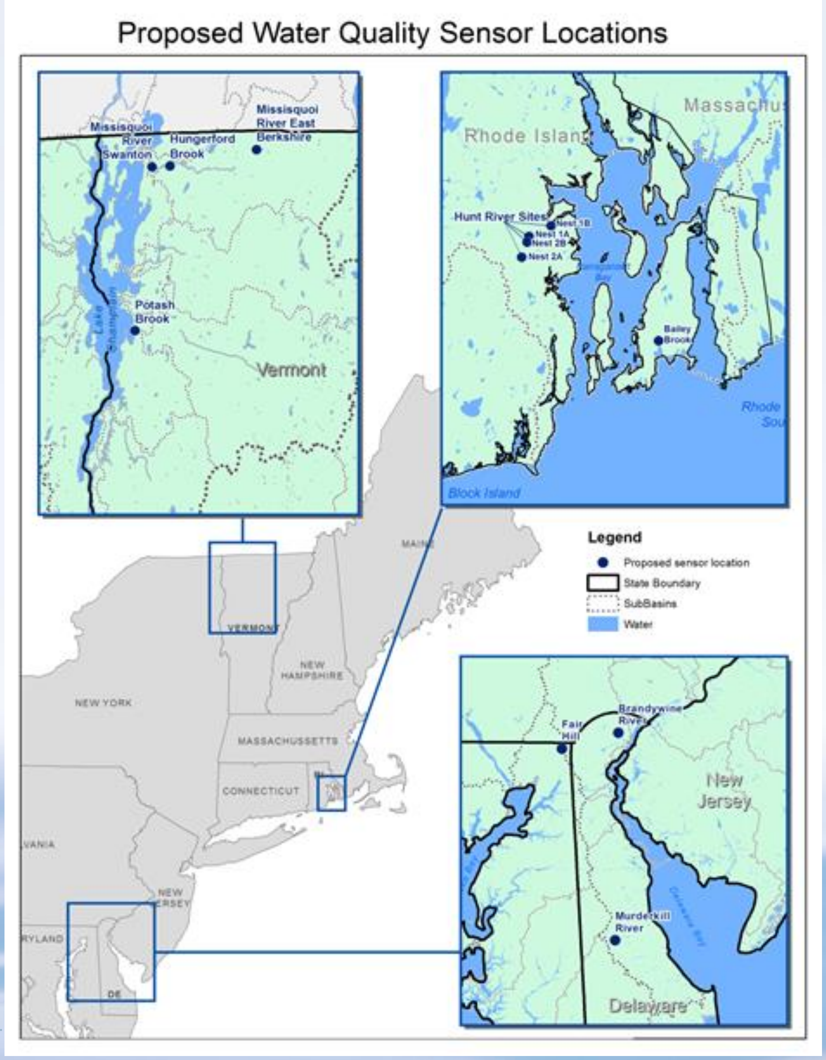
Sensor Group Progress Report to AAAS 2013-2014

RII – Track -2 IIA 1330446

NEWRnet Sensor Group 2013-14 Report Outline

- Group Wide Activities and Sensor Selection
- VT Sites
- RI Sites
- DE Sites
- Synoptic Water Sampling
- Regional Research Themes and Initial Data
- Sensor Development Through Pilot Studies (Dwyer)



Summary of Group Activities

- Foster productive collaborative dynamics
- 2 Group Meetings hosted by RI
- October 2013-Initial meeting and sensor demonstration by vendors
- May 2014-Sensor configuration, RI site visits, coordinated research plan development
- Many group conference calls
- Successful recruitment of graduate students and technical staff
- Involvement of undergraduate interns in research

