D-468
Mount Rainier

Annual Data Summary

MOUNT RAINIER NATIONAL PARK

2000

National Park Service
Gaseous Air Pollutant Monitoring Network

NATIONAL PARK SERVICE
AIR RESOURCES DIVISION

Report No. NPS D-468

Annual Data Summary

MOUNT RAINIER NATIONAL PARK

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National Park Service
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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 Mount Rainier National Park the ARD specifically recognizes Liza Petersen for performing the technical and administrative skills required to help provide the data presented within this report.

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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, 40 monitoring sites in 35 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.

NATIONAL PARK SERVICE
GASEOUS POLLUTANT MONITORING NETWORK

2000 Ozone and Sulfur Dioxide Monitoring Sites

1.2 MOUNT RAINIER NATIONAL PARK

Mount Rainier National Park, a Class I area, is located in Washington about 40 kilometers southeast of Seattle. Its location and site specifications are presented on the following page.

The purpose of Mount Rainier National Park is to protect, preserve and interpret the natural, scenic and historical resources. Mount Rainier is a classic example of a dormant composite volcano, with the largest single-peak glacial system in the contiguous United States. The park also contains outstanding examples of the native flora and fauna of the Cascade Mountains.

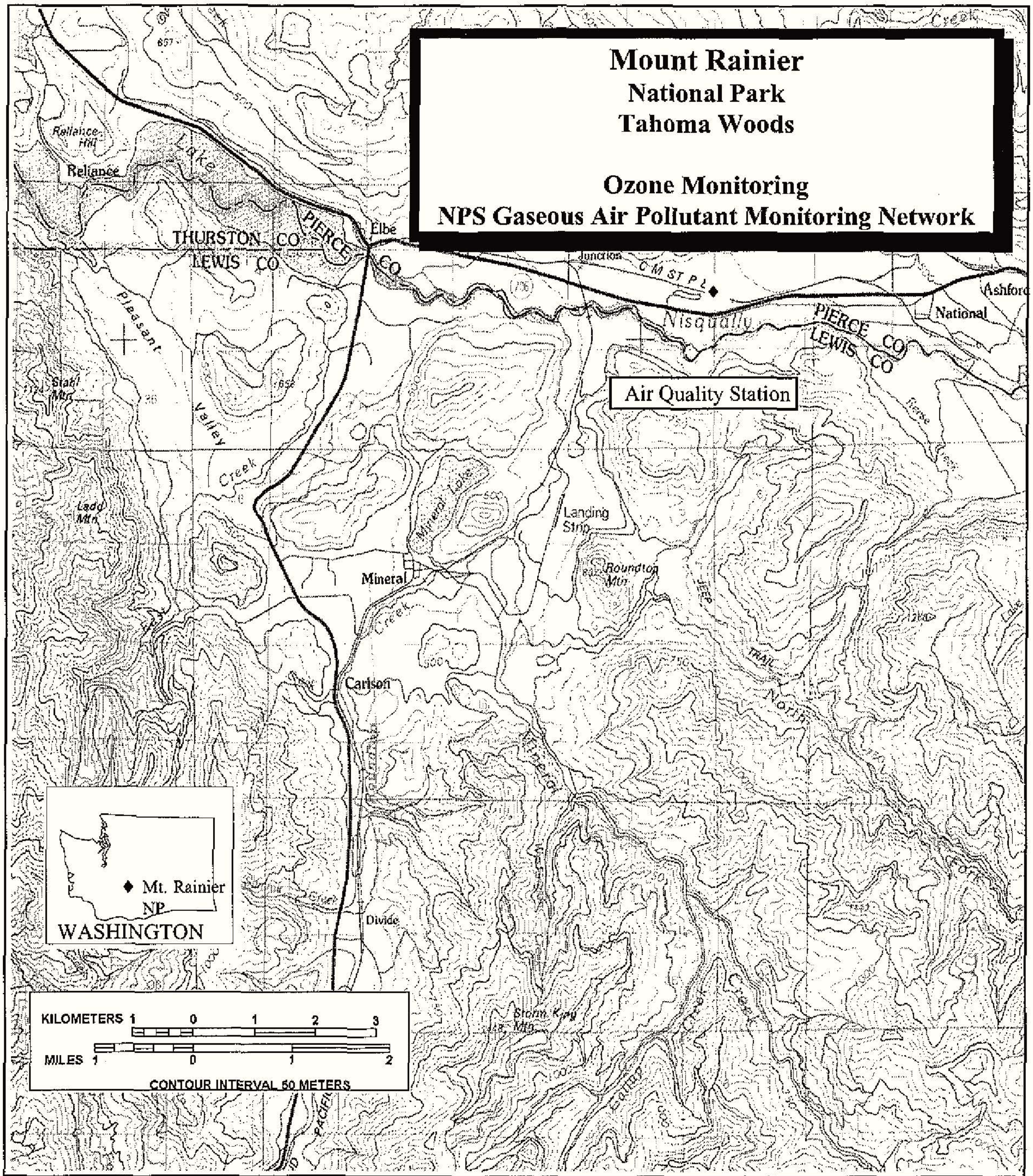
The topography of the park is rugged and precipitous, consisting mainly of peaks and valleys. The Cascade Range of the east, the Tatoosh Range on the south, and mountains on all sides tower from 2,000 to 4,000 feet above the valleys. These mountains are dwarfed by the mass of Mount Rainier. The spectacular glacier-covered volcanic peak of Mount Rainier is the park's prime attraction. It rises to 14,410 feet above sea level and almost 10,000 feet in a single peak above surrounding peaks and valleys of the Cascade Range.

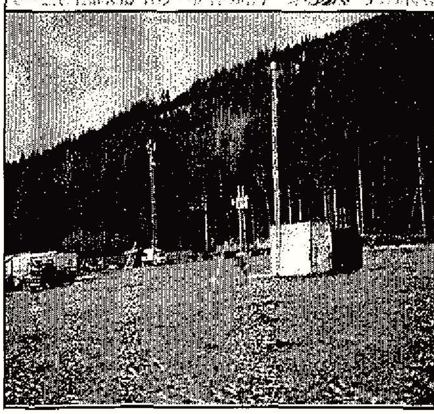
Over 700 species of vascular plants are found in the park, including spectacular virgin forests containing nearly 40 percent of the species of trees native to the region. Forests of Douglas fir, western red cedar and western hemlock occur primarily in the western hemlock zone, while Pacific silver fir, Alaska cedar, noble fir and western white pine appear in the silver fir zone. Spectacular subalpine flower fields laced by stands of mountain hemlock and subalpine fir dominate the mountain hemlock zone. The harsh alpine zone supports hardy alpine plants, including mosses and lichens, in areas free from ice and snow.

Wildlife includes at least 126 species of birds, 54 species of mammals, and 17 species of reptiles and amphibians. Examples are: white-tailed ptarmigan, blue and ruffed grouse, varied thrush, grey jay, raven, mountain goat, deer, black bear, elk, coyote, bobcat, marmot, redlegged frog, tailed frog, Pacific giant salamander and Pacific garter snake.

Mount Rainier
National Park
Tahoma Woods

Ozone Monitoring
NPS Gaseous Air Pollutant Monitoring Network





SITE IDENTIFICATION

Site Abbreviation:	MORA
AIRS ID NO.:	53-053-1010

INSTRUMENTATION

O_3 Analyzer	Delta Temperature
Calibrator	Temperature
Wind Speed	Solar Radiation
Wind Direction	Precipitation
Relative Humidity	

MAP INFORMATION

Mean Elevation:	421 m
Longitude:	122° 07' 18"W
Latitude:	46° 45' 41"N
UTM Zone:	10
Easting:	567074 m
Northing:	5178805 m
Map Reference:	Centralia 46122-E1 1:100,000

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 Mount Rainier National Park Tahoma Woods Final Data 01/01/00 - 12/31/00						
Parameter	Par Code	Data Recovery			Valid Data	
		No. Possible	No. Collected	% Collected	No. Valid	% Valid
Ozone Analyzer	O3	8784	7959	90.6	7792	88.7
Scalar Wind Speed	SWS	8784	8721	99.3	8690	98.9
Vector Wind Speed	VWS	8784	8638	98.3	8607	98.0
Vector Wind Direction	VWD	8784	8638	98.3	8607	98.0
Standard Deviation for Wind Direction	SDWD	8784	8638	98.3	8607	98.0
Ambient Temperature (aspirated)	TMP	8784	8755	99.7	8755	99.7
Delta Temperature	DTP	8784	8755	99.7	8755	99.7
Relative Humidity	RH	8784	8749	99.6	8329	94.8
Precipitation	RNF	8784	8700	99.0	8700	99.0
Wetness Sensor	WET	8784	8736	99.5	8736	99.5
Solar Radiation	SOL	8784	8736	99.5	8736	99.5
Filter Pack Flow Rate	FLOW	8760	8736	99.7	8736	99.7

Notes: All statistics are for hourly averages.

The number collected does not include normal maintenance or events beyond the control of the network.

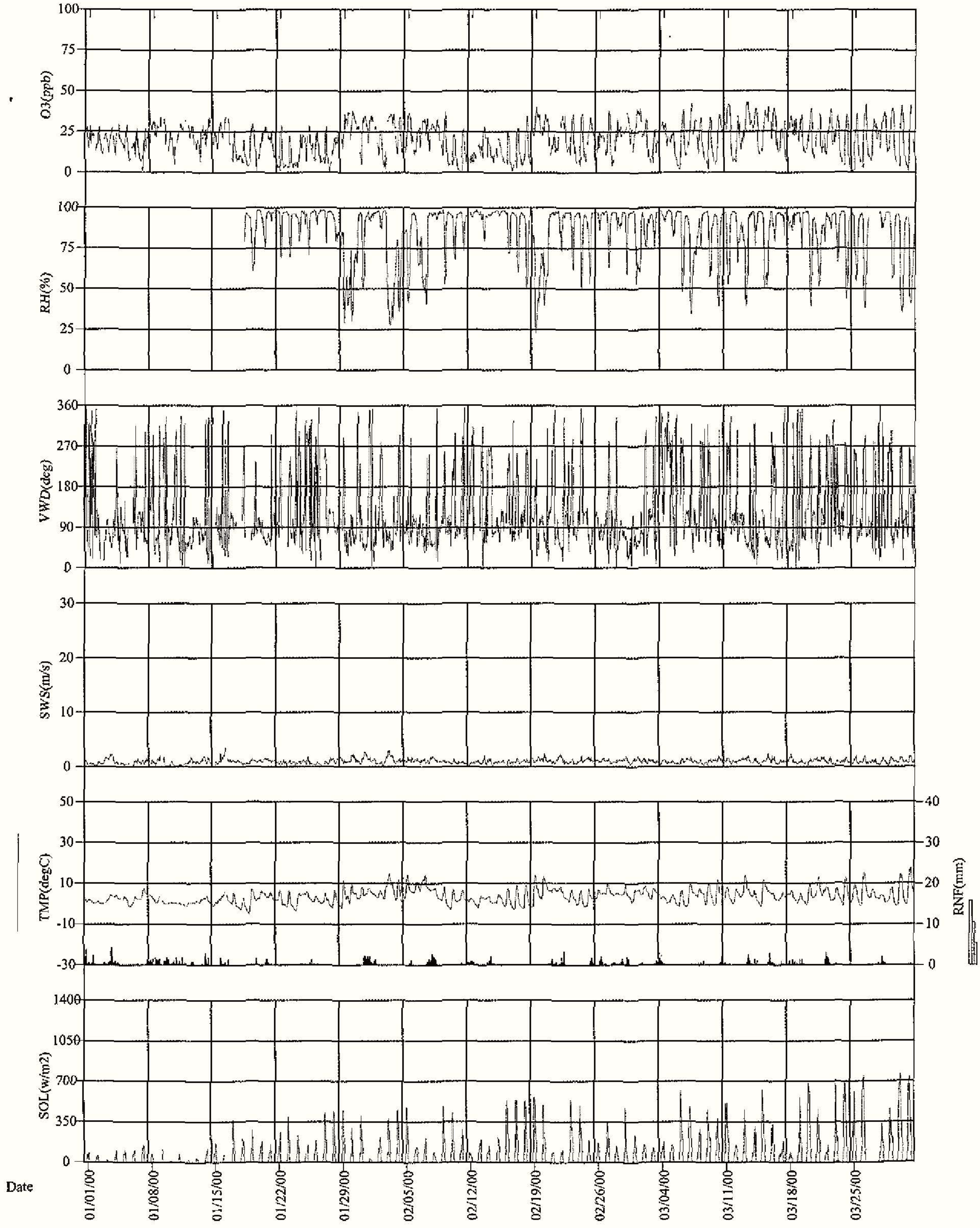
The percent valid is calculated against the number possible.

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.

NPS Performance Goals:

Quarterly Criteria:	Monthly Criteria:
100% of sites, >= 85% valid data capture	100% of sites, >= 60% valid data capture
90% of sites, >= 90% valid data capture	90% of sites, >= 75% valid data capture
80% of sites, >= 95% valid data capture	80% of sites, >= 85% valid data capture

