

Clean Air Status and Trends Network (CASTNET) Quarterly Data Summary for First Quarter 2019 (January through March)

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

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Introduction

This quarterly report summarizes the Clean Air Status and Trends Network (CASTNET) data collected during first quarter 2019. 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 O₃ concentrations. This report also analyzes data on continuous, trace-level NO_y from eight sites and continuous SO₂ concentrations from three sites. Other QC statistics are given in the CASTNET First Quarter 2019 Quality Assurance Report (Wood, 2019).

Figure 1. Fourth Highest Daily Maximum 8-hour Average O₃ Concentrations through First Quarter 2019



Figure 1 shows fourth highest daily maximum 8-hour average (DM8A) O₃ concentrations measured through first quarter 2019. No sites exceeded the 0.070 parts per million (ppm) National Ambient Air Quality Standard for O₃. Dinosaur National Monument, UT (DIN431) was the only site that equaled the NAAQS. The highest DM8A concentrations at DIN431 were observed in February 2019 during stagnant weather with shallow inversions and snow cover, conditions that were shown to produce high O₃ levels in the Uinta Basin (Lyman *et al.*, 2016).

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

Quarterly mean HNO₃, SO₂, Cl⁻, K⁺, Mg²⁺, and Na⁺ concentrations decreased at eastern sites in 2019, and NO₃⁻, NH₄⁺, total NO_{3,4}⁻, and SO₄²⁻ concentrations increased. Ca²⁺ concentrations did not change. Quarterly mean NO₃⁻, SO₂, Cl⁻, Ca²⁺, K⁺, Mg²⁺, and Na⁺ concentrations decreased at western sites in 2019 while HNO₃, NH₄⁺, total NO_{3,4}⁻, and SO₄²⁻ concentrations increased.

Quarterly O₃ concentrations were analyzed using box plots constructed by averaging all valid hourly O₃ concentrations within first quarter 2019 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. Mean O₃ concentrations at western sites, which were higher than at the eastern sites, increased in first quarter 2019.

