California Environmental Protection Agency
Air Resources Board

2012
Annual Data Quality Report

Monitoring and Laboratory Division
Quality Management Branch
Primary Quality Assurance Organization

Page intentionally left blank

2012

Annual Data Quality Report

California Air Resources Board's
Primary Quality Assurance Organization

Prepared by:

Data Analysis and Special Projects Section
Quality Management Branch
Monitoring and Laboratory Division
Air Resources Board

April 2014

Page intentionally left blank

Table of Contents

Appendices

Page intentionally left blank

Executive Summary

The Code of Federal Regulations (CFR) defines the California Air Resources Board (ARB) as one of five 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).

This review focuses primarily on the precision (the degree of mutual agreement among individual measurements of the same property) and 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. Where appropriate, comparisons against other PQAOs in California and the national average are also made. These PQAOs include the: Bay Area Air Quality Management District (BAAQMD), San Diego County Air Pollution Control District (SDAPCD), South Coast Air Quality Management District (SCAQMD), and National Park Service (NPS). With regard to the national comparison, the average includes agencies defined as "state," "county," "district," or "tribal." 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). In some cases, PQAOs may have collected certain precision and/or bias/accuracy data but did not upload to AQS; most often, 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). 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 of the instrument response and the reference gas.

Precision for most particulate matter (PM) samplers is assessed via collocated sampling whereby two identical or equivalent samplers are operated side-by-side.[1] Bias for PM samplers is assessed by using the routine flow rate verifications performed by site operators.[2] Accuracy for both gaseous and PM pollutants 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. Precision and

[1] Collocated sampling is required for all PM samplers except continuous PM10.
[2] All PM samplers are required to undergo monthly flow rate verifications except for high-vol PM10 samplers, where quarterly flow checks are required. However, only flow rate verification data for continuous PM10 samplers are required to be uploaded to AQS.

accuracy data for 2012 from both gaseous and PM samplers are summarized below and in Tables ES-1A, ES-1B, and ES-2.

Gaseous Samplers

As indicated in Table ES-1A, almost all of the gaseous instruments operating under ARB's PQAO met the precision completeness goal of at least 75% of the required QC checks submitted to AQS. In addition, CFR precision and accuracy criteria (from both one-point QC checks and performance audits) were met at the PQAO level, with only a few sites not meeting the appropriate criteria.

PM Samplers

Key PM findings and recommendations are highlighted below:

Findings

- Due to the apparent discrepancy between CFR and U.S. EPA's data quality indicator report (AMP255) regarding the required number of collocated PM samplers and the subsequent uncertainty regarding this requirement, the collocated monitoring criteria is not specifically addressed in this year's report. However, ARB's PQAO is falling short of the required amount of collocated sampling for one or more methods of collecting PM.

- For the collocated samplers that were present, ARB's PQAO reported a high percentage of precision data.

- For the collected PM collocated data, ARB's PQAO met the precision criteria for PM10 but was unable to meet the precision criteria for any method of collecting PM2.5 at the PQAO level.

- Performance audit program accuracy data indicate that 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 from continuous analyzers that are uploaded to AQS.

Recommendations

- 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 collocation requirement for monitoring PM. This includes, but is not limited to, clearly defining in AQS which sampler is primary and which is secondary in the collocated locations. In addition, investigation into the causes behind the PM2.5 precision problems is encouraged.

- Air monitoring agencies within ARB's PQAO are encouraged to upload flow rate verification data (monthly flow checks) to U.S. EPA's AQS for all PM sampling

methods. Currently, flow rate verifications are required to be performed on all PM samplers, but only those from continuous PM10 are required to be uploaded. To enhance consistency in regulation and avoid any confusion, U.S. EPA is considering making it mandatory that data on flow rate checks be uploaded to AQS for all PM sampler methods. Such information would allow for a more comprehensive assessment of PM accuracy.

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 2012 ambient data for the ARB's PQAO have been certified and are considered suitable for comparison to federal standards.

Based on the results in this report, the data producers are encouraged to assess their monitoring networks to make sure that AQS accurately reflects the number of sites operating and that all required precision and accuracy data collected are reported to AQS. The statistics reported herein 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.

Table ES-1A. 2012 Summary of Precision and Bias/Accuracy Results - Gases

Pollutant	PQAO	% of Samplers Meeting 75% Precision Completeness Goal	CFR Criteria for Precision (CV) Met?	CFR Criteria for Bias Met?	CFR Criteria for Accuracy Via Audits?
Carbon Monoxide (CO)	ARB	100%	Yes	Yes	Yes
	BAAQMD	100%	Yes	Yes	Yes
	SCAQMD	97%	Yes	Yes	Yes
	SDAPCD	100%	Yes	Yes	Yes
	NATIONAL	98%	Yes	Yes	Yes
Nitrogen Dioxide (NO_2)	ARB	98%	Yes	Yes	Yes
	BAAQMD	100%	Yes	Yes	Yes
	SCAQMD	96%	Yes	Yes	Yes
	SDAPCD	100%	Yes	Yes	Yes
	NATIONAL	95%	Yes	Yes	Yes
Ozone (O_3)	ARB	97%	Yes	Yes	Yes
	BAAQMD	100%	Yes	Yes	Yes
	NPS	100%	Yes	Yes	Yes
	SCAQMD	100%	Yes	Yes	Yes
	SDAPCD	100%	Yes	Yes	Yes
	NATIONAL	98%	Yes	Yes	Yes
Sulfur Dioxide (SO_2)	ARB	93%	Yes	Yes	Yes
	BAAQMD	100%	Yes	Yes	Yes
	SCAQMD	89%	Yes	Yes	Yes
	SDAPCD	100%	Yes	Yes	Yes
	NATIONAL	96%	Yes	Yes	Yes

- CFR precision and bias criteria for gases are based on one-point QC checks. Specific criteria can be found in Section III and Appendix A. 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 other gases.
- NPS=National Park Service.
- Source: Air Quality System, AMP 255 Data Quality Indicator Report, run April 3, 2014.
- National = average of state, county, district, and tribal sites, including those in California; AMP 255 Data Quality Indicator Report, run April 9, 2014

Table ES-1B. 2012 Summary of Precision and Bias/Accuracy Results - PM

Pollutant	PQAO	% of Samplers Meeting 75% Precision Completeness Goal	CFR Criteria for Precision (CV) Met?	CFR Criteria for Bias Met?	CFR Criteria for Accuracy Via Audits?
PM10	ARB	100%	Yes	Yes	Yes
	BAAQMD	100%	Yes	NDA	Yes
	SCAQMD	100%	Yes	Yes	Yes
	SDAPCD	100%	Yes	NDA	Yes
	NATIONAL	98%	Yes	NDA	Yes
PM2.5	ARB	95%	No	Yes	Yes
	BAAQMD	100%	No	NDA	Yes
	SCAQMD	100%	Yes	Yes	Yes
	SDAPCD	100%	Yes	NDA	Yes
	NATIONAL	93%	No	NDA	Yes

- PM precision criteria are based on collocated measurements; PM 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.
- NDA=No Data Available from AQS; see first bullet above.
- Bias for PM2.5 in ARB's PQAO is based on limited data. See Table B2 for details.
- Source: Air Quality System, AMP 255 Data Quality Indicator Report, run April 3, 2014.
- Lead has been removed due to insufficient data for ARB's PQAO in 2012.
- National = average of state, county, district, and tribal sites, including those in California; AMP 255 Data Quality Indicator Report, run April 9, 2014

Table ES-2. Completeness of Required 2012 Performance Audits

Pollutant	PQAO	Number of Samplers	% of Samplers That Met the Required # of Audits?
CO	ARB	28	82% [a]
	BAAQMD	13	100%
	SCAQMD	29	97%
	SDAPCD	3	100%
	NATIONAL	307	97%
NO_2	ARB	52	100%
	BAAQMD	16	100%
	SCAQMD	27	96%
	SDAPCD	9	89%
	NATIONAL	361	97%
O_3	ARB	108	97%
	BAAQMD	20	100%
	NPS	8	88%
	SCAQMD	32	97%
	SDAPCD	10	90%
	NATIONAL	1109	99%
SO_2	ARB	14	86% [a]
	BAAQMD	10	100%
	SCAQMD	9	78%
	SDAPCD	1	100%
	NATIONAL	387	97%
PM10	ARB	103	94%
	BAAQMD	8	100%
	SCAQMD	36	100%
	SDAPCD	7	100%
	NATIONAL	885	79%
PM2.5	ARB	73	95%
	BAAQMD	14	100%
	SCAQMD	29	97%
	SDAPCD	18	100%
	NATIONAL	1201	85%

- [a] ARB was unable to conduct performance audits of trace-level instruments in 2012; these audits are expected to commence by the third quarter of 2014. Actual number of trace-level instruments for ARB's PQAO: five for CO and two for SO_2.
- CFR requires that gaseous instruments be audited once per year and particulate samplers that operate more than seven months be audited twice. If particulate samplers operate less than seven months but more than three months, only one audit is required.
- Source: Air Quality System, AMP 255 Data Quality Indicator Report, run April 3, 2014.
- National = average of state, county, district, and tribal sites, including those in California; AMP 255 Data Quality Indicator Report, run April 9, 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 (SDAPCD). In addition, the National Park Service (NPS) is its own 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.

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," 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 B of this report.

II. QUALITY ASSURANCE, QUALITY ASSESSMENT, AND QUALITY CONTROL

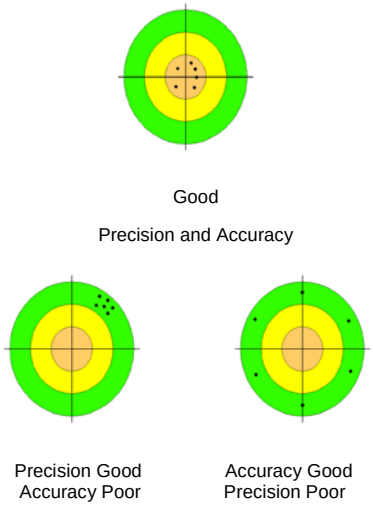
Quality assurance is an integrated system of management activities that involves planning, implementing, assessing, and assuring data quality through a process, item, or service that meets users' needs for quality, completeness, and representativeness. Known data quality enables users to make judgments 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.



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.

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.[3] 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

[3] 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

gaseous instruments are also used to estimate bias. For continuous PM, bias can be estimated from the monthly flow rate verifications. Available tools for assessing precision and bias are summarized in Appendix A of this report. Detailed descriptions of the coefficient of variation and the bias estimator, including the formulae behind the calculations, can be found in Appendix C.

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.[4]

Air Quality Data Actions (AQDA) are a key tool used by the Quality Management Branch (QMB) of the Monitoring and Laboratory Division to confirm the data set meets the established control limits. 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. 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. Outside of the AQDA process, data could also be flagged if monitoring agencies determined that 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 has been identified by ARB and U.S. EPA as an essential component for improving data quality and facilitating continuous process improvement. To meet this need, QMB developed 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 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 operated by 5 major PQAOs in 15 separate air basins operating in California. Within ARB's PQAO, there are

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

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

A. Gaseous Criteria Pollutants

Gaseous Pollutants Assessed:

- Carbon monoxide (CO)
- Ozone (O_3)
- Nitrogen dioxide (NO_2)
- Sulfur dioxide (SO_2)

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% for O_3, 10% for CO and SO_2, and 15% 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 of 40 CFR 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 for each site. 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% for O_3, +/-15% for NO_2,[5] and +/-10% for CO and SO_2. A detailed description of the bias estimator, including the formulae behind the calculations, can be found in Appendix C of this report.

Bias estimates are further verified via the through-the-probe performance audits. ARB acceptance criteria for performance audits for 2012 were: +/-10% for O_3 (with warning at +/-7%) and +/-15% for CO, NO_2, and SO_2 (with warning at +/-10%) for each audit point.

CFR requires that the one-point QC checks be performed at least once every two weeks on each automated sampler, which translates to a minimum of 26 checks per year for a sampler that operates year-round. ARB's policy is to audit 100% of local air districts' sites within its PQAO each year and audit non-ARB PQAO monitoring sites at

[5]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.

least once every 5 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 QA Handbook Volume II can be found in Appendix A.

Precision and Bias Results:

For gaseous pollutants required by 40 CFR (CO, NO_2, O_3, and SO_2), ARB's PQAO (as well as other California PQAOs and the national average) met the precision and bias criteria in 2012, as shown in Table A1. Information for years 2010 and 2011 are provided for a historical perspective. In general, 2012 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 A1 includes the number of sites with less than 75 percent of the required precision data reported for 2012.

Table A1. 2010-2012 Gaseous Pollutant Instrument Precision and Bias Results

Pollutant	PQAO	Year	# of Instruments	# of Instruments with less than 75% of Required Q/C checks*	Upper Bound of Coefficient of Variation	CFR Criteria Met for Precision Met?	Bias	CFR Criteria for Bias Met?
Carbon Monoxide (CO)	ARB	2012	28	0	4.95	Yes	+/- 3.70	Yes
		2011	26	0	4.27	Yes	+/- 3.40	Yes
		2010	29	0	4.64	Yes	+/- 3.74	Yes
	BAAQMD	2012	13	0	1.38	Yes	+ 1.24	Yes
		2011	13	0	1.70	Yes	+/- 1.32	Yes
		2010	15	0	1.65	Yes	+/- 1.17	Yes
	SCAQMD	2012	29	1	3.73	Yes	+/- 2.84	Yes
		2011	27	0	3.58	Yes	+/- 2.84	Yes
		2010	27	0	3.23	Yes	+/- 2.60	Yes
	SDAPCD	2012	3	0	3.21	Yes	+/- 2.78	Yes
		2011	3	0	4.16	Yes	+/- 3.00	Yes
		2010	4	0	4.69	Yes	+ 4.96	Yes
	NATIONAL	2012	329	7	3.86	Yes	+/- 3.78	Yes
		2011	335	11	3.50	Yes	+/- 3.64	Yes
		2010	335	9	3.90	Yes	+/- 3.72	Yes

Pollutant	PQAO	Year	# of Instruments	# of Instruments with less than 75% of Required Q/C checks*	Upper Bound of Coefficient of Variation	CFR Criteria Met for Precision Met?	Bias	CFR Criteria for Bias Met?
Nitrogen Dioxide (NO_2)	ARB	2012	52	1	5.23	Yes	+/- 3.92	Yes
		2011	50	1	4.95	Yes	+/- 3.67	Yes
		2010	53	0	5.03	Yes	+/- 3.86	Yes
	BAAQMD	2012	16	0	1.82	Yes	+/- 1.46	Yes
		2011	15	0	1.92	Yes	+/- 1.54	Yes
		2010	16	0	1.90	Yes	+/- 1.43	Yes
	SCAQMD	2012	27	1	4.51	Yes	+/- 3.76	Yes
		2011	27	0	6.42	Yes	+/- 4.89	Yes
		2010	27	0	4.79	Yes	+/- 3.74	Yes
	SDAPCD	2012	9	0	4.27	Yes	+/- 3.53	Yes
		2011	8	0	3.84	Yes	- 3.26	Yes
		2010	8	0	4.86	Yes	+/- 3.94	Yes
	NATIONAL	2012	378	18	4.48	Yes	+/- 4.48	Yes
		2011	361	14	4.74	Yes	+/- 4.65	Yes
		2010	377	17	4.57	Yes	+/- 4.49	Yes
Ozone (O_3)	ARB	2012	108	3	3.78	Yes	+/- 2.81	Yes
		2011	106	2	3.81	Yes	+/- 3.08	Yes
		2010	107	1	4.20	Yes	+/- 3.22	Yes
	BAAQMD	2012	20	0	1.55	Yes	+/- 1.27	Yes
		2011	19	0	1.65	Yes	+/- 1.29	Yes
		2010	21	0	1.55	Yes	+/- 1.19	Yes
	NPS	2012	8	0	2.20	Yes	+/- 1.66	Yes
		2011	8	0	2.04	Yes	+/- 1.67	Yes
		2010	8	0	2.30	Yes	- 1.70	Yes
	SCAQMD	2012	32	0	2.49	Yes	+/- 2.04	Yes
		2011	31	0	3.90	Yes	+/- 2.57	Yes
		2010	31	0	3.00	Yes	+/- 2.31	Yes
	SDAPCD	2012	10	0	3.03	Yes	+/- 2.31	Yes
		2011	10	0	3.39	Yes	+/- 2.50	Yes
		2010	10	1	2.65	Yes	+ 2.34	Yes
	NATIONAL	2012	1181	18	2.35	Yes	+/- 2.42	Yes
		2011	1164	19	2.42	Yes	+/- 2.49	Yes
		2010	1168	17	2.40	Yes	+/- 2.50	Yes

Pollutant	PQAO	Year	# of Instruments	# of Instruments with less than 75% of Required Q/C checks*	Upper Bound of Coefficient of Variation	CFR Criteria Met for Precision Met?	Bias	CFR Criteria for Bias Met?
Sulfur Dioxide (SO_2)	ARB	2012	14	1	4.63	Yes	+/- 3.71	Yes
		2011	14	1	4.26	Yes	+/- 3.30	Yes
		2010	15	0	4.63	Yes	+/- 3.54	Yes
	BAAQMD	2012	10	0	1.67	Yes	+/- 1.26	Yes
		2011	10	0	1.61	Yes	+/- 1.41	Yes
		2010	11	0	1.72	Yes	+/- 1.37	Yes
	SCAQMD	2012	9	1	5.21	Yes	+/- 4.20	Yes
		2011	9	0	8.32	Yes	+/- 5.82	Yes
		2010	8	0	3.79	Yes	- 3.58	Yes
	SDAPCD	2012	1	0	1.09	Yes	- 5.50	Yes
		2011	4	0	4.27	Yes	- 4.95	Yes
		2010	3	0	3.78	Yes	+/- 3.07	Yes
	NATIONAL	2012	406	16	3.87	Yes	+/- 4.24	Yes
		2011	401	11	3.64	Yes	+/- 3.78	Yes
		2010	398	15	3.64	Yes	+/- 3.73	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, with the goal of at least 75 percent completed and uploaded to AQS.
- Source: Air Quality System, AMP 255 Data Quality Indicator Report, run April 3, 2014.
- National = average of state, county, district, and tribal sites, including those in California; AMP 255 Data Quality Indicator Report, run April 9, 2014

Table A2 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, all districts met the CV requirement and had no more than one site with less than 75 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 (precision, bias, and precision data completeness) in graphical format[6] on an annual basis. Appendix D lists the U.S. EPA Air Quality System (AQS) IDs associated with each monitoring site. Detailed information on precision (CV), bias, and the number of one-point QC checks performed at each monitoring station in California can be found in Appendix E. As shown, all but a few individual sites in ARB's PQAO met the precision and bias CFR criteria based on one-point QC checks for gaseous pollutants.

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

Table A2. 2012 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)	# Instruments	# Instruments with less than 75% of Required QC checks	Upper Bound of Coefficient of Variation
Carbon Monoxide (CO)	Antelope Valley AQMD	D	1	0	1.48
	Butte County AQMD	A	2	0	2.32
	Imperial County APCD	B	2	0	4.65
	Mojave Desert AQMD	D	2	0	2.30
	Monterey Bay Unified APCD	D	1	0	1.90
	North Coast Unified AQMD	D	2	0	3.62
	Sacramento County APCD	D	4	0	2.94
	San Joaquin Valley Unified APCD	B	8	0	3.80
	Santa Barbara County APCD	B	6	0	3.57
Nitrogen Dioxide (NO_2)	Antelope Valley AQMD	D	1	0	1.71
	Butte County AQMD	A	2	0	2.51
	Feather River AQMD	A	1	0	4.53
	Imperial County APCD	B	2	0	4.29
	Mojave Desert AQMD	D	3	1	3.08
	Monterey Bay Unified APCD	D	1	0	2.11
	North Coast Unified AQMD	D	2	0	5.92
	Placer County APCD	A	1	0	4.74
	Sacramento County APCD	D	6	0	3.99
	San Joaquin Valley Unified APCD	B	16	0	5.14
	San Luis Obispo County APCD	D	3	0	3.11
	Santa Barbara County APCD	B	11	0	4.28
	Ventura County APCD	D	2	0	4.02
	Yolo-Solano APCD	A	1	0	3.62
Ozone (O_3)	Amador County APCD	A	1	0	3.15
	Antelope Valley AQMD	D	1	0	2.40
	Butte County AQMD	A	3	0	3.55
	Calaveras County APCD	A	1	0	2.14
	Colusa County APCD	A	1	0	1.55
	Eastern Kern APCD	A	1	0	1.65
	El Dorado County AQMD	A	3	0	3.12
	Feather River AQMD	A	2	0	4.68
	Glenn County APCD	A	1	0	2.63
	Imperial County APCD	B	4	0	3.59

Pollutant	Geographic Area	Monitoring by (District=D, ARB=A, or Both=B)	# Instruments	# Instruments with less than 75% of Required QC checks	Upper Bound of Coefficient of Variation
Ozone (O_3)	Lake County APCD	D	1	0	1.12
	Mariposa County APCD	A	1	0	3.05
	Mendocino County AQMD	A	1	1	0.78
	Mojave Desert AQMD	B	6	1	3.38
	Monterey Bay Unified APCD	D	7	0	2.06
	North Coast Unified AQMD	D	2	0	3.40
	Northern Sierra AQMD	B	2	0	2.97
	Northern Sonoma County APCD	A	1	0	4.16
	Placer County APCD	B	5	1	1.12
	Sacramento Metropolitan AQMD	B	7	0	2.64
	San Joaquin Valley Unified APCD	B	23	0	2.77
	San Luis Obispo County APCD	B	7	0	2.02
	Santa Barbara County APCD	B	12	0	2.50
	Shasta County APCD	A	3	0	1.23
	Siskiyou County APCD	D	1	0	5.32
	Tehama County APCD	B	2	0	1.47
	Tuolumne County APCD	A	1	0	1.68
	Ventura County APCD	D	5	0	1.39
	Yolo-Solano APCD	B	3	0	1.57
Sulfur Dioxide (SO_2)	Imperial County APCD	A	1	0	5.22
	Mojave Desert AQMD	D	2	1	3.72
	North Coast Unified AQMD	D	2	0	2.13
	Sacramento Metropolitan AQMD	D	1	0	3.58
	San Joaquin Valley Unified APCD	A	1	0	2.13
	San Luis Obispo County APCD	B	1	0	0.93
	Santa Barbara County APCD	D	6	0	2.61

- AQMD – Air Quality Management District
- APCD – Air Pollution Control District
- CFR Limit for CV: 7% for O_3, 15% for NO_2, 10% for CO and SO_2.
- Source: Air Quality System, AMP 255 Data Quality Indicator Report, run April 3, 2014.

Accuracy Validation: 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.

In implementing CFR requirements, 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 5 years. Non-ARB PQAOs perform some audits on their own as part of the annual performance evaluation program.

Table A3 summarizes the 2012 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 2012 corroborate what the span checks revealed: that ARB's PQAO (as well as other California PQAOs) is providing accurate data for all gaseous pollutants. The average percent differences were less than 4% in absolute value for all gaseous pollutants in each PQAO, well below the acceptance criteria (+/-10% for ozone, +/-15% for other gases). This fact is further strengthened by the small number of audits that did not meet ARB performance criteria.

Table A3. 2012 Results for Performance Audits of Gaseous Pollutant Instruments

Pollutant	PQAO	Number of Samplers	Number of Samplers Audited	Number of Audits Not Meeting ARB Criteria	Average Percent Difference
Carbon Monoxide (CO)	ARB	28	23 [a]	1	-4.08
	BAAQMD	13	13	0	-1.22
	SCAQMD	29	28	0	0.64
	SDAPCD	3	3	0	-4.67
Nitrogen Dioxide (NO_2)	ARB	52	52	1	-2.14
	BAAQMD	16	16	0	-0.51
	SCAQMD	27	26	1	-5.14
	SDAPCD	9	8	0	-1.95
Ozone (O_3)	ARB	108	105	3	-0.58
	BAAQMD	20	20	0	0.27
	NPS	8	7	0	1.12
	SCAQMD	31	31	1	0.53
	SDAPCD	10	9	0	1.22
Sulfur Dioxide (SO_2)	ARB	14	12[a]	1	0.06
	BAAQMD	10	10	0	-4.31
	SCAQMD	9	7	0	-4.46
	SDAPCD	1	1	0	-2.91

- [a] ARB was unable to conduct performance audits of trace-level instruments in 2012; these audits are expected to commence by the third quarter of 2014. Actual number of trace-level instruments for ARB: five for CO and two for SO2.
- The ARB performance audit criteria for 2012 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.
- Source: Air Quality System, AMP 255 Data Quality Indicator Report, run April 3, 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.

