National Park Service
Gaseous Pollutant Monitoring Program

The
Monitor

For National Park Service
Air Quality Station Operators

SPRING 2005

NETWORK NEWS

Network update

Funding challenges at the National Park Service Air Resources Division have required streamlining of the Gaseous Pollutant Monitoring Program. As of March 1, 2005, all air monitoring (ozone, sulfur dioxide, meteorological, and filter pack sampling) at Olympic National Park, WA, ceased. The Lookout Point station at Sequoia-Kings Canyon National Parks, CA, was also terminated (its CASTNet filter pack sampling has been moved to the Ash Mountain station). In addition, some seasonal sites will not be reestablished this summer. Additional adjustments are likely in the future to accommodate changes in available funding and to realign network monitoring priorities.

After more than five years of operation, the ozone monitoring on Channel Islands National Park, CA, that was jointly run by NPS and the counties of Ventura and Santa Barbara, is being shut down. This station was being used in conjunction with computer modeling, and to determine if high mainland surface ozone was adversely affecting the islands.

Joshua Tree National Park, CA, is planning a second ozone and particulate monitoring station near Cottonwood that will be solar-powered. The park often sees very high mid-day ozone concentrations, but because it is in two different counties, it has been difficult to get agreement on the extent of ozone non-attainment. The new station in Riverside County will help resolve the questions.

Yosemite National Park, CA, has used passive ozone sampling and portable ozone monitors in several summer studies that show vertical and spatial variability of ozone concentrations. The park plans to buy their own portable ozone system to use in conjunction with vegetation injury studies. Operations will be coordinated with the ARD monitoring support programs.

The monitoring station in Ambler, AK, for the Western Arctic network is finally operational. This station, in a remote location just above the Arctic Circle, has proven to be a challenge to get a long-term operator. Visibility, aerosol, wet/dry deposition, mercury deposition, and meteorological measurements are being made at the station.

Portable ozone stations

The portable ozone monitoring stations (POMS) will continue to be a part of the air program. Most stations from last season are being reinstalled for a second (or third) season, and additional stations are being deployed at Dinosaur National Monument, CO; Assateague Islands National Seashore, MD/VA; and at two eastern sites in the Cumberland-Piedmont Network, in the Appalachian Mountains area of the eastern U.S. These parks have not had any previous ozone monitoring and don't have other monitors nearby. Monitoring results will be compared to the Air Atlas estimates and the national ozone standards.

***NETWORK NEWS** continued on page 2....*

What's inside:

***NETWORK NEWS** continued from page 1....*

Real-time ozone and meteorological data available hourly on the Web

Real-time ozone and meteorology data for all monitoring locations throughout the GPMP network, will soon be available on the NPS Web site.

NPS ARD personnel created the new Web page last summer for these data, which may provide useful, networkwide information to you and your station. Log onto *http://www2.nature.nps.gov/air/monitoring/network.cfm#data* and click the Current Ozone and Weather Data link under Data Type. The data are updated hourly. In addition to viewing specific parameter values, links are provided to the parks' Webcams, EPA's AIRNow Web site, a key to the ozone health advisory color code system, and previous years' ozone data exceedances tables for all sites.

The Monitor articles available for reference

If you haven't been an air quality operator for the past eight years you've missed out on some pretty good articles in The Monitor newsletter. These past articles are now available on the GPMP Web site, and the list will grow as time goes on.

On the GPMP Web site (*http://ard-aq-request.air-resource.com/project*) look for the folder, Articles from The Monitor. The articles are contained in three subfolders labeled: How Does That Work, Operator's Toolbox, and Technical Articles. Many of the articles (in PDF format) are one page, allowing for easy printing for future reference. Some of the articles already on the Web site are:

How Does That Work

- CASTNet filter pack systems
- Relative humidity sensors
- Solar radiation sensors

Operator's Toolbox

- 8-day stackplots
- Getting to know your datalogger
- Restoring DataView

Technical Articles

- Data losses happen
- Mercury monitoring
- Using DataView to review data

Annual data summaries expected in June

The Gaseous Pollutant Monitoring Program's 2004 annual data summaries are expected to be completed and delivered by June 30. The summaries will be of the same format as last year's 2003 summaries.

