California Environmental Protection Agency
Air Resources Board

2013
Annual Data Quality Report

Monitoring and Laboratory Division
Quality Management Branch
Primary Quality Assurance Organization

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2013

Annual Data Quality Report

California Air Resources Board's
Primary Quality Assurance Organization

Prepared by:

Quality Management Branch
Monitoring and Laboratory Division
Air Resources Board

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Executive Summary

The Code of Federal Regulations (CFR) defines the California Air Resources Board (ARB) as one of four primary quality assurance organizations (PQAO) in California responsible for monitoring air pollutants and assessing data quality. The purpose of this report is to provide ambient air quality data producers and users with a centralized review of the data quality within ARB's PQAO with respect to measurement quality objectives (MQO).

The MQO's reviewed include data capture (amount of ambient data reported), precision (the degree of mutual agreement among individual measurements of the same property), bias/accuracy (the degree of agreement between an observed value and an accepted known or reference value) of gaseous criteria and particulate matter measurements, and the amount of precision and bias/accuracy data collected and reported. The criteria by which the assessments are made are mostly dictated in CFR[1] and are listed in Appendix A of this report (while Appendix B provides details on which instruments/samplers did not meet certain criteria). Where appropriate, comparisons to other PQAOs in California and the national average[2] are also made. These PQAOs include: Bay Area Air Quality Management District (BAAQMD), San Diego County Air Pollution Control District (SDCAPCD), and South Coast Air Quality Management District (SCAQMD). It is important to note that this assessment is solely based on data available in the U.S. Environmental Protection Agency's (U.S. EPA) Air Quality System (AQS). PQAOs may have collected certain precision and/or bias/accuracy data but did not upload to AQS; in some cases, that particular information was not federally required to be uploaded.

The gaseous pollutants assessed include: carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2). The ambient data capture rate represents the percentage of ambient data collected and uploaded to AQS to that of the total amount of data possible. For gaseous pollutants, one-point quality control (QC) precision checks (mostly automated) are performed by the monitoring organizations to confirm the instrument's ability to respond to a known concentration of gas. Precision represents the degree of variability among the one-point checks. The one-point checks are also used to assess bias/accuracy for each instrument. This is done by comparing the difference between the instrument response and a reference gas.

Precision for most particulate matter (PM10 and PM2.5) samplers is assessed via collocated sampling whereby two identical or equivalent samplers are operated side-by-side.[3] Bias for PM samplers is assessed by using the routine flow rate verifications performed by site operators. Note that while all PM samplers are required to undergo monthly flow rate verifications except for high-vol PM10 samplers, where quarterly flow

[1] Title 40 CFR Appendix A to Part 58, and Quality Assurance Handbook Volume II Appendix D.
[2] National average includes state, county, district, National Park Service, and tribal sites, including those in California.
[3] Collocated sampling is required for all PM samplers except continuous PM10.

checks are required, only flow rate verification data for continuous PM10 samplers are required to be uploaded to AQS. Accuracy for both gaseous instruments and PM samplers is further verified by the performance evaluation audit program using through-the-probe audit techniques on gaseous instruments and checking flow rates on particulate samplers.

Compared to the 2012 version, this report adds the ambient data capture rate, three-year averages at the PQAO level (where appropriate), and replaces the summary tables in the Executive Summary with graphical displays. In addition, to further the understanding of the PM program, detailed information on bias and precision are discussed and graphed. Lastly, a listing of all instances where an MQO was not met is included in an appendix (Appendix B).

The ambient data capture rate and the accompanying precision and accuracy data for 2013 from both gaseous instruments and PM samplers are summarized below and in Figures ES-1 through ES-10.

Gaseous Instruments

Key findings and recommendations pertaining to gaseous instruments are highlighted below.

- Ninety-six percent of the gaseous instruments operating under ARB's PQAO achieved the ambient data capture rate of at least 75 percent in 2013.
- Ninety percent of the gaseous instruments operating under ARB's PQAO reported 100 percent of the required QC checks submitted to AQS.
- CFR precision and bias/accuracy criteria (from one-point QC checks) were met at the PQAO level.
- Performance audit data indicate that, except for a few instruments, ARB's PQAO met the audit criteria. This finding is consistent with the bias information obtained from the one-point QC checks.
- These findings are consistent with those in 2012.

<u>Recommendations – Gaseous Program</u>

- Although MQOs associated with the gaseous instruments were met at the PQAO level, there were instances of analyzers not meeting the MQO (e.g. ambient data capture rate, submittal of required QC checks, etc). Monitoring agencies should investigate why these objectives were not met for each analyzer in their respective jurisdictions and develop corrective actions, if appropriate, to meet them in subsequent years.

PM Samplers

Key findings on PM are highlighted below, followed with some recommendations.

- Ninety-five percent of the particulate samplers operating under ARB's PQAO achieved the ambient data capture rate of at least 75 percent in 2013.

- Similar to 2012, ARB's PQAO is short of meeting the required number of collocated sampling sites for one or more methods of collecting PM in 2013. A detailed assessment of this can be found in ARB's *Annual Monitoring Network Report for Twenty-three Districts in California.*[4]

- For the eleven pairs of collocated PM2.5 samplers that were present within ARB's PQAO in 2013, ten reported 100 percent of the required precision data. This is an improvement from 2012, where eight of eleven reported complete precision data.

- For the PM collocated data that were collected and reported, ARB's PQAO met the precision criteria for PM10, but was unable to meet it for PM2.5 for three of the methods used in the network. However, compared to 2012, when none of the methods met the criteria for PM2.5, the coefficient of variation (CV) values dropped considerably for three of the methods, indicating some improvement in PM2.5 precision.

- Although there is no specific MQO for bias between collocated PM samplers, an assessment of bias between collocated PM samplers was performed and showed some unusually high values.

- Flow rate verifications are required to be performed on all PM samplers, but only those from continuous PM10 are required to be uploaded. Data from several continuous PM10 samplers from ARB, Mendocino County Air Pollution Control District, and Mojave Desert Air Quality Management District were missing in AQS for 2013. Similar problems existed in 2012.

- The audit accuracy data indicates that except for two cases, ARB's PQAO met ARB criteria for flow rate audits. This finding is consistent with the limited bias information that can be ascertained from the routine flow rate verification data available in AQS.

<u>Recommendations – PM Program</u>

- ARB and the local air monitoring agencies within ARB's PQAO should continue to work in collaboration to ensure that the entire ARB PQAO meets the federal

[4] http://www.arb.ca.gov/aqd/amnr/amnr.htm

collocation requirement for monitoring PM. This includes, but is not limited to, deploying additional samplers and clearly defining in AQS the primary and secondary samplers.

- An investigation into the cause(s) behind low PM2.5 precision and the large bias between some of the collocated PM2.5 samplers is encouraged.

- Air monitoring agencies within ARB's PQAO are encouraged to upload flow rate verification data (monthly or quarterly flow checks) to U.S. EPA's AQS for all PM sampling methods. Although only data from continuous PM10 samplers are required to be uploaded, to enhance consistency in regulation and avoid any confusion, U.S. EPA is proposing to require that data on flow rate checks be uploaded to AQS for all PM sampler methods[5]. Such information would allow for a more comprehensive assessment of PM accuracy.

- Aside from the above recommendations, there were instances of samplers not meeting the MQO (e.g. ambient data capture rate, submittal of required collocated measurements, etc). Monitoring agencies should investigate why these objectives were not met for each sampler in their respective jurisdictions and develop corrective actions, if appropriate, to meet them in subsequent years.

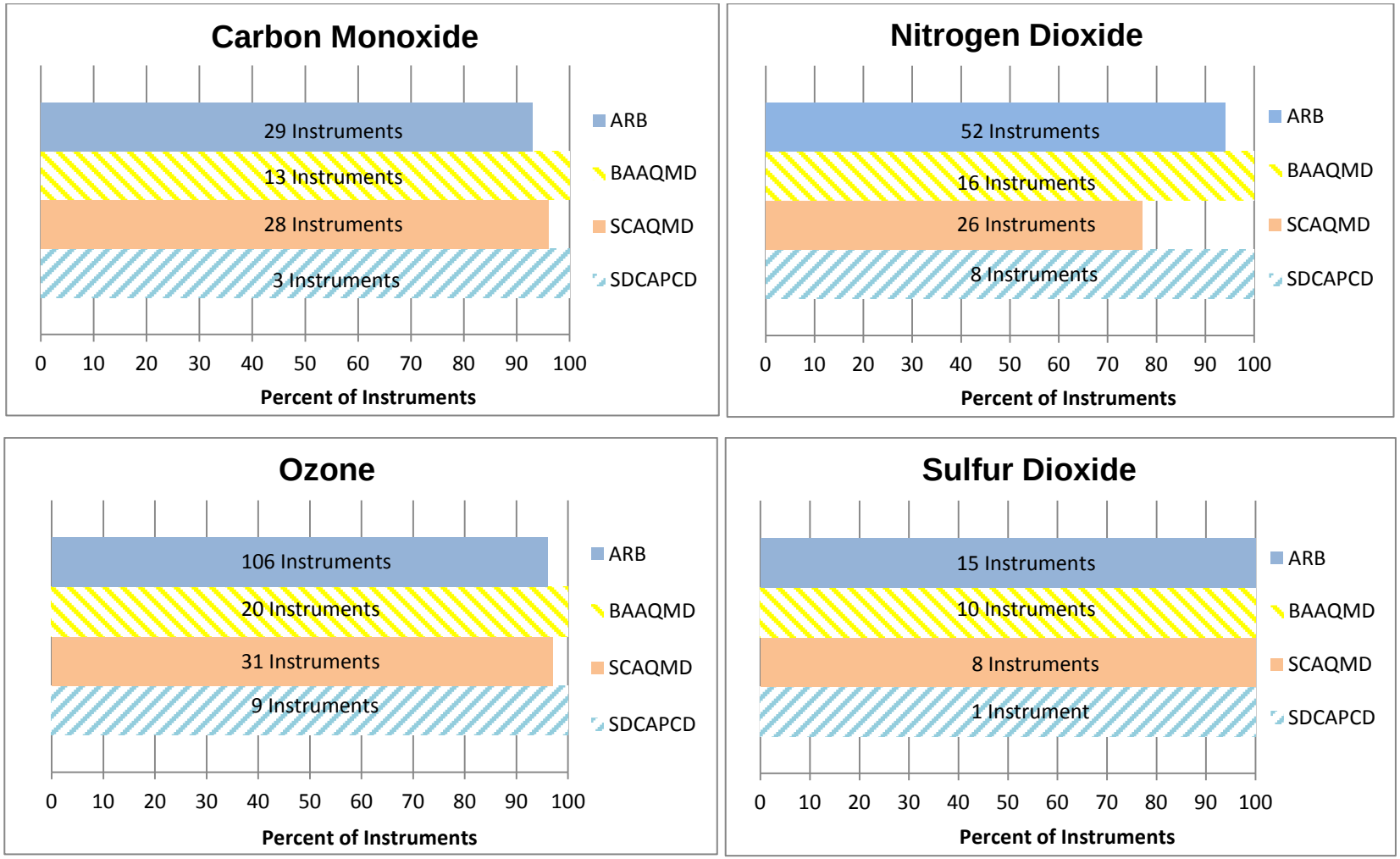
The statistics reported herein are intended as assessment tools for the data producers and users to identify areas where program improvements can be made to achieve all MQOs set by U.S. EPA or the data producers themselves. Although CFR criteria for precision and accuracy are generally applied and evaluated at the PQAO level, assessments at the district or site level may differ and can be important as well. However, it is important to note that when certain CFR criteria are not met, it does not necessarily mean that the corresponding air quality data should not be used, but rather, the data should be used with the knowledge of the quality behind it. The 2013 ambient data in AQS for ARB's PQAO have been certified and are considered suitable for comparison to federal standards.

In addition, data producers are encouraged to assess their monitoring networks to ensure that AQS accurately reflects the number of sites/samplers operating and that all required ambient, precision, and accuracy data collected are continually reported to AQS in a timely manner (within 90 days of the end of each quarter per CFR).

[5] http://www.gpo.gov/fdsys/pkg/FR-2014-09-11/pdf/2014-19758.pdf

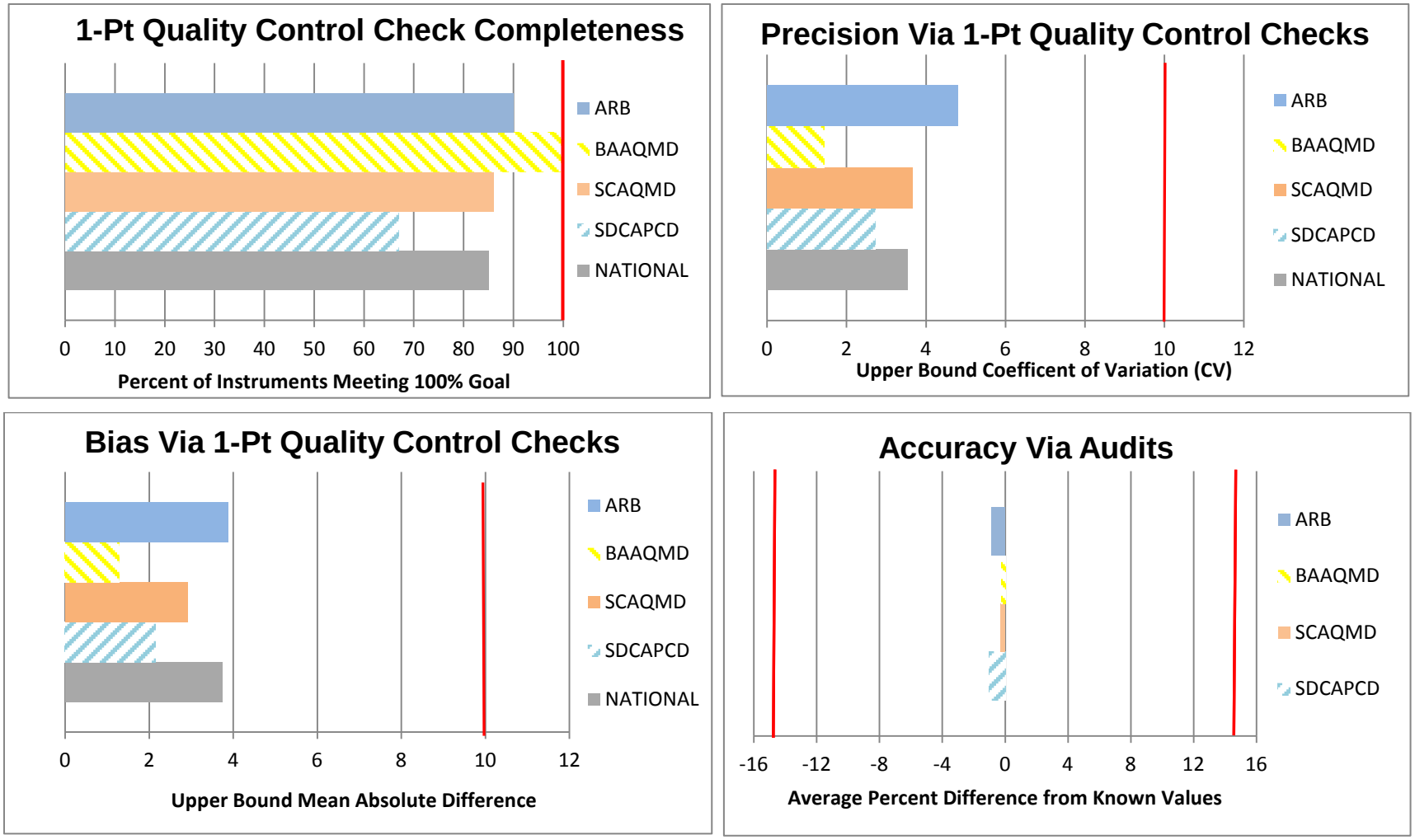
Figure ES-1. Percent of Gaseous Instruments Meeting Seventy-Five Percent Ambient Data Capture Rate

(Total Instruments in Network Indicated on Bars)



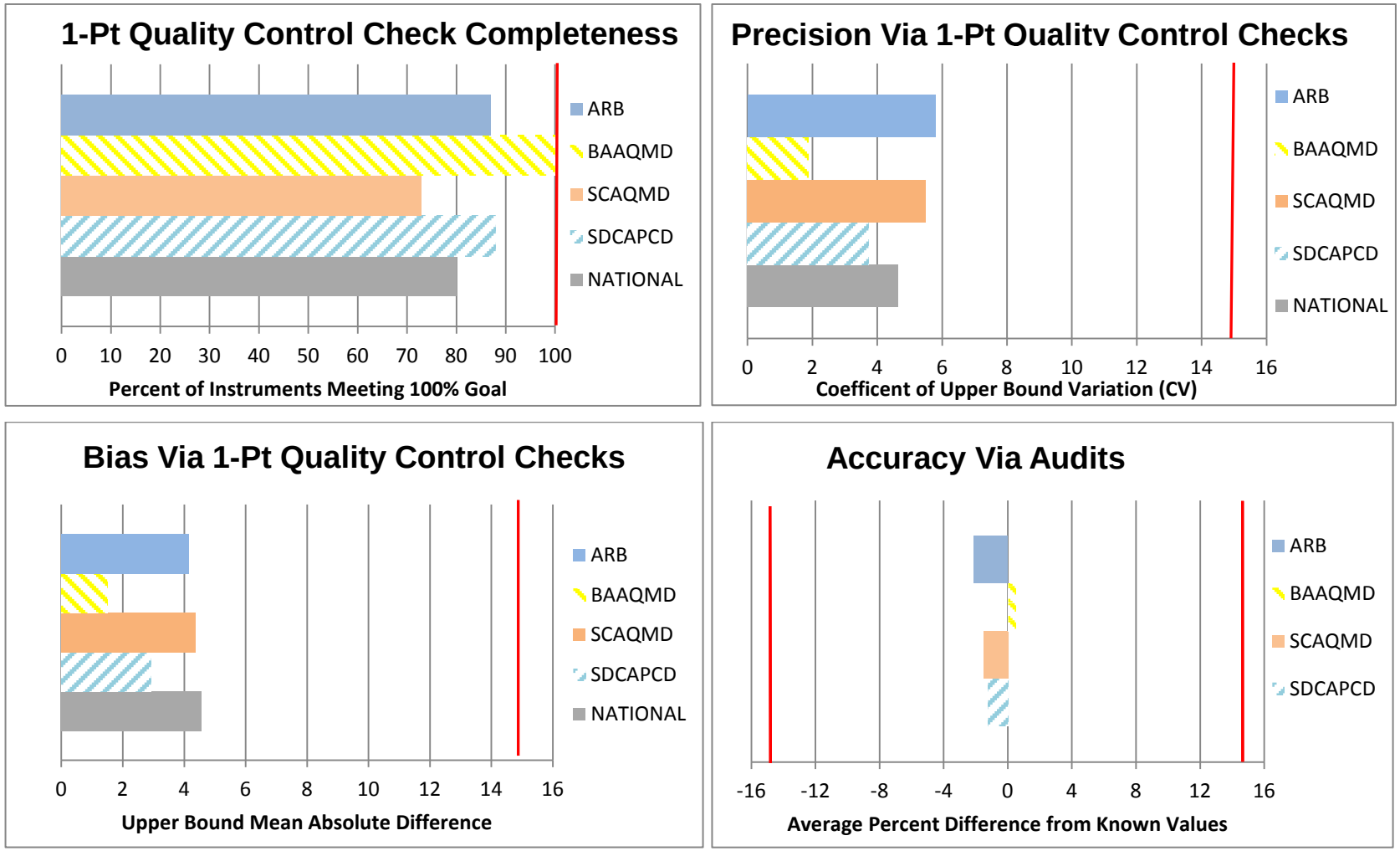
- Source: Air Quality System, AMP 430 Data Completeness Report, run December 11, 2014.

Figure ES-2. 2013 Precision and Bias/Accuracy Results – Carbon Monoxide (CO)



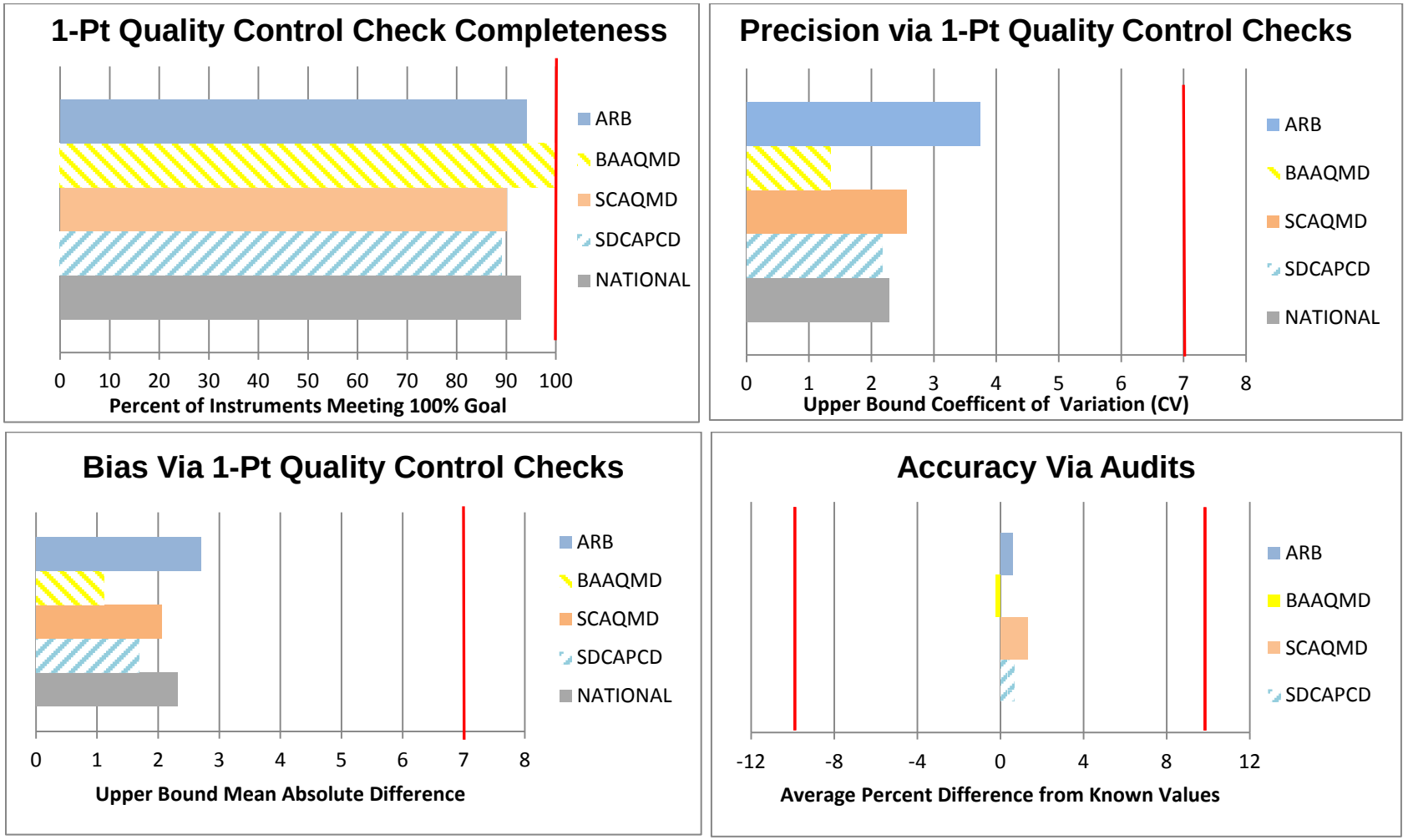
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 11, 2014.
- National average includes state, county, district, National Park Service, and tribal sites, including those in California; AMP 256 Data Quality Indicator Report, run December 11, 2014.
- The 2013 CFR limit for precision and bias were ±10% for CO. Further details on instruments not meeting these criteria can be viewed in Appendix B.
- The ARB performance audit criteria for 2013: ±15% for CO for each audit point. Only audits conducted by ARB were subjected to the AQDA process.

Figure ES-3. 2013 Precision and Bias/Accuracy Results – Nitrogen Dioxide (NO_2)



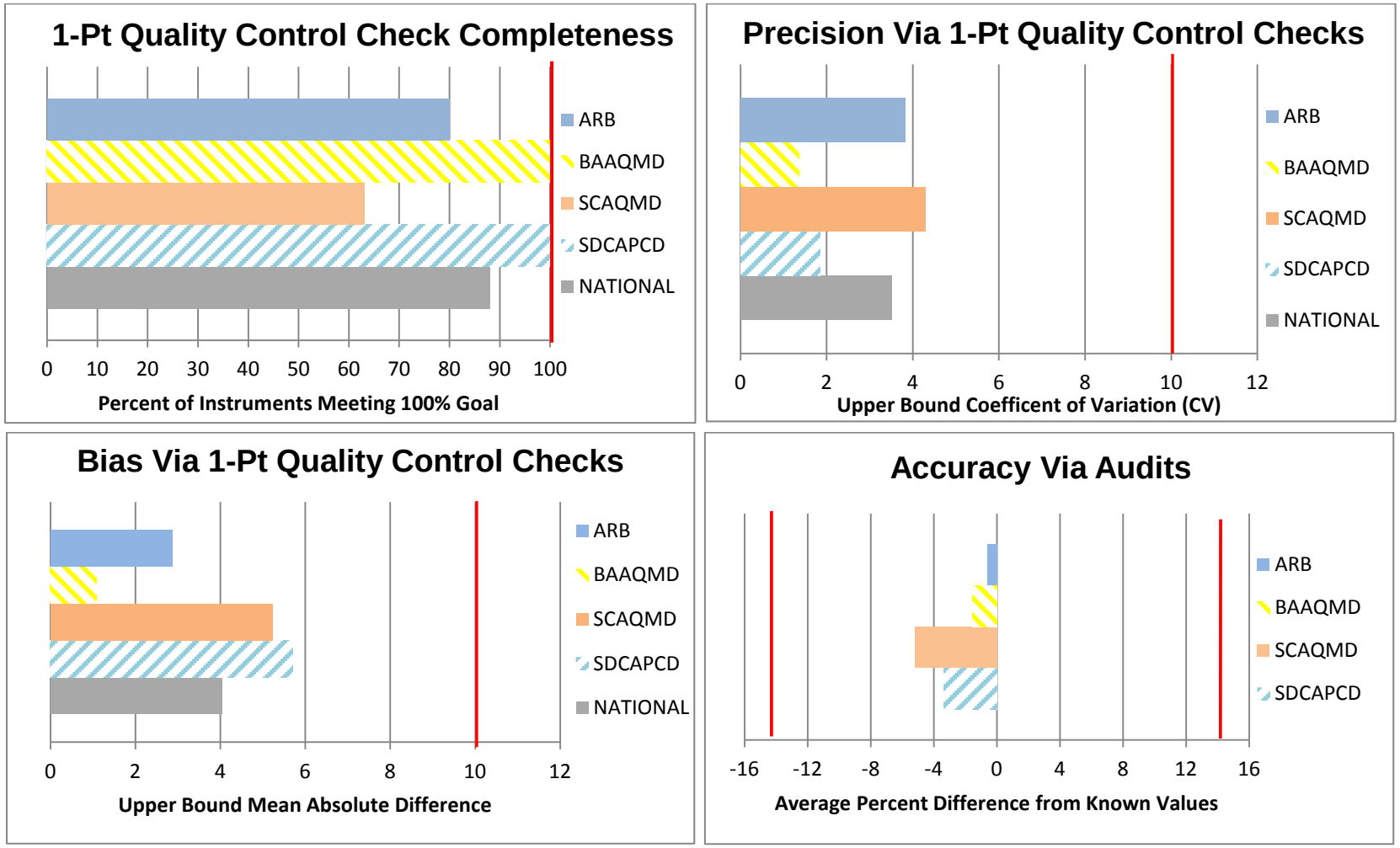
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 11, 2014.
- National average includes state, county, district, National Park Service, and tribal sites, including those in California; AMP 256 Data Quality Indicator Report, run December 11, 2014.
- The 2013 CFR limit for precision and bias was ±15% for NO_2. Further details on instruments not meeting these criteria can be viewed in Appendix B.
- The ARB performance audit criteria for 2013: ±15% for NO_2 for each audit point. Only audits conducted by ARB were subjected to the AQDA process.

Figure ES-4. 2013 Precision and Bias/Accuracy Results – Ozone (O_3)



- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 11, 2014.
- National average includes state, county, district, and tribal sites, including those in California; AMP 256 Data Quality Indicator Report, run December 11, 2014.
- The 2013 CFR limit for precision and bias was ± 7% for O_3. Further details on instruments not meeting these criteria can be viewed in Appendix B.
- The ARB performance audit criteria for 2013: ± 10% for O_3 for each audit point. Only audits conducted by ARB were subjected to the AQDA process.

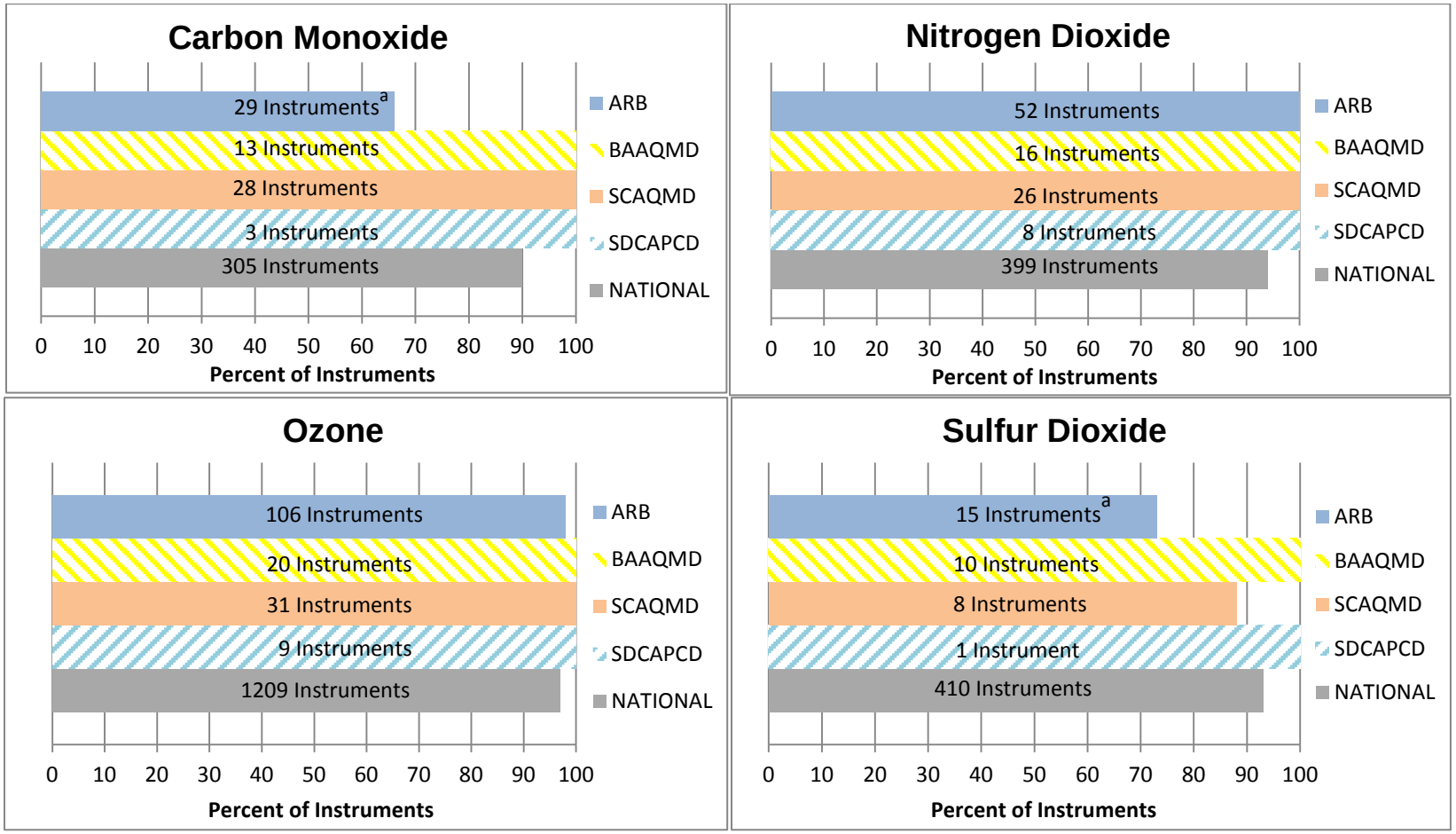
Figure ES-5. 2013 Precision and Bias/Accuracy Results – Sulfur Dioxide (SO_2)



- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 11, 2014.
- National average includes state, county, district, National Park Service, and tribal sites, including those in California; AMP 256 Data Quality Indicator Report, run December 11, 2014.
- The 2013 CFR limit for precision and bias was ± 10% for SO_2. Further details on instruments not meeting these criteria can be viewed in Appendix B.
- The ARB performance audit criteria for 2013: ± 15% for SO_2 for each audit point. Only audits conducted by ARB were subjected to the AQDA process.

Figure ES-6. Percent of Gaseous Instruments Meeting the Required Number of Performance Audits

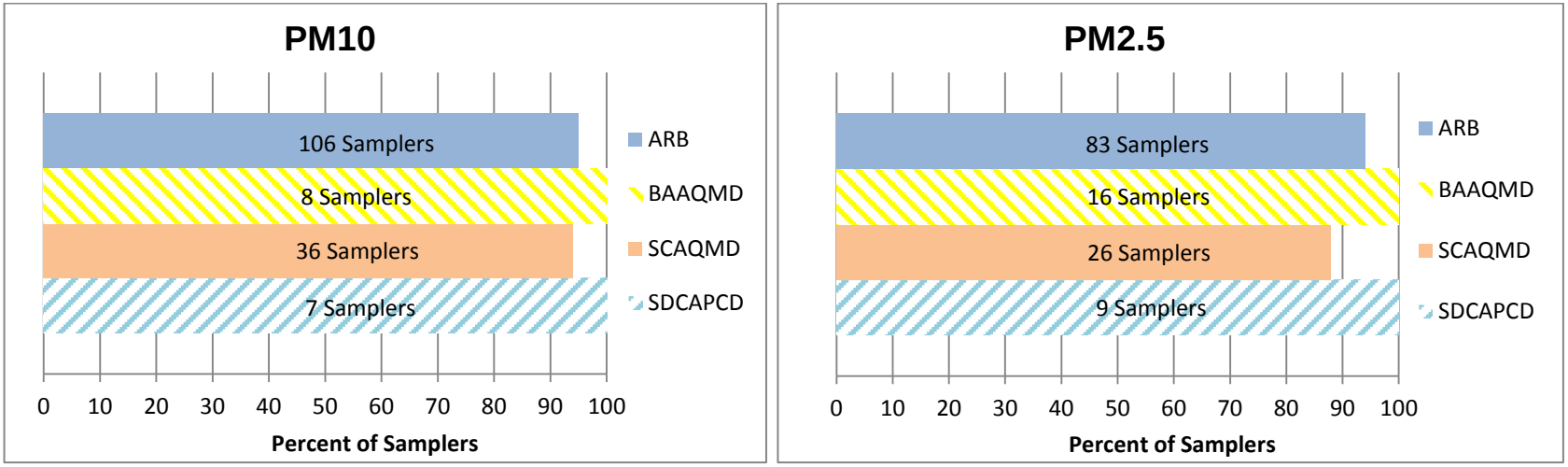
(Total Instruments in Network Indicated on Bars)



- [a] ARB was unable to conduct performance audits of trace-level instruments in 2013; these audits are expected to commence by the third quarter of 2014. Actual number of trace-level instruments for ARB's PQAO: ten for CO and four for SO_2.
- CFR requires that gaseous instruments be audited once per year. Further details on instruments not meeting these criteria can be viewed in Appendix B.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 11, 2014.
- National average includes state, county, district, National Park Service, and tribal sites, including those in California; AMP 256 Data Quality Indicator Report, run December 11, 2014.

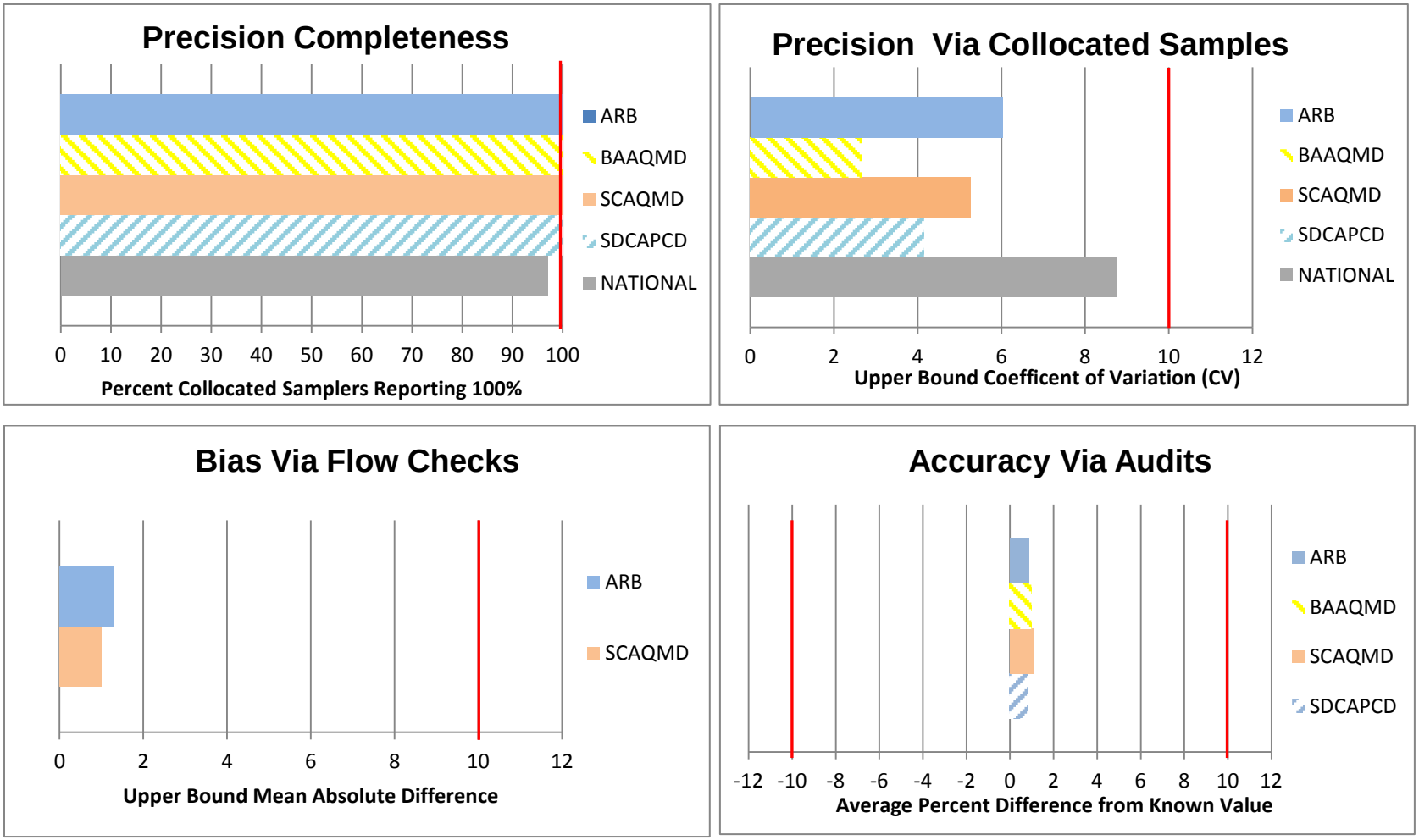
Figure ES-7. Percent of Particulate Samplers Meeting Seventy-Five Percent Ambient Data Capture Rate

(Total Samplers in Network Indicated on Bars)



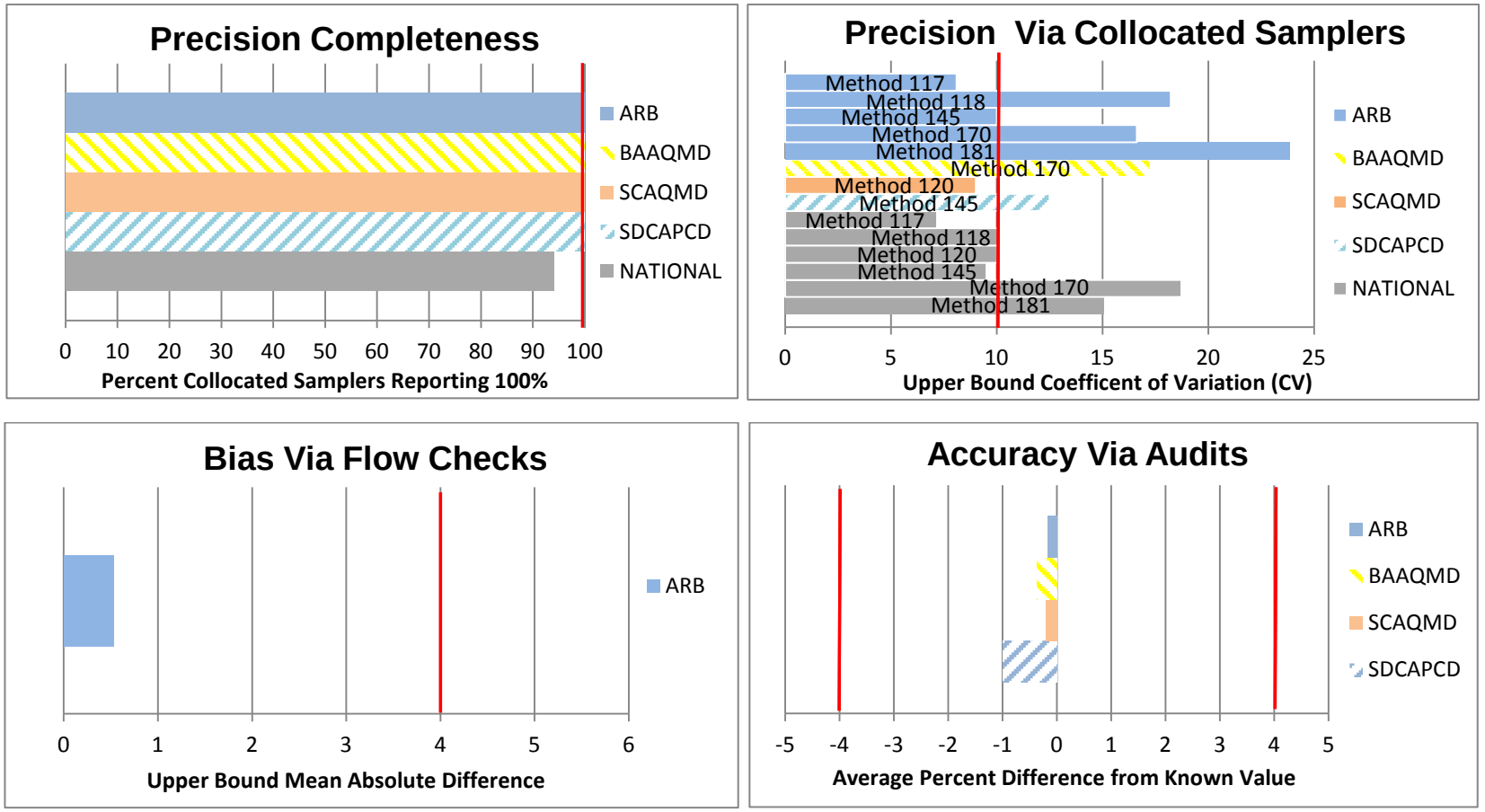
- Source: Air Quality System, AMP 430 Data Completeness Report, run December 11, 2014.

