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Air Quality Monitoring Assessment for Pouce Coupe 200 Road BC OGC CAMEL

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1.0 INTRODUCTION

The Commission Air Monitoring Environmental Laboratory (CAMEL) was deployed at the Encana South Central Liquids Hub (SCLH) near Pouce Coupe from July 29, 2016 to May 28, 2018, to measure ambient air quality and meteorological conditions. The recorded (RAW) data is available from the BC Air Data Archive Website[1] under the station name "Pouce Coupe 200 Road CAMEL". All recorded data was validated under separate contract with the British Columbia Oil & Gas Commission (BC OGC). This report is based entirely on validated data.

Millennium EMS Solutions Ltd. (MEMS) was retained by BC OGC to provide an assessment of the monitoring data. The analysis in this report was based on the hourly monitoring data provided by BC OGC for the period from September 12, 2016 to May 25, 2018. All measurements were analyzed by hour of day and month of year. Frequency distributions of the data were prepared and elevated readings were compared to British Columbia (B.C.) or Alberta ambient air quality objectives (AAQOs). The report also provides information in clear graphic form and provides concise summaries of the information for public release.

2.0 LOCATION

The location of CAMEL was within rural area 8.5 km south of the Village of Pouce Coupe (referred to as the Pouce Coupe station hereafter) is 700 m west of the Dawson Creek Tupper Highway at Peace River Regional District. It is one of the stations at British Columbia Northeast Air Zone as listed in Table 2-1 and presented in Figure 2-1.

Table 2-1 Location of Pouce Coupe Station - Pouce Coupe 200 Road CAMEL

Latitude	Longitude	UTM Coordinates (m) [NAD83/UTM Zone 10 N]	
		Easting	Northing
55.634323	-120.132649	680,488	6,169,111

[1] https://envistaweb.env.gov.bc.ca/

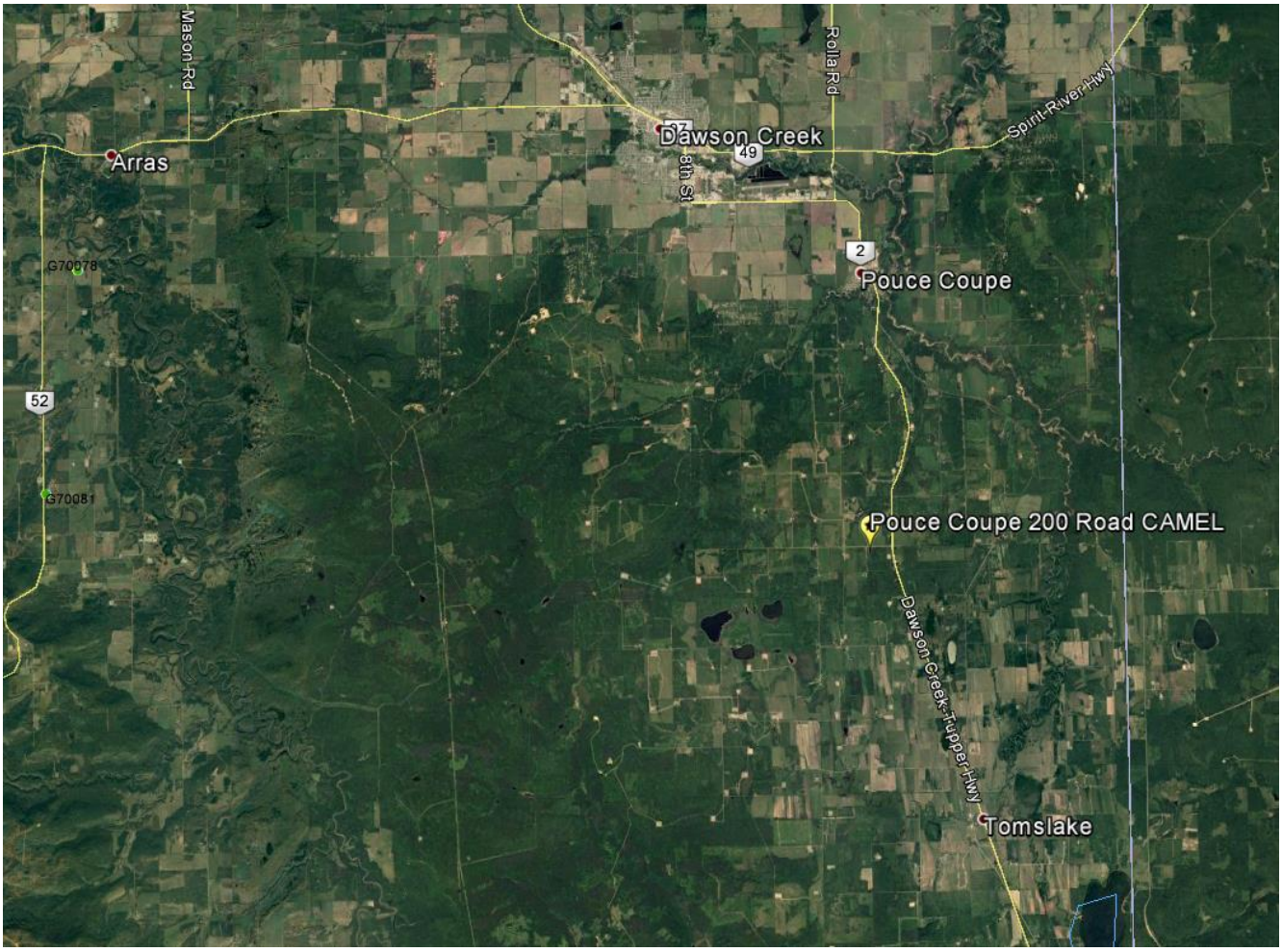

Figure 2-1 Location of Pouce Coupe Station - Pouce Coupe 200 Road CAMEL

3.0 METEOROLOGY MEASUREMENTS

Table 3-1 is the summary of the meteorology measurements at the Pouce Coupe station for the period from September 12, 2016 to May 25, 2018. Data availability was 95% for all meteorological measurements.

Table 3-1 Meteorology Measurement at Pouce Coupe Station (September 12, 2016 to May 25, 2018)

Parameter	Unit	Minimum	Min Date	Maximum	Max Date	Average	Data [%]
Wind Speed	m/s	0.0	27/01/2018 1:00	5.6	12/02/2017 12:00	1.5	95%
Wind Direction	Degree	8.0	20/02/2017 22:00	357	04/03/2017 20:00	204	95%
Ambient Temperature	°C	-35.8	30/12/2017 5:00	29.9	06/09/2017 14:00	1.6	95%
Ambient RH	% RH	17.0	27/04/2018 18:00	99.0	30/09/2016 18:00	66.8	95%
Ambient Pressure	mmHg	667	16/02/2017 9:00	707	07/12/2016 22:00	688	95%
Precipitation	mm	0.0	12/09/2016 0:00	6.0	14/06/2017 16:00	0.0	95%

3.1 Wind

Figure 3-1 is a wind rose showing the frequency of hourly average winds for the period. Calms are defined as wind speeds less than about 0.5 m/s. The wind roses show that winds at the Pouce Coupe site were most frequent and strongest from west southwest.

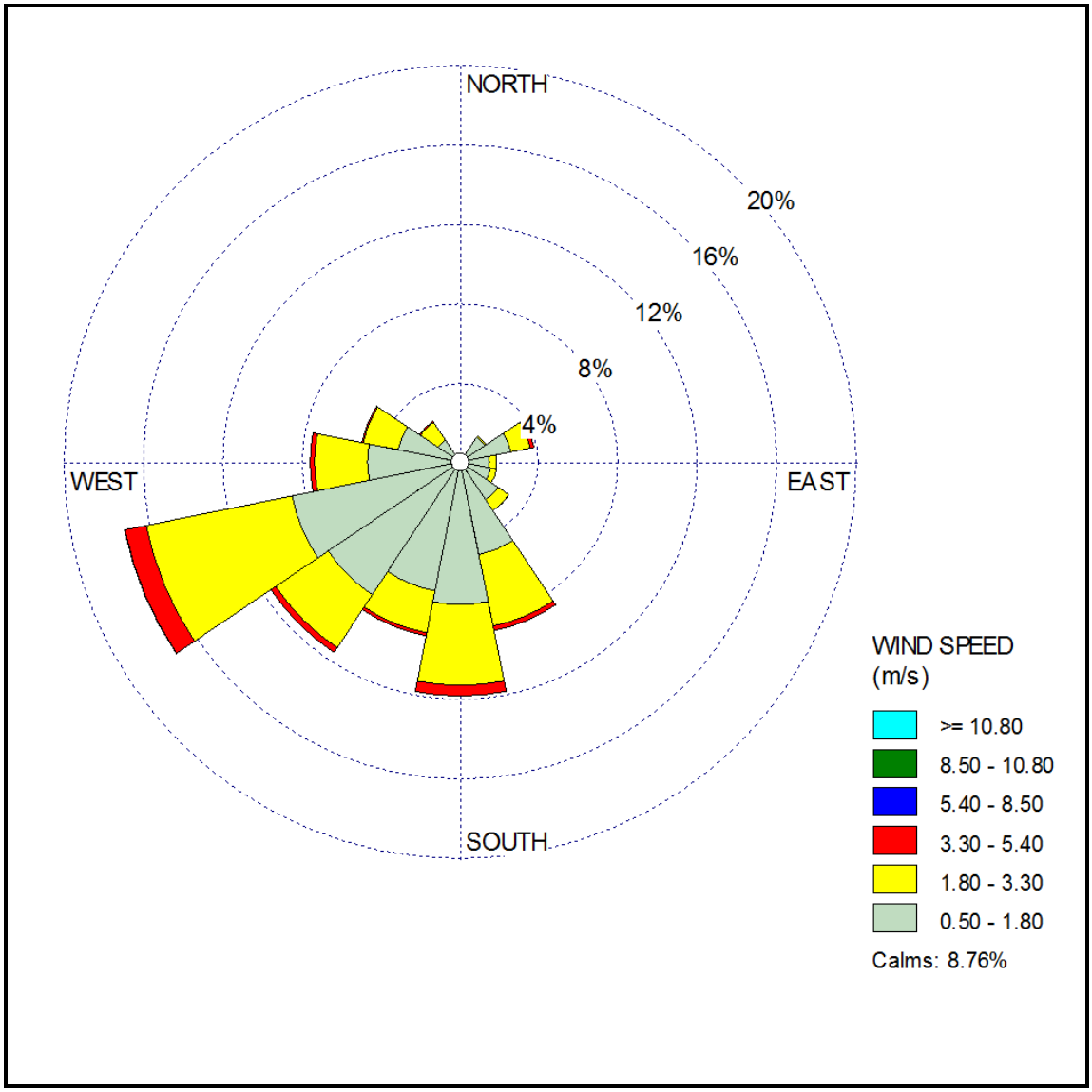

Figure 3-1 Wind Rose at the Pouce Coupe Site (September 12, 2016 to May 25, 2018)

Figure 3-2 shows the overall frequency distribution of wind speeds. Calm winds occurred about 8.8% of the time in the area. Winds were generally light, with 55% winds less then 1.8 m/s and 28% winds less than 3 m/s.

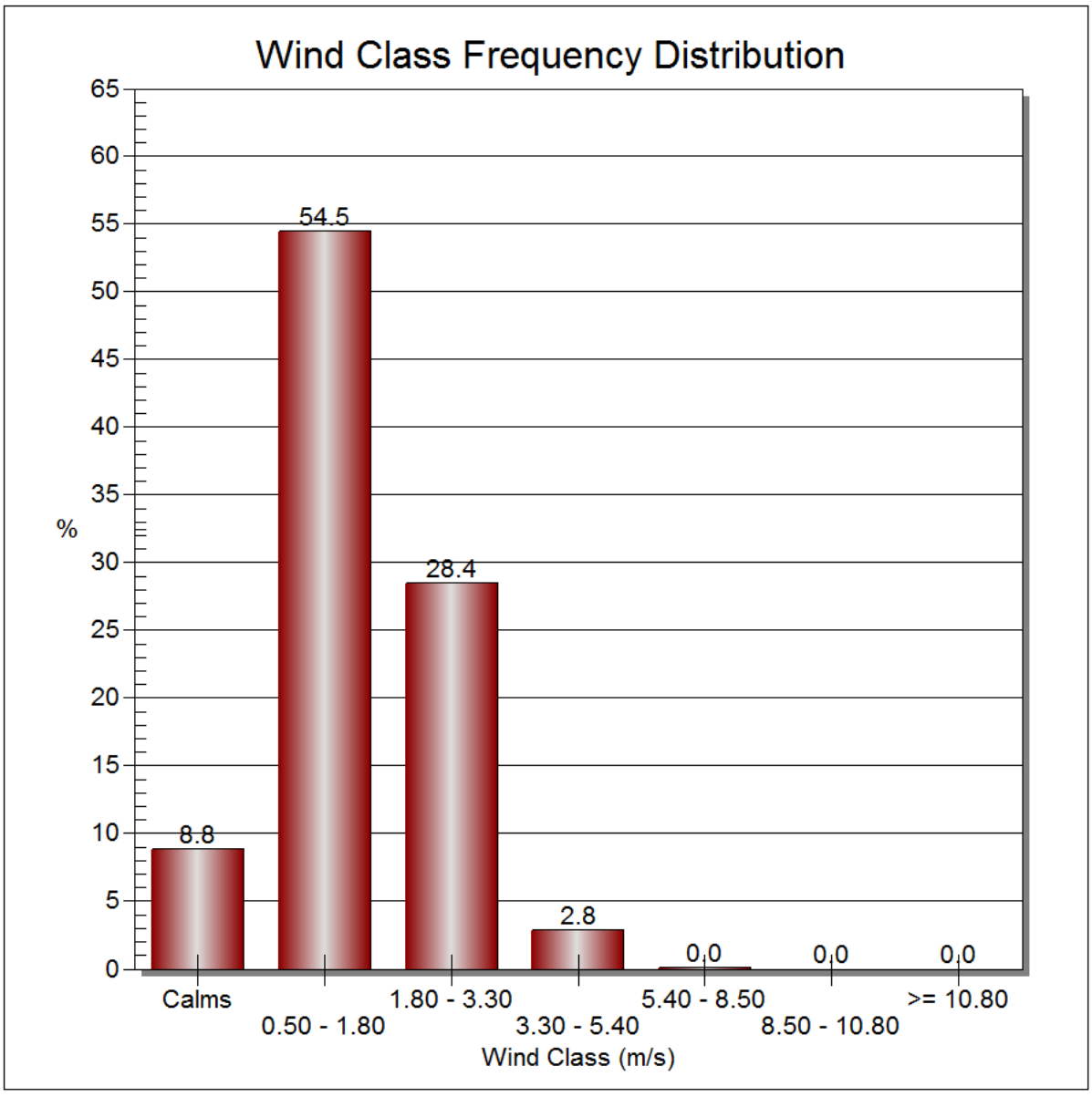

Figure 3-2 Wind Class Frequency Distribution at the Pouce Coupe Site (September 12, 2016 to May 25, 2018)

3.2 Ambient Temperature

The diurnal and seasonal temperature variations are presented in Figure 3-3. The results indicate the following:

- Median hourly temperatures were highest in mid-afternoon as a result of solar heating; and temperatures were lowest before sunrise (around 05:00).
- Median temperatures ranged from about -10°C in February to about +15°C in July.

