Ocean Networks Canada

Ferry Maintenance Report – Queen of Alberni

Date: December 5, 2014

Arrival: 12:45PM sailing to Tsawassen. We signed in at terminal supervisor at Duke Point.

Reporter: Chris Sundstrom (Servicing), Akash Sastri (Science Analysis)

Attending Personnel: Chris Sundstrom (ONC-Operations), Akash Sastri (ONC-Science), Chuning Wang (UBC)

Reason for Visit

Regular instrument servicing + Calibration/comparison of Optode Instruments measurements

Observations

1. There was moisture and/or leaks In the Instrument Box. The overall impression of the moisture was that it primarily came from condensation, but smelling of the fluid indicated a low level of salinity, suggesting very small (drip-level) leaking as well.
2. The AADI optode was slightly dirty with some limited sediment/biofilm growth within the housing.
3. The BBFL2 had a partial layer of sediment in the housing and some minor fouling on the sensing surface. Fouling was noticed on the “bottom” surface of the horizontal housing.
4. The Seabird 45 CT sensor was mildly dirty, with no mussels found growing within the housing on the sensor outlet port.
5. The flex tubing was in good shape, having been replaced recently. ALL of the barb fittings were, however, installed incorrectly, potentially causing one or more small micro-leaks and risking blowout of the piping.
6. The sea chest showed no signs of leaks.
7. The inline filter (sea strainer) was checked and was found to be slightly dirty and required cleaning.
8. The leak sensor was incorrectly installed and incorrectly manufactured.

Actions Taken

1. Opened both boxes and observed function. The system was off upon arrival; reset the breaker (off-on) and the system started up cleanly. Unknown why the system turned itself off.
2. Powered down and disassembled instruments in lower assembly.
3. Cleaned and checked over instruments in Engineering room. Cleaned CT sensor connector to remove sediment and biofouling growth.
4. Ran pre- and post- calibration with standard solutions and with Orange test stick and blue test stick for CDOM fluorescence and Chl fluorescence.
5. Re-assembled the instruments in the lower box. ALL hose connections were re-done properly to assure no leakage occurs from this source. Replaced the leak sensor with a longer flexible unit and installed correctly.
6. Checked over Sea chest and valves, no leaks apparent.
7. Checked and cleaned the sea strainer. Removed biofilm and sediment fouling from the strainer.
8. Installed second OPTODE system in series with the permanent OPTODE. Attached water sampling tubing to the CT sensor sample tap.
9. Turned ON the system.
10. No leaks in instrument housing and checked flow output at sea strainer. Flow was good. Visually confirmed flow direction at the BBFL2 and confirmed the volume filled with water and began draining correctly.
11. Conducted water sampling and cross-correlated OPTODE data collection.
12. Turned OFF the system.
13. Removed secondary OPTODE system and re-plumbed the permanent OPTODE system correctly.
14. Turned ON the system.
15. Signed out at Engineering room.

Future Actions

1. Monitor growth of Mussels within the system. There were indications of possible mussel growth starting in the Sea Strainer system.
2. Educate all personnel as to proper installation procedures for leak sensor and hose clamps.

Discussion of Test Procedures and Results

The test procedures used are documented in the supplemental report, which also provides preliminary analysis of the data and its consequences.

PICTURES

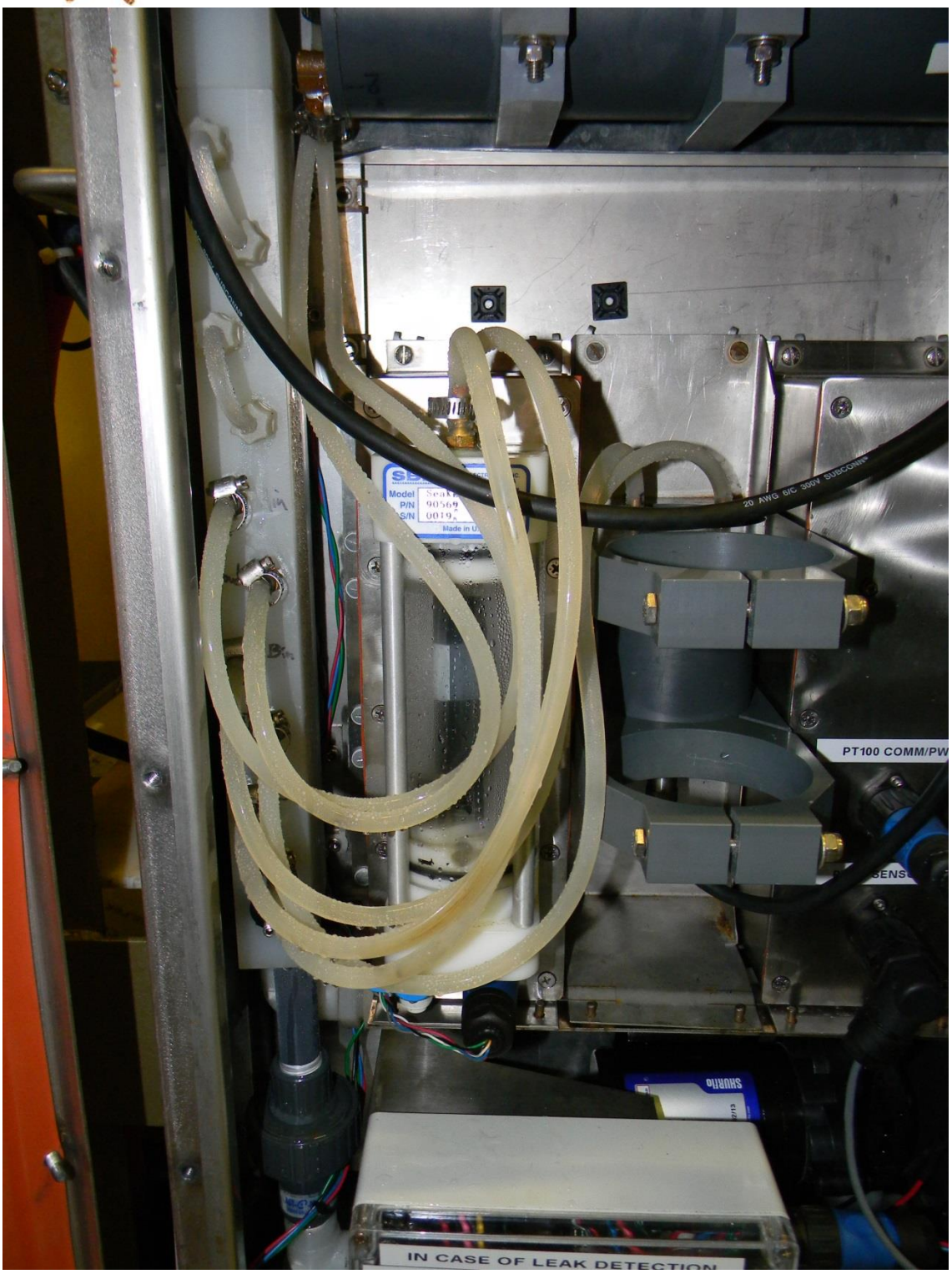

Figure 1: Evidence of leaks within the housing. Note how the water is primarily confined to the outside of tubing, or logical (gravity) drip locations.

