Effectiveness of an Autonomous Nutrient Analyzer in the San Francisco Estuary: *Our Experience with Envirotech's 4-Channel EcoLAB*

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What does the EcoLAB Do?

- 4-channel nutrient analyzer that measures nitrate, silicate, phosphate, and ammonium simultaneously
- Good tool for monitoring episodic loading events in fresh or marine systems
- Produces high frequency nutrient data
- Adaptable range of measureable nutrient concentrations – from oligiotrophic to eutrophic conditions

EcoLAB's Technology

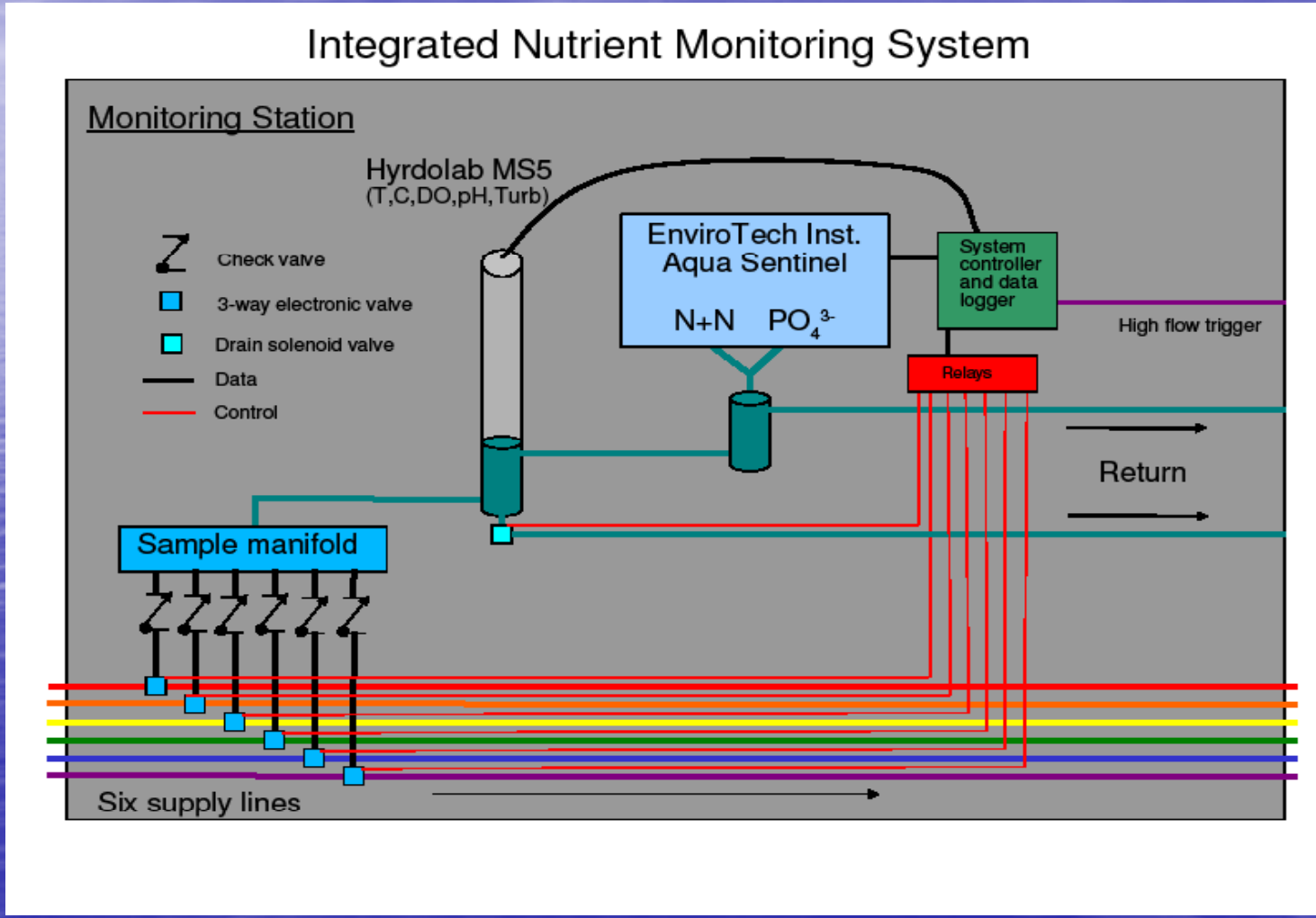
- Performs individual chemical reactions for: NO_3+NO_2; PO_4; $Si(OH)_4$; NH_4 via reagent-based wet chemistry (approx 1 hr/ each analysis)
- 16 port rotary valve; motor-driven syringe; LED detectors (akin to single wavelength colorimeters); on-board data acquisition system; data stored on Compact Flash memory card; customizable chemistry scripts
- System can used in relative real-time with telemetry application
- System can be used on benchtop or moored (small footprint)
- Powered by either 12V DC or thru an integrated battery pack

