3 HIGH WIND EXCEPTIONAL EVENT: February 11, 2012

3.1 Summary of Event

The passing of a backdoor cold front caused high winds and blowing dust in southern Doña Ana County resulting in an exceedance of the PM_{10} 24-hour NAAQS at the Desert View monitoring site and the $PM_{2.5}$ annual NAAQS at the Sunland Park monitoring site on this date. The FEM TEOM continuous monitor at the Desert View site recorded a 24-hour average PM_{10} concentration of 158 µg/m^3. The FRM Partisol monitor at the Sunland Park site recorded concentrations resulting in an annual concentration of 12.7 µg/m^3. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured at Sunland Park (130 µg/m^3), Anthony (77 µg/m^3), and Holman (71 µg/m^3) monitoring sites (Figure 3-1). The averages in this figure were calculated using PM_{10} FEM TEOM and $PM_{2.5}$ FRM Partisol instrument data for the four days before and after the event. Elevated concentrations were also recorded by the $PM_{2.5}$ non-FEM/FRM TEOMs (Figure 3-2).

As the event unfolded, the wind blew from the east-southeast throughout the border region. These high velocity winds passed over large areas of desert within Texas, New Mexico and Mexico. The co-occurrence of high winds and elevated levels of blowing dust, little to no point sources in the area, and the high hourly and daily PM_{10} and $PM_{2.5}$ concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

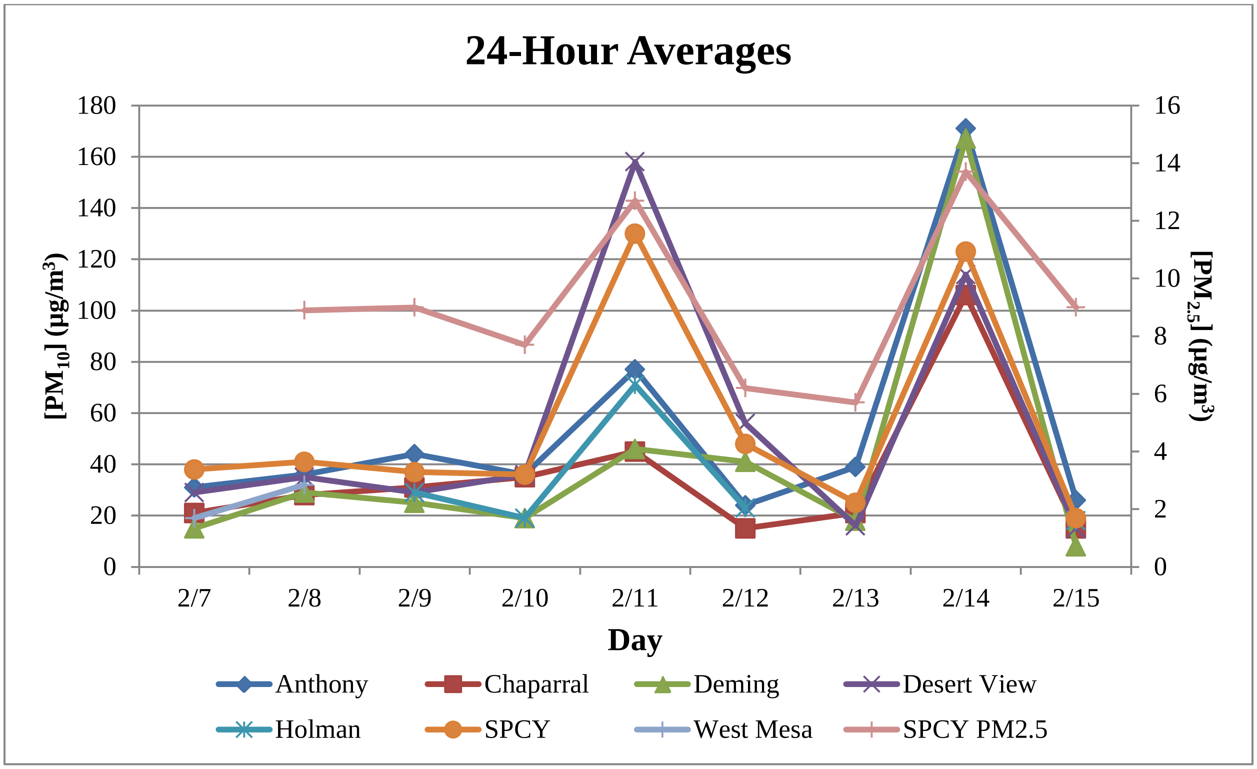


Figure 3-1. PM_{10} 24-hour averages before and after February 11, 2012.

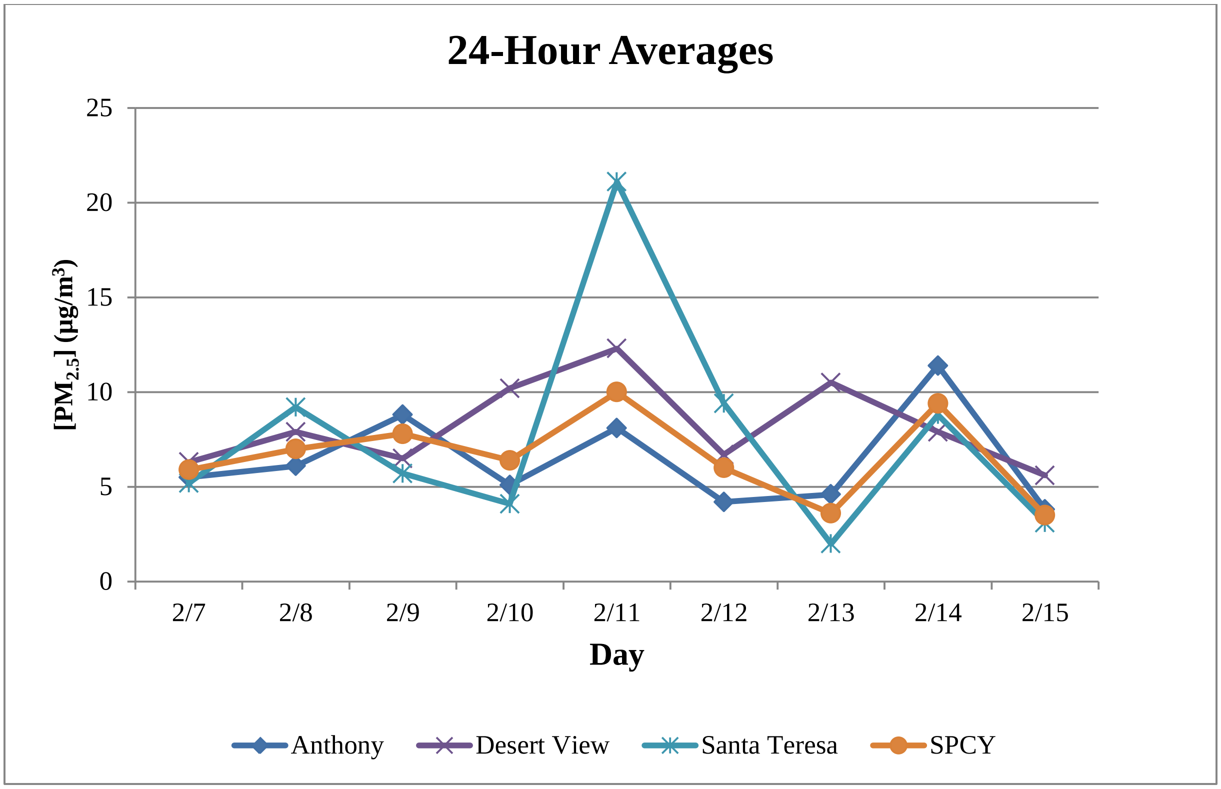


Figure 3-2. $PM_{2.5}$ 24-hour averages before and after February 11, 2012. Non-FEM TEOM Data.

3.2 Is Not Reasonably Controllable or Preventable

3.2.1 Suspected Source Areas and Categories Contributing to the Event

Sources of windblown dust contributing to this exceedance include the natural desert, residential properties, agricultural land and unpaved roads in western Texas and New Mexico. City of Las Cruces and Doña Ana County Ordinances require BACM for any dust producing activities. The largest and most likely sources of windblown dust include the natural desert in Texas and New Mexico (see Section 3.2.4 below).

3.2.2 Sustained and Instantaneous Wind Speeds

EPA uses a default entrainment threshold of sustained wind speeds at 11.2 m/s (25 mph) for natural and well controlled anthropogenic sources contributing to natural events caused by high wind and blowing dust (EPA, 2013). Under the Doña Ana and Luna County NEAPs, EPA and NMED agreed that wind gusts exceeding 18 m/s would overwhelm any natural and well-controlled anthropogenic sources and cause windblown dust. On February 11, sustained wind speeds exceeded EPA's default threshold at two of the eight monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at three of the eight monitoring sites (Figures 3-3 and 3-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 1800 hour and ending at the 2400 hour.

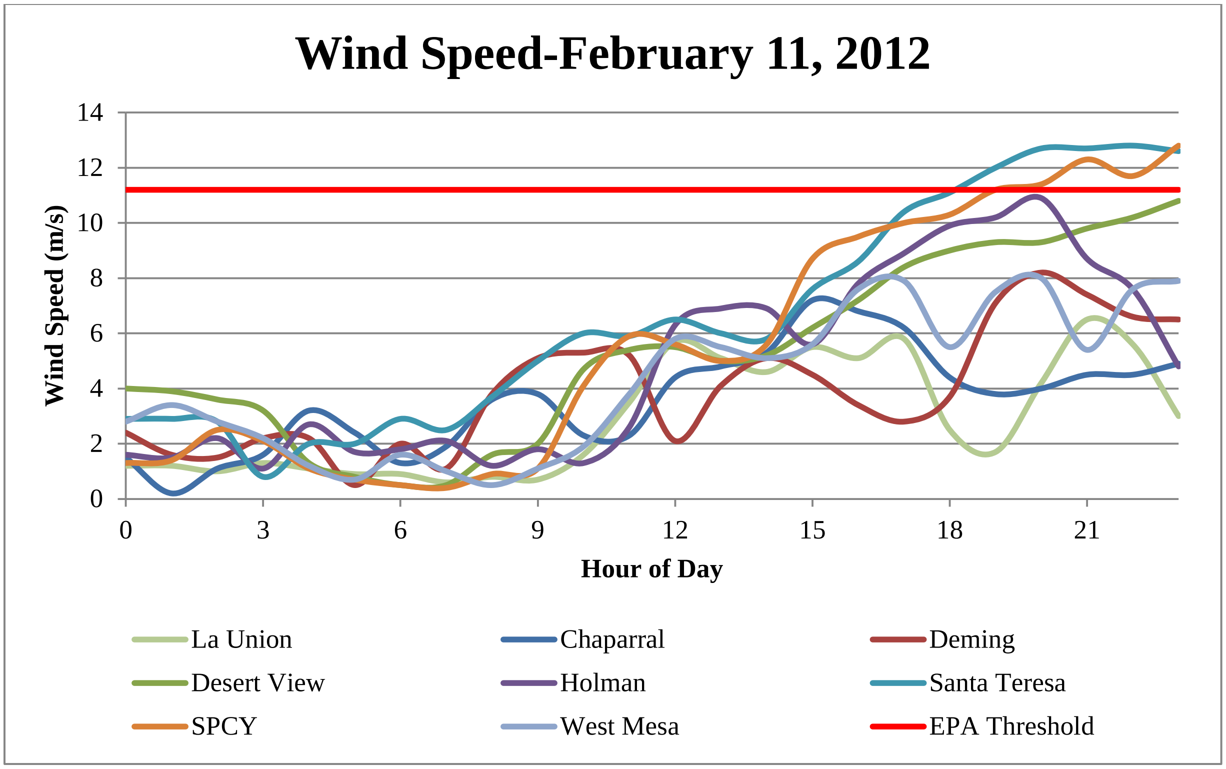


Figure 3-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

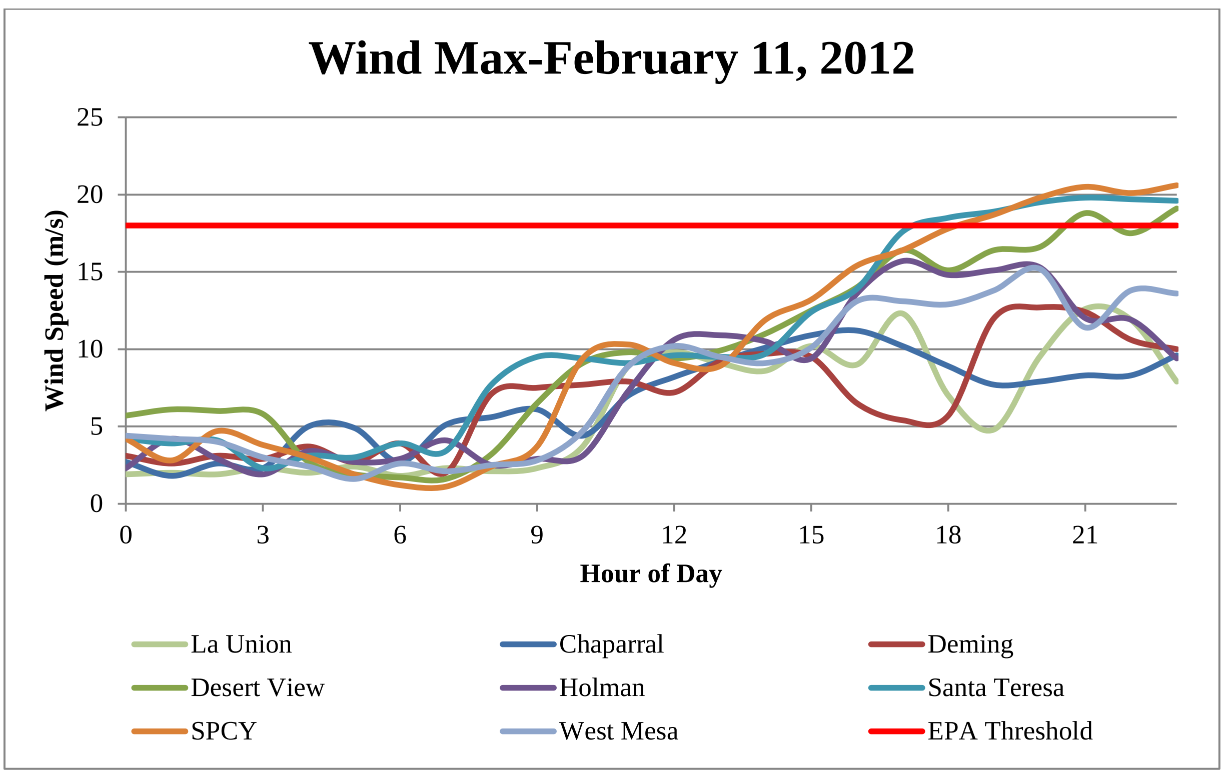


Figure 3-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

3.2.3 Recurrence Frequency

The monitoring sites in Doña Ana and Luna Counties can record exceedances of the PM_{10} NAAQS throughout the year. From 2007-2011 the PM_{10} FEM TEOM monitors recorded 254 exceedances and the PM_{10} FRM Wedding monitors recorded 6 exceedances (Figure A-1). The Deming Airport and Desert View monitoring sites (FEM TEOMs) were established in 2006 and 2007 respectively and do not show exceedances until the year following startup. The SPCY $PM_{2.5}$ FRM Partisol recorded 37 exceedances of the 24-Hour NAAQS from 2007-2011 (Figure A-2). See appendix A for a more in-depth discussion about recurrence frequency and the number of exceedances at each monitoring site.

3.2.4 Controls Analysis

The local ordinances and MOUs adopted under the NEAP direct the implementation of BACM for sources of dust in Doña Ana County. The ordinances regulate disturbed lands, construction and demolition, vacant parking lots and materials handling and transportation. Our investigation did not identify any unusual PM_{10} producing activities on this day, and anthropogenic emissions remained constant before, during and after the event. The most likely source contributing to the event is the natural desert in New Mexico and Texas. The southern sites in Doña Ana County recorded the highest 24-hour averages in the monitoring network. A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from Texas to the monitors in southern Doña Ana County. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 3-5). Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in Texas and Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

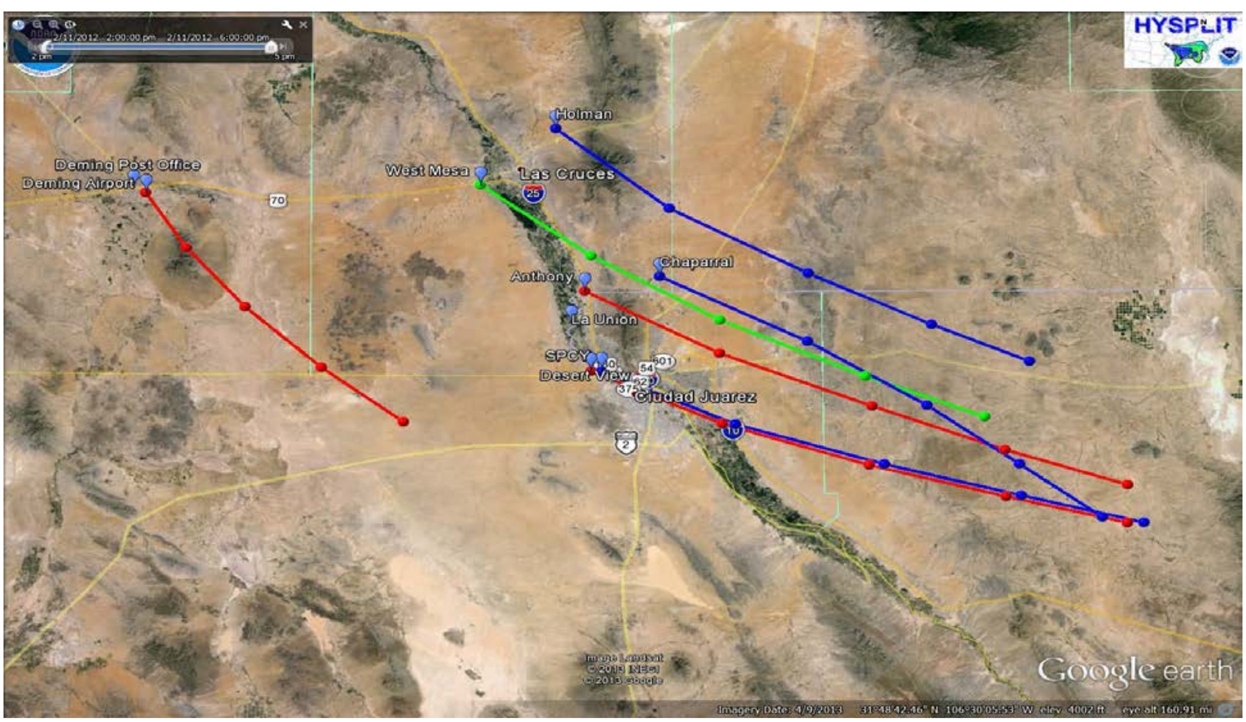


Figure 3-5. HYSPLIT back-trajectory model analysis for February 11, 2012.

3.3 Historical Fluctuations Analysis

3.3.1 Annual and Seasonal 24-hour Average Fluctuations

Since being established, the monitoring sites in Doña Ana and Luna Counties have recorded exceedances of the PM_{10} NAAQS. High winds cause these exceedances and they can occur at any time of year (Figure B-6 through B-13). Most exceedances occur from late winter through early summer (February-June) and are associated with the passage of Pacific cold fronts. High winds caused all recorded exceedances from 2007-2011 and NMED submitted natural events demonstrations to EPA under the NEAP or EER.

Since the 24-hour $PM_{2.5}$ NAAQS was lowered from 65 to 35 µg/m^3 in 2006, the SPCY Partisol monitor has routinely recorded exceedances of the standard. These exceedances occurred throughout the year during high and low wind conditions. In 2009, NMED investigated the cause of the low wind exceedances and found that emissions from Ciudad Juárez, Mexico contribute significantly to elevated concentrations. The high wind exceedances were caused by blowing dust on days when PM_{10} monitors also recorded exceedances.

Appendix B contains a more in-depth discussion about historical fluctuations and charts showing annual and seasonal trends at each monitoring site.

Table B-1 and B-2 show normal historical fluctuations with and without high wind natural events that caused exceedances from 2007-2011. The analysis excludes only those high wind events that resulted in an exceedance. Data for PM_{10} in this table includes FRM Wedding and FEM TEOM measurements and data for $PM_{2.5}$ comes from the FRM Partisol measurements from 2007-2011. The recorded value for this day (158 µg/m^3) is above the maximum value recorded when no high wind exceedances are included and is above the 95^{th} percentile for all but the 1700 hour at Desert View.

An hourly data distribution analysis was performed for PM_{10} and $PM_{2.5}$ concentrations, wind speeds and wind gusts (Appendices C, D and E). All data used for the PM_{10} distribution charts come from the FEM TEOM monitors and the non-FEM/FRM $PM_{2.5}$ TEOM monitor at SPCY. Overlaying the hourly data for February 11, 2012 on the hourly data distribution plots shows that the values recorded during the high wind event exceed the 95^{th} percentile for PM_{10}, $PM_{2.5}$, wind speed and wind gusts (Figures 3-6a-b through 3-8a-b). The top whiskers of the box and whisker plots represent the 95^{th} percentile of data. The hourly PM_{10} values during the high wind blowing dust storm far exceed the historical 95^{th} percentile of data.

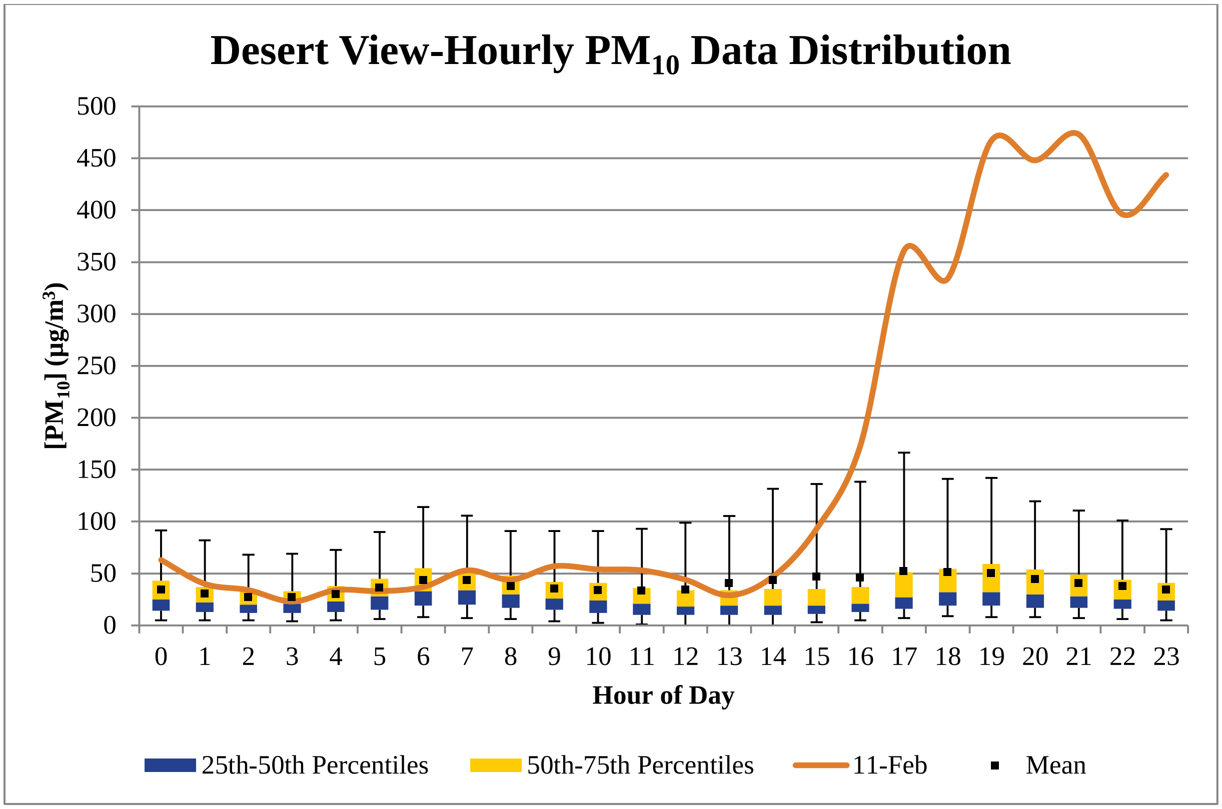
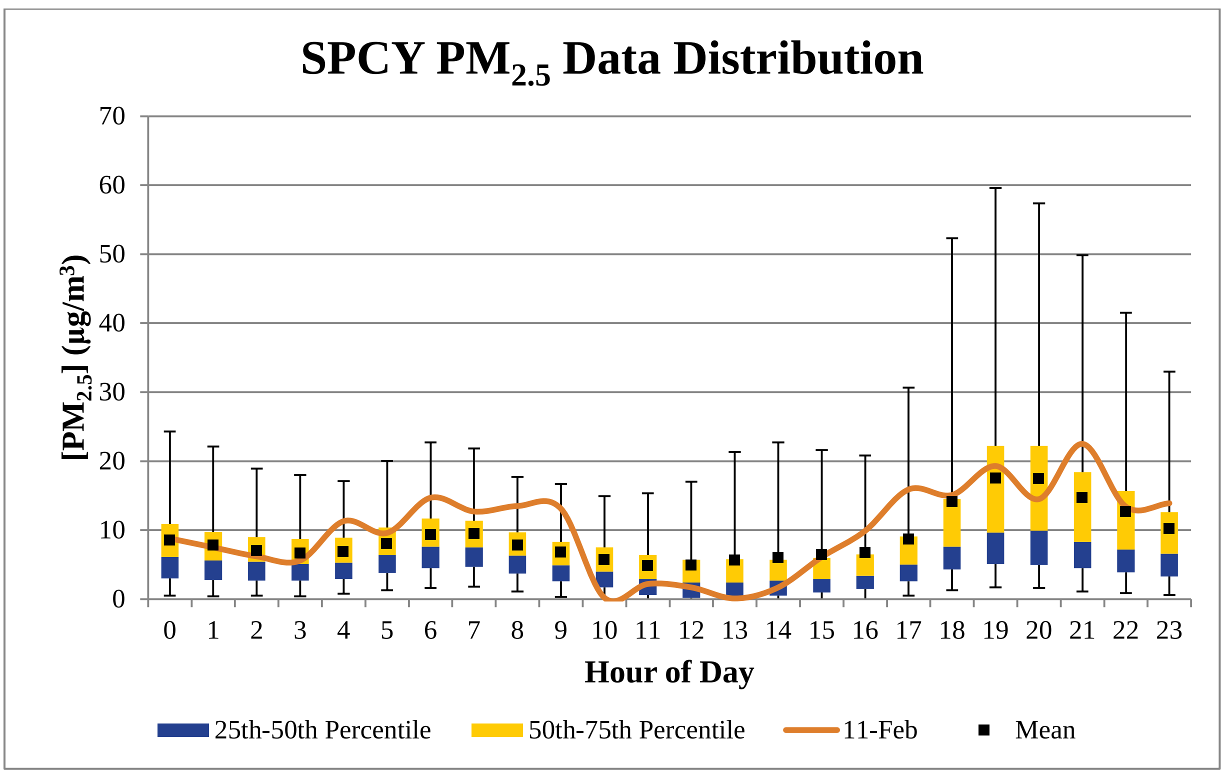


Figure 3-6a. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for February 11, 2012.