PM is subject to formal MQOs in federal and State regulations. Appendix A lists the complete 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%. Collocated sampling is required to assess precision for manual and continuous PM2.5 sampling. Each PQAO is required to have a certain number of collocated sites to represent its monitoring network.

For continuous PM10 samplers, bias is assessed using the monthly flow rate verifications and comparing the absolute bias upper bound against CFR criterion of 4% difference. Detailed calculations are explained in section C.5 of Appendix C. Although monthly flow rate verifications are available in AQS for some continuous PM2.5 instruments as well, CFR does not require that this data be uploaded. In 2012, only some sites under ARB's PQAO collected and reported monthly flow rate data for continuous PM2.5. Samplers based on manual methods are subject to routine flow rate verifications; however, their results are also not required to be submitted to AQS. Currently, the accuracy of manual samplers is assessed strictly via the semi-annual flow rate audits.

The accuracy of all particulate samplers is assessed 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 during a semi-annual flow rate performance audit. As listed in Appendix A of this report, ARB's 2012 performance criteria, based on the average percent difference during a semi-annual flow rate audit, were: +/-10% for PM10, +/-15% for TSP, and +/-4% for PM2.5.

Precision and Bias: 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 $\mu g/m^3$; (2) PM_{10} (Hi-Vol): 15 $\mu g/m^3$; (3) PM10 (Lo-Vol): 3 $\mu g/m^3$; (4) PM2.5: 3 $\mu g/m^3$. The collocated pairs of data that meet

these limits are then used to calculate the upper bound of coefficient of variation (CV) as an estimate of precision at each site. Title 40 CFR requires that this upper bound of the CV not exceed 10% for both PM10 and PM2.5. A detailed description of CV, including formulae for calculating it, can be found in Appendix C.

Due to the apparent discrepancy between the AQS data quality indicator report (AMP255) and CFR regarding the required amount of collocated PM monitoring, the collocation requirement is not discussed herein. Rather, Table B1 shows the number of sites with collocated precision data reported in respective years. Note that due to insufficient data for ARB's PQAO in 2012, 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 2010 and 2011 are provided for historical perspectives. A few highlights include:

- For the collocated samplers that were present, ARB's PQAO reported a high percentage of precision data.
- For PM10, the CV was below 10% in ARB's PQAO (as well as other California PQAOs and the national average).
- For PM2.5, ARB's PQAO did not meet the 10% CV requirement at the PQAO level for all methods of collection for which data are available. (CVs in other PQAOs, both in and outside of California, were generally lower).

Table B1. 2010-2012 Precision Results Based on Available Collocated PM Samplers

Pollutant	PQAO	Year	Method Code	# of Collocated Samplers Reported	% Precision Completeness	Upper Bound of Coefficient of Variation	CFR Criteria for Precision Met?
PM10	ARB	2012	All	5	100	5.46	Yes
		2011	All	6	100	4.56	Yes
		2010	All	7	100	3.99	Yes
	BAAQMD	2012	All	1	100	4.16	Yes
		2011	All	1	100	3.76	Yes
		2010	All	1	100	2.69	Yes
	SCAQMD	2012	All	3	100	5.05	Yes
		2011	All	3	100	4.73	Yes
		2010	All	3	100	7.37	Yes
	SDAPCD	2012	All	4	100	3.57	Yes
		2011	All	2	100	3.34	Yes
		2010	All	2	100	3.85	Yes
	NATIONAL	2012	All	115	98	7.58	Yes
		2011	All	115	91	7.96	Yes
		2010	All	117	94	8.85	Yes
PM2.5	ARB	2012	117	1	100	***14.89***	No
		2011	117	1	100	16.42	No
		2010	117	2	100	11.05	No
		2012	118	7	100	***16.69***	No
		2011	118	4	100	17.80	No
		2010	118	5	100	12.36	No
		2012	145	2*	85	***18.90***	No
		2011	145	2	95	13.17	No
		2010	145	1	NDA	NDA	NDA
		2012	170	2	100	***23.19***	No
		2011	170	2	100	14.92	No
		2010	170	3	100	26.53	No
	BAAQMD	2012	117	NDA	NDA	NDA	NDA
		2011	117	NDA	NDA	NDA	NDA
		2010	117	NDA	NDA	NDA	NDA
		2012	145	1	100	8.98	Yes
		2011	145	2	100	12.50	No
		2010	145	1	100	4.98	Yes
		2012	170	2	100	***13.17***	No
		2011	170	1	100	15.09	No
		2010	170	1	100	14.03	No

Pollutant	PQAO	Year	Method Code	# of Collocated Samplers Reported	% Precision Completeness	Upper Bound of Coefficient of Variation	CFR Criteria for Precision Met?
PM2.5	SCAQMD	2012	120	4	100	9.05	Yes
		2011	120	3	100	8.06	Yes
		2010	120	3	100	6.75	Yes
		2012	170	NDA	NDA	NDA	NDA
		2011	170	NDA	NDA	NDA	NDA
		2010	170	NDA	NDA	NDA	NDA
	SDAPCD	2012	118	NDA	NDA	NDA	NDA
		2011	118	NDA	NDA	NDA	NDA
		2010	118	2	100	13.60	No
		2012	145	2*	100	8.37	Yes
		2011	145	1	100	4.85	Yes
		2010	145	NDA	NDA	NDA	NDA
		2012	170	NDA	NDA	NDA	NDA
		2011	170	NDA	NDA	NDA	NDA
		2010	170	1	100	14.94	No
	NATIONAL	2012	117	8	88	***10.50***	No
		2011	117	9	100	10.20	No
		2010	117	14	93	8.34	Yes
		2012	118	90	96	***10.30***	No
		2011	118	86	94	8.76	Yes
		2010	118	90	96	11.50	No
		2012	120	13	92	***11.00***	No
		2011	120	16	100	8.91	Yes
		2010	120	23	87	9.38	Yes
		2012	145	29	100	***10.30***	No
		2011	145	28	96	8.63	Yes
		2010	145	24	96	12.40	No
		2012	170	18	89	***19.50***	No
		2011	170	14	100	21.50	No
		2010	170	8	100	17.10	No

- *PM2.5 data from Calexico-Ethel is listed under ARB's PQAO, not San Diego APCD (as in AMP 256).
- CFR Limit is a coefficient of variation of ≤ 10% for PM. Percent precision completeness is based on data collected from collocated samples.
- 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.
- ***Bold italicized*** font indicates CV greater than 10% in 2012 while underlined font indicates CV greater than 10% in 2010 or 2011.
- NDA= No collocated data available from AQS, but ambient data were reported to AQS.
- Source: Air Quality System, AMP 255 Data Quality Indicator Report, run April 3, 2014.
- National = average of state, county, district, and tribal sites, including those in California; AMP 255 Data Quality Indicator Report, run April 9, 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 2012 for PM2.5. Bias results via the monthly flow rate verifications are shown in Table B2-1 and B2-2. In summary, the bias criteria of +/- 4% were met for all years in each PQAO for which data are available. However, all PQAOs are encouraged to upload more data.

Table B2-1. 2012 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	2012	35	32	0.24	+/- 1.18	Yes
		2011	31	19	0.41	+/- 1.71	Yes
		2010	28	21	0.22	+/- 1.66	Yes
	SCAQMD	2012	11	11	-0.09	+/- 1.69	Yes
		2011	15	15	-0.27	+/- 1.25	Yes
		2010	14	NDA	NDA	NDA	NDA

- Flow rate verifications available for continuous PM methods only, with just PM10 required to be in AQS.
- CFR criteria for bias: +/-4% (of standard).
- NDA= No Data Available from AQS.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run April 10, 2014.

Table B2-2. 2012 Continuous 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	2012	35	9	0.00	+/- 0.39	Yes
		2011	29	3	0.15	+/- 0.75	Yes
		2010	25	3	0.36	+/- 0.79	Yes
	BAAQMD	2012	12	NDA	NDA	NDA	NDA
		2011	8	NDA	NDA	NDA	NDA
		2010	0	NDA	NDA	NDA	NDA
	SCAQMD	2012	7	6	-0.19	+/- 1.13	Yes
		2011	8	8	-0.12	+/- 0.86	Yes
		2010	6	NDA	NDA	NDA	NDA
	SDAPCD	2012	6	NDA	NDA	NDA	NDA
		2011	5	NDA	NDA	NDA	NDA
		2010	3	NDA	NDA	NDA	NDA

- 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.
- Source: Air Quality System, AMP 256 Data Quality Indicator Report, run April 3, 2014.

Table B3 breaks down the statistics displayed in Table B1 under ARB's PQAO by local air districts. Monitoring sites within these areas may be operated by the district, ARB, or both. With the exception of the collocated PM2.5 samplers in the Great Basin Unified Air Pollution Control District, a majority of areas reported 100 percent, or nearly 100 percent, of the required precision data. The upper bound CV was met in all districts. However, the CV for PM2.5 is exceeded at all districts except the Sacramento Metropolitan Air Quality Management District.

Table B3. 2012 Precision Results for Districts within ARB's PQAO

Pollutant	Geographic Area	Method Code	Monitoring by (District=D, ARB=A, or Both=B)	# of Collocated Samplers Reported	% Precision Completeness	Upper Bound of Coefficient of Variation
PM10	Sacramento Metropolitan APCD	All	D	1	100	5.60
	San Joaquin Valley Unified APCD	All	B	2	100	9.14
	Santa Barbara County APCD	All	D	1	100	7.10
	Ventura County APCD	All	D	1	100	3.37
PM2.5	Great Basin Unified APCD	145	D	1	80	***18.07***
	Imperial County APCD	145*	A	1	90	***19.74***
	Mojave Desert AQMD	117	D	1	100	***14.89***
	Monterey Bay Unified APCD	170	D	1	100	***15.18***
	Northern Sierra AQMD	118	D	1	100	***12.36***
	Sacramento Metropolitan AQMD	118	D	1	90	6.90
	San Joaquin Valley Unified APCD	118	A	4	100	***16.95***
	San Joaquin Valley Unified APCD	170	A	1	100	***23.75***
	Ventura County APCD	118	D	1	100	***12.34***

- CFR Limit for CV is 10% for PM.
- ***Bold italicized*** font indicates CV greater than 10% in 2012.
- NDA= No data available from AQS.
- *PM2.5 data from Calexico-Ethel is listed under ARB's PQAO, not San Diego APCD (as in AMP 255).
- Source: Air Quality System, AMP 255 Data Quality Indicator Report, run April 3, 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. 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 B4 summarizes the 2012 performance audit results for PM samplers. It displays the number of samplers as well as those that met the required number of audits in 2012 (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 2012. Outside of ARB's PQAO, other PQAOs are responsible for conducting their own independent audits of the instruments.

Overall, the results of the audited samplers indicate that the PM samplers in the network were operating within ARB performance criteria. This observation is further strengthened by the lack of audits that did not meet ARB criteria in 2012. 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 B2-2).

Table B4. 2012 Results for Particulate Sampler Performance Audits

Pollutant	PQAO	Number of Samplers	Number of Samplers Audited	Number of Audits Not Meeting ARB Criteria	Average Percent Difference
PM10	ARB	103	97[a]	0	0.2
	BAAQMD	8	8	0	2.0
	SCAQMD	36	36	0	0.7
	SDAPCD	7	7	0	- 1.2
PM2.5	ARB	73	69[b]	0	-0.1
	BAAQMD	14	14	0	0.1
	SCAQMD	29	28	0	-0.1
	SDAPCD	18	18	0	0.0

- [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 performance audit criteria for 2012 were +/-10% for PM10 and +/-4% for PM2.5. Only audits conducted by ARB were subjected to the AQDA process.
- 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, few if less than 3 months.
- Source: Air Quality System, AMP 255 Data Quality Indicator Report, run April 3, 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 2012.

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

- ARB's PQAO (as well as other PQAOs and the national average) met, or nearly met, the precision completeness requirement for the gaseous pollutants.
- All of the California PQAOs met the CFR criteria for precision and bias based on one-point QC checks, which is consistent with the national average.
- There were a few analyzers that did not meet the required number of audits because ARB was unable to conduct performance audits of trace-level instruments in 2012. 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 few analyzers among the California PQAOs not passing performance audit criteria. This validates the bias estimates based on one-point QC checks.

Particulate Matter (PM10, and PM2.5)

- In assessing the collocated sampling completeness requirement criteria, it is recommended that each monitoring district 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 in the collocated sites in AQS.
- Based on collocated PM data, CFR requirements for precision were met by ARB's PQAO (as well as other California PQAOs and the national average) for PM10. However, ARB's PQAO did not meet the precision requirements at the PQAO level for all methods of collecting PM2.5, as shown in Table IV-1. Further investigation into the possible causes behind PM2.5 precision problems is encouraged.

Table IV-1. 2012 Precision Assessment for PM2.5

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

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

- ARB's PQAO (as well as SCAQMD) flow rate verifications from continuous PM10 samplers met the CFR criteria for bias. Currently, flow rate verifications are required to be performed on all PM samplers, but only those from continuous PM10 are required to be uploaded. To enhance consistency in regulation and avoid any confusion, U.S. EPA is considering making it mandatory that data on flow rate checks be uploaded to AQS for all PM sampler methods. Thus, ARB encourages local air monitoring agencies within ARB's PQAO to upload flow rate verification data (one-point monthly 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.

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 2012 ambient data for the ARB's PQAO have been certified and are considered suitable for comparison to federal 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.

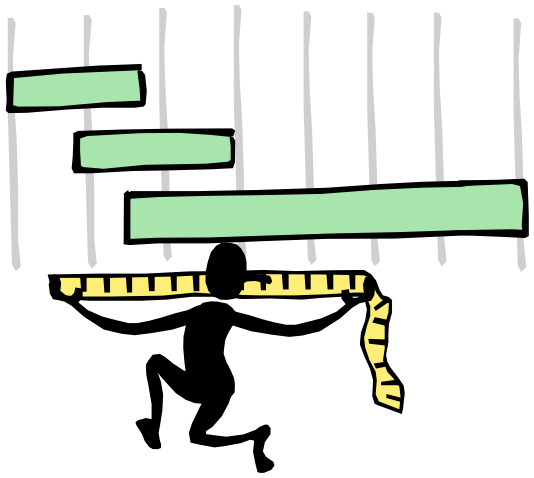
This page intentionally left blank.

APPENDIX A

U.S. EPA's
MEASUREMENT QUALITY OBJECTIVES

TOOLS FOR ASSESSING PRECISION AND BIAS/ACCURACY

ARB PERFORMANCE AUDIT CRITERIA



This page intentionally left blank.

Table 1. Ambient Air Monitoring Measurement Quality Samples

(Table A-2 in 40 CFR 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 PM_{10},$PM_{2.5}$, $PM_{10-2.5}$	Section 3.2.3	Each sampler	Once every month	≤ 4% of standard and 5% of design value
Semi-annual flow rate audit PM_{10}, $PM_{2.5}$, $PM_{10-2.5}$	Section 3.2.4	Each sampler	Once every 6 months	≤ 4% of standard and 5% of design value
Collocated sampling $PM_{2.5}$, $PM_{10-2.5}$	Section 3.2.5	15%	Every twelve days	$PM_{2.5}$, - 10% precision $PM_{10-2.5}$- - 15% precision
PM Performance evaluation program $PM_{2.5}$,$PM_{10-2.5}$	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	$PM_{2.5}$, - ± 10% bias $PM_{10-2.5}$- - ±15% bias
Manual Methods				
Collocated sampling PM_{10}, TSP, $PM_{10-2.5}$, $PM_{2.5}$	3.3.1 and 3.3.5	15%	Every 12 days PSD -every 6 days	PM_{10}, $PM_{2.5}$, - 10% precision $PM_{10-2.5}$- - 15% precision TSP - 20% precision
Flow rate verification PM_{10} (low Vol),$PM_{10-2.5}$, $PM_{2.5}$	3.3.2	Each sampler	Once every month	≤ 4% of standard and 5% of design value
Flow rate verification PM_{10} (High-Vol), TSP	3.3.2	Each sampler	Once every quarter	≤ 4% of standard and 5% of design value
Semi-annual flow rate audit PM_{10} (low Vol),$PM_{10-2.5}$, $PM_{2.5}$	3.3.3	Each sampler, all locations	Once every 6 months	≤ 4% of standard and 5% of design value
Semi-annual flow rate audit PM_{10} , TSP , $PM_{2.5}$	3.3.3	Each sampler, all locations	Once every 6 months	≤ 10% of standard and design value
Manual Methods Lead	3.3.4	1. Each sampler 2. Analytical (lead strips)	1. Include with TSP 2. Each quarter	1. Same as for TSP. 2. - ± 10% bias
Performance evaluation program $PM_{2.5}$, $PM_{10-2.5}$	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	$PM_{2.5}$, - ± 10% bias $PM_{10-2.5}$- - ±15% 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 Performance Audit Criteria
(2012)

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 %	PM_{10}, Dichotomous (Dichot), Tapered Element Oscillating Microbalance (TEOM), Beta Attenuated Monitors (BAM)
±4 % (Flow) ±5 % (Design)	None None	$PM_{2.5}$

Acceptance Criteria For Meteorological (MET) Sensors

Limits	Sensor
±1.0° Celsius (±0.5°C PAMS only)	Ambient Temperature
±2.25mm of Mercury (Hg)	Barometric Pressure
less than or equal to 5° 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.

This page intentionally left blank.

APPENDIX B

METEOROLOGICAL SENSOR PERFORMANCE AUDITS CONDUCTED BY ARB

This page intentionally left blank.

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 (AMTAC) agreed to define the level of acceptability for meteorological data as those used by the U.S. EPA for both the Prevention of Significant Deterioration (PSD) and Photochemical Assessment Monitoring Stations (PAMS) programs. QAS 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. 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 2012 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.

2012 Results for Meteorological Sensor Performance Audits Conducted by ARB

Sensor	PQAO	Number of Audits	Number of Audits That Failed	Avg % or Degree Difference	Minimum	Maximum
Ambient Temperature (degrees C)	ARB	112	1	0.2	- 0.3	1.4
	Other PQAOs	0	0	NDA	NDA	NDA
Wind Direction (degrees)	ARB	86	1	0.6	- 5.4	16.2
	Other PQAOs	1	0	0.2	NDA	NDA
Horizontal Wind Speed (%)	ARB	105	0	-0.2	- 4.1	4.3
	Other PQAOs	0	0	NDA	NDA	NDA
Barometric Pressure (mmHg)	ARB	36	1	- 0.2	- 2.1	2.0
	Other PQAOs	2	0	0.2	0.1	0.2

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. NDA= No data available from AQS.

APPENDIX C

DETAILED CALCULATIONS OF STATISTICS USED TO ASSESS PRECISION AND ACCURACY

This page intentionally left blank.

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*	*$PM_{2.5}$ Bias*	*$PM_{2.5}$ 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						
$PM_{2.5}$		One-Point Flow Rate	Bias Estimate	Absolute Bias Estimate	Semi-Annual Flow Rate	Precision Estimate	
PM_{10}		One-Point Flow Rate			Semi-Annual Flow Rate	Precision Estimate	
Lead							Precision Estimate/ Bias Estimate

C.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

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

C.2 Precision Estimates from Collocated Samples

Applies to: $PM_{2.5}$, PM_{10}, Lead

40 CFR Part 58 Appendix A References:

- ***4.2.1 Precision Estimate from Collocated Samplers***
- ***4.3.1 Precision Estimate($PM_{2.5}$)***
- ***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)
$PM_{2.5}$	3
Lo-Vol $PM_{2.5}$	3
Hi-Vol $PM_{2.5}$	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.

C.3 $PM_{2.5}$ Bias Assessment

Applies to: $PM_{2.5}$

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 s_d is an estimate of the variability of the average bias and is calculated using Equation 15 below:

Equation 15

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

C.4 $PM_{2.5}$ Absolute Bias Assessment

Applies to: $PM_{2.5}$

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).

C.5 One-Point Flow Rate Bias Estimate

Applies to: PM_{10}, $PM_{2.5}$

40 CFR Part 58 Appendix A References:

- ***4.2.2 Bias Estimate Using One-Point Flow Rate Verifications (PM_{10})***
- ***4.3.2 Bias Estimate ($PM_{10\text{-}2.5}$)***
- ***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).

C.6 Semi-Annual Flow Rate Audits

Applies to: PM_{10}, TSP, $PM_{2.5}$, $PM_{10-2.5}$

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 D

CALIFORNIA'S AIR MONITORING STATIONS

This page intentionally left blank.

This appendix provides the reader with the complete listing of monitoring stations in 2012 organized in two ways:

1. by AQS ID, monitoring stations, and geographic area; and
2. by geographic area, monitoring stations,and AQS ID.
   AQS IDs are used in Appendix E.

AQS ID	Monitoring Station	Geographic Area
060010007	Livermore-793 Rincon Avenue	Bay Area AQMD
060010009	Oakland-9925 International Blvd	Bay Area AQMD
060010011	Oakland-West	Bay Area AQMD
060012001	Hayward-La Mesa	Bay Area AQMD
060012005	Livermore-13224 Patterson Pass Road	Bay Area AQMD
060050002	Jackson-Clinton Road	Amador County APCD
060070002	Chico-Manzanita Avenue	Butte County AQMD
060070007	Paradise-4405 Airport Road	Butte County AQMD
060090001	San Andreas-Gold Strike Road	Calaveras County
060111002	Colusa-Sunrise Blvd	Colusa County APCD
060130002	Concord-2975 Treat Blvd	Bay Area AQMD
060130006	Richmond-7th Street	Bay Area AQMD
060131001	Crockett-Kendall Avenue	Bay Area AQMD
060131002	Bethel Island Road	Bay Area AQMD
060131004	San Pablo-Rumrill Blvd	Bay Area AQMD
060132001	Martinez-Jones Street	Bay Area AQMD
060170010	Placerville-Gold Nugget Way	El Dorado County AQMD
060170012	Echo Summit	El Dorado County AQMD
060170020	Cool-Highway 193	El Dorado County AQMD
060190007	Fresno-Drummond Street	San Joaquin Valley APCD
060190008	Fresno-1st Street	San Joaquin Valley APCD
060190242	Fresno-Sierra Skypark #2	San Joaquin Valley APCD
060192009	Tranquility-32650 West Adams Avenue	San Joaquin Valley APCD
060194001	Parlier	San Joaquin Valley APCD
060195001	Clovis-N Villa Avenue	San Joaquin Valley APCD
060210003	Willows-720 N Colusa Street	Glenn County APCD
060231004	Eureka-Jacobs	North Coast Unified AQMD
060231005	Eureka-Humboldt Hill	North Coast Unified AQMD
060250005	Calexico-Ethel Street	Imperial County APCD
060251003	El Centro-9th Street	Imperial County APCD
060254003	Westmorland-W 1st Street	Imperial County APCD
060254004	Niland-English Road	Imperial County APCD
060270101	Death Valley Natl Monument	National Park Service
060271003	Keeler-Cerro Gordo Road	Great Basin Unified APCD
060290007	Edison	San Joaquin Valley APCD
060290008	Maricopa-Stanislaus Street	San Joaquin Valley APCD
060290011	Mojave-923 Poole Street	Eastern Kern APCD
060290014	Bakersfield-5558 California Avenue	San Joaquin Valley APCD
060290232	Oildale-3311 Manor Street	San Joaquin Valley APCD
060295002	Arvin-Di Giorgio	San Joaquin Valley APCD
060296001	Shafter-Walker Street	San Joaquin Valley APCD
060311004	Hanford-S Irwin Street	San Joaquin Valley APCD

