

Clean Air Status and Trends Network

Quarterly Data Summary for First Quarter 2023 (January through March)

Prepared for: U.S. Environmental Protection Agency (EPA), Clean Air Markets Division

EPA Contract No.: 68HERH21D0006, CASTNET Base Program (1003)

Prepared by: WSP Environment and Infrastructure, Inc., Gainesville, Florida

WSP Project No.: 6064226103

Submitted: June 30, 2023

Introduction

This quarterly report summarizes the Clean Air Status and Trends Network (CASTNET) data collected during first quarter 2023. 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 first quarter data and include completeness and precision of filter concentrations and hourly O_3 concentrations. This report also analyzes data for continuous, trace-level NO_y from the six of eight sites that were operational during first quarter and continuous SO_2 concentrations from three sites. Other QC statistics are given in the CASTNET First Quarter 2023 Quality Assurance Report (WSP, 2023).

Figure 1. Fourth Highest Daily Maximum 8-hour Average O_3 Concentrations (ppb) through First Quarter 2023



Figure 1 shows fourth highest daily maximum 8-hour average (DM8A) O₃ concentrations measured through first quarter 2023. One site, DIN431, UT, exceeded the 0.070 parts per million (ppm) National Ambient Air Quality Standard (NAAQS) for O₃ at a measured DM8A concentration of 98 ppb. High wintertime concentrations are not unusual at this site because of emissions from regional oil and gas development coupled with temperature inversions and enhanced photochemistry from persistent snow cover (Prezzi *et. al.*, 2022)

Trends

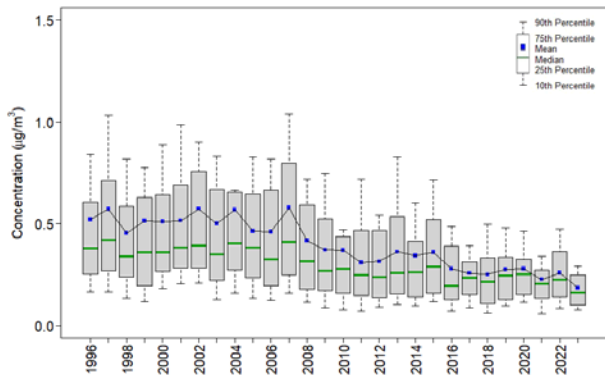
Trend analyses were performed based on filter pack pollutant concentrations measured in micrograms per cubic meter (µg/m³) of air at the 34 eastern and 16 western reference sites during first quarter. Trends in quarterly mean filter pack and O₃ concentrations are shown using box plots in Figures 2 through 13.

First Quarter Concentrations

All quarterly mean concentrations except for SO₄²⁻ (one percent increase) decreased at eastern sites in 2023. All quarterly mean concentrations decreased at western sites.

Quarterly O₃ concentrations were analyzed using box plots constructed by averaging all valid hourly O₃ concentrations within first quarter 2023 by site and then averaging those averages for all eastern and western reference sites (Figure 13). The figure shows an overall increase in quarterly mean O₃ concentrations at eastern sites and little change at western sites. Mean O₃ concentrations at both eastern and western sites decreased in first quarter 2023. Overall, quarterly mean O₃ concentrations were higher at the western reference sites than at the eastern sites.

Figure 2. Trends in First Quarter Mean HNO₃ Concentrations
Western Reference Sites



Eastern Reference Sites

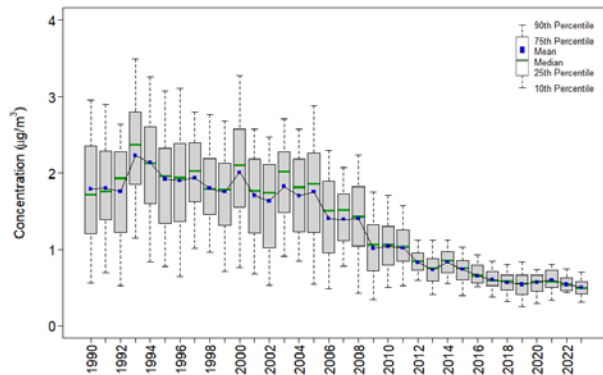
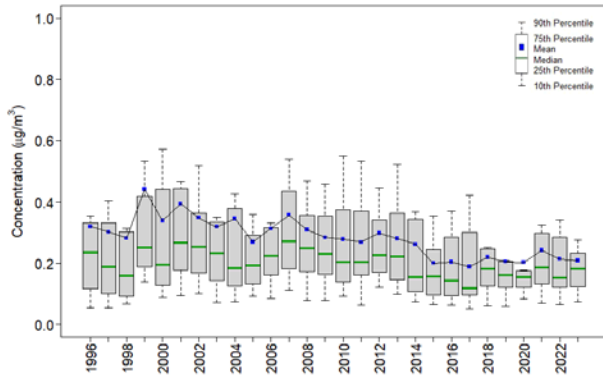


Figure 3. Trends in First Quarter Mean NO₃⁻ Concentrations
Western Reference Sites



Eastern Reference Sites

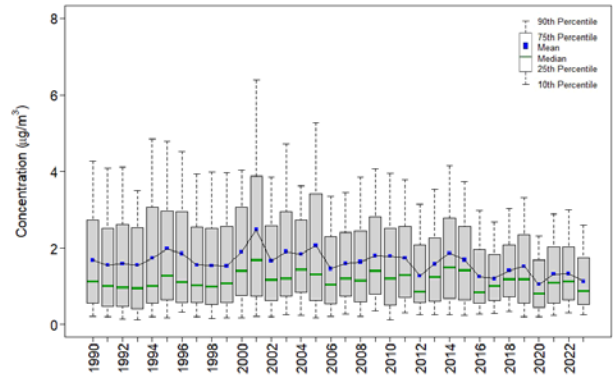
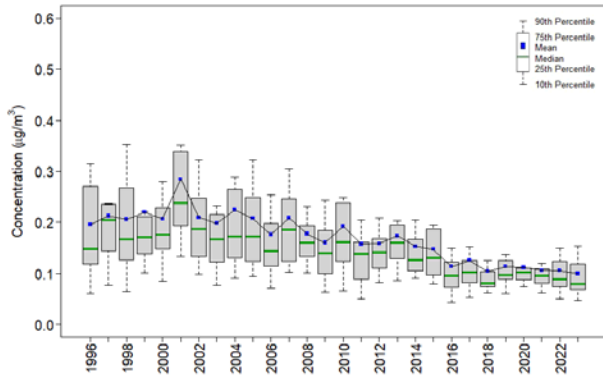


Figure 4. Trends in First Quarter Mean NH₄⁺ Concentrations
Western Reference Sites



Eastern Reference Sites

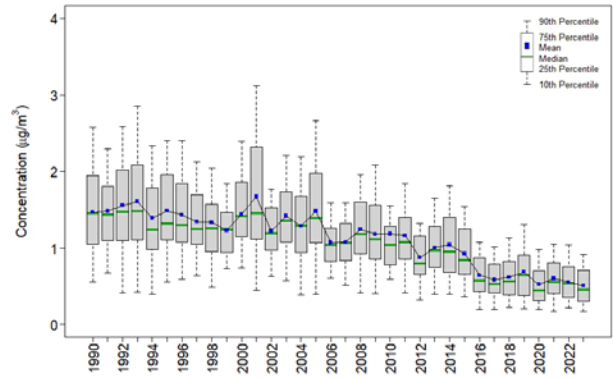
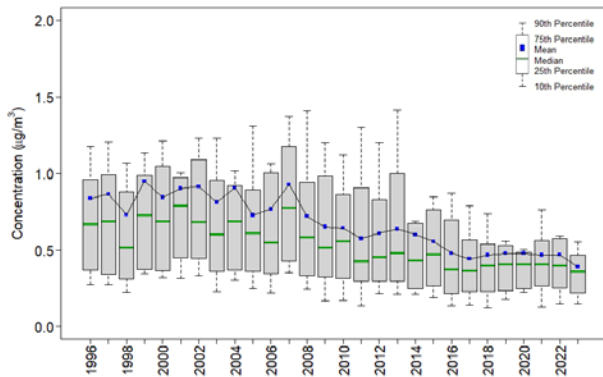


Figure 5. Trends in First Quarter Mean Total NO₃⁻ Concentrations
Western Reference Sites



Eastern Reference Sites

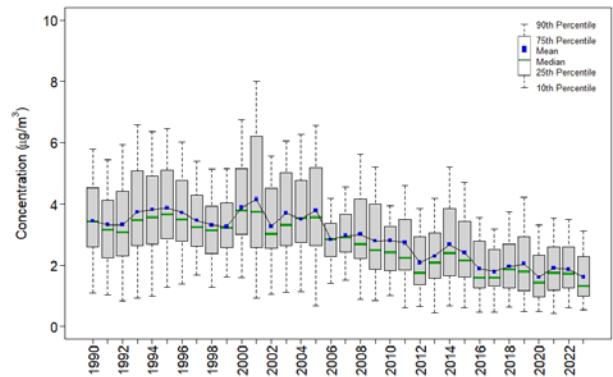
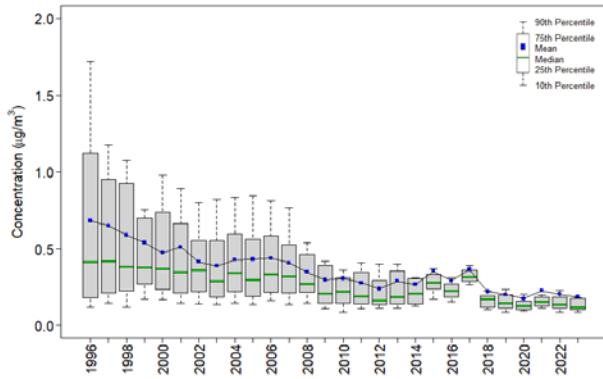


Figure 6. Trends in First Quarter Mean SO₂ Concentrations
Western Reference Sites



Eastern Reference Sites

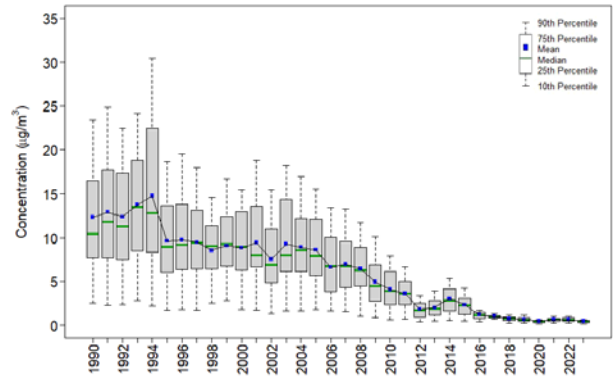
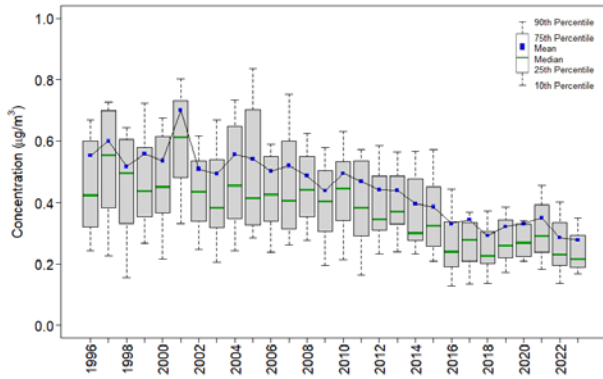


