

Evaluation and Correction of SATURN-03 Dissolved Oxygen (DO) Measurements (4/19/19 – 7/13/20)

Background:

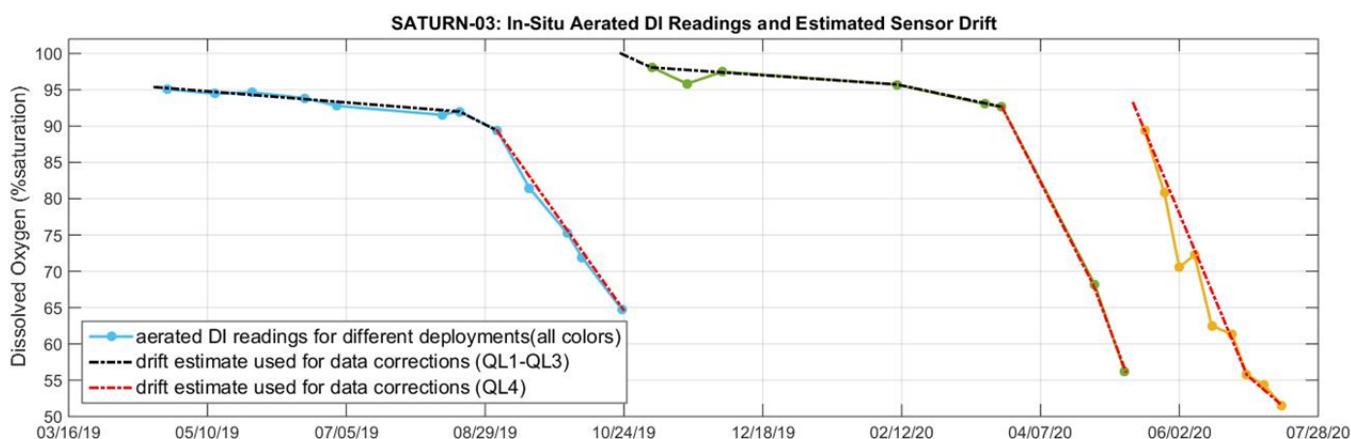
The dissolved oxygen sensors deployed at SATURN-03 are evaluated with measurements of 100% aerated deionized (DI) water prior to deployment. In addition, aerated DI is transported to the station and is pumped through the system on a regular basis to monitor the performance, fouling and or drift of the sensor *in situ*.

Data Evaluation & Correction Details:

The following sensors were deployed during this time period:

- **SBE43 #2274:** 4/19/19 – 10/23/19
- **SBE43 #2310:** 10/23/19 – 5/15/20
- **SBE43 #1166:** 5/15/20 – 7/13/20

In situ DI readings (table of data included at the end):



The aerated DI readings shown in the plot above indicate that for the deployments of sensors #2274 (light blue) and #2310 (green) the sensors drifted slowly for 4-6 months before the onset of rapid drift/fouling. However, for unknown reasons and unlike most deployments, sensor #1166 (yellow) deployed in May 2020 began failing from the point of deployment. Corrections were applied to all of the dissolved oxygen data based on these *in-situ* DI water readings with the assumption of linear drift (as indicated by the dashed lines). For the periods of accelerated drift (red dashed lines), the data have been flagged as poor (QL4) and should be used with caution and only for potential qualitative analyses.

Correction Calculations:

The correction factor (CF) is an adjustment to the Soc term of the sensor calibration and is an adjustment to the slope of the calibration rather than offset. In simplified terms, the CF is calculated as the ratio of the known good reading (in this case 100%) to the observed reading :

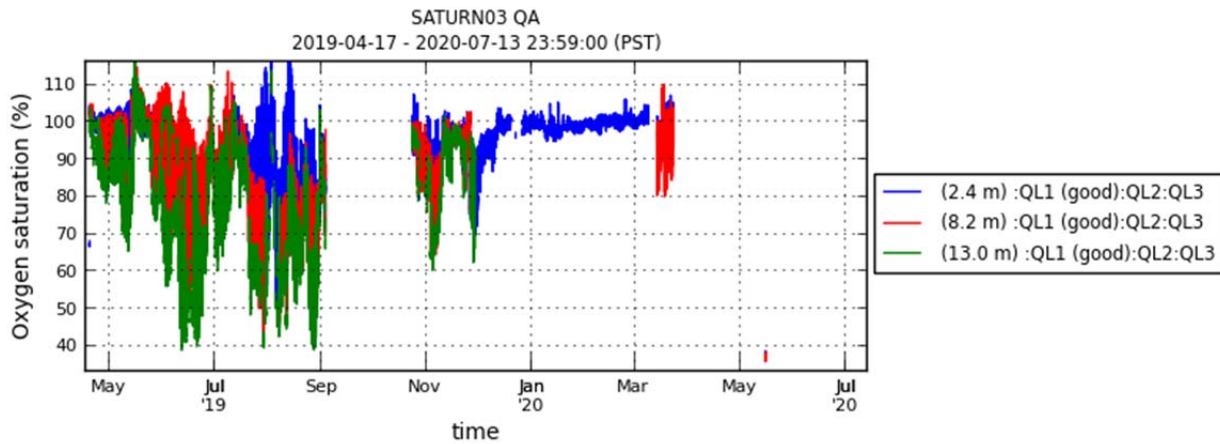
$$CF = 100\% / (\text{reading in } 100\% \text{ aerated DI}) ; \quad \text{Corrected data} = \text{raw data} * CF.$$

