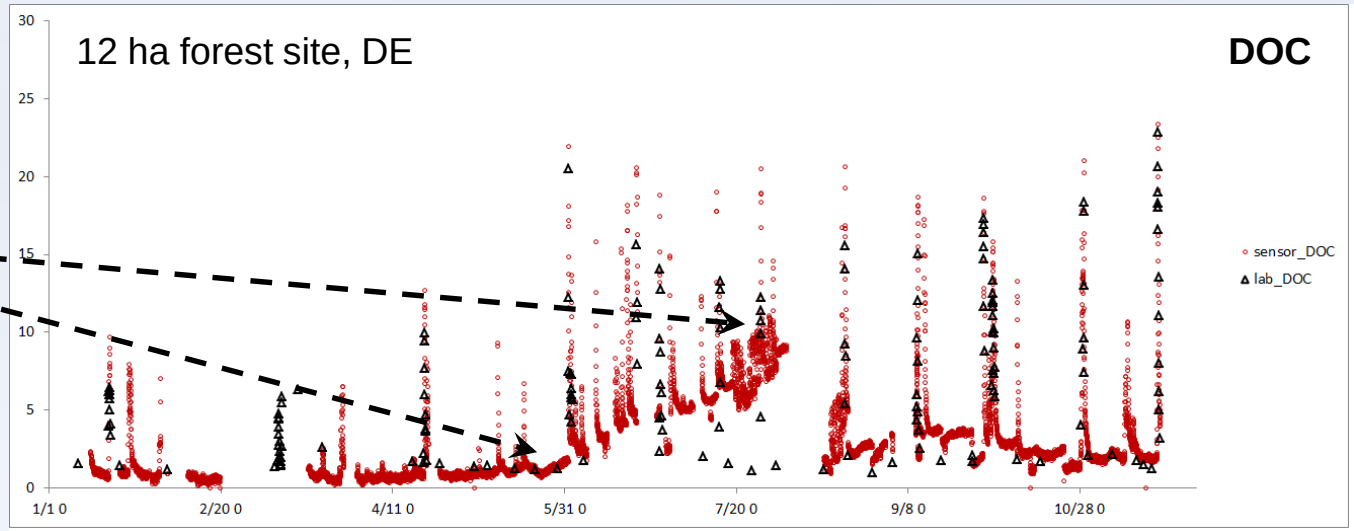
Sensor fouling issues

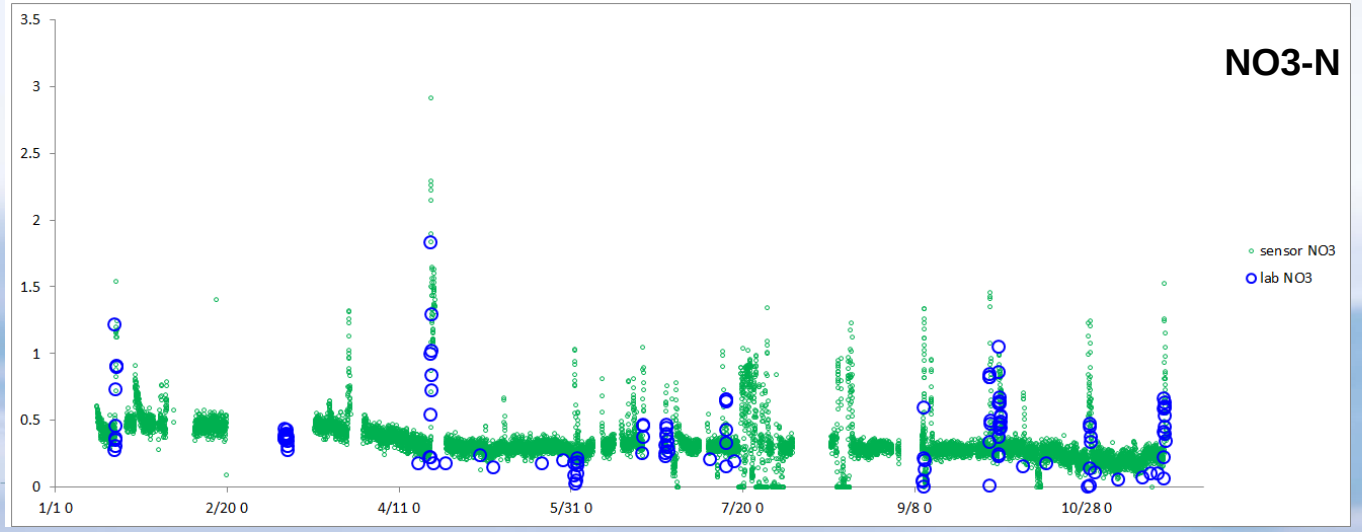
Fouling drifts need careful attention and corrections

