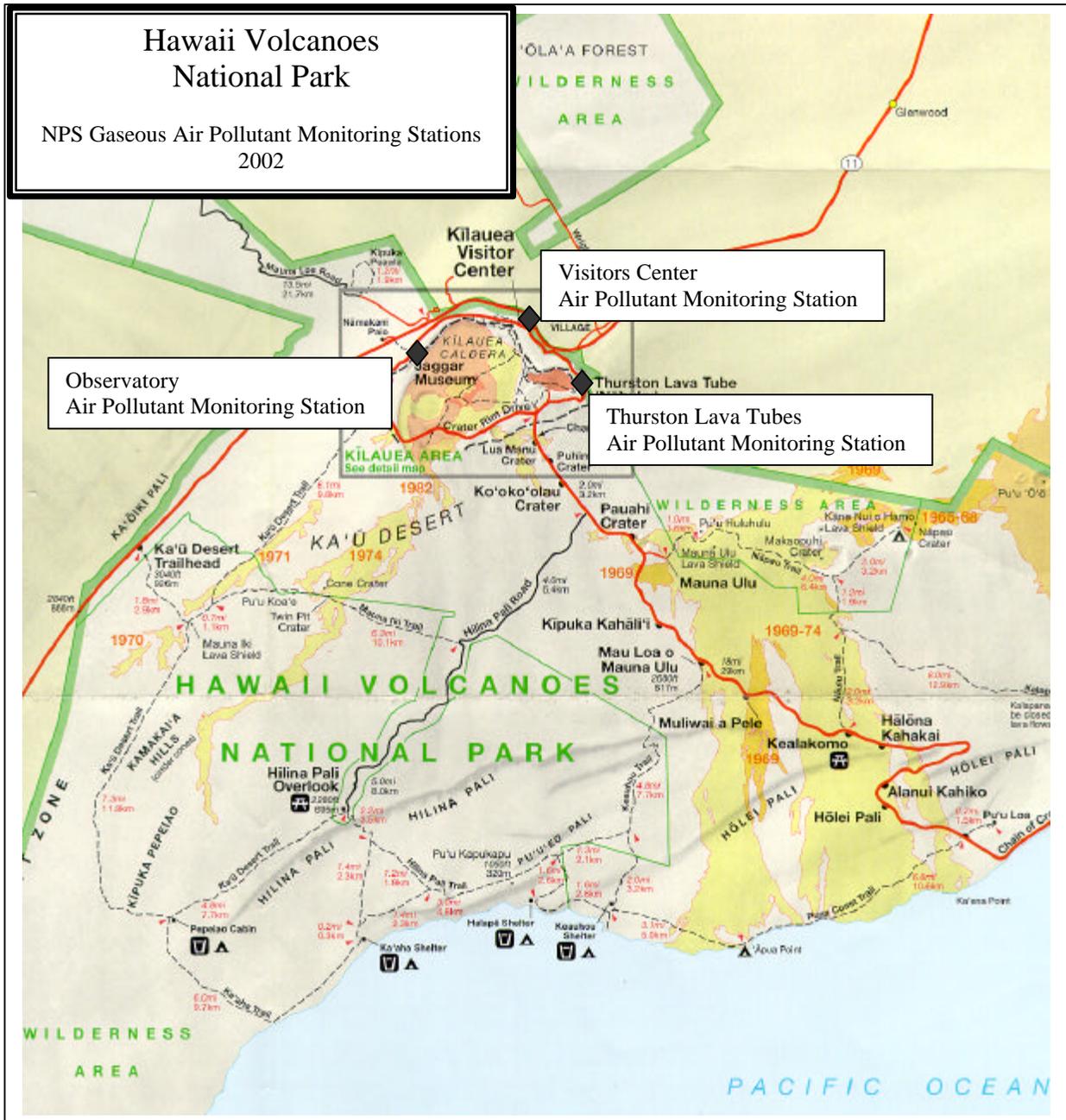


**Annual Data Summary**  
**HAWAII VOLCANOES NATIONAL PARK**  
**2002**  
**National Park Service**  
**Gaseous Air Pollutant Monitoring Network**



**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



The National Park Service maintained three air pollutant monitoring sites in Hawaii Volcanoes National Park during 2002. Data from each site are summarized in this report.

**Annual Data Summary**  
**HAWAII VOLCANOES NATIONAL PARK**  
**Observatory**

**2002**

**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 C2350010840 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](mailto: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](mailto: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 Hawaii Volcanoes National Park, the ARD specifically recognizes Tamar Elias 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	Hawaii Volcanoes National Park - Observatory	1-3
2.0	DATA SUMMARY	2-1
2.1	Overview	2-1
2.2	Sulfur Dioxide Data Summary	2-7
2.3	Supplemental Sulfur Dioxide Data Summary	2-19
2.4	Meteorological Data Summary	2-27
3.0	NATIONAL PARK SERVICE AIR RESOURCES DIVISION DATA SOURCES	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
Sulfur Dioxide Daily 1-Hour Maximum Concentrations and National Ambient Air Quality Standards Comparison	2-8
Sulfur Dioxide Standards, 1-Hour Maximum	2-9

## LIST OF FIGURES AND TABLES (Continued)

	<u>Page</u>
Sulfur Dioxide Standards, 24-Hour Block Average	2-10
Sulfur Dioxide Standards, Maximum of 3-Hour Block Average	2-11
Sulfur Dioxide Yearly Frequency Distribution	2-12
Maximum Sulfur Dioxide Concentration Comparisons for Three Years	2-13
Quarterly Diurnal Sulfur Dioxide Plots	2-14
Annual Diurnal Sulfur Dioxide Plots	2-15
Quarterly Sulfur Dioxide Pollutant Roses	2-16
Annual Sulfur Dioxide Pollutant Roses	2-17
Sulfur Dioxide Precision Check Data Summary	2-18
Supplemental Sulfur Dioxide Daily 1-Hour Maximum Concentrations and National Ambient Air Quality Standards Comparison	2-20
Supplemental Sulfur Dioxide Three Year Comparison	2-21
Quarterly Diurnal Supplemental Sulfur Dioxide Plots	2-22
Annual Diurnal Supplemental Sulfur Dioxide Plots	2-23
Quarterly Supplemental Sulfur Dioxide Pollutant Roses	2-24
Annual Supplemental Sulfur Dioxide Pollutant Roses	2-25
Supplemental Sulfur Dioxide Precision Check Data Summary	2-26
Summary of Selected Meteorological Data	2-28
Quarterly Wind Roses	2-29
Annual Wind Rose	2-30

## **1.0 INTRODUCTION**

### **1.1 THE NATIONAL PARK SERVICE GASEOUS POLLUTANT MONITORING PROGRAM (GPMP)**

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.

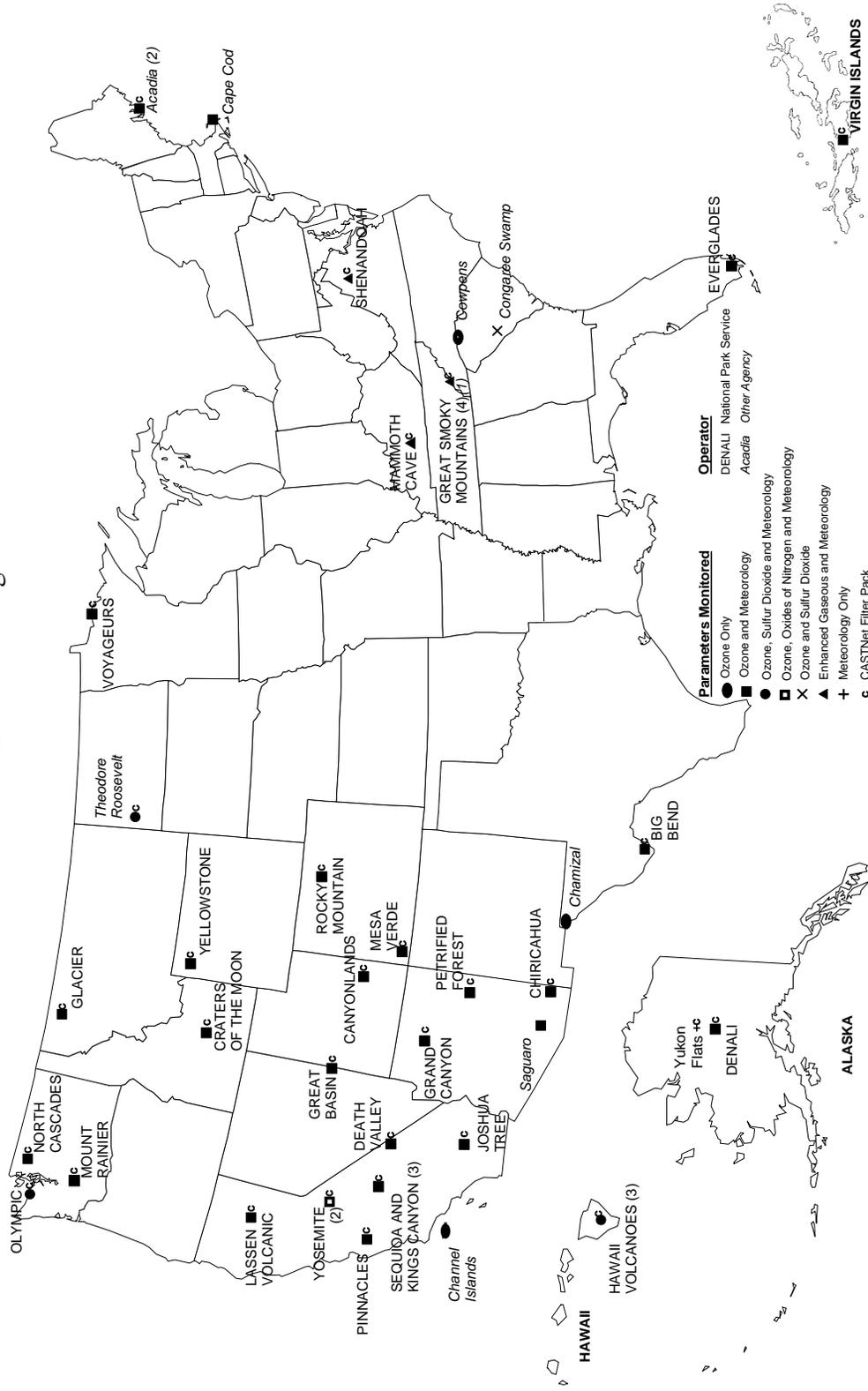
Other monitoring objectives call for the collection of data to support the National Park Service's required involvement in both the development of state air quality control plans, and the evaluation of permit applications for new or expanding air pollution sources wishing to locate near park units. The 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 Program site locations and measured parameters collected in this reporting year are shown on the map on the following page. During this reporting period, 47 monitoring sites in 37 units of the National Park System had some combination of ozone, sulfur dioxide, nitrogen, meteorological, and Clean Air Status and Trends Network (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 digital copy of all data collected during the year and data summary products are available; see Section 3.0 for information on obtaining these data. Individual reports are generated for each site where monitoring was conducted in the national park network.

# NATIONAL PARK SERVICE GASEOUS POLLUTANT MONITORING NETWORK

## 2002 Monitoring Sites



## **1.2 HAWAII VOLCANOES NATIONAL PARK**

Hawaii Volcanoes National Park, a Class I area, is located in the southeastern portion of the island of Hawaii. The island is situated at the southeastern end of the Hawaiian chain and is the largest and most recently formed. Its location and site specifications are presented on the following page.

The park was established by Congress in 1916 to conserve the volcanic features, endemic Hawaiian ecosystems, Hawaiian cultural and archeological remains, and inherent scenic values for visitor enjoyment and appreciation and for their scientific and historic values. In 1987, Congress designated 123 thousand of the park's 229 thousand acres as a wilderness area. Hawaii Volcanoes National Park was designated a Biosphere Reserve in 1980, and a World Heritage Site in 1987.

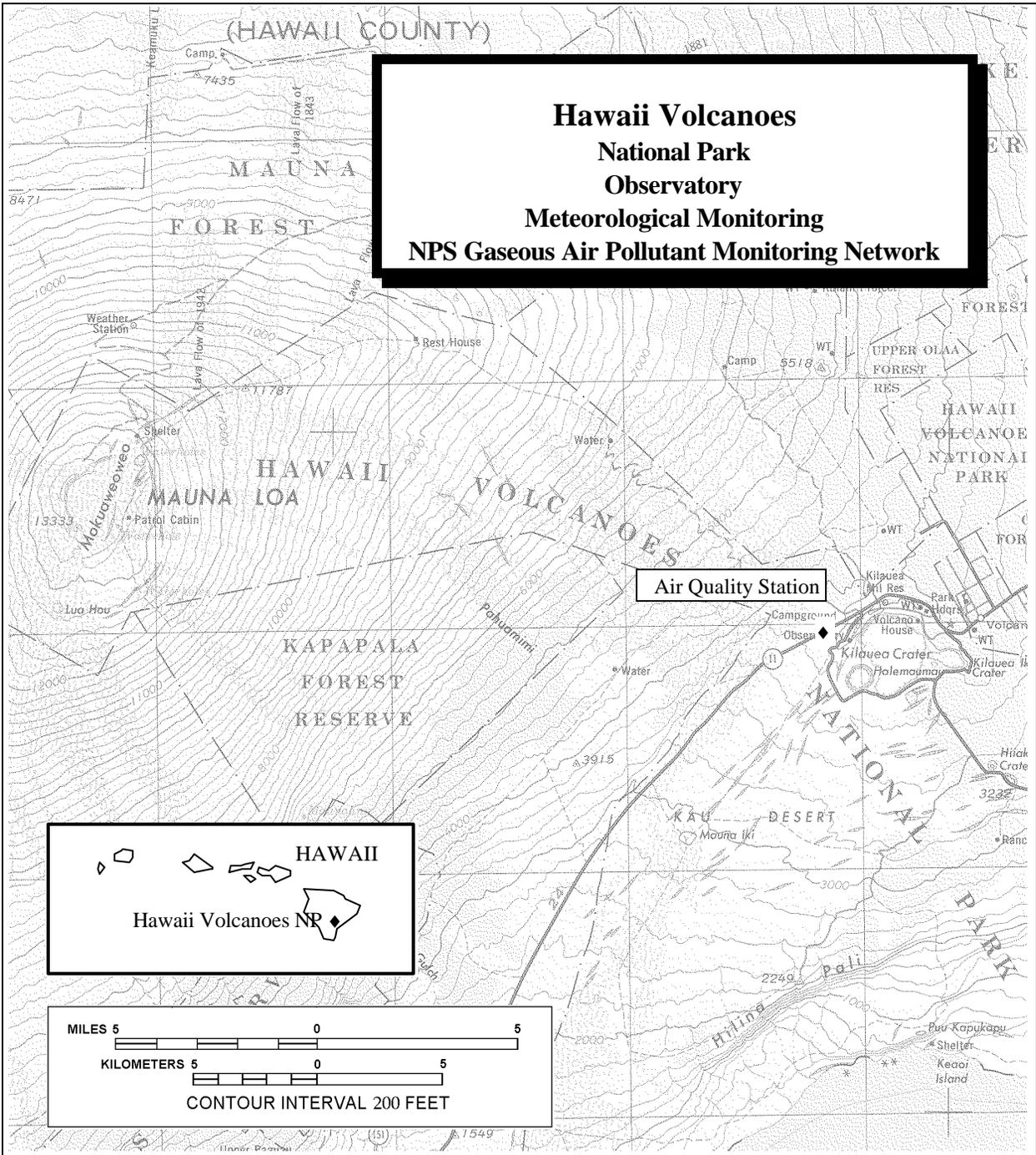
Hawaii Volcanoes National Park contains within its boundaries two of the most active volcanoes in the world, Mauna Loa and Kilauea, along with numerous historical, archeological, and biological resources.

