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Gilbert S. Raynor and Janet V. Hayes

April 1978

ATMOSPHERIC SCIENCES DIVISION
DEPARTMENT OF ENERGY AND ENVIRONMENT

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ABSTRACT

Hourly precipitation samples were collected at Brookhaven National Laboratory from June 1976 through May 1977 using an Automatic Sequential Precipitation Sampler. Conventional meteorological data were recorded for each sample period. The samples were analyzed for pH, conductivity and concentrations of sulfate, nitrate, ammonium, sodium and chloride ions. Statistical analyses were performed of the relationships between selected chemical variables and between them and meteorological conditions. Results are presented in a series of tables.

INTRODUCTION

This report contains results of statistical analyses of the chemistry of hourly precipitation samples collected at Brookhaven National Laboratory from June 1, 1976 to May 31, 1977, and the relationships between the chemical variables and selected meteorological parameters. Nearly all hours having precipitation amounts large enough for analysis are included in the data base. Only two precipitation events and small portions of two others were missed due to mechanical problems or to outages caused by lightning or power failure.

The data are presented here for the benefit of other users. Interpretation of the data will be presented elsewhere.

EXPERIMENTAL METHODS

Precipitation samples were taken with the Brookhaven Automatic Sequential Precipitation Sampler. A description of the sampler, its operation and method of handling the samples were presented earlier.⁽¹⁾

Samples were analyzed by the Analytical Chemistry Group, Department of Energy and Environment, using procedures described as follows:

pH is determined as soon as possible after the sample is received using an Orion pH meter.

SPECIFIC CONDUCTIVITY is determined as soon as possible after the sample is received using a Markson Electromark Digital Analyzer.

$\text{NO}_3^- + \text{NO}_2^-$ are determined colorimetrically using an automated procedure and the Technicon Auto Analyzer. NO_3^- is reduced with hydrazine and the NO_2^- reacts with sulfanilamide under acidic conditions to form a diazo compound. This compound couples with N-1-naphthylethylenediamine dihydrochloride to form a reddish-purple azo dye which is read at 530 nm. Samples are refrigerated prior to analysis to prevent degradation of the ions.

NH_4^+ is determined using the Berthelot reaction in which a blue-colored compound, indophenol blue, is formed when a solution of an ammonium salt is added to sodium phenoxide followed by the addition of sodium hypochlorite in an alkaline medium. The indophenol blue is measured at 630 nm. The procedure is automated and run on a Technicon Auto Analyzer. Samples are refrigerated prior to this analysis to prevent degradation of the NH_4^+ .

$\text{SO}_4^{=}$ analyses are performed using an automated turbidimetric procedure and the Technicon Auto Analyzer. $\text{SO}_4^{=}$ is converted to a BaSO_4 suspension under controlled conditions and the resulting turbidity is read at 420 nm. An alternate procedure occasionally used is the methyl thymol blue colorimetric procedure. Identical results are obtained with both procedures.

CL^- is determined using an automated colorimetric procedure and the Technicon Auto Analyzer. Thiocyanate ion (SCN^-) is liberated from mercuric thiocyanate through sequestering of mercury by chloride. The liberated SCN^- in the presence of ferric ion forms a highly colored ferric thiocyanate, in concentration proportional to the original chloride. The complex is measured at 467 nm.

Na^+ is determined by atomic absorption analysis using a Perkin-Elmer 303 or Instrumentation Laboratory Atomic Absorption Spectrophotometer.

DATA

Data recorded for each hourly sample included date, sample number, time of beginning and end of sample, duration the cover was open, precipitation event number within the month, precipitation amount, precipitation type, cloud type, synoptic type causing the precipitation, wind direction and speed at a height of 108 m, air temperature and the chemical parameters enumerated above.

The meteorological parameters are self-explanatory except for the following cases. In precipitation type, thunderstorm hours include all hours in which a thunderstorm occurred even though the thunderstorm did not last the entire hour. It also includes hours of thunderstorm with hail. Snow includes all frozen precipitation, such as sleet and snow showers since not enough hours of these types occurred to classify them separately.

Under synoptic type, low includes all cases in which the precipitation could not be attributed to a specific type of front. Cold front precipitation includes precipitation both ahead of and behind the front. Squall lines include pre-frontal troughs.

Certain derived parameters were obtained from the original data. pH values were converted to molar concentrations of hydrogen ions. Ratios of selected ionic species were computed. Excess conductivity was calculated to give a measure of conductivity attributable to constituents other than H^+ . Excess sulfate was calculated to determine the non-seawater

sulfate contribution using the sulfate/chloride and chloride/sodium ratios in seawater. Sodium was used as the reference since the chloride/sodium ratios in the precipitation samples were consistently above the seawater ratio suggesting sources of chloride other than the ocean.

DATA ANALYSIS

Analytical procedures and methods of data presentation were selected so that the results would have maximum usefulness to the greater number of potential users. Statistical analyses were performed by an electronic computer making extensive use of the Statistical Package for the Social Sciences (SPSS)⁽²⁾ which eliminated much programming and facilitated computations.

Chemical parameters of the samples and ratios between them were related by standard linear correlation and regression techniques. The relationship of chemical species to meteorological conditions was determined by categorizing the chemical data by meteorological parameters and computing the mean, standard deviation and other statistics of the resulting distributions.

For these same categories, a weighted mean was computed by weighting the value of each chemical parameter by the amount of precipitation in that hour. The weighted mean values approximate those values which would be obtained if all samples taken under a selected condition were mixed and a single analysis performed. These means are most appropriate for relating precipitation chemistry to long term effects such as effects on soils or ground water. The unweighted means give greater importance to extreme events and are more appropriate for relating the chemistry of a category to short-term effects such as plant damage by "acid rain."

All data were used except that one extreme hourly value of conductivity and one of sulfate concentration were removed for the regression analyses but not for the statistical analyses. Also, several hours of data during the peak of Hurricane Belle were removed from all analyses since they had concentrations of chloride and sodium about three orders of magnitude above normal.

RESULTS

Results are presented here in tabular form. Units are all in ppm except hydrogen ion (10^{-4} M) and conductivity (μ mhos/cm). Ratios are non-dimensional. Graphical presentation of selected results will be included in future analytical papers. The tables are largely self-explanatory but are described briefly below.

Relationships between chemical parameters

The relationships between selected chemical parameters are shown in Table 1 where the slope and intercept of the linear regression equations relating the variables and the linear correlation coefficient between the variables are given. Where one variable could be considered dependent and the other independent, the former was used as the y variable and the latter as the x variable; where no such relationship was presumed, the choice of x and y variables was arbitrary. Some pairs of variables show varying degrees of positive correlation. This does not necessarily imply a physical cause and effect since both may be related to some other variable. Other pairs show no correlation but the results are included to document that fact.

The variability of selected chemical parameters by pH class is shown in Tables 2a-2n. Included for each class are weighted mean, mean, standard deviation, minimum, maximum and number of cases.

Relationship of chemical to meteorological parameters

Tables 3a-3g through 18a-18g present the means and statistics of the chemical variables classified by the following meteorological variables: season, synoptic type, precipitation type, precipitation rate, wind speed, wind direction and air temperature.

ACKNOWLEDGMENTS

This study would have been impossible without the participation and cooperation of many people. Bernard Manowitz, Leonard Newman and Lance Evans participated in the original design of the project. John McNeil assisted in the design and construction of the sampler and was primarily responsible for its operation and for collection of the samples. Chemical analyses were performed under the direction of Leonard Newman by Mary Kinsley, Daniel Leahy, Robert Wilson, Cleveland Dodge, Donna White, Tom McGee and Dan Spandau. George Hendrey, Stephen Schwartz and others suggested some of the derived parameters and supplied pertinent information from the literature.

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Table 1

Correlation and Regression Analyses of Relationships
Between Chemical Variables
(See text for units.)