Figure 2. Trends in First Quarter Mean HNO₃ Concentrations

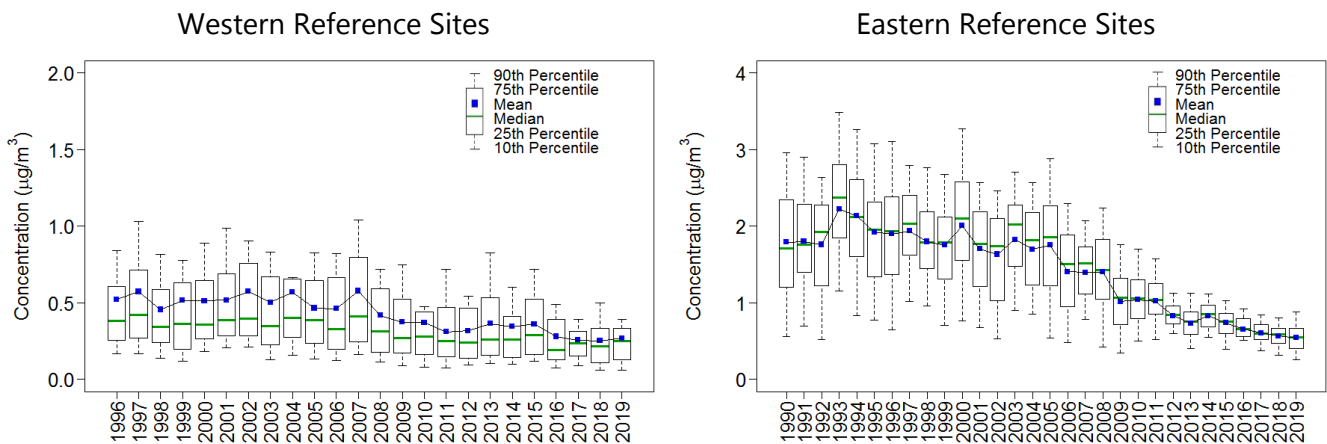


Figure 3. Trends in First Quarter Mean NO₃ Concentrations

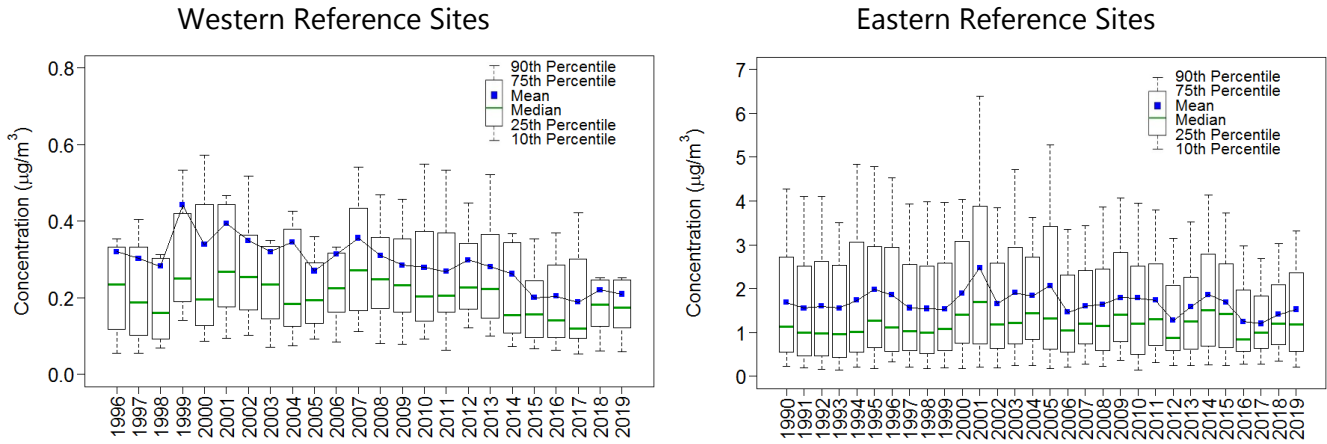


Figure 4. Trends in First Quarter Mean NH₄⁺ Concentrations

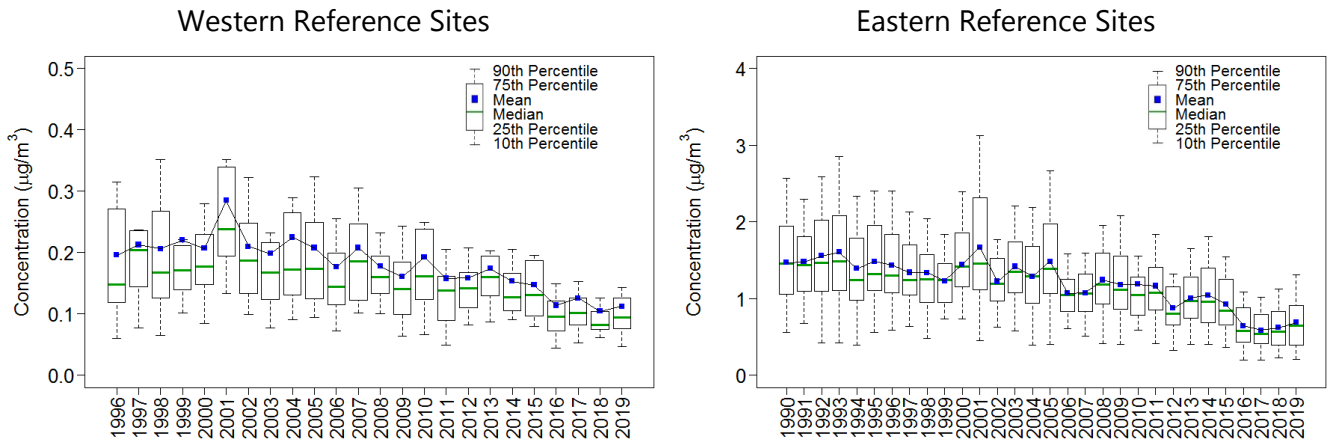


Figure 5. Trends in First Quarter Mean Total NO₃ Concentrations

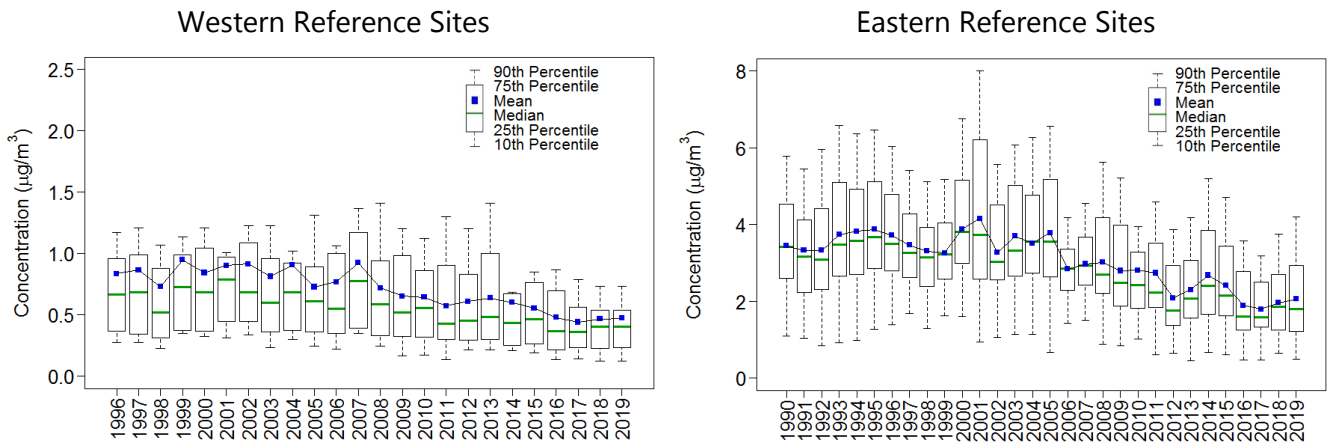


Figure 6. Trends in First Quarter Mean SO₂ Concentrations

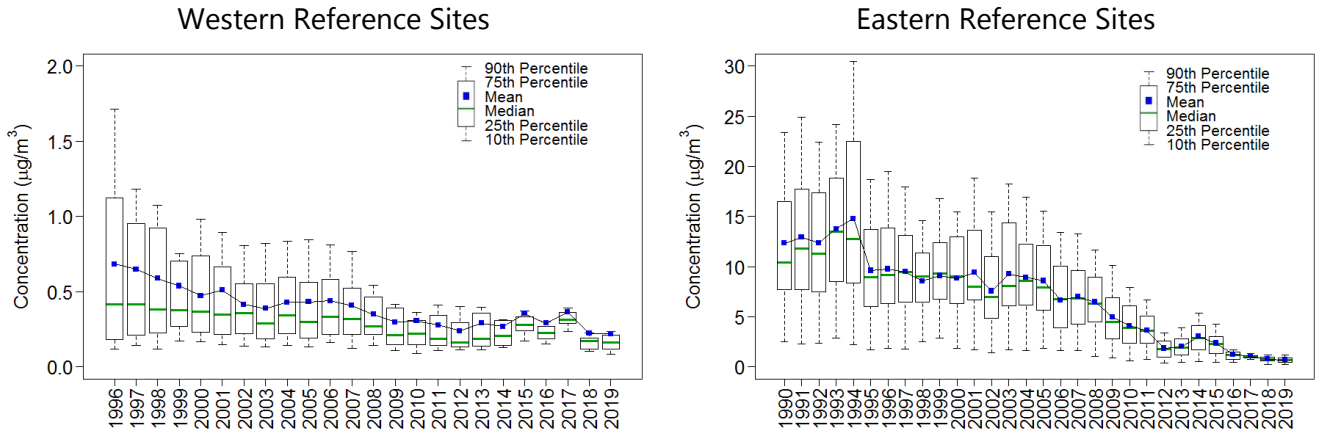


Figure 7. Trends in First Quarter Mean SO₄²⁻ Concentrations

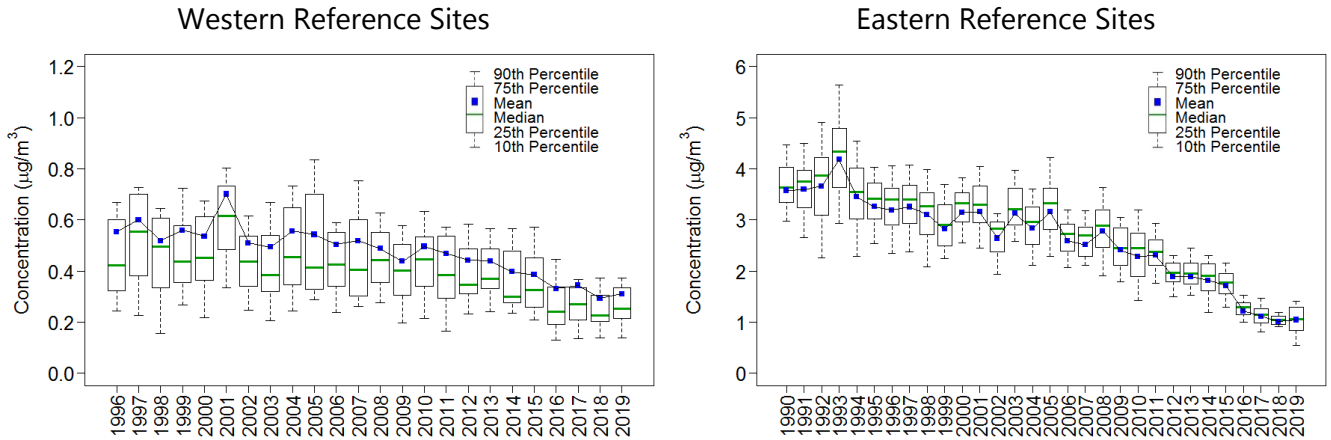


Figure 8. Trends in First Quarter Mean Cl⁻ Concentrations

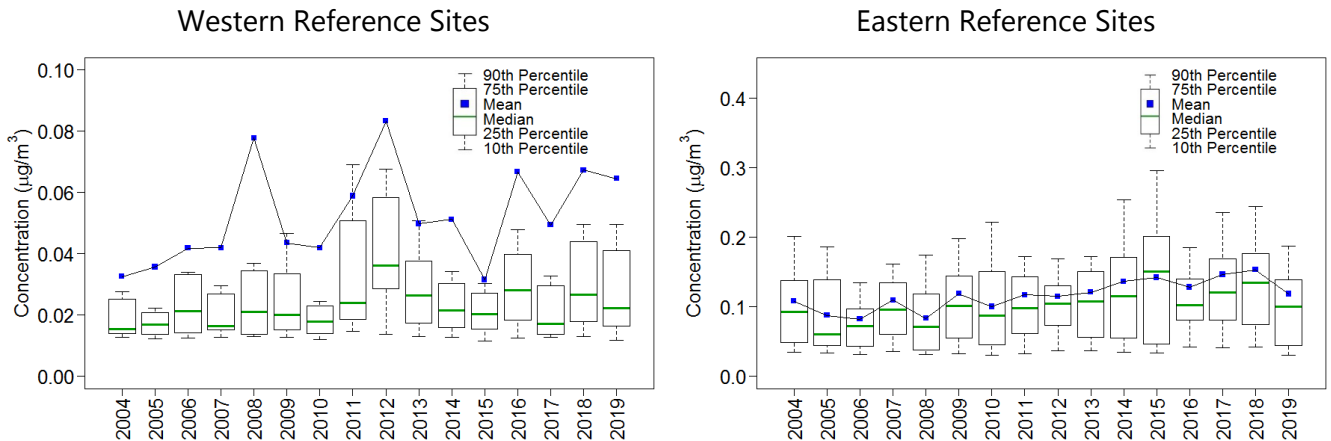


Figure 9. Trends in First Quarter Mean Ca²⁺ Concentrations

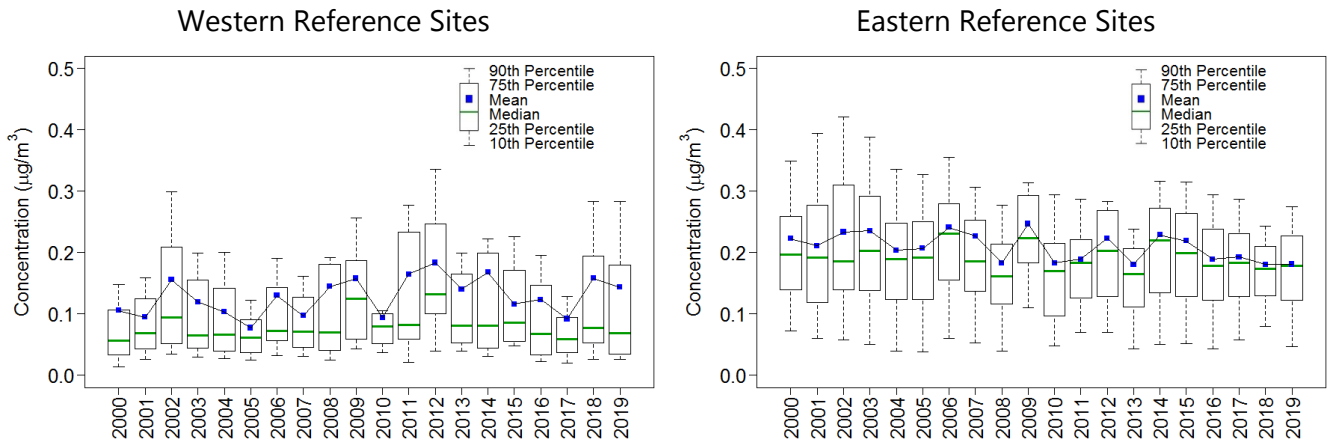


Figure 10. Trends in First Quarter Mean K⁺ Concentrations

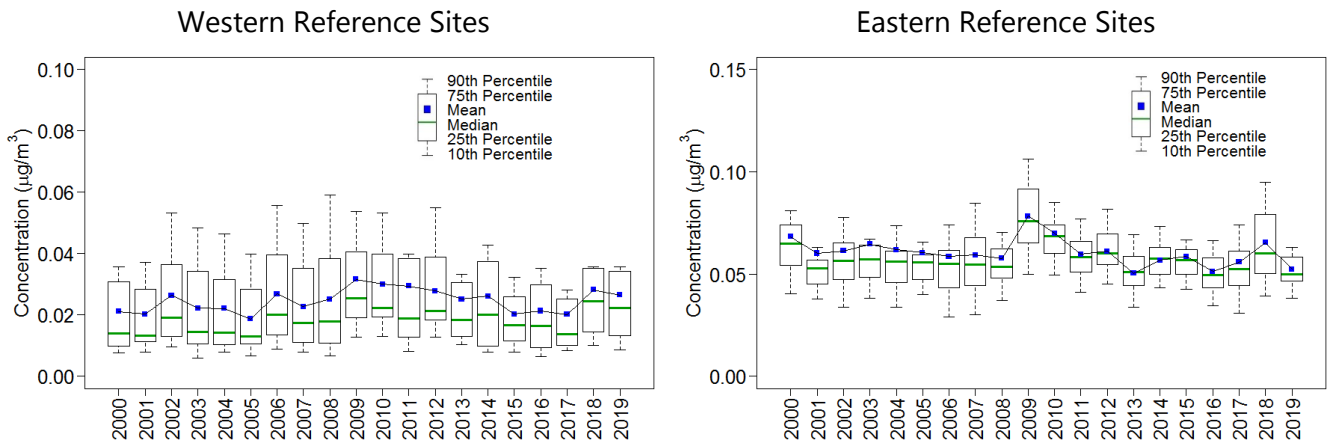


Figure 11. Trends in First Quarter Mean Mg²⁺ Concentrations

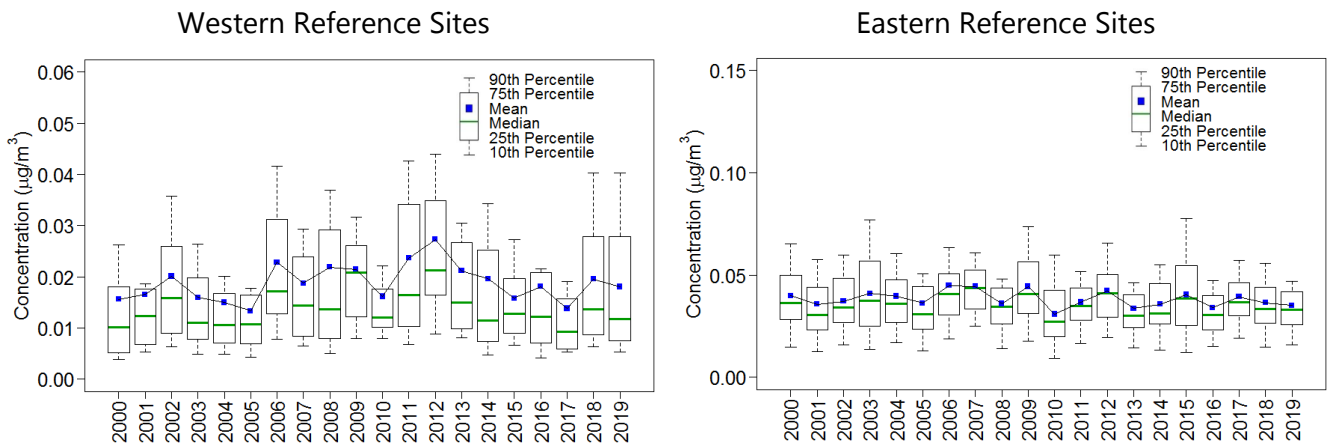


Figure 12. Trends in First Quarter Mean Na⁺ Concentrations

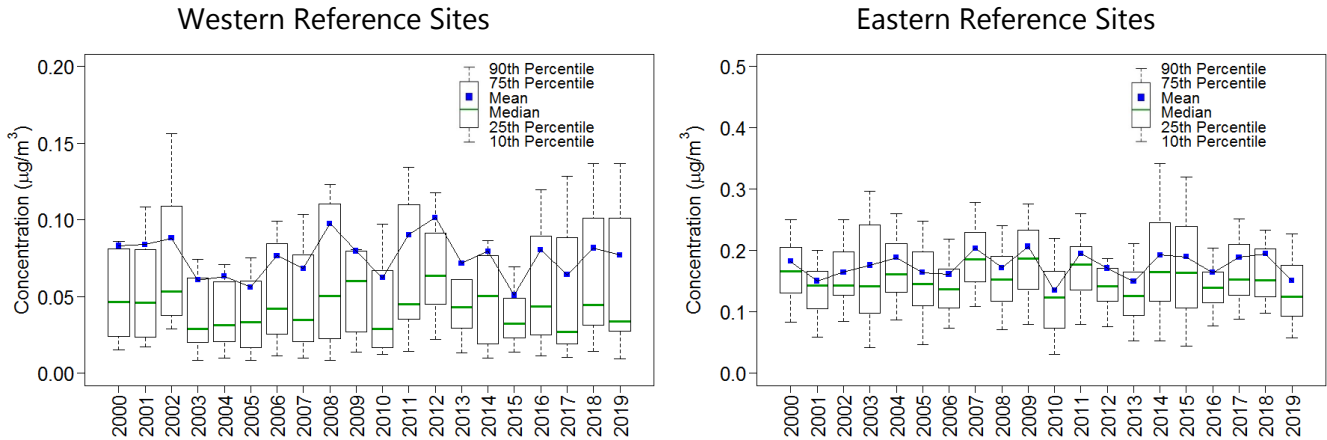
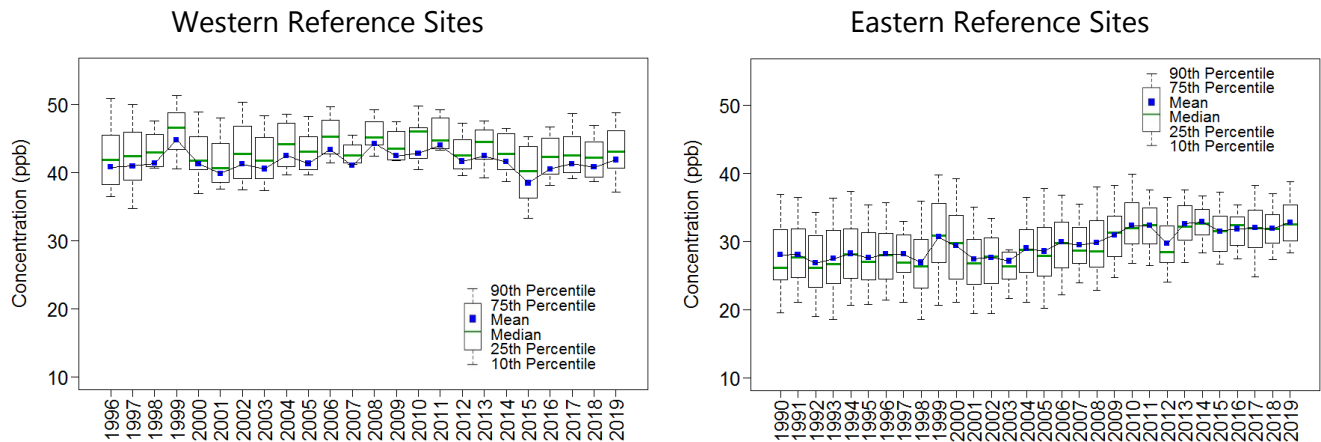


Figure 13. Trends in First Quarter Mean O₃ Concentrations



Changes in 3-year Average First Quarter Concentrations

Three-year averages of quarterly mean concentrations of total NO₃⁻, NH₄⁺, SO₂, and SO₄²⁻ were reduced over the period 1990–1992 through 2017–2019 for eastern reference sites and 1996–1998 through 2017–2019 for western reference sites. O₃ concentrations increased at eastern sites and showed almost no change at western sites. Tables 1 and 2 summarize changes in 3-year average first quarter concentrations.

