The Newsletter for Air Quality Station Operators

National Park Service (NPS)
Gaseous Pollutant Monitoring Program

Environmental Protection Agency (EPA)
CASTNET program

In this issue...

NETWORK NEWS

Newsletter to serve all of CASTNET

Starting with this issue, The Monitor will broaden its audience to include all of the Clean Air Status and Trends Network (CASTNET) in addition to the National Park Service's Gaseous Pollutant Monitoring Program (GPMP). The newsletter's purpose, to inform station operators of general news and network changes and to disseminate technical information, will remain the same. This combined newsletter recognizes that although NPS and EPA operate CASTNET sites independently, we all follow the same network protocols and pool the data to track what is happening in rural air quality.

This newsletter includes many topics common to all of CASTNET monitoring and will serve to further unify our approach. EPA and their field support contractor, MACTEC, will be contributing to the newsletter. Should you have any questions or have an idea for an article, please contact ARS at telephone 970-484-7941.

What is CASTNET?

The Clean Air Status and Trends Network (CASTNET) is a national program developed under mandate of the 1990 Clean Air Act Amendments to monitor acidic deposition, tropospheric (ground level) ozone, and other forms of atmospheric pollution. In conjunction with other national monitoring networks, CASTNET data are used to determine the effectiveness of national emission control programs and to assess temporal trends in atmospheric pollutants and spatial deposition patterns. The data are also used for long-range transport model evaluations and effects research. The network is cooperatively sponsored and operated by the Environmental Protection Agency (EPA) and the National Park Service (NPS).

Today, CASTNET is a well-established, long-term environmental monitoring network consisting of nearly 90 sites that measure ambient concentrations of aerosols and gases throughout the continental United States and Alaska. Data from the 34 most representative and longest running sites, which are in the eastern U.S., provide information on trends in regional pollutants.

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NETWORK NEWS continued from page 1....

Network update

EPA and the NPS CASTNET technical directors and their respective contractors held a meeting in July in Denver, CO, to coordinate their activities and assess future directions for the network. The session included a broad presentation of the deposition model and detailed discussion of day-to-day network operations. A primary purpose of the meeting was to identify where site operations and data validation procedures differ between agencies and to eliminate those differences where possible.

One change that resulted from the meeting is a move toward adjustment of the frequency and timing of the automated "precision/span/zero" checks. A network-wide frequency of every other day is being planned for the future. It was also agreed that ozone particulate filters would be changed monthly except where stations are traditionally extremely dusty, or impacted by fires, pollen release, or other occasional occurrence. The filters should be visually inspected every week but only changed monthly, unless a dirty filter is noted during a weekly check.

CASTNET monitoring sites on tribal lands

Three CASTNET monitoring sites are located on tribal lands as a result of a cooperative effort among EPA Headquarters (HQ), EPA Regions, tribal governments, and the Inter-Tribal Environmental Council (ITEC), a non-profit agency which provides member tribes with technical support and training in environmental fields. This collaborative effort has resulted in monitoring sites operating on the tribal lands of the Cherokee Nation in eastern Oklahoma, the Alabama-Coushatta in eastern Texas, and the Santee Sioux in northern Nebraska.

All three tribes initially received grants from EPA Regions 6 and 7 to purchase monitoring equipment and establish a site. EPA Regional staff and ITEC then worked with the local tribal environmental staff to help with the installation of the site, operation of instruments, and the interpretation of results. EPA HQ and Regions continue to support the tribes in the operation and instrument calibration and maintenance of their sites as part of the CASTNET network.

Having CASTNET monitoring sites on tribal lands provides benefits to both tribes and EPA. For the tribes involved, it enhances their ability to develop and run their own environmental programs that help to protect their communities and environment. Locating these sites on tribal lands also helps EPA (both HQ and Regions) obtain regional data that are used to monitor long-term trends in air pollution and understand the behavior of atmospheric pollutants.

