



## Project Summary

# Precision and Accuracy Assessments for State and Local Air Monitoring Networks 1981-1986: Supplement to EPA/600/4-88/007

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**Precision and accuracy assessments of air quality data obtained from state and local air monitoring agencies from 1981 through 1986 are summarized in graphical form for each reporting organization. For most reporting organizations, the graphs show an improvement in data quality during the six-year period. Comparisons across reporting organizations for the same pollutant measurements reveal persistent, significant differences.**

**The data quality assessments are also summarized and shown graphically for each Region and for the nation. Persistent, significant differences are evident among the Regions. Investigation to identify the causes of these differences and implementation of appropriate corrective actions are recommended to further improve data quality. The importance of the originating agencies' plotting of quality control charts for the individual site results is emphasized. Examples of the charts included in Florida's quarterly quality assurance report are presented and discussed.**

**The work covered by the full report was completed as of July 1988. The report is a supplement to EPA/600/4-88/007.**

*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

Federal regulations promulgated on May 10, 1979 require the state and local air monitoring agencies to perform special checks to assess the accuracy and precision of their ambient air measurement systems for the criteria pollutants. The special checks have been required since January 1, 1981, and a summarized form of the results is reported to the EPA, Environmental Monitoring Systems Laboratory (EMSL), Research Triangle Park (RTP), North Carolina for further summarization and evaluation.

Details concerning the performance of the special checks and the reporting of the results have been presented in annual reports for the years 1981 through 1986. The annual results for each reporting organization were tabulated in the reports, and graphical presentations were made to show time trends from year to year for the EPA regions and the nation.

The purpose of the full report is to present graphs of the results for each reporting organization for the six-year period, 1981-1986, so that time trends and other relationships can be shown.

Revised regulations of March 19, 1986 require that the special checks for accuracy and precision be continued and that all of the raw data rather than summarized results be reported to EMSL/RTP for all special checks made after December 31, 1986. Because the more detailed reporting of data for 1987 and beyond will enable a more detailed summarization, analysis, and evaluation to be made, it was deemed appropriate to provide this six-year graphical summary for each reporting organization to the states and EPA Regional Offices.

Also included in the full report is some discussion of the need for the originating agencies to maintain quality control charts for each site. Examples of charts that the State of Florida includes in its quarterly quality assurance report are presented and discussed.

## Results by Reporting Organization

Air monitoring data quality assessments, as 95 percent probability limits, are shown graphically for each reporting organization by year.

Figures 1 and 2 illustrate the form and arrangement of the graphs for each reporting organization. The example, Kentucky, Jefferson County Air Pollution Control District, was selected because it shows the reporting for all possible measurement methods. The first page shows the graphs for Continuous Methods, while the second shows the graphs for Manual Methods. The Continuous Methods are presented in the following order, from top to bottom: CO, SO<sub>2</sub>, NO<sub>2</sub>, and O<sub>3</sub>. The Manual methods are presented in the following order, from top to bottom: Total Suspended Particulates (TSP), SO<sub>2</sub>, NO<sub>2</sub>, and Pb. The scales for all corresponding graphs are the same throughout to enable visual comparisons to be made from reporting organization to reporting organization.

The upper and lower extremes of the vertical bars shown for each year represent the upper and lower 95 percent probability limits, respectively, for all of the precision and accuracy checks made during the year in the reporting organization. It is expected that 5 percent of the results of the individual precision or accuracy checks would exceed these limits. The mid-points of the vertical bars are connected to better

show trends and biases. In all cases the vertical scales on each chart are the percent deviation of an observed precision and accuracy result from a test or reference value.

For more detail concerning the actual precision and accuracy checks and the computations of the 95 percent probability limits, the reader is referred to the previously issued annual reports.