Mount Rainier National Park

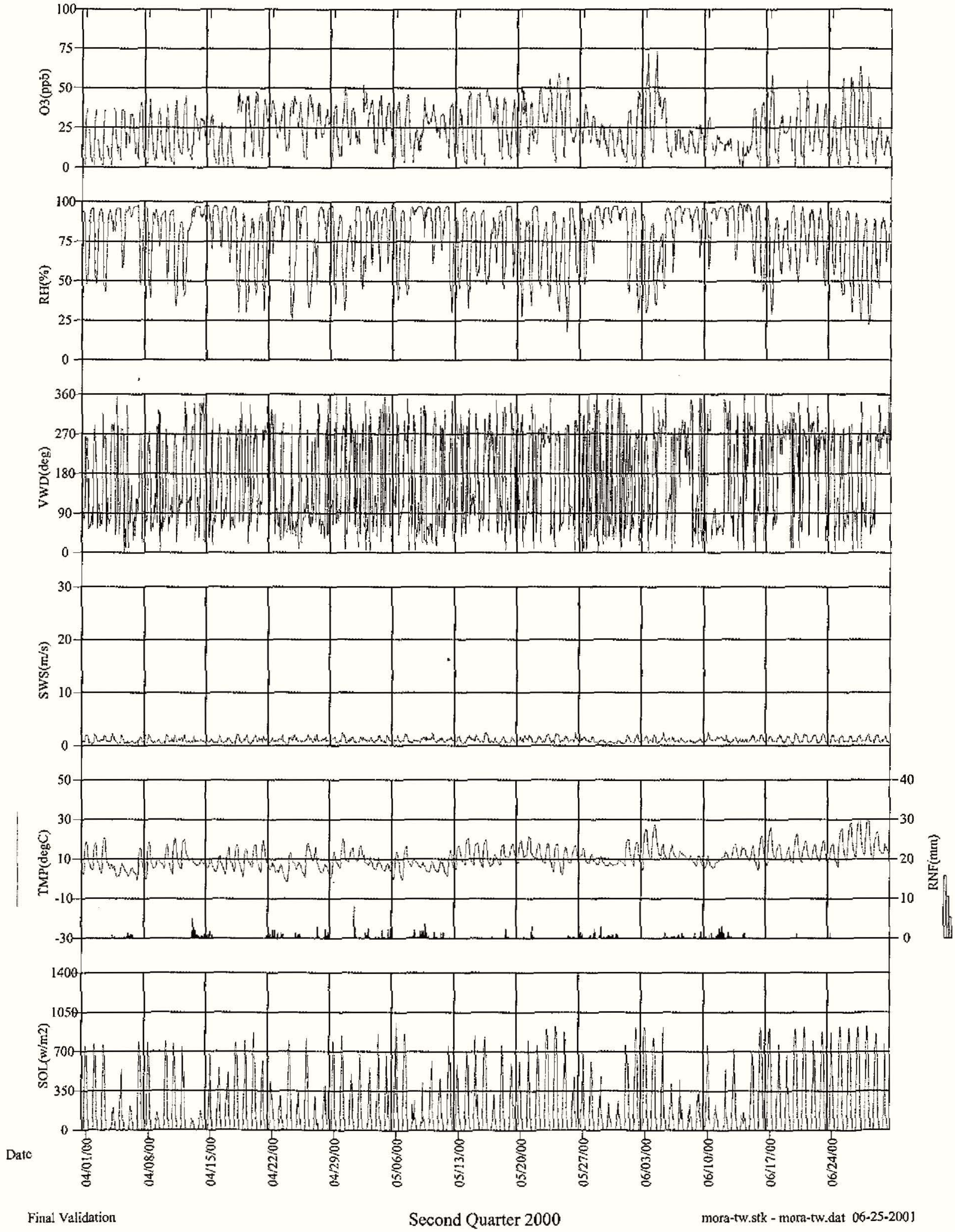


Final Validation

First Quarter 2000

mora-tw.stk - mora-tw.dat 06-25-2001

Mount Rainier National Park

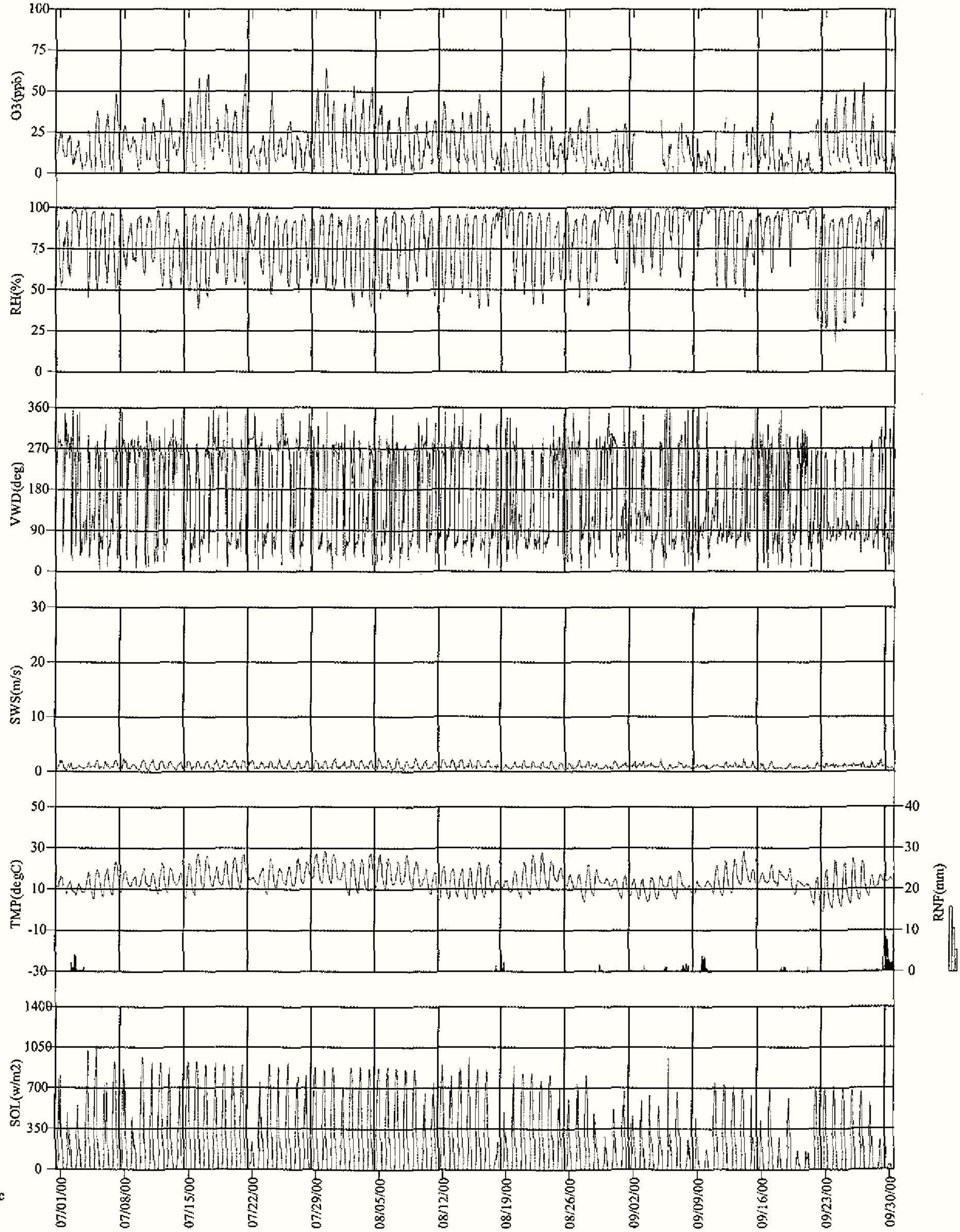


Final Validation

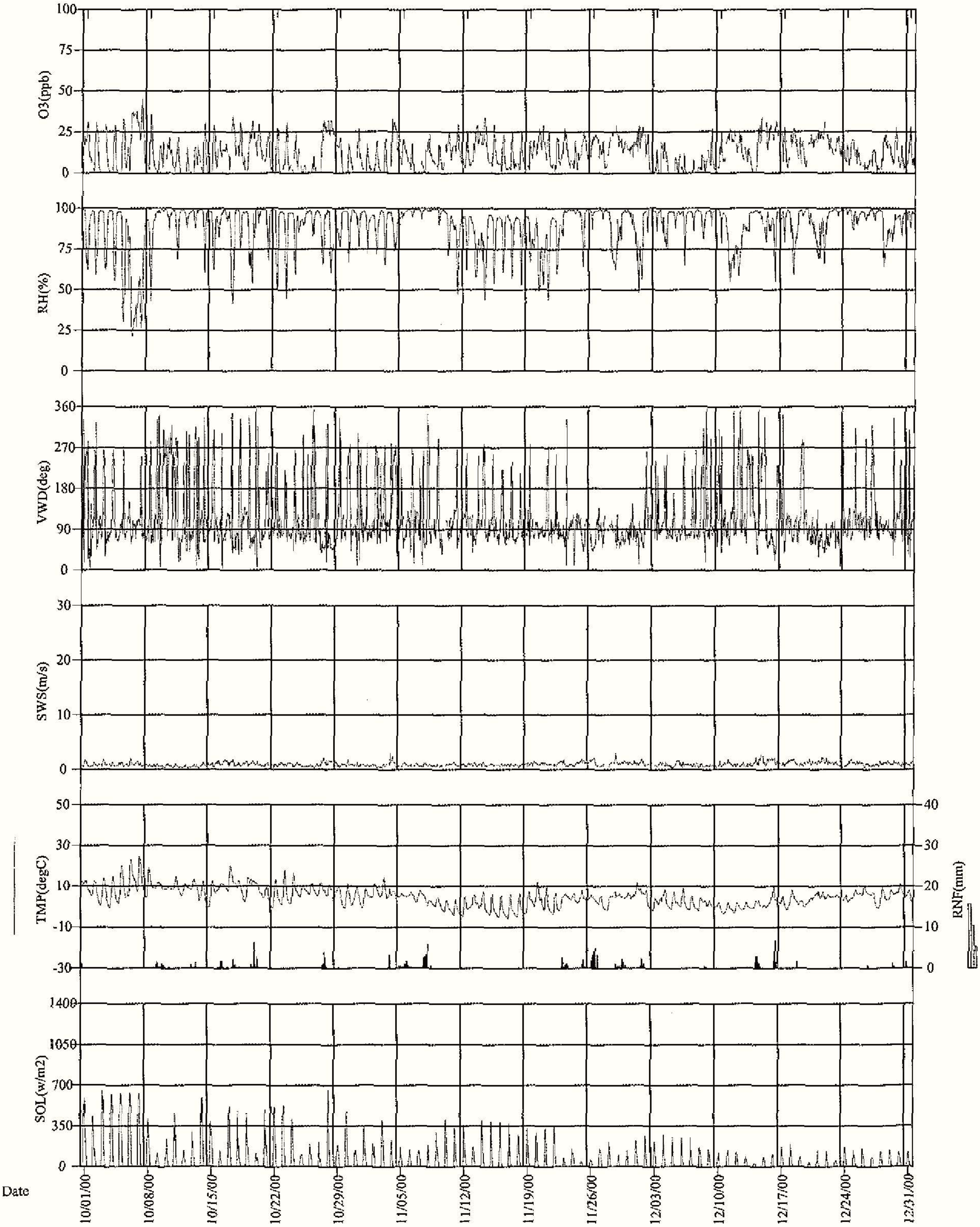
Second Quarter 2000

mora-tw.stk - mora-tw.dat 06-25-2001

Mount Rainier National Park



Mount Rainier National Park



2.2 OZONE DATA SUMMARY

Ozone Quick Look Annual Summary Statistics
Mount Rainier National Park
Tahoma Woods
01/01/00 - 12/31/00

STATISTIC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAY-SEP	ANNUAL
DAILY 1-HR MAXIMUM	38	40	43	51	59	73	64	62	55	45	34	34	73	73
NO. OF DAYS	(31)	(29)	(31)	(30)	(31)	(30)	(31)	(31)	(28)	(31)	(30)	(31)	(151)	(364)
AVERAGE DAILY MAXIMUM	29	31	36	40	42	39	37	36	29	27	24	22	37	33
NO. OF DAYS	(31)	(29)	(31)	(30)	(31)	(30)	(31)	(31)	(28)	(31)	(30)	(31)	(151)	(364)
MAXIMUM DAILY MEAN	31	31	31	33	37	40	33	28	24	29	22	26	40	40
NO. OF DAYS	(29)	(29)	(31)	(27)	(31)	(28)	(31)	(31)	(20)	(30)	(30)	(30)	(141)	(347)
AVERAGE DAILY MEAN	18	20	22	24	27	23	20	18	13	12	12	12	21	19
NO. OF DAYS	(29)	(29)	(31)	(27)	(31)	(28)	(31)	(31)	(20)	(30)	(30)	(30)	(141)	(347)
MAX PEAK:MIN RATIO	29.000	25.000	41.000	42.000	50.000	56.000	58.000	46.000	51.000	38.000	23.000	25.000	58.000	58.000
NO. OF DAYS	(26)	(28)	(30)	(24)	(31)	(23)	(19)	(9)	(10)	(12)	(24)	(20)	(92)	(256)
AVERAGE PEAK:MIN RATIO	5.790	6.129	7.866	9.877	7.623	13.637	15.807	14.192	15.463	13.298	7.752	7.365	12.312	9.456
NO. OF DAYS	(26)	(28)	(30)	(24)	(31)	(23)	(19)	(9)	(10)	(12)	(24)	(20)	(92)	(256)
MAX 9AM-4PM AVERAGE	35	35	40	43	53	57	55	49	41	35	29	28	57	57
NO. OF DAYS	(28)	(29)	(31)	(26)	(30)	(28)	(31)	(31)	(22)	(31)	(30)	(31)	(93)	(348)
MONTHLY 9AM-4PM AVERAGE	21	25	31	35	37	33	30	28	22	19	17	15	31	26
NO. OF DAYS	(28)	(29)	(31)	(26)	(30)	(28)	(31)	(31)	(22)	(31)	(30)	(31)	(93)	(348)
MAX 7AM-7PM AVERAGE	33	34	36	39	48	51	47	39	36	33	28	26	51	51
NO. OF DAYS	(29)	(29)	(31)	(27)	(31)	(28)	(31)	(31)	(23)	(31)	(30)	(31)	(94)	(352)
MONTHLY 7AM-7PM AVERAGE	20	23	27	30	34	30	26	24	19	16	14	13	28	23
NO. OF DAYS	(29)	(29)	(31)	(27)	(31)	(28)	(31)	(31)	(23)	(31)	(30)	(31)	(94)	(352)
MONTHLY MEAN	19	20	22	23	27	23	20	17	13	12	12	12	20	19
NO. OF HOURS	(661)	(632)	(672)	(638)	(673)	(636)	(674)	(676)	(537)	(670)	(651)	(672)	(3196)	(7792)
SUM0 EXPOSURE INDEX	12419	12462	15092	14887	18323	14511	13274	11783	6748	8304	7980	8372	64639	144155
NO. OF HOURS	(661)	(632)	(672)	(638)	(673)	(636)	(674)	(676)	(537)	(670)	(651)	(672)	(3196)	(7792)
SUM60 EXPOSURE INDEX	-	-	-	-	-	716	489	122	-	-	-	-	1327	1327
NO. OF HOURS	(0)	(0)	(0)	(0)	(0)	(11)	(8)	(2)	(0)	(0)	(0)	(0)	(21)	(21)
SUM80 EXPOSURE INDEX	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NO. OF HOURS	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
W126 EXPOSURE INDEX	72	99	184	304	608	864	499	275	100	53	25	29	2346	3112
NO. OF HOURS	(661)	(632)	(672)	(638)	(673)	(636)	(674)	(676)	(537)	(670)	(651)	(672)	(3196)	(7792)

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

* Statistics defined in the Quick Look subsection of the Glossary

Final Validation

5/24/2001

Frequency Distribution
Ozone Analyzer

Mount Rainier National Park
Tahoma Woods
Monitoring Season: 04/01/00 - 10/31/00[1]

Averaging Period	% Obs.[3]	# Obs.[2]	Min. Obs.[4]	Percentile[5] 10	30	50	70	90	95	99	Max. Obs.	2nd Max.	Arith. Mean	Geo. Mean	Geo. Stdv.
1-Hour	94	4504	0.010	0.020	0.029	0.034	0.042	0.052	0.057	0.064	0.073	0.072	0.0360	0.0337	1.46

Concentrations in parts per million (ppm)

[1] 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.

[2] The number of observations (# Obs.) includes all valid observations recorded within the Monitoring Season.

[3] 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..

[4] The minimum observation value (Min. Obs.) is the minimum daily maximum recorded during the Monitoring Season.

[5] The percentiles and other statistics are derived from the daily maximums.

