

# The Monitor

## CASTNET

Clean Air Status and Trends Network

Spring 2010

The Newsletter for Air Quality Station Operators



National Park Service (NPS)  
Gaseous Pollutant Monitoring Program  
(GPMP)



Environmental Protection Agency (EPA)  
Clean Air Status and Trends Network  
(CASTNET) program

## NETWORK NEWS

### NAAQS changes in store for 2010

The EPA announced it would reconsider the 2008 primary National Ambient Air Quality Standard (NAAQS) for ozone, to ensure it is scientifically sound and protective of human health. EPA last changed the primary standard in 2008, when it was strengthened from 0.08 ppm (over an 8-hour period) to 0.075 ppm. EPA is now proposing a primary standard between 0.060 and 0.070 ppm measured over 8 hours. A final decision is expected by August 2010. A secondary ozone standard is also receiving some attention.

EPA is also looking to strengthen the primary sulfur dioxide ( $\text{SO}_2$ ) standard. It proposes to revoke the current 24-hour and annual standards and institute a new, 1-hour standard between 50 and 200 ppb. Changes to  $\text{SO}_2$  monitoring and reporting requirements are also proposed; monitors would be placed in urban areas and in areas with high  $\text{SO}_2$  emission levels. A final decision is expected by June 2010. New limits for the secondary  $\text{SO}_2$  standard, which will protect the environment, may be proposed in 2011.

EPA has already finalized new limits for the nitrogen dioxide ( $\text{NO}_2$ ) primary standard. The new 1-hour standard is 100 ppb, while the existing annual average standard of 53 ppb is retained. In addition, monitoring of  $\text{NO}_2$  is now required near roadways in cities with populations of at least 500,000. Larger cities will require additional monitors.

### Spatial variability of western dry chemistry concentrations

The CASTNET program measures a number of dry chemical species using weekly filter packs. The dry deposition of nitrogen to natural areas is known to acidify soils, to induce biological species changes, and to act as a fertilizer that helps promote the growth of exotic plant species.

The question, then, is how dense does a network of sites need to be, to adequately capture the rural spatial variability of the dry chemistry species? A separate program run by the NPS may help answer this question. A network of 18-20 portable ozone monitoring systems (POMS) is run by NPS during the summer months, mostly at western locations. Four of the POMS are also equipped with CASTNET filter pack systems at a sampling height of 20 feet. Some preliminary POMS findings that answer our question are presented here.

*Western dry chemistry continued on page 2....*

### EPA expected to certify 2B ozone analyzer

Both the NPS and the Forest Service have been using small, low-power ozone analyzers in portable stations to survey ozone concentrations at remote locations. The portable stations include the model 202 ozone analyzer from 2B Technologies. NPS has been running 15-20 units with good success for the last five summers. 2B Technologies recently completed all the tests required to demonstrate analyzer performance and submitted an application to certify the model 202. EPA reviewed the application and it appears they will approve the model 202 ozone monitor as an EPA-designated equivalent method instrument. A final decision will be posted in the U.S. *Federal Register*. Certification of the analyzer will lead to a much broader acceptance of the data and will allow state air pollution agencies to consider using the analyzers in their networks. Visit <http://www.nature.nps.gov/air/studies/portO3.cfm> for more information.

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

## **CASTNET plans ammonia study**

MACTEC and EPA's Clean Air Markets Division (CAMD -- the EPA division that manages and funds the EPA-sponsored CASTNET sites) are currently planning and preparing for a special study designed to measure reactive nitrogen (Nr), including gaseous ammonia ( $\text{NH}_3$ ), at select CASTNET sites for one year. The study is being conducted in partnership with other EPA principal investigators at EPA's Office of Research and Development (ORD) and Office of Air Quality Planning and Standards (OAQPS), both of which are also contributing to fund the study. Currently, the traditional CASTNET 3-stage filter pack captures particulate ammonium ( $\text{NH}_4^+$ ) and nitrate ( $\text{NO}_3^-$ ) on the first filter (Teflon). There is a known bias of particulate ammonium and particulate  $\text{NO}_3^-$  due to the volatilization of ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ) during the length of the CASTNET sampling period (one week). This also leads to errors in the partitioning between particulate  $\text{NO}_3^-$  and gaseous nitric acid ( $\text{HNO}_3$ ), which is collected on the second filter (nylon). The ammonia study will include the deployment of:

- Radiello passive ammonia samplers,
- Traditional CASTNET filter packs with an additional fourth stage filter impregnated with phosphorus acid ( $\text{H}_3\text{PO}_3$ ) to collect atmospheric  $\text{NH}_3$  and any volatilized  $\text{NH}_4^+$  (an  $\text{NH}_x$ -filter),
- Met One SASS  $\text{NH}_3$  denuders,
- Met One SASS ion canisters, and
- Duplicate annular denuder systems (ADS) as the reference method.

