

**Annual Data Summary**  
**PINNACLES NATIONAL MONUMENT**  
**2001**  
**National Park Service**  
**Gaseous Air Pollutant Monitoring Network**



**AIR RESOURCES DIVISION**  
**RESEARCH AND MONITORING BRANCH**  
12795 West Alameda Parkway  
P.O. Box 25287  
Lakewood, Colorado 80225  
Telephone: (303) 969-2820  
Fax: (303) 969-2822

This Annual Data Summary was prepared under NPS Contract CX-1270-96-007 by:

**Air Resource Specialists, Inc.**  
1901 Sharp Point Drive, Suite E  
Fort Collins, Colorado 80525  
Telephone: (970) 484-7941  
Fax: (970) 484-3423

For additional copies of this report or reports for other NPS units, contact:

**National Park Service Air Resources Division**  
Information Management Center  
c/o Air Resource Specialists, Inc.  
1901 Sharp Point Drive, Suite E  
Fort Collins, Colorado 80525  
Telephone: (970) 484-7941  
Fax: (970) 484-3423  
E-Mail: AIR-IMC@AIR-RESOURCE.COM

or

**National Park Service**  
Air Resources Division  
P.O. Box 25287  
Lakewood, Colorado 80225-02587  
Telephone: (303) 969-2130  
E-Mail: AQ\_INFO@AQD.NPS.GOV

## **ACKNOWLEDGEMENTS**

The National Park Service Air Resources Division (ARD) recognizes the level of effort required by individual park units, site operators, auditors, cooperating state and local agencies, and ARD contractors. ARD sincerely appreciates the contributions of all participants in assisting with the collection, validation, and reporting of these air quality and meteorological data.

At Pinnacles National Monument, the ARD specifically recognizes Paul Johnson and Chad Moore for performing the technical and administrative skills required to help produce the data presented within this report.

## TABLE OF CONTENTS

<b><u>Section</u></b>		<b><u>Page</u></b>
1.0	INTRODUCTION	1-1
1.1	The National Park Service Gaseous Pollutant Monitoring Network	1-1
1.2	Pinnacles National Monument	1-3
2.0	DATA SUMMARY	2-1
2.1	Overview	2-1
2.2	Ozone Data Summary	2-7
2.3	Meteorological Data Summary	2-23
2.4	Dry Deposition Data Summary	2-27
3.0	NATIONAL PARK SERVICE AIR RESOURCES DIVISION DATA SOURCES	3-1
3.1	Guide to Attached Data Disks	3-1
3.2	Other Sources for Retrieving National Park Service Gaseous Pollutant Data	3-1
4.0	GLOSSARY	4-1
4.1	Definitions and Computational Procedures for National Park Service Quick Look Annual Summary Statistics Table	4-1
4.2	Air Quality Glossary	4-4
4.3	Glossary of Units	4-6

## LIST OF FIGURES AND TABLES

	<b><u>Page</u></b>
Map of National Park Service Gaseous Pollutant Monitoring Network Ozone and Sulfur Dioxide Monitoring Sites	1-2
Site Specifications	1-4
Data Collection Statistics	2-2
First Quarter Data Stackplot	2-3
Second Quarter Data Stackplot	2-4
Third Quarter Data Stackplot	2-5
Fourth Quarter Data Stackplot	2-6

## LIST OF FIGURES AND TABLES (Continued)

	<b><u>Page</u></b>
Ozone Quick Look Annual Summary Statistics	2-8
Ozone Annual Frequency Distribution	2-9
Ozone Daily 1-Hour Maximum Concentrations and National Ambient Air Quality Standards Comparison	2-10
Attainment Status with EPA Proposed Primary Ozone Standards	2-11
Ten Highest 1-Hour Average Ozone Concentrations	2-12
Episodes with 1-Hour Ozone Concentrations $\geq 100$ ppb and $> 124$ ppb	2-13
Episodes with 8-Hour Ozone Concentrations $>84$ ppb	2-14
Ozone Rank Listings of Second Highest 1-Hour Average Concentrations, Maximum 8-Hour Average Concentrations, and Annual Sum60 Exposure Index for All NPS Monitoring Sites	2-15
Plot of Maximum Ozone Concentration Comparison for Three Years	2-16
Map of National Park Service Gaseous Pollutant Monitoring Network, Second Highest Hourly Ozone Concentration	2-17
Quarterly Diurnal Ozone Plots	2-18
Annual Diurnal Ozone Plot	2-19
Quarterly Ozone Pollutant Roses	2-20
Annual Ozone Pollutant Rose	2-21
Ozone Precision Check Data Summary	2-22
Summary of Selected Meteorological Data	2-24
Quarterly Wind Roses	2-25
Annual Wind Rose	2-26
Quarterly and Annual Average Concentrations	2-28
Weekly Concentrations Report	2-29
Three Year Comparison of Maximum and Average Concentrations	2-30

## LIST OF FIGURES AND TABLES (Continued)

	<b><u>Page</u></b>
Average Particulate Nitrate Concentrations	2-31
Nitric Acid Concentrations	2-32
Average Total Nitrate Concentrations	2-33
Average Ammonium Concentrations	2-34
Average Particulate Sulfate Concentrations	2-35
Average Sulfur Dioxide Concentrations	2-36
SO <sub>4</sub> /SO <sub>2</sub> Ratio	2-37
Data Disk Contents	3-2
NPS IMC and AIRS Invalid Data Codes	3-3

## **1.0 INTRODUCTION**

### **1.1 THE NATIONAL PARK SERVICE GASEOUS POLLUTANT MONITORING NETWORK**

Gaseous air pollutants, including ozone and sulfur dioxide, are of concern to the National Park Service (NPS). Pollutants like these can affect park unit biological resources as well as the health of park unit residents and visitors. The NPS established a gaseous pollutant monitoring program for several pollutants linked to effects on NPS resources. This program was designed to meet certain resource management objectives.

The primary objective of this monitoring program is to establish the status and trends of park unit air quality conditions and to determine if a park unit is exceeding the National Ambient Air Quality Standards established by the U.S. Environmental Protection Agency (EPA) to protect public health and welfare. In addition, such monitoring is designed to detect changes or trends in pollution levels over time. A monitoring station may also be established if there is documented biological injury due to air pollution in a park unit. Information on ambient air pollution levels is an important part of research on effects of air pollutants on NPS resources, and can help confirm suspected causes of observed effects.

Other monitoring objectives call for the collection of data to support the National Park Service's required involvement in both the development of state air quality control plans, and the evaluation of permit applications for new or expanding air pollution sources wishing to locate near park units. The Clean Air Act gives federal land managers and superintendents an affirmative responsibility to protect air quality related values in Class I areas and to assess whether new sources will have an adverse impact on park unit resources and values. Information on air quality levels in NPS units can also be used to evaluate the performance of atmospheric models that simulate how pollutants are transported into park units and predict impacts on the park unit caused by air pollution sources.

The National Park Service Gaseous Pollutant Monitoring Network site locations and measured parameters collected in this reporting year are shown on the map on the following page. During this reporting period, 45 monitoring sites in 36 units of the National Park System had some combination of ozone, sulfur dioxide, meteorological, and CASTNet dry deposition monitoring. Monitoring methods and quality assurance procedures used in the national park network meet the applicable 40 CFR Part 58 EPA requirements. This allows for the direct comparison of NPS collected data with that collected by the EPA, and state and local air pollution control agencies. Data collected by this network are incorporated in the EPA Aerometric Information Retrieval System (AIRS) database which is a national database of all air quality data collected throughout the country. These data are also stored in the NPS Air Resources Division's Information Management Center (IMC) that allows for easy access and analysis of data.

This report includes a variety of data summaries for data collected at an individual monitoring site at a national park unit during this reporting period. These summaries highlight the average range and frequency of the data collected during the year. A PC-compatible diskette containing a digital copy of all data collected during the year and data summary products included in this report is available. Individual reports are generated for each site where monitoring was conducted in the national park network.



## 1.2 PINNACLES NATIONAL MONUMENT

Pinnacles National Monument is located in California, about 100 miles south-southeast of San Francisco. The wilderness portion of the monument is a Class I area. Its location and site specifications are presented on the following page.

Pinnacles National Monument was established by presidential proclamation in 1908 to protect, for their scientific interest, the natural formations known as the Pinnacles Rocks under Department of Agriculture administration. Transferred to the Department of Interior in 1910, they came under the National Park Service when the Act of August 25, 1916, created the Service and added the purpose of providing for public use and enjoyment. In 1976, Congress designated about 13 thousand of the area's 16 thousand acres as wilderness area.

The monument preserves a unique mixture of volcanic pinnacle formations and the only example of a coastal broadleaf chaparral ecosystem found in the National Park System. The Pinnacles are remnants of volcanic activity and are in an advanced stage of decomposition caused by weathering, block faulting, and earthquakes. The rock formations often rise vertically several hundred meters.

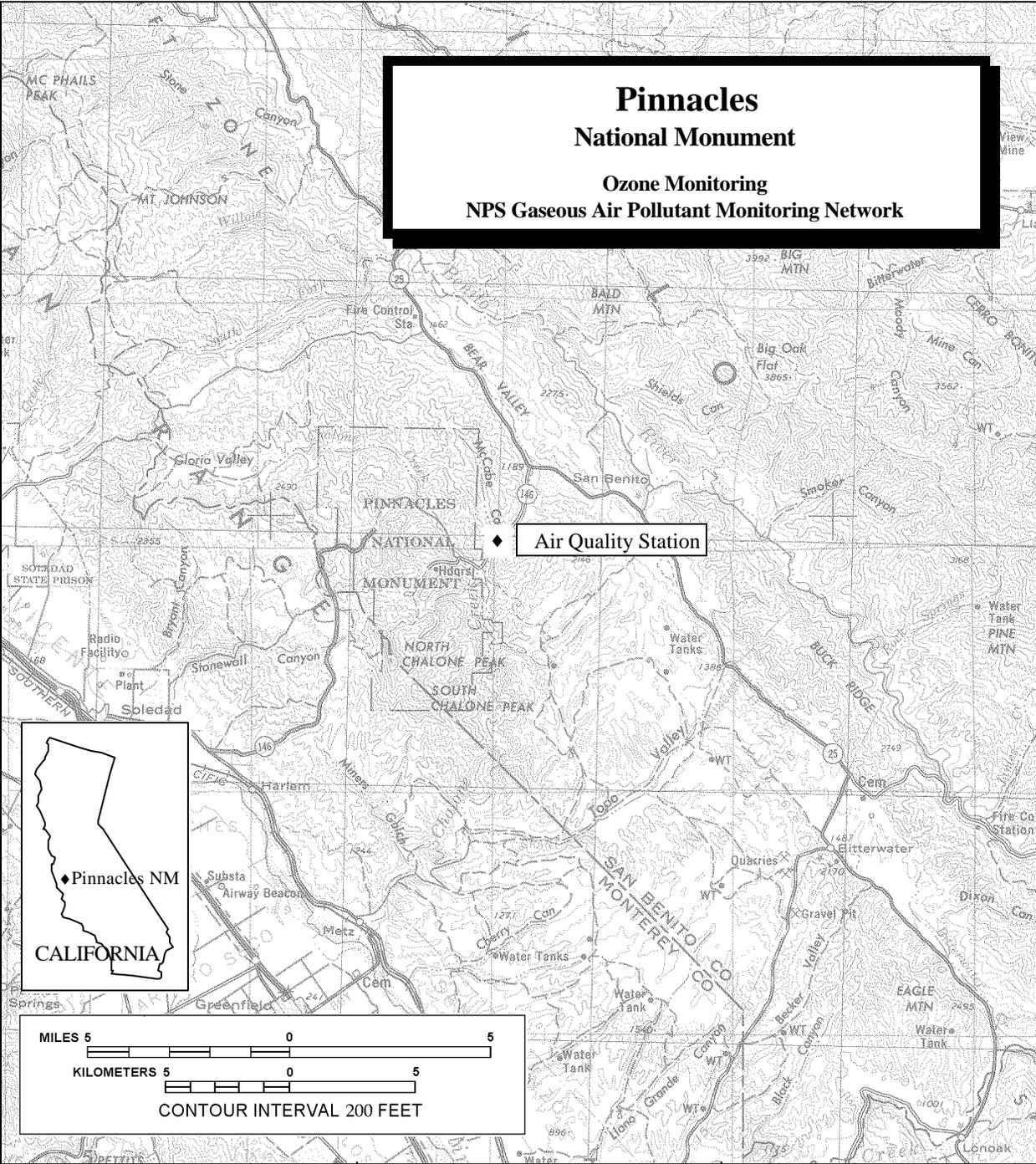
Located on the eastern edge of the Pacific plate, the park is an excellent example of tectonic plate movement. The rock is believed to have originated in a formation some 195 miles south of the park's present position, and then moved northward, along the San Andreas Fault, at a rate of approximately 1.5 inches per year.

While the Pinnacles themselves cover 10 percent of the monument and support little vegetation, about 80 percent of the land is covered with coastal chaparral. This community mainly consists of plants such as chamise, buckbrush, manzanita and Digger pine. The remaining 10 percent is composed of riparian communities, principally an oak, cottonwood, sycamore, and Digger pine relationship.

The park supports a wide variety of mammals, reptiles, birds, amphibians, and insects. Chief among these are the coast blacktailed deer, bobcat, raccoon, grey fox, coyote, Pacific coastal rattlesnake, prairie falcon, turkey vulture, raven, and golden eagle.

# Pinnacles National Monument

## Ozone Monitoring NPS Gaseous Air Pollutant Monitoring Network



SITE IDENTIFICATION		MAP INFORMATION
Site Abbreviation: PINN		Mean Elevation: 335 m
AIRS ID NO.: 06-069-0003		Longitude: 121° 09' 20"W
		Latitude: 36° 29' 06"N
INSTRUMENTATION		UTM Zone: 10
O <sub>3</sub> Analyzer	Delta Temperature	Easting: 665224 m
Calibrator	Temperature	Northing: 4039124 m
Wind Speed	Solar Radiation	Map Reference: Monterey
Wind Direction	Precipitation	NJ 10-12 1974
Relative Humidity	Filter Pack	1:250,000
Wetness		

## **2.0 DATA SUMMARY**

### **2.1 OVERVIEW**

Based on the site specifications during this annual reporting period, data summaries and statistics are provided in this section.

Data Collection Statistics  
Pinnacles National Monument

Final Validation  
01/01/2001 - 12/31/2001

Parameter	Interval	Par Code	Data Recovery			Valid Data	
			No. Possible	No. Collected	% Collected	No. Valid	% Valid
Ozone Analyzer	hourly	O3	8760	8328	95.1	8328	95.1
Scalar Wind Speed	hourly	SWS	8760	8722	99.6	8516	97.2
Vector Wind Speed	hourly	VWS	8760	8722	99.6	8516	97.2
Vector Wind Direction	hourly	VWD	8760	8722	99.6	8713	99.5
Standard Deviation for Wind Direction	hourly	SDWD	8760	8722	99.6	8713	99.5
Ambient Temperature (aspirated)	hourly	TMP	8760	8721	99.6	8676	99.0
Delta Temperature	hourly	DTP	8760	8721	99.6	7976	91.1
Relative Humidity	hourly	RH	8760	8728	99.6	8728	99.6
Precipitation	hourly	RNF	8760	8681	99.1	8558	97.7
Wetness Sensor	hourly	WET	8760	8726	99.6	8726	99.6
Solar Radiation	hourly	SOL	8760	8726	99.6	8553	97.6
Filter Pack Flow Rate	hourly	FLOW	8760	8730	99.7	8730	99.7

Notes: The percent valid is calculated against the number possible. Automatic zeros and spans are performed daily on most ambient gas analyzers, therefore, no ambient data can be collected during this time. As a result, the maximum percent valid for ambient gas data typically can not be greater than 95.8.

