1989 AUTOMATED AND DIURNAL NONMETHANE ORGANIC COMPOUND MONITORING PROGRAM SAMPLING STUDY

FINAL REPORT

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FINAL REPORT

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1.0 SUMMARY AND CONCLUSIONS

A study was performed to validate the automated cryogenic preconcentration and direct flame ionization detection (APDFID) system to measure ambient air nonmethane organic compound (NMOC) concentrations continuously. The study was conducted during a four-week period in Raleigh, NC between July 23 and August 19, 1989. Additional 3-hour, 12-hour, and 24-hour integrated canister samples were taken and analyzed for NMOC concentration by the cryogenic preconcentration and direct flame ionization detection (PDFID) method for comparative purposes.

Temperature, barometric pressure, relative humidity, wind speed, wind direction, solar radiation intensity, and NO_2 and NO_x concentrations were recorded throughout the sampling period. The overall 6:00 a.m. to 9:00 a.m. concentration average was 0.159 ppmC. No trends of NMOC concentrations as functions of the meteorological variables or humidity were apparent.

No significant differences were detected between APDFID NMOC concentration measurements and the NMOC concentration measurements made by the PDFID system using integrated ambient air canister samples. NMOC concentration measurements by the APDFID system averaged within 10% of the integrated PDFID measurements.

The integrated 3-, 12- and 24-hour diurnal canister sampling system operated in an acceptable manner. There was a significant difference between the weighted average 3- and 12-hour NMOC measured concentrations when compared to the 24-hour sample concentration.

Another objective of the study was to obtain ambient air NMOC concentrations throughout the day to help decide the most appropriate time(s) to sample air for NMOC concentration. For both the 3-hour integrated canister samples, and the APDFID results, the 6:00 a.m. to 9:00 a.m. samples appeared to have the highest average NMOC concentration of any of the 3-hour periods during daylight hours. Since the primary use of the NMOC concentration is to predict the generation of ozone through the photolysis reactions, it appears that the 6:00 a.m. to 9:00 a.m. time period is an appropriate averaging period.

To determine whether a different time interval is more appropriate, would require comparing an ozone prediction model with actual NMOC, NO_x, and O_3 data throughout daylight hours, and/or predaylight hours, to determine which time interval resulted in the closest fit to the model. Such a comparison was beyond the scope of this study.

2.0 INTRODUCTION

From July 23 through August 19, 1989 Radian Corporation field tested two approaches for obtaining NMOC concentrations throughout the 24-hour day. The first approach involved the use of an APDFID instrument which was capable of automatically acquiring, cryogenically preconcentrating, and analyzing ambient air for NMOC. The APDFID instrument had the capacity to take and analyze about four NMOC concentration measurements per hour. The instrument took an integrated 9-minute sample and analyzed the sample during the next 6-minutes. The complete sampling analysis cycle was about 15 minutes. The instrument is designed to operate unattended 24-hours per day.

The second approach involved the use of SUMMA®-treated stainless steel canisters to acquire six integrated ambient air samples for various segments of the day. Three-hour integrated whole ambient air samples were taken every other day from 6:00 a.m. to 9:00 a.m., 9:00 a.m. to noon, noon to 3:00 p.m., and 3:00 p.m. to 6:00 p.m. A 12-hour sample was taken from 6:00 p.m. to 6:00 a.m., and a 24-hour sample was taken from 6:00 a.m. to 6:00 a.m. These six integrated samples were taken and analyzed to verify and confirm the results of the APDFID instrument.

All sampling was done at the U.S. Environmental Protection Agency 1989 Raleigh (RLNC) NMOC monitoring site.[1] Both the automated and integrated diurnal ambient air samples were taken from a common sampling manifold, and analyzed by the PDFID methodology described in Compendium Method TO-12.[2] Samples collected and analyzed for the APDFID diurnal study and for the EPA NMOC site at Raleigh were included in this study for comparison purposes. The standard NMOC samples from the Raleigh site were included because they represent data from a collocated site. In addition to the NMOC results, meteorological data (wind speed, wind direction, relative humidity, solar radiation intensity, and temperature) were continuously recorded for the entire duration of the study. Hourly station barometric pressure readings were obtained from the weather bureau at the Raleigh-Durham airport.

Three types of samples are discussed in this report: (1) The RLNC samples came from the Raleigh, NC site and were 6:00 a.m. to 9:00 a.m.

integrated canister samples collected with separate NMOC Monitoring Program samplers and analyzed by the PDFID method; (2) Integrated diurnal samples were collected on the manifold diagrammed in Figure 1 and analyzed by the PDFID method according to the schedule specified in Table 1; and (3) APDFID samples (9-minute samples) were taken approximately four times per hour. The APDFID samples were integrated to one-hour averages. The one-hour averages were also averaged into various time intervals to compare the APDFID results with the RLNC samples and the integrated diurnal samples.

2.1 OBJECTIVES

The primary objectives of the automated and diurnal NMOC sampling study were:

1. To obtain the NMOC concentration data with integrated 3-hour, 12-hour, and 24-hour samples (and with automated 24-hour data), necessary to help decide the most appropriate time(s) during the day to sample air for its NMOC concentration; and
2. To validate the mechanical reliability, precision, and accuracy of the APDFID instrument in sampling ambient air and analyzing its NMOC concentration continuously for a four-week period.

An additional objective was to relate the NMOC concentration to temperature, humidity, solar radiation intensity, and a wind velocity vector directed from the potential sources of air-borne organic chemicals to the site. The main source of air-borne organic chemicals near the RLNC site was from automobile traffic on North Boulevard (U.S. 1) about 1500 feet west of the site.

2.2 EXPERIMENTAL APPROACH

Table 1 gives the monitoring sample schedule for both the automated and integrated diurnal samples. Both types of samples were obtained for a four-week period. The automated unit was calibrated (zero and span) every other day using a propane standard referenced to a National Institute of Standards and Technology (NIST). The automated and diurnal study sampling device was separate from the sampling manifold[3] used for the 1989 Raleigh NMOC

TABLE 1. AUTOMATED AND DIURNAL NMOC MONITORING SAMPLE SCHEDULE

Weekday	Sample Numbers Scheduled to Begin Sampling			
	Week 1	Week 2	Week 3	Week 4
Sunday	4 7 2 5 8 3 6	8 *	4 7 2 5 8 3 6	8 *
Monday	1 8 *	1 4 7 2 5 8 3 6	1 8 *	1 4 7 2 5 8 3 6
Tuesday	1 4 7 2 5 8 3 6	1 8 *	1 4 7 2 5 8 3 6	1 8 *
Wednesday	1 8 *	1 4 7 2 5 8 3 6	1 8 *	1 4 7 2 5 8 3 6
Thursday	1 4 7 2 5 8 3 6	1 8 *	1 4 7 2 5 8 3 6	1 8 *
Friday	1 8 *	1 4 7 2 5 8 3 6	1 8 *	1 4 7 2 5 8 3 6
Saturday	4 7 2 5 8 3 6	8 *	4 7 2 5 8 3 6	8

Sample Numbers and Description:

1. 6:00 a.m. to 9:00 a.m. Raleigh Sample for NMOC Monitoring Program
2. 6:00 a.m. to 9:00 a.m. 3-hour diurnal sample
3. 9:00 a.m. to 12:00 Noon 3-hour diurnal sample
4. 12:00 Noon to 3:00 p.m. 3-hour diurnal sample
5. 3:00 p.m. to 6:00 p.m. 3-hour diurnal sample
6. 6:00 p.m. to 6:00 a.m. 12-hour diurnal sample
7. 6:00 a.m. to 6:00 a.m. 24-hour diurnal sample
8. APDFID NMOC instrument. 24-hour sampling daily

* Indicates calibration of APDFID instrument between 9:00 a.m. and 6:00 p.m.

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Monitoring Program site. Figure 1 shows a schematic diagram of the sample manifold used for both the automated and integrated diurnal samples. The sampling manifold inlet for the automated and diurnal samples was collocated with the sample inlet for EPA's 1989 Raleigh NMOC monitoring site, and was 12 feet above ground level. Three-hour, 12-hour, and 24-hour integrated whole ambient air samples were taken in 6-liter (L) stainless steel canisters. The RLNC samples were 3-hour integrated whole ambient air samples taken in canisters from 6:00 a.m. to 9:00 a.m., Monday through Friday. Simultaneously, an APDFID instrument was used to acquire and analyze four 9-minute NMOC samples per hour, 24 hours per day for the full 4-week sampling period. The APDFID system was not able to sustain 24-hour sampling for long periods of time. The reasons for sampling interruptions are discussed below along with a discussion of measures which could overcome the problems and enable the instrument to operate reliably over longer periods of time. As noted in Table 1 the APDFID instrument was calibrated every other day. This caused a planned one-hour interruption in the APDFID sample acquisition schedule.

The automated monitoring, and diurnal sampling matrix is given in Table 1. Sample Numbers 1 through 8 distinguish between the several types of samples being taken during the study. Sample No. 1, the regular 6:00 a.m. to 9:00 a.m. NMOC Monitoring Program (RLNC) sample was collected at the Raleigh site and analyzed at Radian's Research Triangle Park, NC laboratory. Sample No. 1 used a separate sampling train and inlet manifold, and samples were acquired Monday through Friday from June 5, 1989, through September 29, 1989.

Integrated diurnal samples (Samples Nos. 2 through 7) were collected every other day, including Saturday and Sunday, over the four-week study period. Sampling times were set so that "Sunday" samples, for example, began at 6:00 a.m. on Sunday. The 24-hour sample scheduled to begin at 6:00 a.m. Sunday extended to 6:00 a.m. on Monday. Likewise the 12-hour integrated sample scheduled to begin on Sunday at 6:00 p.m. extended to 6:00 a.m. on Monday. Three-hour diurnal samples were taken during daylight hours according to the schedules shown in Table 1.

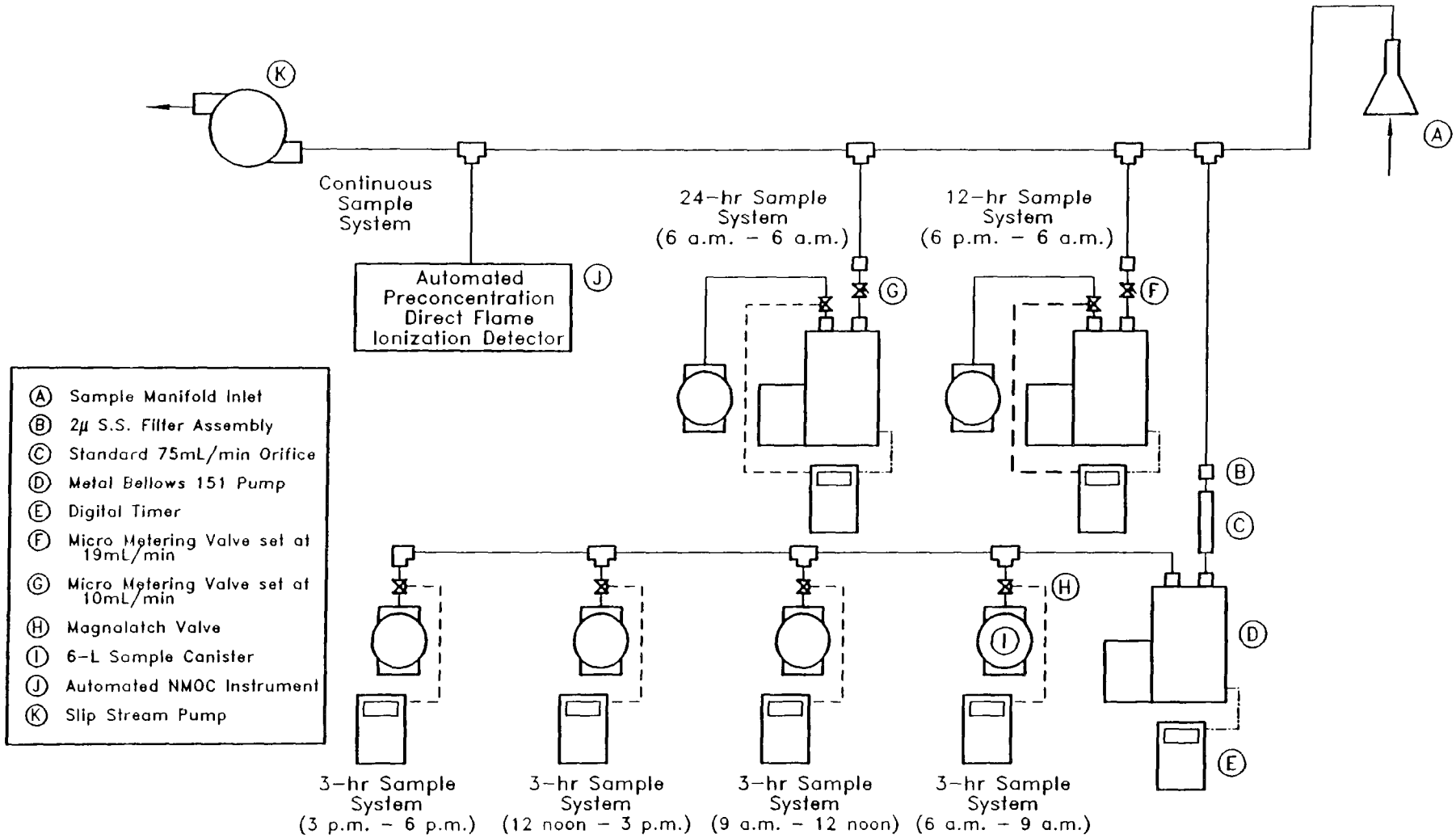

Figure 1. Automated and diurnal nonmethane organic compound study sampling schematic.

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3.0 RESULTS

The results for this study are discussed and compared in three ways. The results discussed in this section include those from the RLNC samples, the integrated diurnal samples, and the APDFID samples. The purpose of showing all the data is to demonstrate how the 6 a.m. to 9 a.m. NMOC concentrations during the sampling interval for the diurnal sampling period (July 23 through August 19) fit into the overall 6 a.m. to 9 a.m. NMOC concentrations for the entire summer.

NMOC concentrations for the 6 a.m. to 9 a.m. diurnal integrated samples are compared to the RLNC NMOC concentrations in Table 3. The APDFID data are presented and compared to the data from integrated diurnal samples and the RLNC samples in Table 4. Finally, the APDFID results are characterized by hours, sample periods, and as functions of meteorological variables.

3.1 1989 RALEIGH, NC MONITORING PROGRAM

The NMOC concentrations from the 1989 Raleigh, NC monitoring site are given in Figures 2, 3, and 4. The RLNC samples include all the data from the 1989 NMOC Monitoring Program at Raleigh, NC for the period from June 5 through September 29, 1989. Figure 2 shows the NMOC concentrations on the vertical axis with the same scale used for sites in the 1988 NMOC Monitoring Program Final Report.[4] This scale shows the relative magnitude of RLNC measurements to the scale required to accommodate other sites around the U.S.. Two horizontal lines are shown in Figures 2 and 3 representing the RLNC mean NMOC concentrations equal to 0.159 ppmC, and the overall mean NMOC concentration of 0.583 ppmC at 21 sites in the 1989 NMOC Monitoring Program. The Raleigh 1989 NMOC mean concentrations averaged about 1/3 the value of the overall mean concentrations at 21 sites in 1989.

Figures 2 and 3 also show the period of time in which diurnal sampling took place, from 1989 Julian date 204 (July 23) through 1989 Julian date 230 (August 19). Figure 4 displays the NMOC Monitoring Program concentrations at the 1989 RLNC site in a stem-and-leaf plot. The column of digits on the left are the stems and the series of digits on the left are the leaves, and are separated from the stems by an open channel. The minimum concentration is the

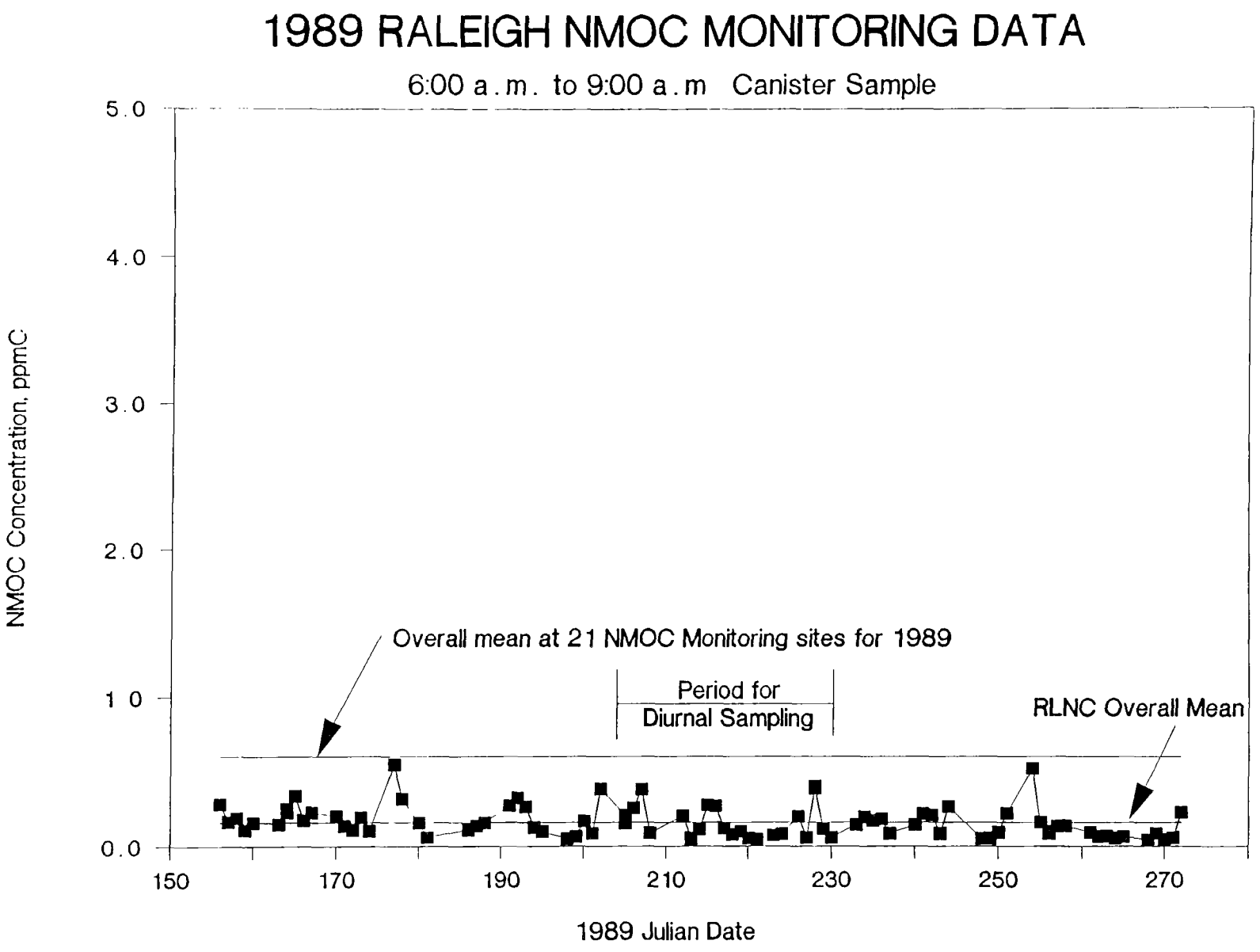

Figure 2. NMOC Monitoring Program concentrations for Raleigh, NC.

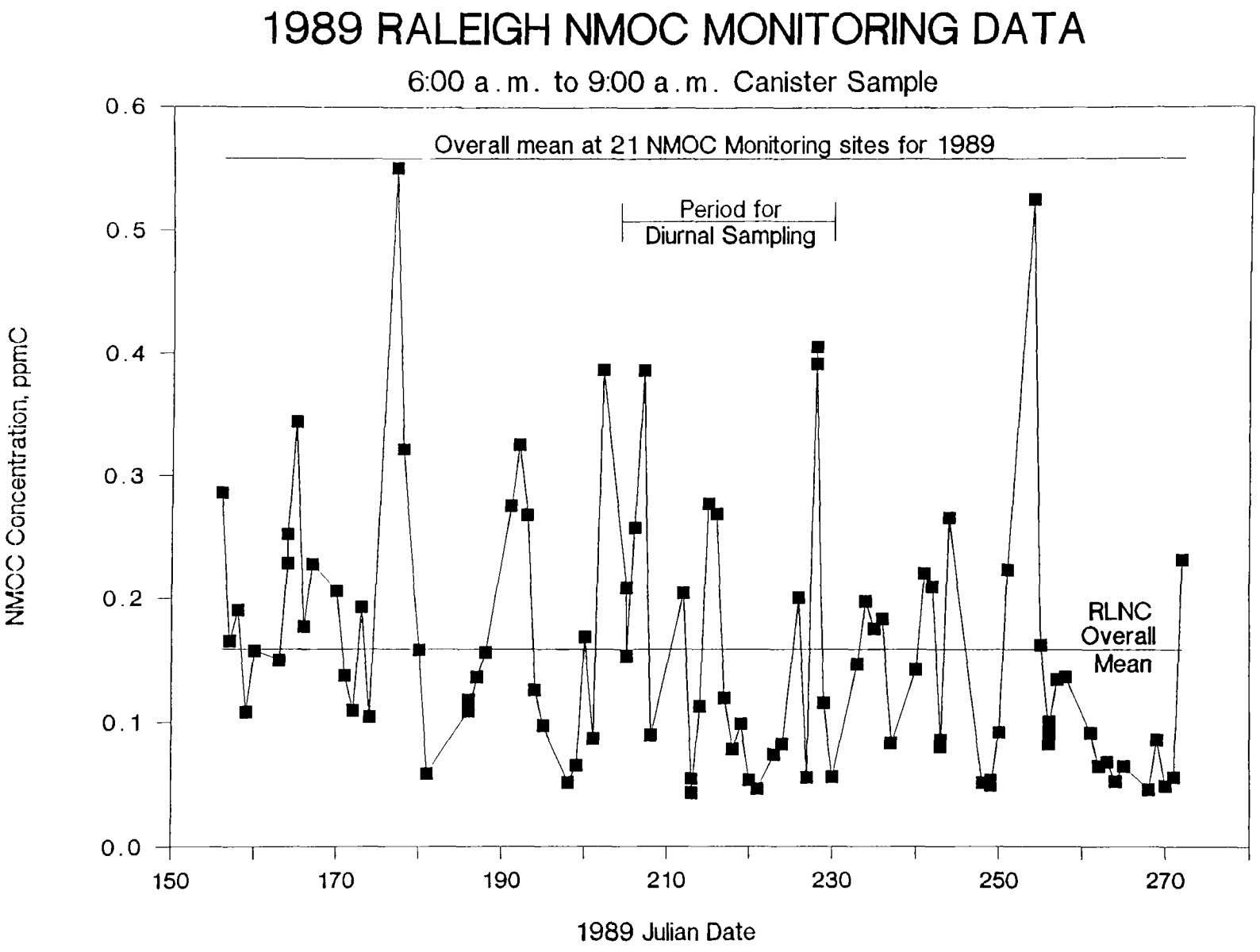

Figure 3. NMOC Monitoring Program concentrations for Raleigh, NC-expanded scale

```
0    44444 55555 55555
0    66667 7
0  H 88888 88899 9999
1    00000 01111 1
1  M 23333
1    44555 55
1    66677
1    8999
2  H 00000
2    22223
2    55
2    66677
2    8
3
3    22
3    4
3
3    889
4    0
5    25
```

Statistics	NMOC Concentration ppmC
Cases	94.
Minimum	0.043
Lower Hinge (H)	0.083
Median (M)	0.131
Mean	0.159
Upper Hinge (H)	0.209
Maximum	0.551
Standard Deviation	0.101
Skewness	1.434
Kurtosis	2.143

Figure 4. Stem-and-leaf plot of the PDFID NMOC concentrations for the 1989 RLNC site, 6:00 a.m. to 9:00 a.m. samples.

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first 4 in the first leaf (at the top of the plot) and is equal to 0.043 ppmC; the maximum concentration is in the lowest leaf at the bottom of the plot and is equal to 0.551 ppmC. Each NMOC concentration analyzed from the 94 integrated morning ambient air samples is plotted, depending on its magnitude in one of the leaves of the plot. "M" on the plot locates the stem of the median, which is 0.131 ppmC. The median indicates that 50% of the NMOC concentrations are less than that of the median, while 50% are larger. "H" marks the stems for the upper and lower hinges. The hinges divide the median into half again, so that 25% of the NMOC concentrations are smaller than the lower hinge (0.083 ppmC at the top part of the plot); and the upper hinge, 0.209 ppmC marks the concentration which is larger than 75% of the NMOC concentrations measured. The stem-and-leaf plot shows the data to be approximately lognormally distributed which is consistent with the frequency distributions found previously.[4]

Table 2 summarizes the 1989 RLNC site data for several periods throughout the summer. The data were divided into months and statistics were calculated for each month. In addition, summary statistics are shown for the period of July 23 through August 19, 1989 which was the time period during which the diurnal sampling was taking place. The results show that the NMOC median concentration was highest in June, declining every month through September. The median concentration during the diurnal sampling period was in line with the concentrations throughout the remainder of the summer.