ARS wins new GPMP contract

The NPS Gaseous Pollutant Monitoring Program operations and data management contract expired in July. After an open solicitation, receiving bid proposals, and a careful review of bids, Air Resource Specialists, Inc. (ARS) was chosen for the new 5-year contract. ARS has been the prime contractor for this program for the past 17 years. Although there have been some changes in the contract type, the same high quality of support is expected in the future.

ARS field specialists not only provide twice-annual station servicing; they also are available to speak with you anytime, to help with problems or questions. Tuesdays, the normal station servicing day, is usually a very busy time, as field specialists talk operators through a procedure or troubleshoot an instrument function.

Tara Porter runs the front desk at ARS.

A "real live person" answers calls at ARS. Tara Porter, ARS' receptionist, will usually be your first contact when you telephone in. She'll direct your call to a field specialist familiar with your station. These are the same specialists that perform the twice-annual servicing visits at NPS monitoring stations. Specialists are available from 8am to 5pm Mountain Time, to answer your questions and help resolve your station problems quickly.

NETWORK NEWS **continued on page 5....**

Monitoring Site Assistance:

NPS CASTNET sites: contact Air Resource Specialists
telephone: 1-800/344-5423 (Mountain Time)

EPA CASTNET sites: contact MACTEC
telephone: 1-888/224-5663 ext. 3611 (Eastern time)

STATION OPERATOR FOCUS

VOYA's Jen Fox studies wildlife and air

Jen Fox acknowledges she "does a little bit of everything" as biological science technician at Voyageurs NP, MN. Mostly this means being outdoors studying all sorts of wildlife, but one day a week she devotes to the air quality station at the park.

Jen has been the air quality station operator at Voyageurs for 2 1/2 years. The station includes ozone, meteorology, wet/dry deposition, and an IMPROVE aerosol sampler. "Hiking to and servicing the station may take 5 hours or it may take 10 hours, depending upon the weather conditions at the station and the amount of troubleshooting and repair needed," said Jen. "Things usually take a lot longer in winter with temperatures that frequently dip down to -20° or -30°F or more, depending on the windchill. Equipment often freezes up and just stops functioning after a certain point."

The remaining four days of the workweek mostly involve being out in the field where the wildlife live. One current project Jen is working on is a three-year loon nesting study, researching the effect of fluctuating water levels on nesting ecology. During the winter months Jen studies large mammals such as black bear, lynx, and wolves. "I'll be starting a new project soon, an aerial survey mapping active beaver colonies," said Jen. "Beaver prefer softer tree species such as aspen as a food source, and cache the wood outside their lodges - a sign of an active colony preparing for winter."

Jen's background is perfect for these studies; she holds a BS in zoology (minor in fisheries and wildlife), and a MS in wildlife biology. It was her graduate research on wolves at Voyageurs NP that landed her the job at the park when it became available. In addition to the wildlife studies and air quality, she is now learning about long-term water quality monitoring.

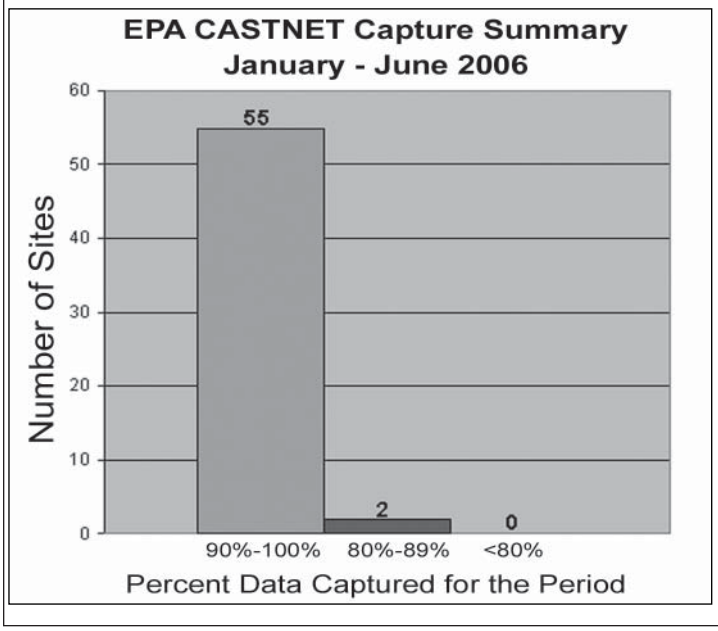
In her free time Jen also plays where the wildlife live - hiking, kayaking, camping, biking, and skiing. Monitoring all sorts of natural resources at Voyageurs leads to their protection, which makes Voyageurs a great place for all to live.

