

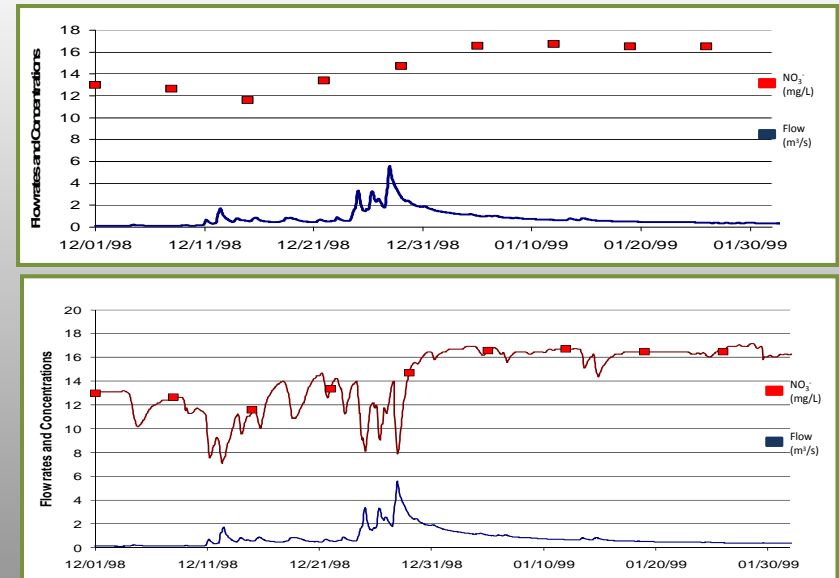
The Evaluation of a Combined Multiplexer Pumping System and Water Quality Probe for Use as a Portable Water Quality Lab

Presenter: Marc Horstman, E.I.

Co-Authors: Elizabeth Allen, E.I. , François Birgand, PhD.,
Phil Harris



Only a Glimpse



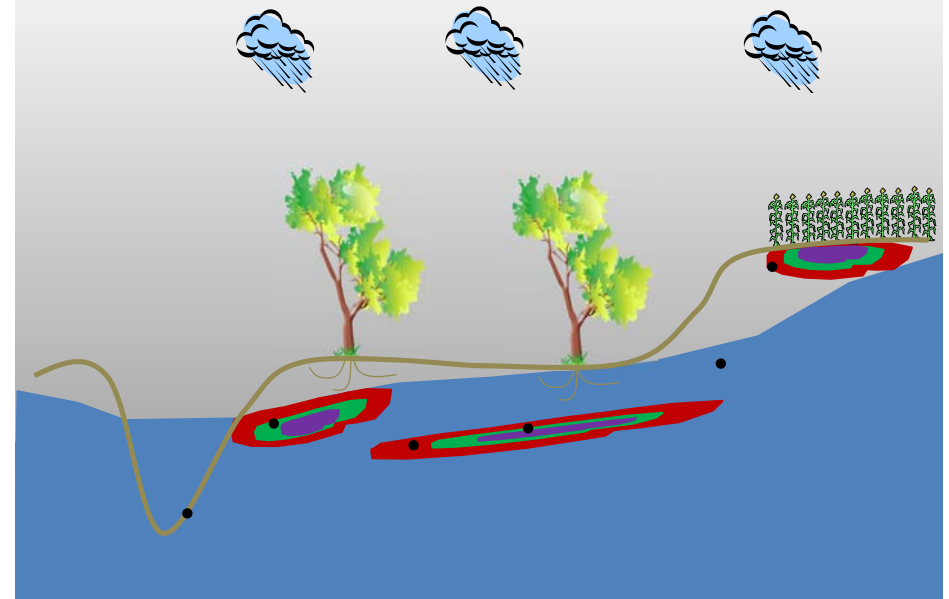
Continuous Solution



•S:CAN Spectro::lyser Probe

- Measures absorption at 256 different wavelengths (200-750 nm, intervals of 2.5nm) to determine contaminant (turbidity, nitrate, TOC and DOC) concentrations.
- Instantaneous data display.
- Can measure up to 15 sec intervals.
- Powered from AC or DC.
- *Very Expensive (~\$25,000)*

