Clean Air Status and Trends Network

Quarterly Data Summary for Fourth Quarter 2025 (October through December)

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Introduction

This quarterly report summarizes the Clean Air Status and Trends Network (CASTNET) data collected during fourth quarter 2025. Trends in pollutants measured at eastern and western reference sites are shown. Results from the quality assurance/quality control (QA/QC) program are presented for fourth quarter data and include completeness and precision of filter concentrations and hourly ozone (O_3) concentrations. This report also analyzes data for continuous, trace-level total reactive oxides of nitrogen (NO_y) from the five sites that were operational during fourth quarter. Other QC statistics are given in the CASTNET Fourth Quarter 2025 Quality Assurance Report (WSP, 2026).

Figure 1. Fourth Highest Daily Maximum 8-hour Average O_3 Concentrations (ppb) for 2025

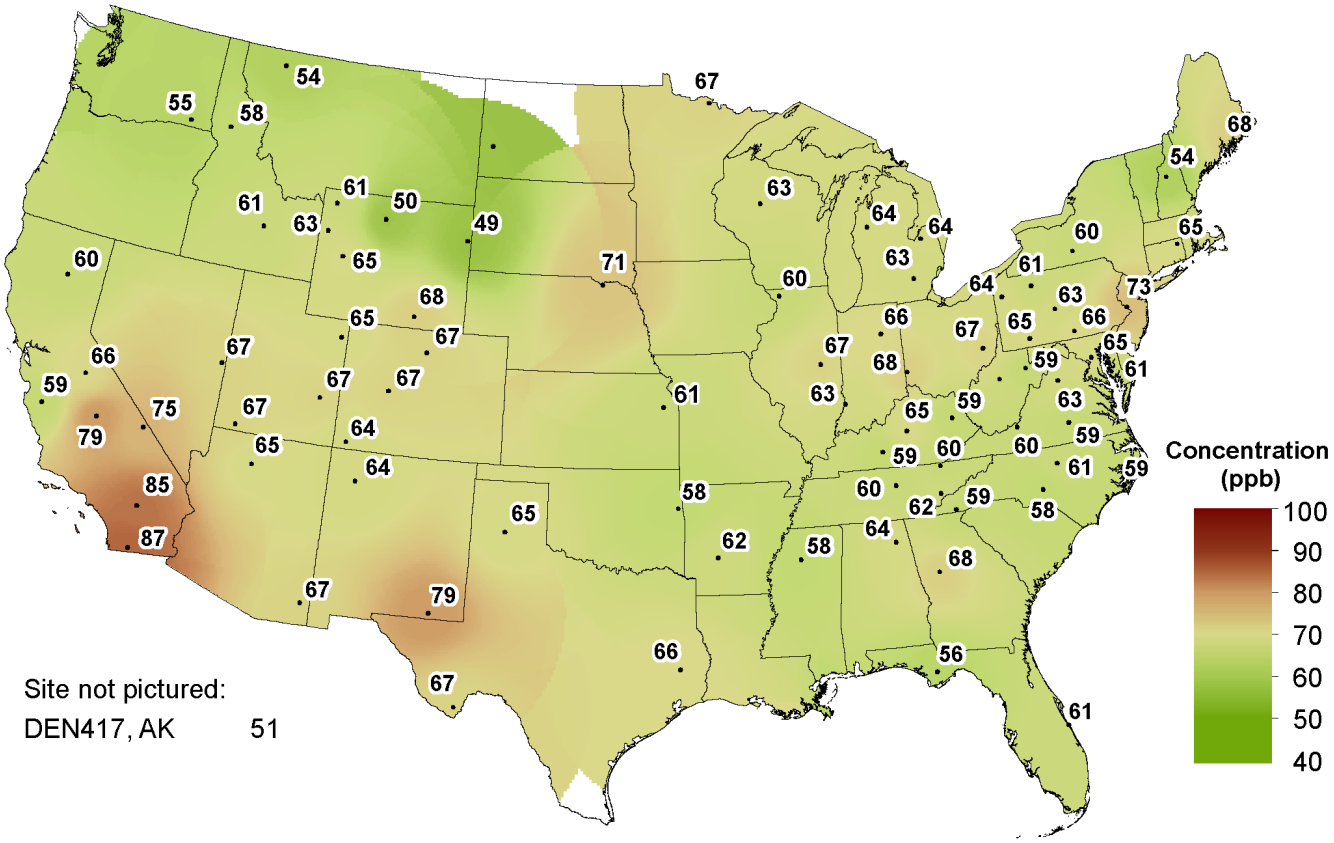


Figure 1 shows fourth highest daily maximum 8-hour average (DM8A) O_3 concentrations in parts per billion (ppb) measured through fourth quarter 2025. Seven sites exceeded the 0.070 parts per million (70 ppb in practice) National Ambient Air Quality Standards for O_3. In the past five years the number of sites with exceedances ranged from 5 to 18.

Trends

Fourth Quarter Concentrations

Trend analyses were performed based on filter pack pollutant concentrations measured in micrograms per cubic meter ($\mu g/m^3$) of air at the 27 eastern and 16 western reference sites during fourth quarter. Quarterly concentrations of nitric acid (HNO_3), nitrate (NO_3^-), ammonium (NH_4^+), total NO_3^-, sulfate (SO_4^{2-}), chloride (Cl^-), calcium (Ca^{2+}), potassium (K^+), magnesium (Mg^{2+}), sodium (Na^+), and O_3 concentrations were analyzed using box plots. Plots were constructed by averaging all valid concentrations for all eastern and western reference sites. The percent change in fourth quarter mean filter pack concentrations and O_3 concentrations at eastern and western reference sites from 2024 to 2025 are shown in Table 1. Trends in quarterly mean filter pack and O_3 concentrations are shown using box plots in Figures 2 through 12.

Table 1. Percent Change in Concentrations from Fourth Quarter 2024 to Fourth Quarter 2025

	O_3	Total NO_3^-	NH_4^+	SO_4^{2-}	Ca^{2+}	K^+	Mg^{2+}	Na^+	Cl^-
Eastern	0	9	17	1	-25	-10	-21	2	-3
Western	-7	-13	-17	-5	-24	-22	-21	-5	-22

Figure 2. Trends in Fourth Quarter Mean HNO_3 Concentrations

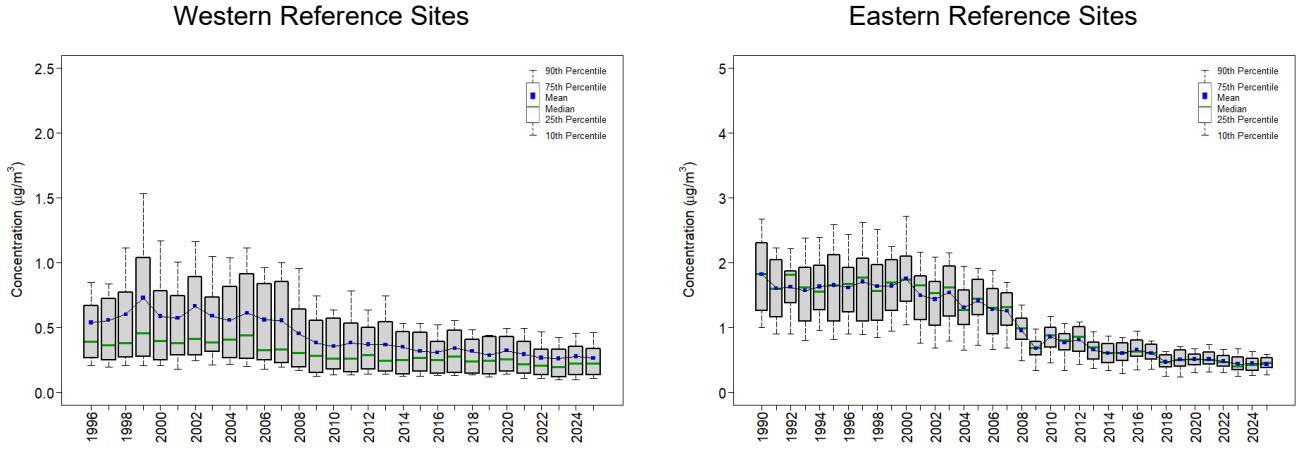
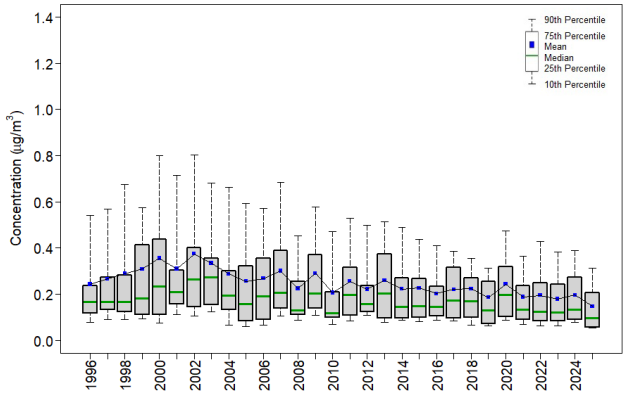


Figure 3. Trends in Fourth Quarter Mean NO_3^- Concentrations

Western Reference Sites



Eastern Reference Sites

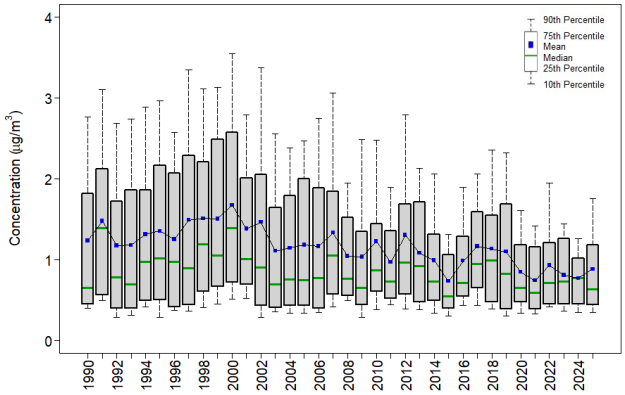
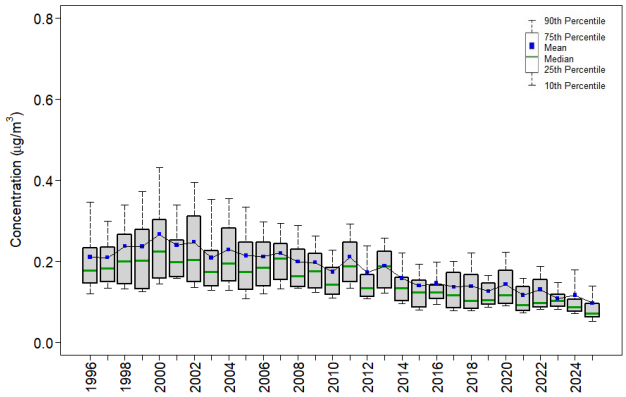


Figure 4. Trends in Fourth Quarter Mean NH_4^+ Concentrations

Western Reference Sites



Eastern Reference Sites

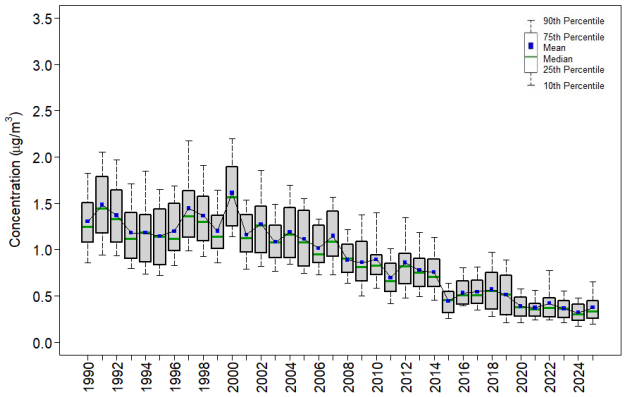
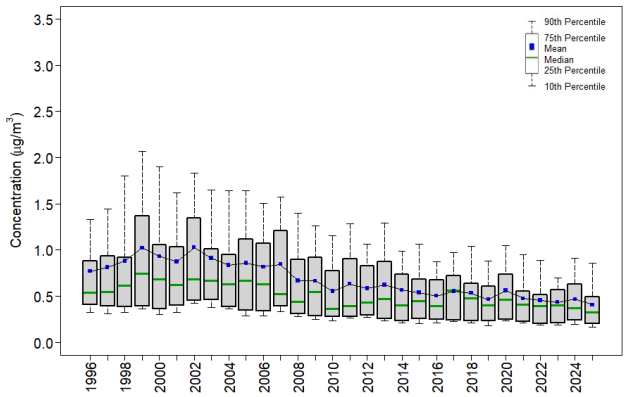