Ozone Standards Report and Daily Maximum 1-Hour Concentrations (ppm)

Mount Rainier National Park

Tahoma Woods

01/01/00 - 12/31/00

Day	Jan-00		Feb-00		Mar-00		Apr-00		May-00		Jun-00		Jul-00		Aug-00		Sep-00		Oct-00		Nov-00		Dec-00	
1	.028	S	.035	T	.039	W		S	.038	M	.036	T	.026	S	.043	T	.030	F	.031	S	.018	W	.029	F
2	.028	S	.026	W	.033	T		S	.052	T	.048	F	.023	S	.054	W		S	.031	M	.019	T	.025	S
3	.027	M	.036	T	.027	F		M	.043	W	.072	S	.020	M	.046	T		S	.030	T	.021	F	.015	S
4	.029	T	.034	F	.031	S	.037	T	.046	T	.073	S	.026	T	.053	F		M	.029	W	.033	S	.019	M
5	.029	W	.036	S	.024	S	.036	W	.041	F	.044	M	.038	W	.042	S	.032	T	.033	T	.020	S	.010	T
6	.027	T	.028	S	.039	M	.034	T	.041	S		T	.036	T	.033	S	.018	W	.038	F	.018	M	.012	W
7	.027	F	.033	M		T	.041	F	.046	S	.025	W	.049	F	.035	M	.031	T	.045	S	.007	T	.008	T
8	.032	S	.033	T	.033	W	.043	S	.024	M	.024	T	.029	S	.048	T	.024	F	.036	S	.025	W	.011	F
9		S	.037	W	.034	T	.037	S	.044	T	.027	F	.022	S	.030	W	.021	S	.019	M	.017	T	.027	S
10	.026	M	.023	T	.036	F	.040	M	.040	W	.032	S	.034	M	.032	T	.014	S	.022	T	.025	F	.025	S
11	.031	T	.027	F	.042	S	.042	T	.034	T	.020	S	.031	T	.033	F		M	.022	W	.030	S	.027	M
12	.032	W	.012	S	.035	S	.045	W	.041	F	.018	M	.045	W	.044	S		T	.016	T	.025	S	.026	T
13	.029	T	.028	S	.043	M	.039	T	.037	S		T	.034	T	.033	S		W	.017	F	.029	M	.016	W
14	.034	F	.023	M	.039	T	.031	F	.048	S	.016	W	.034	F	.037	M		T	.031	S	.034	T	.032	T
15	.031	S	.021	T	.040	W	.033	S	.047	M	.037	T	.046	S	.038	T	.028	F	.029	S	.029	W	.034	F
16		S	.025	W	.039	T	.028	S	.050	T	.041	F	.058	S	.048	W	.025	S	.020	M	.023	T	.032	S
17	.026	M	.027	T	.032	F	.026	M	.045	W	.058	S	.060	M	.038	T	.037	S	.035	T	.025	F	.031	S
18	.020	T	.035	F	.035	S	.049	T	.044	T	.033	S	.034	T	.013	F	.015	M	.031	W	.025	S	.027	M
19	.030	W	.040	S	.035	S	.045	W	.043	F	.032	M	.042	W	.019	S	.027	T	.032	T	.020	S	.022	T
20	.028	T	.036	S	.039	M	.048	T	.051	S	.050	T	.038	T	.028	S	.014	W	.030	F	.029	M	.023	W
21	.026	F	.023	M	.036	T	.043	F	.041	S	.055	W	.061	F	.033	M	.013	T	.025	S	.027	T	.028	T
22	.029	S	.035	T	.039	W	.042	S	.051	M	.040	T	.018	S	.046	T	.033	F	.027	S	.022	W	.031	F
23	.022	S	.036	W	.035	T	.041	S	.056	T	.040	F	.023	S	.062	W	.033	S	.031	M	.027	T	.022	S
24	.023	M	.036	T	.035	F	.045	M	.059	W	.033	S	.050	M	.029	T	.049	S	.025	T	.020	F	.018	S
25	.029	T	.034	F	.036	S	.042	T	.057	T	.056	S	.022	T	.019	F	.046	M	.011	W	.025	S	.020	M
26	.025	W	.026	S	.041	S	.046	W	.031	F	.056	M	.032	W	.028	S	.051	T	.010	T	.023	S	.007	T
27	.028	T	.038	S	.033	M	.041	T	.040	S	.064	T	.023	T	.033	S	.055	W	.032	F	.020	M	.014	W
28	.023	F	.033	M	.037	T	.037	F	.032	S	.057	W	.024	F	.040	M	.036	T	.032	S	.029	T	.023	T
29	.037	S	.036	T	.040	W	.040	S	.028	M	.031	T	.052	S	.027	T	.026	F	.022	S	.027	W	.028	F
30	.038	S			.041	T	.051	S	.028	T	.021	F	.064	S	.010	W	.019	S	.018	M	.020	T	.020	S
31	.035	M			.041	F			.026	W			.044	M	.027	T			.027	T			.028	S
Valid Days	29		29		30		27		31		28		31		31		23		31		30		31	
Maximum	.038		.040		.043		.051		.059		.073		.064		.062		.055		.045		.034		.034	
Violations	0		0		0		0		0		0		0		0		0		0		0		0	

7792 Total Samples
88.7 % Possible
351 Valid daily maxima

0 Daily-maxima exceeding the standard of .12 ppm (starred[*])
5 Missing days assumed to be less than the standard
0 Daily maximas exceed the alert level of .200 ppm

Concentrations in parts per million (ppm)

Final Validation

5/24/2001

Mount Rainier National Park

2000 Attainment Status With U.S. Environmental Protection Agency (EPA)
PRIMARY Ozone National Ambient Air Quality Standard

Ozone Season: April through October

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)
2000	57	95%	Yes	61	59	57	57	56

Ozone Analyzer 10 Highest Daily 1-Hour Average Maximum Concentrations Mount Rainier National Park Final Validation 01/01/2000 - 12/31/2000			
Value	Date	Hour	Concentration (ppb)
Ozone Analyzer			
1	06/04/2000	15	73*
2	06/03/2000	16	72*
3	06/27/2000	13	64*
4	07/30/2000	14	64*
5	08/23/2000	14	62*
6	07/21/2000	16	61
7	07/17/2000	14	60*
8	05/24/2000	15	59*
9	06/17/2000	16	58
10	07/16/2000	15	58**

* This value was also recorded during one or more hours later in the day.
** 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
Mount Rainier National Park

01/01/2000 - 12/31/2000
FINAL VALIDATION

Site	Date	Beginning Hour	No. Hours ≥ 100 ppb	No. Hours >124 ppb	Max (ppb)
	No values greater than or equal 100 ppb during this period				
		Total	0	0	

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/m³ exceeds the standard.) (40 CFR 50.9 with reference to Appendix D and H.)

Episodes with 8-Hour Average Ozone Concentrations > 84 ppb Mount Rainier National Park 01/01/2000 - 12/31/2000 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
	No values exceeded 84 ppb during this period			
	0	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^3).

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

01/01/2000 - 12/31/2000

Second Highest 1-Hour Average Concentration		
Site	Rank	Concentration (ppb)
CACO-XX	1	139
JOTR-YV	2	123
GRSM-CD	3	122
YOSE-TD	4	118
SEKI-AS	5	117
COWP-XX	6	115
GRSM-CM	7	114
SEKI-LP	8	114
CHAM-XX	9	111
GRSM-LR	10	110
MACA-HM	11	108
ACAD-CM	12	106
SEKI-LK	13	104
COSW-BL	14	98
GRSM-CC	15	97
ROMO-LP	16	97
PINN-ES	17	96
SHEN-BM	18	95
CHIS-XX	19	92
LAVO-ML	20	88
MEVE-MY	21	88
DEVA-PV	22	87
ACAD-MH	23	85
SAGU-PC	24	84
GRBA-MY	25	82
CANY-IS	26	81
GRCA-AS	27	81
VOYA-SB	28	79
CHIR-ES	29	77
CRMO-VC	30	77
EVER-BC	31	76
YELL-WT	32	73
MORA-TW	33	72
BIBE-KB	34	71
THRO-VC	35	65
GLAC-WG	36	61
OLYM-VC	37	58
VIIS-LP	38	58
NOCA-MM	39	56
HAVO-TH	40	50
DENA-HQ	41	47

4th Highest 8-hour Average Concentration		
Site	Rank	Concentration (ppb)
SEKI-AS	1	105
SEKI-LP	2	101
GRSM-CD	3	100
GRSM-CM	4	96
GRSM-LR	5	96
JOTR-YV	6	96
SEKI-LK	7	90
COWP-XX	8	88
MACA-HM	9	88
YOSE-TD	10	87
CACO-XX	11	83
GRSM-CC	12	81
CHAM-XX	13	80
SHEN-BM	14	80
DEVA-PV	15	79
PINN-ES	16	78
ROMO-LP	17	78
GRBA-MY	18	77
ACAD-CM	19	76
CANY-IS	20	76
LAVO-ML	21	74
COSW-BL	22	73
MEVE-MY	23	73
SAGU-PC	24	72
CHIR-ES	25	71
GRCA-AS	26	71
ACAD-MH	27	70
CRMO-VC	28	66
EVER-BC	29	66
CHIS-XX	30	65
VOYA-SB	31	65
YELL-WT	32	65
BIBE-KB	33	64
THRO-VC	34	59
MORA-TW	35	57
GLAC-WG	36	56
VIIS-LP	37	49
NOCA-MM	38	48
OLYM-VC	39	47
DENA-HQ	40	44
HAVO-TH	41	43

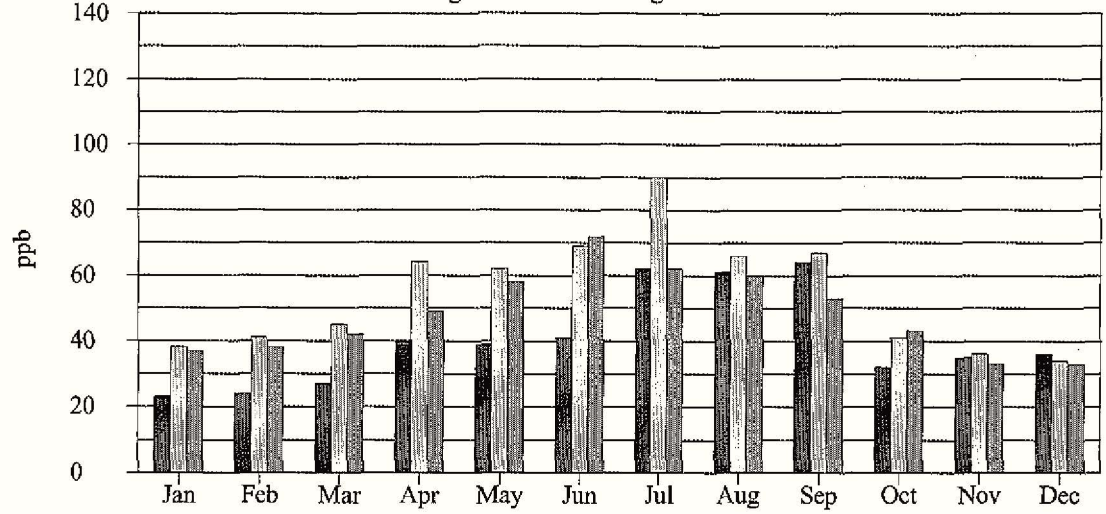
Annual Sum60 Exposure Index			
Site	Rank	Sum60	Count
GRSM-CD	1	195667	2756
GRSM-CM	2	178087	2517
SEKI-LP	3	144383	1894
GRSM-LR	4	138346	1981
JOTR-YV	5	121960	1685
YOSE-TD	6	98751	1433
SEKI-AS	7	91473	1149
SEKI-LK	8	89676	1263
DEVA-PV	9	79510	1207
SHEN-BM	10	73844	1093
ROMO-LP	11	65673	984
GRBA-MY	12	64706	993
GRCA-AS	13	63983	1003
CANY-IS	14	61642	949
COWP-XX	15	57188	803
MEVE-MY	16	55431	851
MACA-HM	17	48907	710
GRSM-CC	18	44635	653
CHIR-ES	19	43204	672
PINN-ES	20	39070	569
LAVO-ML	21	32335	490
CACO-XX	22	30948	440
CHAM-XX	23	30889	439
SAGU-PC	24	26476	400
COSW-BL	25	25769	380
CRMO-VC	26	23165	364
ACAD-CM	27	19339	279
YELL-WT	28	17033	271
ACAD-MH	29	12712	192
EVER-BC	30	8725	133
VOYA-SB	31	7241	112
CHIS-XX	32	5906	89
BIBE-KB	33	5842	92
THRO-VC	34	2348	38
MORA-TW	35	1327	21
GLAC-WG	36	666	11
VIIS-LP	37	64	1
OLYM-VC	38	61	1
DENA-HQ	39	0	0
HAVO-TH	40	0	0
NOCA-MM	41	0	0

Mount Rainier
National Park
Tahoma Woods

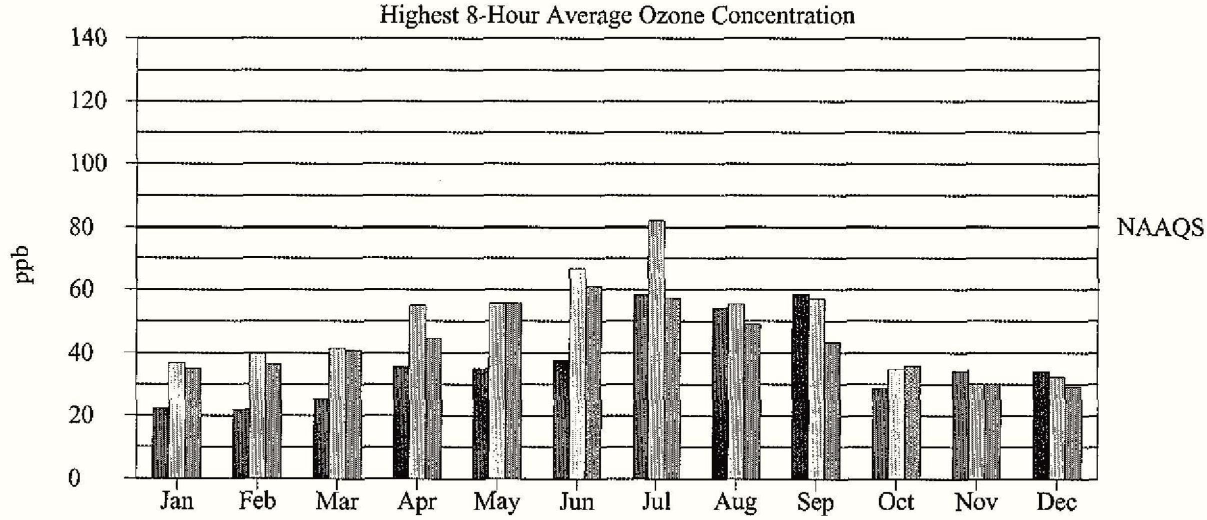
Ozone
Three Year Comparison

1998 - 2000

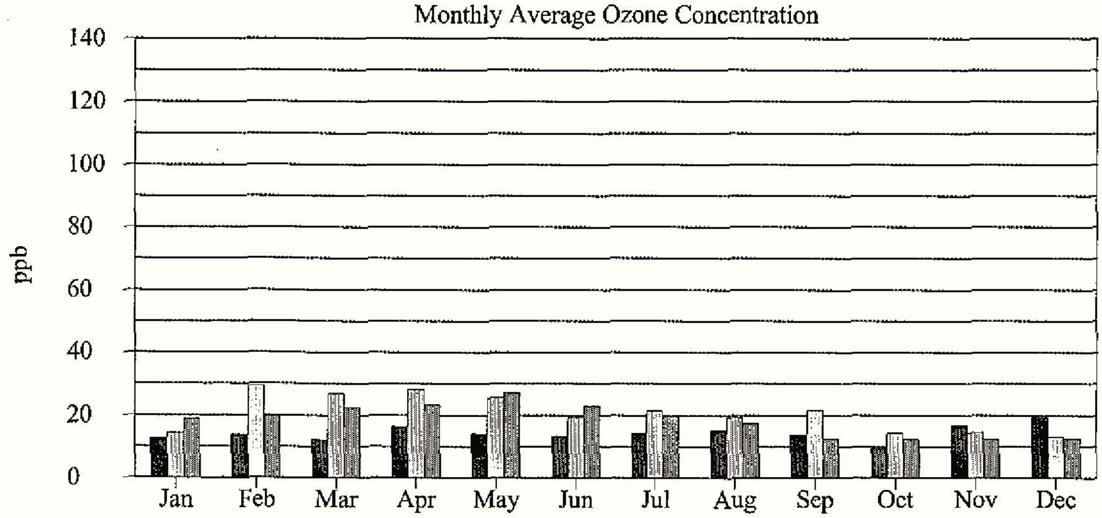
Second Highest 1-Hour Average Ozone Concentration