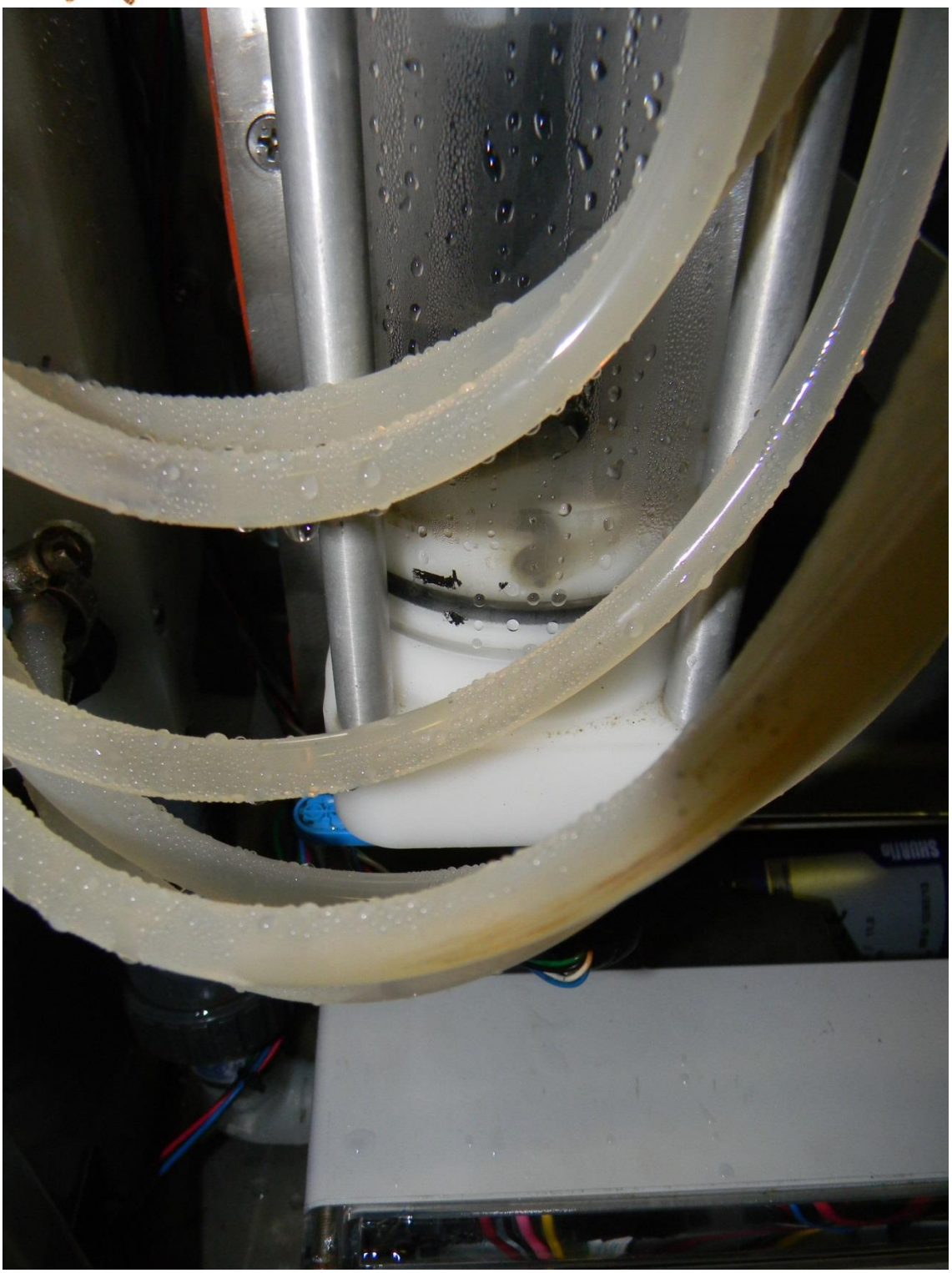

Figure 2: Close-up of water on tubing.