Greater effect on DOC than NO3-N

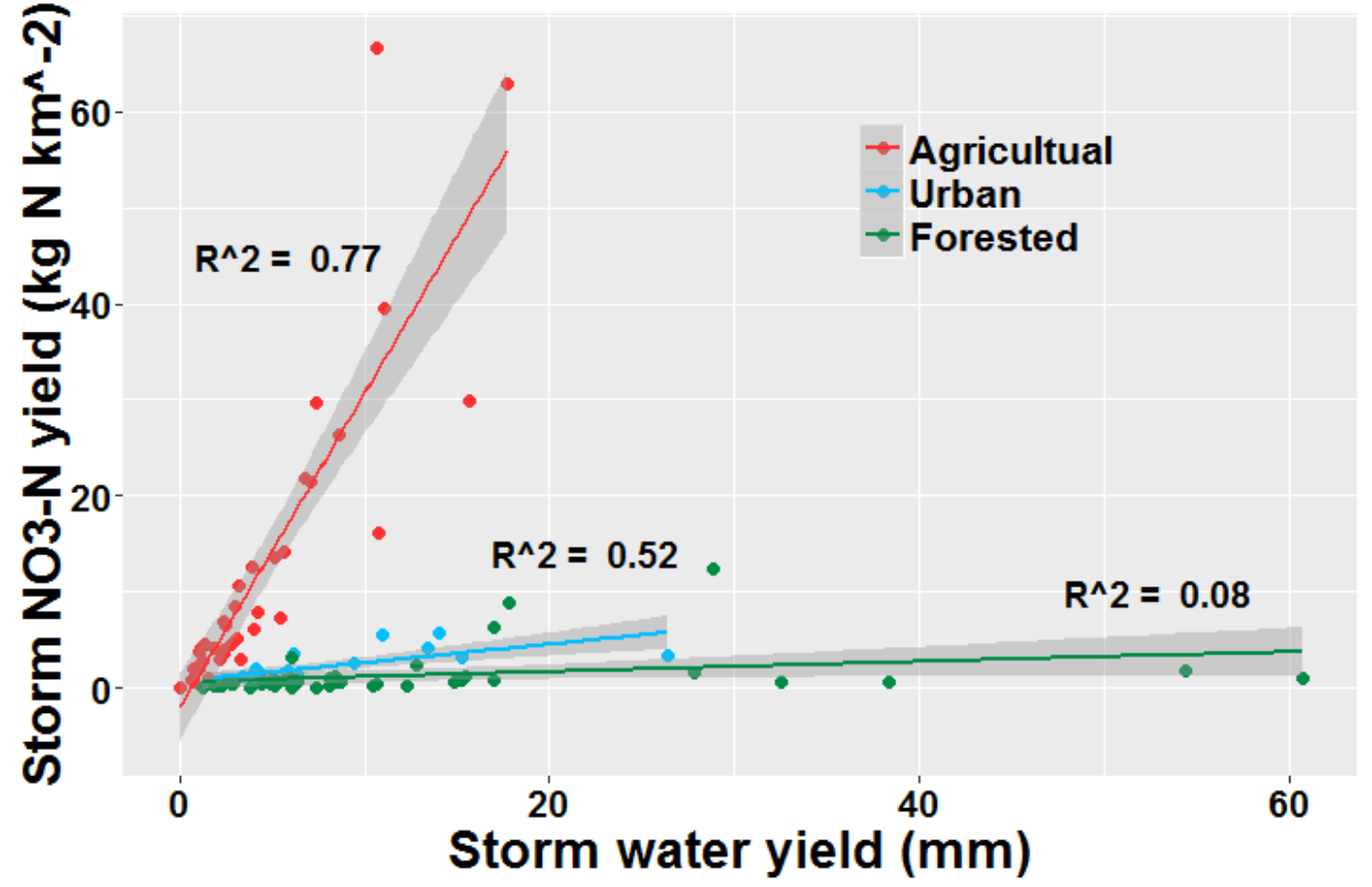
Cleaning required with acid

Detection limit issues with No3-N

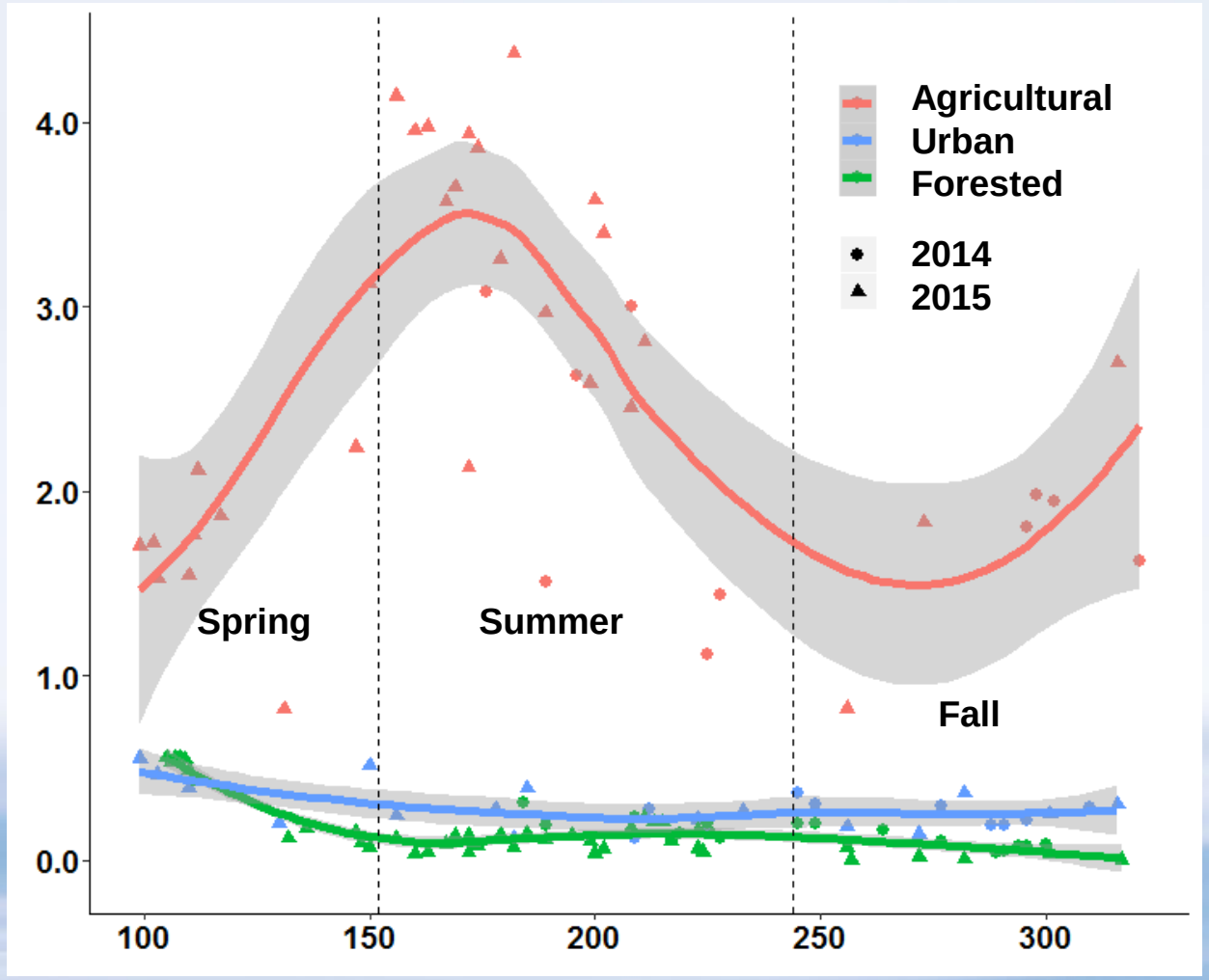




