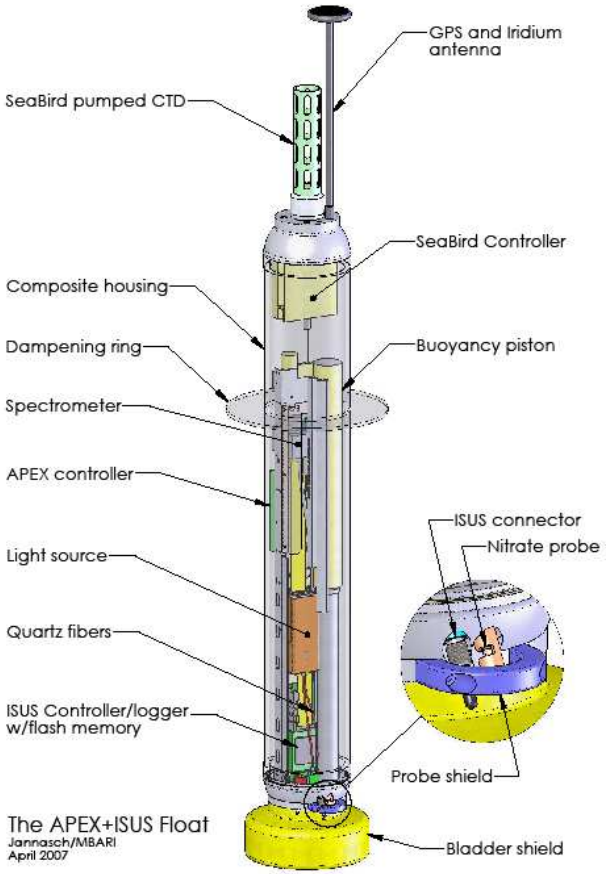
# ISUS/SUNA Nitrate Sensors in Apex Profiling Floats

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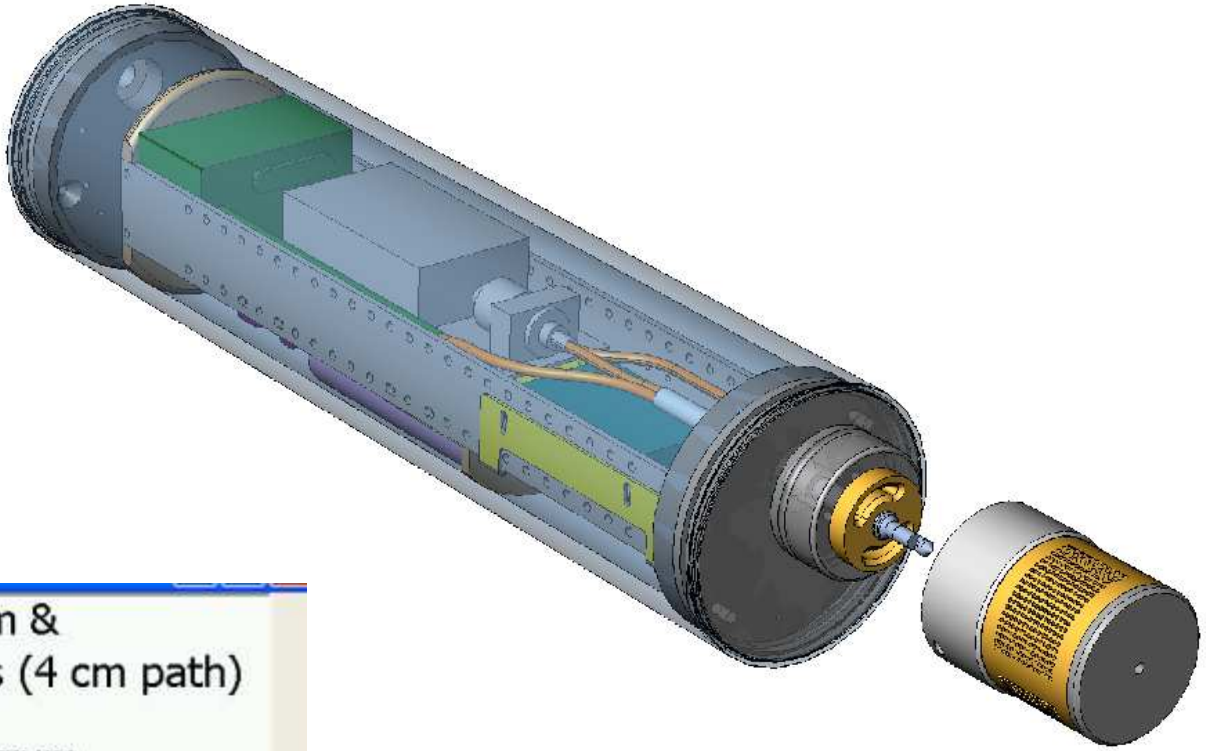
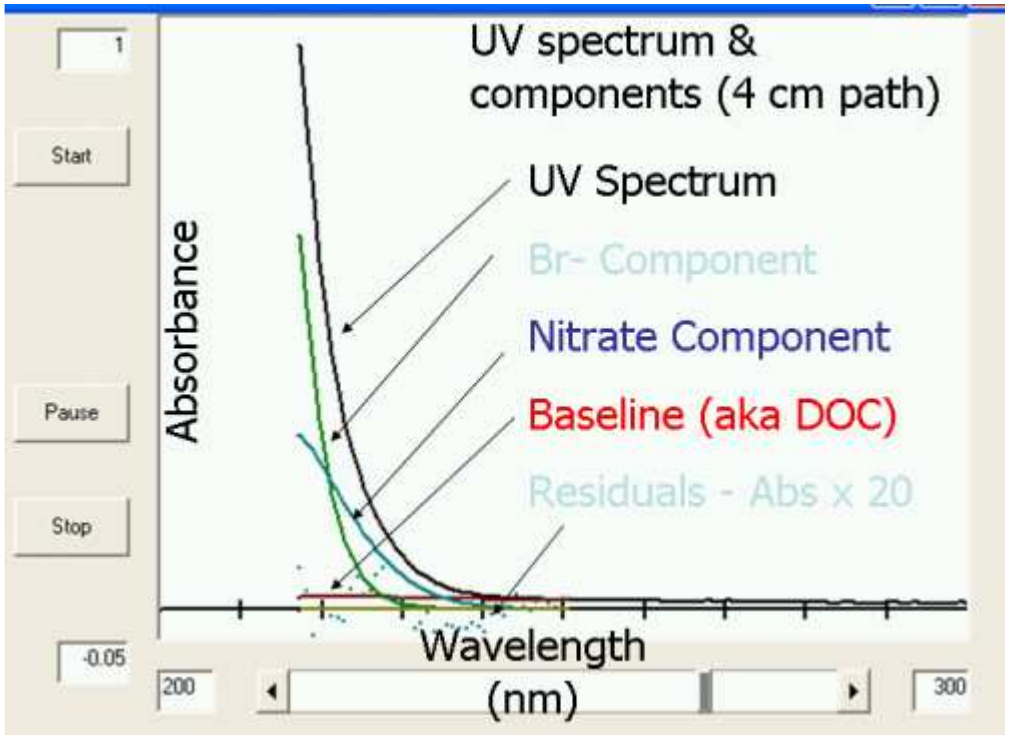
NOPP

MBARI In Situ Ultraviolet Spectro-photometer (ISUS). Now commercially available from Satlantic.