AQS ID	Monitoring Station	Geographic Area
060333001	Lakeport-Lakeport Blvd	Lake County AQMD
060370002	Azusa	South Coast AQMD
060370016	Glendora-Laurel	South Coast AQMD
060370113	West Los Angeles-VA Hospital	South Coast AQMD
060371002	Burbank-W Palm Avenue	South Coast AQMD
060371103	Los Angeles-North Main Street	South Coast AQMD
060371201	Reseda	South Coast AQMD
060371302	Compton-700 North Bullis Road	South Coast AQMD
060371602	Pico Rivera-4144 San Gabriel	South Coast AQMD
060371701	Pomona	South Coast AQMD
060372005	Pasadena-S Wilson Avenue	South Coast AQMD
060374002	North Long Beach	South Coast AQMD
060374006	Long Beach-2425 Webster Street	South Coast AQMD
060375005	Los Angeles-Westchester Parkway	South Coast AQMD
060376012	Santa Clarita	South Coast AQMD
060379033	Lancaster-43301 Division Street	Antelope Valley AQMD
060390004	Madera-Pump Yard	San Joaquin Valley APCD
060392010	Madera-28261 Avenue 14	San Joaquin Valley APCD
060410001	San Rafael	Bay Area AQMD
060430003	Yosemite Natl Park-Turtleback Dome	National Park Service
060430006	Jerseydale - 6440 Jerseydale	Mariposa County APCD
060450008	Ukiah-E Gobbi Street	Mendocino County AQMD
060470003	Merced-S Coffee Avenue	San Joaquin Valley APCD
060530002	Carmel Valley-Ford Road	Monterey Bay Unified APCD
060530008	King City-415 Pearl Street	Monterey Bay Unified APCD
060531003	Salinas-#3	Monterey Bay Unified APCD
060550003	Napa-Jefferson Avenue	Bay Area AQMD
060570005	Grass Valley-Litton Building	Northern Sierra AQMD
060570007	White Cloud Mountain	Northern Sierra AQMD
060571001	Truckee-Fire Station	Northern Sierra AQMD
060590007	Anaheim-Pampas Lane	South Coast AQMD
060591003	Costa Mesa-Mesa Verde Drive	South Coast AQMD
060592022	Mission Viejo-26081 Via Pera	South Coast AQMD
060595001	La Habra	South Coast AQMD
060610002	Auburn-Dewitt-C Avenue	Placer County APCD
060610004	Colfax-City Hall	Placer County APCD
060610006	Roseville-N Sunrise Blvd	Placer County APCD
060650004	Mira Loma-10551 Bellegrave	South Coast AQMD
060650008	Joshua Tree National Park	National Park Service
060650012	Banning Airport	South Coast AQMD
060650016	Winchester-33700 Borel Road	South Coast AQMD
060651003	Riverside-Magnolia	South Coast AQMD
060652002	Indio-Jackson Street	South Coast AQMD

AQS ID	Monitoring Station	Geographic Area
060655001	Palm Springs-Fire Station	South Coast AQMD
060656001	Perris	South Coast AQMD
060658001	Riverside-Rubidoux	South Coast AQMD
060658005	Mira Loma Van Buren	South Coast AQMD
060659001	Lake Elsinore-W Flint Street	South Coast AQMD
060659003	Blythe-445 West Murphy Street	Mojave Desert AQMD
060670002	North Highlands-Blackfoot Way	Sac Metro AQMD
060670006	Sacramento-Del Paso Manor	Sac Metro AQMD
060670007	Sacramento-El Camino and Watt	Sac Metro AQMD
060670010	Sacramento-T Street	Sac Metro AQMD
060670011	Elk Grove-Bruceville Road	Sac Metro AQMD
060670012	Folsom-Natoma Street	Sac Metro AQMD
060670014	Sacramento-Goldenland Court	Sac Metro AQMD
060675003	Sloughhouse	Sac Metro AQMD
060690002	Hollister-Fairview Road	Monterey Bay Unified APCD
060690003	Pinnacles National Monument	National Park Service
060710001	Barstow	Mojave Desert AQMD
060710005	Crestline	South Coast AQMD
060710012	Phelan-Beekley Road and Phelan Road	Mojave Desert AQMD
060710306	Victorville-14306 Park Avenue	Mojave Desert AQMD
060711004	Upland	South Coast AQMD
060711234	Trona-Athol and Telegraph	Mojave Desert AQMD
060712002	Fontana-Arrow Highway	South Coast AQMD
060714001	Hesperia-Olive Street	Mojave Desert AQMD
060714003	Redlands-Dearborn	South Coast AQMD
060719002	Joshua Tree-National Monument	National Park Service
060719004	San Bernardino-4th Street	South Coast AQMD
060730001	Chula Vista	San Diego County APCD
060730003	El Cajon-Redwood Avenue	San Diego County APCD
060730006	San Diego-Overland Avenue	San Diego County APCD
060731001	Del Mar-Mira Costa College	San Diego County APCD
060731002	Escondido-E Valley Parkway	San Diego County APCD
060731006	Alpine-Victoria Drive	San Diego County APCD
060731008	Camp Pendleton	San Diego County APCD
060731010	San Diego-1110 Beardsley Street	San Diego County APCD
060731016	San Diego-Kearny Villa Road	San Diego County APCD
060732007	Otay Mesa-Paseo International	San Diego County APCD
060750005	San Francisco-Arkansas Street	Bay Area AQMD
060771002	Stockton-Hazelton Street	San Joaquin Valley APCD
060773005	Tracy-Airport	San Joaquin Valley APCD
060790005	Paso Robles-Santa Fe Avenue	San Luis Obispo County APCD
060792006	San Luis Obispo-3220 South Higuera St	San Luis Obispo County APCD
060793001	Morro Bay	San Luis Obispo County APCD

AQS ID	Monitoring Station	Geographic Area
060794002	Nipomo-Regional Park	San Luis Obispo County APCD
060798001	Atascadero-Lewis Avenue	San Luis Obispo County APCD
060798005	Red Hills	San Luis Obispo County APCD
060798006	Carrizo Plains School-9640 Carrizo	San Luis Obispo County APCD
060811001	Redwood City	Bay Area AQMD
060830008	El Capitan Beach	Santa Barbara County APCD
060830011	Santa Barbara-700 East Canon Perdido	Santa Barbara County APCD
060831008	Santa Maria-906 S Broadway	Santa Barbara County APCD
060831013	Lompoc-HSandP	Santa Barbara County APCD
060831014	Paradise Road-Los Padres National Forest	Santa Barbara County APCD
060831018	Gaviota-GTC Site B	Santa Barbara County APCD
060831020	Exxon Site 10-UCSB West Campus	Santa Barbara County APCD
060831021	Carpinteria-Gobernador Road	Santa Barbara County APCD
060831025	Las Flores Canyon #1	Santa Barbara County APCD
060832004	Lompoc-S H Street	Santa Barbara County APCD
060832012	Goleta-Fairview	Santa Barbara County APCD
060833001	Santa Ynez-Airport Road	Santa Barbara County APCD
060834003	Vandenberg Air Force Base-STS Power	Santa Barbara County APCD
060850002	Gilroy-9th Street	Bay Area AQMD
060850005	San Jose-Jackson Street	Bay Area AQMD
060851001	Los Gatos	Bay Area AQMD
060852006	San Martin-Murphy Avenue	Bay Area AQMD
060852009	Cupertino-22601 Voss Ave	Bay Area AQMD
060870003	Davenport	Monterey Bay Unified APCD
060870007	Santa Cruz-2544 Soquel Avenue	Monterey Bay Unified APCD
060890004	Redding-Health Dept Roof	Shasta County AQMD
060890007	Anderson-North Street	Shasta County AQMD
060890009	Shasta Lake-13791 Lake Blvd	Shasta County AQMD
060893003	Lassen Volcanic Natl Park-Manzanita Lake	National Park Service
060932001	Yreka-Foothill Drive	Siskiyou County APCD
060950004	Vallejo-304 Tuolumne Street	Bay Area AQMD
060950005	Fairfield-Chadbourne Road	Bay Area AQMD
060953003	Vacaville-Ulatis Drive	Yolo-Solano AQMD
060970003	Santa Rosa-5th Street	Bay Area AQMD
060971003	Healdsburg-Municipal Airport	Northern Sonoma County APCD
060990005	Modesto-14th Street	San Joaquin Valley APCD
060990006	Turlock-S Minaret Street	San Joaquin Valley APCD
060990006	Turlock-S Minaret Street	San Joaquin Valley APCD
061010003	Yuba City-Almond Street	Feather River AQMD
061010004	Sutter Buttes-S Butte	Feather River AQMD
061030004	Tuscan Butte	Tehama County APCD
061030005	Red Bluff-Oak Street	Tehama County APCD

AQS ID	Monitoring Station	Geographic Area
061070006	Sequoia Natl Park-Lower Kaweah	National Park Service
061070009	Sequoia and Kings Canyon Natl Park	National Park Service
061072002	Visalia-N Church Street	San Joaquin Valley APCD
061072010	Porterville-1839 Newcomb Street	San Joaquin Valley APCD
061090005	Sonora-Barretta Street	Tuolumne County APCD
061110007	Thousand Oaks-Moorpark Road	Ventura County APCD
061110009	Piru-3301 Pacific Avenue	Ventura County APCD
061111004	Ojai-Ojai Avenue	Ventura County APCD
061112002	Simi Valley-Cochran Street	Ventura County APCD
061112003	Ventura-Emma Wood State Beach	Ventura County APCD
061113001	El Rio-Rio Mesa School #2	Ventura County APCD
061130004	Davis-UCD Campus	Yolo-Solano AQMD
061131003	Woodland-Gibson Road	Yolo-Solano AQMD

Geographic Area	Monitoring Station	AQS ID
Amador County APCD	Jackson-Clinton Road	060050002
Antelope Valley AQMD	Lancaster-43301 Division Street	060379033
Bay Area AQMD	Livermore-793 Rincon Avenue	060010007
Bay Area AQMD	Oakland-9925 International Blvd	060010009
Bay Area AQMD	Oakland-West	060010011
Bay Area AQMD	Hayward-La Mesa	060012001
Bay Area AQMD	Livermore-13224 Patterson Pass Road	060012005
Bay Area AQMD	Concord-2975 Treat Blvd	060130002
Bay Area AQMD	Richmond-7th Street	060130006
Bay Area AQMD	Crockett-Kendall Avenue	060131001
Bay Area AQMD	Bethel Island Road	060131002
Bay Area AQMD	San Pablo-Rumrill Blvd	060131004
Bay Area AQMD	Martinez-Jones Street	060132001
Bay Area AQMD	San Rafael	060410001
Bay Area AQMD	Napa-Jefferson Avenue	060550003
Bay Area AQMD	San Francisco-Arkansas Street	060750005
Bay Area AQMD	Redwood City	060811001
Bay Area AQMD	Gilroy-9th Street	060850002
Bay Area AQMD	San Jose-Jackson Street	060850005
Bay Area AQMD	Los Gatos	060851001
Bay Area AQMD	San Martin-Murphy Avenue	060852006
Bay Area AQMD	Cupertino-22601 Voss Ave	060852009
Bay Area AQMD	Vallejo-304 Tuolumne Street	060950004
Bay Area AQMD	Fairfield-Chadbourne Road	060950005
Bay Area AQMD	Santa Rosa-5th Street	060970003
Butte County AQMD	Chico-Manzanita Avenue	060070002
Butte County AQMD	Paradise-4405 Airport Road	060070007
Calaveras County	San Andreas-Gold Strike Road	060090001
Colusa County APCD	Colusa-Sunrise Blvd	060111002
Eastern Kern APCD	Mojave-923 Poole Street	060290011
El Dorado County AQMD	Placerville-Gold Nugget Way	060170010
El Dorado County AQMD	Echo Summit	060170012
El Dorado County AQMD	Cool-Highway 193	060170020
Feather River AQMD	Yuba City-Almond Street	061010003
Feather River AQMD	Sutter Buttes-S Butte	061010004
Glenn County APCD	Willows-720 N Colusa Street	060210003
Great Basin Unified APCD	Keeler-Cerro Gordo Road	060271003
Imperial County APCD	Calexico-Ethel Street	060250005
Imperial County APCD	El Centro-9th Street	060251003
Imperial County APCD	Westmorland-W 1st Street	060254003
Imperial County APCD	Niland-English Road	060254004
Lake County AQMD	Lakeport-Lakeport Blvd	060333001
Mariposa County APCD	Jerseydale - 6440 Jerseydale	060430006
Mendocino County AQMD	Ukiah-E Gobbi Street	060450008

Geographic Area	Monitoring Station	AQS ID
Mojave Desert AQMD	Blythe-445 West Murphy Street	060659003
Mojave Desert AQMD	Barstow	060710001
Mojave Desert AQMD	Phelan-Beekley Road and Phelan Road	060710012
Mojave Desert AQMD	Victorville-14306 Park Avenue	060710306
Mojave Desert AQMD	Trona-Athol and Telegraph	060711234
Mojave Desert AQMD	Hesperia-Olive Street	060714001
Monterey Bay Unified APCD	Carmel Valley-Ford Road	060530002
Monterey Bay Unified APCD	King City-415 Pearl Street	060530008
Monterey Bay Unified APCD	Salinas-#3	060531003
Monterey Bay Unified APCD	Hollister-Fairview Road	060690002
Monterey Bay Unified APCD	Davenport	060870003
Monterey Bay Unified APCD	Santa Cruz-2544 Soquel Avenue	060870007
National Park Service	Death Valley Natl Monument	060270101
National Park Service	Yosemite Natl Park-Turtleback Dome	060430003
National Park Service	Joshua Tree National Park	060650008
National Park Service	Pinnacles National Monument	060690003
National Park Service	Joshua Tree-National Monument	060719002
National Park Service	Lassen Volcanic Natl Park-Manzanita Lake	060893003
National Park Service	Sequoia Natl Park-Lower Kaweah	061070006
National Park Service	Sequoia and Kings Canyon Natl Park	061070009
North Coast Unified AQMD	Eureka-Jacobs	060231004
North Coast Unified AQMD	Eureka-Humboldt Hill	060231005
Northern Sierra AQMD	Grass Valley-Litton Building	060570005
Northern Sierra AQMD	White Cloud Mountain	060570007
Northern Sierra AQMD	Truckee-Fire Station	060571001
Northern Sonoma County APCD	Healdsburg-Municipal Airport	060971003
Placer County APCD	Auburn-Dewitt-C Avenue	060610002
Placer County APCD	Colfax-City Hall	060610004
Placer County APCD	Roseville-N Sunrise Blvd	060610006
Sac Metro AQMD	North Highlands-Blackfoot Way	060670002
Sac Metro AQMD	Sacramento-Del Paso Manor	060670006
Sac Metro AQMD	Sacramento-El Camino and Watt	060670007
Sac Metro AQMD	Sacramento-T Street	060670010
Sac Metro AQMD	Elk Grove-Bruceville Road	060670011
Sac Metro AQMD	Folsom-Natoma Street	060670012
Sac Metro AQMD	Sacramento-Goldenland Court	060670014
Sac Metro AQMD	Sloughhouse	060675003
San Diego County APCD	Chula Vista	060730001
San Diego County APCD	El Cajon-Redwood Avenue	060730003
San Diego County APCD	San Diego-Overland Avenue	060730006
San Diego County APCD	Del Mar-Mira Costa College	060731001
San Diego County APCD	Escondido-E Valley Parkway	060731002

Geographic Area	Monitoring Station	AQS ID
San Diego County APCD	Alpine-Victoria Drive	060731006
San Diego County APCD	Camp Pendleton	060731008
San Diego County APCD	San Diego-1110 Beardsley Street	060731010
San Diego County APCD	San Diego-Kearny Villa Road	060731016
San Diego County APCD	Otay Mesa-Paseo International	060732007
San Joaquin Valley APCD	Fresno-Drummond Street	060190007
San Joaquin Valley APCD	Fresno-1st Street	060190008
San Joaquin Valley APCD	Fresno-Sierra Skypark #2	060190242
San Joaquin Valley APCD	Tranquility-32650 West Adams Avenue	060192009
San Joaquin Valley APCD	Parlier	060194001
San Joaquin Valley APCD	Clovis-N Villa Avenue	060195001
San Joaquin Valley APCD	Edison	060290007
San Joaquin Valley APCD	Maricopa-Stanislaus Street	060290008
San Joaquin Valley APCD	Bakersfield-5558 California Avenue	060290014
San Joaquin Valley APCD	Oildale-3311 Manor Street	060290232
San Joaquin Valley APCD	Arvin-Di Giorgio	060295002
San Joaquin Valley APCD	Shafter-Walker Street	060296001
San Joaquin Valley APCD	Corcoran-Patterson Avenue	060310004
San Joaquin Valley APCD	Hanford-S Irwin Street	060311004
San Joaquin Valley APCD	Madera-Pump Yard	060390004
San Joaquin Valley APCD	Madera-28261 Avenue 14	060392010
San Joaquin Valley APCD	Merced-S Coffee Avenue	060470003
San Joaquin Valley APCD	Stockton-Hazelton Street	060771002
San Joaquin Valley APCD	Tracy-Airport	060773005
San Joaquin Valley APCD	Modesto-14th Street	060990005
San Joaquin Valley APCD	Turlock-S Minaret Street	060990006
San Joaquin Valley APCD	Turlock-S Minaret Street	060990006
San Joaquin Valley APCD	Visalia-N Church Street	061072002
San Joaquin Valley APCD	Porterville-1839 Newcomb Street	061072010
San Luis Obispo County APCD	Paso Robles-Santa Fe Avenue	060790005
San Luis Obispo County APCD	San Luis Obispo-3220 South Higuera St	060792006
San Luis Obispo County APCD	Morro Bay	060793001
San Luis Obispo County APCD	Nipomo-Regional Park	060794002
San Luis Obispo County APCD	Atascadero-Lewis Avenue	060798001
San Luis Obispo County APCD	Red Hills	060798005
San Luis Obispo County APCD	Carrizo Plains School-9640 Carrizo	060798006
Santa Barbara County APCD	El Capitan Beach	060830008
Santa Barbara County APCD	Santa Barbara-700 East Canon Perdido	060830011
Santa Barbara County APCD	Santa Maria-906 S Broadway	060831008
Santa Barbara County APCD	Lompoc-HSandP	060831013
Santa Barbara County APCD	Paradise Road-Los Padres National Forest	060831014
Santa Barbara County APCD	Gaviota-GTC Site B	060831018
Santa Barbara County APCD	Exxon Site 10-UCSB West Campus	060831020

Geographic Area	Monitoring Station	AQS ID
Santa Barbara County APCD	Carpinteria-Gobernador Road	060831021
Santa Barbara County APCD	Las Flores Canyon #1	060831025
Santa Barbara County APCD	Lompoc-S H Street	060832004
Santa Barbara County APCD	Goleta-Fairview	060832012
Santa Barbara County APCD	Santa Ynez-Airport Road	060833001
Santa Barbara County APCD	Vandenberg Air Force Base-STS Power	060834003
Shasta County AQMD	Redding-Health Dept Roof	060890004
Shasta County AQMD	Anderson-North Street	060890007
Shasta County AQMD	Shasta Lake-13791 Lake Blvd	060890009
Siskiyou County APCD	Yreka-Foothill Drive	060932001
South Coast AQMD	Azusa	060370002
South Coast AQMD	Glendora-Laurel	060370016
South Coast AQMD	West Los Angeles-VA Hospital	060370113
South Coast AQMD	Burbank-W Palm Avenue	060371002
South Coast AQMD	Los Angeles-North Main Street	060371103
South Coast AQMD	Reseda	060371201
South Coast AQMD	Compton-700 North Bullis Road	060371302
South Coast AQMD	Pico Rivera-4144 San Gabriel	060371602
South Coast AQMD	Pomona	060371701
South Coast AQMD	Pasadena-S Wilson Avenue	060372005
South Coast AQMD	North Long Beach	060374002
South Coast AQMD	Long Beach-2425 Webster Street	060374006
South Coast AQMD	Los Angeles-Westchester Parkway	060375005
South Coast AQMD	Santa Clarita	060376012
South Coast AQMD	Anaheim-Pampas Lane	060590007
South Coast AQMD	Costa Mesa-Mesa Verde Drive	060591003
South Coast AQMD	Mission Viejo-26081 Via Pera	060592022
South Coast AQMD	La Habra	060595001
South Coast AQMD	Mira Loma-10551 Bellegrave	060650004
South Coast AQMD	Banning Airport	060650012
South Coast AQMD	Winchester-33700 Borel Road	060650016
South Coast AQMD	Riverside-Magnolia	060651003
South Coast AQMD	Indio-Jackson Street	060652002
South Coast AQMD	Palm Springs-Fire Station	060655001
South Coast AQMD	Perris	060656001
South Coast AQMD	Riverside-Rubidoux	060658001
South Coast AQMD	Mira Loma Van Buren	060658005
South Coast AQMD	Lake Elsinore-W Flint Street	060659001
South Coast AQMD	Crestline	060710005
South Coast AQMD	Upland	060711004
South Coast AQMD	Fontana-Arrow Highway	060712002
South Coast AQMD	Redlands-Dearborn	060714003
South Coast AQMD	San Bernardino-4th Street	060719004

Geographic Area	Monitoring Station	AQS ID
Tehama County APCD	Tuscan Butte	061030004
Tehama County APCD	Red Bluff-Oak Street	061030005
Tuolumne County APCD	Sonora-Barretta Street	061090005
Ventura County APCD	Thousand Oaks-Moorpark Road	061110007
Ventura County APCD	Piru-3301 Pacific Avenue	061110009
Ventura County APCD	Ojai-Ojai Avenue	061111004
Ventura County APCD	Simi Valley-Cochran Street	061112002
Ventura County APCD	Ventura-Emma Wood State Beach	061112003
Ventura County APCD	El Rio-Rio Mesa School #2	061113001
Yolo-Solano AQMD	Vacaville-Ulatis Drive	060953003
Yolo-Solano AQMD	Davis-UCD Campus	061130004
Yolo-Solano AQMD	Woodland-Gibson Road	061131003

Page intentionally left blank

APPENDIX E

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

This page intentionally left blank.

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.