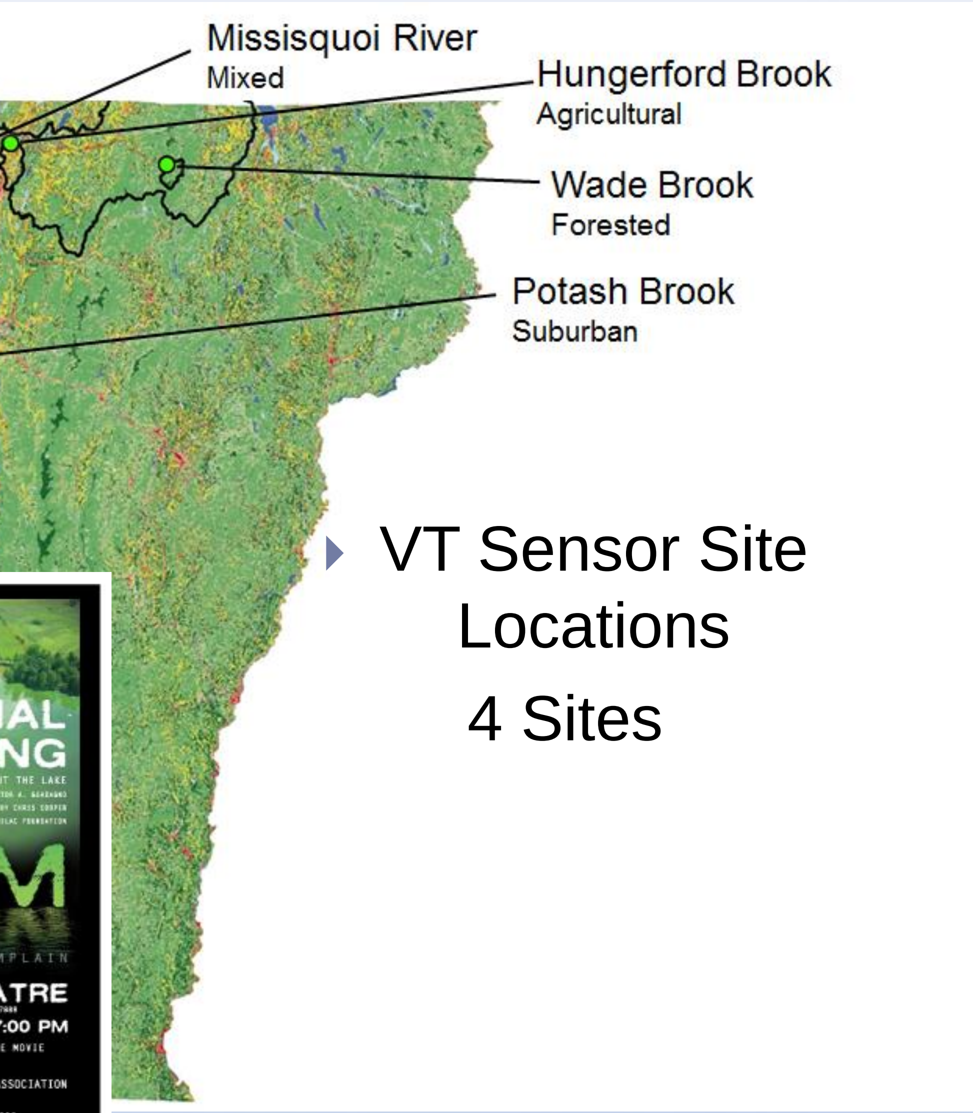
- Successful installation of functional regional sensor array
- **AGU 2014-The Ongoing Sensor Revolution in the Hydrologic Sciences: Quantifying Hot Spot and Hot Moment Controls on Water Quality Across Scale** (3 abstracts, two with graduate student first authors)

Sensor Selections

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

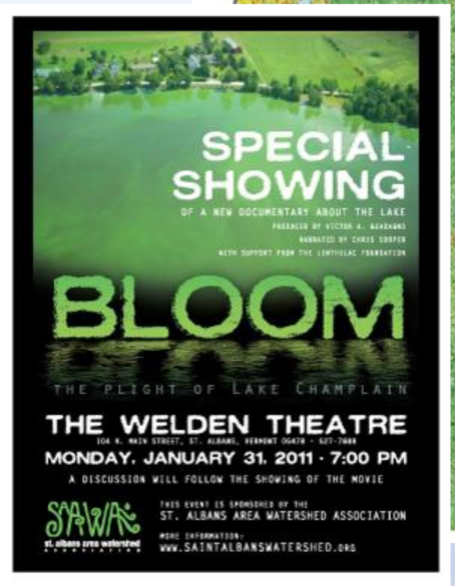
Vermont NEWRnet Sensor Network:

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



- VT Sensor Site Locations

  4 Sites

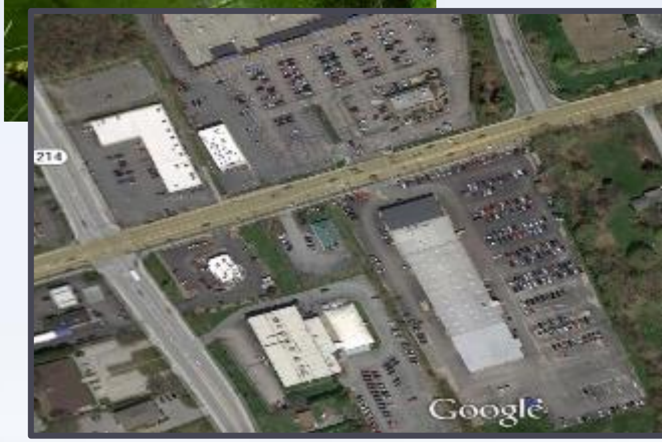


RI Sensor Sites: Gold, Chase, Addy, Garfield

Experimental Watersheds:

Common Physiography (dense till) and Scale

- **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

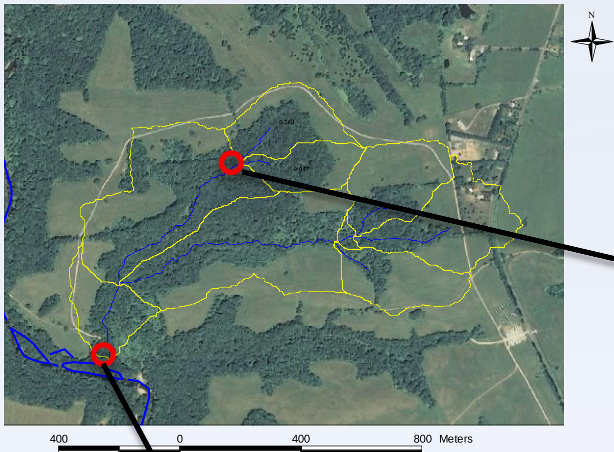
- Sensor Site locations in Delaware & Maryland – 3 sites

- 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



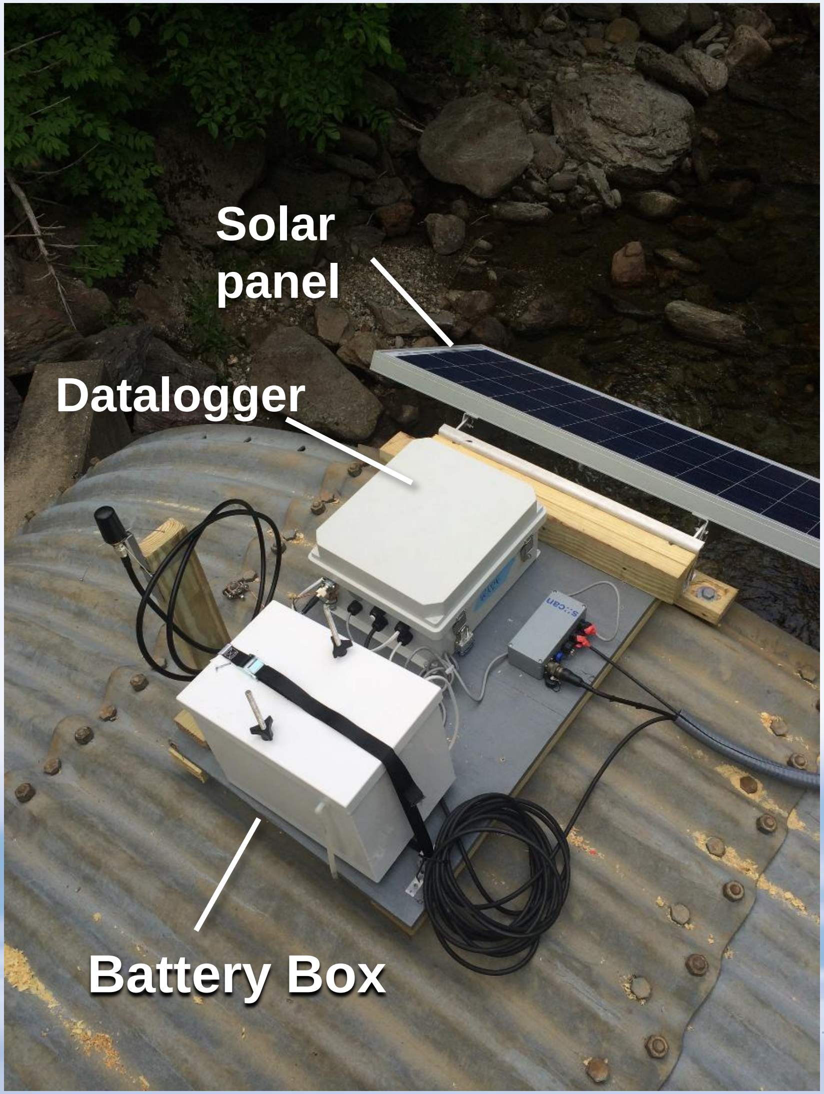
12 ha stream

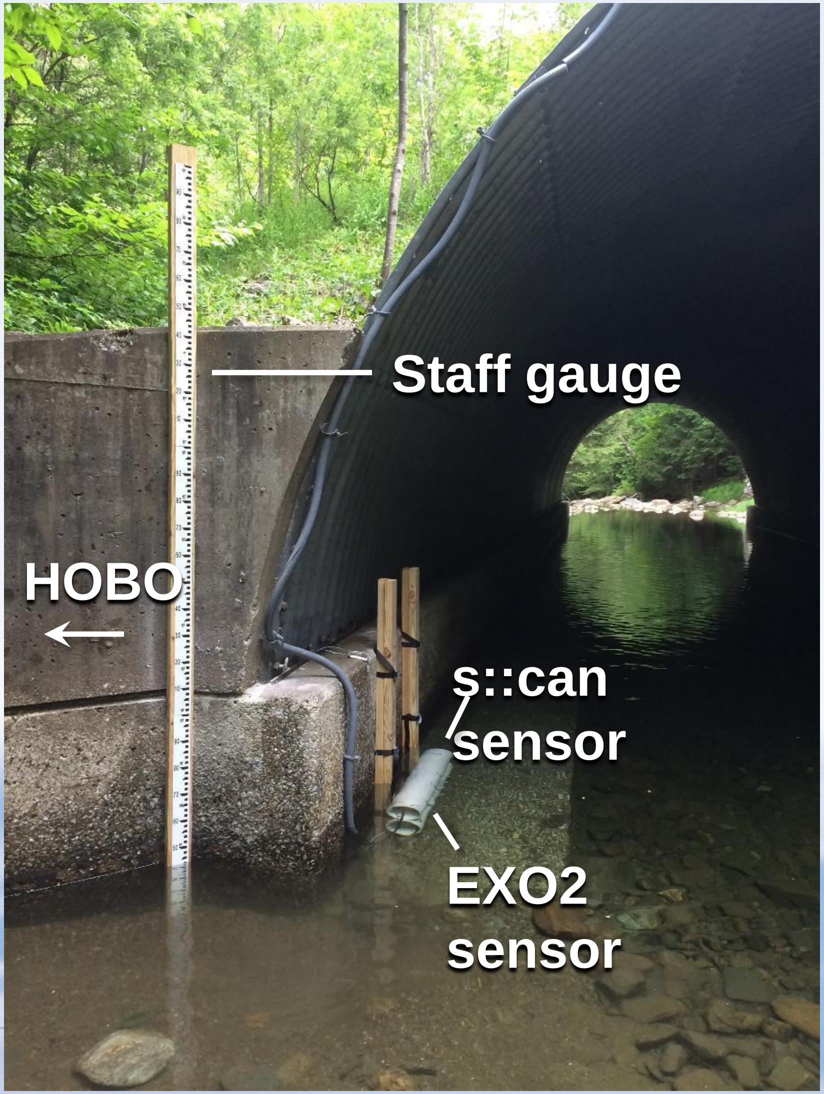