Performance Goals:

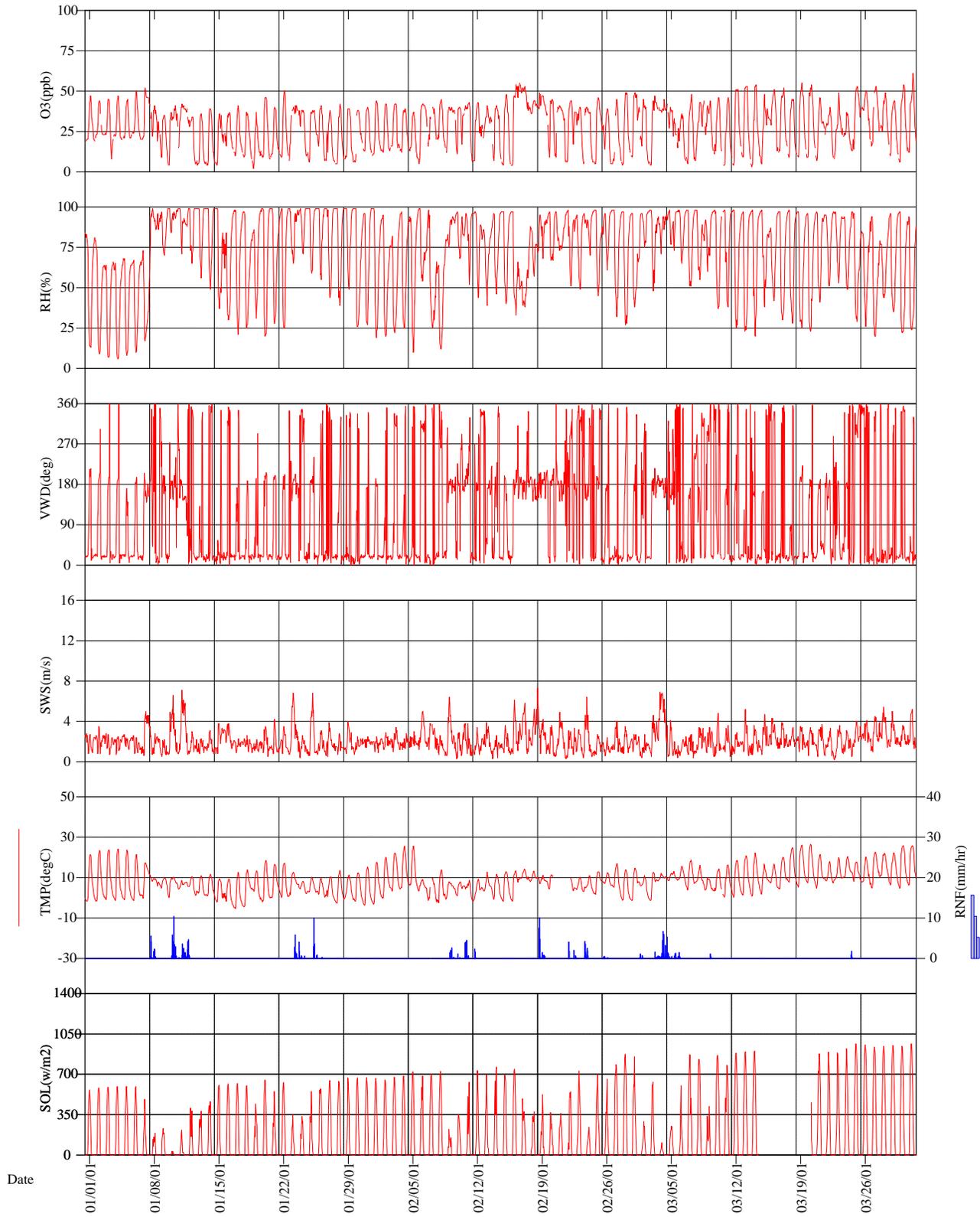
Quarterly Criteria:

100% of sites, >= 85% valid data capture  
90% of sites, >= 90% valid data capture  
80% of sites, >= 95% valid data capture

Monthly Criteria:

100% of sites, >= 60% valid data capture  
90% of sites, >= 75% valid data capture  
80% of sites, >= 85% valid data capture

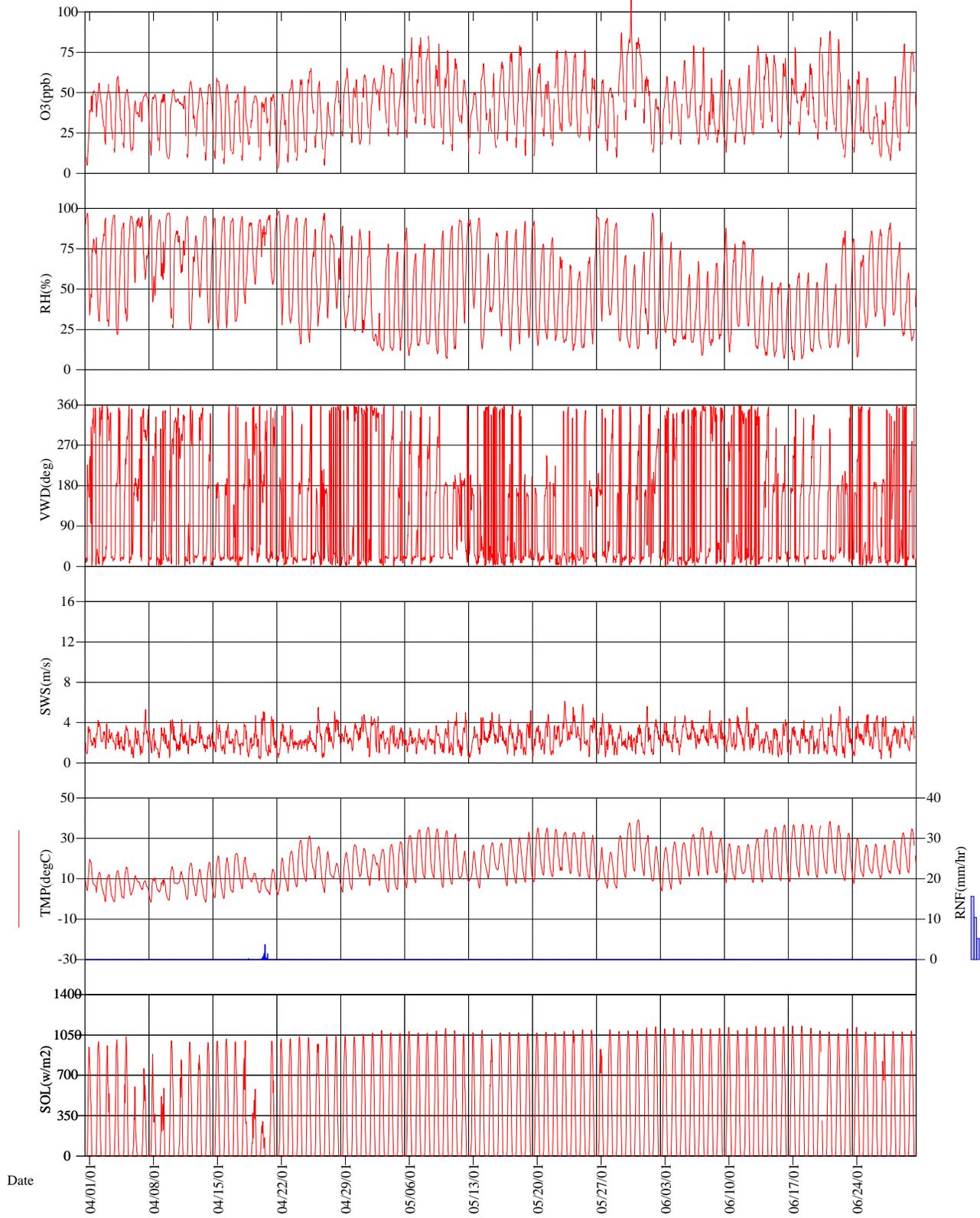
# Pinnacles National Monument



Final Validation

First Quarter 2001

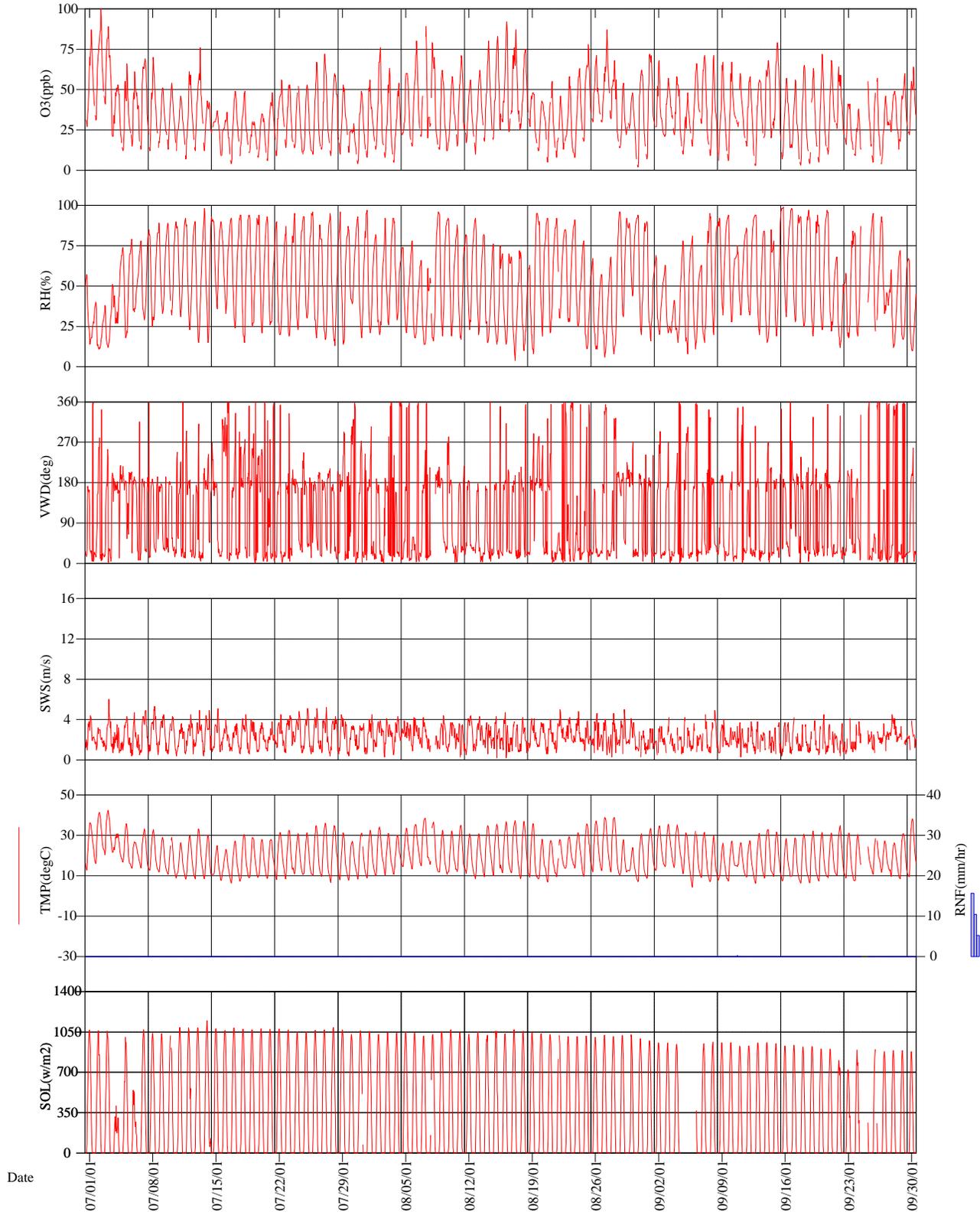
# Pinnacles National Monument



Final Validation

Second Quarter 2001

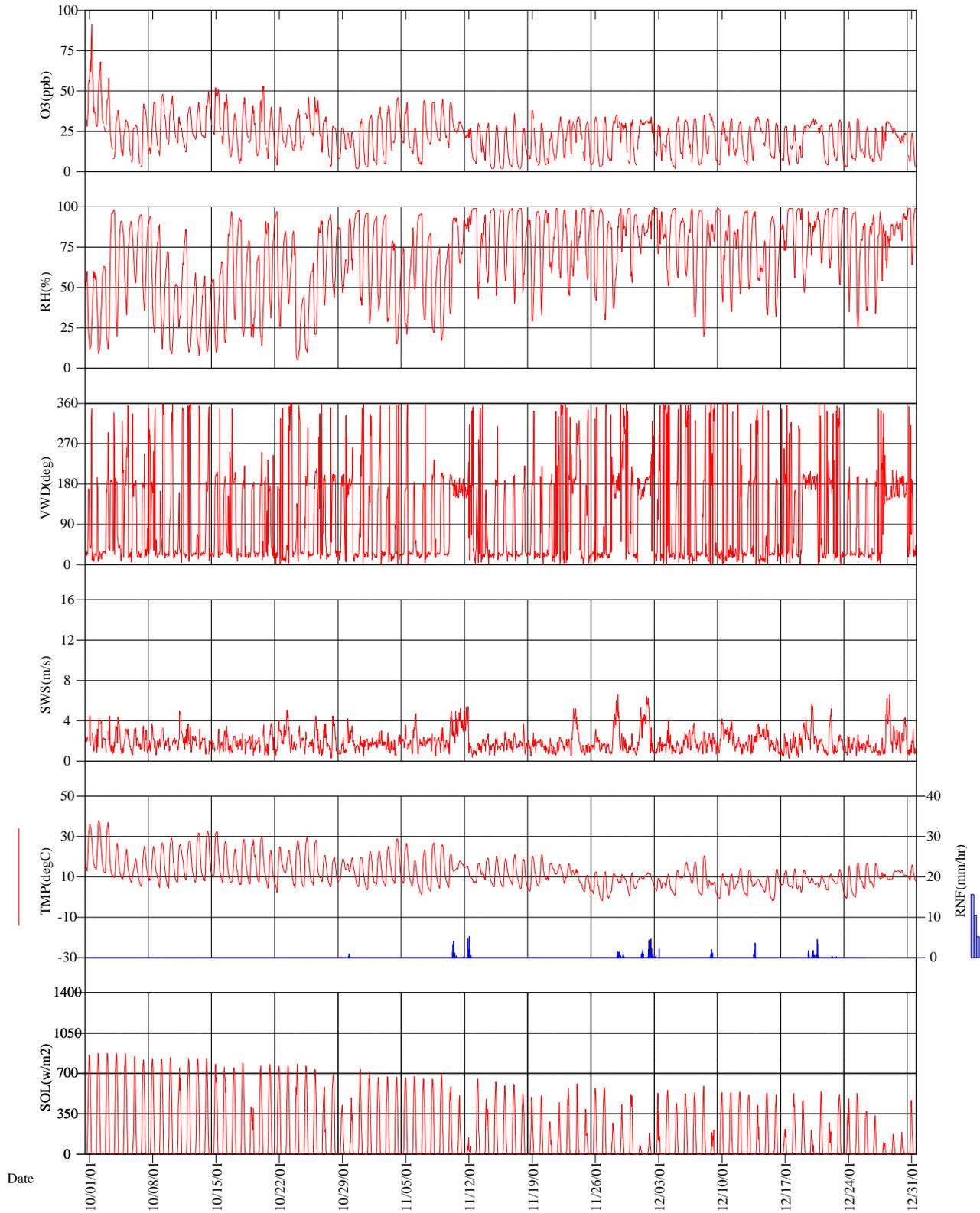
# Pinnacles National Monument



Final Validation

Third Quarter 2001

# Pinnacles National Monument



Final Validation

Fourth Quarter 2001

## **2.2 OZONE DATA SUMMARY**

Ozone Quick Look Annual Summary Statistics  
Pinnacles National Monument

01/01/2001 - 12/31/2001

STATISTIC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAY- SEP	ANNUAL
DAILY 1-HR MAXIMUM	52 (31)	55 (28)	61 (31)	65 (30)	108 (31)	88 (30)	100 (31)	92 (31)	79 (30)	91 (31)	46 (30)	36 (31)	108 (153)	108 (365)
AVERAGE DAILY MAXIMUM	41 (31)	44 (28)	48 (31)	53 (30)	71 (31)	66 (30)	57 (31)	67 (31)	61 (30)	43 (31)	35 (30)	31 (31)	64 (153)	51 (365)
MAXIMUM DAILY MEAN	36 (31)	49 (28)	40 (31)	47 (30)	69 (31)	55 (30)	64 (31)	55 (30)	49 (29)	51 (31)	31 (30)	30 (31)	69 (151)	69 (363)
AVERAGE DAILY MEAN	26 (31)	30 (28)	30 (31)	37 (30)	47 (31)	42 (30)	35 (31)	39 (30)	35 (29)	27 (31)	20 (30)	20 (31)	40 (151)	32 (363)
MAX PEAK:MIN RATIO	18.500	13.500	18.000	16.333	8.700	7.500	12.250	31.000	21.667	16.500	14.500	17.000	31.000	31.000
NO. OF DAYS	(31)	(28)	(31)	(30)	(31)	(30)	(31)	(30)	(29)	(31)	(30)	(31)	(151)	(363)
AVERAGE PEAK:MIN RATIO	5.509	5.687	5.986	5.159	3.732	3.570	5.145	5.718	7.120	4.823	6.745	5.298	5.035	5.363
NO. OF DAYS	(31)	(28)	(31)	(30)	(31)	(30)	(31)	(30)	(29)	(31)	(30)	(31)	(151)	(363)
MAX 9AM-4PM AVERAGE	44 (31)	52 (27)	50 (31)	59 (30)	80 (31)	78 (30)	79 (31)	70 (30)	65 (28)	61 (31)	42 (30)	32 (31)	80 (150)	80 (361)
MONTHLY 9AM-4PM AVERAGE	36 (31)	40 (27)	42 (31)	48 (30)	59 (31)	54 (30)	46 (31)	52 (30)	50 (28)	36 (31)	30 (30)	27 (31)	52 (150)	43 (361)
MAX 7AM-7PM AVERAGE	41 (31)	50 (28)	45 (31)	56 (30)	80 (31)	70 (30)	75 (31)	68 (30)	61 (29)	61 (31)	39 (30)	31 (31)	80 (151)	80 (363)
MONTHLY 7AM-7PM AVERAGE	32 (31)	36 (28)	38 (31)	45 (30)	58 (31)	52 (30)	43 (31)	49 (30)	45 (29)	33 (31)	26 (30)	24 (31)	49 (151)	40 (363)
MONTHLY MEAN	26 (710)	30 (638)	30 (708)	37 (689)	47 (708)	42 (684)	35 (711)	39 (703)	35 (667)	27 (709)	21 (689)	20 (712)	40 (3473)	32 (8328)
SUM0 EXPOSURE INDEX	18213 (710)	19020 (638)	21579 (708)	25334 (689)	33540 (708)	28734 (684)	24615 (711)	27320 (703)	23594 (667)	19239 (709)	14128 (689)	13951 (712)	137803 (3473)	269267 (8328)
SUM60 EXPOSURE INDEX	-	-	61	626	12998	7670	4556	7624	4285	754	-	-	37133	38574
NO. OF HOURS	(0)	(0)	(1)	(10)	(186)	(111)	(64)	(110)	(65)	(11)	(0)	(0)	(536)	(558)
SUM80 EXPOSURE INDEX	-	-	-	-	2026	673	1196	1266	-	173	-	-	5161	5334
NO. OF HOURS	(0)	(0)	(0)	(0)	(24)	(8)	(14)	(15)	(0)	(2)	(0)	(0)	(61)	(63)
W126 EXPOSURE INDEX	400	676	988	2148	9696	6124	3967	5843	3412	934	171	91	29041	34449
NO. OF HOURS	(710)	(638)	(708)	(689)	(708)	(684)	(711)	(703)	(667)	(709)	(689)	(712)	(3473)	(8328)

