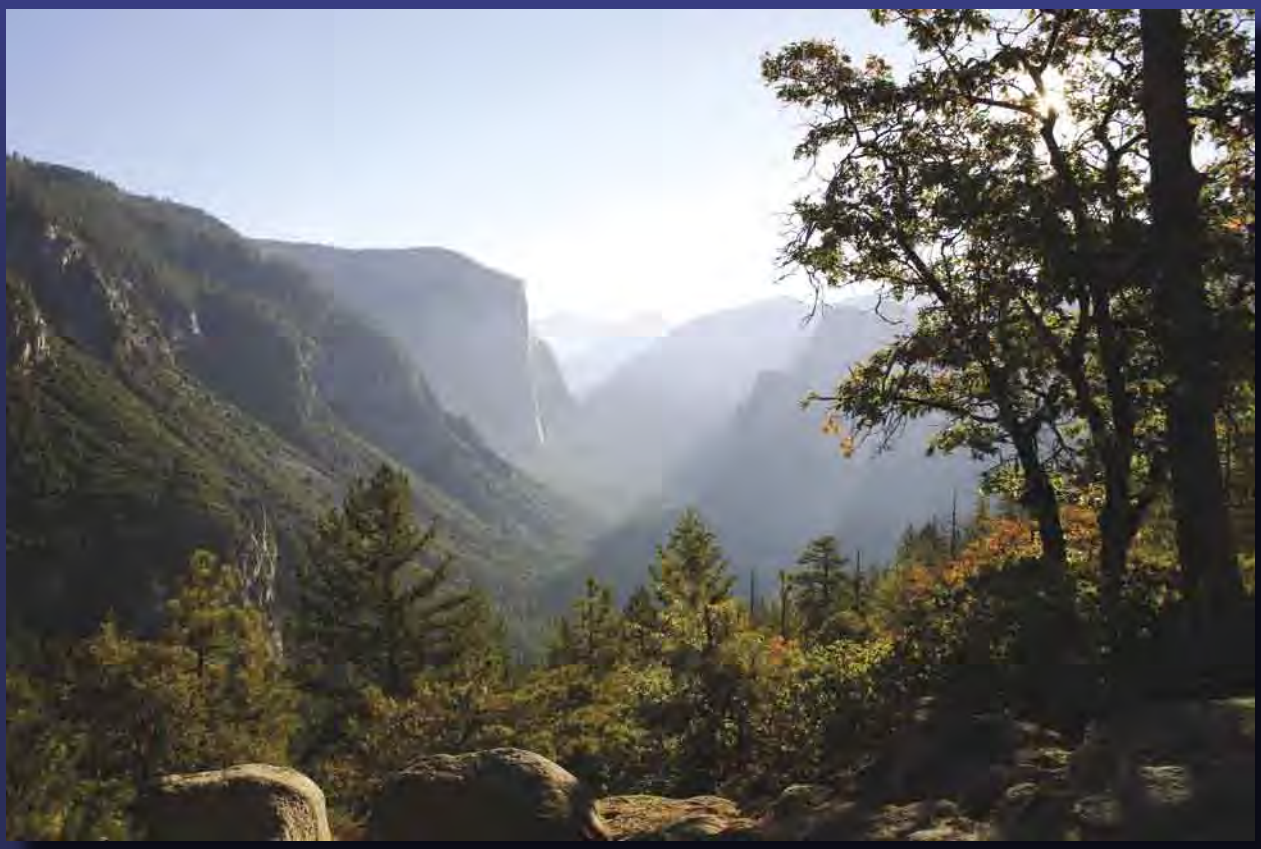
National Park Service
U.S. Department of the Interior

Natural Resource Program Center
Air Resources Division

Annual Data Summary 2005

Gaseous Pollutant Monitoring Program
Ozone, Sulfur Dioxide, Particulate Matter,
Meteorological Observations



On the Cover
Yosemite National Park -
Inspiration Point, California
NPS photo by L. Tarnay

Inside Cover
Yosemite National Park -
Merced River Air Quality
Monitoring Station
NPS photo by L. Tarnay

Annual Data Summary 2005

Gaseous Pollutant Monitoring Program
Ozone, Sulfur Dioxide, Particulate Matter,
Meteorological Observations

Report No. NPS D-1782

National Park Service
Air Resources Division
P.O. Box 25287
Denver, CO 80225-0287

August 2006

U.S. Department of the Interior
National Park Service
Natural Resource Program Center

This annual data summary was prepared for the National Park Service under contract C2350010840 by:

Air Resource Specialists, Inc.
1901 Sharp Point Drive, Suite E
Fort Collins, Colorado 80525

For additional copies of this report contact:

Air Resource Specialists, Inc.
1901 Sharp Point Drive, Suite E
Fort Collins, CO 80525
Telephone: (970) 484-7941
Fax: (970) 484-3423
E-mail: air-imc@air-resource.com

or

National Park Service Denver Service Center
Technical Information Center
12795 W. Alameda Parkway
Denver, CO 80225-0287
Telephone: (303) 969-2130
E-mail: TIC_requests@nps.gov

or

The report can be downloaded from
http://www2.nature.nps.gov/air/monitoring/ads/ADSReport.cfm

NPS D-1782, August 2006

Printed on recycled paper

Contents

Foreword iii

1.0 Introduction 1-1

2.0 Network Description 2-1
2.1 GPMP Network Monitoring 2-1
2.2 Cooperating Programs 2-1
2.2.1 State Programs 2-2
2.2.2 CASTNet 2-2
2.2.3 Passive Ozone 2-2
2.2.4 IMPROVE 2-2
2.2.5 NADP/NTN and NADP/MDN 2-2

3.0 Data Summaries 3-1
3.1 Ozone Data Summaries 3-2
3.1.1 Annual Ozone Summaries 3-2
3.1.2 Ozone Violation Summaries 3-9
3.1.3 Long-Term Ozone Trends 3-14
3.1.3.1 Application of Theil and Regression Techniques 3-14
3.1.3.2 Ozone Trends Compared to a Reference Year 3-18
3.1.3.3 Spatial Ozone Changes Over 10 Years 3-19
3.1.3.4 Passive Ozone Sampling Program Trends 3-20
3.1.3.5 Trends When There Are Multiple Monitors 3-21
3.1.3.6 Trends Comments 3-23
3.1.3.7 More Information on the Web 3-23
3.1.3.8 Literature 3-23
3.1.4 Resource Injury Indices 3-24
3.2 Sulfur Dioxide Data Summaries 3-29
3.3 Particulate Matter Data Summaries 3-32
3.3.1 $PM_{2.5}$ Data Summaries 3-32
3.3.2 PM_{10} Data Summaries 3-35
3.4 Meteorological Data Summaries 3-38

4.0 Data Quality Assurance 4-1
4.1 Data Collection 4-1
4.2 Precision and Accuracy 4-10

Yosemite National Park, California
NPS photo by L. Tarnay

Station Photographs

Yosemite NP - Merced River Inside Front Cover
Craters of the Moon NM and Preserve ii
Olympic NP iii
Mesa Verde NP 2-1
North Cascades NP 2-2
Pinnacles NM 3-1
Hawaii Volcanoes NP - Observatory 3-9
Acadia NP 3-15
Badlands NP 3-29
Mammoth Cave NP 3-35
Great Smoky Mountains NP - Cades Cove 3-38

Figures

Figure 2-1. Air quality monitoring in or nearby park units 2-3

Figure 3-1. Annual fourth highest daily maximum 8-hour average ozone concentrations (in ppb) 3-6

Figure 3-2. Annual number of days with daily maximum 8-hour average ozone values ≥ 85 ppb 3-7

Figure 3-3. Annual second highest 1-hour average ozone concentrations (in ppb) 3-8

Figure 3-4. Three-year running average ozone violation summary ranking (highest 40 sites), 2003-2005 3-13

Figure 3-5. Ozone linear regression trends in eastern parks for the period of record 3-16

Figure 3-6. GPRA-Theil trends in western parks over the last 10 years (1995-2005) 3-17

Figure 3-7. Difference in ozone from two 5-year periods: 1995-1999 and 2000-2004 3-19

Figure 3-8. Ozone air quality changes in NPS units 3-20

Figure 3-9. Ozone trends over the past 10 years (1995-2005) using passive sampling 3-21

Figure 3-10. Trends for multiple monitoring locations in Great Smoky Mountains National Park 3-22

Figure 3-11. Annual 3-month maximum SUM06 exposure index 3-28

Tables

Table 2-1. Site Specifications 2-4

Table 3-1. Daily maximum 8-hour average ozone concentrations (ppb) 3-3

Table 3-2. Three-year running average ozone violation summary - primary standard 3-10

Table 3-3. Changes in ozone at national parks over different time periods 3-18

Table 3-4. Summary of indices for resource injury (SUM06, W126, and N100) 3-25

Table 3-5. Summary of sulfur dioxide data 3-30

Table 3-6. Summary of $PM_{2.5}$ data from non-equivalency methods 3-33

Table 3-7. Summary of PM_{10} data from reference and equivalency methods 3-36

Table 3-8. PM_{10} violation summary - daily standard 3-37

Table 3-9. PM_{10} violation summary - annual standard 3-37

Table 3-10. Summary of selected meteorological data 3-39

Table 4-1. Data collection statistics 4-2

Table 4-2. Network summary of data collection statistics 4-6

Table 4-3. Ozone analyzer precision and accuracy summary 4-11

Table 4-4. Ozone analyzer precision and accuracy overall network summary 4-19

Craters of the Moon NM and Preserve - Ambient Air Quality Monitoring Station

Foreword

2005 Annual Report

This annual data summary report includes data from all Gaseous Pollutant Monitoring Program (GPMP) stations. Several parks with stations operated by other agencies are also included. Air quality and meteorological data from these sites for 2005 have been collected, validated, and made available to the Environmental Protection Agency (EPA), the parks, and the public. The data summarized in this report, as well as data from previous years, can be accessed and viewed graphically on the National Park Service (NPS) Air Resources Division (ARD) Web site (*http://www2.nature.nps.gov/air/monitoring/index.cfm*). This report also presents several measures of how well the network has functioned (data precision, accuracy, and collection rates), and contains summaries related to the pollutant National Ambient Air Quality Standards and thresholds for resource injury.

Olympic NP Portable Ozone Monitoring Station

Changes in 2005

The number of NPS ozone monitoring sites decreased slightly in 2005, however, new monitors within 5-10 miles of park units have been added to this report. The NPS ARD also completed and submitted to EPA a revised Quality Management Plan and Quality Assurance Project Plan. These documents are important to certify the ozone network.

2005 saw an increase in the number of portable ozone monitoring systems (POMS) operated by the NPS. These POMS serve the "baseline monitoring" function described in the 1991 NPS Monitoring Strategy. POMS were used in 13 locations in 2005. Data from these sites are included in many of the summaries in this report and the hourly data are available on the NPS ARD's Web site.

At least 16 POMS stations will be deployed in 2006 including new stations at Carlsbad Caverns National Park, Cumberland Gap National Historic Park, Colorado National Monument, and Natchez Trace Parkway. If your park unit has an interest in deploying a POMS, please contact John Ray (303-969-2820).

Budget constraints have put pressure on the monitoring network such that a limited amount of new or replacement equipment is being purchased, the Alaska arctic monitoring site has been put on indefinite hold, and funds for park support of monitoring are tight. It is expected that budgets will continue to be tight in the coming year.

Highlights in 2005

During 2005, only 6 parks operated by the NPS exceeded the ozone standard for the fourth highest 8-hour daily maximum ozone concentrations, as indicated in the table below. An exceedance occurs when an 8-hour average ozone concentration is equal to or greater than 85 ppb.

Park/Site	4th Highest Daily Maximum 8-Hour Avg. O_3 Concentration (ppb)	Number of Exceedances
Death Valley	85	4
Great Smoky Mountains - Look Rock	86	7
Joshua Tree	104	35
Sequoia and Kings Canyon:		
Ash Mountain	107	54
Lower Kaweah	97	32
Yosemite - Turtleback Dome	85	5
Zion	91	4

Special Studies in 2005

Each year several special air quality studies are conducted in individual parks. The objectives of these studies fall under the following monitoring objectives of the GPMP:

- Provide data for atmospheric model development and evaluation.
- Identify pollutants which may injure park natural resources or affect human health by measuring these pollutants and correlating observed effects on resources to ambient levels of pollutants.

Yellowstone NP Snowcoach
NPS photo by J.Ray

Yellowstone National Park – Yellowstone continues to fund monitoring of carbon monoxide (CO) and fine particles ($PM_{2.5}$) at two locations to relate snowmobile usage to ambient air quality. Over the past couple of years, CO and $PM_{2.5}$ levels at locations with high snowmobile activity have declined. Detailed emission data from snowmobiles and snowcoaches were collected using portable instrumentation in January 2006. The park plans to use these data in modeling and in the revision to the Winter Use Plan to include a Best Available Technology (BAT) for snowcoaches.

Cumberland-Piedmont – The Cumberland-Piedmont network within the Inventory and Monitoring Program conducted portable ozone and passive ozone sampling at 28 locations in 14 parks during the summer of 2005. Two POMS units were deployed at multiple locations for three-week periods during the summer.

Network Quality Assurance

Overall data capture for NPS ozone monitoring continues to be high (97%) and exceeds NPS objectives and EPA requirements. David Maxwell has taken over as the quality assurance officer of the GPMP. The CASTNet program continues to press for high data quality and has started an audit program.

The GPMP acknowledges and thanks the many park employees who perform the majority of the air quality monitoring by keeping the stations operational and working on air quality issues.

Dr. John D. Ray

GPMP Program Manager
NPS Air Resources Division
303-969-2820
john_d_ray@nps.gov

1.0 Introduction

The overall purpose of the National Park Service (NPS) Gaseous Pollutant Monitoring Program (GPMP) is to monitor the status and trends of ambient air quality conditions in national park units. This purpose is outlined by the Clean Air Act of 1963 (including the 1970, 1977, and 1990 amendments) and the Organic Act of 1916, which assign the federal land managers the responsibility of protecting the natural resources in national parks. Several monitoring objectives have been derived from this purpose.

Primary Monitoring Objectives
Gaseous Pollutant Monitoring Program

- Establish baseline concentrations of air pollution in national park units
- Assess trends in air quality
- Determine compliance with National Ambient Air Quality Standards
- Provide data for the development and revision of national and regional air pollution control policies
- Provide data for atmospheric model development and evaluation
- Identify air pollutants that may injure or damage park natural resources, measure these pollutants, and correlate observed effects on resources to ambient levels of pollutants

Other NPS 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 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 units caused by air pollution sources.

To meet these objectives the NPS Air Resources Division (ARD) has established a network of stations to monitor ozone (O_3), sulfur dioxide (SO_2), carbon monoxide (CO), oxides of nitrogen (NO_x), particulate matter (PM), and meteorological conditions in the parks. This data summary report presents only O_3, SO_2, PM, and meteorological data. Other gas and particulate monitoring are performed at several sites for specific air quality studies. Ozone, meteorological, and some SO_2 monitoring methods and quality assurance procedures adopted by the GPMP network were developed in accordance with the EPA regulations of 40 CFR, Part 58, Appendix D, which, although addressing primarily health-effects based monitoring in areas of high population, are generally pertinent to the GPMP. These design criteria allow for the direct comparison of data collected by the NPS with that collected by the EPA, and state and local air pollution control agencies. As a supplement to the basic network, the ARD also conducts shorter-term air quality monitoring including passive ozone, portable ozone, and special studies monitoring in selected parks. In addition, the ARD cooperates with other national and state programs that monitor ambient gases, meteorology, deposition chemistry, particulate matter, and visibility.

Data collected by this network are incorporated in the EPA Air Quality System (AQS) database, which is a national database of air quality data collected throughout the country. These data are also stored in the NPS ARD's Information Management Center (IMC), and are publicly available through the NPS ARD's Web site at *http://www2.nature.nps.gov/air/Monitoring/network.cfm#data*.

2.0 Network Description

The POMS are intended for short-term seasonal use at locations where reference method monitoring has not occurred or is not practical.

The NPS air quality monitoring strategy has focused primarily on Class I areas defined by the Clean Air Act Amendments of 1977. The Gaseous Pollutant Monitoring Program network consists of individual stations located in national park units throughout the United States. The NPS also participates with other agencies in cooperative monitoring programs. This section describes the GPMP network and cooperating programs.

2.1 GPMP Network Monitoring

During 2005, ninety-four (94) monitoring sites in sixty-eight (68) units of the National Park System conducted some combination of ozone, sulfur dioxide, particulate matter, and meteorological monitoring.

Mesa Verde NP Air Quality Monitoring Station

The locations of the sites that operated during the year are presented on the map in Figure 2-1. The parameters monitored at each park unit are indicated with colored flags. The CASTNet flag identifies sites where the NPS operates Clean Air Status and Trends Network monitoring systems in cooperation with the EPA's CASTNet program to quantify dry atmospheric deposition. The enhanced gaseous and/or particulates flag indicates that the NPS sponsors additional or high-resolution gaseous or particulate monitoring at the park. Monitoring agencies and park units with more than one monitoring site are indicated. Site specifications, including site names, abbreviations, AQS identification numbers, locations, and monitored parameters are listed in Table 2-1.

In addition to monitoring for regulatory compliance, the NPS added non-certified portable ozone monitoring systems (POMS) to the GPMP in 2003. These sites employ portable non-reference, non-equivalent method ozone and meteorological monitoring stations, generally configured for solar and battery power. Throughout this report, POMS site names in tables and figures have been underlined to distinguish them from monitoring sites meeting all EPA guidelines.

2.2 Cooperating Programs

Data from cooperating programs are reported by those programs and are not included in this report. The exception to that is ozone, sulfur dioxide, particulate matter, and meteorology collected in NPS units by state agencies which supplement the data collected by the GPMP.

2.2.1 State Programs - The NPS cooperates with a number of state agencies. At some sites, state air quality agencies provide measurement and operations support, and data are generally shared directly among cooperating agencies. Relevant ozone, sulfur dioxide, particulate matter, and meteorological data submitted by states to the EPA AQS are retrieved for inclusion in this report.

There are also numerous sites near park units operated by state or other agencies, independent of the NPS. Data from these sites are also retrieved from the EPA AQS for inclusion in this report, but are presented separately from data collected by state sites in cooperation with the NPS.

Throughout this report, state operated and reported monitoring site names in tables and figures are indicated in italics.

2.2.2 CASTNet - Most GPMP stations operate in a cooperative effort with the EPA Clean Air Status and Trends Network (CASTNet). Weekly integrated particulate samples are collected on filter packs at CASTNet sites. The samples are analyzed for ambient atmospheric nitrates, sulfates, ammonium, sulfur dioxide, and nitric acid, and the results are used to estimate atmospheric dry deposition. More information is available at the CASTNet Web site: *http://www.epa.gov/castnet*.

2.2.3 Passive Ozone - To expand the spatial sampling of ozone in national parks, the Research and Monitoring Branch, (RMB) of the NPS ARD adopted the use of low-cost passive ozone samplers. Weekly integrated ozone concentrations are measured in the parks during the ozone season, typically late spring through early fall. Operators change the ozone badges weekly and mail them to a contract laboratory for analysis. The results are compiled and reported by the RMB.

North Cascades NP Dry Deposition and Precipitation

2.2.4 IMPROVE - The Interagency Monitoring of Protected Visual Environments (IMPROVE) is a consortium of federal and state agencies which conduct visibility monitoring in Class I areas, including national parks. A number of instruments are used to monitor visibility, including:

- Aerosol samplers, which collect 24-hr integrated particle samples every three days on a series of filter media. Filters are later analyzed for $PM_{2.5}$ and PM_{10} mass, elements, ions, and carbon.
- Transmissometers, which directly measure the atmospheric light extinction over a sight path of several kilometers.
- Nephelometers, which perform point optical measurements of the scattering component of atmospheric light extinction.
- Cameras which document the appearance of a scene as viewed through the atmosphere. Digital images from many sites are posted to the Internet along with relevant air quality data and other information in near real-time for public viewing.

More information is available at the IMPROVE Web site at *http://vista.cira.colostate.edu/improve*.

2.2.5 NADP/NTN and NADP/MDN - The National Atmospheric Deposition Program/ National Trends Network (NADP/NTN) includes wet deposition monitoring at over 250 sites nationwide. The NADP network has been collecting data for over 20 years, and is coordinated from the Program Office at the Illinois State Water Survey in Champaign, Illinois. Data for all major ions are available in concentrations and depositions expressed by kilograms/hectare. The National Atmospheric Deposition Program/ Mercury Deposition Network (NADP/MDN) includes wet mercury deposition monitoring at over 80 sites nationwide. More information about both of these programs is available at the NADP Web site: *http://nadp.sws.uiuc.edu/*.

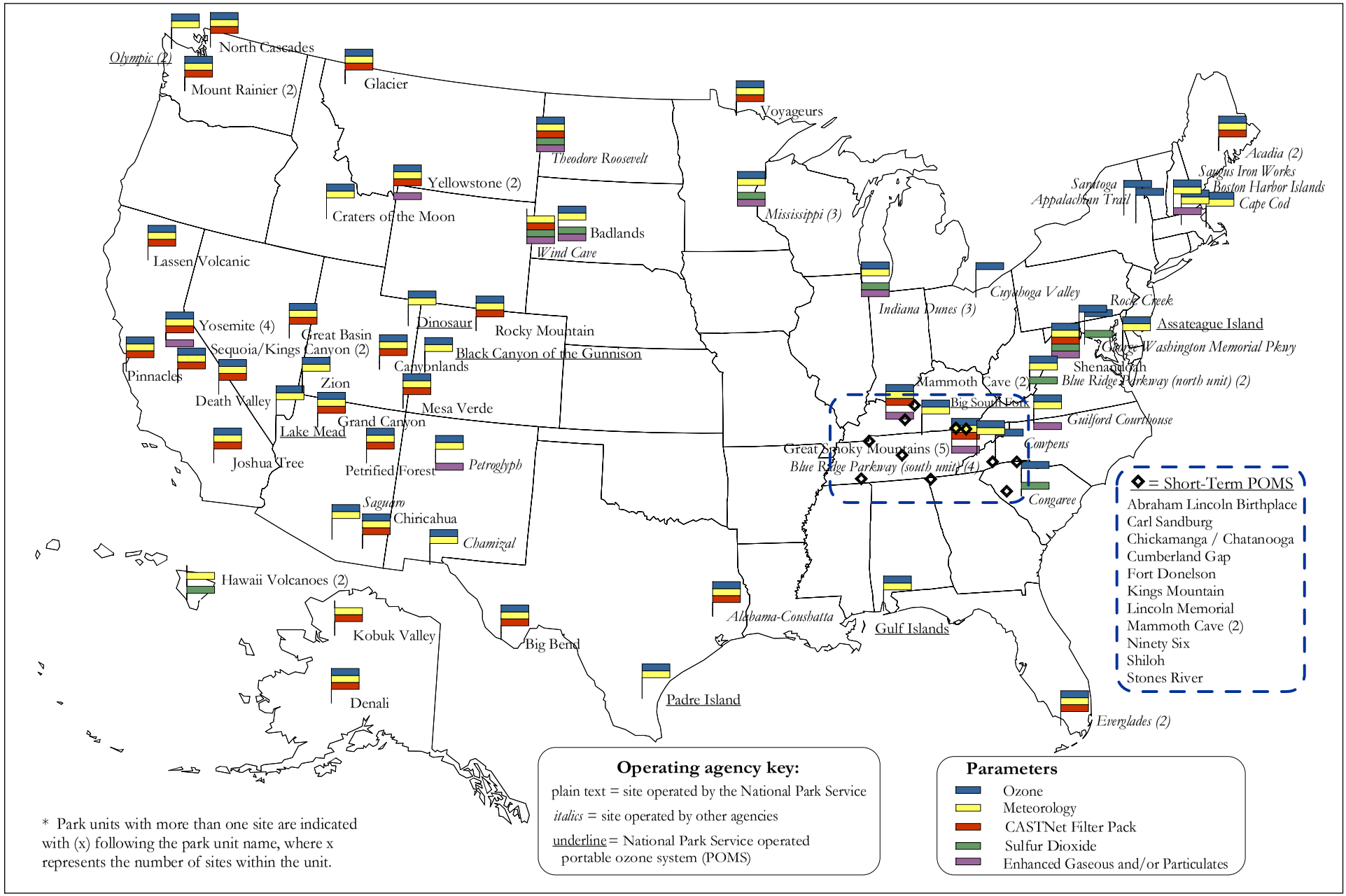


Figure 2-1. Air quality monitoring in or nearby park units.

Table 2-1. Site specifications.

Sites operated by the National Park Service

National Park Unit	Site Name	State	NPS Abbr.	CASTNet Abbr.	AQS ID Number	Latitude	Longitude	Elev. (m)	O3 Years[1]	SO2	VWD[2]	SWS[3]	TMP	RH	RNF	WET	DTP	SOL	Filter Pack[4]
Abraham Lincoln Birthplace	Knob Creek High	KY	ABLI-KC	—	—	37.6089	85.6436	240	1	—	X	X	X	X	X	—	—	X	—
Assateague Island	Maintenance Area	MD	ASIS-MA	—	—	38.2511	75.1594	3	1	—	X	X	X	X	X	—	—	X	—
Badlands	Visitor Center	SD	BADL-VC	—	46-071-1001	43.7436	101.9414	739	9	—	X	X	X	X	X	—	—	X	—
Big Bend	K-Bar Ranch Road	TX	BIBE-KB	BBE401	48-043-0101	29.3022	103.1772	1052	16	—	X	X	X	X	X	X	X	X	X
Big South Fork	Taft Story Fields	TN	BISO-TS	—	—	36.4725	84.6806	451	3	—	X	X	X	X	X	—	—	X	—
Black Canyon of the Gunnison	Gravel Pit	CO	BLCA-GP	—	—	38.5803	107.7167	2408	3	—	X	X	X	X	X	—	—	X	—
Canyonlands	Island in the Sky	UT	CANY-IS	CAN407	49-037-0101	38.455	109.8217	1813	14	—	X	X	X	X	X	X	X	X	X
Carl Sandburg	Granite Dome 14	NC	CASA-GD	—	—	35.265	82.4511		1	—	—	—	—	X	—	—	—	—	—
Chickamanga/Chatanooga	Maintenance Area Field	GA	CHCH-MA	—	—	34.9183	85.27	237	1	—	—	—	X	X	—	—	—	—	—
Chiricahua	Entrance Station	AZ	CHIR-ES	CHA467	04-003-8001	32.0092	109.3892	1570	15	—	X	X	X	X	X	X	X	X	X
Craters of the Moon	Visitor Center	ID	CRMO-VC	—	16-023-0101	43.4606	113.5622	1815	14	—	X	X	X	X	—	—	—	X	—
Cumberland Gap	Pinnacles	TN	CUGA-PI	—	—	36.6064	83.6647	749	1	—	—	—	X	X	—	—	—	—	—
Denali	Headquarters	AK	DENA-HQ	DEN417	02-290-0003	63.0539	150.8547	661	19	—	X	X	X	X	X	X	X	X	X
Death Valley	Park Village	CA	DEVA-PV	DEV412	06-027-0101	36.5092	116.8481	125	13	—	X	X	X	X	X	X	X	X	X
Dinosaur	West Entrance Housing	UT	DINO-WE	—	—	40.4372	109.3047	1463	1	—	X	X	X	X	X	—	—	X	X
Everglades	Beard Center	FL	EVER-BC	EVE419	12-086-0030	25.3911	80.6806	2	—	—	X	X	X	X	X	X	X	X	X
Fort Donelson	Visitor Center	TN	FODO-VC	—	—	36.4825	87.8622	172	1	—	—	—	X	X	—	—	—	—	—
Glacier	West Glacier Horse Stables	MT	GLAC-WG	GLR468	30-029-8001	48.5103	113.9956	976	14	—	X	X	X	X	X	X	X	X	X
Great Basin	Maintenance Yard	NV	GRBA-MY	GRB411	32-033-0101	39.005	114.2158	2067	13	—	X	X	X	X	X	X	X	X	X
Grand Canyon	The Abyss	AZ	GRCA-AS	GRC474	04-005-8001	36.2828	113.0958	1433	13	—	X	X	X	X	X	X	X	X	X
Great Smoky Mountains	Cades Cove	TN	GRSM-CC	—	47-009-0102	35.5619	83.4981	2021	13	—	X	X	X	X	X	—	—	X	—
Great Smoky Mountains	Clingmans Dome	TN	GRSM-CD	—	47-155-0102	35.6967	83.6086	1243	13	—	X	X	X	X	X	—	—	X	—
Great Smoky Mountains	Cove Mountain	TN	GRSM-CM	—	47-155-0101	35.6967	83.6086	1243	18	—	X	X	X	X	X	—	—	X	—
Great Smoky Mountains	Look Rock	TN	GRSM-LR	GRS420	47-009-0101	35.6331	83.9422	793	18	—	X	X	X	X	X	X	X	X	X
Gulf Islands	Fort Pickens Entrance Stn.	FL	GUIS-FP	—	—	30.3183	87.2553	6	2	—	X	X	X	X	X	—	—	X	—
Hawaii Volcanoes	Observatory	HI	HAVO-OB	—	15-001-0007	19.4203	155.2881	1123	—	X	X	X	X	X	X	—	—	—	—
Hawaii Volcanoes	Visitor Center	HI	HAVO-VC	—	15-001-0005	19.4308	155.2578	1215	—	X	X	X	X	X	X	—	—	X	—
Joshua Tree	Black Rock	CA	JOTR-BR	JOT403	06-071-9002	34.0714	116.3906	1244	13	—	X	X	X	X	X	X	X	X	X

-- continued --

Table 2-1 (continued). Site specifications.