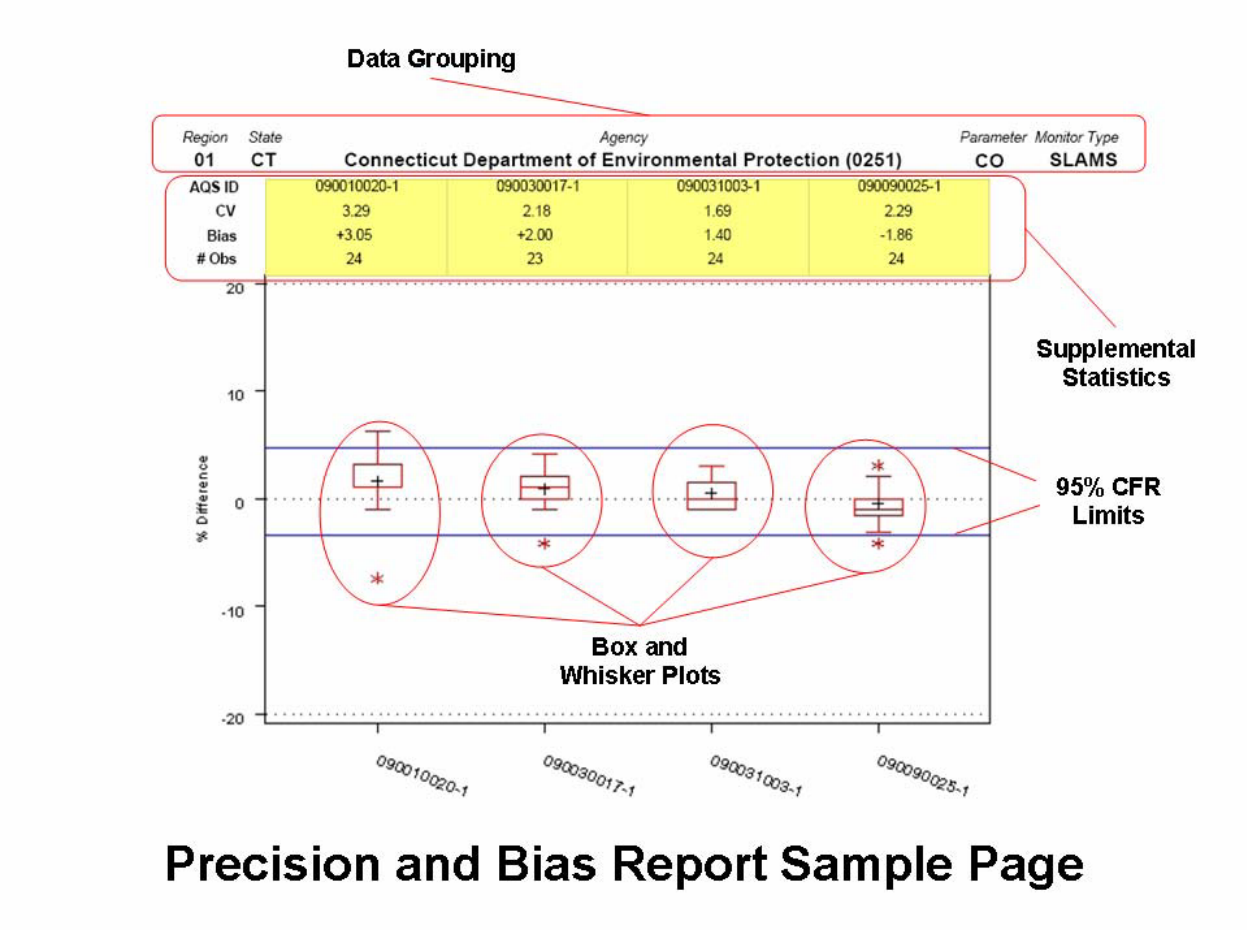
A document describing these statistics is available from U.S. EPA:
http://www.epa.gov/ttn/amtic/parslist.html

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)

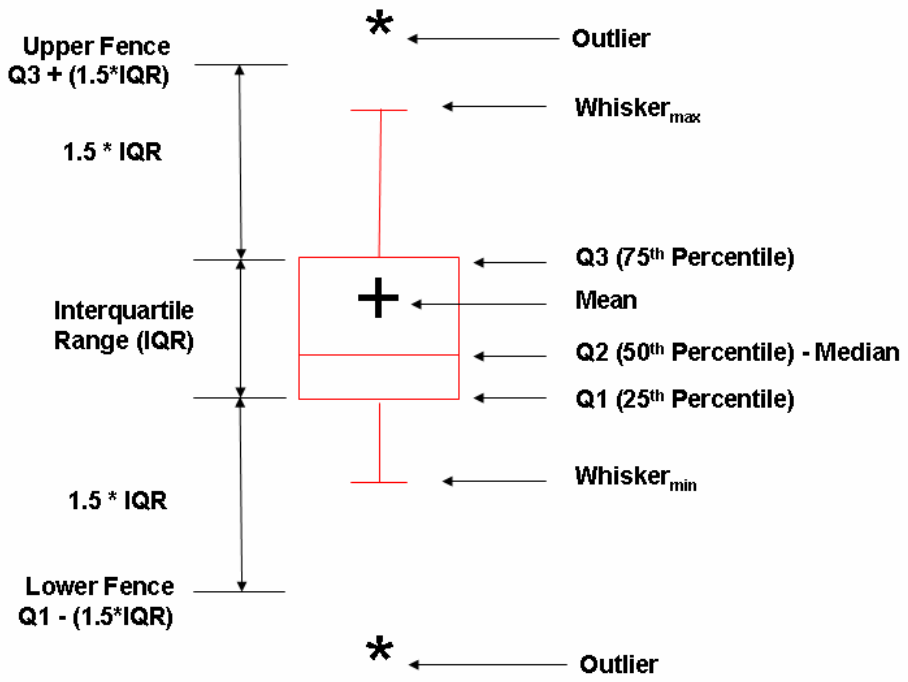
In addition to the statistics represented in the graph, the following information and statistics are displayed for each monitor within each data grouping:

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

- # Obs - Number of Samples contained within the set

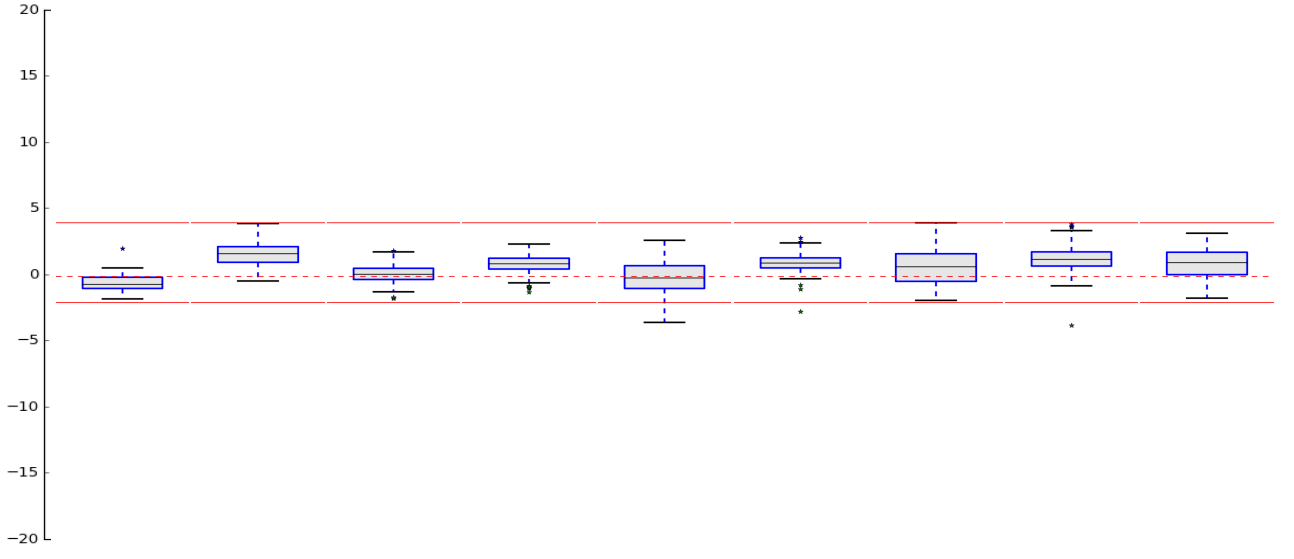
A “Box and Whisker Plot” is created for each monitor within a reporting organization measuring a gaseous criteria pollutant (carbon monoxide, nitrogen dioxide, ozone, and sulfur dioxide). A singe box plot is based on the percent relative error statistics from the one-point precision checks for a single monitoring site measuring a pollutant conducted within the effective time period in 2012. 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.

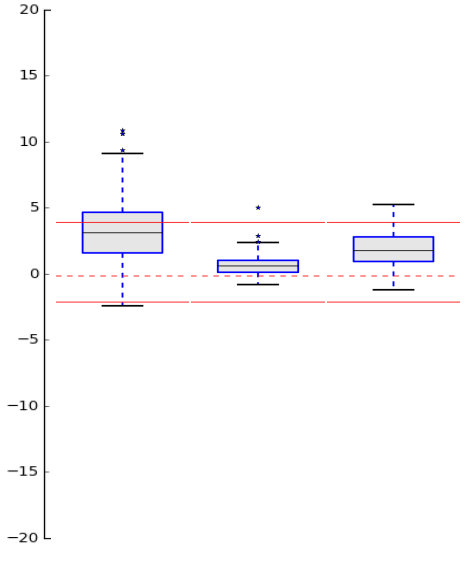


Components of a Schematic Box and Whisker Plot

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	0.55	0.81	0.64	0.66	1.2	0.66	1.43	0.96	1.11
Bias	-0.6	+1.63	+/-0.53	+0.96	+/-0.98	+1.03	+/-1.3	+1.36	+1.23
# Obs	159	158	158	159	156	158	157	158	159
Method	093	093	054	054	054	054	054	054	054

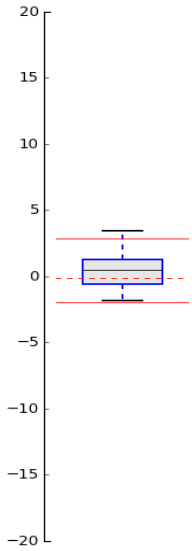


Site	06-085-0005	06-095-0004	06-097-0003
POC	1	1	1
CV	2.33	0.75	1.19
Bias	+3.4	+0.86	+1.96
# Obs	160	158	156
Method	554	054	054



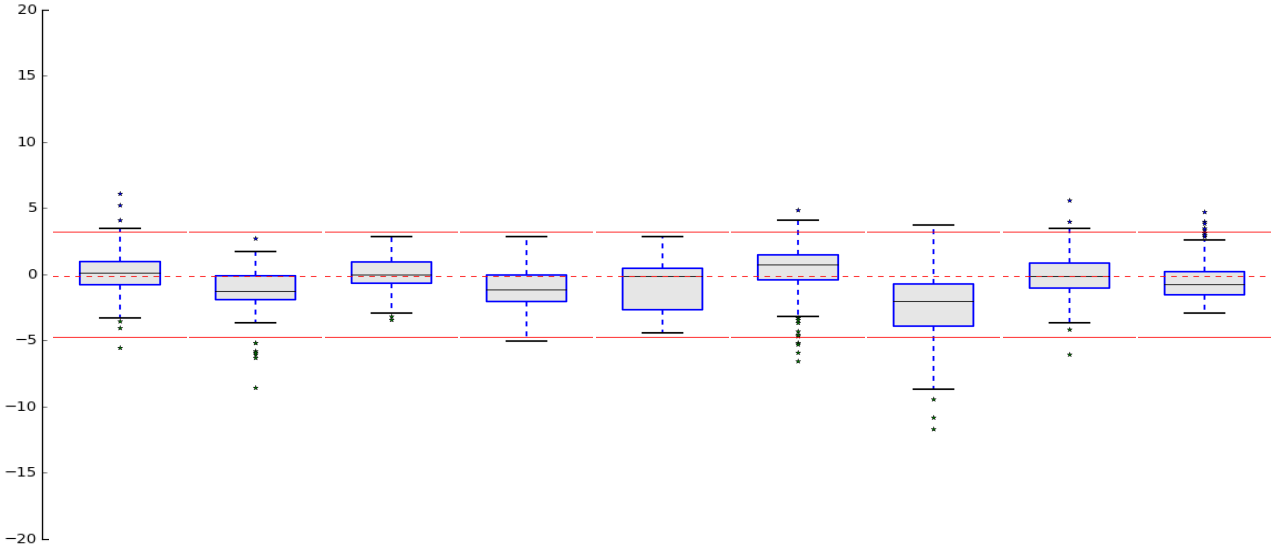
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	Bay Area Air Quality Management District (0086)	Carbon monoxide	SPECIAL PURPOSE	2012	1

Site	06-085-2009
POC	1
CV	1.17
Bias	+/-1.06
# Obs	159
Method	054

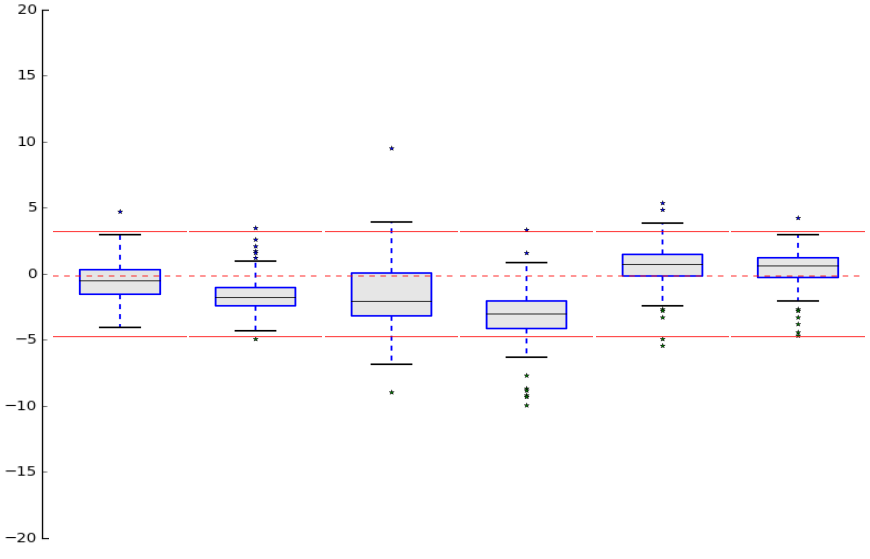


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	Bay Area Air Quality Management District (0086)	Nitrogen dioxide (NO2)	SLAMS	2012	15

Site	06-001-0007	06-001-0009	06-001-0011	06-001-2005	06-013-0002	06-013-1002	06-013-1004	06-013-2007	06-041-0001
POC	1	1	1	1	1	1	1	1	1
CV	1.57	1.55	1.09	1.38	1.57	1.85	2.51	1.5	1.57
Bias	+/-1.24	+/-1.47	+/-0.88	+/-1.35	+/-1.34	+/-1.56	-2.64	+/-1.2	+/-1.32
# Obs	157	159	154	156	156	159	155	157	158
Method	074	074	074	074	074	074	074	074	074

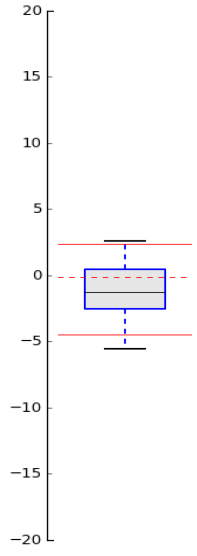


Site	06-055-0003	06-075-0005	06-081-1001	06-085-0005	06-095-0004	06-097-0003
POC	1	1	1	1	1	1
CV	1.33	1.29	2.24	1.91	1.52	1.25
Bias	+/-1.12	-1.67	+/-2.15	-3.04	+1.36	+/-1.11
# Obs	158	158	158	154	158	156
Method	074	074	074	074	074	074



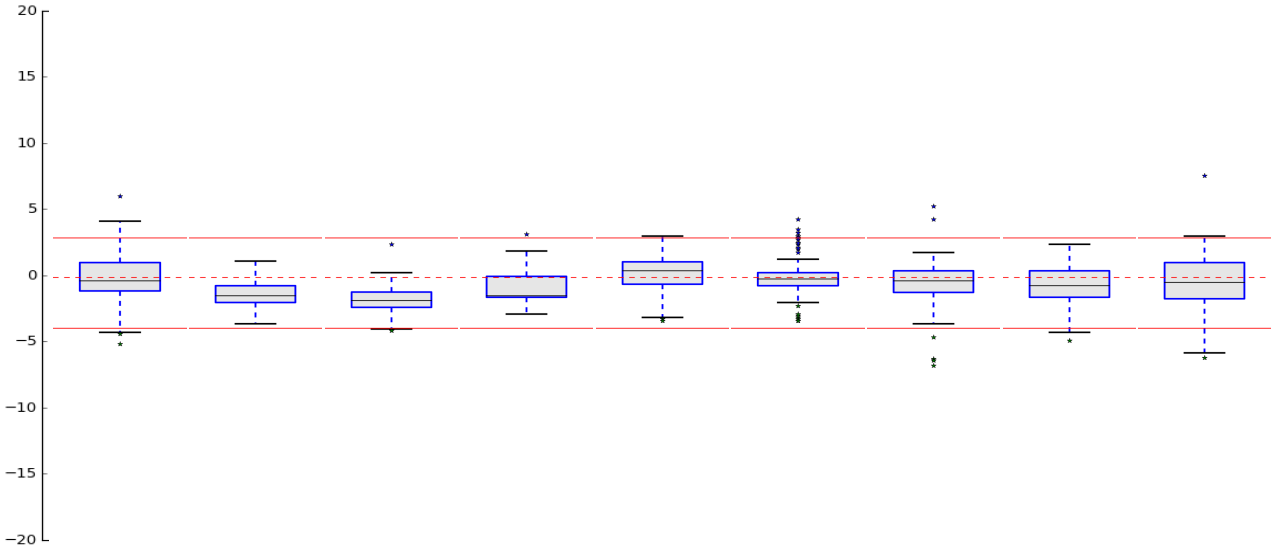
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	Bay Area Air Quality Management District (0086)	Nitrogen dioxide (NO2)	SPECIAL PURPOSE	2012	1

Site	06-085-2009
POC	1
CV	1.67
Bias	+/-1.59
# Obs	159
Method	074

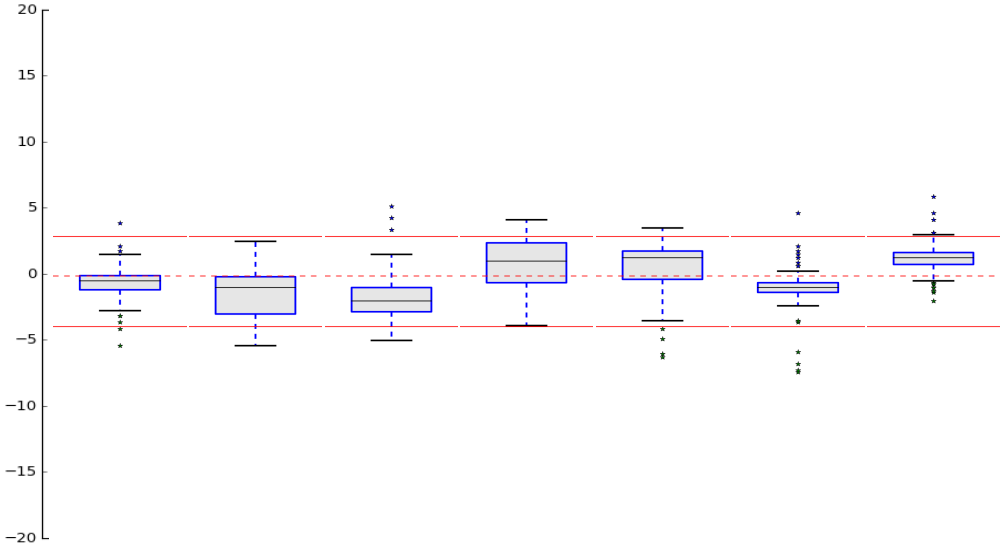


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	Bay Area Air Quality Management District (0086)	Ozone	SLAMS	2012	16

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	1.65	0.8	0.99	1.25	1.3	1.23	1.6	1.37	2.0
Bias	+/-1.3	-1.25	-1.67	+/-1.34	+/-1.09	+/-0.88	+/-1.2	+/-1.21	+/-1.65
# Obs	158	155	112	158	159	157	157	158	159
Method	047	047	047	047	047	047	047	047	047

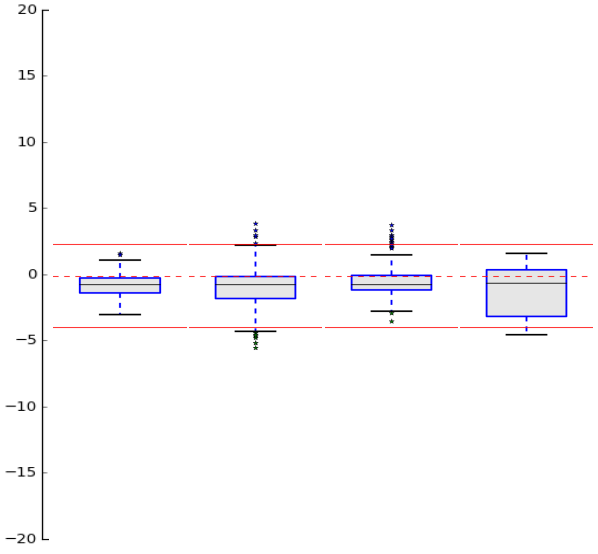


Site	06-085-0002	06-085-0005	06-085-1001	06-085-2006	06-095-0004	06-095-0005	06-097-0003
POC	1	1	1	1	1	1	1
CV	1.22	1.57	1.4	1.85	1.76	1.49	1.01
Bias	+/-0.98	-1.61	-1.91	+/-1.75	+/-1.57	-1.29	+1.41
# Obs	100	155	159	105	157	106	156
Method	047	047	047	047	047	047	047



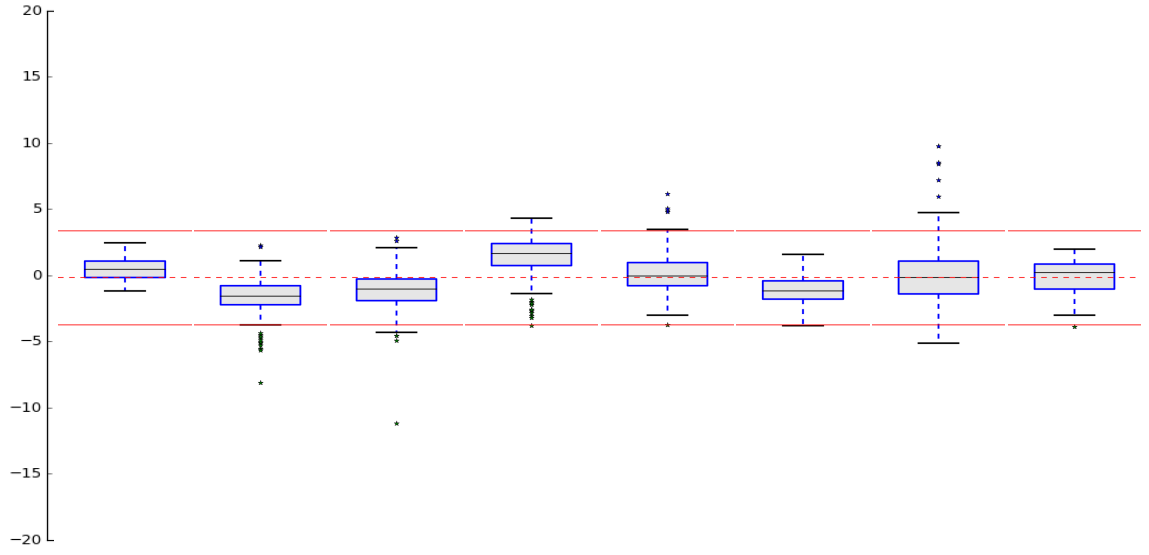
REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	CA	Bay Area Air Quality Management District (0086)	Ozone	SPECIAL PURPOSE	2012	4

Site	06-001-0009	06-013-1004	06-041-0001	06-085-2009
POC	1	1	1	1
CV	0.83	1.76	1.4	1.82
Bias	-0.87	-1.48	+/-1.15	+/-1.71
# Obs	159	156	158	159
Method	047	047	047	047



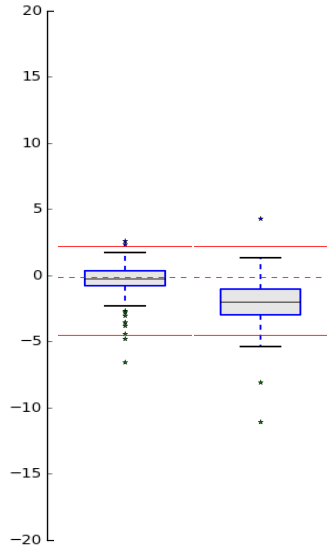
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	Bay Area Air Quality Management District (0086)	Sulfur dioxide	SLAMS	2012	8

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	0.79	1.48	1.5	1.58	1.47	0.96	2.32	1.22
Bias	+0.81	-1.62	-1.34	+1.89	+/-1.14	-1.12	+/-1.71	+/-1.01
# Obs	157	148	157	159	156	159	167	158
Method	060	060	060	060	060	060	060	060



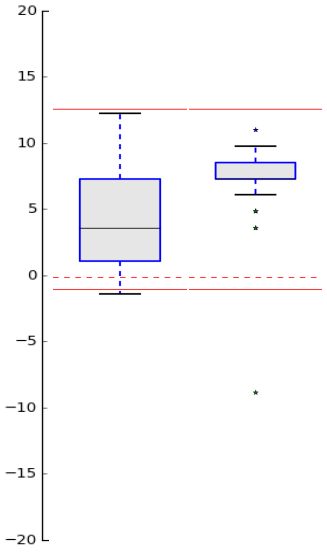
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	Bay Area Air Quality Management District (0086)	Sulfur dioxide	SPECIAL PURPOSE	2012	2

Site	06-013-1001	06-085-2009
POC	1	1
CV	1.23	1.6
Bias	+/-0.89	-1.95
# Obs	158	158
Method	060	060



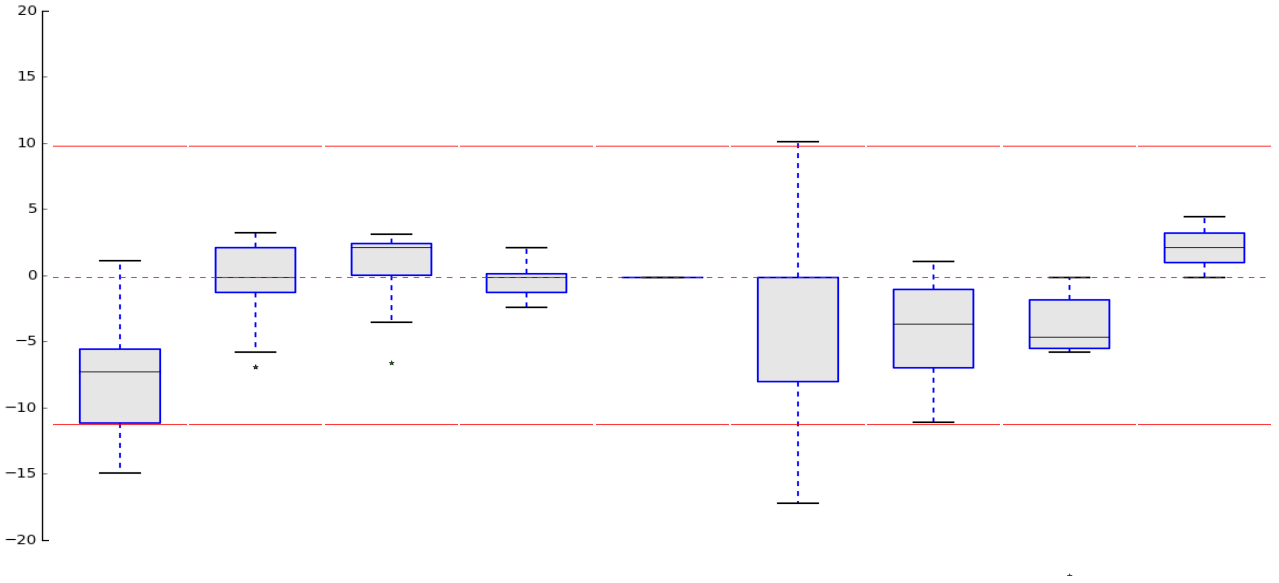
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	California Air Resources Board (0145)	Carbon monoxide	INDUSTRIAL	2012	2