2. Process Insights & Watershed Response-Storms

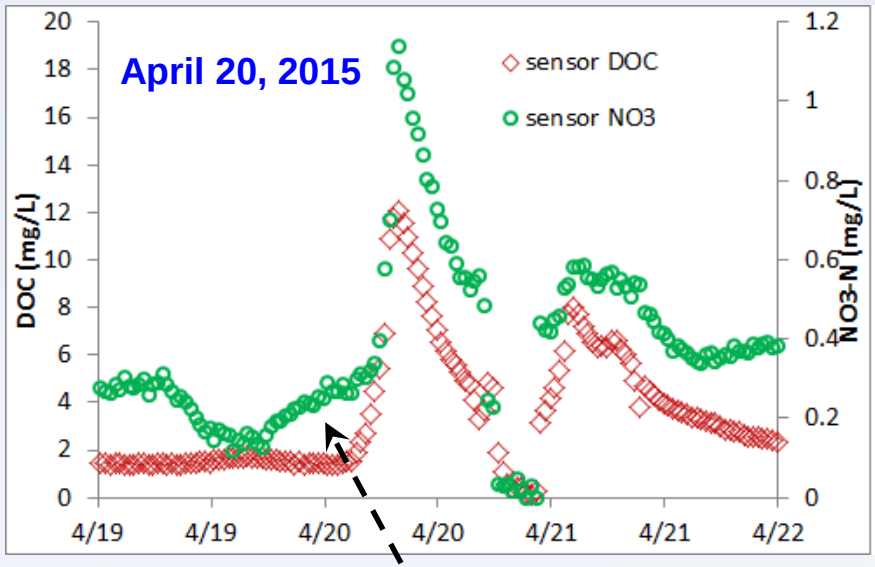


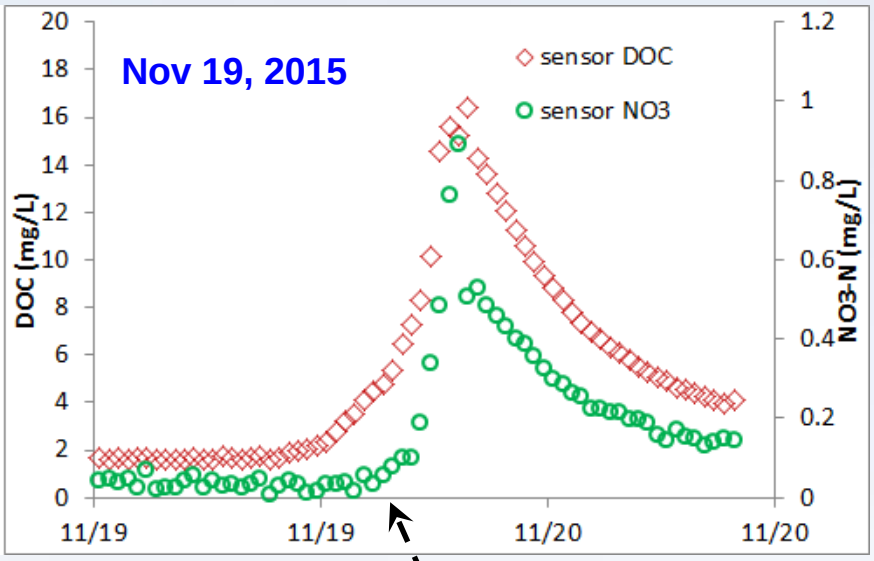
2. Process Insights & Watershed Response-Storms, Seasonality and LULC