3.2 DIURNAL SAMPLES

Two kinds of diurnal samples were obtained and analyzed. One type included the 3-, 12-, and 24-hour ambient air samples, which we have called integrated diurnal samples, and which were taken in SUMMA® treated canisters and analyzed by PDFID. The second type of diurnal samples were taken from the sampling manifold and analyzed by the APDFID system. Hourly concentrations for the APDFID samples were numerically integrated from 9-minute sample intervals, and then appropriate 3-, 6-, and 24-hour averages of the hourly APDFID results were compared to the NMOC concentrations from the integrated diurnal canister samples. The RLNC 6:00 a.m. to 9:00 a.m. integrated samples were compared to the diurnal integrated 6:00 a.m. to 9:00 a.m. canister samples in Section 3.2.1.

TABLE 2. 1989 NMOC MONITORING PROGRAM - 1989 RLNC SITE

Time Interval	Cases	Min ppmC	Median ppmC	Mean ppmC	Max ppmC	Std Dev ppmC	Skewness ppmC	Kurtosis ppmC
June 5 - Sept 29	94	0.0430	0.1305	0.1592	0.5505	0.1062	1.434	2.143
June 5 - June 30	20	0.0585	0.1839	0.2063	0.5505	0.1093	1.597	2.999
July 1 - July 31	22	0.0515	0.1450	0.1771	0.3865	0.0995	1.855	-0.3670
Aug 1 - Aug 31	28	0.0430	0.1145	0.1450	0.4050	0.0983	1.232	0.869
Sept 1 - Sept 29	24	0.0463	0.0891	0.1200	0.5255	0.1060	2.585	7.030
July 23 - Aug 19	24	0.0430	0.1145	0.1597	0.4050	0.1163	0.925	-0.380

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Each of the comparisons performed to evaluate the equivalency of the integrated canister samples analyzed by the PDFID method with the APDFID samples averaged over the same time periods, is described in this section.

3.2.1 Raleigh Monitoring Program Samples vs. Diurnal Samples

In Table 3, the 6:00 a.m. to 9:00 a.m. NMOC concentrations for the integrated diurnal samples are compared to the NMOC concentrations for the RLNC samples (also 6:00 a.m. to 9:00 a.m.). The second column in Table 3 gives NMOC concentrations for the RLNC samples and the third column gives the integrated diurnal sample concentrations for the 6:00 a.m. to 9:00 a.m. interval. The fourth through the seventh columns give statistics comparing the concentrations of the two samples. Difference is defined relative to the RLNC sample:

$$\text{Difference} = (\text{Diurnal} \quad \text{RLNC}). \tag{1}$$

Percent difference is defined as:

$$\%\ \text{Difference} = (\text{difference/average}) \times 100, \tag{2}$$

where average is the mean of the RLNC and the diurnal sample concentrations. Absolute % difference is the absolute value of % difference. Averages and standard deviations of all columns except the first column are given. By inspection, average difference, average % difference, and average absolute % difference are not significantly different from zero.

Average % difference and average absolute % difference may be compared to similar statistics for 1988 NMOC Monitoring Program duplicate samples.[4] For the 1988 duplicate samples average % difference was equal to 0.313 compared to 1.524 for the duplicate pairs in Table 3. Absolute % difference for the 1988 NMOC Monitoring Program averaged 8.72 compared to 12.82 for the RLNC-Diurnal samples.

Figure 5 offers an explanation for the observed behavior. Duplicate sample concentrations for the 1988 Monitoring Program averaged 0.591 ppmC, while Table 3 shows the 6:00 a.m. to 9:00 a.m. diurnal samples to average

TABLE 3. RLNC SAMPLES VS. INTEGRATED DIURNAL SAMPLES

1989 Julian Date Sampled	RLNC NMOC ppmC	Diurnal 6-9 a.m. NMOC ppmC	Difference ppmC	Average ppmC	% Difference	Absolute % Difference
206	0.258	0.117	-0.141	0.1875	-75.20	75.20
208	0.089	0.099	0.010	0.0940	10.64	10.64
212	0.204	0.208	0.004	0.2060	1.94	1.94
214	0.113	0.118	0.005	0.1155	4.33	4.33
218	0.079	0.079	0.000	0.0790	0.00	0.00
220	0.054	0.062	0.008	0.0580	13.79	13.79
224	0.083	0.080	-0.003	0.0815	-3.68	3.68
226	0.201	0.206	0.005	0.2035	2.46	2.46
228	0.405	0.407	0.002	0.4060	0.49	0.49
228	0.391	0.407	0.016	0.3990	4.01	4.01
230	0.056	0.072	0.016	0.0638	24.45	24.45
Average =	0.1757	0.1686	-0.0071	0.1722	-1.5243	12.8177
Count =	11	11	11	11	11	11
Std Dev =	0.1287	0.1278	0.0448	0.1263	25.6694	21.9261

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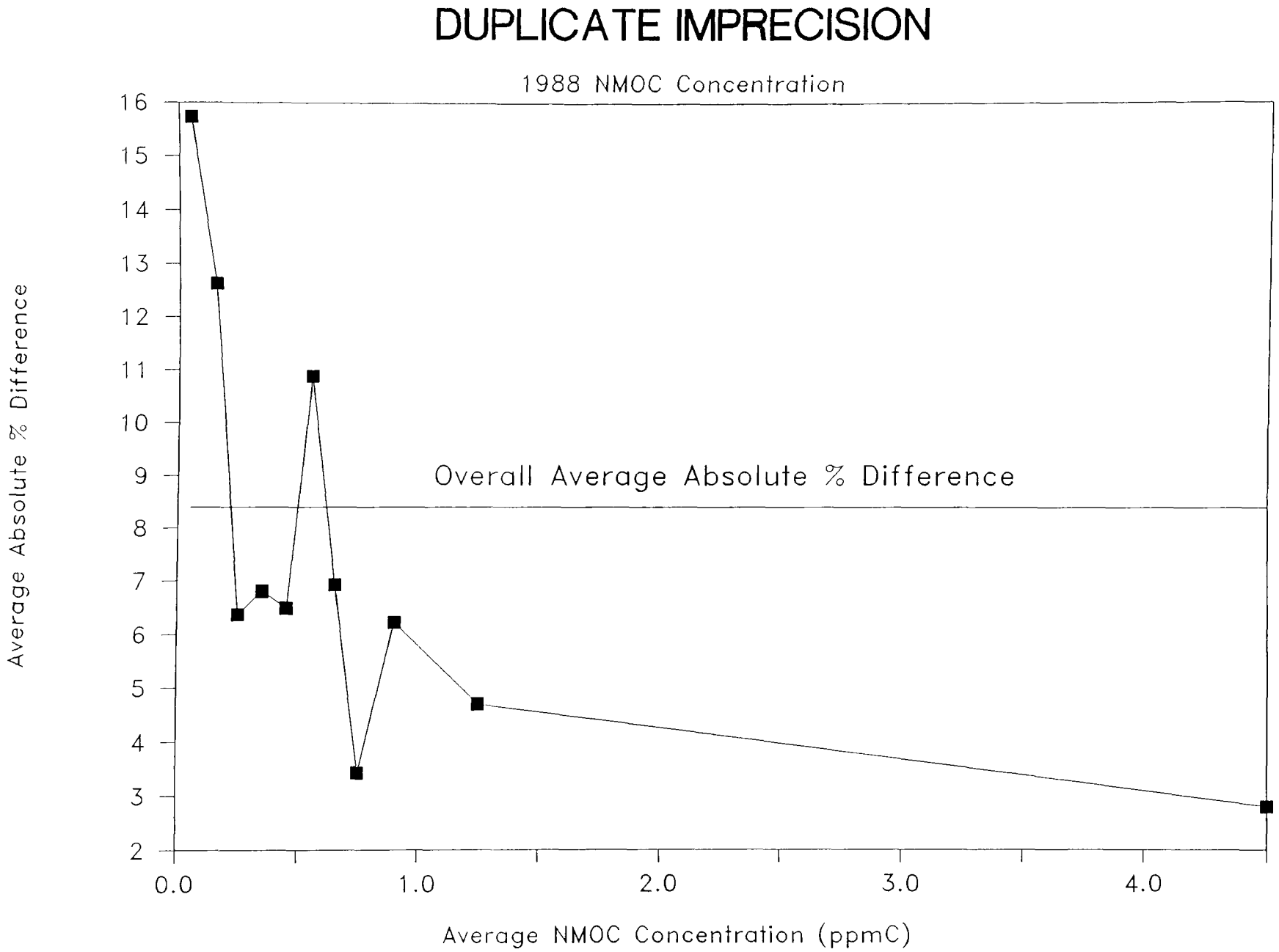

Figure 5. Duplicate NMOC sample results comparing average concentration with absolute percent difference.

0.169 ppmC. Figure 5 was taken from the 1988 NMOC Final Report[4] and shows that as the average NMOC concentration decreases below 0.5 ppmC, the average % difference increases rapidly. At an average duplicate sample concentration of 0.169 ppmC, Figure 5 shows an average % difference of about 12.75 which is in line with the calculated average absolute % difference of 12.82.

3.2.2 Integrated Diurnal Samples at Six Sampling Periods

Table 4 gives the results of the analysis of integrated ambient air samples over the diurnal sampling periods shown. The sample numbers shown in Table 4 correspond with those indicated in Table 1. Diurnal Sample #2 (D.S. #2) was the integrated canister sample taken from 6:00 a.m. to 9:00 a.m. Diurnal Average #9 is a weighted 24-hour average calculated according to Equation 2.

$$\text{Average \#9} = (3 \times \text{D.S.\#2} + 3 \times \text{D.S.\#3} + 3 \times \text{D.S.\#4} + 3 \times \text{D.S.\#5} + 12 \times \text{D.S.\#6})/24. \quad (3)$$

Weighted 24-hour average #9 (Equation 3) is compared to the measured 24-hour average, D.S. #7, in the last four columns of Table 4. Column 9 is the difference between average #9 and D.S. #7. Columns 10, 11, and 12 are their average, % difference, and absolute % difference respectively. Although the % difference ranges from -3.93 to 31.58, the average % difference is a moderate 13.30. There appears to be a positive bias in the difference, however. Student's t test, testing the hypothesis that the mean difference is zero, concludes by rejecting the null hypothesis (Ho: $\mu_d = 0$) at the 0.05 level of significance. If the conclusion were reached that there was a positive bias in the average differences, the probability is 95% that we have reached the correct conclusion.

This means that the weighted 3- and 12-hour average #9 gives a statistically significantly higher average than the 24-hour D.S. #7. A possible explanation for this occurrence is that the samples in some of the sampling periods were not fully integrated samples. Another explanation may be that the sampling and analytical errors in the data set of this study were

TABLE 4. 1989 RALEIGH DIURNAL SITE SAMPLES

	Diurnal Sample (D.S.)						Average[a]				
	#2	#3	#4	#5	#6	#7	#9				
Julian Date Sampled	Diurnal 6 a.m.-9 a.m. NMOC ppmC	Diurnal 9 a.m.-Noon NMOC ppmC	Diurnal Noon 3 p.m. NMOC ppmC	Diurnal 3 p.m.-6 p.m. NMOC ppmC	Diurnal 6 p.m.-6 a.m. NMOC ppmC	Diurnal 6 a.m.-6 a.m. NMOC ppmC	NMOC ppmC	Difference (#9-#7) ppmC	Average (#7&#9) NMOC ppmC	% Difference	Absolute % Difference
204					0.562	0.478					
206	0.117	0.060	0.077	0.080	0.528	0.226	0.3058	0.0798	0.2659	30.00	30.00
208	0.099	0.156	0.119	0.104	0.241	0.172	0.1803	0.0083	0.1761	4.68	4.68
210		0.081		0.070	0.293	0.127					
212	0.208	0.145	0.079	0.120	0.220	0.137	0.1790	0.0420	0.1580	26.58	26.58
214	0.118	0.110	0.103	0.064	0.312	0.196	0.2054	0.0094	0.2007	4.67	4.67
216		0.194	0.129	0.099	0.214	0.204					
218	0.079	0.062	0.048	0.053	0.194	0.097	0.1273	0.0303	0.1121	26.98	26.98
220	0.062	0.046	0.046	0.049	0.183	0.085	0.1169	0.0319	0.1009	31.58	31.58
222	0.051	0.052	0.059	0.067	0.083	0.059	0.0701	0.0111	0.0646	17.23	17.23
224	0.080	0.090	0.098	0.092	0.183	0.136	0.1365	0.0005	0.1363	0.37	0.37
226	0.206	0.066	0.059	0.050	0.121	0.111	0.1081	-0.0029	0.1095	- 2.67	2.67
228	0.407	0.192	0.065	0.099	0.190	0.198	0.1904	-0.0076	0.1942	- 3.93	3.93
230	0.072	0.064	0.085	0.055	0.149	0.098	0.1089	0.0111	0.1034	10.76	10.76
Average =	0.1362	0.1014	0.0805	0.0771	0.2481	0.1660	0.1571	0.0194	0.1474	13.30	14.50
Cases =	11	13	12	13	14	14	11	11	11	11	11
Std Dev =	0.1032	0.0528	0.0270	0.0235	0.1395	0.1031	0.0640	0.0250	0.0575	13.52	12.12

[a] Average #9 = (3 x D.S. #2 + 3 x D.S #3 + 3 x D.S. #4 + 3 x D.S #5 + 12 x D.S. #6)/24

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TABLE 5. COMPARISON OF SAMPLING PERIOD MEANS

Null Hypothesis Ho	Degrees of Freedom, df	Test Statistic t	Critical $t_{df,\ 0.975}$
$\mu_2 = \mu_3$	22	1.065	2.074
$\mu_2 = \mu_4$	21	1.807	2.080
$\mu_2 = \mu_5$	22	2.012	2.074
$\mu_2 = \mu_6$	23	2.222	2.069

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lower than the typical errors encountered in this kind of measurement, i.e.the standard deviations were unusually low for the NMOC concentration range encountered.

Further comparisons of these data tested whether a significant difference was apparent between the sampling periods. Table 5 compares the average NMOC concentrations for each sampling period (#3 through #6) with the average concentration for the 6:00 a.m. to 9:00 a.m. period. The Null Hypotheses for these tests are shown in column one of the table. The degrees of freedom for the test, the test statistics,and the critical test statistic, $t_{df,0.975}$, are given in the remaining columns of Table 5. The only null hypothesis that can be rejected, at the 0.05 level of significance is the last one $\mu_2 = \mu_6$, because the test statistic, t = 2.222, is greater than the critical statistic, $t_{23,\ 0.975} = 2.069$. The results of this study indicate that the average concentration of NMOC collected in the 6:00 p.m. to 6:00 a.m. samples was significantly higher for this study than the average concentrations of the 6:00 a.m. to 9:00 a.m. samples.

These results indicate that the building of NMOC concentration during the night is greater than the average NMOC concentrations in the 6:00 a.m. to 9:00 a.m. time period. It is to be noted that photochemical reactions in the 6:00 a.m. to 9:00 a.m. time interval would not be expected to be as large as in the 9:00 a.m. to 3:00 p.m. time period.

3.2.3 APDFID Samples Compared to Diurnal Samples

Table 6 compares the average APDFID sample concentrations with the integrated canister concentrations for the same sampling period, analyzed by PDFID. The second column, Wj, designates the weekday (Sunday, Wj=1, Monday, Wj=2, ..., Saturday, Wj=7). The column marked Pk represents different time periods throughout the day. (Time Period Pk=1 is for 6:00 a.m. to 9:00 a.m.; Pk=2 is for 9:00 to Noon; Pk=3 for Noon to 3:00 p.m.; Pk=4 for 3:00 p.m. to 6:00 p.m.; Pk=5 for 6:00 p.m. to 6:00 a.m.; Pk=6 for 6:00 a.m. to 6:00 a.m.).

Difference, % difference, and absolute % difference are calculated in a manner similar to the statistics in Table 4 using the integrated PDFID concentration as the reference value. Percent difference and absolute %

TABLE 6. COMPARISON OF PDFID AND APDFID CONCENTRATIONS AT VARIOUS SAMPLING PERIODS

1989 Julian Date	Wj	Pk	APDFID ppmC	PDFID ppmC	Average ppmC	Difference ppmC	% Diff	Absolute % Diff
208	5	1	0.0436	0.099	0.0713	-0.0554	-77.7	77.7
208	5	2	0.0895	0.156	0.1228	-0.0665	-54.2	54.2
208	5	3	0.0855	0.199	0.1023	-0.0335	-32.8	32.8
212	2	1	0.1641	0.204	0.1841	-0.0399	-21.7	21.7
212	2	1	0.1641	0.208	0.1861	-0.0439	-23.6	23.6
212	2	2	0.1822	0.145	0.1636	0.0372	22.7	22.7
212	2	3	0.0936	0.079	0.0863	0.0146	16.9	16.9
212	2	4	0.0584	0.120	0.0892	-0.0616	-69.1	69.1
212	2	5	0.0861	0.220	0.1531	-0.1339	-87.5	87.5
212	2	6	0.1104	0.137	0.1237	-0.0266	-21.5	21.5
216	6	1	0.2625	0.269	0.2658	-0.0065	2.4	2.4
216	6	2	0.3416	0.194	0.2678	0.1476	55.1	55.1
216	6	2	0.2823	0.204	0.2432	0.0783	32.2	32.2
218	1	3	0.0461	0.048	0.0471	-0.0019	4.0	4.0
218	1	4	0.0304	0.053	0.0417	-0.0226	-54.2	54.2
218	1	5	0.1195	0.194	0.1568	-0.0745	-47.5	47.5
218	1	6	0.0924	0.097	0.0947	-0.0046	4.9	4.9
219	2	1	0.0935	0.099	0.0963	-0.0055	5.7	5.7
220	3	1	0.0542	0.054	0.0541	0.0002	0.4	0.4
220	3	1	0.0542	0.062	0.0581	-0.0078	-13.4	13.4
220	3	2	0.0691	0.046	0.0576	0.0231	40.1	40.1
220	3	3	0.0513	0.046	0.0487	0.0053	10.9	10.9
220	3	4	0.0573	0.049	0.0532	0.0083	15.6	15.6
220	3	5	0.1206	0.183	0.1518	-0.0624	-41.1	41.1
220	3	6	0.0736	0.085	0.0793	-0.0114	-14.4	14.4
222	5	3	0.0620	0.059	0.0605	0.0030	5.0	5.0
222	5	4	0.1217	0.067	0.0944	0.0547	58.0	58.0
222	5	5	0.0515	0.083	0.0673	-0.0315	-46.8	46.8
222	5	6	0.0657	0.059	0.0624	0.0067	10.7	10.7
228	4	3	0.0955	0.065	0.0803	0.0305	38.0	38.0
228	4	3	0.0955	0.059	0.0773	0.0365	47.2	47.2
228	4	6	0.1026	0.111	0.1068	-0.0084	7.9	7.9
228	4	6	0.1026	0.198	0.1503	-0.0954	-63.6	63.5
229	5	1	0.1082	0.116	0.1121	-0.0078	7.0	7.0
	Average =		0.1068	0.1173	0.1120	-0.0105	-10.23	30.99
	Count =		34	34	34	34	34	34
	Std Dev =		0.0699	0.0635	0.0617	0.0513	38.18	24.01

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difference reference the differences to the average of the two concentrations. The average difference between the APDFID and PDFID concentrations is -0.0105 ppmC, which is not significantly different from zero at 0.05 level of significance. Likewise, the average % delta is -10.2, which is also not significantly different from zero. The absolute % difference is about 31%, which appears to be large. In view of the overall average NMOC concentration, equal to about 0.11 ppmC, however, the precision of 31% is a reasonable value.

Therefore, we conclude APDFID and integrated canister diurnal NMOC concentrations are equivalent. Likewise the APDFID instrument and the canister 3-hour samples analyzed by the PDFID method give equivalent results.

3.3 APDFID DATA CHARACTERIZATION

The APDFID NMOC concentrations were obtained by the automatic analysis of 9-minute samples. The time interval for the sampling/analysis cycle of the APDFID instrument varied from 16 to 19 minutes. The data were numerically integrated by the trapezoidal rule to give hourly average NMOC concentrations. The hourly average NMOC concentrations determined by the integration of the APDFID measurements are shown in the stem-and-leaf plot of Figure 6.

Statistics for the 248 APDFID hourly measurements are shown in Figure 6. Also shown are the 6:00 a.m. to 9:00 a.m. PDFID measurements taken at the RLNC site for the entire summer monitoring program. The PDFID statistics are seen to be larger except for the number of cases, the maximum , the skewness, and the kurtosis. The standard deviations of the APDFID hourly NMOC concentration are about equal to the 3-hour 6:00 a.m. to 9:00 a.m. integrated samples for the entire summer. These observations regarding the 6:00 a.m. to 9:00 a.m. RLNC Monitoring Program NMOC concentration distribution as compared to the PDFID measured NMOC concentration distribution for all hourly time intervals, lend credence to the assertion made earlier that the APDFID and the integrated canister concentration (analyzed by the PDFID method) are equivalent.

Table 7 shows various hourly statistics for the 1989 Raleigh diurnal APDFID NMOC data. The first row shows the same statistics given in Figure 6 for all of the combined APDFID data. Subsequent rows in Table 7 summarize the minimum, the mean, the median, the maximum, the range, and standard deviations

```
 1    7
 2    23348 9
 3    00112 35577 8889
 4    00011 33333 44555 56788 899
 5 H  00111 33334 44555 5666  67777 78899 99
 6    01222 22344 44444 55677 77999 99
 7 M  00000 03345 55566 66778 88899
 8    00112 23334 45667 77888 8999
 9    01233 44555 56788 8999
10    11122 337
11 H  00012 33344 789
12    23346 788
13    2357
14    0279
15    1348
16    01146
17    0088
18
19    9
20    19
21    8
22    5
24    1
25    0
26    089
27    49
29    6
31    8
34    1
36    8
38    0
44    08
47    568
48    8
49    2
50    5
53    8
66    1
82    9
```

	APDFID NMOC ppmC	6-9 a.m. PDFID NMOC ppmC
Cases	248.	94.
Minimum	0.017	0.043
Lower Hinge (H)	0.056	0.083
Median (M)	0.078	0.131
Mean	0.112	0.159
Upper Hinge (H)	0.114	0.209
Maximum	0.829	0.551
Standard Deviation	0.111	0.101
Skewness	3.160	1.434
Kurtosis	11.791	2.143

Figure 6. Stem-and-leaf plot of the APDFID NMOC hourly and PDFID concentrations for the RLNC site.

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TABLE 7. 1989 RALEIGH DIURNAL APDFID NMOC DATA

Hour	Cases	Min ppmC	Mean ppmC	Median ppmC	Max ppmC	Range ppmC	Std Dev ppmC
1-24	248	0.0174	0.1124	0.0784	0.8294	0.8120	0.1110
1	12	0.0456	0.1260	0.0825	0.5389	0.4933	0.1363
2	10	0.0378	0.1128	0.0744	0.4763	0.4385	0.1301
3	10	0.0408	0.1150	0.0649	0.5055	0.4647	0.1397
4	9	0.0395	0.1050	0.0759	0.3689	0.3294	0.1029
5	10	0.0438	0.0921	0.0780	0.2506	0.2068	0.0617
6	7	0.0298	0.0940	0.0849	0.1995	0.1697	0.0628
7	7	0.0330	0.0974	0.0826	0.2692	0.2362	0.0823
8	7	0.0315	0.1332	0.0740	0.3187	0.2872	0.1149
9	6	0.0782	0.1563	0.1024	0.3415	0.2633	0.1058
10	4	0.0578	0.0869	0.0852	0.1195	0.0617	0.0258
11	4	0.0590	0.1173	0.1045	0.2014	0.1424	0.0602
12	12	0.0380	0.0774	0.0746	0.1285	0.0905	0.0376
13	8	0.0444	0.0720	0.0723	0.0957	0.0513	0.0201
14	10	0.0242	0.0811	0.0685	0.2411	0.2169	0.0586
15	12	0.0382	0.1313	0.0643	0.8294	0.7912	0.2212
16	12	0.0174	0.1228	0.0625	0.6614	0.6440	0.1730
17	14	0.0355	0.1028	0.0677	0.4922	0.4567	0.1157
18	15	0.0404	0.1008	0.0761	0.4782	0.4378	0.1063
19	15	0.0235	0.1133	0.0755	0.3803	0.3568	0.0936
20	15	0.0415	0.1116	0.0870	0.2966	0.2551	0.0657
21	14	0.0239	0.1394	0.1067	0.4480	0.4241	0.1098
22	14	0.0227	0.1355	0.1082	0.4407	0.4180	0.1125
23	14	0.0284	0.1120	0.0674	0.4755	0.4471	0.1181
24	13	0.0304	0.1201	0.0947	0.4883	0.4579	0.1172

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for each hour in the day. Means from the table are plotted in Figure 7 for each hour of the day.

Figure 8 plots the minimum, mean and maximum for each hour of the day. Figure 9 plots the median NMOC concentration for each hour of the day.