Figure ES-8. 2013 Precision and Bias/Accuracy Results – PM10



- Precision for manual PM10 samplers is based on collocated samples; bias criteria for both manual and continuous samplers are based on mandatory flow checks. However, only continuous PM10 flow checks are required to be reported to AQS. Specific criteria can be found in Section III and Appendix A.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 11, 2014. Further details on samplers not meeting criteria can be viewed in Appendix B.
- National average includes state, county, district, National Park Service, and tribal sites, including those in California; AMP 256 Data Quality Indicator Report, run December 11, 2014.
- ARB's performance audit criteria for 2013: ±10% for PM10. Only audits conducted by ARB were subjected to the AQDA process.

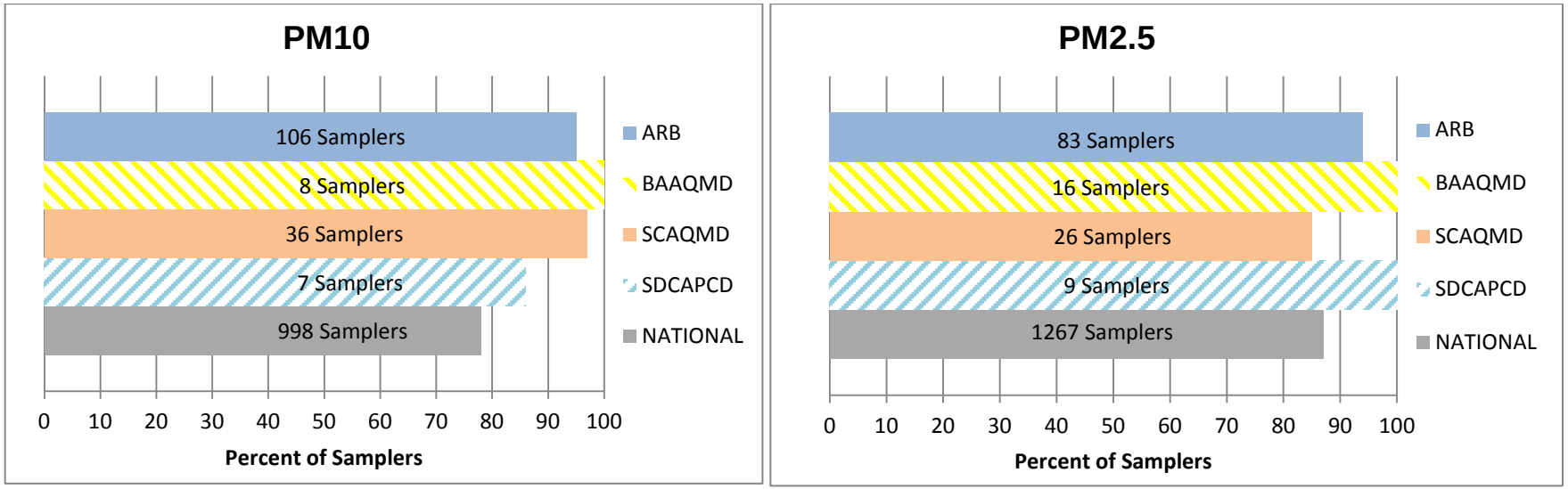
Figure ES-9. 2013 Precision and Bias/Accuracy Results – PM2.5



- PM2.5 precision criteria are based on collocated measurements; PM2.5 bias criteria are based on flow checks (only flow rate checks from continuous PM10 are required to be reported to AQS). Specific criteria can be found in Section III and Appendix A. Further details on samplers not meeting criteria can be viewed in Appendix B.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 11, 2014.
- National average includes state, county, district, National Park Service, and tribal sites, including those in California; AMP 256 Data Quality Indicator Report, run December 11, 2014.
- Method 117 = R & P Model 2000 PM2.5 Sampler w/WINS; Method 118= R & P Model 2025 PM2.5 Sequential w/WINS; Method 120= Andersen RAAS2.5-300 PM2.5 SEQ w/WINS; Method 145= R & P Model 2025 PM2.5 Sequential Air Sampler w/VSCC; Method 170= Met One BAM-1020 Mass Monitor w/VSCC; Method 181= Thermo TEOM 1400a FDMS.
- ARB's performance audit criteria for 2013: ±4% for PM2.5. Only audits conducted by ARB were subjected to the AQDA process.

Figure ES-10. Percent of PM Samplers Meeting the Required Number of Performance Audits

(Total Samplers in Network Indicated on Bars)



- The number of audits required per year: two if sampler is operating for more than seven months, one if less than seven months but more than three months, zero if less than three months. Further details on samplers not meeting criteria can be viewed in Appendix B.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 11, 2014.
- National average includes state, county, district, National Park Service, and tribal sites, including those in California; AMP 256 Data Quality Indicator Report, run December 11, 2014.

I. INTRODUCTION

The California Air Resources Board (ARB) is the governmental agency delegated under State law with the authority and responsibility for collecting ambient air quality data as directed by the federal Clean Air Act of 1977 and Clean Air Act Amendments of 1990. ARB and local air pollution control agencies operate ambient monitoring stations throughout the State. As stated in the Code of Federal Regulations (CFR), the U.S. Environmental Protection Agency (U.S. EPA) has defined ARB as the Primary Quality Assurance Organization (PQAO) for all of California with the exception of the Bay Area Air Quality Management District (BAAQMD), the South Coast Air Quality Management District (SCAQMD), and the San Diego County Air Pollution Control District (SDCAPCD). In addition, the National Park Service (NPS) is its own PQAO at the national level; unlike in previous years, this report will not discuss NPS as a PQAO.

A PQAO is a local air district or a coordinated aggregation of such organizations that is responsible for a set of stations that monitors the same pollutants and for which data quality assessments can logically be pooled. Each criteria pollutant sampler/monitor at a monitoring station in the State and Local Air Monitoring Station (SLAMS) Network must be associated with one, and only one, PQAO.[6]

Factors defining a PQAO include:

- Operation by a common team of field operators according to a common set of procedures.
- Use of a common quality assurance project plan or standard operating procedures.
- Common calibration facilities and standards.
- Oversight by a common quality assurance organization.
- Support by a common management, laboratory, or headquarters.

The purpose of this report is to provide ambient air quality data producers and users with a centralized review of the data quality within ARB's PQAO. Specifically, data from instruments measuring criteria gaseous and particulate pollutants are compared to measurement quality objectives (MQO). Where appropriate, comparisons to the national average and other PQAOs in California are also made. (The national average includes agencies defined as "state," "county," "district," "National Park Service," or "tribal.") In addition, when auditing gaseous and particulate samplers, ARB also conducts performance audits of meteorological sensors (if present). Details on such audits can be found in Appendix C of this report.

[6] Samplers may also be identified as Special Purpose Monitors (SPM) or Industrial (ID) monitors. SPM and ID monitors are also subject to the same CFR criteria as SLAM monitors. The statistics reported in this report are predominantly the result of SLAM monitors but also include a small number of SPM and ID monitors as well.

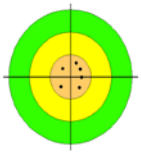
II. QUALITY ASSURANCE

Quality assurance is an integrated system of management activities that involves planning, implementing, assessing, and assuring data quality through a process, item, or service that meets users' needs for quality, completeness, and representativeness. Known data quality enables users to make judgments about compliance with air quality standards, air quality trends, and health effects based on sound data with a known level of confidence.

Quality assurance is composed of two main activities: quality control (QC) and quality assessment. QC is composed of a set of internal tasks performed routinely at the instrument level that ensures accurate and precise measured ambient air quality data. QC tasks address sample collection, handling, analysis, and reporting. Examples include calibrations, routine service checks, chain-of-custody documentation, duplicate analyses, development and maintenance of standard operating procedures, and routine preparation of QC reports.

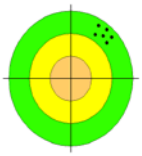
Quality assessment is a set of external, quantitative tasks that provide certainty that the QC system is satisfactory and that the stated quantitative programmatic objectives for air quality data are met. Staff independent of data generators performs these external tasks, which include conducting regular performance audits, on-site system audits, inter-laboratory comparisons, and periodic evaluations of internal QC data.

The objective of quality assurance is to provide accurate and precise data, minimize data loss due to malfunctions, and to assess the validity of the air monitoring data to provide representative and comparable data of known precision and accuracy. The illustration to the right shows the relationship between precision and accuracy.

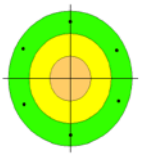


Good
Precision and Accuracy

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. It is a random component of error and is estimated by various techniques using some derivation of the standard deviation.



Precision Good
Accuracy Poor



Accuracy Good
Precision Poor

Bias is the systematic or persistent distortion of a measurement process which causes error in one direction. It is determined by estimating the positive and negative deviation from the true value as a percentage of the true value. When a certain bias is detected, the measurement process is said to be

"inaccurate." The term "bias" is used to describe accuracy in CFR.[7] In this report, the two terms are used interchangeably.

Precision is based on one-point QC checks for gaseous instruments and paired measurements from collocated samplers for particulate matter (PM). For precision, the statistic is the upper bound of the coefficient of variation (CV), which reflects the highest estimate of the variability in the instrument's measurements. One-point QC checks for gaseous instruments are also used to estimate bias. For PM, bias can be estimated from flow rate verifications; however, only flow rate verifications from continuous PM10 analyzers are required to be uploaded to AQS. Available tools for assessing precision and bias are summarized in Appendix A of this report (while details on cases where the criteria for precision or bias are not met can be found in Appendix B). Detailed descriptions of the coefficient of variation and the bias estimator, including the formulae behind the calculations, can be found in Appendix D.

Accuracy of the instruments is further validated or assessed by the through-the-probe performance audits conducted via the annual performance evaluation program for gaseous pollutants or via the semi-annual flow rate audits for PM. Appendix A lists ARB's audit performance criteria, which were developed to closely match the National Performance Audit Program.[8]

Consistent with the goals of assessing precision and accuracy of the instruments/samplers, this report also assesses the amount of ambient air quality data produced by the instruments or samplers. Depending on the sampling frequency of each respective instrument or sampler, data capture is compiled as a percentage of the ambient data collected over the total amount of data possible.

Air Quality Data Actions (AQDA) are a key tool used by the Quality Management Branch (QMB) of the Monitoring and Laboratory Division to identify and correct issues which would adversely affect the quality of the ambient data generated by the samplers. An AQDA is initiated by ARB auditors upon a failed audit or when siting and/or temperature conditions are not met. After an AQDA has been issued, an investigation into the causes of the failure will determine an outcome on the affected data. The data in question can be affected in three ways: released, corrected, or invalidated. Data that are released meet compliance criteria and can be used in all aspects of decision making. In some cases, data are flagged with qualifier codes as they are released. Corrected data pertains to when a calculated correction value is applied, rendering the data as meeting the established control criteria. Invalidated data are considered not for record, meaning the data set will not be utilized in any designation, enforcement, or regulatory decisions. As such, null codes are associated with invalidated data. Outside of the AQDA process, data could also be flagged if monitoring agencies determined that

[7] http://www.ecfr.gov/cgi-bin/retrieveECFR?gp=1&SID=cd262bfedc5072c4808c47832bf484bb&ty=HTML&h=L&n=40y6.0.1.1.6&r=PART#40:6.0.1.1.6.7.1.3.34

[8] http://www.epa.gov/ttn/amtic/files/ambient/npap/NPAPQAPPrvsn012709onforTTP.pdf

the collected data were influenced by an exceptional or natural event. Additionally, there are informational flags that do not impact the usage of the data.

The implementation of a comprehensive corrective action system throughout ARB's PQAO is an essential component for improving data quality and facilitating continuous process improvement. To meet this need, QMB implemented the Corrective Action Notification (CAN) process in late 2012. The CAN process documents issues that impact, or potentially impact, data quality, completeness, storage, or reporting. The goal of the CAN process is to investigate, correct, and reduce the recurrence of these issues. As such, the CAN process will identify issues not addressed by AQDAs, improve data quality, and help ensure compliance with state, federal, and local requirements.

ARB's Quality Assurance Program is outlined in a six-volume Quality Assurance Manual, which guides the operation of the quality assurance programs used by ARB, local air districts, and private industry in California. The six-volume Quality Assurance Manual is available at http://www.arb.ca.gov/aaqm/qa/qa-manual/qa-manual.htm.

There are more than 250 air monitoring sites among the four California PQAOs in 15 separate air basins operating in California. Within ARB's PQAO, there are 21 local air districts operating sites under ARB's guidance. Information about each air monitoring station audited by QMB is available at http://www.arb.ca.gov/qaweb/.

III. DATA QUALITY - STATISTICAL SUMMARY RESULTS

The results are presented for two groups of pollutants: gases and particulate matter. For each group, the amount of ambient data collected (or captured) is discussed first, followed with an assessment of the quality behind the data.

A. Gaseous Criteria Pollutants

The gaseous pollutants assessed in this report are carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2).

Ambient Data Capture: Data capture, as described in this report, is derived from the AQS completeness report AMP 430. The calculated number in AMP 430 represents the average of the monthly data capture rates for the calendar year and may not always be indicative of whether the 75 percent regulatory completeness requirement[9] is met for a

[9] 40 CFR Part 50 states that the ambient data from a given instrument or sampler, in a calendar year, must be at least 75% complete to be included in making regulatory decisions, such as determinations of attainment of the ambient air quality standards. The State of California defines data "completeness" in a similar way, also using 75 percent as its criteria. However, unlike the federal definition, the State requirement factors in the high season of the pollutant in the completeness criteria (e.g. only months within the high ozone season are considered for ozone standard).

particular pollutant. Note that while this report discusses the data capture rate of at least 75% percent, ARB's goal is 85% or more.

Table A1 presents the percentage of instruments that reported at least 75 percent of the possible ambient data for each gaseous pollutant for each PQAO. Table A2 displays similar information for ARB and each local air district operating within ARB's PQAO. As shown in the tables, very few instruments within ARB's PQAO reported a data capture rate of less than 75 percent.

Table A1. 2013 Ambient Gaseous Pollutant Data Capture Results

Pollutant	PQAO	# of Instruments	# of Instruments Reporting ≥ 75% Ambient Data Capture	# of Instruments Reporting < 75% Ambient Data Capture	% of Instruments Reporting ≥ 75% Ambient Data
CO	ARB	29	27	2	93
	BAAQMD	13	13	0	100
	SCAQMD	28	27	1	96
	SDCAPCD	3	3	0	100
NO_2	ARB	52	49	3	94
	BAAQMD	16	16	0	100
	SCAQMD	26	20	6	77
	SDCAPCD	8	8	0	100
O_3	ARB	106	103	3	97
	BAAQMD	20	20	0	100
	SCAQMD	31	30	1	97
	SDCAPCD	9	9	0	100
SO_2	ARB	15	15	0	100
	BAAQMD	10	10	0	100
	SCAQMD	8	8	0	100
	SDCAPCD	1	1	0	100

- Further details on instruments not reporting ≥ 75% ambient data can be viewed Appendix B.
- Source: Air Quality System, AMP 430 Data Completeness Report, run December 11, 2014.

Table A2. 2013 Ambient Gaseous Pollutant Data Capture Results for Local Air Districts Within ARB's PQAO

Pollutant	District Name	# of Instruments	# of Instruments Reporting ≥ 75% Ambient Data	% of Instruments Reporting ≥ 75% Ambient Data
CO	Antelope Valley AQMD	1	1	100
	Butte County AQMD	1	1	100
	Imperial County APCD	3	3	100
	Mojave Desert AQMD	2	1	50
	Monterey Bay Unified APCD	1	1	100
	North Coast Unified AQMD	2	2	100
	Sacramento Metropolitan AQMD	4	4	100
	San Joaquin Valley Unified APCD	9	8	89
	Santa Barbara County APCD	6	6	100
NO_2	Antelope Valley AQMD	1	1	100
	Butte County AQMD	1	1	100
	Feather River AQMD	1	1	100
	Imperial County APCD	2	2	100
	Mojave Desert AQMD	3	3	100
	Monterey Bay Unified APCD	1	1	100
	North Coast Unified AQMD	2	2	100
	Placer County APCD	1	1	100
	Sacramento Metropolitan AQMD	7	6	86
	San Joaquin Valley Unified APCD	16	14	88
	San Luis Obispo County APCD	3	3	100
	Santa Barbara County APCD	11	11	100
	Ventura County APCD	2	2	100
	Yolo-Solano AQMD	1	1	100
O_3	Amador County APCD	1	1	100
	Antelope Valley AQMD	1	1	100
	Butte County AQMD	2	2	100
	Calaveras County APCD	1	1	100
	Colusa County APCD	1	1	100
	Eastern Kern APCD	1	1	100
	El Dorado County AQMD	3	3	100
	Feather River AQMD	2	2	100
	Glenn County APCD	1	1	100
	Imperial County APCD	4	3	75
	Lake County APCD	1	1	100
	Mariposa County APCD	1	1	100
	Mendocino County AQMD	1	0	0

Table A2 (cont'd). 2013 Ambient Gaseous Pollutant Data Capture Results for Local Air Districts Within ARB's PQAO

Pollutant	District Name	# of Instruments	# of Instruments Reporting ≥ 75% Ambient Data	% of Instruments Reporting ≥ 75% Ambient Data
O_3	Mojave Desert AQMD	6	6	100
	Monterey Bay Unified APCD	6	6	100
	North Coast Unified AQMD	2	2	100
	Northern Sierra AQMD	2	2	100
	Northern Sonoma County APCD	1	1	100
	Placer County APCD	5	5	100
	Sacramento Metropolitan AQMD	7	7	100
	San Joaquin Valley Unified APCD	23	22	96
	San Luis Obispo County APCD	7	7	100
	Santa Barbara County APCD	12	12	100
	Shasta County AQMD	3	3	100
	Siskiyou County APCD	1	1	100
	Tehama County APCD	2	2	100
	Tuolumne County APCD	1	1	100
	Ventura County APCD	5	5	100
	Yolo-Solano AQMD	3	3	100
SO_2	Imperial County APCD	2	2	100
	Mojave Desert AQMD	2	2	100
	North Coast Unified AQMD	2	2	100
	Sacramento Metropolitan AQMD	1	1	100
	San Joaquin Valley Unified APCD	1	1	100
	San Luis Obispo County APCD	1	1	100
	Santa Barbara County APCD	6	6	100

- Further details on instruments not reporting ≥ 75% ambient data can be viewed in Appendix B.
- Source: Air Quality System, AMP 430 Data Completeness Report, run December 11, 2014.

Precision and Bias: One-point QC checks (mostly automated) are performed by the monitoring organizations to confirm the instrument's ability to respond to a known concentration of gas. The degree of variability in each of these measurements is computed as the precision of that instrument's measurements. For precision, the statistic defined in Title 40, CFR Part 58 Appendix A, is the upper bound of the coefficient of variation (CV), which reflects the highest tolerable variability in the data. This CV upper bound is not to exceed 7 percent for O_3, 10 percent for CO and SO_2, and 15 percent for NO_2.

These one-point QC checks are also used to estimate the bias inherent in the sampling system associated with each instrument. Appendix A to Part 58 outlines how bias is calculated based on one-point QC checks for gaseous pollutants. The bias estimator is the upper bound on the mean absolute value of the percent differences between the instrument's response and the true value of the gas concentration. A sign (positive/negative) is applied when the 25th and 75th percentiles are of the same sign. In other words, when at least 75 percent of the differences are all positive or negative, the bias estimate has a sign. Otherwise, the bias is denoted with "±." For bias, the CFR criteria are: ±7 percent for O_3, ±15 percent for NO_2,[10] and ±10 percent for CO and SO_2. A detailed description of the bias estimator, including the formulae behind the calculations, can be found in Appendix D of this report.

Bias estimates are further verified via the through-the-probe performance audits. ARB acceptance criteria for performance audits for 2013 were: ±10 percent for O_3 (with warning at ±7 percent) and ±15 percent for CO, NO_2, and SO_2 (with warning at ±10 percent) for each audit point.

CFR requires that the one-point QC checks be performed at least once every two weeks on each automated instrument, which translates to a minimum of 26 checks per year for a instrument that operates year-round. ARB's policy is to audit 100 percent of local air districts' sites within its PQAO each year and audit non-ARB PQAO monitoring sites at least once every five years. Non-ARB PQAOs perform some audits on their own as part of the annual performance evaluation program. A complete listing of all MQOs set forth by U.S. EPA under Title 40 CFR and the Quality Assurance (QA) Handbook Volume II can be found in Appendix A of this report.

For gaseous pollutants required by 40 CFR (CO, NO_2, O_3, and SO_2), ARB's PQAO (as well as other California PQAOs) met the precision and bias criteria in 2013, as shown in Table A3. Information for years 2011 and 2012 are provided for a historical perspective. Three-year averages for each PQAO are also included. In general, 2013 precision data are consistent with those in the previous two years. In addition, the required number of QC checks was achieved at most stations. Table A3 includes the number of instruments with less than 100 percent of the required precision data reported for 2013.

[10]The MQO goal for NO_2 was established in guidance in 2006 as 10% and was updated in 2013 to 15%. The goal of 15% was established in regulation in 2010. Prior to 2010, there was no goal in regulation.

Table A3. 2011-2013 Gaseous Pollutant Instrument Precision and Bias Results

Pollutant	PQAO	Year	# of Instruments	# of Instruments with less than 100% of Required Q/C checks	Upper Bound of Coefficient of Variation	CFR Criteria for Precision Met?	Bias	CFR Criteria for Bias Met?
CO	ARB	2013	29	3	4.81	Yes	± 3.88	Yes
		2012	28	4	4.95	Yes	± 3.70	Yes
		2011	27	2	4.25	Yes	± 3.39	Yes
		Avg	-	-	4.70	Yes	± 3.61	Yes
	BAAQMD	2013	13	0	1.45	Yes	+ 1.29	Yes
		2012	13	0	1.38	Yes	+ 1.24	Yes
		2011	13	0	1.70	Yes	± 1.32	Yes
		Avg	-	-	1.50	Yes	± 1.26	Yes
	SCAQMD	2013	28	4	3.66	Yes	± 2.92	Yes
		2012	28	2	3.73	Yes	± 2.84	Yes
		2011	29	3	3.58	Yes	± 2.84	Yes
		Avg	-	-	3.62	Yes	± 2.81	Yes
	SDCAPCD	2013	3	1	2.72	Yes	± 2.15	Yes
		2012	3	0	3.21	Yes	± 2.78	Yes
		2011	3	0	4.16	Yes	± 3.00	Yes
		Avg	-	-	3.40	Yes	± 2.54	Yes
	NATIONAL	2013	305	46	3.54	Yes	± 3.73	Yes
		2012	317	43	3.74	Yes	± 3.74	Yes
		2011	323	65	3.45	Yes	± 3.61	Yes
NO_2	ARB	2013	52	7	5.80	Yes	± 4.16	Yes
		2012	52	4	5.22	Yes	± 3.91	Yes
		2011	50	5	4.95	Yes	± 3.68	Yes
		Avg	-	-	5.35	Yes	± 3.89	Yes
	BAAQMD	2013	16	0	1.89	Yes	± 1.50	Yes
		2012	16	0	1.82	Yes	± 1.46	Yes
		2011	15	0	1.92	Yes	± 1.54	Yes
		Avg	-	-	1.86	Yes	± 1.48	Yes
	SCAQMD	2013	26	8	5.50	Yes	± 4.38	Yes
		2012	26	17	4.51	Yes	± 3.76	Yes
		2011	27	1	6.42	Yes	± 4.89	Yes
		Avg	-	-	5.49	Yes	± 4.28	Yes

Table A3 (cont'd). 2011-2013 Gaseous Pollutant Instrument Precision and Bias Results

Pollutant	PQAO	Year	# of Instruments	# of Instruments with less than 100% of Required Q/C checks	Upper Bound of Coefficient of Variation	CFR Criteria for Precision Met?	Bias	CFR Criteria for Bias Met?
NO_2	SDCAPCD	2013	8	1	3.74	Yes	± 2.93	Yes
		2012	9	1	4.27	Yes	± 3.53	Yes
		2011	8	2	3.84	Yes	± 3.26	Yes
		Avg	-	-	3.87	Yes	± 3.13	Yes
	NATIONAL	2013	399	80	4.65	Yes	± 4.56	Yes
		2012	390	85	4.45	Yes	± 4.49	Yes
		2011	378	92	4.75	Yes	± 4.65	Yes
O_3	ARB	2013	106	7	3.75	Yes	± 2.70	Yes
		2012	107	9	3.73	Yes	± 2.76	Yes
		2011	106	7	3.74	Yes	± 3.02	Yes
		Avg	-	-	3.75	Yes	± 2.80	Yes
	BAAQMD	2013	20	0	1.34	Yes	± 1.11	Yes
		2012	20	0	1.55	Yes	± 1.27	Yes
		2011	19	0	1.66	Yes	± 1.29	Yes
		Avg	-	-	1.52	Yes	± 1.21	Yes
	SCAQMD	2013	31	3	2.56	Yes	± 2.06	Yes
		2012	31	4	2.49	Yes	± 2.04	Yes
		2011	32	2	3.90	Yes	± 2.57	Yes
		Avg	-	-	3.01	Yes	± 2.18	Yes
	SDCAPCD	2013	9	1	2.17	Yes	± 1.68	Yes
		2012	10	1	3.03	Yes	± 2.31	Yes
		2011	10	2	3.39	Yes	± 2.50	Yes
		Avg	-	-	2.87	Yes	± 2.10	Yes
	NATIONAL	2013	1209	85	2.27	Yes	± 2.32	Yes
		2012	1202	104	2.33	Yes	± 2.40	Yes
		2011	1199	143	2.40	Yes	± 2.48	Yes
SO_2	ARB	2013	15	3	3.82	Yes	± 2.86	Yes
		2012	14	3	4.65	Yes	± 3.73	Yes
		2011	15	3	4.34	Yes	± 3.42	Yes
		Avg	-	-	4.18	Yes	± 3.22	Yes
	BAAQMD	2013	10	0	1.35	Yes	± 1.09	Yes
		2012	10	0	1.67	Yes	± 1.26	Yes
		2011	10	0	1.61	Yes	± 1.41	Yes
		Avg	-	-	1.56	Yes	± 1.23	Yes

Table A3 (cont'd). 2011-2013 Gaseous Pollutant Instrument Precision and Bias Results

Pollutant	PQAO	Year	# of Instruments	# of Instruments with less than 100% of Required Q/C checks	Upper Bound of Coefficient of Variation	CFR Criteria for Precision Met?	Bias	CFR Criteria for Bias Met?
SO_2	SCAQMD	2013	8	3	4.30	Yes	± 5.23	Yes
		2012	8	5	5.21	Yes	± 4.20	Yes
		2011	9	2	8.32	Yes	± 5.82	Yes
		Avg	-	-	6.27	Yes	± 4.92	Yes
	SDCAPCD	2013	1	0	1.85	Yes	- 5.70	Yes
		2012	1	0	1.09	Yes	- 5.50	Yes
		2011	4	3	4.27	Yes	- 4.95	Yes
		Avg	-	-	3.20	Yes	- 5.52	Yes
	NATIONAL	2013	410	52	3.51	Yes	± 4.04	Yes
		2012	400	68	3.89	Yes	± 4.27	Yes
		2011	396	80	3.61	Yes	± 3.76	Yes

- CFR limits for precision (CV): 7% for O_3, 15% for NO_2, 10% for CO and SO_2; for bias: ± 7% for O_3, ± 15% for NO_2, ± 10% for CO and SO_2. Both are based on QC checks required to be performed every two weeks.
- Further details on instruments not meeting these criteria can be viewed in Appendix B.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 11, 2014.
- National average includes state, county, district, National Park Service, and tribal sites, including those in California; AMP 256 Data Quality Indicator Report, run December 11, 2014.

Table A4 displays precision data for each local air district within ARB's PQAO in which sites are operated, with CV averaged across sites within each district. Monitoring sites within these areas may be operated by the district, ARB, or both. As shown in the table, with the exception of one instrument in Feather River, all districts met the CV requirement and had very few instruments with less than 100 percent of required QC data reported.

In order to provide decision makers with data of known quality, U.S. EPA presents three data quality indicators in graphical format[11] on an annual basis. Appendix E lists the U.S. EPA Air Quality System (AQS) identification numbers associated with each monitoring site. U.S. EPA's graphs provide detailed information on precision (CV), bias, and the number of one-point QC checks performed at each monitoring station in California (Appendix F). As shown, all but eight instruments in ARB's PQAO met the precision and bias CFR criteria based on one-point QC checks for gaseous pollutants.

[11] http://www.epa.gov/ttn/amtic/files/ambient/qaqc/boxplots.pdf

Table A4. 2013 Gaseous Pollutant Instrument Precision Results for Local Air Districts Within ARB's PQAO

Pollutant	Geographic Area	Monitoring by (District=D, ARB=A, or Both=B)	# of Instruments	# of Instruments with less than 100% of Required QC checks	Upper Bound of Coefficient of Variation
CO	Antelope Valley AQMD	D	1	0	2.56
	Butte County AQMD	A	1	0	3.05
	Imperial County APCD	B	3	1	7.56
	Mojave Desert AQMD	D	2	0	2.78
	Monterey Bay Unified APCD	D	1	0	1.47
	North Coast Unified AQMD	D	2	2	3.54
	Sacramento Metropolitan AQMD	D	4	0	2.59
	San Joaquin Valley Unified APCD	B	9	0	2.76
	Santa Barbara County APCD	B	6	0	3.44
NO_2	Antelope Valley AQMD	D	1	0	4.18
	Butte County AQMD	A	1	0	2.48
	Feather River AQMD	A	1	0	15.37
	Imperial County APCD	B	2	1	6.00
	Mojave Desert AQMD	D	3	0	5.13
	Monterey Bay Unified APCD	D	1	0	2.06
	North Coast Unified AQMD	D	2	2	7.50
	Placer County APCD	A	1	0	3.03
	Sacramento Metropolitan AQMD	B	7	3	5.07
	San Joaquin Valley Unified APCD	B	16	0	4.51
	San Luis Obispo County APCD	D	3	0	2.95
	Santa Barbara County APCD	B	11	1	4.46
	Ventura County APCD	D	2	0	3.77
	Yolo-Solano AQMD	A	1	0	7.65
O_3	Amador County APCD	A	1	0	3.04
	Antelope Valley AQMD	D	1	0	1.48
	Butte County AQMD	A	2	0	4.46
	Calaveras County APCD	A	1	0	3.63
	Colusa County APCD	A	1	0	4.34
	Eastern Kern APCD	D	1	0	1.76
	El Dorado County AQMD	A	3	0	3.40
	Feather River AQMD	A	2	0	2.48
	Glenn County APCD	A	1	0	2.57

Table A4 (cont'd). 2013 Gaseous Pollutant Instrument Precision Results for Local Air Districts Within ARB's PQAO

Pollutant	Geographic Area	Monitoring by (District=D, ARB=A, or Both=B)	# of Instruments	# of Instruments with less than 100% of Required QC checks	Upper Bound of Coefficient of Variation
O_3	Imperial County APCD	B	4	2	6.71
	Lake County APCD	D	1	0	0.23
	Mariposa County APCD	A	1	0	4.24
	Mendocino County AQMD	D	1	1	NDA
	Mojave Desert AQMD	B	6	0	2.28
	Monterey Bay Unified APCD	D	6	0	1.75
	North Coast Unified AQMD	D	2	2	3.77
	Northern Sierra AQMD	B	2	0	1.99
	Northern Sonoma County APCD	D	1	0	1.54
	Placer County APCD	B	5	1	1.06
	Sacramento Metropolitan AQMD	B	7	1	2.63
	San Joaquin Valley Unified APCD	B	23	0	3.15
	San Luis Obispo County APCD	B	7	0	1.61
	Santa Barbara County APCD	B	12	0	3.04
	Shasta County APCD	A	3	0	1.02
	Siskiyou County APCD	D	1	0	2.86
	Tehama County APCD	B	2	0	1.30
	Tuolumne County APCD	A	1	0	3.39
	Ventura County APCD	D	5	0	1.97
	Yolo-Solano AQMD	B	3	0	3.25
SO_2	Imperial County APCD	A	2	0	2.27
	Mojave Desert AQMD	D	2	0	3.11
	North Coast Unified AQMD	D	2	2	5.02
	Sacramento Metropolitan AQMD	D	1	0	4.40
	San Joaquin Valley Unified APCD	A	1	0	2.25
	San Luis Obispo County APCD	B	1	0	1.86
	Santa Barbara County APCD	D	6	1	3.20

- NDA= No Data Available from AQS.
- AQMD – Air Quality Management District
- APCD – Air Pollution Control District
- CFR Limit for precision CV: 7% for O_3, 15% for NO_2, 10% for CO and SO_2, based on QC checks required to be performed every two weeks.
- Further details on instruments not meeting these criteria can be viewed in Appendix B.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 11, 2014.

Accuracy Validation Via Performance Audits: To further validate bias estimates from one-point QC checks, CFR requires that independent performance audits be conducted and the average percent differences be evaluated against pre-determined criteria. In addition, auditing results should be assessed as to whether they are in agreement with the one-point QC checks.

Table A5 summarizes the 2013 performance audit results for the gaseous criteria pollutants. Accuracy is represented as an average percent difference. The average percent difference is the arithmetic mean of the combined differences from the known value of all the individual audit points. Audit results show that, in general, all gaseous instruments met ARB criteria for bias at the PQAO level.

Performance audit results in 2013 corroborate what the QC checks revealed: that ARB's PQAO is providing accurate data for all gaseous pollutants. The average percent differences at the PQAO level were well below the audit criteria (±10 percent for ozone, ±15 percent for other gases) for all gaseous pollutants. This fact is further strengthened by the small number of audits that did not meet ARB performance audit criteria.

Table A5. 2013 Results for Performance Audits of Gaseous Pollutant Instruments

Pollutant	PQAO	# of Samplers	# of Samplers Audited	# of Audits Not Meeting ARB Criteria	Average Percent Difference
CO	ARB	29	19 [a]	1	- 0.88
	BAAQMD	13	13	0	- 0.25
	SCAQMD	28	28	0	- 0.27
	SDCAPCD	3	3	0	- 1.02
NO_2	ARB	52	52	0	- 2.11
	BAAQMD	16	16	0	0.47
	SCAQMD	26	26	1	- 1.51
	SDCAPCD	8	8	0	- 1.25
O_3	ARB	106	104	2	0.59
	BAAQMD	20	20	0	- 0.20
	SCAQMD	31	31	1	1.29
	SDCAPCD	9	9	0	0.65
SO_2	ARB	15	11 [a]	0	- 0.63
	BAAQMD	10	10	0	- 1.56
	SCAQMD	8	7	0	- 5.22
	SDCAPCD	1	1	0	- 3.35

- [a] ARB was unable to conduct performance audits of trace-level instruments in 2013; these audits are expected to commence by the fourth quarter of 2014. The ARB PQAO had ten trace-level CO instruments and four trace-level SO_2 instruments operating in 2013.
- The ARB performance audit criteria for 2013 were: ±10% for O_3 and ±15% for CO, NO_2, and SO_2 for each audit point. Only audits conducted by ARB were subjected to the AQDA process.
- Further details on instruments not meeting these criteria can be viewed in Appendix B.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 11, 2014.

B. Particulate Matter

Particulate Samplers

Particulate matter (PM) monitoring is conducted using both manual and continuous type samplers. Manual samplers are operated on a one-in-six-day sampling schedule for PM10, and a similar, or more frequent schedule, for PM2.5. Continuous samplers report hourly values. (ARB's PQAO particulate program also includes total suspended particulates (TSP), sulfate, and lead monitoring.)

Similar to the discussion of gaseous pollutants, ambient data capture is discussed first, followed with an assessment of the quality of the data captured.

Ambient Data Capture: Data capture, as described in this report, is derived from the AQS completeness report AMP 430. The calculated number in AMP 430 represents the average of the monthly data capture rates for the calendar year and may not always be indicative of whether the 75 percent regulatory completeness requirement[12] is met for a particular pollutant. Note that while this report discusses the data capture rate of at least 75% percent, ARB's goal is 85% or more.

Table B1 presents the percentage of samplers that reported an ambient data capture rate of at least 75 percent for each PQAO. Table B2 displays similar information for each local air district within ARB's PQAO in which a PM sampler was operated. As can be seen in these tables, very few PM samplers within ARB's PQAO failed to report at least a 75 percent data capture rate for the indicated ambient PM data.

Precision and Bias: PM is subject to formal measurement quality objectives (MQOs) in federal and State regulations. Appendix A of this report lists the MQOs stated in CFR and U.S. EPA guidance. For all methods of collecting PM10 and PM2.5, Title 40 CFR Part 58 Appendix A specifies using the upper bound of CV to assess precision. This CV upper bound is not to exceed 10 percent. Collocated sampling is required to assess precision for manual PM10 and both manual and continuous PM2.5 sampling. Each PQAO is required to have a certain number of collocated sites to represent its monitoring network.

[12] 40 CFR Part 50 states that the ambient data from a given instrument or sampler, in a calendar year, must be at least 75% complete to be included in making regulatory decisions, such as determinations of attainment of the ambient air quality standards. The State of California defines data "completeness" in a similar way, also using 75 percent as its criteria. However, unlike the federal definition, the State requirement factors in the high season of the pollutant in the completeness criteria.

Table B1. 2013 Ambient PM Data Capture Results

Pollutant	PQAO	# of Samplers	# of Samplers Reporting ≥ 75% Data Capture	# of Samplers Reporting < 75% Data Capture	% of Samplers Reporting ≥ 75% Data Capture
PM10	ARB	106	101	5	95
	BAAQMD	8	8	0	100
	SCAQMD	36	34	2	94
	SDCAPCD	7	7	0	100
PM2.5	ARB	83	78	5	94
	BAAQMD	16	16	0	100
	SCAQMD	26	23	3	88
	SDCAPCD	9	9	0	100

- Further details on samplers not reporting ≥ 75% ambient data can be viewed in Appendix B.
- Source: Air Quality System, AMP 430 Data Completeness Report, run December 11, 2014.

For continuous PM10 samplers, bias is assessed using the monthly flow rate verifications and comparing the absolute bias upper bound against CFR criterion of four percent difference. Detailed calculations are explained in section D.5 of Appendix D. Although monthly flow rate verifications are available in AQS for some PM2.5 instruments as well, CFR does not require that this data be uploaded. In 2013, flow rate data from some of PM2.5 samplers within ARB's PQAO was collected and reported.

The accuracy of all particulate samplers is assessed via the semi-annual flow rate audit by comparing the instrument's flow rate to a certified orifice (PM10 and TSP), or a calibrated mass flow meter (TEOM, PM2.5, and BAM samplers) that is certified against a National Institute of Standards and Technology traceable flow device or calibrator. As listed in Appendix A of this report, ARB's 2013 performance criteria, based on the average percent difference during a semi-annual flow rate audit, were ±10 percent for PM10 and ±4 percent for PM2.5.

Precision of the data is based on the standard deviation of the percent differences of the mass concentrations of the two identical or equivalent samplers. At low concentrations, precision based on the measurements of collocated samplers may be relatively poor. For this reason, collocated measurement pairs are selected for use in the precision calculations only when both measurements are equal to or above the following limits: (1) TSP: 20 µg/m^3; (2) PM10 (Hi-Vol): 15 µg/m^3; (3) PM10 (Lo-Vol): 3 µg/m^3; (4) PM2.5: 3 µg/m^3. The collocated pairs of data that meet these limits are then used to calculate the upper bound of CV as an estimate of precision at each site. Title 40 CFR requires that this upper bound of the CV not exceed 10 percent for both PM10 and PM2.5 at the PQAO level. A detailed description of CV, including formulae for calculating it, can be found in Appendix D.

Table B2. 2013 Ambient PM Data Capture Results for Local Air Districts Within ARB's PQAO

Pollutant	District Name	# of Samplers	# of Samplers Reporting ≥ 75% Data	% of Samplers Reporting ≥ 75% Data
PM10	Antelope Valley AQMD	2	2	100
	Butte County AQMD	1	1	100
	Calaveras County APCD	1	1	100
	Colusa County APCD	1	0	0
	Eastern Kern APCD	3	3	100
	Feather River AQMD	1	1	100
	Glenn County APCD	1	1	100
	Great Basin Unified APCD	14	13	93
	Imperial County APCD	5	5	100
	Mariposa County APCD	1	1	100
	Mendocino County AQMD	1	1	100
	Mojave Desert AQMD	8	8	100
	Monterey Bay Unified APCD	2	2	100
	North Coast Unified AQMD	5	5	100
	Northern Sonoma County APCD	3	3	100
	Placer County APCD	3	3	100
	Sacramento Metropolitan AQMD	9	9	100
	San Joaquin Valley Unified APCD	19	16	84
	San Luis Obispo County APCD	6	6	100
	Santa Barbara County APCD	7	7	100
	Shasta County AQMD	3	3	100
	Siskiyou County APCD	1	1	100
	Tehama County APCD	1	1	100
	Ventura County APCD	5	5	100
	Yolo-Solano AQMD	3	3	100
PM2.5	Antelope Valley AQMD	1	1	100
	Butte County AQMD	1	1	100
	Calaveras County APCD	1	1	100
	Colusa County APCD	1	1	100
	Eastern Kern APCD	1	0	50
	Feather River AQMD	1	1	100
	Great Basin Unified APCD	3	2	67
	Imperial County APCD	4	4	100
	Lake County APCD	1	1	100
	Mendocino County AQMD	2	0	0
	Mojave Desert AQMD	2	2	100
	Monterey Bay Unified APCD	6	6	100

Table B2 (cont'd). 2013 Ambient PM Data Capture Results for Local Air Districts Within ARB's PQAO

Pollutant	District Name	# of Samplers	# of Samplers Reporting ≥ 75% Data	% of Samplers Reporting ≥ 75% Data
PM2.5	North Coast Unified AQMD	4	3	75
	Northern Sierra AQMD	6	6	100
	Placer County APCD	2	2	100
	Sacramento Metropolitan AQMD	5	5	100
	San Joaquin Valley Unified APCD	23	23	100
	San Luis Obispo County APCD	4	4	100
	Santa Barbara County APCD	2	2	100
	Shasta County AQMD	2	2	100
	Siskiyou County APCD	1	1	100
	Tehama County APCD	1	1	100
	Ventura County APCD	8	8	100
	Yolo-Solano AQMD	1	1	100

- Further details on samplers not reporting ≥ 75% ambient data can be viewed in Appendix B.
- Source: Air Quality System, AMP 430 Data Completeness Report, run December 11, 2014.