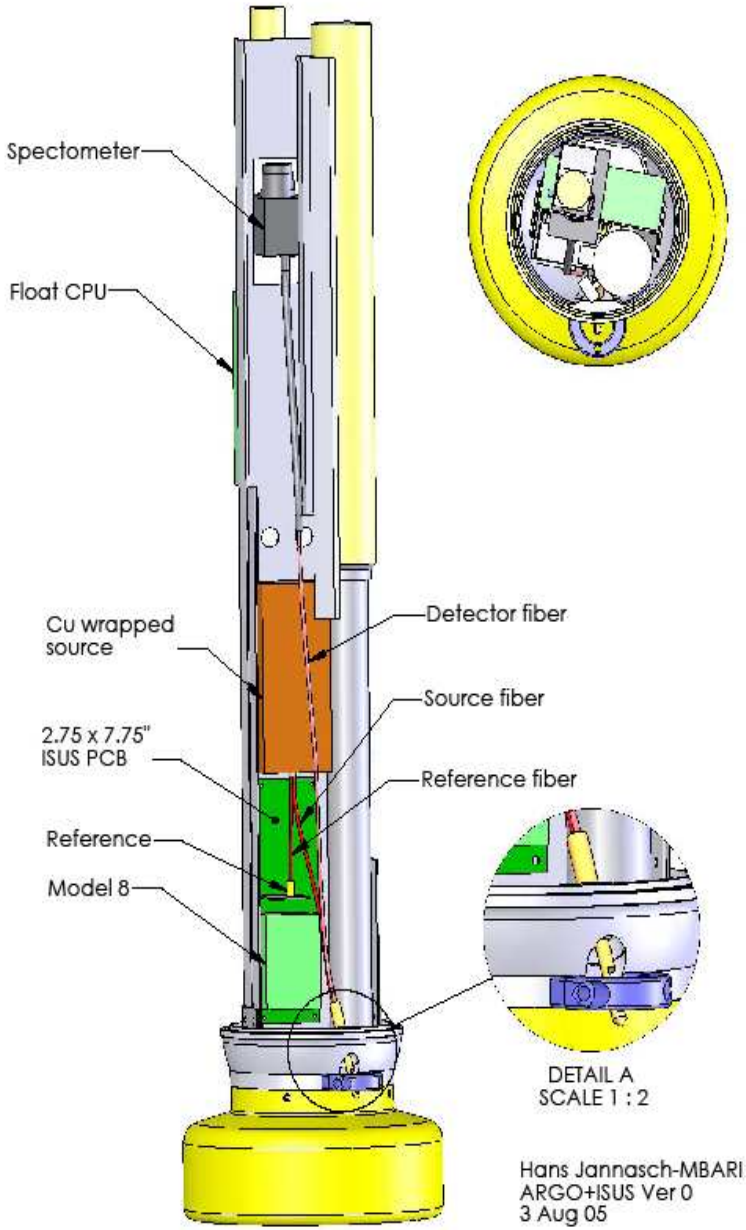




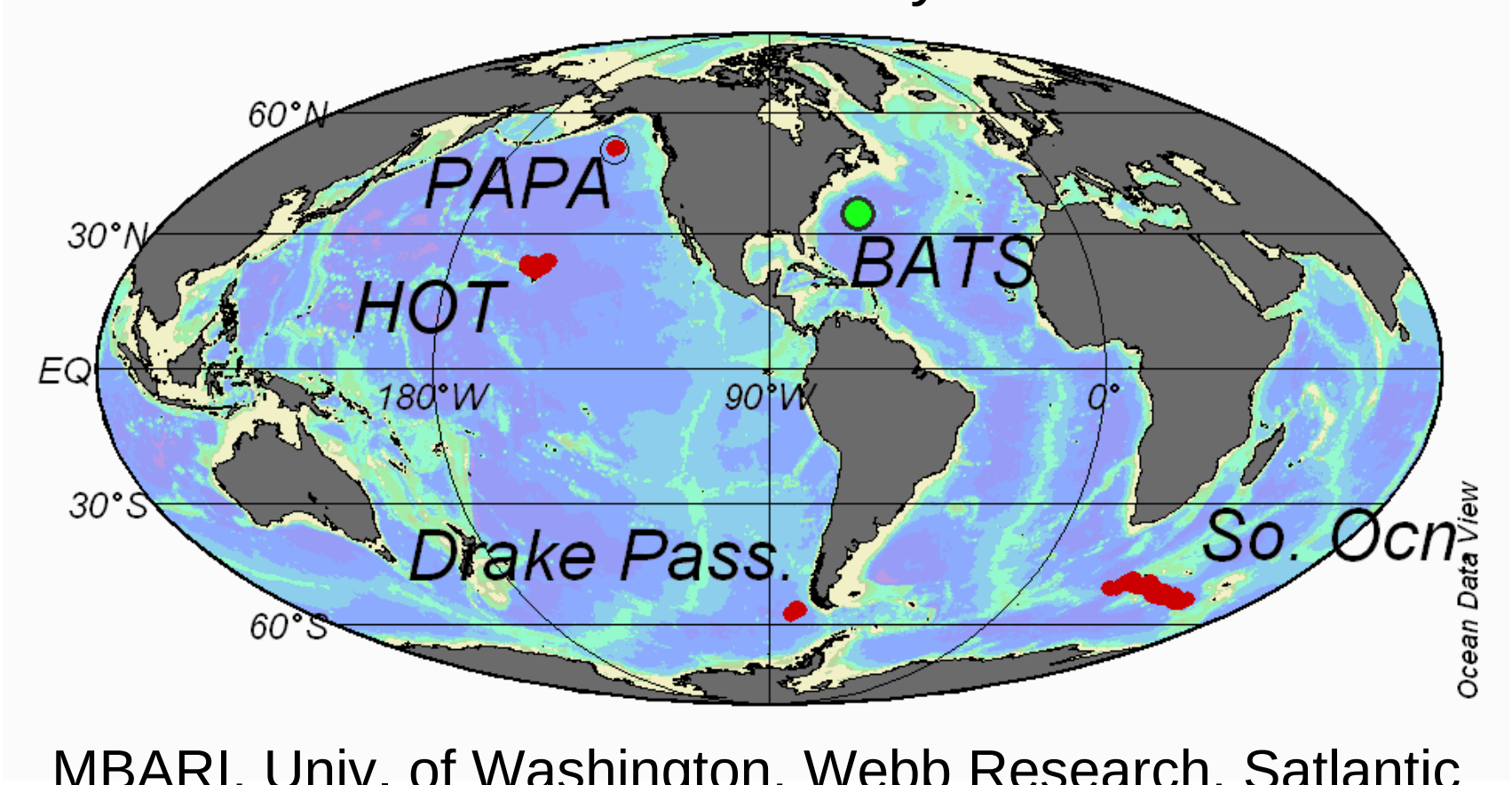

Nitrate measured directly using UV absorption spectrum from 217 to 240 nm (Johnson & Coletti, Deep-Sea Res. I, 49, 1291 2002).

ISUS integrated into APEX float.

- 44 joule/$NO_3^-$ measurement
- 60 $NO_3^-$ meas./profile to 1000 m
- Detection limit ~0.5 µM
- Float endurance 260 profiles to 1000 m. ~4 year life at 5 day cycle time.
- Requires Iridium comms. & Li batteries