2. Process Insights & Watershed Response-Storms

Differences in within-event nitrate-N response

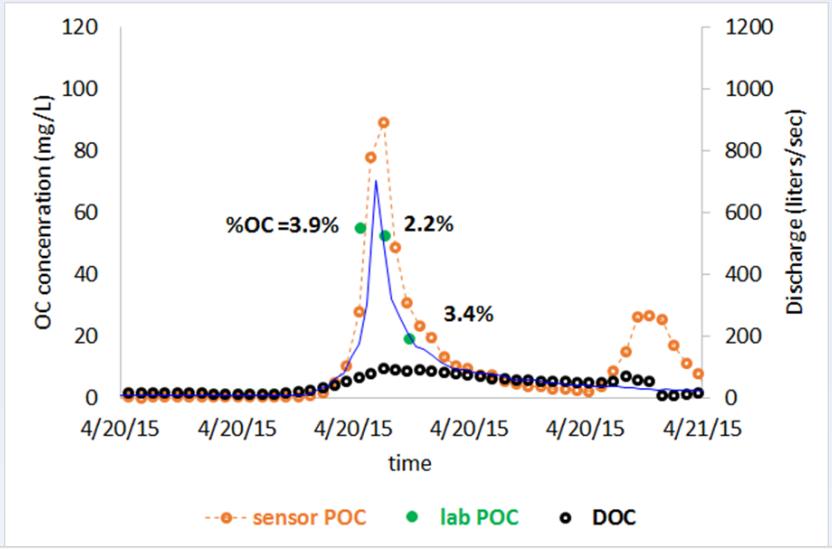


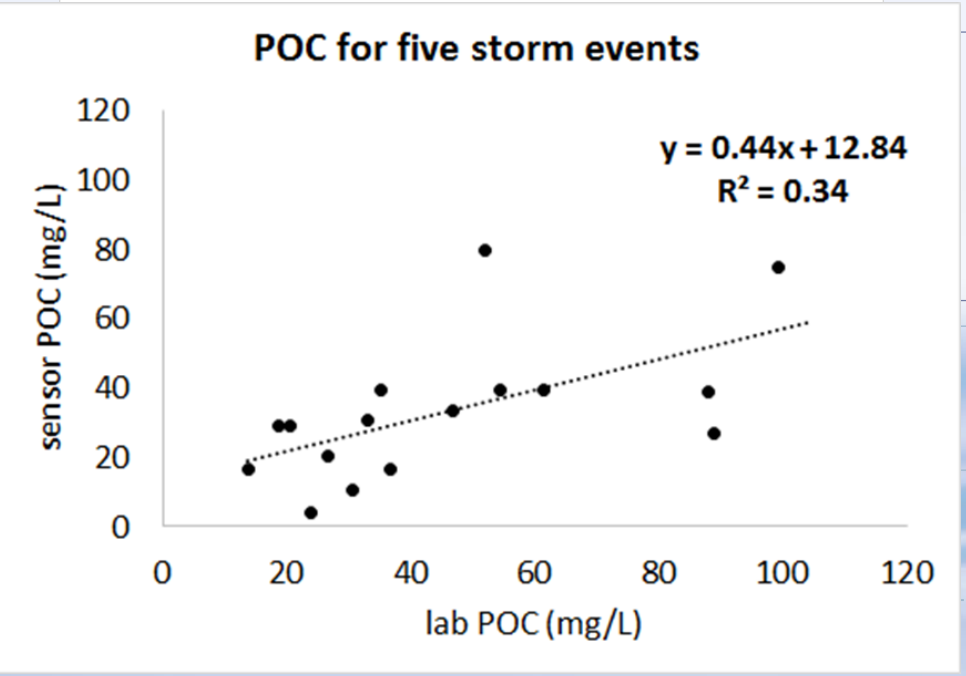


- higher pre-storm NO3-N conc.
- NO3-N increase occurs early,
- **NO3-N available in- & near-stream pools**

- low pre-storm NO3-N conc.
- NO3-N increase occurs later,
- **NO3-N depleted in- & near-stream pools?**

2. Process Insights & Watershed Response-Storms



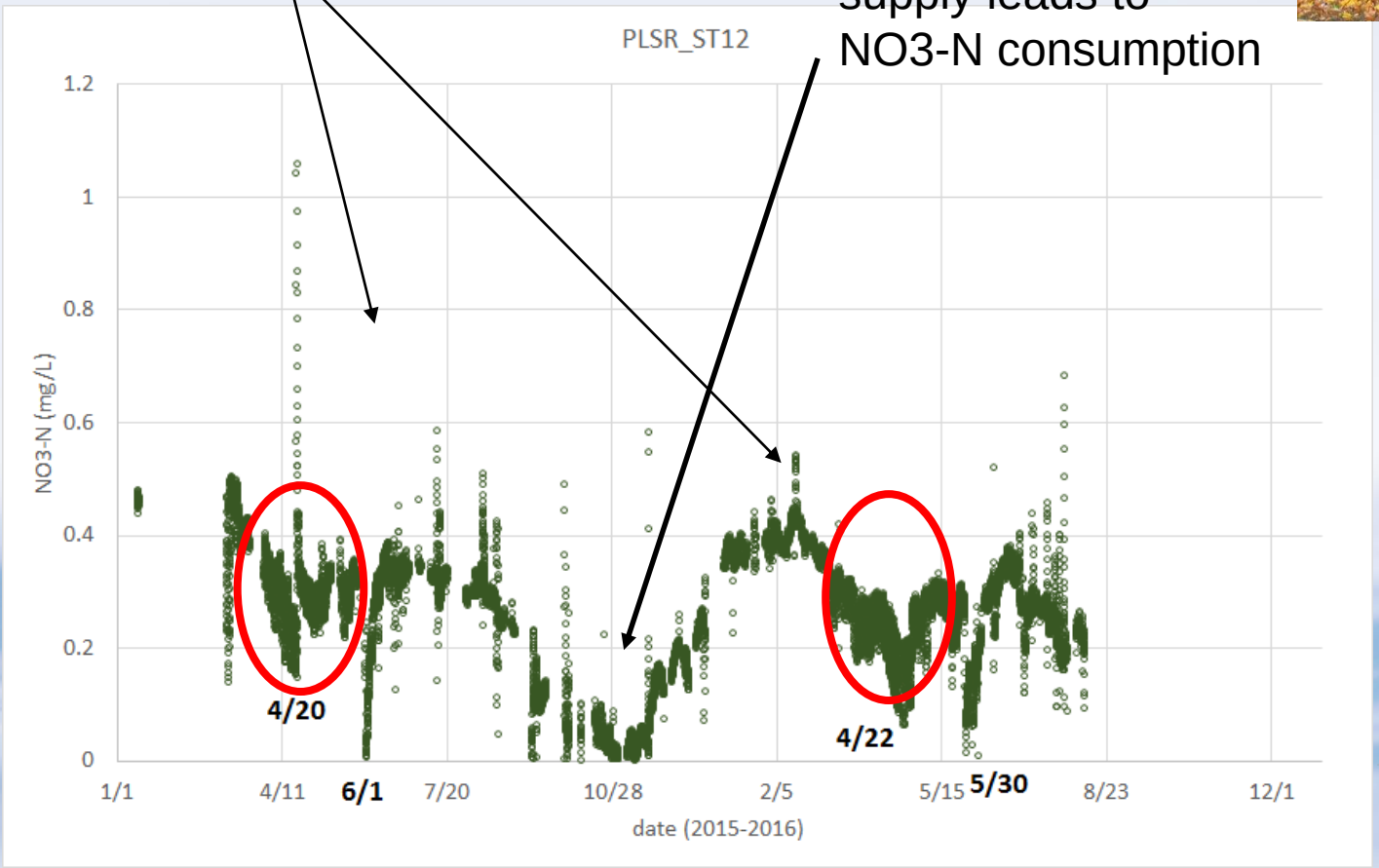


Sensor POC predictions were not as strong as the DOC predictions, but additional calibrations could produce closer fits