Varying With Space and Time

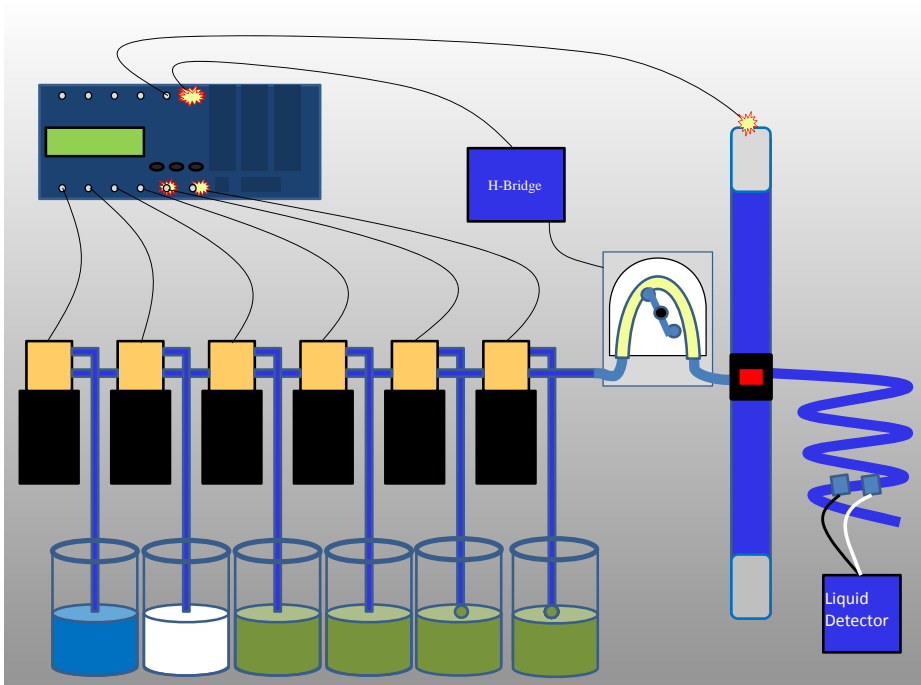


Objectives

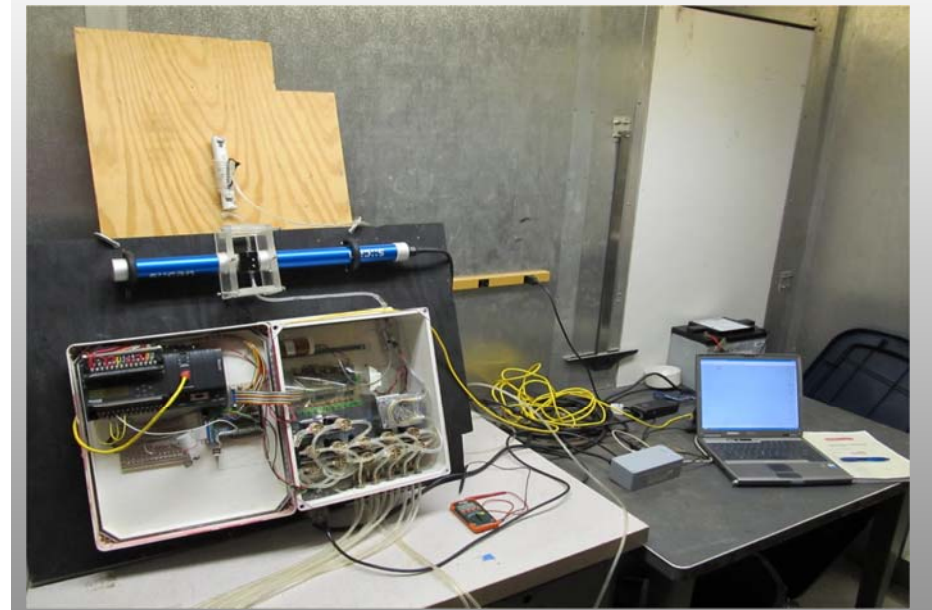
- Expanding the improved temporal resolution measuring device to expanding spatial resolution.
- Constraints:
 - 1 hour temporal resolution for up to 10-12 ports or measuring sites.
 - up to 5 meters of head.
 - Stand alone automatic reliable system.