Table 1. Eastern Reference Sites: 3-Year Mean Nitrogen, Sulfur, and O₃ Pollutant Concentrations

	Total NO ₃ ⁻ (µg/m ³)	NH ₄ ⁺ (µg/m ³)	SO ₂ (µg/m ³)	SO ₄ ²⁻ (µg/m ³)	O ₃ (ppb)
1990–1992	3.4	1.5	12.5	3.6	28
2017–2019	1.9	0.6	0.8	1.1	32
Percent Change	-42	-58	-93	-71	16

Table 2. Western Reference Sites: 3-Year Mean Nitrogen, Sulfur, and O₃ Pollutant Concentrations

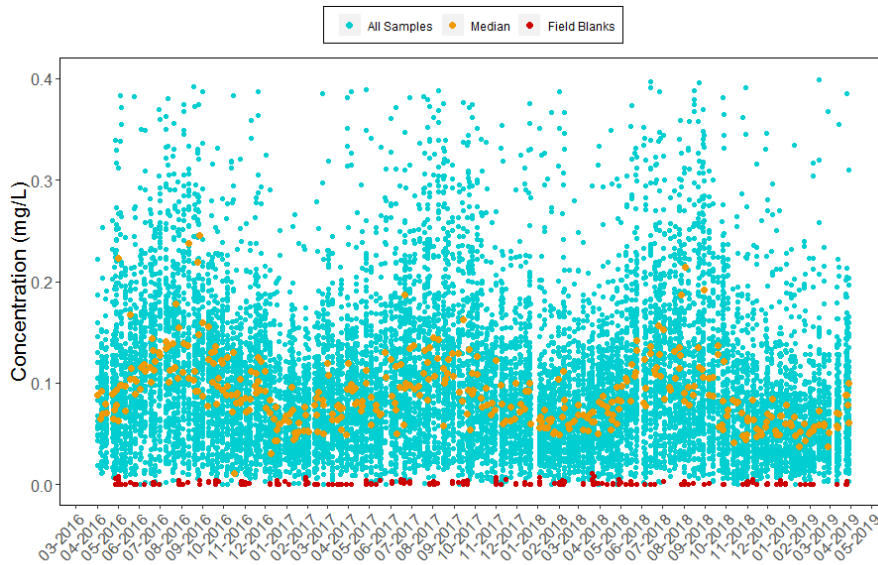
	Total NO ₃ ⁻ (µg/m ³)	NH ₄ ⁺ (µg/m ³)	SO ₂ (µg/m ³)	SO ₄ ²⁻ (µg/m ³)	O ₃ (ppb)
1996–1998	0.8	0.2	0.6	0.6	41
2017–2019	0.5	0.1	0.3	0.3	41
Percent Change	-43	-44	-58	-43	1

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 (FB) in milligrams per liter (mg/L) of 11 parameters from second quarter 2016 through first quarter 2019. These figures provide indications of potential issues with concentration measurements relative to detection and reporting limits.

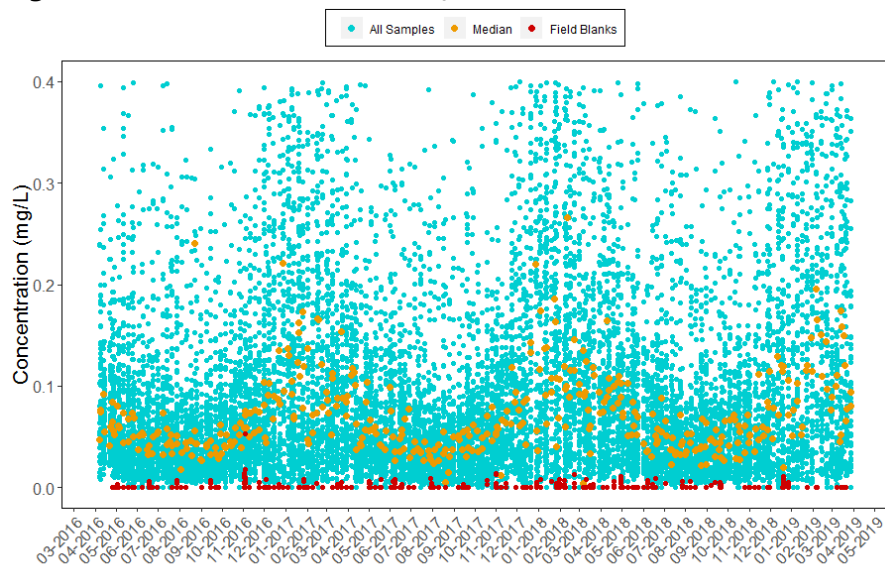
Previous review of filter pack analysis control charts indicated possible potassium contamination (Figure 22). Corrective actions were implemented and subsequent testing indicated these actions have been effective. View the recent data in Figure 22.

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



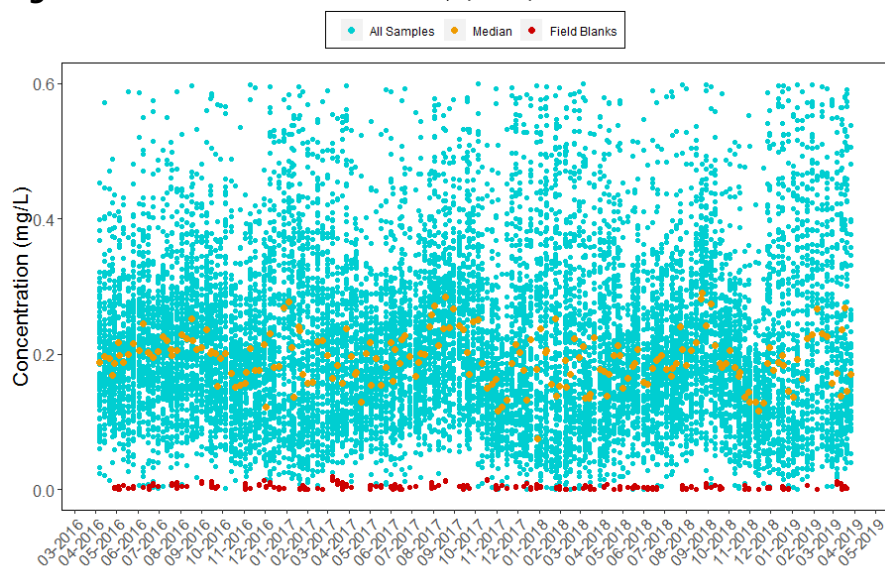
Note: Nominal reporting limit is 0.008 mg/L.