Biological Science Technician Jen Fox is involved with many natural resource projects at Voyageurs National Park, Minnesota.

DATA COLLECTION SUMMARY

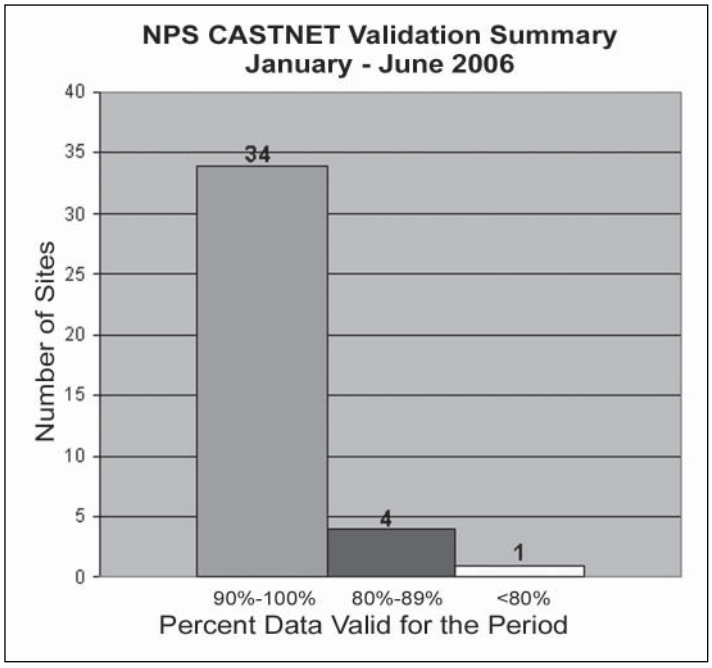
EPA Site Data Capture Summary

Data capture for the EPA CASTNET sites for January through June 2006 are summarized in the graph below. The network achieved an average 99% collection for the period.



NPS Site Data Validation Summary

Data validation for the NPS CASTNET sites for the most recent six months' of validated data (January through June 2006) are summarized in the graph below. The network achieved an average 93% final validation for the period.



FEATURE ARTICLE

CASTNET analysis and results

Introduction

The 1990 Clean Air Act directed that long-term monitoring of air quality and meteorology be conducted in rural areas of the United States to track atmospheric deposition and ambient air pollution trends. Consequently, the Environmental Protection Agency (EPA) created the Clean Air Status and Trends Network (CASTNET) in 1991. CASTNET's predecessor, the National Dry Deposition Network (NDDN), began in 1986. The approximately 50 NDDN sites were then transferred to CASTNET at its outset in 1991. As a result, some CASTNET sites have been collecting data for more than 20 years.

The original design was based on the assumption that dry deposition could be estimated as the product of measured pollutant concentrations and modeled deposition velocities. The concept has been expanded through the years that followed. CASTNET is now a national air quality monitoring network that provides data for determining the relationship between air pollutant emissions, air quality, deposition, and ecological effects.

