RV *INVESTIGATOR*

HYDROCHEMISTRY DATA PROCESS REPORT

Voyage:	IN2016_v05
Chief Scientist:	Zoran Ristovski
Voyage title:	The Great Barrier Reef as a significant source of climatically relevant aerosol particles
Report compiled by:	Kendall Sherrin and Cassie Schwanger

Contents

1 Itinerary

Depart Leg	Date	Time
Brisbane	28 September 2016	1000
Arrive	Date	Time
Brisbane	24 October 2016	1500

2 Key personnel list

Name	Role	Organisation
Zoran Ristovski	Chief Scientist	QUT
Lisa Woodward	Voyage Manager	CSIRO
Kendall Sherrin	Hydrochemist	CSIRO
Cassie Schwanger	Hydrochemist	CSIRO

3 Summary

All finalized data can be obtained from the CSIRO data centre. RMNS corrected nutrient data will be provided at a later date to the data centre.

3.1 Hydrochemistry

Analysis parameter	Total	Processing Status at voyage end
Nutrients (Seal AA3)	460 CTD 29 uwy 84 exp	Completed
Salinity (Guildline salinometer)	201 CTD	Completed
Dissolved Oxygen	206 CTD	Completed

Note: CTD-samples collected from NISKIN bottles on CTD rosette, UWY-underway samples collected from underway seawater intake and EXP-experimental samples.

3.2 Rosette and CTD

- 62 CTD stations were sampled with a 24 bottle rosette (12 L).
- The following deployments were not sampled for hydrochemistry: 9, 10, 15.
- See in2016_v05_HYD_VoyageReport.pdf (voyage report) for more details on sample collection.

3.3 Procedure Summary

The procedure for data processing is outline in Figure 1.

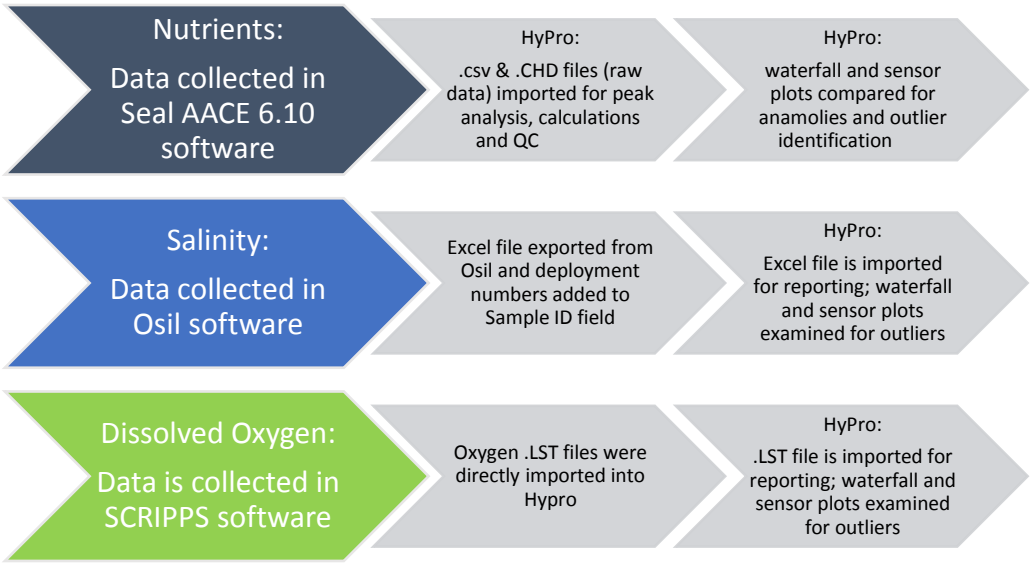


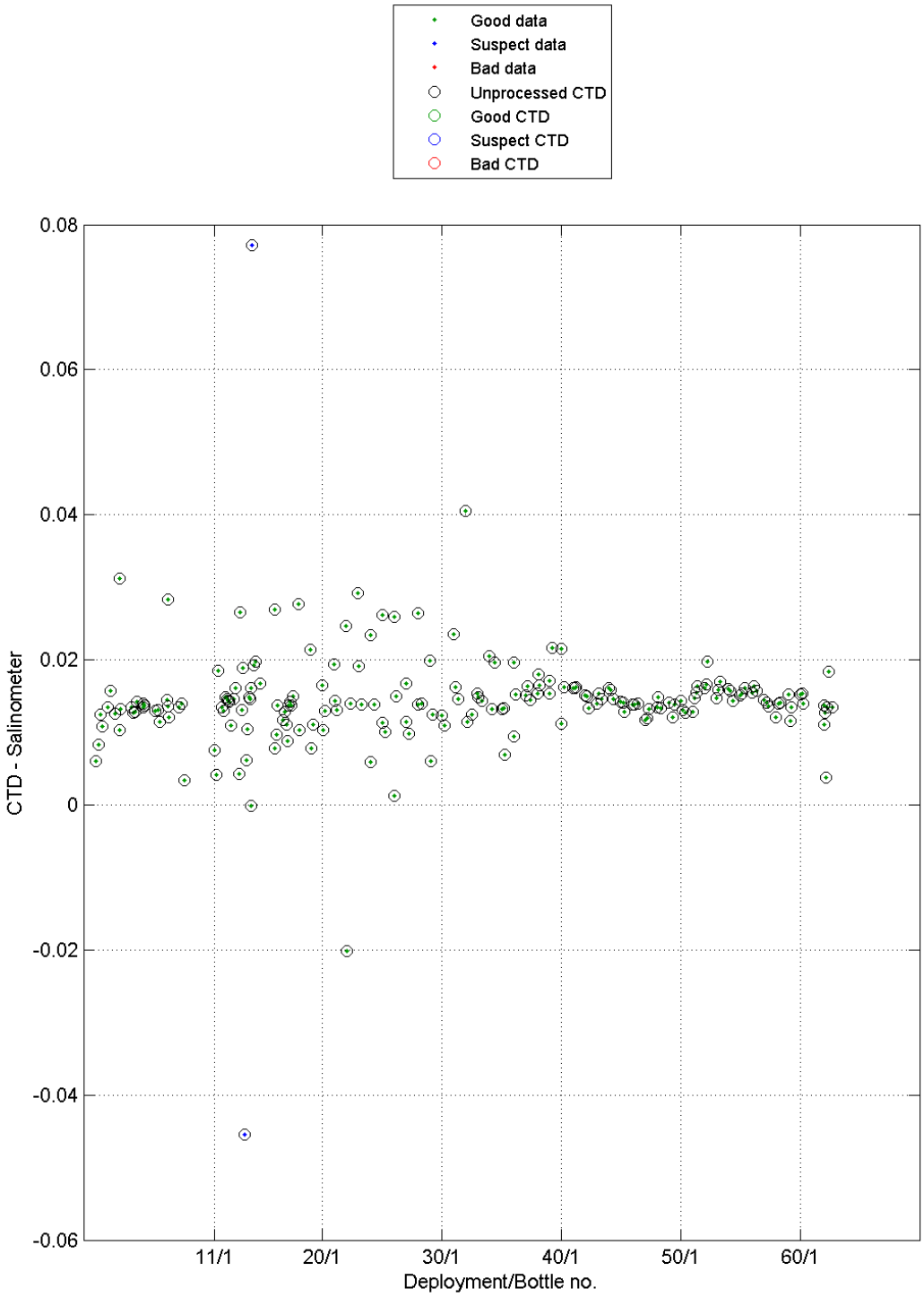
Figure 1: The process above shows the data trail procedure from the initial data generated to output via HyPro for reporting.

4 Salinity Data Processing

4.1 Salinity Parameter Summary

Details	
HyPro Version	4.14
Instrument	Guildline Autosal Laboratory Salinometer 8400(B) – SN 71611
Software	OSIL Data Logger
Methods	Hydrochemistry Operations Manual + Quick Reference Manual
Accuracy	± 0.001 salinity units
Analyst(s)	Kendall Sherrin
Lab Temperature (±0.5°C)	20.0 -23.5°C during analysis.
Bath Temperature	23.996°C
Reference Material	Osil IAPSO - Batch P158
Sampling Container type	200 ml volume OSIL bottles made of type II glass (clear) with disposable plastic insert and plastic screw cap.
Sample Storage	Samples held in Salt Room for 7-8 hrs to reach 22°C before analysis
Comments	Instrument 71611 running fine.

4.2 CTD vs Hydro Salinities Plot



4.3 Missing or Suspect Salinity Data and Actions taken

Data is flagged based on notes from CTD sampling log sheet, observations during analysis, and examination of depth profile and waterfall plots.

