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Project Summary

Summary of Precision and Accuracy Assessments for the State and Local Air Monitoring Networks —1981

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This report covers the first year of collecting Precision and Accuracy data from state and local monitoring agencies. The data are summarized by state and pollutant, and then by region and the nation.

A brief comparison of the precision and accuracy from the Precision and Accuracy Reporting System and the independent performance audit program conducted by the Environmental Monitoring Systems Laboratory is presented.

This Project Summary was developed by EPA's Environmental Monitoring Systems Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The purpose of this document is to report the first year of data from the Precision and Accuracy Reporting System (PARS). Federal regulations promulgated on May 10, 1979, required quality assurance precision and accuracy (P&A)* data to be collected. Collection started January 1, 1981, according to guidelines set forth in 40 CFR Part 58 (44FR27558-27604). These guidelines provide for more uniform Quality Assurance programs and reporting requirements across all state and local air monitoring stations.

The bulk of the material presented in this report results from the considerable efforts of the state and local agencies to produce and report the data quality assessments for P&A.

Comparisons have been made of the accuracy data collected for PARS and the results of the Performance Audit (PA) Program, which has been an ongoing program conducted by the Environmental Monitoring Systems Laboratory (EMSL) since the early 1970's.

Background

Ambient air quality data, collected by states and local agencies, have been stored in the National Aerometric Data Bank (NADB) since 1957. These data are used in planning the nation's air pollution control strategy, in determining if the National Air Quality Standards are being achieved, and in determining long-term trends of air quality. Prior to the air monitoring regulations of May 10, 1979, the procedures used in selecting monitoring sites, in operating and controlling the equipment, and in calculating, validating and reporting the data varied considerably among agencies. Frequently the procedures being used were not well-documented. This made it difficult to compare data from different sites and agencies.

*When one speaks of precision and accuracy of measurement data,[1] one really means the precision and accuracy of the measurement process from which the measurement data are obtained. *Precision* is a measure of the "repeatability of the measurement process under specified conditions." *Accuracy* is a measure of "closeness to the truth."

To help alleviate this problem, the May 10, 1979, regulation mentioned in the Introduction imposed uniformity on data collected after December 31, 1980, and intended to be submitted to the NADB. For example, only EPA reference, equivalent, or other EPA-approved air monitoring methods were to be used. Also, calibration standards were to be traceable to National Bureau of Standards (NBS) or other authoritative standards. Further, the quality assurance systems of the states were required to be documented and approved by the EPA Regional Offices. Finally, the reporting organizations must also follow specific procedures when assessing the P&A of their measurement systems and were required to report the P&A data quarterly to EPA.

The precision assessments were generally determined either by performing repeated measurements on approximately ambient-level "calibration" gases at two-week intervals, or by obtaining duplicate results from collocated samplers. The accuracy assessments were generally determined by analyzing blind audit materials traceable to NBS. During each calendar year, each site or instrument must be audited at least once. Details concerning the specific procedures and computations used to assess P&A are contained in the regulations.

When a request is made for ambient air quality monitoring data from the NADB, the requestor receives the P&A data along with the routine monitoring data. The requestor, or user, of the data can feel more confident that the data are of the quality indicated by the assessments and that the data have been obtained from an agency having a planned and documented quality assurance system. The EPA can also rely on the data in producing its control strategies and determining whether standards have been met.

Results

The first year of data collected for P&A has been compiled and summarized. All 141 reporting organizations reported P&A data for particulates, using the method that is used throughout the nation. Other methods were not reported from all organizations for several reasons. First, reporting organizations in some areas no longer use the manual methods for SO_2 and NO_2, having installed only continuous analyzers. Since the cut-off date for approval as a State and Local Air Monitoring (SLAM) site was January 1, 1983, some sites had not yet been approved for some other methods. Of course, some problems did arise simply because this was the first year of data collection. Typical start-up problems were: following instructions correctly, using the proper form, coding the proper numbers into the correct fields, and mailing the results to the right place. Through the efforts of EMSL's Quality Assurance Division (QAD), the regional quality assurance offices, and the state and local agencies, the P&A data have been reviewed and verified for completeness and accuracy.

All data summaries presented in this report were based on all of the data received from the state and local agencies; no outliers were removed from the data set. An evaluation of removing outliers from the PARS data set did not indicate significant changes in the data summary average values.

The P&A numbers for particulate data from the high volume sampler are impressive. From 13,248 valid collocated data pairs, the national average of lower and upper probability limits for precision are -12% and +13%. The accuracy probabilities calculated from 5,560 audits are even more impressive with lower and upper and lower probabilities of -06% and +07%.

Results from the PARS Program

Table 1 exhibits the national averages for each of the manual pollutant methods in the PARS system.

The precision limits reflect the repeatability of the methodology used in the field to collect and analyze the samples at ambient levels. The spread of the limits may be somewhat inflated because of measurements at relatively low concentration levels.

The accuracy of the manual methods indicates the limits at predetermined concentration levels for the chemical analysis performed in the samples for lead, sulfur dioxide, and nitrogen dioxide. For the particulate, the accuracy measurement is for the flow rate only. The probability limits for manual accuracy are extremely good and reflect the quality of work done in the chemical laboratories for lead,sulfur dioxide, and nitrogen dioxide analyses, and in the field for flow rate measurement for particulates.