As can be seen in Figures 1 and 2, the scale ranges (%) are as follows:

	Precision	Accuracy All Levels
<u>Continuous Methods</u>		
CO	-40 to +40	-40 to +40
SO <sub>2</sub>	-40 to +40	-50 to +50
NO <sub>2</sub>	-40 to +40	-70 to +70
O <sub>3</sub>	-40 to +40	-40 to +40
<u>Manual Methods</u>		
TSP	-40 to +40	-30 to +30
SO <sub>2</sub>	-100 to +100	-30 to +30
NO <sub>2</sub>	-80 to +80	-20 to +40
Pb	-80 to +80	-40 to +40

Figures 1 and 2 also show that although the graphs for the continuous SO<sub>2</sub> and NO<sub>2</sub> and the manual SO<sub>2</sub> and NO<sub>2</sub> are located in the same positions on the page for comparison purposes, the scales are different. Always shown at the top of each page is the EPA Region number, the state number and name, and the reporting organization number and name.

## Order of Presentation

The graphs in the report are presented in the following order:

1. By Region, in numerical order;
2. Within Region by state, in alphabetical and numerical order.
3. Within State by reporting organization, in numerical order.

In addition to the graphs for the 169 reporting organizations in the nation,

summary graphs are included for each the EPA Regions and for the nation.

## Observations from the Graphical Presentations

A number of trends or effects can readily be perceived by a visual review of the graphs. Examples of some of the trends or effects are given below. The discussions of the various examples shown in the figures are not intended to be complete. A critical review of particular graphs may reveal other significant patterns.

**Negative or Positive Bias.** A slight negative bias for the continuous SO<sub>2</sub> method has been noted from the Regional graphs of all of the annual reports, 1981-1986 (see Figure 1). Possible explanations for these negative biases, given in the annual reports, have been the negative instrument drift of the analyzers or degradation of the precision/accuracy check materials. An example of these negative biases for reporting organizations is given below. The negative bias for precision and accuracy is about 10 percent. A few reporting organizations show a positive bias.

**Time Trends.** For many of the reporting organizations, improvement is very evident, as shown by decreasing widths of the probability limits (Figure 4). However, some reporting organizations show either no improvement or worsening.

**Wide Limits, Narrow Limits.** Some reporting organizations have considerably wider probability limits than others, indicating much poorer precision and accuracy. Such reporting organizations should perform a thorough review of their measurement systems to determine the causes of the excessive variability and take appropriate corrective actions to improve their results. Something may also be gained from discussions with those reporting organizations that seem to do much better than most. The graphs for Figure 5 show consistently wide and narrow limits.

**Similar Patterns of Variability.** Normally, biases occur at one level of accuracy; they also occur at the other levels as well. These conditions would exist when all of the limits are too wide, too narrow, show the same trend over time, etc. Several examples of such patterns are shown in Figure 6. In other cases, however, the patterns from level to level may not be uniform or smooth but may

95% Probability Limits 81-86  
Continuous Methods

Reg: 04  
State: 18 Kentucky  
Repor: 002 KY, Jefferson Co. Air Poll. Control Dist