Figures 7 and 8 show a significant increase in the average NMOC concentration from 6:00 a.m. to 9:00 a.m. (hours 7,8, and 9), while the average NMOC decreases, as expected, for hours 12, 13,and 14. For hours 15 through 4, Figure 8 shows that the maximum NMOC concentration for each hour was greater than 0.3 ppmC, although the average hovered around 0.1 ppmC. The median followed the same trends except for hour 8 (7:00 a.m. to 8:00 a.m.) which was below the overall average median.

Figure 10 shows boxplots of the NMOC concentrations for each hour of the day. The rectangles for each hour show the midrange of the data. The horizontal line inside the rectangle marks the NMOC concentration of the median. The upper and lower ends of the rectangle mark the upper and lower hinges of the ranked data. Three quarters of the data are smaller than the upper hinge and one quarter of the data is smaller than the lower hinge. The absolute difference between the upper and lower hinge is called the Hspread. Inner fences are defined as follows:

$$\text{lower inner fence} = \text{lower hinge} \quad (1.5 \times \text{Hspread}), \text{ and} \qquad (4)$$

$$\text{upper outer fence} = \text{upper hinge} + (1.5 \times \text{Hspread}). \qquad (5)$$

The outer fences are defined as follows:

$$\text{lower outer fence} = \text{lower hinge} - (3 \times \text{Hspread}), \text{ and} \qquad (6)$$

$$\text{upper outer fence} = \text{upper hinge} + (3 \times \text{Hspread}). \qquad (7)$$

Values outside the inner fences are plotted with asterisks. Values outside the outer fences are plotted with empty circles. Whiskers extended from the boxes to the extreme (maximum and minimum) values or to the inner fences, whichever give shorter whiskers. The boxplots give a general impression of the overall level, the amount of spread of the data, symmetry, and the presence or absence of outliers. Figure 10 shows the presence of outliers, some of which are greater than 0.4 ppmC. The boxplots show that the NMOC data

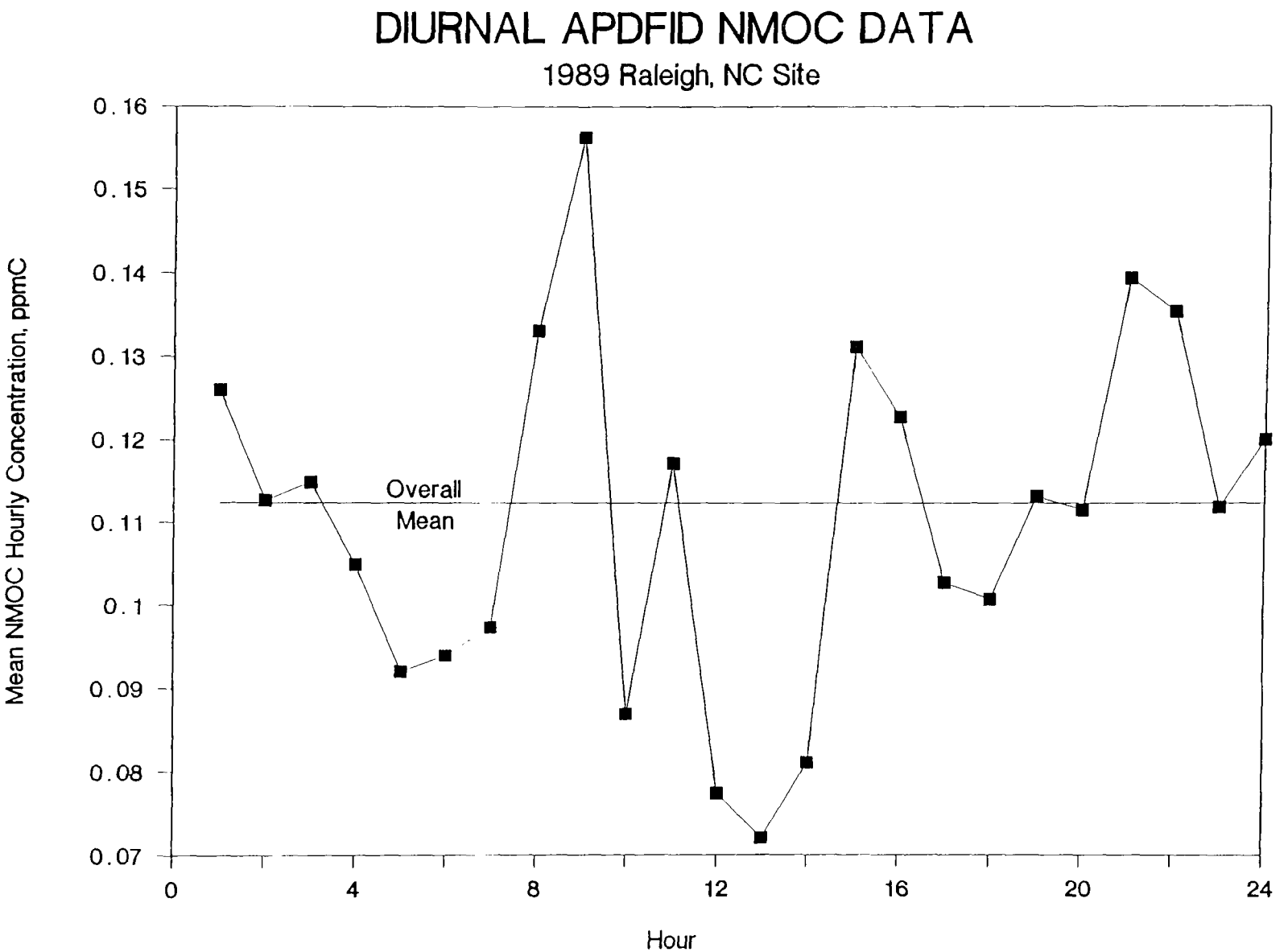

Figure 7. Hourly mean NMOC concentrations.

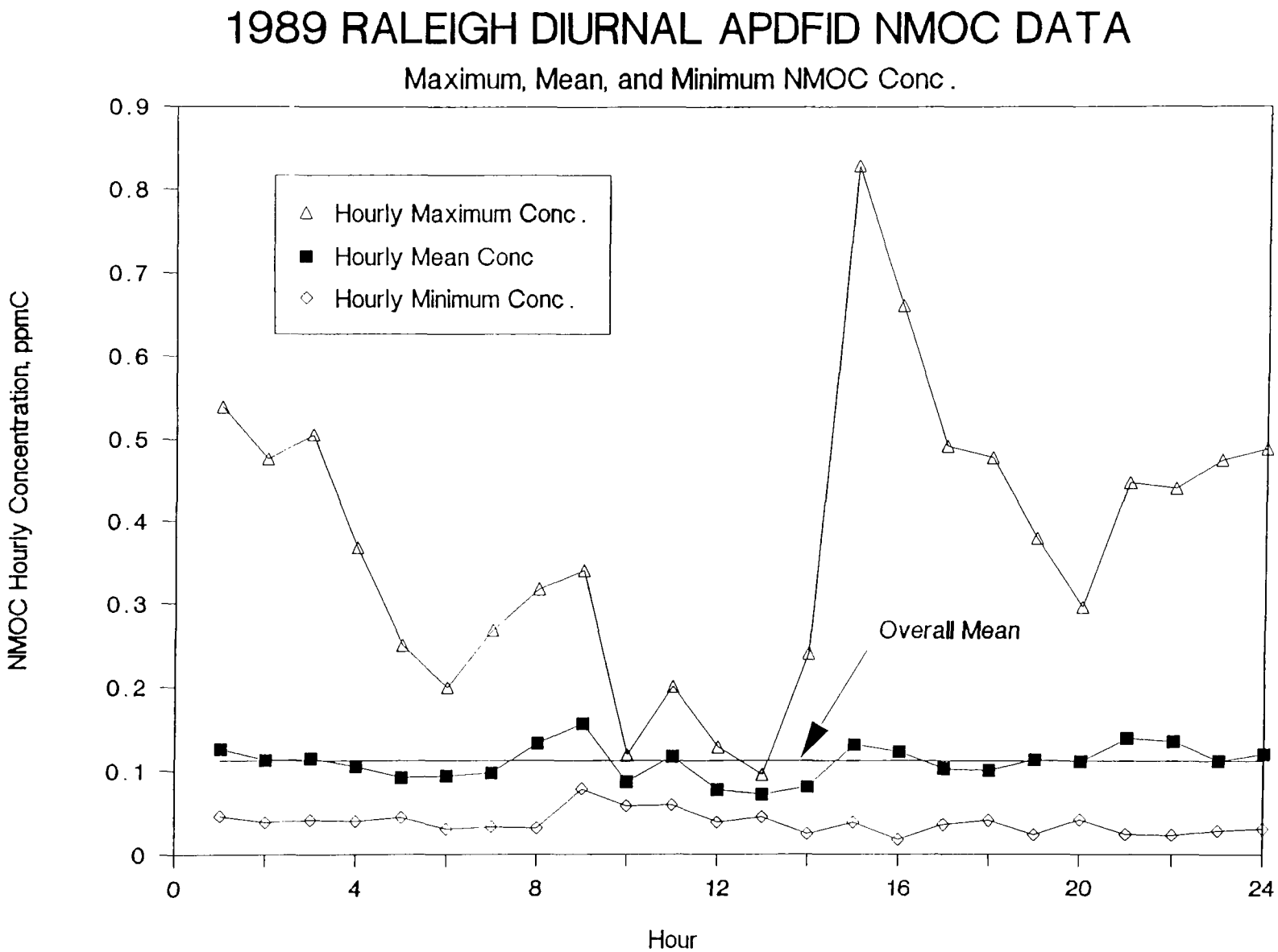

Figure 8. Hourly minimum, mean, and maximum concentrations.

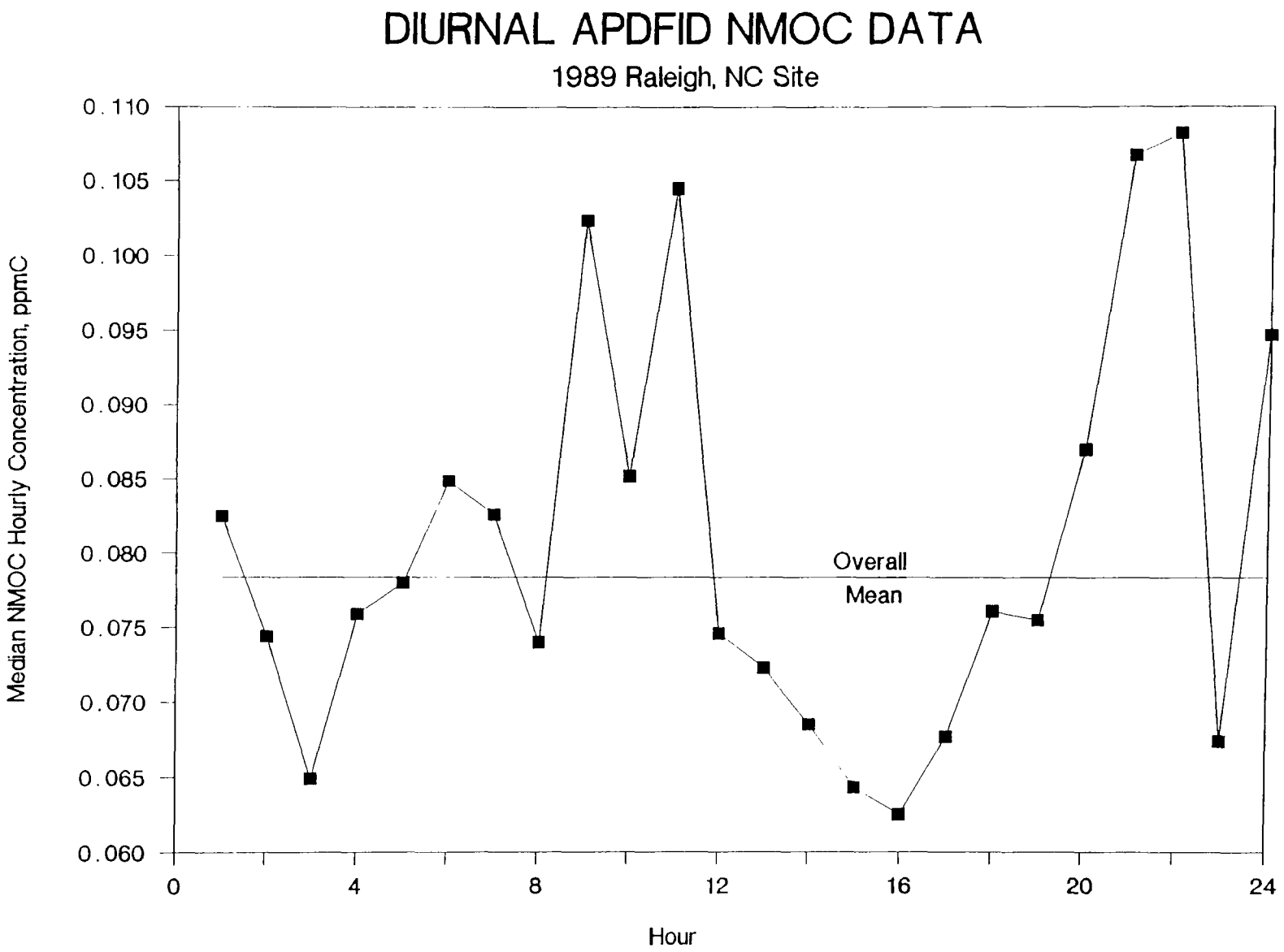

Figure 9. Hourly median concentrations.

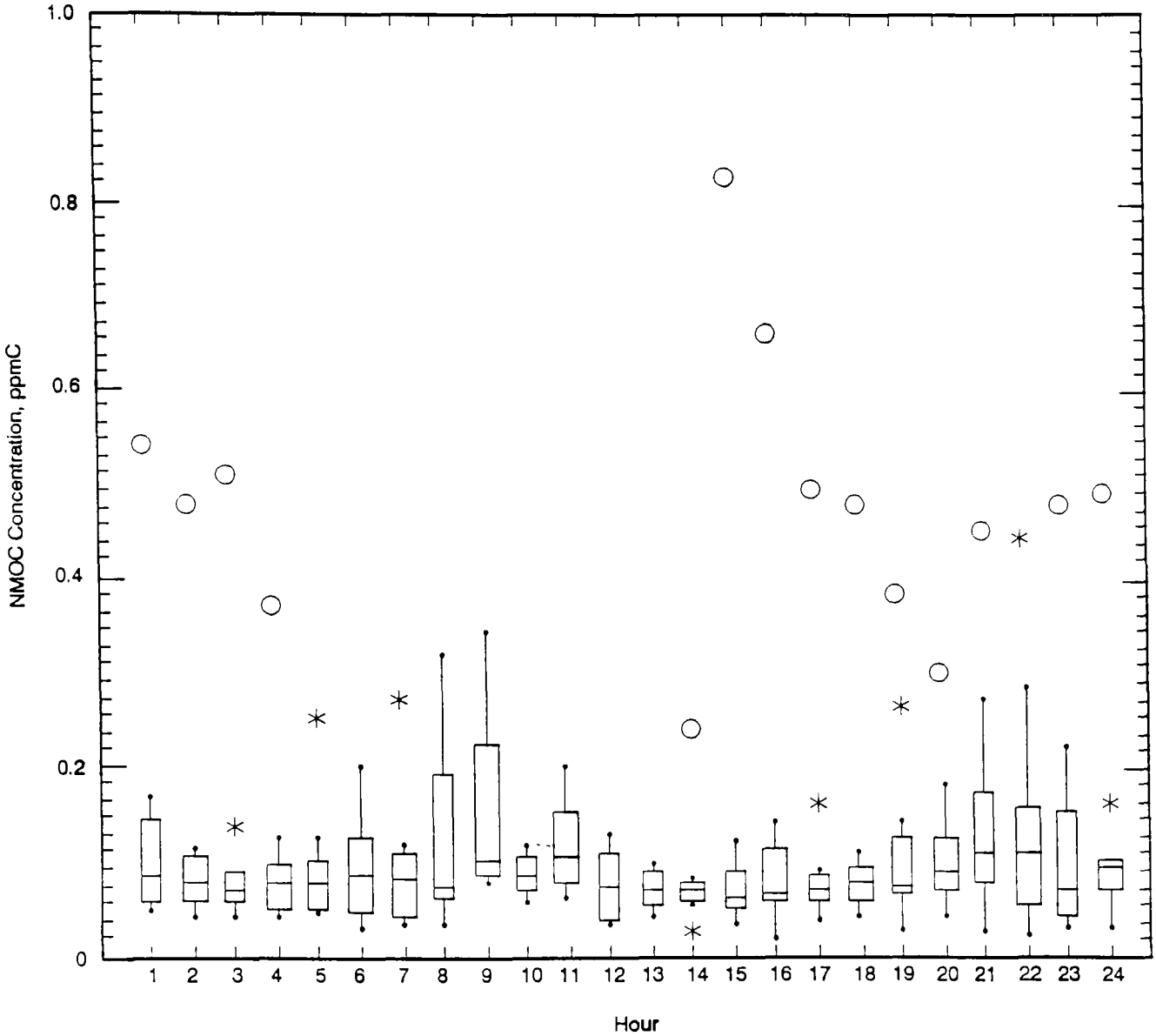

Figure 10. Boxplots of NMOC Concentrations for each hour of the day.

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are skewed, as confirmed by the stem-and-leaf plots (Figures 4 and 6). The boxplots for hours 8 and 9 show large spans of data, whereas for hour 10, 13, and 14, the overall spans are much smaller. The NMOC levels of the medians for the boxplots should correspond to the medians plotted in Figure 9. Boxplots are a compact way of indicating the character and distribution of the hourly NMOC readings.

3.3.1 Correlations Among APDFID Data

Nine-minute APDFID samples were taken at intervals ranging from 16 to 19 minutes. As indicated earlier, the data were integrated to give hourly averages. The hourly averages are recorded in Appendix B along with hourly average valves of wind speed, wind direction, temperature, solar radiation intensity, percent relative humidity, and station barometric pressure (at the station at Raleigh-Durham airport). Appendix B also indicates the 1989 Julian date, and a column labeled "Diurnal Minutes." Diurnal minutes were defined to simplify the integration calculations as follows:

$$\text{Diurnal minutes} = (\text{Julian date} \quad 203) \times 1440 + (\text{hour} \times 60). \tag{8}$$

Diurnal minutes are tabulated as a function of 1989 Julian date and hour throughout the day in Appendix A.

The hourly average data were converted to absolute units: wind speed and wind direction were converted to hourly average velocity vectors perpendicular to the highway (U.S. 1) in the direction of the RLNC site; temperature was converted to kelvins; solar radiation units were converted to joules per square meter (J/m^2) and percent relative humidity was converted to mole fraction water. These conversions were made so that the variables could be used in the various correlations and analyses of covariance described below. The hourly average concentrations were averaged over the six sampling periods (Pk) given in Table 1. The APDFID and the PDFID (integrated) concentrations averaged over the sampling periods were given in Appendix C, along with diurnal minutes, temperature (kelvins), solar radiation (J/m^2), humidity (mole fraction), velocity vector (m/s), Si, Wk, Pk, and NMOC concentration (ppmC).

Variable Si is a fixed variable indicating whether the results were obtained from APDFID (Si=1) or from the PDFID (Si=2) measurement. Wk indicates the weekday, Sunday, Wk=1, Monday, Wk=2, etc. through Saturday, Wk=7.

Table 8 gives the correlation matrix for the diurnal variables and includes data from PDFID as well as APDFID NMOC concentrations. The table gives binary correlation coefficients for the eight variables shown. Only one variable pair shows a significant correlation, and that is the T-H pair. Because the temperature is used to calculate the vapor pressure of water used to calculate the humidity, a correlation of these two variables is not unexpected. No other variable pair shows a significant correlation, with $r > 0.9$. The Bartlett chi-square statistic shown in Table 8 tests the global hypothesis concerning the significance of all the correlations in the matrix.[5] With the probability in the Bartlett chi-square test equal to zero, the test is significant which indicates that there may be some real correlations among the variables. The relationship between temperature and humidity have already been cited. One of the objectives of the study was to determine which among the variables, T, SRAD, H, V, S, W, and P, might be significant independent variables, using NMOC as a dependent variable. The bottom row in the correlation of matrix shown in Table 7 indicates that a correlation between NMOC and other variables is not likely. In order for a correlation to be likely, the correlation coefficients should be in the range between 0.75 and 1.0 and -0.75 to 1.0

A number of analyses of covariance (ANOCOVA) were performed on the data and their results are summarized in Table 9. Variables S,P, and W were fixed variables while T, SRAD, and V were continuous variables. The humidity variable, H, was not used as an independent variable because of its dependence on T. As seen in Table 8, H, has the highest correlation with the other variables, except for NMOC. Variable H was therefore not used in the ANOCOVA, where NMOC was the dependent variable.

It is difficult to interpret the results of the ANOCOVA. The most general conclusion that can be reached is that the NMOC concentration was so low, and the variability was also so low that assigning significant trends was not possible. The SP, or S x P, interaction term appeared to be significant whenever S and P were used as independent variables.

TABLE 8. CORRELATION MATRIX FOR DIURNAL VARIABLES

Variable	T	SRAD	H	V	S	W	P	NMOC
T	1.000							
SRAD	0.730	1.000						
H	0.978	0.799	1.000					
V	0.500	0.264	0.477	1.000				
S	-0.161	-0.183	-0.177	-0.010	1.000			
W	-0.287	-0.179	-0.277	0.028	0.155	1.000		
P	0.212	0.131	0.243	-0.007	-0.296	-0.027	1.000	
NMOC	0.086	-0.148	0.038	0.186	0.146	0.016	0.047	1.000

Number of observations = 172

Bartlett chi-square statistic 870.215; df = 28; Prob = 0.00

T = Period (P) average temperature, kelvins;
SRAD = Period solar radiation intensity, J/m^2;
H = Period humidity, mole fraction water in air sample;
V = Period velocity vector, m/s;
S = Measurement type S=1 for APDFID; S=2 for PDFID;
W = Weekday Sunday, W=1; Monday, W=2 ...; and Saturday, W=7;
P = Sampling period for average P=1, 6:00 a.m. to 9:00 a.m.; P=2, 9:00 a.m. to Noon; P=3, Noon to 3:00 p.m.; P=4, 3:00 p.m. to 6:00 p.m.; P=5, 6:00 p.m. to 6:00 a.m.; and P=6, 6:00 a.m. to 6:00 a.m.; and
NMOC = NMOC concentration, ppmC.

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TABLE 9. RESULTS OF ANALYSES OF COVARIANCE

Case No.	Dependent Variable	Independent Variables	Significant Variable(s)	Probability(ies)	Multiple R
1	NMOC	S,P,SP,T,SRAD,V	SP	0.014	0.488
2	NMOC	S,P,SP,T,SRAD	SP	0.014	0.475
3	NMOC	S,P,SP,T,V	SP,P	0.015, 0.00077	0.488
4	NMOC	S,W,SW,T,V	S	0.023	0.343
5	NMOC	S,P,W,SP,SW,WP, T,SRAD,V	Singular Matrix*		
6	NMOC	W,P,WP,T,V	P,T	0.00019, 0.0014	0.609
7	NMOC	P,T,SRAD,V			0.380
8	NMOC	W,T,SRAD,V	T,SRAD	0.005, 0.00012	0.359
9	NMOC	S,T,SRAD,V	T,SRAD	0.005, 0.0022	0.362
10	NMOC	S,W,SW,T,SRAD,V	S,T,SRAD	0.02, 0.0023, 0.00025	0.437
11	NMOC	S,P,SP,T^2,SRAD,V	SP	0.014	0.488

* A singular matrix occurred because there may have been too few observations, or too many missing cells in the analysis of covariance.

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Whenever P and SRAD were used as independent variables in the same ANOCOVA, neither was significant. However, T and SRAD appeared to be significant when used as independent variables in the absence of P as an independent variable. Using T^2 in place of T as an independent variable did not appear to increase the overall correlation significantly. In no case did V become a significant variable. Variable S was significant in only one case, Case No. 10.

There were sufficient cases in the ANOCOVA in which one variable or another was significant, to suggest that with NMOC data having a larger range of variability and magnitude, there would be clearer trends of cause and effect between the independent and dependent variables.

Table 9 shows the multiple correlation coefficients, R, to range between 0.343 to 0.609, averaging about 0.44. Such a range indicates that additional other independent and/or dependent variables need to be used to improve the correlations. Perhaps a better dependent variable would be the ratio of $NMOC/NO_x$. Using NMOC as one of the independent variables with NO_x, or O_3 as the dependent variable may also give better correlations.

4.0 EQUIPMENT PERFORMANCE

One of the primary objectives of the study was to validate the mechanical reliability and precision of the APDFID apparatus. Integrated 3-hour, 12-hour, and 24-hour diurnal whole air canister samples were used to validate the APDFID results.

The diurnal sample collection system yielded a project completeness of 96.1%, whereas the APDFID system yielded a completeness of about 40%. As a result of the field test of the APDFID system a number of modifications were suggested to improve the APDFID completeness.

The diurnal sampling system will be described below and will be followed by a description of the APDFID system.