Sites operated by the National Park Service

National Park Unit	Site Name	State	NPS Abbr.	CASTNet Abbr.	AQS ID Number	Latitude	Longitude	Elev. (m)	O3 Years[1]	SO2	VWD[2]	SWS[3]	TMP	RH	RNF	WET	DTP	SOL	Filter Pack[4]
Kings Mountain	Resevoir Hill	SC	KIMO-RH	—	—	35.1381	81.3872	325	1	—	—	—	X	X	—	—	—	—	—
Kobuk Valley	Ambler	AK	KOVA-AM	KVA428	02-290-0004	67.0925	157.8719	67	—	—	X	X	X	X	X	X	X	X	X
Lake Mead	Meadview	AZ	LAME-ME	—	—	36.0194	114.0686	881	4	—	X	X	X	X	X	—	—	X	—
Lassen Volcanic	Manzanita Lake Fire Stn.	CA	LAVO-ML	LAV410	06-089-3003	40.5403	121.5764	1756	19	—	X	X	X	X	X	X	X	X	X
Lincoln Memorial University	University Field	TN	LIME-UF	—	—	36.5775	83.6569		1	—	—	—	X	X	—	—	—	—	—
Mammoth Cave	Biogarden	KY	MACA-BI	—	—	37.2178	86.0736	219	2	—	X	X	X	X	X	—	—	X	—
Mammoth Cave	Great Onyx Meadow Portable	KY	MACA-GP	—	—	37.2178	86.0736	219	15	—	—	—	X	X	—	—	—	—	—
Mammoth Cave	Houchin Meadow	KY	MACA-HM	MAC426	21-061-0501	37.1864	86.0411	258	10	—	X	X	X	X	X	X	X	X	X
Mammoth Cave	Great Onyx Job Corps	KY	MACA-JC	—	—	37.2503	86.2325	234	1	—	—	—	X	X	—	—	—	—	—
Mesa Verde	Resource Mngment Area	CO	MEVE-RM	MEV405	08-083-0101	37.1983	108.4903	2177	13	—	X	X	X	X	X	X	X	X	X
Mount Rainier	Tahoma Vista	WA	MORA-TV	—	—	46.7583	122.1244	415	2	—	X	X	X	X	X	—	—	X	—
Mount Rainier	Tahoma Woods	WA	MORA-TW	MOR409	53-053-1010	46.7581	122.1225	423	15	—	X	X	X	X	X	X	X	X	X
Ninety Six Historical Park	Bumble Bee Hill	SC	NISI-BB	—	—	34.1481	82.0128	151	1	—	—	—	X	X	—	—	—	—	—
North Cascades	Marblemount Ranger Stn.	WA	NOCA-MM	NCS415	53-057-0013	48.5397	121.4472	109	10	—	X	X	X	X	X	X	X	X	X
Olympic	Hurricane Ridge Portable	WA	OLYM-HP	—	—	47.995	123.3847	939	2	—	X	X	X	X	X	—	—	X	—
Padre Island	Malaquite Visitor Center	TX	PAIS-MV	—	—	27.4267	97.2983	6	1	—	X	X	X	X	X	—	—	X	—
Petrified Forest	South Entrance	AZ	PEFO-SE	PET427	04-017-0119	34.8225	109.8919	1723	4	—	X	X	X	X	X	X	X	X	X
Pinnacles	SW of East Entrance Stn.	CA	PINN-ES	PIN414	06-069-0003	36.485	121.1556	317	19	—	X	X	X	X	X	X	X	X	X
Rocky Mountain	Long's Peak	CO	ROMO-LP	ROM406	08-069-0007	40.3833	105.5667	2407	20	—	X	X	X	X	X	X	X	X	X
Sequoia and Kings Canyon	Ash Mountain	CA	SEKI-AS	SEK430	06-107-0009	36.4894	118.8269	457	7	—	X	X	X	X	X	X	X	X	X
Sequoia and Kings Canyon	Lower Kaweah	CA	SEKI-LK	—	06-107-0006	36.5658	118.7772	1890	22	—	X	X	X	X	X	—	—	X	—
Shenandoah	Big Meadows	VA	SHEN-BM	SHN418	51-113-0003	38.5231	78.4347	1073	23	X	X	X	X	X	X	X	X	X	X
Shiloh	Russian Tenant Field	TN	SHIL-RT	—	—	35.1572	88.3394		1	—	—	—	X	X	—	—	—	—	—
Stones River	Chicago Bottom Field	TN	STRI-CB	—	—	35.8786	86.4361	168	1	—	—	—	X	X	—	—	—	—	—
Voyageurs	Sullivan Bay	MN	VOYA-SB	VOY413	27-137-0034	48.4128	92.8292	429	10	—	X	X	X	X	X	X	X	X	X
Yellowstone	Old Faithful	WY	YELL-OF	—	56-039-1012	44.4569	110.8314	2246	—	—	X	X	X	X	—	—	—	—	—
Yellowstone	Water Tank	WY	YELL-WT	YEL408	56-039-1011	44.4569	110.8314	2246	10	—	X	X	X	X	X	X	X	X	X
Yosemite	Merced River	CA	YOSE-MR	—	06-043-0033	37.7431	119.5939	1219	4	—	X	X	X	X	X	—	—	X	—

-- continued --

Table 2-1 (continued). Site specifications.

Sites operated by the National Park Service

National Park Unit	Site Name	State	NPS Abbr.	CASTNet Abbr.	AQS ID Number	Latitude	Longitude	Elev. (m)	O3 Years[1]	SO2	VWD[2]	SWS[3]	TMP	RH	RNF	WET	DTP	SOL	Filter Pack[4]
Yosemite	Turtleback Dome	CA	YOSE-TD	YOS404	06-043-0003	37.7961	119.8581	1408	13	—	X	X	X	X	X	X	X	X	X
Yosemite	Tioga Pass	CA	YOSE-TP	—	—	37.9108	119.2586	3037	1	—	—	—	X	X	—	—	—	—	—
Zion	Dalton's Wash	UT	ZION-DW	—	49-053-0130	37.1983	113.1506	1213	2	—	X	X	X	X	X	—	—	X	—

 # active park units: 47 **# active park sites: 59**

Sites operated by cooperating state agencies

National Park Unit	Site Name	State	NPS Abbr.	CASTNet Abbr.	AQS ID Number	Latitude	Longitude	Elev. (m)	O3 Years[1]	SO2	VWD[2]	SWS[3]	TMP	RH	RNF	WET	DTP	SOL	Filter Pack[4]
Acadia	Cadillac Mountain	ME	ACAD-CM	—	23-009-0102	44.3472	68.2278	466	11	—	X	X	X	X	—	—	—	—	—
Acadia	McFarland Hill	ME	ACAD-MH	ACA416	23-009-0103	44.3739	68.2606	129	8	—	X	X	X	X	X	X	X	X	X
Cape Cod	Cape Cod	MA	CACO-XX	—	25-001-0002	41.9758	70.0247	41	19	—	X	X	X	X	—	—	—	X	—
Chamizal	Chamizal	TX	CHAM-XX	—	48-141-0044	31.7656	106.455	1128	14	—	X	X	X	X	—	—	—	X	—
Congaree	Congaree Bluff	SC	COSW-BL	—	45-079-0021	33.8147	80.7811	34	6	X	—	—	—	—	—	—	—	—	—
Cowpens	State Monitor	SC	COWP-SM	—	45-021-0002	35.1303	87.8164	297	18	—	—	—	—	—	—	—	—	—	—
Great Smoky Mountains	Purchase Knob	NC	GRSM-PK	—	37-087-0036	35.59	83.0775	1500	11	—	—	—	—	—	—	—	—	—	—
Saguaro	Pima County	AZ	SAGU-PC	—	04-019-0021	32.1744	110.7364	938	14	—	X	X	X	X	—	—	—	X	—
Theodore Roosevelt	Painted Cany. VC	ND	THRO-VC	THR422	38-007-0002	46.8947	103.3778	850	8	X	X	X	X	X	X	X	X	X	X
Wind Cave	Visitor Center	SD	WICA-VC	WNC429	46-033-0132	43.5578	103.4839	1292	2	—	X	X	X	X	X	X	X	X	X
Yosemite	Village	CA	YOSE-VI	—	06-043-1001	37.7458	119.6028	1216	—	—	—	—	—	—	—	—	—	—	—

 # active park units: 10 **# active park sites: 11**

-- continued --

Table 2-1 (continued). Site specifications.

Nearby sites operated by other agencies

National Park Unit	Site Name	State	NPS Abbr.	CASTNet Abbr.	AQS ID Number	Latitude	Longitude	Elev. (m)	O3 Years[1]	SO2	VWD[2]	SWS[3]	TMP	RH	RNF	WET	DTP	SOL	Filter Pack[4]
Alabama-Coushatta	CASTNet site	TX	ALCO-CA	—	—	38.8689	89.6228	164	18	—	X	X	X	X	X	X	X	X	X
Appalachian Trail	Mount Greylock Summit	MA	APTR-MG	—	25-003-4002	42.6367	73.1686	1140	17	—	—	—	—	—	—	—	—	—	—
Blue Ridge Parkway	7510 Blue Ridge Parkway	NC	BLRI-75	—	37-011-0002	35.9717	81.9342	987	7	—	—	—	X	X	—	—	—	—	—
Blue Ridge Parkway	Blue Ridge Parkway	NC	BLRI-BR	—	37-199-0003	35.7378	82.2853	1982	14	—	—	—	—	—	—	—	—	—	—
Blue Ridge Parkway	Vinton Elementary	VA	BLRI-VE	—	51-161-1004	37.2856	79.8842	346	25	—	—	—	—	—	—	—	—	—	—
Blue Ridge Parkway	Frying Pan Mountain	NC	BLRI-FP	—	37-087-0035	35.3792	82.7925	1585	12	—	—	—	X	X	—	—	—	—	—
Blue Ridge Parkway	Route 191	NC	BLRI-RO	—	37-021-0030	35.5	82.6	675	17	—	—	—	—	—	—	—	—	—	—
Blue Ridge Parkway	Ranger Station	VA	BLRI-RS	—	51-163-0003	37.6261	79.5131	280	7	—	—	—	—	—	—	—	—	—	—
Boston Harbor Islands	Former Nike Missle Site	MA	BOHA-NM	—	25-025-0041	42.3175	70.9689	10	8	—	X	X	X	X	—	—	—	X	—
Cuyahoga Valley	800 Patterson	OH	CUVA-PA	—	39-153-0020	41.1061	81.5039	305	26	—	—	—	—	—	—	—	—	—	—
Everglades	Cutler Road	FL	EVER-CR	—	12-086-0029	25.5861	80.3269	4	21	—	—	—	—	—	—	—	—	—	—
George Washington Pkwy	Alexandria Health	VA	GEWA-AH	—	51-510-0009	38.8108	77.0447	23	37	—	—	—	—	—	—	—	—	—	—
Guilford Courthouse	Mendenhall Middle School	NC	GUCO-MM	—	37-081-0013	36.1092	79.8011	247	5	—	—	X	X	X	X	—	X	X	—
Indiana Dunes	Gas Station	IN	INDU-GS	—	18-091-0005	41.7169	86.9075	187	30	—	X	X	X	—	—	—	X	—	—
Indiana Dunes	Ammunition Bunker	IN	INDU-AB	—	18-089-0022	41.5733	87.3047	183	13	—	X	X	X	X	—	—	—	X	—
Indiana Dunes	Water Treatment Plant	IN	INDU-WT	—	18-127-0024	41.6175	87.1992	183	23	—	—	—	—	—	—	—	—	—	—
Mississippi	Anoka County Airport	MN	MISS-AC	—	27-003-1002	41.1397	93.2075	281	27	—	—	—	—	—	—	—	—	—	—
Mississippi	Somerset Town Hall	WI	MISS-ST	—	55-109-1002	45.1244	92.6625	278	39	—	X	X	—	—	—	—	—	—	—
Mississippi	Washington County	MN	MISS-WC	—	27-163-6015	45.1189	92.855	0	9	—	—	—	—	—	—	—	—	—	—
Olympic	Blyn Lookout Relay	WA	OLYM-BL	—	53-009-0005	48.0086	122.9728	600	1	—	—	—	—	—	—	—	—	—	—
Petroglyph	Westside Taylor Ranch	NM	PETR-WT	—	35-001-0027	35.1519	106.6836	5111	7	—	—	—	X	—	—	—	—	X	—
Rock Creek	Achbold Parkway	DC	ROCR-AP	—	11-001-0025	38.9753	77.0228	91	26	—	—	—	—	—	—	—	—	—	—
Saugus Iron Works	Lynn Water Treatment	MA	SAIR-LW	—	25-009-2006	42.4744	70.9725	52	14	—	X	X	X	X	X	—	—	X	—

-- continued --

Table 2-1 (continued). Site specifications.

Nearby sites operated by other agencies

National Park Unit	Site Name	State	NPS Abbr.	CASTNet Abbr.	AQS ID Number	Latitude	Longitude	Elev. (m)	O3 Years[1]	SO2	VWD[2]	SWS[3]	TMP	RH	RNF	WET	DTP	SOL	Filter Pack[4]
Saratoga	Stillwater	NY	SARA-ST	—	36-091-0004	43.0122	73.6489	120	18	—	—	—	—	—	—	—	—	—	—
# active park units: 15	**# active park sites: 24**																		

1. The values in this column represent the number of years an ozone analyzer has been operational at the site.

2. Cape Cod reports wind direction as scalar wind direction rather than vector wind direction.

3. Saguaro reports wind speed as vector wind speed rather than scalar wind speed.

4. A filter pack is a part of the CASTNet network and is used to measure dry deposition using the "inferential method". This method combines air quality concentration data with meteorological measurements and land use functions to compute deposition velocities. Ambient air is drawn across the filter at either 3.0 or 1.5 liters per minute. The filter is then analyzed in a lab to yield 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+} are also measured from the filter samples.

Key:

O3 = Ozone Analyzer
SO2 = Sulfur Dioxide Analyzer
VWD = Vector Wind Direction
SWS = Scalar Wind Speed
TMP = Ambient Temperature
RH = Relative Humidity
RNF = Precipitation
WET = Wetness Sensor
DTP = Delta Temperature
SOL = Solar Radition

italics = site operated by other agencies

underline = National Park Service operated portable ozone system (POMS)

3.0 Data Summaries

Ground-level ozone, sulfur dioxide, and particulate matter are regulated under the Clean Air Act, the comprehensive federal law that regulates air quality in the United States. Among other things, the Clean Air Act requires the U.S. EPA to set standards for "criteria pollutants". These standards, known as the National Ambient Air Quality Standards (NAAQS), define the national targets for acceptable concentrations of each of the criteria pollutants. For each pollutant, EPA has developed two NAAQS standards:

- The "primary standard", which is intended to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly.
- The "secondary standard", which is intended to prevent damage to the environment and property, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

This section presents 2005 data summaries for the NPS GPMP. Ozone summaries for all sites are presented first, followed by data summaries for sulfur dioxide, particulate matter, and meteorological parameters. In these data summary products, site names of EPA-certified sites operated by the NPS are indicated with plain text, site names of EPA-certified sites operated by state or other agencies are written in italics, and site names of portable ozone monitoring systems (POMS) operated by the NPS are underlined. Long-term POMS sites typically operated May through September. Short-term POMS sites typically operated for three weeks during this same period.

Throughout this report data summary tables are split according to each of these groups. Generally, four or five site groupings are provided in each table to compare data among sites that are operated in a similar manner.

Pinnacles NM Ambient Air Quality Monitoring Station

3.1 Ozone Data Summaries

Ground-level ozone, produced by the reaction of nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight, is one of the most widespread pollutants affecting vegetation and public health in the U.S. Although ozone is principally viewed as an urban problem, ozone and its precursor emissions can travel long distances, resulting in elevated ozone levels in national parks. Combustion processes from power plants, automobiles, and industries are the main anthropogenic emitters of NO_x. Vehicles, industries, and natural vegetation emit VOCs.

Exposure to ozone affects human health, causing acute respiratory problems, aggravation of asthma, temporary decreases in lung capacity in some adults, inflammation of lung tissue, and impairment of the body's immune system. Ozone also affects vegetation in national parks.

Research shows that some plants are more sensitive than humans to ozone and that effects on plants occur well below the EPA National Ambient Air Quality Standards (NAAQS).

The NAAQS primary standard for ozone is 0.08 ppm over an 8-hour period. An exceedance of the standard occurs when an 8-hour average ozone concentration is greater than or equal to 85 ppb. An exceedance of the standard is not the same as a violation. A violation occurs when the 3-year average of the fourth highest daily maximum 8-hour average ozone concentration equals or exceeds 85 ppb. The secondary ozone standard defined by the EPA is the same as the primary standard.

To quantify ozone exposure to plants, various indices other than the primary and secondary standards are often used. These indices, described further in Section 3.1.4, are believed to be biologically relevant because they take into account both peak ozone concentrations and cumulative exposure to ozone.

Yellowstone NP, Wyoming

3.1.1 Annual Ozone Summaries - Table 3-1 summarizes O_3 measurements with respect to the daily maximum 8-hour average concentrations at each EPA monitoring site. The five highest daily maximum 8-hour average ozone concentrations are listed, as well as the total number of days with exceedances of the NAAQS 8-hour standard (8-hour average ozone values greater than or equal to 85 ppb). At each EPA-certified monitoring site, the fourth highest value column and the number of days column are both color-coded to identify sites where the fourth highest daily maximum 8-hour average ozone value exceeded the 8-hour standard during 2005. Note that other sites may have experienced fewer than four exceedances of the 8-hour standard but are not color coded. Ozone summary statistics from POMS are not color coded and should be compared to EPA standards for reference purposes only.

In 2005, 8 of the NPS and cooperating state operated sites exceeded the 8-hour standard, as compared to 11 sites in 2004. From 2004 to 2005, 15 sites had an increase in the number of days with an exceedance of the 8-hour standard and only 3 sites had a decrease.

The map in Figure 3-1 presents the annual fourth highest 8-hour average ozone concentrations for all network sites listed in Table 3-1. Ozone values for EPA-certified sites are color-coded to represent values below (green) and above (orange and red) the national standard. Data from portable sites (no color) are included for reference only.

The map in Figure 3-2 presents the annual number of days which exceeded the 8-hour standard for all network sites listed in Table 3-1. The data points are color-coded to distinguish between sites that did not exceed NAAQS (green) and those that did (orange and red). Data from portable sites (no color) are included for reference only.

The map in Figure 3-3 presents the annual second highest 1-hour average ozone concentrations for all network sites. Ozone values for EPA-certified sites are color-coded to represent four distinct levels. Ozone values from portable sites (no color) are included for reference only.

Table 3-1. Daily maximum 8-hour average ozone concentrations (ppb).

Sites operated by the National Park Service

National Park Unit	Site Name	Valid Number of Days	1st Highest	2nd Highest	3rd Highest	4th Highest[1]	5th Highest	# Days with 8-Hour Average O3 Values >=85 ppb[1]
Badlands	Visitor Center	359	71	71	71	69	68	0
Big Bend	K-Bar Ranch Road	323	70	67	66	65	64	0
Canyonlands	Island in the Sky	318	71	71	69	68	67	0
Chiricahua	Entrance Station	346	73	73	72	72	70	0
Craters of the Moon	Visitor Center	353	52	49	48	48	48	0
Denali	Headquarters	362	54	53	51	51	50	0
Death Valley	Park Village	340	101	86	85	85	84	4
Glacier	West Glacier Horse Stables	353	61	59	59	57	56	0
Great Basin	Maintenance Yard	358	80	77	74	73	73	0
Grand Canyon	The Abyss	355	89	83	80	79	75	1
Great Smoky Mountains	Cades Cove	193	75	74	68	66	66	0
Great Smoky Mountains	Clingmans Dome	175	86	81	79	78	78	1
Great Smoky Mountains	Cove Mountain	358	88	86	83	79	79	2
Great Smoky Mountains	Look Rock	358	92	89	86	86	85	7
Joshua Tree	Black Rock	354	112	109	105	104	103	35
Lassen Volcanic	Manzanita Lake Fire Stn.	357	78	70	69	67	67	0
Mammoth Cave	Houchin Meadow	362	82	79	78	75	75	0
Mesa Verde	Resource Mngment Area	363	78	78	76	76	73	0
Mount Rainier	Tahoma Woods	291	57	53	49	47	47	0
North Cascades	Marblemount Ranger Stn.	301	58	50	50	48	48	0
Petrified Forest	South Entrance	308	82	81	72	70	70	0
Pinnacles	SW of East Entrance Stn.	363	85	76	74	71	70	1
Rocky Mountain	Long's Peak	341	84	78	75	73	73	0
Sequoia and Kings Canyon	Ash Mountain	345	112	109	108	107	105	54
Sequoia and Kings Canyon	Lower Kaweah	359	102	102	100	97	95	32
Shenandoah	Big Meadows	318	81	81	81	81	78	0
Voyageurs	Sullivan Bay	356	80	79	74	70	68	0
Yellowstone	Water Tank	348	69	62	60	60	58	0
Yosemite	Merced River	313	66	63	63	61	61	0
Yosemite	Turtleback Dome	362	96	94	86	85	85	5
Zion	Dalton's Wash	347	109	100	95	91	78	4

Sites operated by cooperating state agencies

National Park Unit	Site Name	Valid Number of Days	1st Highest	2nd Highest	3rd Highest	4th Highest[1]	5th Highest	# Days with 8-Hour Average O3 Values >=85 ppb[1]
Acadia	Cadillac Mountain	178	94	94	88	83	83	3
Acadia	McFarland Hill	357	83	74	73	71	70	0
Cape Cod	Cape Cod	178	95	94	88	88	88	7
Chamizal	Chamizal	342	78	77	71	69	67	0
Congaree	Congaree Bluff	318	81	78	78	74	74	0
Cowpens	State Monitor	355	82	80	79	78	77	0
Great Smoky Mountains	Purchase Knob	203	82	82	82	82	82	0
Saguaro	Pima County	364	87	82	80	79	79	1
Theodore Roosevelt	Painted Cany. VC	343	62	61	60	59	59	0
Wind Cave	Visitor Center	362	77	71	71	70	69	0

-- continued --

Table 3-1 (continued). Daily maximum 8-hour average ozone concentrations (ppb).

Nearby sites operated by other agencies

National Park Unit	Site Name	Valid Number of Days	1st Highest	2nd Highest	3rd Highest	4th Highest[1]	5th Highest	# Days with 8-Hour Average O3 Values >=85 ppb[1]
Alabama-Coushatta	CASTNet site	308	75	74	73	72	72	0
Appalachian Trail	Mount Greylock Summit	155	91	89	87	87	87	6
Blue Ridge Parkway	7510 Blue Ridge Parkway	210	83	79	78	74	73	0
Blue Ridge Parkway	Blue Ridge Parkway	202	85	84	84	80	80	1
Blue Ridge Parkway	Vinton Elementary	211	79	78	77	76	75	0
Blue Ridge Parkway	Frying Pan Mountain	204	84	84	82	82	80	0
Blue Ridge Parkway	Route 191	213	85	82	80	79	78	1
Blue Ridge Parkway	Ranger Station	213	76	75	74	74	73	0
Boston Harbor Islands	Former Nike Missle Site	179	95	91	89	86	85	5
Cuyahoga Valley	800 Patterson	213	96	89	89	89	87	7
Everglades	Cutler Road	338	70	69	67	67	66	0
George Washington Pkwy	Alexandria Health	206	89	86	81	81	80	2
Guilford Courthouse	Mendenhall Middle School	196	94	88	85	82	81	3
Indiana Dunes	Gas Station	179	97	93	91	84	81	3
Indiana Dunes	Ammunition Bunker	175	101	100	90	89	89	7
Indiana Dunes	Water Treatment Plant	180	109	98	91	90	89	7
Mississippi	Anoka County Airport	330	79	73	73	70	70	0
Mississippi	Somerset Town Hall	252	86	77	75	71	69	1
Mississippi	Washington County	177	81	74	73	72	72	0
Olympic	Blyn Lookout Relay	104	62	62	54	53	51	0
Petroglyph	Westside Taylor Ranch	357	81	77	77	73	72	0
Rock Creek	Achbold Parkway	356	87	84	82	77	77	1
Saugus Iron Works	Lynn Water Treatment	359	99	96	94	88	86	6
Saratoga	Stillwater	298	94	92	92	84	79	3

-- continued --

Table 3-1 (continued). Daily maximum 8-hour average ozone concentrations (ppb).

Long-term portable ozone monitoring systems[2]

National Park Unit	Site Name	Valid Number of Days	1st Highest	2nd Highest	3rd Highest	4th Highest[1]	5th Highest	# Days with 8-Hour Average O3 Values >=85 ppb[1]
Assateague Island	Maintenance Area	100	92	74	72	72	71	1
Big South Fork	Taft Story Fields	152	68	68	66	66	66	0
Black Canyon of the Gunnison	Gravel Pit	149	69	69	68	68	67	0
Dinosaur	West Entrance Housing	161	73	72	68	67	67	0
Gulf Islands	Fort Pickens Entrance Stn.	114	82	77	76	74	73	0
Lake Mead	Meadview	188	123	101	85	84	83	3
Mammoth Cave	Biogarden	158	69	66	66	65	63	0
Mount Rainier	Tahoma Vista	152	71	67	67	65	64	0
Olympic	Hurricane Ridge Portable	122	57	55	53	51	50	0
Padre Island	Malaquite Visitor Center	130	83	73	73	71	67	0
Yosemite	Tioga Pass	63	64	59	58	56	56	0

Short-term portable ozone monitoring systems[2]

National Park Unit	Site Name	Valid Number of Days	1st Highest	2nd Highest	3rd Highest	4th Highest[1]	5th Highest	# Days with 8-Hour Average O3 Values >=85 ppb[1]
Abraham Lincoln Birthplace	Knob Creek High	20	59	57	53	50	47	0
Carl Sandburg	Granite Dome 14	19	61	54	48	44	41	0
Chickamanga/Chatanooga	Maintenance Area Field	20	69	69	64	61	59	0
Cumberland Gap	Pinnacles	38	75	67	56	56	55	0
Fort Donelson	Visitor Center	20	49	44	44	42	39	0
Kings Mountain	Resevoir Hill	26	74	72	65	64	64	0
Lincoln Memorial University	University Field	20	72	69	64	60	59	0
Mammoth Cave	Great Onyx Meadow Portable	41	45	44	40	36	35	0
Mammoth Cave	Great Onyx Job Corps	41	67	59	59	55	50	0
Ninety Six Historical Park	Bumble Bee Hill	20	63	60	45	44	42	0
Shiloh	Russian Tenant Field	19	63	60	59	58	55	0
Stones River	Chicago Bottom Field	20	62	50	48	46	44	0

1. The primary and secondary National Ambient Air Quality Standard for ozone is 0.08 ppm over an 8-hour period. (An exceedance of the standard occurs when an 8-hour average ozone concentration is greater than or equal to 85 ppb. A violation of the standard occurs when the 3-year average of the fourth highest daily maximum 8-hour average ozone concentration equals or exceeds 85 ppb.) Exceedances of the standard are highlighted here in orange or red.

Note: The color coding break points follow the color categories used on the EPA's AIRNOW Web Site (www.airnow.gov).