EcoLAB Specifications (from Website)

(http://envirotechinstruments.com)

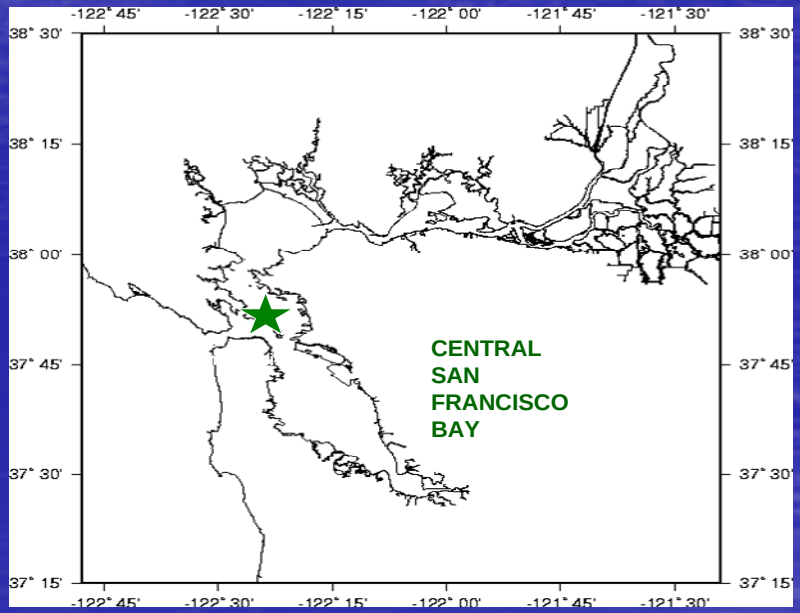
- Nitrate Ranges (µM) – 0-10; 0-30; 0-60; 0-120; 0-300 (@ 543 nm)
- Silicate Ranges (µM) – 0-10; 0-60 (@ 810 nm)
- Phosphate Ranges (µM) – 0-1; 0-3; 0-6 (@ 880 nm)
- Ammonium Ranges (µM) 0-10, 0-50; 0-100 - uses OPA fluorescence method)
- Precision (% range) 1% - 3%
- Sensitivity (µM) - 0.05 for all
- Endurance (max) 4- 6 months (2 months only for Si and PO4)
- Dimensions 12.2” (310 mm) diameter x 23.2” (590 mm)
- Weight Air: 55 lbs (25 kg) - Water: 8.8 lbs (4 kg)
- Depth capability 100 m standard - 250 m optional
- Power consumption : 260 mA / Sleep: 100 µA / Mean: 22 mA (for 8 weeks)
- Communications RS232 - ASCII - 19.2 kbaud (N81) / 300 baud - 57.6 kbaud
- Power supply 12 volt DC (range 9.0 - 15.5 volts)
- Materials uPVC & polypropylene (housings), titanium (fittings)

