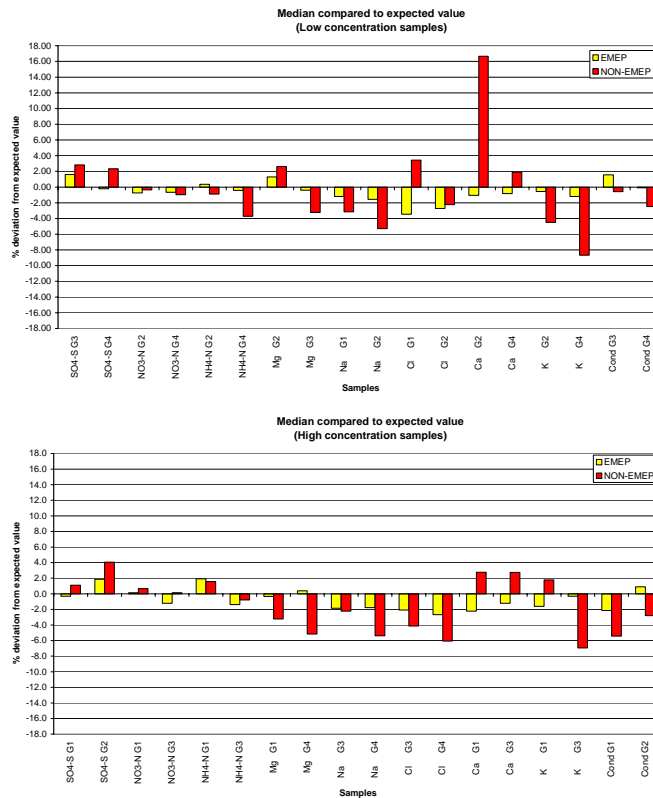


The twenty-first intercomparison of analytical methods within EMEP

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Jan Schaug and Anne-Gunn Hjellbrekke



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**EMEP Co-operative Programme for Monitoring and Evaluation
of the Long-range Transmission of Air Pollutants
in Europe**

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analytical methods within EMEP**

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The twenty-first intercomparison of analytical methods within EMEP

1. Introduction

36 different laboratories in European countries are performing chemical analysis of air and precipitation samples within EMEP (Co-operative Programme for Monitoring and Evaluation of Long-range Transmission of Air Pollutants in Europe). Since the measurement programme is based on individual national networks, the participating laboratories apply different sampling and analytical methods. Most of the methods used are described in the manual for sampling and chemical analysis (EMEP, 1996).

In order to improve the data comparability and to get a picture of the different laboratories' performance, interlaboratory comparisons are organised by the Chemical Co-ordinating Centre (CCC) at the Norwegian Institute for Air Research (NILU). So far twenty-one intercomparisons have been arranged (Hanssen, 1988, 1990; Hanssen et al., 1983; Hanssen and Ladegård, 1984, 1985, 1987; Hanssen and Skjelmoen, 1992, 1994, 1995, 1996, 1997, 2001; Thrane, 1978, 1980a, 1980b, 1981, Uggerud et al., 2001, 2002, 2003).

Since 2000 the laboratory intercomparisons within EMEP have also been open for participation of laboratories from other networks.

This report gives the results of the twenty-first interlaboratory test.

2. Organisation of the intercomparison

The samples for the twenty-first intercomparison (see Table 2) were prepared and distributed to 68 laboratories in July 2003.

Most of the laboratories had returned their results to the CCC within one month after the deadline given as 15 October 2003. A total of 56 laboratories have returned their results. This includes 32 EMEP-laboratories.

The participating laboratories received the theoretical (expected) values by e-mail 26.11.2003. The laboratories were given the opportunity to compare their results with the expected ones, and give corrected values if obvious mistakes e.g. misprints had occurred. A few corrections were reported. In those cases the corrected values are used in this report. In accordance with the decision of the Steering Body of EMEP, the results are presented in such a way that the different laboratories are identified. Tables 3a and 3b give the names of the participating laboratories together with the numbers used when presenting the results in tables and figures.

Information received on the analytical methods used is given in Tables 4–7.

3. Data handling

The data reported from the participants are presented in Tables 9, 11, 13, 15, 17 and 19–30.

3.1 Data analysis

The reported values are presented in the tables in decreasing order together with the number of the laboratory. The expected (theoretical) value, the number of results, the arithmetic mean value, the median, the standard deviation and the relative standard deviation in percent are also given. After the first statistical run with all results included, the calculation was repeated with the outliers excluded. The outliers (unused) are defined as the results more than two standard deviations from the mean value in the first run.

The ratio between expected values (theoretical) to reported values, the ratio between measured to calculated conductivity and the ratio between equivalent concentrations of anions to equivalent concentrations cations, are presented in tables.

3.2 Bar plots

Bar-plots are used for the graphical presentation of the data. Figures 2–16 are showing the relative deviation from expected value for the different laboratories. There is one plot for each single sample.

Figure 17 gives median compared to expected value for the results reported by EMEP-laboratories and the other participating laboratories, respectively.

3.3 Youden plot

The Youden plot is a graphical method to analyse inter-laboratory data where the samples are ordered in pairs with similar concentrations. One plot is made for each pair of samples and gives results for all participating laboratories. The plots visualize both systematic and random errors.

The plot is drawn as a scatter plot where each point represents a pair of concentrations for one laboratory. The expected values for the two samples are drawn as solid blue lines. The arithmetic average of the measured values excluding outliers are drawn as dotted lines. The solid lines divide the plot in four quadrants and a 45° reference line going through the intercept of the solid lines may be added.

If errors are due to random factors, the points will be evenly distributed around the mean value and situated in all four quadrants.

If systematic errors dominate, the results will be close to 45° reference line, and be situated in the upper right quadrant (overestimation) or lower left quadrant (underestimation).

Drawing a line from a given point perpendicular on the 45° reference line gives two line segments, one from the point to the intercept on the reference line (a),

and one continuing from the intercept to the point representing the expected values (b). The lengths of these line segments are measures of the random and systematic errors respectively.

Ellipses with radii corresponding to the data quality objectives (DQO, Table 1) are added in each plot. The data points are colour coded depending on the magnitude of errors as given in Table 1. Arrows indicate point outside the plot area.

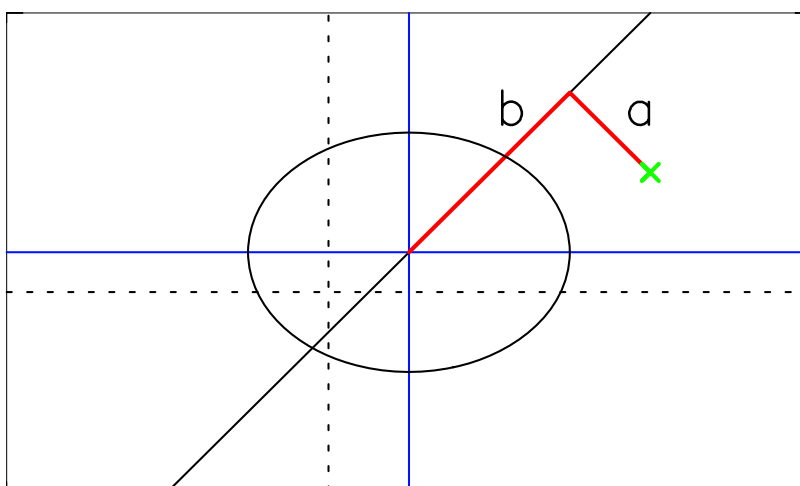


Figure 1: Youden plot showing concentrations for a pair of samples (green), expected values (blue lines), average of measured values (dotted lines) and random and systematic errors (red lines)

In Figures 18–33 the reported data are presented in Youden plots.

Table 1: Youden plot parameters.

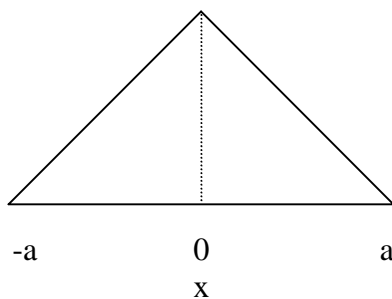
Radii	Components
10%	SO ₂ in abs.sol, NO ₂ in abs.sol.
20%	SO ₂ , HNO ₃ and NH ₃ in impregnated filter
Radii = DQO	Components
10% accuracy or better	SO ₄ ²⁻ -S, NO ₃ ⁻ -N
15% accuracy or better	NH ₄ ⁺ , Cl ⁻ , Ca ²⁺ , K ⁺ , Mg ²⁺ , Na ⁺ , cond
0.1 units	pH
Criteria	Colour
Within 0.5*DQO	Blue
Within DQO	Green
Within 2*DQO	Orange
> 2*DQO	Red

3.4 Estimating random and systematic errors from laboratory comparisons

Table 35 presents relative random and relative systematic errors obtained by the different laboratories in the analysis of each parameter in the precipitation samples. The calculation method and assumptions used are given in Chapter 3.4.1 and Chapter 3.4.2.

3.4.1 Estimating random errors

Systematic errors or bias in the laboratory analyses give a constant shift in the results from the expected ones at a particular concentration level. It is assumed that laboratories taking part in comparisons will obtain results near the expected ones when this bias is removed, and that the differences between expected and obtained results more often will be close to zero than not. A triangular distribution, based upon this assumption, can be used to quantify the random errors in the laboratory results (Eurachem, 2000).



The triangle distribution is symmetric with a baseline $2a$. The height in the triangle will be $1/a$ when the triangle area equals 1. The standard uncertainty is given by

$$u(x) = \frac{a}{\sqrt{6}} \quad (1)$$

and more than 95 % of the data will be within $\pm 2 \cdot u(x)$. The distance from $-a$ to a (i.e. $2a$) is called the range. When applied on the laboratory comparison results, the range equals the distance between the largest and smallest of the four differences between expected and found concentrations. As long as the bias can be assumed to be constant for the samples in the comparison of a specific component, it cannot have an effect on the distance corresponding to $2a$. The bias may be dependent upon the concentrations, but can be considered approximate constant for the concentrations used here in the comparison of the main components in precipitation, since the differences between the concentrations are small.

L and T represent the laboratories' and the expected concentrations respectively, and D is the difference. The difference for the lowest concentration is

$$D_1 = L_1 - T_1 \quad (2)$$

and the differences are D_1, D_2, D_3, D_4 in increasing order.

The range is $D_4 - D_1$ and the standard uncertainty for the differences $u(D)$ becomes

$$u(D) = \frac{(D_4 - D_1)}{(2 \cdot \sqrt{6})}. \quad (3)$$

The average expected concentration T for the four samples is given by

$$T = \frac{(T_1 + T_2 + T_3 + T_4)}{4} \quad (4)$$

The relative standard uncertainty, RSD, for 4 samples is given by $\frac{u(D)}{T}$, or

$$RSD = \frac{2 \cdot (D_4 - D_1 \cdot 100)}{\sqrt{6} \cdot (T_1 + T_2 + T_3 + T_4)} \%, \quad (5)$$

and 95 per cent of the laboratory results in this comparison are expected to be within $\pm 2 \cdot RSD$.

If the data quality objectives (DQO) likewise are looked upon as 95 percentiles, then 95 per cent of the laboratory analytical results should not be more than 10 or 15 per cent from the correct values (10 per cent for S and N containing components and 15 per cent for other components).

Correspondingly, the values $2 \cdot RSD$ should therefore be less than 10 or 15 per cent in order to comply with the DQO.

3.4.2 Estimating systematic errors

An estimation of bias in single measurements requires a long data series, and four samples as we normally have in laboratory comparison, are merely able to give an indication of the bias or a very coarse estimate.

Coarse estimates have been performed here in the cases where the four samples had similar concentrations and where all four laboratory results were either higher or lower than the expected concentrations. The median of the differences D_i , as defined above, was taken as a measure of the bias, B , in these cases.

$$B = \text{median}[D_i] \quad (6)$$

A relative bias, RB , was also calculated based upon the average expected concentration T , as defined in (4).

$$RB = \frac{4 \cdot \text{median}[D_i] \cdot 100}{(T_1 + T_2 + T_3 + T_4)} \% \quad (7)$$

4. Results

4.1 Sulphur dioxide in absorbing solution (A-samples)

Four samples and one blank solution were distributed to the laboratories that use the hydrogen peroxide absorption solution method. The results are given in Table 9, Figures 2 and 18. For those laboratories that reported a blank value this has been subtracted from the reported results. The ratios of measured value to expected value are presented in Table 10.

The sulphate concentration in the sample solutions correspond to a SO₂ concentration in air of 2.70–6.79 µg S m⁻³, when 70 ml absorbing solution and 3.6 m³ sampling volume is used.

Only 5 laboratories have reported values for SO₂ in absorbing solution.

4.2 Sulphur dioxide and nitric acid on impregnated filter (B-samples)

Five impregnated filter samples (including one blank) for determination of sulphur dioxide were analysed by 19 laboratories. The value reported for the blank filter was subtracted from the other values before the data were used.

The amount of sulphur on the distributed filters corresponds to air concentrations between 0.80-2.56 µg S m⁻³ when 25 m³ is sampled.

In addition to sulphur dioxide, nitric acid was added to the same impregnated filters for determination of HNO₃-N. The value reported for the blank filter was subtracted from the other values before using the data.

The amount of nitrogen on the distributed filters corresponds to air concentrations between 0.39 µg N m⁻³–1.37 µg N m⁻³ when 25 m³ sampling volume is used.

Sulphur dioxide results show prevalence of systematic versus random errors. The systematic error is most clearly for the low concentration samples.

Nitric acid on impregnated filters shows good agreement with expected values. Few outliers are reported and most results are within the 10% of expected value.

The results are presented in Tables 11 and 13 and Figures 3, 4, 19 and 20.

4.3 Nitrogen dioxide in absorbing solution (C-samples)

The four samples distributed were made to represent both absorption solutions and extracts from iodide-impregnated glass filters. The samples contain known amounts of sodium nitrite diluted in water. In order to assure sample stability and to give the laboratories the opportunity to use the matrix they use in their daily routine, the distributed samples were to be diluted 1:10. The results should be reported as the diluted concentrations.

The 10 times diluted samples correspond to air concentrations between 3.4-6.75 µg NO₂-N m⁻³, when 70 ml absorbing solution and 1.4 m³ are used. If

4 ml extraction solution and 0.7 m³ sampling volume are used, the samples correspond to air concentrations between 0.39-0.77 µg NO₂-N m⁻³.

Nitrogen dioxide in absorbing solution shows good agreement with expected values. Few outliers are reported and most results are within the 10% of expected value. The Youden plots show prevalence of systematic error versus random error.

The results are presented in Table 14 and Figures 5 and 21.

4.4 Ammonia on impregnated filters (J-samples)

For the second time impregnated filters for determination of ammonia were distributed. Six impregnated filters inclusive two unidentified blank filters were sent to 21 laboratories. 19 laboratories have reported their analytical results. The two blank values reported by each laboratory were averaged and subtracted from the other values reported before the data were used. The results are shown in Table 17 and Figures 6 and 22.

The amount of nitrogen on the filters correspond to air concentrations between 0.30-1.52 µg N m⁻³, if 25 m³ sampling volume is used.

Several reported values are more than 20% away from expected value. Youden plot shows that for the low concentration filters a considerable number of random errors are present. For the high concentration filters several results are biased low.

4.5 Precipitation (G-samples)

Four precipitation samples were distributed and 2748 single results from 56 laboratories were reported. 109 results were identified as outliers. This is ~4% of the data, which is about the same as obtained last year. It should be noted that 47% of the outliers are caused by only four laboratories, which report more than 10 outliers each. The results are presented in Tables 19–30 and Figures 7–16 and 23–33.

4.5.1 Conductivity and ion balance

In EMEP, conductivity measurements are mainly used for quality control reasons. When all the main ions in the precipitation have been measured, conductivity values are compared with values calculated from the reported results. Table 31 gives the ratios of the measured to the calculated values.

Low concentration ions do not contribute much to the sum of ionic conductivities. By looking at the ratio of measured to calculated conductivity, errors in determination of low concentration ions may not be revealed. To include low concentration ions in the quality control, ion balance control must be used. This ratio should be used as a tool in the quality control system for those laboratories that measure all main components. The ratios of equivalent concentrations of anions versus equivalent concentrations of cations are shown in Table 32.

The Youden plot of conductivity shows mainly systematic error, which may be due to bad calibration of the instrument.

5. Conclusions

A total of 56 laboratories participated in the twenty-first intercomparison. 32 of these laboratories are within the EMEP network.

For all the samples analysed, the deviations from theoretical values are calculated. Figure 16 shows the median values compared to the expected values for all the parameters. For the EMEP laboratories the median deviations for both low- and high concentration samples are less than 4%. This is the same as obtained in the last intercomparison. Median deviations except for Ca and K are for other participants less than 7%, which is the same as in earlier intercomparisons. Determination of low concentrations of Ca and K seems to have been more troublesome and median deviations including Ca and K are less than 16%.

As in earlier intercomparisons, outliers are defined as values that deviate more than two standard deviations from the mean value. Outliers occur for all samples and almost all parameters. Out of a total of 2748 single results, 122 are defined as outliers. This is 5% of the reported data, which is a slight increase compared to earlier intercomparisons.

In Table 33 the ratio of the median values to the theoretical values for all the parameters is presented. As can be seen from this table, all parameters have median values that are in good agreement with the theoretical values.

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Appendix 1

Tables

Table 2: Samples distributed for the nineteenth interlaboratory test.

A.	5 synthetic samples for determination of SO ₂ , consisting of 0.3% H ₂ O ₂ absorbing solution and containing different concentrations of sulphuric acid. One of the samples was an unidentified blank.
B.	6 KOH-impregnated Whatman 40 filters, comprising 1 blank and 8 filters to which different amounts of sulphuric acid have been added.
C.	4 synthetic samples for determination of NO ₂ consisting of sodium nitrite diluted in water.
J.	6 Whatman 40 filters impregnated with 3% oxalic acid, comprising 2 blank and 4 filters to which different amounts of ammonium salt solution have been added.
G.	4 synthetic precipitation samples, containing SO ₄ ²⁻ , NO ₃ ⁻ , NH ₄ ⁺ , H ⁺ , Na ⁺ , Mg ²⁺ and Cl ⁻ , and Ca ²⁺ and K ⁺ .

Table 3a: EMEP laboratories participating in the nineteenth laboratory intercomparison. The numbers in front of the names are used in tables and figures.

Austria	(1)	Umweltbundesamt Zweigstelle Sud, Klagenfurt
Canada	(26)	Meteorological Service of Canada, Toronto
Croatia	(35)	Meteorological and Hydrological Service of Croatia
Czech Republic	(3)	Czech Hydrometeorological Institute, Praha
Denmark	(4)	National Environmental Research Institute. Air Pollution Laboratory
Estonia	(38)	Estonian Environmental Research Centre, Tallinn
Finland	(5)	Finnish Meteorological Institute. Air Quality Department
France	(6)	Laboratories Wolff
Germany	(7)	IfE Leipzig GmbH, Umweltlabor
Germany	(8)	Umweltbundesamt, Messtelle Schauinsland
Hungary	(10)	Institute for Atmospheric Physics
Iceland	(11)	Ídntæknistofnun Íslands (Technological Inst. of Iceland)
Ireland	(12)	Met Eirann, Dublin
Italy	(13)	C.N.R. Istituto Inquinamento Atmosferico
Italy	(30)	Joint Research centre, Ispra
Latvia	(33)	Air Pollution Observation Laboratory
Lithuania	(32)	Atmospheric Pollution Research Laboratory, Institute of Physics, Vilnius
Netherlands	(14)	National Institute of Public Health and Environmental Protection (RIVM)
Norway	(15)	Norwegian Institute for Air Research (NILU)
Macedonia	(40)	Hydrometeorological Institute, Skopje
Poland	(16)	Institute of Meteorology and Water Management, Warsaw
Poland	(39)	Environmental Monitoring Laboratory, Institute of Environmental Protection
Romania	(18)	Research and Engineering Institute for Environment
Russian Federation	(22)	Institute of Global Climate and Ecology
Serbia and Montenegro	(24)	Rep. Hydrometeorological Institute of Serbia
Slovakia	(31)	Slovak Hydrometeorological Institute
Slovenia	(36)	Hydrometeorological Institute of Slovenia
Spain	(19)	Centro Nacional de Sanidad Ambiental
Sweden	(20)	Swedish Environmental Research Institute (IVL), Gothenburg
Switzerland	(21)	Swiss Federal Laboratories for Materials Testing (EMPA)
Turkey	(34)	Refik Saydam Institute, Ankara
United Kingdom	(23)	AEA Technology, National Environmental Technology Centre
United States of America	(27)	Illinois State Water Survey

Table 3b: Participating laboratories outside the EMEP network.

Germany	(104)	Hessige Landwirtschaftliche
Sweden	(106)	IVL Svenska Miljöinstitutet AB, Aneboda
Finland	(107)	The Finnish Forest Institute
Germany	(109)	Institut für Bondenkunde und Waldernährung der Universität, Göttingen
Germany	(110)	Thüringer Landesanstalt für Landwirtschaft (TTL), Jena
Finland	(111)	Finnish Forest Research Institute, Vantaa Research Centre
Germany	(112)	Niedersächsische Forstliche Versuchsanstalt (NVF)
Germany	(113)	Landesforstanstalt Eberswalde, abt. Waldökologie
Italy	(114)	C.N.R. Istituto Italiano di Idrobiologia
Germany	(115)	Bayerische Landesanstalt f. Wald- und Forstwirtschaft
Switzerland	(116)	Institute for Applied Plant Biology
Germany	(117)	Sächsische Landesanstalt für Forsten, Graupa
Germany	(118)	Forstliche Versuchs-und Forschungsansta
Germany	(120)	Landwirtschaftliche Untersuchungs- und Forschungsanstalt (LUFA)
Germany	(121)	Landesamt für Natur und Umwelt
Italy	(126)	APPA Laboratorio Biologico Provinciale
Italy	(130)	Universita degli Studi Siena
China	(131)	Chongqing Institute of Environmental Science and Monitoring
Belarus	(133)	Institute for Problems of Natural Resources Use and Ecology
China	(135)	Hunan Research Institute of Environmental Protection Science
China	(136)	Guangzhou Research Institute of Environmental Protection
China	(138)	Guizhou Research Institute of Environmental Protection Science, Guiyang
Italy	(140)	C.N.R. Istituto di Ricerca sulle Acque

Table 4: Analytical methods used at the participating laboratories for the determination of sulphur dioxide in absorbing solution (A).

Method	Laboratory
1. Ion chromatography	6, 15, 17, 19, 21, 23

Table 5: Analytical methods used at the participating laboratories for the determination of sulphur dioxide on impregnated filters (B).

Method	Laboratory
1. Spectrophotometry	16
2. Ion chromatography	3, 4, 5, 8, 11, 12, 13, 15, 20, 22, 31,32, 33, 34, 36, 38, 116, 131, 135, 138
3. Capillary Ion Analysis	39

Table 6: Analytical methods used at the participating laboratories for determination of nitric acid on impregnated filters (B).

Method	Laboratory
1. Reduction to nitrite	16
2. Ion chromatography	3, 4, 5, 8, 11, 13, 15, 20, 22, 31,32, 33, 34, 36, 116,131, 135, 138
3. Capillary Ion Analysis	39

Table 7: Analytical method for determination of ammonia on impregnated filters (J).

Method	Laboratory
1. Spectrophotometry	3, 4, 8, 10, 19,32, 33,34 39, 116,
2. FIA	11
3 Ion chromatography	5, 13,15, 20, 36, 131, 135, 138

Table 8: Analytical method used for NO₂ in absorbing solution (C).

Method	Laboratory
1. Spectrophotometry	3, 4, 8, 12, 15, 16, 19, 20, 22, 23, 31,32, 33, 34, 35, 38, 39, 131, 135
Ion chromatography	36

Table 9: Analytical results for sulphur dioxide in absorbing solution.

SO ₂ in absorbing solution				SO ₂ in absorbing solution			
Sample no.: 1				Sample no.: 2			
Theoretical value:		0.301		Theoretical value:		0.152	
Unit: µg S / ml				Unit: µg S / ml			
Run 1:				Run 1:			
Number of laboratories:		5		Number of laboratories:		5	
Arithmetic mean value:		0.272		Arithmetic mean value:		0.139	
Median:		0.291		Median:		0.141	
Standard deviation		0.055		Standard deviation		0.021	
Rel. st. deviation (%)		20.268		Rel. st. deviation (%)		15.150	
Run 2:				Run 2:			
Number of laboratories:		5		Number of laboratories:		5	
Arithmetic mean value:		0.272		Arithmetic mean value:		0.139	
Median:		0.291		Median:		0.141	
Standard deviation		0.055		Standard deviation		0.021	
Rel. st. deviation (%)		20.268		Rel. st. deviation (%)		15.150	
Results in decreasing order:				Results in decreasing order:			
23	0.319	15	0.264	23	0.162	15	0.125
21	0.304	19	0.180	21	0.155	19	0.111
6	0.291			6	0.141		
SO ₂ in absorbing solution				SO ₂ in absorbing solution			
Sample no.: 3				Sample no.: 4			
Theoretical value:		0.341		Theoretical value:		0.160	
Unit: µg S / ml				Unit: µg S / ml			
Run 1:				Run 1:			
Number of laboratories:		5		Number of laboratories:		5	
Arithmetic mean value:		0.314		Arithmetic mean value:		0.150	
Median:		0.330		Median:		0.152	
Standard deviation		0.045		Standard deviation		0.015	
Rel. st. deviation (%)		14.255		Rel. st. deviation (%)		9.991	
Run 2:				Run 2:			
Number of laboratories:		5		Number of laboratories:		5	
Arithmetic mean value:		0.314		Arithmetic mean value:		0.150	
Median:		0.330		Median:		0.152	
Standard deviation		0.045		Standard deviation		0.015	
Rel. st. deviation (%)		14.255		Rel. st. deviation (%)		9.991	
Results in decreasing order:				Results in decreasing order:			
23	0.354	15	0.304	23	0.168	19	0.136
21	0.341	19	0.241	21	0.161	15	0.134
6	0.330			6	0.152		

Table 10: The ratios of the theoretical values and the results found by the laboratories in the determination of sulphur dioxide in absorbing solutions.

Lab. No	Measured value / Expected				Average
	Sample No				
	A1	A2	A3	A5	
6	0.97	0.93	0.97	0.95	0.95
15	0.88	0.82	0.89	0.84	0.86
19	0.60	0.73	0.71	0.85	0.72
21	1.01	1.02	1.00	1.00	1.01
23	1.06	1.06	1.04	1.05	1.05

Table 11: Analytical results for sulphur dioxide in impregnated filter.

SO₂-S on impregnated filter
 Sample no.: B1
 Theoretical value: 24.048
 Unit: µg S / FIL

Run 1:
 Number of laboratories: 20
 Arithmetic mean value: 23.279
 Median: 23.087
 Standard deviation 4.021
 Rel. st. deviation (%) 17.272

Run 2:
 Number of laboratories: 19
 Arithmetic mean value: 22.828
 Median: 23.003
 Standard deviation 3.573
 Rel. st. deviation (%) 15.653

Results in decreasing order:
 15 31.850 (*) 31 23.003
 138 28.699 116 22.900
 131 27.110 34 22.619
 135 26.870 39 22.000
 4 26.500 3 21.390
 32 26.220 20 20.980
 5 24.910 22 19.100
 33 23.721 11 18.860
 8 23.633 38 16.800
 16 23.170 36 15.240

SO₂-S on impregnated filter
 Sample no.: B3
 Theoretical value: 18.036
 Unit: µg S / FIL

Run 1:
 Number of laboratories: 20
 Arithmetic mean value: 16.473
 Median: 16.950
 Standard deviation 3.794
 Rel. st. deviation (%) 23.034

Run 2:
 Number of laboratories: 19
 Arithmetic mean value: 16.922
 Median: 17.200
 Standard deviation 3.307
 Rel. st. deviation (%) 19.545

Results in decreasing order:
 138 21.958 116 16.700
 32 21.930 31 16.547
 135 20.120 16 15.900
 4 19.900 34 15.536
 15 19.350 3 14.990
 131 19.060 20 14.930
 5 18.350 11 13.370
 8 17.691 22 11.800
 33 17.281 38 8.900
 39 17.200 36 7.940 (*)

SO₂-S on impregnated filter
 Sample no.: B4
 Theoretical value: 56.112
 Unit: µg S / FIL

Run 1:
 Number of laboratories: 20
 Arithmetic mean value: 53.843
 Median: 54.138
 Standard deviation 4.795
 Rel. st. deviation (%) 8.905

Run 2:
 Number of laboratories: 19
 Arithmetic mean value: 54.387
 Median: 54.200
 Standard deviation 4.244
 Rel. st. deviation (%) 7.804

Results in decreasing order:
 131 60.540 8 54.076
 32 60.290 16 52.980
 15 59.850 22 52.200
 135 59.340 33 51.838
 138 58.939 20 50.590
 4 57.800 3 50.260
 31 56.214 116 48.900
 5 55.230 36 48.840
 34 54.303 11 46.970
 39 54.200 38 43.500 (*)

SO₂-S on impregnated filter
 Sample no.: B5
 Theoretical value: 40.080
 Unit: µg S / FIL

Run 1:
 Number of laboratories: 19
 Arithmetic mean value: 38.591
 Median: 38.644
 Standard deviation 3.905
 Rel. st. deviation (%) 10.119

Run 2:
 Number of laboratories: 19
 Arithmetic mean value: 38.591
 Median: 38.644
 Standard deviation 3.905
 Rel. st. deviation (%) 10.119

Results in decreasing order:
 131 45.070 39 38.600
 138 43.885 5 38.470
 135 43.320 3 37.020
 4 42.500 16 36.960
 15 42.350 20 36.110
 38 41.300 22 35.000
 31 39.218 116 33.200
 8 39.121 11 32.600
 34 38.729 36 31.140
 33 38.644

Table 12: The ratios of the theoretical values and the results found by the laboratories in the determination of sulphur dioxide on impregnated filters. The reported results are corrected for blank value (B1).

Lab. No	Measured / Expected value				Average
	Sample No				
	B1	B3	B4	B5	
3	0.89	0.83	0.90	0.92	0.88
4	1.10	1.10	1.03	1.06	1.06
5	1.04	1.02	0.98	0.96	0.99
8	0.98	0.98	0.96	0.98	0.97
11	0.78	0.74	0.84	0.81	0.80
12	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00
15	1.32	1.07	1.07	1.06	1.07
16	0.96	0.88	0.94	0.92	0.92
19	0.00	0.00	0.00	0.00	0.00
20	0.87	0.83	0.90	0.90	0.88
22	0.79	0.65	0.93	0.87	0.82
31	0.96	0.92	1.00	0.98	0.97
32	1.09	1.22	1.07		1.15
33	0.99	0.96	0.92	0.96	0.95
34	0.94	0.86	0.97	0.97	0.93
36	0.63	0.44	0.87	0.78	0.70
38	0.70	0.49	0.78	1.03	0.77
39	0.91	0.95	0.97	0.96	0.96
116	0.95	0.93	0.87	0.83	0.88
131	1.13	1.06	1.08	1.12	1.09
135	1.12	1.12	1.06	1.08	1.08

Table 13: Analytical results for nitric acid on impregnated filter.