Figure 5. Trends in Fourth Quarter Mean Total NO_3^- Concentrations

Western Reference Sites



Eastern Reference Sites

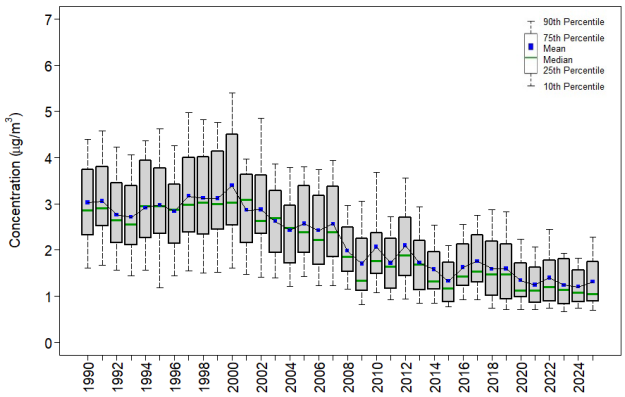
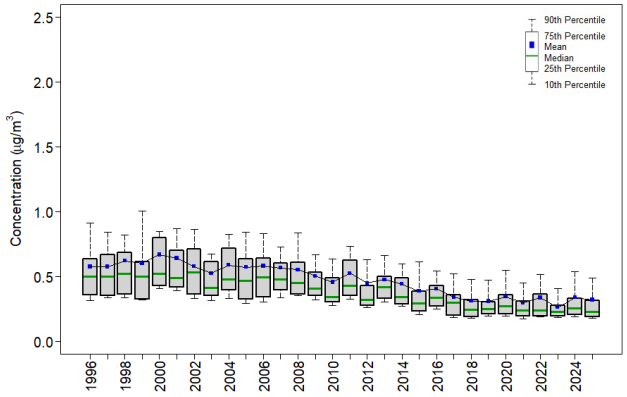


Figure 6. Trends in Fourth Quarter Mean SO_4^{2-} Concentrations

Western Reference Sites



Eastern Reference Sites

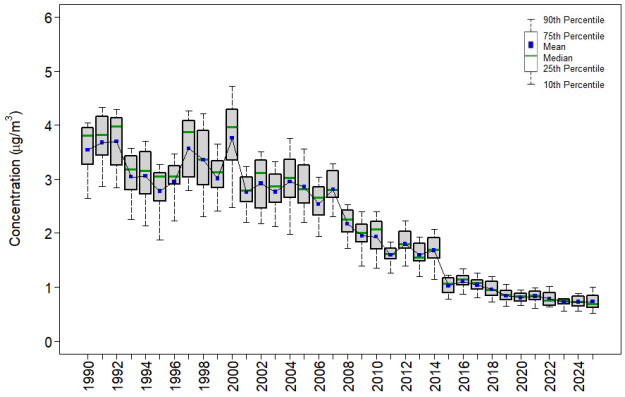
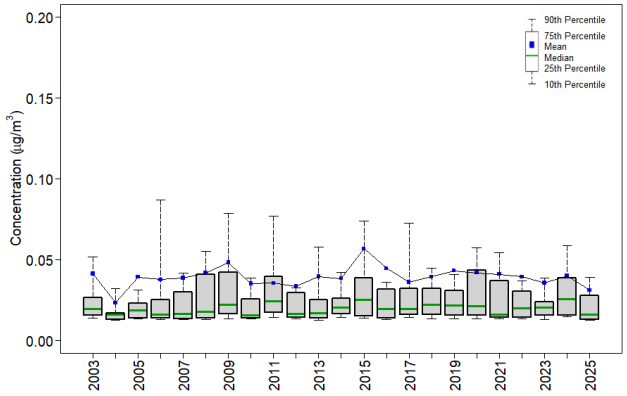


Figure 7. Trends in Fourth Quarter Mean Cl^- Concentrations

Western Reference Sites



Eastern Reference Sites

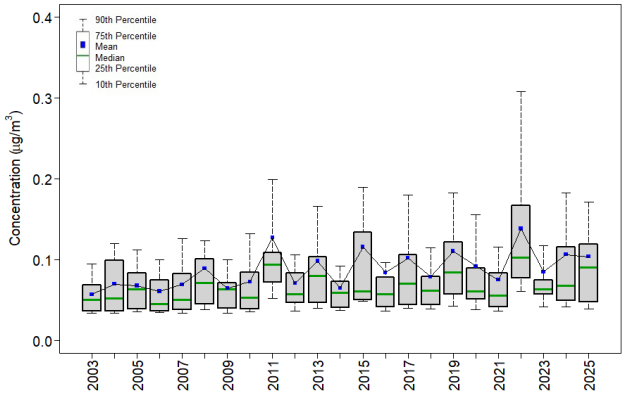
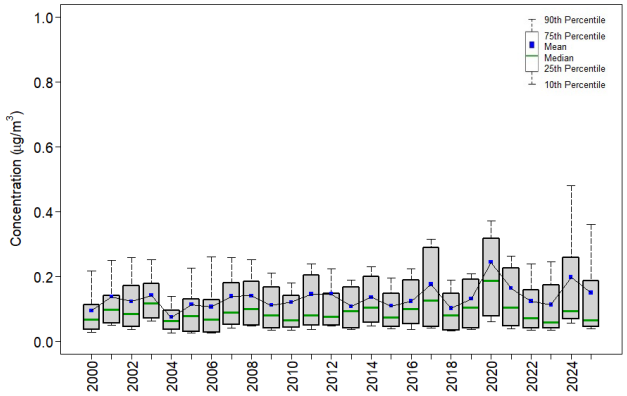


Figure 8. Trends in Fourth Quarter Mean Ca^{2+} Concentrations

Western Reference Sites



Eastern Reference Sites

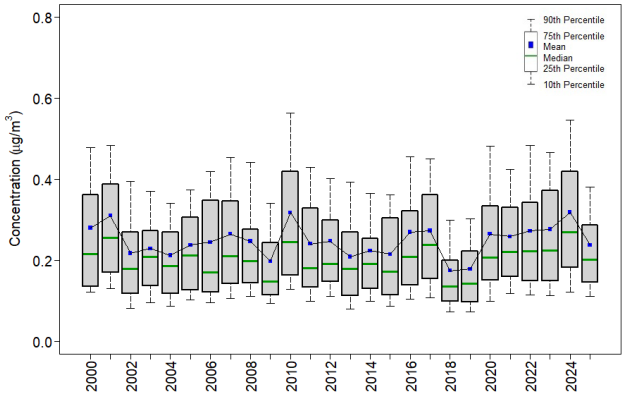
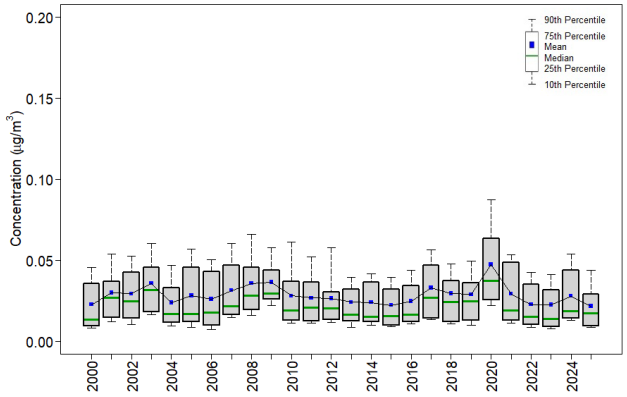


Figure 9. Trends in Fourth Quarter Mean K^+ Concentrations

Western Reference Sites



Eastern Reference Sites

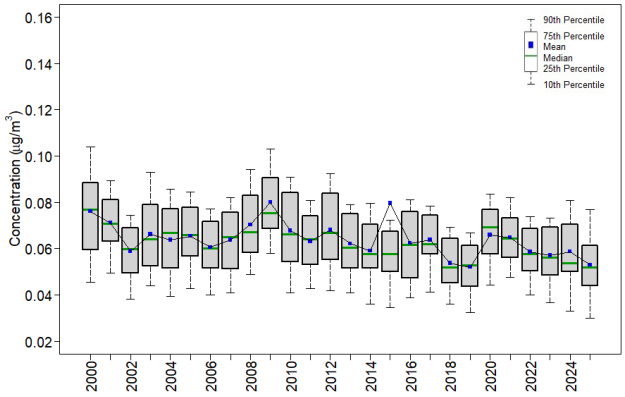
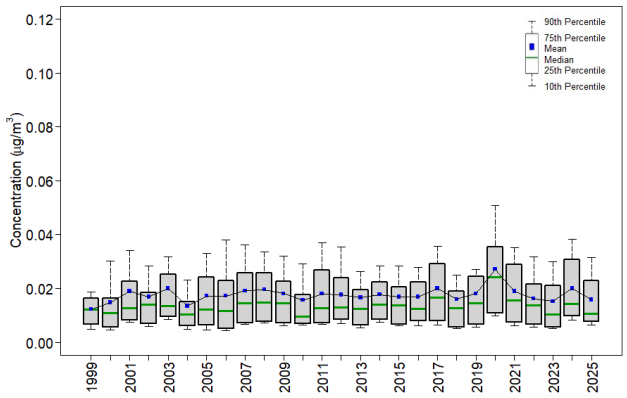


Figure 10. Trends in Fourth Quarter Mean Mg^{2+} Concentrations

Western Reference Sites



Eastern Reference Sites

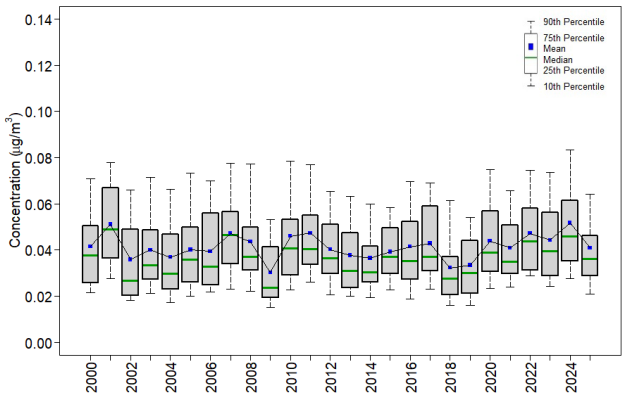
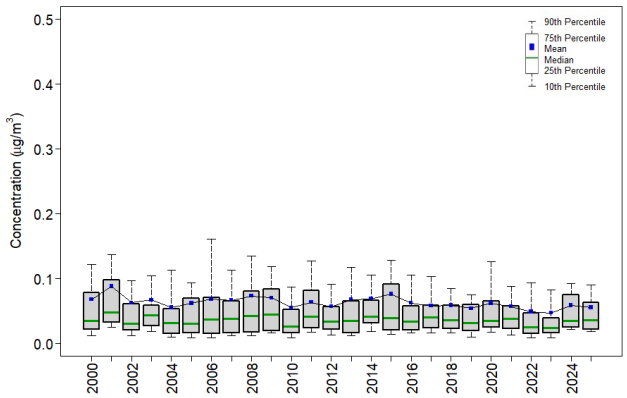


