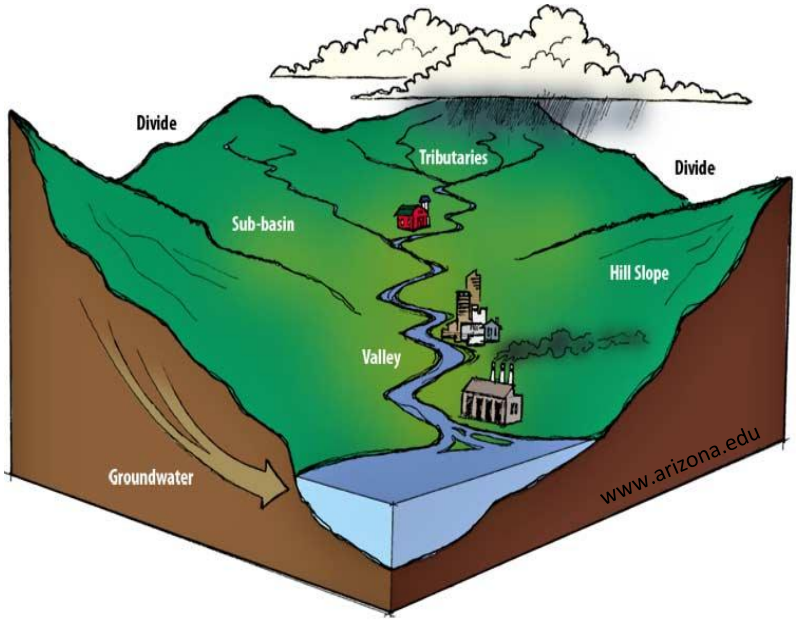
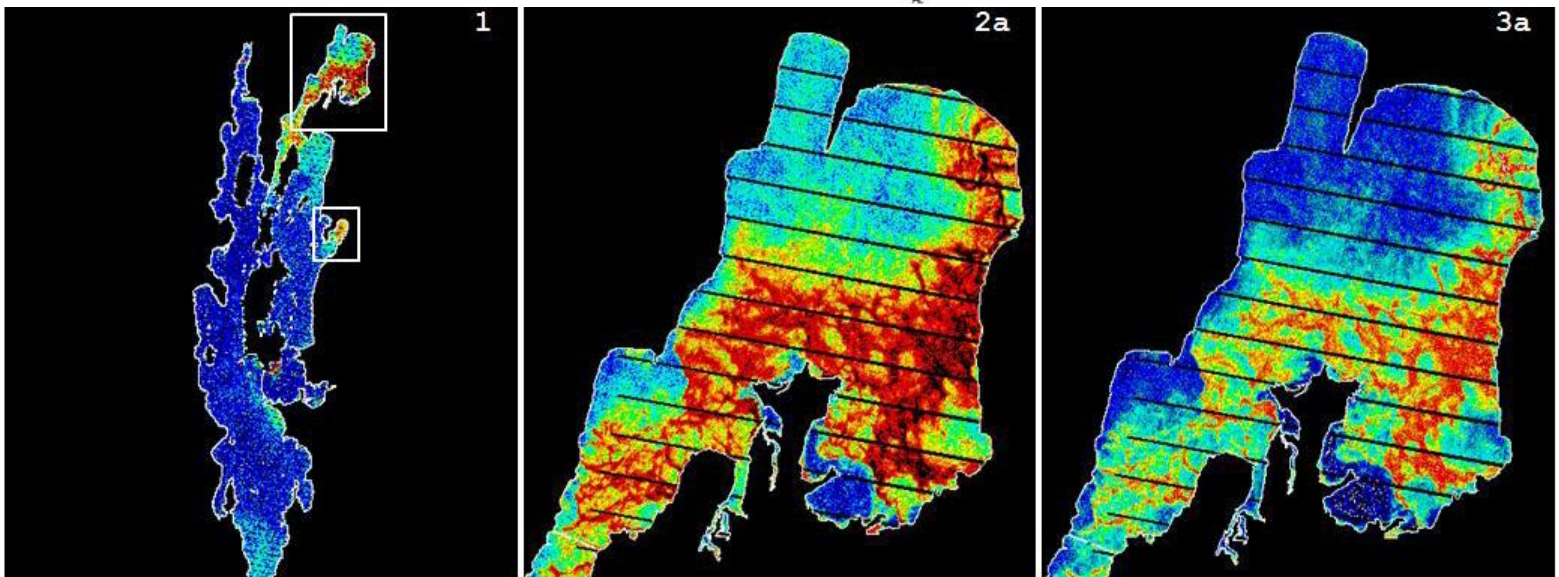
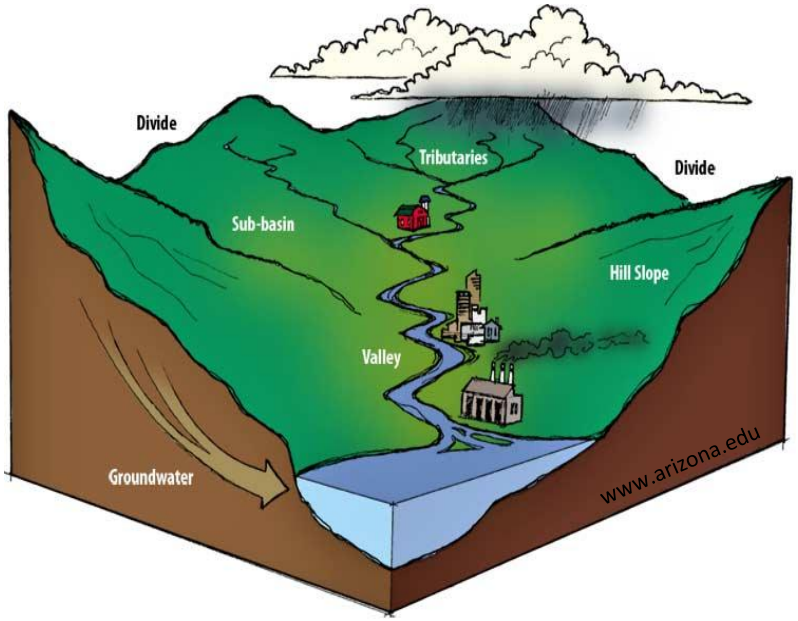
RACC-Question 1

Andrew Schroth, Courtney Giles, Peter Isles





Question 1 overview

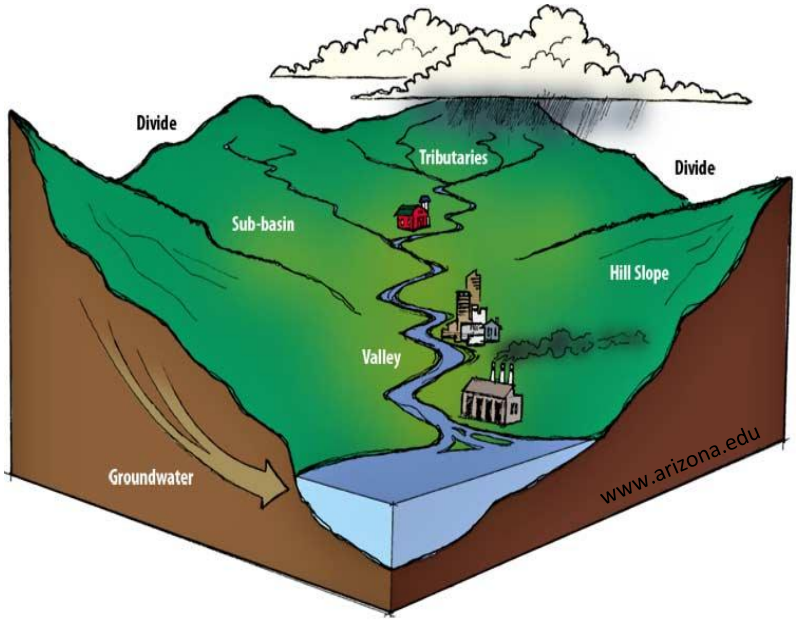


What are the nutrient & sediment loads to the lake?

Where do they come from?

What conditions lead to the occurrence of Harmful Algal Blooms (HABs)?