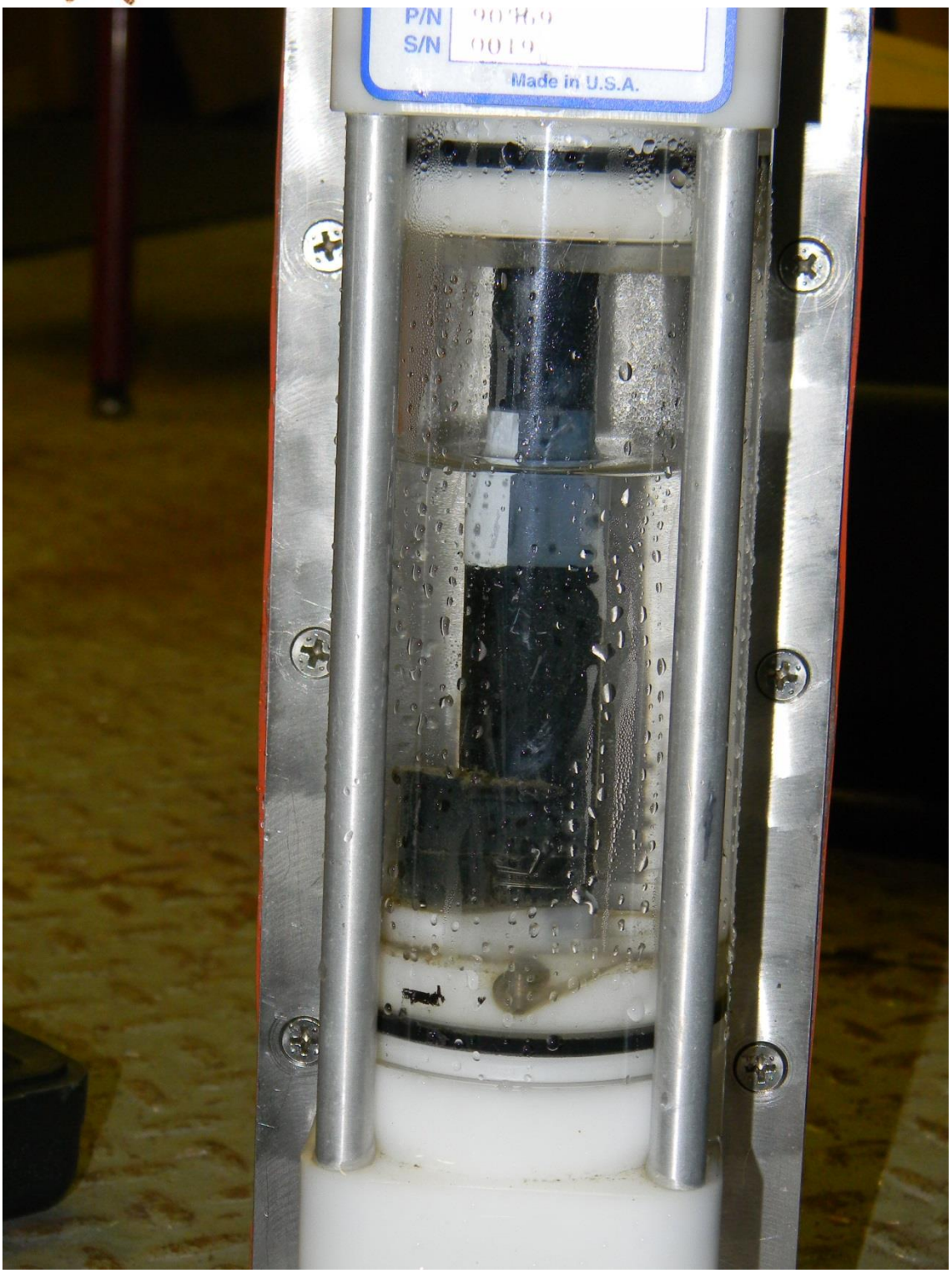

Figure 3: Fouling just starting to be apparent in the CT unit.

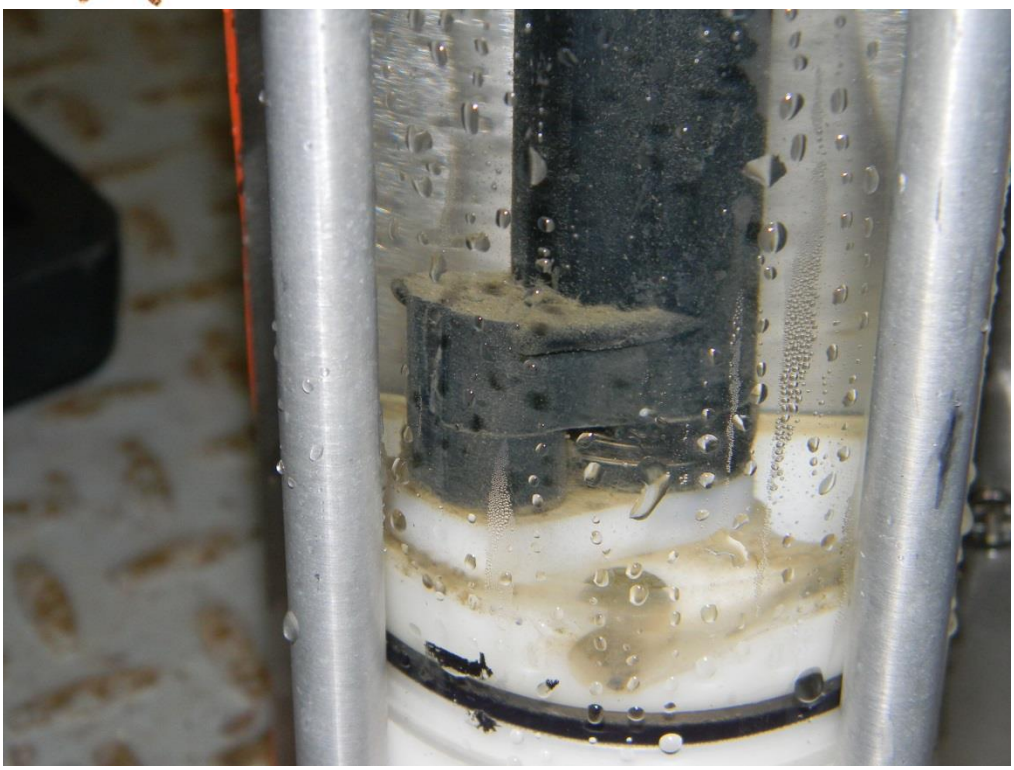

Figure 4: Fouling in the CT unit.

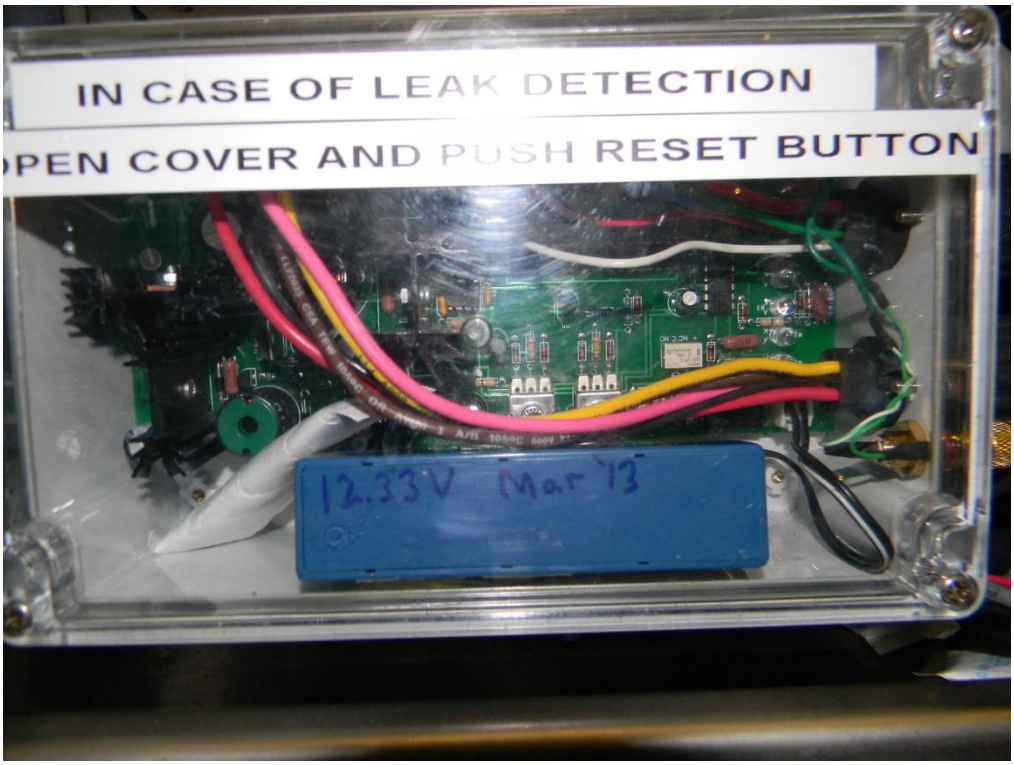

Figure 5: Note: pump was off upon arrival.