Figure 11. Trends in Fourth Quarter Mean Na^+ Concentrations

Western Reference Sites



Eastern Reference Sites

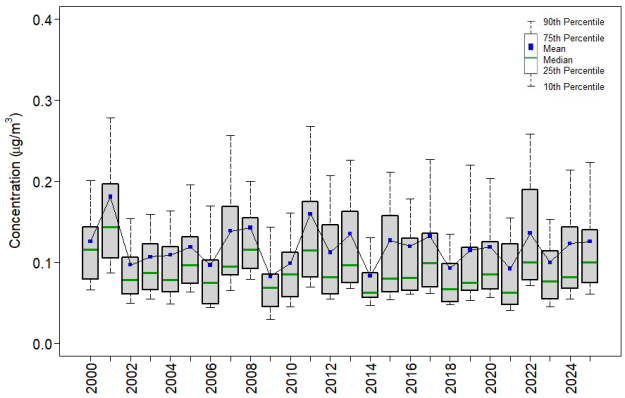
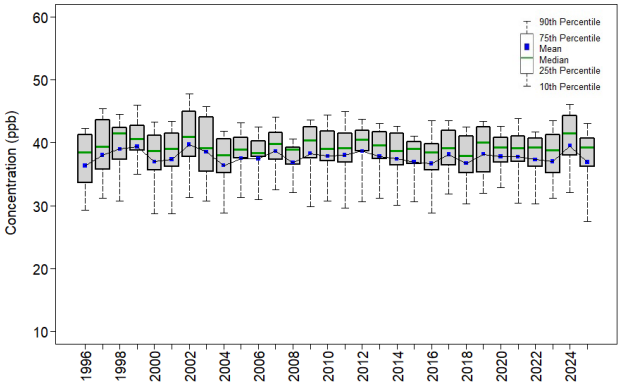
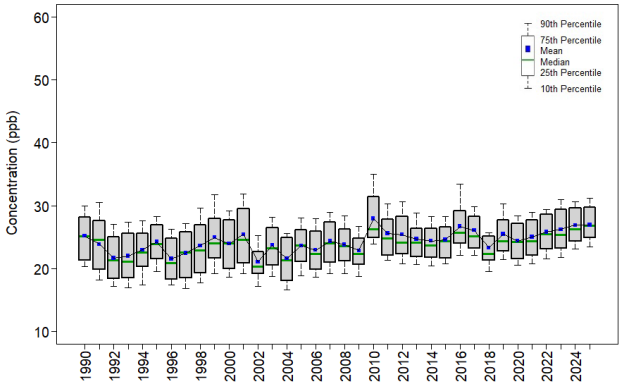


Figure 12. Trends in Fourth Quarter Mean O_3 Concentrations

Western Reference Sites



Eastern Reference Sites



Changes in Three-Year Average Fourth Quarter Concentrations

Tables 2 and 3 summarize changes in three-year averages of quarterly mean concentrations of O_3, total NO_3^-, NH_4^+, and SO_4^{2-} over the period 1990–1992 and 2023–2025 for the eastern reference sites and 1996–1998 through 2023–2025 for the western reference sites. Changes in Ca^{2+}, K^+, Mg^{2+}, Na^+ and Cl^- concentrations are shown from 2004–2006 through 2023–2025.

Table 2. Eastern Reference Sites: Three-Year Mean Values (ppb or µg/m^3)

	O_3 (ppb)	Total NO_3^-	NH_4^+	SO_4^{2-}	Ca^{2+}	K^+	Mg^{2+}	Na^+	Cl^-
1990–1992	24	2.9	1.4	3.6					
2004–2006					0.23	0.06	0.04	0.11	0.07
2023–2025	27	1.3	0.4	0.7	0.28	0.06	0.05	0.12	0.10
Percent Change	13	-58	-75	-80	19	-11	18	10	49

Note: Ozone concentrations are given as ppb. Concentrations for all other parameters are in µg/m^3.

Table 3. Western Reference Sites: Three-Year Mean Values (ppb or µg/m^3)

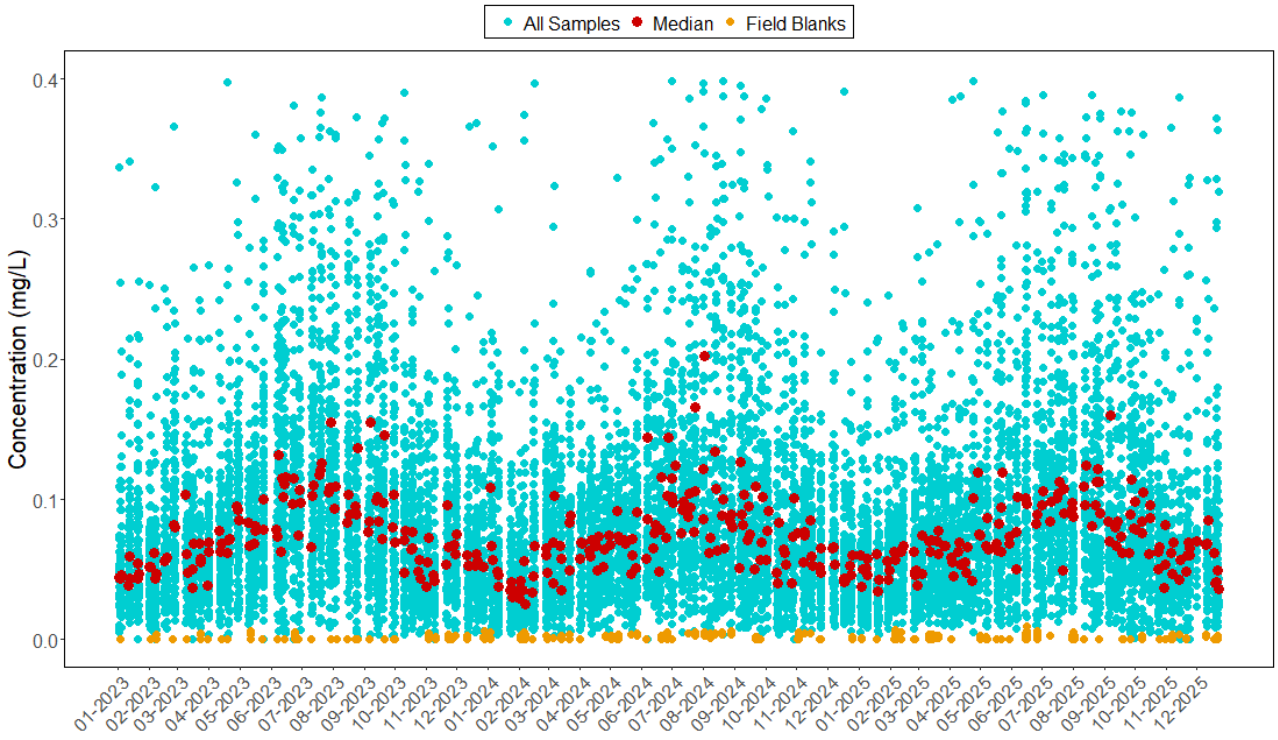
	O_3 (ppb)	Total NO_3^-	NH_4^+	SO_4^{2-}	Ca^{2+}	K^+	Mg^{2+}	Na^+	Cl^-
1996–1998	38	0.8	0.2	0.6					
2004–2006					0.10	0.03	0.02	0.06	0.03
2023–2025	38	0.4	0.1	0.3	0.16	0.02	0.02	0.05	0.04
Percent Change	0	-46	-49	-45	68	-6	9	-12	6

Note: Ozone concentrations are given as ppb. Concentrations for all other parameters are in µg/m^3.

Time Series of Laboratory Analysis Parameters for All Sites

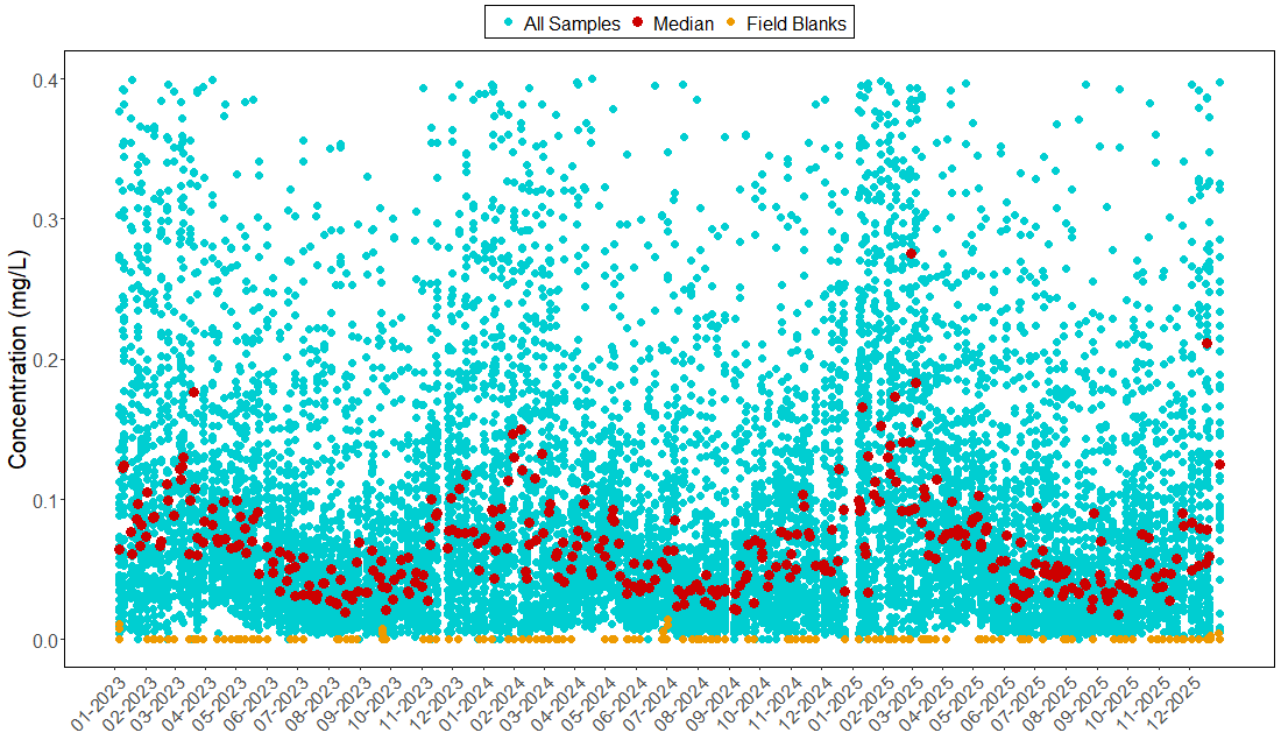
Time series of laboratory-analyzed concentrations of field samples and field blanks of 11 parameters are illustrated in Figures 13 through 23. Data points range from first quarter 2023 through fourth quarter 2025, and concentrations are measured in milligrams per liter (mg/L) of 11 parameters. These figures indicate potential issues with concentration measurements relative to detection and reporting limits.