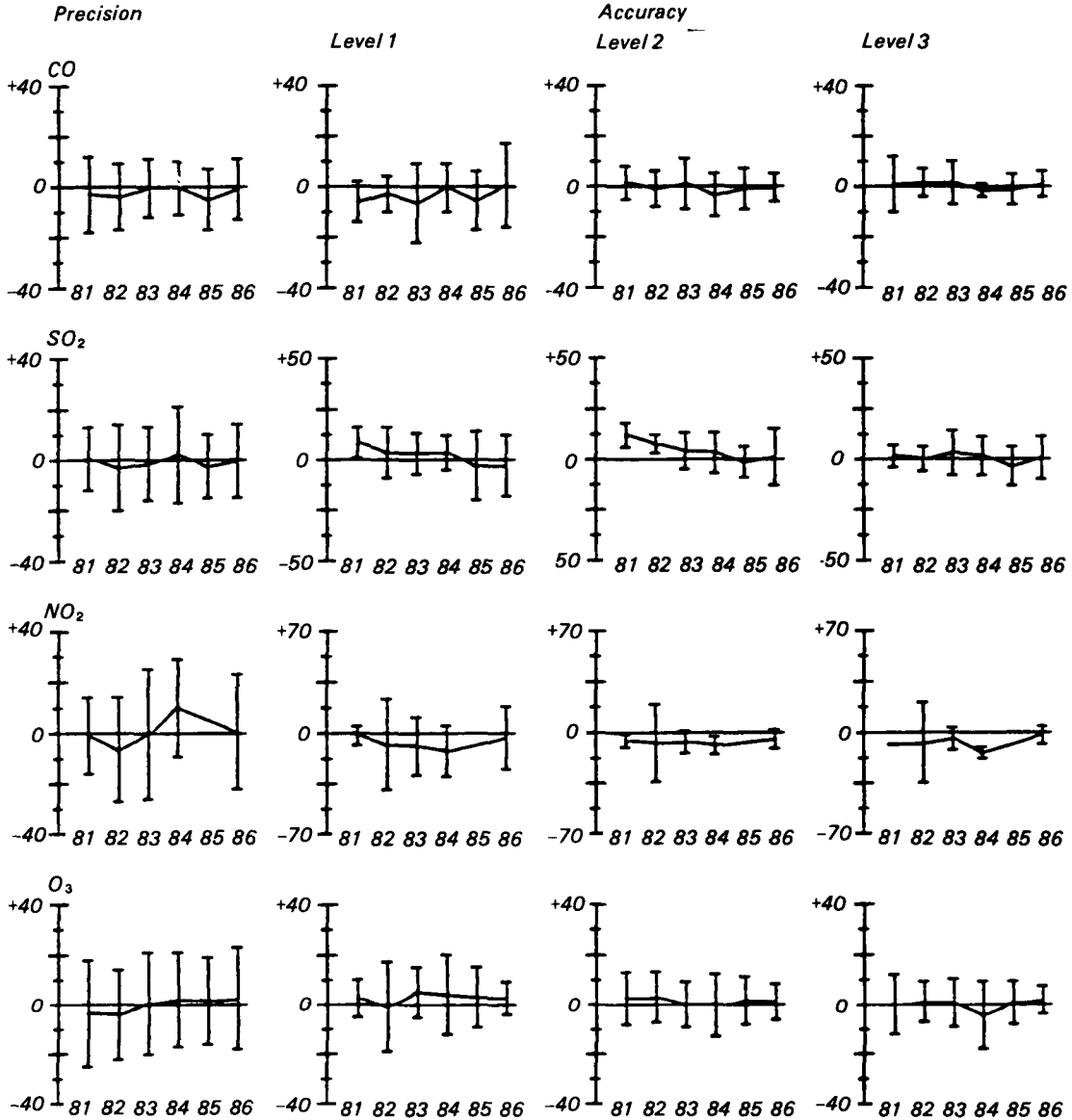


Figure 1. Example graphs for a reporting organization, continuous method results.

vary considerably in a similar pattern from year to year.

**Trends Across Accuracy Levels.** The probability limits, which are percentages, are generally wider for level 1 than level 2 and wider for level 2 than level 3. In other words, the length of the vertical bars decreases with increasing level

This is the usual relationship for most measurement methods.

The decreasing limits with increasing level is particularly evident in Figure 7.

In many of the other charts, the above relationship may not be evident visually but would be shown from the actual numerical values. This relationship is more evident from the regional and

national charts that appear in Appendices H and I of the full report, as these result from a much larger amount of data.

**Zero Limits.** Some of the charts show the upper and lower probability limits as zeros (Figure 8). Such instances represent years when no data were reported. The charts for the EPA Regions and the nation show similar patterns and