Color shading key:

4th highest 8-hr. avg.

= 85 - 104 ppb ozone concentration

>105 ppb ozone concentration

days with 8-hr. avg. >= 85 ppb

= 4 - 10 days

>10days

2. The GPMP Portable Ozone Monitoring Systems (POMS) do not meet EPA standards for regulatory monitoring. However, ozone summary statistics from portable systems can be compared to EPA standards for reference purposes.

italics = site operated by other agencies

underline = National Park Service operated portable ozone system (POMS)

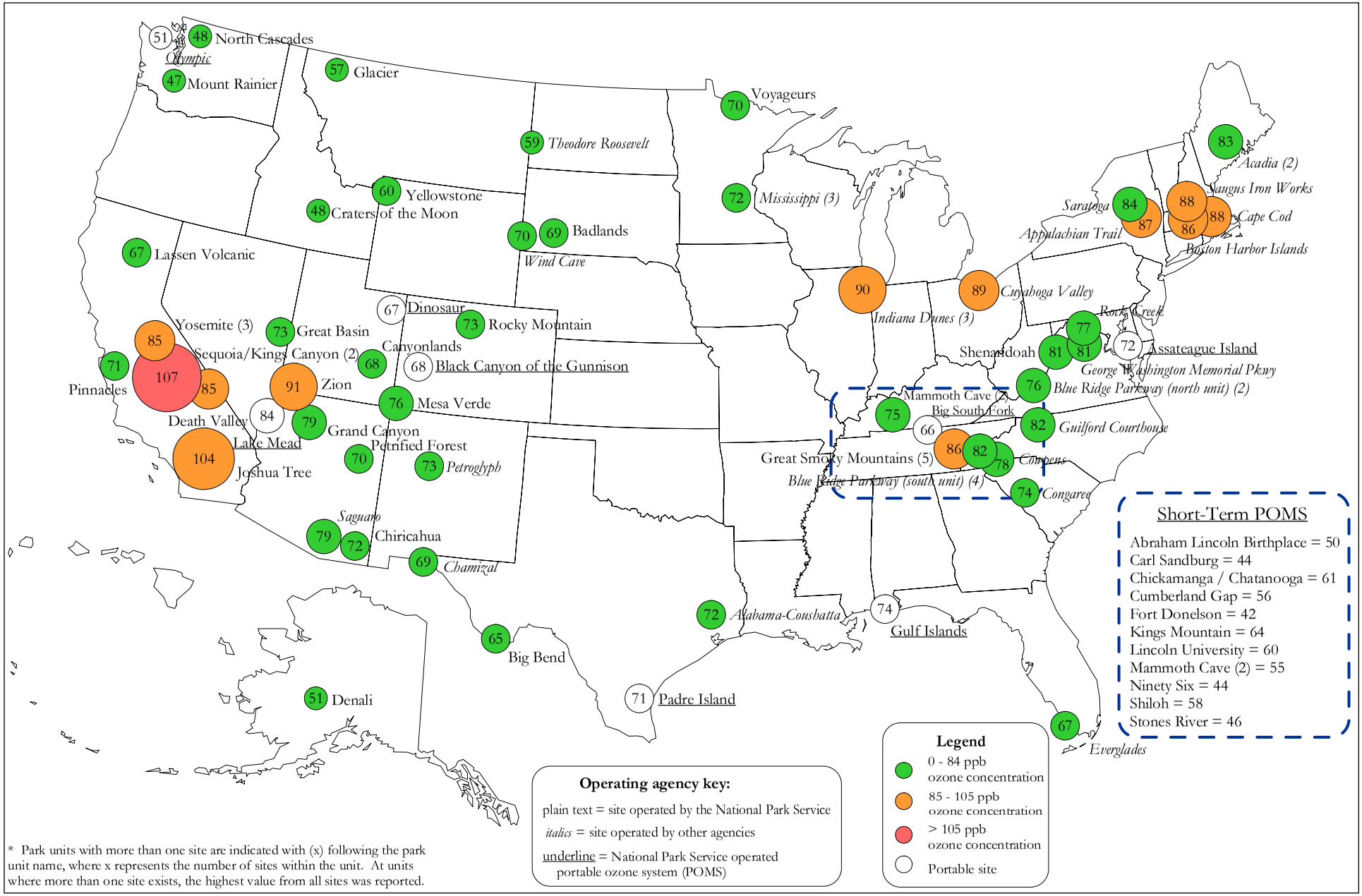


Figure 3-1. Annual fourth highest daily maximum 8-hour average ozone concentrations (in ppb).

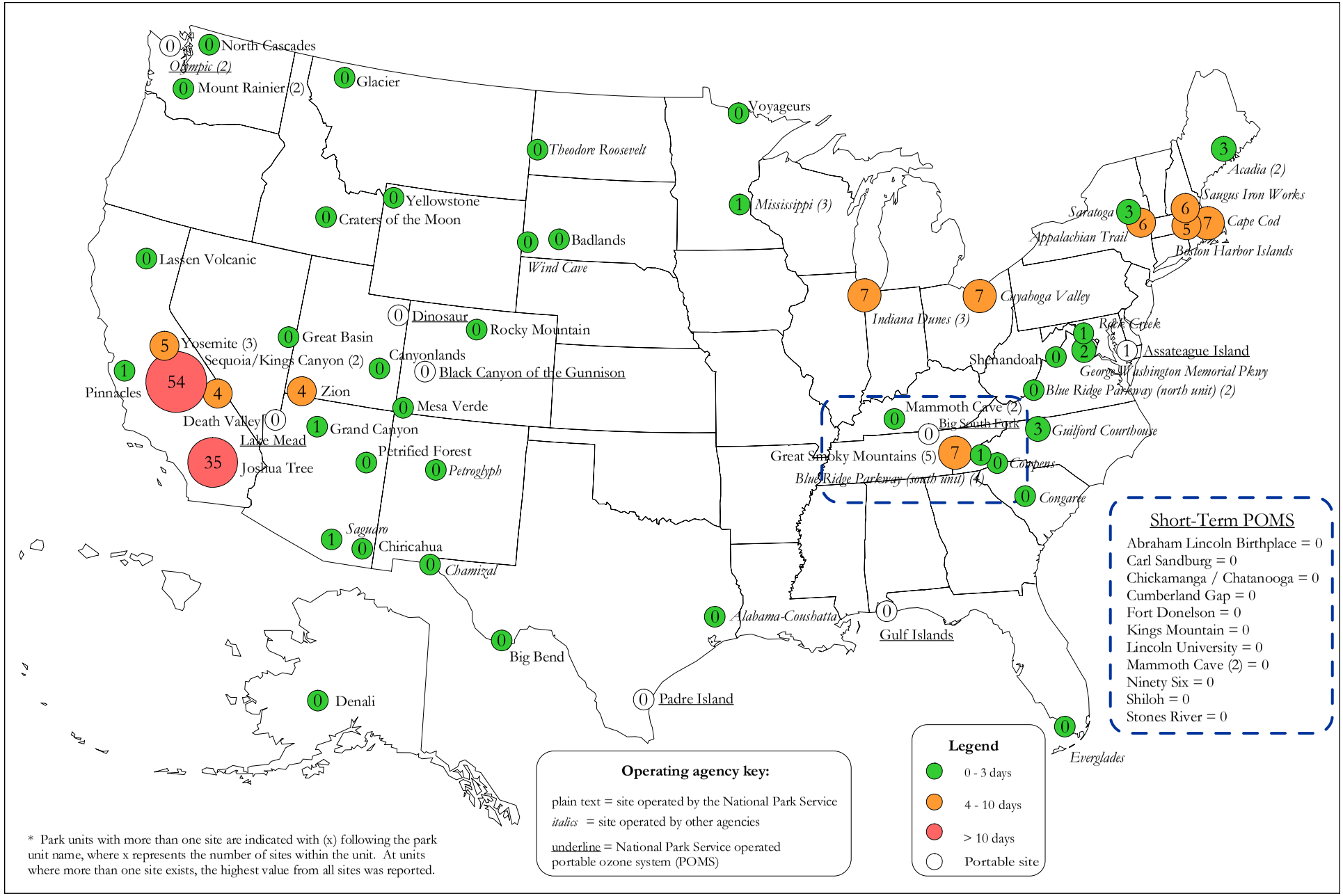


Figure 3-2. Annual number of days with daily maximum 8-hour average ozone values ≥ 85 ppb.

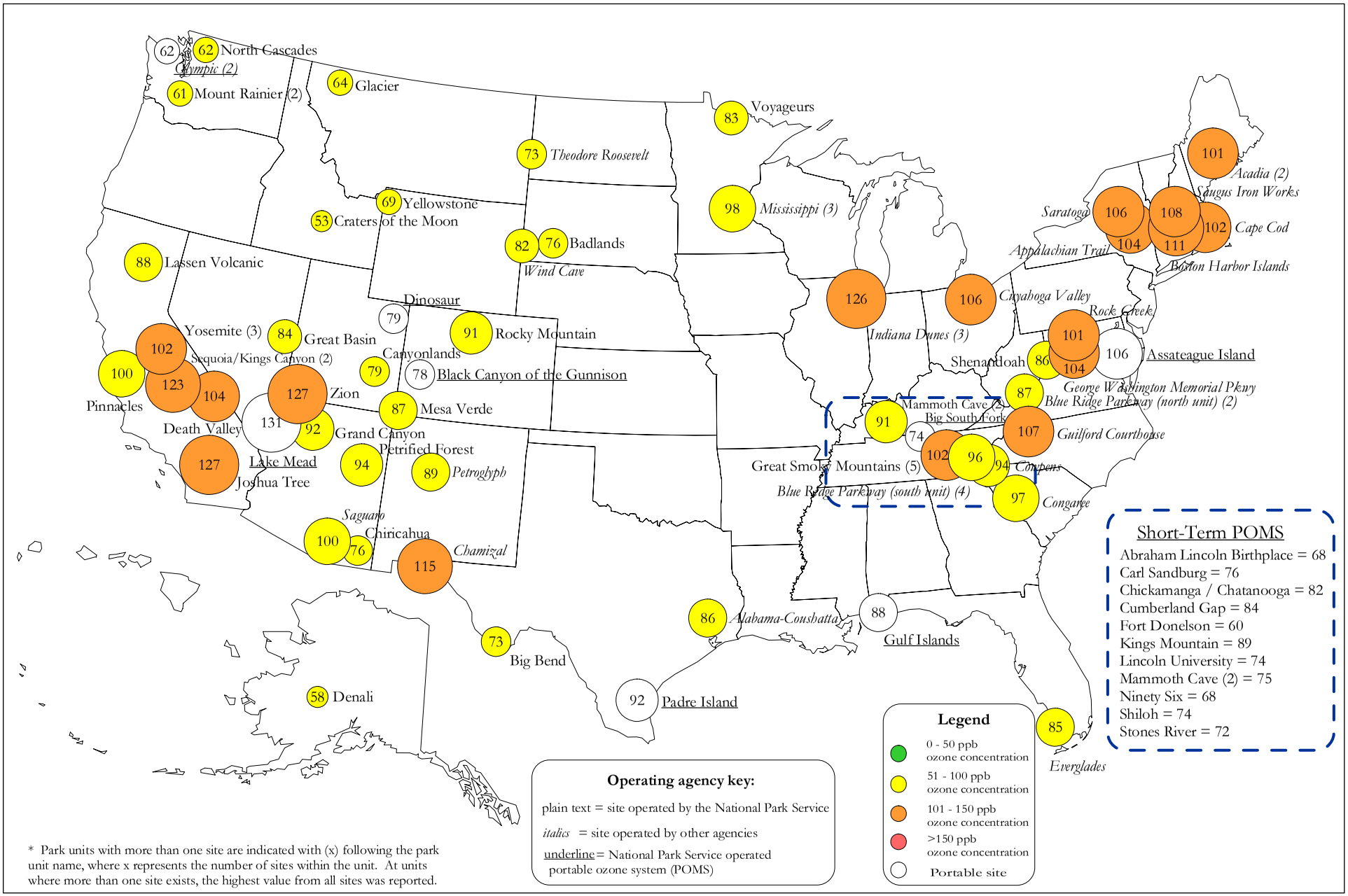
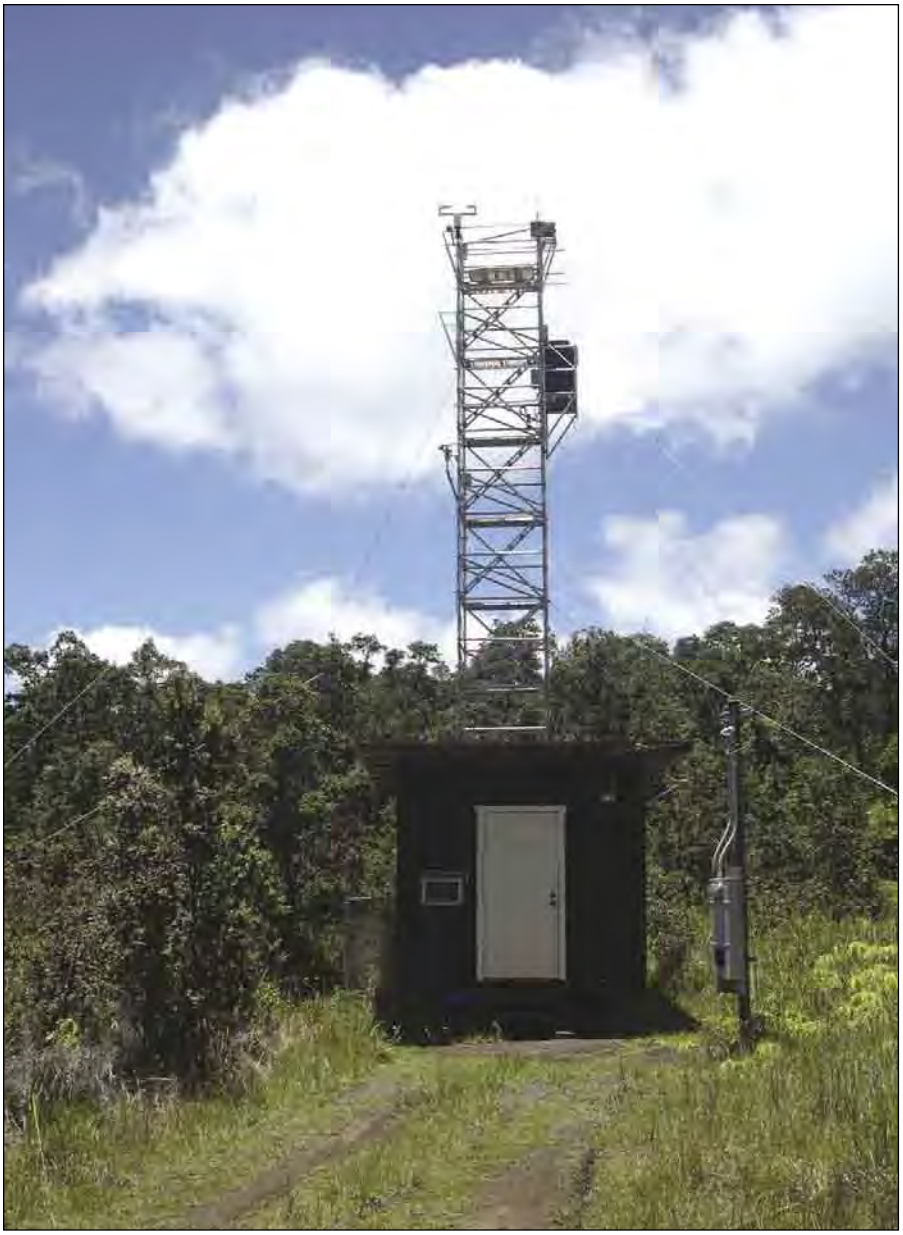


Figure 3-3. Annual second highest 1-hour average ozone concentrations (in ppb).



Hawaii Volcanoes NP - Observatory Ambient Air Quality Monitoring Station

3.1.2 Ozone Violation Summaries - Table 3-2 presents ozone violation summaries for NPS-operated and cooperating sites for all 3-year periods over the last 10 years, with violations indicated in orange and red. For sites operating independently of the NPS, only the 2003-2005 violation summary is presented. A violation of the standard occurs when the 3-year average of the fourth highest daily maximum 8-hour average ozone concentration equals or exceeds 85 ppb. Table values in parentheses indicate that the EPA data completeness requirement for the 3-year period was not met. However, annual fourth highest daily maximum 8-hour ozone concentrations greater than or equal to 85 ppb for calendar years not meeting the EPA data completeness requirement are included in the NAAQS violation computation.

In 2005, 6 of the NPS and cooperating state-operated sites within 5 national park units were in violation of the NAAQS 8-hour standard, whereas in 2004, 10 sites within 6 units violated the standard. Only 1 site that operated independently of the NPS recorded a violation in 2005.

Figure 3-4 presents a ranked list of sites based on the 2003 – 2005 ozone violation summary data presented in the first column of Table 3-2. Only the 40 highest ranked sites are presented in this figure.

Table 3-2. Three-year running average ozone violation summary - primary standard.

Sites operated by the National Park Service

National Park Unit	Site Name	2003 - 2005	2002 - 2004	2001 - 2003	2000 - 2002	1999 - 2001	1998 - 2000	1997 - 1999	1996 - 1998
Badlands	Visitor Center	(66)	(64)	(67)	—	—	—	—	—
Big Bend	K-Bar Ranch Road	63	62	62	(62)	(63)	66	65	68
Canyonlands	Island in the Sky	71	72	70	(71)	(71)	73	70	70
Chiricahua	Entrance Station	71	70	69	69	70	70	68	68
Craters of the Moon	Visitor Center	60	67	(65)	(63)	(63)	66	(64)	(63)
Denali	Headquarters	52	53	54	49	49	48	53	52
Death Valley	Park Village	81	80	81	81	79	80	79	79
Glacier	West Glacier Horse Stables	56	55	53	49	48	51	47	50
Great Basin	Maintenance Yard	72	72	70	72	72	73	72	72
Grand Canyon	The Abyss	74	74	74	73	72	73	73	72
Great Smoky Mountains	Cades Cove	(67)	73	76	79	81	(85)	(83)	79
Great Smoky Mountains	Clingmans Dome	(79)	(87)	(92)	(98)	(98)	(102)	(98)	(94)
Great Smoky Mountains	Cove Mountain	78	86	92	96	96	101	(100)	97
Great Smoky Mountains	Look Rock	86	91	92	94	96	104	104	98
Joshua Tree	Black Rock	105	106	99	94	92	102	109	112
Lassen Volcanic	Manzanita Lake Fire Stn.	68	71	72	74	77	78	76	72
Mammoth Cave	Houchin Meadow	73	77	80	84	88	94	(92)	(89)
Mesa Verde	Resource Mngment Area	70	68	67	69	69	70	(66)	(67)
Mount Rainier	Tahoma Woods	(61)	63	61	56	60	57	51	52
North Cascades	Marblemount Ranger Stn.	(51)	51	50	46	48	46	43	(43)
Petrified Forest	South Entrance	(71)	(66)	(64)	(55)	—	—	—	—
Pinnacles	SW of East Entrance Stn.	75	80	81	81	(79)	(82)	82	86
Rocky Mountain	Long's Peak	77	82	81	78	74	77	74	74
Sequoia and Kings Canyon	Ash Mountain	(105)	(105)	(107)	(105)	(104)	(105)	(105)	—
Sequoia and Kings Canyon	Lower Kaweah	97	101	101	98	(94)	(93)	(96)	98
Shenandoah	Big Meadows	(80)	82	87	85	87	93	96	92
Voyageurs	Sullivan Bay	66	64	65	(64)	67	68	70	(66)
Yellowstone	Water Tank	61	63	65	65	67	67	65	(62)
Yosemite	Merced River	(63)	(67)	(66)	(72)	—	—	—	—
Yosemite	Turtleback Dome	88	90	90	89	86	88	86	88
Zion	Dalton's Wash	(82)	(74)	—	—	—	—	—	—
# Park Units with Violations:		**4**	**4**	**5**	**5**	**6**	**6**	**6**	**7**
# Sites with Violations:		**5**	**7**	**8**	**8**	**9**	**10**	**9**	**9**

-- continued --

Table 3-2 (continued). Three-year running average ozone violation summary - primary standard.

Sites operated by cooperating state agencies

National Park Unit	Site Name	2003 - 2005	2002 - 2004	2001 - 2003	2000 - 2002	1999 - 2001	1998 - 2000	1997 - 1999	1996 - 1998
Acadia	Cadillac Mountain	82	88	94	93	89	87	(89)	(87)
Acadia	McFarland Hill	74	80	87	84	85	83	(90)	(88)
Cape Cod	Cape Cod	86	88	95	93	96	89	(95)	(93)
Chamizal	Chamizal	72	78	79	81	75	(79)	(76)	(79)
Congaree	Congaree Bluff	71	74	77	77	(74)	(73)	—	—
Cowpens	State Monitor	75	80	84	87	87	92	93	89
Great Smoky Mountains	Purchase Knob	78	82	86	88	87	90	90	(85)
Saguaro	Pima County	(76)	(75)	(76)	(54)	(33)	(33)	(33)	(33)
Theodore Roosevelt	Painted Cany. VC	59	60	61	59	58	(57)	(56)	(54)
Wind Cave	Visitor Center	(70)	—	—	—	—	—	—	—
# Park Units with Violations:		**1**	**2**	**3**	**4**	**4**	**4**	**4**	**4**
# Sites with Violations:		**1**	**2**	**4**	**4**	**5**	**4**	**5**	**5**

-- continued --

Table 3-2 (continued). Three-year running average ozone violation summary - primary standard.

Nearby sites operated by other agencies

National Park Unit	Site Name	2003 - 2005
Alabama-Coushatta	CASTNet site	(72)
Appalachian Trail	Mount Greylock Summit	(80)
Blue Ridge Parkway	7510 Blue Ridge Parkway	71
Blue Ridge Parkway	Blue Ridge Parkway	76
Blue Ridge Parkway	Vinton Elementary	74
Blue Ridge Parkway	Frying Pan Mountain	78
Blue Ridge Parkway	Route 191	74
Blue Ridge Parkway	Ranger Station	71
Boston Harbor Islands	Former Nike Missle Site	81
Cuyahoga Valley	800 Patterson	85
Everglades	Cutler Road	66
George Washington Pkwy	Alexandria Health	81
Guilford Courthouse	Mendenhall Middle School	(82)
Indiana Dunes	Gas Station	78
Indiana Dunes	Ammunition Bunker	76
Indiana Dunes	Water Treatment Plant	78
Mississippi	Anoka County Airport	68
Mississippi	Somerset Town Hall	(69)
Mississippi	Washington County	(68)
Olympic	Blyn Lookout Relay	(53)
Petroglyph	Westside Taylor Ranch	72
Rock Creek	Achbold Parkway	78
Saugus Iron Works	Lynn Water Treatment	83
Saratoga	Stillwater	82
# Park Units with Violations:		**1**
# Sites with Violations:		**1**

1. The primary and secondary National Ambient Air Quality Standard for ozone is 0.08 ppm over an 8-hour period. (An exceedance of the standard occurs when an 8-hour average ozone concentration is greater than or equal to 85 ppb. A violation of the standard occurs when the 3-year average of the fourth highest daily maximum 8-hour average ozone concentration equals or exceeds 85 ppb.) Violations of the standard are highlighted here in orange and red.

Color shading key:

4th highest 8-hr. avg.

= 85 - 104 ppb ozone concentration

>=105 ppb ozone concentration

( ) Note: A number in parenthesis () indicates that data completeness was not met. 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.

italics = site operated by other agencies

underline = National Park Service operated portable ozone system (POMS)

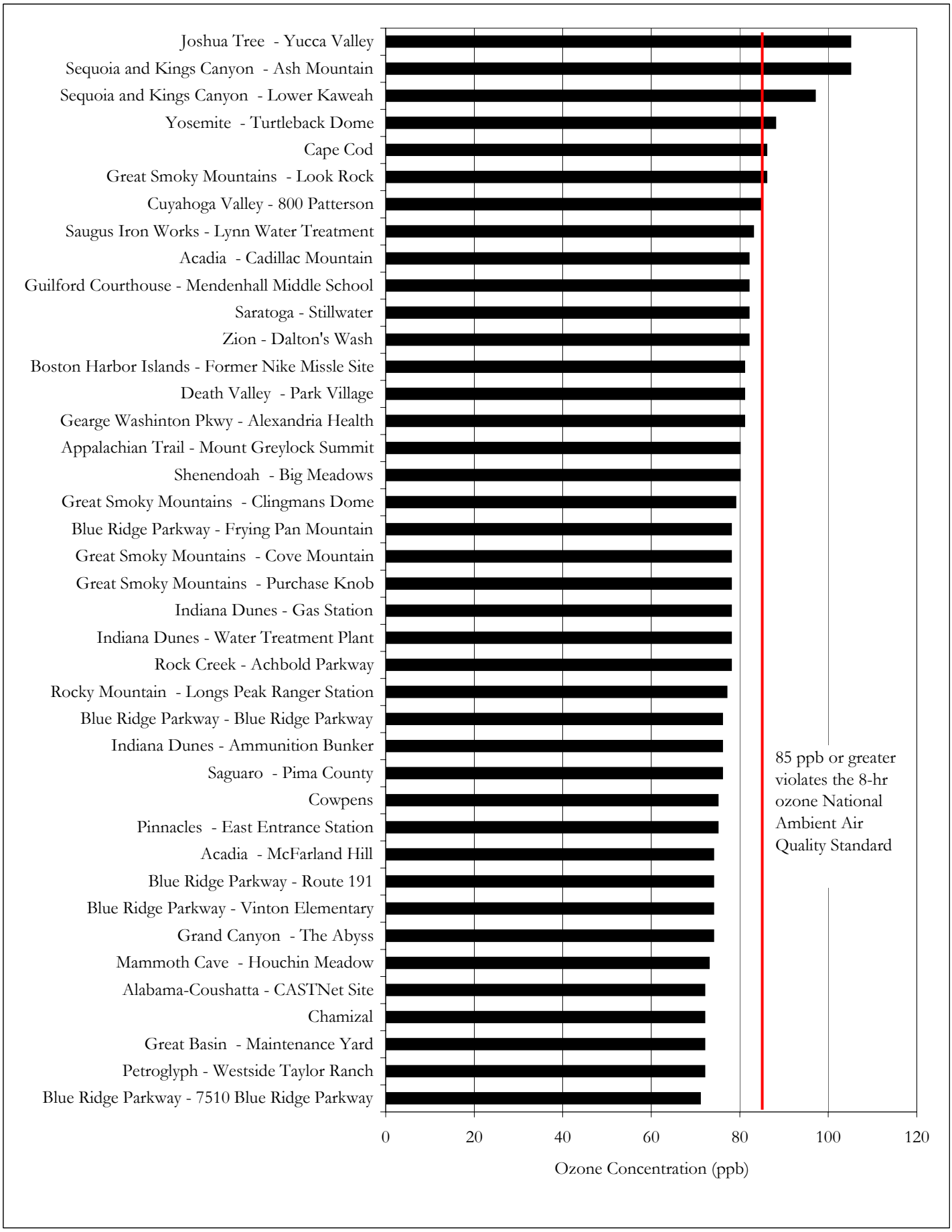


Figure 3-4. Three-year running average ozone violation summary ranking (highest 40 sites), 2003-2005.

The Theil technique does not assume the data is normally distributed and is less sensitive to outlier points than least squares regression. The trend is calculated by finding the slope between all possible pairs of points, and then finding the median of all slopes. The significance of the Theil slope is found by assuming the true slope is zero, then calculating the probability that the estimated slope occurred by chance. No model is assumed in this technique and there is little future prediction ability.

Linear regression - The statistical method of least squares regression can be used to get a linear regression line for a trend. The method assumes the data are independent and normally distributed. For air pollutants this is often not the case. The persistence of pollutants means they are likely to be autocorrelated. Since ozone and its precursors have lifetimes less than a year, the annual values are less likely to be correlated. More important to the trend discussion is whether a linear model is the right model and if the data really reflect multi-variant relationships. The period of the regression can have a strong influence on the trend result.

3.1.3 Long-Term Ozone Trends - The determination of ozone trends is an important objective of the monitoring network, but there is no universally accepted definition of trend. Different types of trend analyses provide unique and useful information. Ideally we would be able to relate the changes in ozone to factors that control its concentration, such as precursor emissions, climate changes, changing transport patterns, global transport, and short-term events like wildfires. In practice, making these connections is very difficult.