Big Elk Creek

79 ha stream

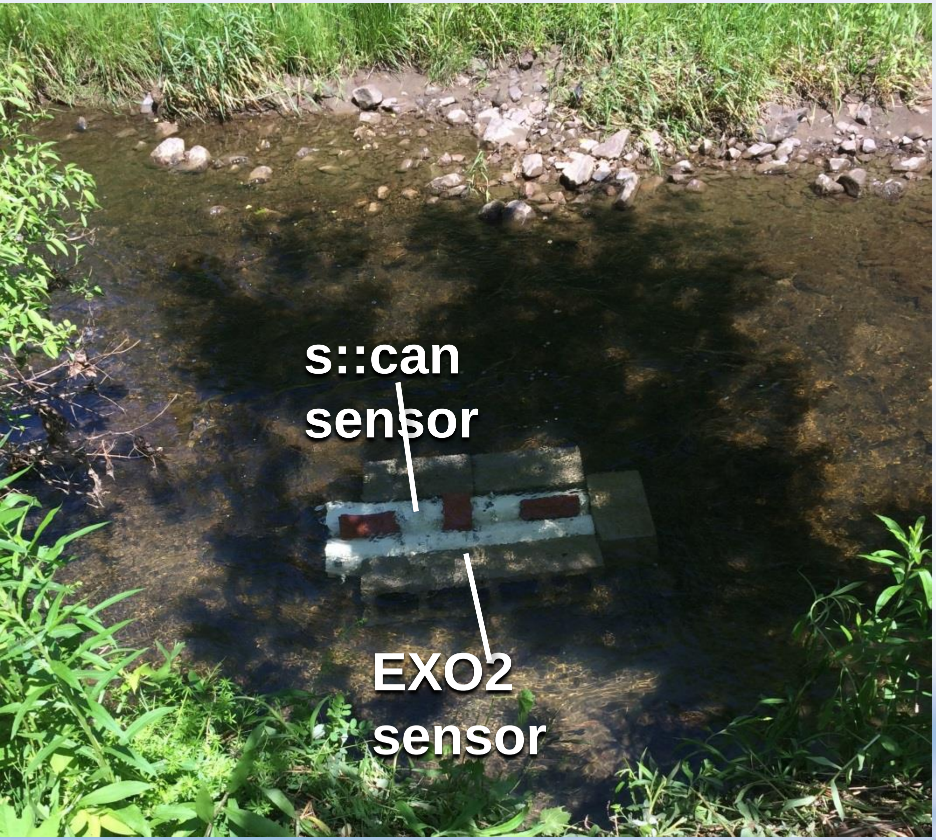
- Forested, “reference” sensor site
- Small, nested, subwatersheds = 79, 12 ha
- Long history of water chemistry (8 years)
- Good understanding of watershed behavior with numerous publications
- Drain into Big Elk Creek – water supply source for the town of Elkton, MD (pop. ~ 15,000)