95% Probability Limits 81-86  
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Reg: 04  
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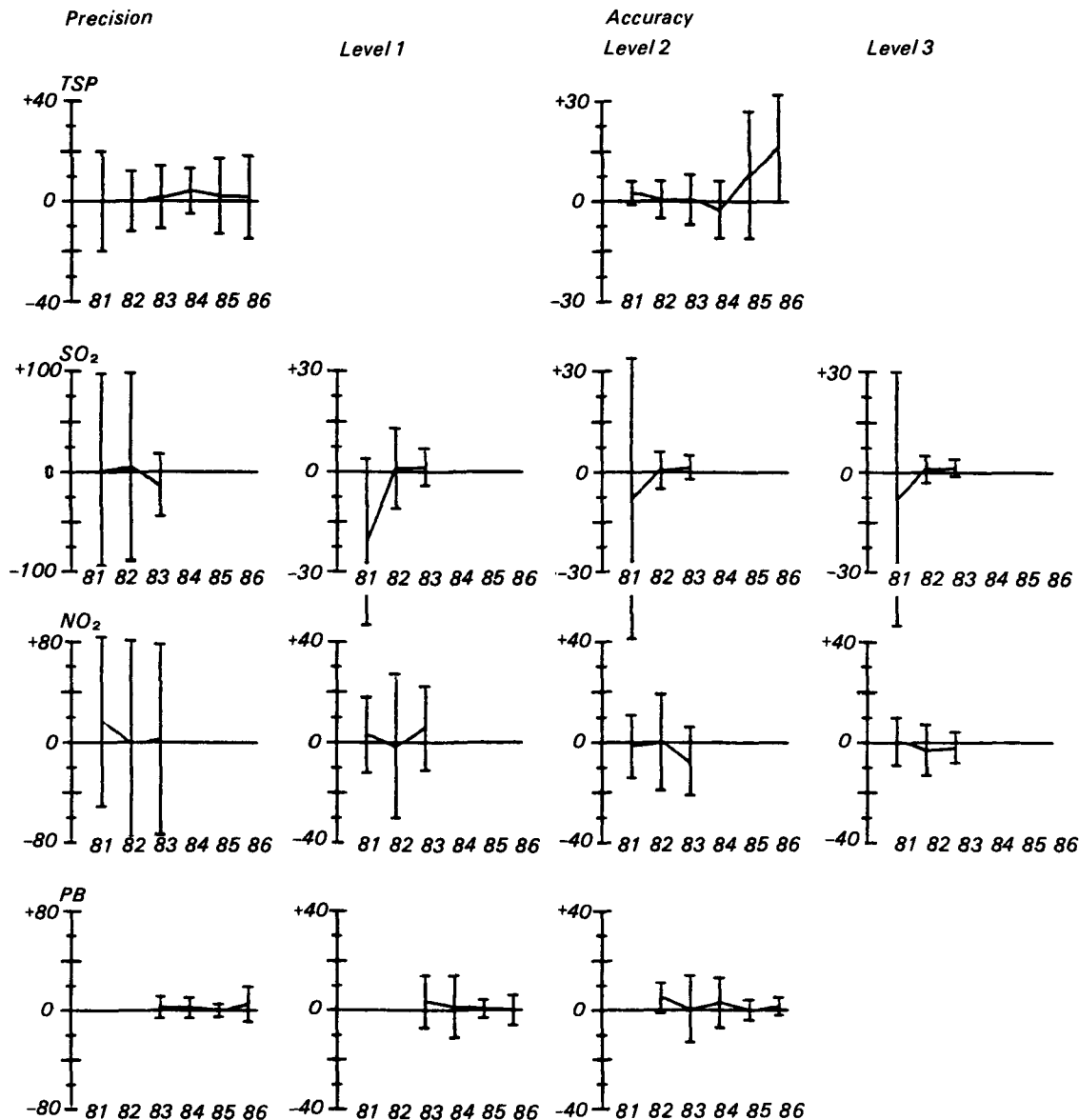


Figure 2. Example graphs for a reporting organization, manual method results.

trends as discussed above for reporting organizations.

**Control Charts for Precision and Accuracy Data**

The importance of the originating agencies preparing and maintaining control charts for each site in a timely manner is emphasized. Reference is

made to EPA/600/4-83/023, *Guideline on the Meaning and Use of Precision and Accuracy Data Required by the 40 CFR Part 58, Appendices A and B*, June 1983, which provided instructions on the preparation of the control charts. Examples of such charts are included in the State of Florida's quarterly quality assurance report. Sample copies of

Florida's report can be obtained or written request to:

Mr. Don Stuart, Administrator  
Quality Assurance Section  
Bureau of Air Quality Management  
Twin Towers Office Building  
2600 Blair Stone Road  
Tallahassee, Florida 32399-2400