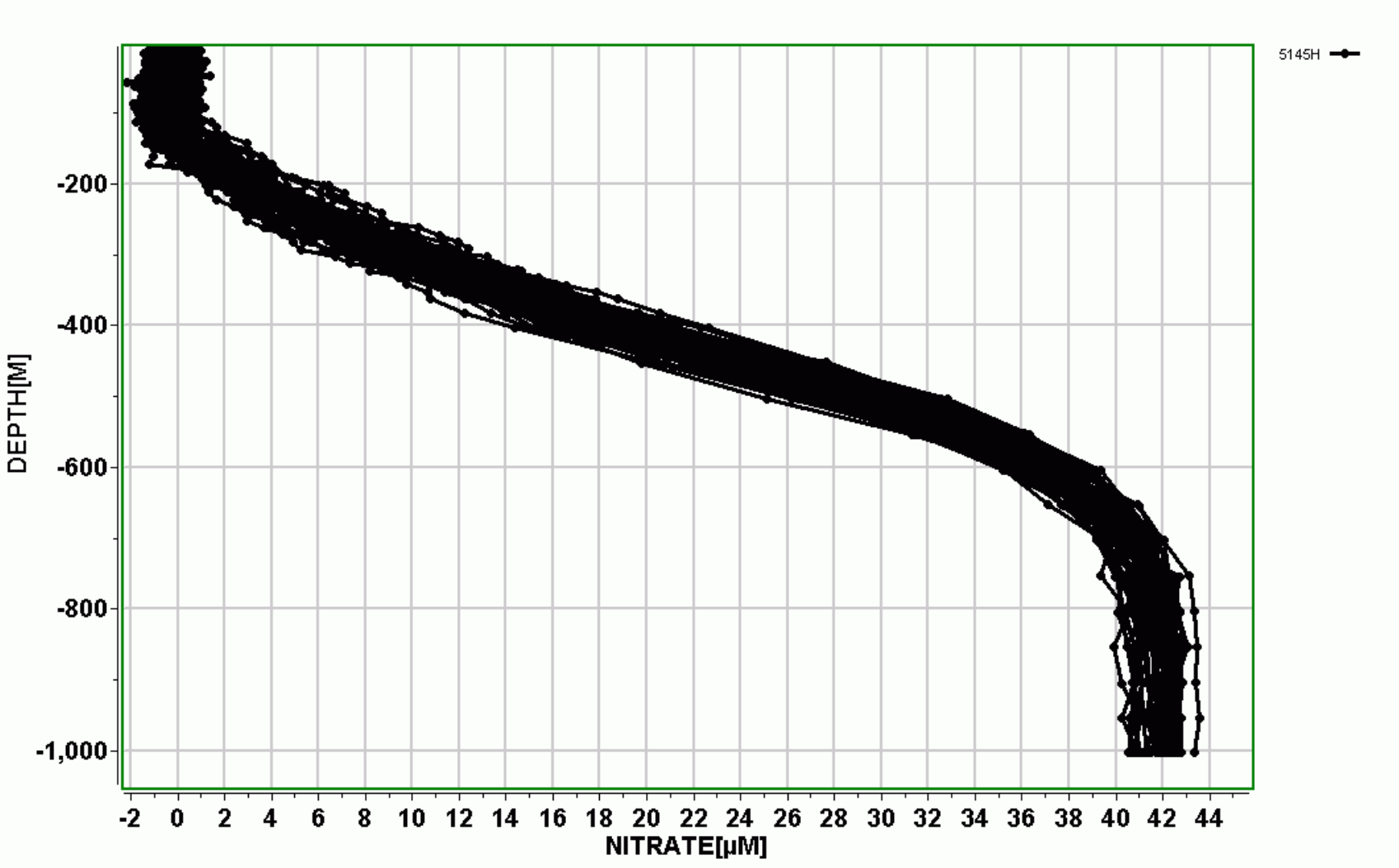


- 4 Apex/ISUS floats deployed, all operating
  - >3 years accumulated operating time
- 1 in transit for June deployment at BATS
- 35+ funded – will create arrays at time series stns.

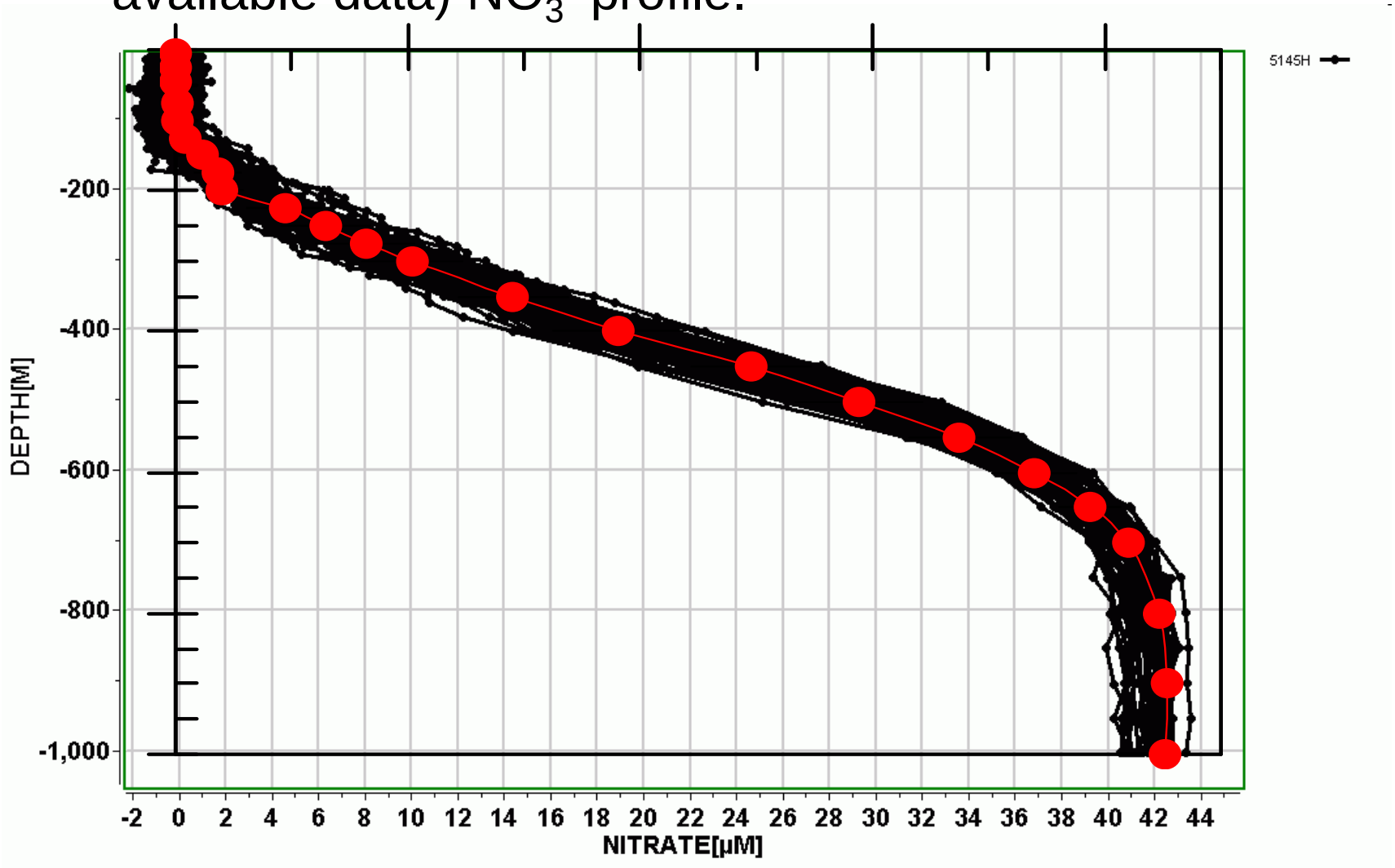



MBARI, Univ. of Washington, Webb Research, Satlantic

Float 5145 near Hawaii Ocean Time-series (HOT).
Now 480 days since deployment in Dec. 2007.



Red dots are HOT mean (last 2 years of available data) $NO_3^-$ profile.