3.3 Relative Humidity

The diurnal and seasonal relative humidity (RH) variations are presented in Figure 3-4. The results indicate the following:

- Median hourly RH were highest before sunrise (04:00 to 05:00); and RH were lowest in mid-afternoon as a result of solar heating.
- Median RH ranged from about -45% in May to about 84% in November, with the most common values between 70 and 75%.

3.4 Ambient Pressure

The diurnal and seasonal ambient pressure variations are presented in Figure 3-5. The results indicate the following:

- There was very little diurnal variation in ambient pressure.
- Minimum ambient pressure ranged from about 667 mmHg in winter (January and February) to 686 mmHg in summer (July), with the least variation in pressure in summer months.

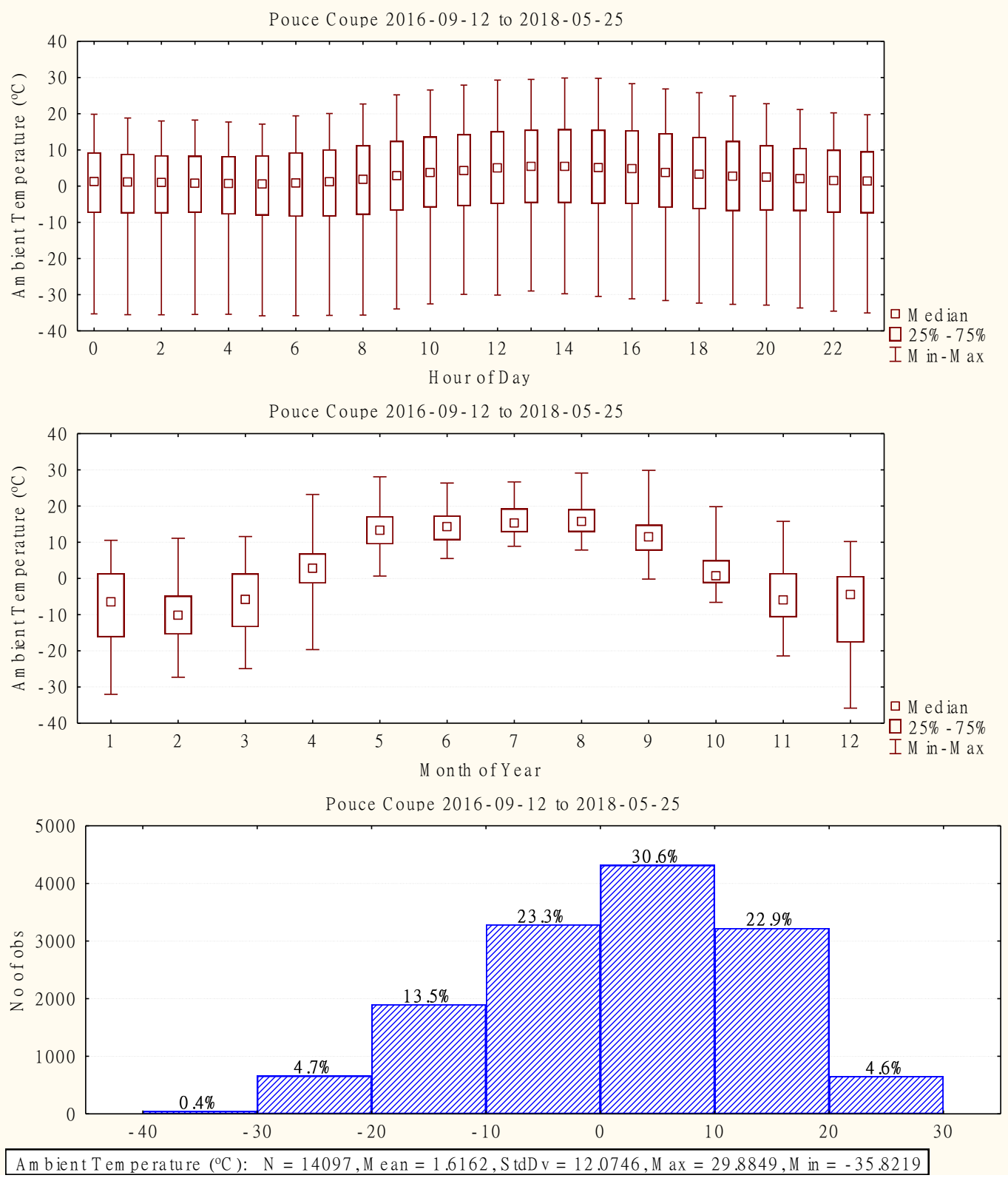

Figure 3-3 Diurnal and Seasonal Variation and Frequency Distribution of Temperature

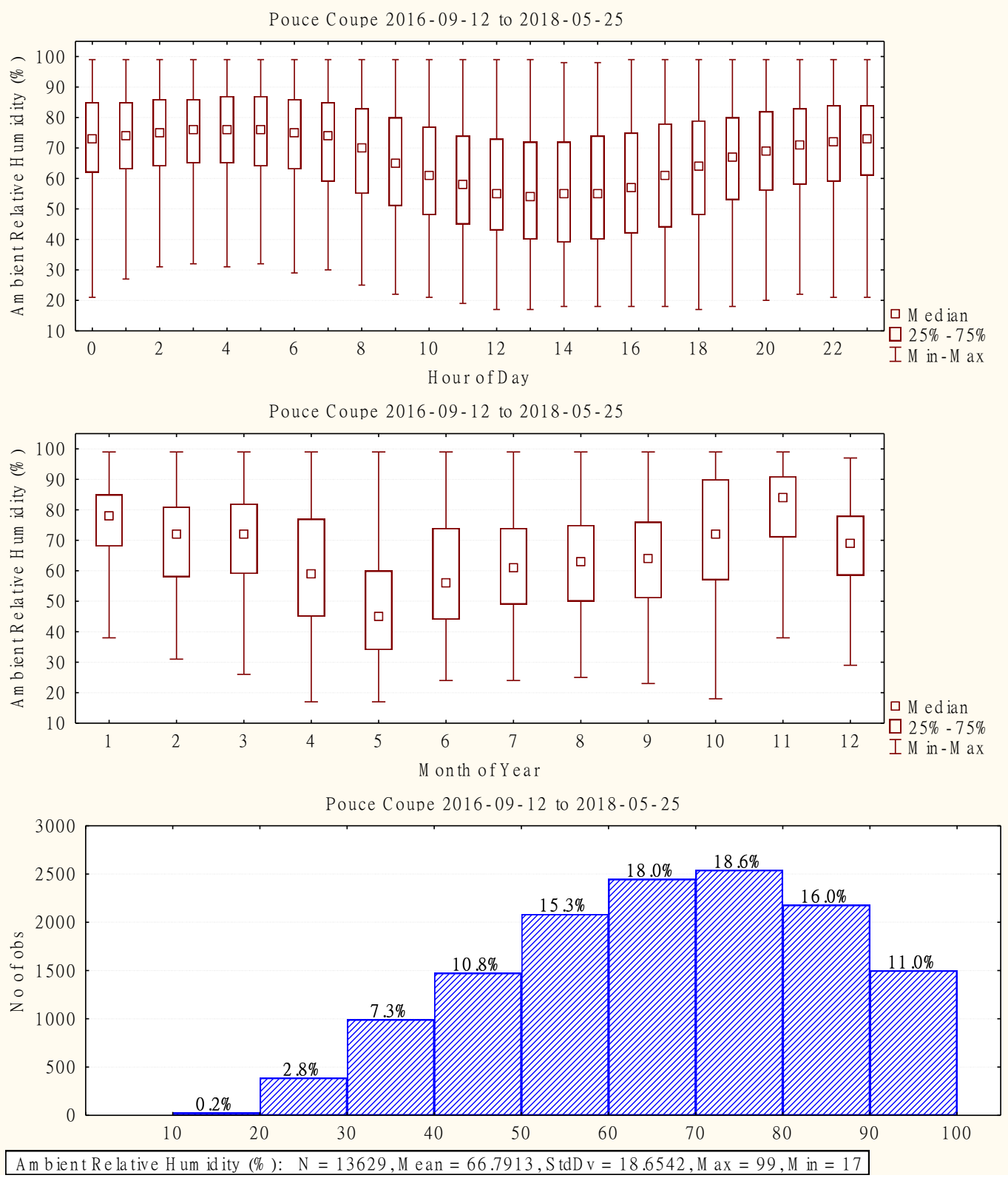

Figure 3-4 Diurnal and Seasonal Variation and Frequency Distribution of Relative Humidity

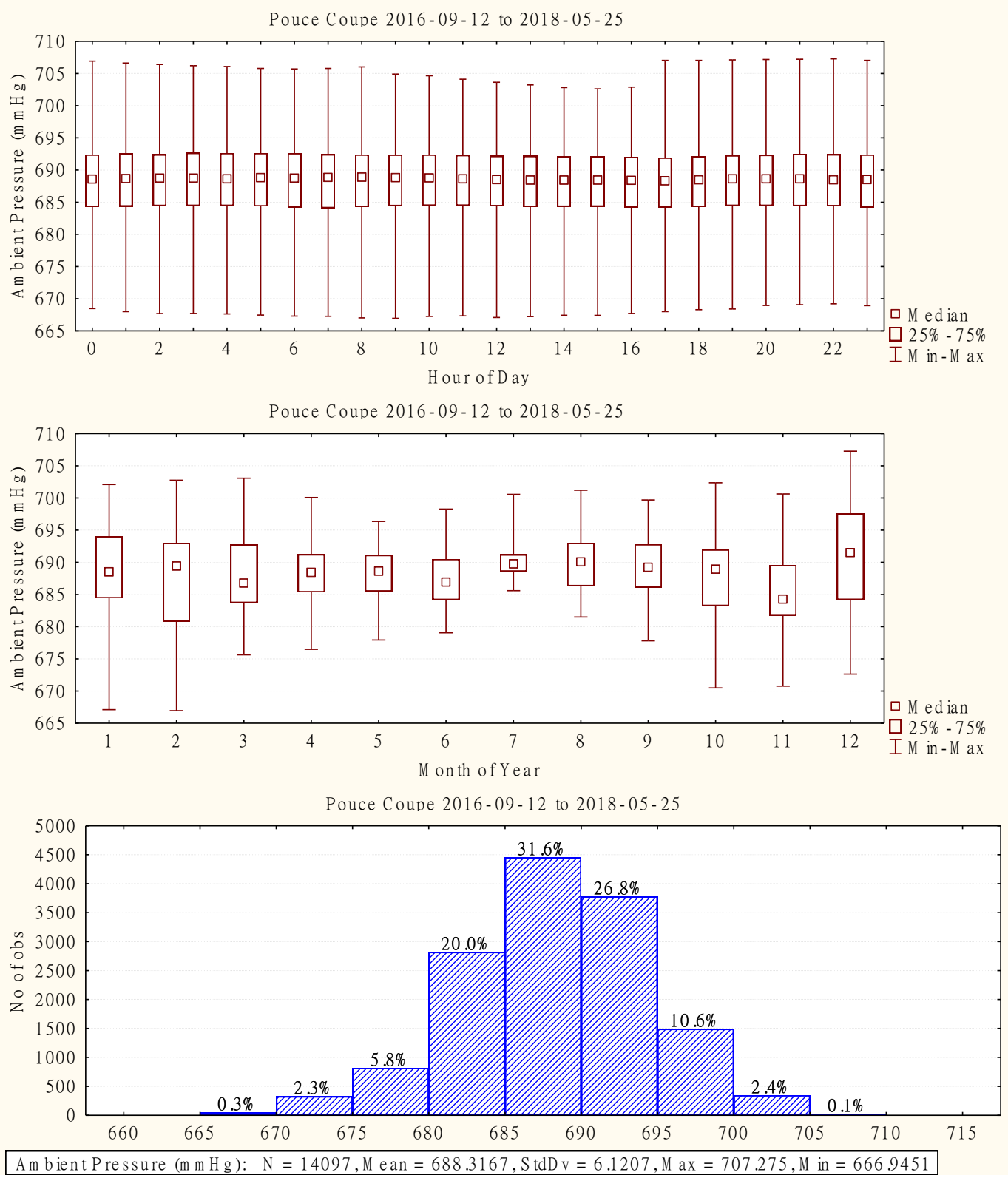

Figure 3-5 Diurnal and Seasonal Variation and Frequency Distribution of Ambient Pressure

3.5 Precipitation

Figure 3-6 shows monthly total precipitation observed at the Pouce Coupe Site for the period September 12, 2016 to May 25, 2018. The total precipitation was 471 mm during this period. The highest monthly precipitation was about 80 mm during May and June 2017.

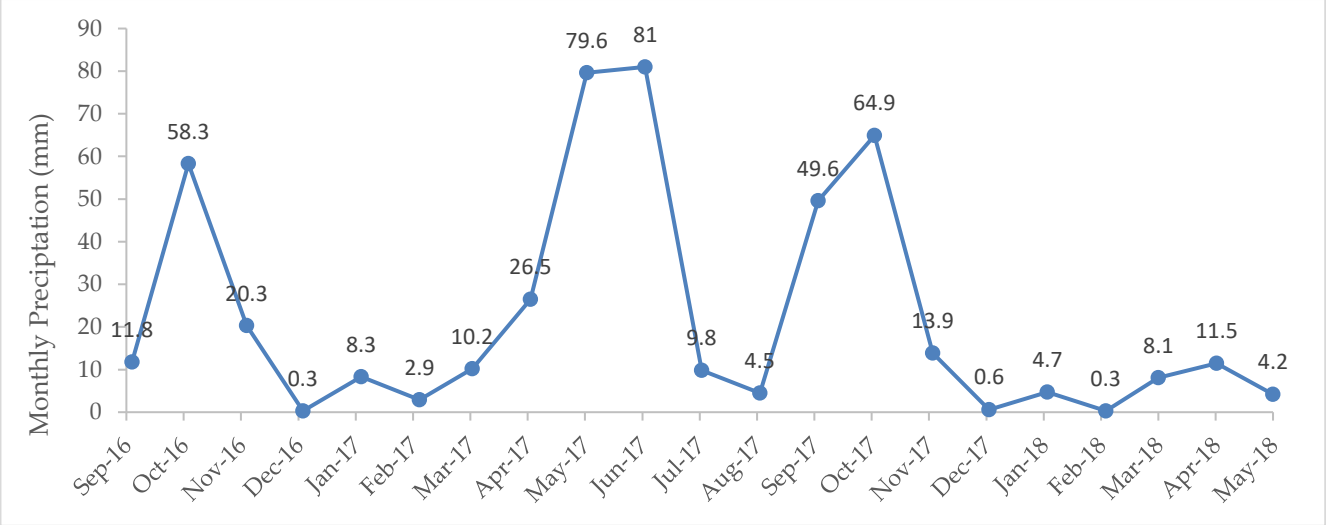

Figure 3-6 Monthly Total Precipitation Values at the Pouce Coupe Site (September 12, 2016 to May 25, 2018)

4.0 AIR QUALITY

4.1 Monitoring Results

Table 4-1 is the summary of the air quality measurements at the Pouce Coupe station for the period September 12, 2016 to May 25, 2018. There were two situations where monitoring equipment was not operating:

- CO monitor failed completely on 12/12/2016 and was replaced on 09/08/2017.
- BTEX monitor developed significant problems on 09/05/2017 and was repaired on 24/07/2017.

