Overview of BREE: Ecological Team Year 1 Research Progress

Co-Leads: Carol Adair and Andrew Schroth

New Team Members: Wilton Burns, Brittany Lancellotti, Erin Seybold

Research Technician: Saul Blocher

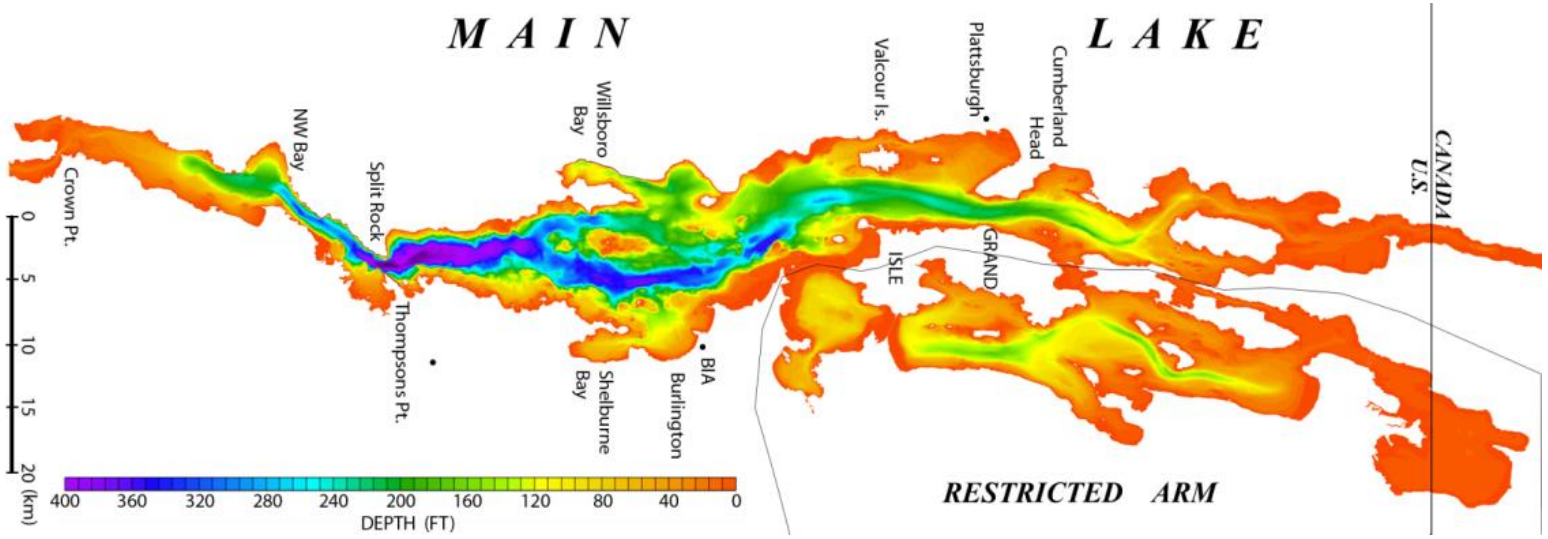
Faculty: Julia Perdrial, Arne Bomblies, Donna Rizzo, Mandar Dewoolkar Stephanie Hurley, LeslieAnne Dupigny-Giroux, Andy Vermilyea, Breck Bowden, Don Ross, Jason Stockwell, Farrah Fatemi, Tom Manley, Pat Manley

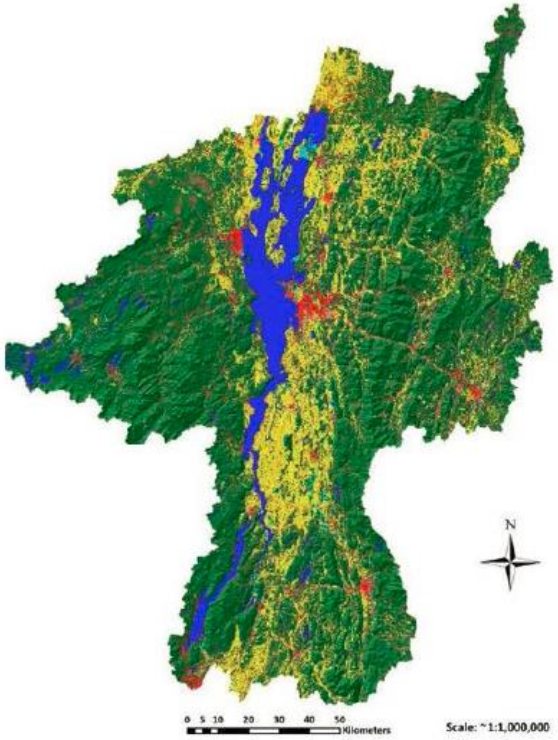
Overarching Ecological Research Questions:

Understanding Extreme Event Impacts on Water Quality Resilience Across Soil-River-Lake Continuum

BREE
Basin Resilience to Extreme Events
in the Lake Champlain Basin

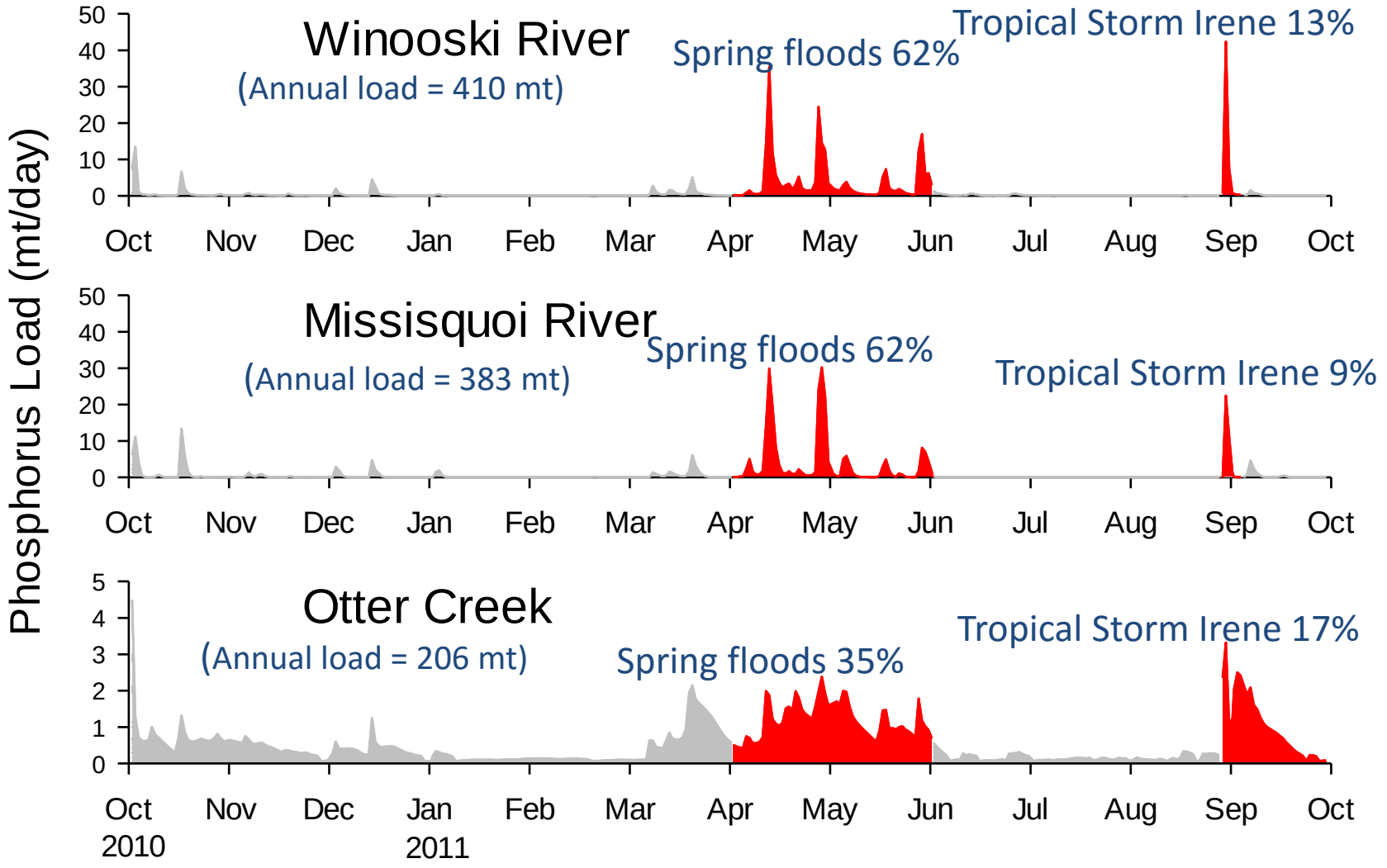
- *How do the biophysical configuration, antecedent conditions, and ongoing changes in climate and land-use within the Basin's terrestrial and aquatic ecological system interact to impact the response of water quality to extreme events?*
- *Are there system properties that are critical to maintaining water quality that can be preserved, restored, or promoted to enhance resilience across the socio ecological system of the Basin?*



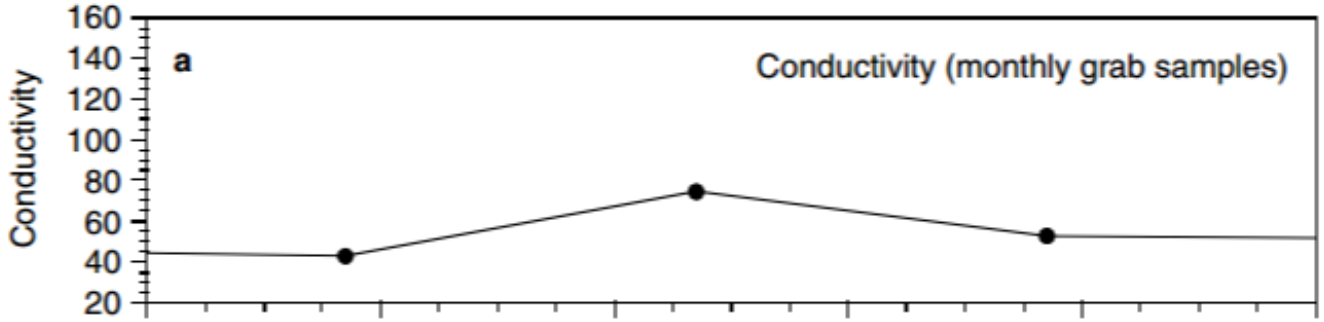


Example of Extreme Event Impacts on Water Quality and Resiliency

Daily phosphorus loads from three Lake Champlain tributaries during water year 2011



High frequency measurements essential tool for characterizing and accurately modeling episodic events.