Question 1 overview



EXTERNAL

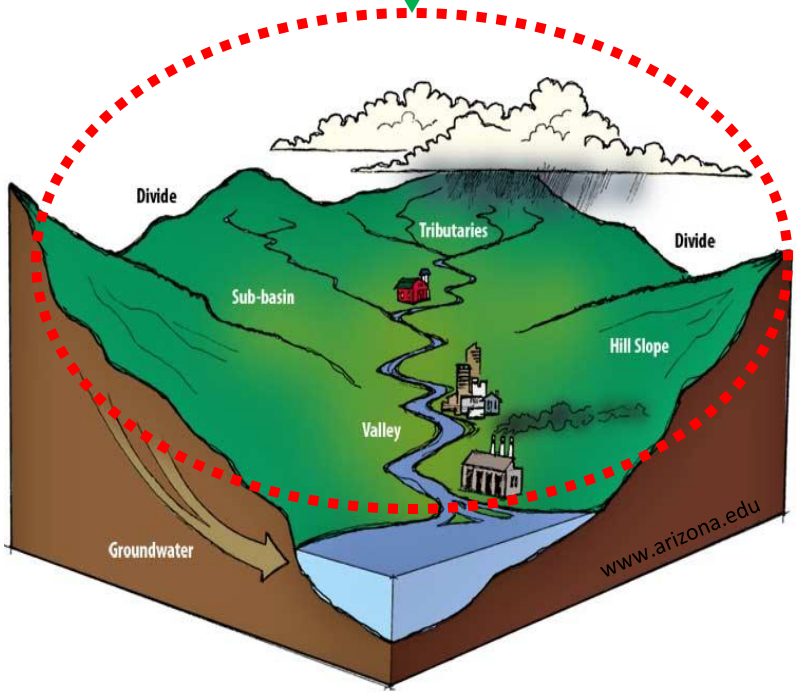
What are the nutrient & sediment loads to the lake?

Where do they come from?

INTERNAL

What conditions lead to the occurrence of Harmful Algal Blooms (HABs)?

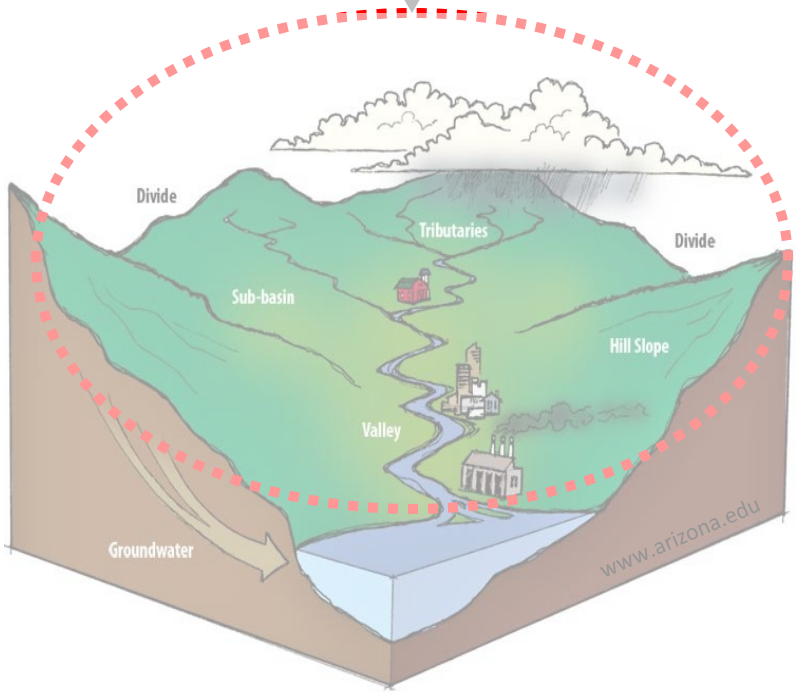
Question 1 overview



External *Processes*

Nutrient & Sediment Transport
to Lake Champlain

Question 1 overview



***External** Processes*

Nutrient & Sediment transport
to Lake Champlain

What are the impacts of… ?

Climate:

Storm intensity and frequency

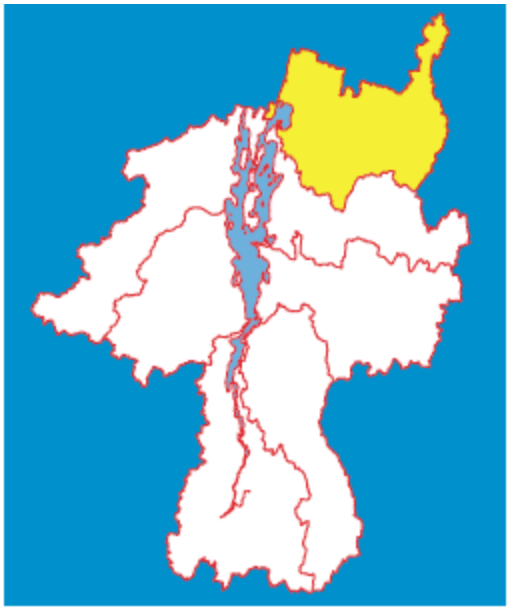
Land-use:

Type and management

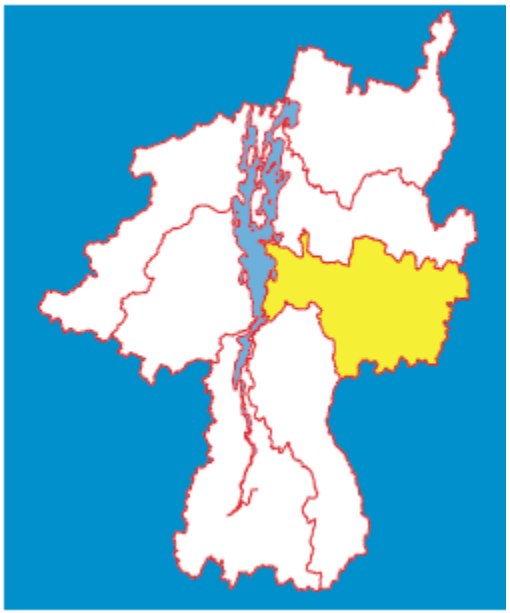
Biogeochemistry:

Nutrient transformations

EXTERNAL Nutrient & Sediment Load **Monitoring**

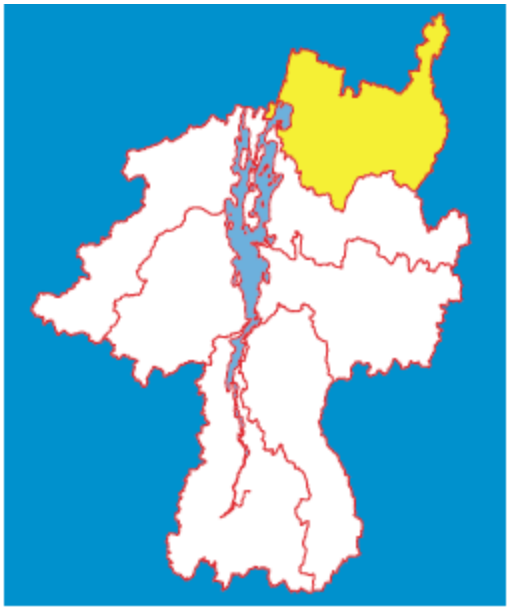


Forested/Agricultural



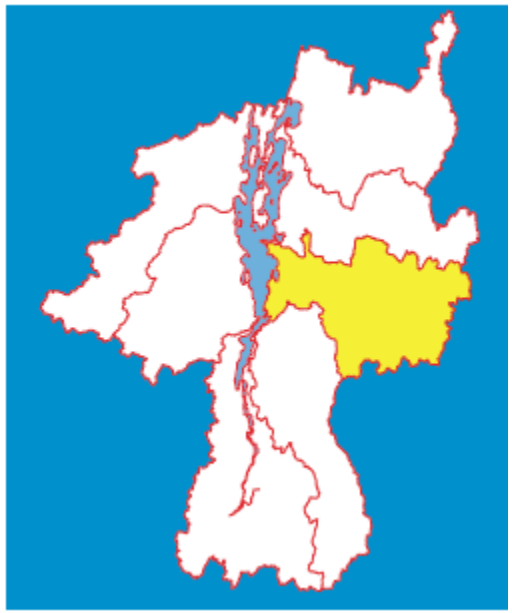
Urban/ Mixed Land-use

EXTERNAL Nutrient & Sediment Load **monitoring**

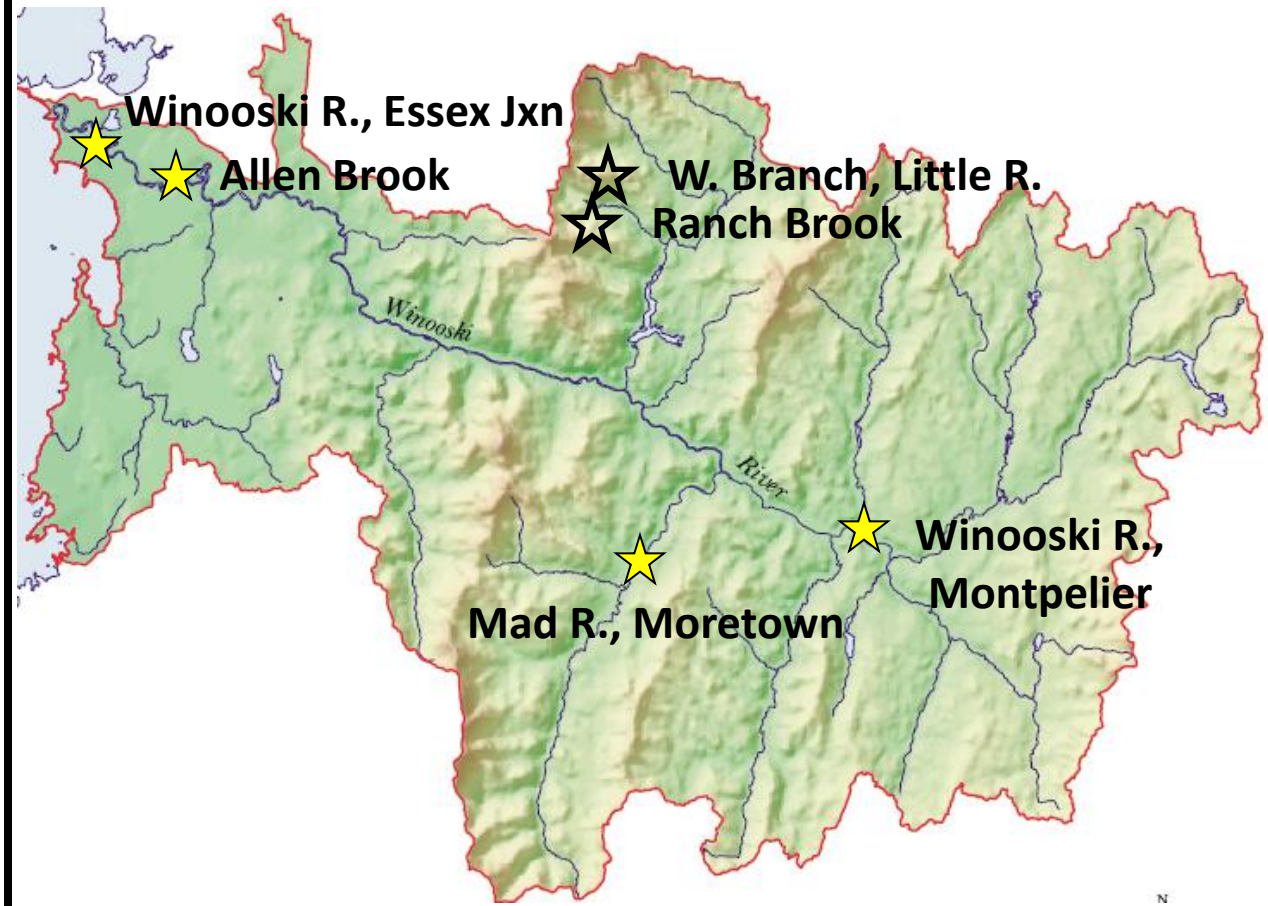


Missisquoi

EXTERNAL Nutrient & Sediment Load **monitoring**



Winooski




ISCO

Saint Michael's water quality interns

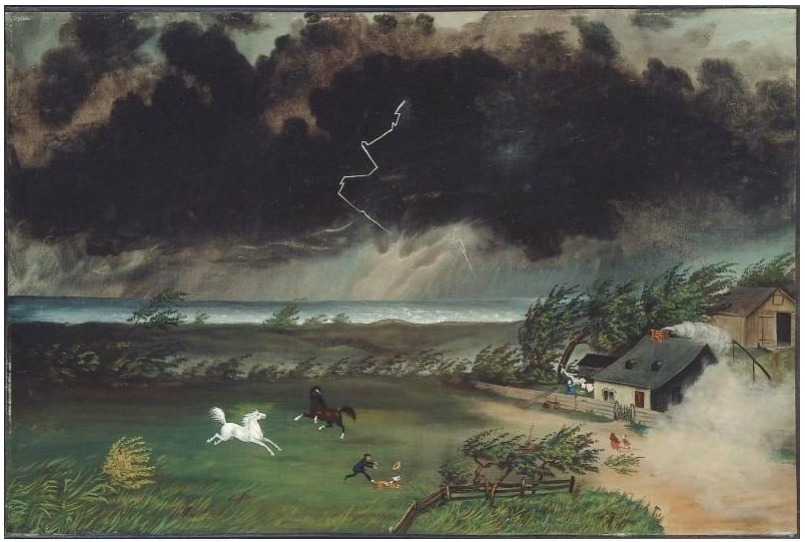
EXTERNAL Nutrient & Sediment Load **monitoring**

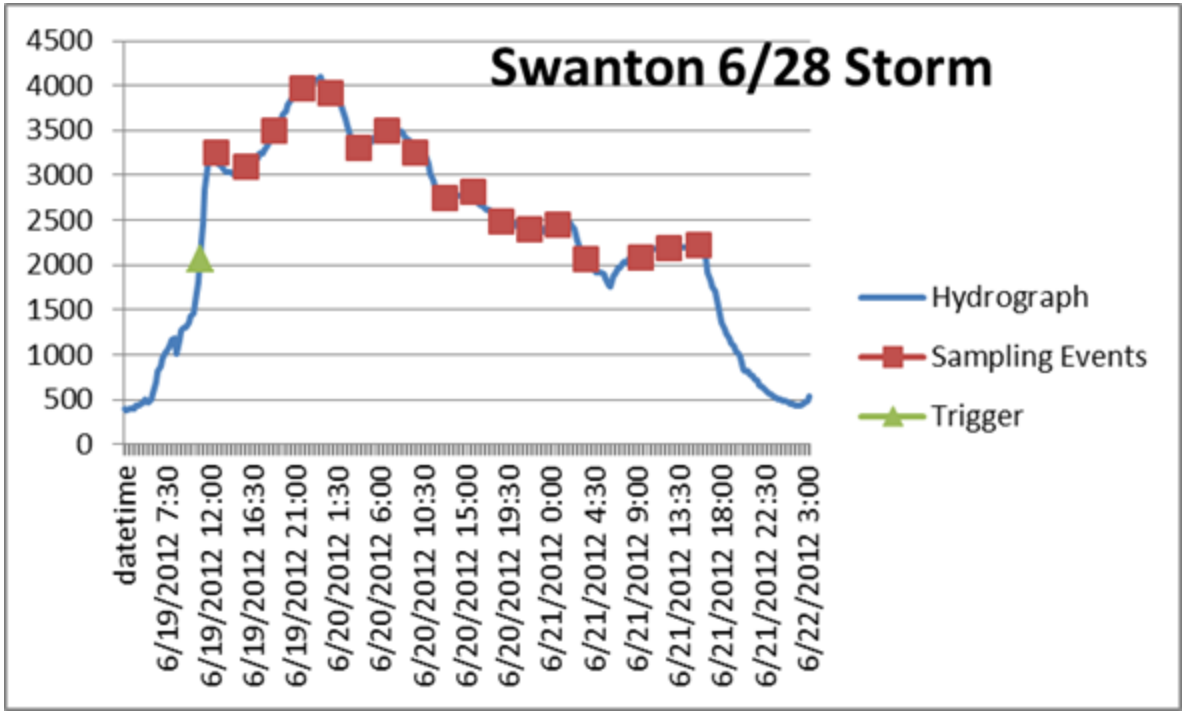
Summer and Drought!
T-storm dominated storm events
low flow relative to historical hydrograph

3 storms have triggered sampling events in some or all streams.