When these two situations are excluded from the respective data sets, availability ranged from 75% to 90% for CO and BTEX, and above 83% for other contaminants.

All measurements at the Pouce Coupe station for the period from September 12, 2016 to May 25, 2018 were analyzed by hour of day, month of year and frequency distribution as shown in Figures 4-1 to 4-16. Comparisons to AAQOs are provided in the following section. Some observations are:

- Ozone measurements were highest in spring likely due to stratospheric intrusion and during afternoons due to photochemical production (Figure 4-1).
- Concentrations of CO and $PM_{2.5}$ were highest in the early morning hours in August 2017 (Figures 4-2 and 4-7). These patterns were consistent with higher altitude plumes mixing to the ground near sunrise. The analysis below suggests the cause of most elevated $PM_{2.5}$ values was forest fire activity, which would also generate increased CO emissions.
- NO_2 measurements were highest in winter and outside of daytime hours likely as a result of trapping combustion emissions (traffic, flaring, compression) within stable layers near the ground, especially just before sunrise (Figures 4-4 and 4-5).
- The highest NMHC values were measured in June to December, but concentrations were low (Figure 4-11). THC (Figure 4-12) showed a similar seasonal pattern, with the lowest values during the day suggesting sources may be have been near ground level, and mixed upward during the day.
- BTEX values (Benzene, Toluene, Ethylbenzene, Xylene) showed a similar seasonal pattern (Figures 4-13 to 4-16) with higher measurements in September to December.

Other data did not show marked diurnal or seasonal variation.

Table 4-1 Air Quality Measurement at Pouce Coupe Station (September 12, 2016 to May 25, 2018)

Contaminant	Unit	Minimum	Min Date	Maximum	Max Date	Average	Data [%]
Ozone	ppb	2.6	08/11/2017 23:00	64.1	07/06/2017 11:00	32.7	83%
CO (1)	ppm	0.1	29/10/2017 19:00	3.3	13/08/2017 4:00	0.2	86%
NO	ppb	0.0	12/09/2016 18:00	69.8	28/11/2016 7:00	0.5	90%
NO_2	ppb	0.0	18/10/2016 13:00	52.4	16/12/2016 8:00	3.0	90%
NO_x	ppb	0.0	17/09/2016 19:00	118.1	28/11/2016 7:00	3.5	90%
SO_2	ppb	0.0	12/09/2016 3:00	9.0	27/01/2018 12:00	0.4	90%
$PM_{2.5}$	ug/m^3	0.0	12/09/2016 0:00	571.5	13/08/2017 5:00	4.8	90%
PM_{10}	ug/m^3	0.0	16/09/2016 17:00	616.2	13/08/2017 5:00	11.4	91%
TRS	ppb	0.0	12/09/2016 0:00	5.5	08/11/2017 5:00	0.6	90%
CH_4	ppm	1.7	20/10/2017 1:00	3.0	12/12/2017 1:00	2.0	80%
NMHC	ppm	0.0	14/09/2016 4:00	2.3	04/08/2017 21:00	0.1	77%
THC	ppm	1.7	23/11/2017 22:00	4.8	04/08/2017 21:00	2.0	75%
Benzene (2)	ppb	0.0	16/09/2016 15:00	5.6	29/10/2017 17:00	0.008	86%
Toluene (2)	ppb	0.0	16/09/2016 15:00	7.4	12/12/2017 1:00	0.008	86%
Ethylbenzene (2)	ppb	0.0	16/09/2016 15:00	3.7	12/09/2017 16:00	0.005	86%
Xylene (2)	ppb	0.0	16/09/2016 15:00	3.2	12/09/2017 16:00	0.007	85%

(1) Due to the repair/replacement, CO monitor was not available on site from 12/12/2016 until 09/08/2017
(2) Due to the repair/replacement, BTEX monitor was not available on site from 09/05/2017 until 24/07/2017