4.1 DIURNAL INTEGRATED SAMPLING SYSTEM DESCRIPTION

As seen in Figure 1, the APDFID and the diurnal collection systems shared a common 1/4-inch outside diameter (o.d.) stainless steel sampling manifold having an inverted glass funnel at the inlet and a high flow slip-stream pump at the outlet. The glass-funnel inlet for the diurnal sampling system was placed within 6 inches of the inlet for the Raleigh, NC (RLNC) NMOC Monitoring Program site. The slipstream pump for the diurnal sampling system maintained at least 12 liters per minute (L/min) through the manifold. The diurnal sample collection system consisted of three subsystems: (1) a subsystem for the 3-hour integrated samples, (2) a system for the 12-hour integrated sample, and (3) a system for the 24-hour sample.

4.1.1 Three-hour Integrated Sample Collection System

The first port on the sampling manifold from the sample manifold inlet was used for the 3-hour samples. The collection system consisted of a 2-micron (μ) stainless steel filter housed in a filter assembly, a fixed orifice assembly, a Metal Bellows MB-151 pump, programmable electronic timers, and a 1/8-inch o.d. manifold from which were located four branches each connected to a 6-L stainless steel canister through a separate Magnalatch latching solenoid

valve. The fixed orifice assembly contained a 75-milliliter per minute (mL/min) critical orifice. The MB-151 pump provided the pressure drop for the critical orifice and was started and stopped by its own dedicated programmable electronic timer. By the end of each sampling period, the MB-151 pump also provided a pressure of about 15 psig in the sample canister. The schedule of activity for collection of integrated samples and operation of the Magnalatch valves is given in Table 10. The 6:00 a.m. to 9:00 a.m. sample was terminated at 8:58 a.m., giving a 178-minute sample (out of 180-minute time period). The 9:00 a.m. to Noon integrated sample began sampling at 9:01 a.m. and was terminated at 11:58 a.m. giving a 177-minute sample out of a 180-minute time period. An interval of about three minutes was provided between the time one sample collection was completed and another began. This static period was required because of the common delivery manifold shared by the diurnal samples. If the solenoid valves, on a system that had just collected sample at (about 15 psig) and a system that had not collected sample (under 15 mm Hg vacuum absolute) were ever open at the same time, there would be a flow of sample from one canister to the other. Both samples would be contaminated in reaching pressure equilibrium.

4.1.2 Twelve-hour Integrated Sampling System

Integrated samples were collected during the 12-hour period 6:00 p.m. and 6:00 a.m. (6:00 p.m. to 5:59 a.m.). The collection system was the second port in the main sampling manifold shown in Figure 1. The 12-hour sampling system with a stainless steel filter, and micro-metering valve, had its own programmable electronic MB-151 pump, Magnalatch solenoid valve, and digital timer. The micro-metering valve was set for a flow of 19 mL/min and the timer was set to activate and deactivate the MB-151 pump and the Magnalatch solenoid valve both at the times shown in Table 10.

4.1.3 Twenty-four-hour Integrated Sampling System

The 24-hour sampling system was the third port on the main sample manifold from the sample inlet. Integrated samples were collected in 6-L canisters during one 24-hour period of each sampling episode. The collection

TABLE 10. SCHEDULE OF ACTIVITY FOR COLLECTION OF INTEGRATED SAMPLES

Day	Time hh mm	System no.	Activity (Refer to Figure 1)
n	05 59	2,3,4,5	Common Sampling Pump K activated.
n	06 00	2	Solenoid Valve H opened; first 3-hour collection started.
n	06 00	7	Sampling pump activated; Solenoid Valve G opened; 2-hour collection started.
n	08 58	2	Solenoid Valve H closed; first 3-hour collection ended.
n	09 01	3	Solenoid valve opened; second 3-hour collection started.
n	11 58	3	Solenoid valve closed; second 3-hour collection ended.
n	12 01	4	Solenoid valve opened; third 3-hour collection started.
n	14 58	4	Solenoid valve closed; third 3-hour collection ended.
n	15 01	5	Solenoid valve opened; fourth 3-hour collection started.
n	18 00	5	Solenoid valve closed; fourth 3-hour collection ended.
n	18 00	6	Sampling pump activated; Solenoid Valve F opened; 12-hour collection started.
n	18 01	2,3,4,5	Common Sampling Pump D deactivated.
n+1	05 59	6	Sampling pump deactivated; solenoid valve closed; 12-hour collection ended.
n+1	05 59	7	Sampling pump deactivated; solenoid valve closed; 24-hour collection ended.

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system was configured exactly the same as the 12-hour collection system except that the micro-metering valve was set for a flow of 10 mL/min. As shown in Table 9, the 24-hour sampling period was set for the integration period between 6:00 a.m. on the day designated as the sampling date and 5:59 a.m. the next day.

All of the diurnal integrated sample equipment operated as designed. Completion in terms of % of valid samples was 96.1. Three samples were voided because of incorrect settings programmed into the timers.

4.2 AUTOMATED CRYOGENIC PRECONCENTRATION AND FLAME IONIZATION DETECTION SYSTEM

The APDFID instrument operating cycle is described in a previous report.[6] One of the objectives of the study was to determine the reliability of the system under field conditions and how well the measurements of NMOC concentration agreed with the measurements obtained from integrated canister samples analyzed by the PDFID method.

Approximately 40% data capture was achieved with the APDFID instrument during the course of the study, but sufficient experience was gained to develop some solutions to of the problems causing data interruptions. APDFID operating limitations experienced in the field included excessive cryogen usage, ice accumulation, power outages and computer lockups due to noise spikes.

About one tank of cryogen (160 L) was used per day prior to finding cryogen leak at the sample trap. Once the leak was corrected, the amount of cryogen used to maintain the trap temperature decreased to about one tank every two days.

Ice accumulation around the cryogenic solenoid valve and cryogen lines leading to the trap created FID electronic noise problems. The signal cable leading form the FID to the electrometer, and the FID support gas lines, were often encased in ice. This problem was resolved after discovery by tightly packing the cryogen solenoid and lines with closed cell insulation material.

Power outages, although infrequent, created down time because the gas chromatograph's operating method would reset. Once the method was reset no other samples were taken. Short power spikes often locked-up the computer,

but did not reset the GC. The Nelson data system software interrupted the signal transfer from the GC to the computer's hard drive. Once the computer was locked-up, the Nelson data system interface could not transfer any data to the hard drive of the computer. The Nelson interface would then store a certain number of sample runs in its on-board memory buffer. Once the on-board buffer was full, no subsequent sample runs were stored. Therefore, if the computer was not able to download data, only a limited number of runs were obtained by the interface. If the power went out during the computer lockup period, then all data in the interface were lost.

4.2.1 Recommended Modifications for the APDFID System

Cryogenic sample trap modification could decrease the amount of cryogen needed to maintain the temperature. A change in the trap material to aluminum, instead of copper, should increase the cooling and heat-transfer efficiency by 30%. The reduction in size of the insulated cavity around the sample trap and increasing the volume of insulation encasing the trap chassis should also decrease the cryogen use.

Moving the cryogenic solenoid valve and cryogen lines away from the GC electronics area to a location outside of the GC will reduce FID electronic noise. Any ice accumulation and water due to frost formation and defrost will not affect the instrument operation and electronics.

An uninterruptible power supply to support the computer and Nelson interface will solve any computer lockup problems experienced by power spikes that do not reset the GC. The proposed modifications to the APDFID system are expected to reduce the cryogen usage by approximately 50%, and to increase the data capture to a goal of 70%.

4.3 APDFID CALIBRATION, AUDIT AND ZERO RESULTS

For initial calibration purposes, APDFID used propane referenced to National Institute of Science and Technology (NIST) propane standards, as required by Compendium Method TO-12. Calibration checks of response factors for propane and zeros, using zero-grade air, were performed every other day throughout the diurnal sampling project.

4.3.1 Initial Calibration of the APDFID system

Initial calibration for the APDFID was performed using n-propane standards referenced to NIST standards. The propane calibration curve for the APDFID apparatus is given in Figure 11. Zero readings of the calibration curve were measured using a zero-air cylinder. The correlation coefficient for the calibration curve was 0.99650.

4.3.2 Daily Response Factors

Response factors were measured every other day using propane with a concentration was about 3.0 ppmC. Figure 12 shows response factors measured over the diurnal sampling period. Four horizontal lines are shown on Figure 12, μ +/- 2σ, and μ +/- 3σ. The μ +/- 2σ lines are called warning limits, and the μ +/- 3σ lines are the control limits. The response factor chart appears to be showing a rising trend in the response factor with time. The data, however, remain within the warning limits. The "runs", or consecutively increasing measurements appear to be no more than five, so the APDFID measurement/calibration check systems appear to remain in control. For future tests with the APDFID system this increase needs to be monitored closely.

4.3.3 Audit Results

Two audit samples containing propane were supplied by the Quality Assurance Division of the U.S. Environmental Protection Agency to determine accuracy of the APDFID instrument. The first audit sample dated July 31, 1989, had a concentration of 0.724 ppmC; and the second audit sample had a concentration of 0.791 ppmC. The analyses of these audit samples by the APDFID instrument showed a bias of +1.52% and 13.40% respectively, for an overall average of -5.94%.

Audit (and precision) results for the analyses conducted by the PDFID analyses of integrated canister samples were periodically conducted on the

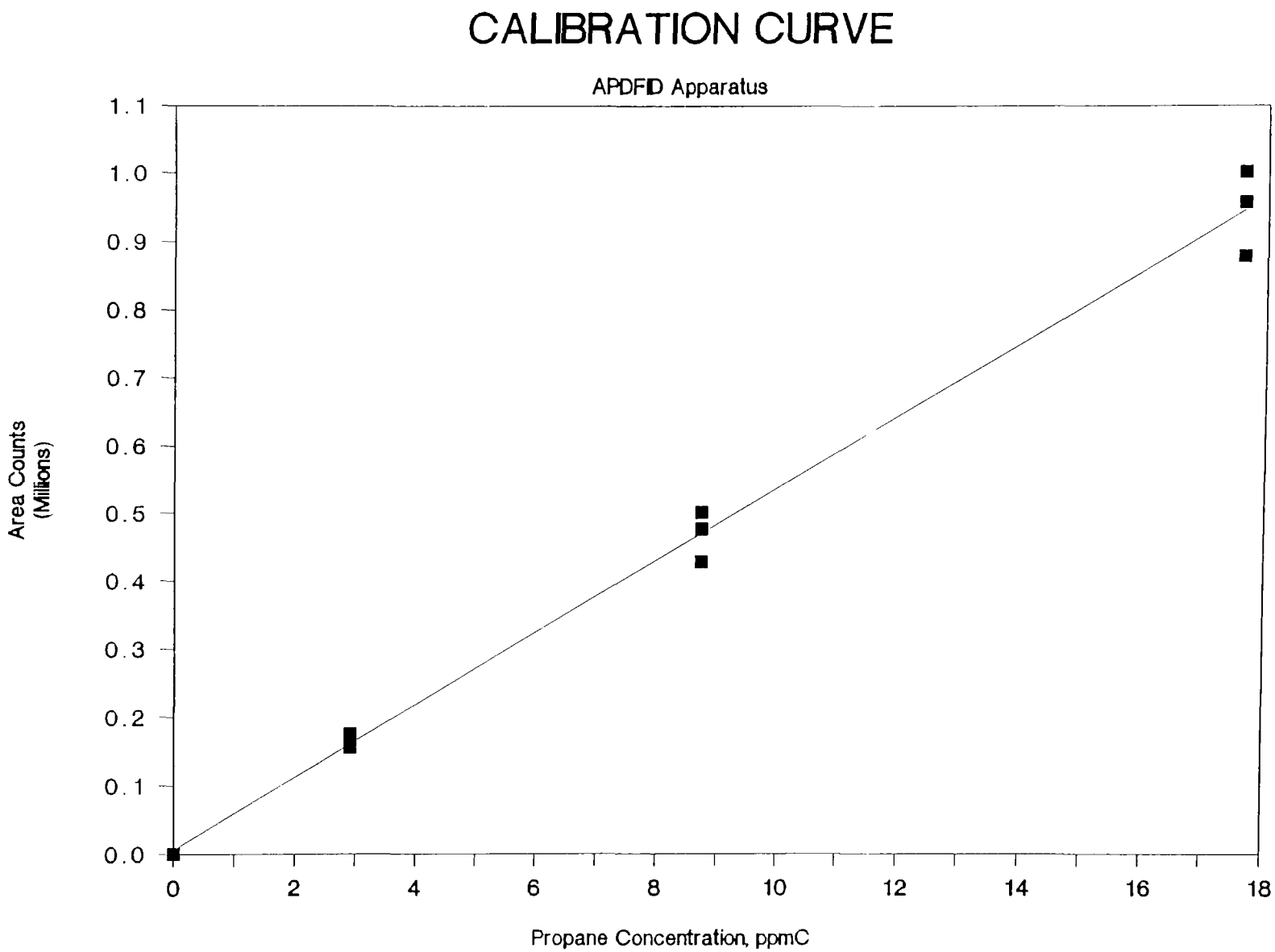

Figure 11. Propane calibration curve for APDFID apparatus.

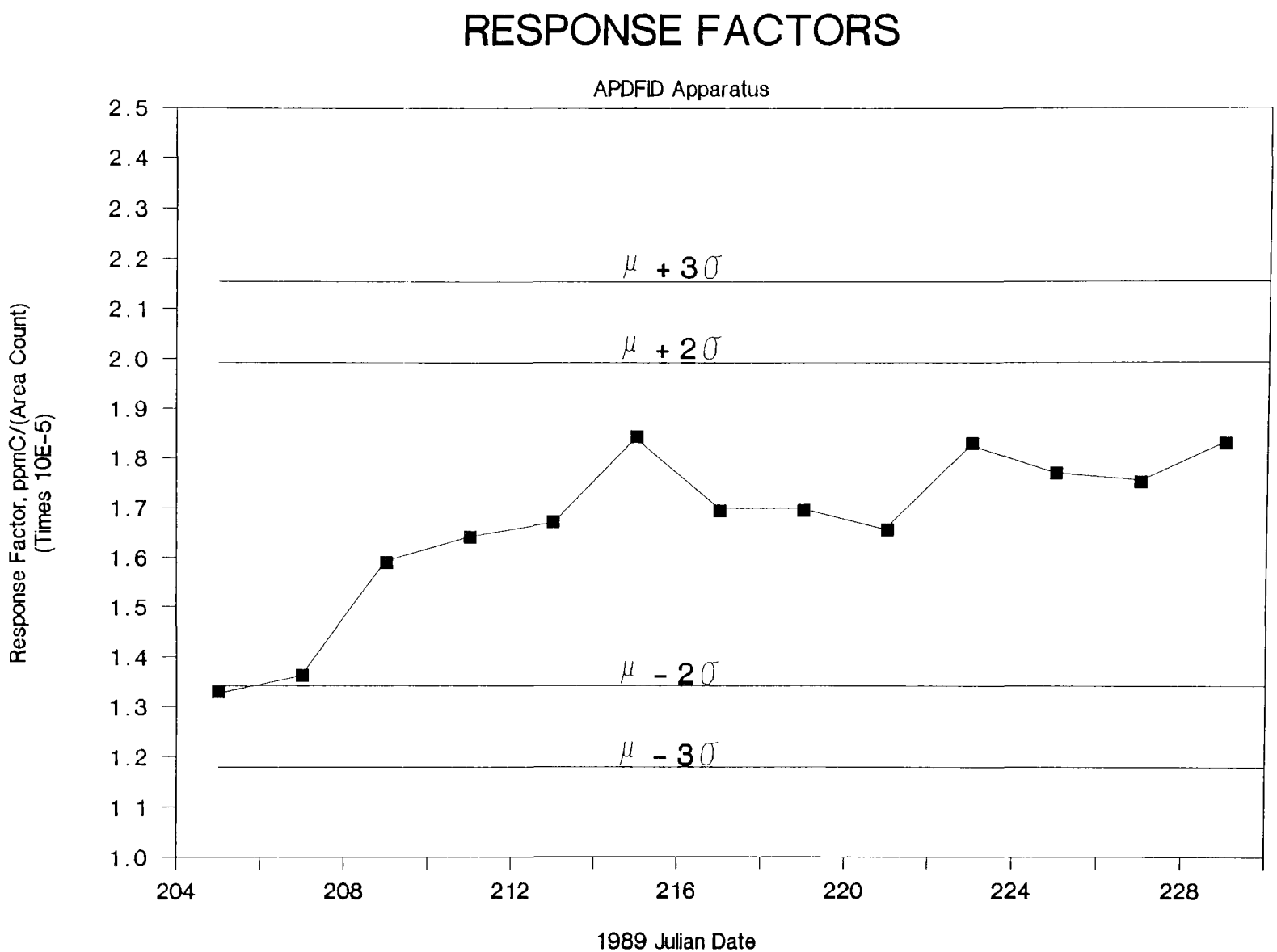

Figure 12. Response factors for APDFID apparatus.

1989 NMOC Monitoring Program. With this analytical instrumentation audit results are typically less than +5%. In 1988, for example, audit results for the four Radian channels were +2.22%, +1,33%, +2.86%, and +4.51%.[4] The results from the audits will be reported in the 1989 NMOC Monitoring Program final report, which is currently in preparation.

4.3.4 Daily Zero

Zero measurements were performed every other day using zero-grade air from a storage cylinder. The daily zero results are shown in Figure 13. Horizontal lines are also shown in Figure 13 at μ +/- 2σ and μ +/- 3σ for the daily zero measurements. Because the magnitude of the early "zero" measurements (Julian dates 205 - 218) were in the same order of magnitude as the NMOC measurements at the Raleigh site, the "daily" NMOC measurements were also plotted in Figure 13. The zeros appear to show some carryover from the NMOC measurements themselves. Unfortunately it was not always possible to plot the "Daily" NMOC measurement performed immediately prior to the zero measurement. The "daily" NMOC concentration shown in Figure 13 was either the overall daily average NMOC, the 6:00 a.m. to 9:00 a.m., or sometimes the 3:00 p.m. to 6:00 p.m. NMOC concentration measurement.

Nevertheless, there appears to be an approximate correlation between the daily NMOC concentration measurement and the zero concentration, perhaps with some lag involved. It is to be emphasized, however, that the concentrations of NMOC were generally so low that such a correlation is tentative at this time. The fact that there normally is such a short time between APDFID measurements, and that purging the cryogenic trap between sampling episodes was brief, could lead to the hypotheses that there may be some carryover of organic material from one sampling episode to the next. Before a more definite evaluation of this phenomenon is made, it will be necessary to carry out additional tests at higher overall NMOC concentration in the range of average concentration above 0.750 ppmC.

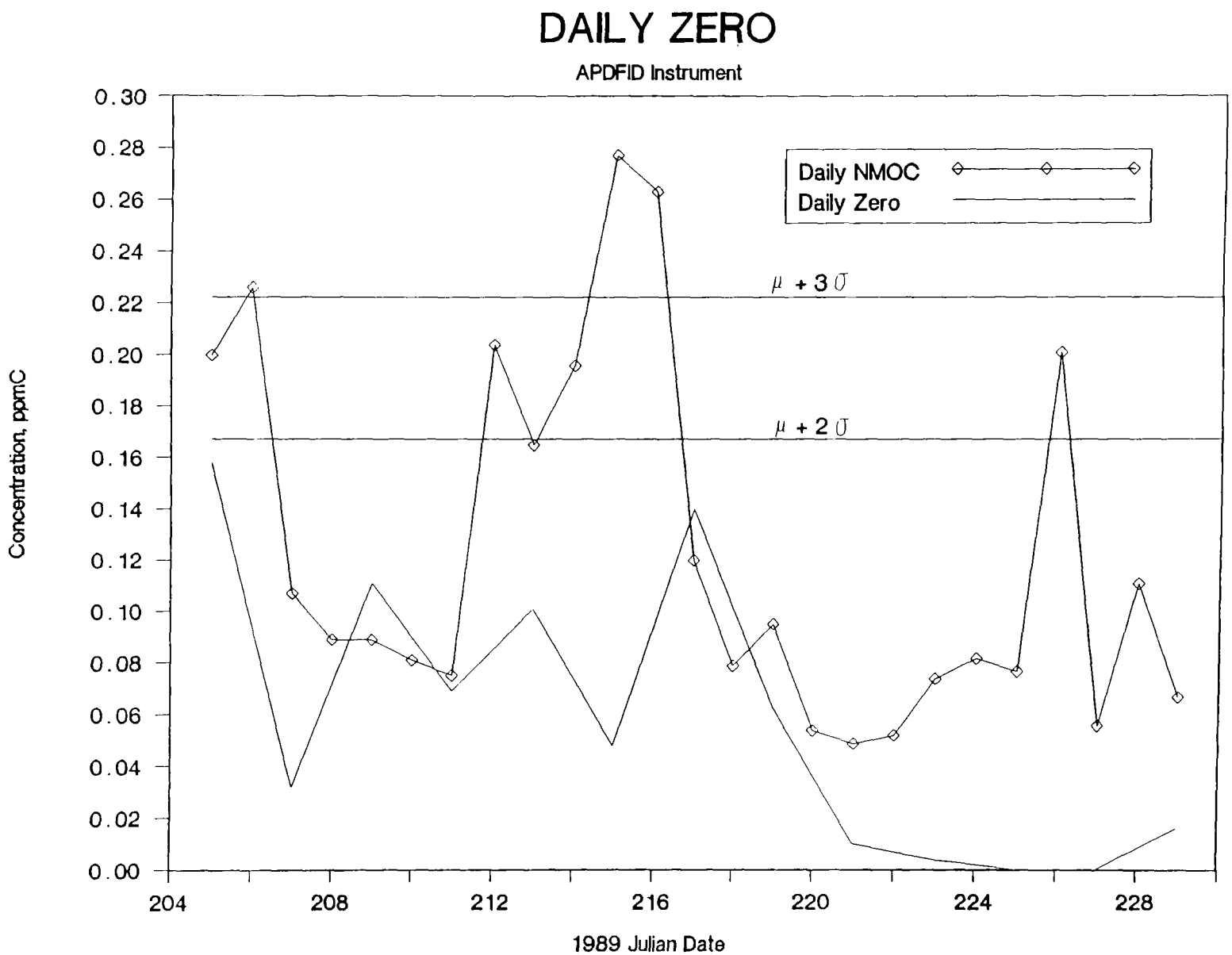

Figure 13. Daily zero for APDFID apparatus.

5.0 CONCLUSIONS

The following is a summary of conclusions drawn from this study.

1. Diurnal integrated samples compared well with APDFID samples. The difference averaged 0.011 ppmC. Percent differences ranged between -87.5 and +58.0 and averaged -10.23. The average absolute % difference was 31.0. No significant differences between the APDFID and the PDFID methods of measurement of NMOC concentration were detected.
2. Diurnal 6:00 a.m. to 9:00 a.m. integrated sample concentration averaged significantly lower than diurnal integrated sample concentrations collected from 6:00 p.m. through 6:00 a.m., at the 0.05 level of significance.
3. The average 6:00 a.m. to 9:00 a.m. NMOC concentration at the Raleigh, NC Monitoring Program site for the summer of 1989 was 0.159 ppmC, which was smaller than the site averages at any of the 38 morning monitoring sites during the summer of 1988.
4. Hourly averages of NMOC concentrations measured by the APDFID system were approximately lognormally distributed and ranged from 0.017 ppmC to 0.829 ppmC. The average concentration was 0.112 ppmC and the median was 0.078 ppmC. The lower hinge was 0.056 ppmC and the upper hinge was 0.114.
5. No trends of NMOC concentration, measured by the APDFID system were discernable as functions of temperature, solar radiation intensity, humidity, or wind velocity vector from the largest NMOC source in the vicinity of the sampling site.
6. The Raleigh NMOC Monitoring Program sample concentrations compared favorably with the diurnal 6:00 a.m. to 9:00 a.m. integrated whole ambient air samples. There was, on the average, only a -0.007 ppmC difference which resulted in a -1.52% difference. The average absolute % difference was 12.8.
7. The weighted average of the 3- and 12-hour integrated diurnal NMOC sample concentrations was significantly higher than the average of the 24-hour sample concentrations.

8. Hourly medians for 6th, 7th, 9th, 10th, 20th, 21st, 22nd, 13th, 14th, 15th, 16th, and 17th hours were significantly less than the overall average medians.
9. Hourly averages followed similar trends although the trends for hourly averages were less well defined because of the presence of a number of outliers among the hourly averages.
10. The low overall NMOC concentration during the study caused the interpretation of hourly NMOC trends to have large uncertainties.
11. No differences in average NMOC concentration measured by the APDFID system were discernable among the days of the week.
12. Zero air measurements performed every other day during the APDFID sampling period suggested that there may be carryover from one nine-minute APDFID measurement to the next. The magnitude and extent of the carryover was not possible to determine because of the low overall NMOC concentration encountered in the study.
13. The 1989 Raleigh Diurnal study with the APDFID apparatus suggested several changes in equipment and operating procedure that would improve the data capture from about 40% to a goal of 70%.
14. The average 6:00 a.m. to 9:00 a.m. NMOC concentration for the period from June 5 through June 30, 1989 was significantly higher than the average NMOC 6:00 a.m. to 9:00 a.m. concentration for September 1989.
15. The average 6:00 a.m. to 9:00 a.m. NMOC concentration decreased each month from 0.2063 ppmC in June 1989 to 0.1200 for September.
16. The 6:00 a.m. to 9:00 .m. concentrations at the Raleigh, NC monitoring site during the period of the diurnal sampling (July 23 to August 19, 1989) was not a significantly different from the average NMOC concentration for the entire summer of 1989.