<u>Variable y</u>	<u>Variable x</u>	<u>Intercept</u>	<u>Slope</u>	<u>Correlation Coefficient</u>
$H^+ \times 10^{-4}$	SO_4^-	-0.123	0.132	0.673
$H^+ \times 10^{-4}$	Excess SO_4^-	-0.165	0.160	0.740
$H^+ \times 10^{-4}$	NO_3^-	0.116	0.559	0.560
$H^+ \times 10^{-4}$	Cl^-	0.451	-0.003	-0.019
$H^+ \times 10^{-4}$	NH_4^+	0.265	0.366	0.291
$H^+ \times 10^{-4}$	Na^+	0.453	-0.002	-0.005
$H^+ \times 10^{-4}$	SO_4^-/Cl^-	0.093	0.081	0.491
$H^+ \times 10^{-4}$	SO_4^-/Na^+	0.302	0.009	0.291
$H^+ \times 10^{-4}$	NO_3^-/SO_4^-	0.310	1.052	0.180
$H^+ \times 10^{-4}$	NH_4^+/NO_3^-	0.488	-0.030	-0.085
$H^+ \times 10^{-4}$	NH_4^+/SO_4^-	0.463	-0.209	-0.031
$H^+ \times 10^{-4}$	Cl^-/Na^+	0.487	-0.009	-0.049
Cond.	$H^+ \times 10^{-4}$	16.426	28.501	0.692
Cond.	SO_4^-	-1.935	8.091	0.856
Cond.	NO_3^-	11.433	36.166	0.739
Cond.	Cl^-	20.843	3.785	0.532
Cond.	NH_4^+	15.582	36.431	0.523
Cond.	Na^+	20.723	8.603	0.535
Ex Cond.	SO_4^-	3.081	2.999	0.517
Ex Cond.	NO_3^-	7.736	13.716	0.469
Ex Cond.	NH_4^+	9.148	14.611	0.342
SO_4^-	NO_3^-	2.184	3.371	0.670
SO_4^-	NH_4^+	2.388	3.878	0.611
NO_3^-	NH_4^+	0.226	0.781	0.607
Na^+	Cl^-	-0.014	0.446	0.969
Ex SO_4^-	NO_3^-	2.022	3.249	0.658
Ex SO_4^-	NH_4^+	1.987	4.366	0.612

Table 2a

Variation in Conductivity (μ mhos/cm) by pH

<u>pH</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
3.00-3.99	194.32	109.43	126.03	38.70	800.00	35
4.00-4.99	21.20	28.03	20.32	3.20	163.00	201
5.00-5.99	9.15	12.82	11.12	2.00	81.20	104
6.00-6.99	15.85	19.33	13.34	4.60	52.50	20
ALL	47.59	31.07	49.87	2.00	800.00	360

Table 2b

Variation in Excess Conductivity (μ mhos/cm) by pH

<u>pH</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
3.00-3.99	135.82	47.31	123.76	0.00	733.15	35
4.00-4.99	8.58	14.16	16.88	0.00	136.44	201
5.00-5.99	7.29	11.07	11.02	0.90	78.67	104
6.00-6.99	15.64	19.12	13.34	4.26	52.28	20
ALL	30.88	16.76	41.93	0.00	733.15	360

Table 2c

Variation in Sulfate Concentration (ppm) by pH

<u>pH</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
3.00-3.99	8.04	10.71	5.92	2.70	27.00	49
4.00-4.99	2.92	3.72	2.19	2.00	14.67	228
5.00-5.99	2.39	3.91	12.56	1.11	142.50	126
6.00-6.99	2.51	3.59	2.75	2.00	13.80	36
ALL	3.72	4.55	7.53	1.11	142.50	439

Table 2d

Variation in Excess Sulfate Concentration (ppm) by pH

<u>pH</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
3.00-3.99	7.87	10.17	5.53	2.78	26.96	45
4.00-4.99	2.69	3.34	2.01	0.84	14.28	215
5.00-5.99	2.15	2.51	1.25	0.71	8.81	117
6.00-6.99	2.03	2.88	1.77	0.50	7.55	30
ALL	3.50	3.82	3.36	0.50	26.96	407

Table 2e

Variation in Nitrate Concentration (ppm) by pH

<u>pH</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
3.00-3.99	0.90	1.65	1.11	0.13	4.30	50
4.00-4.99	0.34	0.57	0.56	0.02	3.45	228
5.00-5.99	0.08	0.23	0.28	0.02	1.65	121
6.00-6.99	0.18	0.42	0.56	0.04	2.58	34
7.00-7.99	0.29	0.29	-	0.29	0.29	1
ALL	0.36	0.59	0.72	0.02	4.30	434

Table 2f

Variation in Ammonium Concentration (ppm) by pH

<u>pH</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
3.00-3.99	0.58	0.96	0.70	0.24	3.50	48
4.00-4.99	0.24	0.38	0.36	0.05	3.64	230
5.00-5.99	0.11	0.31	0.43	0.02	2.58	125
6.00-6.99	0.41	0.90	1.08	0.08	5.40	36
ALL	0.27	0.47	0.57	0.02	5.40	439

Table 2g

Variation in Sodium Concentration (ppm) by pH

<u>pH</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
3.00-3.99	0.54	1.09	2.96	0.06	20.50	47
4.00-4.99	0.76	1.08	1.82	0.01	15.40	220
5.00-5.99	0.47	0.66	0.96	0.02	5.75	118
6.00-6.99	1.51	1.81	4.54	0.09	24.80	30
ALL	0.64	1.02	2.13	0.01	24.80	415

Table 2h

Variation in Chloride Concentration (ppm) by pH

<u>pH</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
3.00-3.99	1.21	2.48	7.02	0.20	49.50	48
4.00-4.99	1.74	2.63	5.07	0.20	46.70	226
5.00-5.99	1.35	1.99	2.75	0.20	19.00	119
6.00-6.99	3.17	3.95	8.32	0.20	46.50	35
7.00-7.99	6.70	6.70	-	6.70	6.70	1
ALL	1.56	2.55	5.18	0.20	49.50	429

Table 2i

Variation in Nitrate/Sulfate Ratio by pH

<u>pH</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
3.00-3.99	0.12	0.19	0.20	0.01	1.05	48
4.00-4.99	0.10	0.15	0.12	0.00	0.72	224
5.00-5.99	0.03	0.08	0.07	0.01	0.38	119
6.00-6.99	0.06	0.10	0.07	0.02	0.29	32
ALL	0.08	0.13	0.12	0.00	1.05	423

Table 2j

Variation in Ammonium/Sulfate Ratio by pH

<u>pH</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
3.00-3.99	0.07	0.11	0.15	0.02	1.07	47
4.00-4.99	0.08	0.10	0.06	0.02	0.33	226
5.00-5.99	0.04	0.10	0.11	0.01	0.81	122
6.00-6.99	0.14	0.22	0.19	0.04	0.94	34
ALL	0.07	0.11	0.11	0.01	1.07	429

Table 2k

Variation in Ammonium/Nitrate Ratio by pH

<u>pH</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
3.00-3.99	0.80	0.98	1.53	0.21	8.64	48
4.00-4.99	1.13	1.14	2.12	0.09	21.00	225
5.00-5.99	1.80	1.68	2.02	0.28	20.00	121
6.00-6.99	2.64	2.63	1.70	0.47	8.50	30
ALL	1.34	1.38	2.05	0.09	21.00	424

Table 2l

Variation in Sulfate/Sodium Ratio by pH

<u>pH</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
3.00-3.99	47.09	36.44	40.91	0.68	164.57	45
4.00-4.99	16.45	14.54	21.05	0.43	200.00	215
5.00-5.99	14.69	13.50	17.36	0.38	160.00	117
6.00-6.99	5.05	7.77	7.20	0.34	28.64	30
ALL	21.48	16.17	23.64	0.34	200.00	407

Table 2m

Variation in Sulfate/Chloride Ratio by pH

<u>pH</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
3.00-3.99	12.56	10.27	6.98	0.28	32.91	47
4.00-4.99	4.10	3.99	3.80	0.22	28.50	221
5.00-5.99	3.79	3.12	2.35	0.11	10.00	118
6.00-6.99	2.05	2.95	2.25	0.15	10.00	33
ALL	5.58	4.37	4.41	0.11	32.91	419

Table 2n

Variation in Chloride/Sodium Ratio by pH

<u>pH</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
3.00-3.99	3.58	3.43	3.00	1.21	18.18	46
4.00-4.99	3.74	3.46	4.12	0.19	50.00	217
5.00-5.99	4.02	4.05	3.88	1.29	30.00	113
6.00-6.99	2.30	2.50	1.22	1.28	7.73	30
ALL	3.76	3.55	3.81	0.19	50.00	406

Table 3a

Variation of pH by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	4.66	4.50	3.74	7.20	124
spring	4.37	4.36	3.64	6.66	151
summer	4.03	4.06	3.21	6.62	92
fall	4.68	4.65	3.68	7.24	156
annual	4.30	4.38	3.21	7.24	523

Table 3b

Variation of pH by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	4.45	4.39	3.21	7.06	89
warm front	4.58	4.48	3.32	7.24	298
cold front	4.02	4.17	3.26	6.70	80
occluded front	4.69	4.82	4.04	6.62	20
squall line	3.88	4.01	3.48	6.52	27
hurricane	5.54	5.57	5.36	5.96	8
all	4.30	4.38	3.21	7.24	523

Table 3c

Variation of pH by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	4.53	4.52	3.32	7.24	361
rain shower	4.31	4.16	3.56	6.70	61
thundershower	3.98	3.91	3.21	6.36	39
snow	4.51	4.49	3.82	6.09	62
all	4.30	4.38	3.21	7.24	523