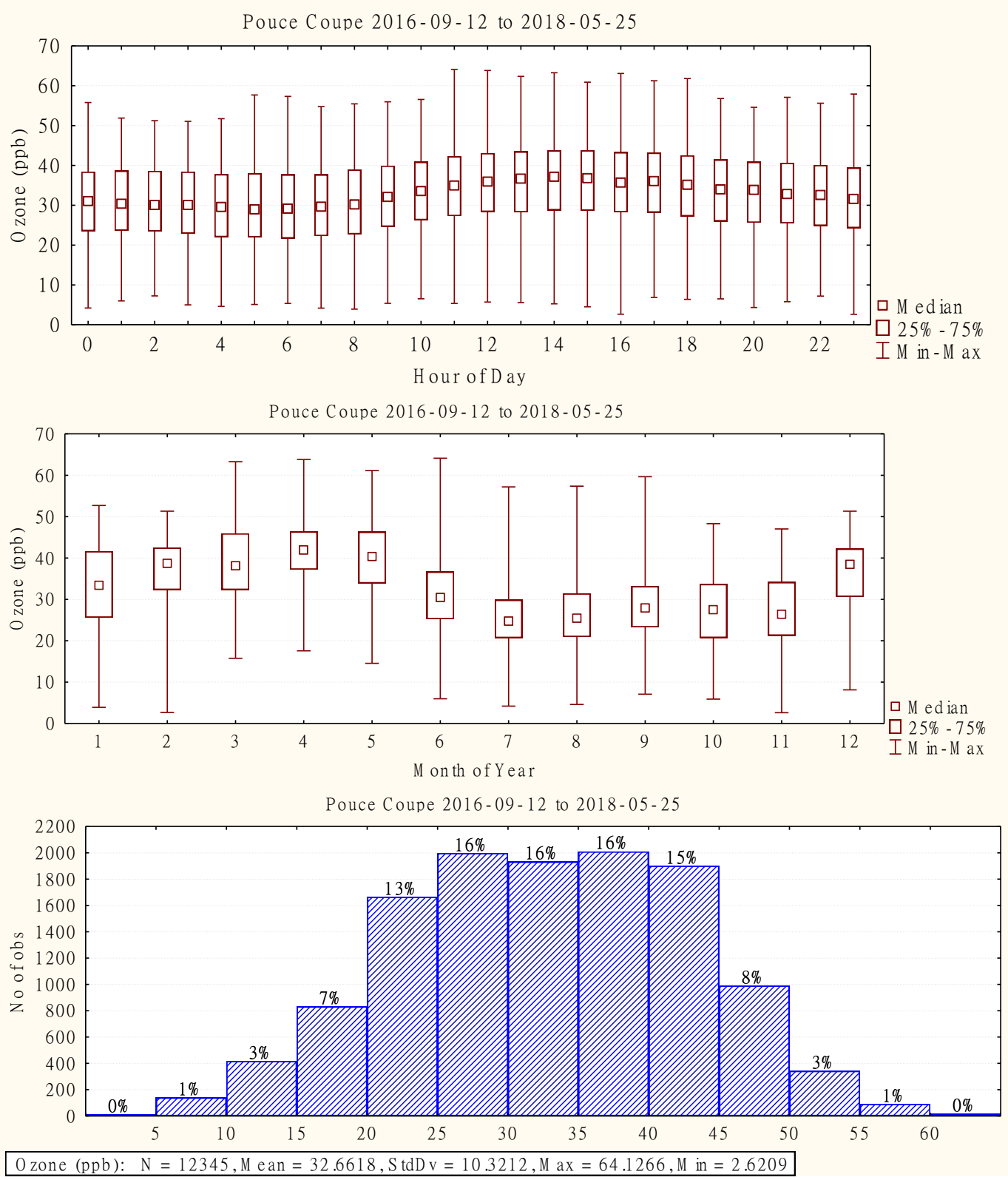

Figure 4-1 Diurnal and Seasonal Variation and Frequency Distribution of Ozone

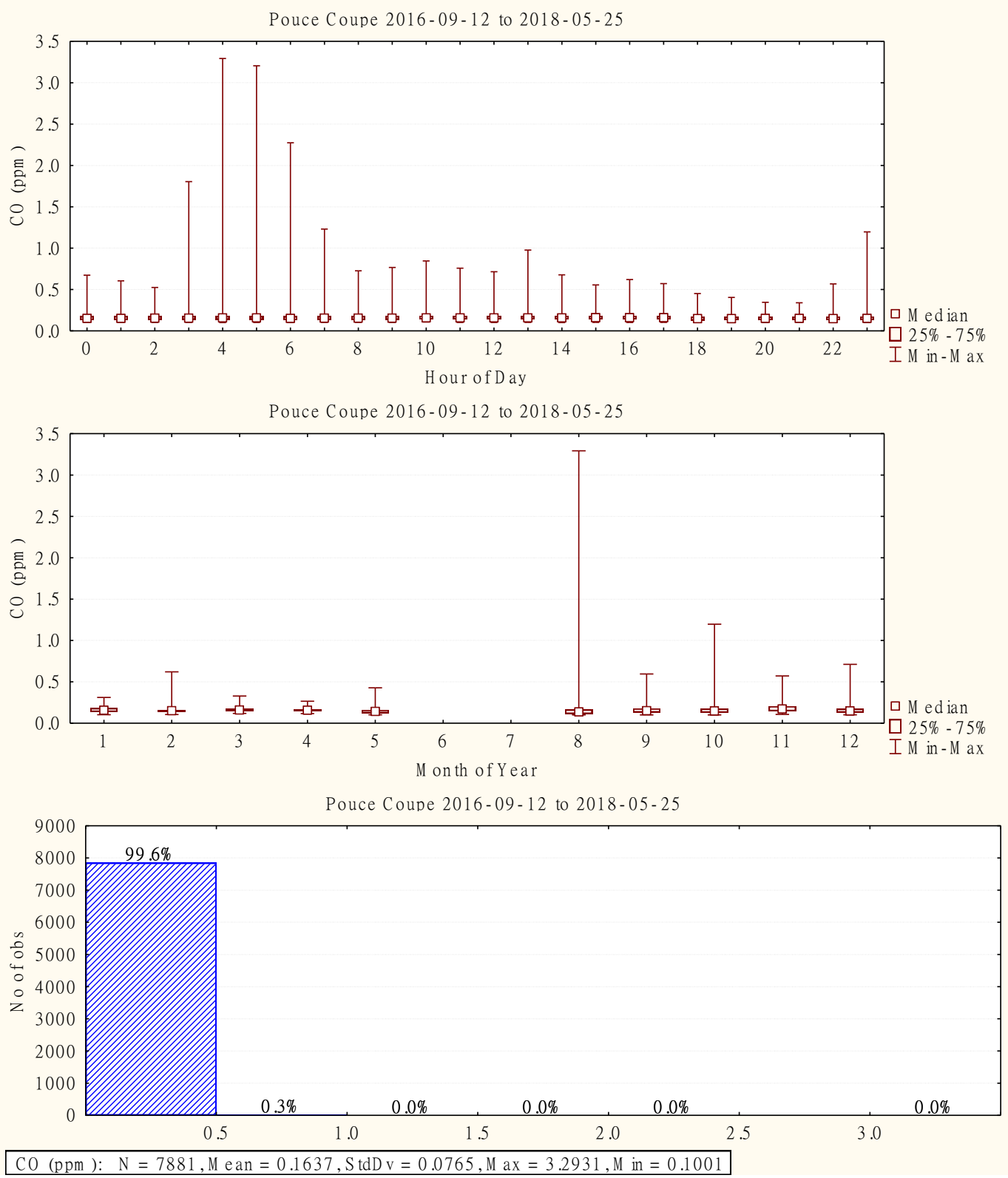

Figure 4-2 Diurnal and Seasonal Variation and Frequency Distribution of CO

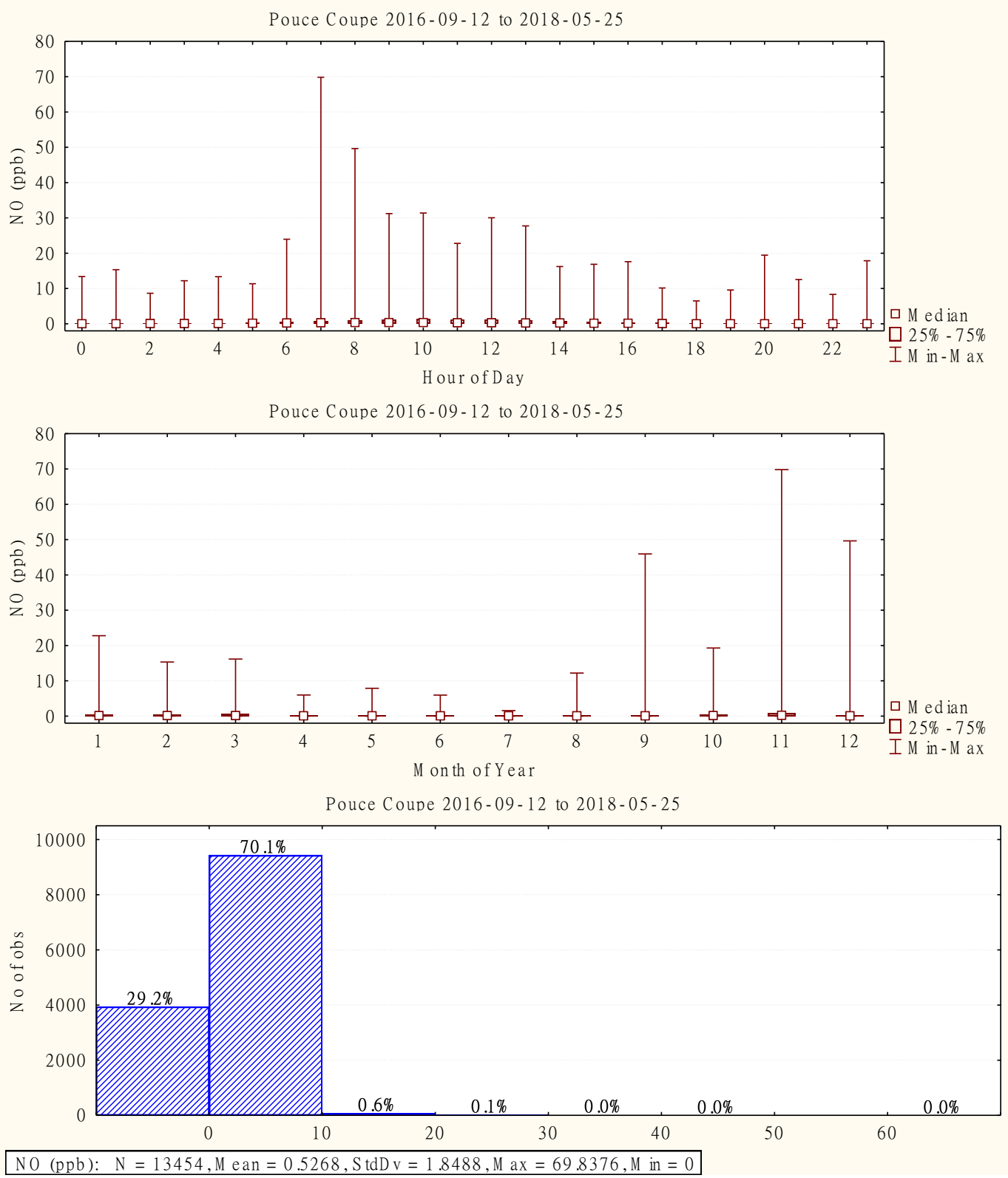

Figure 4-3 Diurnal and Seasonal Variation and Frequency Distribution of NO

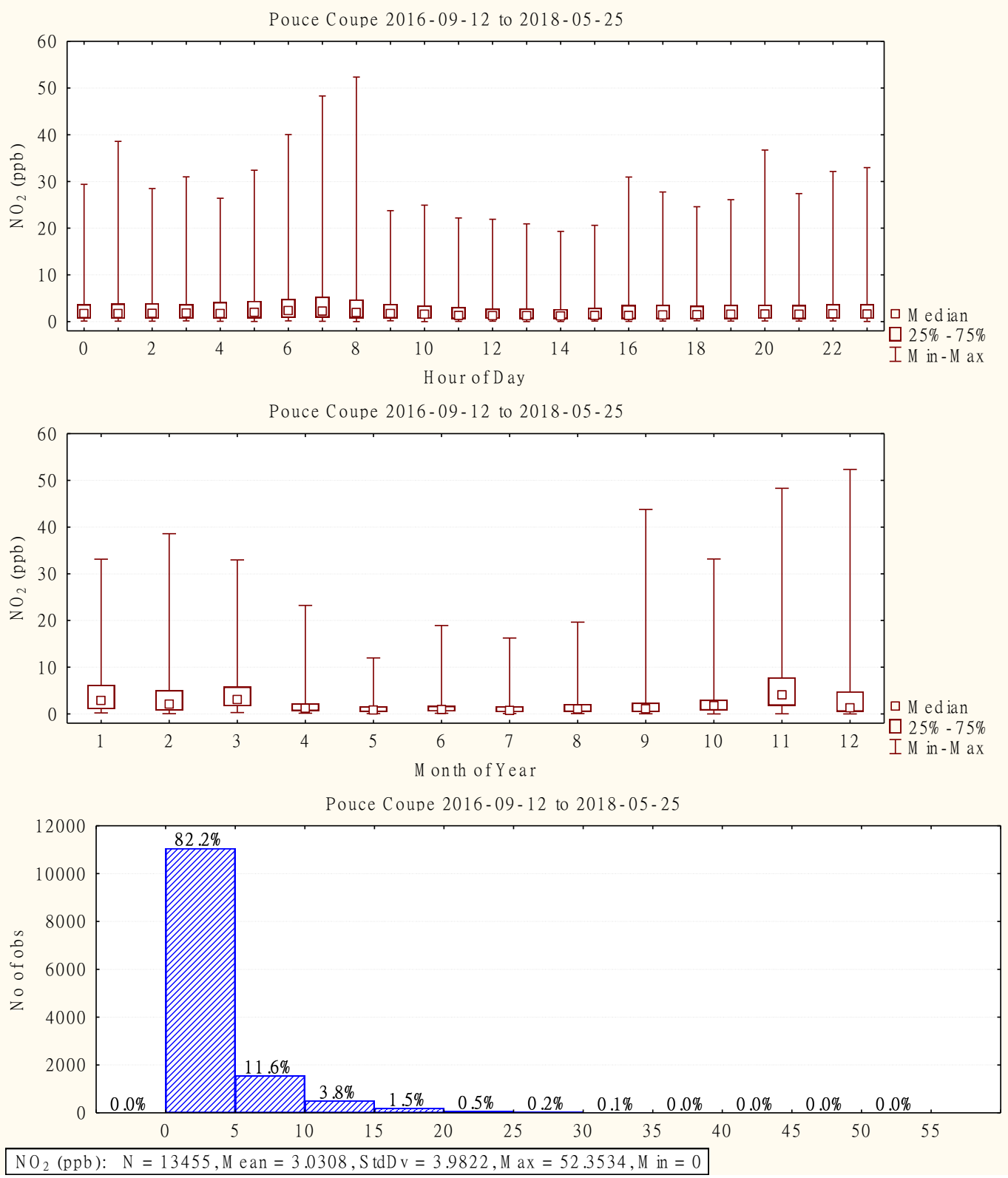

Figure 4-4 Diurnal and Seasonal Variation and Frequency Distribution of NO_2

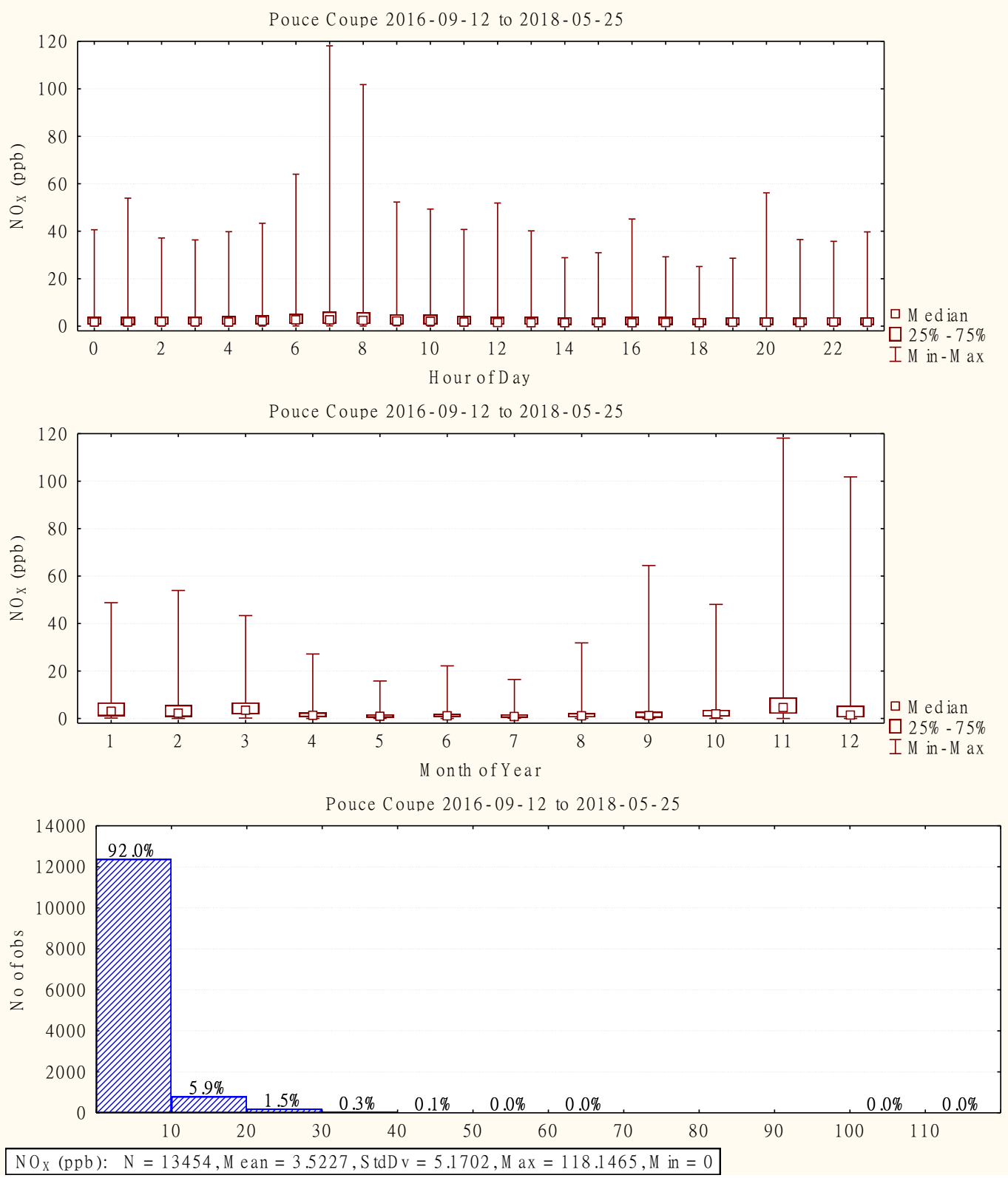

Figure 4-5 Diurnal and Seasonal Variation and Frequency Distribution of NOx

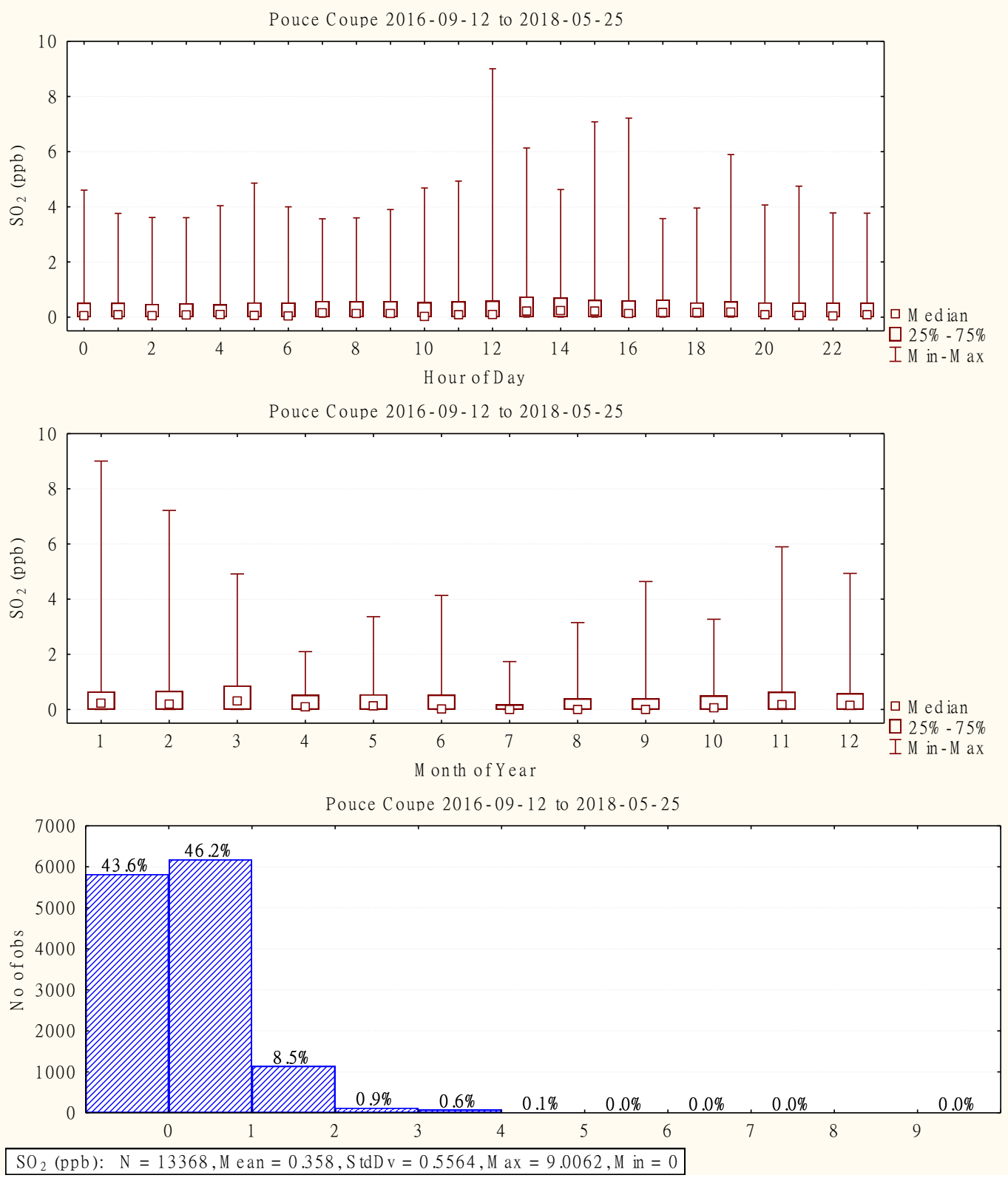

Figure 4-6 Diurnal and Seasonal Variation and Frequency Distribution of SO_2

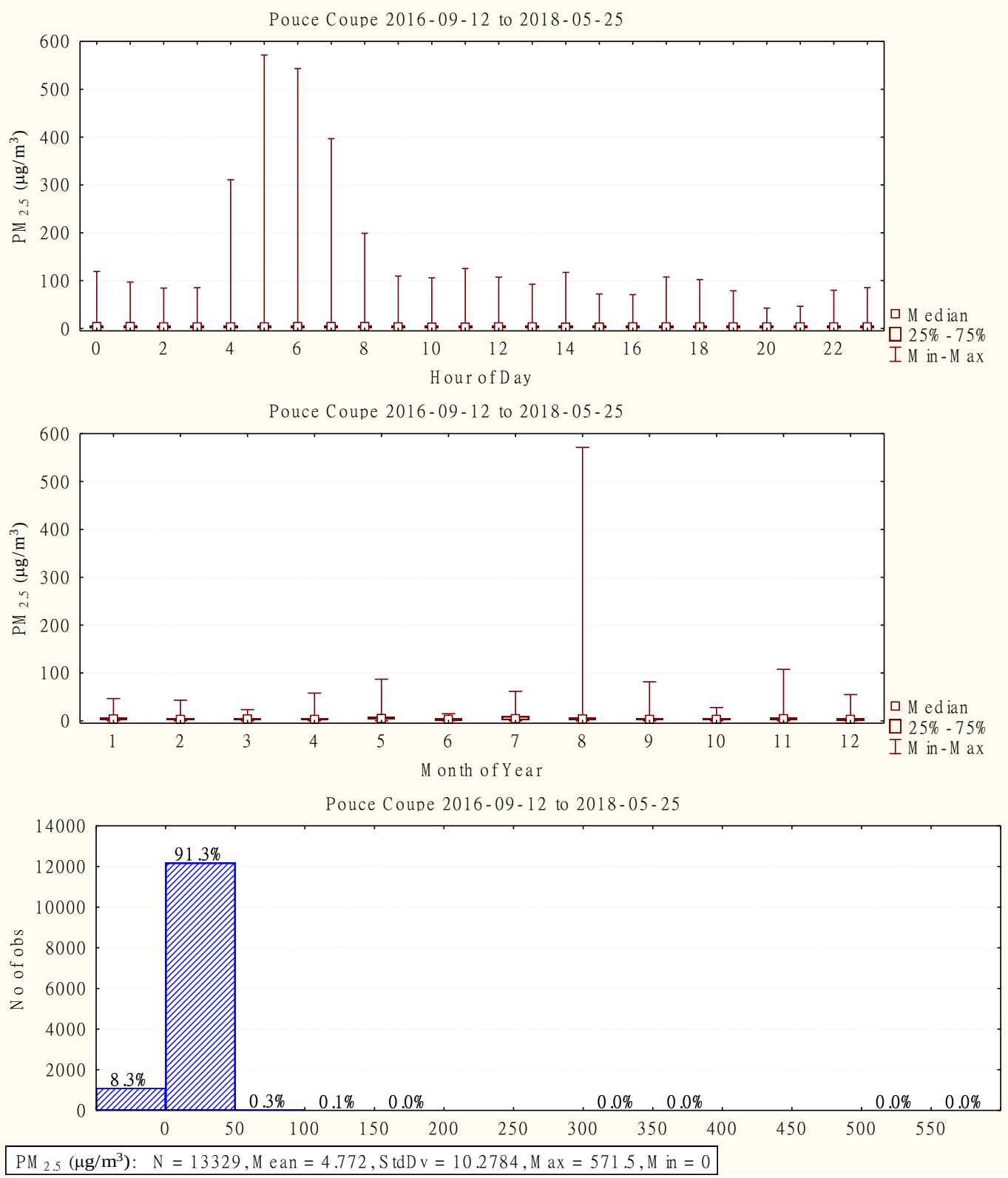

Figure 4-7 Diurnal and Seasonal Variation and Frequency Distribution of $PM_{2.5}$