ARB's PQAO is short of meeting the required amount of collocated sampling for one or more methods of collecting PM. A detailed assessment of this can be found in ARB's *Annual Monitoring Network Report for Twenty-three Districts in California.*[13] Table B3 shows the number of sites with collocated precision data reported in respective years. Note that due to limited data[14] for ARB's PQAO in 2013, lead is not discussed herein.

Precision Results: For the reported collocated sites, CFR requires that 30 paired observations per year be collected from each site with collocated samplers operating the entire year. Table B1 displays precision percent completeness (measured as a percent of the collected samples over the required number of observations) in addition to the CV upper bound. Information for years 2011 and 2012 are provided for historical perspectives. Three-year PQAO averages are also included. A few highlights include:

- For the eleven pairs of collocated samplers that were present within ARB's PQAO, ten reported 100 percent of the required precision data.
- For PM10, the CV was below 10 percent in ARB's PQAO (as well as other California PQAOs).
- For PM2.5, ARB's PQAO did not meet the 10 percent CV requirement at the PQAO level for three out of the five methods of collection for which data are available. However, compared to 2012, the CV values dropped considerably for three of the methods used to collect PM2.5, indicating some improvement in PM2.5 precision.

[13] http://www.arb.ca.gov/aqd/amnr/amnr2014draft.pdf
[14] In 2013, there are two lead samplers in ARB's PQAO: Fresno-Garland and Calexico-Ethel. Neither has a collocated sampler.

Table B3. 2011-2013 Precision Results Based on Available Collocated PM Samplers

Pollutant	PQAO	Year	Method Code	# Pairs of Collocated Samplers Reported	% Precision Completeness	Upper Bound of Coefficient of Variation	CFR Criteria for Precision Met?
PM10	ARB	2013	All	4	100	6.03	Yes
		2012	All	5	100	5.46	Yes
		2011	All	7	100	4.55	Yes
		Avg	All	-	100	5.19	Yes
	BAAQMD	2013	All	1	100	2.65	Yes
		2012	All	1	100	4.16	Yes
		2011	All	1	100	3.76	Yes
		Avg	All	-	100	3.35	Yes
	SCAQMD	2013	All	3	100	5.28	Yes
		2012	All	3	100	5.05	Yes
		2011	All	3	100	4.73	Yes
		Avg	All	-	100	4.87	Yes
	SDCAPCD	2013	All	1	100	4.15	Yes
		2012	All	4	100	3.60	Yes
		2011	All	2	100	3.34	Yes
		Avg	All	-	100	3.61	Yes
	NATIONAL	2013	All	141	97	8.75	Yes
		2012	All	153	96	10.08	Yes
		2011	All	156	96	9.11	Yes
PM2.5	ARB	2013	117	1	100	8.10	Yes
		2012	117	1	100	15.77	No
		2011	117	1	100	17.44	No
		2013	118	6	100	***18.22***	No
		2012	118	7	100	16.70	No
		2011	118	6	100	15.97	No
		2013	145	1	100	*9.68*	Yes
		2012	145	2	100	20.52	No
		2011	145	1	100	20.11	No
		2013	170	2	100	***16.62***	No
		2012	170	2	100	23.19	No
		2011	170	2	100	16.87	No
		2013	181	1	100	***23.85***	No
		2012	181	NDA	NDA	NDA	NDA
		2011	181	NDA	NDA	NDA	NDA
		Avg	-	-	100	20.56	No
	BAAQMD	2013	145	NDA	NDA	NDA	NDA
		2012	145	1	100	8.98	Yes
		2011	145	2	100	12.50	No

Table B3 (cont'd). 2011-2013 Precision Results Based on Available Collocated PM Samplers

Pollutant	PQAO	Year	Method Code	# Pairs of Collocated Samplers Reported	% Precision Completeness	Upper Bound of Coefficient of Variation	CFR Criteria for Precision Met?
PM2.5	BAAQMD	2013	170	2	100	***17.27***	No
		2012	170	2	100	13.17	No
		2011	170	1	100	15.09	No
		Avg	-	-	100	**15.77**	No
	SCAQMD	2013	120	3	100	9.01	Yes
		2012	120	4	100	9.05	Yes
		2011	120	3	100	8.06	Yes
		Avg	-	-	100	8.47	Yes
	SDCAPCD	2013	145	1	100	***12.51***	No
		2012	145	2	93	7.84	Yes
		2011	145	1	100	4.85	Yes
		2013	170	NDA	NDA	NDA	NDA
		2012	170	NDA	NDA	NDA	NDA
		2011	170	NDA	NDA	NDA	NDA
		Avg	-	-	98	***10.78***	No
	NATIONAL	2013	117	6	92	7.17	Yes
		2012	117	8	90	10.31	No
		2011	117	9	90	10.13	No
		2013	118	83	95	***10.16***	No
		2012	118	87	96	10.67	No
		2011	118	83	93	8.84	Yes
		2013	120	9	90	***10.17***	No
		2012	120	14	95	10.78	No
		2011	120	19	92	9.05	Yes
		2013	145	54	98	9.50	Yes
		2012	145	54	96	10.65	No
		2011	145	49	96	8.70	Yes
		2013	170	34	98	***18.73***	No
		2012	170	26	94	19.82	No
		2011	170	21	97	20.22	No
		2013	181	5	100	***15.06***	No
		2012	181	3	100	14.65	No
		2011	181	2	100	12.55	No

- CFR Limit is a coefficient of variation of ≤ 10% for PM. Percent precision completeness is based on data collected from collocated samples. Further details on samplers not meeting these criteria can be found in Appendix B.
- Method 117 = R & P Model 2000 PM2.5 Sampler w/WINS; Method 118= R & P Model 2025 PM2.5 Sequential w/WINS; Method 120= Andersen RAAS2.5-300 PM2.5 SEQ w/WINS; Method 145= R & P Model 2025 PM2.5 Sequential Air Sampler w/VSCC; Method 170= Met One BAM-1020 Mass Monitor w/VSCC; Method 181=Thermo TEOM 1400a FDMS.
- ***Bold italicized*** font indicates CV greater than 10% in 2013 while underlined font indicates CV greater than 10% in 2011 or 2012.
- NDA= No collocated data available from AQS, but ambient data were reported to AQS.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 11, 2014.
- National average includes state, county, district, National Park Service, and tribal sites, including those in California; AMP 256 Data Quality Indicator Report, run December 11, 2014

Table B4 breaks down the statistics displayed in Table B3 under ARB's PQAO by local air districts. Monitoring sites within these areas may be operated by the district, ARB, or both. All areas except Sacramento Metro reported 100 percent of the required precision data. The upper bound CV was met in all districts for PM10. However, the CV for PM2.5 is exceeded at all districts except the Imperial County Air Pollution Control District and Mojave Desert Air Quality Management District.

To further compare the performance of the collocated samplers, an assessment of bias between the collocated samplers was conducted. While there is no requirement for this analysis, 40 CFR Appendix A to Part 58, section 4.3, recommends that this assessment be performed when the primary monitor is a federal equivalent method and the collocated monitor is an federal reference method. In this report, the bias calculations are provided for all collocated samplers in ARB's PQAO network (for informational purposes only). The bias (average difference between "primary" and "secondary" or "collocated" samplers) was estimated using the same procedure for calculating PM2.5 absolute bias, as outlined in Appendix D, section D.4. As shown in the far-right column of Table B4, the results reveal some large biases between the paired PM2.5 samplers within ARB's PQAO.

Information from Table B4 for individual pairs of PM samplers is presented in graphical format in Appendix G (ARB's Precision and Bias Graphics for Stations Monitoring Particulate Matter in California), with monitor AQS identification numbers found in Appendix E.

Table B4. 2013 Precision Results for Districts within ARB's PQAO

Pollutant	Geographic Area	Method Code (Primary/ Secondary)	Monitoring by (District=D, ARB=A)	# Pairs of Collocated Samplers Reported	% Precision Completeness	Upper Bound of Coefficient of Variation	Bias Between Collocated Samplers (%)
PM10	Sacramento Metro AQMD	All	D	1	100	3.77	+ 4.14
	San Joaquin Valley Unified APCD	All	D	1	100	3.40	- 3.62
		All	A	1	100	6.76	± 3.50
	Ventura County APCD	All	D	1	100	8.77	- 9.09
PM2.5	Great Basin Unified APCD	181/145	D	1	100	***23.85***	+ 27.67
	Imperial County APCD	145/145	A	1	100	9.68	± 9.92
	Mojave Desert AQMD	117/117	D	1	100	8.10	± 9.70
	Monterey Bay Unified APCD	170/117	D	1	100	***14.15***	+ 30.31
	Northern Sierra AQMD	118/118	D	1	100	***11.22***	+ 18.05
	Sacramento Metro AQMD	118/118	D	1	97	***11.58***	± 13.59
	San Joaquin Valley Unified APCD	118/170	A	1	100	***14.75***	- 21.30
		118/170	A	1	100	***22.09***	± 21.95
		118/118	A	1	100	***28.70***	± 38.78
	San Joaquin Valley Unified APCD	170/170	A	1	100	***16.58***	+ 52.92
	Ventura County APCD	118/170	D	1	100	***15.93***	± 18.74

- CFR Limit for CV is 10% for PM. Further details on samplers not meeting these criteria can be viewed in Appendix B.
- ***Bold italicized*** font indicates CV greater than 10% in 2013.
- Bias between collocated samplers: positive number indicates primary > secondary (collocated).
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 11, 2014.

Bias Results Via Monthly Flow Rate Verifications: As noted earlier, only continuous PM10 samplers are required to report monthly flow rate verifications to AQS. Although not required, ARB's PQAO also reported some flow rate verifications to AQS in 2013 for PM2.5. Bias results via the monthly flow rate verifications for 2013 and the preceding two years, as well as the 3-year average, are shown in Table B5-1 and B5-2. In summary, the bias criteria of ± 10 percent for PM10 and ± 4 percent for PM2.5 were met in each PQAO for which data are available. However, all PQAOs are encouraged to upload all flow rate verification data for a more comprehensive assessment of PM bias.

Table B5-1. 2013 Continuous PM10 Bias Results Based on Flow Rate Verifications

Pollutant	PQAO	Year	# of Samplers in Network	# of Samplers Reporting Flow Rates	Average % Difference	Bias (%)	CFR Criteria for Bias Met?
PM10	ARB	2013	39	30	0.15	± 1.28	Yes
		2012	35	30	0.24	± 1.18	Yes
		2011	35	19	0.41	± 1.37	Yes
		Avg	-	-	0.27	± 1.39	Yes
	SCAQMD	2013	11	11	-0.66	± 1.01	Yes
		2012	11	11	-0.09	± 1.69	Yes
		2011	15	15	-0.27	± 1.25	Yes
		Avg	-	-	-0.31	± 1.62	Yes

- Flow rate verifications available for continuous PM methods only, with just PM10 required to be in AQS.
- CFR criteria for bias: ±10% (of standard).
- Further details on samplers not meeting these criteria can be viewed in Appendix B.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 11, 2014.

Table B5-2. 2013 PM2.5 Bias Results Based on Flow Rate Verifications

Pollutant	PQAO	Year	# of Samplers in Network	# of Samplers Reporting Flow Rates	Average % Difference	Bias (%)	CFR Criteria for Bias Met?
PM2.5	ARB	2013	83	14	- 0.13	± 0.53	Yes
		2012	75	12	- 0.03	± 0.36	Yes
		2011	62	4	0.17	± 0.60	Yes
		Avg	-	-	0.01	± 0.50	Yes

- Although not federally required to be reported to AQS, the following districts within ARB's PQAO uploaded data: Great Basin Unified APCD, Monterey Bay Unified APCD, and San Luis Obispo County APCD.
- CFR criteria for bias: ±4% (of standard).
- NDA= No Data Available from AQS.
- For SCAQMD, a change in coding PM2.5 samplers from 88101 to 88502 resulted in no data for PM2.5 reported in AMP 256 for 2011-2013.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 11, 2014.

Accuracy Validation Via Performance Audits: Since an accurate measurement of PM is dependent upon the flow rate, ARB and other PQAOs are required to conduct semi-annual flow rate audits on all PM samplers at each site. Such audits are to be conducted five to seven months apart on each sampler in a given calendar year. In addition, as explained earlier, PQAOs are also required to submit the continuous PM10 monthly flow rate verifications to AQS; in this case, bias estimates based on flow rate verifications are further verified using the semi-annual flow rate audit data.

Table B6 summarizes the 2013 performance audit results for PM samplers. It displays the number of samplers as well as those that met the required number of audits in 2013. (Two audits are required if a sampler operates more than seven months; one audit if less than seven months but more than three months, zero if less than three months.) The average percent difference between the sampler flow rates and the audit flow rates represents the arithmetic mean of the combined differences from the certified value of all the individual audit points for each sampler.

ARB conducts all of the semi-annual flow rate audits for samplers operating within ARB's PQAO. In addition, certain local districts within ARB's PQAO were to conduct their own audits in 2013. ARB's policy is to audit non-ARB PQAO monitoring sites at least once every five years. Non-ARB PQAOs are responsible for performing audits on their own as part of the annual performance evaluation program.

Overall, the results of the audited samplers indicate that except for two cases, the PM samplers in the network were operating within ARB's flow rate audit criteria. For continuous PM10, flow rate audit results agree with bias estimates based on the flow rate verifications under ARB's PQAO, further validating that the continuous PM10 samplers were operating accurately. Similar results also apply to PM2.5 samplers which reported flow rate verifications (as shown in Table B5-2). Thus, the PM network operating under ARB's PQAO is generally accurate.

Table B6. 2013 Results for Particulate Sampler Flow Rate Audits

Pollutant	PQAO	# of Samplers	# of Samplers Audited	# of Flow Rate Audits Not Meeting ARB Criteria	Average Percent Difference
PM10	ARB	106	101[a]	1	0.85
	BAAQMD	8	8	0	0.99
	SCAQMD	36	35	0	1.11
	SDCAPCD	7	6	0	0.78
PM2.5	ARB	83	78[b]	1	- 0.17
	BAAQMD	16	16	0	- 0.37
	SCAQMD	26	22	0	- 0.20
	SDCAPCD	9	9	0	- 0.99

- [a]A few PM10 samplers not listed as "audited" were found to be non-operational at the time of the scheduled audits; AQDAs were issued, but it was not feasible for re-audits to be performed.
- [b]A few PM2.5 samplers not listed as "audited" had audits performed on dates that were not 5 to 7 months apart, not meeting CFR requirements on timing.
- ARB's flow rate audit criteria for 2013 were ±10% for PM10 and ±4% for PM2.5. Only audits conducted by ARB were subjected to the AQDA process. Further details on samplers not meeting these criteria can be found in Appendix B.
- The number of audits required per year: two if sampler is operating for more than seven months, one if less than seven months but more than three months, zero if less than three months.
- Further details on samplers not meeting these criteria can be viewed in Appendix B.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run December 10, 2014.

IV. CONCLUSIONS AND RECOMMENDATIONS

This report provides ambient air quality data producers and users with a centralized review of the data quality within ARB's PQAO with respect to MQOs. In addition, comparisons to other PQAOs in California and the national average are shown where appropriate.

Below are some highlights for 2013.

Gaseous Pollutants (CO, O_3, NO_2, and SO_2)

- Ninety-six percent of the instruments operating under ARB's PQAO achieved the ambient data capture rate of at least 75 percent in 2013.
- Ninety percent of the instruments operating within ARB's PQAO reported 100 percent of the required one-point QC checks for the gaseous pollutants.
- All of the California PQAOs met the CFR criteria for precision and bias based on one-point QC checks.
- There were a small number of analyzers that did not meet the required number of audits because ARB was unable to conduct performance audits of trace-level instruments in 2013. The performance audit acceptance criteria were met, on

average, at the PQAO level for ARB's PQAO (as well as other PQAOs) with only a small number of analyzers not passing performance audit criteria. This validates the bias estimates based on one-point QC checks.

Particulate Matter (PM10 and PM2.5)

- Ninety-five percent of the particulate samplers operating under ARB's PQAO achieved the ambient data capture rate of at least 75 percent in 2013.
- ARB's PQAO is short of meeting the required number of collocated sampling sites for one or more methods of collecting PM. In assessing the collocated sampling completeness requirement criteria, it is recommended that each monitoring agency within ARB's PQAO update information in AQS to reflect all site closures and work with ARB in calculating the collocated sampling requirements for manual PM10 and all PM2.5 sites appropriately. At least annually, these assessments should include, but are not limited to, clearly defining the primary and the secondary samplers at the collocated sites in AQS.
- For the eleven pairs of collocated samplers that were present within ARB's PQAO, ten reported 100 percent of the required precision data.
- Based on collocated PM data, CFR requirements for precision were met by ARB's PQAO (as well as other California PQAOs) for PM10. However, ARB's PQAO did not meet the precision requirements at the PQAO level for three out of the five methods of collecting PM2.5, as shown in Table IV-1. Although precision values showed improvement compared to previous years, an investigation into further improving PM2.5 precision is encouraged.

Table IV-1. 2013 Precision Assessment for PM2.5

PQAO	Method 117	Method 118	Method 120	Method 145	Method 170	Method 181
ARB	✓	X	-----	✓	X	X
BAAQMD	-----	-----	-----	NDA	X	-----
SCAQMD	-----	-----	✓	-----	-----	-----
SDCAPCD	-----	-----	-----	X	NDA	-----

Dashed marks (----) = method not applicable to PQAO; X = No; and ✓ = Yes. NDA=No data available in AQS.

- Although there is no specific MQO for bias between collocated PM samplers, an assessment of bias between collocated PM samplers in ARB's PQAO was performed and showed some unusually high values. An investigation into the cause(s) behind the large bias between some of the collocated PM2.5 sampler is encouraged.
- Flow rate verifications are required to be performed on all PM samplers, but only those from continuous PM10 are required to be uploaded. Data from several continuous PM10 samplers from ARB, Mendocino County APCD, and Mojave Desert AQMD were missing in AQS for 2013. To enhance consistency in regulation and avoid any confusion, U.S. EPA is proposing to require that data on

flow rate checks be uploaded to AQS for all PM sampler methods[15]. Thus, it is encouraged that all monitoring agencies within ARB's PQAO upload flow rate verification data (one-point flow checks) to U.S. EPA's AQS for all PM sampling methods, as such information would allow for a more comprehensive assessment of PM accuracy.

- Flow rate audit data indicate that except for two cases, ARB's PQAO met ARB criteria. This finding is consistent with the limited bias information that can be ascertained from the routine flow rate verification data available in AQS.

Although CFR criteria for precision and accuracy are generally applied and evaluated at the PQAO level, assessments at the district or site level may differ and can be important as well. Therefore, data producers are strongly encouraged to review the site-level information and assess whether their data quality objectives are met. It is important to note that when certain CFR criteria are not met, it does not necessarily mean that the corresponding air quality data should not be used, but rather, the data should be used with the knowledge of the quality behind it. The 2013 ambient data in AQS for the ARB's PQAO have been certified and are considered suitable for comparison to federal ambient air quality standards.

The statistics presented in this report are intended as assessment tools for the data producers to identify areas where program improvements can be made to achieve all MQOs set by U.S. EPA or the data producers themselves. ARB has recently implemented a comprehensive corrective action system throughout ARB's PQAO which is expected to serve as an essential component for improving data quality and facilitating continuous process improvement. Specifically, ARB developed the Corrective Action Notification (CAN) process that can be used to document issues that impact or potentially impact data quality, completeness, storage, or reporting. The goal of the CAN process is to investigate, correct, and reduce the recurrence of these issues. As such, the information obtained from this report can be coupled with the CAN process to identify issues (not already identified by AQDAs), improve data quality, and ensure compliance with State, federal, and local requirements.

A complete listing of all references used in this report can be found in Appendix H.

[15] http://www.gpo.gov/fdsys/pkg/FR-2014-09-11/pdf/2014-19758.pdf

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APPENDIX A

U.S. EPA's
MEASUREMENT QUALITY OBJECTIVES

TOOLS FOR ASSESSING PRECISION AND BIAS/ACCURACY

ARB PERFORMANCE AUDIT CRITERIA

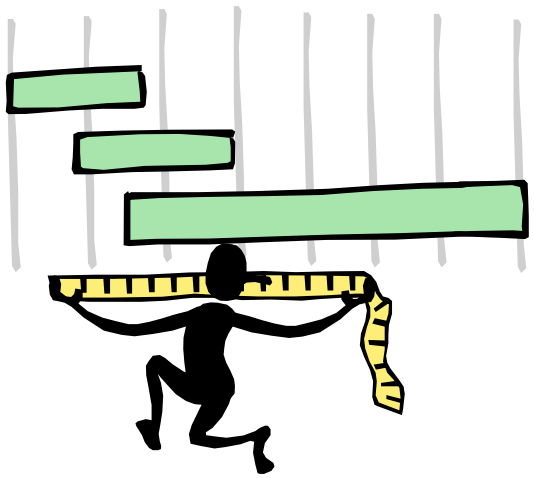

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Table 1. Ambient Air Monitoring Measurement Quality Samples

(Table A-2 in 40 CFR Part 58 Appendix A; QA Handbook Volume II Appendix D)

Method	CFR Reference	Coverage (annual)	Minimum frequency	MQOs
Automated Methods				
One-Point QC: for SO_2, NO_2, O_3, CO	Section 3.2.1	Each analyzer	Once per 2 weeks	**O_3** Precision 7%, Bias ± 7%. **NO_2** Precision 15%, Bias ± 15%. **SO_2 and CO** Precision 10% , Bias ± 10%
Annual performance evaluation for SO_2, NO_2, O_3, CO	Section 3.2.2	Each analyzer	Once per year	≤ 15 % for each audit concentration
National performance audit program for SO_2, NO_2, O_3, CO	Section 2.4	20% of sites per year	Once per year	**O_3** ≤ 10 % for each audit concentration **NO_2, SO_2, CO** ≤ 15 % for each audit concentration
Flow rate verification PM10, PM2.5	Section 3.2.3	Each sampler	Once every month	PM10 ≤ 10% of standard and design value PM2.5 ≤ 4% of standard and 5% of design value
Semi-annual flow rate audit PM10, PM2.5	Section 3.2.4	Each sampler	Once every 6 months	PM10 ≤ 10% of standard and design value PM2.5 ≤ 4% of standard and 5% of design value
Collocated sampling PM2.5	Section 3.2.5	15%	Every twelve days	10% precision
PM Performance evaluation program PM2.5	Section 3.2.7	1. 5 valid audits for primary QA orgs, with ≤ 5 sites 2. 8 valid audits for primary QA orgs, with > 5 sites 3. All samplers in 6 years	Over all 4 quarters	± 10% bias
Manual Methods				
Collocated sampling PM10, TSP, PM2.5	3.3.1 and 3.3.5	15%	Every 12 days	PM10, PM2.5, - 10% precision TSP - 20% precision
Flow rate verification PM10 (low Vol), PM2.5	3.3.2	Each sampler	Once every month	≤ 4% of standard and 5% of design value
Flow rate verification PM10 (High-Vol), TSP	3.3.2	Each sampler	Once every quarter	≤ 10% of standard and design value
Semi-annual flow rate audit PM10 (low Vol), PM2.5	3.3.3	Each sampler, all locations	Once every 6 months	≤ 4% of standard and 5% of design value
Semi-annual flow rate audit PM10 (High-Vol), TSP	3.3.3	Each sampler, all locations	Once every 6 months	≤ 10% of standard and design value
Performance evaluation program PM2.5	3.3.7 and 3.3.8	1. 5 valid audits for primary QA orgs, with ≤ 5 sites 2. 8 valid audits for primary QA orgs, with ≥ 5 sites 3. All samplers in 6 years	Over all 4 quarters	± 10% bias

Tools for Assessing Precision and Bias/Accuracy

Pollutant	Precision			Bias/Accuracy			
	1-Pt QC Checks (in AQS)	Collocated Measurements (in AQS)		1-Pt QC Checks (in AQS)	Flow Rate Verification (in AQS)	Flow checks performed (not required in AQS)	Performance Audits (in AQS)
Gaseous							
O3, CO, NO2, SO2	☑			☑			annual
Continuous							
PM2.5		☑				☑ monthly	semi-annual
PM10					☑ monthly		semi-annual
Manual							
PM2.5		☑				☑ monthly	semi-annual
PM10 (high vol)		☑				☑ quarterly	semi-annual
PM10 (low vol)		☑				☑ monthly	semi-annual

ARB's Performance Audit Criteria
(2013)

ARB's Control and Warning Limits

Limits		Instrument
Control	Warning	
±10 %	±7 %	Ozone
±15 %	±10 %	Carbon Monoxide, Nitrogen Dioxide, Sulfur Dioxide
±15 %	±10 %	Total Suspended Particulate (TSP) Samplers, including Lead.
±10 %	±7 %	PM10, Dichotomous (Dichot), Tapered Element Oscillating Microbalance (TEOM), Beta Attenuated Monitors (BAM)
±4 % (Flow) ±5 % (Design)	None None	PM2.5

Acceptance Criteria For Meteorological (MET) Sensors

Limits	Sensor
±1.0^{o} Celsius (±0.5^{o}C PAMS only)	Ambient Temperature
±2.25mm of Mercury (Hg)	Barometric Pressure
less than or equal to 5^{o} combined accuracy and orientation error	Wind Direction
less than or equal to 0.5m/s	Wind Direction Starting Threshold
±0.25m/s between 0.5 and 5m/s and less than 5 % difference above 5m/s	Horizontal Wind Speed
less than or equal to 0.5m/s	Horizontal Wind Speed Starting Threshold

Note: ARB does not audit relative humidity, solar radiation, and vertical wind speed.

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APPENDIX B

ARB's PQAO
DATA QUALITY ISSUES

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Background

This appendix contains a listing of samplers that did not meet a particular measurement quality objective (MQO). These data are provided for informational purposes only, as most MQOs are assessed at the PQAO level.

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Gases - Ambient Data Completeness <75% Reported						
Site #	**POC**	**Site Name**	**Geographic Area**	**Field Collection Organization**	**Pollutant**	**Issue/Comment**
06-077-1002	3	Stockton Hazelton	San Joaquin Valley APCD	ARB	CO	69% reported
06-071-0001	1	Barstow	Mojave Desert AQMD	Mojave Desert AQMD	CO	73% reported
06-067-0012	1	Folsom-Natoma Street	Sac Metro AQMD	Sac Metro AQMD	NO_2	71% reported
06-019-5001	1	Clovis	San Joaquin Valley APCD	San Joaquin Valley APCD	NO_2	73% reported
06-039-0004	1	Madera Pump yard	San Joaquin Valley APCD	San Joaquin Valley APCD	NO_2	48% reported
06-025-4003	1	Westmorland	Imperial County APCD	Imperial County APCD	O_3	0% reported (power failure; nonoperational)
06-045-0008	1	Ukiah	Mendocino County APCD	Mendocino County APCD	O_3	30% reported (data logger error)
06-077-3005	1	Tracy	San Joaquin Valley APCD	San Joaquin Valley APCD	O_3	71% reported
Gases - Precision/Bias 1-Point QC Checks <100% Reported						
Site #	**POC**	**Site Name**	**Geographic Area**	**Field Collection Organization**	**Pollutant**	**Issue/Comment**
06-023-1004	1	Eureka-Jacobs	North Coast Unified AQMD	North Coast Unified AQMD	CO	92% reported (SP)
06-023-1005	1	Eureka-Humboldt Hill	North Coast Unified AQMD	North Coast Unified AQMD	CO	92% reported (SP)
06-025-1003	1	El Centro-9th Street	Imperial County APCD	Imperial County APCD	CO	96% reported
06-023-1004	1	Eureka-Jacobs	North Coast Unified AQMD	North Coast Unified AQMD	NO_2	92% reported (SP)
06-023-1005	1	Eureka-Humboldt Hill	North Coast Unified AQMD	North Coast Unified AQMD	NO_2	92% reported (SP)
06-025-1003	1	El Centro-9th Street	Imperial County APCD	Imperial County APCD	NO_2	92% reported
06-067-0006	1	Sacramento-Del Paso Manor	Sac Metro AQMD	Sac Metro AQMD	NO_2	77% reported
06-067-0012	1	Folsom-Natoma Street	Sac Metro AQMD	Sac Metro AQMD	NO_2	69% reported
06-067-0014	1	Sacramento - Goldenland court	Sac Metro AQMD	Sac Metro AQMD	NO_2	92% reported

Gases - Precision/Bias 1-Point QC Checks <100% Reported						
Site #	**POC**	**Site Name**	**Geographic Area**	**Field Collection Organization**	**Pollutant**	**Issue/Comment**
06-083-1021	1	Carpinteria-Gobernador Rd	Santa Barbara County APCD	Santa Barbara County APCD	NO_2	96% reported (ID)
06-023-1004	1	Eureka-Jacobs	North Coast Unified AQMD	North Coast Unified AQMD	O_3	92% reported (SP)
06-023-1005	1	Eureka-Humboldt Hill	North Coast Unified AQMD	North Coast Unified AQMD	O_3	92% reported (SP)
06-025-4003	1	Westmorland-W 1st Street	Imperial County APCD	Imperial County APCD	O_3	0% reported (power failure; nonoperational)
06-025-4004	1	Niland-English Road	Imperial County APCD	Imperial County APCD	O_3	92% reported
06-045-0008	1	Ukiah-E Gobbi Street	Mendocino County APCD	Mendocino County APCD	O_3	27% reported (data logger error)
06-061-1004	1	Tahoe City	Placer County APCD	Placer County APCD	O_3	50% reported
06-067-0012	1	Folsom-Natoma St	Sac Metro AQMD	Sac Metro AQMD	O_3	92% reported
06-023-1004	1	Eureka-Jacobs	North Coast Unified AQMD	North Coast Unified AQMD	SO_2	92% reported (SP)
06-023-1005	1	Eureka-Humboldt Hill	North Coast Unified AQMD	North Coast Unified AQMD	SO_2	92% reported (SP)
06-083-1013	1	Lompoc-HSandP	Santa Barbara County APCD	Santa Barbara County APCD	SO_2	73% reported (ID)
Gases - Precision Criteria Exceeded						
Site #	**POC**	**Site Name**	**Geographic Area**	**Field Collection Organization**	**Pollutant**	**Issue/Comment**
06-025-1003	1	El Centro-9th Street	Imperial County APCD	Imperial County APCD	CO	CV Value > 10% (11.70)
06-101-0003	1	Yuba City-Almond Street	Feather River AQMD	ARB	NO_2	CV Value > 15% (15.37)
06-025-4004	1	Niland-English Road	Imperial County APCD	Imperial County APCD	O_3	CV Value > 7% (10.32)
06-113-0004	1	Davis	Yolo-Solano AQMD	ARB	O_3	CV Value > 7% (7.67)
Gases - Bias Criteria Exceeded						
Site #	**POC**	**Site Name**	**Geographic Area**	**Field Collection Organization**	**Pollutant**	**Issue/Comment**
06-023-1004	1	Eureka-Jacobs	North Coast Unified AQMD	North Coast Unified AQMD	CO	Bias Value > 10% (11.37) (SP)
06-083-4003	1	Vandenberg Air Force Base	Santa Barbara County APCD	Santa Barbara County APCD	CO	Bias Value > 10% (10.28) (ID)

Gases - Bias Criteria Exceeded						
Site #	**POC**	**Site Name**	**Geographic Area**	**Field Collection Organization**	**Pollutant**	**Issue/Comment**
06-023-1005	1	Eureka-Humboldt Hill	North Coast Unified AQMD	North Coast Unified AQMD	O_3	Bias Value > 7% (9.20)
06-045-0008	1	Ukiah	Mendocino County APCD	Mendocino County APCD	O_3	Bias Value > 7% (-12.60)
06-012-1004	1	Eureka-Jacobs	North Coast Unified AQMD	North Coast Unified AQMD	SO_2	Bias Value > 10% (11.98)
Gases - Audits Not Performed						
Site #	**POC**	**Site Name**	**Geographic Area**	**Field Collection Organization**	**Pollutant**	**Issue/Comment**
06-007-0008	3	Chico East Ave	Butte County APCD	ARB	CO	Unable to audit trace instrument
06-019-0011	3	Fresno Garland	San Joaquin Valley Unified APCD	ARB	CO	Unable to audit trace instrument
06-025-0005	1	Calexico-Ethel Street	Imperial County APCD	ARB	CO	Unable to audit trace instrument
06-025-0005	3	Calexico-Ethel Street	Imperial County APCD	ARB	CO	Unable to audit trace instrument
06-067-0006	1	Sacramento-Del Paso Manor	Sac Metro AQMD	Sac Metro AQMD	CO	Unable to audit trace instrument
06-077-1002	1	Stockton-Hazelton Street	San Joaquin Valley APCD	ARB	CO	Unable to audit trace instrument
06-077-1002	3	Stockton-Hazelton Street	San Joaquin Valley APCD	ARB	CO	Unable to audit trace instrument
06-083-0011	3	Santa Barbara-700 East Canon Perdido	Santa Barbara County APCD	ARB	CO	Unable to audit trace instrument (SP)
06-083-1008	3	Santa Maria-906 S Broadway	Santa Barbara County APCD	ARB	CO	Unable to audit trace instrument
06-099-0005	3	Modesto-14th Street	San Joaquin Valley APCD	ARB	CO	Unable to audit trace instrument
06-025-4003	1	Westmorland-W 1st Street	Imperial County APCD	Imperial County APCD	O_3	Audit not performed; non-operational
06-061-1004	1	Tahoe City	Placer County APCD	Placer County APCD	O_3	Audit not performed
06-019-0011	3	Fresno Garland	San Joaquin Valley APCD	ARB	SO_2	Unable to audit trace instrument

Gases - Audits Not Performed						
Site #	**POC**	**Site Name**	**Geographic Area**	**Field Collection Organization**	**Pollutant**	**Issue/Comment**
06-025-0005	1	Calexico-Ethel Street	Imperial County APCD	ARB	SO_2	Unable to audit trace instrument
06-025-0005	3	Calexico-Ethel Street	Imperial County APCD	ARB	SO_2	Unable to audit trace instrument
06-067-0006	1	Sacramento-Del Paso Manor	Sac Metro AQMD	Sac Metro AQMD	SO_2	Unable to audit trace instrument
Gases - Audit Criteria Not Met						
Site #	**POC**	**Site Name**	**Geographic Area**	**Field Collection Organization**	**Pollutant**	**Issue/Comment**
06-025-1003	1	El Centro-9th Street	Imperial County APCD	Imperial County APCD	CO	Exceeds 15% criteria
06-023-1005	1	Eureka-Humboldt Hill	North Coast Unified AQMD	North Coast Unified AQMD	O_3	Exceeds 10% criteria
06-029-6001	1	Shafter	San Joaquin Valley APCD	ARB	O_3	Exceeds 10% criteria
PM - Ambient Data Completeness <75% Reported						
Site #	**POC**	**Site Name**	**Geographic Area**	**Field Collection Organization**	**Pollutant**	**Issue/Comment**
06-011-1002	2	Colusa-Sunrise Blvd	Colusa County APCD	ARB	PM10	72% reported
06-027-1003	7	Keeler-Cerro Gordo Road	Great Basin Unified APCD	Great Basin Unified APCD	PM10	42% reported
06-029-0014	1	Bakersfield-5558 California Avenue	San Joaquin Valley APCD	ARB	PM10	54% reported
06-029-0014	2	Bakersfield-5558 California Avenue	San Joaquin Valley APCD	ARB	PM10	64% reported
06-099-0005	7	Modesto-14th Street	San Joaquin Valley APCD	ARB	PM10	68% reported
06-023-1005	1	Eureka-Humboldt Hill	North Coast Unified AQMD	North Coast Unified AQMD	PM2.5	74% reported (SP)
06-027-1003	2	Keeler-Cerro Gordo Road	Great Basin Unified APCD	Great Basin Unified APCD	PM2.5	58% reported
06-029-0015		Ridgecrest	Eastern Kern APCD	Eastern Kern APCD	PM2.5	44% reported
06-045-2002	3	Willits-125 E Commercial Street	Mendocino County APCD	Mendocino County APCD	PM2.5	44% reported
06-045-0006	3	Ukiah-County Library	Mendocino County APCD	Mendocino County APCD	PM2.5	23% reported (data logger error)

PM - Precision Criteria Not Met (CV >10%)						
Site #	**POC**	**Site Name**	**Geographic Area**	**Field Collection Organization**	**Pollutant**	**Issue/Comment**
06-019-0011	1	Fresno Garland	San Joaquin Valley APCD	ARB	PM2.5	CV=14.75
06-029-0014	1	Bakersfield-5558 California Avenue	San Joaquin Valley APCD	ARB	PM2.5	CV=28.70
06-099-0005	1	Modesto-14th Street	San Joaquin Valley APCD	ARB	PM2.5	CV=22.09
06-111-0007	1	Thousand Oaks-Moorpark Road	Ventura County APCD	Ventura County APCD	PM2.5	CV=15.93
06-077-1002	3	Stockton-Hazelton Street	San Joaquin Valley APCD	ARB	PM2.5	CV=16.58
06-027-1003	3	Keeler-Cerro Gordo Road	Great Basin Unified APCD	Great Basin Unified APCD	PM2.5	CV=23.85
06-053-1003	3	Salinas-#3	Monterey Bay Unified APCD	Monterey Bay Unified APCD	PM2.5	CV=14.15
06-057-1001	1	Truckee-Fire Station	Northern Sierra AQMD	Northern Sierra APCD	PM2.5	CV=11.22
06-067-0006	1	Sacramento-Del Paso Manor	Sac Metro AQMD	Sac Metro AQMD	PM2.5	CV=11.58
Continuous PM10 Samplers Not Uploading Flow Rate Verification Checks						
Site #	**POC**	**Site Name**	**Geographic Area**	**Field Collection Organization**	**Pollutant**	**Issue/Comment**
06-029-0011	2	Mojave-923 Poole Street	Eastern Kern APCD	ARB	PM10	Missing Flow Rate
06-045-0010	1	Fort Bragg-300 Dana Street	Mendocino County APCD	Mendocino County APCD	PM10	Missing Flow Rate
06-067-0010	4	Sacramento-T Street	Sac Metro AQMD	ARB	PM10	Missing Flow Rate
06-071-0001	1	Barstow	Mojave Desert AQMD	Mojave Desert AQMD	PM10	Missing Flow Rate
06-079-0005	2	Paso Robles-Santa Fe Avenue	San Luis Obispo County APCD	ARB	PM10	Missing Flow Rate
06-079-2006	2	San Luis Obispo-3220 South Higuera St	San Luis Obispo County APCD	ARB	PM10	Missing Flow Rate
06-083-0011	3	Santa Barbara-700 East Canon Perdido	Santa Barbara County APCD	ARB	PM10	Missing Flow Rate
06-083-1008	3	Santa Maria-906 S Broadway	Santa Barbara County APCD	ARB	PM10	Missing Flow Rate
06-099-0005	7	Modesto-14th Street	San Joaquin Valley APCD	ARB	PM10	Missing Flow Rate

PM Flow Rate Audits Not Performed						
Site #	**POC**	**Site Name**	**Geographic Area**	**Field Collection Organization**	**Pollutant**	**Issue/Comment**
06-027-1003	7	Keeler-Cerro Gordo Road	Great Basin Unified APCD	Great Basin Unified APCD	PM10	Audits not performed within 5-7 months
06-029-0014	1	Bakersfield-5558 California Avenue	San Joaquin Valley APCD	ARB	PM10	1 Audit; 2 required
06-029-0014	2	Bakersfield-5558 California Avenue	San Joaquin Valley APCD	ARB	PM10	1 Audit; 2 required
06-031-0004	7	Corcoran-Patterson Avenue	San Joaquin Valley APCD	San Joaquin Valley APCD	PM10	1 Audit; 2 required
06-067-0010	4	Sacramento- T Street	Sac Metro AQMD	ARB	PM10	1 Audit; 2 required
06-019-0011	4	Fresno Garland	San Joaquin Valley APCD	ARB	PM2.5	Audit not performed (SP)
06-023-1005	1	Eureka-Humboldt Hill	North Coast Unified AQMD	North Coast Unified AQMD	PM2.5	Audit not performed (SP)
06-033-3001	1	Lakeport-Lakeport Blvd	Lake County APCD	Lake County APCD	PM2.5	1 Audit; 2 required
06-089-3004	1	Redding	Shasta County AQMD	Shasta County AQMD	PM2.5	Audit not performed (SP)
06-089-3005	1	Shasta Lake	Shasta County AQMD	Shasta County AQMD	PM2.5	Audit not performed
PM Flow Rate Audits Exceeding Criteria						
Site #	**POC**	**Site Name**	**Geographic Area**	**Field Collection Organization**	**Pollutant**	**Issue/Comment**
06-023-1002	1	Eureka 6th & I	North Coast Unified AQMD	North Coast Unified AQMD	PM10	Exceeds ± 10%
06-103-0006	3	Red Bluff	Tehama County APCD	Tehama County APCD	PM2.5	Exceeds ± 4%

APPENDIX C

METEOROLOGICAL SENSOR PERFORMANCE AUDITS CONDUCTED BY ARB

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Meteorology

Meteorological Tower

ARB and local air districts monitor meteorological parameters such as wind speed, wind direction, ambient temperature, relative humidity, barometric pressure, and total solar radiation. Real-time meteorological data are generated to characterize meteorological processes such as transport and diffusion, and to make air quality forecasts and burn-day decisions. The data are also used for control strategy modeling and urban airshed modeling. A State/local meteorology subcommittee of the Air Monitoring Technical Advisory Committee agreed to define the level of acceptability for meteorological data as those used by U.S. EPA for both the Prevention of Significant Deterioration and Photochemical Assessment Monitoring Stations programs. QMB audits according to those levels.

The wind speed, wind direction, barometric pressure, and outside temperature data sets are subject to meeting ARB's performance criteria, which can be found in Appendix A of this report. Relative humidity sensors are not audited by ARB. Since the inception of the meteorological audit program, the data quality has improved significantly.

Accuracy: The accuracy of meteorological sensors is checked by annual performance audits. The table below summarizes the 2013 audit results. They represent the data collected by ARB. As meteorological sensors are not required in CFR to be audited by other PQAOs, and ARB only audits non-PQAO sites at least once every five years, the number of audits under ARB PQAO appears large compared to a few audits under other PQAOs. The average percent or degree difference represents the arithmetic mean of the combined differences from the certified value of all the individual audit points for each sensor. The minimum and maximum are included to convey the range in the percent differences. Information about the meteorological monitoring program is available at http://www.arb.ca.gov/aaqm/met.htm.