Concentrations in parts per billion (ppb)

Exposures in parts per billion-hours (ppb-hr)

Final Validation

\* Statistics defined in the Quick Look subsection of the Glossary

5/7/02

Frequency Distribution															
Pinnacles National Monument															
Monitoring Season: 01/01/01 - 12/31/01 <sup>1</sup>															
Averaging Period	% Obs. <sup>3</sup>	# Obs. <sup>2</sup>	Min. Obs. <sup>4</sup>	10	30	50	Percentile <sup>5</sup>			99	Max. Obs.	2nd Max.	Arith. Mean	Geo. Mean	Geo. Stdv.
							70	90	95						
1-Hour	99	8328	0.024	0.031	0.041	0.049	0.058	0.075	0.080	0.091	0.108	0.100	0.0512	0.0488	1.37
Concentrations in parts per million (ppm)															

<sup>1</sup>Records for this report are selected in accordance with the AIRS Geo-Common file criteria. These criteria are based on the state-specific Monitoring Season defined in AIRS.

<sup>2</sup>The number of observations (# Obs.) includes all valid observations recorded within the Monitoring Season.

<sup>3</sup>The percent of valid observations (% Obs.) is the percentage of valid days to the number of possible monitoring days during the Monitoring Season. A valid day is defined as a day with 9 or more valid observations between 9:00 a.m. and 9:00 p.m..

<sup>4</sup>The minimum observation value (Min. Obs.) is the minimum daily maximum recorded during the Monitoring Season.

<sup>5</sup>The percentiles and other statistics are derived from the daily maximums.

**Ozone Standards Report and  
Daily Maximum 1-Hour Concentrations (ppm)  
Pinnacles National Monument**

**01/01/2001 - 12/31/2001**

Day	Jan-01	Feb-01	Mar-01	Apr-01	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01
1	.047 M	.044 T	.049 T	.051 S	.061 T	.060 F	.087 S	.056 W	.072 S	.091 M	.035 T	.032 S
2	.044 T	.042 F	.045 F	.056 M	.059 W	.046 S	.100 M	.076 T	.068 S	.068 T	.040 F	.034 S
3	.045 W	.042 S	.047 S	.055 T	.067 T	.060 S	.089 T	.063 F	.057 M	.058 W	.041 S	.029 M
4	.047 T	.039 S	.045 S	.060 W	.065 F	.057 M	.053 W	.054 S	.058 T	.038 T	.046 S	.027 T
5	.045 F	.037 M	.042 M	.052 T	.071 S	.070 T	.066 T	.060 S	.048 W	.032 F	.043 M	.034 W
6	.050 S	.042 T	.036 T	.045 F	.084 S	.079 W	.061 F	.080 M	.066 T	.029 S	.027 T	.032 T
7	.052 S	W	.048 W	.050 S	.084 M	.078 T	.069 S	T	.071 F	.042 S	.044 W	.033 F
8	.042 M	.045 T	.043 T	.049 S	.085 T	.059 F	.070 S	.079 W	.071 S	.043 M	.043 T	.035 S
9	.035 T	.040 F	.044 F	.049 M	.080 W	.064 S	.051 M	.062 T	.067 S	.048 T	.045 F	.036 S
10	.041 W	.040 S	.046 S	.052 T	.076 T	.058 S	.054 T	.058 F	.067 M	.047 W	.043 S	.031 M
11	.042 T	.043 S	.046 S	.048 W	.071 F	.059 M	.046 W	.071 S	.060 T	.034 T	.031 S	.033 T
12	.039 F	.043 M	.051 M	.057 T	.058 S	.067 T	.061 T	.056 S	.058 W	.040 F	.027 M	.031 W
13	.036 S	.041 T	.053 T	.053 F	.050 S	.079 W	.076 F	.062 M	.056 T	.043 S	.030 T	.028 T
14	.039 S	.041 W	.054 W	.055 S	.068 M	.074 T	.043 S	.080 T	.068 F	.050 S	.030 W	.034 F
15	.036 M	.048 T	.048 T	.059 S	.062 T	.073 F	.037 S	.083 W	.079 S	.052 M	.029 T	.033 S
16	.037 T	.054 F	.051 F	.055 M	.069 W	.071 S	.036 M	.092 T	.057 S	.048 T	.028 F	.030 S
17	.041 W	.055 S	.052 S	.049 T	.075 T	.078 S	.049 T	.087 F	.056 M	.036 W	.036 S	.028 M
18	.037 T	.044 S	.045 S	.054 W	.079 F	.056 M	.049 W	.075 S	.065 T	.046 T	.027 S	.029 T
19	.037 F	.049 M	.055 M	.048 T	.065 S	.068 T	.030 T	.048 S	.063 W	.041 F	.038 M	.029 W
20	.046 S	.045 T	.054 T	.047 F	.068 S	.084 W	.035 F	.043 M	.072 T	.053 S	.030 T	.033 T
21	.040 S	.041 W	.046 W	.049 S	.057 M	.088 T	.048 S	.055 T	.068 F	.040 S	.025 W	.030 F
22	.050 M	.044 T	.040 T	.049 S	.076 T	.083 F	.056 S	.046 W	.064 S	.040 M	.034 T	.030 S
23	.041 T	.040 F	.049 F	.058 M	.076 W	.058 S	.053 M	.058 T	.041 S	.029 T	.032 F	.032 S
24	.038 W	.040 S	.037 S	.058 T	.075 T	.063 S	.052 T	.063 F	.038 M	.039 W	.034 S	.031 M
25	.038 T	.046 S	.053 S	.065 W	.076 F	.059 M	.053 W	.078 S	T	.046 T	.031 S	.033 T
26	.041 F	.039 M	.050 M	.057 T	.059 S	.042 T	.067 T	.071 S	.057 W	.046 F	.034 M	.028 W
27	.038 S	.045 T	.053 T	.044 F	.058 S	.044 W	.072 F	.087 M	.046 T	.034 S	.034 T	.027 T
28	.042 S	.049 W	.049 W	.057 S	.053 M	.060 T	.060 S	.068 T	.049 F	.028 S	.035 W	.031 F
29	.039 M		.044 T	.065 S	.087 T	.080 F	.053 S	.054 W	.060 S	.027 M	.031 T	.030 S
30	.038 T		.054 F	.058 M	.108 W	.075 S	.029 M	.048 T	.064 S	.025 T	.032 F	.024 S
31	.040 W		.061 S	.084 T		.049 T	.062 F			.033 W		
Valid Days	31	27	31	30	31	30	31	30	29	31	30	30
Maximum	.052	.055	.061	.065	.108	.088	.100	.092	.079	.091	.046	.036
Violations	0	0	0	0	0	0	0	0	0	0	0	0

8305 Total Samples  
95.1 % Possible  
361 Valid daily maxima  
Final Validation

Concentrations in parts per million (ppm)

5/9/02

Pinnacles National Monument

2001 Attainment Status With U.S. Environmental Protection Agency (EPA)  
PRIMARY Ozone National Ambient Air Quality Standard

Ozone Season: January through December

The primary National Ambient Air Quality Standard for ozone is designed to protect human health. The level of the primary ozone standard promulgated by the EPA on July 18, 1997 is 0.08 parts per million (ppm) [80 parts per billion, (ppb)], daily maximum 8-hour average. The primary ozone standard is met at an ambient monitoring site when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.08 ppm. This standard is not met when the 3-year average is greater than 0.08 ppm. Using the EPA's rounding convention, a computed 3-year average ozone concentration of 0.085 ppm (85 ppb) is the smallest value that is greater than the level of the 0.08 ppm standard.

The primary standard requires 90 percent data completeness, on average, during the 3-year period, with no single year within the period having less than 75 percent data completeness. This data completeness requirement would have to be satisfied in order to determine that the standard has been met at a monitoring site. However, calendar years with less than 75 percent data completeness are included in the computation if the annual fourth-highest daily maximum 8-hour concentration is greater than the level of the standard. A site could be found not to have met the standard with less than complete data. The percent data completeness is the percent of valid ozone monitoring days. A day is valid if valid 8-hour averages are available for at least 75 percent of possible hours in the day (i.e., at least 18 of the 24 averages). An 8-hour average is considered valid if at least 75 percent (or 6) of the hourly averages for the 8-hour period are available.

The table below lists the 3-year average fourth-highest daily maximum 8-hour ozone concentration based on data collected during the reported year and the two previous years. This is the number to compare to the level of the new primary standard. The 3-year average data completeness percent and the reported year highest five daily maximum 8-hour averages are also tabulated. A 'No' in the Data Comp % Met? column indicates EPA data completeness requirement was not met for the three-year period.

Year	3-Year Avg 4th High Daily Max 8-hr Ozone (ppb)	3-Year Avg Data Complete %	Data Complete % Met?	Annual 1st High Daily Max 8-hr Ozone (ppb)	Annual 2nd High Daily Max 8-hr Ozone (ppb)	Annual 3rd High Daily Max 8-hr Ozone (ppb)	Annual 4th High Daily Max 8-hr Ozone (ppb)	Annual 5th High Daily Max 8-hr Ozone (ppb)
2001	79	88%	No	88	86	80	79	78

Ozone Analyzer			
10 Highest Daily 1-Hour Average Maximum Concentrations Pinnacles National Monument			
Final Validation 01/01/2001 - 12/31/2001			
Value	Date	Hour	Concentration (ppb)
Ozone Analyzer			
1	05/30/2001	19	108
2	07/02/2001	18	100
3	08/16/2001	16	92
4	10/01/2001	18	91
5	07/03/2001	14	89
6	08/07/2001	18	89
7	06/21/2001	14	88
8	05/29/2001	18	87
9	07/01/2001	17	87
10	08/17/2001	17	87**

\*\* This value was also recorded on one or more days later in the reported period.

Episodes with 1-Hour Ozone Concentrations  
 ≥ 100 ppb and > 124 ppb  
 Pinnacles National Monument

01/01/2001 - 12/31/2001  
 FINAL VALIDATION

Site	Date	Beginning Hour	No. Hours		Max (ppb)
			≥ 100 ppb	>124 ppb	
PINN-ES	05/30/01	19	1	0	108
PINN-ES	07/02/01	18	1	0	100
		<b>Total</b>	2	0	108

Note: The primary and secondary national ambient air standard for ozone that applied in 1996 is 0.12 ppm over a one hour period not to be exceeded more than once per year. (A value greater than .12 ppm, 124 ppb, or 235 ug/m<sup>3</sup> exceeds the standard.) (40 CFR 50.9 with reference to Appendix D and H.)

**Episodes with 8-Hour Average Ozone Concentrations > 84 ppb**

**Pinnacles National Monument**

01/01/2001 - 12/31/2001

**FINAL VALIDATION**

Site	Date	Start and End Time of Daily Maximum 8-Hour Average > 84 ppb (hr)	Daily Maximum 8-Hour Average (ppb)	Number of 8-Hour Averages > 84 ppb During the Day
PINN-ES	05/30/01	13 - 20	88	5
PINN-ES	07/02/01	13 - 20	86	3
	2	Days with 8-hour average concentrations > 84 ppb		

Note: This table presents episodes of high ozone based on running 8-hour averages. In 1997, the EPA published new primary and secondary national ambient air quality standards for ozone based on 8-hour average ozone concentrations. Attainment of the new primary standard is reached if the annual fourth highest daily maximum 8-hour ozone concentration, averaged over three years, does not exceed 0.08 ppm (84 ppb or 157 ug/m<sup>3</sup>).

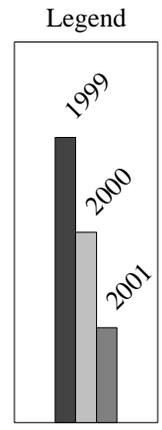
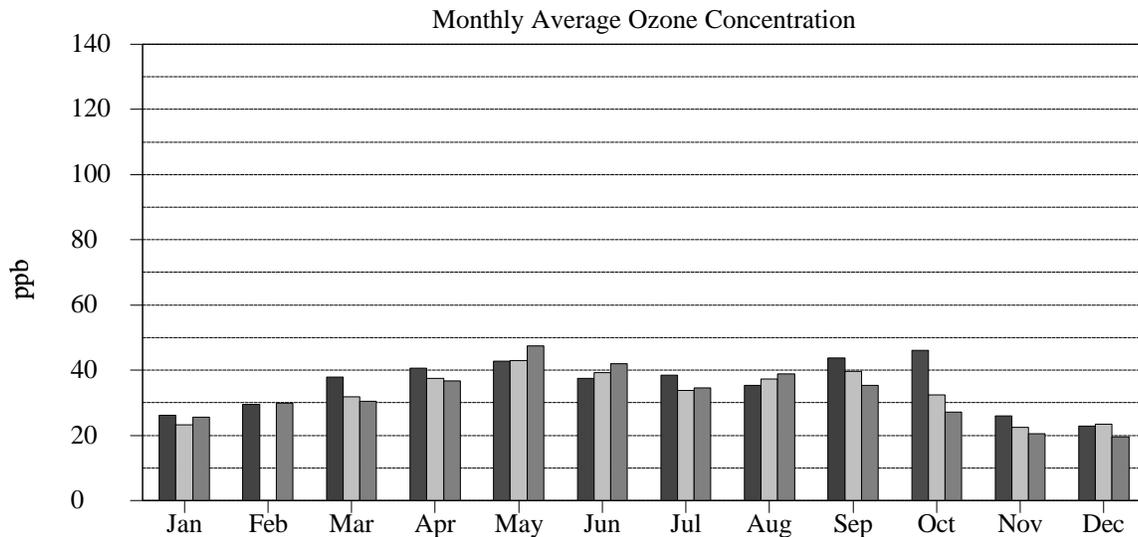
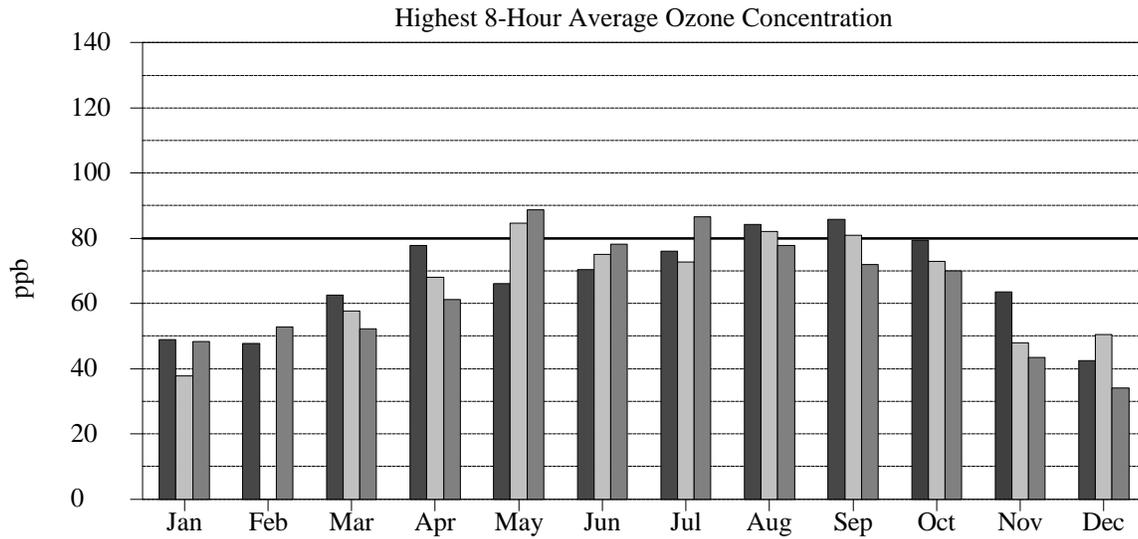
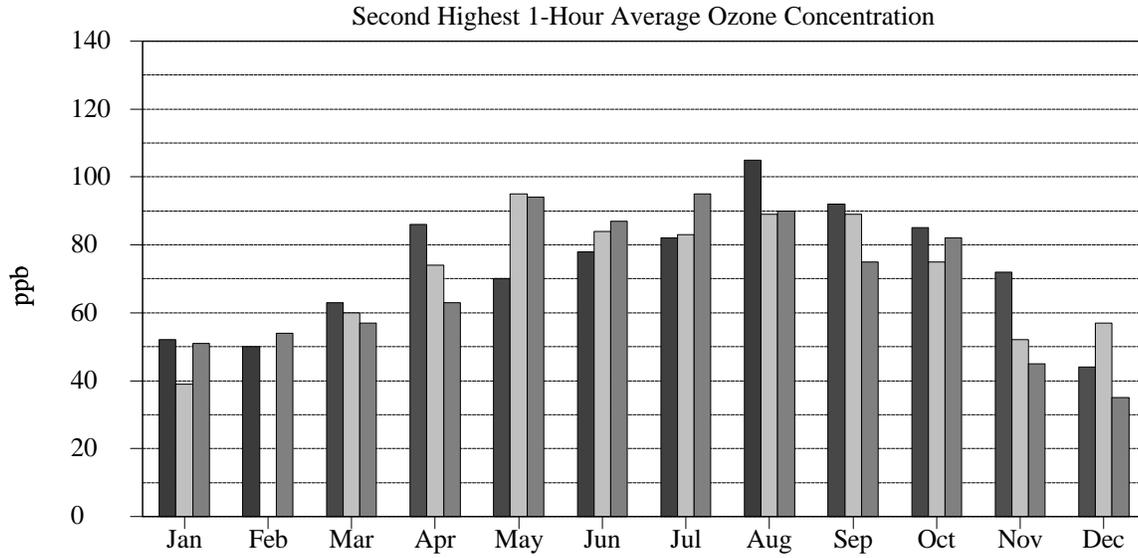
Ozone Rank Listings of Second Highest 1-Hour Average Concentrations, 4th Highest 8-Hour Average Concentrations, and Annual SUM60 Exposure Index for All NPS Monitoring Sites