Integrating EcoLAB into existing monitoring programs

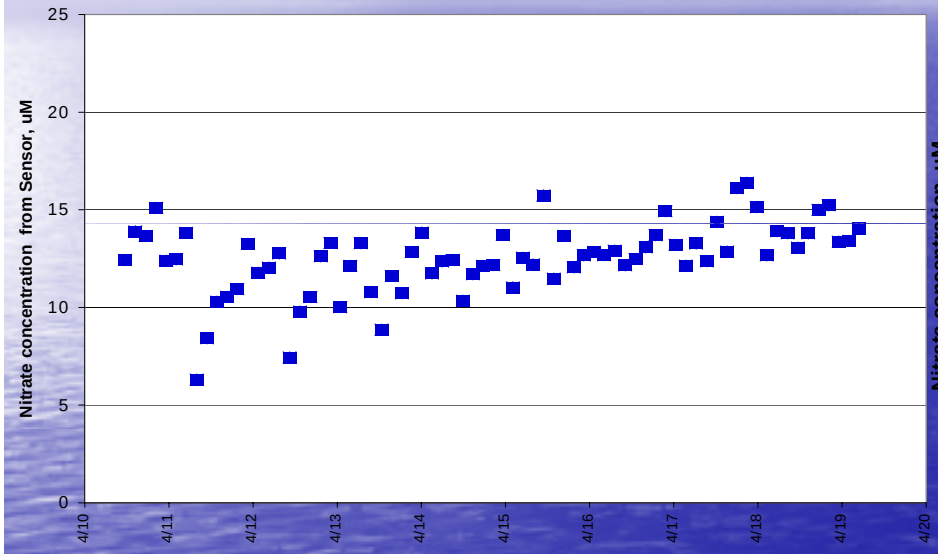


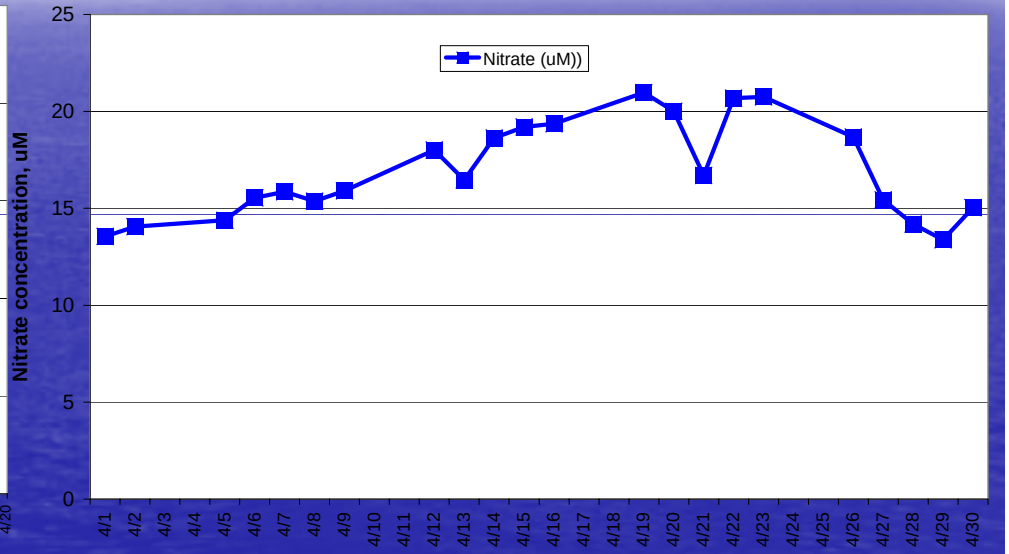
EcoLAB Applications at RTC

- Originally used as part of central SF Bay monitoring station (CiCORE project)
- Used for multiple deployments utilizing all 4 nutrient channels



Comparison of SF Bay nitrate (µM) with the EcoLAB (hourly sampling) and bucket samples (daily)
April 2005