Figure 15. Concentrations of NO_3^- (as N) from Teflon Filters



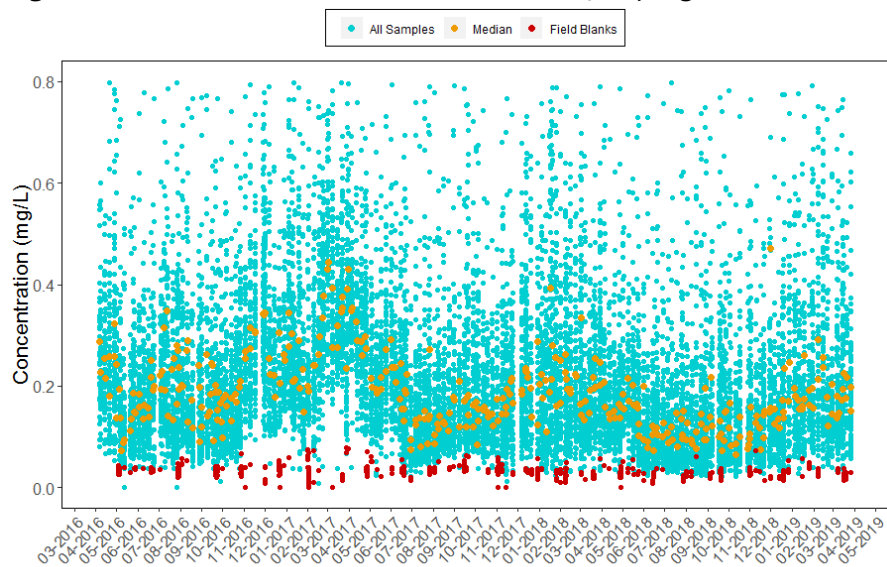
Note: Nominal reporting limit is 0.008 mg/L.

Figure 16. Concentrations of NH_4^+ (as N) from Teflon Filters



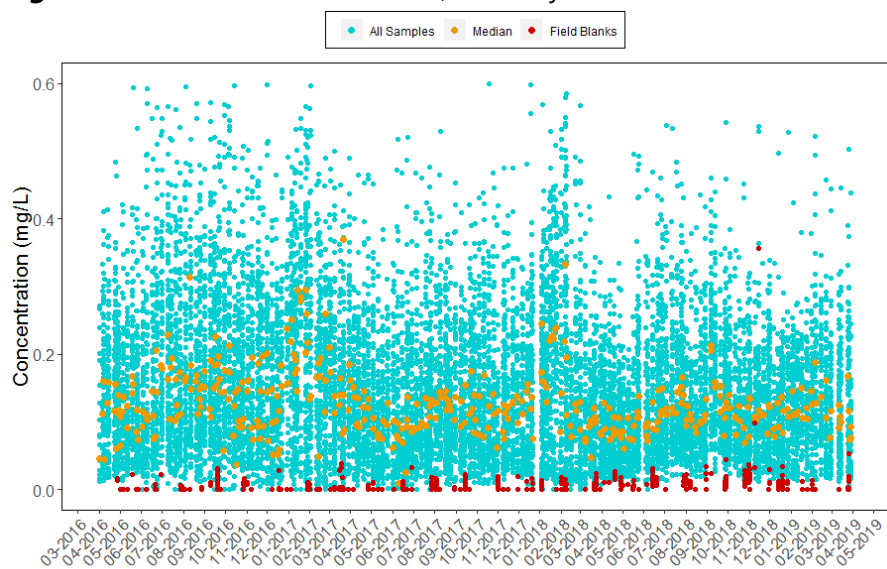
Note: Nominal reporting limit is 0.020 mg/L.

Figure 17. Concentrations of SO₂ from K₂CO₃ Impregnated Cellulose Filters



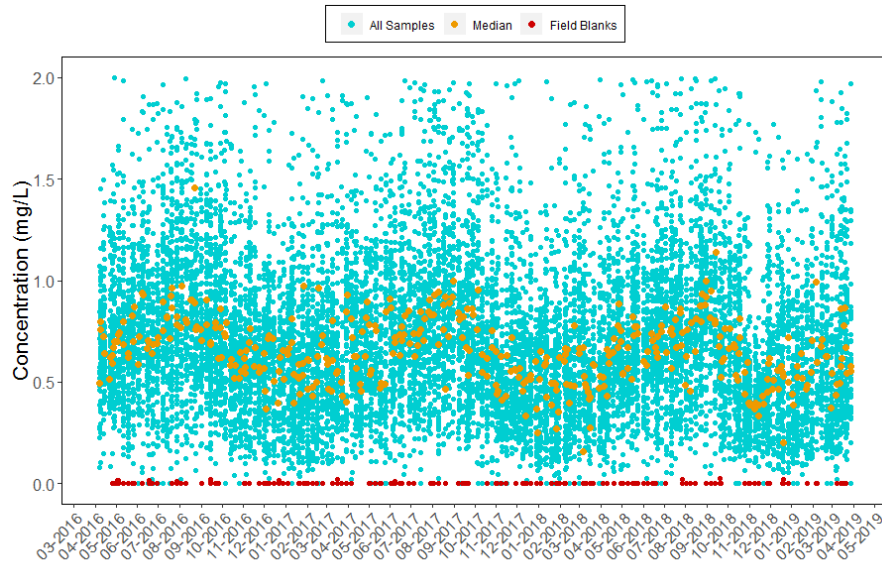
Note: Nominal reporting limit is 0.040 mg/L.

Figure 18. Concentrations of SO₄²⁻ from Nylon Filters



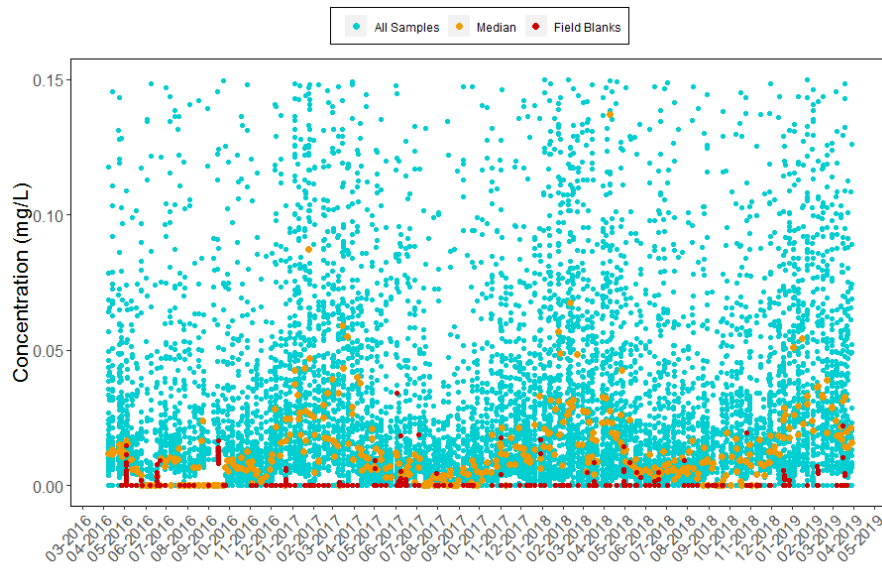
Note: Nominal reporting limit is 0.040 mg/L.

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



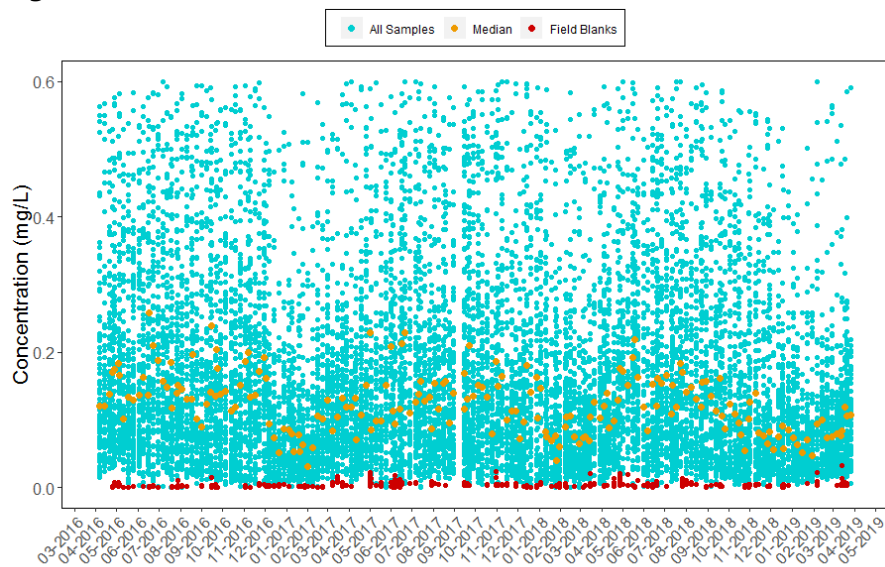
Note: Nominal reporting limit is 0.040 mg/L.

Figure 20. Concentrations of Cl^- from Teflon Filters



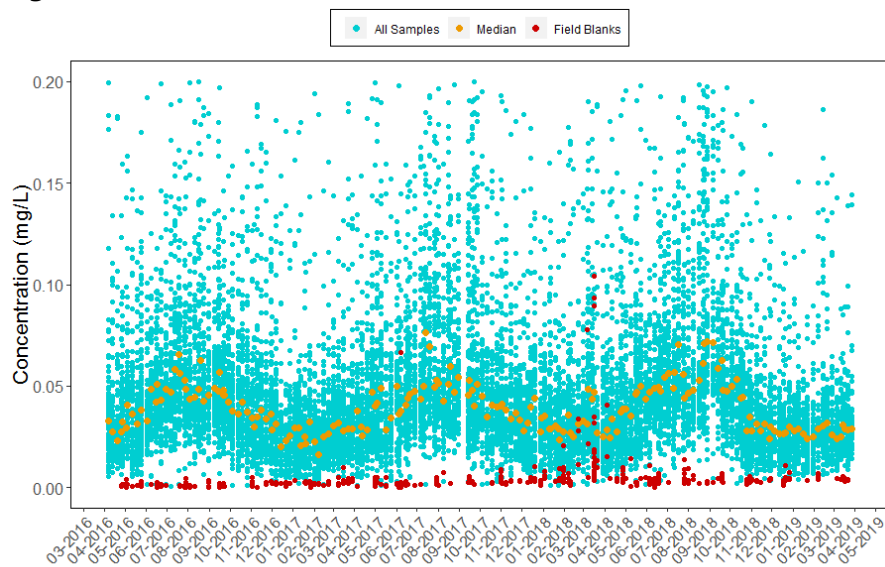
Note: Nominal reporting limit is 0.020 mg/L.