The passive  $\text{NH}_3$  samplers are part of the NADP Ammonia Monitoring Network (AMoN), a relatively new initiative with the goal of establishing a long-term ammonia monitoring network. Currently, AMoN sites measure  $\text{NH}_3$  concentrations at two-week intervals as an average of triplicate Radiello samplers. For more information on AMoN, visit <http://nadp.sws.uiuc.edu/nh3net>. Other measurements collected will have one-week sampling periods, and will be collected for two consecutive weeks every four weeks for one year, in order to characterize the seasonality of the reactive nitrogen components in question.

CASTNET sites tentatively selected for the study include: Arendtsville, PA (ARE128); Cherokee Nation, OK (CHE185); Connecticut Hill, NY (CTH110); Palo Duro Canyon State Park, TX (PAL190); and the collocated site at Rocky Mountain National Park, CO (ROM206).

The end results of the study will provide an improved understanding of the performance the traditional 3-stage CASTNET filter pack, and will assess the viability of switching to the 4-stage CASTNET filter pack for all sites (a recommendation made during the August 2009 CASTNET workshop held in Research Triangle Park, NC). For more information on the CASTNET study, contact Chris Rogers at [cmrogers@mactec.com](mailto:cmrogers@mactec.com).

### **Western dry chemistry continued from page 1....**

Statistical distributions show that the southern California sites have much higher total nitrogen concentrations than other western sites. There also appears to be a gradient in total nitrogen that increases from east to west. The New Mexico and Texas sites are an exception to this gradient, as they have higher nitrogen concentrations than the other sites in the West (a broad area of Utah, Colorado, Wyoming, and the Dakotas all have lower total nitrogen concentrations and similar means). The data suggest that there are strong gradients about major source areas that may not be fully represented spatially by the current network. No attempt was made in this analysis to account for elevation differences. Most of the western sites fall below  $0.8 \mu\text{g}/\text{m}^3$  and are probably fairly represented even with the widely spaced network in those areas.

More information can be gained from the other dry chemistry compounds and the samples that indicate episodes. We'll save that for a publication with more space to devote to the subject. Currently we see that the Pinto Wells site in Joshua Tree, CA, and the Carlsbad Caverns, NM, site indicate transport from pollution source areas and help define the gradient from higher to lower concentrations. The Devil's Tower, WY, and Dinosaur, CO, filter pack samplers, however, do not add much new information. The Dinosaur site has nearby oil and gas development, and pollution from Salt Lake City may be transported into the monument. Since the nitrogen and ozone concentrations don't seem elevated, it appears that any impact from those source areas to Dinosaur is not detectable with the POMS ozone and filter systems.

#### **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. 6629 and/or 6620  
(Eastern Time)

## STATION OPERATOR FOCUS

### Monitoring and profession combine for Roger Russell at Speedwell, TN (SPD111)

Roger Russell, operator at the Speedwell, TN, monitoring site, finds what he wants to do, then does it for a very long time. One example is his profession as a corporate pilot; another is his job as site operator for the CASTNET air quality station. Roger has been the operator at SPD111 (in northeast Tennessee) since the site's inception in 1989.

When Roger's father was approached in 1989 to operate an air quality station on his dairy farm, he obliged, but it was Roger who took responsibility for servicing the instrumentation. It takes Roger, on average, about two hours every Tuesday to service the station -- more if the grass needs mowing around the shelter. He recently spent additional time replacing the rotted shelter floor and adding moisture-prevention measures both inside and out.

Both monitoring and piloting involve meteorology; monitoring documents it while piloting maneuvers through its ever-changing conditions in the skies. Roger holds a B.A. degree in Academic Psychology, but soon after earning it he discovered what he really wanted to do, which was piloting aircraft. He now pilots corporate jets, shuttling businesspeople to and from where they need to be.

Roger also helps his father with the farming chores, tending to cattle, and corn and tobacco crops. He enjoys being outdoors and sees the country through motorcycle rides.