HNO₃-N on impregnated filter
 Sample no.: B1
 Theoretical value: 11.452
 Unit: µg N / FIL

Run 1:
 Number of laboratories: 18
 Arithmetic mean value: 11.221
 Median: 11.119
 Standard deviation 0.582
 Rel. st. deviation (%) 5.187

Run 2:
 Number of laboratories: 17
 Arithmetic mean value: 11.151
 Median: 11.060
 Standard deviation 0.515
 Rel. st. deviation (%) 4.615

Results in decreasing order:
 32 12.420 (*) 16 11.060
 15 12.200 34 11.014
 135 12.110 3 10.950
 39 11.600 36 10.900
 5 11.590 31 10.887
 8 11.431 33 10.713
 131 11.260 116 10.600
 4 11.200 22 10.500
 138 11.178 20 10.370

HNO₃-N on impregnated filter
 Sample no.: B4
 Theoretical value: 39.264
 Unit: µg N / FIL

Run 1:
 Number of laboratories: 19
 Arithmetic mean value: 38.493
 Median: 39.000
 Standard deviation 2.413
 Rel. st. deviation (%) 6.269

Run 2:
 Number of laboratories: 18
 Arithmetic mean value: 38.891
 Median: 39.050
 Standard deviation 1.726
 Rel. st. deviation (%) 4.438

Results in decreasing order:
 138 41.505 5 38.800
 131 41.420 8 38.584
 135 41.010 16 38.220
 39 40.200 34 38.096
 31 40.052 3 37.080
 32 39.930 116 36.300
 4 39.500 20 36.010
 36 39.300 33 35.938
 22 39.100 11 31.330 (*)
 15 39.000

HNO₃-N on impregnated filter
 Sample no.: B3
 Theoretical value: 32.720
 Unit: µg N / FIL

Run 1:
 Number of laboratories: 19
 Arithmetic mean value: 32.708
 Median: 32.144
 Standard deviation 3.035
 Rel. st. deviation (%) 9.279

Run 2:
 Number of laboratories: 18
 Arithmetic mean value: 32.130
 Median: 32.122
 Standard deviation 1.739
 Rel. st. deviation (%) 5.412

Results in decreasing order:
 138 43.118 (*) 116 32.100
 22 35.300 15 32.100
 39 34.300 8 31.987
 135 34.120 33 31.694
 32 33.150 34 31.500
 4 33.100 16 31.320
 131 32.600 3 31.010
 5 32.600 20 29.600
 36 32.200 11 27.510
 31 32.144

HNO₃-N on impregnated filter
 Sample no.: B5
 Theoretical value: 14.724
 Unit: µg N / FIL

Run 1:
 Number of laboratories: 18
 Arithmetic mean value: 14.193
 Median: 14.312
 Standard deviation 1.578
 Rel. st. deviation (%) 11.119

Run 2:
 Number of laboratories: 17
 Arithmetic mean value: 14.520
 Median: 14.323
 Standard deviation 0.774
 Rel. st. deviation (%) 5.328

Results in decreasing order:
 138 15.995 36 14.300
 135 15.590 16 14.220
 39 15.300 3 14.210
 8 15.271 31 14.008
 131 15.230 20 13.800
 15 14.900 33 13.511
 5 14.780 22 13.500
 4 14.500 116 13.400
 34 14.323 11 8.630 (*)

Table 14: The ratios of the theoretical values and the results found by the laboratories in the determination of nitric acid on impregnated filters. The reported results are corrected for blank value (B1).

Lab.No	Measured / Expected value				Average
	Sample No				
	B1	B3	B4	B5	
3	0.96	0.95	0.94	0.97	0.95
4	0.98	1.01	1.01	0.98	1.00
5	1.01	1.00	0.99	1.00	1.00
8	1.00	0.98	0.98	1.04	1.00
11	0.00	0.84	0.80	0.59	0.56
15	1.07	0.98	0.99	1.01	1.01
16	0.97	0.96	0.97	0.97	0.97
20	0.91	0.90	0.92	0.94	0.92
22	0.92	1.08	1.00	0.92	0.98
31	0.95	0.98	1.02	0.95	0.98
32	1.08	1.01	1.02	0.00	0.78
33	0.94	0.97	0.92	0.92	0.93
34	0.96	0.96	0.97	0.97	0.97
36	0.95	0.98	1.00	0.97	0.98
39	1.01	1.05	1.02	1.04	1.03
116	0.93	0.98	0.92	0.91	0.94
131	0.98	1.00	1.05	1.03	1.02
135	1.06	1.04	1.04	1.06	1.05

Table 15: Analytical results for nitrogen dioxide in absorbing solution.

NO2-N in absorbing solution				NO2-N in absorbing solution			
Sample no.: C1				Sample no.: C2			
Theoretical value:		0.102		Theoretical value:		0.074	
Unit: µg N / ml				Unit: µg N / ml			
Run 1:				Run 1:			
Number of laboratories:		20		Number of laboratories:		20	
Arithmetic mean value:		0.101		Arithmetic mean value:		0.072	
Median:		0.102		Median:		0.073	
Standard deviation		0.005		Standard deviation		0.008	
Rel. st. deviation (%)		5.234		Rel. st. deviation (%)		10.880	
Run 2:				Run 2:			
Number of laboratories:		19		Number of laboratories:		19	
Arithmetic mean value:		0.102		Arithmetic mean value:		0.074	
Median:		0.102		Median:		0.074	
Standard deviation		0.005		Standard deviation		0.005	
Rel. st. deviation (%)		4.517		Rel. st. deviation (%)		6.324	
Results in decreasing order:				Results in decreasing order:			
32	0.109	22	0.101	33	0.083	34	0.073
33	0.109	20	0.101	39	0.078	38	0.073
34	0.107	38	0.100	32	0.078	8	0.072
135	0.106	131	0.100	20	0.077	35	0.071
39	0.105	12	0.100	36	0.077	31	0.070
4	0.104	35	0.098	131	0.077	23	0.070
8	0.102	23	0.097	4	0.076	19	0.068
36	0.102	19	0.094	16	0.076	12	0.067
3	0.102	31	0.092	135	0.076	15	0.064
16	0.102	15	0.089 (*)	22	0.074	3	0.045 (*)
NO2-N in absorbing solution				NO2-N in absorbing solution			
Sample no.: C3				Sample no.: C4			
Theoretical value:		0.125		Theoretical value:		0.135	
Unit: µg N / ml				Unit: µg N / ml			
Run 1:				Run 1:			
Number of laboratories:		20		Number of laboratories:		20	
Arithmetic mean value:		0.124		Arithmetic mean value:		0.135	
Median:		0.124		Median:		0.135	
Standard deviation		0.007		Standard deviation		0.007	
Rel. st. deviation (%)		5.424		Rel. st. deviation (%)		5.127	
Run 2:				Run 2:			
Number of laboratories:		20		Number of laboratories:		19	
Arithmetic mean value:		0.124		Arithmetic mean value:		0.134	
Median:		0.124		Median:		0.135	
Standard deviation		0.007		Standard deviation		0.006	
Rel. st. deviation (%)		5.424		Rel. st. deviation (%)		4.494	
Results in decreasing order:				Results in decreasing order:			
20	0.137	34	0.124	33	0.150 (*)	34	0.135
4	0.133	39	0.124	32	0.145	131	0.135
33	0.133	16	0.122	23	0.143	20	0.135
32	0.131	22	0.122	135	0.140	38	0.133
135	0.130	38	0.121	4	0.139	35	0.131
23	0.128	35	0.120	16	0.137	22	0.129
8	0.125	19	0.116	39	0.137	19	0.127
36	0.125	31	0.115	3	0.136	12	0.126
131	0.125	12	0.114	8	0.136	31	0.126
3	0.125	15	0.112	36	0.135	15	0.122

Table 16: The ratios of the theoretical values and the results found by the laboratories in the determination of nitrogen dioxide in absorbing solutions.

Lab.No	Measured / Expected				Average
	Sample No.				
	C1	C2	C3	C4	
3	1.00	0.60	1.00	1.00	0.90
4	1.02	1.02	1.06	1.03	1.03
8	1.01	0.97	1.11	1.00	1.02
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
12	0.98	0.90	0.91	0.93	0.93
15	0.88	0.86	0.89	0.90	0.88
16	1.00	1.02	0.97	1.01	1.00
19	0.92	0.91	0.92	0.94	0.92
20	0.99	1.03	1.09	1.00	1.03
22	0.99	0.99	0.97	0.95	0.98
23	0.96	0.94	1.02	1.06	0.99
24	0.00	0.00	0.00	0.00	0.00
31	0.91	0.94	0.92	0.93	0.92
32	1.07	1.05	1.05	1.07	1.06
33	1.08	1.12	1.06	1.11	1.09
34	1.05	0.98	0.99	1.00	1.01
35	0.97	0.95	0.96	0.97	0.96
36	1.00	1.03	1.00	1.00	1.01
38	0.98	0.98	0.97	0.98	0.98
39	1.03	1.05	0.99	1.01	1.02
131	0.98	1.03	1.00	1.00	1.00
135	1.04	1.02	1.04	1.03	1.03

Table 17: Analytical results for ammonia on impregnated filter.

NH₃-N on impregnated filter
 Sample no.: J1
 Theoretical value: 8.020
 Unit: µg N / FIL

Run 1:
 Number of laboratories: 19
 Arithmetic mean value: 8.121
 Median: 7.960
 Standard deviation 0.876
 Rel. st. deviation (%) 10.790

Run 2:
 Number of laboratories: 18
 Arithmetic mean value: 7.985
 Median: 7.938
 Standard deviation 0.662
 Rel. st. deviation (%) 8.285

Results in decreasing order:
 135 10.580 (*) 3 7.915
 8 9.178 32 7.900
 33 8.935 11 7.835
 138 8.810 5 7.610
 131 8.630 4 7.575
 39 8.386 19 7.431
 116 8.300 15 7.345
 13 8.150 20 6.968
 34 8.088 10 6.710
 36 7.960

NH₃-N on impregnated filter
 Sample no.: J4
 Theoretical value: 20.050
 Unit: µg N / FIL

Run 1:
 Number of laboratories: 19
 Arithmetic mean value: 19.383
 Median: 19.400
 Standard deviation 1.594
 Rel. st. deviation (%) 8.226

Run 2:
 Number of laboratories: 18
 Arithmetic mean value: 19.574
 Median: 19.557
 Standard deviation 1.399
 Rel. st. deviation (%) 7.148

Results in decreasing order:
 8 22.400 34 19.308
 33 21.935 15 19.245
 13 20.800 4 19.175
 116 20.500 36 19.100
 138 20.350 3 18.635
 131 19.940 5 18.320
 19 19.789 20 17.256
 135 19.740 10 16.726
 11 19.715 39 15.945 (*)
 32 19.400

NH₃-N on impregnated filter
 Sample no.: J3
 Theoretical value: 36.090
 Unit: µg N / FIL

Run 1:
 Number of laboratories: 19
 Arithmetic mean value: 34.354
 Median: 34.820
 Standard deviation 3.709
 Rel. st. deviation (%) 10.796

Run 2:
 Number of laboratories: 19
 Arithmetic mean value: 34.354
 Median: 34.820
 Standard deviation 3.709
 Rel. st. deviation (%) 10.796

Results in decreasing order:
 33 41.535 138 34.750
 32 39.200 3 34.545
 8 38.111 4 33.675
 116 37.300 36 33.300
 13 36.100 15 33.145
 135 35.890 20 29.460
 131 35.630 10 28.986
 19 35.467 39 27.965
 11 35.115 34 27.732
 5 34.820

NH₃-N on impregnated filter
 Sample no.: J6
 Theoretical value: 12.030
 Unit: µg N / FIL

Run 1:
 Number of laboratories: 19
 Arithmetic mean value: 11.387
 Median: 11.575
 Standard deviation 1.519
 Rel. st. deviation (%) 13.341

Run 2:
 Number of laboratories: 18
 Arithmetic mean value: 11.599
 Median: 11.617
 Standard deviation 1.240
 Rel. st. deviation (%) 10.695

Results in decreasing order:
 33 13.535 15 11.545
 8 13.378 19 11.352
 131 13.110 36 11.200
 138 12.880 20 10.984
 116 12.400 3 10.865
 11 12.015 34 10.306
 13 11.800 39 9.206
 32 11.800 10 9.174
 135 11.660 5 7.570 (*)
 4 11.575

Table 18: The ratios of the theoretical values and the results found by the laboratories in the determination of ammonia on impregnated filters. The reported results are corrected for an average blank value (J1 and J6).

Lab. no.	Measured / Expected				Average
	Sample No.				
	J1	J3	J4	J6	
3	0.99	0.96	0.93	0.90	0.94
4	0.94	0.93	0.96	0.96	0.95
5	0.95	0.96	0.91	0.63	0.86
8	1.14	1.06	1.12	1.11	1.11
10	0.84	0.80	0.83	0.76	0.81
11	0.98	0.97	0.98	1.00	0.98
13	1.02	1.00	1.04	0.98	1.01
15	0.92	0.92	0.96	0.96	0.94
19	0.93	0.98	0.99	0.94	0.96
20	0.87	0.82	0.86	0.91	0.86
32	0.99	1.09	0.97	0.98	1.00
33	1.11	1.15	1.09	1.13	1.12
34	1.01	0.77	0.96	0.86	0.90
36	0.99	0.92	0.95	0.93	0.95
39	1.05	0.77	0.80	0.77	0.85
116	1.03	1.03	1.02	1.03	1.03
131	1.08	0.99	0.99	1.09	1.04
135	1.32	0.99	0.98	0.97	1.07
138	1.10	0.96	1.01	1.07	1.04

Table 19: Analytical results for sulphate in precipitations samples.

SO42--S				SO42--S			
Sample no.: G1				Sample no.: G2			
Theoretical value:		1.637		Theoretical value:		1.618	
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories:		54		Number of laboratories:		54	
Arithmetic mean value:		1.744		Arithmetic mean value:		1.773	
Median:		1.639		Median:		1.660	
Standard deviation		0.595		Standard deviation		0.614	
Rel. st. deviation (%)		34.093		Rel. st. deviation (%)		34.658	
Run 2:				Run 2:			
Number of laboratories:		52		Number of laboratories:		52	
Arithmetic mean value:		1.630		Arithmetic mean value:		1.656	
Median:		1.635		Median:		1.658	
Standard deviation		0.095		Standard deviation		0.125	
Rel. st. deviation (%)		5.843		Rel. st. deviation (%)		7.537	
Results in decreasing order:				Results in decreasing order:			
130	5.000 (*)	36	1.638	130	5.040 (*)	135	1.660
126	4.390 (*)	21	1.632	126	4.570 (*)	36	1.656
133	2.094	6	1.627	133	2.238	31	1.648
38	1.730	26	1.623	121	1.830	6	1.646
121	1.730	104	1.620	118	1.810	26	1.642
14	1.720	7	1.618	39	1.764	23	1.637
111	1.710	20	1.611	14	1.743	7	1.636
138	1.704	112	1.610	38	1.740	34	1.634
13	1.700	23	1.610	114	1.740	1	1.630
107	1.697	30	1.609	35	1.739	112	1.630
114	1.690	34	1.608	138	1.731	30	1.626
33	1.683	110	1.600	13	1.730	20	1.621
118	1.680	1	1.600	115	1.730	116	1.615
35	1.675	11	1.596	107	1.725	15	1.600
32	1.672	136	1.596	120	1.710	10	1.596
131	1.664	116	1.587	32	1.701	11	1.595
27	1.661	15	1.580	33	1.699	16	1.590
8	1.660	10	1.566	111	1.690	136	1.580
120	1.660	109	1.560	5	1.683	109	1.580
5	1.657	24	1.550	4	1.682	104	1.560
115	1.650	16	1.542	27	1.681	117	1.560
31	1.648	117	1.540	8	1.680	19	1.555
4	1.648	140	1.520	131	1.677	140	1.540
135	1.647	19	1.517	3	1.673	24	1.530
3	1.646	22	1.472	110	1.670	22	1.467
39	1.643	18	1.423	21	1.661	113	1.410
12	1.640	113	1.420	12	1.660	18	1.280
SO42--S				SO42--S			
Sample no.: G3				Sample no.: G4			
Theoretical value:		0.864		Theoretical value:		0.946	
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories:		54		Number of laboratories:		54	
Arithmetic mean value:		0.933		Arithmetic mean value:		0.997	
Median:		0.880		Median:		0.948	
Standard deviation		0.328		Standard deviation		0.345	
Rel. st. deviation (%)		35.207		Rel. st. deviation (%)		34.620	
Run 2:				Run 2:			
Number of laboratories:		52		Number of laboratories:		52	
Arithmetic mean value:		0.870		Arithmetic mean value:		0.933	
Median:		0.880		Median:		0.946	
Standard deviation		0.070		Standard deviation		0.097	
Rel. st. deviation (%)		8.043		Rel. st. deviation (%)		10.418	
Results in decreasing order:				Results in decreasing order:			
130	2.580 (*)	109	0.880	130	2.830 (*)	21	0.947
126	2.530 (*)	1	0.880	126	2.500 (*)	36	0.945
120	0.980	3	0.878	133	1.086	31	0.944
133	0.966	21	0.878	121	1.050	3	0.941
118	0.960	26	0.875	120	1.040	1	0.940
38	0.940	6	0.872	118	1.030	26	0.936
32	0.940	36	0.872	14	1.009	6	0.934
14	0.937	117	0.870	38	1.000	20	0.932
138	0.932	20	0.868	115	1.000	34	0.929
111	0.920	34	0.861	138	0.996	117	0.920
135	0.918	116	0.861	136	0.991	112	0.920
33	0.914	112	0.860	131	0.977	104	0.920
131	0.910	16	0.856	33	0.977	16	0.916
5	0.900	39	0.852	4	0.972	15	0.916
114	0.900	110	0.850	114	0.970	32	0.911
35	0.897	15	0.848	39	0.969	23	0.908
13	0.895	23	0.844	5	0.968	30	0.903
27	0.894	30	0.840	135	0.966	140	0.890
8	0.891	19	0.833	13	0.966	110	0.890
12	0.890	104	0.830	116	0.963	109	0.880
121	0.890	115	0.820	7	0.961	11	0.876
4	0.889	140	0.820	27	0.961	19	0.873
7	0.887	11	0.816	8	0.960	10	0.870
107	0.887	24	0.810	111	0.960	24	0.850
31	0.884	22	0.766	107	0.958	22	0.821
136	0.881	113	0.750	12	0.950	113	0.810
10	0.880	18	0.490	35	0.948	18	0.359

Table 20: Analytical results for nitrate in precipitations samples.

NO3-N				NO3-N			
Sample no.: G1				Sample no.: G2			
Theoretical value:		0.607		Theoretical value:		0.546	
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories:		54		Number of laboratories:		54	
Arithmetic mean value:		0.687		Arithmetic mean value:		0.528	
Median:		0.690		Median:		0.537	
Standard deviation		0.098		Standard deviation		0.076	
Rel. st. deviation (%)		14.294		Rel. st. deviation (%)		14.459	
Run 2:				Run 2:			
Number of laboratories:		51		Number of laboratories:		51	
Arithmetic mean value:		0.695		Arithmetic mean value:		0.536	
Median:		0.691		Median:		0.537	
Standard deviation		0.033		Standard deviation		0.022	
Rel. st. deviation (%)		4.719		Rel. st. deviation (%)		4.040	
Results in decreasing order:				Results in decreasing order:			
133	1.031 (*)	126	0.690	133	0.773 (*)	6	0.537
40	0.865	118	0.690	40	0.585	23	0.537
113	0.740	6	0.690	114	0.565	131	0.537
12	0.730	110	0.690	39	0.561	14	0.536
38	0.730	14	0.690	104	0.560	4	0.535
135	0.727	26	0.690	38	0.560	107	0.534
104	0.720	21	0.689	113	0.560	10	0.534
114	0.715	7	0.688	118	0.560	21	0.534
33	0.715	32	0.688	12	0.560	7	0.532
39	0.714	130	0.686	13	0.559	140	0.530
120	0.710	4	0.685	35	0.556	3	0.527
13	0.710	1	0.680	33	0.556	34	0.524
35	0.708	34	0.673	116	0.553	126	0.520
27	0.707	140	0.670	1	0.550	112	0.520
20	0.705	15	0.669	120	0.550	15	0.517
8	0.704	19	0.668	121	0.548	19	0.514
5	0.704	10	0.667	8	0.547	110	0.510
138	0.703	24	0.660	20	0.546	115	0.510
31	0.702	117	0.660	27	0.546	117	0.510
115	0.700	112	0.660	138	0.546	16	0.508
23	0.698	30	0.658	135	0.544	30	0.503
107	0.698	22	0.657	5	0.544	11	0.502
131	0.696	16	0.656	32	0.542	24	0.500
116	0.696	11	0.650	130	0.541	22	0.492
36	0.692	111	0.647	31	0.539	111	0.473
121	0.691	109	0.470 (*)	26	0.537	109	0.290 (*)
3	0.691	136	0.150 (*)	36	0.537	136	0.121 (*)
NO3-N				NO3-N			
Sample no.: G3				Sample no.: G4			
Theoretical value:		0.738		Theoretical value:		0.521	
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories:		54		Number of laboratories:		54	
Arithmetic mean value:		0.722		Arithmetic mean value:		0.500	
Median:		0.730		Median:		0.510	
Standard deviation		0.090		Standard deviation		0.067	
Rel. st. deviation (%)		12.408		Rel. st. deviation (%)		13.433	
Run 2:				Run 2:			
Number of laboratories:		52		Number of laboratories:		51	
Arithmetic mean value:		0.736		Arithmetic mean value:		0.510	
Median:		0.730		Median:		0.511	
Standard deviation		0.039		Standard deviation		0.019	
Rel. st. deviation (%)		5.325		Rel. st. deviation (%)		3.762	
Results in decreasing order:				Results in decreasing order:			
133	0.874	6	0.730	133	0.638 (*)	112	0.510
40	0.865	1	0.730	35	0.543	140	0.510
126	0.830	7	0.728	38	0.540	26	0.510
113	0.780	4	0.728	118	0.540	126	0.510
135	0.771	21	0.727	33	0.534	23	0.509
12	0.770	26	0.726	116	0.531	107	0.508
130	0.761	14	0.725	113	0.530	21	0.508
115	0.760	131	0.723	115	0.530	138	0.507
33	0.757	121	0.721	40	0.530	7	0.506
32	0.752	39	0.720	12	0.530	36	0.503
35	0.752	3	0.716	39	0.527	120	0.500
13	0.751	34	0.712	135	0.524	131	0.499
38	0.750	10	0.711	13	0.523	3	0.498
104	0.750	140	0.710	8	0.522	34	0.497
114	0.748	19	0.707	114	0.521	16	0.496
27	0.746	16	0.703	1	0.520	15	0.494
116	0.746	110	0.700	5	0.520	117	0.490
31	0.746	112	0.700	104	0.520	19	0.488
138	0.744	30	0.698	121	0.519	10	0.485
5	0.743	15	0.696	27	0.519	111	0.484
20	0.742	111	0.692	20	0.518	30	0.479
8	0.741	22	0.690	130	0.517	11	0.478
118	0.740	117	0.690	32	0.516	24	0.470
107	0.738	24	0.670	31	0.513	110	0.470
23	0.737	11	0.669	14	0.513	22	0.456
120	0.730	109	0.540 (*)	4	0.512	109	0.270 (*)
36	0.730	136	0.171 (*)	6	0.511	136	0.120 (*)

Table 21: Analytical results for ammonium in precipitations sample.

NH4-N				NH4-N			
Sample no.: G1				Sample no.: G2			
Theoretical value:		0.441		Theoretical value:		0.281	
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories:		54		Number of laboratories:		54	
Arithmetic mean value:		0.456		Arithmetic mean value:		0.287	
Median:		0.450		Median:		0.280	
Standard deviation		0.068		Standard deviation		0.063	
Rel. st. deviation (%)		14.838		Rel. st. deviation (%)		21.811	
Run 2:				Run 2:			
Number of laboratories:		51		Number of laboratories:		51	
Arithmetic mean value:		0.447		Arithmetic mean value:		0.274	
Median:		0.449		Median:		0.280	
Standard deviation		0.021		Standard deviation		0.023	
Rel. st. deviation (%)		4.768		Rel. st. deviation (%)		8.563	
Results in decreasing order:				Results in decreasing order:			
109	0.770 (*)	31	0.449	109	0.590 (*)	117	0.280
40	0.760 (*)	131	0.446	40	0.530 (*)	21	0.280
138	0.499	4	0.444	116	0.429 (*)	135	0.280
30	0.497	21	0.443	30	0.312	4	0.278
33	0.490	8	0.443	34	0.299	5	0.277
116	0.485	130	0.442	22	0.298	130	0.277
34	0.473	7	0.442	35	0.292	36	0.276
104	0.470	14	0.441	121	0.291	8	0.274
23	0.468	24	0.440	107	0.291	10	0.273
114	0.464	117	0.440	33	0.290	111	0.273
35	0.464	118	0.439	104	0.290	120	0.270
20	0.461	135	0.437	23	0.290	12	0.270
112	0.460	39	0.436	6	0.290	15	0.270
107	0.460	5	0.436	112	0.290	24	0.270
140	0.460	36	0.436	38	0.290	39	0.269
19	0.458	16	0.435	131	0.286	16	0.266
6	0.457	126	0.435	31	0.285	118	0.262
13	0.457	32	0.431	3	0.285	115	0.260
3	0.456	12	0.430	19	0.285	1	0.260
27	0.453	15	0.430	114	0.285	126	0.260
121	0.451	18	0.428	13	0.284	113	0.260
26	0.451	115	0.420	27	0.283	138	0.257
10	0.451	133	0.412	18	0.283	32	0.250
22	0.451	1	0.400	20	0.283	14	0.248
120	0.450	113	0.400	7	0.281	136	0.203
38	0.450	110	0.400	140	0.280	133	0.194
111	0.450	136	0.296 (*)	26	0.280	110	0.190
NH4-N				NH4-N			
Sample no.: G3				Sample no.: G4			
Theoretical value:		0.521		Theoretical value:		0.241	
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories:		54		Number of laboratories:		54	
Arithmetic mean value:		0.517		Arithmetic mean value:		0.254	
Median:		0.515		Median:		0.237	
Standard deviation		0.069		Standard deviation		0.086	
Rel. st. deviation (%)		13.322		Rel. st. deviation (%)		33.711	
Run 2:				Run 2:			
Number of laboratories:		51		Number of laboratories:		51	
Arithmetic mean value:		0.512		Arithmetic mean value:		0.235	
Median:		0.515		Median:		0.236	
Standard deviation		0.027		Standard deviation		0.024	
Rel. st. deviation (%)		5.240		Rel. st. deviation (%)		10.046	
Results in decreasing order:				Results in decreasing order:			
40	0.800 (*)	126	0.515	18	0.703 (*)	35	0.237
109	0.770 (*)	7	0.514	109	0.540 (*)	131	0.236
33	0.570	8	0.514	40	0.500 (*)	23	0.236
116	0.563	34	0.513	116	0.299	15	0.236
120	0.540	117	0.510	31	0.297	111	0.236
35	0.540	5	0.509	22	0.281	135	0.234
104	0.540	36	0.509	112	0.260	121	0.233
23	0.539	135	0.509	30	0.259	8	0.233
20	0.538	16	0.507	34	0.257	130	0.232
114	0.536	3	0.507	3	0.254	120	0.230
31	0.534	118	0.506	107	0.249	12	0.230
140	0.530	138	0.505	114	0.246	113	0.230
6	0.528	22	0.502	21	0.245	117	0.230
19	0.527	39	0.500	6	0.245	38	0.230
131	0.526	32	0.500	36	0.244	24	0.230
111	0.525	133	0.497	5	0.244	10	0.229
107	0.524	14	0.495	20	0.243	13	0.223
13	0.523	12	0.490	7	0.242	126	0.222
30	0.522	38	0.490	19	0.242	1	0.220
27	0.521	15	0.490	16	0.241	118	0.219
26	0.521	1	0.480	32	0.240	39	0.217
112	0.520	115	0.480	33	0.240	136	0.214
121	0.519	110	0.480	104	0.240	115	0.200
21	0.518	24	0.470	140	0.240	14	0.195
10	0.517	113	0.470	27	0.240	138	0.193
4	0.517	18	0.393	26	0.239	110	0.190
130	0.515	136	0.252 (*)	4	0.238	133	0.155

Table 22: Analytical results for pH in precipitations samples.

pH				pH			
Sample no.: G1				Sample no.: G2			
Theoretical value:		4.120		Theoretical value:		4.070	
Unit: pH-unit				Unit: pH-unit			
Run 1:				Run 1:			
Number of laboratories:		56		Number of laboratories:		56	
Arithmetic mean value:		4.189		Arithmetic mean value:		4.115	
Median:		4.178		Median:		4.100	
Standard deviation		0.101		Standard deviation		0.085	
Rel. st. deviation (%)		2.407		Rel. st. deviation (%)		2.070	
Run 2:				Run 2:			
Number of laboratories:		53		Number of laboratories:		53	
Arithmetic mean value:		4.184		Arithmetic mean value:		4.098	
Median:		4.176		Median:		4.100	
Standard deviation		0.058		Standard deviation		0.041	
Rel. st. deviation (%)		1.381		Rel. st. deviation (%)		1.011	
Results in decreasing order:				Results in decreasing order:			
38	4.610 (*)	3	4.176	38	4.500 (*)	36	4.100
126	4.440 (*)	107	4.170	40	4.400 (*)	107	4.100
40	4.390	27	4.170	126	4.370 (*)	1	4.100
104	4.340	121	4.170	19	4.230	8	4.100
19	4.310	7	4.170	115	4.210	4	4.098
133	4.290	8	4.170	133	4.190	110	4.090
113	4.270	36	4.170	113	4.170	130	4.090
115	4.260	4	4.166	109	4.150	106	4.090
35	4.240	5	4.160	34	4.142	22	4.090
109	4.230	21	4.160	14	4.140	135	4.080
117	4.220	31	4.160	20	4.120	10	4.080
14	4.210	15	4.160	114	4.120	33	4.080
1	4.210	33	4.160	111	4.120	21	4.080
136	4.210	118	4.150	136	4.120	11	4.080
140	4.200	130	4.150	140	4.120	39	4.080
34	4.195	135	4.150	3	4.111	116	4.070
24	4.190	11	4.140	112	4.110	118	4.070
106	4.190	39	4.140	26	4.110	121	4.070
111	4.190	138	4.140	117	4.110	5	4.070
20	4.190	116	4.130	24	4.110	104	4.070
114	4.190	23	4.130	7	4.110	23	4.050
112	4.180	10	4.130	13	4.100	138	4.050
110	4.180	12	4.130	15	4.100	131	4.050
22	4.180	6	4.110	16	4.100	18	4.050
13	4.180	131	4.110	27	4.100	120	4.040
32	4.180	18	4.110	31	4.100	12	4.040
16	4.180	30	4.060	32	4.100	6	4.020
26	4.180	120	3.810 (*)	35	4.100	30	4.010
pH				pH			
Sample no.: G3				Sample no.: G4			
Theoretical value:		4.520		Theoretical value:		4.430	
Unit: pH-unit				Unit: pH-unit			
Run 1:				Run 1:			
Number of laboratories:		56		Number of laboratories:		56	
Arithmetic mean value:		4.559		Arithmetic mean value:		4.474	
Median:		4.540		Median:		4.460	
Standard deviation		0.129		Standard deviation		0.108	
Rel. st. deviation (%)		2.836		Rel. st. deviation (%)		2.414	
Run 2:				Run 2:			
Number of laboratories:		55		Number of laboratories:		53	
Arithmetic mean value:		4.544		Arithmetic mean value:		4.454	
Median:		4.540		Median:		4.460	
Standard deviation		0.072		Standard deviation		0.054	
Rel. st. deviation (%)		1.589		Rel. st. deviation (%)		1.222	
Results in decreasing order:				Results in decreasing order:			
40	5.350 (*)	106	4.540	40	5.070 (*)	106	4.460
126	4.770	140	4.540	38	4.710 (*)	107	4.460
38	4.750	21	4.530	126	4.710 (*)	4	4.460
19	4.750	27	4.530	19	4.640	3	4.456
133	4.690	33	4.530	14	4.580	15	4.450
113	4.660	39	4.530	113	4.550	21	4.450
109	4.610	7	4.530	133	4.540	33	4.440
14	4.600	4	4.527	111	4.530	120	4.440
16	4.590	11	4.520	140	4.510	11	4.440
136	4.580	13	4.520	115	4.510	135	4.440
34	4.571	135	4.510	109	4.500	116	4.430
35	4.570	5	4.500	16	4.490	121	4.430
110	4.570	130	4.500	34	4.485	39	4.430
111	4.570	121	4.500	136	4.480	32	4.430
117	4.570	104	4.500	117	4.480	138	4.420
22	4.560	116	4.500	22	4.480	104	4.420
114	4.560	118	4.500	24	4.480	12	4.410
32	4.560	138	4.500	110	4.470	118	4.410
20	4.560	23	4.490	112	4.470	130	4.400
115	4.560	120	4.490	31	4.470	131	4.400
15	4.550	10	4.480	114	4.470	18	4.400
107	4.550	131	4.480	20	4.470	10	4.400
112	4.550	36	4.460	7	4.460	23	4.400
24	4.550	12	4.460	8	4.460	5	4.400
26	4.550	1	4.460	13	4.460	1	4.380
3	4.548	6	4.450	26	4.460	36	4.370
31	4.540	18	4.430	27	4.460	6	4.360
8	4.540	30	4.400	35	4.460	30	4.320

Table 23: Analytical results for strong acid calculated from pH.