Kirchner et al. (2004)

Design novel monitoring network across soil-stream-lake continuum to capture and understand critical processes/drivers and inform integrated models

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in the Lake Champlain Basin

Riparian Monitoring

- Water Quality Resilience: maintenance of or rapid return to good water quality with extreme events

- Nutrient transport & transformation
  - What properties and processes are key to maintain water quality?
  - What conditions promote them?

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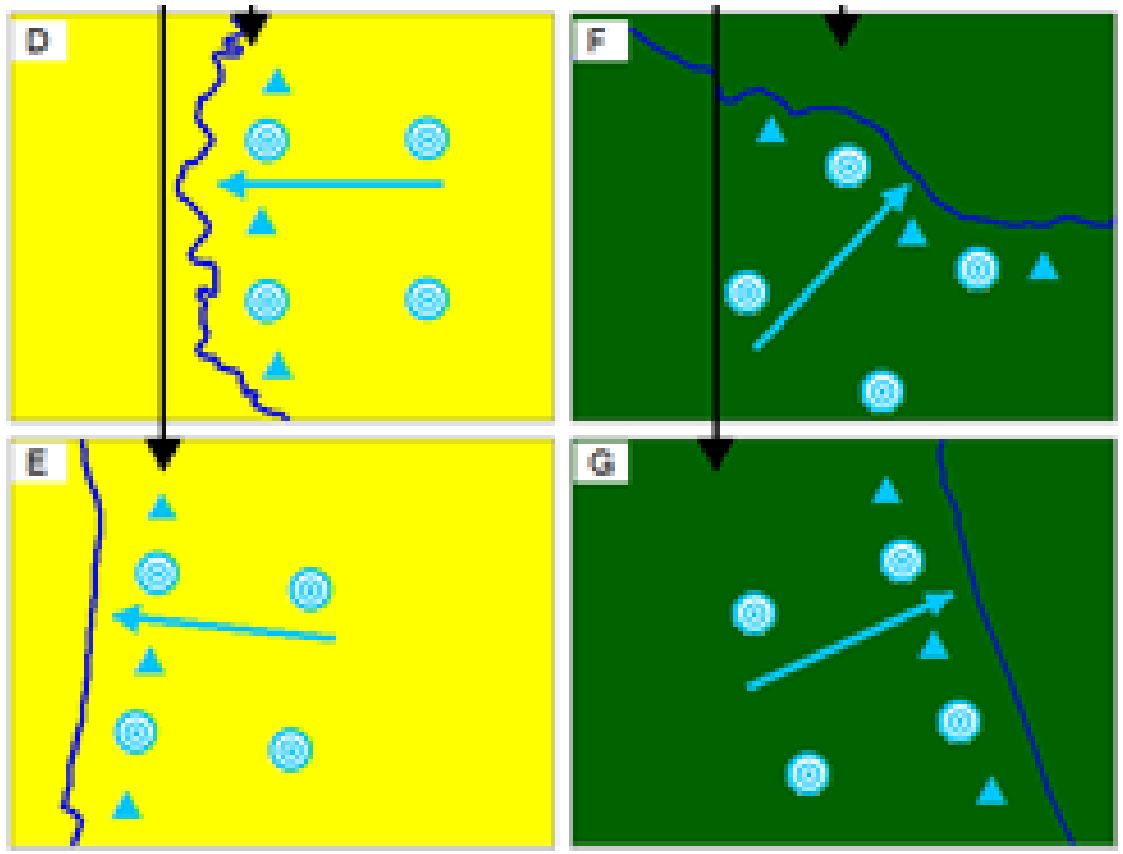
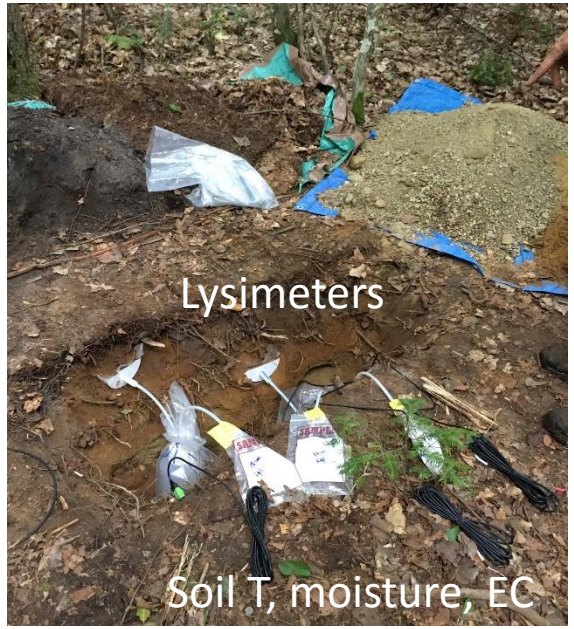
  - What conditions promote them?

- Sensors transects installed into 4 sites
  - 2 Agricultural
  - 2 Forested



Riparian Monitoring: tools

- Physical conditions:
  - Soil T, moisture, electric conductivity
- Gases, redox (triangles):
  - Redox, CO_2, O_2
- Nutrients, carbon, metals:
  - Lysimeter & shallow monitoring wells
- Weather stations
- Phenocams
- Targeted sampling (soils, soil water, groundwater)



Accomplished Year 1: Watershed Site Selection

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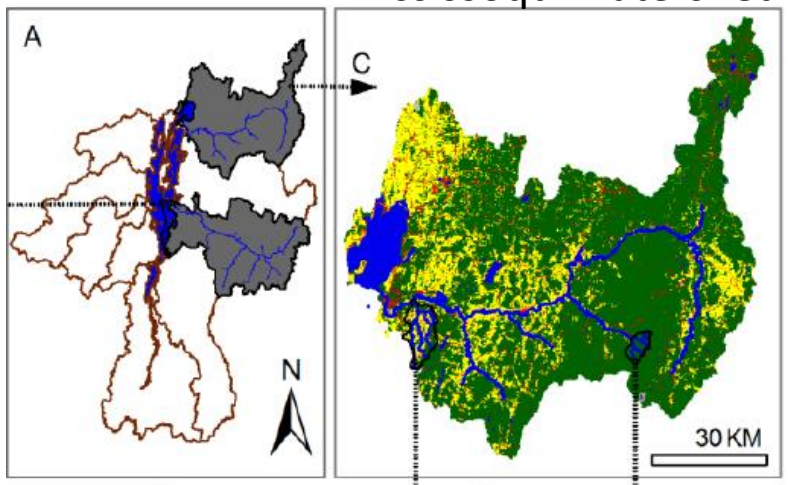
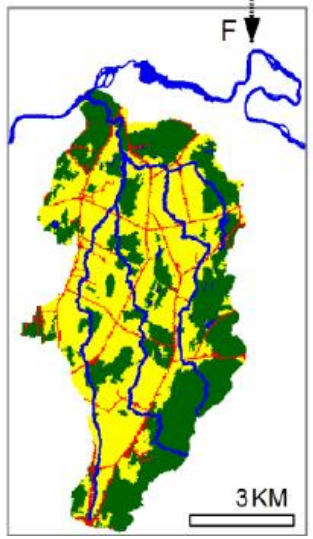
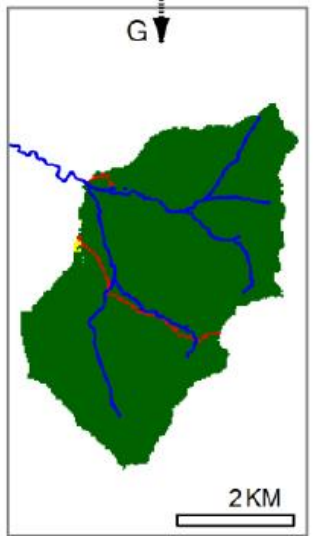
Basin Resilience to Extreme Events
in the Lake Champlain Basin