Figure 6: Correctly and incorrectly install hose clamps. The top clamp has been reinstalled correctly (set as close to the base of the barb as possible, snug without serious deformation of the rubber). The bottom clamp is set too far toward the end of the barb.

Figure 7: Some minor fouling and sediment within the OPTODE housing.

Figure 8: Sediment within the OPTODE housing.

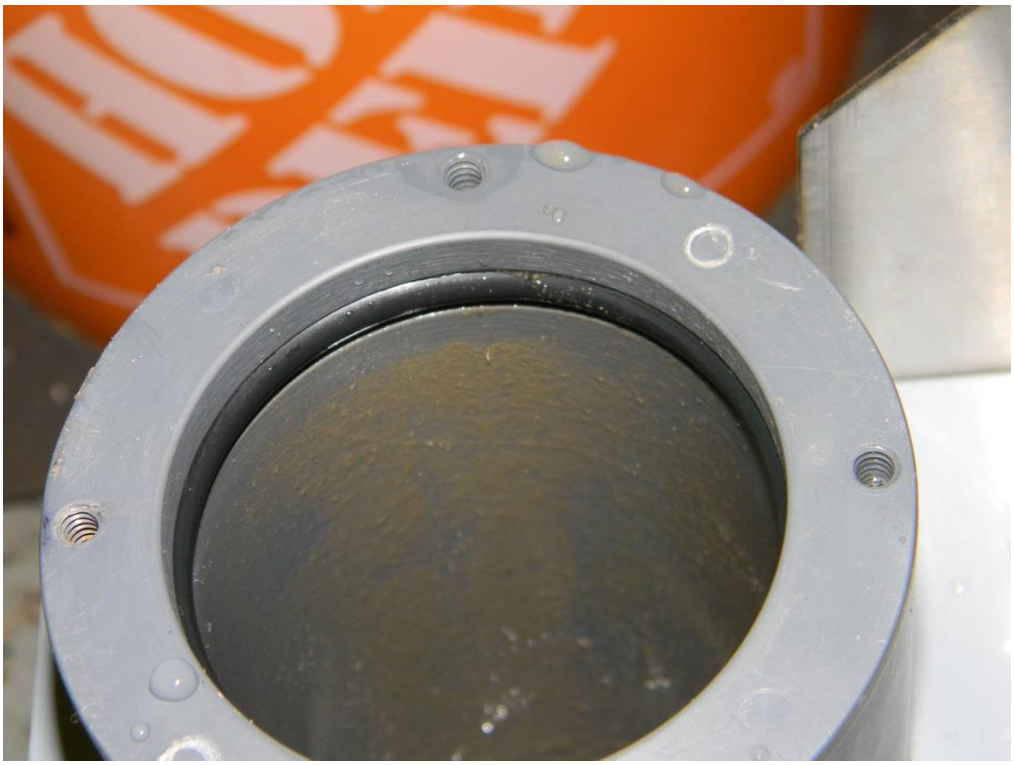

Figure 9: Sediment and fouling within the BBFL2 housing.

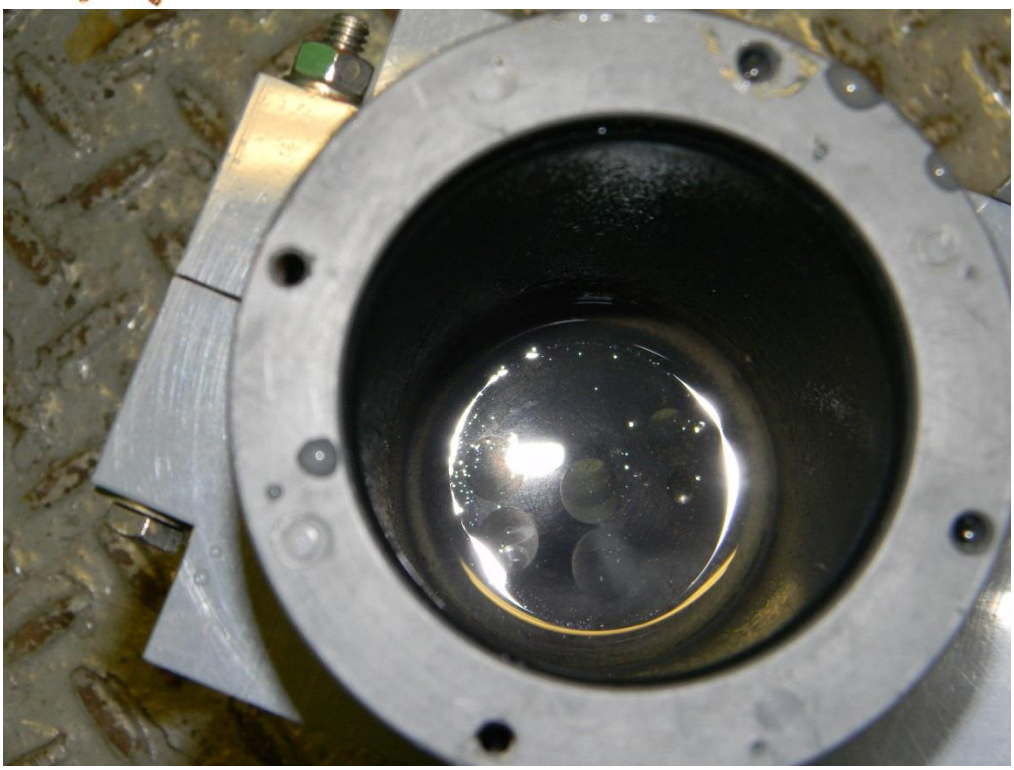

Figure 10: BBFL2 sensing face.

Figure 11: Interior of CT sensor.

Figure 12: Sea strainer.