2. Process Insights & Watershed Response-Seasonal Dynamics

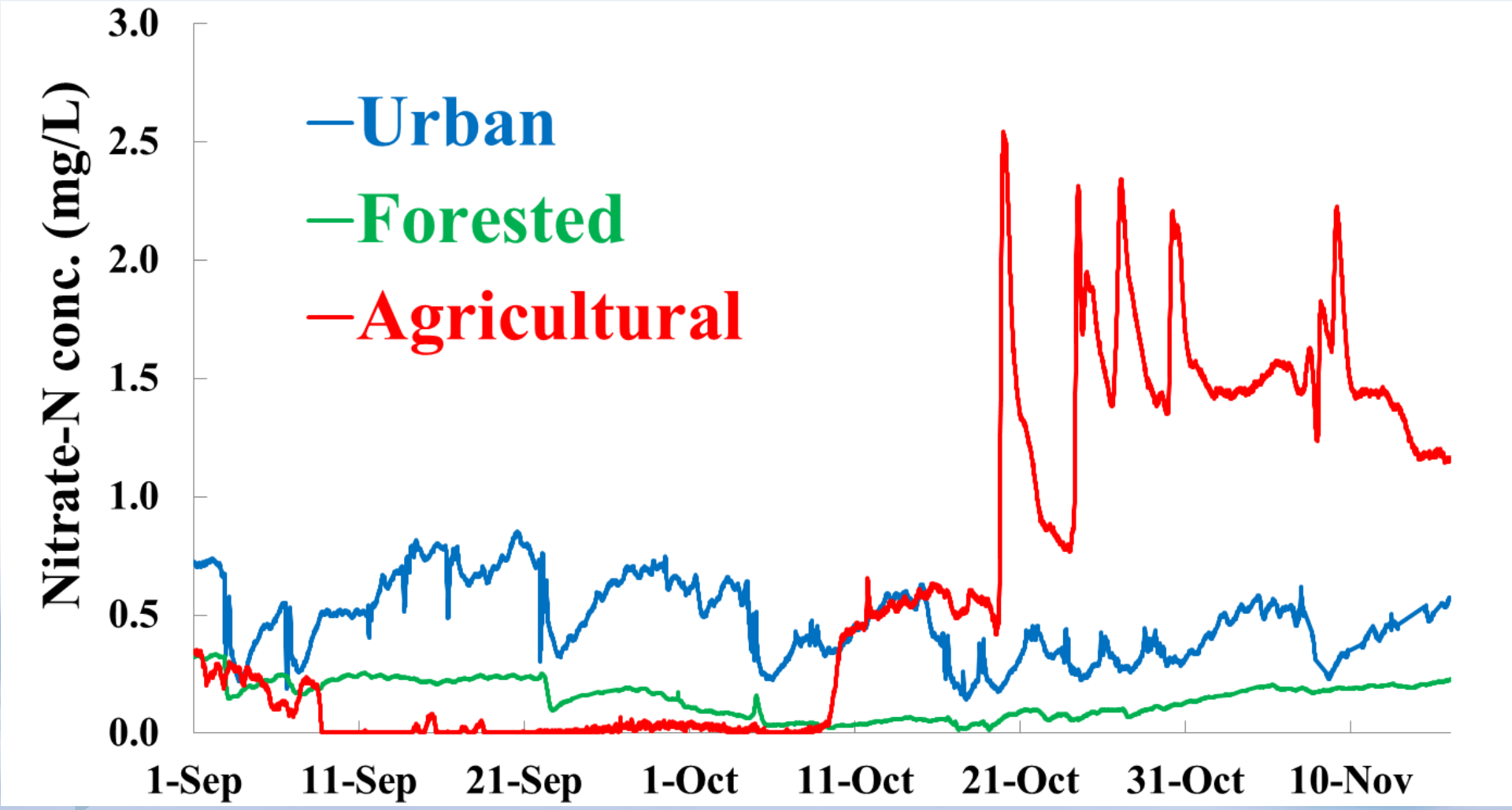
"**vernal algal bloom**" and NO3-N consumption