Strong acid calculated from pH		Strong acid calculated from pH	
Sample no.: 1		Sample no.: 2	
Theoretical value:	75.000	Theoretical value:	85.000
Unit: µeq/l		Unit: µeq/l	
Run 1:		Run 1:	
Number of laboratories:	56	Number of laboratories:	56
Arithmetic mean value:	66.390	Arithmetic mean value:	77.880
Median:	66.375	Median:	79.433
Standard deviation	15.934	Standard deviation	11.993
Rel. st. deviation (%)	24.000	Rel. st. deviation (%)	15.400
Run 2:		Run 2:	
Number of laboratories:	54	Number of laboratories:	53
Arithmetic mean value:	65.526	Arithmetic mean value:	80.135
Median:	66.375	Median:	79.433
Standard deviation	9.051	Standard deviation	7.354
Rel. st. deviation (%)	13.812	Rel. st. deviation (%)	9.177
Results in decreasing order:		Results in decreasing order:	
120 154.882 (*) 13 66.069		30 96.977 36 79.433	
30 87.767 32 66.069		6 95.499 107 79.433	
18 77.625 16 66.069		12 91.201 1 79.433	
131 77.625 22 66.069		120 91.201 13 79.433	
6 77.625 110 66.069		18 89.125 15 79.433	
23 74.131 112 66.069		23 89.125 16 79.433	
10 74.131 26 66.069		131 89.125 8 78.977	
116 74.131 106 64.565		138 89.125 112 77.625	
12 74.131 114 64.565		116 85.114 7 77.625	
39 72.444 24 64.565		118 85.114 26 77.625	
138 72.444 20 64.565		104 85.114 24 77.625	
11 72.444 111 64.565		121 85.114 117 77.625	
118 70.795 34 63.826		5 85.114 3 77.446	
135 70.795 140 63.096		10 83.176 20 75.858	
130 70.795 14 61.660		21 83.176 136 75.858	
21 69.183 136 61.660		11 83.176 140 75.858	
5 69.183 1 61.660		39 83.176 111 75.858	
31 69.183 117 60.256		135 83.176 114 75.858	
33 69.183 109 58.884		33 83.176 14 72.444	
15 69.183 35 57.544		110 81.283 34 72.111	
4 68.234 115 54.954		130 81.283 109 70.795	
27 67.608 113 53.703		106 81.283 113 67.608	
36 67.608 133 51.286		22 81.283 133 64.565	
121 67.608 19 48.978		4 79.799 115 61.660	
107 67.608 104 45.709		27 79.433 19 58.884	
7 67.608 40 40.738		31 79.433 126 42.658 (*)	
8 67.104 126 36.308		32 79.433 40 39.811 (*)	
3 66.681 38 24.547 (*)		35 79.433 38 31.623 (*)	
Strong acid calculated from pH		Strong acid calculated from pH	
Sample no.: 3		Sample no.: 4	
Theoretical value:	30.000	Theoretical value:	37.500
Unit: µeq/l		Unit: µeq/l	
Run 1:		Run 1:	
Number of laboratories:	56	Number of laboratories:	56
Arithmetic mean value:	28.475	Arithmetic mean value:	34.354
Median:	28.840	Median:	34.674
Standard deviation	5.435	Standard deviation	6.225
Rel. st. deviation (%)	19.088	Rel. st. deviation (%)	18.119
Run 2:		Run 2:	
Number of laboratories:	53	Number of laboratories:	52
Arithmetic mean value:	28.937	Arithmetic mean value:	35.163
Median:	28.840	Median:	34.674
Standard deviation	3.882	Standard deviation	3.974
Rel. st. deviation (%)	13.414	Rel. st. deviation (%)	11.301
Results in decreasing order:		Results in decreasing order:	
30 39.506 (*) 140 28.840		30 47.863 (*) 106 34.674	
18 37.154 8 28.609		6 43.652 107 34.674	
6 35.481 3 28.314		36 42.658 4 34.674	
1 34.674 112 28.184		1 41.687 7 34.674	
36 34.674 15 28.184		18 39.811 13 34.674	
12 34.674 24 28.184		5 39.811 8 34.415	
131 33.113 26 28.184		130 39.811 112 33.884	
10 33.113 107 28.184		10 39.811 20 33.884	
120 32.359 115 27.542		23 39.811 31 33.884	
23 32.359 22 27.542		131 39.811 114 33.884	
118 31.623 32 27.542		12 38.905 110 33.884	
104 31.623 20 27.542		118 38.905 22 33.113	
5 31.623 114 27.542		104 38.019 136 33.113	
121 31.623 110 26.915		138 38.019 117 33.113	
130 31.623 111 26.915		121 37.154 24 33.113	
116 31.623 35 26.915		39 37.154 34 32.734	
138 31.623 117 26.915		32 37.154 16 32.359	
135 30.903 34 26.853		116 37.154 109 31.623	
13 30.200 136 26.303		120 36.308 115 30.903	
11 30.200 16 25.704		33 36.308 140 30.903	
4 29.717 14 25.119		135 36.308 111 29.512	
39 29.512 109 24.547		11 36.308 133 28.840	
21 29.512 113 21.878		21 35.481 113 28.184	
27 29.512 133 20.417		15 35.481 14 26.303	
33 29.512 19 17.783		3 34.995 19 22.909	
7 29.512 38 17.783		26 34.674 126 19.498 (*)	
31 28.840 126 16.982 (*)		27 34.674 38 19.498 (*)	
106 28.840 40 4.467 (*)		35 34.674 40 8.511 (*)	

Table 24: Analytical results for strong acid in precipitations samples.

H				H			
Sample no.:	G1			Sample no.:	G2		
Theoretical value:	75.000			Theoretical value:	85.000		
Unit:	µeq			Unit:	µeq		
Run 1:				Run 1:			
Number of laboratories:	3			Number of laboratories:	3		
Arithmetic mean value:	79.067			Arithmetic mean value:	94.167		
Median:	79.000			Median:	94.000		
Standard deviation	3.900			Standard deviation	6.752		
Rel. st. deviation (%)	4.933			Rel. st. deviation (%)	7.170		
Run 2:				Run 2:			
Number of laboratories:	3			Number of laboratories:	3		
Arithmetic mean value:	79.067			Arithmetic mean value:	94.167		
Median:	79.000			Median:	94.000		
Standard deviation	3.900			Standard deviation	6.752		
Rel. st. deviation (%)	4.933			Rel. st. deviation (%)	7.170		
Results in decreasing order:				Results in decreasing order:			
6	83.000	14	75.200	126	101.000	14	87.500
126	79.000			6	94.000		
H				H			
Sample no.:	G3			Sample no.:	G4		
Theoretical value:	30.000			Theoretical value:	37.500		
Unit:	µeq			Unit:	µeq		
Run 1:				Run 1:			
Number of laboratories:	3			Number of laboratories:	3		
Arithmetic mean value:	41.267			Arithmetic mean value:	44.500		
Median:	39.000			Median:	47.000		
Standard deviation	10.780			Standard deviation	9.014		
Rel. st. deviation (%)	26.123			Rel. st. deviation (%)	20.256		
Run 2:				Run 2:			
Number of laboratories:	3			Number of laboratories:	3		
Arithmetic mean value:	41.267			Arithmetic mean value:	44.500		
Median:	39.000			Median:	47.000		
Standard deviation	10.780			Standard deviation	9.014		
Rel. st. deviation (%)	26.123			Rel. st. deviation (%)	20.256		
Results in decreasing order:				Results in decreasing order:			
126	53.000	14	31.800	126	52.000	14	34.500
6	39.000			6	47.000		

Table 25: Analytical results for chloride in precipitations samples.

Cl				Cl			
Sample no.: G1				Sample no.: G2			
Theoretical value:		0.145		Theoretical value:		0.203	
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories:		49		Number of laboratories:		49	
Arithmetic mean value:		0.148		Arithmetic mean value:		0.209	
Median:		0.140		Median:		0.198	
Standard deviation		0.067		Standard deviation		0.075	
Rel. st. deviation (%)		45.459		Rel. st. deviation (%)		36.100	
Run 2:				Run 2:			
Number of laboratories:		48		Number of laboratories:		48	
Arithmetic mean value:		0.140		Arithmetic mean value:		0.200	
Median:		0.140		Median:		0.198	
Standard deviation		0.039		Standard deviation		0.042	
Rel. st. deviation (%)		27.833		Rel. st. deviation (%)		21.243	
Results in decreasing order:				Results in decreasing order:			
133	0.526 (*)	26	0.140	133	0.638 (*)	26	0.197
110	0.250	38	0.140	32	0.298	36	0.195
115	0.220	32	0.139	118	0.290	7	0.195
40	0.219	34	0.138	115	0.290	4	0.193
120	0.200	39	0.136	40	0.283	14	0.193
113	0.190	14	0.136	110	0.280	15	0.191
118	0.190	35	0.135	120	0.260	104	0.190
33	0.187	16	0.133	140	0.250	16	0.188
140	0.170	24	0.130	33	0.250	34	0.187
5	0.160	126	0.130	113	0.230	6	0.183
31	0.156	104	0.130	114	0.220	18	0.180
136	0.153	15	0.129	5	0.212	126	0.180
1	0.150	6	0.121	3	0.210	24	0.180
7	0.150	130	0.120	38	0.210	136	0.176
114	0.150	23	0.115	39	0.210	116	0.165
21	0.148	11	0.106	107	0.207	130	0.160
3	0.147	116	0.105	27	0.206	11	0.157
30	0.147	22	0.105	30	0.205	23	0.156
13	0.146	20	0.101	21	0.203	20	0.152
27	0.145	131	0.099	13	0.203	22	0.142
107	0.144	138	0.092	31	0.201	131	0.138
4	0.141	135	0.075	12	0.200	138	0.135
36	0.141	18	0.045	1	0.200	135	0.129
12	0.140	10	0.043	8	0.200	10	0.116
8	0.140			35	0.198		
Cl				Cl			
Sample no.: G3				Sample no.: G4			
Theoretical value:		0.579		Theoretical value:		0.637	
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories:		55		Number of laboratories:		55	
Arithmetic mean value:		0.558		Arithmetic mean value:		0.616	
Median:		0.565		Median:		0.613	
Standard deviation		0.051		Standard deviation		0.050	
Rel. st. deviation (%)		9.142		Rel. st. deviation (%)		8.138	
Run 2:				Run 2:			
Number of laboratories:		53		Number of laboratories:		52	
Arithmetic mean value:		0.558		Arithmetic mean value:		0.612	
Median:		0.565		Median:		0.612	
Standard deviation		0.044		Standard deviation		0.035	
Rel. st. deviation (%)		7.870		Rel. st. deviation (%)		5.652	
Results in decreasing order:				Results in decreasing order:			
40	0.704 (*)	15	0.561	40	0.825 (*)	32	0.611
33	0.657	126	0.560	113	0.740 (*)	130	0.610
140	0.650	14	0.551	115	0.700	39	0.610
113	0.640	130	0.550	140	0.690	4	0.603
32	0.640	30	0.550	18	0.674	14	0.603
18	0.629	4	0.548	33	0.666	107	0.602
115	0.620	6	0.547	110	0.660	20	0.602
118	0.600	107	0.546	31	0.647	104	0.600
111	0.596	19	0.546	27	0.640	116	0.597
114	0.590	131	0.540	12	0.640	138	0.597
12	0.590	34	0.539	114	0.640	34	0.595
38	0.590	20	0.532	118	0.640	131	0.593
26	0.585	104	0.530	26	0.640	120	0.590
1	0.580	109	0.530	5	0.635	135	0.588
110	0.580	135	0.525	15	0.634	19	0.588
31	0.578	24	0.520	3	0.632	109	0.580
21	0.575	16	0.515	8	0.632	126	0.580
27	0.575	112	0.510	21	0.631	24	0.580
5	0.574	11	0.508	13	0.627	133	0.576
13	0.573	117	0.499	35	0.626	11	0.568
3	0.572	121	0.497	111	0.624	117	0.565
116	0.572	23	0.494	136	0.623	121	0.561
120	0.570	39	0.486	7	0.622	112	0.560
136	0.570	138	0.486	1	0.620	16	0.558
8	0.569	10	0.477	38	0.620	10	0.544
35	0.567	133	0.467	36	0.619	23	0.540
7	0.567	22	0.420 (*)	6	0.614	22	0.495 (*)
36	0.565			30	0.613		

Table 26: Analytical results for sodium in precipitations samples.

Na				Na			
Sample no.: G1				Sample no.: G2			
Theoretical value:		0.336		Theoretical value:		0.454	
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories:		53		Number of laboratories:		53	
Arithmetic mean value:		0.326		Arithmetic mean value:		0.438	
Median:		0.330		Median:		0.444	
Standard deviation		0.042		Standard deviation		0.039	
Rel. st. deviation (%)		12.765		Rel. st. deviation (%)		8.962	
Run 2:				Run 2:			
Number of laboratories:		49		Number of laboratories:		48	
Arithmetic mean value:		0.326		Arithmetic mean value:		0.439	
Median:		0.330		Median:		0.444	
Standard deviation		0.026		Standard deviation		0.028	
Rel. st. deviation (%)		7.965		Rel. st. deviation (%)		6.376	
Results in decreasing order:				Results in decreasing order:			
140	0.460 (*)	110	0.330	32	0.550 (*)	114	0.440
118	0.420 (*)	130	0.330	109	0.530 (*)	19	0.439
32	0.400	138	0.321	121	0.510	20	0.439
109	0.390	1	0.320	118	0.490	104	0.430
4	0.379	21	0.319	22	0.490	138	0.430
22	0.370	35	0.319	1	0.480	35	0.429
126	0.360	135	0.317	4	0.479	135	0.423
112	0.350	131	0.314	126	0.470	34	0.422
30	0.343	10	0.314	112	0.460	12	0.420
14	0.343	117	0.312	131	0.460	110	0.420
26	0.342	34	0.311	36	0.458	33	0.420
104	0.340	12	0.310	26	0.457	140	0.420
7	0.340	33	0.310	5	0.456	120	0.420
39	0.338	120	0.308	39	0.456	10	0.419
36	0.337	38	0.307	13	0.455	23	0.415
5	0.336	3	0.307	107	0.454	11	0.415
6	0.335	31	0.306	30	0.453	31	0.415
13	0.335	133	0.300	7	0.453	117	0.410
27	0.334	11	0.296	15	0.450	3	0.407
107	0.334	23	0.292	130	0.450	38	0.397
20	0.333	40	0.288	16	0.450	40	0.385
8	0.332	111	0.282	8	0.449	113	0.380
19	0.331	113	0.280	27	0.448	111	0.377
114	0.330	115	0.270	116	0.448	136	0.356 (*)
16	0.330	116	0.204 (*)	6	0.447	133	0.350 (*)
15	0.330	136	0.200 (*)	21	0.444	115	0.350 (*)
121	0.330			14	0.444		
Na				Na			
Sample no.: G3				Sample no.: G4			
Theoretical value:		0.537		Theoretical value:		0.789	
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories:		53		Number of laboratories:		53	
Arithmetic mean value:		0.523		Arithmetic mean value:		0.749	
Median:		0.527		Median:		0.760	
Standard deviation		0.060		Standard deviation		0.075	
Rel. st. deviation (%)		11.535		Rel. st. deviation (%)		9.977	
Run 2:				Run 2:			
Number of laboratories:		48		Number of laboratories:		50	
Arithmetic mean value:		0.512		Arithmetic mean value:		0.754	
Median:		0.524		Median:		0.760	
Standard deviation		0.038		Standard deviation		0.051	
Rel. st. deviation (%)		7.379		Rel. st. deviation (%)		6.703	
Results in decreasing order:				Results in decreasing order:			
22	0.718 (*)	6	0.526	22	0.994 (*)	109	0.760
116	0.683 (*)	30	0.523	32	0.870	110	0.760
32	0.670 (*)	110	0.520	1	0.840	34	0.759
109	0.650 (*)	16	0.520	4	0.823	131	0.756
118	0.580	35	0.518	118	0.820	12	0.750
140	0.580	104	0.510	126	0.800	135	0.750
1	0.570	12	0.510	36	0.798	120	0.743
4	0.567	120	0.502	7	0.795	11	0.743
126	0.560	14	0.500	5	0.795	3	0.742
39	0.543	34	0.496	107	0.793	140	0.740
7	0.540	10	0.494	112	0.790	10	0.736
5	0.540	3	0.492	39	0.787	23	0.734
112	0.540	135	0.491	26	0.785	14	0.733
36	0.539	31	0.488	21	0.785	138	0.719
107	0.537	11	0.487	20	0.781	113	0.710
26	0.536	23	0.486	8	0.781	31	0.706
21	0.535	138	0.476	114	0.780	33	0.700
20	0.535	117	0.471	130	0.780	121	0.680
8	0.532	113	0.460	35	0.779	117	0.677
131	0.531	33	0.460	30	0.778	136	0.664
15	0.530	40	0.451	27	0.775	111	0.654
114	0.530	111	0.448	16	0.770	38	0.651
121	0.530	38	0.447	19	0.769	40	0.651
130	0.530	136	0.427	13	0.769	115	0.630
19	0.529	115	0.420	6	0.767	133	0.550 (*)
13	0.527	133	0.400 (*)	104	0.760	116	0.494 (*)
27	0.527			15	0.760		

Table 27: Analytical results for magnesium in precipitations samples.

Mg				Mg			
Sample no.: G1				Sample no.: G2			
Theoretical value:	0.155			Theoretical value:	0.077		
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories:	52			Number of laboratories:	52		
Arithmetic mean value:	0.151			Arithmetic mean value:	0.079		
Median:	0.151			Median:	0.078		
Standard deviation	0.020			Standard deviation	0.014		
Rel. st. deviation (%)	13.083			Rel. st. deviation (%)	17.992		
Run 2:				Run 2:			
Number of laboratories:	47			Number of laboratories:	50		
Arithmetic mean value:	0.152			Arithmetic mean value:	0.077		
Median:	0.152			Median:	0.078		
Standard deviation	0.010			Standard deviation	0.008		
Rel. st. deviation (%)	6.551			Rel. st. deviation (%)	10.053		
Results in decreasing order:				Results in decreasing order:			
20	0.213 (*)	107	0.151	126	0.150 (*)	5	0.078
126	0.210 (*)	14	0.151	20	0.125 (*)	14	0.077
118	0.171	114	0.150	136	0.101	120	0.077
112	0.170	115	0.150	112	0.090	39	0.077
138	0.169	117	0.150	30	0.088	12	0.076
135	0.163	23	0.150	138	0.088	117	0.076
34	0.162	16	0.150	22	0.084	36	0.076
3	0.161	121	0.150	118	0.083	11	0.076
33	0.160	110	0.150	135	0.083	16	0.076
104	0.160	130	0.150	3	0.081	40	0.076
7	0.160	27	0.150	13	0.080	27	0.075
15	0.160	8	0.149	1	0.080	35	0.075
22	0.159	30	0.149	15	0.080	8	0.075
31	0.159	111	0.147	31	0.080	116	0.074
13	0.159	6	0.147	104	0.080	34	0.074
131	0.158	12	0.147	130	0.080	111	0.073
21	0.157	40	0.143	33	0.080	23	0.073
5	0.156	1	0.140	114	0.080	140	0.070
11	0.156	113	0.140	113	0.080	109	0.070
26	0.155	4	0.136	121	0.079	115	0.070
19	0.155	38	0.133	131	0.079	4	0.068
10	0.154	133	0.127	10	0.079	133	0.068
120	0.154	140	0.120	21	0.079	6	0.067
35	0.153	136	0.108 (*)	26	0.079	110	0.060
39	0.153	109	0.100 (*)	7	0.078	107	0.056
36	0.152	116	0.091 (*)	19	0.078	38	0.055
Mg				Mg			
Sample no.: G3				Sample no.: G4			
Theoretical value:	0.093			Theoretical value:	0.116		
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories:	52			Number of laboratories:	52		
Arithmetic mean value:	0.092			Arithmetic mean value:	0.114		
Median:	0.090			Median:	0.116		
Standard deviation	0.016			Standard deviation	0.016		
Rel. st. deviation (%)	17.044			Rel. st. deviation (%)	14.136		
Run 2:				Run 2:			
Number of laboratories:	50			Number of laboratories:	50		
Arithmetic mean value:	0.092			Arithmetic mean value:	0.114		
Median:	0.090			Median:	0.116		
Standard deviation	0.009			Standard deviation	0.010		
Rel. st. deviation (%)	9.734			Rel. st. deviation (%)	8.634		
Results in decreasing order:				Results in decreasing order:			
126	0.160 (*)	1	0.090	126	0.180 (*)	19	0.115
20	0.123	114	0.090	20	0.142	8	0.114
22	0.112	115	0.090	112	0.130	135	0.114
35	0.108	8	0.090	35	0.129	120	0.113
116	0.104	27	0.090	138	0.126	16	0.113
138	0.104	16	0.090	22	0.125	27	0.112
135	0.100	104	0.090	118	0.123	12	0.111
112	0.100	15	0.090	7	0.123	11	0.111
118	0.099	109	0.090	1	0.120	121	0.110
3	0.098	33	0.090	33	0.120	130	0.110
7	0.097	113	0.090	3	0.120	113	0.110
131	0.097	12	0.089	104	0.120	114	0.110
121	0.095	111	0.088	131	0.119	115	0.110
13	0.095	30	0.087	21	0.119	6	0.109
21	0.095	117	0.087	13	0.118	23	0.109
26	0.094	23	0.085	10	0.118	111	0.109
5	0.094	6	0.084	30	0.118	117	0.108
10	0.093	133	0.082	26	0.118	40	0.101
36	0.093	4	0.081	5	0.117	140	0.100
19	0.093	40	0.081	14	0.117	110	0.100
31	0.093	107	0.081	36	0.116	109	0.100
34	0.092	110	0.080	39	0.116	4	0.098
120	0.092	130	0.080	107	0.116	133	0.097
39	0.092	140	0.080	15	0.116	38	0.092
14	0.091	38	0.068	31	0.116	116	0.087
11	0.091	136	0.029 (*)	34	0.116	136	0.050 (*)

Table 28: Analytical results for calcium in precipitations samples.

Ca				Ca			
Sample no.: G1				Sample no.: G2			
Theoretical value:		0.287		Theoretical value:		0.192	
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories:		53		Number of laboratories:		53	
Arithmetic mean value:		0.288		Arithmetic mean value:		0.203	
Median:		0.283		Median:		0.192	
Standard deviation		0.063		Standard deviation		0.045	
Rel. st. deviation (%)		21.760		Rel. st. deviation (%)		22.266	
Run 2:				Run 2:			
Number of laboratories:		49		Number of laboratories:		50	
Arithmetic mean value:		0.288		Arithmetic mean value:		0.199	
Median:		0.283		Median:		0.192	
Standard deviation		0.032		Standard deviation		0.028	
Rel. st. deviation (%)		11.054		Rel. st. deviation (%)		14.253	
Results in decreasing order:				Results in decreasing order:			
104	0.510 (*)	21	0.283	104	0.410 (*)	14	0.192
118	0.450 (*)	30	0.281	114	0.300 (*)	19	0.191
22	0.386	34	0.280	118	0.290	15	0.190
107	0.359	13	0.280	20	0.252	33	0.190
20	0.358	19	0.280	130	0.250	38	0.190
117	0.331	140	0.280	107	0.242	13	0.190
126	0.330	8	0.279	109	0.240	110	0.190
109	0.330	131	0.278	126	0.240	21	0.188
138	0.322	7	0.278	135	0.236	11	0.188
10	0.310	31	0.277	133	0.236	120	0.187
115	0.310	111	0.275	136	0.229	7	0.187
33	0.310	27	0.273	138	0.228	111	0.185
32	0.300	3	0.273	140	0.220	35	0.184
110	0.300	135	0.271	10	0.214	27	0.183
112	0.300	4	0.270	131	0.212	8	0.182
1	0.300	35	0.270	22	0.209	32	0.180
130	0.300	38	0.266	1	0.200	12	0.180
15	0.300	23	0.262	3	0.200	4	0.180
26	0.292	12	0.260	115	0.200	30	0.178
114	0.290	113	0.260	112	0.200	34	0.175
36	0.290	6	0.260	5	0.198	23	0.164
5	0.290	40	0.242	31	0.197	6	0.164
39	0.288	121	0.220	117	0.196	113	0.160
16	0.288	136	0.200	36	0.195	40	0.153
14	0.283	133	0.136 (*)	26	0.195	121	0.130
120	0.283	116	0.049 (*)	39	0.195	116	0.087 (*)
11	0.283			16	0.192		
Ca				Ca			
Sample no.: G3				Sample no.: G4			
Theoretical value:		0.326		Theoretical value:		0.239	
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories:		53		Number of laboratories:		53	
Arithmetic mean value:		0.318		Arithmetic mean value:		0.241	
Median:		0.322		Median:		0.239	
Standard deviation		0.065		Standard deviation		0.044	
Rel. st. deviation (%)		20.330		Rel. st. deviation (%)		18.260	
Run 2:				Run 2:			
Number of laboratories:		49		Number of laboratories:		48	
Arithmetic mean value:		0.320		Arithmetic mean value:		0.234	
Median:		0.322		Median:		0.238	
Standard deviation		0.035		Standard deviation		0.028	
Rel. st. deviation (%)		10.801		Rel. st. deviation (%)		11.984	
Results in decreasing order:				Results in decreasing order:			
107	0.520 (*)	14	0.322	109	0.380 (*)	21	0.239
104	0.470 (*)	16	0.320	107	0.370 (*)	26	0.237
118	0.400	34	0.320	104	0.340 (*)	19	0.236
22	0.390	117	0.319	118	0.330 (*)	31	0.236
35	0.363	19	0.317	126	0.300	120	0.235
138	0.362	8	0.314	140	0.290	34	0.235
1	0.360	120	0.314	10	0.288	30	0.235
131	0.351	111	0.312	35	0.259	8	0.234
126	0.350	30	0.308	138	0.258	13	0.231
10	0.350	133	0.308	7	0.251	111	0.229
140	0.350	4	0.307	1	0.250	27	0.227
7	0.342	6	0.306	115	0.250	135	0.226
135	0.341	38	0.304	15	0.250	131	0.225
115	0.340	27	0.304	112	0.250	11	0.223
15	0.340	12	0.300	130	0.250	12	0.220
112	0.340	33	0.290	32	0.250	4	0.220
110	0.340	20	0.290	38	0.250	20	0.218
3	0.332	23	0.286	117	0.247	23	0.217
36	0.332	130	0.280	3	0.244	6	0.214
31	0.332	40	0.270	36	0.244	40	0.192
26	0.330	109	0.260	39	0.242	113	0.190
114	0.330	113	0.250	5	0.241	22	0.189
5	0.329	121	0.240	33	0.240	136	0.175
21	0.329	32	0.220	16	0.240	121	0.160
39	0.328	136	0.123 (*)	114	0.240	133	0.156
11	0.322	116	0.077 (*)	110	0.240	116	0.153 (*)
13	0.322			14	0.239		

Table 29: Analytical results for potassium in precipitations samples.