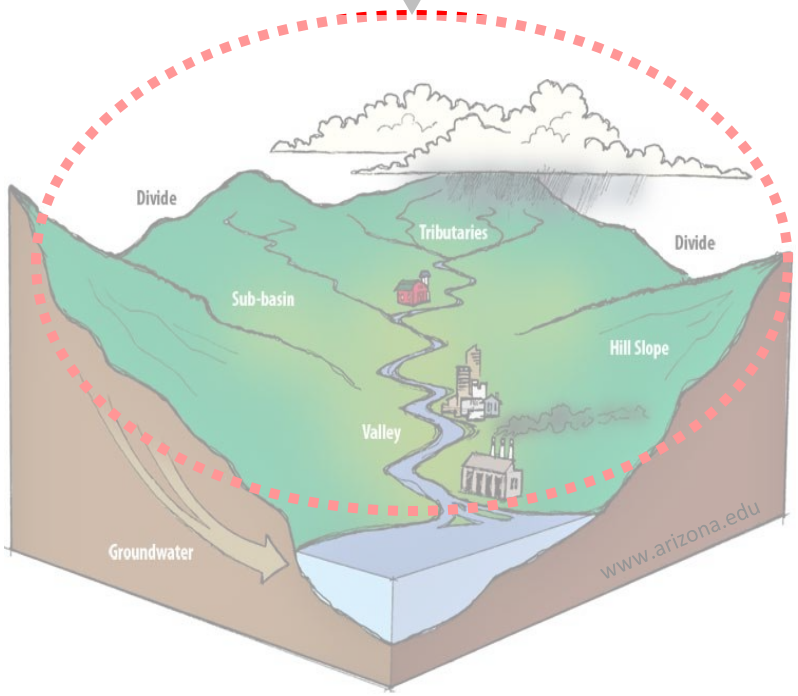
Base flow grab sampling by interns

This is annual variability!





Question 1 overview



External Processes

Where do these nutrients and sediments come from?

SOURCES of INTEREST

Soils-Ross

Forested Landscape and Rural Roads-Wemple

Stream Bank-Rizzo/Dewoolkar

Farm Fields-Bomblies et al.

Missisquoi Ag Soils Sampling-Don Ross' Group

N/P Distribution through soil landscape

- With the cooperation of crop consultants and dairy farmers-locate transects along stream banks of the Missisquoi and its tributaries
- 3 points for each transect:
  - 1 m from stream bank edge
  - Halfway through riparian buffer
  - 5 m into corn
- 4 depths: 0-15 (plow layer), 15-30, 30-60 and 60-90 cm
- Where possible, also obtain bank samples
- at 1 m intervals.

Question 1 overview

***External** Processes*

Where do these nutrients and sediments come from?

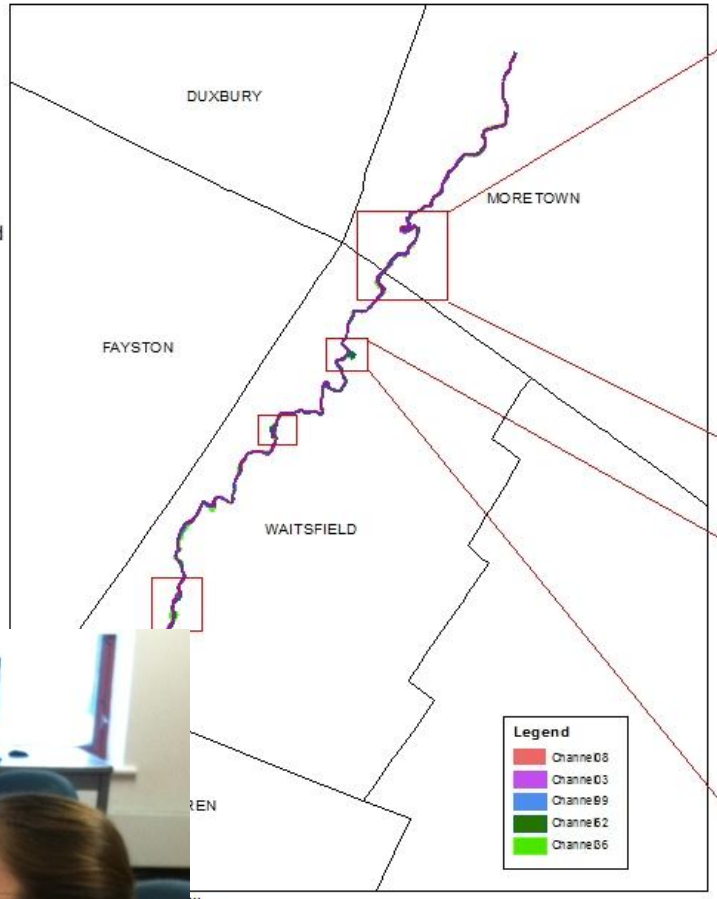
SOURCES of INTEREST

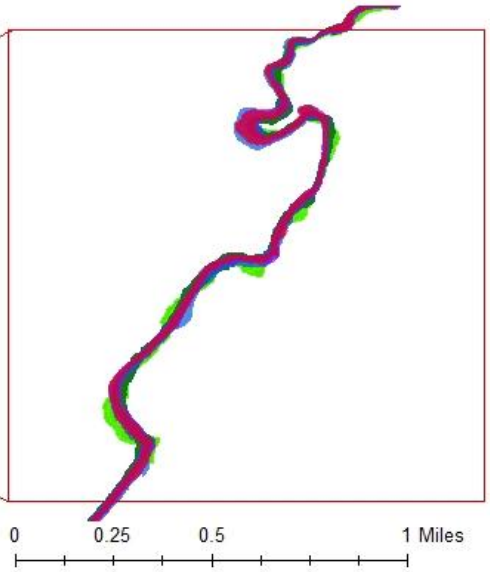
- Agricultural runoff
- **Forested areas and rural roads**

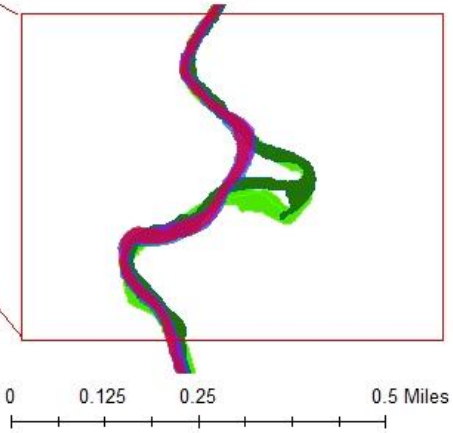
Beverly Wemple *et al.*
UVM

Stream Channel Migration on the Mad River

Mad River Watershed
Study Area

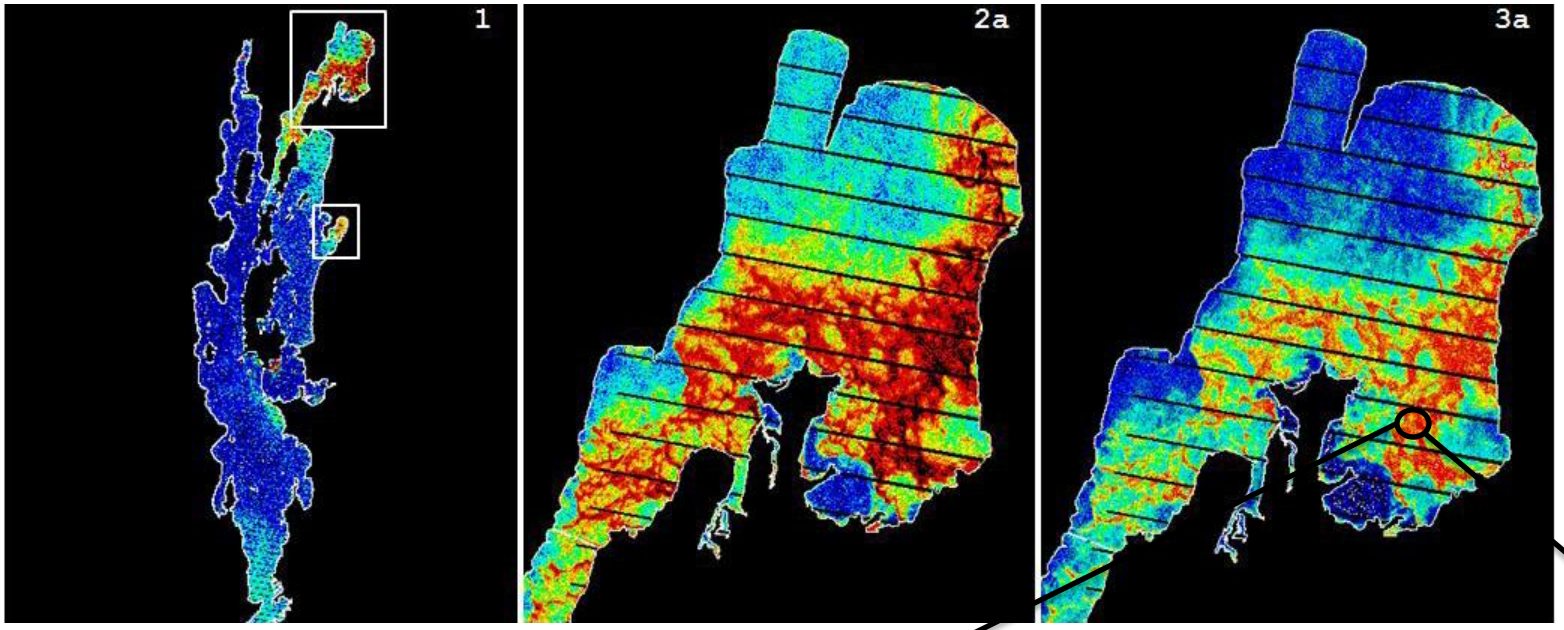






INTERNAL (In-Lake) Processes

What conditions lead to the occurrence of
Harmful Algal Blooms (HABs)?