Figure 13. Concentrations of NO_3^- (as N) from Nylon Filters



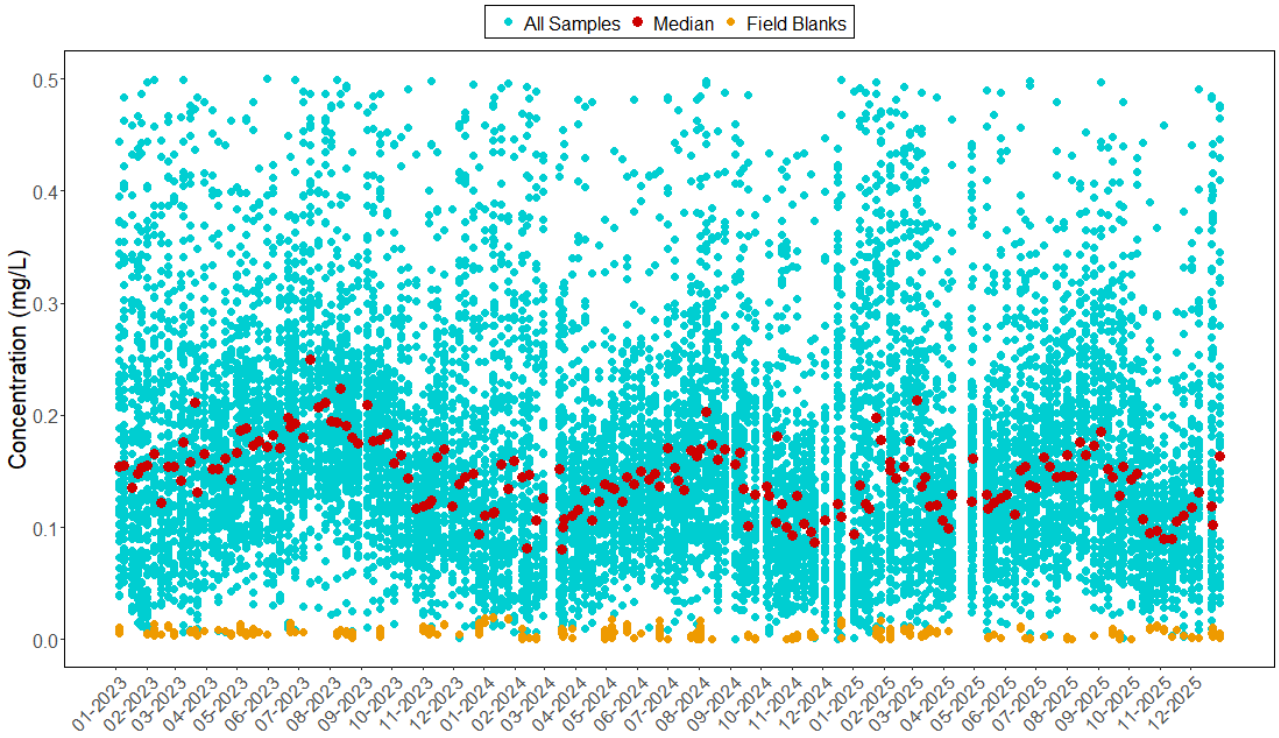
Note: Nominal reporting limit is 0.008 mg/L

Figure 14. Concentrations of NO_3^- (as N) from Teflon Filters



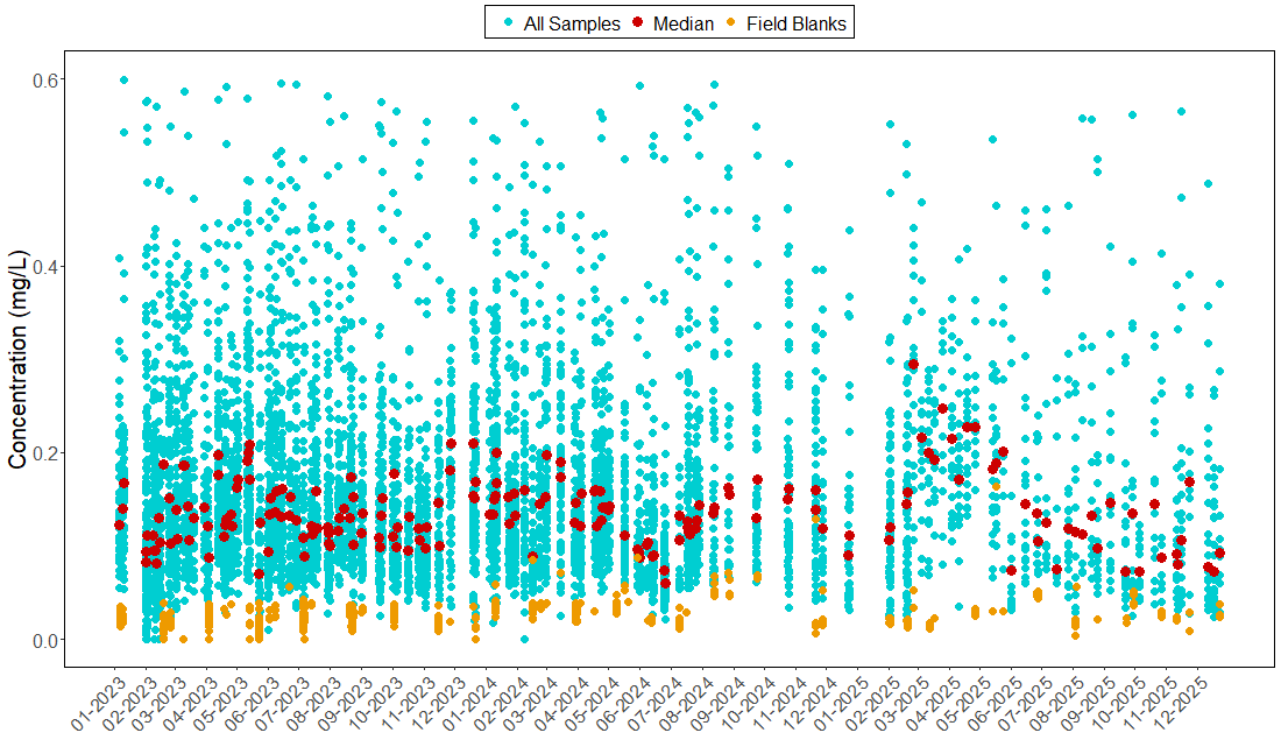
Note: Nominal reporting limit is 0.008 mg/L

Figure 15. Concentrations of NH_4^+ (as N) from Teflon Filters



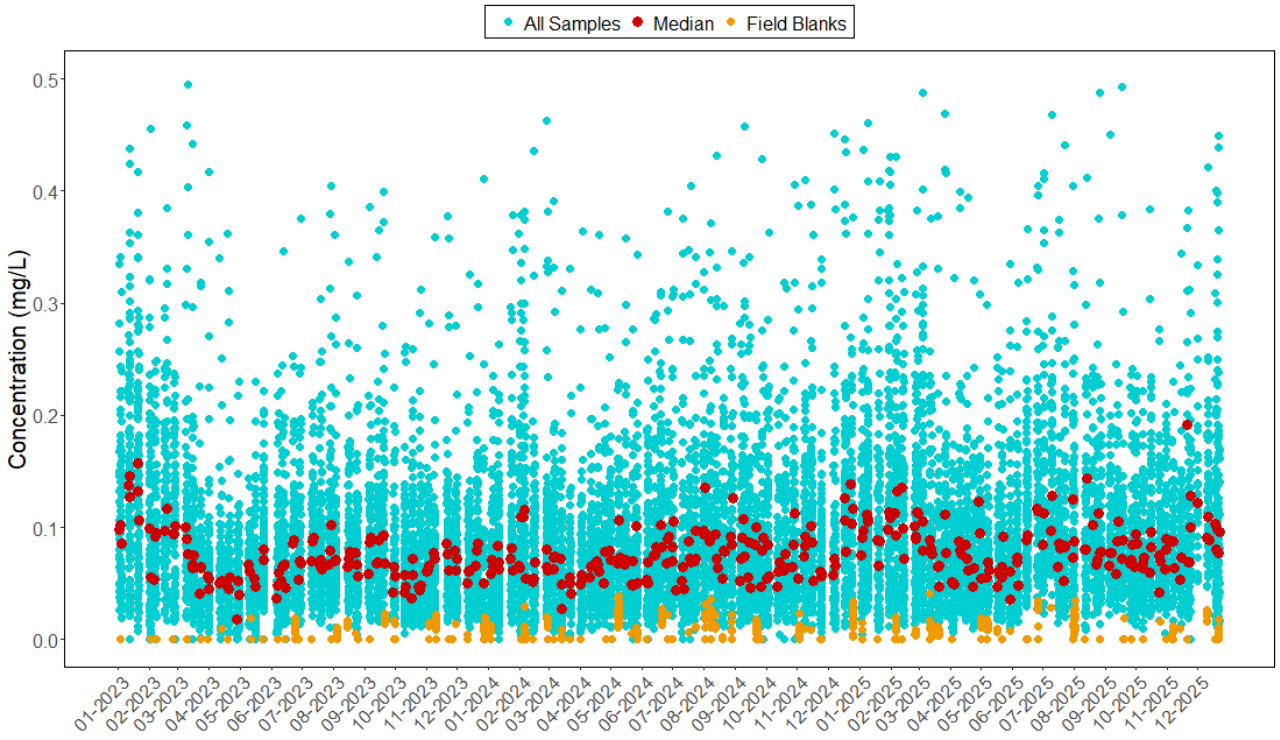
Note: Nominal reporting limit is 0.020 mg/L

Figure 16. Concentrations of SO_2 from Potassium Carbonate-impregnated Cellulose Filters



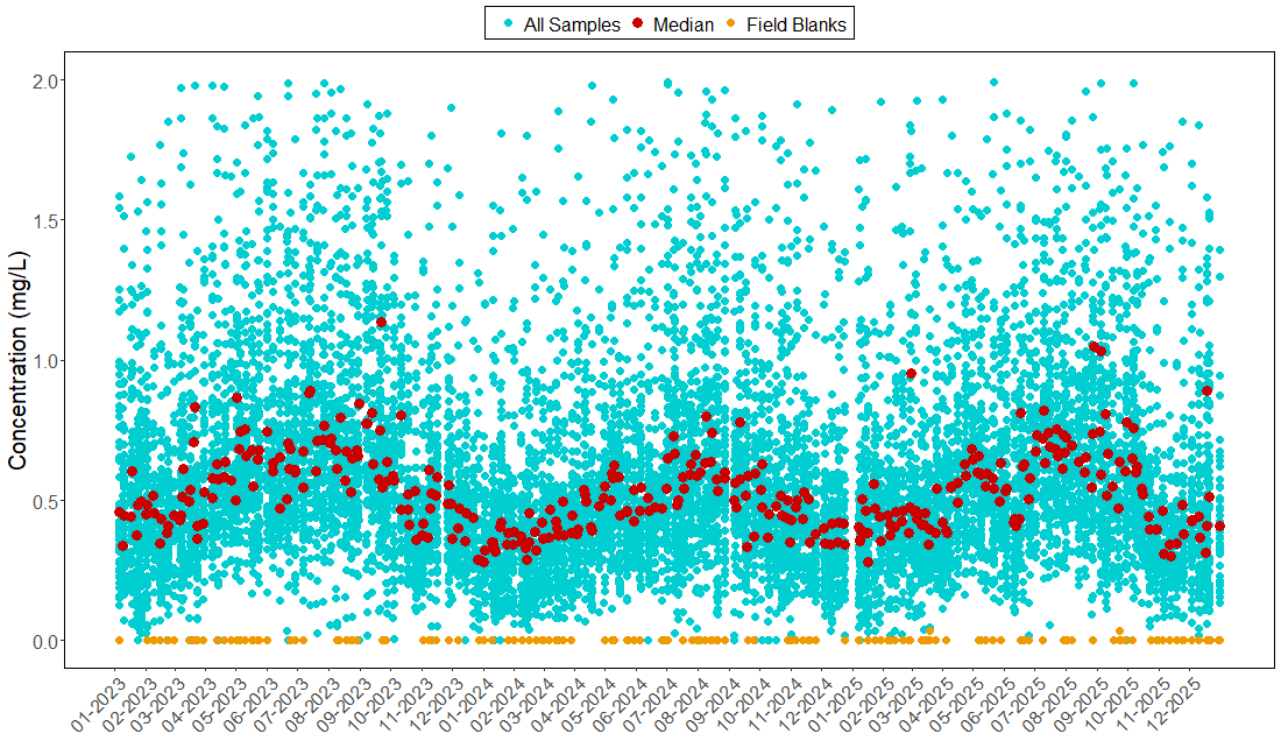
Note: Nominal reporting limit is 0.040 mg/L

