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IOCCP-JAMSTEC 2018 Inter-laboratory Calibration Exercise of a Certified Reference Material for Nutrients in Seawater

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Preface

Inorganic nutrient concentrations in seawater are a fundamental component of marine ecosystems, and have been identified collectively as one of the Essential Ocean Variables. The ability to measure the concentrations of nitrate, nitrite, phosphate, silicic acid, and ammonium with a high degree of certainty is vital when addressing global questions such as "How are eutrophication and pollution impacting ocean productivity and water quality?", and "How are changing global conditions affecting the bio-availability of macronutrients", as well as local questions, such as "How is agricultural run-off affecting this particular bay?" However, the usability of the nutrient concentrations has suffered from the lack of comparability of data collected in different locations and times by the same or different analysts.

It is important therefore that the ability of the international science community to conduct the analyses used to answer such questions is rigorously assessed, and recommendations made where required for improved performance, methodology, and standardisation.

We therefore congratulate Prof. Michio Aoyama and the team for leading the IOCCP—JAMSTEC 2017-2018 Inter-laboratory Comparison Exercise, and the 71 laboratories that participated in this 6th Intercomparison Exercise. It is heartening to see that most of these laboratories are able to analyse nutrient concentrations within the certified uncertainty of the unknowns provided. The recommendations included in this report provide guidance for increasing the ability of the global community to answer questions about the changing marine macronutrient environment.

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Abstract

In 2017, the International Ocean Carbon Coordination Project (IOCCP) and the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) decided to conduct the 6th International Inter-Calibration Exercise, the "2017/18 inter-laboratory comparison exercise of Certified Reference Materials of Nutrients in Seawater, CRM". As was the case with the previous four inter-comparison (IC) studies organized by MRI-JMA and the previous IOCCCP-JAMSTEC IC exercise in 2015, the aim of this IC exercise was to improve the level of comparability by exchanging knowledge among participating laboratories. The scale of the study was expanded. One hundred seven laboratories in 33 countries across five continents received a letter of invitation to the IC exercise, and 71 laboratories in 30 counties agreed to participate in this IC exercise. Results were returned from 69 laboratories in 30 countries. The data were statistically analyzed, and the results are described in this report.

The agreement between consensus median/mean and certified values was within uncertainty for all five samples used in this IC exercise. Only small discrepancies existed among core laboratories that reported close-to-consensus values and certified values.

Normalized cumulative distributions for nitrate and phosphate obtained in 2018 were better (i.e., flatter) than the normalized cumulative distributions obtained from previous IC exercises conducted in 2008, 2012, and 2015. The indication is that comparability of nitrate and phosphate analysis among the laboratories has gradually improved from 2008 to 2018. In contrast with the nitrate and phosphate results, the normalized cumulative distribution for silicate obtained in 2018 was similar to the distributions in previous years. The indication is that comparability of silicate analysis among the laboratories has not changed during these years.

The results of this IC exercise also showed that nonlinearity of the calibration curves for the nutrient analyses in each laboratory is still a significant source of reduced comparability of nutrient data. Analysis of ranked scatter plots led to this conclusion. The implication is that we need to use a set of nutrient CRMs, the concentrations of which cover the whole range of nutrient concentrations in the world's oceans to maintain comparability of results.

Thirty-eight laboratories among 69 laboratories used a CRM/RM. The remaining 31 laboratories did not use a CRM/RM or did not reply to the questionnaire. It is obvious that the number of the laboratories that use CRMs has been increasing since 2008. In general, the reported results from laboratories that used CRMs were located in the central part of the ranked plots and showed good Z-scores, as expected. The results of this IC exercise imply that the majority of the participating laboratories are very capable of measuring nutrient concentrations in seawater, and using CRMs will further increase the comparability of results. The results may be SI traceable in the near future.

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1. Introduction

The objective of this inter-laboratory calibration exercise was to evaluate and improve the comparability of global nutrient data for the world's oceans.

In 2003, 2006, 2008, and 2012, inter-laboratory comparison studies of Reference Material of Nutrients in Seawater (RMNS) were conducted by M. Aoyama at the Meteorological Research Institute (MRI), Japan and collaborators worldwide (Aoyama, 2006, Aoyama et al., 2007, 2008, 2016). Samples were prepared with nutrient concentrations that covered the concentration range of nutrients in the Pacific Ocean, which has the highest nutrient concentrations among the open oceans of the world. The samples were prepared in a natural seawater matrix in a single bottle so that four determinants (nitrate, nitrite, phosphate, and silicate) could be simultaneously analyzed.

In 2014/2015, the International Ocean Carbon Coordination Project (IOCCP) and the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) decided to conduct the International Inter-Calibration Exercise, the "2014 inter-laboratory comparison study of Certified Reference Material of Nutrients in Seawater and Reference Material of Nutrients in Seawater (CRM & RMNS)". We thank Scientific Committee on Oceanic Research (SCOR) Working Group 147 "Towards comparability of global oceanic nutrient data (COMPONUT)", co-chaired by Michio Aoyama (Japan) and Malcolm Woodward (UK), for their support of the IOCCP-JAMSTEC inter-laboratory calibration exercise.

In the 2014/2015 inter-laboratory calibration (I/C) exercise, we used four lots of recently certified reference material (CRM) produced by KANSO CO., LTD. Former RMNS produced by KANSO had already shown an excellent homogeneity of 0.2 %, and the concentrations of nitrate, phosphate, and silicate did not change more than 1.0 % during 6.4 years. By the criterion of International Organization for Standardization (ISO) Guide 35:2006, there was no instability of the RM nutrient concentrations (Aoyama et al., 2012). We also used three CRMs provided by the National Metrology Institute of Japan, which were certified in March 2014. The Korean Institute of Ocean Science and Technology (KIOST) also offered to provide their recently developed RMs to this I/C exercise. The Royal Netherlands Institute for Sea Research, NIOZ, also offered to provide silicate stock solution to contribute to the overall assessment of results from this I/C exercise.

The report of the previous IOCCP-JAMSTEC 2014/2015 inter-laboratory comparison study of Certified Reference Material of Nutrients in Seawater and Reference Material of Nutrients in Seawater (CRM & RMNS) have already been published with an ISBN as a printed version and web version (Aoyama et al., 2015).

Results obtained in several previous inter-laboratory comparison studies have indicated that variability of in-house standards of the participating laboratories and handling of nonlinearity of the instruments of the participating laboratories are the primary sources of inter-laboratory discrepancies. It is therefore obvious that the use of a certified reference material for nutrients in seawater, CRM, and use of the same

methodology for measuring nutrient concentrations are essential for improving the accuracy and establishing global comparability and traceability of nutrient data for the world's oceans.

In 2017, the International Ocean Carbon Coordination Project (IOCCP) and the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) decided to conduct the 6th International Inter-Calibration Exercise, the "2017/18 inter-laboratory comparison exercise of Certified Reference Material of Nutrients in Seawater, CRM". As with the previous four inter-comparison studies organized by MRI and the previous IOCCCP-JAMSTEC I/C exercise in 2015, the aim of this I/C exercise was to improve the level of comparability by exchange of knowledge among participating laboratories. Compared with the previous studies, the scale of the study has been expanded, and 107 laboratories in 30 countries across five continents received an invitation letter to participate in the I/C exercise. Finally, 71 laboratories agreed to participate in the I/C exercise and 69 laboratories reported their results. We are now publishing this report with the names of the participants and an organizer.

2. Preparation and samples sent to the participants

In 2017, IOCCP and JAMSTEC co-organized an inter-laboratory calibration exercise of nutrients in seawater in collaboration with SCOR WG147. A list of candidates was prepared based on the previous participants, and some laboratories were newly added based on the information from SCOR WG147, IOCCP Scientific Steering Committee (SSG) members, and the Synoptic Arctic Survey group. The invitation letter (Appendix IV) was sent to 107 laboratories.

The certified values of the four or five CRMs used as samples in this inter-laboratory calibration exercise are shown in Table 1.

The Korean Institute of Ocean Science and Technology, KIOST, offered to provide their recently developed RMs to this I/C exercise.

A set of four or five samples of CRMs was distributed to all 71 participating laboratories around the globe (33 countries/regions) at no charge. In this I/C exercise, the sample with the highest silicate concentration was not distributed to laboratories that were not familiar with such a high silicate concentration. Korean RMs were also distributed to the same laboratories.

In addition, three sets of samples used in the IOCCCP-JAMSTEC 2014/15 IC exercise were sent to three laboratories to check the stability and comparability of the previous samples used in the IC exercise. Four sets of five CRMs used in this IC exercise were also sent to four laboratories in the United States, India, Netherlands, and South Africa to check the stability during transportation. Those samples were returned intact and analyzed at JAMSTEC.

Table 1. Certified values of the five samples of CRM used in this IC exercise.

	Sample	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
Nitrate	Certificate Value (μmol kg^{-1})	**19.66**	**43.4**	**0.01***	**5.498**	**23.7**
	Expanded Uncertainty (μmol kg^{-1})	**0.15**	**0.4**	**0.03**	**0.050**	**0.2**
Nitrite	Certificate Value (μmol kg^{-1})	**0.063**	**0.070**	**0.016**	**0.018**	**0.06**
	Expanded Uncertainty (μmol kg^{-1})	**0.010**	**0.015**	**0.009**	**0.0044**	**0.03**
Silicate	Certificate Value (μmol kg^{-1})	**36.58**	**159.7**	**0.06***	**13.93**	**56.4**
	Expanded Uncertainty (μmol kg^{-1})	**0.22**	**1.0**	**0.09**	**0.099**	**0.5**
Phosphate	Certificate Value (μmol kg^{-1})	**1.407**	**3.06**	**0.012***	**0.446**	**1.70**
	Expanded Uncertainty (μmol kg^{-1})	**0.014**	**0.03**	**0.006**	**0.0082**	**0.02**

3. Participants and response

Seventy-one laboratories in 33 countries replied to the call for participants. The participating laboratories are listed in Table A1 in Appendix I and are cross-referenced by laboratory number to the laboratories participating in the previous I/C studies in Table A2.

Results were returned from 69 laboratories in 30 countries/regions. Table 2 summarizes the number of responses from participants and the number of responses analyzed statistically to calculate the values presented in this report. All reported information from participants is summarized as reported in Table A3. However, only numerical values were statistically analyzed. If the reported results were less than a certain value (e.g., <0.10), below the detection limit, or ND, those results were not included in the statistical analysis to calculate, for example, an arithmetic mean in this report.

Table 2. Summary of responses from participants.

Sample #	Number of results		Sample #	Number of results	
	Received	Statistically analyzed		Received	Statistically analyzed
	Nitrate+Nitrite			Nitrite	
Sample #1	62	62	Sample #1	61	58
Sample #2	38	38	Sample #2	39	38
Sample #3	62	56	Sample #3	61	56
Sample #4	62	62	Sample #4	61	56
Sample #5	62	62	Sample #5	61	58
	Nitrate			Phosphate	
Sample #1	53	53	Sample #1	68	68
Sample #2	34	34	Sample #2	41	41
Sample #3	53	50	Sample #3	68	59
Sample #4	53	53	Sample #4	68	68
Sample #5	53	53	Sample #5	68	68

Table 2. Summary of responses from participants (continued).

Sample #	Number of results		Sample #	Number of results	
	Received	Statistically analyzed		Received	Statistically analyzed
	Silicate			Dissolved organic phosphate(DOP)	
Sample #1	66	66	Sample #1	8	8
Sample #2	39	39	Sample #2	7	7
Sample #3	66	59	Sample #3	8	8
Sample #4	66	66	Sample #4	8	8
Sample #5	65	65	Sample #5	8	8
	Ammonia			Dissolved organic nitrogen (DON)	
Sample #1	30	30	Sample #1	8	8
Sample #2	18	18	Sample #2	7	7
Sample #3	30	30	Sample #3	8	8
Sample #4	30	30	Sample #4	8	8
Sample #5	30	30	Sample #5	8	8
				Dissolved organic carbon (DOC)	
			Sample #1	1	1
			Sample #2	1	1
			Sample #3	1	1
			Sample #4	1	1
			Sample #5	1	1

4. Statistical analyses

4.1 Raw mean, median, and standard deviation

Mean, median, and standard deviation were calculated using reported values, except when the reported value was below the detection limit, less than a certain value, or ND. Results are shown in Table 3.

4.2 Robust statistics

Robust statistics is a convenient, modern way of summarizing results when a small proportion of the results are suspected of being outliers. Most estimates of central tendency (e.g., the arithmetic mean, in this report the raw mean in Table 3) and dispersion (e.g., standard deviation, in this report the Raw SD in Table 3) depend for their interpretation on an implicit assumption that the data comprise a random sample from a normal distribution. But the data that were analyzed in this report may have deviated from that model. They were often heavy tailed (i.e., contained a higher or lower than expected proportion of results far from the mean) and may have contained outliers, as can be seen from the ranked plots shown in Figures 1-1 to 5-2. A robust mean (H15 mean) and standard deviation (H15 Sd) were therefore calculated based on the AMC method (AMC, 2001). Results are shown in Table 3.

4.3 Consensus mean, median, and standard deviation

Successive *t*-tests at the 95% confidence level were applied to the results before estimating the consensus mean, consensus median, and consensus standard deviation, as was done in the previous inter-comparison studies (Aminot and Kirkwood, 1995; Aoyama, 2006; Aoyama et al., 2007, 2008, 2016). Tests were applied until a stable mean was reached. Stable means were obtained at the 5th to 12th tests for sets of results. The consensus mean, consensus median, and consensus standard deviation were calculated when all the remaining data were within the estimated consensus mean ± 2 times the consensus standard deviation.

4.4 Calculation of Z-scores

Z-scores were used to evaluate the performance of laboratories, as was the case in the previous inter-comparison studies (Aminot and Kirkwood, 1995; Aoyama 2006, Aoyama et al., 2007, 2008, 2016).

The *Z*-score for each analysis was defined as follows:

$$Z_{par} = \mathrm{ABS}((C_{par} - C_{consensus})/P_{par}) \qquad (1)$$

where Z_{par} is the Z-score for an analysis; C_{par} is the concentration of an RMNS sample measured by a laboratory for the parameter of interest (nitrate, phosphate, or silicate); $C_{consensus}$ is the consensus sample concentration for the parameter of interest, described in section 4.1; and P_{par} is the standard deviation of the sample concentration for the parameter of interest.

The Z-score for all determinants, nitrate+nitrite, nitrate, nitrite, phosphate, and silicate, were calculated and are shown in Tables 6-1 to 6-5. We calculated combined Z-scores for phosphate and nitrate+nitrite to evaluate performance in the estimation of an important biogeochemical parameter, the N/P ratio; results are shown in Table 6-6. We also calculated combined Z-scores for phosphate, nitrate+nitrite, and silicate (Table 6-7) to assess the overall performance of the nutrient measurements made in each laboratory.

Table 3. Raw and robust* statistics for nutrient concentrations calculated using all reported values.

Nutrient	Sample #	n	Raw Mean µmol kg^{-1}	Raw Median µmol kg^{-1}	Raw SD µmol kg^{-1}	Robust mean µmol kg^{-1}	Robust SD µmol kg^{-1}
Nitrate+ Nitrite	Sample #1	62	19.60	19.69	2.98	19.59	0.57
	Sample #2	38	43.02	43.19	8.01	42.98	1.29
	Sample #3	56	0.22	0.07	0.51	0.10	0.09
	Sample #4	62	5.59	5.49	0.79	5.47	0.22
	Sample #5	62	23.75	23.78	3.55	23.69	0.68
Nitrate	Sample #1	53	19.82	19.64	2.80	19.59	0.49
	Sample #2	34	43.68	43.08	7.64	43.04	1.01
	Sample #3	50	0.26	0.05	0.60	0.10	0.12
	Sample #4	53	5.65	5.50	0.86	5.48	0.23
	Sample #5	53	24.02	23.74	3.43	23.69	0.69
Nitrite	Sample #1	58	0.07	0.07	0.03	0.07	0.02
	Sample #2	38	0.09	0.09	0.04	0.09	0.02
	Sample #3	56	0.03	0.03	0.03	0.02	0.02
	Sample #4	56	0.03	0.03	0.04	0.03	0.02
	Sample #5	58	0.07	0.07	0.03	0.06	0.02
Phosphate	Sample #1	68	1.42	1.41	0.16	1.41	0.05
	Sample #2	41	3.10	3.07	0.28	3.07	0.10
	Sample #3	59	0.08	0.02	0.23	0.03	0.03
	Sample #4	68	0.48	0.44	0.17	0.44	0.03
	Sample #5	68	1.74	1.70	0.23	1.71	0.06
Silicate	Sample #1	66	35.42	36.08	3.00	35.80	1.59
	Sample #2	39	153.14	157.42	17.76	156.81	5.14
	Sample #3	59	0.10	0.10	0.46	0.12	0.13
	Sample #4	66	13.38	13.57	1.10	13.55	0.66
	Sample #5	65	54.37	55.62	5.42	55.39	2.33

***Robust (H15) means and standard deviations were calculated using Huber's method with 1.5 as the multiplier in the Winsorisation process (AMC, 2001).**

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5. Results

The database includes results from 69 of 71 laboratories. In this report, the main text presents a summary of five CRMs, and Appendix V presents a summary of three KIOST RMs.

5.1 Ranked scatter-plots of the results

Figures 1 to 5 are ranked scatter-plots for nitrate+nitrite, nitrate, nitrite, phosphate, and silicate, respectively. For nitrate+nitrite, nitrate, nitrite, phosphate, and silicate, the laboratory results were sorted in order of the concentrations reported for sample #5, because sample #5 contained the mid nitrate, phosphate, and silicate concentrations of the samples and all participants received and analyzed sample #5.

Cross-referenced tables to find the lab number corresponding to the order of ranked results are shown as Tables A8-1 to A8-5 in Appendix III for Figures 1 to 5.

In each of Figures 1 to 5, the ranked concentration plots for a particular nutrient would be proportional and roughly parallel to each other for samples with different nutrient concentrations if each laboratory appropriately compensated for the nonlinearity of the calibration curves. However, as is evident in the figures, there were non-proportional results from some laboratories for all of the determinants. This was also the case in the previous I/C studies.

These results indicate that nonlinearity of the calibration curves for nutrient analysis is one of the significant causes of diminished comparability of nutrient data. The implication is that we need to use a set of CRMs that include nutrient concentrations that cover the whole range of measured nutrient concentrations in the world's oceans to ensure comparability of results.

Figures 2 to 5 present the certified values and associated uncertainties reported by the providers of the CRMs.

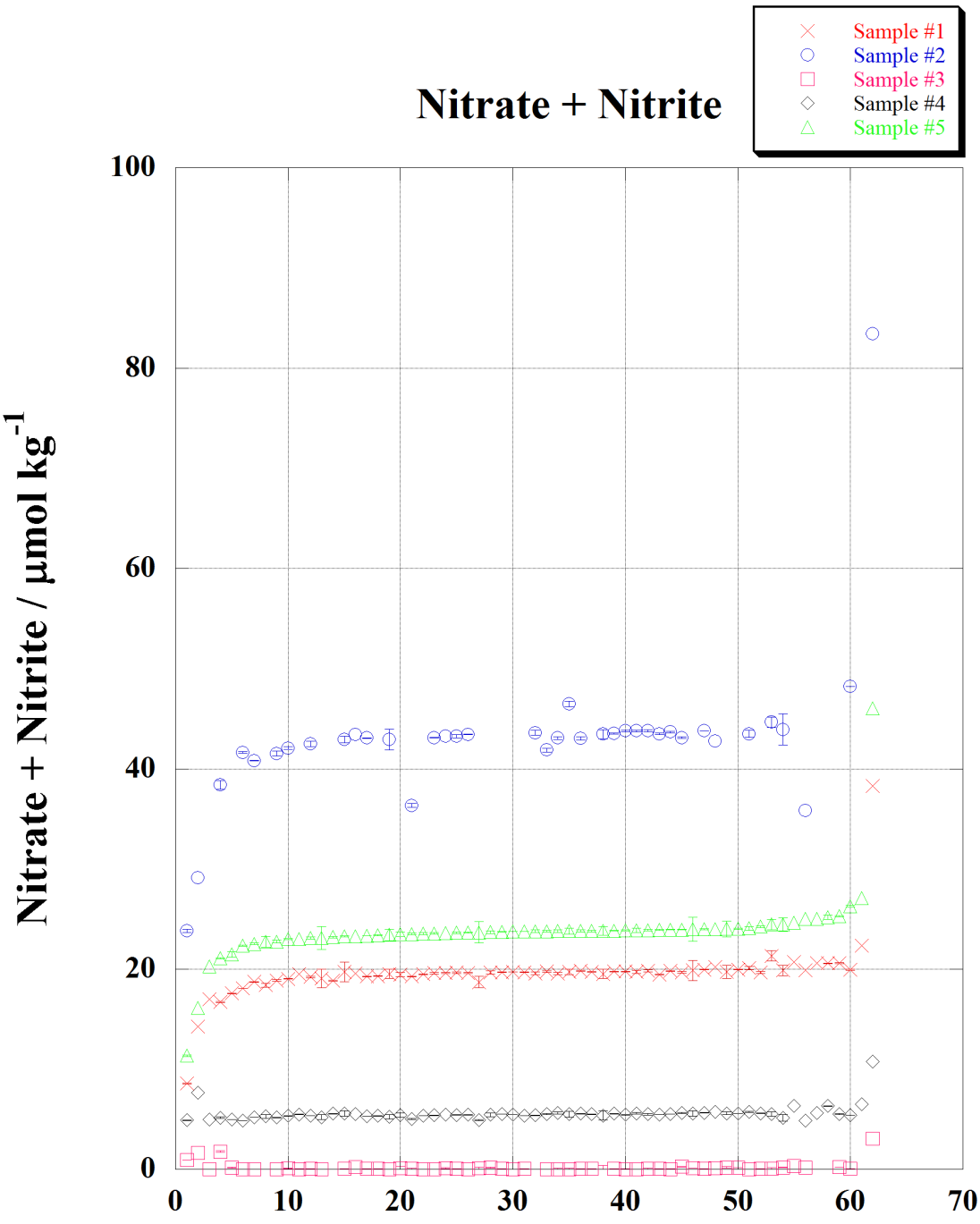

Figure 1. Nitrate+Nitrite results for five CRMs. Laboratories are ranked in order of concentrations reported for sample #5.

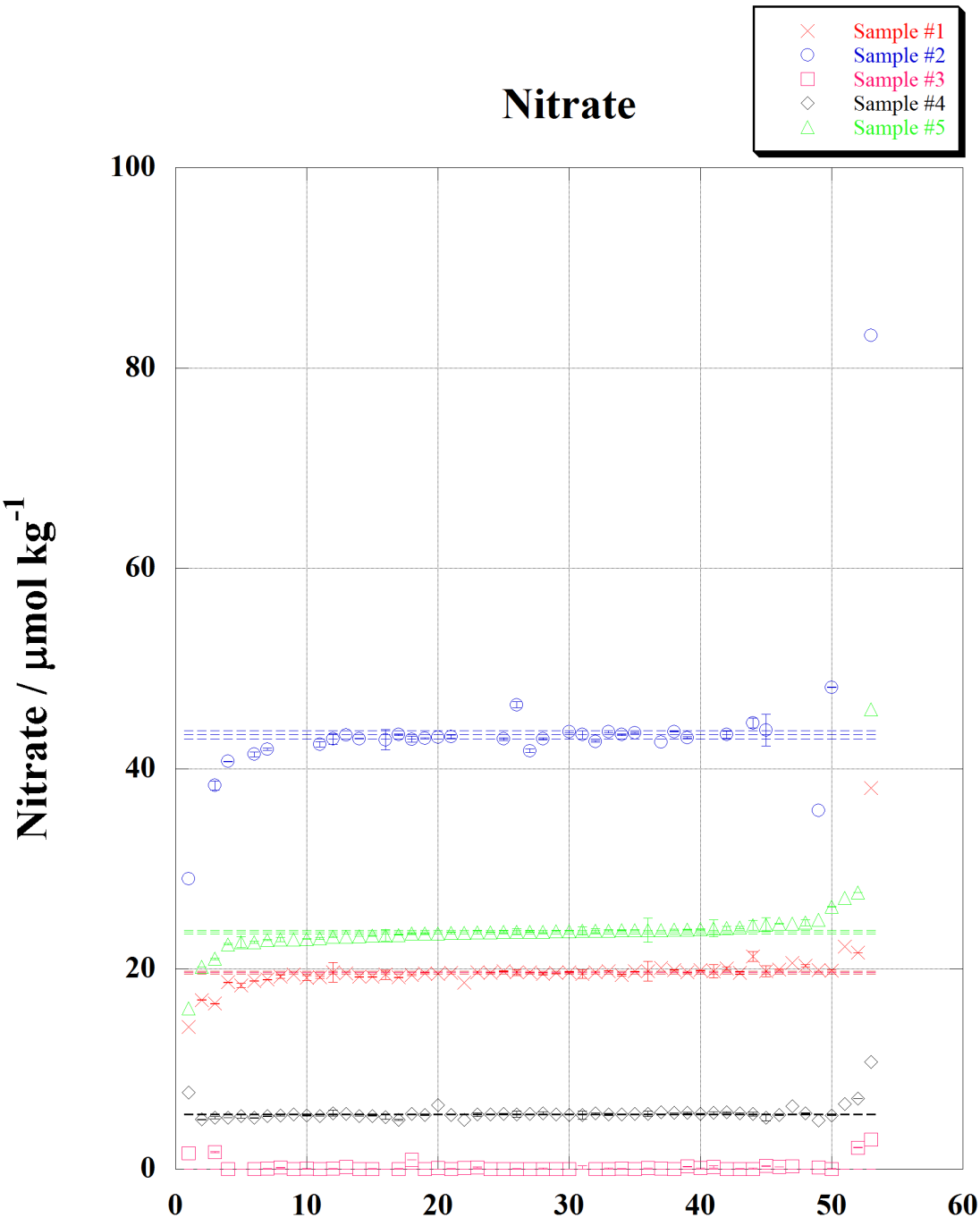

Figure 2. Nitrate results for five CRMs. Laboratories are ranked in order of concentrations reported for sample #5.

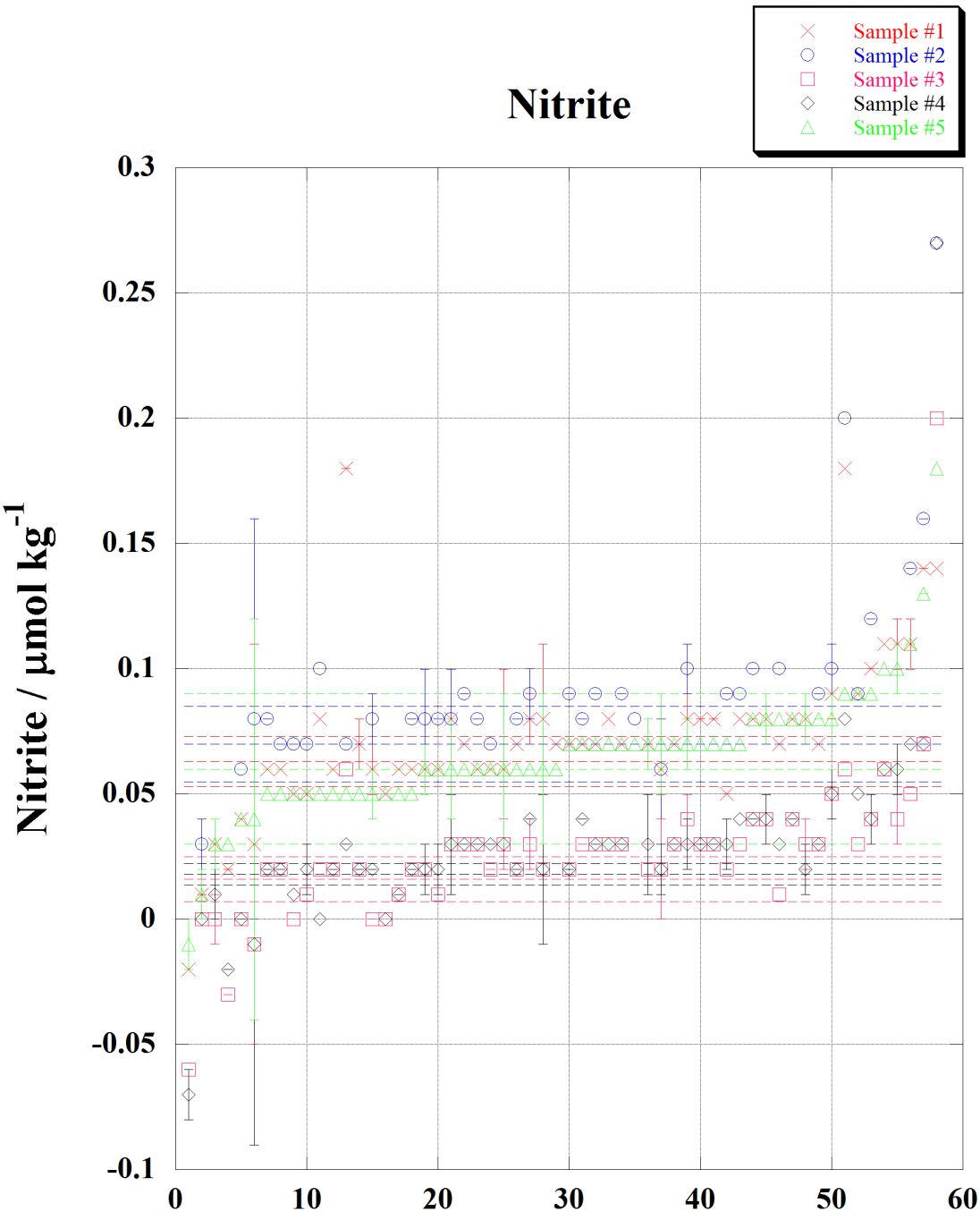

Figure 3. Nitrite results for five CRMs. Laboratories are ranked in order of concentrations reported for sample #5.

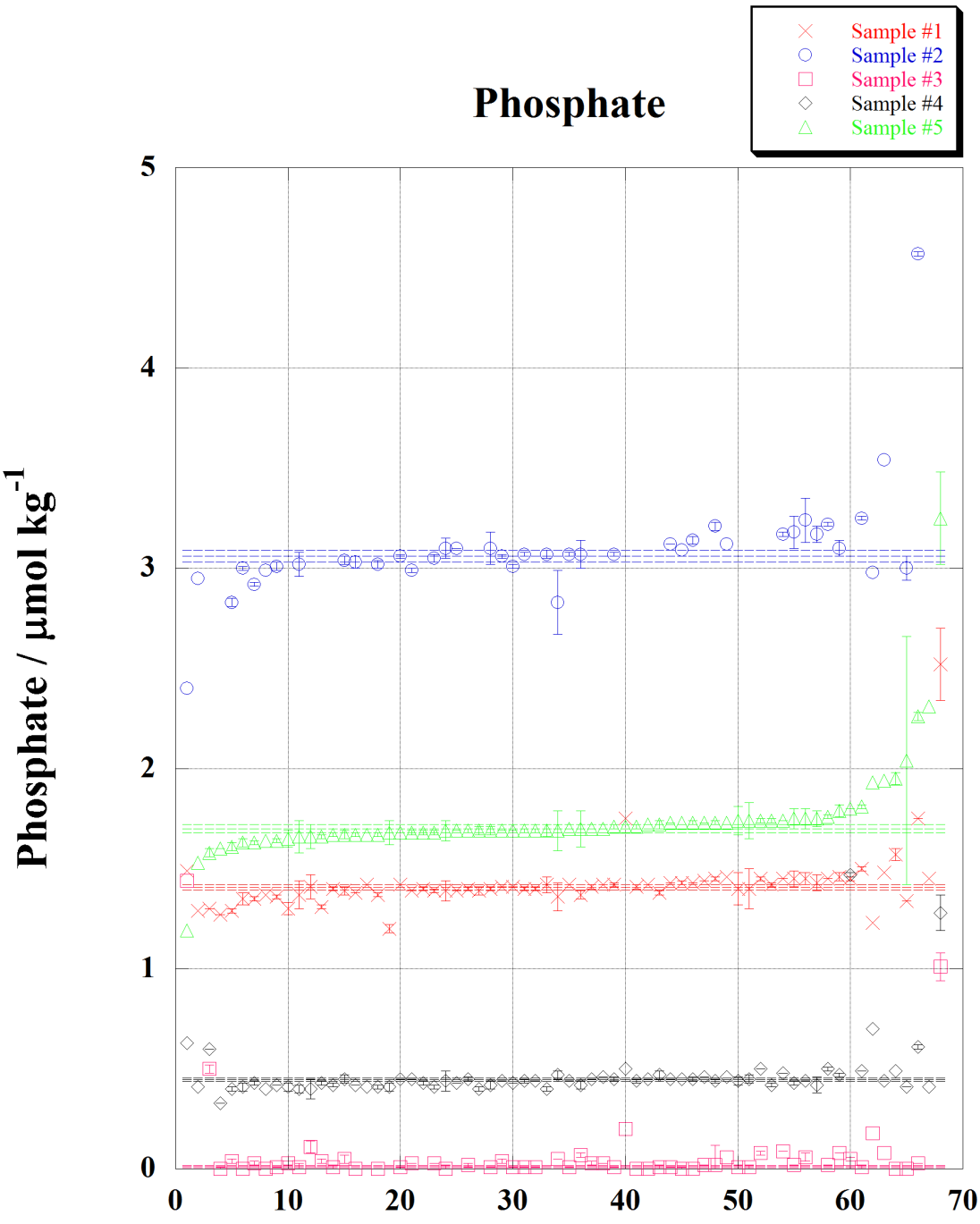

Figure 4. Phosphate results for five CRMs. Laboratories are ranked in order of concentrations reported for sample #5.

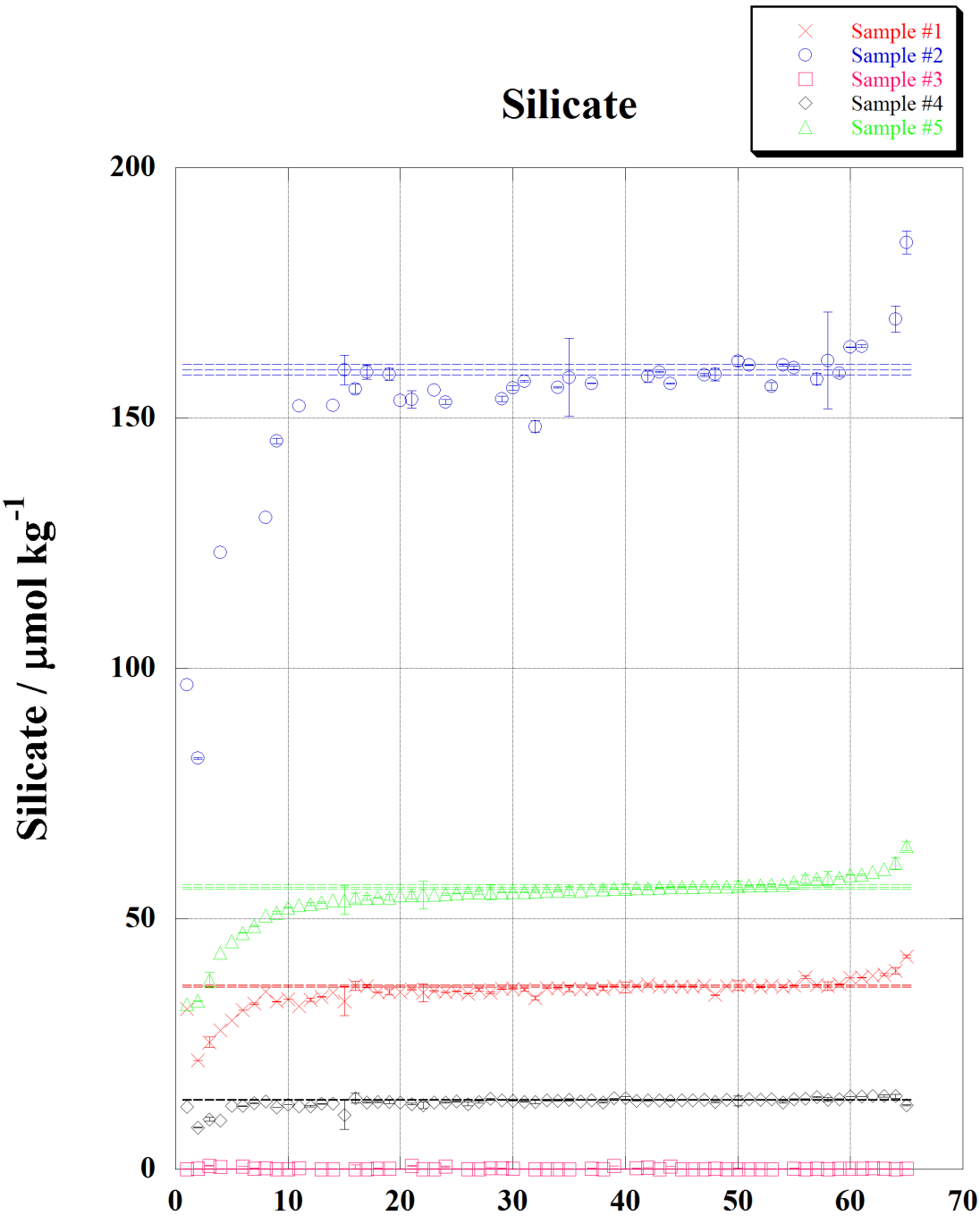

Figure 5. Silicate results for five CRMs. Laboratories are ranked in order of concentrations reported for sample #5.

5.2 Consensus means, medians, and standard deviations

The consensus means, medians, and standard deviations (Table 4) were calculated using the data that passed the successive *t*-test screens described in Section 4.1. The consensus means and medians were in close agreement for all parameters for all samples. The consensus means and medians for all parameters were within the uncertainties of the certified values of the CRMs used as samples #1 to #5.

Table 4. Consensus means, medians, and standard deviations, and certified values and uncertainties of five samples.

Nutrient	Sample #	N*	Consensus Mean µmol kg^{-1}	Consensus Median µmol kg^{-1}	Consensus SD µmol kg^{-1}	Certified values µmol kg^{-1}	uncertainty (k =2) µmol kg^{-1}
Nitrate + Nitrite	Sample#1	36 (62)	19.71	19.71	0.14	19.72	0.16
	Sample#2	23 (38)	43.38	43.43	0.33	43.5	0.4
	Sample#3	35 (56)	0.05	0.06	0.03	0.03	0.04
	Sample#4	42 (62)	5.51	5.52	0.10	5.52	0.05
	Sample#5	32 (62)	23.81	23.81	0.16	23.8	0.2
Nitrate	Sample#1	31 (53)	19.67	19.66	0.15	19.66	0.15
	Sample#2	22 (34)	43.24	43.18	0.34	43.4	0.4
	Sample#3	26 (50)	0.03	0.03	0.02	0.01	0.03
	Sample#4	38 (53)	5.50	5.50	0.11	5.498	0.050
	Sample#5	39 (53)	23.65	23.74	0.38	23.7	0.2
Nitrite	Sample#1	43 (58)	0.07	0.07	0.01	0.063	0.010
	Sample#2	30 (38)	0.08	0.08	0.01	0.070	0.015
	Sample#3	46 (56)	0.02	0.02	0.01	0.016	0.009
	Sample#4	41 (56)	0.03	0.03	0.01	0.018	0.0044
	Sample#5	49 (58)	0.06	0.06	0.01	0.06	0.03
Phosphate	Sample#1	50 (68)	1.41	1.41	0.03	1.407	0.014
	Sample#2	31 (41)	3.06	3.07	0.06	3.06	0.03
	Sample#3	39 (59)	0.01	0.01	0.01	0.012	0.006
	Sample#4	55 (68)	0.43	0.43	0.02	0.446	0.0082
	Sample#5	51 (68)	1.70	1.69	0.03	1.70	0.02
Silicate	Sample#1	43 (66)	36.18	36.19	0.53	36.58	0.22
	Sample#2	29 (39)	157.34	157.84	2.66	159.7	1.0
	Sample#3	41 (59)	0.06	0.05	0.06	0.06	0.09
	Sample#4	46 (66)	13.69	13.71	0.32	13.93	0.099
	Sample#5	39 (65)	55.67	55.65	0.78	56.4	0.5

***Numbers in parentheses are the initial numbers of values before successive *t*-tests reduced the sample size to *n* (see text).**

5.3 Summary of analytical precision of participating laboratories and consensus standard deviations

Table 5 compares the median and range of analytical precision reported by participants (analytical precision of participating laboratory in Table 4) and the consensus standard deviation in terms of the coefficient of variation relative to the consensus median values are shown in Table 4.

Table 5. Median and range of analytical precision of participating laboratories, and consensus coefficient of variation for nutrient analyses of all samples.

Sample #	Nutrients	Analytical precision of participating laboratories		Consensus coefficient of variation	
		N	Median % (range)	N	CV (%)
Sample #1	Nitrate+Nitrite	52	0.3 (0–5)	36	0.7
	Phosphate	59	0.7 (0–7.1)	50	2.1
	Silicate	57	0.3 (0–8.7)	43	1.5
Sample #2	Nitrate+Nitrite	32	0.3 (0–3.6)	23	0.8
	Phosphate	34	0.6 (0–5.7)	31	2.0
	Silicate	32	0.4 (0–6)	29	1.7
Sample #3	Nitrate+Nitrite	46	16.7 (0 to 330)	35	50
	Phosphate	42	5.5 (0 to 500)	39	100
	Silicate	43	18.8 (0 to 700)	41	120
Sample #4	Nitrate+Nitrite	52	0.5 (0–8.3)	42	1.8
	Phosphate	57	2.3 (0–12.5)	55	4.7
	Silicate	56	0.7 (0–26.7)	46	2.3
Sample #5	Nitrate+Nitrite	51	0.4 (0–5)	32	0.7
	Phosphate	58	0.6 (0–30.4)	51	1.8
	Silicate	54	0.3 (0–5.4)	39	1.4

5.4 *Z*-scores

Tables 6-1 to 6-7 present *Z*-scores for participating laboratories computed as described in section 4.4. *Z*-scores indicate how the measurement of a particular determinant in a sample by an individual laboratory compared to the consensus value for that determinant in that sample as determined by all participating laboratories. *Z*-values are proportional to the consensus standard deviation, with a *Z*-value less than 1.0 indicating a measurement within ±1 SD of the consensus median value.

Table 6-1. *Z*-scores for nitrate+nitrite analyses.

Lab	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
5	0.9	0.7		1.0	0.1
7	3.0	0.3	0.3	2.3	1.7
8	0.2	1.4	1.7	1.0	3.3
10	0.1	9.4	0.7	0.2	0.0
14	3.1	0.9	0.7	1.9	3.1
17	132.6	121.4	100.3	52.9	138.9
19	0.4	1.2	0.0	0.4	0.4
23	5.9	5.6	1.0	3.2	6.6
26	11.6	3.9	0.3	0.4	4.1
27	2.9		0.7	1.4	2.6
28	0.1		4.0	0.4	0.7
29	1.8		2.0	0.8	1.9
30					
32	9.2			1.9	6.8
35	0.4	0.5	1.7	0.6	0.2
37					
38	11.5	5.3	0.7	6.1	9.1
39	0.9	0.9	0.0	0.4	0.9
40	0.9	0.1	7.3	0.4	3.3
41	1.5	22.9	5.0	6.3	7.4
45					
49	3.5	2.7	0.3	1.5	4.4
50	0.1	1.2	0.0	1.1	0.4
51	1.9		4.3	0.8	1.5
52	0.2		5.3	1.0	1.3
56	0.6	0.4	3.0	0.3	1.1
57	0.4	0.3	0.3	0.6	1.1
59	1.1	1.6	5.3	3.5	4.1
65	0.7	0.2	0.7	0.4	0.9
69	6.3			8.3	8.6
80	38.7	43.2	53.0	21.6	47.9
86	1.8	0.4	1.0	0.2	0.8
88	7.1		3.7	5.6	0.8
89	3.1	21.3	1.0	4.8	1.8
90	21.3	15.1	58.3	3.3	17.0
91	0.0		2.0	0.3	0.3
92	0.0		0.3	0.1	0.1
93	0.7	0.9	0.7	0.9	1.4

Table 6-1. *Z*-scores for nitrate+nitrite analyses (continued).

Lab	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
95	0.4	4.6	1.7	0.3	0.1
98	4.5		1.7	2.8	4.3
101	6.3		6.7	0.5	9.3
102	1.4		0.0	0.1	4.9
106	1.7	14.7	1.0	0.8	15.6
107	1.1		3.3	0.7	1.0
109	1.1	1.0	0.7	0.7	0.0
111	7.1		10.0	8.6	5.1
112	0.1		1.0	1.1	0.3
113	1.0	0.9	1.7	1.4	0.1
114	1.6		1.0	1.4	1.6
118	19.4		2.3	5.2	22.1
124	0.1	0.8	7.7	1.4	0.9
125	1.0	1.3	0.3	0.1	0.6
129					
135	6.3			1.4	7.5
136					
137	1.9	1.3	0.3	1.6	1.1
138	0.1		0.3	0.2	0.4
139					
140	6.1			0.8	3.8
141	0.2		1.0	1.1	2.7
143	7.0	7.8	1.3	3.1	7.9
148	3.6	1.9	2.7	2.6	1.1
149	79.4	59.2	30.3	5.9	77.8
150	15.1		4.7	5.2	14.6
151					
153	19.0			10.4	20.4
155	1.3	1.3	1.0	2.4	2.4
156	4.7	3.9	2.3	1.6	5.0
157	1.3	0.2	3.3	1.1	0.1

Table 6-2. *Z*-scores for nitrate analyses.