2013 Results for Meteorological Sensor Performance Audits Conducted by ARB

Sensor	PQAO	# of Audits	# of Audits That Failed	Avg % or Degree Difference	Minimum	Maximum
Ambient Temperature (degrees C)	ARB	94	2	- 0.02	- 0.6	1.7
	Other PQAOs	4	0	- 0.0	- 0.2	0.2
Wind Direction (degrees)	ARB	75	2	0.19	- 3.8	7.0
	Other PQAOs	6	0	0.37	- 0.8	1.8
Horizontal Wind Speed (%)	ARB	95	2	- 0.24	- 19.2	4.3
	Other PQAOs	6	0	- 0.43	- 1.3	0.2
Barometric Pressure (mmHg)	ARB	36	0	- 0.11	- 2.0	4.5
	Other PQAOs	4	0	- 0.65	- 1.9	0.6

Note: ARB's acceptance criteria for meteorological sensors are: ± 1 degree Celsius for ambient temperature, 5% combined accuracy and orientation error for wind direction, 0.25% m/s between 0.5 and 5 m/s and 5% difference above 5 m/s for horizontal wind speed, and ± 2.25 mm Hg for barometric pressure.

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APPENDIX D

DETAILED CALCULATIONS OF STATISTICS USED TO ASSESS PRECISION AND ACCURACY

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The materials in this Appendix were adapted from U.S. EPA's "Guideline on the Meaning and the Use of Precision and Bias Data Required by 40 CFR Part 58 to Appendix A".

Data Quality Indicators Calculated for Each Measured Pollutant

Pollutant	*Gaseous Assessments (Precision or Bias)*	*One-Point Flow Rate Bias Estimate*	*PM2.5 Bias*	*PM2.5 Absolute Bias*	*Semi-Annual Flow Rate Audits*	*Precision Estimate from Collocated Samples*	*Lead Bias*
O_3	Precision Estimate/ Bias Estimate						
SO_2	Precision Estimate/ Bias Estimate						
NO_2	Precision Estimate/ Bias Estimate						
CO	Precision Estimate/ Bias Estimate						
PM2.5		One-Point Flow Rate	Bias Estimate	Absolute Bias Estimate	Semi-Annual Flow Rate	Precision Estimate	
PM10		One-Point Flow Rate			Semi-Annual Flow Rate	Precision Estimate	
Lead							Precision Estimate/ Bias Estimate

D.1 Gaseous Precision and Bias Assessments

Applies to: CO, O_3, NO_2, SO_2

40 CFR Part 58 Appendix A References:

- ***4.1.1 Percent Difference***
- ***4.1.2 Precision Estimate***
- ***4.1.3 Bias Estimate***
- ***4.1.3.1 Assigning a sign (positive / negative) to the bias estimate.***
- ***4.1.3.2 Calculate the 25th and 75th percentiles of the percent differences for each site.***
- ***4.1.4 Validation of Bias Using the one-point QC Checks***

Precision and bias estimates are based on 1-point Q/C checks. Then, bias estimates are validated using the annual performance evaluations (audits).

Percent Difference

Equations from this section come from *CFR Pt. 58, App. A, Section 4, "Calculations for Data Quality Assessment"*. For each single point check, calculate the percent difference, d_i, as follows:

Equation 1

$$d_i = \frac{meas - audit}{audit} \cdot 100$$

where *meas* is the concentration indicated by the monitoring organization's instrument and *audit* is the audit concentration of the standard used in the QC check being measured.

Precision Estimate

The precision estimate is used to assess the one-point QC checks for gaseous pollutants described in section 3.2.1 of CFR Part 58, Appendix A. The precision estimator is the coefficient of variation upper bound and is calculated using Equation 2 as follows:

Equation 2

$$CV = \sqrt{\frac{n \cdot \sum_{i=1}^{n} d_i^2 - \left(\sum_{i=1}^{n} d_i\right)^2}{n(n-1)}} \cdot \sqrt{\frac{n-1}{\chi^2_{0.1,n-1}}}$$

where $\chi^2_{0.1,n-1}$ is the 10th percentile of a chi-squared distribution with *n-1* degrees of freedom.

Bias Estimate

The bias estimate is calculated using the one point QC checks for SO_2, NO_2, O_3, or CO described in CFR, section 3.2.1. The bias estimator is an upper bound on the mean absolute value of the percent differences as described in Equation 3 as follows:

Equation 3

$$|bias| = AB + t_{0.95,n-1} \cdot \frac{AS}{\sqrt{n}}$$

where *n* is the number of single point checks being aggregated; $t_{0.95,n-1}$ is the 95th quantile of a t-distribution with n-1 degrees of freedom; the quantity *AB* is the mean of the absolute values of the d_i's (calculated by Equation 1) and is expressed as Equation 4 as follows:

Equation 4

$$AB = \frac{1}{n} \cdot \sum_{i=1}^{n} |d_i|$$

and the quantity *AS* is the standard deviation of the absolute value of the d_i's and is calculated using Equation 5 as follows:

Equation 5

$$AS = \sqrt{\frac{n \cdot \sum_{i=1}^{n} |d_i|^2 - \left(\sum_{i=1}^{n} |d_i|\right)^2}{n(n-1)}}$$

Since the bias statistic as calculated in Equation 3 of this Appendix uses absolute values, it does not have a tendency (negative or positive bias) associated with it. A sign will be designated by rank ordering the percent differences (d_i's) of the QC check samples from a given site for a particular assessment interval. Calculate the 25th and 75th percentiles of the percent differences for each site. The absolute bias upper bound should be flagged as positive if both percentiles are positive and negative if both percentiles are negative. The absolute bias upper bound would not be flagged if the 25th and 75th percentiles are of different signs (i.e. straddling zero).

Validation of Bias

The annual performance evaluations (audits) for SO_2, NO_2, O_3, or CO are used to verify the results obtained from the one-point QC checks and to validate those results across a range of concentration levels. To quantify this annually at the site level and at the 3-year primary quality assurance organization level, probability limits will be calculated from the one-point QC checks using equations 6 and 7:

Equation 6

$$\text{Upper Probability Limit} = m + 1.96 \cdot S$$

Equation 7

$$\text{Lower Probability Limit} = m - 1.96 \cdot S$$

where, m is the mean (equation 8):

Equation 8

$$m = \frac{1}{k} \cdot \sum_{i=1}^{k} d_i$$

where, k is the total number of one point QC checks for the interval being evaluated and S is the standard deviation of the percent differences (equation 9) as follows:

Equation 9

$$S = \sqrt{\frac{k \cdot \sum_{i=1}^{k} d_i^2 - \left(\sum_{i=1}^{k} d_i \right)^2}{k(k-1)}}$$

D.2 Precision Estimates from Collocated Samples

Applies to: PM2.5, PM10, Lead

40 CFR Part 58 Appendix A References:

- ***4.2.1 Precision Estimate from Collocated Samplers***
- ***4.3.1 Precision Estimate(PM2.5)***
- ***4.4.1 Precision Estimate (Lead)***

Precision is estimated for manual instrumentation via duplicate measurements from collocated samplers at a minimum concentration (see table below for minimum concentration levels).

Minimum Concentration Levels for Particulate Matter Precision Assessments

Pollutant	Minimum Concentration Level (in µg/m^3)
PM2.5	3
Lo-Vol PM2.5	3
Hi-Vol PM10	15
Lead	0.15

Precision is aggregated at the primary quality assurance organization (PQAO) level quarterly, annually, and at the 3-year level. For each collocated data pair, the relative percent difference, d_i, is calculated by Equation 4.

Equation 10

$$d_i = \frac{X_i - Y_i}{(X_i + Y_i)/2} \cdot 100$$

where X_i is the concentration of the primary sampler and Y_i is the concentration value from the audit sampler.

The precision upper bound statistic, CV_{ub}, is a standard deviation on d_i with a 90 percent upper confidence limit (Equation 11).

Equation 11

$$CV\_ub = \sqrt{\frac{n \cdot \sum_{i=1}^{n} d_i^{\,2} - \left(\sum_{i=1}^{n} d_i\right)^2}{2n(n-1)}} \cdot \sqrt{\frac{n-1}{\chi^2_{0.1,n-1}}}$$

where, n is the number of valid data pairs being aggregated, and $\chi^2_{0.1,n-1}$ is the 10th percentile of a chi-squared distribution with n-1 degrees of freedom. The factor of 2 in the denominator adjusts for the fact that each d_i is calculated from two values with error.

D.3 PM2.5 Bias Assessment

Applies to: PM2.5

40 CFR Part 58 Appendix A Reference:

- ***4.3.2 Bias Estimate ($PM_{2.5}$)***

The bias estimate is calculated using the Performance Evaluation Program (PEP) audits described in CFR, section 4.1.3 of Part 58, Appendix A. The bias estimator is based on upper and lower probability limits on the mean percent differences (Equation 1). The mean percent difference, *D*, is calculated by Equation 12 below.

Equation 12

$$D = \frac{1}{n_j} \cdot \sum_{i=1}^{n_j} d_i$$

Confidence intervals can be constructed for these average bias estimates in Equation 12 of this document using equations 13 and 14 below:

Equation 13

$$\text{Upper 90\% Confidence Interval} = D + t_{0.95,df} \cdot \frac{s_d}{\sqrt{n_j}}$$

Equation 14

$$\text{Lower 90\% Confidence Interval} = D - t_{0.95,df} \cdot \frac{s_d}{\sqrt{n_j}}$$

Where, $t_{0.95,df}$ is the 95th quantile of a t-distribution with degrees of freedom df=n_j-1 and $\underline{s_d}$ is an estimate of the variability of the average bias and is calculated using Equation 15 below:

Equation 15

$$s_d = \sqrt{\frac{\sum_{i=1}^{n_j} (d_i - D)^2}{n_j - 1}}$$

D.4 PM2.5 Absolute Bias Assessment

Applies to: PM2.5

40 CFR Part 58 Appendix A Reference:

- ***4.1.3 Bias Estimate***

The bias estimate is calculated using the Performance Evaluation Program (PEP) audits described in CFR, section 4.1.3 of Part 58, Appendix A. The bias estimator is an upper bound on the mean absolute value of the percent differences (Equation 1), as described in Equation 3 as follows:

Equation 3

$$|bias| = AB + t_{0.95,n-1} \cdot \frac{AS}{\sqrt{n}}$$

where n is the number of PEP audits being aggregated; $t_{0.95,n-1}$ is the 95th quantile of a t-distribution with n-1 degrees of freedom; the quantity AB is the mean of the absolute values of the d_i's (calculated by Equation 1) and is expressed as Equation 4 as follows:

Equation 4

$$AB = \frac{1}{n} \cdot \sum_{i=1}^{n} |d_i|$$

and the quantity AS is the standard deviation of the absolute value of the d_i's (Equation 1) and is calculated using Equation 5 as follows:

Equation 5

$$AS = \sqrt{\frac{n \cdot \sum_{i=1}^{n} |d_i|^2 - \left(\sum_{i=1}^{n} |d_i|\right)^2}{n(n-1)}}$$

Since the bias statistic as calculated in Equations 3 and 6 of this Appendix uses absolute values, it does not have a sign direction (negative or positive bias) associated with it. A sign will be designated by rank ordering the percent differences of the QC check samples from a given site for a particular assessment interval. Calculate the 25th and 75th percentiles of the percent differences for each site. The absolute bias upper bound should be flagged as positive if both percentiles are positive and negative if both percentiles are negative. The absolute bias upper bound would not be flagged if the 25th and 75th percentiles are of different signs (i.e. straddling zero).

D.5 One-Point Flow Rate Bias Estimate

Applies to: PM10, PM2.5

40 CFR Part 58 Appendix A References:

- ***4.2.2 Bias Estimate Using One-Point Flow Rate Verifications (PM10)***
- ***4.3.2 Bias Estimate (PM10-2.5)***
- ***Assigning a sign (positive / negative) to the bias estimate.***

The bias estimate is calculated using the collocated audits previously described. The bias estimator is an upper bound on the mean absolute value of the percent differences (Equation 1), as described in Equation 3 as follows:

Equation 3

$$|bias| = AB + t_{0.95,n-1} \cdot \frac{AS}{\sqrt{n}}$$

where *n* is the number of flow audits being aggregated; $t_{0.95,n-1}$ is the 95th quantile of a t-distribution with n-1 degrees of freedom; the quantity *AB* is the mean of the absolute values of the d_i's (calculated by Equation 4) and is expressed as Equation 4 as follows:

Equation 4

$$AB = \frac{1}{n} \cdot \sum_{i=1}^{n} |d_i|$$

and the quantity *AS* is the standard deviation of the absolute value of the d_i's (Equation 4) and is calculated using Equation 5 as follows:

Equation 5

$$AS = \sqrt{\frac{n \cdot \sum_{i=1}^{n} |d_i|^2 - \left(\sum_{i=1}^{n} |d_i|\right)^2}{n(n-1)}}$$

Since the bias statistic as calculated in Equation 3 of this Appendix uses absolute values, it does not have a sign direction (negative or positive bias) associated with it. A sign will be designated by rank ordering the percent differences of the QC check samples from a given site for a particular assessment interval. Calculate the 25th and 75th percentiles of the percent differences for each site. The absolute bias upper bound should be flagged as positive if both percentiles are positive and negative if both percentiles are negative. The absolute bias upper bound would not be flagged if the 25th and 75th percentiles are of different signs (i.e. straddling zero).

D.6 Semi-Annual Flow Rate Audits

Applies to: PM10, TSP, PM2.5, PM10-2.5

40 CFR Part 58 Appendix A References:

- ***4.2.3 Assessment Semi-Annual Flow Rate Audits***
- ***4.2.4 Percent Differences***

The flow rate audits are used to assess the results obtained from the one-point flow rate verifications and to provide an estimate of flow rate acceptability. For each flow rate audit, calculate the percent difference in volume using equation 1 of this Appendix where meas is the value indicated by the sampler's volume measurement and audit is the actual volume indicated by the auditing flow meter.

Equation 1

$$d_i = \frac{meas - audit}{audit} \cdot 100$$

To quantify this annually at the site level and at the 3-year primary quality assurance

organization level, probability limits are calculated from the percent differences using equations 6 and 7 of this document where m is the mean described in equation 8 of this document and k is the total number of one-point flow rate verifications for the year

Equation 6

$$\text{Upper Probability Limit} = m + 1.96 \cdot S$$

Equation 7

$$\text{Lower Probability Limit} = m - 1.96 \cdot S$$

where, m is the mean (equation 8):

Equation 8

$$m = \frac{1}{k} \cdot \sum_{i=1}^{k} d_i$$

where, k is the total number of one point QC checks for the interval being evaluated and S is the standard deviation of the percent differences (equation 9) as follows:

Equation 9

$$S = \sqrt{\frac{k \cdot \sum_{i=1}^{k} d_i^2 - \left(\sum_{i=1}^{k} d_i \right)^2}{k(k-1)}}$$

APPENDIX E

CALIFORNIA'S AIR MONITORING STATIONS

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This appendix provides the reader with the complete listing of monitoring stations in 2013 organized in two ways:

1. by AQS number, monitoring stations, county, and field collection organization; and
2. by monitoring stations, county, field collection organization, and AQS number.

AQS numbers are used in Appendices F and G.

AQS #	Monitoring Station	County	Field Collection Organization
06-001-0007	Livermore-793 Rincon Avenue	Alameda	Bay Area AQMD
06-001-0009	Oakland-9925 International Blvd	Alameda	Bay Area AQMD
06-001-0011	Oakland-West	Alameda	Bay Area AQMD
06-001-2001	Hayward-La Mesa	Alameda	Bay Area AQMD
06-001-2005	Livermore-13224 Patterson Pass Road	Alameda	Bay Area AQMD
06-005-0002	Jackson-Clinton Road	Amador	Air Resources Board
06-007-0007	Paradise-4405 Airport Road	Butte	Air Resources Board
06-007-0008	Chico East Ave	Butte	Air Resources Board
06-009-0001	San Andreas-Gold Strike Road	Calaveras	Air Resources Board
06-011-1002	Colusa-Sunrise Blvd	Colusa	Air Resources Board
06-013-0002	Concord-2975 Treat Blvd	Contra Costa	Bay Area AQMD
06-013-0006	Richmond-7th Street	Contra Costa	Bay Area AQMD
06-013-1001	Crockett-Kendall Avenue	Contra Costa	Bay Area AQMD
06-013-1002	Bethel Island Road	Contra Costa	Bay Area AQMD
06-013-1004	San Pablo-Rumrill Blvd	Contra Costa	Bay Area AQMD
06-013-2001	Martinez-Jones Street	Contra Costa	Bay Area AQMD
06-017-0010	Placerville-Gold Nugget Way	El Dorado	Air Resources Board
06-017-0012	Echo Summit	El Dorado	Air Resources Board
06-017-0020	Cool-Highway 193	El Dorado	Air Resources Board
06-019-0007	Fresno-Drummond Street	Fresno	San Joaquin Valley Unified APCD
06-019-0008	Fresno-1st Street	Fresno	Air Resources Board
06-019-0011	Fresno Garland	Fresno	Air Resources Board
06-019-0242	Fresno-Sierra Skypark #2	Fresno	San Joaquin Valley Unified APCD
06-019-2009	Tranquility-32650 West Adams Avenue	Fresno	San Joaquin Valley Unified APCD
06-019-4001	Parlier	Fresno	San Joaquin Valley Unified APCD
06-019-5001	Clovis-N Villa Avenue	Fresno	San Joaquin Valley Unified APCD
06-021-0003	Willows-720 N Colusa Street	Glenn	Air Resources Board
06-023-1002	Eureka-I Street	Humboldt	North Coast AQMD
06-023-1004	Eureka-Jacobs	Humboldt	North Coast AQMD
06-023-1005	Eureka-Humboldt Hill	Humboldt	North Coast AQMD
06-025-0005	Calexico-Ethel Street	Imperial	Air Resources Board
06-025-1003	El Centro-9th Street	Imperial	Imperial County APCD
06-025-4003	Westmorland-W 1st Street	Imperial	Imperial County APCD
06-025-4004	Niland-English Road	Imperial	Imperial County APCD
06-027-1003	Keeler-Cerro Gordo Road	Inyo	Great Basin Unified APCD
06-029-0007	Edison	Kern	Air Resources Board
06-029-0008	Maricopa-Stanislaus Street	Kern	San Joaquin Valley Unified APCD
06-029-0011	Mojave-923 Poole Street	Kern	Air Resources Board
06-029-0014	Bakersfield-5558 California Avenue	Kern	Air Resources Board
06-029-0232	Oildale-3311 Manor Street	Kern	Air Resources Board
06-029-5002	Arvin-Di Giorgio	Kern	Air Resources Board

AQS #	Monitoring Station	County	Field Collection Organization
06-029-6001	Shafter-Walker Street	Kern	Air Resources Board
06-031-0004	Corcoran-Patterson Ave	Kings	San Joaquin Valley Unified APCD
06-031-1004	Hanford-S Irwin Street	Kings	San Joaquin Valley Unified APCD
06-033-3001	Lakeport-Lakeport Blvd	Lake	Lake County APCD
06-037-0002	Azusa	Los Angeles	South Coast AQMD
06-037-0016	Glendora-Laurel	Los Angeles	South Coast AQMD
06-037-0113	West Los Angeles-VA Hospital	Los Angeles	South Coast AQMD
06-037-1002	Burbank-W Palm Avenue	Los Angeles	South Coast AQMD
06-037-1103	Los Angeles-North Main Street	Los Angeles	South Coast AQMD
06-037-1201	Reseda	Los Angeles	South Coast AQMD
06-037-1302	Compton-700 North Bullis Road	Los Angeles	South Coast AQMD
06-037-1602	Pico Rivera-4144 San Gabriel	Los Angeles	South Coast AQMD
06-037-1701	Pomona	Los Angeles	South Coast AQMD
06-037-2005	Pasadena-S Wilson Avenue	Los Angeles	South Coast AQMD
06-037-4002	North Long Beach	Los Angeles	South Coast AQMD
06-037-4006	Long Beach-2425 Webster Street	Los Angeles	South Coast AQMD
06-037-5005	Los Angeles-Westchester Parkway	Los Angeles	South Coast AQMD
06-037-6012	Santa Clarita	Los Angeles	South Coast AQMD
06-037-9033	Lancaster-43301 Division Street	Los Angeles	Antelope Valley APCD
06-039-0004	Madera-Pump Yard	Madera	San Joaquin Valley Unified APCD
06-039-2010	Madera-28261 Avenue 14	Madera	San Joaquin Valley Unified APCD
06-041-0001	San Rafael	Marin	Bay Area AQMD
06-043-0006	Jerseydale - 6440 Jerseydale	Mariposa	Air Resources Board
06-045-0006	Ukiah	Mendocino	Mendocino County APCD
06-045-0008	Ukiah-E Gobbi Street	Mendocino	Mendocino County APCD
06-045-2002	Willits-125 E	Mendocino	Mendocino County APCD
06-047-0003	Merced-S Coffee Avenue	Merced	San Joaquin Valley Unified APCD
06-053-0002	Carmel Valley-Ford Road	Monterey	Monterey Bay Unified APCD
06-053-0008	King City-415 Pearl Street	Monterey	Monterey Bay Unified APCD
06-053-1003	Salinas-#3	Monterey	Monterey Bay Unified APCD
06-055-0003	Napa-Jefferson Avenue	Napa	Bay Area AQMD
06-057-0005	Grass Valley-Litton Building	Nevada	Northern Sierra APCD
06-057-0007	White Cloud Mountain	Nevada	Air Resources Board
06-057-1001	Truckee-Fire Station	Nevada	Northern Sierra APCD
06-059-0007	Anaheim-Pampas Lane	Orange	South Coast AQMD
06-059-1003	Costa Mesa-Mesa Verde Drive	Orange	South Coast AQMD
06-059-2022	Mission Viejo-26081 Via Pera	Orange	South Coast AQMD
06-059-5001	La Habra	Orange	South Coast AQMD
06-061-0002	Auburn-Dewitt-C Avenue	Placer	Placer County APCD
06-061-0004	Colfax-City Hall	Placer	Placer County APCD
06-061-0006	Roseville-N Sunrise Blvd	Placer	Air Resources Board
06-061-1004	Tahoe City	Placer	Placer County APCD

AQS #	Monitoring Station	County	Field Collection Organization
06-065-0004	Mira Loma-10551 Bellegrave	Riverside	South Coast AQMD
06-065-0012	Banning Airport	Riverside	South Coast AQMD
06-065-1003	Riverside-Magnolia	Riverside	South Coast AQMD
06-065-2002	Indio-Jackson Street	Riverside	South Coast AQMD
06-065-5001	Palm Springs-Fire Station	Riverside	South Coast AQMD
06-065-6001	Perris	Riverside	South Coast AQMD
06-065-8001	Riverside-Rubidoux	Riverside	South Coast AQMD
06-065-8005	Mira Loma Van Buren	Riverside	South Coast AQMD
06-065-9001	Lake Elsinore-W Flint Street	Riverside	South Coast AQMD
06-065-9003	Blythe-445 West Murphy Street	Riverside	Air Resources Board
06-067-0002	North Highlands-Blackfoot Way	Sacramento	Sacramento Metropolitan AQMD
06-067-0006	Sacramento-Del Paso Manor	Sacramento	Sacramento Metropolitan AQMD
06-067-0007	Sacramento-El Camino and Watt	Sacramento	Sacramento Metropolitan AQMD
06-067-0010	Sacramento-T Street	Sacramento	Air Resources Board
06-067-0011	Elk Grove-Bruceville Road	Sacramento	Sacramento Metropolitan AQMD
06-067-0012	Folsom-Natoma Street	Sacramento	Sacramento Metropolitan AQMD
06-067-0014	Sacramento-Goldenland Court	Sacramento	Sacramento Metropolitan AQMD
06-067-4001	Sacramento-Health Dept	Sacramento	Sacramento Metropolitan AQMD
06-067-5003	Sloughhouse	Sacramento	Sacramento Metropolitan AQMD
06-069-0002	Hollister-Fairview Road	San Benito	Monterey Bay Unified APCD
06-071-0001	Barstow	San Bernardino	Mojave Desert AQMD
06-071-0005	Crestline	San Bernardino	South Coast AQMD
06-071-0012	Phelan-Beekley Road and Phelan Road	San Bernardino	Mojave Desert AQMD
06-071-0306	Victorville-14306 Park Avenue	San Bernardino	Mojave Desert AQMD
06-071-1004	Upland	San Bernardino	South Coast AQMD
06-071-1234	Trona-Athol and Telegraph	San Bernardino	Mojave Desert AQMD
06-071-2002	Fontana-Arrow Highway	San Bernardino	South Coast AQMD
06-071-4001	Hesperia-Olive Street	San Bernardino	Mojave Desert AQMD
06-071-4003	Redlands-Dearborn	San Bernardino	South Coast AQMD
06-071-9004	San Bernardino-4th Street	San Bernardino	South Coast AQMD
06-073-0001	Chula Vista	San Diego	San Diego County APCD
06-073-0003	El Cajon-Redwood Avenue	San Diego	San Diego County APCD
06-073-1016	San Diego-Kearny Villa Road	San Diego	San Diego County APCD
06-073-2007	Otay Mesa-Paseo International	San Diego	San Diego County APCD
06-075-0005	San Francisco-Arkansas Street	San Francisco	Bay Area AQMD
06-077-1002	Stockton-Hazelton Street	San Joaquin	Air Resources Board
06-077-3005	Tracy	San Joaquin	San Joaquin Valley Unified APCD
06-079-0005	Paso Robles-Santa Fe Avenue	San Luis Obispo	Air Resources Board
06-079-2006	San Luis Obispo-3220 South Higuera St	San Luis Obispo	Air Resources Board
06-079-3001	Morro Bay	San Luis Obispo	San Luis Obispo County APCD
06-079-4002	Nipomo-Regional Park	San Luis Obispo	San Luis Obispo County APCD

AQS #	Monitoring Station	County	Field Collection Organization
06-079-8001	Atascadero-Lewis Avenue	San Luis Obispo	San Luis Obispo County APCD
06-079-8005	Red Hills	San Luis Obispo	San Luis Obispo County APCD
06-079-8006	Carrizo Plains School-9640 Carrizo	San Luis Obispo	San Luis Obispo County APCD
06-081-1001	Redwood City	San Mateo	Bay Area AQMD
06-083-0008	El Capitan Beach	Santa Barbara	Santa Barbara County APCD
06-083-0011	Santa Barbara-700 East Canon Perdido	Santa Barbara	Air Resources Board
06-083-1008	Santa Maria-906 S Broadway	Santa Barbara	Santa Barbara County APCD
06-083-1013	Lompoc-HSandP	Santa Barbara	Santa Barbara County APCD
06-083-1014	Paradise Road-Los Padres National Forest	Santa Barbara	Santa Barbara County APCD
06-083-1018	Gaviota-GTC Site B	Santa Barbara	Santa Barbara County APCD
06-083-1020	Exxon Site 10-UCSB West Campus	Santa Barbara	Santa Barbara County APCD
06-083-1021	Carpinteria-Gobernador Road	Santa Barbara	Santa Barbara County APCD
06-083-1025	Las Flores Canyon #1	Santa Barbara	Santa Barbara County APCD
06-083-2004	Lompoc-South H Street	Santa Barbara	Santa Barbara County APCD
06-083-2011	Goleta-Fairview	Santa Barbara	Santa Barbara County APCD
06-083-3001	Santa Ynez-Airport Road	Santa Barbara	Santa Barbara County APCD
06-083-4003	Vandenberg Air Force Base-STS Power	Santa Barbara	Santa Barbara County APCD
06-085-0002	Gilroy-9th Street	Santa Clara	Bay Area AQMD
06-085-0005	San Jose-Jackson Street	Santa Clara	Bay Area AQMD
06-085-1001	Los Gatos	Santa Clara	Bay Area AQMD
06-085-2006	San Martin-Murphy Avenue	Santa Clara	Bay Area AQMD
06-085-2009	Cupertino-22601 Voss Ave	Santa Clara	Bay Area AQMD
06-087-0007	Santa Cruz-2544 Soquel Avenue	Santa Cruz	Monterey Bay Unified APCD
06-089-0004	Redding-Health Dept Roof	Shasta	Shasta County APCD
06-089-0007	Anderson-North Street	Shasta	Shasta County APCD
06-089-0009	Shasta Lake-13791 Lake Blvd	Shasta	Shasta County APCD
06-093-2001	Yreka-Foothill Drive	Siskiyou	Siskiyou County APCD
06-095-0004	Vallejo-304 Tuolumne Street	Solano	Bay Area AQMD
06-095-0005	Fairfield-Chadbourne Road	Solano	Bay Area AQMD
06-095-3003	Vacaville-Ulatis Drive	Solano	Yolo-Solano AQMD
06-097-0003	Santa Rosa-5th Street	Sonoma	Northern Sonoma County APCD
06-079-2006	San Luis Obispo-3220 South Higuera St	San Luis Obispo	Air Resources Board
06-079-3001	Morro Bay	San Luis Obispo	San Luis Obispo County APCD
06-079-4002	Nipomo-Regional Park	San Luis Obispo	San Luis Obispo County APCD
06-095-3003	Vacaville-Ulatis Drive	Solano	Yolo-Solano AQMD
06-097-1003	Healdsburg-Municipal Airport	Sonoma	Northern Sonoma County APCD
06-099-0005	Modesto-14th Street	Stanislaus	Air Resources Board
06-099-0006	Turlock-S Minaret Street	Stanislaus	San Joaquin Valley Unified APCD
06-101-0003	Yuba City-Almond Street	Sutter	Air Resources Board
06-101-0004	Sutter Buttes-S Butte	Sutter	Air Resources Board
06-103-0004	Tuscan Butte	Tehama	Air Resources Board
06-103-0005	Red Bluff-Oak Street	Tehama	Tehama County APCD
06-105-0002	Weaverville- Court & Church Sts	Trinity	North Coast Unified AQMD

AQS #	Monitoring Station	County	Field Collection Organization
06-107-2002	Visalia-N Church Street	Tulare	Air Resources Board
06-107-2010	Porterville-1839 Newcomb Street	Tulare	San Joaquin Valley Unified APCD
06-109-0005	Sonora-Barretta Street	Tuolumne	Air Resources Board
06-111-0007	Thousand Oaks-Moorpark Road	Ventura	Ventura County APCD
06-111-0009	Piru-3301 Pacific Avenue	Ventura	Ventura County APCD
06-111-1004	Ojai-Ojai Avenue	Ventura	Ventura County APCD
06-111-2002	Simi Valley-Cochran Street	Ventura	Ventura County APCD
06-111-2003	Ventura-Emma Wood State Beach	Ventura	Ventura County APCD
06-111-3001	El Rio-Rio Mesa School #2	Ventura	Ventura County APCD
06-113-0004	Davis-UCD Campus	Yolo	Air Resources Board
06-113-1003	Woodland-Gibson Road	Yolo	Yolo-Solano AQMD

Monitoring Station	County	Field Collection Organization	AQS #
Alpine-Victoria Drive	San Diego	San Diego County APCD	06-073-1006
Anaheim-Pampas Lane	Orange	South Coast AQMD	06-059-0007
Anderson-North Street	Shasta	Shasta County APCD	06-089-0007
Arvin-Di Giorgio	Kern	Air Resources Board	06-029-5002
Atascadero-Lewis Avenue	San Luis Obispo	San Luis Obispo County APCD	06-079-8001
Auburn-Dewitt-C Avenue	Placer	Placer County APCD	06-061-0002
Azusa	Los Angeles	South Coast AQMD	06-037-0002
Bakersfield-5558 California Avenue	Kern	Air Resources Board	06-029-0014
Banning Airport	Riverside	South Coast AQMD	06-065-0012
Barstow	San Bernardino	Mojave Desert AQMD	06-071-0001
Bethel Island Road	Contra Costa	Bay Area AQMD	06-013-1002
Blythe-445 West Murphy Street	Riverside	Air Resources Board	06-065-9003
Burbank-W Palm Avenue	Los Angeles	South Coast AQMD	06-037-1002
Calexico-Ethel Street	Imperial	Air Resources Board	06-025-0005
Camp Pendleton	San Diego	San Diego County APCD	06-073-1008
Carmel Valley-Ford Road	Monterey	Monterey Bay Unified APCD	06-053-0002
Carpinteria-Gobernador Road	Santa Barbara	Santa Barbara County APCD	06-083-1021
Carrizo Plains School-9640 Carrizo	San Luis Obispo	San Luis Obispo County APCD	06-079-8006
Chico-East Avenue	Butte	Air Resources Board	06-007-0008
Chula Vista	San Diego	San Diego County APCD	06-073-0001
Clovis-N Villa Avenue	Fresno	San Joaquin Valley Unified APCD	06-019-5001
Colfax-City Hall	Placer	Placer County APCD	06-061-0004
Colusa-Sunrise Blvd	Colusa	Air Resources Board	06-011-1002
Compton-700 North Bullis Road	Los Angeles	South Coast AQMD	06-037-1302
Concord-2975 Treat Blvd	Contra Costa	Bay Area AQMD	06-013-0002
Cool-Highway 193	El Dorado	Air Resources Board	06-017-0020
Corcoran-Patterson Avenue	Kings	San Joaquin Valley Unified APCD	06-031-0004
Costa Mesa-Mesa Verde Drive	Orange	South Coast AQMD	06-059-1003
Crestline	San Bernardino	South Coast AQMD	06-071-0005
Crockett-Kendall Avenue	Contra Costa	Bay Area AQMD	06-013-1001
Cupertino-22601 Voss Ave	Santa Clara	Bay Area AQMD	06-085-2009
Davis-UCD Campus	Yolo	Air Resources Board	06-113-0004
Del Mar-Mira Costa College	San Diego	San Diego County APCD	06-073-1001
Echo Summit	El Dorado	Air Resources Board	06-017-0012
Edison	Kern	Air Resources Board	06-029-0007
El Cajon-Redwood Avenue	San Diego	San Diego County APCD	06-073-0003
El Capitan Beach	Santa Barbara	Santa Barbara County APCD	06-083-0008
El Centro-9th Street	Imperial	Imperial County APCD	06-025-1003
El Rio-Rio Mesa School #2	Ventura	Ventura County APCD	06-111-3001

Monitoring Station	County	Field Collection Organization	AQS #
Elk Grove-Bruceville Road	Sacramento	Sacramento Metropolitan AQMD	06-067-0011
Escondido-E Valley Parkway	San Diego	San Diego County APCD	06-073-1002
Eureka-Humboldt Hill	Humboldt	North Coast AQMD	06-023-1005
Eureka-I Street	Humboldt	North Coast AQMD	06-023-1002
Eureka-Jacobs	Humboldt	North Coast AQMD	06-023-1004
Exxon Site 10-UCSB West Campus	Santa Barbara	Santa Barbara County APCD	06-083-1020
Fairfield-Chadbourne Road	Solano	Bay Area AQMD	06-095-0005
Folsom-Natoma Street	Sacramento	Sacramento Metropolitan AQMD	06-067-0012
Fontana-Arrow Highway	San Bernardino	South Coast AQMD	06-071-2002
Fresno-1st Street	Fresno	Air Resources Board	06-019-0008
Fresno-Drummond Street	Fresno	San Joaquin Valley Unified APCD	06-019-0007
Fresno-Garland	Fresno	Air Resources Board	06-019-0011
Fresno-Sierra Skypark #2	Fresno	San Joaquin Valley Unified APCD	06-019-0242
Gaviota-GTC Site B	Santa Barbara	Santa Barbara County APCD	06-083-1018
Gilroy-9th Street	Santa Clara	Bay Area AQMD	06-085-0002
Glendora-Laurel	Los Angeles	South Coast AQMD	06-037-0016
Goleta-Fairview	Santa Barbara	Santa Barbara County APCD	06-083-2011
Grass Valley-Litton Building	Nevada	Northern Sierra APCD	06-057-0005
Hanford-S Irwin Street	Kings	San Joaquin Valley Unified APCD	06-031-1004
Hayward-La Mesa	Alameda	Bay Area AQMD	06-001-2001
Healdsburg-Municipal Airport	Sonoma	Northern Sonoma County APCD	06-097-1003
Hesperia-Olive Street	San Bernardino	Mojave Desert AQMD	06-071-4001
Hollister-Fairview Road	San Benito	Monterey Bay Unified APCD	06-069-0002
Indio-Jackson Street	Riverside	South Coast AQMD	06-065-2002
Jackson-Clinton Road	Amador	Air Resources Board	06-005-0002
Jerseydale - 6440 Jerseydale	Mariposa	Air Resources Board	06-043-0006
Joshua Tree National Park	Riverside	National Park Service	06-065-0008
Joshua Tree-National Monument	San Bernardino	National Park Service	06-071-9002
Keeler-Cerro Gordo Road	Inyo	Great Basin Unified APCD	06-027-1003
King City-415 Pearl Street	Monterey	Monterey Bay Unified APCD	06-053-0008
La Habra	Orange	South Coast AQMD	06-059-5001
Lake Elsinore-W Flint Street	Riverside	South Coast AQMD	06-065-9001
Lakeport-Lakeport Blvd	Lake	Lake County APCD	06-033-3001
Lancaster-43301 Division Street	Los Angeles	Antelope Valley APCD	06-037-9033
Las Flores Canyon #1	Santa Barbara	Santa Barbara County APCD	06-083-1025
Lassen Volcanic Natl Park-Manzanita	Shasta	National Park Service	06-089-3003
Livermore-13224 Patterson Pass Road	Alameda	Bay Area AQMD	06-001-2005
Livermore-793 Rincon Avenue	Alameda	Bay Area AQMD	06-001-0007
Lompoc-HSandP	Santa Barbara	Santa Barbara County APCD	06-083-1013
Lompoc-South H Street	Santa Barbara	Santa Barbara County APCD	06-083-2004
Long Beach-2425 Webster Street	Los Angeles	South Coast AQMD	06-037-4006
Los Angeles-North Main Street	Los Angeles	South Coast AQMD	06-037-1103

Monitoring Station	County	Field Collection Organization	AQS #
Los Angeles-Westchester Parkway	Los Angeles	South Coast AQMD	06-037-5005
Los Gatos	Santa Clara	Bay Area AQMD	06-085-1001
Madera-28261 Avenue 14	Madera	San Joaquin Valley Unified APCD	06-039-2010
Madera-Pump Yard	Madera	San Joaquin Valley Unified APCD	06-039-0004
Maricopa-Stanislaus Street	Kern	San Joaquin Valley Unified APCD	06-029-0008
Martinez-Jones Street	Contra Costa	Bay Area AQMD	06-013-2001
Merced-S Coffee Avenue	Merced	San Joaquin Valley Unified APCD	06-047-0003
Mira Loma Van Buren	Riverside	South Coast AQMD	06-065-8005
Mira Loma-10551 Bellegrave	Riverside	South Coast AQMD	06-065-0004
Mission Viejo-26081 Via Pera	Orange	South Coast AQMD	06-059-2022
Modesto-14th Street	Stanislaus	Air Resources Board	06-099-0005
Mojave-923 Poole Street	Kern	Air Resources Board	06-029-0011
Morro Bay	San Luis Obispo	San Luis Obispo County APCD	06-079-3001
Napa-Jefferson Avenue	Napa	Bay Area AQMD	06-055-0003
Niland-English Road	Imperial	Imperial County APCD	06-025-4004
Nipomo-Regional Park	San Luis Obispo	San Luis Obispo County APCD	06-079-4002
North Highlands-Blackfoot Way	Sacramento	Sacramento Metropolitan AQMD	06-067-0002
North Long Beach	Los Angeles	South Coast AQMD	06-037-4002
Oakland-9925 International Blvd	Alameda	Bay Area AQMD	06-001-0009
Oakland-West	Alameda	Bay Area AQMD	06-001-0011
Oildale-3311 Manor Street	Kern	Air Resources Board	06-029-0232
Ojai-Ojai Avenue	Ventura	Ventura County APCD	06-111-1004
Otay Mesa-Paseo International	San Diego	San Diego County APCD	06-073-2007
Palm Springs-Fire Station	Riverside	South Coast AQMD	06-065-5001
Paradise Road-Los Padres National	Santa Barbara	Santa Barbara County APCD	06-083-1014
Paradise-4405 Airport Road	Butte	Air Resources Board	06-007-0007
Parlier	Fresno	San Joaquin Valley Unified APCD	06-019-4001
Pasadena-S Wilson Avenue	Los Angeles	South Coast AQMD	06-037-2005
Paso Robles-Santa Fe Avenue	San Luis Obispo	Air Resources Board	06-079-0005
Perris	Riverside	South Coast AQMD	06-065-6001
Phelan-Beekley Road and Phelan Road	San Bernardino	Mojave Desert AQMD	06-071-0012
Pico Rivera-4144 San Gabriel	Los Angeles	South Coast AQMD	06-037-1602
Piru-3301 Pacific Avenue	Ventura	Ventura County APCD	06-111-0009
Placerville-Gold Nugget Way	El Dorado	Air Resources Board	06-017-0010
Pomona	Los Angeles	South Coast AQMD	06-037-1701
Porterville-1839 Newcomb Street	Tulare	San Joaquin Valley Unified APCD	06-107-2010
Red Bluff-Oak Street	Tehama	Tehama County APCD	06-103-0005
Red Hills	San Luis Obispo	San Luis Obispo County APCD	06-079-8005
Redding-Health Dept Roof	Shasta	Shasta County APCD	06-089-0004
Redlands-Dearborn	San Bernardino	South Coast AQMD	06-071-4003
Redwood City	San Mateo	Bay Area AQMD	06-081-1001

Monitoring Station	County	Field Collection Organization	AQS #
Reseda	Los Angeles	South Coast AQMD	06-037-1201
Richmond-7th Street	Contra Costa	Bay Area AQMD	06-013-0006
Riverside-Magnolia	Riverside	South Coast AQMD	06-065-1003
Riverside-Rubidoux	Riverside	South Coast AQMD	06-065-8001
Roseville-N Sunrise Blvd	Placer	Air Resources Board	06-061-0006
Sacramento-Del Paso Manor	Sacramento	Sacramento Metropolitan AQMD	06-067-0006
Sacramento-El Camino and Watt	Sacramento	Sacramento Metropolitan AQMD	06-067-0007
Sacramento-Goldenland Court	Sacramento	Sacramento Metropolitan AQMD	06-067-0014
Sacramento-Health Dept	Sacramento	Sacramento Metropolitan AQMD	06-067-4001
Sacramento-T Street	Sacramento	Air Resources Board	06-067-0010
Salinas-#3	Monterey	Monterey Bay Unified APCD	06-053-1003
San Andreas-Gold Strike Road	Calaveras	Air Resources Board	06-009-0001
San Bernardino-4th Street	San Bernardino	South Coast AQMD	06-071-9004
San Diego-1110 Beardsley Street	San Diego	San Diego County APCD	06-073-1010
San Diego-Kearny Villa Road	San Diego	San Diego County APCD	06-073-1016
San Diego-Overland Avenue	San Diego	San Diego County APCD	06-073-0006
San Francisco-Arkansas Street	San Francisco	Bay Area AQMD	06-075-0005
San Jose-Jackson Street	Santa Clara	Bay Area AQMD	06-085-0005
San Luis Obispo-3220 South Higuera	San Luis Obispo	Air Resources Board	06-079-2006
San Martin-Murphy Avenue	Santa Clara	Bay Area AQMD	06-085-2006
San Pablo-Rumrill Blvd	Contra Costa	Bay Area AQMD	06-013-1004
San Rafael	Marin	Bay Area AQMD	06-041-0001
Santa Barbara-700 East Canon Perdido	Santa Barbara	Air Resources Board	06-083-0011
Santa Clarita	Los Angeles	South Coast AQMD	06-037-6012
Santa Cruz-2544 Soquel Avenue	Santa Cruz	Monterey Bay Unified APCD	06-087-0007
Santa Maria-906 S Broadway	Santa Barbara	Air Resources Board	06-083-1008
Santa Ynez-Airport Road	Santa Barbara	Santa Barbara County APCD	06-083-3001
Shafter-Walker Street	Kern	Air Resources Board	06-029-6001
Shasta Lake-13791 Lake Blvd	Shasta	Shasta County APCD	06-089-0009
Simi Valley-Cochran Street	Ventura	Ventura County APCD	06-111-2002
Sloughhouse	Sacramento	Sacramento Metropolitan AQMD	06-067-5003
Sonora-Barretta Street	Tuolumne	Air Resources Board	06-109-0005
Stockton-Hazelton Street	San Joaquin	Air Resources Board	06-077-1002
Sutter Buttes-S Butte	Sutter	Air Resources Board	06-101-0004
Tahoe City	Placer	Placer County APCD	06-061-1004
Thousand Oaks-Moorpark Road	Ventura	Ventura County APCD	06-111-0007
Tracy	San Joaquin	San Joaquin Valley Unified APCD	06-077-3005
Tranquility-32650 West Adams	Fresno	San Joaquin Valley Unified APCD	06-019-2009
Trona-Athol and Telegraph	San Bernardino	Mojave Desert AQMD	06-071-1234
Truckee-Fire Station	Nevada	Northern Sierra APCD	06-057-1001
Turlock-S Minaret Street	Stanislaus	San Joaquin Valley Unified APCD	06-099-0006

Monitoring Station	County	Field Collection Organization	AQS #
Tuscan Butte	Tehama	Air Resources Board	06-103-0004
Ukiah-County Library	Mendocino	Mendocino County APCD	06-045-0006
Ukiah-E Gobbi Street	Mendocino	Mendocino County APCD	06-045-0008
Upland	San Bernardino	South Coast AQMD	06-071-1004
Vacaville-Ulatis Drive	Solano	Yolo-Solano AQMD	06-095-3003
Vallejo-304 Tuolumne Street	Solano	Bay Area AQMD	06-095-0004
Vandenberg Air Force Base-STS	Santa Barbara	Santa Barbara County APCD	06-083-4003
Ventura-Emma Wood State Beach	Ventura	Ventura County APCD	06-111-2003
Victorville-14306 Park Avenue	San Bernardino	Mojave Desert AQMD	06-071-0306
Visalia-N Church Street	Tulare	Air Resources Board	06-107-2002
Weaverville-Court & Church Sts	Trinity	North Coast Unified AQMD	06-105-0002
West Los Angeles-VA Hospital	Los Angeles	South Coast AQMD	06-037-0113
Westmorland-W 1st Street	Imperial	Imperial County APCD	06-025-4003
White Cloud Mountain	Nevada	Air Resources Board	06-057-0007
Willits-125 E Commercial St	Mendocino	Mendocino County APCD	06-045-2002
Willows-720 N Colusa Street	Glenn	Air Resources Board	06-021-0003
Winchester-33700 Borel Road	Riverside	South Coast AQMD	06-065-0016
Woodland-Gibson Road	Yolo	Yolo-Solano AQMD	06-113-1003
Yosemite Natl Park-Turtleback Dome	Mariposa	National Park Service	06-043-0003
Yreka-Foothill Drive	Siskiyou	Siskiyou County APCD	06-093-2001
Yuba City-Almond Street	Sutter	Air Resources Board	06-101-0003

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APPENDIX F

U.S. EPA's PRECISION AND BIAS GRAPHICS FOR STATIONS MONITORING GASEOUS CRITERIA POLLUTANTS IN CALIFORNIA

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Background

U.S. EPA revised 40 CFR Part 58 Appendix A in order to base the precision and bias measurement quality objectives on confidence intervals. Since the criteria pollutant data are important in making air quality decisions (i.e., comparison to the National Ambient Air Quality Standards), remaining precision and bias estimates at upper confidence limits provides a higher probability of making appropriate decisions. This statistic provides a conservative approach to measuring precision and bias.