Figure 7. Trends in First Quarter Mean SO₄²⁻ Concentrations
Western Reference Sites



Eastern Reference Sites

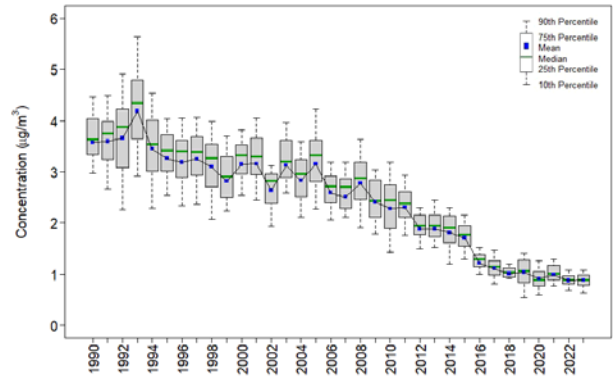
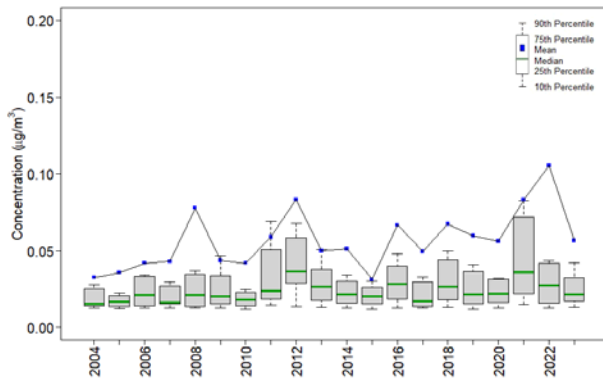


Figure 8. Trends in First Quarter Mean Cl⁻ Concentrations
Western Reference Sites



Eastern Reference Sites

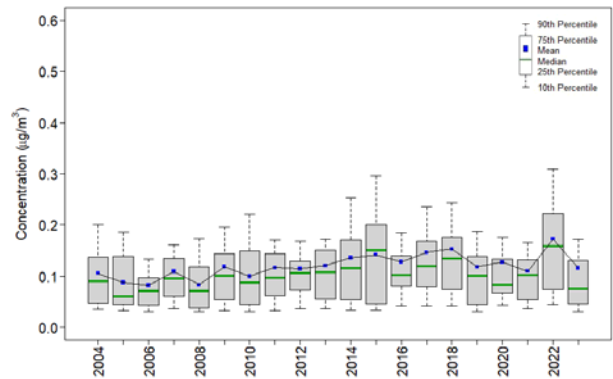
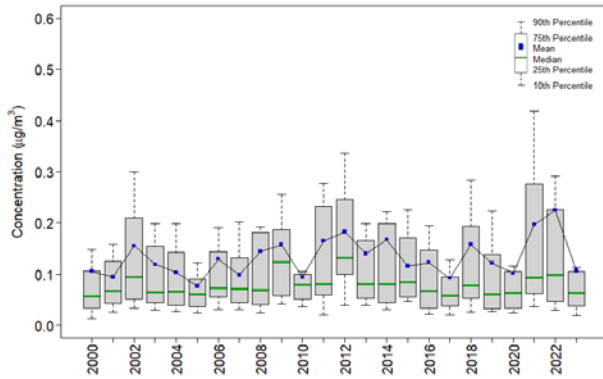


Figure 9. Trends in First Quarter Mean Ca²⁺ Concentrations
Western Reference Sites



Eastern Reference Sites

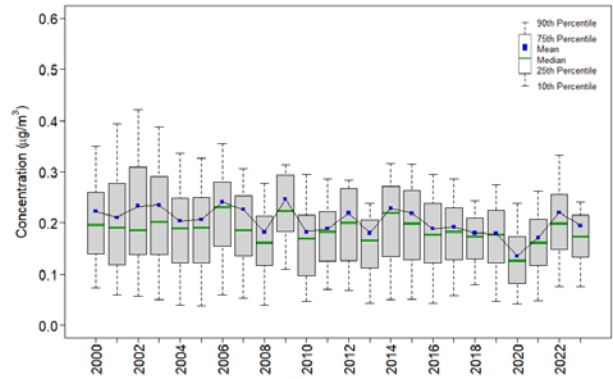
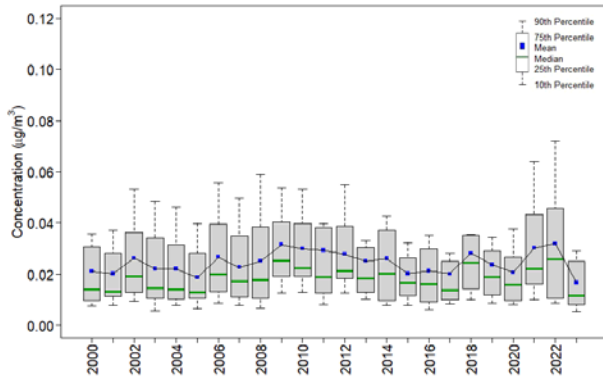


Figure 10. Trends in First Quarter Mean K⁺ Concentrations
Western Reference Sites



Eastern Reference Sites

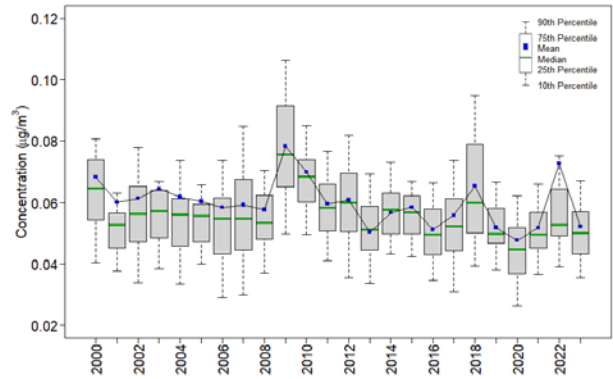
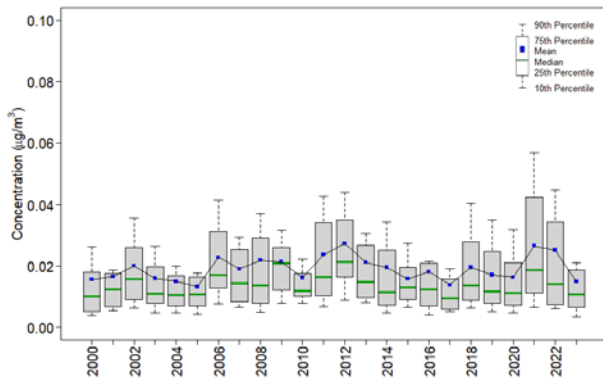


Figure 11. Trends in First Quarter Mean Mg²⁺ Concentrations
Western Reference Sites



Eastern Reference Sites

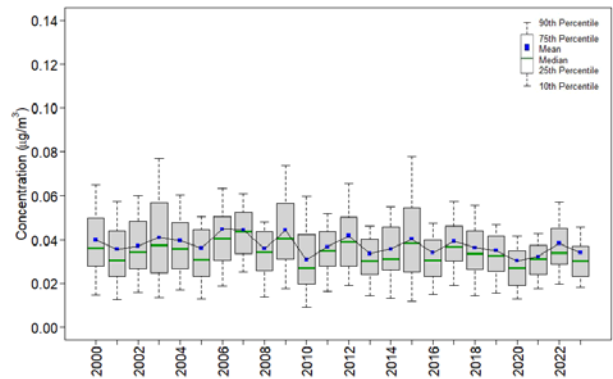
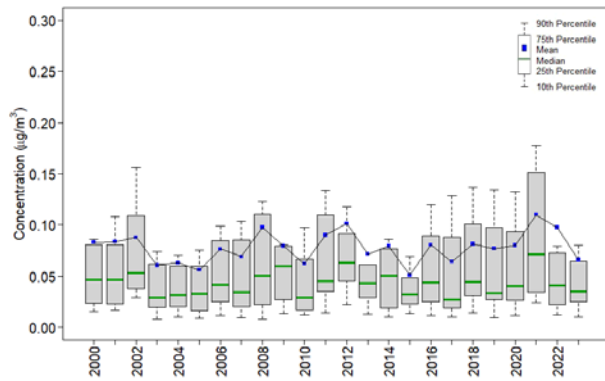


Figure 12. Trends in First Quarter Mean Na⁺ Concentrations
Western Reference Sites



Eastern Reference Sites

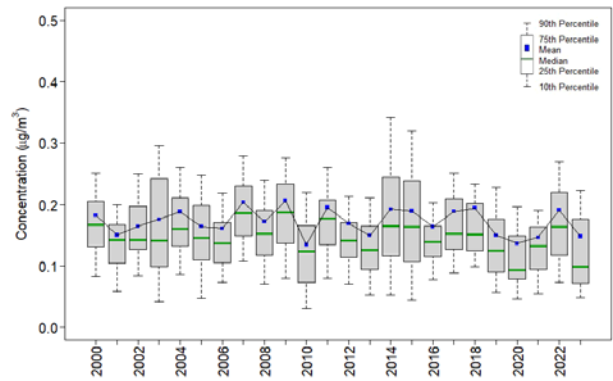
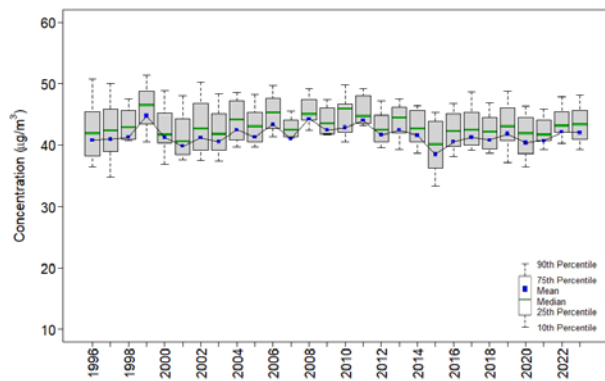
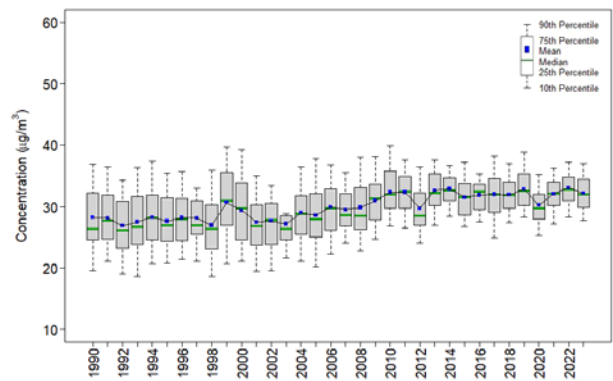


Figure 13. Trends in First Quarter Mean O₃ Concentrations
Western Reference Sites



Eastern Reference Sites



Changes in 3-year Average First Quarter Concentrations

As shown in Table 1 and Table 2, three-year averages of quarterly mean concentrations of total NO₃⁻, NH₄⁺, SO₂, and SO₄²⁻ were reduced over the period 1990–1992 through 2021–2023 for eastern reference sites and 1996–1998 through 2021–2023 for western reference sites. O₃ concentrations increased at eastern sites and showed a one percent increase at western reference sites. Ca²⁺, K⁺, Mg²⁺, and Na⁺ levels declined at eastern sites from 2004–2006 through 2021–2023. Cl⁻ values increased. At western sites, Cl⁻ and base cation concentrations increased from 2004-2006 through 2021-2023.