Program participants will receive two hardcopies, and additional copies will be available for download from the GPMP Web site. To download, log onto *http://ard-aq-request.air-resource.com/project*. Look under Project Reports. ARS will notify project participants via e-mail when the summaries will be available.

Comments regarding the summaries are welcome and may be sent to:

John Ray, NPS ARD
Telephone: 303/969-2820
E-mail: John_D_Ray@nps.gov

or Joe Adlhoch, ARS
Telephone: 970/484-7941
E-mail: Jadlhoch@air-resource.com

Checklist instructions to be revised

DataView's checklist instructions (CIs) accompany the onscreen instrument checklists, and are intended to aid operators in completing the checklists. Many of these CIs were developed in 2000, so they are undergoing a thorough review to ensure they are still applicable, accurate, and complete. When the review is finished, the revised documents will be uploaded to your DataView system remotely from ARS.

Remember that these CIs are instructional documents to guide you through your station checks. The instructions can be accessed by clicking on the button labeled *Get Instruction,* located at the bottom of each checklist screen.

To view both the checklist and its accompanying instruction simultaneously, open the instruction. Then right-click on the taskbar at the bottom of your DataView screen, and click Tile Windows Horizontally. (These instructions are also available on the GPMP Web site -- see the article Viewing Checklists and Instructions under Articles from The Monitor).

Contact ARS if you have any comments or questions about these instructions.

STATION OPERATOR FOCUS

He's been everywhere, but Canyonlands' Black George likes it there

Sit a spell with Black George and you're sure to hear some interesting stories. Now in his 80's, Black George dedicated his career to working for the government. He spent 3 1/2 years in the Navy during World War II and over 31 years with the United States Geological Survey (USGS), before moving onto the National Park Service for the past 19 years. Now a volunteer ranger at Canyonlands NP, Utah, Black George has been servicing the air quality site for nearly 3 years, and enjoys every week.

"I've been a volunteer ranger at Canyonlands for 12 years now," said Black George. "Being a volunteer frees rangers to do other things. They are frequently in training or called out to emergencies. Volunteers save rangers a day's work each week by taking care of the air quality station." Canyonlands has an extensive air monitoring station, which collects ozone, ambient temperature, delta temperature, relative humidity, wind speed and direction, solar radiation, precipitation, and wetness data. The CASTNet and IMPROVE programs also have instrumentation there including a wet/dry deposition sampler, aerosol sampler, and transmissometer.

In addition to servicing the air quality site every week, Black George also serves on the river patrol at Canyonlands. Much of the western U.S. is currently in a drought pattern and the last large amount of water at Canyonlands was in 1997, "... when the river rushed through Cataract Canyon at more than 70,000 cubic feet per second," according to Black George. "Our patrol that year performed 140 rescues on the river and captured 40 runaway boats, with no deaths."

Volunteer Ranger Black George checks the IMPROVE aerosol sampler at the air quality monitoring site in Canyonlands NP, Utah.

Black George has also worked at Bryce Canyon and Big Bend National Parks, in Utah and Texas respectively, and at the High Uintas Wilderness of the Wasatch-Cache National Forest, Utah. During the winter of 1992-93 he was snowbound in the Uintas for 5 months and reported meteorological observations to the National Weather Service in Salt Lake City by radio. These adventures, as well as his time with the USGS, allowed him to travel extensively over the globe, to all seven continents and two trips around the world. He has been on Antarctica and worked in the Middle East. He has lived in Brazil, Saudi Arabia, and Liberia, and has hiked the Himalayas in Nepal and India, and the Andes mountains in Peru. His most recent adventure was a trip on the Trans-Siberia Railway in Russia.

"Now I spend my time at Canyonlands, it's my favorite part of the world," said Black George. "I can spend a lifetime here, with new experiences all the time."