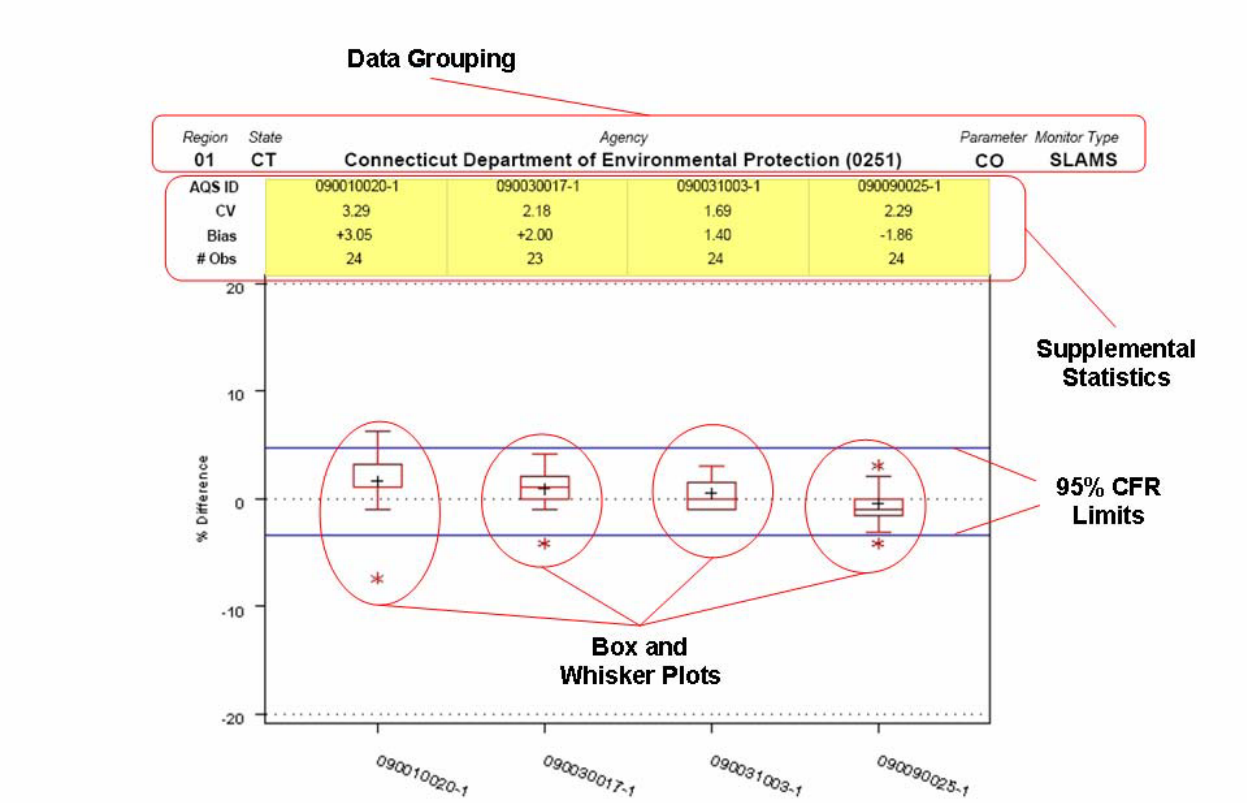
A document describing these statistics is available from U.S. EPA:
http://www.epa.gov/ttn/amtic/parslist.html

Estimates of both bias and precision for the four automated gaseous methods (CO, NO_2, O_3, and SO_2) are derived from the bi-weekly one-point QC (formerly called precision) checks. Since each site is required to perform the QC checks at an acceptable frequency, there is enough information to assess and control data quality at the site level. In 2005, OAQPS developed a new report in AQS (AMP255 – Data Quality Indicator Summary Report) that summarized precision, bias, and completeness of the required QC data for each criteria pollutant. The data tables may be generated at any time within the AQS application using the standard report. The plots in this Appendix depict the summary statistics in graphical form. The elements of these plots are briefly described below. Details on these plots, including definitions of terms involved, are available at:
http://www.epa.gov/ttn/amtic/files/ambient/qaqc/boxplots.pdf

Description of the Plots

Each graph presented is comprised of four parts. The four parts of each graph are as follows:

- Data Grouping
- Supplemental Statistics
- Box and Whisker Plots
- 95% CFR Confidence Limits



Precision and Bias Report Sample Page

A given plot will display up to nine box plots per graph and a maximum of two graphs will appear on a given page.

Each page of the report displays the results for a particular data grouping. A "data grouping" is defined by unique combinations of Region – State – Agency – Pollutant - Monitor Type Classification combinations. The data grouping is located at the top of each page. The plots are sorted in the following order:

1. Region
2. State Abbreviation (i.e. CA)
3. Agency Code (0086=Bay Area; 0145=ARB; 0972=South Coast; 0942=San Diego)
4. Parameter (CO, NO_2, O_3, SO_2)
5. Monitor Type Classification (OTHER, SLAMS)

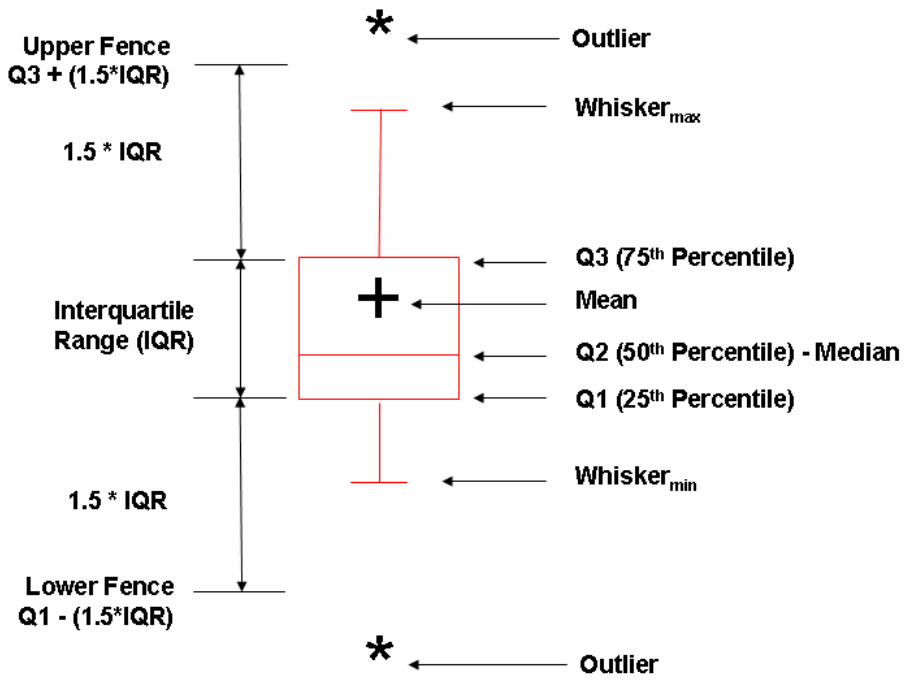
In addition to the statistics represented in the graph, the following information and statistics are displayed for each monitor within each data grouping:

- AQS ID – The plots are sorted by the AQS ID in ascending order (See AQS ID by monitor name in Appendix E).
- Bias Upper Bound
- CV Upper Bound

- # Obs - Number of Samples contained within the set

A “Box and Whisker Plot” is created for each monitor within a reporting organization measuring a gaseous criteria pollutant (carbon monoxide, nitrogen dioxide, ozone, and sulfur dioxide). A singe box plot is based on the percent relative error statistics from the one-point precision checks for a single monitoring site measuring a pollutant conducted within the effective time period in 2013. Multiple box plots are displayed within a data grouping. A box plot displays the following statistics:

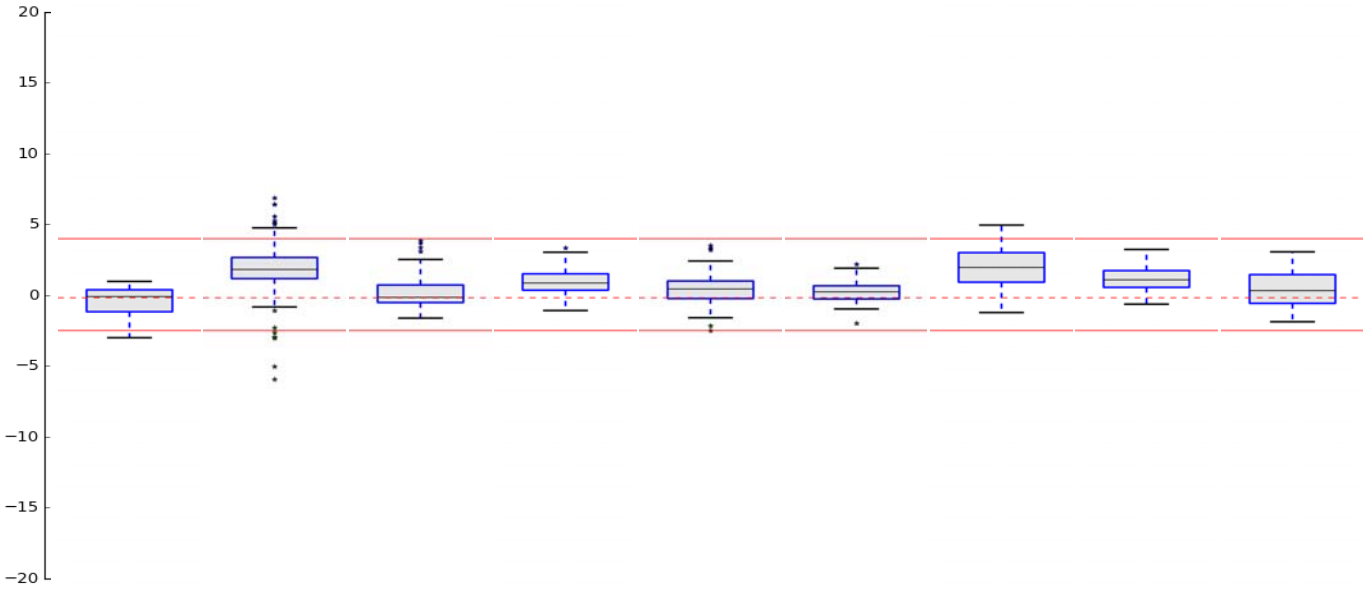
- Q3 (75th Percentile)
- Q2 (50th Percentile) - Median
- Q1 (25th Percentile)
- Arithmetic Mean
- $Whisker_{min}$ & $Whisker_{max}$: the lowest and highest values, respectively, that are found within the upper and lower fence. The upper and lower fences are defined as values between Q1 - (1.5*IQR) and Q3 + (1.5 * IQR), where “IQR” = Q3-Q1.
- Outliers: All values that fall outside (above or below) the upper and lower fences.
- 95% CFR Upper Confidence Limit for each data grouping
- 95% CFR Lower Confidence Limit for each data grouping. The 95% Confidence Limits are displayed as blue lines with the box and whisker plots.



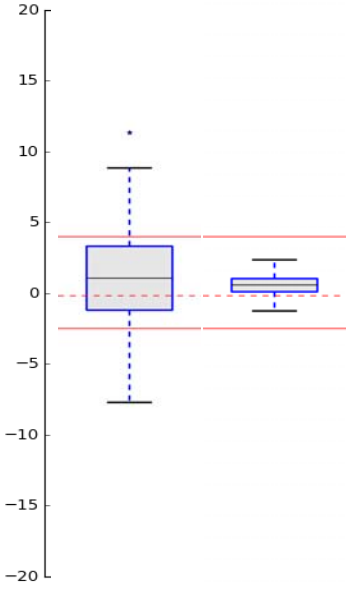
Components of a Schematic Box and Whisker Plot

REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	CA	Bay Area Air Quality Management District (0086)	Carbon monoxide	SLAMS	2013	11

Site	06-001-0009	06-001-0011	06-013-0002	06-013-1002	06-013-1004	06-041-0001	06-055-0003	06-075-0005	06-081-1001
POC	1	1	1	1	1	1	1	1	1
CV	0.95	1.7	1.0	0.94	0.94	0.65	1.42	0.86	1.19
Bias	+/-0.8	+2.22	+/-0.77	+1.2	+/-0.88	+/-0.62	+2.09	+1.31	+/-1.08
# Obs	157	157	158	122	158	158	159	159	159
Method	093	093	054	054	054	054	054	054	054

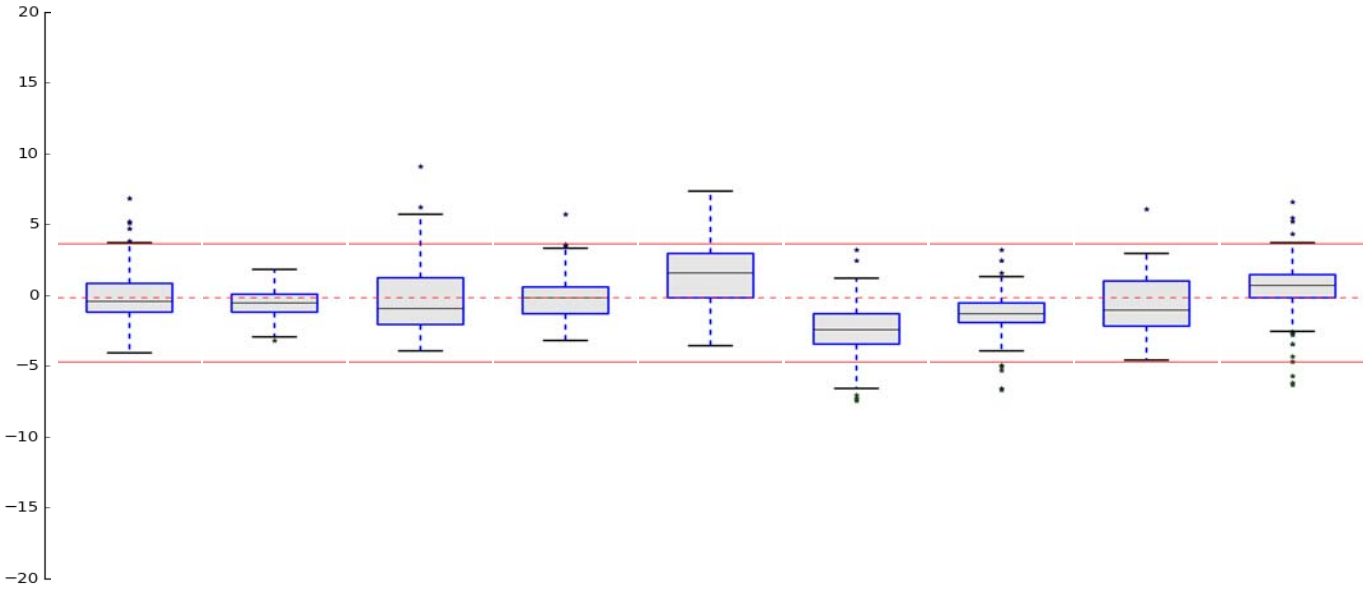


Site	06-085-0005	06-095-0004
POC	1	1
CV	3.33	0.67
Bias	+/-2.86	+0.82
# Obs	156	159
Method	554	054

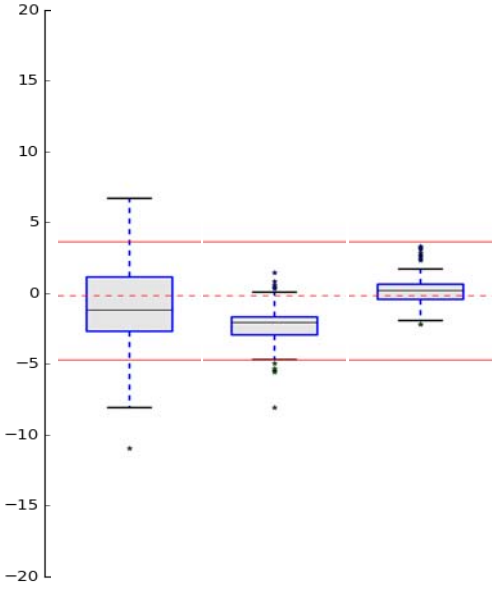


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	Bay Area Air Quality Management District (0086)	Nitrogen dioxide (NO2)	SLAMS	2013	12

Site	06-001-0007	06-001-0009	06-001-0011	06-013-0002	06-013-1002	06-013-1004	06-041-0001	06-055-0003	06-075-0005
POC	1	1	1	1	1	1	1	1	1
CV	1.82	0.87	2.29	1.44	2.04	1.7	1.38	1.82	1.81
Bias	+/-1.41	+/-0.78	+/-1.88	+/-1.13	+2.16	-2.29	-1.42	+/-1.63	+1.54
# Obs	157	159	156	158	123	158	154	159	157
Method	074	074	074	074	074	074	074	074	074

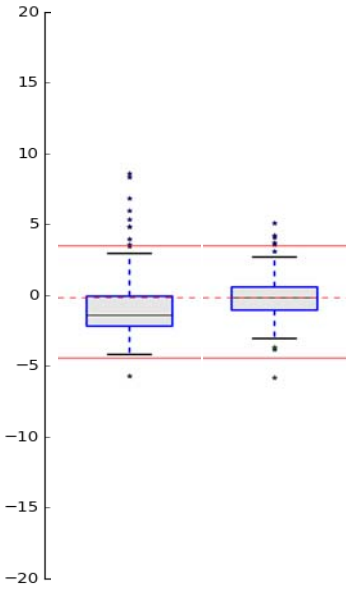


Site	06-081-1001	06-085-0005	06-095-0004
POC	1	1	1
CV	3.07	1.22	0.92
Bias	+/-2.56	-2.1	+/-0.76
# Obs	159	156	159
Method	074	074	074



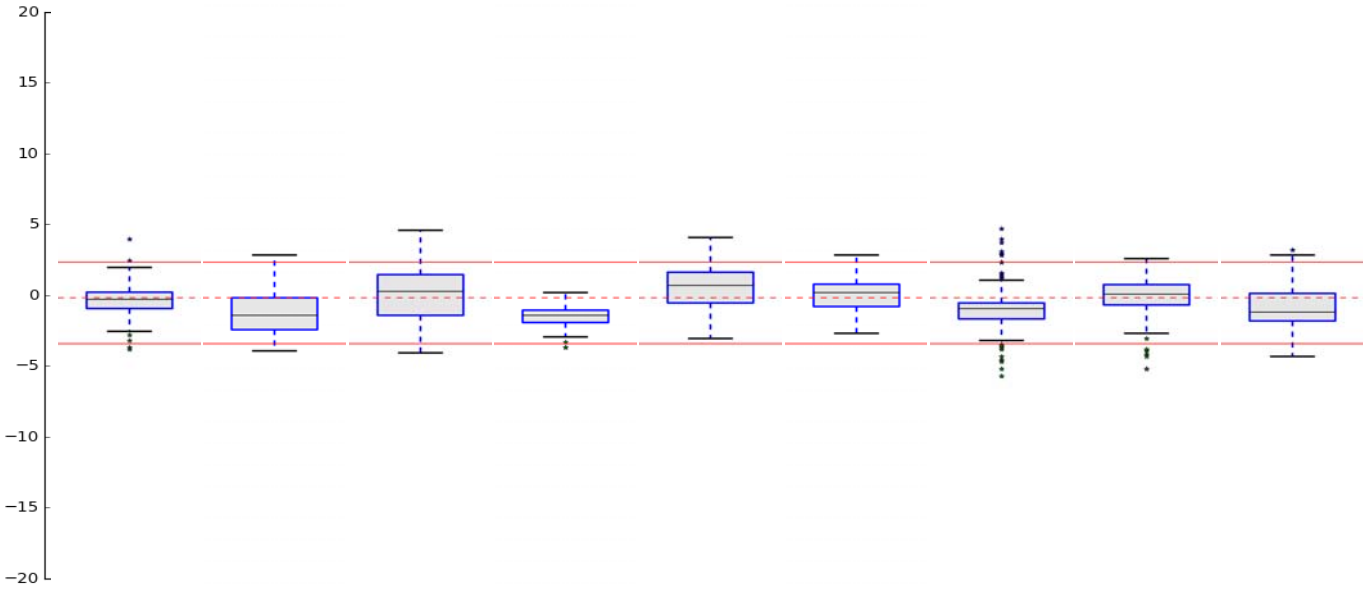
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	Bay Area Air Quality Management District (0086)	Nitrogen dioxide (NO2)	SPM	2013	2

Site	06-001-2005	06-013-2007
POC	1	1
CV	2.27	1.51
Bias	+/-1.87	+/-1.14
# Obs	144	145
Method	074	074

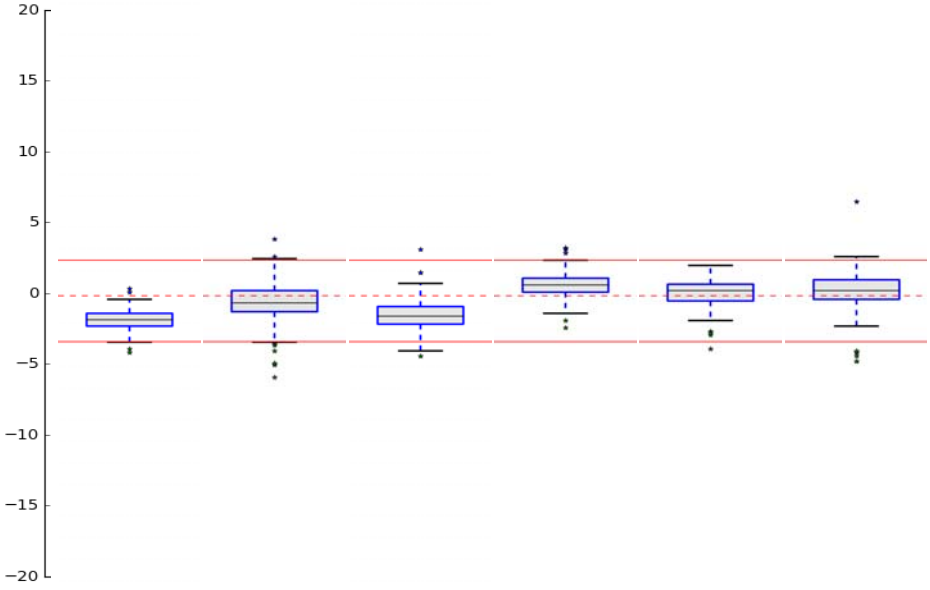


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	Bay Area Air Quality Management District (0086)	Ozone	SLAMS	2013	15

Site	06-001-0007	06-001-0011	06-001-2001	06-013-0002	06-013-1002	06-013-2007	06-055-0003	06-075-0005	06-081-1001
POC	1	1	1	1	1	1	1	1	1
CV	1.02	1.3	1.7	0.65	1.31	0.93	1.49	1.31	1.4
Bias	+/-0.8	-1.44	+/-1.46	-1.29	+/-1.28	+/-0.8	-1.33	+/-0.99	+/-1.29
# Obs	156	158	106	158	123	106	159	159	159
Method	047	047	047	047	047	047	047	047	047

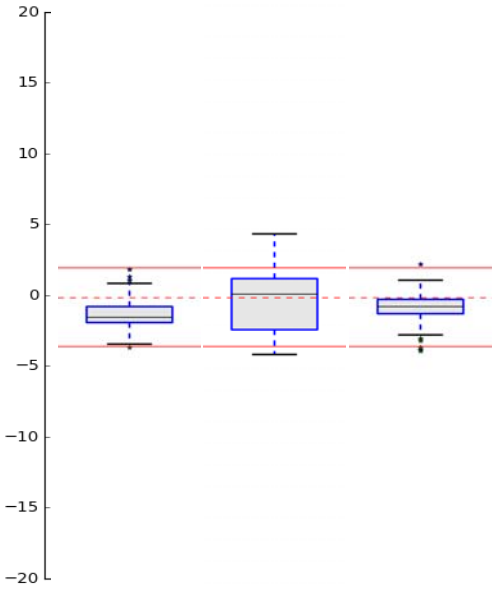


Site	06-085-0002	06-085-0005	06-085-1001	06-085-2006	06-095-0004	06-095-0005
POC	1	1	1	1	1	1
CV	0.7	1.44	1.18	0.97	0.89	1.57
Bias	-1.6	+/-1.16	-1.52	+0.99	+/-0.72	+/-1.17
# Obs	106	156	106	105	159	106
Method	047	047	047	047	047	047



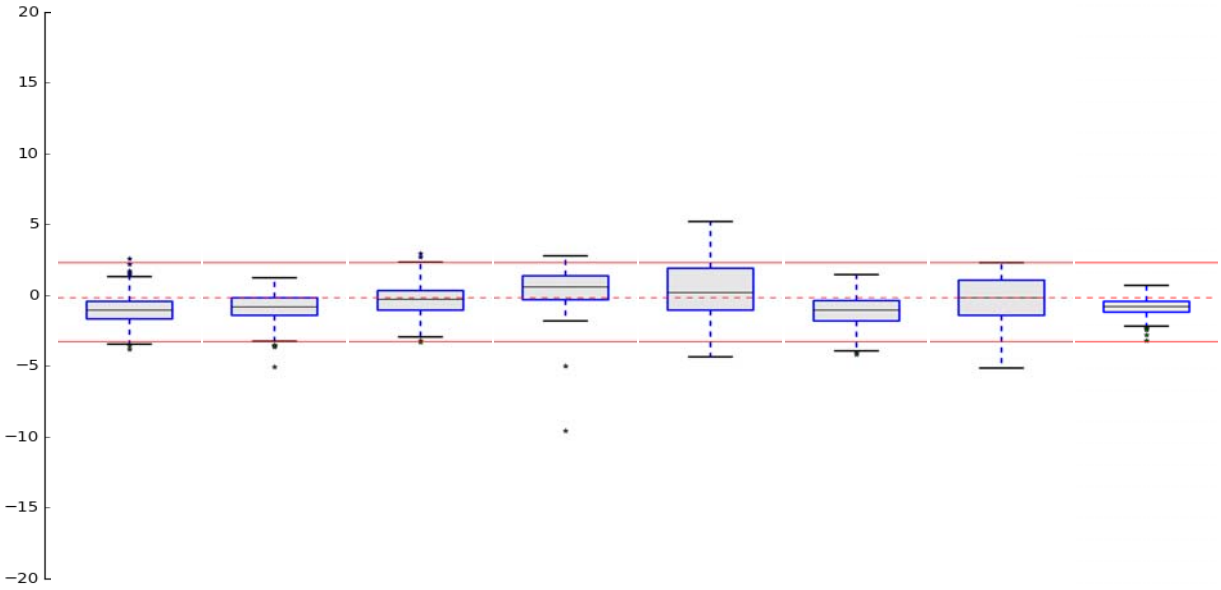
REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	CA	Bay Area Air Quality Management District (0086)	Ozone	SPM	2013	3

Site	06-001-0009	06-013-1004	06-041-0001
POC	1	1	1
CV	0.94	1.85	0.89
Bias	-1.26	+/-1.58	-0.84
# Obs	158	158	154
Method	047	047	047



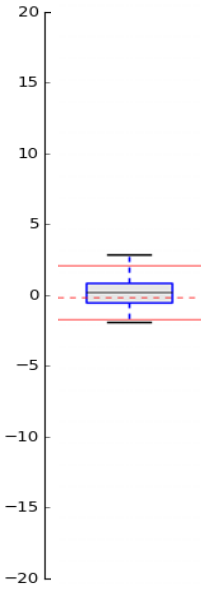
REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	CA	Bay Area Air Quality Management District (0086)	Sulfur dioxide	SLAMS	2013	8

Site	06-001-0011	06-013-0002	06-013-0006	06-013-1002	06-013-1004	06-013-2001	06-085-0005	06-095-0004
POC	1	1	1	1	1	1	1	1
CV	1.09	0.93	1.11	1.46	1.82	1.1	1.51	0.65
Bias	-1.12	-0.91	+/-0.9	+/-1.21	+/-1.59	-1.17	+/-1.2	-0.74
# Obs	158	158	159	123	158	159	156	159
Method	060	060	060	060	060	060	560	060



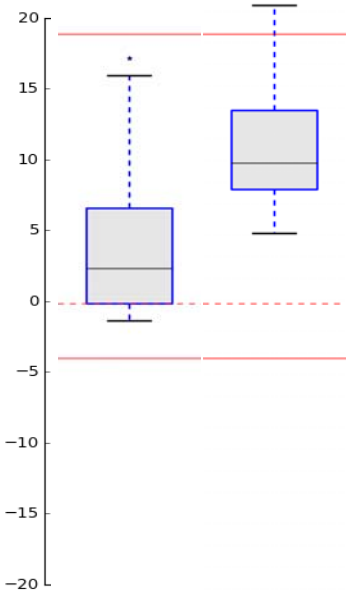
REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	**CA**	**Bay Area Air Quality Management District (0086)**	**Sulfur dioxide**	**SPM**	**2013**	**1**

Site	06-013-1001
POC	1
CV	0.93
Bias	+/-0.8
# Obs	159
Method	060



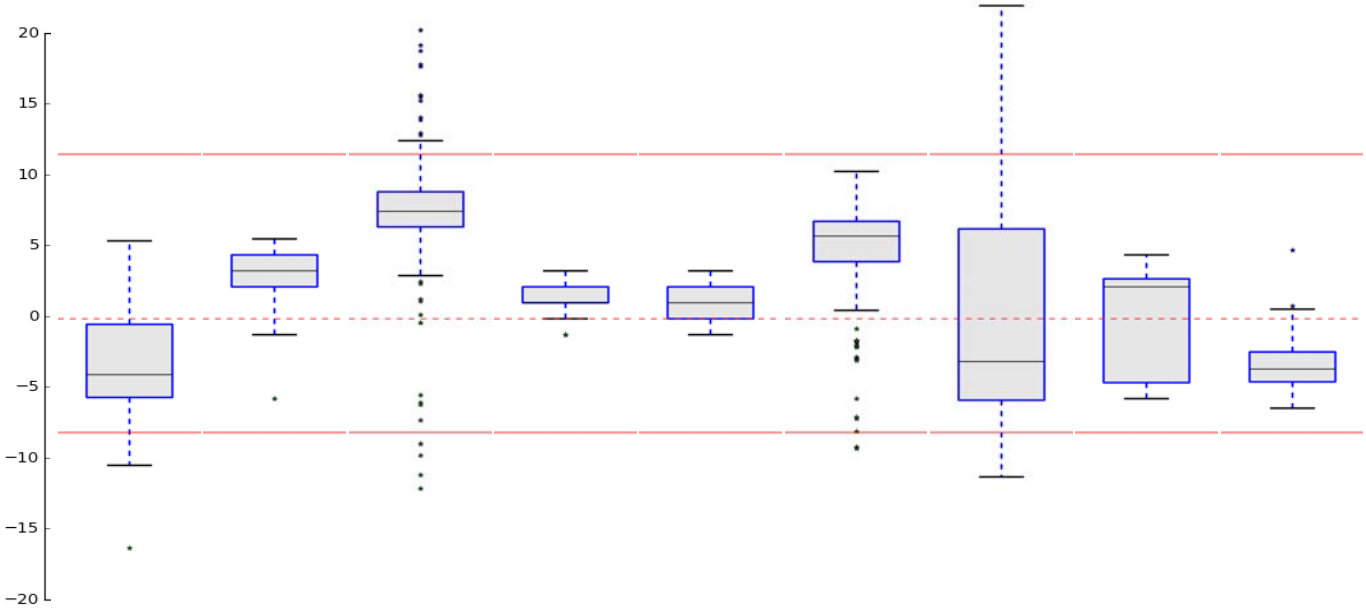
REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	**CA**	**California Air Resources Board (0145)**	**Carbon monoxide**	**INDUSTRIAL**	**2013**	**2**

Site	06-083-1025	06-083-4003
POC	1	1
CV	5.99	3.9
Bias	+5.52	+10.28
# Obs	51	51
Method	093	093

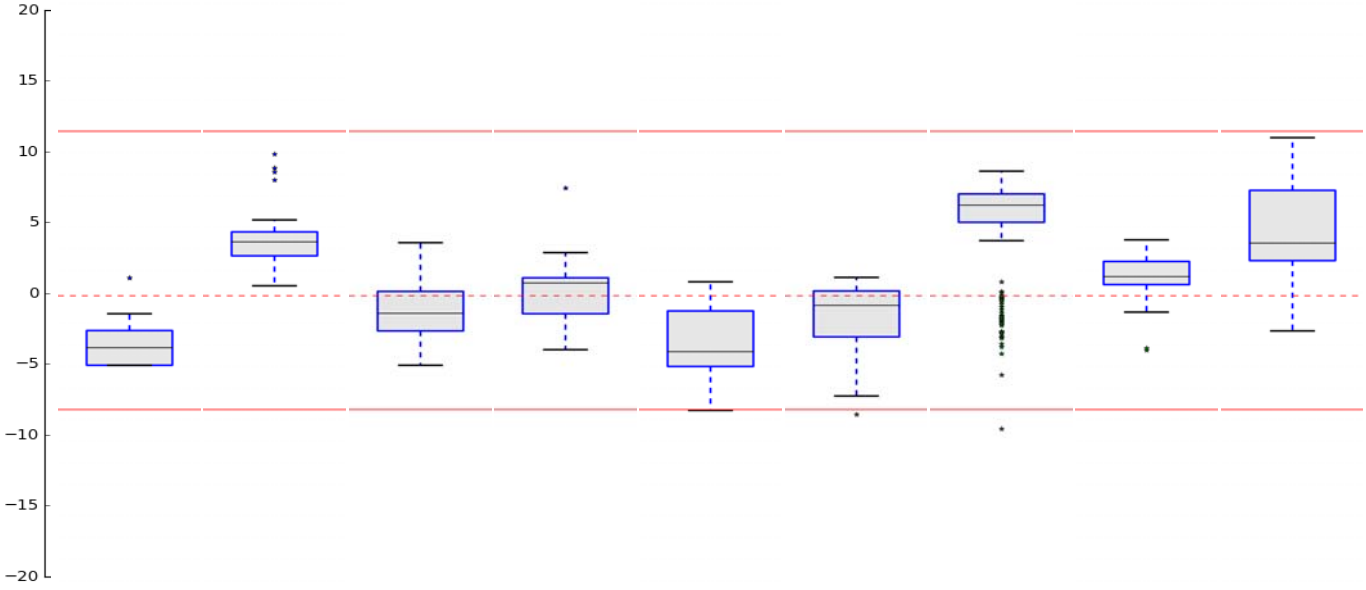


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	California Air Resources Board (0145)	Carbon monoxide	SLAMS	2013	21

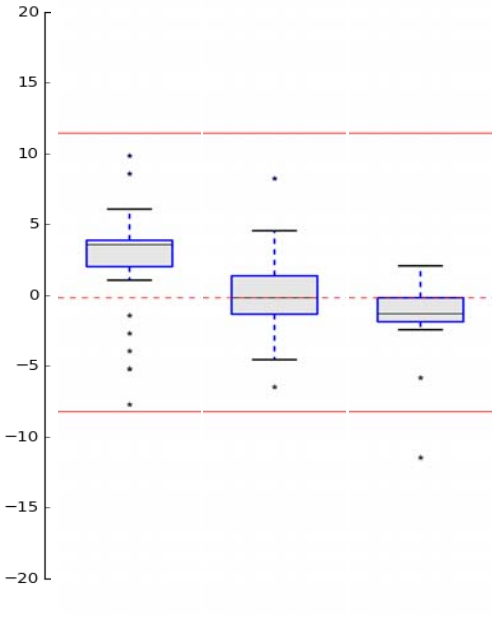
Site	06-007-0008	06-019-0007	06-019-0011	06-019-0242	06-019-5001	06-025-0005	06-025-1003	06-029-2012	06-037-9033
POC	3	1	3	1	1	3	1	1	1
CV	3.05	2.38	3.93	1.02	1.15	3.62	11.7	4.1	2.56
Bias	-3.66	+3.29	+7.39	+1.32	+1.31	+5.27	+/-9.58	+/-3.61	-3.55
# Obs	257	49	261	52	52	166	25	51	26
Method	593	054	593	054	054	593	093	054	093



Site	06-053-1003	06-067-0006	06-067-0007	06-067-0014	06-071-0001	06-071-0306	06-077-1002	06-083-1008	06-083-2004
POC	1	1	1	1	1	1	3	3	1
CV	1.47	2.96	2.42	2.54	2.78	2.77	6.32	1.02	3.5
Bias	-3.42	+4.71	+/-2.14	+/-1.96	-3.8	+/-2.45	+5.84	+1.53	+4.73
# Obs	50	24	24	24	26	26	204	248	50
Method	054	593	066	066	093	093	593	593	093

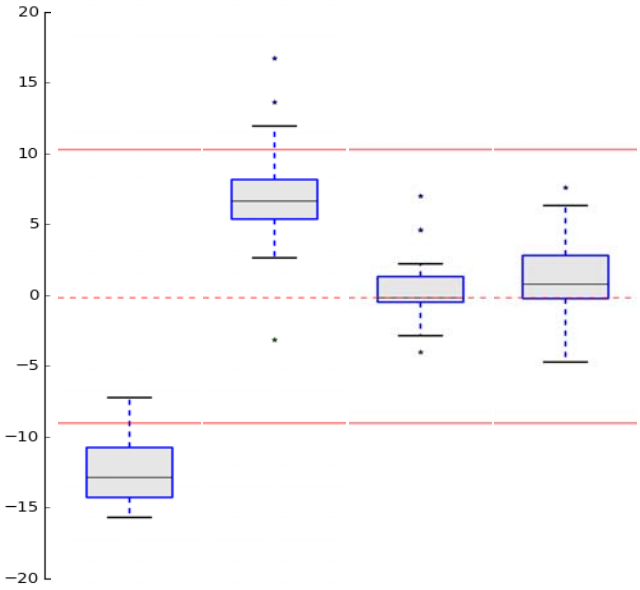


Site	06-083-2011	06-099-0005	06-099-0006
POC	1	3	1
CV	3.92	1.8	1.91
Bias	+4.1	+/-1.46	-1.6
# Obs	44	248	51
Method	093	593	054



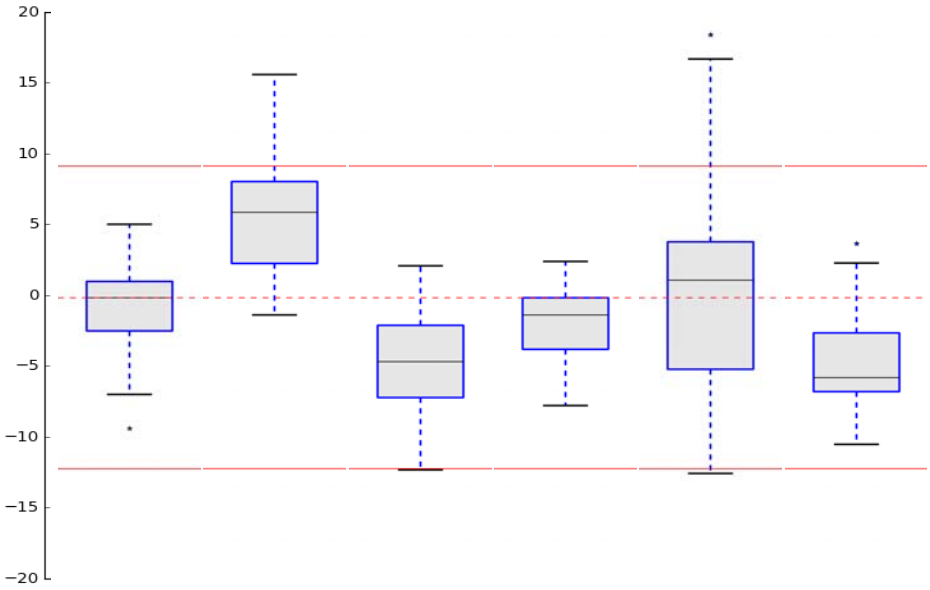
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	California Air Resources Board (0145)	Carbon monoxide	SPM	2013	4