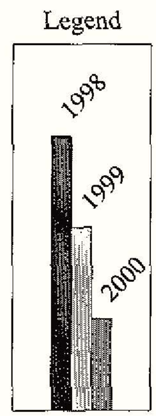


Highest 8-Hour Average Ozone Concentration



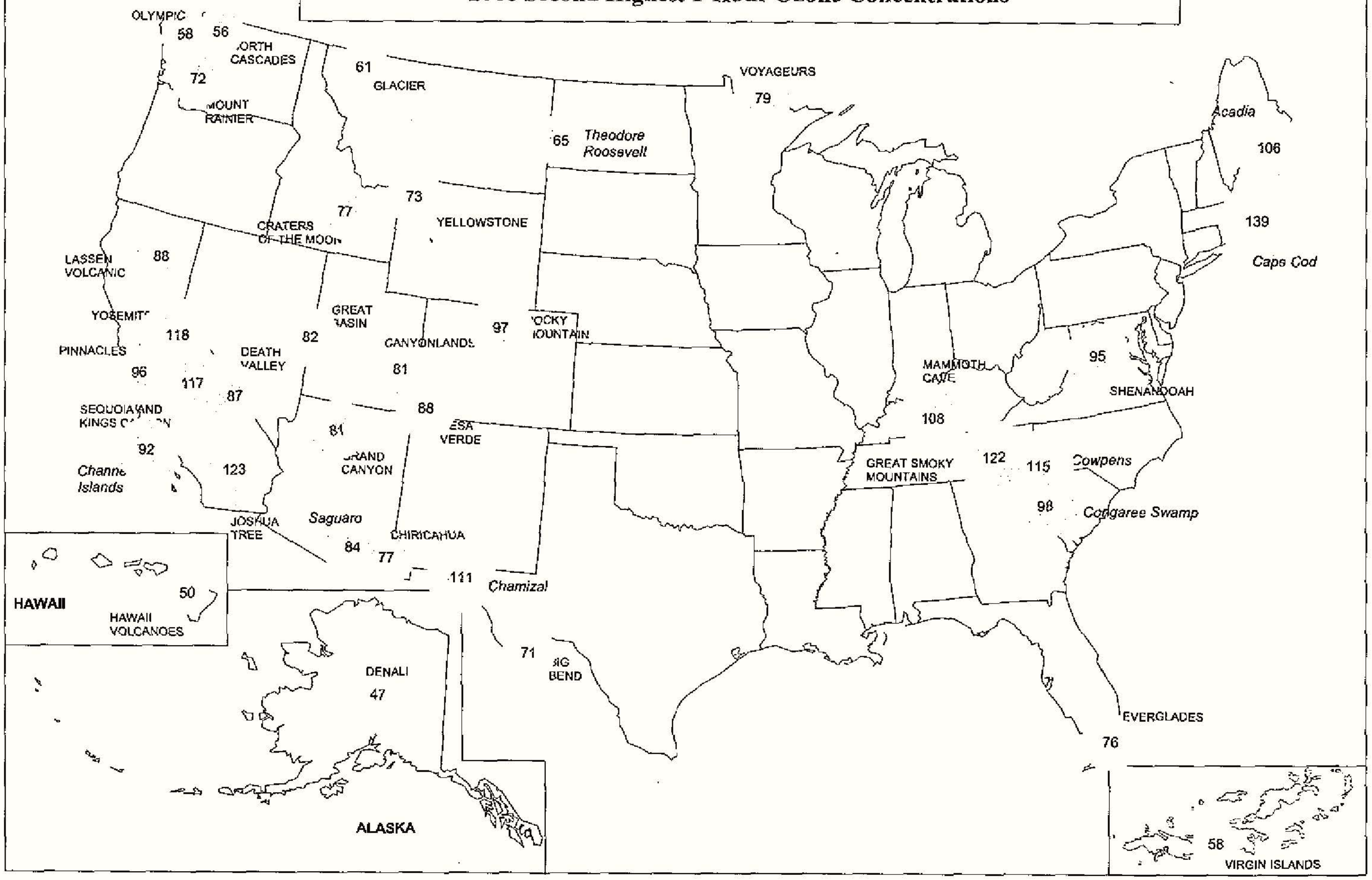
Monthly Average Ozone Concentration





NATIONAL PARK SERVICE
GASEOUS POLLUTANT MONITORING NETWORK

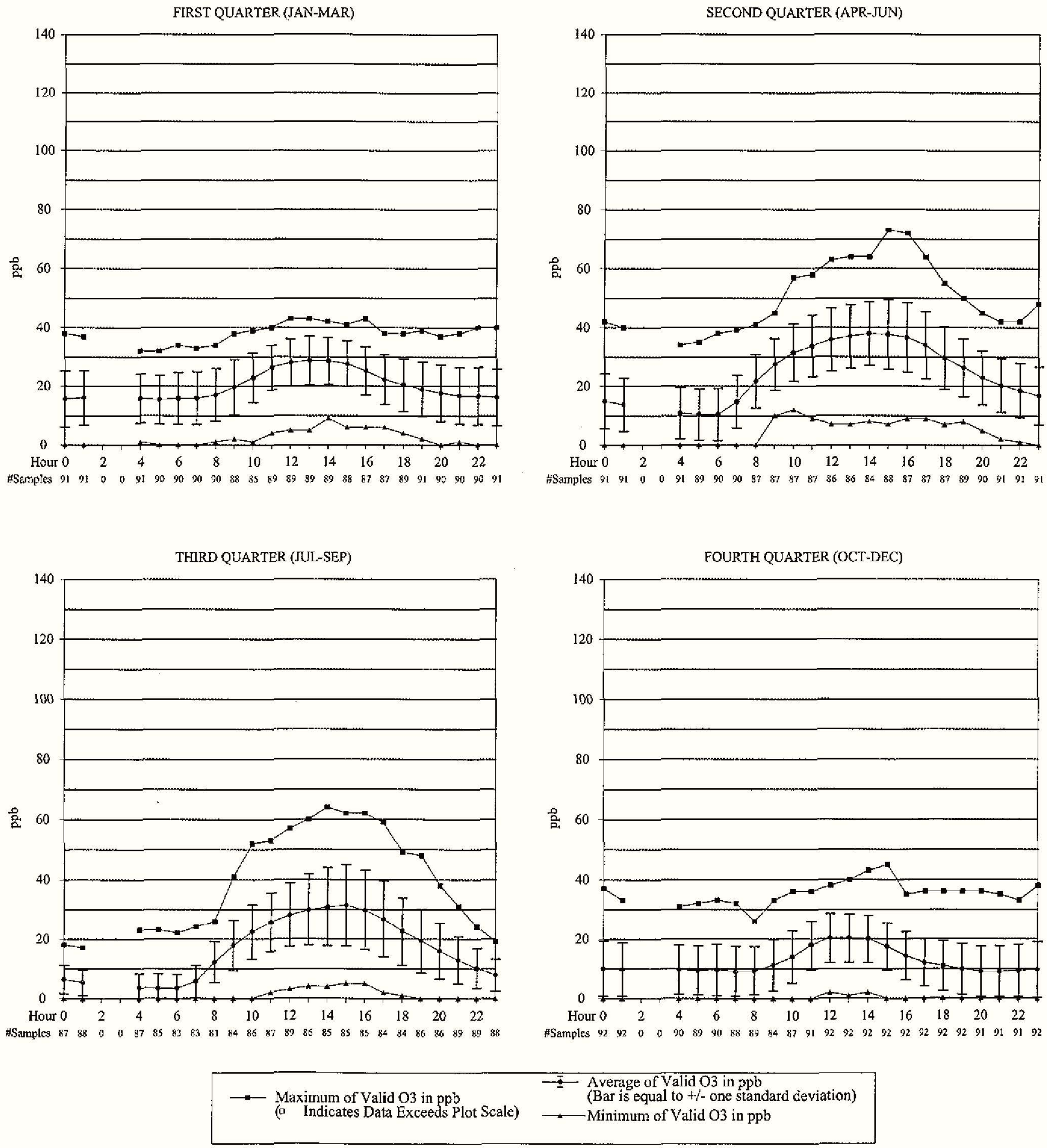
2000 Second Highest 1-Hour Ozone Concentrations



Mount Rainier
National Park
Tahoma Woods

Quarterly Diurnal
Ozone Plots

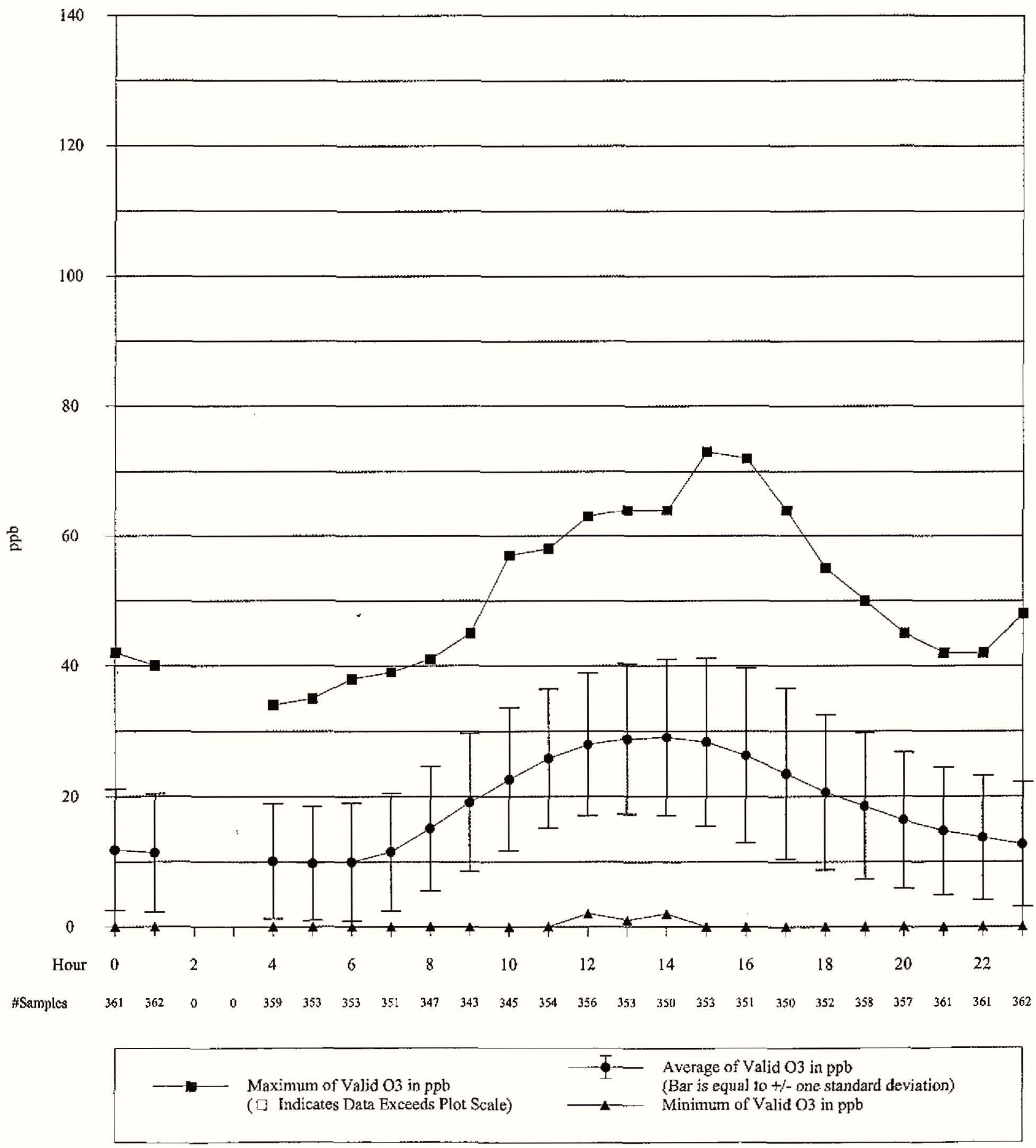
2000



Mount Rainier
National Park
Tahoma Woods

Annual Diurnal
Ozone Plot

2000

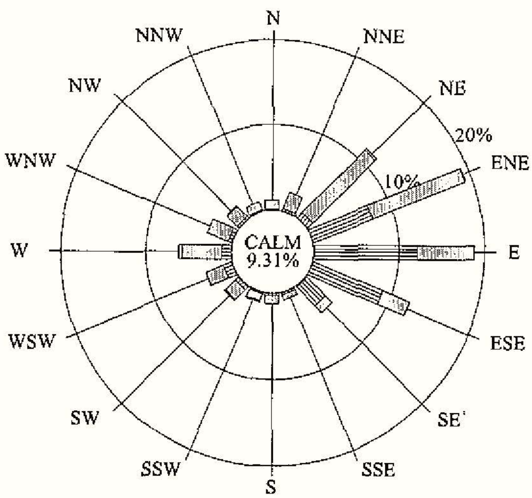


Mount Rainier
National Park
Tahoma Woods

Quarterly Ozone
Pollutant Rose

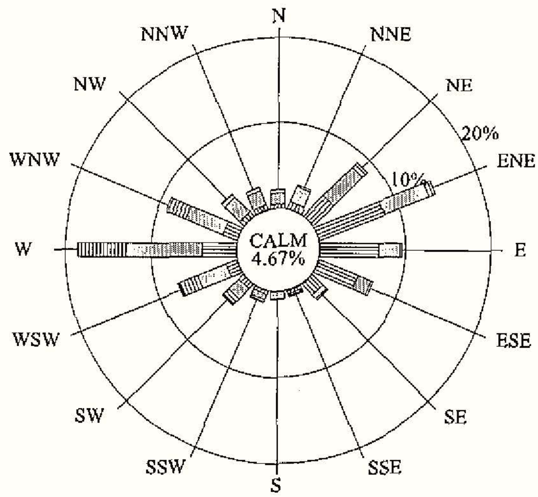
2000

FIRST QUARTER (JAN-MAR)