Figure 21. Concentrations of Ca²⁺ from Teflon Filters



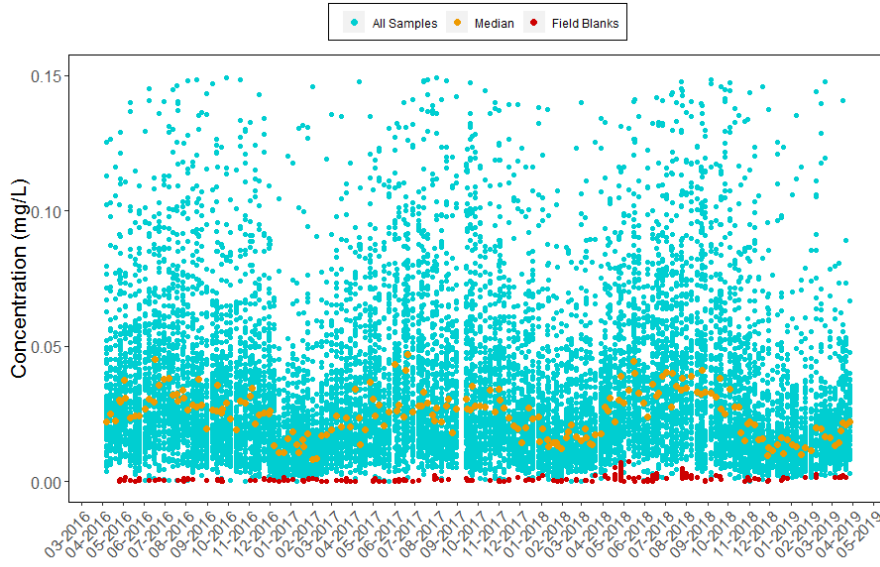
Note: Nominal reporting limit is 0.006 mg/L.

Figure 22. Concentrations of K⁺ from Teflon Filters



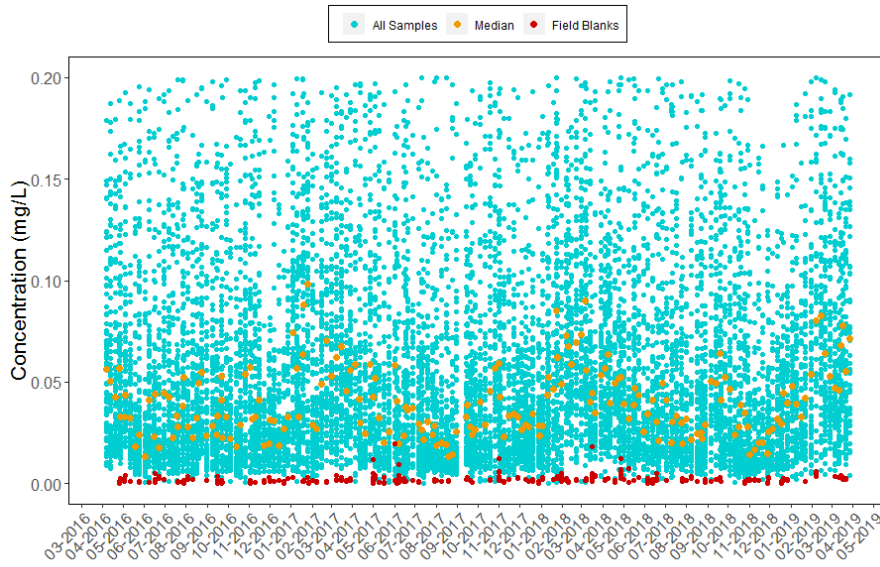
Note: Nominal reporting limit is 0.006 mg/L.

Figure 23. Concentrations of Mg^{2+} 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 MCK131/231, KY pair continued operating during the government shutdown (December 22, 2018 through January 25, 2019). The ROM406/206 pair is located at a National Park Service site, and ROM406 did not operate during the government shutdown. Only nine weeks of concentration data are available for the ROM406/206 statistical comparison for first quarter 2019.

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

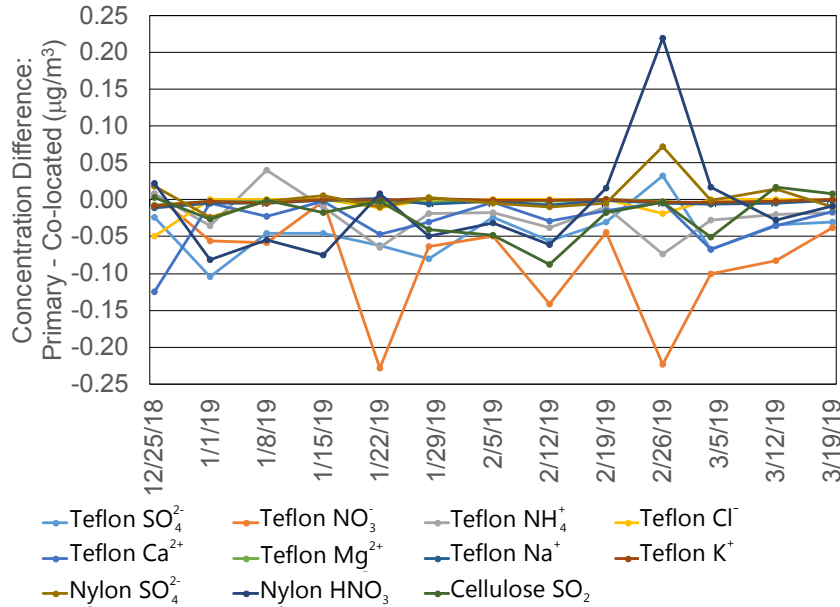
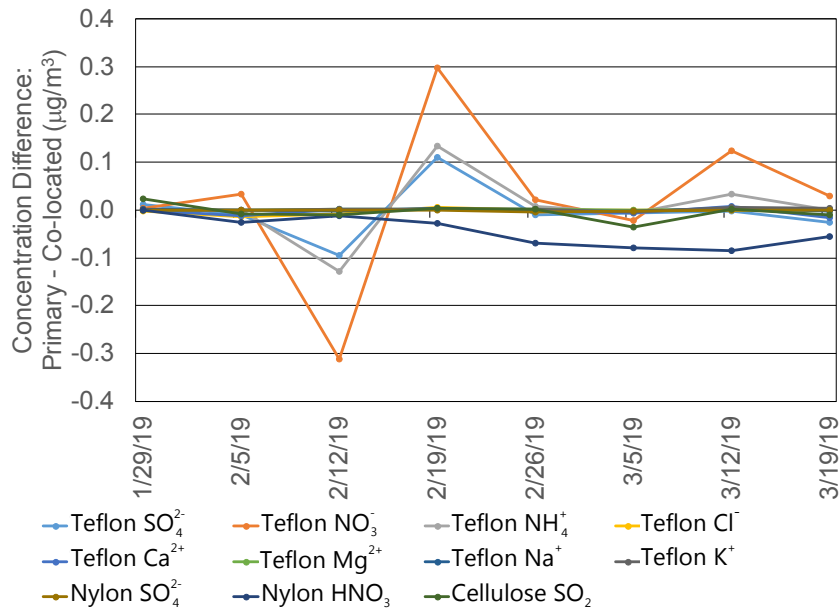


Figure 26. Time Series of Filter Concentration Differences between ROM406 and ROM206, CO



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 2019. The MARPD values met the 20 percent criterion, except for NO₃⁻ at ROM406/206. The difference in filter pack change times on 2/19/2019 resulted in the high MARPD for NO₃⁻. The ROM406 filter was changed at 9:00 a.m., and the ROM206 filter was changed at 7:00 p.m. Measured NO_y concentrations varied by 350 percent over that 10-hour period.

Table 3. Precision (MARPD) for Co-located Filter Pack Data during First Quarter 2019

	SO ₄ ²⁻	NO ₃ ⁻	NH ₄ ⁺	Ca ²⁺	Mg ²⁺	Na ⁺	K ⁺	Cl ⁻	HNO ₃	SO ₂	Total NO ₃ ⁻
MCK131/231, KY											
\bar{X} (μg/m ³)	1.25	1.47	0.77	0.18	0.03	0.08	0.05	0.04	0.80	0.64	2.25
\bar{Y} (μg/m ³)	1.29	1.55	0.79	0.20	0.03	0.08	0.05	0.04	0.81	0.65	2.34
MAD	0.05	0.08	0.03	0.02	0.00	0.00	0.00	0.00	0.05	0.03	0.09
MARPD	3.97	5.58	3.57	10.15	6.29	4.48	2.88	4.47	6.69	4.84	4.31
ROM406/206, CO*											
\bar{X} (μg/m ³)	0.46	0.54	0.29	0.06	0.01	0.04	0.02	0.02	0.34	0.13	0.87
\bar{Y} (μg/m ³)	0.46	0.52	0.29	0.07	0.01	0.04	0.02	0.03	0.39	0.14	0.70
MAD	0.04	0.13	0.05	0.01	0.00	0.00	0.00	0.00	0.06	0.01	0.13
MARPD	7.61	20.14	12.55	9.78	11.05	9.78	16.35	13.69	14.64	11.25	12.85

Note: * ROM406/206 included only nine weeks of comparisons due to the government shutdown. Sampling resumed at ROM406 on 1/29/2019.

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 2019 (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	Comment
CVL151, MS	84.6	84.6	84.6	84.6	84.6	84.6	84.6	84.6	One sample was invalidated due to suspect concentration data.
UND002, VT	84.6	84.6	84.6	84.6	84.6	84.6	84.6	84.6	Intermittent power failures affected two sampling weeks.
BWR139, MD	76.9	76.9	76.9	76.9	76.9	76.9	76.9	76.9	Three 2-week samples were collected during the quarter.
MAC426, KY	76.9	76.9	76.9	76.9	76.9	76.9	76.9	76.9	Sampling was affected by the government shutdown. Sampling in 2019 began week 4.
ACA416, ME	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	Sampling was affected by the government shutdown. Sampling in 2019 began week 5.
BAS601, WY	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
BBE401, TX	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
BUF603, WY	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
CAN407, UT	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
CHA467, AZ	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
DUK008, NC	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
GLR468, MT	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
GRB411, NV	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
GRC474, AZ	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
MEV405, CO	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
NEC602, WY	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
PAR107, WV	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
PET427, AZ	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
PIN414, CA	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	

Table 4. Sites with less than 90 Percent Data Completeness for Filter Concentrations for First Quarter 2019 (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	Comment
ROM406, CO	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	Sampling was affected by the government shutdown. Sampling in 2019 began week 5.
SEK430, CA	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
SHE604, WY	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
THR422, ND	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
VOY413, MN	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
YOS404, CA	69.2	69.2	69.2	69.2	69.2	69.2	69.2	69.2	
JOT403, CA	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	Sampling was affected by the government shutdown. Sampling in 2019 began week 5. Week 5 was a 2-week sample.
LAV410, CA	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	Sampling was affected by the government shutdown. Sampling in 2019 began week 5. Week 7 had insufficient flow volume due to power outages.
WNC429, SD	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	Sampling was affected by the government shutdown. Sampling in 2019 began week 5. Week 11 was invalidated due to suspect concentration and flow rate data.
EVE419, FL	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	Sampling was affected by the government shutdown. Sampling in 2019 began week 5. Two additional weeks were affected by a malfunctioning mass flow controller.
YEL408, WY	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	Sampling was affected by the government shutdown. The first valid sample in 2019 was week 6. Week 8 was a 2-week sample.
KIC003, KS	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	No tribal site operator was available in 2019 until mid-March.
BFT142, NC	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	Site was down due to damage from Hurricane Florence until late March.
FOR605, WY	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	Sampling was temporarily halted during March pending replacement of a malfunctioning mass flow controller.
NIC001, NY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Site was closed for park infrastructure work.