Site	06-023-1004	06-023-1005	06-067-0002	06-083-0011
POC	1	1	1	3
CV	2.83	4.24	2.69	2.29
Bias	-11.37	+7.55	+/-2.0	+/-2.1
# Obs	24	24	24	210
Method	054	054	066	593



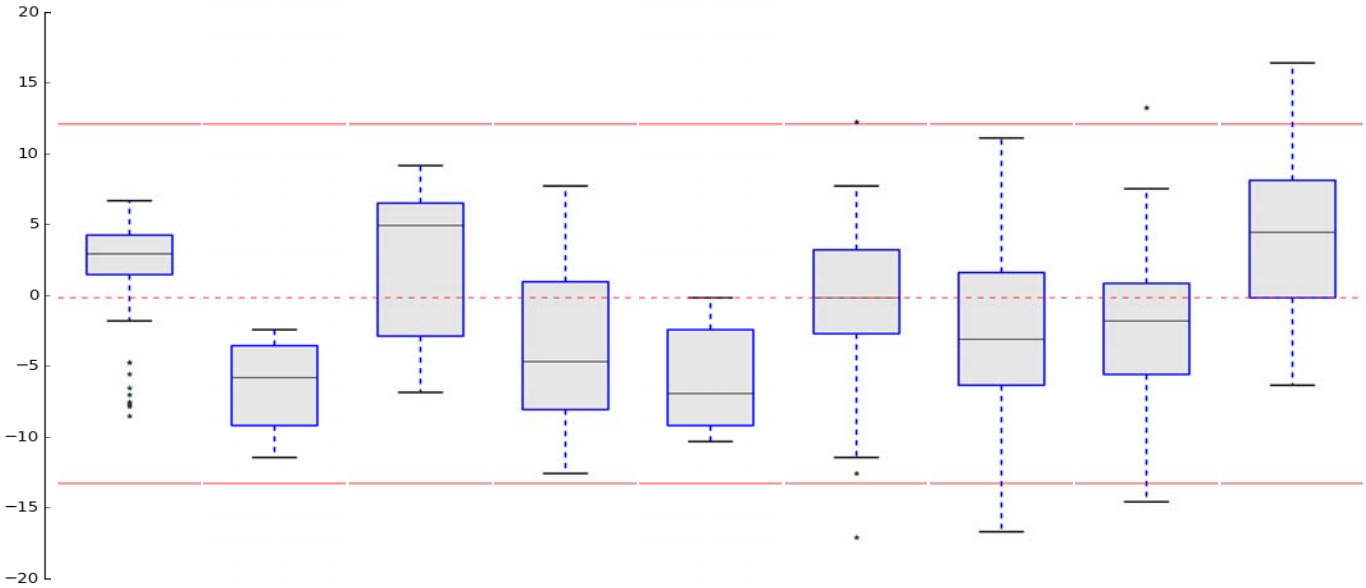
REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	CA	California Air Resources Board (0145)	Nitrogen dioxide (NO2)	INDUSTRIAL	2013	6

Site	06-083-1013	06-083-1014	06-083-1018	06-083-1021	06-083-1025	06-083-4003
POC	1	1	1	1	1	1
CV	3.63	4.27	3.82	3.15	6.78	3.88
Bias	+/-2.91	+5.99	-4.87	-2.75	+/-5.41	-5.37
# Obs	27	26	44	25	51	37
Method	074	074	099	074	099	099

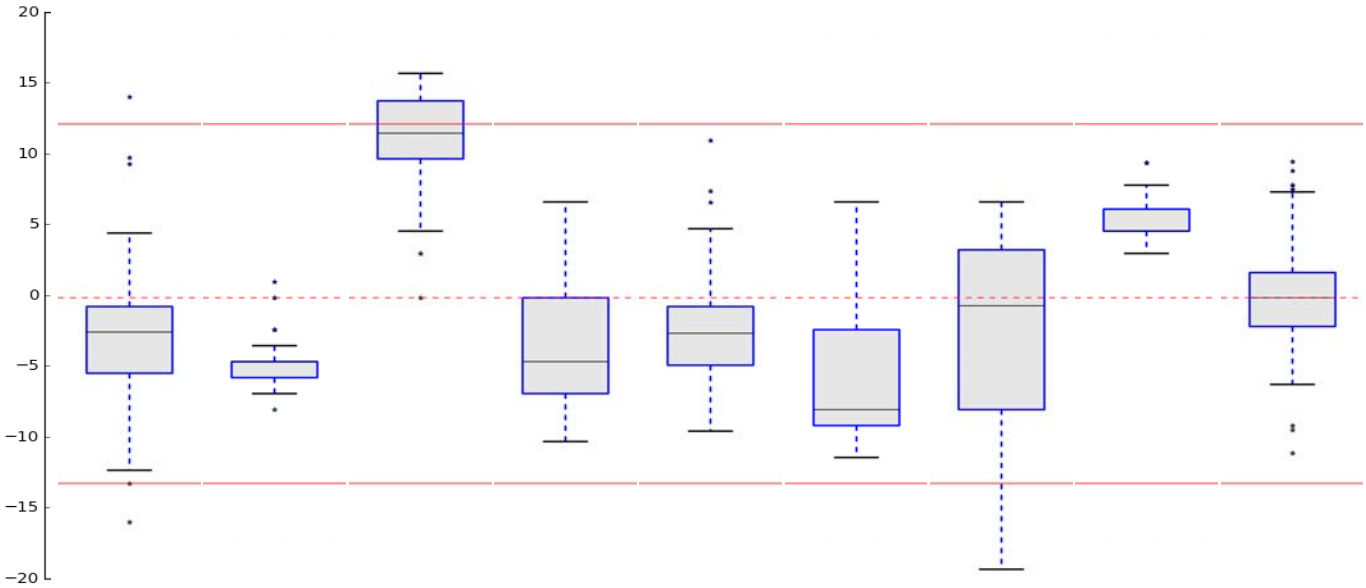


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	California Air Resources Board (0145)	Nitrogen dioxide (NO2)	SLAMS	2013	44

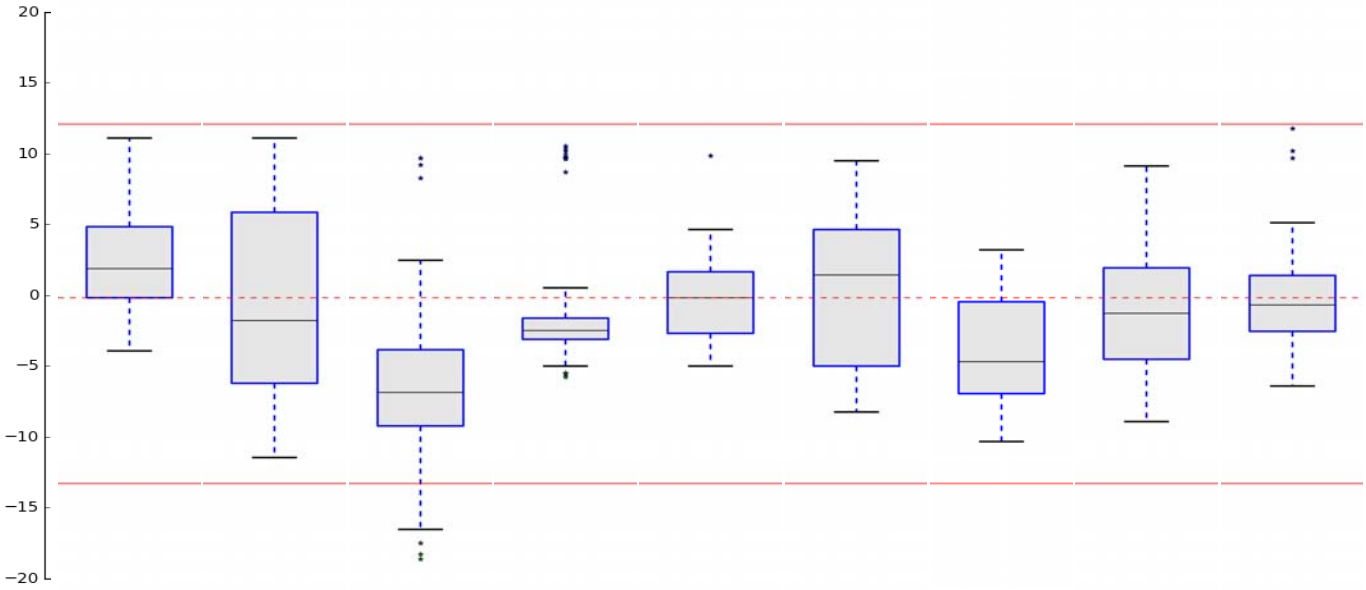
Site	06-007-0008	06-019-0007	06-019-0011	06-019-0242	06-019-4001	06-019-5001	06-025-0005	06-025-1003	06-029-0007
POC	1	1	1	1	1	1	1	1	1
CV	2.48	2.77	4.58	5.29	3.71	10.81	5.31	6.69	5.14
Bias	+3.07	-5.85	+/-4.66	+/-5.35	-5.73	+/-7.18	+/-4.8	+/-5.42	+5.61
# Obs	257	52	257	52	48	52	218	24	216
Method	099	074	099	074	074	074	099	099	099



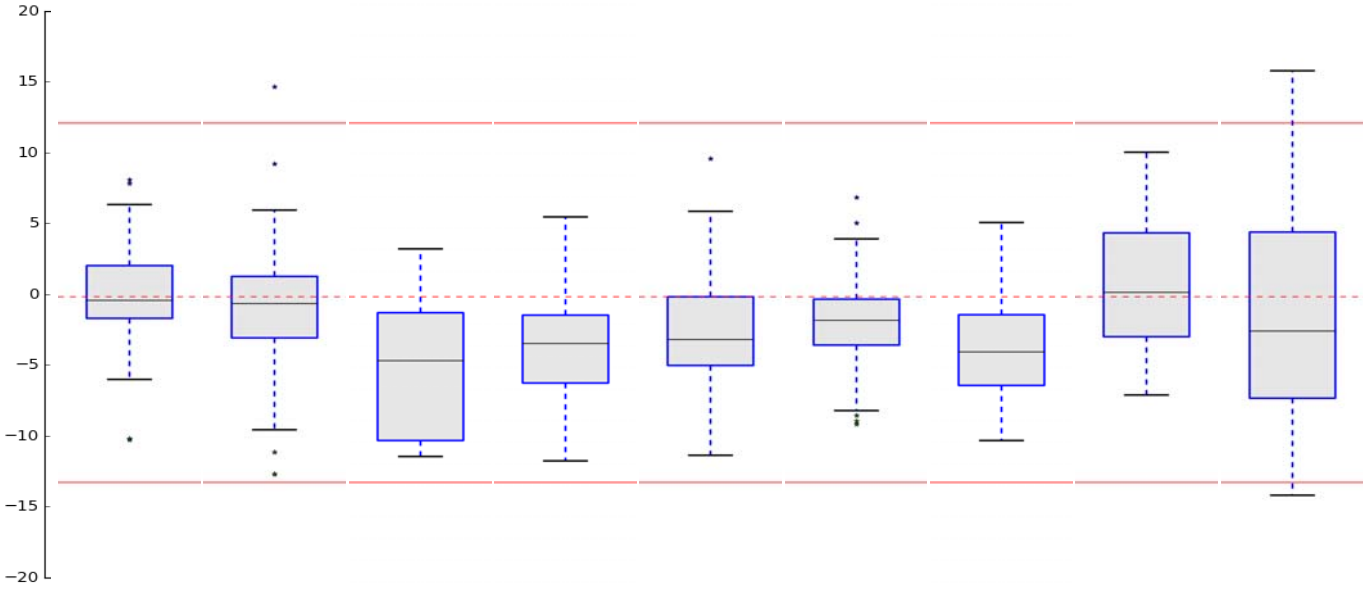
Site	06-029-0014	06-029-2012	06-029-6001	06-031-1004	06-037-9033	06-039-0004	06-047-0003	06-053-1003	06-061-0006
POC	1	1	1	1	1	1	1	1	1
CV	3.73	1.84	2.84	4.68	4.18	4.38	6.66	2.06	3.03
Bias	-3.64	-4.53	+10.37	-4.93	-3.91	-6.52	+/-5.78	+5.53	+/-2.36
# Obs	205	51	234	52	51	43	52	50	250
Method	099	074	099	074	099	074	074	074	099



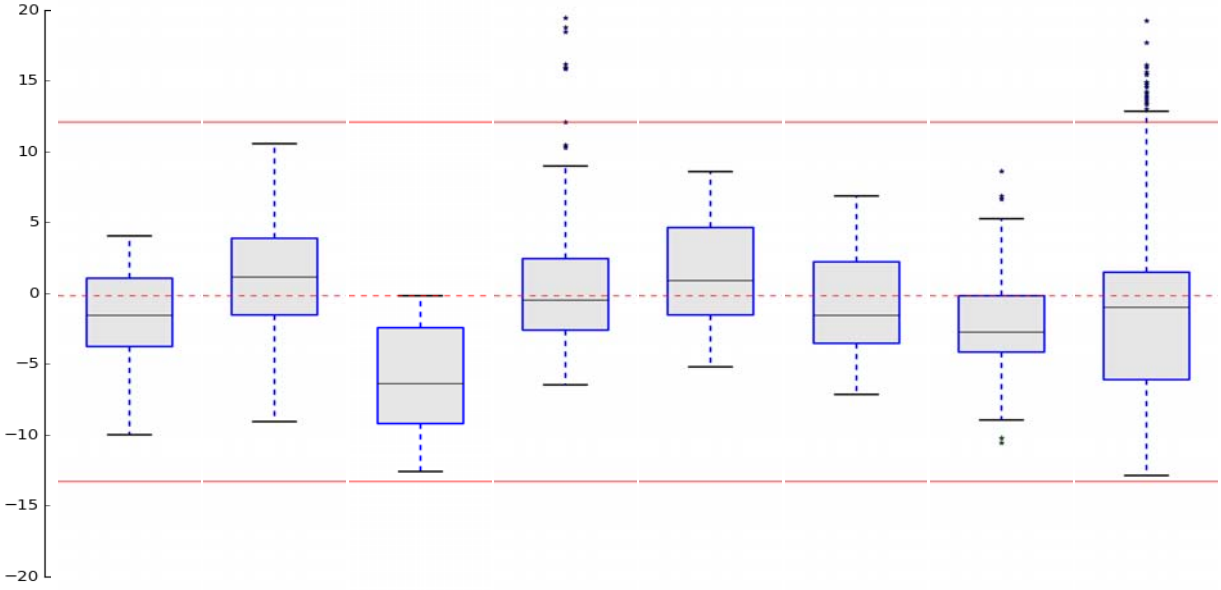
Site	06-067-0002	06-067-0006	06-067-0010	06-067-0010	06-067-0011	06-067-0012	06-067-0014	06-071-0001	06-071-0306
POC	1	1	1	3	1	1	1	1	1
CV	4.17	8.22	5.45	2.95	3.72	6.37	4.56	5.05	5.75
Bias	+3.96	+/-6.69	-6.91	-2.75	+/-2.93	+/-5.17	-5.27	+/-4.15	+/-3.85
# Obs	24	18	95	160	24	16	22	48	48
Method	074	035	099	599	074	035	074	099	099



Site	06-071-1234	06-077-1002	06-077-3005	06-079-3001	06-079-4002	06-079-8001	06-083-0008	06-083-0011	06-083-1008
POC	1	2	1	1	1	1	1	1	1
CV	4.6	3.42	5.23	2.92	3.53	2.4	3.84	4.17	6.84
Bias	+/-3.55	+/-2.65	-5.85	-3.72	-3.55	-2.33	-4.46	+/-3.64	+/-5.96
# Obs	32	244	52	351	249	363	49	217	243
Method	099	099	074	099	099	099	099	099	099

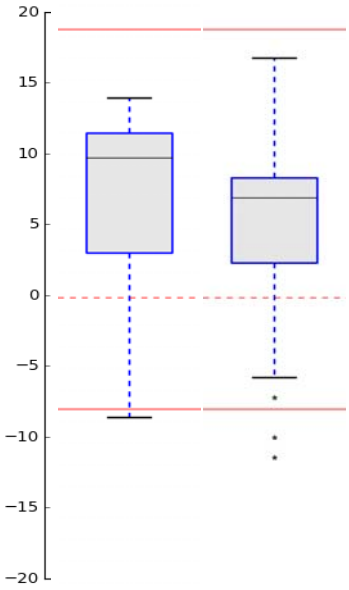


Site	06-083-2004	06-083-2011	06-099-0006	06-101-0003	06-107-2002	06-111-2002	06-111-3001	06-113-0004
POC	1	1	1	1	1	1	1	1
CV	3.68	5.04	3.84	15.37	3.24	3.55	3.98	7.65
Bias	+/-3.15	+/-4.2	-6.1	+/-7.3	+/-2.95	+/-2.96	-3.67	+/-5.36
# Obs	51	46	52	193	251	58	66	250
Method	099	099	074	099	099	082	082	099



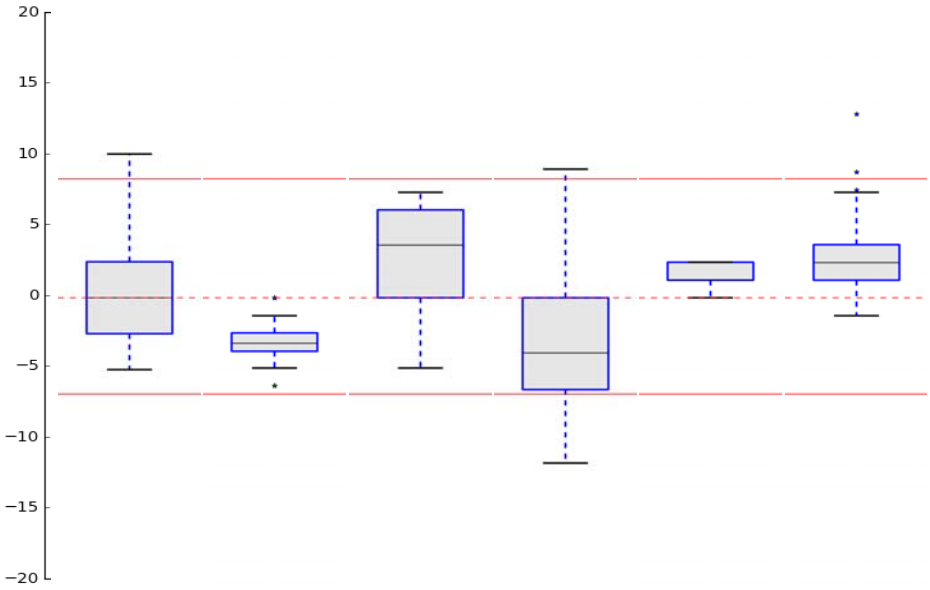
REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	CA	California Air Resources Board (0145)	Nitrogen dioxide (NO2)	SPM	2013	2

Site	06-023-1004	06-023-1005
POC	1	1
CV	7.35	7.64
Bias	+8.82	+7.55
# Obs	24	24
Method	074	074



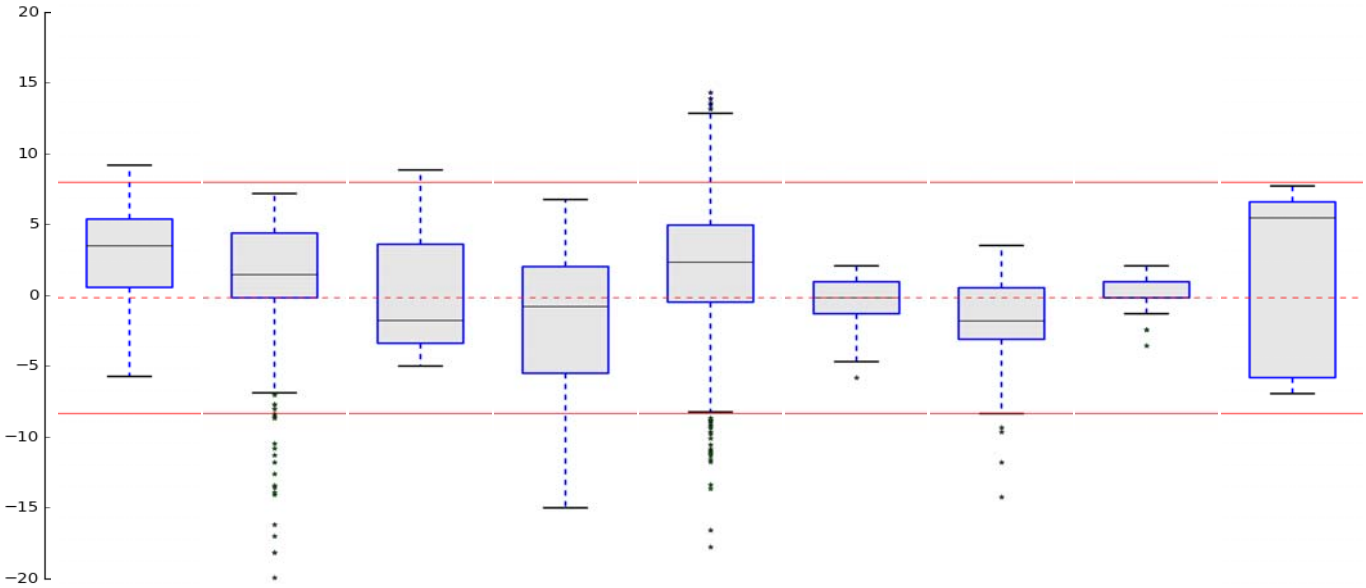
REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	**CA**	**California Air Resources Board (0145)**	**Ozone**	**INDUSTRIAL**	**2013**	**6**

Site	06-083-1013	06-083-1014	06-083-1018	06-083-1021	06-083-1025	06-083-4003
POC	1	1	1	1	1	1
CV	3.91	1.84	3.64	5.25	0.75	2.91
Bias	+/-3.08	-3.15	+3.84	-5.4	+1.63	+3.31
# Obs	27	26	48	27	51	48
Method	047	047	087	087	087	087

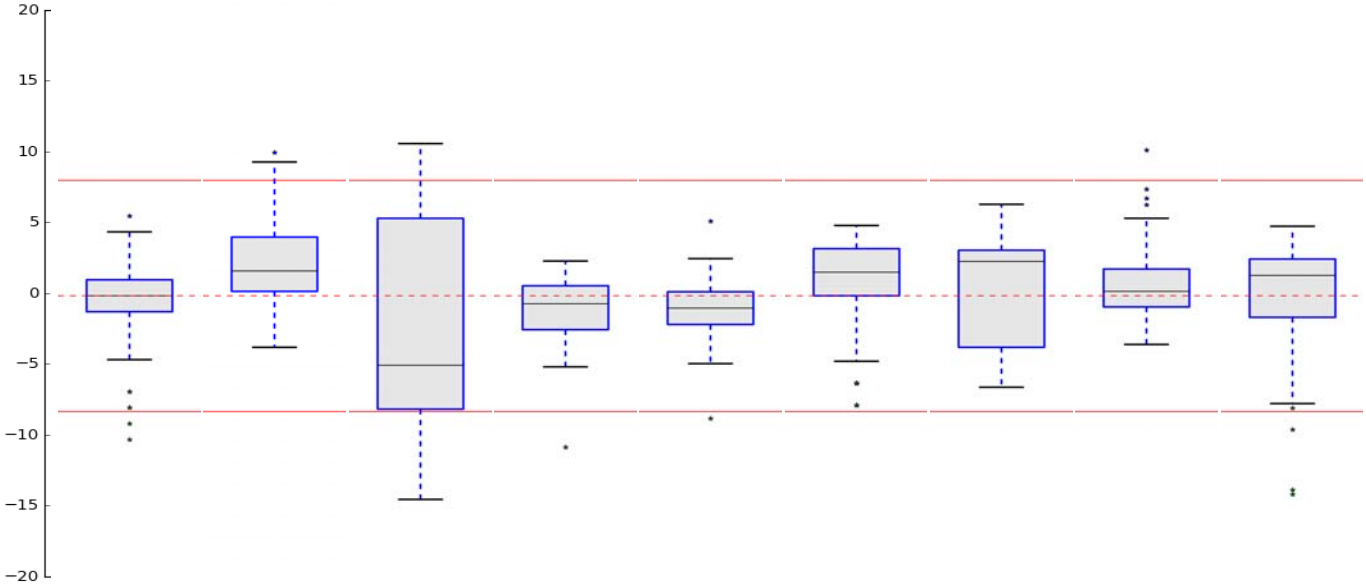


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	**CA**	**California Air Resources Board (0145)**	**Ozone**	**SLAMS**	**2013**	**87**

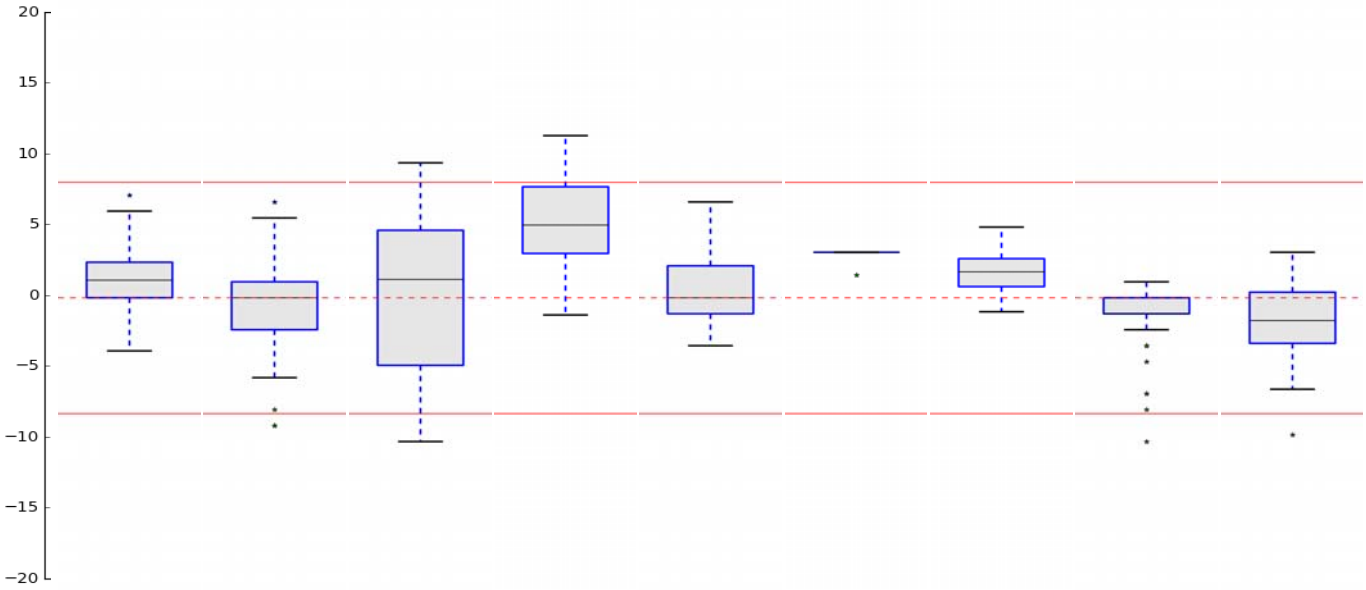
Site	06-005-0002	06-007-0008	06-009-0001	06-011-1002	06-017-0010	06-019-0007	06-019-0011	06-019-0242	06-019-4001
POC	1	1	1	1	1	1	1	1	1
CV	3.04	4.6	3.63	4.34	5.31	1.66	2.6	1.12	5.96
Bias	+3.53	+3.52	+/-3.1	+/-3.72	+/-4.57	+/-1.29	+/-2.32	+0.86	+/-5.8
# Obs	363	257	347	365	358	50	261	52	52
Method	087	087	087	087	087	087	087	087	087



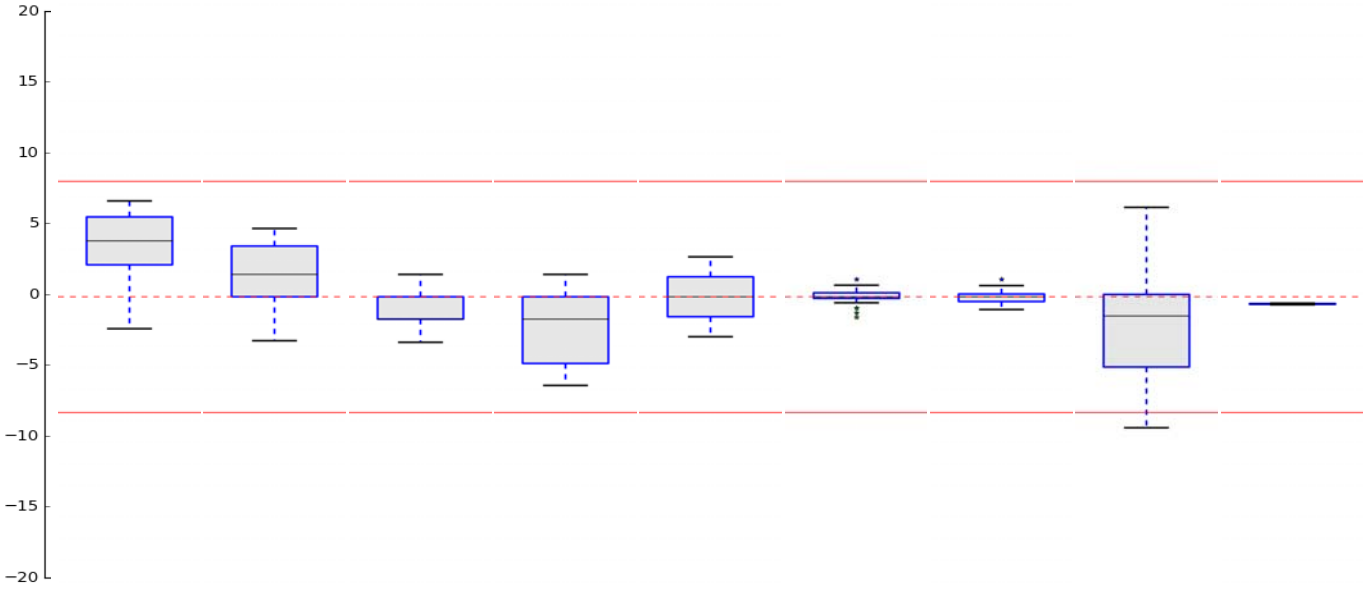
Site	06-019-5001	06-021-0003	06-025-0005	06-025-1003	06-025-4004	06-029-0007	06-029-0008	06-029-0011	06-029-0014
POC	1	1	1	1	1	1	1	1	1
CV	3.49	2.57	6.85	2.96	10.32	3.17	4.25	1.76	2.87
Bias	+/-2.63	+2.61	+/-6.48	+/-2.3	+/-6.08	+2.58	+/-3.76	+/-1.43	+/-2.38
# Obs	52	353	232	26	24	230	52	328	228
Method	087	087	087	087	087	087	087	087	087



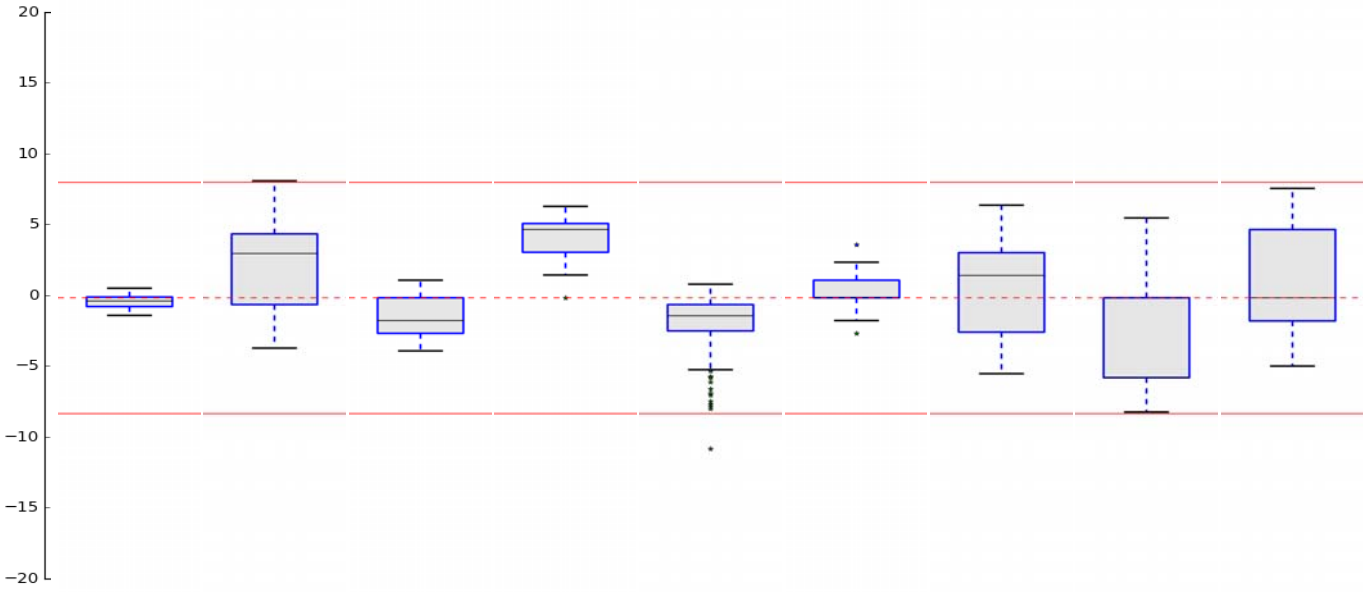
Site	06-029-0232	06-029-2012	06-029-5002	06-029-6001	06-031-1004	06-033-3001	06-037-9033	06-039-0004	06-039-2010
POC	1	1	1	1	1	1	1	1	1
CV	1.71	3.77	4.71	2.76	2.53	0.23	1.48	2.47	2.9
Bias	+1.6	+/-3.02	+/-4.29	+4.97	+/-1.99	+2.88	+1.98	-1.89	+/-2.61
# Obs	310	51	339	226	52	52	41	52	52
Method	087	087	087	087	087	087	087	087	087



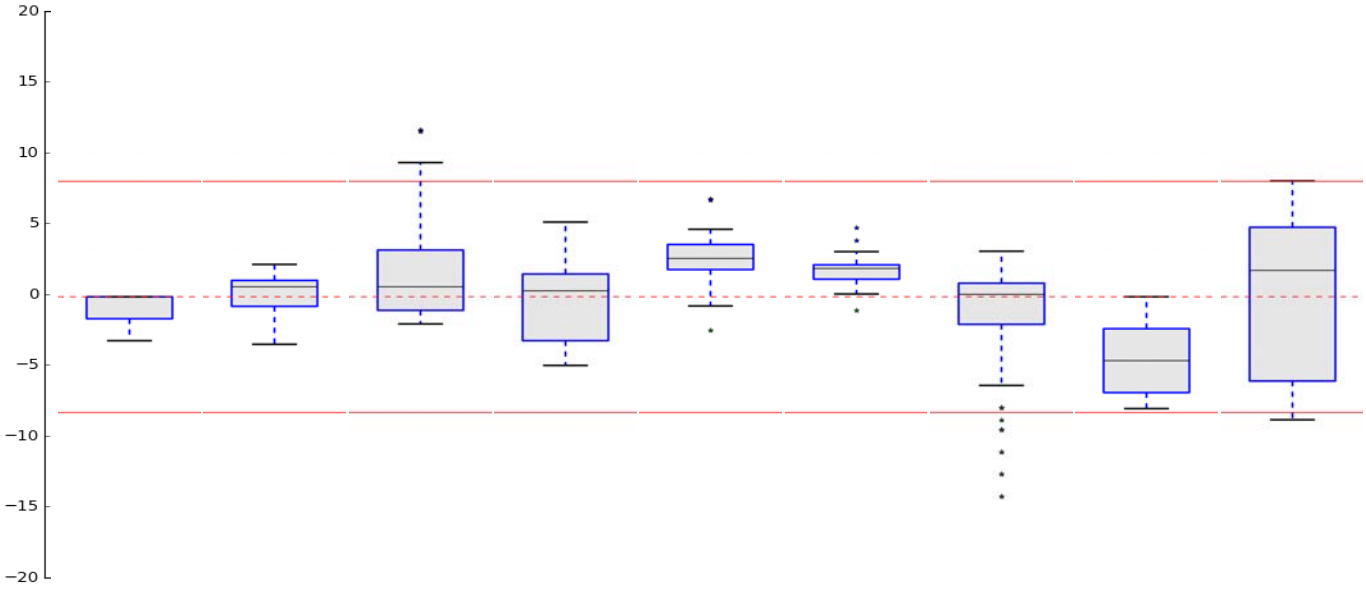
Site	06-047-0003	06-053-0002	06-053-0008	06-053-1003	06-057-0005	06-061-0003	06-061-0004	06-061-0006	06-061-1004
POC	1	1	1	1	1	1	1	1	1
CV	2.35	2.49	1.16	2.83	1.93	0.54	0.48	3.2	0.57
Bias	+3.8	+2.29	-1.23	-3.06	+/-1.6	+/-0.4	+/-0.37	+/-2.97	-0.77
# Obs	52	52	52	52	32	33	33	250	2
Method	087	047	047	047	087	087	087	087	087



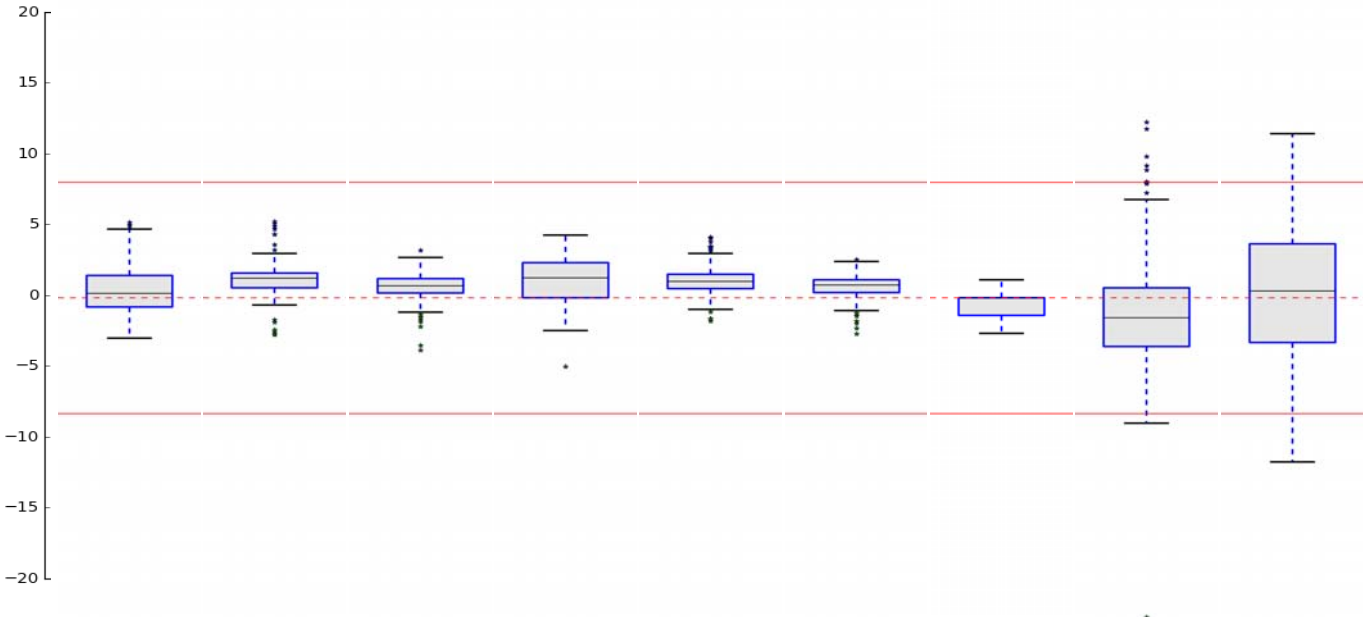
Site	06-061-2002	06-065-9003	06-067-0002	06-067-0006	06-067-0010	06-067-0011	06-067-0012	06-067-0014	06-067-5003
POC	1	1	1	1	1	1	1	1	1
CV	0.49	2.59	1.77	2.02	1.64	1.51	3.98	4.16	4.07
Bias	+/-0.46	+/-2.9	-2.06	+4.32	-1.72	+1.21	+/-3.25	-4.53	+/-3.42
# Obs	31	357	24	24	254	24	22	24	24
Method	087	087	019	019	087	019	019	019	087



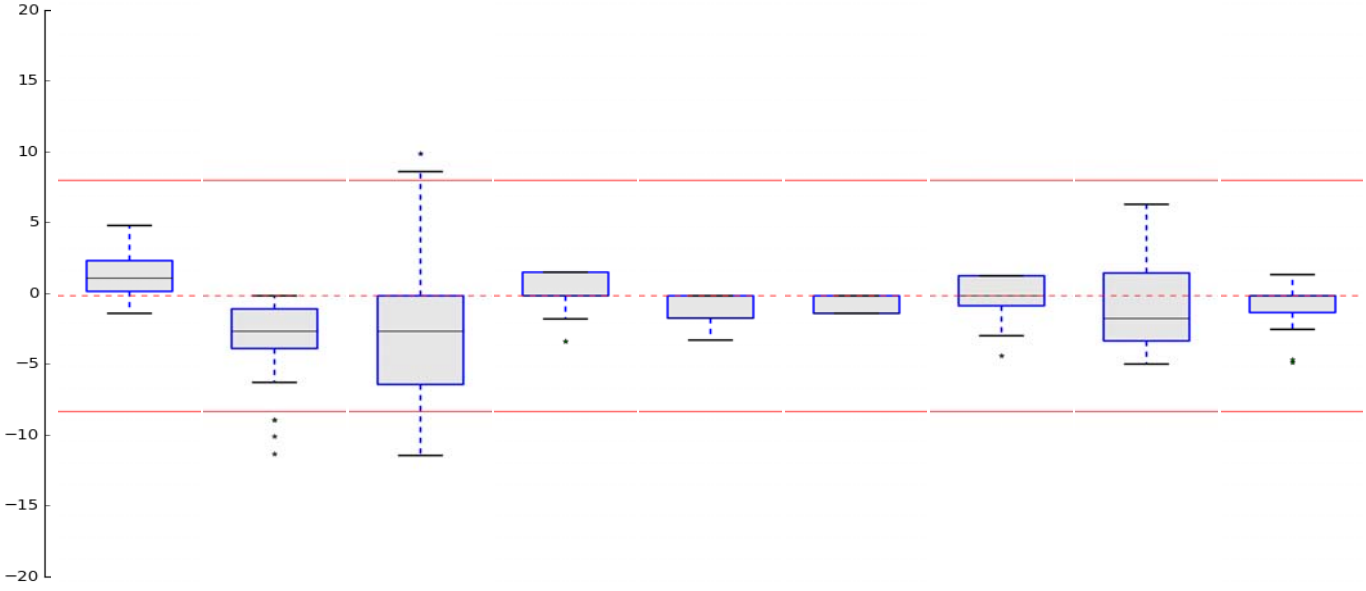
Site	06-069-0002	06-071-0001	06-071-0012	06-071-0306	06-071-1234	06-071-4001	06-077-1002	06-077-3005	06-079-0005
POC	1	1	1	1	1	1	1	1	1
CV	0.82	1.49	3.78	2.85	1.89	1.07	3.23	2.57	4.87
Bias	-0.64	+/-1.25	+/-3.01	+/-2.46	+2.87	+1.9	+/-2.28	-4.31	+/-4.41
# Obs	52	35	44	41	38	41	245	52	331
Method	047	087	087	087	087	087	087	087	087