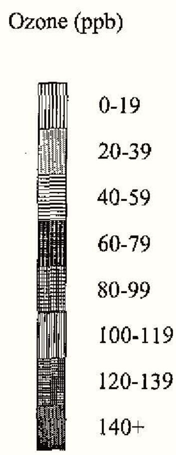


100.0% Collected 85.6% Valid
2184 Possible /2184 Collected /1869 Valid

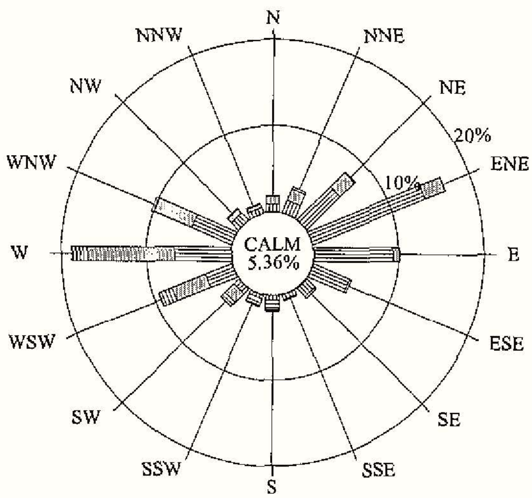
SECOND QUARTER (APR-JUN)



100.0% Collected 89.1% Valid
2184 Possible /2184 Collected /1947 Valid

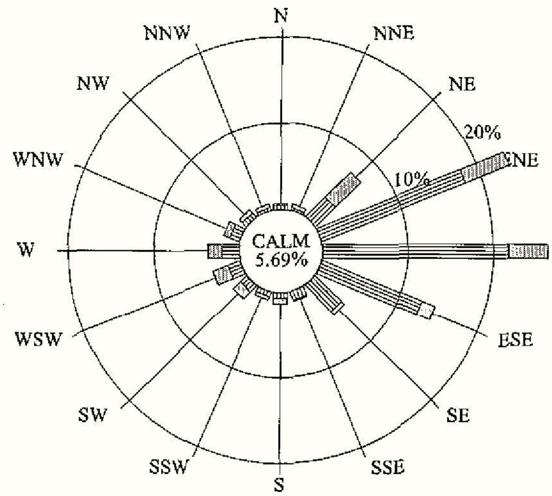


THIRD QUARTER (JUL-SEP)



100.0% Collected 85.4% Valid
2208 Possible /2208 Collected /1886 Valid

FOURTH QUARTER (OCT-DEC)

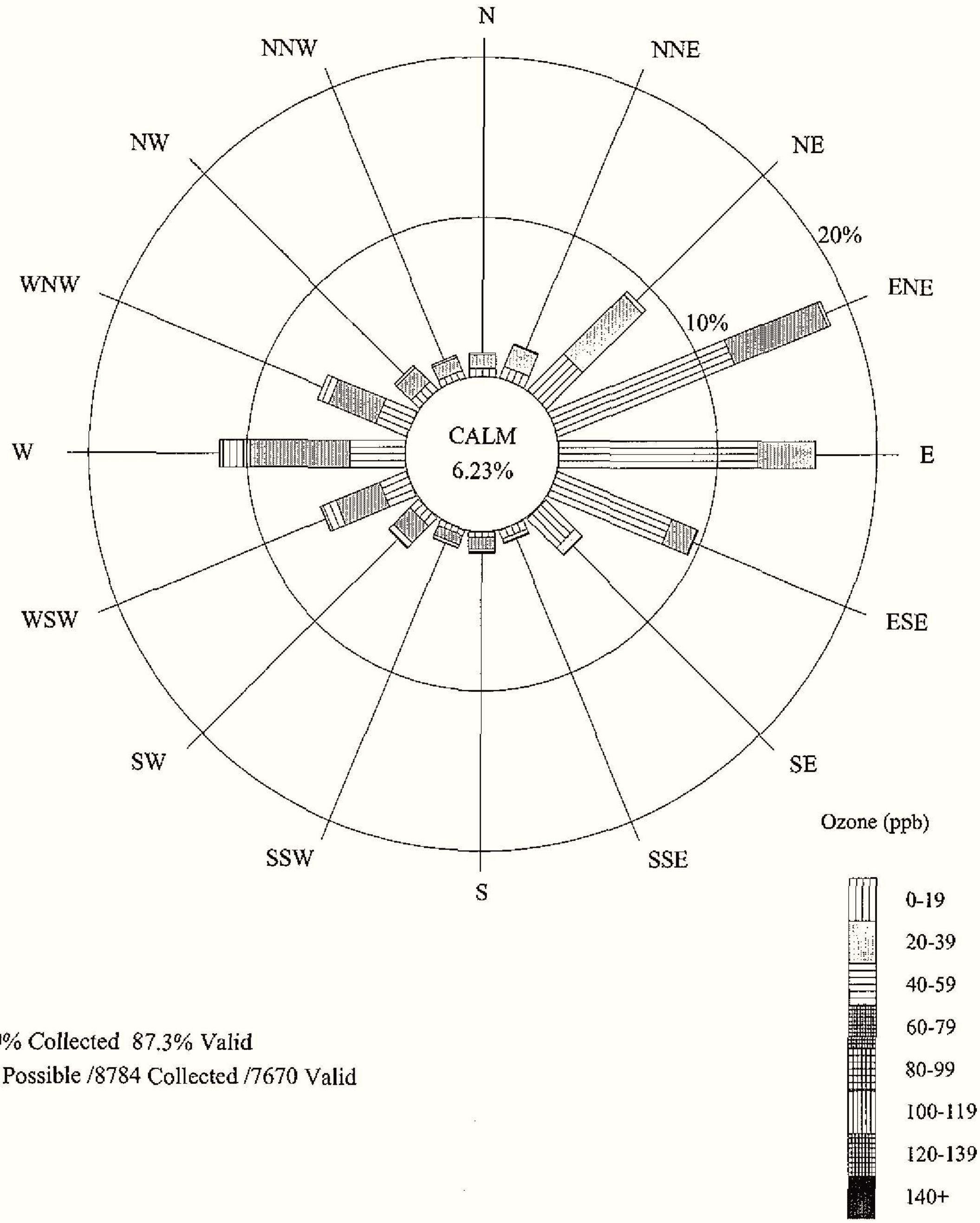


100.0% Collected 89.1% Valid
2208 Possible /2208 Collected /1968 Valid

Mount Rainier
National Park
Tahoma Woods

Annual Ozone
Pollutant Rose

2000



100.0% Collected 87.3% Valid
8784 Possible /8784 Collected /7670 Valid

Ozone Precision Check Summary
Mount Rainier National Park

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.[1] 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[2] of all the individual precision check percent differences for the quarter, and the upper and lower 95% probability limits[3] 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 01/01/2000 - 12/31/2000				
Calendar Quarter	Number of Precision Checks	Average Percent Difference [1 2]	Lower 95% Probability Limit [3]	Upper 95% Probability Limit [3]
1	13	-5.93	-8.14	-3.72
2	13	-4.24	-11.02	2.55
3	12	3.49	0.85	6.12
4	13	2.76	-0.50	6.01

[1] Percent Difference= $\frac{\text{analyzer - transfer std}}{\text{transfer std}}$ X 100.

[2] *Average Percent Difference is the mean of all individual precision check percent differences during the quarter.*

[3] 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

Mount Rainier National Park

Final Validation

01/01/2000 - 12/31/2000

Parameter	Value	Units	Number	Std Dev
SCALAR WIND SPEED				
Average	1.0	m/s	8690	0.4
Maximum	3.5	m/s		
Percent calm = 6.62				
AMBIENT TEMPERATURE				
Average	8.3	degC	8755	6.5
Maximum	30.7	degC		
Minimum	-5.9	degC		
RELATIVE HUMIDITY				
Average	83	percent	8329	18
Maximum	100	percent		
Minimum	18	percent		
PRECIPITATION (Rainfall or Snow melt)				
Average non-zero rate	.9	mm/hr	1168	.9
Maximum non-zero rate	8.3	mm/hr		
Minimum non-zero rate	.3	mm/hr		
Accumulated during period	1095.8	mm		
SOLAR RADIATION				
Average Daily Total	9,917,849	joules/m2day	365	7,472,081
Maximum Daily Total	25,932,800	joules/m2day		
Minimum Daily Total	288,000	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.

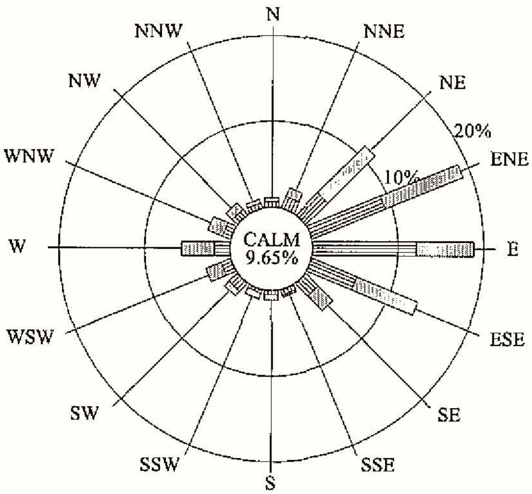
NA indicates instrument not available.

Mount Rainier
National Park
Tahoma Woods

Quarterly Wind Rose

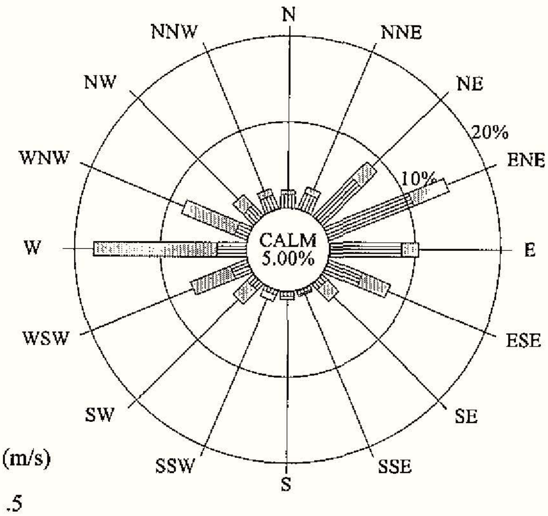
2000

FIRST QUARTER (JAN-MAR)

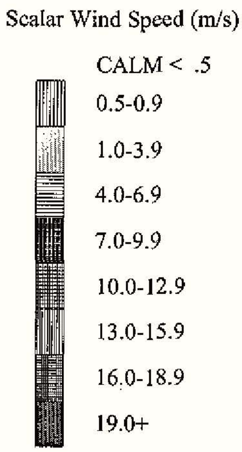


100.0% Collected 94.0% Valid
2184 Possible /2184 Collected /2052 Valid

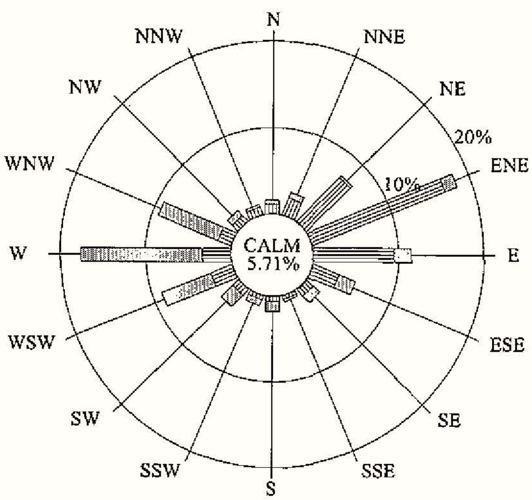
SECOND QUARTER (APR-JUN)



100.0% Collected 99.7% Valid
2184 Possible /2184 Collected /2178 Valid

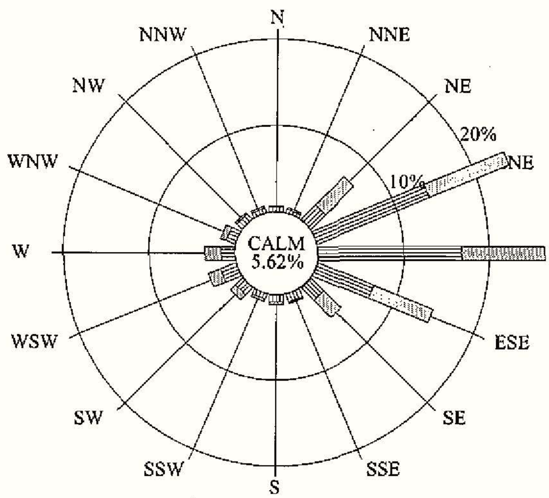


THIRD QUARTER (JUL-SEP)



100.0% Collected 100.0% Valid
2208 Possible /2208 Collected /2207 Valid

FOURTH QUARTER (OCT-DEC)

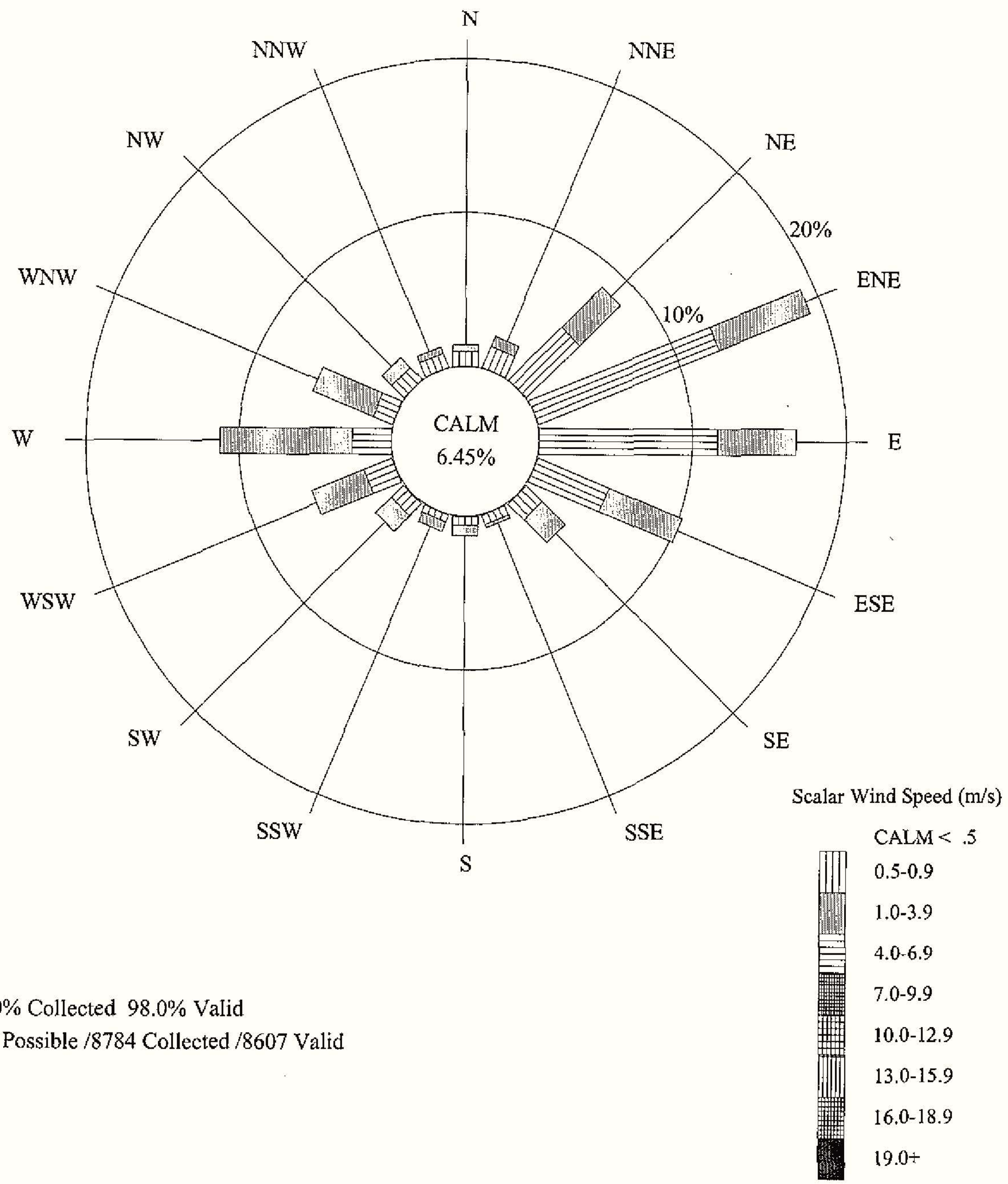


100.0% Collected 98.3% Valid
2208 Possible /2208 Collected /2170 Valid

Mount Rainier
National Park
Tahoma Woods

Annual Wind Rose

2000



100.0% Collected 98.0% Valid
8784 Possible /8784 Collected /8607 Valid

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 2000 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 preliminary 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 (SO_4^{2-}), particulate nitrate (NO_3^-), particulate ammonium (NH_4^+), sulfur dioxide (SO_2), and nitric acid (HNO_3). In some cases, the positive ions Na^+, K^+, Ca^{2+}, and 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/ardpublc/acidrain/castnet/about.html). Initial CASTNet results have shown that dry deposition can be a significant portion of total acidic deposition.