Being a long-time operator of the station has allowed Roger to perceive small, yet ongoing changes to the air. "The air quality here seems to have improved since 1989," said Roger. "Cumberland Mountain is 1.3 miles away and in August and September we were never able to see the mountain. It is visible now though. This area is downwind from sulfur-coal plants which now have scrubbers on them. I can also see an improvement in the amount of particulate built up on the filter packs. Monitoring air quality is for a good cause."

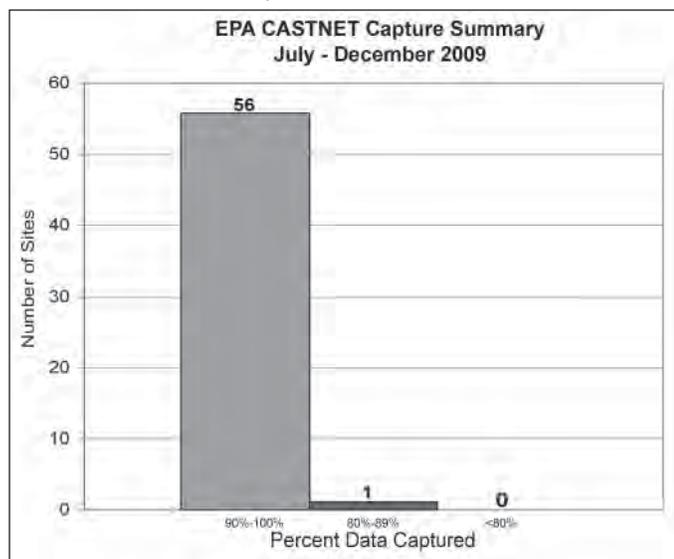


Roger Russell has serviced SPD111 since the site's inception in 1989.

## DATA COLLECTION SUMMARY

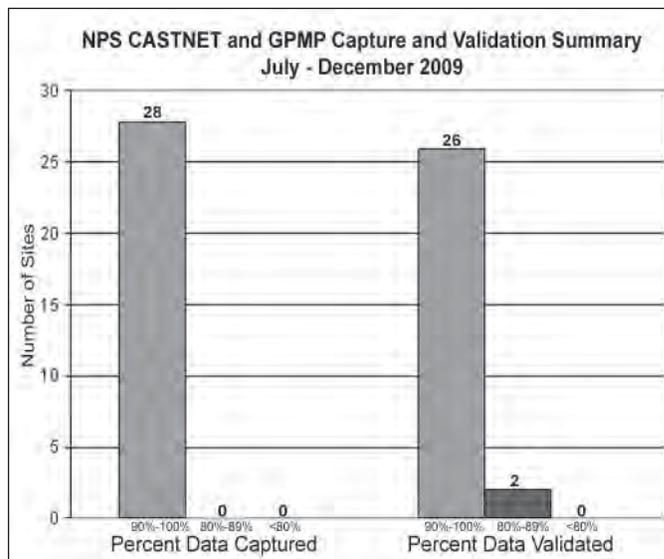
### EPA site data capture summary

Ozone data capture for the EPA CASTNET sites for July through December 2009 is summarized in the graph below. The network achieved an average 98% collection for the period. Data validation statistics for the period will not be available until mid-July 2010.



### NPS data capture and validation summary

Ozone data capture for the NPS CASTNET and GPMP sites for July through December 2009 achieved an average of 99% collection as illustrated in the graph below. Data validation for the same sites and period are also shown. The network achieved an average 97% final validation for the period.



## FEATURE ARTICLE

### Identifying approaches for optimizing CASTNET monitoring

Summary the August 2009 Workshop (by G. Bowker, U.S. Environmental Protection Agency)

#### Program background

CASTNET is a long-term program for monitoring the principal air pollutants involved in acidic deposition, and for evaluating the trends in these pollutants resulting from emissions reductions programs. CASTNET operates more than 80 regional sites for measuring air pollutant concentrations and meteorological conditions, and records observations needed to compute dry deposition fluxes. Sites are located in areas where urban influences are minimal. Through an interagency agreement, the NPS sponsors 27 CASTNET sites located in national parks and other Class I areas.

The practice of consistent quality-assured methods for more than 15 years has resulted in a CASTNET data set that is fundamental in evaluating the effectiveness of sulfur dioxide (SO<sub>2</sub>) and nitrogen oxide (NO<sub>x</sub>) emissions reductions required by the Acid Rain Program (ARP), NO<sub>x</sub> Budget Trading Program (NBP), and other emission reduction programs. Furthermore, the NPS uses CASTNET data to ensure that air quality does not adversely affect the natural resources, scenery, wildlife, or historical objects within the U.S. national parks.