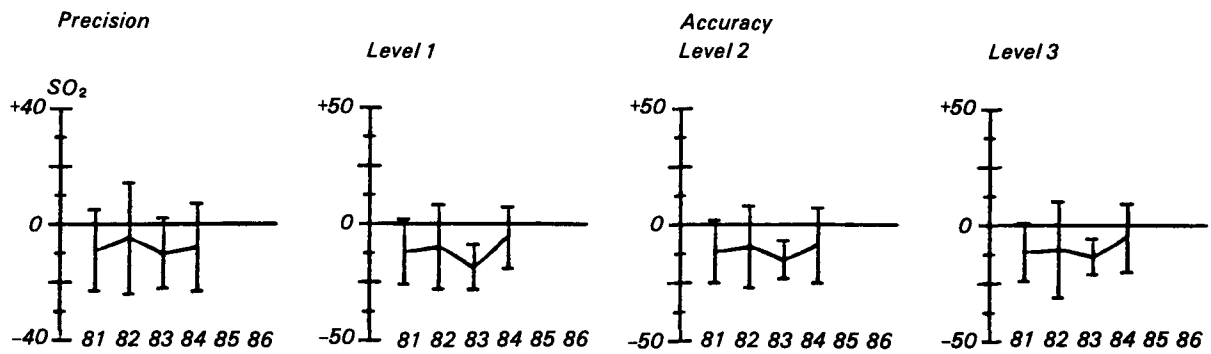


Figure 3. Example of negative bias reported for SO<sub>2</sub> continuous method.

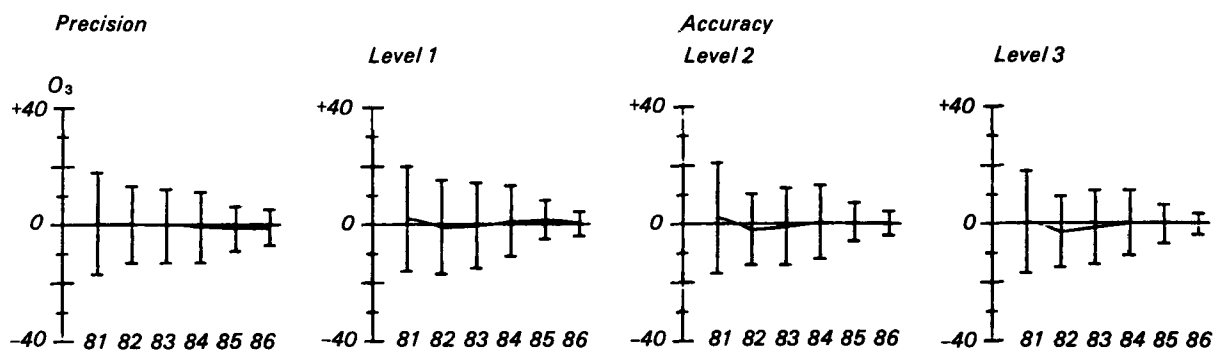


Figure 4. Example of improvement in precision and accuracy over time.