Site	06-083-1025	06-083-4003
POC	1	1
CV	3.63	2.89
Bias	+4.85	+7.09
# Obs	51	51
Method	093	093

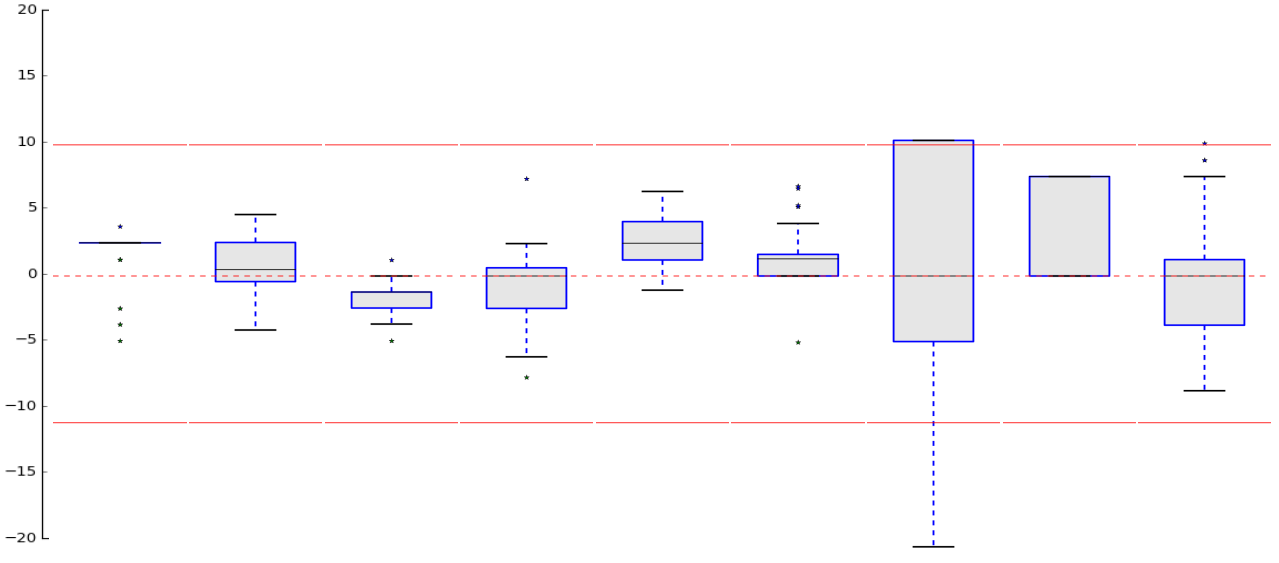


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	California Air Resources Board (0145)	Carbon monoxide	SLAMS	2012	21

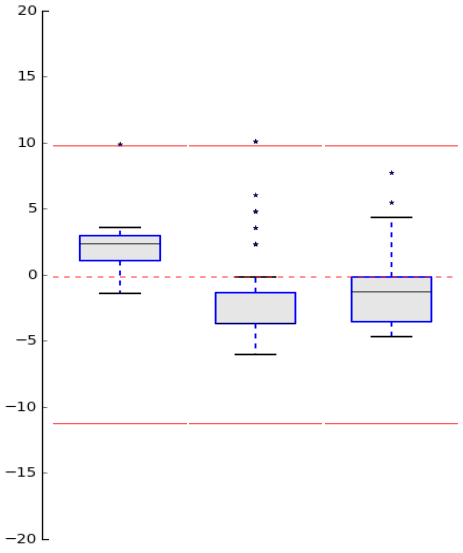
Site	06-007-0008	06-019-0007	06-019-0011	06-019-0242	06-019-5001	06-025-0005	06-025-1003	06-029-2012	06-037-9033
POC	3	1	3	1	1	1	1	1	1
CV	3.42	2.85	2.46	1.06	0.0	5.17	4.12	11.1	1.48
Bias	-7.5	+/-2.19	+2.26	+/-0.81	+0.0	-4.5	-4.84	-7.89	+2.49
# Obs	87	52	33	52	49	207	24	26	39
Method	593	054	593	054	054	067	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	1	3	1
CV	1.9	2.61	1.57	3.51	2.07	2.53	7.63	3.79	4.46
Bias	+2.36	+/-2.17	-1.93	+/-2.7	+2.92	+2.2	+/-6.94	+4.12	+/-3.59
# Obs	49	24	24	23	36	36	238	66	51
Method	054	593	066	066	093	093	054	067	093

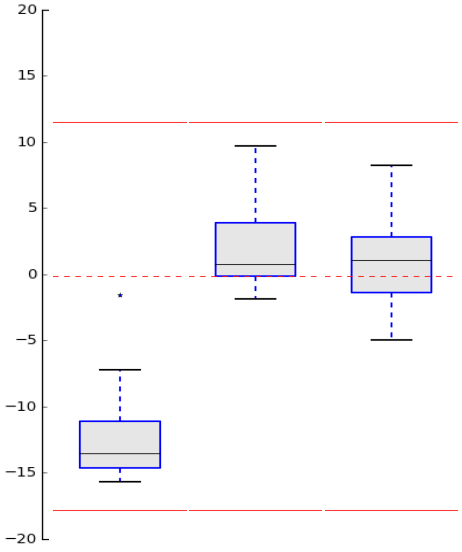


Site	06-083-2011	06-099-0005	06-099-0006
POC	1	1	1
CV	2.25	2.6	2.72
Bias	+2.78	-2.72	-2.26
# Obs	51	258	52
Method	093	067	054



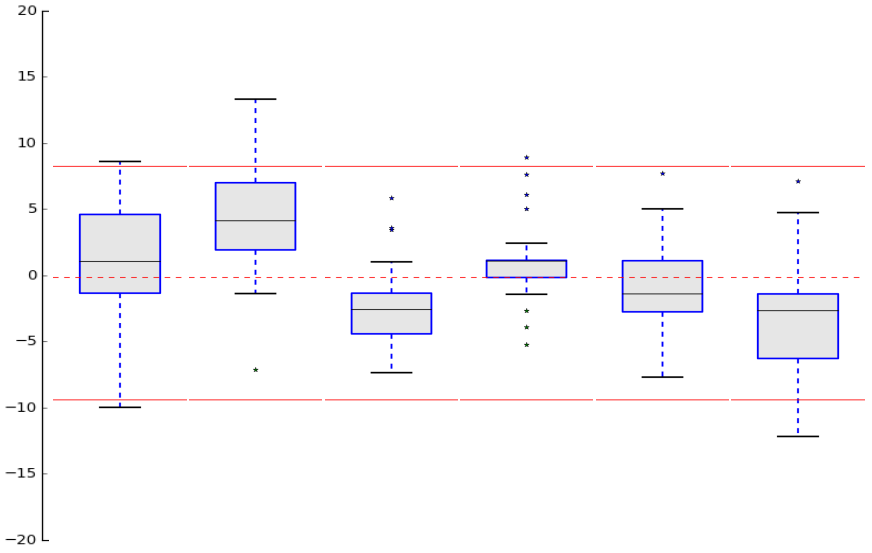
REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	CA	California Air Resources Board (0145)	Carbon monoxide	SPECIAL PURPOSE	2012	3

Site	06-023-1004	06-023-1005	06-067-0002
POC	1	1	1
CV	3.78	3.46	4.05
Bias	-12.05	+3.14	+/-3.42
# Obs	24	24	24
Method	054	054	066



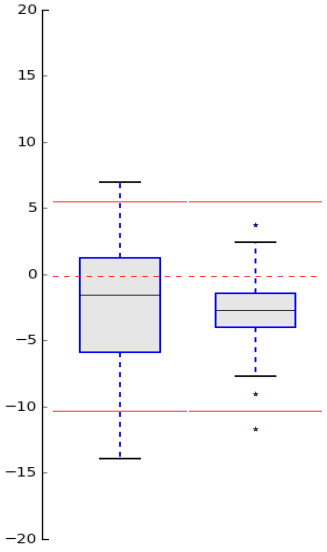
REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	CA	California Air Resources Board (0145)	Nitrogen dioxide (NO2)	INDUSTRIAL	2012	6

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	4.65	4.64	2.87	3.37	3.42	4.75
Bias	+/-3.89	+5.42	-3.18	+2.68	+/-2.82	-4.76
# Obs	28	32	51	27	51	46
Method	074	074	074	074	099	074



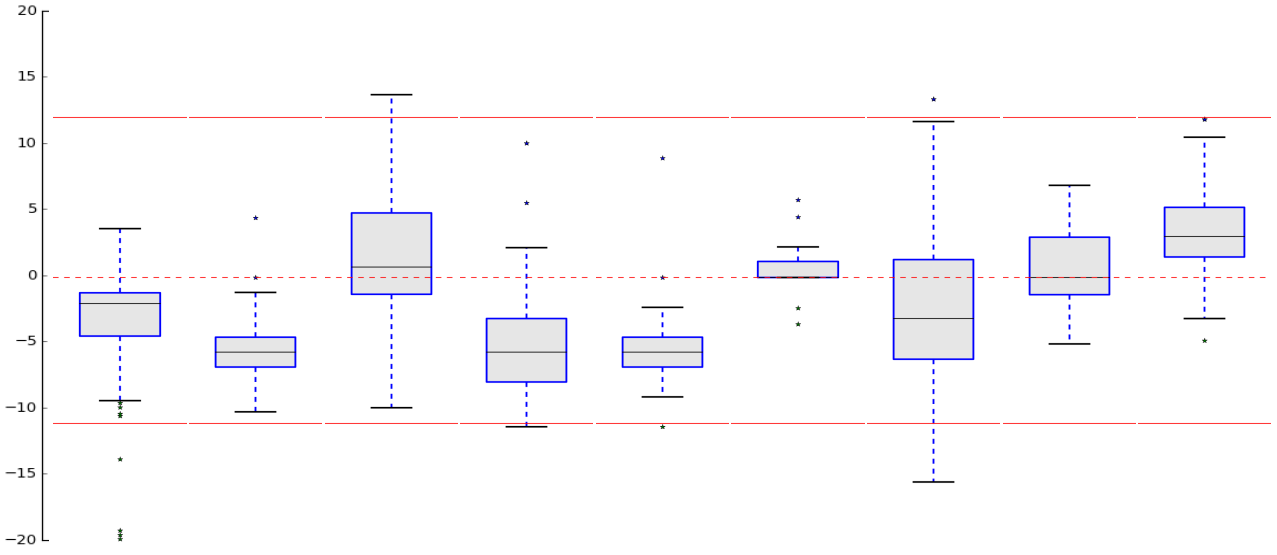
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	California Air Resources Board (0145)	Nitrogen dioxide (NO2)	PAMS	2012	2

Site	06-111-2002	06-111-3001
POC	1	1
CV	4.94	3.09
Bias	+/-4.36	-3.32
# Obs	53	53
Method	082	082

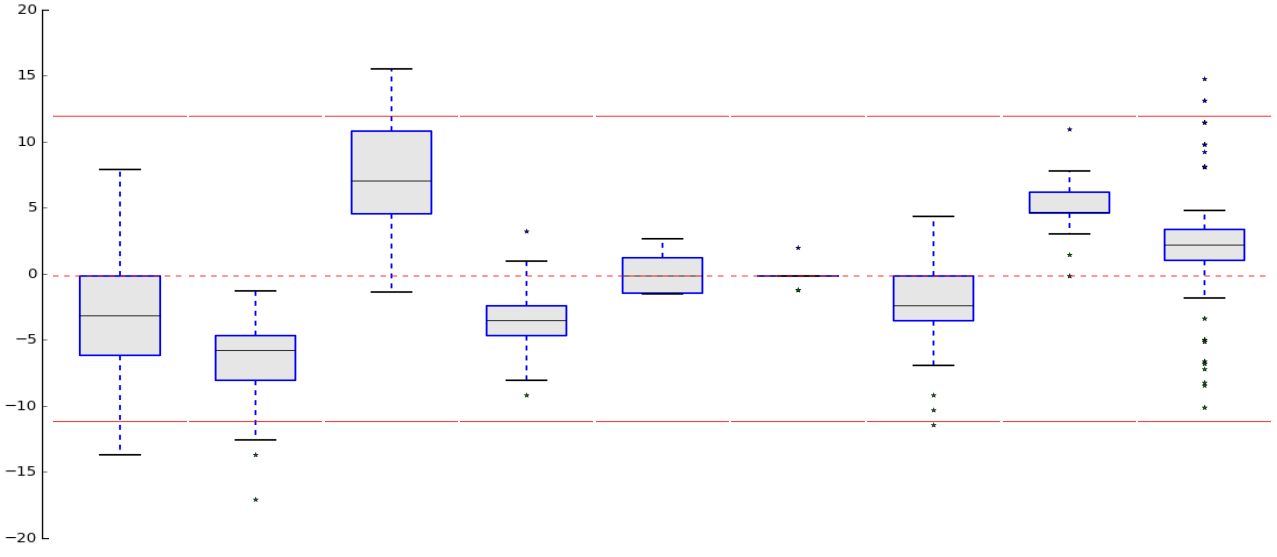


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	California Air Resources Board (0145)	Nitrogen dioxide (NO2)	SLAMS	2012	41

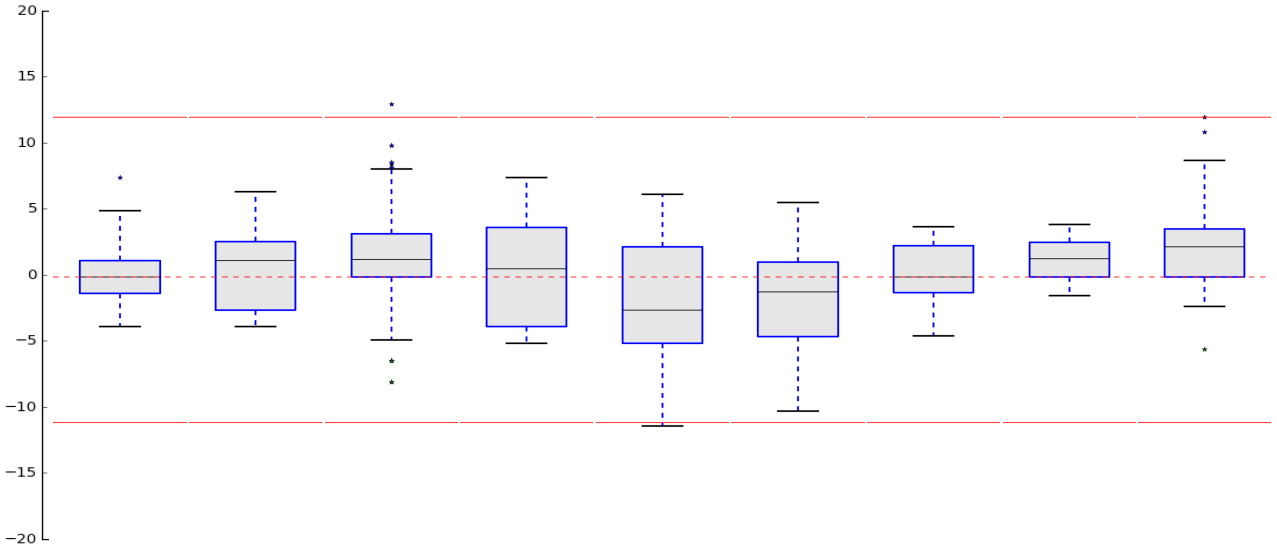
Site	06-007-0008	06-019-0007	06-019-0011	06-019-0242	06-019-4001	06-019-5001	06-025-0005	06-025-1003	06-029-0007
POC	1	1	1	1	1	1	1	1	1
CV	3.89	2.68	5.12	6.52	9.42	1.34	4.88	3.69	2.9
Bias	-3.66	-5.29	+/-4.04	-6.74	-7.93	+0.99	+/-4.39	+/-2.97	+3.43
# Obs	131	52	180	52	52	52	230	24	250
Method	099	074	099	074	074	074	074	099	074



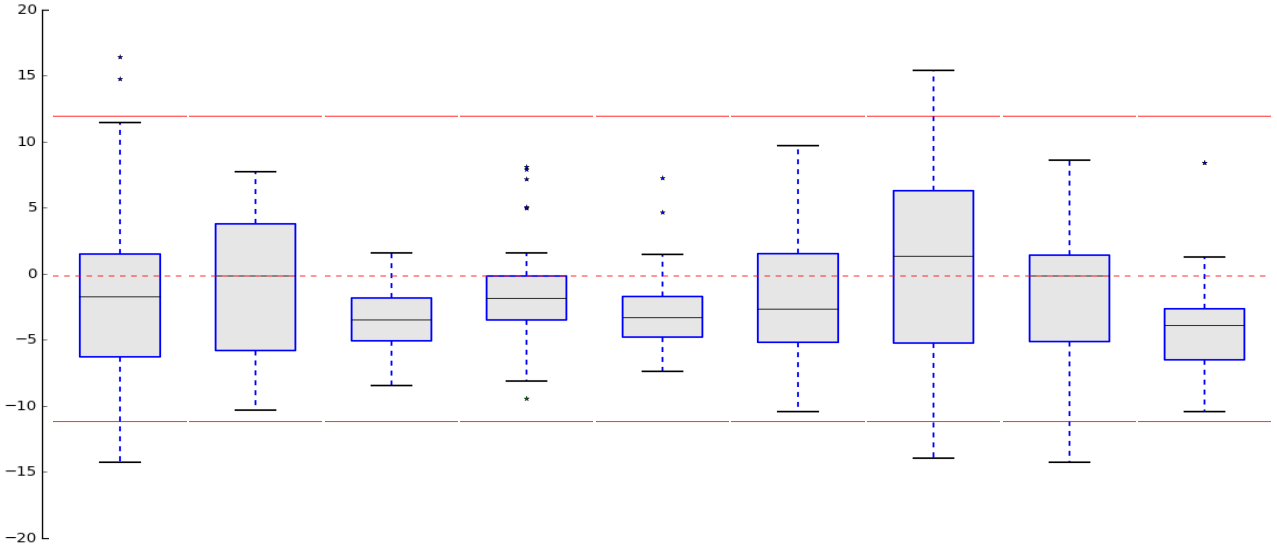
Site	06-029-0014	06-029-2012	06-029-6001	06-031-1004	06-037-9033	06-039-0004	06-047-0003	06-053-1003	06-061-0006
POC	1	1	1	1	1	1	1	1	1
CV	4.19	4.03	3.73	2.46	1.71	0.38	14.42	2.11	4.74
Bias	-3.94	-7.13	+6.99	-3.63	+/-1.44	+0.15	-6.93	+5.13	+4.07
# Obs	252	26	236	50	39	52	52	49	221
Method	074	074	074	074	099	074	074	074	099



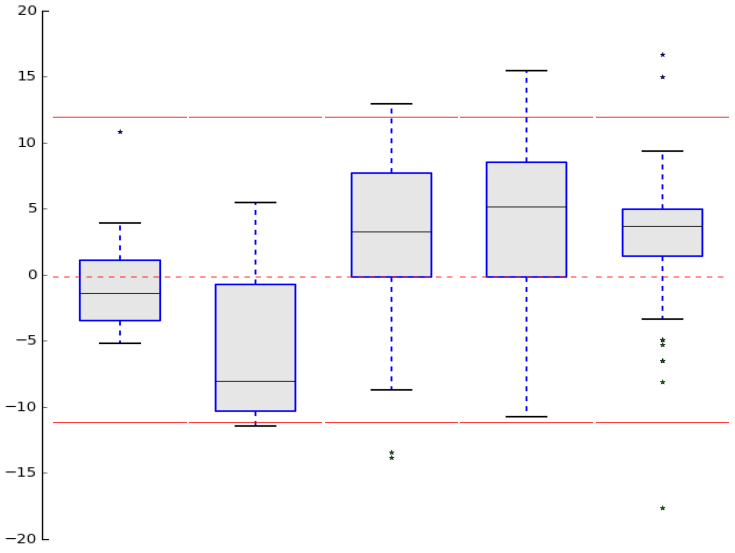
Site	06-067-0002	06-067-0006	06-067-0010	06-067-0011	06-067-0012	06-067-0014	06-071-0001	06-071-0306	06-071-1234
POC	1	1	1	1	1	1	1	1	1
CV	2.7	3.37	3.47	4.57	5.43	4.39	2.09	1.9	5.24
Bias	+/-2.05	+/-2.88	+2.97	+/-3.76	+/-4.8	+/-3.73	+/-1.75	+2.04	+4.74
# Obs	24	24	249	24	24	24	36	36	18
Method	074	035	074	074	035	074	099	099	099



Site	06-077-1002	06-077-3005	06-079-3001	06-079-4002	06-079-8001	06-083-0008	06-083-0011	06-083-1008	06-083-2004
POC	2	1	1	1	1	1	1	1	1
CV	4.98	9.25	2.37	4.02	2.95	5.11	6.42	4.52	3.91
Bias	+/-4.26	+/-6.41	-3.27	-3.34	-3.64	+/-4.47	+/-5.55	+/-3.69	-4.64
# Obs	247	52	52	48	50	52	218	247	50
Method	074	074	035	035	035	099	074	074	074

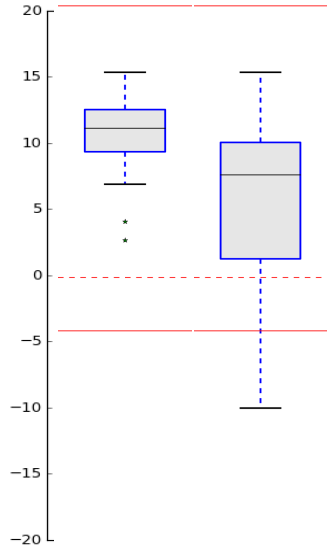


Site	06-083-2011	06-099-0006	06-101-0003	06-107-2002	06-113-0004
POC	1	1	1	1	1
CV	3.41	5.73	4.53	5.04	3.62
Bias	+/-2.84	-6.94	+4.69	+5.55	+3.96
# Obs	38	52	231	252	244
Method	099	074	074	074	074



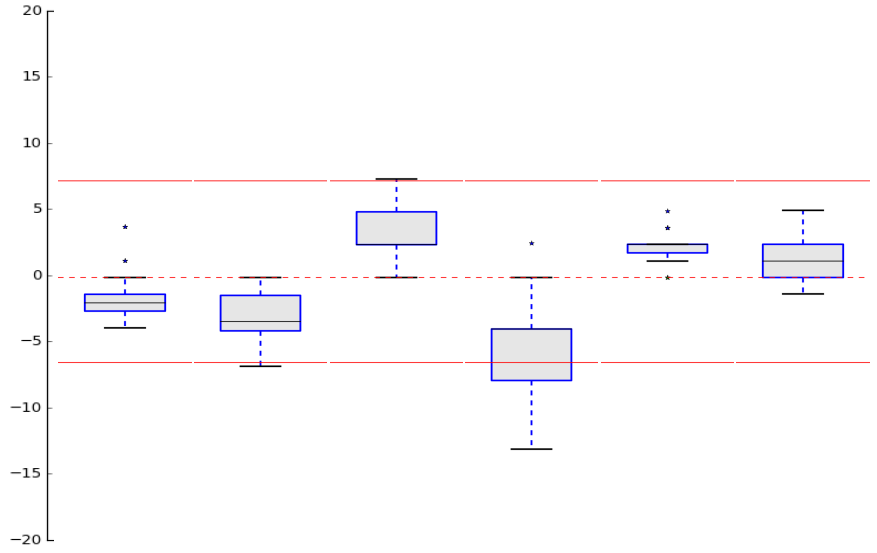
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	California Air Resources Board (0145)	Nitrogen dioxide (NO2)	SPECIAL PURPOSE	2012	2

Site	06-023-1004	06-023-1005
POC	1	1
CV	3.34	8.49
Bias	+10.37	+8.98
# Obs	24	24
Method	074	074