Lab	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
5					
7	2.7	0.5	0.5	2.0	1.1
8	0.1	0.8	3.0	0.9	1.1
10	0.1	9.3	1.5	0.0	0.2
14	3.0	0.7	1.0	1.8	1.0
17	122.8	117.7	148.5	47.4	58.7
19	0.1	1.3	1.5	0.6	0.4
23	5.7	5.3	1.5	3.2	2.5
26	10.6	3.9	0.0	0.3	2.0
27	3.0		0.0	1.6	0.9
28	0.1		7.0	0.4	0.1
29					
30					
32	8.7			1.7	2.6
35					
37					
38					
39	0.6	1.0	0.0	0.2	0.6
40	0.8	0.4	11.0	0.4	1.1
41	1.7	21.8	8.5	5.6	3.3
45	2.9		7.0	1.2	1.9
49	3.3	2.3	0.0	1.6	1.6
50	0.1	1.5	0.0	0.8	0.4
51	1.5		5.5	0.5	0.8
52	0.8		10.0	1.3	1.1
56	0.9	0.2	5.5	8.6	0.2
57	0.4	0.1	1.0	0.6	0.1
59	0.9	1.8	15.5	3.3	2.0
65					
69					
80	36.4	41.8	79.5	19.7	19.9
86	1.9	0.5	1.5	0.3	0.6
88	6.8		5.5	5.2	0.1
89	3.4	0.5	0.0	4.9	0.6
90	20.8	14.4	85.0	3.1	6.9
91					
92	0.2		0.5	0.0	0.3
93	0.7	0.6	0.5	0.7	0.3

Table 6-2. *Z*-scores for nitrate analyses (continued).

Lab	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
95	0.2	4.2	1.5	0.2	0.2
98					
101	2.0		12.0	0.7	2.3
102	1.3		0.5	0.0	1.8
106	1.3	14.4	1.0	1.0	6.8
107	0.9		4.5	0.6	0.7
109	0.8	0.8	0.5	0.6	0.2
111	6.2		12.5	7.4	2.3
112					
113	1.1	0.7	1.5	1.1	0.2
114					
118	18.4		3.5	4.8	9.0
124	0.2	0.4	12.5	1.4	0.8
125	0.6	1.4	1.0	0.3	0.4
129	3.7		1.5	1.4	1.7
135					
136	4.5		11.5	0.9	2.6
137	1.6	1.4	0.5	1.4	0.7
138	0.3		0.5	0.0	0.1
139	1.6	0.9	47.5	0.6	0.3
140					
141	0.4		1.0	0.8	1.4
143	6.6	7.4	1.5	3.0	3.1
148	3.1	1.7	3.5	2.0	0.7
149					
150					
151	13.2		107.5	14.2	10.5
153	17.3			9.6	9.0
155	1.5	1.0		2.5	0.8
156	4.8	3.8	2.5	1.7	1.9
157	1.0	0.5	3.5	0.8	0.4

Table 6-3. *Z*-scores for nitrite analyses.

Lab	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
5	0.0	1.0	0.0	1.0	1.0
7	1.0	0.0	0.0	1.0	0.0
8	1.0	0.0	1.0	1.0	0.0
10	1.0	0.0	1.0	0.0	0.0
14	1.0	0.0	0.0	1.0	1.0
17	11.0	12.0	4.0	5.0	3.0
19	1.0	2.0	2.0	1.0	2.0
23	0.0	0.0	1.0	1.0	1.0
26	0.0	1.0	1.0	0.0	1.0
27	1.0		2.0	1.0	2.0
28	4.0		2.0	2.0	3.0
29	1.0		1.0	0.0	1.0
30	7.0	19.0	18.0	24.0	12.0
32					
35	0.0	1.0	1.0	0.0	0.0
37					
38	1.0	0.0	1.0	0.0	0.0
39	0.0	1.0	1.0	0.0	1.0
40		0.0			1.0
41	0.0	2.0	1.0	0.0	2.0
45	0.0		0.0	0.0	1.0
49	1.0	1.0	0.0	1.0	1.0
50	1.0	1.0	0.0	0.0	0.0
51	1.0		2.0	1.0	2.0
52	1.0		1.0	0.0	0.0
56	2.0	1.0	2.0	2.0	1.0
57	2.0	1.0	1.0	1.0	1.0
59	1.0	2.0	0.0	1.0	1.0
65					
69					
80	1.0	2.0	0.0	3.0	1.0
86	0.0	0.0	0.0	1.0	0.0
88	1.0		0.0	1.0	1.0
89	4.0	6.0	3.0	4.0	5.0
90	11.0	1.0	4.0	0.0	1.0
91					
92	0.0		0.0	1.0	1.0
93	3.0	2.0	2.0	3.0	2.0

Table 6-3. *Z*-scores for nitrite analyses (continued).

Lab	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
95	1.0	0.0	2.0	1.0	1.0
98					
101	5.0		5.0	5.0	3.0
102	2.0		2.0	3.0	1.0
106	1.0	1.0	1.0	1.0	0.0
107	1.0		1.0	1.0	2.0
109	0.0	1.0	1.0	0.0	2.0
111	4.0		4.0	3.0	4.0
112	0.0		1.0	0.0	1.0
113	1.0	2.0	2.0	0.0	1.0
114					
118	1.0		0.0	1.0	0.0
124					
125	2.0	2.0	3.0	2.0	2.0
129	1.0		1.0	2.0	1.0
135	0.0				0.0
136	9.0		8.0	10.0	7.0
137	1.0	0.0	0.0	1.0	1.0
138	1.0		1.0	0.0	1.0
139	6.0	5.0	2.0	3.0	5.0
140					
141	1.0		1.0	0.0	1.0
143	2.0	1.0	0.0	0.0	1.0
148	2.0	1.0	1.0	2.0	3.0
149	7.0	8.0	5.0	4.0	7.0
150					
151	4.0		2.0	3.0	4.0
153	5.0				
155	1.0	1.0	1.0	1.0	1.0
156	3.0	4.0	2.0	1.0	3.0
157	4.0	0.0	3.0	4.0	2.0

Table 6-4. *Z*-scores for phosphate analyses.

Lab	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
5	1.7	0.7	7.0	2.0	3.0
7	1.3	2.0	1.0	0.0	1.7
8	1.3	3.0	5.0	0.5	1.7
10	0.7	0.7	1.0	0.5	0.3
14	0.7	0.7		0.0	0.3
17	2.3	8.0	7.0	0.5	8.0
19	0.3	0.2	0.0	1.0	0.3
23	1.3	2.7	1.0	3.5	2.0
26	1.3	0.7	0.0	1.5	1.3
27	0.3		0.0	0.5	1.0
28	0.0		10.0	1.5	1.3
29	0.3		1.0	1.0	0.3
30	2.7	11.0	143.0	10.0	17.0
32	7.0			1.0	0.7
35	0.3	0.2	0.0	0.5	0.0
37	0.3	0.0	0.0	1.0	0.7
38	0.7	1.2	2.0	1.0	0.7
39	0.7	1.0	0.0	1.0	1.0
40	4.0	1.8		1.0	5.7
41	1.3	1.2	1.0	1.5	2.0
45	0.7			1.5	0.3
49					
50	0.3	0.7	0.0	0.5	0.3
51	0.3			0.0	0.7
52	0.3		0.0	0.5	1.3
56	0.7	0.5	1.0	1.0	1.0
57	2.0	1.0	1.0	1.0	2.3
59	1.3	0.2	6.0	0.5	0.0
65	0.0	0.0	3.0	0.5	0.3
69	1.3		4.0	52.0	3.3
80	6.0	1.3	17.0	13.5	7.7
86	0.0	0.8	0.0	0.0	0.3
88	4.7		1.0	5.0	3.3
89	11.3	25.2	2.0	9.0	18.7
90	4.0	3.8	3.0	1.5	3.0
91	0.3		1.0	1.0	0.7
92	0.0		2.0	1.0	0.0
93	1.7	0.8	0.0	0.5	2.0

Table 6-4. *Z*-scores for phosphate analyses (continued).

Lab	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
95	2.3	1.0	1.0	1.0	11.3
98	37.0		100.0	42.5	51.7
101	1.0		0.0	2.0	0.7
102	5.3		1.0	3.0	8.3
106	3.0	3.2	0.0	3.0	3.7
107	0.3		0.0	1.0	1.3
109	0.3	0.2	0.0	0.5	0.3
111	11.3		19.0	3.5	0.3
112	0.3		0.0	0.5	0.3
113	0.7	0.3	4.0	1.0	1.0
114	1.0	0.5	1.0	0.5	1.0
118	0.0		1.0	0.5	0.3
124	0.3	0.2		1.5	0.3
125	2.0	2.3	2.0	0.0	2.3
129	1.3		7.0	3.5	1.3
135	0.3			1.0	1.0
136	3.7		2.0	1.0	1.7
137	0.7	1.3	1.0	1.0	1.0
138	0.3		2.0	1.5	0.0
139	0.7	0.2	2.0	1.0	0.7
140	0.3			0.5	1.3
141	1.0		1.0	1.5	1.0
143	1.3	2.5	1.0	0.5	1.0
148	1.7	1.0	5.0	1.5	1.0
149	1.3	1.8	8.0	2.5	1.3
150	3.7		49.0	8.5	4.0
151	3.3		3.0	0.0	1.3
153	1.3			1.0	20.3
155	1.7	3.8	4.0	2.0	0.3
156	1.3	0.7	1.0	1.0	1.0
157	0.7	1.8	5.0	0.5	1.7

Table 6-5. *Z*-scores for silicate analyses.

Lab	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
5	1.4	0.4	5.7	0.5	0.7
7	0.8	0.7	0.5	0.9	1.8
8	1.3	0.5	1.5	0.7	1.7
10	1.1	1.5	1.0	0.0	1.2
14	0.7	0.2	9.5	0.1	0.9
17	15.8	12.8	7.8	12.3	15.9
19	1.2	1.2	0.2	1.0	1.3
23	2.6	0.5	1.7	0.7	1.0
26	0.8	1.6	0.7	0.8	3.1
27	0.5		0.5	0.7	1.4
28	0.5		0.2	0.7	0.5
29	5.8		1.2	1.3	9.0
30	7.9	22.8	1.0	3.7	29.1
32	1.7		3.7	1.5	0.4
35	0.6	0.7	0.7	0.4	0.7
37					
38	3.6	3.4	0.0	0.7	0.3
39	1.0	0.5	0.0	0.6	1.0
40	1.4	1.4		1.0	1.2
41	1.6	1.8	1.0	1.6	2.4
45	1.9		0.5	1.9	0.5
49	0.3	1.3	3.2	0.5	0.4
50	1.2	0.2	1.7	2.4	3.0
51	1.2			0.5	0.7
52	0.1		1.0	0.9	0.4
56	1.0	0.6	1.0	1.0	1.0
57	1.1	0.4	0.7	1.2	1.4
59	0.4	1.3	11.3	1.8	1.2
65	0.2	0.1	1.2	0.2	0.3
69					
80	1.1	10.2	4.2	0.4	6.4
86	1.2	1.0	2.2	1.0	2.2
88	0.0		1.0	0.2	0.1
89	0.5	0.0		0.5	0.4
90	5.0	4.5	0.7	4.1	5.6
91	0.7		1.2	0.4	0.9
92	0.9		0.8	0.8	1.1
93	0.2	0.5	0.8	0.1	0.4

Table 6-5. *Z*-scores for silicate analyses (continued).

Lab	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
95	6.6	4.7	1.0	3.0	7.0
98	20.3		11.5	11.5	22.9
101	3.2		0.8	1.8	3.1
102	5.2		2.0	3.0	5.5
106	12.1	10.4	1.0	2.8	11.4
107	1.7		1.0	2.7	1.1
109	4.1	2.7	1.2	2.8	4.1
111	4.8		3.5	3.1	4.9
112	0.7		1.0	0.4	1.0
113	1.0	0.6	1.0	1.8	1.9
114	4.7		0.7	2.5	
118	4.3		10.0	3.3	3.5
124	0.5	1.2		0.9	1.5
125	0.0	0.4	0.8	0.2	0.1
129	1.4		2.3	0.7	1.8
135	0.4			0.3	0.0
136	4.2		0.5	1.3	3.0
137	3.9	2.6	1.0	2.8	4.0
138	0.6		10.5	1.8	0.5
139	1.4	1.5	8.8	1.0	0.9
140	0.3			1.8	0.5
141	0.8		3.5	0.0	0.7
143					
148	6.7	1.8	2.8	3.5	3.7
149	27.2	28.3	1.7	16.5	28.3
150	4.1		0.2	2.3	4.3
151	8.2		9.0	3.2	10.8
153	12.2			3.0	13.0
155	0.1	0.3	0.5	0.8	0.0
156	1.6	0.6	0.8	1.1	3.3
157	4.9	0.9	50.3	8.8	2.4

Table 6-6. Combined *Z*-scores for phosphate and nitrate+nitrite analyses.

Lab	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
5	1.3	0.7		1.5	1.6
7	2.2	1.2	0.7	1.2	1.7
8	0.8	2.2	3.4	0.8	2.5
10	0.4	5.1	0.9	0.4	0.2
14	1.9	0.8		1.0	1.7
17	67.5	64.7	53.7	26.7	73.5
19	0.4	0.7	0.0	0.7	0.4
23	3.6	4.2	1.0	3.4	4.3
26	6.5	2.3	0.2	1.0	2.7
27	1.6		0.4	1.0	1.8
28	0.1		7.0	1.0	1.0
29	1.1		1.5	0.9	1.1
30					
32	8.1			1.5	3.8
35	0.4	0.4	0.9	0.6	0.1
37					
38	6.1	3.3	1.4	3.6	4.9
39	0.8	1.0	0.0	0.7	1.0
40	2.5	1.0		0.7	4.5
41	1.4	12.1	3.0	3.9	4.7
45	1.8			1.4	1.1
49					
50	0.2	1.0	0.0	0.8	0.4
51	1.1			0.4	1.1
52	0.3		2.7	0.8	1.3
56	0.7	0.5	2.0	0.7	1.1
57	1.2	0.7	0.7	0.8	1.7
59	1.2	0.9	5.7	2.0	2.1
65	0.4	0.1	1.9	0.5	0.6
69	3.8			30.2	6.0
80	22.4	22.3	35.0	17.6	27.8
86	0.9	0.6	0.5	0.1	0.6
88	5.9		2.4	5.3	2.1
89	7.2	23.3	1.5	6.9	10.3
90	12.7	9.5	30.7	2.4	10.0
91	0.2		1.5	0.7	0.5
92	0.0		1.2	0.6	0.1
93	1.2	0.9	0.4	0.7	1.7

Table 6-6. Combined *Z*-scores for phosphate and nitrate+nitrite analyses (continued).

Lab	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
95	1.4	2.8	1.4	0.7	5.7
98	20.8		50.9	22.7	28.0
101	3.7		3.4	1.3	5.0
102	3.4		0.5	1.6	6.6
106	2.4	9.0	0.5	1.9	9.7
107	0.7		1.7	0.9	1.2
109	0.7	0.6	0.4	0.6	0.2
111	9.2		14.5	6.1	2.7
112	0.2		0.5	0.8	0.3
113	0.9	0.6	2.9	1.2	0.6
114	1.3		1.0	1.0	1.3
118	9.7		1.7	2.9	11.2
124	0.2	0.5		1.5	0.6
125	1.5	1.8	1.2	0.1	1.5
129	2.5		4.3	2.5	1.5
135	3.3			1.2	4.3
136	4.1		6.8	1.0	2.2
137	1.3	1.3	0.7	1.3	1.1
138	0.2		1.2	0.9	0.2
139	1.2	0.6	24.8	0.8	0.5
140	3.2			0.7	2.6
141	0.6		1.0	1.3	1.9
143	4.2	5.2	1.2	1.8	4.5
148	2.7	1.5	3.9	2.1	1.1
149	40.4	30.5	19.2	4.2	39.6
150	9.4		26.9	6.9	9.3
151	8.3		55.3	7.1	5.9
153	10.2			5.7	20.4
155	1.5	2.6	2.5	2.2	1.4
156	3.0	2.3	1.7	1.3	3.0
157	1.0	1.0	4.2	0.8	0.9

Table 6-7. Combined *Z*-scores for phosphate, nitrate+nitrite, and silicate analyses.

Lab	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
5	1.3	0.6		1.2	1.3
7	1.7	1.0	0.6	1.1	1.7
8	0.9	1.6	2.7	0.7	2.2
10	0.6	3.9	0.9	0.2	0.5
14	1.5	0.6		0.7	1.4
17	50.2	47.4	38.4	21.9	54.3
19	0.6	0.9	0.1	0.8	0.7
23	3.3	2.9	1.2	2.5	3.2
26	4.6	2.1	0.3	0.9	2.8
27	1.2		0.4	0.9	1.7
28	0.2		4.7	0.9	0.8
29	2.6		1.4	1.0	3.7
30					
32	6.0			1.5	2.6
35	0.4	0.5	0.8	0.5	0.3
37					
38	5.3	3.3	0.9	2.6	3.4
39	0.9	0.8	0.0	0.7	1.0
40	2.1	1.1		0.8	3.4
41	1.5	8.6	2.3	3.1	3.9
45	1.8			1.5	0.9
49					
50	0.5	0.7	0.6	1.3	1.2
51	1.1			0.4	1.0
52	0.2		2.1	0.8	1.0
56	0.8	0.5	1.7	0.8	1.0
57	1.2	0.6	0.7	0.9	1.6
59	0.9	1.0	7.5	1.9	1.8
65	0.3	0.1	1.6	0.4	0.5
69					
80	15.3	18.2	24.7	11.8	20.7
86	1.0	0.7	1.1	0.4	1.1
88	3.9		1.9	3.6	1.4
89	5.0	15.5		4.8	7.0
90	10.1	7.8	20.7	3.0	8.5
91	0.3		1.4	0.6	0.6
92	0.3		1.0	0.6	0.4
93	0.9	0.7	0.5	0.5	1.3

Table 6-7. Combined *Z*-scores for phosphate, nitrate+nitrite, and silicate analyses (continued).

Lab	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5
95	3.1	3.4	1.2	1.4	6.1
98	20.6		37.7	18.9	26.3
101	3.5		2.5	1.4	4.4
102	4.0		1.0	2.0	6.2
106	5.6	9.4	0.7	2.2	10.2
107	1.0		1.4	1.5	1.1
109	1.8	1.3	0.6	1.3	1.5
111	7.7		10.8	5.1	3.4
112	0.4		0.7	0.7	0.5
113	0.9	0.6	2.2	1.4	1.0
114	2.4		0.9	1.5	
118	7.9		4.4	3.0	8.6
124	0.3	0.7		1.3	0.9
125	1.0	1.3	1.0	0.1	1.0
129	2.1		3.6	1.9	1.6
135	2.3			0.9	2.8
136	4.1		4.7	1.1	2.4
137	2.2	1.7	0.8	1.8	2.0
138	0.3		4.3	1.2	0.3
139	1.2	0.9	19.4	0.9	0.6
140	2.2			1.0	1.9
141	0.7		1.8	0.9	1.5
143					
148	4.0	1.6	3.5	2.5	1.9
149	36.0	29.8	13.3	8.3	35.8
150	7.6		18.0	5.3	7.6
151	8.2		39.8	5.8	7.5
153	10.8			4.8	17.9
155	1.0	1.8	1.8	1.7	0.9
156	2.5	1.7	1.4	1.2	3.1
157	2.3	1.0	19.5	3.5	1.4

5.5 Normalized cumulative distributions of reported nitrate, phosphate, and silicate concentrations in the 2008, 2012, 2015, and 2018 I/C studies

Normalized cumulative distributions of reported nitrate, phosphate, and silicate concentrations in the 2008, 2012, 2015, and 2018 I/C studies are shown in Figures 6–8.

Each reported concentration from a participating laboratory was divided by the consensus median (2008 I/C and 2012 I/C) or certified value (2015 I/C and 2018 I/C) of each comparison study to compare comparability among the laboratories in each I/C exercise in 2008, 2012, 2015, and 2018. Y-axis in Figure 6, 7 and 8 show concentration ratio to consensus median (2008 I/C and 2012 I/C) or certified value (2015 I/C and 2018 I/C) while X-axis show rank of each laboratory in terms of percent in each I/C. Phosphate concentrations were around 1.5 μmol kg^{-1} in four I/C exercises, Nitrate concentrations ranged from 24 to 35 μmol kg^{-1}in four I/C exercises. Silicate concentrations were around 55-66 μmol kg^{-1} in 2008, 2012 and 2018 I/C exercises and 101 μmol kg^{-1} in 2015 I/C exercise due to availability of data.

The normalized cumulative distributions for nitrate and phosphate in 2018 were improved (i.e., flatter) compared with the normalized cumulative distributions of previous IC exercises. This improvement might indicate that comparability of nitrate and phosphate analyses among the laboratories became gradually better from 2008 to 2018. In contrast to the nitrate and phosphate results, the normalized cumulative distributions for silicate were similar in 2018 and in previous years. The comparability of silicate analyses among the laboratories apparently did not change from 2008 to 2018.

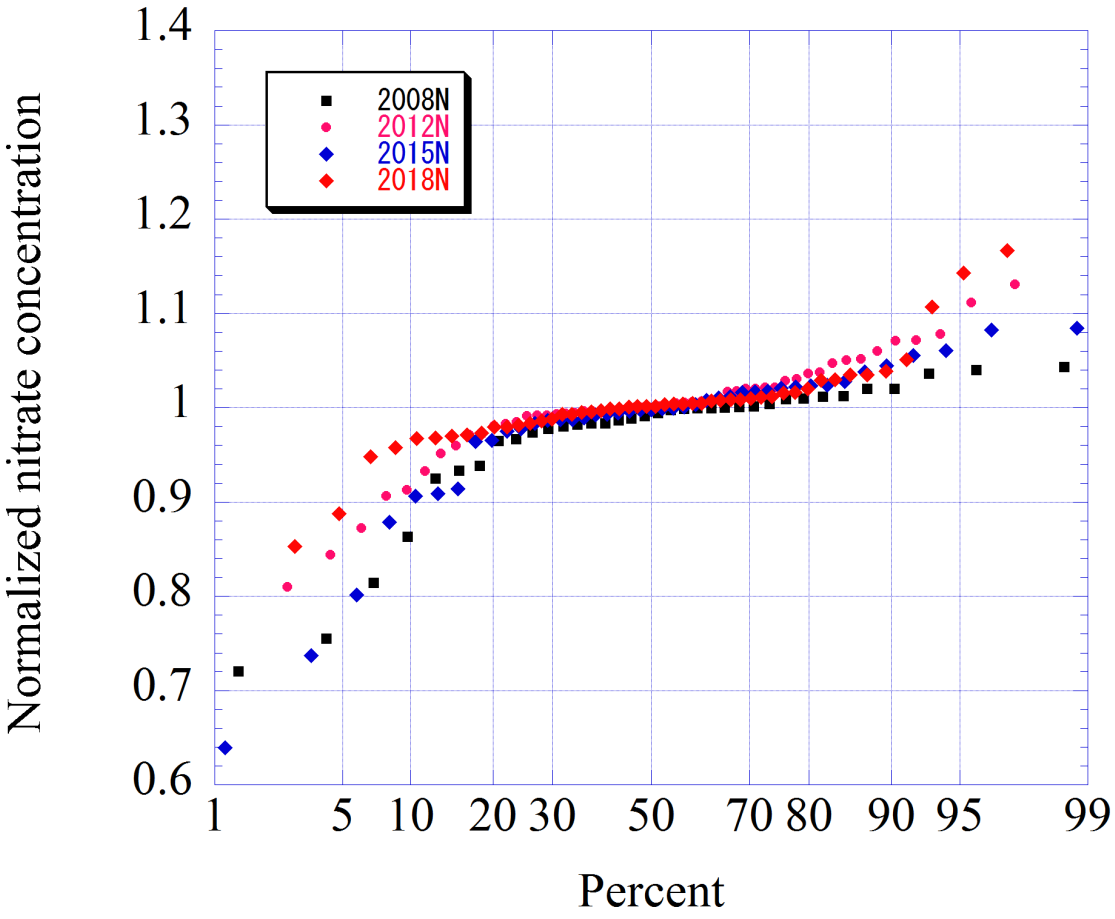

Figure 6. Cumulative distribution of reported nitrate concentrations in the 2008, 2012, 2015, and 2018 I/C studies.

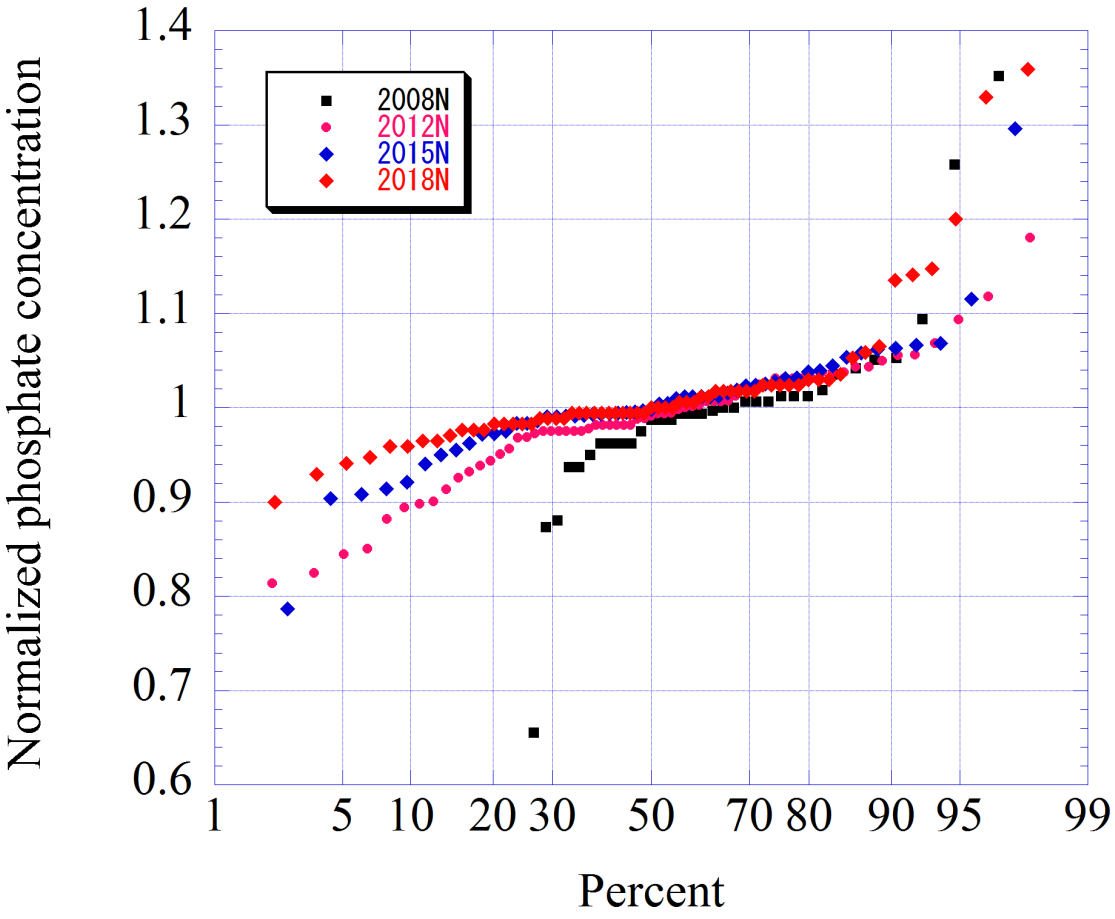

Figure 7. Cumulative distribution of reported phosphate concentrations in the 2008, 2012, 2015, and 2018 I/C studies.

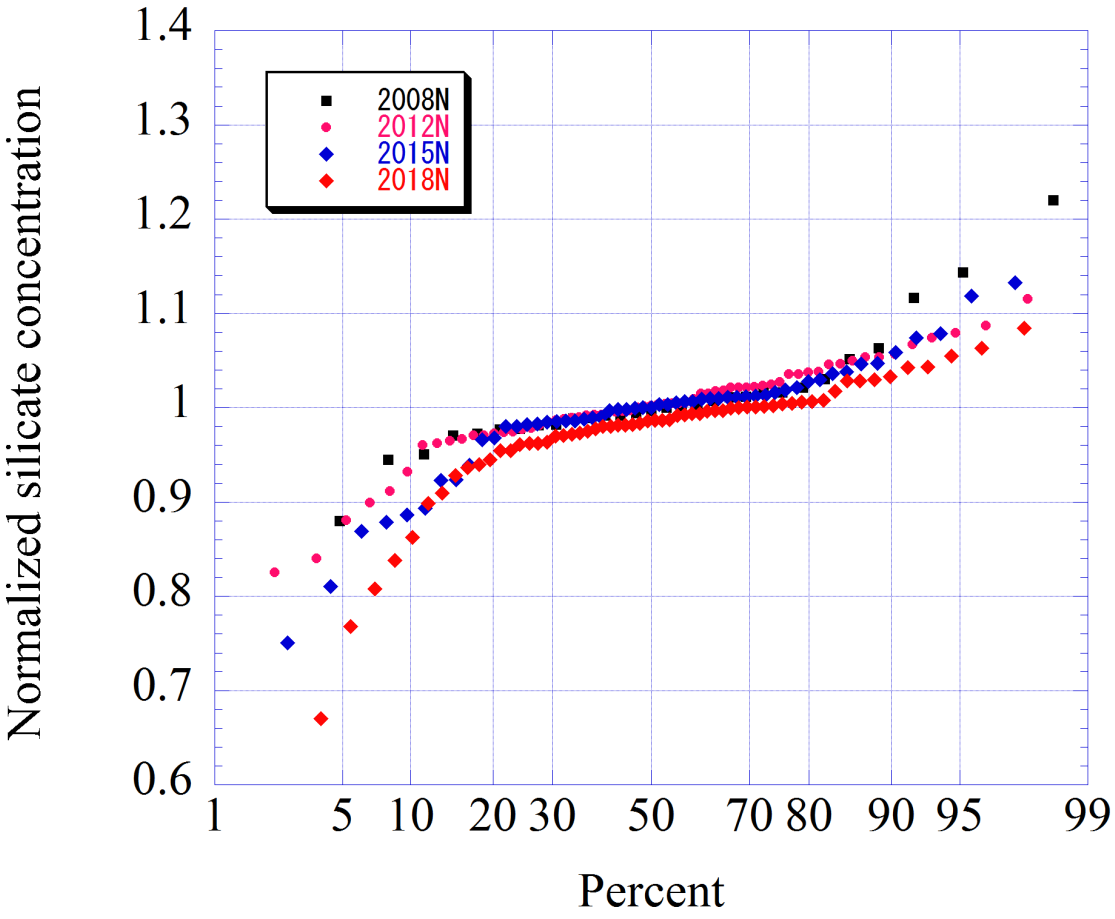

Figure 8. Cumulative distribution of reported silicate concentrations in the 2008, 2012, 2015, and 2018 I/C studies.

6. Comparison with certified values and current status of CRM use

We see excellent agreement between consensus median/mean and certified values within uncertainty as shown in Table 4. However, small discrepancies exist among core laboratories that reported close-to-consensus values and between those laboratories and certified values, as shown in Figures 1 to 5.

In this IC exercise, participants were asked about their methodology and about the instruments they used to measure nutrient concentrations in the CRM/RM. For the main four determinants (nitrate+nitrite, nitrate, nitrite, phosphate, and silicate), 28 laboratories among the 69 laboratories stated that they used the following:

CRMs:	
KANSO	25 laboratories
SCOR-JAMSTEC	2 laboratories
NMIJ	1 laboratory
RMs:	
MOOS-3	1 laboratory
VKI-Eurofin	2 laboratories
Quasimeme	2 laboratories
EstoniaRM	1 laboratory
OSIL	2 laboratories
WAKO	1 laboratory
Reagecon RM	1 laboratory

Thirty-eight laboratories among the 69 laboratories used a CRM/RM; the remaining 31 laboratories did not use a CRM/RM or did not reply to the questionnaire. It is obvious that the number of laboratories that use CRMs has been increasing since 2008, especially after the GO-SHIP nutrients manual was published in 2010 (Hyde et al., 2010). In general, the results reported by laboratories that used CRMs are located in the central part of the ranked plots, and their *Z*-scores were good in general, as expected.

The results of this IC exercise imply that the majority of the participating laboratories are very capable of measuring nutrient concentrations in seawater. Use of CRMs will further enhance the comparability of their assay results. The results could be SI traceable in the near future.

7. Discussion and conclusions

In each of Figures 1 to 5, the ranked concentration plots for a particular nutrient would be proportional and roughly parallel to each other for samples with different

nutrient concentrations if each laboratory compensated appropriately for the nonlinearity of the calibration curves. However, as is evident in Figures 1 to 5, there were non-proportional results from some laboratories for all of the determinants. This was also the case in the previous I/C studies.

These results indicate that nonlinearity of the calibration curves for nutrient analysis is a significant cause of lower comparability of the nutrient data. The implication is that we need to use a set of nutrient CRMs that includes the whole range of nutrient concentrations in the world's oceans in order to maintain comparability of results throughout that range of nutrient concentrations.

The normalized cumulative distributions of nitrate and phosphate were better in 2018 than in previous years. The curves were flatter compared with the normalized cumulative distributions in previous IC exercises. The indication is that comparability of nitrate and phosphate analyses among the laboratories gradually improved from 2008 to 2018. In contrast with the nitrate and phosphate results, the normalized cumulative distribution for silicate in 2018 was similar to the distributions from previous years. The indication is that comparability of silicate analyses among the laboratories did not change during the same time period.

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Appendix I

Table A1 List of participants

Table A2 Cross reference for Lab numbers in 2018, 2015, 2012, 2008, 2006 and 2003 I/C studies

Table A1 List of participants

Lab#	Name	Affliation	Country
5	Marc Knockaert Koen Parmentier	OD NATURE – ECOCHEM	Belgium
7	Elisabete de Santis Braga Vitor Gonsalez Chiozzini	Oceanographic Institute of the University of São Paulo	Brazil
8	Rodolfo Paranhos	Institute of Biology, Rio de Janeiro Federal University (UFRJ)	Brazil
10	Chris Payne	University of British Columbia, Department of Earth, Ocean & Atmospheric Sciences	Canada
14	Minhan Dai Lifang Wang	Laboratory of Marine Environmental Science, Xiamen University	China
17	Jun Sun	College of Marine and Environmental Sciences, Tianjin University of Science and Technology	China
19	Anne Daniel Florian Caradec	Ifremer, DYNECO/PELAGOS, Plouzané	France
23	Patrick Raimbault	The National Center for Scientific Research (CNRS), Mediterranean Institute of Oceanology (MIO)	France
26	Joanna Waniek	Leibniz Institut für Ostseeforschung Warnemünde	Germany
27	Rita Kramer Annika Grage	Bundesamt für Seeschifffahrt und Hydrographie (BSH), Laboratorium Sülldorf	Germany
28	Kai-Uwe Ludwichowski	Alfred-Wegener-Institute Bremerhaven	Germany
29	Alice Benoit-Cattin-Breton Sólveig Rósa Ólafsdóttir	Marine Research Institute	Iceland
30	Muhamed Ashraf P	ICAR-Central Institute of Fisheries Technology, Fishing Technology Division	India
32	Nurit Kress Yael Segal Jacob Silverman	Israel Oceanographic & Limnological Res, National Institute of Oceanography	Israel

35	Naoki Nagai Shu Saito	Marine Division, Global Environment and Marine Department, Japan Meteorological Agency	Japan
37	Takeshi Yoshimura	Graduate School of Environmental Science, Hokkaido University	Japan
38	Taketoshi Kodama	Japan Sea National Fisheries Research Institute, Japan Fisheries Research and Education Agency	Japan
39	Jan van Ooijen	Royal NIOZ	Netherlands
40	Mike Crump	National Institute of Water and Atmospheric Research (NIWA)	New Zealand
41	Kjell Gundersen Linda Lunde Fonnes Jane Strømstad Møgster	Institute of Marine Research	Norway
45	Raymond Edward Roman	University of Cape town, Dept of Oceanography	South Africa
49	Mark Stinchcombe Edward W. Mawji	National Oceanography Centre, Southampton	UK
50	E. Malcolm S. Woodward	Plymouth Marine Laboratory	UK
51	Pamela Walsham	Marine Scotland - Science	UK
52	Claire Mahaffey Clare Davis	Department of Earth, Ocean and Ecological Sciences, SOES, University of Liverpool	UK
56	Susan Becker	Scripps Institution of Oceanography	USA
57	Jia-Zhong Zhang	NOAA Atlantic Oceanographic and Meteorological Laboratory (AOML), Miami, Florida	USA
59	Marguerite Blum	Monterey Bay Aquarium Research Institute	USA
65	Karin Björkman David Karl Carolina Funkey	University of Hawaii at Manoa, Dept. of Oceanography	USA
69	Aristide Márquez	Oriente University, Oceanographic Institute of Venezuela, Departament of Oceanography. Laboratory of nutritious elements	Venezuela

80	Jesus Ledesma	Instituto del Mar del Perú	Peru
86	Martina Kralj Lidia Urbini Michele Giani	Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS)	Italy
88	Durita Sørensen	Faroe Marine Research Institute	Faroe Islands
89	Trevor McCormack Pauline Frew	Scottish Environment Protection Agency	UK
90	Adil Bakir	Environmental Chemistry Analysis Laboratory (ECAL), University of Portsmouth	UK
91	Sarah-Ann Quesnel	Institute of Ocean Sciences, Fisheries and Oceans Canada	Canada
92	Thierry Cariou	Station Biologique de Roscoff, Centre national de la recherche scientifique (CNRS) / Université Pierre et Marie Curie	France
93	Frank Malien	GEOMAR Helmholtz Center for Ocean Research, Kiel	Germany
95	Hema Naik	National Institute of Oceanography	India
98	Silvie Lainela	Estonian Marine Institute of Tartu University	Estonia
101	Jun-Ho Koo	National Institute of Fisheries Science (NIFS)	Republic of Korea
102	Francesca Margiotta Augusto Passarelli Roberto Gallia	Stazione Zoologica Anton Dohrn	Italia
106	Elisa Berdalet Mara Abad	Institut de Ciències del Mar (ICM-CSIC), Barcelona	Spain
107	Laurent Coppola Emilie Diamond Riquier	Observatoire oceanologique de Villefranche-sur-Mer (CNRS-UPMC)	France
109	Tae Keun Rho	KIOST (Korea Institute of Ocean Science & Technology)	Republic of Korea
111	Jolanta Lewandowska	Institute of Oceanology Polish Academy of Sciences, Marine Chemistry and Biochemistry Department	Poland

112	Christine Rees	CSIRO, Oceans and Atmosphere	Australia
113	David Faber Daniel Schuller	Scripps Institution of Oceanography, CalCOFI Group, UC San Diego	USA
114	Miriam E. Solis	LOQyCA – Centro para el estudio de los sistemas marinos (CONICET)	Argentina
118	Colin A. Stedmon Karen Edelvang	Technical University of Denmark, National Institute for Aquatic Resources (AQUA)	Denmark
124	Jinyoung Jung Sung Ho Kang	Korea Polar Reseach Institute	Republic of Korea
125	Peter Thamer Marc Ringuette Kumiko Azetsu-Scott Blair Greenan	Bedford Institute of Oceanography	Canada
129	Fuminori Hashihama	Tokyo University of Marine Science and Technology	Japan
135	Triona McGrath	The Marine Institute	Ireland
136	Claire Normandeau Doug Wallace Liz A. Kerrigan	Dalhousie University in Halifax	Canada
137	Hiroshi Ogawa	Atmosphere and ocean research institute, the University of Tokyo	Japan
138	Hideki Yamamoto	Reseach Promotion Group, Mutsu Institute for Oceanography, JAMSTEC	Japan
139	Hiromi Kasai	Hokkaido National Fisheries Research Institute, Japan Fisheries Research and Education Agency	Japan
140	Patricia López García	Plataforma Oceánica de Canarias (PLOCAN) - Oceanic Platform of the Canary Islands	Spain
141	Yoko Kiyomoto	Seikai National Fisheries Research Institute, Japan Fisheries Research and Education Agency	Japan

143	Victor F. Camacho Ibar Maria del Carmen Ávila López	Instituto de Investigaciones Oceanológicas, Universidad Autónoma de Baja California	USA
148	Jerry Frank	University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Nutrient Analytical Services Laboratory	USA
149	Vasiliy Povazhnyi	Arctic and Antarctic Research Institute	Russia
150	Mi-OK Park	Marine Environment Analysis Center Korea Marine Environment management Corporation (KOEM)	Republic of Korea
151	Ana Rodriguez	INSTITUTO OCEANOGRÁFICO DE LA ARMADA (INOCAR)	Ecuador
153	Robinson Fidel Casanova Rosero	CENTRO DE INVESTIGACIONES OCEANOGRÁFICAS E HIDROGRÁFICAS DEL PACÍFICO (CCCP).	Colombia
155	Yoann Le Merrer Karine Collin Olivier Pierre-Duplessix	IFREMER LERMPL, Nantes	France
156	Robert Rember Ana Aguilar-Islas	University of Alaska, Fairbanks	USA
157	Thanos Gkritzalis	Flanders Marine Institute	Belgium

Table A2 Cross reference for Lab numbers in the 2015, 2012, 2008, 2006 and 2003 I/C studies

2018 I/C	2015 I/C	2012 I/C	2008 I/C	2006 I/C	2003 I/C
		1			
		2			
		3			
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	9	9	33	33	
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		13			
14	14	14	5	5	1
		15	50	50	
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17	17	17			
		18	42	42	
19	19	19	7	7	6
	20	20	19	19	
		21	23	23	
		22	73		
23	23	23	71		
		24	17	17	
		25	37	37	
26	26	26	53	53	
27	27	27	66		
28	28	28			
29	29	29	61		
30	30	30			
		31			
32	32	32	1	1	2
		33			
139		34	10	10	17
35	35	35	29	29	9
		36	38	38	13

37	37	37	40	40	
38	38	38	65		8
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	48	48			
49	49	49	6	6	
50	50	50	14	14	
51	51	51	62		
52	52	52	75		
		53	28-1	28	
		54			
		55			
56	56	56	3	3	3
57	57	57	4	4	
	58	58	9	9	
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	61	61			
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		51	51	
		52	52	7
		55	55	14
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Appendix II

Results reported by participants

Table A3 Nutirient results reported by the participants

Table A4 Ammonia results reported by the participants

Table A5 DOP results reported by the participants

Table A6 DON results reported by the participants

Table A7 DOC results reported by the participants

(Concentrations in Talbes A3-A7 are in units of μmol kg^{-1})