Mississoqui watershed



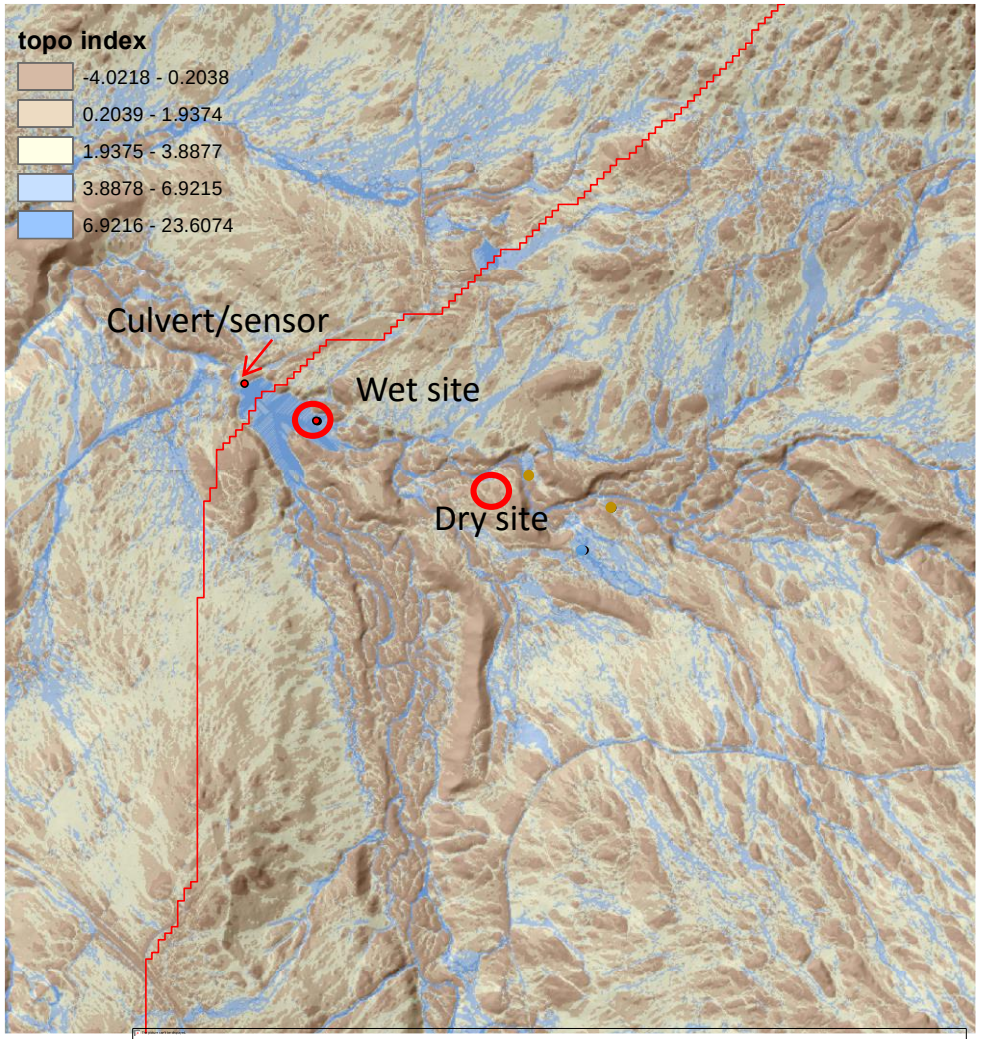
Hungerford Brook





Wade Brook

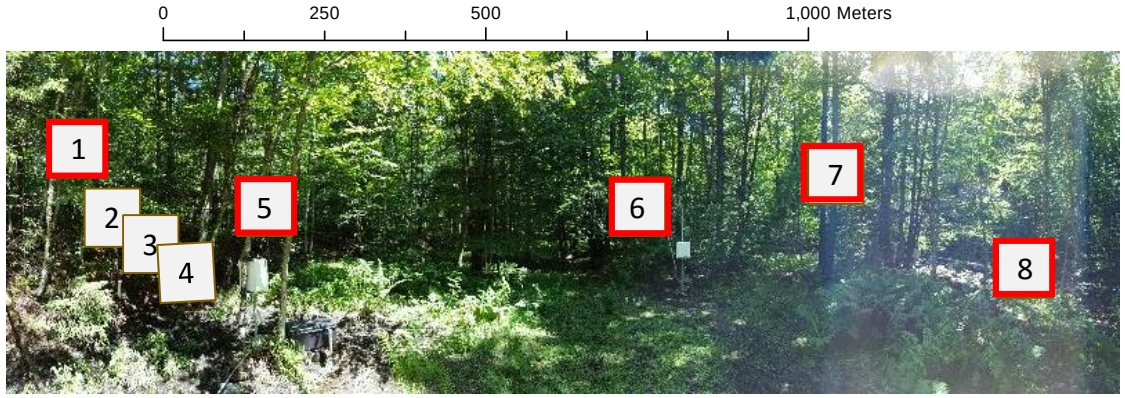
Wade Brook Watershed: forested sites

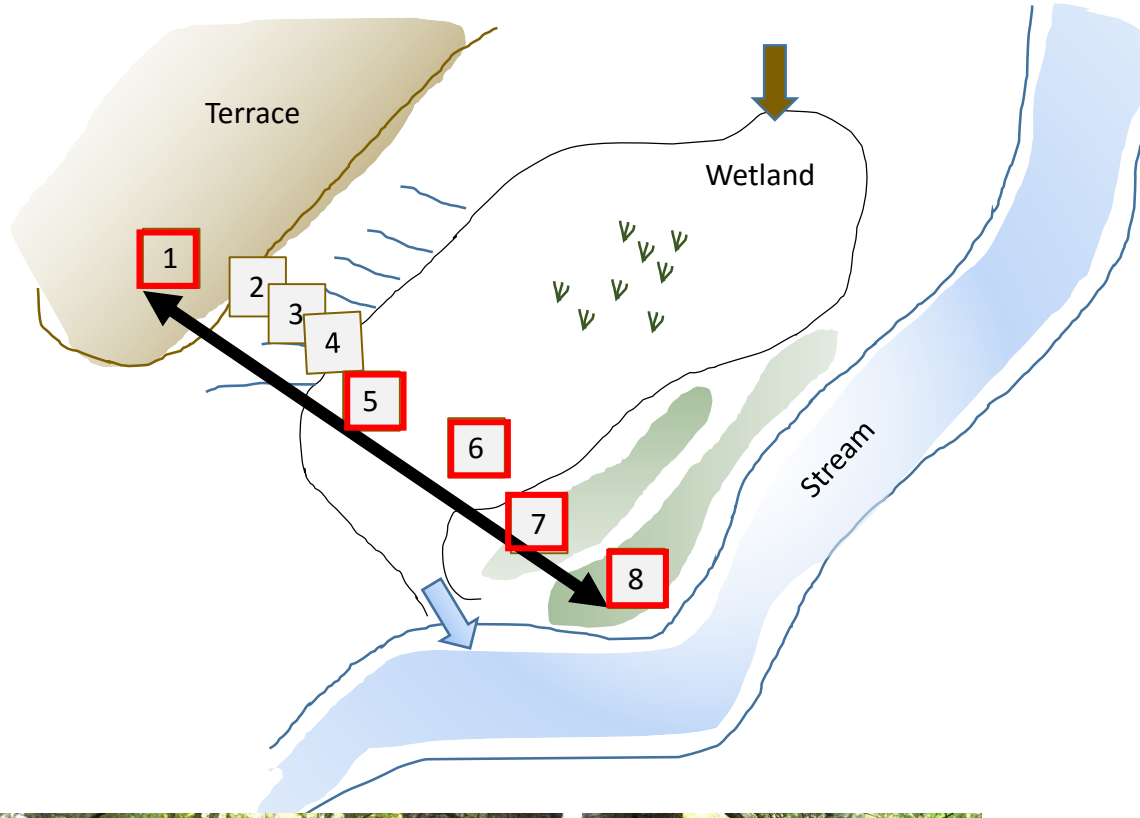


Wet site

Dry site

Accomplished Year 1: Installation of Wade Brook forested wet site





2016 Wade Brook wet site installation

Prep

2016 Wade Brook wet site installation

Digging

2016 Wade Brook wet site installation

Soil solution samplers

Soil Oxygen Sensors

CO_2 sensors

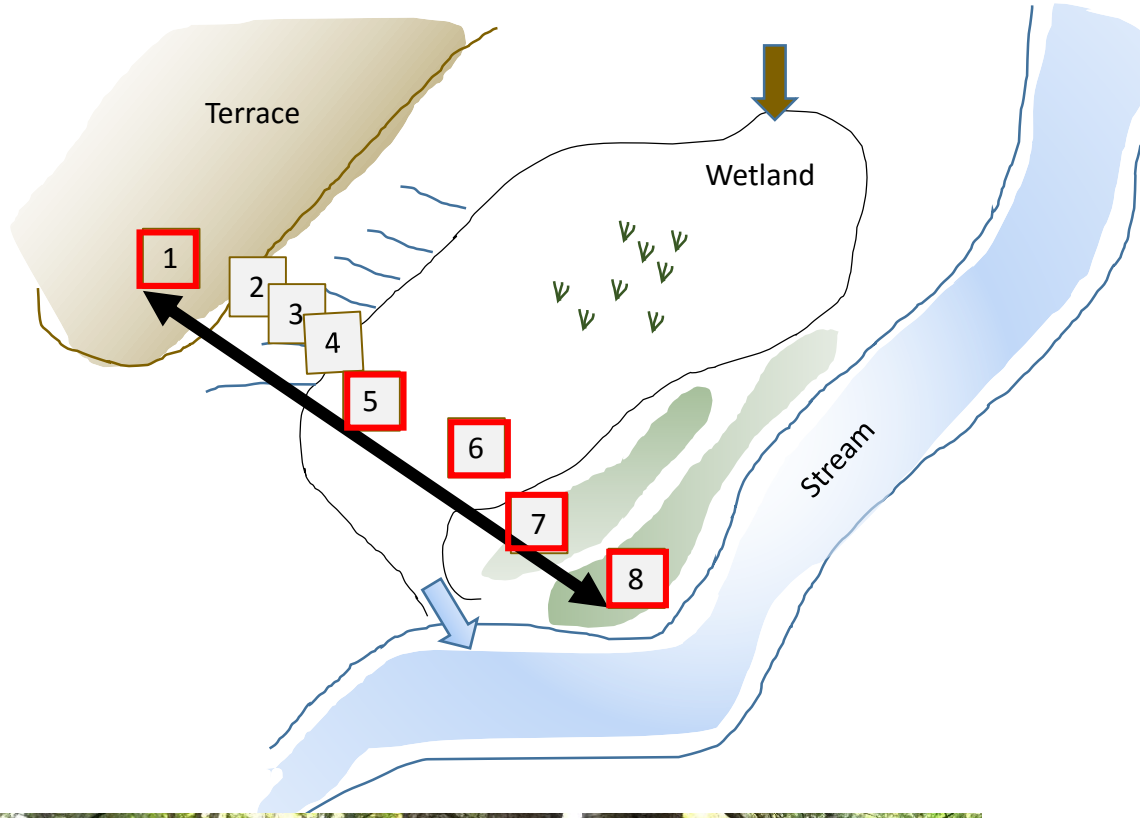
Soil description

Power supply

Data loggers

Accomplished Year 1:
Data collection, troubleshooting

- Site 1: Soil profile characterization, initial soil samples
- Troubleshooting: Power supply, sensor network