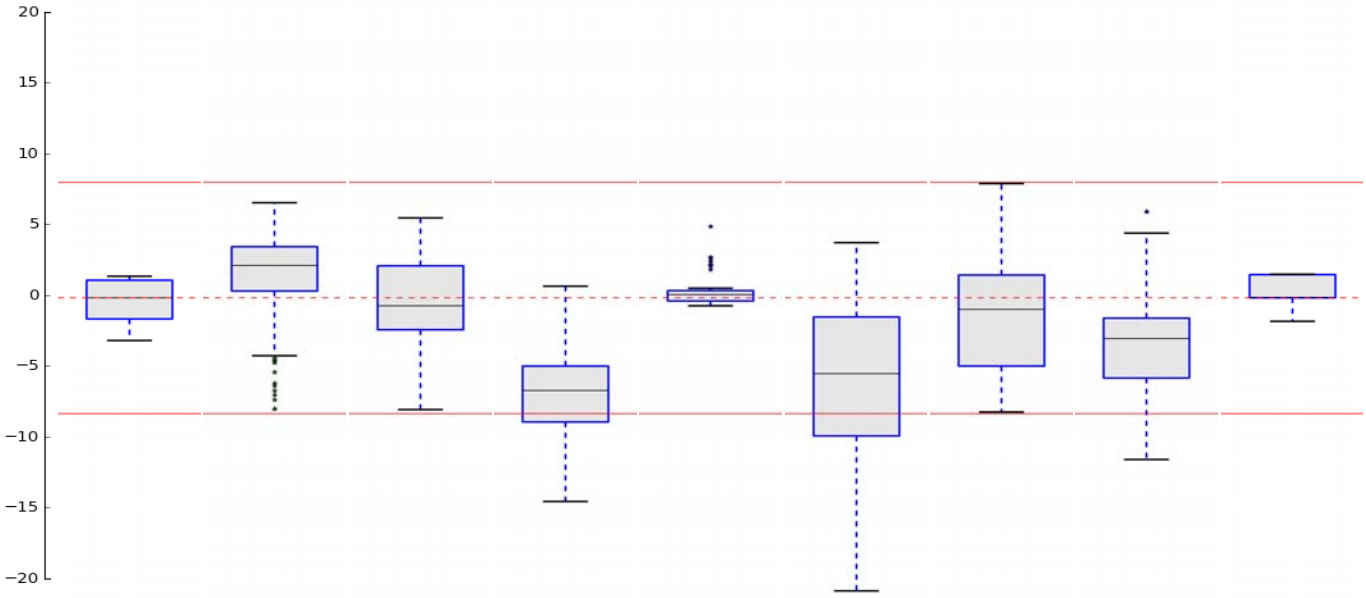
Site	06-079-2006	06-079-3001	06-079-4002	06-079-8001	06-079-8005	06-079-8006	06-083-0008	06-083-0011	06-083-1008
POC	1	1	1	1	1	1	1	1	1
CV	1.57	0.89	0.85	1.48	0.87	0.74	0.95	3.94	4.63
Bias	+/-1.28	+1.31	+0.92	+1.58	+1.21	+0.93	-0.77	+/-3.21	+/-3.89
# Obs	365	362	333	361	351	361	51	246	261
Method	087	087	087	087	087	087	087	087	087



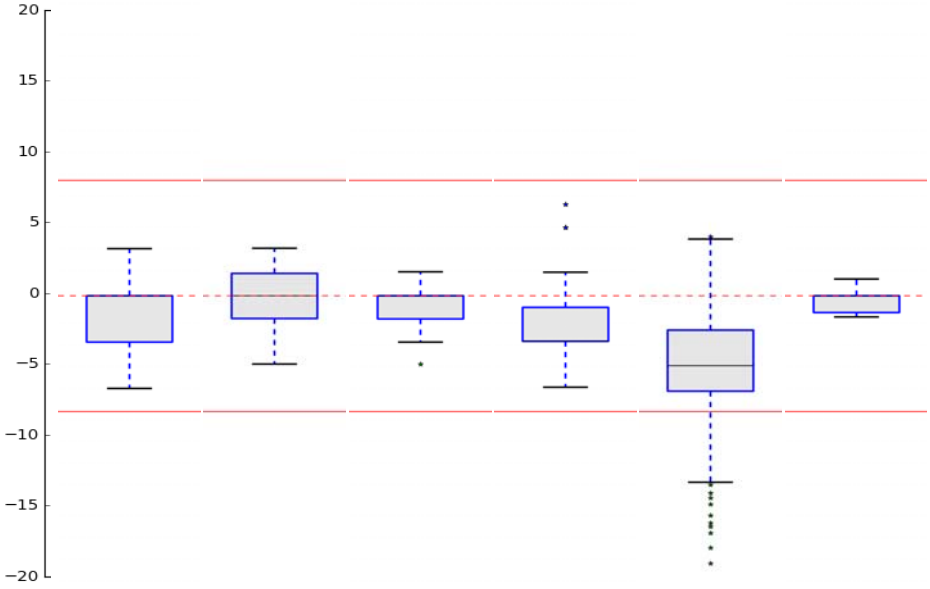
Site	06-083-2004	06-083-2011	06-083-3001	06-087-0007	06-089-0004	06-089-0007	06-089-0009	06-093-2001	06-095-3003
POC	1	1	1	1	1	1	1	1	1
CV	1.21	2.85	4.64	1.27	0.92	0.65	1.49	2.86	1.35
Bias	+1.49	-3.03	-4.42	+1.06	-1.05	-0.75	+/-1.11	+/-2.41	-0.93
# Obs	50	48	48	52	35	49	35	28	48
Method	087	087	087	047	087	019	087	019	087



Site	06-097-1003	06-099-0005	06-099-0006	06-101-0003	06-103-0005	06-107-2002	06-107-2010	06-109-0005	06-111-0007
POC	1	1	1	1	1	1	1	1	1
CV	1.54	2.74	3.22	2.85	1.25	4.94	4.12	3.39	1.12
Bias	+/-1.19	+2.75	+/-2.74	-6.21	+/-0.92	-5.98	+/-3.54	-3.73	+0.95
# Obs	27	250	52	215	39	251	52	363	101
Method	087	087	087	087	087	087	087	087	087

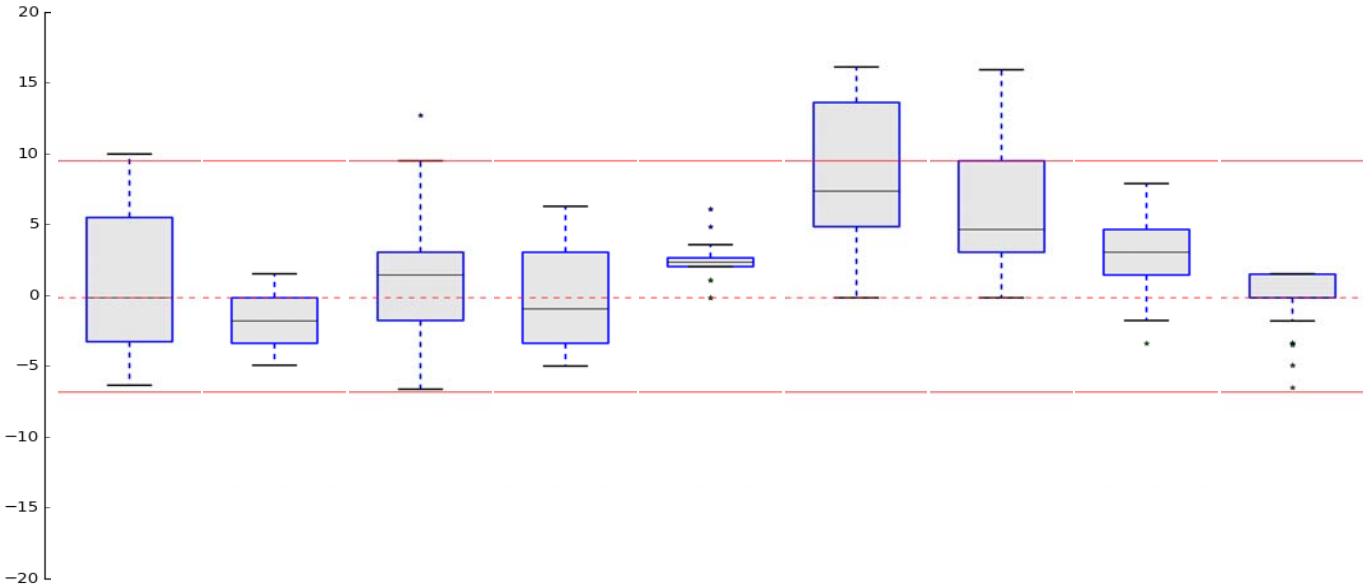


Site	06-111-0009	06-111-1004	06-111-2002	06-111-3001	06-113-0004	06-113-1003
POC	1	1	1	1	1	1
CV	2.34	1.95	1.35	3.09	7.67	0.73
Bias	-2.05	+/-1.64	-0.97	-3.23	-6.07	-0.57
# Obs	98	91	58	67	255	49
Method	087	087	087	087	087	087

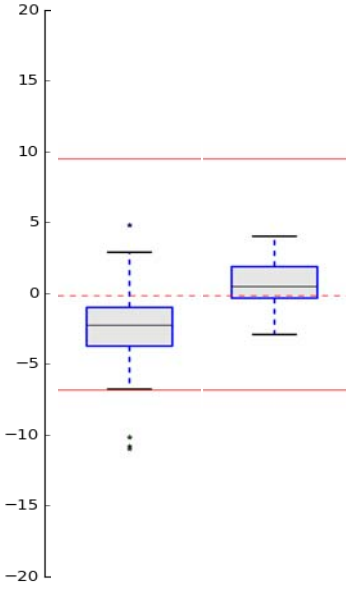


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	California Air Resources Board (0145)	Ozone	SPM	2013	11

Site	06-007-0007	06-017-0012	06-017-0020	06-019-2009	06-023-1004	06-023-1005	06-043-0006	06-057-0007	06-087-1003
POC	1	1	1	1	1	1	1	1	1
CV	4.31	1.99	2.96	3.42	1.82	5.72	4.35	2.1	1.91
Bias	+/-3.71	-2.2	+/-2.75	+/-2.85	+2.83	+9.2	+6.11	+2.84	+1.36
# Obs	356	32	182	52	24	24	158	168	52
Method	087	087	087	087	047	047	087	087	047

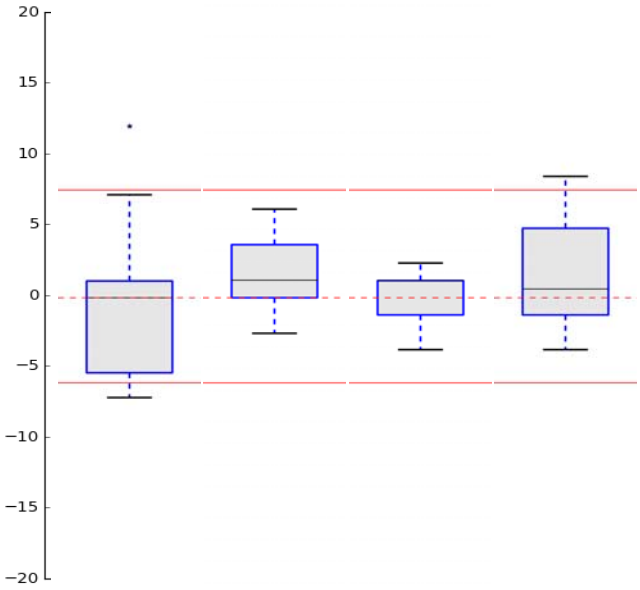


Site	06-101-0004	06-103-0004
POC	1	1
CV	2.16	1.38
Bias	-2.46	+/-1.27
# Obs	173	182
Method	087	087



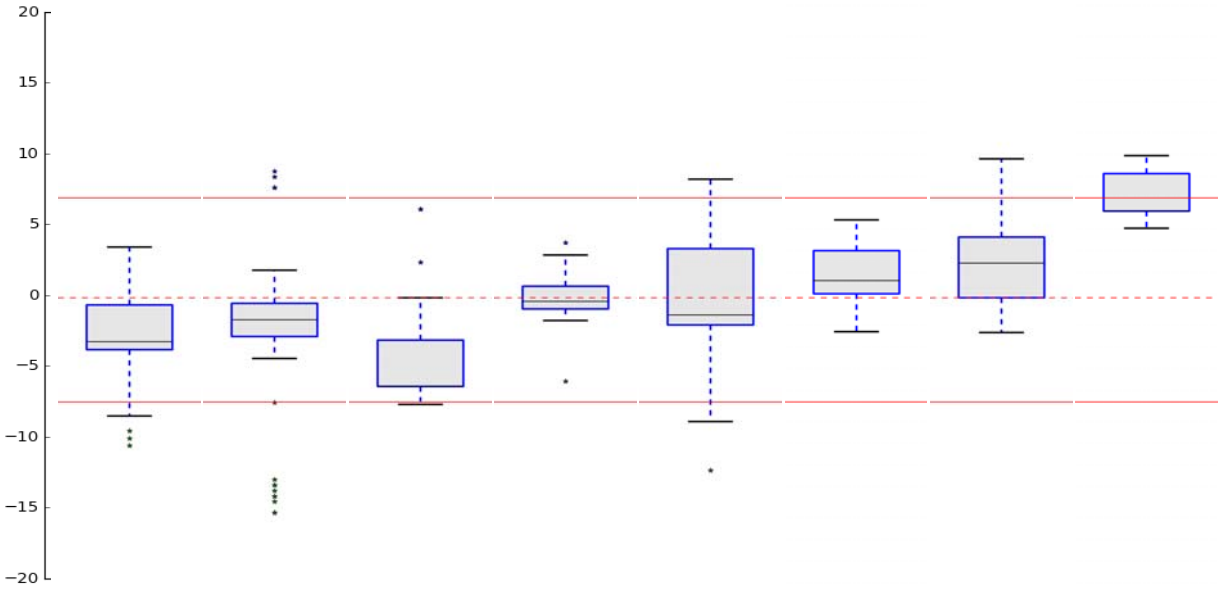
REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	**CA**	**California Air Resources Board (0145)**	**Sulfur dioxide**	**INDUSTRIAL**	**2013**	**4**

Site	06-083-1013	06-083-1020	06-083-1025	06-083-4003
POC	1	2	1	1
CV	6.52	2.7	1.7	3.96
Bias	+/-5.26	+2.59	+/-1.42	+/-3.62
# Obs	19	26	51	48
Method	100	060	060	060



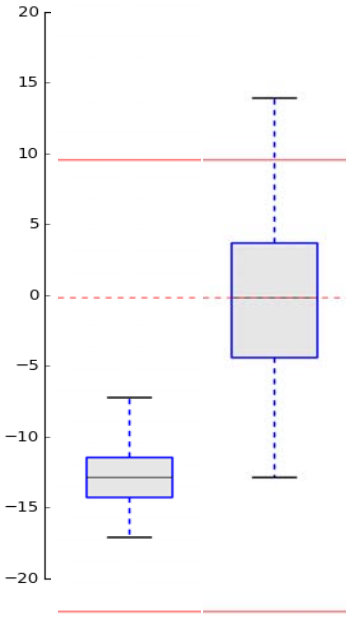
REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	**CA**	**California Air Resources Board (0145)**	**Sulfur dioxide**	**SLAMS**	**2013**	**8**

Site	06-019-0011	06-025-0005	06-067-0006	06-071-0306	06-071-1234	06-079-2004	06-083-0008	06-083-2004
POC	3	3	1	1	1	1	1	1
CV	2.25	3.25	4.59	1.65	4.57	1.86	2.59	1.72
Bias	-2.72	-2.58	-5.43	+/-1.25	+/-3.66	+1.93	+2.93	+6.61
# Obs	260	194	24	44	33	319	51	51
Method	560	560	600	077	077	009	060	060



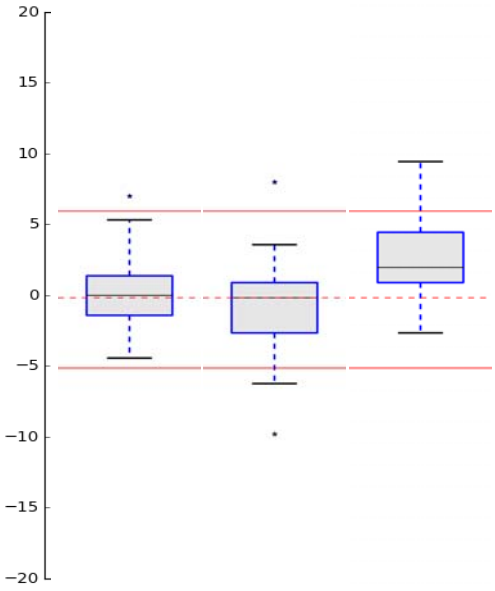
REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	**CA**	**California Air Resources Board (0145)**	**Sulfur dioxide**	**SPM**	**2013**	**2**

Site	06-023-1004	06-023-1005
POC	1	1
CV	2.77	7.27
Bias	-11.98	+/-5.89
# Obs	24	24
Method	060	060



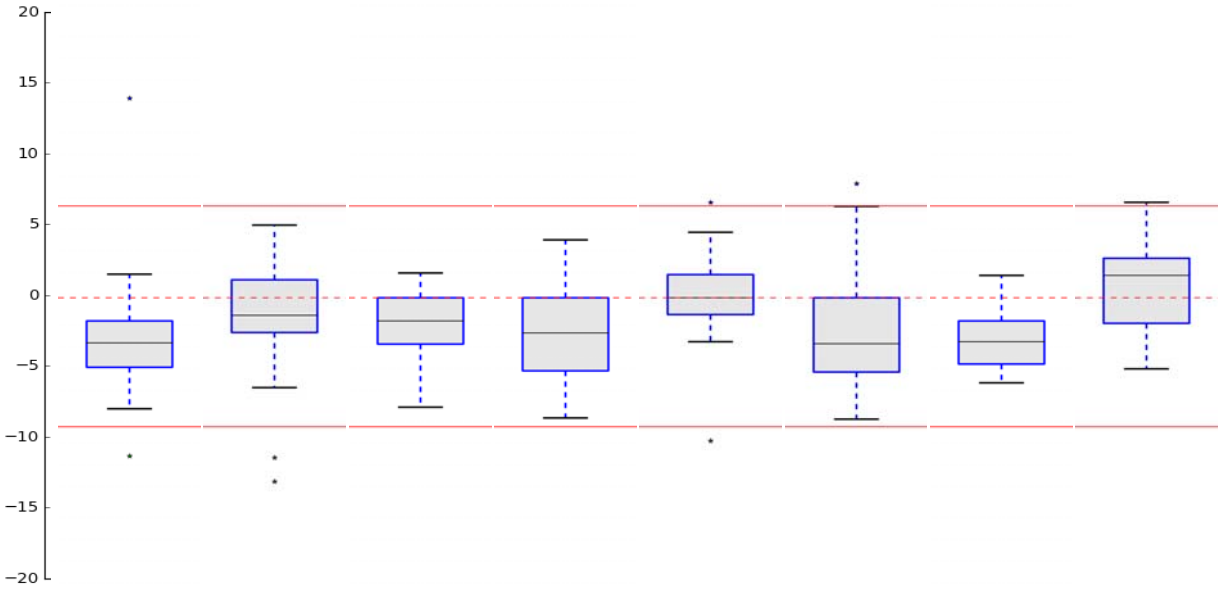
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	San Diego County Air Pollution Control District (0942)	Carbon monoxide	SLAMS	2013	3

Site	06-073-0003	06-073-1002	06-073-1010
POC	3	1	1
CV	2.18	4.03	2.75
Bias	+/-1.74	+/-3.21	+3.27
# Obs	85	25	28
Method	554	054	054



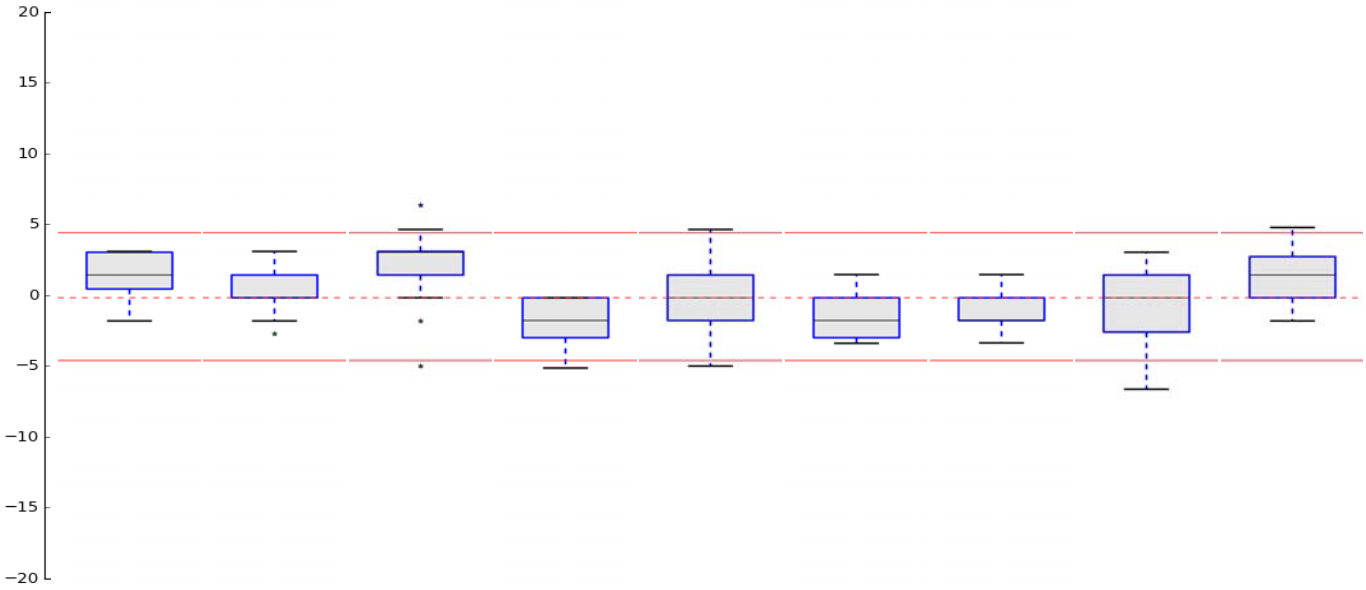
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	San Diego County Air Pollution Control District (0942)	Nitrogen dioxide (NO2)	SLAMS	2013	8

Site	06-073-0001	06-073-0003	06-073-1002	06-073-1006	06-073-1008	06-073-1010	06-073-1016	06-073-2007
POC	1	1	1	1	1	1	1	1
CV	4.77	2.95	2.8	7.87	3.34	5.03	1.83	3.58
Bias	-4.63	+/-2.26	-2.84	-5.78	+/-2.38	-4.7	-3.23	+/-2.98
# Obs	27	83	26	26	25	28	27	26
Method	074	074	074	074	074	074	074	074



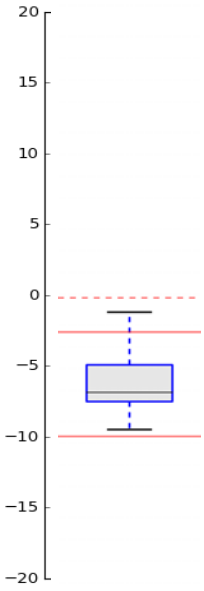
REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	CA	San Diego County Air Pollution Control District (0942)	Ozone	SLAMS	2013	9

Site	06-073-0001	06-073-0003	06-073-1001	06-073-1002	06-073-1006	06-073-1008	06-073-1010	06-073-1016	06-073-2007
POC	1	1	1	1	1	1	1	1	1
CV	1.69	1.5	2.95	1.88	2.9	1.83	1.33	2.85	1.88
Bias	+1.95	+1.21	+3.28	-1.92	+/-2.28	-1.78	-1.33	+/-2.35	+1.96
# Obs	27	27	18	26	28	26	28	27	27
Method	047	047	047	047	047	047	047	047	047



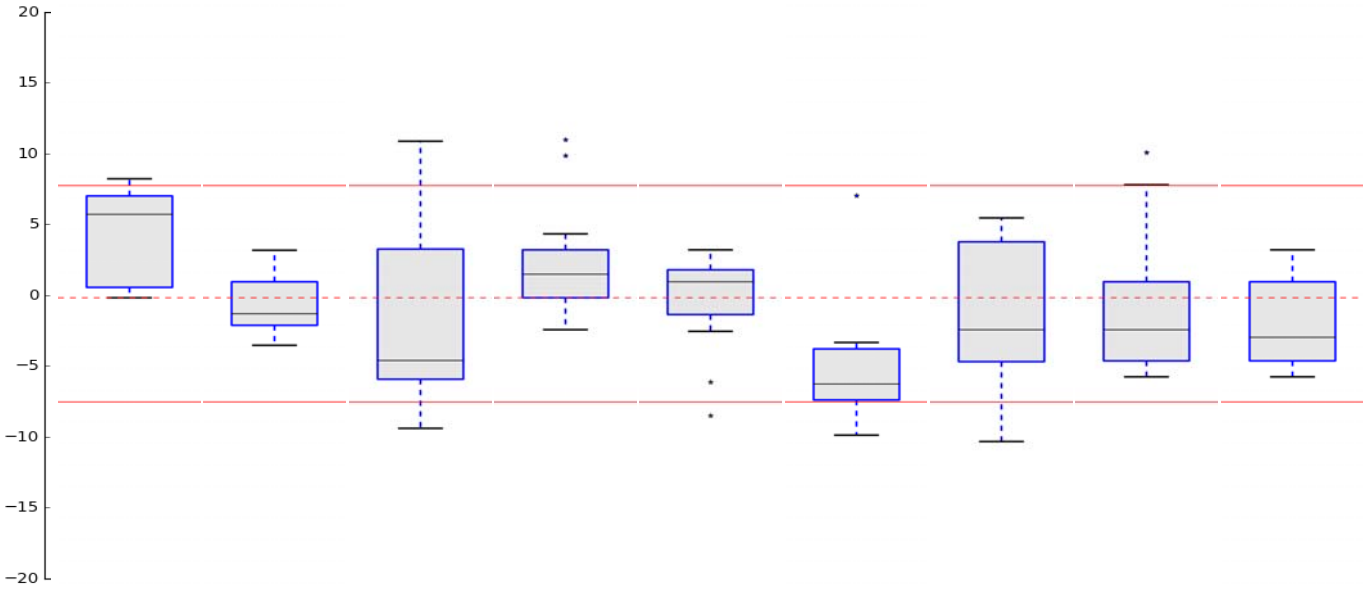
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	San Diego County Air Pollution Control District (0942)	Sulfur dioxide	SLAMS	2013	1

Site	06-073-0003
POC	3
CV	1.85
Bias	-5.7
# Obs	87
Method	560

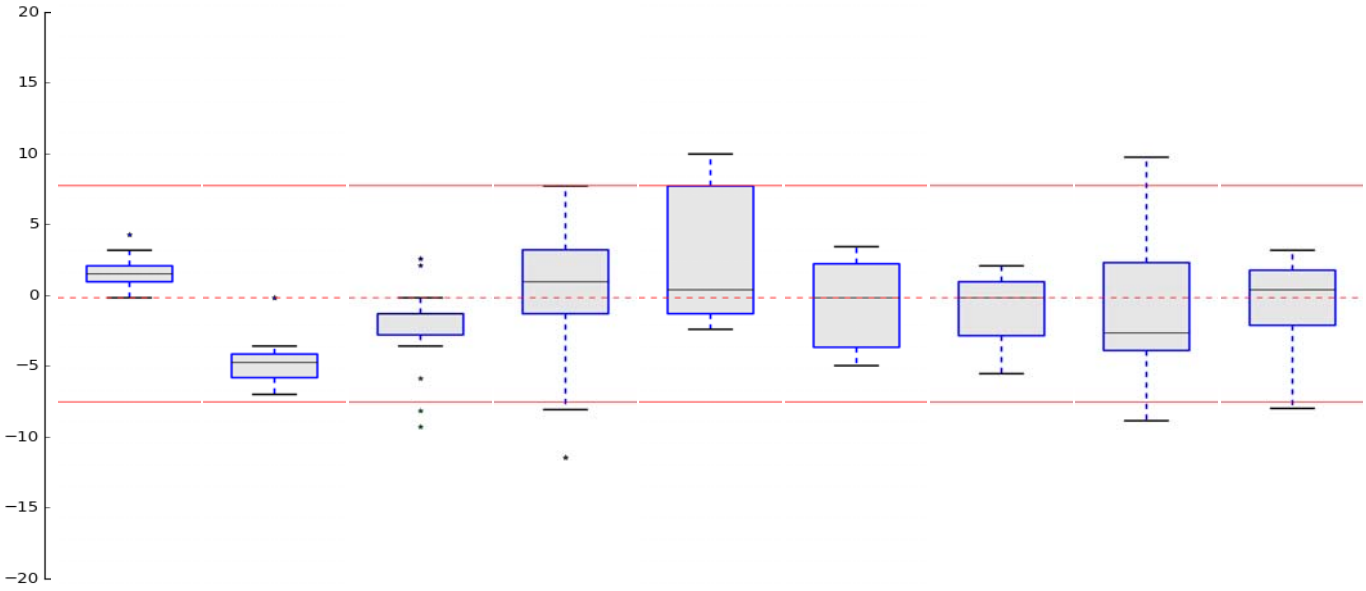


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	South Coast Air Quality Management District (0972)	Carbon monoxide	SLAMS	2013	27

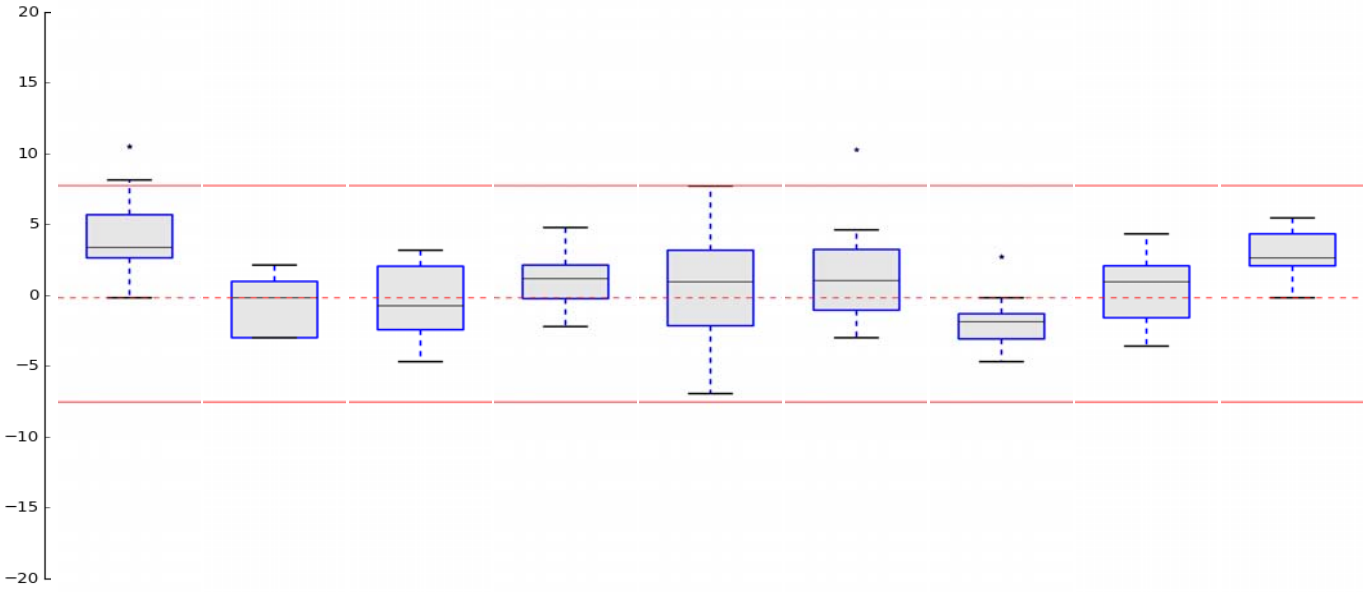
Site	06-037-0002	06-037-0016	06-037-0113	06-037-1002	06-037-1103	06-037-1103	06-037-1201	06-037-1302	06-037-1602
POC	1	2	1	1	1	9	1	1	1
CV	3.54	2.05	6.78	3.69	2.98	9.39	5.58	4.78	3.32
Bias	+5.15	+/-1.74	+/-5.82	+3.25	+/-2.36	-7.47	+/-4.78	+/-4.04	+/-3.37
# Obs	26	26	27	26	26	6	27	26	26
Method	158	158	106	158	158	593	106	158	158



Site	06-037-1701	06-037-2005	06-037-4006	06-037-5005	06-037-6012	06-059-0007	06-059-1003	06-059-2022	06-059-5001
POC	1	1	1	1	1	1	1	1	1
CV	1.37	2.73	2.99	5.75	4.99	3.41	2.74	4.76	2.77
Bias	+2.05	-4.62	-2.84	+/-4.48	+/-4.74	+/-2.88	+/-2.34	+/-3.98	+/-2.19
# Obs	26	15	26	25	26	26	26	27	26
Method	106	158	158	106	106	158	106	106	106

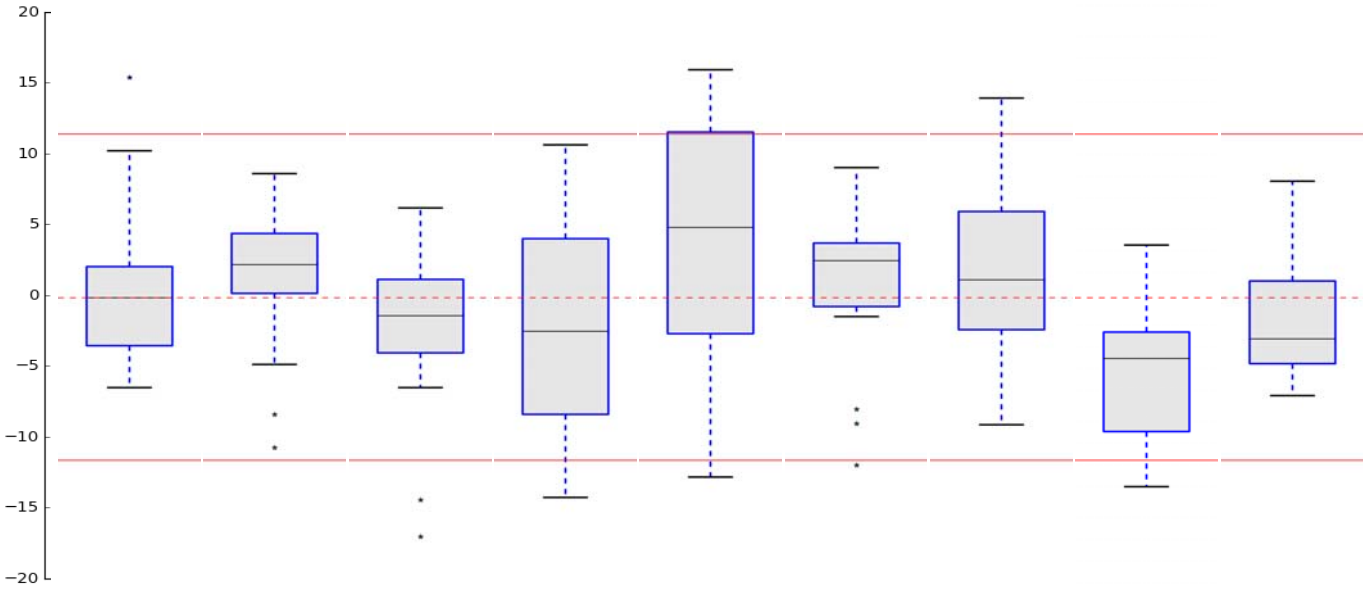


Site	06-065-1003	06-065-5001	06-065-8001	06-065-8001	06-065-8005	06-065-9001	06-071-1004	06-071-2002	06-071-9004
POC	1	1	1	9	1	1	1	1	1
CV	3.39	1.93	2.66	2.25	4.21	3.32	1.95	2.82	2.03
Bias	+5.16	+/-1.65	+/-2.26	+/-2.17	+/-3.5	+/-2.94	-2.14	+/-2.38	+3.24
# Obs	26	26	26	20	26	26	26	24	26
Method	106	106	158	593	106	106	106	106	158

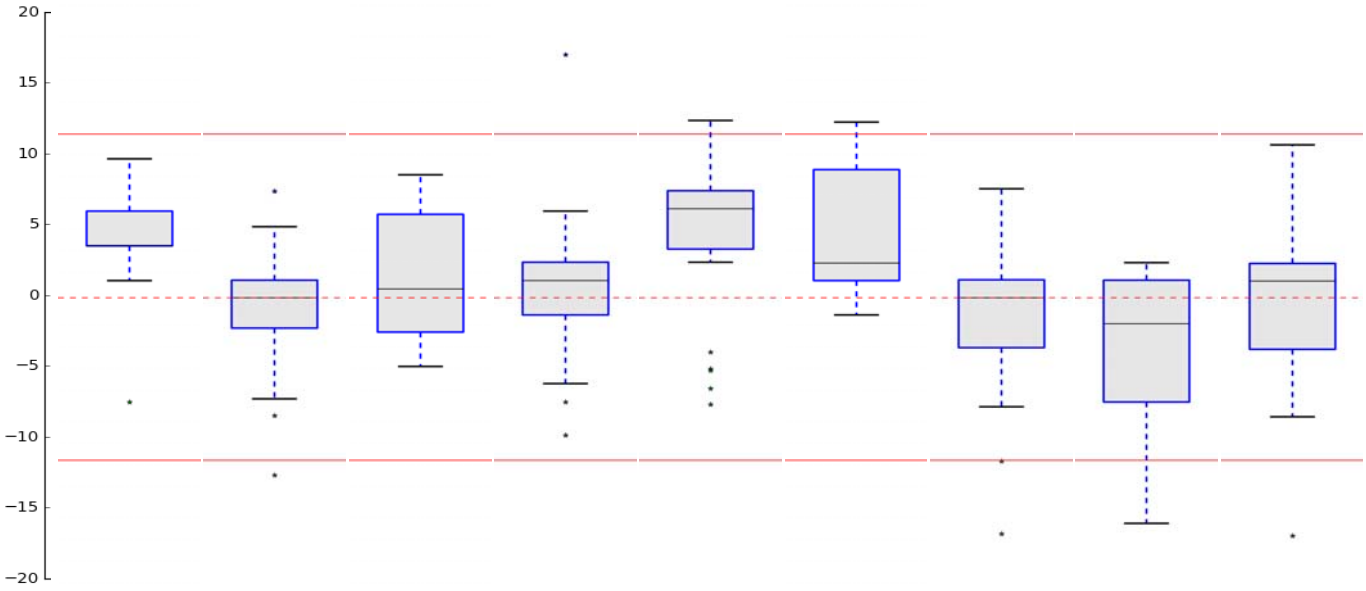


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	South Coast Air Quality Management District (0972)	Nitrogen dioxide (NO2)	SLAMS	2013	25

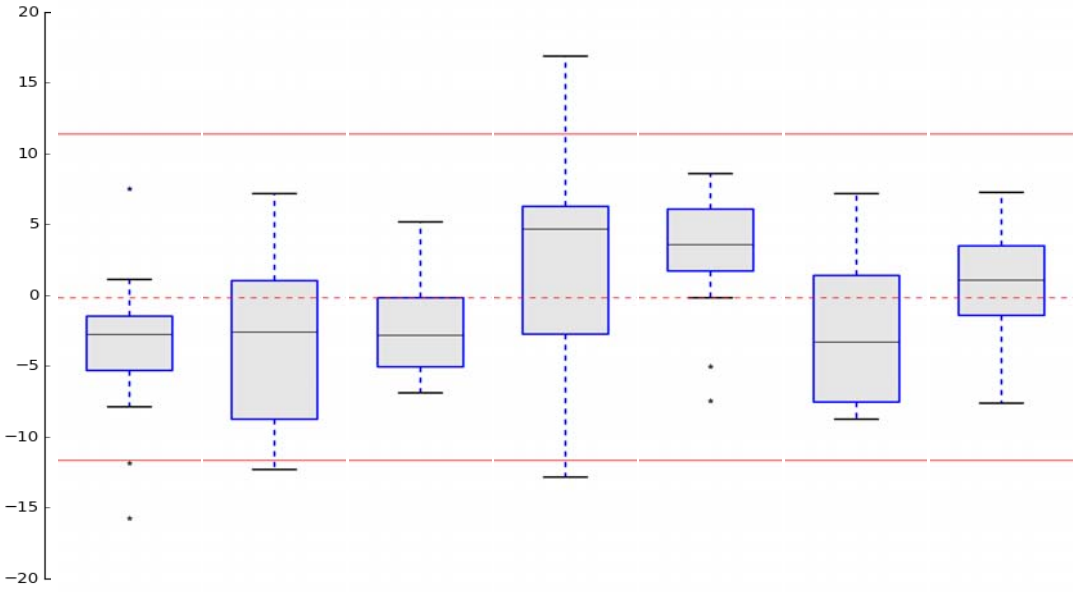
Site	06-037-0002	06-037-0016	06-037-0113	06-037-1002	06-037-1103	06-037-1201	06-037-1302	06-037-1602	06-037-1701
POC	2	1	1	2	1	2	1	1	2
CV	6.02	4.8	5.81	8.63	10.3	5.53	7.1	5.12	4.24
Bias	+/-4.68	+4.14	+/-4.64	+/-7.28	+/-9.01	+/-4.44	+/-5.88	-6.12	+/-3.72
# Obs	26	26	25	23	19	23	26	26	26
Method	074	074	074	074	074	074	074	074	099