Table 1. Eastern Reference Sites: 3-Year Mean Values (ppb or µg/m³)

Parameter	O ₃ (ppb)	Total NO ₃ ⁻	NH ₄ ⁺	SO ₂	SO ₄ ²⁻	Ca ²⁺	K ⁺	Mg ²⁺	Na ⁺	Cl ⁻
1990–1992	28	3.4	1.5	12.5	3.6					
2004–2006						0.22	0.06	0.04	0.17	0.09
2021–2023	32	1.8	0.6	0.6	0.9	0.20	0.06	0.03	0.16	0.13
Percent Change	17	-47	-63	-95	-75	-10	-2	-13	-5	45

Note: Ozone concentrations are given as ppb. Concentrations for all other parameters are given as µg/m³.

Table 2. Western Reference Sites: 3-Year Mean Values (ppb or $\mu\text{g}/\text{m}^3$)

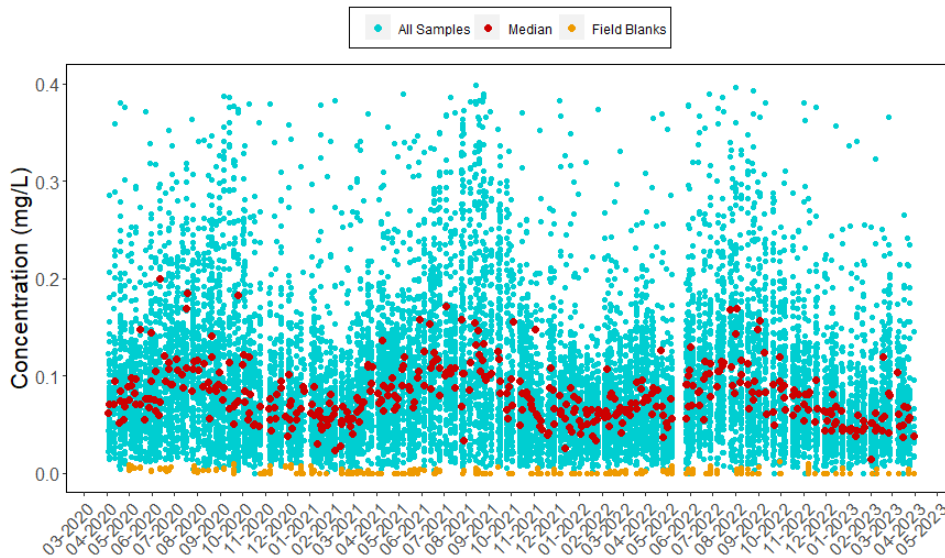
Parameter	O ₃ (ppb)	Total NO ₃ ⁻	NH ₄ ⁺	SO ₂	SO ₄ ²⁻	Ca ²⁺	K ⁺	Mg ²⁺	Na ⁺	Cl ⁻
1996–1998	41	0.8	0.2	0.6	0.6					
2004–2006						0.10	0.02	0.02	0.07	0.04
2021–2023	42	0.4	0.1	0.2	0.3	0.18	0.03	0.02	0.09	0.08
Percent Change	1	-45	-49	-68	-45	71	17	31	40	123

Note: Ozone concentrations are given as ppb. Concentrations for all other parameters are in $\mu\text{g}/\text{m}^3$.

Time Series of Laboratory Analysis Parameters for All Sites

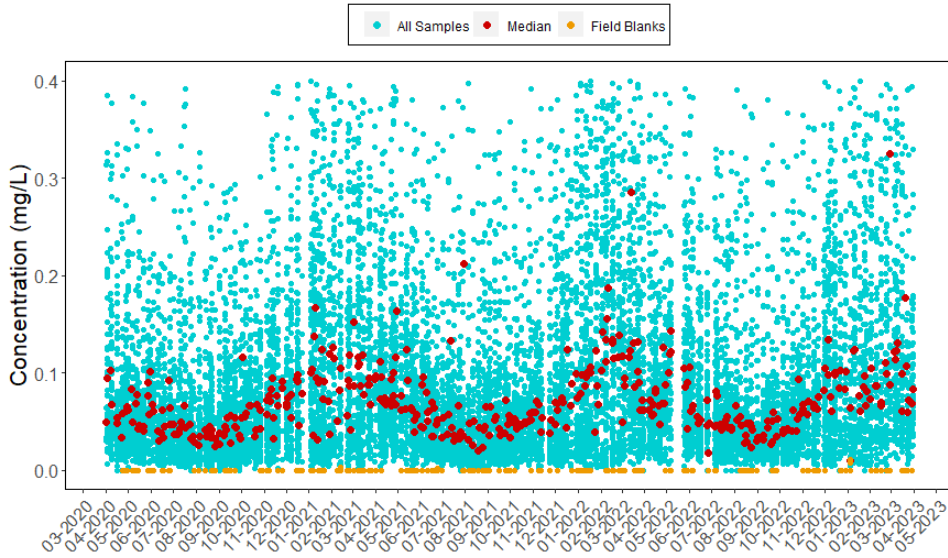
Figures 14 through 24 give time series of laboratory-analyzed concentrations of field samples and field blanks in milligrams per liter (mg/L) of 11 parameters from second quarter 2020 through first quarter 2023. These figures provide indications of potential issues with concentration measurements relative to detection and reporting limits.

Figure 14. Concentrations of NO₃⁻ (as N) from Nylon Filters



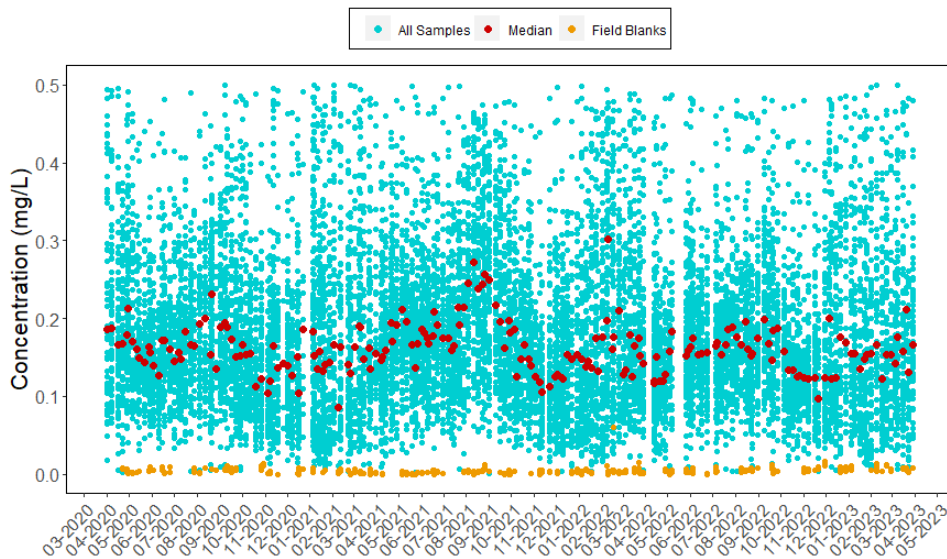
Note: Nominal reporting limit is 0.008 mg/L

Figure 15. Concentrations of NO₃ (as N) from Teflon Filters



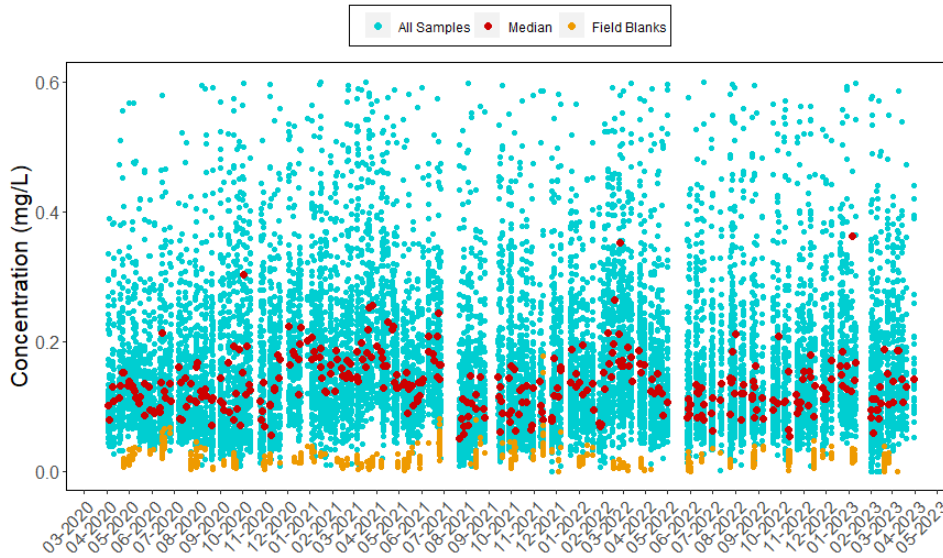
Note: Nominal reporting limit is 0.008 mg/L

Figure 16. Concentrations of NH₄⁺ (as N) from Teflon Filters



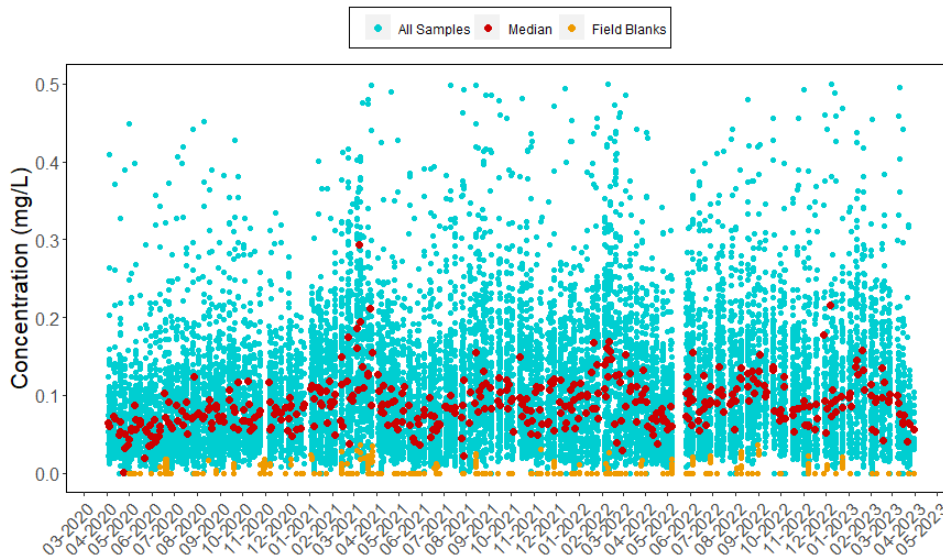
Note: Nominal reporting limit is 0.020 mg/L