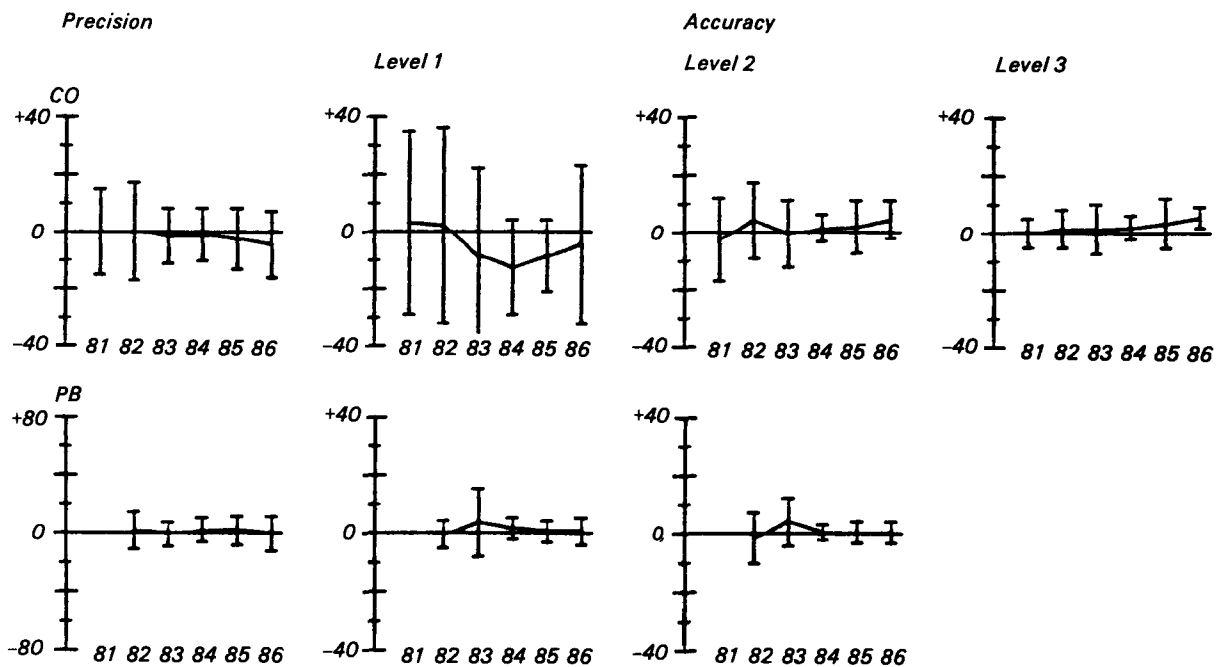


Figure 5. Examples of consistently wide and narrow probability limits.

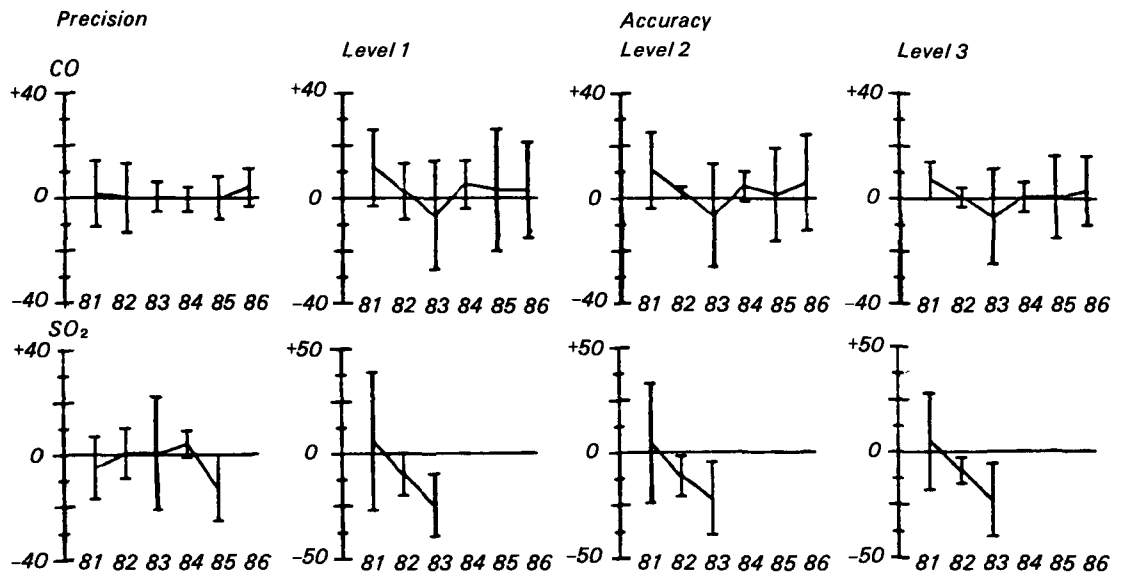


Figure 6. Examples of graphs showing results that vary considerably in a similar pattern from year to year.