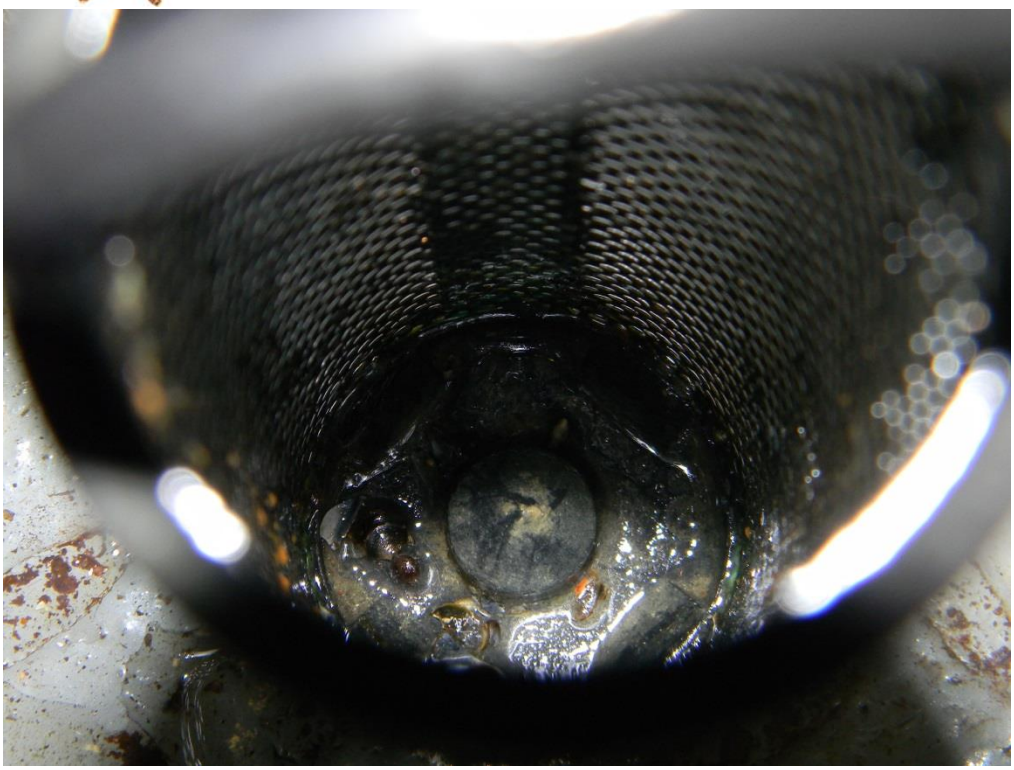

Figure 13: Sea Strainer interior.

Figure 14: Sea Strainer.

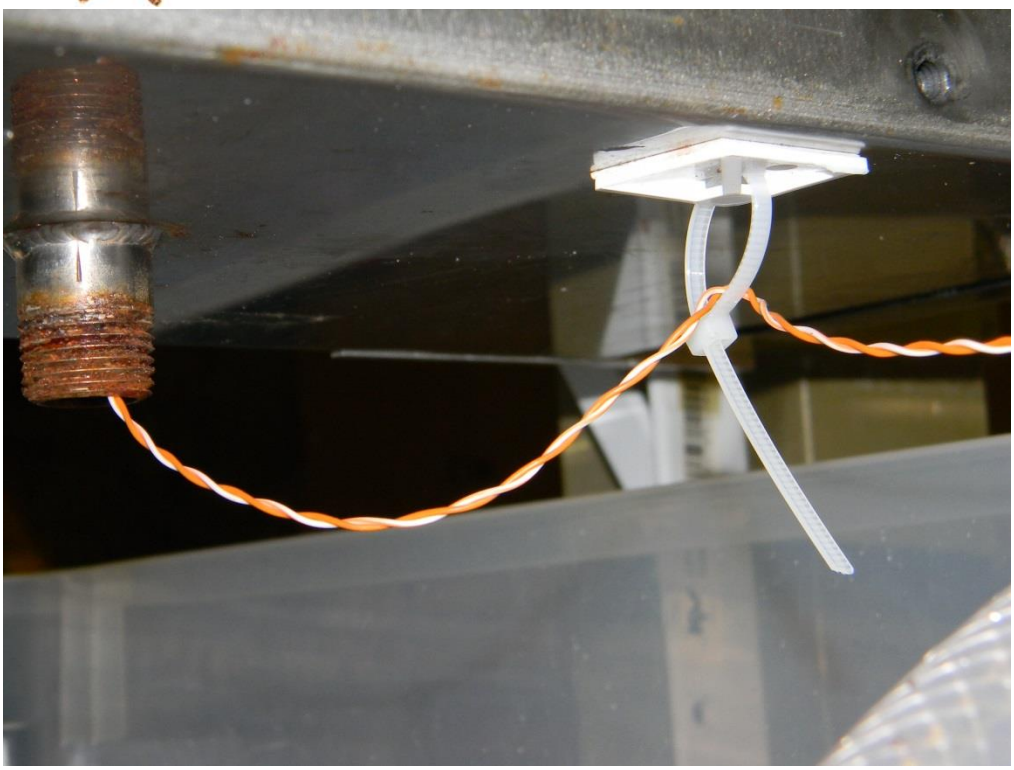

Figure 15: Correct installation of leak sensor. Note the drip loop before the sensor (which extends downward to right of image).

Figure 16: Temporary double-OPTODE and sample tube setup.

