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Monitoring the Long-Memory Air Quality Data Using ARFIMA Model

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Abstract

Control chart is commonly used in the industry to help ensure stability of manufacturing process and quality of products. Control chart is also used to monitor the environmental data, such as industrial waste or effluent of manufacturing processes, however, it has to be modified if the environmental data exhibit the property of long memory. In this paper, the control chart for fractionally integrated autoregressive moving-average (ARFIMA) model is proposed to monitor the long-memory air quality data. In addition, empirical examples of control chart using autoregressive integrated moving-average (ARIMA) and ARFIMA models are compared. The result shows that control charts using ARFIMA model could be more appropriate than those using ARIMA model.

Keywords: long-memory, control chart, ARFIMA model, ARIMA model.

1. Introduction

Control chart is a useful statistical tool in quality control and improvement to monitor the variation of the key characteristics of products and to detect assignable causes that affect manufacturing or other environmental process. By applying control charts to environmental data, the change of the model of air quality can also be studied. Unlike the traditional control charts in which observations are assumed to be independent, observations of air quality usually have autocorrelations. Therefore, control charts should be used with modifications. Pan and Chen (2004) found that PM10 and O3 of air quality in the Taipei city follow ARIMA models and then compared the performance of four control charts for monitoring autocorrelated air pollution data to select the most appropriate one.

When applying control charts to autocorrelated data, it is assumed commonly that the data could be approximated by a statistical model and white noises. After fitting appropriate model to the data, the residuals are calculated. If the model is suitable, residuals should be independently and identically normally distributed and control charts can be applied to residuals then. If the control charts give a signal, the process will be intervened and necessary corrective actions need to be taken.

According to Chan and Hwang (1996), PM10 is the most important pollutant that deteriorates the air quality in Taiwan. Therefore, PM10 with long memory is the main

pollutant discussed in this paper. The objective of this study is to develop a procedure of applying ARFIMA models to monitor long-memory air quality data. We show that natural logarithm of PM10 in southern Taiwan follows ARFIMA models instead of ARIMA models. Comparison of the suitability of applying ARIMA and ARFIMA models to air quality data are also conducted.

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2. Development of Control Charts for Long- Memory Data

If data are not independent, data are fitted with a suitable model before control charts are used. ARIMA models are commonly used to fit autocorrelated data. Because of their simplicity and flexibility, they became very popular in applied time series analysis (Beran, 1994). The definition of ARIMA process is as following:

Definition 2.1 Let Z_t be a process such that

$$\Phi_p(B)(1-B)^d Z_t = \theta_0 + \Theta_q(B)a_t \qquad (1)$$

where d is positive integer or zero, B is the backshift operator ($BZ_t=Z_{t-1}$), ε_t is white noise, and $\Phi_p(B) = (1-\phi_1 B - \cdots - \phi_p B^p)$ and $\Theta_q(B) = (1-\theta_1 B - \cdots - \theta_q B^q)$ share no common factors. Then Z_t is called an ARIMA(p, d, q) process.

> If a process is not stationary, some order of difference of the process is usually taken to make it stationary before control charts are applied.

Although ARIMA models are popular, they are not suitable to model data with long memory. ARFIMA models was proposed by Granger and Joyeux (1980) and Hosking (1981) to fit long-memory data, it is similar to Equation (1) except d is a real number between –0.5 and 0.5. There are several possible definitions of the property 'long memory.', for example, any discrete time series process with autocorrelation function (ACF), $\rho(h)$, at lag h possesses long memory if the quantity $\lim_{n\to\infty} \sum_{h=-n}^{n} |\rho(h)|$ is nonfinite.

When time series data have long memory, control charts for ARFIMA models are needed. The residual control charts of ARFIMA models are proposed in this study. Processes are modeled by ARFIMA model first, control charts are applied to the residuals then. There are Phase I and Phase II of constructing control charts. Phase I of constructing control charts for ARFIMA models are as follows:

1. Collect historical air quality or environmental data.
2. Fit the data collected in step 1 with an appropriate model. Check the suitability of the model. After a proper model is selected, residuals can be calculated.
3. Establish control limits for the residuals.
4. Delete any residuals fallen beyond the control limits and estimate parameters of control charts again.
5. Reestablish control limits for the residuals again.
6. Repeat step 4 and step 5 until there are no outliers/out-of-control signals.

If models and parameters of processes are known in advance, then the control limits could be calculated and one can bypass the Phase I. The control limits established in Phase I are used to monitor processes in Phase II. Most control charts for autocorrelated processes do not follow the procedures mentioned above. A literature survey would undoubtedly reveal that distinction between these two phases is lacking in most papers

(Faltin et al., 1997). There seems to be a tendency to focus on Phase I, although this is usually not explicitly stated.

If a control chart can detect the change of parameters earlier than other control charts, it will be a better choice. Generally speaking, $\overline{X}$ chart would be a better choice if the larger mean shift is concerned. If the smaller mean shift is to be detected, then either EWMA or CUSUM chart can do the job well.

3. Comparison of ARFIMA and ARIMA Models

3.1 Example of Using the PM10 Data of Nantsz

Nantsz station is a surveillance stations located in the southern Taiwan where is known for a long history of public protest for pollution. The hourly air quality data of PM10 collected by Nantsz station between 1999 and 2002 is discussed and a total 725 observations were recorded during 1999 to 2000 and 712 observations were recorded between 2001 and 2002. In Phase I, the 725 observations gathered during 1999 and 2000 are treated as historical data. A natural logarithm of PM10, denoted by ln(PM10), has successfully achieved the goal of stabling the variance without deseasonalizing and detrending the raw data. It is found that ARFIMA(0,d,1) is suitable for ln(PM10). After model fitting, a diagnostic of residuals are performed to check the suitability of residual control chart. To monitor the change of residuals, EWMA chart is suggested to be used since it is known for its sensitivity to detect small sustained shift of process and its robustness to non-normal data. Assume residual at t-th time is r_t. The control statistic of EWMA residual control chart can be written as Equation 2.

$$Y_t = (1-\lambda)Y_{t-1} + \lambda r_t \qquad (2)$$

When EWMA chart is used, the parameter λ and the in-control ARL should be decided first. A different size of mean shift needs different λ. If a smaller mean shift is concerned, a smaller λ needs to be used. The parameterλof residual EWMA chart is set to be 0.1 and control limits are set to have in-control ARLs 370.8 according to Montgomery (2001). With applications of EWMA statistics in Phase I, the appropriate model can be written as Equation (3):

$$(1\text{-}B)^{0.47}\,(\ln(PM10_t) - 4.34) = (1+ 0.16B)\,\varepsilon_t\,. \qquad (3)$$

In Phase II, EWMA residual control chart constructed in Phase I is applied to the residuals as shown in Fig. 1.

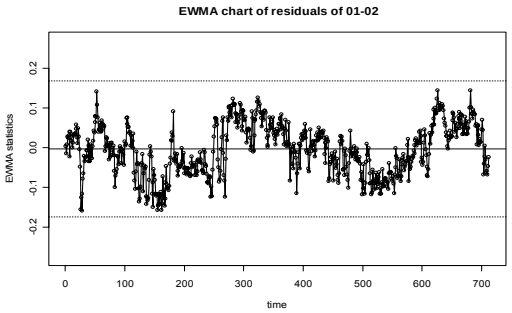

Figure 1. EWMA chart for the residuals of Nantsz's ln(PM10) data in Phase II using ARFIMA model.

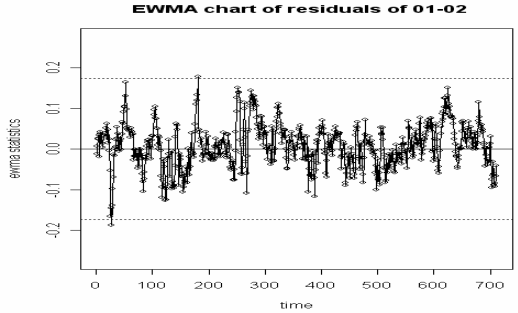

Figure 2. EWMA chart for the residuals of Nantsz's ln(PM10) data in Phase II using ARIMA model.

Fig. 1 indicates that no residual is out of control, which implies that ln(PM10) data in Phase II is likely to follow the similar pattern of Phase I. Thus, we may conclude that there is no evidence that the air quality of PM10 at Nantsz in Phase II is different from Phase I. This means that the air quality in Nantsz area has not been improved from 1999 to 2002 period. Further corrective actions need to be done.

If the long-term autocorrelations were ignored, then the most commonly used models to fit time series are ARIMA models. In contrast with the ARFIMA model, ARIMA model is compared for assessing the suitability of model selection. It is found that ARIMA (0, 1, 2) model could fit the air quality data of Nantsz from 1999 to 2000. With a proper Box-Cox transformation(λ=2) the residuals are normally distributed, then EWMA control chart is applied to these transformed residuals. After performing the procedures in Phase I, the appropriate model can be written as Equation (4).

$$\mathbf{(1\text{-}B)\ ln(PM10_t)= -.0003 +(1\text{-}0.4031B\ \text{-}0.2883B^2)}\ \varepsilon_t . \qquad \mathbf{(4)}$$

In Phase II, we use Equation (4) to fit ln(PM10) of Nantsz collected between 2001 to 2002. Despite of the fact that residuals could not been transformed to be normally distributed with Box-Cox method, EWMA control charts shown in Fig. 2 are applied to monitor the residuals without transformation. Fig. 2 indicates that there are two points out of control and its pattern is different from Fig. 1. This Nantsz example demonstrates that the ARFIMA model is more appropriate than ARIMA model. False alarms would occur if one selects a wrong ARIMA model instead of using ARFIMA model.

3.2 Example of Using the PM10 data of Tsoying

For comparison with Nantsz's data, the PM10 data collected by Tsoying station, which is near Nantsz station, is discussed. A total 729 observations were recorded during 1999 to 2000 and 717 observations were recorded between 2001 and 2002.All the procedures are similar to Nantsz example. It is found that at the end of Phase I, the appropriate model can be written as Equation (5):

$$(1\text{-}\ 0.17B+0.17\ B^2)\ (1\text{-}B)^{0.49}\ (\ln(PM10_t)\ \text{-}\ 4.27) = \varepsilon_t . \qquad (5)$$

In Phase II, EWMA control chart, shown in Fig. 3, indicates that one residual is out of control, which implies that ln(PM10) data in Phase II is likely to follow the similar pattern of Phase I except one day, in that day air quality of Tsoying has abruptly changed.

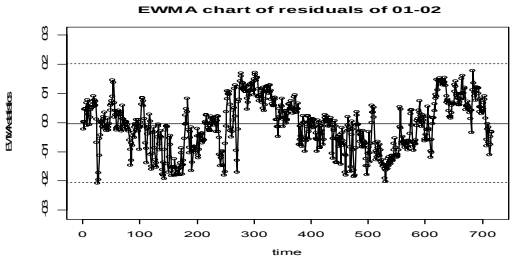

Figure 3. EWMA control chart for the residuals of Tsoying's data in Phase II using ARFIMA model

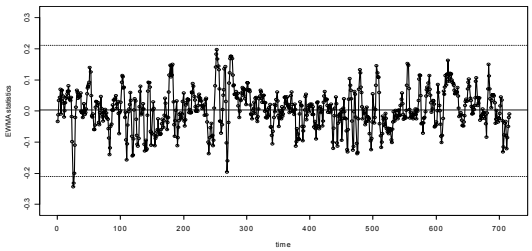

Figure 4. EWMA control chart for the residuals of Tsoying's data in Phase II using ARIMA model

If the long-term autocorrelations were ignored, then the most commonly used models to fit time series are ARIMA models. At the end of Phase I the appropriate model can be written as Equation (6).

$$(1\text{-}B)\ \ln(PM10_t)= -.0002 +(1\text{-}0.6855B +0.1171B^2)\ \varepsilon_t . \qquad (6)$$

In Phase II, EWMA control chart, shown in Fig. 4, indicates that there are two points out of control and its pattern is different from Fig. 3. This demonstrates that the ARFIMA model is more appropriate than ARIMA model and false alarms would occur if one selects a wrong ARIMA model instead of using ARFIMA model.