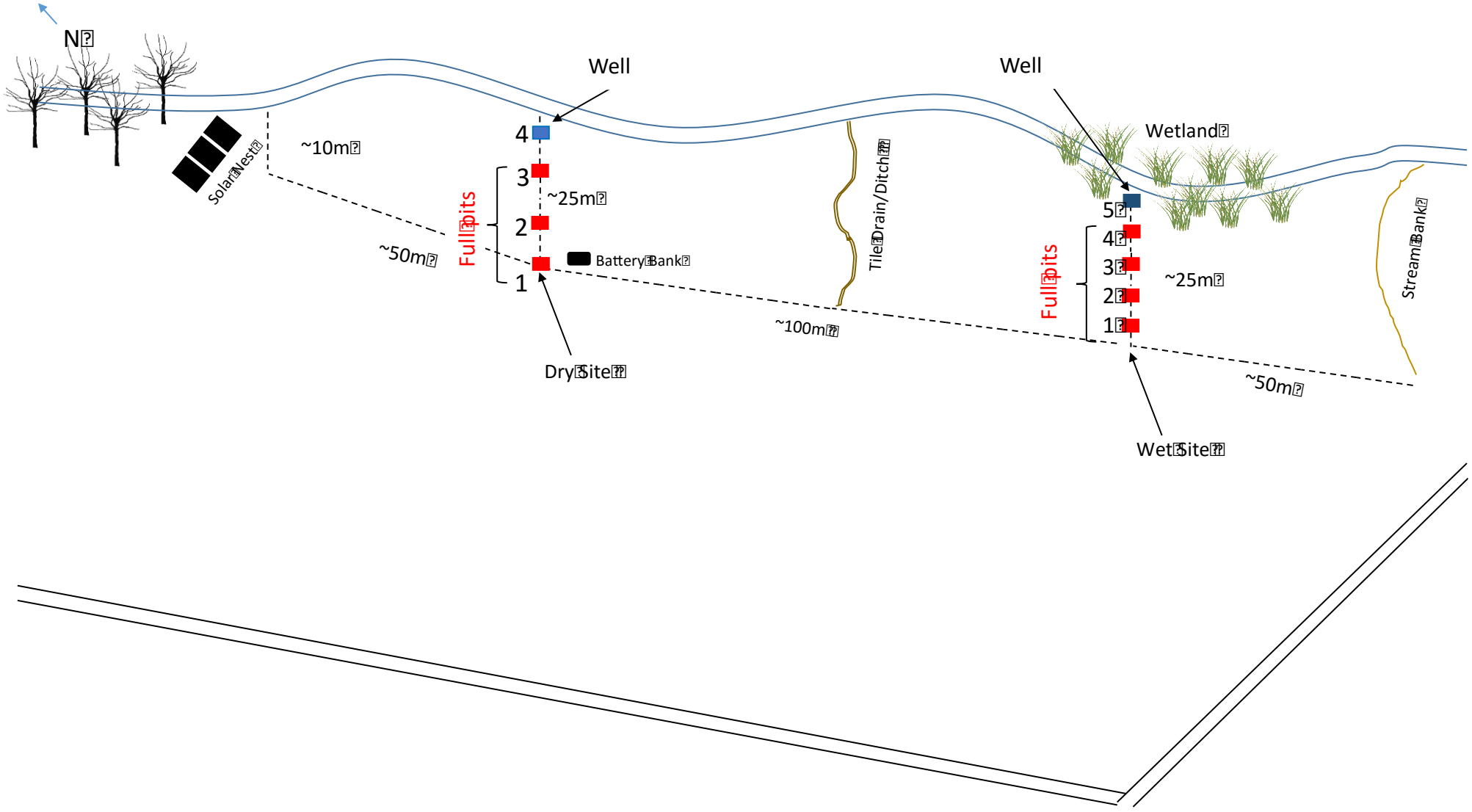
Year 2: Install Wade Brook forested dry site

Year 2: Install Hungerford Brook agricultural sites

Wet site

Dry site

Year 2: Install Hungerford Brook agricultural sites



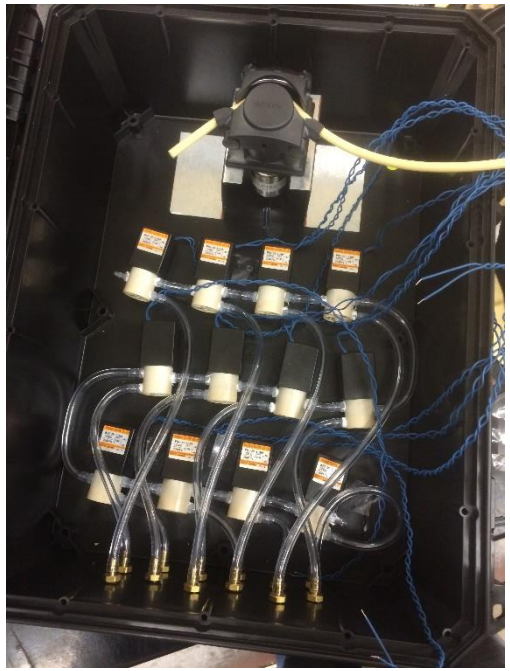
Year 2: Data collection

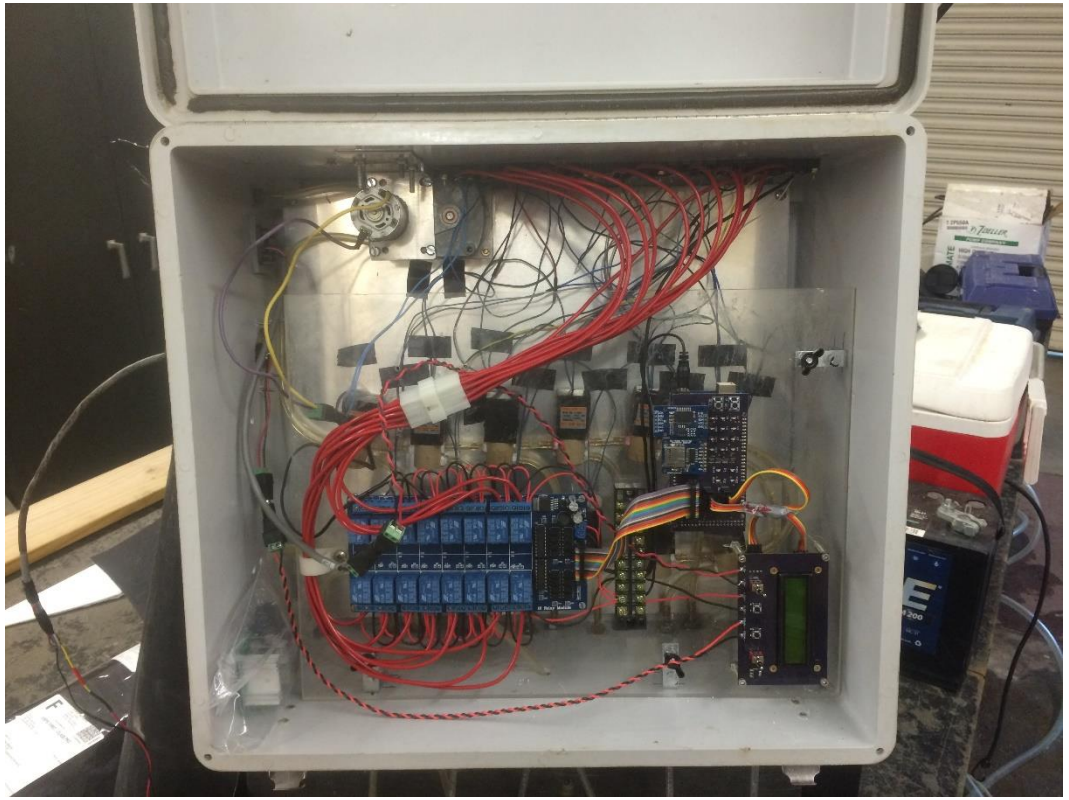
- Sites 2-4: Soil profile characterization, initial soil samples
- Continued troubleshooting, standard operating procedures
- Data collection, field/lab methods and sampling

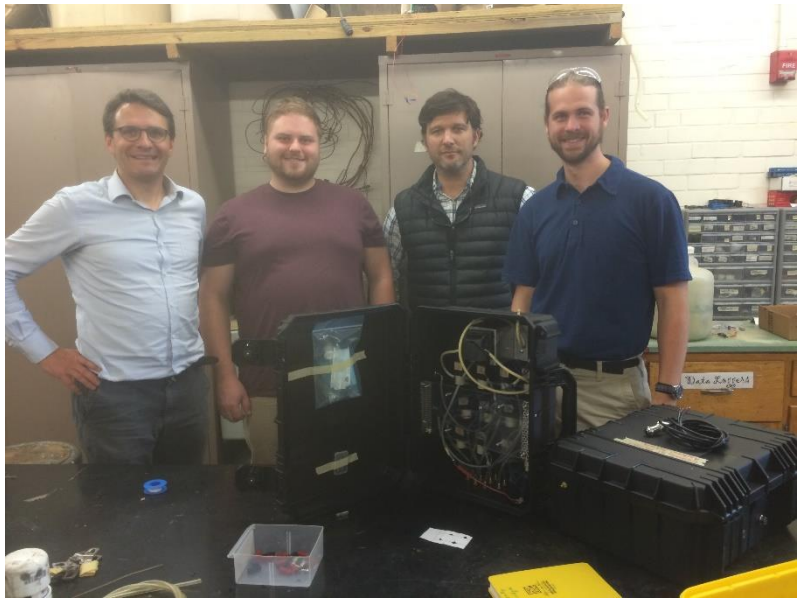
Water Monitoring Tools:
Water Chemistry, Physics and Ecology

- Spectrolyser (DOC, POC, NO3, turbidity……)
- YSI EXO2 (PC/ChlA, T, DO, pH, conductivity, fDOM)
- ISCO (nutrients and sediment)
- 3 YSI profilers
- Temperature chains (water column stability)
- ADCP(flow)
- LISTXX(particle transport)
- Targeted Water ‘Grab’ Sampling