Table 3d

Variation of pH by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	4.32	4.39	3.26	7.24	257
0.04-0.10	4.36	4.35	3.21	6.40	175
0.11-0.25	4.52	4.51	3.66	6.70	59
0.26-0.50	4.29	4.30	3.48	5.92	23
≥ 0.51	4.06	4.17	3.72	5.46	9
all	4.30	4.38	3.21	7.24	523

Table 3e

Variation of pH by Wind Speed at 108 m

<u>wind speed</u> <u>(m sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	4.45	4.37	3.63	6.69	26
3-5	4.10	4.30	3.21	7.06	210
6-9	4.33	4.35	3.26	7.24	191
≥ 10	4.78	4.69	3.98	7.20	96
all	4.30	4.38	3.21	7.24	523

Table 3f

Variation of pH by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	4.78	4.75	4.25	6.12	42
NE	4.59	4.49	3.68	6.66	69
E	4.52	4.44	3.41	7.06	93
SE	4.24	4.26	3.32	7.20	89
S	4.52	4.41	3.56	6.99	71
SW	4.13	4.16	3.21	7.24	70
W	4.01	4.46	3.71	6.39	28
NW	3.96	4.45	3.48	6.28	61
all	4.30	4.38	3.21	7.24	523

Table 3g

Variation of pH by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
10-19	4.33	4.33	4.33	4.33	1
20-29	4.46	4.47	3.82	6.10	38
30-39	4.53	4.49	3.83	5.59	76
40-49	4.52	4.46	3.74	6.70	140
50-59	4.47	4.48	3.64	7.20	106
60-69	4.38	4.41	3.21	7.24	89
70-79	4.00	4.06	3.26	7.06	72
80-89	3.98	3.98	3.98	3.98	1
all	4.30	4.38	3.21	7.24	523

Table 4a

Variation in Hydrogen Ion Concentration $\times 10^{-4} M$
by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	0.22	0.32	0.37	0.00	1.82	124
spring	0.43	0.44	0.42	0.00	2.29	151
summer	0.93	0.87	1.37	0.00	6.17	92
fall	0.21	0.22	0.37	0.00	2.09	156
annual	0.51	0.42	0.71	0.00	6.17	523

Table 4b

Variation in Hydrogen Ion Concentration $\times 10^{-4} M$
by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	0.36	0.41	0.85	0.00	6.17	89
warm front	0.27	0.33	0.49	0.00	4.79	298
cold front	0.96	0.67	1.01	0.00	5.50	80
occluded front	0.20	0.15	0.23	0.00	0.91	20
squall line	1.33	0.98	0.97	0.00	3.31	27
hurricane	0.03	0.03	0.01	0.01	0.04	8
all	0.51	0.42	0.71	0.00	6.17	523

Table 4c

Variation in Hydrogen Ion Concentration $\times 10^{-4} M$
by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	0.30	0.30	0.50	0.00	4.79	361
rain shower	0.49	0.70	0.78	0.00	2.75	61
thundershower	1.05	1.22	1.59	0.00	6.17	39
snow	0.31	0.32	0.32	0.01	1.51	62
all	0.51	0.42	0.71	0.00	6.17	523

Table 4d

Variation in Hydrogen Ion Concentration $\times 10^{-4} M$
by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	0.47	0.41	0.80	0.00	5.50	257
0.04-0.10	0.43	0.45	0.63	0.00	6.17	175
0.11-0.25	0.31	0.31	0.38	0.00	2.19	59
0.26-0.50	0.51	0.51	0.81	0.01	3.31	23
≥ 0.51	0.88	0.68	0.73	0.04	1.91	9
all	0.51	0.42	0.71	0.00	6.17	523

Table 4e

Variation in Hydrogen Ion Concentration $\times 10^{-4} M$
by Wind Speed at 108 m

<u>wind speed</u> <u>(m sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	0.36	0.42	0.58	0.00	2.34	26
3-5	0.80	0.50	0.86	0.00	6.17	210
6-9	0.47	0.45	0.68	0.00	5.50	191
≥ 10	0.17	0.20	0.23	0.00	1.05	96
all	0.51	0.42	0.71	0.00	6.17	523

Table 4f

Variation in Hydrogen Ion Concentration $\times 10^{-4} M$
by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	0.17	0.18	0.19	0.01	1.00	42
NE	0.26	0.32	0.40	0.00	2.09	69
E	0.30	0.36	0.50	0.00	3.89	93
SE	0.57	0.56	0.86	0.00	4.79	89
S	0.30	0.39	0.57	0.00	2.75	71
SW	0.75	0.69	1.21	0.00	6.17	70
W	0.97	0.34	0.55	0.00	1.95	28
NW	1.11	0.36	0.58	0.01	3.31	61
all	0.51	0.42	0.71	0.00	6.17	523

Table 4g

Variation in Hydrogen Ion Concentration $\times 10^{-4} M$
by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
10-19	0.47	0.47	-	0.47	0.47	1
20-29	0.35	0.34	0.34	0.01	1.51	38
30-39	0.30	0.32	0.30	0.03	1.48	76
40-49	0.30	0.35	0.36	0.00	1.82	140
50-59	0.34	0.33	0.47	0.00	2.29	106
60-69	0.42	0.39	0.80	0.00	6.17	89
70-79	0.99	0.87	1.38	0.00	5.50	72
80-89	1.05	1.05	-	1.05	1.05	1
all	0.51	0.42	0.71	0.00	6.17	523

Table 5a

Variation in Conductivity (μ mhos/cm)
by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	17.31	28.51	35.18	3.00	228.00	76
spring	21.29	26.28	19.50	3.20	98.70	118
summer	106.46	53.81	107.01	2.00	800.00	60
fall	18.23	25.36	20.07	2.50	100.00	106
annual	47.59	31.07	49.87	2.00	800.00	360

Table 5b

Variation in Conductivity (μ mhos/cm)
by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	19.35	25.60	24.29	3.30	120.00	61
warm front	16.81	24.77	25.10	2.50	228.00	210
cold front	50.07	46.46	35.55	4.80	170.00	54
occluded front	19.79	17.98	15.90	4.60	58.90	12
squall line	256.08	110.56	203.19	12.00	800.00	14
hurricane	8.80	9.24	5.49	2.00	19.00	8
all	47.59	31.07	49.87	2.00	800.00	360

Table 5c

Variation in Conductivity (μ mhos/cm)
by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	18.16	23.95	24.08	2.50	228.00	256
rain shower	28.20	47.22	33.39	7.90	170.00	35
thundershower	126.46	71.00	132.27	2.00	800.00	36
snow	21.40	25.61	21.10	3.10	82.00	33
all	47.59	31.07	49.87	2.00	800.00	360

Table 5d

Variation in Conductivity (μ mhos/cm)
by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	34.80	34.74	29.40	3.10	170.00	109
0.04-0.10	26.68	30.32	30.55	2.00	228.00	162
0.11-0.25	16.74	17.06	16.17	3.60	100.00	58
0.26-0.50	23.26	23.40	33.02	2.50	120.00	23
≥ 0.51	148.96	119.80	275.98	3.00	800.00	8
all	47.59	31.07	49.87	2.00	800.00	360

Table 5e

Variation in Conductivity (μ mhos/cm)
by Wind Speed at 108 m

<u>speed (m. sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	16.89	26.87	18.85	9.70	69.50	18
3-5	91.89	36.47	73.29	2.00	800.00	134
6-9	28.51	30.95	32.07	3.10	228.00	131
≥ 10	14.22	22.85	19.62	3.00	107.00	77
all	47.59	31.07	49.87	2.00	800.00	360

Table 5f

Variation in Conductivity (μ mhos/cm)
by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	19.02	21.66	13.23	4.70	54.00	29
NE	15.25	23.52	21.49	2.00	100.00	47
E	15.80	22.95	18.89	3.10	100.00	68
SE	31.26	35.42	39.55	2.50	228.00	64
S	19.81	28.37	29.30	4.80	170.00	54
SW	39.38	44.32	34.38	3.30	170.00	43
W	49.47	31.41	31.79	7.60	120.00	15
NW	246.90	42.86	125.12	3.10	800.00	40
all	47.59	31.07	49.87	2.00	800.00	360

Table 5g

Variation in Conductivity (μ mhos/cm)
by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
20-29	24.91	27.41	20.45	8.00	82.00	18
30-39	20.58	26.24	18.34	3.10	90.00	54
40-49	15.07	23.08	26.14	3.20	228.00	102
50-59	23.13	30.43	27.55	3.00	163.00	77
60-69	22.86	30.55	28.37	2.00	120.00	61
70-79	128.21	56.66	119.22	4.10	800.00	47
80-89	49.40	49.40	-	49.40	49.40	1
all	47.59	31.07	49.87	2.00	800.00	360

Table 6a

Variation in Excess Conductivity (μ mhos/cm)
by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	10.79	18.84	28.54	1.09	183.90	76
spring	7.26	10.96	12.89	0.00	54.74	118
summer	75.63	27.60	94.55	0.00	733.15	60
fall	10.85	15.60	10.55	2.07	55.38	106
annual	30.88	16.76	41.93	0.00	733.15	360