Some possible uses for the trends information and the techniques that might be used are:

Information use	Trend techniques to use
• Policy and performance metric	GPRA version of Theil analysis
• Determination and prediction of attainment status	Time series plots, linear regression analysis
• Assessment of control strategy effectiveness	Spatial trends, linear regression on selected periods, non-parametric methods
• Prediction of potential harmful effects to resources or visitors	Spatial and climatic pollutant plots

GPRA = Government Performance and Results Act

This section provides some of this trend information, but leaves the connection to performance, control strategies, and resource changes to other, more thorough analysis documents.

3.1.3.1 Application of Theil and Regression Techniques - Two significant factors that influence trends are the pollutant emission rates, which are constantly changing, and the annual climate variations which can dominate ozone production and transport factors. In this section, several ways of looking at trends are examined, the most recent results are presented, and some factors that effect ozone trends are explored.

Air quality trends in the parks, including ozone trends, have been reported for several years as part of the annual Government Performance and Results Act (GPRA) report (*http://www2.nature.nps.gov/air/pubs/pdf/gpra/Gpra2005_Report_03202006_Final.pdf*). A non-parametric statistical technique, the Theil method, has been used to estimate GPRA trends over a moving 10-year period. (Only recent changes were considered relevant as a performance measure.) The resulting trend information is then simplified to three categories of increasing, no change, or decreasing for purposes of counting results.

A second, commonly used trend technique is linear regression. These results are generally presented as a plot of the annual values over time with the regression line overlaid. The public may have an expectation that air pollution has a consistent geometric progression, but it can be quite variable from year to year. Relating factors that affect ozone concentrations, like control strategies or climate, to changes in trend can only be done if those changes can be recognized.

In Figures 3-5 and 3-6, ozone linear regression trends for the period of record and GPRA-Theil trends over the last 10 years are compared for selected park units in the Eastern and Western United States. The symbols on the center map are the GPRA-Theil trends. Increasing and decreasing Theil trends are indicated by upward and downward arrows, and insignificant trends are indicated by a square. Around the map are plots of the annual fourth highest daily maximum 8-hour ozone from 1987 to 2005, with linear regression slopes indicated, again by upward, downward, and sideways arrows indicating increasing, decreasing, and insignificant trends. Most of the NPS eastern monitoring sites show a decrease in ozone from about 1999 to present. Shenandoah, Mammoth Cave, Great Smoky Mountains, and Cowpens have strong decreases over the last 5-6 years (highlighted with dark green ellipses). Notice the effect of picking different time periods to consider for the trends. The GPRA-Theil analysis used for policy and performance uses a sliding 10-year average (highlight by the light-green dotted boxes). The four park units with the latest strong decrease in ozone had increasing ozone in the 1990s until about 1999-2000. The result over the last 10 years is therefore No Change.

The regression analysis uses all the data available since monitoring started at the monitoring locations (17-19 years). The trend "window" is important to the result and much of the difference between the two methods is due to the period considered.

Both of the methods used to determine a trend are correct, but the context is important. Only Cape Cod and perhaps Acadia (McFarland Hill) have shown a real overall decrease in ozone over their monitoring periods to the present. Ozone concentrations went from initially above the standard to being close to the standard in 2005. All the other sites show variability during the period of record that makes it much harder to determine if a long-term trend is present. At four of the eastern parks in Figure 3-5, the decreasing ozone in the last 6-7 years (dark-green dashed-line ellipses) is thought to reflect decreasing nitrogen oxides (NO_x) emissions by point sources in the eastern U.S. (see the 2004 Annual Data Summary Report for a discussion). The trends plots presented in Figures 3-5 and 3-6 give several pieces of relevant information: 1) if the ozone is above the standard, 2) if the measured ozone is moving away (up or down) from the standard, and 3) the slope or how fast the change is relative to the standard. From that perspective, Great Smoky Mountains and Cape Cod are a concern and only Cape Cod has shown long-term progress towards decreasing to below the standard. Acadia has progressed to below the standard for ozone, but progress seems to have stalled since 1994. The four parks with recent downward trends (dark-green ellipses) are all headed below the standard, but overall haven't changed much since the late 1980s.

The western parks present a somewhat different picture (see Figure 3-6). The GPRA-Theil analysis and the regression trend are more in agreement in the west where the year-to-year variability seems to be lower. The center part of the western map is dominated by increasing ozone trends. The western parks are more likely to have ozone below the standard than the eastern parks. Only Sequoia, Yosemite, Joshua Tree, and Death Valley violate the standard. The changes in ozone over the last 10-18 years of observations are in the 5-10 ppb range. Rocky Mountain is approaching the standard and has an upward trend. In general, monitoring locations more distant from emission sources and areas of ozone formation tend not to have the variability seen at the eastern monitoring sites. For example, Sequoia, Pinnacles (not shown), and Joshua Tree (not shown) parks have wider swings in ozone concentrations because of their downwind proximity to polluted urban areas.

Acadia NP Air Quality Monitoring Station

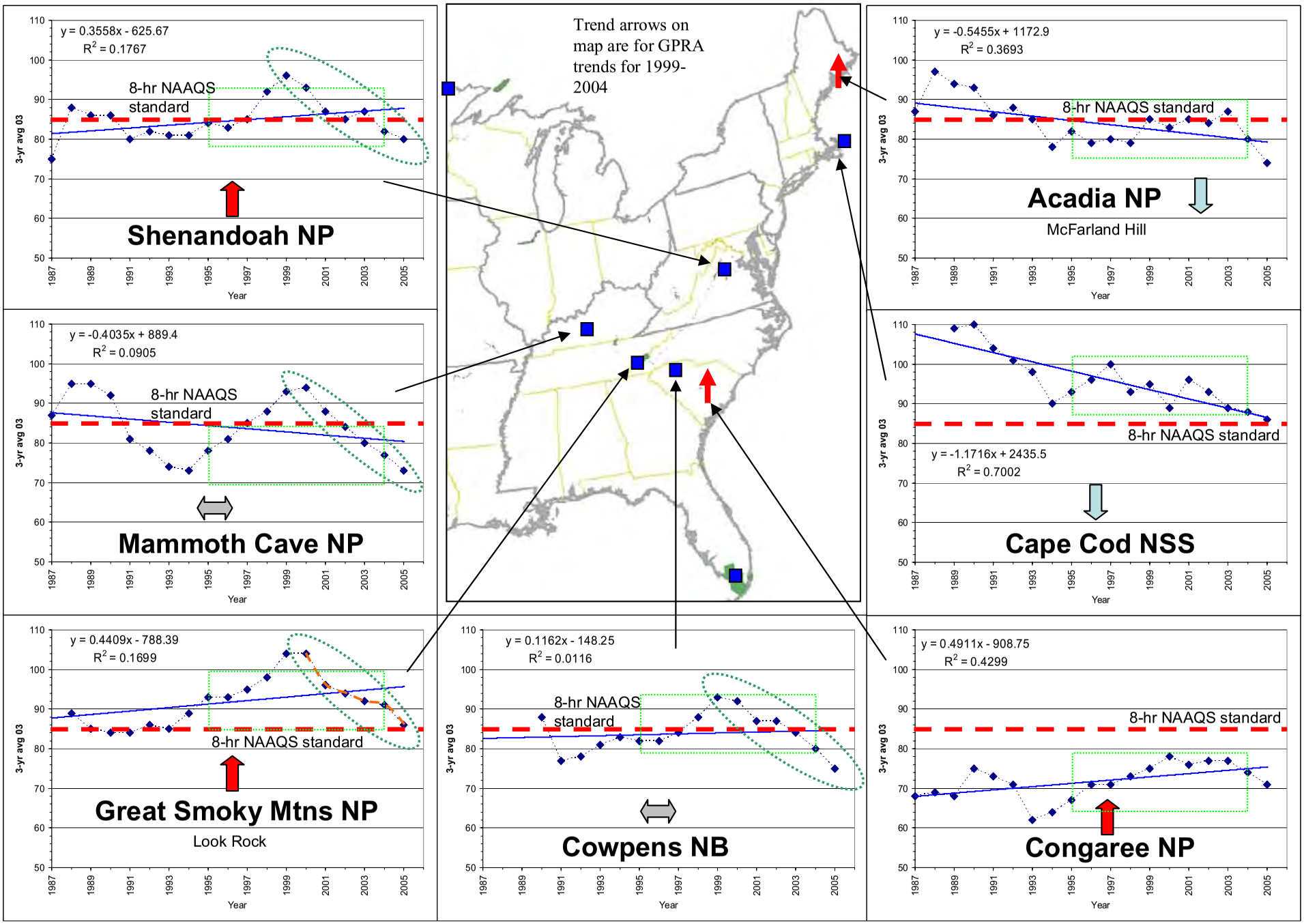


Figure 3-5. Ozone linear regression trends in eastern parks for the period of record.

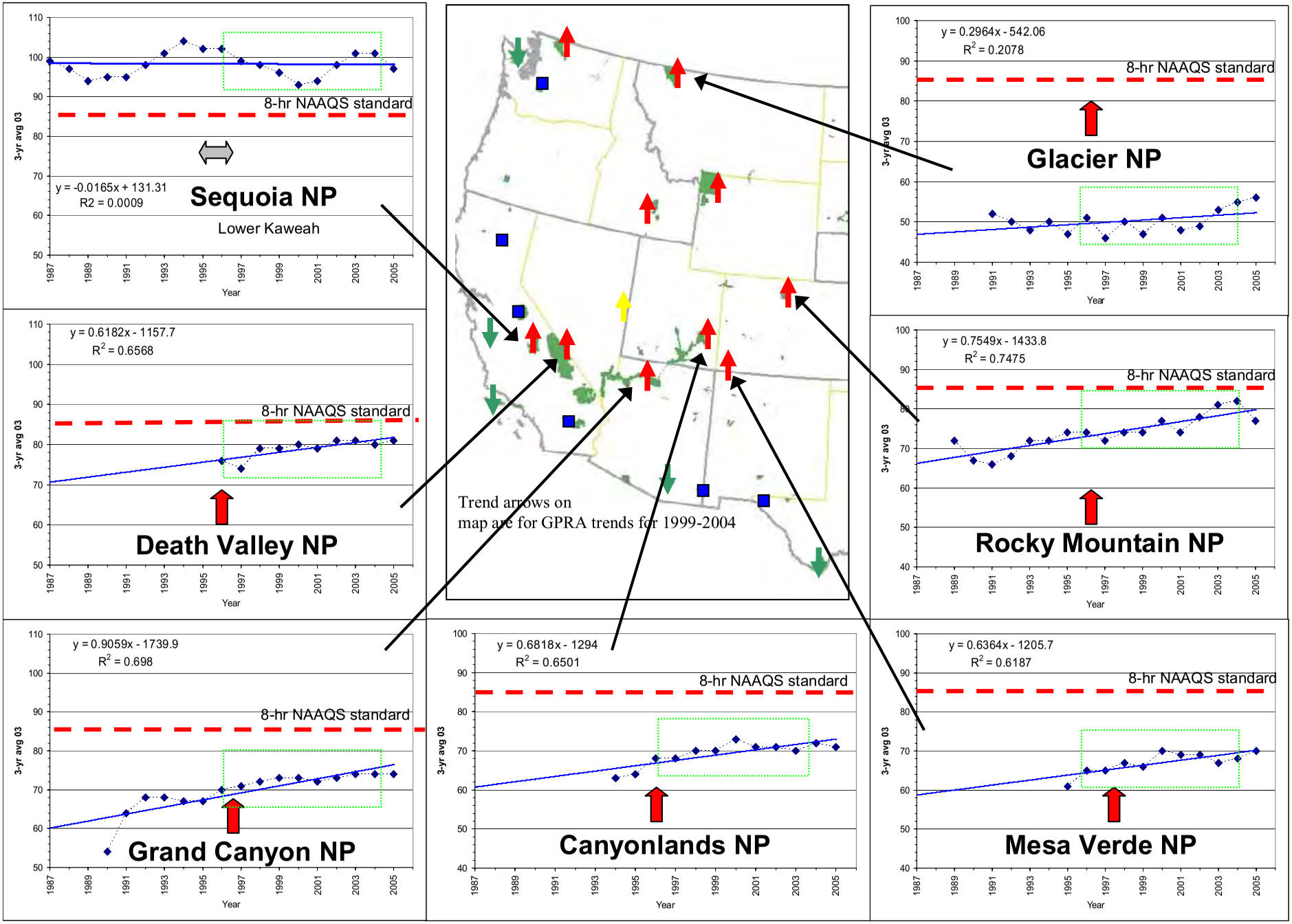


Figure 3-6. GPRA-Theil trends in western parks over the last 10 years (1995-2005).

3.1.3.2 Ozone Trends Compared to a Reference Year - The EPA in its ozone trends reports often uses a reference year (1990) for comparisons with more recent measurements. For the parks where the NPS has direct monitoring data, the change in the ozone between 1990 and selected years can be a trend indicator. Three time periods of 15, 10, and 5 years were chosen and the 3-year average statistic used to determine violations of the ozone NAAQS standard were selected to avoid some of the natural year-to-year variations. Table 3-3 shows the 3-year ozone averages (in ppb) and the changes over 15, 10, and 5 years.

Table 3-3. Changes in ozone at national parks over different time periods.

		3-yr avg 4th high daily max 8-hr avg O3 (ppb) **				O3 change over period (ppb)		
						15 yrs	10 yrs	5 yrs
Park Name	Years of data	1990	1995	2000	2005	1990 to 2005	1995 to 2005	2000 to 2005
Acadia - Cadillac Mtn	9			87	82			-5
Acadia - McFarland Hill	21	93	82	83	74	-19	-8	-9
Badlands	2				60			
Big Bend	13		65	66	63		-2	-3
Cape Cod	17	110	93	89	86	-24	-7	-3
Canyonlands	12		64	73	71		7	-2
Chamizal	12		72	79	72		0	-7
Chiricahua	15		69	70	71		2	1
Channel Islands	12	64		66		4		
Congaree Swamp	23	75	67	78	71		4	-7
Cowpens	16	88	82	92	75	-13	-7	-17
Craters of the Moon	12		58	66	60		2	-6
Denali	17	49	50	48	52	3	2	4
Death Valley	10			80	81			1
Everglades	17	65	62	68		-3	0	
Glacier	15		47	51	56		9	5
Great Basin	11		62	73	72		10	-1
Grand Canyon	16		67	73	74		7	1
Great Smoky Mountains - Cades Cove	10			85	67			-18
Great Smoky Mountains - Clingmans Dome	11		79	102	79		0	-23
Great Smoky Mountains - Cove Mtn	16	84	90	101	78	-6	-12	-23
Great Smoky Mountains - Look Rock	19	84	93	104	86	2	-7	-18
Great Smoky Mountains - Purchase Knob	2				78			
Hawaii Volcanoes	4							
Joshua Tree	17	98	102	102	105		3	3
Lava Beds	16	73	72	78	68	-5	-4	-10
Mammoth Cave	19	92	78	94	73			-21
Mesa Verde	11		61	70	70		9	0
Mount Rainier	11		62	57	61		-1	4
North Cascades	8			46	51			5
Olympic	15	45	42	43		-5	-2	
Petrified Forest	7	68			71	3		
Pinnacles	17	83	81	82	75	-8	-6	-7
Rocky Mountain	17	67	74	77	77	10	3	0
Saguaro	22	74	81	73	76	2	-5	3
Sequoia-Kings Canyon - Ash Mtn	5				105			
Sequoia-Kings Canyon - Lower Kaweah	20	95	102	93	97	2	-5	4
Sequoia-Kings Canyon - Lookout Point	8			102				
Shenandoah	21	86	84	93	80	-6	-4	-13
Theodore-Roosevelt	21	64	56	57	59	-5	3	2
Virgin Islands	4			45				
Voyageurs	17	57	62	68	66		4	-2
Yellowstone	17	61	58	67	61	0	3	-6
Yosemite - Merced River	2				63			
Yosemite - Turtleback Dome	13		92	88	88		-4	0

** Light and dark orange indicates ozone in violation of the NAAQS standard.

Note: For parks where monitoring ended, the 2004 data is used in place of 2005 data. Change is not calculated for sites that moved during the period.

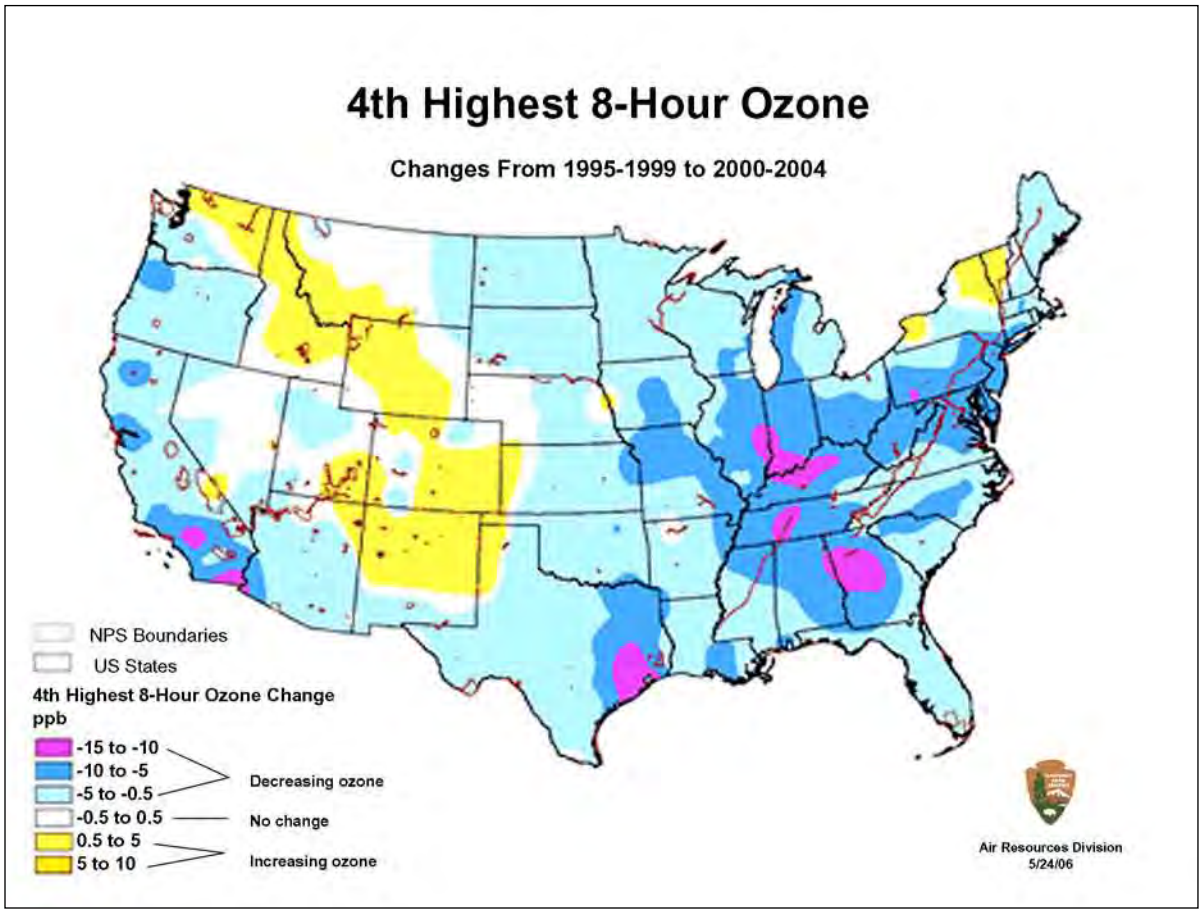
Legend:		
O3 change	Coding	Description
> +10		**Degrading (increasing O3)**
+4 to +9		Degrading
-4 to +4		**No change**
-4 to -9		Improving
< -10		**Improving (decreasing O3)**

The 15-year period is a good check to determine if air quality has changed since the GPMP network started monitoring and is representative of "long-term" progress. From the table, Rocky Mountain National Park has degrading ozone over the last 15 years and Great Basin has degrading ozone over the last 10 years. In the East, some improvements in ozone have occurred over the 15 years at several park units: Acadia, Cape Cod, Mammoth Cave, and Cowpens. Five parks have had large decreases in ozone in the last five years. Only Glacier and North Cascades have had minor increases in ozone in recent years. The results from this approach show improving ozone trends in the East and a few parks in the West with degrading trend indicators. There are more parks with improving than degrading ozone trends in the last five-year period.

3.1.3.3 Spatial Ozone Changes Over 10 Years - To this point the focus has been on ozone trends in park units, however, most parks do not have direct monitoring and the parks must be considered in the context of the changing regional air pollution. The Air Atlas project (see ozone maps at *http://www2.nature.nps.gov/air/Maps/AirAtlas/index.cfm*) gives a better sense of the spatial changes in ozone by using the change in two five-year averages. Figure 3-7 shows the difference in ozone from two 5-year periods: 1995-1999 and 2000-2004. The outlook for much of the U.S. is promising. The eastern U.S. and the west coast states show decreasing ozone. Most of the western U.S. is unchanged or slightly increasing; for example, the areas in Colorado, New Mexico, and Arizona (yellow areas on the map) have higher ozone concentrations over the 10-year period. This method ignores any changes shorter than five years and doesn't go back as far into the past. It does give a better geographical sense of ozone differences and gives estimates for all parks, not just the ones with monitors.

A trend analysis was made by the Air Resources Division to create an air quality scorecard for all the park units. An ozone change map was used, as above, but with one less year in the analysis. When the differences are reduced to just two trend categories, improving/no change or degrading, then the trend looks like the map in Figure 3-8. Only the Intermountain West area and the far Northeast stand out as degrading ozone concentrations in park units. Most of the park units with degrading trends in this analysis are in areas that are currently below the ozone standard.

Figure 3-7. Difference in ozone from two 5-year periods: 1995-1999 and 2000-2004.



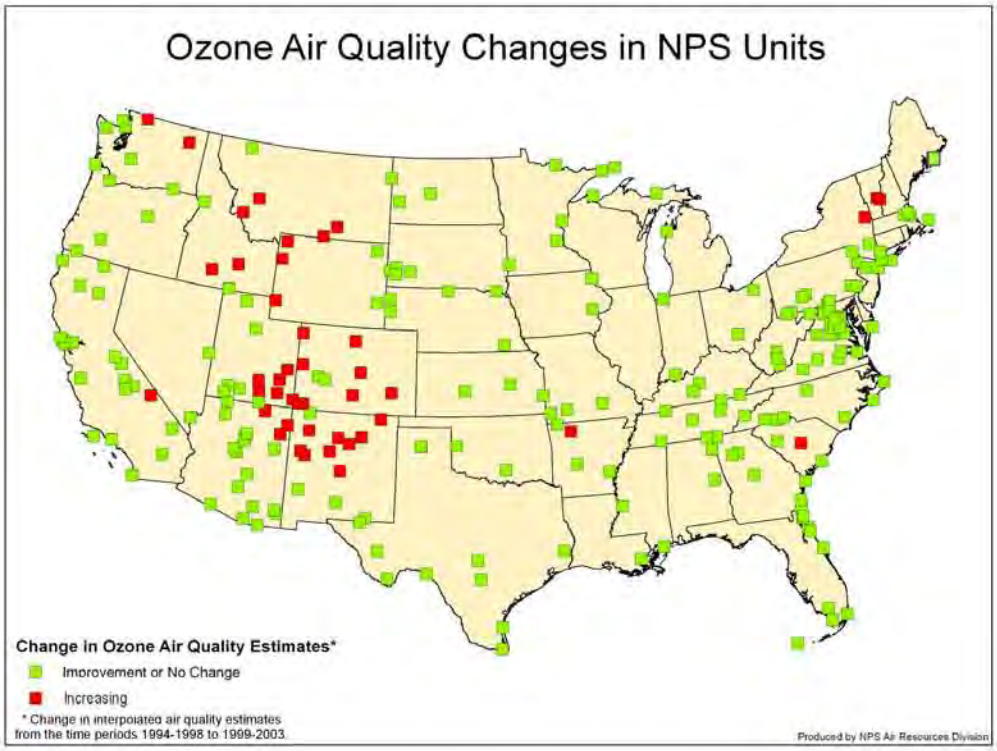


Figure 3-8. Ozone air quality changes in NPS units.

3.1.3.4 Passive Ozone Sampling Program Trends - Most of the ozone data reported by ARD is based on averaging hourly data to get another statistical measure. The passive ozone samplers collect weekly average data for the key summer ozone season from which trends can be determined. There are 7 to 10 years of passive ozone data from a number of parks. A Theil trend analysis was done on the annual averages from the weekly samples (See *http://www2.nature.nps.gov/air/studies/passives.cfm* for program details). Most of the coverage for this program was in the West (Figure 3-9). Three of the western parks (Badlands, Zion, and Lava Beds) have significant increasing ozone trends at the 0.05 level. Several other western park units have increasing trends at a lower level of statistical certainty. Although the weekly average ozone measurements correlate to statistics such as second-highest hourly ozone or fourth highest of the daily maximum 8-hour ozone, the passive sampler trend looks at the change in the mid-level ozone. There were nine parks with no trend (40%) and overall there were more parks in the passive sampler program with improving/no change ozone (52)% than with degrading ozone.

The difference in ozone statistic, the period of years with data, and summer-only collection makes it difficult to compare the ozone trends at the passive sampler parks directly with the other methods that look at the high ozone event days. This suggests that perhaps a metric for high, median, and low ozone concentrations should be examined for trends in the hourly datasets. Although the focus is generally on the national standard or very high ozone event days, following the lead of the visibility program to track the 20% highest ozone days and the 20% lowest ozone days might provide valuable, more comprehensive insight into the effects of ozone.