01/01/2001 - 12/31/2001

Second Highest 1-Hour Average Concentration		
Site	Rank	Concentration (ppb)
CACO-XX	1	139
CHAM-XX	2	127
SEKI-AS	3	119
ACAD-CM	4	118
SEKI-LP	5	117
ACAD-MH	6	112
GRSM-CD	7	110
COSW-BL	8	109
COWP-XX	9	109
SEKI-LK	10	108
YOSE-TD	11	107
GRSM-CM	12	105
SHEN-BM	13	104
JOTR-YV	14	100
PINN-ES	15	100
MACA-HM	16	95
GRSM-LR	17	93
DEVA-PV	18	92
GRSM-PK	19	92
GRSM-CC	20	88
ROMO-LP	21	84
LAVO-ML	22	83
GRBA-MY	23	80
MEVE-MY	24	76
YELL-WT	25	76
SAGU-PC	26	75
CHIS-XX	27	74
MORA-TW	28	74
BIBE-KB	29	73
GRCA-AS	30	73
VOYA-SB	31	73
CANY-IS	32	72
EVER-BC	33	72
CHIR-ES	34	71
CRMO-VC	35	69
DENA-HQ	36	63
THRO-VC	37	63
NOCA-MM	38	58
GLAC-WG	39	55
OLYM-VC	40	54
VIIS-LP	41	52
HAVO-TH	42	43

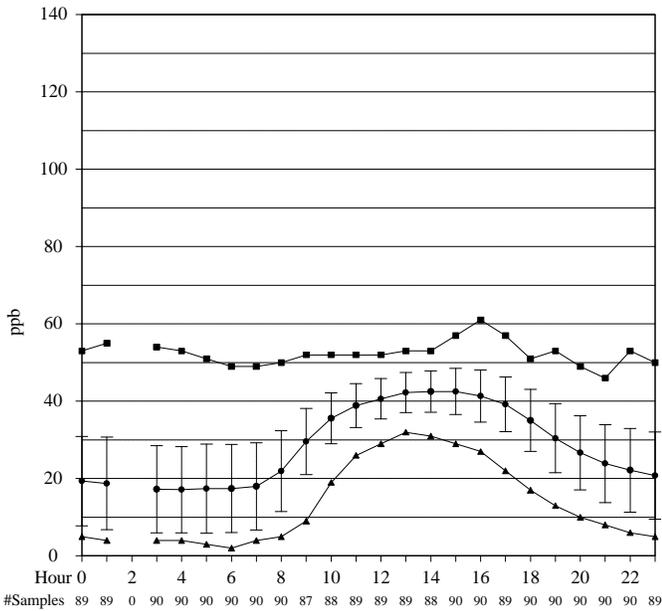
4th Highest 8-hour Average Concentration		
Site	Rank	Concentration (ppb)
CACO-XX	1	105
SEKI-AS	2	104
ACAD-CM	3	101
SEKI-LP	4	101
SEKI-LK	5	96
ACAD-MH	6	94
GRSM-CD	7	93
GRSM-CM	8	91
SHEN-BM	9	90
YOSE-TD	10	87
GRSM-LR	11	86
GRSM-PK	12	83
DEVA-PV	13	81
COWP-XX	14	80
JOTR-YV	15	80
MACA-HM	16	80
PINN-ES	17	79
COSW-BL	18	76
CHAM-XX	19	75
GRSM-CC	20	75
LAVO-ML	21	73
GRCA-AS	22	70
ROMO-LP	23	70
CHIR-ES	24	67
GRBA-MY	25	67
CANY-IS	26	66
SAGU-PC	27	66
YELL-WT	28	66
MEVE-MY	29	65
CHIS-XX	30	64
BIBE-KB	31	62
VOYA-SB	32	62
EVER-BC	33	60
MORA-TW	34	59
THRO-VC	35	58
CRMO-VC	36	56
DENA-HQ	37	55
GLAC-WG	38	49
NOCA-MM	39	48
OLYM-VC	40	45
VIIS-LP	41	43
HAVO-TH	42	37

Annual Sum60 Exposure Index			
Site	Rank	Sum60 Count	
SEKI-AS	1	183484	2389
GRSM-CM	2	165410	2388
SEKI-LP	3	154722	2066
SEKI-LK	4	154150	2115
GRSM-CD	5	124707	1798
DEVA-PV	6	107113	1614
GRSM-LR	7	106526	1564
SHEN-BM	8	102234	1488
YOSE-TD	9	86002	1259
GRSM-PK	10	72157	1075
CACO-XX	11	47572	637
MACA-HM	12	44974	664
JOTR-YV	13	42646	621
COWP-XX	14	38829	561
PINN-ES	15	38574	558
GRCA-AS	16	36890	581
ACAD-CM	17	36401	486
COSW-BL	18	33550	491
GRSM-CC	19	33513	497
LAVO-ML	20	32438	489
ACAD-MH	21	31322	425
GRBA-MY	22	30094	474
CHAM-XX	23	22235	322
MEVE-MY	24	21689	345
CANY-IS	25	20183	321
ROMO-LP	26	19803	306
SAGU-PC	27	19230	295
YELL-WT	28	17146	273
CHIR-ES	29	16673	265
CHIS-XX	30	8340	131
BIBE-KB	31	5243	82
VOYA-SB	32	3415	53
EVER-BC	33	3256	52
MORA-TW	34	2910	45
THRO-VC	35	1893	31
CRMO-VC	36	827	13
DENA-HQ	37	687	11
NOCA-MM	38	122	2
GLAC-WG	39	0	0
HAVO-TH	40	0	0
OLYM-VC	41	0	0
VIIS-LP	42	0	0

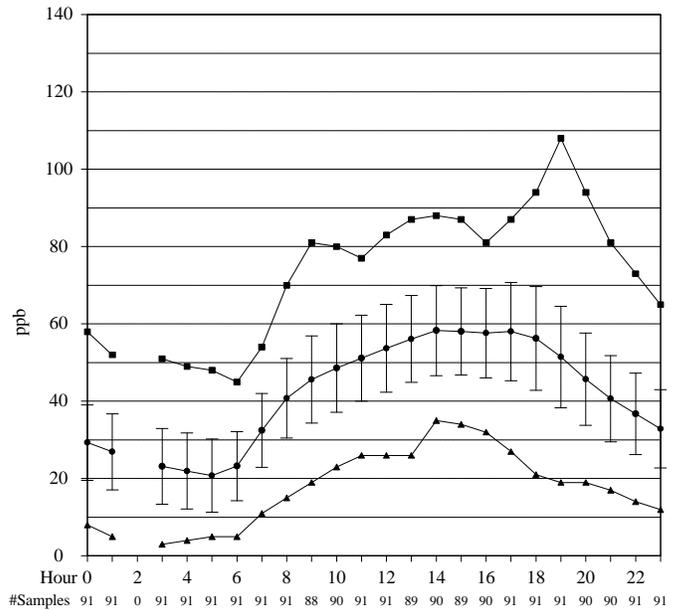




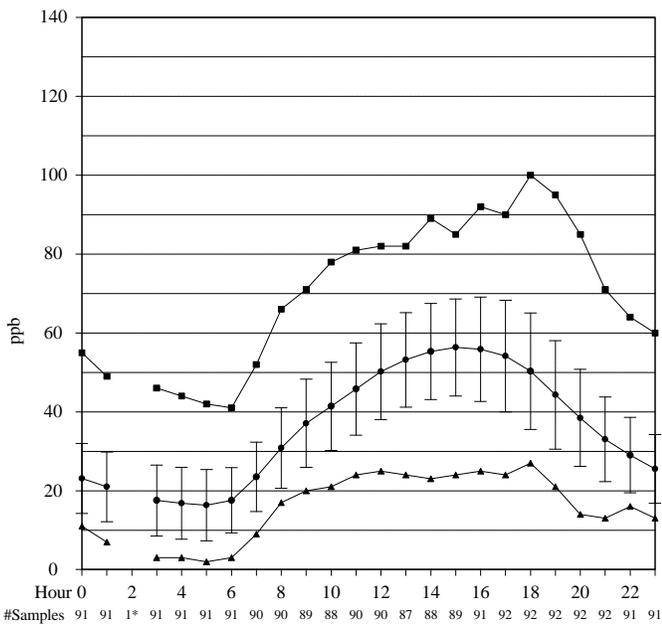
FIRST QUARTER (JAN-MAR)



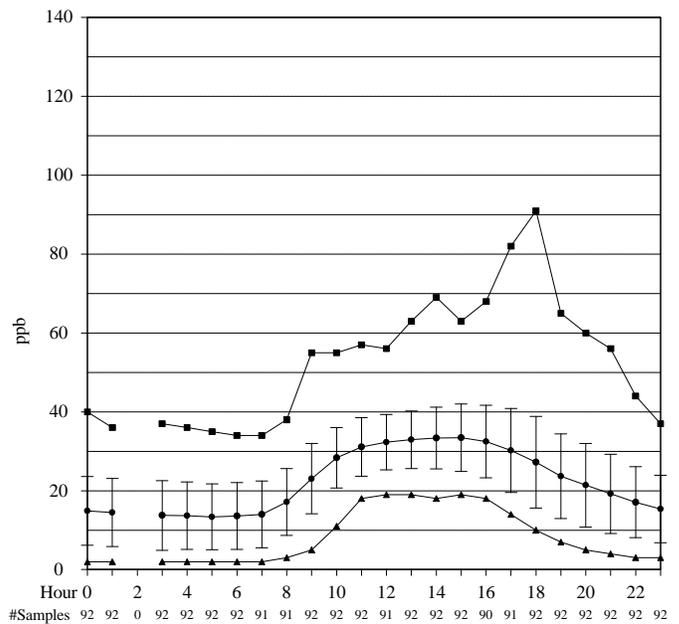
SECOND QUARTER (APR-JUN)



THIRD QUARTER (JUL-SEP)



FOURTH QUARTER (OCT-DEC)

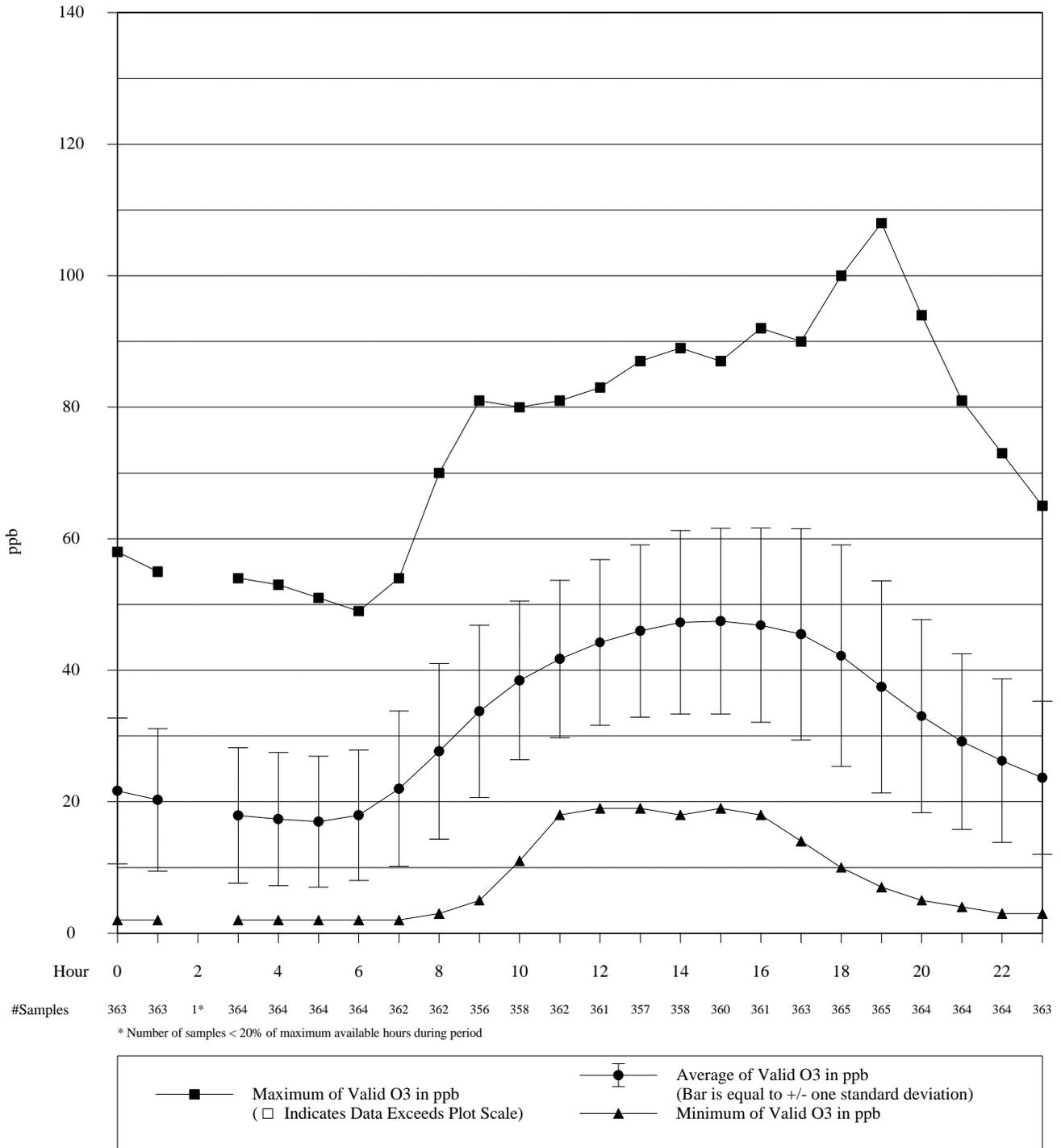


\* Number of samples < 20% of maximum available hours during period

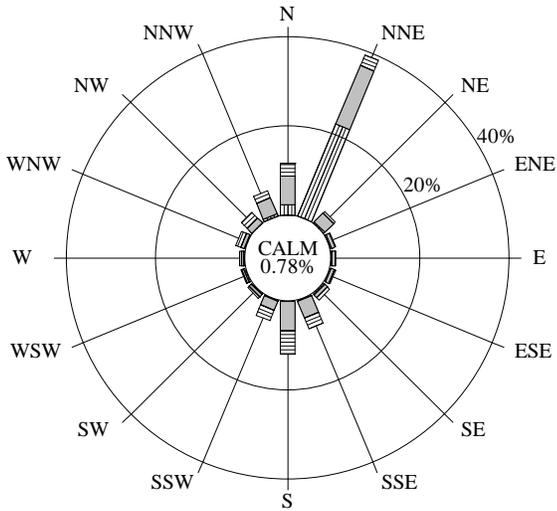
Maximum of Valid O3 in ppb  
 (□ Indicates Data Exceeds Plot Scale)