Precision of Ozone Concentrations

Time series of co-located hourly O₃ concentration differences for first quarter 2019 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 Differences in Co-located O₃ Concentrations for MCK131/231, KY

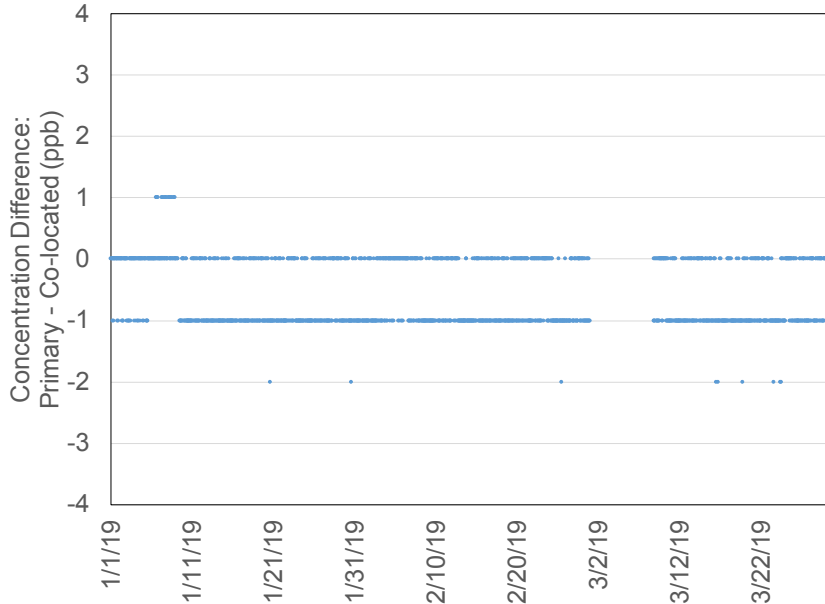


Figure 28. Time Series of the Differences in Co-located O₃ Concentrations for ROM406/206, CO

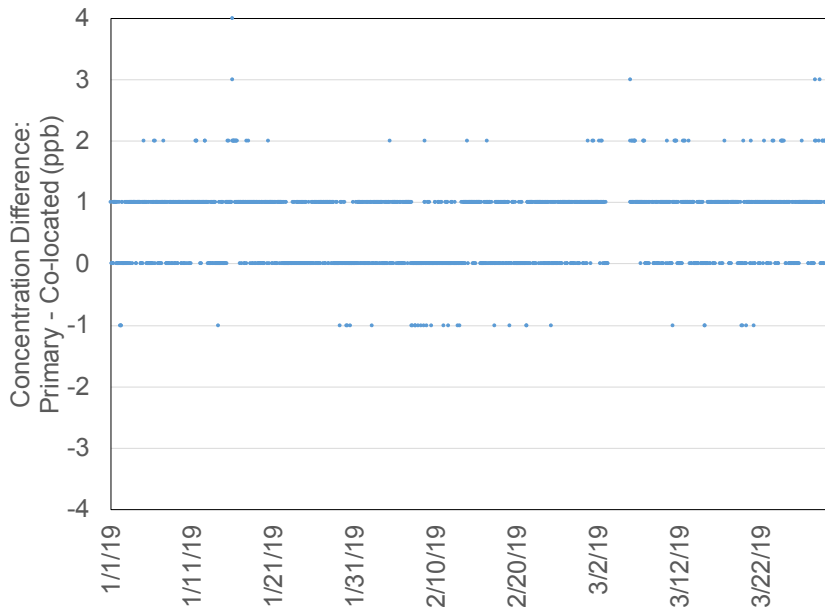


Table 5 gives MARPD data for O₃ data measured at the two co-located sites.

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

Site Pair	Quarter	Start Date	MARPD	Records
MCK131/231, KY				
	2	4/1/2018	1.5	1786
	3	7/2/2018	1.5	1921
	4	10/1/2018	1.0	2025
	1	1/1/2019	2.0	1873
ROM406/206, CO				
	2	4/1/2018	1.3	2064
	3	7/1/2018	1.1	2068
	4	10/1/2018	1.9	1973
	1	1/1/2019	1.5	1983

Completeness for O₃ Concentrations

Calculation of an annual 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.

Table 6. Sites with less than 90 Percent Data Completeness for DM8A O₃ Concentrations during First Quarter 2019

Site ID	Percent Completeness	Comments
BFT142, NC	14.4	As a result of damage from Hurricane Florence, the site was not operational until late March 2019.
ARE128, PA	83.3	The analyzer pump failed resulting in an approximately 2-week data loss.
LAV410, CA	83.3	Intermittent power failures during the quarter affected sampler operation.
SUM156, FL	84.4	The analyzer was affected by a combination of a failing analyzer pump and high analyzer bench temperatures.
CVL151, AR	86.7	The analyzer was affected by a combination of power outages and analyzer in service mode.
HOX148, MI	86.7	The analyzer pump failed resulting in a 10-day data loss.
BWR139, MD	88.9	Ozone data were not collected from 1/7/2019 to 1/15/2019 due to a communications issue.
SAL133, IN	88.9	The analyzer pump failed resulting in a 9-day data loss.

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 2019	Q2 2018– Q1 2019	Comments
LAV410, CA	89.2	94.4	Intermittent power failures occurred during the quarter.
SAL133, IN	89.2	96.7	The analyzer pump failed resulting in a 9-day data loss.
HOX148, MI	86.6	94.6	The analyzer pump failed resulting in a 10-day data loss.
ARE128, PA	85.2	95.1	The analyzer pump failed resulting in an approximately 2-week data loss.
BFT142, NC	14.9	40.2	The site did not resume operation until late March 2019 due to damage from Hurricane Florence.

Filter Pack Total Nitrate and Continuous Trace-level NO_y Concentrations at Eight 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 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 eight sites with available data are shown in Table 8. Ratios of NO_y to total NO₃⁻ varied from 3.17 at GRS420 to 7.15 at ROM206.

Table 8. Summary of Total NO₃⁻ and NO_y Measurements for First Quarter 2019

Site ID	Elevation	Total NO ₃ ⁻ (ppb)	NO _y (ppb)	Ratio
DUK008, NC	164	0.63	3.60	6.06
BVL130, IL	213	1.71	5.41	3.50
MAC426, KY	243	0.87	2.78	3.62
HWF187, NY	497	0.27	1.57	6.45
GRS420, TN	793	0.39	1.29	3.17
PNF126, NC	1216	0.32	1.24	4.35
PND165, WY	2386	0.12	0.66	5.66
ROM206, CO	2742	0.21	1.32	7.15