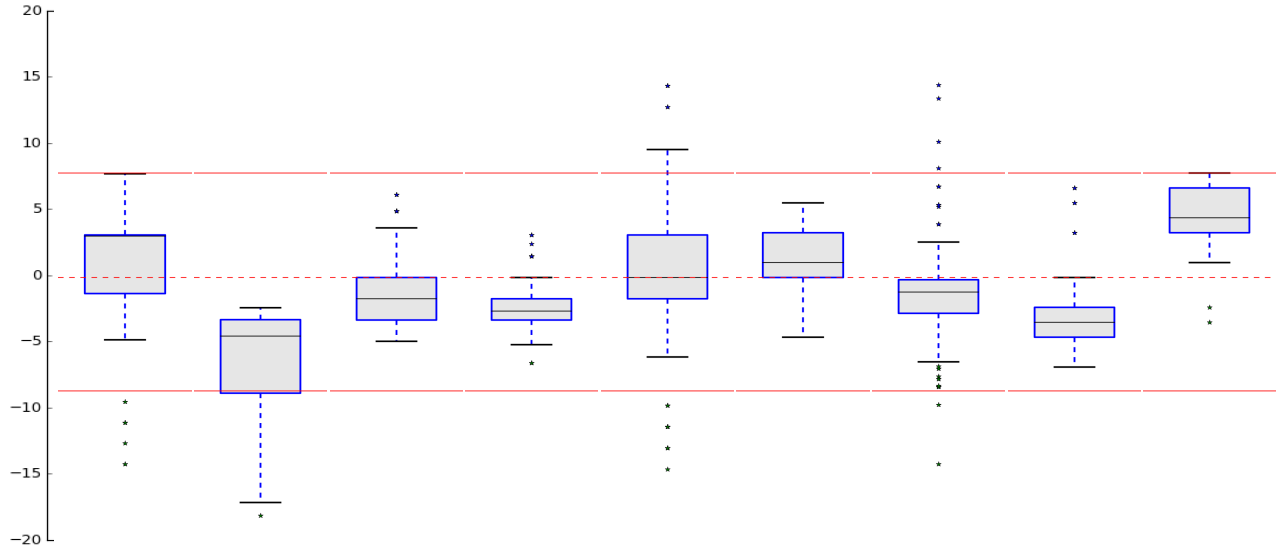
REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	CA	California Air Resources Board (0145)	Ozone	INDUSTRIAL	2012	6

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	2.36	1.83	1.7	3.65	1.0	1.55
Bias	-2.41	-3.32	+3.49	-5.5	+2.31	+1.67
# Obs	26	28	52	29	51	52
Method	047	047	087	087	087	087

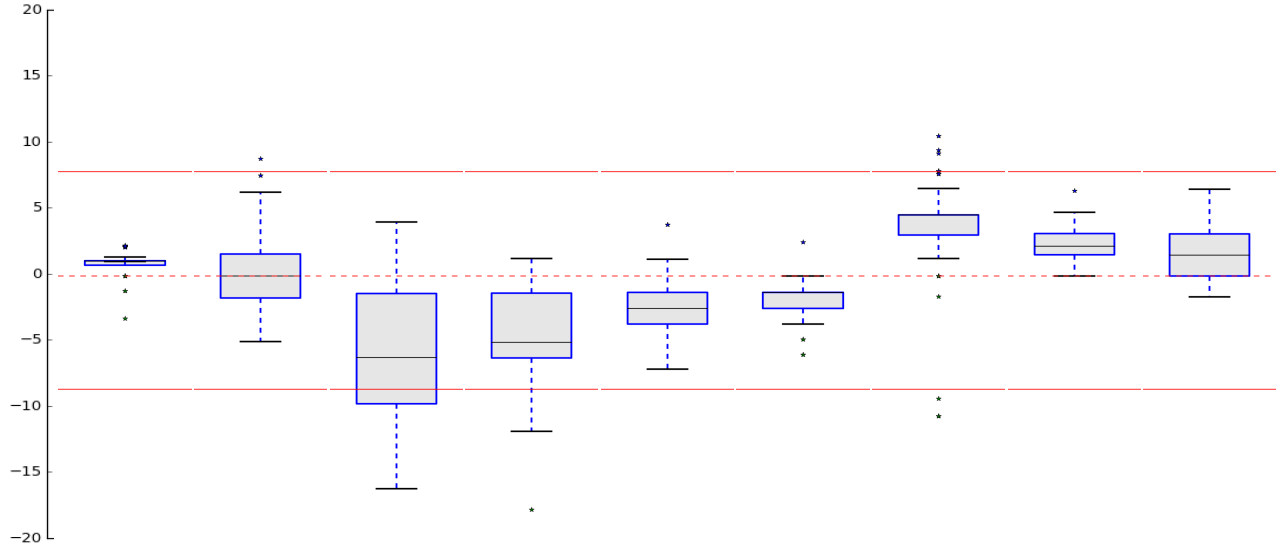


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	California Air Resources Board (0145)	Ozone	SLAMS	2012	87

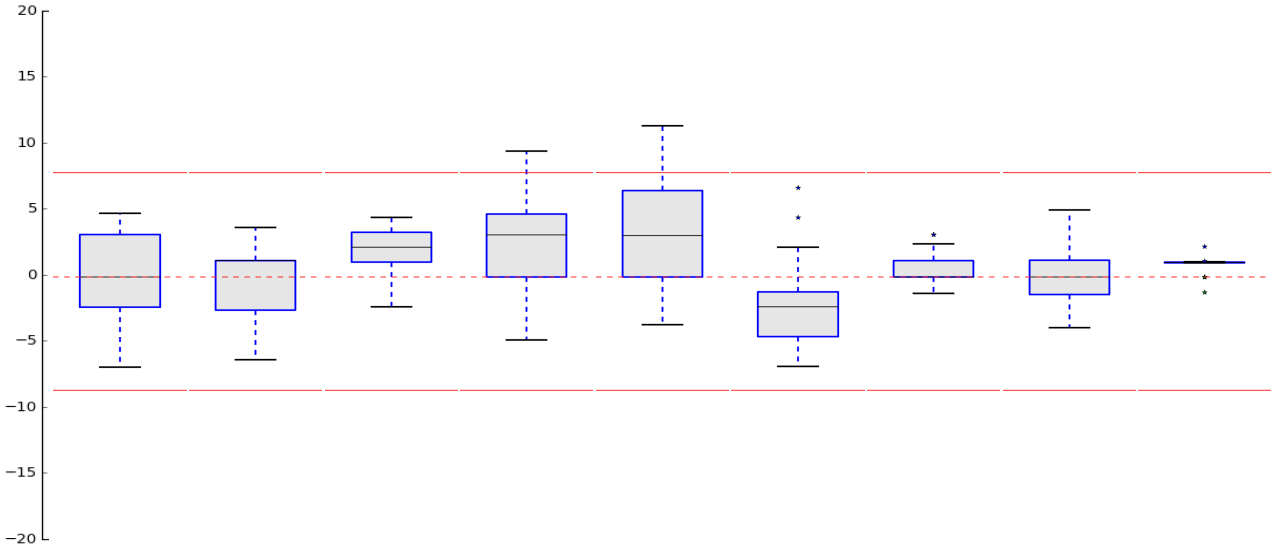
Site	06-005-0002	06-007-0008	06-009-0001	06-011-1002	06-017-0010	06-019-0007	06-019-0011	06-019-0242	06-019-4001
POC	1	1	1	1	1	1	1	1	1
CV	3.15	3.59	2.14	1.55	4.3	2.6	3.48	5.61	2.38
Bias	+/-2.89	-5.93	-2.1	-2.36	+/-3.17	+2.29	-2.66	-4.81	+4.81
# Obs	350	131	355	361	359	52	181	52	52
Method	087	087	087	087	087	087	087	087	087



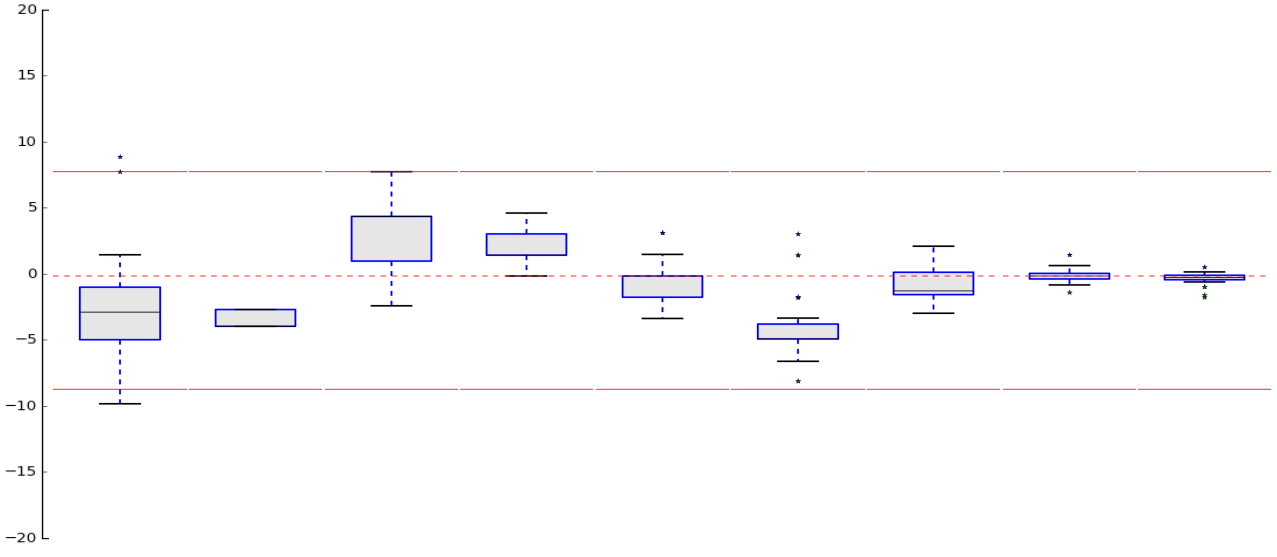
Site	06-019-5001	06-021-0003	06-025-0005	06-025-1003	06-025-4003	06-025-4004	06-029-0007	06-029-0008	06-029-0011
POC	1	1	1	1	1	1	1	1	1
CV	1.05	2.63	5.02	4.42	2.86	2.07	2.54	1.65	1.65
Bias	+1.22	+/-2.05	-5.98	-5.5	-3.12	-2.52	+3.92	+2.38	+1.75
# Obs	52	364	218	25	24	25	249	43	365
Method	087	087	087	087	087	087	087	087	087



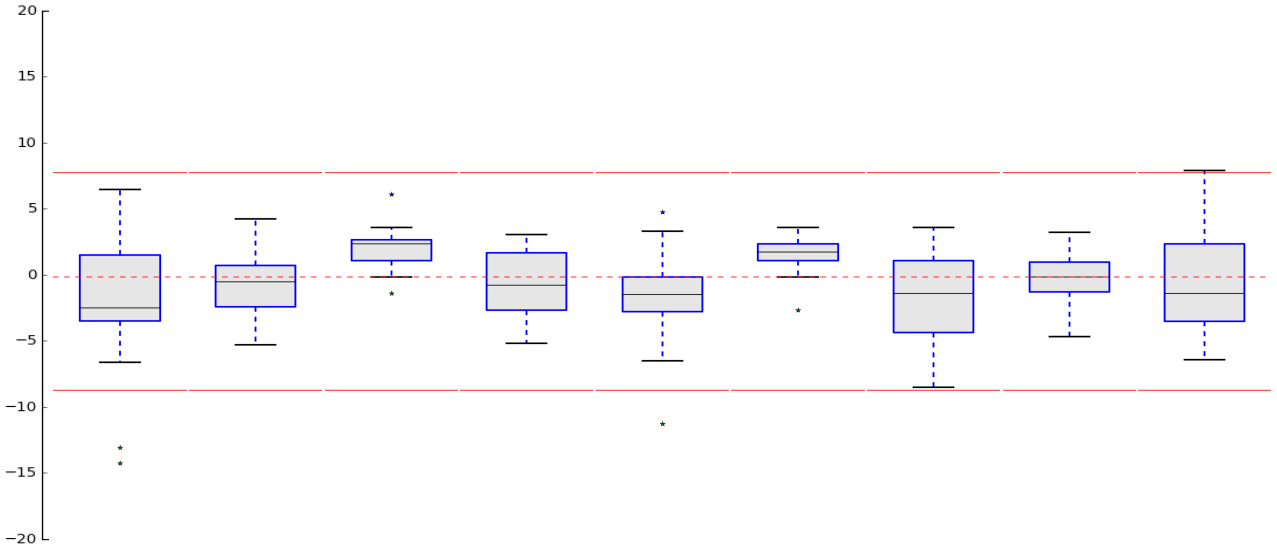
Site	06-029-0014	06-029-0232	06-029-2012	06-029-5002	06-029-6001	06-031-1004	06-033-3001	06-037-9033	06-039-0004
POC	1	1	1	1	1	1	1	1	1
CV	2.82	2.13	1.83	3.07	3.32	2.7	1.12	2.4	0.59
Bias	+/-2.36	+/-1.77	+2.53	+3.57	+3.84	-3.1	+0.78	+/-1.99	+0.9
# Obs	255	237	26	339	245	48	52	37	52
Method	087	087	087	087	087	087	087	087	087



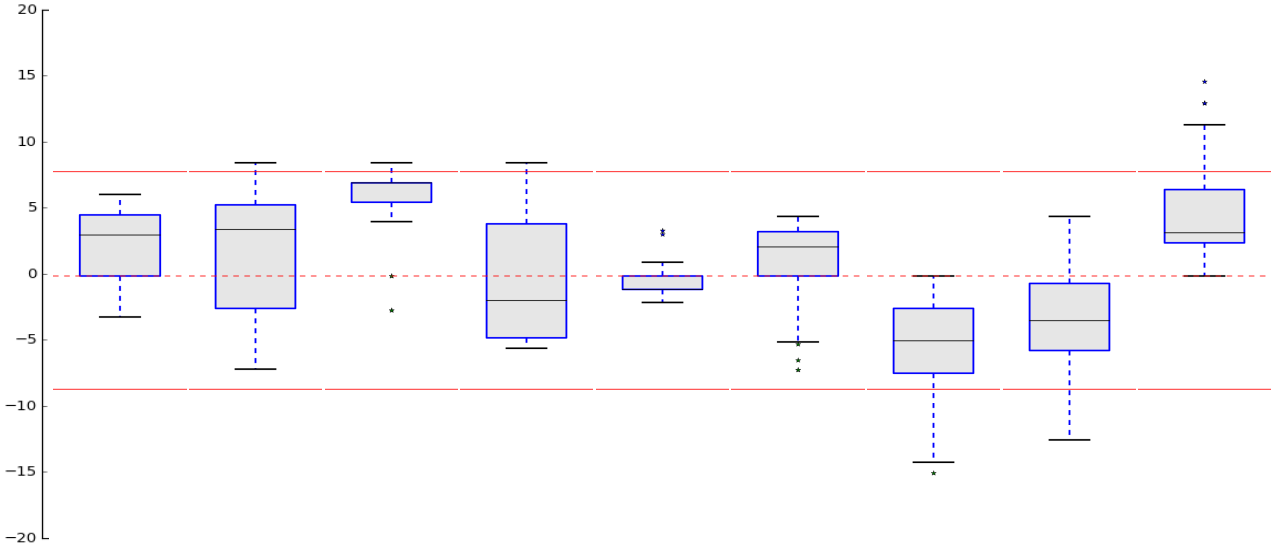
Site	06-039-2010	06-045-0008	06-047-0003	06-053-0002	06-053-0008	06-053-1003	06-057-0005	06-061-0003	06-061-0004
POC	1	1	1	1	1	1	1	1	1
CV	3.42	0.78	2.56	1.12	1.66	2.4	1.53	0.53	0.48
Bias	-3.36	-3.28	+3.57	+2.3	-1.38	-4.26	+/-1.33	+/-0.4	+/-0.37
# Obs	52	12	52	54	53	50	32	33	35
Method	087	087	087	047	047	047	087	087	087



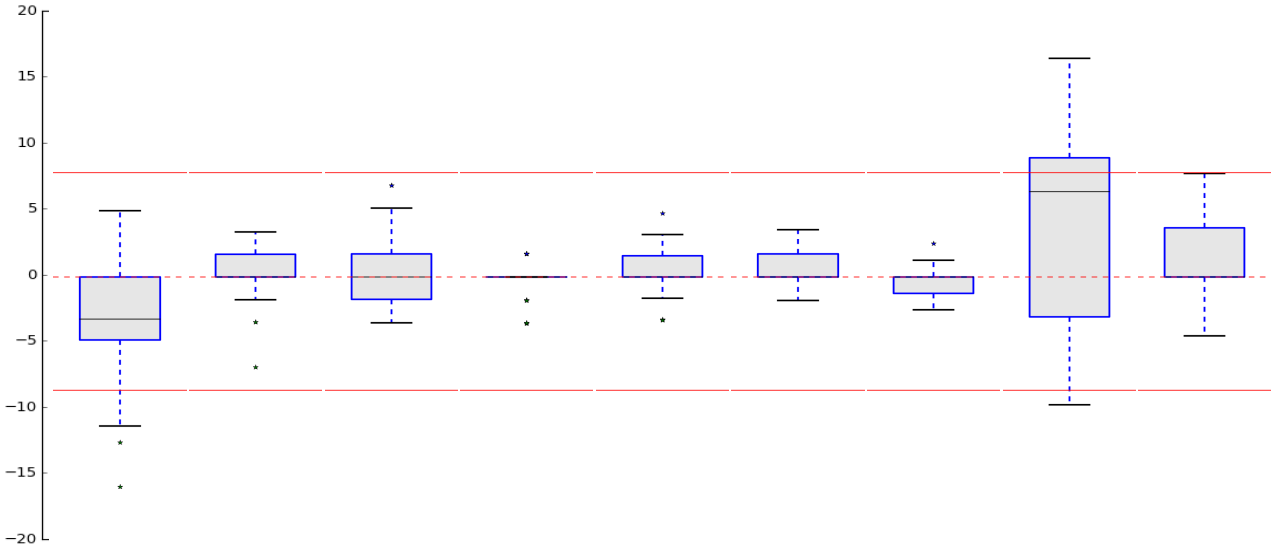
Site	06-061-0006	06-065-9003	06-067-0002	06-067-0006	06-067-0010	06-067-0011	06-067-0012	06-067-0014	06-067-5003
POC	1	1	1	1	1	1	1	1	1
CV	2.82	1.87	1.85	2.72	2.34	1.51	3.89	2.34	4.0
Bias	+/-2.59	+/-1.57	+2.46	+/-2.22	-2.07	+1.99	+/-3.4	+/-1.89	+/-3.29
# Obs	226	358	24	24	254	24	24	24	24
Method	087	087	019	019	087	019	019	019	087



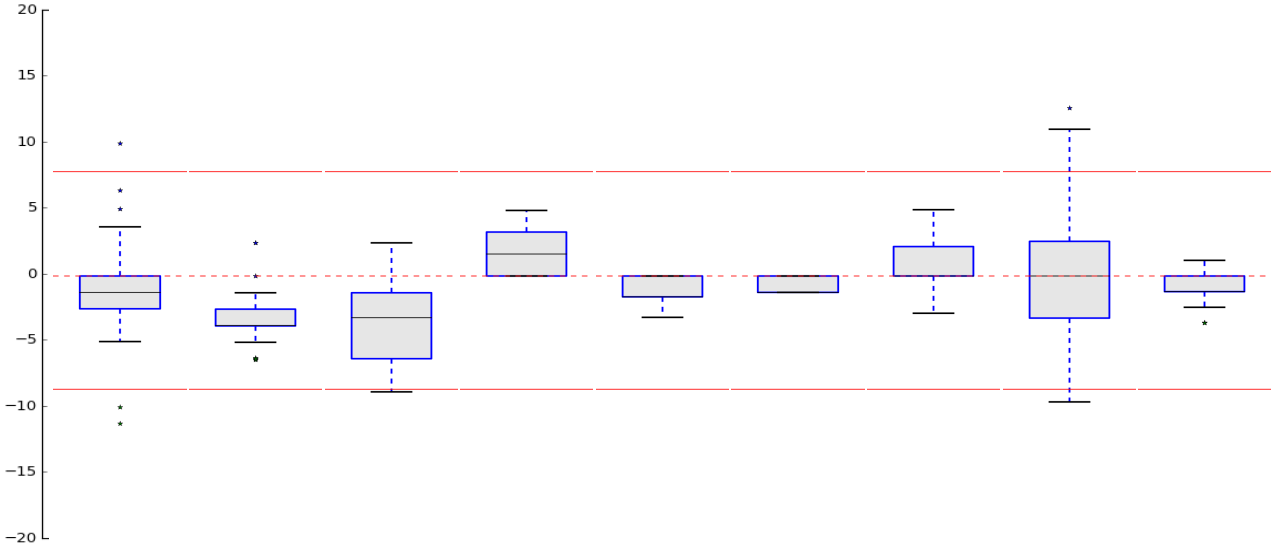
Site	06-069-0002	06-071-0001	06-071-0012	06-071-0306	06-071-1234	06-071-4001	06-077-1002	06-077-3005	06-079-0005
POC	1	1	1	1	1	1	1	1	1
CV	2.58	4.75	2.89	5.04	1.83	3.9	3.02	4.25	2.56
Bias	+2.87	+/-4.26	+5.72	+/-4.34	-1.5	+3.35	-4.76	-4.39	+4.04
# Obs	52	35	37	36	18	33	260	52	259
Method	047	087	087	087	087	087	087	087	087



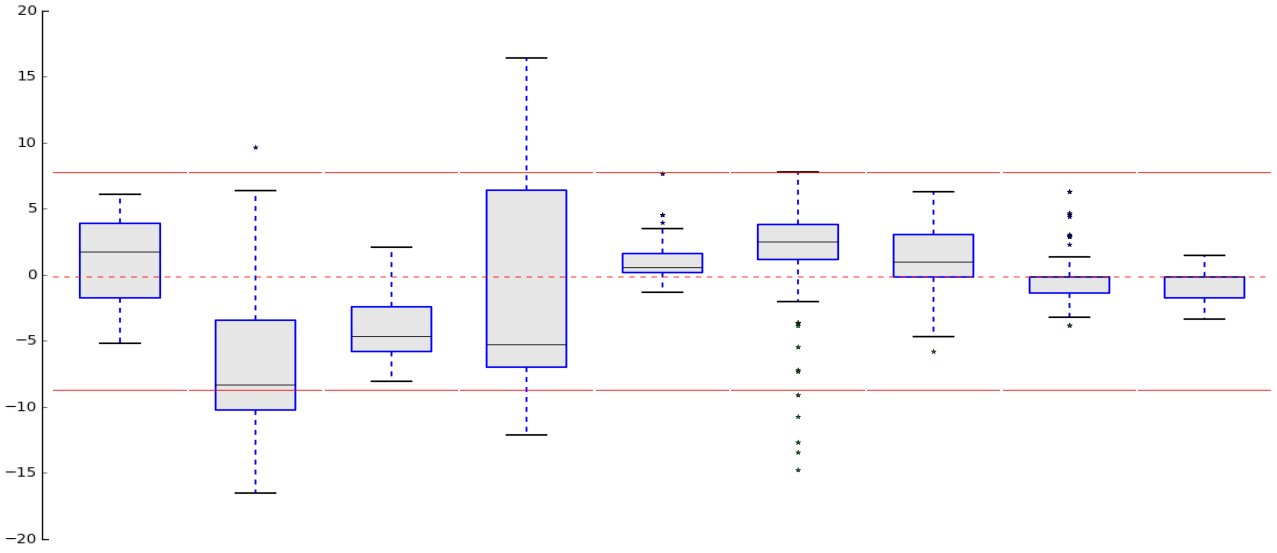
Site	06-079-2006	06-079-3001	06-079-4002	06-079-8001	06-079-8005	06-079-8006	06-083-0008	06-083-0011	06-083-1008
POC	1	1	1	1	1	1	1	1	1
CV	2.69	1.91	2.66	1.37	1.47	1.49	1.0	6.33	2.42
Bias	-3.26	+1.4	+/-2.05	+0.94	+1.13	+1.17	-0.82	+/-6.36	+1.9
# Obs	329	52	49	50	52	52	53	237	256
Method	087	087	087	087	087	087	087	087	087