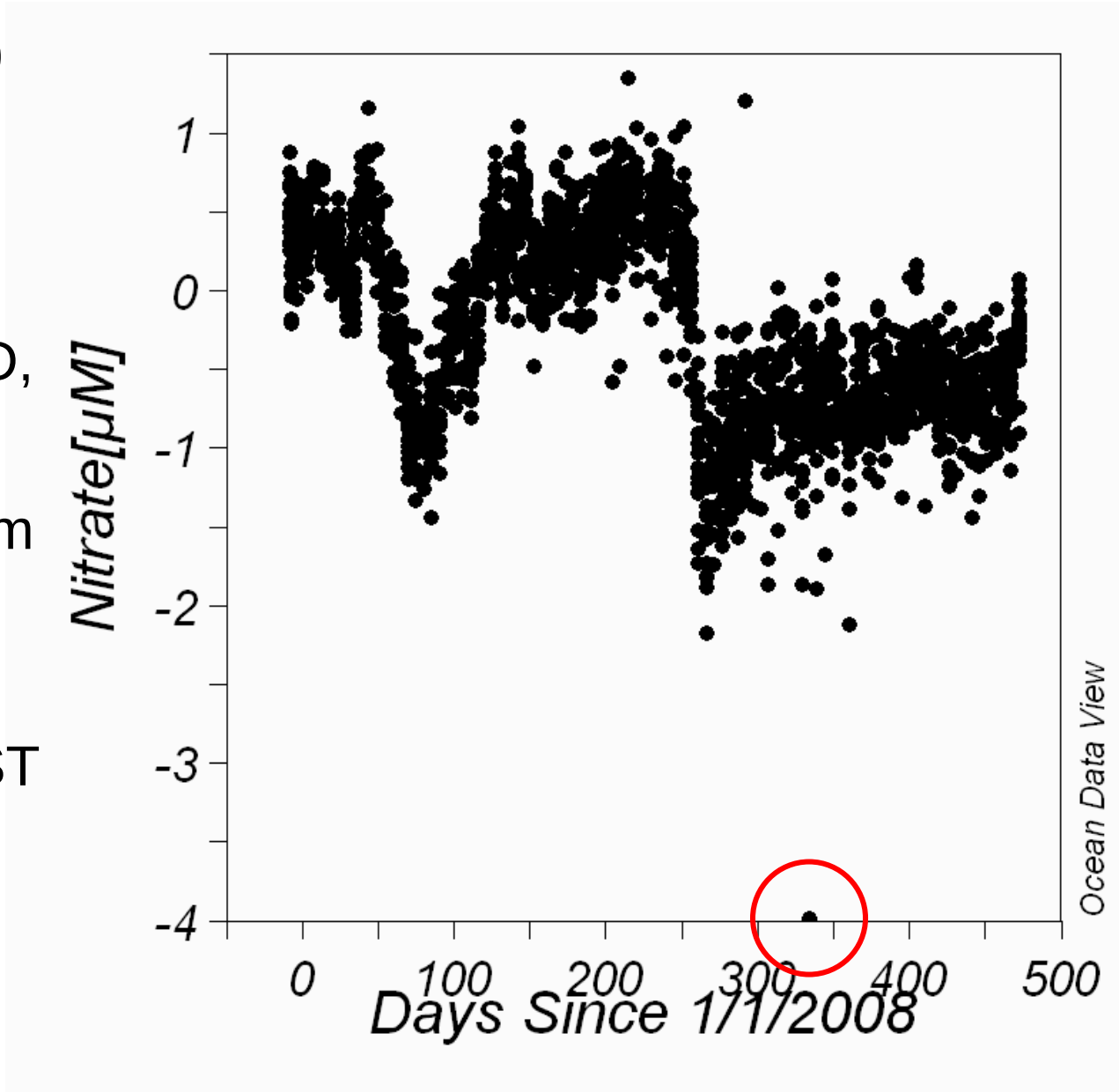


All HOT float $NO_3^-$ values at 0 to 100 m over 480 days. As transmitted by float

-0.2±0.6 µM (1 SD, N=1862)

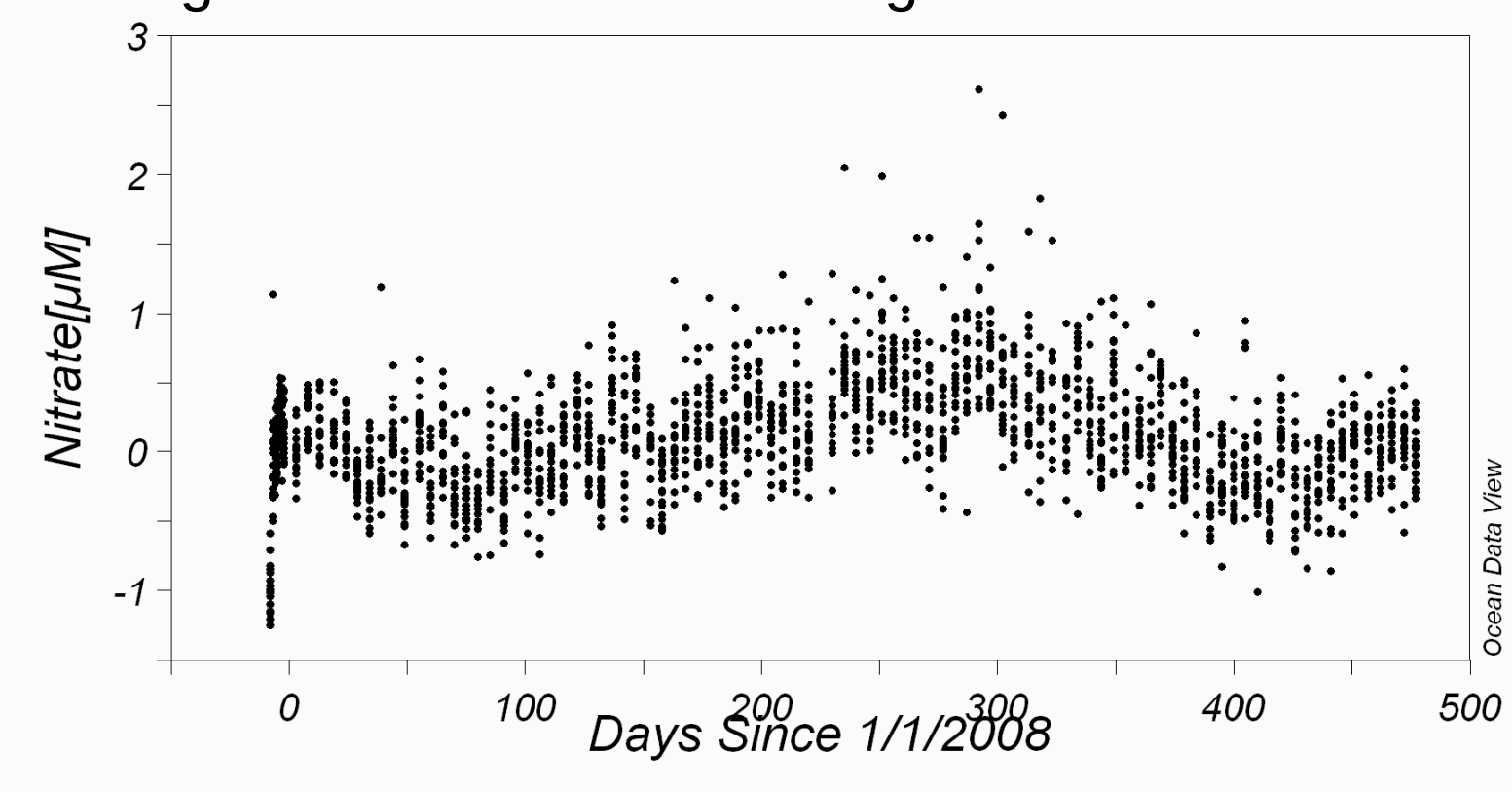
Clearly not random – intermittent fouling.

This is the WORST case so far for stability.