K				K			
Sample no.: G1				Sample no.: G2			
Theoretical value: 0.280				Theoretical value: 0.178			
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories: 52				Number of laboratories: 52			
Arithmetic mean value: 0.278				Arithmetic mean value: 0.180			
Median: 0.272				Median: 0.176			
Standard deviation 0.073				Standard deviation 0.045			
Rel. st. deviation (%) 26.327				Rel. st. deviation (%) 25.239			
Run 2:				Run 2:			
Number of laboratories: 50				Number of laboratories: 50			
Arithmetic mean value: 0.266				Arithmetic mean value: 0.172			
Median: 0.271				Median: 0.176			
Standard deviation 0.035				Standard deviation 0.024			
Rel. st. deviation (%) 13.027				Rel. st. deviation (%) 13.776			
Results in decreasing order:				Results in decreasing order:			
133	0.700 (*)	22	0.272	109	0.390 (*)	7	0.176
109	0.450 (*)	114	0.270	116	0.355 (*)	31	0.176
118	0.360	126	0.270	22	0.213	21	0.174
32	0.320	130	0.270	117	0.211	5	0.174
30	0.314	12	0.270	112	0.210	8	0.171
112	0.310	27	0.270	32	0.210	23	0.171
35	0.290	36	0.269	38	0.206	130	0.170
104	0.290	117	0.266	118	0.200	114	0.170
6	0.288	21	0.264	133	0.200	36	0.169
5	0.287	111	0.261	131	0.195	135	0.168
14	0.286	1	0.260	14	0.191	4	0.167
20	0.286	4	0.260	12	0.190	16	0.166
3	0.285	31	0.255	3	0.184	138	0.161
19	0.285	131	0.254	26	0.182	30	0.160
26	0.284	138	0.254	19	0.182	111	0.160
107	0.283	34	0.251	6	0.182	104	0.160
38	0.282	33	0.250	15	0.180	33	0.160
15	0.280	110	0.250	1	0.180	140	0.160
121	0.280	120	0.245	110	0.180	120	0.155
13	0.280	140	0.240	126	0.180	136	0.152
39	0.278	113	0.240	35	0.180	113	0.150
16	0.275	10	0.226	13	0.180	10	0.135
135	0.275	40	0.209	20	0.179	34	0.133
7	0.273	115	0.180	107	0.178	121	0.120
23	0.273	116	0.164	27	0.177	115	0.110
8	0.272	136	0.158	39	0.177	40	0.101
K				K			
Sample no.: G3				Sample no.: G4			
Theoretical value: 0.331				Theoretical value: 0.127			
Unit: µg/l				Unit: µg/l			
Run 1:				Run 1:			
Number of laboratories: 52				Number of laboratories: 52			
Arithmetic mean value: 0.313				Arithmetic mean value: 0.125			
Median: 0.322				Median: 0.124			
Standard deviation 0.065				Standard deviation 0.034			
Rel. st. deviation (%) 20.879				Rel. st. deviation (%) 27.346			
Run 2:				Run 2:			
Number of laboratories: 49				Number of laboratories: 50			
Arithmetic mean value: 0.315				Arithmetic mean value: 0.120			
Median: 0.324				Median: 0.123			
Standard deviation 0.038				Standard deviation 0.020			
Rel. st. deviation (%) 12.156				Rel. st. deviation (%) 16.884			
Results in decreasing order:				Results in decreasing order:			
109	0.590 (*)	104	0.320	116	0.307 (*)	7	0.124
32	0.400	114	0.320	133	0.200 (*)	14	0.123
22	0.394	12	0.320	118	0.160	5	0.122
20	0.363	36	0.319	112	0.160	8	0.121
118	0.360	131	0.316	22	0.157	130	0.120
112	0.360	14	0.316	31	0.141	33	0.120
35	0.345	21	0.310	126	0.140	114	0.120
5	0.344	4	0.307	109	0.140	13	0.120
126	0.340	130	0.300	12	0.140	135	0.119
38	0.336	1	0.300	32	0.140	36	0.119
3	0.335	111	0.299	140	0.140	30	0.118
6	0.334	23	0.297	3	0.133	4	0.117
19	0.333	34	0.295	38	0.132	111	0.113
26	0.333	30	0.291	19	0.131	136	0.111
107	0.332	33	0.290	1	0.130	131	0.111
39	0.331	120	0.289	34	0.130	120	0.111
7	0.331	113	0.280	15	0.129	113	0.110
31	0.331	140	0.280	26	0.129	23	0.104
110	0.330	138	0.279	6	0.129	104	0.100
15	0.330	10	0.264	35	0.129	110	0.100
27	0.330	121	0.260	21	0.127	138	0.092
117	0.328	40	0.238	27	0.126	10	0.091
16	0.325	136	0.206	16	0.125	40	0.077
13	0.325	115	0.200	39	0.125	121	0.076
135	0.325	116	0.155 (*)	107	0.124	115	0.070
8	0.324	133	0.100 (*)	20	0.124	117	0.068

Table 30: Analytical results for conductivity in precipitations samples.

Cond.		Cond.	
Sample no.: G1		Sample no.: G2	
Theoretical value:	43.300	Theoretical value:	44.600
Unit: $\mu\text{S}/\text{cm}$		Unit: $\mu\text{S}/\text{cm}$	
Run 1:		Run 1:	
Number of laboratories:	54	Number of laboratories:	54
Arithmetic mean value:	40.653	Arithmetic mean value:	43.369
Median:	41.700	Median:	44.450
Standard deviation	3.525	Standard deviation	3.473
Rel. st. deviation (%)	8.671	Rel. st. deviation (%)	8.009
Run 2:		Run 2:	
Number of laboratories:	51	Number of laboratories:	51
Arithmetic mean value:	41.277	Arithmetic mean value:	44.059
Median:	42.000	Median:	44.600
Standard deviation	2.392	Standard deviation	1.929
Rel. st. deviation (%)	5.795	Rel. st. deviation (%)	4.379
Results in decreasing order:		Results in decreasing order:	
12 45.700 126 41.700		12 47.700 107 44.400	
14 45.000 111 41.500		31 46.700 32 44.400	
23 45.000 106 41.400		36 46.300 33 44.400	
31 44.570 15 41.400		3 46.200 6 44.200	
115 44.000 117 41.300		21 46.200 5 44.200	
36 43.900 118 41.000		23 46.100 117 43.900	
21 43.730 140 40.900		20 46.030 106 43.800	
19 43.200 138 40.900		115 46.000 138 43.500	
30 43.100 131 40.600		18 45.800 15 43.400	
20 43.020 22 40.300		19 45.500 140 43.200	
3 42.950 1 40.300		114 45.400 131 43.000	
32 42.800 16 39.700		30 45.300 118 43.000	
114 42.700 7 39.300		10 45.200 111 42.800	
27 42.600 136 39.200		104 45.000 121 42.800	
112 42.500 113 38.900		38 45.000 34 42.700	
10 42.500 34 38.700		35 45.000 22 42.600	
35 42.500 11 38.700		120 45.000 11 42.300	
39 42.400 18 38.600		27 44.900 16 42.300	
33 42.250 130 37.800		39 44.800 7 41.600	
107 42.200 38 37.500		14 44.800 136 40.800	
8 42.200 110 37.000		109 44.700 113 40.600	
13 42.200 121 37.000		112 44.700 130 40.500	
109 42.200 135 35.400		13 44.700 110 40.000	
5 42.100 104 35.000		126 44.700 135 37.200	
4 42.000 116 33.120 (*)		4 44.600 116 34.910 (*)	
120 42.000 40 29.000 (*)		1 44.600 24 30.000 (*)	
6 41.700 24 28.000 (*)		8 44.500 40 30.000 (*)	
Cond.		Cond.	
Sample no.: G3		Sample no.: G4	
Theoretical value:	25.700	Theoretical value:	26.200
Unit: $\mu\text{S}/\text{cm}$		Unit: $\mu\text{S}/\text{cm}$	
Run 1:		Run 1:	
Number of laboratories:	54	Number of laboratories:	54
Arithmetic mean value:	25.472	Arithmetic mean value:	25.489
Median:	25.800	Median:	25.900
Standard deviation	1.840	Standard deviation	1.883
Rel. st. deviation (%)	7.225	Rel. st. deviation (%)	7.386
Run 2:		Run 2:	
Number of laboratories:	52	Number of laboratories:	52
Arithmetic mean value:	25.760	Arithmetic mean value:	25.777
Median:	25.800	Median:	25.950
Standard deviation	1.116	Standard deviation	1.166
Rel. st. deviation (%)	4.334	Rel. st. deviation (%)	4.524
Results in decreasing order:		Results in decreasing order:	
130 28.500 13 25.800		114 28.400 34 25.900	
31 28.030 126 25.700		31 28.130 138 25.900	
12 27.600 6 25.700		12 27.900 5 25.800	
104 27.000 117 25.700		104 27.000 6 25.700	
18 26.880 8 25.700		23 26.900 112 25.700	
34 26.800 15 25.700		18 26.830 107 25.600	
14 26.600 10 25.630		36 26.800 140 25.500	
3 26.500 138 25.600		39 26.760 131 25.400	
30 26.500 5 25.600		3 26.660 11 25.400	
36 26.500 140 25.500		21 26.650 15 25.400	
21 26.430 38 25.500		14 26.600 111 25.400	
4 26.300 111 25.500		30 26.600 106 25.300	
121 26.300 106 25.400		20 26.400 7 25.100	
32 26.300 107 25.300		27 26.400 32 25.100	
114 26.300 7 25.200		1 26.400 22 25.100	
1 26.300 11 25.200		19 26.400 110 25.000	
20 26.240 131 25.200		121 26.300 118 25.000	
19 26.200 118 25.000		4 26.300 13 24.800	
27 26.100 22 24.500		10 26.200 38 24.600	
39 26.100 113 24.500		8 26.200 113 24.500	
23 26.100 110 24.000		35 26.130 16 23.800	
115 26.000 136 24.000		33 26.000 136 23.700	
120 26.000 16 23.700		109 26.000 130 23.500	
35 26.000 116 22.600		115 26.000 116 23.250	
109 25.900 135 22.200		117 26.000 135 22.100	
112 25.800 24 18.000 (*)		120 26.000 24 19.000 (*)	
33 25.800 40 18.000 (*)		126 25.900 40 17.000 (*)	

Table 31: Ratio of the measured to the calculated conductivity in synthetic precipitation samples (G1-G4).

Lab.No.	Measured value / calculated value				Remarks
	G1	G2	G3	G4	
1	1.06	1.04	0.96	0.95	
3	1.06	1.10	1.06	1.06	
4	1.03	1.04	1.03	1.04	
5	1.02	0.98	0.97	0.95	
6	0.95	0.91	0.94	0.91	
7	0.97	0.99	0.98	0.99	
8	1.04	1.04	1.02	1.04	
10	1.01	1.04	0.97	1.00	
11	0.99	1.02	1.17	1.08	NH ₄ ⁺ and K ⁺ are missing
12	1.06	1.02	1.01	1.05	
13	1.01	1.03	0.99	0.98	
14	1.15	1.10	1.11	1.20	
15	1.01	1.02	1.05	1.01	
16	1.01	1.00	1.00	0.99	
18					Reports only NH ₄ ⁺ , Cl ⁻ , pH and cond
19	1.30	1.31	1.25	1.29	Cl ⁻ values < LOD
20	1.07	1.10	1.05	1.06	
21	1.06	1.05	1.04	1.04	
22	1.02	1.00	1.00	1.04	
23	1.05	1.00	1.00	1.02	
24	0.77	0.77	0.86	0.92	K ⁺ , Ca ²⁺ , Na ⁺ and Mg ²⁺ are missing
26					Cond. is missing
27	1.04	1.04	1.02	1.05	
30	0.90	0.93	0.93	0.90	
31	1.08	1.09	1.10	1.12	
32	1.07	1.03	1.05	0.98	
33	1.01	1.00	1.00	1.00	
34	0.99	1.07	1.11	1.06	
35	1.13	1.04	1.04	1.03	
36	1.08	1.08	0.97	0.96	
38	1.44	1.69	1.19	1.24	
39	1.00	1.00	1.04	1.02	
40					SO ₄ ²⁻ is missing
104	1.03	1.00	1.02	1.02	
107	1.02	1.03	0.99	1.00	
109	1.11	1.11	1.05	1.07	Cl ⁻ values < LOD
110	0.93	0.93	1.00	1.04	
111	1.06	1.05	1.05	1.11	Cl ⁻ values < LOD
112	1.07	1.07	1.04	1.03	Cl ⁻ values < LOD
113	1.13	1.09	1.12	1.11	
114	1.06	1.07	1.05	1.13	
115	1.22	1.26	1.08	1.10	
116	0.80	0.77	0.88	0.90	
117	1.11	1.06	1.07	1.09	Cl ⁻ value missing
118	0.95	0.93	0.92	0.91	
120	0.59	0.95	0.97	1.00	
121	0.91	0.95	1.02	1.02	
126	0.95	1.00	0.85	0.93	
130	0.65	0.67	0.83	0.65	
131	0.92	0.93	0.94	0.95	
133					Cond. is missing
135	0.85	0.84	0.85	0.86	
136	1.16	1.06	1.28	1.08	
138	0.95	0.94	0.97	0.99	
140	1.06	1.05	1.01	1.07	

Table 32: Ratio of equivalent concentration of anions to the equivalent concentration of cation measured in synthetic precipitation samples.

Lab.No.	Measured value / calculated value					Remarks
	G1	G2	G3	G4	Average	
1	1.11	1.05	0.97	0.95	1.02	
3	1.07	1.08	1.03	1.01	1.05	
4	1.06	1.07	1.02	1.04	1.05	
5	1.06	1.03	1.01	0.99	1.02	
6	0.98	0.95	0.96	0.96	0.96	
7	1.04	1.06	1.00	1.01	1.03	
8	1.08	1.09	1.04	1.05	1.06	
10	0.95	1.00	0.97	0.91	0.96	
11	1.33	1.20	1.51	1.18	1.30	NH ₄ ⁺ and K ⁺ are missing
12	1.06	1.00	1.04	1.03	1.03	
13	0.97	1.10	1.02	1.07	1.04	
14	1.13	1.17	1.11	1.21	1.15	
15	1.00	1.02	1.00	1.00	1.01	
16	1.01	1.02	1.02	1.01	1.01	
17						
18	0.83	0.78	0.74	0.46	0.70	Reports only NH ₄ ⁺ , Cl ⁻ , pH and cond
19	1.10	1.13	1.07	1.08	1.09	Cl ⁻ values < LOD
20	1.00	1.01	0.99	1.01	1.00	
21	1.05	1.03	1.01	1.01	1.02	
22	0.92	0.89	0.82	0.81	0.86	
23	1.01	0.99	0.99	0.98	0.99	
24	1.54	1.41	1.83	2.08	1.71	K ⁺ , Ca ²⁺ , Na ⁺ and Mg ²⁺ are missing
26	1.05	1.06	1.01	1.02	1.03	
27	1.08	1.08	1.04	1.05	1.06	
30	0.88	0.90	0.91	0.87	0.89	
31	1.06	1.06	1.03	1.03	1.05	
32	1.15	1.13	1.15	1.03	1.11	
33	1.06	1.07	1.09	1.08	1.08	
34	1.05	1.11	1.03	1.02	1.05	
35	1.15	1.11	1.02	1.03	1.08	
36	1.06	1.06	0.97	0.94	1.01	
38	1.62	1.74	1.27	1.35	1.50	
39	1.03	1.11	0.91	0.96	1.00	
40						SO ₄ ²⁻ is missing
104	1.17	0.98	0.89	0.92	0.99	
107	1.02	1.11	0.88	0.94	0.99	
109	0.83	0.79	0.70	0.61	0.73	Cl ⁻ values < LOD
110	1.09	1.13	0.94	0.96	1.03	
111	1.13	1.12	0.98	1.05	1.07	Cl ⁻ values < LOD
112	1.00	1.05	0.89	0.91	0.96	Cl ⁻ values < LOD
113	1.19	1.12	1.04	0.99	1.08	
114	1.10	1.11	0.98	0.98	1.04	
115	1.24	1.34	1.01	1.15	1.19	
116	1.08	0.92	0.93	0.98	0.98	
117	1.08	1.05	0.95	1.00	1.02	Cl ⁻ value missing
118	1.00	1.09	0.93	0.94	0.99	
120	0.69	1.04	0.96	1.01	0.93	
121	1.14	1.11	0.94	1.07	1.06	
126	2.46	3.00	1.91	1.96	2.33	
130	2.31	2.51	1.86	1.93	2.15	
131	1.01	1.00	0.90	0.94	0.96	
133	1.73	1.71	1.32	1.44	1.55	
135	1.06	1.04	0.97	0.98	1.01	
136	0.97	0.87	0.96	0.80	0.90	
138	1.03	1.05	0.96	1.00	1.01	
140	1.04	1.05	0.88	0.96	0.98	

Table 33: The ratio of the median values to the theoretical values for all parameters and samples.

Parameter	Sample No.	Median / Expected
SO4-S	G1	1.00
	G2	1.03
	G3	1.02
	G4	1.00
NO3-N	G1	1.00
	G2	0.99
	G3	0.99
	G4	0.99
NH4-N	G1	1.02
	G2	1.00
	G3	0.99
	G4	0.99
pH (calc.From H+)	G1	0.89
	G2	0.93
	G3	0.96
	G4	0.92
H	G1	1.05
	G2	1.11
	G3	1.30
	G4	1.25
Mg	G1	0.98
	G2	1.01
	G3	0.98
	G4	1.00
Na	G1	0.98
	G2	0.97
	G3	0.98
	G4	0.96
Cl	G1	0.97
	G2	0.98
	G3	0.98
	G4	0.96
Ca	G1	0.99
	G2	1.01
	G3	0.99
	G4	1.00
K	G1	0.97
	G2	0.99
	G3	0.97
	G4	0.98
Cond	G1	0.96
	G2	1.00
	G3	1.00
	G4	0.99

Table 34: Analytical methods used for the determination of chemical constituents in precipitation samples.

Constituents	Methods	Laboratory
SO ₄	1. Thorin 2. Ion chromatography 3. Capillary electrophoresis 4. ICP-AES 5. FIA	18 1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21, 22, 23, 24, 26, 27, 31,32, 33, 34, 35, 36, 38, 104, 107,110, 111, 114, 115, 116, 118, 126, 130, 131, 133, 135, 136, 138, 140 39 109, 112, 113, 117 121
NO ₃	1 Griess after Cd-red. 2 Ion chromatography 3 UV-method/Photometric 4 Capillary electrophoresis 5 FIA	112,117 1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21, 22, 23, 24, 26, 27, 31,32, 33, 34, 35, 36, 38, 107,110, 113, 114, 115, 116, 118, 126,130, 131, 133, 135, 136, 138, 140 40, 104, 39 109, 111, 121
NH ₄	1 Indophenol 2 Berthelot reaction, salicylate 3 Ion chromatography 4 Flow injection analysis (FIA) 5 Chloramin T 6 Nessler method 7 Kjeldahl 8 Photometry	10, 19, 20, 32, 33, 34, 39, 40, 112, 114, 116, 117, 126, 140 26, 118, 1, 5, 6, 7, 8, 12, 13, 15, 21, 22, 23, 24, 31, 35, 36, 107,113, 115, 131,135,136 14, 27, 109, 111, 121 16 18, 3, 4, 104, 110,114, 133
H ⁺	1 Acidimetric titration 2 Alkali titration to spec. pH	14, 126 6,
Mg	1 Atomic absorption (AAS) 2 Ion chromatography 3 ICP-AES 4 ICP-MS	3, 4, 10, 16, 19, 22, 26, 27, 33, 34, 38, 39, 40, 116, 133 1, 5, 6, 7, 8, 12, 13, 15, 20, 21, 23, 31, 35, 36, 107,113, 114, 126, 130, 131, 135, 136, 138, 140 11, 104, 109, 111, 112, 115, 117, 118, 121 14,
Na	1 AES 2 AAS 3 ICP-AES 5 Ion chromatography 6 ICP-MS	32, 33, 38, 39, 116, 133 3, 4, 10, 16, 19, 26, 27, 34, 40, 11, 104, 109, 110,111, 112, 115, 117,118, 121 1, 5, 6, 7, 8, 12, 13, 15, 20, 21, 22, 23, 31, 35, 36, 107, 113, 114, 126, 130, 131, 135, 136, 138, 140 14
Cl	1 Mercury thiocyanate-iron 2 Ion chromatography 3 Capillary electrophoresis 4 Potensiometric method 5 FIA	18, 117, 40 1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21, 22, 23, 24, 26, 27, 31,32, 33, 34, 35, 36, 38, 104, 107,110, 111, 113, 114, 115, 116, 118, 126,130, 131, 133, 135, 136, 138, 140 39 109, 112 121
Ca	1 AAS 2 ICP-AES 3 Ion chromatography 6 AES 7 ICP-MS	3, 4, 10, 16, 19, 22, 26, 27, 33, 34, 38, 39, 40, 116, 133 11, 104, 109,110, 111, 112, 115,117, 118, 121 1, 5, 6, 7, 8, 12, 15, 20,21, 23, 31, 35, 36, 107, 113, 114, 126, 130, 131, 135, 136, 138, 140 32, 14
K	1 AAS 2 Ion chromatography 3 AES 4 ICP-AES 5 ICP-MS	3, 4, 10, 16, 19, 26, 27, 33, 34, 35, 40, 1, 5, 6, 7, 8, 12, 13, 15, 20, 21, 22, 23, 31, 35, 36, 107, 113, 114, 126,130, 131, 135, 136, 138, 140 32, 39, 116, 133 11, 104, 109, 110,111, 112, 115, 117, 118, 121, 14

Table 35: Relative random and systematic errors obtained by the different laboratories in the analysis of each parameter in the precipitation samples.

Lab. no.	SO ₄ ²⁻		NO ₃ ⁻		NH ₄ ⁺		Mg ²⁺		H ⁺ calc	
	Random error %	Systematic error %	Random error %	Systematic error %	Random error %	Systematic error %	Random error %	Systematic error %	Random error %	Systematic error %
1	2	0	1	0	2	-8	8	0	13	-1
3	2	1	2	-2	3	2	1	4	5	-9
4	2	2	0	-1	1	-1	4	-14	5	-7
5	1	2	1	1	2	-1	0	1	6	2
6	1	0	1	-1	1	2	1	-8	6	0
7	1	1	1	-1	1	0	2	4	5	-9
8	1	2	1	1	1	-2	1	-2	5	-8
10	3	-4	1	-4	2	-2	1	1	4	1
11	2	-4	2	-6			2	-1	2	-3
12	1	1	2	4	2	-3	3	-4	5	5
13	3	4	1	2	4	1	1	2	7	-7
14	2	6	1	-1	5	-8	2	-1	6	-21
15	1	-2	1	-4	0	-3	3	3	3	-7
16	3	-2	1	-5	2	-3	1	-3	3	0
18	12	-28			65	-1			3	6
19	3	-5	1	-4	2	1	1	0	10	-36
20	1	0	1	1	2	3	12	35	6	-11
21	2	1	1	-1	1	0	0	2	4	-3
22	2	-11	2	-8	6	4	6	7	5	-7
23	2	-2	1	0	4	4	1	-5	4	4
24	1	-7	3	-7	6	-3			6	-10
26	1	0	1	-1	1	0	1	1	5	-9
27	2	2	1	1	1	0	1	-3	5	-7
30	2	-2	1	-6	6	7	6	-2	2	20
31	1	1	1	0	6	3	1	1	3	-8
32	4	4	1	0	3	-4			6	-7
33	2	4	1	3	6	8	3	3	4	-3
34	1	-1	1	-3	4	5	4	0	7	-14
35	4	3	1	3	3	4	6	5	11	-8
36	1	0	1	-1	2	-1	1	0	9	-1
38	2	7	2	4	4	0	1	-21	30	-60
39	5	1			2	-4	1	0	2	-2
40			11	14	8	73	5	-11	14	-56
104	1	-2			3	4	3	3	22	1
106									7	-6
107	3	3	1	-1	2	2	8	-7	4	-7
109	3	-4	3	-37	9	82	19	-10	8	-18
110	3	-2	3	-6	6	-12	4	-13	4	-6
111	2	5	2	-7	2	0	1	-5	5	-15
112	1	-1	2	-4	2	4	3	12	5	-10
113	3	-14	2	5	4	-8	7	-4	9	-23
114	3	4	1	3	2	3	3	-4	6	-11
115	5	3	3	2	2	-8	1	-5	15	-23
116	2	0	1	2	12	14	28	-15	2	0
117	3	-3	2	-5	1	-2	3	-5	8	-10
118	5	7	2	2	2	-5	4	6	4	1
120	3	7	2	0	3	0	1	-1	58	8
121	6	8	2	0	2	1	3	-1	6	0
126	45	174	7	0	2	-3	7	59	21	-50
130	55	207	2	0	1	-1	6	-5	5	-2
131	1	3	2	-2	1	1	1	3	1	5
133	17	24	14	30	7	-15	7	-14	11	-26
135	1	2			1	-1	4	6	4	-3
136	3	-1	11	-77	27	-30	33	-50	7	-12
138	2	5	1	1	12	-5	1	10	5	2
140	2	-5	2	-2	2	1	10	-13	8	-14

Table 35, cont.

Lab. no.	Na ⁺		Cl ⁻		Ca ²⁺		K ⁺		Cond.	
	Random error %	Systematic error %	Random error %	Systematic error %	Random error %	Systematic error %	Random error %	Systematic error %	Random error %	Systematic error %
1	5	6	2	0	5	5	5	-5	4	0
3	1	-9	1	0	3	2	0	2	2	2
4	1	6	3	-5	1	-7	2	-7	2	0
5	0	0	2	1	1	1	3	1	1	-1
6	2	-2	1	-6	1	-10	1	2	2	-1
7	1	1	2	-3	4	1	1	-1	4	-6
8	0	-1	1	-1	1	-3	0	-3	1	0
10	2	-7	2	-25	4	9	6	-21	2	0
11	1	-8	3	-15	2	-2	36	0	5	-5
12	1	-6	2	0	2	-9	4	0	2	6
13	2	-1	1	-1	1	-2	2	-1	2	-1
14	5	-4	3	-5	1	-1	5	0	2	2
15	2	-1	2	-4	3	5	1	0	2	-3
16	1	-2	7	-10	1	0	2	-2	2	-7
18			16	2					7	2
19	1	-2	6	-10	1	-2	1	2	1	1
20	1	-1	2	-12	17	7	6	2	2	1
21	1	-1	1	-1	1	-1	4	-4	1	2
22	13	21	12	-26	23	16	13	14	2	-5
23	1	-9	7	-17	3	-10	5	-7	2	3
24			5	-10					9	0
26	1	0	1	0	1	1	0	1		
27	1	-2	1	0	2	-5	2	0	1	1
30	2	-1	3	-3	2	-4	13	-6	1	2
31	4	-8	1	1	3	0	7	0	1	6
32	5	-17	13	7	19	0	10	16		
33	5	-10	5	11	9	0	6	-10	1	-1
34	1	0	4	-7	2	-2	9	-14	7	-3
35	1	-3	1	-3	8	2	2	3	1	0
36	1	1	1	-3	0	2	1	-4	1	2
38	8	-14	3	0	5	-4	5	2	7	
39	1	0	10	-5	0	1	0	-1	2	1
40	7	-15	12	26	3	-18	8	-32	8	-34
104	3	-5	4	-7	19	69	7	-6	11	2
106									2	-3
107	0	0	4	-4	23	39	1	0	1	-1
109	11	12	6	-14	32	17	44	83	1	0
110	2	-4	11	13	3	3	6	-6	6	-9
111	6	-16	13	-7	1	-4	3	-8	2	-4
112	1	1	11	-12	1	5	1	14		
113	2	-14	8	14	8	-16	6	-15	4	-8
114	1	-2	1	2	17	1	1	-4	3	2
115	7	-21	5	18	2	5	13	-37	2	1
116	34	-13	3	-10	25	-66	63	13	8	-18
117	7	-10	4	-19	8	2	16	-4	2	-1
118	4	7	9	8	14	36	10	14	2	-4
120	1	-7	11	6	1	-2	5	-13	2	0
121	13	-1	8	-23	4	-28	13	-24	8	-3
126	1	4	4	-5	6	17	4	2	2	0
130	0	-1	2	-7	16	5	4	-4	10	-10
131	3	-3	3	-12	6	2	8	-7	3	-4
133	16	-23	57	41	31	-19	116	21		
135	2	-7	3	-16	9	0	1	-3	5	-17
136	3	-22	4	-3	38	-29	19	-32	3	-9
138	4	-8	6	-15	3	14	6	-13	3	-2
140	13	1	5	13	9	10	11	-13	3	-3

Appendix 2

Figures

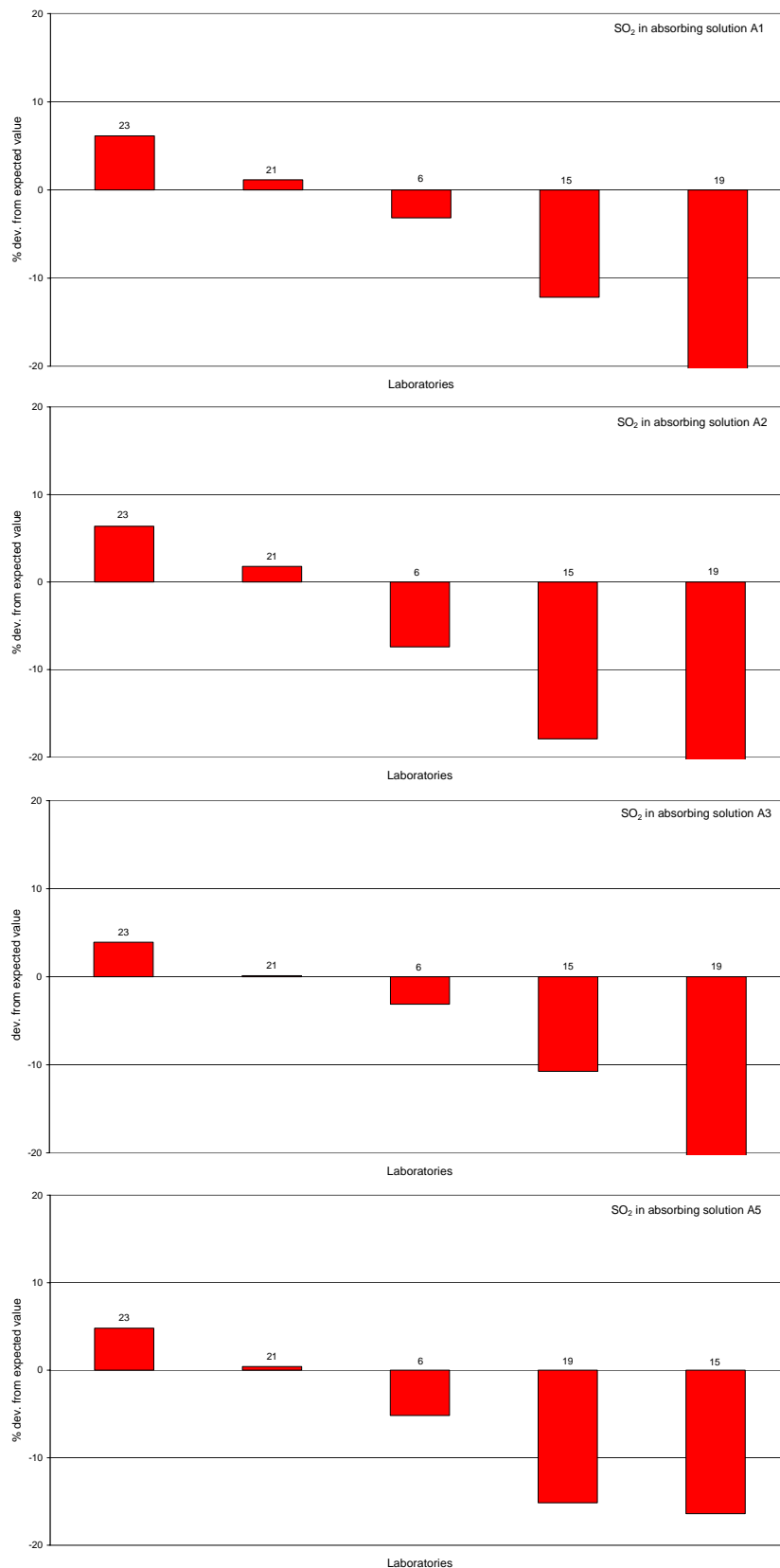


Figure 2: SO₂ in absorbing solution.