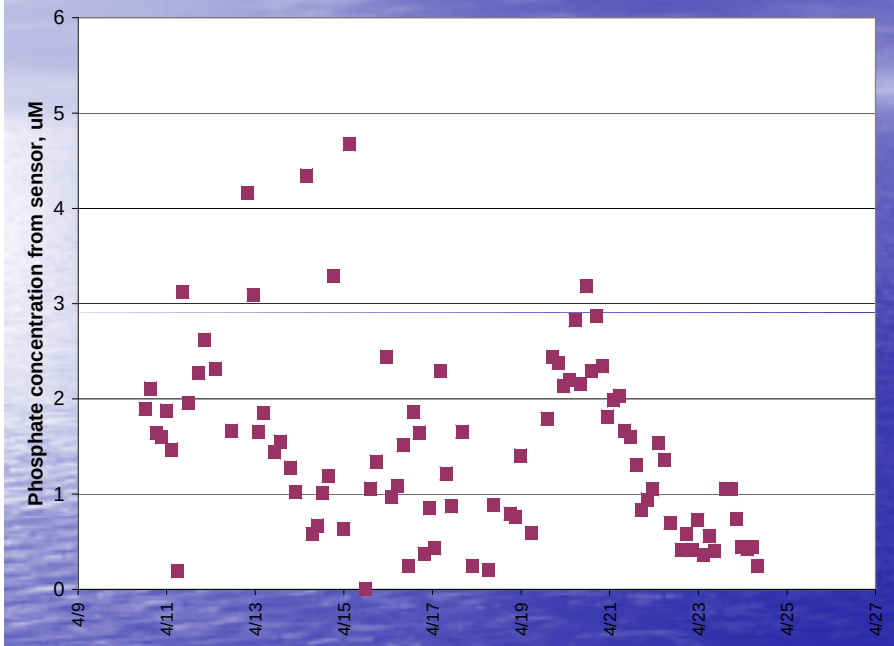


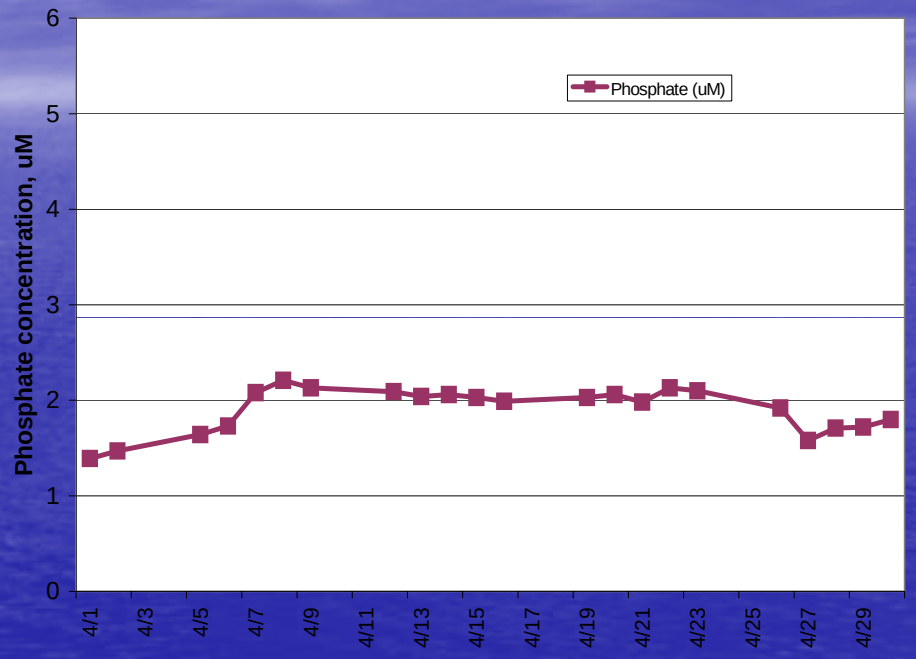


Nitrate measured every 3 hours using EcoLAB nutrient sensor

Nitrate measured daily using bucket and an Auto-Analyzer

Comparison of SF Bay phosphate (µM) with the EcoLAB (hourly sampling) and bucket samples (daily) – April 2005