Figures 3-6b. $PM_{2.5}$ hourly data distribution from 2007-2011 overlaid by hourly values for February 11, 2012.

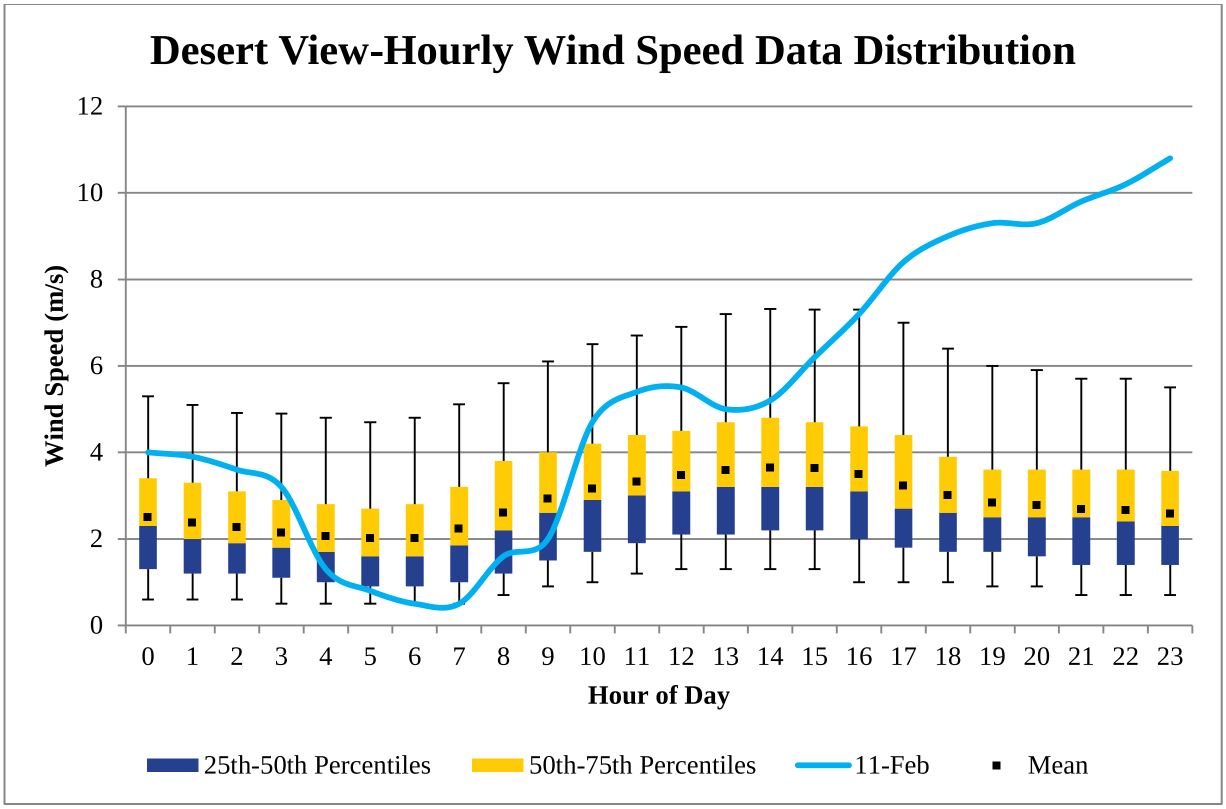


Figure 3-7a. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for February 11, 2012.

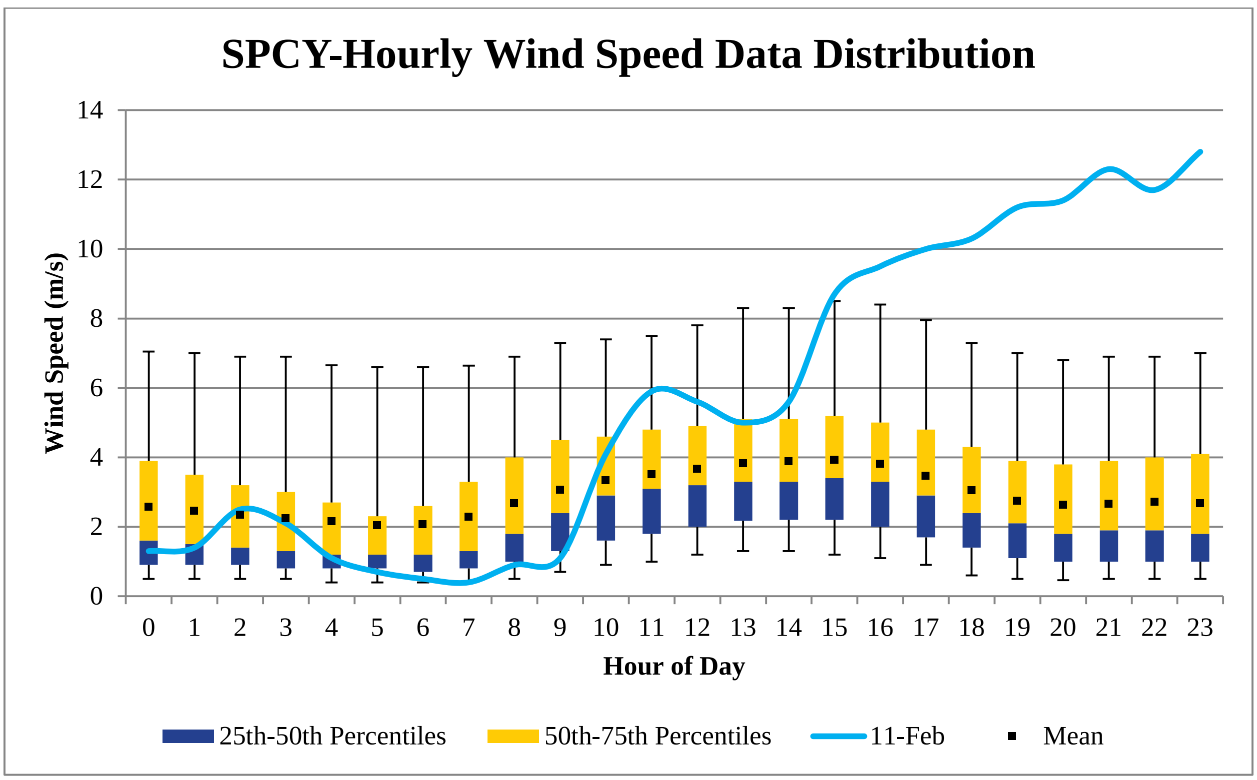


Figure 3-7b. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for February 11, 2012.

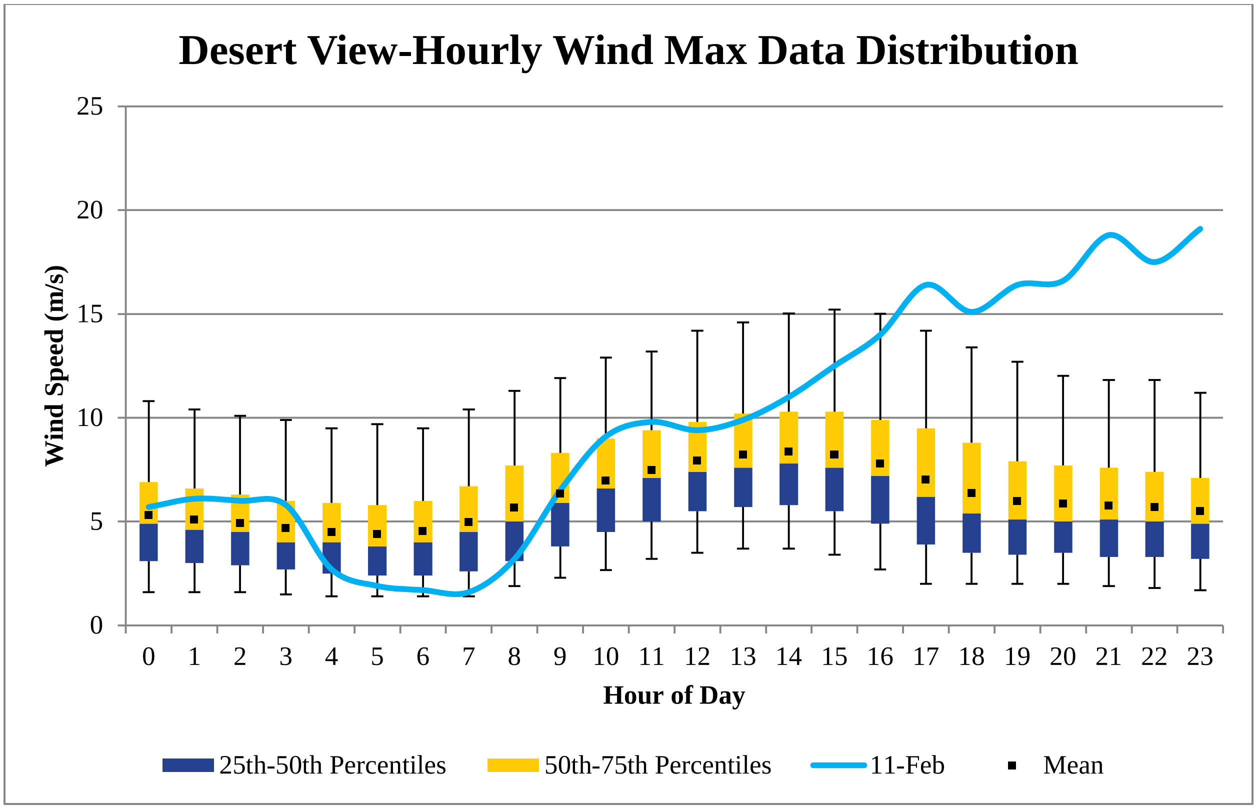


Figure 3-8a. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for February 11, 2012.

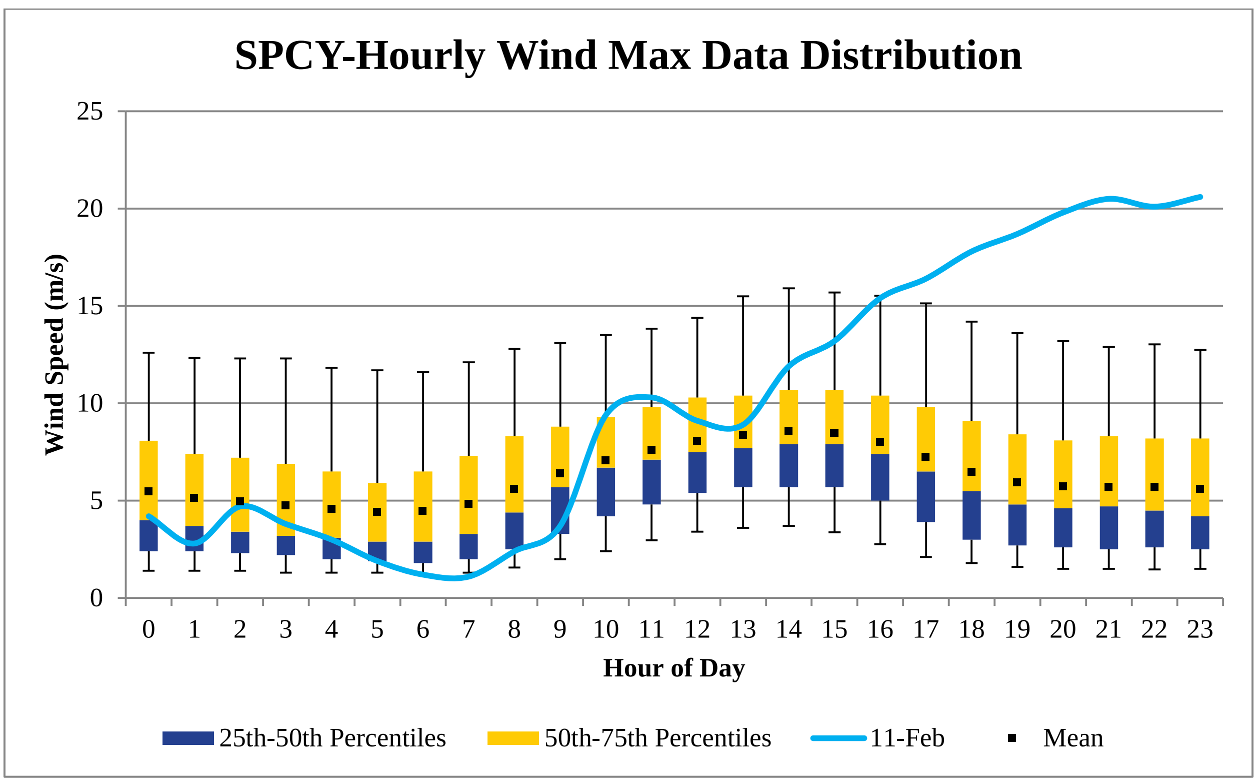


Figure 3-8b. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for February 11, 2012.

3.4 Clear Causal Relationship

A complex winter storm and backdoor cold front passed through New Mexico on February 11, 2012. The cold front moved slowly as it was situated between an area of high pressure over the Great Plains and an area of low pressure where Arizona, Nevada and California meet. As the backdoor cold front slowly moved west, a tight pressure gradient formed over New Mexico increasing surface winds (Figure 3-9). The surface front caused the high winds with little contribution from the upper storm system (Figure 3-10).

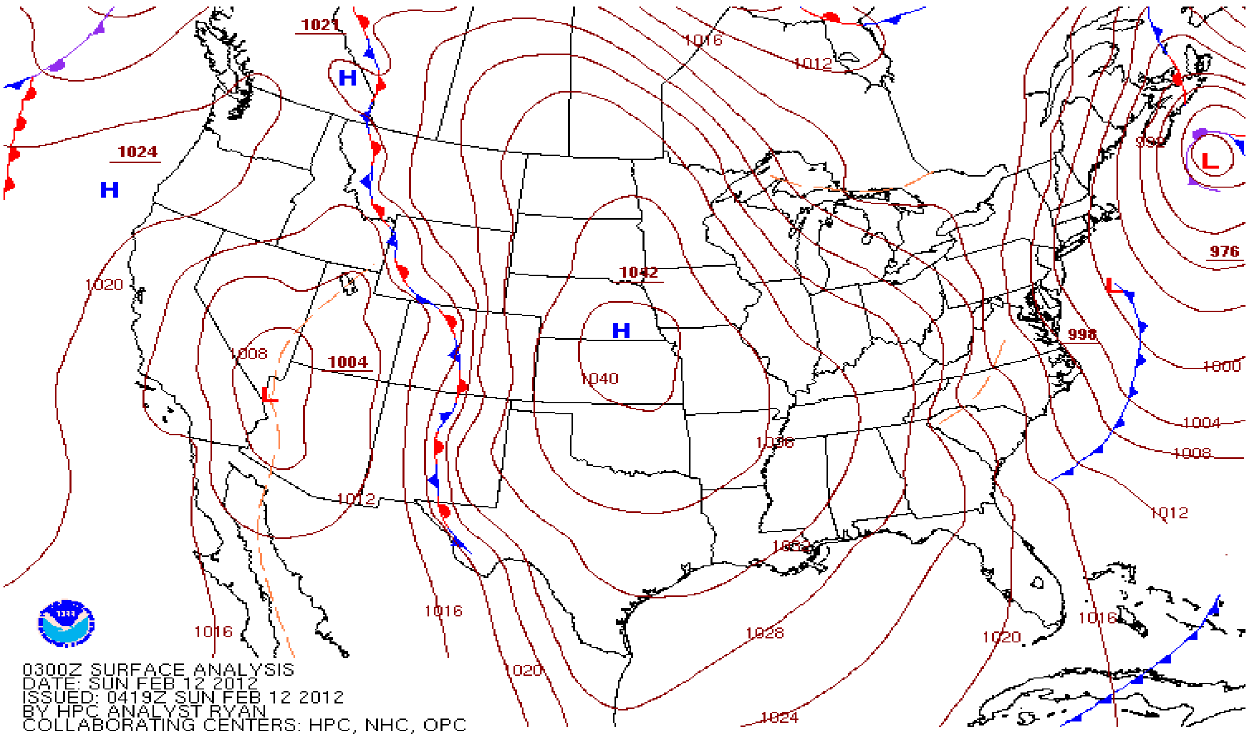


Figure 3-9. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for February 11, 2012 at the 2000 hour.

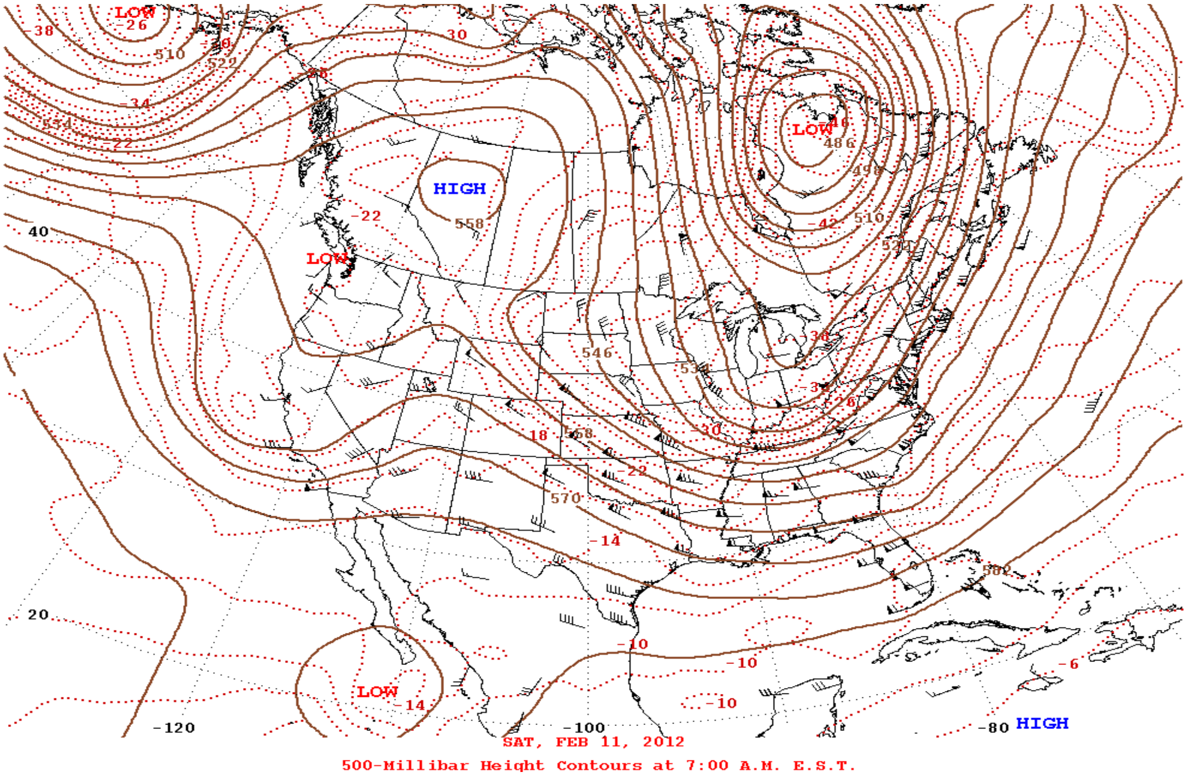


Figure 3-10. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on February 11, 2012.

The weather pattern described above generated strong east-southeast winds beginning at the 1500 hour and lasting through the 2300 hour. Beginning at the 1700 hour, wind speeds exceeded the historical 95th percentile of data at Desert View as shown in Figure 3-7. Peak wind speeds ranged from 6.5 m/s at La Union to 12.8 m/s at SPCY and Santa Teresa (Figure 3-3). Peak wind gusts ranged from 11.2 m/s at Chaparral to 20.6 m/s at SPCY (Figure 3-4). Blowing dust caused elevated levels of PM_{10} at Desert View and $PM_{2.5}$ at SPCY during the same period as high winds as demonstrated by the time series plot in Figure 3-11a-b. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (1700-2400 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 3-12a-b). Maximum hourly PM_{10} concentrations ranged from 107 $\mu g/m^3$ at Chaparral to 562 $\mu g/m^3$ at SPCY. Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations during the evening hours, the time of the exceedances. (Figure 3-13).