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
5																				
	Sample #1	2018	02	01	22	19.59	0.12	2			2	0.07	0.00	2	1.46	0.02	2	36.90	0.26	2
	Sample #2	2018	02	01	22	43.61	0.26	2			2	0.09	0.00	2	3.10	0.04	2	158.30	1.11	2
	Sample #3	2018	02	01	22	<0.23	0.00	2			2	0.02	0.00	2	0.08	0.00	2	0.40	0.00	2
	Sample #4	2018	02	01	22	5.41	0.03	2			2	0.02	0.00	2	0.47	0.01	2	13.84	0.10	2
	Sample #5	2018	02	01	22	23.79	0.14	2			2	0.07	0.00	2	1.79	0.03	2	56.21	0.39	2
7																				
	Sample #1	2018	02	21	21.2	20.13	0.16	2	20.07	0.16	2	0.06	0.01	2	1.45	0.04	2	36.60	0.33	2
	Sample #2	2018	02	21	21.3	43.49	0.35	2	43.41	0.35	2	0.08	0.02	2	3.18	0.08	2	159.20	1.44	2
	Sample #3	2018	02	21	21.3	0.04	0.00	2	0.02	0.00	2	0.02	0.01	2	0.02	0.00	2	0.03	0.00	2
	Sample #4	2018	02	21	21.4	5.74	0.05	2	5.72	0.05	2	0.02	0.01	2	0.43	0.01	2	13.39	0.12	2
	Sample #5	2018	02	21	21.3	24.08	0.19	2	24.08	0.19	2	0.06	0.01	2	1.75	0.05	2	54.25	0.49	2
8																				
	Sample #1	2018	02	26	25	19.74	0.98	2	19.68	0.98	2	0.06	0.00	2	1.45	0.03	2	35.47	0.62	2
	Sample #2	2018	02	26	25	42.93	0.35	2	42.96	0.52	2	0.08	0.00	2	3.24	0.11	2	158.77	1.20	2
	Sample #3	2018	02	26	25	0.10	0.00	2	0.09	0.01	2	0.01	0.00	2	0.06	0.02	2	0.15	0.02	2
	Sample #4	2018	02	26	25	5.61	0.27	2	5.60	0.30	2	0.02	0.01	2	0.44	0.00	2	13.48	0.28	2
	Sample #5	2018	02	26	25	23.28	0.06	2	23.22	0.06	2	0.06	0.00	2	1.75	0.05	2	54.35	0.61	2
10																				
	Sample #1	2018	01	19	23	19.73	0.29	2	19.66	0.29	2	0.08	0.02	2	1.39	0.05	2	36.75	0.98	2
	Sample #2	2018	01	19	23	46.47	0.29	2	46.39	0.29	2	0.08	0.02	2	3.10	0.05	2	161.43	0.98	2
	Sample #3	2018	01	19	23	0.03	0.10	2	0.00	0.10	2	0.03	0.02	2	0.00	0.02	2	0.00	0.29	2
	Sample #4	2018	01	19	23	5.53	0.29	2	5.50	0.29	2	0.03	0.02	2	0.44	0.05	2	13.70	0.98	2
	Sample #5	2018	01	19	23	23.81	0.29	2	23.74	0.29	2	0.06	0.02	2	1.69	0.05	2	56.62	0.98	2
14																				
	Sample #1	2018	01	05	22	19.28	0.02	2	19.22	0.02	2	0.06	0.00	2	1.39	0.00	2	36.57	0.01	2
	Sample #2	2018	01	05	22	43.08	0.02	2	43.01	0.02	2	0.08	0.00	2	3.10	0.00	2	156.90	0.11	2
	Sample #3	2018	01	05	22	0.07	0.00	2	0.05	0.00	2	0.02	0.00	2	<0.04		2	0.63	0.02	2
	Sample #4	2018	01	05	22	5.32	0.00	2	5.30	0.00	2	0.02	0.00	2	0.43	0.00	2	13.71	0.01	2
	Sample #5	2018	01	05	22	23.32	0.01	2	23.27	0.01	2	0.05	0.00	2	1.69	0.00	2	56.38	0.07	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
17																				
	Sample #1	2018	01	27	37	38.28		2	38.09		2	0.18		2	1.48		2	27.83		2
	Sample #2	2018	01	27	37	83.45		2	83.25		2	0.20		2	3.54		2	123.21		2
	Sample #3	2018	01	27	37	3.06		2	3.00		2	0.06		2	0.08		2	0.53		2
	Sample #4	2018	01	27	37	10.80		2	10.71		2	0.08		2	0.44		2	9.76		2
	Sample #5	2018	01	27	37	46.04		2	45.95		2	0.09		2	1.94		2	43.31		2
19																				
	Sample #1	2018	02	06	20	19.76	0.04	2	19.68	0.04	2	0.08	0.00	2	1.42	0.01	2	36.83	0.03	2
	Sample #2	2018	02	06	20	43.79	0.09	2	43.69	0.09	2	0.10	0.00	2	3.07	0.01	2	160.63	0.06	2
	Sample #3	2018	02	06	20	0.05	0.03	2	0.00	0.03	2	0.04	0.00	2	0.01	0.00	2	0.05	0.06	2
	Sample #4	2018	02	06	20	5.47	0.02	2	5.43	0.02	2	0.04	0.00	2	0.45	0.01	2	14.01	0.07	2
	Sample #5	2018	02	06	20	23.87	0.06	2	23.79	0.06	2	0.08	0.00	2	1.71	0.01	2	56.66	0.03	2
23																				
	Sample #1	2018	02	28	20	18.88	0.07	2	18.81	0.07	2	0.07	0.00	2	1.45	0.00	2	34.83	0.09	2
	Sample #2	2018	02	28	20	41.53	0.23	2	41.44	0.23	2	0.08	0.00	2	3.22	0.01	2	158.74	1.22	2
	Sample #3	2018	02	28	20	0.02	0.00	2	0.00	0.01	2	0.03	0.00	2	0.02	0.00	2	0.16	0.03	2
	Sample #4	2018	02	28	20	5.19	0.02	2	5.15	0.02	2	0.04	0.00	2	0.50	0.01	2	13.46	0.08	2
	Sample #5	2018	02	28	20	22.76	0.12	2	22.69	0.12	2	0.07	0.00	2	1.76	0.01	2	56.48	0.06	2
26																				
	Sample #1	2018	01	17	20	21.33	0.51	2	21.26	0.49	2	0.07	0.02	2	1.37	0.07	2	36.61	0.88	2
	Sample #2	2018	01	17	20	44.66	0.51	2	44.57	0.49	2	0.09	0.02	2	3.02	0.06	2	161.57	9.69	2
	Sample #3	2018	01	17	20	0.06	0.12	2	0.03	0.10	2	0.03	0.02	2	0.01	0.02	2	0.10	0.00	2
	Sample #4	2018	01	17	20	5.55	0.21	2	5.53	0.20	2	0.03	0.02	2	0.40	0.02	2	13.96	0.39	2
	Sample #5	2018	01	17	20	24.46	0.51	2	24.39	0.49	2	0.07	0.02	2	1.66	0.08	2	58.09	1.45	2
27																				
	Sample #1	2017	11	28	22.4	19.30	0.03	2	19.22	0.03	2	0.08	0.01	2	1.40	0.01	2	36.42	0.08	2
	Sample #3	2017	11	28	22.4	0.07	0.03	2	0.03	0.03	2	0.04	0.01	2	0.01	0.01	2	0.09	0.08	2
	Sample #4	2017	11	28	22.4	5.37	0.03	2	5.33	0.03	2	0.04	0.01	2	0.42	0.01	2	13.92	0.08	2
	Sample #5	2017	11	28	22.4	23.39	0.03	2	23.31	0.03	2	0.08	0.01	2	1.67	0.01	2	56.72	0.08	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
28																				
	Sample #1	2018	01	15	20	19.69	0.15	2	19.66	0.15	2	0.03	0.01	2	1.41	0.06	2	35.91	0.24	2
	Sample #3	2018	01	15	20	0.17	0.05	2	0.17	0.05	2	0.00	0.01	2	0.11	0.03	2	0.05	0.03	2
	Sample #4	2018	01	15	20	5.47	0.20	2	5.46	0.20	2	0.01	0.01	2	0.40	0.05	2	13.46	0.23	2
	Sample #5	2018	01	15	20	23.70	0.15	2	23.67	0.15	2	0.03	0.01	2	1.66	0.06	2	55.28	0.34	2
29																				
	Sample #1	2017	12	05	21.0	19.46	0.20	2			2	0.08		2	1.40	0.01	2	33.09	0.15	2
	Sample #3	2017	12	05	21.0	0.11	0.20	2			2	0.03		2	0.02	0.01	2	0.13	0.15	2
	Sample #4	2017	12	05	21.0	5.43	0.20	2			2	0.03		2	0.45	0.01	2	13.26	0.15	2
	Sample #5	2017	12	05	21.0	23.50	0.20	2			2	0.07		2	1.69	0.01	2	48.63	0.15	2
30																				
	Sample #1	2018	02	04	28			2			2	0.14		2	1.49		2	32.02		2
	Sample #2	2018	02	04	28			2			2	0.27		2	2.40		2	96.75		2
	Sample #3	2018	02	04	28			2			2	0.20		2	1.44		2	0.00		2
	Sample #4	2018	02	04	28			2			2	0.27		2	0.63		2	12.51		2
	Sample #5	2018	02	04	28			2			2	0.18		2	1.19		2	32.99		2
32																				
	Sample #1	2018	06	17	20	18.42	0.19	2	18.36	0.20	2	<0.06	0.15	2	1.20	0.02	2	35.29	0.18	2
	Sample #3	2018	06	17	20	<0.08	0.19	2	<0.10	0.20	2	<0.06	0.15	2	<0.01	0.02	2	0.28	0.12	2
	Sample #4	2018	06	17	20	5.32	0.19	2	5.31	0.20	2	<0.06	0.15	2	0.41	0.02	2	14.16	0.12	2
	Sample #5	2018	06	17	20	22.73	0.56	2	22.68	0.56	2	<0.06	0.15	2	1.68	0.06	2	55.34	1.45	2
35																				
	Sample #1	2017	12	02	21.9	19.77	0.03	2			2	0.07	0.00	2	1.42	0.00	2	36.48	0.04	2
	Sample #2	2017	12	02	21.9	43.55	0.06	2			2	0.09	0.00	2	3.07	0.01	2	159.23	0.15	2
	Sample #3	2017	12	02	21.9	0.10	0.00	2			2	0.03	0.00	2	0.01	0.00	2	0.02	0.00	2
	Sample #4	2017	12	02	21.9	5.57	0.01	2			2	0.03	0.00	2	0.44	0.00	2	13.82	0.01	2
	Sample #5	2017	12	02	21.9	23.84	0.03	2			2	0.06	0.00	2	1.70	0.00	2	56.23	0.05	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
37																				
	Sample #1	2018	02	19	19.6			2			2			2	1.42	0.00	2			2
	Sample #2	2018	02	19	19.6			2			2			2	3.06	0.01	2			2
	Sample #3	2018	02	19	19.6			2			2			2	0.01	0.00	2			2
	Sample #4	2018	02	19	19.6			2			2			2	0.45	0.00	2			2
	Sample #5	2018	02	19	19.6			2			2			2	1.68	0.00	2			2
38																				
	Sample #1	2017	12	21	20	18.10	0.02	2			2	0.06	0.00	2	1.39	0.00	2	34.26	0.36	2
	Sample #2	2017	12	21	20	41.64	0.07	2			2	0.08	0.00	2	2.99	0.01	2	148.35	1.16	2
	Sample #3	2017	12	21	20	0.03	0.01	2			2	0.03	0.00	2	0.03	0.00	2	0.06	0.14	2
	Sample #4	2017	12	21	20	4.90	0.00	2			2	0.03	0.00	2	0.45	0.00	2	13.46	0.30	2
	Sample #5	2017	12	21	20	22.36	0.05	2			2	0.06	0.00	2	1.68	0.01	2	55.46	0.17	2
39																				
	Sample #1	2017	12	19	21	19.83	0.03	2	19.76	0.03	2	0.07	0.00	2	1.43	0.00	2	36.72	0.10	2
	Sample #2	2017	12	19	21	43.67	0.06	2	43.58	0.07	2	0.09	0.00	2	3.12	0.00	2	158.68	0.29	2
	Sample #3	2017	12	19	21	0.05	0.01	2	0.03	0.01	2	0.03	0.00	2	0.01	0.00	2	0.06	0.04	2
	Sample #4	2017	12	19	21	5.55	0.01	2	5.52	0.01	2	0.03	0.00	2	0.45	0.00	2	13.87	0.10	2
	Sample #5	2017	12	19	21	23.96	0.03	2	23.89	0.03	2	0.07	0.00	2	1.73	0.00	2	56.45	0.10	2
40																				
	Sample #1	2017	11	17	20	19.58		2	19.55		2	<0.07		2	1.29		2	35.46		2
	Sample #2	2017	11	17	20	43.42		2	43.36		2	0.08		2	2.95		2	153.53		2
	Sample #3	2017	11	17	20	0.27		2	0.25		2	<0.07		2	<0.03		2	<0.18		2
	Sample #4	2017	11	17	20	5.55		2	5.54		2	<0.07		2	0.41		2	13.38		2
	Sample #5	2017	11	17	20	23.29		2	23.22		2	0.07		2	1.53		2	54.71		2
41																				
	Sample #1	2018	02	12	21	19.92		2	19.92		2	0.07		2	1.37		2	35.35		2
	Sample #2	2018	02	12	21	35.84		2	35.84		2	0.10		2	2.99		2	152.53		2
	Sample #3	2018	02	12	21	0.20		2	0.20		2	0.01		2	0.00		2	0.00		2
	Sample #4	2018	02	12	21	4.88		2	4.88		2	0.03		2	0.40		2	13.18		2
	Sample #5	2018	02	12	21	25.00		2	24.90		2	0.08		2	1.64		2	53.81		2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
45																				
	Sample #1				20			2	19.23	0.15	2	0.07	0.01	2	1.39	0.02	2	35.15	0.10	2
	Sample #3				20			2	0.17	0.03	2	0.02	0.01	2	below det	below d	2	0.03	0.01	2
	Sample #4				20			2	5.37	0.06	2	0.03	0.02	2	0.40	0.01	2	13.08	0.39	2
	Sample #5				20			2	22.94	0.22	2	0.07	0.01	2	1.69	0.02	2	55.26	0.15	2
49																				
	Sample #1	2018	02	26	18.5	19.22	0.10	2	19.17	0.10	2	0.06	0.00	2			2	36.05	0.06	2
	Sample #2	2018	02	26	18.5	42.50	0.27	2	42.45	0.27	2	0.07	0.00	2			2	153.87	0.58	2
	Sample #3	2018	02	26	18.5	0.06	0.02	2	0.03	0.02	2	0.02	0.00	2			2	0.25	0.05	2
	Sample #4	2018	02	26	18.5	5.36	0.01	2	5.33	0.01	2	0.02	0.00	2			2	13.86	0.06	2
	Sample #5	2018	02	26	18.5	23.11	0.10	2	23.06	0.10	2	0.05	0.00	2			2	55.34	0.04	2
50																				
	Sample #1	2018	02	26	22.2	19.72	0.15	2	19.66	0.15	2	0.06	0.00	2	1.40	0.01	2	36.81	0.16	2
	Sample #2	2018	02	27	21.6	43.78	0.07	2	42.73	0.07	2	0.07	0.00	2	3.10	0.08	2	157.84	1.12	2
	Sample #3	2018	02	26	22.2	0.05	0.00	2	0.03	0.00	2	0.02	0.00	2	0.01	0.00	2	0.16	0.03	2
	Sample #4	2018	02	26	22.2	5.62	0.06	2	5.59	0.06	2	0.03	0.00	2	0.42	0.02	2	14.46	0.10	2
	Sample #5	2018	02	26	22.2	23.88	0.21	2	23.81	0.21	2	0.06	0.00	2	1.69	0.02	2	58.01	0.32	2
51																				
	Sample #1	2018	02	05	19.8	19.97	0.02	2	19.89	0.03	2	0.08	0.00	2	1.40	0.01	2	35.57	0.03	2
	Sample #3	2018	02	05	19.8	0.18	0.01	2	0.14	0.02	2	0.04	0.00	2	<0.03	0.00	2	<0.085	0.02	2
	Sample #4	2018	02	05	19.8	5.59	0.02	2	5.55	0.03	2	0.04	0.00	2	0.43	0.01	2	13.54	0.03	2
	Sample #5	2018	02	05	19.8	24.05	0.05	2	23.97	0.06	2	0.08	0.00	2	1.68	0.01	2	55.15	0.03	2
52																				
	Sample #1	2018	03	13	22	19.74	0.64	2	19.79	0.67	2	0.06	0.04	2	1.40	0.08	2	36.12	0.35	2
	Sample #3	2018	03	13	22	0.21	0.09	2	0.23	0.10	2	0.03	0.01	2	0.01	0.01	2	0.00	0.13	2
	Sample #4	2018	03	13	22	5.61	0.14	2	5.64	0.14	2	0.03	0.00	2	0.44	0.02	2	13.40	0.13	2
	Sample #5	2018	03	13	22	24.02	0.81	2	24.07	0.83	2	0.06	0.03	2	1.74	0.07	2	55.96	0.60	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
56																				
	Sample #1	2018	02	06	21	19.63	0.06	2	19.53		2	0.05		2	1.43	0.01	2	35.64	0.08	2
	Sample #2	2018	02	06	21	43.26		2	43.16		2	0.07		2	3.09		2	155.65		2
	Sample #3	2018	02	06	21	0.14	0.06	2	0.14		2	0.00		2	0.00	0.01	2	0.00	0.08	2
	Sample #4	2018	02	06	21	5.48		2	6.44		2	0.01		2	0.45		2	13.38		2
	Sample #5	2018	02	06	21	23.63		2	23.58		2	0.05		2	1.73		2	54.88		2
57																				
	Sample #1	2018	02	21	22.8	19.66	0.08	2	19.61	0.08	2	0.05	0.00	2	1.35	0.03	2	36.74	0.10	2
	Sample #2	2018	02	21	22.8	43.27	0.15	2	43.20	0.15	2	0.07	0.00	2	3.00	0.01	2	156.41	0.78	2
	Sample #3	2018	02	21	22.8	0.06	0.04	2	0.05	0.04	2	0.01	0.00	2	0.00	0.00	2	0.10	0.00	2
	Sample #4	2018	02	21	22.8	5.45	0.01	2	5.43	0.01	2	0.02	0.01	2	0.41	0.02	2	14.07	0.00	2
	Sample #5	2018	02	21	22.8	23.64	0.08	2	23.60	0.08	2	0.05	0.00	2	1.63	0.02	2	56.77	0.29	2
59																				
	Sample #1	2018	01	30	20	19.87	0.54	2	19.81	0.55	2	0.06	0.01	2	1.37	0.02	2	35.97	0.08	2
	Sample #2	2018	01	30	20	43.92	1.56	2	43.86	1.58	2	0.06	0.02	2	3.07	0.07	2	153.77	1.79	2
	Sample #3	2018	01	30	20	0.21	0.03	2	0.34	0.03	2	0.02	0.02	2	0.07	0.01	2	0.74	0.09	2
	Sample #4	2018	01	30	20	5.16	0.31	2	5.14	0.32	2	0.02	0.01	2	0.42	0.02	2	13.10	0.19	2
	Sample #5	2018	01	30	20	24.47	0.68	2	24.40	0.71	2	0.07	0.02	2	1.70	0.09	2	54.74	0.73	2
65																				
	Sample #1	2018	04	11	21.5	19.61	0.05	2			2			2	1.41	0.00	2	36.10	0.04	2
	Sample #2	2018	04	11	21.5	43.43	0.02	2			2			2	3.06	0.01	2	156.97	0.05	2
	Sample #3	2018	04	11	21.5	0.03	0.02	2			2			2	0.04	0.01	2	0.13	0.15	2
	Sample #4	2018	04	11	21.5	5.47	0.02	2			2			2	0.44	0.00	2	13.76	0.00	2
	Sample #5	2018	04	11	21.5	23.67	0.04	2			2			2	1.69	0.00	2	55.92	0.02	2
69																				
	Sample #1	2018	02	15	20	20.59	0.02	2			2			2	1.45	0.01	2			2
	Sample #3	2018	02	15	20	nd		2			2			2	0.05	0.01	2			2
	Sample #4	2018	02	15	20	6.34	0.02	2			2			2	1.47	0.01	2			2
	Sample #5	2018	02	15	20	25.18	0.22	2			2			2	1.80	0.00	2			2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
80																				
	Sample #1	2018	02	16	20	14.29		2	14.21		2	0.08		2	1.23		2	35.58		2
	Sample #2	2018	02	16	20	29.13		2	29.03		2	0.10		2	2.98		2	130.23		2
	Sample #3	2018	02	16	20	1.64		2	1.62		2	0.02		2	0.18		2	0.31		2
	Sample #4	2018	02	16	20	7.67		2	7.67		2	0.00		2	0.70		2	13.56		2
	Sample #5	2018	02	16	20	16.15		2	16.10		2	0.05		2	1.93		2	50.67		2
86																				
	Sample #1	2018	01	23	20	19.46	0.06	2	19.38	0.06	2	0.07	0.00	2	1.41	0.00	2	36.79	0.07	2
	Sample #2	2018	01	23	20	43.50	0.08	2	43.42	0.08	2	0.08	0.00	2	3.01	0.01	2	160.10	0.35	2
	Sample #3	2018	01	23	20	0.08	0.01	2	0.06	0.01	2	0.02	0.00	2	0.01	0.00	2	0.19	0.07	2
	Sample #4	2018	01	23	20	5.49	0.01	2	5.47	0.01	2	0.02	0.00	2	0.43	0.00	2	14.01	0.10	2
	Sample #5	2018	01	23	20	23.94	0.07	2	23.88	0.08	2	0.06	0.00	2	1.69	0.00	2	57.40	0.17	2
88																				
	Sample #1	2018	01	24	20	18.71	0.58	2	18.65		2	0.06	0.00	2	1.27	0.00	2	36.19	0.02	2
	Sample #3	2018	01	24	20	0.16	0.11	2	0.14		2	0.02	0.00	2	0.00	0.01	2	0.00	0.02	2
	Sample #4	2018	01	24	20	4.95	0.06	2	4.93		2	0.02	0.00	2	0.33	0.00	2	13.76	0.02	2
	Sample #5	2018	01	24	20	23.68	1.07	2	23.63		2	0.05	0.00	2	1.60	0.00	2	55.62	0.28	2
89																				
	Sample #1	2018	01	30	20	19.27	0.02	2	19.16	0.02	2	0.11	0.01	2	1.75	0.00	2	35.92	0.29	2
	Sample #2	2018	01	30	20	36.35	0.19	2	43.40	0.08	2	0.14	0.00	2	4.57	0.01	2	157.42	0.17	2
	Sample #3	2018	01	30	20	0.08	0.04	2	0.03	0.04	2	0.05	0.00	2	0.03	0.00	2	<0.5	0.28	2
	Sample #4	2018	01	30	20	5.03	0.05	2	4.96	0.05	2	0.07	0.00	2	0.61	0.01	2	13.53	0.02	2
	Sample #5	2018	01	30	20	23.52	0.07	2	23.41	0.02	2	0.11	0.00	2	2.26	0.02	2	55.40	0.08	2
90																				
	Sample #1	2018	02	22	20	16.73	0.03	2	16.55	0.03	2	0.18	0.00	2	1.29	0.01	2	33.52	0.04	2
	Sample #2	2018	02	22	20	38.40	0.46	2	38.33	0.46	2	0.07	0.00	2	2.83	0.02	2	145.44	0.54	2
	Sample #3	2018	02	22	20	1.80	0.07	2	1.73	0.07	2	0.06	0.00	2	0.04	0.01	2	0.02	0.00	2
	Sample #4	2018	02	22	20	5.18	0.09	2	5.16	0.09	2	0.03	0.00	2	0.40	0.01	2	12.38	0.03	2
	Sample #5	2018	02	22	20	21.09	0.07	2	21.04	0.08	2	0.05	0.00	2	1.61	0.02	2	51.31	0.22	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
91																				
	Sample #1	2018	01	16	20	19.71	0.00	2			2			2	1.42	0.00	2	36.55	0.05	2
	Sample #3	2018	01	16	20	-0.01	0.00	2			2			2	0.00	0.00	2	-0.01	0.03	2
	Sample #4	2018	01	16	20	5.48	0.01	2			2			2	0.45	0.00	2	13.83	0.02	2
	Sample #5	2018	01	16	20	23.76	0.01	2			2			2	1.72	0.00	2	56.40	0.10	2
92																				
	Sample #1	2018	01	09	18.6	19.71	0.05	2	19.64	0.05	2	0.07	0.01	2	1.41	0.01	2	36.63	0.03	2
	Sample #3	2018	01	09	18.6	0.06	0.01	2	0.04	0.01	2	0.02	0.00	2	0.03	0.01	2	0.01	0.01	2
	Sample #4	2018	01	09	18.6	5.52	0.03	2	5.50	0.03	2	0.02	0.00	2	0.45	0.00	2	13.95	0.02	2
	Sample #5	2018	01	10	17.5	23.82	0.08	2	23.77	0.07	2	0.05	0.00	2	1.70	0.00	2	56.51	0.03	2
93																				
	Sample #1	2017	12	07	20.5	19.61	0.08	2	19.57	0.08	2	0.04	0.00	2	1.36	0.01	2	36.06	0.14	2
	Sample #2	2017	12	07	20.5	43.10	0.03	2	43.04	0.03	2	0.06	0.00	2	3.01	0.02	2	156.07	0.46	2
	Sample #3	2017	12	07	20.5	0.03	0.02	2	0.02	0.02	2	0.00	0.00	2	0.01	0.00	2	0.11	0.10	2
	Sample #4	2017	12	07	20.5	5.42	0.02	2	5.42	0.02	2	0.00	0.00	2	0.42	0.00	2	13.71	0.03	2
	Sample #5	2017	12	07	20.5	23.58	0.07	2	23.54	0.07	2	0.04	0.00	2	1.64	0.01	2	55.37	0.09	2
95																				
	Sample #1	2018	05	08	28	19.76	0.08	2	19.70	0.08	2	0.06	0.01	2	1.34	0.00	2	39.69	0.67	2
	Sample #2	2018	05	08	28	41.88	0.19	2	41.81	0.19	2	0.08	0.01	2	3.00	0.06	2	169.80	2.62	2
	Sample #3	2018	05	08	28	0.00	0.00	2	0.00	0.00	2	0.00	0.00	2	0.00	0.00	2	0.00	0.00	2
	Sample #4	2018	05	08	28	5.54	0.03	2	5.52	0.03	2	0.02	0.00	2	0.41	0.00	2	14.64	0.34	2
	Sample #5	2018	05	08	28	23.79	0.10	2	23.74	0.10	2	0.05	0.01	2	2.04	0.62	2	61.16	1.14	2
98																				
	Sample #1	2018	04	19	21.7	19.08	0.95	2			2			2	2.52	0.18	2	25.43	1.02	2
	Sample #3	2018	04	19	21.7	0.00	0.00	2			2			2	1.01	0.07	2	0.75	0.03	2
	Sample #4	2018	04	19	21.7	5.23	0.26	2			2			2	1.28	0.09	2	10.02	0.40	2
	Sample #5	2018	04	19	21.7	23.12	1.16	2			2			2	3.25	0.23	2	37.82	1.51	2
101																				
	Sample #1	2018	04	16	24.1	20.59	0.05	2	19.97	0.05	2	0.02	0.00	2	1.38	0.01	2	34.48	0.07	2
	Sample #3	2018	04	16	24.1	0.25	0.00	2	0.27	0.00	2	-0.03	0.00	2	0.01	0.01	2	0.01	0.00	2
	Sample #4	2018	04	16	24.1	5.56	0.06	2	5.42	0.06	2	-0.02	0.00	2	0.47	0.02	2	13.11	0.02	2
	Sample #5	2018	04	16	24.1	25.30	0.07	2	24.53	0.07	2	0.03	0.00	2	1.72	0.02	2	53.28	0.18	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
102																				
	Sample #1	2018	02	19	18	19.52		2	19.47		2	0.05		2	1.57	0.03	2	38.93	0.22	2
	Sample #3	2018	02	19	18	0.05	0.01	2	0.04	0.01	2	0.00		2	0.00		2	0.18		2
	Sample #4	2018	02	19	18	5.50	0.03	2	5.50	0.03	2	0.00		2	0.49		2	14.65	0.22	2
	Sample #5	2018	02	19	18	23.02		2	22.98		2	0.05		2	1.95	0.03	2	59.96		2
106																				
	Sample #1	2017	12	22	21.06	19.95	0.08	2	19.86	0.09	2	0.08	0.01	2	1.50	0.01	2	42.57	0.25	2
	Sample #2	2017	12	22	21.06	48.23	0.02	2	48.13	0.02	2	0.09	0.01	2	3.25	0.01	2	185.09	2.29	2
	Sample #3	2017	12	22	21.06	0.08	0.01	2	0.05	0.01	2	0.03	0.01	2	0.01	0.01	2	0.12	0.06	2
	Sample #4	2017	12	22	21.06	5.43	0.01	2	5.39	0.01	2	0.04	0.00	2	0.49	0.00	2	12.80	0.10	2
	Sample #5	2017	12	22	21.06	26.30	0.07	2	26.24	0.07	2	0.06	0.00	2	1.81	0.01	2	64.56	0.88	2
107																				
	Sample #1	2018	02	22	20	19.87	0.99	2	19.80	0.99	2	0.08	0.01	2	1.40	0.10	2	35.27	1.76	2
	Sample #3	2018	02	22	20	0.15	0.01	2	0.12	0.01	2	0.03	0.01	2	0.01	0.01	2	0.00	0.01	2
	Sample #4	2018	02	22	20	5.58	0.28	2	5.56	0.28	2	0.02	0.01	2	0.45	0.02	2	12.82	0.64	2
	Sample #5	2018	02	22	20	23.97	1.20	2	23.90	1.20	2	0.08	0.01	2	1.74	0.09	2	54.81	2.74	2
109																				
	Sample #1	2017	11	14	21.1	19.86	0.06	2	19.79	0.06	2	0.07	0.00	2	1.40	0.01	2	38.35	0.04	2
	Sample #2	2017	11	14	21.1	43.05	0.15	2	42.96	0.15	2	0.09	0.00	2	3.07	0.01	2	164.41	0.23	2
	Sample #3	2017	11	14	21.1	0.07	0.00	2	0.04	0.00	2	0.03	0.00	2	0.01	0.00	2	0.13	0.01	2
	Sample #4	2017	11	14	21.1	5.58	0.02	2	5.56	0.02	2	0.03	0.00	2	0.44	0.01	2	14.60	0.01	2
	Sample #5	2017	11	14	21.1	23.81	0.11	2	23.72	0.11	2	0.08	0.00	2	1.69	0.01	2	58.85	0.13	2
111																				
	Sample #1	2018	02	06	20	20.70		2	20.60		2	0.11		2	1.75		2	38.71		2
	Sample #3	2018	02	06	20	0.35		2	0.28		2	0.06		2	0.20		2	0.27		2
	Sample #4	2018	02	06	20	6.37		2	6.31		2	0.06		2	0.50		2	14.69		2
	Sample #5	2018	02	06	20	24.63		2	24.53		2	0.10		2	1.71		2	59.49		2
112																				
	Sample #1	2017	12	14	21.0	19.70	0.01	2			2	0.07	0.00	2	1.40	0.01	2	36.55	0.04	2
	Sample #3	2017	12	14	21.0	0.08	0.00	2			2	0.03	0.00	2	0.01	0.00	2	0.00	0.00	2
	Sample #4	2017	12	14	21.0	5.40	0.00	2			2	0.03	0.00	2	0.44	0.00	2	13.82	0.02	2
	Sample #5	2017	12	14	21.0	23.77	0.02	2			2	0.07	0.00	2	1.69	0.01	2	56.43	0.07	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
113																				
	Sample #1	2018	02	05	20	19.57	0.13	2	19.51	0.13	2	0.08	0.01	2	1.39	0.02	2	36.69	0.97	2
	Sample #2	2018	02	06	20	43.07	0.13	2	42.99	0.13	2	0.10	0.01	2	3.04	0.02	2	155.89	0.97	2
	Sample #3	2018	02	07	20	0.00	0.13	2	0.00	0.13	2	0.04	0.01	2	0.05	0.02	2	0.00	0.97	2
	Sample #4	2018	02	04	20	5.65	0.13	2	5.62	0.13	2	0.03	0.01	2	0.45	0.02	2	14.25	0.97	2
	Sample #5	2018	02	02	20	23.80	0.13	2	23.74	0.13	2	0.07	0.01	2	1.67	0.02	2	54.19	0.97	2
114																				
	Sample #1	2018	05	09	24	19.49	0.04	2			2			2	1.38	0.00	2	33.69	0.15	2
	Sample #2	2018	05	09	24			2			2			2	3.03	0.03	2			2
	Sample #3	2018	05	09	24	0.02	0.01	2			2			2	0.00	0.00	2	0.02	0.06	2
	Sample #4	2018	05	09	24	5.37	0.00	2			2			2	0.42	0.00	2	12.88	0.22	2
	Sample #5	2018	05	09	24	23.56	0.11	2			2			2	1.67	0.01	2			2
118																				
	Sample #1	2018	03	22	20.1	16.99		2	16.91	0.02	2	0.08	0.03	2	1.41	0.01	2	33.93	0.31	2
	Sample #3	2018	03	22	20.1	-0.02		2	-0.04	0.02	2	0.02	0.03	2	0.00		2	-0.54		2
	Sample #4	2018	03	22	20.1	4.99		2	4.97	0.02	2	0.02	0.03	2	0.44	0.01	2	12.64	0.14	2
	Sample #5	2018	03	22	20.1	20.28		2	20.22	0.02	2	0.06	0.03	2	1.71	0.01	2	52.98	0.31	2
124																				
	Sample #1	2018	02	09	22	19.70	0.06	2	19.70	0.06	2	N.D	N.D	2	1.42	0.04	2	36.46	0.14	2
	Sample #2	2018	02	09	22	43.11	0.08	2	43.11	0.08	2	N.D	N.D	2	3.07	0.02	2	160.60	0.21	2
	Sample #3	2018	02	09	22	0.28	0.04	2	0.28	0.04	2	N.D	N.D	2	N.D	N.D	2	N.D	N.D	2
	Sample #4	2018	02	09	22	5.65	0.03	2	5.65	0.03	2	N.D	N.D	2	0.40	0.01	2	13.41	0.14	2
	Sample #5	2018	02	09	22	23.96	0.02	2	23.96	0.02	2	N.D	N.D	2	1.69	0.03	2	56.83	0.14	2
125																				
	Sample #1	2018	01	24	20.9	19.85	0.10	2	19.76	0.10	2	0.09	0.01	2	1.35	0.01	2	36.19	0.07	2
	Sample #2	2018	01	24	20.9	43.80	0.10	2	43.70	0.10	2	0.10	0.01	2	2.92	0.01	2	156.17	0.07	2
	Sample #3	2018	01	24	20.9	0.06	0.10	2	0.01	0.10	2	0.05	0.01	2	0.03	0.01	2	0.01	0.07	2
	Sample #4	2018	01	24	20.9	5.52	0.10	2	5.47	0.10	2	0.05	0.01	2	0.43	0.01	2	13.75	0.07	2
	Sample #5	2018	01	24	20.9	23.90	0.10	2	23.81	0.10	2	0.08	0.01	2	1.63	0.01	2	55.63	0.07	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
129																				
	Sample #1	2017	12	26	21.7			2	19.11	0.23	2	0.06	0.00	2	1.45	0.01	2	35.42	0.11	2
	Sample #3	2017	12	26	21.7			2	0.06	0.01	2	0.01	0.00	2	0.08	0.01	2	0.20	0.06	2
	Sample #4	2017	12	26	21.7			2	5.35	0.02	2	0.01	0.00	2	0.50	0.00	2	13.48	0.06	2
	Sample #5	2017	12	26	21.7			2	23.01	0.06	2	0.05	0.00	2	1.74	0.01	2	54.27	0.08	2
135																				
	Sample #1	2017	12	12	20	20.59		2			2	0.07		2	1.42		2	35.99		2
	Sample #3	2017	12	12	20	<0.02		2			2	<0.04		2	<0.01		2	<0.03		2
	Sample #4	2017	12	12	20	5.65		2			2	<0.04		2	0.41		2	13.58		2
	Sample #5	2017	12	12	20	25.01		2			2	0.06		2	1.67		2	55.67		2
136																				
	Sample #1	2018	01	22	20			2	20.35	0.10	2	-0.02	0.00	2	1.30	0.03	2	38.42	0.26	2
	Sample #3	2018	01	22	20			2	-0.20	0.04	2	-0.06	0.00	2	0.03	0.01	2	0.09	0.02	2
	Sample #4	2018	01	22	20			2	5.60	0.03	2	-0.07	0.01	2	0.41	0.02	2	14.09	0.04	2
	Sample #5	2018	01	26	20			2	24.62	0.28	2	-0.01	0.01	2	1.65	0.04	2	58.00	0.80	2
137																				
	Sample #1	2018	01	17	24.5	19.97	0.02	2	19.91	0.02	2	0.06	0.00	2	1.43	0.00	2	38.26	0.02	2
	Sample #2	2018	01	17	24.5	43.80	0.02	2	43.72	0.02	2	0.08	0.00	2	3.14	0.02	2	164.22	0.04	2
	Sample #3	2018	01	17	24.5	0.06	0.01	2	0.04	0.01	2	0.02	0.00	2	0.00	0.00	2	0.12	0.05	2
	Sample #4	2018	01	17	24.5	5.67	0.01	2	5.65	0.01	2	0.02	0.00	2	0.45	0.01	2	14.57	0.03	2
	Sample #5	2018	01	17	24.5	23.98	0.05	2	23.93	0.05	2	0.05	0.00	2	1.73	0.01	2	58.82	0.07	2
138																				
	Sample #1	2018	01	18	20	19.70	0.02	2	19.63	0.02	2	0.08	0.00	2	1.42	0.00	2	36.48	0.02	2
	Sample #3	2018	01	18	20	0.06	0.01	2	0.04	0.01	2	0.03	0.00	2	0.03	0.00	2	0.69	0.01	2
	Sample #4	2018	01	18	20	5.53	0.01	2	5.50	0.01	2	0.03	0.00	2	0.46	0.00	2	14.25	0.02	2
	Sample #5	2018	01	18	20	23.74	0.02	2	23.67	0.02	2	0.07	0.00	2	1.70	0.00	2	56.05	0.03	2
139																				
	Sample #1	2017	12	04	20			2	19.43	0.10	2	0.01	0.00	2	1.39	0.01	2	35.44	0.10	2
	Sample #2	2017	12	04	20			2	42.95	0.29	2	0.03	0.01	2	3.05	0.02	2	153.27	0.49	2
	Sample #3	2017	12	04	20			2	0.98	0.00	2	0.00	0.00	2	0.03	0.00	2	0.59	0.10	2
	Sample #4	2017	12	04	20			2	5.56	0.00	2	0.00	0.00	2	0.41	0.01	2	13.37	0.10	2
	Sample #5	2017	12	04	20			2	23.53	0.10	2	0.01	0.01	2	1.68	0.01	2	54.97	0.20	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
140																				
	Sample #1	2018	02	06	22.0	18.85	0.04	2			2			2	1.42	0.01	2	36.36	1.01	2
	Sample #3	2018	02	06	22.0	BDL		2			2			2	BDL		2	BDL		2
	Sample #4	2018	02	06	22.0	5.59	0.03	2			2			2	0.42	0.01	2	14.26	0.31	2
	Sample #5	2018	02	06	22.0	23.20	0.07	2			2			2	1.74	0.01	2	56.06	1.01	2
141																				
	Sample #1	2018	01	25	22	19.68	0.13	2	19.61	0.13	2	0.08	0.00	2	1.44	0.00	2	36.60	0.07	2
	Sample #3	2018	01	25	22	0.08	0.01		0.05	0.01		0.03	0.00		0.02	0.00		0.27	0.03	
	Sample #4	2018	01	25	22	5.62	0.05	2	5.59	0.05	2	0.03	0.00	2	0.46	0.00	2	13.69	0.04	2
	Sample #5	2018	01	25	22	24.24	0.10	2	24.17	0.10	2	0.07	0.00	2	1.73	0.00	2	56.18	0.17	2
143																				
	Sample #1	2018	02	22	18	18.73	0.02	2	18.68	0.03	2	0.05	0.00	2	1.45	0.01	2			2
	Sample #2	2018	02	22	18	40.82	0.04	2	40.73	0.04	2	0.09	0.00	2	3.21	0.02	2			2
	Sample #3	2018	02	22	18	0.01	0.00	2	0.00	0.00	2	0.02	0.00	2	0.02	0.10	2			2
	Sample #4	2018	02	22	18	5.20	0.01	2	5.17	0.01	2	0.03	0.01	2	0.44	0.01	2			2
	Sample #5	2018	02	22	18	22.54	0.08	2	22.47	0.08	2	0.07	0.00	2	1.73	0.01	2			2
148																				
	Sample #1	2018	01	10	20	20.22		2	20.13		2	0.09		2	1.46		2	32.61		2
	Sample #2				20	42.75		2	42.66		2	0.09		2	3.12		2	152.49		2
	Sample #3				20	0.13		2	0.10		2	0.03		2	0.06		2	0.23		2
	Sample #4				20	5.77		2	5.72		2	0.05		2	0.46		2	12.58		2
	Sample #5	2018	01	30	20	23.99		2	23.90		2	0.09		2	1.73		2	52.81		2
149																				
	Sample #1	2018	04	17	24	8.59	0.05	2			2	0.14	0.00	2	1.45	0.00	2	21.77	0.04	2
	Sample #2	2018	04	17	24	23.83	0.15	2			2	0.16	0.00	2	3.17	0.01	2	82.10	0.15	2
	Sample #3	2018	04	17	24	0.96	0.01	2			2	0.07	0.00	2	0.09	0.00	2	0.16	0.00	2
	Sample #4	2018	04	17	24	4.92	0.03	2			2	0.07	0.00	2	0.48	0.00	2	8.40	0.01	2
	Sample #5	2018	04	17	24	11.36	0.07	2			2	0.13	0.00	2	1.74	0.00	2	33.63	0.06	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
150																				
	Sample #1	2018	01	05	20	17.59	0.03	2			2			2	1.30	0.00	2	34.03	0.03	2
	Sample #3	2018	01	05	20	0.19	0.04	2			2			2	0.50	0.02	2	0.07	0.03	2
	Sample #4	2018	01	05	20	4.99	0.00	2			2			2	0.60	0.00	2	12.97	0.01	2
	Sample #5	2018	01	05	20	21.47	0.27	2			2			2	1.58	0.02	2	52.34	0.05	2
151																				
	Sample #1	2018	02	27	20			2	21.65	0.01	2	0.11	0.01	2	1.31	0.01	2	31.84	0.01	2
	Sample #3	2018	02	27	20			2	2.18	0.01	2	0.04	0.01	2	0.04	0.01	2	0.60	0.01	2
	Sample #4	2018	02	27	20			2	7.06	0.01	2	0.06	0.01	2	0.43	0.01	2	12.67	0.01	2
	Sample #5	2018	02	27	20			2	27.65	0.01	2	0.10	0.01	2	1.66	0.01	2	47.27	0.01	2
153																				
	Sample #1	2018	01	23	24.4	22.37		2	22.26		2	0.12		2	1.45		2	29.72		2
	Sample #3	2018	01	23	24.4	<0.12		2	<0.12		2	<0.01		2	<0.02		2	<0.02		2
	Sample #4	2018	01	23	24.4	6.55		2	6.55		2	<0.01		2	0.41		2	12.73		2
	Sample #5	2018	01	23	24.4	27.08		2	27.08		2	<0.01		2	2.31		2	45.55		2
155																				
	Sample #1	2018	01	19	20	19.53	0.47	2	19.45	0.47	2	0.08		2	1.36	0.07	2	36.12	0.58	2
	Sample #2	2018	01	19	20	42.95	1.03	2	42.90	1.03	2	0.09		2	2.83	0.16	2	158.15	7.81	2
	Sample #3	2018	01	19	20	0.02	0.00	2	<0.49		2	0.03		2	0.05	0.00	2	0.09	0.00	2
	Sample #4	2018	01	19	20	5.27	0.23	2	5.23	0.24	2	0.04		2	0.47	0.02	2	13.96	0.22	2
	Sample #5	2018	01	19	20	23.43	0.57	2	23.36	0.56	2	0.07		2	1.69	0.10	2	55.65	0.89	2
156																				
	Sample #1	2018	02	16	20.5	19.05	0.04	2	18.95	0.04	2	0.10	0.00	2	1.37	0.01	2	37.01	0.10	2
	Sample #2	2018	02	16	20.5	42.08	0.12	2	41.96	0.12	2	0.12	0.00	2	3.02	0.02	2	158.99	0.67	2
	Sample #3	2018	02	16	20.5	0.12	0.02	2	0.08	0.02	2	0.04	0.01	2	0.00	0.00	2	0.11	0.07	2
	Sample #4	2018	02	16	20.5	5.35	0.03	2	5.31	0.03	2	0.04	0.01	2	0.41	0.01	2	14.05	0.11	2
	Sample #5	2018	02	16	20.5	23.01	0.05	2	22.92	0.05	2	0.09	0.00	2	1.67	0.01	2	58.24	0.17	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
157																				
	Sample #1	2018	02	15	19.8	19.53	0.45	2	19.52	0.42	2	0.03	0.08	2	1.43	0.04	2	33.60	2.91	2
	Sample #2	2018	02	15	19.8	43.45	0.45	2	43.40	0.42	2	0.08	0.08	2	3.17	0.04	2	159.65	2.91	2
	Sample #3	2018	02	15	19.8	-0.05	0.45	2	-0.04	0.42	2	-0.01	0.08	2	-0.04	0.04	2	-2.96	2.91	2
	Sample #4	2018	02	15	19.8	5.40	0.45	2	5.41	0.42	2	-0.01	0.08	2	0.42	0.04	2	10.89	2.91	2
	Sample #5	2018	02	15	19.8	23.82	0.45	2	23.80	0.42	2	0.04	0.08	2	1.75	0.04	2	53.81	2.91	2