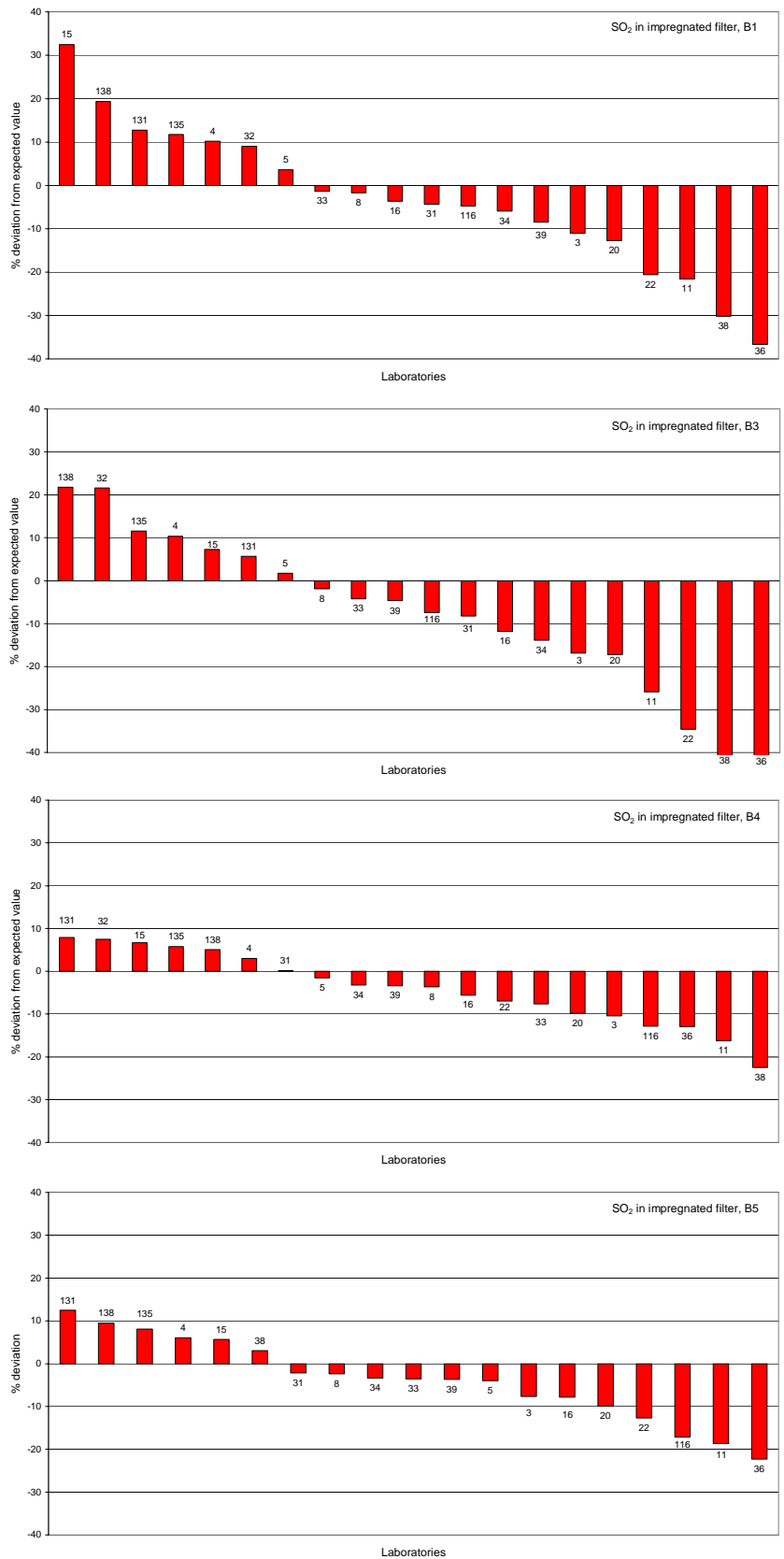


Figure 3: SO₂ in impregnated filter.

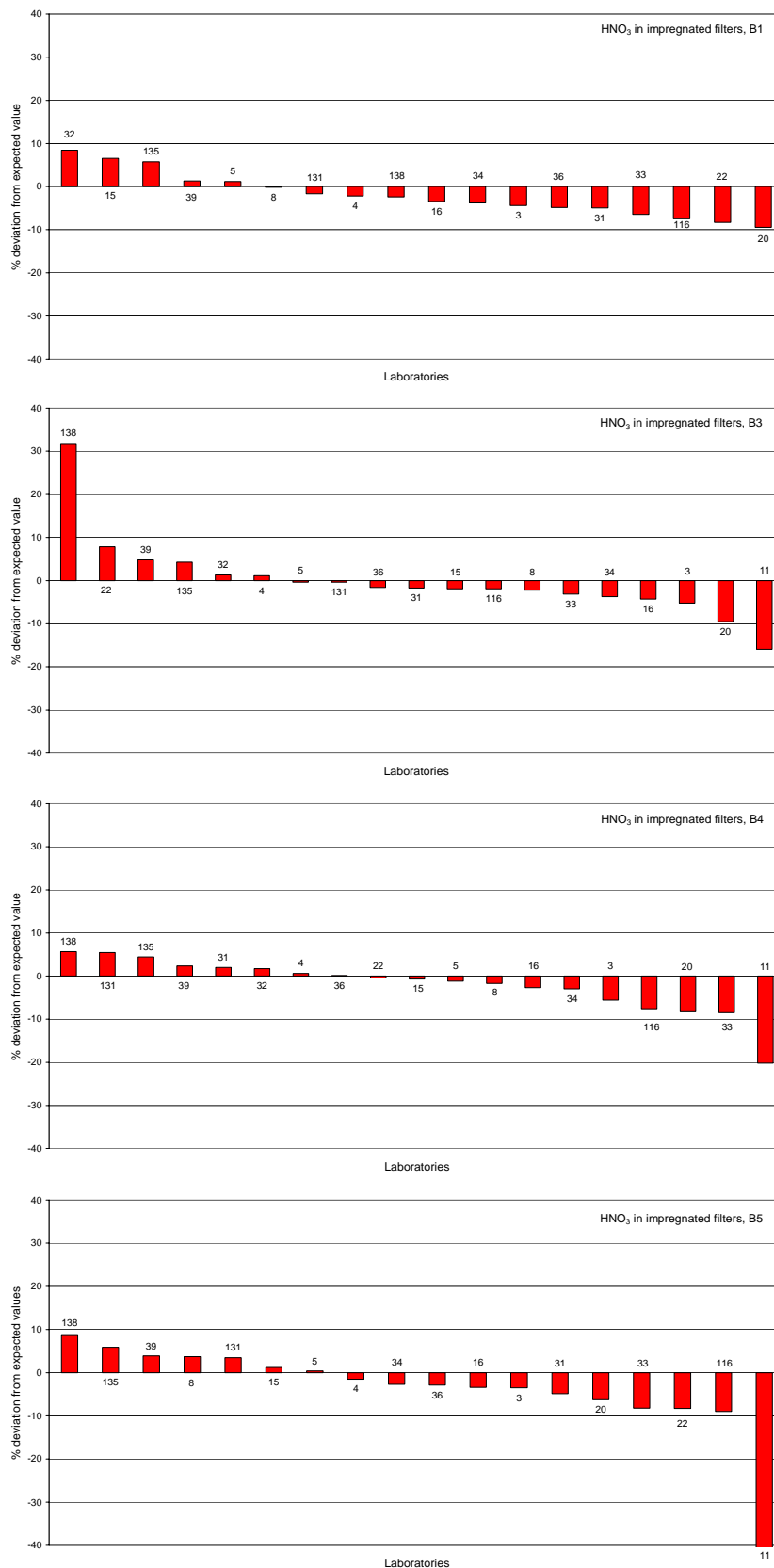


Figure 4: HNO₃ in impregnated filter.

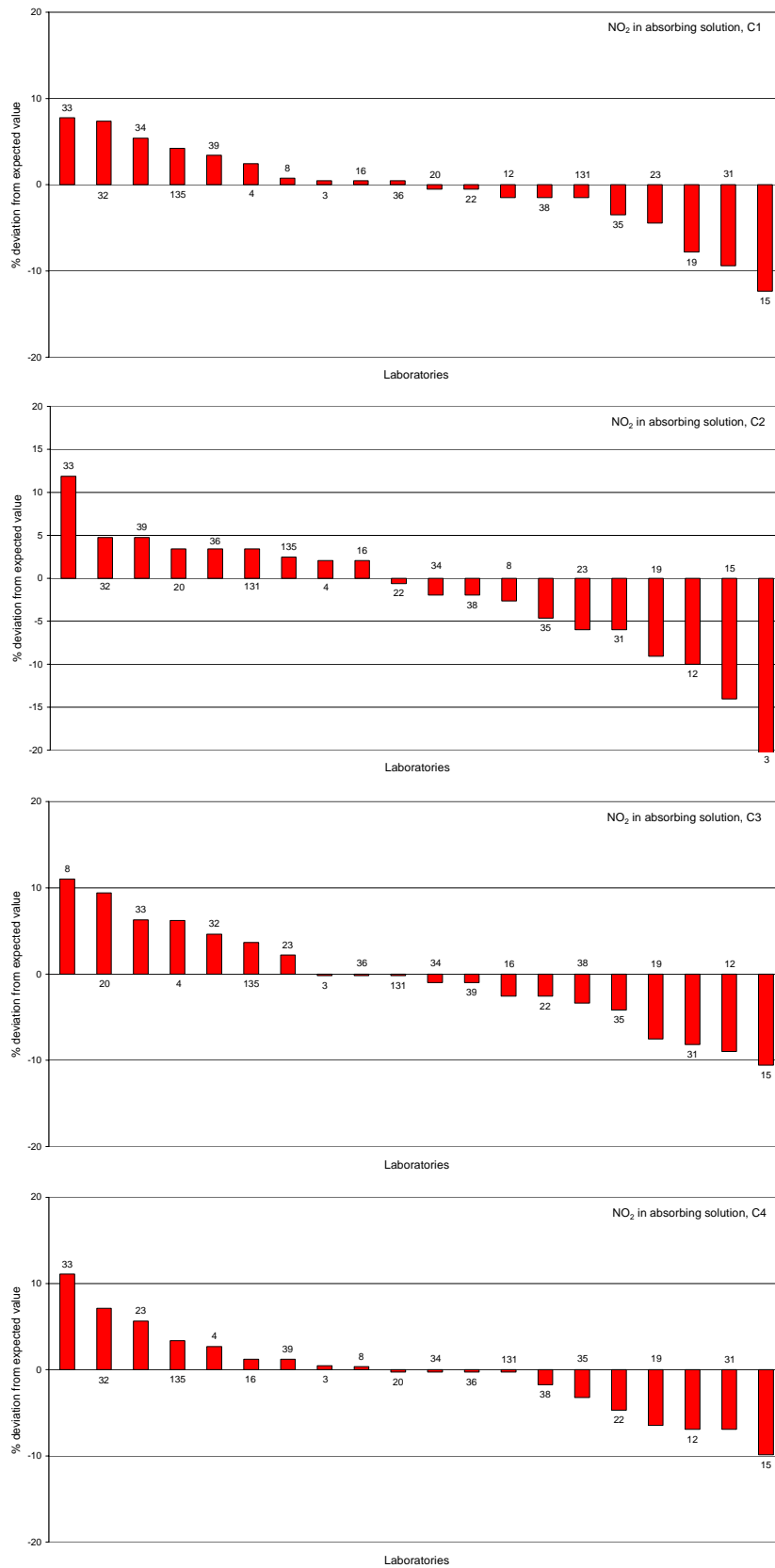


Figure 5: NO₂ in absorbing solution.

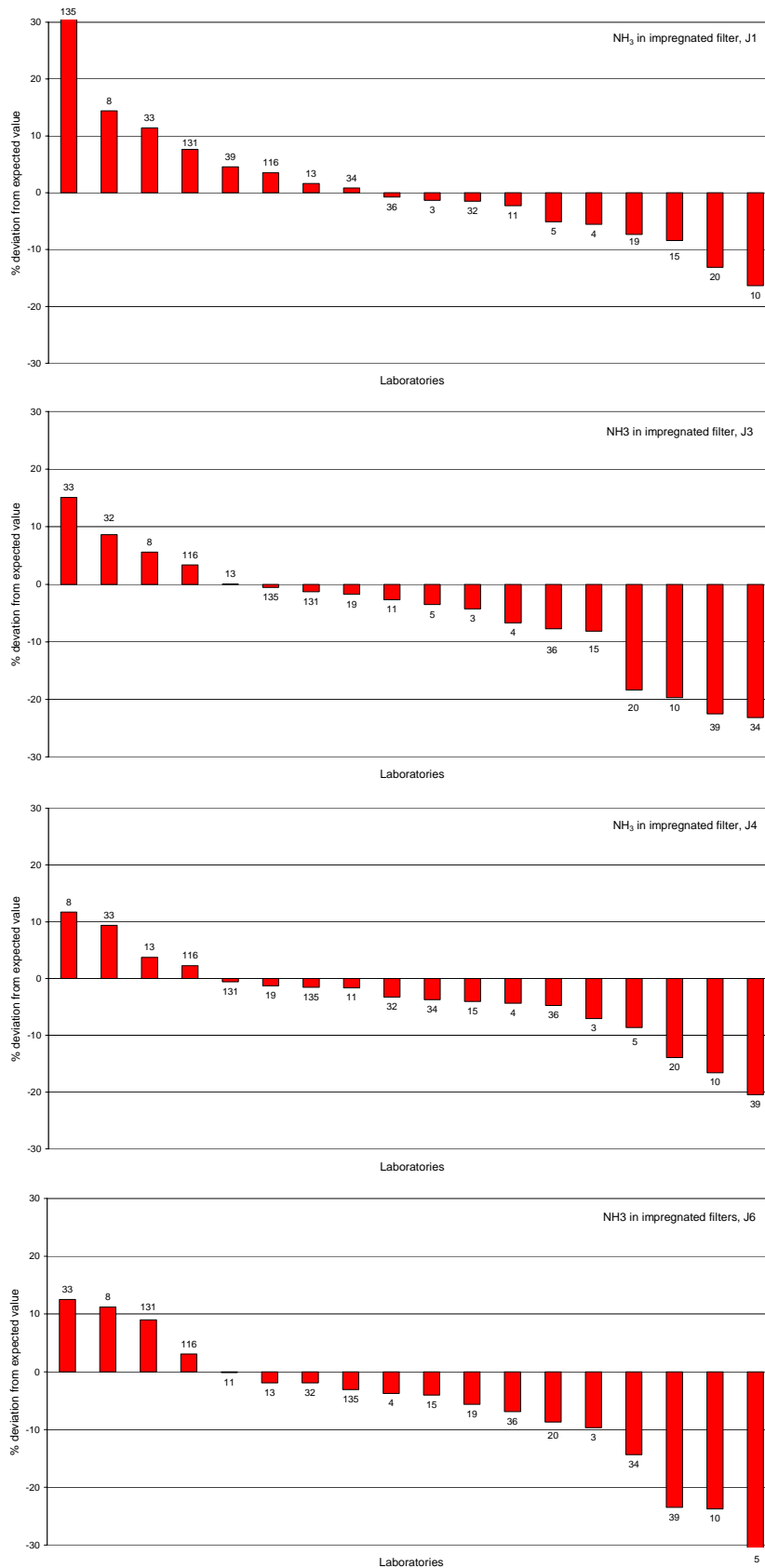


Figure 6: NH₃ in impregnated filter.

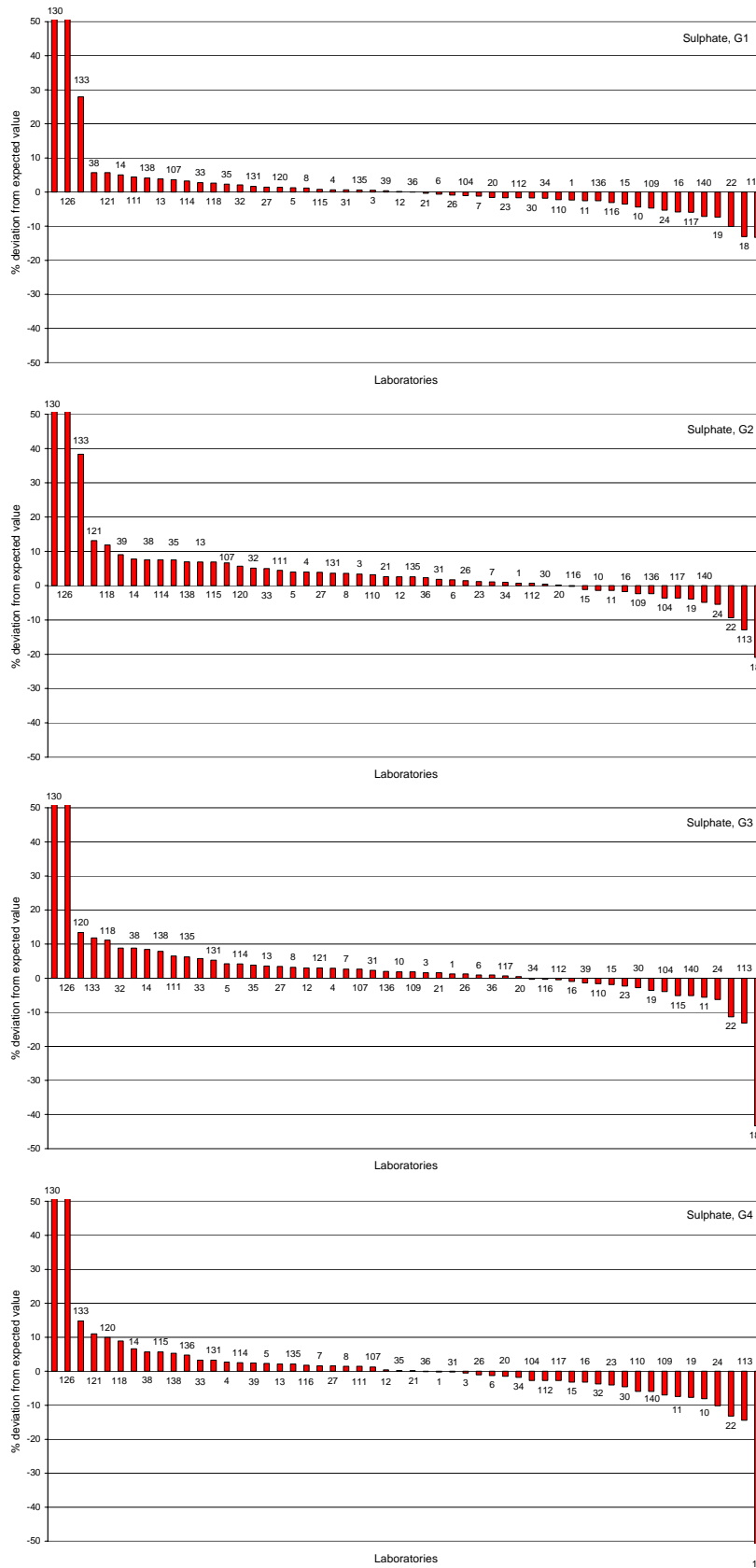


Figure 7: Percent deviation from theoretical value for sulphate.

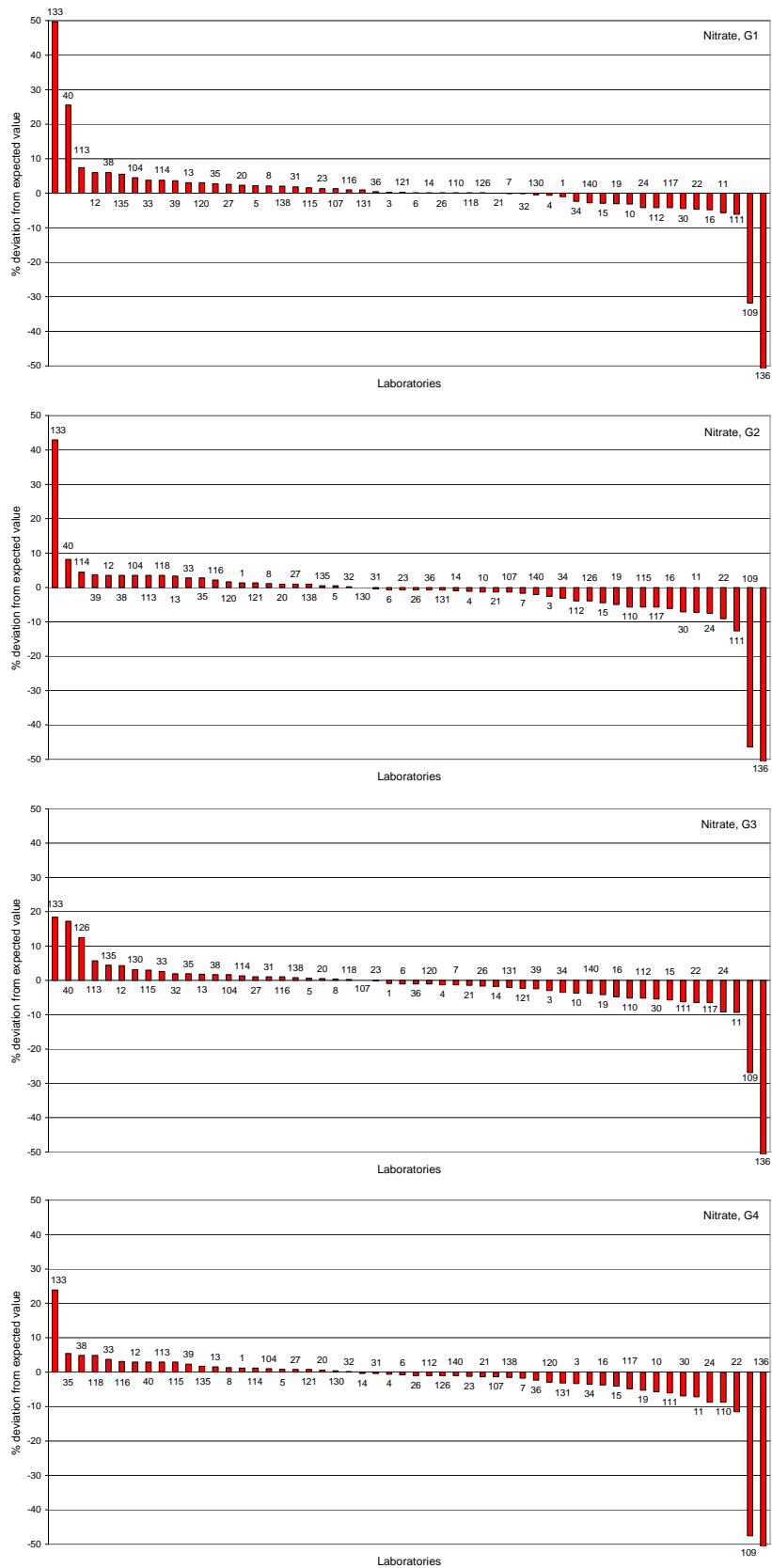


Figure 8: Percent deviation from theoretical value for nitrate.

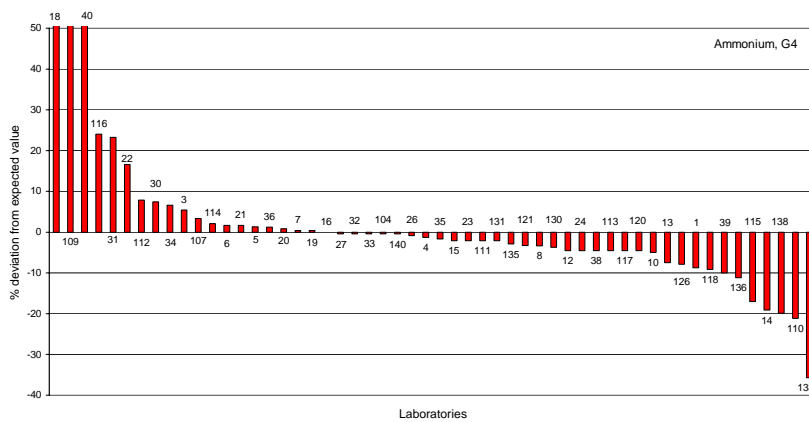
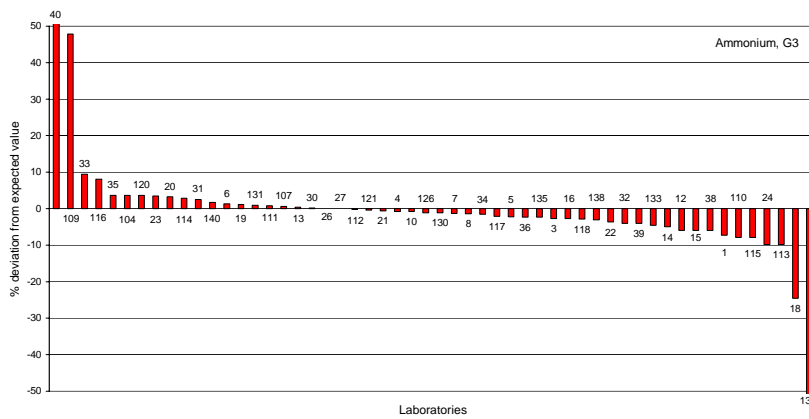
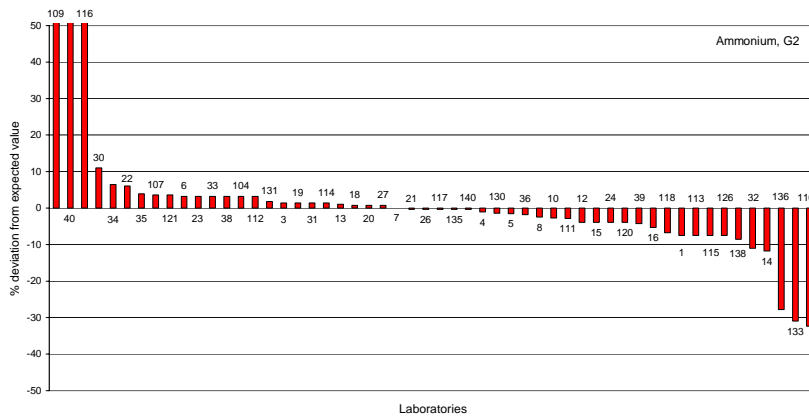
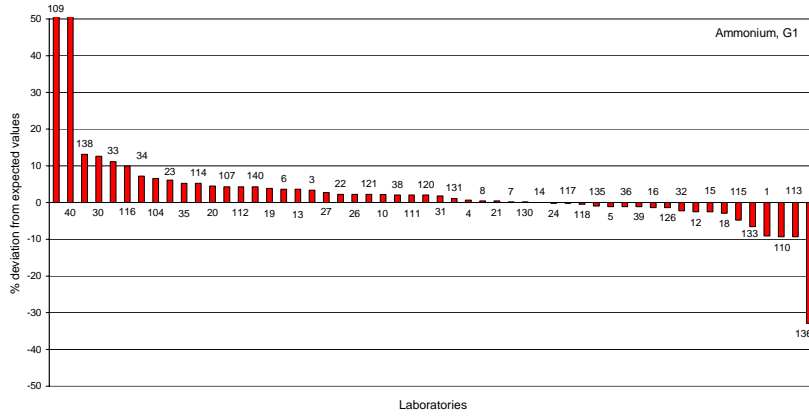


Figure 9: Percent deviation from theoretical value for ammonium.