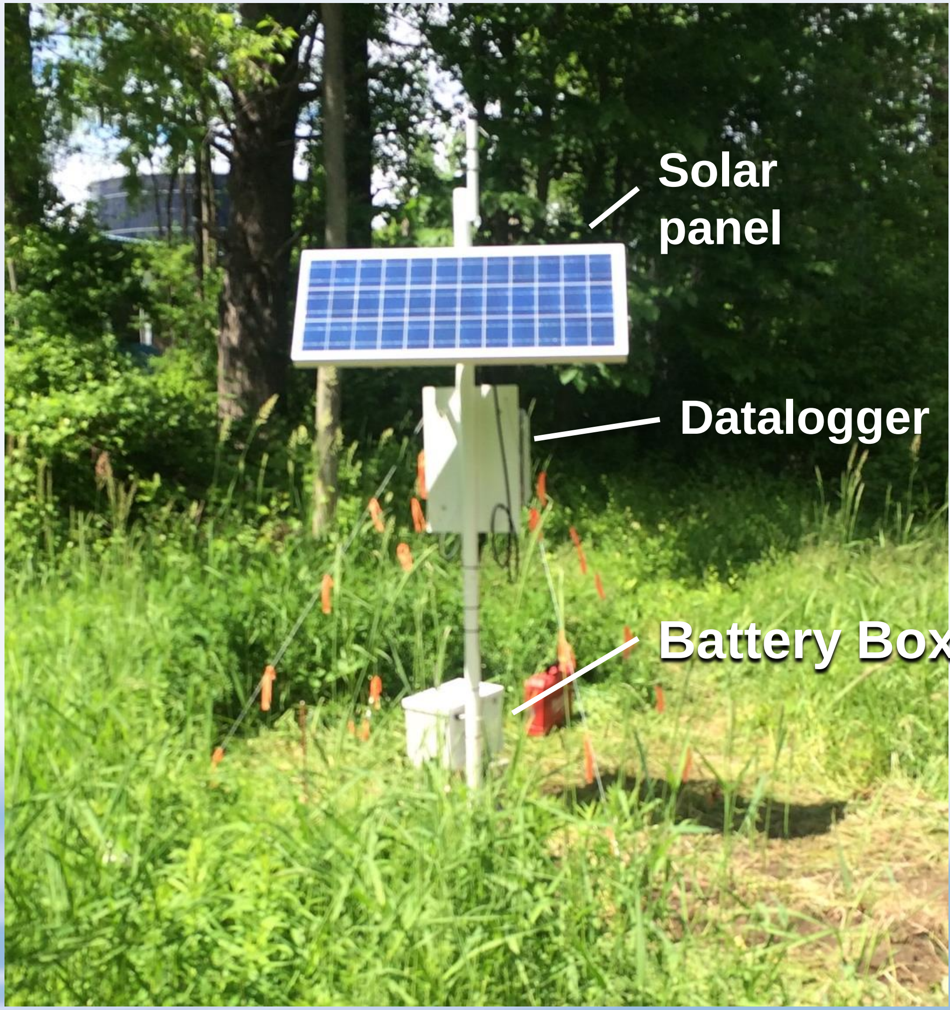
Field Installations - Forested





Field Installations - Suburban





Rating Curve Development

- Sites without USGS gage
- Stage data collected with HOBO U20 pressure transducers
- Standard velocity area and salt dilution methods