CASTNET data have clearly demonstrated that pollutant emission reductions have resulted in cleaner air and in lower deposition of acids and acidifying chemicals. The CASTNET data set also serves as one basis to gauge planned and future emissions reduction programs, especially providing input for the development and evaluation of numerical models that serve as tools for regulatory assessment and for understanding atmospheric processes.

#### Workshop structure and goals

A widely-attended workshop was held at the EPA offices in Research Triangle Park, North Carolina, in 2009. Participants included leading air quality scientists, site operators, and government scientists from many different agencies. The purpose of the workshop was to review the state of CASTNET monitoring and provide input to the EPA and NPS on improvements that could reduce or potentially eliminate limitations of the current instrumentation and methods, and to address contemporary and projected assessment needs. The overarching goal was to articulate a strategy that would optimize the CASTNET monitoring program while balancing new costs with savings and efficiencies.

Four broad questions were posed to the participants prior to the workshop. In addition, each participant was given a spreadsheet as a visualization tool for how their answers to the four questions would affect the overall budget. For example, if a site, an instrument, or a parameter was added to satisfy a goal of the network, a site, instrument or parameter would need to be cut to stay within the constraints of the current budget.

The workshop was broken up into different sessions. First, small groups met in break-out sessions in which participants discussed scenarios for optimizing CASTNET, while preserving the elements deemed necessary for meeting ongoing EPA and NPS goals. Recommendations for improvements focused on addressing contemporary and projected needs for more accurate and representative data, especially to better represent reactive nitrogen species and deposition, and to better support model development, including diagnostic and source/receptor evaluations.

Second, recommendations from the individual breakout sessions were vetted into several plenary sessions. Notwithstanding the many valuable suggestions of individual participants, the summary that follows represents a consensus of the body of participants.

#### Participant response

The four questions posed to the participants and a summary of the responses from the participants of the workshop follow.

**Question 1:** Which air pollutant measurements are most critical to CASTNET objectives (reactive nitrogen, reduced nitrogen, sulfur, ozone, etc)? What temporal resolution is needed to make these measurements most useful for assessments and model development?

**Response 1:** The workshop community recognized the great value of nearly all CASTNET measurements. The measurements made using the filterpacks drew the most attention (although ozone measurements were also recognized to be of great value). The longevity of continuous measurements makes the network unique and adds great value for people interested in program assessment and long-term trends, as well as those interested in numerical model development/evaluation. It was noted, however, that adding more highly-temporally resolved measurements, and measurements of additional chemical species would enhance the utility of the network

for model evaluation. While hourly measurements would be useful, daily measurements would not add value to model development. In addition, adding sites to capture 'problem pollutants' in critical areas of the country, such as ammonia (NH<sub>3</sub>) in the central U.S., would add value for understanding the changes in emissions and atmospheric pollutant composition.

**Question 2:** Should CASTNET add chemical species or parameters to its current measurement set? If so, what instrumentation and methods are needed? What operator expertise is required for new measurements? What quality-assurance protocols should be followed? Where should the additional monitoring occur?

**Response 2:** It was recommended that additional instruments be introduced at select CASTNET sites to address the need for more accurate and representative measurements, especially to better represent the ambient as well as deposition flux of reactive nitrogen (Nr) species. A second point that was reiterated was better support for model development, including diagnostic and source/receptor evaluations. In particular, there was wide recognition of the importance of NH<sub>3</sub> deposition in terrestrial and aquatic systems in rural and remote areas (e.g., Rocky Mountain National Park) and near agricultural sources (e.g., the Chesapeake Bay watershed). A recent National Research Council report calls on programs, including CASTNET, to develop the capacity to monitor NH<sub>3</sub>, as well as all Nr species. Workshop participants suggested that CASTNET focus on measurements of nitrogen species to address these assessment and research needs. The participants recommended that this be achieved by adding gaseous NH<sub>3</sub> measurements to the suite of routine CASTNET measurements at all sites, and by adding true NO<sub>2</sub>, NO<sub>y</sub>, and Nr measurements at select sites.