Air Quality Measurements

CASTNET measures rural, regionally representative concentrations of atmospheric sulfur and nitrogen pollutants and ozone in order to detect and quantify trends, define the geographic distribution of rural pollutants, and estimate dry deposition. The goal of estimating dry deposition also requires data on several meteorological parameters, on vegetation, and on land use. Sulfur and nitrogen pollutants are measured using a three-stage filter pack that exposes three different types of filters to the ambient air for a week. The filters are shipped to the laboratory analysis contractor, MACTEC, in Gainesville, FL, for chemical analysis. The analyses product is concentration values for gaseous sulfur dioxide (SO_2), nitric acid (HNO_3), particulate sulfate (SO_4), and nitrate (NO_3).

CASTNET collects meteorological data primarily to provide input to the Multi-Layer Model (MLM). The MLM is used to calculate hourly deposition velocities, which, when combined with concentration data, provides estimates of dry deposition. The hourly estimates are aggregated and converted to seasonal and annual values in order to characterize dry deposition across the United States and to determine trends in dry deposition rates. Estimates of wet deposition are obtained from the National Atmospheric Deposition Program/National Trends Network (NADP/NTN), that operates precipitation sampling systems to measure the concentrations and deposition rates of air pollutants that are removed from the atmosphere by precipitation. NADP/NTN has sampling locations at or near virtually every CASTNET site. Together, CASTNET and NADP/NTN allow assessments of total (dry + wet) deposition throughout the United States.

Air Quality Trends

More than 40 CASTNET sites, located primarily in the eastern United States, have been operating since the late 1980s. The 34 most regionally representative of these sites are considered to be CASTNET trend reference sites. Quarterly and annual ambient air concentration trends are the best indicators of actual changes in pollutant emissions. Trends based on yearly averages are less likely to be influenced by temporary or regional factors such as a forest fires or unusual seasonal weather patterns.

Figure 1 shows that total sulfur deposition has declined significantly over the last 16 years at the 34 trend sites. The sharp decline in 1995 closely parallels the reductions in sulfur dioxide emissions, which resulted from electric generating utilities' compliance with Phase I of the Acid

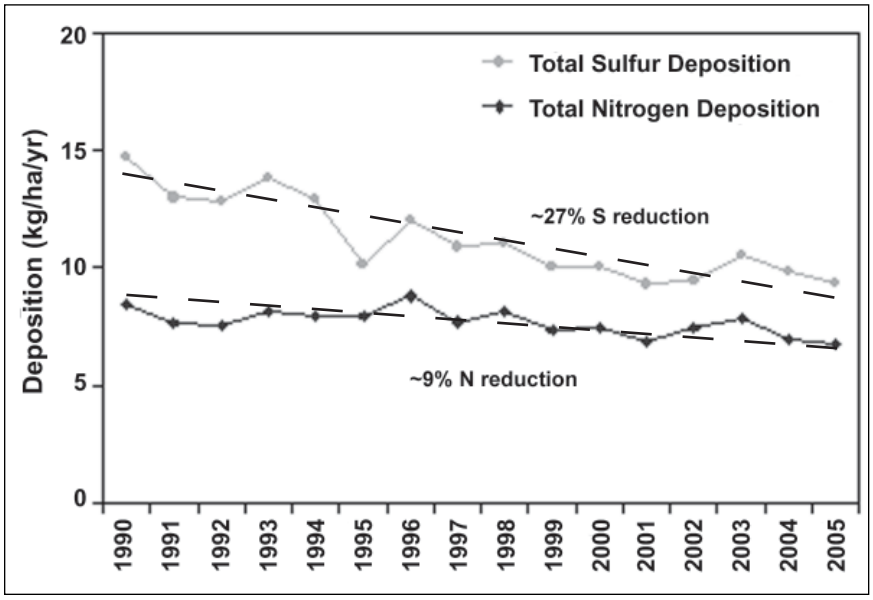


Figure 1. Trends for the annual total deposition (kg/ha/yr) for sulfur and nitrogen at the 34 eastern long-term CASTNET sites.