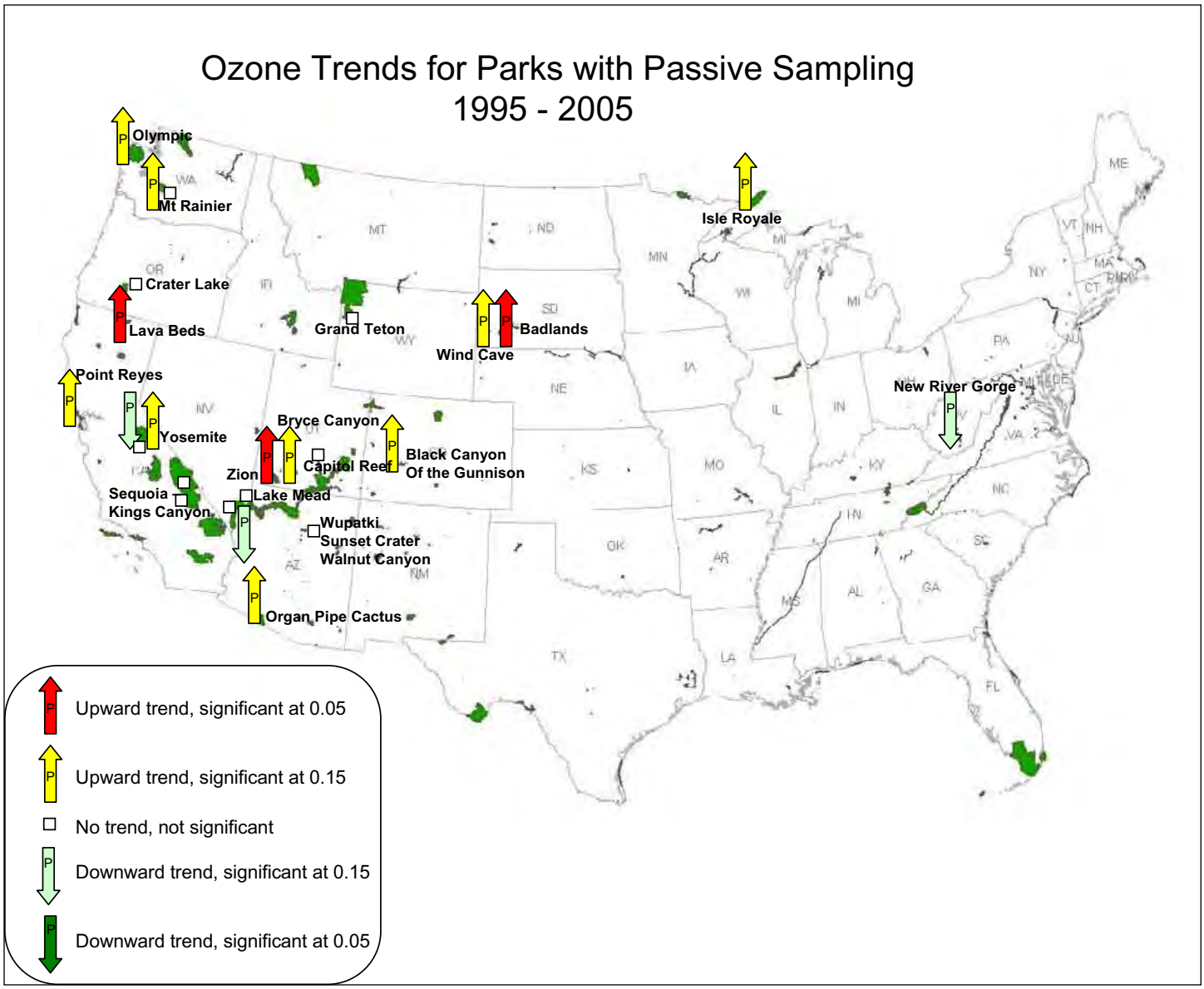
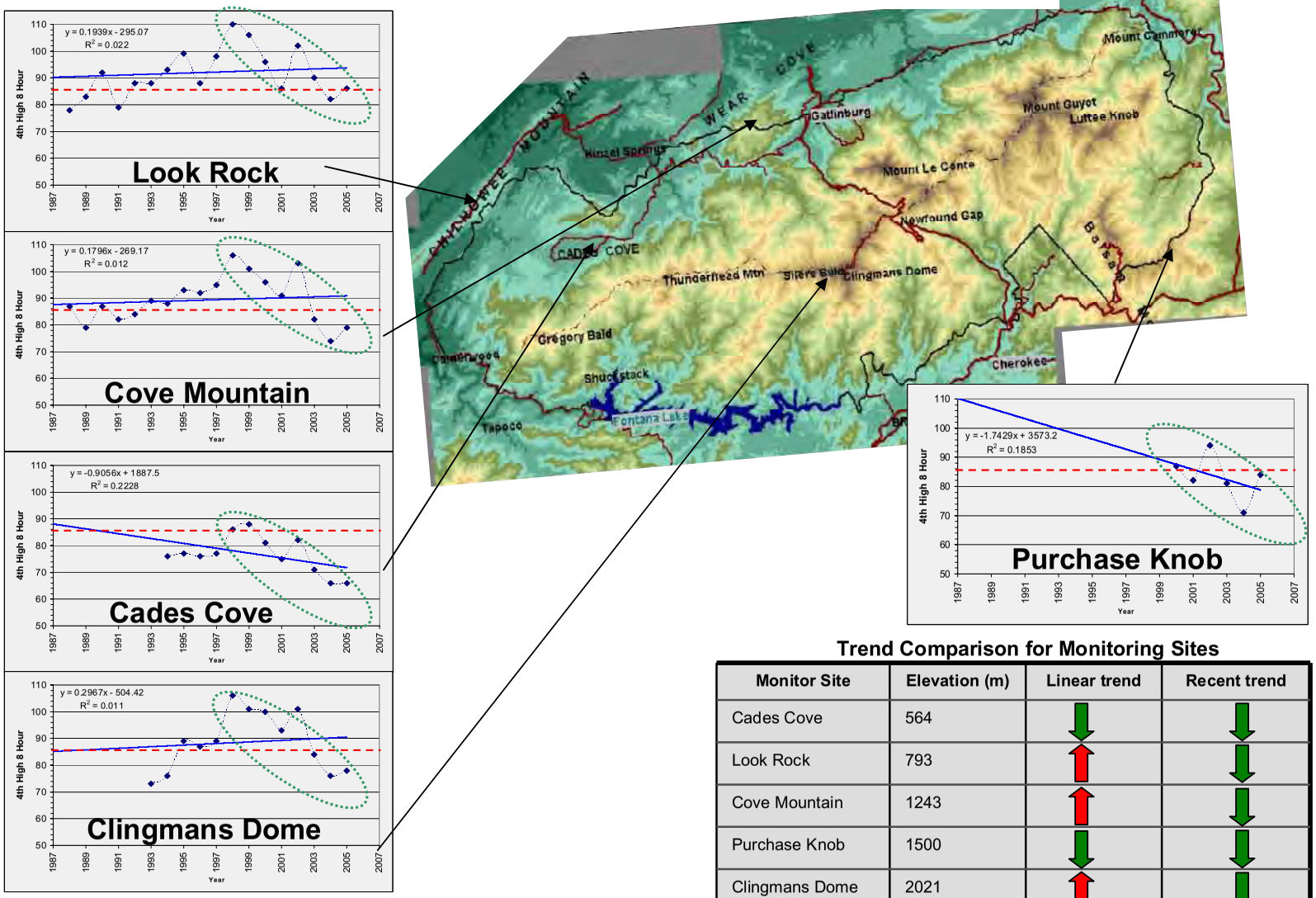


Figure 3-9. Ozone trends over the past 10 years (1995-2005) using passive sampling.

3.1.3.5 Trends When There Are Multiple Monitors - In most parks with monitors, despite the complex terrain, only one monitoring station is available to represent the park air quality. Great Smoky Mountains National Park provides one of the rare cases where data from multiple stations within a park are available. Figure 3-10 presents trend summaries for five sites within the park. The time series plots and linear regression lines for each station have slightly different trends. Some of the difference in trends is due to the length of ozone record. There was a long increase in ozone through the 1990s and a rapid decrease in ozone in the last 5-6 years. The table compares the full record trends (12-18 years) and the more recent changes (6-8 years). All five stations indicate that ozone concentrations are on a path to move below the 8-hour ozone standard.



Trend Comparison for Monitoring Sites

Monitor Site	Elevation (m)	Linear trend	Recent trend
Cades Cove	564	↓	↓
Look Rock	793	↑	↓
Cove Mountain	1243	↑	↓
Purchase Knob	1500	↓	↓
Clingmans Dome	2021	↑	↓

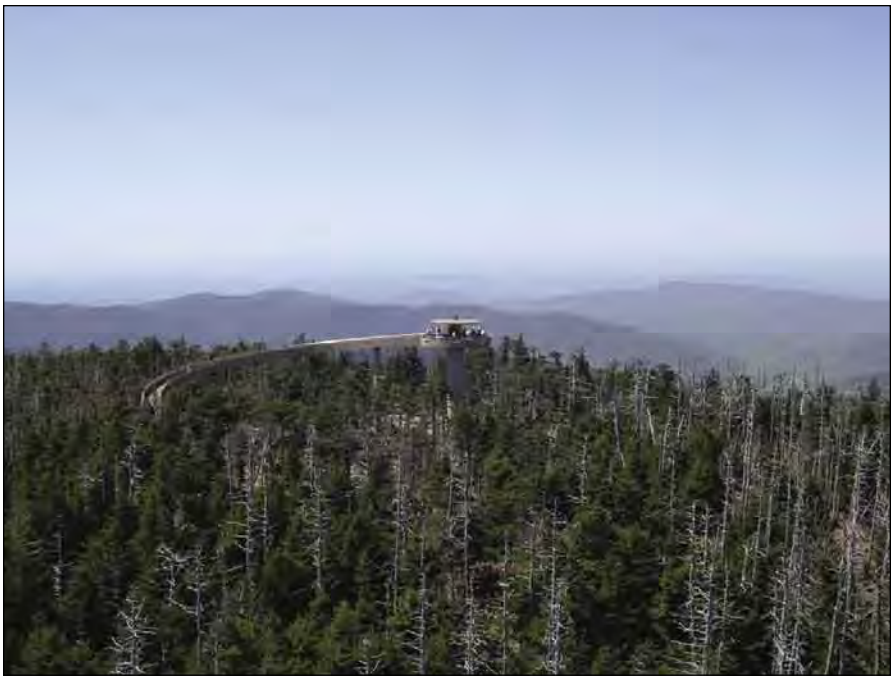
Figure 3-10. Trends for multiple monitoring locations in Great Smoky Mountains National Park. Usually the monitor with the highest ozone is chosen to represent the park air quality where there are multiple monitoring stations.

3.1.3.6 Trends Comments - In summary, the ozone trends outlook in park units where monitoring occurs, is favorable and promising. Ozone concentrations are decreasing or stable in most areas of the country that have had high ozone. Portions of the intermountain region of the west and the eastern U.S. have increasing ozone concentrations based on the highest 8-hour averages. Very importantly, some areas in the eastern U.S. now seem to be responding to NO_x emission reductions as predicted by researchers and computer modeling.

No single trends method captures the full detail of the changes in ozone. Trends evaluations need to consider the spatial variability, the time of year, which statistical metric is most suitable, what time period to use, and how emission changes might relate. Each method used to determine a trend provides different information towards understanding ozone changes and the possible causes.

3.1.3.7 More Information on the Web - Annual fourth highest 8-hr concentrations in parks *http://www2.nature.nps.gov/air/Monitoring/exceed.cfm*

Annual NAAQS exceedance counts in parks *http://www2.nature.nps.gov/air/Monitoring/ParkExceedDays.htm*



Great Smoky Mountains NP - Clingman's Dome Tower

Performance measures (GPRA report on trends) *http://www2.nature.nps.gov/air/who/npsPerfMeasures.cfm*

Ozone interpolation maps as 5-year averages (Air Atlas) *http://massive.natnet.du.edu/website/AirAtlas9903/viewer.htm*

3.1.3.8 Literature - The following literature references are recent articles on trends that use NPS ozone monitoring data in a portion of their analysis:

Jeff Lehman, Kristen Swinton, Steve Bortnick, Cody Hamilton, Ellen Baldridge, Brian Eder and Bill Cox, **Spatio-temporal characterization of tropospheric ozone across the eastern United States**, *Atmospheric Environment, Volume 38, Issue 26, August 2004, Pages 4357-4369.*

Roxanne Vingarzan, **A review of surface ozone background levels and trends**, *Atmospheric Environment, Volume 38, Issue 21, July 2004, Pages 3431-3442.*

S.J. Oltmans, A.S. Lefohn, J.M. Harris, I. Galbally, H.E. Scheel, G. Bodeker, E. Brunke, H. Claude, D. Tarasick, B.J. Johnson et al, **Long-term changes in tropospheric ozone,** *Atmospheric Environment, Volume 40, Issue 17, June 2006, Pages 3156-3173.*

Daniel Q. Tong and Denise L. Mauzerall, **Spatial variability of summertime tropospheric ozone over the continental United States: Implications of an evaluation of the CMAQ model,** *Atmospheric Environment, Volume 40, Issue 17, June 2006, Pages 3041-3056.*

3.1.4 Resource Injury Indices - To quantify ozone exposure to plants, various indices other than the NAAQS primary and secondary standards are often used. These indices, defined below, take into account both peak ozone concentrations and cumulative exposure to ozone.

- SUM06 – A cumulative index that is calculated as the maximum 3-month sum of the 0800-2000 hourly average ozone concentrations during the ozone season that are equal to or greater than 0.06 ppm (60 ppb). The units of this index are ppm-hr. Several thresholds have been developed for SUM06 (Heck and Cowling, 1997).
- W126 – A cumulative index that is calculated as the sum of all hourly ozone concentrations during the EPA-designated ozone season, where a weighting function is used to give increasing significance (weights between 0 and 1) to concentrations of ozone greater than 0.040 ppm (40 ppb), and no weight to concentrations below 0.040 ppm (40 ppb). Units of this index are ppm-hr.
- N100 – The number of hours with ozone concentrations greater than or equal to 0.10 ppm (100 ppb). This index is reported without units. The N100 index is often considered along with the W126 in assessing the possible impact of the exposure. Several thresholds have been developed for W126 and N100 (Lefohn et al, 1997).

SUM06 thresholds
No risk
to ozone sensitive vegetation
0-7 ppm-hr

Higher risk
to ozone sensitive vegetation
8-16 ppm-hr

Highest risk
to ozone sensitive vegetation
>16 ppm-hr

Table 3-4 presents the ozone exposure indices summary statistics for 2005. Summaries for portable ozone sites are included for reference only. Since portable sites are deployed for seasonal use, there may be significant biases in SUM06, W126, and N100 exposure indices calculated from their data. These statistics were not calculated for sites that were operational for less than three months during the year. In 2005 these sites were all of the short-term portable sites as well as Yosemite-Tioga Pass.

The map in Figure 3-11 presents the annual 3-month maximum SUM06 exposure index for all network sites listed in Table 3-4. Index values are color-coded to represent three distinct levels of cumulative exposure. Data from portable sites (no color) are included for reference only. The SUM06 risk thresholds are relative and not absolute.

Ozone effects depend not only on ozone exposure, but on other factors that may ameliorate or magnify the extent of ozone injury, including soil moisture, presence of other air pollutants, insects or diseases, and other environmental stresses. A high SUM06 exposure in a drought year, for example, may not result in vegetation injury because stomatal closure to prevent moisture loss will also prevent ozone uptake.

In evaluating risk to vegetation from ozone, it is useful to consider not only the SUM06 but also the W126 and N100 exposures. If more than one exposure index is above the threshold for effects, the potential for injury increases.

In 2005, assessments were completed to evaluate the potential for ozone injury to vegetation at many national park service units. The assessments are available at *http://www2.nature.nps.gov/air/pubs/ecoeffects.cfm*. Information on ozone-sensitive plant species is available at *http://www2.nature.nps.gov/air/pubs/pdf/baltfinalreport1.pdf*.

References

Heck, W.W. and E.B. Cowling. 1997. The Need for a Long-Term Cumulative Secondary Ozone Standard – An Ecological Perspective. Environmental Management. January.

Lefohn, A.S., W. Jackson, D. Shadwick, and H.P. Knudsen. 1997. Effect of Surface Ozone Exposures on Vegetation Grown in the Southern Appalachian Mountains: Identification of Possible Areas of Concern. Atmospheric Environment 31(11):1695-1708.

	W126	***N100***
Highly Sensitive Species	*5.9 ppm-hr*	*6*
Moderately Sensitive Species	*23.8 ppm-hr*	*51*
Low Sensitivity Species	*66.6 ppm-hr*	*135*

Table 3-4. Summary of indices for resource injury (SUM06, W126, and N100).

Sites operated by the National Park Service

National Park Unit	Site Name	O3 % Valid	SUM06[1] (ppm-hr)	W126[2] (ppm-hr)	N100[3]
Badlands	Visitor Center	99.2	10.6	21.4	0
Big Bend	K-Bar Ranch Road	92.1	8.4	27.6	0
Canyonlands	Island in the Sky	95.1	31.0	46.3	0
Chiricahua	Entrance Station	95.9	29.5	41.4	0
Craters of the Moon	Visitor Center	97.2	0.0	4.7	0
Denali	Headquarters	99.8	0.0	6.0	0
Death Valley	Park Village	95.2	59.8	97.4	7
Glacier	West Glacier Horse Stables	98.4	0.9	6.2	0
Great Basin	Maintenance Yard	99.0	33.3	48.3	0
Grand Canyon	The Abyss	99.2	44.6	60.6	0
Great Smoky Mountains	Cades Cove	98.9	8.1	11.7	0
Great Smoky Mountains	Clingmans Dome	98.6	30.0	49.0	0
Great Smoky Mountains	Cove Mountain	99.6	38.2	72.8	2
Great Smoky Mountains	Look Rock	99.3	55.8	84.5	1
Joshua Tree	Black Rock	97.8	73.8	130.8	94
Lassen Volcanic	Manzanita Lake Fire Stn.	99.4	16.5	26.7	0
Mammoth Cave	Houchin Meadow	99.8	24.7	38.7	0
Mesa Verde	Resource Mngment Area	99.8	45.7	66.2	0
Mount Rainier	Tahoma Woods	81.2	0.3	1.4	0
North Cascades	Marblemount Ranger Stn.	83.8	0.0	2.2	0
Petrified Forest	South Entrance	91.3	38.6	45.2	1
Pinnacles	SW of East Entrance Stn.	99.6	19.4	22.9	2
Rocky Mountain	Long's Peak	96.5	18.8	44.8	0
Sequoia and Kings Canyon	Ash Mountain	97.8	115.6	114.9	111
Sequoia and Kings Canyon	Lower Kaweah	99.3	98.1	94.3	42
Shenandoah	Big Meadows	92.8	38.3	53.4	0
Voyageurs	Sullivan Bay	98.8	11.0	19.8	0
Yellowstone	Water Tank	98.4	3.4	25.7	0
Yosemite	Merced River	98.8	2.9	7.2	0
Yosemite	Turtleback Dome	99.1	65.8	73.8	6
Zion	Dalton's Wash	97.2	43.0	50.2	12

-- continued --

Table 3-4 (continued). Summary of indices for resource injury (SUM06, W126, and N100).

Sites operated by cooperating state agencies

National Park Unit	Site Name	O3 % Valid	SUM06[1] (ppm-hr)	W126[2] (ppm-hr)	N100[3]
Acadia	Cadillac Mountain	99.0	14.4	23.6	2
Acadia	McFarland Hill	99.5	7.5	18.2	0
Cape Cod	Cape Cod	97.3	17.6	30.8	5
Chamizal	Chamizal	99.4	6.8	14.7	4
Congaree	Congaree Bluff	89.1	15.1	19.4	0
Cowpens	State Monitor	98.9	17.4	30.7	1
Great Smoky Mountains	Purchase Knob	93.8	46.6	56.0	0
Saguaro	Pima County	99.7	28.4	45.2	2
Theodore Roosevelt	Painted Cany. VC	94.9	1.3	11.5	0
Wind Cave	Visitor Center	99.2	14.1	34.0	0

Nearby sites operated by other agencies

National Park Unit	Site Name	O3 % Valid	SUM06[1] (ppm-hr)	W126[2] (ppm-hr)	N100[3]
Alabama-Coushatta	CASTNet site	85.5	15.7	21.8	0
Appalachian Trail	Mount Greylock Summit	97.5	20.1	30.4	3
Blue Ridge Parkway	7510 Blue Ridge Parkway	95.7	16.6	18.2	0
Blue Ridge Parkway	Blue Ridge Parkway	94.1	46.0	53.4	0
Blue Ridge Parkway	Vinton Elementary	98.5	15.5	25.1	0
Blue Ridge Parkway	Frying Pan Mountain	94.5	47.1	57.4	0
Blue Ridge Parkway	Route 191	99.9	16.7	19.1	1
Blue Ridge Parkway	Ranger Station	98.9	11.2	18.5	0
Boston Harbor Islands	Former Nike Missle Site	97.1	12.7	19.4	6
Cuyahoga Valley	800 Patterson	99.9	30.6	37.4	5
Everglades	Cutler Road	94.8	9.7	14.4	0
George Washington Pkwy	Alexandria Health	97.2	18.4	20.9	3
Guilford Courthouse	Mendenhall Middle School	95.5	23.0	31.3	3
Indiana Dunes	Gas Station	98.1	19.6	27.0	9
Indiana Dunes	Ammunition Bunker	97.8	18.9	26.3	15
Indiana Dunes	Water Treatment Plant	99.3	23.2	31.4	17
Mississippi	Anoka County Airport	99.8	8.4	13.9	0
Mississippi	Somerset Town Hall	97.6	11.4	14.0	1
Mississippi	Washington County	98.8	11.9	14.9	0
Olympic	Blyn Lookout Relay	70.6	0.0	1.7	0
Petroglyph	Westside Taylor Ranch	99.9	22.2	31.9	0
Rock Creek	Achbold Parkway	98.0	19.8	21.5	2
Saugus Iron Works	Lynn Water Treatment	97.3	16.0	26.4	11
Saratoga	Stillwater	96.5	15.9	25.4	5

-- continued --

Table 3-4 (continued). Summary of indices for resource injury (SUM06, W126, and N100).

Portable ozone monitoring systems

National Park Unit	Site Name	O3 % Valid	SUM06[1] (ppm-hr)	W126[2] (ppm-hr)	N100[3]
Assateague Island	Maintenance Area	84.2	9.6	9.8	3
Big South Fork	Taft Story Fields	96.8	3.5	9.4	0
Black Canyon of the Gunnison	Gravel Pit	93.2	21.4	29.3	0
Dinosaur	West Entrance Housing	99.3	11.5	18.2	0
Gulf Islands	Fort Pickens Entrance Stn.	97.1	13.7	14.8	0
Lake Mead	Meadview	99.5	76.0	81.5	14
Mammoth Cave	Biogarden	99.9	5.6	6.5	0
Mount Rainier	Tahoma Vista	99.9	1.9	5.3	0
Olympic	Hurricane Ridge Portable	91.1	0.1	2.3	0
Padre Island	Malaquite Visitor Center	91.4	7.0	9.3	0

1. SUM06 exposure index represents the sum of the 0800-2000 hourly ozone concentrations equaling or exceeding 0.06 ppm. The value reported here represents a three month maximum value during the ozone season. Units are ppm-hr.

2. W126 exposure index represents the sum of all hourly ozone concentrations where each concentration is weighted by a function that gives greater emphasis to the higher hourly concntrations while still including the lower ones. Units are ppm-hr. For more information on the W126 exposure index go to http://www2.nature.nps.gov/air/AQBasics/glossary.cfm

3. N100 represents the number of hourly ozone concentrations greater than or equal to 0.100 ppm (100 ppb).

italics = site operated by other agencies

underline = National Park Service operated portable ozone system (POMS)

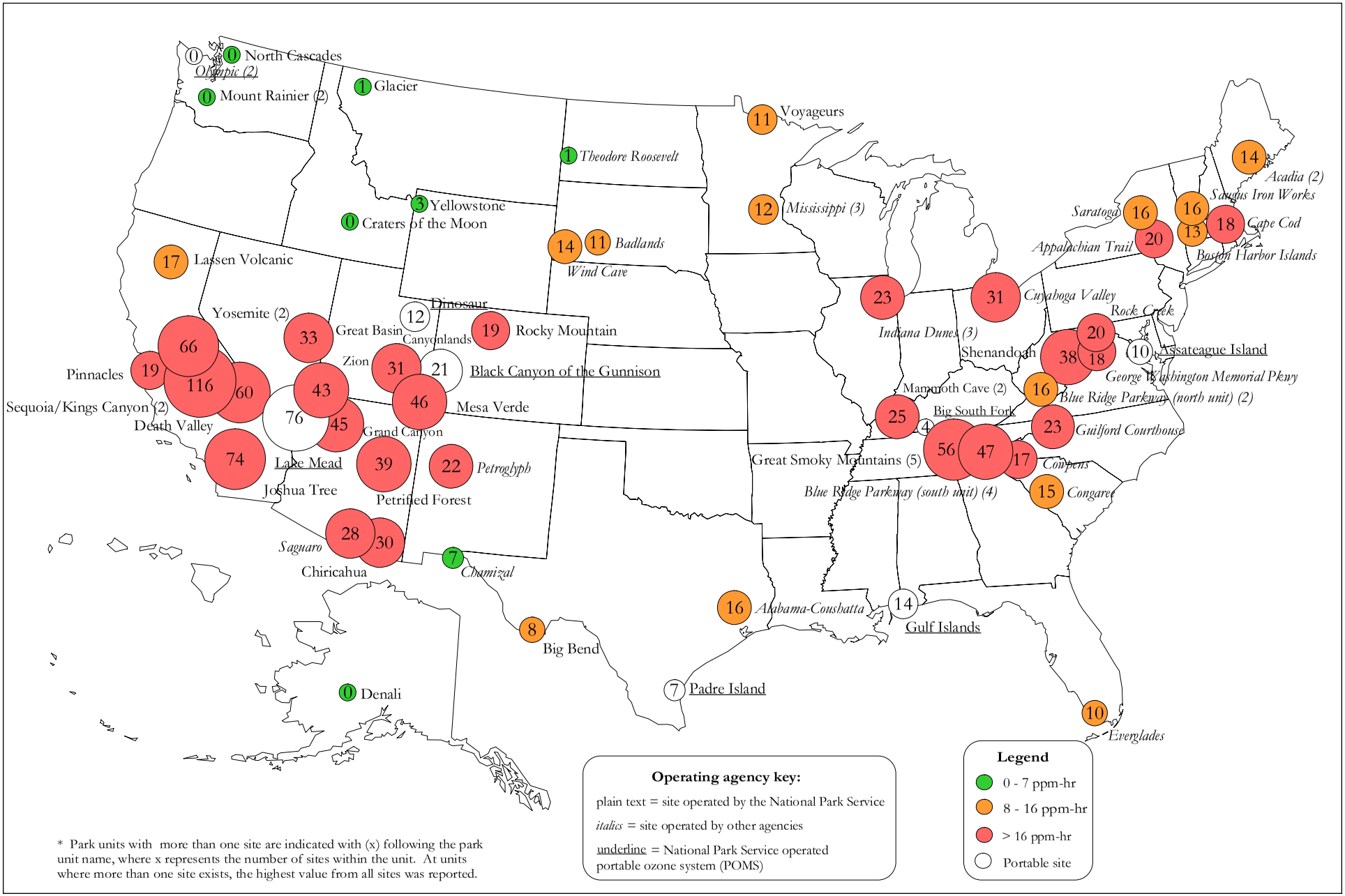


Figure 3-11. Annual 3-month maximum SUM06 exposure index.

3.2 Sulfur Dioxide Data Summaries

Sulfur dioxide (SO_2) is a criteria pollutant that over time undergoes chemical transformations in the atmosphere to form aqueous sulfur compounds, such as sulfuric acid, and particulate sulfate that can lead to environmental and health effects. Both sulfur dioxide and fine particulate sulfate can cause respiratory problems. Sulfur dioxide and acidic sulfate deposited on the earth's surface can affect aquatic and terrestrial ecosystems. Sulfur compounds are a major constituent of acid rain and sulfate is one of the particulate species responsible for visibility degradation and regional haze.

The Primary National Ambient Air Quality Standards for sulfur dioxide are an annual arithmetic mean of 0.03 ppm (34 ppb) and a 24-hour mean of 0.14 ppm (144 ppb), not to be exceeded more than once per year. The secondary NAAQS is a 3-hour mean of 0.50 ppm (549 ppb), not to be exceeded more than once per year. Table 3-5 summarizes sulfur dioxide measurements for comparison to these standards and lists the number of exceedances for each. Maximum hourly concentrations for each site are also presented in the table for reference.

At Hawaii Volcanoes National Park sulfur dioxide data are collected using a lower range and an upper range. The lower range does not capture values higher than 999 ppb, but is considered to be an EPA equivalency method. The upper range captures values above 999 ppb accurately, but is not an EPA reference method. Data presented in this report were collected using the upper range to give a more accurate representation of sulfur dioxide values.

Badlands NP Air Quality Monitoring Station

Table 3-5. Summary of sulfur dioxide data.

Sites operated by the National Park Service

National Park Unit	Site Name	Annual Arithmetic Mean (ppb)[1]	Highest Daily 24-Hour Average Concentrations[2] (ppb)					Highest Daily Maximum 3-Hour Average Concentration[3] (ppb)					Highest Daily Maximum 1-Hour Average Concentration (ppb)			
			1st Highest	2nd Highest	3rd Highest	4th Highest	No. of days with 24-Hour Average >= 145 ppb	1st Highest	2nd Highest	3rd Highest	4th Highest	No. of days with 3-Hour Maximum >= 550 ppb	1st Highest	2nd Highest	3rd Highest	4th Highest
Hawaii Volcanoes *	Observatory	19	322	308	193	169	7	1340	813	776	767	5	2372	1255	1249	1039
Hawaii Volcanoes *	Visitor Center	15	224	222	198	180	6	1020	769	723	616	6	1841	1279	1141	1014
Shenandoah *	Big Meadows	2	13	12	10	9	0	22	22	19	18	0	27	24	24	22

Sites operated by cooperating state agencies

National Park Unit	Site Name	Annual Arithmetic Mean (ppb)[1]	Highest Daily 24-Hour Average Concentrations[2] (ppb)					Highest Daily Maximum 3-Hour Average Concentration[3] (ppb)					Highest Daily Maximum 1-Hour Average Concentration (ppb)			
			1st Highest	2nd Highest	3rd Highest	4th Highest	No. of days with 24-Hour Average >= 145 ppb	1st Highest	2nd Highest	3rd Highest	4th Highest	No. of days with 3-Hour Maximum >= 550 ppb	1st Highest	2nd Highest	3rd Highest	4th Highest
Badlands	Visitor Center	1	3	3	3	3	0	4	4	4	3	0	0	0	0	0
Congaree	Congaree Bluff	1	10	10	8	8	0	43	43	37	36	0	90	66	66	62
Theodore Roosevelt	Painted Cany. VC	0	2	2	2	2	0	5	5	5	4	0	8	8	7	6
Wind Cave	Visitor Center	0	7	2	2	2	0	37	3	3	3	0	0	0	0	0

-- continued --

Table 3-5 (continued). Summary of sulfur dioxide data.