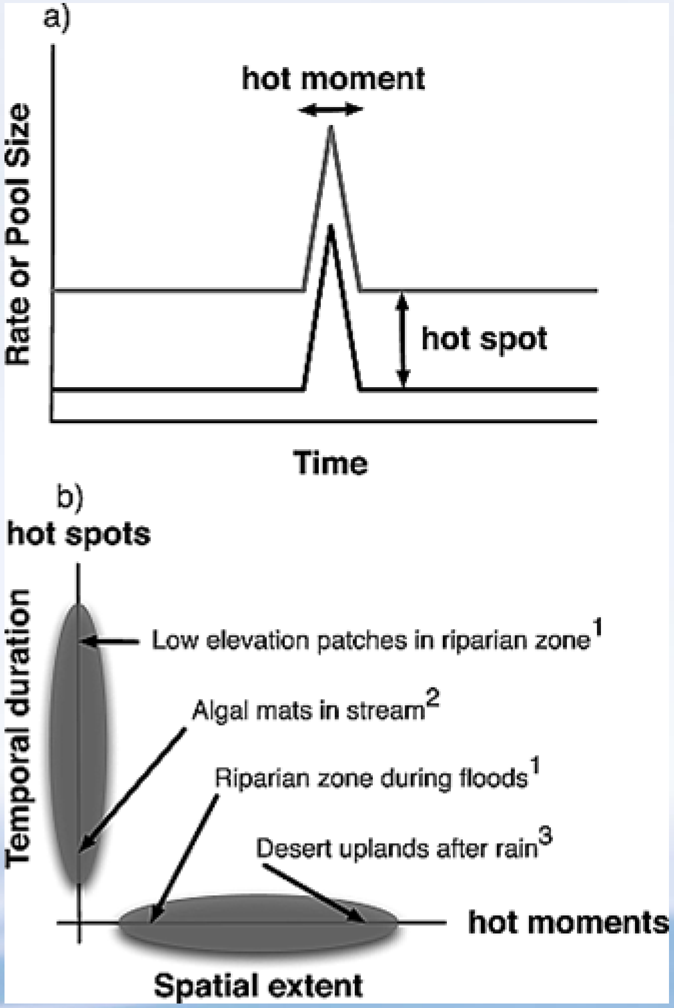
Synoptic Water Sampling

- 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 ISCO-automated)
  - Consistent sampling protocols, standard suite of analyses for each sampling event

- 2) Additional synoptic sampling events and detailed analyses for particular research questions. Organic matter composition, pollutant export, additional application of full UV/Vis spectra