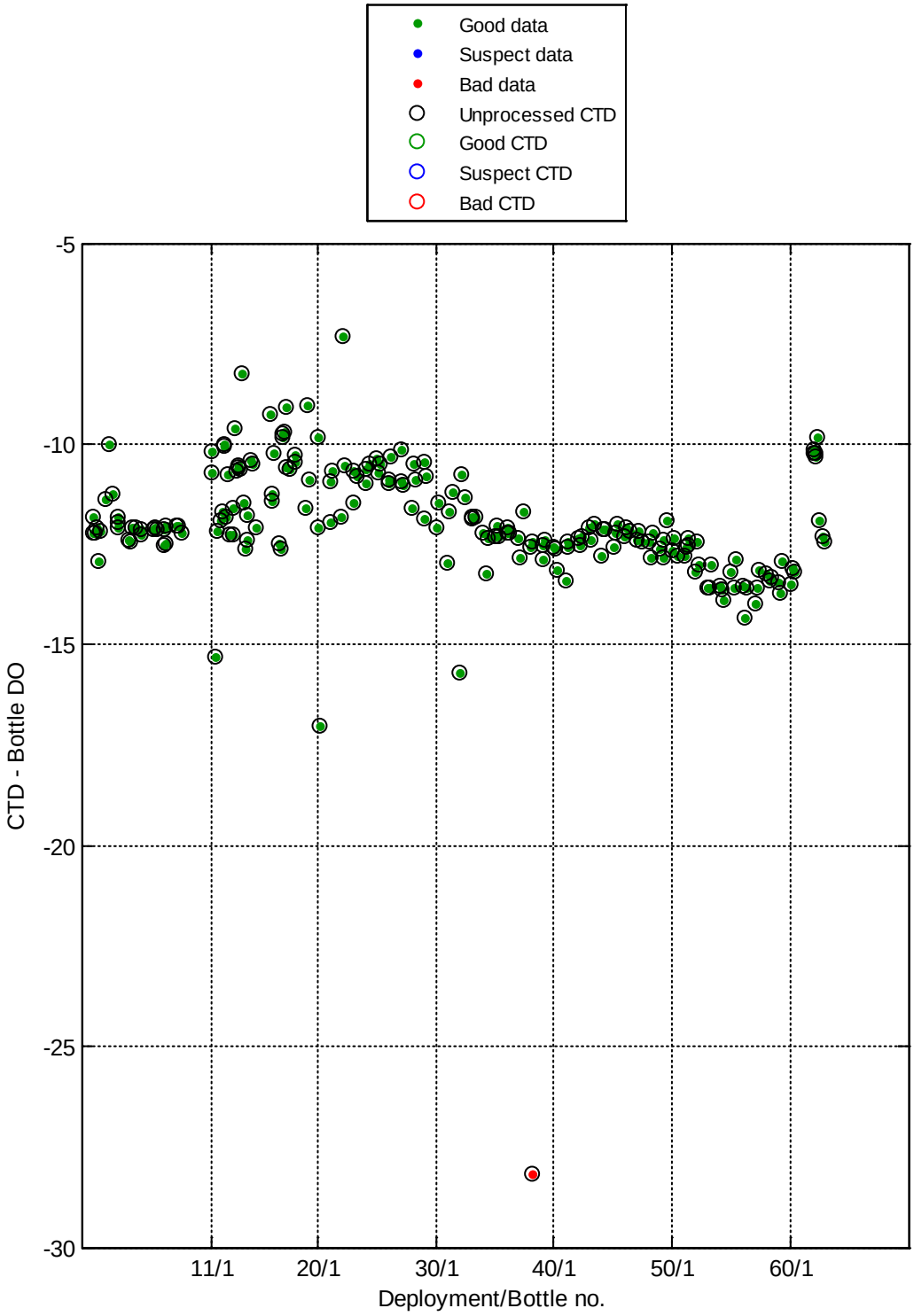
CTD	RP	Bottle	Flag	Reason for Flag or Action
13	12	H05	0	Possible sampling error
14	03	H13	0	Possible sampling error

5 Dissolved Oxygen Data Processing

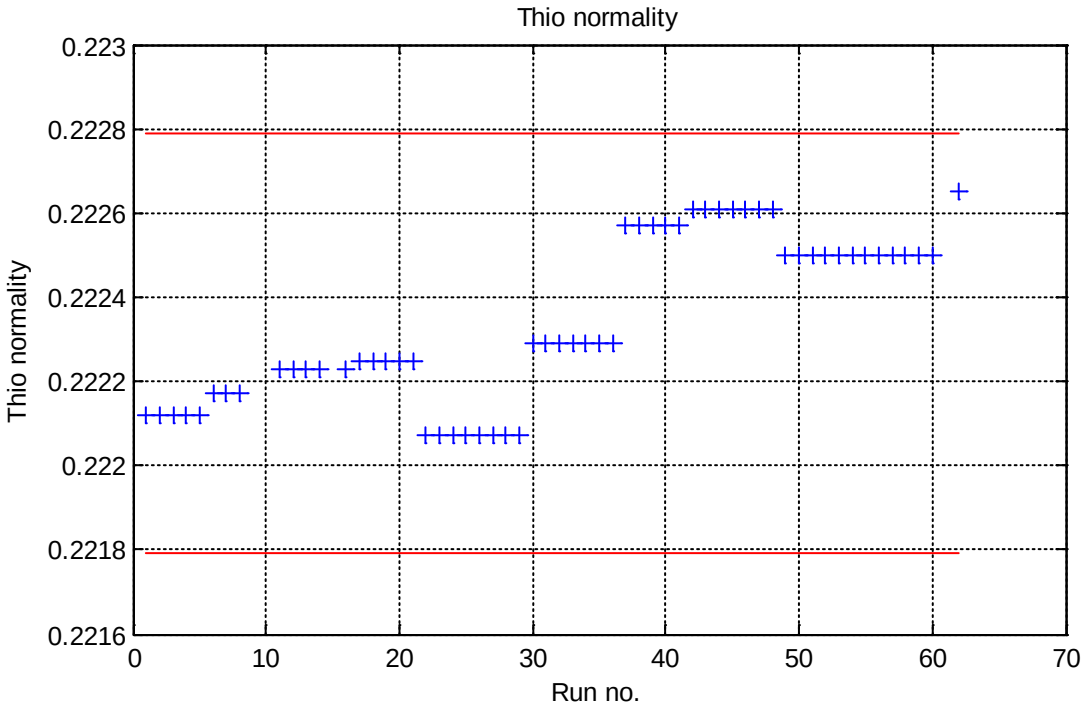
5.1 Dissolved Oxygen Parameter Summary

Details	
HyPro Version	4.14
Instrument	Automated Photometric Oxygen system
Software	SCRIPPS
Methods	SCRIPPS
Accuracy	0.01 ml/L + 0.5%
Analyst(s)	Cassie Schwanger
Lab Temperature (±1°C)	Variable, 20.0 - 24.5°C
Sample Container type	Pre-numbered glass 140 mL glass vial w/stopper, sorted into 18 per box and boxes labelled A to S.
Sample Storage	Samples were stored within Hydrochemistry lab under the forward starboard side bench until analysis. All samples were analysed within ~48 hrs
Comments	All data recorded; no issues encountered during voyage.

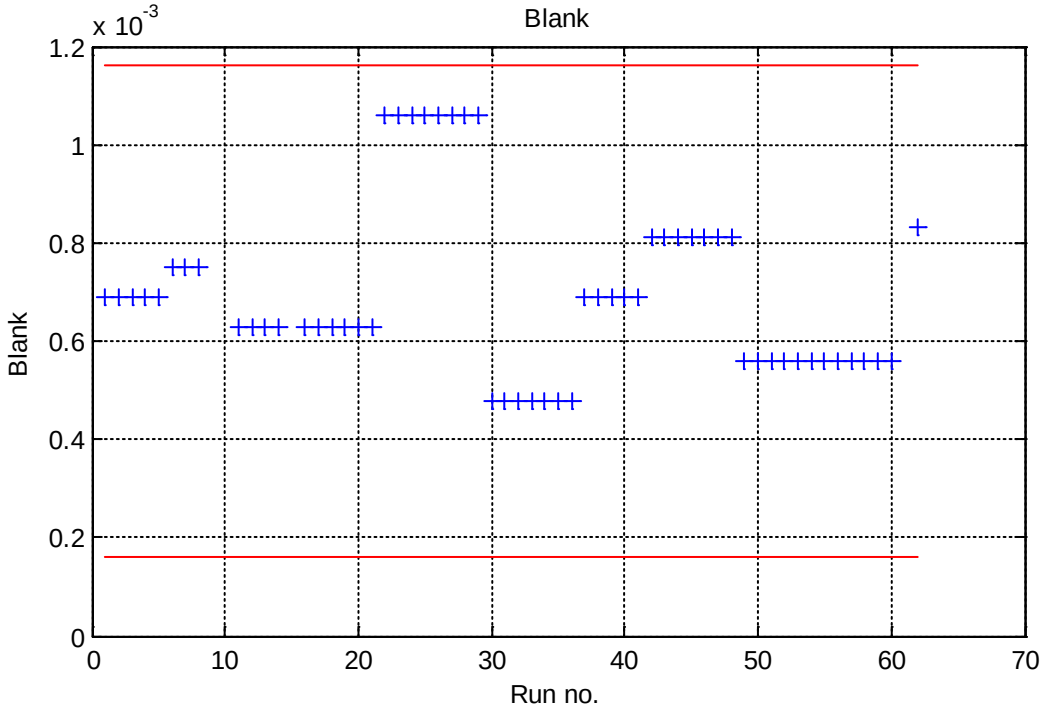
5.2 CTD vs Hydro DO Plot



5.3 Dissolved Oxygen thiosulphate normality across voyage



5.4 Dissolved Oxygen blank concentration across voyage



5.5 Missing or Suspect Dissolved Oxygen Data and Actions taken

Data is flagged as Good, Suspect or Bad in Hypro based on notes from CTD sampling log sheet, observations during analysis, and examination of depth profile and waterfall plots.

CTD	RP	Run	Analysis	Flag	Reason for Flag or Action
14	1 & 2	Oxy014	DO	141	The flask lids not matching - swapped when sampled; samples not analysed
38	5	Oxy038	DO	133	Bubble in sample – check data in hypro

6 Nutrient Data Processing

6.1 Nutrient Parameter Summary

Details					
HyPro Version	4.14				
Instrument	AA3				
Software	Seal AACE 6.10				
Methods	AA3 Analysis Methods internal manual				
Nutrients analysed	☒ Silicate	☒ Phosphate	☒ Nitrate + Nitrite	☒ Nitrite	☒ Ammonia
Concentration range	112 µmol l^{-1}	3 µmol l^{-1}	36.4 µmol l^{-1}	1.4 µmol l^{-1}	2.0 µmol l^{-1}
Method Detection Limit* (MDL)	0.2 µmol l^{-1}	0.02 µmol l^{-1}	0.02 µmol l^{-1}	0.02 µmol l^{-1}	0.02 µmol l^{-1}
Matrix Corrections	N	N	N	N	N
Analyst(s)					
Lab Temperature (±1°C)	Variable/spikes, 20.0 – 24.5°C				
Reference Material	RMNS – CD (primary); CA				
Sampling Container type	50 ml HDPE bottles (CTD, UWY & EXP)				
Sample Storage	< 2 hrs at room temperature or ≤ 12 hrs @ 4°C				
Pre-processing of Samples	None				
Comments	Non-CTD related samples were analysed and processed with the prefix-uwy and exp. EXP and UWY samples were measured within a ~12 hour period of sample collection. All UWY and EXP samples were logged into ELOG.				

6.2 Nutrient calibration and data parameter summary

During the course of the voyage all run parameters were recorded - LNSW batch, new cadmium column, new stock standard, daily standard information, fresh reagent batch information, instrumentation settings, pump tube changes and pump tube hours. This information and is available upon request.

Experimental and underway sampling information is contained within the ELog file found in the local_docs folder.

The raw data is imported into Hypro for peak determination. For each analysis run (indicated by a NUT###), HyPro fits the best calibration curve to the standards by performing several passes over each standard point. If the measured value is different from the calculated value it will allocate less weighting to the point in the calibration curve. HyPro will mark these points as suspect or bad within the calibration curve. Following standard procedures, the operator may choose to remove bad calibration points by placing a # in front of the peak start column within the data file (see section 6.6 for edited data). Below are the standard corrections and settings that Hypro applies to the raw data.