For other chemical species, it was also recommended that CASTNET adopt a tiered approach to monitoring, in which most sites follow the current protocols while a few sites make enhanced measurements. By adopting a tiered approach to monitoring, a few sites could be specially equipped with additional analyzers, adapted to make high time resolution, continuous concentration measurements of many particle and gaseous chemical species. These measurements would support diagnostic model evaluations of fine particle formation. Further, the concentration data could be used to estimate the dry deposition fluxes of the individual nitrogen species.

**Question 3:** Should CASTNET directly measure dry deposition, rather than relying solely on estimates from inferential calculations?

**Response 3:** A clear need was expressed for verifying the inferential dry deposition estimates at CASTNET sites with a variety of land surfaces and vegetation types and conditions. It was recommended that CASTNET add instrumentation to verify the current dry deposition estimates. This would involve making direct flux measurements at several sites and comparing these measurements to the MLM-derived dry deposition velocities. CASTNET would then be able to characterize the uncertainty in their dry deposition measurements.

The participants also suggested that CASTNET pursue a partnership with the AmeriFlux program. AmeriFlux is a multi-agency program with a goal of quantifying carbon, water, and energy fluxes over major vegetation types and across seasons and years. Currently, there are more than 30 AmeriFlux sites in the continental United States. AmeriFlux scientists could benefit from CASTNET flux measurements of nitrogen, sulfur, and other pollutants.

**Question 4:** What aspects of the CASTNET program, if any, could be eliminated or reduced in scope (e.g., meteorological measurements, dry deposition modeling) without affecting the robust dataset the network provides?

**Response 4:** The participants identified areas that could be cut to produce a cost-savings, which could be used to modernize and improve CASTNET equipment and measurements. The discussion focused on the possibility of discontinuing meteorological measurements at sites with greater than four years of data measurements. The second area in which the participants saw potential for cost reduction was the number of sites in certain regions of the country where we currently have a high density of measurements. Participants emphasized that the EPA and NPS should evaluate the network strategy and demonstrate (in a statistical sense) that the current network distribution is meeting the agencies' goals in the most-efficient manner.

#### **Summary**

The results and discussions from the workshop will be published in a cohesive report and posted on the CASTNET Web site (<http://www.epa.gov/castnet>). Overall, the participants gave the EPA and NPS positive feedback on the goals laid out for the network and the progress made toward reaching those goals over the two-day workshop.

The workshop initiated the process of articulating a strategy to continue to ensure that CASTNET continues to provide high quality data that is useful for the broadest community without exceeding the current budget. The EPA and NPS will continue to reach out to the scientific community, data users, site operators and interested participants for feedback on potential changes to the network.

## SHOP TALK

### Optimal indoor shelter conditions



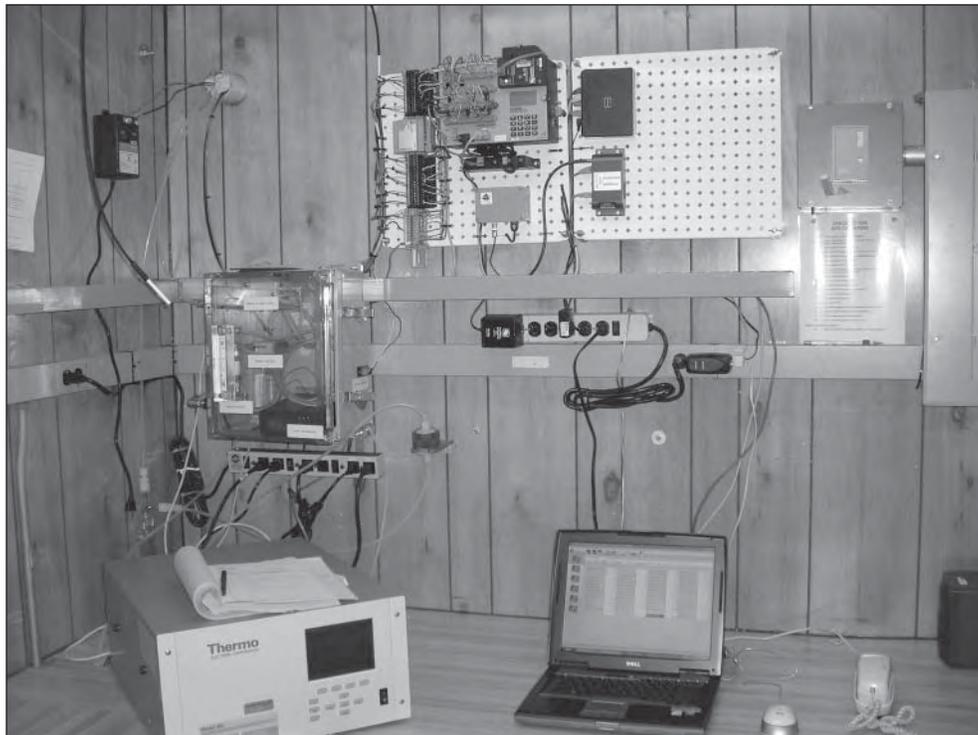
Maintaining proper environmental and working conditions inside your CASTNET monitoring station shelter is important not only for assuring the quality of data collected, but also for your safety, ease of use, and extended service life of your shelter. With the approach of spring, it is time to recheck the structural and operational conditions of the monitoring shelter.