Table 6b

Variation in Excess Conductivity (μ mhos/cm)
by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	9.87	12.18	9.60	0.00	49.98	61
warm front	8.59	14.07	20.28	0.00	183.90	210
cold front	16.52	20.71	17.00	0.00	78.67	54
occluded front	11.24	10.97	8.62	0.00	27.48	12
squall line	209.06	72.06	191.33	0.00	733.15	14
hurricane	7.79	8.30	5.39	1.08	17.70	8
all	30.88	16.76	41.93	0.00	733.15	360

Table 6c

Variation in Excess Conductivity (μ mhos/cm)
by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	8.85	13.59	17.94	0.00	183.90	256
rain shower	11.90	21.98	16.22	0.00	73.75	35
thundershower	91.09	36.01	121.43	0.00	733.15	36
snow	11.67	14.86	14.85	0.00	64.86	33
all	30.88	16.76	41.93	0.00	733.15	360

Table 6d

Variation in Excess Conductivity (μ mhos/cm)
by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	17.57	19.00	17.51	0.00	136.44	109
0.04-0.10	15.27	16.28	20.96	0.00	183.90	162
0.11-0.25	6.73	6.81	7.01	0.00	25.44	58
0.26-0.50	5.98	6.32	8.50	0.00	30.65	23
≥ 0.51	119.31	98.33	256.59	1.32	733.15	8
all	30.88	16.76	41.93	0.00	733.15	360

Table 6e

Variation in Excess Conductivity (μ mhos/cm)
by Wind Speed at 108 m

<u>wind speed</u> <u>(m sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	5.01	11.03	9.12	0.00	32.74	18
3-5	64.74	18.91	63.52	0.00	733.15	134
6-9	12.52	16.19	23.43	0.00	183.90	131
≥ 10	8.80	15.35	16.39	0.00	91.71	77
all	30.88	16.76	41.93	0.00	733.15	360

Table 6f

Variation in Excess Conductivity (μ mhos/cm)
by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	13.15	14.68	9.06	4.08	49.98	29
NE	6.79	10.55	11.19	0.00	41.40	47
E	6.30	10.40	11.33	0.00	64.86	68
SE	12.39	19.81	30.58	0.00	183.90	64
S	10.24	15.57	17.13	0.00	78.67	54
SW	15.73	20.66	18.05	0.00	82.85	43
W	17.67	16.04	14.17	0.00	51.75	15
NW	206.11	29.22	114.50	0.00	733.15	40
all	30.88	16.76	41.93	0.00	733.15	360

Table 6g

Variation in Excess Conductivity (μ mhos/cm)
by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
20-29	13.15	14.56	10.55	3.58	37.90	18
30-39	10.78	15.41	14.57	0.00	64.86	54
40-49	5.64	11.11	20.44	0.00	183.90	102
50-59	11.41	16.94	20.02	0.00	136.44	77
60-69	11.35	16.12	14.70	0.00	82.85	61
70-79	94.40	32.08	106.11	0.00	733.15	47
80-89	12.65	12.65	-	12.65	12.65	1
all	30.88	16.76	41.93	0.00	733.15	360

Table 7a

Variation in Sulfate Concentration (ppm)
by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	2.84	3.85	2.80	2.00	14.67	98
spring	2.97	3.85	3.16	2.00	26.30	135
summer	5.40	8.09	16.97	2.49	142.50	73
fall	2.82	3.81	2.62	1.11	16.29	133
annual	3.72	4.55	7.53	1.11	142.50	439

Table 7b

Variation in Sulfate Concentration (ppm)
by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	3.00	3.59	2.93	1.11	15.15	77
warm front	2.72	3.74	2.84	2.00	27.00	251
cold front	5.99	8.16	17.24	2.00	142.50	68
occluded front	2.49	2.43	0.58	2.00	4.30	15
squall line	6.43	8.54	6.35	2.49	23.04	19
hurricane	2.50	2.52	0.07	2.49	2.70	8
all	3.72	4.55	7.53	1.11	142.50	439

Table 7c

Variation in Sulfate Concentration (ppm)
by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	2.81	3.61	2.85	1.11	27.00	308
rain shower	4.91	10.39	20.50	2.01	142.50	47
thundershower	5.56	6.02	4.76	2.00	17.88	37
snow	3.33	3.67	2.18	2.00	13.30	47
all	3.72	4.55	7.53	1.11	142.50	439

Table 7d

Variation in Sulfate Concentration (ppm)
by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	5.61	6.14	11.12	1.11	142.50	179
0.04-0.10	3.52	3.71	3.19	1.29	22.50	169
0.11-0.25	2.60	2.62	1.17	2.00	7.95	59
0.26-0.50	3.45	3.46	2.82	2.00	12.96	23
≥ 0.51	4.93	3.98	2.84	2.00	9.90	9
all	3.72	4.55	7.53	1.11	142.50	439

Table 7e

Variation in Sulfate Concentration (ppm)
by Wind Speed at 108 m

<u>wind speed</u> <u>(m sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	2.59	3.54	1.97	2.00	7.75	21
3-5	4.83	4.89	4.31	1.29	27.00	163
6-9	3.89	5.33	11.29	1.11	142.50	167
≥ 10	2.30	2.66	1.24	2.00	7.90	88
all	3.72	4.55	7.53	1.11	142.50	439

Table 7f

Variation in Sulfate Concentration (ppm)
by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	2.57	2.86	1.13	1.11	6.60	35
NE	2.85	3.62	2.50	1.29	13.20	57
E	2.71	3.63	2.20	2.00	15.15	79
SE	3.91	4.81	4.59	2.00	27.00	76
S	3.10	4.10	3.95	2.00	22.50	63
SW	5.38	8.86	19.00	2.01	142.50	55
W	4.65	4.32	3.34	2.00	15.99	24
NW	6.11	3.76	3.18	2.00	16.29	50
all	3.72	4.55	7.53	1.11	142.50	439

Table 7g

Variation in Sulfate Concentration (ppm)
by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
20-29	3.66	3.87	2.55	2.00	13.30	26
30-39	2.98	3.61	2.06	2.00	14.67	66
40-49	2.59	3.59	2.64	2.00	14.20	121
50-59	2.98	3.85	2.60	1.10	12.80	90
60-69	3.50	6.48	16.30	2.01	142.50	77
70-79	5.76	6.41	6.01	2.01	27.00	58
80-89	5.26	5.26	-	5.26	5.26	1
all	3.72	4.55	7.53	1.11	142.50	439

Table 8a

Variation in Excess Sulfate Concentration (ppm)
by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	2.58	3.43	2.47	1.34	14.28	85
spring	2.70	3.20	2.23	0.84	13.74	124
summer	5.19	5.86	5.73	1.96	26.96	70
fall	2.65	3.58	2.54	0.50	16.26	128
annual	3.50	3.82	3.36	0.50	26.96	407

Table 8b

Variation in Excess Sulfate Concentration (ppm)
by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	2.77	3.33	2.99	0.96	14.96	73
warm front	2.50	3.30	2.52	0.50	26.96	232
cold front	5.70	5.90	4.39	1.90	20.87	61
occluded front	2.17	2.09	0.62	0.84	3.50	15
squall line	6.31	7.72	6.26	2.40	23.01	17
hurricane	2.31	2.31	0.21	1.96	2.56	8
all	3.50	3.82	3.36	0.50	26.96	407

Table 8c

Variation in Excess Sulfate Concentration (ppm)
by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	2.58	3.19	2.59	0.50	26.96	291
rain shower	4.19	6.80	4.96	1.84	23.01	41
thundershower	5.49	5.97	4.78	1.98	17.74	36
snow	3.10	3.42	2.23	1.73	13.02	39
all	3.50	3.82	3.36	0.50	26.96	407

Table 8d

Variation in Excess Sulfate Concentration (ppm)
by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	4.80	4.87	3.98	0.96	26.96	150
0.04-0.10	3.24	3.42	3.12	0.50	21.90	166
0.11-0.25	2.46	2.47	1.16	1.42	7.88	59
0.26-0.50	3.34	3.35	2.76	1.62	12.82	23
≥ 0.51	4.88	3.93	2.86	1.84	9.85	9
all	3.50	3.82	3.36	0.50	26.96	407

Table 8e

Variation in Excess Sulfate Concentration (ppm)
by Wind Speed at 108 m

<u>wind speed</u> <u>(m sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	2.46	3.28	1.93	1.88	7.61	19
3-5	4.77	4.72	4.29	1.27	26.96	152
6-9	3.48	3.90	2.90	0.96	20.87	153
≥ 10	2.03	2.17	1.06	0.50	7.73	83
all	3.50	3.82	3.36	0.50	26.96	407