AIR QUALITY GLOSSARY

Cumulative effect - the impact on an air quality related value (AQRV) resulting from total pollutant loading from all sources including the contributing effects of new and modified sources of air pollution. A single source may cause individual minor, but cumulatively significant, effects on AQRVs.

Ecological effects - long-term or short-lived changes in the normal functioning of an ecosystem, resulting in biological, economic, social, and aesthetic losses. Studies are conducted to determine the nature or extent of air pollution and deposition effects on ecosystems.

Mobile sources - moving objects that release regulated air pollutants; mobile sources include cars, trucks, buses, planes, boats, trains, motorcycles, and gas-powered lawn mowers.

Sensitive receptor - the air quality related value, or part thereof, that is the most responsive to, or the most easily affected by, the type of air pollution in question. For example, at Great Smoky Mountains National Park, the spruce-fir forest is a sensitive receptor.

Sulfur dioxide (SO_2) - a criteria air pollutant. Sulfur dioxide is a gas produced by burning sulfur-rich coal, most notably in power plants. Some industrial processes, such as production of paper and smelting of metals, also produce sulfur dioxide. Sulfur dioxide is also a key component of other air pollutants such as sulfuric acid, a major constituent of acid rain, and sulfate aerosols that can significantly reduce visibility.

FEATURE ARTICLE

Portable ozone monitoring systems (POMS) provide another monitoring option

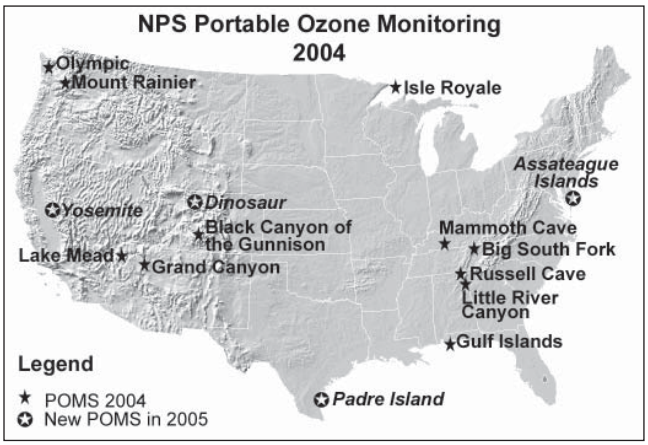
Intended uses

The 1991 NPS air quality monitoring strategy (*http://www2.nature.nps.gov/air/Monitoring/docs/trenddoc.htm*), proposed a network of baseline stations that would move every five years and a network of trend stations with indefinite lifetimes. Very few baseline stations ended up being re-deployed because of the high cost and few trend sites were ever deployed. Recent advances in analyzers, solar panels, and satellite communications have allowed us to assemble open-frame monitoring stations that are low-power and self-contained. We now have a way to do survey-type monitoring at a relatively low cost and to move the stations easily. The basic portable ozone monitoring system (POMS) measures ozone and weather, but also can be outfitted to do filter-pack sampling and $PM_{2.5}$ sampling. Communications can be by satellite, telephone line, cell phone, and data module transfers. With this flexibility, locations in the interior of parks or in remote places can still have a monitoring station.

A typical POMS station on a barrier island at Gulf Islands National Seashore, FL/AL, prior to hurricane Ivan. The station survived high winds and flooding.

Locations

During 2004 there were 10 POMS deployed in parks and in Summer 2005 there are expected to be 14 units operating. This represents a one-third expansion of the NPS ozone monitoring network (GPMN) that measures hourly values using EPA-certified instrumentation. Four new sites and two roving stations will be used in 2005 (Isle Royale and Grand Canyon will move elsewhere).