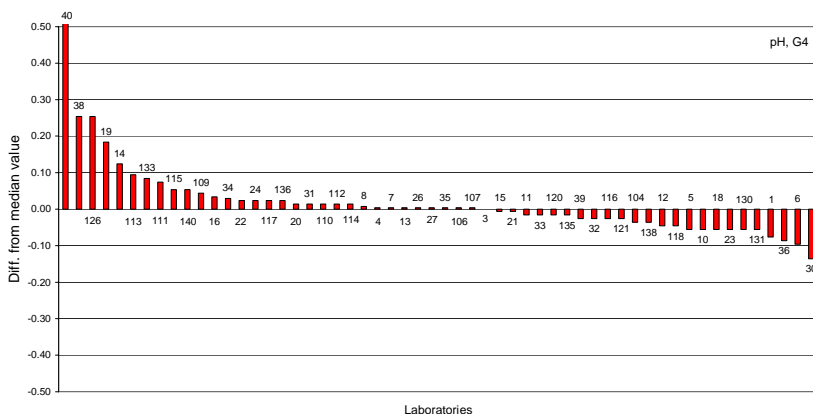
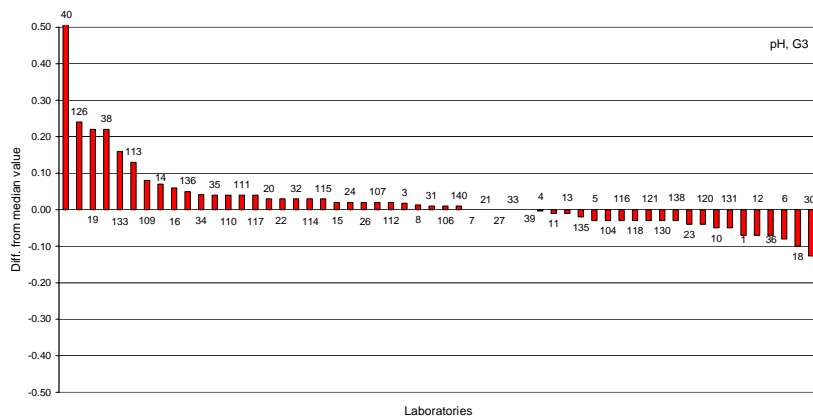
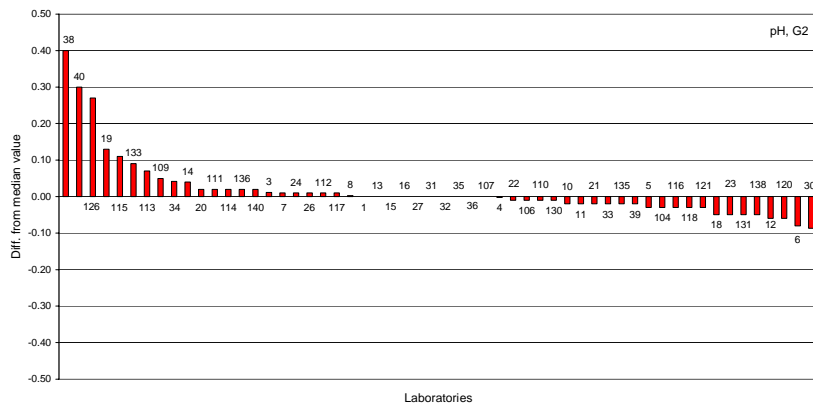
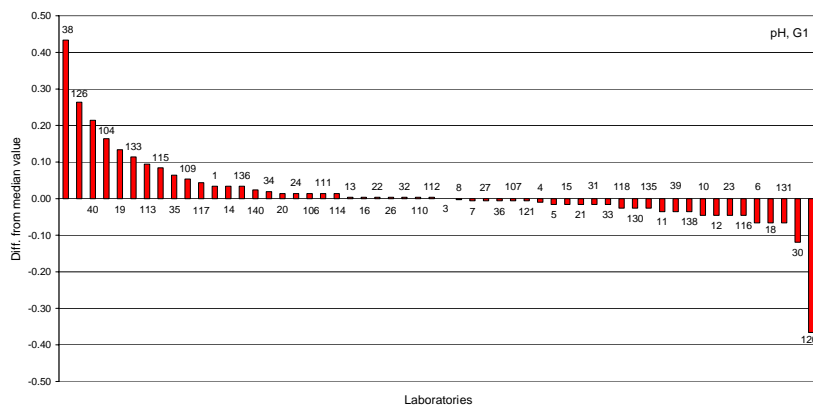


Figure 10: Percent deviation from theoretical value for pH.

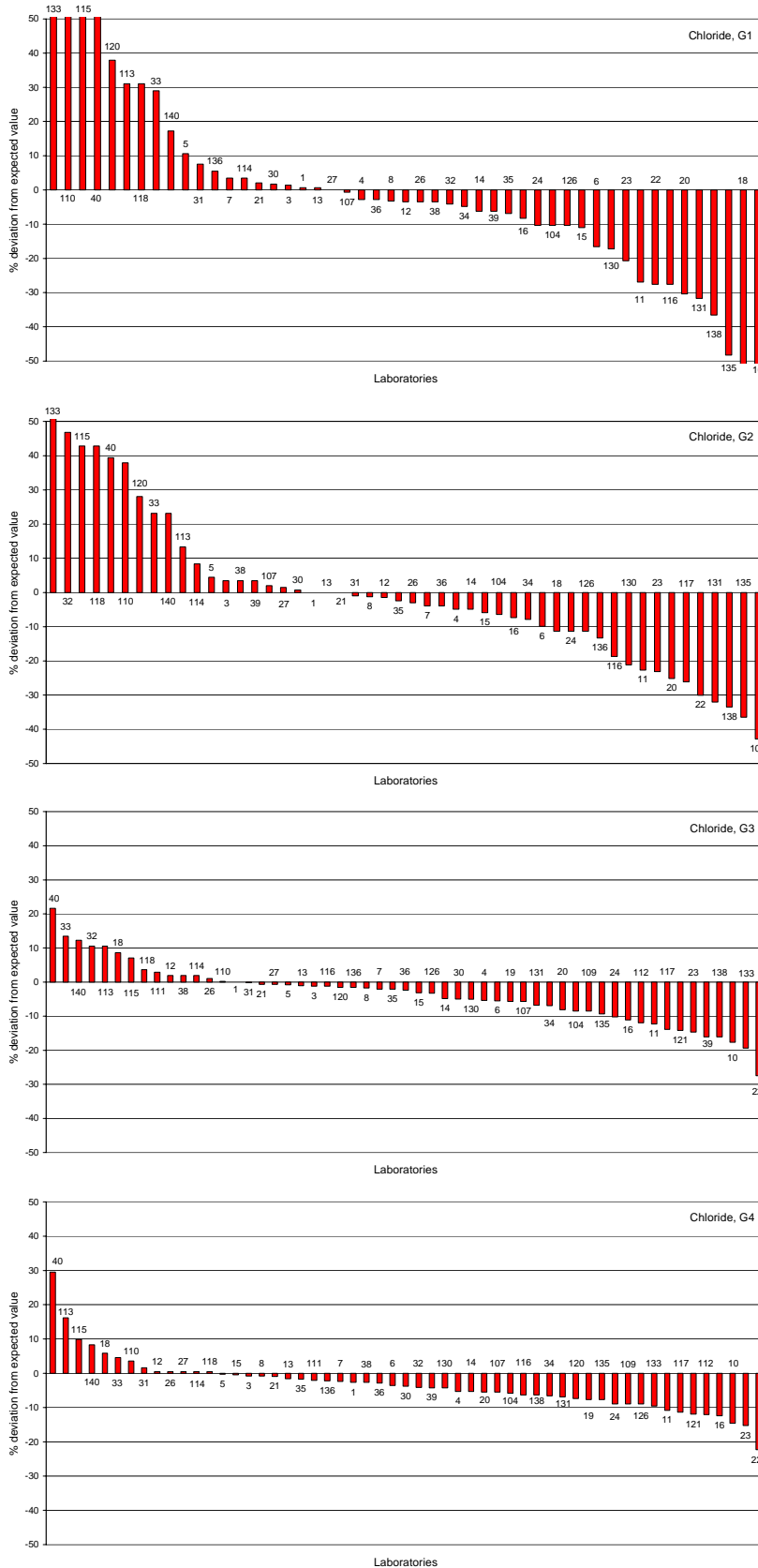


Figure 11: Percent deviation from theoretical value for chloride.

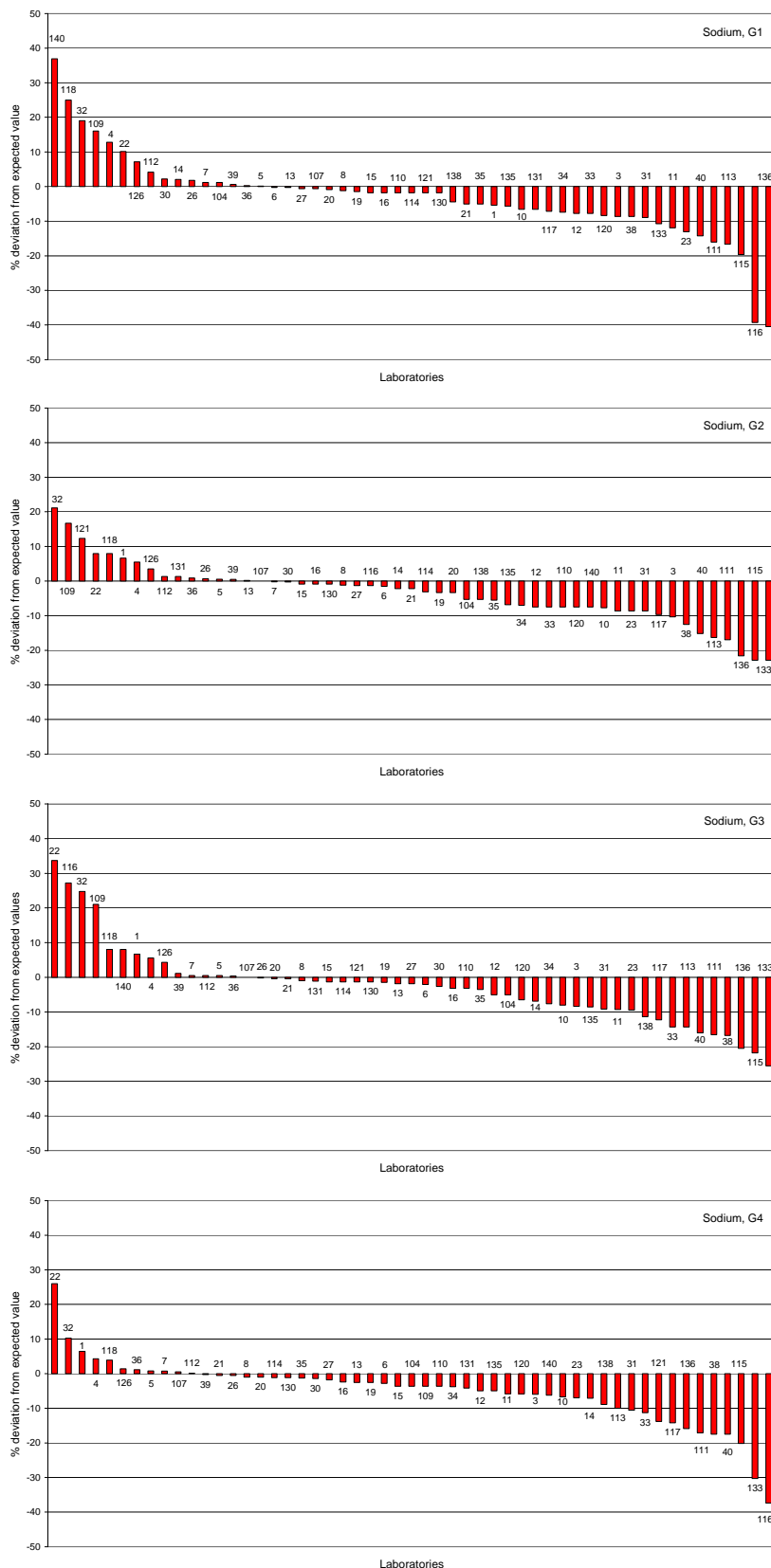


Figure 12: Percent deviation from theoretical value for sodium.

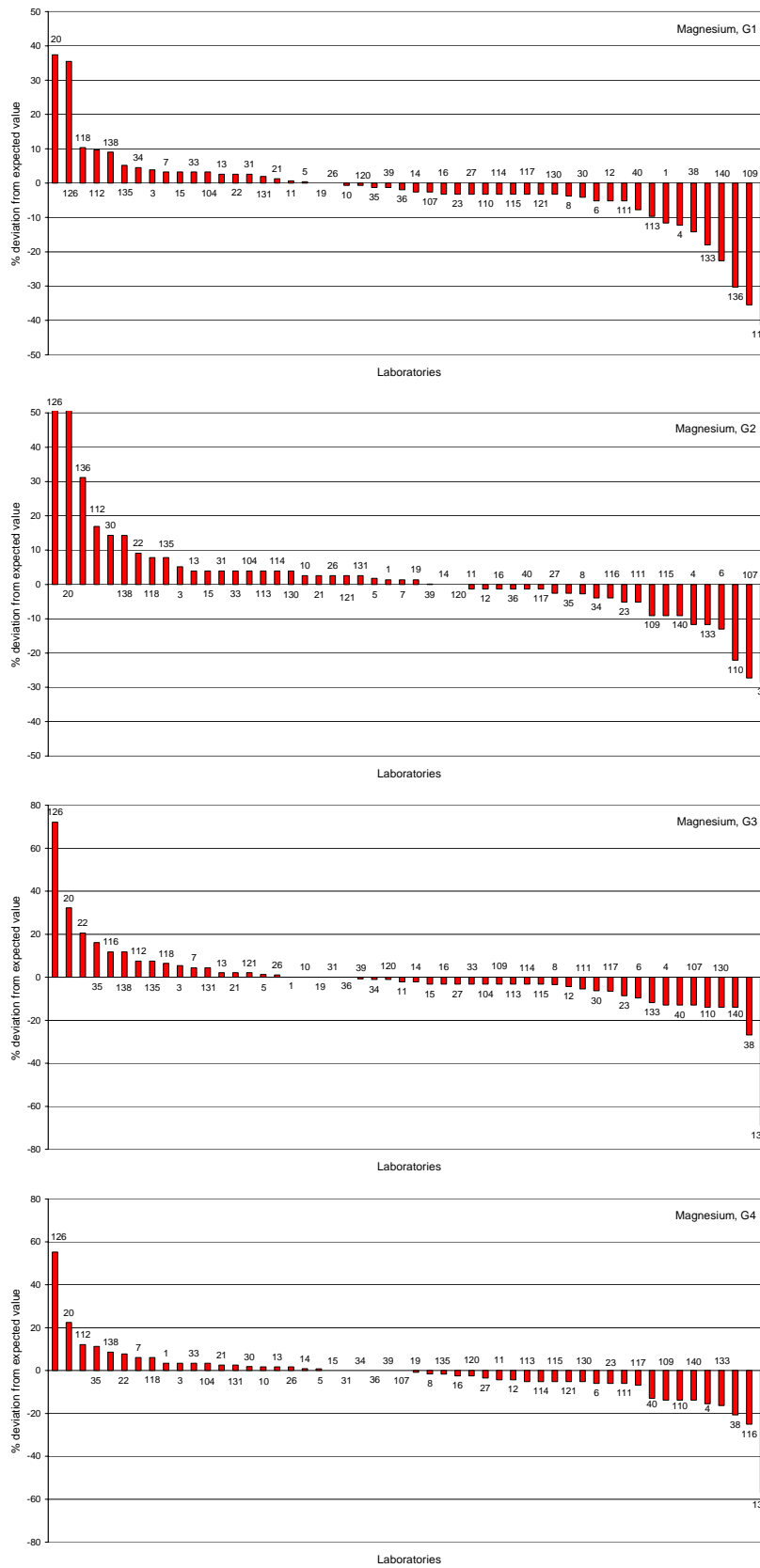


Figure 13: Percent deviation from theoretical value for magnesium.

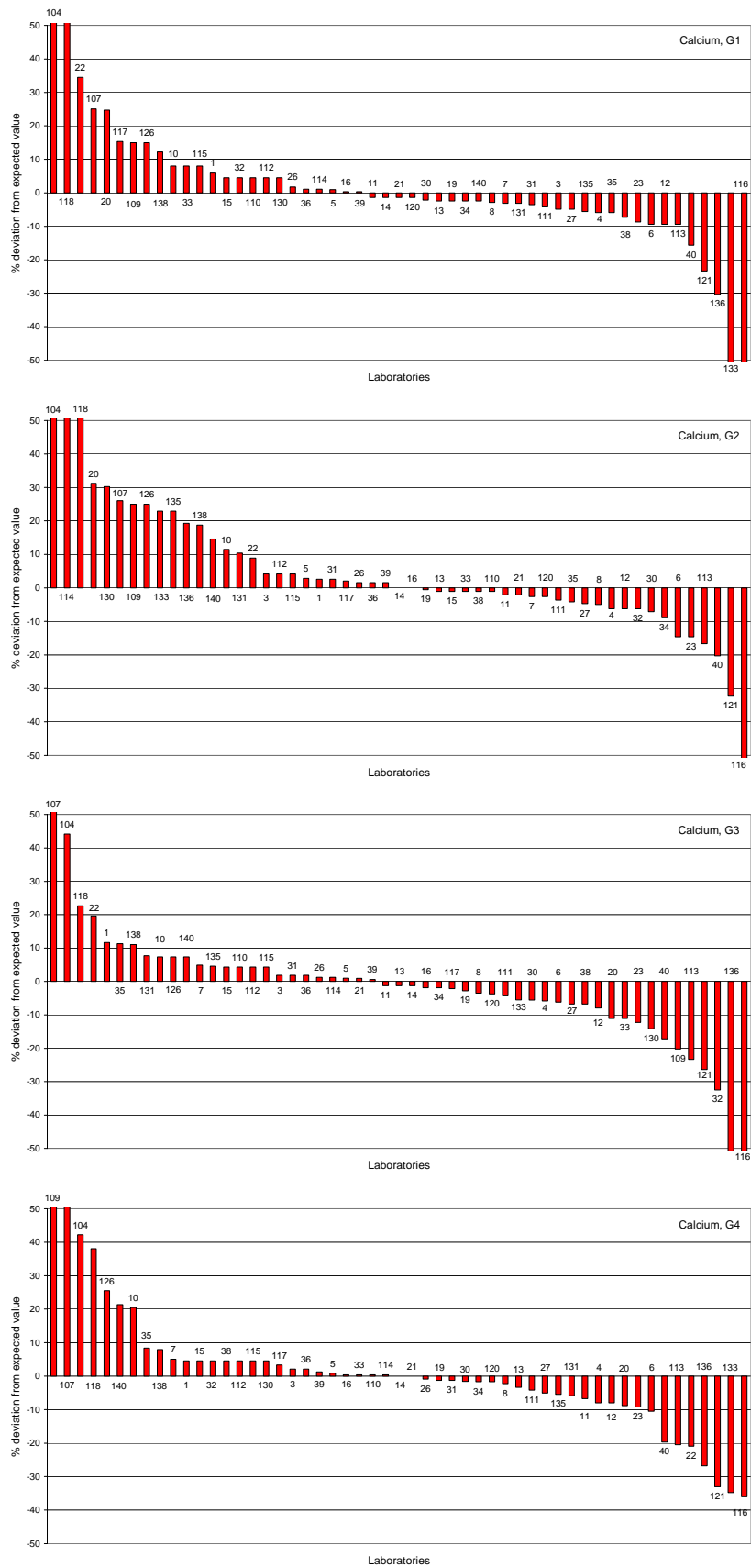


Figure 14: Percent deviation from theoretical value for calcium.

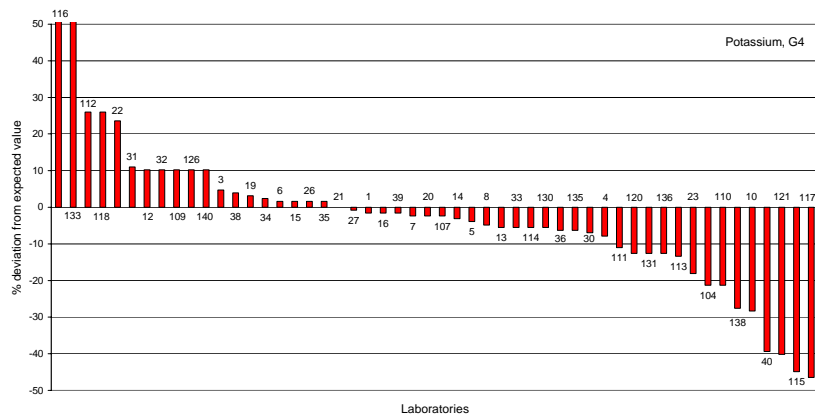
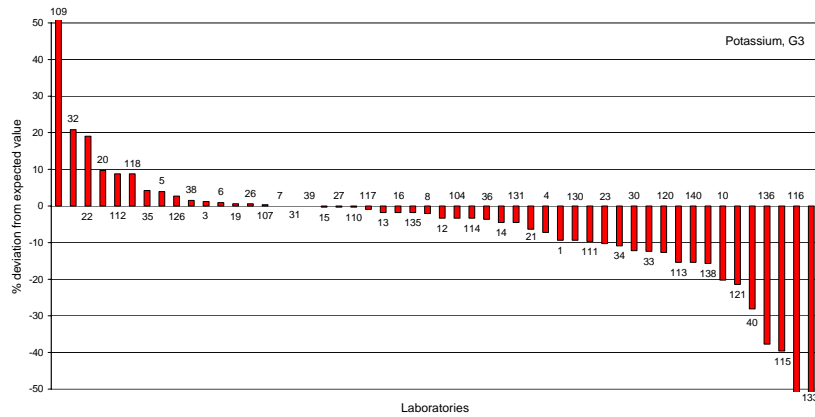
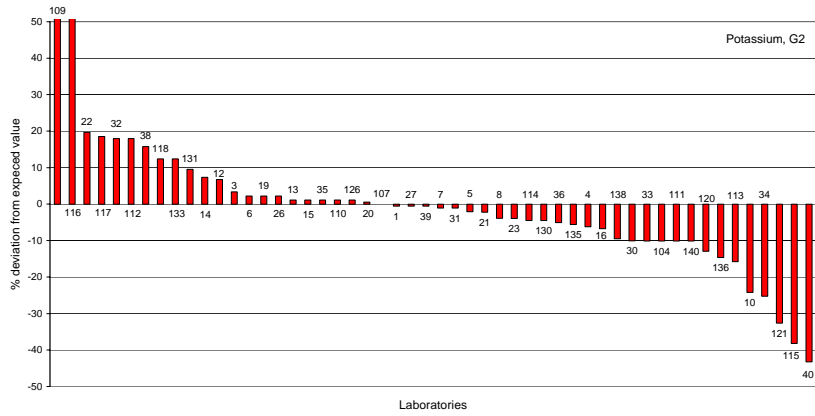
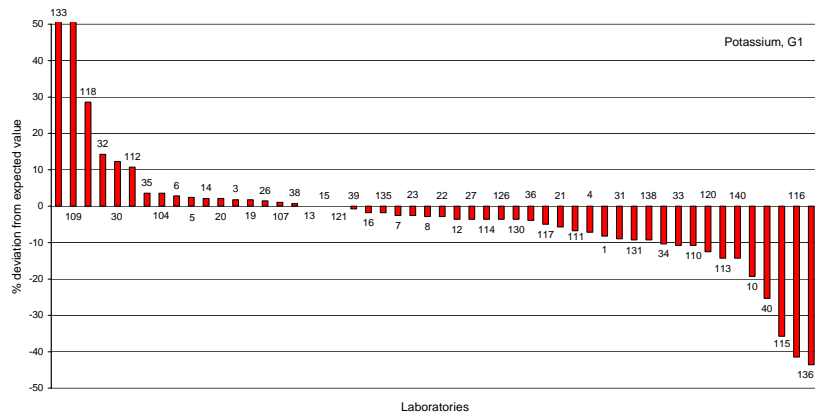


Figure 15: Percent deviation from theoretical value for potassium.

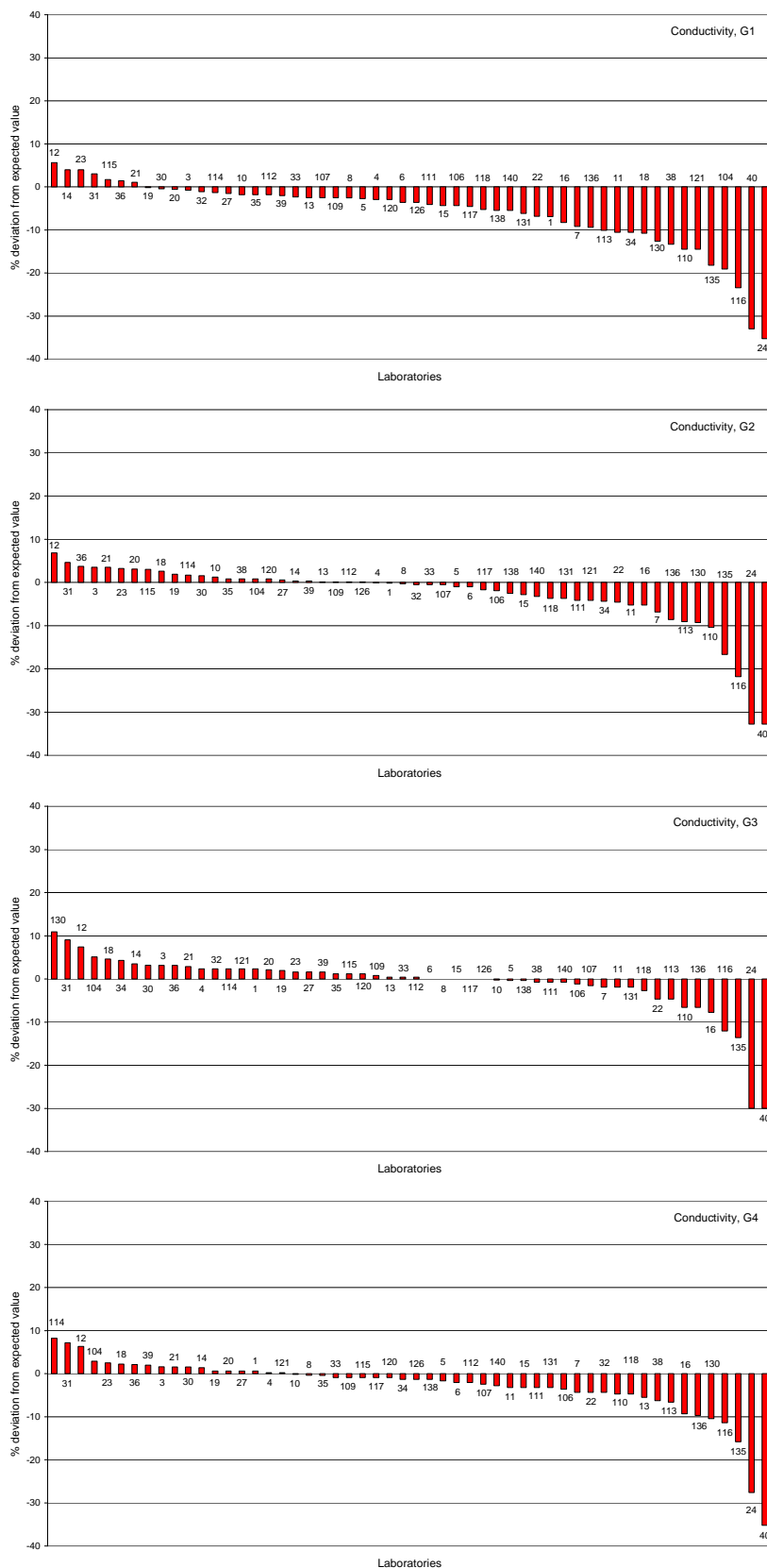


Figure 16: Percent deviation from theoretical value for conductivity.

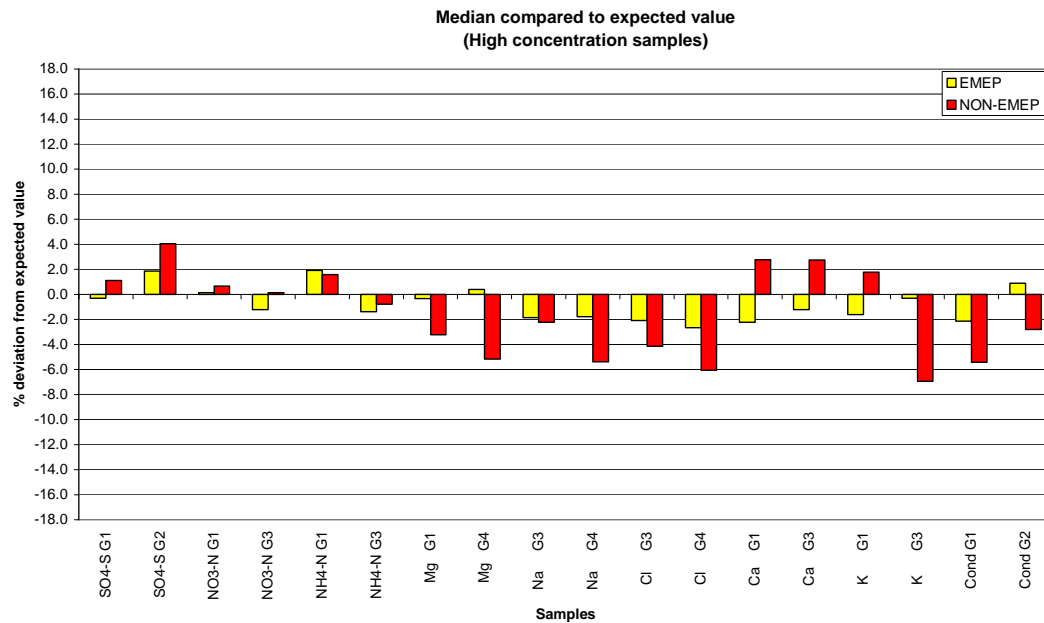
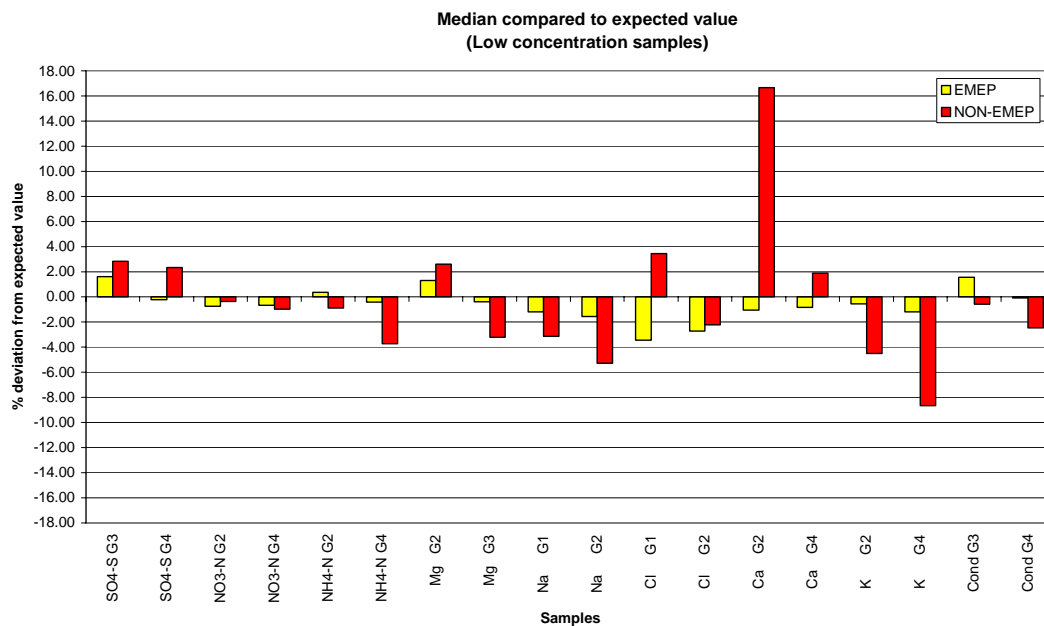


Figure 17: The median compared to theoretical value.