Missisquoi Bay Monitoring Station (UVM, Midd)

Linking climate, hydrodynamics, geochemistry and ecology to explain bloom dynamics

Hydrodynamics

Hydrodynamics can drive biogeochemistry and ultimately biology!

Hydrodynamics:
- **20 Sensors @ 12 Sites**
- **6 U.S. & 6 Canadian**
- **5 are Perimeter Sites**

Martin Mimeault (CA) was instrumental in making Canada ops happen

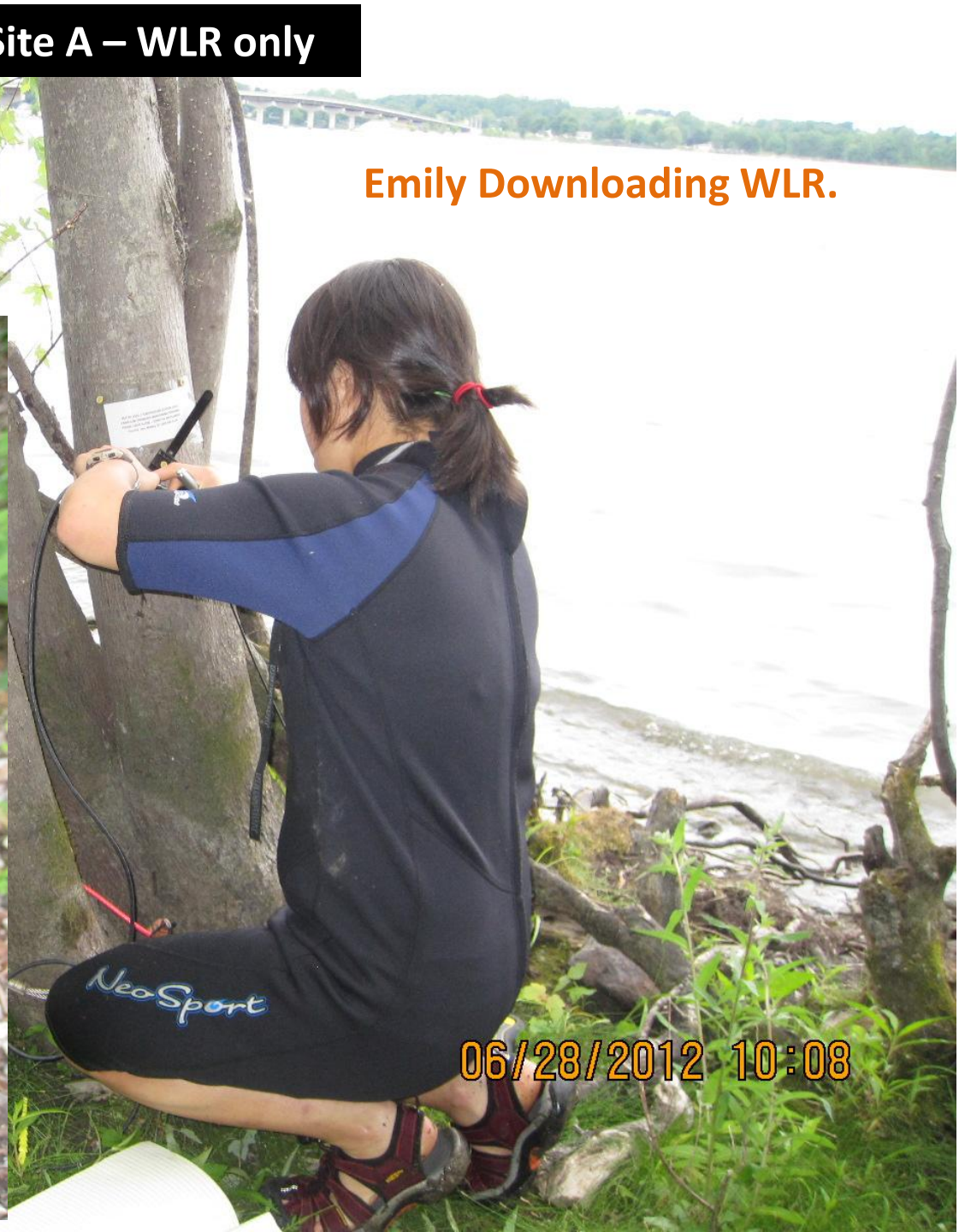
Hydrodynamics Monitoring Array
- **-describe local physical state**
- **-current**
- **-sediment transport**
- **-water levels**
- **-temperature profile lateral and vertical**
- **-waves**