Instrument Proposed

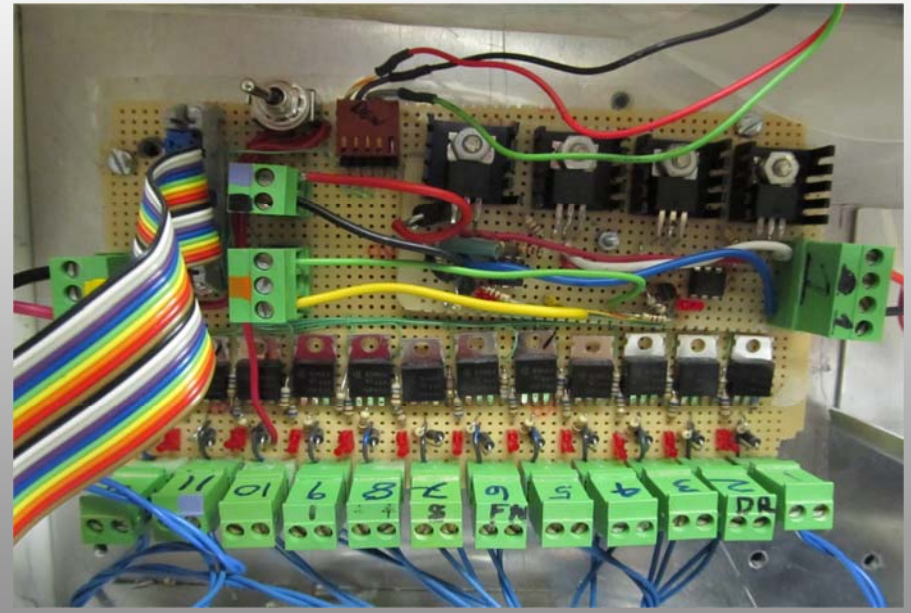
- Multiplexer pumping system associated with automatic water quality probe
 - Peristaltic pump
 - 12 solenoid valves for 12 ports
 - Programmable Logic controller
 - Automatic water quality probe