Autumn nitrate depression - Leaf fall and OC supply leads to NO3-N consumption

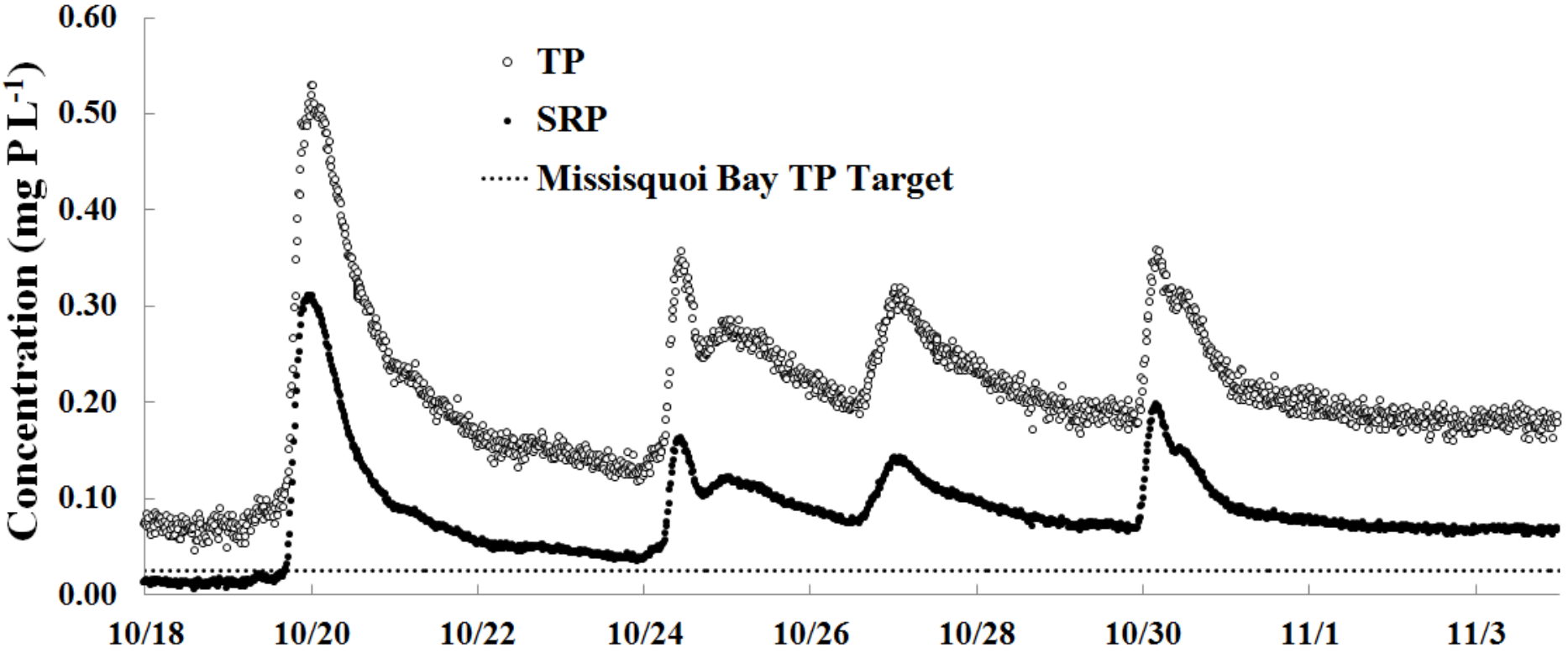


2. Process Insights & Watershed Response-Seasonality

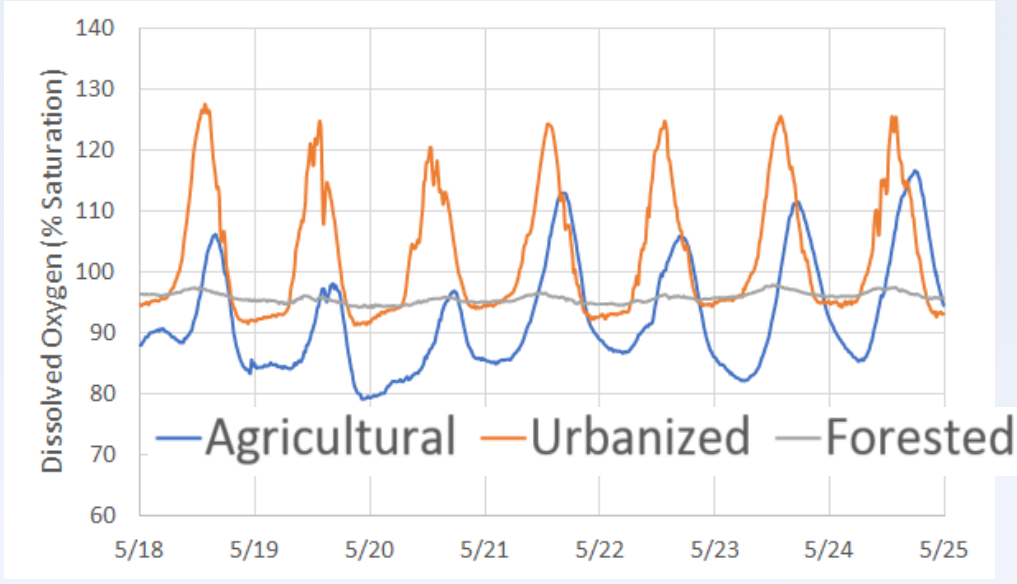
VT Nitrate-N concentrations: similar (but later) crash in forest, algal bloom triggers late summer crash in agricultural system, no crash in urban