Kilauea and Mauna Loa volcanoes are the dominant features of the park. Surrounded by recent lava flow materials and unique endemic plant communities, these volcanoes are dynamic landforms where new lava flows can drastically change the landscape. Recent eruptions have covered many acres with lava up to 300 feet deep, created new land where flows enter the ocean, and built up a new mountain where none existed before. These two volcanoes are the most studied and best understood volcanoes in the world because of the favorable opportunities afforded for fundamental and detailed research which are not duplicated or even approached in any other part of the world.

Hawaii flora is remarkable for its extraordinary degree of endemism. Ninety-five percent of the native species are found only in these islands. Although park boundaries were drawn primarily to include recent lava flows and the summits of Kilauea and Mauna Loa volcanoes, there is within the park, albeit limited in extent, a rich diversity of species and vegetation types. Diverse natural vegetation zones include tropical rain forest, woodlands, shrublands, grasslands, and alpine tundra.

Birds are the most important aspect of the park's wildlife and include endemic species of honeycreeper, owl, thrush, hawk, and flycatcher. No fish are found within the park. The Hawaiian bat is the only native land mammal. However, feral animals, such as goats and pigs, have done great damage to the native plant and animal communities.

The park's cultural and historical resources include Hawaiian religious sites, prehistoric and historic trails and routes and relatively modern historic structures.



SITE IDENTIFICATION		MAP INFORMATION	
Site Abbreviation:	HAVO-OB	Mean Elevation:	1123 m
AIRS ID NO.:	15-001-0007	Longitude:	155° 17' 17"W
		Latitude:	19° 25' 13"N
INSTRUMENTATION		UTM Zone:	30
Wind Speed	Temperature	Easting:	866455 m
Wind Direction	Precipitation	Northing:	3535 m
Barometric Pressure	SO <sub>2</sub> Analyzer	Map Reference:	Hawaii
Relative Humidity			NE 5-1,5
			1975
			1:250,000

## **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  
Hawaii Volcanoes National Park  
Observatory

Final Validation

01/01/2002 - 12/31/2002

Parameter	Interval	Par Code	Data Recovery			Valid Data	
			No. Possible	No. Collected	% Collected	No. Valid	% Valid
Sulfur Dioxide Analyzer	hourly	SO2	8760	7761	88.6	7662	87.5
SO2 Additional Analyzer	hourly	SO2ADD	8760	7769	88.7	7576	86.5
Scalar Wind Speed	hourly	SWS	8760	8723	99.6	8723	99.6
Vector Wind Speed	hourly	VWS	8760	8723	99.6	8723	99.6
Vector Wind Direction	hourly	VWD	8760	8723	99.6	8723	99.6
Standard Deviation for Wind Direction	hourly	SDWD	8760	8723	99.6	8723	99.6
Ambient Temperature (aspirated)	hourly	TMP	8760	8728	99.6	8728	99.6
Relative Humidity	hourly	RH	8760	8728	99.6	8728	99.6
Precipitation	hourly	RNF	8760	8694	99.2	8427	96.2
Barometric Pressure	hourly	BAR	8760	8728	99.6	8728	99.6

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:

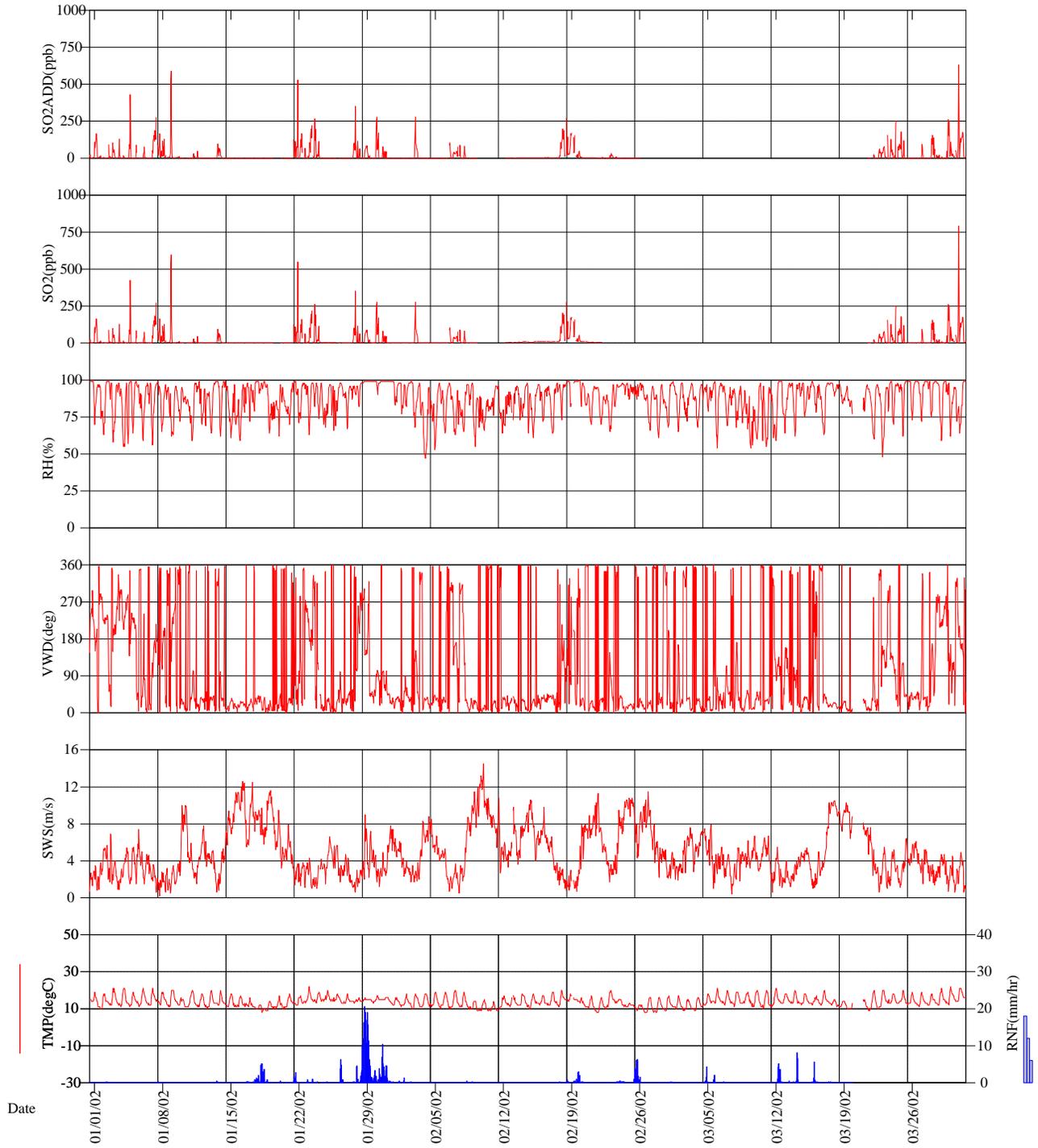
Quarterly Criteria:

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

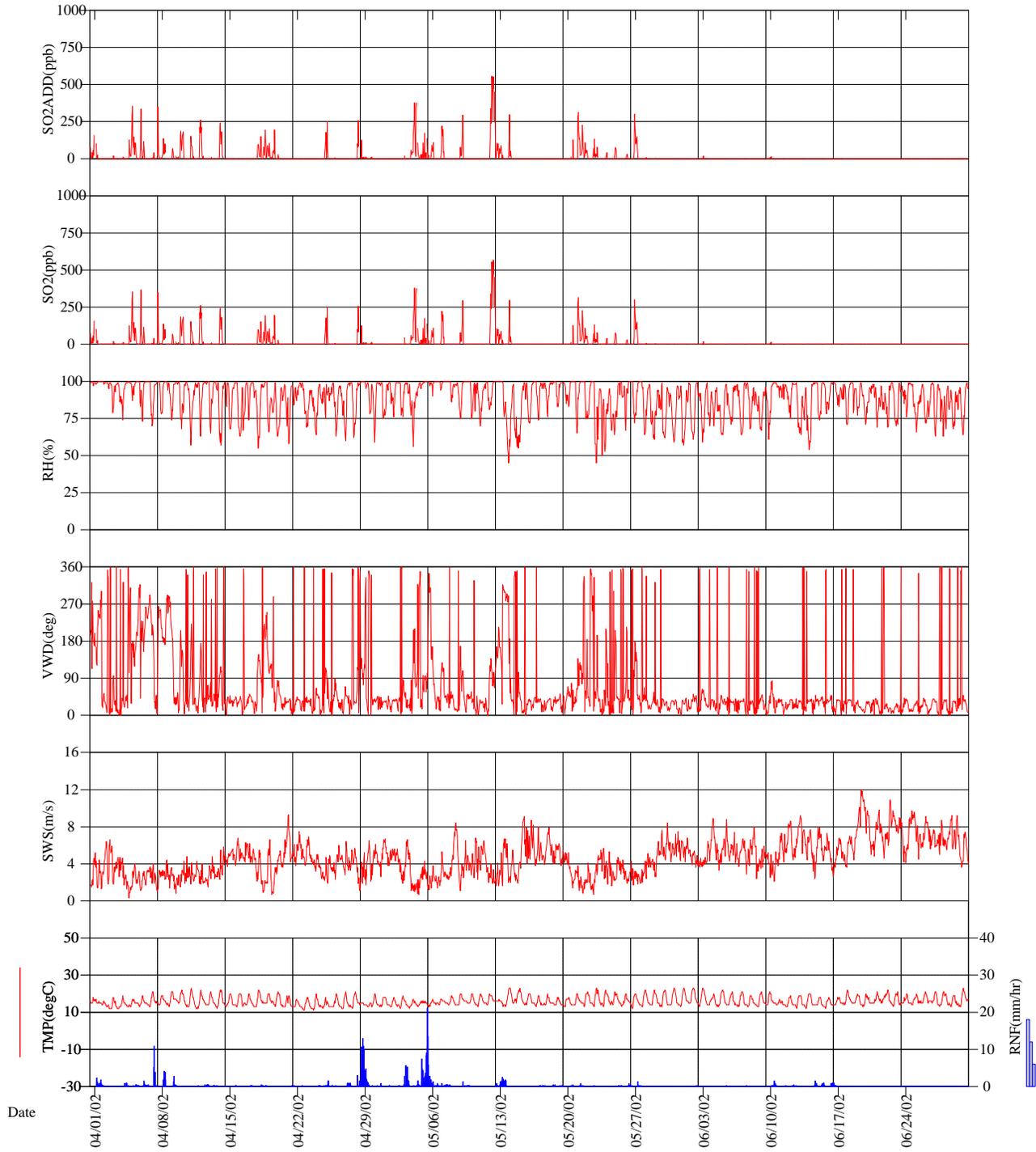
### Hawaii Volcanoes National Park - Observatory



Final Validation

First Quarter 2002

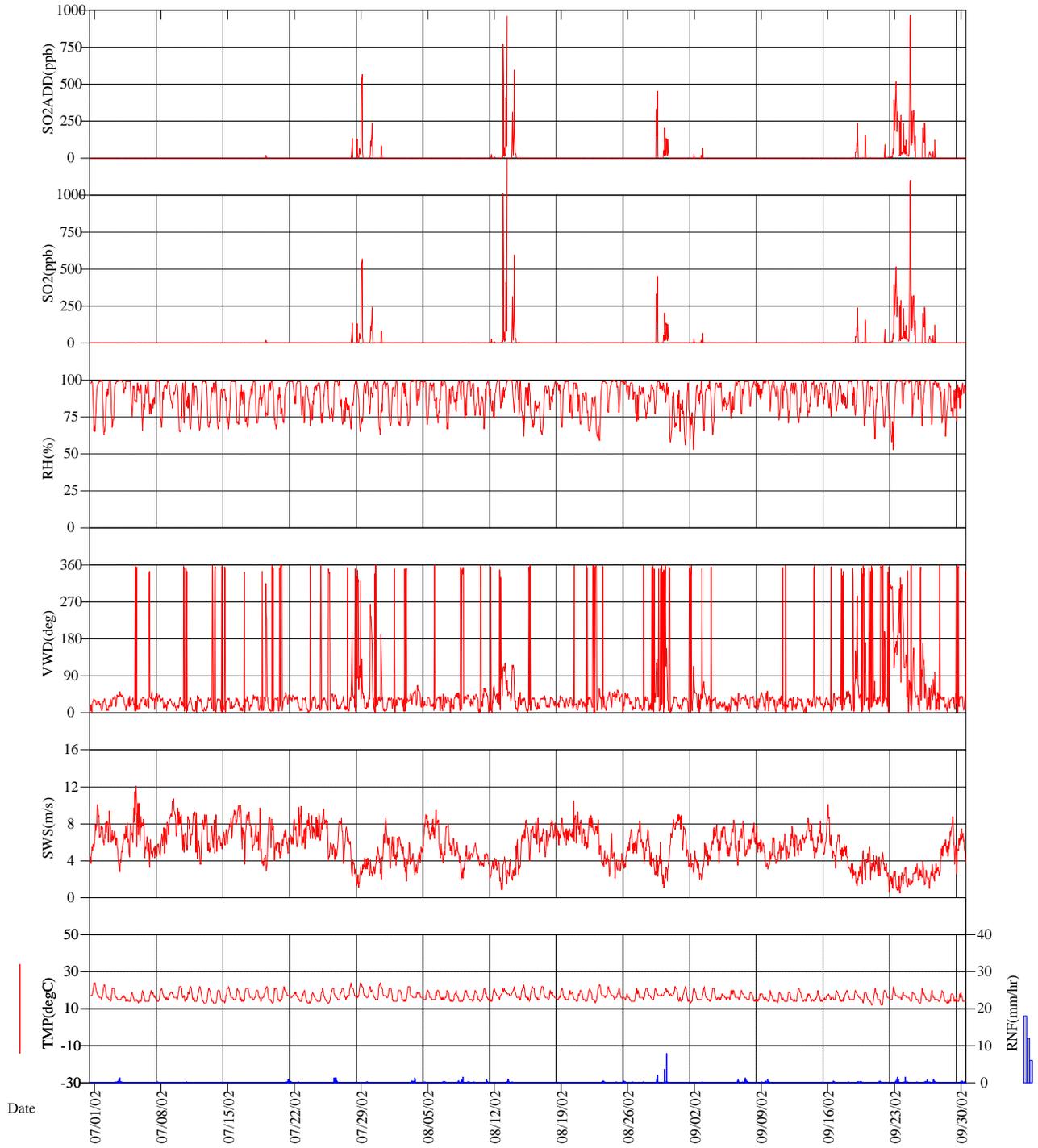
# Hawaii Volcanoes National Park - Observatory