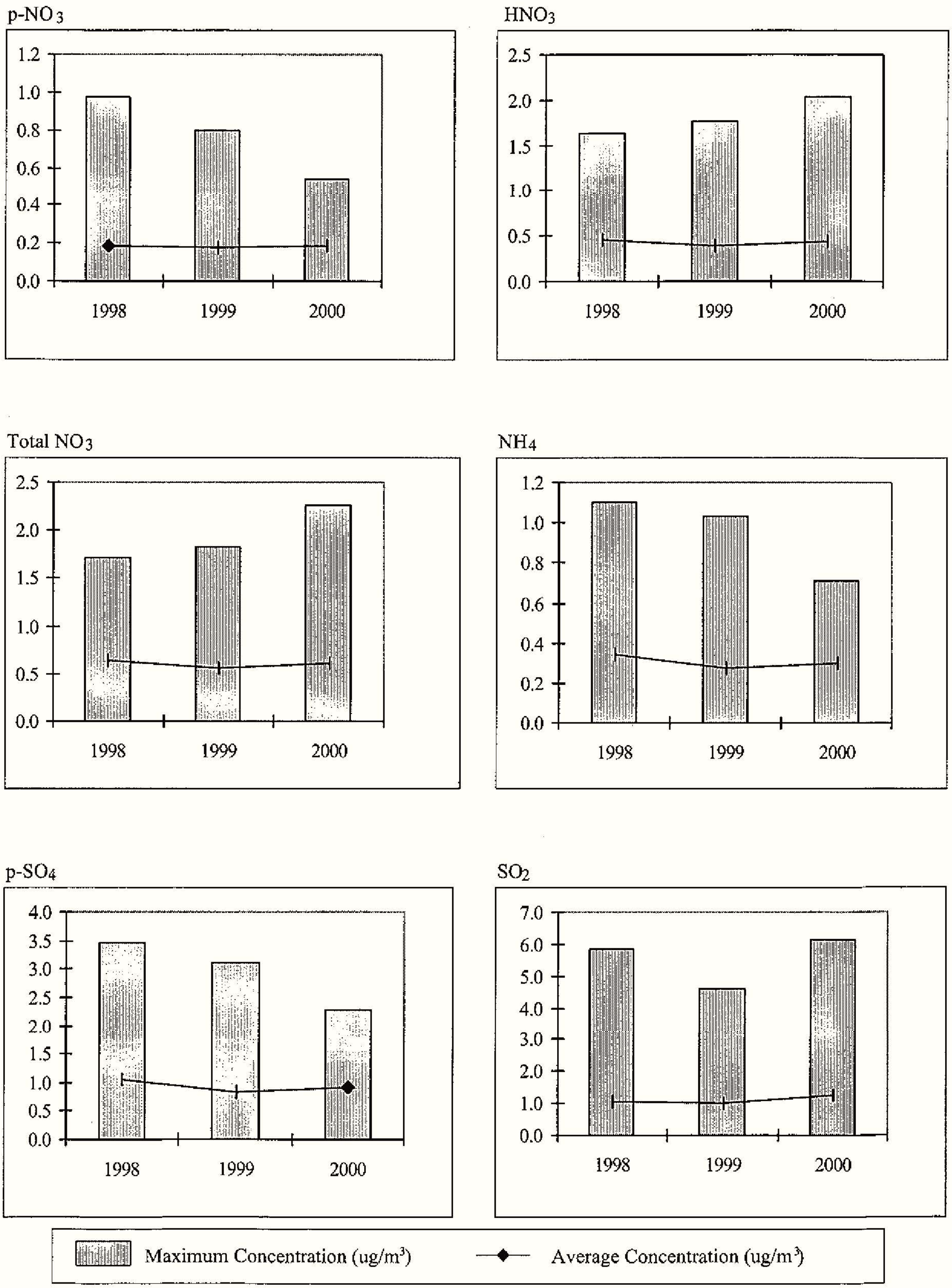
CASTNet Dry Deposition Monitoring Quarterly and Annual Average Concentrations Mount Rainier National Park 1/1/2000 - 12/31/200(								
Quarter	No.Valid Samples	p-NO_3 (ug/m^3)	HNO_3 (ug/m^3)	Total NO_3 (ug/m^3)	NH_4 (ug/m^3)	p-SO_4 (ug/m^3)	SO_2 (ug/m^3)	SO_4 /SO_2 Ratio
1	12	0.119	0.090	0.208	0.120	0.350	0.493	0.710
2	13	0.307	0.551	0.849	0.326	1.016	0.822	1.236
3	13	0.175	0.934	1.094	0.529	1.661	2.974	0.558
4	13	0.120	0.120	0.239	0.202	0.559	0.720	0.777
Annual Average		0.181	0.430	0.605	0.298	0.907	1.267	0.716
Standard Deviation		0.110	0.479	0.519	0.193	0.633	1.454	

Data Recovery Table			
Total No. Filters	No. Invalidated	Data Capture	No. Valid Hours
51	0	100.0%	8511.0

CASTNet Dry Deposition Monitoring Weekly Concentrations Report
Mount Rainier National Park
1/1/2000 -12/31/2000

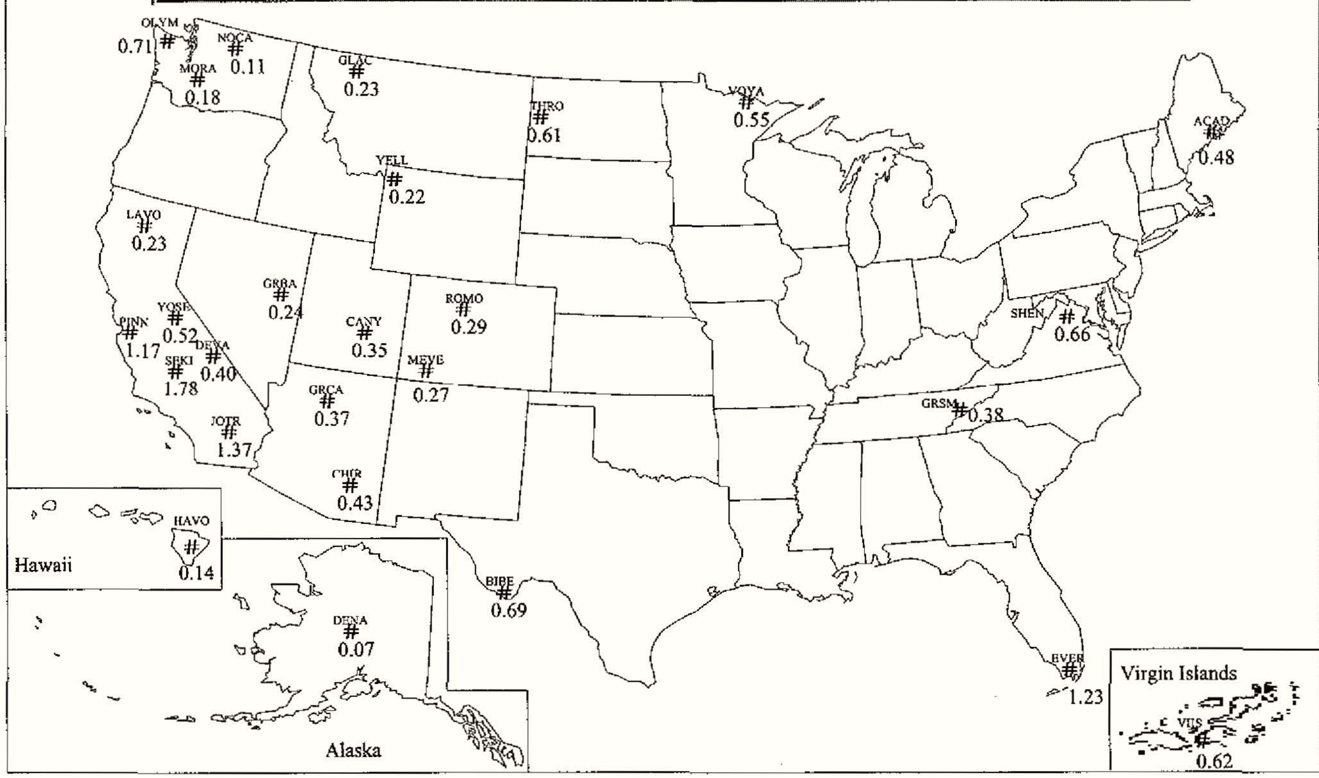
On Date	Off Date	p-NO_3 (ug/m^3)	HNO_3 (ug/m^3)	Total NO_3 (ug/m^3)	NH_4 (ug/m^3)	p-SO_4 (ug/m^3)	SO_2 (ug/m^3)	SO_4/SO_2 Ratio
01/04/00	01/11/00	0.068	0.068	0.134	0.071	0.272	0.701	0.388
01/11/00	01/18/00	0.062	0.063	0.124	0.048	0.112	0.262	0.429
01/18/00	01/25/00	0.062	0.067	0.128	0.074	0.131	0.150	0.874
01/25/00	02/01/00	0.058	0.089	0.145	0.140	0.369	0.413	0.893
02/01/00	02/08/00	0.139	0.067	0.205	0.070	0.151	0.377	0.399
02/08/00	02/15/00	0.143	0.063	0.205	0.115	0.291	0.318	0.912
02/15/00	02/22/00	0.104	0.162	0.264	0.127	0.301	0.225	1.338
02/22/00	02/29/00	0.116	0.059	0.174	0.049	0.181	0.140	1.291
02/29/00	03/07/00	0.196	0.160	0.354	0.172	0.452	0.728	0.620
03/07/00	03/14/00	0.119	0.106	0.224	0.222	0.640	0.244	2.623
03/14/00	03/21/00	0.099	0.059	0.157	0.067	0.295	0.384	0.768
03/21/00	03/28/00	0.264	0.118	0.380	0.288	1.007	1.971	0.511
03/28/00	04/04/00	0.201	0.672	0.863	0.333	1.099	0.785	1.400
04/04/00	04/11/00	0.418	0.317	0.730	0.474	1.458	0.568	2.567
04/11/00	04/18/00	0.195	0.413	0.601	0.371	1.058	1.015	1.042
04/18/00	04/25/00	0.337	0.259	0.592	0.240	0.819	1.265	0.648
04/25/00	05/02/00	0.306	0.100	0.405	0.171	0.454	0.287	1.580
05/02/00	05/09/00	0.444	0.122	0.563	0.228	0.651	0.206	3.165
05/09/00	05/16/00	0.231	0.188	0.416	0.247	0.638	0.664	0.961
05/16/00	05/23/00	0.166	0.452	0.611	0.484	1.565	2.121	0.738
05/23/00	05/30/00	0.266	2.025	2.258	0.257	0.815	0.392	2.080
05/30/00	06/06/00	0.288	0.539	0.818	0.344	1.018	0.663	1.535
06/06/00	06/13/00	0.180	0.279	0.455	0.208	0.573	0.268	2.135
06/13/00	06/20/00	0.418	0.518	0.928	0.336	1.287	0.843	1.526
06/20/00	06/27/00	0.540	1.281	1.801	0.539	1.772	1.605	1.104
06/27/00	07/04/00	0.226	0.759	0.973	0.465	1.246	4.379	0.284
07/04/00	07/11/00	0.225	1.086	1.293	0.619	2.288	2.527	0.905
07/11/00	07/18/00	0.227	1.342	1.548	0.676	2.154	4.519	0.477
07/18/00	07/25/00	0.187	1.394	1.559	0.529	1.706	2.308	0.739
07/25/00	08/01/00	0.111	1.177	1.269	0.613	1.762	5.918	0.298
08/01/00	08/08/00	0.159	1.390	1.526	0.711	2.019	2.622	0.770
08/08/00	08/15/00	0.283	1.057	1.324	0.629	2.045	2.586	0.791
08/15/00	08/22/00	0.145	0.842	0.973	0.492	1.475	2.219	0.665
08/22/00	08/29/00	0.226	1.049	1.258	0.601	1.826	6.146	0.297
08/29/00	09/05/00	0.183	0.306	0.485	0.264	0.886	0.360	2.464
09/05/00	09/12/00	0.095	0.377	0.466	0.317	1.147	1.810	0.634
09/12/00	09/19/00	0.109	0.925	1.019	0.649	2.195	2.591	0.847
09/19/00	09/26/00	0.097	0.436	0.527	0.316	0.838	0.678	1.237
09/26/00	10/03/00	0.134	0.460	0.586	0.511	1.631	2.909	0.561
10/03/00	10/10/00	0.136	0.245	0.377	0.271	0.716	0.450	1.593
10/10/00	10/17/00	0.269	0.160	0.426	0.272	0.594	0.381	1.557
10/17/00	10/24/00	0.131	0.060	0.190	0.139	0.430	0.684	0.629
10/24/00	10/31/00	0.132	0.062	0.193	0.202	0.501	0.156	3.212
10/31/00	11/07/00	0.185	0.059	0.243	0.147	0.502	0.506	0.992
11/07/00	11/14/00	0.081	0.061	0.141	0.263	0.672	0.252	2.671
11/14/00	11/21/00	0.058	0.145	0.200	0.247	0.545	0.388	1.405
11/21/00	11/28/00	0.058	0.059	0.117	0.118	0.330	0.366	0.902
11/28/00	12/05/00	0.070	0.064	0.133	0.084	0.229	0.163	1.406
12/05/00	12/12/00	0.074	0.060	0.133	0.169	0.457	2.434	0.188
12/12/00	12/19/00	0.174	0.069	0.242	0.139	0.442	0.503	0.879
12/19/00	12/26/00	0.060	0.061	0.119	0.060	0.219	0.168	1.304