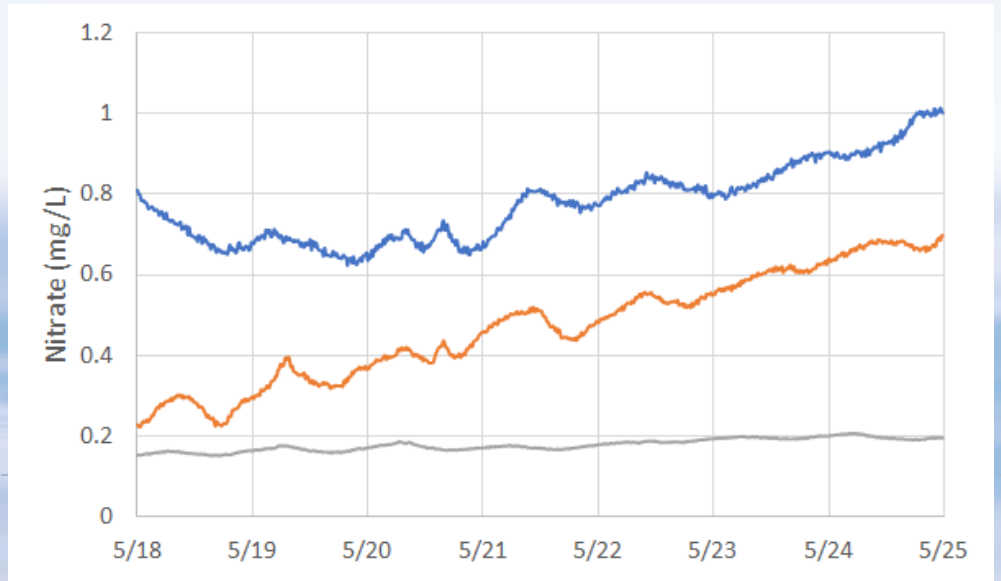


2. Process Insights & Watershed Response-P/TMDL Application?

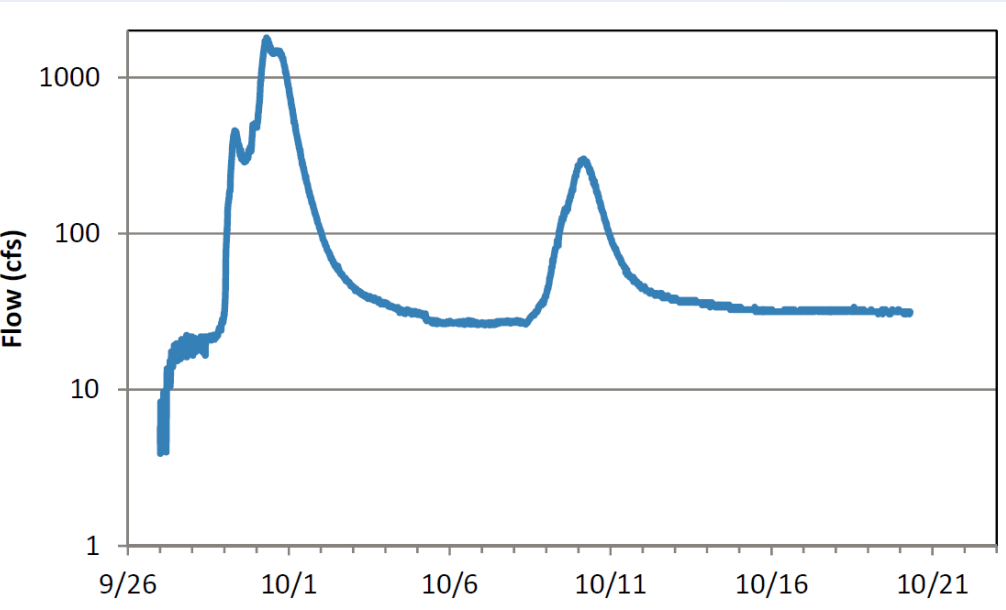


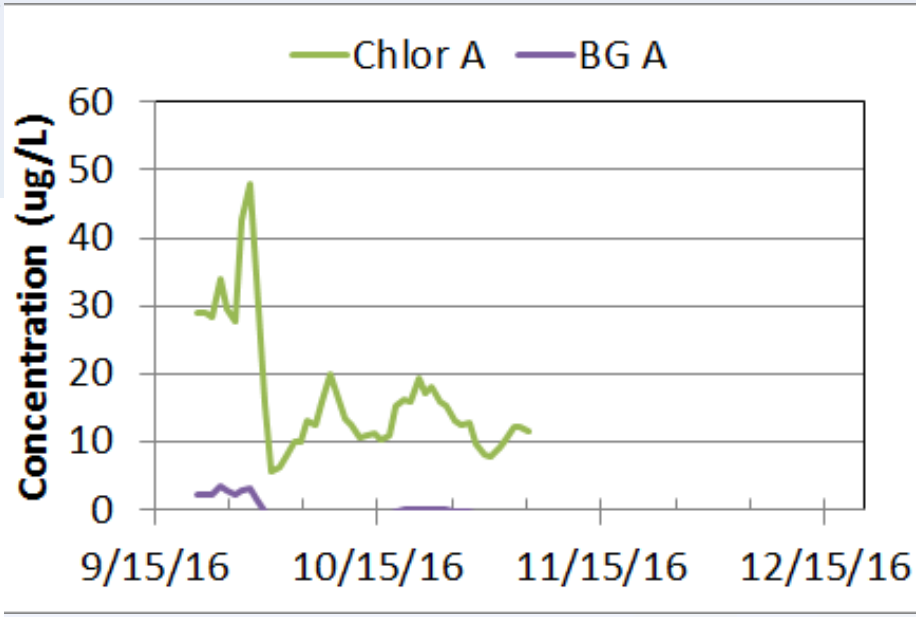
2. Process Insights & Watershed Response-in-stream ecosystem productivity and nutrient cycling