Rain Program. Total sulfur deposition declined from a 1990-1992 mean of 13.5 kg/ha/yr to a 2002-2005 mean of 9.9, a 27% reduction. The trend line for total nitrogen deposition suggests a slight decline over the 16 years. Three-year means of total nitrogen deposition from the beginning and end of the periods showed a reduction by about 9%. Dry deposition accounts for anywhere from 10% to 70% of total deposition for both sulfur and nitrogen depending on location and local climate. The contribution of dry deposition is much more significant in and near major source regions, (e.g., about 50% near the Ohio River Valley). Median values are approximately 40% for sulfur deposition and 30% for nitrogen deposition.

CASTNET ozone monitoring provides information on geographic patterns in regional ozone and on how concentrations in rural areas compare to the national standard. The ozone data also provide information on trends in rural ozone. The trend line (Figure 2) for the 34 eastern long-term stations shows that since 2002, ozone concentrations have declined for the fourth highest daily maximum 8-hour ozone concentrations. The relatively low concentrations observed in 2003 and 2004 were caused, in part, by unusually cool, cloudy, and wet weather during the ozone season. However, the median fourth highest daily maximum 8-hour ozone concentration for 2005 was the second lowest in the history of the network despite the return to normal ozone season weather conditions. The recent decline in rural ozone and nitrate levels has been attributed to the documented reductions in nitrogen oxides (NO_X) emissions, as well as weather conditions. NO_X emissions in the eastern United States have declined over the last several years because of the Acid Rain Program, EPA's NO_X State Implementation Plan (SIP) Call, and several other NO_X control programs.

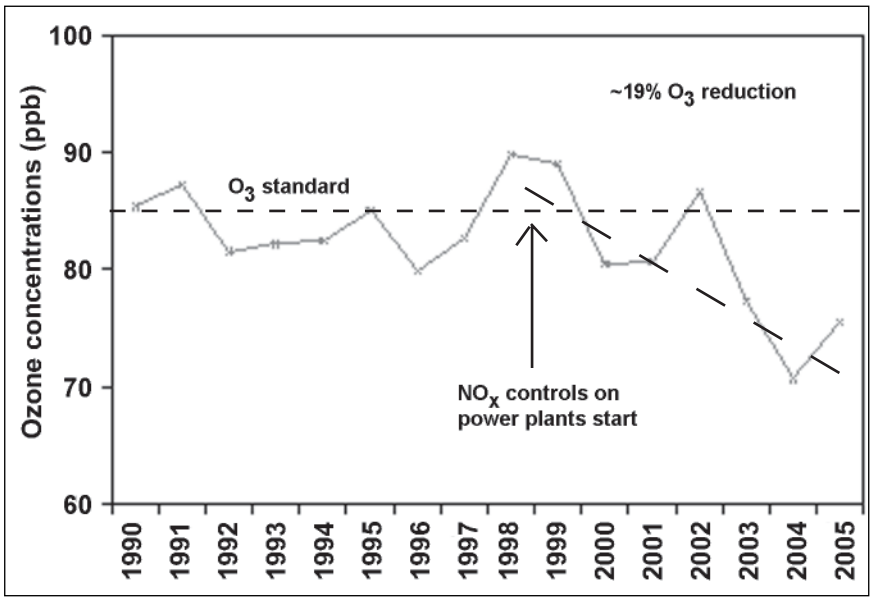


Figure 2. Trends for the fourth highest daily maximum 8-hour ozone concentrations (ppb) at the 34 eastern long-term CASTNET sites.

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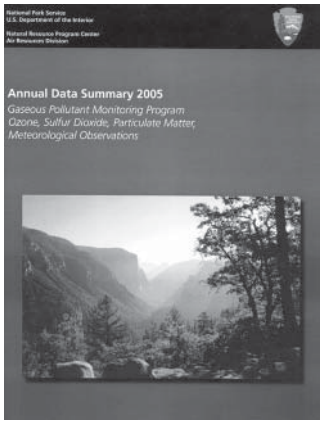
Annual data summary sports new look



By now you should have received notification that the 2005 Annual Data Summary for the NPS Gaseous Pollutant Monitoring Program has been released. Park superintendents received a hardcopy and site operators and others involved in the monitoring program, including state-operated site staff, received an e-mail notification stating where to access the summary online (*http://www2.nature.nps.gov/air/monitoring/index.cfm*).