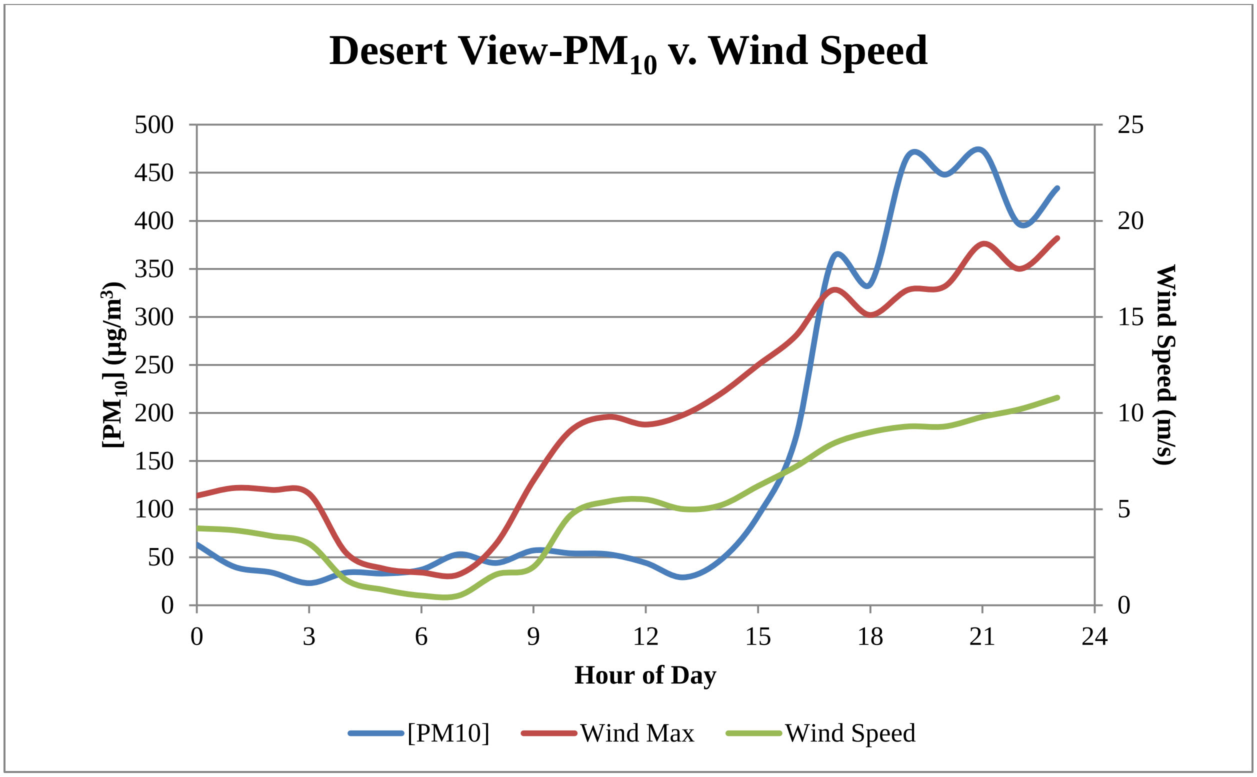


Figure 3-11a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

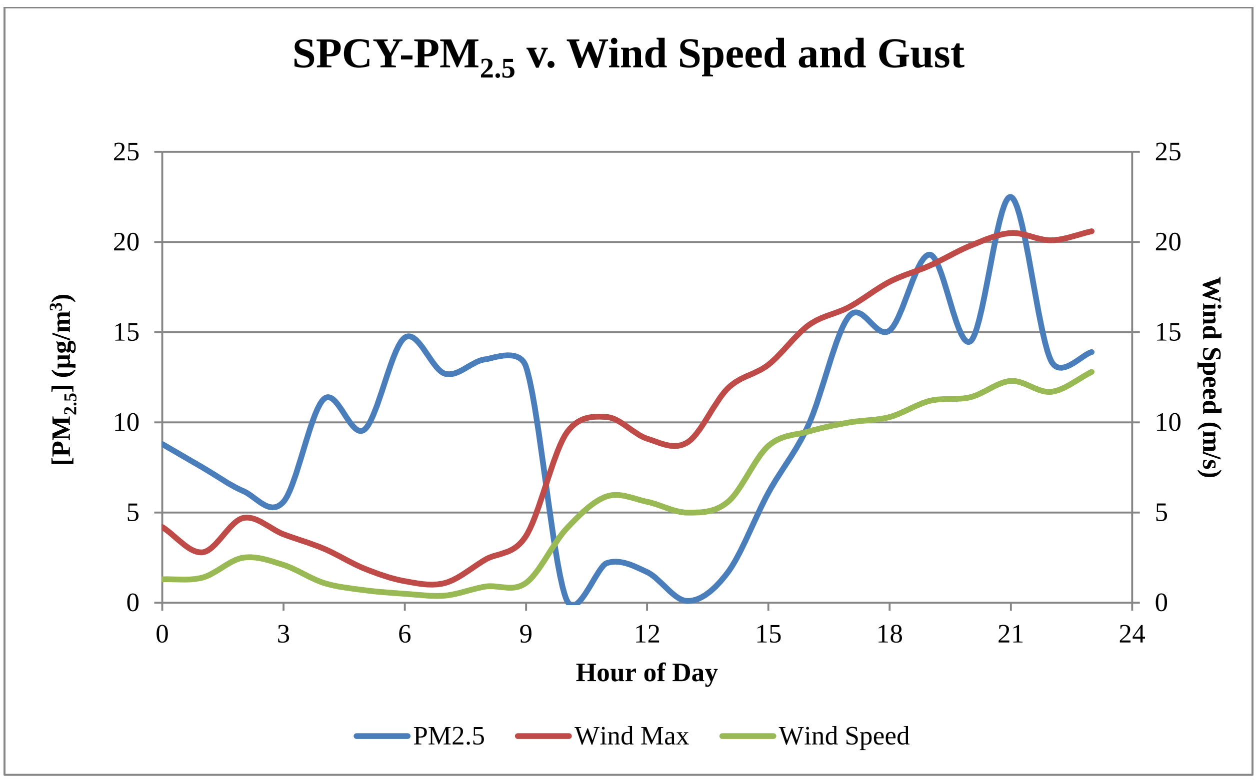


Figure 3-11b. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

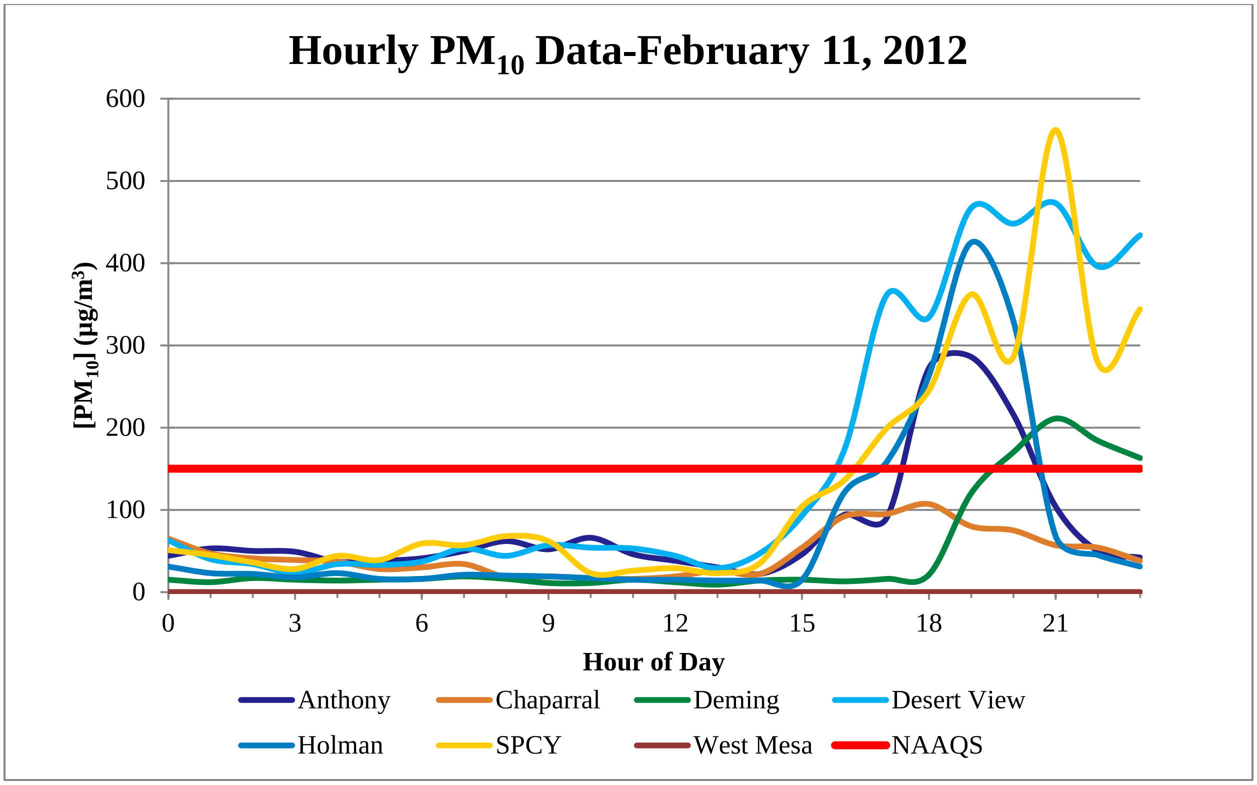


Figure 3-12a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

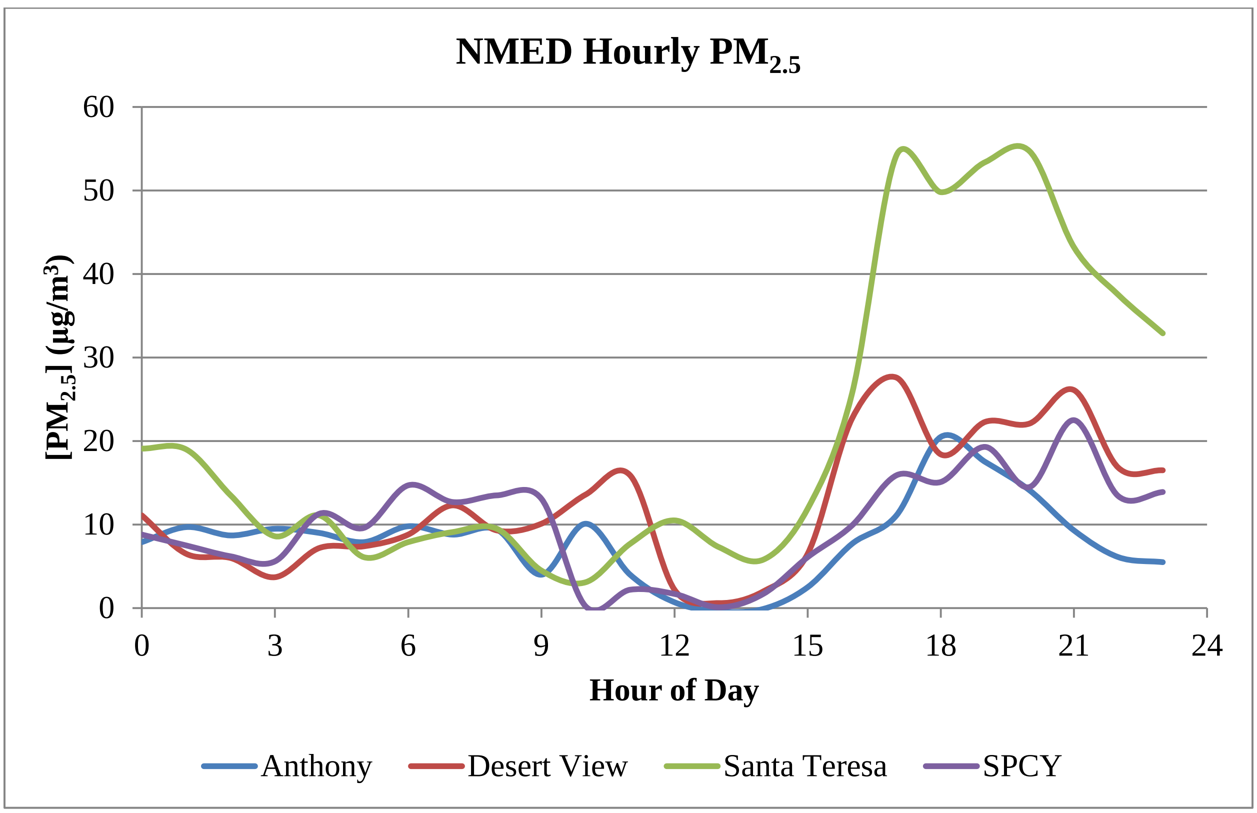


Figure 3-12b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors. Non-FEM hourly $PM_{2.5}$ data.

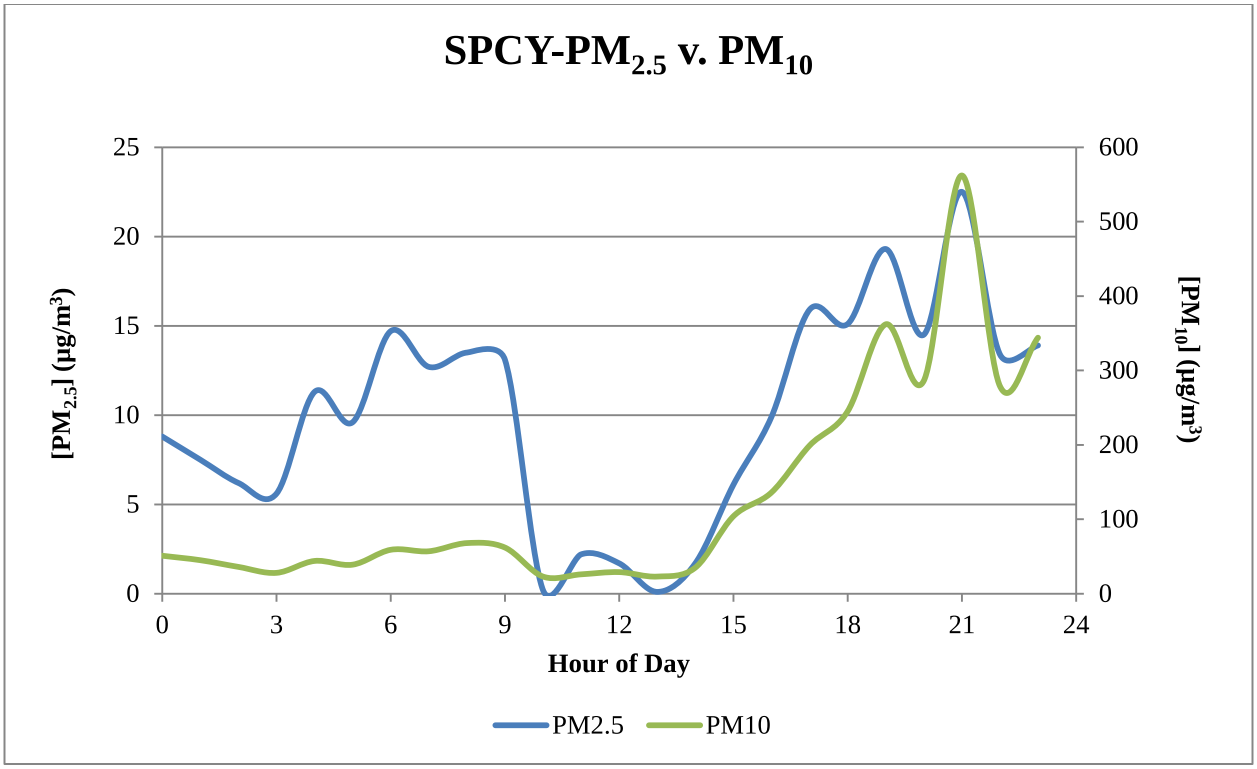


Figure 3-13. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on February 11, 2012.

The elevated $PM_{2.5}$ at the SPCY monitor seen between 0400 and 0900 hours is likely due to increased sulfate levels (precursors to $PM_{2.5}$) originating in Mexico. Figure 3-14 shows the Monterey Aerosol Modeling done by the Navy Research Laboratory at 0500 hour MST. Winds were from the southwest-west at this hour but wind speeds were less than 1 m/s. Wind patterns were most likely driven by the topography of the area, with Mount Cristo Rey channeling emissions from Mexico to the SPCY monitor.

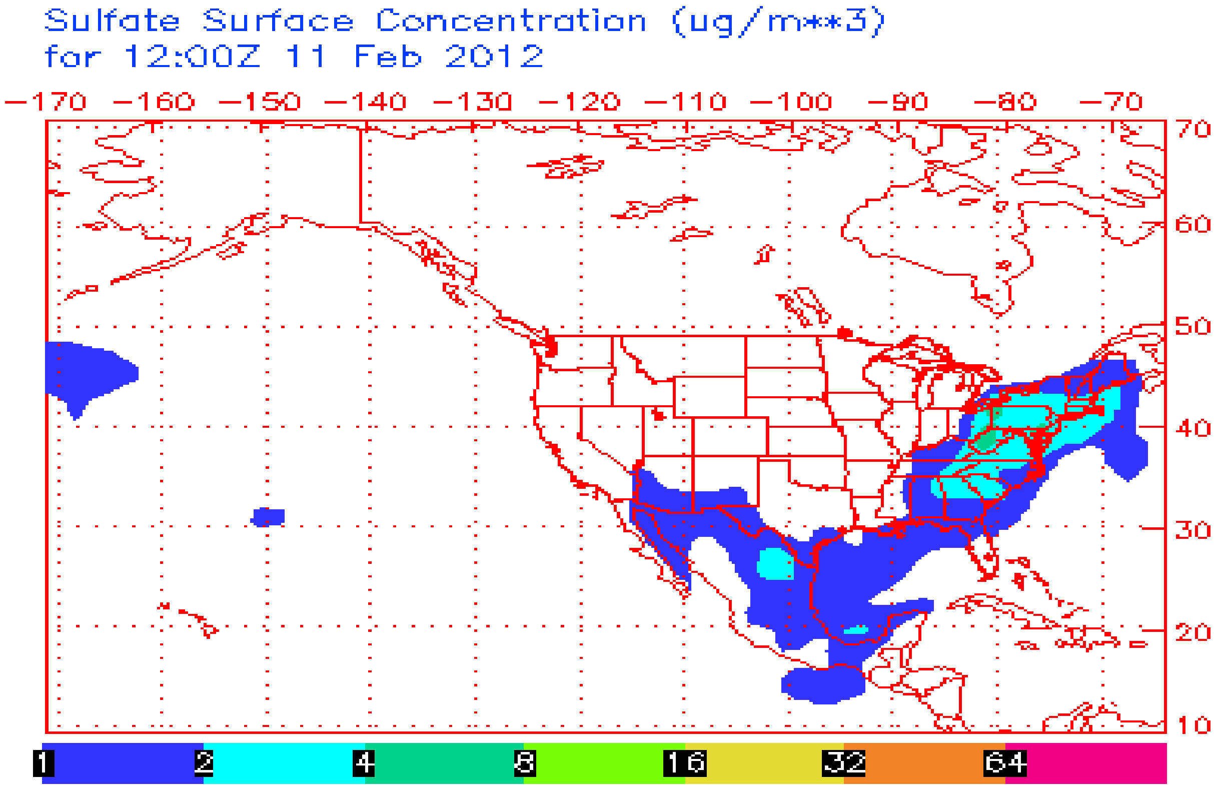


Figure 3-14. Monterey Aerosol Modeling showing sulfate surface concentrations at 0500 hour on February 11, 2012. The source of sulfates affecting New Mexico appear to originate in Mexico.

3.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality February 11, 2012.

3.6 Natural Event

The Clear Causal Relationship and not Reasonably Controllable or Preventable analyses show that this was a natural event caused by high wind and blowing dust.

3.7 No Exceedance but for the Event

The Desert View monitor detected blowing dust around the 1600 hour with hourly concentrations heavily impacted until the 2400 hour. The eight hourly PM_{10} values from 1600 - 2300 hours (173, 361, 334, 467, 448, 473, 396, and 434) µg/m^3 at Desert View are well above the 24-hour average standard, as well as above the 95th percentile for corresponding hours at Desert View. By replacing these eight hourly values with the 95th percentile of hourly data at the Desert View site, the resulting 24-hour average (73 µg/m^3) does not exceed the NAAQS (Table 3-1). The values in red represent the 95th percentile of all hourly data collected at Desert View, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	63	63
1	40	40
2	34	34
3	23	23
4	34	34
5	33	33
6	37	37
7	53	53
8	44	44
9	57	57
10	54	54
11	53	53
12	44	44
13	29	29
14	47	47
15	93	93
16	173	**138**
17	361	**166**
18	334	**141**
19	467	**142**
20	448	**120**
21	473	**111**
22	396	**101**
23	434	**93**
24-Hour Average	159	**73**

Table 3-1. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Desert View on February 11, 2012.

The SPCY $PM_{2.5}$ monitor detected elevated levels due to blowing dust from 1700 to 2100 hours on February 11, 2012. Despite the elevated levels monitored in the morning the evening spikes were more intense and above 15 µg/m^3. Although these elevated concentrations do not exceed the 24-hour NAAQS for $PM_{2.5}$, they contribute to an annual exceedance level of 12.7 µg/m^3 for this date. The strong correlation between hourly $PM_{2.5}$ and PM_{10} peaks in the early evening also point to windblown dust affecting the monitor. Previous studies have shown that $PM_{2.5}$/PM_{10} ratios vary from 0.11 to 0.45 in the Paso del Norte (Arimoto et. al, 2001; Li et al, 2001). The ratios above 0.30 were observed in downtown El Paso and Ciudad Juárez and indicate a heavy impact from mobile sources. The lower ratios were observed in areas with less vehicular traffic and crustal material dominated the PM_{10} fraction. The $PM_{2.5}$/PM_{10} ratio for the SPCY site was 0.10 for this date. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

4 HIGH WIND EXCEPTIONAL EVENT: February 14, 2012

4.1 Summary of Event

The passing of a Pacific cold front caused high winds and blowing dust in southern Doña Ana County and Luna County resulting in exceedances of the PM_{10} 24-hour NAAQS at the Anthony and Deming monitoring sites and an exceedance of the $PM_{2.5}$ annual NAAQS at SPCY monitoring site on this date. The PM_{10} FEM TEOM continuous monitors at these sites recorded 24-hour average concentrations of 171 and 167 µg/m^3, respectively. The $PM_{2.5}$ FRM Partisol monitor at the SPCY site recorded a 24-hour average concentration of 13.7 µg/m^3. Although no other monitoring site recorded an exceedance on this date, elevated PM_{10} concentrations were measured at SPCY (123 µg/m^3), Desert View (114 µg/m^3), and Chaparral (106 µg/m^3) monitoring sites (Figure 4-1). The averages in this figure were calculated using PM_{10} FEM TEOM and $PM_{2.5}$ FRM Partisol instrument data for the four days before and after the event. Elevated concentrations were also recorded by the $PM_{2.5}$ non-FEM/FRM TEOMs (Figure 4-2).

As the event unfolded, the wind blew from the southwest throughout the border region. These high velocity winds passed over large areas of desert within New Mexico and Mexico. The co-occurrence of high winds and elevated levels of blowing dust, little to no point sources in the area, and the high hourly and daily PM_{10} and $PM_{2.5}$ concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

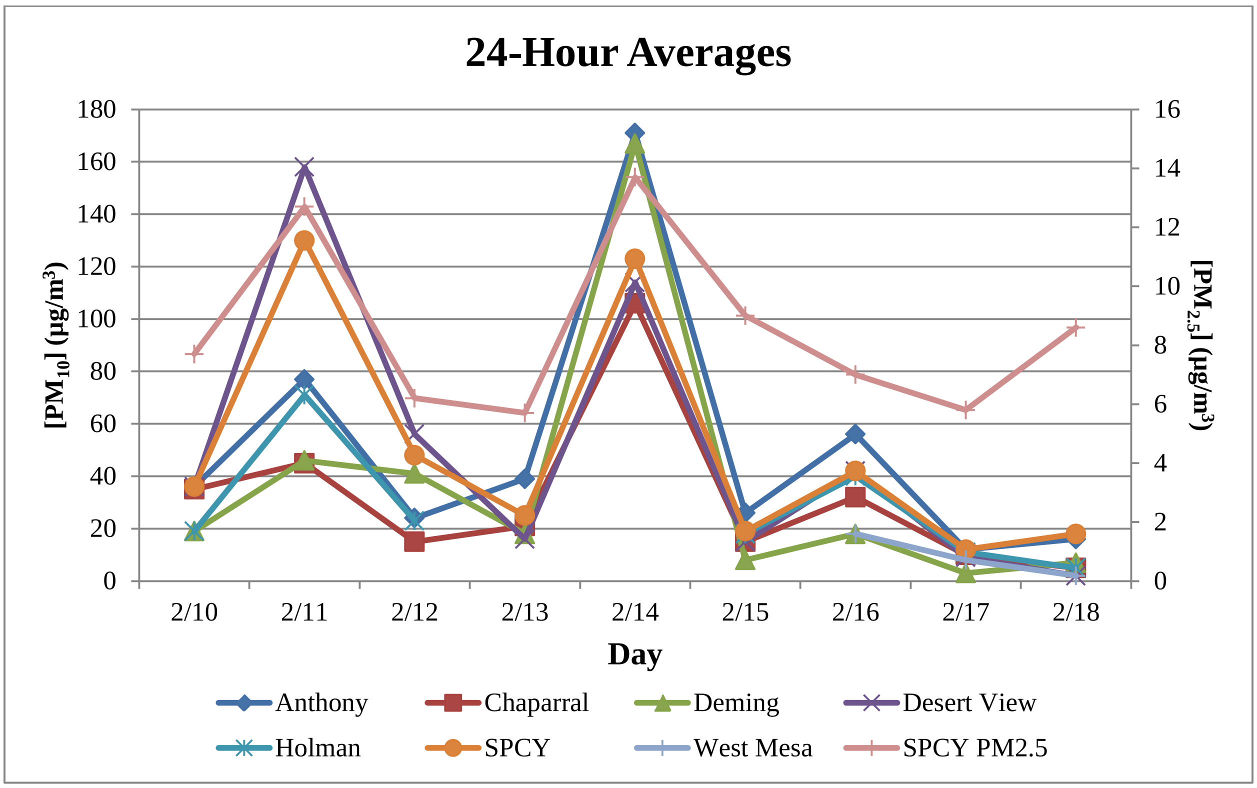


Figure 4-1. PM_{10} 24-hour averages before and after February 14, 2012.

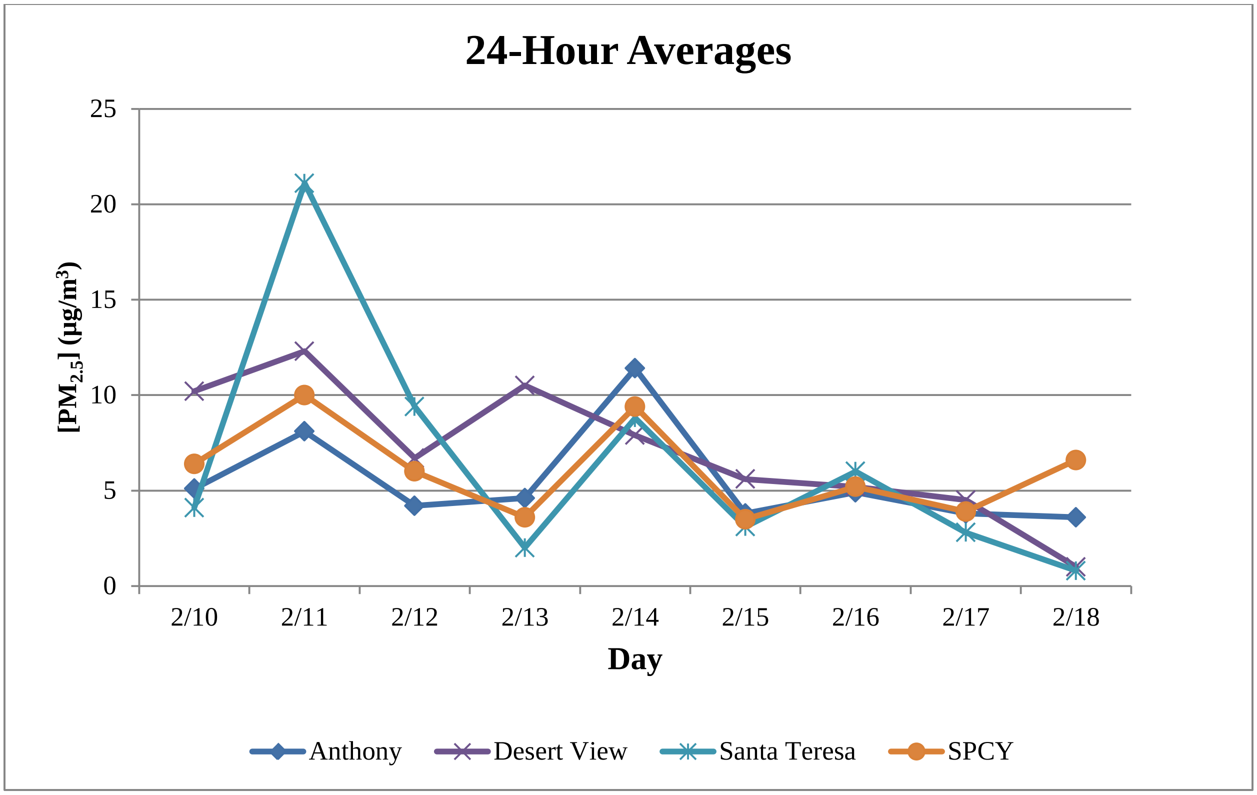


Figure 4-2. $PM_{2.5}$ 24-hour averages before and after February 14, 2012. Non-FEM TEOM Data.

4.2 Is Not Reasonably Controllable or Preventable

4.2.1 Suspected Source Areas and Categories Contributing to the Event

Sources of windblown dust contributing to this exceedance include the natural desert, residential properties, agricultural land and unpaved roads in Mexico and New Mexico. Agricultural tilling and crop planting may have contributed to this event. The City of Las Cruces, City of Deming and Doña Ana and Luna Counties Ordinances require BACM for any dust producing activities. The largest and most likely sources of windblown dust are the natural desert and playas in New Mexico and northern Mexico (see Section 4.2.4 below).