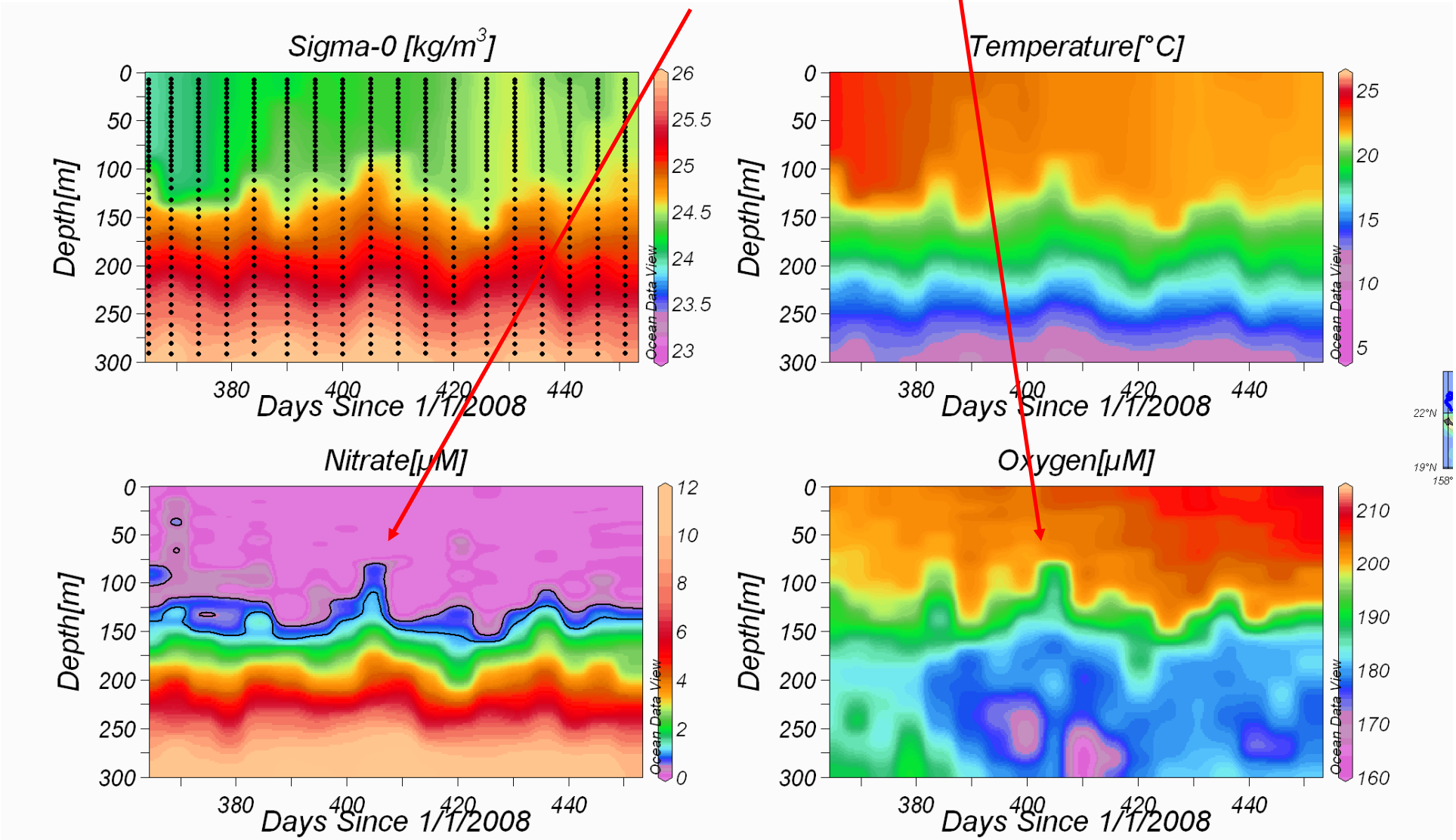


Because all data transmitted, revised algorithm development possible - HOT data with improved calculation.

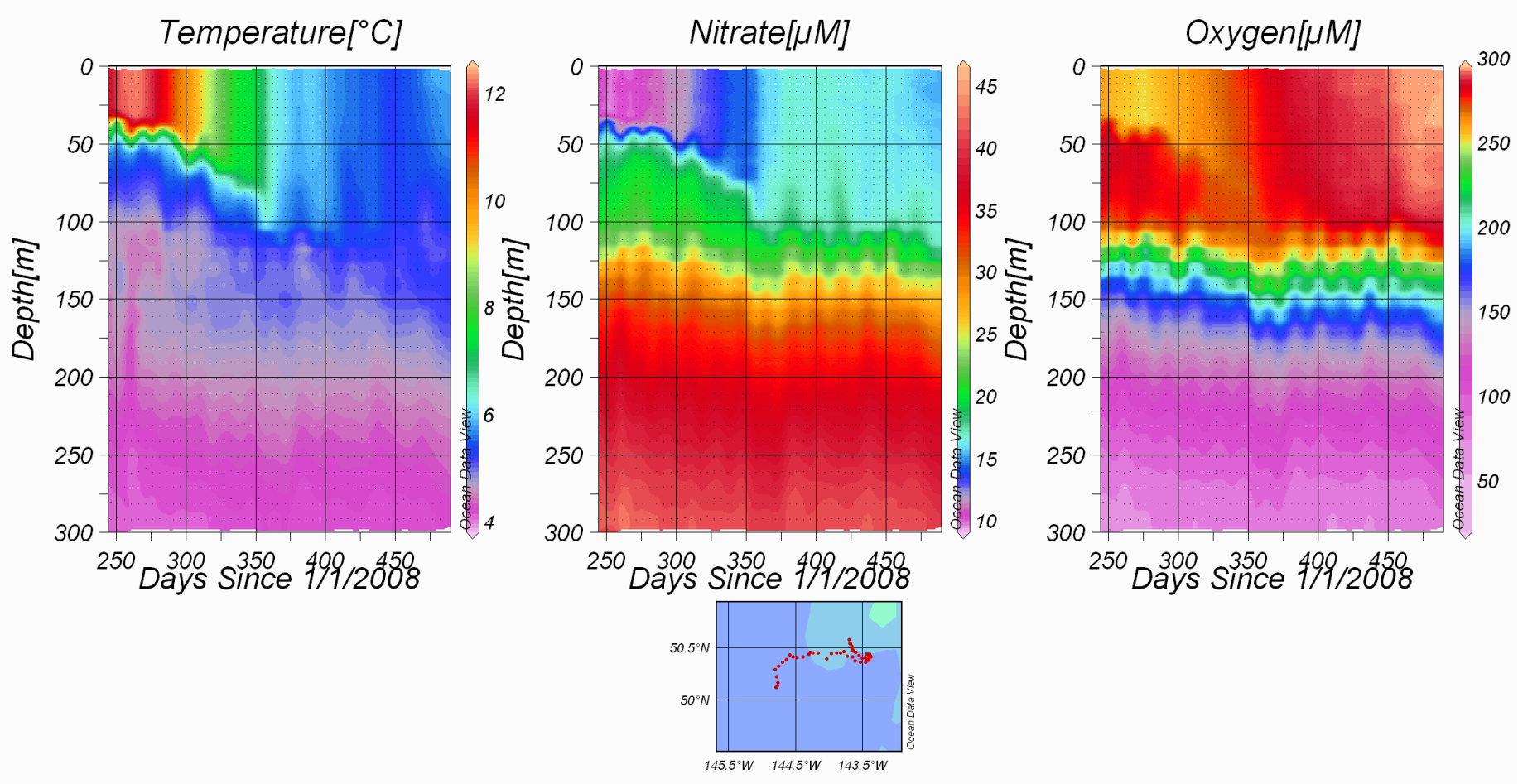
mean ± 1 SD = 0.11 ± 0.4 µM. Pretty good, but 2X improvement theoretically possible. New Apex/ISUS design should eliminate fouling.



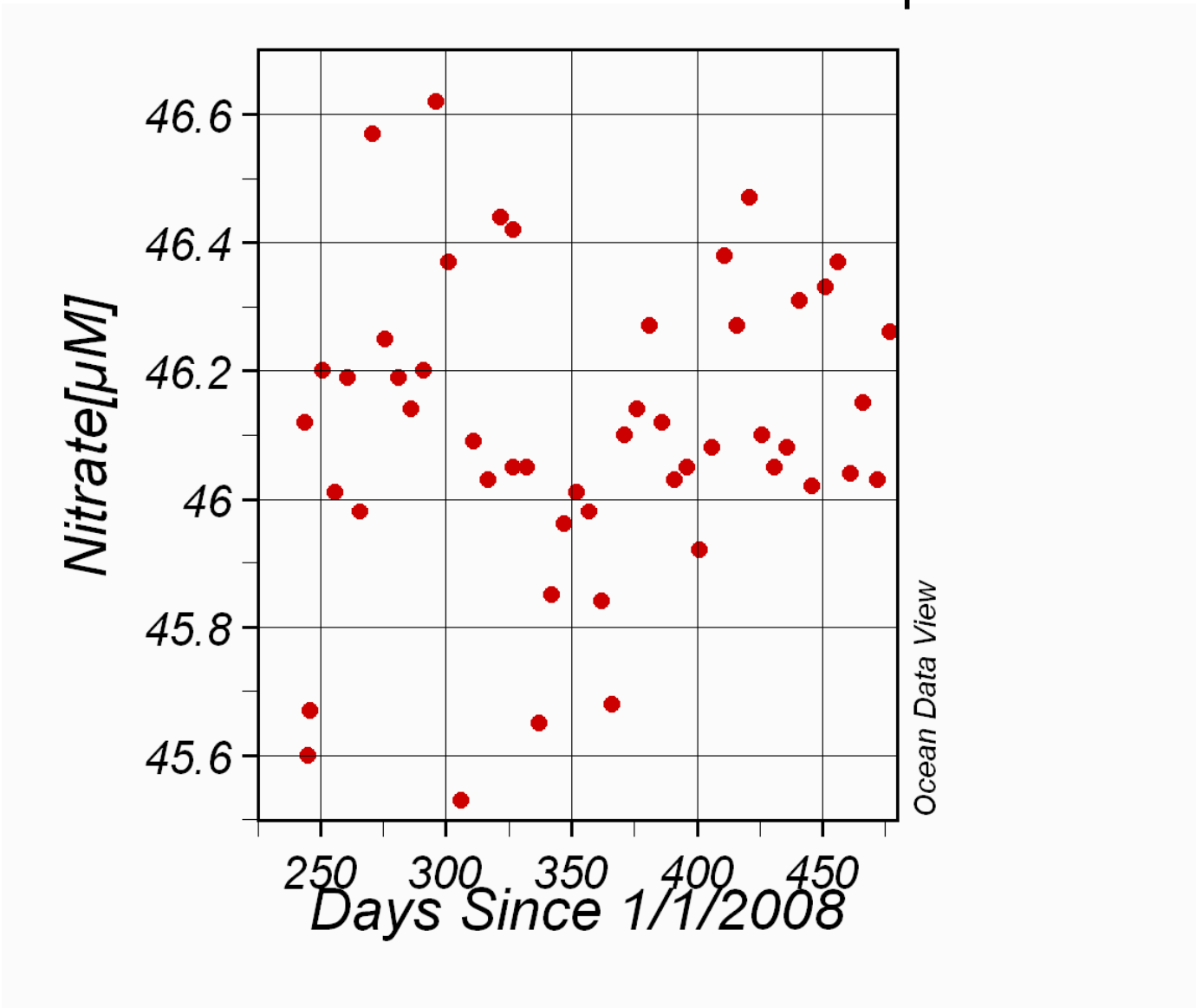
Upper 100 m has nitrate < 0.05 µM most (all?) of the time.
Contour line at 0.5 & 1 µM $NO_3^-$. Is $NO_3^-$ at 75 m real?
Contemporaneous with $O_2$, T, σ. Likely real.