Result Details	Silicate	Phosphate	Nitrate + Nitrite	Nitrite	Ammonia
Data Reported as	µmol l^{-1}	µmol l^{-1}	µmol l^{-1}	µmol l^{-1}	µmol l^{-1}
Calibration Curve degree	Linear	Linear	Quadratic	Quadratic	Quadratic
Forced through zero?	N	N	N	N	N
# of points in Calibration	6	6	6	6	6
Matrix Correction	N	N	N	N	N
Blank Correction	N	N	N	N	N
Carryover Correction (Hypro)	Y	Y	Y	Y	Y
Baseline Correction (Hypro)	Y	Y	Y	Y	Y
Drift Correction (Hypro)	Y	Y	Y	Y	Y
Data Adj for RMNS	N	N	N	N	N
Window Defined*	HyPro	HyPro	HyPro	HyPro	HyPro
Medium of Standards	LNSW (bulk on deck of Investigator) collected on 28/09/2016. Four 15 L carboys were filtered with 10 micron filter and stored in the hydrochemistry laboratory at 21°C.				
Medium of Baseline	18.2 Ω MQ				
Proportion of samples in duplicate?	1 duplicate for each CTD from NISKIN bottle 1				
Comments	Calibration and QC data that was edited or removed is located in the table in section 6.6. The reported data is not corrected to the RMNS. Per run RMNS data can be found in Appendix 7.4.				

6.3 Accuracy - Reference Material for Nutrient in Seawater (RMNS) Plots

The certified reference materials (CRM) for silicate, phosphate, nitrate and nitrite in seawater produced by KANSO – Japan was used in each nutrient analysis to ensure the accuracy of results. The RMNS was run 4 times after the calibration standards. No QC data is supplied for the experimental ammonia samples as there is not a CRM. Accuracy is determined by comparing the new standard batch with the old and tracking to ensure the concentration is within 1% accuracy between batches.

The RMNS Lot CD was analysed during every run. RMNS Lot CA was ran weekly throughout the voyage. RMNS results were converted from µ mol/kg to µ mol l^{-1} at 21°C in the following table.

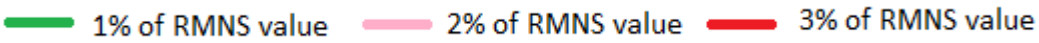
Table 1: RMNS CA and CD concentrations (µM) at 21°C

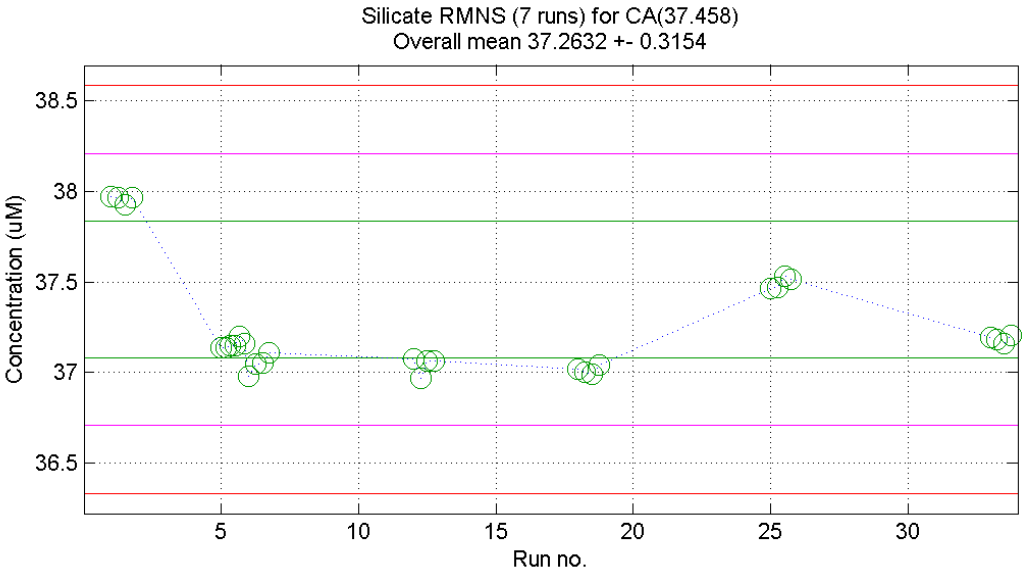
RMNS	NO_3	NO_X	NO_2	PO_4	SiO_4
CA	20.13	20.20	0.065	1.44	37.46
CD	5.63	5.65	0.018	0.457	14.26

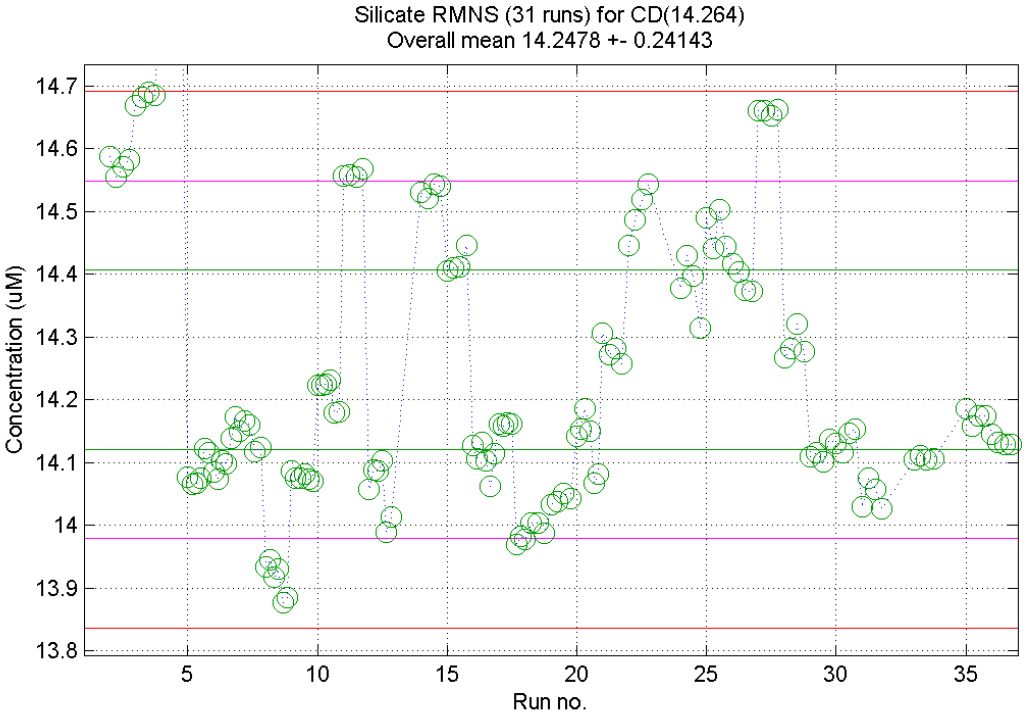
The submitted nutrient results do NOT have RMNS corrections applied.

The following plots show RMNS values within 1% (green lines), 2% (pink lines) and 3% (red lines) of the published RMNS value except for nitrite. The nitrite limit is set to ±0.020 µM (MDL) as 1% is below the method MDL. The GO-SHIP criteria (Hyde *et al*., 2010), reference section 7.3, specifies using 1-3 % of full scale (depending on the nutrient) as acceptable limits of accuracy. The calculated RMNS values per CTD are reported in the table in section 7.4.