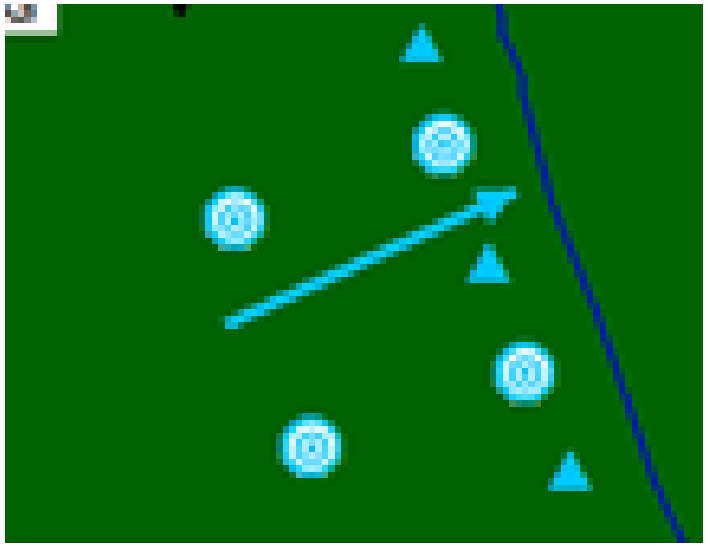
Accomplished Year 1:
Multiplexer Construction





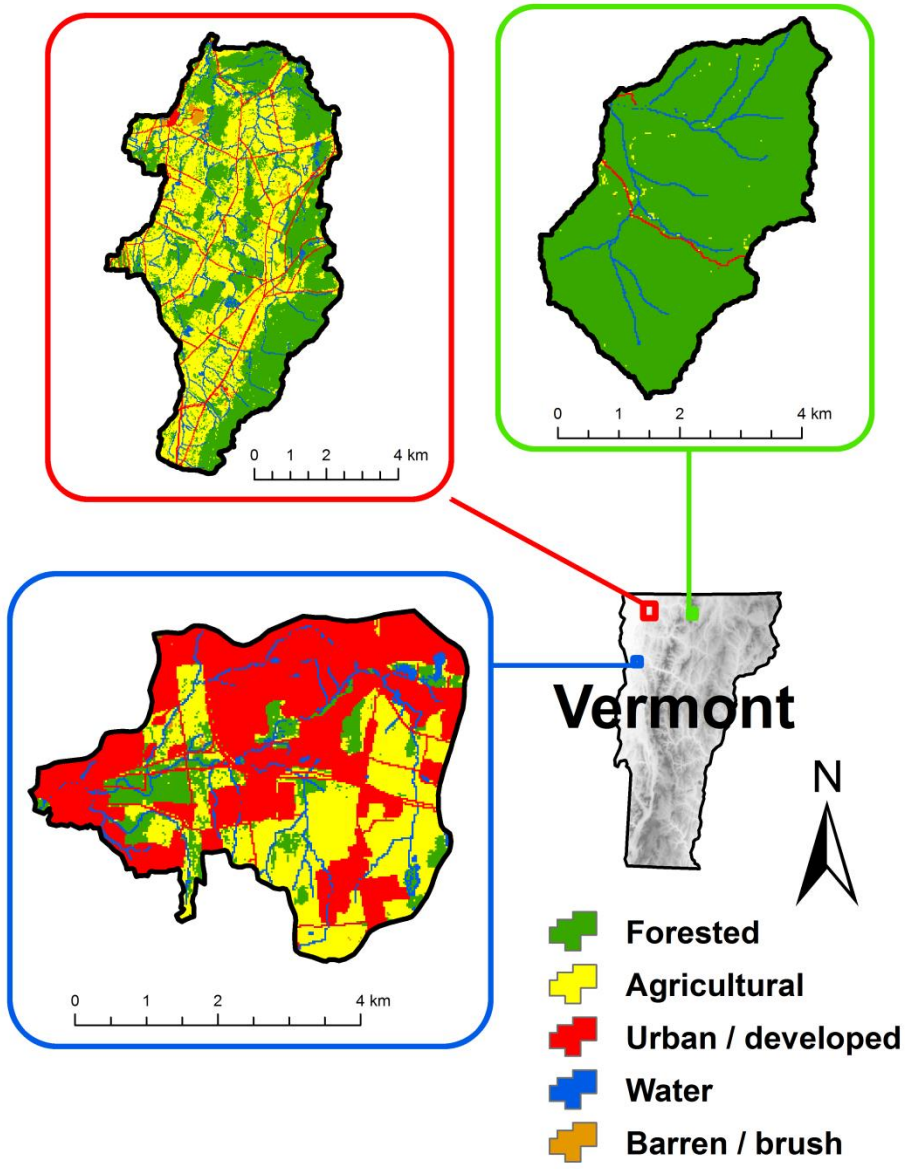


Riparian Well Transect
Hillslope-Stream



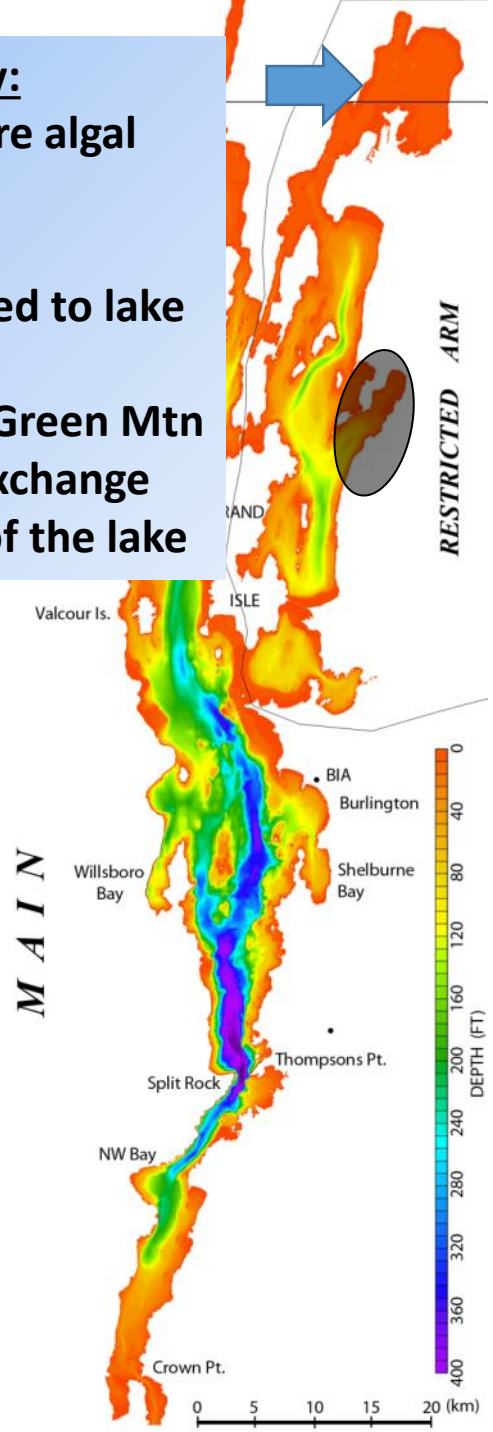
Install Well Transects in Year 2

Accomplished Year 1: In-Stream Biogeochemical and Hydrologic Observatories Deployed



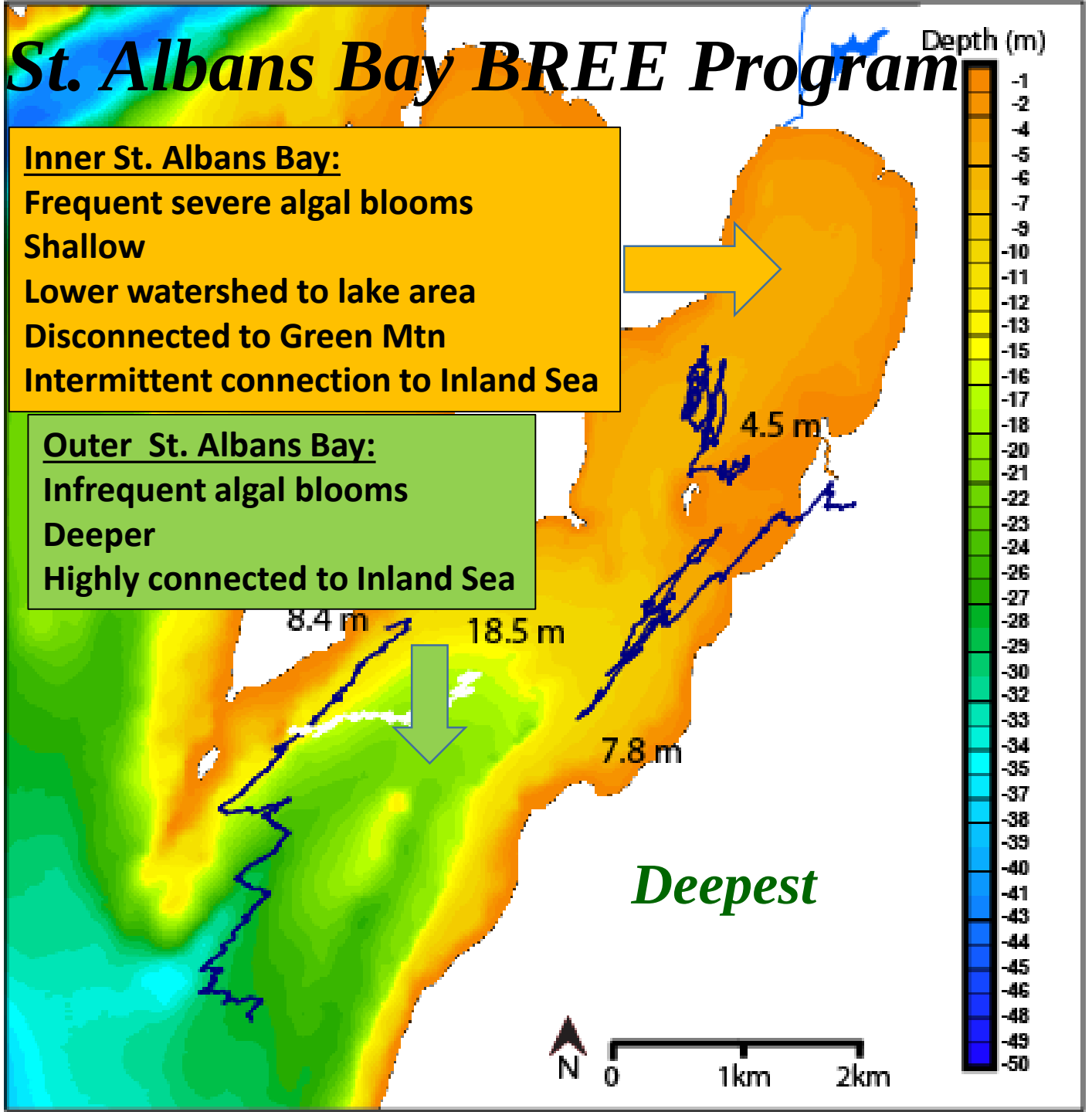
St. Albans Bay BREE Program

Missisquoi Bay:
Frequent severe algal blooms
Shallow
Large watershed to lake area
Connected to Green Mtn
Very limited exchange with the rest of the lake