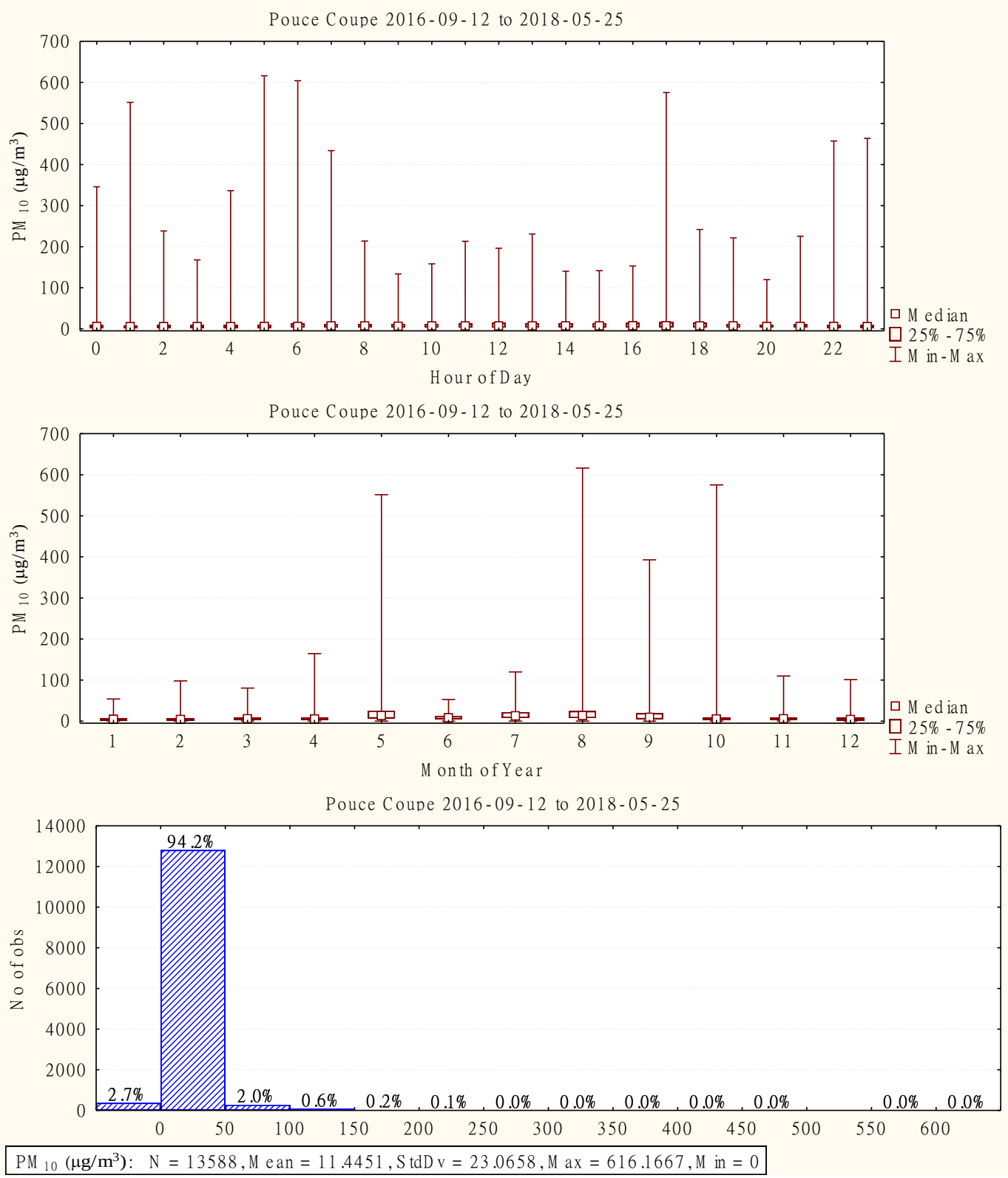

Figure 4-8 Diurnal and Seasonal Variation and Frequency Distribution of PM_{10}

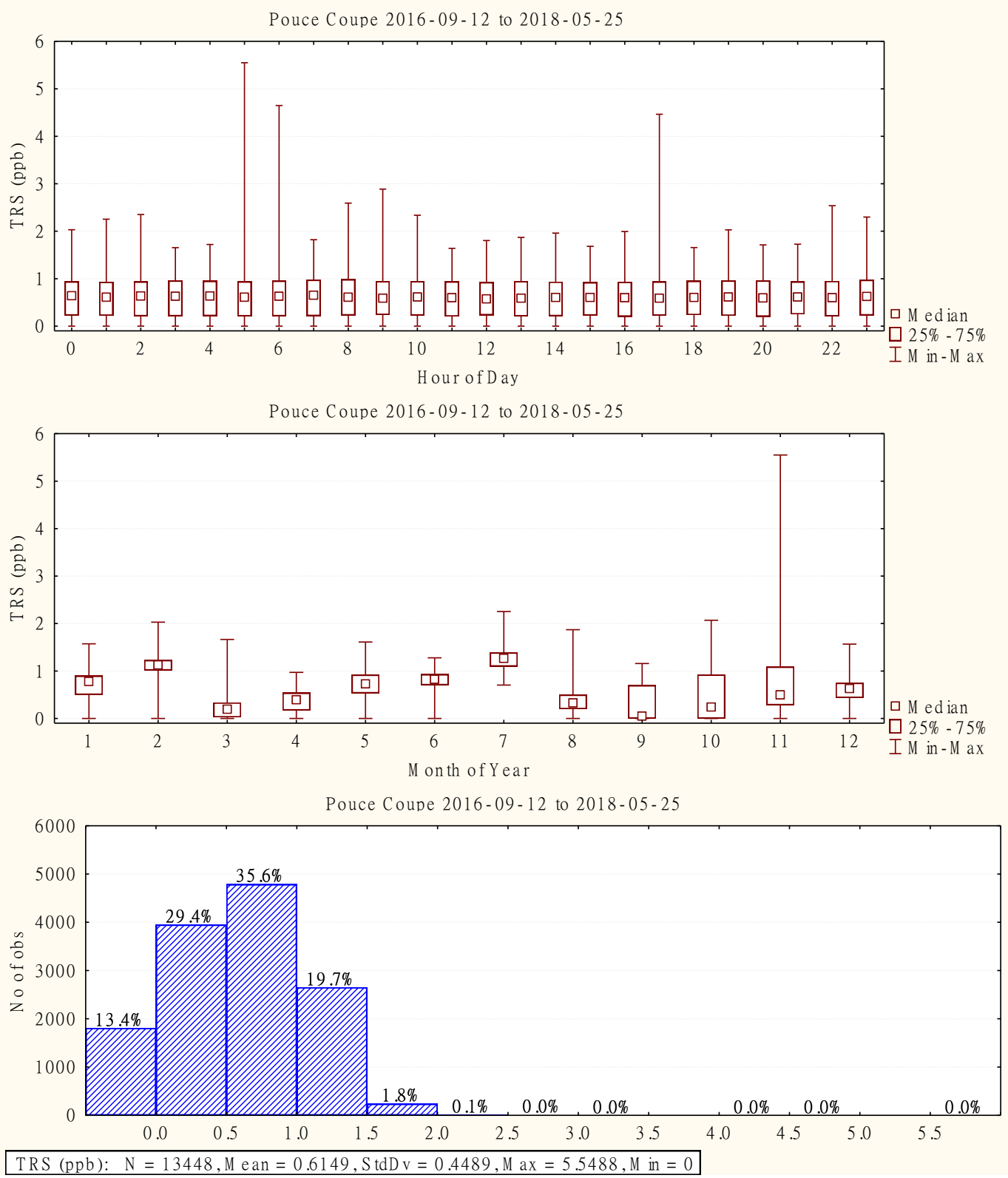

Figure 4-9 Diurnal and Seasonal Variation and Frequency Distribution of TRS

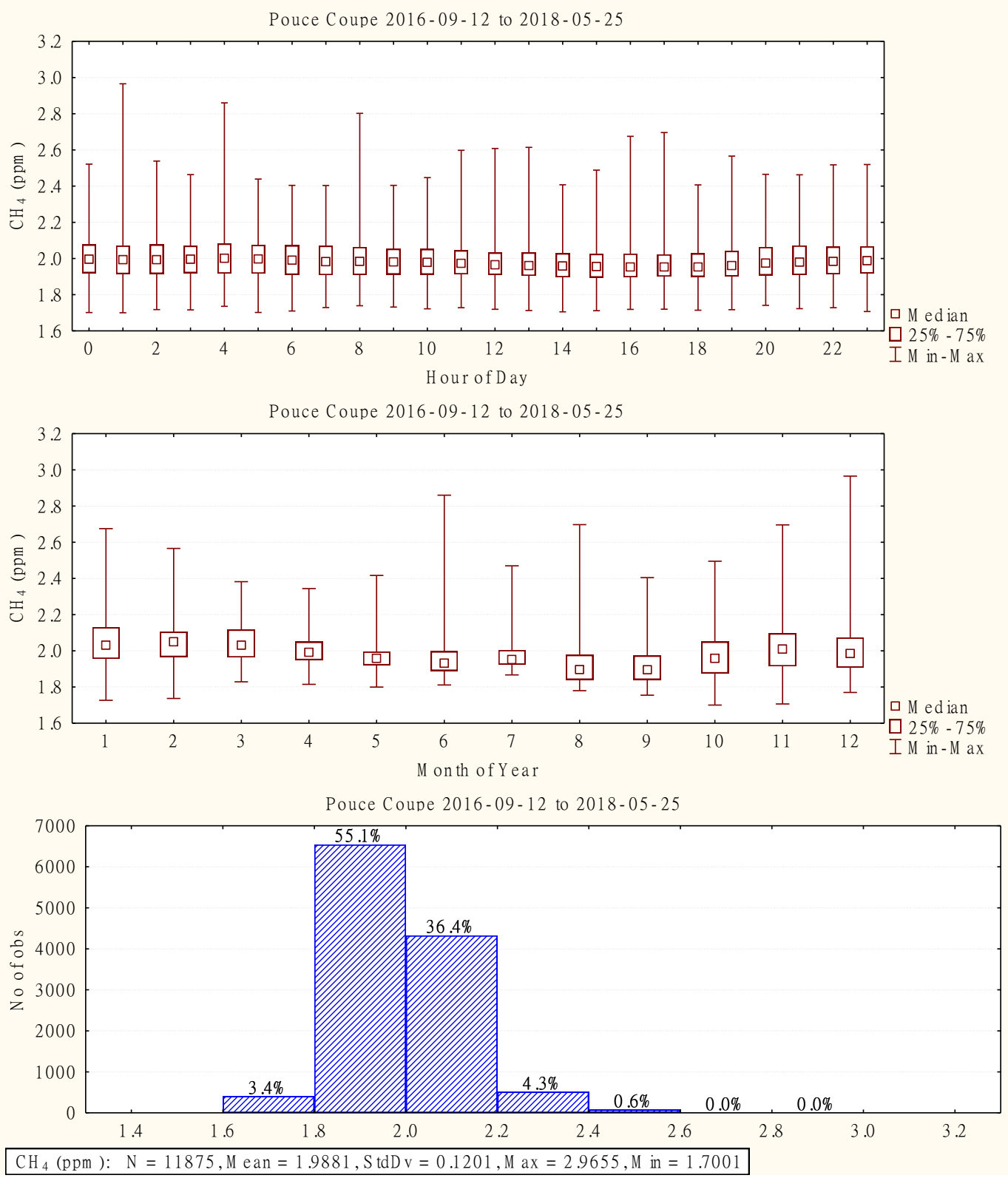

Figure 4-10 Diurnal and Seasonal Variation and Frequency Distribution of CH_4

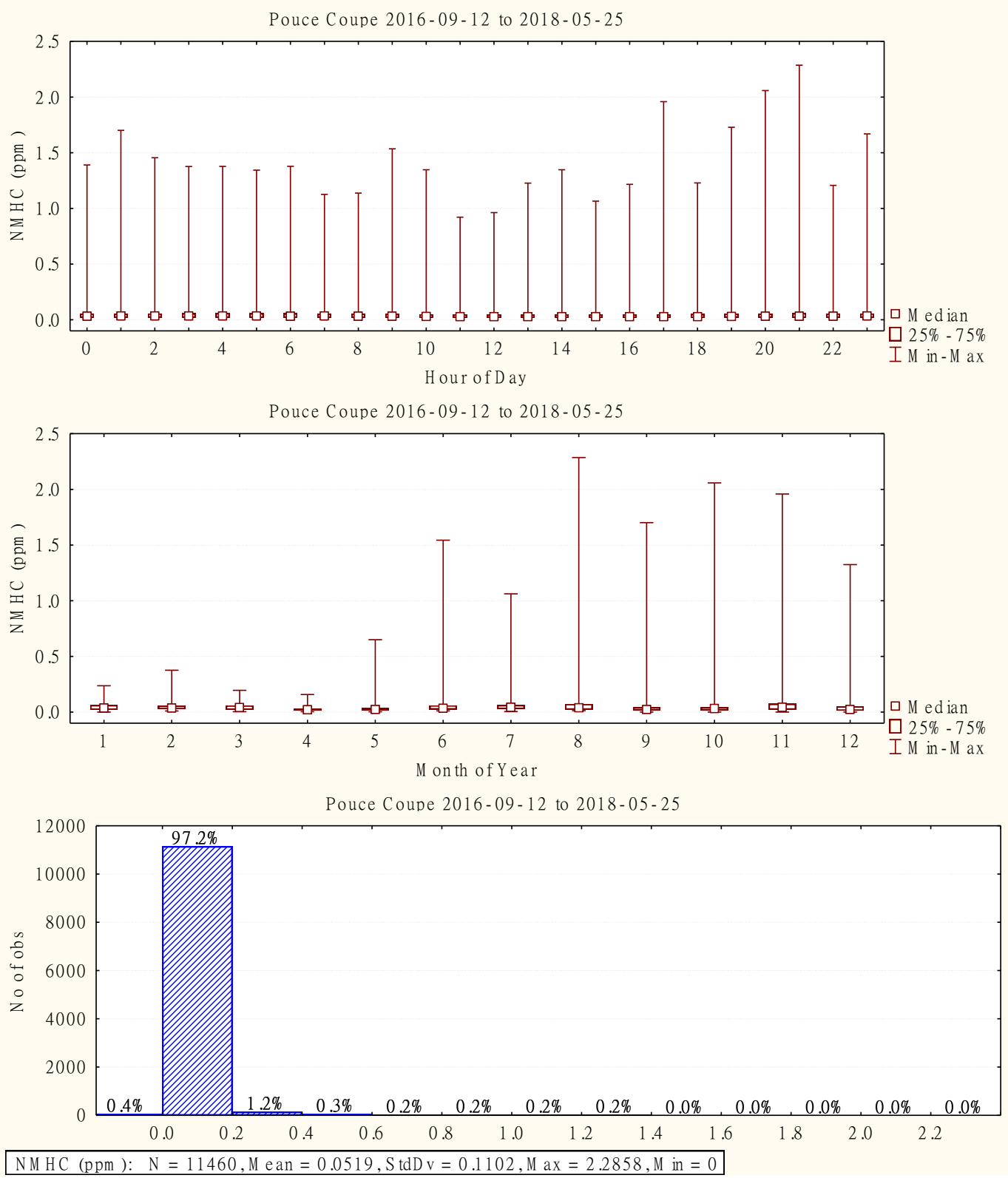

Figure 4-11 Diurnal and Seasonal Variation and Frequency Distribution of NHMC