Table 8f

Variation in Excess Sulfate Concentration (ppm)
by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	2.27	2.53	1.05	0.96	6.56	30
NE	2.69	3.41	2.56	1.27	13.10	52
E	2.58	3.35	2.04	1.45	14.96	76
SE	3.69	4.16	4.31	1.34	26.96	74
S	2.88	3.77	3.86	0.50	21.90	60
SW	4.66	5.56	3.83	1.84	17.74	47
W	4.54	4.38	3.67	1.73	15.90	19
NW	5.96	3.48	3.26	0.84	16.26	49
all	3.50	3.82	3.36	0.50	26.96	407

Table 8g

Variation in Excess Sulfate Concentration (ppm)
by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
20-29	3.57	3.75	2.66	1.88	13.02	22
30-39	2.69	3.22	2.09	0.84	14.28	61
40-49	2.38	3.03	1.97	1.45	13.74	108
50-59	2.74	3.59	2.50	0.96	12.72	86
60-69	3.11	4.04	3.49	0.50	20.87	72
70-79	5.65	6.05	5.93	1.09	26.96	57
80-89	5.24	5.24	-	5.24	5.24	1
all	3.50	3.82	3.36	0.50	26.96	407

Table 9a

Variation in Nitrate Concentration (ppm)
by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	0.38	0.81	0.91	0.02	4.30	97
spring	0.31	0.53	0.67	0.02	3.53	136
summer	0.43	0.62	0.83	0.02	4.10	72
fall	0.26	0.47	0.47	0.02	2.58	129
annual	0.36	0.59	0.72	0.02	4.30	434

Table 9b

Variation in Nitrate Concentration (ppm)
by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	0.41	0.60	0.89	0.02	3.60	79
warm front	0.24	0.52	0.67	0.02	4.30	246
cold front	0.64	0.85	0.71	0.05	3.53	66
occluded front	0.36	0.32	0.45	0.04	1.94	16
squall line	0.53	0.90	0.57	0.10	1.94	18
hurricane	0.06	0.06	0.03	0.02	0.11	8
all	0.36	0.59	0.72	0.02	4.30	434

Table 9c

Variation in Nitrate Concentration (ppm)
by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	0.23	0.42	0.55	0.02	4.10	303
rain shower	0.48	1.03	0.91	0.03	3.53	44
thundershower	0.51	0.80	0.85	0.02	3.28	38
snow	0.84	1.07	0.92	0.05	4.30	49
all	0.36	0.59	0.72	0.02	4.30	434

Table 9d

Variation in Nitrate Concentration (ppm)
by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	0.85	0.86	0.82	0.02	4.30	173
0.04-0.10	0.48	0.52	0.66	0.02	3.60	170
0.11-0.25	0.18	0.19	0.21	0.02	1.17	59
0.26-0.50	0.24	0.24	0.38	0.02	1.33	23
≥ 0.51	0.34	0.26	0.29	0.02	0.65	9
all	0.36	0.59	0.72	0.02	4.30	434

Table 9e

Variation in Nitrate Concentration (ppm)
by Wind Speed at 108 m

<u>wind speed</u> <u>(m sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	0.31	0.83	0.97	0.02	3.45	19
3-5	0.47	0.66	0.71	0.02	4.10	163
6-9	0.46	0.66	0.75	0.02	4.30	165
≥ 10	0.12	0.26	0.48	0.02	3.00	87
all	0.36	0.59	0.72	0.02	4.30	434

Table 9f

Variation in Nitrate Concentration (ppm)
by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	0.38	0.58	0.53	0.02	2.43	36
NE	0.29	0.53	0.61	0.02	2.75	57
E	0.18	0.41	0.64	0.02	4.30	81
SE	0.30	0.55	0.76	0.02	4.10	74
S	0.29	0.54	0.81	0.03	3.60	62
SW	0.78	1.04	0.79	0.03	3.28	51
W	0.67	0.73	0.69	0.19	3.00	22
NW	0.62	0.55	0.67	0.05	3.00	51
all	0.36	0.59	0.72	0.02	4.30	434

Table 9g

Variation in Nitrate Concentration (ppm)
by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
20-29	1.03	1.24	0.91	0.17	3.00	28
30-39	0.38	0.60	0.75	0.02	4.30	67
40-49	0.25	0.55	0.67	0.02	3.45	119
50-59	0.27	0.45	0.55	0.02	3.53	85
60-69	0.29	0.47	0.57	0.02	3.28	75
70-79	0.44	0.68	0.88	0.02	4.10	59
80-89	0.98	0.98	-	0.98	0.98	1
all	0.36	0.59	0.72	0.02	4.30	434

Table 10a

Variation in Ammonium Concentration (ppm)

by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	0.21	0.39	0.34	0.02	1.49	95
spring	0.26	0.43	0.56	0.05	3.64	137
summer	0.31	0.48	0.66	0.05	3.80	73
fall	0.26	0.55	0.63	0.05	5.40	134
annual	0.27	0.47	0.57	0.02	5.40	439

Table 10b

Variation in Ammonium Concentration (ppm)

by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	0.26	0.41	0.44	0.02	2.90	77
warm front	0.20	0.41	0.50	0.02	5.40	250
cold front	0.41	0.76	0.76	0.05	3.64	68
occluded front	0.15	0.16	0.12	0.05	0.50	16
squall line	0.48	0.80	0.86	0.07	3.80	19
hurricane	0.08	0.08	0.04	0.05	0.16	8
all	0.27	0.47	0.57	0.02	5.40	439

Table 10c

Variation in Ammonium Concentration (ppm)

by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	0.20	0.39	0.47	0.02	5.40	308
rain shower	0.39	1.02	0.93	0.02	3.80	46
thundershower	0.36	0.51	0.61	0.05	2.90	37
snow	0.36	0.44	0.33	0.05	1.26	48
all	0.27	0.47	0.57	0.02	5.40	439

Table 10d

Variation in Ammonium Concentration (ppm)

by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	0.66	0.75	0.73	0.05	5.40	179
0.04-0.10	0.31	0.32	0.31	0.02	2.10	169
0.11-0.25	0.16	0.16	0.13	0.02	0.59	59
0.26-0.50	0.18	0.18	0.22	0.05	0.77	23
≥ 0.51	0.29	0.24	0.30	0.02	0.98	9
all	0.27	0.47	0.57	0.02	5.40	439

Table 10e

Variation in Ammonium Concentration (ppm)
by Wind Speed at 108 m

<u>wind speed</u> <u>(m sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	0.17	0.46	0.48	0.05	1.80	21
3-5	0.35	0.54	0.57	0.05	3.80	166
6-9	0.34	0.53	0.66	0.02	5.40	164
≥ 10	0.11	0.22	0.25	0.02	1.20	88
all	0.27	0.47	0.57	0.02	5.40	439

Table 10f

Variation in Ammonium Concentration (ppm)
by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	0.25	0.35	0.21	0.05	1.01	36
NE	0.22	0.44	0.44	0.05	1.80	58
E	0.18	0.36	0.41	0.05	2.90	80
SE	0.21	0.39	0.49	0.04	3.64	75
S	0.25	0.60	0.77	0.02	5.40	64
SW	0.48	0.83	0.82	0.02	3.80	52
W	0.40	0.61	0.68	0.09	2.58	23
NW	0.49	0.29	0.27	0.05	1.26	51
all	0.27	0.47	0.57	0.02	5.40	439

Table 10g

Variation in Ammonium Concentration (ppm)
by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
20-29	0.39	0.43	0.32	0.05	1.26	27
30-39	0.27	0.36	0.29	0.05	1.40	67
40-49	0.20	0.39	0.39	0.05	2.58	119
50-59	0.25	0.49	0.56	0.02	3.64	90
60-69	0.21	0.54	0.64	0.05	2.50	77
70-79	0.36	0.65	0.96	0.05	5.40	58
80-89	0.51	0.51	-	0.51	0.51	1
all	0.27	0.47	0.57	0.02	5.40	439

Table 11a

Variation in Sodium Concentration (ppm)
by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	0.79	1.21	3.00	0.03	20.50	89
spring	0.86	1.25	1.58	0.01	7.70	124
summer	0.38	0.87	2.90	0.06	24.80	73
fall	0.63	0.74	1.06	0.08	6.62	129
annual	0.64	1.02	2.13	0.01	24.80	415

Table 11b

Variation in Sodium Concentration (ppm)
by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	0.91	1.09	1.40	0.07	7.70	74
warm front	0.69	1.02	2.13	0.01	20.50	236
cold front	0.38	0.59	0.71	0.02	4.02	61
occluded front	1.24	1.37	1.70	0.09	5.42	15
squall line	0.44	1.86	5.44	0.09	24.80	20
hurricane	0.75	0.82	0.75	0.09	2.12	8
all	0.64	1.02	2.13	0.01	24.80	415