Here are a few items that you should check and actions you should take in the event of deviation from required or desired conditions:

- Integrity of the building envelope – Are there any gaps or holes in the walls, ceiling, floor, or around the door? This is important because maintaining an internal temperature of 20° to 30°C (68° to 86°F) is required for ozone (O<sub>3</sub>) data generated by your O<sub>3</sub> analyzer to be considered valid. If you notice that there are leaks in the building envelope, please let us know and we will arrange repairs. MACTEC and ARS staff also check for and repair building envelope integrity defects during site visits.
- Proper operation of the heating and cooling systems – With the shift from heating to cooling, it is important to confirm that your air conditioning (AC) system is

operating properly. Please turn the AC system on to verify that cold air is produced. If not, call your MACTEC or ARS contact so that we can arrange for the repair or replacement of your AC unit before warm weather arrives. This is also important for maintaining the proper range of internal temperature, as discussed above.

- Proper functioning of your thermostatically controlled heating, ventilation, and air conditioning (HVAC) system – Even when your HVAC unit is functioning, if the thermostatic control is not, then internal shelter temperature may deviate outside of required limits. Check that the internal temperature of the shelter and the thermostat match. Then raise or lower the temperature of the thermostat and check that the HVAC responds by raising or lowering the shelter temperature to match the thermostat.
- Proper draining of your HVAC system – Be sure that the drain line from your AC condensate drip tray drains to the outside. This may be by way of a line or by a tilting of the drip pan so that condensate drains to the outside. If you have a drip line, check to be sure that it is not clogged by insects or other debris. Improper drainage of condensate has caused wall and floor damage at several sites.
- Disposal or return of old paperwork or equipment – Old paper forms, shipping materials, and nonessential equipment and parts accumulate inside shelters. This can pose safety and fire hazards, and interfere with the ease of operation of your site. Please note the excess materials and equipment that have accumulated inside your shelter, and advise your CASTNET or ARS contact. They will advise you how to return or disposal of materials.
- Neat and systematic organization of wiring and flow tubing – Over time, as equipment is added or repaired, power and signal lines become disorganized. Replacement of data logger and modem systems in MACTEC CASTNET shelters has remedied



Interior of the Stockton, IL, monitoring station (STK138).

*Shelter continued on page 7...*

## OPERATOR'S TOOLBOX

### Spring cleaning: Your CASTNET site conditions



Winter can cause damage to your CASTNET site and shelter. Here are a few things that you should check now that winter is on its way out, and spring is approaching:

- Frost heaving of posts, pilings, and towers – If you live in an area that has deep freezing of the soil, then you know what this is. Heaving of shelter pilings can cause twisting of the shelter frame and breaking of seals and riveted joints. This can then result in water leakage into the shelter or shelter wall. Frost heave may also affect utility service poles, sensor posts, tower bases, and guy wire anchors causing instability and possibly unsafe conditions.
- Freeze splitting of pipes – Freezing water inside sensor mount posts, tower tubing, or other hollow structures can cause splitting of tubing. This has occurred at many sites in colder areas, and typically is observed as a splitting of the aluminum tower tubing.
- Loosening of guy wires – Materials other than water will contract or shrink at lower temperatures. This can cause a tightening of guy wires and subsequent loosening as temperatures rise. Check your guy wires for tightness. If there is more than an inch of free play in a guy wire, the turnbuckle should be tightened. If no further adjustment is possible, notify your MACTEC or ARS contact, and repairs will be scheduled.
- Kinked, compressed, or compromised signal wires and flow tubing – Over time, flow tubing and signal

and power wires may become degraded by ultraviolet radiation, ozone, repeated bending or rubbing, or inadvertent damage during routine site operation. Check for bent or cracked flow tubing and chafed, bent, or broken wires, as well as compromised wire insulation, and notify your MACTEC or ARS contact should damage be observed.