The 2005 data summary sports a different look than previous summaries. The new format corresponds with other NPS science documents, and includes many photographs of scenic park vistas and air quality monitoring stations. Many readers expressed interest in seeing these other park views and monitoring stations around the country.

The summary's cover photograph this year features Yosemite National Park, CA, compliments of Lee Tarnay, Physical Scientist/Air Resource Specialist at the park.

Servicing reports now available on site

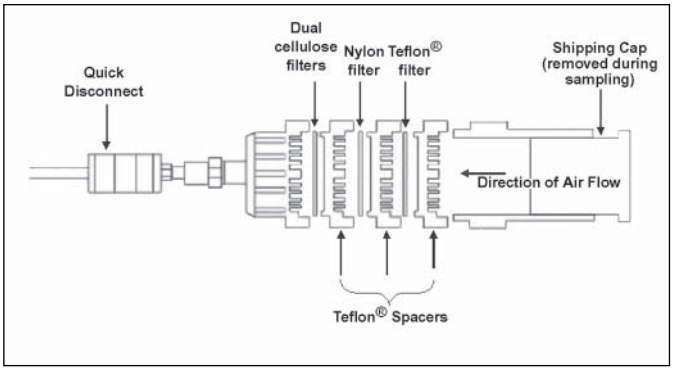
The twice-annual maintenance and calibration reports, completed by ARS' field specialists after servicing NPS monitoring sites, are now available in DataView at each site. Just click on "Site Documentation" and follow the prompts. Reports are available for 2006, and new reports will be uploaded to the sites as they are created.

LAB TALK

Filter pack lifecycle

It's Tuesday – time for a site visit to change out the filter pack. Those filter packs arrive like clockwork every week. It is easy to exchange the new filter pack for the one on the tower, but have you wondered about the lifecycle of a filter pack? How does it become a filter pack, and what happens to it after it is removed from the tower?

The CASTNET filter pack is comprised of four filters separated from one another into three stages by Teflon® spacers. To ensure that CASTNET data are of the highest quality, strict quality control and quality assurance procedures are in place to follow data from "cradle to grave." This process includes verifying that the filters are not contaminated prior to being loaded into the filter packs. It also includes maintaining a chain-of-custody trail so each filter and its resultant data can be located anywhere in the system at any time. All stages of filter and filter pack handling are designed to minimize contact and the possibility of contamination or misdirection. Included in this design, as a precaution against contamination, is the requirement that gloves be worn and tweezers be used when handling the filter packs and/or filters.



CASTNET filter pack drawing showing individual components.

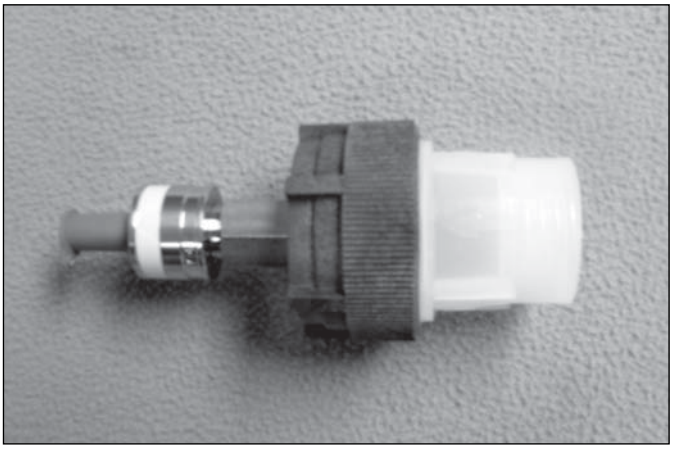
To create the filter pack that arrives at each CASTNET site weekly, first, a selection of new filters is acceptance tested to ensure that background contamination is within acceptable limits. Usually, background contamination is negligible. However, if it is not, the group of filters represented by those selected is rejected for use in the field and selections from new groups are tested until a group is deemed acceptable. Second, the filter pack assembly is carefully cleaned with deionized water, oven-dried, and inspected for damage or possible air leaks, which allow for contamination and interfere with rates of airflow through the filter pack. The assembly is either repaired or replaced if it is damaged. Pollutants are determined from each filter pack as presented in Table 1.