Figure 17. Concentrations of SO_4^{2-} from K_2CO_3 -impregnated Cellulose Filters



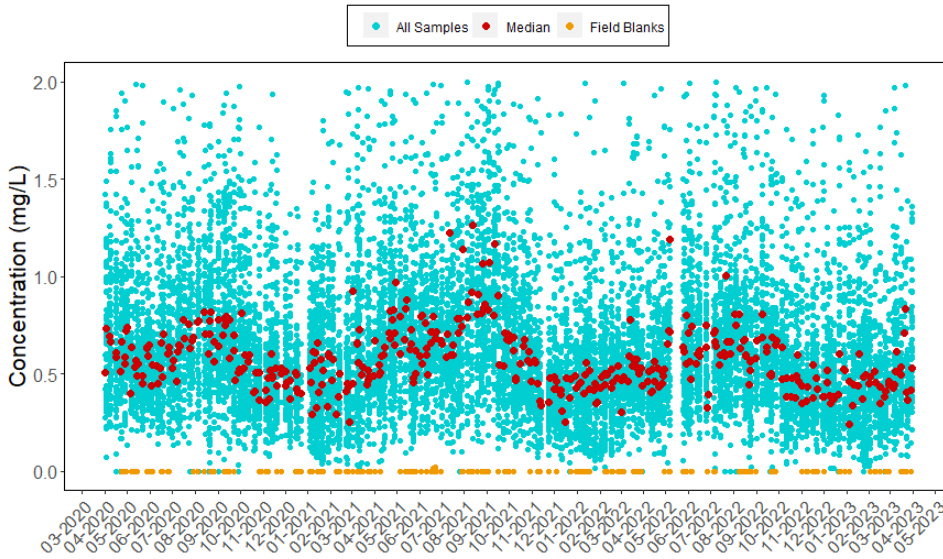
Note: Nominal reporting limit is 0.040 mg/L

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



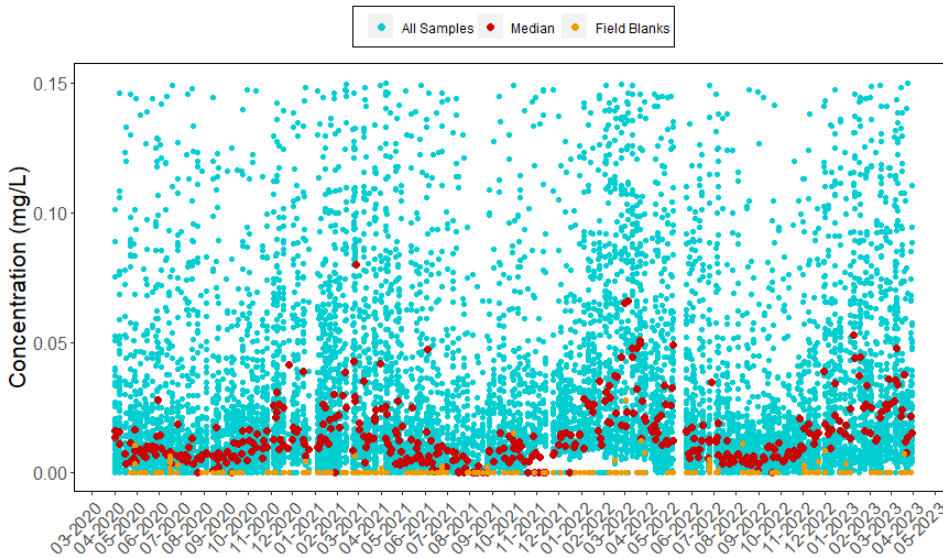
Note: Nominal reporting limit is 0.040 mg/L

Figure 19. Concentrations of SO_4^{2-} from Teflon Filters



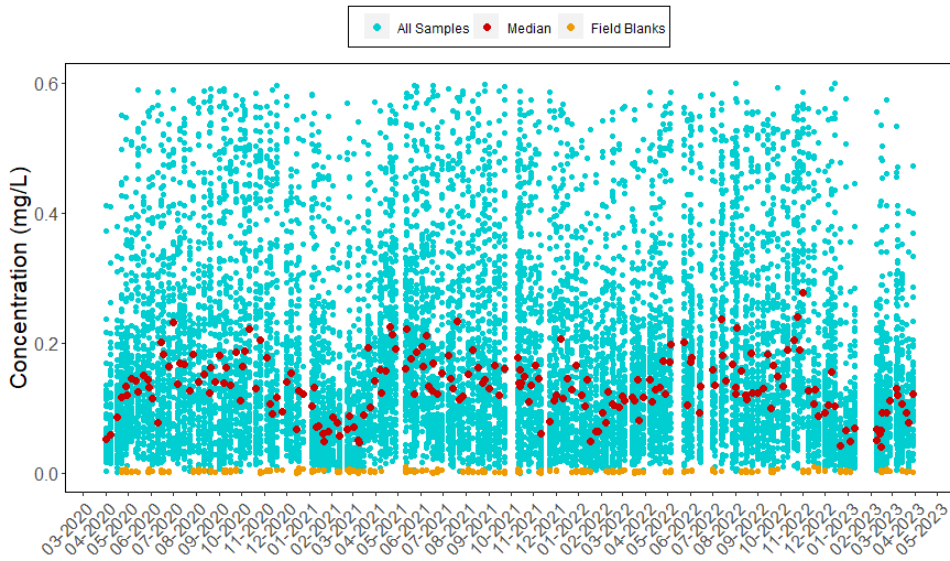
Note: Nominal reporting limit is 0.040 mg/L

Figure 20. Concentrations of Cl^- from Teflon Filters



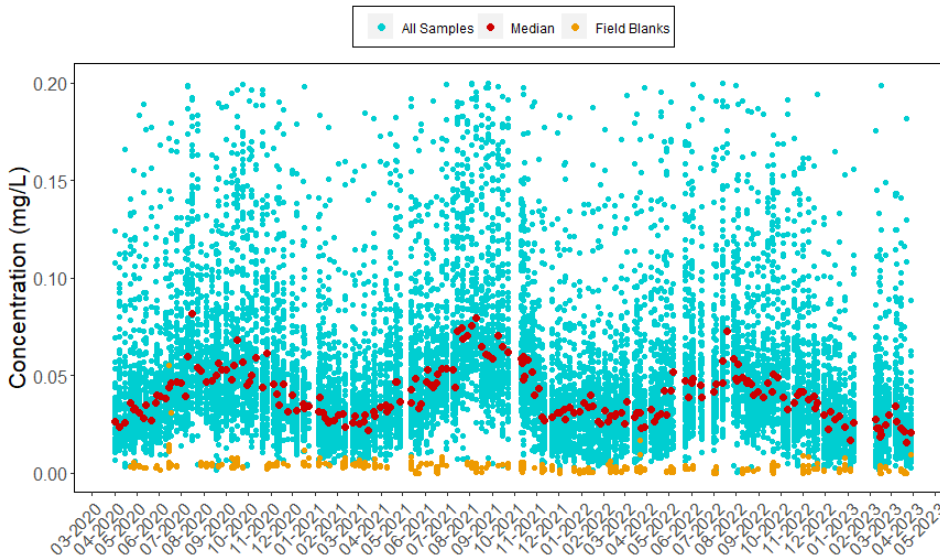
Note: Nominal reporting limit is 0.020 mg/L

Figure 21. Concentrations of Ca²⁺ from Teflon Filters



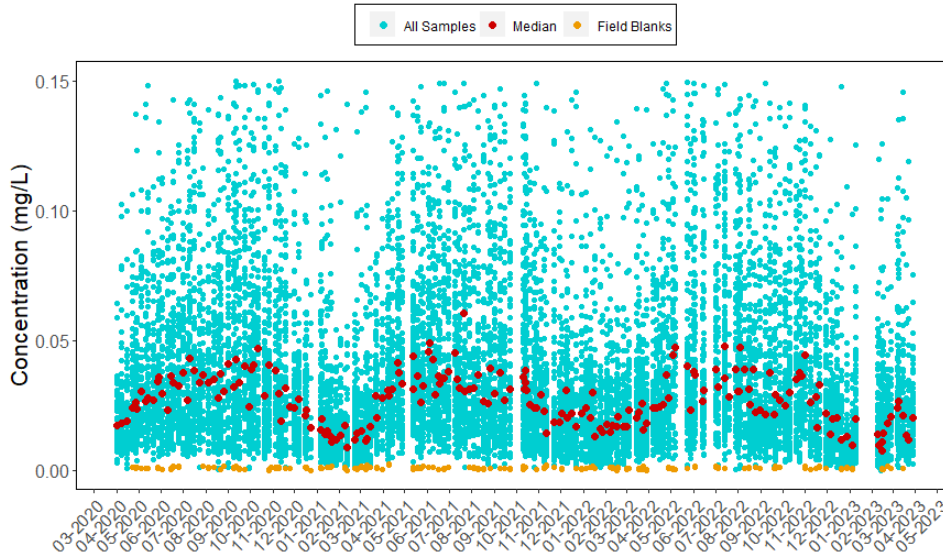
Note: Nominal reporting limit is 0.006 mg/L

Figure 22. Concentrations of K⁺ from Teflon Filters



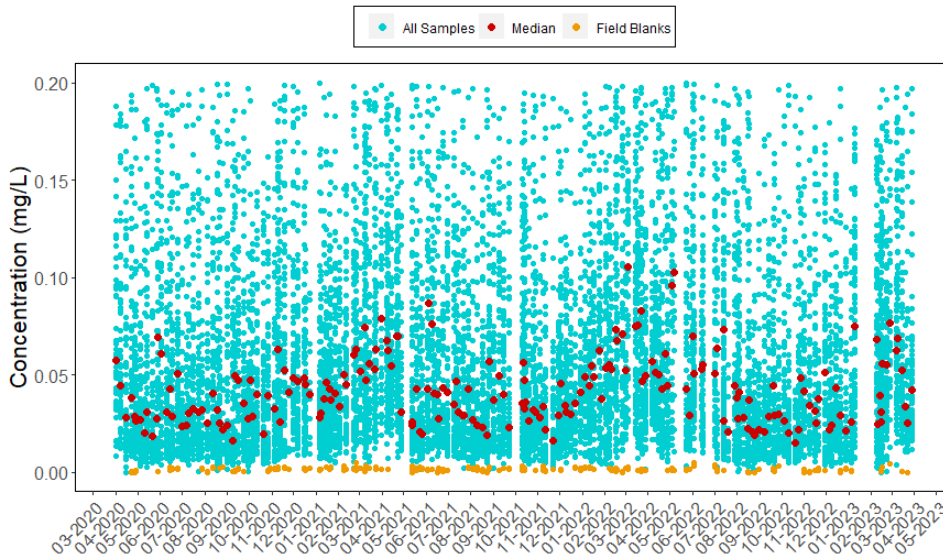
Note: Nominal reporting limit is 0.006 mg/L

Figure 23. Concentrations of Mg²⁺ from Teflon Filters



Note: Nominal reporting limit is 0.003 mg/L

Figure 24. 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 25 and 26 show times series of concentration differences between the two sets of co-located sites. The divergence of difference lines in Figure 25 was caused by flow problems at MCK231, KY during sampling weeks 4, 5 and 6.