4. Conclusion

In this paper control charts using ARFIMA model are used to monitor long-memory air quality data. The proposed procedures of applying ARFIMA models to monitor air quality data can also be used for monitoring other long-memory environmental data. Through two empirical examples of air quality of southern Taiwan, one set of ln(PM10) data follows ARFIMA(0, 0.47,1) model while another one follows ARFIMA(2, 0.49,0) model, we have demonstrated that control charts using ARFIMA models are more appropriate than control charts using ARIMA models in monitoring long-memory air quality data. When monitoring autocorrelated data, the meaning of "out-of-control" indicates not only the residuals of processes may deviate from what are assumed, but also the underlying model of the process might be changed.

Due to the complexity of the ARFIMA model, procedures for constructing an appropriate control chart especially in Phase II is more difficult than the traditional autocorrelated control charts. To ensure the efficiency and effectiveness of monitoring environmental data with long memory, it is suggested that an on-line analyzer of the residual control chart using ARFIMA model be developed to help practitioners understand the quality change of the environment, so a timely corrective action can be made.

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Ambient Air Monitoring and Quality Assurance in the Hurricane Katrina Disaster Relief Effort

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Emergency response always provides unique challenges to responders. Hurricane Katrina provided an immediate challenge where EPA had to bring all of its resources to bear including providing ambient air monitoring for the residents of the affected area. Region 4 is no stranger to hurricane relief, but the Katrina relief was above and beyond anything performed in the past. Among Region 4's response activities was the implementation of a temporary air monitoring network to measure PM2.5, PM10, VOCs, SVOCs, chromium +6, carbonyls, and asbestos in the areas affected by open burning and mass demolition. With such a wide range of pollutants monitored using various methods by a rotation of employees, general quality assurance can prove to be a daunting task.

EPA has many regulations and quality assurance guidance which give direction to how a network and sites are to be constructed, but how are these to be translated into an emergency response event where time is of the essence and resources are limited? In the hurricane Katrina case, these directives were all considered and strategies were made at the regional level for its own particular needs. New samplers were used, including the BGI frm OMNI and PQ100, and samplers were adapted for different uses which required the investigation of what each of these needed in terms of quality assurance. Through the technical expertise of the field crews and the research and input of various technical experts across the nation, an acceptable level of quality assurance and quality control was able to be achieved to ensure accurate, precise, and representative data.

The author will give a summary of the network design, equipment used, quality assurance parameters, sampling strategy, present status, problems encountered, and suggestions for better response in future events.

Quality Assurance and Data Issues Related to the Air Quality System (AQS)

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Overview

EPA's Air Quality System (AQS) is the official national repository of ambient air quality data collected in the United States. AQS data is accessed by thousands of environmental scientists, medical researchers, and private citizens each year. Having data correctly entered in the system is vital in compiling a reliable dataset in order to meet our air quality objectives. In the past year, several new enhancements have been added to AQS to assist in the collection and analysis of audit information. With the assistance of these tools and results from other analyses of the data, several data quality issues have been raised with respect to the quality of some of the audit information being collected.

New Quality Assurance Features Available in AQS

On an annual basis, OAQPS publishes the "Completeness, Precision and Bias Data Summaries for the Criteria Pollutants of the Ambient Air Quality Monitoring Program". In the past, these assessments have been created by contract support staff and then published to the EPA's Transfer Technology Network (TTN). AQS has duplicated the ability to produce the tabular portion of this report. The report is referenced in the remainder of this document by its AQS report code of "AMP255". AMP255 uses the standard report submittal procedures within the AQS application, meaning reports may be generated for any desired geographic and temporal range. This allows any user of the AQS system to be able to determine the completeness and precision and bias estimates of any monitor whenever needed, rather than having to wait for the annual assessment to be posted. Additionally, it is anticipated that the report will be run on a quarterly basis by OAQPS staff to track how agencies are performing and submitting their data throughout the year.

AMP255 produces a series of comma-separated files and a Microsoft Excel macro that can format the files to take advantage of "Auto Filtering" and sorting features standard within Excel. This is the first report in AQS to support the importing of data directly into Microsoft Excel. Documentation on how to download the files and how to use the macro are available in a "readme.txt" file that is provided with the report output.

Historically, the annual assessments have also included "Box and Whisker Plots" of the gaseous precision and bias estimates per reporting organization. AQS does not currently have the graphing capabilities required to generate these plots. However, OAQPS will

still provide these plots on an annual basis (as well as the data tables) and post the results on the TTN. These files can be obtained at www.epa.gov/ttn/amtic/parslist.html.

Another enhancement that has been added to AQS is the ability for the system to automatically generate collocated precision data records based on the submittal of the ambient concentration data. Until this feature was added, users were required to submit their ambient concentration data and collocated precision data separately. Now, the AQS software will evaluate if there are collocated monitors for the same pollutant at the same site. If collocated monitors have submitted data for the same day, then AQS will make "pairings" of the values submitted and automatically enter them into the precision data table without any further input from the user.

Current AQS Data Issues: Define Collocated $PM_{2.5}$ Monitoring in AQS

In order for the new report and automatic collocated precision data generation feature to work properly, sites must explicitly define their collocated monitors within AQS. Each of the new features requires a different amount of information in the collocation definitions in order to work as designed. For the new report, only criteria pollutants are considered. Consequently, the following discussion pertains only to PM_{10} and $PM_{2.5}$ monitors. The report is assuming that for each monitor designated to be a collocated monitor for the reporting organization, there must be a monitor collocation record in the database where the monitor is "flagged" as being the primary monitor. There is a restriction in AQS that only one monitor may be designated as the primary monitor for a site at any given point in time. The report uses these monitor collocation definition records to determine if the proper number of collocated samples is being collected within the reporting organization.

The automatic collocated precision generation enhancement requires at least two (2) monitor collocation records: one to define which monitor is the primary monitor, and one for the collocated monitor. Since a collocated precision audit involves two monitors, AQS always associates the results of the collocated precision audit with the primary monitor. It is by these monitor collocation definitions that the system is able to determine which values submitted are to be associated as a valid collocated pair and to which monitor the audit should be associated.

It is estimated that 34% of the reporting organizations have properly identified their collocated $PM_{2.5}$ monitors within AQS. This evaluation was made by counting the number of sites within the reporting organization that had at least 1 active $PM_{2.5}$ monitor that belongs in the State and Local Air Monitoring Stations network (SLAMS). This count was then multiplied by 0.15, and rounded up to the next integer (Appendix A of 40 CFR Part 58 requires that 15% of a reporting organizations SLAMS network be collocated or 1 monitor; whichever is greater). A second count within AQS was performed evaluating the number of active $PM_{2.5}$ SLAMS monitors that had a defined primary monitor. Of the 115 reporting organizations with at least 1 active $PM_{2.5}$ SLAMS monitor, 70 did not have a defined primary monitor. Five additional agencies had at least

one defined primary monitor, but failed to meet the 15% of the number of active monitors within the reporting organization, as required by Appendix A.

The term "active monitors" refers to any $PM_{2.5}$ monitor whose associated "sampling end date" field in AQS is not populated. This definition was chosen in order to be consistent with the definition used by AMP255. Due to this definition, it is possible that AMP255 over-estimates the number of required monitors within the reporting organization. For example: If a reporting organization is acquiring data from 9 monitors, the reporting organization may be expecting that one collocated $PM_{2.5}$ monitor is required (9 * 0.15 = 1.35; this rounds down to 1 monitor). However, if the sample period definitions in AQS have 10 monitors "open" (that is, 10 records exist where the sampling end date is blank), AMP255 is going to calculate that two collocated $PM_{2.5}$ monitors are required (10 * 0.15 = 1.5; rounding up to 2 monitors). So, as part of the evaluation as to whether the proper number of monitors are defined as collocated within the monitoring network, care should be taken to ensure that only the monitors that are currently in operation, are defined as such within AQS.

Current AQS Data Issues: Reporting of Flow Data

One of the common auditing types of data reported to AQS are flow audits. Historically this information has been reported to AQS in some form of flow units. Examples include "Liters per Minute" (AQS unit code = "073"), "Cubic Feet per Minute" (AQS unit code = "072"), and "Cubic Meters per Minute" (AQS unit code = "083"). In January of 2004, it was requested that AQS be more specific about what the flow unit actually represented. This request was made to indicate whether the flow unit was in terms of the local conditions at the monitoring site (based on the ambient temperature and local atmospheric pressure) or if the values were in terms of the flow rate at "standard conditions" (25 degrees centigrade and one atmosphere of ambient pressure). It was decided that the existing AQS unit values represented the flow rate data in terms of standard conditions. Corresponding new unit codes were created to express the flow rate values in terms of local site conditions ("Liters per Minute Local Conditions" = "118" and "Cubic Meters per Minute Local Conditions" = "119").

The preference of reporting the flow data in standard condition units versus local conditions units that OAQPS has stated for flow data should be consistent with the methods for collecting the ambient data for the compound. For example, the ambient data for $PM_{2.5}$ is measured in $\mu g/m^3$ local conditions. PM_{10} is measured in $\mu g/m^3$ standard conditions. Consequently, the preference would be to report the flow data for $PM_{2.5}$ in local conditions and PM_{10} in standard conditions. It is important to note that AQS will accept the flow data in either standard or local conditions.

Due to this change in the definition of the AQS unit code, data may be stored in the incorrect unit of measure. The primary flow data of interest is $PM_{2.5}$ and PM_{10}, but this data condition could exist for any pollutant for which flow audit data is collected and reported to AQS. It is important to remember that although the data may be incorrectly stored in the database, the percent differences between the samples should remain the

same. This is important because evaluations of this data are based on the percent differences between the samples.

A program has been developed within OAQPS that will update the affected data within AQS to change the unit of measure from the incorrect value to the correct value. However, since we cannot be certain where this change is appropriate, involvement from the data submitters would be appreciated. To date, eight state agencies (South Carolina, North Dakota, Missouri, Montana, Washington, Massachusetts, Tennessee, and Mississippi) have contacted OAQPS indicating that this change needed to be made to their data. The script does not take long to run (generally less than 2 minutes), but OAQPS must have permission to change the data prior to taking any action. If you feel this change would be appropriate for the data within your agency, please contact Jonathan Miller (miller.jonathan@epa.gov) specifying the agency you are associated with, what pollutants are involved, and include a statement indicating that we have your approval in making this change. You will be notified once the changes are complete.