Table 1. Filter analysis and calculations for reported species.

Reported Species	Filter Analysis and Calculations
Particulate sulfate (SO_4)	Particulate SO_4 from the Teflon filter
Particulate nitrate (NO_3)	Particulate NO_3 from the Teflon filter
Particulate ammonium (NH_4)	NH_4 from the Teflon filter
Total sulfur dioxide (SO_2)	SO_2 from the Cellulose filter +SO_2 from the Nylon filter
Total nitrate (NO_3)	Particulate NO_3 from the Teflon filter +NO_3 from the Nylon filter
Nitric acid (HNO_3)	HNO_3 from the Nylon filter
Anions and Cations (Ca^{2+}, Cl^-, Mg^{2+}, Na^+, K^+)	Ca^{2+}, Cl^-, Mg^{2+}, Na^+, K^+ from the Teflon filter

Each filter pack assembly is loaded with one Teflon® filter (first stage), one nylon filter (second stage), and two cellulose (paper) filters impregnated with a potassium carbonate solution (third stage). As the filter packs are loaded, they are assigned identification numbers and chain-of-custody tracking begins. The tracking numbers are generated by the laboratory and are used to track the filters and filter documentation (Site Status Report Form - SSRF) on their travels to and from the field. The filter pack is then packed with the SSRF and sent to the site for sampling.

When the filter pack is returned to the CASTNET laboratory in Gainesville, FL, it is logged in to maintain the chain-of-custody documentation and to indicate to project personnel that the exposed filter pack is "in-house." It is then delivered to the sample custodian in the laboratory who carefully removes the exposed filters from the filter pack. The condition of the filters is examined, and then each filter is placed in a bottle that is labeled with the filter ID number and placed in cold storage pending sample



Fully assembled CASTNET filter pack.

Filter packs **continued on page 7....**

Filter packs **continued from page 6....**

processing. To begin sample processing, the laboratory adds an extraction fluid primarily consisting of deionized water and places the bottles in a mechanical shaker. The deionized water "extracts" the pollutants from the filter and allows for laboratory analysis of pollutant concentrations using ion chromatography. These filter concentration data are then validated through a series of steps before being finalized and reported. The data continue to carry the identification number and can be traced back through the system from any point. This ability to track each datum from cradle to grave serves as a quality assurance/quality control step for ensuring the quality and reliability of CASTNET data.

OPERATOR'S TOOLBOX

Evaluating met measurements

CASTNET collects meteorological data primarily to provide input to the Multi-Layer Model (MLM), the mathematical model used to calculate hourly deposition velocities and to estimate dry deposition of pollutants to the environment. The hourly estimates are aggregated to seasonal and annual values in order to characterize dry deposition across the United States and to determine trends in dry deposition rates.

Reliable MLM simulations require high-quality meteorological measurements as input. The model calculations are most dependent on accurate measurements of wind speed, the standard deviation of wind direction (sigma theta), and relative humidity. An updated version of the model, which will be delivered to the CASTNET team within the next year, also requires reliable measurements of temperature and the 2 to 10 meter temperature difference (delta temperature).

One of the site operator' duties during the weekly Tuesday station visit is to assess the reasonableness of the current meteorological measurements. Perhaps the most practical way to evaluate wind speed data is to use the Beaufort Wind Scale that was developed by British Rear Admiral, Sir Francis Beaufort in 1805 (see Table 1). Data logger output of wind speed should be consistent with the wind effects listed in the table. For example, a wind speed of 6.0 m/sec should be manifested by the movement of small tree branches.