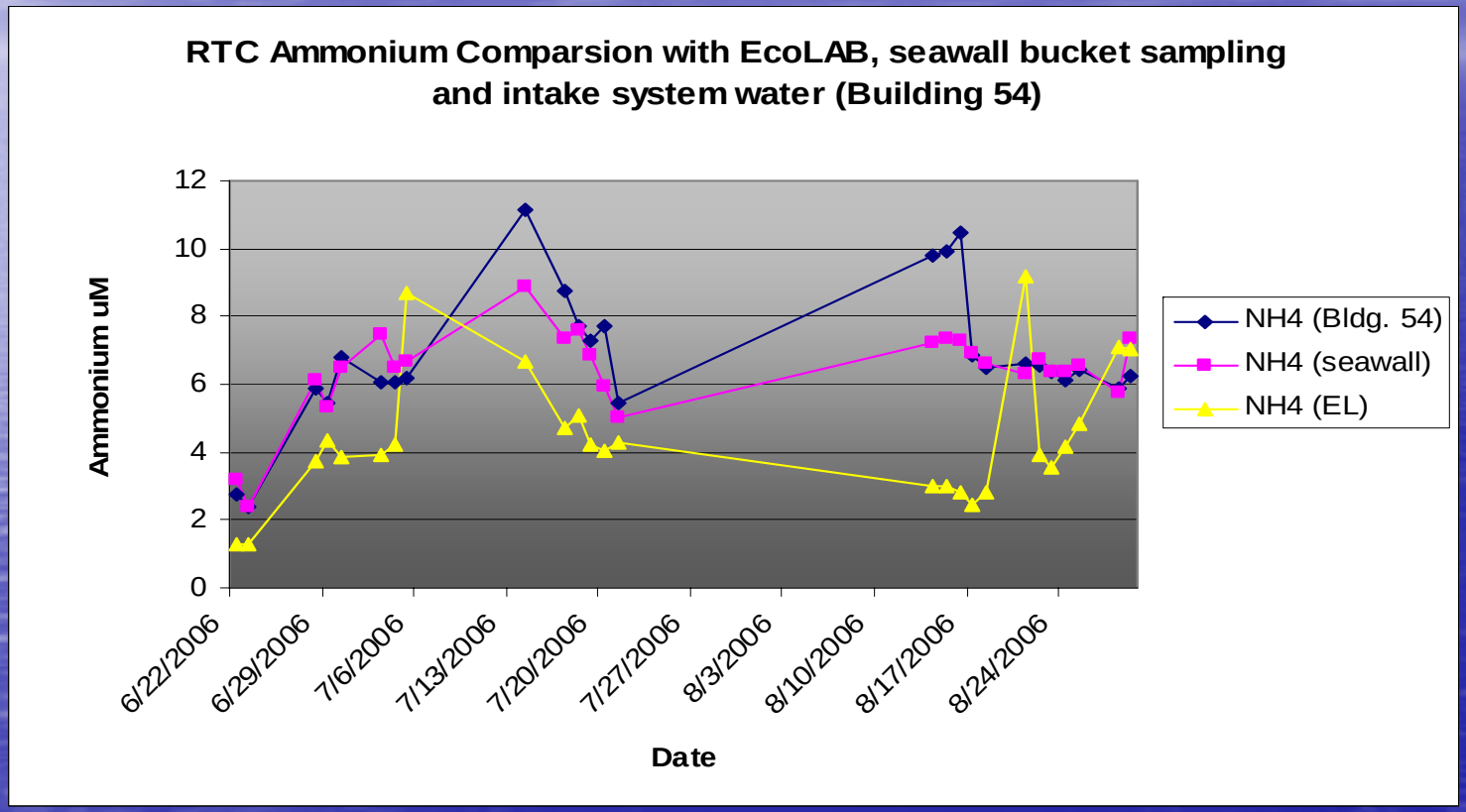




Phosphate measured every 3 hours using EcoLAB nutrient sensor

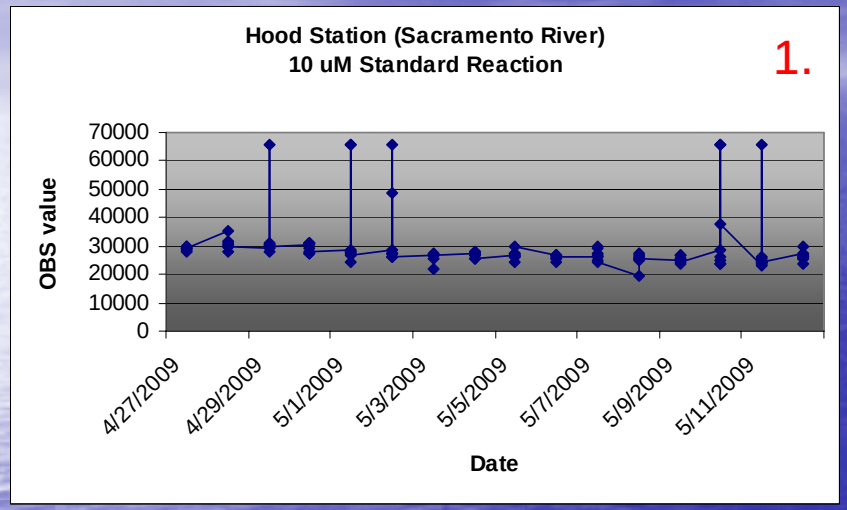
Phosphate measured daily using bucket and an Auto-Analyzer

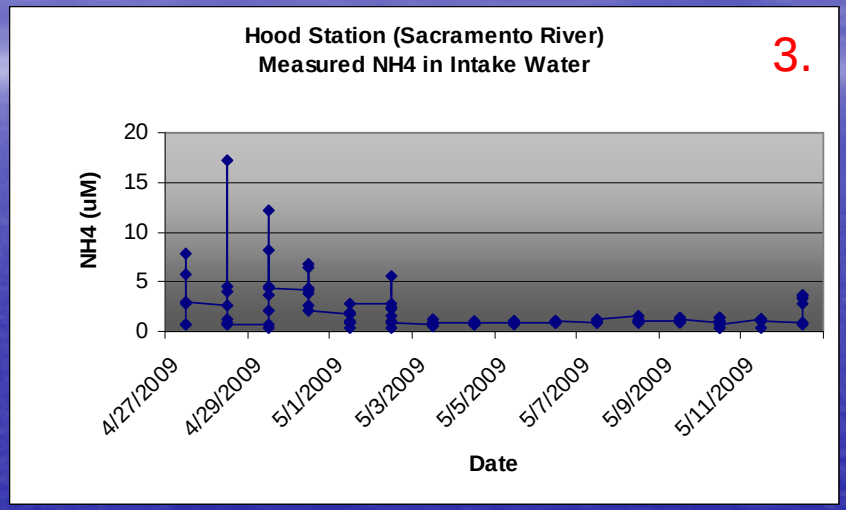
Comparison of SF Bay ammonium (µM) with the EcoLAB (hourly sampling), bucket samples (daily), and bay water intake system: June – August 2006