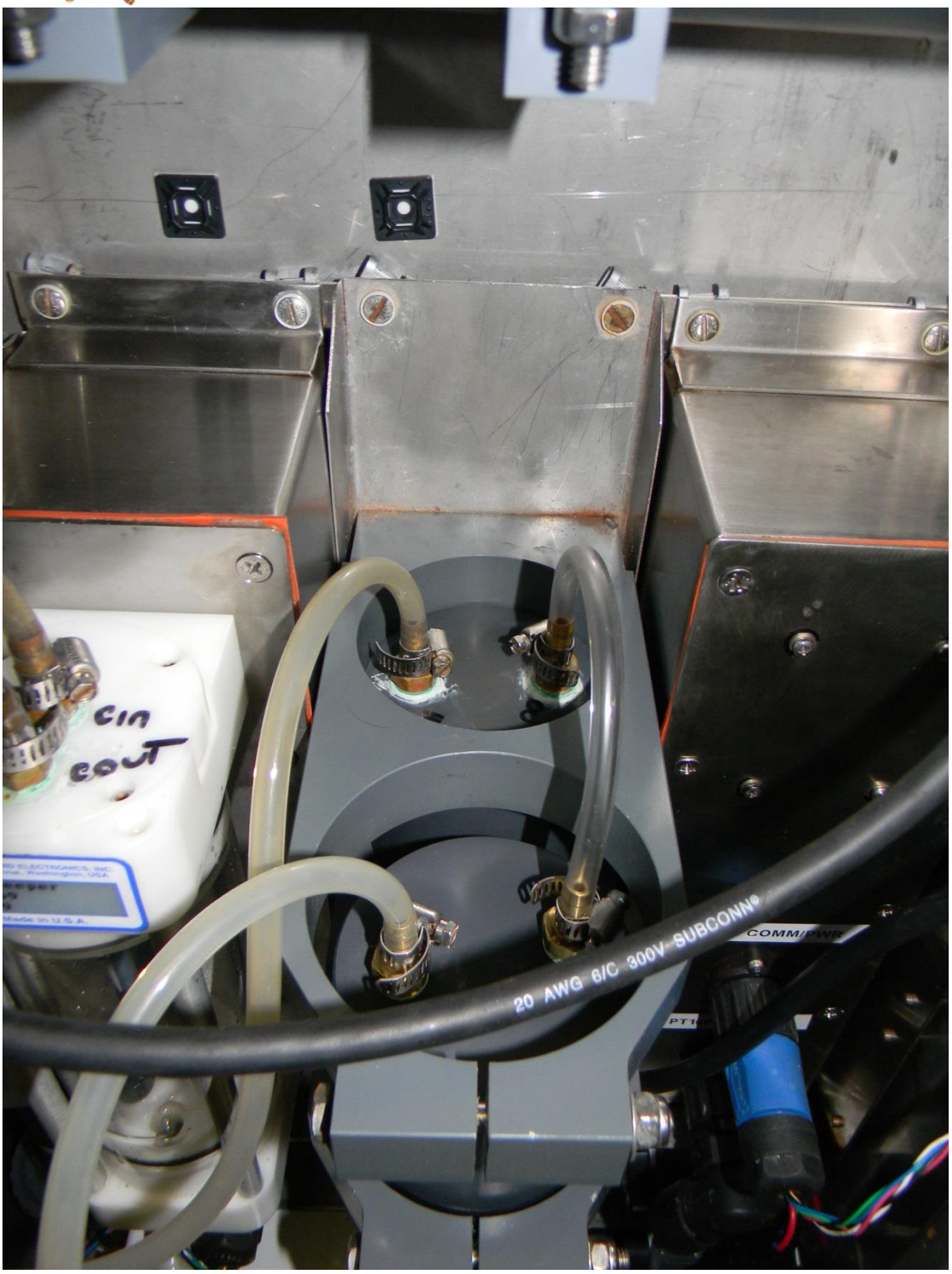

Figure 17: Double OPTODE setup.

Figure 18: Chuning Wang doing oxygen sampling.

Figure 19: Akash Sastri recording sample data.

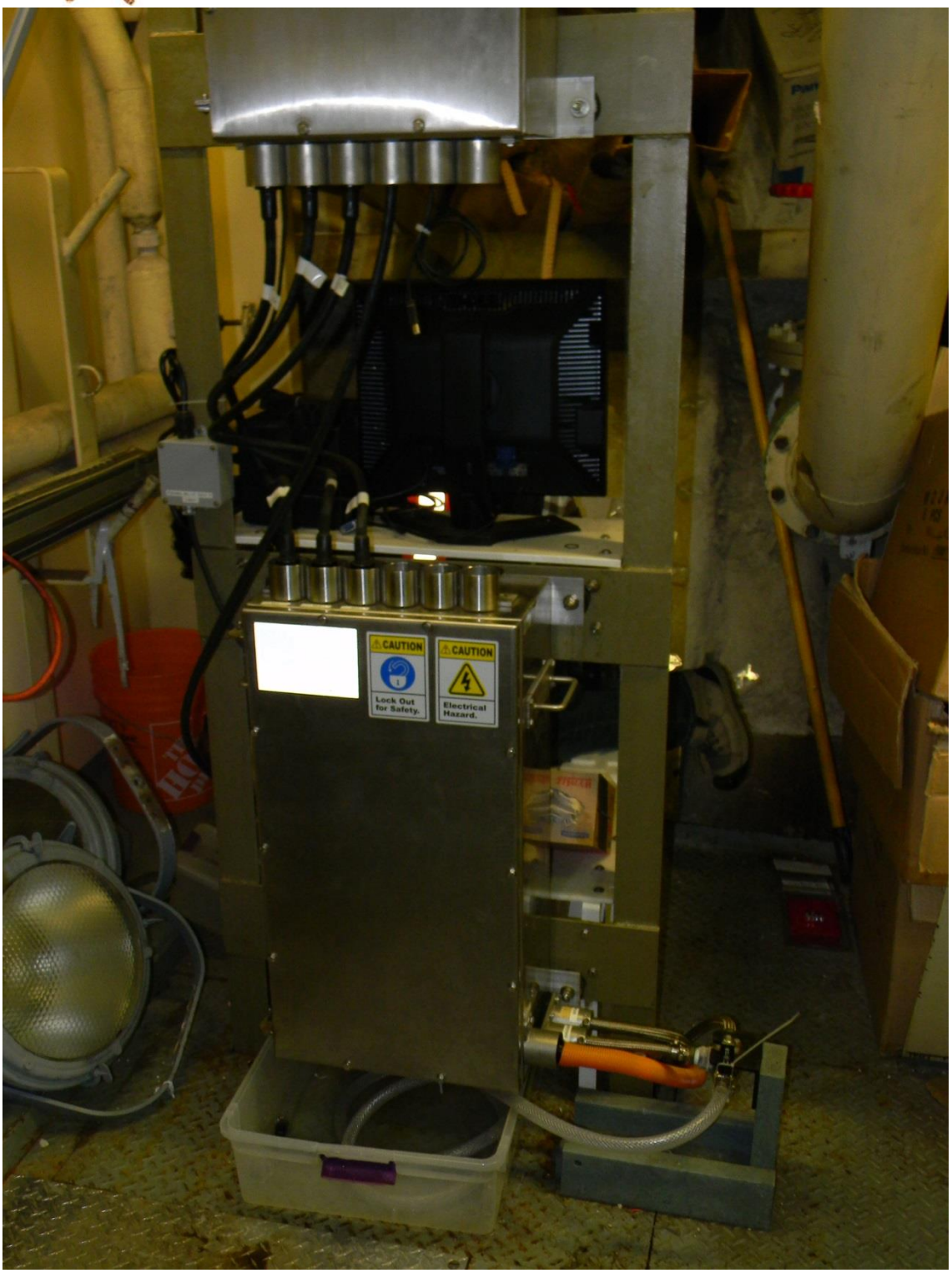

Figure 20: System upon completion.