Current Data Issues: Suspect Single-Point Gaseous Precision Checks

During an analysis of the reported values of the single-point precision checks for ozone, it was discovered that an unusually large number of values were reported either 10 times higher than expected or 10 times lower than expected. The range defined within 40 CFR Part 58 Appendix A (Appendix A) for the single-point precision checks for ozone, nitrogen dioxide, and sulfur dioxide is between 0.08 and 0.10 parts per million (ppm). For carbon monoxide, the range of values is between 8 and 10 ppm. Upon further investigation, over 52,000 data points were found where either the reported value or the test concentration value was outside of this range (for purposes of the analysis, the range was redefined to be between 0.072 and 0.110 ppm (7.2 to 11 ppm for Carbon Monoxide)). This figure represents approximately 3% of the total population of all single-point precision checks submitted to AQS. It is important to note that the identified suspect data is distributed over a nearly 20 year history (the earliest found values begin in 1986). Although that does give some context for the prevalence for the problem, it also raises the possibility that correction of some of the data may not be possible, given the age of the data involved and the unlikelihood that proper documentation exists.

There are many possible causes for data to be outside of the range specified by Appendix A. Reason 1: The sample is a Regionally Approved Allowance. There is a provision that the samples can be above the defined range, but these values must be approved by the appropriate Regional personnel. AQS currently does not currently include a data field to identify the single-point gaseous precision checks where the Region as approved these allowances.

Reason 2: The incorrect unit of measure is assigned to the sample. There are numerous cases where the magnitude of the value is in the correct range, but when you convert the values based on the unit of measure associated with the value, the value is no longer within the defined range. For example, an ozone sample value of 0.08 $\mu g/m^3$ will convert to approximately 0.00004 ppm.

Reason 3: A transcription error occurred when formatting the data to be submitted to AQS. There are several cases where the data is exactly 10 times higher or 10 time lower than the defined range. It is believed that there are several cases where a value such as 0.80 ppm was intended to be reported as 0.080 ppm.

Lists of the suspect data points are being compiled by OAQPS personnel and organized by the owners of the data. These lists will be distributed to the appropriate AQS data contacts for further investigation. It is hoped that by distributing the workload of reviewing and correcting these suspect data, the data can be corrected quickly.

Future AQS QA Data Features

AQS is continuing to try to improve the quality of the information that it stores. Having quality audit data is essential for AQS to continue to be viewed as the most comprehensive and reliable data source for ambient air quality data available. To this end, there are several planned enhancements to AQS currently being considered. It should be noted that the incorporation of these enhancements is subject to change due to availability of resources and agency priorities.

The AQS team is currently working with members of OAQPS' Quality Assurance Team in incorporating historical data collected for the National Performance Audit Program (NPAP). NPAP audits are available as far back as 1989. As an additional function, the creation of tools to help expedite the entry of future information into AQS is also being developed. It is anticipated that full implementation of these tools and the entry of the NPAP data will be in December 2006.

In an effort to enhance the screening of the data being entered into AQS, additional validations may be incorporated for the single-point precision checks. These additional checks will ensure that the values entered are within 10% of the defined range for the criteria gaseous pollutants. If the entered value is outside of this range, the user will be prompted with a warning of the condition. This will significantly cut down on the data entry errors previously discussed.

Additional data review validation will be conducted by OAQPS. To assist with these reviews, a new validation check may be incorporated to the "Critical Review Report". This report is used by OAQPS staff to highlight values that are of a suspect nature. The report currently highlights values that have a very large percent difference between the audit data pairs. The report will be enhanced to also show those values that exist outside of the defined operational range.

The AQS Team is also working on making labeling elements associated with the quality assurance program consistent with the language used in the Code of Federal Regulations. It is believed that these changes will assist new users as well as analysts not familiar with the AQS database in understanding the data being presented to them. An additional feature being added to assist users with the naming of data elements is the incorporation

of the Environmental Sampling, Analysis and Results data standard (ESAR) within the AQS XML schema. The ESAR standards are intended to be used and shared across all environmental data media. ESAR is a voluntary program intended to unify the naming of the business processes of collection, analyzing, and reporting of environmental data.

The quality assurance data within AQS is continuing to become more accessible and more frequently analyzed. It is more important than ever that the information stored within AQS be of the highest quality possible. The National Air Data Group within OAQPS will continue to work with State, local, and Tribal organizations to identify and correct suspicious data. As seen, we have a long way to go to create as reliable and useful database as possible. However, with the continued dedication and commitment of our data partners, AQS will continue to be the most comprehensive and reliable data source available for ambient air quality data.

TECHNICAL SESSION:
Ambient Air II

Electronic Recordkeeping and the National Ambient Monitoring QA Program

Catherine Brown, U.S. EPA Region 9

The National Ambient Monitoring Program has grown to consist of electronic recordkeeping to a greater and greater extent. Ensuring the quality of electronic databases and other records has been addressed in different ways by different federal entities. Some agencies have started to have 'requirements' based on federal decisions or directives like Executive Orders, etc. EPA has drafted a rule, CROMERRR, to modify CFR to remove obstacles to electronic reporting and recordkeeping. Among other elements, the rule will require validation of electronic signature on reports to EPA and set standards for e-record-keeping under any EPA program. Fully-electronic environmental measurement systems eventually have to comply with EPA's electronic recordkeeping policy, when developed. The status of the policy and quality assurance guideline development within EPA will be reviewed, including the Enterprise Content Management System (ECMS) efforts.

Quality Assurance Tools for Small Organizations from the Tribal Air Monitoring Support Center

Melinda Ronca-Battista
Tribal Air Monitoring Support Center
Northern Arizona University

We have developed a set of tools for tribal environmental monitoring organizations that have been designed for small organizations such as tribal environmental offices that conduct monitoring and manage, interpret, and report their own data. These tools include:

- MS Access databases for filter-based air monitoring and continuous monitoring, including implementation of QC calculations and data review,
- MS Excel templates and associated Word procedures for data verification,
- Tutorials and procedures for using ArcInfo to map data,
- Five internet-based course modules designed to teach and provide tools for air monitoring data management, including fundamental concepts, the use of MS Excel, general database design, the use of MS Access with specific database examples for a small organization, and data reporting including AQS submittal.

This paper will present the background for the development of these tools, the audience for whom they were designed, and examples of their use by tribal organizations. Although the tools have been developed specifically with air monitoring as the examples, any type of environmental monitoring data can be managed using these tools if some modifications are made. It is the author's intent to facilitate collaboration with others on the further development of these tools to improve consistency in data management, interpretation, and reporting.

Standard Operating Procedures – Friend or Foe?

Anna Kelley
Quality Assurance & Monitoring Coordinator
Hamilton County Department of Environmental Services
Cincinnati, Ohio

While Standard Operating Procedures, SOP, are not a required element of any Quality Assurance Project Plan, they are a very necessary part of the day to day operations and an essential part of ensuring data quality. In the ambient air monitoring field, a monitoring organization benefits having SOPs in place. With today's fast pace in this field, having them in place and keeping them up to date can be a challenge.

This presentation will briefly explore some of the pitfalls as well as the mountain tops of having SOPs in place. We will also examine the need for detail in an SOP.

TECHNICAL SESSION:
Ambient Air III

Performance Auditing of a Human Air Pollution Exposure System for PM2.5

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ABSTRACT

Databases derived from human health effects research play a vital role in setting environmental standards. An underlying assumption in using these databases for standard setting purposes is that they are of adequate quality. The performance auditing program described in this manuscript provides novel methods for determining data quality for one form of human health effects research, human exposure to PM2.5. PM2.5 is defined as particulate matter (PM) in the ambient air having aerodynamic diameters less than or equal to a nominal 2.5 Fm measured by a reference method specified by EPA or measured by methods designated by EPA to be equivalent to the reference method.[1] This paper presents the development and implementation of a performance auditing program for a particulate matter concentrator exposure system used by EPA researchers to expose human volunteers to PM2.5 air pollution. Audit procedures for determining the accuracy of critical operating parameters of the system are described. The results of audits of the system's ability to measure temperature, humidity, and PM2.5 concentration and distribution within the exposure chamber are listed. The utility of the performance auditing program in assisting health effects researchers to determine the adequacy of databases obtained from the PM2.5 concentrator exposure system in meeting their research requirements is discussed.

INTRODUCTION

The United States Environmental Protection Agency (EPA) operates a human exposure facility (HEF) at Chapel Hill, NC, to study health effects caused by air pollution. The aerosol concentrator chamber (HEF Chamber AC89) is used by EPA researchers to expose human volunteers to PM2.5. Ambient air is drawn from above the roof of the HEF through a symmetrical PM2.5 inlet that removes all PM having aerodynamic diameters greater than 2.5 Fm. The remaining particles are then concentrated by a factor of 6 to 8 by passing them through an aerosol concentrator consisting of a series of virtual impactors. By design, particles in the size range 0.1 to 2.5 Fm in diameter are concentrated. The resulting concentrated PM2.5 air is conditioned for appropriate temperature and humidity and is then passed through a particle inlet port into a 4 ft (wide) by 7 ft (long) by 6 ft (high) stainless aluminum aerosol concentrator exposure chamber. Air enters the chamber at a point directly above and in front of the subject's head and is drawn from the chamber at a flow rate of approximately 200 L/min. Ambient gases and particles smaller than 0.1 Fm enter the chamber but are not concentrated.

From May 1998 through January 2006, we developed a performance auditing program to determine the adequacy of data obtained from the PM2.5 exposure system to meet EPA research objectives. This included preparing auditing procedures and performing audits of the system.

METHODS

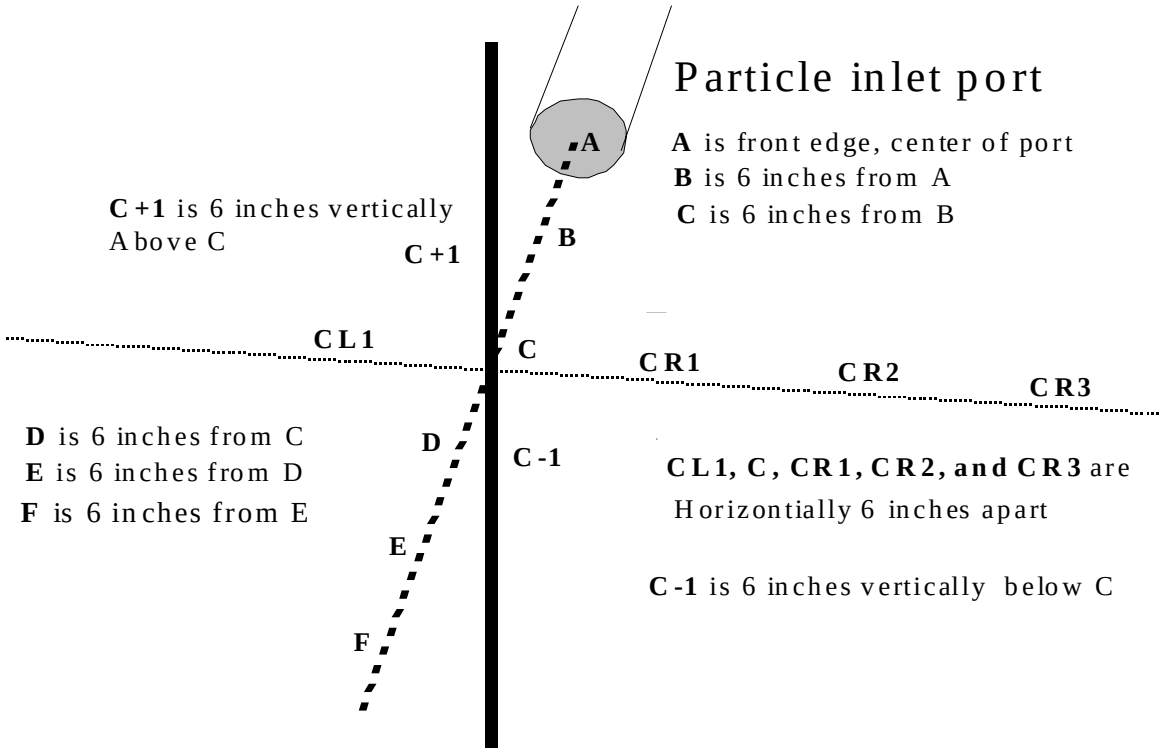
In consultation with the PM2.5 research staff of EPA's Human Studies Division, we identified PM2.5 concentration, PM2.5 spatial distribution within the chamber, particle size distribution, temperature, and relative humidity (RH) as exposure chamber operating parameters that could affect the accuracy of PM2.5 exposure data. We then developed audit procedures to determine the measurement accuracy of each parameter. We did not perform audits during actual human exposures due to size constraints of the chamber. However except for increasing operating times for some of the PM audits, we did operate the chamber during each audit similar to an actual human exposure. The PM2.5 concentrations present in the chamber varied from audit to audit as was also the case for the actual exposures.