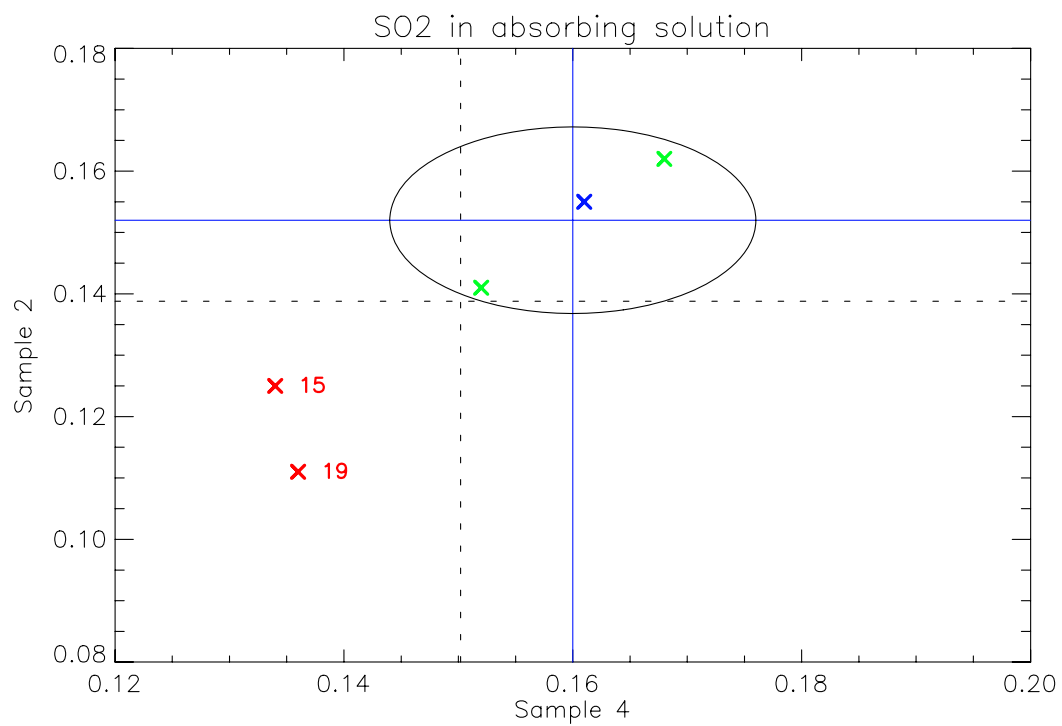
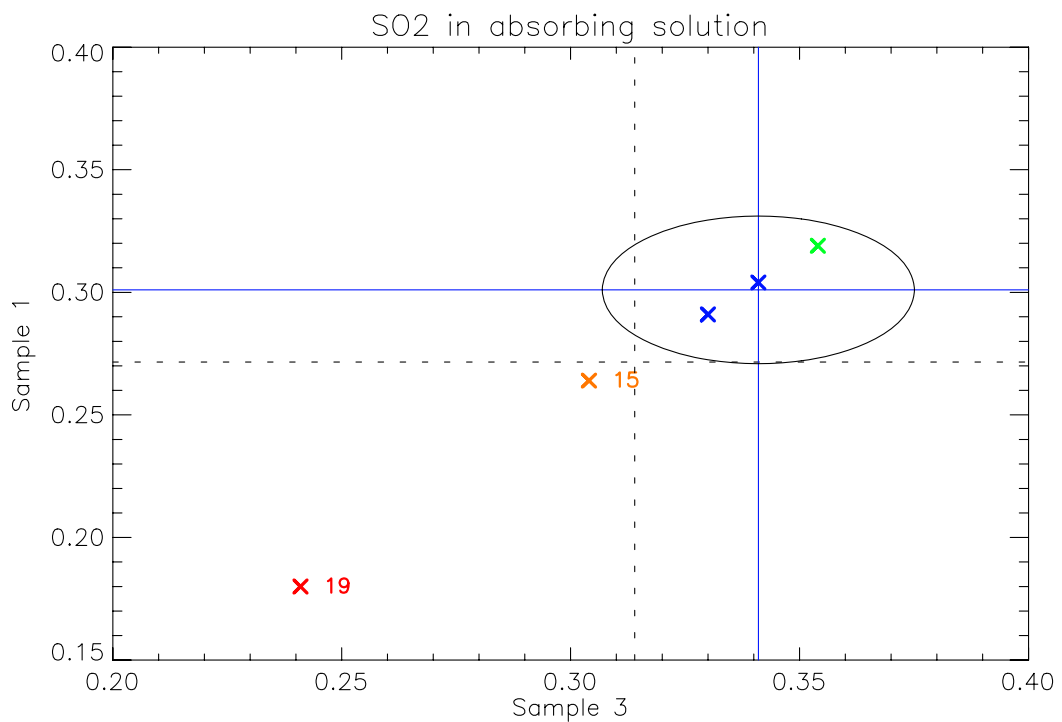


Figure 18: Youden plot of SO₂-S in absorbing solution.

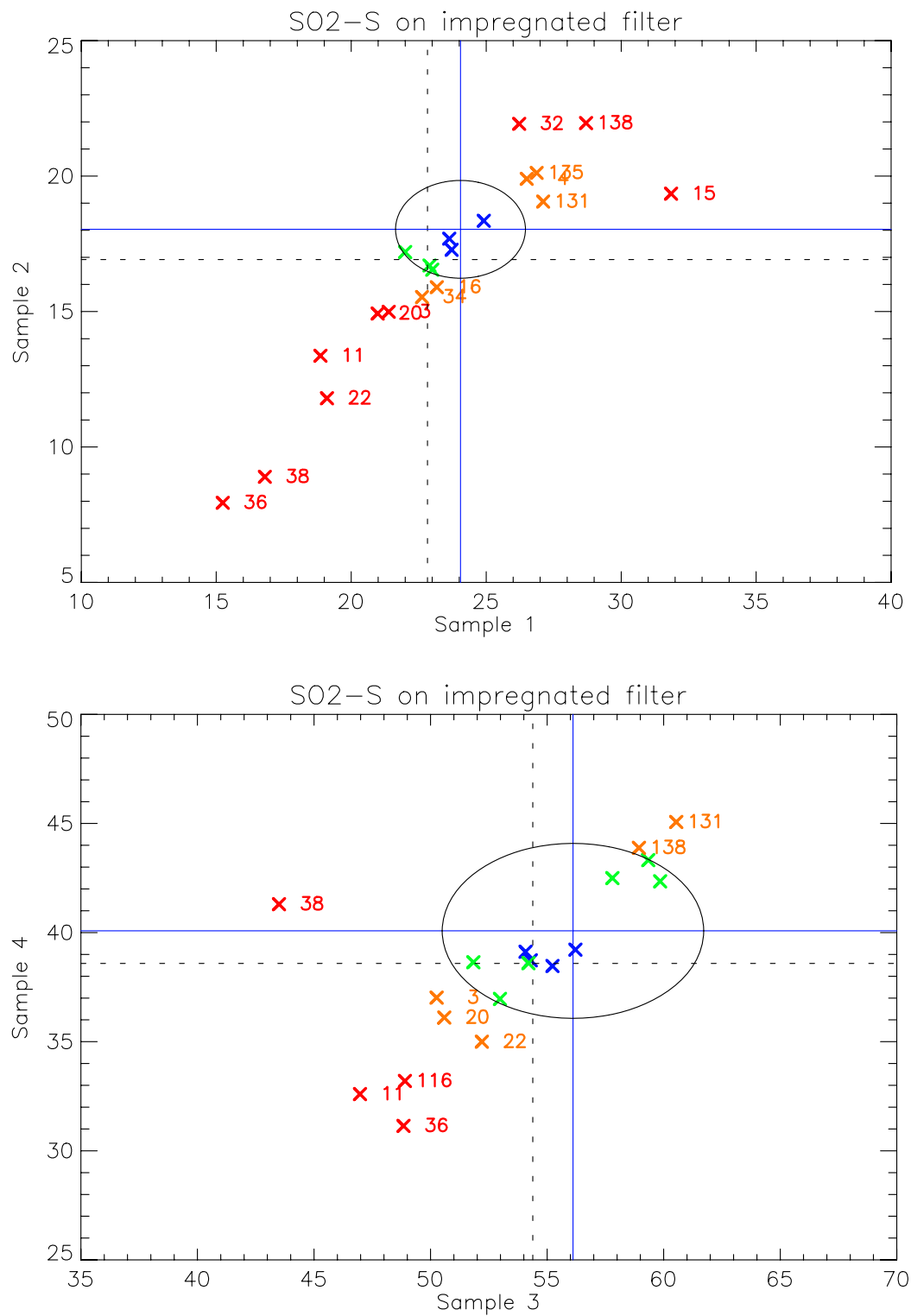


Figure 19: Youden plot of SO₂-S on impregnated filter.

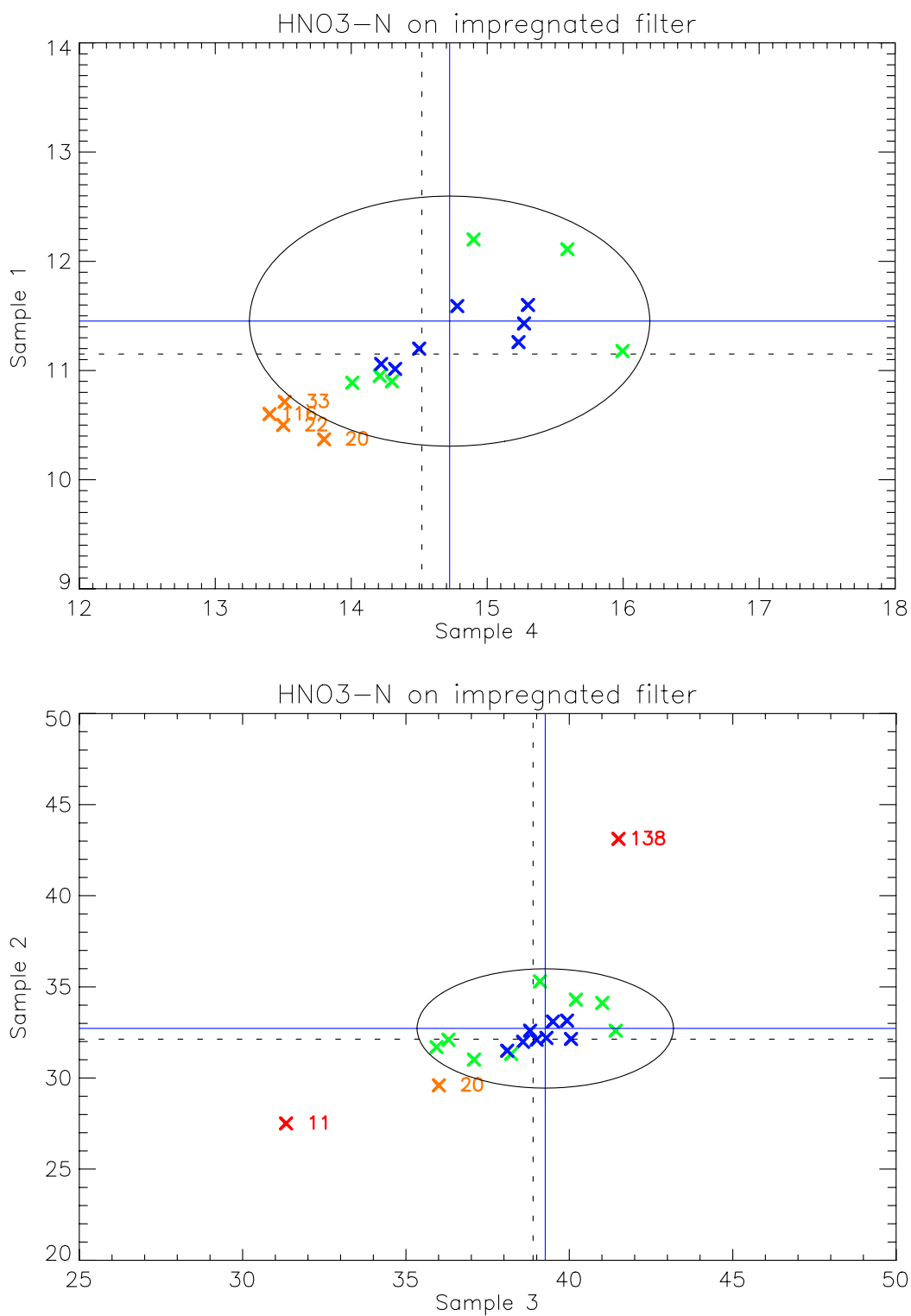


Figure 20: Youden plot of $\text{HNO}_3\text{-N}$ on impregnated filter.

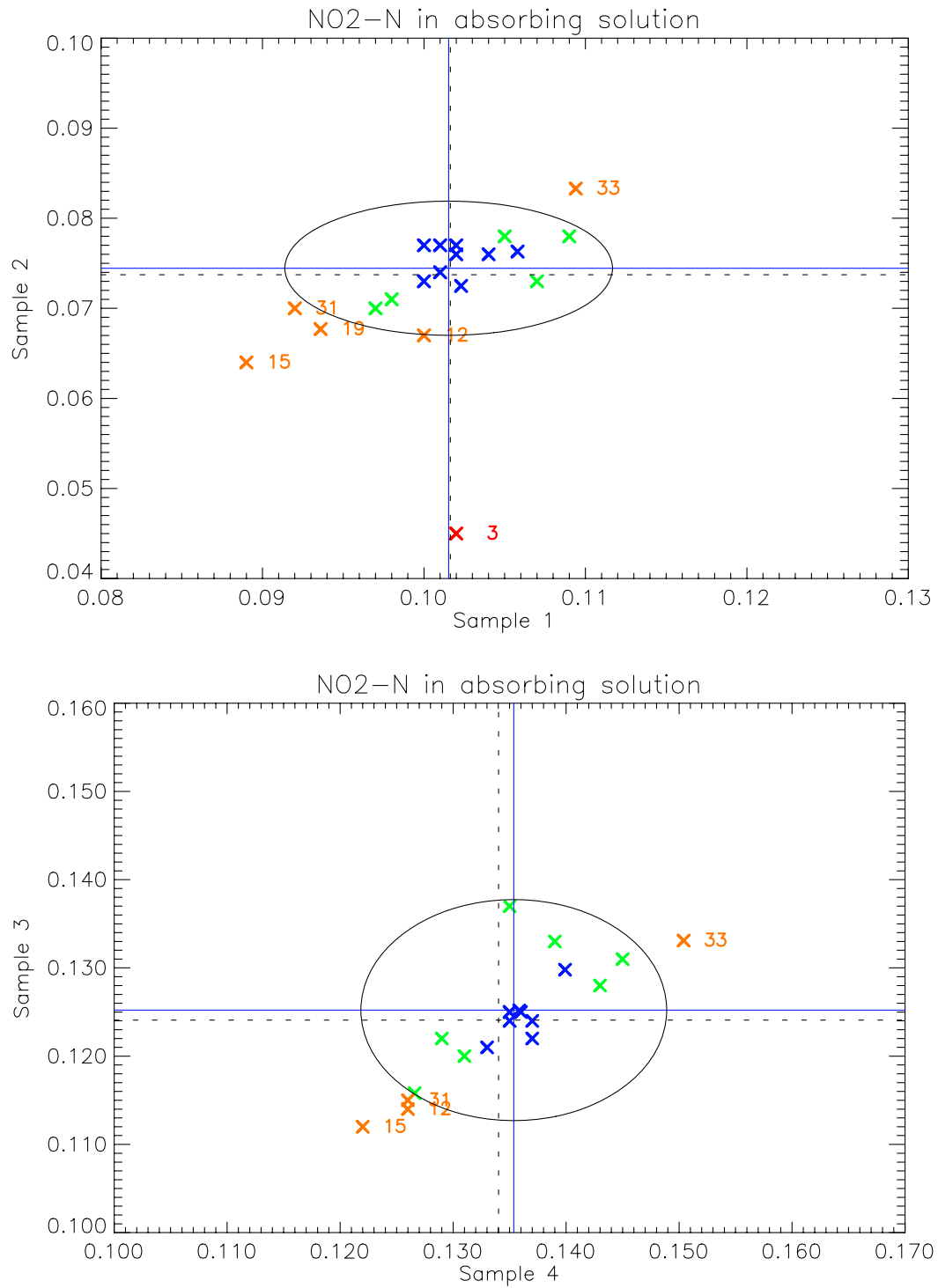


Figure 21: Youden plot of NO₂-N in absorbing solution.

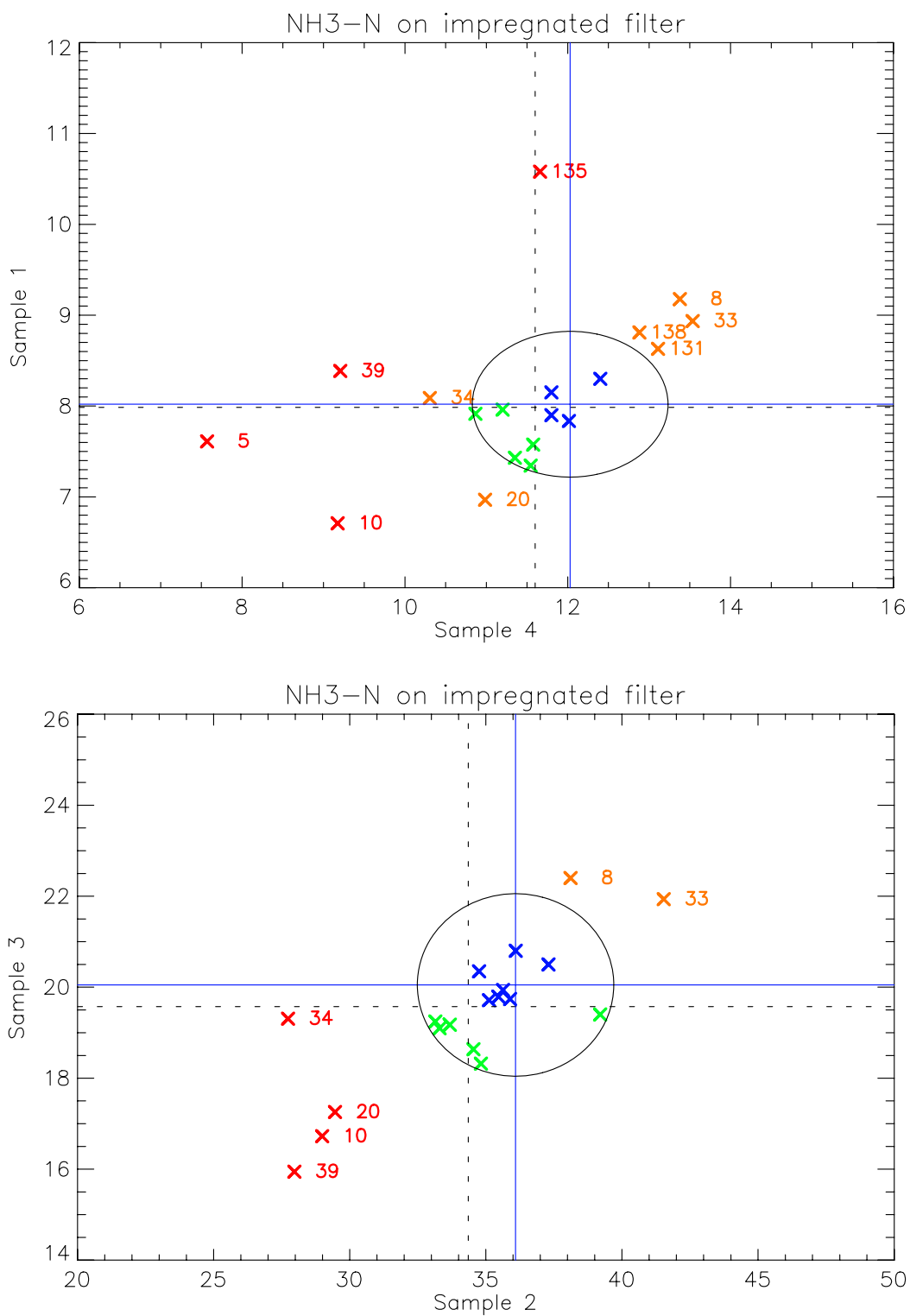


Figure 22: Youden plot of NH₃-N on impregnated filter.

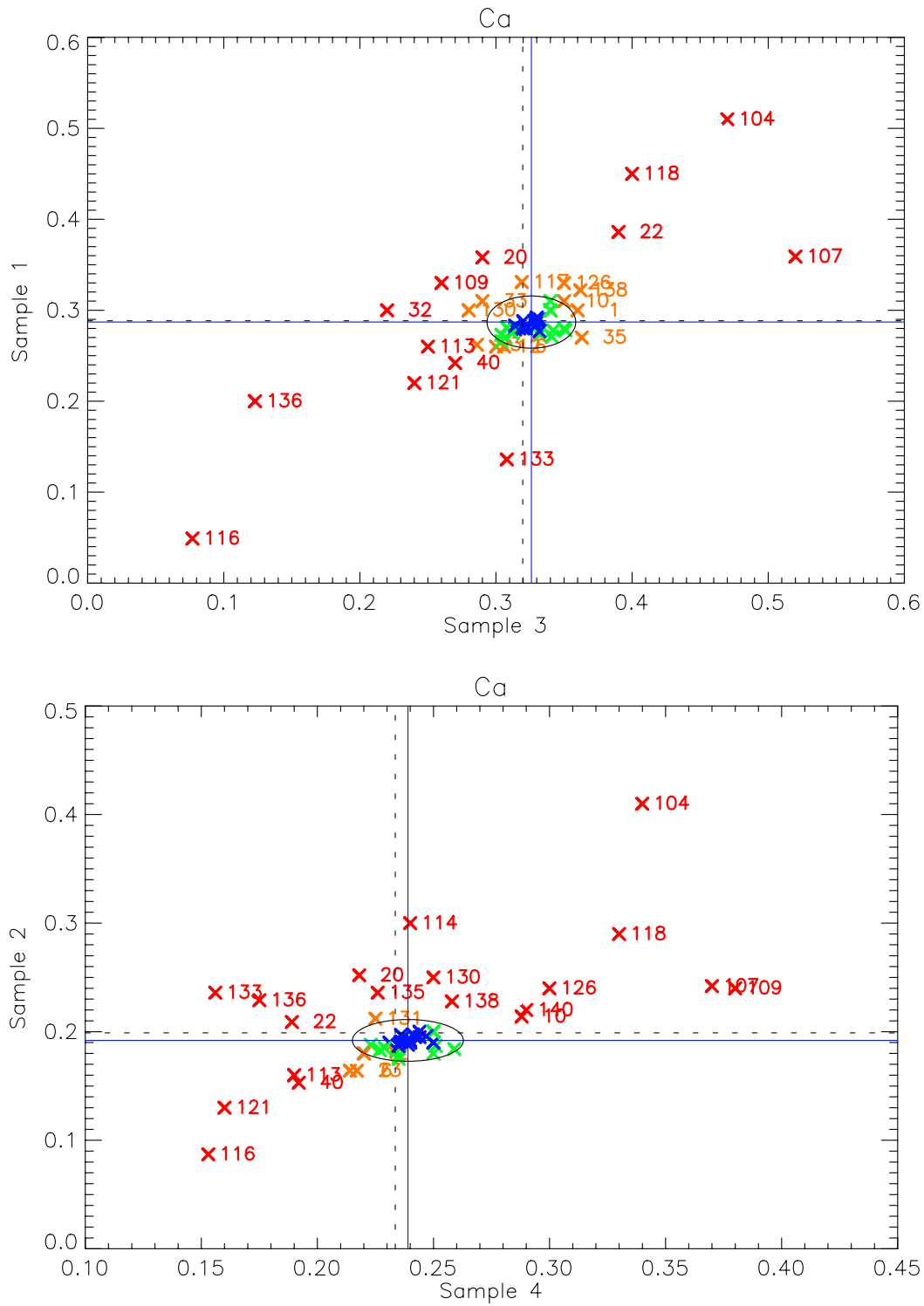


Figure 23: Youden plot of Ca in precipitation.

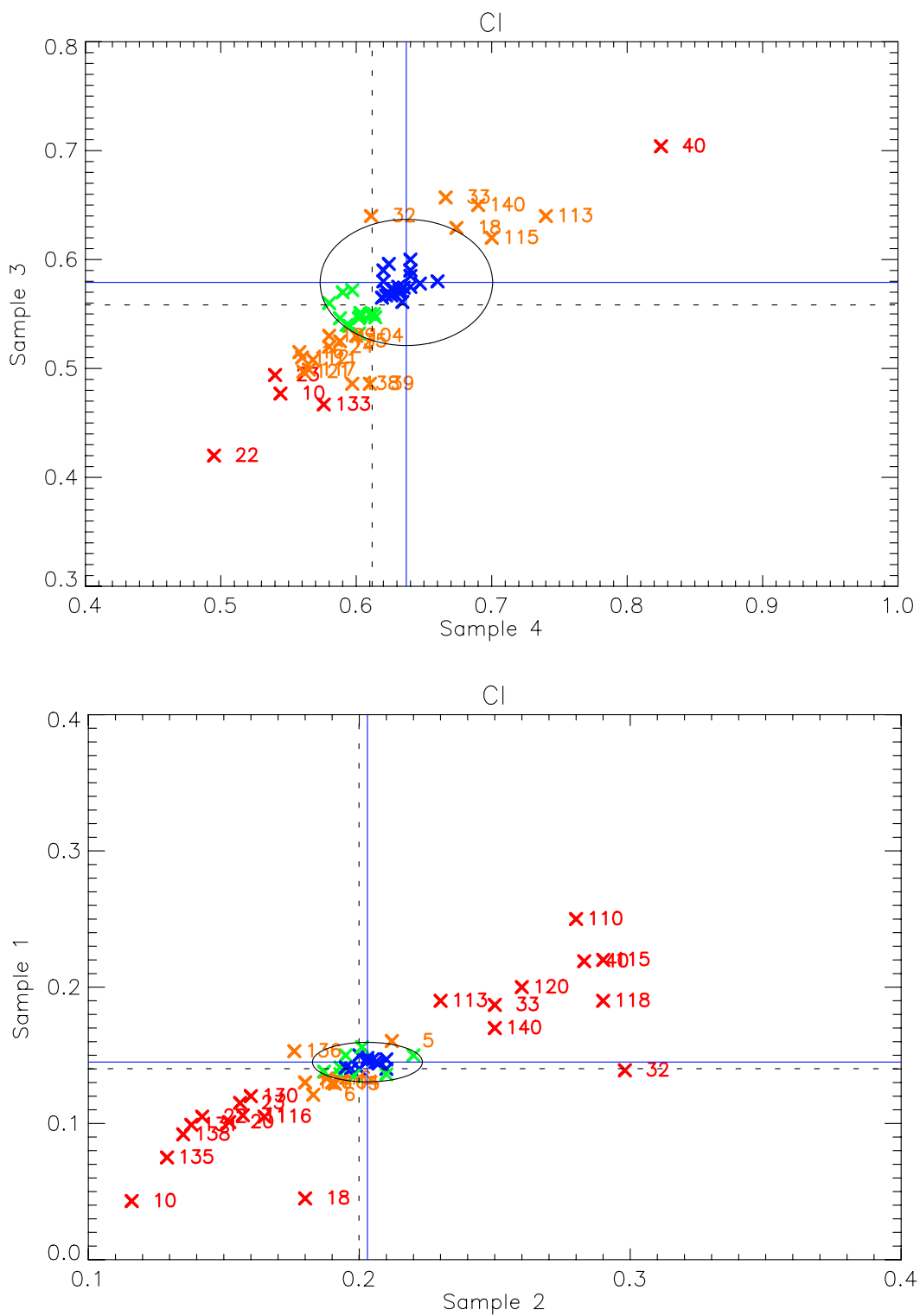


Figure 24: Youden plot of Cl in precipitation.

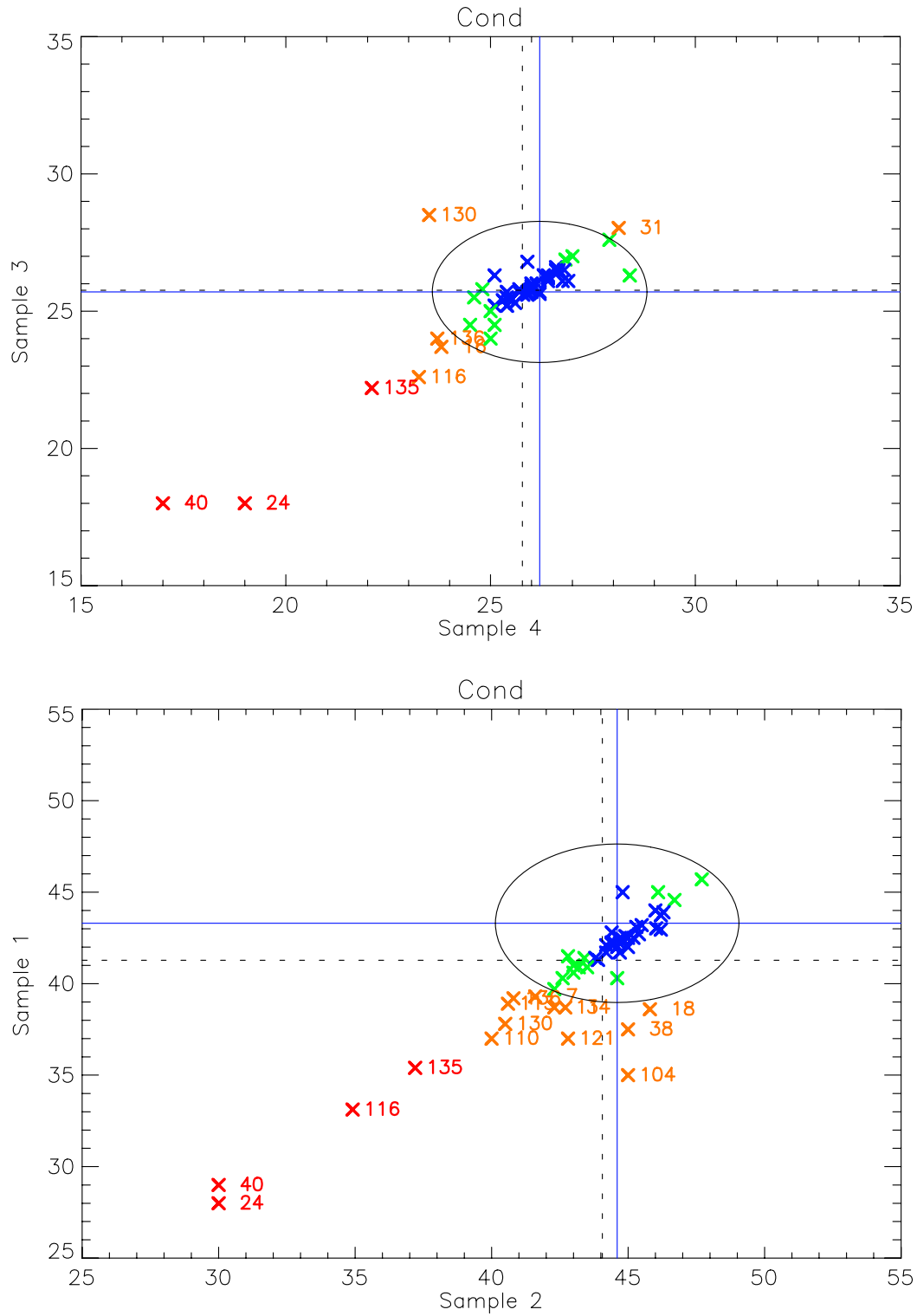


Figure 25: Youden plot of conductivity in precipitation.