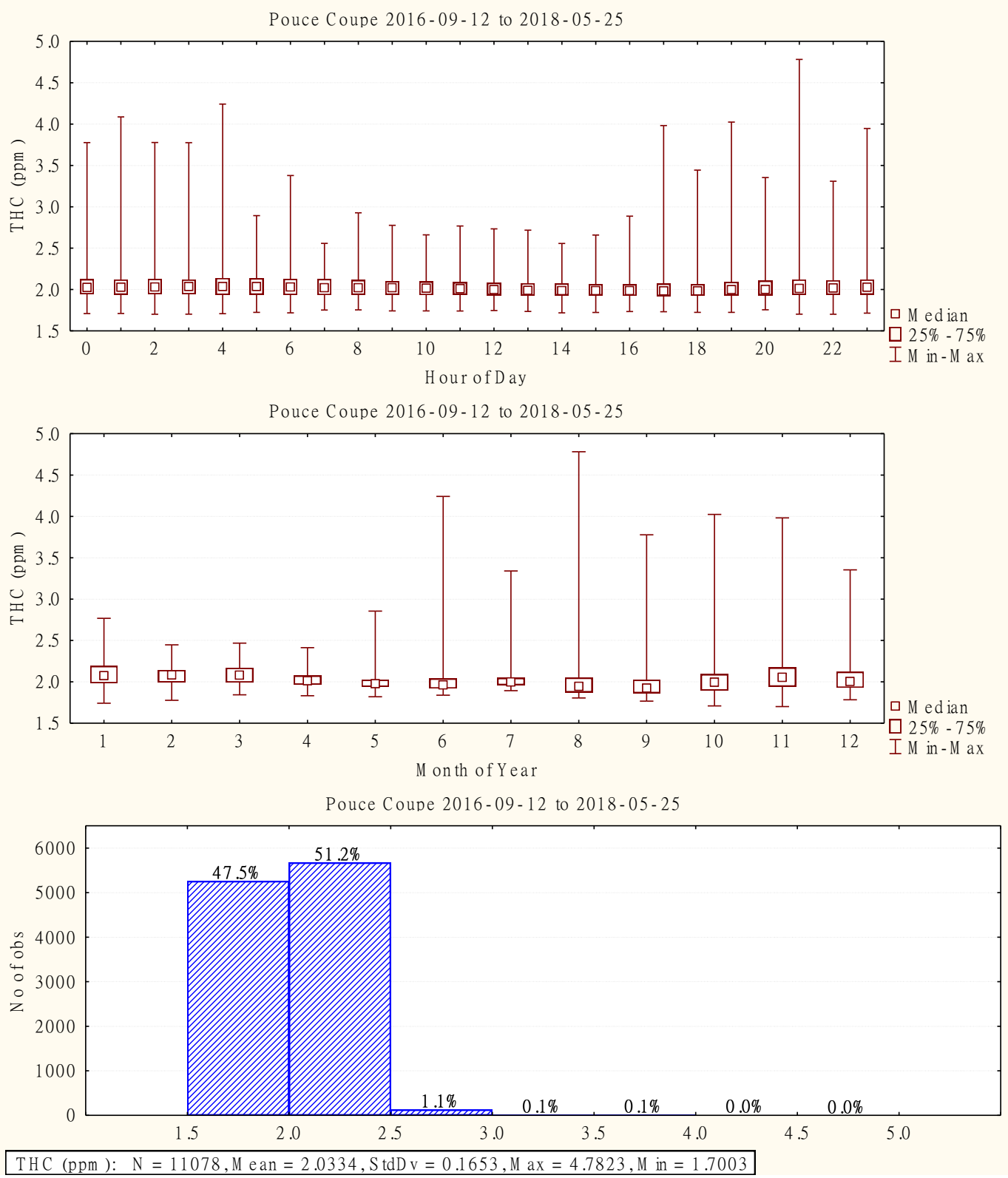

Figure 4-12 Diurnal and Seasonal Variation and Frequency Distribution of THC

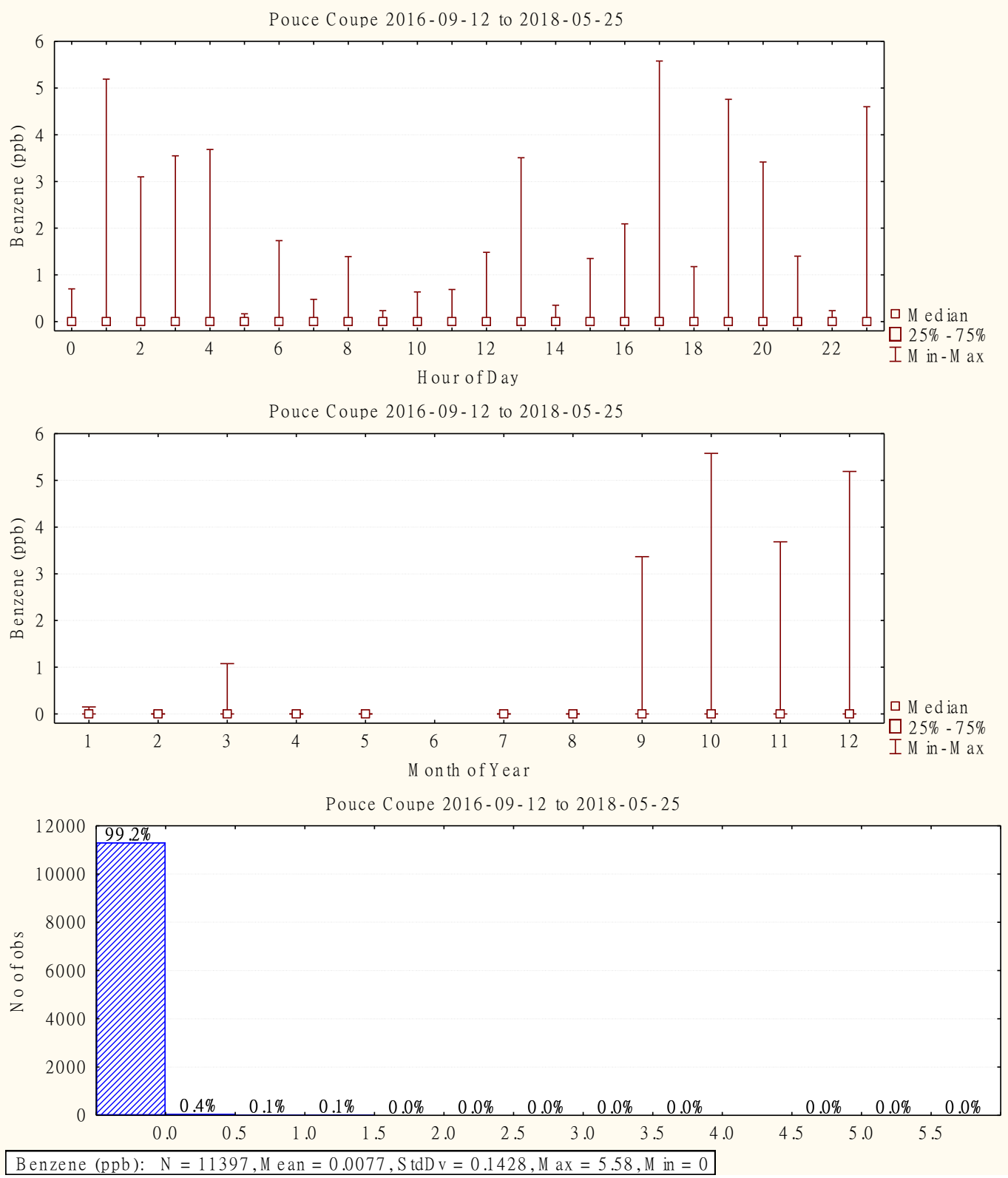

Figure 4-13 Diurnal and Seasonal Variation and Frequency Distribution of Benzene

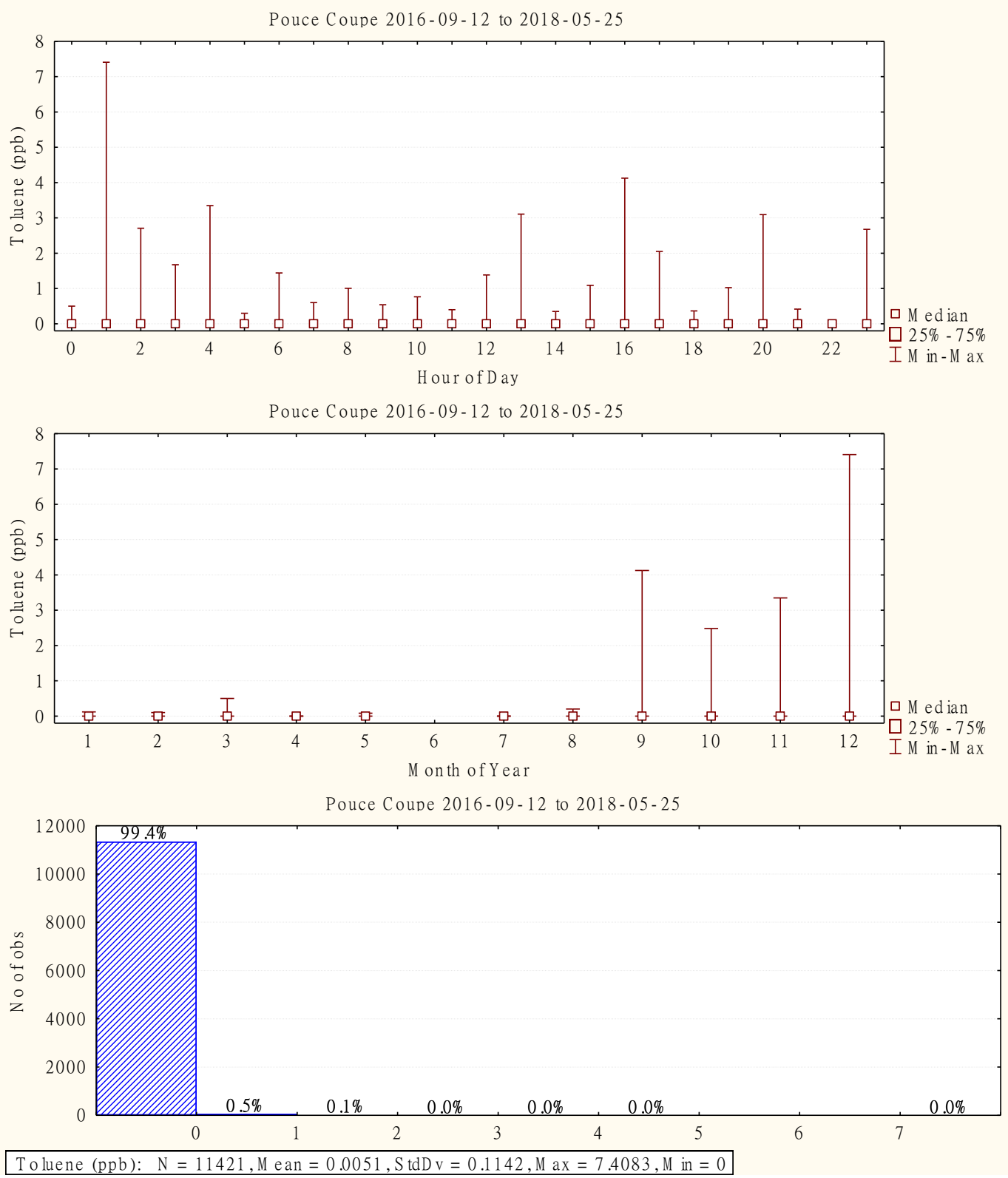

Figure 4-14 Diurnal and Seasonal Variation and Frequency Distribution of Toluene

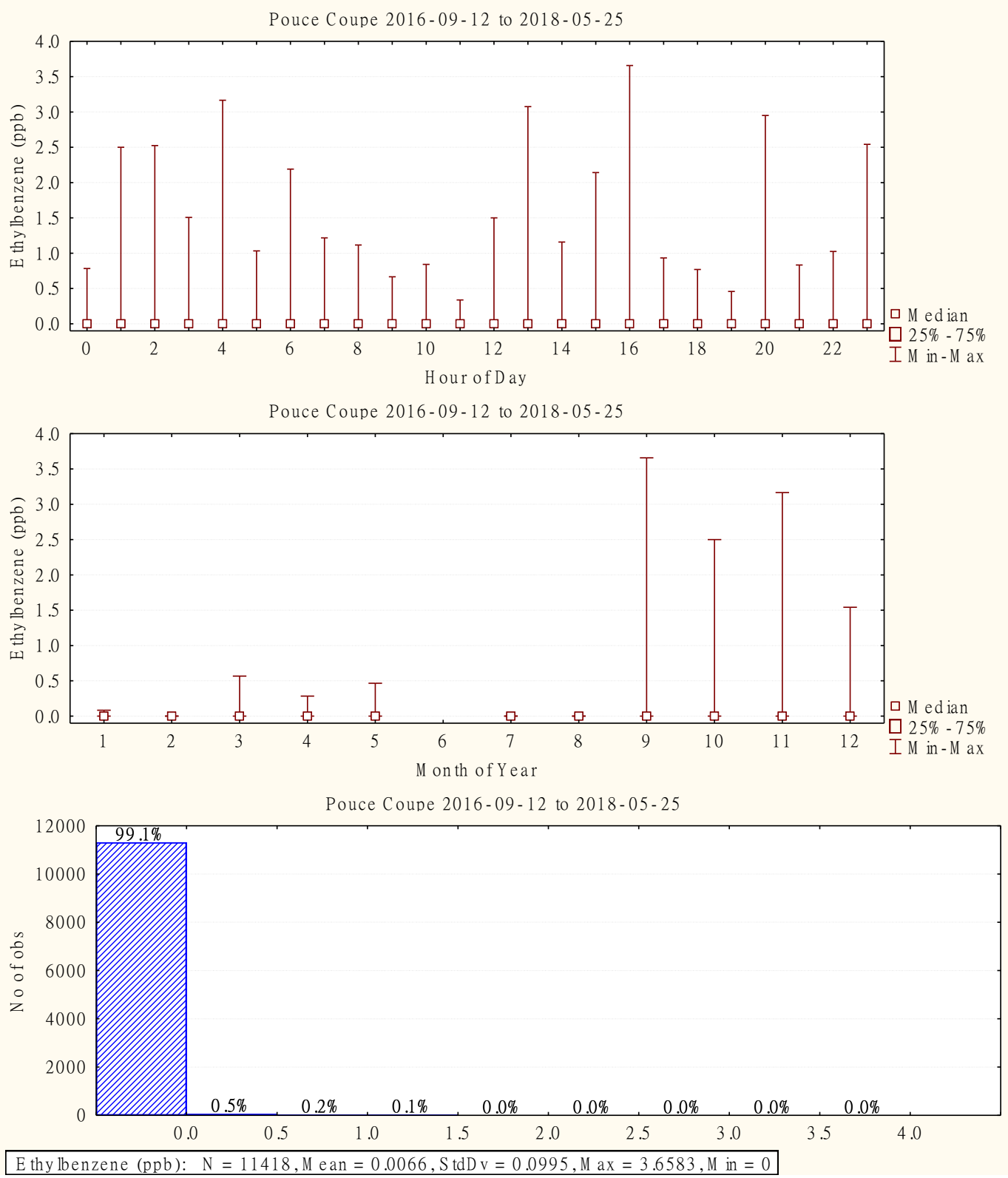

Figure 4-15 Diurnal and Seasonal Variation and Frequency Distribution of Ethylbenzene