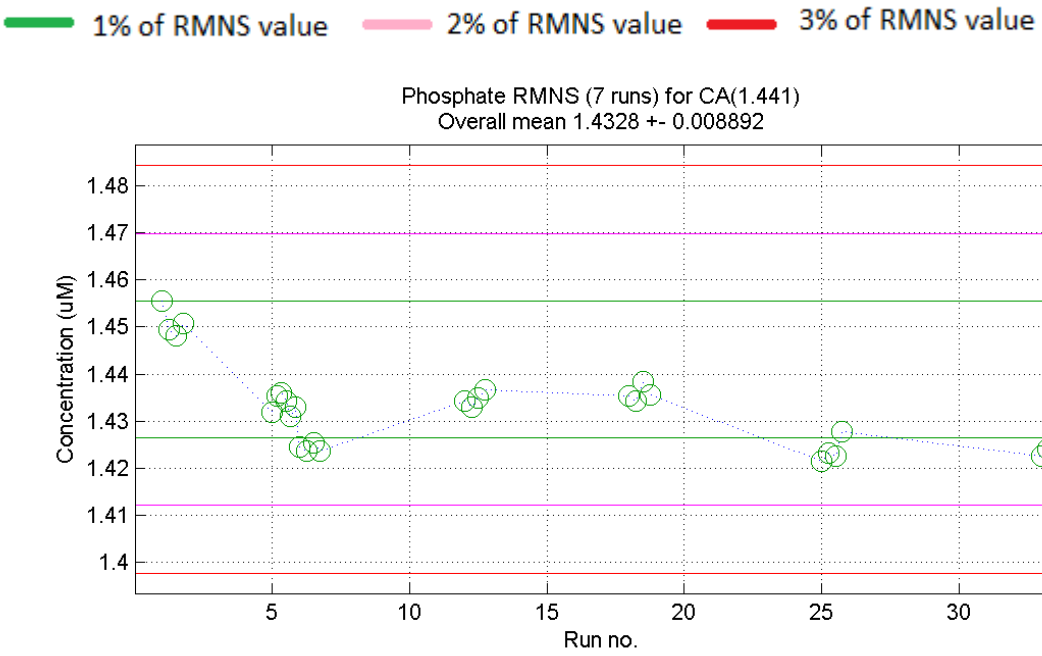
6.3.1 Silicate RMNS Plot

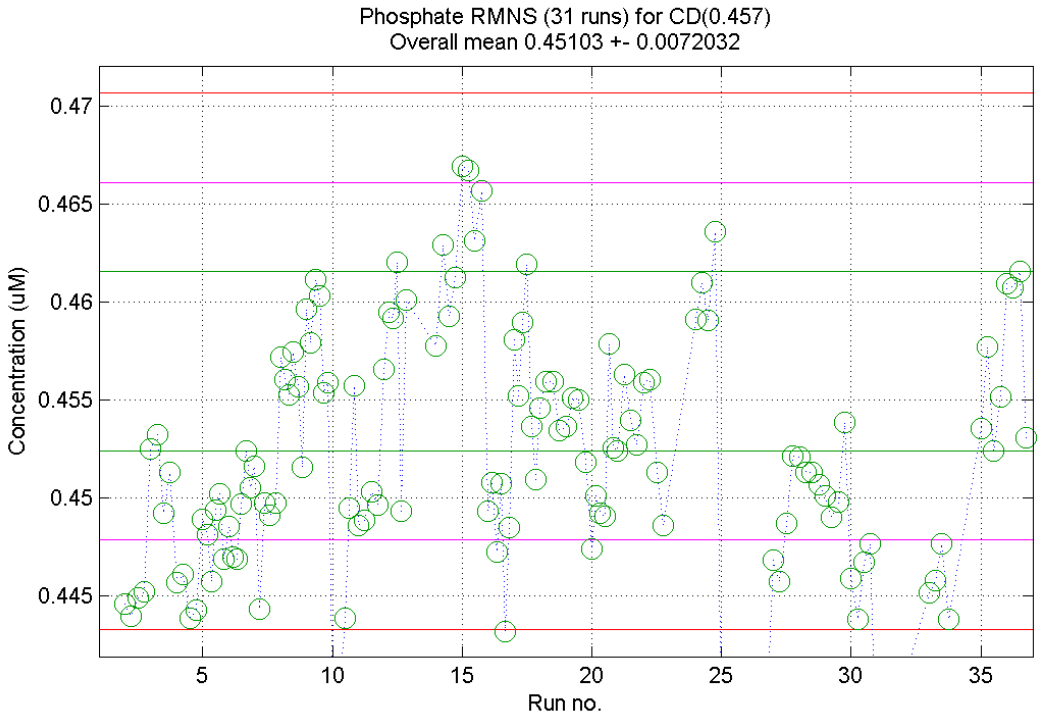




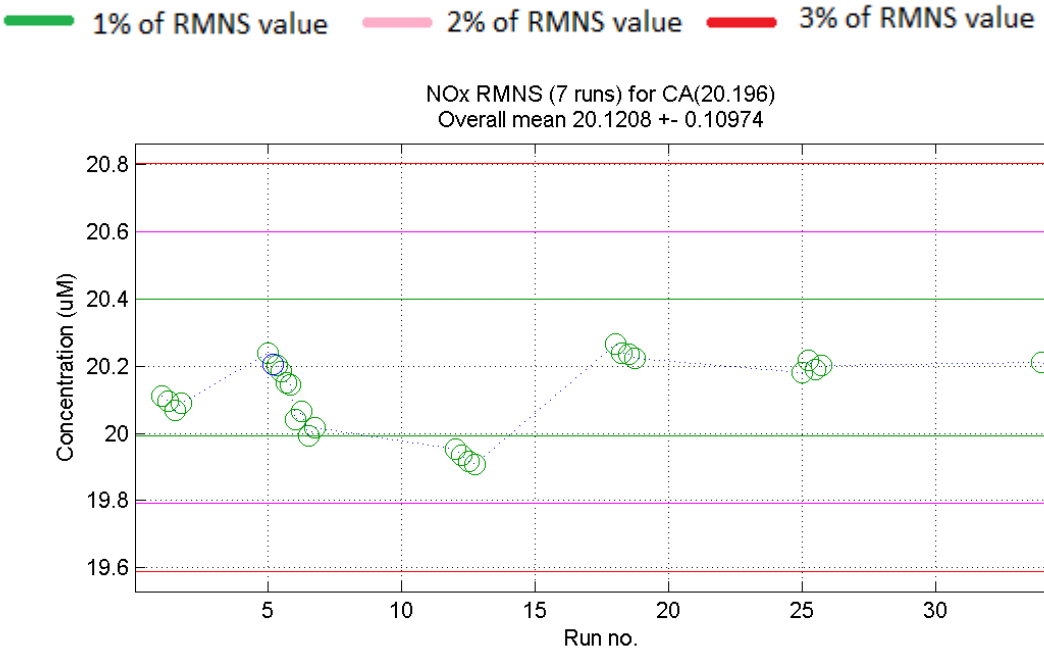


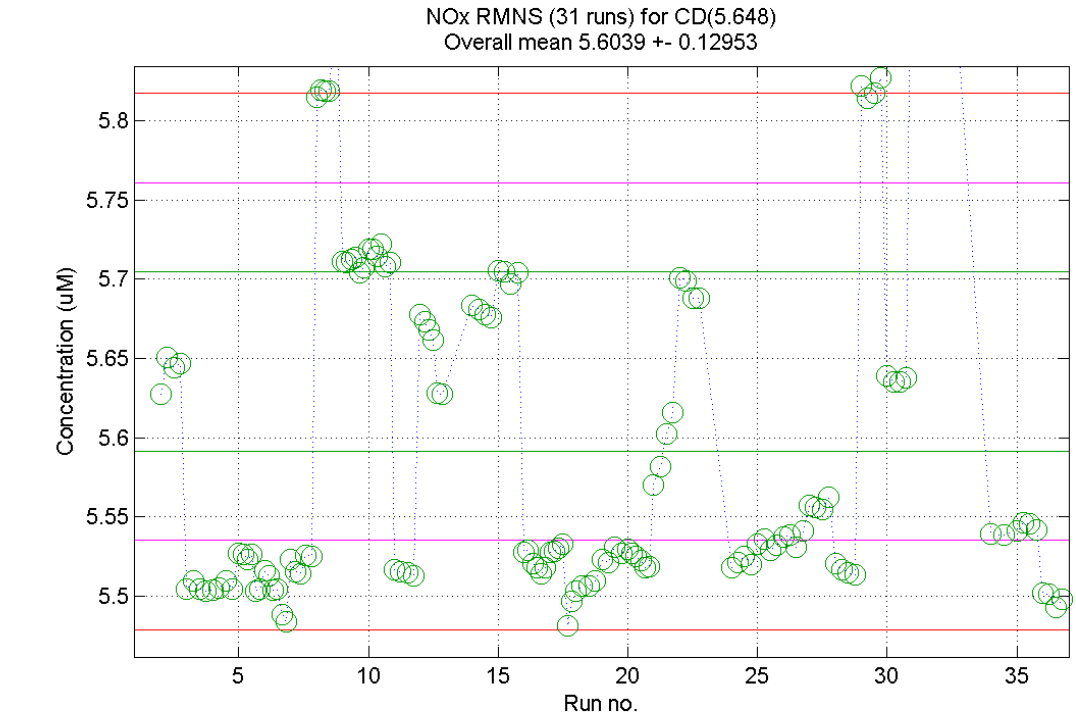
6.3.2 Phosphate RMNS Plot



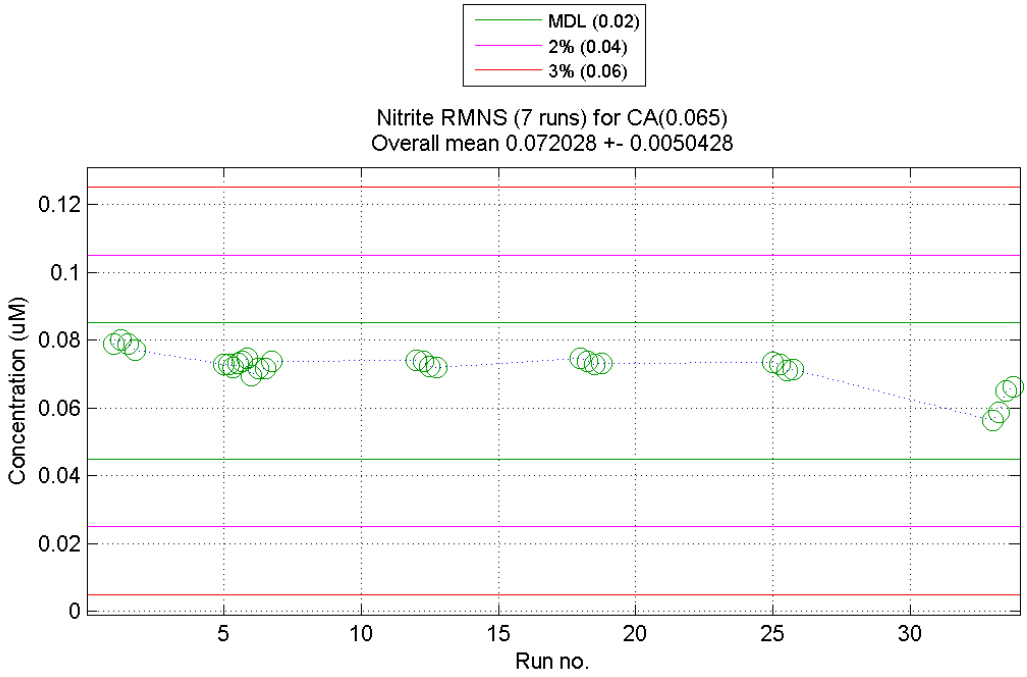


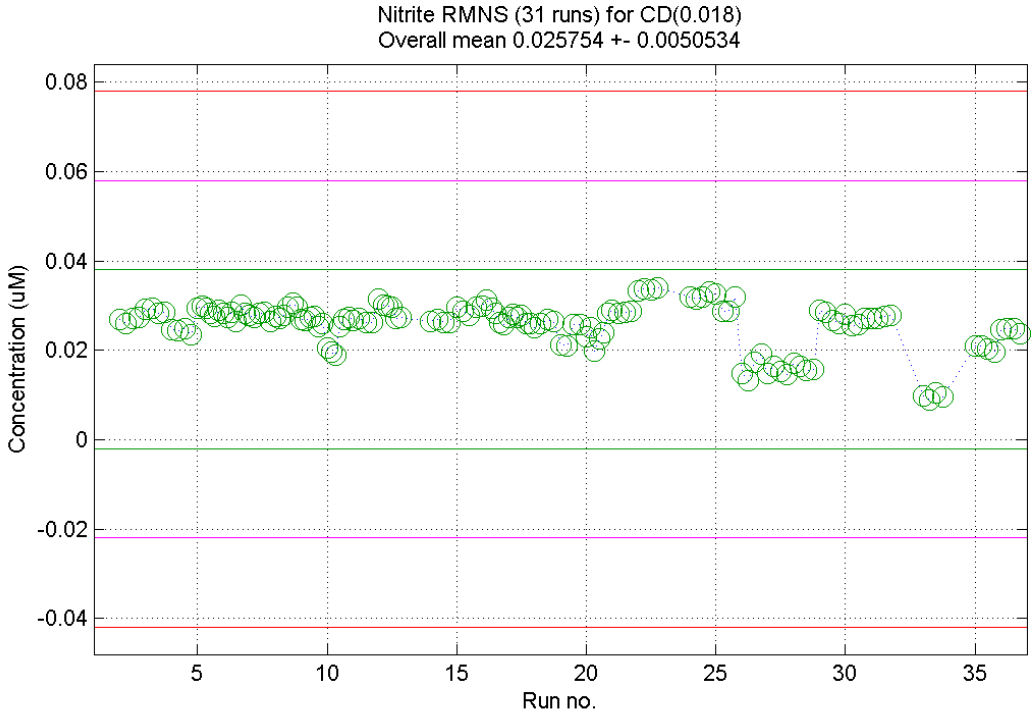
6.3.3 Nitrate + Nitrite (NOx) RMNS Plot





6.3.4 Nitrite RMNS Plot





6.4 Analytical Precision

The CSIRO Hydrochemistry method measurement uncertainty (MU) has been calculated for each nutrient based on variation in the calibration curve, calibration standards, pipette and glassware calibration, and precision of the CRM over time (Armishaw 2003).