*See SBE application note 64-2, June 2012 revision for more information

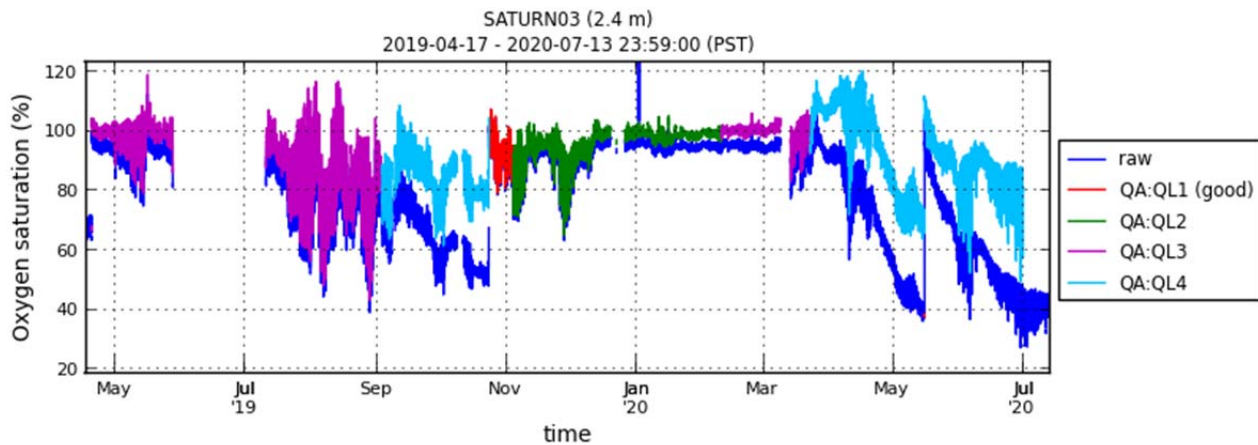
Based on the DI data, the following corrections were applied to the dissolved oxygen data:

Correction Start	Correction End	Starting % Drift	Ending % Drift	Starting CF	Ending CF	Quality Level
4/19/19 12:00	8/19/19 10:30	4.7	8.0	1.049	1.087	QL3
8/19/19 10:30	9/3/19 10:00	8.0	10.6	1.087	1.119	QL3
9/3/19 10:00	10/7/19 0:00	10.6	28.0	1.119	1.389	QL4
9/3/19 10:00	10/23/19 13:15	10.6	35.3	1.119	1.546	QL4
10/23/19 13:15	11/4/19 0:00	0.0	1.9	1	1.0196	QL1
11/4/19 0:00	2/10/20 0:00	1.9	4.3	1.0196	1.045	QL2
2/10/20 0:00	3/23/20 0:00	4.3	7.3	1.045	1.079	QL3
3/23/20 0:00	4/29/20 12:40	7.3	31.8	1.079	1.466	QL4
4/29/20 12:40	5/15/20 15:00	31.8	43.8	1.466	1.779	QL4
5/15/20 15:00	6/29/20 0:00	6.9	44.3	1.074	1.795	QL4
6/29/20 0:00	7/13/20 0:00	44.3	48.5	1.795	1.94	QL4

The following figure shows the resulting corrected data for quality levels QL1-QL3 as plotted by the CMOP data explorer (http://www.stccmop.org/datamart/observation_network/dataexplorer/):



This plot shows the raw and corrected near-surface level data, with the different quality levels (including the QL4 data) plotted in different colors



Station DI readings

SATURN-03 on-station aerated DI readings							
Date	DO (%sat)		Date	DO (%sat)		Date	DO (%sat)
4/24/2019	95.08		11/4/2019	98.08		5/19/2020	89.37
5/13/2019	94.45		11/18/2019	95.83		5/27/2020	80.78
5/28/2019	94.66		12/2/2019	97.47		6/2/2020	70.53
6/18/2019	93.84		2/10/2020	95.73		6/8/2020	72.27
7/1/2019	92.79		3/16/2020	93.05		6/15/2020	62.49
8/12/2019	91.55		3/23/2020	92.65		6/23/2020	61.31
8/19/2019	92.01		4/29/2020	68.19		6/29/2020	55.73
9/3/2019	89.39		5/11/2020	56.17		7/6/2020	54.29
9/16/2019	81.44		sensor replacement			7/13/2020	51.55
10/1/2019	75.28					sensor replacement	
10/7/2019	71.91						
10/23/2019	64.71						
sensor replacement							