In situ CDOM and Chlorophyll fluorescence (BBFL2) corrections
December 5, 2014

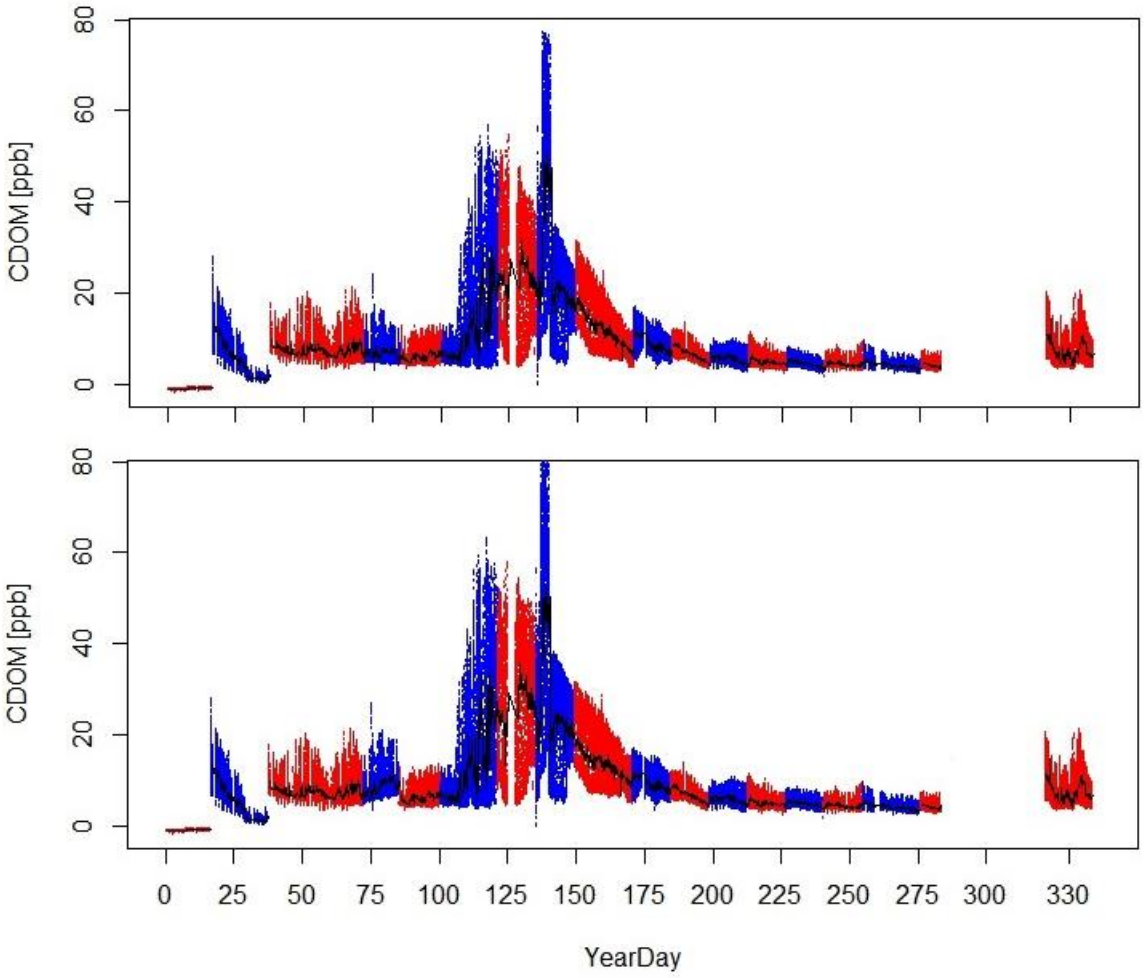

Figure 1. Time series of a) un-corrected; and b) corrected CDOM fluorescence measured en route between Duke Point (Vancouver Island) and Tsawwassen (Mainland, BC) by the BBFL2 unit of the SeaKeeper 1000 instrument suite on board the BC ferry, the Queen of Alberni. Red and blue symbols are used to distinguish between instrument cleaning dates. The difference between pre- and post-cleaning fluorescence of diluted tonic water was typically used to calculate a correction factor (%) which was applied as a linear correction retrospectively between cleaning dates. The most recent cleaning event took place on December 5, 2014. In keeping with most recent maintenance trips, we have used pre- and post- values for Sprite Zero (correction factor = ~ 2%; See Table 1.) rather than Tonic water, although the difference between pre- and post- fluorescence values for Tonic Water were also positive. The correction factor was applied retrospectively to CDOM fluorescence values (b) between October 4 and December 5, 2014. The Queen of Alberni was out of service between October 11 and November 17, 2014. Note: an instrument inter-calibration applied to all data following day 149 when BBFL2-786 was swapped out for BBFL2-787.