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



CASTNet Dry Deposition Monitoring Sites / National Park Service Units

Average Particulate Nitrate (p-NO3) Concentrations (ug/m3) for Entire Year 2000



Key:

ACAD	Acadia NP
BIBE	Big Bend NP
CANY	Canyonlands NP
CHIR	Chiricahua NM
DENA	Denali NP
DEVA	Death Valley NP
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GRCA	Grand Canyon NP
GRSM	Great Smokies NP
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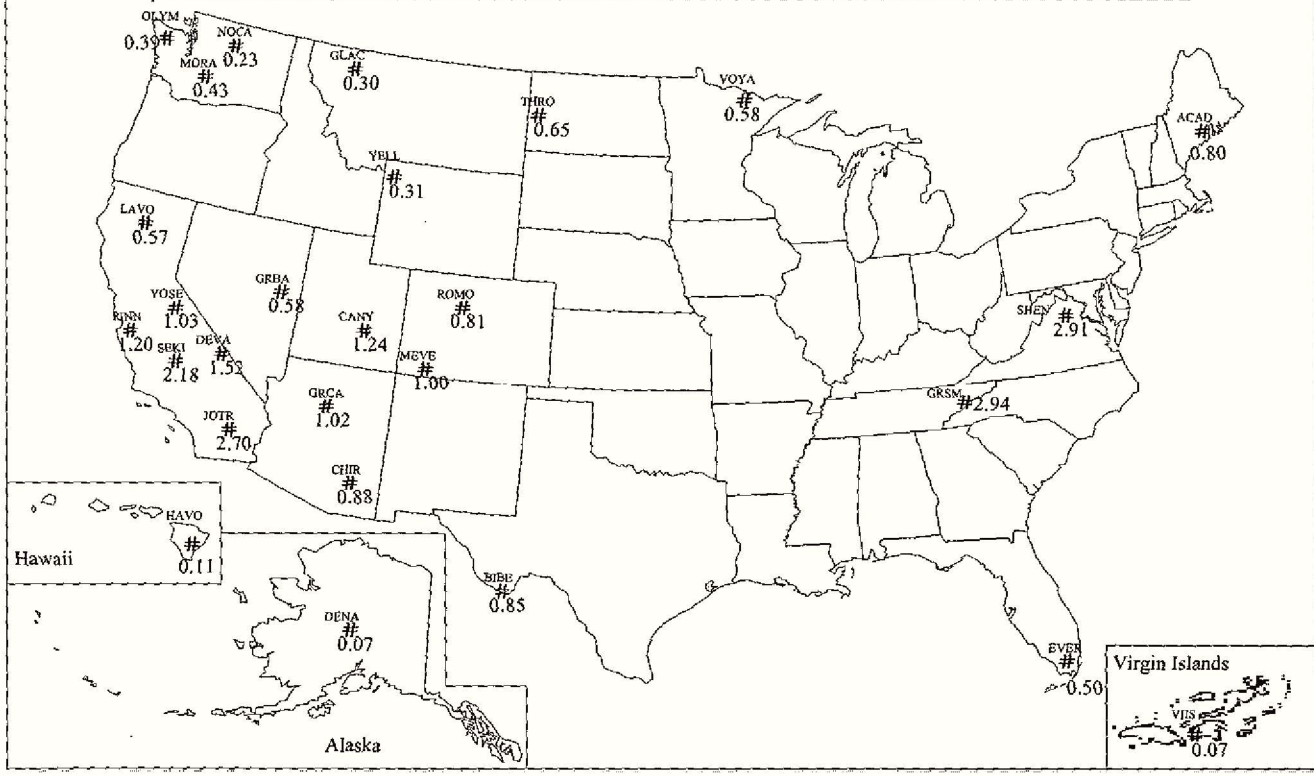
NOCA	North Cascades NP
OLYM	Olympic NP
PINN	Pinnacles NM
ROMO	Rocky Mountain NP
SEKI	Sequoia NP
SHEN	Shenandoah NP
THRO	Th. Roosevelt NP
VIIS	Virgin Islands NP
VOYA	Voyageurs NP
YELL	Yellowstone NP
YOSE	Yosemite NP

CASTNet Dry Deposition Monitoring Sites / National Park Service Units

Average Nitric Acid (HNO3) Concentrations (ug/m3) for Entire Year 2000



Key:

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BIBE	Big Bend NP
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DENA	Denali NP
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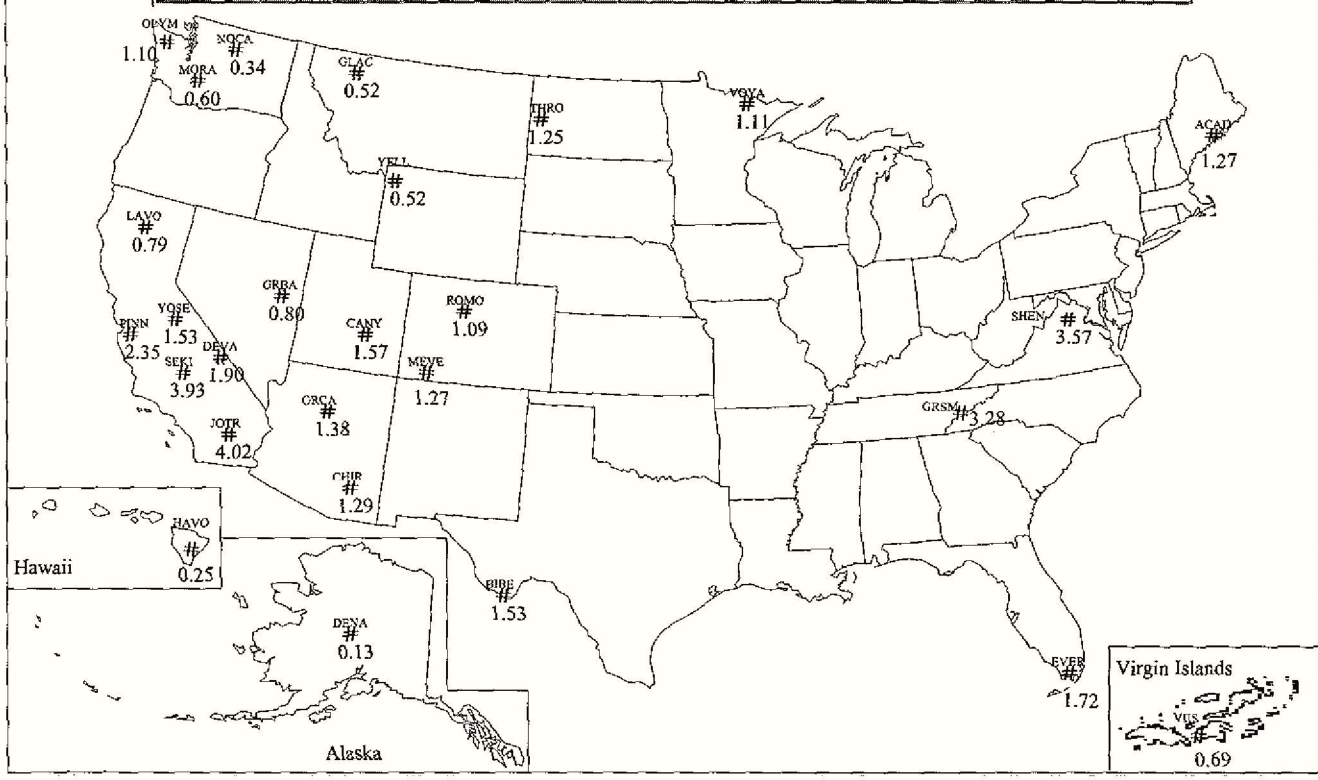
NOCA	North Cascades NP
OLYM	Olympic NP
PINN	Pinnacles NM
ROMO	Rocky Mountain NP
SEKI	Sequoia NP
SHEN	Shenandoah NP
THRO	Th. Roosevelt NP
VIIS	Virgin Islands NP
VOYA	Voyageurs NP
YELL	Yellowstone NP
YOSE	Yosemite NP

CASTNet Dry Deposition Monitoring Sites / National Park Service Units

Average Total Nitrate (Total NO3) Concentrations (ug/m3) for Entire Year 2000



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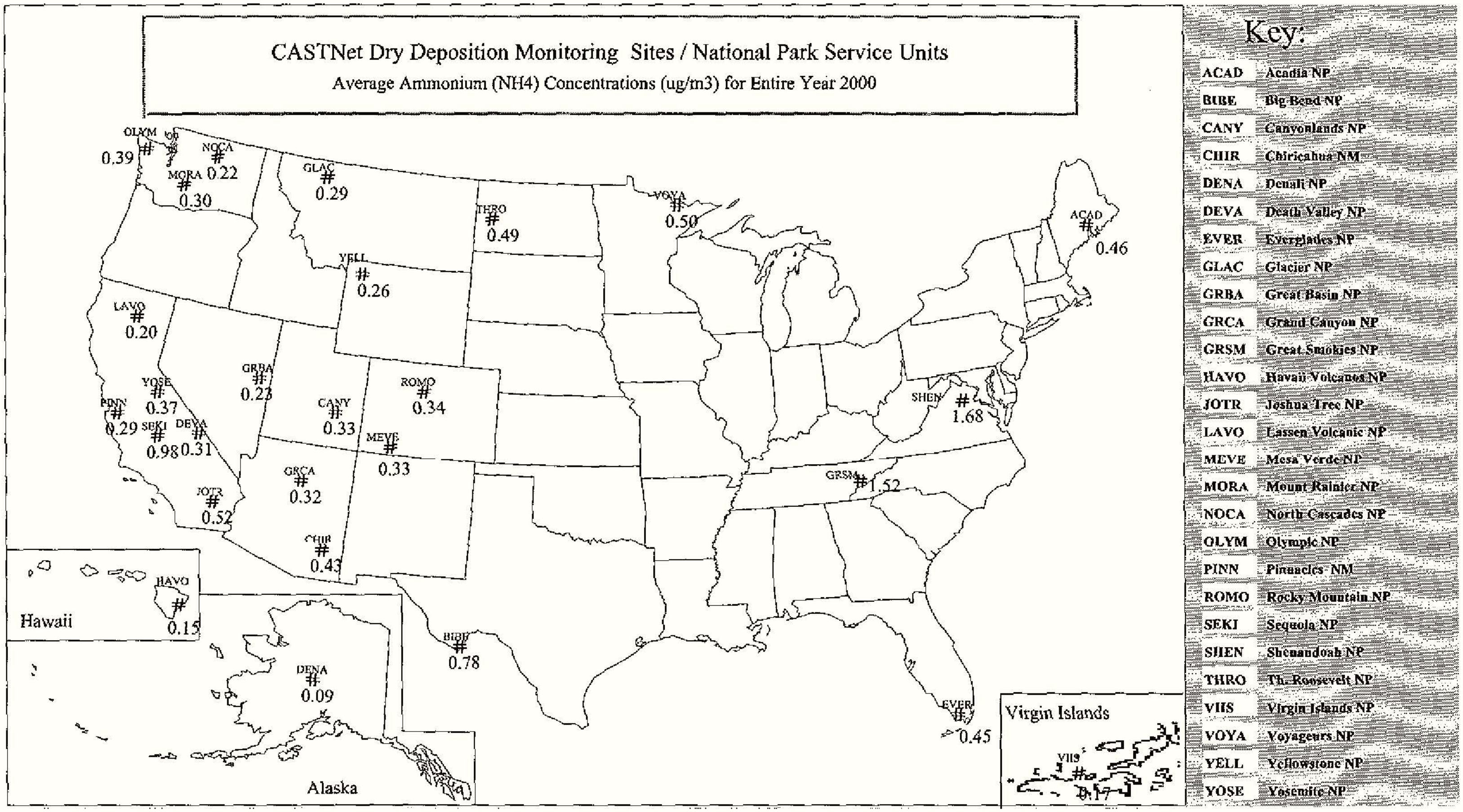

CASTNet Dry Deposition Monitoring Sites / National Park Service Units
Average Ammonium (NH4) Concentrations (ug/m3) for Entire Year 2000
OLYM 0.39
NOCA 0.22
MORA 0.30
GLAC 0.29
THRO 0.49
VOYA 0.50
ACAD 0.46
YELL 0.26
LAVO 0.20
GRBA 0.23
YOSE 0.37
PINN 0.29
SEKI 0.98
DEVA 0.31
CANY 0.33
ROMO 0.34
MEVE 0.33
SHEN 1.68
GRCA 0.32
JOTR 0.52
GRSM 1.52
CHIR 0.43
HAVO 0.15
Hawaii
BIBE 0.78
DENA 0.09
Alaska
EVER 0.45
Virgin Islands
VIIS 0.17
Key:
ACAD Acadia NP
BIBE Big Bend NP
CANY Canyonlands NP
CHIR Chiricahua NM
DENA Denali NP
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GRBA Great Basin NP
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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
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THRO Th. Roosevelt NP
VIIS Virgin Islands NP
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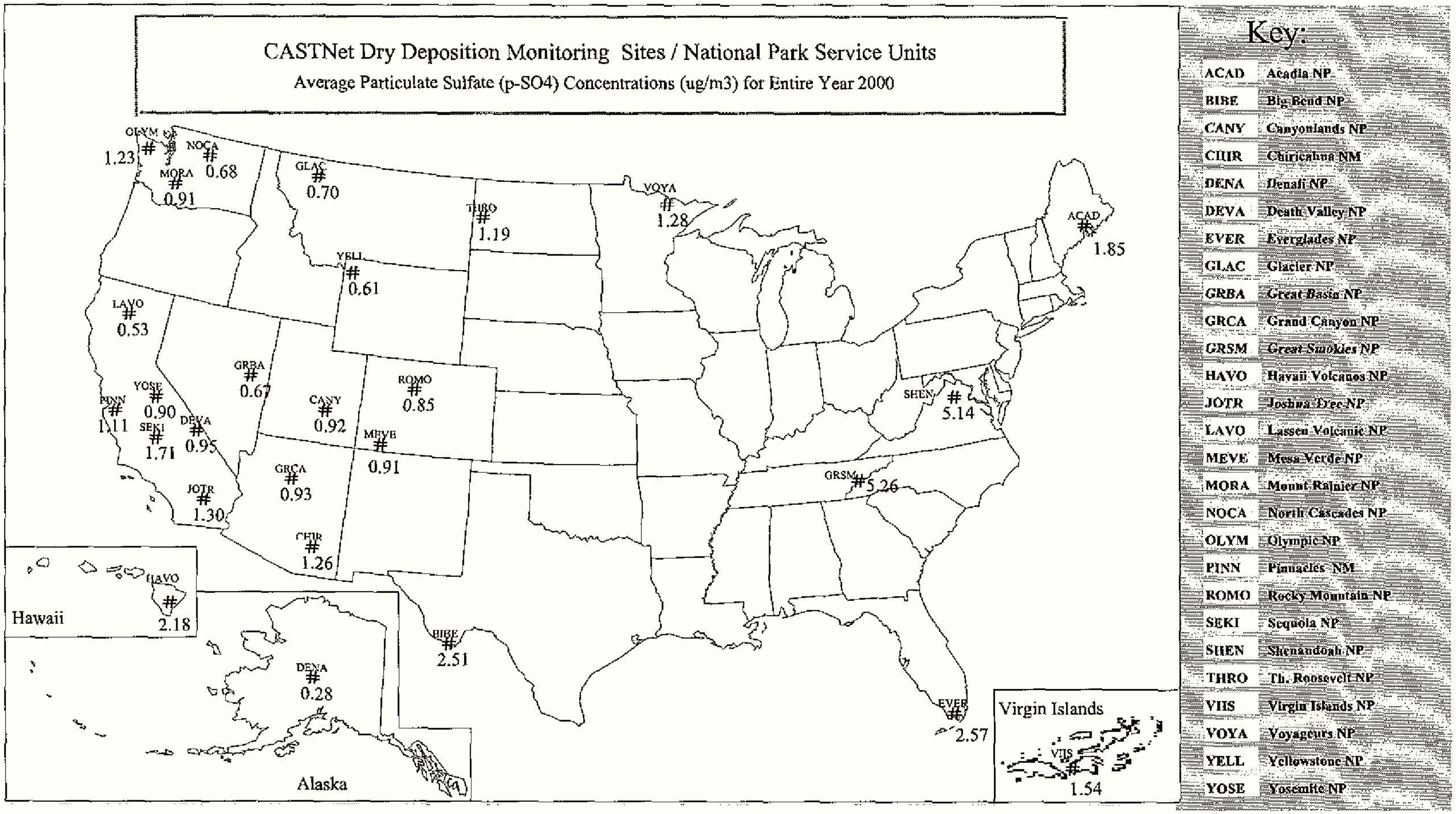
YELL Yellowstone NP
YOSE Yosemite NP