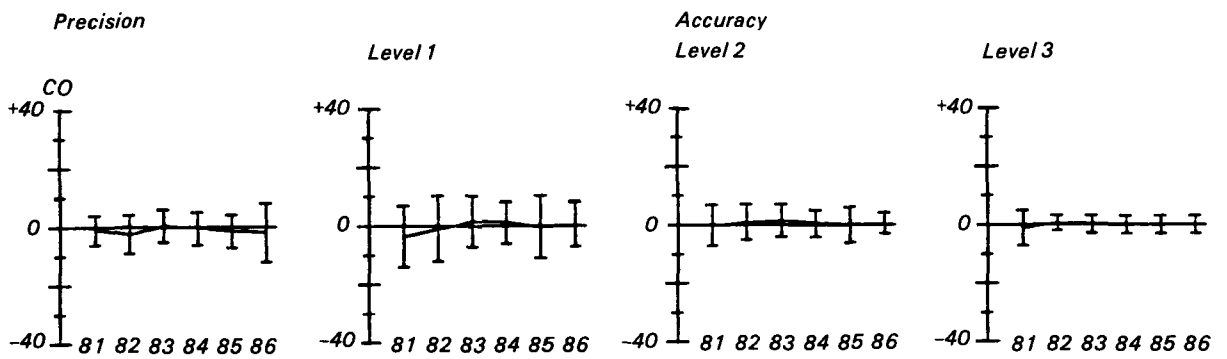


Figure 7. Example graphs showing decreasing limits with increasing accuracy levels.

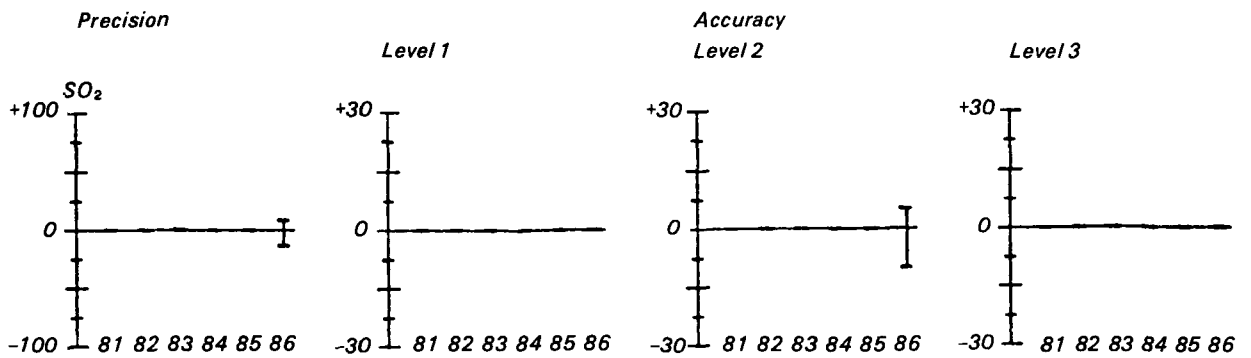


Figure 8. Example graphs for years when no data were reported.

Several examples are given below  
 Figure 9 shows a definite bias between the two collocated TSP samplers during the first and second quarters of 1987

Figure 10 reveals a significant shift in the bias from the first to the second quarter of 1987.

A definite improvement in the uniformity of the precision check results for the ozone results is evident from Figure 11.

### Conclusions and Recommendations

The charts in the appendices of the full report show in graphical form the yearly results of precision checks and accuracy audits for each of the years 1981-1986 for each reporting organization in the nation and reveal a number of persistent and significant trends and relationships. A general improvement in monitoring data quality during these years is indicated. However, significant differences exist among reporting organizations and EPA Regions. These differences warrant continued investigation by the Regional Offices to further improve and make more uniform the quality of data obtained by the ambient air monitoring networks of the nation.

Recommendations are again made that quality control charts, as described and recommended in *Guideline on the Meaning and Use of Precision and Accuracy Data Required by 40 CFR Part 58, Appendices A and B*, EPA/600/4-83/023, June 1983, be prepared and maintained in a timely manner for each monitoring site to detect as soon as possible significant trends, biases, and out-of-control conditions. Corrective actions resulting from the appropriate use of control charts for the precision and accuracy data will further improve data quality.

Examples of charts maintained by the State of Florida (included in their quality assurance report) are provided to illustrate how these charts are made and used to detect significant trends and biases that should be investigated and corrected. It is recommended that all the states prepare and issue a quarterly or an annual quality assurance report similar to that issued by the State of Florida.