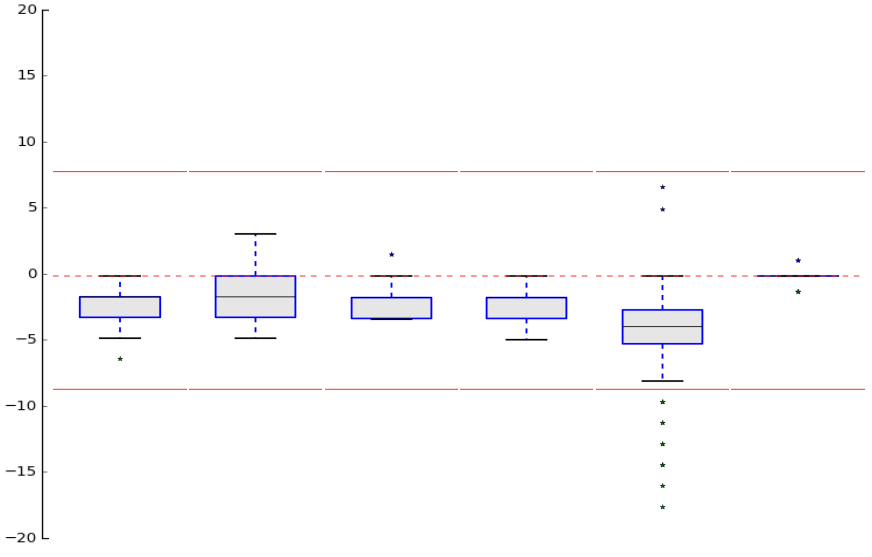
Site	06-083-2004	06-083-2011	06-083-3001	06-087-0007	06-089-0004	06-089-0007	06-089-0009	06-093-2001	06-095-3003
POC	1	1	1	1	1	1	1	1	1
CV	3.49	1.77	2.93	1.6	0.91	0.65	2.13	5.32	0.96
Bias	-2.81	-3.51	-3.8	+2.13	-1.12	-0.71	+1.68	+/-4.17	-0.89
# Obs	52	54	52	49	41	48	38	28	49
Method	087	087	087	047	087	087	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	4.16	4.75	2.59	6.89	1.71	3.39	2.87	1.68	1.02
Bias	+/-3.71	-6.99	-3.82	+/-6.42	+1.58	+3.27	+2.41	-1.12	-0.83
# Obs	28	250	52	247	46	253	51	357	53
Method	087	087	087	087	087	087	087	087	087

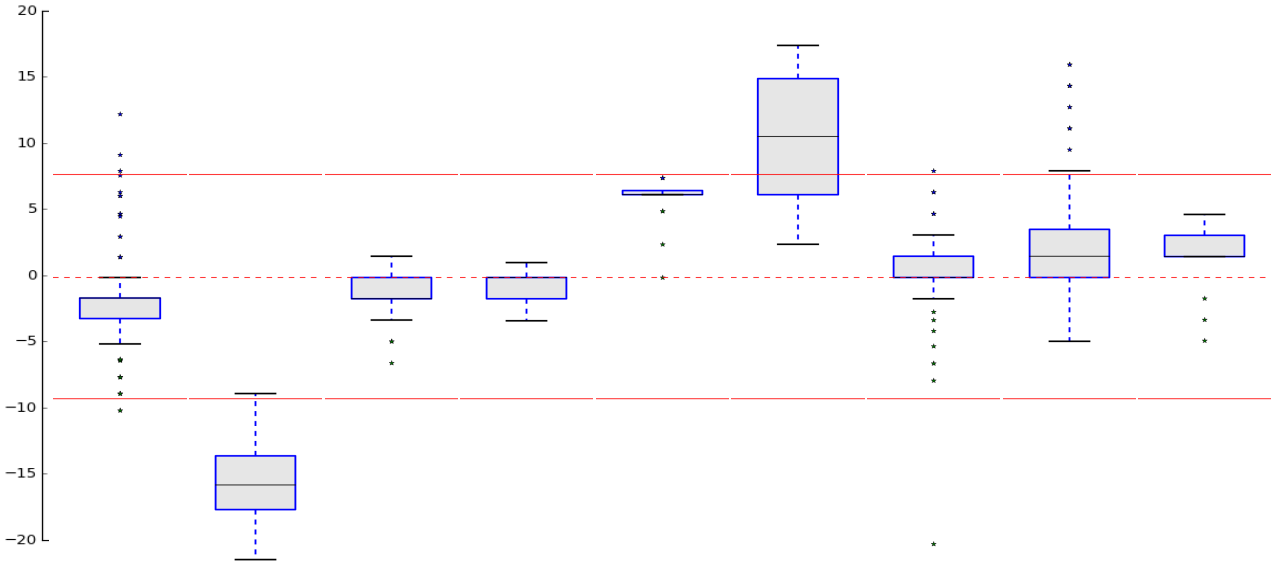


Site	06-111-0009	06-111-1004	06-111-2002	06-111-3001	06-113-0004	06-113-1003
POC	1	1	1	1	1	1
CV	1.69	1.87	1.23	1.13	3.04	0.7
Bias	-2.22	-2.11	-1.97	-2.26	-4.01	+0.47
# Obs	53	53	53	53	249	46
Method	087	087	087	087	087	087

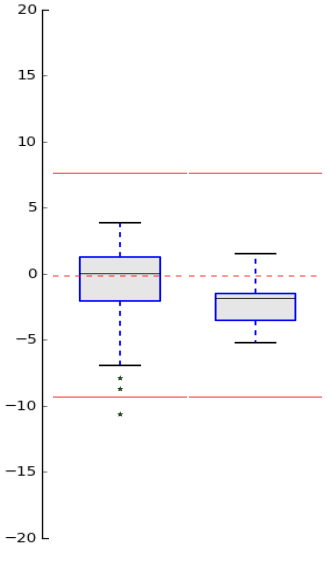


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	California Air Resources Board (0145)	Ozone	SPECIAL PURPOSE	2012	11

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	3.03	3.71	1.39	1.15	1.87	4.93	3.24	4.32	2.64
Bias	-3.05	-14.61	-1.61	-0.94	+5.85	+10.51	+2.17	+3.77	+2.6
# Obs	360	24	202	52	24	24	102	180	20
Method	087	087	087	087	047	047	087	087	047

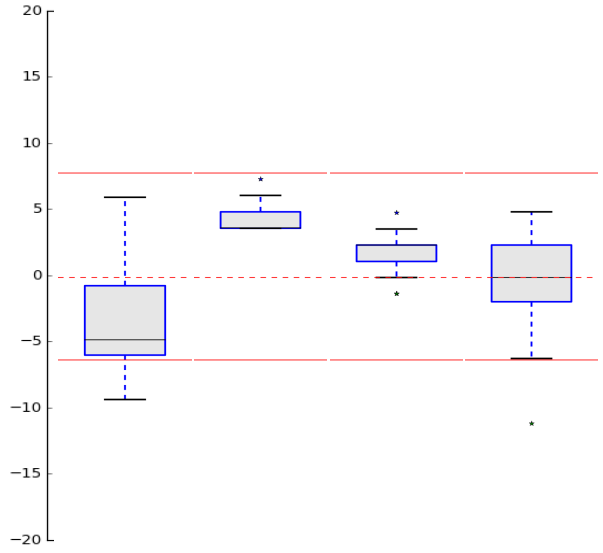


Site	06-101-0004	06-103-0004
POC	1	1
CV	2.46	1.23
Bias	+/-1.94	-1.71
# Obs	174	204
Method	087	087



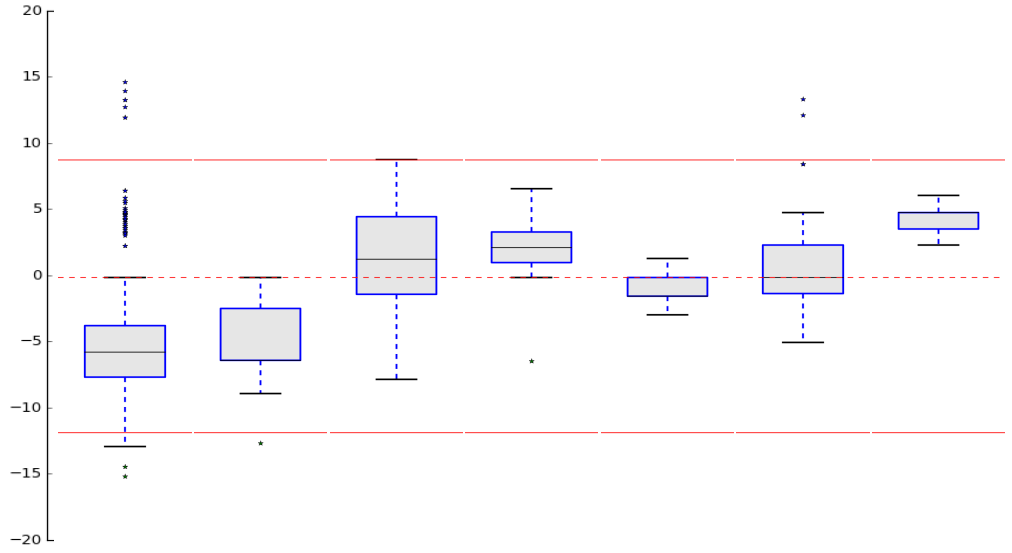
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	California Air Resources Board (0145)	Sulfur dioxide	INDUSTRIAL	2012	4

Site	06-083-1013	06-083-1020	06-083-1025	06-083-4003
POC	1	2	1	1
CV	5.1	1.09	1.49	3.14
Bias	-5.04	+4.28	+2.07	+/-2.45
# Obs	27	26	51	51
Method	100	060	060	100



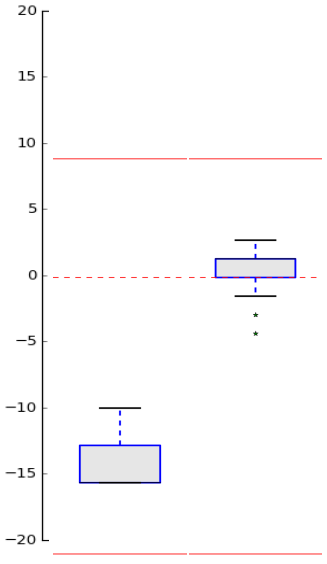
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	California Air Resources Board (0145)	Sulfur dioxide	SLAMS	2012	7

Site	06-025-0005	06-067-0006	06-071-0306	06-071-1234	06-079-2004	06-083-0008	06-083-2004
POC	1	1	1	1	1	1	1
CV	5.22	3.58	4.23	3.2	0.93	3.76	1.06
Bias	-5.72	-5.17	+/-3.69	+3.38	-1.12	+/-2.82	+3.91
# Obs	231	24	36	19	52	52	51
Method	009	600	077	077	009	060	100



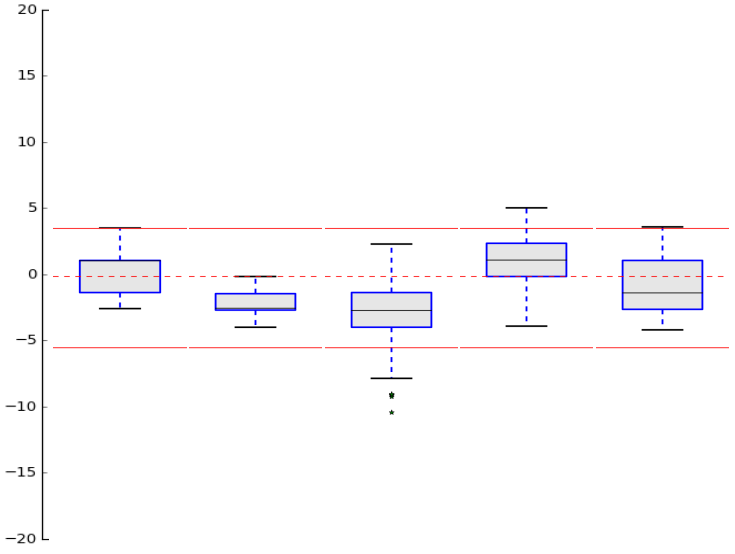
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	California Air Resources Board (0145)	Sulfur dioxide	SPECIAL PURPOSE	2012	2

Site	06-023-1004	06-023-1005
POC	1	1
CV	2.37	1.89
Bias	-13.09	+1.61
# Obs	20	24
Method	060	060



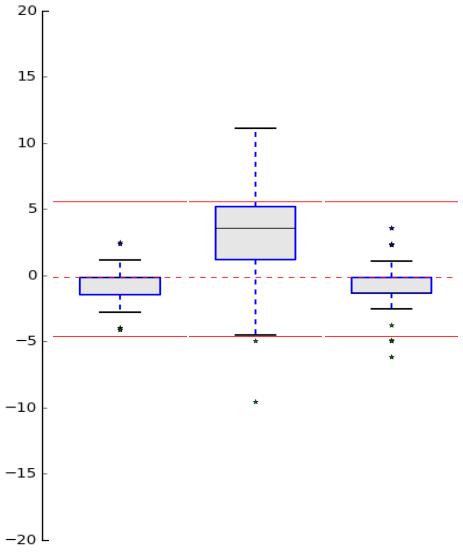
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	National Park Service (0745)	Ozone	CASTNET	2012	5

Site	06-043-0003	06-069-0003	06-071-9002	06-089-3003	06-107-0009
POC	1	1	1	1	1
CV	1.29	0.66	2.37	1.29	1.77
Bias	+/-1.18	-1.86	-3.08	+1.34	+/-1.62
# Obs	351	358	363	358	363
Method	047	047	047	047	047



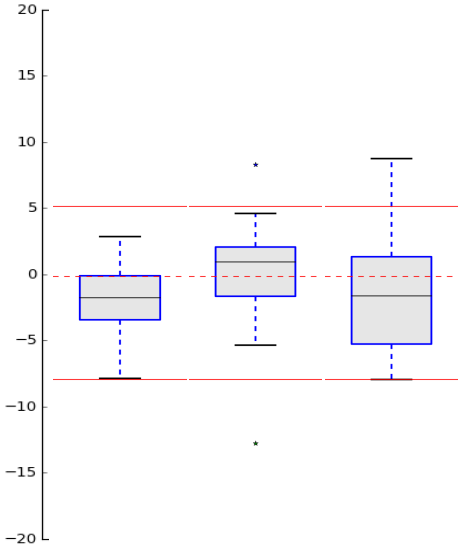
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	National Park Service (0745)	Ozone	NON-EPA FEDERAL	2012	3

Site	06-027-0101	06-065-0008	06-107-0006
POC	1	1	1
CV	1.16	2.64	1.44
Bias	-0.98	+3.6	-1.12
# Obs	363	270	357
Method	047	901	047



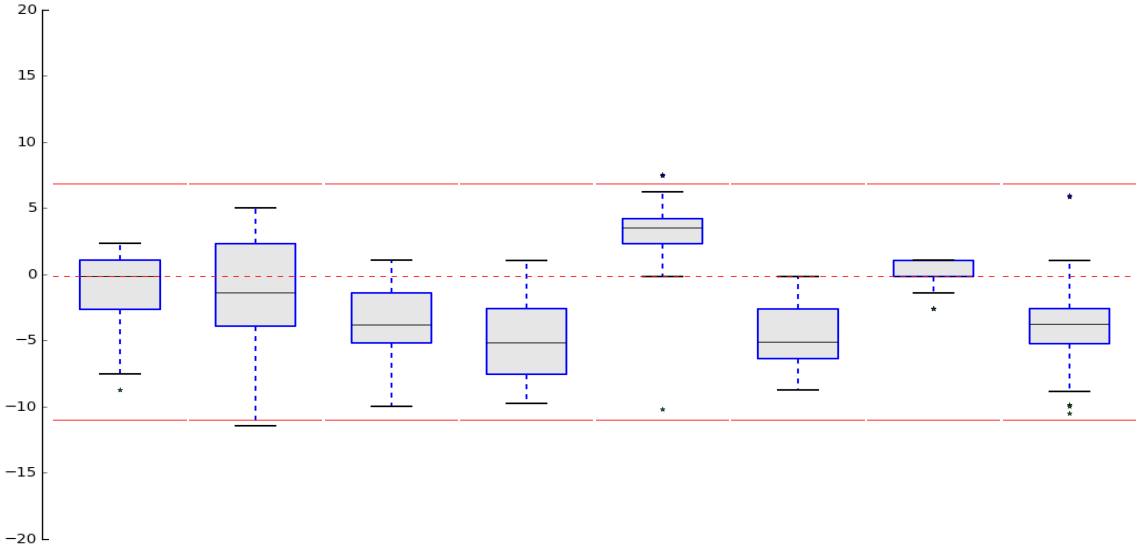
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	San Diego County Air Pollution Control District (0942)	Carbon monoxide	SLAMS	2012	3

Site	06-073-0003	06-073-1002	06-073-1010
POC	3	1	1
CV	2.26	4.43	5.27
Bias	+/-2.35	+/-3.52	+/-4.49
# Obs	89	27	26
Method	554	054	054



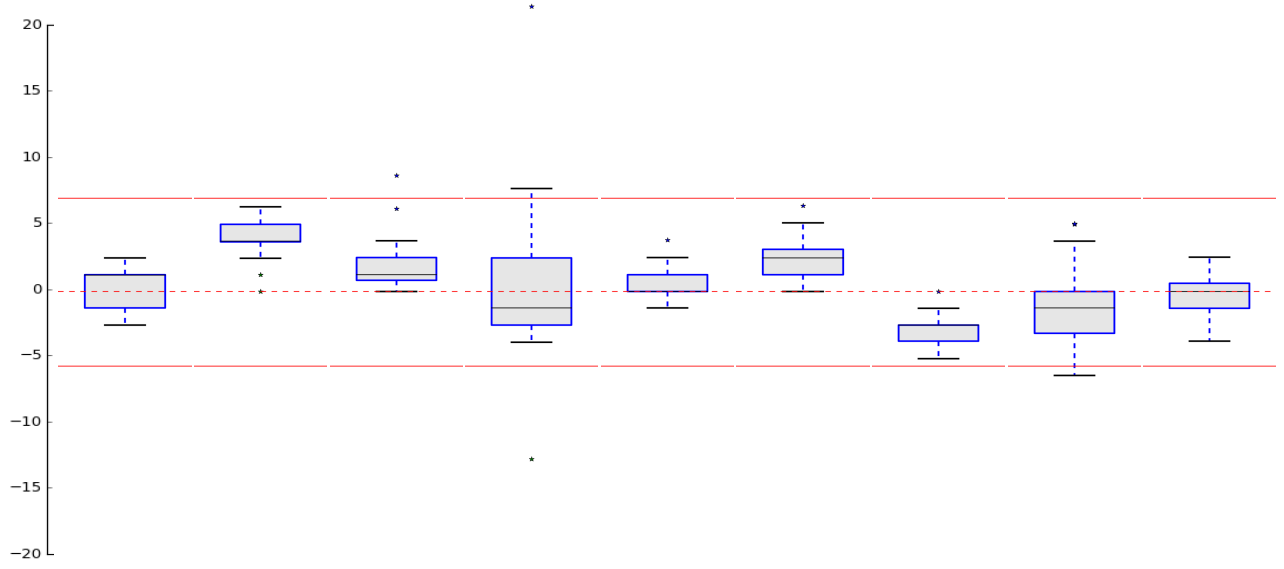
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	San Diego County Air Pollution Control District (0942)	Nitrogen dioxide (NO2)	SLAMS	2012	8

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	8.01	4.1	3.12	3.37	3.55	2.56	1.52	4.61
Bias	+/-5.09	+/-3.54	-3.82	-5.26	+4.12	-4.57	+1.18	-4.86
# Obs	27	90	27	27	27	26	22	26
Method	074	074	074	099	074	074	074	074



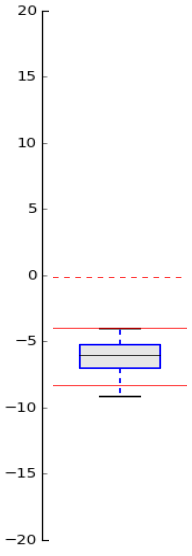
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	San Diego County Air Pollution Control District (0942)	Ozone	SLAMS	2012	9

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	1.63	1.6	2.28	6.44	1.3	1.62	1.23	3.55	1.41
Bias	+/-1.43	+4.2	+2.23	+/-4.77	+1.1	+2.82	-3.05	-2.94	+/-1.09
# Obs	27	27	24	27	27	27	26	23	27
Method	047	047	047	047	047	047	047	047	047



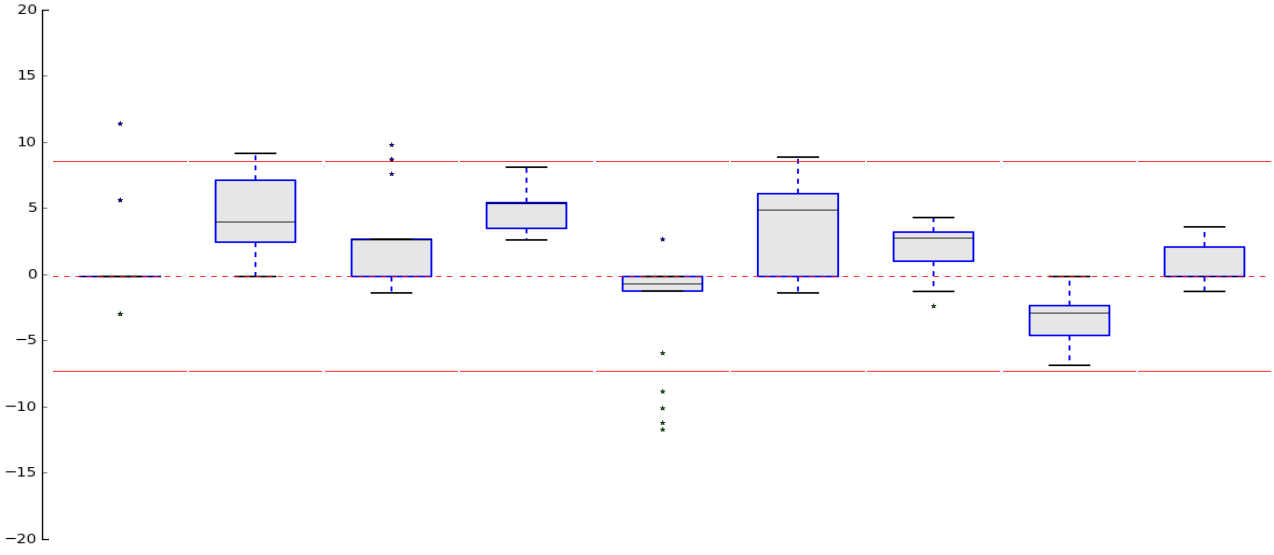
Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	San Diego County Air Pollution Control District (0942)	Sulfur dioxide	SLAMS	2012	1

Site	06-073-0003
POC	3
CV	1.09
Bias	-5.5
# Obs	85
Method	560

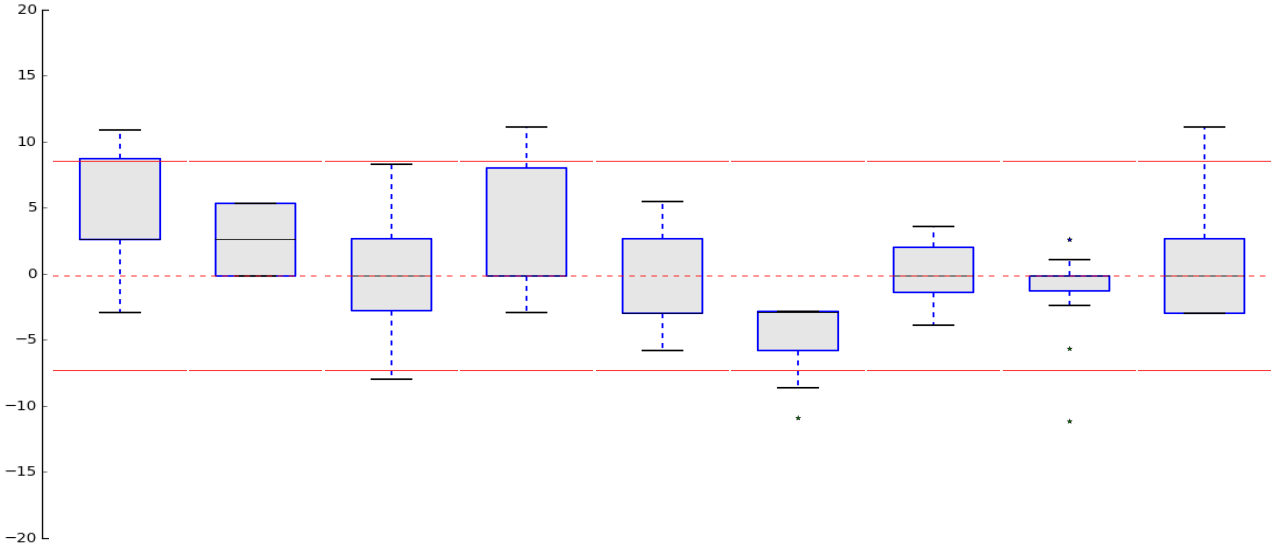


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	South Coast Air Quality Management District (0972)	Carbon monoxide	SLAMS	2012	26