Table A4 Ammonia

Lab	Sample	Ammonia	err	Nitrite	err	Nitrate	err	Nitrate+Nitrite	err
5									
	Sample #1	1.14	0.01	0.07	0.00			19.59	0.12
	Sample #2	0.59	0.01	0.09	0.00			43.61	0.26
	Sample #3	0.08	0.00	0.02	0.00			<0.23	0.00
	Sample #4	1.54	0.02	0.02	0.00			5.41	0.03
	Sample #5	0.68	0.01	0.07	0.00			23.79	0.14
8									
	Sample #1	3.06	0.14	0.06	0.00	19.68	0.98	19.74	0.98
	Sample #2	3.05	0.07	0.08	0.00	42.96	0.52	42.93	0.35
	Sample #3	2.42	0.10	0.01	0.00	0.09	0.01	0.10	0.00
	Sample #4	4.69	0.60	0.02	0.01	5.60	0.30	5.61	0.27
	Sample #5	2.56	0.03	0.06	0.00	23.22	0.06	23.28	0.06
17									
	Sample #1	1.04		0.18		38.09		38.28	
	Sample #2	0.96		0.20		83.25		83.45	
	Sample #3	0.88		0.06		3.00		3.06	
	Sample #4	1.53		0.08		10.71		10.80	
	Sample #5	0.79		0.09		45.95		46.04	
19									
	Sample #1	1.06	0.04	0.08	0.00	19.68	0.04	19.76	0.04
	Sample #2	0.90	0.01	0.10	0.00	43.69	0.09	43.79	0.09
	Sample #3	1.11	0.00	0.04	0.00	0.00	0.03	0.05	0.03
	Sample #4	1.79	0.00	0.04	0.00	5.43	0.02	5.47	0.02
	Sample #5	0.93	0.00	0.08	0.00	23.79	0.06	23.87	0.06
27									
	Sample #1	1.37	0.03	0.08	0.01	19.22	0.03	19.30	0.03
	Sample #3	0.76	0.03	0.04	0.01	0.03	0.03	0.07	0.03
	Sample #4	1.52	0.03	0.04	0.01	5.33	0.03	5.37	0.03
	Sample #5	0.92	0.03	0.08	0.01	23.31	0.03	23.39	0.03
28									
	Sample #1	0.99	0.15	0.03	0.01	19.66	0.15	19.69	0.15
	Sample #3	1.40	0.19	0.00	0.01	0.17	0.05	0.17	0.05
	Sample #4	2.00	0.20	0.01	0.01	5.46	0.20	5.47	0.20
	Sample #5	1.83	0.20	0.03	0.01	23.67	0.15	23.70	0.15
32									
	Sample #1	0.99	0.15	<0.06	0.15	18.36	0.20	18.42	0.19
	Sample #3	0.93	0.15	<0.06	0.15	<0.10	0.20	<0.08	0.19
	Sample #4	1.84	0.30	<0.06	0.15	5.31	0.20	5.32	0.19
	Sample #5	1.36	0.27	<0.06	0.15	22.68	0.56	22.73	0.56

Table A4 Ammonia

Lab	Sample	Ammonia	err	Nitrite	err	Nitrate	err	Nitrate+Nitrite	err
39									
	Sample #1	1.56	0.02	0.07	0.00	19.76	0.03	19.83	0.03
	Sample #2	1.04	0.02	0.09	0.00	43.58	0.07	43.67	0.06
	Sample #3	1.42	0.02	0.03	0.00	0.03	0.01	0.05	0.01
	Sample #4	2.10	0.02	0.03	0.00	5.52	0.01	5.55	0.01
	Sample #5	1.23	0.02	0.07	0.00	23.89	0.03	23.96	0.03
40									
	Sample #1	1.74		<0.07		19.55		19.58	
	Sample #2	0.63		0.08		43.36		43.42	
	Sample #3	0.99		<0.07		0.25		0.27	
	Sample #4	1.69		<0.07		5.54		5.55	
	Sample #5	1.14		0.07		23.22		23.29	
50									
	Sample #1	1.47	0.03	0.06	0.00	19.66	0.15	19.72	0.15
	Sample #2	0.97	0.02	0.07	0.00	42.73	0.07	43.78	0.07
	Sample #3	1.32	0.02	0.02	0.00	0.03	0.00	0.05	0.00
	Sample #4	2.45	0.12	0.03	0.00	5.59	0.06	5.62	0.06
	Sample #5	1.12	0.07	0.06	0.00	23.81	0.21	23.88	0.21
51									
	Sample #1	1.15	0.03	0.08	0.00	19.89	0.03	19.97	0.02
	Sample #3	1.20	0.03	0.04	0.00	0.14	0.02	0.18	0.01
	Sample #4	1.96	0.03	0.04	0.00	5.55	0.03	5.59	0.02
	Sample #5	1.34	0.03	0.08	0.00	23.97	0.06	24.05	0.05
86									
	Sample #1	1.13	0.02	0.07	0.00	19.38	0.06	19.46	0.06
	Sample #2	0.38	0.03	0.08	0.00	43.42	0.08	43.50	0.08
	Sample #3	0.34	0.01	0.02	0.00	0.06	0.01	0.08	0.01
	Sample #4	0.94	0.03	0.02	0.00	5.47	0.01	5.49	0.01
	Sample #5	0.49	0.06	0.06	0.00	23.88	0.08	23.94	0.07
89									
	Sample #1	1.49	0.03	0.11	0.01	19.16	0.02	19.27	0.02
	Sample #2	0.57	0.00	0.14	0.00	43.40	0.08	36.35	0.19
	Sample #3	0.94	0.02	0.05	0.00	0.03	0.04	0.08	0.04
	Sample #4	2.21	0.02	0.07	0.00	4.96	0.05	5.03	0.05
	Sample #5	1.32	0.03	0.11	0.00	23.41	0.02	23.52	0.07

Table A4 Ammonia

Lab	Sample	Ammonia	err	Nitrite	err	Nitrate	err	Nitrate+Nitrite	err
95									
	Sample #1	9.46	0.21	0.06	0.01	19.70	0.08	19.76	0.08
	Sample #2	9.04	0.35	0.08	0.01	41.81	0.19	41.88	0.19
	Sample #3	11.11	0.31	0.00	0.00	0.00	0.00	0.00	0.00
	Sample #4	14.59	0.22	0.02	0.00	5.52	0.03	5.54	0.03
	Sample #5	13.35	0.10	0.05	0.01	23.74	0.10	23.79	0.10
101									
	Sample #1	1.87	0.02	0.02	0.00	19.97	0.05	20.59	0.05
	Sample #3	1.57	0.01	-0.03	0.00	0.27	0.00	0.25	0.00
	Sample #4	2.12	0.05	-0.02	0.00	5.42	0.06	5.56	0.06
	Sample #5	1.58	0.00	0.03	0.00	24.53	0.07	25.30	0.07
102									
	Sample #1	1.59		0.05		19.47		19.52	
	Sample #3	0.91		0.00		0.04	0.01	0.05	0.01
	Sample #4	1.84		0.00		5.50	0.03	5.50	0.03
	Sample #5	1.42		0.05		22.98		23.02	
106									
	Sample #1	0.96	0.03	0.08	0.01	19.86	0.09	19.95	0.08
	Sample #2	0.62	0.01	0.09	0.01	48.13	0.02	48.23	0.02
	Sample #3	1.04	0.02	0.03	0.01	0.05	0.01	0.08	0.01
	Sample #4	1.63	0.06	0.04	0.00	5.39	0.01	5.43	0.01
	Sample #5	1.30	0.05	0.06	0.00	26.24	0.07	26.30	0.07
109									
	Sample #1	0.95	0.01	0.07	0.00	19.79	0.06	19.86	0.06
	Sample #2	0.61	0.01	0.09	0.00	42.96	0.15	43.05	0.15
	Sample #3	0.91	0.00	0.03	0.00	0.04	0.00	0.07	0.00
	Sample #4	1.48	0.02	0.03	0.00	5.56	0.02	5.58	0.02
	Sample #5	0.74	0.01	0.08	0.00	23.72	0.11	23.81	0.11
111									
	Sample #1	3.90		0.11		20.60		20.70	
	Sample #3	3.22		0.06		0.28		0.35	
	Sample #4	3.25		0.06		6.31		6.37	
	Sample #5	2.47		0.10		24.53		24.63	
112									
	Sample #1	1.44	0.01	0.07	0.00			19.70	0.01
	Sample #3	1.30	0.01	0.03	0.00			0.08	0.00
	Sample #4	1.77	0.01	0.03	0.00			5.40	0.00
	Sample #5	1.50	0.01	0.07	0.00			23.77	0.02

Table A4 Ammonia

Lab	Sample	Ammonia	err	Nitrite	err	Nitrate	err	Nitrate+Nitrite	err
113									
	Sample #1	2.67	0.26	0.08	0.01	19.51	0.13	19.57	0.13
	Sample #2	1.01	0.26	0.10	0.01	42.99	0.13	43.07	0.13
	Sample #3	1.84	0.26	0.04	0.01	0.00	0.13	0.00	0.13
	Sample #4	3.26	0.26	0.03	0.01	5.62	0.13	5.65	0.13
	Sample #5	2.42	0.26	0.07	0.01	23.74	0.13	23.80	0.13
124									
	Sample #1	2.44	0.95	N.D	N.D	19.70	0.06	19.70	0.06
	Sample #2	1.96	0.97	N.D	N.D	43.11	0.08	43.11	0.08
	Sample #3	2.35	1.07	N.D	N.D	0.28	0.04	0.28	0.04
	Sample #4	2.94	1.17	N.D	N.D	5.65	0.03	5.65	0.03
	Sample #5	2.84	1.17	N.D	N.D	23.96	0.02	23.96	0.02
125									
	Sample #1	2.46	0.09	0.09	0.01	19.76	0.10	19.85	0.10
	Sample #2	1.46	0.09	0.10	0.01	43.70	0.10	43.80	0.10
	Sample #3	1.86	0.09	0.05	0.01	0.01	0.10	0.06	0.10
	Sample #4	2.64	0.09	0.05	0.01	5.47	0.10	5.52	0.10
	Sample #5	2.32	0.09	0.08	0.01	23.81	0.10	23.90	0.10
129									
	Sample #1	1.51	0.01	0.06	0.00	19.11	0.23		
	Sample #3	1.16	0.01	0.01	0.00	0.06	0.01		
	Sample #4	1.60	0.01	0.01	0.00	5.35	0.02		
	Sample #5	1.43	0.01	0.05	0.00	23.01	0.06		
136									
	Sample #1	1.90	0.02	-0.02	0.00	20.35	0.10		
	Sample #3	1.67	0.01	-0.06	0.00	-0.20	0.04		
	Sample #4	1.74	0.01	-0.07	0.01	5.60	0.03		
	Sample #5	1.77	0.01	-0.01	0.01	24.62	0.28		
137									
	Sample #1	1.77	0.00	0.06	0.00	19.91	0.02	19.97	0.02
	Sample #2	0.76	0.00	0.08	0.00	43.72	0.02	43.80	0.02
	Sample #3	1.04	0.00	0.02	0.00	0.04	0.01	0.06	0.01
	Sample #4	2.10	0.01	0.02	0.00	5.65	0.01	5.67	0.01
	Sample #5	1.12	0.00	0.05	0.00	23.93	0.05	23.98	0.05
138									
	Sample #1	1.66	0.01	0.08	0.00	19.63	0.02	19.70	0.02
	Sample #3	1.25	0.00	0.03	0.00	0.04	0.01	0.06	0.01
	Sample #4	1.62	0.01	0.03	0.00	5.50	0.01	5.53	0.01
	Sample #5	1.13	0.00	0.07	0.00	23.67	0.02	23.74	0.02

Table A4 Ammonia

Lab	Sample	Ammonia	err	Nitrite	err	Nitrate	err	Nitrate+Nitrite	err
141									
	Sample #1	1.58	0.01	0.08	0.00	19.61	0.13	19.68	0.13
	Sample #3	1.30	0.02	0.03	0.00	0.05	0.01	0.08	0.01
	Sample #4	1.66	0.01	0.03	0.00	5.59	0.05	5.62	0.05
	Sample #5	1.12	0.02	0.07	0.00	24.17	0.10	24.24	0.10
148									
	Sample #1	0.75		0.09		20.13		20.22	
	Sample #2	0.59		0.09		42.66		42.75	
	Sample #3	0.97		0.03		0.10		0.13	
	Sample #4	1.55		0.05		5.72		5.77	
	Sample #5	1.02		0.09		23.90		23.99	
155									
	Sample #1	0.80	0.09	0.08		19.45	0.47	19.53	0.47
	Sample #2	1.18	0.13	0.09		42.90	1.03	42.95	1.03
	Sample #3	1.67	0.18	0.03		<0.49		0.02	0.00
	Sample #4	2.63	0.21	0.04		5.23	0.24	5.27	0.23
	Sample #5	1.75	0.10	0.07		23.36	0.56	23.43	0.57

Table A5 DOP

Lab	Sample	Phosphate	err	DOP	err
5					
	Sample #1	1.46	0.02	1.78	0.02
	Sample #2	3.10	0.04	3.52	0.05
	Sample #3	0.08	0.00	0.23	0.00
	Sample #4	0.47	0.01	0.76	0.01
	Sample #5	1.79	0.03	2.11	0.03
32					
	Sample #1	1.20	0.02	0.53	0.15
	Sample #3	<0.01	0.02	0.15	0.15
	Sample #4	0.41	0.02	0.26	0.15
	Sample #5	1.68	0.06	0.21	0.15
39					
	Sample #1	1.43	0.00	0.33	0.02
	Sample #2	3.12	0.00	0.30	0.03
	Sample #3	0.01	0.00	0.28	0.02
	Sample #4	0.45	0.00	0.24	0.02
	Sample #5	1.73	0.00	0.35	0.02
40					
	Sample #1	1.29		0.32	
	Sample #2	2.95		0.36	
	Sample #3	<0.03		0.25	
	Sample #4	0.41		0.28	
	Sample #5	1.53		0.48	
65					
	Sample #1	1.41	0.00	0.31	0.00
	Sample #2	3.06	0.01	0.32	0.01
	Sample #3	0.04	0.01	0.25	0.01
	Sample #4	0.44	0.00	0.26	0.01
	Sample #5	1.69	0.00	0.37	0.01
86					
	Sample #1	1.41	0.00	0.06	0.02
	Sample #2	3.01	0.01	0.07	0.01
	Sample #3	0.01	0.00	0.14	0.02
	Sample #4	0.43	0.00	0.17	0.01
	Sample #5	1.69	0.00	0.12	0.01

Table A5 DOP

Lab	Sample	Phosphate	err	DOP	err
106					
	Sample #1	1.50	0.01	0.50	0.01
	Sample #2	3.25	0.01	0.35	0.10
	Sample #3	0.01	0.01	0.31	0.04
	Sample #4	0.49	0.00	0.38	0.06
	Sample #5	1.81	0.01	0.37	0.06
148					
	Sample #1	1.46		0.54	
	Sample #2	3.12		0.67	
	Sample #3	0.06		0.32	
	Sample #4	0.46		0.40	
	Sample #5	1.73		0.61	

Table A6 DON

Lab	Sample	DON	err	Nitrate	err	Nitrite	err	Nitrate+Nitrite	err	Ammonia	err
5											
	Sample #1	22.37	0.22			0.07	0.00	19.59	0.12	1.14	0.01
	Sample #2	44.53	0.45			0.09	0.00	43.61	0.26	0.59	0.01
	Sample #3	5.64	0.06			0.02	0.00	<0.23	0.00	0.08	0.00
	Sample #4	11.59	0.12			0.02	0.00	5.41	0.03	1.54	0.02
	Sample #5	26.85	0.27			0.07	0.00	23.79	0.14	0.68	0.01
32											
	Sample #1	2.42	1.56	18.36	0.20	<0.06	0.15	18.42	0.19	0.99	0.15
	Sample #3	4.28	1.56	<0.10	0.20	<0.06	0.15	<0.08	0.19	0.93	0.15
	Sample #4	3.48	1.56	5.31	0.20	<0.06	0.15	5.32	0.19	1.84	0.30
	Sample #5	2.68	1.56	22.68	0.56	<0.06	0.15	22.73	0.56	1.36	0.27
39											
	Sample #1	3.32	0.29	19.76	0.03	0.07	0.00	19.83	0.03	1.56	0.02
	Sample #2	2.05	0.29	43.58	0.07	0.09	0.00	43.67	0.06	1.04	0.02
	Sample #3	3.81	0.20	0.03	0.01	0.03	0.00	0.05	0.01	1.42	0.02
	Sample #4	3.81	0.20	5.52	0.01	0.03	0.00	5.55	0.01	2.10	0.02
	Sample #5	2.93	0.29	23.89	0.03	0.07	0.00	23.96	0.03	1.23	0.02
40											
	Sample #1	3.07		19.55		<0.07		19.58		1.74	
	Sample #2	1.33		43.36		0.08		43.42		0.63	
	Sample #3	3.35		0.25		<0.07		0.27		0.99	
	Sample #4	3.62		5.54		<0.07		5.55		1.69	
	Sample #5	3.59		23.22		0.07		23.29		1.14	
65											
	Sample #1	5.83	0.05					19.61	0.05		
	Sample #2	3.99	0.02					43.43	0.02		
	Sample #3	5.30	0.03					0.03	0.02		
	Sample #4	7.15	0.03					5.47	0.02		
	Sample #5	4.71	0.05					23.67	0.04		
86											
	Sample #1	4.60	0.20	19.38	0.06	0.07	0.00	19.46	0.06	1.13	0.02
	Sample #2	3.84	0.04	43.42	0.08	0.08	0.00	43.50	0.08	0.38	0.03
	Sample #3	4.76	0.06	0.06	0.01	0.02	0.00	0.08	0.01	0.34	0.01
	Sample #4	4.98	0.35	5.47	0.01	0.02	0.00	5.49	0.01	0.94	0.03
	Sample #5	4.39	0.15	23.88	0.08	0.06	0.00	23.94	0.07	0.49	0.06
106											
	Sample #1	3.28	0.22	19.86	0.09	0.08	0.01	19.95	0.08	0.96	0.03
	Sample #2	1.43	0.74	48.13	0.02	0.09	0.01	48.23	0.02	0.62	0.01
	Sample #3	4.34	0.27	0.05	0.01	0.03	0.01	0.08	0.01	1.04	0.02
	Sample #4	4.59	0.18	5.39	0.01	0.04	0.00	5.43	0.01	1.63	0.06

Table A6 DON

Lab	Sample	DON	err	Nitrate	err	Nitrite	err	Nitrate+Nitrite	err	Ammonia	err
	Sample #5	0.81	0.44	26.24	0.07	0.06	0.00	26.30	0.07	1.30	0.05
148											
	Sample #1	6.22		20.13		0.09		20.22		0.75	
	Sample #2	8.26		42.66		0.09		42.75		0.59	
	Sample #3	7.96		0.10		0.03		0.13		0.97	
	Sample #4	8.72		5.72		0.05		5.77		1.55	
	Sample #5	7.08		23.90		0.09		23.99		1.02	

Table A7 DOC

Lab	Sample	DOC	err
106			
	Sample #1	101.25	0.56
	Sample #2	165.78	2.74
	Sample #3	165.48	3.69
	Sample #4	131.19	2.13
	Sample #5	86.55	2.30

Appendix III

Table A8-1 Cross reference table of ranked order and Lab # for Figure 1

Table A8-2 Cross reference table of ranked order and Lab # for Figure 2

Table A8-3 Cross reference table of ranked order and Lab # for Figure 3

Table A8-4 Cross reference table of ranked order and Lab # for Figure 4

Table A8-5 Cross reference table of ranked order and Lab # for Figure 5

Table A8-1 Cross reference table of ranked order and Lab # for Figure 1

rank	Lab No.	Lab name
1	**149**	Arctic and Antarctic Research Institute, Russia, Russia
2	**80**	Instituto del Mar del Perú, Peru
3	**118**	Technical University of Denmark, National Institute for Aquatic Resources (AQUA) , Denmark
4	**90**	Environmental Chemistry Analysis Laboratory (ECAL), University of Portsmouth, UK
5	**150**	Marine Environment Analysis Center Korea Marine Environment management Corporation(KOEM), Republic of Korea
6	**38**	Japan Sea National Fishers Research Institute, Fishers Research Agency, Japan
7	**143**	Instituto de Investigaciones Oceanológicas Universidad Autónoma de Baja California, USA
8	**32**	Israel Oceanographic & Limnological Res, National Institute of Oceanography, Israel
9	**23**	The National Center for Scientific Research(CNRS), Mediterranean Institute of Oceanology (MIO), France
10	**156**	University of Alaska, Fairbanks, USA
11	**102**	Stazione Zoologica Anton Dohrn, Italia
12	**49**	National Oceanography Centre, Southampton, UK
13	**98**	Estonian Marine Institute of Tartu University, Estonia
14	**140**	Oceánica de Canarias (PLOCAN) - Oceanic Platform of the Canary Islands, Spain
15	**8**	Institute of Biology, Rio de Janeiro Federal University(UFRJ), Brazil
16	**40**	National Institute of Water and Atmospheric Research (NIWA), New Zealand
17	**14**	Laboratory of Marine Environmental Science Xiamen University , China
18	**27**	Marine Chemistry Instruments Bundesamt für Seeschifffahrt und Hydrographie (BSH), Laboratorium Sülldorf, Germany
19	**155**	IFREMER LERMPL, Nantes, FRANCE, France
20	**29**	Marine Research Institute, Iceland
21	**89**	Scottish Environment Protection Agency, UK
22	**114**	LOQyCA – Centro para el estudio de los sistemas marinos (CONICET), Argentina
23	**93**	GEOMAR Helmholtz Center for Ocean Research, Kiel, Germany
24	**56**	Scripps Institution of Oceanography, USA

25	**57**	NOAA Atlantic Oceanographic and Meteorological Laboratory (AOML), Miami, Florida, USA
26	**65**	University of Hawaii at Manoa, Dept. of Oceanography, USA
27	**88**	Faroe Marine Research Institute, Faroe Islands
28	**28**	Alfred-Wegener-Institute Bremerhaven, Germany
29	**138**	Reseach Promotion Group, Mutsu Institute for Oceanography, JAMSTEC, Japan
30	**91**	Institute of Ocean Sciences, Fisheries and Oceans Canada, Canada
31	**112**	CSIRO, Oceans and Atmosphere, Australia
32	**5**	OD NATURE – ECOCHEM, Belgium
33	**95**	National Institute of Oceanography, India
34	**113**	Scripps Institution of Oceanography, CalCOFI Group, UC San Diego, USA
35	**10**	University of British Columbia, Department of Earth, Ocean & Atmospheric Sciences, Canada
36	**109**	KIOST (Korea Institute of Ocean Science & Technology), Republic of Korea
37	**92**	Station Biologique de Roscoff, Centre national de la recherche scientifique (CNRS) / Université Pierre et Marie Curie, France
38	**157**	Flanders Marine Institute, Belgium
39	**35**	Marine Division, Global Environment and Marine Department, Japan Meteorological Agency, Japan
40	**19**	Ifremer, DYNECO/PELAGOS, Plouzané, France
41	**50**	Plymouth Marine Laboratory, UK
42	**125**	Bedford Institute of Oceanography, Canada
43	**86**	Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS), Italy
44	**39**	Royal NIOZ, Netherlands
45	**124**	Korea Polar Reseach Institute, Republic of Korea
46	**107**	Observatoire oceanologique de Villefranche-sur-Mer (CNRS-UPMC), France
47	**137**	Atmosphere and ocean research institute, the University of Tokyo, Japan
48	**148**	University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Nutrient Analytical Services Laboratory, USA
49	**52**	Department of Earth, Ocean and Ecological Sciences, SOES, University of Liverpool, UK
50	**51**	Marine Scotland - Science, UK
51	**7**	Oceanographic Institute of the University of São Paulo, Brazil
52	**141**	Seikai National Fisheries Research Institute, Fisheries Rrsearch Agency, Japan

53	**26**	Leibniz Institut für Ostseeforschung Warnemünde, Germany
54	**59**	Monterey Bay Aquarium Research Institute, USA
55	**111**	Institute of Oceanology Polish Academy of Sciences, Marine Chemistry and Biochemistry Department, Poland
56	**41**	Institute of Marine Research, Norway
57	**135**	The Marine Institute, Ireland
58	**69**	Oriente University, Oceanographic Institute of Venezuela, Departament of Oceanography. Laboratory of nutritious elements, Venezuela
59	**101**	National Institute of Fisheries Science(NIFS), Republic of Korea
60	**106**	Institut de Ciències del Mar (ICM-CSIC), Barcelona, Spain
61	**153**	CENTRO DE INVESTIGACIONES OCEANOGRÁFICAS E HIDROGRÁFICAS DEL PACÍFICO (CCCP)., Colombia
62	**17**	College of Marine and Environmental Sciences, Tianjin University of Science and Technology, China

Table A8-2 Cross reference table of ranked order and Lab # for Figure 2

rank	Lab No.	Lab name
1	**80**	Instituto del Mar del Perú, Peru
2	**118**	Technical University of Denmark, National Institute for Aquatic Resources (AQUA) , Denmark
3	**90**	Environmental Chemistry Analysis Laboratory (ECAL), University of Portsmouth, UK
4	**143**	Instituto de Investigaciones Oceanológicas Universidad Autónoma de Baja California, USA
5	**32**	Israel Oceanographic & Limnological Res, National Institute of Oceanography, Israel
6	**23**	The National Center for Scientific Research(CNRS), Mediterranean Institute of Oceanology (MIO), France
7	**156**	University of Alaska, Fairbanks, USA
8	**45**	University of Cape town, Dept of Oceanography, South Africa
9	**102**	Stazione Zoologica Anton Dohrn, Italia
10	**129**	Tokyo University of Marine Science and Technology, Japan
11	**49**	National Oceanography Centre, Southampton, UK
12	**8**	Institute of Biology, Rio de Janeiro Federal University(UFRJ), Brazil
13	**40**	National Institute of Water and Atmospheric Research (NIWA), New Zealand
14	**14**	Laboratory of Marine Environmental Science Xiamen University , China
15	**27**	Marine Chemistry Instruments Bundesamt für Seeschifffahrt und Hydrographie (BSH), Laboratorium Sülldorf, Germany
16	**155**	IFREMER LERMPL, Nantes, FRANCE, France
17	**89**	Scottish Environment Protection Agency, UK
18	**139**	Hokkaido National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan
19	**93**	GEOMAR Helmholtz Center for Ocean Research, Kiel, Germany
20	**56**	Scripps Institution of Oceanography, USA
21	**57**	NOAA Atlantic Oceanographic and Meteorological Laboratory (AOML), Miami, Florida, USA
22	**88**	Faroe Marine Research Institute, Faroe Islands
23	**28**	Alfred-Wegener-Institute Bremerhaven, Germany
24	**138**	Reseach Promotion Group, Mutsu Institute for Oceanography, JAMSTEC, Japan

25	**109**	KIOST (Korea Institute of Ocean Science & Technology), Republic of Korea
26	**10**	University of British Columbia, Department of Earth, Ocean & Atmospheric Sciences, Canada
27	**95**	National Institute of Oceanography, India
28	**113**	Scripps Institution of Oceanography, CalCOFI Group, UC San Diego, USA
29	**92**	Station Biologique de Roscoff, Centre national de la recherche scientifique (CNRS) / Université Pierre et Marie Curie, France
30	**19**	Ifremer, DYNECO/PELAGOS, Plouzané, France
31	**157**	Flanders Marine Institute, Belgium
32	**50**	Plymouth Marine Laboratory, UK
33	**125**	Bedford Institute of Oceanography, Canada
34	**86**	Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS), Italy
35	**39**	Royal NIOZ, Netherlands
36	**107**	Observatoire oceanologique de Villefranche-sur-Mer (CNRS-UPMC), France
37	**148**	University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Nutrient Analytical Services Laboratory, USA
38	**137**	Atmosphere and ocean research institute, the University of Tokyo, Japan
39	**124**	Korea Polar Reseach Institute, Republic of Korea
40	**51**	Marine Scotland - Science, UK
41	**52**	Department of Earth, Ocean and Ecological Sciences, SOES, University of Liverpool, UK
42	**7**	Oceanographic Institute of the University of São Paulo, Brazil
43	**141**	Seikai National Fisheries Research Institute, Fisheries Rrsearch Agency, Japan
44	**26**	Leibniz Institut für Ostseeforschung Warnemünde, Germany
45	**59**	Monterey Bay Aquarium Research Institute, USA
46	**101**	National Institute of Fisheries Science(NIFS), Republic of Korea
47	**111**	Institute of Oceanology Polish Academy of Sciences, Marine Chemistry and Biochemistry Department, Poland
48	**136**	Dalhousie University in Halifax, Canada, Canada
49	**41**	Institute of Marine Research, Norway
50	**106**	Institut de Ciències del Mar (ICM-CSIC), Barcelona, Spain
51	**153**	CENTRO DE INVESTIGACIONES OCEANOGRÁFICAS E HIDROGRÁFICAS DEL PACÍFICO (CCCP)., Colombia

52	**151**	INSTITUTO OCEANOGRÁFICO DE LA ARMADA (INOCAR), Ecuador
53	**17**	College of Marine and Environmental Sciences, Tianjin University of Science and Technology, China

Table A8-3 Cross reference table of ranked order and Lab # for Figure 3

rank	Lab No.	Lab name
1	**136**	Dalhousie University in Halifax, Canada, Canada
2	**139**	Hokkaido National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan
3	**28**	Alfred-Wegener-Institute Bremerhaven, Germany
4	**101**	National Institute of Fisheries Science(NIFS), Republic of Korea
5	**93**	GEOMAR Helmholtz Center for Ocean Research, Kiel, Germany
6	**157**	Flanders Marine Institute, Belgium
7	**14**	Laboratory of Marine Environmental Science Xiamen University , China
8	**49**	National Oceanography Centre, Southampton, UK
9	**56**	Scripps Institution of Oceanography, USA
10	**57**	NOAA Atlantic Oceanographic and Meteorological Laboratory (AOML), Miami, Florida, USA
11	**80**	Instituto del Mar del Perú, Peru
12	**88**	Faroe Marine Research Institute, Faroe Islands
13	**90**	Environmental Chemistry Analysis Laboratory (ECAL), University of Portsmouth, UK
14	**92**	Station Biologique de Roscoff, Centre national de la recherche scientifique (CNRS) / Université Pierre et Marie Curie, France
15	**95**	National Institute of Oceanography, India
16	**102**	Stazione Zoologica Anton Dohrn, Italia
17	**129**	Tokyo University of Marine Science and Technology, Japan
18	**137**	Atmosphere and ocean research institute, the University of Tokyo, Japan
19	**7**	Oceanographic Institute of the University of São Paulo, Brazil
20	**8**	Institute of Biology, Rio de Janeiro Federal University(UFRJ), Brazil
21	**10**	University of British Columbia, Department of Earth, Ocean & Atmospheric Sciences, Canada
22	**35**	Marine Division, Global Environment and Marine Department, Japan Meteorological Agency, Japan
23	**38**	Japan Sea National Fishers Research Institute, Fishers Research Agency, Japan
24	**50**	Plymouth Marine Laboratory, UK
25	**52**	Department of Earth, Ocean and Ecological Sciences, SOES, University of Liverpool, UK

26	**86**	Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS), Italy
27	**106**	Institut de Ciències del Mar (ICM-CSIC), Barcelona, Spain
28	**118**	Technical University of Denmark, National Institute for Aquatic Resources (AQUA) , Denmark
29	**135**	The Marine Institute, Ireland
30	**5**	OD NATURE – ECOCHEM, Belgium
31	**23**	The National Center for Scientific Research(CNRS), Mediterranean Institute of Oceanology (MIO), France
32	**26**	Leibniz Institut für Ostseeforschung Warnemünde, Germany
33	**29**	Marine Research Institute, Iceland
34	**39**	Royal NIOZ, Netherlands
35	**40**	National Institute of Water and Atmospheric Research (NIWA), New Zealand
36	**45**	University of Cape town, Dept of Oceanography, South Africa
37	**59**	Monterey Bay Aquarium Research Institute, USA
38	**112**	CSIRO, Oceans and Atmosphere, Australia
39	**113**	Scripps Institution of Oceanography, CalCOFI Group, UC San Diego, USA
40	**138**	Reseach Promotion Group, Mutsu Institute for Oceanography, JAMSTEC, Japan
41	**141**	Seikai National Fisheries Research Institute, Fisheries Rrsearch Agency, Japan
42	**143**	Instituto de Investigaciones Oceanológicas Universidad Autónoma de Baja California, USA
43	**155**	IFREMER LERMPL, Nantes, FRANCE, France
44	**19**	Ifremer, DYNECO/PELAGOS, Plouzané, France
45	**27**	Marine Chemistry Instruments Bundesamt für Seeschifffahrt und Hydrographie (BSH), Laboratorium Sülldorf, Germany
46	**41**	Institute of Marine Research, Norway
47	**51**	Marine Scotland - Science, UK
48	**107**	Observatoire oceanologique de Villefranche-sur-Mer (CNRS-UPMC), France
49	**109**	KIOST (Korea Institute of Ocean Science & Technology), Republic of Korea
50	**125**	Bedford Institute of Oceanography, Canada
51	**17**	College of Marine and Environmental Sciences, Tianjin University of Science and Technology, China
52	**148**	University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Nutrient Analytical Services Laboratory, USA
53	**156**	University of Alaska, Fairbanks, USA

54	**111**	Institute of Oceanology Polish Academy of Sciences, Marine Chemistry and Biochemistry Department, Poland
55	**151**	INSTITUTO OCEANOGRÁFICO DE LA ARMADA (INOCAR), Ecuador
56	**89**	Scottish Environment Protection Agency, UK
57	**149**	Arctic and Antarctic Research Institute, Russia, Russia
58	**30**	ICAR-Central Institute of Fisheries Technology, Fishing Technology Division, India

Table A8-4 Cross reference table of ranked order and Lab # for Figure 4

rank	Lab No.	Lab name
1	**30**	ICAR-Central Institute of Fisheries Technology, Fishing Technology Division, India
2	**40**	National Institute of Water and Atmospheric Research (NIWA), New Zealand
3	**150**	Marine Environment Analysis Center Korea Marine Environment management Corporation(KOEM), Republic of Korea
4	**88**	Faroe Marine Research Institute, Faroe Islands
5	**90**	Environmental Chemistry Analysis Laboratory (ECAL), University of Portsmouth, UK
6	**57**	NOAA Atlantic Oceanographic and Meteorological Laboratory (AOML), Miami, Florida, USA
7	**125**	Bedford Institute of Oceanography, Canada
8	**41**	Institute of Marine Research, Norway
9	**93**	GEOMAR Helmholtz Center for Ocean Research, Kiel, Germany
10	**136**	Dalhousie University in Halifax, Canada, Canada
11	**26**	Leibniz Institut für Ostseeforschung Warnemünde, Germany
12	**28**	Alfred-Wegener-Institute Bremerhaven, Germany
13	**151**	INSTITUTO OCEANOGRÁFICO DE LA ARMADA (INOCAR), Ecuador
14	**27**	Marine Chemistry Instruments Bundesamt für Seeschifffahrt und Hydrographie (BSH), Laboratorium Sülldorf, Germany
15	**113**	Scripps Institution of Oceanography, CalCOFI Group, UC San Diego, USA
16	**114**	LOQyCA – Centro para el estudio de los sistemas marinos (CONICET), Argentina
17	**135**	The Marine Institute, Ireland
18	**156**	University of Alaska, Fairbanks, USA
19	**32**	Israel Oceanographic & Limnological Res, National Institute of Oceanography, Israel
20	**37**	Graduate School of Environmental Science, Hokkaido University , Japan
21	**38**	Japan Sea National Fishers Research Institute, Fishers Research Agency, Japan
22	**51**	Marine Scotland - Science, UK
23	**139**	Hokkaido National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan

24	**10**	University of British Columbia, Department of Earth, Ocean & Atmospheric Sciences, Canada
25	**14**	Laboratory of Marine Environmental Science Xiamen University , China
26	**29**	Marine Research Institute, Iceland
27	**45**	University of Cape town, Dept of Oceanography, South Africa
28	**50**	Plymouth Marine Laboratory, UK
29	**65**	University of Hawaii at Manoa, Dept. of Oceanography, USA
30	**86**	Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS), Italy
31	**109**	KIOST (Korea Institute of Ocean Science & Technology), Republic of Korea
32	**112**	CSIRO, Oceans and Atmosphere, Australia
33	**124**	Korea Polar Reseach Institute, Republic of Korea
34	**155**	IFREMER LERMPL, Nantes, FRANCE, France
35	**35**	Marine Division, Global Environment and Marine Department, Japan Meteorological Agency, Japan
36	**59**	Monterey Bay Aquarium Research Institute, USA
37	**92**	Station Biologique de Roscoff, Centre national de la recherche scientifique (CNRS) / Université Pierre et Marie Curie, France
38	**138**	Reseach Promotion Group, Mutsu Institute for Oceanography, JAMSTEC, Japan
39	**19**	Ifremer, DYNECO/PELAGOS, Plouzané, France
40	**111**	Institute of Oceanology Polish Academy of Sciences, Marine Chemistry and Biochemistry Department, Poland
41	**118**	Technical University of Denmark, National Institute for Aquatic Resources (AQUA) , Denmark
42	**91**	Institute of Ocean Sciences, Fisheries and Oceans Canada, Canada
43	**101**	National Institute of Fisheries Science(NIFS), Republic of Korea
44	**39**	Royal NIOZ, Netherlands
45	**56**	Scripps Institution of Oceanography, USA
46	**137**	Atmosphere and ocean research institute, the University of Tokyo, Japan
47	**141**	Seikai National Fisheries Research Institute, Fisheries Rrsearch Agency, Japan
48	**143**	Instituto de Investigaciones Oceanológicas Universidad Autónoma de Baja California, USA
49	**148**	University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Nutrient Analytical Services Laboratory, USA

50	**52**	Department of Earth, Ocean and Ecological Sciences, SOES, University of Liverpool, UK
51	**107**	Observatoire oceanologique de Villefranche-sur-Mer (CNRS-UPMC), France
52	**129**	Tokyo University of Marine Science and Technology, Japan
53	**140**	Oceánica de Canarias (PLOCAN) - Oceanic Platform of the Canary Islands, Spain
54	**149**	Arctic and Antarctic Research Institute, Russia, Russia
55	**7**	Oceanographic Institute of the University of São Paulo, Brazil
56	**8**	Institute of Biology, Rio de Janeiro Federal University(UFRJ), Brazil
57	**157**	Flanders Marine Institute, Belgium
58	**23**	The National Center for Scientific Research(CNRS), Mediterranean Institute of Oceanology (MIO), France
59	**5**	OD NATURE – ECOCHEM, Belgium
60	**69**	Oriente University, Oceanographic Institute of Venezuela, Departament of Oceanography. Laboratory of nutritious elements, Venezuela
61	**106**	Institut de Ciències del Mar (ICM-CSIC), Barcelona, Spain
62	**80**	Instituto del Mar del Perú, Peru
63	**17**	College of Marine and Environmental Sciences, Tianjin University of Science and Technology, China
64	**102**	Stazione Zoologica Anton Dohrn, Italia
65	**95**	National Institute of Oceanography, India
66	**89**	Scottish Environment Protection Agency, UK
67	**153**	CENTRO DE INVESTIGACIONES OCEANOGRÁFICAS E HIDROGRÁFICAS DEL PACÍFICO (CCCP)., Colombia
68	**98**	Estonian Marine Institute of Tartu University, Estonia

Table A8-5 Cross reference table of ranked order and Lab # for Figure 5

rank	Lab No.	Lab name
1	**30**	ICAR-Central Institute of Fisheries Technology, Fishing Technology Division, India
2	**149**	Arctic and Antarctic Research Institute, Russia, Russia
3	**98**	Estonian Marine Institute of Tartu University, Estonia
4	**17**	College of Marine and Environmental Sciences, Tianjin University of Science and Technology, China
5	**153**	CENTRO DE INVESTIGACIONES OCEANOGRÁFICAS E HIDROGRÁFICAS DEL PACÍFICO (CCCP)., Colombia
6	**151**	INSTITUTO OCEANOGRÁFICO DE LA ARMADA (INOCAR), Ecuador
7	**29**	Marine Research Institute, Iceland
8	**80**	Instituto del Mar del Perú, Peru
9	**90**	Environmental Chemistry Analysis Laboratory (ECAL), University of Portsmouth, UK
10	**150**	Marine Environment Analysis Center Korea Marine Environment management Corporation(KOEM), Republic of Korea
11	**148**	University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Nutrient Analytical Services Laboratory, USA
12	**118**	Technical University of Denmark, National Institute for Aquatic Resources (AQUA) , Denmark
13	**101**	National Institute of Fisheries Science(NIFS), Republic of Korea
14	**41**	Institute of Marine Research, Norway
15	**157**	Flanders Marine Institute, Belgium
16	**113**	Scripps Institution of Oceanography, CalCOFI Group, UC San Diego, USA
17	**7**	Oceanographic Institute of the University of São Paulo, Brazil
18	**129**	Tokyo University of Marine Science and Technology, Japan
19	**8**	Institute of Biology, Rio de Janeiro Federal University(UFRJ), Brazil
20	**40**	National Institute of Water and Atmospheric Research (NIWA), New Zealand
21	**59**	Monterey Bay Aquarium Research Institute, USA
22	**107**	Observatoire oceanologique de Villefranche-sur-Mer (CNRS-UPMC), France
23	**56**	Scripps Institution of Oceanography, USA

24	**139**	Hokkaido National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan
25	**51**	Marine Scotland - Science, UK
26	**45**	University of Cape town, Dept of Oceanography, South Africa
27	**28**	Alfred-Wegener-Institute Bremerhaven, Germany
28	**32**	Israel Oceanographic & Limnological Res, National Institute of Oceanography, Israel
29	**49**	National Oceanography Centre, Southampton, UK
30	**93**	GEOMAR Helmholtz Center for Ocean Research, Kiel, Germany
31	**89**	Scottish Environment Protection Agency, UK
32	**38**	Japan Sea National Fishers Research Institute, Fishers Research Agency, Japan
33	**88**	Faroe Marine Research Institute, Faroe Islands
34	**125**	Bedford Institute of Oceanography, Canada
35	**155**	IFREMER LERMPL, Nantes, FRANCE, France
36	**135**	The Marine Institute, Ireland
37	**65**	University of Hawaii at Manoa, Dept. of Oceanography, USA
38	**52**	Department of Earth, Ocean and Ecological Sciences, SOES, University of Liverpool, UK
39	**138**	Reseach Promotion Group, Mutsu Institute for Oceanography, JAMSTEC, Japan
40	**140**	Oceánica de Canarias (PLOCAN) - Oceanic Platform of the Canary Islands, Spain
41	**141**	Seikai National Fisheries Research Institute, Fisheries Rrsearch Agency, Japan
42	**5**	OD NATURE – ECOCHEM, Belgium
43	**35**	Marine Division, Global Environment and Marine Department, Japan Meteorological Agency, Japan
44	**14**	Laboratory of Marine Environmental Science Xiamen University , China
45	**91**	Institute of Ocean Sciences, Fisheries and Oceans Canada, Canada
46	**112**	CSIRO, Oceans and Atmosphere, Australia
47	**39**	Royal NIOZ, Netherlands
48	**23**	The National Center for Scientific Research(CNRS), Mediterranean Institute of Oceanology (MIO), France
49	**92**	Station Biologique de Roscoff, Centre national de la recherche scientifique (CNRS) / Université Pierre et Marie Curie, France
50	**10**	University of British Columbia, Department of Earth, Ocean & Atmospheric Sciences, Canada
51	**19**	Ifremer, DYNECO/PELAGOS, Plouzané, France

52	**27**	Marine Chemistry Instruments Bundesamt für Seeschifffahrt und Hydrographie (BSH), Laboratorium Sülldorf, Germany
53	**57**	NOAA Atlantic Oceanographic and Meteorological Laboratory (AOML), Miami, Florida, USA
54	**124**	Korea Polar Reseach Institute, Republic of Korea
55	**86**	Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS), Italy
56	**136**	Dalhousie University in Halifax, Canada, Canada
57	**50**	Plymouth Marine Laboratory, UK
58	**26**	Leibniz Institut für Ostseeforschung Warnemünde, Germany
59	**156**	University of Alaska, Fairbanks, USA
60	**137**	Atmosphere and ocean research institute, the University of Tokyo, Japan
61	**109**	KIOST (Korea Institute of Ocean Science & Technology), Republic of Korea
62	**111**	Institute of Oceanology Polish Academy of Sciences, Marine Chemistry and Biochemistry Department, Poland
63	**102**	Stazione Zoologica Anton Dohrn, Italia
64	**95**	National Institute of Oceanography, India
65	**106**	Institut de Ciències del Mar (ICM-CSIC), Barcelona, Spain

Appendix IV

Invitation letter to 2017/18 I/C exercise

15 September 2017

Dear Colleague,

The International Ocean Carbon Coordination Project (IOCCP) and the Japan Agency for Marine-Earth Science and Technology (JAMATEC) are pleased to invite you to participate in the 6th International Inter-Calibration Exercise, the "2017/18 inter-laboratory comparison exercise of Certified Reference Material of Nutrients in Seawater, CRM".

This "2017/18 inter-laboratory comparison exercise of Certified Reference Material of Nutrients in Seawater, CRM" is planned to test the global comparability of nutrient measurements and to promote the use of CRM of nutrients in seawater. As with the previous four inter-comparison studies organized by MRI-JMA and previous IOCCCP-JAMSTEC IC exercise in 2015, the aim is also to improve the level of comparability by exchange of knowledge among participating laboratories. Therefore, if you join this inter-comparison exercise, you will be asked to report (1) the concentrations of nutrients in the samples we send you and (2) the details of analytical methods you use. The scale of the study has been expanded and 98 laboratories are receiving this invitation in 30 countries across five continents.