Figure 29. Comparison of DUK008 Weekly Mean NO_y and Total NO_3^- Concentrations

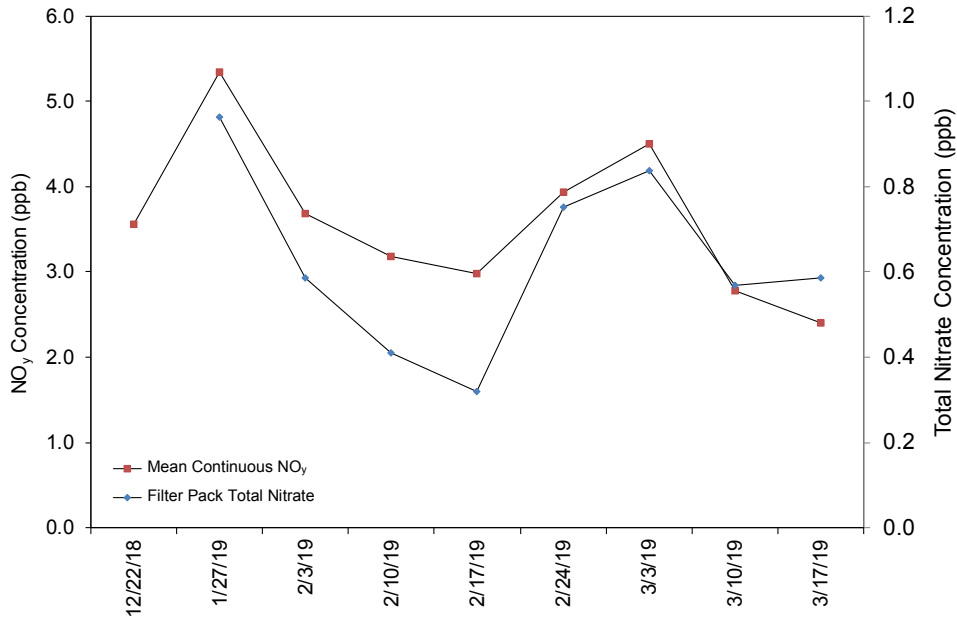


Figure 30. Comparison of BVL130 Weekly Mean NO_y and Total NO_3^- Concentrations

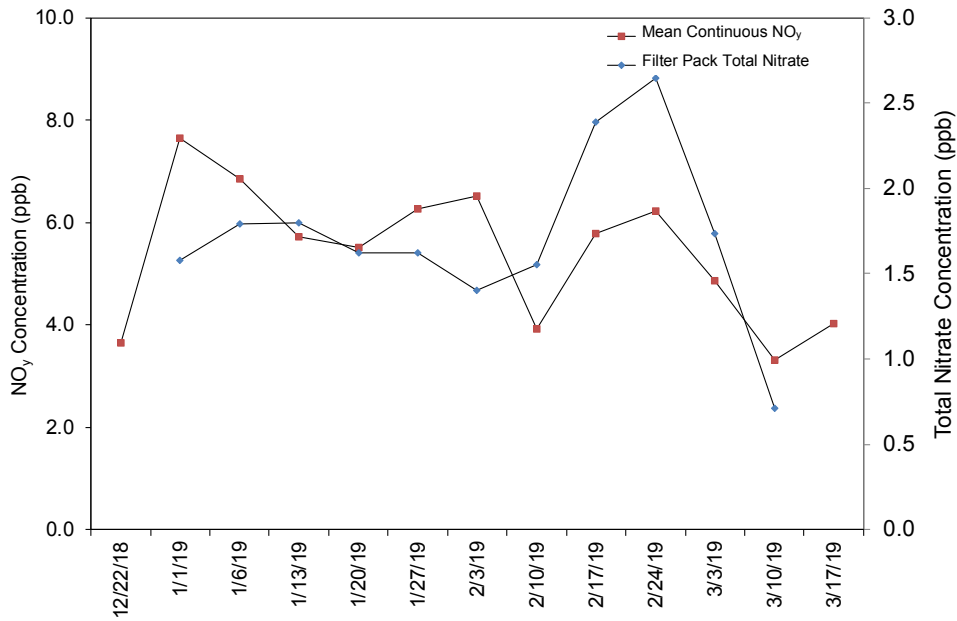


Figure 31. Comparison of MAC426 Weekly Mean NO_y and Total NO₃ Concentrations

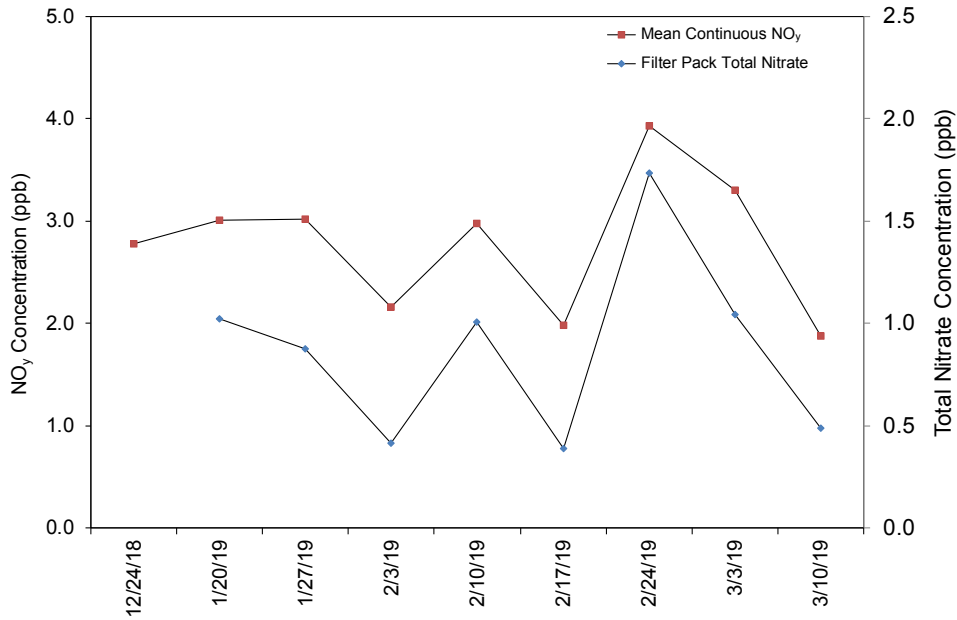


Figure 32. Comparison of HWF187 Weekly Mean NO_y and Total NO₃ Concentrations

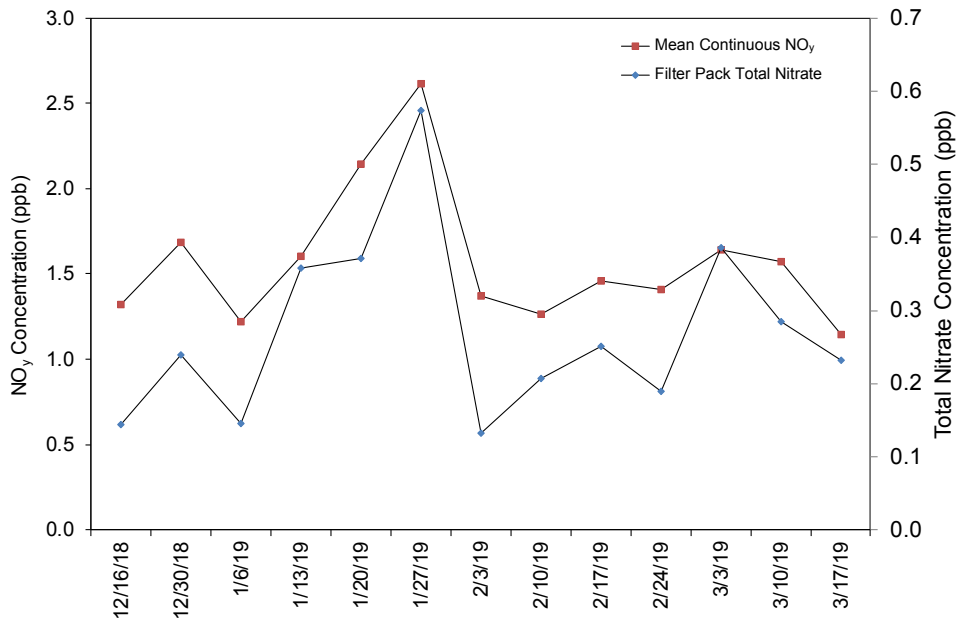


Figure 33. Comparison of GRS420 Weekly Mean NO_y and Total NO₃ Concentrations

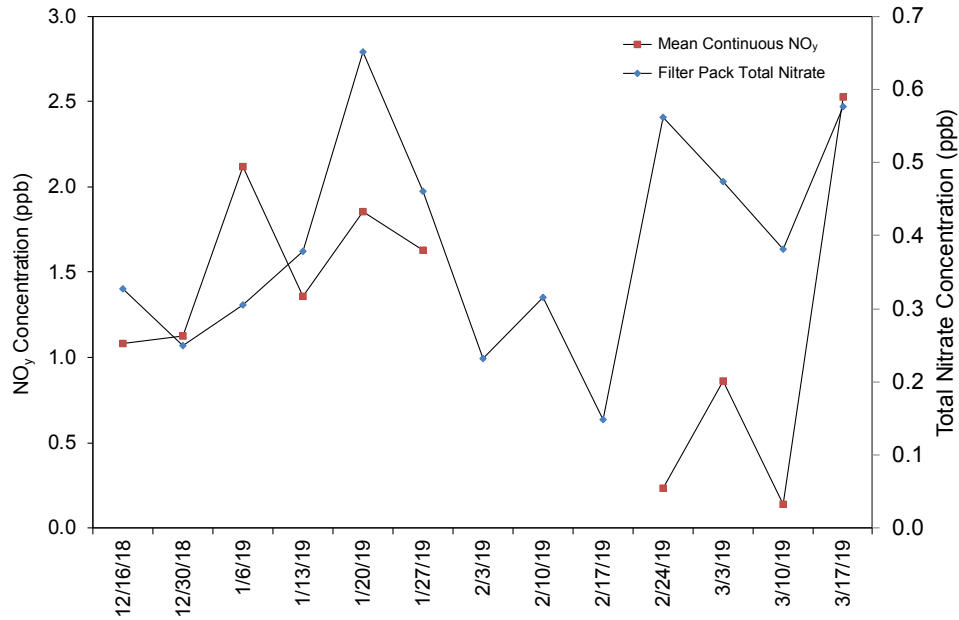


Figure 34. Comparison of PNF126 Weekly Mean NO_y and Total NO₃ Concentrations

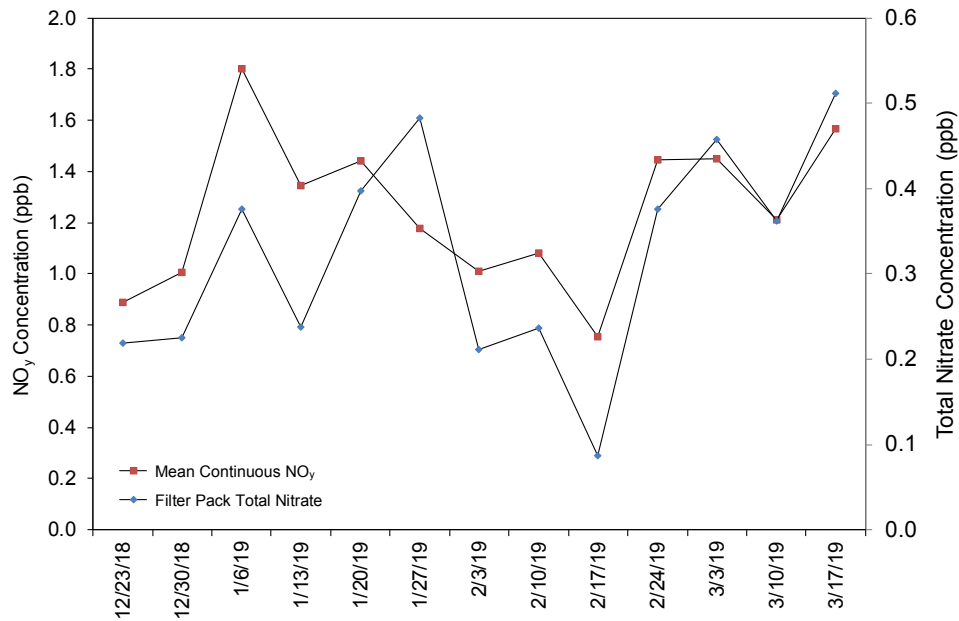


Figure 35. Comparison of PND165 Weekly Mean NO_y and Total NO₃ Concentrations

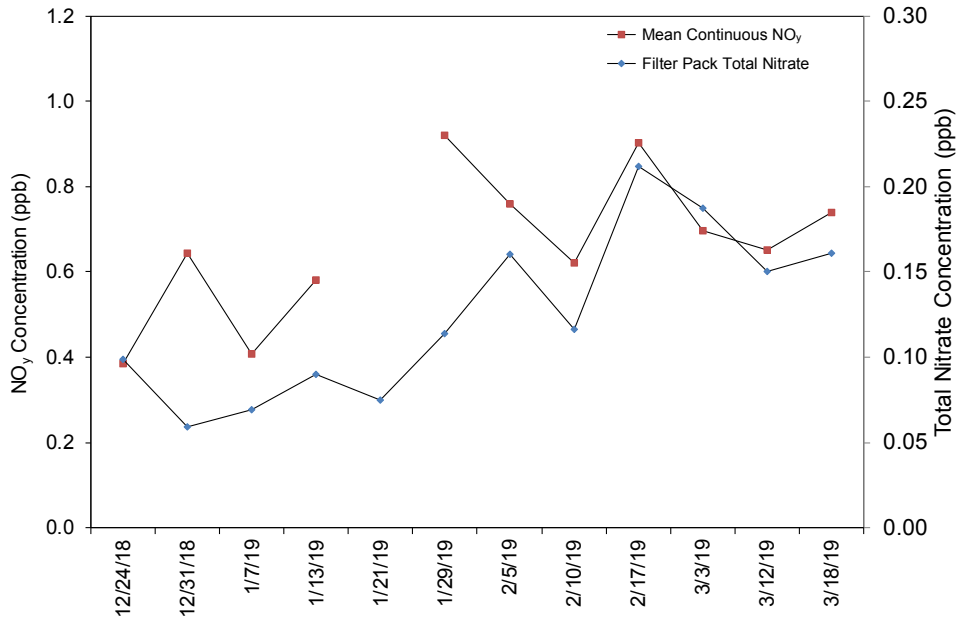
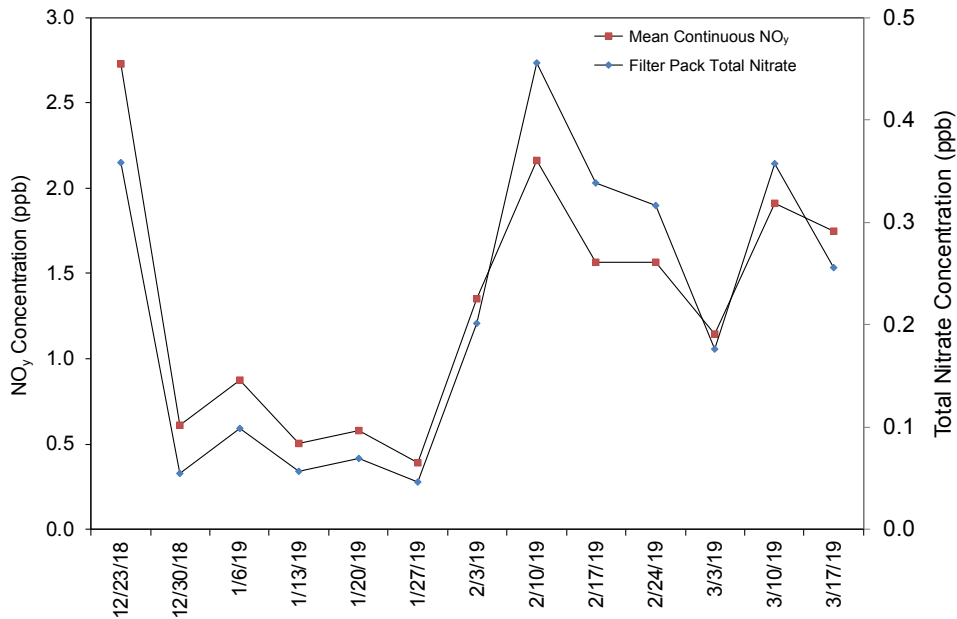