The P&A limits for automated methods are in general good for the first year of data collection. Table 2 indicates the amount of effort involved, with over 10,000 precision checks each being performed for SO_2 and O_3 instruments.

Although the results are good for the first year, further improvement is believed possible. Details of the individual states' results are presented in the body of the detailed report. The regions for which further improvement should be possible are those showing the larger of variability in the results.

Comparison of Results from the PARS and the PA Program

A general comparison between the accuracy data of the PARS program and the PA data is included in this report. The audit data are the results of an independent check conducted by the QAD of the EMSL. Blind samples are sent to the laboratories that perform the state and local agencies' analyses. The samples are analyzed and results are sent to QAD where they are evaluated.

Since precision assessments are not made in the PA program, only accuracy can be compared across the PARS and the PA programs. For the purpose of this report, the results from PARS and the PA system are compared at approximately the same levels. Also, the results are compared on a *state basis,* which means that for states with more than one laboratory involved, the results are averaged. Since the PARS data are presented with outliers, the same approach was taken with the audit data. Knowledge of the historical audit data reports, however, indicates that the presence of outliers does make a significant difference in the average audit results for the performance audits.

Future reports which compare PA and PARS are planned. Those reports will address the comparison in more detail, making a laboratory-to-reporting organization comparison with and without the inclusion of outliers.

Comparisons of the national averages of the probability limits exhibit correlations between the results of the two programs. However, in general (except for the manual NO_2), the spread of the limits is wider at level 1 than at levels 2, 3, and 4. Lack of better agreement can be attributed to a number of factors. First, the inclusion of outlier values in the PA data appears to have introduced some excessive distortion of general trends. Second, for both data sets, variations due to many sources of error are averaged together to obtain the national averages, thereby masking any correlations which may have existed for the results of individual agencies. Third, the concentration levels for the two systems do not

Table 1. *National Precision and Accuracy Probability Limit Averages for Manual Methods*

	Precision			Accuracy						
					Probability Limits (%)					
	Number of Valid Collocated	Probability Limits (%)		No. of	Level 1		Level 2		Level 3	
Pollutant	Data Pairs	Lower	Upper	Audits	Lower	Upper	Lower	Upper	Lower	Upper
TSP	13,248	-12	+13	5,560	---	---	-06	+07	---	---
Lead	416	-25	+30	577	-11	+08	-09	+02	---	---
Sulfur Dioxide	965	-51	+57	711	-16	+09	-09	+07	-08	+06
Nitrogen Dioxide	752	-41	+44	769	-07	+10	-04	+06	-04	+05

Table 2. *National Precision and Accuracy Probability Limit Averages for Automated Analyzers*

	Precision			Accuracy						
					Probability Limits (%)					
	No. of Precision	Probability Limits (%)		No. of	Level 1		Level 2		Level 3	
	Checks	Lower	Upper	Audits	Lower	Upper	Lower	Upper	Lower	Upper
SO_2	10,821	-15	+09	1,062	-17	+13	-13	+11	-13	+11
O_3	10,399	-12	+10	1,336	-14	+12	-10	+09	-10	+09
CO	7,996	-10	+08	821	-13	+13	-07	+08	-07	+06
NO_2	2,487	-14	+12	329	-21	+26	-12	+11	-10	+08

coincide exactly at each of the audit levels. Fourth, the PA data are the results of independent *external* audits while the PARS accuracy data are based on the results of independent *internal* audits. The expected effects of the first and last-mentioned factors would be to cause the spread of the limits for the performance audits to be wider than that for the PARS. Examination of the results, shown in Table 3, confirm this expectation.

Table 3. *Summary Report of QAD Performance Audits (PA) vs PARS Accuracy Audit Data for Year 1981*

		National Averages Probability Limits (%)							
Pollutant and Method Code	Audits	Level 1 Lower	Level 1 Upper	Level 2 Lower	Level 2 Upper	Level 3 Lower	Level 3 Upper	Level 4 Lower	Level 4 Upper
C42101 CO									
PA	1118	-14	+10	-8	+8	-7	+7		
PARS	(666)	(-18)	(+19)	(-8)	(+9)	(-8)	(+8)	(-30)	(+15)
I42602 NO_2									
PA	234	-29	+23	-12	+8	-13	+8	-11	+7
PARS	(716)	(-9)	(+12)	(-6)	(+7)	(-5)	(+6)		
I42401 SO_2									
PA	157	-44	+28	-30	+20	-16	+10	-20	+12
PARS	(640)	(-22)	(+15)	(-17)	(+13)	(-14)	(+12)		
I12128 Lead									
PA	84	-25	+19	-15	+11	-15	+10		
PARS	(535)	(-12)	(+8)	(-7)	(+5)				
I111101 HIV									
PA	2114			-18	+19				
PARS	(3073)			(-10)	(+10)				

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The complete report, entitled "Summary of Precision and Accuracy Assessments for the State and Local Air Monitoring Networks—1981," (Order No. PB 84-189 968; Cost: $11.50, subject to change) will be available only from:

National Technical Information Service
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