Performance

We have done extensive side-by-side and collocated field monitoring comparisons of the 2B Technologies, Inc. analyzers and our standard, EPA-certified analyzers, Thermo Environmental Instruments (TEI). No two ozone analyzers match exactly what they observe on a minute-by-minute basis. The 2B analyzers have a slight tendency to over-report during the day and under-report at night, something we have traced to a slight relative humidity sensitivity in some instruments. Linearity of response and a lack of temperature sensitivity over an ambient temperature range of -10° to 50°C is excellent. Still, it has been a learning experience with the 2B Technologies analyzers. They have different maintenance requirements and failure modes than we see with the TEI analyzers. For example, at a couple of locations we started to see large up-down spikes at about sunrise every day. This was traced to rapid changes in relative humidity that caused a temporary off-scale instrument response, as a component in the analyzer aged. We invalided those hours in the data and now have a parts replacement schedule to avoid that instrument problem.

We check the calibration of the 2B Technologies analyzers before deployment in the spring and at the end of the season. The change in calibration for five recent instrument checks is 1.8% average, 3.4% max change (compared to the TEI EPA-certified analyzers, of 2.5% average, 3.7% max change). Daily zero-air checks and data review are used to determine the health of the analyzers while they are in the field. We believe the 2B Technologies analyzers deployed in the POMS give comparable results to the standard ozone monitoring station.

Sample data - results

Let's look at some of the data from the POMS and compare them to other nearby monitors and to Air Atlas ozone estimates (*http://massive.natnet.du.edu/website/AirAtlas9903/viewer.htm*). None of the POMS locations are in violation of the ozone NAAQS, however, Black Canyon of the Gunnison, CO, and Lake Mead, AZ, are close. The Gulf Islands, FL/AL, location had only about five weeks of data before hurricane Frances took it out, but during that time it had two 8-hr ozone exceedances at 97 and 90 ppb.

A comparison of ozone measured at POMS parks to the 8-hr ozone standard of 85 ppb:

POMS park	2004 4th Hi 8-hr	2003 4th Hi 8-hr	2-yr avg	2004 change
BLCA	80.3			
LAME	80.1	77.0	78.6	3.1
GUIS	78.3			
GRCA	74.8	66.1	70.4	8.6
BISO	63.6	64.8	64.2	-1.1
MACA	63.0			
MORA	63.0			
ISRO	58.5	60.8	59.6	-2.3
OLYM	56.8			

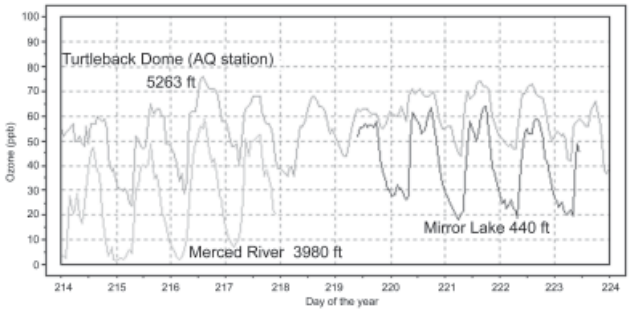
The Mount Rainier and Olympic, WA, POMS were located at higher elevation sites within the main body of the parks, rather than the low elevation sites just outside the park boundaries where our official monitoring stations are located. Observed POMS hourly data confirmed the information we had obtained with passive ozone samplers at both parks, mainly that our monitoring stations are under-reporting the ozone concentrations that occur within the parks. At Olympic, the Port Angeles station is being shut down and the POMS on Hurricane Ridge will be their sole air quality station in 2005.

At Grand Canyon, AZ, the traditional ozone monitor is on the South Rim and sees fairly stable concentrations in the 50 ppb range. We have long suspected that higher ozone concentrations occur within the canyon and on the North Rim due to transport from the west and up the Colorado River drainage. The POMS station on the North Rim and west of the fixed station sees higher daytime ozone. Farther to the west and at lower elevation, the POMS station at Meadview near Lake Mead had even higher ozone. A gradient in ozone from high concentrations around Las Vegas to lower values to the east is observed. Passive ozone measurements from the rim to the river in the Grand Canyon show increasing concentrations of ozone within the canyon.