4.2.2 Sustained and Instantaneous Wind Speeds

EPA uses a default entrainment threshold of sustained wind speeds at 11.2 m/s (25 mph) for natural and well controlled anthropogenic sources contributing to natural events caused by high wind and blowing dust (EPA, 2013). Under the Doña Ana and Luna County NEAPs, EPA and NMED agreed that wind gusts exceeding 18 m/s would overwhelm any natural and well-controlled anthropogenic sources and cause windblown dust. On February 14, 2012, sustained wind speeds exceeded EPA's default threshold at four of the eight monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at seven of the eight monitoring sites (Figures 4-3 and 4-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 1300 hour and ending at the 1800 hour.

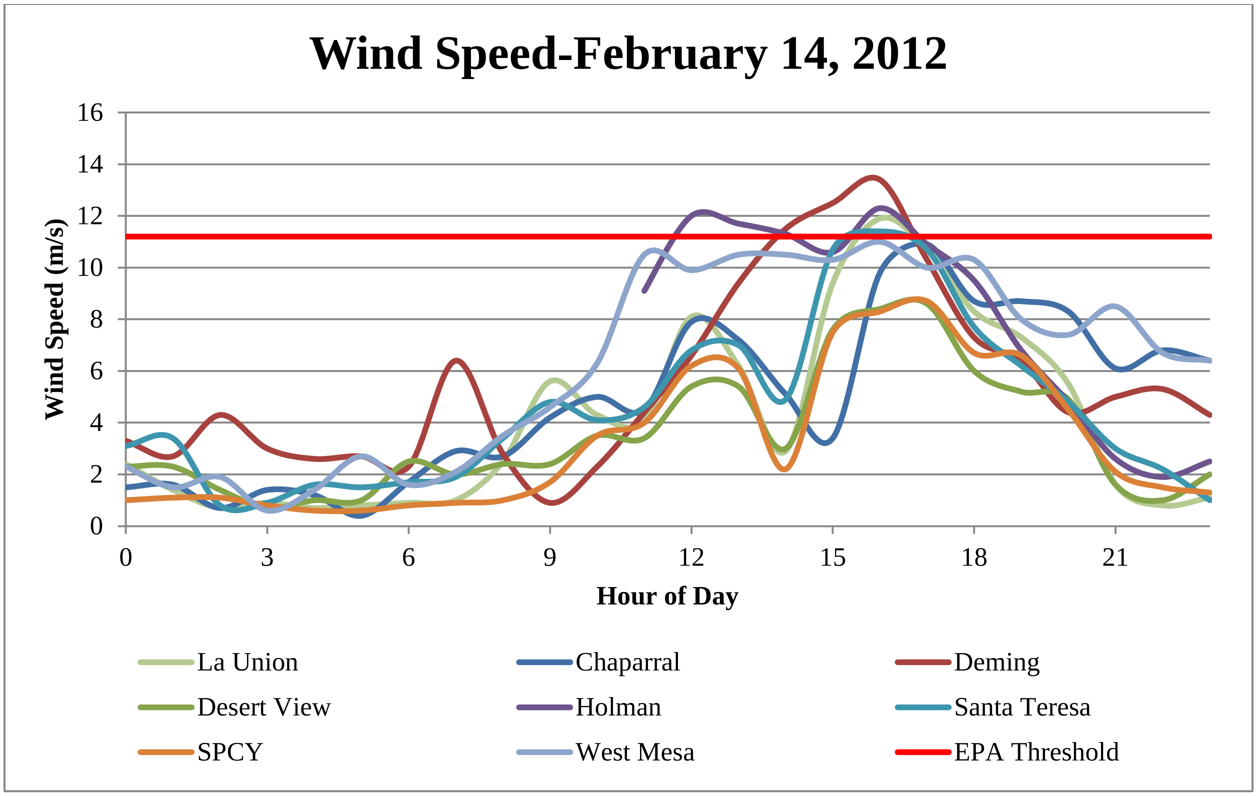


Figure 4-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

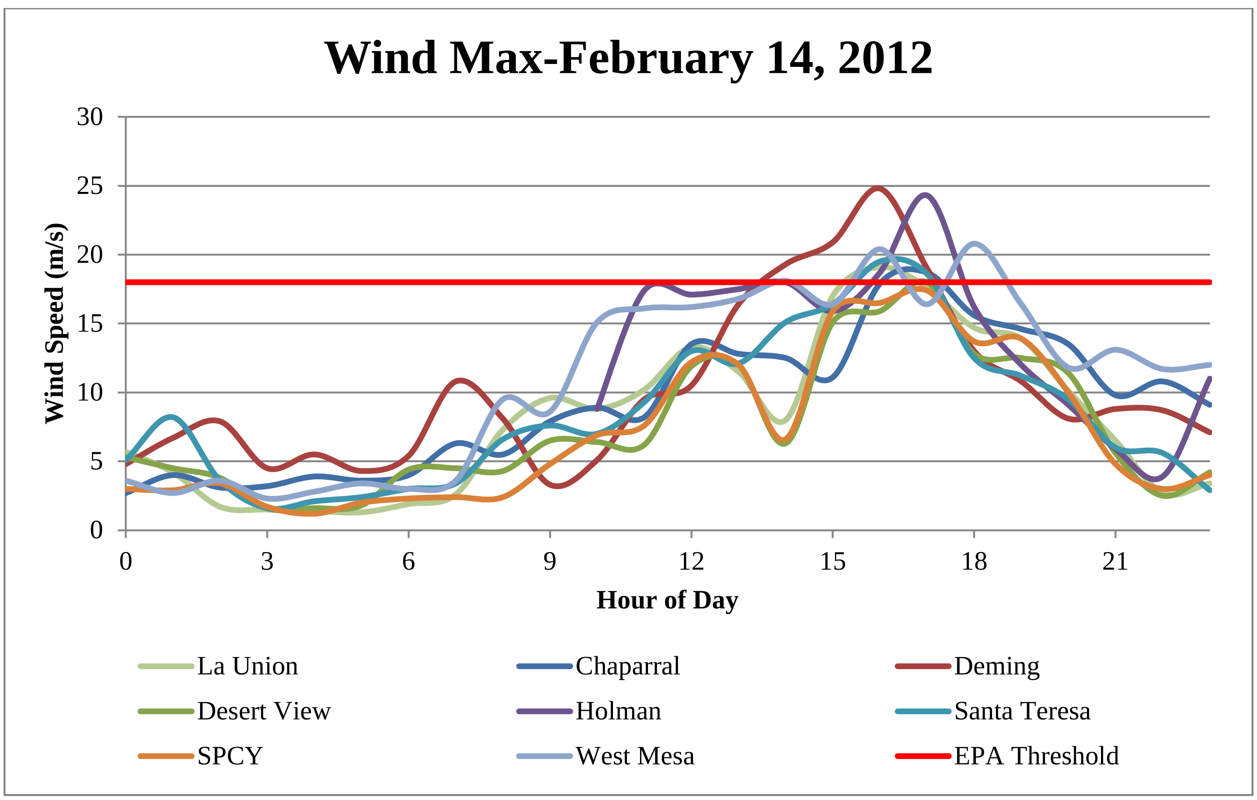


Figure 4-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

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4.2.4 Controls Analysis

The local ordinances and MOUs adopted under the NEAP direct the implementation of BACM for sources of dust in Doña Ana and Luna Counties. The ordinances regulate disturbed lands, construction and demolition, vacant parking lots and materials handling and transportation. Our investigation did not identify any unusual PM_{10} producing activities on this day, and anthropogenic emissions remained constant before, during and after the event. The most likely source contributing to the event is the natural desert in New Mexico and northern Mexico. The southern sites in Doña Ana County and Deming Airport recorded the highest 24-hour averages in the monitoring network (The West Mesa and Holman monitoring sites do not have data for this date). A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from Arizona and Mexico to the monitors in southern Doña Ana County and Luna County. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 4-5). Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

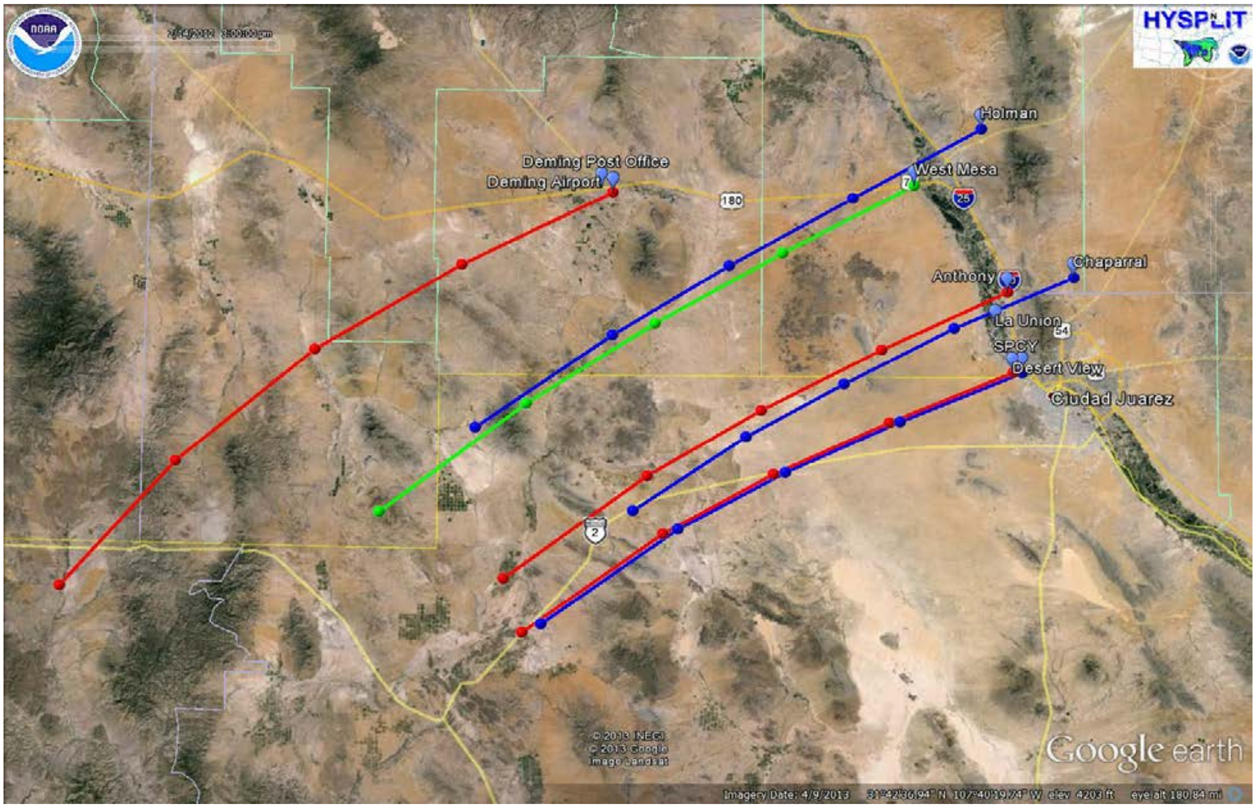

Figure 4-5. HYSPLIT back-trajectory model analysis for February 14, 2012.

4.3 Historical Fluctuations Analysis

4.3.1 Annual and Seasonal 24-hour Average Fluctuations

Since being established, the monitoring sites in Doña Ana and Luna Counties have recorded exceedances of the PM_{10} NAAQS. High winds cause these exceedances and they can occur at any time of year (Figure B-6 through B-13). Most exceedances occur from late winter through early summer (February-June) and are associated with the passage of Pacific cold fronts. High winds caused all recorded exceedances from 2007-2011and NMED submitted natural events demonstrations to EPA under the NEAP or EER.

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An hourly data distribution analysis was performed for PM_{10} and $PM_{2.5}$ concentrations, wind speeds and wind gusts (Appendices C, D and E). All data used for the PM_{10} distribution charts come from the FEM TEOM monitors and the non-FEM/FRM $PM_{2.5}$ TEOM monitor at SPCY. Overlaying the hourly data for February 14, 2012 on the hourly data distribution plots shows that the values recorded during the high wind event exceed the 95th percentile for PM_{10}, $PM_{2.5}$, wind speed and wind gusts (Figures 4-6a-c through 4-8a-c). The top whiskers of the box and whisker plots represent the 95th percentile of data. The hourly PM_{10} values during the high wind blowing dust storm far exceed the historical 95th percentile of data.

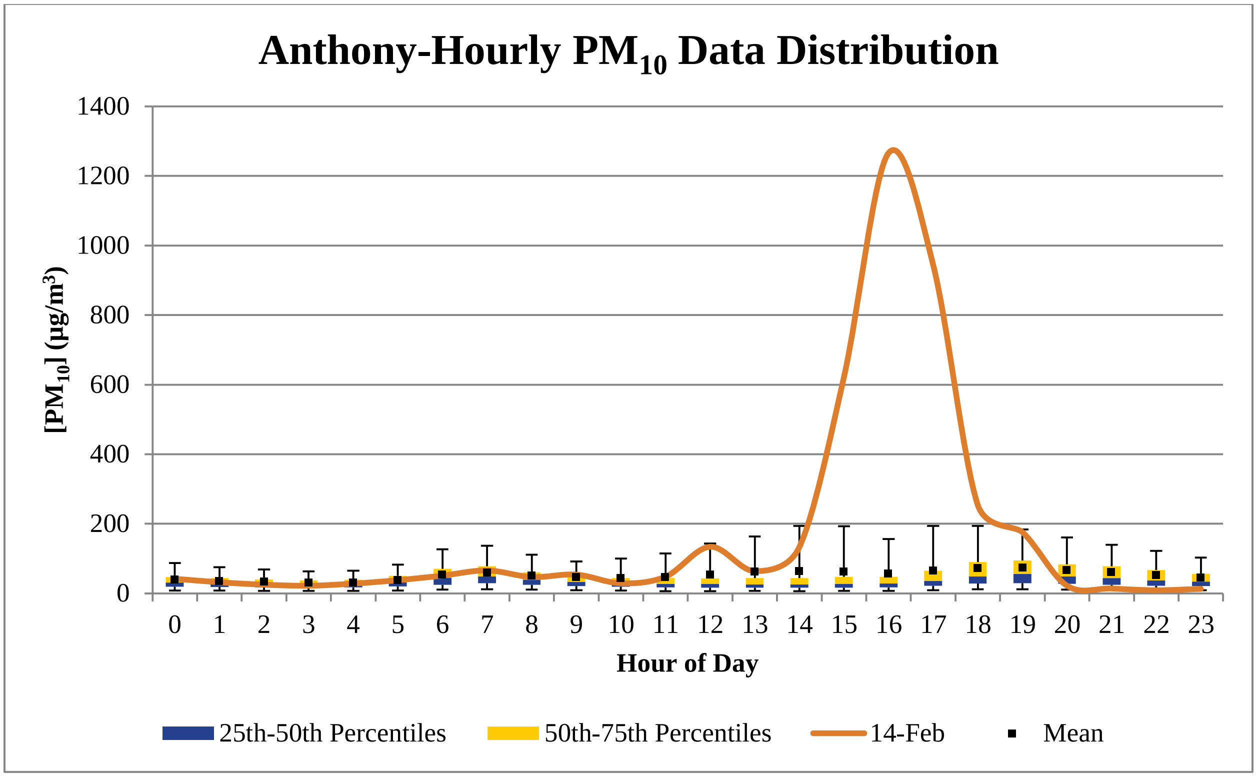


Figure 4-6a. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for February 14, 2012.

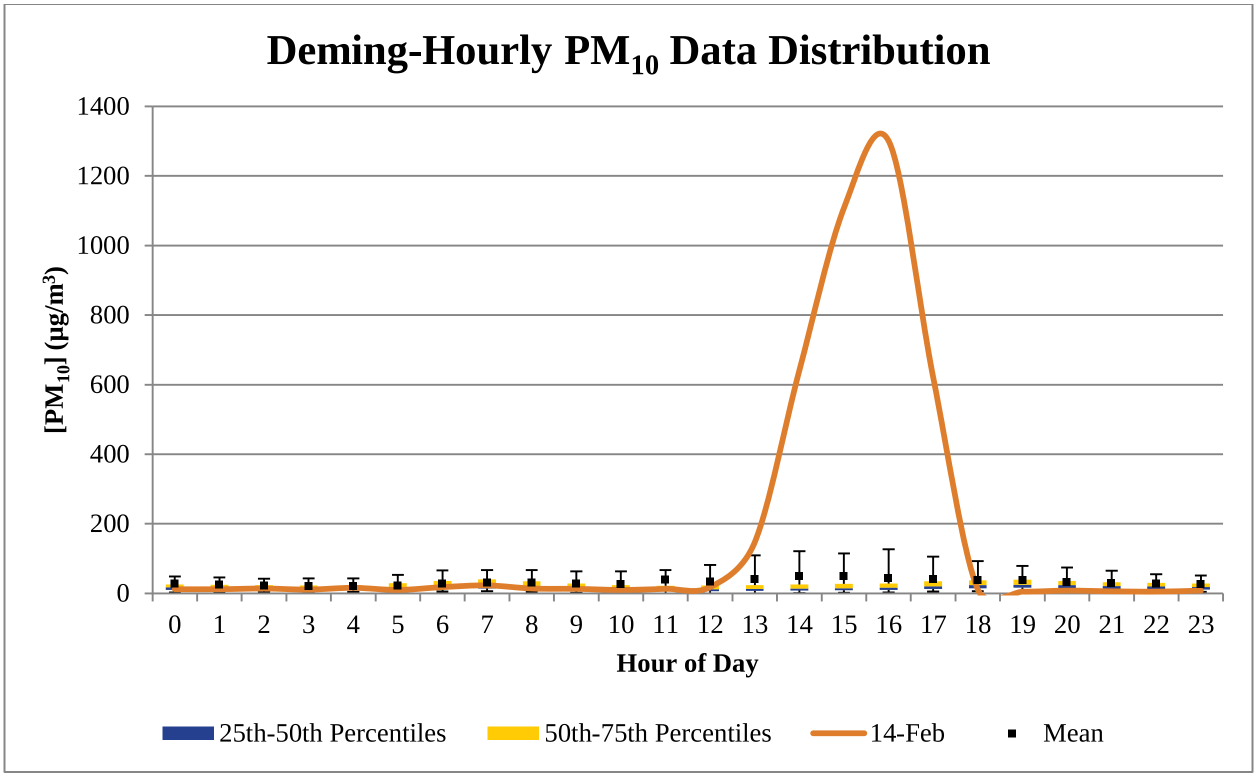


Figure 4-6b. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for February 14, 2012.

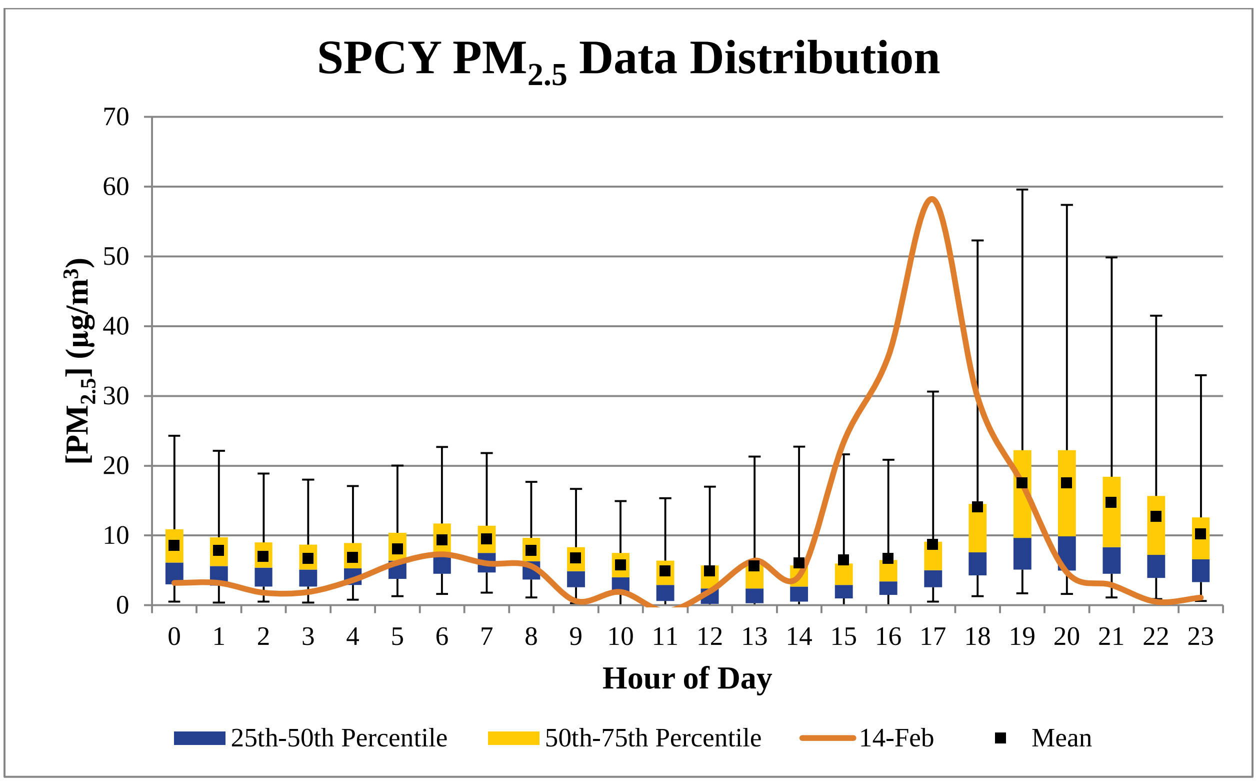


Figure 4-6c. $PM_{2.5}$ hourly data distribution from 2007-2011 overlaid by hourly values for February 14, 2012.

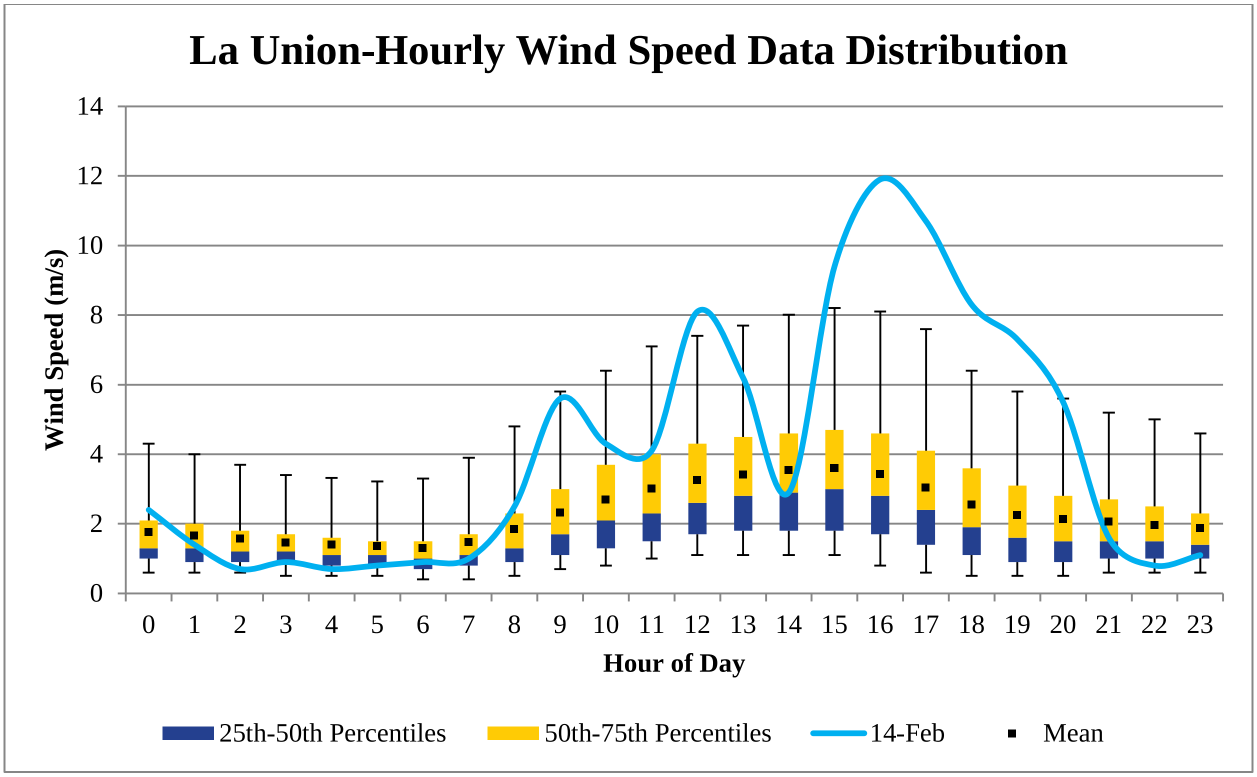


Figure 4-7a. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for February 14, 2012.