	Silicate	Phosphate	Nitrate + Nitrite (NOx)	Nitrite	Ammonia
Calculated MU* @ 1 µmol l^{-1}	±0.017	±0.020	±0.017	±0.108	±0.066¥

*The reported uncertainty is an expanded uncertainty using a coverage factor of 2 giving a 95% level of confidence.

¥The ammonia MU precision component does not include data on the CRM.

Method detection limits (MDL) achieved during the voyage were much lower than the nominal detection limits, indicating high analytical precision at lower concentrations. Results are µmol l^{-1}. The precision of the RMNS is was also determined.

MDL	Silicate	Phosphate	Nitrate + Nitrite (NOx)	Nitrite	Ammonia
*Nominal MDL**	*0.20*	*0.02*	*0.02*	*0.02*	*0.02*
Min	0.01	0.002	0.003	0.001	0.002
Max	0.251	0.021	0.024	0.012	0.005
Mean	**0.088**	**0.009**	**0.010**	**0.003**	**0.003**
Median	0.068	0.008	0.009	0.003	0.003
Precision of MDL (stdev)	0.059	0.005	0.005	0.002	0.001

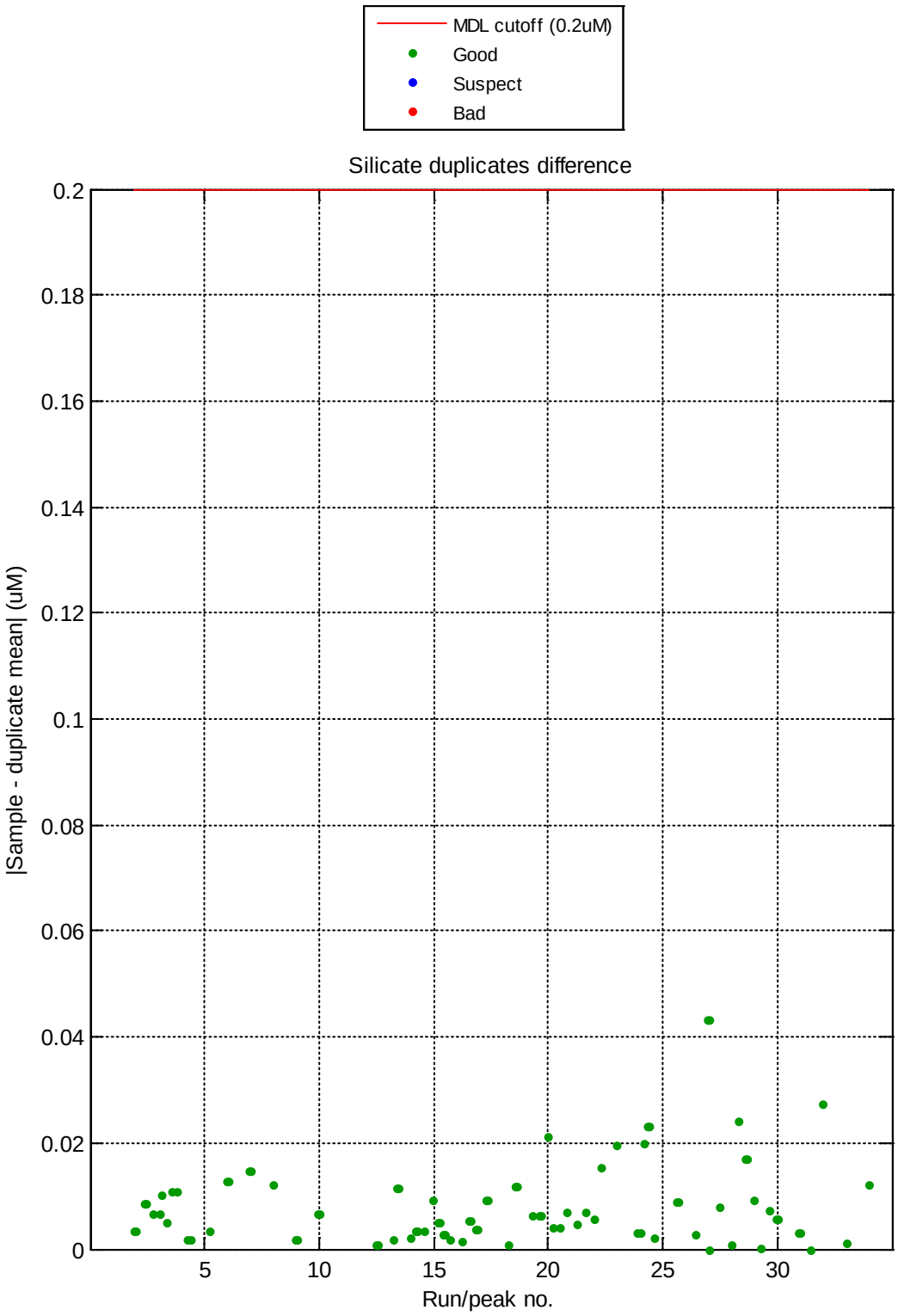
*MDL is based on 3 times the standard deviation of Low Nutrient Seawater (LNSW) analysed in each nutrient run.

Pub. RMNS CD (µmol l^{-1})	*14.264*	*0.457*	*5.648*	*0.018*	-
uncertainty	*± 0.101*	*± 0.008*	*± 0.056*	*± 0.005*	
RMNS Min	13.915	0.435	5.501	0.010	-
RMNS Max	15.003	0.466	6.096	0.034	-
RMNS Mean	**14.284**	**0.451**	**5.603**	**0.026**	**-**
RMNS Median	14.174	0.451	5.537	0.027	-
RMNS Std Dev	0.253	0.007	0.132	0.005	-

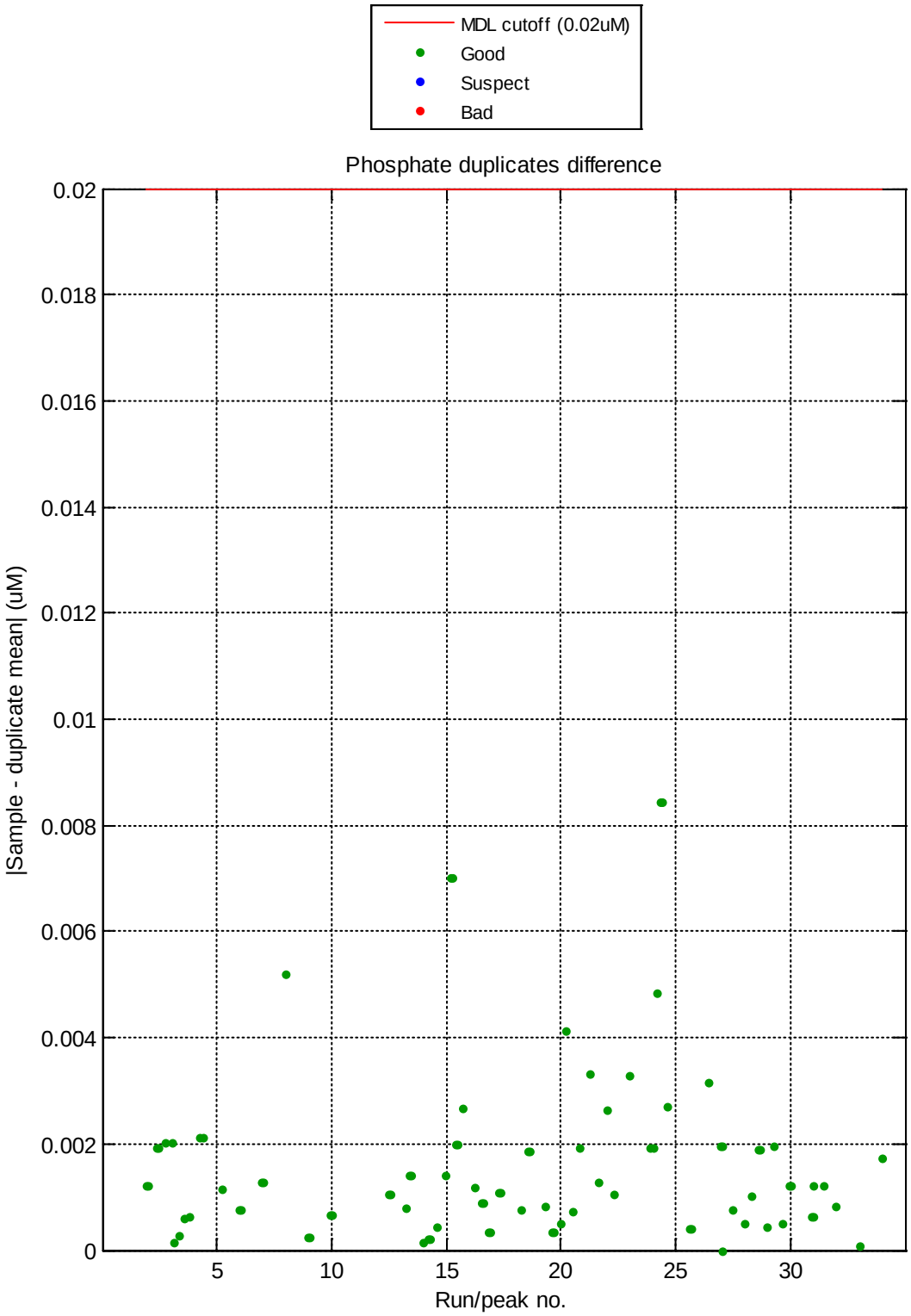
6.5 Sampling Precision

Duplicates samples were collected from NISKIN bottle 1 to measure the precision of nutrient sampling (this is not a measurement of analytical precision). The duplicate measurements are reported in the data as an average when the duplicates are flagged GOOD. The sampling precision is deemed good if difference between duplicate concentrations is below the MDL for silicate, phosphate and nitrite and within 0.05 µM for nitrate.