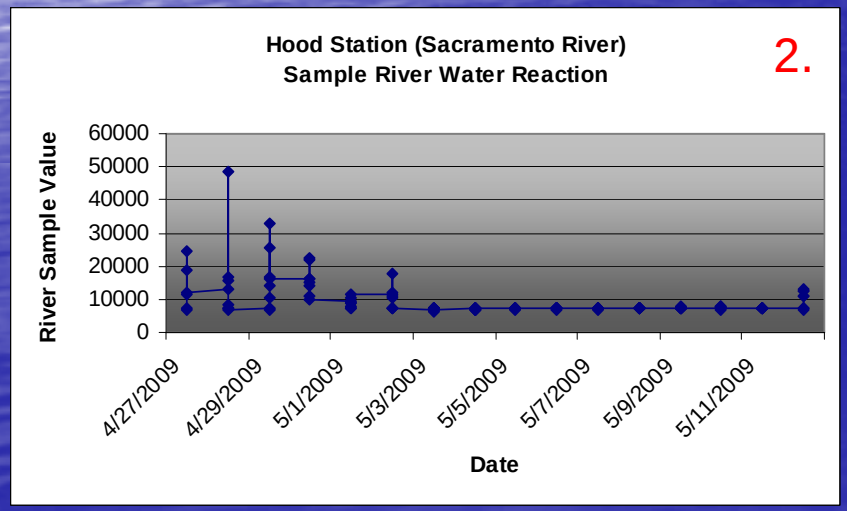


Disparity between EcoLAB vs. bucket and bay water intake data sets; most likely induced by fine sediment interfering with NH_4 fluorescence method – tends to underestimate concentrations by factor of >2x.

Ammonium Data
Hood Station (Sacramento River)
May 2009







EcoLAB unit was deployed on the Sacramento River in May 2009 to measure NH_4 only. Graph 1 shows the on-board standard (OBS) reaction; graph 2 shows the river water reaction; and graph 3 shows calculated NH4 concentrations. OBS measurement/concentration is accurate (lab verified @ 10.1 µM). Measured Sacramento River water is suspiciously low (graph 3). Actual river sample taken the day of deployment (from river, not station intake = 38.8 µM); station intake water = 1.0 µM. ***We are currently still trying to unravel this mysterious discrepancy.*

Our Personal Experience with EcoLAB's Performance

- "Less is more" – can run 2 analyses well (our best success was with nitrate and silicate); had more problems with phosphate and ammonium
- Needed a fair amount of training to get it up and running (fairly complex); especially figuring out sample scripting codes and taking data from instrument to the web
- Definitely not a "set it and forget it" model; sampling areas with high sediment loads can be problematic
- Instrument needed a lot of QA/QC before deployment
- Good data can be obtained, but instrument requires a lot of technical time to make this happen

Advantages/Disadvantages

- **Advantages –** quality data can be obtained; wet chemistry methods robust and “tried and true”; compact size; relatively easy to set up in a field station; housing and internal mechanics very good quality; solid computer communication via RS232 connection (although dated technology now); very customizable sampling methods

- **Disadvantages –** very hard to have all 4 channels working simultaneously; high sediment loads can affect accuracy of on-board chemistry; labor intensive for maintaining and quality controlling; initially hard to establish real-time web link; a relatively new technology which makes the user feel like a “beta tester”; software clumsy and not always reliable

Conclusions

- EcoLAB instrument is most effective when used for 1-2 analyses per deployment
- Pre-filtering sample water is a must to ensure accurate results
- Steep learning curve to figuring out instrument; but once time has been invested – good data can be obtained.
- Company support is adequate; but other third party company's exist (e.g. greeneyesobserving.com) that can help users get up and running more quickly and professionally.