Nearby sites operated by other agencies

National Park Unit	Site Name	Annual Arithmetic Mean (ppb)[1]	Highest Daily 24-Hour Average Concentrations[2] (ppb)					Highest Daily Maximum 3-Hour Average Concentration[3] (ppb)					Highest Daily Maximum 1-Hour Average Concentration (ppb)			
			1st Highest	2nd Highest	3rd Highest	4th Highest	No. of days with 24-Hour Average >= 145 ppb	1st Highest	2nd Highest	3rd Highest	4th Highest	No. of days with 3-Hour Maximum >= 550 ppb	1st Highest	2nd Highest	3rd Highest	4th Highest
Blue Ridge Parkway	Vinton Elementary	3	10	9	9	8	0	23	14	13	12	0	0	0	0	0
George Washington Pkwy	Alexandria Health	5	20	18	18	16	0	77	68	51	49	0	0	0	0	0
Indiana Dunes	Gas Station	3	17	16	15	13	0	34	32	26	23	0	0	0	0	0
Indiana Dunes	Ammunition Bunk	4	50	42	38	31	0	165	78	77	72	0	0	0	0	0

1. The primary annual National Ambient Air Quality Standard for sulfur dioxide is an annual arithmetic mean of 0.03 ppm. (A value greater than 0.03 ppm, 34 ppb, or 80 $\mu g/m^3$ exceeds the standard.) (40 CFR 50.4.)

2. The primary daily National Ambient Air Quality Standard for sulfur dioxide is 0.14 ppm over a 24-hour period not to be exceeded more than once per year. (A value greater than 0.14 ppm, 144 ppb, or 365 $\mu g/m^3$ exceeds the standard.) (40 CFR 50.4.)

3. The secondary National Ambient Air Quality Standard for sulfur dioxide is 0.5 ppm over a 3-hour period not to be exceeded more than once per year. (A value greater than 0.5 ppm, 549 ppb, or 1300 $\mu g/m^3$ exceeds the standard.) (40 CFR 50.5.)

*This site collected sulfur dioxide data using an instrument or a range that is not an EPA reference method.

Color shading key:

>34 ppb annual arithmetic mean, >144 ppb 24-hour average, or >549 ppb 3-hour average

italics = site operated by other agencies

underline = National Park Service operated portable ozone system (POMS)

3.3 Particulate Matter Data Summaries

Particulate matter (PM), is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. Particles smaller than about 10 micrometers in diameter (PM_{10}) can enter the human respiratory system and cause health problems. Particles smaller than about 2.5 micrometers in diameter ($PM_{2.5}$) are most significantly tied to health concerns and, additionally, predominantly responsible for visibility degradation and regional haze. Acidic particulate matter can lead to acid deposition or acid rain. Sources of particulate matter include: industrial activities, vehicle exhaust, fires, vegetation, construction activities, wind-blown dust, and gaseous emissions which undergo chemical processes in the atmosphere to condense into particulate or liquid form.

The primary National Ambient Air Quality Standards for $PM_{2.5}$ are an annual arithmetic mean of 15 μg/m³ and a 24-hour mean of 65 μg/m³. An exceedance of the standard occurs when either an annual arithmetic mean is greater than 15.0 μg/m³ or a 24-hour average is greater than 65 μg/m³. An exceedance of the standard is not the same as a violation. A violation occurs when either the 3-year average of the annual mean is greater than 15.0 μg/m³ or the 3-year average of the 98th percentile 24-hour average concentrations is greater than 65 μg/m³.

The primary National Ambient Air Quality Standards for PM_{10} are an annual arithmetic mean of 50 μg/m³ and a 24-hour mean of 150 μg/m³. An exceedance of the standard occurs when either an annual arithmetic mean is greater than 50 μg/m³ or a 24-hour average is greater than 150 μg/m³. Again, an exceedance of the standard is not the same as a violation. A violation occurs when a 24-hour average concentration greater than 150 μg/m³ occurs more than once in a calendar year, or when the 3-year average of the weighted annual mean is greater than 50 μg/m³.

3.3.1 $PM_{2.5}$ Data Summaries - Table 3-6 summarizes $PM_{2.5}$ measurements with respect to both the daily 24-hour average maximum concentrations and the annual arithmetic mean. Since none of the $PM_{2.5}$ monitors at these sites are EPA-certified, these comparisons are made for reference purposes only. The four highest and 98th percentile 24-hour average concentrations are listed, as well as the total number of days with 24-hour average $PM_{2.5}$ concentrations greater than 65μg/m³. No violation summaries for $PM_{2.5}$ data are presented.

Western North Carolina, near Great Smoky Mountains National Park
NPS photo by J. Renfro

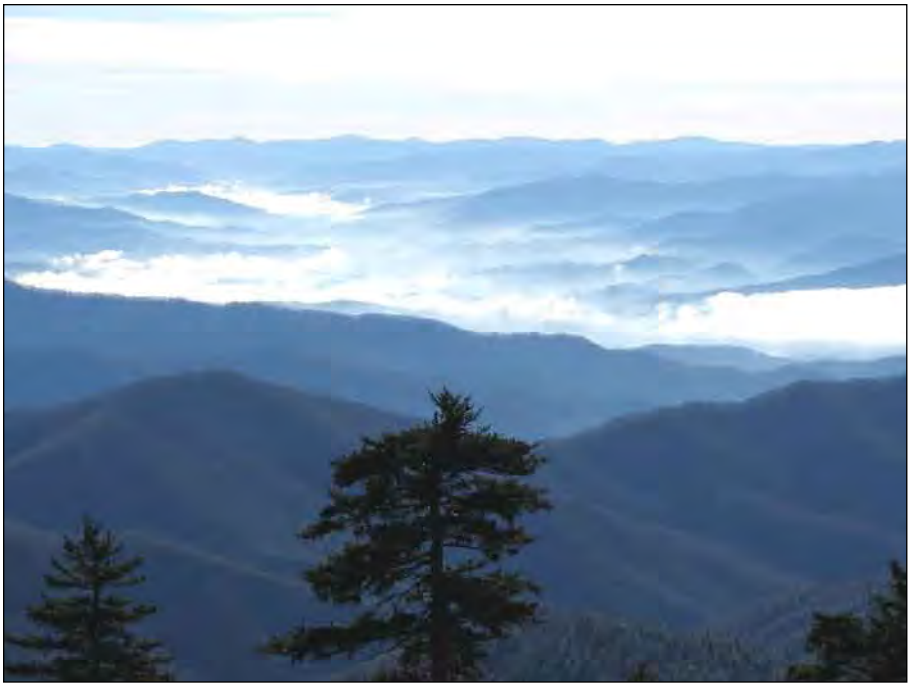


Table 3-6. Summary of $PM_{2.5}$ data from non-equivalency methods.

Sites operated by the National Park Service

National Park Unit	Site Name	Sampler Type*	% Valid[1]	Annual Arithmetic Mean[2] (μ/m³)	Highest Daily 24-Hour Average Concentrations[3] (μg/m³)					
					1st Highest	2nd Highest	3rd Highest	4th Highest	98th Percentile Value	No. of days with 24-Hour Average >65 μg/m³
Badlands	Visitor Center	Bam 1020	94.8	3.5	12	12	11	11	11	0
Great Smoky Mountains	Look Rock	Bam 1020	98.6	14.0	42	42	40	39	37	0
Shenandoah	Big Meadows	Bam 1020	93.6	11.3	41	33	32	31	29	0
Yellowstone	Old Faithful	Bam 1020	96.5	4.5	14	11	11	11	10	0

Sites operated by cooperating state agencies

National Park Unit	Site Name	Sampler Type*	% Valid[1]	Annual Arithmetic Mean[2] (μ/m³)	Highest Daily 24-Hour Average Concentrations[3] (μg/m³)					
					1st Highest	2nd Highest	3rd Highest	4th Highest	98th Percentile Value	No. of days with 24-Hour Average >65 μg/m³
Acadia	McFarland Hill	Bam 1020	96.8	4.8	29	27	24	23	19	0
Theodore Roosevelt	Painted Cany. VC	Bam 1020	93.5	5.3	17	14	14	13	12	0
Wind Cave	Visitor Center	Bam 1020	96.9	3.8	20	18	13	12	10	0
Yosemite	Village	Bam 1020	95.1	13.8	73	62	44	42	29	1

-- continued --

Table 3-6 (continued). Summary of $PM_{2.5}$ data from non-equivalency methods.

Nearby sites operated by other agencies

National Park Unit	Site Name	Sampler Type*	% Valid[1]	Annual Arithmetic Mean[2] (μ/m³)	Highest Daily 24-Hour Average Concentrations[3] (μg/m³)					
					1st Highest	2nd Highest	3rd Highest	4th Highest	98th Percentile Value	No. of days with 24-Hour Average >65 μg/m³
Guilford Courthouse	Mendenhall Middle School	Bam 1020	96.3	14.0	41	40	39	36	34	0
Indiana Dunes	Ammunition Bunker	Bam 1020	98.8	16.3	122	64	57	52	40	1
Indiana Dunes	Water Treatment Plant	Bam 1020	75.3	30.0	72	69	65	63	59	2
Mississippi	Anoka County Airport	Bam 1020	98.0	10.8	59	51	39	38	30	0
Mississippi	Somerset Town Hall	Bam 1020	97.7	9.7	37	34	32	31	29	0
Petroglyph	Westside Taylor Ranch	Bam 1020	94.7	4.8	44	17	17	16	14	0
Saugus Iron Works	Lynn Water Treatment	Bam 1020	96.9	6.0	23	21	20	18	21	0

1. At sites operated by an agency other than the National Park Service the primary responsibility for the operation and data reporting of particulate matter belongs to the operating agency.

2. The primary annual National Ambient Air Quality Standard for $PM_{2.5}$ is an annual arithmetic mean of 15.0 μg/m³ (An exceedance of the standard occurs when an annual arithmetic mean of $PM_{2.5}$ concentrations is greater than 15.0 μg/m³. A violation of the standard occurs when the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations is greater than 15.0 μg/m³ (40 CFR 50.7.)

3. The primary daily National Ambient Air Quality Standard for $PM_{2.5}$ is a 24-hour average concentration of 65 μg/m³. (An exceedance of the standard occurs when a 24-hour average $PM_{2.5}$ concentration is greater than 65 μg/m³. A violation of the standard occurs when the 3-year average of the annual 98th percentile of 24-hour $PM_{2.5}$ concentrations is greater than 65 μg/m³.) (40 CFR 50.7.)

*TEOM = tapered element oscillating micro-balance
BAM = Beta Attenuation Monitor

italics = site operated by other agencies

<u>underline</u> = National Park Service operated portable ozone system (POMS)

3.3.2 PM_{10} Data Summaries - Table 3-7 summarizes PM_{10} measurements with respect to both the daily 24-hour average maximum concentrations and the annual arithmetic mean at each EPA-certified monitoring site. The four highest 24-hour average concentrations are listed, as well as the total number of days with exceedances of the NAAQS 24-hour standard (24-hour average PM_{10} concentrations greater than or equal to 150 $\mu g/m^3$). The annual arithmetic mean column and the number of days column are color-coded to identify sites where an exceedance of the annual or 24-hour standard occurred.

Table 3-8 presents a PM_{10} violation summary based on the 24-hour average standard for one-year periods over the last three years, with violations (a 24-hour average concentration of more than 150 $\mu g/m^3$ occurring more than once in a calendar year) indicated in red. Table values in parentheses indicate that the EPA data completeness requirement for the 3-year period was not met. However, calendar quarters not meeting the EPA data completeness requirement are included in the NAAQS violation computation if the resulting 24-hour average percentile exceeds the standard.

Table 3-9 presents a PM_{10} violation summary based on the annual standard. The most recent 3-year period is listed, with violations indicated in red (3-year average of annual mean PM_{10} concentrations greater than 50 $\mu g/m^3$). Table values in parentheses indicate that the EPA data completeness requirement for the 3-year period was not met. However, an annual mean from a year that does not meet completeness requirements is included in the violation computation if each calendar quarter contains at least 11 samples and the resulting annual mean exceeds the standard.

Mammoth Cave NP - Ambient Air Quality Monitoring Station

Table 3-7. Summary of PM_{10} data from reference and equivalency methods.

Sites operated by cooperating state agencies

National Park Unit	Site Name	Sampler Type*	% Valid[1]	Annual Arithmetic Mean[2] (μ/m³)	Highest Daily 24-Hour Average Concentrations[3] (μg/m³)				
					1st Highest	2nd Highest	3rd Highest	4th Highest	No. of days with 24-Hour Average >65 μg/m³
Badlands	Visitor Center	BAM	99.0	9	40	40	30	30	0
Wind Cave	Visitor Center	BAM	98.0	7	30	30	20	20	0

1. At sites operated by an agency other than the National Park Service the primary responsibility for the operation and data reporting of particulate matter belongs to the operating agency.

2. The primary annual National Ambient Air Quality Standard for PM_{10} is an annual arithmetic mean of 50 μg/m³ (An exceedance of the standard occurs when an annual arithmetic mean of PM_{10} concentrations is greater than 50 μg/m³. A violation of the standard occurs when the 3-year average of the weighted annual mean PM_{10} concentrations is greater than 50 μg/m³ (40 CFR 50.6.)

3. The primary daily National Ambient Air Quality Standard for PM_{10} is a 24-hour average concentration of 150 μg/m³. (An exceedance of the standard occurs when a 24-hour average PM_{10}concentration is greater than 150 μg/m³. A violation of the standard occurs when a 24-hour average concentration greater than 150 μg/m³ occurs more than once in a calendar year.) (40 CFR 50.6.)

*TEOM = tapered element oscillating micro-balance
BAM = Beta Attenuation Monitor

Color shading key:

>50 μg/m³ annual arithmetic mean,
>150 μg/m³ 24-hour average

italics = site operated by other agencies

underline = National Park Service operated portable ozone system (POMS)

Table 3-8. PM_{10} violation summary - daily standard[1].

Sites operated by cooperating state agencies, 2003-2005

National Park Unit	Site Name	Sampler Type*	2005	2004	2003
Badlands	Visitor Center	BAM	40	—	—
Wind Cave	Visitor Center	BAM	30	—	—

[1]The primary daily National Ambient Air Quality Standard for PM_{10} is a 24-hour average concentration of 150μg/m³. (An exceedance of the standard occurs when a 24-hour average PM_{10} concentration is greater than 150 μg/m³. A violation of the standard occurs when a 24-hour average concentration greater than 150μg/m³ occurs more than once in a calendar year.) (40 CFR 50.6.)

*TEOM = tapered element oscillating micro-balance
BAM = Beta Attenuation Monitor

Color shading key:
> 1 24-hour average concentration >150 μg/m³

italics = site operated by other agencies

<u>underline</u> = National Park Service operated portable ozone system (POMS)

Table 3-9. PM_{10} violation summary - annual standard[1].

Sites operated by cooperating state agencies, 2003-2005

National Park Unit	Site Name	Sampler Type*	2003 - 2005
Badlands	Visitor Center	BAM	(9)
Wind Cave	Visitor Center	BAM	(7)

[1]The primary annual National Ambient Air Quality Standard for PM_{10} is an annual arithmetic mean of 50 μg/m³. (An exceedance of the standard occurs when an annual arithmetic mean of PM_{10} concentration is greater than 50 μg/m³. A violation of the standard occurs when the 3-year average of the weighted annual mean PM_{10} concentrations is greater than 50 μg/m³.) (40 CFR 50.6.)

*TEOM = tapered element oscillating micro-balance
BAM = Beta Attenuation Monitor

Color shading key:
> 50 μg/m³ 3-year average of annual means

() Note: A number in parenthesis () indicates that data completeness was not met. The primary annual standard requires 75 percent data completeness during the 3-year period, with no single calendar quarter 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 quarters with less than 75 percent data completeness are included in the computation if there are at least 11 samples per quarter and the resulting annual mean exceeds the standard. A site could be found not to have met the standard with less than complete data.

italics = site operated by other agencies

<u>underline</u> = National Park Service operated portable ozone system (POMS)

3.4 Meteorological Data Summaries

Meteorological data collected along with air quality parameters are used to better understand the local conditions and transport of air pollutants. In addition, meteorological data are essential for air quality deposition modeling efforts. Refer to Table 2-1 for a list of meteorological parameters collected at each site.

Table 3-10 presents a summary of selected meteorological data for all sites. The parameters included are wind speed, ambient temperature, relative humidity, and precipitation.

Great Smoky Mountains NP - Cades Cove Ambient Air Quality Monitoring Station

Table 3-10. Summary of selected meteorological data.

Sites operated by the National Park Service

		Wind Speed (Scalar[1]) (m/s)	Ambient Temperature (degrees C)			Relative Humidity (%)			Precipitation (mm)
National Park Unit	**Site Name**	**Average**	**Average**	**Maximum**	**Minimum**	**Average**	**Maximum**	**Minimum**	**Accumulated during period**
Badlands	Visitor Center	4.0	10.6	40.4	-27.6	57	98	6	42.9
Big Bend	K-Bar Ranch Road	3.4	20.5	38.9	-7.8	42	99	3	205.8
Canyonlands	Island in the Sky	2.9	12.5	36.4	-13.3	42	99	2	246.9
Chiricahua	Entrance Station	3.0	16.1	35.7	-8.5	42	100	7	284.6
Craters of the Moon	Visitor Center	3.3	6.1	33.1	-20.5	49	97	6	—
Death Valley	Park Village	3.6	25.7	49.8	5.7	24	99	2	102.8
Denali	Headquarters	1.3	-0.3	26.9	-32.0	68	98	17	261.8
Everglades	Beard Center	2.1	24.0	34.4	5.4	78	100	23	1600.2
Glacier	West Glacier Horse Stables	1.1	7.0	32.3	-30.0	74	100	16	935.7
Grand Canyon	The Abyss	2.8	10.8	32.9	-9.7	44	99	3	416.3
Great Basin	Maintenance Yard	2.7	8.9	34.1	-13.7	48	100	3	173.1
Great Smoky Mountains	Cades Cove	1.1	15.6	32.9	-12.1	80	100	16	983.3
Great Smoky Mountains	Clingmans Dome	3.7	11.2	22.7	-8.4	89	100	4	1021.8
Great Smoky Mountains	Cove Mountain	4.6	11.3	29.5	-15.1	72	100	3	863.6
Great Smoky Mountains	Look Rock	2.5	13.2	29.2	-13.7	70	100	14	1150.3
Hawaii Volcanoes	Observatory	5.2	16.0	25.5	8.5	85	100	11	1591.9
Hawaii Volcanoes	Visitor Center	3.8	16.0	25.6	8.1	90	100	22	2502.9
Joshua Tree	Black Rock	3.7	16.0	38.3	-0.3	39	100	3	540.4
Kobuk Valley	Ambler	2.4	-0.8	28.6	-44.2	67	98	21	212.1
Lassen Volcanic	Manzanita Lake Fire Stn.	2.0	7.1	29.7	-10.7	65	100	11	1270.2
Mammoth Cave	Houchin Meadow	1.7	14.4	34.5	-13.2	70	100	17	1129.2
Mesa Verde	Resource Mngment Area	2.9	10.6	32.9	-13.2	44	99	3	474.2
Mount Rainier	Tahoma Woods	1.1	9.0	31.7	-7.0	84	100	11	1377.6
North Cascades	Marblemount Ranger Stn.	1.4	10.1	33.3	-6.4	78	100	7	1726.6
Petrified Forest	South Entrance	4.1	13.3	36.3	-12.5	41	97	4	134.2
Pinnacles	SW of East Entrance Stn.	2.2	14.7	40.1	-3.1	63	97	5	365.8
Rocky Mountain	Long's Peak	2.8	4.4	26.6	-29.7	50	99	6	416.5
Sequoia and Kings Canyon	Ash Mountain	2.4	16.9	38.6	-0.7	56	100	9	573.1

-- continued --

Table 3-10 (continued). Summary of selected meteorological data.

Sites operated by the National Park Service

		Wind Speed (Scalar[1]) (m/s)	Ambient Temperature (degrees C)			Relative Humidity (%)			Precipitation (mm)
National Park Unit	**Site Name**	**Average**	**Average**	**Maximum**	**Minimum**	**Average**	**Maximum**	**Minimum**	**Accumulated during period**
Sequoia and Kings Canyon	Lower Kaweah	1.7	9.0	29.5	-7.4	66	100	8	1159.7
Shenandoah	Big Meadows	2.5	8.2	27.3	-20.1	74	100	8	1407.4
Voyageurs	Sullivan Bay	2.7	4.9	33.5	-33.2	72	100	11	768.2
Yellowstone	Old Faithful	2.0	2.2	29.7	-33.7	67	100	9	—
Yellowstone	Water Tank	1.6	1.5	28.4	-26.0	69	99	12	382.8
Yosemite	Merced River	0.2	10.2	33.7	-7.7	73	99	5	1142.5
Yosemite	Turtleback Dome	3.9	10.9	30.3	-5.4	55	99	6	1087.5
Zion	Dalton's Wash	3.0	15.3	41.0	-6.1	42	97	3	351.8

Sites operated by cooperating state agencies

		Wind Speed (Scalar[1]) (m/s)	Ambient Temperature (degrees C)			Relative Humidity (%)			Precipitation (mm)
National Park Unit	**Site Name**	**Average**	**Average**	**Maximum**	**Minimum**	**Average**	**Maximum**	**Minimum**	**Accumulated during period**
Acadia	Cadillac Mountain	6.4	13.3	27.8	-3.4	81	100	17	—
Acadia	McFarland Hill	3.4	7.2	30.5	-24.4	73	100	19	1327.7
Cape Cod	Cape Cod	2.7	9.5	30.9	-14.2	86	100	11	—
Chamizal	Chamizal	3.3	19.7	39.9	-6.9	34	96	4	—
Saguaro	Pima County	2.7	21.8	41.8	1.3	29	95	2	—
Theodore Roosevelt	Painted Cany. VC	5.2	6.9	35.0	-30.4	63	100	10	395.5
Wind Cave	Visitor Center	3.0	10.3	37.1	-22.2	50	98	8	350.8

-- continued --

Table 3-10 (continued). Summary of selected meteorological data.

Nearby sites operated by other agencies

		Wind Speed (Scalar[1]) (m/s)	Ambient Temperature (degrees C)			Relative Humidity (%)			Precipitation (mm)
National Park Unit	**Site Name**	**Average**	**Average**	**Maximum**	**Minimum**	**Average**	**Maximum**	**Minimum**	**Accumulated during period**
Alabama-Coushatta	CASTNet site	1.9	19.2	36.7	-2.0	72	100	14	860.5
Blue Ridge Parkway	7510 Blue Ridge Parkway	—	11.9	32.4	-15.8	82	100	16	—
Blue Ridge Parkway	Frying Pan Mountain	—	2.1	20.6	-18.7	74	100	16	—
Blue Ridge Parkway	Ranger Station	—	12.1	35.3	-14.0	72	99	14	—
Boston Harbor Islands	Former Nike Missle Site	3.4	8.1	30.9	-18.1	79	100	27	—
Guilford Courthouse	Mendenhall Middle School	1.4	15.5	35.9	-6.1	72	99	18	779.7
Indiana Dunes	Ammunition Bunker	3.4	10.6	37.8	-17.8	74	100	23	—
Indiana Dunes	Gas Station	3.3	10.9	36.5	-16.5	—	—	—	—
Mississippi	Somerset Town Hall	2.1	—	—	—	—	—	—	—
Petroglyph	Westside Taylor Ranch	—	16.5	38.3	-6.9	—	—	—	—
Saugus Iron Works	Lynn Water Treatment	2.7	9.4	33.9	-22.1	69	99	12	41.8

-- continued --

Table 3-10 (continued). Summary of selected meteorological data.

Portable ozone monitoring systems

		Wind Speed (Scalar[1]) (m/s)	Ambient Temperature (degrees C)			Relative Humidity (%)			Precipitation (mm)
National Park Unit	**Site Name**	**Average**	**Average**	**Maximum**	**Minimum**	**Average**	**Maximum**	**Minimum**	**Accumulated during period**
Abraham Lincoln Birthplace	Knob Creek High	—	25.0	34.8	15.2	80	98	34	—
Assateague Island	Maintenance Area	1.4	23.8	32.9	8.7	80	98	34	276.0
Big South Fork	Taft Story Fields	0.6	20.7	33.7	-1.0	75	97	23	470.6
Black Canyon of the Gunnison	Gravel Pit	2.3	14.9	32.5	-3.8	45	99	7	191.2
Carl Sandburg	Granite Dome 14	—	22.8	32.6	16.5	83	98	43	—
Chickamanga/Chatanooga	Maintenance Area Field	—	24.9	34.6	19.0	84	98	44	—
Cumberland Gap	Pinnacles	—	19.3	32.0	4.9	72	99	27	—
Dinosaur	West Entrance Housing	1.4	19.8	40.8	-0.7	43	100	7	104.6
Fort Donelson	Visitor Center	—	23.5	33.0	13.6	79	98	33	—
Gulf Islands	Fort Pickens Entrance Stn.	3.9	25.6	34.4	11.8	73	98	25	1500.7
Kings Mountain	Resevoir Hill	—	21.8	32.9	13.7	75	99	30	—
Lake Mead	Meadview	3.8	26.6	43.6	8.2	24	98	5	100.0
Lincoln Memorial University	University Field	—	24.0	31.9	14.7	75	98	32	—
Mammoth Cave	Biogarden	0.5	22.1	36.4	0.2	78	100	25	475.0
Mammoth Cave	Great Onyx Job Corps	—	18.1	31.3	0.3	76	99	23	—
Mammoth Cave	Great Onyx Meadow Portal	—	17.0	32.0	-1.1	84	98	25	—
Mount Rainier	Tahoma Vista	0.6	12.6	31.5	2.0	75	98	12	533.2
Ninety Six Historical Park	Bumble Bee Hill	—	24.7	32.6	17.2	83	98	43	—
Olympic	Hurricane Ridge Portable	0.8	8.3	23.1	-9.4	75	100	12	217.0
Padre Island	Malaquite Visitor Center	6.0	27.8	37.7	16.5	77	95	26	209.2
Shiloh	Russian Tenant Field	—	23.3	33.7	13.2	80	98	33	—
Stones River	Chicago Bottom Field	—	26.4	36.9	18.8	76	98	33	—
Yosemite	Tioga Pass	—	9.8	22.5	-4.6	50	98	11	—

1. Saguaro reports wind speed as vector wind speed rather than scalar wind speed.

Note: Dashed lines represent no data available for that particular parameter at that site.

italics = site operated by other agencies

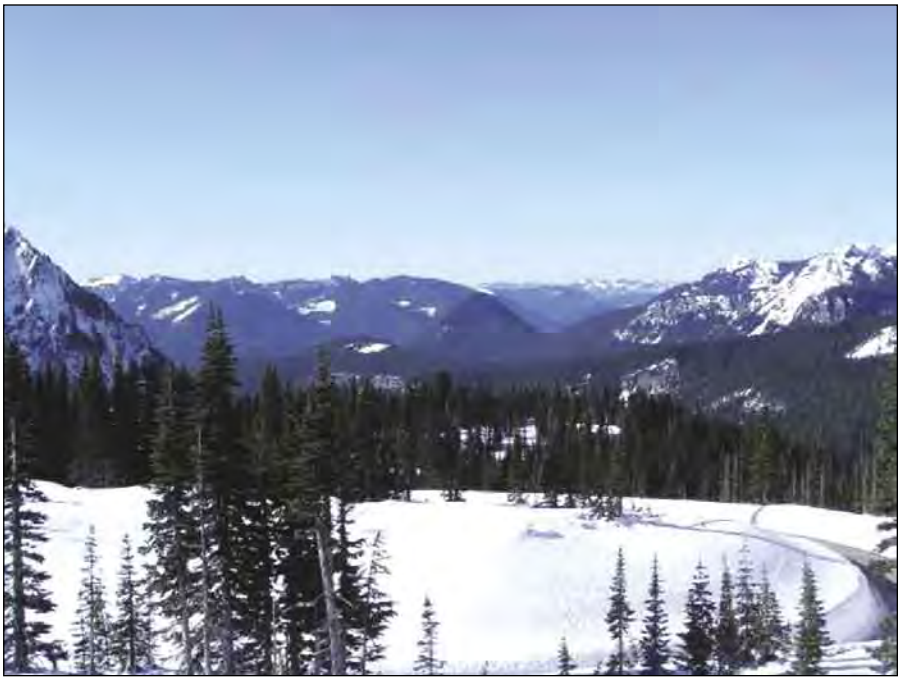
underline = National Park Service operated portable ozone system (POMS)

4.0 Data Quality Assurance

4.1 Data Collection

Table 4-1 presents data collection statistics for each parameter by site and presents the overall network average by parameter. The network average valid data collection for ozone at sites operated by the National Park Service was 96.7%, and for sulfur dioxide was 92.6%.