Figure 17. Concentrations of SO_4^{2-} from Nylon Filters



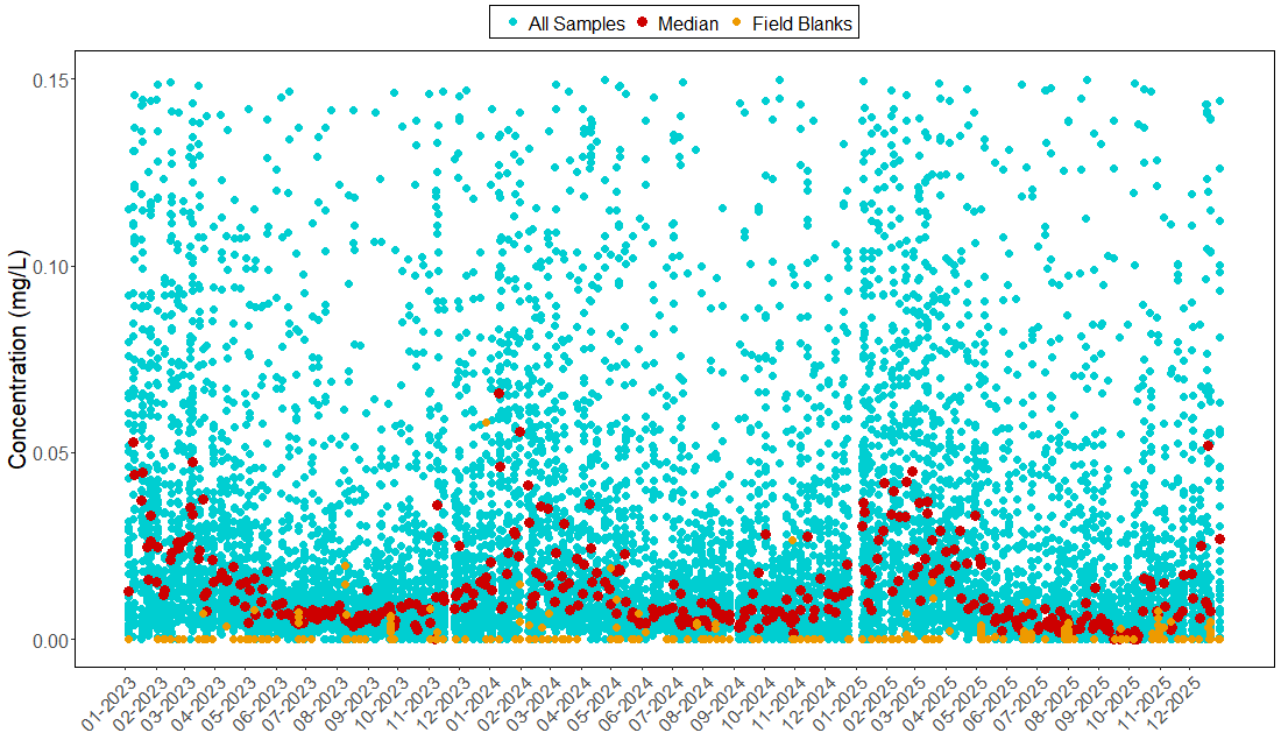
Note: Nominal reporting limit is 0.040 mg/L

Figure 18. Concentrations of SO_4^{2-} from Teflon Filters



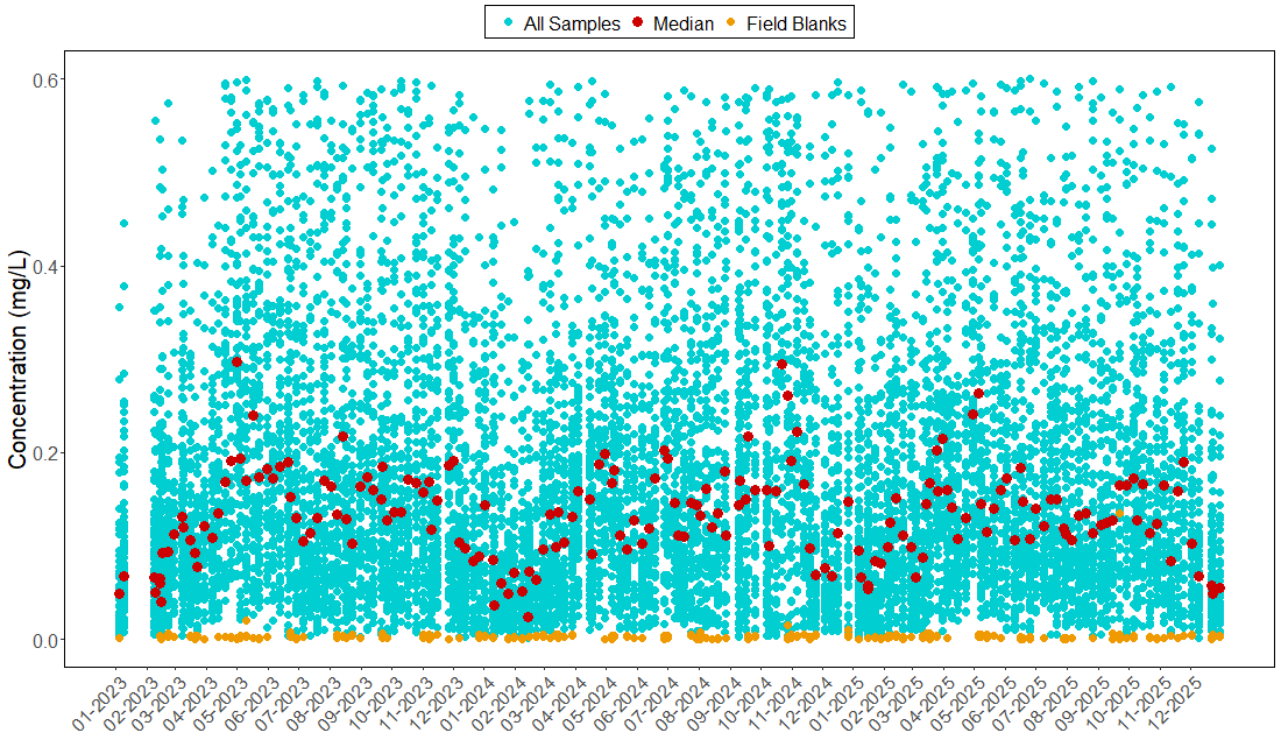
Note: Nominal reporting limit is 0.040 mg/L

Figure 19. Concentrations of Cl^- from Teflon Filters



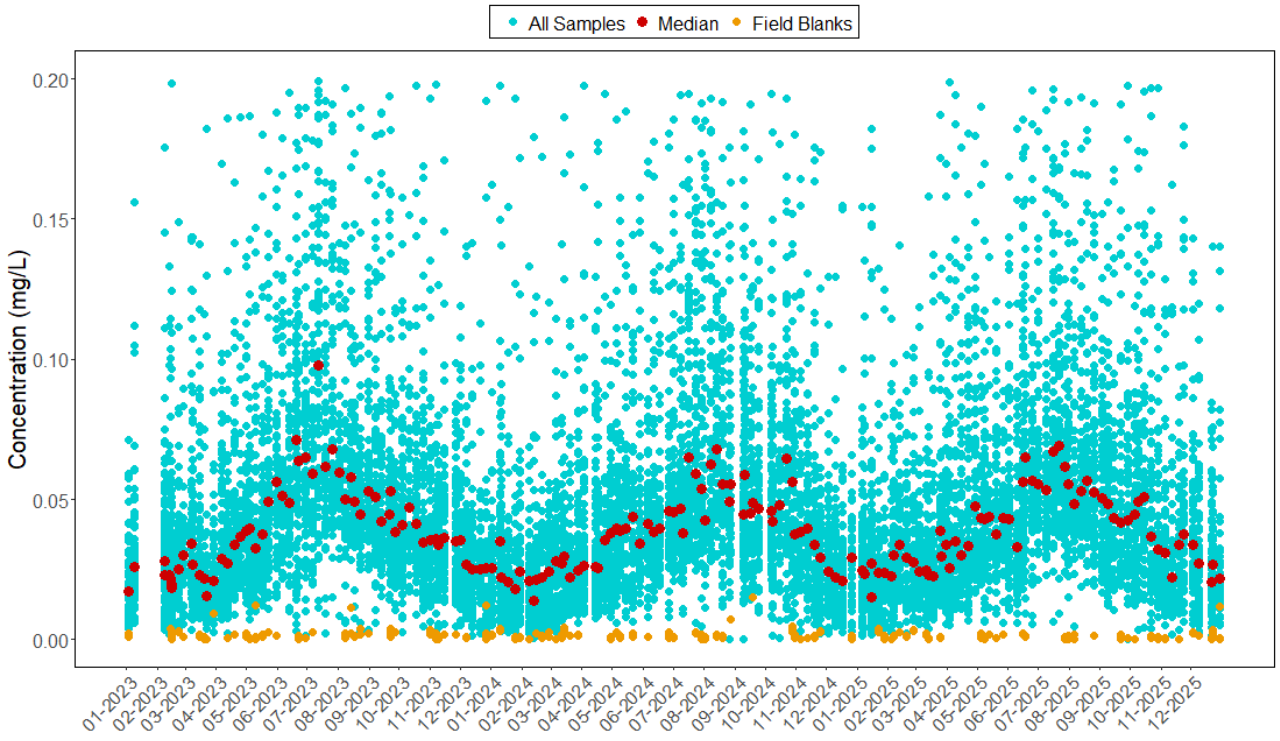
Note: Nominal reporting limit is 0.020 mg/L

Figure 20. Concentrations of Ca^{2+} from Teflon Filters



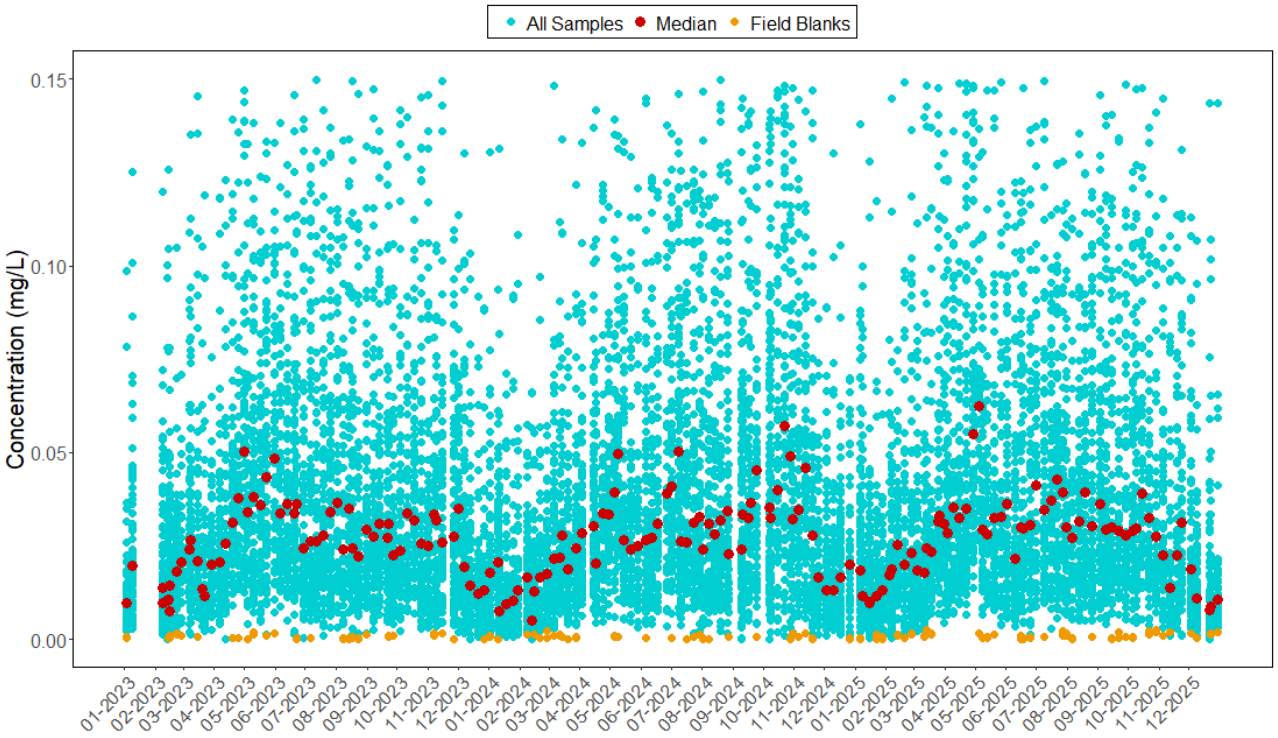
Note: Nominal reporting limit is 0.006 mg/L