Figure 25. Time Series of Filter Concentration Differences between MCK131 and MCK231, KY

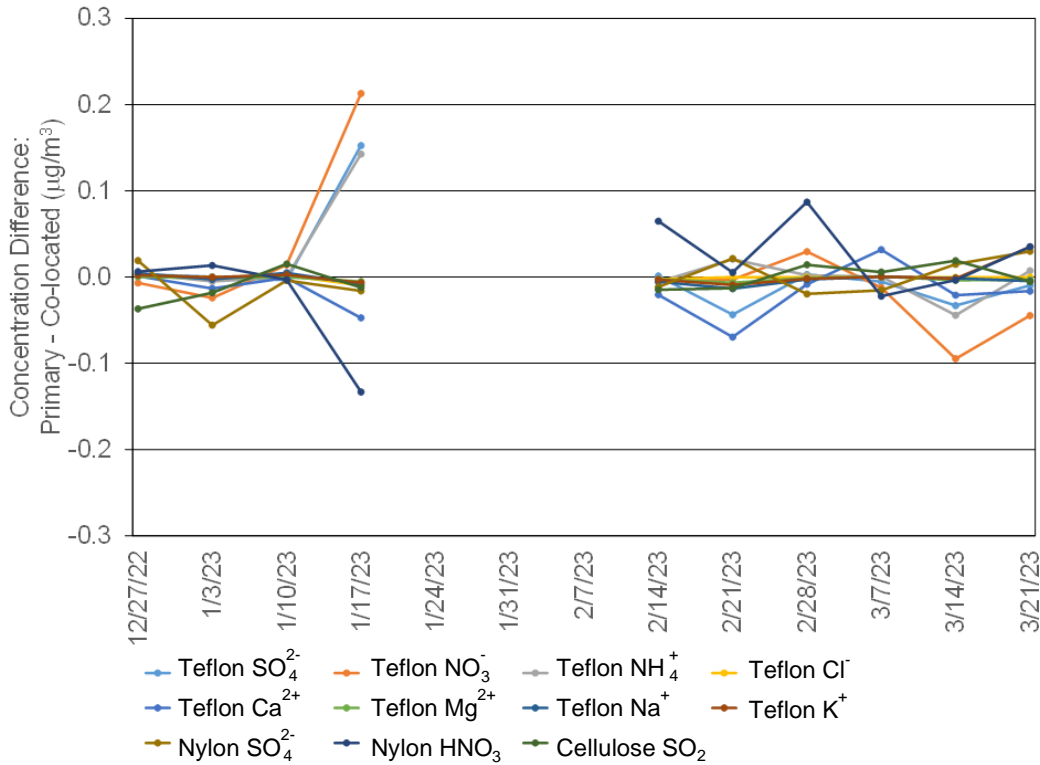
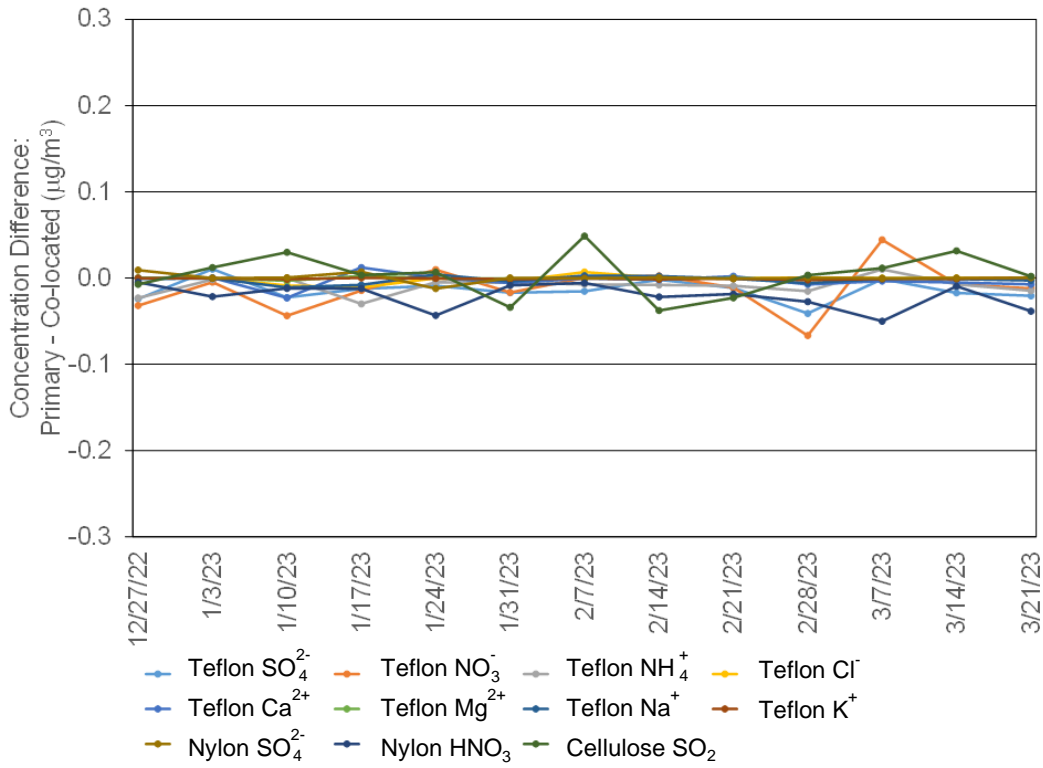


Figure 26. Time Series of Filter Concentration Differences between ROM406 and ROM206, CO



Precision of Filter Pack Concentrations

Table 3 shows mean absolute relative percent differences (MARPD) for concentrations measured at MCK131/231 and ROM406/206 during first quarter 2023. The MARPD values met the 20 percent criterion.

Table 3. Precision (MARPD) for Co-located Filter Pack Data during First Quarter 2023

	Total NO ₃ ⁻	HNO ₃	NO ₃ ⁻	NH ₄ ⁺	SO ₂	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	Na ⁺	K ⁺	Cl ⁻
MCK131/231, KY											
\bar{X} (μg/m ³)	1.02	0.88	0.50	0.22	0.03	0.08	0.06	0.04	0.71	0.40	1.77
\bar{Y} (μg/m ³)	1.01	0.88	0.49	0.24	0.03	0.08	0.05	0.04	0.71	0.41	1.58
MAD	0.03	0.05	0.02	0.02	0.00	0.00	0.01	0.00	0.05	0.02	0.05
MARPD	2.30	5.45	4.42	10.32	9.28	5.39	9.25	3.63	7.00	4.77	3.49
ROM406/206, CO											
\bar{X} (μg/m ³)	0.27	0.28	0.15	0.06	0.01	0.03	0.01	0.03	0.20	0.13	0.48
\bar{Y} (μg/m ³)	0.28	0.29	0.16	0.06	0.01	0.03	0.01	0.03	0.23	0.13	0.52
MAD	0.02	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.03	0.02	0.04
MARPD	8.07	13.59	7.04	12.16	14.94	14.80	10.79	8.84	13.77	19.82	10.86

Completeness for Filter Pack Concentrations

Table 4 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.

Table 4. Sites with less than 90 Percent Data Completeness for Filter Concentrations for First Quarter 2023 (1 of 3)

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
ANA115, MI	0	0	0	0	0	0	0	0	Site was mothballed due to EPA's FY2022 budget.
ASH135, ME	0	0	0	0	0	0	0	0	Site was mothballed due to EPA's FY2022 budget.
BWR139, MD	77	77	77	77	77	77	77	77	Two-week samples were collected twice during the quarter and an additional sample was lost because the filter pack was not securely installed.
CDR119, WV	0	0	0	0	0	0	0	0	Site was mothballed due to EPA's FY2022 budget.
CDZ171, KY	0	0	0	0	0	0	0	0	Site was mothballed due to EPA's FY2022 budget.
DCP114, OH	0	0	0	0	0	0	0	0	Site was mothballed due to EPA's FY2022 budget.
DEN417, AK	85	85	85	85	85	85	85	85	Two filter packs appeared to be unexposed and were invalidated.
EGB181, ON	15	15	15	15	15	15	15	15	This site had polling issues that required manual data download. Only two weeks of flow data were available for calculation of atmospheric concentrations for this report.
GLR468, MT	69	69	69	69	69	69	69	69	One 3-week sample was collected during the quarter. Two additional filter pack samples were lost because of power failure.
GRC474, AZ	85	85	85	85	85	85	85	85	A 2-week sample was cancelled due to weather conditions.
GTH161, CO	85	85	85	85	85	85	85	85	Two filter packs appeared to be unexposed and were invalidated.

Table 4. Sites with less than 90 Percent Data Completeness for Filter Concentrations for First Quarter 2023 (2 of 3)

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
HWF187, NY	0	0	0	0	0	0	0	0	Site was mothballed due to EPA's FY2022 budget.
KIC003, KS	77	77	77	77	77	77	77	77	The site was not operated in mid-March due to personnel issues. Site returned to operation in June.
LAV410, CA	62	62	62	62	62	62	62	62	The last fourth quarter 2022 sample was installed for 3 weeks, which affected two first quarter 2023 samples. In addition, a 3-week and a 2-week sample were collected during the quarter.
LPO010, CA	70	70	70	70	70	70	70	70	The site was installed 1/26/23 and sampling started with week 4. A 3-week sample was installed on week 5 and 2-week sample was installed on week 11.
MCK231, KY	77	77	77	77	77	77	77	77	There was a flow system leak that affected three samples.
MEV405, CO	85	85	85	85	85	85	85	85	Two 2-week samples were collected during the quarter.
MKG113, PA	69	69	69	69	69	69	69	69	A mass flow controller malfunction affected four samples.
NEC602, WY	77	77	77	77	77	77	77	77	From 2/13/23 - 3/2/23 the pump for the flow system was installed backwards.
PNF126, NC	0	0	0	0	0	0	0	0	Site was mothballed due to EPA's FY2022 budget.
PSU106, PA	0	0	0	0	0	0	0	0	Site was mothballed due to EPA's FY2022 budget.
QAK172, OH	85	85	85	85	85	85	85	85	One 3-week sample was operated during the quarter and another sample was invalidated due to a Teflon and Nylon filter swap.