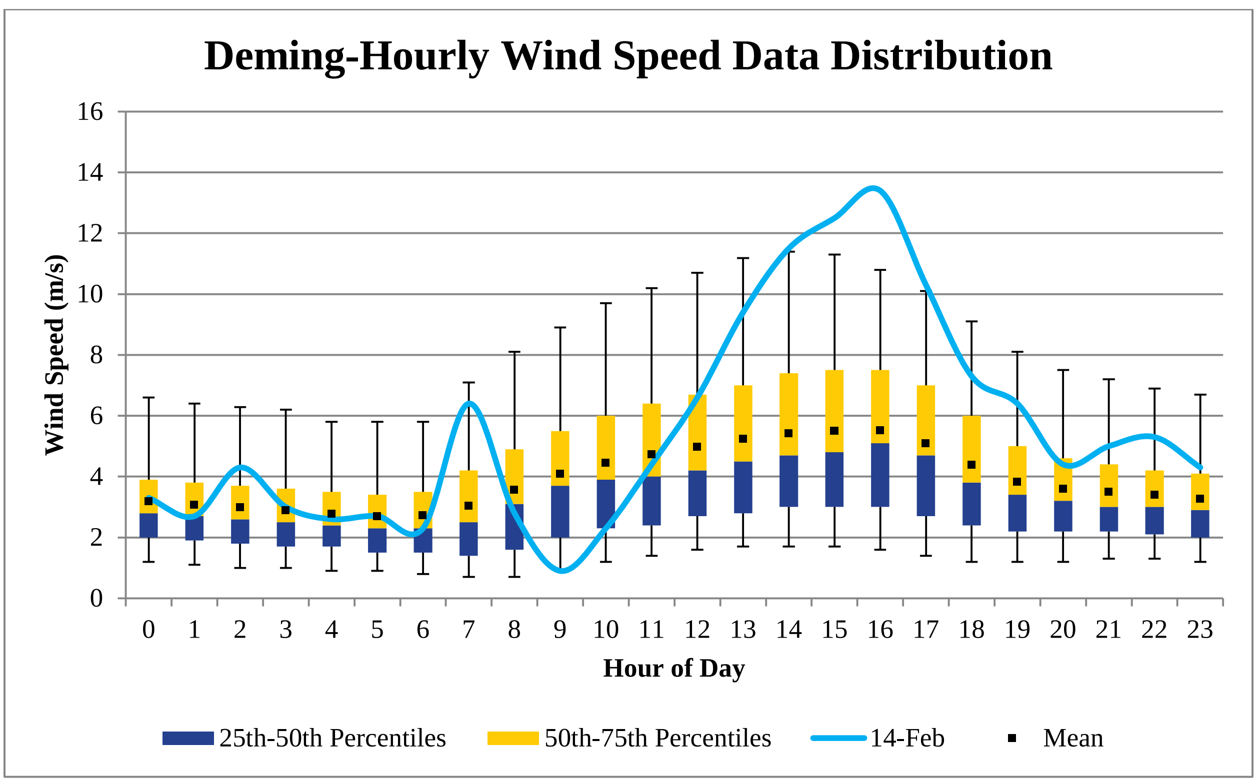


Figure 4-7b. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for February 14, 2012.

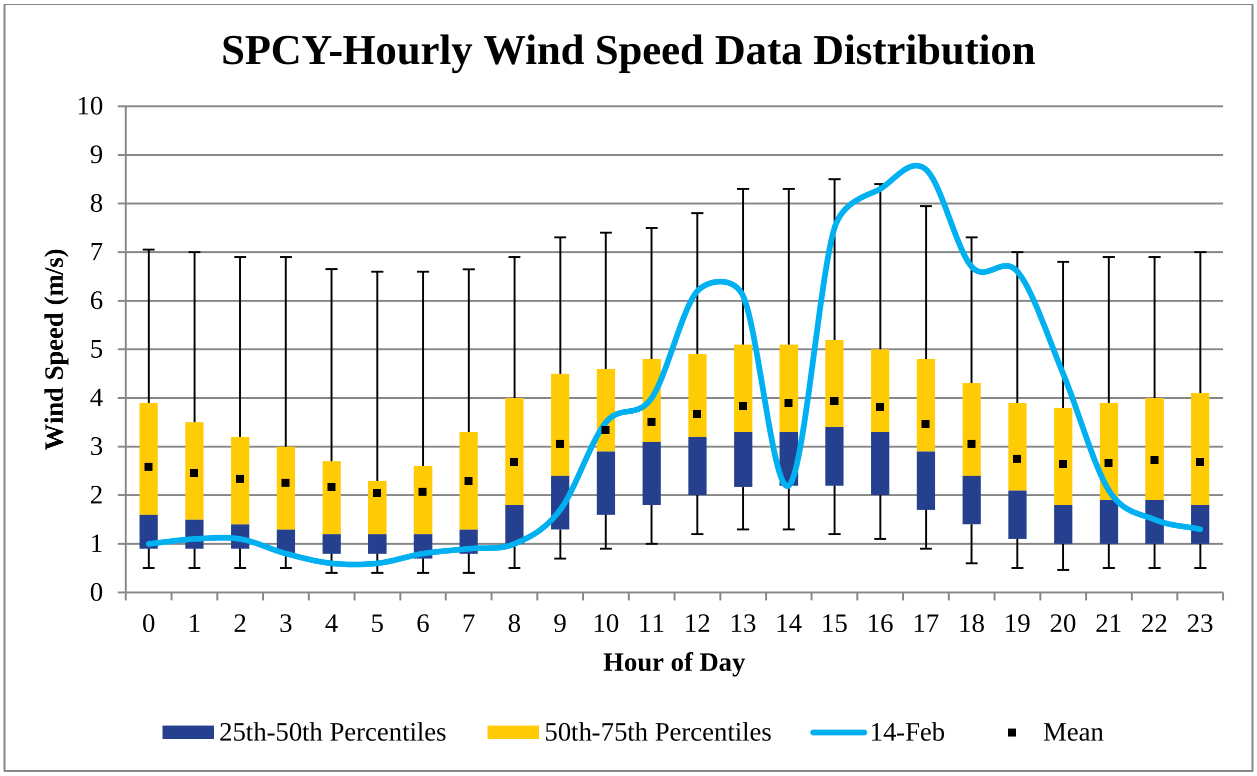


Figure 4-7c. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for February 14, 2012

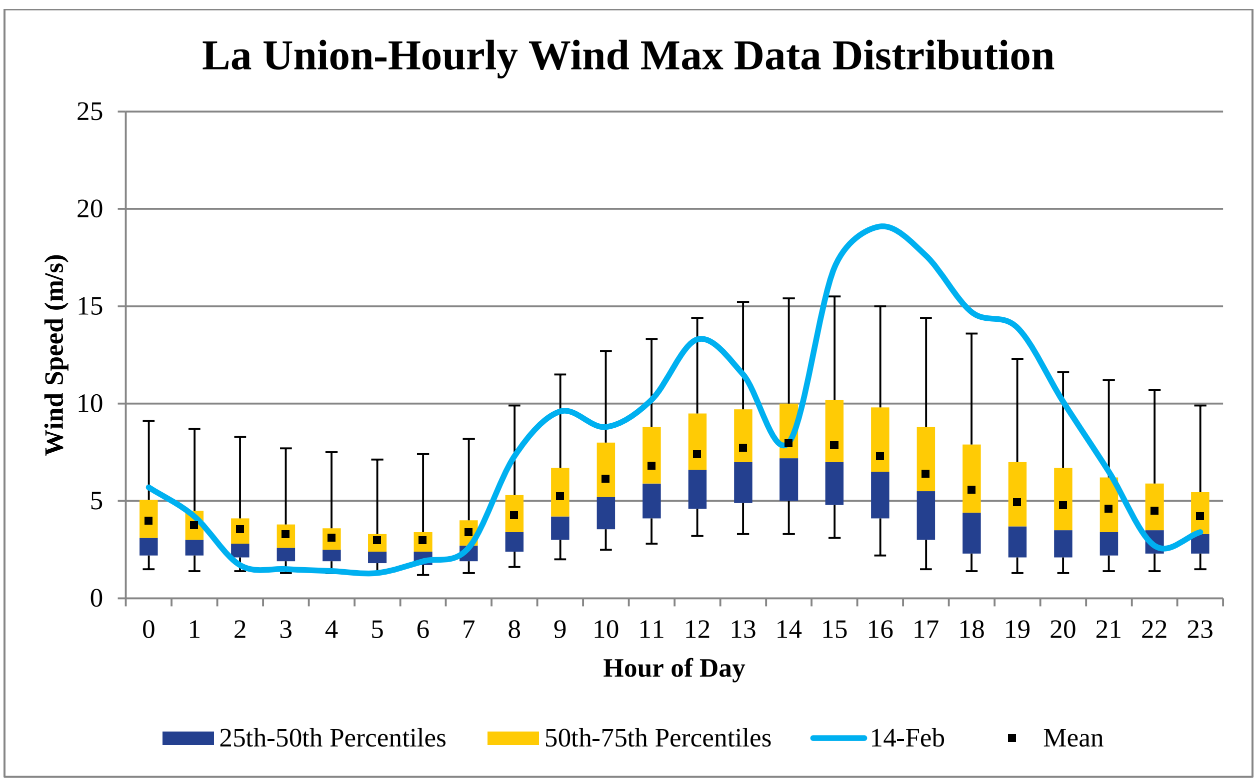


Figure 4-8a. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for February 14, 2012.

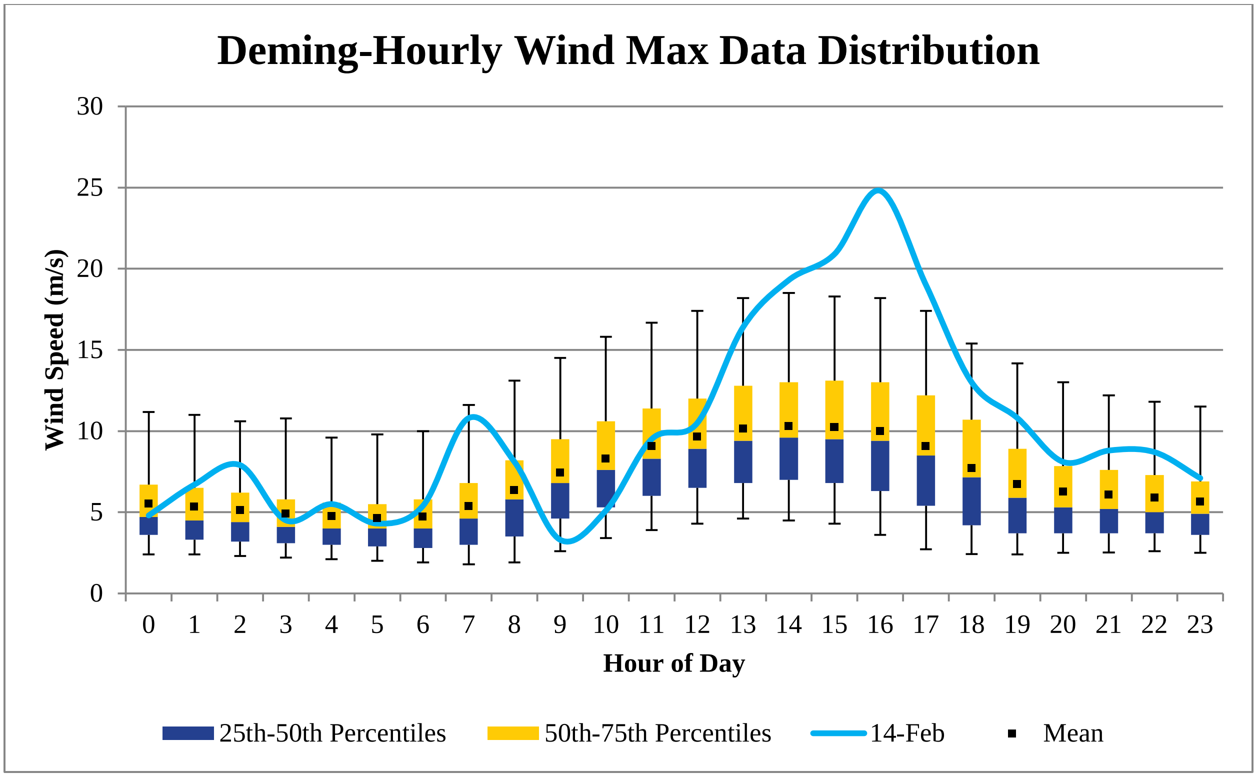


Figure 4-8b. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for February 14, 2012.

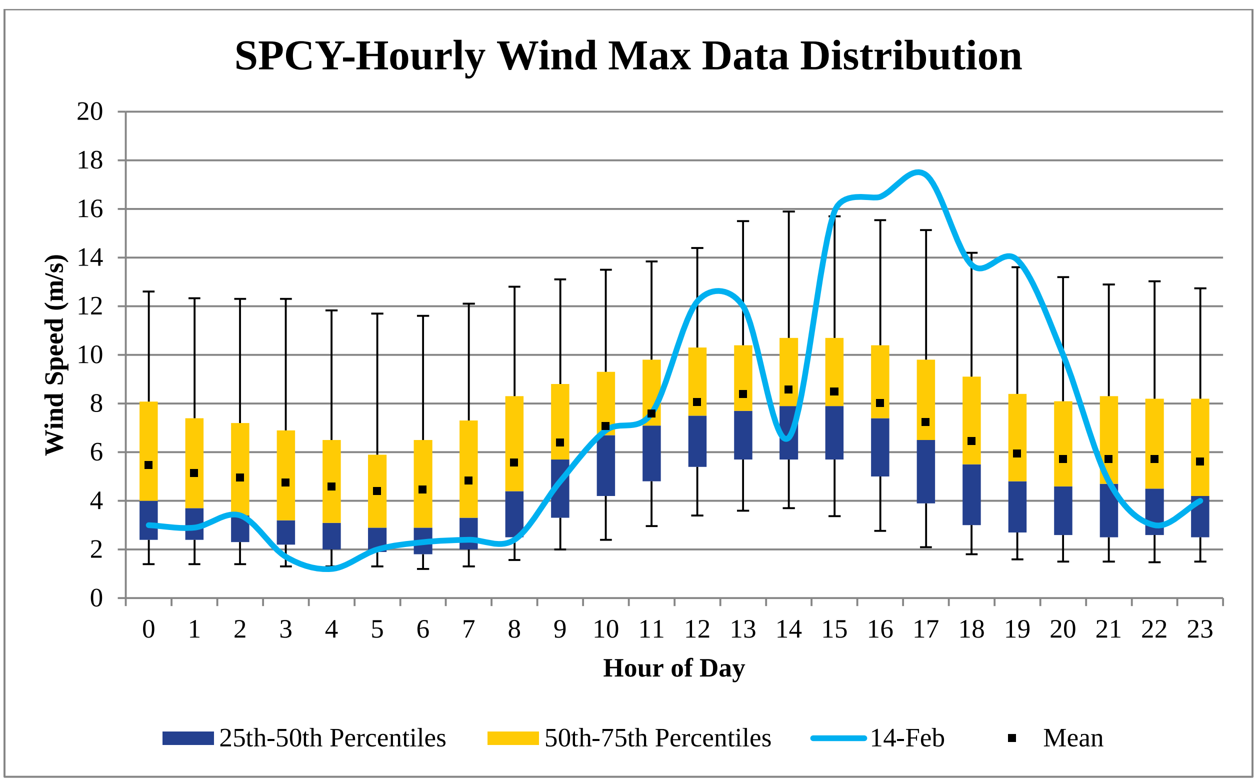


Figure 4-8c. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for February 14, 2012.

4.4 Clear Causal Relationship

A strong winter system and associated Pacific cold front passed through New Mexico on February 14, 2012. As the Pacific cold front moved through New Mexico, the pressure gradient tightened and winds became stronger at the surface (Figure 4-9). The upper level low helped to tighten the surface pressure gradient and the wind direction in the upper atmosphere aligned with the surface wind direction (Figure 4-10). Diurnal heating of the surface allowed winds aloft to mix downward, increasing the surface wind velocities and provided the turbulence required for vertical mixing and horizontal transport.

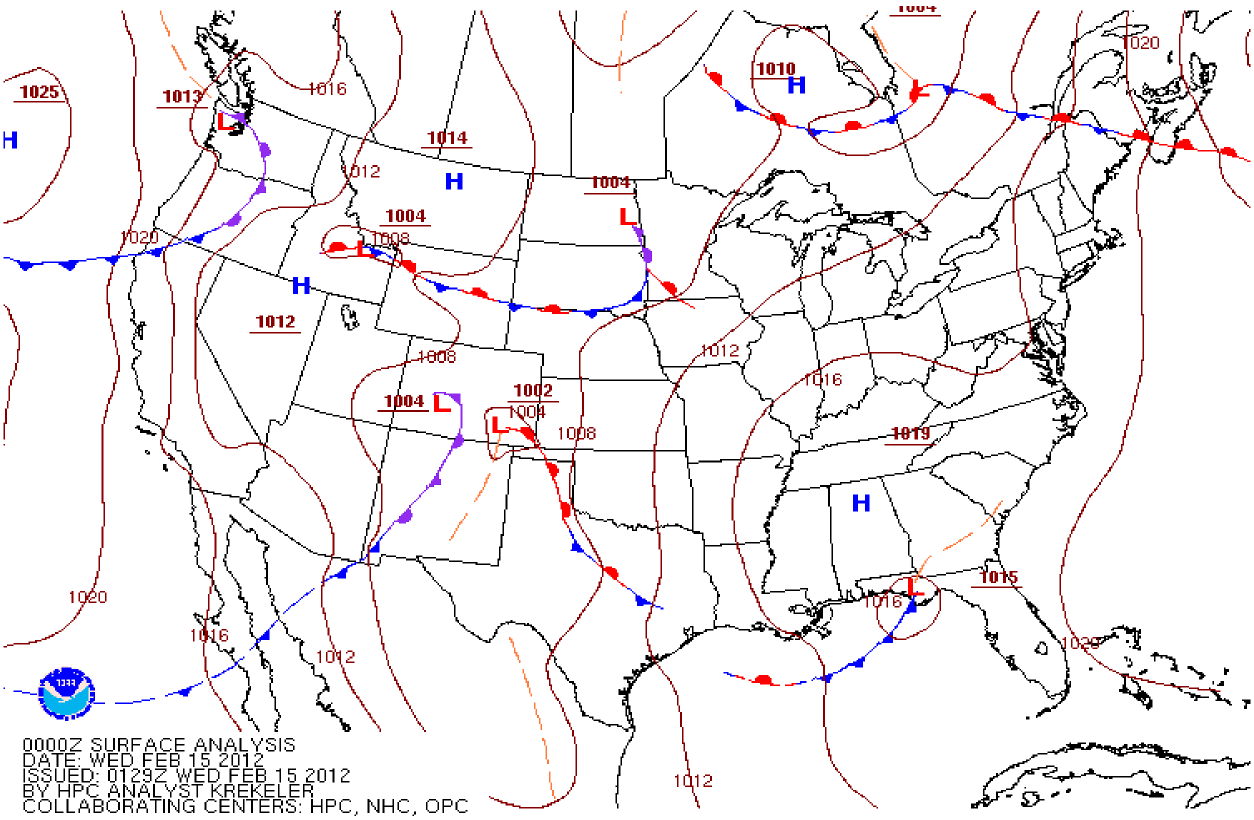


Figure 4-9. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for February 14, 2012 at the 1700 hour.

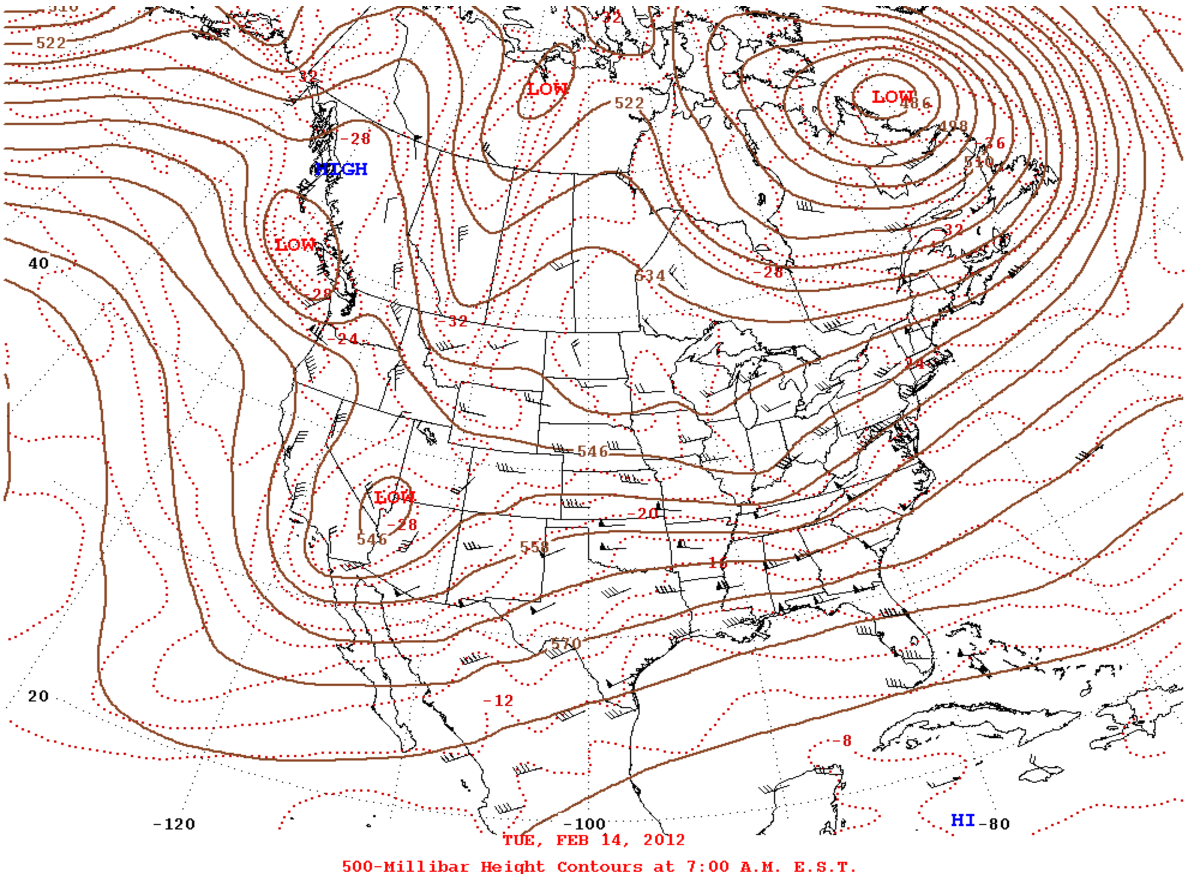


Figure 4-10. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on February 14, 2012.

The weather pattern described above generated strong southwesterly winds beginning at the 1400 hour and lasting through the 1700 hour. Beginning at the 1400 hour, wind speeds exceeded 11.2 m/s at Deming as shown in Figure 4-3. Peak wind speeds ranged from 8.6 m/s at Desert View to 13.4 m/s at Deming (Figure 4-3). Peak wind gusts ranged from 17.4 m/s at Sunland Park to 24.8 m/s at Deming (Figure 4-4). Blowing dust caused elevated levels of PM_{10} and $PM_{2.5}$ during the same period as high winds as demonstrated by the time series plot in Figure 4-11a-c. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (1400-1700 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 4-12a-b). Maximum hourly PM_{10} concentrations ranged from 936 µg/m^3 at Chaparral to 1301 µg/m^3 at Deming. Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 4-13).