Inner St. Albans Bay:
Frequent severe algal blooms
Shallow
Lower watershed to lake area
Disconnected to Green Mtn
Intermittent connection to Inland Sea

Outer St. Albans Bay:
Infrequent algal blooms
Deeper
Highly connected to Inland Sea



Accomplished Year 1: Deployment of Saint Albans Bay Advanced Biogeochemical and Hydrodynamic Monitoring Array

Measure-ChlA/PC, T, Cond, pH, DO, FDOM, Turbidity every hr. at 0.5 depth intervals at 3 Sites

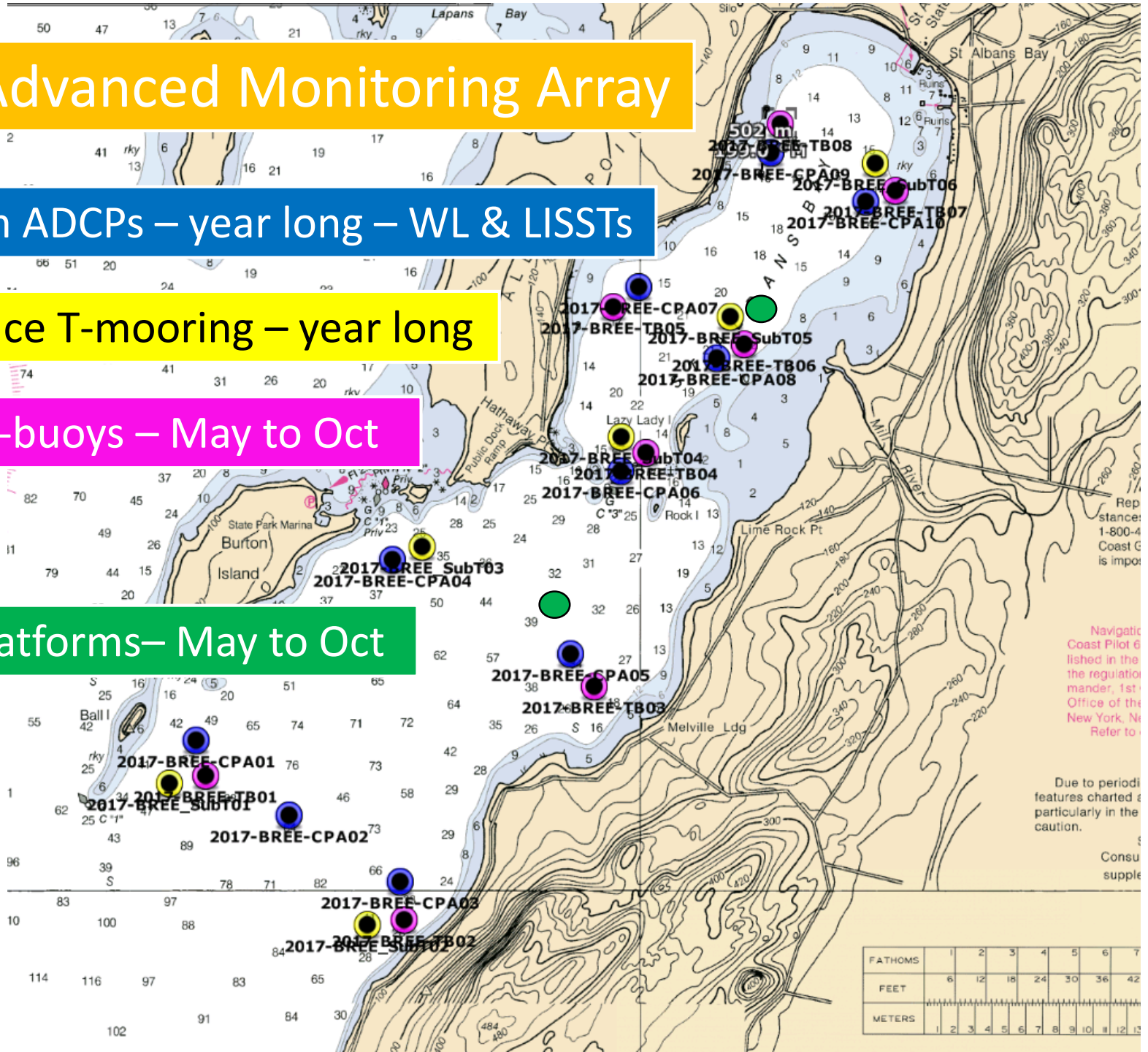
St. Albans Bay Advanced Monitoring Array