You can consult the reports from previous inter-laboratory comparison exercises at the IOCCP nutrients web site:
http://www.ioccp.org/index.php/nutrients

A chapter of the GO-SHIP manual on nutrient methods entitled *Recommendations for the Determination of Nutrients in Seawater to High Levels of Precision and Inter-Comparability using Continuous Flow Analyzers* (Hydes et al., 2010) is available from the GO-SHIP website at http://www.go-ship.org/HydroMan.html

Please use the attached reply form to confirm your participation. Take note of the following timetable and important points:

1. Your acceptance must be received by 15 October 2017.
2. We will acknowledge receipt of your reply and send out a list of the participants by 1 November 2017. If you do not receive an acknowledgement by 1 November 2017, please contact us.
3. A positive reply to us confirms: (1) your wish to participate in this inter-comparison exercise and (2) your ability to meet the reporting deadline of 28 February 2018.
4. You will receive a set of samples of CRM free of charge from JAMSTEC. Samples will be shipped mid of November 2017. This IC exercise, 4 bottles of samples of which silicate concentrations are lower than 100 micro mol kg-1 will be distributed to all participants. One bottle of which nutrients concentrations are similar with those of the North Pacific deep water will not distributed to laboratories where you are not familiar with those concentrations. Please indicate your experiences in the reply sheet. More details of samples will be provided later.
5. We expect to receive data on concentrations for nitrate, nitrite, phosphate and silicate from all participants.

6. We also welcome data for concentrations of ammonia and dissolved organic nitrogen and phosphorus from labs able to perform such analyses.
7. All resulting data reports will fully acknowledge the contribution of each participant.
8. Results of this IC exercise will be published with ISBN. A draft of this IC exercise will be distributed until 30 June 2018.

Best regards,

Prof. Michio AOYAMA, Dr.
Principal Research Scientist, RCGC - JAMSTEC
Professor, Institute of Environmental Radioactivity, Fukushima University, Japan
IOCCP Scientific Steering Group Expert for Nutrients (www.ioccp.org/nutrients)
Tel: +81-24-504-2882
E-mail: r706@ipc.fukushima-u.ac.jp

Application form for 2017/18 Inter-comparison exercise of Certified Reference Material of Nutrients in Seawater (CRM)

I have received your letter and now return this sheet to confirm my intention to participate.

Your lab. #		
Name:		
Affiliation:		
Full postal address to receive samples:		
E-mail		
Date:		
Experience of high silicate concentration	I am NOT familiar with high silicate concentration above 150 micro mol kg-1. Check x if yes ☐	
The geographical coordinate of your laboratory as latitude and longitude (we use this data to make a plot of geographical distribution of participating laboratory)	Lat.	
	Long.	
Your comment:		

PLEASE RETURN APPLICATION FORM TO

By email to: ic_nuts_crm@jamstec.go.jp
And by standard mail to:

Prof. Michio AOYAMA, Dr.
Institute of Environmental Radioactivity, Fukushima University
Kanayagawa-1, Fukushima, 963-1260, Japan

Appendix V

Results KIOST of RMs

Figure KIOST-1. Nitrate+Nitrite results for KIOST RMs. Laboratories are ranked in order of concentrations reported for NAY.

Figure KIOST-2. Nitrate results for KIOST RMs. Laboratories are ranked in order of concentrations reported for NAY.

Figure KIOST-3. Nitrite results for KIOST RMs. Laboratories are ranked in order of concentrations reported for NBA.

Figure KIOST-4. Phosphate results for KIOST RMs. Laboratories are ranked in order of concentrations reported for NAY.

Figure KIOST-5. Silicate results for KIOST RMs. Laboratories are ranked in order of concentrations reported for NAY.

Table KIOST-1-1. Comparison between certified value by KANSO and measured value by KIOST.

Table KIOST-1-2. Homogeneity of K-RMS.

Table KIOST-1-3. Assigned values of KIOST RMS.

Table KIOST-2. Summary of responses from participants.

Table KIOST-3. Raw and robust statistics for nutrient concentrations calculated using all reported values.

Table KIOST-4. Consensus means, medians, and standard deviations for 3 samples.

Description on KIOST Nutrient Reference Materials for Seawater (K-RMS)

1. Source seawater

Natural seawater was collected from Seawater Utilization Plant Research Center in Korea which provides seawater from the coastal station in Goseong at a depth of 650m (Goseong coastal water). Also collected from the surface at an open station (36^{o} 5'N, 129 ^{o}48'E) in the East Sea. Seawater from the 650m of coastal station was collected on November, 2016 and seawater from the surface at open station was collected with Niskin bottles on R/V Eardo on August, 2015 (East Sea surface water). NAY batch was made by Goseong coastal water, NAZ batch was mixed with Goseong coastal water and East Sea surface water in a ratio of 1:2. And NBA batch was mixed with Goseong coastal water and East Sea surface water in a ratio of 2:1.

2. Pasteurization

Natural Seawater was filtered into a 100 L titanium tank through 0.22 μm pore size membrane filter and was autoclaved at 120 ^{o}C 210 kPa for 2 hours. Then it was cooled down to room temperature with homogenizing on rotary turn table.

3. Bottling

Pasteurized seawater was transferred directly to sterilized 15ml test tube with screw cap (Kartell, Germany) for one day within class 100 clean bench in a class 1000 clean room. 2000 tubes of K-RMS were made for each batch within two days, and three batches were produced in total.

4. Package

Three batches of K-RMS were vacuum sealed with aluminum film bag in the clean room. Total dimension of package is 10 cm*10 cm*3cm and total weight is less than 50 g. Each bottle contains only 12 ml of reference material.

5. Homogeneity

Nutrients were analyzed using QuAAtro CFA system (SEAL Analytical). During the analysis, reference materials of nutrients in seawater (KANSO) were analyzed simultaneously. Our results of reference material were remained within the expanded uncertainty provided by the manufacturers. Randomly selected K-RMS was analyzed with triplicate for 10 months from January to November, 2017.

Table KIOST-1. Homogeneity of K-RMS.

K-RMS (Salinity)		Nitrite (μmol kg^{-1})	Nitrate+Nitrite (μmol kg^{-1})	Ammonium (μmol kg^{-1})	Phosphate (μmol kg^{-1})	Silicate (μmol kg^{-1})
K-RMS NAY (33.973)	Average	0.06	23.42	0.72	1.71	40.65
	SD	0.01	0.31	0.12	0.02	0.69
	CV, %	16.67	1.32	16.67	1.17	1.70

K-RMS NAZ (34.177)	Average	0.04	8.19	0.74	0.61	16.51
	SD	0.01	0.14	0.10	0.02	0.28
	CV, %	25	1.71	13.51	3.26	1.70
K-RMS NBA (34.286)	Average	0.11	15.50	0.76	1.10	28.11
	SD	0.02	0.37	0.18	0.02	0.50
	CV, %	18.18	2.39	23.68	1.82	1.78

6. Participants and response

During 2018 IOCCP/JAMSTEC co-organized inter-laboratory comparison study of nutrient reference material, 69 laboratories from 32 countries were participated for the analysis of KIOST nutrient reference material (K-RMS). Results were submitted by 62 laboratories. Table KIOST-2 summarizes participant numbers used for statistical treatment in this report. Average values were used for statistical treatment.

Table KIOST-2. Summary of responses from participants.

Nutrient	Sample #	Number of results Statistically treated	Nutrient	Sample #	Number of results Statistically treated
Nitrate +Nitrite	NAY	52	Phosphate	NAY	57
	NAZ	54		NAZ	56
	NBA	54		NBA	58
Nitrate	NAY	39	Silicate	NAY	57
	NAZ	40		NAZ	58
	NBA	41		NBA	58
Nitrite	NAY	49	Ammonia	NAY	26
	NAZ	49		NAZ	26
	NBA	51		NBA	26

7. Raw means, medians, and standard deviations

The consensus means and medians for all parameters are in good agreement with the assigned values within the standard deviations.

Table KIOST-3. Raw and robust statistics for nutrient concentrations calculated using all reported values.

Nutrient	Sample #	n	Raw Mean	Raw Median	Raw SD	Robust mean	Robust SD
			µmol kg^{-1}	µmol kg^{-1}	µmol kg^{-1}	µmol kg^{-1}	µmol kg^{-1}
Nitrate+Nitrite	Sample NAY	52	23.19	23.11	3.57	23.05	0.86
	Sample NAZ	54	8.14	8.00	1.90	8.02	0.39
	Sample NBA	54	15.44	15.27	2.84	15.33	0.83
Nitrate	Sample NAY	39	23.51	23.04	3.62	23.03	0.72
	Sample NAZ	40	8.22	7.96	1.95	7.98	0.33
	Sample NBA	41	15.51	15.16	2.85	15.26	0.75
Nitrite	Sample NAY	49	0.08	0.07	0.14	0.07	0.03
	Sample NAZ	49	0.07	0.05	0.07	0.06	0.04
	Sample NBA	51	0.17	0.14	0.09	0.15	0.06
Phosphate	Sample NAY	57	1.70	1.71	0.30	1.71	0.06
	Sample NAZ	56	0.64	0.62	0.16	0.62	0.04
	Sample NBA	58	1.10	1.11	0.22	1.11	0.06
Silicate	Sample NAY	57	37.36	38.91	6.01	38.47	1.67
	Sample NAZ	58	15.40	15.73	2.70	15.53	0.72
	Sample NBA	58	26.38	26.96	4.49	26.79	1.36

8. Ranked scatter-plots

Ranked scatter-plots of nitrate+nitrite, nitrate, nitrite, phosphate and silicate of three K-RMS are shown at Figures KIOST- 1 to KIOST-5. For nitrate+nitrite, nitrate, phosphate and silicate, the laboratories results were sorted in order of the concentrations reported for NAY. For nitrite, the laboratories results were sorted in order of the concentrations for NBA. General trends of ranked scatter-plots of K-RMS are similar to those of KANSO.

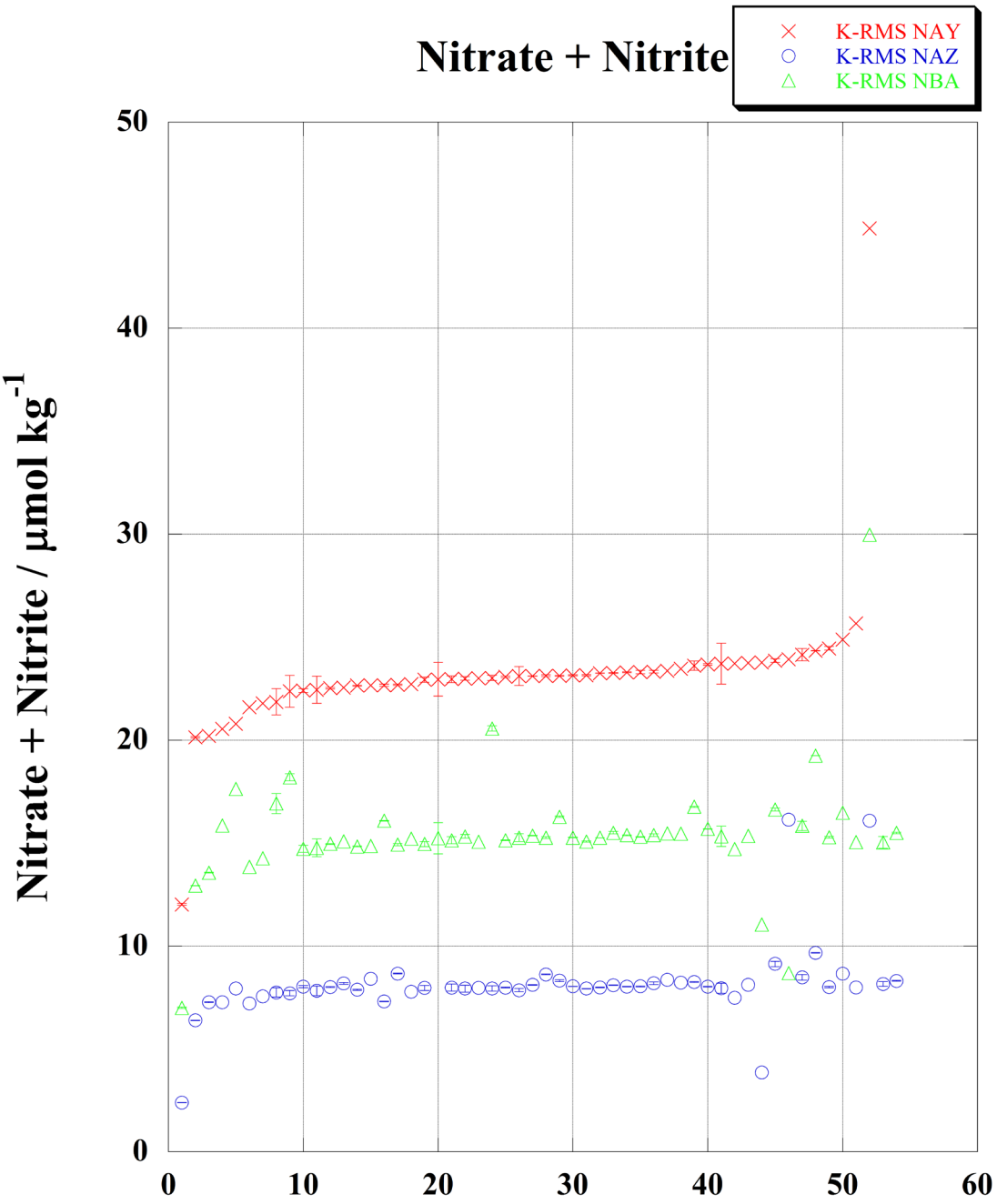

Figure KIOST-1. Nitrate+Nitrite results for KIOST RMs. Laboratories are ranked in order of concentrations reported for NAY.

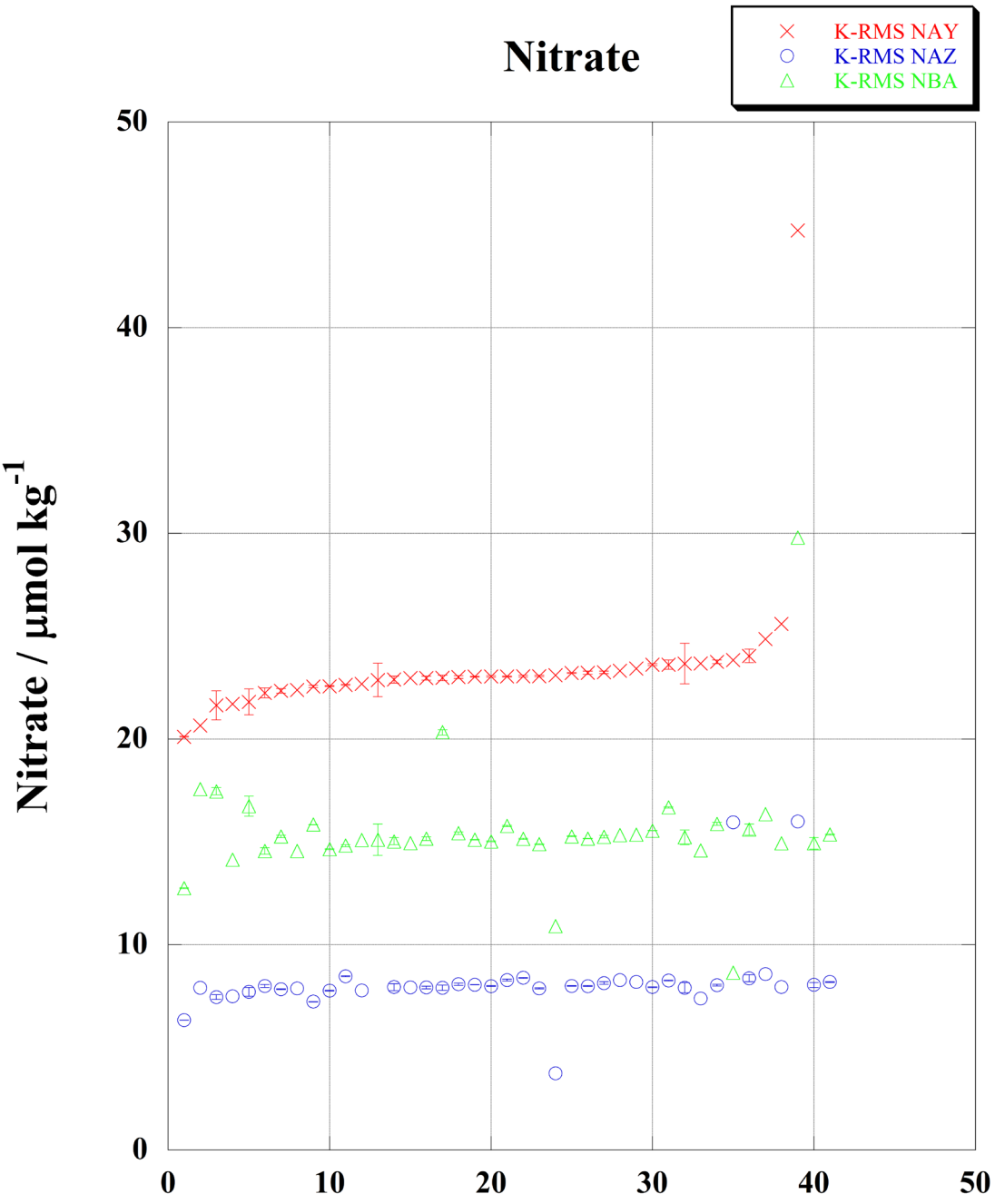

Figure KIOST-2. Nitrate results for KIOST RMs. Laboratories are ranked in order of concentrations reported for NAY.

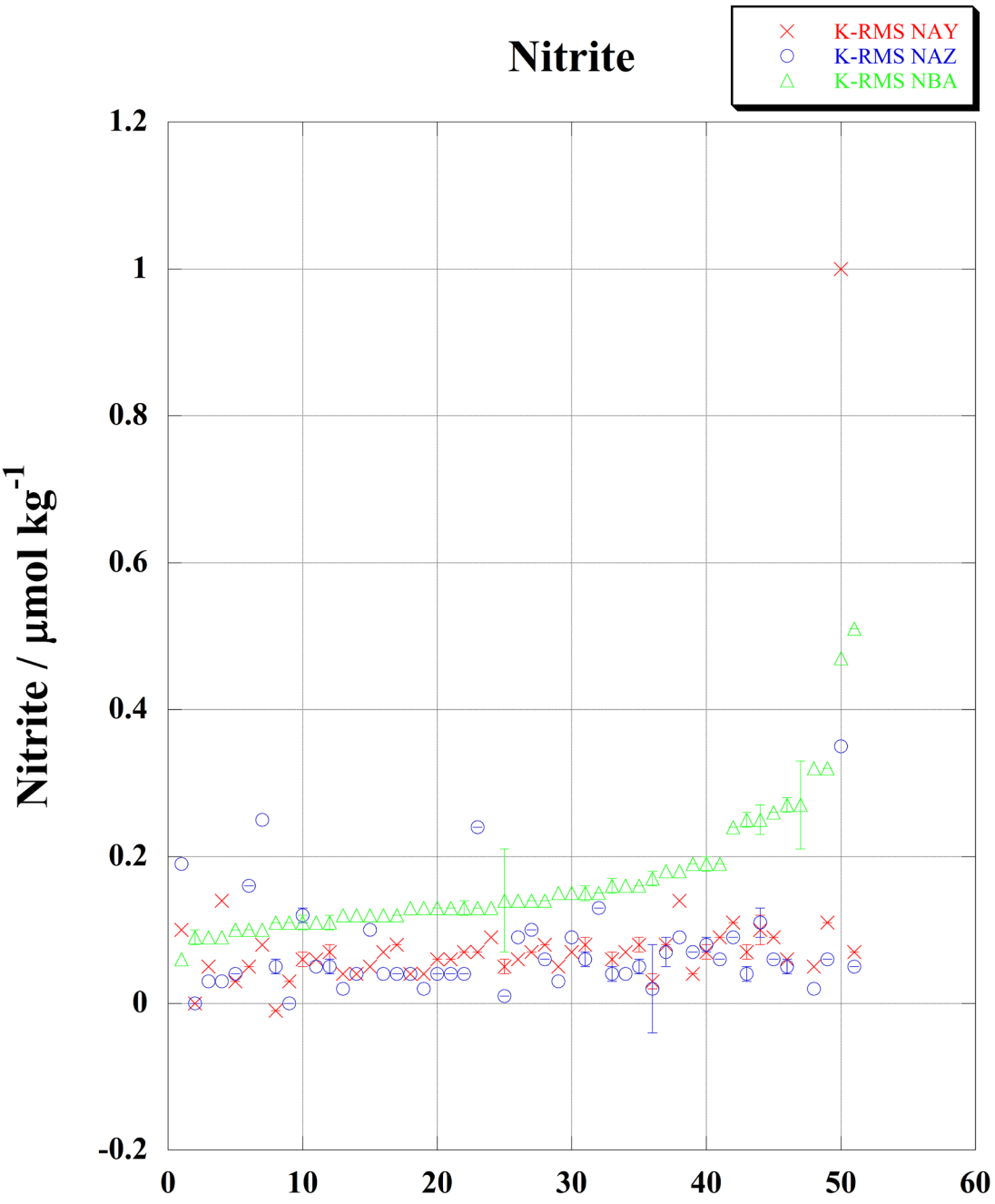

Figure KIOST-3. Nitrite results for KIOST RMs. Laboratories are ranked in order of concentrations reported for NBA.

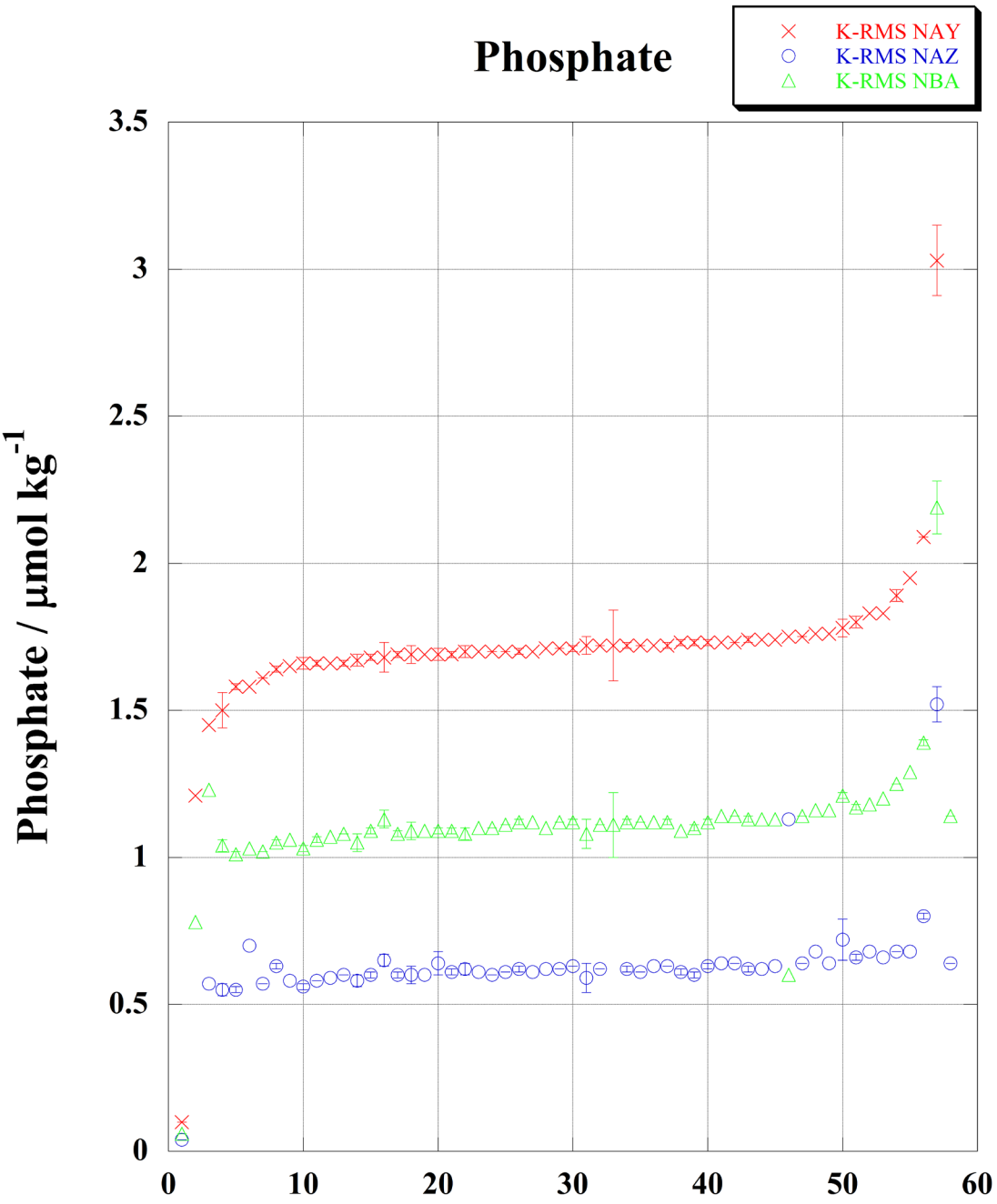

Figure KIOST-4. Phosphate results for KIOST RMs. Laboratories are ranked in order of concentrations reported for NAY.

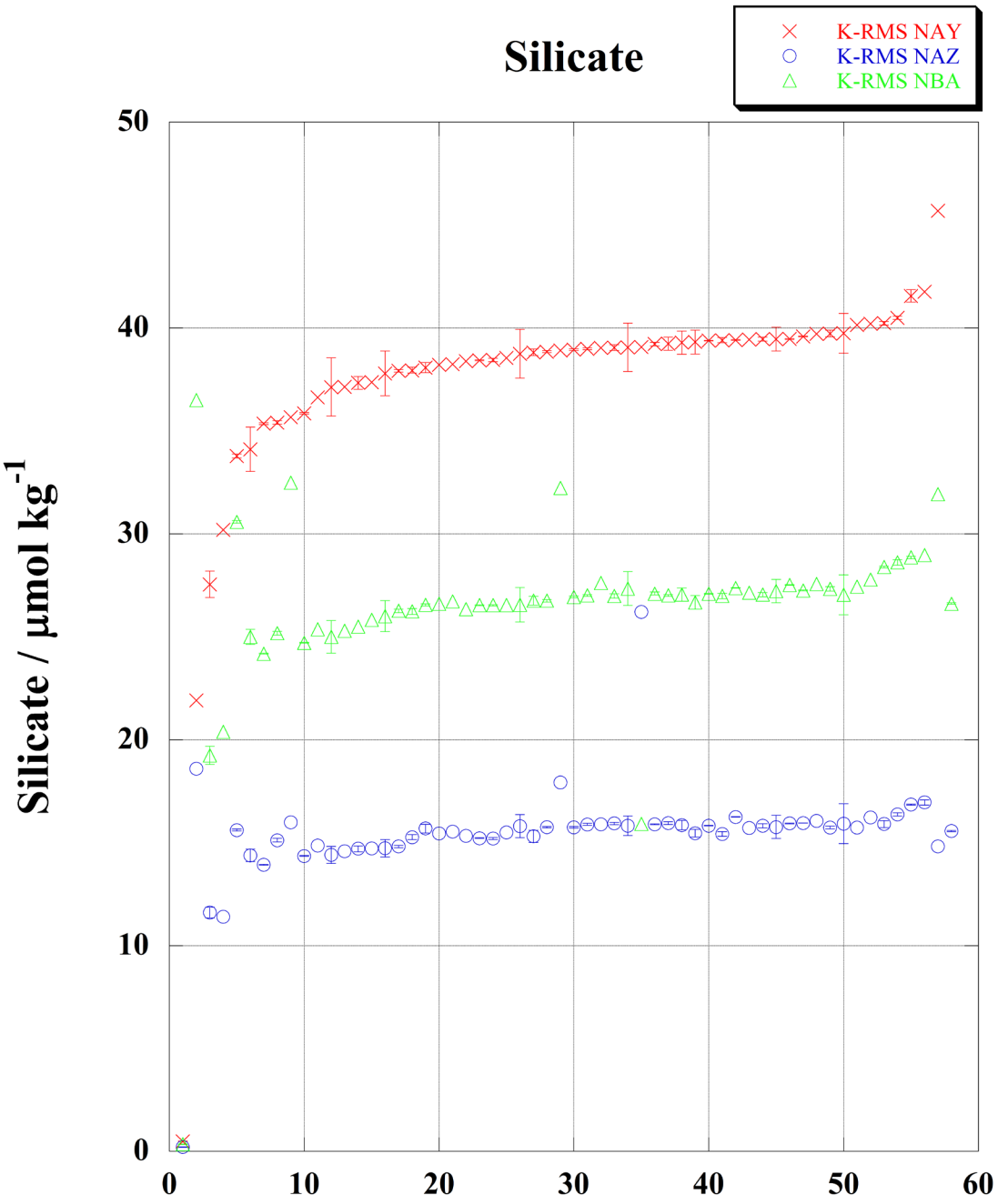

Figure KIOST-5. Silicate results for KIOST RMs. Laboratories are ranked in order of concentrations reported for NAY.

9. Consensus means, medians, and standard deviations

The consensus means and medians for all parameters are in good agreement with the assigned values within the standard deviations.

Table KIOST-4. Consensus means, medians, and standard deviations for 3 samples.

Nutrient	Sample #	n	Consensus Mean μmol kg^{-1}	Consensus Median μmol kg^{-1}	Consensus SD μmol kg^{-1}
Nitrate+Nitrite	Sample NAY	38 (52)	23.12	23.12	0.43
	Sample NAZ	26 (54)	7.99	7.99	0.08
	Sample NBA	30 (54)	15.21	15.26	0.19
Nitrate	Sample NAY	30 (39)	23.06	23.04	0.43
	Sample NAZ	28 (40)	7.98	7.96	0.15
	Sample NBA	27 (41)	15.08	15.10	0.29
Nitrite	Sample NAY	42 (49)	0.06	0.07	0.02
	Sample NAZ	39 (49)	0.05	0.04	0.02
	Sample NBA	40 (51)	0.13	0.13	0.03
Phosphate	Sample NAY	40 (57)	1.71	1.71	0.03
	Sample NAZ	39 (56)	0.62	0.62	0.02
	Sample NBA	35 (58)	1.11	1.11	0.02
Silicate	Sample NAY	38 (57)	39.05	39.07	0.63
	Sample NAZ	37 (58)	15.72	15.76	0.27
	Sample NBA	34 (58)	26.93	27.00	0.38

Table KIOST-5-1. Median and range of analytical precision of participating laboratories, and consensus coefficient of variation for analyses of nutrients in NAY.

Nutrients	Analytical precision of participating laboratories		Consensus coefficient of variation	
	n	Median% (range)	n	CV%
Nitrate+Nitrite	34	0.3 (0-4.2)	38	1.9
Phosphate	38	0.6 (0-7)	40	1.8
Silicate	38	0.3 (0.1-3.8)	38	1.6

Table KIOST-5-2. Median and range of analytical precision of participating laboratories, and consensus coefficient of variation for analyses of nutrients in NAZ.

Nutrients	Analytical precision of participating laboratories		Consensus coefficient of variation	
	n	Median% (range)	n	CV%
Nitrate+Nitrite	37	0.3 (0.1-3.1)	26	1
Phosphate	38	1.6 (0-9.7)	39	3.2
Silicate	40	0.5 (0.1-6.1)	37	1.7

Table KIOST-5-3. Median and range of analytical precision of participating laboratories, and consensus coefficient of variation for analyses of nutrients in NBA.

Nutrients	Analytical precision of participating laboratories		Consensus coefficient of variation	
	n	Median% (range)	n	CV%
Nitrate+Nitrite	37	0.3 (0.1-5)	30	1.2
Phosphate	38	0.9 (0-9.9)	35	1.8
Silicate	38	0.4 (0-3.6)	34	1.4

10. Z-score

Table KIOST-6-1. *Z*-scores for nitrate+nitrite analyses.

Lab	NAY	NAZ	NBA
5	3.1	0.3	0.4
8	1.4	0.5	0.6
10	0.4	0.1	0.4
14	0.9	2.5	0.0
17	50.5	101.1	77.7
19	0.4	0.6	0.5
23	4.1	8.4	6.6
26		2.1	1.0
27	1.1	1.4	2.0
28	0.3	0.8	0.6
29	0.4	0.4	1.4
35	0.1	0.6	0.3
37			
38	3.6	9.8	7.2
39	0.4	0.5	0.9
40	1.1	5.3	1.9
41	1.4	6.4	2.7
45			
49	1.0	8.4	1.5
51	0.1	0.8	0.7
56	0.3	0.4	0.8
57	5.4	0.6	12.7
59	2.4	6.1	3.3
65	0.3	1.4	1.5
69	1.7	14.3	7.5
80			
86	1.3	0.5	2.5
88	0.0	1.6	0.3
89	1.1	8.5	4.6
90	6.9	20.0	12.0
91	2.8	21.0	21.2

Table KIOST-6-1. *Z*-scores for nitrate+nitrite analyses (continued).

Lab	NAY	NAZ	NBA
92	0.6	4.6	1.4
93	0.1	0.1	0.4
95	0.0	7.9	0.3
98	1.6	2.0	2.3
101	1.7	3.5	15.7
102	1.3	2.4	0.6
106	5.9	0.0	0.9
107	2.9	3.0	9.0
109	0.0	4.1	5.6
112	0.3	0.0	0.3
113	0.2	0.6	28.2
114		0.1	
118	6.8	9.0	8.7
124	1.1	3.3	8.2
125	0.5	2.5	0.9
129			
135	1.5	1.5	0.7
136			
137	0.8	2.9	1.3
138	0.0	1.5	0.8
139			
140	1.4	0.3	1.3
141		4.0	1.5
143	3.1	5.4	5.0
148	1.9	101.8	34.3
149	25.8	69.9	43.2
150	6.0	9.1	3.4
151			
153	1.5	51.6	21.9
155	0.4		0.1
156	1.7	0.5	2.6

Table KIOST-6-2. *Z*-scores for nitrate analyses.

Lab	NAY	NAZ	NBA
5			
8	1.4	0.5	0.5
10	0.4	0.3	0.2
14	0.9	1.4	0.0
17	50.4	53.4	50.8
19	0.4	0.0	0.3
23	4.2	3.9	4.3
26		0.4	0.6
27	1.1	1.5	1.5
28	0.2	0.4	0.2
29			
35			
37			
38			
39	0.4	0.1	0.7
40			
41	1.4	4.0	1.7
45	1.7	1.0	0.6
49	1.0	3.2	0.9
51	0.0	0.7	0.7
56	0.2	0.4	0.5
57	5.6	0.5	8.6
59	2.3	2.5	1.8
65			
69			
80			
86	1.3	0.3	1.6
88			
89	1.2	5.1	2.6
90	6.9	11.0	8.1
91			

Table KIOST-6-2. *Z*-scores for nitrate analyses (continued).

Lab	NAY	NAZ	NBA
92	0.6	1.9	0.9
93	0.1	0.0	0.2
95	0.0	2.7	0.2
98			
101	3.3	3.5	8.2
102			
106	5.9	0.3	0.6
107	2.9	1.9	5.7
109	0.1	2.0	2.4
112			
113	0.2	0.5	18.1
114			
118			
124	1.3	1.8	5.5
125	0.4	1.0	0.6
129	1.6	0.7	1.8
135			
136	1.6	0.3	2.7
137	0.8	1.3	0.9
138	0.1	0.5	0.1
139	0.1	0.6	1.2
140			
141		1.3	1.0
143	3.1	3.3	3.3
148	1.8	53.1	22.2
149			
150			
151			
153	0.1	28.3	14.5
155	0.4		0.1
156	1.9	0.1	1.8

Table KIOST-6-3. *Z*-scores for nitrite analyses.

Lab	NAY	NAZ	NBA
5	0.5	0.5	0.0
8	0.0	0.0	4.7
10	0.5	0.0	0.7
14	1.0	1.5	0.3
17	4.0	2.0	1.7
19	1.0	0.5	0.3
23	0.0	2.0	0.3
26	0.0	3.5	0.7
27	0.5	1.5	2.0
28	1.5	1.5	1.3
29	0.5	0.5	1.0
35	0.0	0.5	0.0
37			
38	0.5	1.0	1.3
39	1.0	0.5	0.3
40	1.0	10.0	1.0
41	0.5	2.5	0.3
45	0.5	2.0	0.3
49	0.5	5.5	1.0
51	1.5	0.5	2.0
56	1.0	0.5	0.0
57	4.0	1.0	1.3
59	2.0	3.0	4.0
65			
69			
80			
86	0.5	2.5	0.3
88			
89	2.5	2.0	3.7
90	1.0	1.0	2.0
91			

Table KIOST-6-3. *Z*-scores for nitrite analyses (continued).

Lab	NAY	NAZ	NBA
92	0.5	2.0	0.7
93	1.5	2.5	0.7
95	0.5	9.5	0.0
98			
101	2.5	0.5	6.3
102	0.5	1.5	6.3
106	0.0	0.0	0.7
107	0.0	0.5	1.0
109	0.5	0.0	12.7
112	0.0	0.5	0.0
113	0.5	0.5	4.0
114			
118	1.0	1.0	1.7
124			4.7
125	1.0	0.5	0.7
129	1.0	1.5	0.0
135	0.5	1.0	0.7
136	3.5	0.0	0.7
137	1.0	0.5	0.3
138	1.5	0.5	4.3
139	3.0	2.5	1.3
140			
141		4.0	0.7
143	0.5	0.5	0.3
148	2.0	7.0	2.3
149	1.5	0.5	1.0
150			
151			
153	47.0	15.0	11.3
155	1.5		0.0
156	1.0	0.0	1.0

Table KIOST-6-4. *Z*-scores for phosphate analyses.

Lab	NAY	NAZ	NBA
5	3.0	2.0	3.0
8	1.0	0.0	1.0
10	0.7	1.0	1.0
14	0.7	1.0	1.0
17	8.0	3.0	9.0
19	0.7	1.0	1.5
23	4.0	2.0	4.5
26	1.3	2.0	3.0
27	1.0	1.0	1.0
28	0.3	1.5	1.5
29	0.3	0.0	0.5
35	0.3	0.0	0.0
37	0.3	0.5	0.5
38	0.0	0.0	0.5
39	1.3	1.0	1.5
40			
41	2.0	2.0	2.5
45	0.7	1.0	1.0
49			
51	0.3	0.0	0.5
56	1.0	0.0	1.0
57	8.7	2.5	6.0
59	2.3	5.0	5.0
65	0.0	0.0	0.5
69			
80			
86	0.3	0.5	0.0
88	0.3	0.5	0.5
89	12.7	9.0	14.0
90	4.3	3.5	5.0
91	0.3	1.0	0.5

Table KIOST-6-4. *Z*-scores for phosphate analyses (continued).

Lab	NAY	NAZ	NBA
92	0.3	0.5	0.5
93	1.7	1.0	1.5
95	1.7	3.0	4.0
98	44.0	45.0	54.0
101	7.0	3.5	3.5
102	6.0	3.0	7.0
106	4.0	3.0	3.5
107	1.0	1.5	1.0
109	0.0	0.5	0.5
112	0.3	0.5	0.5
113	0.3	0.0	1.5
114	1.7	1.5	2.0
118	0.7	0.5	1.0
124	0.7	0.5	0.5
125	2.3	0.5	3.0
129	1.7	3.0	2.5
135	0.3	0.5	0.5
136	1.7	2.0	2.5
137	1.0	0.5	1.0
138	0.7	1.0	1.5
139	0.7	0.5	1.0
140	0.7	1.0	0.5
141		1.0	1.5
143	1.7	1.0	2.5
148	1.3	25.5	25.5
149	3.3	2.5	4.5
150	4.3	4.0	4.0
151	53.7	29.0	52.5
153	16.7		16.5
155	0.3		0.0
156	0.7	1.0	1.5

Table KIOST-6-5. *Z*-scores for silicate analyses.

Lab	NAY	NAZ	NBA
5	1.1	0.0	1.1
8	1.5	0.2	1.0
10	0.7	0.2	0.8
14	0.6	0.0	0.5
17	14.1	16.0	17.2
19	1.1	1.3	1.7
23	3.0	4.2	4.3
26	0.4	0.5	0.3
27	0.1	0.6	0.2
28	1.8	1.7	1.8
29	5.8	2.2	4.6
35	0.5	0.4	0.4
37			
38	2.7	3.7	2.9
39	0.7	0.4	0.3
40	1.1	1.4	1.5
41	1.3	1.0	0.9
45	1.8	3.4	1.8
49	0.0	0.8	0.1
51	1.0	1.9	1.1
56	0.8	0.8	1.1
57	5.4	1.0	14.6
59	0.4	1.5	0.5
65	0.3	0.6	0.5
69			
80	27.2	10.6	25.2
86	1.9	0.7	3.8
88	3.1	4.9	5.1
89	8.4	0.4	9.6
90	5.1	5.1	5.8
91	0.7	0.8	1.6

Table KIOST-6-5. *Z*-scores for silicate analyses (continued).

Lab	NAY	NAZ	NBA
92	1.8	1.9	2.2
93	0.3	0.1	0.5
95	0.5	0.3	1.0
98	18.3	15.3	20.2
101	7.8	5.0	5.1
102	4.3	4.6	5.3
106	10.6	3.4	13.1
107	2.0	3.7	2.5
109	4.0	4.2	5.1
112	0.9	0.9	0.8
113	1.1	0.7	0.3
114			
118	2.7	3.8	3.8
124	0.6	1.1	0.1
125	0.2	0.1	0.0
129	1.3	0.7	0.6
135	0.0	0.6	1.8
136	2.3	2.4	4.4
137	1.8	0.0	1.3
138	0.6	2.0	1.2
139	1.0	1.9	1.1
140	0.4	1.0	0.7
141		0.6	0.8
143			
148	0.1	38.9	29.0
149	5.9	6.7	7.2
150	3.8	3.2	4.1
151	61.2	57.4	70.0
153	0.2	8.2	14.0
155	0.0	0.4	1.1
156	0.3	0.9	0.2

Table KIOST-6-6. Combined *Z*-scores for phosphate and nitrate+nitrite analyses.

Lab	NAY	NAZ	NBA
5	3.1	1.2	1.7
8	1.2	0.3	0.8
10	0.6	0.6	0.7
14	0.8	1.8	0.5
17	29.3	52.1	43.4
19	0.6	0.8	1.0
23	4.1	5.2	5.6
26		2.1	2.0
27	1.1	1.2	1.5
28	0.3	1.2	1.1
29	0.4	0.2	1.0
35	0.2	0.3	0.2
37			
38	1.8	4.9	3.9
39	0.9	0.8	1.2
40			
41	1.7	4.2	2.6
45	1.2	1.0	0.8
49			
51	0.2	0.4	0.6
56	0.7	0.2	0.9
57	7.1	1.6	9.4
59	2.4	5.6	4.2
65	0.2	0.7	1.0
69			
80			
86	0.8	0.5	1.3
88	0.2	1.1	0.4
89	6.9	8.8	9.3
90	5.6	11.8	8.5
91	1.6	11.0	10.9

Table KIOST-6-6. Combined *Z*-scores for phosphate and nitrate+nitrite analyses (continued).

Lab	NAY	NAZ	NBA
92	0.5	2.6	1.0
93	0.9	0.6	1.0
95	0.9	5.5	2.2
98	22.8	23.5	28.2
101	4.4	3.5	9.6
102	3.7	2.7	3.8
106	5.0	1.5	2.2
107	2.0	2.3	5.0
109	0.0	2.3	3.1
112	0.3	0.3	0.4
113	0.3	0.3	14.9
114		0.8	
118	3.8	4.8	4.9
124	0.9	1.9	4.4
125	1.4	1.5	2.0
129	1.7	1.9	2.2
135	0.9	1.0	0.6
136	1.7	1.2	2.6
137	0.9	1.7	1.2
138	0.4	1.3	1.2
139	0.4	0.6	1.1
140	1.1	0.7	0.9
141		2.5	1.5
143	2.4	3.2	3.8
148	1.6	63.7	29.9
149	14.6	36.2	23.9
150	5.2	6.6	3.7
151			
153	9.1		19.2
155	0.4		0.1
156	1.2	0.8	2.1

Table KIOST-6-7. Combined *Z*-scores for phosphate, nitrate+nitrite, and silicate analyses.

Lab	NAY	NAZ	NBA
5	2.4	0.8	1.5
8	1.3	0.2	0.9
10	0.6	0.4	0.7
14	0.7	1.2	0.5
17	24.2	40.0	34.6
19	0.7	1.0	1.2
23	3.7	4.9	5.1
26		1.5	1.4
27	0.7	1.0	1.1
28	0.8	1.3	1.3
29	2.2	0.9	2.2
35	0.3	0.3	0.2
37			
38	2.1	4.5	3.5
39	0.8	0.6	0.9
40			
41	1.6	3.1	2.0
45	1.4	1.8	1.1
49			
51	0.5	0.9	0.8
56	0.7	0.4	1.0
57	6.5	1.4	11.1
59	1.7	4.2	2.9
65	0.2	0.7	0.8
69			
80			
86	1.2	0.6	2.1
88	1.1	2.3	2.0
89	7.4	6.0	9.4
90	5.4	9.5	7.6
91	1.3	7.6	7.8

Table KIOST-6-7. Combined *Z*-scores for phosphate, nitrate+nitrite, and silicate analyses (continued).