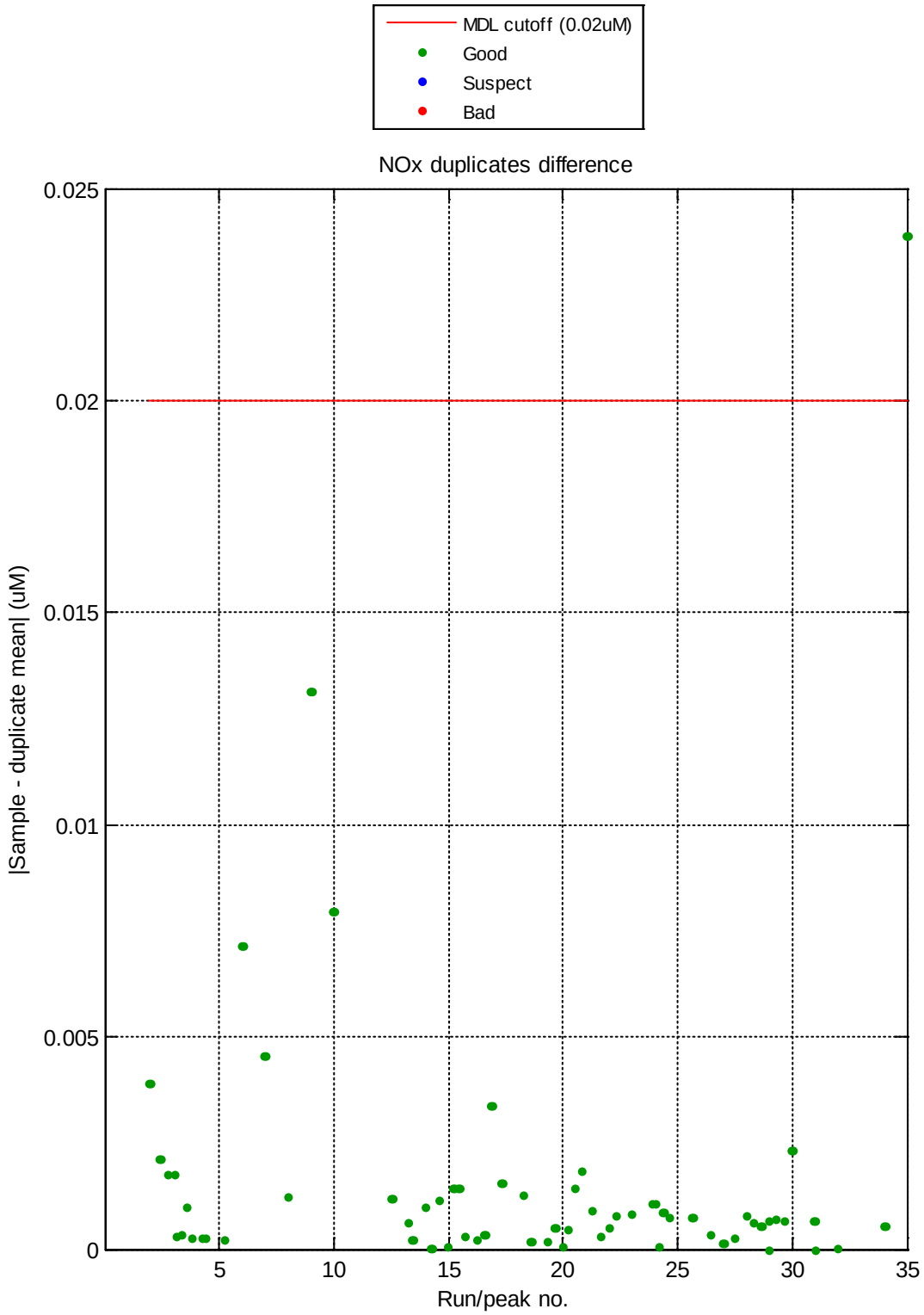
6.5.1 Silicate Duplicate Plot



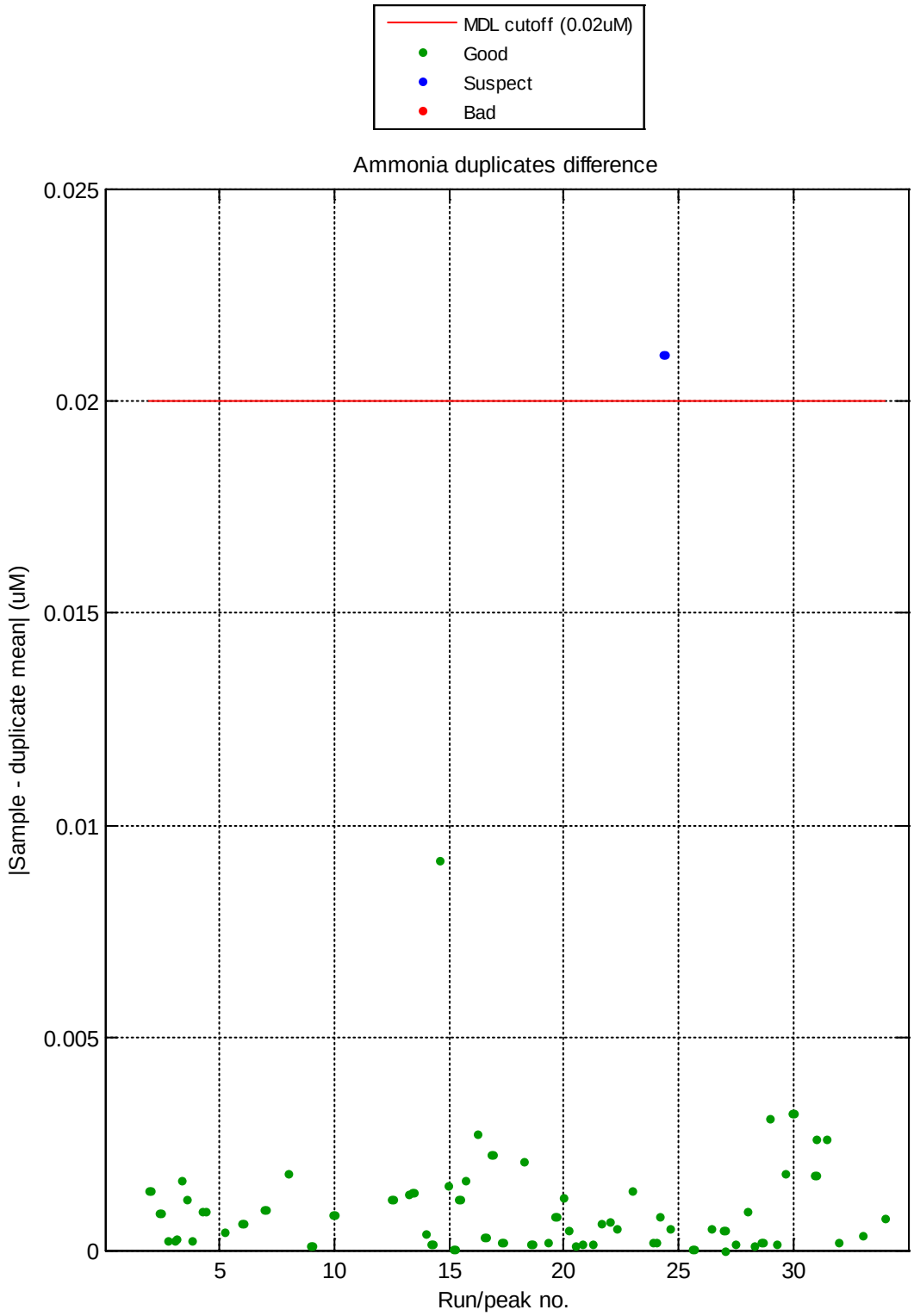
6.5.2 Phosphate Duplicate Plot



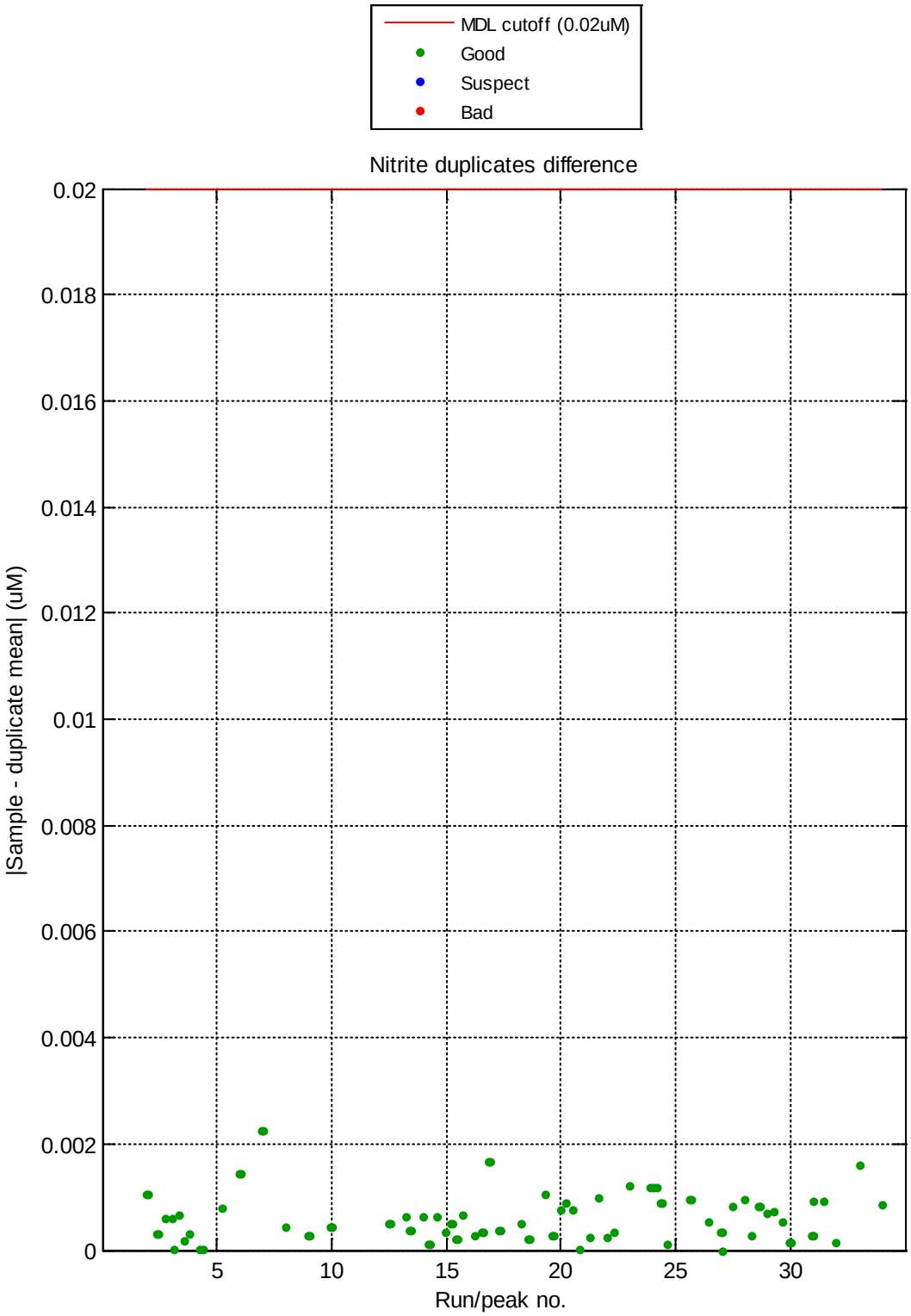
6.5.3 Nitrate + Nitrite (NOx) Duplicate Plot