10 platform ADCPs – year long – WL & LISSTs

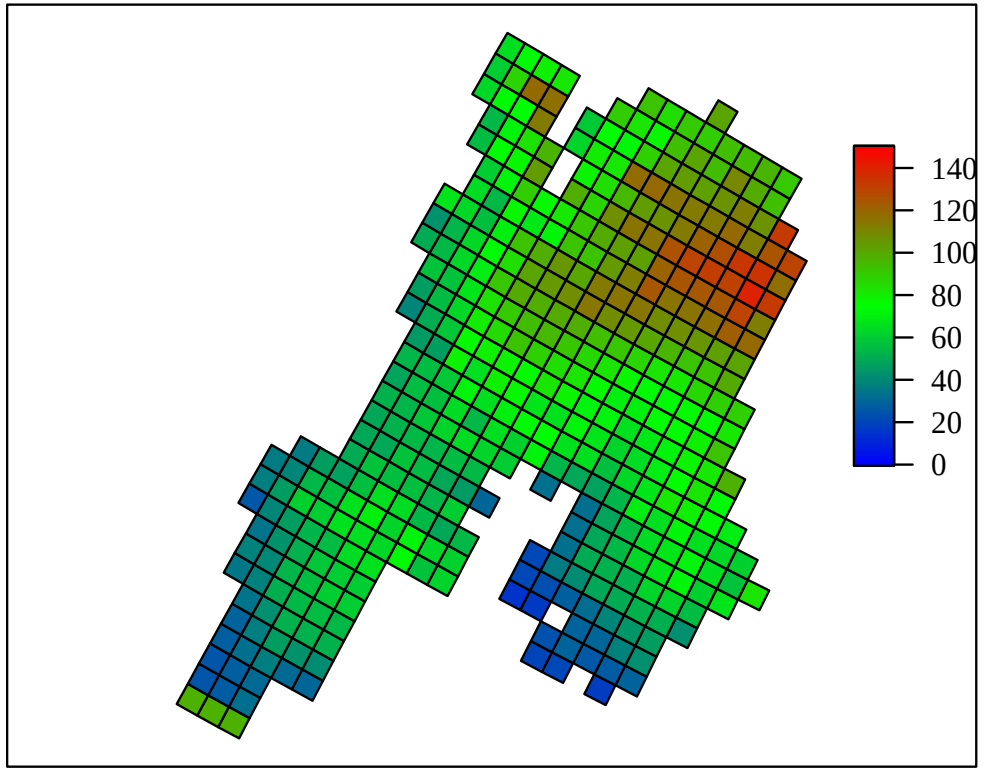
6 Sub-surface T-mooring – year long

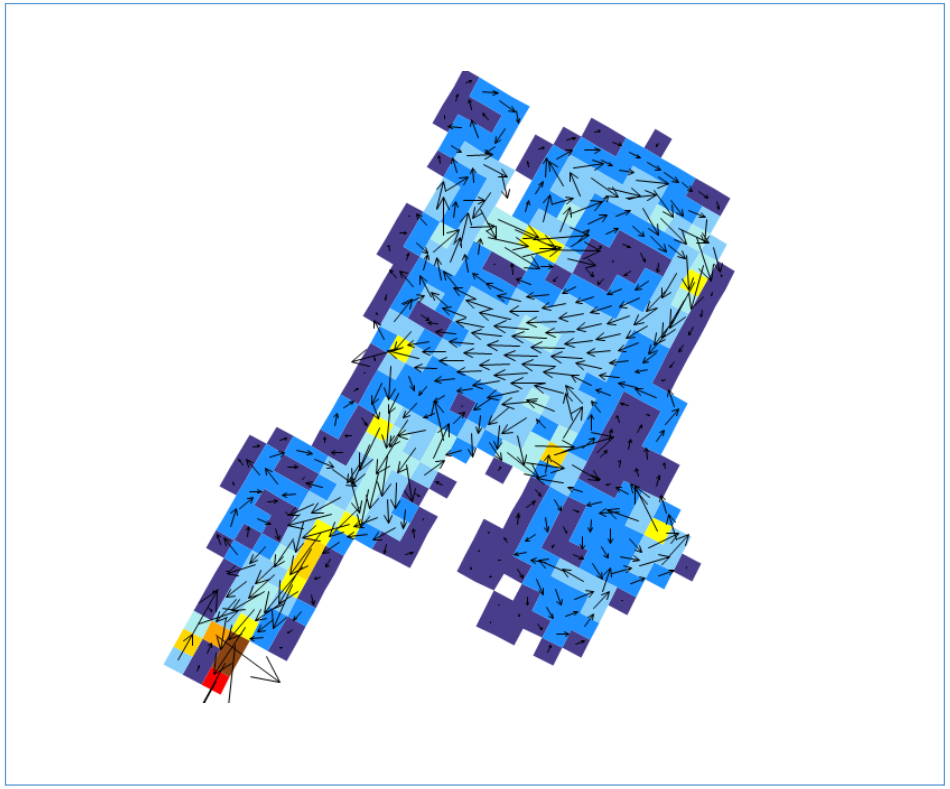
8 Surface T-buoys – May to Oct

2 Biogeochemistry Platforms– May to Oct

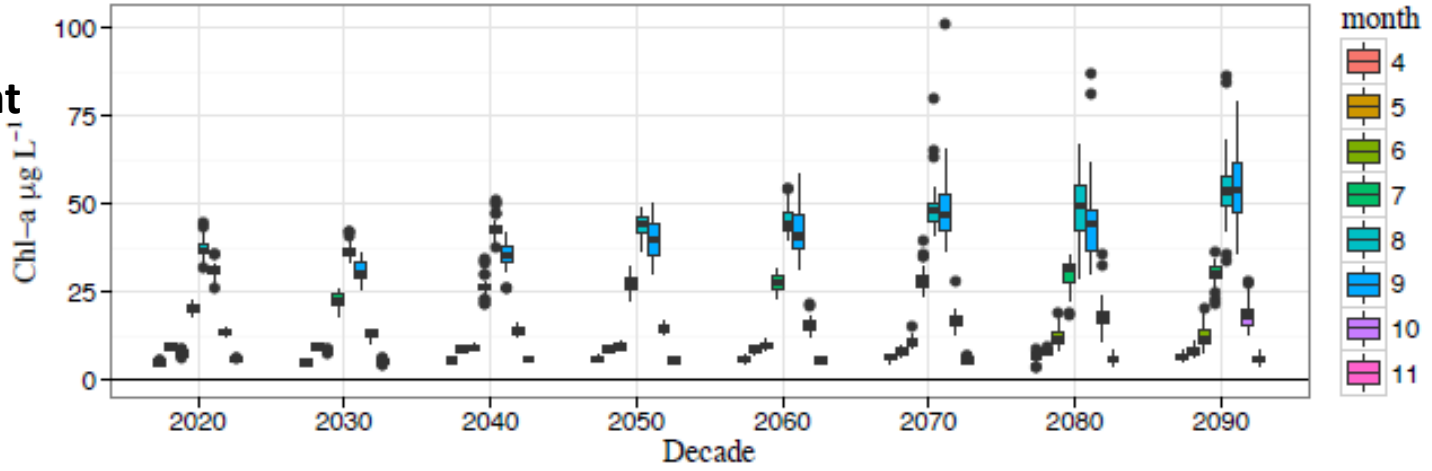


Lake Model Development





Ongoing work and improvement of MB IAM while developing new lake models



Using High Frequency Environmental Monitoring Data to Understand and Model Impacts Extreme Events and Water Quality Resiliency

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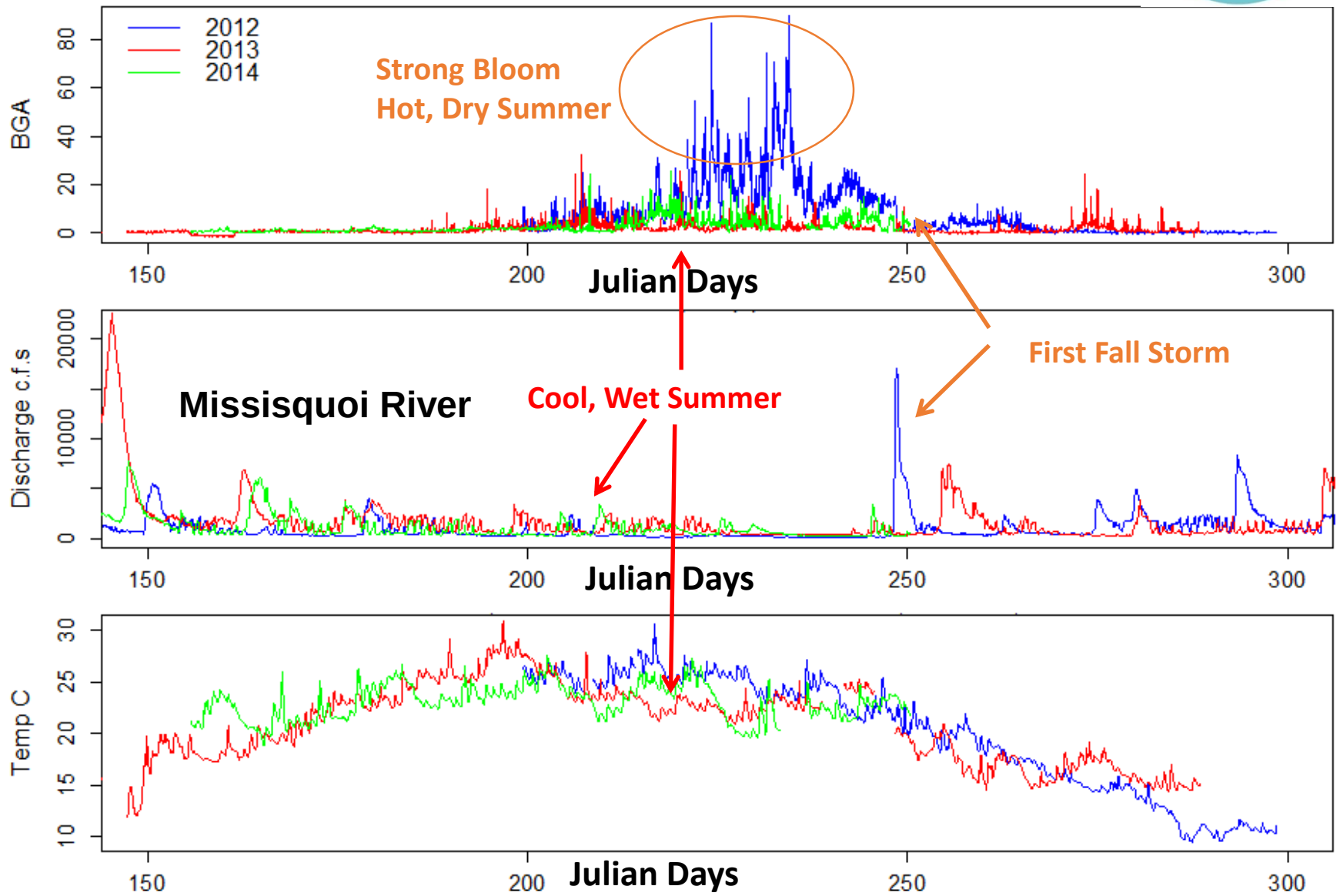
in the Lake Champlain Basin



Differences Between Sites Nutrients

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Basin Resilience to Extreme Events
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Figure 7. Total phosphorus concentrations (mg/L) in Missisquoi Bay, St. Albans Bay, and Burlington Bay over the 2006 growing season.

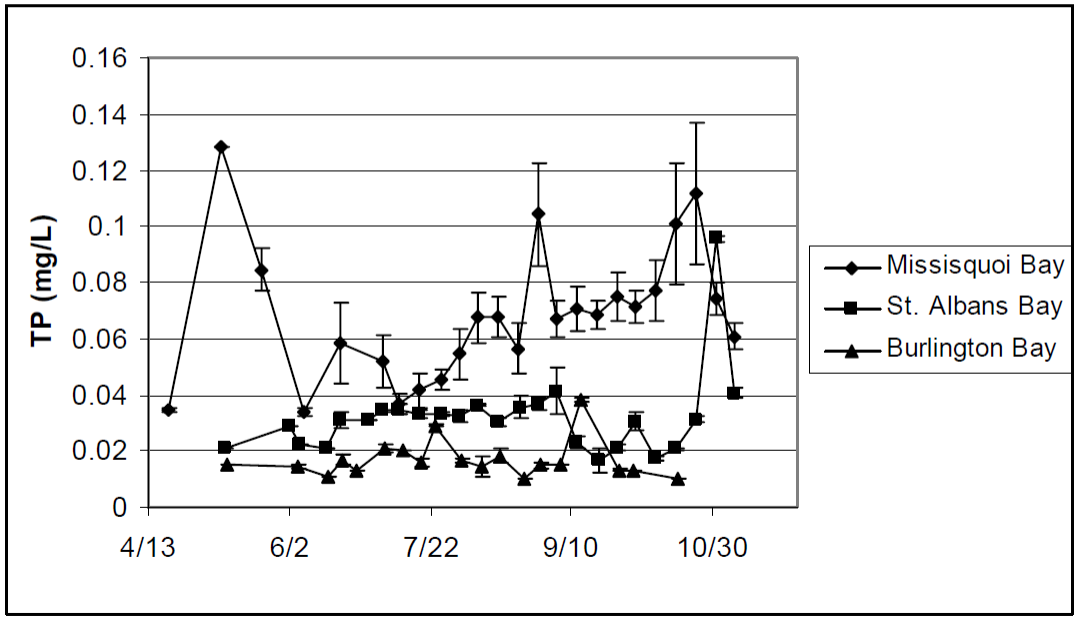
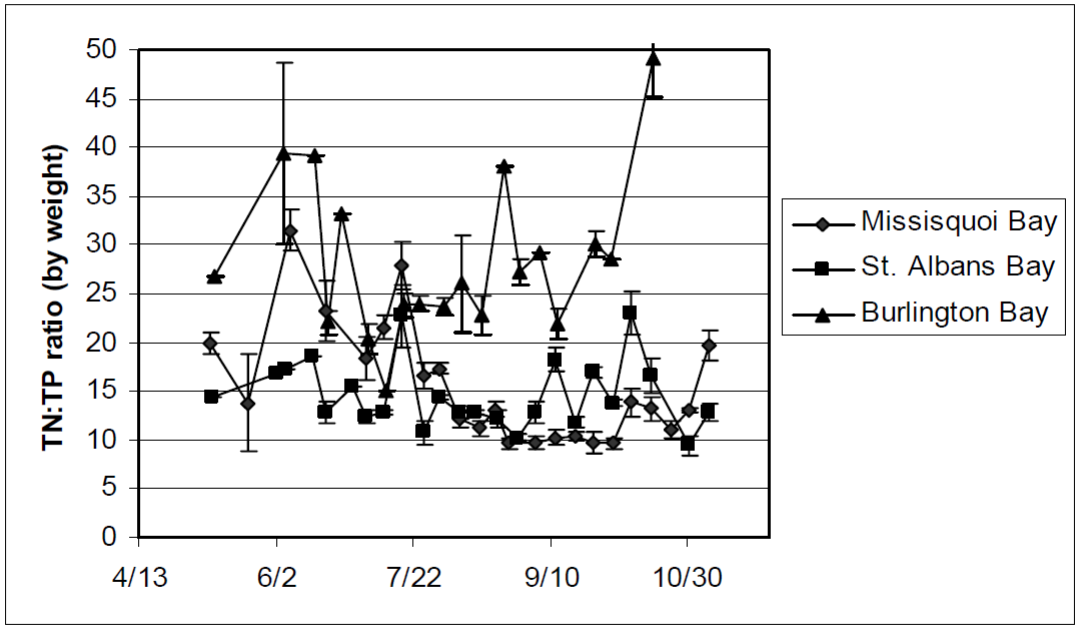


Figure 8. TN:TP ratios across all stations sampled in Burlington Bay, St. Albans Bay and Missisquoi Bay in 2006.