Site	06-037-2005	06-037-4006	06-037-5005	06-037-6012	06-059-0007	06-059-1003	06-059-5001	06-065-0012	06-065-1003
POC	1	1	1	1	5	1	2	1	3
CV	4.66	4.57	5.22	5.43	6.32	4.71	5.62	6.12	6.85
Bias	+5.4	+/-3.47	+/-4.6	+/-4.08	+6.64	+5.56	+/-4.31	+/-5.62	+/-5.35
# Obs	15	26	26	26	24	26	26	26	23
Method	074	074	074	099	099	074	074	074	074

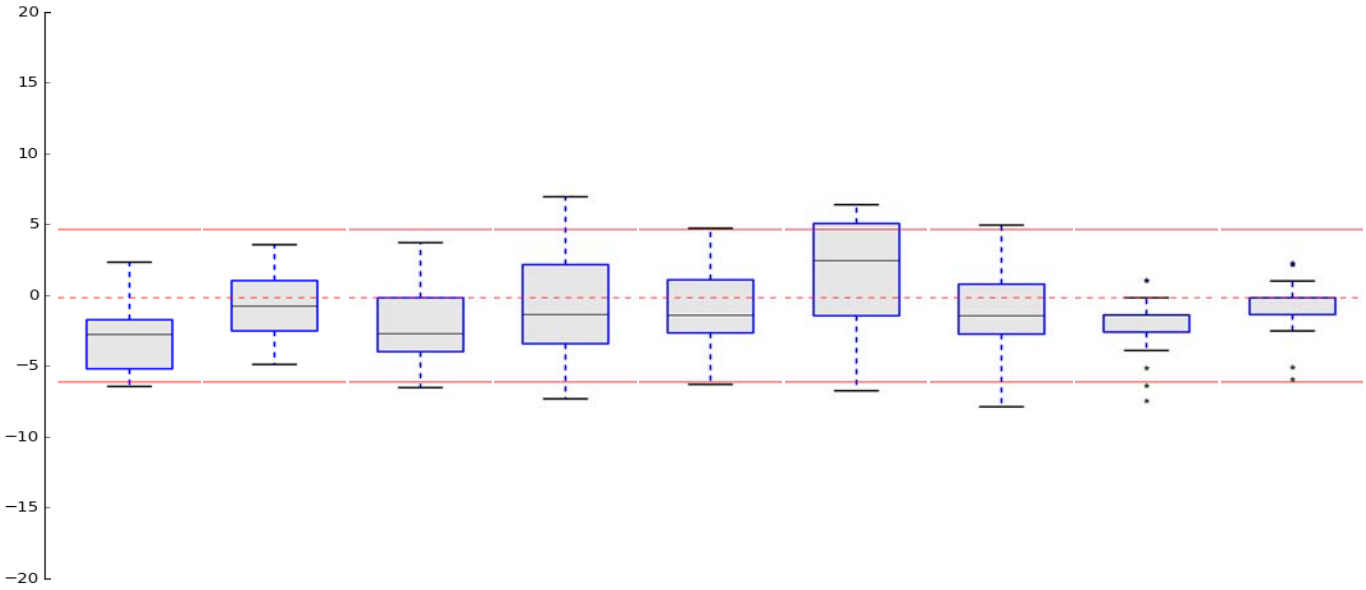


Site	06-065-5001	06-065-8001	06-065-8005	06-065-9001	06-071-1004	06-071-2002	06-071-9004
POC	2	2	1	1	2	1	1
CV	4.83	6.64	3.74	8.5	4.12	5.54	4.1
Bias	-4.9	+/-5.85	-3.59	+/-7.44	+4.5	+/-4.96	+/-3.42
# Obs	26	26	26	26	23	24	26
Method	074	074	074	074	074	099	074

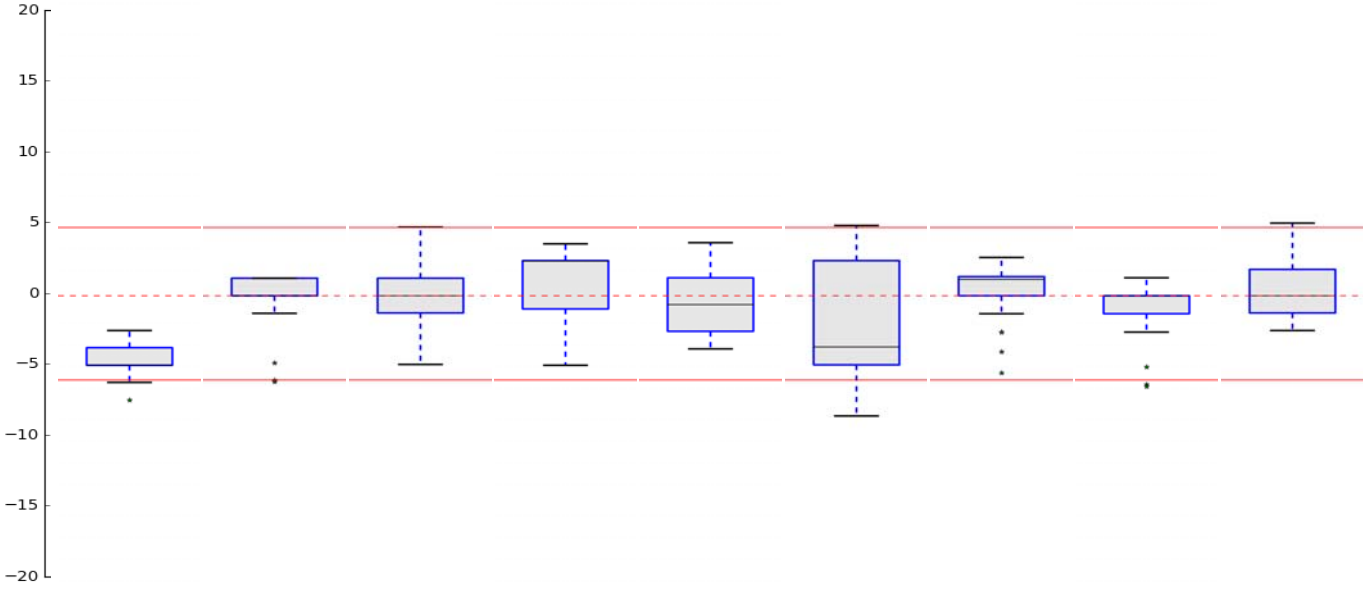


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	South Coast Air Quality Management District (0972)	Ozone	SLAMS	2013	30

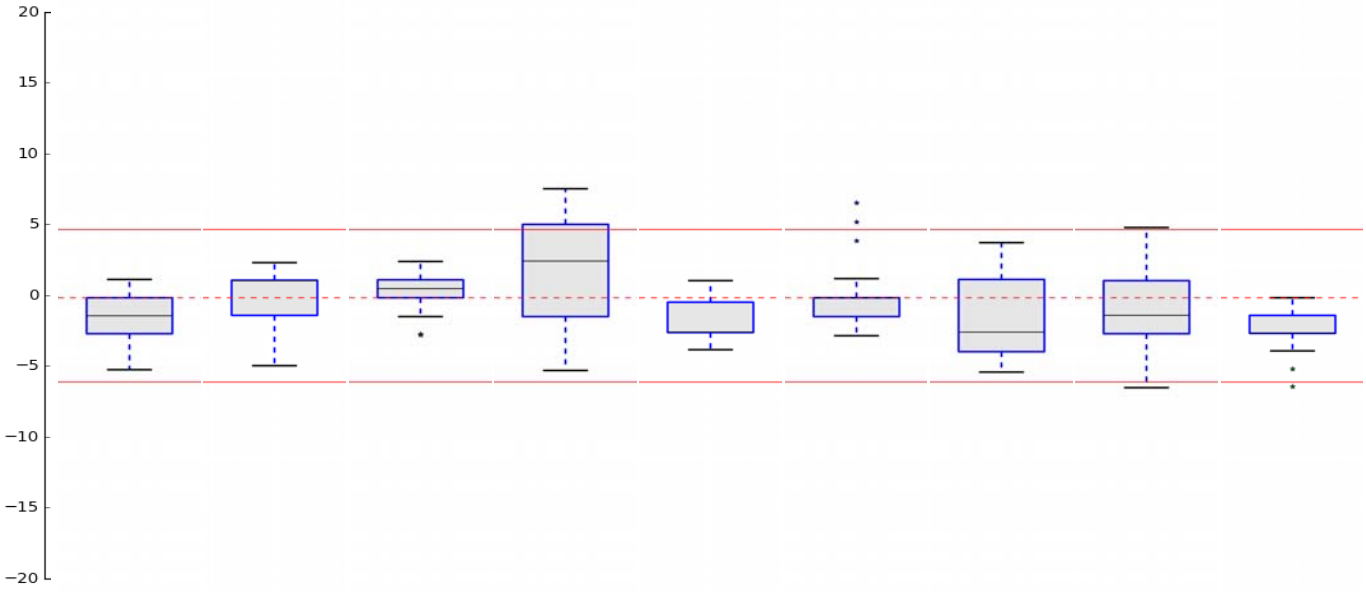
Site	06-037-0002	06-037-0016	06-037-0113	06-037-1002	06-037-1103	06-037-1201	06-037-1302	06-037-1602	06-037-1701
POC	1	1	1	1	1	1	1	1	1
CV	2.36	2.29	2.66	4.26	2.8	4.07	3.26	2.18	2.13
Bias	-3.33	+/-1.9	-2.62	+/-3.5	+/-2.35	+/-3.71	+/-2.78	-2.25	-1.55
# Obs	26	26	27	26	26	27	26	26	26
Method	087	087	087	087	087	087	047	087	087



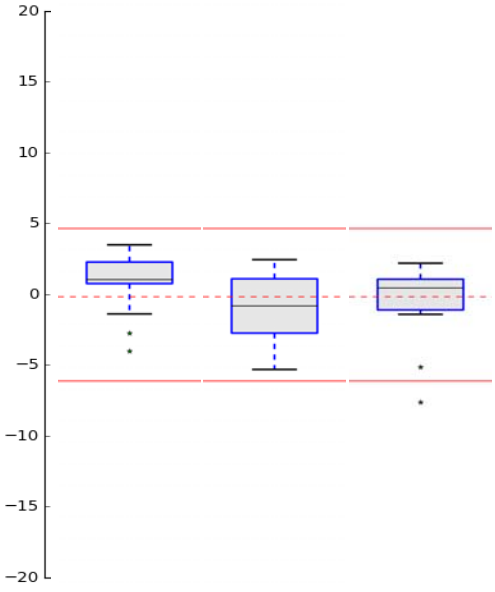
Site	06-037-2005	06-037-4006	06-037-5005	06-037-6012	06-059-0007	06-059-1003	06-059-2022	06-059-5001	06-065-0012
POC	1	1	1	1	1	1	1	1	1
CV	1.42	2.36	2.55	2.72	2.3	4.82	2.25	2.26	2.43
Bias	-4.47	+1.71	+/-1.91	+/-2.45	+/-2.0	+/-4.23	+1.78	-1.75	+/-1.98
# Obs	15	26	26	26	26	26	27	26	19
Method	087	047	087	087	047	087	087	047	087



Site	06-065-0016	06-065-2002	06-065-5001	06-065-6001	06-065-8001	06-065-8005	06-065-9001	06-071-0005	06-071-1004
POC	1	1	1	1	1	1	1	1	2
CV	2.08	2.1	1.61	4.17	1.68	2.49	3.19	2.84	1.57
Bias	-2.04	+/-1.71	+1.32	+/-3.89	-2.01	-1.82	+/-2.93	+/-2.39	-2.52
# Obs	27	26	26	25	26	26	26	27	26
Method	087	087	087	047	087	087	047	047	087

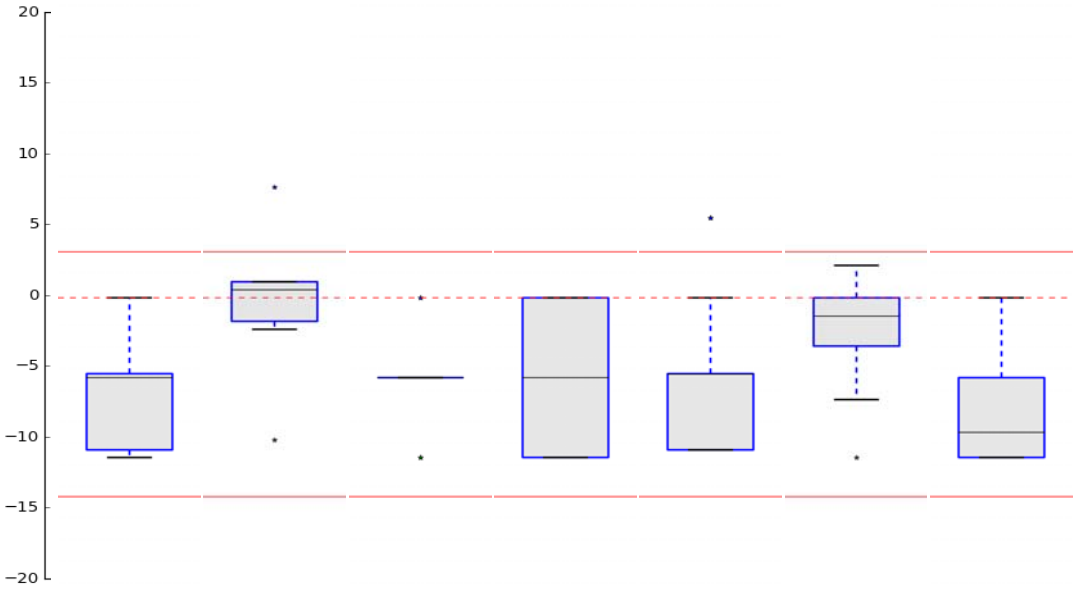


Site	06-071-2002	06-071-4003	06-071-9004
POC	1	1	1
CV	2.05	2.63	2.35
Bias	+1.94	+/-2.21	+/-1.73
# Obs	24	26	26
Method	087	087	087



REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	CA	South Coast Air Quality Management District (0972)	Sulfur dioxide	SLAMS	2013	7

Site	06-037-1002	06-037-1103	06-037-4006	06-037-5005	06-059-1003	06-065-8001	06-071-2002
POC	2	9	1	1	1	9	1
CV	3.74	9.08	2.74	5.2	6.06	2.98	3.57
Bias	-7.43	+/-6.33	-5.94	-6.03	-7.15	-2.84	-8.3
# Obs	26	6	26	26	26	28	24
Method	560	560	560	560	560	560	560



APPENDIX G

ARB's PRECISION AND BIAS GRAPHICS FOR STATIONS MONITORING PARTICULATE MATTER IN CALIFORNIA

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Background

Similar to Appendix F, this appendix presents precision and bias graphics for sites monitoring particulate matter. First, bias graphics are presented for individual samplers. Then, precision based on collocated samplers is displayed for sites with paired samplers. In addition to precision, bias estimates between each pair of samplers are also provided on the graphs. While there is no requirement for this analysis, 40 CFR Appendix A to Part 58, section 4.3, recommends that this assessment be performed when the primary monitor is a federal equivalent method and the collocated monitor is an federal reference method. In this appendix, the bias calculations are provided for all collocated samplers in ARB's PQAO network (for informational purposes only). The bias (average difference between "primary" and "secondary" or "collocated" samplers) was estimated using the same procedure for calculating PM2.5 absolute bias, as outlined in Appendix D, section D.4.

Description of Plots

The first set of graphics presents bias estimates based on flow rate verifications. Then, precision of individual pairs of collocated samplers is presented, with bias estimates as described above.

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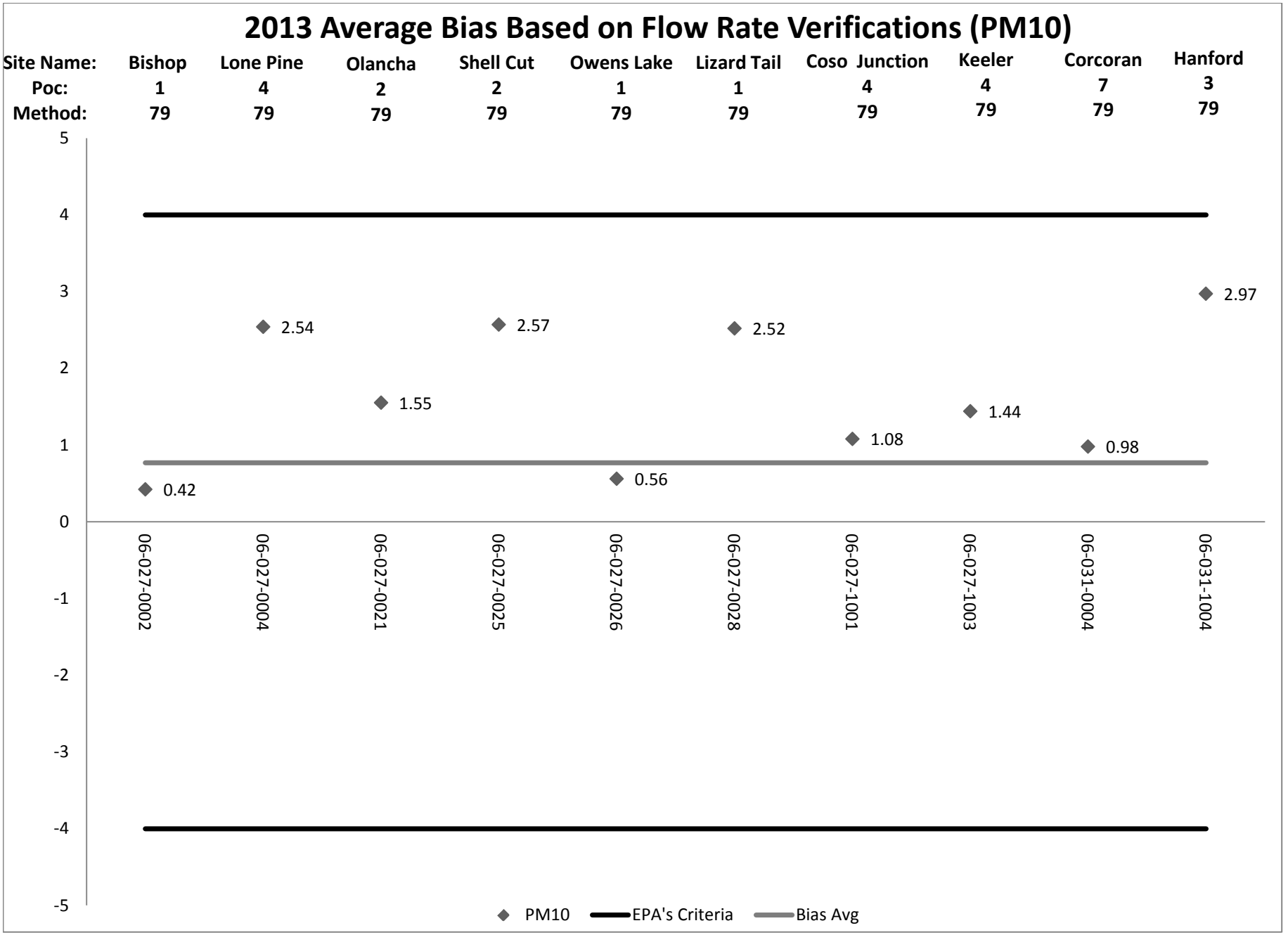
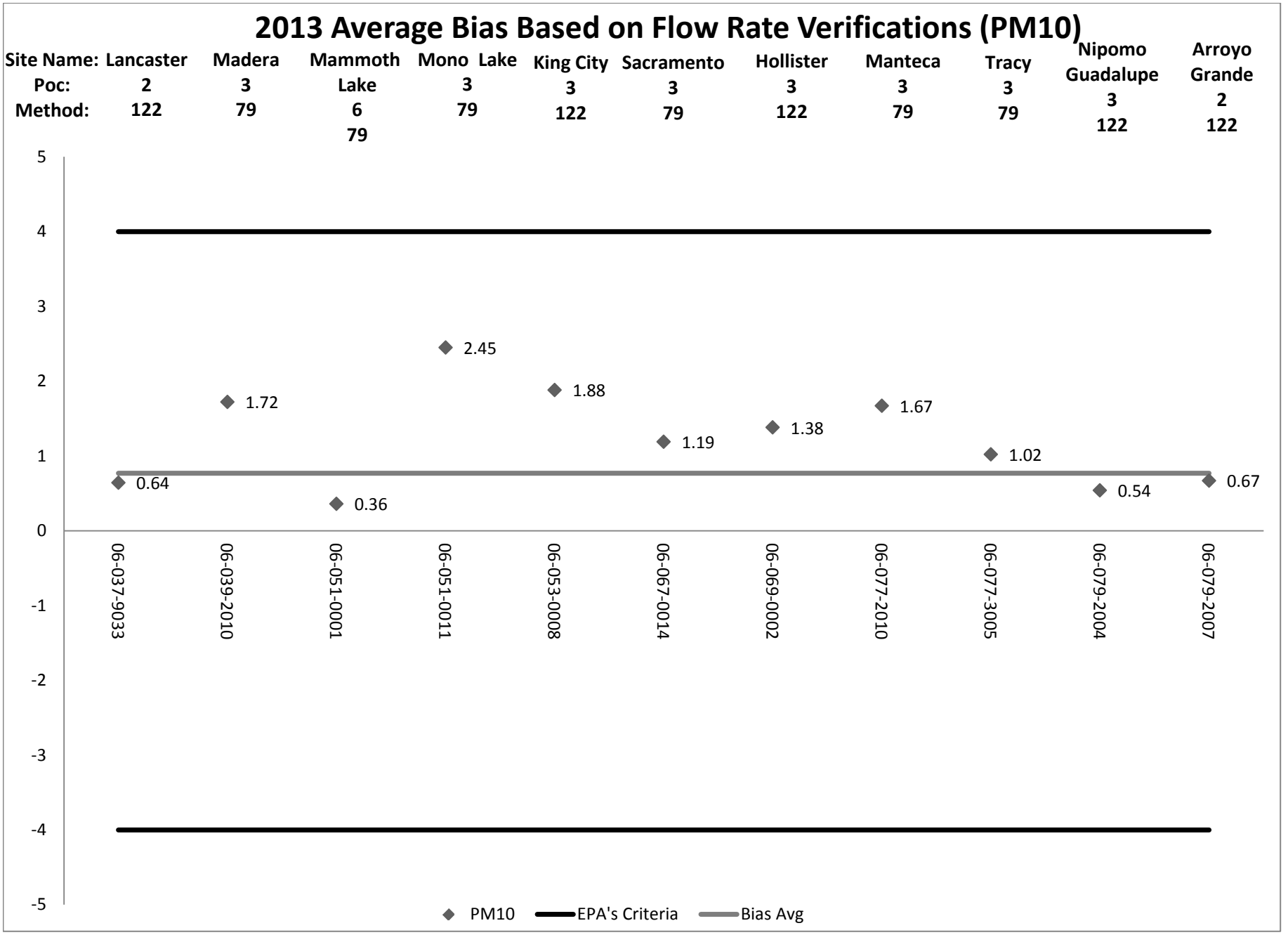
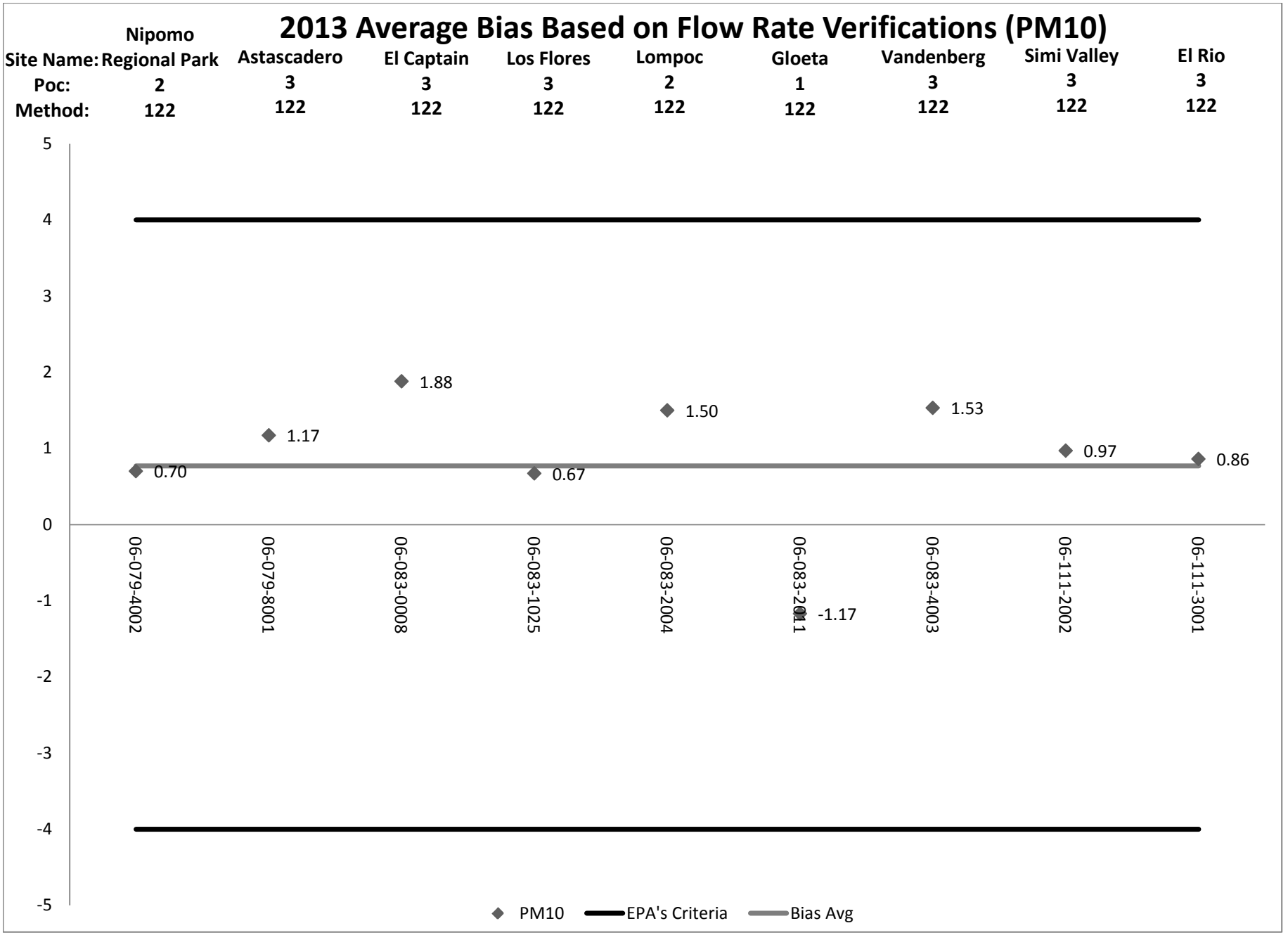
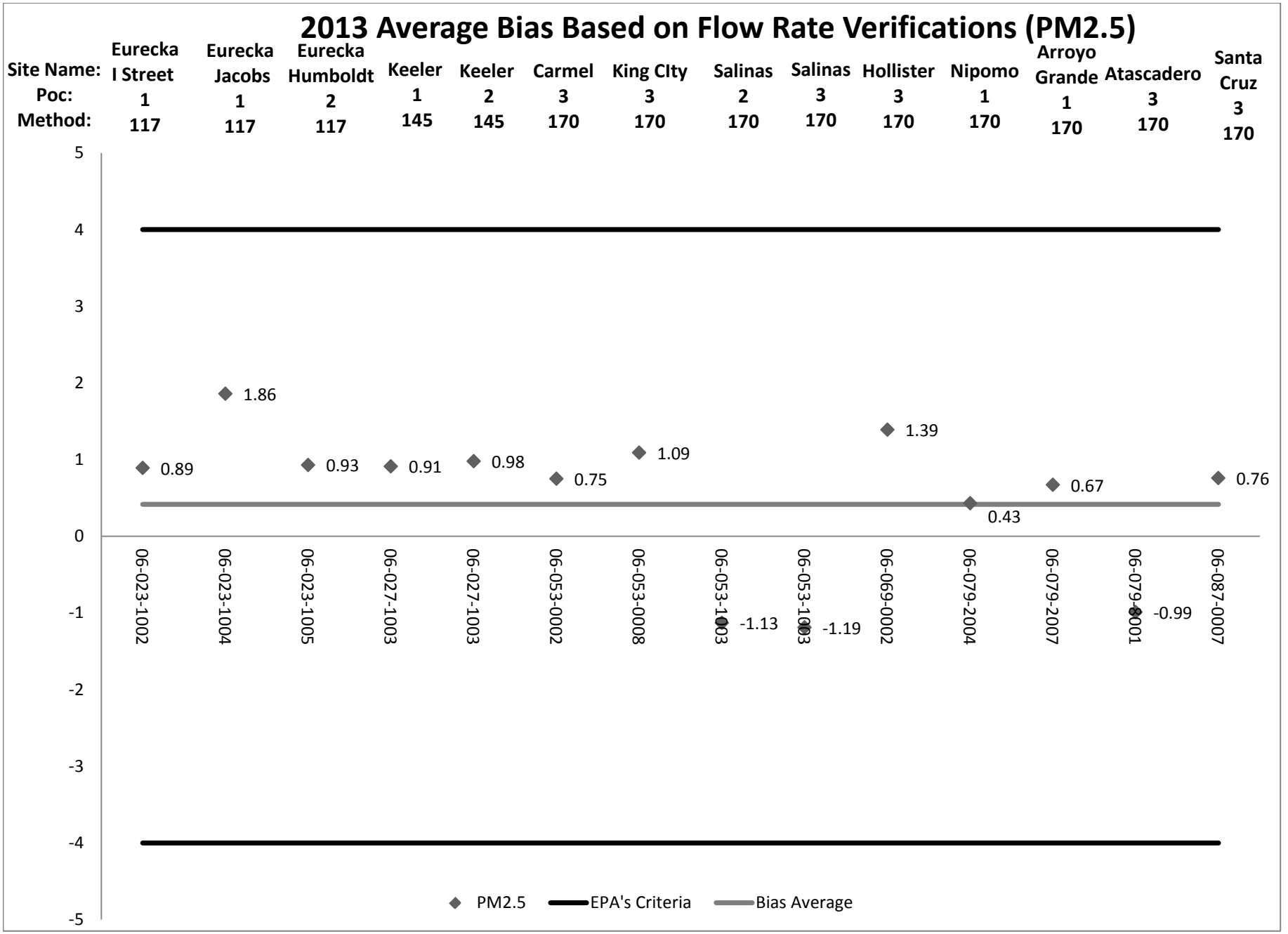

2013 Average Bias Based on Flow Rate Verifications (PM10)
Site Name: Bishop Lone Pine Olancha Shell Cut Owens Lake Lizard Tail Coso Junction Keeler Corcoran Hanford
Poc: 1 4 2 2 1 1 4 4 7 3
Method: 79 79 79 79 79 79 79 79 79 79
5
4
3
2
1
0
-1
-2
-3
-4
-5
0.42
2.54
1.55
2.57
0.56
2.52
1.08
1.44
0.98
2.97
06-027-0002
06-027-0004
06-027-0021
06-027-0025
06-027-0026
06-027-0028
06-027-1001
06-027-1003
06-031-0004
06-031-1004
PM10
EPA's Criteria
Bias Avg

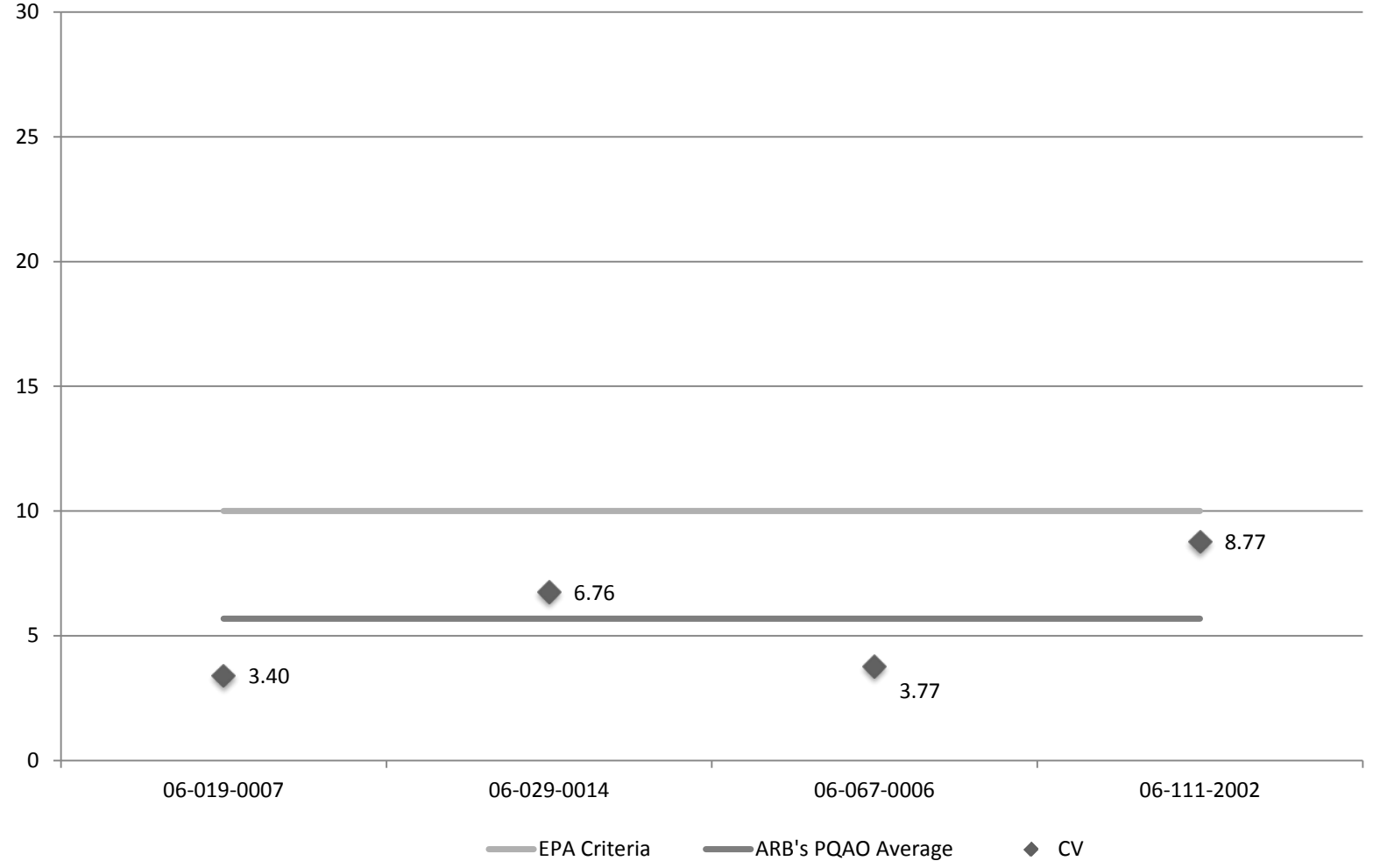

2013 Average Bias Based on Flow Rate Verifications (PM10)
Site Name: Lancaster Madera Mammoth Lake Mono Lake King City Sacramento Hollister Manteca Tracy Nipomo Guadalupe Arroyo Grande
Poc: 2 3 6 3 3 3 3 3 3 3 2
Method: 122 79 79 79 122 79 122 79 79 122 122
5
4
3
2
1
0
-1
-2
-3
-4
-5
0.64
1.72
0.36
2.45
1.88
1.19
1.38
1.67
1.02
0.54
0.67
06-037-9033
06-039-2010
06-051-0001
06-051-0011
06-053-0008
06-067-0014
06-069-0002
06-077-2010
06-077-3005
06-079-2004
06-079-2007
PM10
EPA's Criteria
Bias Avg


2013 Average Bias Based on Flow Rate Verifications (PM10)
Site Name: Nipomo Regional Park
Poc: 2
Method: 122
Astascadero 3 122
El Captain 3 122
Los Flores 3 122
Lompoc 2 122
Gloeta 1 122
Vandenberg 3 122
Simi Valley 3 122
El Rio 3 122
5
4
3
2
1
0
-1
-2
-3
-4
-5
0.70
1.17
1.88
0.67
1.50
-1.17
1.53
0.97
0.86
06-079-4002
06-079-8001
06-083-0008
06-083-1025
06-083-2004
06-083-2011
06-083-4003
06-111-2002
06-111-3001
PM10
EPA's Criteria
Bias Avg


2013 Average Bias Based on Flow Rate Verifications (PM2.5)
Site Name: Eurecka I Street
Poc: 1
Method: 117
Eurecka Jacobs 1 117
Eurecka Humboldt 2 117
Keeler 1 145
Keeler 2 145
Carmel 3 170
King CIty 3 170
Salinas 2 170
Salinas 3 170
Hollister 3 170
Nipomo 1 170
Arroyo Grande 1 170
Atascadero 3 170
Santa Cruz 3 170
5
4
3
2
1
0
-1
-2
-3
-4
-5
0.89
1.86
0.93
0.91
0.98
0.75
1.09
-1.13
-1.19
1.39
0.43
0.67
-0.99
0.76
06-023-1002
06-023-1004
06-023-1005
06-027-1003
06-027-1003
06-053-0002
06-053-0008
06-053-1003
06-053-1003
06-069-0002
06-079-2004
06-079-2007
06-079-4001
06-087-0007
PM2.5
EPA's Criteria
Bias Average

2013 Precision Based on Collocated Samplers (PM10)

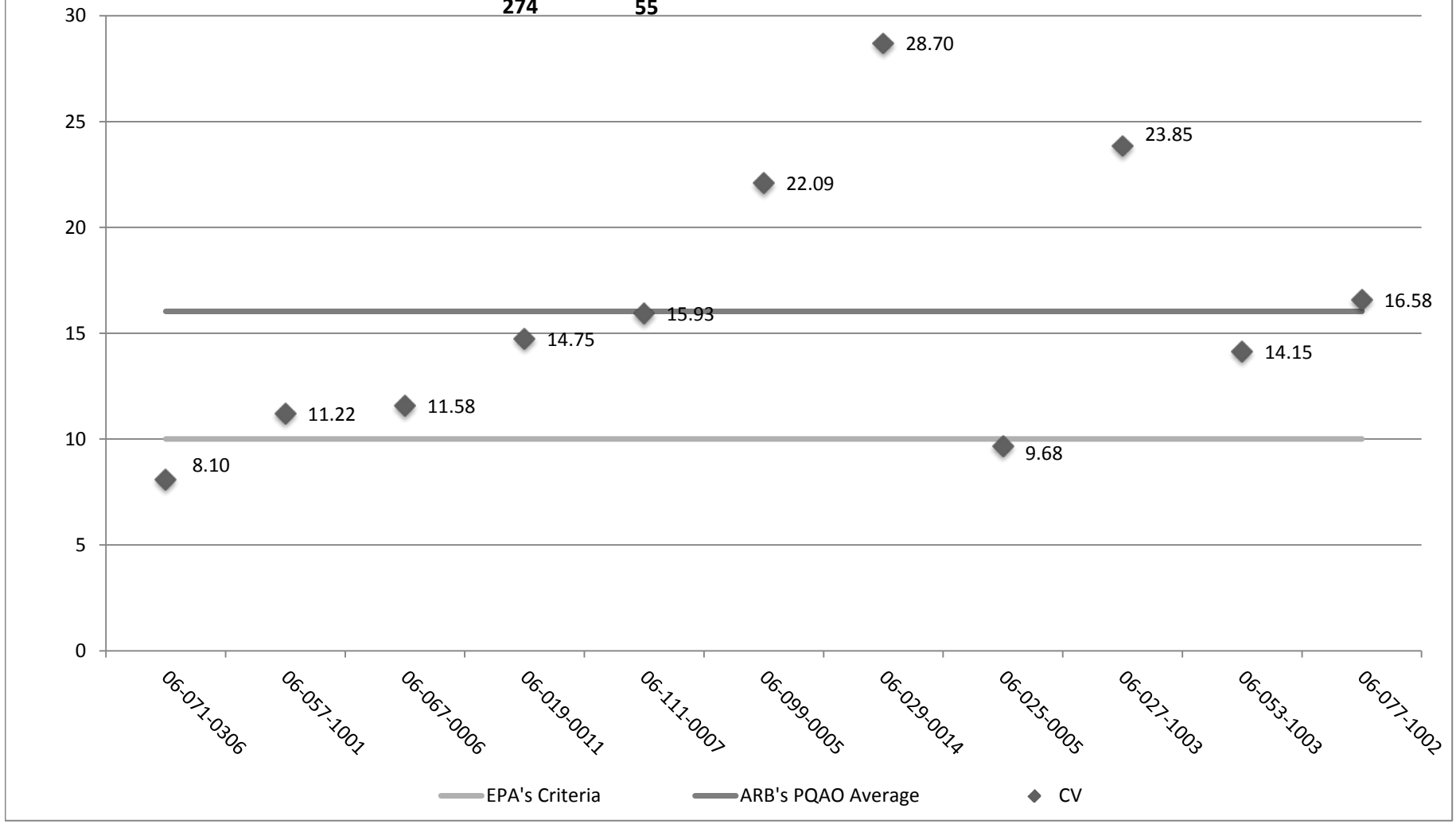
Site Name:	Fresno-Drummond	Bakersfield	Sacramento-Del Paso	Cochran
Poc:	1	1	1	1
CV Value:	3.40	6.76	3.77	8.77
Bias*:	-3.62	+/- 3.50	+ 4.14	- 9.09
Observations:	54	39	34	43



*Bias is for collocated pairs of PM samplers.

2013 Precision Based on Collocated Samplers (PM2.5)

Site Name:	Victorville	Truckee	Sac-Del Paso	Fresno	Thousand Oaks	Modesto	Bakersfield	Calexico-Ethel	Keeler	Salinas	Stockton
Poc:	1	1	1	Garland 1	1	1	1	1	3	3	3
CV Value:	8.10	11.22	11.58	14.75	15.93	22.09	28.70	9.68	23.85	14.15	16.58
Bias*:	+/- 9.70	+ 18.05	+/- 13.59	- 21.30	+/- 18.74	+/- 21.95	+/- 38.78	+/- 9.92	+ 27.67	+ 30.31	+ 52.92
Method*:	117/117	118/118	118/118	118/170	118/170	118/170	118/118	145/145	181/145	170/117	170/170
Obs:	46	44	27	274	55	28	46	75	87	44	338



*Bias is for collocated pairs of PM samplers.
*Method codes are listed as primary/secondary.

APPENDIX H

REFERENCES

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References

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3. State and Local Air Monitoring Network Plan, California Air Resources Board, June 2009.

4. Code of Federal Regulations, Title 40, Protection of the Environment, Part 58, Ambient Air Quality Surveillance (Nov 2012).

5. Air Monitoring Quality Assurance Manual. Volume I. Quality Assurance Plan, Monitoring and Laboratory Division, California Air Resources Board, June 2005.