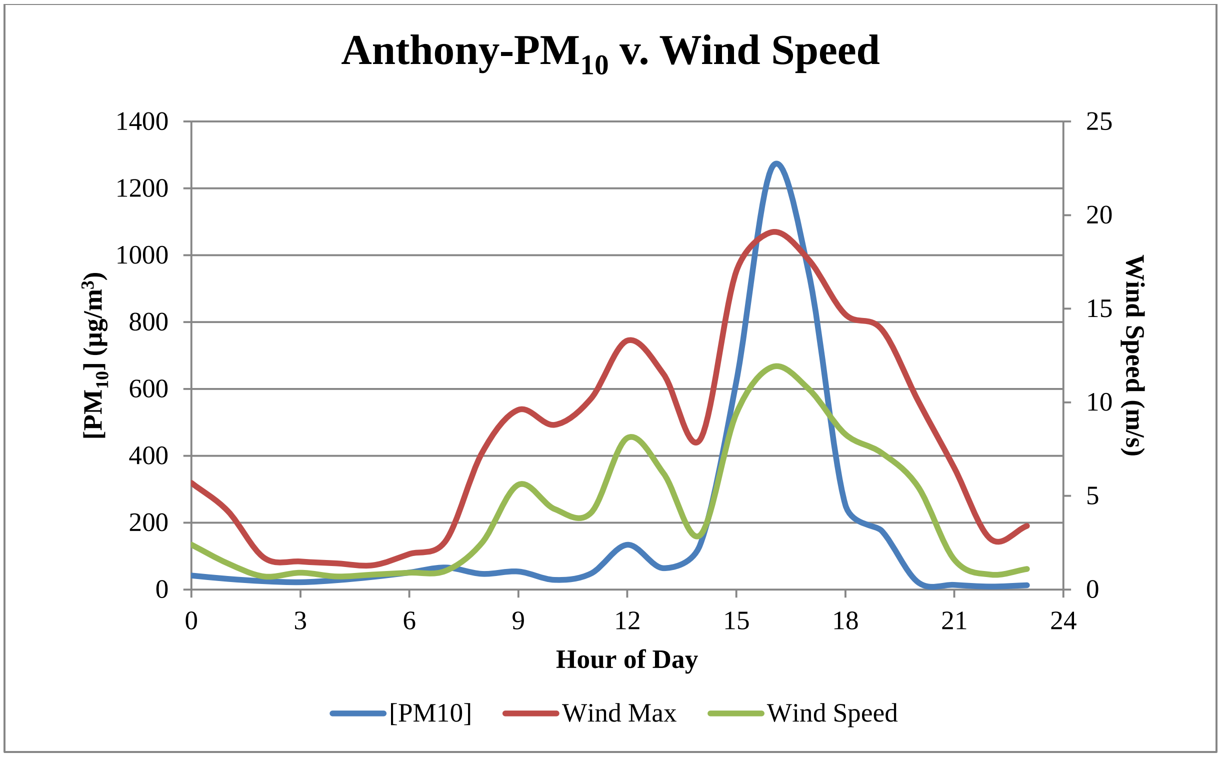


Figure 4-11a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

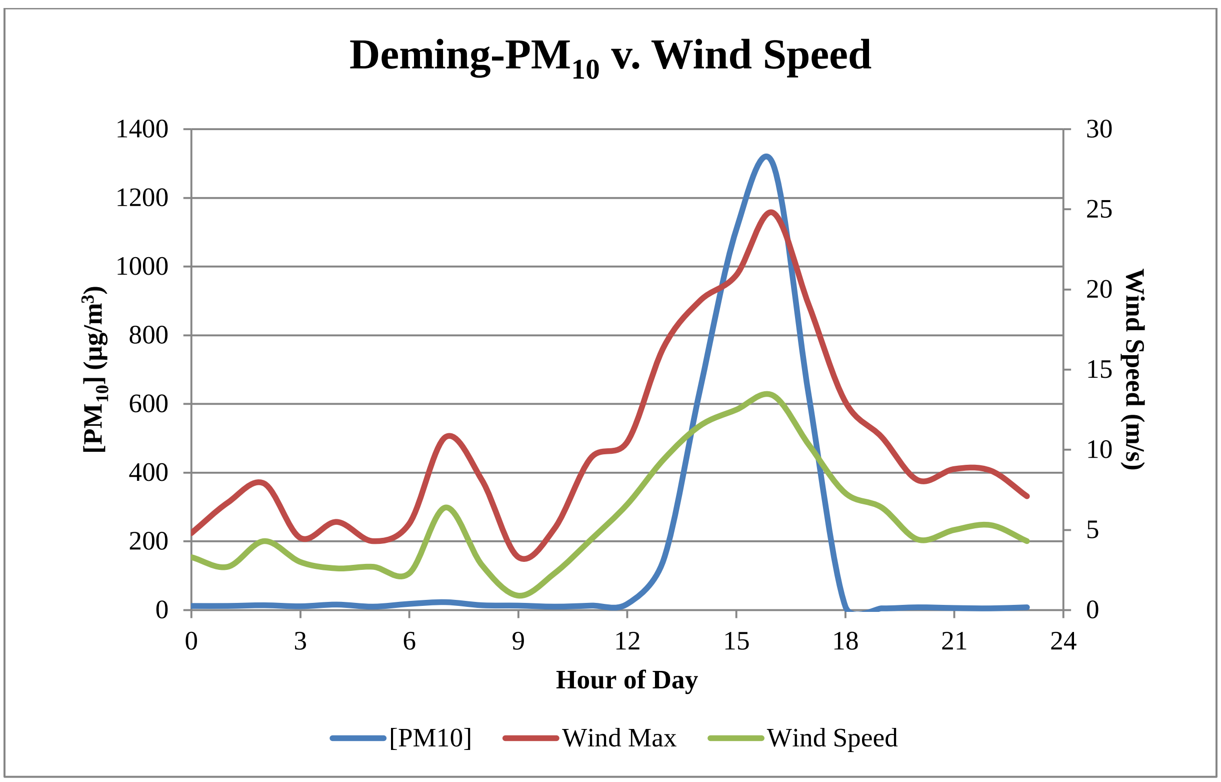


Figure 4-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

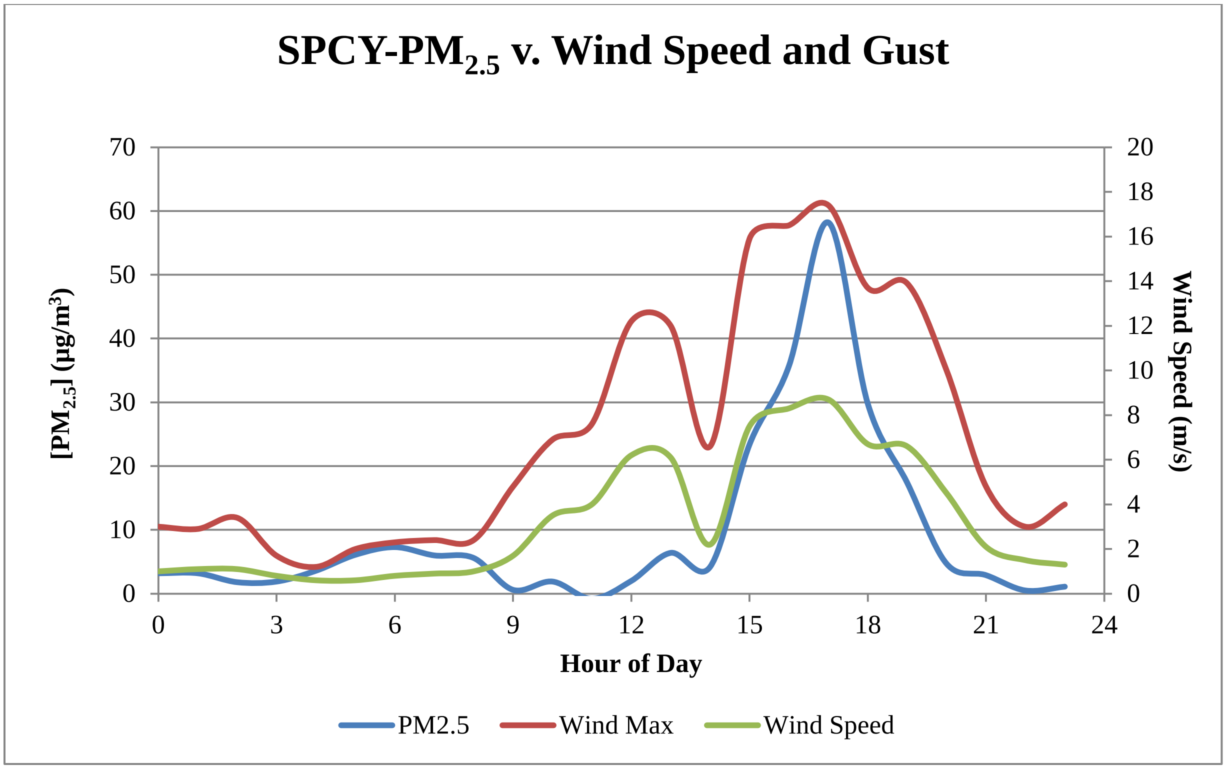


Figure 4-11c. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

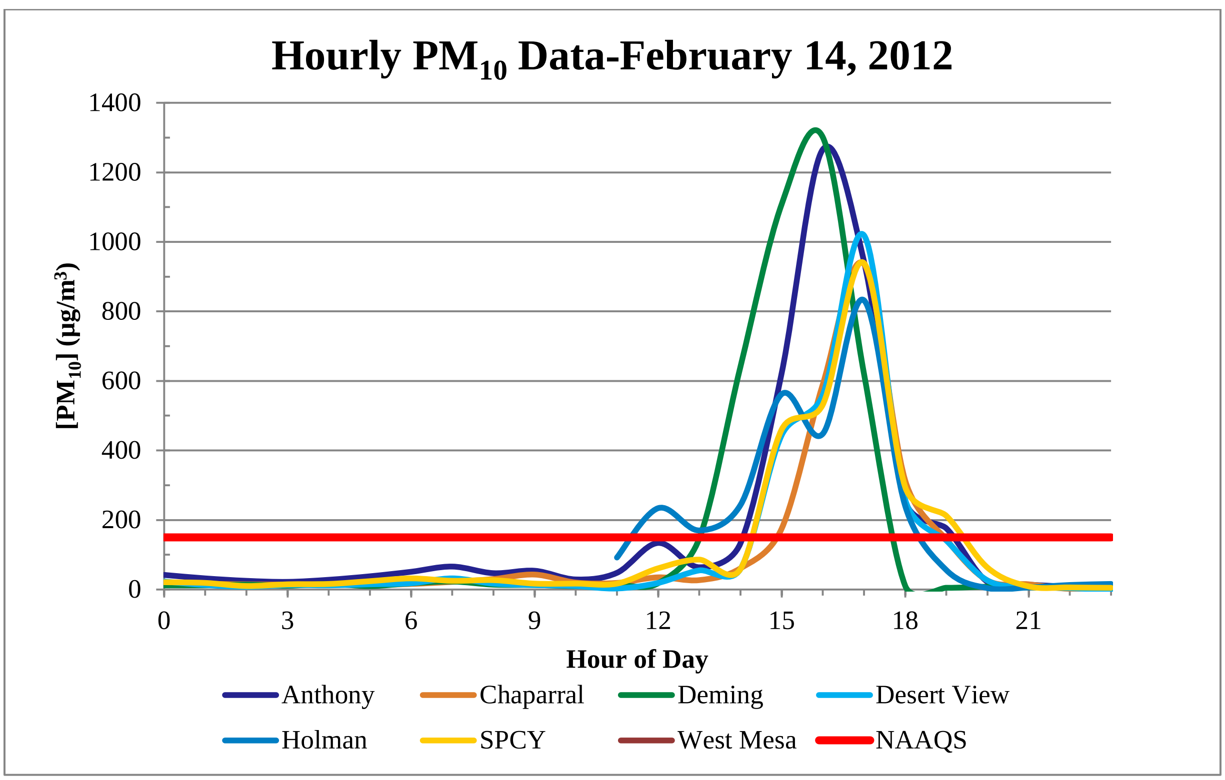


Figure 4-12b. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

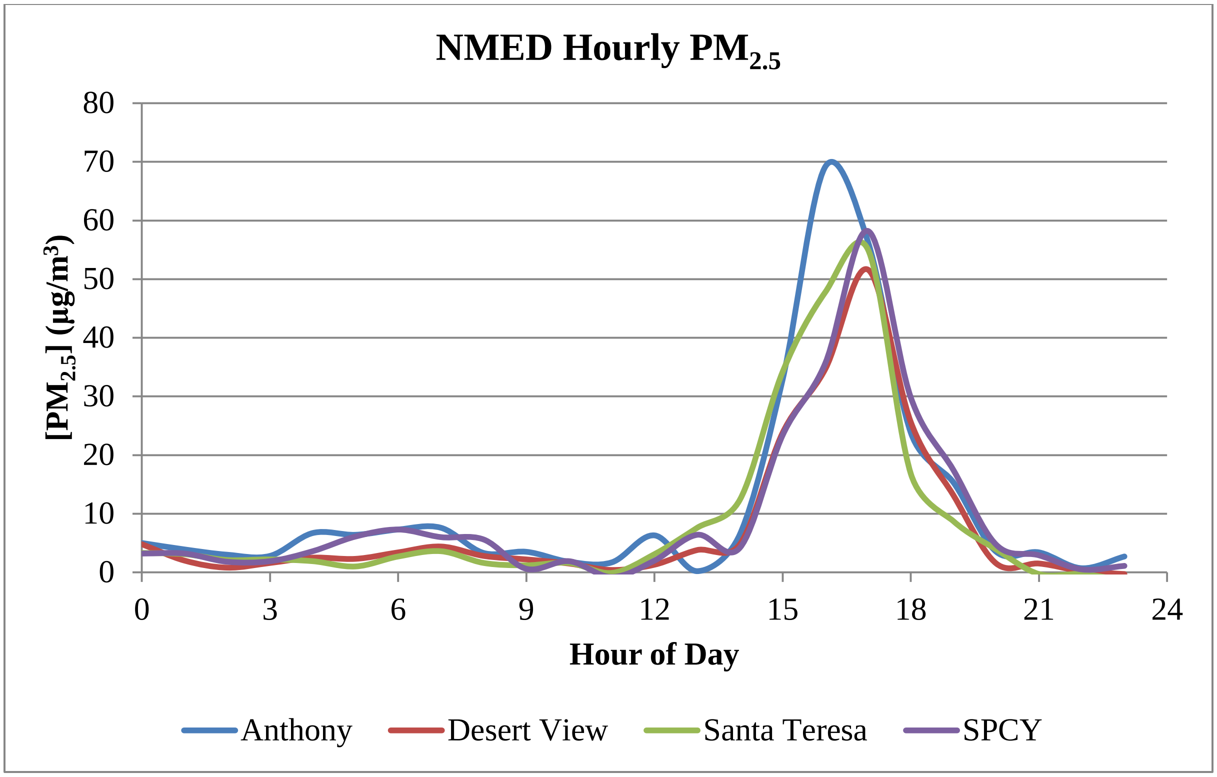


Figure 4-12b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors. Non-FEM hourly $PM_{2.5}$ data.

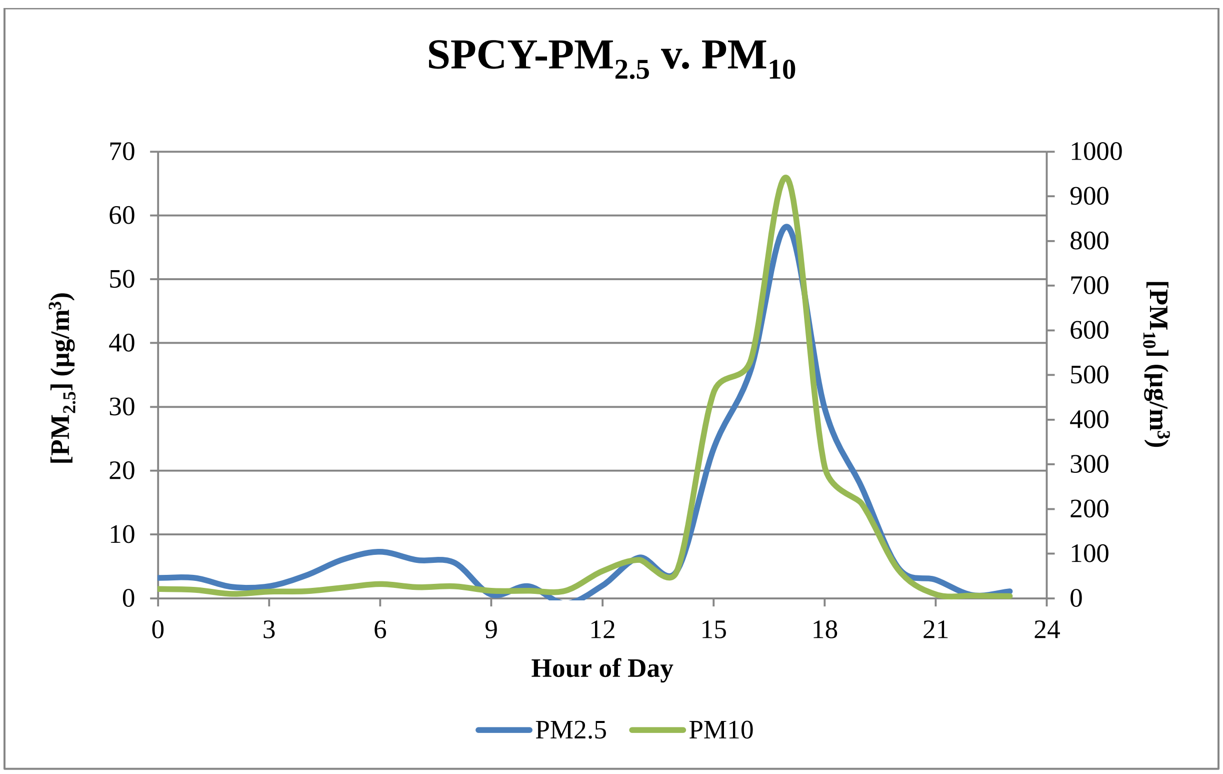


Figure 4-13. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on February 14, 2012.

The NM Border Air Quality Blog wrote the following about February 14, 2012: "The focus is on the winds today. A windy day is in store for the border region today. … The high winds are compounded by gusts from isolated showers this afternoon." (DuBois, 2012). The Southwest Weather Bulletin highlighted this date by reporting: "Windy with winds gusting around 50 mph across the lowlands and almost 70 mph near the mountains" (NWS, 2012). The NWS also issued a wind advisory from the 1100 hour through the 2300 hour warning that:

> WINDS WILL BE STRONG ENOUGH TO BLOW SMALL OBJECTS AND DEBRIS AROUND. WINDS WILL ALSO CREATE LOCALIZED BLOWING DUST OVER EXPOSED DIRT SURFACES WHICH MAY REDUCE VISIBILITIES TO NEARBY MOTORISTS (NWS, 2012).

4.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on February 14, 2012.

4.6 Natural Event

The Clear Causal Relationship and not Reasonably Controllable or Preventable analyses show that this was a natural event caused by high wind and blowing dust.

4.7 No Exceedance but for the Event

The SPCY $PM_{2.5}$ monitor detected elevated levels due to blowing dust from 1500 to 1900 hours on February 14, 2012. Although these elevated concentrations do not exceed the 24-hour NAAQS for $PM_{2.5}$, they contribute to an annual exceedance level of 13.7 $\mu g/m^3$ for this date. The strong correlation between hourly $PM_{2.5}$, PM_{10} and wind speeds peaks also point to windblown dust affecting the monitor. Previous studies have shown that $PM_{2.5}/PM_{10}$ ratios vary from 0.11 to 0.45 in the Paso del Norte (Arimoto et. al, 2001; Li et al, 2001). The ratios above 0.30 were observed in downtown El Paso and Ciudad Juárez and indicate a heavy impact from mobile sources. The lower ratios were observed in areas with less vehicular traffic and crustal material dominated the PM_{10} fraction. The $PM_{2.5}/PM_{10}$ ratio for the SPCY site was 0.11 for this date ($PM_{2.5}$ Partisol/PM_{10} TEOM). NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

The Anthony monitor detected blowing dust around the 1500 hour with hourly concentrations heavily impacted until the 1800 hour. The four hourly PM_{10} values (622, 1266, 954 and 254 $\mu g/m^3$) from 1500 - 1800 hours cause the exceedance of the 24-hour average standard at Anthony. By replacing these four hourly values with the 95th percentile of hourly data at the Anthony site, the resulting 24-hour average (71 $\mu g/m^3$) does not exceed the NAAQS (Table 4-1). The values in red represent the 95th percentile of all hourly data collected at Anthony, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	42	22
1	32	21
2	25	18
3	22	28
4	28	31
5	38	31
6	51	46
7	66	56
8	47	49
9	54	26
10	29	24
11	48	44
12	134	88
13	64	122
14	133	160
15	622	**194**
16	1266	**157**
17	944	**194**
18	254	**194**
19	176	156
20	22	10
21	14	9
22	9	14
23	13	7
24-Hour Average	172	**71**

Table 4-1. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Anthony.

The Deming monitor detected blowing dust around the 1300 hour with hourly concentrations heavily impacted until the 1700 hour. The five hourly PM_{10} values from 1300 – 1800 hours at

Deming alone exceed the 24-hour average standard [(147 + 641 + 1108 + 1301 + 621) µg/m^3 = 3818 µg/m^3; 3818 µg/m^3/24 = 159 µg/m^3]. By replacing these five hourly values with the 95th percentile of hourly data at the Deming site, the resulting 24-hour average (34µg/m^3) does not exceed the NAAQS (Table 4-1). The values in red represent the 95th percentile of all hourly data collected at Anthony, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	12	12
1	12	12
2	14	14
3	11	11
4	16	16
5	10	10
6	18	18
7	23	23
8	14	14
9	13	13
10	10	10
11	13	13
12	18	18
13	147	**109**
14	641	**121**
15	1108	**115**
16	1301	**127**
17	621	**106**
18	11	11
19	5	5
20	8	8
21	6	6
22	5	5
23	8	8
24-Hour Average	167	**34**

Table 4-2. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Deming.

5 HIGH WIND EXCEPTIONAL EVENT: February 28, 2012

5.1 Summary of Event

The passing of a Pacific cold front caused high winds and blowing dust in Doña Ana County resulting in exceedances of the PM_{10} 24-hour NAAQS and the $PM_{2.5}$ annual NAAQS at the Chaparral, Holman, Desert View and Sunland Park monitoring sites on this date. The PM_{10} FEM TEOM continuous monitors at these sites recorded 24-hour average concentrations of 183, 192, 276, and 301 $\mu g/m^3$, respectively. The $PM_{2.5}$ FRM Partisol monitor at Sunland Park recorded a 24-hour average concentration of 25.7 $\mu g/m^3$. Although no other monitoring site recorded an exceedance on this date, elevated PM_{10} concentrations were measured at the Anthony (116$\mu g/m^3$) monitoring site (Figure 5-1). The averages in this figure were calculated using PM_{10} FEM TEOM and $PM_{2.5}$ FRM Partisol instrument data for the four days before and after the event. Elevated concentrations were also recorded by the $PM_{2.5}$ non-FEM/FRM TEOMs (Figure 5-2).

As the event unfolded, the wind blew from the west throughout the border region. These high velocity winds passed over large areas of desert within Arizona, New Mexico and Mexico. The co-occurrence of high winds and elevated levels of blowing dust, little to no point sources in the area, and the high hourly and daily PM_{10} and $PM_{2.5}$ concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

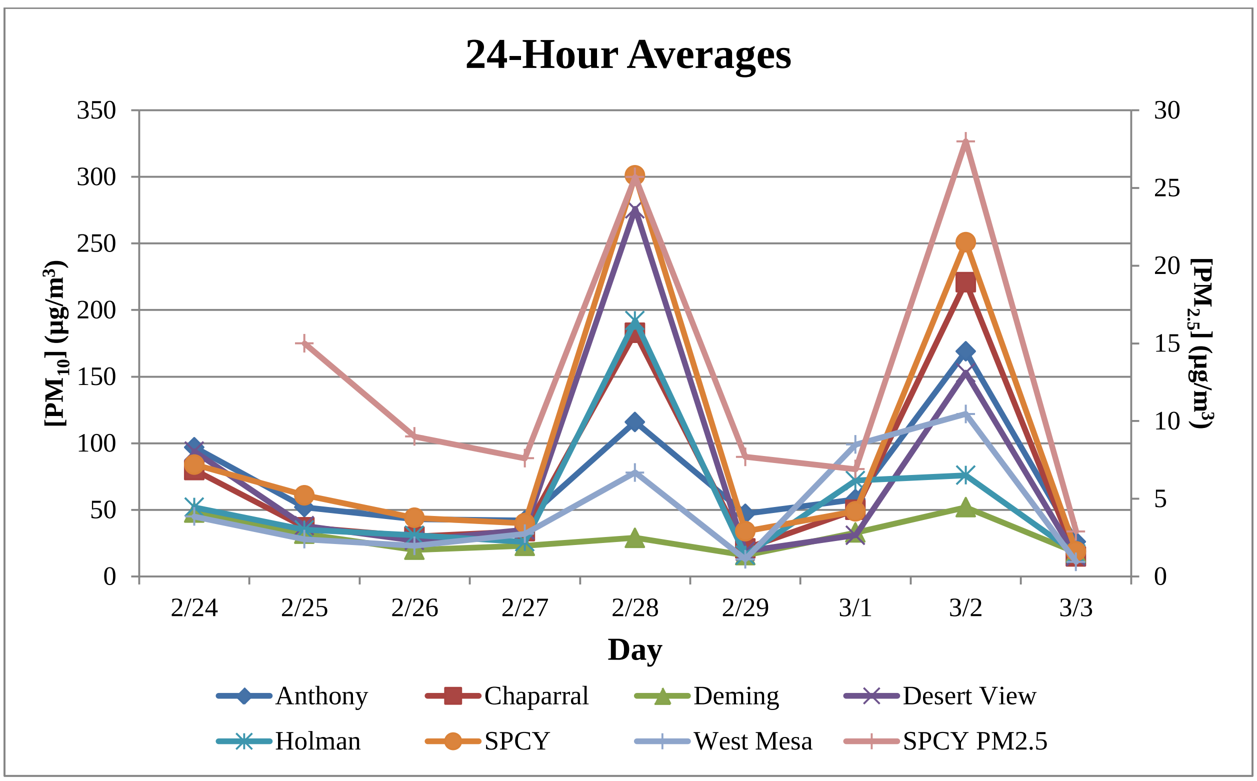


Figure 5-1. PM_{10} 24-hour averages before and after February 28, 2012.

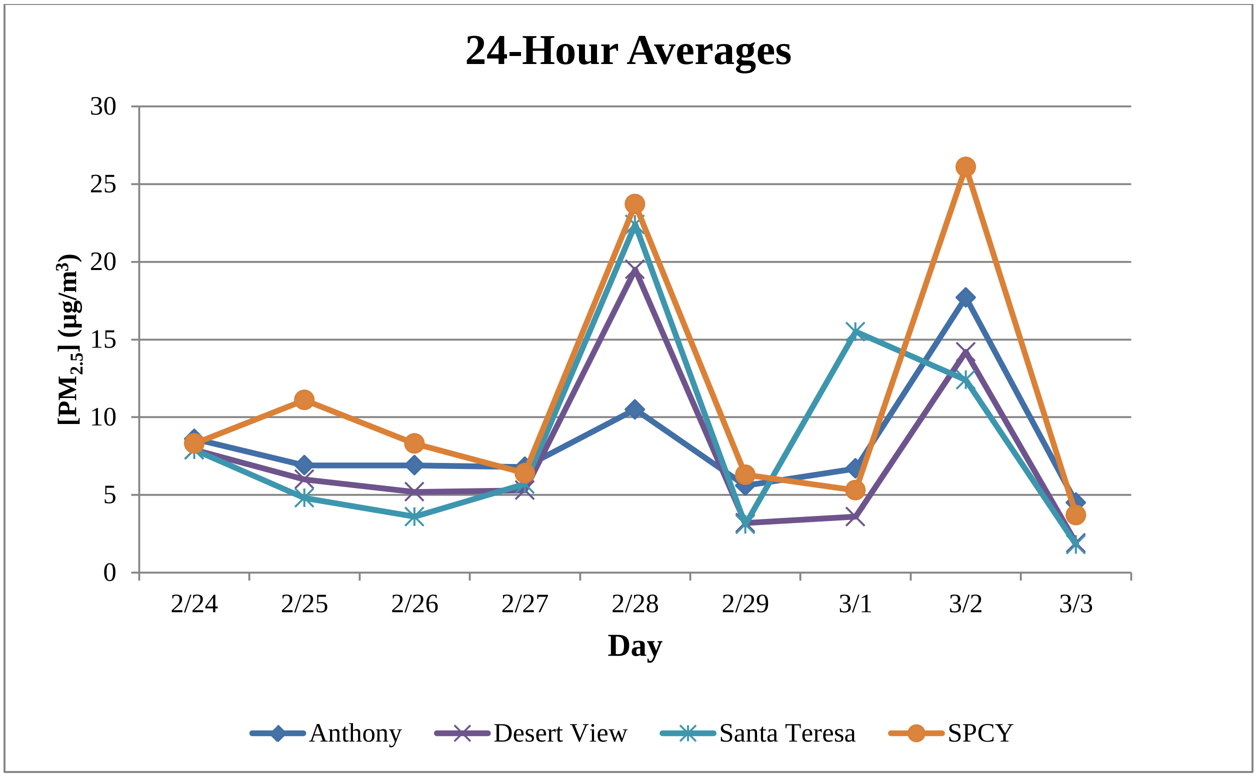


Figure 5-2. $PM_{2.5}$ 24-hour averages before and after February 28, 2012. Non-FEM TEOM Data.