Lab	NAY	NAZ	NBA
92	0.9	2.3	1.4
93	0.7	0.4	0.8
95	0.7	3.7	1.8
98	21.3	20.8	25.5
101	5.5	4.0	8.1
102	3.9	3.3	4.3
106	6.8	2.1	5.8
107	2.0	2.7	4.2
109	1.3	2.9	3.7
112	0.5	0.5	0.5
113	0.5	0.4	10.0
114			
118	3.4	4.4	4.5
124	0.8	1.6	2.9
125	1.0	1.0	1.3
129	1.5	1.5	1.6
135	0.6	0.9	1.0
136	1.9	1.6	3.2
137	1.2	1.1	1.2
138	0.4	1.5	1.2
139	0.6	1.0	1.1
140	0.8	0.8	0.8
141		1.9	1.3
143			
148	1.1	55.4	29.6
149	11.7	26.4	18.3
150	4.7	5.4	3.8
151			
153	6.1		17.5
155	0.2		0.4
156	0.9	0.8	1.4

Table KIOST-A1. List of participants.

Lab#	Name	Affiliation	Country
5	Marc Knockaert Koen Parmentier	OD NATURE – ECOCHEM	Belgium
8	Rodolfo Paranhos	Institute of Biology, Rio de Janeiro Federal University (UFRJ)	Brazil
10	Chris Payne	University of British Columbia, Department of Earth, Ocean & Atmospheric Sciences	Canada
14	Minhan Dai Lifang Wang	Laboratory of Marine Environmental Science, Xiamen University	China
17	Jun Sun	College of Marine and Environmental Sciences, Tianjin University of Science and Technology	China
19	Anne Daniel Florian Caradec	Ifremer, DYNECO/PELAGOS, Plouzané	France
23	Patrick Raimbault	The National Center for Scientific Research (CNRS), Mediterranean Institute of Oceanology (MIO)	France
26	Joanna Waniek	Leibniz Institut für Ostseeforschung Warnemünde	Germany
27	Rita Kramer Annika Grage	Bundesamt für Seeschifffahrt und Hydrographie (BSH), Laboratorium Sülldorf	Germany
28	Kai-Uwe Ludwichowski	Alfred-Wegener-Institute Bremerhaven	Germany
29	Alice Benoit-Cattin-Breton Sólveig Rósa Ólafsdóttir	Marine Research Institute	Iceland
35	Naoki Nagai Shu Saito	Marine Division, Global Environment and Marine Department, Japan Meteorological Agency	Japan
37	Takeshi Yoshimura	Graduate School of Environmental Science, Hokkaido University	Japan
38	Taketoshi Kodama	Japan Sea National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan	Japan

39	Jan van Ooijen	Royal NIOZ	Netherlands
40	Mike Crump	National Institute of Water and Atmospheric Research (NIWA)	New Zealand
41	Kjell Gundersen Linda Lunde Fonnes Jane Strømstad Møgster	Institute of Marine Research	Norway
45	Raymond Edward Roman	University of Cape town, Dept of Oceanography	South Africa
49	Mark Stinchcombe Edward W. Mawji	National Oceanography Centre, Southampton	UK
51	Pamela Walsham	Marine Scotland - Science	UK
56	Susan Becker	Scripps Institution of Oceanography	USA
57	Jia-Zhong Zhang	NOAA Atlantic Oceanographic and Meteorological Laboratory (AOML), Miami, Florida	USA
59	Marguerite Blum	Monterey Bay Aquarium Research Institute	USA
65	Karin Björkman David Karl Carolina Funkey	University of Hawaii at Manoa, Dept. of Oceanography	USA
69	Aristide Márquez	Oriente University, Oceanographic Institute of Venezuela, Departament of Oceanography. Laboratory of nutritious elements	Venezuela
80	Jesus Ledesma	Instituto del Mar del Perú	Peru
86	Martina Kralj Lidia Urbini Michele Giani	Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS)	Italy
88	Durita Sørensen	Faroe Marine Research Institute	Faroe Islands
89	Trevor McCormack Pauline Frew	Scottish Environment Protection Agency	UK
90	Adil Bakir	Environmental Chemistry Analysis Laboratory (ECAL), University of Portsmouth	UK
91	Sarah-Ann Quesnel	Institute of Ocean Sciences, Fisheries and Oceans Canada	Canada
92	Thierry Cariou	Station Biologique de Roscoff, Centre national de la recherche scientifique (CNRS) / Université Pierre et Marie Curie	France
93	Frank Malien	GEOMAR Helmholtz Center for Ocean Research, Kiel	Germany

95	Hema Naik	National Institute of Oceanography	India
98	Silvie Lainela	Estonian Marine Institute of Tartu University	Estonia
101	Jun-Ho Koo	National Institute of Fisheries Science (NIFS)	Republic of Korea
102	Francesca Margiotta Augusto Passarelli Roberto Gallia	Stazione Zoologica Anton Dohrn	Italia
106	Elisa Berdalet Mara Abad	Institut de Ciències del Mar (ICM-CSIC), Barcelona	Spain
107	Laurent Coppola Emilie Diamond Riquier	Observatoire oceanologique de Villefranche-sur-Mer (CNRS-UPMC)	France
109	Tae Keun Rho	KIOST (Korea Institute of Ocean Science & Technology)	Republic of Korea
112	Christine Rees	CSIRO, Oceans and Atmosphere	Australia
113	David Faber Daniel Schuller	Scripps Institution of Oceanography, CalCOFI Group, UC San Diego	USA
114	Miriam E. Solis	LOQyCA – Centro para el estudio de los sistemas marinos (CONICET)	Argentina
118	Colin A. Stedmon Karen Edelvang	Technical University of Denmark, National Institute for Aquatic Resources (AQUA)	Denmark
124	Jinyoung Jung Sung Ho Kang	Korea Polar Research Institute	Republic of Korea
125	Peter Thamer Marc Ringuette Kumiko Azetsu-Scott Blair Greenan	Bedford Institute of Oceanography	Canada
129	Fuminori Hashihama	Tokyo University of Marine Science and Technology	Japan
135	Triona McGrath	The Marine Institute	Ireland
136	Claire Normandeau Doug Wallace Liz A. Kerrigan	Dalhousie University in Halifax, Canada	Canada
137	Hiroshi Ogawa	Atmosphere and ocean research institute, the University of Tokyo	Japan
138	Hideki Yamamoto	Research Promotion Group, Mutsu Institute for Oceanography, JAMSTEC	Japan

139	Hiromi Kasai	Hokkaido National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan	Japan
140	Patricia López García	Plataforma Oceánica de Canarias (PLOCAN) - Oceanic Platform of the Canary Islands	Spain
141	Yoko Kiyomoto	Seikai National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan	Japan
143	Victor F. Camacho Ibar Maria del Carmen Ávila López	Instituto de Investigaciones Oceanológicas, Universidad Autónoma de Baja California	USA
148	Jerry Frank	University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Nutrient Analytical Services Laboratory	USA
149	Vasiliy Povazhnyi	Arctic and Antarctic Research Institute, Russia	Russia
150	Mi-OK Park	Marine Environment Analysis Center Korea Marine Environment management Corporation (KOEM)	Republic of Korea
151	Ana Rodriguez	INSTITUTO OCEANOGRÁFICO DE LA ARMADA (INOCAR)	Ecuador
153	Robinson Fidel Casanova Rosero	CENTRO DE INVESTIGACIONES OCEANOGRÁFICAS E HIDROGRÁFICAS DEL PACÍFICO (CCCP).	Colombia
155	Yoann Le Merrer Karine Collin Olivier Pierre-Duplessix	IFREMER LERMPL, Nantes, FRANCE	France
156	Robert Rember Ana Aguilar-Islas	University of Alaska, Fairbanks	USA

Table KIOST-A2. Results reported by the participants.

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
5																				
	Sample NAY	2018	02	01	22	24.30	0.15	2			2	0.07	0.00	2	1.82	0.03	2	39.72	0.28	2
	Sample NAY	2018	02	01	22	24.30	0.15	2			2	0.07	0.00	2	1.78	0.02	2	39.67	0.28	2
	Sample NAY	2018	02	01	22	24.76	0.15	2			2	0.06	0.00	2	1.81	0.03	2	39.80	0.28	2
	Sample NAZ	2018	02	01	22	8.10	0.05	2			2	0.05	0.00	2	0.66	0.01	2	15.84	0.11	2
	Sample NAZ	2018	02	01	22	7.93	0.05	2			2	0.03	0.00	2	0.65	0.01	2	15.70	0.11	2
	Sample NAZ	2018	02	01	22	7.99	0.05	2			2	0.04	0.00	2	0.66	0.01	2	15.65	0.11	2
	Sample NBA	2018	02	01	22	15.04	0.09	2			2	0.14	0.01	2	1.15	0.02	2	27.42	0.19	2
	Sample NBA	2018	02	01	22	15.44	0.09	2			2	0.13	0.01	2	1.18	0.02	2	27.72	0.19	2
	Sample NBA	2018	02	01	22	15.35	0.09	2			2	0.13	0.01	2	1.17	0.02	2	26.85	0.19	2
8																				
	Sample NAY	2018	02	26	25	23.40	1.78	2	23.35	1.79	2	0.06	0.01	2	1.74	0.02	2	38.00	0.40	2
	Sample NAY	2018	02	26	25	24.15	2.03	2	24.09	2.03	2	0.07	0.00	2	1.74	0.00	2	38.06	0.35	2
	Sample NAY	2018	02	26	25	23.59	1.25	2	23.54	1.25	2	0.05	0.00	2	1.74	0.00	2	38.19	0.54	2
	Sample NAZ	2018	02	26	25	7.89	0.40	2	7.85	0.40	2	0.04	0.00	2	0.62	0.01	2	15.91	0.59	2
	Sample NAZ	2018	02	26	25	8.03	0.49	2	7.96	0.47	2	0.07	0.02	2	0.62	0.01	2	15.56	0.23	2
	Sample NAZ	2018	02	26	25	7.94	0.41	2	7.90	0.41	2	0.05	0.00	2	0.63	0.01	2	15.56	0.03	2
	Sample NBA	2018	02	26	25	14.66	1.05	2	14.89	0.36	2	0.25	0.01	2	1.14	0.02	2	26.74	0.01	2
	Sample NBA	2018	02	26	25	15.02	0.61	2	14.90	0.60	2	0.12	0.01	2	1.12	0.00	2	26.39	0.14	2
	Sample NBA	2018	02	26	25	16.31	0.85	2	15.88	0.83	2	0.43	0.02	2	1.14	0.02	2	26.51	0.13	2
10																				
	Sample NAY	2018	01	19	23	23.05	0.29	2	22.99	0.29	2	0.06	0.02	2	1.70	0.05	2	39.53	0.98	2
	Sample NAY	2018	01	19	23	23.04	0.29	2	22.97	0.29	2	0.07	0.02	2	1.69	0.05	2	39.50	0.98	2
	Sample NAY	2018	01	19	23	22.79	0.29	2	22.70	0.29	2	0.09	0.02	2	1.69	0.05	2	39.35	0.98	2
	Sample NAZ	2018	01	19	23	8.00	0.29	2	7.95	0.29	2	0.05	0.02	2	0.60	0.05	2	15.77	0.98	2
	Sample NAZ	2018	01	19	23	8.01	0.29	2	7.96	0.29	2	0.05	0.02	2	0.60	0.05	2	15.74	0.98	2
	Sample NAZ	2018	01	19	23	7.92	0.29	2	7.87	0.29	2	0.05	0.02	2	0.60	0.05	2	15.78	0.98	2
	Sample NBA	2018	01	19	23	14.94	0.29	2	14.82	0.29	2	0.12	0.02	2	1.08	0.05	2	27.12	0.98	2
	Sample NBA	2018	01	19	23	15.15	0.29	2	15.03	0.29	2	0.12	0.02	2	1.09	0.05	2	27.26	0.98	2
	Sample NBA	2018	01	19	23	15.30	0.29	2	15.20	0.29	2	0.10	0.02	2	1.10	0.05	2	27.27	0.98	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
14																				
	Sample NAY	2018	01	05	22	22.70		2	22.65		2	0.04		2	1.69		2	39.46		2
	Sample NAY	2018	01	05	22	22.67		2	22.63		2	0.04		2	1.69		2	39.46		2
	Sample NAY	2018	01	05	22	22.78		2	22.74		2	0.04		2	1.69		2	39.43		2
	Sample NAZ	2018	01	05	22	7.81		2	7.79		2	0.02		2	0.60		2	15.71		2
	Sample NAZ	2018	01	05	22	7.77		2	7.74		2	0.03		2	0.59		2	15.71		2
	Sample NAZ	2018	01	05	22	7.79		2	7.77		2	0.02		2	0.60		2	15.73		2
	Sample NBA	2018	01	05	22	15.89		2	15.80		2	0.09		2	1.10		2	27.11		2
	Sample NBA	2018	01	05	22	14.74		2	14.61		2	0.13		2	1.07		2	27.11		2
	Sample NBA	2018	01	05	22	15.01		2	14.87		2	0.14		2	1.09		2	27.18		2
17																				
	Sample NAY	2018	01	27	37	44.88		2	44.72		2	0.16		2	1.94		2	30.16		2
	Sample NAY	2018	01	27	37	44.69		2	44.57		2	0.13		2	1.89		2	30.12		2
	Sample NAY	2018	01	27	37	44.98		2	44.86		2	0.12		2	2.03		2	30.29		2
	Sample NAZ	2018	01	27	37	16.19		2	16.06		2	0.13		2	0.70		2	11.40		2
	Sample NAZ	2018	01	27	37	15.95		2	15.90		2	0.05		2	0.72		2	11.40		2
	Sample NAZ	2018	01	27	37	16.11		2	16.02		2	0.09		2	0.61		2	11.40		2
	Sample NBA	2018	01	27	37	29.98		2	29.75		2	0.23		2	1.29		2	20.44		2
	Sample NBA	2018	01	27	37	29.58		2	29.47		2	0.11		2	1.29		2	20.28		2
	Sample NBA	2018	01	27	37	30.37		2	30.18		2	0.19		2	1.28		2	20.42		2
19																				
	Sample NAY	2018	02	06	20.0	23.35		2	23.28		2	0.07		2			2			2
	Sample NAY	2018	02	06	20.0	23.18	0.08	2	23.08	0.08	2	0.10	0.00	2	1.73		2	39.72		2
	Sample NAY	2018	02	06	20.0	23.37		2	23.31		2	0.07		2			2			2
	Sample NAZ	2018	02	06	20.0	7.92	0.02	2	7.84	0.02	2	0.08	0.00	2	0.64		2	16.06		2
	Sample NAZ	2018	02	06	20.0	8.12		2	8.07		2	0.05		2			2			2
	Sample NAZ	2018	02	06	20.0	8.07		2	8.03		2	0.04		2			2			2
	Sample NBA	2018	02	06	20.0	15.37		2	15.21		2	0.16		2			2			2
	Sample NBA	2018	02	06	20.0	15.08	0.01	2	14.97	0.01	2	0.11	0.00	2	1.14		2	27.56		2
	Sample NBA	2018	02	06	20.0	15.46		2	15.30		2	0.16		2			2			2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
23																				
	Sample NAY	2018	02	28	20.0	24.96		2	24.89		2	0.06		2	1.84		2	37.53		2
	Sample NAY	2018	02	28	20.0	25.02		2	24.96		2	0.05		2	1.85		2	37.55		2
	Sample NAY	2018	02	28	20.0	24.68		2	24.72		2	0.06		2	1.81		2	36.35		2
	Sample NAZ	2018	02	28	20.0	8.74		2	8.53		2	0.21		2	0.65		2	14.21		2
	Sample NAZ	2018	02	28	20.0	8.57		2	8.52		2	0.05		2	0.67		2	15.09		2
	Sample NAZ	2018	02	28	20.0	8.66		2	8.64		2	0.02		2	0.67		2	14.43		2
	Sample NBA	2018	02	28	20.0	16.24		2	16.13		2	0.11		2	1.21		2	25.63		2
	Sample NBA	2018	02	28	20.0	16.43		2	16.33		2	0.11		2	1.20		2	25.53		2
	Sample NBA	2018	02	28	20.0	16.74		2	16.56		2	0.19		2	1.18		2	24.72		2
26																				
	Sample NAY	2018	01	17	20			2			2	0.06	0.02	2	1.67	0.03	2	39.26	0.99	2
	Sample NAY	2018	01	17	20			2			2	0.05	0.02	2	1.67	0.03	2	39.36	0.99	2
	Sample NAY	2018	01	17	20			2			2	0.06	0.02	2	1.67	0.03	2	39.26	0.99	2
	Sample NAZ	2018	01	17	20	8.63	0.21	2	8.38	0.20	2	0.25	0.02	2	0.58	0.03	2	15.82	0.40	2
	Sample NAZ	2018	01	17	20	7.88	0.21	2	7.82	0.20	2	0.06	0.02	2	0.58	0.03	2	15.92	0.40	2
	Sample NAZ	2018	01	17	20	7.97	0.21	2	7.93	0.20	2	0.04	0.02	2	0.58	0.03	2	15.82	0.40	2
	Sample NBA	2018	01	17	20	15.02	0.51	2	14.91	0.49	2	0.11	0.02	2	1.05	0.05	2	27.05	0.67	2
	Sample NBA	2018	01	17	20	14.95	0.51	2	14.84	0.49	2	0.11	0.02	2	1.05	0.05	2	27.05	0.06	2
	Sample NBA	2018	01	17	20	15.12	0.51	2	15.02	0.49	2	0.11	0.02	2	1.05	0.05	2	27.05	0.67	2
27																				
	Sample NAY	2017	11	28	22.4	22.60	0.03	2	22.53	0.03	2	0.07	0.01	2	1.67	0.01	2	38.96	0.08	2
	Sample NAY	2017	11	28	22.4	22.57	0.03	2	22.50	0.03	2	0.07	0.01	2	1.68	0.01	2	38.83	0.08	2
	Sample NAY	2017	11	28	22.4	22.75	0.03	2	22.68	0.03	2	0.06	0.01	2	1.68	0.01	2	39.18	0.08	2
	Sample NAZ	2017	11	28	22.4	7.86	0.03	2	7.64	0.03	2	0.13	0.01	2	0.60	0.01	2	15.83	0.08	2
	Sample NAZ	2017	11	28	22.4	7.66	0.03	2	7.60	0.03	2	0.05	0.01	2	0.61	0.01	2	15.93	0.08	2
	Sample NAZ	2017	11	28	22.4	8.11	0.03	2	8.05	0.03	2	0.05	0.01	2	0.60	0.01	2	15.88	0.08	2
	Sample NBA	2017	11	28	22.4	14.71	0.03	2	14.60	0.03	2	0.12	0.01	2	1.08	0.01	2	26.92	0.08	2
	Sample NBA	2017	11	28	22.4	14.74	0.03	2	14.61	0.03	2	0.14	0.01	2	1.08	0.01	2	27.12	0.08	2
	Sample NBA	2017	11	28	22.4	15.04	0.03	2	14.72	0.03	2	0.31	0.01	2	1.11	0.01	2	27.00	0.08	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
28																				
	Sample NAY	2018	01	15	20.0	23.12	0.15	2	23.09	0.15	2	0.03	0.02	2	1.74	0.06	2	37.80	0.24	2
	Sample NAY	2018	01	15	20.0	22.81	0.15	2	22.77	0.15	2	0.04	0.02	2	1.70	0.06	2	37.96	0.24	2
	Sample NAY	2018	01	15	20.0	23.04	0.15	2	23.01	0.15	2	0.03	0.02	2	1.72	0.06	2	38.09	0.24	2
	Sample NAZ	2018	01	15	20.0	7.96	0.29	2	7.95	0.10	2	0.01	0.10	2	0.60	0.08	2	15.28	0.21	2
	Sample NAZ	2018	01	15	20.0	7.90	0.29	2	7.88	0.10	2	0.02	0.10	2	0.59	0.08	2	15.23	0.21	2
	Sample NAZ	2018	01	15	20.0	7.94	0.29	2	7.92	0.10	2	0.02	0.10	2	0.58	0.08	2	15.29	0.21	2
	Sample NBA	2018	01	15	20.0	15.40	0.15	2	15.27	0.15	2	0.13	0.02	2	1.07	0.08	2	26.14	0.24	2
	Sample NBA	2018	01	15	20.0	14.99	0.15	2	14.84	0.15	2	0.15	0.02	2	1.06	0.08	2	26.18	0.24	2
	Sample NBA	2018	01	15	20.0	15.56	0.15	2	15.34	0.15	2	0.22	0.02	2	1.12	0.08	2	26.37	0.24	2
29																				
	Sample NAY	2017	12	05	21.0	23.04	0.20	2			2	0.08		2	1.69	0.01	2	35.38	0.15	2
	Sample NAY	2017	12	05	21.0	22.88	0.20	2			2	0.07		2	1.70	0.01	2	35.41	0.15	2
	Sample NAY	2017	12	05	21.0	22.87	0.20	2			2	0.06		2	1.71	0.01	2	35.44	0.15	2
	Sample NAZ	2017	12	05	21.0	8.00	0.20	2			2	0.04		2	0.62	0.01	2	15.13	0.15	2
	Sample NAZ	2017	12	05	21.0	7.95	0.20	2			2	0.04		2	0.62	0.01	2	15.13	0.15	2
	Sample NAZ	2017	12	05	21.0	7.94	0.20	2			2	0.04		2	0.62	0.01	2	15.10	0.15	2
	Sample NBA	2017	12	05	21.0	14.90	0.20	2			2	0.12		2	1.12	0.01	2	25.17	0.15	2
	Sample NBA	2017	12	05	21.0	14.95	0.20	2			2	0.15		2	1.11	0.01	2	25.14	0.15	2
	Sample NBA	2017	12	05	21.0	15.01	0.20	2			2	0.20		2	1.13	0.01	2	25.19	0.15	2
35																				
	Sample NAY	2017	12	02	21.9	23.08	0.03	2			2	0.06	0.00	2	1.72	0.00	2	39.42	0.04	2
	Sample NAY	2017	12	02	21.9	23.25	0.03	2			2	0.05	0.00	2	1.72	0.00	2	39.41	0.04	2
	Sample NAY	2017	12	02	21.9	23.08	0.03	2			2	0.07	0.00	2	1.72	0.00	2	39.33	0.04	2
	Sample NAZ	2017	12	02	21.9	7.97	0.01	2			2	0.05	0.00	2	0.62	0.00	2	15.83	0.02	2
	Sample NAZ	2017	12	02	21.9	7.95	0.01	2			2	0.04	0.00	2	0.62	0.00	2	15.82	0.02	2
	Sample NAZ	2017	12	02	21.9	8.19	0.01	2			2	0.03	0.00	2	0.62	0.00	2	15.82	0.02	2
	Sample NBA	2017	12	02	21.9	15.08	0.02	2			2	0.11	0.00	2	1.09	0.00	2	27.02	0.03	2
	Sample NBA	2017	12	02	21.9	15.18	0.02	2			2	0.10	0.00	2	1.11	0.00	2	27.10	0.03	2
	Sample NBA	2017	12	02	21.9	15.55	0.02	2			2	0.19	0.00	2	1.12	0.00	2	27.16	0.03	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
37																				
	Sample NAY	2018	02	19	19.6			2			2			2	1.71		2			2
	Sample NAY	2018	02	19	19.6			2			2			2	1.70		2			2
	Sample NAY	2018	02	19	19.6			2			2			2	1.70		2			2
	Sample NAZ	2018	02	19	19.6			2			2			2	0.61		2			2
	Sample NAZ	2018	02	19	19.6			2			2			2	0.62		2			2
	Sample NAZ	2018	02	19	19.6			2			2			2	0.61		2			2
	Sample NBA	2018	02	19	19.6			2			2			2	1.09		2			2
	Sample NBA	2018	02	19	19.6			2			2			2	1.12		2			2
	Sample NBA	2018	02	19	19.6			2			2			2	1.10		2			2
38																				
	Sample NAY	2017	12	21	20.0	21.90		2			2	0.05		2	1.74		2	37.44		2
	Sample NAY	2017	12	21	20.0	21.46		2			2	0.04		2	1.70		2	37.20		2
	Sample NAY	2017	12	21	20.0	21.42		2			2	0.05		2	1.69		2	37.46		2
	Sample NAZ	2017	12	21	20.0	7.13		2			2	0.03		2	0.62		2	14.47		2
	Sample NAZ	2017	12	21	20.0	7.29		2			2	0.03		2	0.62		2	14.69		2
	Sample NAZ	2017	12	21	20.0	7.20		2			2	0.02		2	0.63		2	15.00		2
	Sample NBA	2017	12	21	20.0	13.87		2			2	0.10		2	1.11		2	26.51		2
	Sample NBA	2017	12	21	20.0	13.75		2			2	0.09		2	1.09		2	25.64		2
	Sample NBA	2017	12	21	20.0	13.94		2			2	0.09		2	1.10		2	25.34		2
39																				
	Sample NAY	2017	12	20	21	23.29	0.03	2	23.23	0.03	2	0.06	0.00	2	1.75	0.00	2	39.46	0.10	2
	Sample NAY	2017	12	20	21	23.26	0.03	2	23.19	0.03	2	0.07	0.00	2	1.75	0.00	2			2
	Sample NAY	2017	12	20	21	23.33	0.03	2	23.22	0.03	2	0.11	0.00	2	1.75	0.00	2			2
	Sample NAZ	2017	12	20	21	8.04	0.01	2	7.99	0.01	2	0.06	0.00	2	0.64	0.00	2			2
	Sample NAZ	2017	12	20	21	7.98	0.01	2	7.94	0.01	2	0.04	0.00	2	0.64	0.00	2			2
	Sample NAZ	2017	12	20	21	8.06	0.01	2	8.03	0.01	2	0.03	0.00	2	0.63	0.00	2	15.82	0.10	2
	Sample NBA	2017	12	20	21	15.28	0.03	2	15.18	0.03	2	0.11	0.00	2	1.13	0.00	2			2
	Sample NBA	2017	12	20	21	15.44	0.03	2	15.29	0.03	2	0.15	0.00	2	1.14	0.00	2	27.05	0.10	2
	Sample NBA	2017	12	20	21	15.43	0.03	2	15.33	0.03	2	0.11	0.00	2	1.14	0.00	2			2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
40																				
	Sample NAY	2017	12	15	20.0	22.73		2			2	<0.07		2			2	38.35		2
	Sample NAY	2017	12	14	20.0	22.52		2			2	0.08		2			2	38.42		2
	Sample NAY	2017	12	15	20.0	22.73		2			2	0.08		2			2	38.39		2
	Sample NAZ	2017	12	22	20.0	7.88		2			2	<0.07		2			2	15.30		2
	Sample NAZ	2017	12	23	20.0	8.02		2			2	<0.07		2			2	15.33		2
	Sample NAZ	2017	12	22	20.0	9.34		2			2	0.25		2			2	15.37		2
	Sample NBA	2018	01	05	20.0	14.71		2			2	0.10		2			2	26.35		2
	Sample NBA	2018	01	05	20.0	14.78		2			2	0.08		2			2	26.39		2
	Sample NBA	2018	01	06	20.0	15.06		2			2	0.13		2			2	26.32		2
41																				
	Sample NAY	2018	02	12	21	23.38		2	23.31		2	0.07		2	1.64		2	38.13		2
	Sample NAY	2018	02	12	21	24.30		2	24.27		2	0.03		2	1.66		2	38.57		2
	Sample NAY	2018	02	12	21	23.48		2	23.43		2	0.05		2	1.66		2	37.97		2
	Sample NAZ	2018	02	12	21	7.09		2	7.08		2	0.01		2	0.58		2	15.50		2
	Sample NAZ	2018	02	12	21	7.92		2	7.65		2	0.27		2	0.58		2	15.17		2
	Sample NAZ	2018	02	12	21	7.43		2	7.41		2	0.02		2	0.58		2	15.65		2
	Sample NBA	2018	02	12	21	14.73		2	14.60		2	0.13		2	1.06		2	26.72		2
	Sample NBA	2018	02	12	21	14.67		2	14.55		2	0.12		2	1.07		2	26.23		2
	Sample NBA	2018	02	12	21	14.70		2	14.59		2	0.11		2	1.06		2	26.84		2
45																				
	Sample NAY				20.0			2	22.34	0.12	2	0.05	0.01	2	1.69	0.02	2	37.92	0.06	2
	Sample NAZ				20.0			2	7.83	0.02	2	0.01	0.00	2	0.64	0.04	2	14.81	0.06	2
	Sample NBA				20.0			2	15.26	0.06	2	0.14	0.07	2	1.09	0.01	2	26.26	0.09	2
49																				
	Sample NAY	2018	02	26	18.5	22.73	0.06	2	22.69	0.06	2	0.05	0.00	2			2	39.07	0.19	2
	Sample NAY	2018	02	26	18.5	22.71	0.07	2	22.66	0.07	2	0.05	0.00	2			2	39.09	0.33	2
	Sample NAY	2018	02	26	18.5	22.60	0.05	2	22.54	0.05	2	0.05	0.00	2			2	38.98	0.21	2
	Sample NAZ	2018	02	26	18.5	7.86	0.03	2	7.81	0.03	2	0.04	0.00	2			2	15.97	0.13	2
	Sample NAZ	2018	02	26	18.5	8.14	0.02	2	7.92	0.02	2	0.17	0.00	2			2	15.81	0.02	2
	Sample NAZ	2018	02	26	18.5	9.99	0.05	2	9.66	0.05	2	0.26	0.00	2			2	16.01	0.14	2
	Sample NBA	2018	02	26	18.5	15.20	0.10	2	15.05	0.10	2	0.13	0.00	2			2	26.96	0.14	2
	Sample NBA	2018	02	26	18.5	14.82	0.07	2	14.73	0.07	2	0.08	0.00	2			2	27.03	0.21	2
	Sample NBA	2018	02	26	18.5	14.75	0.07	2	14.66	0.07	2	0.08	0.00	2			2	26.96	0.21	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
51																				
	Sample NAY	2018	02	05	19.8	23.21	0.05	2	23.13	0.06	2	0.08	0.00	2	1.72	0.01	2	38.60	0.03	2
	Sample NAY	2018	02	05	19.8	23.34	0.05	2	23.25	0.06	2	0.10	0.00	2	1.71	0.01	2	38.60	0.03	2
	Sample NAY	2018	02	05	19.8	22.90	0.05	2	22.81	0.06	2	0.09	0.00	2	1.72	0.01	2	38.08	0.03	2
	Sample NAZ	2018	02	05	19.8	7.94	0.02	2	7.89	0.03	2	0.05	0.00	2	0.61	0.01	2	15.40	0.03	2
	Sample NAZ	2018	02	05	19.8	7.99	0.02	2	7.94	0.03	2	0.05	0.00	2	0.62	0.01	2	15.21	0.03	2
	Sample NAZ	2018	02	05	19.8	7.86	0.02	2	7.79	0.03	2	0.07	0.00	2	0.64	0.01	2	15.02	0.03	2
	Sample NBA	2018	02	05	19.8	15.24	0.05	2	14.93	0.06	2	0.30	0.00	2	1.11	0.01	2	26.87	0.03	2
	Sample NBA	2018	02	05	19.8	15.07	0.05	2	14.95	0.06	2	0.12	0.00	2	1.11	0.01	2	26.46	0.03	2
	Sample NBA	2018	02	05	19.8	14.90	0.05	2	14.75	0.06	2	0.14	0.00	2	1.13	0.01	2	26.26	0.03	2
56																				
	Sample NAY				21	23.00		2			2	0.04		2	1.74		2	38.59		2
	Sample NAY	2018	01	01	21	22.99		2	22.96		2	0.04		2	1.74		2	38.49		2
	Sample NAZ				21	8.01		2	7.99		2	0.02		2	0.63		2	15.43		2
	Sample NAZ				21	7.94		2	7.92		2	0.02		2	0.64		2	15.53		2
	Sample NAZ				21	7.92		2	7.84		2	0.08		2	0.60		2	15.53		2
	Sample NBA				21	14.87		2	14.78		2	0.10		2	1.12		2	26.56		2
	Sample NBA				21	14.89		2	14.81		2	0.09		2	1.13		2	26.47		2
	Sample NBA				21	15.42		2	15.22		2	0.21		2	1.13		2	26.56		2
57																				
	Sample NAY	2018	02	21	22.8	23.10		2	23.06		2	0.04		2	1.64		2	39.97		2
	Sample NAY	2018	02	21	22.8	23.17		2	23.10		2	0.07		2	1.65		2	39.58		2
	Sample NAY	2018	02	21	22.8	22.95		2	22.90		2	0.06		2	1.64		2	42.61		2
	Sample NAZ	2018	02	21	22.8	8.07		2	8.03		2	0.04		2	0.56		2	16.12		2
	Sample NAZ	2018	02	21	22.8	7.91		2	7.89		2	0.03		2	0.57		2	15.93		2
	Sample NAZ	2018	02	21	22.8	7.83		2	7.79		2	0.03		2	0.57		2	15.93		2
	Sample NBA	2018	02	21	22.8	16.11		2	15.80		2	0.31		2	1.07		2	27.46		2
	Sample NBA	2018	02	21	22.8	14.92		2	14.84		2	0.10		2	1.03		2	27.17		2
	Sample NBA	2018	02	21	22.8	15.03		2	14.93		2	0.11		2	1.03		2	27.66		2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
59																				
	Sample NAY	2018	01	30	20.0	24.53	0.37	2	24.42	0.45	2	0.10	0.05	2	1.73	0.07	2	38.97	0.11	2
	Sample NAY	2018	01	30	20.0	24.03	0.46	2	23.91	0.52	2	0.11	0.04	2	1.84	0.06	2	39.03	0.37	2
	Sample NAY	2018	01	30	20.0	23.90	0.69	2	23.80	0.73	2	0.10	0.01	2	1.78	0.03	2	38.45	0.26	2
	Sample NAZ	2018	01	30	20.0	8.57	0.20	2	8.49	0.26	2	0.07	0.04	2	0.65	0.02	2	15.72	0.21	2
	Sample NAZ	2018	01	30	20.0	8.50	0.31	2	8.31	0.37	2	0.20	0.00	2	0.74	0.17	2	15.59	0.18	2
	Sample NAZ	2018	01	30	20.0	8.36	0.18	2	8.29	0.24	2	0.07	0.04	2	0.77	0.12	2	14.62	0.87	2
	Sample NBA	2018	01	30	20.0	15.77	0.42	2	15.64	0.46	2	0.13	0.01	2	1.13	0.01	2	26.68	0.11	2
	Sample NBA	2018	01	30	20.0	15.54	0.21	2	15.37	0.31	2	0.17	0.05	2	1.30	0.04	2	26.66	0.50	2
	Sample NBA	2018	01	30	20.0	16.18	0.46	2	15.75	0.60	2	0.45	0.02	2	1.21	0.01	2	26.92	0.38	2
65																				
	Sample NAY	2018	04	25	21.5			2			2			2			2	39.22	0.09	2
	Sample NAY	2018	04	13	21.5	23.26	0.02	2			2			2	1.71	0.00	2			2
	Sample NAZ	2018	04	13	21.5	8.10	0.01	2			2			2	0.62	0.00	2			2
	Sample NAZ	2018	04	25	21.5			2			2			2			2	15.89	0.02	2
	Sample NBA	2018	04	25	21.5			2			2			2			2	27.10	0.07	2
	Sample NBA	2018	04	13	21.5	15.50	0.06	2			2			2	1.12	0.00	2			2
69																				
	Sample NAY	2018	01	25	20.0	23.60	0.22	2			2			2			2			2
	Sample NAY	2018	01	25	20.0	23.92	0.22	2			2			2			2			2
	Sample NAY	2018	01	25	20.0	24.07	0.01	2			2			2			2			2
	Sample NAZ	2018	01	25	20.0	9.03	0.22	2			2			2			2			2
	Sample NAZ	2018	01	25	20.0	9.03	0.22	2			2			2			2			2
	Sample NAZ	2018	01	25	20.0	9.34	0.22	2			2			2			2			2
	Sample NBA	2018	01	25	20.0	16.47	0.01	2			2			2			2			2
	Sample NBA	2018	01	25	20.0	16.95	0.22	2			2			2			2			2
	Sample NBA	2018	01	25	20.0	16.47	0.01	2			2			2			2			2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
80																				
	Sample NAY	2018	02	16	20.0			2			2			2			2	26.01		2
	Sample NAY	2018	02	16	20.0			2			2			2			2	15.30		2
	Sample NAY	2018	02	16	20.0			2			2			2			2	24.41		2
	Sample NAZ	2018	02	16	20.0			2			2			2			2	25.27		2
	Sample NAZ	2018	02	16	20.0			2			2			2			2	15.30		2
	Sample NAZ	2018	02	16	20.0			2			2			2			2	15.20		2
	Sample NBA	2018	02	16	20.0			2			2			2			2	37.24		2
	Sample NBA	2018	02	16	20.0			2			2			2			2	36.22		2
	Sample NBA	2018	02	16	20.0			2			2			2			2	36.05		2
86																				
	Sample NAY	2018	01	23	20	23.39	0.09	2	23.31	0.09	2	0.08	0.00	2	1.71	0.00	2	39.96	0.04	2
	Sample NAY	2018	01	23	20	23.84	0.03	2	23.79	0.03	2	0.06	0.00	2	1.70	0.00	2	41.09	0.14	2
	Sample NAY	2018	01	23	20	23.79	0.06	2	23.72	0.06	2	0.06	0.00	2	1.69	0.00	2	39.64	0.21	2
	Sample NAZ	2018	01	23	20	8.02	0.03	2	7.98	0.03	2	0.04	0.00	2	0.61	0.00	2	16.01	0.04	2
	Sample NAZ	2018	01	23	20	7.99	0.02	2	7.95	0.02	2	0.04	0.00	2	0.61	0.00	2	15.68	0.52	2
	Sample NAZ	2018	01	23	20	8.08	0.03	2	7.87	0.03	2	0.21	0.01	2	0.62	0.00	2	16.02	0.02	2
	Sample NBA	2018	01	23	20	15.97	0.03	2	15.80	0.03	2	0.17	0.00	2	1.11	0.00	2	27.86	0.07	2
	Sample NBA	2018	01	23	20	15.48	0.02	2	15.36	0.02	2	0.12	0.00	2	1.11	0.00	2	28.31	0.07	2
	Sample NBA	2018	01	23	20	15.58	0.02	2	15.47	0.02	2	0.12	0.00	2	1.10	0.00	2	28.99	0.06	2
88																				
	Sample NAY	2017	12	21	20.0	22.73	0.07	2			2			2	1.72	0.01	2	36.97	3.36	2
	Sample NAY	2017	12	21	20.0	23.08	0.74	2			2			2	1.73	0.00	2	37.30	1.22	2
	Sample NAY	2017	12	21	20.0	23.52	1.15	2			2			2	1.72	0.00	2	37.13	2.24	2
	Sample NAZ	2017	12	21	20.0	7.85	0.11	2			2			2	0.61	0.00	2	14.56	0.31	2
	Sample NAZ	2017	12	21	20.0	7.82	0.22	2			2			2	0.61	0.00	2	14.35	0.68	2
	Sample NAZ	2017	12	21	20.0	7.90	0.01	2			2			2	0.60	0.00	2	14.28	0.98	2
	Sample NBA	2017	12	21	20.0	15.29	0.22	2			2			2	1.12	0.00	2	25.21	0.64	2
	Sample NBA	2017	12	21	20.0	15.56	0.53	2			2			2	1.12	0.01	2	24.96	1.07	2
	Sample NBA	2017	12	21	20.0	14.94	0.05	2			2			2	1.12	0.00	2	24.80	2.03	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
89																				
	Sample NAY	2018	01	30	20.0	22.71	0.17	2	22.60	0.16	2	0.11	0.00	2	2.09	0.01	2	26.81	0.06	2
	Sample NAY	2018	01	30	20.0	22.59	0.07	2	22.49	0.07	2	0.11	0.00	2	2.07	0.00	2	35.94	0.29	2
	Sample NAY	2018	01	30	20.0	22.68	0.04	2	22.57	0.03	2	0.12	0.01	2	2.10	0.00	2	38.60	0.06	2
	Sample NAZ	2018	01	30	20.0	7.24	0.01	2	7.15	0.01	2	0.09	0.00	2	0.80	0.04	2	15.53	0.05	2
	Sample NAZ	2018	01	30	20.0	7.33	0.02	2	7.24	0.02	2	0.09	0.00	2	0.79	0.00	2	15.66	0.06	2
	Sample NAZ	2018	01	30	20.0	7.37	0.03	2	7.28	0.02	2	0.09	0.00	2	0.80	0.01	2	15.65	0.12	2
	Sample NBA	2018	01	30	20.0	14.46	0.01	2	14.30	0.01	2	0.16	0.00	2	1.37	0.01	2	38.43	0.10	2
	Sample NBA	2018	01	30	20.0	19.14	0.03	2	18.74	0.03	2	0.39	0.00	2	1.41	0.02	2	26.61	0.10	2
	Sample NBA	2018	01	30	20.0	14.64	0.00	2	14.46	0.01	2	0.18	0.01	2	1.38	0.01	2	26.70	0.09	2
90																				
	Sample NAY	2018	02	22	20.0	19.79	0.05	2	19.76	0.05	2	0.04	0.00	2	1.61	0.02	2	35.65	0.10	2
	Sample NAY	2018	02	22	20.0	20.19	0.04	2	20.16	0.04	2	0.03	0.00	2	1.58	0.01	2	35.98	0.04	2
	Sample NAY	2018	02	22	20.0	20.44	0.04	2	20.40	0.03	2	0.04	0.00	2	1.55	0.02	2	35.95	0.05	2
	Sample NAZ	2018	02	22	20.0	6.40	0.01	2	6.37	0.01	2	0.03	0.00	2	0.55	0.01	2	14.30	0.02	2
	Sample NAZ	2018	02	22	20.0	6.23	0.04	2	6.08	0.04	2	0.15	0.00	2	0.54	0.03	2	14.45	0.02	2
	Sample NAZ	2018	02	22	20.0	6.55	0.01	2	6.53	0.01	2	0.03	0.00	2	0.56	0.00	2	14.29	0.04	2
	Sample NBA	2018	02	22	20.0	12.70	0.02	2	12.61	0.02	2	0.09	0.00	2	1.01	0.01	2	24.62	0.06	2
	Sample NBA	2018	02	22	20.0	13.47	0.02	2	13.09	0.02	2	0.38	0.00	2	0.99	0.01	2	24.84	0.02	2
	Sample NBA	2018	02	22	20.0	12.62	0.05	2	12.53	0.05	2	0.09	0.00	2	1.03	0.02	2	24.67	0.04	2
91																				
	Sample NAY	2018	01	18	20.0	24.34	0.02	2			2			2	1.70	0.00	2	39.48	0.06	2
	Sample NAY	2018	01	18	20.0	24.30	0.01	2			2			2	1.71	0.01	2	39.48	0.00	2
	Sample NAY	2018	01	18	20.0	24.38	0.02	2			2			2	1.70	0.00	2	39.46	0.02	2
	Sample NAZ	2018	01	18	20.0	8.54	0.02	2			2			2	0.60	0.00	2	15.90	0.00	2
	Sample NAZ	2018	01	18	20.0	8.53	0.01	2			2			2	0.60	0.00	2	15.91	0.00	2
	Sample NAZ	2018	01	18	20.0	11.95	0.02	2			2			2	0.60	0.00	2	15.99	0.05	2
	Sample NBA	2018	01	18	20.0	25.34	0.01	2			2			2	1.10	0.00	2	28.13	0.02	2
	Sample NBA	2018	01	18	20.0	16.25	0.01	2			2			2	1.10	0.00	2	27.24	0.00	2
	Sample NBA	2018	01	18	20.0	16.12	0.02	2			2			2	1.10	0.00	2	27.20	0.00	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
92																				
	Sample NAY	2018	01	09	18.6	23.23		2	23.16		2	0.07		2	1.72		2	40.17		2
	Sample NAY	2018	01	09	18.6	23.32		2	23.26		2	0.07		2	1.71		2	40.23		2
	Sample NAY	2018	01	09	18.6	23.56		2	23.51		2	0.06		2	1.72		2	40.24		2
	Sample NAZ	2018	01	09	18.6	8.50		2	8.30		2	0.20		2	0.63		2	16.26		2
	Sample NAZ	2018	01	09	18.6	8.22		2	8.18		2	0.04		2	0.62		2	16.22		2
	Sample NAZ	2018	01	09	18.6	8.35		2	8.32		2	0.03		2	0.63		2	16.18		2
	Sample NBA	2018	01	09	18.6	15.25		2	15.15		2	0.11		2	1.11		2	27.62		2
	Sample NBA	2018	01	09	18.6	15.57		2	15.47		2	0.10		2	1.13		2	27.85		2
	Sample NBA	2018	01	09	18.6	15.60		2	15.37		2	0.23		2	1.12		2	27.87		2
93																				
	Sample NAY	2017	12	07	20.5	23.02	0.05	2	23.00	0.05	2	0.02	0.00	2	1.66	0.01	2	38.78	0.15	2
	Sample NAY	2017	12	07	20.5	22.99	0.03	2	22.98	0.03	2	0.03	0.00	2	1.67	0.02	2	38.83	0.04	2
	Sample NAY	2017	12	07	20.5	23.19	0.10	2	23.15	0.10	2	0.05	0.00	2	1.66	0.01	2	38.94	0.04	2
	Sample NAZ	2017	12	07	20.5	8.01	0.03	2	8.00	0.03	2	0.01	0.00	2	0.60	0.00	2	15.73	0.05	2
	Sample NAZ	2017	12	07	20.5	7.97	0.05	2	7.97	0.05	2	0.00	0.00	2	0.59	0.00	2	15.70	0.05	2
	Sample NAZ	2017	12	07	20.5	7.97	0.04	2	7.97	0.04	2	0.00	0.00	2	0.60	0.00	2	15.83	0.06	2
	Sample NBA	2017	12	07	20.5	14.95	0.04	2	14.88	0.04	2	0.07	0.00	2	1.07	0.01	2	26.82	0.03	2
	Sample NBA	2017	12	07	20.5	14.95	0.04	2	14.87	0.04	2	0.07	0.00	2	1.07	0.00	2	26.84	0.17	2
	Sample NBA	2017	12	07	20.5	15.48	0.04	2	15.30	0.04	2	0.18	0.00	2	1.09	0.01	2	26.59	0.03	2
95																				
	Sample NAY	2018	04	21	30	23.00	0.08	2	22.92	0.08	2	0.08	0.00	2	1.62	0.02	2	37.79	2.20	2
	Sample NAY	2018	04	21	30	23.14	0.06	2	23.08	0.07	2	0.06	0.01	2	1.73	0.03	2	38.39	1.91	2
	Sample NAY	2018	04	21	30	23.21	0.08	2	23.14	0.07	2	0.06	0.01	2	1.62	0.03	2	40.08	2.08	2
	Sample NAZ	2018	04	21	30	9.59	0.03	2	8.96	0.01	2	0.63	0.01	2	0.56	0.01	2	16.31	1.22	2
	Sample NAZ	2018	04	21	30	8.10	0.05	2	8.05	0.05	2	0.06	0.00	2	0.56	0.01	2	15.54	0.79	2
	Sample NAZ	2018	04	21	30	8.16	0.00	2	8.12	0.01	2	0.04	0.01	2	0.56	0.01	2	15.56	0.87	2
	Sample NBA	2018	04	21	30	15.45	0.08	2	15.32	0.07	2	0.13	0.01	2	1.05	0.01	2	26.74	2.01	2
	Sample NBA	2018	04	21	30	15.15	0.05	2	15.03	0.06	2	0.12	0.01	2	1.01	0.01	2	26.59	0.96	2
	Sample NBA	2018	04	21	30	15.19	0.05	2	15.07	0.05	2	0.13	0.00	2	1.04	0.01	2	26.31	1.16	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
98																				
	Sample NAY				21.7	22.75	1.14	2			2			2	3.04	0.21	2	27.60	1.10	2
	Sample NAY				21.7	22.79	1.14	2			2			2	3.05	0.21	2	27.56	1.10	2
	Sample NAY	2018	01	01	21.7	21.77	1.09	2			2			2	3.01	0.21	2	27.48	1.10	2
	Sample NAZ				21.7	7.78	0.39	2			2			2	1.46	0.10	2	11.64	0.47	2
	Sample NAZ				21.7	7.88	0.39	2			2			2	1.62	0.11	2	11.63	0.47	2
	Sample NAZ				21.7	7.84	0.39	2			2			2	1.48	0.10	2	11.52	0.46	2
	Sample NBA				21.7	14.72	0.74	2			2			2	2.03	0.14	2	19.10	0.76	2
	Sample NBA				21.7	14.13	0.71	2			2			2	2.43	0.17	2	19.57	0.78	2
	Sample NBA				21.7	15.46	0.77	2			2			2	2.12	0.15	2	19.05	0.76	2
101																				
	Sample NAY	2018	04	16	24.1	21.82	1.92	2	21.06	1.78	2	0.19	0.00	2	1.42	0.16	2	33.27	2.78	2
	Sample NAY	2018	04	16	24.1	21.35	1.26	2	20.67	1.18	2	0.09	0.00	2	1.42	0.06	2	32.63	1.66	2
	Sample NAY	2018	04	16	24.1	23.93	0.15	2	23.19	0.12	2	0.06	0.00	2	1.67	0.02	2	36.42	0.06	2
	Sample NAZ	2018	04	16	24.1	7.41	0.21	2	7.17	0.20	2	0.04	0.00	2	0.57	0.04	2	13.89	0.67	2
	Sample NAZ	2018	04	16	24.1	8.06	0.13	2	7.77	0.09	2	0.08	0.00	2	0.54	0.01	2	14.89	0.19	2
	Sample NAZ	2018	04	16	24.1	7.67	0.31	2	7.40	0.27	2	0.07	0.00	2	0.53	0.02	2	14.32	0.55	2
	Sample NBA	2018	04	16	24.1	15.38	0.07	2	14.85	0.07	2	0.13	0.00	2	1.04	0.01	2	25.43	0.23	2
	Sample NBA	2018	04	16	24.1	14.82	0.51	2	14.19	0.36	2	0.30	0.01	2	0.99	0.06	2	23.77	1.06	2
	Sample NBA	2018	04	16	24.1	24.38	0.07	2	23.32	0.36	2	0.53	0.00	2	1.08	0.01	2	25.76	0.16	2
102																				
	Sample NAY	2018	02	19	18	22.57		2			2			2	1.84	0.03	2	41.23		2
	Sample NAY	2018	02	19	18			2			2	0.05		2	1.96	0.03	2			2
	Sample NAY	2018	02	19	18	22.53		2			2			2	1.87	0.03	2	42.31		2
	Sample NAZ	2018	02	19	18			2			2	0.02		2	0.69	0.00	2	16.79	0.22	2
	Sample NAZ	2018	02	19	18	8.11	0.05	2			2			2	0.66	0.00	2	16.69	0.23	2
	Sample NAZ	2018	02	19	18	8.24	0.05	2			2			2	0.69	0.00	2	17.36	0.22	2
	Sample NBA	2018	02	19	18	15.18		2			2			2	1.25	0.00	2	29.11		2
	Sample NBA	2018	02	19	18	14.99		2			2			2	1.24	0.00	2	28.81		2
	Sample NBA	2018	02	19	18			2			2	0.32		2	1.27	0.00	2			2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
106																				
	Sample NAY	2017	12	22	22.06	25.50		2	25.43		2	0.07		2	1.83		2	46.58		2
	Sample NAY	2017	12	22	22.06	25.98		2	25.93		2	0.05		2	1.83		2	46.09		2
	Sample NAY	2017	12	22	22.06	25.49		2	25.43		2	0.05		2	1.84		2	44.43		2
	Sample NAZ	2017	12	22	22.06	7.93		2	7.84		2	0.08		2	0.68		2	14.72		2
	Sample NAZ	2017	12	22	22.06	8.04		2	8.00		2	0.03		2	0.67		2	15.15		2
	Sample NAZ	2017	12	22	22.06	8.00		2	7.95		2	0.05		2	0.69		2	14.55		2
	Sample NBA	2017	12	22	22.06	15.05		2	14.93		2	0.11		2	1.18		2	32.16		2
	Sample NBA	2017	12	22	22.06	15.06		2	14.96		2	0.10		2	1.17		2	31.27		2
	Sample NBA	2017	12	22	22.06	15.00		2	14.88		2	0.12		2	1.19		2	32.32		2
107																				
	Sample NAY	2018	02	12	20.0	22.32	1.12	2	22.25	1.11	2	0.07	0.01	2	1.68	0.08	2	37.30	1.87	2
	Sample NAY	2018	02	12	20.0	21.48	1.07	2	21.43	1.07	2	0.05	0.01	2	1.68	0.08	2	37.60	1.88	2
	Sample NAY	2018	02	12	20.0	21.78	1.09	2	21.71	1.08	2	0.07	0.01	2	1.69	0.08	2	38.49	1.92	2
	Sample NAZ	2018	02	12	20.0	7.76	0.39	2	7.72	0.39	2	0.04	0.01	2	0.65	0.03	2	14.17	0.71	2
	Sample NAZ	2018	02	12	20.0	7.98	0.40	2	7.93	0.40	2	0.05	0.01	2	0.65	0.03	2	14.67	0.73	2
	Sample NAZ	2018	02	12	20.0	7.50	0.37	2	7.46	0.37	2	0.04	0.01	2	0.66	0.03	2	15.34	0.77	2
	Sample NBA	2018	02	12	20.0	20.36	1.02	2	20.20	1.01	2	0.15	0.01	2	1.11	0.06	2	25.50	1.28	2
	Sample NBA	2018	02	12	20.0	14.73	0.74	2	14.51	0.73	2	0.21	0.01	2	1.14	0.06	2	26.61	1.33	2
	Sample NBA	2018	02	12	20.0	15.63	0.78	2	15.52	0.78	2	0.11	0.01	2	1.13	0.06	2	25.89	1.29	2
109																				
	Sample NAY	2017	11	14	20	23.12	0.02	2	23.04	0.02	2	0.07	0.00	2	1.71	0.01	2	41.56	0.30	2
	Sample NAZ	2017	11	14	20	8.32	0.04	2	8.28	0.04	2	0.05	0.00	2	0.63	0.00	2	16.85	0.03	2
	Sample NBA	2017	11	14	20	16.28	0.03	2	15.77	0.03	2	0.51	0.00	2	1.12	0.01	2	28.85	0.06	2
112																				
	Sample NAY	2017	12	14	21.0	23.26	0.02	2			2	0.06	0.00	2	1.72	0.01	2	39.56	0.04	2
	Sample NAY	2017	12	14	21.0	23.35	0.02	2			2	0.06	0.00	2	1.72	0.01	2	39.66	0.04	2
	Sample NAY	2017	12	14	21.0	23.13	0.02	2			2	0.07	0.00	2	1.71	0.01	2	39.56	0.04	2
	Sample NAZ	2017	12	14	21.0	8.07	0.01	2			2	0.04	0.00	2	0.63	0.00	2	16.02	0.02	2
	Sample NAZ	2017	12	14	21.0	7.95	0.01	2			2	0.04	0.00	2	0.62	0.00	2	15.92	0.02	2
	Sample NAZ	2017	12	14	21.0	7.95	0.01	2			2	0.04	0.00	2	0.63	0.00	2	15.92	0.02	2
	Sample NBA	2017	12	14	21.0	15.30	0.02	2			2	0.13	0.00	2	1.12	0.01	2	27.25	0.03	2
	Sample NBA	2017	12	14	21.0	15.14	0.02	2			2	0.11	0.00	2	1.13	0.01	2	27.25	0.03	2
	Sample NBA	2017	12	14	21.0	15.33	0.02	2			2	0.15	0.00	2	1.12	0.01	2	27.25	0.03	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
113																				
	Sample NAY	2018	02	06	20.0	23.02	0.13	2	22.97	0.13	2	0.07	0.01	2	1.70	0.02	2	39.75	0.97	2
	Sample NAZ	2018	02	05	20.0	7.94	0.13	2	7.90	0.13	2	0.04	0.01	2	0.62	0.02	2	15.92	0.97	2
	Sample NBA	2018	02	03	20.0	20.56	0.13	2	20.32	0.13	2	0.25	0.01	2	1.08	0.02	2	27.04	0.97	2
114																				
	Sample NAY	2018	05	09	24			2			2			2	1.66		2			2
	Sample NAY	2018	05	09	24			2			2			2	1.65		2			2
	Sample NAY	2018	05	09	24			2			2			2	1.66		2			2
	Sample NAZ	2018	05	09	24			2			2			2	0.60		2			2
	Sample NAZ	2018	05	09	24	7.91		2			2			2	0.59		2			2
	Sample NAZ	2018	05	09	24	8.04		2			2			2	0.59		2			2
	Sample NBA	2018	05	09	24			2			2			2	1.06		2			2
	Sample NBA	2018	05	09	24			2			2			2	1.08		2			2
	Sample NBA	2018	05	09	24			2			2			2	1.07		2			2
118																				
	Sample NAY	2018	03	22	20.1	20.19		2			2	0.08		2	1.74		2	37.24		2
	Sample NAY	2018	03	22	20.1	20.27		2			2	0.06	0.00	2	1.74	0.01	2	37.48	0.31	2
	Sample NAY	2018	03	22	20.1	20.15		2			2	0.09		2	1.71		2	37.30		2
	Sample NAZ	2018	03	22	20.1	7.25		2			2	0.04		2	0.61		2	14.74		2
	Sample NAZ	2018	03	22	20.1	7.30		2			2	0.11	0.02	2	0.61	0.01	2	14.65	0.14	2
	Sample NAZ	2018	03	22	20.1	7.27	0.02	2			2	0.05		2	0.60		2	14.70		2
	Sample NBA	2018	03	22	20.1	13.38		2			2	0.22		2	1.09		2	25.43		2
	Sample NBA	2018	03	22	20.1	13.52	0.02	2			2	0.19		2	1.10		2	25.57		2
	Sample NBA	2018	03	22	20.1	13.79		2			2	0.14		2	1.09		2	25.44		2
124																				
	Sample NAY	2018	02	09	20	24.02	0.64	2	24.02	0.64	2	N.D	N.D	2	1.72	0.01	2	39.42	0.21	2
	Sample NAY	2018	02	09	20	23.28	0.18	2	23.28	0.18	2	N.D	N.D	2	1.75	0.01	2	39.40	0.25	2
	Sample NAY	2018	02	09	20	23.52	0.21	2	23.52	0.21	2	N.D	N.D	2	1.73	0.01	2	39.40	0.21	2
	Sample NAZ	2018	02	09	20	8.27	0.06	2	8.27	0.06	2	N.D	N.D	2	0.63	0.01	2	15.43	0.17	2
	Sample NAZ	2018	02	09	20	8.33	0.03	2	8.33	0.03	2	N.D	N.D	2	0.64	0.02	2	15.38	0.23	2
	Sample NAZ	2018	02	09	20	8.16	0.01	2	8.16	0.01	2	N.D	N.D	2	0.63	0.00	2	15.44	0.18	2
	Sample NBA	2018	02	09	20	15.49	0.00	2	15.49	0.00	2	N.D	N.D	2	1.13	0.00	2	26.91	0.25	2
	Sample NBA	2018	02	09	20	19.65	0.06	2	19.37	0.09	2	0.27	0.06	2	1.13	0.01	2	27.15	0.24	2
	Sample NBA	2018	02	09	20	15.15	0.02	2	15.15	0.02	2	N.D	N.D	2	1.10	0.02	2	26.88	0.19	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
125																				
	Sample NAY	2018	01	24	20.9	23.33	0.10	2	23.26	0.10	2	0.07	0.01	2	1.64	0.01	2	39.00	0.07	2
	Sample NAY	2018	01	24	20.9	23.39	0.10	2	23.32	0.10	2	0.08	0.01	2	1.63	0.01	2	38.90	0.07	2
	Sample NAY	2018	01	24	20.9	23.23	0.10	2	23.15	0.10	2	0.08	0.01	2	1.64	0.01	2	38.94	0.07	2
	Sample NAZ	2018	01	24	20.9	8.21	0.10	2	8.16	0.10	2	0.06	0.01	2	0.66	0.01	2	15.72	0.07	2
	Sample NAZ	2018	01	24	20.9	8.18	0.10	2	8.13	0.10	2	0.06	0.01	2	0.61	0.01	2	15.67	0.07	2
	Sample NAZ	2018	01	24	20.9	8.17	0.10	2	8.11	0.10	2	0.07	0.01	2	0.62	0.01	2	15.83	0.07	2
	Sample NBA	2018	01	24	20.9	15.48	0.10	2	15.30	0.10	2	0.18	0.01	2	1.04	0.01	2	27.05	0.07	2
	Sample NBA	2018	01	24	20.9	15.23	0.10	2	15.11	0.10	2	0.13	0.01	2	1.05	0.01	2	26.72	0.07	2
	Sample NBA	2018	01	24	20.9	15.44	0.10	2	15.31	0.10	2	0.13	0.01	2	1.07	0.01	2	27.03	0.07	2
129																				
	Sample NAY	2017	12	26	21.7			2	22.47		2	0.05		2	1.76		2	38.28		2
	Sample NAY	2017	12	26	21.7			2	22.46		2	0.03		2	1.76		2	38.17		2
	Sample NAY	2017	12	26	21.7			2	22.25		2	0.03		2	1.76		2	38.27		2
	Sample NAZ	2017	12	26	21.7			2	7.79		2	0.02		2	0.68		2	15.49		2
	Sample NAZ	2017	12	26	21.7			2	7.99		2	0.01		2	0.68		2	15.50		2
	Sample NAZ	2017	12	26	21.7			2	7.83		2	0.02		2	0.69		2	15.59		2
	Sample NBA	2017	12	26	21.7			2	14.58		2	0.22		2	1.15		2	27.16		2
	Sample NBA	2017	12	26	21.7			2	14.50		2	0.09		2	1.17		2	26.57		2
	Sample NBA	2017	12	26	21.7			2	14.57		2	0.08		2	1.16		2	26.41		2
135																				
	Sample NAY	2017	12	13	20.0	23.24		2			2	0.05		2	1.76		2	39.58		2
	Sample NAY	2017	12	19	20.0	23.47		2			2	0.05		2	1.67		2	38.45		2
	Sample NAY	2017	12	12	20.0	24.55		2			2	0.05		2	1.68		2	39.07		2
	Sample NAZ	2017	12	13	20.0	8.33		2			2	0.02		2	0.62		2	15.85		2
	Sample NAZ	2017	12	12	20.0	8.12		2			2	0.03		2	0.60		2	15.66		2
	Sample NAZ	2017	12	12	20.0	7.88		2			2	0.03		2	0.60		2	16.16		2
	Sample NBA	2017	12	13	20.0	15.64		2			2	0.25		2	1.14		2	27.66		2
	Sample NBA	2017	12	12	20.0	14.94		2			2	0.10		2	1.09		2	27.25		2
	Sample NBA	2017	12	13	20.0	15.47		2			2	0.10		2	1.12		2	27.93		2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
136																				
	Sample NAY	2018	01	23	20.0			2	23.96	0.14	2	-0.01	0.00	2	1.66	0.01	2	40.34	0.02	2
	Sample NAY	2018	01	23	20.0			2	23.42	0.09	2	0.00	0.01	2	1.66	0.01	2	40.27	0.17	2
	Sample NAY	2018	01	23	20.0			2	23.88	0.23	2	-0.02	0.01	2	1.66	0.03	2	40.88	0.17	2
	Sample NAZ	2018	01	23	20.0			2	8.12	0.05	2	0.22	0.01	2	0.60	0.00	2	16.09	0.21	2
	Sample NAZ	2018	01	23	20.0			2	8.08	0.12	2	-0.04	0.01	2	0.58	0.01	2	16.56	0.13	2
	Sample NAZ	2018	01	23	20.0			2	7.88	0.03	2	-0.04	0.01	2	0.57	0.01	2	16.47	0.05	2
	Sample NBA	2018	01	23	20.0			2	16.18	0.12	2	0.24	0.00	2	1.07	0.01	2	28.87	0.35	2
	Sample NBA	2018	01	23	20.0			2	15.76	0.12	2	0.05	0.01	2	1.06	0.01	2	28.64	0.23	2
	Sample NBA	2018	01	23	20.0			2	15.67	0.12	2	0.04	0.00	2	1.05	0.01	2	28.31	0.10	2
137																				
	Sample NAY	2018	01	17	24.5	23.46		2	23.42		2	0.04		2	1.71		2	40.11		2
	Sample NAY	2018	01	17	24.5	23.51		2	23.47		2	0.05		2	1.76		2	40.20		2
	Sample NAY	2018	01	17	24.5	23.40		2	23.36		2	0.04		2	1.74		2	40.14		2
	Sample NAZ	2018	01	17	24.5	8.11		2	8.08		2	0.02		2	0.63		2	15.71		2
	Sample NAZ	2018	01	17	24.5	8.36		2	8.29		2	0.08		2	0.63		2	15.74		2
	Sample NAZ	2018	01	17	24.5	8.18		2	8.16		2	0.02		2	0.62		2	15.74		2
	Sample NBA	2018	01	17	24.5	15.59		2	15.43		2	0.16		2	1.14		2	27.45		2
	Sample NBA	2018	01	17	24.5	15.53		2	15.43		2	0.10		2	1.13		2	27.45		2
	Sample NBA	2018	01	17	24.5	15.26		2	15.17		2	0.10		2	1.12		2	27.38		2
138																				
	Sample NAY	2018	01	18	20.0	23.11	0.02	2	23.03	0.02	2	0.08	0.00	2	1.73	0.00	2	39.34	0.03	2
	Sample NAY	2018	01	18	20.0	23.21	0.02	2	23.13	0.02	2	0.08	0.00	2	1.74	0.00	2	39.53	0.03	2
	Sample NAY	2018	01	18	20.0	23.02	0.02	2	22.92	0.02	2	0.10	0.00	2	1.73	0.00	2	39.39	0.03	2
	Sample NAZ	2018	01	18	20.0	8.05	0.01	2	7.98	0.01	2	0.06	0.00	2	0.65	0.00	2	16.24	0.02	2
	Sample NAZ	2018	01	18	20.0	8.19	0.01	2	8.14	0.01	2	0.05	0.00	2	0.64	0.00	2	16.27	0.02	2
	Sample NAZ	2018	01	18	20.0	8.10	0.01	2	8.04	0.01	2	0.06	0.00	2	0.64	0.00	2	16.24	0.02	2
	Sample NBA	2018	01	18	20.0	15.72	0.02	2	15.35	0.02	2	0.37	0.00	2	1.14	0.00	2	27.52	0.02	2
	Sample NBA	2018	01	18	20.0	15.11	0.02	2	14.96	0.02	2	0.15	0.00	2	1.14	0.00	2	27.33	0.02	2
	Sample NBA	2018	01	18	20.0	15.26	0.02	2	14.99	0.02	2	0.27	0.00	2	1.14	0.00	2	27.25	0.02	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
139																				
	Sample NAY	2017	12	04	20.0			2	23.14	0.10	2	0.00	0.00	2	1.70	0.00	2	38.48	0.10	2
	Sample NAY	2017	12	04	20.0			2	22.95	0.10	2	0.00	0.00	2	1.68	0.01	2	38.48	0.10	2
	Sample NAY	2017	12	04	20.0			2	22.95	0.10	2	0.01	0.01	2	1.68	0.02	2	38.38	0.20	2
	Sample NAZ	2017	12	04	20.0			2	8.01	0.10	2	0.00	0.00	2	0.61	0.01	2	15.23	0.10	2
	Sample NAZ	2017	12	04	20.0			2	8.01	0.00	2	0.00	0.00	2	0.61	0.01	2	15.23	0.00	2
	Sample NAZ	2017	12	04	20.0			2	8.20	0.10	2	0.00	0.00	2	0.61	0.01	2	15.13	0.10	2
	Sample NBA	2017	12	04	20.0			2	15.52	0.10	2	0.06	0.02	2	1.09	0.02	2	26.56	0.00	2
	Sample NBA	2017	12	04	20.0			2	15.52	0.10	2	0.11	0.01	2	1.10	0.00	2	26.56	0.00	2
	Sample NBA	2017	12	04	20.0			2	15.23	0.10	2	0.09	0.01	2	1.09	0.01	2	26.46	0.10	2
140																				
	Sample NAY	2018	02	06	22.0	22.70	0.07	2			2			2	1.74	0.01	2	40.02	1.01	2
	Sample NAY	2018	02	06	22.0	22.58	0.07	2			2			2	1.74	0.01	2	37.53	1.01	2
	Sample NAY	2018	02	06	22.0	22.27	0.07	2			2			2	1.72	0.01	2	40.41	1.01	2
	Sample NAZ	2018	02	06	22.0	7.97	0.04	2			2			2	0.59	0.01	2	16.00	0.31	2
	Sample NAZ	2018	02	06	22.0	8.09	0.04	2			2			2	0.61	0.01	2	14.88	0.31	2
	Sample NAZ	2018	02	06	22.0	7.96	0.04	2			2			2	0.60	0.01	2	15.51	0.31	2
	Sample NBA	2018	02	06	22.0	15.36	0.04	2			2			2	1.12	0.01	2	25.30	0.57	2
	Sample NBA	2018	02	06	22.0	14.68	0.04	2			2			2	1.08	0.01	2	27.64	0.57	2
	Sample NBA	2018	02	06	22.0	14.84	0.04	2			2			2	1.11	0.01	2	27.08	0.57	2
141																				
	Sample NAY	2018	01	23	22			2			2			2			2			2
	Sample NAY	2018	01	23	22			2			2			2			2			2
	Sample NAY	2018	01	23	22			2			2			2			2			2
	Sample NAZ	2018	01	25	22	8.53	0.04	2	8.22	0.03	2	0.31	0.01	2	0.64	0.00	2	15.57	0.03	2
	Sample NAZ	2018	01	25	22	8.19	0.05	2	8.15	0.05	2	0.03	0.00	2	0.64	0.00	2	15.57	0.03	2
	Sample NAZ	2018	01	25	22	8.22	0.01	2	8.18	0.01	2	0.04	0.00	2	0.64	0.00	2	15.55	0.08	2
	Sample NBA	2018	01	25	22	15.50	0.04	2	15.40	0.04	2	0.11	0.00	2	1.13	0.00	2	26.62	0.03	2
	Sample NBA	2018	01	25	22	15.55	0.04	2	15.35	0.03	2	0.21	0.01	2	1.14	0.00	2	26.58	0.05	2
	Sample NBA	2018	01	25	22	15.43	0.07	2	15.33	0.06	2	0.12	0.00	2	1.14	0.00	2	26.63	0.07	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
143																				
	Sample NAY	2018	02	26	20	21.71		2	21.65		2	0.06		2	1.78		2			2
	Sample NAY	2018	02	26	20	21.83		2	21.75		2	0.08		2	1.74		2			2
	Sample NAY	2018	02	26	20	21.79		2	21.73		2	0.07		2	1.76		2			2
	Sample NAZ	2018	02	26	20	7.61		2	7.58		2	0.03		2	0.63		2			2
	Sample NAZ	2018	02	26	20	7.62		2			2			2	0.63		2			2
	Sample NAZ	2018	02	26	20	7.45		2	7.40		2	0.05		2	0.65		2			2
	Sample NBA	2018	02	26	20	14.20		2	14.07		2	0.13		2	1.16		2			2
	Sample NBA	2018	02	26	20	14.28		2	14.16		2	0.12		2	1.16		2			2
	Sample NBA	2018	02	26	20	14.29		2	14.17		2	0.12		2	1.17		2			2
148																				
	Sample NAY				20.0	23.99		2	23.89		2	0.11		2	1.75		2	38.59		2
	Sample NAY	2018	01	10	20.0	23.93		2	23.82		2	0.10		2	1.74		2	39.08		2
	Sample NAY				20.0	23.86		2	23.78		2	0.08		2	1.75		2	39.57		2
	Sample NAZ	2018	01	30	20.0	15.62		2	15.49		2	0.14		2	1.15		2	26.36		2
	Sample NAZ				20.0	17.16		2	16.86		2	0.29		2	1.10		2	25.66		2
	Sample NAZ				20.0	15.62		2	15.49		2	0.14		2	1.14		2	26.60		2
	Sample NBA				20.0	8.58		2	8.53		2	0.05		2	0.62		2	15.55		2
	Sample NBA				20.0	8.58		2	8.50		2	0.08		2	0.59		2	16.20		2
	Sample NBA				20.0	8.92		2	8.87		2	0.06		2	0.60		2	15.98		2
149																				
	Sample NAY	2018	04	17	24	12.22	0.08	2			2	0.03	0.00	2	1.60	0.00	2	36.17	0.07	2
	Sample NAY	2018	04	17	24	12.03	0.08	2			2	0.03	0.00	2	1.59	0.00	2	35.33	0.06	2
	Sample NAY	2018	04	17	24	11.80	0.08	2			2	n.d.		2	1.64	0.00	2	34.54	0.06	2
	Sample NAZ	2018	04	17	24	2.37	0.01	2			2	n.d.		2	0.53	0.00	2	13.68	0.02	2
	Sample NAZ	2018	04	17	24	2.36	0.01	2			2	0.02	0.00	2	0.55	0.00	2	13.90	0.03	2
	Sample NAZ	2018	04	17	24	2.47	0.02	2			2	0.06	0.00	2	0.63	0.00	2	14.19	0.03	2
	Sample NBA	2018	04	17	24	7.12	0.05	2			2	0.12	0.00	2	1.02	0.00	2	23.93	0.04	2
	Sample NBA	2018	04	17	24	7.16	0.05	2			2	0.09	0.00	2	1.03	0.00	2	24.39	0.04	2
	Sample NBA	2018	04	17	24	6.73	0.04	2			2	0.08	0.00	2	1.02	0.00	2	24.22	0.04	2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
150																				
	Sample NAY	2018	01	05	20.0	20.29		2			2			2	1.60		2	36.66		2
	Sample NAY	2018	01	05	20.0	20.55		2			2			2	1.58		2	36.62		2
	Sample NAY	2018	01	05	20.0	20.82		2			2			2	1.56		2	36.61		2
	Sample NAZ	2018	01	05	20.0	7.31		2			2			2	0.68		2	14.87		2
	Sample NAZ	2018	01	05	20.0	7.28		2			2			2	0.73		2	14.84		2
	Sample NAZ	2018	01	05	20.0	7.18		2			2			2	0.68		2	14.86		2
	Sample NBA	2018	01	05	20.0	20.65		2			2			2	1.03		2	25.52		2
	Sample NBA	2018	01	05	20.0	13.46		2			2			2	1.02		2	25.26		2
	Sample NBA	2018	01	05	20.0	13.44		2			2			2	1.05		2	25.29		2
151																				
	Sample NAY	2018	02	27	20.0			2			2			2			2			2
	Sample NAY	2018	02	27	20.0			2			2			2			2			2
	Sample NAY	2018	02	27	20.0			2			2			2	0.10	0.00	2	0.49	0.01	2
	Sample NAZ	2018	02	27	20.0			2			2			2			2			2
	Sample NAZ	2018	02	27	20.0			2			2			2	0.04	0.00	2	0.21	0.01	2
	Sample NAZ	2018	02	27	20.0			2			2			2			2			2
	Sample NBA	2018	02	27	20.0			2			2			2			2			2
	Sample NBA	2018	02	27	20.0			2			2			2			2			2
	Sample NBA	2018	02	27	20.0			2			2			2	0.06	0.00	2	0.35	0.01	2
153																				
	Sample NAY	2018	01	23	24.4	22.84		2	22.02		2	0.82		2	0.64		2	38.91		2
	Sample NAY	2018	01	23	24.4	24.25		2	23.08		2	1.17		2	1.78		2	38.91		2
	Sample NAY	2018	01	23	24.4	24.19		2	24.19		2	<0.01		2	1.21		2	38.91		2
	Sample NAZ	2018	01	23	24.4	1.91		2	1.91		2	<0.01		2	<0.02		2	18.87		2
	Sample NAZ	2018	01	23	24.4	6.40		2	6.05		2	0.35		2	<0.02		2	16.03		2
	Sample NAZ	2018	01	23	24.4	3.26		2	3.26		2	<0.01		2	<0.02		2	18.87		2
	Sample NBA	2018	01	23	24.4	14.44		2	13.97		2	0.47		2	0.64		2	27.47		2
	Sample NBA	2018	01	23	24.4	15.82		2	15.82		2	<0.01		2	<0.02		2	41.74		2
	Sample NBA	2018	01	23	24.4	2.88		2	2.88		2	<0.01		2	0.92		2	27.47		2