6.5.4 Ammonia Duplicate Plot

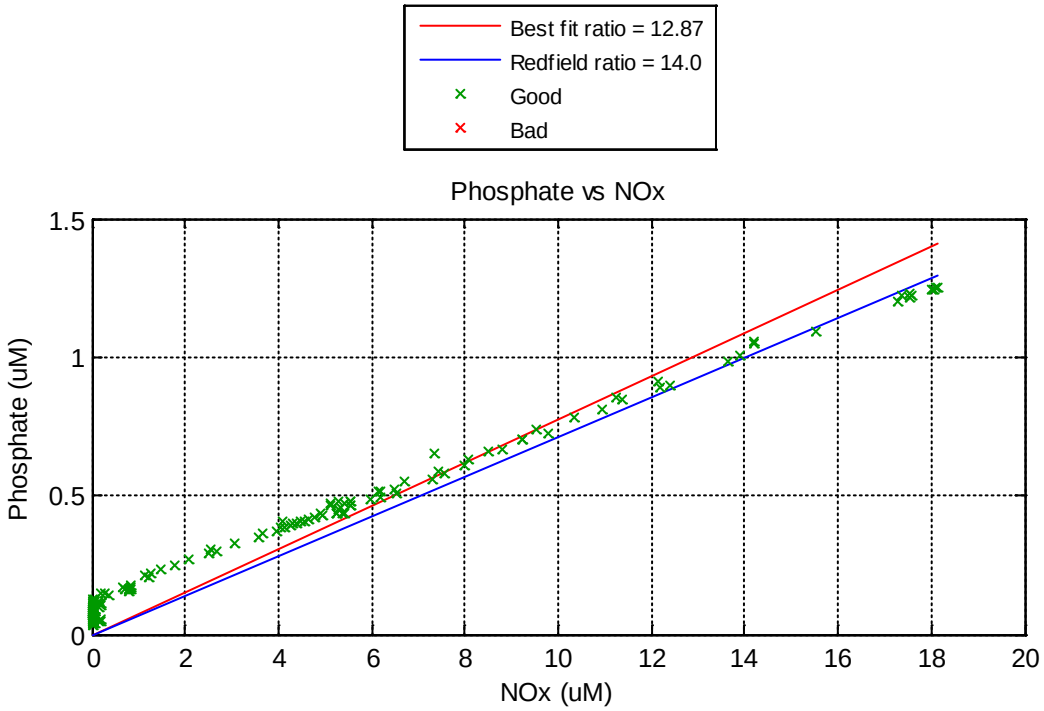


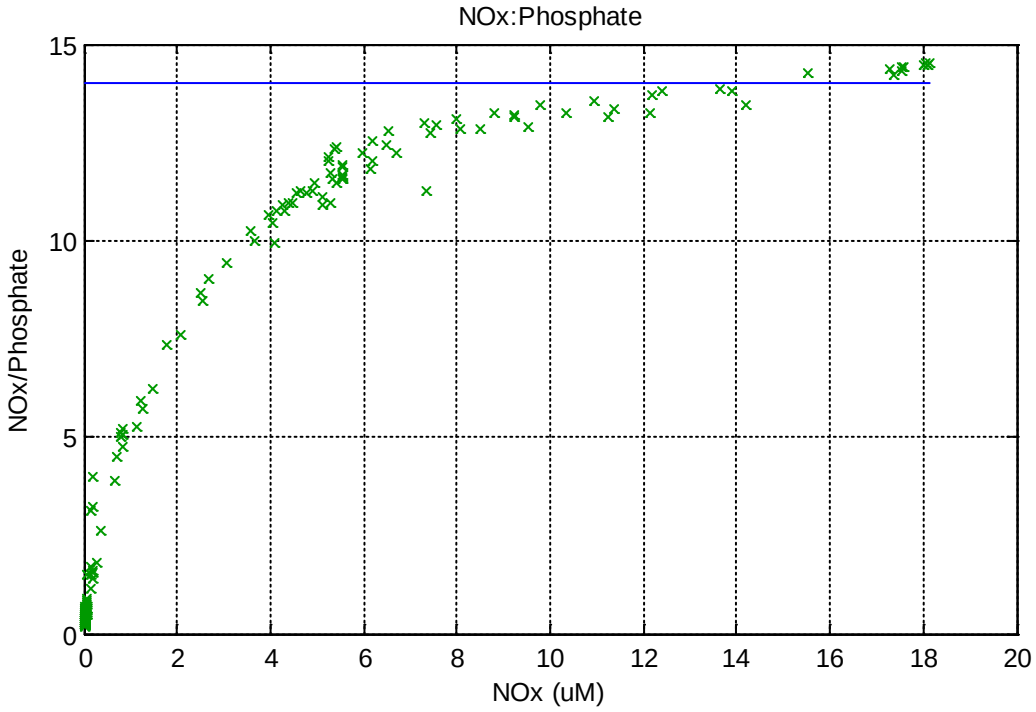
6.5.5 Nitrite Duplicate Plot



6.5.6 Redfield Ratio Plot (14.0)

Plots consists of phosphate versus NOx, best fit ratio = 12.87.





6.6 Calibration and QC edited data

All calibration data was left as is for Hypro to evaluate except that found in the table below. Suspect Calibrants were interpreted by Hypro and never edited. All calibrations were deemed 'Good'. More details on per run quality of the calibration can be found in the supporting documents.

CTD	Peak	Analysis	Flag	Reason for Flag or Action
Nut031	Cal 5 and Drifts	Silicate	bad	There was an issue with one of the reagent lines – all Cal 5/drifts other than the first primer/drift and last drift were bad as determined by hypro; no data was edited or removed
Nut033	All	NOx	removed	Large drift caused RMNS to be out at start of run…re-ran; changed the metal union on the color reagent line and new transmission tubing – Data is in Nut034 – also added more drifts through the run

6.7 Investigation of Missing or Flagged Nutrient Data and Actions taken.

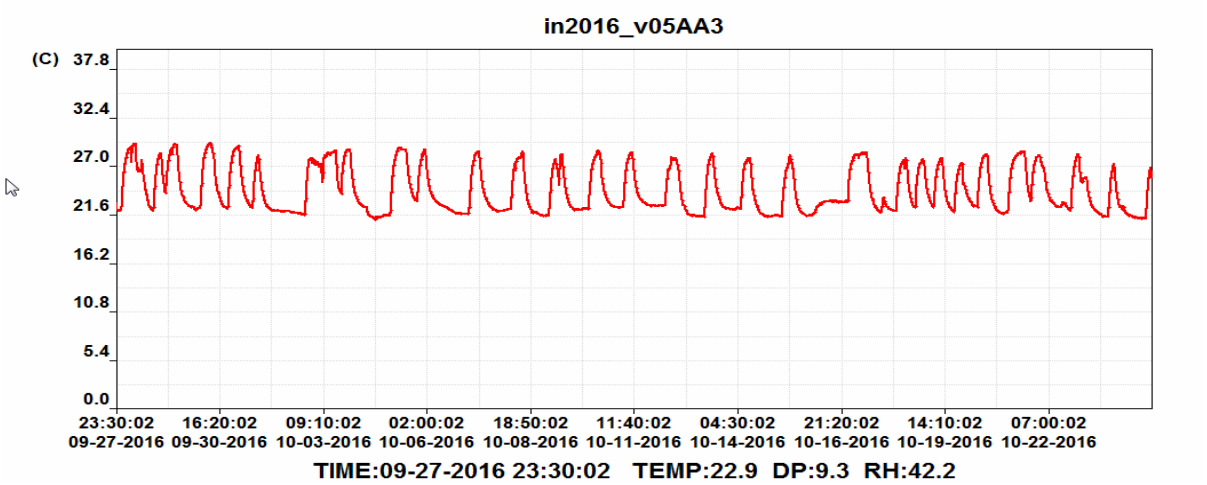
The table below identifies all flagged data and data that was repeated. Data that falls below the detection limit, Flag 63, is not captured in this table. All GOOD data is flagged 0 in the .csv and .netcdf files. Refer to Appendix 7.2 for flag explanations.

CTD	RP	Analysis	Flag	Reason for Flag or Action
EXP	25	PO4	129	Peak off scale; sample 1:1 diluted and repeated 5.48µM
46	1	ammonia	69	Duplicates greater than 0.02µM
51	12	NOx	0	Peak has a dip; sample put in fridge to re-run as test; value from re-run used (#'d in file)
60	10	Silicate	0	The sample was re-dipped due to silicate peak shapes – first dip #'d for silicate; repeat data was #'d for NOx
62	1	NOx	0/69	Difference in duplicates 0.05µM – changed from Suspect to Good

6.8 Temperature & Humidity Change over Nutrient Analyses

The temperature and humidity within the AA3 chemistry module was logged using a temperature/humidity logger QP6013 (Jaycar) placed on the deck of the chemistry module.