Final Validation

Second Quarter 2002

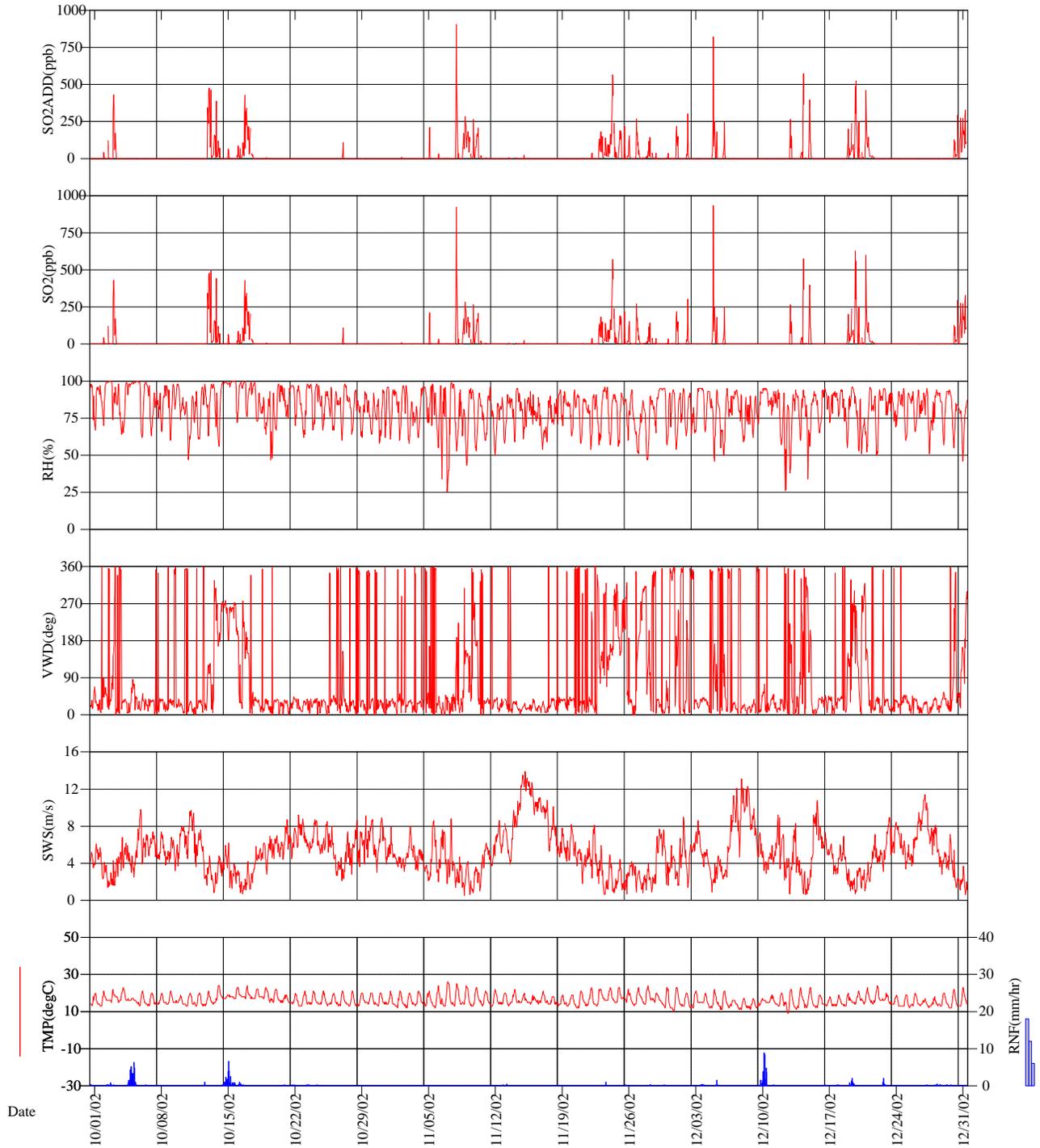
# Hawaii Volcanoes National Park - Observatory



Final Validation

Third Quarter 2002

### Hawaii Volcanoes National Park - Observatory



Final Validation

Fourth Quarter 2002

## **2.2 SULFUR DIOXIDE DATA SUMMARY**

Sulfur Dioxide Five Highest Daily 1-Hour Averages, 3-Hour Block Averages, and 24-Hour Block Averages Hawaii Volcanoes National Park Observatory Final Validation 01/01/2002 - 12/31/2002			
Rank	Date	Hour	Concentration (ppb)
Highest Daily 1-Hour Averages			
1	09/25/02	4	967.0
2	08/13/02	20	960.0
3	11/08/02	10	905.0
4	12/05/02	8	821.0
5	03/31/02	6	631.0
Highest 3-Hour Block Averages			
1	09/25/02	3-5	824.0
2	11/08/02	9-11	543.3
3	05/12/02	15-17	496.0
4	11/24/02	18-20	473.0
5	08/13/02	18-20	468.0
Highest 24-Hour Block Averages			
1	09/25/02	00-23	223.8
2	05/12/02	00-23	193.7
3	11/24/02	00-23	152.2
4	10/17/02	00-23	152.1
5	10/13/02	00-23	148.4

Note: The primary and secondary ambient air standards for SO<sup>2</sup> are:

Annual Primary Standard - 0.03 ppm; annual arithmetic mean not to be exceeded.

(A value greater than .03 ppm, 34 ppb, or 80 µg/m<sup>3</sup> exceeds the standard.)

24-Hour Primary Standard - 0.14 ppm; not to be exceeded more than once per year.

(A value greater than .14 ppm, 144 ppb, or 365 µg/m<sup>3</sup> exceeds the standard.)

3-Hour Secondary Standard - 0.5 ppm; not to be exceeded more than once per year.

(A value greater than .5 ppm, 549 ppb, or 1300 µg/m<sup>3</sup> exceeds the standard.)

(40 CFR 50.4 and 50.5 with reference to Appendix A.)

**Sulfur Dioxide Standards Report and  
Daily Maximum 1-Hour Average (ppm)  
Hawaii Volcanoes National Park - Observatory  
01/01/2002 - 12/31/2002**

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Obs	Max
1	0.166	0.001		0.157	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.218	11	0.218
2	0.091	0.001		0.001	0.001	0.001	0.001	0.001	0.001	0.120	0.010	0.302	11	0.302
3	0.103	0.277		0.020	0.019	0.018	0.001	0.001	0.066	0.430	0.001	0.001	11	0.430
4	0.130	0.001		0.012	0.377	0.001	0.001	0.001	0.001	0.001	0.001	0.001	11	0.377
5	0.429	0.001		0.353	0.172	0.001	0.001	0.001	0.001	0.001	0.211	0.821	11	0.821
6	0.076	0.090		0.335	0.108	0.001	0.001	0.001	0.001	0.001	0.033	0.245	11	0.335
7	0.275	0.103		0.041	0.221	0.001	0.001	0.001	0.001	0.001	0.004	0.001	11	0.275
8	0.166	0.088		0.349	0.001	0.001	0.001	0.001	0.001	0.001	0.905	0.001	11	0.905
9	0.589	0.001		0.069	0.294	0.001	0.001	0.002	0.001	0.001	0.284	0.001	11	0.589
10	0.012			0.184	0.001	0.015	0.001	0.001	0.001	0.001	0.264	0.001	10	0.264
11	0.031			0.152	0.001	0.001	0.001	0.001	0.001	0.001	0.020	0.001	10	0.152
12	0.047	0.001		0.261	0.555	0.001	0.001	0.026	0.001	0.001	0.001	0.001	11	0.555
13	0.001	0.002		0.009	0.118	0.001	0.001	0.960	0.001	0.476	0.008	0.264	11	0.960
14	0.097	0.003		0.242	0.298	0.001	0.001	0.595	0.001	0.387	0.007	0.574	11	0.595
15	0.001	0.003		0.001	0.001	0.001	0.001	0.007	0.001	0.065	0.025	0.397	11	0.397
16	0.001	0.004		0.001	0.001	0.001	0.001	0.001	0.001	0.086	0.003	0.001	11	0.086
17	0.001	0.004		0.001	0.001	0.001	0.001	0.001	0.001	0.427	0.003	0.001	11	0.427
18	0.001	0.270		0.150	0.001	0.001	0.001	0.001	0.002	0.031	0.001	0.001	11	0.270
19	0.001	0.170		0.193	0.001	0.001	0.019	0.001	0.237	0.007	0.001	0.238	11	0.238
20	0.001	0.048		0.195	0.012	0.001	0.001	0.001	0.156	0.001	0.001	0.525	11	0.525
21	0.125	0.003	0.001	0.001	0.313	0.001	0.001	0.001	0.004	0.001	0.005	0.461	12	0.461
22	0.528	0.008	0.023	0.001	0.226	0.001	0.001	0.001	0.091	0.001	0.037	0.016	12	0.528
23	0.221	0.032	0.155	0.001	0.131	0.001	0.001	0.001	0.516	0.001	0.182	0.001	12	0.516
24	0.266	0.009	0.250	0.001	0.041	0.001	0.001	0.001	0.288	0.001	0.565	0.001	12	0.565
25	0.001	0.001	0.178	0.250	0.075	0.001	0.001	0.001	0.967	0.001	0.188	0.001	12	0.967
26	0.001	0.001	0.001	0.007	0.030	0.001	0.001	0.001	0.241	0.001	0.217	0.001	12	0.241
27	0.001		0.092	0.001	0.300	0.001	0.001	0.001	0.122	0.108	0.266	0.001	11	0.300
28	0.351		0.155	0.258	0.008	0.001	0.134	0.001	0.001	0.001	0.143	0.001	11	0.351
29	0.083		0.022	0.125	0.004	0.001	0.566	0.001	0.453	0.001	0.038	0.001	11	0.566
30	0.277		0.261	0.011	0.001	0.001	0.241	0.203	0.001	0.001	0.035	0.293	11	0.293
31	0.077		0.631		0.001	0.001	0.082	0.002	0.001	0.001	0.329	0.631	7	0.631
Number	31	24	11	30	31	30	31	31	30	31	30	31		
Maximum	0.589	0.277	0.631	0.353	0.555	0.018	0.566	0.960	0.967	0.476	0.905	0.821		
Mean	0.1339	0.0468	0.1608	0.1127	0.1069	0.0020	0.0345	0.0733	0.0913	0.0696	0.1153	0.1516		Annual Maximum: 0.967
	Annual Observations: 341												Annual Mean: .0885	

Sulfur Dioxide Standards Report and  
Daily Maximum 24-Hour Average (ppm)  
Hawaii Volcanoes National Park - Observatory  
01/01/2002 - 12/31/2002

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Obs	Max
1	0.040	0.001		0.041	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.034	11	0.041
2	0.008	0.001		0.001	0.001	0.001	0.001	0.001	0.002	0.010	0.001	0.023	11	0.023
3	0.016	0.037		0.002	0.002	0.002	0.001	0.001	0.005	0.067	0.001	0.001	11	0.067
4	0.010	0.001		0.001	0.105	0.001	0.001	0.001	0.001	0.001	0.001	0.001	11	0.105
5	0.044	0.001		0.085	0.031	0.001	0.001	0.001	0.001	0.001	0.017	0.092	11	0.092
6	0.009	0.005		0.033	0.021	0.001	0.001	0.001	0.001	0.001	0.004	0.020	11	0.033
7	0.067	0.030		0.003	0.041	0.001	0.001	0.001	0.001	0.001	0.001	0.001	11	0.067
8	0.047	0.014		0.050	0.001	0.001	0.001	0.001	0.001	0.001	0.088	0.001	11	0.088
9	0.064	0.001		0.010	0.035	0.001	0.001	0.001	0.001	0.001	0.118	0.001	11	0.118
10	0.003			0.053	0.001	0.002	0.001	0.001	0.001	0.001	0.063	0.001	10	0.063
11	0.004			0.022	0.001	0.001	0.001	0.001	0.001	0.001	0.003	0.001	10	0.022
12	0.004			0.055	<b>0.194</b>	0.001	0.001	0.004	0.001	0.001	0.001	0.001	10	0.194
13	0.001	0.002		0.001	0.042	0.001	0.001	0.144	0.001	<b>0.149</b>	0.001	0.032	11	0.149
14	0.022	0.003		0.049	0.024	0.001	0.001	0.070	0.001	0.061		0.059	10	0.070
15	0.001	0.002		0.001	0.001	0.001	0.001	0.001	0.001	0.006	0.002	0.047	11	0.047
16	0.001	0.003		0.001	0.001	0.001	0.001	0.001	0.001	0.012	0.001	0.001	11	0.012
17	0.001	0.003		0.001	0.001	0.001	0.001	0.001	0.001	<b>0.152</b>	0.001	0.001	11	0.152
18	0.001	0.074		0.032	0.001	0.001	0.001	0.001	0.001	0.004	0.001	0.001	11	0.074
19	0.001	0.078		0.048	0.001	0.001	0.003	0.001	0.027	0.001	0.001	0.046	11	0.078
20		0.010		0.020	0.001	0.001	0.001	0.001	0.014	0.001	0.001	0.114	10	0.114
21	0.007	0.002		0.001	0.063	0.001	0.001	0.001	0.001	0.001	0.001	0.076	11	0.076
22	0.068	0.002		0.001	0.041	0.001	0.001	0.001	0.008	0.001	0.003	0.003	11	0.068
23	0.051	0.007		0.001	0.021	0.001	0.001	0.001	0.142	0.001	0.050	0.001	12	0.142
24	0.041	0.002		0.001	0.004	0.001	0.001	0.001	0.067	0.001	<b>0.152</b>	0.001	12	0.152
25	0.001	0.001		0.034	0.011	0.001	0.001	0.001	<b>0.224</b>	0.001	0.053	0.001	12	0.224
26		0.001		0.001	0.005	0.001	0.001	0.001	0.050	0.001	0.027	0.001	10	0.050
27	0.001			0.010	0.001	0.057	0.001	0.001	0.016	0.008	0.042	0.001	11	0.057
28	0.050			0.036	0.024	0.001	0.012	0.001	0.001	0.001	0.027	0.001	11	0.050
29	0.026			0.005	0.009	0.001	0.094	0.048	0.001	0.001	0.003	0.001	11	0.094
30	0.051			0.064	0.002	0.001	0.035	0.040	0.001	0.001	0.003	0.032	11	0.064
31	0.014			0.108	0.001	0.001	0.006	0.001	0.001	0.001	0.001	0.121	7	0.121
Number	29	22	9	30	31	30	31	31	30	31	29	31		
Maximum	0.068	0.078	0.108	0.085	0.194	0.002	0.094	0.144	0.224	0.152	0.152	0.121		
Mean	0.0226	0.0127	0.0396	0.0195	0.0230	0.0011	0.0057	0.0107	0.0192	0.0158	0.0230	0.0231		
Annual Observations: 334										Annual Mean: .0167				
										Annual Maximum: 0.224				
										5 Bolded Values Exceed Primary Standard of 0.145				