Average of Valid O3 in ppb  
 (Bar is equal to +/- one standard deviation)

Minimum of Valid O3 in ppb

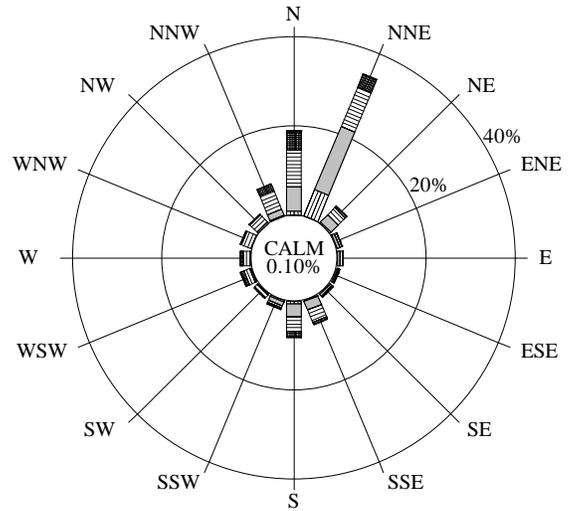


FIRST QUARTER (JAN-MAR)



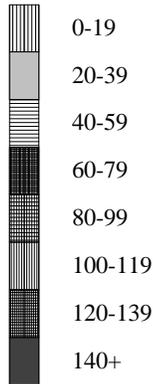
95.2% Collected 95.2% Valid  
2160 Possible /2056 Collected /2056 Valid  
(includes WS and WD)

SECOND QUARTER (APR-JUN)

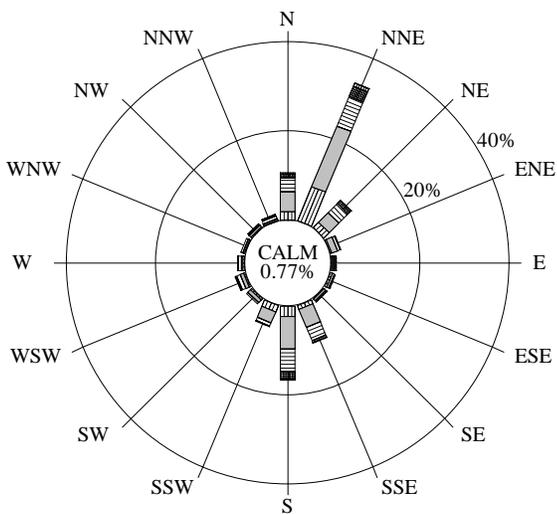


95.3% Collected 95.3% Valid  
2184 Possible /2081 Collected /2081 Valid  
(includes WS and WD)

Ozone (ppb)

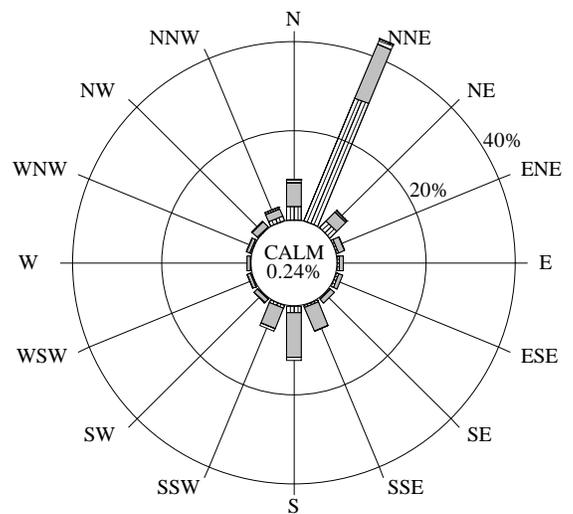


THIRD QUARTER (JUL-SEP)

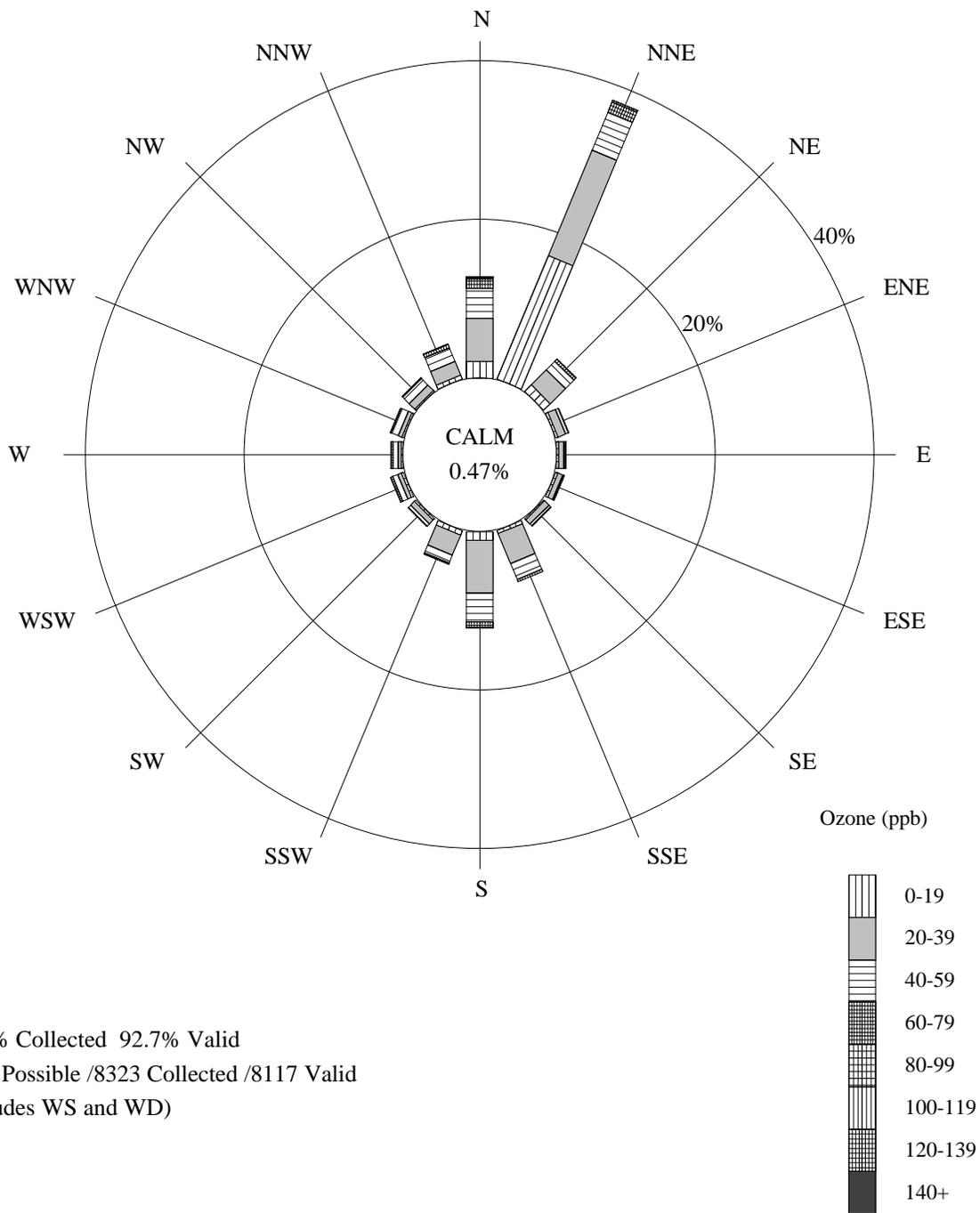


94.0% Collected 87.8% Valid  
2208 Possible /2076 Collected /1938 Valid  
(includes WS and WD)

FOURTH QUARTER (OCT-DEC)



95.6% Collected 92.5% Valid  
2208 Possible /2110 Collected /2042 Valid  
(includes WS and WD)



95.0% Collected 92.7% Valid  
 8760 Possible /8323 Collected /8117 Valid  
 (includes WS and WD)

Ozone Precision Check Summary  
Pinnacles National Monument

Precision checks are required by the Environmental Protection Agency (EPA) of all monitoring instruments collecting data which are to be submitted to the EPA Aerometric Information Retrieval System (AIRS). A precision check is performed by challenging the pollutant analyzer with a known concentration of gas (between 0.08 and 0.10 ppm for ozone and sulfur dioxide) from the pollutant transfer standard. This precision check must be performed at least every 14 days of monitoring operation. The percent difference between the analyzer and the transfer standard is then calculated.<sup>1</sup> According to NPS Standard Operating Procedures, the pollutant analyzer must respond within 10% of the transfer standard. The table below gives the number of precision checks performed during each quarter, the average<sup>2</sup> of all the individual precision check percent differences for the quarter, and the upper and lower 95% probability limits<sup>3</sup> for precision checks. The probability limits represent the interval having a 95% chance of containing the true average percent difference. The quarterly average percent difference and probability limits should ideally be within +/- 10%.

Final Validation 01/01/2001 - 12/31/2001				
Calendar Quarter	Number of Precision Checks	Average Percent Difference <sup>1 2</sup>	Lower 95% Probability Limit <sup>3</sup>	Upper 95% Probability Limit <sup>3</sup>
1	88	2.09	0.90	3.29
2	88	2.31	1.52	3.11
3	69	2.21	1.13	3.30
4	82	2.40	1.71	3.10

<sup>1</sup> Percent Difference=  $\frac{\text{analyzer} - \text{transfer std}}{\text{transfer std}} \times 100$ .

<sup>2</sup> Average Percent Difference is the mean of all individual precision check percent differences during the quarter.

<sup>3</sup> Upper/Lower 95% Probability Limits=(Average Percent Difference) +/- (1.96)(Standard Deviation of precision check percent differences in the quarter.)

## **2.3 METEOROLOGICAL DATA SUMMARY**

Summary of Selected Meteorological Data

Pinnacles National Monument

Final Validation

01/01/2001 - 12/31/2001

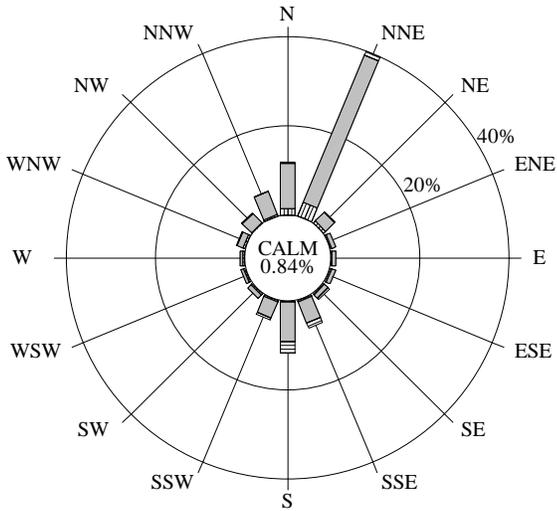
Parameter	Value	Units	Number	Std Dev
<b>SCALAR WIND SPEED</b>				
Average	2.2	m/s	8516	1.1
Maximum	7.3	m/s		
Percent calm = 0.47				
<b>AMBIENT TEMPERATURE</b>				
Average	14.5	degC	8676	9.0
Maximum	42.4	degC		
Minimum	-5.3	degC		
<b>RELATIVE HUMIDITY</b>				
Average	62	percent	8728	27
Maximum	99	percent		
Minimum	4	percent		
<b>PRECIPITATION (Rainfall or Snow melt)</b>				
Average non-zero rate	1.1	mm/hr	365	1.6
Maximum non-zero rate	10.4	mm/hr		
Minimum non-zero rate	.1	mm/hr		
Accumulated during period	395.6	mm		
<b>SOLAR RADIATION</b>				
Average Daily Total	18,254,049	joules/m2day	359	8,809,376
Maximum Daily Total	32,009,600	joules/m2day		
Minimum Daily Total	464,000	joules/m2day		

Note: Calms are included in the average scalar wind speed and are defined as winds less than 0.5 m/s (1.0 mph).

Solar radiation terms are based on the calculation of the total amount of solar energy incident on a unit area during each day. The maximum and minimum daily totals are selected from the list of daily totals. The totals for all days are then added and divided by the number of days to yield the average daily total. Only days with 24 valid values are included in these statistics.

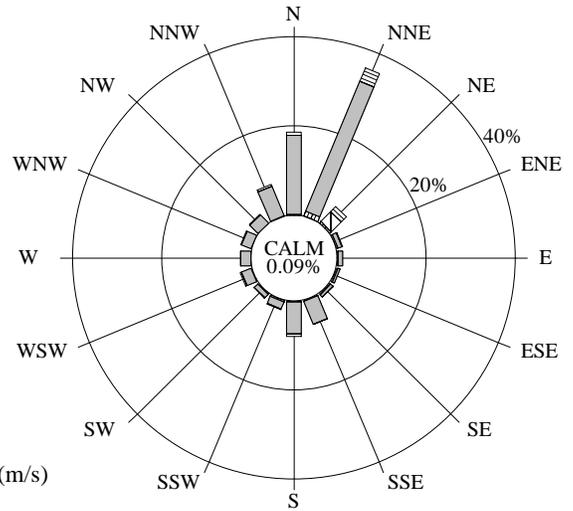
NA indicates instrument not available.

FIRST QUARTER (JAN-MAR)



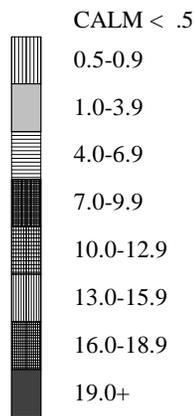
99.7% Collected 99.7% Valid  
2160 Possible /2154 Collected /2154 Valid  
(includes WS and WD)

SECOND QUARTER (APR-JUN)

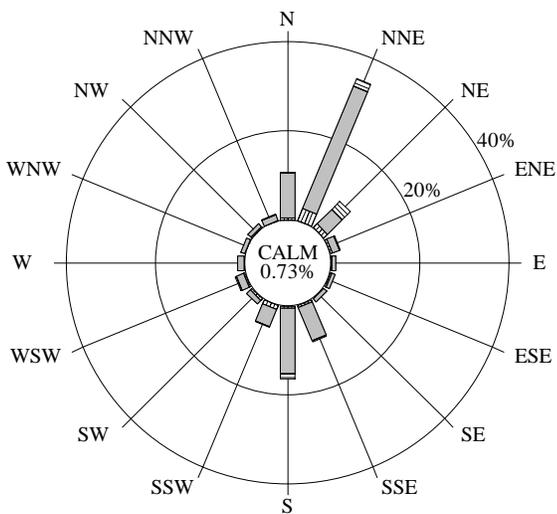


99.8% Collected 99.8% Valid  
2184 Possible /2180 Collected /2180 Valid  
(includes WS and WD)

Scalar Wind Speed (m/s)



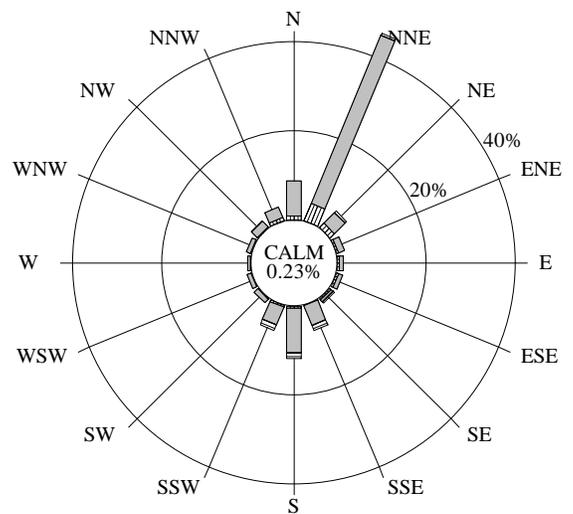
THIRD QUARTER (JUL-SEP)