2018 IC results reported by the participants

in micro moles per kilogram

Lab	Sample	Year	Month	Day	Temperature	NOX	ERR	Flag	Nitrate	ERR	Flag	Nitrite	ERR	Flag	Phosphate	ERR	Flag	Silicate	ERR	Flag
155																				
	Sample NAY	2018	01	19	20.0			2			2			2			2	39.06	1.17	2
	Sample NAY	2018	01	19	20.0	22.46	1.12	2	22.36	1.12	2	0.10		2	1.72	0.17	2			2
	Sample NAY	2018	01	19	20.0	23.44	1.17	2	23.37	1.17	2	0.07		2	1.72	0.17	2			2
	Sample NAZ	2018	01	19	20.0			2			2			2			2			2
	Sample NAZ	2018	01	19	20.0			2			2			2			2	15.82	0.47	2
	Sample NAZ	2018	01	19	20.0			2			2			2			2			2
	Sample NBA	2018	01	19	20.0	15.23	0.76	2	15.10	0.76	2	0.13		2	1.11	0.11	2			2
	Sample NBA	2018	01	19	20.0			2			2			2			2			2
	Sample NBA	2018	01	19	20.0			2			2			2			2	27.34	0.82	2
156																				
	Sample NAY	2018	02	16	21.3	22.44	0.17	2	22.36	0.18	2	0.08	0.01	2	1.70	0.01	2	39.39	0.21	2
	Sample NAY	2018	02	16	21.3	22.40	0.16	2	22.02	0.67	2	0.08	0.02	2	1.67	0.02	2	38.81	0.89	2
	Sample NAY	2018	02	16	21.3	22.40	0.15	2	22.33	0.17	2	0.07	0.02	2	1.69	0.01	2	39.53	0.19	2
	Sample NAZ	2018	02	16	21.3	7.76	0.05	2	7.73	0.10	2	0.05	0.01	2	0.60	0.00	2	15.96	0.11	2
	Sample NAZ	2018	02	16	21.3	8.62		2	8.59		2	0.04		2	0.59		2	15.90		2
	Sample NAZ	2018	02	16	21.3	7.72	0.08	2	7.65	0.09	2	0.07	0.01	2	0.61	0.01	2	15.99	0.09	2
	Sample NBA	2018	02	16	21.3	14.70	0.18	2	14.57	0.18	2	0.13	0.00	2	1.09	0.01	2	27.10	0.07	2
	Sample NBA	2018	02	16	21.3	14.69	0.17	2	14.56	0.18	2	0.13	0.00	2	1.09	0.01	2	27.10	0.07	2
	Sample NBA	2018	02	16	21.3	14.77	0.41	2	14.52	0.40	2	0.23	0.01	2	1.07	0.02	2	26.84	0.11	2

Table KIOST-A3. Ammonia results reported by the participants

Lab#	Sample	AMMONIA	ERR	NO2	ERR	NO3	ERR	NOX	ERR
5									
	Sample NAY	0.61	0.01	0.07	0.00			24.30	0.15
	Sample NAY	0.62	0.01	0.06	0.00			24.76	0.15
	Sample NAY	0.64	0.01	0.07	0.00			24.30	0.15
	Sample NAZ	0.65	0.01	0.05	0.00			8.10	0.05
	Sample NAZ	0.64	0.01	0.04	0.00			7.99	0.05
	Sample NAZ	0.67	0.01	0.03	0.00			7.93	0.05
	Sample NBA	0.98	0.01	0.13	0.01			15.44	0.09
	Sample NBA	0.69	0.01	0.14	0.01			15.04	0.09
	Sample NBA	0.77	0.01	0.13	0.01			15.35	0.09
8									
	Sample NAY	0.97	0.20	0.07	0.00	24.09	2.03	24.15	2.03
	Sample NAY	1.04	0.06	0.05	0.00	23.54	1.25	23.59	1.25
	Sample NAY	1.07	0.04	0.06	0.01	23.35	1.79	23.40	1.78
	Sample NAZ	1.05	0.15	0.04	0.00	7.85	0.40	7.89	0.40
	Sample NAZ	1.55	0.24	0.07	0.02	7.96	0.47	8.03	0.49
	Sample NAZ	1.01	0.06	0.05	0.00	7.90	0.41	7.94	0.41
	Sample NBA	7.91	0.49	0.43	0.02	15.88	0.83	16.31	0.85
	Sample NBA	4.82	0.19	0.25	0.01	14.89	0.36	14.66	1.05
	Sample NBA	0.89	0.01	0.12	0.01	14.90	0.60	15.02	0.61
17									
	Sample NAY	0.25		0.13		44.57		44.69	
	Sample NAY	0.37		0.16		44.72		44.88	
	Sample NAY	0.11		0.12		44.86		44.98	
	Sample NAZ	0.29		0.09		16.02		16.11	
	Sample NAZ	0.33		0.05		15.90		15.95	
	Sample NAZ	0.13		0.13		16.06		16.19	
	Sample NBA	0.64		0.19		30.18		30.37	
	Sample NBA	1.42		0.23		29.75		29.98	
	Sample NBA	0.94		0.11		29.47		29.58	
19									
	Sample NAY	0.92	0.01	0.10	0.00	23.08	0.08	23.18	0.08
	Sample NAY	0.71		0.07		23.31		23.37	
	Sample NAY	0.71		0.07		23.28		23.35	
	Sample NAZ	0.98	0.01	0.08	0.00	7.84	0.02	7.92	0.02
	Sample NAZ	0.72		0.05		8.07		8.12	
	Sample NAZ	0.72		0.04		8.03		8.07	
	Sample NBA	2.98		0.16		15.21		15.37	
	Sample NBA	0.94		0.16		15.30		15.46	
	Sample NBA	0.76	0.01	0.11	0.00	14.97	0.01	15.08	0.01

Lab#	Sample	AMMONIA	ERR	NO2	ERR	NO3	ERR	NOX	ERR
27									
	Sample NAY	0.82	0.03	0.07	0.01	22.50	0.03	22.57	0.03
	Sample NAY	0.77	0.03	0.07	0.01	22.53	0.03	22.60	0.03
	Sample NAY	0.67	0.03	0.06	0.01	22.68	0.03	22.75	0.03
	Sample NAZ	0.79	0.03	0.05	0.01	8.05	0.03	8.11	0.03
	Sample NAZ	0.64	0.03	0.05	0.01	7.60	0.03	7.66	0.03
	Sample NAZ	2.55	0.03	0.13	0.01	7.64	0.03	7.86	0.03
	Sample NBA	0.67	0.03	0.12	0.01	14.60	0.03	14.71	0.03
	Sample NBA	1.33	0.03	0.14	0.01	14.61	0.03	14.74	0.03
	Sample NBA	2.93	0.03	0.31	0.01	14.72	0.03	15.04	0.03
28									
	Sample NAY	0.59	0.20	0.03	0.02	23.01	0.15	23.04	0.15
	Sample NAY	0.56	0.20	0.04	0.02	22.77	0.15	22.81	0.15
	Sample NAY	0.68	0.20	0.03	0.02	23.09	0.15	23.12	0.15
	Sample NAZ	0.56	0.20	0.02	0.10	7.92	0.10	7.94	0.29
	Sample NAZ	0.62	0.20	0.01	0.10	7.95	0.10	7.96	0.29
	Sample NAZ	0.66	0.20	0.02	0.10	7.88	0.10	7.90	0.29
	Sample NBA	1.73	0.24	0.13	0.02	15.27	0.15	15.40	0.15
	Sample NBA	2.27	0.24	0.15	0.02	14.84	0.15	14.99	0.15
	Sample NBA	2.17	0.24	0.22	0.02	15.34	0.15	15.56	0.15
39									
	Sample NAY	0.74	0.01	0.06	0.00	23.23	0.03	23.29	0.03
	Sample NAY	1.21	0.01	0.11	0.00	23.22	0.03	23.33	0.03
	Sample NAY	0.71	0.01	0.07	0.00	23.19	0.03	23.26	0.03
	Sample NAZ	0.98	0.01	0.06	0.00	7.99	0.01	8.04	0.01
	Sample NAZ	0.68	0.01	0.04	0.00	7.94	0.01	7.98	0.01
	Sample NAZ	0.79	0.01	0.03	0.00	8.03	0.01	8.06	0.01
	Sample NBA	0.69	0.01	0.11	0.00	15.33	0.03	15.43	0.03
	Sample NBA	0.85	0.01	0.11	0.00	15.18	0.03	15.28	0.03
	Sample NBA	1.50	0.02	0.15	0.00	15.29	0.03	15.44	0.03
40									
	Sample NAY	0.70		<0.07				22.73	
	Sample NAY	0.90		0.08				22.73	
	Sample NAY	1.35		0.08				22.52	
	Sample NAZ	2.57		0.25				9.34	
	Sample NAZ	0.61		<0.07				7.88	
	Sample NAZ	0.75		<0.07				8.02	
	Sample NBA	1.21		0.13				15.06	
	Sample NBA	0.76		0.10				14.71	
	Sample NBA	0.71		0.08				14.78	

Lab#	Sample	AMMONIA	ERR	NO2	ERR	NO3	ERR	NOX	ERR
51									
	Sample NAY	0.61	0.03	0.09	0.00	22.81	0.06	22.90	0.05
	Sample NAY	0.69	0.03	0.08	0.00	23.13	0.06	23.21	0.05
	Sample NAY	1.05	0.03	0.10	0.00	23.25	0.06	23.34	0.05
	Sample NAZ	0.72	0.03	0.05	0.00	7.89	0.03	7.94	0.02
	Sample NAZ	1.01	0.03	0.07	0.00	7.79	0.03	7.86	0.02
	Sample NAZ	0.72	0.03	0.05	0.00	7.94	0.03	7.99	0.02
	Sample NBA	1.20	0.03	0.14	0.00	14.75	0.06	14.90	0.05
	Sample NBA	1.28	0.03	0.12	0.00	14.95	0.06	15.07	0.05
	Sample NBA	2.60	0.03	0.30	0.00	14.93	0.06	15.24	0.05
86									
	Sample NAY	0.34	0.09	0.06	0.00	23.79	0.03	23.84	0.03
	Sample NAY	0.46	0.08	0.08	0.00	23.31	0.09	23.39	0.09
	Sample NAY	0.33	0.03	0.06	0.00	23.72	0.06	23.79	0.06
	Sample NAZ	3.12	0.09	0.21	0.01	7.87	0.03	8.08	0.03
	Sample NAZ	0.30	0.01	0.04	0.00	7.98	0.03	8.02	0.03
	Sample NAZ	0.34	0.08	0.04	0.00	7.95	0.02	7.99	0.02
	Sample NBA	0.21	0.05	0.12	0.00	15.36	0.02	15.48	0.02
	Sample NBA	1.01	0.10	0.17	0.00	15.80	0.03	15.97	0.03
	Sample NBA	0.26	0.05	0.12	0.00	15.47	0.02	15.58	0.02
89									
	Sample NAY	0.69	0.01	0.12	0.01	22.57	0.03	22.68	0.04
	Sample NAY	0.69	0.03	0.11	0.00	22.60	0.16	22.71	0.17
	Sample NAY	1.56	0.24	0.11	0.00	22.49	0.07	22.59	0.07
	Sample NAZ	0.66	0.14	0.09	0.00	7.15	0.01	7.24	0.01
	Sample NAZ	0.84	0.10	0.09	0.00	7.28	0.02	7.37	0.03
	Sample NAZ	0.73	0.02	0.09	0.00	7.24	0.02	7.33	0.02
	Sample NBA	0.64	0.06	0.18	0.01	14.46	0.01	14.64	0.00
	Sample NBA	8.21	0.03	0.39	0.00	18.74	0.03	19.14	0.03
	Sample NBA	0.65	0.01	0.16	0.00	14.30	0.01	14.46	0.01
95									
	Sample NAY	1.67	0.03	0.08	0.00	22.92	0.08	23.00	0.08
	Sample NAY	1.48	0.10	0.06	0.01	23.14	0.07	23.21	0.08
	Sample NAY	1.72	0.10	0.06	0.01	23.08	0.07	23.14	0.06
	Sample NAZ	1.98	0.17	0.06	0.00	8.05	0.05	8.10	0.05
	Sample NAZ	1.77	0.21	0.04	0.01	8.12	0.01	8.16	0.00
	Sample NAZ	7.50	0.10	0.63	0.01	8.96	0.01	9.59	0.03
	Sample NBA	1.40	0.00	0.12	0.01	15.03	0.06	15.15	0.05
	Sample NBA	2.06	0.07	0.13	0.01	15.32	0.07	15.45	0.08
	Sample NBA	2.71	0.20	0.13	0.00	15.07	0.05	15.19	0.05