Refer to "in2016_v05_hyd_voyagereport.docx" for room temperature graphs, nutrient samples were placed on XY3 auto sampler at the average room temperature of approximately 22^{o}C.



7 Appendix

7.1 Salinity Reference Material

Osil IAPSO Standard Seawater	
Batch	P158
Use by date	25/03/18
K_{15}	0.99940

7.2 Hypro Flag Key for CSV & NetCDF file

Flag	Meaning
0	Data is GOOD – nothing detected.
192	Data not processed.
63	Below nominal detection limit.
69	Data flagged suspect by operator. Set suspect by software if Calibration or Duplicate data is outside of set limits but not so far out as to be flagged bad.
65	Peak shape is suspect.
133	Error flagged by operator. Data is bad – operator identified by # in slk file or by clicking on point.
129	Peak exceeds maximum A/D value. Data is bad.
134	Error flagged by software. Peak shape is bad - Median Absolute Deviation (MAD) analysis used. Standards, MDL's and Duplicates deviate from the median, Calibration data falls outside set limits.
141	Missing data, no result for sample ID. Used in netcdf file as an array compiles results. Not used in csv file.
79	Method Detection Limit (MDL) during run was equal to or greater than nominal MDL. Data flagged as suspect.

7.3 GO-SHIP Specifications

Salinity Accuracy of 0.001 is possible with Autosal™ salinometers and concomitant attention to methodology, e.g., monitoring Standard Sea Water. Accuracy with respect to one particular batch of Standard Sea Water can be achieved at better than 0.001 PSS-78. Autosal precision is better than 0.001 PSS-78. High precision of approximately 0.0002 PSS-78 is possible following the methods of Kawano (this manual) with great care and experience. Air temperature stability of ± 1°C is very important and should be recorded.[1]

O_2 Target accuracy is that 2 sigma should be less than 0.5% of the highest concentration found in the ocean. Precision or reproducibility (2 sigma) is 0.08% of the highest concentration found in the ocean.

SiO_2 Approximately 1-3% accuracy†, 2 and 0.2% precision, full-scale.

PO_4 Approximately 1-2% accuracy†, 2 and 0.4% precision, full scale.

NO_3 Approximately 1% accuracy†, 2 and 0.2% precision, full scale.

Notes: † If no absolute standards are available for a measurement then *accuracy* should be taken to mean the *reproducibility* presently obtainable in the better laboratories.

1 Keeping constant temperature in the room where salinities are determined greatly increases their quality. Also, room temperature during the salinity measurement should be noted for later interpretation, if queries occur. Additionally, monitoring and recording the bath temperature is also recommended. The frequent use of IAPSO Standard Seawater is endorsed. To avoid the changes that occur in Standard Seawater, the use of the most recent batches is recommended. The bottles should also be used in an interleaving fashion as a consistency check within a batch and between batches.

2 Developments of reference materials for nutrients are underway that will enable improvements in the relative accuracy of measurements and clearer definition of the performance of laboratories when used appropriately and the results are reported with the appropriate meta data.

7.4 RMNS Values for each CTD

Samples	SiO_4		PO_4		NO_2		NOx	
	measured	nominal	measured	nominal	measured	nominal	measured	nominal
CTD 1	**37.956**	37.458	**1.451**	1.441	**0.079**	0.065	**20.09**	20.196
CTD 2-3	**14.574**	14.264	**0.445**	0.457	**0.027**	0.018	**5.642**	5.648
CTD 4-7; UWY 1-4	**14.681**	14.264	**0.452**	0.457	**0.029**	0.018	**5.505**	5.648
CTD 8 ; UWY 5-8	**15.003**	14.264	**0.445**	0.457	**0.024**	0.018	**5.506**	5.648
UWY 9-11	**14.560**	14.264	**0.449**	0.457	**0.027**	0.018	**5.515**	5.648
CTD 11; UWY 12-16	**37.155**	37.458	**1.434**	1.441	**0.073**	0.065	**20.187**	20.196
	14.088	14.264	**0.448**	0.457	**0.029**	0.018	**5.518**	5.648
CTD 12	**37.048**	37.458	**1.424**	1.441	**0.072**	0.065	**20.028**	20.196
	14.112	14.264	**0.449**	0.457	**0.028**	0.018	**5.501**	5.648
CTD 13	**14.143**	14.264	**0.449**	0.457	**0.028**	0.018	**5.521**	5.648
CTD 14	**13.915**	14.264	**0.456**	0.457	**0.029**	0.018	**5.830**	5.648
CTD 16	**14.077**	14.264	**0.458**	0.457	**0.027**	0.018	**5.710**	5.648
UWY 17-20	**14.210**	14.264	**0.445**	0.457	**0.023**	0.018	**5.715**	5.648
CTD 17; UWY 21-24	**37.043**	37.458	**1.435**	1.441	**0.073**	0.065	**19.928**	20.196
	14.057	14.264	**0.458**	0.457	**0.029**	0.018	**5.656**	5.648
CTD 18-20; UWY 25-28; EXP 1-7								
CTD 21-23; UWY 29	**14.534**	14.264	**0.46**	0.457	**0.026**	0.018	**5.679**	5.648
CTD 24-26; EXP 8-15	**14.419**	14.264	**0.466**	0.457	**0.029**	0.018	**5.703**	5.648
CTD 27-29; EXP 16-19	**14.108**	14.264	**0.448**	0.457	**0.028**	0.018	**5.521**	5.648
CTD 30; EXP 20-25	**14.099**	14.264	**0.456**	0.457	**0.027**	0.018	**5.516**	5.648
CTD 31-32; EXP 27-38	**37.014**	37.458	**1.436**	1.441	**0.074**	0.065	**20.241**	20.196
	13.993	14.264	**0.455**	0.457	**0.026**	0.018	**5.506**	5.648
CTD 33-35	**14.041**	14.264	**0.454**	0.457	**0.023**	0.018	**5.526**	5.648
CTD 36-38; EXP 39-43	**14.130**	14.264	**0.451**	0.457	**0.024**	0.018	**5.523**	5.648
CTD 39-41	**14.280**	14.264	**0.454**	0.457	**0.029**	0.018	**5.592**	5.648
CTD 42-43; EXP 44-50	**14.499**	14.264	**0.453**	0.457	**0.034**	0.018	**5.694**	5.648
CTD 44								
CTD 45-47; EXP 51-68	**14.380**	14.264	**0.461**	0.457	**0.032**	0.018	**5.521**	5.648

Samples	SiO_4		PO_4		NO_2		NOx	
	measured	nominal	measured	nominal	measured	nominal	measured	nominal
CTD 48; EXP 69-72	**37.495**	37.458	**1.424**	1.441	**0.072**	0.065	**20.198**	20.196
	14.469	14.264	**0.438**	0.457	**0.03**	0.018	**5.532**	5.648
CTD 49-50	**14.392**	14.264	**0.435**	0.457	**0.016**	0.018	**5.537**	5.648
CTD 51-52	**14.659**	14.264	**0.448**	0.457	**0.015**	0.018	**5.557**	5.648
CTD 53-55	**14.287**	14.264	**0.451**	0.457	**0.016**	0.018	**5.516**	5.648
CTD 56-58	**14.116**	14.264	**0.451**	0.457	**0.028**	0.018	**5.82**	5.648
CTD 59	**14.137**	14.264	**0.446**	0.457	**0.027**	0.018	**5.637**	5.648
CTD 60	**14.048**	14.264	**0.435**	0.457	**0.027**	0.018	**6.096**	5.648
CTD 61-62	**37.184**	37.458	**1.426**	1.441	**0.062**	0.065	**20.2**	20.196
	14.106	14.264	**0.446**	0.457	**0.010**	0.018	**5.539**	5.648
EXP 73-80	**14.174**	14.264	**0.455**	0.457	**0.020**	0.018	**5.544**	5.648
EXP 81-84	**14.134**	14.264	**0.459**	0.457	**0.024**	0.018	**5.498**	5.648

7.5 Nutrient Methods

CSIRO Oceans and Atmosphere Hydrochemistry nutrient analysis is performed with a segmented flow auto-analyser – Seal AA3 – to measure silicate, phosphate, nitrite, nitrate plus nitrite, and ammonia.

Table 2: Calibration range and detection limits of nutrient analysis

Details					
Instrument	AA3				
Software	Seal AACE 6.10				
Methods	AA3 Analysis Methods internal manual				
Nutrient	Silicate	Phosphate	Nitrate + Nitrite	Nitrite	Ammonia
Concentration range	140 µmol l^{-1}	3 µmol l^{-1}	42 µmol l^{-1}	1.4 µmol l^{-1}	2.0 µmol l^{-1}
Method Detection Limit (MDL)	0.2 µmol l^{-1}	0.02 µmol l^{-1}	0.02 µmol l^{-1}	0.02 µmol l^{-1}	0.02 µmol l^{-1}

Silicate analysis is based on a modified Armstrong et al. (1967) method. Silicate in seawater reacts with acidified ammonium molybdate to produce silicomolybdic acid. This solution will also react with phosphate producing a phosphomolybdic acid. Tartaric acid is introduced to remove this interference. Finally, Stannous Chloride (Tin II Chloride) is added to reduce silicomolybdic acid to the blue compound silicomolybdous acid which can be detected at 660 nm or 820 nm.

Phosphate measurement is based on the original Murphy and Riley (1962) method with some modifications developed at the NIOZ-SGNOS Practical Workshop 2012 optimizing antimony catalyst/phosphate ratio and reduction of silicate interferences by pH. Phosphate in seawater forms

a phosphomolybdenum blue complex with acidified ammonium molybdate reduced by ascorbic acid which can be detected at 880 nm.

Nitrate is determined by first reducing to nitrite via a basic buffered copperized cadmium column before the colour reaction (Wood et al., 1967). Nitrite in seawater will react with sulphanilamide under acidic conditions to form a diazo compound. This compound couples with 1-N-naphthly-ethylenediamine di-hydrochloride to produce a reddish purple azo complex which can be detected at 520 nm.

The ammonia method, developed by Roger Kérouel and Alain Aminot, IFREMER (1997 Mar.Chem.57), is based on the reaction of ammonium with orthophtaldialdehyde and sulfite at a pH of 9.0-9.5 producing an intensely fluorescent product; excitation 370 nm, emission 460 nm.

Detailed SOPs can be obtained from the CSIRO Oceans and Atmosphere Hydrochemistry Group on request.

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