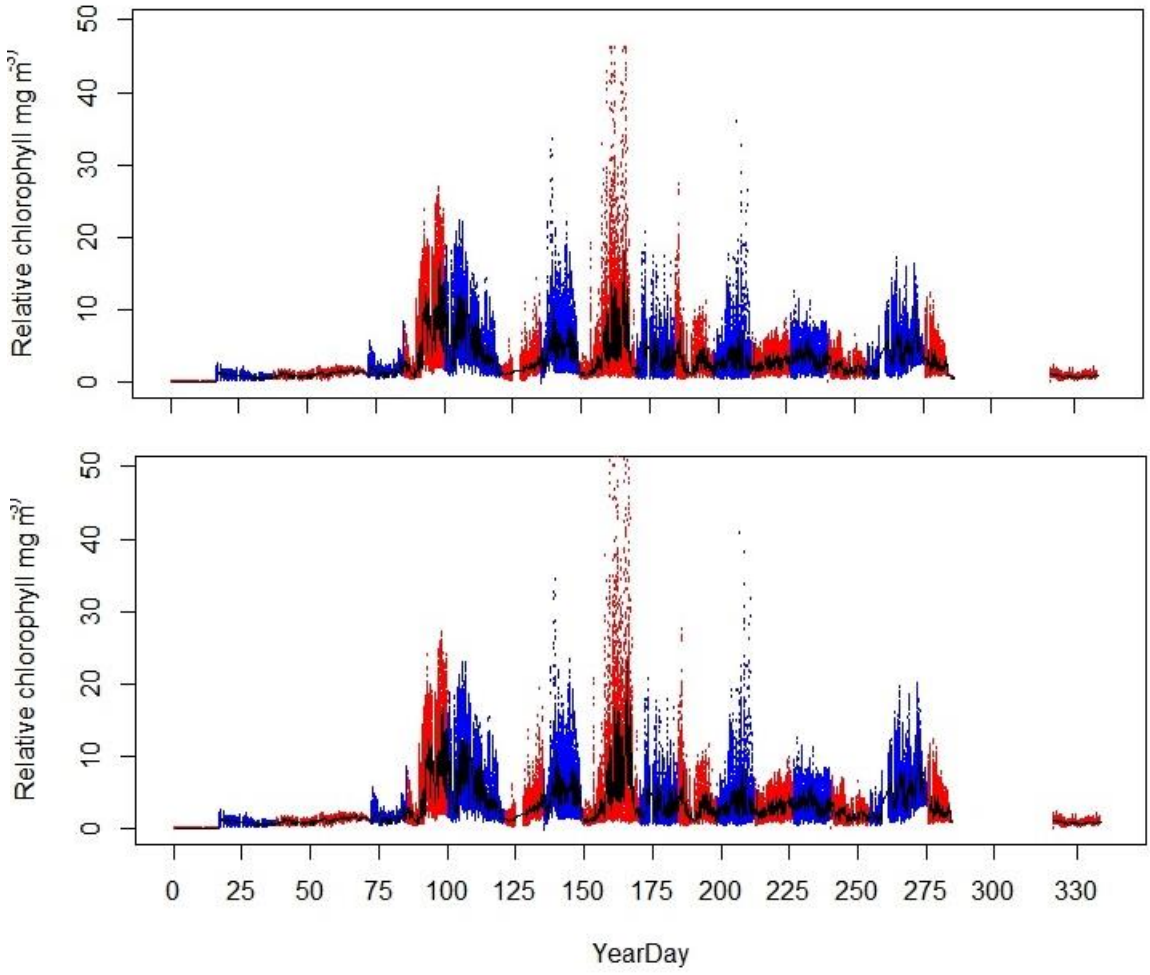

Figure 2. Time series of a) un-corrected; and b) corrected Chl fluorescence measured en route between Duke Point (Vancouver Island) and Tsawwassen (Mainland, BC) by the BBFL2 unit of the SeaKeeper 1000 instrument suite on board the BC ferry, the Queen of Alberni. Red and blue symbols are used to distinguish between instrument cleaning dates. The difference between pre- and post-cleaning fluorescence of diet coke was used to calculate a correction factor (%) which was applied as a linear correction retrospectively between cleaning dates. The most recent cleaning event took place on December 5, 2014. On this date we measured a positive (~2%) response of Diet Coke fluorescence to cleaning (see Table 1). This correction factor was applied retrospectively from October 4 through December 5, 2014. Note: an instrument inter-calibration applied to all data following day 149 when BBFL2-786 was swapped out for BBFL2-787.

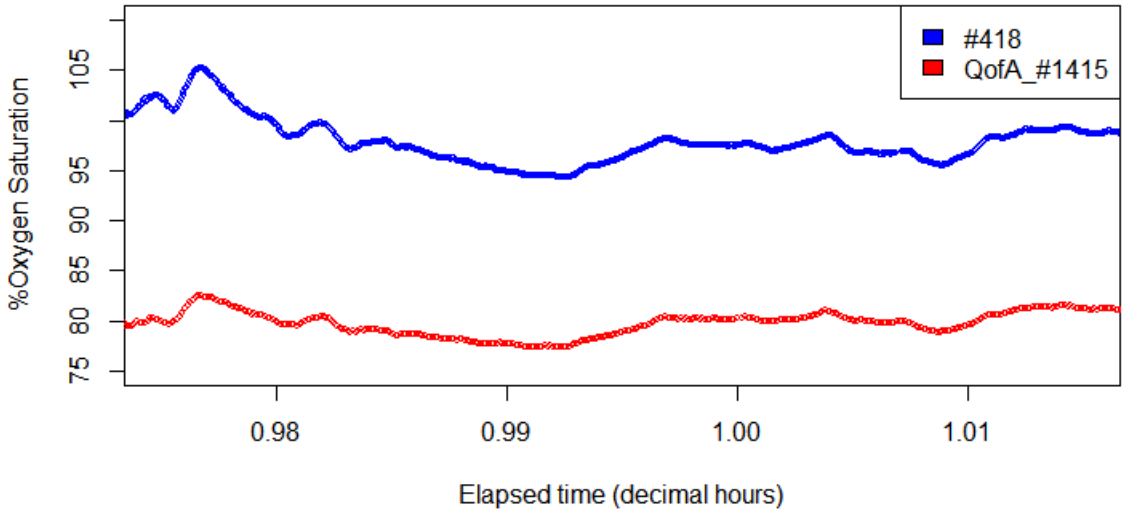

Figure 3. A suspected underestimation of oxygen saturation measured by the Queen of Alberni was identified by Chuning Wang (UBC) following his comparison of oxygen saturation values between the Queen of Alberni and Spirit of Vancouver Island, (October 3-11, 2014) in the vicinity of Tsawwassen. This figure represents a preliminary assessment of this potential under-estimate. The red symbols represent O_2 saturation values measured en route departing from Tsawwassen at ~15:15 on December 5, 2014. A second optode (Aanderra #418) calibrated in the lab (2-point zero/saturated) was placed in line (see photos above) with the resident instrument (#1415). Blue symbols represent #418 measurements. Note; no corrections for salinity have been made here (i.e. optode #418 calibrated assuming salinity of 0); nevertheless, both optodes capture a very similar spatial-temporal pattern with a significant offset indicating instrument #1415 is significantly underestimating. Chuning Wang also collected discrete water samples for Winkler titrations alongside these optode measurements and will present a more detailed comparison shortly.

Table 1. December 5, 2014. Mean (±standard error) values of pre- and post-cleaning fluorescence for solutions/fluorescent sticks specific to CDOM and Chlorophyll fluorescence. '□ fluor' values for Diet Coke (Chl) and diluted tonic water or Sprite Zero (CDOM) have been used at every cleaning since March 14, 2014 to assess the degree of signal decay between cleanings. The post-cleaning fluorescence values for the pink and blue sticks were lower than pre- values, yielding a negative response to cleaning. All other (solution-based) measurements yielded positive responses to cleaning; however moderate, suggesting minimal biofouling since the last cleaning which took place during a complete system maintenance on November 4-5, 2014.

CDOM/Chl Fluorescence	Method	Pre- (mean± SEM)	Post- (mean± SEM)	Δ fluor (%)
CDOM	Diluted tonic water	164.13± 0.05	179.80± 0.02	0.09
CDOM	Sprite Zero	47.28± 0.02	48.37± 0.02	0.02
CDOM	Blue fluorescent stick	71.38± 0.02	48.12± 0.06	-0.48
Chl	Diet Coke	5.80±0.005	5.91±0.001	0.02
Chl	Pink fluorescent stick	6.26±0.001	4.27±0.002	-0.47