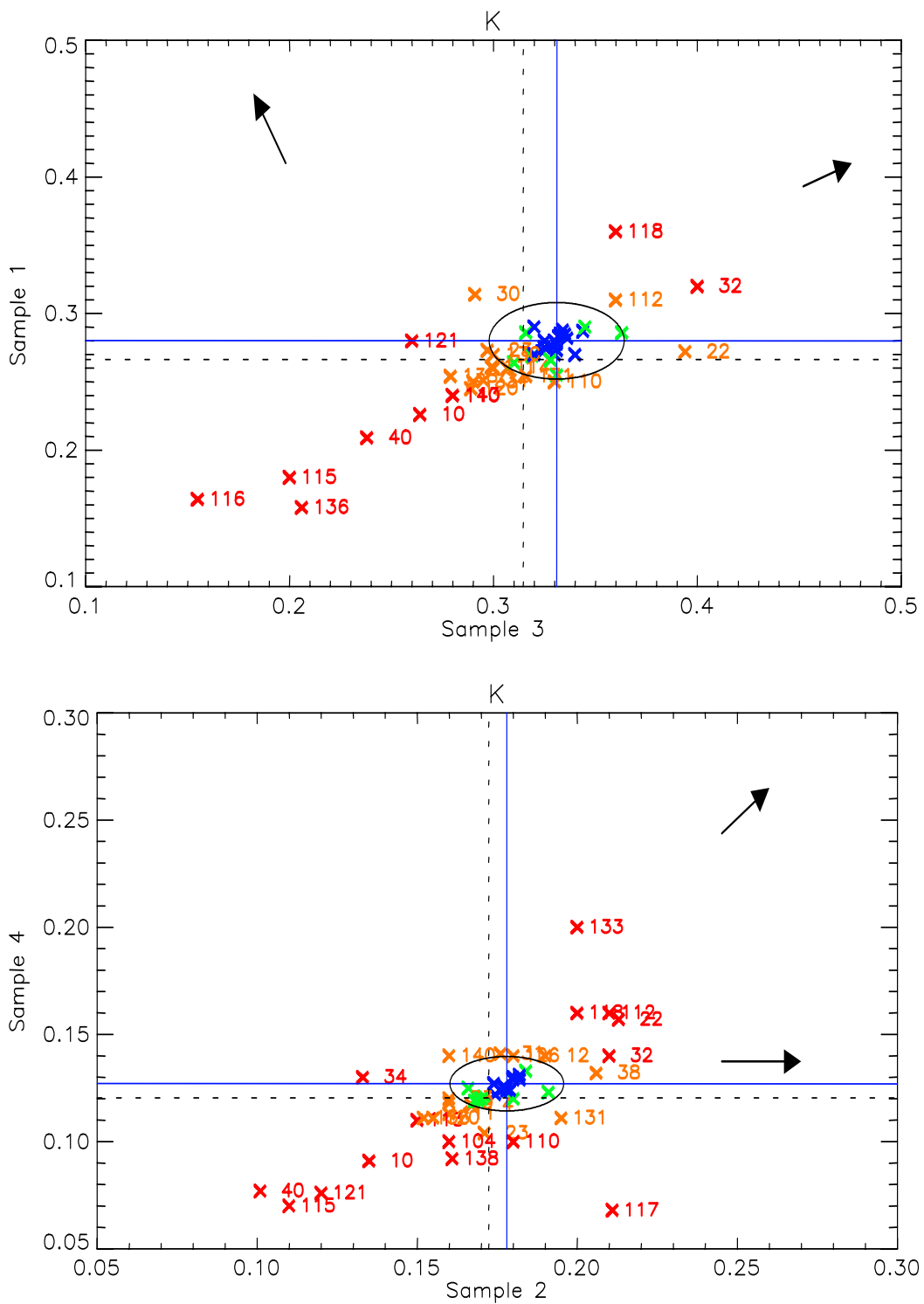


Figure 26: Youden plot of K in precipitation.

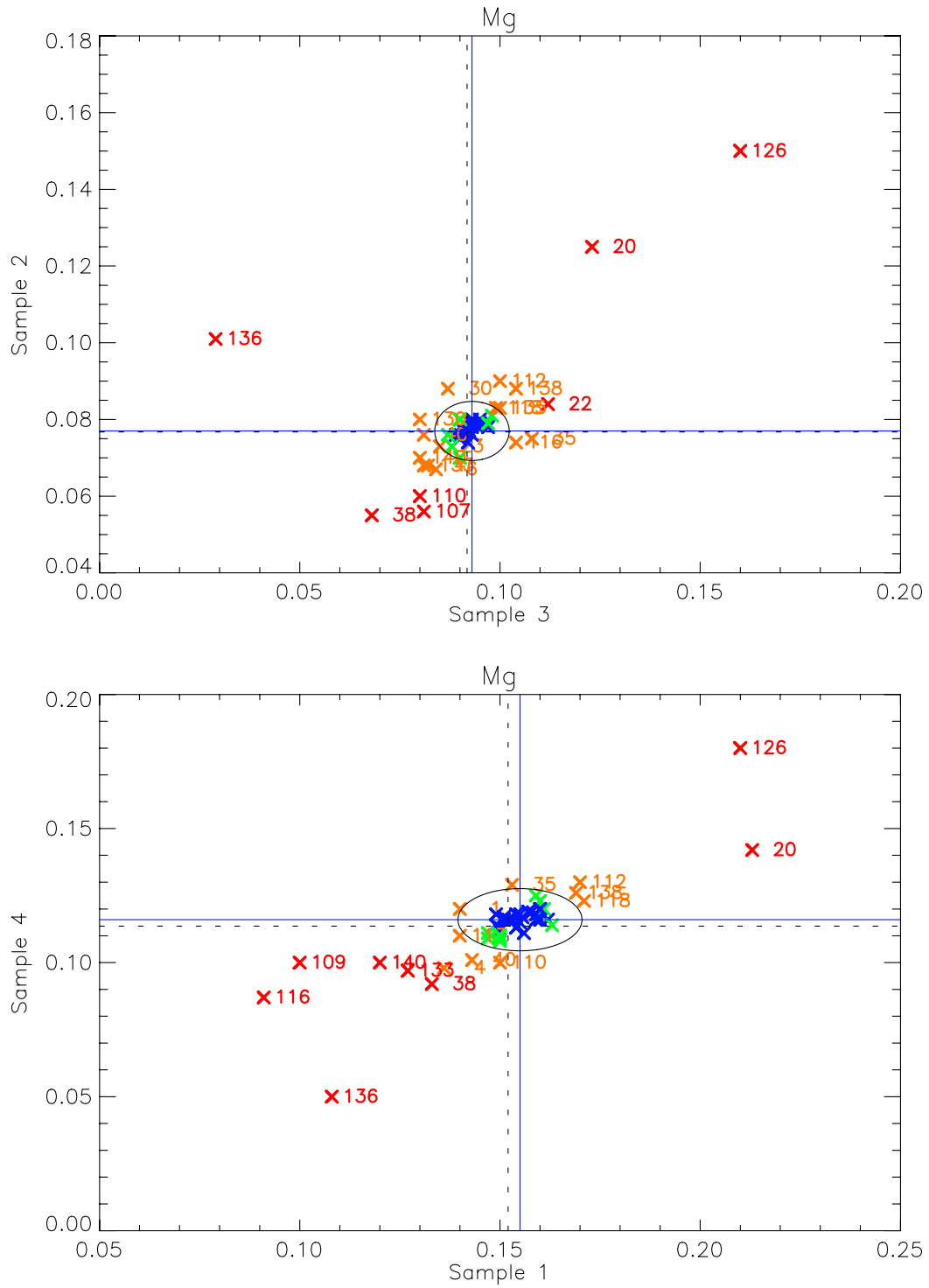


Figure 27: Youden plot of Mg in precipitation.

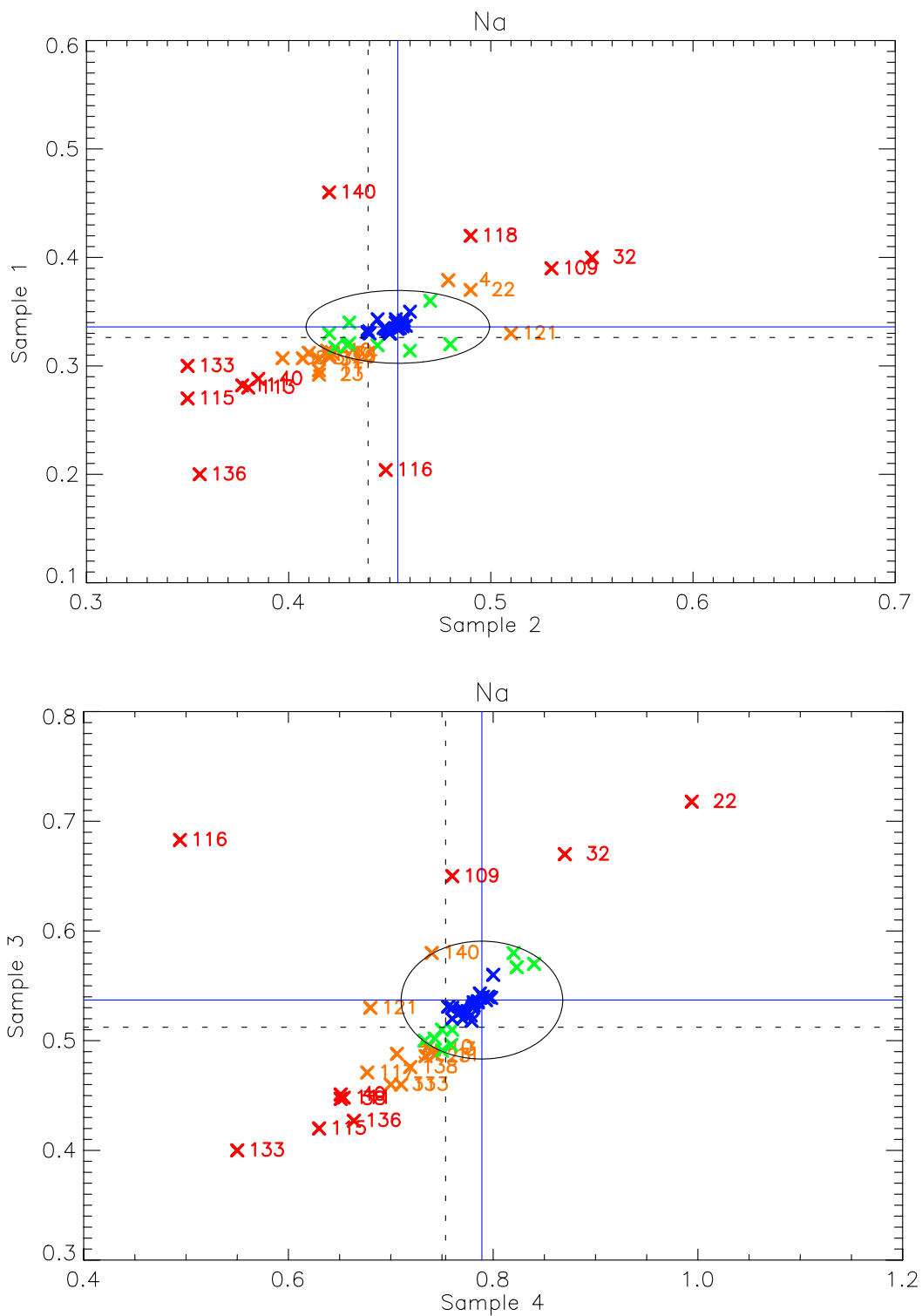


Figure 28: Youden plot of Na in precipitation.

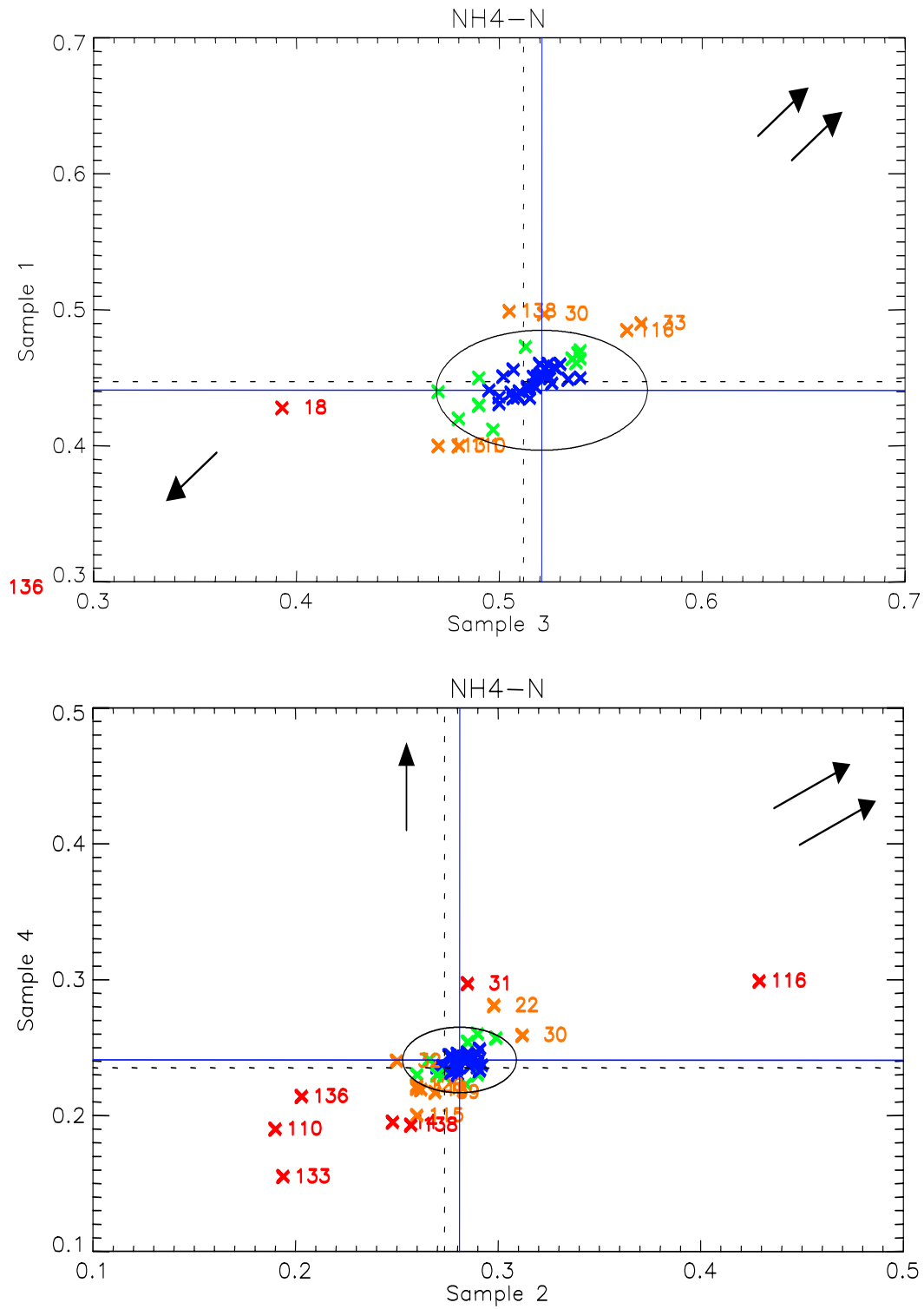


Figure 29: Youden plot of NH₄-N in precipitation.

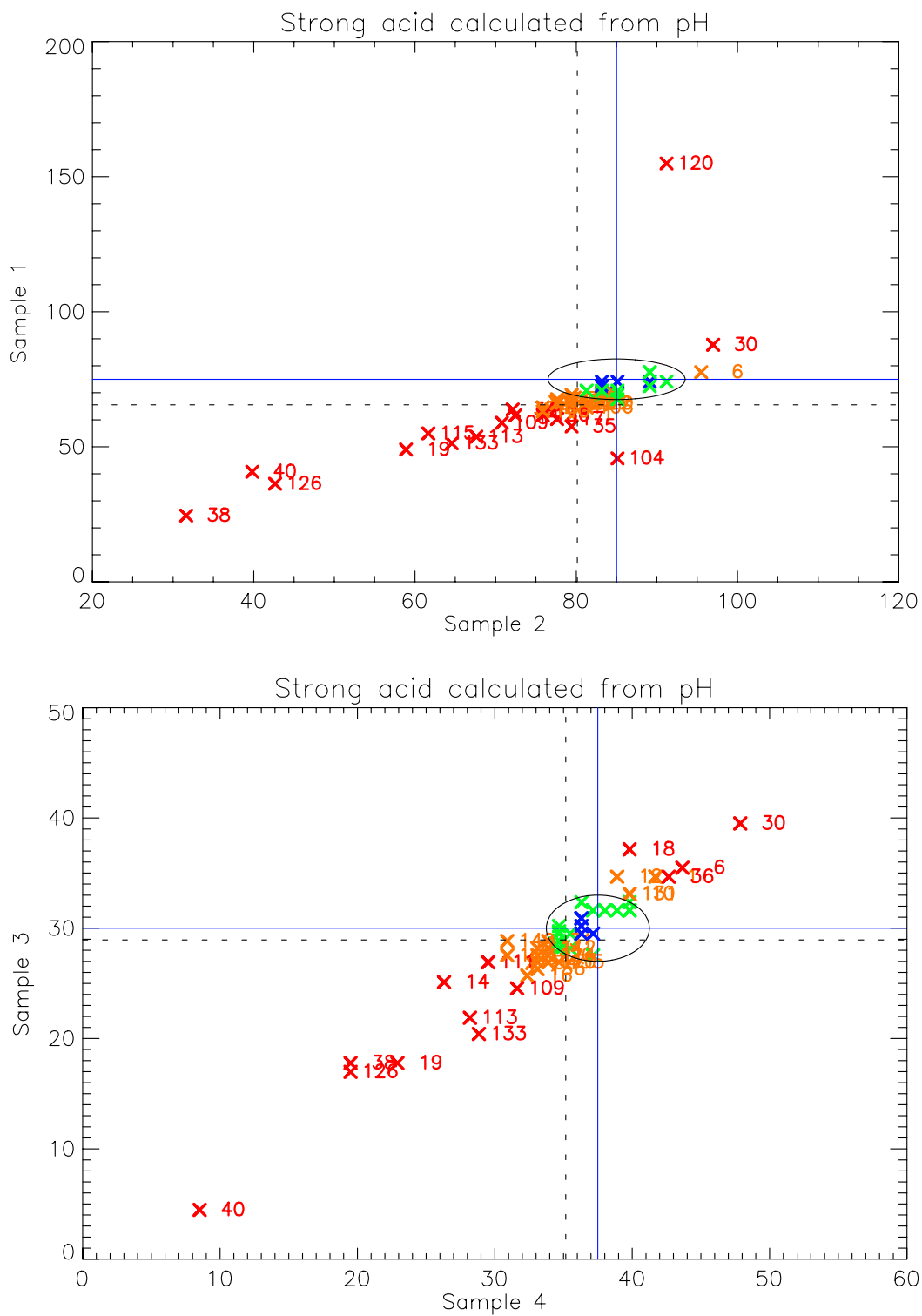


Figure 30: Youden plot of strong acid in precipitation.

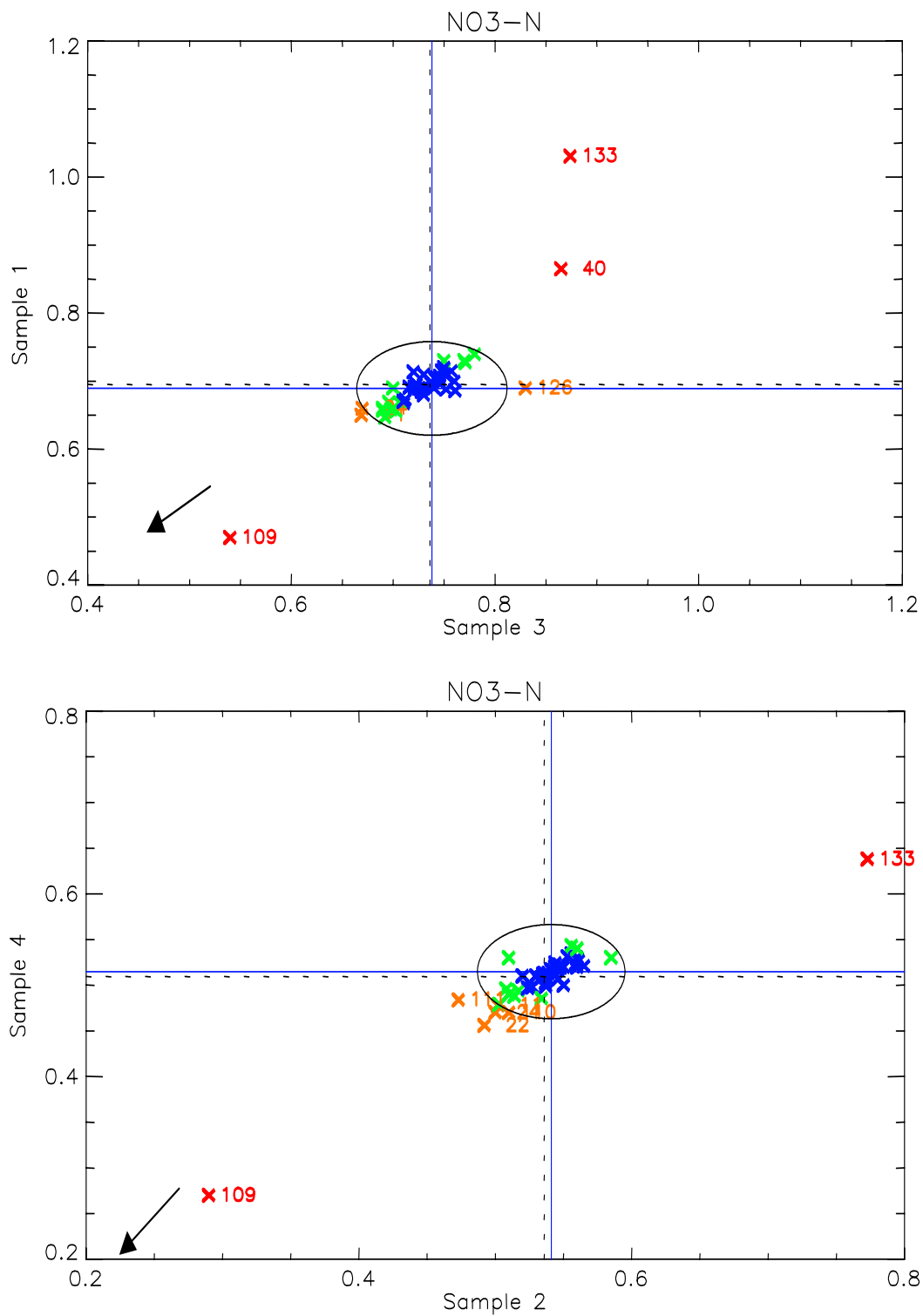


Figure 31: Youden plot of $\text{NO}_3\text{-N}$ in precipitation.

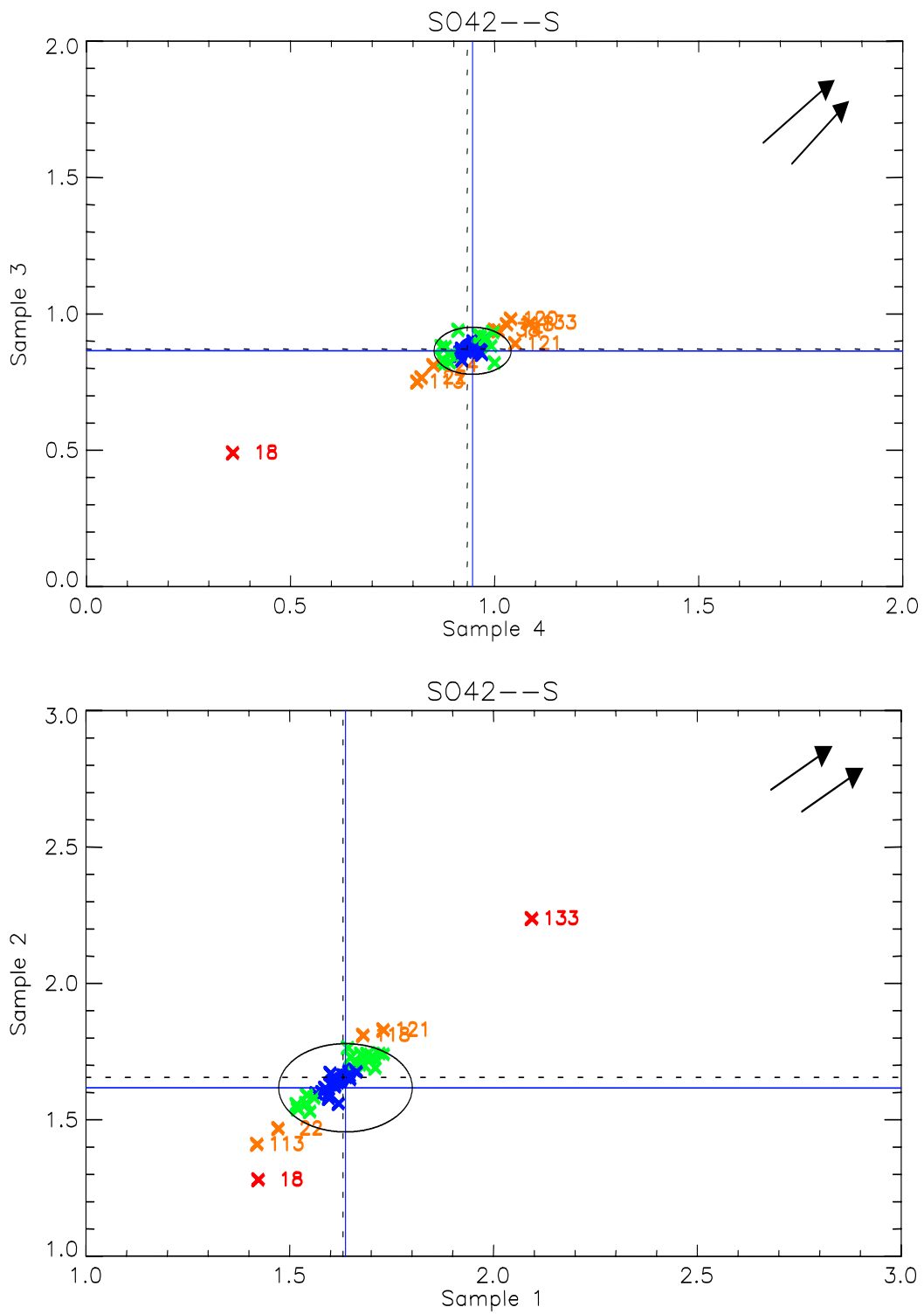


Figure 32: Youden plot of SO₄-S in precipitation.

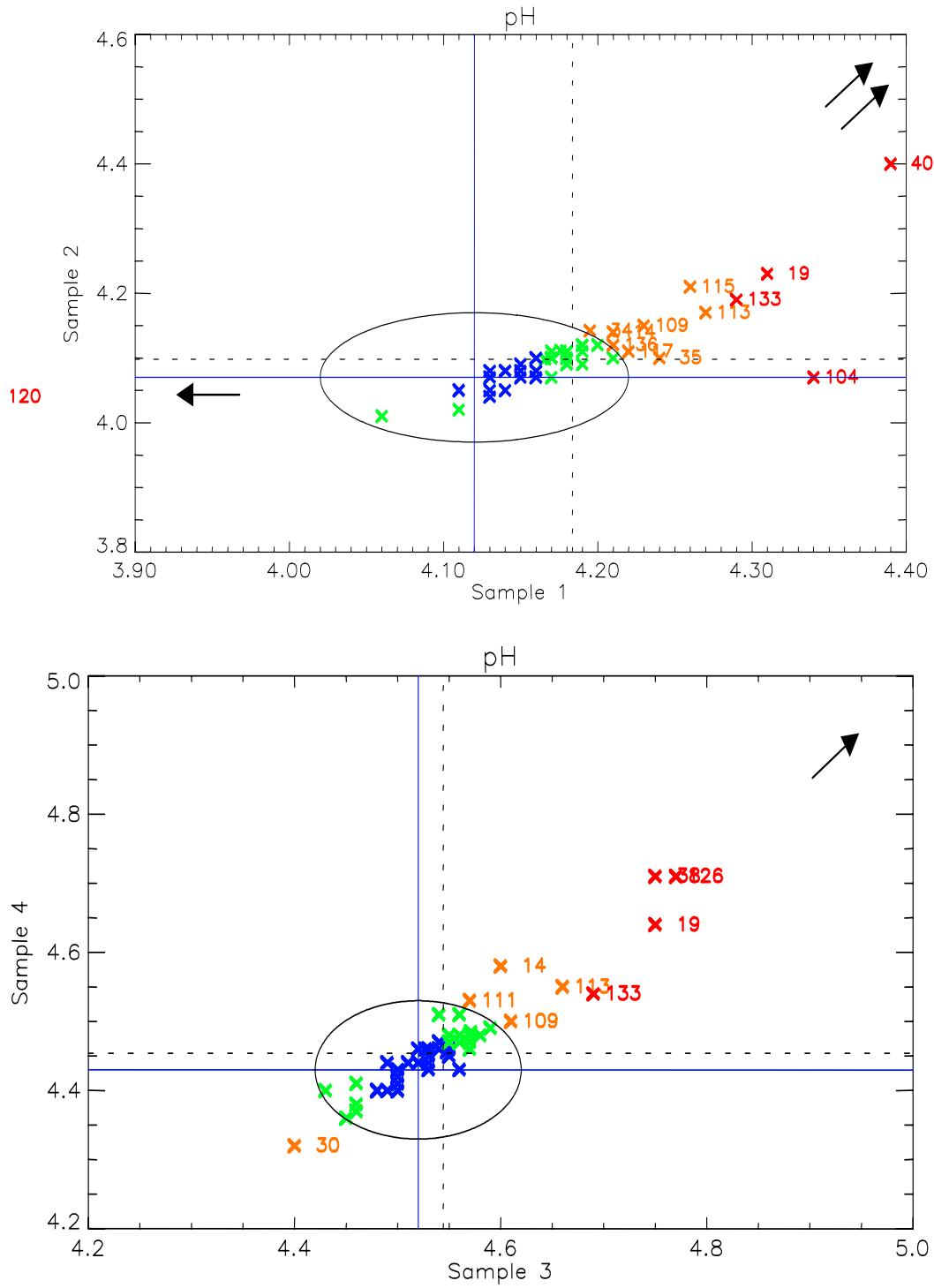


Figure 33: Youden plot of pH in precipitation.