Table 4-2 presents a network summary of data collection statistics by parameter. Annual and quarterly network average statistics are presented, along with the number and percentage of sites which met the minimum EPA data collection criteria of 75%. For 2005, 31 of 31 ozone sites and 3 of 4 sulfur dioxide sites met or exceeded the annual EPA criteria at sites operated by the National Park Service.



Mount Rainier NP, Washington

Table 4-1. Data collection statistics.

Sites operated by the National Park Service

National Park Unit	Site Name	Parameter Code										
		O3 % valid[1]	SO2 % valid[1]	VWD[2] % valid[1]	SWS[3] % valid[1]	TMP % valid[1]	RH % valid[1]	RNF % valid[1]	WET % valid[1]	DTP % valid[1]	SOL % valid[1]	FLOW % valid[1]
Badlands	Visitor Center	99.2	98.9	76.2	98.8	99.7	99.7	55.3	—	—	97.1	—
Big Bend	K-Bar Ranch Road	92.1	—	98.2	98.2	96.9	98.6	98.5	90.8	96.9	97.0	94.3
Canyonlands	Island in the Sky	95.1	—	97.7	97.7	99.8	99.5	99.0	98.8	99.8	99.8	99.5
Chiricahua	Entrance Station	95.9	—	99.9	99.9	99.9	97.0	99.3	99.3	99.9	99.9	99.9
Craters of the Moon	Visitor Center	97.2	—	99.8	99.8	99.5	98.5	—	—	—	95.9	—
Denali	Headquarters	99.8	—	99.9	99.9	99.9	100.0	99.7	99.9	99.9	99.9	99.9
Death Valley	Park Village	95.2	—	99.4	99.4	98.7	99.5	98.9	98.9	98.7	99.3	99.6
Everglades	Beard Center	—	—	88.6	88.6	95.6	95.6	95.1	95.5	80.8	95.7	97.4
Glacier	West Glacier Horse Stables	98.4	—	86.2	94.1	81.4	99.9	99.2	99.4	81.4	99.7	99.9
Great Basin	Maintenance Yard	99.0	—	97.1	97.1	98.4	99.5	84.5	98.9	98.4	98.5	89.7
Grand Canyon	The Abyss	99.2	—	99.5	99.5	99.5	99.6	99.1	90.2	99.5	99.7	99.4
Great Smoky Mountains	Cades Cove	98.9	—	97.6	97.6	99.9	90.9	99.2	—	—	99.9	—
Great Smoky Mountains	Clingmans Dome	98.6	—	99.1	99.1	99.1	99.1	96.9	—	—	99.1	—
Great Smoky Mountains	Cove Mountain	99.6	—	99.1	99.1	96.3	98.7	80.2	—	—	99.3	—
Great Smoky Mountains	Look Rock	99.3	—	99.2	99.2	99.3	99.4	98.9	98.9	99.3	99.4	99.6
Hawaii Volcanoes	Observatory	—	97.7	100.0	100.0	100.0	99.9	99.4	—	—	—	—
Hawaii Volcanoes	Visitor Center	—	99.4	99.9	99.9	100.0	100.0	99.5	—	—	91.2	—
Joshua Tree	Black Rock	97.8	—	94.3	94.3	99.9	99.9	99.2	99.3	99.9	99.9	99.9
Kobuk Valley	Ambler	—	—	54.5	98.4	97.4	97.4	55.9	97.2	97.4	97.4	53.1
Lassen Volcanic	Manzanita Lake Fire Stn.	99.4	—	96.7	96.7	99.5	99.5	98.9	99.1	99.5	99.6	90.1
Mammoth Cave	Houchin Meadow	99.8	—	99.6	99.9	99.6	100.0	99.1	99.4	81.8	100.0	100.0
Mesa Verde	Resource Mngment Area	99.8	—	99.7	99.7	99.8	100.0	99.3	99.4	98.0	99.8	100.0
Mount Rainier	Tahoma Woods	81.2	—	88.6	95.3	99.7	99.8	99.1	80.2	98.2	97.3	99.8
North Cascades	Marblemount Ranger Stn.	83.8	—	99.2	99.2	99.3	99.4	98.6	98.8	99.3	99.4	99.4
Petrified Forest	South Entrance	91.3	—	84.2	98.3	98.5	98.6	55.8	97.9	98.5	98.0	98.6
Pinnacles	SW of East Entrance Stn.	99.6	—	99.6	99.6	99.6	99.8	99.1	95.2	99.6	99.6	97.5
Rocky Mountain	Long's Peak	96.5	—	99.6	99.6	99.8	99.9	97.0	99.3	99.8	99.9	99.7
Sequoia and Kings Canyon	Ash Mountain	97.8	—	99.4	99.4	99.5	88.2	73.3	99.1	99.7	99.5	97.4

-- continued --

Table 4-1 (continued). Data collection statistics.

Sites operated by the National Park Service

National Park Unit	Site Name	Parameter Code										
		O3 % valid[1]	SO2 % valid[1]	VWD[2] % valid[1]	SWS[3] % valid[1]	TMP % valid[1]	RH % valid[1]	RNF % valid[1]	WET % valid[1]	DTP % valid[1]	SOL % valid[1]	FLOW % valid[1]
Sequoia and Kings Canyon	Lower Kaweah	99.3	——	99.3	99.3	99.3	99.6	98.8	——	——	99.3	——
Shenandoah	Big Meadows	92.8	74.6	95.2	98.8	98.8	98.7	98.4	97.0	98.8	99.0	95.7
Voyageurs	Sullivan Bay	98.8	——	91.8	91.8	99.9	99.9	99.2	99.5	99.9	99.9	99.9
Yellowstone	Old Faithful	——	——	94.4	99.3	99.9	99.9	——	——	——	——	——
Yellowstone	Water Tank	98.4	——	99.5	99.5	99.5	99.6	93.0	93.5	87.2	79.5	99.8
Yosemite	Merced River	98.8	——	99.7	99.7	99.6	99.7	99.2	——	——	99.8	——
Yosemite	Turtleback Dome	99.1	——	97.6	97.6	99.3	99.3	66.3	98.8	99.2	99.4	99.3
Zion	Dalton's Wash	97.2	——	98.5	98.5	95.8	89.0	96.8	——	——	98.9	——
Average Network Data Collection		**96.7**	**92.6**	**95.5**	**98.1**	**98.6**	**98.5**	**92.2**	**97.0**	**96.4**	**98.1**	**96.9**

Sites operated by cooperating state agencies

National Park Unit	Site Name	Parameter Code										
		O3 % valid[1]	SO2 % valid[1]	VWD[2] % valid[1]	SWS[3] % valid[1]	TMP % valid[1]	RH % valid[1]	RNF % valid[1]	WET % valid[1]	DTP % valid[1]	SOL % valid[1]	FLOW % valid[1]
Acadia	Cadillac Mountain	99.0	——	95.6	96.3	99.9	99.9	——	——	——	——	——
Acadia	McFarland Hill	99.5	——	98.8	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.8
Cape Cod	Cape Cod	97.3	——	93.1	98.5	99.7	99.7	——	——	——	99.7	——
Chamizal	Chamizal	99.4	——	99.6	99.8	99.8	99.9	——	——	——	99.9	——
Congaree	Congaree Bluff	89.1	93.5	——	——	——	——	——	——	——	——	——
Cowpens	State Monitor	98.9	——	——	——	——	——	——	——	——	——	——
Great Smoky Mountains	Purchase Knob	93.8	——	——	——	——	——	——	——	——	——	——
Saguaro	Pima County	99.7	——	99.2	99.3	100.0	100.0	——	——	——	99.6	——
Theodore Roosevelt	Painted Cany. VC	94.9	94.9	95.0	95.0	94.9	95.0	94.4	94.5	94.9	88.1	84.3
Wind Cave	Visitor Center	99.2	99.2	98.9	99.0	59.5	97.3	98.5	94.1	59.5	98.8	99.1
Average Network Data Collection		**97.1**	**95.9**	**97.3**	**98.4**	**92.9**	**98.7**	**97.6**	**96.2**	**84.7**	**97.7**	**94.4**

-- continued --

Table 4-1 (continued). Data collection statistics.

Nearby sites operated by other agencies

National Park Unit	Site Name	Parameter Code										
		O3 % valid[1]	SO2 % valid[1]	VWD[2] % valid[1]	SWS[3] % valid[1]	TMP % valid[1]	RH % valid[1]	RNF % valid[1]	WET % valid[1]	DTP % valid[1]	SOL % valid[1]	FLOW % valid[1]
Alabama-Coushatta	CASTNet site	85.5	—	97.7	97.7	97.7	97.7	96.6	97.0	95.4	95.2	97.6
Appalachian Trail	Mount Greylock Summit	97.5	—	—	—	—	—	—	—	—	—	—
Blue Ridge Parkway	7510 Blue Ridge Parkway	95.7	—	—	—	99.7	99.7	—	—	—	—	—
Blue Ridge Parkway	Blue Ridge Parkway	94.1	—	—	—	—	—	—	—	—	—	—
Blue Ridge Parkway	Vinton Elementary	98.5	97.2	—	—	—	—	—	—	—	—	—
Blue Ridge Parkway	Frying Pan Mountain	94.5	—	—	—	95.6	95.5	—	—	—	—	—
Blue Ridge Parkway	Route 191	99.9	—	—	—	—	—	—	—	—	—	—
Blue Ridge Parkway	Ranger Station	98.9	—	—	—	100.0	100.0	—	—	—	—	—
Boston Harbor Islands	Former Nike Missle Site	97.1	—	—	99.7	99.7	99.7	—	—	—	99.7	—
Cuyahoga Valley	800 Patterson	99.9	—	—	—	—	—	—	—	—	—	—
Everglades	Cutler Road	94.8	—	—	—	—	—	—	—	—	—	—
George Washington Pkwy	Alexandria Health	97.2	91.7	—	—	—	—	—	—	—	—	—
Guilford Courthouse	Mendenhall Middle School	95.5	—	—	97.4	96.5	99.9	99.9	—	96.5	99.9	—
Indiana Dunes	Gas Station	98.1	99.9	—	99.8	99.8	—	—	—	99.8	—	—
Indiana Dunes	Ammunition Bunker	97.8	97.7	—	90.7	99.9	99.8	—	—	—	99.8	—
Indiana Dunes	Water Treatment Plant	99.3	—	—	—	—	—	—	—	—	—	—
Mississippi	Anoka County Airport	99.8	97.4	—	—	—	—	—	—	—	—	—
Mississippi	Somerset Town Hall	97.6	—	—	99.7	—	—	—	—	—	—	—
Mississippi	Washington County	98.8	—	—	—	—	—	—	—	—	—	—
Olympic	Blyn Lookout Relay	70.6	—	—	—	—	—	—	—	—	—	—
Petroglyph	Westside Taylor Ranch	99.9	—	—	—	99.0	—	—	—	—	98.3	—
Rock Creek	Achbold Parkway	98.0	—	—	—	—	—	—	—	—	—	—
Saugus Iron Works	Lynn Water Treatment	97.3	—	—	99.9	99.9	99.9	100.0	—	—	29.8	—
Saratoga	Stillwater	96.5	—	—	—	—	—	—	—	—	—	—
Average Network Data Collection		**96.1**	**96.8**	**97.7**	**97.8**	**98.8**	**99.4**	**98.8**	**97.0**	**97.3**	**86.4**	**97.6**

-- continued --

Table 4-1 (continued). Data collection statistics.

Portable ozone monitoring systems[4]

National Park Unit	Site Name	Parameter Code										
		O3 % valid[1]	SO2 % valid[1]	VWD[2] % valid[1]	SWS[3] % valid[1]	TMP % valid[1]	RH % valid[1]	RNF % valid[1]	WET % valid[1]	DTP % valid[1]	SOL % valid[1]	FLOW % valid[1]
Abraham Lincoln Birthplace	Knob Creek High	100.0	—	—	—	100.0	100.0	—	—	—	—	—
Assateague Island	Maintenance Area	84.2	—	100.0	100.0	100.0	100.0	100.0	—	—	100.0	—
Big South Fork	Taft Story Fields	96.8	—	100.0	100.0	100.0	100.0	100.0	—	—	100.0	—
Black Canyon of the Gunnison	Gravel Pit	93.2	—	99.9	99.9	99.9	99.9	99.9	—	—	99.9	—
Carl Sandburg	Granite Dome 14	100.0	—	—	—	100.0	100.0	—	—	—	—	—
Chickamanga/Chatanooga	Maintenance Area Field	100.0	—	—	—	100.0	100.0	—	—	—	—	—
Cumberland Gap	Pinnacles	96.0	—	—	—	97.8	97.8	—	—	—	—	—
Dinosaur	West Entrance Housing	99.3	—	100.0	100.0	99.4	99.4	100.0	—	—	99.4	98.4
Fort Donelson	Visitor Center	100.0	—	—	—	99.8	100.0	—	—	—	—	—
Gulf Islands	Fort Pickens Entrance Stn.	97.1	—	99.9	99.9	99.8	99.8	99.8	—	—	93.5	—
Kings Mountain	Resevoir Hill	100.0	—	—	—	100.0	100.0	—	—	—	—	—
Lake Mead	Meadview	99.2	—	99.9	99.9	99.9	99.9	99.8	—	—	99.9	—
Lincoln Memorial University	University Field	100.0	—	—	—	100.0	100.0	—	—	—	—	—
Mammoth Cave	Biogarden	99.9	—	100.0	100.0	99.9	99.9	100.0	—	—	99.9	—
Mammoth Cave	Great Onyx Meadow Portable	99.9	—	—	—	100.0	100.0	—	—	—	—	—
Mammoth Cave	Great Onyx Job Corps	100.0	—	—	—	100.0	100.0	—	—	—	—	—
Mount Rainier	Tahoma Vista	99.9	—	100.0	100.0	100.0	100.0	100.0	—	—	100.0	—
Ninety Six Historical Park	Bumble Bee Hill	99.8	—	—	—	100.0	100.0	—	—	—	—	—
Olympic	Hurricane Ridge Portable	91.1	—	100.0	100.0	100.0	100.0	100.0	—	—	100.0	—
Padre Island	Malaquite Visitor Center	91.4	—	100.0	99.9	100.0	99.7	100.0	—	—	69.6	—
Shiloh	Russian Tenant Field	96.4	—	—	—	100.0	100.0	—	—	—	—	—
Stones River	Chicago Bottom Field	100.0	—	—	—	100.0	100.0	—	—	—	—	—
Yosemite	Tioga Pass	99.9	—	—	—	100.0	100.0	—	—	—	—	—
Average Network Data Collection		**96.6**		**100**	**100.0**	**99.9**	**99.8**	**99.9**			**96.1**	**98.4**

Key:

O3 = Ozone Analyzer
SO2 = Sulfur Dioxide Analyzer
VWD = Vector Wind Direction
SWS = Scalar Wind Speed
TMP = Ambient Temperature
RH = Relative Humidity
RNF = Precipitation
WET = Wetness Sensor
DTP = Delta Temperature
SOL = Solar Radition
FLOW = Filter Pack Flow Rate

1. The percent is calculated against the number possible. Percent valid can be less than 100% due to routine maintenance, power failures, audits or other circumstances where the instrument was not available to collect data. Percent valid can also be less than 100% due to influencing factors such as instrument error, operator error, timing problems, flow issues, and other factors that affect instrument operation. When calculating percent valid for O_3 and SO_2, calibration events were removed from the number possible.

2. Cape Cod reports wind direction as scalar wind direction rather than vector wind direction.

3. Saguaro reports wind speed as vector wind speed rather than scalar wind speed.

4. Portable ozone monitoring systems typically operate during the summer ozone season only.

italics = site operated by other agencies

underline = National Park Service operated portable ozone system (POMS)

Table 4-2. Network summary of data collection statistics.

Sites operated by the National Park Service

Calendar Quarter	Network Data Collection Statistic[1]	Units	Parameter Code										
			O3	SO2	VWD	SWS	TMP	RH	RNF	WET	DTP	SOL	FLOW
Annual	Annual Network Average	%	96.7	92.6	95.5	98.1	98.6	98.5	92.2	97.0	96.4	98.1	96.9
	No. Sites>=75% Valid	No. Sites (%)	31 (100%)	3 (75%)	35 (97%)	36 (100%)	36 (100%)	36 (100%)	29 (85%)	25 (100%)	25 (100%)	34 (100%)	24 (96%)
	No. Sites <75% Valid	No. Sites (%)	0 (0%)	1 (25%)	1 (3%)	0 (0%)	0 (0%)	0 (0%)	5 (15%)	0 (0%)	0 (0%)	0 (0%)	1 (4%)
1	Quarterly Network Average	%	97.1	97.6	92.2	99.2	99.6	99.3	95.4	97.2	96.5	98.1	95.6
	No. Sites >=75% Valid	No. Sites (%)	29 (100%)	4 (100%)	31 (91%)	34 (100%)	34 (100%)	34 (100%)	31 (97%)	23 (96%)	23 (96%)	31 (97%)	23 (96%)
	No. Sites <75% Valid	No. Sites (%)	0 (0%)	0 (0%)	3 (9%)	0 (0%)	0 (0%)	0 (0%)	1 (3%)	1 (4%)	1 (4%)	1 (3%)	1 (4%)
2	Quarterly Network Average	%	96.0	99.0	97.1	98.7	99.5	97.6	90.7	98.3	99.6	99.1	96.3
	No. Sites >=75% Valid	No. Sites (%)	30 (97%)	4 (100%)	34 (94%)	36 (100%)	36 (100%)	34 (94%)	29 (85%)	25 (100%)	25 (100%)	34 (100%)	23 (92%)
	No. Sites <75% Valid	No. Sites (%)	1 (3%)	0 (0%)	2 (6%)	0 (0%)	0 (0%)	2 (6%)	5 (15%)	0 (0%)	0 (0%)	0 (0%)	2 (8%)
3	Quarterly Network Average	%	96.3	91.8	98.6	98.9	98.8	98.2	88.9	96.5	96.9	98.1	97.0
	No. Sites >=75% Valid	No. Sites (%)	30 (97%)	4 (100%)	36 (100%)	36 (100%)	36 (100%)	35 (97%)	30 (88%)	24 (96%)	24 (96%)	33 (97%)	24 (96%)
	No. Sites <75% Valid	No. Sites (%)	1 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (3%)	4 (12%)	1 (4%)	1 (4%)	1 (3%)	1 (4%)
4	Quarterly Network Average	%	97.4	82.4	93.8	95.7	96.3	98.9	94.1	95.8	92.5	97.1	98.6
	No. Sites >=75% Valid	No. Sites (%)	30 (97%)	3 (75%)	32 (91%)	33 (94%)	34 (97%)	35 (100%)	31 (94%)	24 (100%)	22 (92%)	32 (97%)	24 (100%)
	No. Sites <75% Valid	No. Sites (%)	1 (3%)	1 (25%)	3 (9%)	2 (6%)	1 (3%)	0 (0%)	2 (6%)	0 (0%)	2 (8%)	1 (3%)	0 (0%)

-- continued --

Table 4-2 (continued). Network summary of data collection statistics.

Sites operated by cooperating state agencies

Calendar Quarter	Network Data Collection Statistic[1]	Units	Parameter Code										
			O3	SO2	VWD	SWS	TMP	RH	RNF	WET	DTP	SOL	FLOW
Annual	Annual Network Average	%	97.1	95.9	97.3	98.4	92.9	98.7	97.6	96.2	84.7	97.7	94.4
	No. Sites>=75% Valid	No. Sites (%)	10 (100%)	3 (100%)	7 (100%)	7 (100%)	6 (86%)	7 (100%)	3 (100%)	3 (100%)	2 (67%)	6 (100%)	3 (100%)
	No. Sites <75% Valid	No. Sites (%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (14%)	0 (0%)	0 (0%)	0 (0%)	1 (33%)	0 (0%)	0 (0%)
1	Quarterly Network Average	%	98.7	97.4	98.7	97.9	98.8	98.9	97.4	97.6	97.8	98.9	97.8
	No. Sites >=75% Valid	No. Sites (%)	7 (100%)	3 (100%)	6 (100%)	6 (100%)	6 (100%)	6 (100%)	3 (100%)	3 (100%)	3 (100%)	6 (100%)	3 (100%)
	No. Sites <75% Valid	No. Sites (%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
2	Quarterly Network Average	%	98.0	96.8	93.6	97.8	96.2	97.7	96.9	91.0	91.3	96.8	97.2
	No. Sites >=75% Valid	No. Sites (%)	10 (100%)	3 (100%)	6 (86%)	7 (100%)	7 (100%)	7 (100%)	3 (100%)	3 (100%)	3 (100%)	6 (100%)	3 (100%)
	No. Sites <75% Valid	No. Sites (%)	0 (0%)	0 (0%)	1 (14%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
3	Quarterly Network Average	%	97.5	96.7	98.4	98.6	93.1	98.9	97.1	97.1	84.1	98.0	97.4
	No. Sites >=75% Valid	No. Sites (%)	10 (100%)	3 (100%)	7 (100%)	7 (100%)	6 (86%)	7 (100%)	3 (100%)	3 (100%)	2 (67%)	6 (100%)	3 (100%)
	No. Sites <75% Valid	No. Sites (%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (14%)	0 (0%)	0 (0%)	0 (0%)	1 (33%)	0 (0%)	0 (0%)
4	Quarterly Network Average	%	93.9	92.6	98.8	99.4	82.9	99.6	99.0	99.1	66.1	97.0	85.3
	No. Sites >=75% Valid	No. Sites (%)	7 (88%)	3 (100%)	6 (100%)	6 (100%)	5 (83%)	6 (100%)	3 (100%)	3 (100%)	2 (67%)	6 (100%)	2 (67%)
	No. Sites <75% Valid	No. Sites (%)	1 (12%)	0 (0%)	0 (0%)	0 (0%)	1 (17%)	0 (0%)	0 (0%)	0 (0%)	1 (33%)	0 (0%)	1 (33%)

-- continued --

Table 4-2 (continued). Network summary of data collection statistics.

Nearby sites operated by other agencies

Calendar Quarter	Network Data Collection Statistic[1]	Units	Parameter Code										
			O3	SO2	VWD	SWS	TMP	RH	RNF	WET	DTP	SOL	FLOW
Annual	Annual Network Average	%	96.1	96.8	97.7	97.8	98.8	99.4	98.8	97.0	97.3	86.4	97.6
	No. Sites>=75% Valid	No. Sites (%)	23 (96%)	5 (100%)	1 (100%)	7 (100%)	10 (100%)	8 (100%)	3 (100%)	1 (100%)	3 (100%)	5 (83%)	1 (100%)
	No. Sites <75% Valid	No. Sites (%)	1 (4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (17%)	0 (0%)
1	Quarterly Network Average	%	95.3	97.6	99.8	94.2	97.3	99.3	99.6	99.2	95.7	81.1	99.6
	No. Sites >=75% Valid	No. Sites (%)	6 (86%)	5 (100%)	1 (100%)	5 (83%)	10 (100%)	8 (100%)	3 (100%)	1 (100%)	3 (100%)	5 (83%)	1 (100%)
	No. Sites <75% Valid	No. Sites (%)	1 (14%)	0 (0%)	0 (0%)	1 (17%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (17%)	0 (0%)
2	Quarterly Network Average	%	95.7	96.6	99.7	98.6	99.8	99.8	99.5	98.9	99.7	83.2	99.5
	No. Sites >=75% Valid	No. Sites (%)	23 (96%)	5 (100%)	1 (100%)	7 (100%)	10 (100%)	8 (100%)	3 (100%)	1 (100%)	3 (100%)	5 (83%)	1 (100%)
	No. Sites <75% Valid	No. Sites (%)	1 (4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (17%)	0 (0%)
3	Quarterly Network Average	%	97.2	96.7	92.2	98.4	98.8	98.7	97.0	91.5	94.2	86.9	92.2
	No. Sites >=75% Valid	No. Sites (%)	24 (100%)	5 (100%)	1 (100%)	7 (100%)	9 (100%)	7 (100%)	3 (100%)	1 (100%)	3 (100%)	5 (83%)	1 (100%)
	No. Sites <75% Valid	No. Sites (%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (17%)	0 (0%)
4	Quarterly Network Average	%	94.9	96.2	99.2	99.4	99.7	99.7	99.2	98.6	99.6	96.6	99.0
	No. Sites >=75% Valid	No. Sites (%)	17 (100%)	5 (100%)	1 (100%)	7 (100%)	8 (100%)	7 (100%)	3 (100%)	1 (100%)	3 (100%)	5 (100%)	1 (100%)
	No. Sites <75% Valid	No. Sites (%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

-- continued --

Table 4-2 (continued). Network summary of data collection statistics.

Portable ozone monitoring systems[2]

Calendar Quarter	Network Data Collection Statistic[1]	Units	Parameter Code										
			O3	SO2	VWD	SWS	TMP	RH	RNF	WET	DTP	SOL	FLOW
Annual	Annual Network Average	%	96.3		100.0	100.0	99.9	99.8	99.9			96.1	98.4
	No. Sites>=75% Valid	No. Sites (%)	23 (100%)	0	10 (100%)	10 (100%)	23 (100%)	23 (100%)	10 (100%)	0	0	9 (90%)	1 (100%)
	No. Sites <75% Valid	No. Sites (%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0	1 (10%)	0 (0%)
1	Quarterly Network Average	%	92.2		98.4	98.4	97.9	97.9	97.4			97.9	
	No. Sites >=75% Valid	No. Sites (%)	1 (100%)	0	1 (100%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)	0	0	1 (100%)	0
	No. Sites <75% Valid	No. Sites (%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0	0 (0%)	0
2	Quarterly Network Average	%	96.9		99.9	99.9	99.8	99.8	99.9			95.7	95.8
	No. Sites >=75% Valid	No. Sites (%)	13 (93%)	0	10 (100%)	10 (100%)	14 (100%)	14 (100%)	10 (100%)	0	0	9 (90%)	1 (100%)
	No. Sites <75% Valid	No. Sites (%)	1 (7%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0	1 (10%)	0 (0%)
3	Quarterly Network Average	%	95.5		100.0	100.0	99.9	99.9	100.0			96.3	100.0
	No. Sites >=75% Valid	No. Sites (%)	21 (100%)	0	10 (100%)	10 (100%)	21 (100%)	21 (100%)	10 (100%)	0	0	10 (100%)	1 (100%)
	No. Sites <75% Valid	No. Sites (%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0	0 (0%)	0 (0%)
4	Quarterly Network Average	%	99.9		100.0	99.9	100.0	99.7	100.0			96.7	100.0
	No. Sites >=75% Valid	No. Sites (%)	10 (100%)	0	8 (100%)	8 (100%)	10 (100%)	10 (100%)	8 (100%)	0	0	7 (88%)	1 (100%)
	No. Sites <75% Valid	No. Sites (%)	0 (0%)	0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	0	1 (12%)	0 (0%)

Key:

O3 = Ozone Analyzer
SO2 = Sulfur Dioxide Analyzer
VWD = Vector Wind Direction
SWS = Scalar Wind Speed
TMP = Ambient Temperature
RH = Relative Humidity
RNF = Precipitation
WET = Wetness Sensor
DTP = Delta Temperature
SOL = Solar Radition
FLOW = Filter Pack Flow Rate

1. Network data collection statistics include: 1) the percent of valid hourly averages for each parameter across the network; 2) the number and percent of sites which achieved the minimum EPA requirement of 75% valid data capture; and 3) the number and percent of sites which failed to meet 75% valid data capture.

2. Portable ozone monitoring systems typically operate during the summer ozone season only.

italics = site operated by other agencies

underline = National Park Service operated portable ozone system (POMS)

4.2 Precision and Accuracy

Ozone analyzers are automatically challenged daily with known zero and span concentrations. Most sites also undergo an automatic daily precision check. At a few sites, precision checks are performed weekly. All EPA reference method ozone sites operate both an analyzer (with ozone generator) and calibrator on site. The daily zero, span, and precision values are measured by both instruments, providing an independent reference to the on-site measurements. The NPS goal is for precision checks to fall within ± 10% of the calibration gas concentration.