Figure 21. Concentrations of K^{+} from Teflon Filters



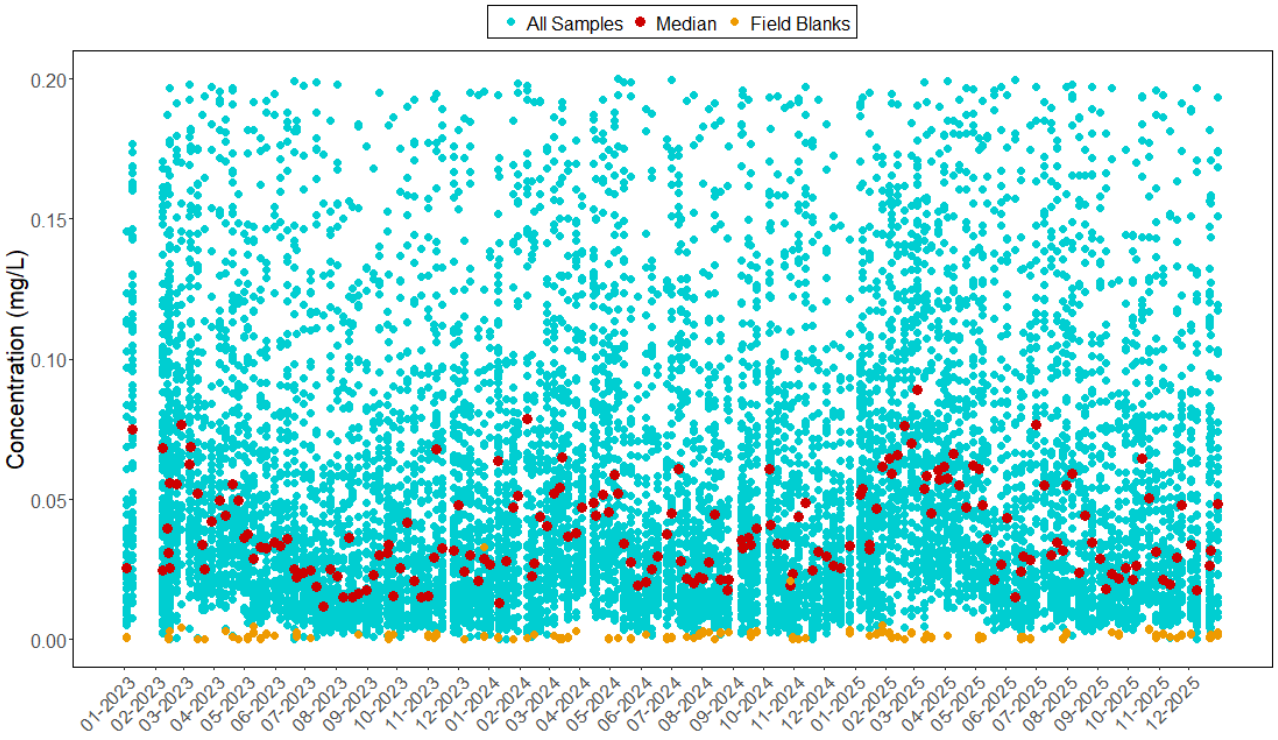
Note: Nominal reporting limit is 0.006 mg/L

Figure 22. Concentrations of Mg^{2+} from Teflon Filters



Note: Nominal reporting limit is 0.003 mg/L

Figure 23. Concentrations of Na^{+} from Teflon Filters



Note: Nominal reporting limit is 0.005 mg/L

Time Series of Concentration Differences from Co-located Sites

Figures 24 and 25 show times series of filter concentration differences between the two sets of co-located sites.

Figure 24. Filter Concentration Differences between MCK131 and MCK231, KY

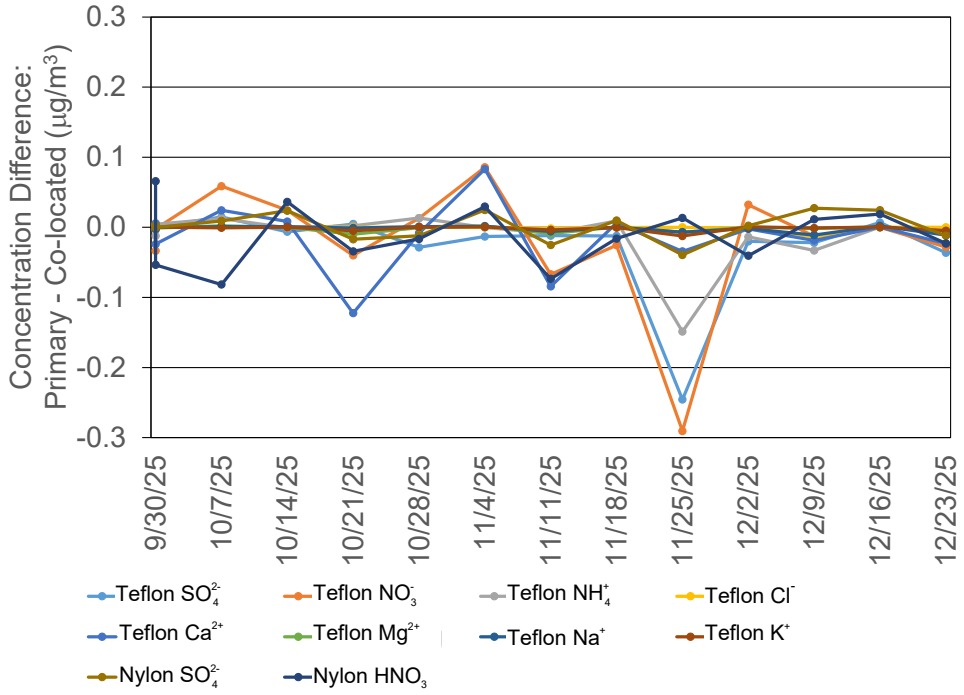
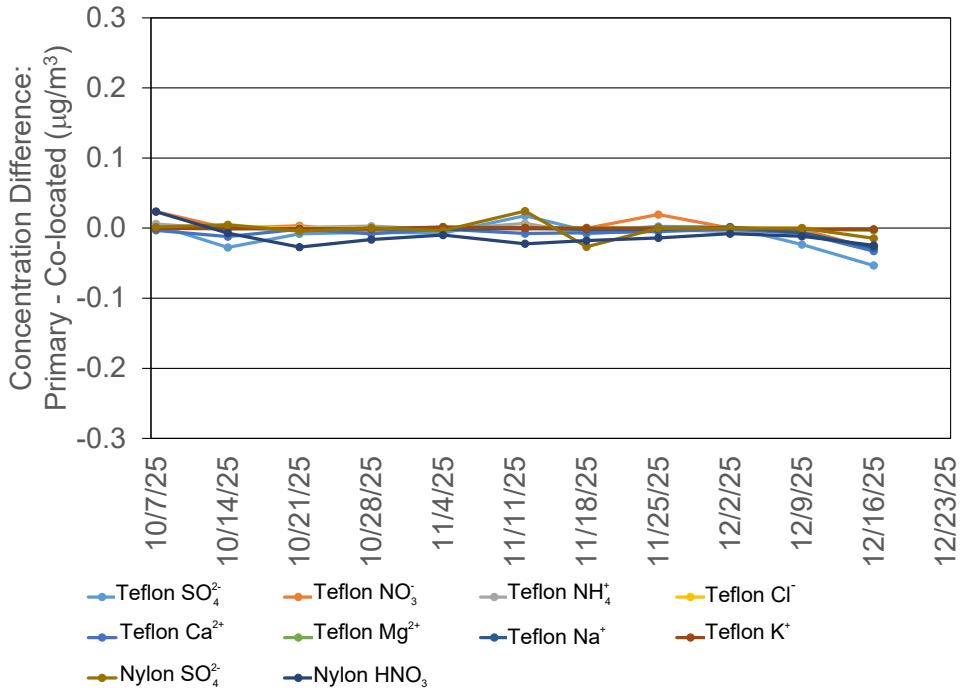


Figure 25. Filter Concentration Differences between ROM406 and ROM206, CO



Precision of Filter Pack Concentrations

Table 4 shows mean absolute relative percent differences (MARPD) for concentrations measured at MCK131/231, KY and ROM406/206, CO during fourth quarter 2025. The MARPD values met the 20 percent criterion.

Table 4. Precision (MARPD) for Co-located Filter Pack Data during Fourth Quarter 2025

	Total NO_3^-	HNO_3	NO_3^-	NH_4^+	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	K^+	Cl^-
MCK131/231, KY										
$\overline{X}$ ($\mu g/m^3$)	1.70	0.60	1.11	0.54	1.03	0.30	0.04	0.08	0.06	0.04
$\overline{Y}$ ($\mu g/m^3$)	1.73	0.61	1.13	0.55	1.05	0.31	0.04	0.08	0.06	0.04
MAD	0.06	0.04	0.05	0.02	0.03	0.03	0.00	0.00	0.00	0.00
MARPD	5.57	6.47	8.13	5.02	4.18	10.95	8.54	8.17	5.17	1.58
ROM406/206, CO										
$\overline{X}$ ($\mu g/m^3$)	0.38	0.27	0.11	0.10	0.26	0.07	0.01	0.02	0.01	0.02
$\overline{Y}$ ($\mu g/m^3$)	0.39	0.29	0.11	0.10	0.26	0.08	0.01	0.02	0.01	0.02
MAD	0.03	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
MARPD	6.89	8.54	5.91	5.82	5.13	15.45	14.03	14.16	7.27	4.47

Completeness for Filter Pack Concentrations

Table 5 shows CASTNET sites with less than 90 percent completeness for weekly filter pack concentrations. Comments are included to provide information on why these sites experienced low data completeness. Nine sites experienced full or partial closures during the government shutdown that occurred 10/01/2025 - 11/12/2025.

Table 5. Sites with Less than 90 Percent Success in Filter Pack Deployment during Fourth Quarter 2025 (1 of 2)

Site ID	Teflon SO_4^{2-}	Teflon NO_3^-	Teflon NH_4^+	Teflon Minor Cations	Teflon Cl^-	Nylon HNO_3	Nylon SO_4^{2-}	Cellulose SO_2	Comments
ACA416, ME*	46	46	46	46	46	46	46	N/A	There was one 7-week sample during the period.
BBE401, TX	85	85	85	85	85	85	85	N/A	There were two 2-week samples during the period.
BEL116, MD	69	69	69	69	69	69	69	N/A	A power failure affected three sampling weeks.
CHA467, AZ	77	77	77	77	77	77	77	N/A	There was one 3-week sample during the period.
CNS011, FL*	54	54	54	54	54	54	54	54	There was one 6-week sample during the period that was invalidated for insufficient flow volume.
COW137, NC	85	85	85	85	85	85	85	N/A	There were two 2-week samples during the period.
CVL151, MS	77	77	77	77	77	77	77	N/A	There was one 4-week sample during the period.
EVE419, FL*	46	46	46	46	46	46	46	N/A	One 7-week sample during the period was invalidated for insufficient flow volume.
GLR468, MT*	46	46	46	46	46	46	46	N/A	One 7-week sample during the period was invalidated for insufficient flow volume.
GRB411, NV*	38	38	38	38	38	38	38	N/A	One 7-week sample during the period was invalidated for insufficient flow volume. In addition, there was also a 2-week sample during the period.
HAS012, KS	69	69	69	69	69	69	69	69	There was one 4-week sample during the period that was invalidated for insufficient flow volume. In addition, there was also a 2-week sample during the period.