Temperature and Relative Humidity Audits

Temperature and relative humidity audits required that we measure temperature and RH in the chamber under actual exposure conditions for a typical exposure interval of one hour. We were able to accomplish these audits by placing a temperature and RH monitor (Vaisala, Inc. model HMI41/HMP41, Woburn, MA) in the exposure chamber and taking temperature and RH readings from the monitor at five minute intervals for one hour. The monitor's temperature and RH responses were calibrated annually to National Institute of Standards and Technology (NIST) specifications.

Particulate Matter Spatial Distribution Audits

It was determined during characterization tests prior to beginning human exposures that particulate matter is not uniformly distributed throughout the chamber. As shown in Figure 1, a diagram of sampling locations for the aerosol concentrator chamber, the highest concentrations are found in a line that extends to 18 inches in front of the chamber's particle inlet port and 6 inches to either the right or left of this line, with the optimum subject breathing position (location C) at 12 inches in front of the chamber's inlet.



We used two matched light-scattering monitors (Thermo Andersen DataRAM model 4, Waltham, MA) to simultaneously measure PM concentrations at the optimum breathing position C and at positions 6" in front of, behind, to the right of, and to the left of C as oriented from the chamber's inlet port to audit for uniformity of particulate matter distribution within this maximum concentration region of the chamber. The monitors were calibrated with a standard aerosol at the factory. Since we were evaluating relative PM changes with location instead of absolute PM concentrations, we used the factory supplied calibration data to determine the PM audit measurements instead of adjusting the monitor's response for the specific PM that was measured.

End-to-End Particulate Matter Audits

To audit the overall performance of the PM2.5 concentrator exposure system, we used three different methods to measure particulate matter concentration and size in the chamber and then compared the measurement results with the particulate matter concentration and size results reported by the exposure system. We used an Andersen model RAAS2.5-100 PM2.5 monitor (EPA designated reference method RAPS-0598-0119) to measure PM2.5 concentrations, as defined by EPA, in the chamber. We also measured the total PM concentration in the chamber by drawing chamber air at a flow rate of 15 L/min through a 47 mm membrane filter (Millipore Type AA). To measure size

distribution of the particulate matter entering the chamber, we used a micro-orifice uniform deposit impactor (MOUDI model 100) obtained from EPA's National Exposure Research Laboratory. The MOUDI operated at a flow rate of 30 L/min and collected particulate matter in nine size ranges from 0.01 Fm to 9.9 Fm in diameter on Gelman R2PJ037 2-Fm pore size PM filters. We calibrated the flow rate devices for all three measurement systems with a NIST-traceable flow standard (BIOS DryCal model DC-1) before use.[2] All three measurement systems were operated simultaneously in the subject breathing zone of the chamber to obtain the audit results. The measurement systems were operated for 2 to 6 hours to increase the amount of PM collected on their filters. All particulate matter filters used for PM2.5, total particulate matter, and size distribution audit measurements were weighed on the same balances under the same temperature and humidity conditions (i.e., 21.5^{E}C +/- 1.5^{E}C and 35% RH +/- 5% RH) as used by the operators for routinely weighing filters from the exposure chamber measurement system. Because of space limitations, an EPA designated reference or equivalent method was not used by the chamber's operators to determine PM2.5. Therefore, we compared our audit results for PM2.5 as well as for total particulate matter to total particulate matter results obtained from the chamber's measurement system. For the particulate matter size distribution audit we determined the percentage of PM in the chamber having aerodynamic diameters less than or equal to 2.5µm.

Due to chamber size constraints, the chamber measurement systems for PM are located in the air supply duct immediately upstream of the chamber instead of in the chamber itself. It was determined during chamber characterization tests that 70% of the PM measured in the duct was present at the optimum subject breathing zone (location C) of the chamber. Therefore, we multiplied PM concentrations found in the duct by 0.7 before comparing our audit results to chamber measurement system results.

RESULTS

We performed 24 temperature audits of the chamber from May 1998 through January 2006. Average audit temperatures ranged from 16^{E}C to 24^{E}C. Differences between the chamber's temperature sensor and the audit temperature device ranged from -0.7^{E}C to 2.1^{E}C.

We also conducted 24 RH audits of the chamber. These audits were performed simultaneously with the temperature audits. The first audit indicated that there was a 29.0% difference between the chamber's RH sensor located in the air supply duct immediately upstream of the chamber and the audit RH sensor located in the optimum breathing zone inside the chamber. This led to the chamber's relative humidity sensor being adjusted for future exposures. After the chamber's RH sensor was adjusted, the maximum absolute difference between the average relative humidities reported by the chamber's data acquisition system (DAS) and the average audit relative humidities was 7.3%.

We performed seven spatial distribution audits. The maximum difference between the four chamber locations and the optimum breathing location (C) was 15.8%. The average response for location C from the DataRAM monitor used for the audits ranged from 13 to 16 Fg/m^3 on 9/7/00 to 289 to 337 Fg/m^3 on 8/30/01.

We performed 21 total particulate matter audits from September 1998 through November 2005. Audit total PM ranged from 7 to 144 Fg/m^3. The differences between total PM reported by the chamber's data acquisition system and our audit results ranged from -2.0 % to 58%.

Results of our 21 PM2.5 audits indicated differences between total PM reported by the chamber's data acquisition system and PM2.5 measured by our audit system that ranged from -18.7% to 62.7%.

We performed 14 PM size distribution audits. The PM mass median diameters reported by our audit system ranged from 0.30 µm to 0.91 µm. The percentage of PM in the chamber with aerodynamic diameters of less than or equal to 2.5µm ranged from 91 to 98.

CONCLUSIONS

The results presented here suggest that a performance auditing program consisting of independent checks of the accuracy of measurement systems of critical operating parameters can be used to periodically determine the quality of data obtained from a PM2.5 exposure system. Specific procedures were developed for auditing the measurement of exposure atmospheres for PM2.5, temperature, and humidity under typical chamber operating conditions. Each procedure resulted in a calculated difference between the value reported by the exposure chamber's data acquisition system and the value associated with the device used to audit the chamber. Procedures were also devised for auditing the size distribution and spatial distribution of PM in the optimum breathing zone for subjects in the chamber. Health effects researchers can associate these audit results to their PM2.5 exposure databases to determine the adequacy of the databases in meeting their research requirements. The results derived from these seven to 24 audits for each exposure chamber operating parameter were used to establish quality assurance limits of +/-2.2^{E}C for temperature, +/-5% for relative humidity, +/- 25% for PM spatial distribution, +/-25% for total PM, +/-25% for PM2.5, and greater than 90% PM less than or equal to an aerodynamic diameter of 2.5µm for particle size distribution.

ACKNOWLEDGEMENTS

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and Environmental Effects Research Laboratory and approved for publication. Approval does not signify that the contents reflect the views of the Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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Growth of the Field Audit Program for EPA's Speciation Trends Network and the Interagency Monitoring of Protected Visual Environments (IMPROVE) Network

Dennis Crumpler, US EPA Office of Air Quality Planning and Standards

The EPA Office of Air Quality Planning and Standards and the Office of Indoor Air and Radiation intensified the Quality Assurance programs in 2005 with respect to field auditing for both networks. We have found that historically the available travel and contract dollars has been somewhat short of that necessary to develop and implement a centralized, successful field-audit program. Prior to 2005 we were able to perform about less than 10 audits in the Speciation Trends and State/ Local/Tribal (SLT) supplemental network and about a dozen audits of the IMPROVE network. The Speciation Trends and SLT supplemental network consists of approximately 250 sites and the IMPROVE and IMPROVE network consists of approximately 170 sites. Our goal has been to develop a program that conducts Federal-level audits at a minimum of 25% of each network every year. Based on current reports we audited 14 sites and 18 samplers of the Speciation Trends and State/ Local/Tribal (SLT) supplemental network (7%) and 33 IMPROVE sites with 34 samplers (20%). Consequently we have made progress, but still have a ways to go.

The increase this past year was accomplished by empowering EPA Regional QA staff as well as some State QA staffs to provide audits for both speciation trends and IMPROVE networks. The strategy is to continue the training program to increase the number of certified EPA Regional and State, local and Tribal auditors. We will increase Regionally-coordinated training courses in 2006 and revise and update "tools of the trade." Because travel dollars continue to be a luxury, we will implement a policy to have sampler and site issues corrected during audits if at all possible. We will initiate electronic reporting to the site owners, EPA Regional Monitoring program and QA staff in order to facilitate follow-up. We are going to develop an on-line recertification procedure in 2006 and roll it out in 2007. We are instituting a new operator-completed monthly sampler parameter check form; that will allow SLTs and EPA QA staff to identify sites that might need an audit.

PM 2.5 Speciation Monthly Sampler Performance Verification Form

Jeffrey Lantz, U.S. EPA , Office of Radiation and Indoor Air

The EPA is instituting a new operator-completed, monthly speciation sampler performance verification form. In 2004, during special studies using speciation trends monitors and monitoring sites, we could not get some of the samplers calibrated properly in order to operate within design specifications for the network. When attempting to set-up and calibrate the samplers for the special studies, and auditing other speciation sites as well, we discovered that the sampler issues were related to sampler age, i.e., mechanical or maintenance maladies, and operator error and misdirected tinkering with the samplers. We also noted reports that certain samplers were not being technically supported satisfactorily by the manufacturers. We realized that these problems could be present throughout the network and across sampler types. In January 2005 we sent out a request for site operators to provide us with 12 months of data from instrument verifications including flow rates, ambient and filter temperature readings, ambient pressure readings, and time settings. We compiled the resultant data into an Excel Spread Sheet; with this spread sheet we were able to perform assessments on the state of the samplers for which we had obtained data. The analysis suggested that, while calibrations and parameter measurements were generally within acceptance criteria, there were intermittent failures for any given parameter. We also discovered that notwithstanding guidance in the National Quality Assurance Project Plan (QAPP), there are a significant number of sites that are not recording this data and tracking it to identify signs of deterioration and overall sampler performance. We determined that a formal process can be implemented for operators to record this information. The data will be reported on a form specific to the site and sampler to which it is assigned. The form will require that the site operators set up the sampler channels for sampling events in a specific order. Sampler performance parameters will be checked on a monthly basis per the QAPP and recorded on the form. The parameter check data will be initially stored by the current Speciation Lab Service Contractor. The flow rate data will be extracted and loaded into AQS leading to an accuracy measurement much like Quarterly audit data for the PM 2.5 FRM mass monitoring program. This will allow EPA (OAQPS), EPA Regional staff and SLT staff to track performance of specific sites, sampler types, and even specific channels. Ultimately, EPA will present all the data from a central repository, the EPA QA Website. An important outcome of the development of the verification form was the recognition that we have been omitting an important comparison in the audit procedure. We have been comparing the flow rate as measured by a certified reference standard to the flowrate that the sampler reports. This is a indication of the calibration of the instrument, which is important. But, what we've missed is a comparison between flowrate measured by the reference standard and the design flowrate, which we believe is a better reflection of the accuracy of the sampler's results. The new data base will provide EPA and its SLT partners with a new way to assess the performance of the network and therefore the monitoring data quality. Data analysts will derive another tool to identify possible outliers and factors that affect uncertainty.