Emily Tending
Deployment Lines
07/25/2012 11:01

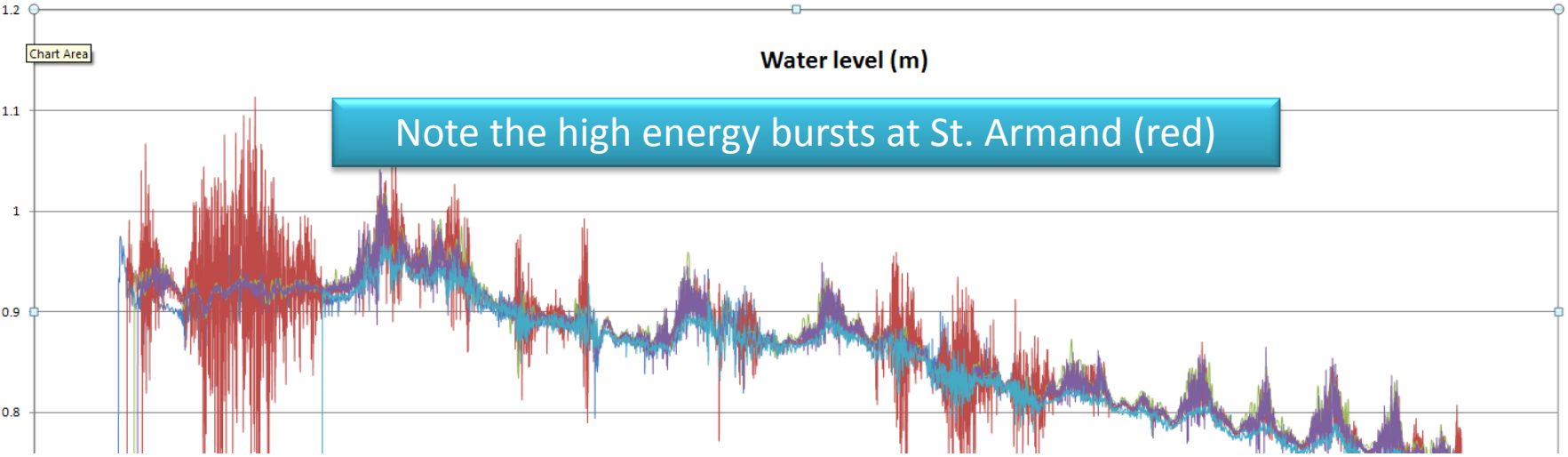
Hydro → 5 Perimeter Sites

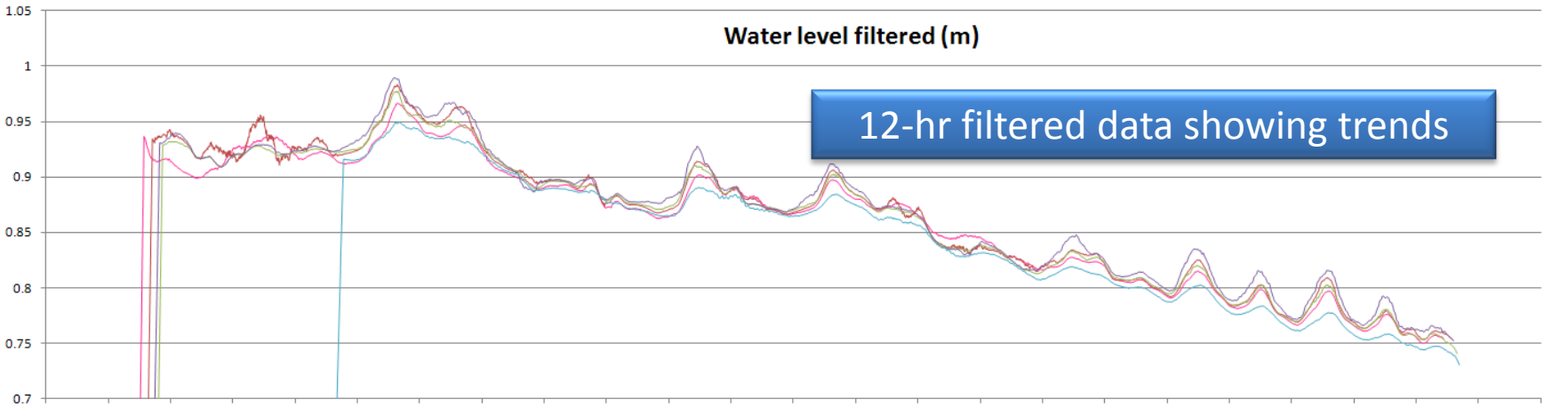
Site A – WLR only

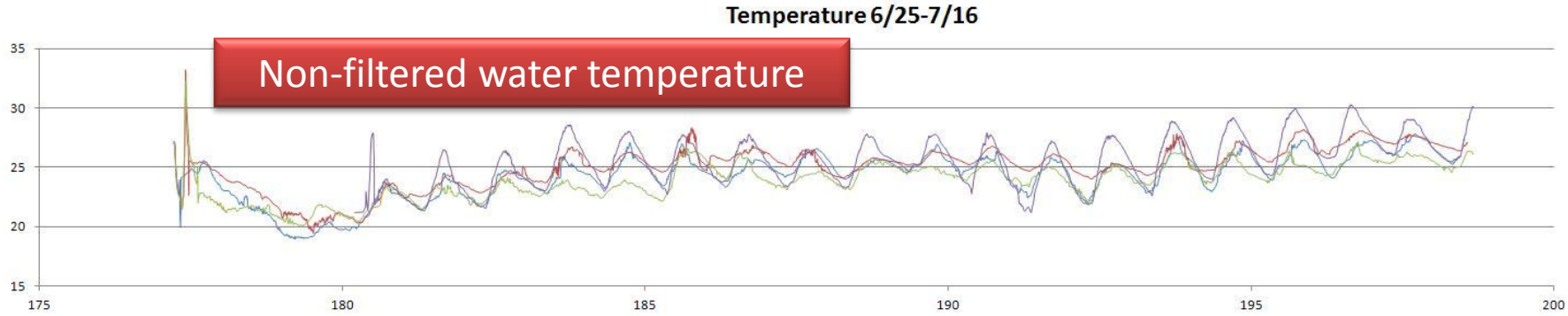
Emily Downloading WLR.



Data? WLR are what we have so far







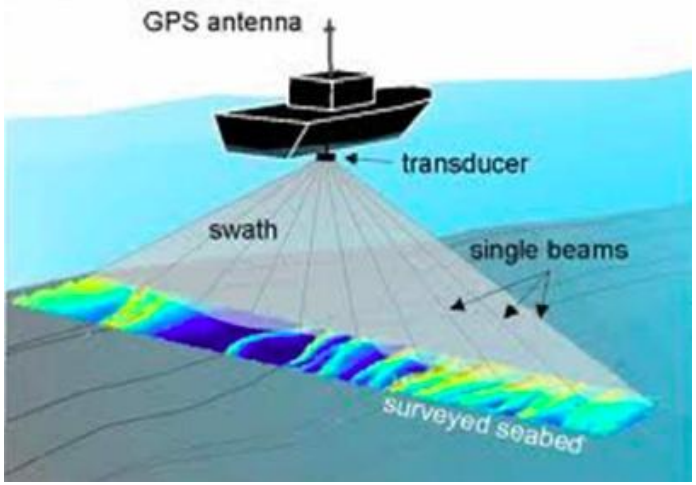
Hydro → Interior Sites
Met Buoy – Great Lakes Observing System (GLOS) Design

Installed on 8/6/12

Data logger
CSI software tools
Cellular communication
Four WebCams (360° view)
Extra memory
RM Young wind speed and direction
Air temperature/relative humidity
Incoming solar radiation sensor (PAR)
RM Young barometric pressure
Titus IWS
Surface water temperature
RPR temperature string (5 m)
Downward looking ADCP

INTERNAL (In-Lake) Processes

Physical Processes-Lake Bed Structure

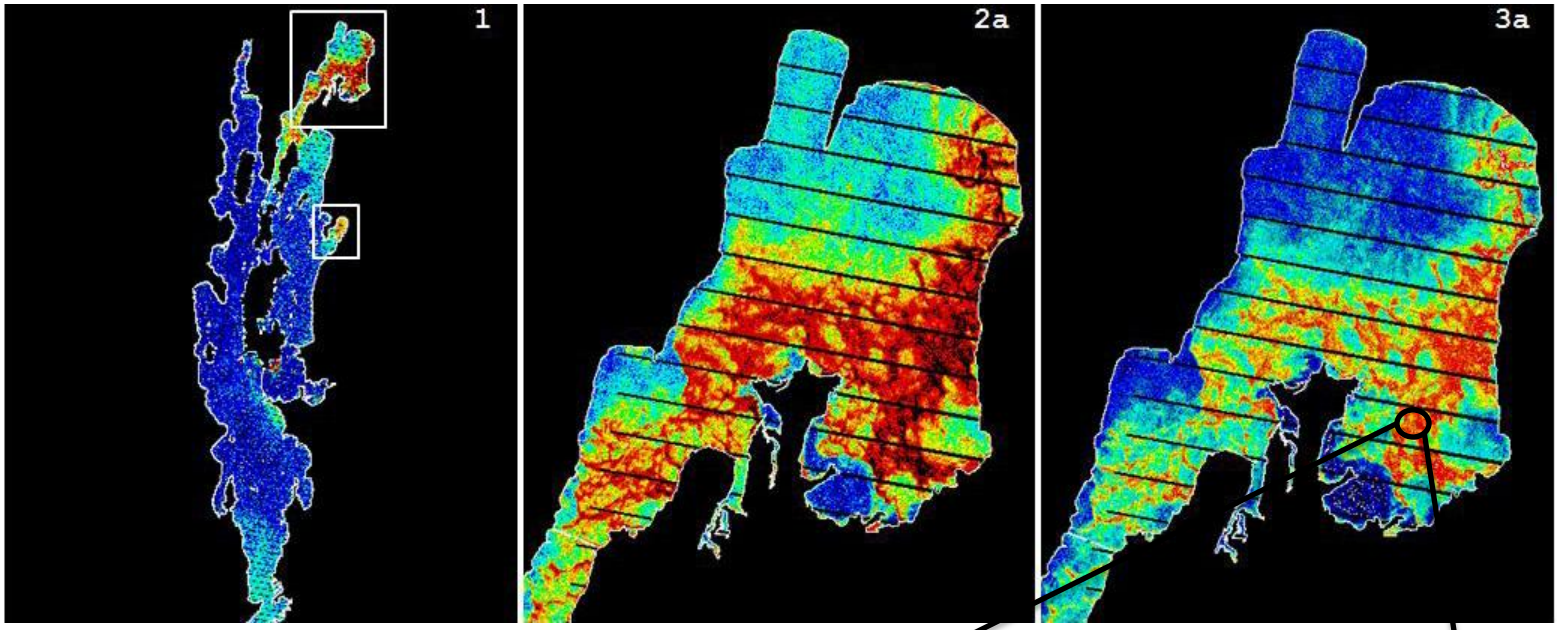


Bathymetry and channel morphology control sediment transport between the bay and the main lake