Table 5. Sites with Less than 90 Percent Success in Filter Pack Deployment during Fourth Quarter 2025 (2 of 2)

Site ID	Teflon SO_4^{2-}	Teflon NO_3^-	Teflon NH_4^+	Teflon Minor Cations	Teflon Cl^-	Nylon HNO_3	Nylon SO_4^{2-}	Cellulose SO_2	Comments
LAV410, CA*	77	77	77	77	77	77	77	N/A	There was one 4-week sample during the period that was invalidated for insufficient flow volume. In addition, there was also a 2-week sample during the period.
LPO010, CA	77	77	77	77	77	77	77	77	There were two 2-week samples during the period. In addition, week 51 was a 5-week sample.
MAR013, FL	77	77	77	77	77	77	77	77	The site began operation 10/20/2025, producing data from weeks 43 - 52.
NIC001, NY	54	54	54	54	54	54	54	54	The flow rate for the first six sampling weeks was invalidated due to calibration failure.
PIN414, CA	85	85	85	85	85	85	85	N/A	There were two 2-week samples during the period.
SHN418, VA	62	62	62	62	62	62	62	N/A	Five sampling weeks were affected by a data logger connection issue.
THR422, ND*	46	46	46	46	46	46	46	N/A	There was one 7-week sample during the period that was invalidated for insufficient flow volume.
VIN140, IN	85	85	85	85	85	85	85	N/A	There was one 2-week sample during the period. In addition, week 51 was a 3-week sample.
VOY413, MN*	46	46	46	46	46	46	46	N/A	There was one 7-week sample during the period that was invalidated for insufficient flow volume.
YOS404, CA*	69	69	69	69	69	69	69	N/A	There were two 3-week samples during the period.

Note: N/A = Filter pack SO_2 concentrations were not measured.

* Impacted by federal government shutdown.

Precision of Ozone Concentrations

Time series of hourly O_3 concentration differences for fourth quarter 2025 are provided in Figures 26 and 27 for co-located sites MCK131/231 and ROM406/206, respectively. The figures indicate no consistent bias between the co-located analyzers at these site locations.

Figure 26. O_3 Concentrations Differences between MCK131 and MCK231, KY

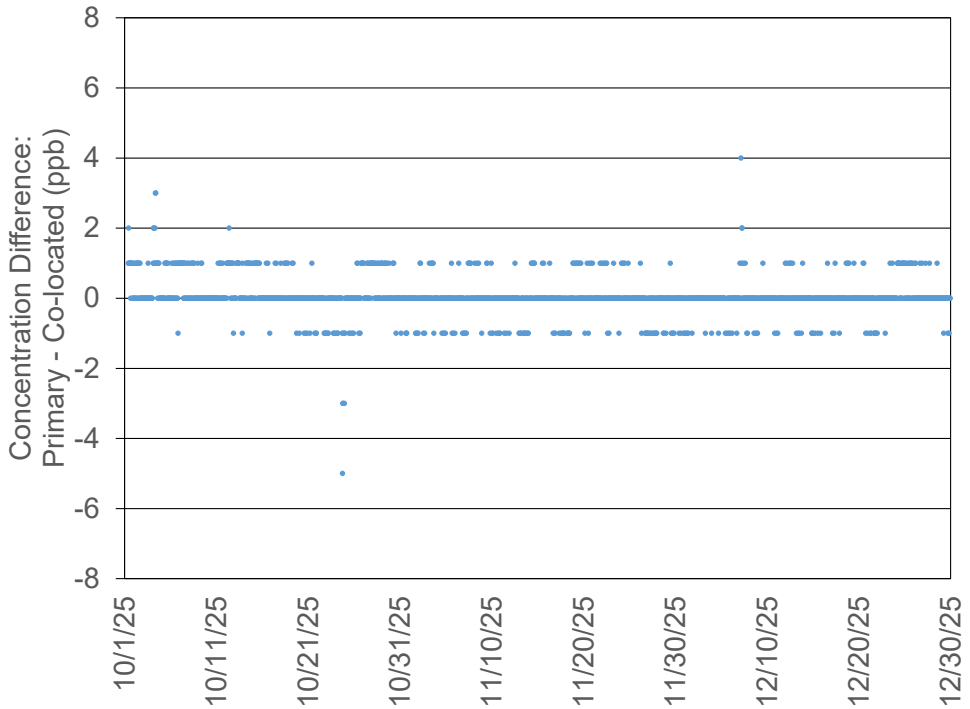


Figure 27. O_3 Concentrations Differences between ROM406 and ROM206, CO

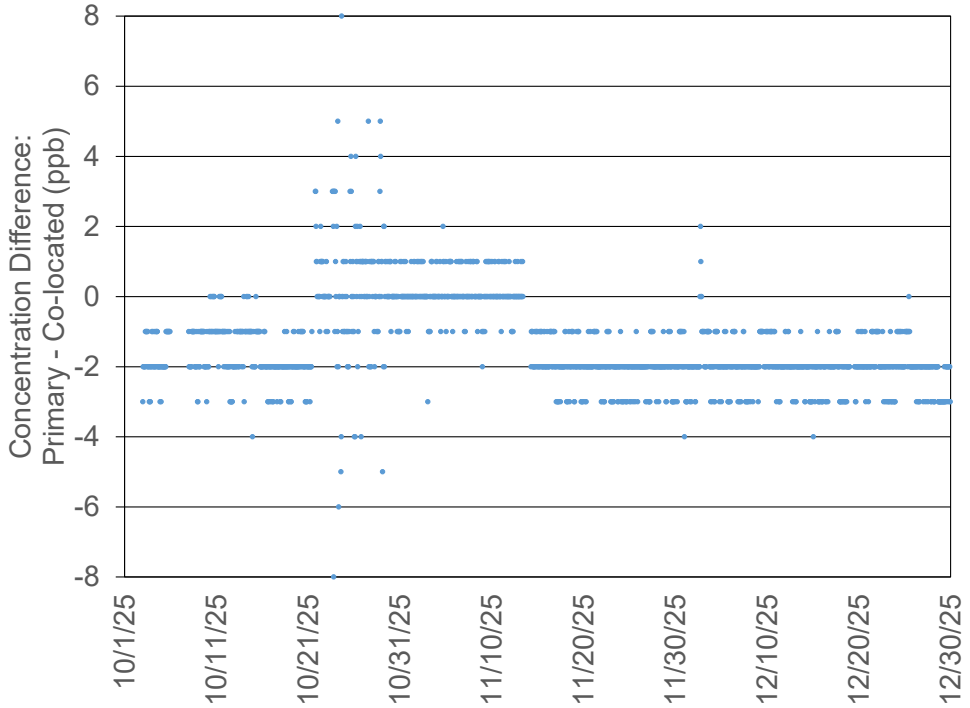


Table 6 gives MARPD data for O_3 data measured at the two co-located sites.

Table 6. Quarterly Precision (MARPD) for Co-located O_3 Concentrations

Site Pair	Quarter	Start Date	MARPD	Records
MCK131/231, KY				
	1	01/01/2025	2.7	1890
	2	04/01/2025	7.3	1885
	3	07/01/2025	2.1	2022
	4	10/01/2025	0.9	2065
ROM406/206, CO				
	1	01/01/2025	0.7	1960
	2	04/01/2025	1.3	2057
	3	07/01/2025	3.9	976
	4	10/01/2025	3.7	1951

Completeness for Ozone Concentrations

Calculation of an annual O_3 value requires 75 percent completeness. However, calculation of the three-year design value used for regulatory purposes requires 90 percent completeness. Table 7 shows CASTNET sites with less than 90 percent completeness for DM8A O_3 concentrations. Comments are provided for these sites.

Table 7. Sites with less than 90 Percent Data Completeness for DM8A Concentrations during Fourth Quarter 2025

Site ID	Percent Completeness	Comments
BEL116, MD	73	Power failed from late October through mid-November.
DEV412, CA	84	Pump failed from 09/19/2025 - 10/07/2025 and again from 10/31/2025 - 11/04/2025.
LAV410, CA	67	Analyzer locked up because photometer reference value needed adjustment.
MEV405, CO	74	Leak occurred at the filter. Data were invalid from 10/21/2025 - 11/13/2025.
OXF122, OH	88	The sample pump failed in December.
PED108, VA	85	QC failures occurred in mid and late December.
VOY413, MN	88	Firmware issue caused invalid data from 10/05/2025 - 10/13/2025.
YEL408, WY	62	Sample pump failed. Data were invalid 10/18/2025 - 11/21/2025.
YOS404, CA	47	Motherboard failed. Data were invalid 10/03/2025 - 11/19/2025.

Table 8 shows CASTNET sites with less than 90 percent completeness for hourly O_3 concentrations during fourth quarter 2025. Comments are provided for these sites. The average-annual percent completeness for each of these sites is included for reference.

Table 8. Sites with less than 90 Percent Data Completeness for O_3 Concentrations

Site ID	Q4 2025	Q1 2025 – Q4 2025	Comments
BEL116, MD	77	90	Power failed from late October through mid-November.
DEV412, CA	86	76	Sample pump failed from 09/19/2025 - 10/07/2025 and again from 10/31/2025 - 11/04/2025.
LAV410, CA	76	80	Analyzer locked up because photometer reference value needed adjustment.
MEV405, CO	75	80	Leak occurred at the filter. Data were invalid from 10/21/2025 - 11/13/2025.
OXF122, OH	89	96	Sample pump failed in December.
YEL408, WY	62	76	Sample pump failed and data were invalid from 10/18/2025 - 11/21/2025.
YOS404, CA	48	67	Motherboard failed and data were invalid from 10/03/2025 - 11/19/2025.

Filter Pack Total Nitrate and Continuous Trace-level NO_y Concentrations at CASTNET Sites

Figures 28 through 32 show a comparison of weekly average continuous NO_y measurements with weekly filter pack total NO_3^- concentrations collected at the five sites with NO_y measurements. The NO_y concentrations were consistently higher than the total NO_3^- levels at all sites. The average weekly NO_y levels, the weekly total NO_3^- concentrations, and their ratios for the five sites with available data are shown in Table 9. Ratios of NO_y to total NO_3^- varied from 2.92 at STK138, IL to 6.25 at DUK008, NC.

Table 9. Summary of Total NO_3^-/NO_y Measurements for Fourth Quarter 2025

Site ID	Elevation	Total NO_3^- (ppb)	NO_y (ppb)	Ratio
BVL130, IL	213	1.04	3.88	4.00
DUK008, NC	164*	0.50	3.07	6.25
GRS420, TN	793	0.35	1.12	3.24
SAN192, NE	386	0.50	1.39	3.07
STK138, IL	281	1.00	3.86	2.92

Note: * The inlet of the enhanced NO_y monitor is located at the top of the 30-meter tower.

Figure 28. Weekly Mean Continuous NO_y and Total NO_3^- Concentrations BVL130, IL

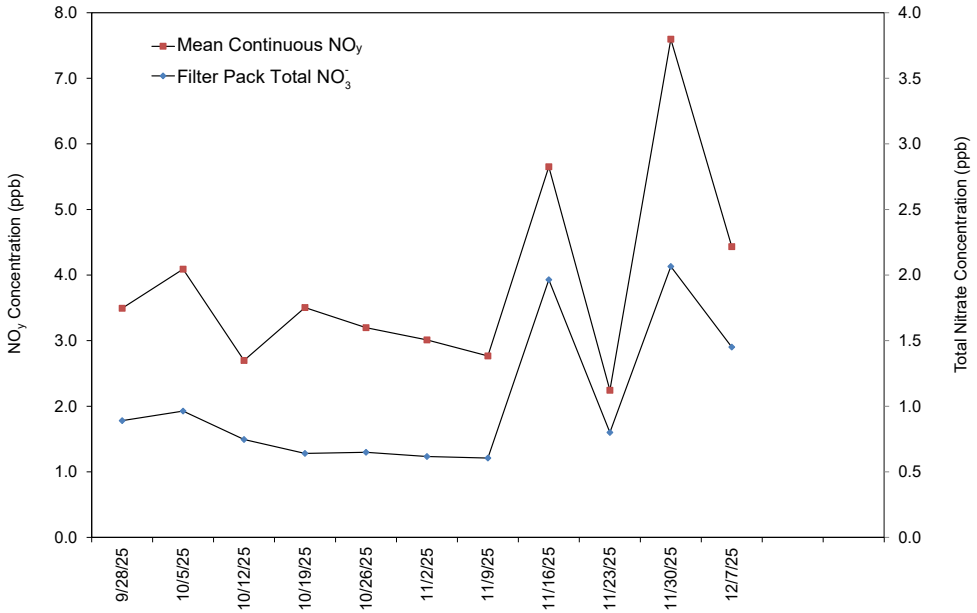


Figure 29. Weekly Mean Continuous NO_y and Total NO_3^- Concentrations at DUK008, NC