Table 4. Sites with less than 90 Percent Data Completeness for Filter Concentrations for First Quarter 2023 (3 of 3)

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
SAN189, NE	85	85	85	85	85	85	85	85	The last fourth quarter 2022 sample was installed for 2 weeks, which affected one first quarter sample. In addition, a 2-week sample was collected during the quarter.
SHE604, WY	85	85	85	85	85	85	85	85	One 2-week sample was collected and one filter pack was lost during shipping.
UND002, VT	0	0	0	0	0	0	0	0	Site was mothballed due to EPA's FY2022 budget.
VOY413, MN	77	77	77	77	77	77	77	77	Filter pack flow was restricted until 3/15/23.
WST109, NH	0	0	0	0	0	0	0	0	Site was mothballed due to EPA's FY2022 budget.
YOS404, CA	69	69	69	69	69	69	69	69	One 3-week sample and two 2-week samples were collected during the quarter.

Precision of Ozone Concentrations

Time series of co-located hourly O₃ concentration differences for first quarter 2023 are provided in Figures 27 and 28 for MCK131/231 and ROM406/206, respectively. The figures indicate no consistent bias between the co-located analyzers at these site locations.

Figure 27. Time Series of the Difference in Co-located O₃ Concentrations for MCK131/231, KY

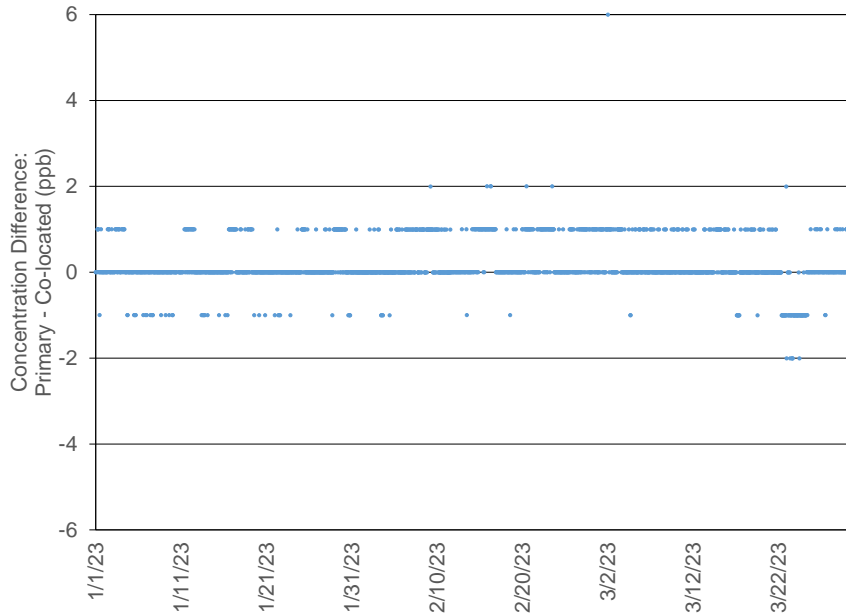


Figure 28. Time Series of the Difference in Co-located O₃ Concentrations for ROM406/206, CO

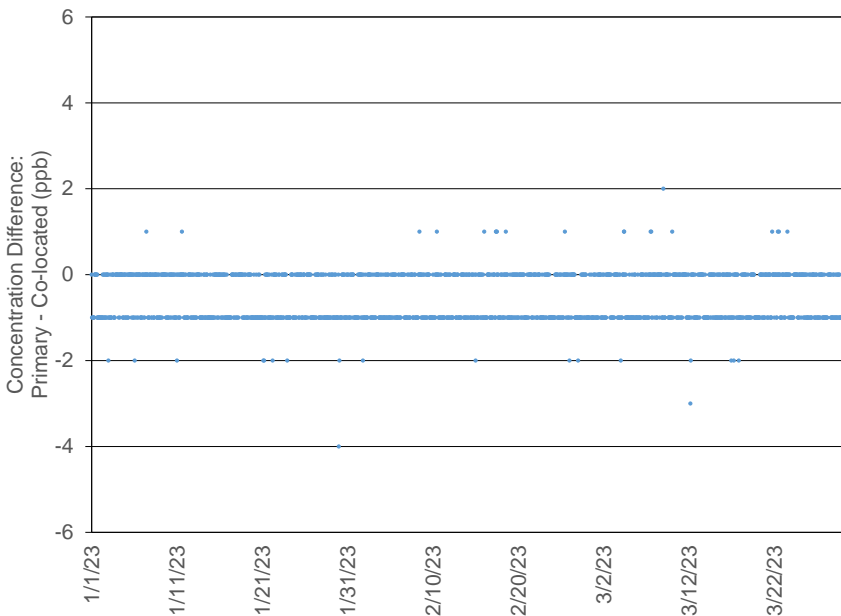


Table 5 gives MARPD data for O₃ data measured at the two co-located sites.

Table 5. Quarterly Precision (MARPD) for Co-located O₃ Concentrations

Site Pair	Quarter	Start Date	MARPD	Records
MCK131/231, KY				
	2	4/1/22	0.6	2066
	3	7/1/22	0.8	2058
	4	10/1/22	0.6	2098
	1	1/1/23	0.9	2040
ROM406/206, CO				
	2	4/1/22	1.5	1932
	3	7/1/22	1.8	1638
	4	10/1/22	1.5	1531
	1	1/1/23	1.2	2046

Completeness for Ozone Concentrations

Calculation of an annual O₃ value requires 75 percent completeness. However, calculation of the 3-year design value used for regulatory purposes requires 90 percent completeness. Table 6 shows CASTNET sites with less than 90 percent completeness for DM8A O₃ concentrations. Comments are provided for these sites.

Tables 6. Sites with less than 90 Percent Data Completeness for DM8A Concentrations during First Quarter 2023

Site ID	Percent Completeness	Comments
ASH135, ME	0	Site was mothballed due to EPA's FY2022 budget.
BBE401, TX	74	Data were invalid 3/2/23 - 3/15/23 due to a pump failure and leak.
CDR119, WV	0	Site was mothballed due to EPA's FY2022 budget.
CDZ171, KY	0	Site was mothballed due to EPA's FY2022 budget.
CND125, NC	81	High shelter and bench temperatures occurred in March due to a malfunctioning air conditioner. The air conditioner was replaced March 30.
DCP114, OH	0	Site mothballed due to EPA's FY2022 budget.
DEN417, AK	74	Data were invalid 2/16/23 - 3/8/23 due to a sample pump failure.
GLR468, MT	83	Data were invalid 3/8/23 - 3/12/23 because the cap was left on the inlet.
HWF187, NY	0	Site was mothballed due to EPA's FY2022 budget.
LAV410, CA	82	Data were invalid 2/14/23 - 2/21/23 due to a sample pump failure.
PNF126, NC	0	Site was mothballed due to EPA's FY2022 budget.
SAN189, NE	84	The sample pump failed 2/17 and was replaced 2/28.
VOY413, MN	82	Data were invalid intermittently from January through early February due to an issue with the lamp intensity.
WST109, NH	0	Site was mothballed due to EPA's FY2022 budget.

Table 7 shows CASTNET sites with less than 90 percent completeness for hourly O₃ concentrations. Comments are provided for these sites. The annual average for each of these sites is included for reference.

Table 7. Sites with less than 90 Percent Data Completeness for O₃ Concentrations

Site ID	Q1 2023	Q2 2022– Q1 2023	Comments
ASH135, ME	0	9	Site was mothballed due to EPA's FY2022 budget.
BBE401, TX	80	91	Data were invalid 3/2/23 - 3/15/23 due to a pump failure and leak.
CDR119, WV	0	11	Site was mothballed due to EPA's FY2022 budget.
CDZ171, KY	0	11	Site was mothballed due to EPA's FY2022 budget.
DCP114, OH	0	11	Site was mothballed due to EPA's FY2022 budget.
DEN417, AK	76	83	Data were invalid 2/16/23 - 3/8/23 due to a sample pump failure.
GLR468, MT	85	93	Data were invalid 3/8/23 - 3/12/23 because the cap was left on the inlet.
HWF187, NY	0	11	Site was mothballed due to EPA's FY2022 budget.
LAV410, CA	88	91	Data were invalid 2/14/23 - 2/21/23 due to a sample pump failure.
PNF126, NC	0	11	Site was mothballed due to EPA's FY2022 budget.
SAN189, NE	86	94	The sample pump failed 2/17 and was replaced 2/28.
VOY413, MN	81	92	Data were invalid intermittently from January through early February due to an issue with the lamp intensity.
WST109, NH	0	11	Site was mothballed due to EPA's FY2022 budget.

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

Figures 29 through 36 show a comparison of weekly average continuous NO_y measurements with weekly filter pack total NO₃ concentrations collected at the six of eight sites with NO_y measurements. The NO_y concentrations were consistently higher than the total NO₃ levels at all sites. The average weekly NO_y levels, the weekly total NO₃ concentrations, and their ratios for the six sites with available data are shown in Table 8. Ratios of NO_y to total NO₃ varied from 3.45 at BVL130 to 6.75 at ROM206. No data are available from HWF187 and PNF126 for first quarter 2023. These sites were mothballed in May 2022 due to EPA's budget constraints.

Table 8. Summary of Total NO₃/NO_y Measurements for First Quarter 2023

Site ID	Elevation	Total NO ₃ (ppb)	NO _y (ppb)	Ratio
DUK008, NC	164*	0.82	2.53	3.67
BVL130, IL	213	1.14	3.80	3.45
MAC426, NY	243	0.68	2.71	4.25
HWF187, NY [‡]	497	Site was mothballed due to EPA's FY2022 budget.		
GRS420, TN	793	0.39	1.53	3.98
PNF126, NC [‡]	1216	Site was mothballed due to EPA's FY2022 budget.		
PND165, WY	2386	0.14	0.72	5.64
ROM206, CO	2742	0.16	1.01	6.75

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

[‡]The site was mothballed in second quarter 2022 due to EPA's FY2022 budget. No measurements were recorded during first quarter 2023.