**Sulfur Dioxide Standards Report and  
Daily Maximum 3-Hour Average (ppm)  
Hawaii Volcanoes National Park - Observatory  
01/01/2002 - 12/31/2002**

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Obs	Max				
1	0.151	0.001	0.089	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.138	11	0.151				
2	0.008	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.011	0.019	0.004	0.150	11	0.15				
3	0.064	0.148	0.009	0.009	0.001	0.009	0.001	0.001	0.022	0.272	0.001	0.001	11	0.272				
4	0.055	0.001	0.004	0.004	0.242	0.001	0.001	0.001	0.001	0.001	0.001	0.001	11	0.242				
5	0.244	0.001	0.261	0.066	0.066	0.001	0.001	0.001	0.001	0.001	0.075	0.368	11	0.368				
6	0.027	0.001	0.159	0.074	0.074	0.001	0.001	0.001	0.001	0.001	0.021	0.097	11	0.159				
7	0.188	0.059	0.014	0.177	0.177	0.001	0.001	0.001	0.001	0.001	0.002	0.001	11	0.188				
8	0.110	0.043	0.185	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.543	0.001	11	0.543				
9	0.263	0.001	0.045	0.122	0.122	0.001	0.001	0.001	0.001	0.001	0.207	0.001	11	0.263				
10	0.009	0.001	0.145	0.001	0.001	0.008	0.001	0.001	0.001	0.001	0.173	0.001	10	0.173				
11	0.015	0.001	0.088	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.009	0.001	10	0.088				
12	0.022	0.001	0.216	0.496	0.496	0.001	0.001	0.013	0.001	0.001	0.001	0.001	11	0.496				
13	0.001	0.002	0.003	0.071	0.071	0.001	0.001	0.468	0.001	0.394	0.001	0.149	11	0.468				
14	0.063	0.003	0.166	0.141	0.141	0.001	0.001	0.258	0.001	0.150	0.003	0.399	11	0.399				
15	0.001	0.003	0.001	0.001	0.001	0.001	0.001	0.003	0.001	0.040	0.009	0.270	11	0.270				
16	0.001	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.041	0.001	0.001	11	0.041				
17	0.001	0.004	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.271	0.001	0.001	11	0.271				
18	0.001	0.149	0.090	0.001	0.001	0.001	0.001	0.001	0.001	0.023	0.001	0.001	11	0.149				
19	0.001	0.137	0.143	0.001	0.001	0.001	0.014	0.001	0.095	0.004	0.001	0.113	11	0.143				
20	0.001	0.036	0.090	0.004	0.004	0.001	0.001	0.001	0.095	0.001	0.001	0.365	11	0.365				
21	0.001	0.003	0.001	0.198	0.198	0.001	0.001	0.001	0.002	0.001	0.002	0.226	11	0.226				
22	0.179	0.002	0.016	0.001	0.160	0.001	0.001	0.001	0.033	0.001	0.013	0.011	12	0.179				
23	0.185	0.017	0.064	0.001	0.058	0.001	0.001	0.001	0.408	0.001	0.137	0.001	12	0.408				
24	0.193	0.004	0.161	0.001	0.022	0.001	0.001	0.001	0.113	0.001	0.473	0.001	12	0.473				
25	0.001	0.001	0.108	0.130	0.061	0.001	0.001	0.001	<b>0.824</b>	0.001	0.167	0.001	12	0.824				
26	0.001	0.001	0.001	0.003	0.020	0.001	0.001	0.001	0.162	0.001	0.094	0.001	12	0.162				
27	0.001	0.001	0.061	0.001	0.188	0.001	0.001	0.001	0.041	0.051	0.150	0.001	11	0.188				
28	0.167	0.001	0.126	0.140	0.003	0.001	0.083	0.001	0.001	0.001	0.086	0.001	11	0.167				
29	0.073	0.012	0.012	0.043	0.002	0.001	0.381	0.206	0.001	0.001	0.013	0.001	11	0.381				
30	0.154	0.173	0.173	0.007	0.001	0.001	0.150	0.096	0.001	0.001	0.012	0.061	11	0.173				
31	0.036	0.342	0.342	0.001	0.001	0.001	0.037	0.001	0.001	0.001	0.201	0.201	7	0.342				
Number	31	24	10	30	31	30	31	31	30	31	30	31						
Maximum	0.263	0.149	0.342	0.261	0.496	0.009	0.381	0.468	0.824	0.394	0.543	0.399						
Mean	0.0715	0.0259	0.1064	0.0680	0.0683	0.0015	0.0223	0.0345	0.0608	0.0415	0.0734	0.0828						
Annual Observations: 340										Annual Mean: .0552					Annual Maximum: 0.824			
<b>1 Bolded Value Exceeds Secondary Standard of 0.55</b>																		

<p style="text-align: center;">Frequency Distribution Sulfur Dioxide Analyzer Hawaii Volcanoes National Park - Observatory</p> <p style="text-align: center;">Monitoring Season: 01/01/2002 - 12/31/2002<sup>1</sup></p>															
BLK AVG	% Obs. <sup>2</sup>	# Obs. <sup>3</sup>	Percentile <sup>4</sup>							Arith.					
			10	25	50	75	90	95	98	99	Max. Obs.	2nd Max.	Min. Obs. <sup>5</sup>	Mean	Std. Dev.
1-Hour	87.5	7662	.001	.001	.001	.001	.033	.104	.203	.298	.967	.960	.001	.0165	.0598
24-Hour		334	.001	.001	.001	.017	.053	.078	.142	.152	.224	.194	.001		
3-Hour		2336	.001	.001	.001	.002	.047	.114	.184	.258	.824	.543	.001		
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 percent of valid observations (% Obs.) is the percentage of valid days to the number of possible monitoring days during the Monitoring

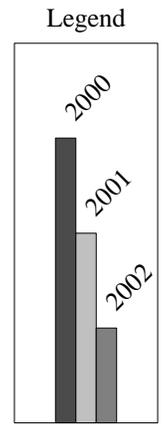
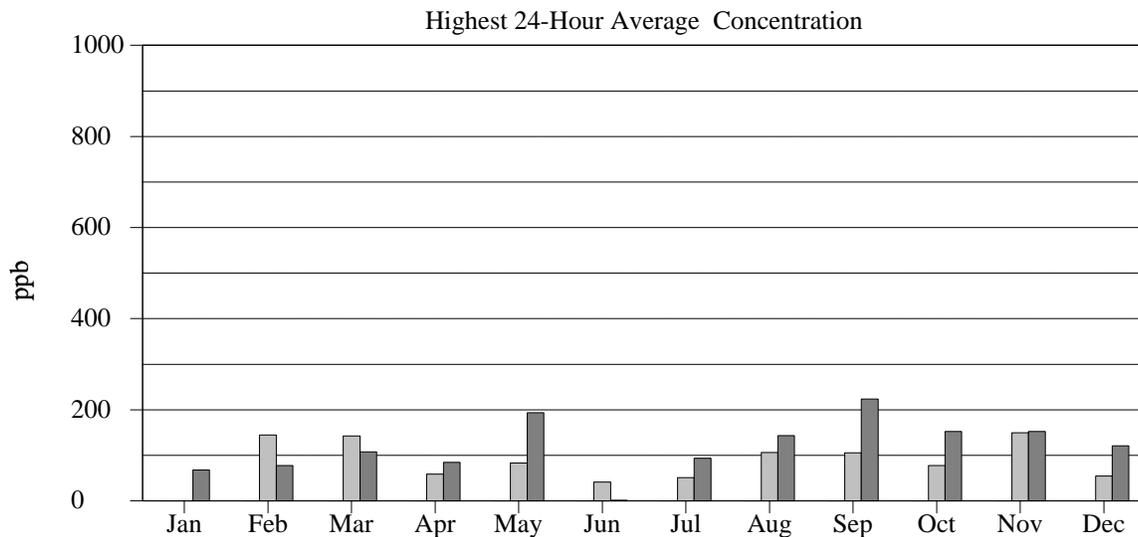
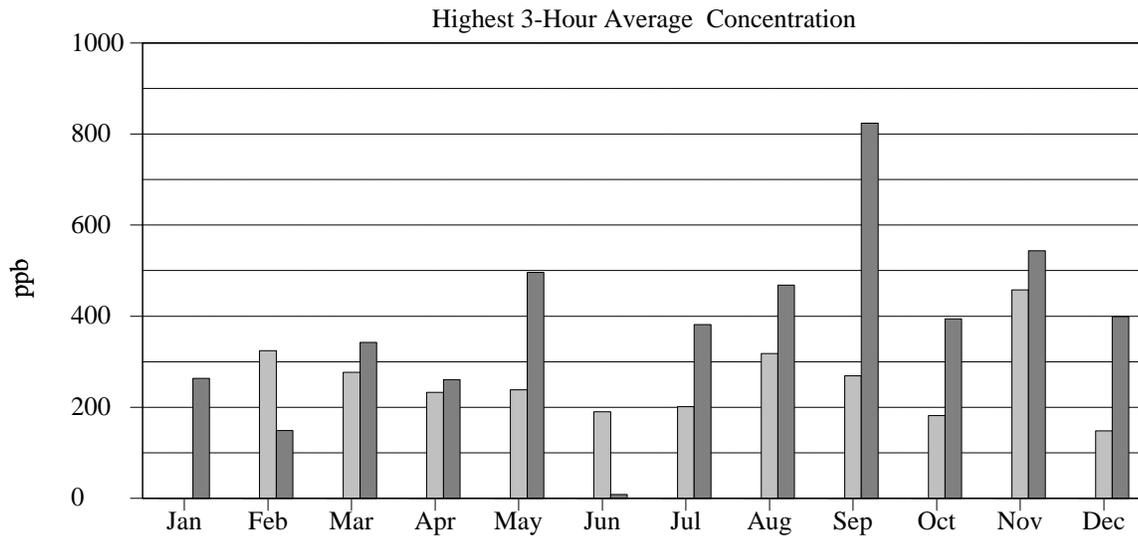
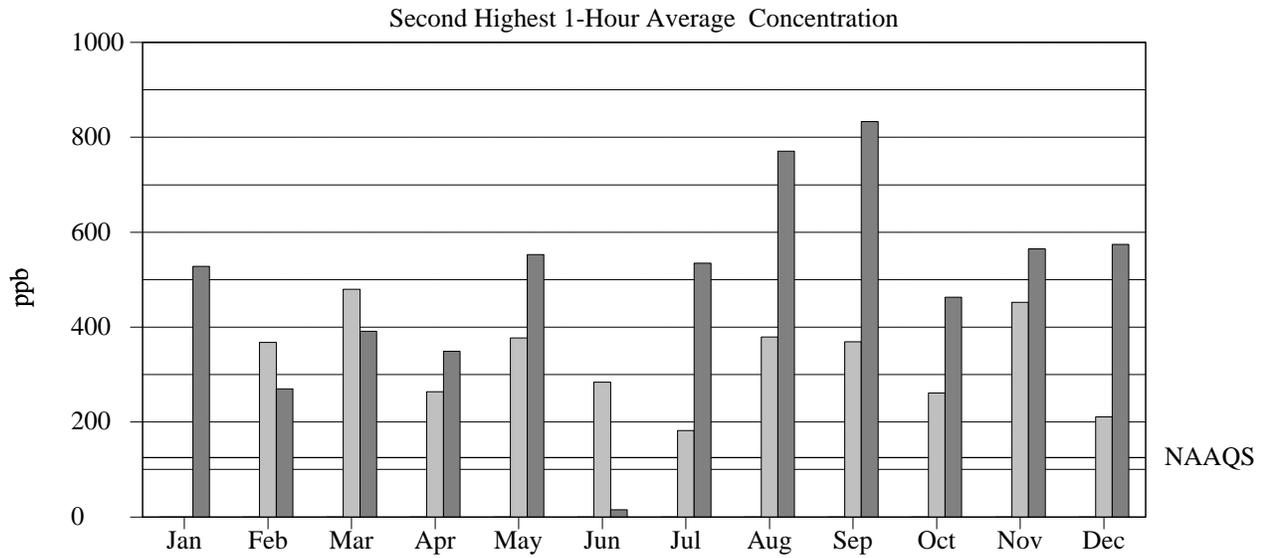
<sup>3</sup> The number of observations (# Obs.) includes all valid observations recorded within the Monitoring Season.

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..