TECHNICAL SESSION:
Ambient Air IV

Improving Portability and Reducing Cost in the Through the Probe (TTP) Performance Laboratory Through Design and Implementation of a Compact Alternative

Avraham Teitz, Mark Shanis, Mustafa Mustafa, and Mark Winter

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M. Shanis at US EPA, OAQPS, Research Triangle Park, NC 27711

Abstract

Region 2 maintains and operates one of EPA's Through the Probe (TTP) Quality Assurance auditing laboratories. The laboratory is transported in a 7000 pound double axle trailer, with a length of 18 feet x 8 feet high x 8 feet wide. A tow vehicle is required to transport the laboratory, and the recommended vehicle is a 1 ton truck, Ford F350 or equivalent. The laboratory analytical equipment consists of an API 701 zero air supply, Environics 9100 Gas Phase Titrator and ozone generator, Thermo 49CPS Ozone analyzer, Thermo 48C CO analyzer, 4 aluminum cylinders 8"diameter x 53" tall containing gas standards, glass gas manifolds and Teflon tubing, a 150' steel jacketed Teflon presentation line, and a desktop computer with Envidas data collection software. Power is provided to the laboratory trailer and it's HVAC system through 2 ONAN 7000 watt commercial power generators, that are fueled by the trailer's 40 gallon fuel tank.

During the 2005 auditing campaign in Region 2, 10 sites were visited and 24 analyzers were audited in New Jersey with this system. In our experience several significant difficulties were encountered. The primary difficulties were the inaccessibility of sites due to the low ground clearance of the trailer, poor maneuverability in dense metropolitan areas, towing safety, and the cost of operation and maintenance of the system.

To address these issues, Region 2 proposed, and EPA OAQPS funded, a more compact arrangement for the TTP laboratory. This compact system fits inside a standard cargo van, and consists of 2 rolling racks with dimensions 36" high x 26" wide x 32" long to house all the analytical instrumentation. Manifolds were constructed of ¼" Teflon and stainless steel fittings and mounted inside the rolling racks. The weight of each of the racks, fully loaded is less than 300 pounds. The presentation line has been shortened from 150' to 50' and is constructed of ½" o.d. x 3/8" i.d. FEP Teflon. The desktop computer has been replaced by a laptop. Power to the instrumentation during transport is provided by a 1000 watt true sine wave power inverter wired to the cargo van electrical system. Instruments are loaded into the van for transport with a folding ramp designed for wheelchair use. This compact system, retains all of the audit functionality of the trailer based system, with the exception of the bench space provided in the trailer.

A significant difference between the two systems is that audits using the compact system are conducted inside the monitoring station being audited, as opposed to a trailer and truck that is stationed alongside the monitoring station. With the compact system, the presentation line is

snaked through the monitoring station door where it is then connected to the station intake manifold. Total power draw of the compact system is less than 800 watts, and it is powered by the stations own electrical power. A small generator is available for cases where there is insufficient power. As the equipment racks feature slide out rails and easily removable doors, the entire system can be configured and operated in the monitoring station with a footprint of 26" x 26", albeit with a height of 4.5 feet. The compact TTP system demonstrated it's equivalency to EPA Region 2's back of the analyzer system, as had the same system in its larger trailer expansion. The ability to transport the system with a smaller footprint will enable more sites to be accessible, due to both field conditions or traffic concerns. The latter is a particular issue with larger metro areas. Field testing and use is planned to commence in April 2006.

Introduction

Region 2 maintains and operates one of EPA's Through the Probe (TTP) Quality Assurance auditing laboratories. The laboratory is transported in a 7000 pound double axle trailer, with a length of 18 feet x 8 feet high x 8 feet wide. A tow vehicle is required to transport the laboratory, and the recommended vehicle is a 1 ton truck, Ford F350 or equivalent. The laboratory analytical equipment consists of an API 701 zero air supply, Environics 9100 Gas Phase Titration (GPT) calibrator and ozone generator, Thermo 49CPS Ozone analyzer, Thermo 48C CO analyzer, 4 aluminum cylinders 8"diameter x 55" tall containing gas standards, glass manifolding, a 150' steel jacketed Teflon presentation line, and a desktop computer with Envidas data collection software. Power is provided to the laboratory trailer and the associated HVAC system through an ONAN 7000 watt commercial power generator (with one spare generator) that is fueled by the trailer's 40 gallon fuel tank.

During the 2005 auditing campaign in Region 2, 10 sites were visited and 24 analyzers were audited in New Jersey with this system. In our experience several significant difficulties were encountered. The primary difficulties were the inaccessibility of sites due to the low ground clearance of the trailer, poor maneuverability in dense metropolitan areas, towing safety, and the cost of operation and maintenance of the system. To address these issues, Region 2 proposed, and EPA OAQPS funded, a more compact arrangement for the TTP laboratory, such that it would fit inside a standard cargo van. .

Materials and Methods

To enable a more compact system, a pair of rolling racks (SKB cases #R912U24) were procured, with dimensions of 26.58" W x 30.45" H x 36" D. The instruments were transferred from the TTP trailer to the rolling racks, with Rack 1 containing the Zero Air Generator, GPT Calibrator, and a Furman AC power conditioner, and Rack 2 containing the CO and O_3 analyzers. To increase portability of the system, further modifications were done, as shown in Figures 1 and 2, which describe the original plumbing of the TTP system in the trailer, and the modified rolling rack system.

Significant modifications were made to the original plumbing layout in configuring the compact system. First, the solenoid valve/stainless steel manifold/pressure regulator feed system for the CO analyzer calibration gases was replaced with a single ¼" o.d. Teflon

line, terminated with a double ended shut off (DESO) stainless steel quick connect stem. As there is a pressure regulator attached to the calibration cylinder, as well as a needle valve in the flow path to the analyzer, it is possible to finely regulate the flow going to the analyzer, obviating the need for the eliminated parts. This comes at the cost of manually attaching the Teflon line to each calibration cylinder in turn, a process of 5 minutes total time. Second, the 2 glass manifolds, each over a foot long, were replaced with ¼" Teflon tees. In place of the front manifold, 2 tees were used, and the branch end of the tees were used to feed the respective CO and O_3 analyzers. The straight branch of the first tee is connected to the gas feed line while the used, and the branch end of the tees were used to

Figure 1.

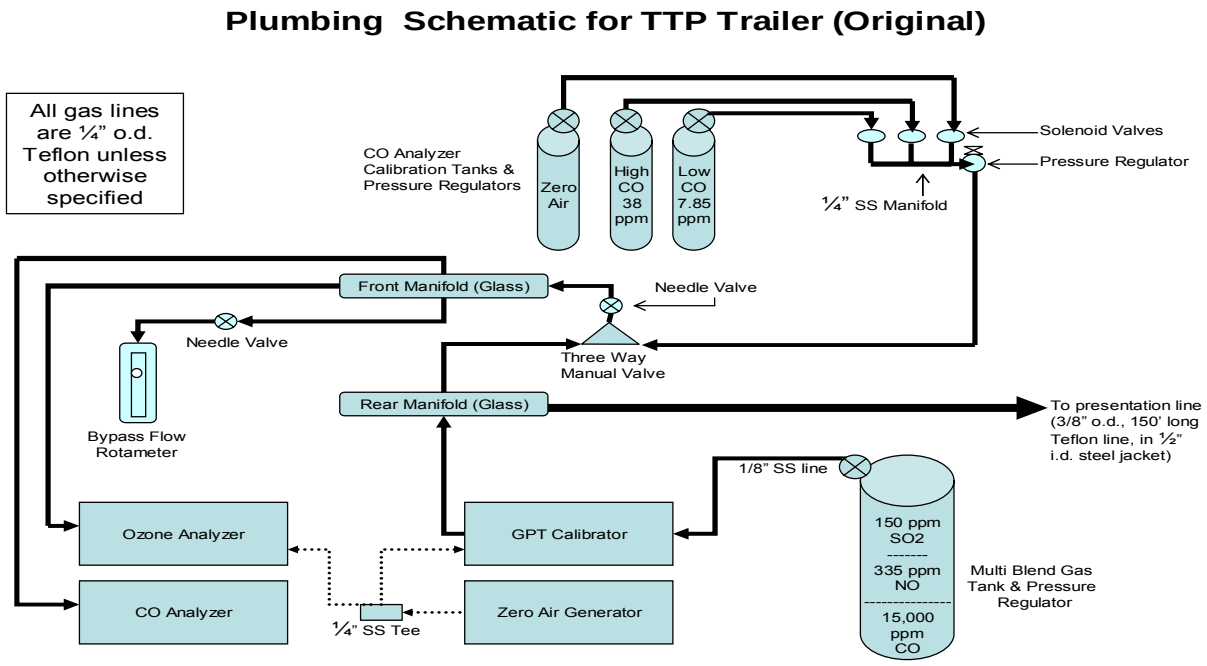
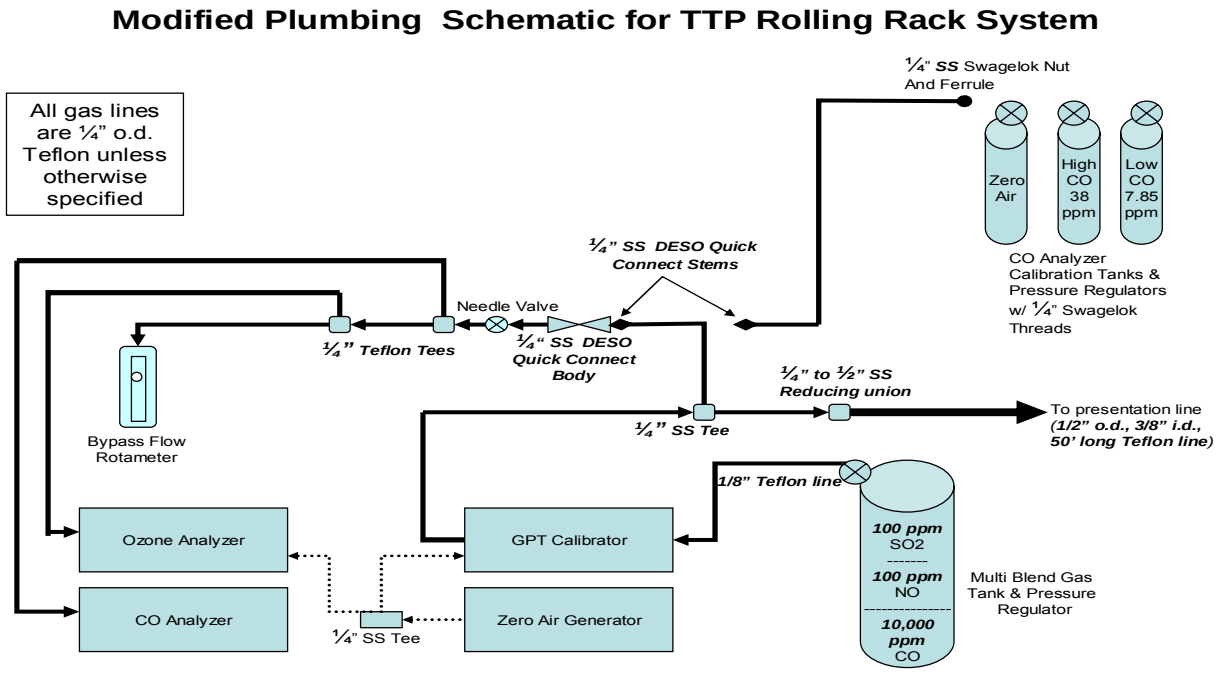