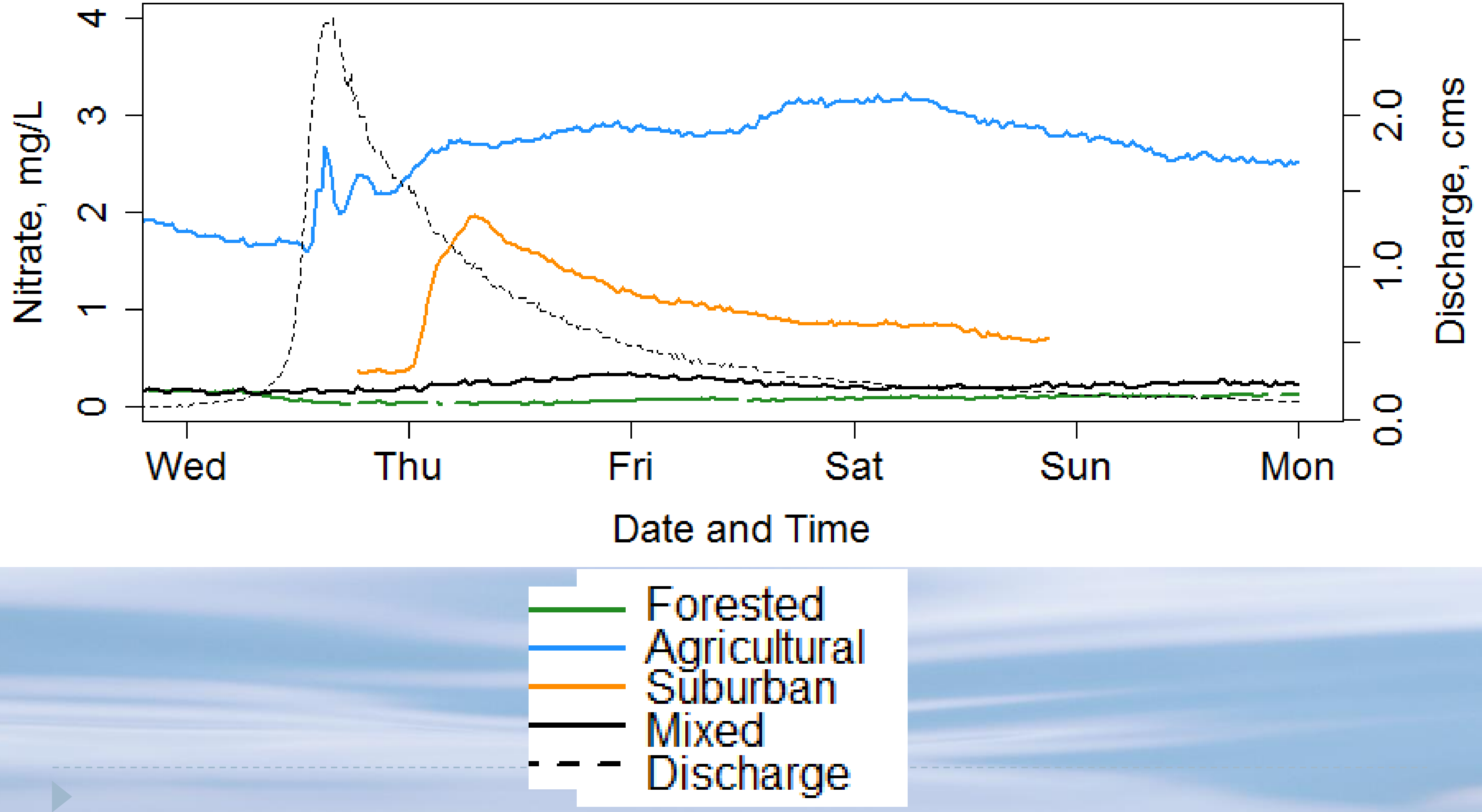
Regional Research Questions

- Can we detect and describe regional hot moments? **Examples:** late summer storms, snowmelt, rain on snow, autumn leaf fall, large regional storms or droughts
- Use sensor (ideal tool) to drive regional synoptic sampling to learn more about hot moments (and spots) within our watersheds
- Anthropogenic hot moments? Can we relate sensor data to specific decisions made in the watershed? Coordinate with social science team!