Layout of System



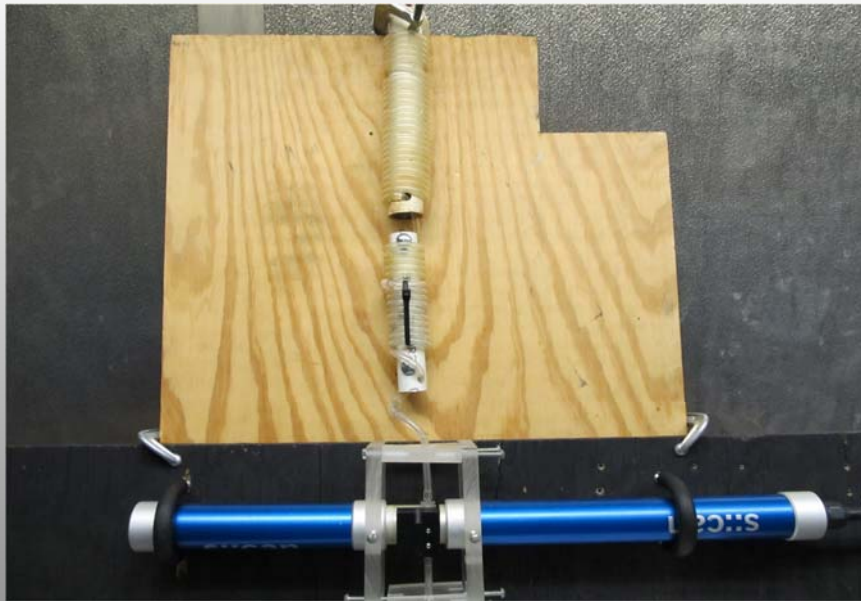
Valve Setup and Controls



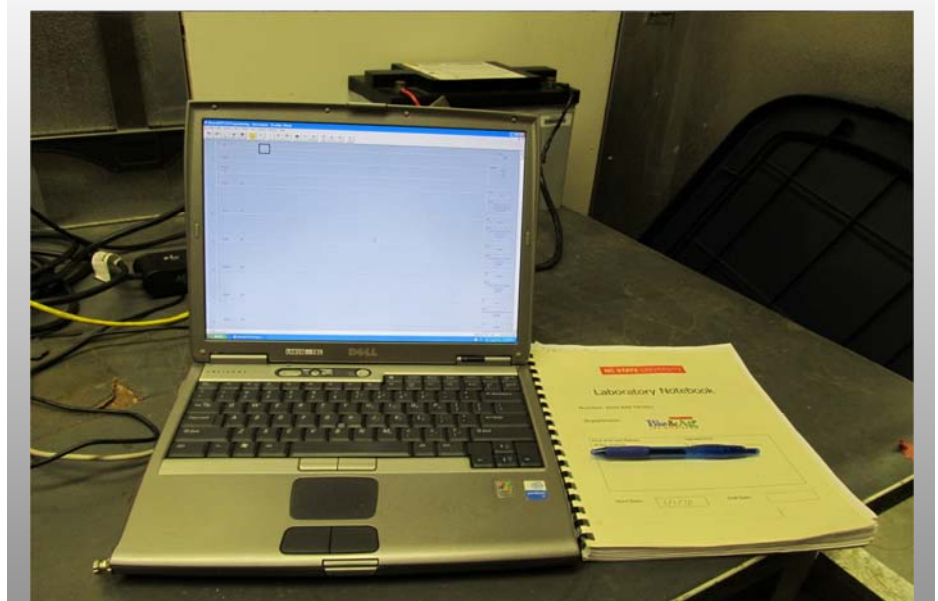
Pumping Systems and Controls



Contamination Prevention



Multiplexer Control

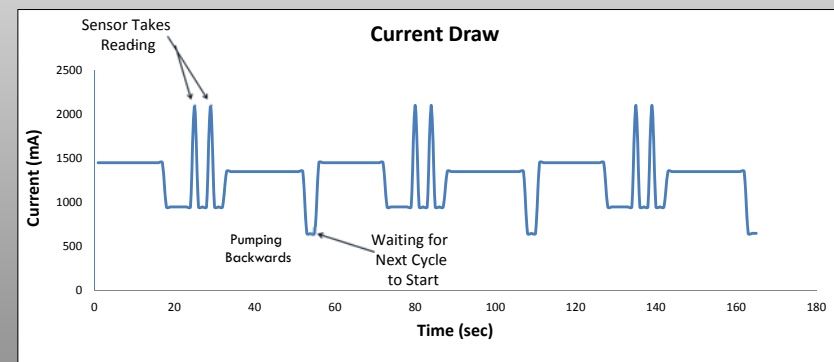


Results: Evaluation of the instrument

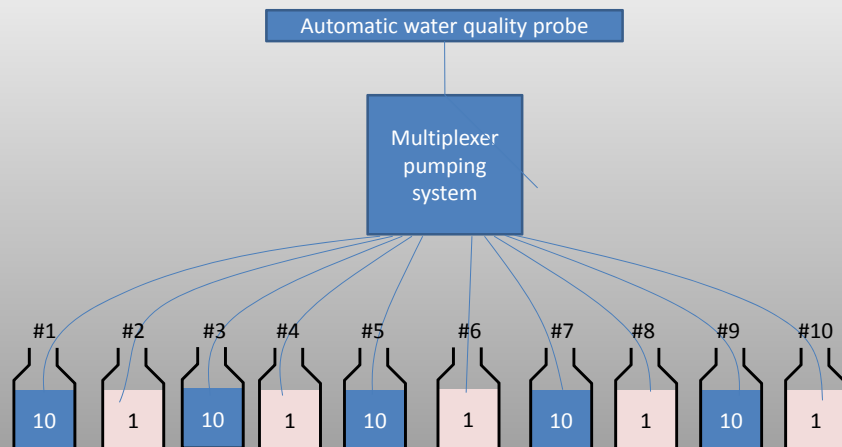
- Power consumption
 - How long will the device run continuously?
- Cross contamination
 - Does the in-line valve system end up contaminating the overall system?
- Reliability over time
 - Can the device run over an extended period (~10 days) without failing?
- Calibration
 - Does any instrument part need calibration?

Power Use

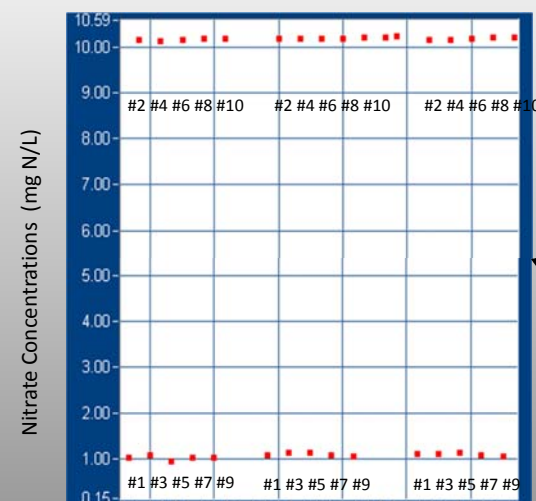
- Power consumption data
 - Can run for ~3.5 days continuously on a 12 V battery.
 - Lab setting: battery system hooked up to a charger.
 - Field setting: battery system tied into a solar panel charging system, thus power depends on weather conditions.