CASTNet Dry Deposition Monitoring Sites / National Park Service Units
Average Particulate Sulfate (p-SO4) Concentrations (ug/m3) for Entire Year 2000
OLYM 1.23
NOCA 0.68
MORA 0.91
GLAC 0.70
THRO 1.19
VOYA 1.28
ACAD 1.85
YELL 0.61
LAVO 0.53
GRBA 0.67
ROMO 0.85
CANY 0.92
YOSE 0.90
PINN 1.11
SEKI 1.71
DEVA 0.95
MEVE 0.91
SHEN 5.14
GRSM 5.26
GRCA 0.93
JOTR 1.30
CHIR 1.26
HAVO 2.18
Hawaii
BIBE 2.51
DENA 0.28
Alaska
EVER 2.57
Virgin Islands
VIIS 1.54
Key:
ACAD Acadia NP
BIBE Big Bend NP
CANY Canyonlands NP
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DENA Denali NP
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VIIS Virgin Islands NP
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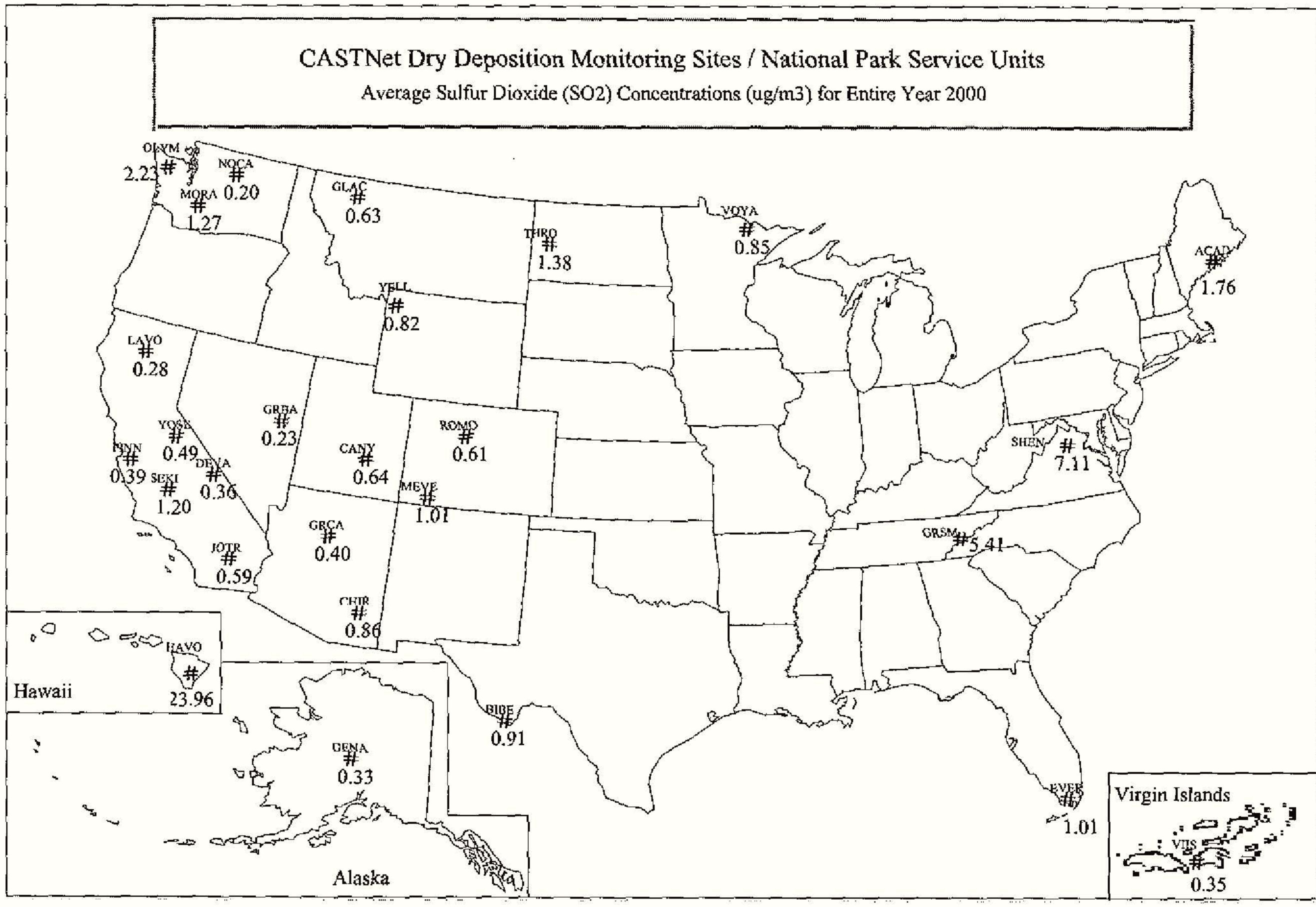

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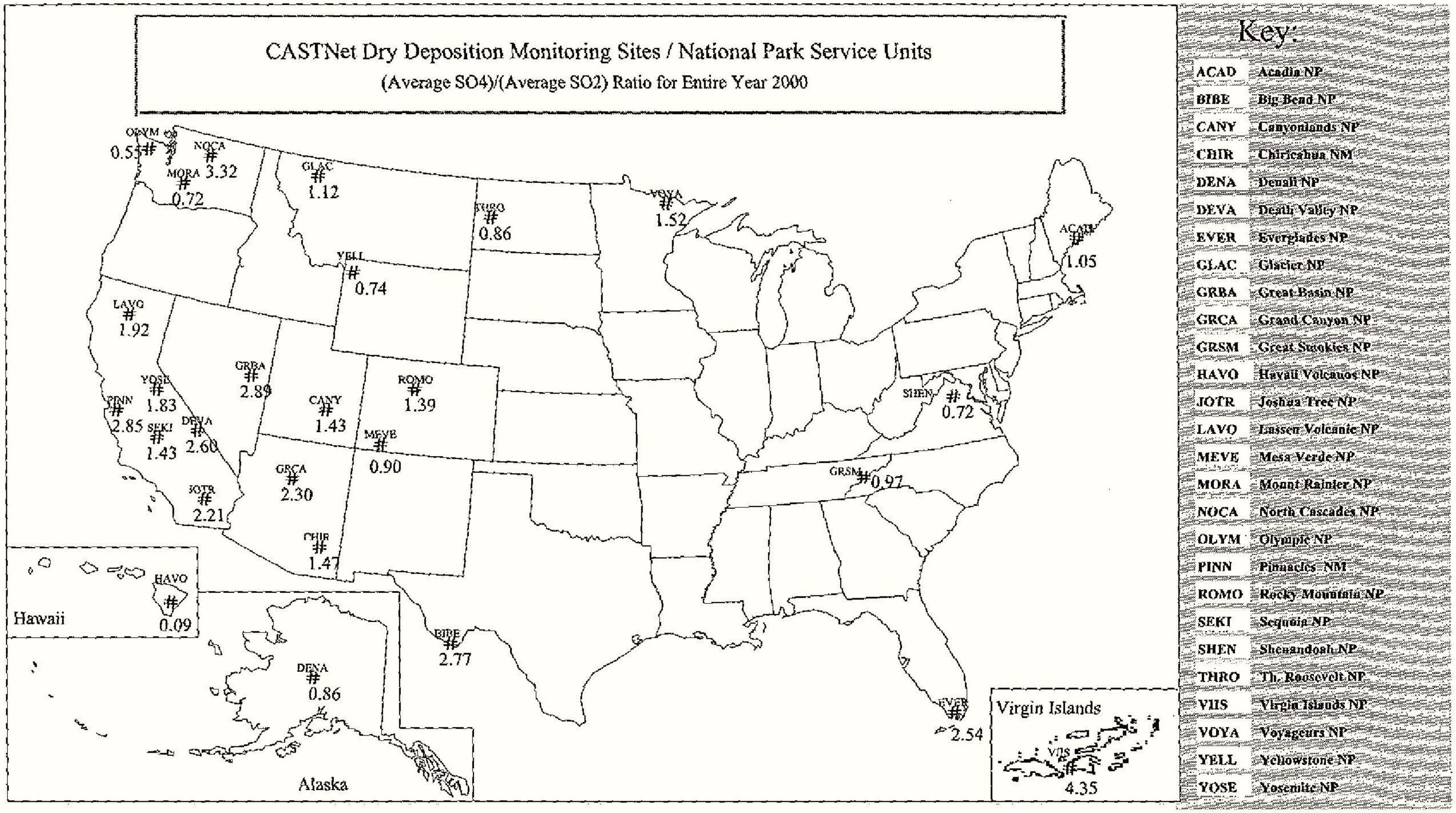
CASTNet Dry Deposition Monitoring Sites / National Park Service Units
(Average SO4)/(Average SO2) Ratio for Entire Year 2000
OLYM 0.55
NOCA 3.32
MORA 0.72
GLAC 1.12
THRO 0.86
VOYA 1.52
ACAD 1.05
YELL 0.74
LAVO 1.92
GRBA 2.89
ROMO 1.39
CANY 1.43
YOSE 1.83
PINN 2.85
SEKI 1.43
DEVA 2.60
MEVE 0.90
SHEN 0.72
GRSM 0.97
GRCA 2.30
JOTR 2.21
CHIR 1.47
HAVO 0.09
Hawaii
DENA 0.86
Alaska
BIBE 2.77
EVER 2.54
Virgin Islands
VIIS 4.35
Key:
ACAD Acadia NP
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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 2000
- 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

Data Disk Contents Summary	
File Name (s)	Description
Hourly	
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 Q*n* = Quarter 1-4 R = Wind Frequency distribution table	
CASTNet Weekly Species Summary Data	
File Name (s)	Description
CASTNet	
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	AIRS CODE	AIRS REASON
TO	Sample time out of limits	9973	Sample time out of limits
IW	Instrument warmup	9978	Voided by operator
OE	Operator error	9978	
BM	Begin monitoring	9979	Miscellaneous void
TL	Station temp low	9979	
OS	Off scale	9979	
EM	End monitoring	9979	
LI	Local interference	9979	
TH	Station temp high	9979	
IM	Instrument malfunction	9980	Machine malfunction
IN	Interference	9981	Bad weather
RF	Recording system failure	9983	Collection error
NA	No data	9987	Monitoring waived
PF	Power failure	9988	Power Failure
PC	Precision check	9990	Precision Check
ZS	Instrument zero/span check	9991	QC Control Points (Zero/Span)
SA	System audit	9992	QC Audit
PA	Performance audit	9992	
MT	Maintenance	9993	Maintenance/Routine Repairs
OR	Out for repair	9993	
CA	Calibration	9995	Multipoint calibration
SC	Station check	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.

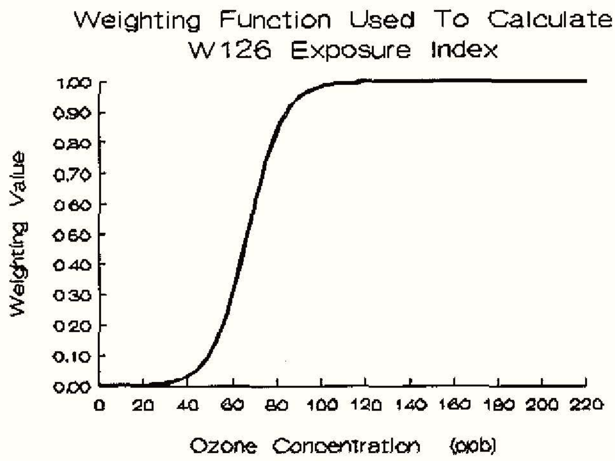
(13) **SUM60 Exposure Index**. The monthly sum of all hourly ozone concentrations equaling or exceeding 60 PPB. Units are PPB-HR. The "MAY-SEP" column sums across the months of May through September to give the cumulative exposure for the growing season. The "ANNUAL" column sums across every month to 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[1] is:

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

where



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 <u>not</u> 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_2, NO_2, PM_{10}, Pb, CO, O_3).

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_3): 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_2): A criteria air pollutant that is a gas produced by burning coal and some industrial processes.

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* 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	μg/m^3 Ozone (at 25°C)
	ppm	2615	μg/m^3 Sulfur Dioxide (at 25°C)
	ppb	0.001	ppm
	ppb	1.960	μg/m^3 Ozone (at 25°C)
	ppb	2.615	μg/m^3 Sulfur Dioxide (at 25°C)
	μg/m^3 Ozone (25°C)	0.0005102	ppm
	μg/m^3 Ozone (25°C)	0.5102	ppb
	μg/m^3 Sulfur Dioxide (25°C)	0.0003824	ppm
	μg/m^3 Sulfur Dioxide (25°C)	0.3824	ppb
Wind Speed	m/s	2.237	mph
	mph	0.4470	m/s
Solar Radiation	ly/min	697	w/m^2
	w/m^2	0.00143	ly/min
Precipitation	mm/hr	0.0394	in/hr
	in/hr	25.4	mm/hr
Temperature	°C + 17.78	1.8	°F
	°F - 32	5/9	°C

Where:
ppm = parts per million
ppb = parts per billion
μg/m^3 = micrograms per cubic meter (at 25°C)
m/s = meters per second
mps = miles per hour
ly/min = langleys per minute
w/m^2 = watts per square meter
mm/hr = millimeters per hour
in/hr = inches per hour
°C = degrees centigrade
°F = degrees fahrenheit