Figure 2.



feed the respective CO and O_3 analyzers. The straight branch of the first tee is connected to the gas feed line while the terminal end of the second tee is connected to an atmospheric vent which is monitored via a 0-1 liter rotameter. The back manifold was replaced with a ¼" stainless steel tee, with the branch end of the tee feeding the front manifold via a ¼" o.d. Teflon tube terminating in a stainless steel DESO quick connect. The straight leg of the tee is plumbed to stainless steel ¼" to ½" reducing union. A third change was exchanging the 150' long x ½" o.d. steel jacketed presentation line for a 50'x ½" o.d (3/8" i.d.) Teflon tube. Since the rolling racks are to be placed inside or alongside the monitoring station in operation, this shorter length is acceptable. Furthermore, the inner diameter of the replacement Teflon line is 1/16" wider than the original presentation line. This, coupled with the shorter tube length, allows for more rapid sample equilibration. The fourth change was the use of the AC power at the site to run the instruments, eliminating the need for the two 7000 watt gas powered generators required to operate the trailer air conditioning and run the instruments. A small Honda 1000 watt generator, is available for special cases when power is unavailable. The desktop computer in the TTP system was exchanged for a laptop computer. Both computers run the ENVIDAS data acquisition software.

To transport the system to the audit site, a step van was obtained and the cargo area modified with E-Track rails and ratchet straps to tie down the instruments, gas cylinders, and other related equipment during transport. A Xantrex 1000 watt true sine wave power inverter was wired to the van electrical system to power the instruments during transport. This is necessary because the CO analyzer requires a 3 hour warm up period before use. The total power draw of the audit equipment is 800 watts, conservatively estimated. The

van was also equipped with a steel safety cage with door between the cargo and passenger compartments of the vehicle. An 8 foot foldable ramp, designed for wheel chair use was procured to roll the equipment in and out of the truck and the audit site. Additionally, a cylinder hand truck is used to transport cylinders to and from the vehicle. At the site, ratchet straps are used to secure and stabilize the cylinders during the audit. It is important to note that the gas cylinders are 55" tall when equipped with Griftan clamshell caps, and some vans may not accommodate this size, in which case a smaller cylinder should be used.

Results and Discussion

To test the compact system's performance, a comparison with Region 2's audit and calibration system was conducted. Table 1 shows the results for O_3, in which the modified TTP system generated and measured the pollutant (using the TTP Thermo 49C), and the presentation line was connected to the Region 2 NIST Standard Reference Photometer.

For SO_2, NO_x, and CO, the TTP system generated the pollutant of interest, and concentrations were determined by the TTP CO analyzer. Although the SO_2 and NO_x are not measured directly, all 3 gases are present in a single multi blend cylinder of known concentration. Therefore, the

Table 1. TTP "Rolling Rack" Generated and Analyzed Ozone vs. Region 2 NIST Standard Reference Photometer

TTP System O3 (ppm)	NIST SRP O3 (ppm)	% Difference
0.000	-0.001	n/a
0.483	0.483	0.1
0.176	0.176	0.1
0.064	0.063	-1.6
0.000	-0.001	n/a

Table 2. TTP "Rolling Rack" vs. R2 Back of Analyzer Audit of a Thermo 48C CO Analyzer, conducted on the same day.

TTP System			R2 Back Of Analyzer (BOA) Audit System		
TTP Output (ppm)	Audited Analyzer Reading (ppm)	% Difference	R2 BOA Output (ppm)	Audited Analyzer Reading (ppm)	% Difference
0.09	-0.21	n/a	0.00	-0.1	n/a
43.94	43.30	-1.5	46.4	45.9	-1.0
20.21	20.10	-0.5	29.2	29.6	1.4

7.92	7.88	-0.5	17.8	18.0	1.1
-0.12	-0.33	n/a	8.7	8.8	0.9

Table 3. TTP "Rolling Rack" vs. R2 Back of Analyzer Audit of a Thermo 43C SO_2 Analyzer, conducted on the same day.

TTP System			R2 Back Of Analyzer (BOA) Audit System		
TTP Output (ppm)	Audited Analyzer Reading (ppm)	% Difference	R2 BOA Output (ppm)	Audited Analyzer Reading (ppm)	% Difference
0.001	0.000	n/a	0.000	0.5	n/a
0.442	0.435	-1.6	0.469	0.462	-1.5
0.203	0.201	-1.0	0.295	0.292	-1.0
0.080	0.081	1.0	0.180	0.179	-0.50
-0.001	0.000	n/a	0.088	0.088	0.23

Table 4. TTP "Rolling Rack" vs. R2 Back of Analyzer System Audit of a Thermo 49C NO_x Analyzer, conducted on the same day. Data is for the NO Portion of the audit.

TTP System			R2 Back Of Analyzer (BOA) Audit System		
TTP NO Output (ppm)	Audited Analyzer NO Reading (ppm)	% Difference	R2 BOA NO Output (ppm)	Audited Analyzer NO Reading (ppm)	% Difference
0.002	0.000	n/a	0.000	0.0	n/a
0.434	0.446	2.8	0.439	0.437	-0.46
0.258	0.267	3.5	0.282	0.281	-0.35
0.170	0.175	3.0	0.177	0.175	-1.02
0.070	0.069	-1.7	0.091	0.092	1.21
-0.003	0.000	n/a			

Table 5. TTP "Rolling Rack" vs. R2 Back of Analyzer System Audit of a Thermo 49C NO_x Analyzer, conducted on the same day. Data is for the NO_2 Portion of the audit.

TTP System			R2 Back Of Analyzer (BOA) Audit System		
TTP NO Output (ppm)	Audited Analyzer NO Reading (ppm)	% Difference	R2 BOA NO Output (ppm)	Audited Analyzer NO Reading (ppm)	% Difference
0.013	0.010	n/a	0.000	0.002	n/a

0.366	**0.371**	**1.4**	**0.371**	**0.369**	**-0.54**
0.185	**0.188**	**1.6**	**0.276**	**0.275**	**-0.54**
0.094	**0.097**	**2.7**	**0.180**	**0.178**	**-1.07**
			0.085	**0.087**	**1.88**
Converter efficiency = 99.7%			**Converter efficiency = 99.8%**		

SO_2 and NO concentrations are determined by proportion, as elaborated in the TTP Standard Operating Procedures. These pollutants were delivered to a separate calibrated set of Region 2 SO_2, NO_x, and CO analyzers using a stainless steel and Teflon delivery manifold. For
comparison, the Region 2 back of the analyzer audit system, consisting of gases, zero air and GPT calibrator, was used to audit the same analyzers. The results are listed in Tables 2-5.

For the ozone comparison, it can be seen that the difference between the modified TTP system and the NIST Standard Reference Photometer was within 0.1% for the two higher pollutant concentrations and 1.6% for the lowest ozone test point. Similarly for SO_2 and CO, the pollutant concentrations generated by both the TTP and the back of the analyzer systems were well within ±1.6% of the analyzer readings. In the NO comparison, the differences were slightly greater. The TTP system ranged from +3.5% to -1.7% difference relative to the audited analyzer, whereas the back of the analyzer system showed differences of -1.02% to +1.21%. Similar trends were exhibited in the NO_2 comparison.

It must be noted that the back of the analyzer system and the TTP systems are completely independent, with respect to gas standards, calibration, zero air supply, tubing, etc. Furthermore, the back of the analyzer system was used for the initial calibration of the audited analyzers. Thus, it was expected that the back of the analyzer audit results would show a smaller difference than the TTP audit results.

Conclusion

The compact TTP system demonstrated it's equivalency to EPA Region 2's back of the analyzer system, as had the same system in its larger trailer expansion. The ability to transport the system with a smaller footprint will enable more sites to be accessible, due to both field conditions or traffic concerns. The latter is a particular issue with larger metro areas. Field testing of the system is expected in April 2006.

Disclaimer: The use of trade names in this paper does not constitute an endorsement of the products by the EPA or the authors.

Status and Changes in EPA Infrastructure for Bias Traceability to NIST

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Abstract

Changes have been and are occurring in a number of the parts of the EPA QA infrastructure authorized and established by EPA's ORD-QA staff in RTP and DC in the 1980's to characterize and promote traceability of EPA ambient air monitoring data to NIST standards. EPA's benchmark Quality Assurance (QA) programs support the comparability of the calibrations that all reporting organizations use to assign values to the otherwise undefined instrumental signals that air monitors provide as the basis of the data reported to EPA for compliance and other uses.

This discussion will address status of changes in the EPA's National Performance Audit Program (NPAP) for Ambient Air Criteria and other Pollutants, the EPA's Standard Reference Photometer (SRP) Program for traceably standardizing ambient ozone measurements, and the EPA Protocol Gas Verification by an independent, EPA-approved, third party. In 1996 EPA OAQPS agreed to take the programs over from EPA ORD, to the extent allowed every year by resources/ priorities.

The transition of the NPAP as a mailed, back-of-the-analyzer(BOA)-only program, into the National Performance Evaluation Program (NPEP = NPAP, mailed/BOA, station operator performed +PEP+TTP) has continued in 2005 and 2006. Summaries of increasing number of TTP and decreasing number of mailed Regional PEs, discussion of net total increase/decrease; first time ever development (2005) and testing (2006) of more portable gaseous Criteria Pollutant TTP PE system, with advantages of much lower cost, much easier access; expansion of Regional TTP vs State TTP program PE, expansion of multi-Regional TTP Lab Sharing, new faster contract mechanism and other implementation trade-offs and approximate costs are discussed. Problems, benefits, & issues from 2005 and for2006 are addressed.