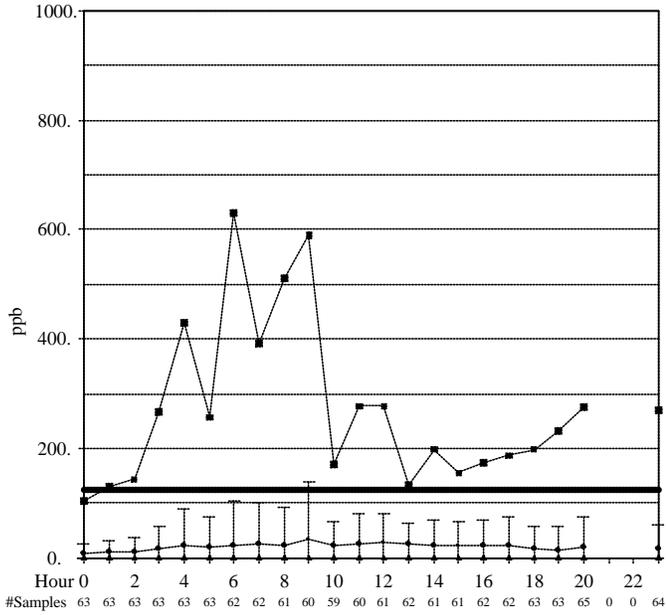
<sup>4</sup> The percentiles and other statistics are derived from the daily maximums.

<sup>5</sup> The minimum observation value (Min. Obs.) is the minimum daily maximum recorded during the Monitoring Season.

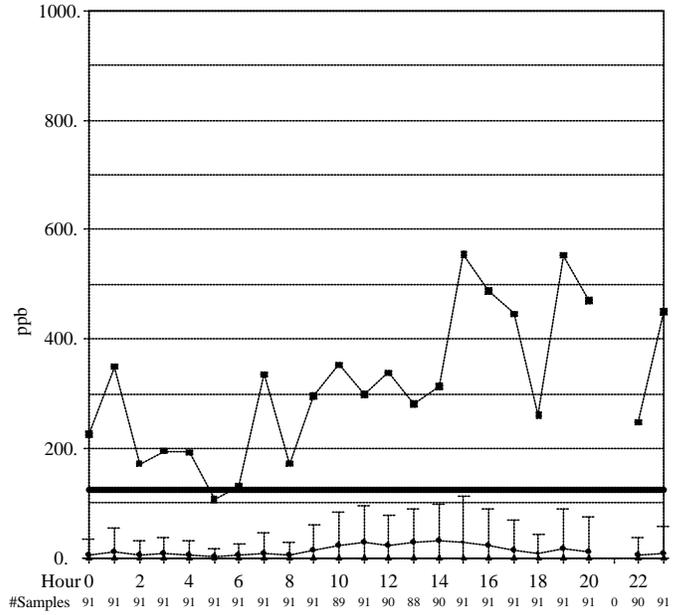
Three Year Comparison



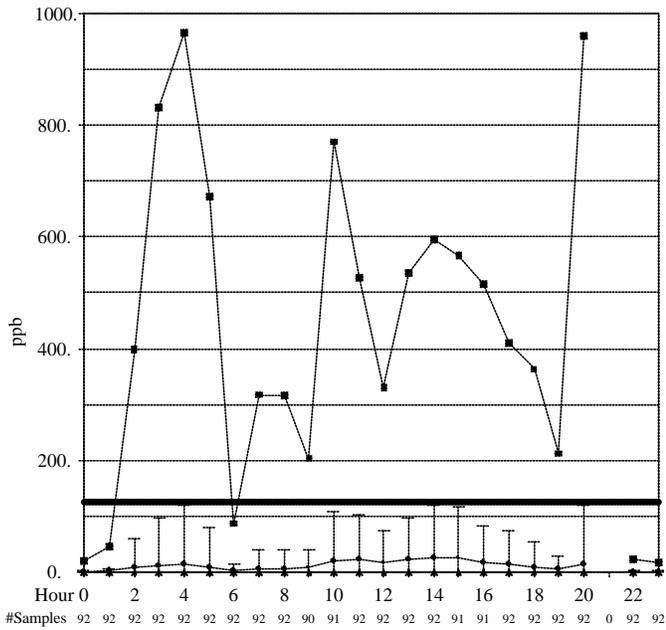
FIRST QUARTER (JAN-MAR)



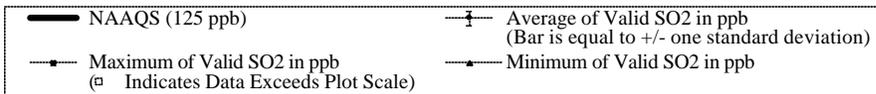
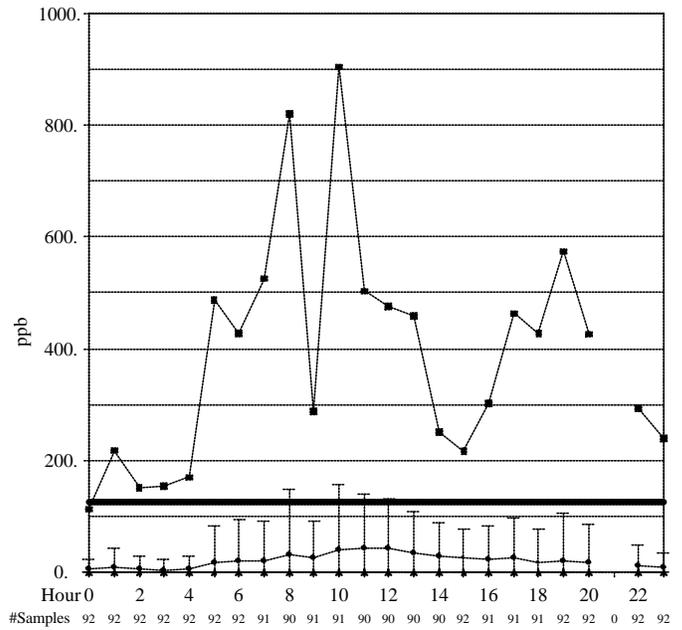
SECOND QUARTER (APR-JUN)

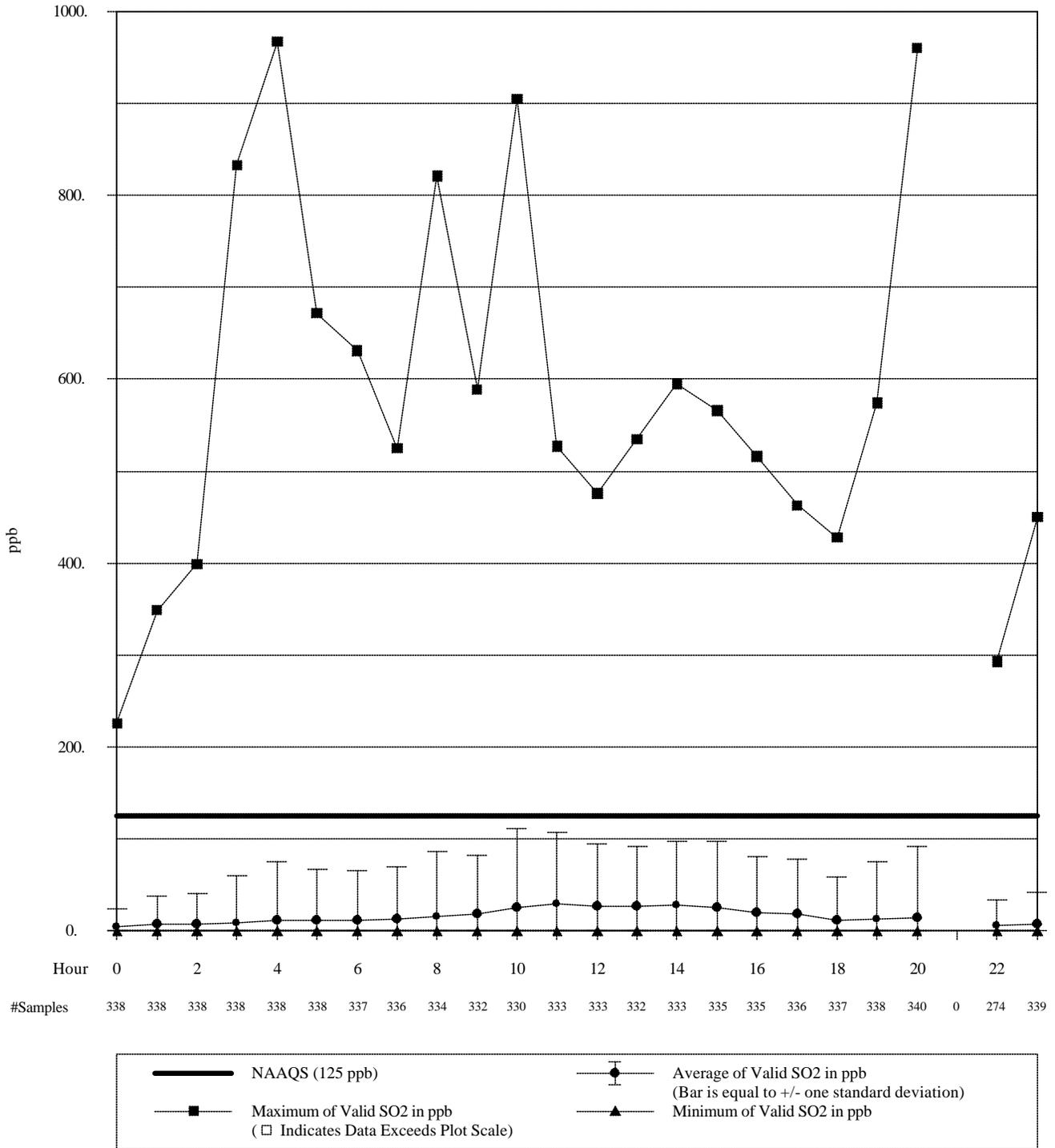


THIRD QUARTER (JUL-SEP)



FOURTH QUARTER (OCT-DEC)



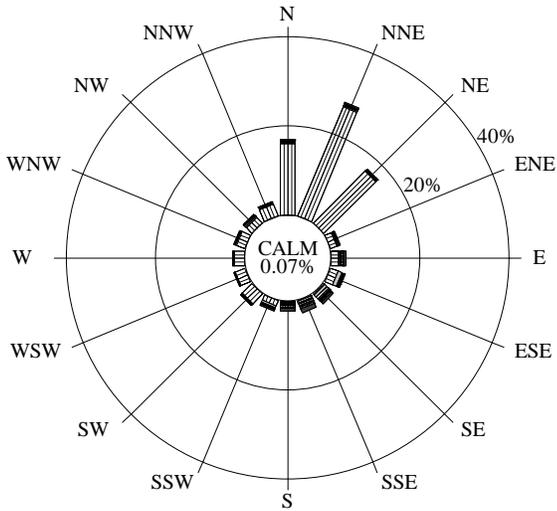


Hawaii Volcanoes  
National Park  
Observatory

Quarterly Sulfur Dioxide  
Pollutant Rose

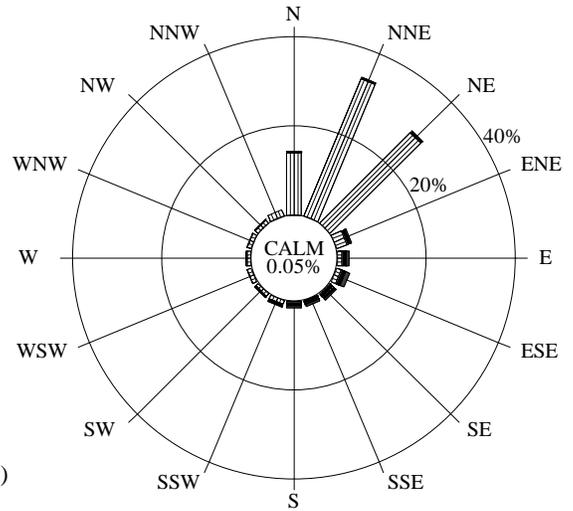
2002

FIRST QUARTER (JAN-MAR)



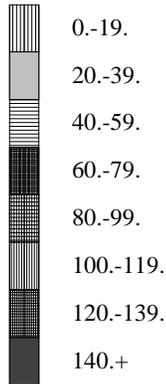
67.7% Collected 63.1% Valid  
2160 Possible /1462 Collected /1363 Valid  
(includes WS and WD)

SECOND QUARTER (APR-JUN)

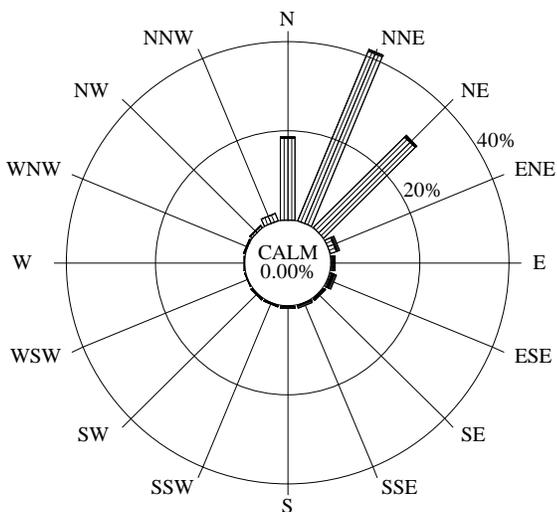


95.5% Collected 95.5% Valid  
2184 Possible /2085 Collected /2085 Valid  
(includes WS and WD)

Sulfur Dioxide (ppb)

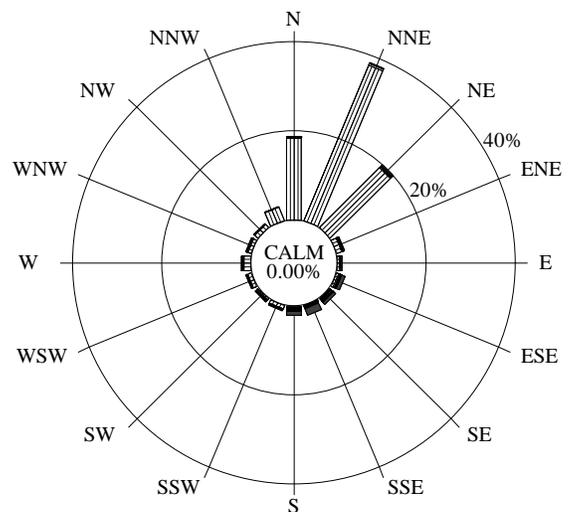


THIRD QUARTER (JUL-SEP)