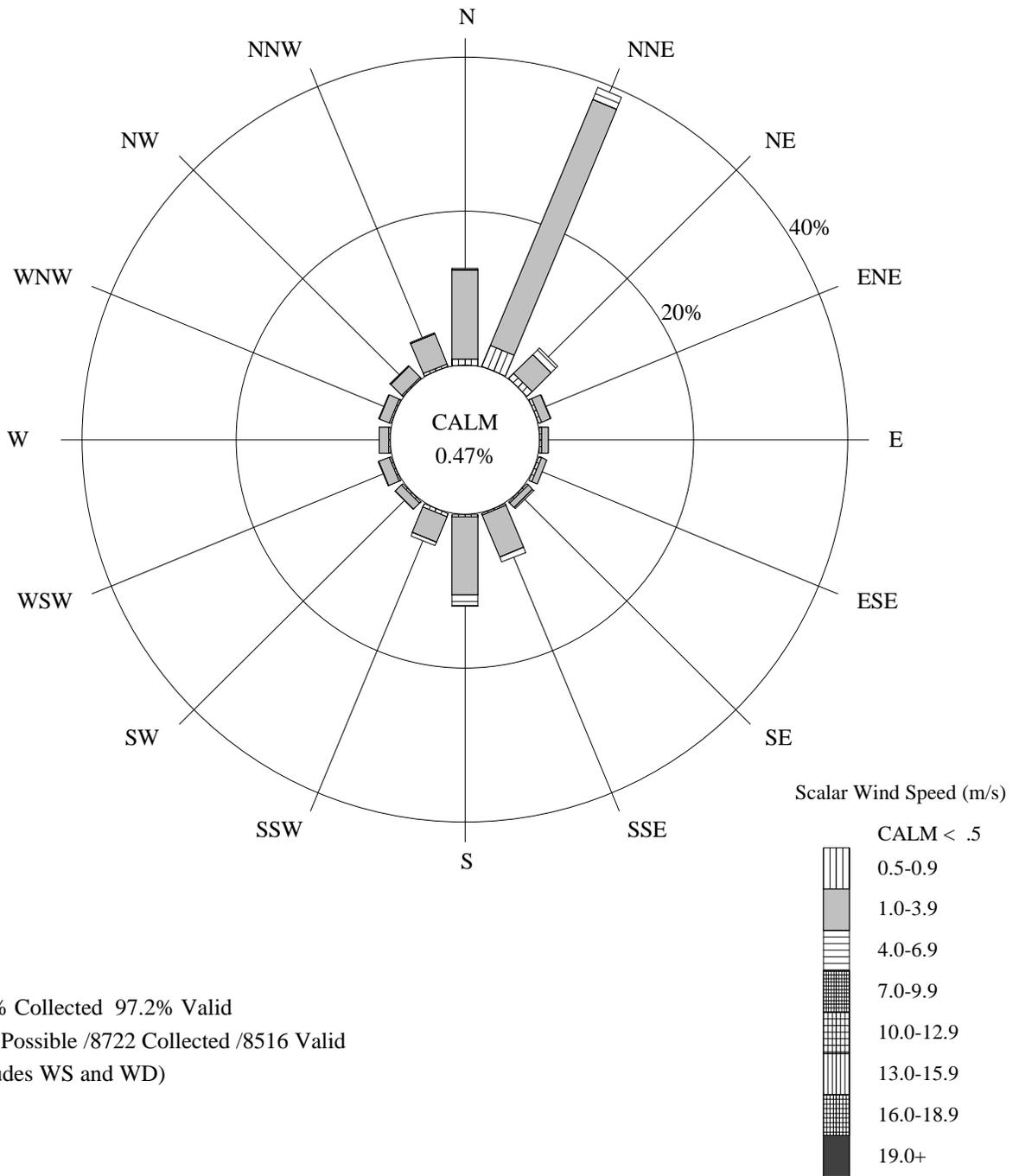
98.7% Collected 92.5% Valid  
2208 Possible /2180 Collected /2042 Valid  
(includes WS and WD)

Final Validation

FOURTH QUARTER (OCT-DEC)



100.0% Collected 96.9% Valid  
2208 Possible /2208 Collected /2140 Valid  
(includes WS and WD)



99.6% Collected 97.2% Valid  
 8760 Possible /8722 Collected /8516 Valid  
 (includes WS and WD)

## 2.4 DRY DEPOSITION DATA SUMMARY

### Clean Air Status and Trends Network (CASTNet) Dry Deposition Monitoring

In 1995, the National Park Service (NPS) and the Environmental Protection Agency (EPA) entered a partnership to jointly measure dry deposition in park units, mostly in the West. A portion of the 1997, 1998, and 1999 data collected from this partnership is presented in this section.

Atmospheric deposition of acidic species takes two pathways: wet deposition and dry deposition. Wet deposition is the result of precipitation events (rain, snow, or fog) that remove particles and gases from the atmosphere. Dry deposition is less event driven, but still involves the transfer of particles and gases from the atmosphere to surfaces and plants. Wet deposition has been well documented for many years. In the national parks, the National Acidic Deposition Program (NADP) measures and reports wet deposition (see the web site at <http://nadp.sws.uiuc.edu> for further information). Dry deposition is much harder to measure and a smaller network of monitoring stations is involved. The method used to measure dry deposition is sometimes called the "inferential method" because air quality concentration data are combined with meteorological measurements and land use functions to compute deposition velocities. The CASTNet program provides long-term estimates of total acidic deposition by adding dry deposition values to wet deposition values.

This annual summary report presents the air quality concentration portion of the dry deposition inferential method, which is the only currently available data set. These data were compiled from the analyses of filters collected by CASTNet deposition filter pack systems in the parks. The filter pack analyses yielded weekly average concentrations of particulate sulfate ( $\text{SO}_4^{2-}$ ), particulate nitrate ( $\text{NO}_3^-$ ), particulate ammonium ( $\text{NH}_4^+$ ), sulfur dioxide ( $\text{SO}_2$ ), and nitric acid ( $\text{HNO}_3$ ). In some cases, the positive ions  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$ , and  $\text{Mg}^{2+}$  were also measured from the filter samples. These concentration data for the individual ionic species are presented as weekly bar charts and summarized by quarter and by year in this report. Concentration data can be used to compare sites and to indicate the amount of acidic species available for deposition. As with the continuous analyzer data, the filter pack concentration data are included on a computer diskette that accompanies this report.

Estimated dry deposition values derived from EPA modeling will be reported at a later time to complete the inferential analyses. When available, these modeling results will be posted on the NPS Air Resources Division Internet web site at <http://www.aqd.nps.gov/ard1> or on the EPA CASTNet site (<http://www.epa.gov/ardpublic/acidrain/castnet/about.html>). Initial CASTNet results have shown that dry deposition can be a significant portion of total acidic deposition.

CASTNet Dry Deposition Monitoring  
Quarterly and Annual Average Concentrations  
Pinnacles National Monument  
1/1/2001 -12/31/2001

Quarter	No. Valid Samples	p-NO <sub>3</sub> (ug/m <sup>3</sup> )	HNO <sub>3</sub> (ug/m <sup>3</sup> )	Total NO <sub>3</sub> (ug/m <sup>3</sup> )	NH <sub>4</sub> (ug/m <sup>3</sup> )	p-SO <sub>4</sub> (ug/m <sup>3</sup> )	SO <sub>2</sub> (ug/m <sup>3</sup> )	SO <sub>4</sub> /SO <sub>2</sub> Ratio
1	9	0.884	0.886	1.756	0.191	0.739	0.203	3.632
2	13	1.484	0.999	2.467	0.253	1.313	0.465	2.822
3	12	1.442	1.488	2.906	0.356	1.775	0.597	2.974
4	14	0.946	1.093	2.022	0.214	0.870	0.282	3.087
Annual Average		1.204	1.128	2.314	0.256	1.192	0.396	3.013
Standard Deviation		0.668	0.638	0.972	0.114	0.605	0.228	

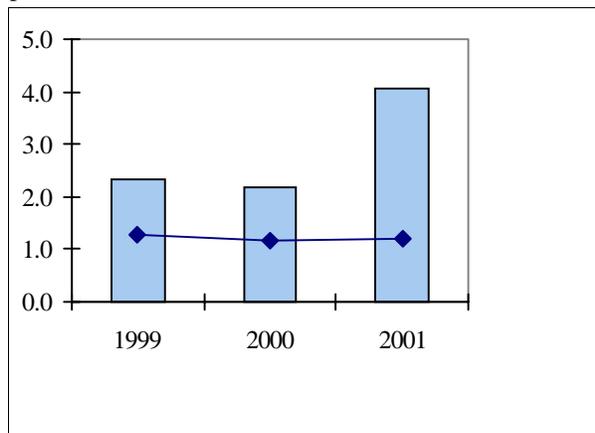
Data Recovery Table			
Total No. Filters	No. Invalidated	Data Capture	No. Valid Hours
48	0	100.0%	8191.0

CASTNet Dry Deposition Monitoring Weekly Concentrations Report  
Pinnacles National Monument  
1/1/2001 - 12/31/2001

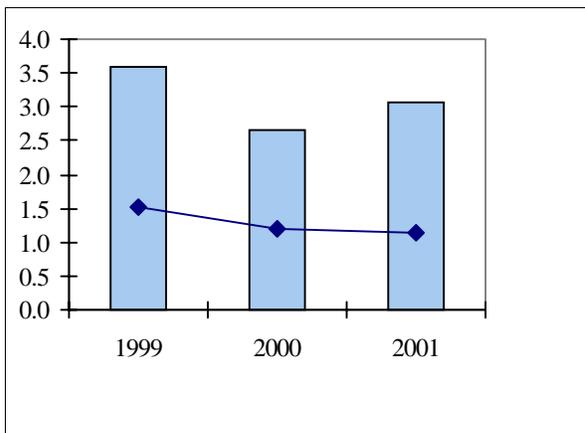
On Date	Off Date	p-NO <sub>3</sub> (ug/m <sup>3</sup> )	HNO <sub>3</sub> (ug/m <sup>3</sup> )	Total NO <sub>3</sub> (ug/m <sup>3</sup> )	NH <sub>4</sub> (ug/m <sup>3</sup> )	p-SO <sub>4</sub> (ug/m <sup>3</sup> )	SO <sub>2</sub> (ug/m <sup>3</sup> )	SO <sub>4</sub> /SO <sub>2</sub> Ratio
12/26/00	01/02/01	0.862	1.455	2.294	0.318	0.448	0.262	1.709
01/30/01	02/08/01	0.482	1.015	1.481	0.194	0.684	0.213	3.211
02/08/01	02/13/01	0.634	0.147	0.778	0.098	0.271	0.107	2.543
02/13/01	02/20/01	0.713	1.151	1.845	0.147	0.590	0.324	1.822
02/20/01	02/27/01	0.662	0.061	0.723	0.111	0.559	0.104	5.365
02/27/01	03/06/01	0.724	0.693	1.406	0.209	0.654	0.138	4.723
03/06/01	03/13/01	1.345	0.665	1.999	0.178	1.111	0.211	5.269
03/13/01	03/20/01	1.393	1.189	2.564	0.183	1.021	0.269	3.803
03/20/01	03/27/01	1.144	1.595	2.714	0.278	1.310	0.203	6.466
03/27/01	04/03/01	1.471	0.895	2.352	0.151	1.028	0.246	4.179
04/03/01	04/10/01	0.896	0.239	1.132	0.190	1.028	0.179	5.747
04/10/01	04/17/01	1.346	0.309	1.650	0.203	1.272	0.249	5.116
04/17/01	04/26/01	1.346	0.751	2.085	0.252	1.178	0.294	3.999
04/26/01	05/01/01	1.410	1.273	2.662	0.308	1.180	0.343	3.444
05/01/01	05/08/01	1.460	0.888	2.333	0.284	1.118	0.597	1.871
05/08/01	05/15/01	2.505	0.947	3.437	0.266	1.991	0.529	3.765
05/15/01	05/22/01	2.121	1.058	3.162	0.329	1.780	0.559	3.184
05/22/01	05/29/01	1.035	1.627	2.636	0.366	1.716	0.401	4.279
05/29/01	06/05/01	1.296	1.487	2.759	0.213	1.374	0.681	2.017
06/05/01	06/12/01	1.181	1.164	2.327	0.259	1.059	0.470	2.252
06/12/01	06/19/01	1.283	1.181	2.445	0.203	0.935	0.791	1.182
06/19/01	06/26/01	1.941	1.173	3.095	0.266	1.407	0.708	1.987
06/26/01	07/03/01	1.269	1.745	2.986	0.351	1.186	0.877	1.353
07/03/01	07/10/01	4.046	1.447	5.471	0.465	3.382	1.101	3.072
07/10/01	07/17/01	0.900	1.183	2.064	0.337	1.811	0.536	3.378
07/17/01	07/24/01	1.410	0.659	2.059	0.325	1.564	0.471	3.319
07/24/01	07/31/01	0.873	1.092	1.948	0.218	1.438	0.687	2.093
07/31/01	08/07/01	1.150	1.546	2.671	0.318	1.161	0.707	1.641
08/07/01	08/14/01	0.848	2.241	3.053	0.542	1.887	0.590	3.197
08/14/01	08/21/01	1.341	1.947	3.257	0.358	1.894	0.595	3.184
08/21/01	09/06/01	1.052	1.207	2.239	0.220	1.323	0.385	3.438
09/06/01	09/11/01	2.981	0.983	3.949	0.341	2.185	0.515	4.242
09/11/01	09/18/01	0.849	1.820	2.640	0.353	1.815	0.286	6.341
09/18/01	09/25/01	0.588	1.981	2.538	0.442	1.660	0.413	4.024
09/25/01	10/03/01	1.141	1.743	2.856	0.379	1.157	0.643	1.800
10/03/01	10/09/01	1.880	1.147	3.009	0.425	1.926	0.266	7.241
10/09/01	10/16/01	1.151	1.030	2.164	0.300	0.769	0.454	1.692
10/16/01	10/23/01	1.546	2.387	3.895	0.258	1.673	0.432	3.873
10/23/01	10/31/01	1.329	1.033	2.345	0.136	1.361	0.300	4.541
10/31/01	11/06/01	0.926	3.075	3.952	0.449	1.128	0.438	2.575
11/06/01	11/14/01	0.767	1.579	2.321	0.149	1.028	0.211	4.862
11/14/01	11/19/01	0.504	1.445	1.927	0.328	0.611	0.239	2.561
11/19/01	11/26/01	0.906	0.223	1.125	0.080	0.643	0.157	4.099
11/26/01	12/03/01	0.647	0.366	1.007	0.091	0.492	0.144	3.417
12/03/01	12/11/01	0.850	0.400	1.243	0.116	0.436	0.263	1.657
12/11/01	12/19/01	0.963	0.345	1.303	0.136	0.369	0.134	2.758
12/19/01	12/26/01	0.503	0.213	0.712	0.063	0.360	0.127	2.839
12/26/01	12/31/01	0.127	0.321	0.443	0.082	0.233	0.140	1.660

Pinnacles National Monument  
 CASTNet Dry Deposition Monitoring  
 Three Year Comparison of Maximum and Average Concentrations