Measuring Cross-Contamination



Results: Low Cross-Contamination

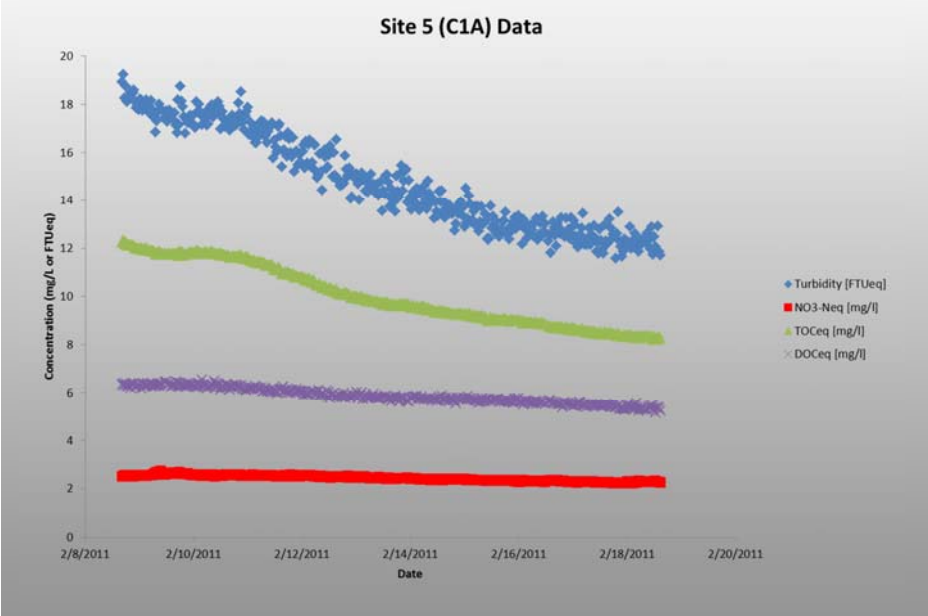


Screen shot from the automatic probe software; Measurements Every 3 min

Reliability Experiment

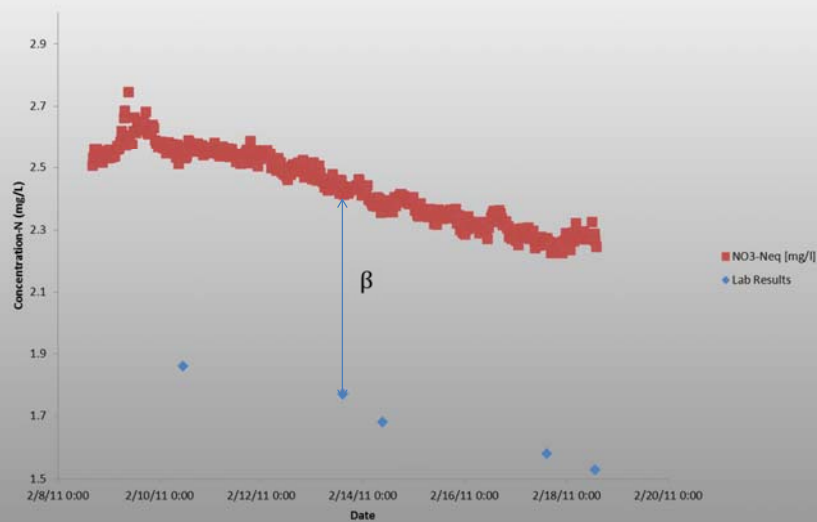


Reliability Experiment Results



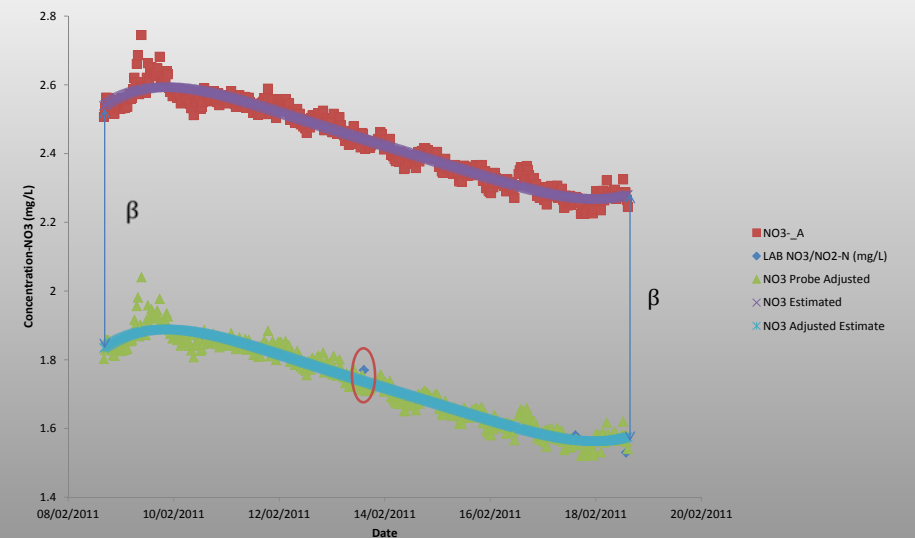
Raw Nitrate Results

Site 5: C1A



Nitrate Results After Calibration

Site 5 (C1A) NO3



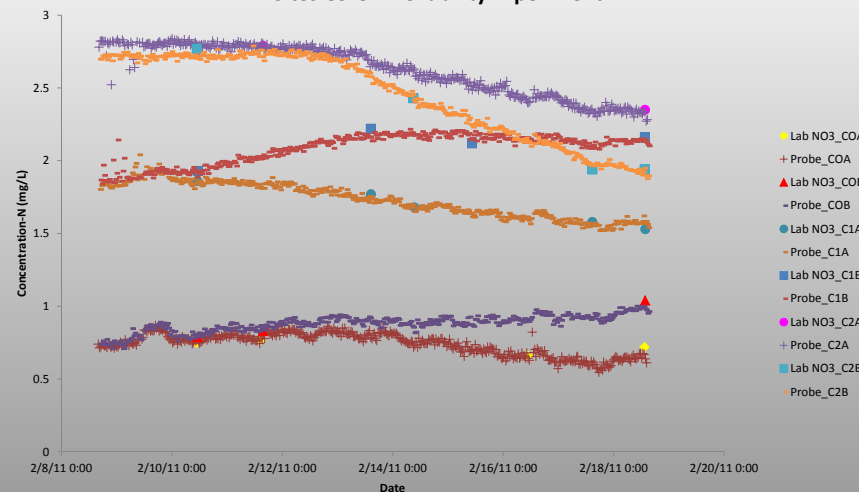
Results

| Nitrate_ "Best Fit" | | | | | | | | |
|---------------------|--------|--------|---------|--------|--------|---------|--------|--------|
| | C0 | | | C1 | | | C2 | |
| | A | B | Average | A | B | Average | A | B |
| % diff | 4.67% | 3.68% | 4.18% | 1.49% | 1.70% | 1.59% | 0.93% | 1.22% |
| Average Variance | 0.0399 | 0.0354 | 0.0376 | 0.0273 | 0.0415 | 0.0344 | 0.0288 | 0.0355 |
| | C3 | | | C4 | | | | |
| | A | B | Average | A | B | Average | | |
| % diff | 5.01% | 2.95% | 3.98% | 2.54% | 0.41% | 1.48% | | |
| Average Variance | 0.2143 | 0.1143 | 0.1643 | 0.1402 | 0.0166 | 0.0784 | | |

- All measurements after calibration had less than 5% difference between measured values and lab results.
- Multiplexer Pumping System appears to fairly accurate when calibrated, requires limited maintenance and proves quick reliable results over a 10 day period.
- Initial parts cost ~\$2,000, but can now measure 11 sites accurately with one probe.