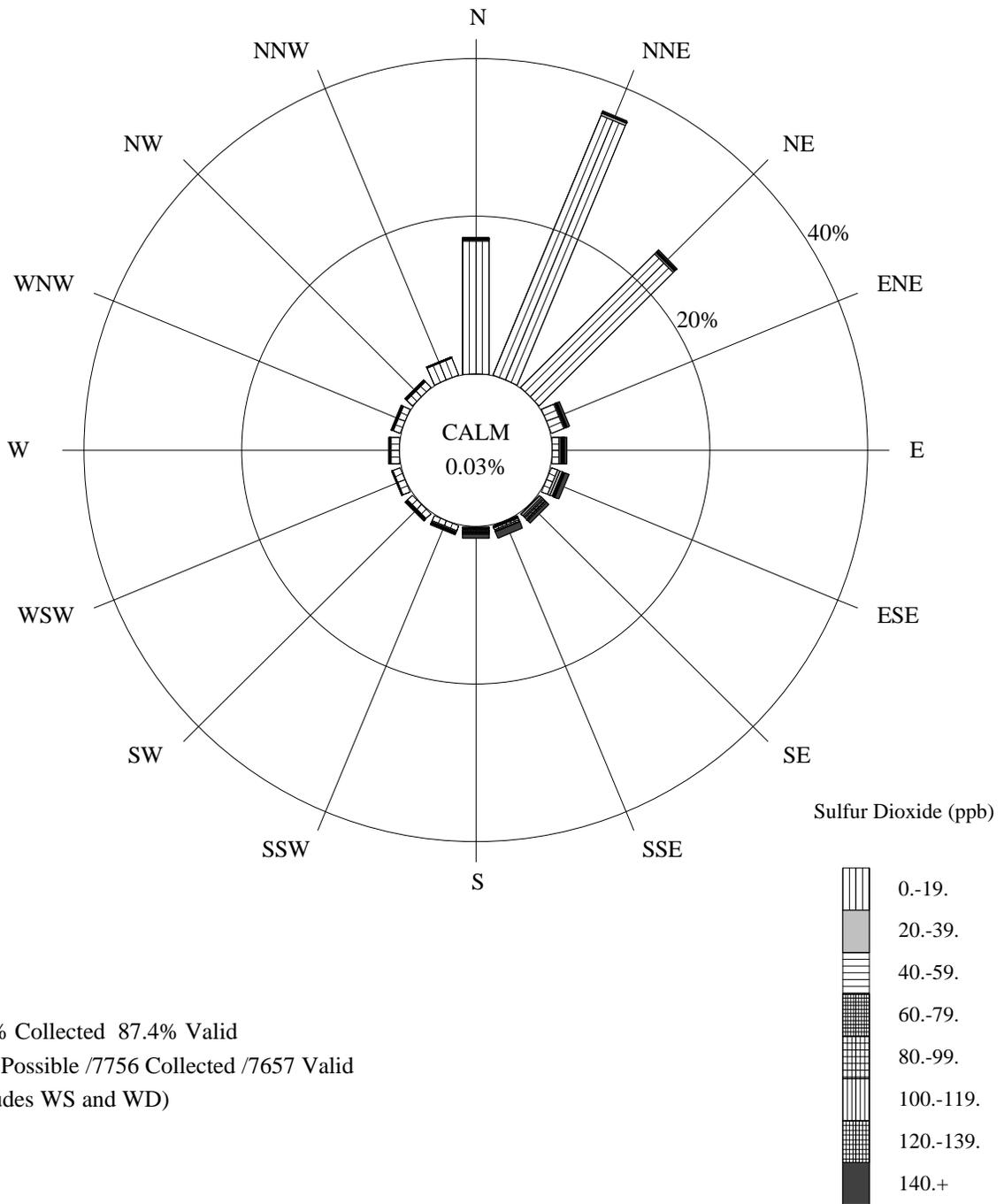
95.6% Collected 95.6% Valid  
2208 Possible /2111 Collected /2111 Valid  
(includes WS and WD)

FOURTH QUARTER (OCT-DEC)



95.0% Collected 95.0% Valid  
2208 Possible /2098 Collected /2098 Valid  
(includes WS and WD)

Final Validation



88.5% Collected 87.4% Valid  
8760 Possible /7756 Collected /7657 Valid  
(includes WS and WD)

Sulfur Dioxide Analyzer Precision Check Summary  
Hawaii Volcanoes National Park  
Observatory

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 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 01/01/2002 - 12/31/2002				
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	55	-0.89	-7.36	5.58
2	77	-2.44	-4.28	-0.60
3	92	-1.12	-2.99	0.75
4	91	0.83	-0.91	2.57

<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 SUPPLEMENTAL SULFUR DIOXIDE DATA SUMMARY**

Supplemental Sulfur Dioxide <sup>‡</sup> Five Highest Daily 1-Hour Averages, 3-Hour Block Averages, and 24-Hour Block Averages Hawaii Volcanoes National Park Observatory Final Validation 01/01/2002 - 12/31/2002			
Rank	Date	Hour	Concentration (ppb)
Highest Daily 1-Hour Averages			
1	08/13/02	20	1244
2	09/25/02	4	1101
3	12/05/02	8	933
4	11/08/02	10	924
5	03/31/02	6	792
Highest 3-Hour Block Averages			
1	09/25/02	3-5	949
2	08/13/02	18-20	563
3	11/08/02	9-11	551
4	08/13/02	9-11	530
5	05/12/02	15-17	496
Highest 24-Hour Block Averages			
1	09/25/02	00-23	240
2	05/12/02	00-23	194
3	08/13/02	00-23	168
4	11/24/02	00-23	153
5	10/17/02	00-23	152

<sup>‡</sup> Supplemental sulfur dioxide is collected from an additional analyzer.

Note: The primary and secondary ambient air standards for SO<sub>2</sub> are:

Annual Primary Standard - 0.03 ppm; annual arithmetic mean not to be exceeded.

(A value greater than .03 ppm, 34 ppb, or 80 µg/m<sup>3</sup> exceeds the standard.)

24-Hour Primary Standard - 0.14 ppm; not to be exceeded more than once per year.

(A value greater than .14 ppm, 144 ppb, or 365 µg/m<sup>3</sup> exceeds the standard.)

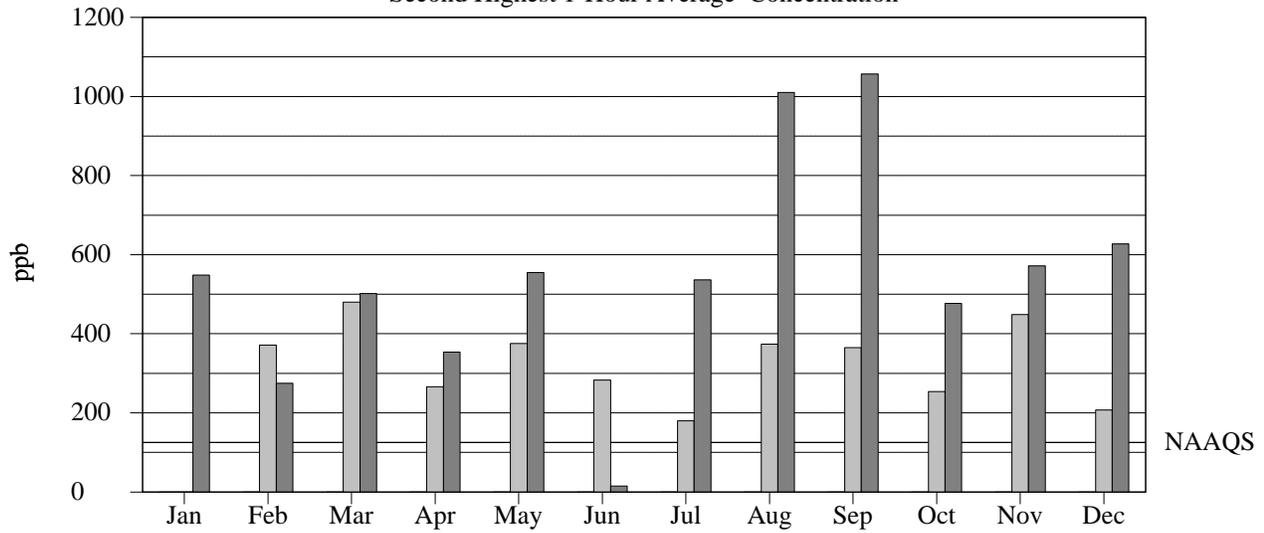
3-Hour Secondary Standard - 0.5 ppm; not to be exceeded more than once per year.

(A value greater than .5 ppm, 549 ppb, or 1300 µg/m<sup>3</sup> exceeds the standard.)

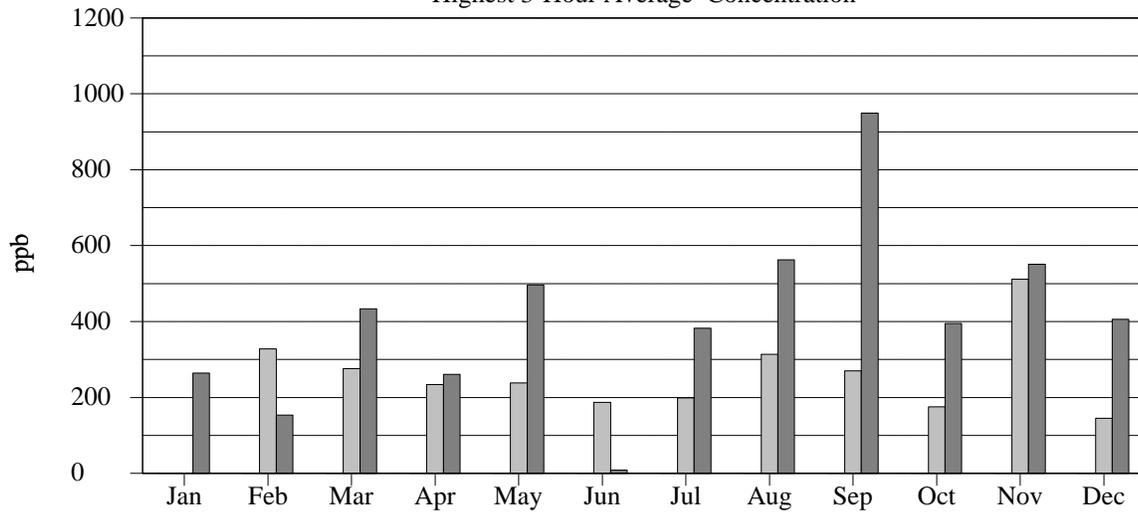
(40 CFR 50.4 and 50.5 with reference to Appendix A.)

Three Year Comparison

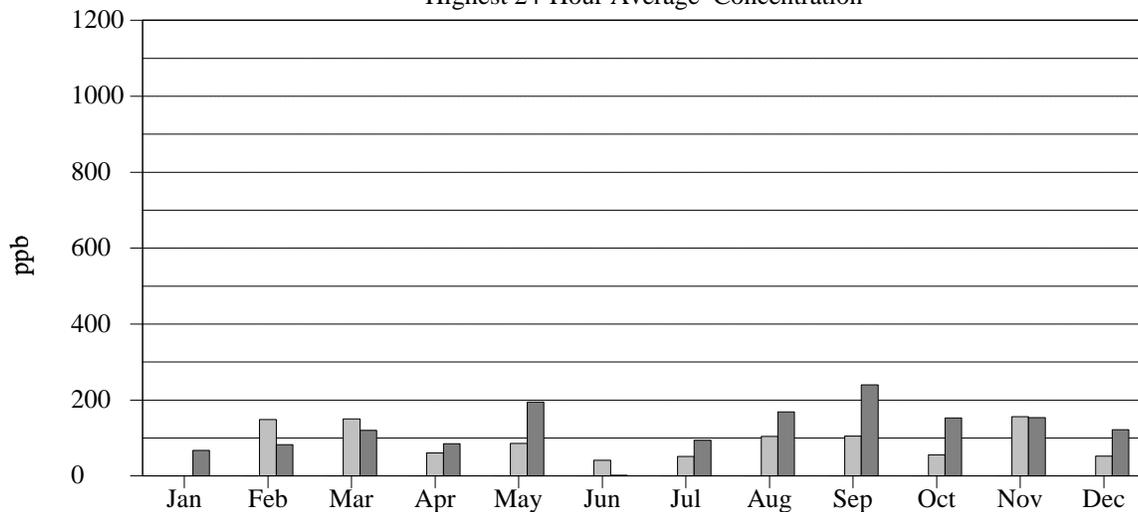
Second Highest 1-Hour Average Concentration



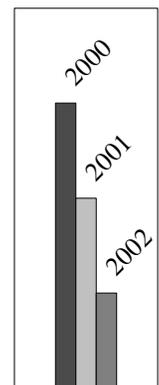
Highest 3-Hour Average Concentration



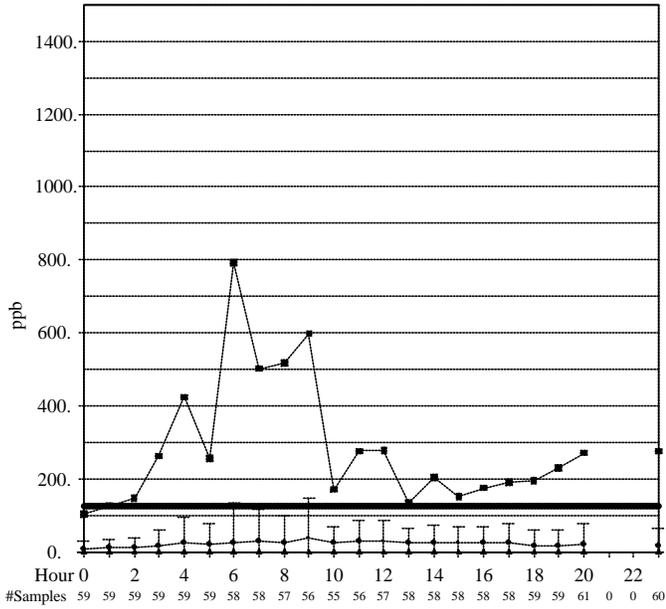
Highest 24-Hour Average Concentration



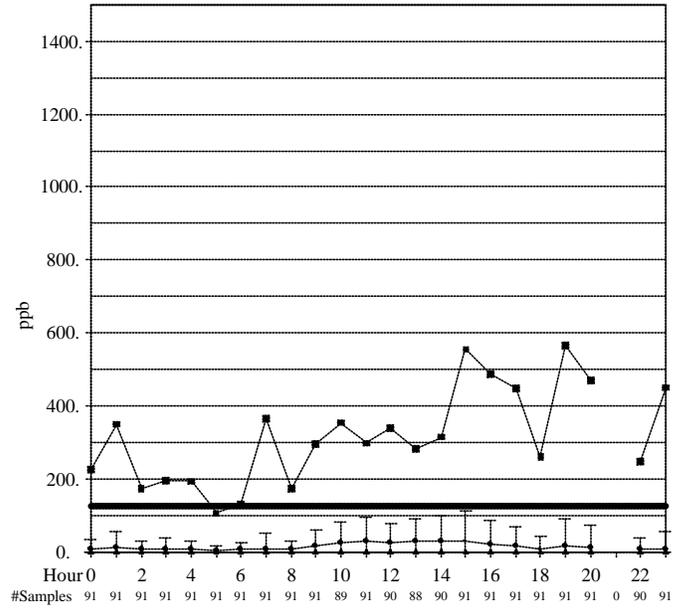
Legend



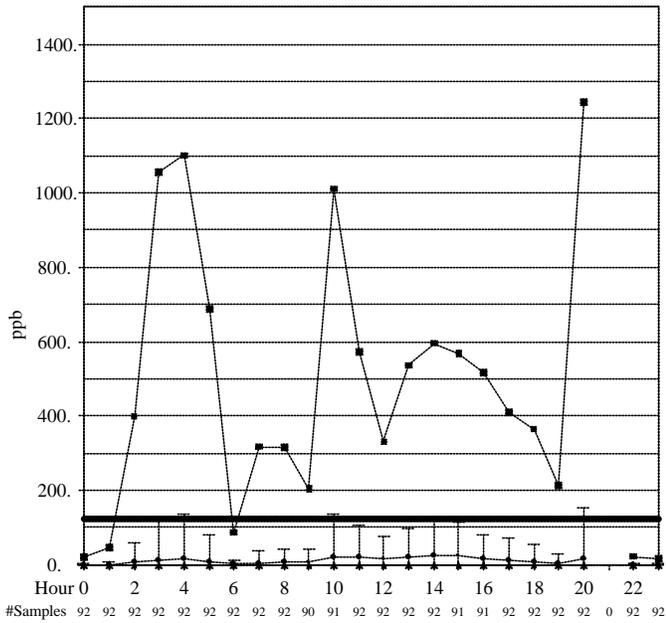
FIRST QUARTER (JAN-MAR)