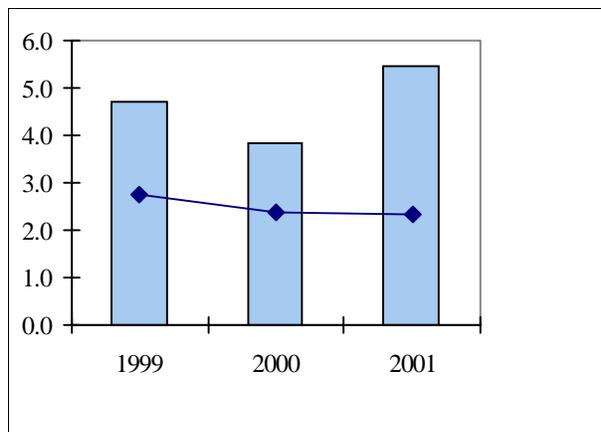
p-NO3



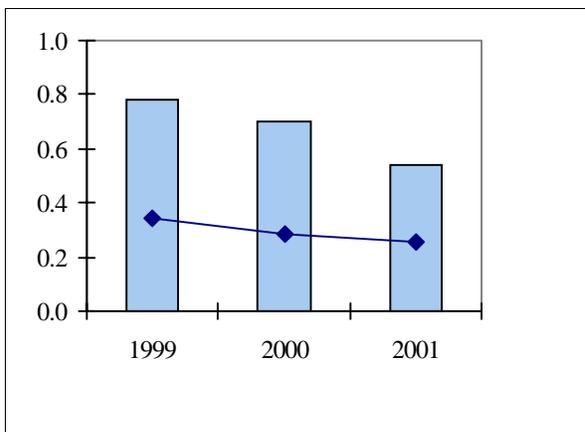
HNO3



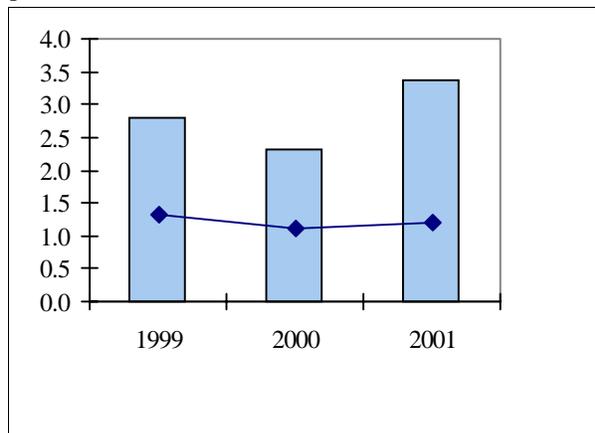
Total NO3



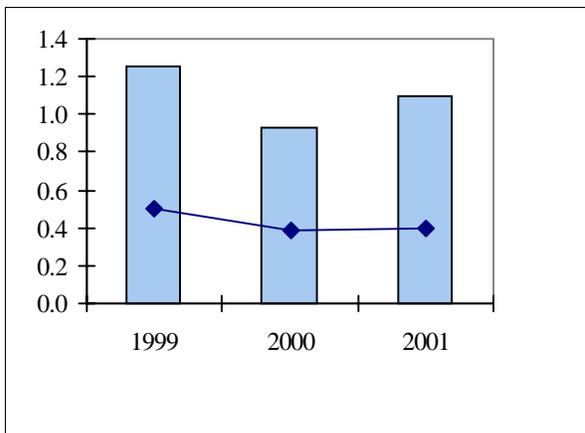
NH4

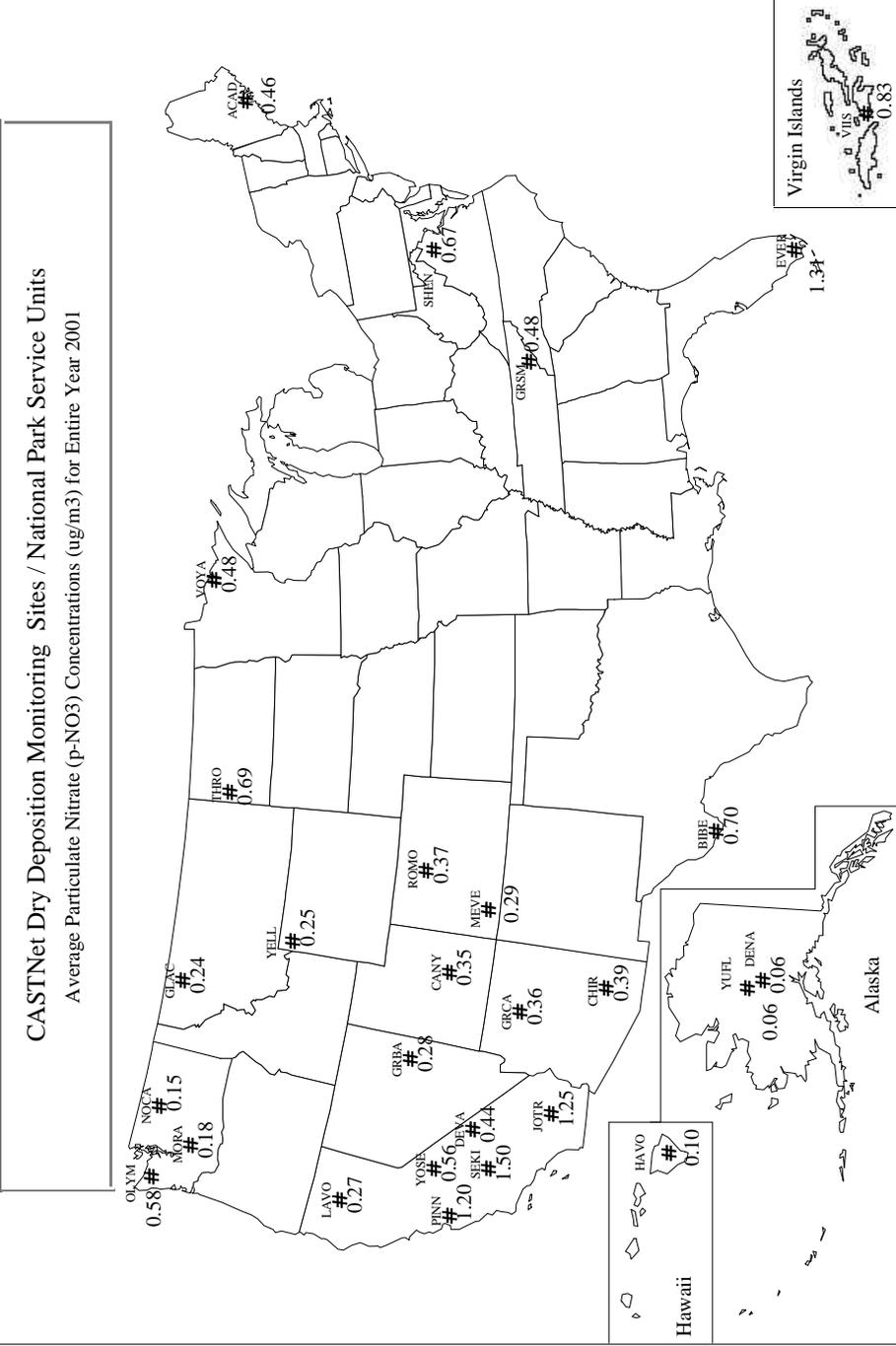


p-SO4



SO2

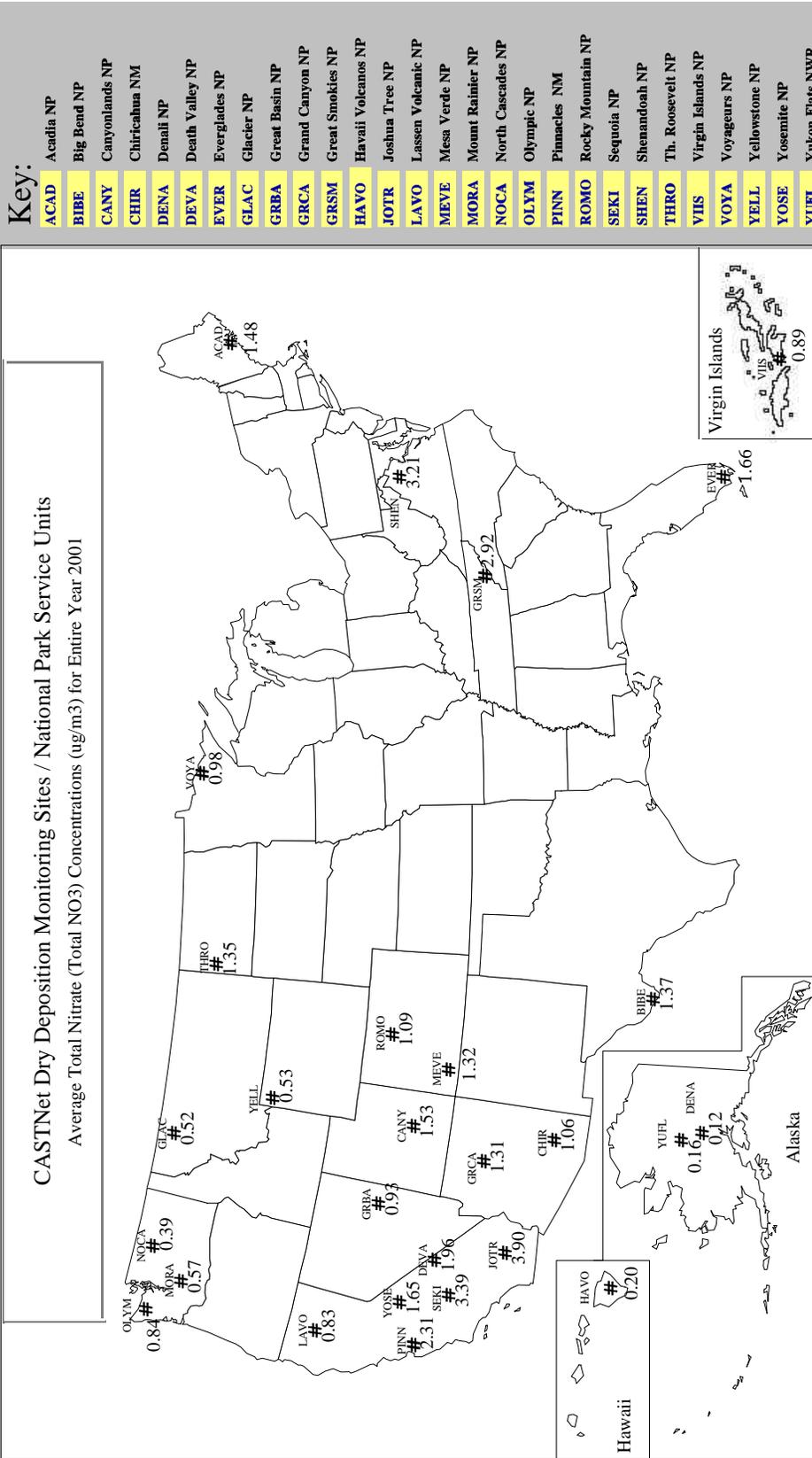


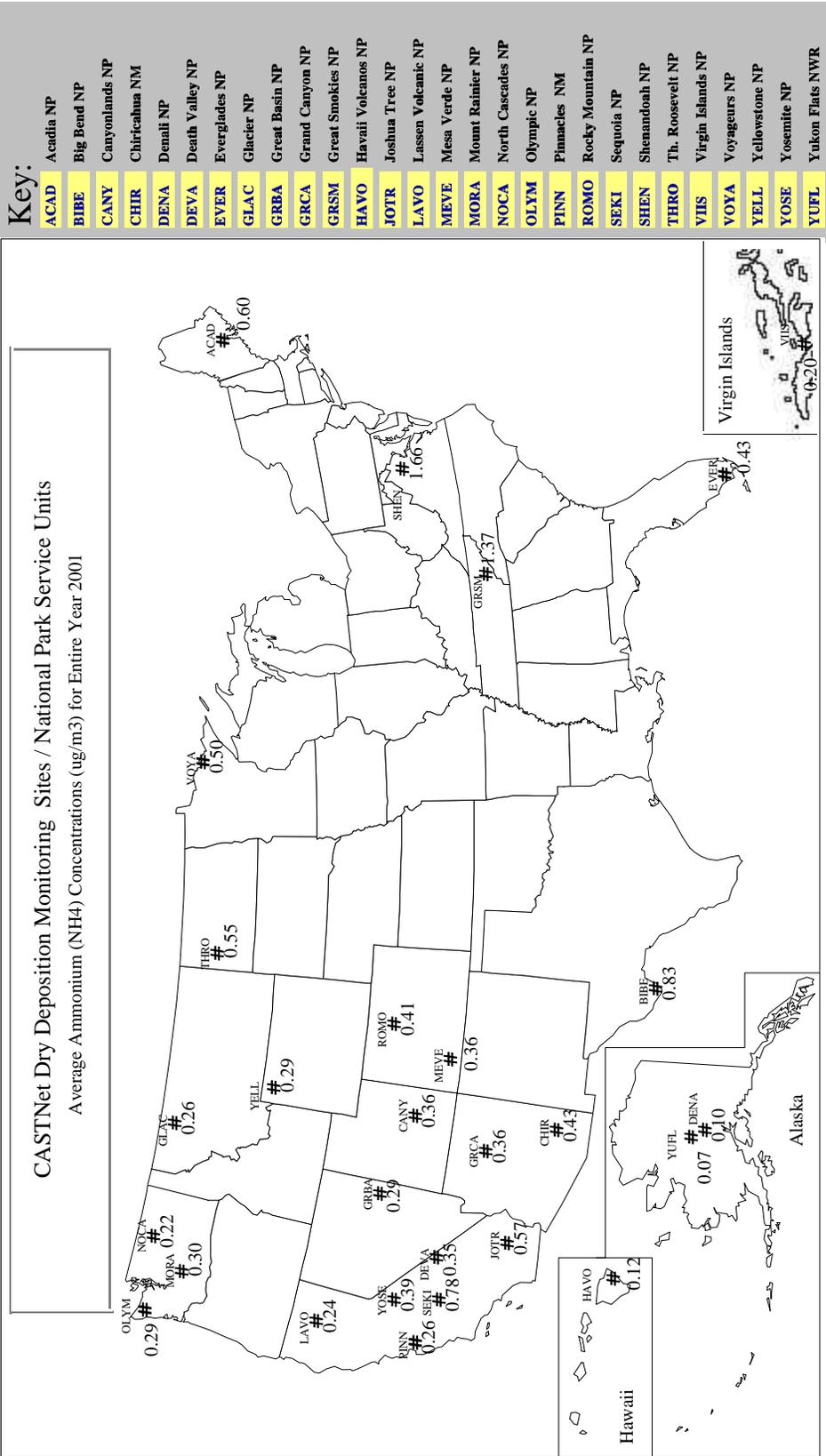


**Key:**

ACAD	Acadia NP
BIBE	Big Bend NP
CANY	Canyonlands NP
CHIR	Chiricahua NM
DENA	Denali NP
DEVA	Death Valley NP
EVER	Everglades NP
GLAC	Glacier NP
GRBA	Great Basin NP
GRCA	Grand Canyon NP
GRSM	Great Smokies NP
HAVO	Hawaii Volcanos NP
JOYR	Joshua Tree NP
LAVO	Lassen Volcanic NP
MEVE	Mesa Verde NP
MORA	Mount Rainier NP
NOCA	North Cascades NP
OLYM	Olympic NP
PINN	Pinnacles NP
ROMO	Rocky Mountain NP
SEKI	Sequoia NP
SHEN	Shenandoah NP
THRO	Th. Roosevelt NP
VIIS	Virgin Islands NP
VOYA	Voyagers NP
YELL	Yellowstone NP
YOSE	Yosemite NP
YUFL	Yukon Flats NWR





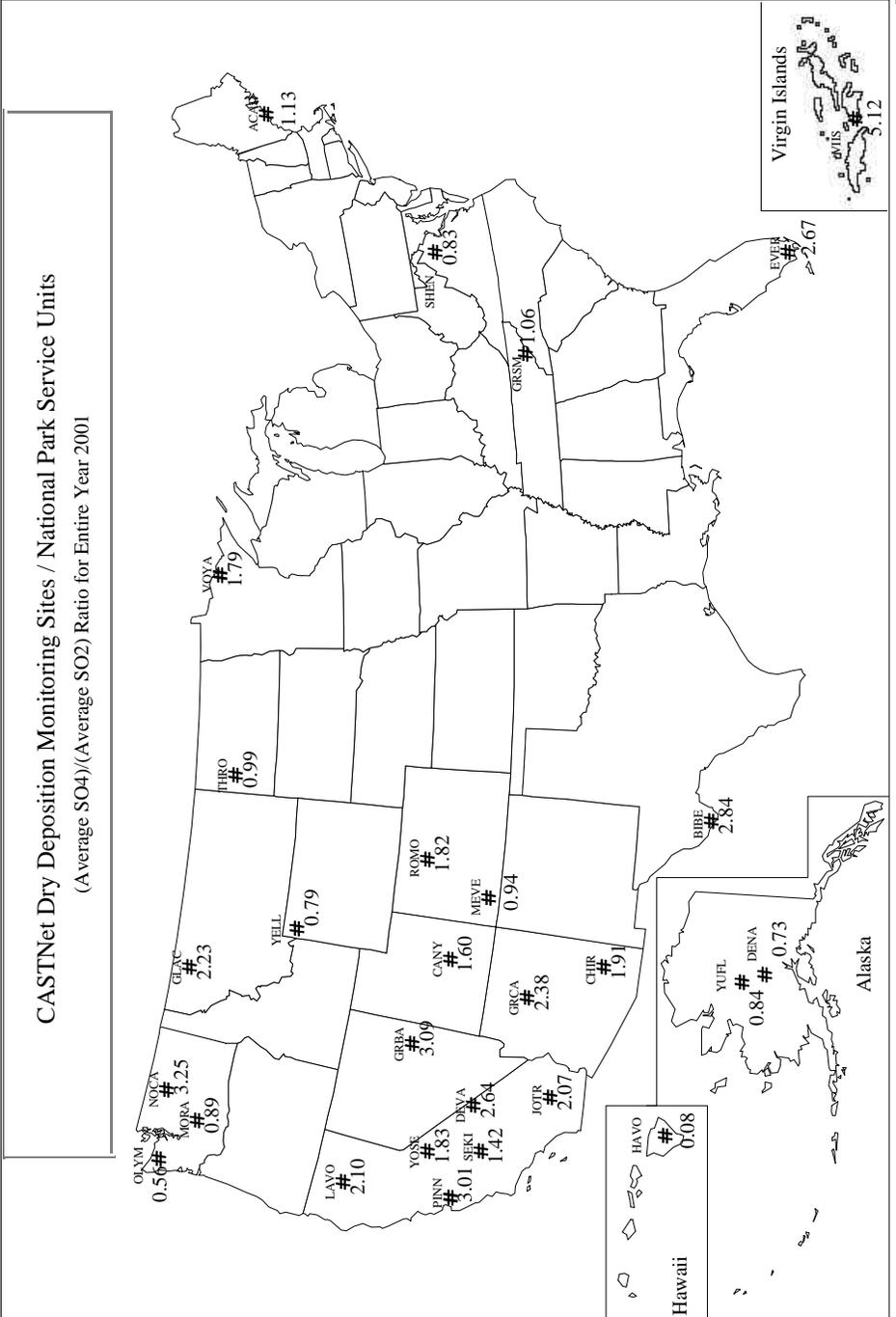






**Key:**

ACAD	Acadia NP
BIBE	Big Bend NP
CANY	Canyonlands NP
CHIR	Chiricahua NM
DENA	Denali NP
DEVA	Death Valley NP
EVER	Everglades NP
GLAC	Glacier NP
GRBA	Great Basin NP
GRCA	Grand Canyon NP
GRSM	Great Smokies NP
HAVO	Hawaii Volcanos NP
JOTR	Joshua Tree NP
LAVO	Lassen Volcanic NP
MEVE	Mesa Verde NP
MORA	Mount Rainier NP
NOCA	North Cascades NP
OLYM	Olympic NP
PINN	Pinnacles NM
ROMO	Rocky Mountain NP
SEKI	Sequoia NP
SHEN	Shenandoah NP
THRO	Th. Roosevelt NP
VIIS	Virgin Islands NP
VOYA	Voyagers NP
YELL	Yellowstone NP
YOSE	Yosemite NP
YUFL	Yukon Flats NWR



### **3.0 NATIONAL PARK SERVICE AIR RESOURCES DIVISION DATA SOURCES**

#### **3.1 GUIDE TO ATTACHED DATA DISKS**

Data disks containing ASCII files of the validated hourly data, as shown in the following table are available. Please return the enclosed postcard or contact the address below. These data may be imported into other programs to perform additional data processing and analysis. The data format of each file is included within each file. The second table describes the validation codes used in the data tables to indicate why data are missing or invalid. Wind and pollutant frequency distribution tables in ASCII format are also included on the diskette if available for this site.