6.0 REFERENCES

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APPENDIX A

CALCULATION OF TIME IN MINUTES FOR THE DIURNAL PROGRAM

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APPENDIX A. CALCULATION OF TIME IN MINUTES FOR THE DIURNAL PROGRAM

1989 Julian Date	Minutes at End of Indicated Hour																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
203	60	120	180	240	300	360	420	480	540	600	660	720	780	840	900	960	1020	1080	1140	1200	1260	1320	1380	1440
204	1500	1560	1620	1680	1740	1800	1860	1920	1980	2040	2100	2160	2220	2280	2340	2400	2460	2520	2580	2640	2700	2760	2820	2880
205	2940	3000	3060	3120	3180	3240	3300	3360	3420	3480	3540	3600	3660	3720	3780	3840	3900	3960	4020	4080	4140	4200	4260	4320
206	4380	4440	4500	4560	4620	4680	4740	4800	4860	4920	4980	5040	5100	5160	5220	5280	5340	5400	5460	5520	5580	5640	5700	5760
207	5820	5880	5940	6000	6060	6120	6180	6240	6300	6360	6420	6480	6540	6600	6660	6720	6780	6840	6900	6960	7020	7080	7140	7200
208	7260	7320	7380	7440	7500	7560	7620	7680	7740	7800	7860	7920	7980	8040	8100	8160	8220	8280	8340	8400	8460	8520	8580	8640
209	8700	8760	8820	8880	8940	9000	9060	9120	9180	9240	9300	9360	9420	9480	9540	9600	9660	9720	9780	9840	9900	9960	10020	10080
210	10140	10200	10260	10320	10380	10440	10500	10560	10620	10680	10740	10800	10860	10920	10980	11040	11100	11160	11220	11280	11340	11400	11460	11520
211	11580	11640	11700	11760	11820	11880	11940	12000	12060	12120	12180	12240	12300	12360	12420	12480	12540	12600	12660	12720	12780	12840	12900	12960
212	13020	13080	13140	13200	13260	13320	13380	13440	13500	13560	13620	13680	13740	13800	13860	13920	13980	14040	14100	14160	14220	14280	14340	14400
213	14460	14520	14580	14640	14700	14760	14820	14880	14940	15000	15060	15120	15180	15240	15300	15360	15420	15480	15540	15600	15660	15720	15780	15840
214	15900	15960	16020	16080	16140	16200	16260	16320	16380	16440	16500	16560	16620	16680	16740	16800	16860	16920	16980	17040	17100	17160	17220	17280
215	17340	17400	17460	17520	17580	17640	17700	17760	17820	17880	17940	18000	18060	18120	18180	18240	18300	18360	18420	18480	18540	18600	18660	18720
216	18780	18840	18900	18960	19020	19080	19140	19200	19260	19320	19380	19440	19500	19560	19620	19680	19740	19800	19860	19920	19980	20040	20100	20160
217	20220	20280	20340	20400	20460	20520	20580	20640	20700	20760	20820	20880	20940	21000	21060	21120	21180	21240	21300	21360	21420	21480	21540	21600
218	21660	21720	21780	21840	21900	21960	22020	22080	22140	22200	22260	22320	22380	22440	22500	22560	22620	22680	22740	22800	22860	22920	22980	23040
219	23100	23160	23220	23280	23340	23400	23460	23520	23580	23640	23700	23760	23820	23880	23940	24000	24060	24120	24180	24240	24300	24360	24420	24480
220	24540	24600	24660	24720	24780	24840	24900	24960	25020	25080	25140	25200	25260	25320	25380	25440	25500	25560	25620	25680	25740	25800	25860	25920
221	25980	26040	26100	26160	26220	26280	26340	26400	26460	26520	26580	26640	26700	26760	26820	26880	26940	27000	27060	27120	27180	27240	27300	27360
222	27420	27480	27540	27600	27660	27720	27780	27840	27900	27960	28020	28080	28140	28200	28260	28320	28380	28440	28500	28560	28620	28680	28740	28800
223	28860	28920	28980	29040	29100	29160	29220	29280	29340	29400	29460	29520	29580	29640	29700	29760	29820	29880	29940	30000	30060	30120	30180	30240
224	30300	30360	30420	30480	30540	30600	30660	30720	30780	30840	30900	30960	31020	31080	31140	31200	31260	31320	31380	31440	31500	31560	31620	31680
225	31740	31800	31860	31920	31980	32040	32100	32160	32220	32280	32340	32400	32460	32520	32580	32640	32700	32760	32820	32880	32940	33000	33060	33120
226	33180	33240	33300	33360	33420	33480	33540	33600	33660	33720	33780	33840	33900	33960	34020	34080	34140	34200	34260	34320	34380	34440	34500	34560
227	34620	34680	34740	34800	34860	34920	34980	35040	35100	35160	35220	35280	35340	35400	35460	35520	35580	35640	35700	35760	35820	35880	35940	36000
228	36060	36120	36180	36240	36300	36360	36420	36480	36540	36600	36660	36720	36780	36840	36900	36960	37020	37080	37140	37200	37260	37320	37380	37440
229	37500	37560	37620	37680	37740	37800	37860	37920	37980	38040	38100	38160	38220	38280	38340	38400	38460	38520	38580	38640	38700	38760	38820	38880
230	38940	39000	39060	39120	39180	39240	39300	39360	39420	39480	39540	39600	39660	39720	39780	39840	39900	39960	40020	40080	40140	40200	40260	40320
231	40380	40440	40500	40560	40620	40680	40740	40800	40860	40920	40980	41040	41100	41160	41220	41280	41340	41400	41460	41520	41580	41640	41700	41760

APPENDIX B

1989 APDFID DIURNAL MONITORING STUDY, RLNC SITE; HOURLY METEROLOGICAL AND NMOC CONCENTRATION DATA

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1989 APDFID DIURNAL MONITORING STUDY, RLNC SITE;
HOURLY METEROLOGICAL AND NMOC CONCENTRATION DATA

Julian Date	Hour	Diurnal Minutes	Wind Speed m/s	Wind Direction Degrees	t Deg. C	Solar Radiation	% Relative Humidity	Bar. Pressure in. Hg	Average ppmC
203	1	60	2.50	202.5	25.00	0.000	64.00	29.725	
203	2	120	2.63	222.5	24.00	0.000	62.00	29.725	
203	3	180	1.63	230.0	23.00	0.000	60.00	29.735	
203	4	240	1.50	207.5	22.50	0.000	60.00	29.745	
203	5	300	1.25	237.5	22.00	0.000	60.00	29.760	
203	6	360	0.75	292.5	21.50	0.000	60.00	29.770	
203	7	420	0.50	47.5	20.00	0.000	60.00	29.780	
203	8	480	1.25	35.0	20.75	0.250	60.00	29.795	
203	9	540	0.75	345.0	23.00	0.750	61.50	29.805	
203	10	600	1.25	0.0	25.25	2.250	66.50	29.815	
203	11	660	1.38	237.5	26.75	4.000	72.00	29.825	
203	12	720	2.00	255.0	27.75	4.250	72.50	29.835	
203	13	780	2.75	222.5	29.00	5.000	74.00	29.820	
203	14	840	2.38	212.5	29.75	3.750	75.50	29.815	
203	15	900	1.75	235.0	30.50	4.375	76.50	29.800	
203	16	960	1.38	150.0	30.00	1.250	74.50	20.810	
203	17	1020	1.75	150.0	29.00	1.250	71.50	29.805	
203	18	1080	2.00	150.0	28.00	0.300	69.50	29.810	
203	19	1140	2.25	150.0	26.50	0.250	67.00	29.815	
203	20	1200	1.88	150.0	24.25	0.000	64.50	29.805	
203	21	1260	1.13	137.5	23.75	0.000	63.00	29.810	
203	22	1320	1.25	120.0	23.00	0.000	62.00	29.840	
203	23	1380	1.38	120.0	23.00	0.000	62.00	29.865	
203	24	1440	0.13	107.5	23.00	0.000	62.00	29.850	
204	1	1500	0.25	205.0	23.00	0.000	62.00	29.840	
204	2	1560	0.13	30.0	21.75	0.000	61.00	29.840	
204	3	1620	0.50	356.3	21.25	0.000	60.00	29.830	
204	4	1680	0.25	28.8	21.00	0.000	58.50	29.830	
204	5	1740	1.25	68.8	21.00	0.000	58.00	29.840	
204	6	1800	1.88	152.5	20.25	0.000	58.00	29.850	
204	7	1860	0.50	120.0	20.25	0.000	58.00	29.870	
204	8	1920	0.38	185.0	21.50	0.375	60.00	29.870	
204	9	1980	0.63	153.8	23.50	1.125	62.00	29.875	
204	10	2040	1.88	163.8	25.50	2.500	66.00	29.875	
204	11	2100	2.25	207.5	27.25	3.688	70.00	29.870	
204	12	2160	1.88	205.0	28.00	4.250	72.00	29.865	
204	13	2220	1.50	220.0	28.25	4.250	70.50	29.855	
204	14	2280	1.25	265.0	29.50	5.625	73.00	29.835	
204	15	2340	2.00	242.5	30.75	4.625	74.00	29.815	
204	16	2400	1.38	37.5	31.00	3.000	76.50	29.795	
204	17	2460	1.88	88.0	30.50	3.500	78.50	29.780	
204	18	2520	2.00	125.0	30.75	2.250	80.00	29.775	
204	19	2580	2.38	190.0	31.75	1.500	79.50	29.775	
204	20	2640	1.75	205.0	30.50	0.750	77.00	29.770	
204	21	2700	1.75	222.5	29.25	0.000	76.00	29.780	
204	22	2760	1.50	255.0	27.75	0.000	73.50	29.795	

1989 APDFID DIURNAL MONITORING STUDY, RLNC SITE;
HOURLY METEROLOGICAL AND NMOC CONCENTRATION DATA

Julian Date	Hour	Diurnal Minutes	Wind Speed m/s	Wind Direction Degrees	t Deg. C	Solar Radiation	% Relative Humidity	Bar. Pressure in. Hg	Average ppmC
204	23	2820	0.75	310.0	26.50	0.000	69.50	29.790	
204	24	2880	0.75	350.0	25.25	0.000	65.00	29.790	
205	1	2940	0.63	135.0	27.50	0.000	62.50	29.800	
205	2	3000	0.50	152.5	27.50	0.000	61.25	29.850	
205	3	3060	0.25	135.0	27.00	0.000	61.00	29.800	
205	4	3120	0.38	330.0	27.50	0.000	61.00	29.800	
205	5	3180	1.00	250.0	27.50	0.000	61.00	29.800	
205	6	3240	0.88	257.5	27.00	0.000	61.00	29.805	
205	7	3300	0.75	297.5	25.50	0.000	61.00	29.810	
205	8	3360	0.63	12.5	24.00	0.125	61.00	29.815	
205	9	3420	0.75	320.0	24.00	1.125	64.50	29.825	
205	10	3480	1.75	342.5	26.50	2.125	69.00	29.815	
205	11	3540	1.50	0.0	29.00	3.250	73.50	29.810	
205	12	3600	1.75	277.5	31.00	4.000	77.00	29.815	
205	13	3660	1.25	190.0	32.00	5.125	78.00	29.815	0.057562
205	14	3720	3.50	357.5	34.00	5.500	79.00	29.805	0.054007
205	15	3780	2.63	147.5	35.50	5.500	80.00	29.775	0.070276
205	16	3840	3.25	277.5	34.50	4.625	81.50	29.775	0.059004
205	17	3900	3.00	337.5	32.00	4.250	80.50	29.745	0.067600
205	18	3960	1.88	360.0	32.00	3.125	80.00	29.735	0.062102
205	19	4020	1.25	360.0	29.00	2.625	79.50	29.725	0.075598
205	20	4080	0.50	90.0	28.00	0.625	72.50	29.730	0.083180
205	21	4140	0.38	140.0	28.00	0.000	67.00	29.755	0.077769
205	22	4200	0.25	70.0	28.00	0.000	64.00	29.705	0.118937
205	23	4260	0.50	227.5	28.00	0.000	63.50	29.775	0.069907
205	24	4320	0.38	147.5	28.00	0.000	62.00	29.785	0.086711
206	1	4380	0.25	120.0	28.00	0.000	62.00	29.800	0.075990
206	2	4440	0.38	90.0	27.00	0.000	62.00	29.805	0.053487
206	3	4500	0.75	90.0	26.00	0.000	62.00	29.800	0.056635
206	4	4560	0.75	80.0	26.00	0.000	62.00	29.800	0.045167
206	5	4620	0.38	100.0	26.00	0.000	62.00	29.805	0.046845
206	6	4680	0.63	95.0	25.50	0.000	61.00	29.815	
206	7	4740	0.50	140.0	25.50	0.000	60.50	29.820	
206	8	4800	0.88	150.0	25.00	0.250	62.00	29.830	
206	9	4860	1.88	150.0	25.00	0.875	63.50	29.830	
206	10	4920	1.00	45.0	26.00	1.625	67.00	29.830	
206	11	4980	2.00	140.0	27.00	2.625	70.00	29.825	
206	12	5040	1.25	35.0	28.00	3.125	72.50	29.820	
206	13	5100	2.38	22.5	28.50	3.750	76.00	29.815	
206	14	5160	1.38	45.0	30.00	4.750	76.00	29.805	
206	15	5220	2.00	45.0	31.00	5.000	77.00	29.785	
206	16	5280	1.75	150.0	32.00	4.500	78.00	29.775	
206	17	5340	2.13	137.5	31.00	4.125	77.00	29.760	
206	18	5400	1.88	125.0	30.00	3.000	75.50	29.760	
206	19	5460	1.38	360.0	30.00	1.875	74.00	29.750	
206	20	5520	1.63	50.0	27.00	0.750	72.00	29.750	

1989 APDFID DIURNAL MONITORING STUDY, RLNC SITE;
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Julian Date	Hour	Diurnal Minutes	Wind Speed m/s	Wind Direction Degrees	t Deg. C	Solar Radiation	% Relative Humidity	Bar. Pressure in. Hg	Average ppmC
206	21	5580	1.38	132.5	27.00	0.125	71.00	29.765	
206	22	5640	1.13	147.5	27.00	0.000	68.50	29.765	
206	23	5700	1.50	77.5	27.00	0.000	65.50	29.765	
206	24	5760	1.75	2.5	27.50	0.000	63.00	29.765	
207	1	5820	3.63	25.0	26.00	0.000	62.00	29.775	
207	2	5880	2.50	50.0	24.50	0.000	61.50	29.780	
207	3	5940	1.63	77.5	24.00	0.000	60.00	29.770	
207	4	6000	1.25	120.0	24.00	0.000	60.00	29.770	
207	5	6060	1.88	80.0	24.00	0.000	60.00	29.765	
207	6	6120	2.63	150.0	23.50	0.000	60.00	29.760	
207	7	6180	0.30	245.0	21.00	0.000	59.00	29.765	
207	8	6240	0.10	110.0	22.50	0.125	58.00	29.770	
207	9	6300	0.10	45.0	25.00	0.750	61.00	29.775	
207	10	6360	0.80	20.0	26.00	1.625	67.00	29.765	
207	11	6420	1.15	155.0	28.00	2.500	72.00	29.755	
207	12	6480	2.00	300.0	30.50	3.625	77.00	29.755	
207	13	6540	2.38	360.0	31.50	4.125	77.50	29.745	
207	14	6600	2.25	232.5	31.00	3.125	77.50	29.730	
207	15	6660	2.25	225.0	33.00	3.375	78.50	29.710	0.056668
207	16	6720	2.38	112.5	32.00	2.625	78.00	29.695	0.076619
207	17	6780	2.25	150.0	32.00	2.375	77.00	29.670	0.067852
207	18	6840	2.00	175.0	33.00	2.250	77.00	29.655	0.099407
207	19	6900	2.00	172.5	31.50	1.375	74.00	29.645	0.260356
207	20	6960	2.38	170.0	29.50	0.500	71.00	29.655	0.170896
207	21	7020	2.50	165.0	28.00	0.250	69.50	29.670	0.164061
207	22	7080	2.00	170.0	27.50	0.000	68.00	29.670	0.153958
207	23	7140	2.50	180.0	26.00	0.000	67.00	29.675	0.151380
207	24	7200	2.25	225.0	25.75	0.000	65.50	29.725	0.097590
208	1	7260	2.13	0.0	23.50	0.000	62.00	29.685	0.050601
208	2	7320	1.88	337.5	22.00	0.000	60.00	29.685	0.065502
208	3	7380	1.38	252.5	22.00	0.000	60.00	29.635	0.064022
208	4	7440	1.63	250.0	22.00	0.000	60.00	29.625	0.075926
208	5	7500	1.50	240.0	22.00	0.000	60.00	29.655	0.056254
208	6	7560	1.88	360.0	22.00	0.000	60.00	29.665	0.030304
208	7	7620	1.13	360.0	22.00	0.000	60.00	29.655	0.037810
208	8	7680	1.38	360.0	23.00	0.125	60.00	29.660	0.062805
208	9	7740	1.75	360.0	25.00	0.500	60.00	29.650	0.078215
208	10	7800	2.63	315.0	28.00	1.500	61.00	29.645	0.091741
208	11	7860	3.13	290.0	29.50	1.750	62.50	29.625	0.098607
208	12	7920	3.13	260.0	31.00	2.500	66.50	29.620	0.087067
208	13	7980	3.00	215.0	27.50	2.500	68.00	29.605	0.093347
208	14	8040	3.00	200.0	26.00	4.375	70.50	29.580	0.076161
208	15	8100	3.38	215.0	27.00	5.000	74.00	29.565	
208	16	8160	4.50	220.0	28.50	3.250	74.50	29.535	
208	17	8220	3.25	220.0	30.00	3.125	74.00	29.515	
208	18	8280	3.13	197.5	30.00	1.125	73.00	29.525	

1989 APDFID DIURNAL MONITORING STUDY, RLNC SITE;
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Julian Date	Hour	Diurnal Minutes	Wind Speed m/s	Wind Direction Degrees	t Deg. C	Solar Radiation	% Relative Humidity	Bar. Pressure in. Hg	Average ppmC
208	19	8340	2.13	270.0	30.00	0.500	70.00	29.520	
208	20	8400	2.38	270.0	27.50	0.500	70.00	29.515	
208	21	8460	2.00	270.0	26.00	0.000	68.00	29.520	
208	22	8520	1.50	260.0	26.00	0.000	67.00	29.525	
208	23	8580	3.38	250.0	24.50	0.000	64.00	29.500	
208	24	8640	1.13	250.0	24.00	0.000	63.00	29.460	
209	1	8700	0.75	260.0	24.00	0.000	62.00	29.480	
209	2	8760	1.00	257.5	23.50	0.000	62.00	29.490	
209	3	8820	1.50	270.0	23.00	0.000	62.00	29.480	
209	4	8880	1.50	255.0	23.00	0.000	62.00	29.465	
209	5	8940	1.63	265.0	23.00	0.000	62.00	29.465	
209	6	9000	1.75	270.0	22.00	0.000	61.25	29.455	
209	7	9060	2.00	270.0	22.00	0.000	61.00	29.465	
209	8	9120	2.63	320.0	23.25	0.250	62.75	29.470	
209	9	9180	2.63	320.0	25.25	1.125	67.00	29.470	
209	10	9240	3.00	360.0	26.25	2.375	69.00	29.465	
209	11	9300	3.63	360.0	28.50	3.625	73.75	29.470	
209	12	9360	3.63	360.0	28.75	2.875	74.00	29.460	
209	13	9420	1.00	360.0	30.75	4.500	74.50	29.455	
209	14	9480	1.00	345.0	32.00	5.125	74.00	29.460	0.077581
209	15	9540	1.38	345.0	32.00	4.875	74.00	29.440	0.092860
209	16	9600	1.63	280.0	32.00	4.500	74.00	29.435	0.059582
209	17	9660	1.63	280.0	32.00	3.500	74.00	29.425	0.088724
209	18	9720	1.00	280.0	32.00	2.625	74.00	29.405	0.099540
209	19	9780	0.88	280.0	32.00	1.625	74.00	29.395	0.117756
209	20	9840	0.25	280.0	31.50	0.625	72.00	29.395	0.128999
209	21	9900	0.00	280.0	30.50	0.125	70.00	29.425	0.178093
209	22	9960	0.75	280.0	28.75	0.000	70.00	29.460	0.158403
209	23	10020	0.38	360.0	24.25	0.000	63.50	29.470	0.043925
209	24	10080	0.13	265.0	24.25	0.000	62.00	29.485	0.070225 *
210	1	10140	0.25	315.0	26.00	0.000	62.00	29.485	0.095936
210	2	10200	1.25	337.5	26.00	0.000	61.25	29.485	0.083253
210	3	10260	1.25	0.0	26.00	0.000	61.00	29.485	0.040857
210	4	10320	0.63	0.0	25.00	0.000	60.75	29.495	0.039593
210	5	10380	0.63	0.0	24.00	0.000	60.00	29.495	0.043861
210	6	10440	0.88	0.0	23.00	0.000	60.00	29.505	0.029880
210	7	10500	0.50	0.0	22.00	0.000	59.25	29.535	0.033063
210	8	10560	0.50	0.0	22.00	0.250	59.50	29.560	0.031599
210	9	10620	1.50	0.0	26.00	1.000	60.50	29.575	
210	10	10680	2.00	0.0	28.00	2.000	63.25	29.595	
210	11	10740	2.38	0.0	28.00	2.125	64.00	29.600	
210	12	10800	2.00	0.0	28.00	1.750	64.00	29.605	
210	13	10860	1.63	50.0	29.50	2.125	64.50	29.605	
210	14	10920	3.25	50.0	30.00	2.500	66.00	29.600	
210	15	10980	3.38	50.0	28.50	2.625	69.25	29.580	
210	16	11040	2.63	50.0	26.00	3.250	71.00	29.570	

1989 APDFID DIURNAL MONITORING STUDY, RLNC SITE;
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Julian Date	Hour	Diurnal Minutes	Wind Speed m/s	Wind Direction Degrees	t Deg. C	Solar Radiation	% Relative Humidity	Bar. Pressure in. Hg	Average ppmC
210	17	11100	2.50	50.0	25.50	3.000	72.00	29.560	
210	18	11160	1.88	50.0	26.00	2.375	72.00	29.565	
210	19	11220	2.50	75.0	25.25	1.500	68.50	29.575	
210	20	11280	3.00	50.0	24.50	0.625	65.50	29.575	
210	21	11340	3.00	75.0	24.00	0.000	63.50	29.580	
210	22	11400	1.75	100.0	24.00	0.000	62.00	29.605	
210	23	11460	1.50	67.5	23.00	0.000	60.25	29.635	
210	24	11520	2.50	45.0	22.00	0.000	58.50	29.635	
211	1	11580	2.38	25.0	20.50	0.000	58.00	29.635	
211	2	11640	3.00	105.0	21.00	0.000	58.00	29.645	
211	3	11700	2.50	100.0	21.00	0.000	57.25	29.645	
211	4	11760	1.75	30.0	19.00	0.000	56.00	29.625	
211	5	11820	0.88	60.0	18.00	0.000	56.00	29.625	
211	6	11880	1.13	127.5	18.00	0.000	56.00	29.635	
211	7	11940	1.38	82.5	18.00	0.000	56.00	20.645	
211	8	12000	1.50	60.0	18.00	0.250	56.00	29.655	
211	9	12060	2.38	37.5	19.00	0.875	58.00	29.665	
211	10	12120	2.38	102.5	21.50	1.500	59.75	29.665	
211	11	12180	2.50	97.5	23.00	2.250	63.50	29.660	
211	12	12240	2.00	120.0	25.00	3.875	66.50	29.655	
211	13	12300	2.63	130.0	26.00	4.500	67.50	29.640	0.063386
211	14	12360	2.00	130.0	27.00	5.250	71.50	29.630	0.057273
211	15	12420	1.13	142.5	26.50	4.250	75.00	29.610	0.058403
211	16	12480	2.00	180.0	26.00	2.875	72.50	29.595	0.049973
211	17	12540	1.88	167.5	28.00	2.625	72.00	29.575	0.050787
211	18	12600	1.13	130.0	26.00	2.250	70.00	29.565	0.064703
211	19	12660	1.00	130.0	26.50	1.250	68.50	29.560	0.069786
211	20	12720	1.25	130.0	27.50	0.625	66.50	29.555	0.087065
211	21	12780	1.63	130.0	26.00	0.000	66.00	29.555	0.103116
211	22	12840	1.50	130.0	26.00	0.000	66.00	29.555	0.102530
211	23	12900	2.00	200.0	25.00	0.000	65.50	29.580	0.099479
211	24	12960	1.38	200.0	25.00	0.000	66.00	29.595	0.055975 *
212	1	13020	2.25	200.0	25.75	0.000	65.25	29.600	0.056901
212	2	13080	0.75	200.0	27.00	0.000	65.00	29.610	0.059464
212	3	13140	1.00	245.0	27.00	0.000	64.00	29.610	0.064461
212	4	13200	0.88	295.0	26.25	0.000	63.50	29.560	0.049620
212	5	13260	1.38	335.0	24.00	0.000	61.25	29.550	0.082981
212	6	13320	0.75	22.5	24.00	0.000	61.00	29.550	0.103095
212	7	13380	2.00	67.5	24.00	0.000	61.00	29.560	0.114790
212	8	13440	1.25	147.5	24.00	0.125	61.00	29.570	0.274410
212	9	13500	1.00	180.0	24.00	0.750	61.50	29.585	0.225643
212	10	13560	1.00	180.0	24.50	2.250	64.50	29.605	0.119554
212	11	13620	1.00	195.0	25.25	2.625	66.75	29.605	0.201435
212	12	13680	1.75	215.0	26.25	2.375	67.75	29.615	0.110287
212	13	13740	1.00	222.5	27.75	4.750	69.50	29.605	0.088580
212	14	13800	1.50	222.5	28.75	2.875	72.50	29.590	0.081951