# Float 5143 at Ocean Station PAPA

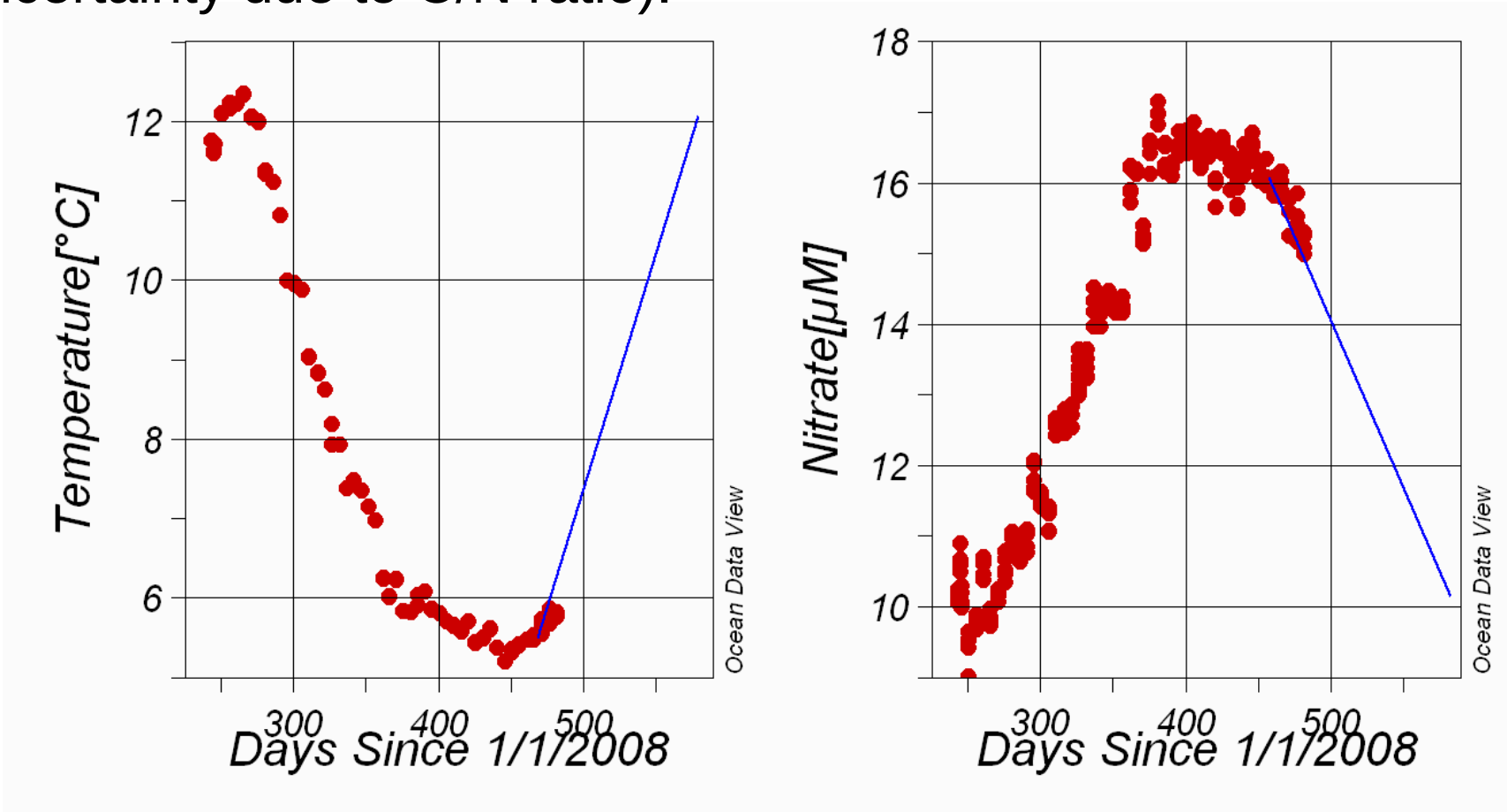


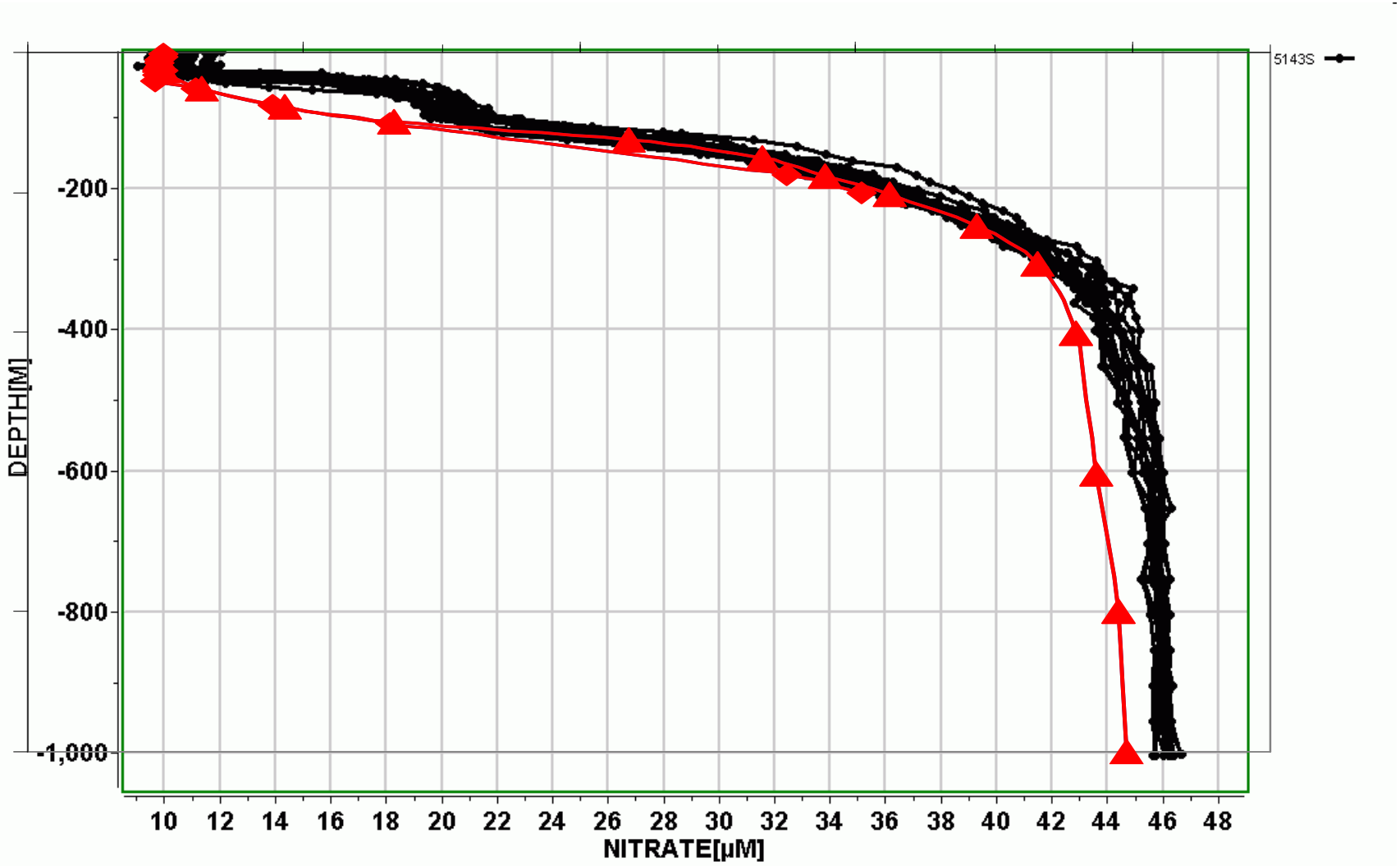
Stn PAPA $NO_3^-$ = 46.1 ± 0.2 µM at 1000 m. No adjustments. About the best one can expect. Detection limit 2 or 3 X 1 SD = 0.4 to 0.6 µM.