The mobile laboratories' flexibility of design addresses the need to acknowledge that monitoring technology develops and evolves, and therefore so does the need for audit equipment, methods, and training infrastructure support. NPEP TTP PEs have been conducted by 5 EPA Regions, on about 174 analyzers at about 127 sites in 25 states, in FY04; and in 9 Regions, on about 371 analyzers, in about 181 sites in 33 states, in FY/CY05

The SRP network of 10 NIST manufactured and certified systems are deployed, based, and operated in 8 of the 10 EPA Regions. They are compared to NIST SRPs using a stationary SRP based in RTP, and a traveling SRP in Las Vegas (LV), are operated by EPA Regions and staff with one exception- the Region 9 SRP has been operated by CA ARB. In the last 4 years, the network has undergone one addition, at the EPA Region 9 Lab in Richmond, CA except for one still needing the second- and can now automatically perform the documented SRP vs SRP procedure and record the generated data used for certifying Regional vs. the LV SRP, and vs. primary and/or transfer standards from state and local agencies, and approved EPA contractors. See latest Operator list on www.epa.gov/ttn/amtic. 2006 Coordinator transition is discussed. After 1996, the ORD's EPA Protocol Gas Verification Program was not continued. EPRI (ca.1998), and then EPA (2003), in response to complaints from the user communities, each performed an additional blind sampling study, and found that, without the program, significant

problems, across pollutants, had again occurred. Although the sample size of the original program was small and inexpensive, vendors paid attention. For very low cost, results improved over the 4-5 years of the program. EPA has proposed new Protocol Gas language to require verification, funded 2006 source sample gathering by a contractor through ICAC and analysis by NIST, and is drafting an implementation plan as the next steps toward establishing a vendor-funded, EPA-approved, 3rd party-operated, blind sampled, publicly-reported verification program.

INTRODUCTION

This discussion will address status and changes in the EPA's National Performance Audit Program (NPAP) for Ambient Air Criteria and other Pollutants, the EPA's Standard Reference Photometer (SRP) Program for traceably standardizing ambient ozone measurements, and the EPA Protocol Gas verification by an independent, EPA-approved, third Party.

Changes have been and are occurring in a number of the parts of the EPA infrastructure authorized and established in the 1980's to characterize and promote traceability of EPA ambient air monitoring data to NIST standards, the basis of the centralized, comparable accuracy of data in the USA. These benchmark Quality Assurance (QA) programs support staff training and evaluation of the comparability of the calibrations that all reporting organizations use to assign values to the otherwise undefined instrumental signals that air monitors provide and are the initial basis of the data reported to EPA for compliance and other purposes.

Importance of the Functions of the Traceability Infrastructure

The Traceability infrastructure has two important functions. The first role is to give EPA Regional oversight managers a handle on S&L proficiency, especially when used in combination with TSAs. Second, probably the greatest value of the NPAP, SRP, and Gas Protocol Verification is to provide state and local agency managers with an independent benchmark tool to check the cost effectiveness of their ongoing operator training, procedure review, data validation, equipment maintenance, and calibration standard recertification activities in their organization.

These training and benchmark roles of the comparability infrastructure verification tools (including systems audits) are especially important for two critical reasons:
1) The turnover of government environmental positions such as field operators and lab analysts in ambient air monitoring is normally a problem, but it has been escalating around the country as the Clean Air Act anniversary enters its 35th year, as well as because of national priorities.
2) The national level benchmark is important because 40 CFR Part 58, does not provide any other independent mechanism for determining how well agencies are doing in carrying out the requirements for the quarterly reporting of annually required, agency-funded audits. In addition, it is becoming more important as the number of sites used to characterize an area goes down (network size decreases), as recommended by the OAQPS National Air Monitoring Strategy, especially at NCOR level 2 sites, and in

particular at level 2 locations for Trace (Precursor) Gas analyzers, and at Air Toxics and other speciation sampler/analyzer locations.

Background/Status of NPAP

Since 1979, participation in the NPAP has been a QA requirement (40CFR part 58, appendices A, B, and C). Devices or materials have been provided as single blind samples used to evaluate the proficiency of the performance of EPA-required methods by the state local, or private monitoring station operators (and their equipment, standards, procedures, management, etc.). Some of the audits are of lab proficiency only, and some test field sampling and lab analyses and reporting. All audits are performed by the audited agency staff, usually *by* the station operator. All audits are provided by a single EPA audit support contractor. A listing of all the sites that have received mailed NPAP audits for ozone, CO, SO2, and NO2, and PM10 SSI/HiVol, from 1989 through 2003, as of March 2003, is provided at the EPA website at *www.epa.gov/ttn/amtic/npaplist,* in 2 parts (1989-1993, and 1994-2003).

As monitoring equipment used in the field have evolved from wet chemistry to continuous methods, so have the audit methods. Unfortunately, recognition of and provision for this evolution has not been built into the regulations or the supporting funding mechanisms.

RTP QA Changes-ORD to OAQPS

EPA's Ambient Air QA program started changing organizationally in 1996 when EPA ORD divested itself of its QA service programs and EPA OAQPS agreed to take over, as well as it could, depending every year on resources allocated and mission priorities.

NPAP Changes-Creation of PEP and Then NPEP

The particulate portion of the NPAP started changing with the addition in 1999 of portable, collocated, PM2.5 samplers, delivered, operated, retrieved and reported by a nationally coordinated, regionally based, group of 3 independent EPA contractors. This program was first approved following many months of communications and eventual agreement between U.S. EPA OAQPS and almost all of the state and local ambient air monitoring agencies. The program is funded with State and Local agency Grants (STAG, 103 type), and is called the Performance Evaluation Program (PEP). Documents and reports of this program are available through the website for ambient monitoring. The website's URL is: http://www.epa.gov/ttn/amtic, at the qaqc\npepqa, and the ...amtic\pm2.5 and other ... /amtic menu choices on the amtic home page.

An effort was started in 2001 to improve the non-PM2.5 NPAP *for* continuous gaseous monitors by combining it, and the centrally coordinated, Regionally operated EPA network of NIST –made Standard Reference Photometers*, or SRPs,* with the PEP, as NPEP, by adding a system of Regional mobile audit laboratories. These laboratories are each based in an EPA Region, as is the PEP program. Currently 6 mobile laboratories have provided laboratory quality audit gases verified at the audit site, and then delivered through the sampling inlet, or probe, and multi-instrument sampling manifold of the audited station. A general description of the TTP Mobile Labs' trailer, tow vehicle, tow safety features and procedures are provided, along with a few example pictures, at the

EPA website at www.epa.gov/ttn/amtic/ambient/qaqc/trailer.pdf. Many more pictures and details are available on request.

Most audits in the US, including the mailed NPAP audits and the agencies' own quarterly reported audits, are delivered just to the back of the audited analyzer *(BOA)*, bypassing station inlet, manifold, and connecting tubing. The model for the EPA Mobile Performance Evaluation (PE) Laboratories is the California Air Resources Board's (CARB's) Through-the-Probe (TTP) Mobile Audit Program. It has been in operation for about 20 years, and is documented on the CARB website. The SOP for the CARB TTP program is included as Appendix in the EPA QA Handbook, Vol II, Part 1, which is posted on the AMTIC website. The EPA Compendium of 11 Mobile TTP PE SOPs is a final draft that has been expanded and revised a number of times as the author and the network of Regional EPA and contractor operators and managers became more experienced with the operation and maintenance of the systems. It has been in review by the operators and managers since the last training session and certification, in Las Vegas, NV in December of 2004. It *is* posted on the www.epa.gov/tnn/amtic/npaplist, where the mailed program QA project plan and SOPs are also listed.

There are a number of important technical and quality differences between the existing mailed EPA NPAP and the new EPA NPEP Mobile TTP PE programs' capabilities and features. They have been discussed in position papers and presentations in previous years at this meeting session. Contact OAQPS ambient air QA staff for more information.

Some situations are not feasible and/or not cost effective for the Mobile lab *TTP* PE. Until the mobile lab components are made as portable as the mailed or PEP PE equipment, the EPA needs to ensure the availability of some minimum level of the mailed program, along with the mobile lab systems. Examples of conditions requiring this resource be retained are sampling stations in: islands, mountains, sky scrapers, high theft inner cities, off-road (some tribal and/or other rural), far northern, cold climate locations.

The biggest cost benefit tradeoff is that it **costs more per audit/PE for the TTP system** than for the mailed system, all costs being included, but the Mobile lab comparison is very much more timely-same day- and meets the independence criteria for quality assessments more completely than the mailed program. The Mobile system's accuracy is also significantly greater than the mailed system's. As measured concentrations get lower, as trace level concentrations become more important, and each analyzer's results become more important (due to there being fewer analyzers per network, as planned for in the EPA monitoring strategy), this greater accuracy will allow greater confidence in reported data, and in the ability to troubleshoot problems on the spot, when discrepancies arise.

Mobile Lab Designed Flexibility, Multi-Use Capability, *& Multi-Regional Sharing*

The mobile laboratories are designed to allow transport and deployment of the PM 2.5 devices, as well as *gaseous and* other audit equipment, and of emergency/hazardous air

sampling, of short duration, when Regional priorities dictate. Initial features included, for example, the roof sampling platform, currently on three of the six mobile labs; the expanded *and* expandable capacity of the data logging system *s* (Dell-based EMC and ENVIDAS systems), digital connectivity, and possible remote control and transmission; flexibly designed and shock-mounted instrument racks; high capacity zero air generator, UPS-PLC system and power source system option features; clamshell cylinder safety caps; and, most recently, as a pilot in Region 2, the installation of the TTP Lab instruments and rack-mounts into padded, high impact plastic cases that can be either rolled by one person, or carried by two, and can fit into the back of minivan or into a small part of a Cargo van. This change has large potential consequences for the national Performance audit efforts. It also frees up a mobile lab trailer that we are planning to equip in 2006 for mobile Precursor Gas audit development, testing, training, and deployment in all Regions.

In general these features of flexible design also address the need to acknowledge that monitoring technology develops and evolves, and therefore so does the need for audit equipment, methods, and infrastructure support This need, addressed by design flexibility, and allowing multiple use capability, is especially true in these times of reducing budgets and increasing need to address varying local air emergency or threat situations.

Performance Accomplishments in 2005: 3rd Yr., Transitional Field Implementation

In 2005, the NPAP Improvement or TTP network became almost nationwide in scope (9 of the 10 Region served, at a funding level of about $300K A goal was set for annual implementation in 2005 that has been met, for the % of the total possible that our level of funding was expected to serve. This goal is what we consider to be the maximum needed per year to reasonably evaluate the existing gaseous Criteria Pollutant analyzers, required to report data to EPA for attainment and related decisions, regarding the % of sites to be audited out of the total possible. We estimate that a 20% level of effort per year will allow us to evaluate all ranges of priority sites in the US network within 5 years.

The table below, Figure 1, Comparison of TROTAL NPAP PEs in 2004&2005, shows the total numbers of audits done in 2005 and in 2004; those planned in 2005; and total possible number of required reporting gaseous monitors and sites in 2004. The table also shows the shift between numbers of audits done in both years by both the TTP independent delivery (increasing) and mailed delivery (decreasing), equipment, and procedures. Note: An expanded table showing the entries for each Region will be available as a handout at the meeting and will be posted at the NPAP Website when the changes for last year are completed. Overall cost changes form 2004 to 2005 to the present will be discussed if desired at the meeting.

FIGURE 1: COMPARISON OF TOTAL NPAP PES IN 2004 & 2005

COMPARISON OF TOTAL NPAP PEs IN 2004 and 2005 (Cf. 20% of Total Monitors)									
	O_3	CO	SO_2	NO_2	Total TTP PE Monitors	Total TTP PE Sites	Min # of Sites PM10 PE	Total Sites-Mailed Gas PE	Mailed PB
2004	119	26	21	20	186	114	39	145	47
2005	141(P) 156(D)	70(P) 54(D)	54(P) 54(D)	67(P) 68(D)	357 (P) 371 (D)	197(P)) *181(D)	33 18(D)	56 38(D)	34
04Total	733	284	339	213	1569	1055			

*** Total includes 9 sites paid for by tribes**
(P) = Planned '05 (D) = Done '05

In summary, the number of sites and the number of monitors per site, have doubled between 2004 and 2005, with an average of 2 monitors per site.