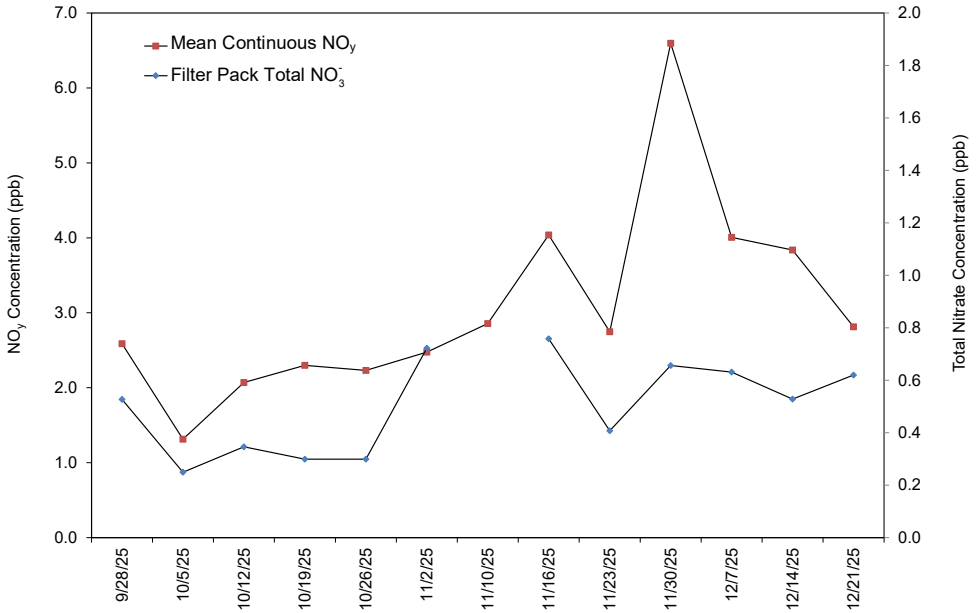


Figure 30. Weekly Mean Continuous NO_y and Total NO_3^- Concentrations GRS420, TN

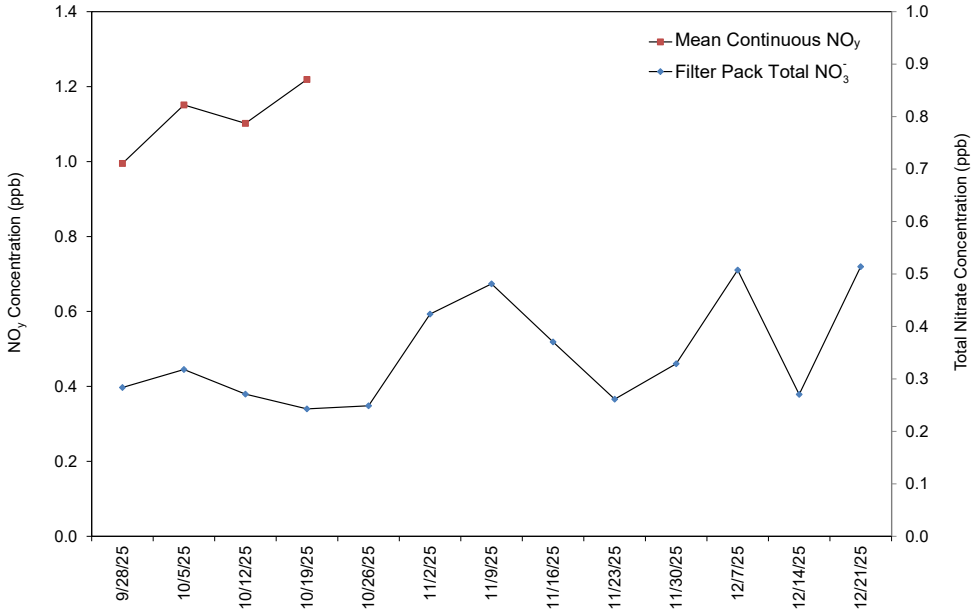


Figure 31. Weekly Mean Continuous NO_y and Total NO_3^- Concentrations SAN192, NE

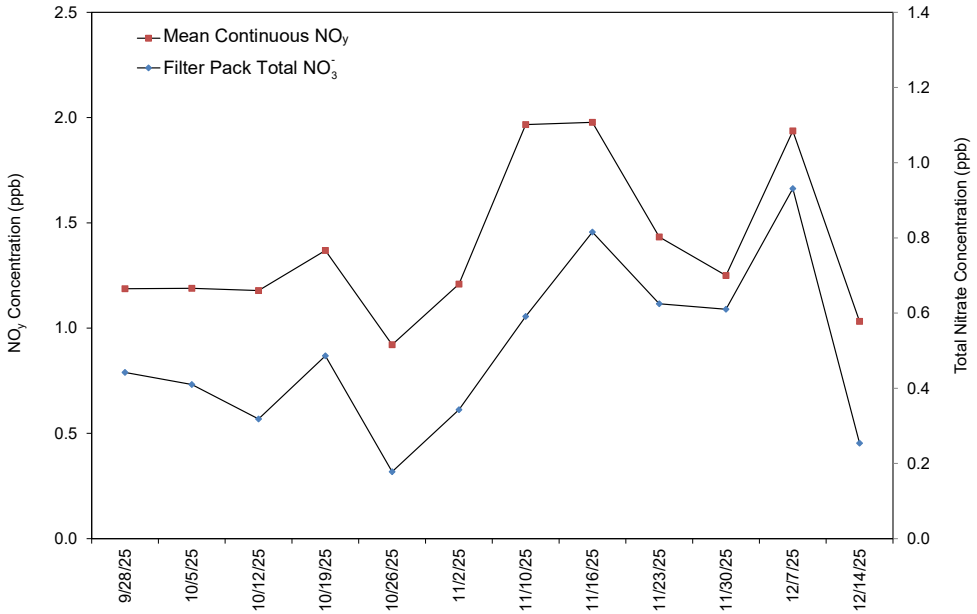
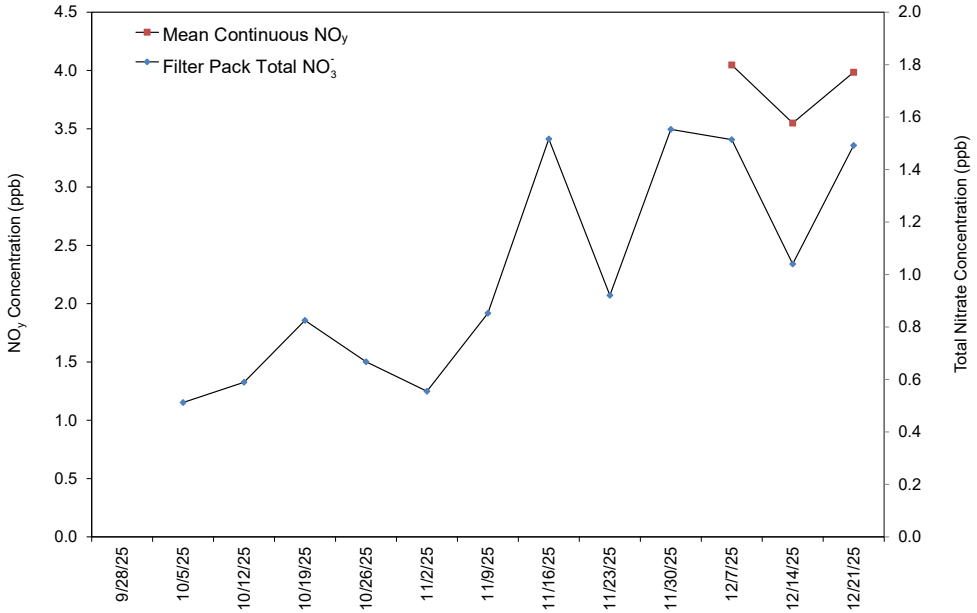


Figure 32. Weekly Mean Continuous NO_y and Total NO_3^- Concentrations STK138, IL



Completeness for Continuous Trace-level Gas measurements

Table 10 shows the percent completeness for CASTNET trace-level gas measurements. Comments are provided for sites with less than 90 percent completeness for hourly trace-level gas concentrations during fourth quarter 2025. The average completeness for first quarter 2025 through fourth quarter 2025 for each of the sites is included for reference.

Table 10. Percent Data Completeness for Continuous Trace-level Gas Measurements (1 of 2)

Site ID	Parameter*	Q4 2025	Q1 2025–Q4 2025	Comments
BVL130, IL	CO	95	94	
	NO	91	92	
	NOY	89	90	Intermittent periods were invalidated for suspect data. In addition, data from 12/30/2025 - 12/31/2025 were invalidated for failure of the bypass pump.
	NOYDIF	89	90	
	SO2_GA	75	89	The sample pump failed 12/13/2025 and was replaced 01/14/2026
CHC432, NM	NO	98	84	
	NOX	98	84	
	NOXDIF	98	84	

Table 10. Percent Data Completeness for Continuous trace-level Gas Measurements (2 of 2)

Site ID	Parameter*	Q4 2025	Q1 2025–Q4 2025	Comments
DUK008, NC	HNO3	90	86	
	NH3	90	63	
	NO	90	91	
	NO2_TRUE	90	91	
	NOX_TRUE	90	91	
	NOY	90	88	
	NOY_MINUS	90	90	
	NOYDIF	90	88	
	TNX	90	86	
GRS420, TN	CO	0	0	The CO analyzer has been removed for repair since April at this site.
	NO	29	63	External converter board failed on the NO_y analyzer. The board was replaced on 01/02/2026 and analyzer recalibrated on 01/07/2026.
	NOY	29	63	
	NOYDIF	77	77	
	SO2_GA	96	80	
SAN192, NE	NO	91	84	
	NOY	91	77	
	NOYDIF	91	75	
STK138, IL	HNO3	19	65	The analyzer was out of calibration from 10/01/2025 to 10/15/2025 affecting all parameters. In addition, the bypass pump and converter malfunctioned from 09/29/2025 to 12/11/2025.
	NH3	19	66	
	NO	73	65	The analyzer was out of calibration 10/01/2025 to 10/15/2025 affecting all parameters.
	NO2_TRUE	73	65	
	NOX_TRUE	73	65	
	NOY	19	67	The analyzer was out of calibration from 10/01/2025 to 10/15/2025 affecting all parameters. In addition, the bypass pump and converter malfunctioned from 09/29/2025 to 12/11/2025.
	NOY_MINUS	68	79	The analyzer was out of calibration from 10/01/2025 to 10/15/2025 affecting all parameters. In addition, there was a denuder issue in early November.
	NOYDIF	19	49	The analyzer was out of calibration from 10/01/2025 to 10/15/2025 affecting all parameters. In addition, the bypass pump and converter malfunctioned from 09/29/2025 to 12/11/2025.
	TNX	73	81	The analyzer was out of calibration from 10/01/2025 to 10/15/2025 affecting all parameters.

Note: * See Table 11

The parameters listed in Table 10 are both calculated and measured. Table 11 provides information on how the parameters listed in Table 10 are obtained.

Table 11. CASTNET Trace-level Gas Measurements

Parameter Name	How Obtained	Description of Process
CO	Measured	Gas filter correlation
HNO3	Calculated	NOY minus NOY-MINUS
NH	Calculated	TNX minus NOY
NO	Measured	Chemiluminescence reaction/no converter used
NO2_True	Calculated	NOX_TRUE minus NO
NOX_True	Measured	Photolytic converter
NOY	Measured	Molybdenum converter at 315° Celsius
NOYDIF	Calculated	NOY minus NO
NOY_MINUS	Measured	Sodium carbonate denuder followed by molybdenum converter at 315° Celsius
NOX	Measured	Molybdenum converter at 325° Celsius
NOXDIF	Calculated	NOX minus NO
SO2_GA	Measured	Ultraviolet fluorescence
TNX	Measured	Platinum/stainless steel converter at 825° Celsius followed by molybdenum converter at 315° Celsius

Reference

WSP USA Environment & Infrastructure Inc. (WSP). 2026. Clean Air Status and Trends Network (CASTNET) Fourth Quarter 2025 Quality Assurance Report. https://www.epa.gov/castnet/documents-reports.