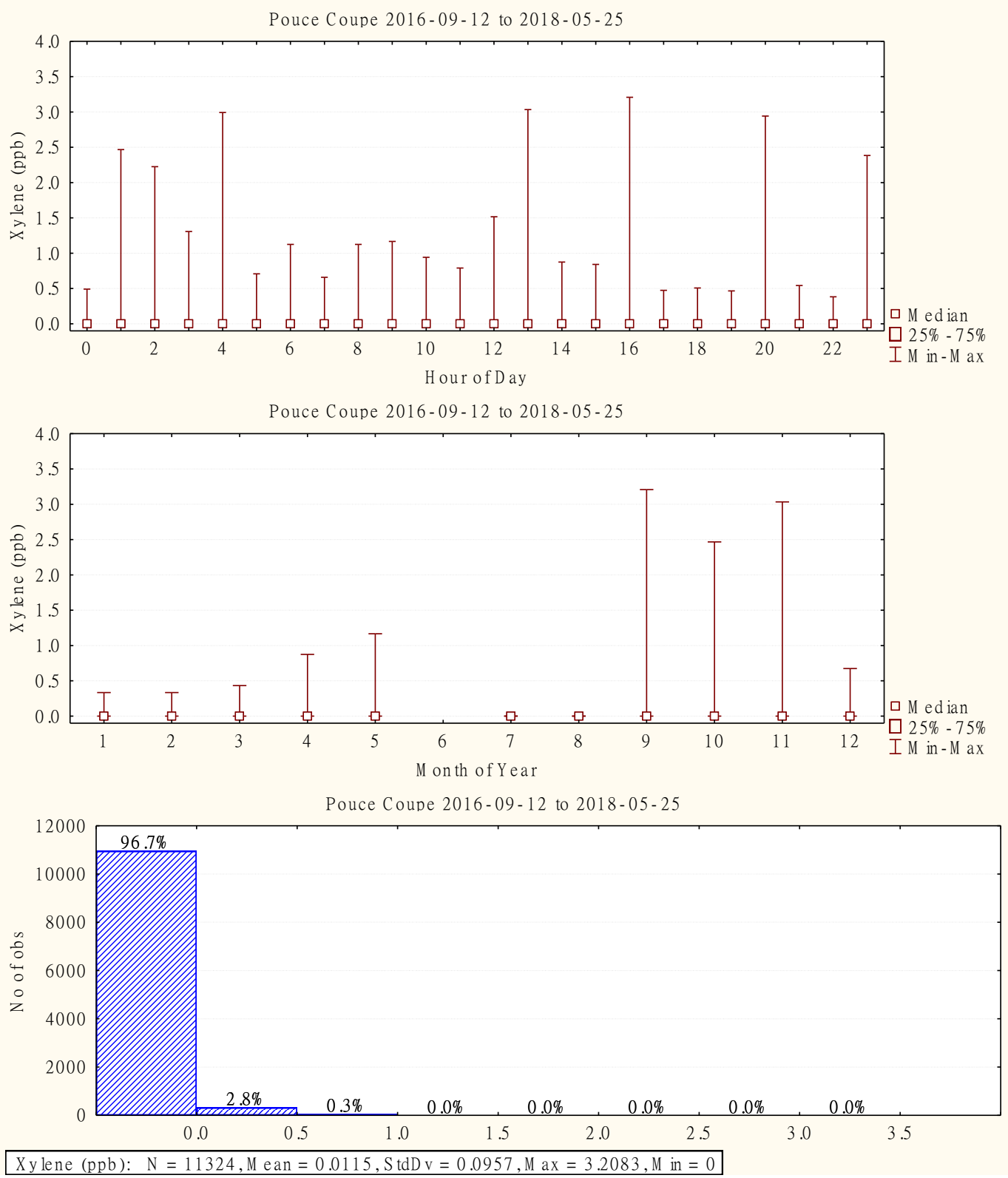

Figure 4-16 Diurnal and Seasonal Variation and Frequency Distribution of Xylene

4.2 Comparison to Air Quality Objectives

The current B.C. Ambient Air Quality Objectives (BCAAQOs, BC MoE 2018) and Alberta Ambient Air Quality Objectives (AAAQOs, AEP 2019) for relevant compounds are presented in Table 4-2. The objectives refer to averaging periods ranging from one hour to one year.

Requirements for the overall duration of air monitoring to determine compliance with ambient air quality objectives differ between jurisdictions:

- BCAAQOs are based on Canadian Ambient Air Quality Standards (CAAQS) for SO_2, NO_2, O_3 and $PM_{2.5}$. For these contaminants, percentiles (98^{th} or 99^{th}) for measurement over 3 consecutive years are required to demonstrate compliance.

- AAAQOs for $PM_{2.5}$ and BTEX require data collection for the averaging period of the objective (1 hour, 24 hour or annual). There is no requirement to collect 3 years of data to demonstrate compliance.

Since CAMEL remained on location for 1.7 years, it is not possible to determine compliance with BCAAQOs for SO_2, NO_2, O_3 and $PM_{2.5}$. In Table 4.2, percentiles are presented (for 1.7 years of data) in italics to indicate that conclusion of compliance with BCAAQOs could not be determined (without 1.3 years of additional data.

Air quality measurements at Pouce Coupe (September 12, 2016 to May 25, 2018) are summarized and compared to relevant objectives in Table 4-2. The table indicates the following exceedances:

- Maximum 24-hour PM_{10} is about 2.8 times higher than BCAAQO (50 µg/m^3); 24-hour PM_{10} objective exceeded approximately 1.8% of the time (10 days of exceedances out of 546 recorded days).
- Maximum 1-hour TRS was 5.5 ppb; a single one hour of exceedance of BCAAQO of 5 ppb.
- Maximum 1-hour $PM_{2.5}$ is about 7 times higher than the Alberta Ambient Air Quality Guideline (AAAQG) of 80 µg/m^3; 1-hour $PM_{2.5}$ AAAQG exceeded approximately 0.15% of the time (20 hours out of 13329 recorded hours).
- Maximum 24-hour $PM_{2.5}$ is about 4 times higher than the AAAQO (29 µg/m^3); 24-hour $PM_{2.5}$ AAAQO exceeded approximately 0.6% of the time (3 days of exceedances out of 530 recorded days).

Details regarding these exceedances are discussed in following sections.

Table 4-2 Summary of Measurement at Pouce Coupe Station, Comparison to Air Quality Guideline

Contaminant	Unit	Period	2016-2018 Measurement	Air Quality Guideline	
SO_2	ppb	99th Percentile Daily 1-hour Maximum (D1HM), averaged over 3 consecutive years (effective Jan 1, 2020)	***4.9***	70	British Columbia [a]
		Maximum Annual (effective Jan 1, 2020)	0.4	5	
NO_2	ppb	98th Percentile Daily 1-hour Maximum (D1HM), averaged over 3 consecutive years	***28.5***	60	
		Maximum Annual	3.0	17	
CO [b]	ppb	Maximum 1-hour	3,300	13,000	
		Maximum 8-hour	1,589	5,000	
O_3	ppb	Maximum 1-hour	64	82	
		8-hour, annual 4th highest max averaged over 3 consecutive years	***55***	63	
$PM_{2.5}$	µg/m³	98th Percentile 24-hour, averaged over 3 consecutive years	***16***	28	
		Maximum Annual, averaged over 3 consecutive years	***4.8***	10	
PM_{10}	µg/m³	Maximum 24-hour	**139**	50	
TRS [b]	ppb	Maximum 1-hour	**5.5**	5	
		Maximum 24-hour	1.7	2	
$PM_{2.5}$	µg/m³	Maximum 1-hour	**572**	80 [c]	Alberta [d]
		Maximum 24-hour	**124**	29	
Benzene	ppb	Maximum 1-hour	5.6	9	
		Maximum Annual	0.01	0.9	
Toluene	ppb	Maximum 1-hour	7.4	449	
		Maximum 24-hour	0.3	106	
Ethylbenzene	ppb	Maximum 1-hour	3.7	460	
Xylene	ppb	Maximum 1-hour	3.2	530	
		Maximum 24-hour	0.3	161	

[a] Source: BCAAQOs (BC MoE 2018).
[b] pollution control objectives, used for reference purposes.
[c] Source: Alberta Ambient Air Quality Guideline (AAAQG), not regulatory objective (AEP 2019)
[d] Source: AAAQOs (AEP 2019).

4.3 $PM_{2.5}$ Exceedances

Table 4-3 lists three days when the daily $PM_{2.5}$ exceeded the AAAQO of 29 µg/m³, with daily average wind speed and direction data. The highest daily $PM_{2.5}$ was 124 µg/m³, which occurred with a wind speed of 1 m/s from the south-southwest on August 13, 2017. The windrose for these $PM_{2.5}$ exceedance days are shown in Figure 4-17.

Table 4-3 Daily $PM_{2.5}$ Exceedance of AAAQO

Date	24-hour $PM_{2.5}$ (µg/m³)	Daily Average Wind Speed (m/s)	Daily Average Wind Direction (degree)
2017-08-13	124.1	1.0	212
2017-09-07	45.0	0.8	200
2017-11-22	35.6	1.6	157

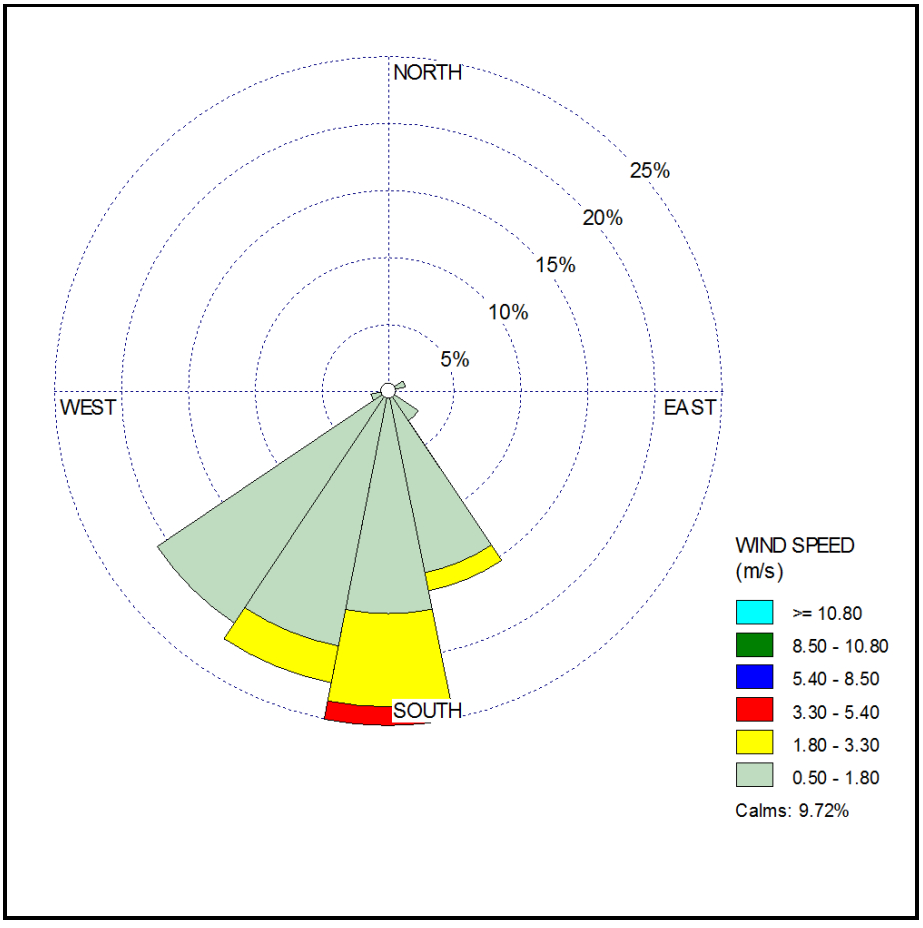

Figure 4-17 Wind Rose for all 24-hour $PM_{2.5}$ Exceedances of AAAQO at the Pouce Coupe Site

Table 4-4 lists hourly $PM_{2.5}$ measurements above the Alberta hourly guideline (80 µg/m³), with wind speed and direction data. Figure 4-18 presents the wind direction variation for hourly $PM_{2.5}$ above AAAQG (80 µg/m³).

Tables and figures both indicate that elevated $PM_{2.5}$ measurements occurred mostly under light southwest winds. Extremely high $PM_{2.5}$ measurements over 200 µg/m³ occurred under 1 m/s wind with a wind direction from 230 to 240 degrees.