Although the Grand Canyon does not appear to currently have ozone concentrations above the NAAQS standard, the transport of air from the urbanized non-attainment areas from the west is a concern and needs to be understood better.

Some experimental programs are using POMS ozone analyzers and moving them around frequently. The Cumberland-Piedmont Inventory and Monitoring Network is applying a strategy that will yield short-term ozone measurements at a number of sites by deploying a POMS for three to five weeks at a site, then moving it to other sites for similar monitoring periods. This approach will supplement full season measurements with passive ozone samplers. At Yosemite, CA, the POMS have been used for week-long measurements at multiple sites and in a vehicle driven up the road to get vertical profiles of ozone. At Great Smoky Mountains, NC/TN, researchers have used 2B Technologies ozone analyzers to measure ozone concentrations at different heights and locations within coneflower patches. Ozone is higher at the edges of the patches.

The data from Yosemite in 2003 shows how the ozone can be different within a park. In the figure below, ozone is plotted for Turtleback Dome on the rim of the valley and two different stations within Yosemite Valley. Both valley sites have lower overnight ozone values and shorter periods mid-day when the ozone is high. Peak and mean ozone concentrations are lower in the Valley than at the Dome.



The portable ozone systems have proven to be flexible and much easier to deploy than the standard monitoring stations. We continue to use them to supplement and expand our long-term monitoring while maintaining high data quality standards. Data can be accessed through the interactive data query Web page (*http://12.45.109.6*) and from our current data Web page (*http://www2.nature.nps.gov/air/data/current/index.htm*). More information on POMS is available at *http://www2.nature.nps.gov/air/studies/portO3.htm*.

ARTICLES OF INTEREST

Correct station siting key to representative regional air quality conditions

NPS Gaseous Pollutant Monitoring Program (GPMP) air quality station data are used for numerous purposes, such as regulatory proceedings, incorporation into environmental impact statements (EISs), inputs into air quality models, supporting vegetation and wildlife studies, and documenting long-term air quality and meteorological trends. Proper siting of stations helps ensure the data are valuable to all of these applications.

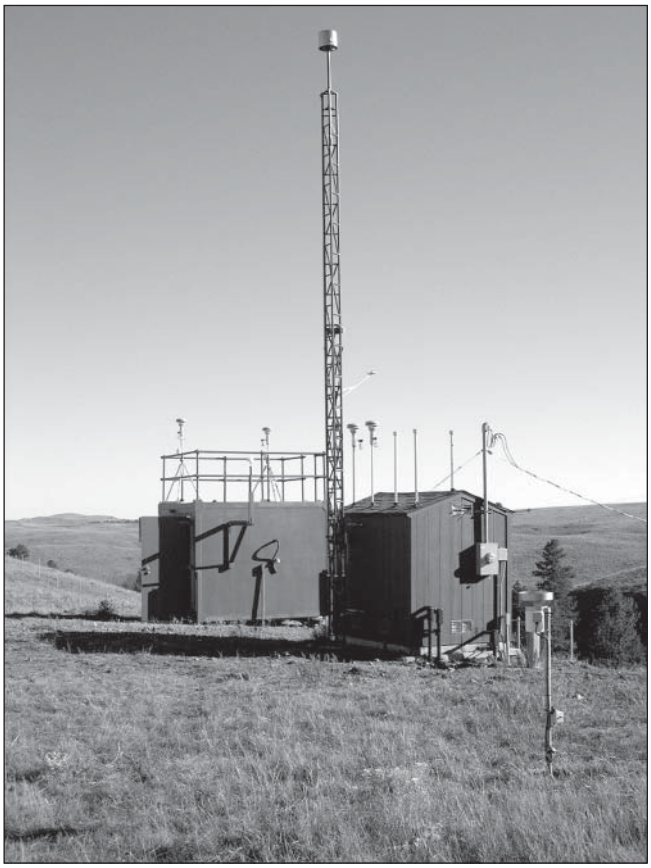
In general, air quality stations are sited to represent different sized airsheds from microscale (a few hundred meters) to global scale. GPMP stations are sited to represent a regional scale, defined by EPA as "a rural area of reasonable homogeneous geography that extends from ten to a few hundred kilometers." Most GPMP sites are intended to represent the air resource within an entire park. Given the varied elevation, geography, and topography within most parks, this is often difficult to do and invariably, compromises are made.