Figure 36. Comparison of ROM206 Weekly Mean NO_y and Total NO₃ Concentrations



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 SO₂ data from BVL130 were incomplete. The continuously measured trace-level concentrations were higher than filter pack concentrations at MAC426 and were comparable at GRS420.

Figure 37. Comparison of BVL130 Weekly Mean SO₂ Concentrations

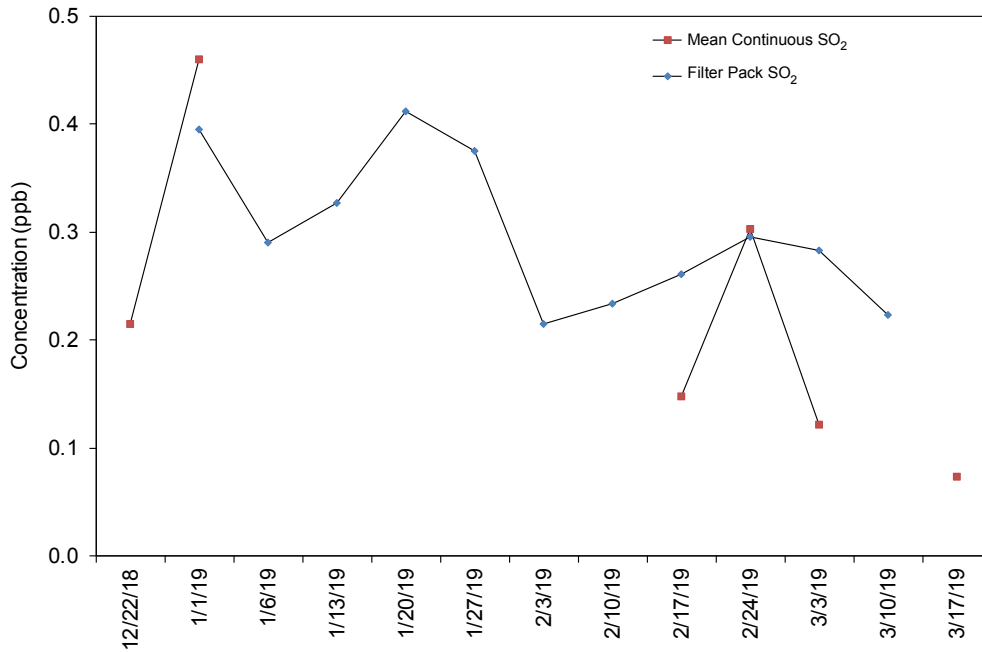


Figure 38. Comparison of MAC426 Weekly Mean SO₂ Concentrations

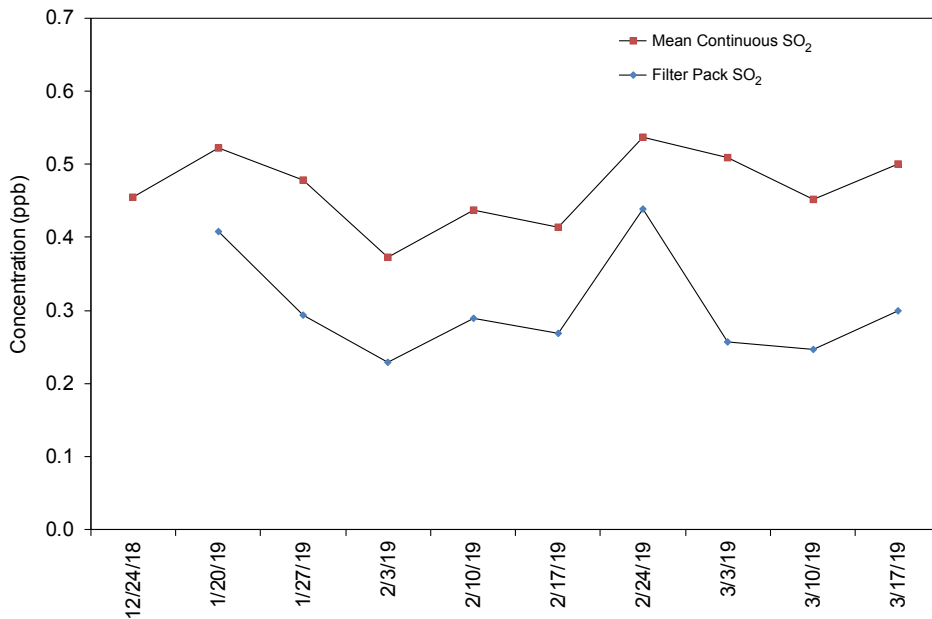
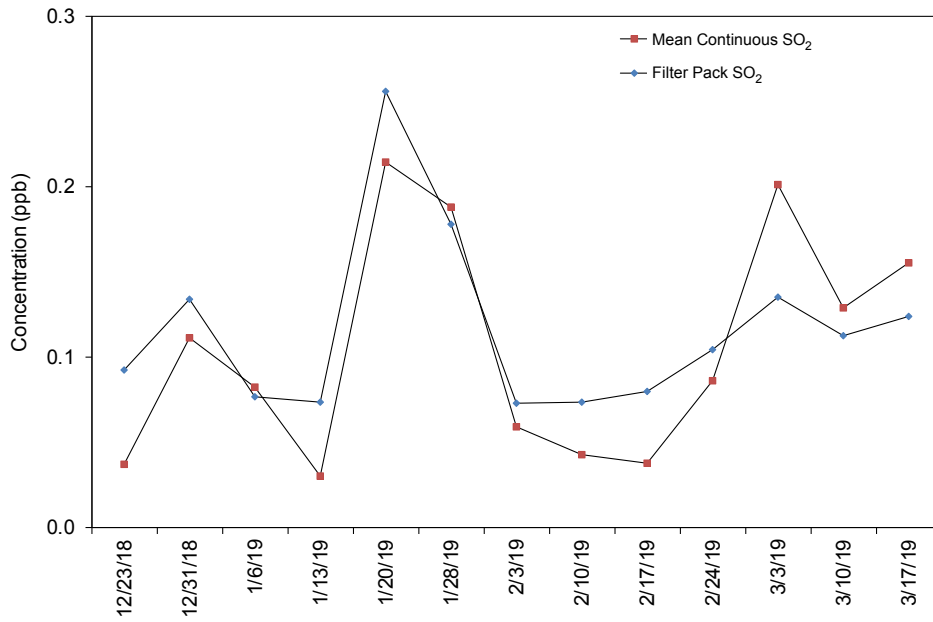


Figure 39. Comparison of GRS420 Weekly Mean SO₂ Concentrations



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 for hourly trace-level gas concentrations during first quarter 2019. The annual hourly average 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 2019	Q2 2018 – Q1 2019	Comments
BVL130, IL	CO	0	47	The analyzer malfunctioned and was removed for troubleshooting in February.
	NO	80	88	ZPS failure occurred and shelter temperatures were below criterion.
	NOY	87	90	Shelter temperatures were below criterion.
	NOYDIF	80	88	ZPS failure occurred and shelter temperatures were below criterion.
	SO2_GA	90	90	
CHC432, NM	NO	98	97	
	NOY	98	97	
	NOYDIF	98	97	
DUK008, NC	HNO3	86	71	The relatively low data completeness was due to a combination of shelter temperatures outside criteria and data invalidated during lengthy QC checks for NH ₃ .
	NH3	86	71	
	NO	86	74	
	NO2_TRUE	86	77	
	NOX_TRUE	86	74	
	NOY	86	71	
	NOY_MINUS	86	72	
	NOYDIF	86	71	
TNX	86	73		
GRS420, TN	CO	91	85	The analyzer pump failed and was replaced during February. Data were invalidated 2/8/2019 to 2/20/2019.
	NO	77	87	
	NOY	77	87	
	NOYDIF	82	88	
	SO2_GA	93	89	
HWF187, NY	NO	93	93	
	NOY	93	93	
	NOYDIF	93	93	
MAC426, KY	CO	87	87	The accumulated effect of calibrations and maintenance throughout the quarter affected data completeness.
	NO	86	86	
	NOY	86	86	
	NOYDIF	86	86	
	SO2_GA	87	89	
PND165, WY	NO	83	80	ZPS failures occurred in late January. The analyzer was calibrated in early February.
	NOY	83	82	
	NOYDIF	83	79	

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

Site ID	Parameter*	Q1 2019	Q2 2018 – Q1 2019	Comments
PNF126, NC	NO	95	90	
	NOY	95	92	
	NOYDIF	95	90	
ROM206, CO	NO	92	91	
	NOY	92	92	
	NOYDIF	92	91	

Note: * See Table 10

ZPS = zero/precision/span quality control checks

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
NH3	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
SO2_GA	Measured	Ultraviolet fluorescence
TNX	Measured	Platinum/stainless steel converter at 825° Celsius followed by molybdenum converter at 315° Celsius

References

Lyman, S., Mansfield, M., Tran, H., and Tran, T. 2016. *Annual Report. Uintah Basin Air Quality Research Project*. Utah State University. Prepared for Utah Legislature, Document Number: BRC_161116A.

Wood Environment & Infrastructure Solutions, Inc. 2019. *Clean Air Status and Trends Network (CASTNET) First Quarter 2019 Quality Assurance Report*.
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