Differences Between Sites: Ecology

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Basin Resilience to Extreme Events
in the Lake Champlain Basin

Figure 9. Seasonal mean percent generic composition of phytoplankton in Missisquoi Bay, 2003-2006.

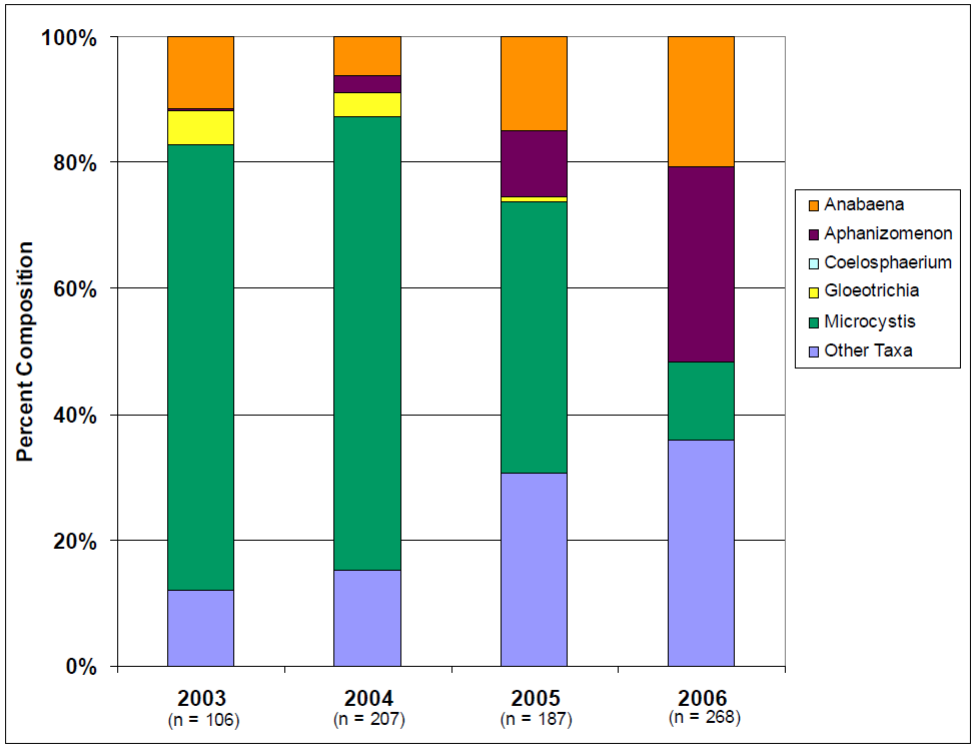
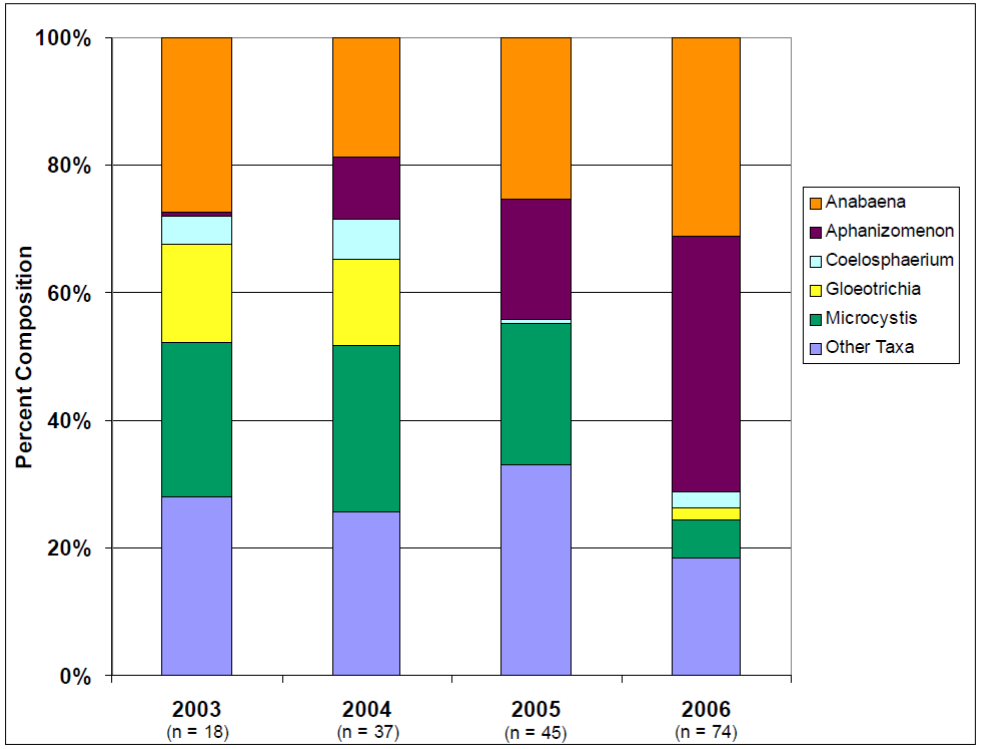


Figure 10. Seasonal mean percent generic composition of phytoplankton in St. Albans Bay, 2003-2006.



Overarching research questions for ecological systems:

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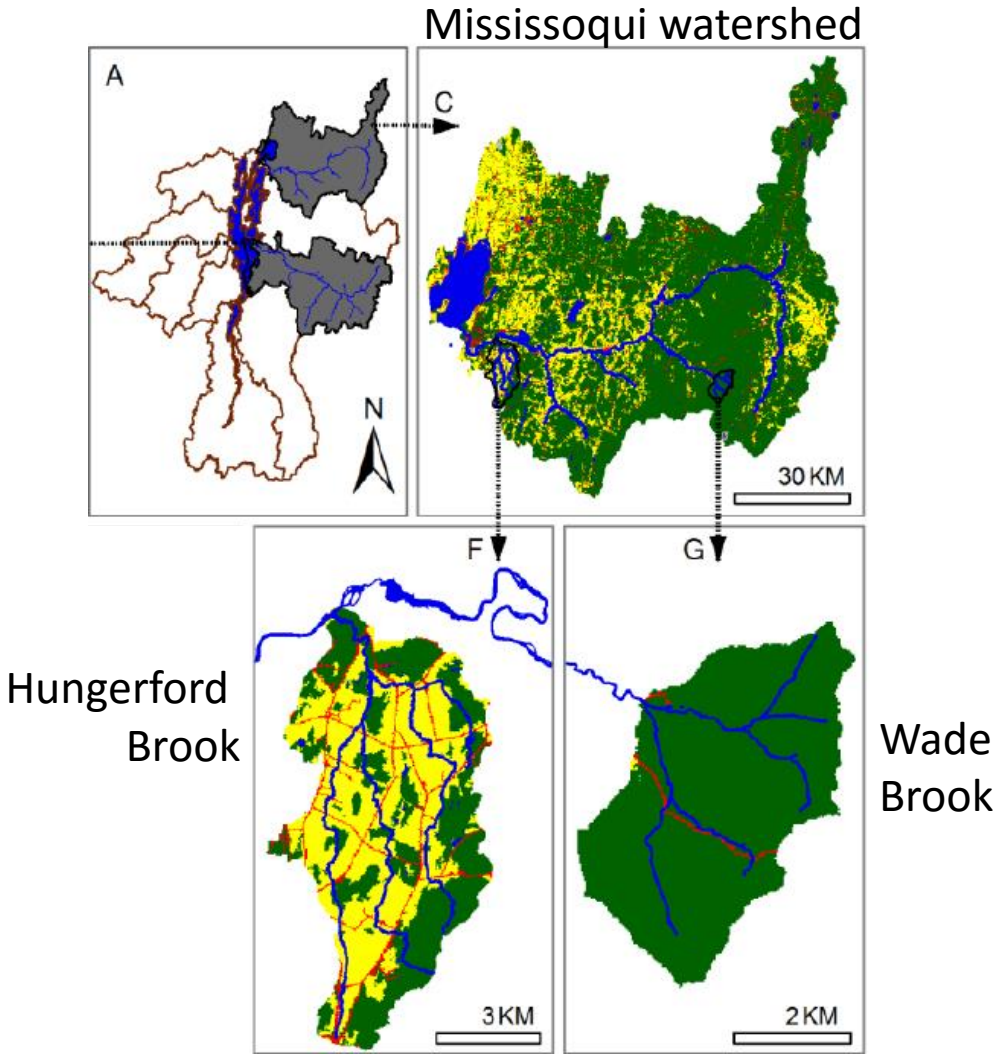

Accomplished Year 1: Incorporating dissolved P into RHESSys

- RHESSys: Biome BGC
  - Incorporating dissolved P into Biome BGC
  - Use soil data, soil sensor data, soil/groundwater chemistry data, river sensor data for calibration/validation

- Upcoming years: RHESSys
  - Gauge data for calibration and validation
  - Incorporate urban environments, stormwater

RHESSys

Regional
Hydro-
Ecologic
Simulation
System