Lab#	Sample	AMMONIA	ERR	NO2	ERR	NO3	ERR	NOX	ERR
101									
	Sample NAY	1.32	0.02	0.06	0.00	23.19	0.12	23.93	0.15
	Sample NAY	2.03	0.08	0.19	0.00	21.06	1.78	21.82	1.92
	Sample NAY	1.01	0.07	0.09	0.00	20.67	1.18	21.35	1.26
	Sample NAZ	1.12	0.01	0.04	0.00	7.17	0.20	7.41	0.21
	Sample NAZ	1.19	0.02	0.08	0.00	7.77	0.09	8.06	0.13
	Sample NAZ	1.19	0.01	0.07	0.00	7.40	0.27	7.67	0.31
	Sample NBA	2.69	0.08	0.30	0.01	14.19	0.36	14.82	0.51
	Sample NBA	9.62	0.03	0.53	0.00	23.32	0.36	24.38	0.07
	Sample NBA	1.18	0.05	0.13	0.00	14.85	0.07	15.38	0.07
102									
	Sample NAY	0.87				0.05			
	Sample NAZ	0.85				0.02			
	Sample NBA	2.72				0.32			
106									
	Sample NAY	0.29		0.07		25.43		25.50	
	Sample NAY	0.37		0.05		25.43		25.49	
	Sample NAY	0.38		0.05		25.93		25.98	
	Sample NAZ	0.44		0.05		7.95		8.00	
	Sample NAZ	0.43		0.03		8.00		8.04	
	Sample NAZ	0.75		0.08		7.84		7.93	
	Sample NBA	0.40		0.12		14.88		15.00	
	Sample NBA	0.48		0.11		14.93		15.05	
	Sample NBA	0.65		0.10		14.96		15.06	
109									
	Sample NAY	0.68	0.01	0.07	0.00	23.04	0.02	23.12	0.02
	Sample NAZ	0.78	0.01	0.05	0.00	8.28	0.04	8.32	0.04
	Sample NBA	2.72	0.01	0.51	0.00	15.77	0.03	16.28	0.03
112									
	Sample NAY	0.75	0.01	0.06	0.00			23.26	0.02
	Sample NAY	0.60	0.00	0.07	0.00			23.13	0.02
	Sample NAY	0.70	0.01	0.06	0.00			23.35	0.02
	Sample NAZ	0.70	0.01	0.04	0.00			7.95	0.01
	Sample NAZ	0.71	0.01	0.04	0.00			7.95	0.01
	Sample NAZ	0.69	0.01	0.04	0.00			8.07	0.01
	Sample NBA	0.86	0.01	0.15	0.00			15.33	0.02
	Sample NBA	1.18	0.01	0.13	0.00			15.30	0.02
	Sample NBA	0.84	0.01	0.11	0.00			15.14	0.02

Lab#	Sample	AMMONIA	ERR	NO2	ERR	NO3	ERR	NOX	ERR
113									
	Sample NAY	0.73	0.26	0.07	0.01	22.97	0.13	23.02	0.13
	Sample NAZ	0.64	0.26	0.04	0.01	7.90	0.13	7.94	0.13
	Sample NBA	14.97	0.26	0.25	0.01	20.32	0.13	20.56	0.13
124									
	Sample NAY	0.70	0.41	N.D	N.D	23.52	0.21	23.52	0.21
	Sample NAY	0.85	0.60	N.D	N.D	24.02	0.64	24.02	0.64
	Sample NAY	0.29	0.06	N.D	N.D	23.28	0.18	23.28	0.18
	Sample NAZ	0.92	0.24	N.D	N.D	8.33	0.03	8.33	0.03
	Sample NAZ	0.52	0.40	N.D	N.D	8.16	0.01	8.16	0.01
	Sample NAZ	0.93	0.78	N.D	N.D	8.27	0.06	8.27	0.06
	Sample NBA	0.70	0.45	N.D	N.D	15.49	0.00	15.49	0.00
	Sample NBA	6.30	0.63	0.27	0.06	19.37	0.09	19.65	0.06
	Sample NBA	3.24	0.88	N.D	N.D	15.15	0.02	15.15	0.02
125									
	Sample NAY	1.22	0.09	0.08	0.01	23.15	0.10	23.23	0.10
	Sample NAY	1.33	0.09	0.07	0.01	23.26	0.10	23.33	0.10
	Sample NAY	1.30	0.09	0.08	0.01	23.32	0.10	23.39	0.10
	Sample NAZ	0.90	0.09	0.06	0.01	8.16	0.10	8.21	0.10
	Sample NAZ	1.11	0.09	0.06	0.01	8.13	0.10	8.18	0.10
	Sample NAZ	1.07	0.09	0.07	0.01	8.11	0.10	8.17	0.10
	Sample NBA	2.60	0.09	0.18	0.01	15.30	0.10	15.48	0.10
	Sample NBA	0.90	0.09	0.13	0.01	15.31	0.10	15.44	0.10
	Sample NBA	0.98	0.09	0.13	0.01	15.11	0.10	15.23	0.10
129									
	Sample NAY	0.73		0.03		22.46			
	Sample NAY	0.71		0.03		22.25			
	Sample NAY	1.22		0.05		22.47			
	Sample NAZ	0.72		0.01		7.99			
	Sample NAZ	0.71		0.02		7.83			
	Sample NAZ	0.74		0.02		7.79			
	Sample NBA	1.77		0.22		14.58			
	Sample NBA	0.62		0.09		14.50			
	Sample NBA	0.76		0.08		14.57			

Lab#	Sample	AMMONIA	ERR	NO2	ERR	NO3	ERR	NOX	ERR
136									
	Sample NAY	1.15	0.03	-0.01	0.00	23.96	0.14		
	Sample NAY	1.07	0.43	0.00	0.01	23.42	0.09		
	Sample NAY	1.08	0.07	-0.02	0.01	23.88	0.23		
	Sample NAZ	3.25	0.17	0.22	0.01	8.12	0.05		
	Sample NAZ	1.26	0.18	-0.04	0.01	7.88	0.03		
	Sample NAZ	0.93	0.01	-0.04	0.01	8.08	0.12		
	Sample NBA	6.63	0.04	0.24	0.00	16.18	0.12		
	Sample NBA	1.30	0.23	0.05	0.01	15.76	0.12		
	Sample NBA	1.29	0.04	0.04	0.00	15.67	0.12		
137									
	Sample NAY	0.67		0.04		23.42		23.46	
	Sample NAY	0.66		0.04		23.36		23.40	
	Sample NAY	0.67		0.05		23.47		23.51	
	Sample NAZ	0.70		0.02		8.16		8.18	
	Sample NAZ	1.09		0.08		8.29		8.36	
	Sample NAZ	0.57		0.02		8.08		8.11	
	Sample NBA	0.64		0.10		15.17		15.26	
	Sample NBA	1.53		0.16		15.43		15.59	
	Sample NBA	0.77		0.10		15.43		15.53	
138									
	Sample NAY	0.87	0.00	0.08	0.00	23.03	0.02	23.11	0.02
	Sample NAY	0.87	0.00	0.08	0.00	23.13	0.02	23.21	0.02
	Sample NAY	0.89	0.00	0.10	0.00	22.92	0.02	23.02	0.02
	Sample NAZ	0.88	0.00	0.06	0.00	7.98	0.01	8.05	0.01
	Sample NAZ	0.89	0.00	0.05	0.00	8.14	0.01	8.19	0.01
	Sample NAZ	0.97	0.00	0.06	0.00	8.04	0.01	8.10	0.01
	Sample NBA	1.56	0.01	0.15	0.00	14.96	0.02	15.11	0.02
	Sample NBA	2.58	0.01	0.27	0.00	14.99	0.02	15.26	0.02
	Sample NBA	2.34	0.01	0.37	0.00	15.35	0.02	15.72	0.02
141									
	Sample NAY	0.70	0.00						
	Sample NAY	0.66	0.01						
	Sample NAY	0.56	0.02						

Lab#	Sample	AMMONIA	ERR	NO2	ERR	NO3	ERR	NOX	ERR
148									
	Sample NAY	0.55		0.08		23.78		23.86	
	Sample NAY	0.59		0.10		23.82		23.93	
	Sample NAY	0.60		0.11		23.89		23.99	
	Sample NAZ	1.08		0.14		15.49		15.62	
	Sample NAZ	1.58		0.29		16.86		17.16	
	Sample NAZ	0.48		0.14		15.49		15.62	
	Sample NBA	0.56		0.06		8.87		8.92	
	Sample NBA	0.62		0.08		8.50		8.58	
	Sample NBA	0.52		0.05		8.53		8.58	
155									
	Sample NAZ	0.87	0.18						
	Sample NAZ	1.02	0.21						
	Sample NBA	0.76	0.16						

Table KIOST-A4-1 Cross reference table of ranked order and Lab # for Figure KIOST-1

rank	Lab No.	Lab name
1	**149**	Arctic and Antarctic Research Institute, Russia, Russia
2	**90**	Environmental Chemistry Analysis Laboratory (ECAL), University of Portsmouth, UK
3	**118**	Technical University of Denmark, National Institute for Aquatic Resources (AQUA) , Denmark
4	**150**	Marine Environment Analysis Center Korea Marine Environment management Corporation (KOEM), Republic of Korea
5	**57**	NOAA Atlantic Oceanographic and Meteorological Laboratory (AOML), Miami, Florida, USA
6	**38**	Japan Sea National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan, Japan
7	**143**	Instituto de Investigaciones Oceanológicas, Universidad Autónoma de Baja California, USA
8	**107**	Observatoire oceanologique de Villefranche-sur-Mer (CNRS-UPMC), France
9	**101**	National Institute of Fisheries Science (NIFS), Republic of Korea
10	**156**	University of Alaska, Fairbanks, USA
11	**98**	Estonian Marine Institute of Tartu University, Estonia
12	**140**	Plataforma Oceánica de Canarias (PLOCAN) - Oceanic Platform of the Canary Islands, Spain
13	**102**	Stazione Zoologica Anton Dohrn, Italia
14	**27**	Bundesamt für Seeschifffahrt und Hydrographie (BSH), Laboratorium Sülldorf, Germany
15	**40**	National Institute of Water and Atmospheric Research (NIWA), New Zealand
16	**89**	Scottish Environment Protection Agency, UK
17	**49**	National Oceanography Centre, Southampton, UK
18	**14**	Laboratory of Marine Environmental Science, Xiamen University, China
19	**29**	Marine Research Institute, Iceland
20	**155**	IFREMER LERMPL, Nantes, FRANCE, France
21	**10**	University of British Columbia, Department of Earth, Ocean & Atmospheric Sciences, Canada
22	**28**	Alfred-Wegener-Institute Bremerhaven, Germany
23	**56**	Scripps Institution of Oceanography, USA
24	**113**	Scripps Institution of Oceanography, CalCOFI Group, UC San Diego, USA

25	**93**	GEOMAR Helmholtz Center for Ocean Research, Kiel, Germany
26	**88**	Faroe Marine Research Institute, Faroe Islands
27	**138**	Reseach Promotion Group, Mutsu Institute for Oceanography, JAMSTEC, Japan
28	**95**	National Institute of Oceanography, India
29	**109**	KIOST (Korea Institute of Ocean Science & Technology), Republic of Korea
30	**35**	Marine Division, Global Environment and Marine Department, Japan Meteorological Agency, Japan
31	**51**	Marine Scotland - Science, UK
32	**112**	CSIRO, Oceans and Atmosphere, Australia
33	**65**	University of Hawaii at Manoa, Dept. of Oceanography, USA
34	**39**	Royal NIOZ, Netherlands
35	**19**	Ifremer, DYNECO/PELAGOS, Plouzané, France
36	**125**	Bedford Institute of Oceanography, Canada
37	**92**	Station Biologique de Roscoff, Centre national de la recherche scientifique (CNRS) / Université Pierre et Marie Curie, France
38	**137**	Atmosphere and ocean research institute, the University of Tokyo, Japan
39	**124**	Korea Polar Reseach Institute, Republic of Korea
40	**86**	Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS), Italy
41	**8**	Institute of Biology, Rio de Janeiro Federal University (UFRJ), Brazil
42	**41**	Institute of Marine Research, Norway
43	**135**	The Marine Institute, Ireland
44	**153**	CENTRO DE INVESTIGACIONES OCEANOGRÁFICAS E HIDROGRÁFICAS DEL PACÍFICO (CCCP)., Colombia
45	**69**	Oriente University, Oceanographic Institute of Venezuela, Departament of Oceanography. Laboratory of nutritious elements, Venezuela
46	**148**	University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Nutrient Analytical Services Laboratory, USA
47	**59**	Monterey Bay Aquarium Research Institute, USA
48	**91**	Institute of Ocean Sciences, Fisheries and Oceans Canada, Canada
49	**5**	OD NATURE – ECOCHEM, Belgium
50	**23**	The National Center for Scientific Research (CNRS), Mediterranean Institute of Oceanology (MIO), France
51	**106**	Institut de Ciències del Mar (ICM-CSIC), Barcelona, Spain

52	**17**	College of Marine and Environmental Sciences, Tianjin University of Science and Technology, China
53	**26**	Leibniz Institut für Ostseeforschung Warnemünde, Germany
54	**141**	Seikai National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan, Japan

Table KIOST-A4-2 Cross reference table of ranked order and Lab # for Figure KIOST-2

rank	Lab No.	Lab name
1	**90**	Environmental Chemistry Analysis Laboratory (ECAL), University of Portsmouth, UK
2	**57**	NOAA Atlantic Oceanographic and Meteorological Laboratory (AOML), Miami, Florida, USA
3	**101**	National Institute of Fisheries Science (NIFS), Republic of Korea
4	**143**	Instituto de Investigaciones Oceanológicas, Universidad Autónoma de Baja California, USA
5	**107**	Observatoire oceanologique de Villefranche-sur-Mer (CNRS-UPMC), France
6	**156**	University of Alaska, Fairbanks, USA
7	**45**	University of Cape town, Dept of Oceanography, South Africa
8	**129**	Tokyo University of Marine Science and Technology, Japan
9	**89**	Scottish Environment Protection Agency, UK
10	**27**	Bundesamt für Seeschifffahrt und Hydrographie (BSH), Laboratorium Sülldorf, Germany
11	**49**	National Oceanography Centre, Southampton, UK
12	**14**	Laboratory of Marine Environmental Science, Xiamen University, China
13	**155**	IFREMER LERMPL, Nantes, FRANCE, France
14	**10**	University of British Columbia, Department of Earth, Ocean & Atmospheric Sciences, Canada
15	**56**	Scripps Institution of Oceanography, USA
16	**28**	Alfred-Wegener-Institute Bremerhaven, Germany
17	**113**	Scripps Institution of Oceanography, CalCOFI Group, UC San Diego, USA
18	**139**	Hokkaido National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan, Japan
19	**138**	Reseach Promotion Group, Mutsu Institute for Oceanography, JAMSTEC, Japan
20	**93**	GEOMAR Helmholtz Center for Ocean Research, Kiel, Germany
21	**109**	KIOST (Korea Institute of Ocean Science & Technology), Republic of Korea
22	**95**	National Institute of Oceanography, India
23	**51**	Marine Scotland - Science, UK
24	**153**	CENTRO DE INVESTIGACIONES OCEANOGRÁFICAS E HIDROGRÁFICAS DEL PACÍFICO (CCCP)., Colombia

25	**39**	Royal NIOZ, Netherlands
26	**19**	Ifremer, DYNECO/PELAGOS, Plouzané, France
27	**125**	Bedford Institute of Oceanography, Canada
28	**92**	Station Biologique de Roscoff, Centre national de la recherche scientifique (CNRS) / Université Pierre et Marie Curie, France
29	**137**	Atmosphere and ocean research institute, the University of Tokyo, Japan
30	**86**	Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS), Italy
31	**124**	Korea Polar Reseach Institute, Republic of Korea
32	**8**	Institute of Biology, Rio de Janeiro Federal University (UFRJ), Brazil
33	**41**	Institute of Marine Research, Norway
34	**136**	Dalhousie University in Halifax, Canada, Canada
35	**148**	University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Nutrient Analytical Services Laboratory, USA
36	**59**	Monterey Bay Aquarium Research Institute, USA
37	**23**	The National Center for Scientific Research (CNRS), Mediterranean Institute of Oceanology (MIO), France
38	**106**	Institut de Ciències del Mar (ICM-CSIC), Barcelona, Spain
39	**17**	College of Marine and Environmental Sciences, Tianjin University of Science and Technology, China
40	**26**	Leibniz Institut für Ostseeforschung Warnemünde, Germany
41	**141**	Seikai National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan, Japan

Table KIOST-A4-3 Cross reference table of ranked order and Lab # for Figure KIOST-3

rank	Lab No.	Lab name
1	**148**	University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Nutrient Analytical Services Laboratory, USA
2	**139**	Hokkaido National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan, Japan
3	**38**	Japan Sea National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan, Japan
4	**57**	NOAA Atlantic Oceanographic and Meteorological Laboratory (AOML), Miami, Florida, USA
5	**149**	Arctic and Antarctic Research Institute, Russia, Russia
6	**49**	National Oceanography Centre, Southampton, UK
7	**40**	National Institute of Water and Atmospheric Research (NIWA), New Zealand
8	**136**	Dalhousie University in Halifax, Canada, Canada
9	**93**	GEOMAR Helmholtz Center for Ocean Research, Kiel, Germany
10	**26**	Leibniz Institut für Ostseeforschung Warnemünde, Germany
11	**106**	Institut de Ciències del Mar (ICM-CSIC), Barcelona, Spain
12	**10**	University of British Columbia, Department of Earth, Ocean & Atmospheric Sciences, Canada
13	**14**	Laboratory of Marine Environmental Science, Xiamen University, China
14	**137**	Atmosphere and ocean research institute, the University of Tokyo, Japan
15	**41**	Institute of Marine Research, Norway
16	**143**	Instituto de Investigaciones Oceanológicas, Universidad Autónoma de Baja California, USA
17	**39**	Royal NIOZ, Netherlands
18	**56**	Scripps Institution of Oceanography, USA
19	**129**	Tokyo University of Marine Science and Technology, Japan
20	**35**	Marine Division, Global Environment and Marine Department, Japan Meteorological Agency, Japan
21	**112**	CSIRO, Oceans and Atmosphere, Australia
22	**5**	OD NATURE – ECOCHEM, Belgium
23	**95**	National Institute of Oceanography, India
24	**155**	IFREMER LERMPL, Nantes, FRANCE, France
25	**45**	University of Cape town, Dept of Oceanography, South Africa

26	**23**	The National Center for Scientific Research (CNRS), Mediterranean Institute of Oceanology (MIO), France
27	**86**	Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS), Italy
28	**19**	Ifremer, DYNECO/PELAGOS, Plouzané, France
29	**135**	The Marine Institute, Ireland
30	**92**	Station Biologique de Roscoff, Centre national de la recherche scientifique (CNRS) / Université Pierre et Marie Curie, France
31	**125**	Bedford Institute of Oceanography, Canada
32	**141**	Seikai National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan, Japan
33	**107**	Observatoire oceanologique de Villefranche-sur-Mer (CNRS-UPMC), France
34	**29**	Marine Research Institute, Iceland
35	**156**	University of Alaska, Fairbanks, USA
36	**28**	Alfred-Wegener-Institute Bremerhaven, Germany
37	**118**	Technical University of Denmark, National Institute for Aquatic Resources (AQUA) , Denmark
38	**17**	College of Marine and Environmental Sciences, Tianjin University of Science and Technology, China
39	**90**	Environmental Chemistry Analysis Laboratory (ECAL), University of Portsmouth, UK
40	**27**	Bundesamt für Seeschifffahrt und Hydrographie (BSH), Laboratorium Sülldorf, Germany
41	**51**	Marine Scotland - Science, UK
42	**89**	Scottish Environment Protection Agency, UK
43	**113**	Scripps Institution of Oceanography, CalCOFI Group, UC San Diego, USA
44	**59**	Monterey Bay Aquarium Research Institute, USA
45	**138**	Reseach Promotion Group, Mutsu Institute for Oceanography, JAMSTEC, Japan
46	**8**	Institute of Biology, Rio de Janeiro Federal University (UFRJ), Brazil
47	**124**	Korea Polar Reseach Institute, Republic of Korea
48	**102**	Stazione Zoologica Anton Dohrn, Italia
49	**101**	National Institute of Fisheries Science (NIFS), Republic of Korea
50	**153**	CENTRO DE INVESTIGACIONES OCEANOGRÁFICAS E HIDROGRÁFICAS DEL PACÍFICO (CCCP)., Colombia
51	**109**	KIOST (Korea Institute of Ocean Science & Technology), Republic of Korea

Table KIOST-A4-4 Cross reference table of ranked order and Lab # for Figure KIOST-4

rank	Lab No.	Lab name
1	**151**	INSTITUTO OCEANOGRÁFICO DE LA ARMADA (INOCAR), Ecuador
2	**153**	CENTRO DE INVESTIGACIONES OCEANOGRÁFICAS E HIDROGRÁFICAS DEL PACÍFICO (CCCP)., Colombia
3	**57**	NOAA Atlantic Oceanographic and Meteorological Laboratory (AOML), Miami, Florida, USA
4	**101**	National Institute of Fisheries Science (NIFS), Republic of Korea
5	**90**	Environmental Chemistry Analysis Laboratory (ECAL), University of Portsmouth, UK
6	**150**	Marine Environment Analysis Center Korea Marine Environment management Corporation (KOEM), Republic of Korea
7	**149**	Arctic and Antarctic Research Institute, Russia, Russia
8	**125**	Bedford Institute of Oceanography, Canada
9	**41**	Institute of Marine Research, Norway
10	**95**	National Institute of Oceanography, India
11	**136**	Dalhousie University in Halifax, Canada, Canada
12	**114**	LOQyCA – Centro para el estudio de los sistemas marinos (CONICET), Argentina
13	**93**	GEOMAR Helmholtz Center for Ocean Research, Kiel, Germany
14	**26**	Leibniz Institut für Ostseeforschung Warnemünde, Germany
15	**27**	Bundesamt für Seeschifffahrt und Hydrographie (BSH), Laboratorium Sülldorf, Germany
16	**107**	Observatoire oceanologique de Villefranche-sur-Mer (CNRS-UPMC), France
17	**156**	University of Alaska, Fairbanks, USA
18	**10**	University of British Columbia, Department of Earth, Ocean & Atmospheric Sciences, Canada
19	**14**	Laboratory of Marine Environmental Science, Xiamen University, China
20	**45**	University of Cape town, Dept of Oceanography, South Africa
21	**139**	Hokkaido National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan, Japan
22	**113**	Scripps Institution of Oceanography, CalCOFI Group, UC San Diego, USA

23	**37**	Graduate School of Environmental Science, Hokkaido University , Japan
24	**91**	Institute of Ocean Sciences, Fisheries and Oceans Canada, Canada
25	**86**	Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS), Italy
26	**29**	Marine Research Institute, Iceland
27	**135**	The Marine Institute, Ireland
28	**38**	Japan Sea National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan, Japan
29	**65**	University of Hawaii at Manoa, Dept. of Oceanography, USA
30	**109**	KIOST (Korea Institute of Ocean Science & Technology), Republic of Korea
31	**28**	Alfred-Wegener-Institute Bremerhaven, Germany
32	**35**	Marine Division, Global Environment and Marine Department, Japan Meteorological Agency, Japan
33	**155**	IFREMER LERMPL, Nantes, FRANCE, France
34	**51**	Marine Scotland - Science, UK
35	**88**	Faroe Marine Research Institute, Faroe Islands
36	**92**	Station Biologique de Roscoff, Centre national de la recherche scientifique (CNRS) / Université Pierre et Marie Curie, France
37	**112**	CSIRO, Oceans and Atmosphere, Australia
38	**118**	Technical University of Denmark, National Institute for Aquatic Resources (AQUA) , Denmark
39	**140**	Plataforma Oceánica de Canarias (PLOCAN) - Oceanic Platform of the Canary Islands, Spain
40	**124**	Korea Polar Reseach Institute, Republic of Korea
41	**19**	Ifremer, DYNECO/PELAGOS, Plouzané, France
42	**138**	Reseach Promotion Group, Mutsu Institute for Oceanography, JAMSTEC, Japan
43	**8**	Institute of Biology, Rio de Janeiro Federal University (UFRJ), Brazil
44	**56**	Scripps Institution of Oceanography, USA
45	**137**	Atmosphere and ocean research institute, the University of Tokyo, Japan
46	**148**	University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Nutrient Analytical Services Laboratory, USA
47	**39**	Royal NIOZ, Netherlands
48	**129**	Tokyo University of Marine Science and Technology, Japan

49	**143**	Instituto de Investigaciones Oceanológicas, Universidad Autónoma de Baja California, USA
50	**59**	Monterey Bay Aquarium Research Institute, USA
51	**5**	OD NATURE – ECOCHEM, Belgium
52	**106**	Institut de Ciències del Mar (ICM-CSIC), Barcelona, Spain
53	**23**	The National Center for Scientific Research (CNRS), Mediterranean Institute of Oceanology (MIO), France
54	**102**	Stazione Zoologica Anton Dohrn, Italia
55	**17**	College of Marine and Environmental Sciences, Tianjin University of Science and Technology, China
56	**89**	Scottish Environment Protection Agency, UK
57	**98**	Estonian Marine Institute of Tartu University, Estonia
58	**141**	Seikai National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan, Japan

Table KIOST-A4-5 Cross reference table of ranked order and Lab # for Figure KIOST-5

rank	Lab No.	Lab name
1	**151**	INSTITUTO OCEANOGRÁFICO DE LA ARMADA (INOCAR), Ecuador
2	**80**	Instituto del Mar del Perú, Peru
3	**98**	Estonian Marine Institute of Tartu University, Estonia
4	**17**	College of Marine and Environmental Sciences, Tianjin University of Science and Technology, China
5	**89**	Scottish Environment Protection Agency, UK
6	**101**	National Institute of Fisheries Science (NIFS), Republic of Korea
7	**149**	Arctic and Antarctic Research Institute, Russia, Russia
8	**29**	Marine Research Institute, Iceland
9	**57**	NOAA Atlantic Oceanographic and Meteorological Laboratory (AOML), Miami, Florida, USA
10	**90**	Environmental Chemistry Analysis Laboratory (ECAL), University of Portsmouth, UK
11	**150**	Marine Environment Analysis Center Korea Marine Environment management Corporation (KOEM), Republic of Korea
12	**88**	Faroe Marine Research Institute, Faroe Islands
13	**23**	The National Center for Scientific Research (CNRS), Mediterranean Institute of Oceanology (MIO), France
14	**118**	Technical University of Denmark, National Institute for Aquatic Resources (AQUA) , Denmark
15	**38**	Japan Sea National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan, Japan
16	**107**	Observatoire oceanologique de Villefranche-sur-Mer (CNRS-UPMC), France
17	**45**	University of Cape town, Dept of Oceanography, South Africa
18	**28**	Alfred-Wegener-Institute Bremerhaven, Germany
19	**8**	Institute of Biology, Rio de Janeiro Federal University (UFRJ), Brazil
20	**41**	Institute of Marine Research, Norway
21	**129**	Tokyo University of Marine Science and Technology, Japan
22	**40**	National Institute of Water and Atmospheric Research (NIWA), New Zealand
23	**51**	Marine Scotland - Science, UK
24	**139**	Hokkaido National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan, Japan

25	**56**	Scripps Institution of Oceanography, USA
26	**95**	National Institute of Oceanography, India
27	**59**	Monterey Bay Aquarium Research Institute, USA
28	**93**	GEOMAR Helmholtz Center for Ocean Research, Kiel, Germany
29	**153**	CENTRO DE INVESTIGACIONES OCEANOGRÁFICAS E HIDROGRÁFICAS DEL PACÍFICO (CCCP)., Colombia
30	**125**	Bedford Institute of Oceanography, Canada
31	**27**	Bundesamt für Seeschifffahrt und Hydrographie (BSH), Laboratorium Sülldorf, Germany
32	**135**	The Marine Institute, Ireland
33	**49**	National Oceanography Centre, Southampton, UK
34	**155**	IFREMER LERMPL, Nantes, FRANCE, France
35	**148**	University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Nutrient Analytical Services Laboratory, USA
36	**65**	University of Hawaii at Manoa, Dept. of Oceanography, USA
37	**156**	University of Alaska, Fairbanks, USA
38	**26**	Leibniz Institut für Ostseeforschung Warnemünde, Germany
39	**140**	Plataforma Oceánica de Canarias (PLOCAN) - Oceanic Platform of the Canary Islands, Spain
40	**35**	Marine Division, Global Environment and Marine Department, Japan Meteorological Agency, Japan
41	**124**	Korea Polar Reseach Institute, Republic of Korea
42	**138**	Reseach Promotion Group, Mutsu Institute for Oceanography, JAMSTEC, Japan
43	**14**	Laboratory of Marine Environmental Science, Xiamen University, China
44	**39**	Royal NIOZ, Netherlands
45	**10**	University of British Columbia, Department of Earth, Ocean & Atmospheric Sciences, Canada
46	**91**	Institute of Ocean Sciences, Fisheries and Oceans Canada, Canada
47	**112**	CSIRO, Oceans and Atmosphere, Australia
48	**19**	Ifremer, DYNECO/PELAGOS, Plouzané, France
49	**5**	OD NATURE – ECOCHEM, Belgium
50	**113**	Scripps Institution of Oceanography, CalCOFI Group, UC San Diego, USA
51	**137**	Atmosphere and ocean research institute, the University of Tokyo, Japan

52	**92**	Station Biologique de Roscoff, Centre national de la recherche scientifique (CNRS) / Université Pierre et Marie Curie, France
53	**86**	Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS), Italy
54	**136**	Dalhousie University in Halifax, Canada, Canada
55	**109**	KIOST (Korea Institute of Ocean Science & Technology), Republic of Korea
56	**102**	Stazione Zoologica Anton Dohrn, Italia
57	**106**	Institut de Ciències del Mar (ICM-CSIC), Barcelona, Spain
58	**141**	Seikai National Fisheries Research Institute, Japan Fisheries Research and Education Agency, Japan, Japan

Appendix VI

History of the inter-comparison studies

History of the Inter-comparison studies

This history of the nutrient inter-laboratory comparison study is based on several reports of previous intercomparison exercises. The histories of the first to fourth ICES exercises were derived from Aminot and Kirkwood's (1995) detailed report of the fifth ICES intercomparison, which includes histories of the first four ICES exercises. Histories of the fifth ICES exercise, the first and second NOAA/NRC inter-laboratory comparison study, and MRI 2003, 2006, 2008, and 2012 intercomparisons are also summarized in this appendix.

1. First ICES Exercise

The first inter-calibration to include nutrients was an entirely Baltic affair in June 1965, when three research vessels met by private agreement in Copenhagen:

Aranda	Institute of Marine Research (IMR), Helsinki
Hermann Wattenberg	Institut für Meereskunde, Kiel
Skagerak	Royal Fishery Board, Gothenburg

Each ship contributed freshly collected bulk samples to the experiment, which were sub-sampled and analyzed onboard each of the three participating ships on the same day. Oxygen, salinity, chlorinity, alkalinity, and phosphate were determined.

2. Second ICES Exercise

The second ICES exercise, which was carried out in 1966 under the auspices of the newly formed ICES Working Group on the Intercalibration of Chemical Methods, was still predominantly a Baltic initiative and consisted of two parts: Part I, Leningrad, during the 5th Conference of Baltic Oceanographers; and Part II, Copenhagen, at the 54th ICES Statutory Meeting.

Part I, Leningrad (May 1966)

The participating research vessels were the following:

Alkor	Institut für Meereskunde, Kiel
Okeanograf	Institute of Marine Research, Leningrad
Prof Otto Krammel	Institut für Meereskunde, Warnemünde
Skagerak	Fisheries Board of Sweden, Gothenburg

The research vessels delivered bulk samples, which were subsampled and analyzed almost immediately for oxygen, salinity, chlorinity, pH, and phosphate.

Part II, Copenhagen (September 1966)

The list of interested parties continued to grow and, in addition to Baltic countries, Norway and the UK were represented. Research vessels delivered bulk samples, and the various participants analyzed samples simultaneously in Copenhagen. The determinants of primary interest included not only oxygen, salinity, chlorinity, and phosphate, as in Part I (Leningrad) and the previous year's exercise (Copenhagen, 1965), but also nitrate, nitrite, and silicate.

The final report, edited by Grasshoff (UNESCO, 1966), makes no mention of nitrate or nitrite, but some of those who were present confessed that these results were "too terrible to be included". To be fair to those involved, 1966 was an early time in the development of heterogeneous cadmium-based nitrate/nitrite reduction techniques, and some of the associated problems were presumably not fully appreciated at the time.

Evidently nitrate analysis had some way to go to achieve the reliability and ease of operation of the Murphy and Riley (1962) phosphate technique, but it is worth noting that intercomparison work on phosphate so far had consisted of simultaneous analysis of freshly obtained subsamples by a small number of highly competent workers, in close contact with each other, exchanging calibration solutions, ideas, technical details, etc. Subsequent to the Copenhagen trial, Jones and Folkard (ICES, 1966) undertook a detailed laboratory examination of the individual methods used by the participants and, in their contribution to Grasshoff's report, they announced, "There seems to be no need for any further intercalibration in the determination of inorganic phosphate by this method."

Clearly this happy state of affairs could not and did not last. Along came the autoanalyzer!

3. Third ICES Exercise

The third ICES exercise was organized by the ICES Working Group on Chemical Analysis of Sea Water under the joint auspices of ICES and SCOR and its official title, "The International Intercalibration Exercise for Nutrient Methods2" shows that it set out to be an ambitious project.

Samples were distributed in 1969–1970, and 45 laboratories from 20 countries submitted results, but the final report on the results of the exercise was not published for several years (ICES, 1977).

The time had come to study "nutrients" separately from oxygen, salinity, chlorinity, and pH, but with the awareness of problems arising from the instability of natural seawater samples, the organizers chose to use standard solutions that were prepared and distributed by the Sagami Chemical Research Center, Japan. [*Note added by Aoyama*: The standard solutions used in this exercise were Cooperative Survey of Kuroshio (CSK) standards, which are solutions in artificial seawater for nitrate, phosphate, and silicate and in pure water for nitrite.]

In this exercise, participants performed the analyses in their own laboratories but, despite being supplied (knowingly) with appropriate blank solutions for each determination, the overall accuracy, particularly for phosphate and nitrate, was disappointing.

The report concludes, "As methods did not diverge much, it is clear that variations must be sought primarily in the standardization procedures. The results will also aid participants in re-evaluating their analytical procedures by comparison of their methods with those that appear most satisfactory from this exercise".

The names of the participating laboratories were listed, as were the tables of results, but it was not possible to link them together. Hindsight suggests that this may have been counterproductive; we now suspect that there is no greater incentive for a laboratory to improve its performance than the knowledge that peer laboratories throughout the world are aware that it is producing poor quality data.

4. Fourth ICES Exercise

Various "workshop" and multi-ship events following the ICES/SCOR exercise included nutrient studies, but it was many years later (1988) that the ICES Marine Chemistry Working Group produced volunteers (Don Kirkwood, Alain Aminot, and Matti Perttilä) to organize the next large-scale intercalibration exercise, designated "NUTS I/C 4". This exercise did not set out to be worldwide. It began only with laboratories in ICES Member Countries, but other laboratories that were interested in participating were not turned away.

The fourth exercise differed from the third exercise in three important respects.

1) The test samples were natural or near-natural seawater rather than standard solutions. (Strictly speaking, this made the exercise an intercomparison rather than an intercalibration.)

2) Participants were unaware that "blank" samples were included.

3) Anonymity was abolished. Participants were made aware from the outset that the final report would list identities of laboratories, results, and a means for any reader to contact them.

Sixty-nine laboratories from 22 countries submitted results and, thanks in some measure to the telefax machine, the final 83-page report (Kirkwood *et al.*, 1991) was in the hands of participants within two years of the distribution of samples. Statistical treatment identified 58 laboratories consistent in phosphate analysis, 51 consistent in nitrate analysis, and 48 consistent in both phosphate and nitrate analysis, including a group of 12 whose results were especially close to the consensus concentrations.

5. Fifth ICES Exercise

Due to the generally perceived need for more and better quality control in analytical measurement, a fifth ICES intercomparison exercise was carried out in 1993. A total of 142 sets of samples were distributed in 31 countries. Results were returned by 132 laboratories, 61 of which had participated in the fourth intercomparison and 56 of which were participating in QUASIMEME (Quality Assurance of Information for Marine Environmental Monitoring in Europe).

The distribution of laboratories was as follows:

UK (22), Germany (18), Sweden (13), France (11), Spain (8), USA (7), Norway (5), Ireland (5), Australia (4) Canada (4), Netherlands (4), Denmark (3), Greece (3), Portugal (3), Belgium (2), Estonia (2), Finland (2), Italy (2), Poland (2), Argentina (1), Bermuda (1), China (1), Faroe Islands (1), Iceland (1), Japan (1), Latvia (1), Lithuania (1), New Zealand (1), Qatar (1), South Africa (1), Turkey (1).

The method of sample preparation and autoclaving for the fifth intercomparison imposed constraints that resulted in there being only two relevant determinants per sample (nitrate and nitrite in one series, and phosphate and ammonia in the other series).

A large volume of low-nutrient natural seawater was spiked with known concentrations of nutrient salts. Although the concentrations in the distributed samples covered a greater concentration range than in the fourth intercomparison, the concentrations were representative of the Atlantic Ocean, 1–26 μmol L^{-1} for nitrate and 0.08–1.85 μmol L^{-1} for phosphate.

There have been no further ICES intercomparison exercises since 1993.

6. QUASIMEME

The European Union (EU) supported the QUASIMEME project between 1993 and 1995. Its aim was to develop a holistic quality assurance program for marine environmental monitoring information in Europe. As a result of this pioneering project, marine network and laboratory performance studies have been established for most of the determinants measured in the marine environmental programs for both monitoring and research purposes. The nutrient part of QUASIMEME was entirely based on the groundbreaking work of ICES experts, and the principles and methodology of ICES IC study were used. The project proved that laboratories that followed on a regular basis the learning programs and the laboratory testing schemes improved the quality of their data. After EU funding was ended in 1995, the QUASIMEME scheme continued on a subscription basis. Now it became possible for any laboratory worldwide to participate. QUASIMEME results have been used to assess the quality of data submitted to the marine conventions for the purpose of assessing the quality of the marine environment.

7. 2000 NOAA/NRC Intercomparison

The test material distributed in this intercomparison was MOOS-1, a certified

reference material for nutrients in seawater (Clancy and Willie, 2004). The sample material was intended to be a certified reference material for silicate, phosphate, nitrite, and nitrate+nitrite. Participating laboratories were each sent two bottles of MOOS-1 and asked to perform duplicate analyses on each of the bottles. The prepared samples were sent to 36 participating laboratories. Thirty sets of results were returned.

The results of this intercomparison may, in several respects, have been compromised by sample homogeneity problems. The target standard deviation for measuring *p*-scores was too broad and did not reflect the measurement precision that could be attained at the time.

8. 2002 NOAA/NRC Intercomparison

A further intercomparison exercise was undertaken to assess the current capabilities of a group of laboratories to quantitate orthophosphate, silicate, nitrite, and nitrite+nitrate in a seawater sample. This was the second such exercise sponsored by the NOAA Center for Coastal Monitoring and Assessment (CCMA) and coordinated by the Institute for National Measurement Standards of the National Research Council of Canada. Two seawater samples—one from Pensacola Sound, FL, and the other MOOS-1—were distributed to 31 laboratories.

Twenty-four laboratories submitted data. Methodologies were not prescribed to the participants; however, all reported results were obtained using traditional colorimetric procedures. Generally, satisfactory agreement among participants was achieved, with results within 10% of the assigned mean values.

The results from this exercise suggested that the homogeneity problem identified in the first NOAA/NRC intercomparison exercise was overcome, although the orthophosphate data indicated a larger inter-laboratory spread of results than expected.

Results for silicate, nitrite, and nitrite+nitrate in the distributed seawater samples were acceptable for the majority of the participants and generally deviated by less than ±10% from the assigned mean. All laboratories used methodologies based on colorimetric principles.

9. 2003 MRI Intercomparison

Autoclaved natural seawater was prepared as inter-laboratory comparison study samples. Sample homogeneity was confirmed by repeatability of measurements. Sets of 6 samples covering a concentration range greater than that in any previous inter-laboratory comparison study were distributed. The concentrations were 0–38 μmol kg^{-1} for nitrate, 0–0.9 μmol kg^{-1} for nitrite, 0–2.7 μmol kg^{-1} for phosphate, and 0–136 μmol kg^{-1} for silicate. A total of 18 sets of samples were distributed to 18 laboratories in 5 countries. Results were returned by 17 laboratories in 5 countries. Although consensus concentrations were obtained for the 6 samples, the standard deviations were 4.5 times and more than 10 times greater than those of the homogeneities for phosphate and silicate, respectively. For nitrate, the standard deviations were only about double the homogeneities. These results indicated that variability of in-house standards of the

participating laboratories, rather than analytical precision, was the primary source of inter-laboratory discrepancies. Therefore, use of a certified RMNS was essential for establishing nutrient datasets that could be compared across laboratories, especially for silicate and phosphate.

10. 2006 MRI Intercomparison

Autoclaved natural seawater was used for an inter-laboratory comparison study of a reference material for nutrients in seawater in 2006, similar to the 2003 intercomparison exercise. Sample homogeneity was confirmed by repeatability of measurements. Homogeneities for nitrate, phosphate, and silicate were 0.2%, 0.3%, and 0.2%, respectively. Sets of 6 samples covering a concentration range of 0.1–42.4 μmol kg^{-1} for nitrate, 0.0–0.6 μmol kg^{-1} for nitrite, 0.0–3.0 μmol kg^{-1} for phosphate, and 1.7–156.1 μmol kg^{-1} for silicate were prepared. A total of 55 sets of samples were distributed to 55 laboratories in 20 countries. Results were returned by 52 laboratories from 19 countries.

11. 2008 MRI Intercomparison

Autoclaved natural seawater was used for the next inter-laboratory comparison study of a reference material for nutrients in seawater in 2008, just as in 2003 and 2006. A total of 58 sets of samples were distributed to 58 laboratories in 20 countries. Results were returned by 52 laboratories from 19 countries.

Two of 6 samples used in the 2008 I/C study were the same lots as used in the 2006 I/C study. Therefore, we could see the internal comparability at each laboratory that participated in both the 2006 and 2008 studies as well as the international comparability of the nutrient data among the participating laboratories.

12. 2012 MRI Intercomparison

Autoclaved natural seawater was used for the next inter-laboratory comparison study of a reference material for nutrients in seawater in 2012, just as in 2003, 2006, and 2008. A total of 69 sets of samples were distributed to 69 laboratories in 28 countries. Results were returned by 67 laboratories in 28 countries.

Sample #1 used in the 2012 I/C study came from the same lots used in the 2006 and 2008 I/C study. Sample #2 used in the 2012 I/C study came from the same lots used in the 2006 I/C study, and sample #3 used in the 2012 I/C study came from the same lots used in the 2008 I/C study. Therefore, we could see the internal comparability at each laboratory that participated in the previous I/C studies as well as the international comparability of the nutrient data among the participating laboratories.

Results of internal comparability showed that our community had good internal comparability, but less external comparability.

13. IOCCP-JAMSTEC 2015 Inter-laboratory Calibration Exercise of a Certified Reference Material for Nutrients in Seawater

In 2014, IOCCP and JAMSTEC co-organized an inter-laboratory calibration exercise of nutrients in seawater using four lots of recently certified RM produced by KANSO. A former RMNS produced by KANSO had already shown an excellent homogeneity of 0.2 %, and the concentrations of nitrate, phosphate, and silicate did not change more than 1.0 % during 6.4 years. By the criterion of ISO Guide 35:2006, there was no instability of the RM nutrient concentrations (Aoyama et al., 2012). Three CRMs provided by the National Metrology Institute of Japan were certified in March 2014.

The Korean Institute of Ocean Science and Technology, KIOST, also offered to provide their recently developed RMs to this I/C exercise. In addition, the Royal Netherlands Institute for Sea Research, NIOZ, offered to provide silicate stock solution to contribute to the overall assessment of results from this I/C exercise.

A set of four samples of CRMs was distributed to all 71 participating laboratories around the globe (28 countries) at no charge, and some combination of three lots of NMIJ CRM were distributed to 21 laboratories, which agreed to pay for them. Korean RMs were also distributed to 24 voluntary laboratories that agreed to analyze them. NIOZ stock solutions were sent to selected laboratories that were working on deep-water samples and agreed to analyze the silicate stock solution.

Seventy-one laboratories in 28 countries replied to the call for participants. Results were returned from 58 laboratories.

In general, the normalized cumulative distributions for nitrate and silicate were quite similar. The magnitudes of comparability during these three I/C studies were thus similar. Those for phosphate were relatively flat, an indication that comparability was better for phosphate analysis than for the other nutrients.

There are good signs in the results that although consensus standard deviations were relatively large, the consensus median/mean of each sample showed good agreement, with certified values of the samples within consensus SDs. This implies that the majority of the participating laboratories had good capability to measure nutrient concentration in seawater, and the use of CRM will further increase the comparability of results. The results may be SI traceable in the near future.

Results of this IC indicated that non-linearity of the calibration curves for nutrient analysis was a significant source of reduced comparability of nutrient data. This implies that we need to use a set of nutrient CRMs the concentrations of which cover the whole range of nutrient concentrations in seawater to maintain comparability of nutrients concentrations measured anywhere in the world's oceans.

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