- Vegetation and other obstructions to flow – Spring is a good time to check for possible violations of siting criteria with regard to surrounding vegetation or structures that may have been moved to, or installed on or near your site. The vegetation on or near your site may have grown considerably since the installation of your site. According to CASTNET siting criteria, no surrounding vegetation or solid structure should be above a 30-degree angle of inclination above the level line of sight when you are standing next to your tower or other devices located on your site. This is to assure that there are no disturbances to air flow, which might interfere with sampling of particles and gases. If any surrounding vegetation or structures exceed this limit, contact your MACTEC or ARS contact, and corrective measures will be documented and scheduled.

A checklist of structural, electrical, and flow system conditions to be checked outside of your shelter will arrive at EPA CASTNET sites within the next 30 days to assist you in assuring that your site remains safe, neat, and in good working order.

As always, should you note other matters of concern outside of your shelter, please contact your MACTEC or ARS contact immediately.

### Shelter *continued from page 6...*

much of the wiring clutter in the shelters. Flow tubing, as well as wiring, may also become disorganized. Check for kinking or bends in flow system tubing and remedy the situation if possible. If your wiring and/or tubing is not neatly organized, please notify your MACTEC or ARS contact. The need to remedy the situation will be noted in your site file so that action will be taken on the next technician site visit. Neatly arranged and labeled wiring and tubing promotes safety, reduces fire hazards, and makes on-site and remote troubleshooting, replacements, and repairs much easier.

- Physical integrity of floor and flooring – The subflooring on many EKTO shelters can be compromised by time

and use, as well as by moisture in the subflooring and in the foam insulation located beneath the subflooring. Tiles may have come loose and need to be replaced. Several shelters have already been repaired. If you have floor tiles missing or your shelter flooring sags or gives way under foot, then advise your MACTEC or ARS contact, and repairs will be scheduled.

A checklist of structural, electrical, and flow system conditions to be checked inside your shelter will arrive at EPA CASTNET sites within the next 30 days to assist you in assuring that your site remains safe, neat, and in good working order.

As always, should you notice other matters of concern inside your shelter, please contact your MACTEC or ARS contact immediately.

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First Class Mail



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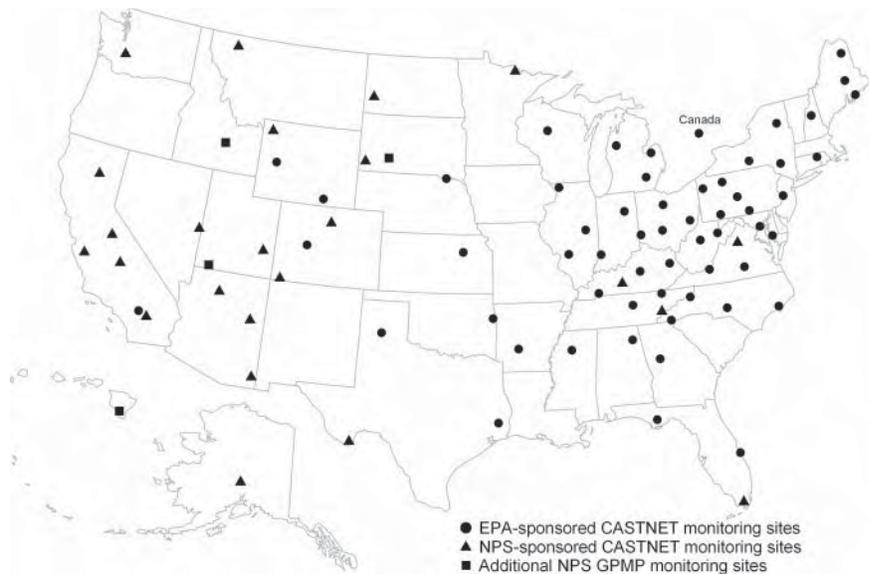
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### CASTNET Monitoring Program Locations



EPA Clean Air Status and Trends Network  
(<http://www.epa.gov/castnet>)

NPS Gaseous Pollutant Monitoring Program Network  
(<http://www.nature.nps.gov/air/monitoring/index.cfm>)