In addition to finding a site that is representative of the park, issues of economics, security, and logistics play a major role in the stations' ultimate location. Usually the ideal monitoring location is miles from existing electrical and telephone utilities, may be visible or accessible by park visitors, or may not have convenient or even year-round access.

Monitoring site locations and placement of meteorological sensors and gaseous sample inlet probes must meet requirements of federal regulations. General siting criteria to consider when locating potential ambient air monitoring stations include:

- The site should be located away from local interferences such as roadways and industrial sources.
- The site's monitored airmass should be representative of regional, not local meteorological conditions.
- It should have good servicing logistics (be accessible year-round yet be secure from vandalism and damage from animals)
- It should have an available power supply.
- It should be aesthetically pleasing in the surrounding environment. When stations are shut down, the NPS requires the site's landscape to be remediated to its natural state.

The ideal monitoring location should be in an open space away from obstructions (anthropogenic and natural). Not all monitoring stations have ideal locations for optimum data representation, but standardizing measurements is of utmost importance for comparing data long-term and among other monitoring locations.



Gaseous Pollutant Monitoring Program air quality shelter (left) and IMPROVE aerosol shelter (right) at Wind Cave National Park, South Dakota, show proper sensor/probe heights, unrestricted airflow to sensors and probes, and are away from obstructions.

Humidity can be less than 100% when raining

Humidity is a measure of the amount of water vapor in the air, not the total amount of vapor and liquid.

Relative humidity is the amount of water vapor actually in the air divided by the amount of water vapor the air can hold.

For clouds to form and rain to start, the air has to reach 100% relative humidity, but only where the clouds are forming or where the rain is coming from. This normally happens when air rises and cools.

Rain will often fall from clouds where the humidity is 100% into air with a lower humidity. Some water from the rain evaporates into the air it is falling through, increasing the humidity, but often not enough to bring the humidity up to 100%.

OPERATOR'S TOOLBOX

Tower climbing safety

The National Park Service Gaseous Pollutant Monitoring Program has a variety of towers installed throughout the network. Some support filter packs, some support meteorological sensors, and a few support both. In any case, caution should be exercised any time you approach a tower.

Meteorological monitoring requires meteorological sensors, and meteorological sensors require meteorological towers. When a meteorological sensor fails, it needs to be serviced or replaced. When this happens, either the top of the tower comes to the ground, or the technician/operator needs to go to the top of the tower where the sensor is mounted. Many meteorological towers allow operator access to the top by hinging in the middle, or tilting over from the base, but most are fixed towers. Occasionally, ARS sends a station operator a replacement sensor and a willing operator climbs the tower to replace it. This is great for data capture -- not so great for operator safety. Please, unless you are authorized by your park to perform this type of maintenance, don't offer (or offer your spouse) to do so. Fortunately, no injuries (that we know of) have occurred and we want to keep it that way. In addition, you would no doubt violate your park's health and safety guidelines if you should climb a tower. ARS field specialists attend tower climbing training and are equipped with the proper equipment to climb safely. If a sensor fails long before a scheduled maintenance visit, we will do what we can to alter the schedule, swing by the park while en route somewhere nearby, or if nephelometer or transmissometer maintenance is scheduled, have a visibility field specialist perform the sensor repair.

Towers that fold or hinge also need to be dealt with cautiously. Some have winches that allow the tower to be lowered by one person. Two people are usually required to safely lower (and raise) base-hinged towers that do not have a winch. Winch or not, visually inspect the tower's base and hinge point before attempting to lower it. Look for metal fatigue or rusting at critical points. Inspect the winch cable for frayed ends or loose clamps. Note also that base-hinged towers need bolts removed in order to allow the tower to lower. Don't forget to reinstall the bolts when the tower is re-erected!