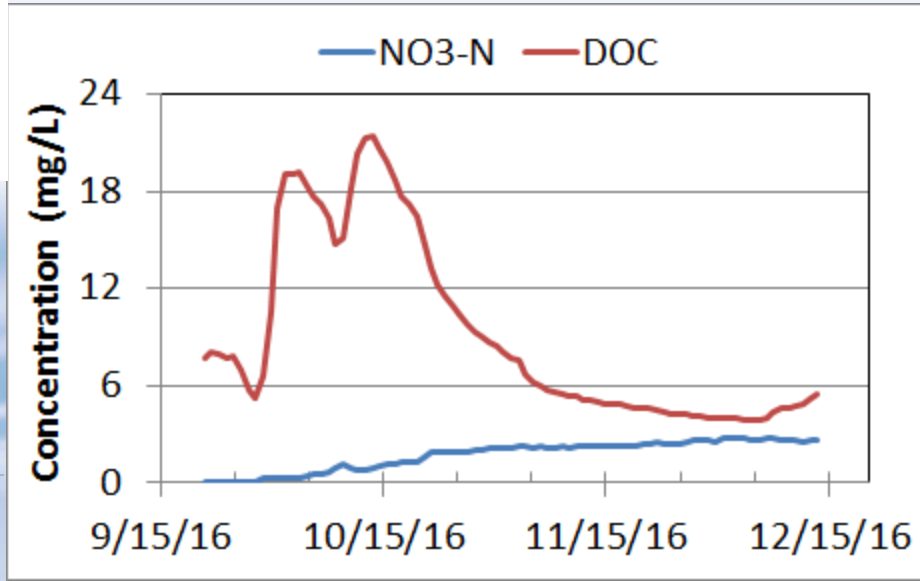




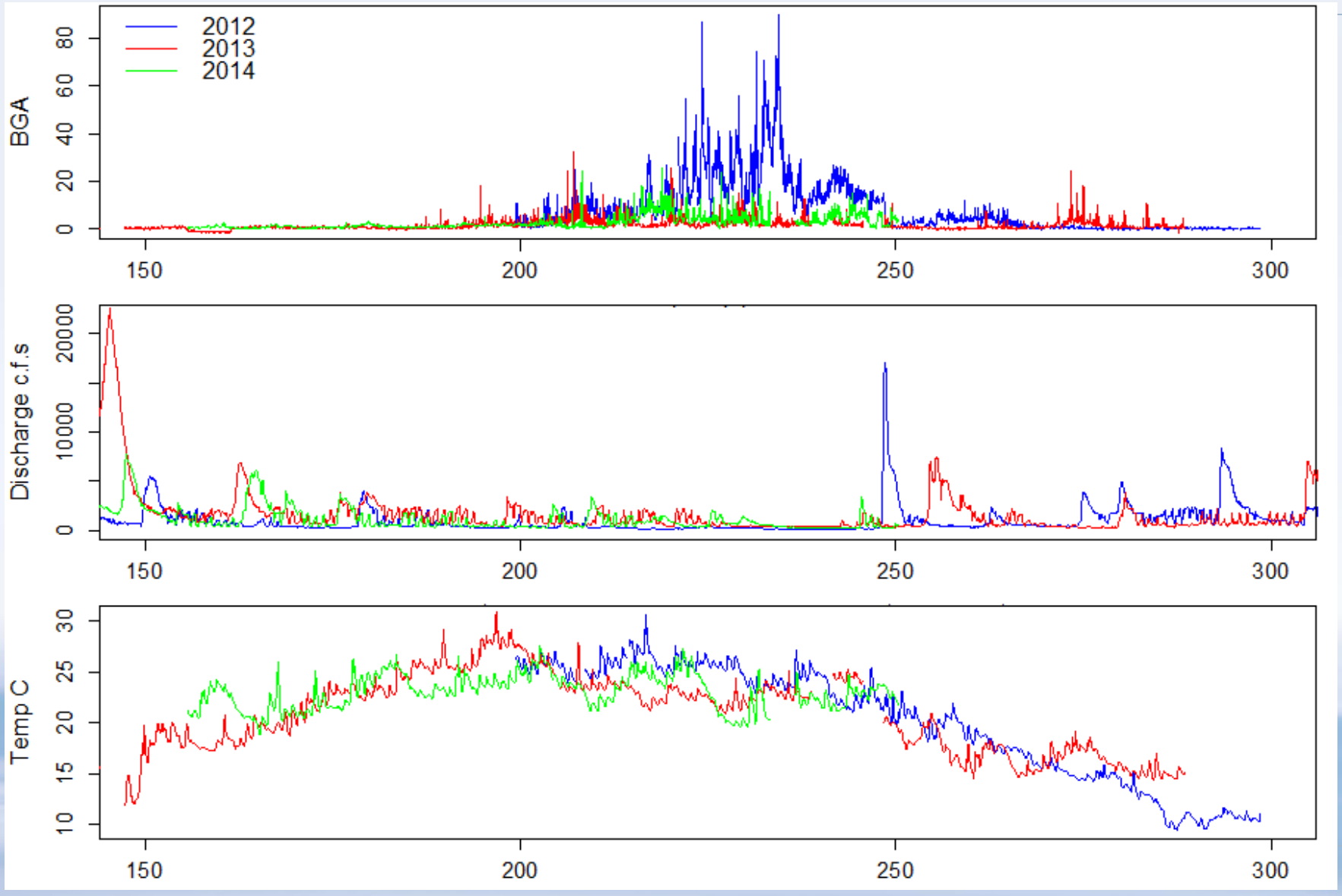
2. Process Insights & Watershed Response-Receiving water ecology and nutrient cycling



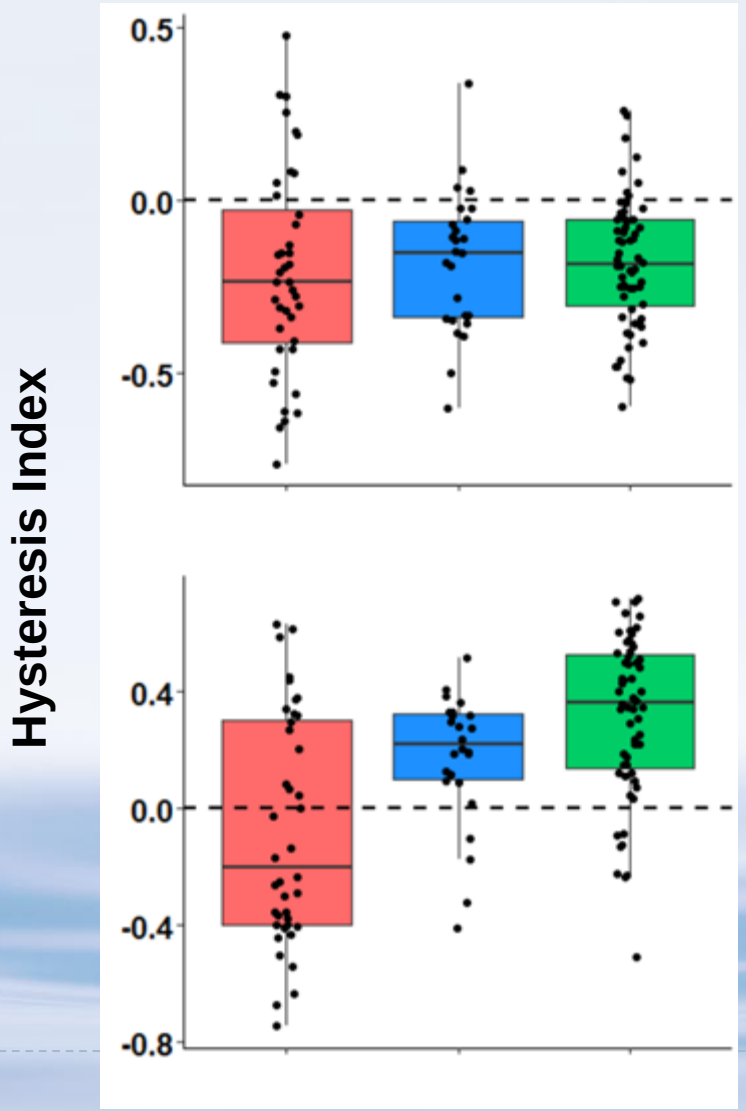




2. Process Insights & Watershed Response- Instream ecology and nutrient cycling



2. Process Insights & Watershed Response-In storm nutrient behavior



Coordinated Regional Sampling

- Example Regional Precipitation Event (10/15-17)
- Storm Driven Synoptic Sampling