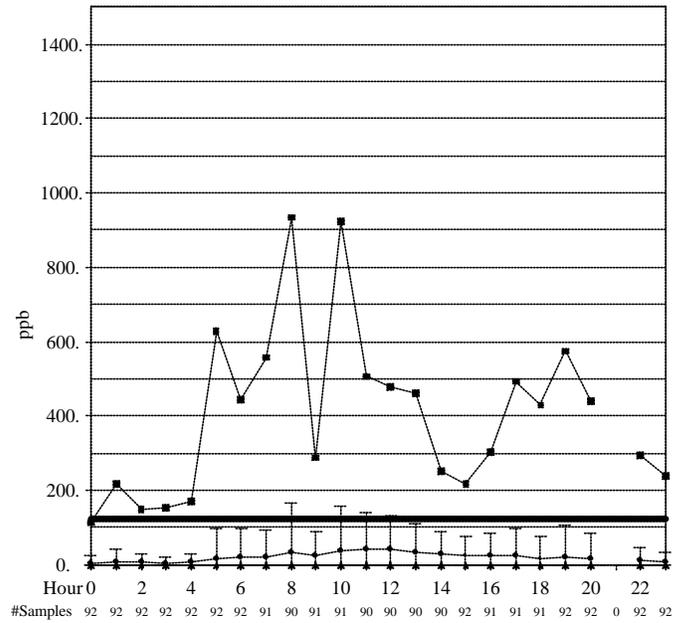
SECOND QUARTER (APR-JUN)



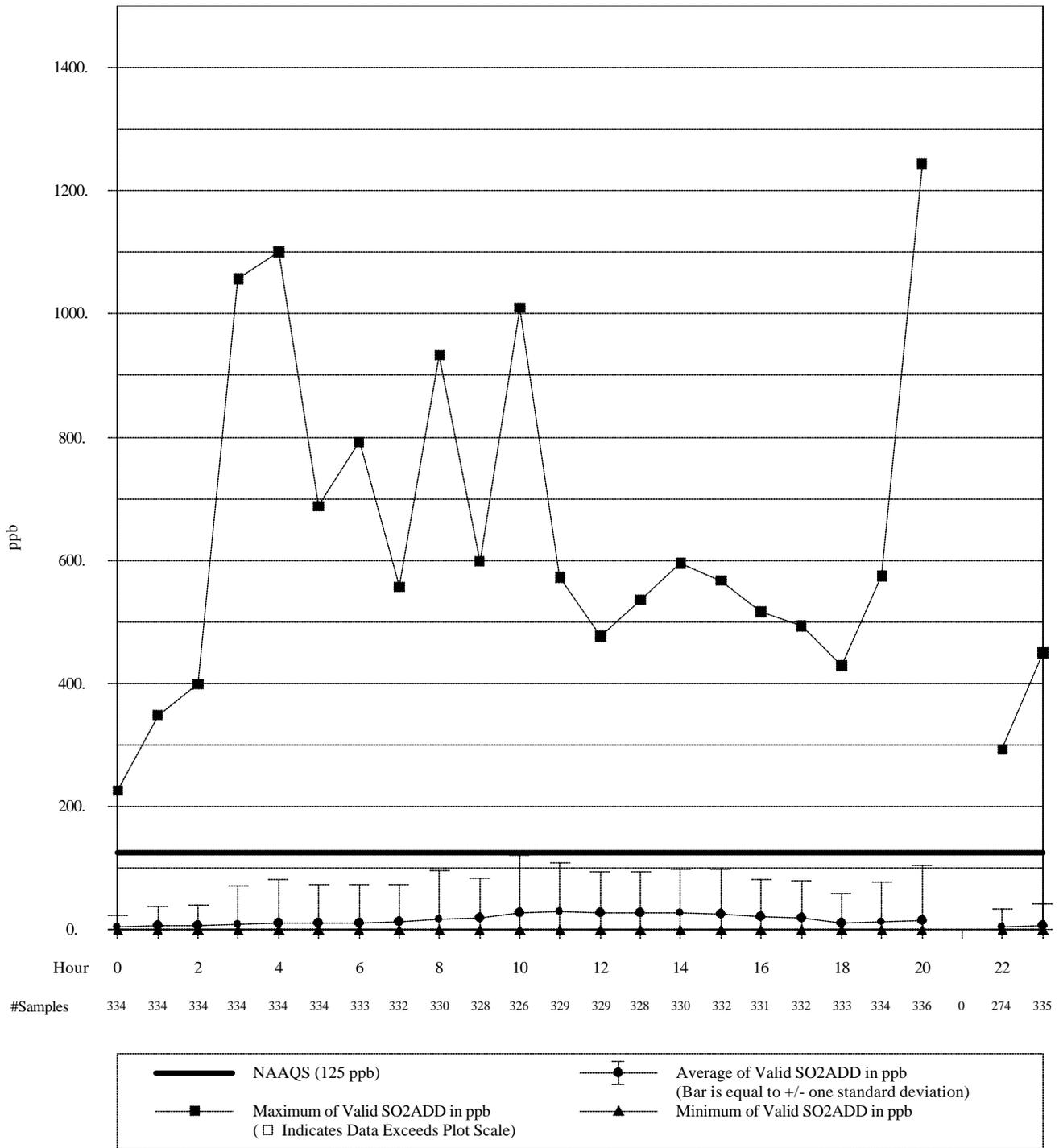
THIRD QUARTER (JUL-SEP)



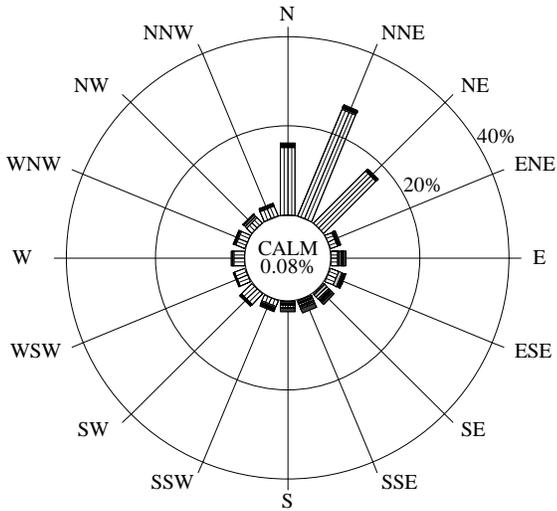
FOURTH QUARTER (OCT-DEC)



NAAQS (125 ppb)	Average of Valid SO2ADD in ppb (Bar is equal to +/- one standard deviation)
Maximum of Valid SO2ADD in ppb (☐ Indicates Data Exceeds Plot Scale)	Minimum of Valid SO2ADD in ppb

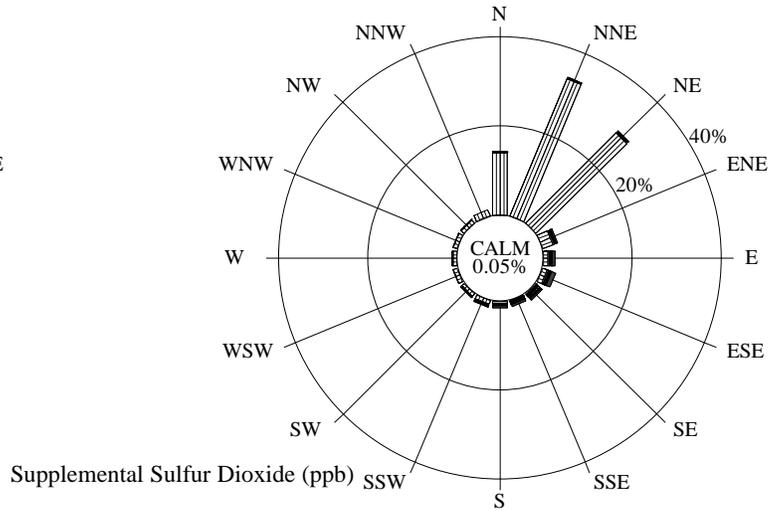


FIRST QUARTER (JAN-MAR)

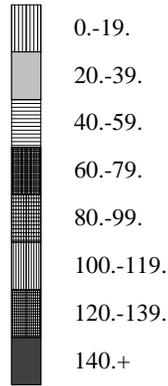


68.1% Collected 59.1% Valid  
2160 Possible /1470 Collected /1277 Valid  
(includes WS and WD)

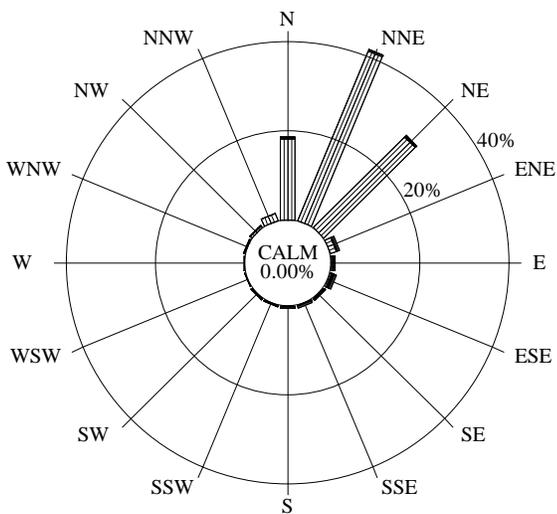
SECOND QUARTER (APR-JUN)



95.5% Collected 95.5% Valid  
2184 Possible /2085 Collected /2085 Valid  
(includes WS and WD)

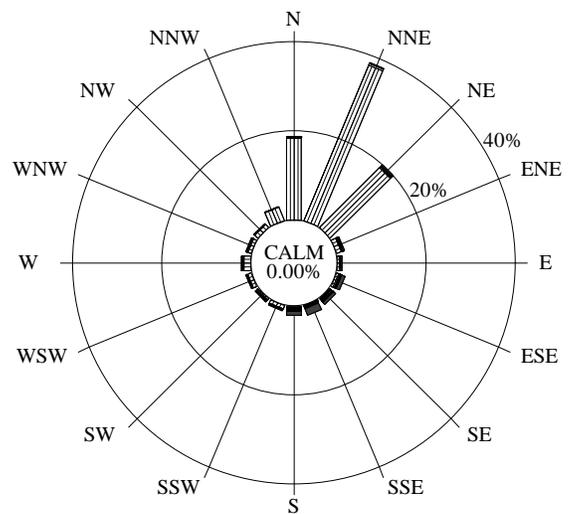


THIRD QUARTER (JUL-SEP)

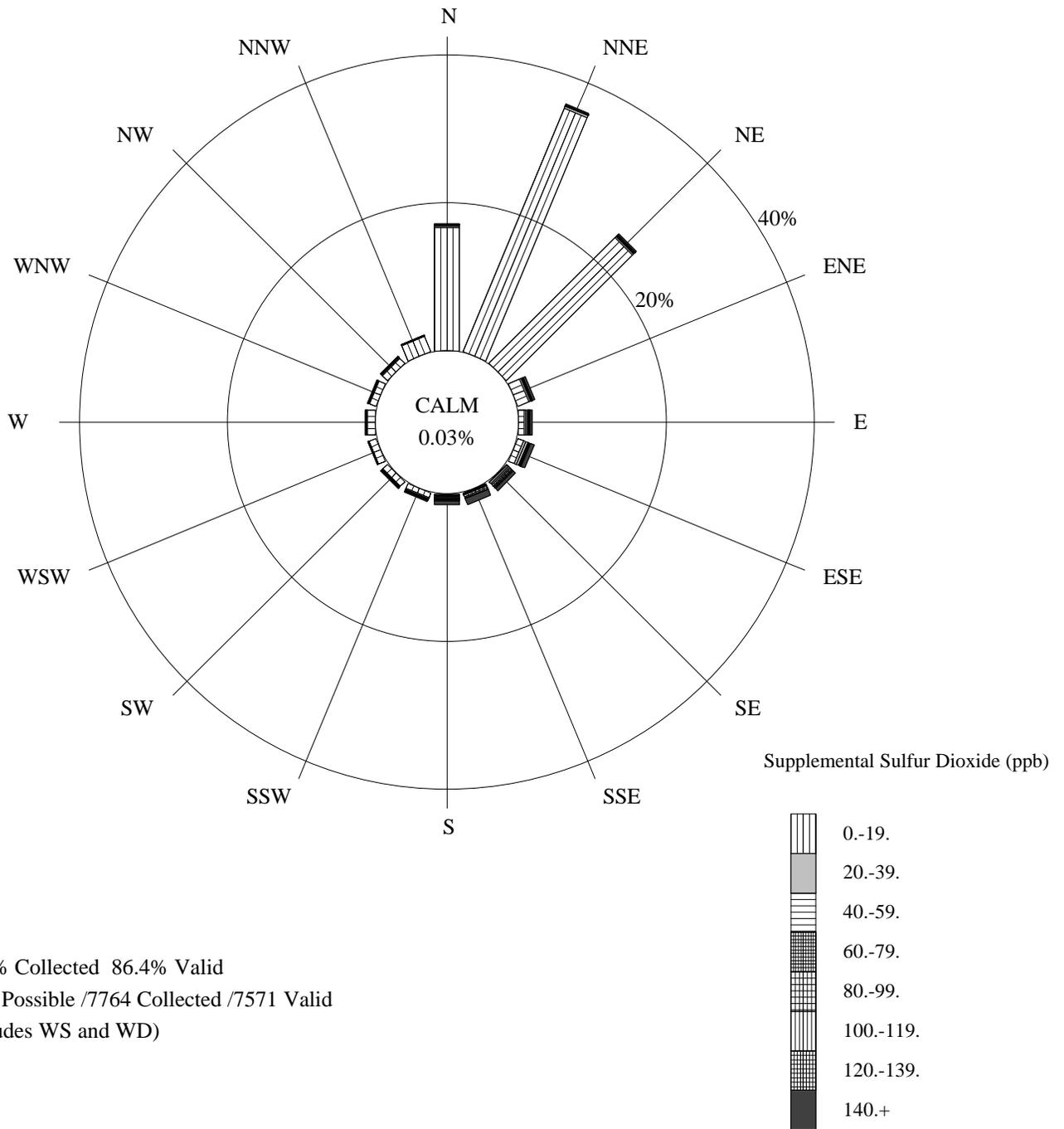


95.6% Collected 95.6% Valid  
2208 Possible /2111 Collected /2111 Valid  
(includes WS and WD)