Table 4-4 Hourly $PM_{2.5}$ Measurements above AAAQG

Date and Time	1-hour $PM_{2.5}$ (µg/m³)	Wind Speed (m/s)	Wind Direction (degree)
2017-08-13 03:00	85.3	1.1	231
2017-08-13 04:00	310.8	0.8	231
2017-08-13 05:00	571.5	0.3	231
2017-08-13 06:00	543.3	0.7	247
2017-08-13 07:00	396.8	0.7	227
2017-08-13 08:00	198.9	0.9	216
2017-08-13 09:00	109.5	1.2	174
2017-08-13 10:00	105.9	1.0	205
2017-08-13 11:00	125.5	1.1	210
2017-08-13 12:00	107.4	1.3	203
2017-08-13 13:00	92.6	1.1	209
2017-08-13 14:00	117.2	0.9	222
2017-08-17 23:00	85.3	1.5	187
2017-08-18 00:00	119.1	1.8	188
2017-08-18 01:00	97.0	1.1	197
2017-08-18 02:00	84.4	1.7	177
2017-09-07 14:00	81.5	1.0	183
2017-11-22 17:00	107.7	2.3	168
2017-11-22 18:00	102.2	2.7	171
2018-05-16 01:00	87.0	0.9	213

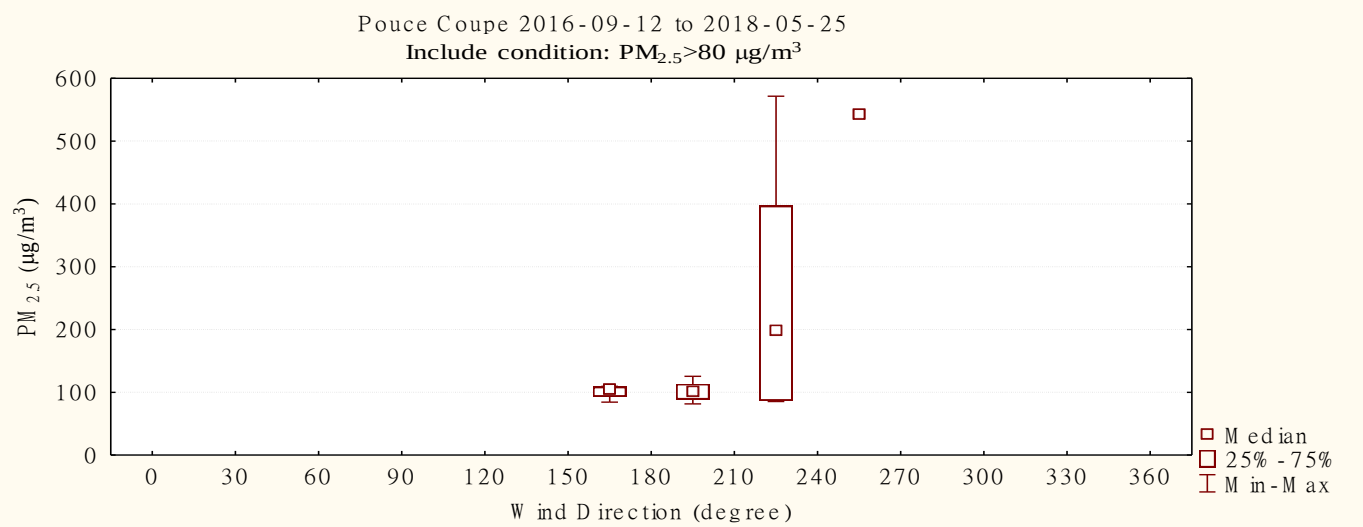

Figure 4-18 Wind Direction Variation of >80 µg/m³ Hourly $PM_{2.5}$ at the Pouce Coupe Site

A potential cause of the high measurements was local forest fires. The frequency of fire events for August 2017 is shown in Figure 4-19, taken from the Canadian Wildland Fire Information System (NRA 2019). The image shows a lot of notable wildfires (>1000 ha) in August 2017 which occurred in southwest of Prince George area, 300 km southwest of the Pouce Coupe station. Detailed information for wildfires occurred with 150 km distance from the Pouce Coupe station are listed in Table 4-5.

As shown in Table 4-4, most of these exceedances occurred from August 13 to 18, 2017, and can be attributed to forest fire activity. The one exceedance on May 16th, 2018 may also be associated with the fire 4 km south of the station.

Table 4-5 Historical Fires within 150 km from Pouce Coupe Station

Latitude	Longitude	Start Date	Distance from Pouce Coupe Station (km)	Fire Name	Size (Ha)
54.58	-121.29	2017-08-07	137	G71597	7.5
54.76	-121.33	2017-08-08	122	G71637	161
55.40	-122.08	2017-08-10	124	G71668	25
55.67	-120.13	2018-05-12	4.0	G70165	27

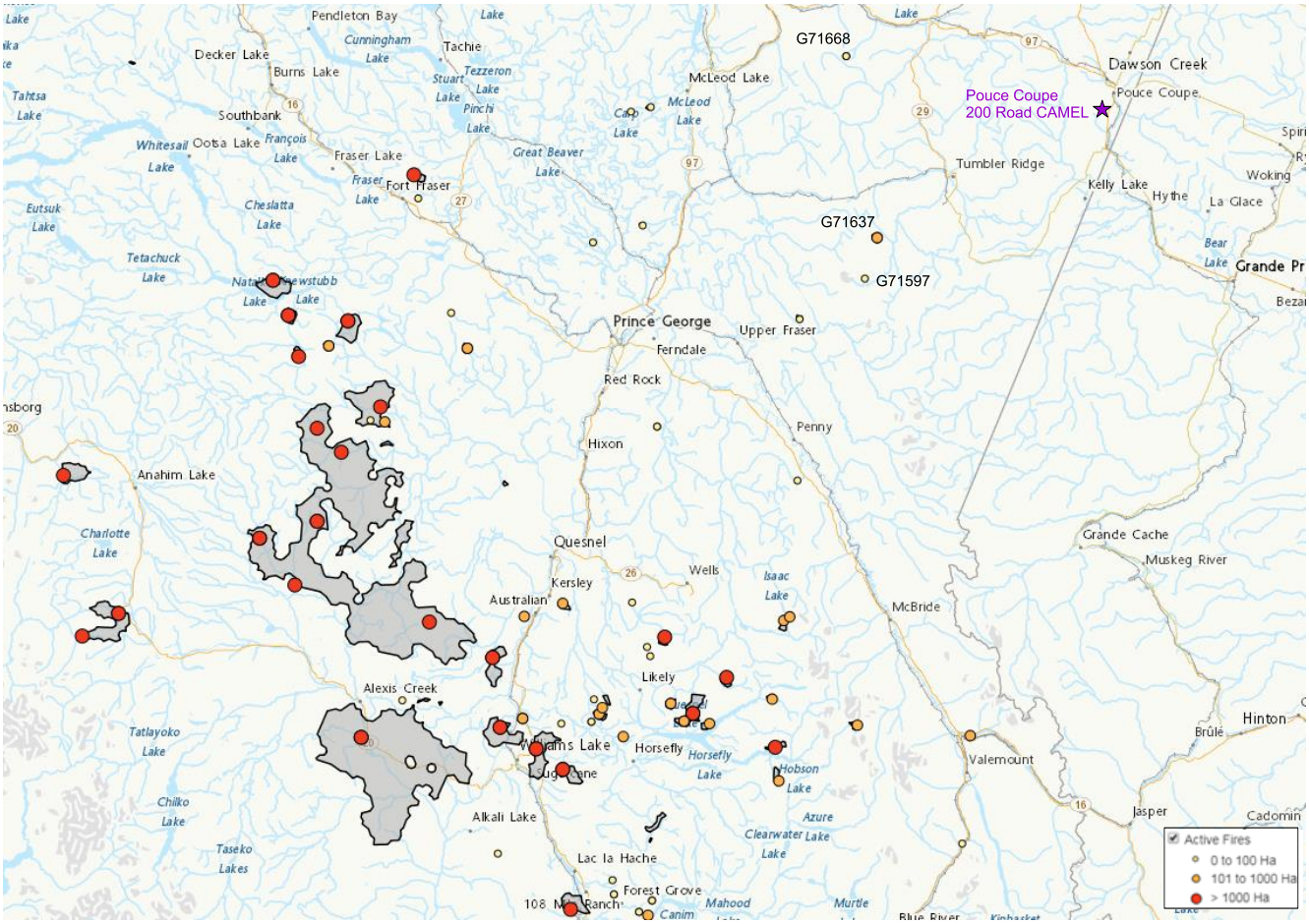

Figure 4-19 Forest Fire Hotspots for August 2017

4.4 PM_{10} Exceedances

Table 4-6 lists ten days when daily PM_{10} exceeds BCAAQO of 50 µg/m^3, with daily average wind speed and direction data. Windrose for these exceedance days are shown in Figure 4-20.

Daily PM_{10} exceedances occurred on May, August to October, with most in late spring during the forest fire season, under light southwest wind.

The highest daily PM_{10} was 139 µg/m^3, which also occurred on August 13, 2017, the same day for the highest daily $PM_{2.5}$ measurement, and which can be attributed to forest fire activity. The elevated daily PM_{10} during May 14 to 16, 2018 may also be associated with the wild fire 4 km south of the station, which started on May 12th, 2018. The elevated daily PM_{10} during May 10 to 11, 2017 was mostly associated with Encana SCLH road construction during this period.

Table 4-6 24-hour PM_{10} Measurements above BCAAQO of 50 µg/m^3

Date	24-hour PM_{10} (µg/m^3)	Daily Average Wind Speed (m/s)	Daily Average Wind Direction (degree)
2016-09-14	54.6	1.2	239
2017-05-10	65.1	1.2	155
2017-05-11	62.6	1.9	91
2017-08-13	139.2	1.0	212
2017-09-07	94.8	0.8	200
2017-10-05	52.4	1.6	224
2017-10-30	72.8	1.9	227
2018-05-14	97.2	1.7	248
2018-05-15	103.1	1.2	248
2018-05-16	54.0	1.0	176

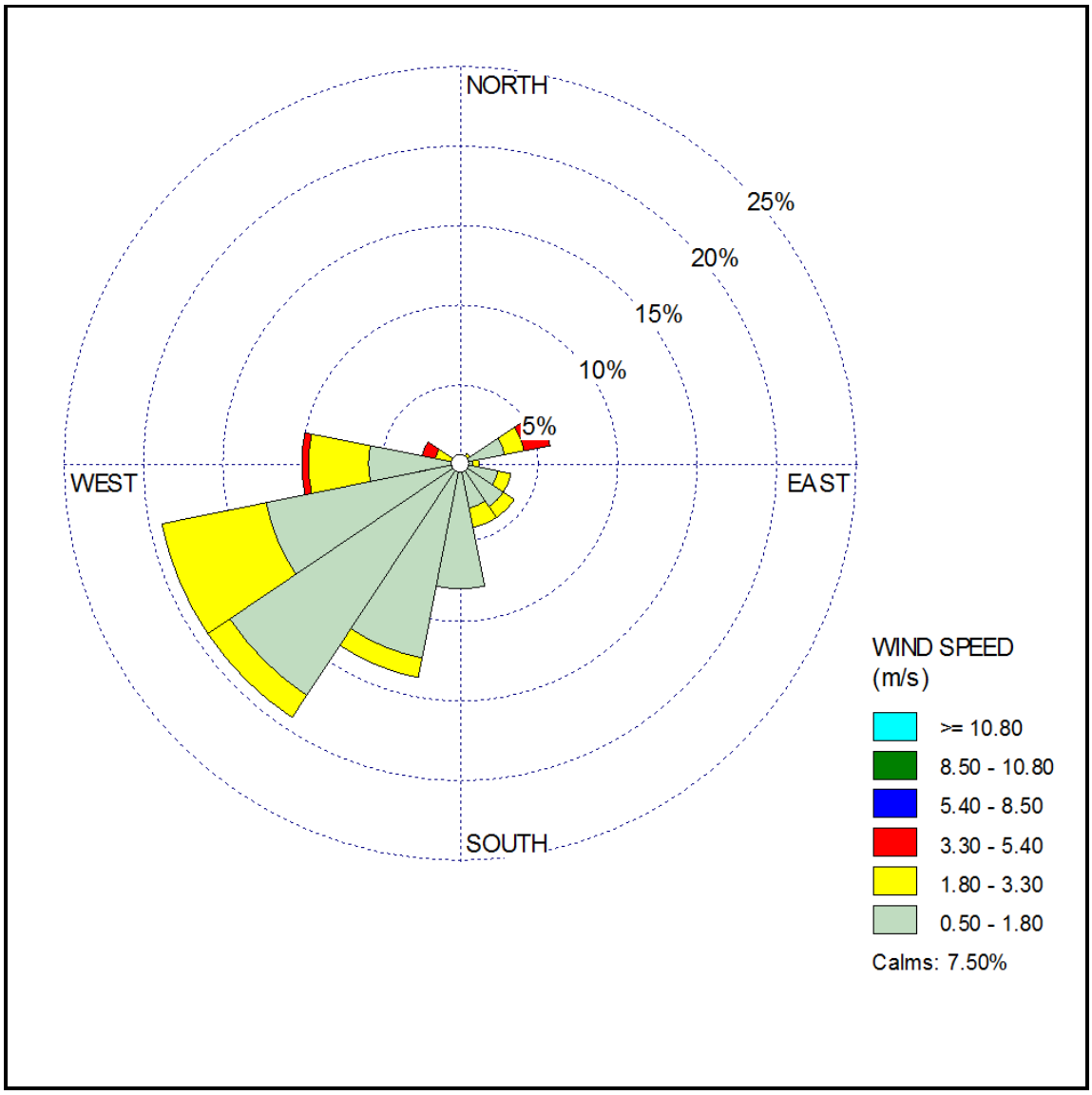

Figure 4-20 Wind Rose for all 24-hour PM_{10} Exceedances of BCAAQO at the Pouce Coupe Site

4.5 TRS Exceedance

In addition to the odour-based BCAAQO for TRS, H_2S odour threshold considered by WHO (2000) is also 5 ppb (7 µg/m^3), using an averaging time of 30 minutes.

Frequency of distribution of TRS (shown above in Figure 4-9) shows that 99.9% of hourly TRS measurements were below 2 ppb.

One exceedance of the BCAAQO and WHO odour threshold of 5 ppb was reported at the Pouce Coupe station for the period from September 12, 2016 to May 25, 2018.

Table 4-7 lists top 10 1-hour TRS measurements, with wind speed and direction data. The table indicates that high TRS measurements mostly occurred during November 5th to 8th under light south-southwest wind.

Table 4-7 Top 10 1-hour TRS Measurements

Date/Time	TRS (ppb)	Wind Speed (m/s)	Wind Direction (degree)
11/8/2017 05:00	5.5	0.6	186
11/6/2017 06:00	4.6	2.4	205
11/5/2017 17:00	4.5	1.7	192
11/8/2017 06:00	3.3	0.2	200
11/8/2017 09:00	2.9	0.1	249
11/17/2017 08:00	2.6	0.9	186
11/5/2017 22:00	2.5	2.5	196
11/6/2017 02:00	2.4	3.1	197
11/8/2017 10:00	2.3	0.1	176

5.0 SUMMARY

Hourly ambient air quality and meteorological monitoring data at Pouce Coupe were provided by BC OGC for the period from September 12, 2016 to May 25, 2018 and summarized in this report. All measurements were analyzed by hour of day, month of year and frequency distribution, also elevated readings including exceedances of B.C. or AB AAQOs.

Data availability was 95% for all meteorology measurements. For ambient air quality measurements, data availability ranged from 75% to 90%.

Where possible data was compared to ambient air quality objectives for British Columbia. For cases where the B.C. objectives do not apply, comparison was made to Alberta objectives. Findings are:

- No concentrations were found to be excess of ambient air quality objectives for British Columbia or Alberta for Ozone (O_3), Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), TRS (24 hour), Benzene (C_6H_6), Toluene (C_7H_8), Ethylbenzene/ BTEX (C_8H_{10}), Total Xylene (X-C_8H_{10})
- Exceedances of BCAAQOs and AAAQOs, for 1-hour TRS, 24-hour $PM_{2.5}$ and PM_{10} were:
  - Maximum 1-hour TRS was 5.5 ppb, and resulted in a single one hour of exceedance of the BCAAQO and WHO odour threshold of 5 ppb.
  - Maximum 1-hour $PM_{2.5}$ was about 7 times higher than the AAAQG (80 µg/m^3) and there were 20 hours of measurements above this value. Analysis showed that most of these high values could be attributed to forest fires in the area.
  - Maximum 24-hour $PM_{2.5}$ was about 4 times higher than AAAQO (29 µg/m^3) and there were three days of measured exceedances.
  - The maximum 24-hour PM_{10} was about 2.8 times higher than BCAAQO (50 µg/m^3), and there were 10 days of exceedances.

The highest particulate measurements were mostly in late spring and summer (May, August and September), during the forest fire season, under light southwest winds. The light winds exacerbated the effects of the fires.

6.0 REFERENCES

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