As summer approaches, be particularly aware of weather and animal hazards. Do not attempt to lower or even approach any type of tower if an electrical storm is in the vicinity or high winds are present. Put off the filter pack change until later. Also, bees, wasps, and snakes can become quite irritated if their home is disturbed. Nests and hives can be established surprisingly fast and a quiet tower one Tuesday can become home to a swarm of bees by the next.

One last note on the CASTNet tipping towers. Take care to fully install the CASTNet filter pack into the quick disconnect. They can appear installed, but more than one operator have been unpleasantly surprised when the tower is erected and the (quite heavy) filter pack slams into the ground inches from their feet. An unwary EPA operator required head stitches in such an incident.

DATA COLLECTION SUMMARY

Data collection statistics for July 2004 through December 2004 are listed below.

- Sites with at least 90% collection (final validation of ambient air quality parameters) include:
  - Acadia
  - Badlands
  - Big Bend
  - Canyonlands
  - Chiricahua
  - Death Valley
  - Denali
  - Glacier
  - Grand Canyon (continuous)
  - Great Basin
  - Great Smoky Mountains:
    - Cades Cove
    - Clingman's Dome
    - Cove Mountain
    - Look Rock
  - Hawaii Volcanoes:
    - Visitor's Center
  - Isle Royale
  - Joshua Tree
  - Kobuk Valley
  - Lake Mead
  - Lassen Volcanic
  - Mammoth Cave (continuous)
  - Mesa Verde
  - Mount Rainier (continuous)
  - North Cascades
  - Olympic (portable)
  - Pinnacles
  - Rocky Mountain
  - Sequoia-Kings Canyon:
    - Lookout Point
  - Shenandoah
  - Theodore Roosevelt
  - Voyageurs
  - Wind Cave
  - Yellowstone
  - Yosemite:
    - Turtleback Dome
  - Zion
- Sites with at least 80% collection (final validation of ambient air quality parameters) include:
  - Craters of the Moon
  - Everglades
  - Gulf Islands
  - Mammoth Cave (portable)
  - Olympic (continuous)
  - Petrified Forest
  - Sequoia-Kings Canyon:
    - Lower Kaweah
  - Yosemite:
    - Merced River
- Sites less than 80% collection (final validation of ambient air quality parameters) include:
  - Big South Fork
  - Black Canyon of the Gunnison
  - Grand Canyon (portable)
  - Hawaii Volcanoes:
    - Observatory
  - Mount Rainier (portable)
  - Sequoia-Kings Canyon:
    - Ash Mountain
- The entire network achieved an average of 88.7% final validation of ambient air quality parameters for the July-December 2004 period.

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

TO:

First Class Mail

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The Monitor

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Air Resource Specialists, Inc.
1901 Sharp Point Drive, Suite E
Fort Collins, CO 80525
Telephone: 970/484-7941
Toll Free: 1-800/344-5423
Fax: 970/484-3423
E-mail: info@air-resource.com

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Newsletter production consultant:
John D. Ray - Program Manager, NPS ARD
Telephone: 303/969-2820

Editor:
Gloria S. Mercer
Air Resource Specialists, Inc.
Telephone: 970/484-7941 ext. 221

NPS Gaseous Pollutant Monitoring Program Network
http://www2.nature.nps.gov/air/monitoring/index.htm

The Gaseous Pollutant Monitoring Program network currently consists of 66 air quality sites that monitor gaseous and meteorological parameters in 49 parks. The network was established as part of a comprehensive NPS air quality program. Data from the program are used to:

- Establish existing or baseline concentrations
- Assess trends in air quality
- Judge compliance with national air quality standards
- Assist in the development of national and regional air pollution control policies
- Provide data for atmospheric research and model development
- Identify and monitor pollutants that have the potential to damage park resources