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Julian Date	Hour	Diurnal Minutes	Wind Speed m/s	Wind Direction Degrees	t Deg. C	Solar Radiation	% Relative Humidity	Bar. Pressure in. Hg	Average ppmC
212	15	13860	1.13	290.0	29.00	2.750	74.00	29.565	0.048846
212	16	13920	1.50	325.0	29.75	4.125	75.25	29.545	0.055810
212	17	13980	1.75	337.5	30.75	2.875	76.50	29.530	0.070541
212	18	14040	1.25	332.5	30.00	2.125	78.00	29.520	0.085906
212	19	14100	0.38	225.0	30.00	0.875	78.50	29.515	0.073949
212	20	14160	1.13	270.0	29.75	0.125	78.00	29.525	0.112876
212	21	14220	2.50	352.5	28.50	0.125	76.00	29.535	0.156956
212	22	14280	1.50	25.0	27.50	0.000	70.75	29.555	0.113947
212	23	14340	1.88	50.0	26.25	0.000	66.50	29.595	0.028406
212	24	14400	2.13	90.0	22.75	0.000	62.25	29.585	0.030402 *
213	1	14460	0.750	22.5	23.00	0.000	60.00	29.580	
213	2	14520	0.625	107.5	24.00	0.000	60.00	29.585	
213	3	14580	1.000	67.5	24.00	0.000	60.00	29.580	
213	4	14640	0.750	225.0	24.00	0.000	60.00	29.570	
213	5	14700	0.750	257.5	24.00	0.000	60.00	29.575	
213	6	14760	0.625	360.0	24.00	0.000	60.00	29.590	
213	7	14820	2.250	360.0	24.00	0.000	60.00	29.610	
213	8	14880	1.250	360.0	24.00	0.000	60.00	29.625	
213	9	14940	0.500	360.0	24.00	0.125	60.00	29.640	
213	10	15000	0.500	67.5	24.00	0.375	60.50	29.655	
213	11	15060	0.500	45.0	24.00	0.375	61.00	29.655	
213	12	15120	0.500	135.0	24.00	0.750	61.00	29.655	
213	13	15180	0.650	135.0	24.50	2.500	61.75	29.650	
213	14	15240	1.000	135.0	26.25	2.625	66.75	29.640	
213	15	15300	0.875	135.0	27.00	4.125	70.00	29.620	
213	16	15360	0.750	135.0	29.00	3.000	68.00	29.600	
213	17	15420	1.000	360.0	28.00	2.000	71.50	29.585	
213	18	15480	1.500	360.0	28.00	0.875	72.00	29.585	0.107169
213	19	15540	1.500	360.0	26.75	0.500	70.50	29.580	0.132028
213	20	15600	0.500	7.5	26.00	0.250	68.00	29.585	0.124116
213	21	15660	1.000	360.0	26.00	0.000	66.50	29.605	0.268695
213	22	15720	2.125	257.5	25.25	0.000	66.00	29.605	0.209387
213	23	15780	1.250	300.0	24.25	0.000	65.00	29.600	0.154582
213	24	15840	0.625	360.0	24.00	0.000	63.50	29.595	0.161132
214	1	15900	0.500	130.0	25.75	0.000	62.25	29.605	0.166285 *
214	2	15960	1.750	182.5	24.25	0.000	62.00	29.580	
214	3	16020	1.875	170.0	24.00	0.000	61.25	29.570	
214	4	16080	1.500	170.0	24.00	0.000	60.00	29.560	
214	5	16140	1.000	182.5	24.00	0.000	60.00	29.575	
214	6	16200	1.000	220.0	24.00	0.000	60.00	29.580	
214	7	16260	1.000	250.0	24.00	0.000	60.00	29.570	
214	8	16320	1.250	250.0	24.00	0.125	60.00	29.590	
214	9	16380	2.000	260.0	24.25	0.625	60.75	29.590	
214	10	16440	2.000	260.0	25.00	1.125	64.25	29.600	
214	11	16500	1.500	260.0	25.00	1.000	67.00	29.600	
214	12	16560	1.500	260.0	25.75	2.375	69.50	29.590	

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Julian Date	Hour	Diurnal Minutes	Wind Speed m/s	Wind Direction Degrees	t Deg. C	Solar Radiation	% Relative Humidity	Bar. Pressure in. Hg	Average ppmC
214	13	16620	1.500	222.5	26.00	3.375	70.00	29.580	
214	14	16680	1.250	225.0	26.50	3.375	70.00	29.560	
214	15	16740	1.125	242.5	27.00	2.000	68.50	29.550	
214	16	16800	2.400	250.0	22.25	1.125	62.00	29.555	
214	17	16860	1.500	160.0	24.00	2.375	68.00	29.450	
214	18	16920	1.000	225.0	24.75	1.875	66.00	29.555	
214	19	16980	1.000	225.0	25.00	0.875	63.00	29.545	
214	20	17040	0.750	165.0	24.00	0.125	61.50	29.545	
214	21	17100	0.250	55.0	23.75	0.000	60.25	29.555	
214	22	17160	0.250	220.0	22.25	0.000	59.50	29.565	
214	23	17220	0.250	60.0	21.50	0.000	58.75	29.575	
214	24	17280	0.750	7.5	21.00	0.000	58.00	29.585	
215	1	17340	0.125	67.5	20.25	0.000	58.00	29.580	
215	2	17400	0.500	90.0	20.00	0.000	58.00	29.575	
215	3	17460	0.500	67.5	20.00	0.000	58.00	29.560	
215	4	17520	0.250	0.0	18.50	0.000	56.00	29.555	
215	5	17580	0.375	90.0	18.00	0.000	56.00	29.560	
215	6	17640	0.500	40.0	18.00	0.000	56.00	29.560	
215	7	17700	0.250	22.5	18.25	0.000	56.00	29.570	
215	8	17760	0.500	30.0	19.50	0.250	56.00	29.570	
215	9	17820	0.750	0.0	21.50	1.000	56.75	29.590	
215	10	17880	1.250	0.0	23.50	2.125	61.75	29.590	
215	11	17940	1.875	0.0	25.00	3.125	66.75	29.600	
215	12	18000	1.250	292.5	27.00	4.000	72.25	29.590	
215	13	18060	1.750	270.0	28.00	4.750	74.00	29.570	
215	14	18120	1.875	270.0	28.50	4.750	74.00	29.560	
215	15	18180	2.625	270.0	29.25	4.700	75.00	29.545	0.829420
215	16	18240	2.500	270.0	30.00	4.250	76.00	29.530	0.661431
215	17	18300	2.500	270.0	31.00	3.500	76.00	29.525	0.492265
215	18	18360	2.625	270.0	32.00	2.250	75.50	29.515	0.478257
215	19	18420	2.500	270.0	31.75	1.375	74.75	29.505	0.380394
215	20	18480	2.000	270.0	30.75	0.500	73.50	29.505	0.296616
215	21	18540	1.750	240.0	30.00	0.000	71.50	29.505	0.448003
215	22	18600	0.750	210.0	29.25	0.000	69.50	29.505	0.440781
215	23	18660	0.750	192.5	28.00	0.000	67.50	29.515	0.475506
215	24	18720	0.500	240.0	26.75	0.000	65.00	29.510	0.488352
216	1	18780	0.500	245.0	26.00	0.000	64.00	29.510	0.538978
216	2	18840	0.875	245.0	25.00	0.000	64.00	29.500	0.476346
216	3	18900	0.625	125.0	23.00	0.000	60.00	29.490	0.505580
216	4	18960	0.750	267.5	23.25	0.000	60.00	29.485	0.368947
216	5	19020	0.875	250.0	23.00	0.000	60.00	29.480	0.250659
216	6	19080	0.875	337.5	22.00	0.000	60.00	29.480	0.199582
216	7	19140	1.375	270.0	22.75	0.000	60.00	29.490	0.269215
216	8	19200	0.875	275.0	23.00	0.375	60.00	29.495	0.318790
216	9	19260	1.125	290.0	23.75	1.125	61.25	29.500	0.341569
216	10	19320	1.375	310.0	27.50	2.375	66.25	29.495	

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216	11	19380	1.750	335.0	31.00	3.500	70.50	29.490	
216	12	19440	2.250	355.0	33.00	4.250	75.25	29.490	
216	13	19500	2.875	330.0	34.00	5.000	78.00	29.480	
216	14	19560	2.250	320.0	34.75	4.875	78.50	29.475	
216	15	19620	2.500	320.0	35.00	4.875	80.00	29.450	
216	16	19680	2.500	320.0	34.75	4.250	80.50	29.440	
216	17	19740	2.625	295.0	34.00	3.375	82.00	29.435	
216	18	19800	3.500	270.0	33.00	2.375	80.00	29.415	
216	19	19860	3.750	270.0	32.00	1.250	79.00	29.405	
216	20	19920	2.750	280.0	31.50	0.250	76.50	29.405	
216	21	19980	2.125	290.0	30.75	0.000	73.50	29.405	
216	22	20040	1.750	270.0	30.00	0.000	72.00	29.415	
216	23	20100	1.375	270.0	29.25	0.000	70.50	29.415	
216	24	20160	1.500	270.0	28.75	0.000	68.50	29.405	
217	1	20220	1.750	270.0	28.00	0.000	68.00	29.400	
217	2	20280	3.000	270.0	27.25	0.000	68.00	29.395	
217	3	20340	2.750	270.0	26.50	0.000	67.00	29.385	
217	4	20400	2.500	270.0	26.00	0.000	64.50	29.380	
217	5	20460	2.375	270.0	26.00	0.000	64.00	29.385	
217	6	20520	3.000	270.0	25.25	0.000	64.00	29.385	
217	7	20580	3.000	270.0	25.00	0.000	64.00	29.395	
217	8	20640	2.000	270.0	25.00	0.000	64.00	29.400	
217	9	20700	2.000	270.0	25.75	0.000	64.00	29.415	
217	10	20760	2.125	287.5	26.00	0.000	64.75	29.405	
217	11	20820	1.375	340.0	28.25	0.000	70.00	29.415	
217	12	20880	1.938	337.7	30.63	2.188	74.13	29.405	
217	13	20940	2.500	335.3	33.00	4.375	78.25	29.385	
217	14	21000	2.625	90.0	33.25	3.875	78.50	29.385	
217	15	21060	2.250	345.0	33.00	2.875	77.25	29.365	
217	16	21120	2.500	270.0	33.00	3.375	79.25	29.345	
217	17	21180	3.625	325.0	30.00	3.250	75.00	29.355	
217	18	21240	1.625	282.5	26.50	1.125	68.25	29.345	
217	19	21300	1.875	245.0	28.00	0.750	70.00	29.320	
217	20	21360	1.125	143.8	28.25	0.375	70.00	29.320	
217	21	21420	0.875	118.8	26.75	0.125	68.25	29.330	
217	22	21480	0.500	312.0	26.00	0.000	65.75	29.355	
217	23	21540	0.500	353.3	25.50	0.000	65.25	29.355	
217	24	21600	1.125	279.0	26.75	0.000	65.75	29.355	
218	1	21660	1.250	272.3	26.75	0.000	67.00	29.345	
218	2	21720	1.875	292.5	27.00	0.000	67.00	29.355	
218	3	21780	2.250	294.8	27.00	0.000	68.00	29.300	
218	4	21840	2.000	276.8	26.25	0.000	66.75	29.270	
218	5	21900	1.375	245.3	26.25	0.000	66.00	29.260	
218	6	21960	2.000	316.0	26.00	0.000	65.75	29.275	
218	7	22020	2.250	306.5	25.00	0.000	64.50	29.295	
218	8	22080	2.000	328.5	25.25	0.375	65.00	29.305	

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218	9	22140	1.500	344.3	27.75	1.625	69.25	29.310	
218	10	22200	1.875	317.3	29.50	2.750	73.00	29.320	
218	11	22260	3.000	324.0	31.00	3.750	76.00	29.320	
218	12	22320	2.625	339.8	31.75	4.625	75.75	29.325	0.062104
218	13	22380	2.375	342.0	32.00	5.125	77.00	29.305	0.051890
218	14	22440	2.750	339.8	32.00	5.250	76.00	29.290	0.024221
218	15	22500	2.000	339.8	32.25	5.000	78.00	29.280	0.038264
218	16	22560	2.750	335.3	33.00	4.500	79.00	29.265	0.017445
218	17	22620	2.625	330.8	33.00	3.750	80.00	29.250	0.035570
218	18	22680	2.625	355.5	33.00	2.625	79.00	29.250	0.040444
218	19	22740	2.750	6.8	32.50	1.500	78.00	29.230	0.023514
218	20	22800	0.625	27.0	31.25	0.375	75.25	29.250	0.070687
218	21	22860	0.250	15.8	28.75	0.000	69.75	29.270	0.135696
218	22	22920	0.250	114.5	27.75	0.000	68.75	29.270	0.279258
218	23	22980	1.000	348.8	27.00	0.000	67.25	29.270	0.218372
218	24	23040	0.750	33.8	27.00	0.000	67.25	29.270	0.161774
219	1	23100	1.375	225.0	25.75	0.000	67.00	29.270	0.133111
219	2	23160	1.750	306.0	27.00	0.000	68.00	29.260	0.101040
219	3	23220	1.500	321.8	26.00	0.000	66.50	29.245	0.088059
219	4	23280	1.125	4.5	24.50	0.000	64.00	29.230	0.095621
219	5	23340	0.875	328.5	24.00	0.000	62.50	29.240	0.086385
219	6	23400	0.750	2.3	23.50	0.000	62.00	29.240	0.084986
219	7	23460	0.500	355.5	23.00	0.000	62.00	29.280	0.082600
219	8	23520	0.625	15.8	24.00	0.500	63.25	29.265	0.113020
219	9	23580	0.625	321.8	26.00	1.250	66.75	29.260	0.114289
219	10	23640	0.875	265.5	27.00	2.375	69.75	29.260	
219	11	23700	2.500	348.8	29.00	3.625	72.50	29.265	
219	12	23760	2.000	180.0	30.50	4.375	74.50	29.260	
219	13	23820	1.875	273.8	31.00	4.500	76.50	29.245	
219	14	23880	2.375	330.5	31.75	4.500	77.00	29.230	0.241149
219	15	23940	2.375	353.3	31.25	3.000	75.75	29.215	0.122748
219	16	24000	2.625	342.0	31.25	3.000	77.50	29.215	0.140472
219	17	24060	2.500	342.0	31.50	2.875	77.00	29.225	0.080280
219	18	24120	3.375	357.8	31.25	2.375	76.25	29.225	0.076112
219	19	24180	2.375	360.0	30.00	1.125	73.50	29.260	0.098444
219	20	24240	1.500	330.8	26.50	0.000	66.75	29.265	0.123469
219	21	24300	2.500	333.8	25.00	0.000	63.75	29.305	0.094335
219	22	24360	2.750	15.8	23.50	0.000	62.50	29.335	0.056040
219	23	24420	2.000	18.0	22.75	0.000	61.25	29.365	0.064952
219	24	24480	1.750	18.0	21.50	0.000	60.00	29.375	0.094719
220	1	24540	2.250	20.3	21.00	0.000	58.25	29.380	0.089059
220	2	24600	2.000	13.5	20.25	0.000	57.75	29.390	0.095650
220	3	24660	1.625	20.3	19.50	0.000	56.25	29.405	0.065432
220	4	24720	1.625	20.3	19.00	0.000	55.75	29.405	0.053167
220	5	24780	1.875	13.5	19.00	0.000	55.00	29.410	0.051665
220	6	24840	1.500	22.5	18.25	0.000	54.75	29.425	0.061107

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220	7	24900	1.375	27.0	17.75	0.000	53.75	29.455	0.043690
220	8	24960	1.125	24.8	17.25	0.250	53.75	29.480	0.057904
220	9	25020	2.000	18.0	18.25	0.875	54.75	29.505	0.090524
220	10	25080	1.250	18.0	19.75	2.000	59.00	29.515	0.057898
220	11	25140	2.250	13.5	21.75	3.125	62.25	29.525	0.059019
220	12	25200	2.125	18.0	23.00	4.000	65.25	29.535	0.038853
220	13	25260	1.500	22.5	22.50	2.500	64.00	29.520	0.044494
220	14	25320	1.500	27.0	22.00	1.625	62.00	29.520	0.070486
220	15	25380	0.750	135.0	22.00	1.500	62.00	29.200	0.044008
220	16	25440	1.125	112.5	22.00	1.625	63.25	29.520	0.060449
220	17	25500	1.500	130.5	22.50	2.125	64.75	29.525	0.067580
220	18	25560	0.875	60.8	23.00	1.250	64.00	29.530	0.079614
220	19	25620	0.500	58.5	22.75	1.000	62.75	29.525	0.113730
220	20	25680	0.750	94.3	21.50	0.125	60.25	29.590	0.178660
220	21	25740	0.625	85.5	20.75	0.000	58.00	29.565	0.110325
220	22	25800	0.750	65.3	20.00	0.000	57.50	29.570	
220	23	25860	0.500	101.3	19.75	0.000	57.00	29.590	
220	24	25920	0.125	69.8	19.50	0.000	57.00	29.605	
221	1	25980	0.375	45.0	19.50	0.000	56.50	29.605	
221	2	26040	0.750	20.3	19.00	0.000	56.00	29.605	
221	3	26100	0.250	36.0	19.00	0.000	55.50	29.605	
221	4	26160	0.250	123.8	18.75	0.000	55.00	29.615	
221	5	26220	0.500	9.0	18.00	0.000	54.75	29.630	
221	6	26280	0.500	36.0	18.00	0.000	54.00	29.645	
221	7	26340	0.750	27.0	18.00	0.000	54.00	29.670	
221	8	26400	1.250	22.5	17.75	0.250	54.00	29.685	
221	9	26460	1.500	22.5	18.50	1.000	55.25	29.700	
221	10	26520	1.125	103.5	20.00	2.000	59.00	29.710	
221	11	26580	1.250	292.5	21.75	2.875	61.25	29.720	
221	12	26640	2.625	148.5	22.25	4.125	64.50	29.715	
221	13	26700	2.250	83.3	23.75	3.625	65.25	29.710	
221	14	26760	2.750	117.0	24.00	3.500	66.00	29.700	
221	15	26820	2.625	121.5	24.00	2.875	65.75	29.695	
221	16	26880	2.000	121.5	23.75	2.375	65.25	29.630	
221	17	26940	1.625	63.0	23.75	2.625	66.75	29.685	
221	18	27000	0.875	162.0	22.50	0.625	62.00	29.685	
221	19	27060	0.500	33.8	22.00	0.250	60.25	29.690	
221	20	27120	1.625	126.0	21.25	0.375	59.50	29.690	
221	21	27180	2.000	123.8	19.50	0.000	57.25	29.700	
221	22	27240	0.875	58.5	19.00	0.000	56.00	29.720	
221	23	27300	0.500	67.8	19.00	0.000	56.00	29.730	
221	24	27360	0.625	51.8	18.25	0.000	55.25	29.730	
222	1	27420	1.250	15.8	18.00	0.000	54.00	29.725	
222	2	27480	0.750	51.8	18.00	0.000	54.00	29.725	
222	3	27540	1.500	31.5	17.50	0.000	54.00	29.720	
222	4	27600	0.625	40.5	17.00	0.000	53.75	29.720	

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222	5	27660	1.000	20.3	17.00	0.000	53.00	29.725	
222	6	27720	1.875	13.5	16.75	0.000	52.00	29.725	
222	7	27780	2.500	18.0	16.00	0.000	51.75	29.730	
222	8	27840	3.250	18.0	16.00	0.000	51.00	29.730	
222	9	27900	4.000	18.0	16.00	0.250	50.50	29.745	
222	10	27960	2.500	22.5	16.50	0.375	51.25	29.750	
222	11	28020	2.625	24.8	17.00	0.375	51.00	29.760	
222	12	28080	2.625	18.0	17.00	0.750	51.00	29.760	0.038033
222	13	28140	3.625	11.3	17.00	0.875	53.25	29.745	0.081398
222	14	28200	3.500	20.3	17.25	0.750	55.50	29.740	0.066588
222	15	28260	2.875	15.8	18.00	0.750	56.00	29.730	0.078254
222	16	28320	2.500	15.8	18.00	0.625	56.50	29.720	0.126759
222	17	28380	2.750	18.0	17.25	0.375	56.00	29.715	0.160172
222	18	28440	3.375	13.5	17.00	0.250	55.50	29.705	0.054354
222	19	28500	3.000	18.0	17.00	0.250	54.50	29.710	0.032380
222	20	28560	2.750	13.5	17.00	0.000	54.00	29.715	0.043275
222	21	28620	2.750	13.5	17.00	0.000	54.00	29.700	0.031025
222	22	28680	3.125	15.8	17.00	0.000	54.00	29.710	0.043080
222	23	28740	2.750	11.3	16.00	0.000	54.00	29.710	0.055277
222	24	28800	3.375	11.3	16.00	0.000	54.00	29.700	0.078572
223	1	28860	2.375	9.0	16.00	0.000	52.00	29.695	0.047930
223	2	28920	2.750	9.0	16.00	0.000	51.50	29.670	0.037823
223	3	28980	2.375	4.5	16.00	0.000	52.00	29.660	0.069183
223	4	29040	2.625	2.3	16.00	0.000	52.00	29.655	
223	5	29100	2.625	11.3	16.00	0.000	52.00	29.645	0.073195 *
223	6	29160	2.375	11.3	16.75	0.000	52.00	29.645	
223	7	29220	1.500	15.8	17.00	0.000	52.00	29.655	
223	8	29280	1.625	9.0	17.00	0.125	52.00	29.665	
223	9	29340	1.875	13.5	17.00	0.125	53.00	29.665	
223	10	29400	2.250	2.3	18.00	0.375	54.00	29.670	
223	11	29460	2.125	6.8	18.00	0.625	54.25	29.675	
223	12	29520	2.000	18.0	18.25	0.500	55.00	29.675	
223	13	29580	1.875	11.3	19.00	0.750	56.00	29.675	
223	14	29640	2.375	2.3	19.00	0.750	56.00	29.665	
223	15	29700	1.875	0.0	19.00	0.875	56.00	29.650	
223	16	29760	2.000	4.5	19.50	0.875	56.75	29.635	
223	17	29820	2.000	13.5	20.00	0.750	58.00	29.640	0.057431 *
223	18	29880	1.875	6.8	19.00	0.500	57.25	29.640	0.051915
223	19	29940	1.750	11.3	19.00	0.125	56.00	29.640	0.054847
223	20	30000	2.000	13.5	19.00	0.125	56.00	29.645	0.069100
223	21	30060	1.625	9.0	19.00	0.000	56.00	29.650	0.067650
223	22	30120	1.750	6.8	19.00	0.000	56.00	29.655	0.045249
223	23	30180	1.750	6.8	19.00	0.000	56.00	29.660	0.035892
223	24	30240	1.625	13.5	19.00	0.000	56.00	29.660	0.041771
224	1	30300	1.375	6.8	18.00	0.000	56.00	29.660	0.045607
224	2	30360	1.250	15.8	18.25	0.000	56.00	29.645	