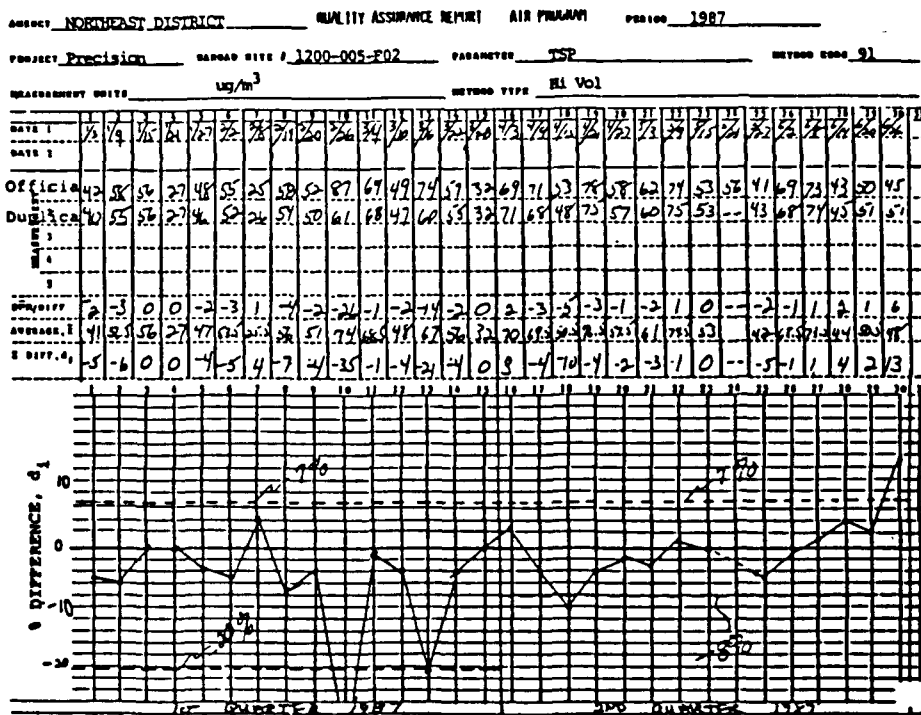


Figure 9. Results of collocated TSP samplers at a site.

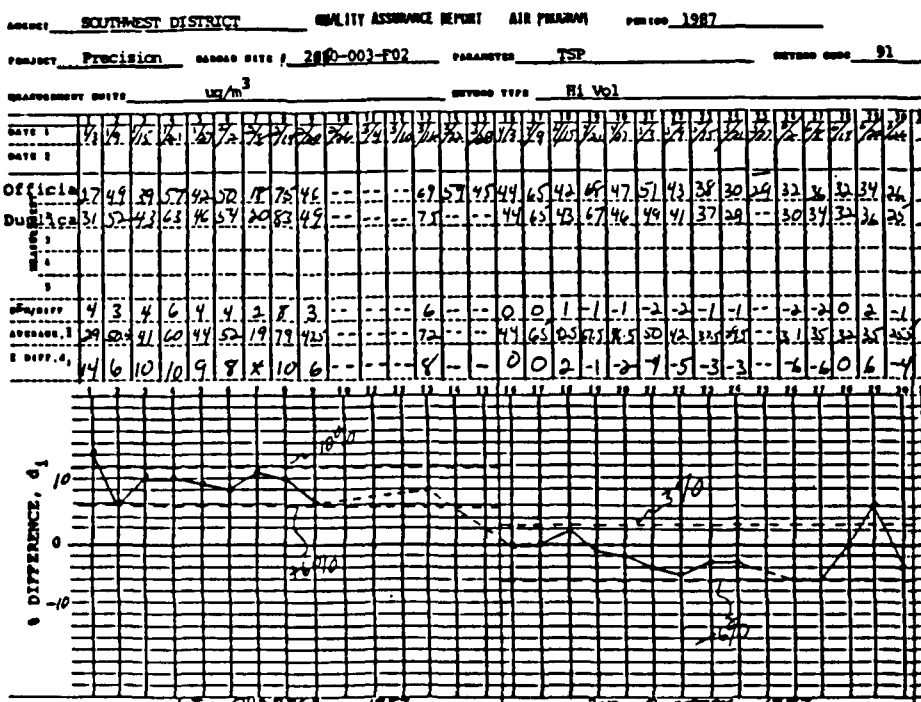


Figure 10. Results of collocated TSP samplers at a second site.