Stn PAPA Temp. and $NO_3^-$ in upper 30 m.  Spring bloom, as evidenced by $NO_3^-$ draw down, just starting.

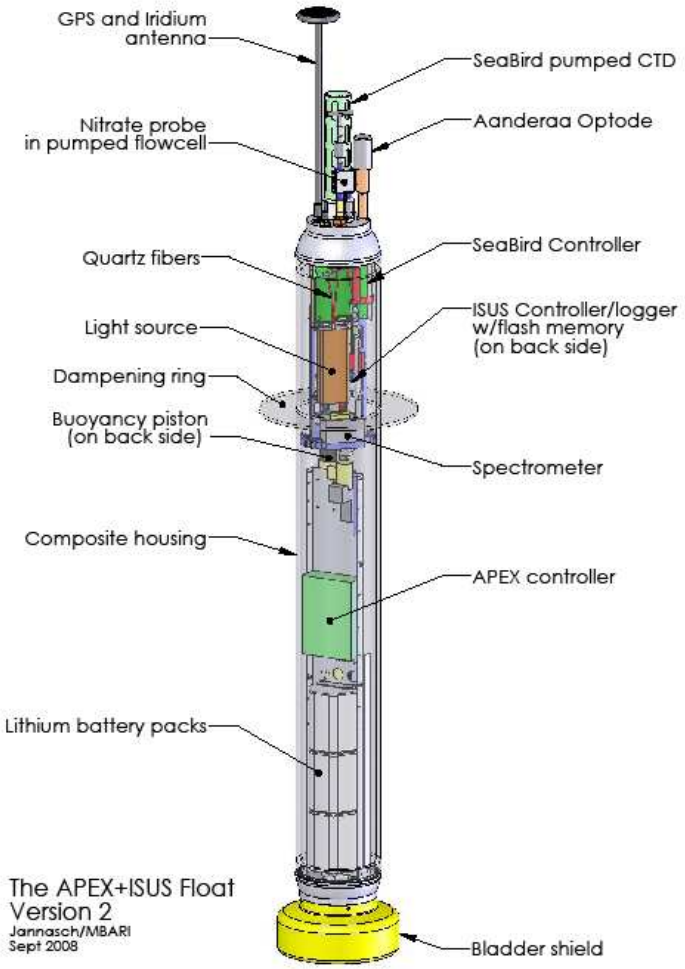
Data merged with a model would be a super tracer of primary production – no uncertainty due to gas exchange (but uncertainty due to C/N ratio).

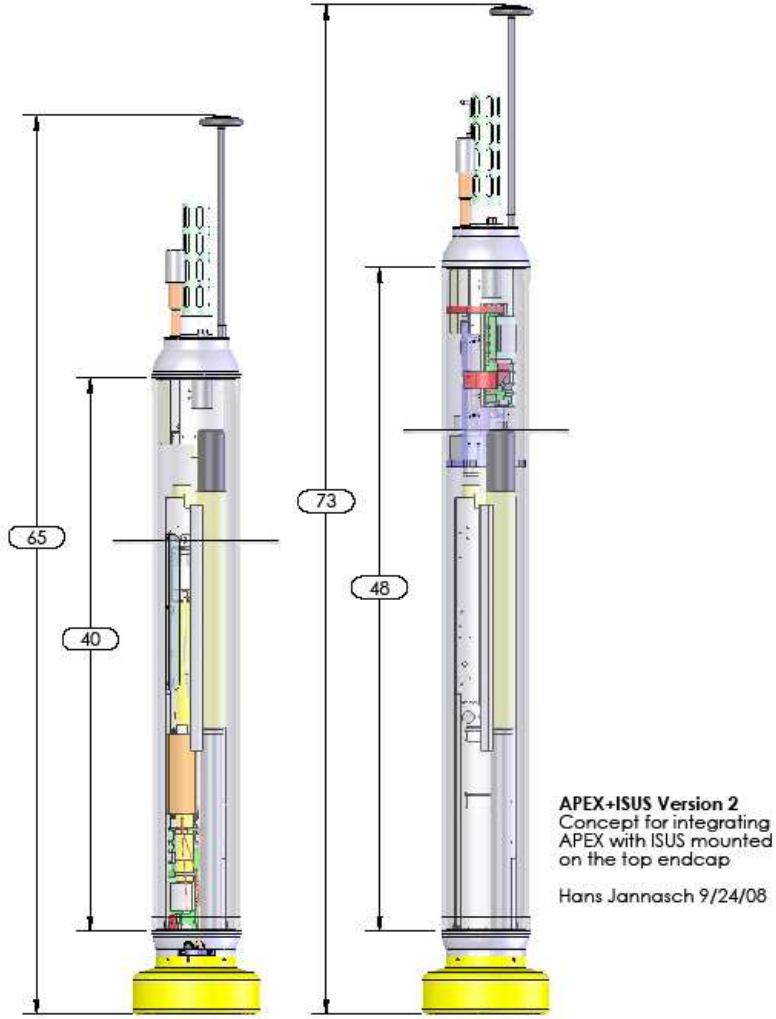





Ocean Station Papa. Compared to most recent profiles from OSP web site, we're too high by ~1 µM over whole profile. Good precision, accuracy can still be improved.

Apex/ISUS version 2. Extended pressure hull by 8” (Float #6 and on) to make ISUS easier to install. Now hangs under upper end cap as integrated unit. Moves UV optics into CTD pumped stream at top of float.