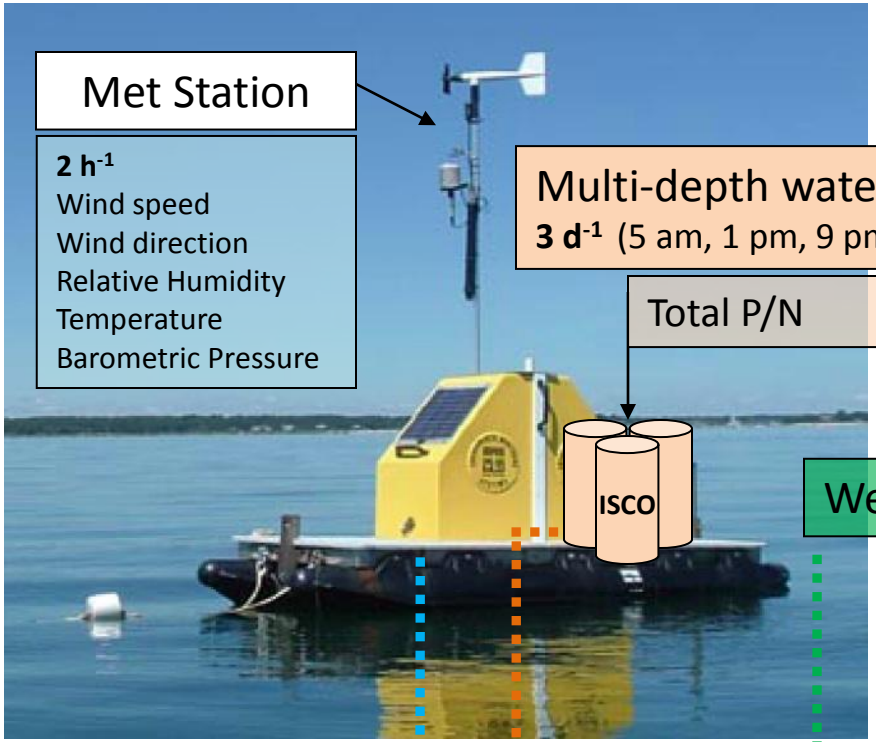
Awaiting Arrival of Midd RV Folger

INTERNAL (In-Lake) Processes

Biogeochemical Controls on HABS



Main Site Monitoring



Met Station

2 h^{-1}
Wind speed
Wind direction
Relative Humidity
Temperature
Barometric Pressure

Multi-depth water sampler

3 d^{-1} (5 am, 1 pm, 9 pm)

Total P/N JSC

YSI Sonde

Temp (C)
Sp. Cond
Cond (uS/cm)
Depth (m)
pH
pH (mV)
ORP (mV)
DO (% sat)
ChlA (ug/L)
ChlA (RFU)
BGA (cells/mL)
BGA (RFU)
Turb (NTU)

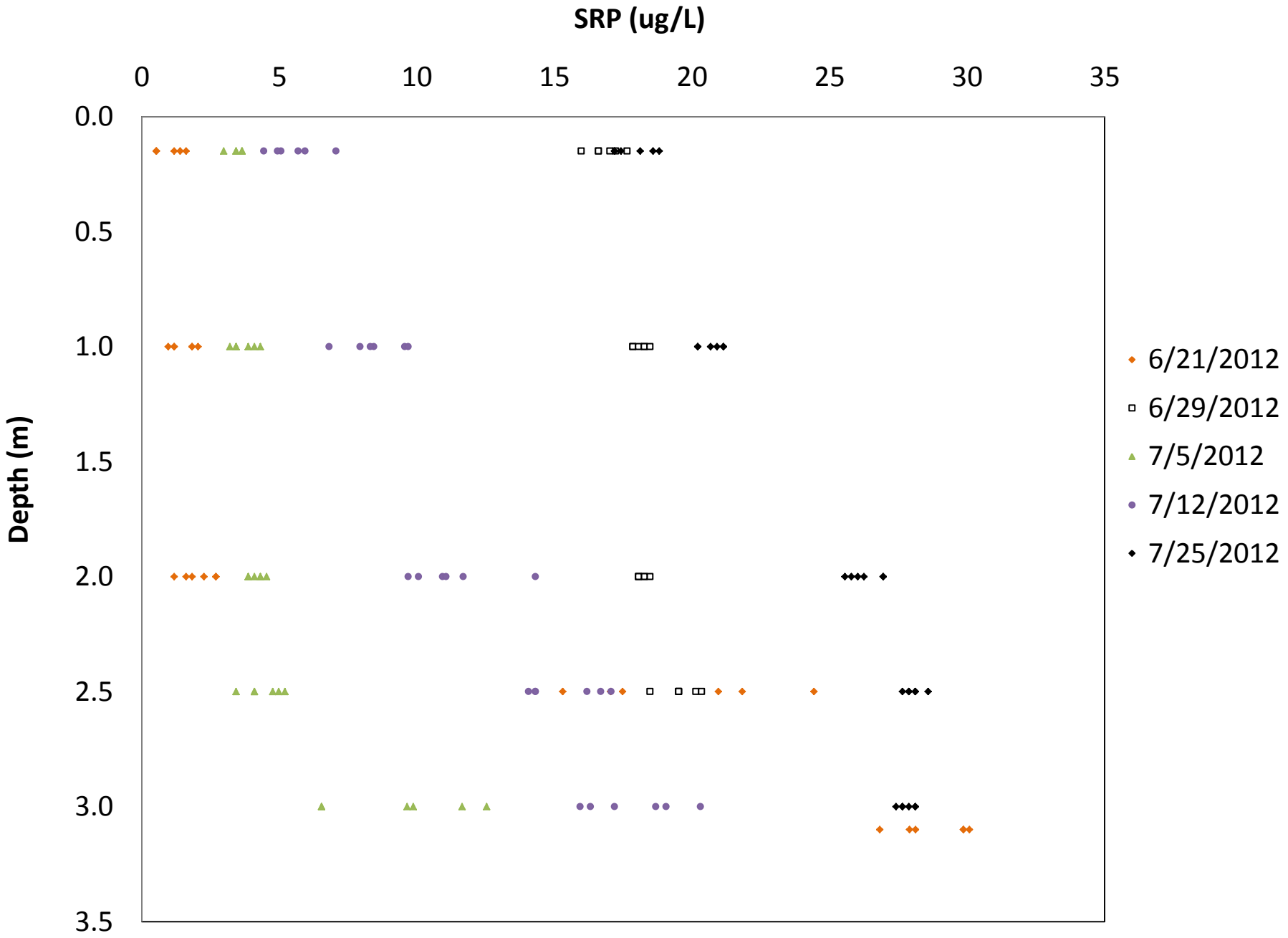
Hourly profiles (0.5 m inc)
Hourly meas. @ 2 m

Weekly Depth Grabs

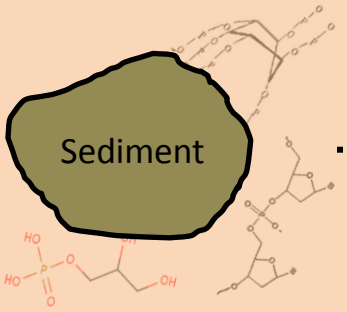
NH_3, NO_3^- JSC
TSS SMC
SRP UVM

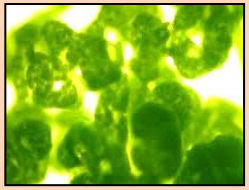
0.15 m
0.5 m
1 m
2 m
2 m
2.5 m
3 m
3 m

Grab Sampling at Main Site Buoy



Sediment-Bound-P
Species Analysis





cyanobacteria

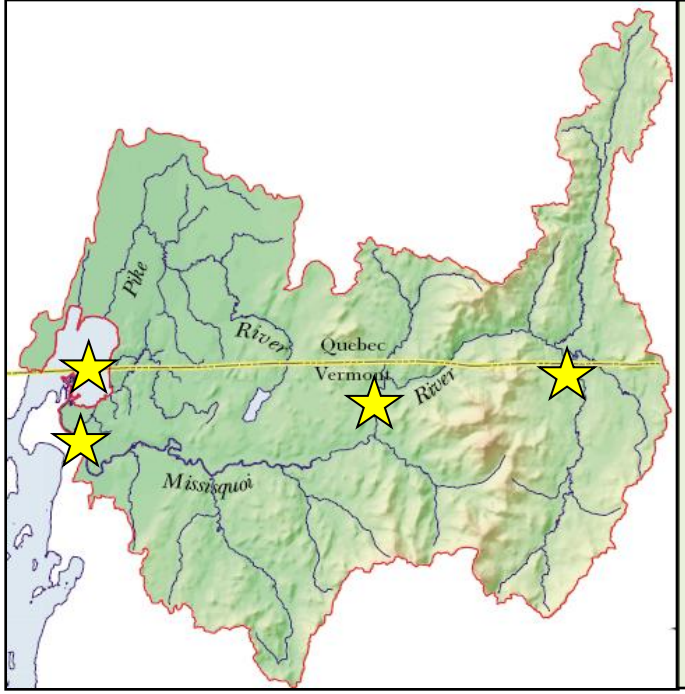
ENZYME HYDROLYSIS
Solution ^{31} P NMR Spectroscopy