Data users should acknowledge the National Park Service Air Resources Division whenever using these data or any portion of this report.

#### **3.2 OTHER SOURCES FOR RETRIEVING NATIONAL PARK SERVICE GASEOUS POLLUTANT DATA**

The data contained in this report may also be obtained from the following sources:

- National Park Service AIRWeb (<http://www.aqd.nps.gov/natnet/ard>) - available after last quarter 1997
- EPA AIRS database
- Data requests directed to:

NPS Air Resources Division  
Information Management Center  
c/o Air Resource Specialists, Inc.  
1901 Sharp Point Drive, Suite E  
Fort Collins, Colorado 80525  
Telephone: (970) 484-7941  
Fax: (970) 484-3423  
E-Mail: AIR-IMC@AIR-RESOURCE.COM

<b>Data Disk Contents Summary</b>	
File Name (s)	Description
<b>Hourly</b>	
ssssyy.DAT	All Validated Air Quality Data
ssssyymm.ppp	Monthly Data Summary Tables
ssssAN95.Rpp	Annual Wind and Pollutant Frequency Distribution
ssssQ195.Rpp	Quarter 1 Wind and Pollutant Frequency Distribution
ssssQ295.Rpp	Quarter 2 Wind and Pollutant Frequency Distribution
ssssQ395.Rpp	Quarter 3 Wind and Pollutant Frequency Distribution
ssssQ495.Rpp	Quarter 4 Wind and Pollutant Frequency Distribution
Where: ssss = site code yy = year mm = month ppp = air quality data parameter code AN = Annual Qn = Quarter 1-4 R = Wind Frequency distribution table	
<b>CASTNet Weekly Species Summary Data</b>	
File Name (s)	Description
<b>CASTNet</b>	
ssssCNyr.ASC	Weekly averages
Where: ssss = site code CN = CASTNet yr = year asc = ascii file	

NPS IMC AND AIRS INVALID DATA CODES				
NPS IMC VAL CODE	REASON	NEW AIRS CODE	OLD AIRS CODE	AIRS REASON
TO	Sample time out of limits	AG	9973	Sample time out of limits
IW	Instrument warmup	AL	9978	Voided by operator
OE	Operator error	AL	9978	Voided by operator
BM	Begin monitoring	AM	9979	Miscellaneous void
TL	Station temp low	AE	9971	Shelter temp outside limits
OS	Off scale	AM	9979	Miscellaneous void
EM	End monitoring	AM	9979	Miscellaneous void
LI	Local interference	AM	9979	Miscellaneous void
TH	Station temp high	AE	9971	Shelter temp outside limits
IM	Instrument malfunction	AN	9980	Machine malfunction
IN	Interference	AO	9981	Bad weather
RF	Recording system failure	AQ	9983	Collection error
NA	No data	AU	9987	Monitoring waived
PF	Power failure	AV	9988	Power Failure
PC	Precision check	AX	9990	Precision Check
ZS	Instrument zero/span check	AY	9991	QC Control Points (Zero/Span)
SA	System audit	AZ	9992	QC Audit
PA	Performance audit	AZ	9992	QC Audit
MT	Maintenance	BA	9993	Maintenance/Routine Repairs
OR	Out for repair	BA	9993	Maintenance/Routine Repairs
CA	Calibration	BC	9995	Multipoint calibration
SC	Station check	BF	9998	Precision/zero/span

## 4.0 GLOSSARY

### 4.1 DEFINITIONS AND COMPUTATIONAL PROCEDURES FOR NATIONAL PARK SERVICE QUICK LOOK ANNUAL SUMMARY STATISTICS REPORT

The National Park Service Quick Look Annual Summary Statistics Table (Page 2-8) provides ozone summary statistics for various indices computed on a monthly basis for an entire year. Growing season (generically defined to be May 1 - September 30) and annual statistics are also presented under the "MAY-SEP" and "ANNUAL" columns, respectively. All concentrations are expressed in the units of parts per billion (PPB) and exposures in parts per billion-hours (PPB-HR). The definitions for each of the statistics appearing on the Quick Look Annual Summary Table are given below.

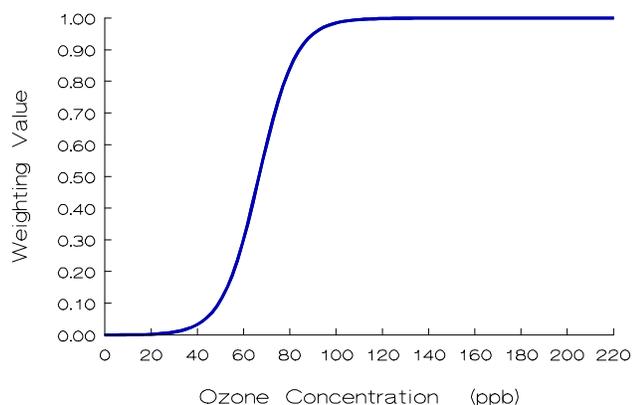
- (1) **Daily 1-Hr Maximum.** The maximum 1-hour average concentration recorded during each month, the growing season or the year regardless of the number of valid hourly observations recorded during a given day. The number in parentheses below this statistic, (N), indicates the number of days in the month, growing season, or year with valid data.
- (2) **Average Daily Maximum.** The average of all Daily 1-Hr Maxima during the month regardless of the number of Daily 1-Hr Maxima recorded during the month. For the "MAY-SEP" column the average of all the Daily Maxima recorded during the growing season is given. For the "ANNUAL" column the average of all the Daily Maxima is given. N is as in (1) above.
- (3) **Maximum Daily Mean.** The maximum of the valid daily means computed for each month, the growing season ("MAY-SEP" column), and the year ("ANNUAL" column). A valid daily mean is one for which 75% of the observations are available for each day, i.e., 18 hours. N is the number of days during each month, growing season, and year with at least 18 observations.
- (4) **Average Daily Mean.** The average of all valid daily means for the month, the growing season ("MAY-SEP" column), and the year ("ANNUAL" column). N is as in (3) above.
- (5) **Max Peak:Min Ratio.** The ratio of the Daily 1-Hr Maximum to the Daily 1-Hr Minimum. A ratio is computed only if a valid Daily Mean is computed and if the Daily 1-Hr Minimum is not equal to zero. N is the number of days with a valid Peak:Min ratio.
- (6) **Average Peak:Min Ratio.** The average of all Peak:Min ratios for the month, growing season, or year. N is as in (5) above.
- (7) **Max 9AM-4PM Average.** The maximum of all valid 9AM-4PM Averages computed for the month, growing season, or year. A valid 9AM-4PM Average is one which has 75% of the observations available during that time period (i.e., 6 hours. N is the number of days with valid averages.)

- (8) **Monthly 9AM-4PM Average.** The average of all valid 9AM-4PM Averages for the month, growing season, or year. N is as in (7) above.
- (9) **Max 7AM-7PM Average.** The maximum of all valid 7AM-7PM Averages computed for the month, growing season, or year. A valid 7AM-7PM Average is one which has 75% of the observations available during that time period, i.e., 9 hours. N is the number of days with valid averages.
- (10) **Monthly 7AM-7PM Average.** The average of all valid 7AM-7PM averages for the month, growing season, or year. N is as in (9) above.
- (11) **Monthly Mean.** The average of all 1-Hr ozone concentrations recorded during the month, growing season, or year. A mean is computed regardless of the number of hours with valid data. N is the number of hours with valid observations.
- (12) **SUM0 Exposure Index.** The monthly sum of all hourly ozone concentrations. Units are PPB-HR. The "MAY-SEP" column sums across the months of May through September to give the cumulative exposure for the growing season. The "ANNUAL" column sums across every month to give the cumulative exposure for the year. N is the number of hours with valid observations and is the same N as in (11) above.
- (13) **SUM60 Exposure Index.** The monthly sum of all hourly ozone concentrations equaling or exceeding 60 PPB. Units are PPB-HR. The "MAY-SEP" column sums across the months of May through September to give the cumulative exposure for the growing season. The "ANNUAL" column sums across every month to give the cumulative exposure for the year. N is the number of hours equaling or exceeding 60 PPB during the month, growing season, or year.
- (14) **SUM80 Exposure Index.** The monthly sum of all hourly ozone concentrations equaling or exceeding 80 PPB. Units are PPB-HR. The "MAY-SEP" column sums across the months of May through September to give the cumulative exposure for the growing season. The "ANNUAL" column sums across every month to give the cumulative exposure for the year. N is the number of hours equaling or exceeding 80 PPB during the month, growing season, or year.
- (15) **W126 Exposure Index.** The monthly sum of all hourly ozone concentrations where each concentration is weighted by a function that gives greater emphasis to the higher hourly concentrations while still including the lower ones. This weighting function provides a weighting value that is unique for each hourly ozone concentration. The weighting function, as described by Lefohn, Laurence, and Kohut<sup>1</sup> is:

$$w_i = \frac{1}{1 + 4403 \exp(-.126c_i)}$$

where

Weighting Function Used To Calculate W126 Exposure Index



$w_i$  = weighting value for hourly concentration  $i$ ,  
and  
 $c_i$  = hourly concentration  $i$  in PPB.

The graph of weighting value versus ozone concentration, in the figure to the left, illustrates the greater weights given to higher hourly ozone concentrations.

Each hour's weighting value is multiplied by its corresponding hourly concentration. This product is summed over all the valid hours in each month to calculate the monthly W126 exposure.

Thus, the monthly W126 exposure is:

$$W126 = \sum_{i=1}^n w_i c_i$$

where

- W126 = monthly W126 exposure index,
- $w_i$  = weighting value for hourly concentration  $i$ ,
- $c_i$  = hourly concentration  $i$  in PPB, and
- $n$  = number of hours in the month with valid ozone concentrations.

The "MAY-SEP" column sums across the months of May through September to give the cumulative exposure for the growing season. The "ANNUAL" column sums across every month to give the cumulative exposure for the year. The exposure units are PPB-HR.

Because each hour contributes to this exposure index,  $N$  is the number of hours with valid observations and is the same  $N$  as in (11) and (12) above.

The U.S. Environmental Protection Agency usually considers air quality statistics, such as a mean, to be "valid" (i.e., representative of the parameter being estimated for the time interval in question) only if 75% or more of the total possible observations have been measured during that time interval. Therefore, one should exercise caution when comparing these statistics between months and sites, particularly those that are not averages (e.g., maxima and exposures) whenever the number of valid observations is less than 75% of the total possible.

## References

1. Lefohn, A.S., J. A. Laurence, and R. J. Kohut. 1988. A Comparison of Indices That Describe the Relationship Between Exposure to Ozone and Reduction in the Yield of Agricultural Crops. *Atmospheric Environment* 22, 1229-1240.

## 4.2 AIR QUALITY GLOSSARY

---

**Acid Deposition:** Air pollution produced when acid chemicals are incorporated into rain, snow, fog, or mist.

**Aerometric Information Retrieval System (AIRS):** A computer-based database of U.S. air pollution information administered by the EPA Office of Air Quality Planning and Standards (U.S. Environmental Protection Agency).

**AIRWeb:** Air Resources Web, an air quality information retrieval system for U.S. parks and wildlife refuges developed by the Air Resources Division of the National Park Service and the Air Quality Branch of the Fish and Wildlife Service.

**Air Pollutant:** An unwanted chemical or other material found in the air.

**Air Pollution:** Degradation of air quality resulting from unwanted chemicals or other materials occurring in the air.

**Air Quality:** The properties and degree of purity of air to which people and natural and heritage resources are exposed (in the context of national parks).

**Air Pollution Control Permitting Process:** Process by which facilities are permitted to emit specified types and quantities of air pollutants.

**Air Quality Related Values (AQRVs):** Values including visibility, flora, fauna, cultural and historical resources, odor, soil, water, and virtually all resources that are dependent upon and affected by air quality. "These values include visibility and those scenic, cultural, biological, and recreation resources of an area that are affected by air quality." (43 Fed. Reg. 15016)

**Ambient Air:** Air that is accessible to the public.

**Class I:** Areas of the country set aside under the Clean Air Act to receive the most stringent degree of air quality protection.

**Class II:** Areas of the country protected under the Clean Air Act but identified for somewhat less stringent protection from air pollution damage than Class I, except in specified cases.

**Clean Air Act:** Originally passed in 1963, our current national air pollution control program is based on the 1970 version of the law. Substantial revisions were made by the 1990 Clean Air Act Amendments.

**Continuous Sampling Device:** An air analyzer that measures air quality components continuously.

**Criteria:** Information on health and/or environmental effects of pollution (in the context of criteria air pollutants).

**Criteria Air Pollutant:** A group of very common air pollutants regulated by EPA on the basis of criteria and for which a National Ambient Air Quality Standard is established (SO<sub>2</sub>, NO<sub>2</sub>, PM<sub>10</sub>, Pb, CO, O<sub>3</sub>).

**Emissions:** Release of pollutants into the air from a source.

**Environmental Protection Agency (EPA):** The federal agency responsible for regulating air quality.

**Monitoring:** Measurement of air pollution.

**National Ambient Air Quality Standards (NAAQS):** Permissible levels of criteria air pollutant established to protect public health and welfare.

**Ozone (O<sub>3</sub>):** A criteria air pollutant that is a strong oxidizing agent, reactive with many other compounds and surfaces, and a health hazard in high concentrations. Ozone is formed by nitrogen oxides and organic compounds reacting in sunlight.

**Source:** Any place or object from which air pollutants are released. Sources that are fixed in space are stationary sources; sources that move are mobile sources.

**Sulfur Dioxide (SO<sub>2</sub>):** A criteria air pollutant that is a gas produced by burning coal and some industrial processes.

---

\* Recent updates to this glossary may be found on the NPSARD AIRWeb - <http://www.aqd.nps.gov/natnet/ard/glossary.htm>.

---

### 4.3 GLOSSARY OF AIR QUALITY UNITS

Units Conversion Table			
Parameter Type	Multiply	By	To Obtain
Pollutant	ppm	1000	ppb
	ppm	1960	$\mu\text{g}/\text{m}^3$ Ozone (at 25°C)
	ppm	2615	$\mu\text{g}/\text{m}^3$ Sulfur Dioxide (at 25°C)
	ppb	0.001	ppm
	ppb	1.960	$\mu\text{g}/\text{m}^3$ Ozone (at 25°C)
	ppb	2.615	$\mu\text{g}/\text{m}^3$ Sulfur Dioxide (at 25°C)
	$\mu\text{g}/\text{m}^3$ Ozone (25°C)	0.0005102	ppm
	$\mu\text{g}/\text{m}^3$ Ozone (25°C)	0.5102	ppb
	$\mu\text{g}/\text{m}^3$ Sulfur Dioxide (25°C)	0.0003824	ppm
	$\mu\text{g}/\text{m}^3$ Sulfur Dioxide (25°C)	0.3824	ppb
Wind Speed	m/s	2.05	mph
	mph	0.489	m/s
Solar Radiation	ly/min	697	$\text{w}/\text{m}^2$
	$\text{w}/\text{m}^2$	0.00143	ly/min
Precipitation	mm/hr	0.0394	in/hr
	in/hr	25.4	mm/hr
Temperature	$^{\circ}\text{C} + 17.78$	1.8	$^{\circ}\text{F}$
	$^{\circ}\text{F} - 32$	5/9	$^{\circ}\text{C}$
Where: ppm = parts per million ppb = parts per billion $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter (at 25°C) m/s = meters per second mph = miles per hour ly/min = langley's per minute $\text{w}/\text{m}^2$ = watts per square meter mm/hr = millimeters per hour in/hr = inches per hour $^{\circ}\text{C}$ = degrees centigrade $^{\circ}\text{F}$ = degrees fahrenheit			