Figure 29. Comparison of DUK008 Weekly Mean NO_y and Total NO₃⁻ Concentrations

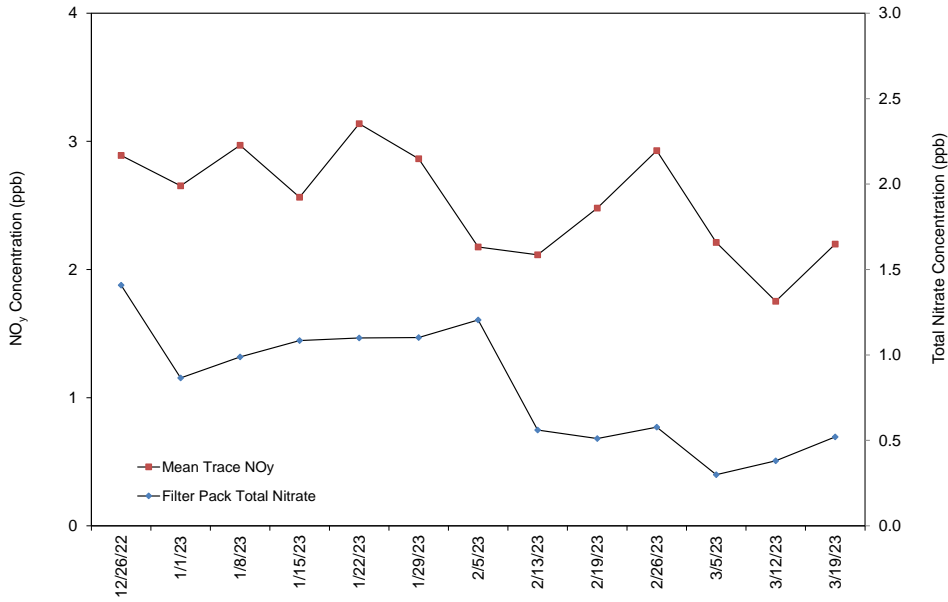


Figure 30. Comparison of BVL130 Weekly Mean NO_y and Total NO₃⁻ Concentrations

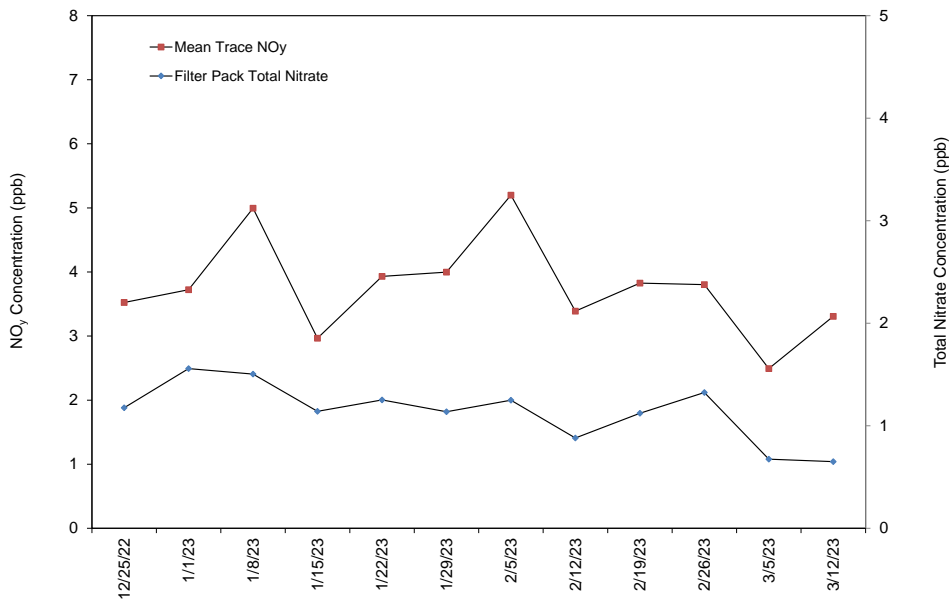


Figure 31. Comparison of MAC426 Weekly Mean NO_y and Total NO₃⁻ Concentrations



Figure 32. Comparison of HWF187 Weekly Mean NO_y and Total NO₃⁻ Concentrations

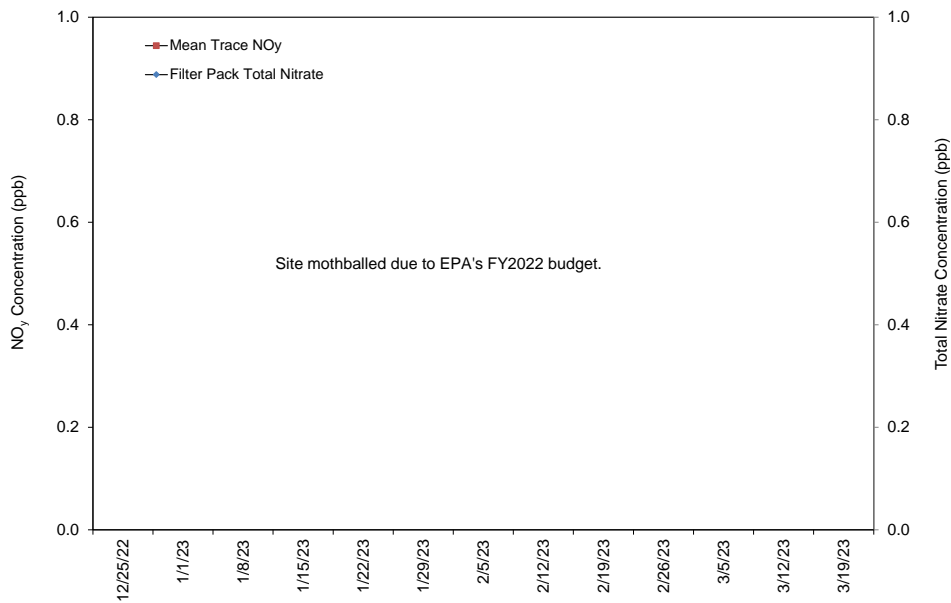


Figure 33. Comparison of GRS420 Weekly Mean NO_y and Total NO₃⁻ Concentrations

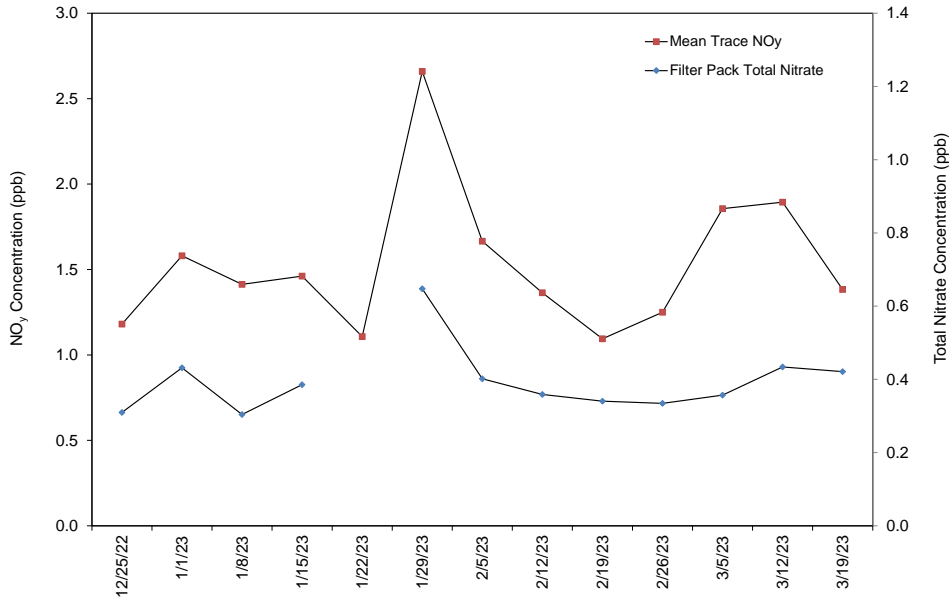


Figure 34. Comparison of PNF126 Weekly Mean NO_y and Total NO₃⁻ Concentrations

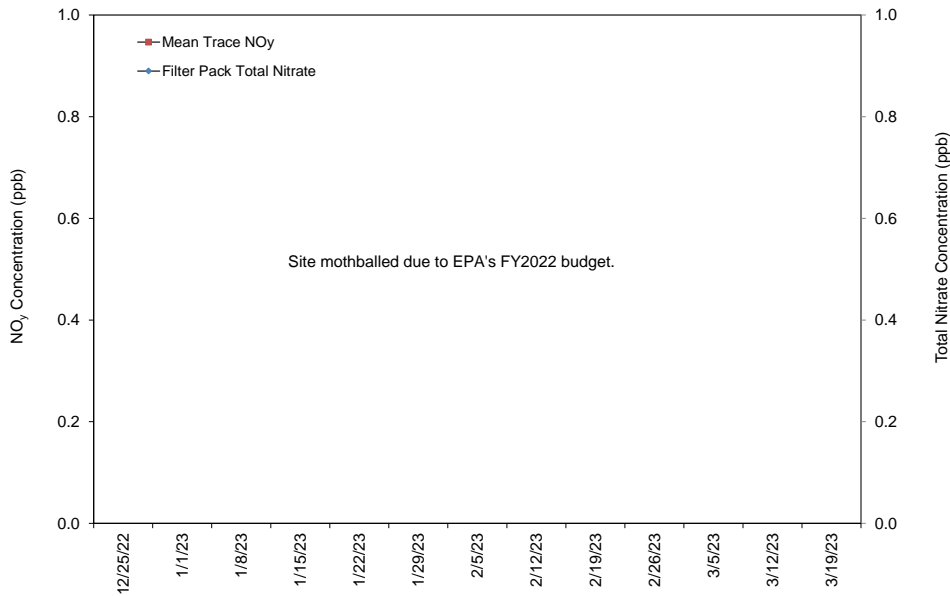


Figure 35. Comparison of PND165 Weekly Mean NO_y and Total NO₃⁻ Concentrations

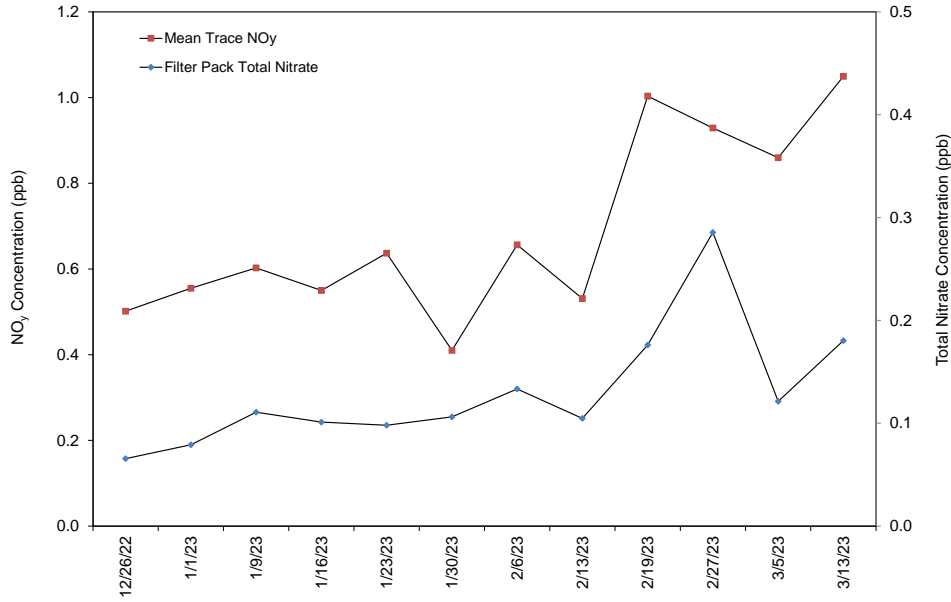
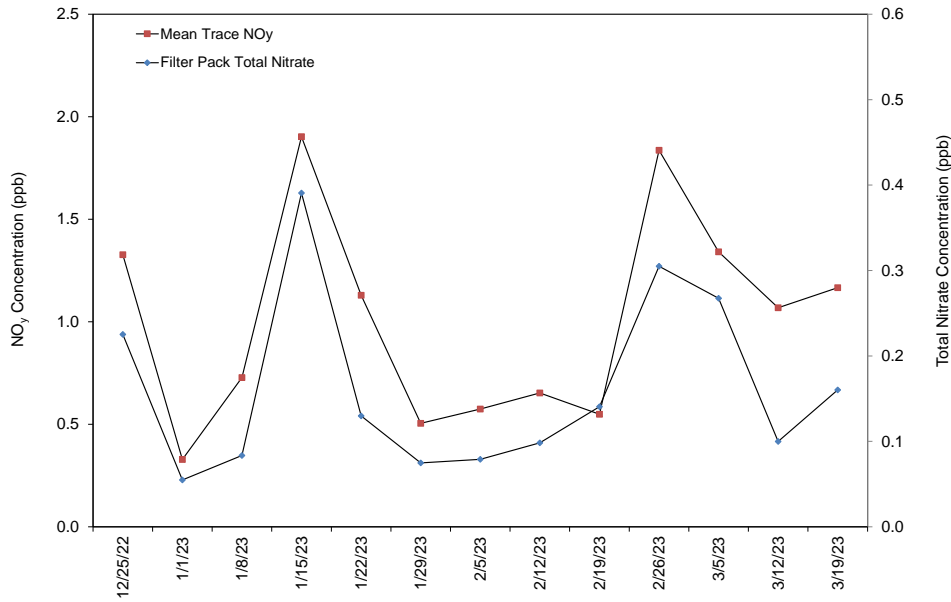