Although the Dec. 2004 certified EPA (Regions 2, 5, and 7) and contractor (Regions 1 ,3, 4, 6,,9, and 10) NPAP TTP operators have been very productive in 2005, using the same detailed draft final procedures, EXCEL workbook, no one could say that the program became either fully funded or routine in 2005. Important refining and improving changes were, and are still occurring. The 3 major developments for 2005 are all goals that the author had from the beginning of the improvement effort, but could not get done until enough operators, funding, and mobile lab system performance were far enough along to take the next steps.

The last 2 of the goals were the ones most aggressively mentioned when the EPA Regions were conveying the concerns to OAQPS about the problems and concerns that the state and local monitoring organizations had against the original mailed program

Most challenging has been the EPA Regional Mobile Lab sharing arrangements that first took place in 2005. By their nature, they reduce the number of audits that can occur in the host Region, and significantly limit the number that can be done in the guest region .However, at a lower overall cost and resource demand, they have provided an opportunity for more operators to get experience and for more state and local agencies to be exposed to the kind of audit that can be done with the very much more timely, helpful(in trouble shooting), higher capacity, and more accurate equipment possible, and used in

the TTP program.

The 2nd critical development was the central assembly use of the 2003-2006TTP EXCEL work books, in 2006, to allow an AQS staff member on detail in our group to work out an access database and enter the audit results data into it. The data being entered has a place already available in AQS, but which so far has not been used. The access database will be used , once it is finalized in design and content, to load the PE data into AQS. It is also very helpful for tracking and summarizing for reports, tasks which are much more difficult and time consuming currently, requiring manual review of our CD and paper data compendium of individual EXCEL workbook files.

The 3rd critical technical development was the design, purchase, assembly, and vehicle fitting in 2005, and lab and field testing and use in 2006 of the Region 2 more portable TTP PE system, in several smaller vehicle types. Modification of the training materials for the use of the Region 2 system will occur as needed during its initial field use for auditing in New York S&L sites.

Summary report tables have been prepared from the database, and include excedance summaries and follow-up assistance by EPA, made possible by the TTP approach.. This will be discussed and shown during the meeting presentation.

National Communication: NPAP Funding Decision Memoranda Sent March 2006

Grant guidance for 2007 has been provided in FY 2006 which requires State, Local, and Tribal (SL&T) Monitoring Organizations to choose how to apply for program their grant funds to provide for the required PEP and NPAP TTP audits in 2007. The guidance allows organizations to choose to not use the National program, if they can show that they can provide an independent and adequate alternative themselves. However, they have to show adequacy by comparisons to the national program, which is our national benchmark of gaseous audit bias measurement.

Due to the need to adequately provide for the alternative approach, decision memoranda have been sent out to all the state and locals , as well as their EPA oversight Regional staff, requiring them to decide and communicate their decision back to EPA OAQPS and the Regions. This decision will have to be provided on a timeline that will allow either their own or the national program to provide the required audits in 2007. The memoranda include tables that show cost breakouts and assumptions for the cost parameters that will enable all organizations to evaluate and decide how best to address the requirements and their costs.

Note: the costs in the Regions have been initially estimated without the cost of replacement. This cost will have to be provided for, probably on an as needed basis. As an item starts needing replacement, as indicated by its latest performance, as compared with past performance, funds will have to be planned for the coming year for a replacement purchase(s).

Net NPAP/NPEP Funding Status, Costs, and Changes

Using the Grant guidance and decision memoranda communications, EPA has moved toward combining the funding and the operations of the new PEP and existing and new NPAP, to allow for a more reliable and cost –effective funding of these programs.

The number of NPAP mailed audits that the 10 Regions had become used to receiving, without more than the agency cost in performing the audits, has dropped drastically. It will be very close to zero in 2006, due to a major funding cut , and the shift to TTP with all available resources. This reduction had already started before the Regional TTP system development started, as a result of a reduction in NPAP contract funds that started in 1999, due to competing program priority needs, and has continued since then. The current NPEP funding is used to operate both mailed and TTP options. As the 6 Regional PEP+TTP (NPEP) systems, and the remaining complementary mailed NPAP program, show what they can do, for the funding amounts they have been given, we have seen the number and quality of audits to increase to a more effective level, starting in the last half of 2004 (after the May Training sessions), and rising through the 1at quarter of 2006, as the remainder of the 2005 funds are spent. New contracts for PEP and TTP are being awarded at different times in 2006, due to the awards for new Regional ESAT contracts in 2006 occurring at different times of the first half of the CY.

EPA SRP Network Status and Changes

The EPA's SRP network of 11 NIST-manufactured and certified systems are deployed, based, and operated in 8 of the 10 EPA Regions. They were coordinated (certified as traceable to NIST) initially by the relatively standard combination of a stationary and a traveling SRP, both based in RTP. Currently the primary (coordinating, traveling) SRP is based in Las Vegas. The network of Regional SRPs has, all along, and is currently operated by EPA Regional staff, with one exception. The EPA Region 9 SRP has been operated by CARB. Now Region 9 has an SRP that will be used to back up the CARB support, given budget uncertainties, especially to nearby states and Regions, and in support of the new Region 9 Mobile TTP PE Lab program.

In 2006, a major positive change is planned and has started to occur. The coordinating SRP and its original partner in RTP are going to be reunited in RTP. This will re-establish the traditional and much more effective approach of having one stationary and one traveling SRP. The separation, along with the 2 recent upgrades, had necessitated scheduling delays and made Coordinating SRP recertification more difficult and resource consuming. The new coordinating SRP location will be in the ORD NRMRL APPCD air equipment standards certification lab that has been managing the stationary RTP SRP since ORD NERL stopped managing it. For more information contact: shanis.mark@epa.gov or moore.scott@epa.gov.

A table of the 11 SRPs and their most recently completed or imminently planned certification dates, locations, and EPA Office is provided below. This and other related information about the SRP network and operation is now provided at the SRP website, at : ..ttn/amtic/srpqa.html

SRP #	Location/Org.	Latest Date Done/ Skd
1	**RTP, NC /**: **ORD**	8-05(done)
3	Edison, NJ / **Region 2**	1-18-06(done)
4	Sacramento, CA / C**ARB**	4-06(Scheduled)
5	Houston, TX / **Region 6**	2-21-06(done)
6	Chicago, IL / **Region 5**	1-27-05(done); (prefer Oct-Dec 06)
7	LV,NV→RTP/**ORD**	7-06 NIST;? 8 or 9-06 Tribal SRP Trng.
8	Golden, CO / **Region 8**	12-13-05(done)
9	N. Chelmsford, MA/ **Rg1**	11-16-05(done)
10	Athens, GA / **Region 4**	7-28-05(done)
13	Kansas City, KS **Region7**	10-05(done)
36	Richmond, CA **Region 9**	3-06

In 2005 and continuing into 2006, the network operators have been carrying out a study to compare the ability of the SRP and well known and used latest commercial analyzers to compare as closely as possible with the SRP while at the same time traveling along with the SRP, to see which ones would be the least to the SRP, in case we need to consider a substitute for the traveling SRP. What has been found so far is that the 1st analyzer tested, the TECO 49C-PS, compares well in analytical performance and also in durability. In mid 2005, the Las Vegas Coordinator obtained an API 400 Ozone analyzer to use for the commercial study. In the early part of the API parallel testing with the SRP, a pump was found to have come off its base- fortunately it did not seem to have caused any noticeable damage . If it had come loose in transit, the situation could have been much. This is why we are doing the study. Although this is only one case, we will be interested to find out if there are any other cases.

A visit to the NIST website on the SRP will provide details about the current system. It will also clarify that NIST has been working out an arrangement with the Bureau Internationale des Poids et Mesures (BIPM) in France. (BIPM), with the goal of the BIPM taking over international support for the growing worldwide SRP network, over the next 5 years. NIST will still provide support to the U.S.(EPA) network.

EPA Traceability Protocol for ...Gaseous Calibration Standards-Status and Changes

Over the years, EPA personnel have experienced and have received anecdotal reports of problems with the reliability/variability of the vendor-certified accuracy of the standard gases bought by state, local, and EPA Regional, and ORD laboratories for use to

calibrate ambient air gaseous monitors.

EPA established and has modified and expanded the scope of its Traceability Protocol for Certifying Gaseous Calibration Standards. In the late 1980s, EPA ORD started reporting the results of a relatively small Protocol Gas verification program. Although sample size was small, probably not statistically representative, and had a relatively very low cost, vendors paid attention. This conclusion is indicated by the fact that the results improved over the 4-5 years of the program (paper at this meeting and session by John Schakenbach, U.S. EPA). Access to reports of the ORD verification program has in the past been made available through the AMTIC website that contains the list of ORD reports and publications.

After ORD's QA service program divestment to OAQPS, the verification program was not continued. However, EPRI (ca.1998), and then EPA (2003-2004; and again starting in 2005 and hoping to finish in 2006), in response to complaints by individuals from the user community, and some requests for re-institution of EPA-approved verification from some members of the gas vendor community, have funded the performance by contractors of additional blind sampling studies. For the completed studies, it was found that, without the program, significant problems, across pollutants, had again occurred.

EPA is therefore looking into a vendor-funded, EPA-approved, 3rd party-operated, blind sampling, publicly-reported verification program.
A team of EPA OAR and ORD staff has continued to hold internal and attend external meetings, and proposed alternative options to the vendors and NIST, the proposed benchmark for the analytical verification (by both EPA and the vendors). EPA has responded to requests for action, in order to get the necessary cooperation from the vendors. Proposed ambient air related CFR wording regarding the verification submitted by OAQPS in 2005. Another group has agreed to add verification wording to its Protocol requirement. Our ORD NRMRL team member and Protocol Specialist has been obtained vendor and other stakeholder comments on proposed changes for the Protocol, and is preparing changes. An EPA purchase request and funding was accepted by NIST for providing the analytical component of the verification. The Institute for Clean Air Companies (ICAC) has used some additional EPA funds to arrange a contract with a 3rd party contractor to get a blind sampling of the number and type of cylinders that EPA has agreed for this one last time to fund, and NIST agreed to verify. This blind sampling task is close to completion. OAQPS has proposed 2 different blind sampling methods for acquiring the cylinder samples for the verification the 2 user communities- source and ambient, which we hope will be practical and acceptable to the stakeholders. In addition to funding the latest test, the arrangements being used in the 2006 test have lead us to work on preparing a draft Implementation Plan for the proposed Protocol Gas Verification Program

Proposed Changes to 40 CFR Part 58- Brief Traceability Infrastructure Clarification

As part of the implementation of the current EPA Ambient Air Monitoring Strategy,

currently under nationwide discussion, including CASAC subcommittee review, CFR changes have been proposed by OAQPS which include the addition of specific references, in 40 CFR Part 58, Appendix A, to the three components of the traceability infrastructure addressed in this paper. Updates and additions to the material currently in the websites are accessible at the following urls: http://www.epa.gov/ttn/amtic/qa or http://www.epa.gov/ttn/emc/news.html, for NPAP and the EPA Gas Protocol, respectively; and currently at the NIST website for the SRP, at http://www.cstl.nist.gov/nist839.03/ozone.html. Information about the EPA network can be obtained through the EPA author and network operating staff.