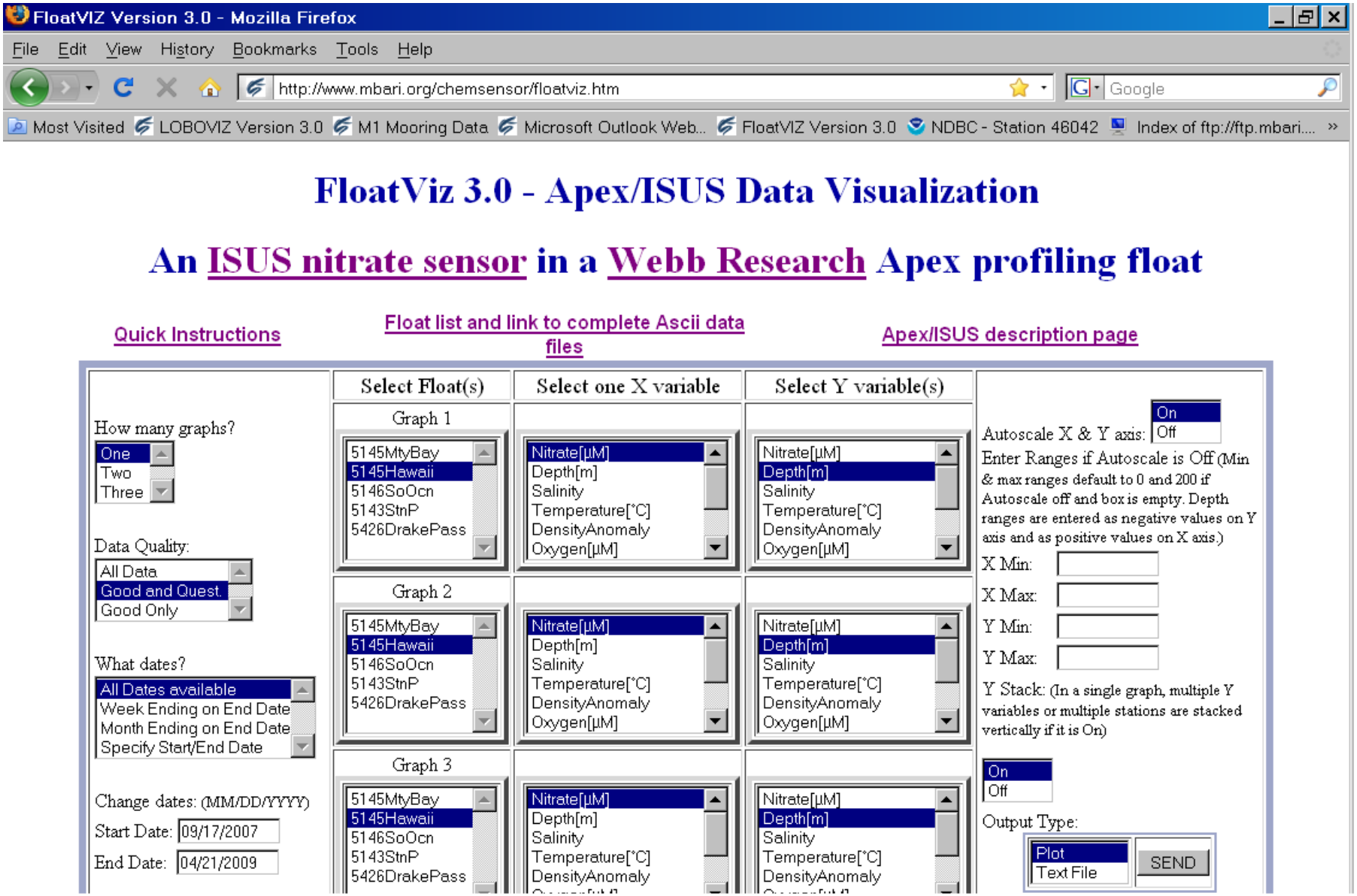


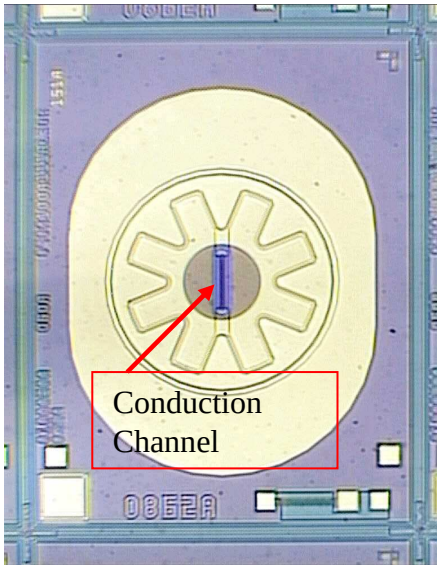



We will also be testing new Satlantic SUNA (Submersible UV Nitrate Analyzer) as external nitrate sensor option on ~6 floats.  Will incorporate latest MBARI algorithm.

NOPP funding with Satlantic and Webb Research to make ISUS or SUNA (or both) a standard sensor option on profiling floats.

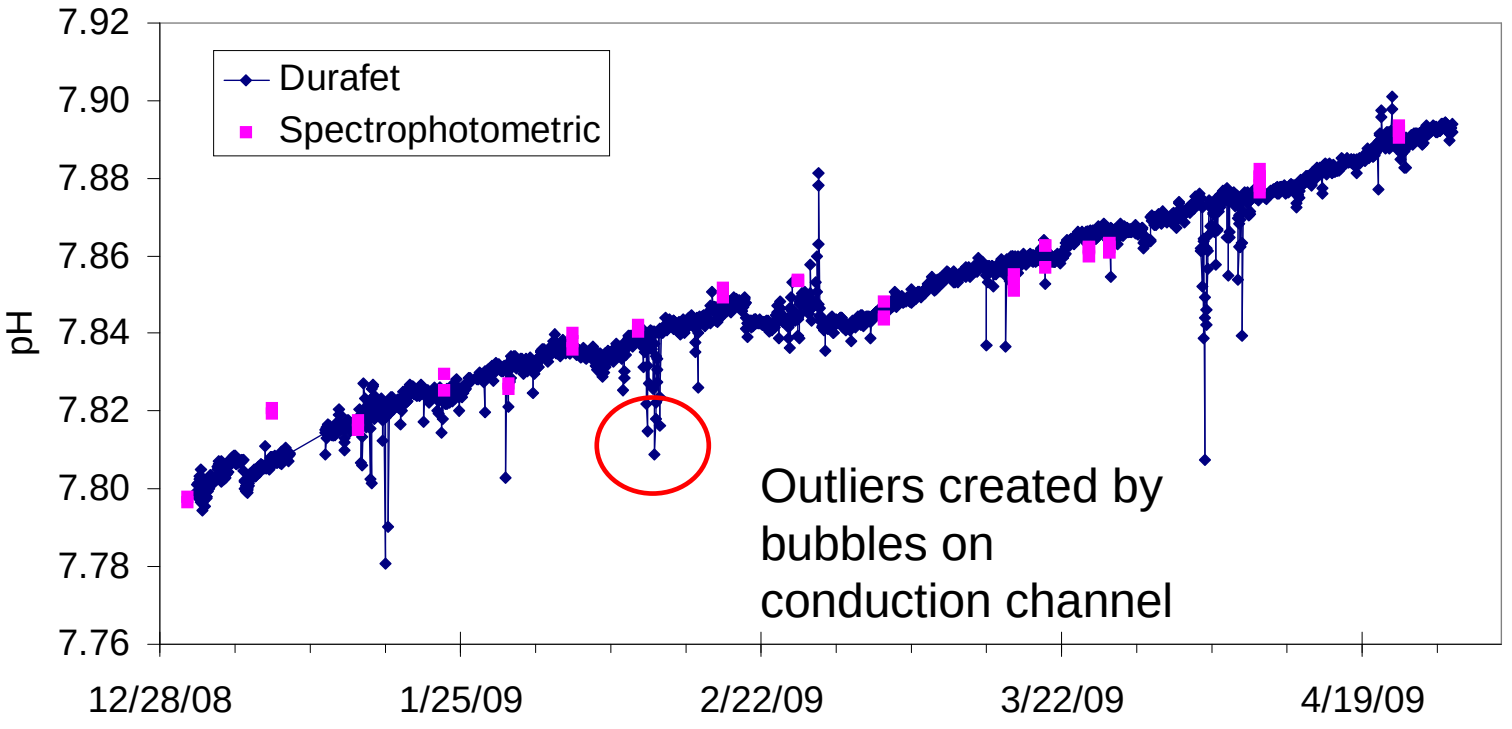
Committed to real time data distribution. Plots and numeric data available in real time at www.mbari.org/chemsensor/floatviz.htm






Honeywell Durafet Ion Sensitive Field Effect Transistor pH sensor – a potential float/glider sensor

- Long-term stability – months at ±0.006 pH in seawater
- High temperature stability – weeks of cycling 5 to 35℃ in equimolar buffers (pH=pK(T)) show >0.01 pH stability
- Pressure tolerance is now limiting factor. Re-engineering packaging to be pressure tolerant – possible, but not easy.
- Low power (µWs), low weight (grams), fast (<1 s)




MBARI Seawater Test Tank – Std. dev. of difference from Spec. pH values is 0.006 over 3+ months (pH going up as tank outgases $CO_2$)