1989 APDFID DIURNAL MONITORING STUDY, RLNC SITE;
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Julian Date	Hour	Diurnal Minutes	Wind Speed m/s	Wind Direction Degrees	t Deg. C	Solar Radiation	% Relative Humidity	Bar. Pressure in. Hg	Average ppmC
224	3	30420	1.375	18.0	19.00	0.000	56.00	29.635	
224	4	30480	1.250	20.3	19.00	0.000	56.00	29.625	
224	5	30540	1.625	11.3	19.00	0.000	56.00	29.625	
224	6	30600	1.750	6.8	19.00	0.000	56.00	29.630	
224	7	30660	1.625	15.8	19.00	0.000	56.00	29.645	
224	8	30720	2.125	9.0	19.00	0.000	56.00	29.655	
224	9	30780	2.625	9.0	19.75	0.500	56.00	29.650	
224	10	30840	2.375	9.0	20.00	0.625	56.00	29.655	
224	11	30900	2.125	2.3	20.00	0.500	56.25	29.670	
224	12	30960	2.625	2.3	20.50	1.000	58.00	29.665	
224	13	31020	2.125	13.5	21.50	1.500	60.25	29.650	
224	14	31080	2.000	9.0	22.50	1.625	62.25	29.640	
224	15	31140	2.125	6.8	23.25	2.375	64.25	29.635	
224	16	31200	1.500	18.0	23.50	1.500	64.00	29.630	
224	17	31260	1.500	11.3	23.00	0.625	62.50	29.625	
224	18	31320	1.750	11.3	23.00	0.500	62.00	29.625	
224	19	31380	1.750	13.5	22.50	0.375	61.50	29.615	
224	20	31440	1.375	15.8	21.75	0.125	60.00	29.615	
224	21	31500	0.750	32.0	20.75	0.000	59.25	29.625	
224	22	31560	0.250	40.5	20.00	0.000	58.00	29.625	
224	23	31620	0.500	101.3	20.00	0.000	56.75	29.635	
224	24	31680	0.250	36.0	19.25	0.000	56.00	29.635	
225	1	31740	0.250	42.8	19.00	0.000	56.00	29.635	
225	2	31800	0.375	60.8	19.00	0.000	56.00	29.615	
225	3	31860	0.000	83.3	19.00	0.000	56.00	29.625	
225	4	31920	0.375	45.0	19.50	0.000	56.50	29.625	
225	5	31980	1.000	11.3	19.50	0.000	56.25	29.630	
225	6	32040	0.625	11.3	20.00	0.000	57.00	29.625	
225	7	32100	0.625	105.8	20.00	0.000	57.00	29.625	
225	8	32160	1.250	33.8	20.00	0.250	57.75	29.645	
225	9	32220	0.750	24.8	20.25	0.625	58.00	29.655	
225	10	32280	1.000	72.0	21.25	0.875	59.00	29.660	
225	11	32340	1.000	162.0	22.75	1.750	61.50	29.670	
225	12	32400	1.250	177.8	25.25	3.500	68.75	29.665	
225	13	32460	1.250	20.3	27.00	4.125	70.50	29.650	
225	14	32520	2.250	94.5	27.25	5.125	72.75	29.640	
225	15	32580	1.625	63.0	28.25	4.500	74.50	29.630	0.087817 *
225	16	32640	1.250	56.3	27.75	3.875	74.50	29.615	0.101846
225	17	32700	1.750	69.8	29.00	3.250	75.25	29.605	0.062548
225	18	32760	1.500	110.3	28.25	2.500	74.50	29.610	0.075783
225	19	32820	1.125	119.3	27.50	1.125	71.25	29.605	0.069509
225	20	32880	0.500	63.0	25.25	0.125	65.50	29.610	0.064789
225	21	32940	1.000	130.5	25.00	0.000	64.00	29.625	0.079699
225	22	33000	1.750	148.5	24.00	0.000	63.25	29.635	0.070880
225	23	33060	0.500	153.0	23.50	0.000	62.00	29.635	0.076975
225	24	33120	0.500	96.8	22.25	0.000	60.75	29.630	0.098210

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Julian Date	Hour	Diurnal Minutes	Wind Speed m/s	Wind Direction Degrees	t Deg. C	Solar Radiation	% Relative Humidity	Bar. Pressure in. Hg	Average ppmC
226	1	33180	0.500	40.5	21.25	0.000	60.00	29.630	0.064221
226	2	33240	0.375	96.8	21.25	0.000	60.00	29.630	0.044420
226	3	33300	0.500	20.3	21.00	0.000	59.25	29.620	0.058722
226	4	33360	0.500	38.3	21.00	0.000	59.00	29.620	0.093819
226	5	33420	0.500	49.5	21.00	0.000	59.00	29.620	0.102373 *
226	6	33480	0.500	24.8	21.00	0.000	59.00	29.620	
226	7	33540	0.250	42.5	21.00	0.000	59.00	29.640	
226	8	33600	0.625	15.8	21.00	0.125	59.25	29.650	
226	9	33660	0.750	47.3	22.00	0.500	60.25	29.640	
226	10	33720	1.125	67.5	22.50	0.625	61.50	29.640	
226	11	33780	2.100	144.0	21.75	0.250	60.50	29.650	
226	12	33840	1.000	42.3	21.00	0.000	59.50	29.665	
226	13	33900	1.375	18.0	22.00	0.750	60.50	29.650	
226	14	33960	1.750	20.3	22.75	1.250	61.75	29.625	
226	15	34020	0.500	105.8	23.00	1.375	62.25	29.620	
226	16	34080	1.125	13.5	23.75	1.375	63.75	29.620	
226	17	34140	1.125	27.0	24.00	1.250	64.75	29.610	
226	18	34200	1.000	13.5	24.00	1.125	64.25	29.610	
226	19	34260	1.000	9.0	23.50	0.375	63.75	29.605	
226	20	34320	1.375	85.5	22.75	0.000	62.25	29.595	
226	21	34380	1.250	128.3	22.00	0.000	60.50	29.595	
226	22	34440	0.375	65.3	22.00	0.000	60.00	29.610	
226	23	34500	0.000	102.8	21.25	0.000	60.00	29.590	
226	24	34560	0.375	54.0	21.00	0.000	59.50	29.580	
227	1	34620	0.625	76.5	21.00	0.000	59.00	29.575	
227	2	34680	1.125	42.8	21.00	0.000	59.00	29.560	
227	3	34740	0.625	31.5	21.00	0.000	59.00	29.550	
227	4	34800	0.250	27.0	21.00	0.000	59.00	29.540	
227	5	34860	0.625	18.0	21.00	0.000	59.00	29.540	
227	6	34920	0.875	11.3	21.00	0.000	58.50	29.545	
227	7	34980	0.875	6.5	21.00	0.000	58.50	29.550	
227	8	35040	1.000	22.5	21.00	0.250	59.25	29.560	
227	9	35100	0.750	13.5	21.25	0.375	60.00	29.560	
227	10	35160	0.750	22.5	22.00	0.750	60.00	29.570	
227	11	35220	1.250	18.0	22.25	0.875	61.25	29.575	
227	12	35280	1.250	6.8	23.25	1.000	62.00	29.575	
227	13	35340	0.625	47.3	24.50	1.500	64.00	29.555	
227	14	35400	0.625	108.0	25.25	2.250	68.00	29.540	
227	15	35460	1.000	31.5	26.75	2.625	70.00	29.520	
227	16	35520	0.750	76.5	27.00	2.250	70.75	29.510	
227	17	35580	1.000	36.0	27.00	1.750	71.75	29.490	0.053576 *
227	18	35640	1.250	78.8	27.50	1.875	72.75	29.485	
227	19	35700	0.875	24.8	27.50	1.250	72.00	29.465	
227	20	35760	0.000	24.8	25.25	0.250	67.50	29.465	
227	21	35820	0.000	92.3	23.50	0.000	63.00	29.475	
227	22	35880	0.375	81.0	23.00	0.000	62.00	29.500	

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Julian Date	Hour	Diurnal Minutes	Wind Speed m/s	Wind Direction Degrees	t Deg. C	Solar Radiation	% Relative Humidity	Bar. Pressure in. Hg	Average ppmC
227	23	35940	0.125	74.3	22.50	0.000	61.75	29.500	
227	24	36000	0.125	87.8	22.00	0.000	60.75	29.500	
228	1	36060	0.625	27.0	21.25	0.000	60.00	29.500	
228	2	36120	0.375	105.8	21.00	0.000	60.00	29.485	
228	3	36180	0.000	60.8	21.00	0.000	58.50	29.475	
228	4	36240	0.000	63.0	21.00	0.000	58.00	29.470	
228	5	36300	0.000	56.3	20.00	0.000	58.00	29.470	
228	6	36360	0.000	78.8	20.00	0.000	57.50	29.470	
228	7	36420	0.375	78.8	20.00	0.000	57.25	29.485	
228	8	36480	0.500	36.0	21.50	0.250	60.00	29.490	
228	9	36540	1.250	9.0	24.25	1.500	63.50	29.495	
228	10	36600	1.125	78.8	26.50	2.500	68.25	29.525	
228	11	36660	1.750	339.8	27.50	1.375	71.25	29.510	0.110367 *
228	12	36720	1.500	274.5	28.75	4.125	75.75	29.495	0.128596
228	13	36780	1.000	277.8	29.50	4.375	74.25	29.485	0.095726
228	14	36840	1.375	87.8	29.50	2.750	75.00	29.470	0.062138
228	15	36900	2.125	128.3	30.00	3.125	75.75	29.450	0.048826
228	16	36960	1.000	171.0	28.75	2.250	71.25	29.440	0.064556
228	17	37020	2.125	220.5	29.00	1.875	73.75	29.425	0.084478
228	18	37080	2.500	234.0	28.00	2.000	71.25	29.435	0.089300
228	19	37140	1.000	344.3	25.25	0.250	65.50	29.445	0.142864
228	20	37200	1.375	56.3	24.50	0.125	64.75	29.455	0.080163
228	21	37260	1.500	9.0	23.75	0.000	63.00	29.490	0.170107
228	22	37320	1.375	92.3	23.25	0.000	62.00	29.500	0.083051
228	23	37380	1.750	189.0	23.00	0.000	62.00	29.505	0.053432
228	24	37440	1.625	220.5	23.00	0.000	62.00	29.515	0.096713
229	1	37500	1.250	98.8	22.50	0.000	61.75	29.515	0.147274
229	2	37560	1.625	4.5	22.00	0.000	61.00	29.515	0.111211
229	3	37620	0.375	65.3	22.00	0.000	60.25	29.495	0.137027
229	4	37680	0.750	42.8	22.00	0.000	60.00	29.550	0.123650
229	5	37740	0.625	193.5	22.00	0.000	60.00	29.515	0.127107
229	6	37800	0.625	189.0	22.00	0.000	60.00	29.515	0.149513
229	7	37860	0.625	78.8	22.00	0.000	60.00	29.515	0.101127
229	8	37920	1.000	144.0	22.00	0.125	60.00	29.535	0.074060
229	9	37980	0.625	72.0	22.25	0.625	61.50	29.560	0.088094
229	10	38040	0.750	85.5	24.25	1.500	65.00	29.565	0.078760
229	11	38100	1.125	63.0	26.50	3.250	71.50	29.580	
229	12	38160	1.625	146.3	27.25	4.250	73.25	29.585	
229	13	38220	0.750	128.3	29.00	4.750	75.00	29.570	
229	14	38280	1.500	139.5	29.50	4.750	75.00	29.560	
229	15	38340	2.000	108.0	29.75	2.250	74.50	29.540	
229	16	38400	2.375	132.8	30.00	3.625	75.50	29.530	
229	17	38460	1.000	117.0	29.00	1.750	72.25	29.530	
229	18	38520	0.750	13.5	27.75	0.750	69.25	29.535	0.048174
229	19	38580	1.125	15.8	25.25	0.250	66.00	29.330	0.055471
229	20	38640	2.250	27.0	24.00	0.000	64.00	29.550	0.041506

1989 APDFID DIURNAL MONITORING STUDY, RLNC SITE;
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Julian Date	Hour	Diurnal Minutes	Wind Speed m/s	Wind Direction Degrees	t Deg. C	Solar Radiation	% Relative Humidity	Bar. Pressure in. Hg	Average ppmC
229	21	38700	1.375	168.8	24.00	0.000	63.00	29.565	0.023981 *
229	22	38760	2.500	297.0	22.75	0.000	62.00	29.615	0.022754 *
229	23	38820	3.875	326.3	21.00	0.000	60.00	29.620	0.040294
229	24	38880	1.875	18.0	20.25	0.000	58.25	29.640	
230	1	38940	1.250	31.5	20.00	0.000	58.00	29.640	
230	2	39000	1.125	87.8	20.00	0.000	57.00	29.605	
230	3	39060	0.625	27.0	20.00	0.000	56.00	29.605	
230	4	39120	0.750	326.3	19.75	0.000	56.00	29.605	
230	5	39180	0.750	6.8	19.00	0.000	56.00	29.605	
230	6	39240	1.375	9.0	19.00	0.000	56.00	29.635	
230	7	39300	1.125	24.8	19.00	0.000	56.00	29.655	
230	8	39360	1.750	18.0	20.00	0.125	57.00	29.660	
230	9	39420	2.000	13.5	21.00	0.750	58.75	29.665	
230	10	39480	1.625	357.8	22.50	1.500	60.50	29.660	
230	11	39540	1.250	225.3	24.00	1.750	64.25	29.675	
230	12	39600	1.250	123.8	25.50	1.875	69.50	29.675	
230	13	39660	1.250	346.5	26.75	3.900	71.00	29.665	
230	14	39720	1.125	117.0	28.00	3.375	70.75	29.655	
230	15	39780	1.625	351.0	28.25	2.875	73.75	29.650	
230	16	39840	0.875	38.3	27.00	2.000	69.50	29.645	
230	17	39900	0.875	13.5	28.00	1.375	71.75	29.635	
230	18	39960	1.250	20.3	26.50	1.500	69.00	29.635	
230	19	40020	1.000	22.5	24.75	0.250	65.25	29.625	
230	20	40080	0.625	341.8	23.50	0.000	63.00	29.625	
230	21	40140	0.500	74.5	22.75	0.000	61.75	29.635	
230	22	40200	0.500	38.3	22.00	0.000	60.25	29.660	
230	23	40260	0.750	36.0	22.00	0.000	60.00	29.650	
230	24	40320	0.875	123.8	21.00	0.000	60.00	29.680	
231	1	40380	0.500	141.8	21.00	0.000	59.25	29.670	
231	2	40440	0.750	38.3	21.00	0.000	58.75	29.660	
231	3	40500	0.875	24.8	21.00	0.000	58.00	29.670	
231	4	40560	0.500	65.3	20.00	0.000	58.00	29.680	
231	5	40620	0.875	87.8	20.00	0.000	58.00	29.650	
231	6	40680	0.625	135.0	20.00	0.000	58.00	29.640	
231	7	40740	0.500	87.8	20.00	0.000	58.00	29.660	
231	8	40800	0.750	45.0	20.00	0.000	58.00	29.685	
Count			680	680	680	680	680	680	249
Minimum			0.000		16.000		50.500	20.645	0.017
Maximum			4.500		35.500		82.000	29.875	0.829
Average			1.477		24.527		64.453	29.563	0.113

APPENDIX C

APDFID DIURNAL CONCENTRATION AND METEROLOGICAL DATA AVERAGED BY DIURNAL SAMPLING PERIODS

jlh.006/cah

APDFID NMOC CONCENTRATION AND METEROLOGICAL DATA
AVERAGED BY DIURNAL SAMPLING PERIODS

Jdate	Diurnal minutes	Temp. kelvins	Solar Rad. J/m^2	Humidity mole fraction	Velocity Vector m/s	Si	Wj	Pk	NMOC ppmC	Code
204	2820	301.38	2091.5	0.0266	0.2606	2	1	5	0.562	OK
204	2460	300.44	8700.0	0.0254	0.1735	2	1	6	0.478	OK
205	3270	298.65	232.4	0.0198	0.4614	2	2	1	0.208	OK
205	3270	298.65	232.4	0.0198	0.4614	2	2	1	0.153	OK
205	3630	305.48	27189.2	0.0376	0.7016	1	2	3	0.056	*
205	3810	307.15	26724.4	0.0427	0.9866	1	2	4	0.066	OK
205	4260	300.98	2962.9	0.0250	-0.2715	1	2	5	0.071	OK
205	3900	301.86	9760.2	0.0280	0.1750	1	2	6	0.068	**
206	4710	298.48	464.8	0.0196	-0.4605	2	3	1	0.117	OK
206	4710	298.48	464.8	0.0196	-0.4605	2	3	1	0.258	OK
206	4890	299.15	9527.8	0.0223	-0.9767	2	3	2	0.060	OK
206	5070	301.98	21611.9	0.0295	-0.8660	2	3	3	0.077	OK
206	5250	304.48	25330.1	0.0352	-1.2416	2	3	4	0.080	OK
206	5700	299.65	2672.4	0.0231	-1.1585	2	3	5	0.528	OK
206	5340	300.34	8453.1	0.0249	-1.0224	2	3	6	0.226	OK
207	6150	295.48	232.4	0.0158	-0.3782	2	4	1	0.386	OK
207	6690	305.48	15569.9	0.0376	-0.5761	1	4	4	0.067	OK
207	7140	299.21	2033.4	0.0232	0.3836	1	4	5	0.117	OK
207	6780	300.18	6652.1	0.0254	0.1845	1	4	6	0.107	**
208	7590	295.48	232.4	0.0161	0.0000	2	5	1	0.099	OK
208	7590	295.48	232.4	0.0161	0.0000	1	5	1	0.044	OK
208	7590	295.48	232.4	0.0161	0.0000	2	5	1	0.089	OK
208	7770	300.65	6971.6	0.0226	1.5976	2	5	2	0.156	OK
208	7770	300.65	6971.6	0.0226	1.5976	1	5	2	0.090	OK
208	7950	301.32	17429.0	0.0261	1.9414	1	5	3	0.086	OK
208	7950	301.32	17429.0	0.0261	1.9414	2	5	3	0.119	OK
208	8130	301.65	21147.2	0.0290	2.3058	2	5	4	0.104	OK
208	8580	298.53	987.6	0.0216	1.6190	2	5	5	0.241	OK
208	8220	299.15	6216.3	0.0225	1.5401	1	5	6	0.073	**
208	8220	299.15	6216.3	0.0225	1.5401	2	5	6	0.172	OK
209	9390	303.65	23238.6	0.0326	0.0863	1	6	3	0.078	**
209	9570	305.15	23935.8	0.0353	1.1855	1	6	4	0.080	OK
209	10020	300.67	2323.9	0.0250	0.3009	1	6	5	0.092	OK
209	9660	300.86	8772.6	0.0262	0.6063	1	6	6	0.089	**
210	10470	295.48	464.8	0.0161	0.0000	1	7	1	0.032	OK
210	10650	300.48	9527.8	0.0228	0.0000	2	7	2	0.081	OK
210	11010	299.82	16499.4	0.0248	-2.1705	2	7	4	0.070	OK
210	11460	295.50	2091.5	0.0169	-1.8267	2	7	5	0.293	OK
210	11100	297.51	5838.7	0.0197	-1.3403	1	7	6	0.032	***
210	11100	297.51	5838.7	0.0197	-1.3403	2	7	6	0.127	OK
211	12270	299.15	25330.1	0.0230	-1.7583	1	1	3	0.060	*
211	12450	299.98	18126.1	0.0258	-0.3636	1	1	4	0.053	OK
211	12900	299.15	1917.2	0.0221	-0.0432	1	1	5	0.075	OK
211	12540	297.65	7523.5	0.0207	-0.6951	1	1	6	0.069	**
212	13350	297.15	232.4	0.0182	-0.9355	2	2	1	0.204	OK
212	13350	297.15	232.4	0.0182	-0.9355	2	2	1	0.208	OK

APDFID NMOC CONCENTRATION AND METEROLOGICAL DATA
AVERAGED BY DIURNAL SAMPLING PERIODS

Jdate	Diurnal minutes	Temp. kelvins	Solar Rad. J/m^2	Humidity mole fraction	Velocity Vector m/s	Si	Wj	Pk	NMOC ppmC	Code
212	13350	297.15	232.4	0.0182	-0.9355	1	2	1	0.164	OK
212	13530	297.73	10457.4	0.0199	0.0863	2	2	2	0.145	OK
212	13530	297.73	10457.4	0.0199	0.0863	1	2	2	0.182	OK
212	13710	300.73	18590.9	0.0258	0.8976	2	2	3	0.079	OK
212	13710	300.73	18590.9	0.0258	0.8976	1	2	3	0.094	OK
212	13890	302.98	18126.1	0.0317	0.8624	1	2	4	0.058	OK
212	13890	302.98	18126.1	0.0317	0.8624	2	2	4	0.120	OK
212	14340	299.30	1510.5	0.0236	-0.2038	1	2	5	0.086	**
212	14340	299.30	1510.5	0.0236	-0.2038	2	2	5	0.220	OK
212	13980	299.47	6681.1	0.0237	0.0119	2	2	6	0.137	OK
212	13980	299.47	6681.1	0.0237	0.0119	1	2	6	0.110	**
213	14790	297.15	0.0	0.0179	0.0000	2	3	1	0.054	OK
213	14790	297.15	0.0	0.0179	0.0000	2	3	1	0.043	OK
213	15780	298.34	755.3	0.0209	0.1869	1	3	5	0.165	**
213	15420	298.36	4066.8	0.0207	-0.0518	1	3	6	0.165	***
214	16230	297.15	232.4	0.0179	0.9190	2	4	1	0.118	OK
214	16230	297.15	232.4	0.0179	0.9190	2	4	1	0.113	OK
214	16410	297.90	5112.5	0.0200	1.8055	2	4	2	0.110	OK
214	16590	299.23	16964.2	0.0236	1.1248	2	4	3	0.103	OK
214	16770	297.57	10225.0	0.0205	0.9134	2	4	4	0.064	OK
214	17220	294.73	1336.2	0.0155	-0.0492	2	4	5	0.312	OK
214	16860	296.35	4734.9	0.0180	0.5707	2	4	6	0.196	OK
215	17670	291.73	464.8	0.0120	-0.2224	2	5	1	0.277	OK
215	18210	303.23	23145.7	0.0323	2.5417	1	5	4	0.661	OK
215	18660	300.55	1917.2	0.0253	0.9931	1	5	5	0.429	OK
215	18300	299.33	8499.5	0.0239	0.9856	1	5	6	0.475	**
216	19110	295.73	697.2	0.0165	0.8605	2	6	1	0.269	OK
216	19110	295.73	697.2	0.0165	0.8605	1	6	1	0.263	OK
216	19290	300.57	13013.6	0.0247	0.9500	2	6	2	0.194	OK
216	19290	300.57	13013.6	0.0247	0.9500	1	6	2	0.342	**
216	19470	307.07	26259.7	0.0411	1.0266	2	6	3	0.129	OK
216	19650	307.73	23238.6	0.0446	1.8643	2	6	4	0.099	OK
216	20100	302.23	1801.0	0.0292	2.4129	2	6	5	0.214	OK
216	19740	302.50	8801.6	0.0305	1.7941	1	6	6	0.282	***
216	19740	302.50	8801.6	0.0305	1.7941	2	6	6	0.204	OK
217	20550	298.23	0.0	0.0205	2.6667	2	7	1	0.120	OK
218	21990	298.57	697.2	0.0213	1.4143	2	1	1	0.079	OK
218	21990	298.57	697.2	0.0213	1.4143	2	1	1	0.079	OK
218	22170	302.57	15105.1	0.0303	1.1478	2	1	2	0.062	OK
218	22350	305.07	27886.4	0.0364	0.8648	2	1	3	0.048	OK
218	22350	305.07	27886.4	0.0364	0.8648	1	1	3	0.046	OK
218	22530	305.90	24633.0	0.0396	1.0421	1	1	4	0.030	OK
218	22530	305.90	24633.0	0.0396	1.0421	2	1	4	0.053	OK
218	22980	301.03	2091.5	0.0270	0.2306	2	1	5	0.194	OK
218	22980	301.03	2091.5	0.0270	0.2306	1	1	5	0.119	OK
218	22620	302.03	9585.9	0.0294	0.6739	2	1	6	0.097	OK