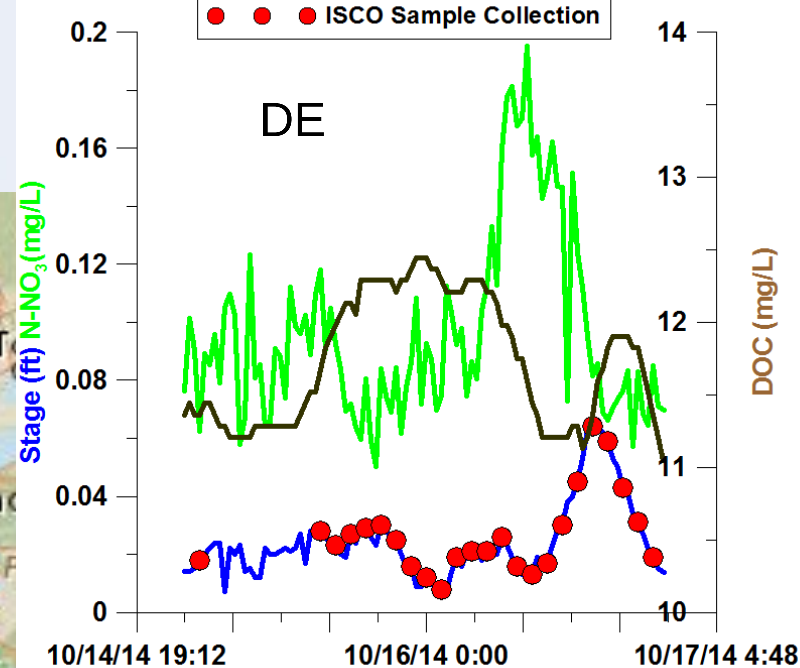
Harms and Grimm, 2008

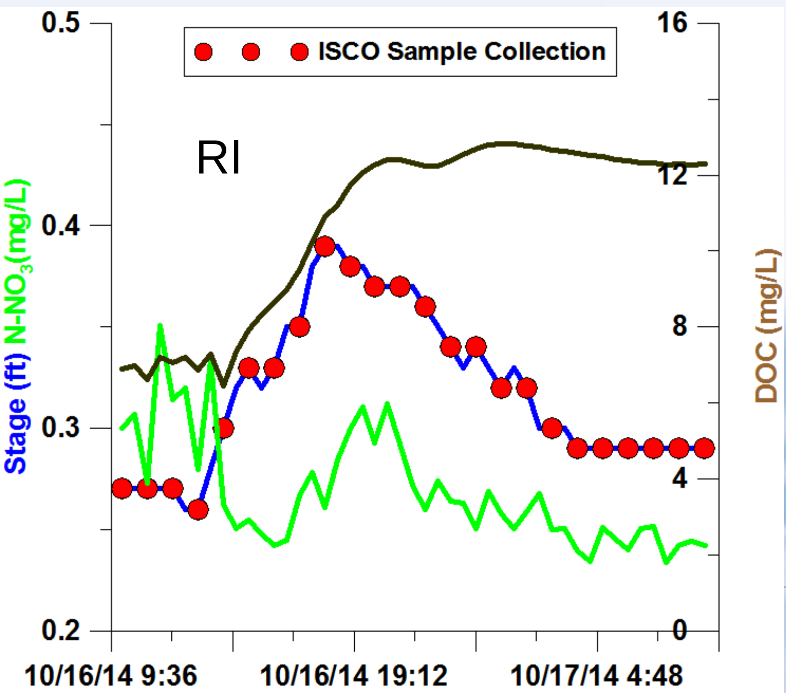
Storm Response Across Sites - Nitrate

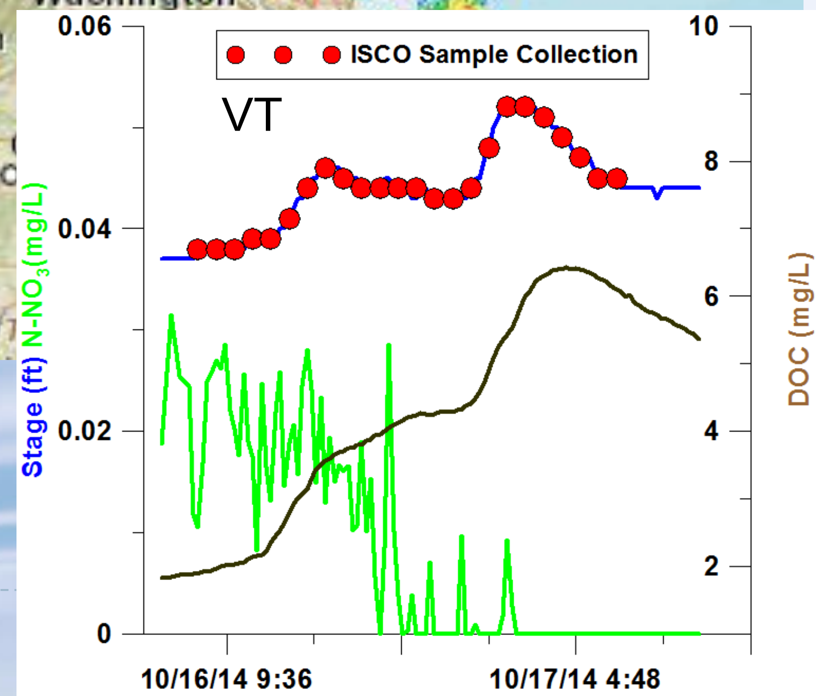


Coordinated Regional Sampling

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







Pilot Grant Sensor Development – URI Jason Dwyer

Buddini Karawdeniya
Ph.D. Candidate Chemistry

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Electroless Plating of Thin Gold Films Directly onto Silicon Nitride Thin Films and into Micropores

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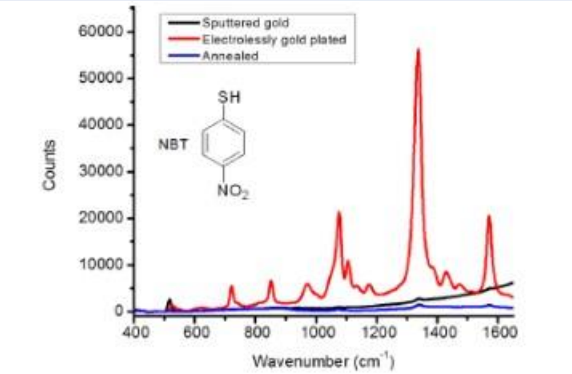
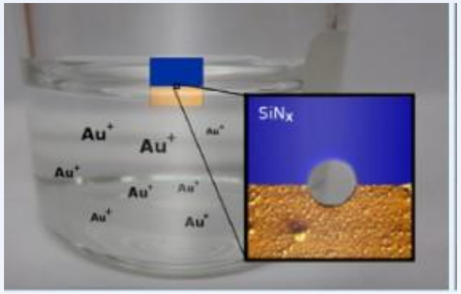


Figure 3. Measured spectra from 1 cm^2 silicon nitride substrates soaked in 0.01 M NBT for 5 min: from a substrate electrolessly gold-plated at 3 °C for 3 h (red), from the same chip plasma cleaned, annealed at 280 °C for 20 min, and plasma cleaned again before NBT exposure (blue), and from a sputtered (30s) gold film (black).



- Worked on applying an electroless gold plating technology to creating inexpensive sensors for surface-enhanced Raman spectroscopy (SERS) of aquatic contaminants such as pesticides
- Poster at the 2014 Gordon Conference on Bioanalytical Sensors
- Published SERS work in an American Chemical Society journal
- Supervised undergraduate student Joshua Doyle