Figure 36. Comparison of ROM206 Weekly Mean NO_y and Total NO₃⁻ Concentrations



Filter Pack and Continuous Trace-level Gas Sulfur Dioxide Concentrations

Figures 37 through 39 provide diagrams that compare weekly filter pack SO₂ concentrations with continuous trace-level gas data measured at BVL130, MAC426, and GRS420. The continuously measured trace-level concentrations were comparable to the filter pack concentrations at MAC426 and were apparently unrelated at BVL130 and GRS420.

Figure 37. Comparison of BVL130 Weekly Mean SO₂ Concentrations

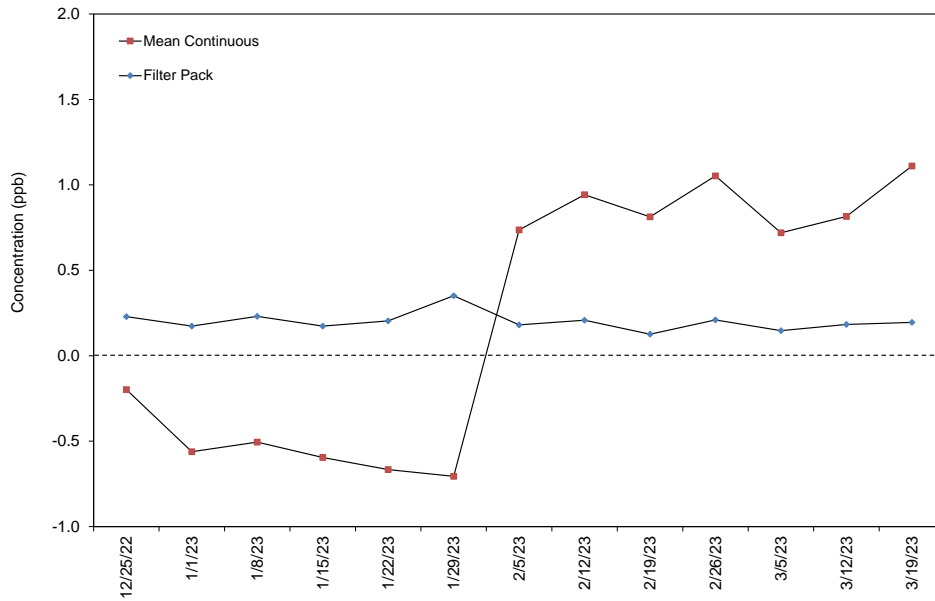


Figure 38. Comparison of MAC426 Weekly Mean SO₂ Concentrations

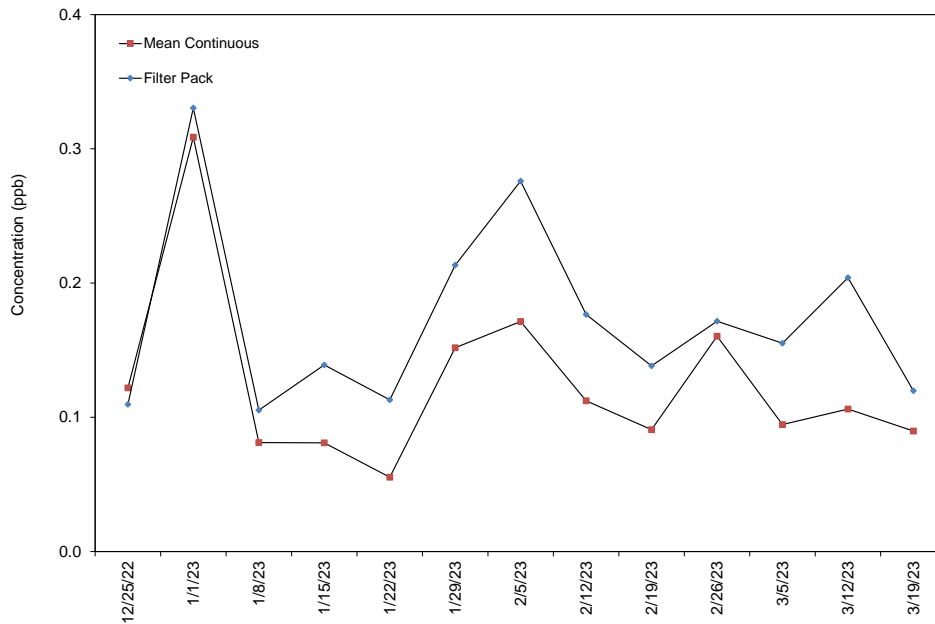
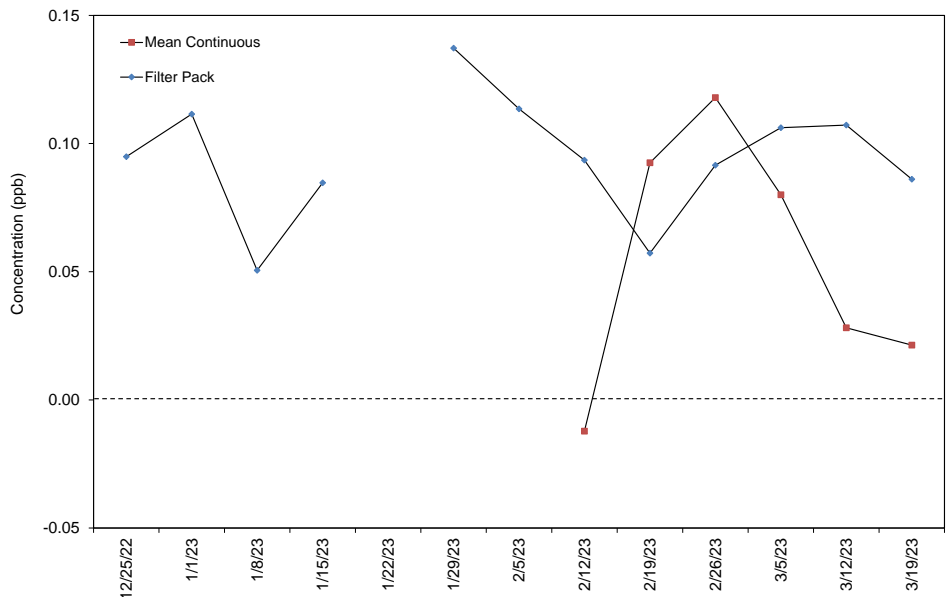


Figure 39. Comparison of GRS420 Weekly Mean SO₂ Concentrations



Completeness for Continuous Trace-level Gas measurements

Table 9 shows the percent completeness for CASTNET trace-level gas measurements. Comments are provided for sites with less than 90 percent completeness (shaded) for hourly trace-level gas concentrations during first quarter 2023. The average for second quarter 2022 through first quarter 2023 for each of the sites is included for reference.

Table 9. Percent Data Completeness for Continuous Trace-level Gas Measurements (1 of 2)

Site ID	Parameter	Q1 2023	Q2 2022– Q1 2023	Comments
BVL130, IL	CO	23	38	The analyzer was recalibrated on 3/9 because of analyzer drift.
	NO	92	83	
	NOY	92	77	
	NOYDIF	92	77	
	SO2_GA	86	88	SO2_GA data were invalidated when the instrument was affected by troubleshooting activities for CO.
CHC432, NM	NO	98	98	
	NOX	98	98	
	NOXDIF	98	98	
DUK008, NC	HNO3	59	69	Suspect data from January were invalidated. Sampling system leak affected data from mid to late March.
	NH3	82	61	
	NO	91	80	
	NO2_TRUE	91	80	
	NOX_TRUE	91	80	
	NOY	91	80	
	NOY_MINUS	59	69	
	NOYDIF	91	80	
	TNX	82	63	

Table 9. Percent Data Completeness for Continuous Trace-level Gas Measurements (2 of 2)

Site ID	Parameter	Q1 2023	Q2 2022– Q1 2023	Comments
GRS420, TN	CO	94	88	Data were invalid 1/1/23 - 2/15/23 due to a bad lamp and a possible leak.
	NO	95	94	
	NOY	95	94	
	NOYDIF	92	92	
	SO2_GA	46	72	
HWF187, NY	NO	0	10	Site was mothballed due to EPA's FY2022 budget.
	NOY	0	10	
	NOYDIF	0	10	
MAC426, KY	CO	87	92	Data were invalid 2/16/23 - 2/23/23 due to a bad power supply.
	NO	97	97	
	NOY	97	97	
	NOYDIF	97	97	
	SO2_GA	97	92	
PND165, WY	NO	96	93	
	NOY	96	91	
	NOYDIF	96	91	
PNF126, NC	NO	0	9	Site was mothballed due to EPA's FY2022 budget.
	NOY	0	9	
	NOYDIF	0	9	
ROM206, CO	NO	94	95	
	NOY	94	95	
	NOYDIF	94	95	

Note: * See Table 10

The parameters listed in Table 9 are both calculated and measured. Table 10 provides information on how the parameters listed in Table 9 are obtained.

Table 10. 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 convert at 315° Celsius

Reference

Prenni, Anthony J., Katherine B. Benedict, Derek E. Day, Barkley C. Sive, Yong Zhou, Lilly Naimie, Kristi A. Gebhart, Tracy Dombek, Miranda De Boskey, Nicole P. Hyslop, Emily Spencer, Quayle M. Chew, Jeffrey L. Collett Jr. & Bret A. Schichtel (2022) Wintertime haze and ozone at Dinosaur National Monument, *Journal of the Air & Waste Management Association*, 72:9, 951-968, DOI: 10.1080/10962247.2022.2048922

WSP USA Environment & Infrastructure Inc. 2023. Clean Air Status and Trends Network (CASTNET) First Quarter 2023 Quality Assurance Report. <https://java.epa.gov/castnet/documents.do>