FOURTH QUARTER (OCT-DEC)



95.0% Collected 95.0% Valid  
2208 Possible /2098 Collected /2098 Valid  
(includes WS and WD)



88.6% Collected 86.4% Valid  
8760 Possible /7764 Collected /7571 Valid  
(includes WS and WD)

SO2 Additional Analyzer Precision Check Summary †  
 Hawaii Volcanoes National Park  
 Observatory

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 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 01/01/2002 - 12/31/2002				
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	42	-0.80	-10.80	9.19
2	77	-1.50	-4.41	1.41
3	92	-0.18	-1.22	0.85
4	91	0.33	-0.86	1.52

† Supplemental sulfur dioxide is collected from an additional analyzer.

<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.)

## **2.4 METEOROLOGICAL DATA SUMMARY**

Summary of Selected Meteorological Data

Hawaii Volcanoes National Park

Observatory

Final Validation

01/01/2002 - 12/31/2002

Parameter	Value	Units	Number	Std Dev
<b>SCALAR WIND SPEED</b>				
Average	5.0	m/s	8723	2.3
Maximum	14.5	m/s		
Percent calm = 0.03				
<b>AMBIENT TEMPERATURE</b>				
Average	15.7	degC	8728	2.8
Maximum	26.0	degC		
Minimum	8.0	degC		
<b>RELATIVE HUMIDITY</b>				
Average	86	percent	8728	12
Maximum	100	percent		
Minimum	25	percent		
<b>PRECIPITATION (Rainfall or Snow melt)</b>				
Average non-zero rate	1.4	mm/hr	845	2.6
Maximum non-zero rate	21.1	mm/hr		
Minimum non-zero rate	.3	mm/hr		
Accumulated during period	1218.0	mm		
<b>SOLAR RADIATION</b>				
Average Daily Total	NA			
Maximum Daily Total	NA			
Minimum Daily Total	NA			

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.

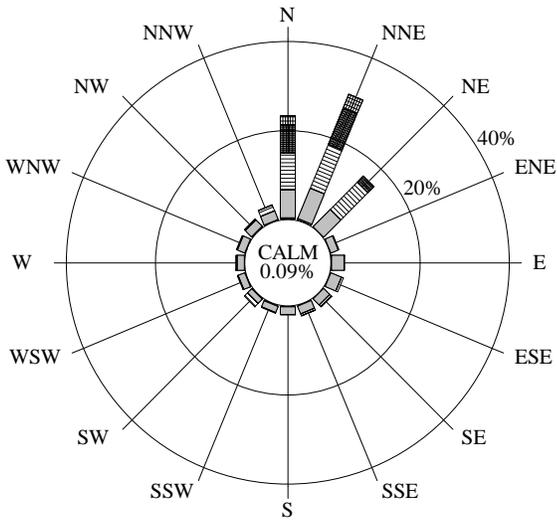
NA indicates instrument not available.

Hawaii Volcanoes  
National Park  
Observatory

Quarterly Wind Rose

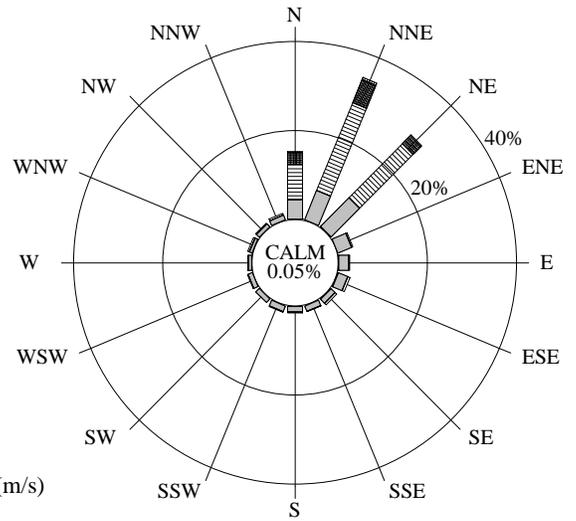
2002

FIRST QUARTER (JAN-MAR)



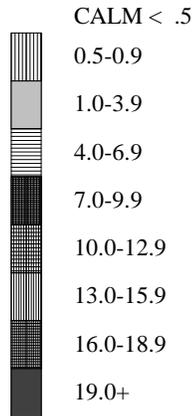
98.4% Collected 98.4% Valid  
2160 Possible /2125 Collected /2125 Valid  
(includes WS and WD)

SECOND QUARTER (APR-JUN)

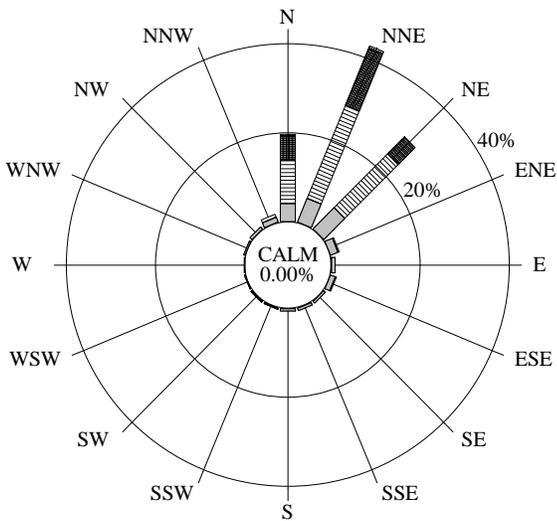


100.0% Collected 100.0% Valid  
2184 Possible /2184 Collected /2184 Valid  
(includes WS and WD)

Scalar Wind Speed (m/s)

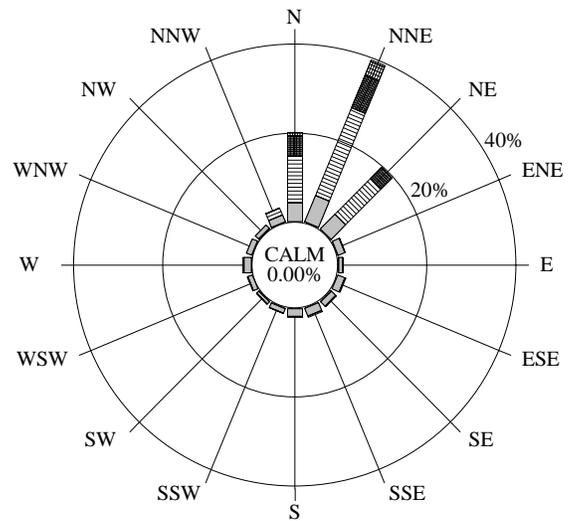


THIRD QUARTER (JUL-SEP)



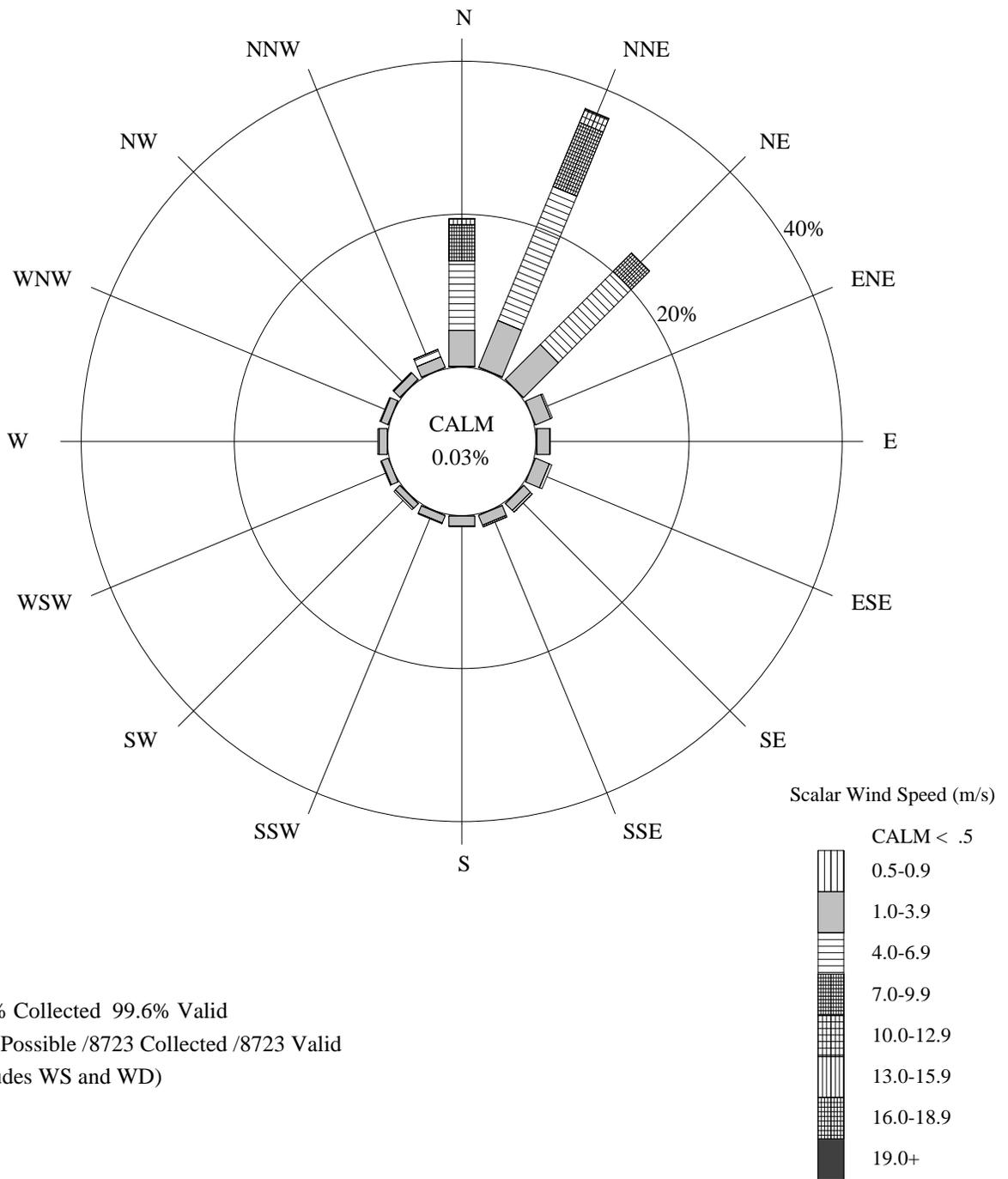
100.0% Collected 100.0% Valid  
2208 Possible /2208 Collected /2208 Valid  
(includes WS and WD)

FOURTH QUARTER (OCT-DEC)



99.9% Collected 99.9% Valid  
2208 Possible /2206 Collected /2206 Valid  
(includes WS and WD)

Final Validation



99.6% Collected 99.6% Valid  
8760 Possible /8723 Collected /8723 Valid  
(includes WS and WD)

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

Meteorological and hourly gaseous data contained in this report may be obtained from the following sources:

- National Park Service AIRWeb (<http://www.aqd.nps.gov/natnet/ard>)
- 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](mailto:AIR-IMC@AIR-RESOURCE.COM)

CASTNet concentration data may be obtained from the following Web site:

<http://www.epa.gov/castnet/data.html>

## 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.

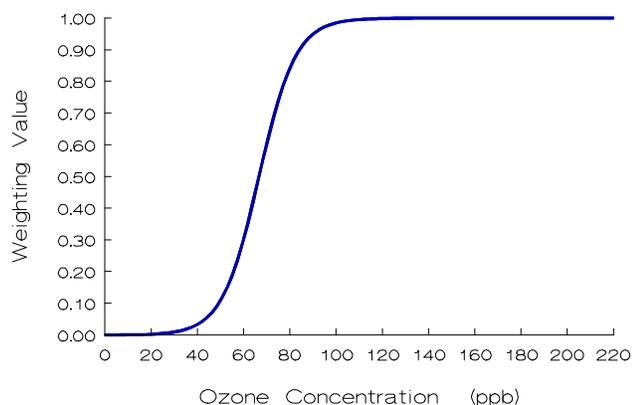
- (1) **Daily 1-Hr Maximum.** The maximum 1-hour average concentration recorded during each month, the growing season or the year regardless of the number of valid hourly observations recorded during a given day. The number in parentheses below this statistic, (N), indicates the number of days in the 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	$^{\circ}\text{C}$
<p>Where:</p> <p>ppm = parts per million</p> <p>ppb = parts per billion</p> <p><math>\mu\text{g}/\text{m}^3</math> = micrograms per cubic meter (at 25°C)</p> <p>m/s = meters per second</p> <p>mps = miles per hour</p> <p>ly/min = langleys per minute</p> <p><math>\text{w}/\text{m}^2</math> = watts per square meter</p> <p>mm/hr = millimeters per hour</p> <p>in/hr = inches per hour</p> <p><math>^{\circ}\text{C}</math> = degrees centigrade</p> <p><math>^{\circ}\text{F}</math> = degrees fahrenheit</p>			