The evaluation of sigma theta, the standard deviation of changes in horizontal wind direction within one hour, is more subtle. The operator should observe the behavior of the wind vane and review 1-minute averages of sigma theta. A fluctuating wind vane should be manifested by relatively large values of sigma theta. Sigma theta values range from a few degrees to almost 90 degrees. A still vane should show a sigma theta value of 0.0. Larger values of sigma theta typically occur during stable conditions with light, but fluctuating, winds and decrease with increasing wind speed. Note the mean sigma theta measurements in the Beaufort table.

The MLM is sensitive to high values of relative humidity (RH). High RH occurs when dew and/or precipitation are present. A feeling of humidity in the air also suggests high values of RH. Wind direction, although not used directly in the MLM, is an important indicator of overall source-receptor relationships. Wind direction measurements can be evaluated by comparing the orientation of the vane (i.e., using the instrument tower's North-South cross-arm as a guide) with 1-minute values from the data logger.

By carefully comparing the meteorological measurements with visual observations, the operator is in the best position to evaluate the meteorological data, which could affect the quality of the MLM simulations of atmospheric dry deposition. Site operators who take the time to review this type of data during Tuesday site visits play a very important role in maintaining the high quality of data reported by CASTNET.

Table 1. Beaufort wind scale.

Wind Speed (m/sec)	Classification	Sigma Theta (degrees)	Appearance of Wind Effects
0.0 to 1.5	Light Air	31.5	Still wind vane.
2.0 to 3.0	Light Breeze	20.2	Wind felt on face, leaves rustle, vane begins to move.
3.5 to 5.0	Gentle Breeze	16.0	Leaves and small twigs constantly moving.
5.5 to 8.0	Moderate Breeze	20.6	Dust, leaves, and loose paper lifted; small tree branches move.
8.5 to 10.5	Fresh Breeze	17.4	Small trees in leaf begin to sway.

Note: Mean sigma theta values were calculated from 2005 measurements at Chiricahua National Monument, AZ (CASTNET site CHA467).

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First Class Mail

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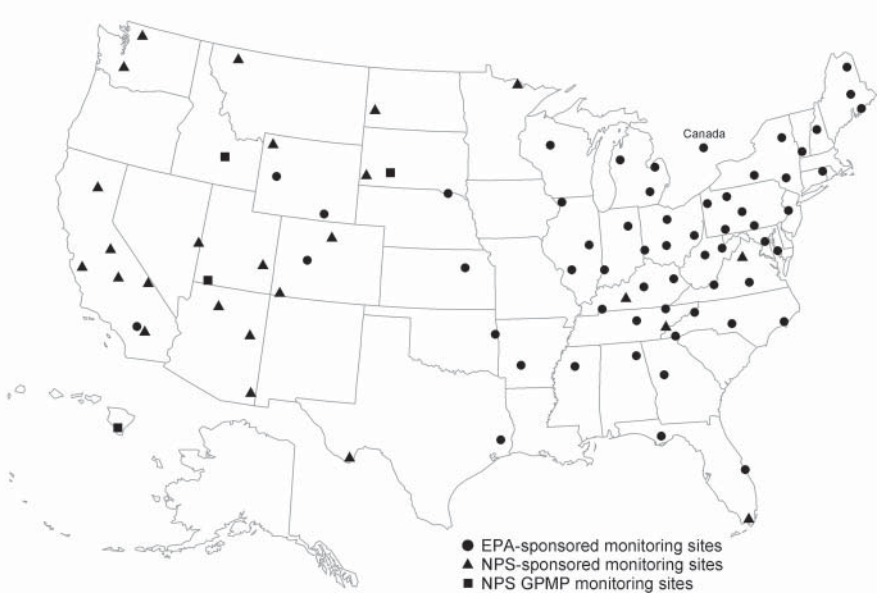
CASTNET Monitoring Program Locations



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