Table 11c

Variation in Sodium Concentration (ppm)
by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	0.79	1.11	2.03	0.01	20.50	295
rain shower	0.73	1.28	3.71	0.02	24.80	44
thundershower	0.32	0.44	0.51	0.03	2.33	36
snow	0.44	0.56	0.90	0.06	5.33	40
all	0.64	1.02	2.13	0.01	24.80	415

Table 11d

Variation in Sodium Concentration (ppm)
by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	0.96	1.14	2.58	0.02	24.80	156
0.04-0.10	1.11	1.16	2.14	0.03	20.50	168
0.11-0.25	0.57	0.59	0.74	0.01	4.38	59
0.26-0.50	0.44	0.46	0.72	0.05	2.85	23
≥ 0.51	0.20	0.23	0.19	0.06	0.66	9
all	0.64	1.02	2.13	0.01	24.80	415

Table 11e

Variation in Sodium Concentration (ppm)
by Wind Speed at 108 m

<u>wind speed</u> <u>(m sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	0.28	0.30	0.23	0.03	0.74	19
3-5	0.28	0.62	2.05	0.01	24.80	158
6-9	0.79	0.99	2.17	0.02	20.50	155
≥ 10	1.04	1.99	2.13	0.05	12.00	83
all	0.64	1.02	2.13	0.01	24.80	415

Table 11f

Variation in Sodium Concentration (ppm)
by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	0.93	1.02	1.80	0.08	7.70	33
NE	0.35	0.44	0.42	0.01	2.02	52
E	0.43	0.69	0.91	0.03	5.33	77
SE	0.78	1.80	3.39	0.05	20.50	75
S	0.84	1.05	1.23	0.02	6.00	61
SW	0.79	1.20	3.58	0.08	24.80	47
W	0.55	0.35	0.43	0.02	1.61	19
NW	0.62	0.97	1.25	0.06	5.42	51
all	0.64	1.02	2.13	0.01	24.80	415

Table 11g

Variation in Sodium Concentration (ppm)
by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
20-29	0.38	0.41	0.41	0.06	1.54	23
30-39	1.01	1.38	1.67	0.03	7.70	65
40-49	0.58	0.97	2.26	0.01	20.50	108
50-59	0.95	1.15	2.24	0.02	15.40	86
60-69	0.61	0.79	1.14	0.08	6.00	73
70-79	0.39	1.04	3.22	0.06	24.80	59
80-89	0.09	0.09	-	0.09	0.09	1
all	0.64	1.02	2.13	0.01	24.80	415

Table 12a
Variation in Chloride Concentration (ppm)
by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	1.91	2.84	6.86	0.20	49.50	96
spring	1.79	2.98	5.17	0.20	46.70	133
summer	0.99	1.87	5.45	0.50	46.50	72
fall	1.84	2.27	3.19	0.50	23.60	128
annual	1.56	2.55	5.18	0.20	49.50	429

Table 12b
Variation in Chloride Concentration (ppm)
by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	2.18	2.95	3.98	0.30	19.00	76
warm front	1.72	2.66	5.75	0.20	49.50	242
cold front	1.02	1.47	1.29	0.20	6.00	66
occluded front	2.93	2.80	2.66	0.20	7.90	16
squall line	0.87	3.57	10.16	0.50	46.50	20
hurricane	1.59	1.66	1.34	0.50	4.00	8
all	1.56	2.55	5.18	0.20	49.50	429

Table 12c
Variation in Chloride Concentration (ppm)
by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	1.88	2.88	5.49	0.20	49.50	302
rain shower	1.53	2.60	6.66	0.30	46.50	47
thundershower	0.89	1.17	1.28	0.20	5.10	35
snow	1.21	1.36	1.80	0.30	9.40	45
all	1.56	2.55	5.18	0.20	49.50	429

Table 12d
Variation in Chloride Concentration (ppm)
by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	2.59	3.17	6.47	0.20	46.70	171
0.04-0.10	2.51	2.61	4.88	0.20	49.50	168
0.11-0.25	1.42	1.44	1.53	0.20	8.30	58
0.26-0.50	1.09	1.10	1.24	0.20	4.10	23
≥ 0.51	0.56	0.59	0.43	0.20	1.70	9
all	1.56	2.55	5.18	0.20	49.50	429

Table 12e

Variation in Chloride Concentration (ppm)
by Wind Speed at 108 m

<u>wind speed</u> <u>(m sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	0.52	0.78	0.48	0.20	1.70	19
3-5	0.85	1.50	3.77	0.20	46.50	161
6-9	1.93	2.81	6.49	0.20	49.50	160
≥ 10	2.31	4.36	4.72	0.20	27.00	89
all	1.56	2.55	5.18	0.20	49.50	429

Table 12f

Variation in Chloride Concentration (ppm)
by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	2.12	2.31	3.74	0.30	17.00	35
NE	1.08	1.20	0.94	0.20	4.00	52
E	1.18	2.54	5.69	0.20	46.70	80
SE	1.91	4.35	8.19	0.20	49.50	76
S	1.76	2.25	2.53	0.20	13.10	61
SW	1.80	2.63	6.38	0.20	46.50	52
W	1.61	2.20	3.96	0.20	19.00	23
NW	1.22	1.87	1.98	0.30	7.90	50
all	1.56	2.55	5.18	0.20	49.50	429

Table 12g

Variation in Chloride Concentration (ppm)
by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
20-29	1.07	1.00	1.16	0.30	6.00	26
30-39	2.14	2.89	3.22	0.20	17.00	64
40-49	1.44	2.69	6.76	0.20	49.50	116
50-59	2.27	3.08	5.44	0.20	37.80	87
60-69	1.67	2.31	3.14	0.50	18.50	77
70-79	0.92	2.17	6.08	0.50	46.50	58
80-89	0.30	0.30	-	0.30	0.30	1
all	1.56	2.55	5.18	0.20	49.50	429

Table 13a

Variation in Nitrate/Sulfate Ratio
by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	0.10	0.19	0.18	0.01	1.05	94
spring	0.09	0.12	0.12	0.00	0.91	134
summer	0.07	0.08	0.06	0.01	0.29	70
fall	0.07	0.12	0.09	0.01	0.62	125
annual	0.08	0.13	0.12	0.00	1.05	423

Table 13b

Variation in Nitrate/Sulfate Ratio
by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	0.10	0.14	0.14	0.01	0.62	74
warm front	0.07	0.12	0.12	0.00	1.05	242
cold front	0.11	0.15	0.12	0.02	0.91	66
occluded front	0.12	0.12	0.11	0.02	0.45	15
squall line	0.09	0.14	0.09	0.04	0.32	17
hurricane	0.02	0.02	0.01	0.01	0.04	8
all	0.08	0.13	0.12	0.00	1.05	423

Table 13c

Variation in Nitrate/Sulfate Ratio
by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	0.07	0.10	0.08	0.00	0.62	297
rain shower	0.09	0.17	0.17	0.01	0.91	42
thundershower	0.08	0.11	0.08	0.01	0.33	37
snow	0.23	0.27	0.20	0.03	1.05	47
all	0.08	0.13	0.12	0.00	1.05	423

Table 13d

Variation in Nitrate/Sulfate Ratio
by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	0.18	0.18	0.16	0.01	1.05	163
0.04-0.10	0.12	0.12	0.09	0.00	0.50	169
0.11-0.25	0.06	0.06	0.05	0.01	0.21	59
0.26-0.50	0.05	0.05	0.05	0.01	0.19	23
≥ 0.51	0.06	0.06	0.07	0.01	0.23	9
all	0.08	0.13	0.12	0.00	1.05	423

Table 13e

Variation in Nitrate/Sulfate Ratio
by Wind Speed at 108 m

<u>wind speed</u> <u>(m sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	0.11	0.22	0.17	0.01	0.62	19
3-5	0.09	0.14	0.11	0.01	0.55	157
6-9	0.11	0.14	0.13	0.00	1.05	161
≥ 10	0.04	0.08	0.10	0.01	0.62	86
all	0.08	0.13	0.12	0.00	1.05	423

Table 13f

Variation in Nitrate/Sulfate Ratio
by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	0.12	0.17	0.13	0.01	0.55	34
NE	0.09	0.16	0.16	0.01	0.72	56
E	0.05	0.10	0.13	0.01	1.05	77
SE	0.06	0.09	0.09	0.00	0.47	74
S	0.07	0.11	0.11	0.02	0.62	62
SW	0.14	0.18	0.13	0.02	0.91	50
W	0.17	0.15	0.05	0.08	0.25	21
NW	0.11	0.14	0.11	0.03	0.62	49
all	0.08	0.13	0.12	0.00	1.05	423