Results

Sites Co-C2: Reliability Experiment



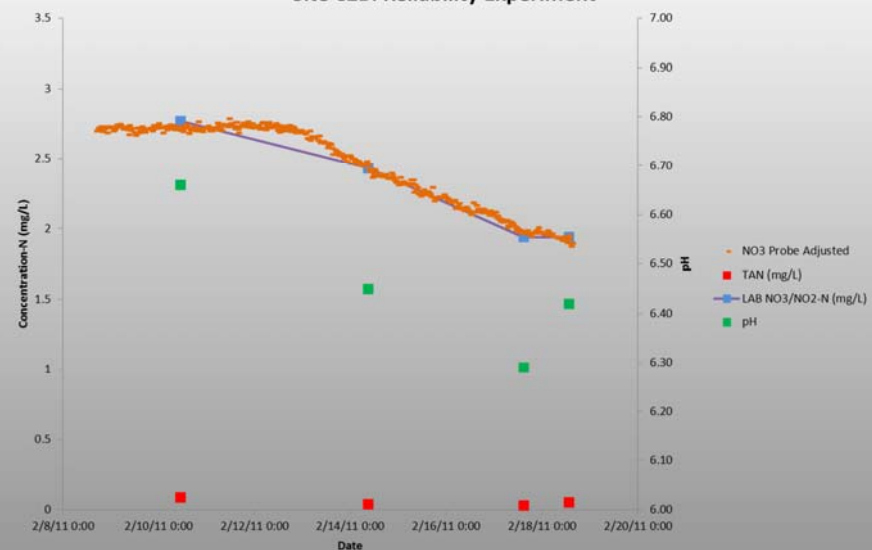
Results

Sites C3-C4: Reliability Experiment

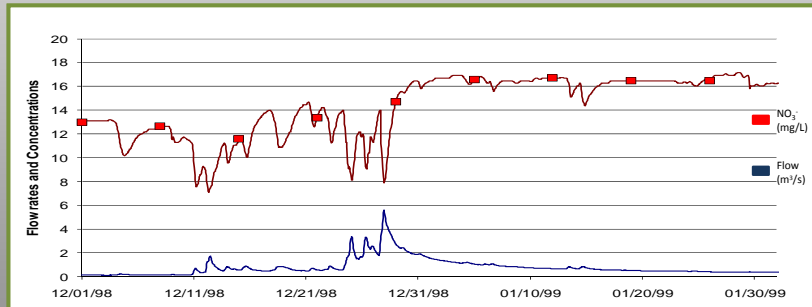
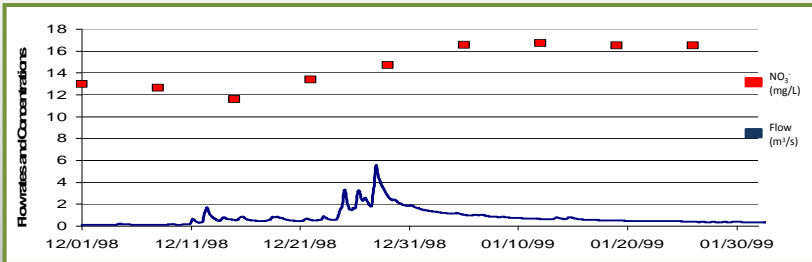


Results

Site C2B: Reliability Experiment

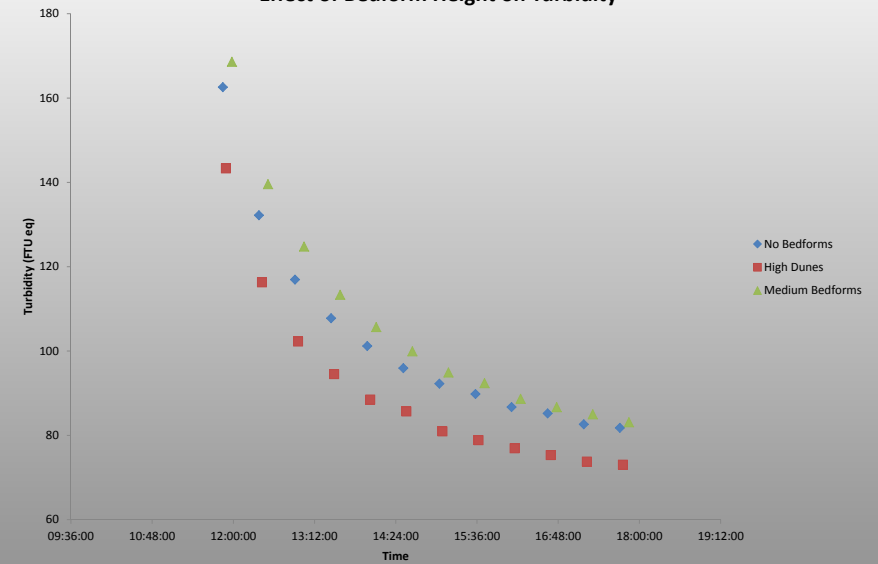


The Big Picture



Spatial and Temporal Combined

Effect of Bedform Height on Turbidity



Questions?