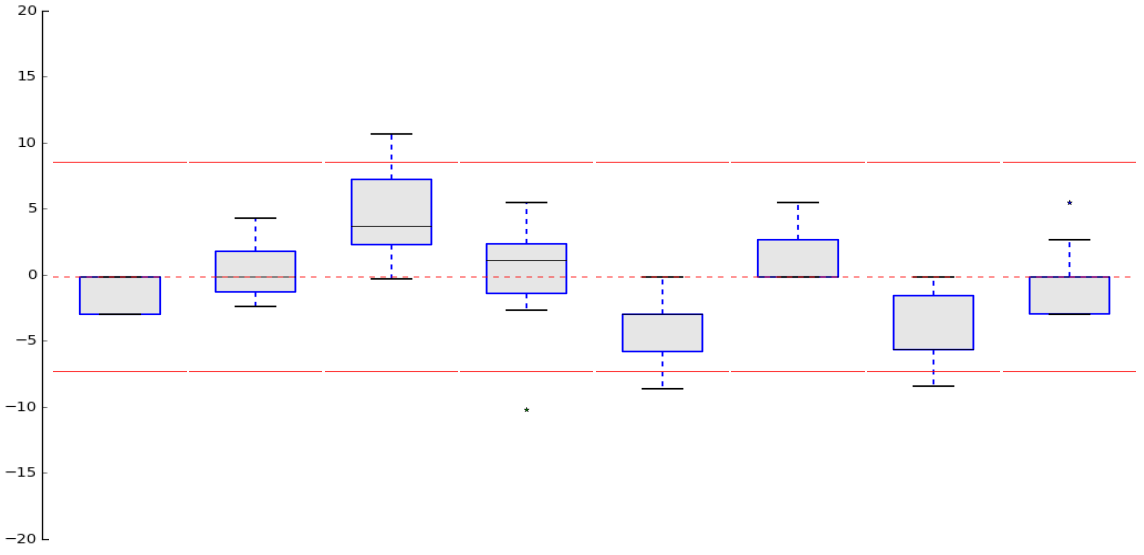
Site	06-037-0002	06-037-0016	06-037-0113	06-037-1002	06-037-1103	06-037-1201	06-037-1302	06-037-1602	06-037-1701
POC	1	2	1	1	1	1	1	1	1
CV	4.2	2.99	3.83	1.82	4.33	3.78	1.94	2.08	1.57
Bias	+2.91	+5.1	+3.87	+5.0	-3.2	+4.76	+2.55	-3.26	+1.38
# Obs	26	26	26	26	26	26	26	26	26
Method	158	158	106	158	158	106	158	158	106



Site	06-037-4002	06-037-4006	06-037-5005	06-037-6012	06-059-0007	06-059-1003	06-059-2022	06-059-5001	06-065-1003
POC	1	1	1	1	1	1	1	1	1
CV	4.51	3.14	3.84	5.29	4.47	2.83	2.4	2.97	4.42
Bias	+5.71	+3.35	+/-3.04	+4.61	+/-3.77	-4.9	+/-1.94	-2.05	+/-3.39
# Obs	26	15	26	26	26	26	26	26	26
Method	158	158	106	106	158	106	106	106	106

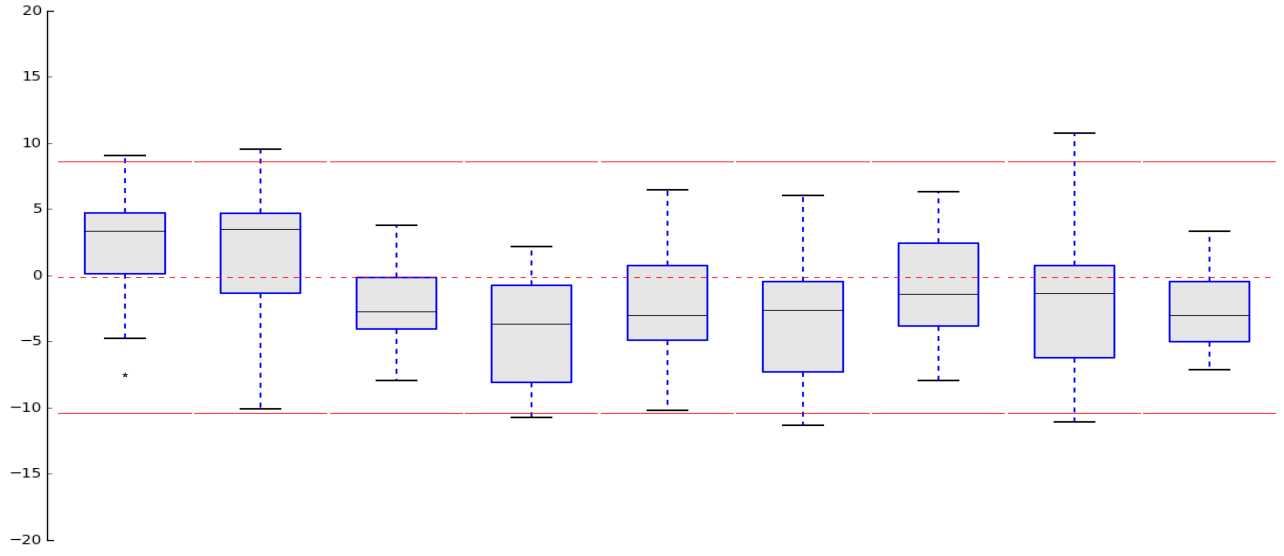


Site	06-065-5001	06-065-8001	06-065-8001	06-065-8005	06-065-9001	06-071-1004	06-071-2002	06-071-9004
POC	1	1	9	1	1	1	1	1
CV	1.55	2.2	3.6	3.52	2.58	1.8	2.69	2.81
Bias	-1.48	+/-1.79	+5.33	+/-2.87	-3.97	+1.65	-4.13	-2.16
# Obs	26	26	24	26	26	26	26	26
Method	106	158	593	106	106	106	106	158

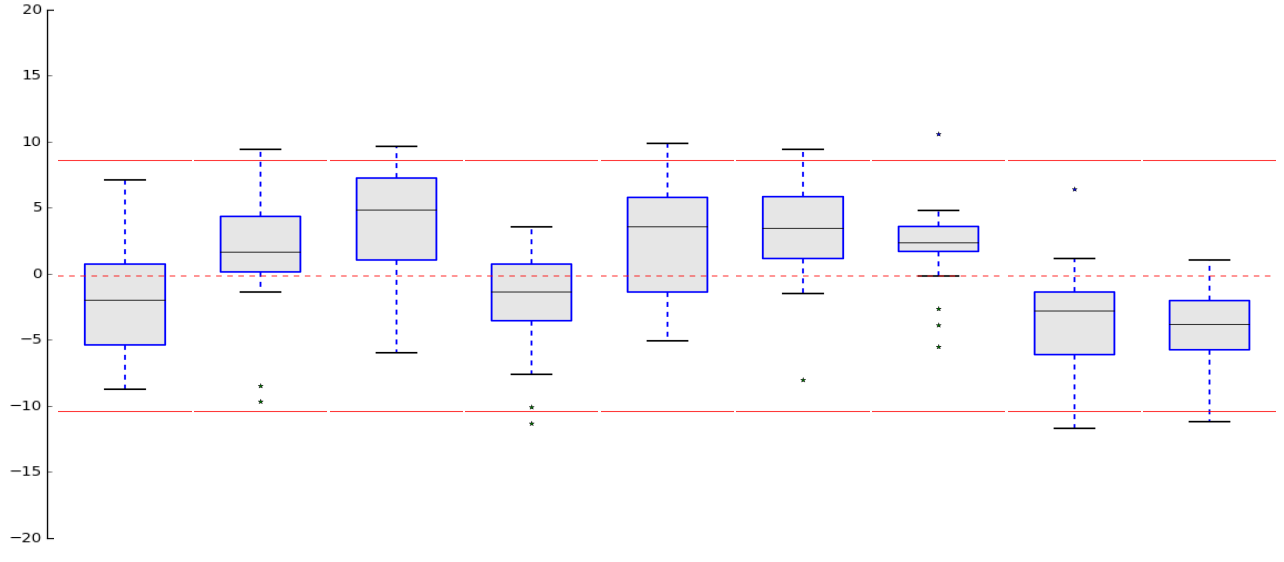


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	South Coast Air Quality Management District (0972)	Nitrogen dioxide (NO2)	SLAMS	2012	25

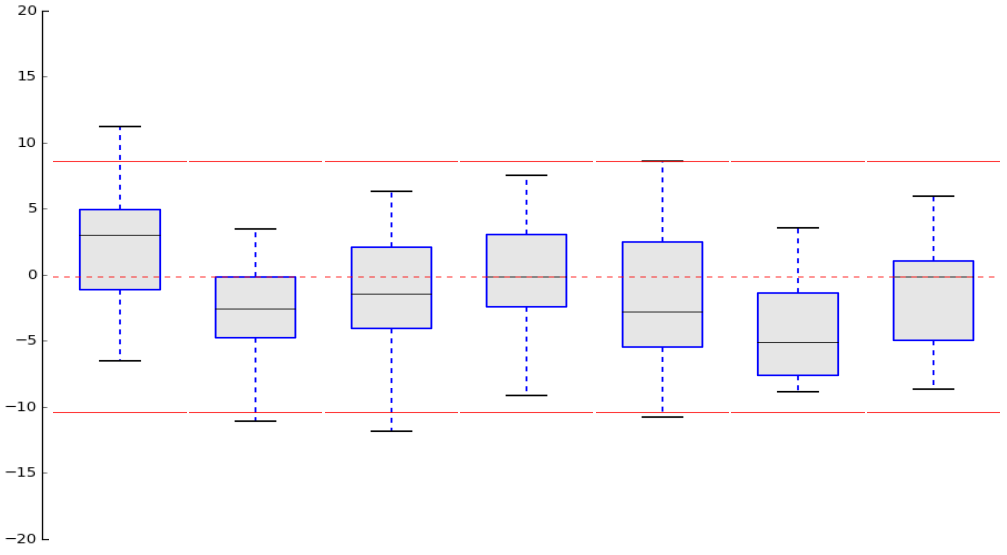
Site	06-037-0002	06-037-0016	06-037-0113	06-037-1002	06-037-1103	06-037-1201	06-037-1302	06-037-1602	06-037-1701
POC	2	1	1	2	1	2	1	1	2
CV	4.23	5.28	3.52	4.58	4.85	5.09	4.55	6.37	3.26
Bias	+4.27	+/-4.68	-3.38	-5.29	+/-4.52	-5.05	+/-3.82	+/-5.37	-3.56
# Obs	26	25	25	22	22	26	24	22	26
Method	074	074	074	074	074	074	074	074	099



Site	06-037-4002	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	2	1	1	1	5	1	2	1	3
CV	5.45	6.36	4.81	4.15	4.57	4.27	3.64	4.65	3.37
Bias	+/-4.54	+5.13	+5.39	+/-3.44	+/-4.41	+4.67	+3.75	-4.88	-4.34
# Obs	18	14	24	26	26	21	23	23	23
Method	074	074	074	099	099	074	074	074	074

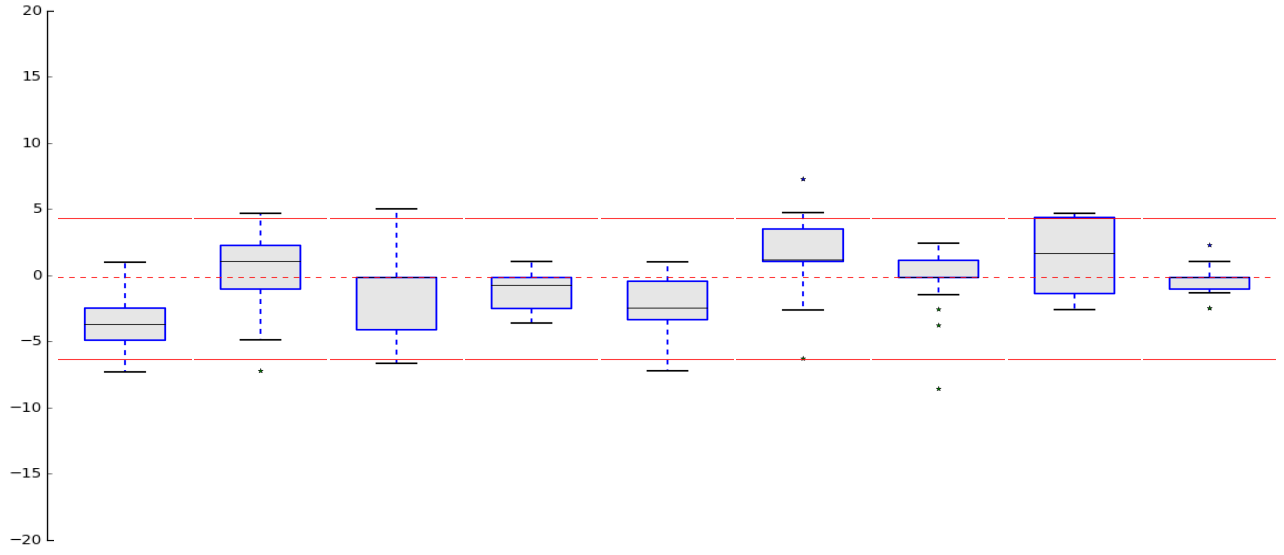


Site	06-065-5001	06-065-8001	06-065-8005	06-065-9001	06-071-1004	06-071-2002	06-071-9004
POC	2	2	1	1	2	1	1
CV	5.21	4.23	5.76	4.42	5.57	4.57	4.14
Bias	+/-4.79	-4.14	+/-4.77	+/-3.45	+/-4.85	-5.21	+/-3.44
# Obs	26	26	22	26	25	25	25
Method	074	074	074	074	074	099	074

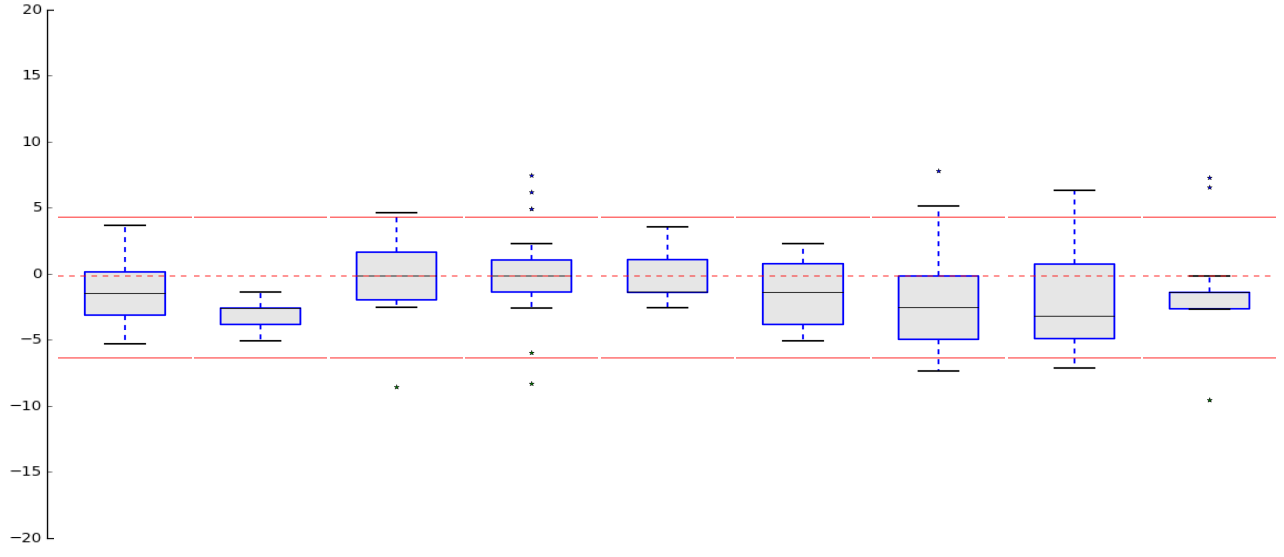


Region	State	PQAO	Parameter	Monitor Type	Year	Monitors in Group
09	CA	South Coast Air Quality Management District (0972)	Ozone	SLAMS	2012	31

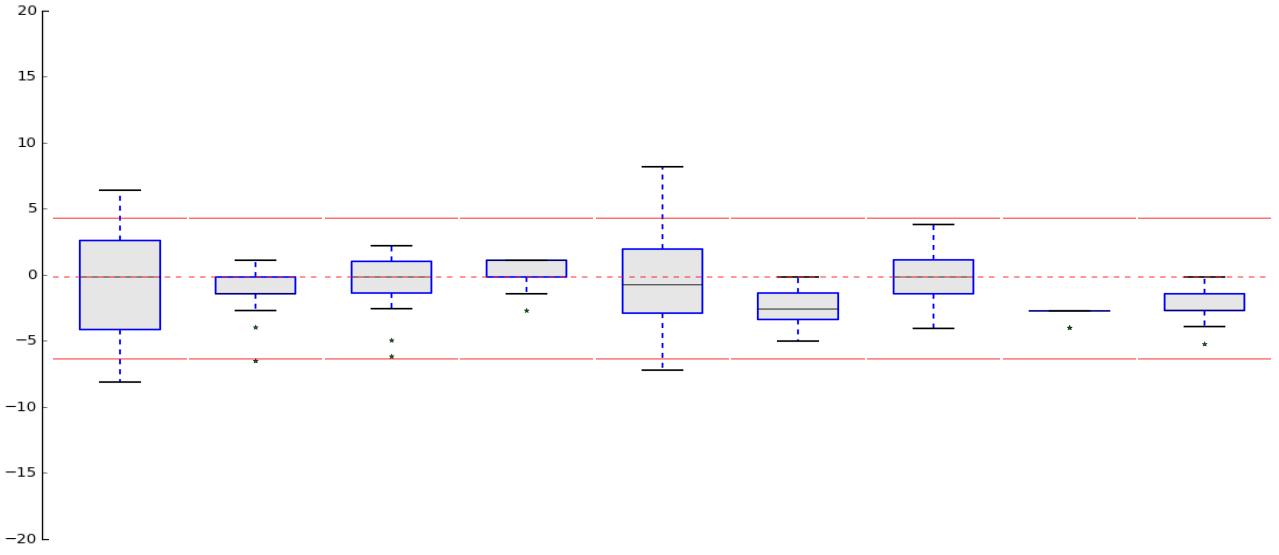
Site	06-037-0002	06-037-0016	06-037-0113	06-037-1002	06-037-1103	06-037-1201	06-037-1302	06-037-1602	06-037-1701
POC	1	1	1	1	1	1	1	1	1
CV	2.22	3.06	3.33	1.7	1.98	3.15	2.45	2.92	1.28
Bias	-3.65	+/-2.44	-2.75	-1.56	-2.3	+3.02	+1.76	+/-2.77	-0.94
# Obs	26	26	25	26	26	25	25	26	26
Method	087	087	087	087	087	087	047	087	087



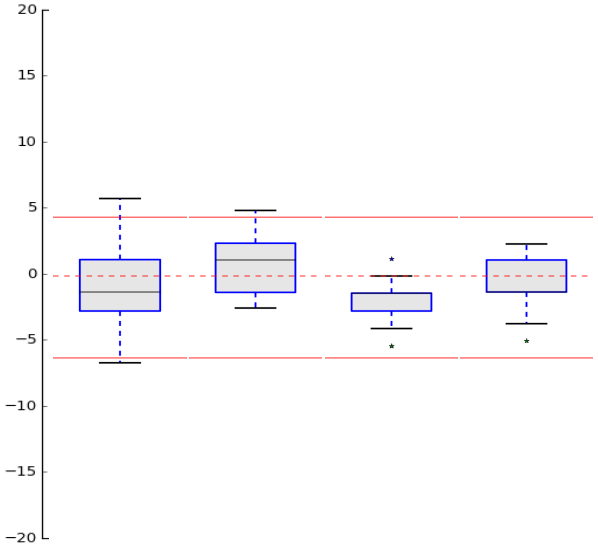
Site	06-037-2005	06-037-4002	06-037-4006	06-037-5005	06-037-6012	06-059-0007	06-059-1003	06-059-2022	06-059-5001
POC	1	1	1	1	1	1	1	1	1
CV	2.83	1.16	3.63	3.63	1.95	2.34	4.32	3.92	3.69
Bias	+/-2.69	-2.73	+/-2.73	+/-2.73	+/-1.66	+/-2.26	-3.96	+/-3.72	-2.98
# Obs	24	26	15	26	26	26	26	26	26
Method	087	087	047	087	087	047	087	087	047



Site	06-065-0012	06-065-0016	06-065-2002	06-065-5001	06-065-6001	06-065-8001	06-065-8005	06-065-9001	06-071-0005
POC	1	1	1	1	1	1	1	1	1
CV	4.87	2.14	2.05	1.05	3.69	1.36	2.14	0.46	1.4
Bias	+/-4.03	-1.88	+/-1.5	+0.98	+/-3.0	-2.39	+/-1.64	-2.53	-2.19
# Obs	24	26	26	26	26	26	26	26	26
Method	087	087	087	087	047	087	087	047	047

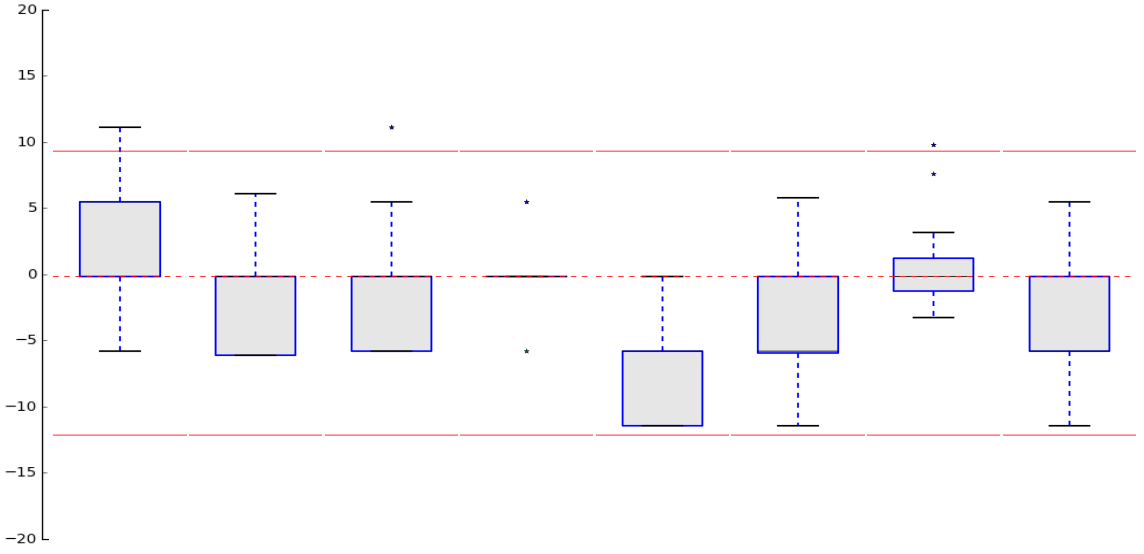


Site	06-071-1004	06-071-2002	06-071-4003	06-071-9004
POC	2	1	1	1
CV	3.62	2.09	1.89	1.81
Bias	+/-2.98	+/-1.84	-2.32	+/-1.54
# Obs	26	26	26	26
Method	087	087	087	087



REGION	STATE	PQAO	PARAMETER	MONITOR TYPE	YEAR	MONITORS IN GROUP
09	CA	South Coast Air Quality Management District (0972)	Sulfur dioxide	SLAMS	2012	8

Site	06-037-1002	06-037-1103	06-037-4002	06-037-4006	06-037-5005	06-059-1003	06-065-8001	06-071-2002
POC	2	9	2	1	1	1	9	1
CV	5.21	5.07	5.78	3.07	5.06	6.59	3.97	4.42
Bias	+5.41	-4.05	-4.67	+1.94	-8.1	-6.3	+/-2.99	-5.17
# Obs	26	21	26	15	17	23	24	22
Method	560	560	560	560	560	560	560	560



APPENDIX F

REFERENCES

This page intentional left blank.

References

1. Quality Assurance Handbook for Air Pollution Measurement Systems. Volume I: A Field Guide to Environmental Quality Assurance, EPA-600/R-34/038a, April 1994.

2. Quality Assurance Handbook for Air Pollution Measurement Systems. Volume II: Ambient Air Quality Monitoring Program, EPA-454/B-13-003, May 2013.

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

4. Air Monitoring Quality Assurance Manual. Volume I. Quality Assurance Plan for Ambient Air Monitoring, Monitoring and Laboratory Division, California Air Resources Board, July 2013.