Table 13g

Variation in Nitrate/Sulfate Ratio
by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
20-29	0.26	0.31	0.18	0.07	0.72	26
30-39	0.11	0.15	0.16	0.01	1.05	65
40-49	0.08	0.13	0.10	0.00	0.62	118
50-59	0.07	0.12	0.12	0.01	0.91	84
60-69	0.07	0.09	0.07	0.01	0.32	71
70-79	0.06	0.08	0.06	0.01	0.29	58
80-89	0.19	0.19	-	0.19	0.19	1
all	0.08	0.13	0.12	0.00	1.05	423

Table 14a

Variation in Ammonium/Sulfate Ratio
by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	0.06	0.10	0.07	0.01	0.33	93
spring	0.08	0.10	0.12	0.02	1.07	134
summer	0.05	0.07	0.06	0.01	0.32	72
fall	0.08	0.14	0.13	0.03	0.94	130
annual	0.07	0.11	0.11	0.01	1.07	429

Table 14b

Variation in Ammonium/Sulfate Ratio
by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	0.07	0.10	0.07	0.01	0.33	74
warm front	0.07	0.11	0.10	0.01	0.94	247
cold front	0.07	0.14	0.16	0.01	1.07	66
occluded front	0.06	0.06	0.05	0.02	0.20	15
squall line	0.07	0.10	0.08	0.03	0.32	18
hurricane	0.03	0.03	0.02	0.02	0.06	8
all	0.07	0.11	0.11	0.01	1.07	429

Table 14c

Variation in Ammonium/Sulfate Ratio
by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	0.07	0.10	0.10	0.01	0.94	302
rain shower	0.07	0.17	0.19	0.01	1.07	44
thundershower	0.06	0.07	0.06	0.02	0.33	37
snow	0.10	0.11	0.07	0.03	0.28	46
all	0.07	0.11	0.11	0.01	1.07	429

Table 14d

Variation in Ammonium/Sulfate Ratio
by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	0.14	0.16	0.14	0.01	1.07	169
0.04-0.10	0.09	0.09	0.06	0.01	0.56	169
0.11-0.25	0.06	0.06	0.04	0.01	0.18	59
0.26-0.50	0.04	0.05	0.04	0.02	0.17	23
≥ 0.51	0.05	0.05	0.04	0.01	0.11	9
all	0.07	0.11	0.11	0.01	1.07	429

Table 14e

Variation in Ammonium/Sulfate Ratio
by Wind Speed at 108 m

<u>wind speed</u> <u>(m sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	0.06	0.11	0.07	0.02	0.29	21
3-5	0.07	0.11	0.11	0.01	0.94	159
6-9	0.09	0.12	0.11	0.01	1.07	162
≥ 10	0.05	0.08	0.08	0.01	0.56	87
all	0.07	0.11	0.11	0.01	1.07	429

Table 14f

Variation in Ammonium/Sulfate Ratio
by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	0.09	0.12	0.06	0.03	0.26	35
NE	0.07	0.11	0.08	0.02	0.33	56
E	0.06	0.09	0.06	0.02	0.28	79
SE	0.05	0.09	0.07	0.02	0.41	75
S	0.08	0.15	0.16	0.01	0.94	63
SW	0.09	0.14	0.16	0.01	1.07	51
W	0.09	0.13	0.16	0.05	0.81	21
NW	0.08	0.08	0.04	0.02	0.19	49
all	0.07	0.11	0.11	0.01	1.07	429

Table 14g

Variation in Ammonium/Sulfate Ratio
by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
20-29	0.10	0.11	0.06	0.03	0.27	26
30-39	0.08	0.09	0.06	0.02	0.28	64
40-49	0.07	0.10	0.09	0.02	0.81	116
50-59	0.07	0.12	0.13	0.01	1.07	89
60-69	0.06	0.12	0.16	0.01	0.94	75
70-79	0.05	0.09	0.08	0.01	0.44	58
80-89	0.10	0.10	-	0.10	0.10	1
all	0.07	0.11	0.11	0.01	1.07	429

Table 15a

Variation in Ammonium/Nitrate Ratio
by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	1.42	1.05	1.52	0.15	13.50	92
spring	1.37	1.54	2.67	0.09	21.00	136
summer	1.00	1.16	0.92	0.21	5.25	71
fall	1.76	1.58	2.04	0.22	20.00	125
annual	1.34	1.38	2.05	0.09	21.00	424

Table 15b

Variation in Ammonium/Nitrate Ratio
by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	1.24	1.27	1.44	0.16	8.64	75
warm front	1.61	1.55	2.47	0.12	21.00	241
cold front	0.77	1.09	1.18	0.21	8.90	65
occluded front	1.12	1.20	1.55	0.09	5.25	16
squall line	0.92	0.80	0.45	0.23	1.96	18
hurricane	1.39	1.57	0.66	0.73	2.50	8
all	1.34	1.38	2.05	0.09	21.00	424

Table 15c

Variation in Ammonium/Nitrate Ratio
by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	1.52	1.49	2.16	0.09	21.00	296
rain shower	0.98	1.58	1.99	0.23	8.90	44
thundershower	1.14	1.26	2.16	0.12	13.50	37
snow	0.71	0.58	0.57	0.15	3.71	47
all	1.34	1.38	2.05	0.09	21.00	424

Table 15d

Variation in Ammonium/Nitrate Ratio
by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	1.35	1.38	1.60	0.16	10.00	164
0.04-0.10	1.34	1.40	2.77	0.09	21.00	169
0.11-0.25	1.34	1.32	0.85	0.12	4.00	59
0.26-0.50	1.43	1.43	0.78	0.42	2.50	23
≥ 0.51	1.22	1.38	0.86	0.49	2.50	9
all	1.34	1.38	2.05	0.09	21.00	424

Table 15e

Variation in Ammonium/Nitrate Ratio
by Wind Speed at 108 m

<u>wind speed</u> <u>(m sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	1.00	1.00	1.64	0.16	7.50	19
3-5	1.14	1.28	1.66	0.12	13.50	158
6-9	1.18	1.23	1.83	0.21	21.00	160
≥ 10	1.76	1.93	2.89	0.09	20.00	87
all	1.34	1.38	2.05	0.09	21.00	424

Table 15f

Variation in Ammonium/Nitrate Ratio
by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	1.14	0.94	0.55	0.22	2.50	35
NE	1.20	1.40	2.19	0.12	13.50	56
E	1.56	1.46	1.23	0.23	7.50	78
SE	1.52	1.90	3.21	0.21	21.00	74
S	1.51	1.96	2.69	0.22	20.00	62
SW	0.70	0.79	0.51	0.23	3.18	48
W	0.61	1.05	1.87	0.23	8.90	20
NW	0.97	0.77	0.60	0.09	3.71	51
all	1.34	1.38	2.05	0.09	21.00	424

Table 15g

Variation in Ammonium/Nitrate Ratio
by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
20-29	0.55	0.47	0.58	0.15	3.18	27
30-39	1.40	1.13	1.69	0.09	13.50	66
40-49	1.49	1.46	2.75	0.12	21.00	115
50-59	1.30	1.38	1.24	0.22	8.64	85
60-69	1.59	1.84	2.60	0.21	20.00	72
70-79	1.12	1.37	1.02	0.28	5.25	58
80-89	0.52	0.52	-	0.52	0.52	1
all	1.34	1.38	2.05	0.09	21.00	424

Table 16a

Variation in Sulfate/Sodium Ratio
by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	15.65	14.01	13.27	0.57	73.33	85
spring	18.61	15.21	28.04	0.43	200.00	124
summer	32.17	23.92	32.26	0.56	164.57	70
fall	13.04	14.28	17.41	0.34	148.09	128
annual	21.48	16.17	23.64	0.34	200.00	407

Table 16b

Variation in Sulfate/Sodium Ratio
by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	9.70	9.18	10.33	0.57	57.14	73
warm front	17.22	16.08	23.41	0.34	200.00	232
cold front	45.11	24.34	29.88	0.93	160.00	61
occluded front	4.99	6.12	6.33	0.43	22.22	15
squall line	25.57	28.56	39.90	0.56	164.57	17
hurricane	11.91	10.91	11.88	1.18	27.67	8
all	21.48	16.17	23.64	0.34	200.00	407

Table 16c

Variation in Sulfate/Sodium Ratio
by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	15.72	13.74	21.60	0.34	200.00	291
rain shower	11.98	25.82	39.63	0.56	164.57	41
thundershower	38.29	26.53	21.17	1.12	84.67	36
snow	16.38	14.55	9.78	1.45	33.33	39
all	21.48	16.17	23.64	0.34	200.00	407

Table 16d

Variation in Sulfate/Sodium Ratio
by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	16.66	16.74	26.52	0.46	164.57	150
0.04-0.10	12.90	13.52	16.78	0.34	117.50	166
0.11-0.25	18.79	18.68	32.88	0.71	200.00	59
0.26-0.50	20.21	20.06	13.79	1.31	58.44	23
≥ 0.51	39.41	28.83	26.13	3.05	84.67	9
all	21.48	16.17	23.64	0.34	200.00	407