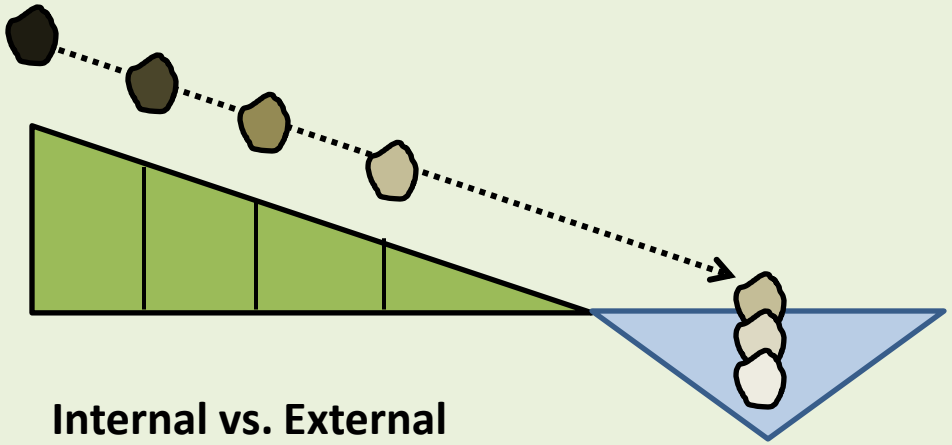
QUESTIONS

What are the primary forms of P transported to Lake Champlain via *external sediment loading*?

How algal-available are these sediment-bound-P forms?

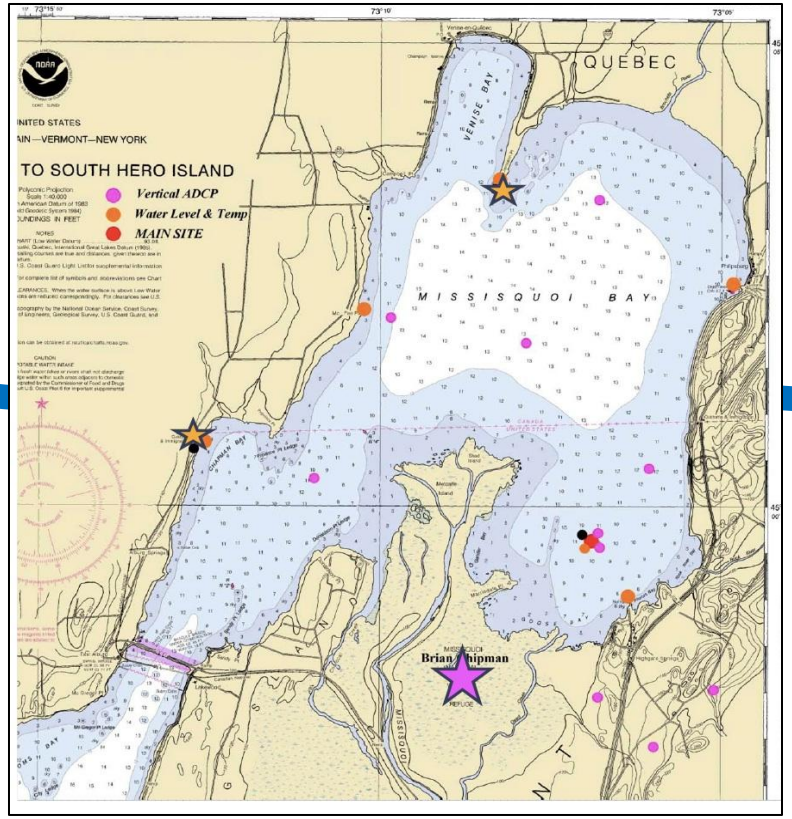
How do redox processes influence P cycling and *internal loading* from lake sediments?





Internal vs. External
Nutrient Transformations

Additional Missisquoi Bay Spatial Sampling



Water column sampling
for all analytes and phytoplankton

Sediment profile sampling
for nutrient species analysis

INTERNAL (In-Lake) Processes

Physical Processes

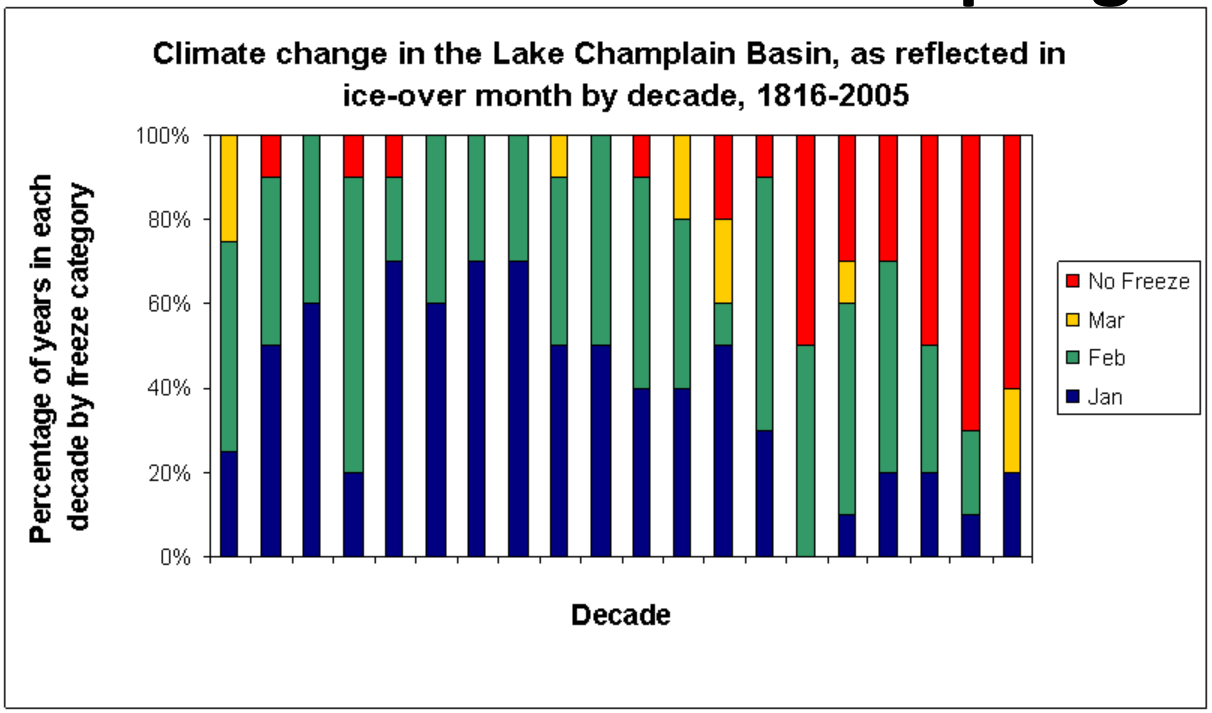
Biogeochemical controls on HABs

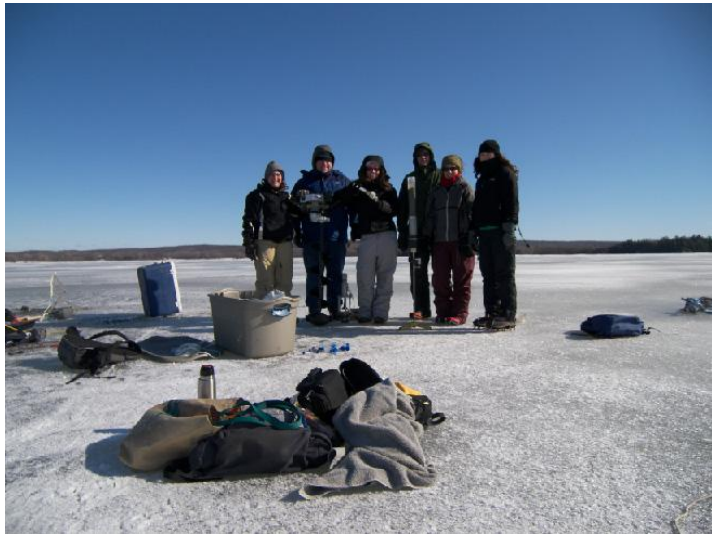
Food web controls on HABs

How does food web structure influence grazing pressure on cyanobacteria, competition for nutrients, and the spatial and temporal dynamics of nutrient recycling?

Sampling & identification
Phytoplankton
Zooplanton
Benthic invertebrates
Aquatic plants
Fish

Future Efforts: Winter Sampling





How does ice cover affect lake biology and chemistry?

Winter grab sampling of water profile
chemistry and biology and sediment cores sampling