5.2 Is Not Reasonably Controllable or Preventable

5.2.1 Suspected Source Areas and Categories Contributing to the Event

Sources of windblown dust contributing to this exceedance include the natural desert, residential properties, agricultural land and unpaved roads in Arizona, Mexico and New Mexico. Agricultural tilling and crop planting is not likely to have contributed to this event. City of Las Cruces, City of Deming and Doña Ana and Luna County Ordinances require BACM for any dust producing activities. The largest and most likely sources of windblown dust from the natural desert and the playas of northern Mexico (see Section 5.2.4 below).

5.2.2 Sustained and Instantaneous Wind Speeds

EPA uses a default entrainment threshold of sustained wind speeds at 11.2 m/s (25 mph) for natural and well controlled anthropogenic sources contributing to natural events caused by high wind and blowing dust (EPA, 2013). Under the Doña Ana and Luna County NEAPs, EPA and NMED agreed that wind gusts exceeding 18 m/s would overwhelm any natural and well-controlled anthropogenic sources and cause windblown dust. On February 28, 2012, sustained wind speeds exceeded EPA's default threshold at five of the eight monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at all of the eight monitoring sites (Figures 5-3 and 5-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 0800 hour and ending at the 1500 hour.

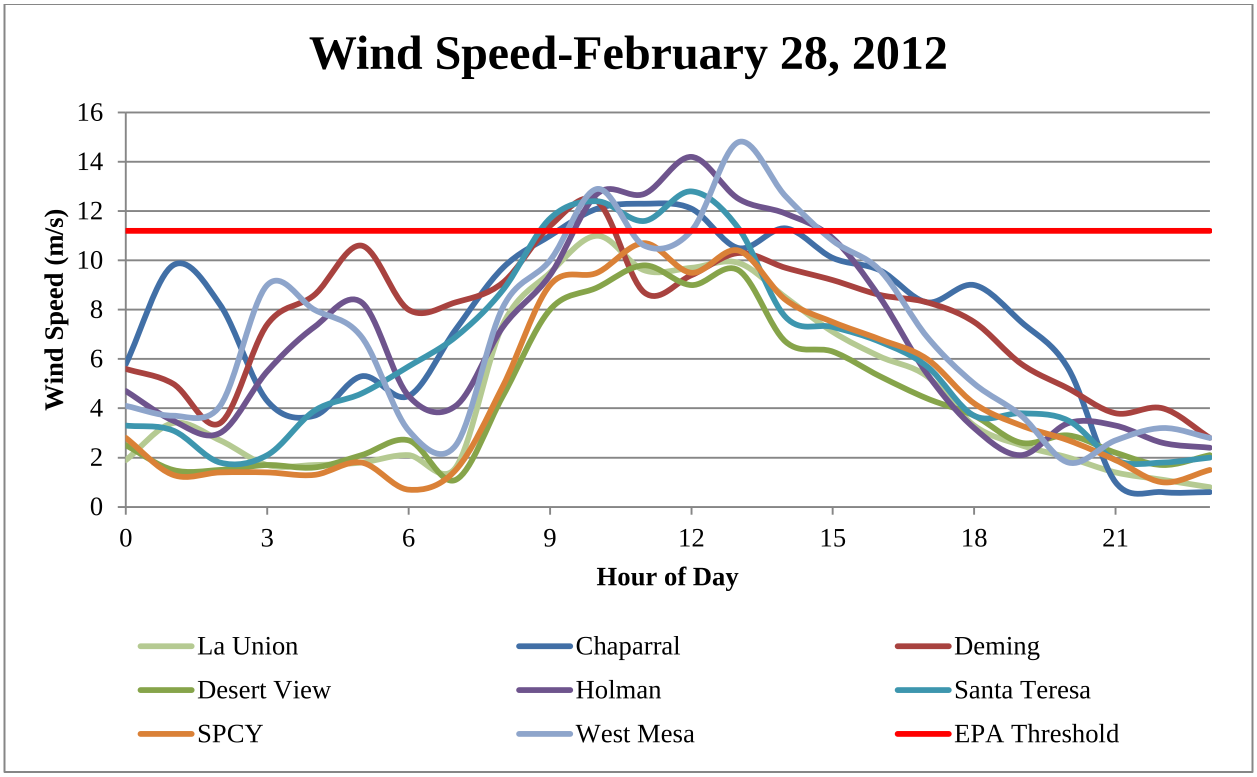


Figure 5-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

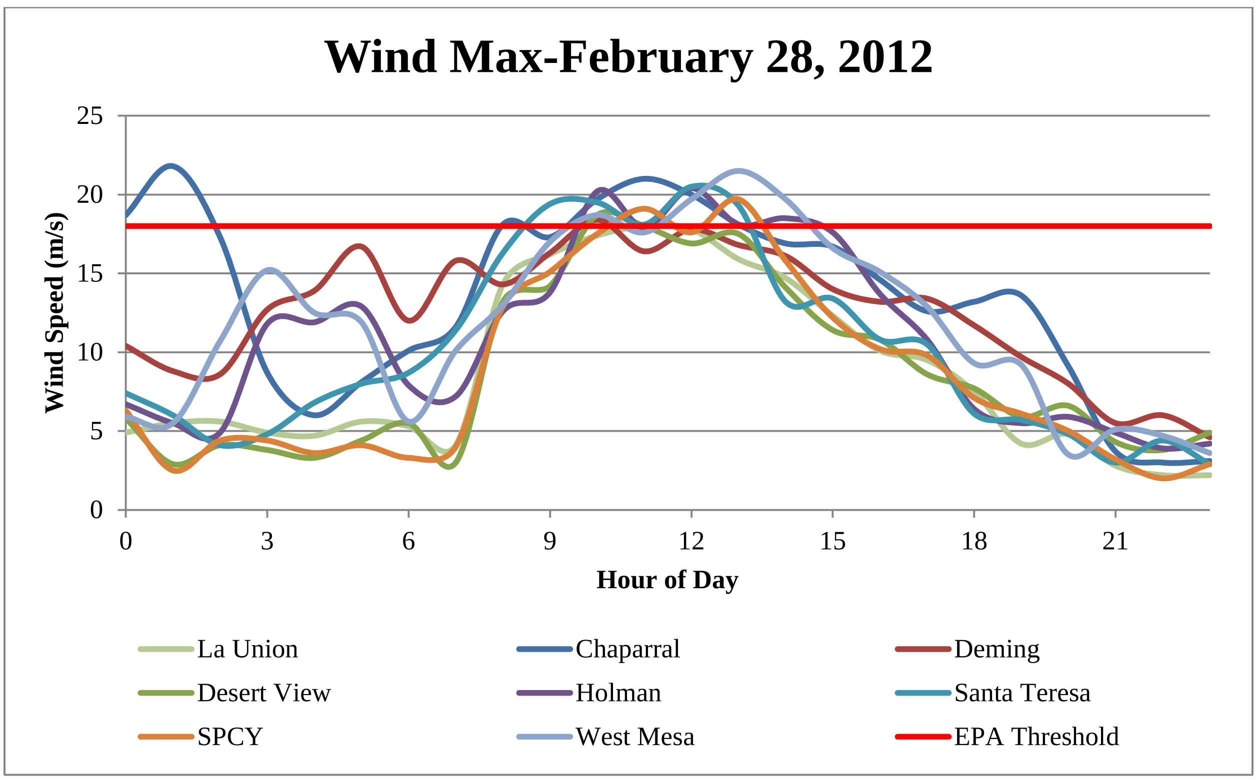


Figure 5-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

5.2.3 Recurrence Frequency

The monitoring sites in Doña Ana and Luna Counties can record exceedances of the PM_{10} NAAQS throughout the year. From 2007-2011 the PM_{10} FEM TEOM monitors recorded 254 exceedances and the PM_{10} FRM Wedding monitors recorded 6 exceedances (Figure A-1). The Deming Airport and Desert View monitoring sites (FEM TEOMs) were established in 2006 and 2007 respectively and do not show exceedances until the year following startup. The SPCY $PM_{2.5}$ FRM Partisol recorded 37 exceedances of the 24-Hour NAAQS from 2007-2011 (Figure A-2). See appendix A for a more in-depth discussion about recurrence frequency and the number of exceedances at each monitoring site.

5.2.4 Controls Analysis

The local ordinances and MOUs adopted under the NEAP direct the implementation of BACM for sources of dust in Doña Ana County. The ordinances regulate disturbed lands, construction and demolition, vacant parking lots and materials handling and transportation. Our investigation did not identify any unusual PM_{10} producing activities on this day, and anthropogenic emissions remained constant before, during and after the event. The most likely source contributing to the event is the natural desert and playas in New Mexico, Arizona and northern Mexico. The sites in Doña Ana County recorded the highest 24-hour averages in the monitoring network. A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from Arizona and Mexico to the monitors in Doña Ana County. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 5-5). Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in Arizona or Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

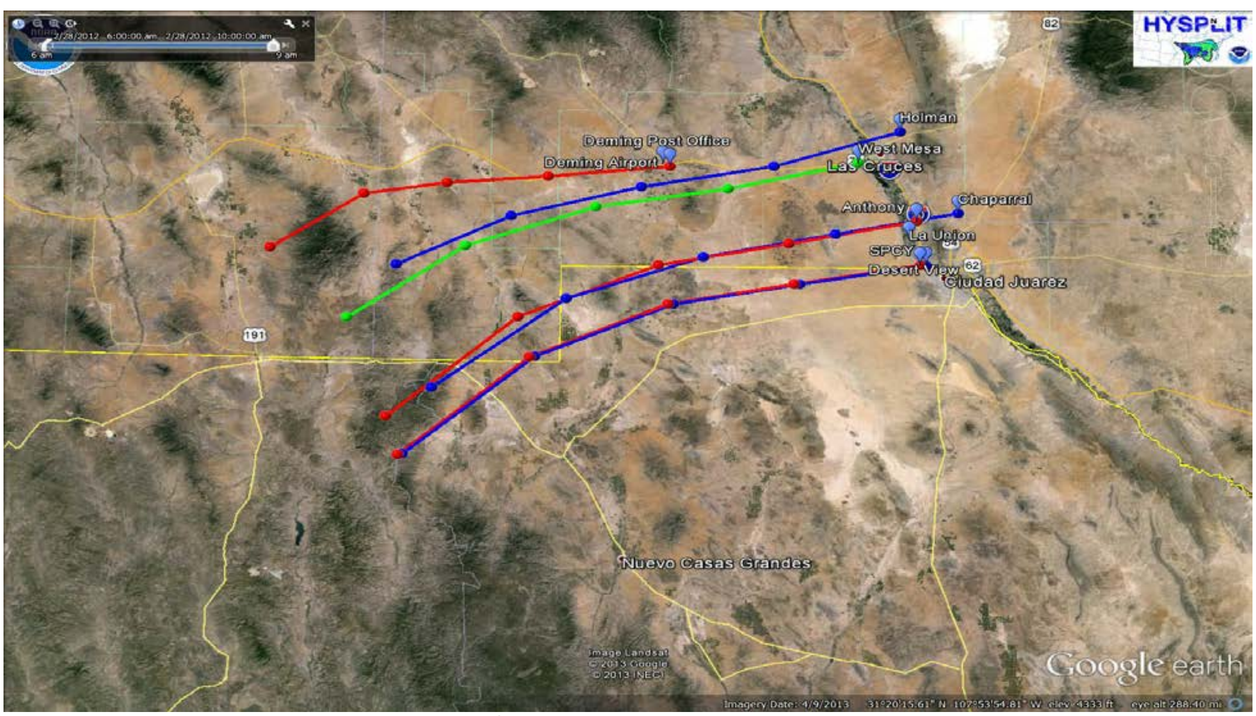


Figure 5-5. HYSPLIT back-trajectory model analysis for February 28, 2012.

5.3 Historical Fluctuations Analysis

5.3.1 Annual and Seasonal 24-hour Average Fluctuations

Since being established, the monitoring sites in Doña Ana and Luna Counties have recorded exceedances of the PM_{10} NAAQS. High winds cause these exceedances and they can occur at any time of year (Figure B-6 through B-13). Most exceedances occur from late winter through early summer (February-June) and are associated with the passage of Pacific cold fronts. High winds caused all recorded exceedances from 2007-2011 and NMED submitted natural events demonstrations to EPA under the NEAP or EER.

Since the 24-hour $PM_{2.5}$ NAAQS was lowered from 65 to 35 µg/m^3 in 2006, the SPCY Partisol monitor has routinely recorded exceedances of the standard. These exceedances occurred throughout the year during high and low wind conditions. In 2009, NMED investigated the cause of the low wind exceedances and found that emissions from Ciudad Juárez, Mexico contribute significantly to elevated concentrations. The high wind exceedances were caused by blowing dust on days when PM_{10} monitors also recorded exceedances.

Appendix B contains a more in-depth discussion about historical fluctuations and charts showing annual and seasonal trends at each monitoring site.

Table B-1 and B-2 show normal historical fluctuations with and without high wind natural events that caused exceedances from 2007-2011. The analysis excludes only those high wind events that resulted in an exceedance. Data for PM_{10} in this table includes FRM Wedding and FEM TEOM measurements and data for $PM_{2.5}$ comes from the FRM Partisol measurements from 2007-2011. The recorded values for this day (183, 192, 276, and 301 µg/m^3) are above the maximum values recorded when no high wind exceedances are included and is above the 95th percentile of all 24-hour averages recorded.

An hourly data distribution analysis was performed for PM_{10} and $PM_{2.5}$ concentrations, wind speeds and wind gusts (Appendices C, D and E). All data used for the PM_{10} distribution charts come from the FEM TEOM monitors and the non-FEM/FRM $PM_{2.5}$ TEOM monitor at SPCY. Overlaying the hourly data for February 28, 2012 on the hourly data distribution plots shows that the values recorded during the high wind event exceed the 95th percentile for PM_{10}, $PM_{2.5}$, wind speed and wind gusts (Figures 5-6a-e through 5-8a-d). The top whiskers of the box and whisker plots represent the 95th percentile of data. The hourly PM_{10} values during the high wind blowing dust storm far exceed the historical 95th percentile of data.

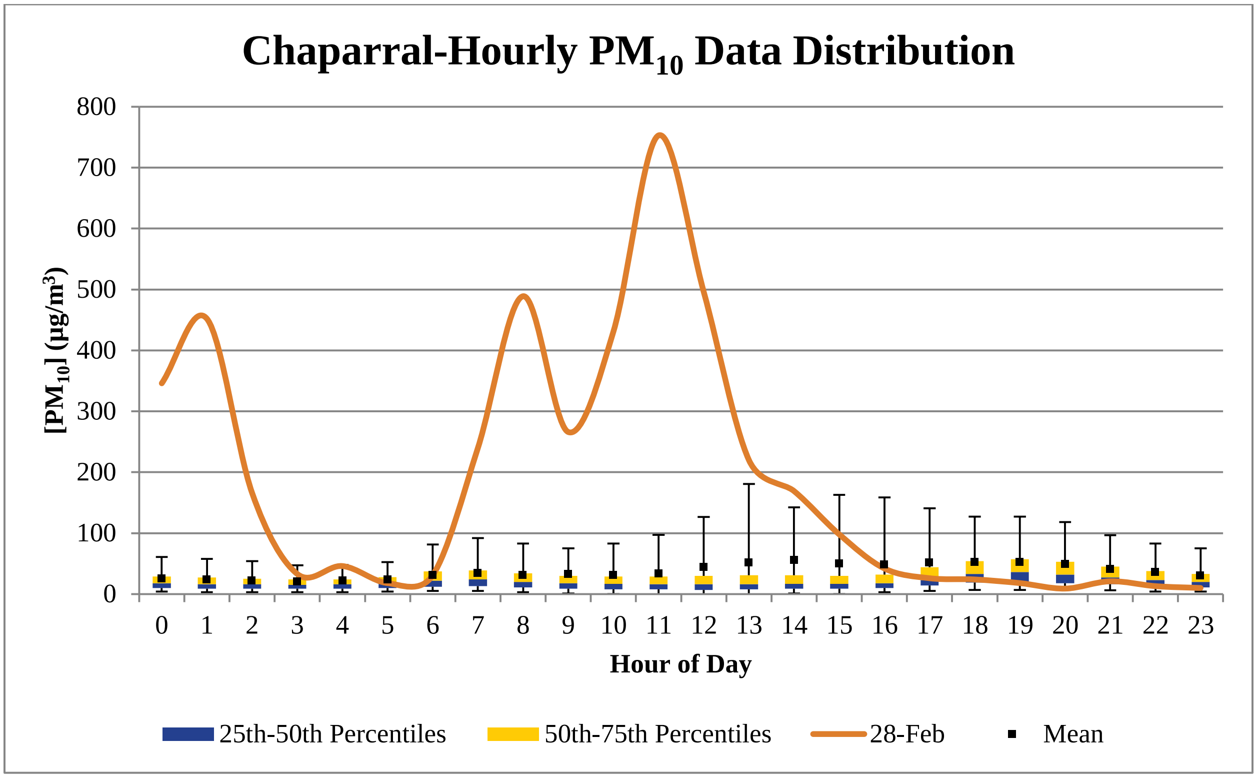


Figure 5-6a. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for February 28, 2012.

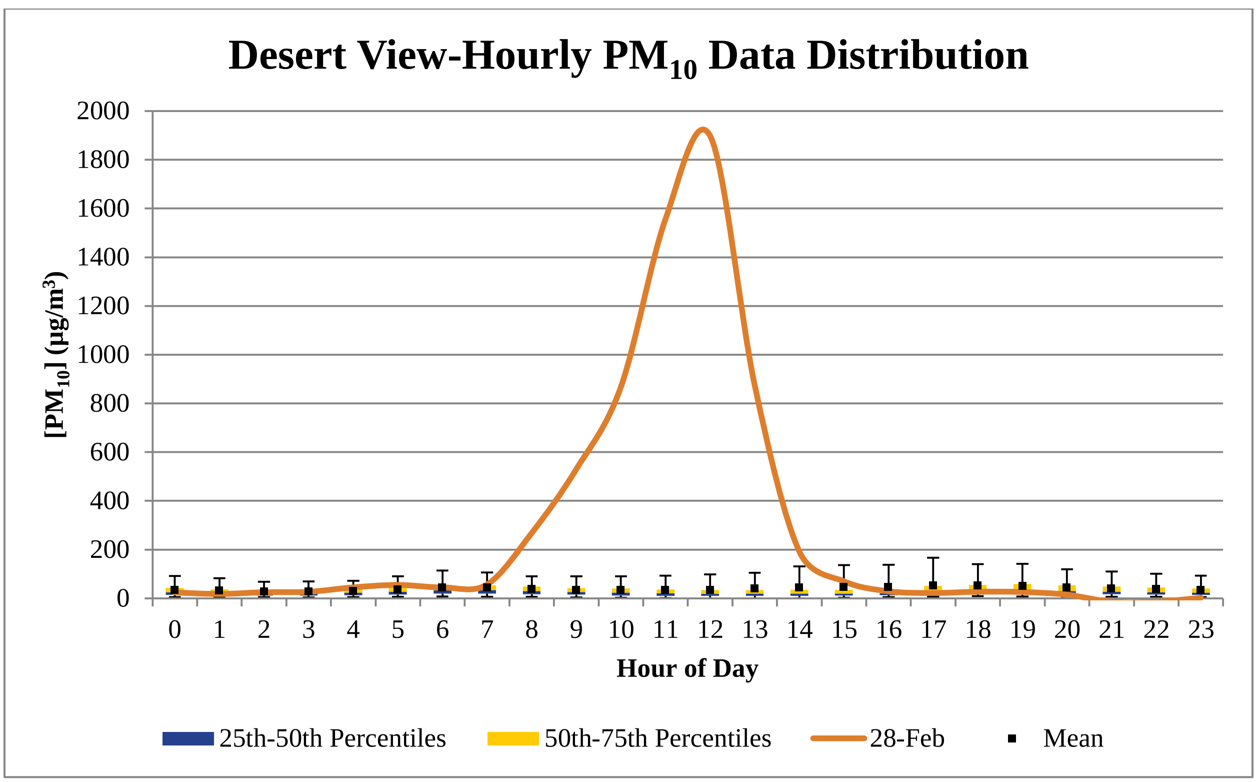


Figure 5-6b. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for February 28, 2012.

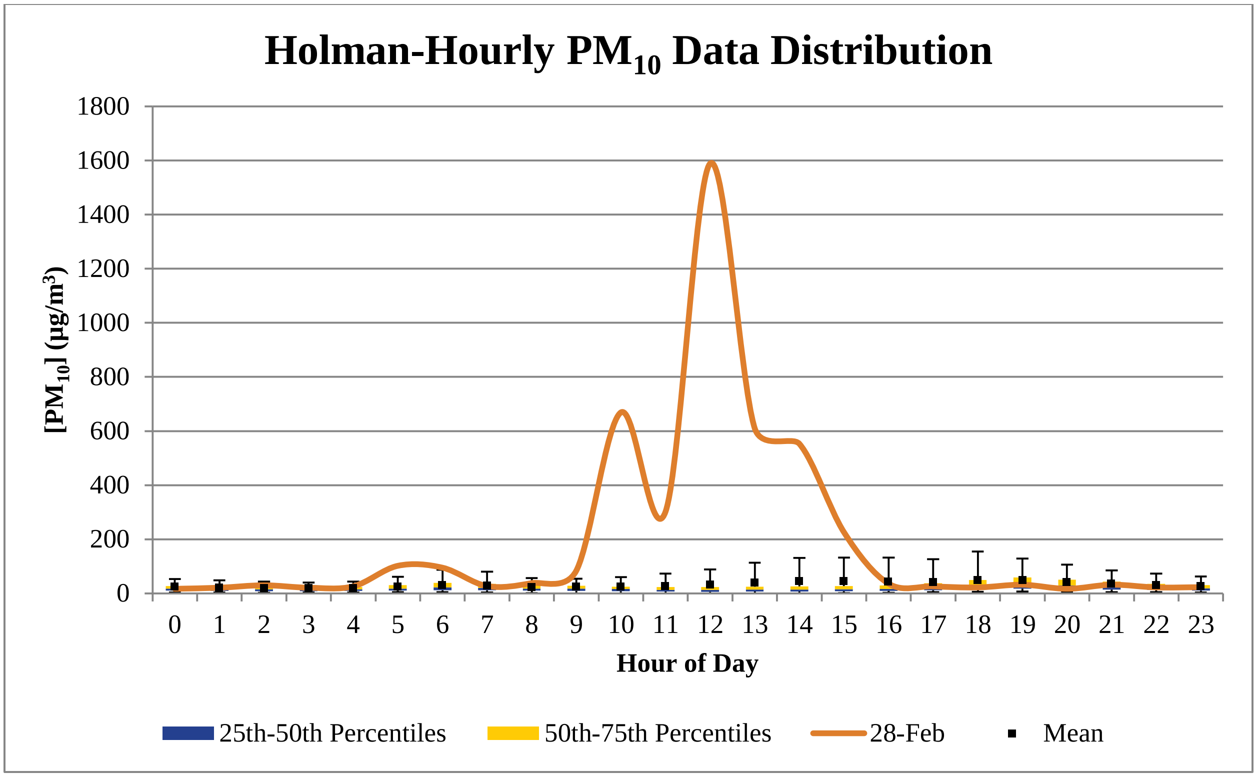


Figure 5-6c. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for February 28, 2012.

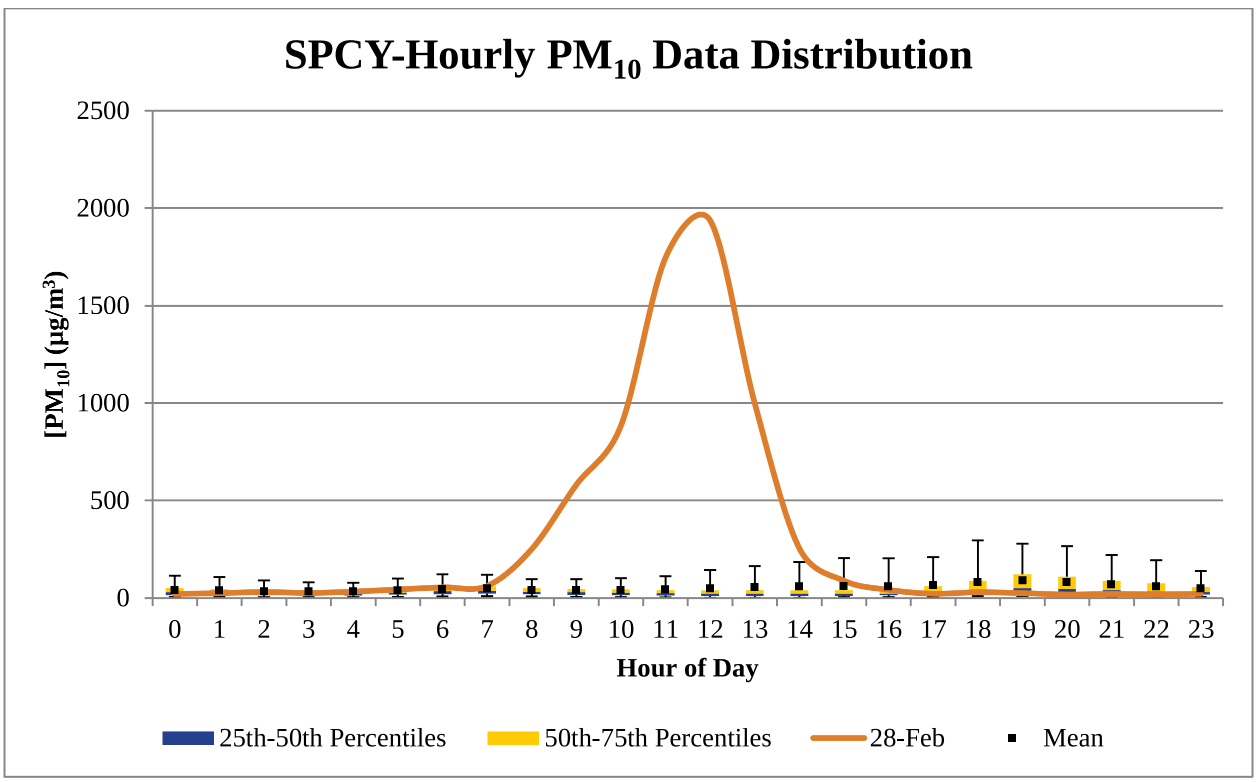


Figure 5-6d. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for February 28, 2012.