Table 16e

Variation in Sulfate/Sodium Ratio
by Wind Speed at 108 m

<u>wind speed</u> <u>(m sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	17.06	18.83	16.32	4.08	73.33	19
3-5	37.04	26.05	31.58	0.56	200.00	152
6-9	12.16	11.91	16.05	0.68	160.00	153
≥ 10	9.84	5.29	7.70	0.34	40.00	83
all	21.48	16.17	23.64	0.34	200.00	407

Table 16f

Variation in Sulfate/Sodium Ratio
by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	9.69	9.73	9.22	0.68	36.68	30
NE	32.29	21.05	32.47	2.13	200.00	52
E	16.34	14.34	14.77	0.91	73.33	76
SE	30.36	17.77	31.57	0.57	164.57	74
S	9.29	10.35	15.21	0.34	100.00	60
SW	18.36	16.50	15.48	0.57	60.25	47
W	16.46	29.00	35.36	1.85	160.00	19
NW	25.38	17.14	23.41	0.43	148.09	49
all	21.48	16.17	23.64	0.34	200.00	407

Table 16g

Variation in Sulfate/Sodium Ratio
by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
20-29	16.98	15.23	9.99	3.51	33.33	22
30-39	10.73	9.99	13.66	0.43	73.33	61
40-49	20.42	16.31	27.48	0.68	200.00	108
50-59	13.08	14.08	16.96	0.57	100.00	86
60-69	15.83	16.74	21.45	0.34	148.09	72
70-79	36.82	24.53	34.66	0.55	164.57	57
80-89	58.44	58.44	-	58.44	58.44	1
all	21.48	16.17	23.64	0.34	200.00	407

Table 17a

Variation in Sulfate/Chloride Ratio
by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	4.80	4.28	3.80	0.25	20.95	92
spring	4.58	4.18	4.77	0.11	28.50	132
summer	8.40	6.65	5.91	0.30	32.91	70
fall	2.93	3.35	2.76	0.15	13.20	125
annual	5.58	4.37	4.41	0.11	32.91	419

Table 17b

Variation in Sulfate/Chloride Ratio
by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	2.92	3.13	3.57	0.11	18.29	73
warm front	4.19	4.06	3.98	0.15	28.50	238
cold front	9.27	6.27	4.78	0.40	21.92	66
occluded front	2.15	2.75	2.71	0.25	10.00	15
squall line	10.13	8.08	7.94	0.30	32.91	18
hurricane	2.92	2.76	1.97	0.62	4.98	8
all	5.58	4.37	4.41	0.11	32.91	419

Table 17c

Variation in Sulfate/Chloride Ratio
by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	3.70	3.54	3.67	0.11	28.50	295
rain shower	4.47	6.10	6.05	0.30	32.91	45
thundershower	10.29	8.63	5.81	0.49	20.95	35
snow	5.03	4.77	3.25	0.29	18.00	44
all	5.58	4.37	4.41	0.11	32.91	419

Table 17d

Variation in Sulfate/Chloride Ratio
by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	4.66	4.50	4.81	0.11	32.91	163
0.04-0.10	3.82	4.03	4.16	0.15	24.10	166
0.11-0.25	3.74	3.76	3.20	0.35	13.50	58
0.26-0.50	5.78	5.80	4.48	0.54	17.53	23
≥ 0.51	10.36	8.57	5.80	1.18	19.80	9
all	5.58	4.37	4.41	0.11	32.91	419

Table 17e

Variation in Sulfate/Chloride Ratio
by Wind Speed at 108 m

<u>wind speed</u> <u>(m sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	5.52	5.13	2.53	2.23	11.00	19
3-5	8.39	6.14	5.23	0.30	32.91	153
6-9	4.01	3.89	3.79	0.22	21.92	159
≥ 10	3.30	2.01	2.60	0.11	10.00	88
all	5.58	4.37	4.41	0.11	32.91	419

Table 17f

Variation in Sulfate/Chloride Ratio
by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	3.07	3.23	2.80	0.31	13.20	32
NE	4.36	4.51	4.74	0.71	28.50	52
E	4.50	4.10	3.57	0.22	20.95	76
SE	6.56	4.31	5.29	0.25	32.91	75
S	3.42	3.67	3.47	0.15	16.15	61
SW	5.94	5.55	5.28	0.30	24.10	52
W	5.08	4.81	4.08	0.11	15.99	23
NW	10.07	4.89	4.74	0.25	19.80	48
all	5.58	4.37	4.41	0.11	32.91	419

Table 17g

Variation in Sulfate/ Chloride Ratio
by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
20-29	5.82	5.70	3.63	0.40	18.00	25
30-39	3.44	3.04	3.33	0.25	20.95	60
40-49	4.87	4.14	3.82	0.22	28.50	116
50-59	3.50	3.55	4.10	0.11	24.10	87
60-69	4.26	4.38	4.10	0.15	21.92	74
70-79	9.21	6.71	6.22	0.29	32.91	56
80-89	17.53	17.53	-	17.53	17.53	1
all	5.58	4.37	4.41	0.11	32.91	419

Table 18a

Variation in Chloride/Sodium Ratio
by Season

<u>season</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
winter	3.16	3.33	2.36	0.19	17.50	88
spring	3.63	3.29	5.32	0.81	50.00	123
summer	3.96	3.48	3.29	1.28	25.50	71
fall	4.19	4.00	3.03	1.32	20.83	124
annual	3.76	3.55	3.81	0.19	50.00	406

Table 18b

Variation in Chloride/Sodium Ratio
by Synoptic Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
low	3.33	3.24	2.73	1.21	17.50	70
warm front	4.00	3.67	4.10	0.19	50.00	233
cold front	4.38	3.90	4.31	1.02	30.00	60
occluded front	3.75	3.04	4.35	0.81	18.65	15
squall line	2.41	2.83	1.42	1.43	5.56	19
hurricane	3.20	3.03	1.71	1.61	5.56	8
all	3.76	3.55	3.81	0.19	50.00	406

Table 18c

Variation in Chloride/Sodium Ratio
by Precipitation Type

<u>type</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
rain	3.77	3.49	3.69	0.81	50.00	289
rain shower	2.39	3.85	4.90	1.02	30.00	43
thundershower	4.04	3.60	4.15	1.11	25.50	34
snow	4.12	3.62	3.06	0.19	18.65	40
all	3.76	3.55	3.81	0.19	50.00	406

Table 18d

Variation in Chloride/Sodium Ratio
by Precipitation Rate

<u>rate (in./hour)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0.00-0.03	3.60	3.64	3.63	0.81	30.00	151
0.04-0.10	3.11	3.15	2.32	0.19	18.65	165
0.11-0.25	4.54	4.40	7.03	1.29	50.00	58
0.26-0.50	3.97	3.86	2.16	1.44	8.62	23
≥ 0.51	3.45	3.11	1.43	1.43	5.56	9
all	3.76	3.55	3.81	0.19	50.00	406

Table 18e

Variation in Chloride/Sodium Ratio
by Wind Speed at 108 m

<u>wind speed</u> <u>(m sec⁻¹)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
0-2	2.71	3.70	2.51	1.40	9.00	19
3-5	4.98	4.34	4.99	0.19	50.00	154
6-9	3.22	3.32	3.09	1.07	30.00	150
≥ 10	2.77	2.47	2.01	0.81	18.65	83
all	3.76	3.55	3.81	0.19	50.00	406

Table 18f

Variation in Chloride/Sodium Ratio
by Wind Direction

<u>direction</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
N	2.73	2.72	1.01	1.70	5.71	32
NE	6.87	4.28	6.85	1.29	50.00	50
E	3.89	3.69	3.44	0.69	25.50	75
SE	4.00	3.34	2.42	1.02	13.57	75
S	2.46	2.76	2.70	1.23	20.83	60
SW	2.90	3.06	1.48	1.29	6.30	47
W	4.31	7.12	7.37	1.79	30.00	19
NW	2.92	3.49	2.82	0.19	18.18	48
all	3.76	3.55	3.81	0.19	50.00	406

Table 18g

Variation in Chloride/Sodium Ratio
by Temperature

<u>temperature(°F)</u>	<u>wt. mean</u>	<u>mean</u>	<u>S. D.</u>	<u>min.</u>	<u>max.</u>	<u>n</u>
20-29	2.98	2.86	1.56	0.19	5.67	23
30-39	2.93	2.90	2.56	0.81	18.65	60
40-49	4.02	3.73	5.61	1.02	50.00	108
50-59	3.49	3.87	3.11	1.38	20.83	84
60-69	4.31	3.95	3.57	1.29	25.50	73
70-79	3.74	3.19	2.22	1.28	13.57	57
80-89	3.33	3.33	-	3.33	3.33	1
all	3.76	3.55	3.81	0.19	50.00	406