Routine quality assurance multipoint calibrations of the GPMP ozone analyzers and calibrators are performed by the site operators monthly, and by the NPS-contracted network field specialists upon initial installation and every six months thereafter. Network field specialists perform their quality assurance checks using an ozone transfer standard (traceable to a NIST-certified primary standard). The NPS goal is for these accuracy checks to fall within ± 10% of the transfer standard gas concentrations. For more information on quality assurance within the network, please refer to the Quality Management Plan (QMP) and the Quality Assurance Project Plan (QAPP) which can be found on the Internet at: *http://www2.nature.nps.gov/air/monitoring/network.cfm#procedures*.

Table 4-3 presents a summary of ozone analyzer precision results and semiannual accuracy results, by quarter, for 2005. Results are color-coded to indicate ideal performance (no shading), acceptable performance (yellow), and unacceptable performance (red). Accuracy results are presented only for NPS-operated sites, and typically include two entries for the year.

Table 4-4 presents a network summary of ozone analyzer precision and accuracy, by quarter, for 2005. Included in the table are the number of sites whose precision and accuracy checks fell within ± 5%, ± 10%, and outside of ± 10%.

Yosemite National Park - aerial view
NPS photo by L. Tarnay

Table 4-3. Ozone analyzer precision and accuracy summary.

Sites operated by the National Park Service

			Precision				Accuracy		
National Park Unit	**Site Name**	**Calendar Quarter**	**Required No. of Precision Checks Met?[1]**	**Avg. Absolute Percent Difference[3,4]**	**Lower 95% Probability Limit[6]**	**Upper 95% Probability Limit[6]**	**Accuracy Check Performed During the Quarter?[2]**	**Avg. Absolute Percent Difference[3,4]**	**Maximum Percent Difference[5]**
Badlands	Visitor Center	1	Y	2.0	-3.6	-0.4	Y	2.1	-3.3
		2	Y	1.7	-3.2	-0.2	Y	3.7	-5.9
		3	Y	0.6	-2.1	0.9	N	—	—
		4	Y	1.5	-3.3	0.3	Y	2.9	-5.9
Big Bend	K-Bar Ranch Road	1	Y	2.9	-13.0	7.1	N	—	—
		2	Y	2.6	-9.3	4.1	Y	1.7	-2.9
		3	Y	3.8	-5.6	-2.1	N	—	—
		4	Y	1.2	-4.7	2.4	Y	0.1	0.4
Canyonlands	Island in the Sky	1	Y	4.8	-0.2	9.9	N	—	—
		2	Y	0.3	-5.7	5.1	Y	1.7	-2.7
		3	Y	1.9	-7.2	3.5	N	—	—
		4	Y	3.7	-0.1	7.5	N	—	—
Chiricahua	Entrance Station	1	Y	0.5	-0.6	1.5	N	—	—
		2	Y	0.2	-0.7	1.2	Y	3.0	4.3
		3	Y	0.6	-0.9	2.0	N	—	—
		4	Y	1.5	0.4	2.6	N	—	—
Craters of the Moon	Visitor Center	1	N	2.9	-5.2	-0.5	N	—	—
		2	Y	1.4	-3.6	0.8	N	—	—
		3	Y	1.4	-3.9	6.6	Y	2.6	4.3
		4	Y	0.9	-2.0	3.9	N	—	—
Denali	Headquarters	1	Y	1.6	-2.7	-0.6	N	—	—
		2	Y	0.7	-2.1	0.8	Y	5.1	5.9
		3	Y	0.0	-1.9	1.8	Y	2.9	-4.1
		4	Y	0.8	-0.3	1.8	N	—	—
Death Valley	Park Village	1	Y	0.0	-3.3	3.3	N	—	—
		2	Y	0.7	-6.4	5.1	Y	11.8	14.7
		3	Y	1.3	-0.5	3.1	N	—	—
		4	Y	0.9	-4.8	3.1	Y	3.3	3.7
Glacier	West Glacier Horse Stables	1	Y	3.0	0.1	6.0	N	—	—
		2	Y	3.7	0.8	6.7	Y	1.5	-2.1
		3	Y	3.3	0.4	6.1	N	—	—
		4	Y	1.7	-6.8	3.4	Y	0.4	-1.4
Great Basin	Maintenance Yard	1	Y	1.1	-5.0	2.9	N	—	—
		2	Y	0.3	-2.0	2.6	Y	1.0	1.5
		3	Y	0.8	-0.4	2.0	N	—	—
		4	Y	0.0	-1.4	1.4	Y	0.9	1.8
Grand Canyon	The Abyss	1	Y	0.4	-1.2	1.9	N	—	—
		2	Y	2.0	-0.5	4.4	Y	3.0	-3.8
		3	Y	2.9	1.8	4.0	N	—	—
		4	Y	1.9	0.6	3.2	Y	1.3	2.7

-- continued --

Table 4-3 (continued). Ozone analyzer precision and accuracy summary.

Sites operated by the National Park Service

			Precision				Accuracy		
National Park Unit	Site Name	Calendar Quarter	Required No. of Precision Checks Met?[1]	Avg. Absolute Percent Difference[3,4]	Lower 95% Probability Limit[6]	Upper 95% Probability Limit[6]	Accuracy Check Performed During the Quarter?[2]	Avg. Absolute Percent Difference[3,4]	Maximum Percent Difference[5]
Great Smoky Mountains	Cades Cove	1	—	—	—	—	—	—	—
		2	Y	1.4	-7.2	4.4	Y	1.2	-4.0
		3	Y	1.6	-5.7	2.5	N	—	—
		4	Y	3.0	-7.0	1.0	Y	2.6	-4.3
Great Smoky Mountains	Clingmans Dome	1	—	—	—	—	—	—	—
		2	Y	0.0	-11.7	11.7	N	—	—
		3	Y	0.6	-6.1	7.3	N	—	—
		4	Y	2.2	-1.3	5.8	N	—	—
Great Smoky Mountains	Cove Mountain	1	Y	0.1	-4.4	4.2	N	—	—
		2	Y	1.7	-1.7	5.0	Y	2.9	3.5
		3	Y	2.5	-0.9	5.9	N	—	—
		4	Y	1.4	-1.7	4.4	Y	5.3	-6.4
Great Smoky Mountains	Look Rock	1	Y	0.4	-2.4	3.2	N	—	—
		2	Y	0.7	-1.1	2.5	Y	9.1	9.9
		3	Y	1.5	0.1	3.0	N	—	—
		4	Y	0.0	-3.0	2.9	N	—	—
Joshua Tree	Black Rock	1	Y	1.3	-3.0	0.3	N	—	—
		2	Y	1.3	-3.4	0.8	Y	2.4	-2.9
		3	Y	0.5	-2.5	1.5	N	—	—
		4	Y	0.3	-3.1	2.4	N	—	—
Lassen Volcanic	Manzanita Lake Fire Stn.	1	Y	0.2	-1.9	2.2	Y	1.6	-2.9
		2	Y	0.3	-1.8	2.3	N	—	—
		3	Y	1.4	-3.5	6.4	Y	1.2	1.9
		4	Y	1.6	-0.9	4.1	N	—	—
Mammoth Cave	Houchin Meadow	1	Y	2.1	-1.9	6.1	Y	9.1	9.9
		2	Y	0.0	-1.0	1.1	N	—	—
		3	Y	1.7	-0.4	3.8	Y	0.7	1.4
		4	Y	1.2	-3.4	5.8	N	—	—
Mesa Verde	Resource Mngment Area	1	Y	0.0	-1.1	1.1	N	—	—
		2	Y	0.9	-0.4	2.2	Y	2.3	2.7
		3	Y	1.6	-0.8	3.9	Y	1.8	2.9
		4	Y	0.2	-1.1	0.7	N	—	—
Mount Rainier	Tahoma Woods	1	Y	5.7	-8.1	-3.3	N	—	—
		2	N	5.0	-12.8	2.9	Y	2.9	4.9
		3	N	3.7	-9.2	1.9	N	—	—
		4	Y	6.3	-13.2	0.5	N	—	—
North Cascades	Marblemount Ranger Stn.	1	N	3.0	-12.7	6.7	N	—	—
		2	Y	3.9	-11.2	3.4	Y	2.1	-5.7
		3	Y	5.3	-12.9	2.3	Y	7.3	-8.4
		4	Y	1.4	-4.3	7.1	N	—	—

-- continued --

Table 4-3 (continued). Ozone analyzer precision and accuracy summary.

Sites operated by the National Park Service

			Precision				Accuracy		
National Park Unit	**Site Name**	**Calendar Quarter**	**Required No. of Precision Checks Met?[1]**	**Avg. Absolute Percent Difference[3,4]**	**Lower 95% Probability Limit[6]**	**Upper 95% Probability Limit[6]**	**Accuracy Check Performed During the Quarter?[2]**	**Avg. Absolute Percent Difference[3,4]**	**Maximum Percent Difference[5]**
Petrified Forest	South Entrance	1	Y	1.0	-4.4	2.4	N	—	—
		2	Y	0.2	-2.1	2.5	Y	2.2	4.2
		3	Y	0.5	-1.0	2.0	N	—	—
		4	Y	1.2	-1.1	3.6	Y	2.1	-4.5
Pinnacles	SW of East Entrance Stn.	1	Y	2.4	-4.5	-0.3	N	—	—
		2	Y	2.7	-4.0	-1.3	N	—	—
		3	Y	0.5	-3.7	2.7	Y	1.6	-2.9
		4	Y	1.5	-4.0	1.0	N	—	—
Rocky Mountain	Long's Peak	1	Y	0.7	-5.0	3.5	Y	7.1	10.0
		2	Y	0.1	-2.7	2.9	N	—	—
		3	Y	2.1	-5.1	1.0	Y	0.3	-0.6
		4	Y	2.5	-10.0	4.9	N	—	—
Sequoia and Kings Canyon	Ash Mountain	1	Y	0.9	-1.1	3.0	Y	0.5	-0.9
		2	Y	1.9	-4.1	0.3	N	—	—
		3	Y	2.0	-4.2	0.2	Y	9.2	11.4
		4	Y	0.2	-2.4	2.1	N	—	—
Sequoia and Kings Canyon	Lower Kaweah	1	Y	0.3	-0.9	1.4	Y	1.6	-1.9
		2	Y	0.2	-1.3	1.7	N	—	—
		3	Y	0.1	-2.4	2.3	N	—	—
		4	Y	0.1	-2.8	2.6	N	—	—
Shenandoah	Big Meadows	1	Y	1.2	-2.0	4.5	N	—	—
		2	Y	2.0	0.9	3.0	Y	3.8	4.3
		3	Y	3.1	0.2	6.0	N	—	—
		4	Y	3.2	1.5	4.9	Y	0.6	-1.1
Voyageurs	Sullivan Bay	1	Y	2.3	-4.9	0.3	N	—	—
		2	Y	1.9	-3.3	-0.4	N	—	—
		3	Y	2.5	-5.0	0.0	Y	2.4	2.6
		4	N	1.6	-4.0	0.9	N	—	—
Yellowstone	Water Tank	1	Y	1.4	-3.7	0.9	N	—	—
		2	Y	1.4	-2.8	0.0	Y	2.8	3.2
		3	Y	2.5	-4.8	-0.2	Y	3.1	-4.2
		4	Y	1.6	0.0	3.2	N	—	—
Yosemite	Merced River	1	Y	0.9	-2.2	0.3	N	—	—
		2	Y	2.0	-5.8	1.9	Y	0.9	1.6
		3	Y	2.0	-3.3	-0.7	N	—	—
		4	Y	2.8	-4.5	-1.2	Y	0.5	1.1

-- continued --

Table 4-3 (continued). Ozone analyzer precision and accuracy summary.

Sites operated by the National Park Service

			Precision				Accuracy		
National Park Unit	Site Name	Calendar Quarter	Required No. of Precision Checks Met?[1]	Avg. Absolute Percent Difference[3,4]	Lower 95% Probability Limit[6]	Upper 95% Probability Limit[6]	Accuracy Check Performed During the Quarter?[2]	Avg. Absolute Percent Difference[3,4]	Maximum Percent Difference[5]
Yosemite	Turtleback Dome	1	Y	0.3	-1.2	1.9	N	—	—
		2	Y	0.1	-1.7	1.8	N	—	—
		3	Y	0.4	-3.6	2.9	N	—	—
		4	Y	2.8	-9.8	4.3	Y	0.5	-1.4
Zion	Dalton's Wash	1	Y	2.1	-2.8	-1.4	N	—	—
		2	Y	2.5	-3.6	-1.4	N	—	—
		3	Y	3.5	-5.3	-1.6	Y	2.2	2.6
		4	Y	3.3	-4.6	-2.1	N	—	—

Sites operated by cooperating state agencies

			Precision				Accuracy		
National Park Unit	Site Name	Calendar Quarter	Required No. of Precision Checks Met?[1]	Avg. Absolute Percent Difference[3,4]	Lower 95% Probability Limit[6]	Upper 95% Probability Limit[6]	Accuracy Check Performed During the Quarter?[2]	Avg. Absolute Percent Difference[3,4]	Maximum Percent Difference[5]
Acadia	McFarland Hill	1	Y	1.0	-1.2	3.3	N	—	—
		2	Y	1.6	-0.2	3.4	N	—	—
		3	Y	1.5	0.0	2.9	N	—	—
		4	Y	1.0	-0.7	2.6	N	—	—
Cape Cod	Cape Cod	1	—	—	—	—	—	—	—
		2	N	0.6	-1.7	0.5	N	—	—
		3	N	1.5	-3.6	0.6	N	—	—
		4	—	—	—	—	—	—	—
Chamizal	Chamizal	1	Y	1.4	-2.3	-0.4	N	—	—
		2	Y	0.8	-8.8	10.4	N	—	—
		3	Y	0.7	-1.8	0.5	N	—	—
		4	Y	0.4	-1.9	1.2	N	—	—
Congaree	Congaree Bluff	1	N	2.9	-5.7	11.4	N	—	—
		2	N	0.2	-7.6	7.2	N	—	—
		3	N	1.6	-6.6	9.8	N	—	—
		4	N	0.2	-3.5	3.9	N	—	—
Cowpens	State Monitor	1	N	2.9	-15.2	9.5	N	—	—
		2	N	3.3	-9.2	2.5	N	—	—
		3	N	0.9	-5.6	3.9	N	—	—
		4	Y	0.4	-6.5	7.3	N	—	—
Great Smoky Mountains	Purchase Knob	1	—	—	—	—	—	—	—
		2	Y	0.6	-2.5	1.3	N	—	—
		3	Y	0.2	-1.0	0.7	N	—	—
		4	Y	0.3	-0.3	1.0	N	—	—
Saguaro	Pima County	1	N	0.0	0.0	0.0	N	—	—
		2	Y	0.2	-1.2	1.6	N	—	—
		3	Y	0.9	-2.4	0.6	N	—	—
		4	Y	0.6	-1.8	0.5	N	—	—

-- continued --

Table 4-3 (continued). Ozone analyzer precision and accuracy summary.

Sites operated by cooperating state agencies

			Precision				Accuracy		
National Park Unit	**Site Name**	**Calendar Quarter**	**Required No. of Precision Checks Met?**[1]	**Avg. Absolute Percent Difference**[3,4]	**Lower 95% Probability Limit**[6]	**Upper 95% Probability Limit**[6]	**Accuracy Check Performed During the Quarter?**[2]	**Avg. Absolute Percent Difference**[3,4]	**Maximum Percent Difference**[5]
Theodore Roosevelt	Painted Cany. VC	1	Y	0.9	-3.1	4.9	N	—	—
		2	Y	0.5	-8.4	7.5	N	—	—
		3	N	0.2	-3.6	4.0	N	—	—
		4	Y	1.1	-5.8	3.6	N	—	—
Wind Cave	Visitor Center	1	N	1.9	0.4	3.4	N	—	—
		2	Y	2.2	2.2	2.2	N	—	—
		3	Y	2.1	0.9	3.3	N	—	—
		4	Y	2.1	1.1	3.0	N	—	—

-- continued --

Table 4-3 (continued). Ozone analyzer precision and accuracy summary.

Nearby sites operated by other agencies

			Precision				Accuracy		
National Park Unit	Site Name	Calendar Quarter	Required No. of Precision Checks Met?[1]	Avg. Absolute Percent Difference[3,4]	Lower 95% Probability Limit[6]	Upper 95% Probability Limit[6]	Accuracy Check Performed During the Quarter?[2]	Avg. Absolute Percent Difference[3,4]	Maximum Percent Difference[5]
Appalachian Trail	Mount Greylock Summit	1	—	—	—	—	—	—	—
		2	N	2.0	-0.3	4.3	N	—	—
		3	N	0.7	-0.3	1.7	N	—	—
		4	—	—	—	—	—	—	—
Blue Ridge Parkway	7510 Blue Ridge Parkway	1	—	—	—	—	—	—	—
		2	Y	2.2	0.3	4.1	N	—	—
		3	Y	2.6	0.3	4.9	N	—	—
		4	Y	2.1	-0.1	4.4	N	—	—
Blue Ridge Parkway	Blue Ridge Parkway	1	—	—	—	—	—	—	—
		2	N	0.1	-1.3	1.5	N	—	—
		3	Y	1.1	-1.4	3.6	N	—	—
		4	Y	2.1	1.8	2.4	N	—	—
Blue Ridge Parkway	Vinton Elementary	1	—	—	—	—	—	—	—
		2	Y	3.3	-7.9	1.3	N	—	—
		3	Y	1.1	-5.7	7.9	N	—	—
		4	Y	3.3	-6.8	0.1	N	—	—
Blue Ridge Parkway	Frying Pan Mountain	1	—	—	—	—	—	—	—
		2	Y	0.4	-2.5	1.8	N	—	—
		3	Y	0.6	-1.8	2.9	N	—	—
		4	Y	0.4	-0.9	1.6	N	—	—
Blue Ridge Parkway	Route 191	1	—	—	—	—	—	—	—
		2	Y	0.2	-1.3	1.7	N	—	—
		3	N	0.9	0.0	1.8	N	—	—
		4	Y	0.4	-0.9	1.6	N	—	—
Blue Ridge Parkway	Ranger Station	1	—	—	—	—	—	—	—
		2	Y	6.7	-11.5	-1.9	N	—	—
		3	Y	1.9	-7.7	3.9	N	—	—
		4	Y	3.6	-4.9	12.2	N	—	—
Boston Harbor Islands	Former Nike Missle Site	1	—	—	—	—	—	—	—
		2	Y	2.5	-4.6	-0.4	N	—	—
		3	Y	3.8	-6.1	-1.5	N	—	—
		4	—	—	—	—	—	—	—
Cuyahoga Valley	800 Patterson	1	—	—	—	—	—	—	—
		2	N	0.1	-2.4	2.6	N	—	—
		3	Y	2.0	-0.8	4.7	N	—	—
		4	Y	1.5	0.4	2.7	N	—	—
Everglades	Cutler Road	1	Y	1.6	-2.5	5.7	N	—	—
		2	Y	0.5	-1.9	0.8	N	—	—
		3	Y	2.0	-4.3	0.2	N	—	—
		4	N	2.2	-1.1	5.6	N	—	—

-- continued --

Table 4-3 (continued). Ozone analyzer precision and accuracy summary.

Nearby sites operated by other agencies

			Precision				Accuracy		
National Park Unit	**Site Name**	**Calendar Quarter**	**Required No. of Precision Checks Met?[1]**	**Avg. Absolute Percent Difference[3,4]**	**Lower 95% Probability Limit[6]**	**Upper 95% Probability Limit[6]**	**Accuracy Check Performed During the Quarter?[2]**	**Avg. Absolute Percent Difference[3,4]**	**Maximum Percent Difference[5]**
George Washington Pkwy	Alexandria Health	1	—	—	—	—	—	—	—
		2	Y	3.0	-1.4	7.5	N	—	—
		3	N	0.6	-6.6	5.4	N	—	—
		4	N	6.2	-6.2	-6.2	N	—	—
Guilford Courthouse	Mendenhall Middle School	1	—	—	—	—	—	—	—
		2	Y	0.8	-1.9	3.5	N	—	—
		3	Y	0.1	-0.6	0.8	N	—	—
		4	Y	0.0	0.0	0.0	N	—	—
Indiana Dunes	Gas Station	1	—	—	—	—	—	—	—
		2	N	1.5	-4.2	1.1	N	—	—
		3	N	2.7	-6.6	1.2	N	—	—
		4	—	—	—	—	—	—	—
Indiana Dunes	Ammunition Bunker	1	—	—	—	—	—	—	—
		2	N	5.1	-11.2	0.9	N	—	—
		3	Y	0.7	-3.8	2.3	N	—	—
		4	—	—	—	—	—	—	—
Indiana Dunes	Water Treatment Plant	1	—	—	—	—	—	—	—
		2	N	2.0	-7.1	3.1	N	—	—
		3	Y	2.6	-6.6	1.4	N	—	—
		4	—	—	—	—	—	—	—
Mississippi	Anoka County Airport	1	Y	3.2	-8.0	1.5	N	—	—
		2	Y	2.7	-7.1	12.4	N	—	—
		3	Y	1.7	-4.6	1.2	N	—	—
		4	Y	0.2	-3.6	3.1	N	—	—
Olympic	Blyn Lookout Relay	1	—	—	—	—	—	—	—
		2	N	2.3	2.3	2.4	N	—	—
		3	Y	0.9	-3.2	1.4	N	—	—
		4	—	—	—	—	—	—	—
Petroglyph	Westside Taylor Ranch	1	N	0.6	-2.9	1.7	N	—	—
		2	N	1.5	-0.8	3.7	N	—	—
		3	N	0.6	-2.4	1.3	N	—	—
		4	N	0.0	-2.5	2.5	N	—	—
Rock Creek	Achbold Parkway	1	Y	0.2	-5.6	5.2	N	—	—
		2	Y	0.9	-4.9	6.7	N	—	—
		3	Y	0.9	-3.0	4.8	N	—	—
		4	Y	1.4	-2.7	5.5	N	—	—

-- continued --

Table 4-3 (continued). Ozone analyzer precision and accuracy summary.

Nearby sites operated by other agencies

			Precision				Accuracy		
National Park Unit	**Site Name**	**Calendar Quarter**	**Required No. of Precision Checks Met?[1]**	**Avg. Absolute Percent Difference[3,4]**	**Lower 95% Probability Limit[6]**	**Upper 95% Probability Limit[6]**	**Accuracy Check Performed During the Quarter?[2]**	**Avg. Absolute Percent Difference[3,4]**	**Maximum Percent Difference[5]**
Saugus Iron Works	Lynn Water Treatment	1	Y	3.3	-4.3	-2.3	N	—	—
		2	N	1.9	-9.0	5.3	N	—	—
		3	Y	4.7	-5.7	-3.7	N	—	—
		4	N	6.7	-9.0	-4.3	N	—	—
Saratoga	Stillwater	1	N	1.7	-1.0	4.4	N	—	—
		2	N	0.0	-3.6	3.6	N	—	—
		3	N	3.8	-11.4	3.8	N	—	—
		4	Y	0.9	-2.7	0.9	N	—	—

Color shading key:

- Ideal: indicates a percent difference within +/-5% or a probability limit within +/-10%
- Acceptable: indicates a percent difference between +/-5.1-10% or a probability limit between +/-10.1-15%
- Unacceptable: indicates a percent difference greater than +/-10% or a probability limit greater than +/-15%

1. Precision checks are required by the Environmental Protection Agency (EPA) of all pollutant analyzers collecting data which are to be submitted to the EPA Air Quality System (AQS). 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.[3] According to NPS Standard Operating Procedures, the pollutant analyzer must respond within 10% of the

2. Accuracy checks are required by the Environmental Protection Agency (EPA) of all pollutant analyzers collecting data which are to be submitted to the EPA Air Quality System (AQS). An accuracy check is performed by challenging the pollutant analyzer with a known concentration of gas from the pollutant transfer standard at several different points. The percent difference between the analyzer and the transfer standard is then calculated.[3] According to NPS Standard Operating Procedures, the pollutant analyzer must respond within 10% of the transfer standard. All accuracy checks reported here were performed by the reporting organization and not by an outside auditor.

3. Percent Difference = ((analyzer - transfer std)/transfer std)x100

4. Average Absolute Percent Difference is the mean of the absolute value of all individual precision check percent differences during the quarter, or the mean of the absolute value of all the percent differences from each point challenged during an accuracy check.

5. Maximum Percent Difference is the highest percent difference from the points of a multipoint (or accuracy) calibration. A positive value indicates the anlyzer read high, a negative value indicates the anlyzer read low.

6. Upper/Lower 95% Probability Limits = (Average Percent Difference)+/-(1.96)(Standard Deviation of precision check percent differences in the quarter). The probability limits represent the interval having a 95% chance of containing the true average percent difference. Probability limits must be within +/-15%.

italics = site operated by other agencies

underline = National Park Service operated portable ozone system (POMS)

Table 4-4. Ozone analyzer precision and accuracy overall network summary.

Sites operated by the National Park Service

		Precision[1] Average Absolute Percent Difference			Accuracy[2] Average Absolute Percent Difference		
Calendar Quarter	**# Operational Sites**	**# Sites within +/- 5%**	**# Sites within +/- 5.1 - 10%**	**# Sites > +/- 10%**	**# Sites within +/- 5%**	**# Sites within +/- 5.1 - 10%**	**# Sites > +/- 10%**
1	29	28	1	0	4	2	0
2	31	31	0	0	17	2	1
3	31	30	1	0	10	2	0
4	31	30	1	0	11	1	0

Sites operated by cooperating state agencies

		Precision[1] Average Absolute Percent Difference			Accuracy[2] Average Absolute Percent Difference		
Calendar Quarter	**# Operational Sites**	**# Sites within +/- 5%**	**# Sites within +/- 5.1 - 10%**	**# Sites > +/- 10%**	**# Sites within +/- 5%**	**# Sites within +/- 5.1 - 10%**	**# Sites > +/- 10%**
1	7	7	0	0	0	0	0
2	9	9	0	0	0	0	0
3	9	9	0	0	0	0	0
4	8	8	0	0	0	0	0

-- continued --

Table 4-4 (continued). Ozone analyzer precision and accuracy overall network summary.

Nearby sites operated by other agencies

		Precision[1] Average Absolute Percent Difference			Accuracy[2] Average Absolute Percent Difference		
Calendar Quarter	# Operational Sites	# Sites within +/- 5%	# Sites within +/- 5.1 - 10%	# Sites > +/- 10%	# Sites within +/- 5%	# Sites within +/- 5.1 - 10%	# Sites > +/- 10%
1	6	6	0	0	0	0	0
2	21	19	2	0	0	0	0
3	21	21	0	0	0	0	0
4	15	13	2	0	0	0	0

1. Precision checks are required by the Environmental Protection Agency (EPA) of all pollutant analyzers collecting data which are to be submitted to the EPA Air Quality System (AQS). 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. According to NPS Standard Operating Procedures, the pollutant analyzer must respond within 10% of the transfer standard.

2. Accuracy checks are required by the Environmental Protection Agency (EPA) of all pollutant analyzers collecting data which are to be submitted to the EPA Air Quality System (AQS). An accuracy check is performed by challenging the pollutant analyzer with a known concentration of gas from the pollutant transfer standard at several different points. The percent difference between the analyzer and the transfer standard is then calculated. According to NPS Standard Operating Procedures, the pollutant analyzer must respond within 10% of the transfer standard.

The U.S. Department of the Interior (DOI) is the nation's principal conservation agency, charged with the mission "to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian tribes and our commitments to island communities". More specifically, Interior protects America's treasures for future generations, provides access to our nation's natural and cultural heritage, offers recreation opportunities, honors its trust responsibilities to American Indians and Alaska Natives and its responsibilities to island communities, conducts scientific research, provides wise stewardship of energy and mineral resources, fosters sound use of land and water resources, and conserves and protects fish and wildlife. The work that we do affects the lives of millions of people; from the family taking a vacation in one of our national parks to the children studying in one of our Indian schools.

NPS D-1782, August 2006

National Park Service
U.S. Department of the Interior

Natural Resource Program Center
Air Resources Division
P.O. Box 25287
Denver, CO 80225-0287

www2.nature.nps.gov/air