APDFID NMOC CONCENTRATION AND METEROLOGICAL DATA
AVERAGED BY DIURNAL SAMPLING PERIODS

Jdate	Diurnal minutes	Temp. kelvins	Solar Rad. J/m^2	Humidity mole fraction	Velocity Vector m/s	Si	Wj	Pk	NMOC ppmC	Code
218	22620	302.03	9585.9	0.0294	0.6739	1	1	6	0.092	**
219	23430	296.65	929.5	0.0183	-0.0533	2	2	1	0.099	OK
219	23430	296.65	929.5	0.0183	-0.0533	1	2	1	0.094	OK
219	23610	300.48	13478.4	0.0257	0.5823	1	2	2	0.114	**
219	23790	304.23	24865.3	0.0347	1.0135	1	2	3	0.241	**
219	23970	304.48	16499.4	0.0356	0.6210	1	2	4	0.115	OK
219	24420	296.42	1626.7	0.0189	-0.2285	1	2	5	0.080	OK
219	24060	298.94	7784.9	0.0237	0.1562	1	2	6	0.097	**
220	24870	290.90	464.8	0.0110	-0.5564	2	3	1	0.054	OK
220	24870	290.90	464.8	0.0110	-0.5564	1	3	1	0.054	OK
220	24870	290.90	464.8	0.0110	-0.5564	2	3	1	0.062	OK
220	25050	293.07	11154.5	0.0138	-0.5099	2	3	2	0.046	OK
220	25050	293.07	11154.5	0.0138	-0.5099	1	3	2	0.069	OK
220	25230	295.65	15105.1	0.0174	-0.6372	1	3	3	0.051	OK
220	25410	295.32	9760.2	0.0170	-0.9034	2	3	4	0.049	OK
220	25410	295.32	9760.2	0.0170	-0.9034	1	3	4	0.057	OK
220	25860	293.28	1103.8	0.0137	-0.4006	1	3	5	0.121	**
220	25860	293.28	1103.8	0.0137	-0.4006	2	3	5	0.183	OK
220	25500	293.50	5112.5	0.0143	-0.5262	1	3	6	0.074	**
220	25500	293.50	5112.5	0.0143	-0.5262	2	3	6	0.085	OK
221	26310	291.07	464.8	0.0110	-0.3709	2	4	1	0.046	OK
222	27750	289.40	0.0	0.0095	-0.7382	2	5	1	0.051	OK
222	27930	289.65	1859.1	0.0095	-1.0973	2	5	2	0.052	OK
222	28110	290.23	4415.3	0.0103	-0.9099	1	5	3	0.062	OK
222	28110	290.23	4415.3	0.0103	-0.9099	2	5	3	0.059	OK
222	28290	290.90	3253.4	0.0114	-0.7696	2	5	4	0.067	OK
222	28290	290.90	3253.4	0.0114	-0.7696	1	5	4	0.122	OK
222	28740	289.57	232.4	0.0099	-0.5538	1	5	5	0.051	*
222	28740	289.57	232.4	0.0099	-0.5538	2	5	5	0.083	OK
222	28380	289.81	1307.2	0.0100	-0.7163	1	5	6	0.066	**
222	28380	289.81	1307.2	0.0100	-0.7163	2	5	6	0.059	OK
223	29190	290.07	232.4	0.0100	-0.3749	2	6	1	0.074	OK
223	29730	292.65	4647.7	0.0129	-0.2079	1	6	4	0.057	**
223	30180	292.00	348.6	0.0122	-0.3124	1	6	5	0.052	**
223	29820	291.68	1510.5	0.0118	-0.3063	1	6	6	0.052	***
224	30630	292.15	0.0	0.0123	-0.3264	2	7	1	0.083	OK
224	30630	292.15	0.0	0.0123	-0.3264	2	7	1	0.080	OK
224	30810	293.07	3021.0	0.0130	-0.2885	2	7	2	0.090	OK
224	30990	294.65	7668.7	0.0154	-0.3040	2	7	3	0.098	OK
224	31170	296.40	8365.9	0.0181	-0.3353	2	7	4	0.092	OK
224	31620	293.42	464.8	0.0138	-0.2731	2	7	5	0.183	OK
224	31260	293.74	2614.3	0.0143	-0.2933	2	7	6	0.136	OK
225	32610	301.48	21611.9	0.0288	-1.3764	1	1	4	0.084	OK
225	33060	296.59	1742.9	0.0186	-0.5660	1	1	5	0.075	OK
225	32700	296.90	7349.2	0.0195	-0.6933	1	1	6	0.077	**
226	33510	294.15	232.4	0.0147	-0.1826	2	2	1	0.201	OK

APDFID NMOC CONCENTRATION AND METEROLOGICAL DATA
AVERAGED BY DIURNAL SAMPLING PERIODS

Jdate	Diurnal minutes	Temp. kelvins	Solar Rad. J/m^2	Humidity mole fraction	Velocity Vector m/s	Si	Wj	Pk	NMOC ppmC	Code
226	33510	294.15	232.4	0.0147	-0.1826	2	2	1	0.206	OK
226	33690	295.23	2556.2	0.0161	-0.9415	2	2	2	0.066	OK
227	34950	294.15	464.8	0.0146	-0.2175	2	3	1	0.056	OK
227	35490	300.07	12316.5	0.0252	-0.6132	1	3	4	0.054	**
227	35580	296.39	3950.6	0.0184	-0.3081	1	3	6	0.054	***
228	36390	293.65	464.8	0.0141	-0.2206	2	4	1	0.405	OK
228	36390	293.65	464.8	0.0141	-0.2206	2	4	1	0.311	OK
228	36390	293.65	464.8	0.0141	-0.2206	2	4	1	0.407	OK
228	36570	299.23	9992.6	0.0230	-0.2311	1	4	2	0.110	**
228	36570	299.23	9992.6	0.0230	-0.2311	2	4	2	0.192	OK
228	36750	302.40	20914.8	0.0306	0.3708	1	4	3	0.095	OK
228	36750	302.40	20914.8	0.0306	0.3708	2	4	3	0.065	OK
228	36750	302.40	20914.8	0.0306	0.3708	2	4	3	0.059	OK
228	36930	302.40	13478.4	0.0301	-0.1484	1	4	4	0.066	OK
228	36930	302.40	13478.4	0.0301	-0.1484	2	4	4	0.050	OK
228	36930	302.40	13478.4	0.0301	-0.1484	2	4	4	0.099	OK
228	37380	296.59	1103.8	0.0183	-0.0996	2	4	5	0.121	OK
228	37380	296.59	1103.8	0.0183	-0.0996	1	4	5	0.113	OK
228	37380	296.59	1103.8	0.0183	-0.0996	2	4	5	0.190	OK
228	37020	298.00	6158.2	0.0214	-0.0785	2	4	6	0.111	OK
228	37020	298.00	6158.2	0.0214	-0.0785	2	4	6	0.198	OK
228	37020	298.00	6158.2	0.0214	-0.0785	1	4	6	0.103	**
229	37830	295.15	232.4	0.0159	-0.3677	1	5	1	0.108	OK
229	37830	295.15	232.4	0.0159	-0.3677	2	5	1	0.116	OK
229	38010	297.48	9992.6	0.0203	-0.7815	1	5	2	0.083	*
229	38820	295.13	464.8	0.0163	0.0249	1	5	5	0.039	***
229	38460	297.20	6477.8	0.0202	-0.4230	1	5	6	0.067	***
230	39270	292.48	232.4	0.0126	-0.4090	2	6	1	0.056	OK
230	39270	292.48	232.4	0.0126	-0.4090	2	6	1	0.072	OK
230	39450	295.65	7436.4	0.0167	0.1615	2	6	2	0.064	OK
230	39630	299.90	17010.7	0.0247	-0.5833	2	6	3	0.085	OK
230	39810	300.90	11619.3	0.0267	-0.1639	2	6	4	0.055	OK
230	40260	295.28	813.4	0.0164	-0.4207	2	6	5	0.149	OK
230	39900	296.25	4944.0	0.0183	-0.3347	2	6	6	0.098	OK

* One datum missing in the average.

** More than one datum missing in the average.

*** So many data missing in the average that the statistic is probably not useful.

APPENDIX D

APDFID NMOC CONCENTRATIONS AND METEROLOGICAL DATA AVERAGED FOR THE 6:00 a.m. TO 9:00 a.m. TIME INTERVAL

jlh.006/cah

APDFID NMOC CONCENTRATIONS AND METEROLOGICAL DATA
AVERAGED FOR THE 6:00 a.m. TO 9:00 a.m. TIME INTERVAL

Jdate	Diurnal minutes	Temp. kelvins	Solar Rad. J/m^2	Humidity mole fraction	Velocity Vector m/s	Si	Wj	Pk	NMOC ppmC	Code
210	10470	295.48	464.8	0.0161	0.0000	1	7	1	0.032	
213	14790	297.15	0.0	0.0179	0.0000	2	3	1	0.043	
208	7590	295.48	232.4	0.0161	0.0000	1	5	1	0.044	
221	26310	291.07	464.8	0.0110	-0.3709	2	4	1	0.046	
222	27750	289.40	0.0	0.0095	-0.7382	2	5	1	0.051	
220	24870	290.90	464.8	0.0110	-0.5564	2	3	1	0.054	
213	14790	297.15	0.0	0.0179	0.0000	2	3	1	0.054	
220	24870	290.90	464.8	0.0110	-0.5564	1	3	1	0.054	
230	39270	292.48	232.4	0.0126	-0.4090	2	6	1	0.056	
227	34950	294.15	464.8	0.0146	-0.2175	2	3	1	0.056	
220	24870	290.90	464.8	0.0110	-0.5564	2	3	1	0.062	
230	39270	292.48	232.4	0.0126	-0.4090	2	6	1	0.072	
223	29190	290.07	232.4	0.0100	-0.3749	2	6	1	0.074	
218	21990	298.57	697.2	0.0213	1.4143	2	1	1	0.079	
218	21990	298.57	697.2	0.0213	1.4143	2	1	1	0.079	
224	30630	292.15	0.0	0.0123	-0.3264	2	7	1	0.080	
224	30630	292.15	0.0	0.0123	-0.3264	2	7	1	0.083	
208	7590	295.48	232.4	0.0161	0.0000	2	5	1	0.089	
219	23430	296.65	929.5	0.0183	-0.0533	1	2	1	0.094	
208	7590	295.48	232.4	0.0161	0.0000	2	5	1	0.099	
219	23430	296.65	929.5	0.0183	-0.0533	2	2	1	0.099	
229	37830	295.15	232.4	0.0159	-0.3677	1	5	1	0.108	
214	16230	297.15	232.4	0.0179	0.9190	2	4	1	0.113	
229	37830	295.15	232.4	0.0159	-0.3677	2	5	1	0.116	
206	4710	298.48	464.8	0.0196	-0.4605	2	3	1	0.117	
214	16230	297.15	232.4	0.0179	0.9190	2	4	1	0.118	
217	20550	298.23	0.0	0.0205	2.6667	2	7	1	0.120	
205	3270	298.65	232.4	0.0198	0.4614	2	2	1	0.153	
212	13350	297.15	232.4	0.0182	-0.9355	1	2	1	0.164	
226	33510	294.15	232.4	0.0147	-0.1826	2	2	1	0.201	
212	13350	297.15	232.4	0.0182	-0.9355	2	2	1	0.204	
226	33510	294.15	232.4	0.0147	-0.1826	2	2	1	0.206	
205	3270	298.65	232.4	0.0198	0.4614	2	2	1	0.208	
212	13350	297.15	232.4	0.0182	-0.9355	2	2	1	0.208	
206	4710	298.48	464.8	0.0196	-0.4605	2	3	1	0.258	
216	19110	295.73	697.2	0.0165	0.8605	1	6	1	0.263	
216	19110	295.73	697.2	0.0165	0.8605	2	6	1	0.269	
215	17670	291.73	464.8	0.0120	-0.2224	2	5	1	0.277	
228	36390	293.65	464.8	0.0141	-0.2206	2	4	1	0.311	
207	6150	295.48	232.4	0.0158	-0.3782	2	4	1	0.386	
228	36390	293.65	464.8	0.0141	-0.2206	2	4	1	0.405	
228	36390	293.65	464.8	0.0141	-0.2206	2	4	1	0.407	

Minimum	0.0315
Maximum	0.4070
Average =	0.1431
Median	0.1036
Cases	42
Standard Deviation	0.1038

APPENDIX E

APDFID NMOC CONCENTRATIONS AND METEROLOGICAL DATA AVERAGED FOR THE 9:00 a.m. TO NOON TIME INTERVAL

jlh.006/cah

APDFID NMOC CONCENTRATIONS AND METEROLOGICAL DATA
AVERAGED FOR THE 9:00 a.m. TO NOON TIME INTERVAL

Jdate	Diurnal minutes	Temp. kelvins	Solar Rad. J/m^2	Humidity mole fraction	Velocity Vector m/s	Si	Wj	Pk	NMOC ppmC	Code
220	25050	293.07	11154.5	0.0138	-0.5099	2	3	2	0.046	
222	27930	289.65	1859.1	0.0095	-1.0973	2	5	2	0.052	
206	4890	299.15	9527.8	0.0223	-0.9767	2	3	2	0.060	
218	22170	302.57	15105.1	0.0303	1.1478	2	1	2	0.062	
230	39450	295.65	7436.4	0.0167	0.1615	2	6	2	0.064	
226	33690	295.23	2556.2	0.0161	-0.9415	2	2	2	0.066	
220	25050	293.07	11154.5	0.0138	-0.5099	1	3	2	0.069	
210	10650	300.48	9527.8	0.0228	0.0000	2	7	2	0.081	
229	38010	297.48	9992.6	0.0203	-0.7815	1	5	2	0.083	*
208	7770	300.65	6971.6	0.0226	1.5976	1	5	2	0.090	
224	30810	293.07	3021.0	0.0130	-0.2885	2	7	2	0.090	
214	16410	297.90	5112.5	0.0200	1.8055	2	4	2	0.110	
228	36570	299.23	9992.6	0.0230	-0.2311	1	4	2	0.110	**
219	23610	300.48	13478.4	0.0257	0.5823	1	2	2	0.114	**
212	13530	297.73	10457.4	0.0199	0.0863	2	2	2	0.145	
208	7770	300.65	6971.6	0.0226	1.5976	2	5	2	0.156	
212	13530	297.73	10457.4	0.0199	0.0863	1	2	2	0.182	
228	36570	299.23	9992.6	0.0230	-0.2311	2	4	2	0.192	
216	19290	300.57	13013.6	0.0247	0.9500	2	6	2	0.194	
216	19290	300.57	13013.6	0.0247	0.9500	1	6	2	0.342	**

Minimum =	0.0460
Maximum -	0.3416
Average	0.1131
Median	0.0900
Cases	20
Standard Deviation	0.0710

APPENDIX F

APDFID NMOC CONCENTRATIONS AND METEROLOGICAL DATA AVERAGED FOR THE NOON TO 3:00 p.m. TIME INTERVAL

jlh.006/cah

APDFID NMOC CONCENTRATIONS AND METEROLOGICAL DATA
AVERAGED FOR THE NOON TO 3:00 p.m. TIME INTERVAL

Jdate	Diurnal minutes	Temp. kelvins	Solar Rad. J/m^2	Humidity mole fraction	Velocity Vector m/s	Si	Wj	Pk	NMOC ppmC	Code
218	22350	305.07	27886.4	0.0364	0.8648	1	1	3	0.046	
218	22350	305.07	27886.4	0.0364	0.8648	2	1	3	0.048	
220	25230	295.65	15105.1	0.0174	-0.6372	1	3	3	0.051	
205	3630	305.48	27189.2	0.0376	0.7016	1	2	3	0.056	*
222	28110	290.23	4415.3	0.0103	-0.9099	2	5	3	0.059	
228	36750	302.40	20914.8	0.0306	0.3708	2	4	3	0.059	
211	12270	299.15	25330.1	0.0230	-1.7583	1	1	3	0.060	*
222	28110	290.23	4415.3	0.0103	-0.9099	1	5	3	0.062	
228	36750	302.40	20914.8	0.0306	0.3708	2	4	3	0.065	
206	5070	301.98	21611.9	0.0295	-0.8660	2	3	3	0.077	
209	9390	303.65	23238.6	0.0303	0.0863	1	6	3	0.078	**
212	13710	300.73	18590.9	0.0258	0.8976	2	2	3	0.079	
230	39630	299.90	17010.7	0.0247	-0.5833	2	6	3	0.085	
208	7950	301.32	17429.0	0.0261	1.9414	1	5	3	0.086	
212	13710	300.73	18590.9	0.0258	0.8976	1	2	3	0.094	
228	36750	32.40	20914.8	0.0306	0.3708	1	4	3	0.095	
224	30990	294.65	7668.7	0.0154	-0.3040	2	7	3	0.098	
214	16590	299.23	16964.2	0.0236	1.1248	2	4	3	0.103	
208	7950	301.32	17429.0	0.0261	1.9414	2	5	3	0.119	
216	19470	307.07	26259.7	0.0411	1.0266	2	6	3	0.129	
219	23790	304.23	24865.3		1.0135	1	2	3	0.241	**

Minimum	0.0480
Maximum	0.2410
Average	0.0852
Median	0.0776
Cases	21
Standard Deviation	0.0425

APPENDIX G

APDFID NMOC CONCENTRATIONS AND METEROLOGICAL DATA AVERAGED FOR THE 3:00 p.m. TO 6:00 p.m. TIME INTERVAL

jlh.006/cah

APDFID NMOC CONCENTRATIONS AND METEROLOGICAL DATA
AVERAGED FOR THE 3:00 p.m. TO 6:00 p.m. TIME INTERVAL

Jdate	Diurnal minutes	Temp. kelvins	Solar Rad. J/m^2	Humidity mole fraction	Velocity Vector m/s	Si	Wj	Pk	NMOC ppmC	Code
218	22530	305.90	24633.0	0.0396	1.0421	1	1	4	0.030	
220	25410	295.32	9760.2	0.0170	-0.9034	2	3	4	0.049	
228	36930	302.40	13478.4	0.0301	-0.1484	2	4	4	0.050	
218	22530	305.90	24633.0	0.0396	1.0421	2	1	4	0.053	
211	12450	299.98	18126.1	0.0258	-0.3636	1	1	4	0.053	
227	35490	300.07	12316.5	0.0252	-0.6132	1	3	4	0.054	**
230	39810	300.90	11619.3	0.0267	-0.1639	2	6	4	0.055	
220	25410	295.32	9760.2	0.0170	-0.9034	1	3	4	0.057	
223	29730	292.65	4647.7	0.0129	-0.2079	1	6	4	0.057	**
212	13890	302.98	18126.1	0.0317	0.8624	1	2	4	0.058	
214	16770	297.57	10225.0	0.0205	0.9134	2	4	4	0.064	
205	3810	307.15	26724.4	0.0427	0.9866	1	2	4	0.066	
228	36930	302.40	13478.4	0.0301	-0.1484	1	4	4	0.066	
222	28290	290.90	3253.4	0.0114	-0.7696	2	5	4	0.067	
207	6690	305.48	15569.9	0.0376	-0.5761	1	4	4	0.067	
210	11010	299.82	16499.4	0.0248	-2.1705	2	7	4	0.070	
206	5250	304.48	25330.1	0.0352	-1.2416	2	3	4	0.080	
209	9570	305.15	23935.8	0.0353	1.1855	1	6	4	0.080	
225	32610	301.48	21611.9	0.0288	-1.3764	1	1	4	0.084	
224	31170	296.40	8365.9	0.0181	-0.3353	2	7	4	0.092	
228	36930	302.40	13478.4	0.0301	-0.1484	2	4	4	0.099	
216	19650	307.73	23238.6	0.0446	1.8643	2	6	4	0.099	
208	8130	301.65	21147.2	0.0290	2.3058	2	5	4	0.104	
219	23970	304.48	16499.4	0.0356	0.6210	1	2	4	0.115	
212	13890	302.98	18126.1	0.0317	0.8624	2	2	4	0.120	
222	28290	290.90	3253.4	0.0114	-0.7696	1	5	4	0.122	
215	18210	303.23	23145.7	0.0323	2.5417	1	5	4	0.661	

Minimum 0.0304
Maximum = 0.6610
Average = 0.0953
Median - 0.0670
Cases 27
Standard Deviation = 0.1155

APPENDIX H

APDFID NMOC CONCENTRATIONS AND METEROLOGICAL DATA AVERAGED FOR THE 6:00 p.m. TO 6:00 a.m. TIME INTERVAL

jlh.006/cah

APDFID NMOC CONCENTRATIONS AND METEROLOGICAL DATA
AVERAGED FOR THE 6:00 p.m. TO 6:00 a.m. TIME INTERVAL

Jdate	Diurnal minutes	Temp. kelvins	Solar Rad. J/m^2	Humidity mole fraction	Velocity Vector m/s	Si	Wj	Pk	NMOC ppmC	Code
229	38820	295.13	464.8	0.0163	0.0249	1	5	5	0.039	***
222	28740	289.57	232.4	0.0099	-0.5538	1	5	5	0.051	*
223	30180	292.00	348.6	0.0122	-0.3124	1	6	5	0.052	**
205	4260	300.98	2962.9	0.0250	-0.2715	1	2	5	0.071	
211	12900	299.15	1917.2	0.0221	-0.0432	1	1	5	0.075	
225	33060	296.59	1742.9	0.0186	-0.5660	1	1	5	0.075	
219	24420	296.42	1626.7	0.0189	-0.2285	1	2	5	0.080	
222	28740	289.57	232.4	0.0099	-0.5538	2	5	5	0.083	
212	14340	299.30	1510.5	0.0236	-0.2038	1	2	5	0.086	**
209	10020	300.67	2323.9	0.0250	0.3009	1	6	5	0.092	
228	37380	296.59	1103.8	0.0183	-0.0996	1	4	5	0.113	
207	7140	299.21	2033.4	0.0232	0.3836	1	4	5	0.117	
218	22980	301.03	2091.5	0.0270	0.2306	1	1	5	0.119	
220	25860	293.28	1103.8	0.0137	-0.4006	1	3	5	0.121	**
228	37380	296.59	1103.8	0.0183	-0.0996	2	4	5	0.121	
230	40260	295.28	813.4	0.0164	-0.4207	2	6	5	0.149	
213	15780	298.34	755.3	0.0209	0.1869	1	3	5	0.165	**
224	31620	293.42	464.8	0.0138	-0.2731	2	7	5	0.183	
220	25860	293.28	1103.8	0.0137	-0.4006	2	3	5	0.183	
228	37380	296.59	1103.8	0.0183	-0.0996	2	4	5	0.190	
218	22980	301.03	2091.5	0.0270	0.2306	2	1	5	0.194	
216	20100	302.23	1801.0	0.0292	2.4129	2	6	5	0.214	
212	14340	299.30	1510.5	0.0236	-0.2038	2	2	5	0.220	
208	8580	298.53	987.6	0.0216	1.6190	2	5	5	0.241	
210	11460	295.50	2091.5	0.0169	-1.8267	2	7	5	0.293	
214	17220	294.73	1336.2	0.0155	-0.0492	2	4	5	0.312	
215	18660	300.55	1917.2	0.0253	0.9931	1	5	5	0.429	
206	5700	299.65	2672.4	0.0231	-1.1585	2	3	5	0.528	
204	2820	301.38	2091.5	0.0266	0.2606	2	1	5	0.562	

Mimimum 0.0387
Maximum - 0.5620
Average = 0.1779
Median 0.1210
Cases = 29
Standard Deviation = 0.1348

APPENDIX I

APDFID NMOC CONCENTRATIONS AND METEROLOGICAL DATA AVERAGED FOR THE 6:00 a.m. TO 6:00 a.m. TIME INTERVAL

jlh.006/cah

APDFID NMOC CONCENTRATIONS AND METEROLOGICAL DATA
AVERAGED FOR THE 6:00 a.m. TO 6:00 a.m. TIME INTERVAL

Jdate	Diurnal minutes	Temp. kelvins	Solar Rad. J/m^2	Humidity mole fraction	Velocity Vector m/s	Si	Wj	Pk	NMOC ppmC	Code
210	11100	297.51	5838.7	0.0197	-1.3403	1	7	6	0.032	***
223	29820	291.68	1510.5	0.0118	-0.3063	1	6	6	0.052	***
227	35580	296.39	3950.6	0.0184	-0.3081	1	3	6	0.054	***
222	28380	289.81	1307.2	0.0100	-0.7163	2	5	6	0.059	
222	28380	289.81	1307.2	0.0100	-0.7163	1	5	6	0.066	**
229	38460	297.20	6477.8	0.0202	-0.4230	1	5	6	0.067	***
205	3900	301.86	9760.2	0.0280	0.1750	1	2	6	0.068	**
211	12540	297.65	7523.5	0.0207	-0.6951	1	1	6	0.069	**
208	8220	299.15	6216.3	0.0225	1.5401	1	5	6	0.073	**
220	25500	293.50	5112.5	0.0143	-0.5262	1	3	6	0.074	**
225	32700	296.90	7349.2	0.0195	-0.6933	1	1	6	0.077	**
220	25500	293.50	5112.5	0.0143	-0.5262	2	3	6	0.085	
209	9660	300.86	8772.6	0.0262	0.6063	1	6	6	0.089	**
218	22620	302.03	9585.9	0.0294	0.6739	1	1	6	0.092	**
218	22620	302.03	9585.9	0.0294	0.6739	2	1	6	0.097	
219	24060	298.94	7784.9	0.0237	0.1562	1	2	6	0.097	**
230	39900	296.25	4944.0	0.0183	-0.3347	2	6	6	0.098	
228	37020	298.00	6158.2	0.0214	-0.0785	1	4	6	0.103	**
207	6780	300.18	6652.1	0.0254	0.1845	1	4	6	0.107	**
212	13980	299.47	6681.1	0.0237	0.0119	1	2	6	0.110	**
228	37020	298.00	6158.2	0.0214	-0.0785	2	4	6	0.111	
210	11100	297.51	5838.7	0.0197	-1.3403	2	7	6	0.127	
224	31260	293.74	2614.3	0.0143	-0.2933	2	7	6	0.136	
212	13980	299.47	6681.1	0.0237	0.0119	2	2	6	0.137	
213	15420	298.36	4066.8	0.0207	-0.0518	1	3	6	0.165	***
208	8220	299.15	6216.3	0.0225	1.5401	2	5	6	0.172	
214	16860	296.35	4734.9	0.0180	0.5707	2	4	6	0.196	
228	37020	298.00	6158.2	0.0214	-0.0785	2	4	6	0.198	
216	19740	302.50	8801.6	0.0305	1.7941	2	6	6	0.204	
206	5340	300.34	8453.1	0.0249	-1.0224	2	3	6	0.226	
216	19740	302.50	8801.6	0.0305	1.7941	1	6	6	0.282	***
215	18300	299.33	8499.5	0.0239	0.9856	1	5	6	0.475	**
204	2460	300.44	8700.0	0.0254	0.1735	2	1	6	0.478	

Minimum -	0.0315
Maximum =	0.4780
Average	0.1356
Median	0.0980
Cases =	33
Standard Deviation	0.1048