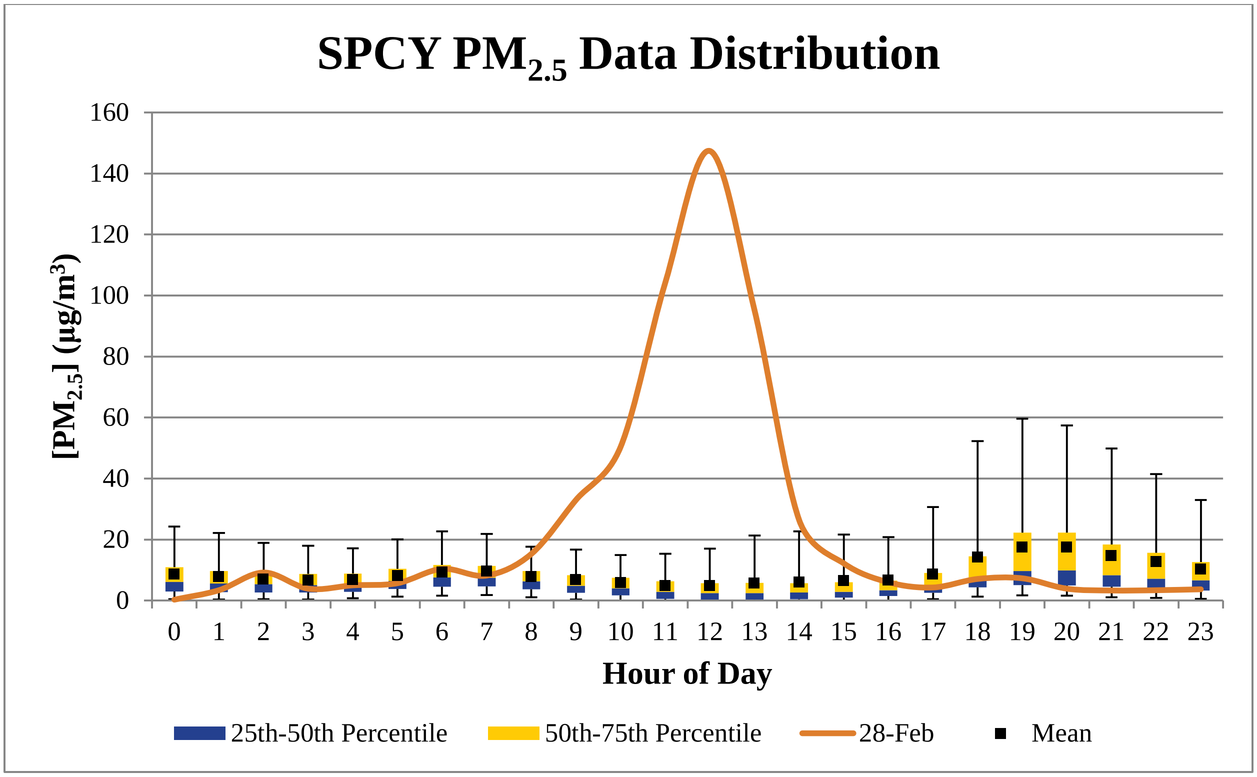


Figure 5-6e. $PM_{2.5}$ hourly data distribution from 2007-2011 overlaid by hourly values for February 28, 2012.

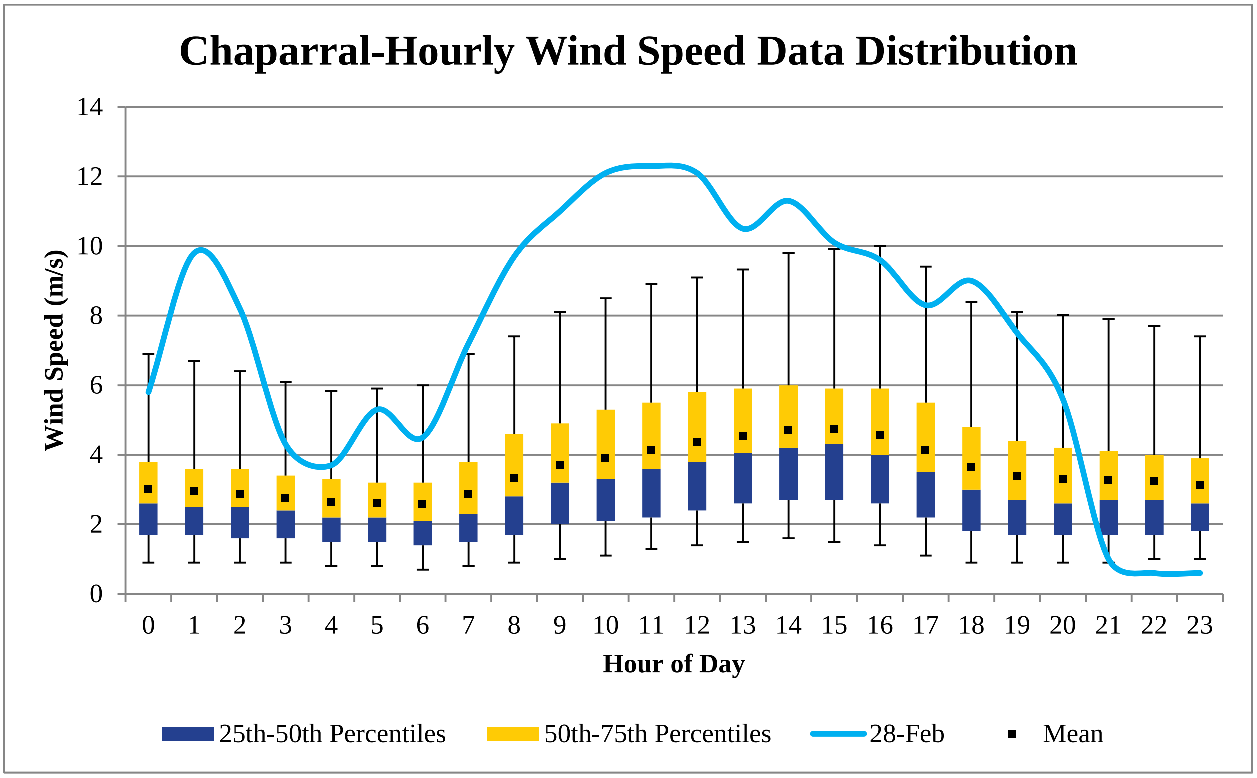


Figure 5-7a. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for February 28, 2012.

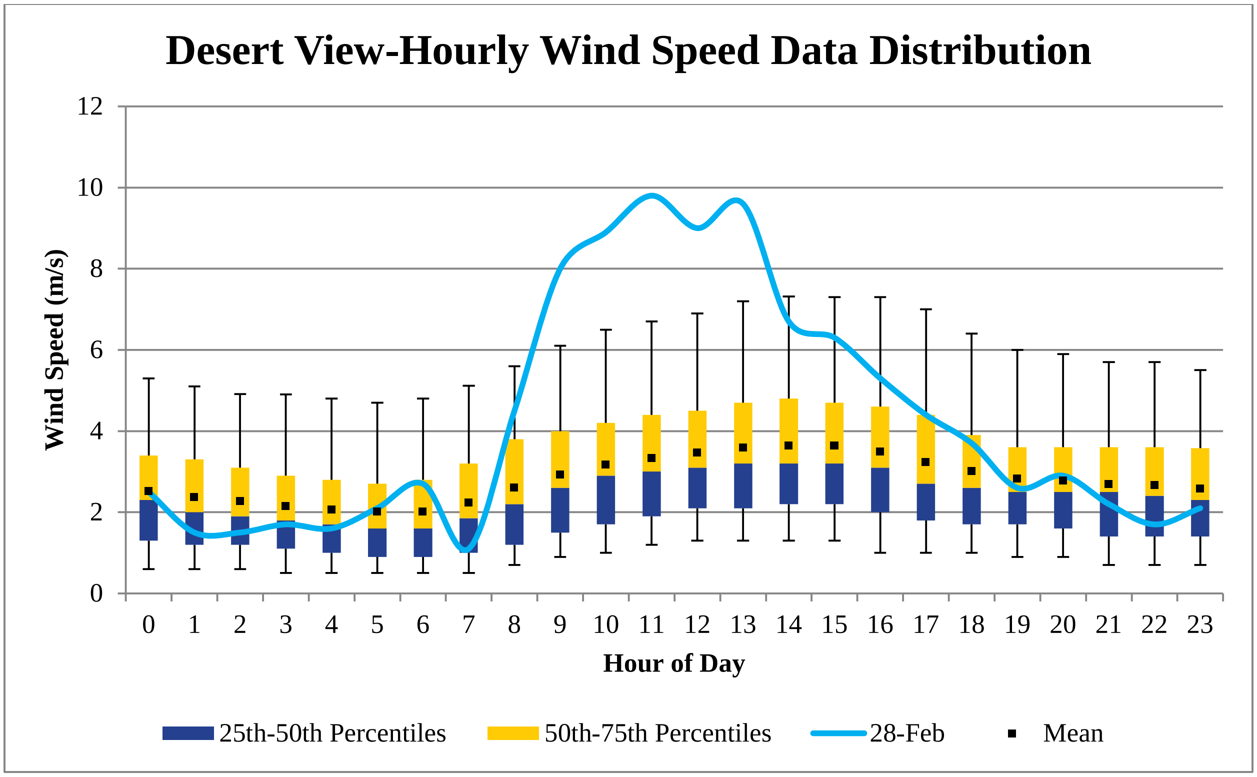


Figure 5-7b. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for February 28, 2012.

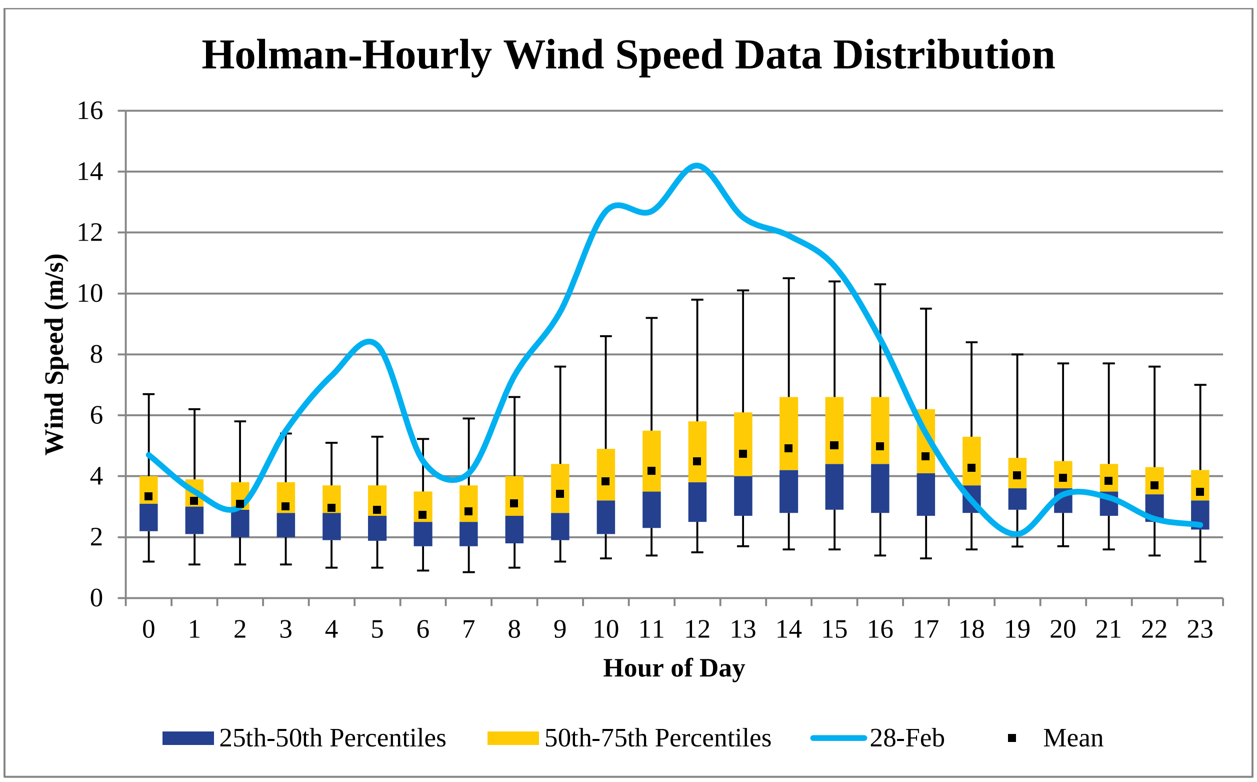


Figure 5-7c. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for February 28, 2012.

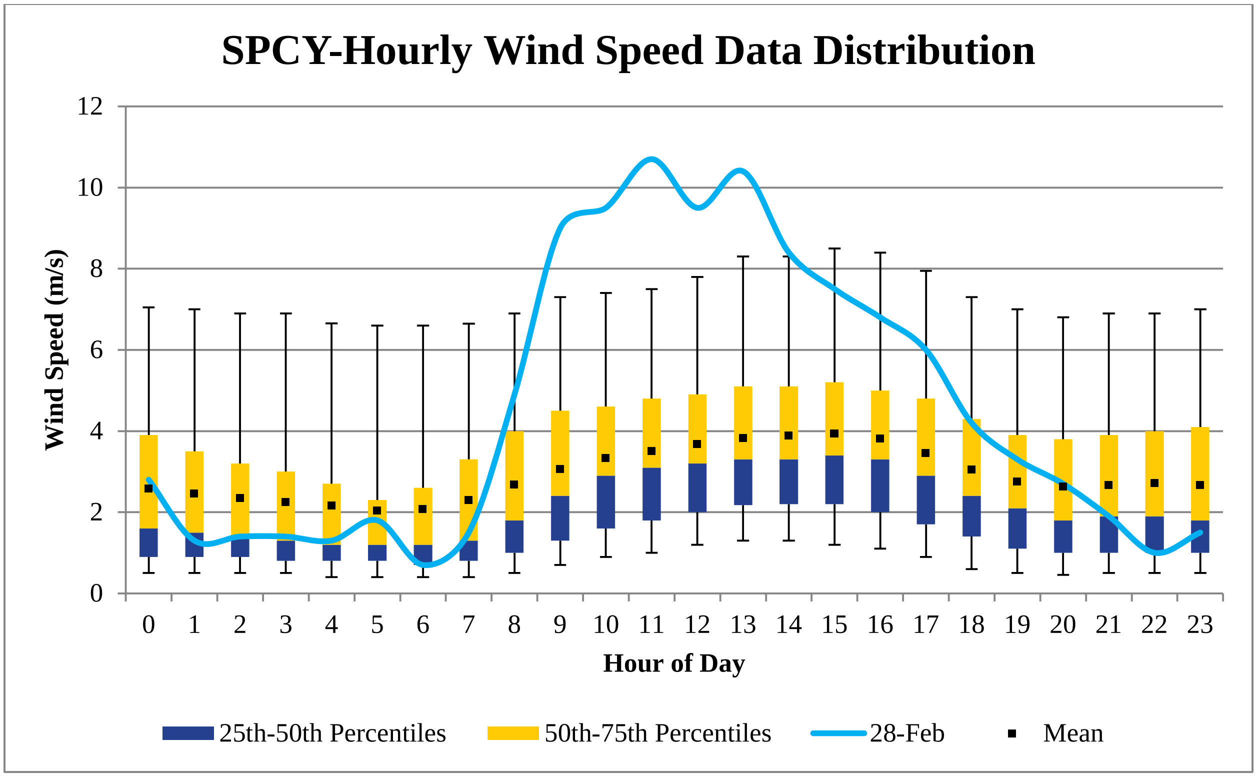


Figure 5-7d. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for February 28, 2012.

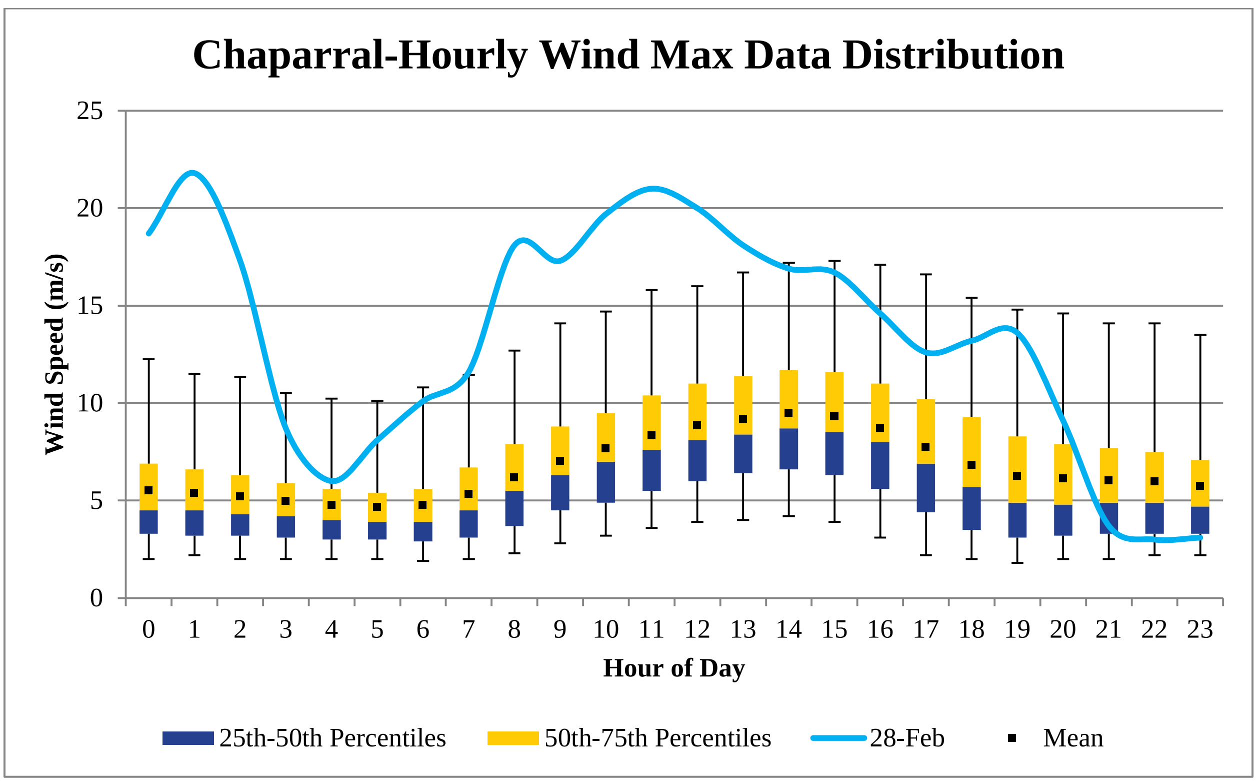


Figure 5-8a. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for February 28, 2012.

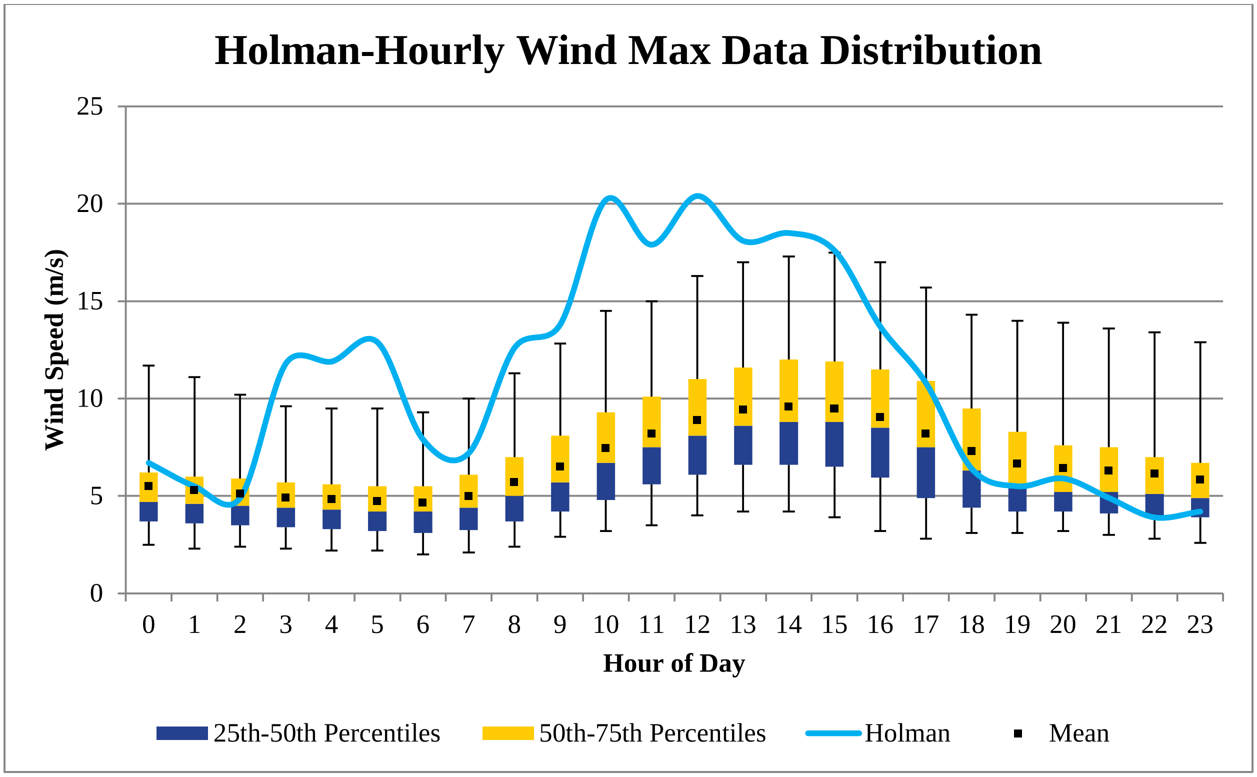


Figure 5-8b. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for February 28, 2012.

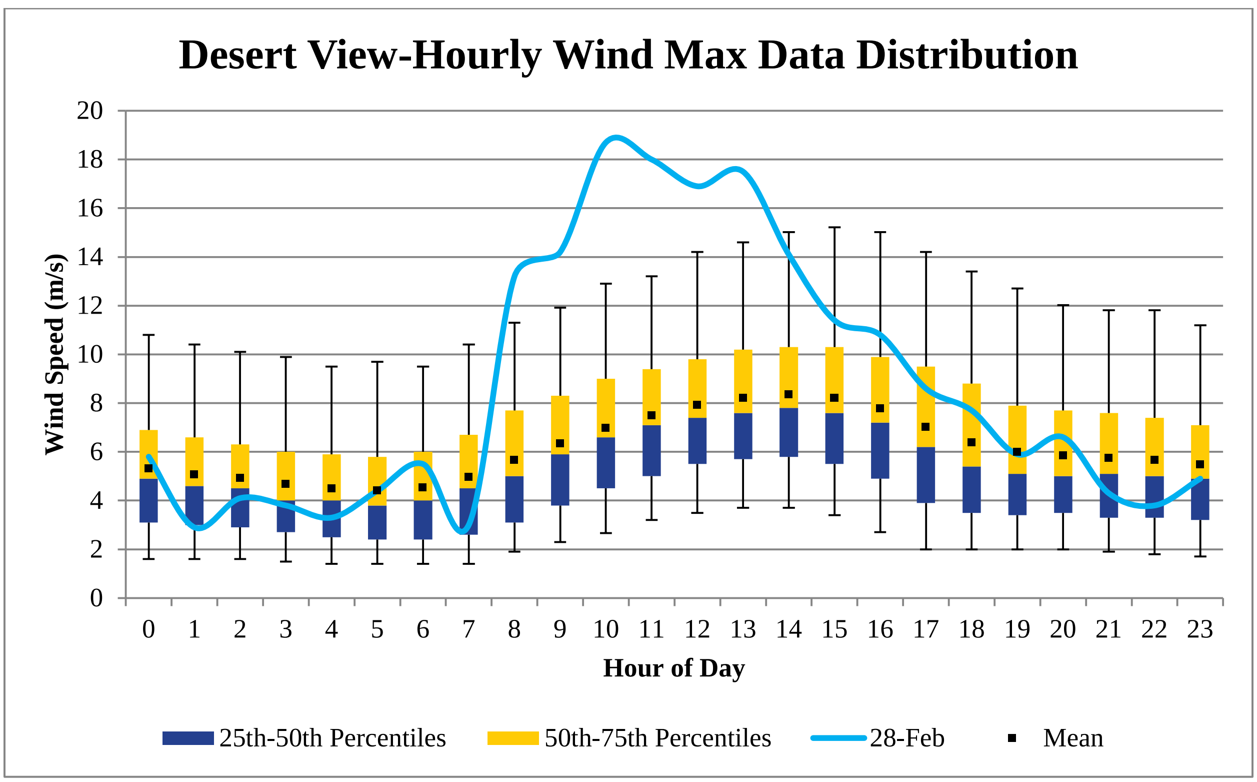


Figure 5-8c. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for February 28, 2012.

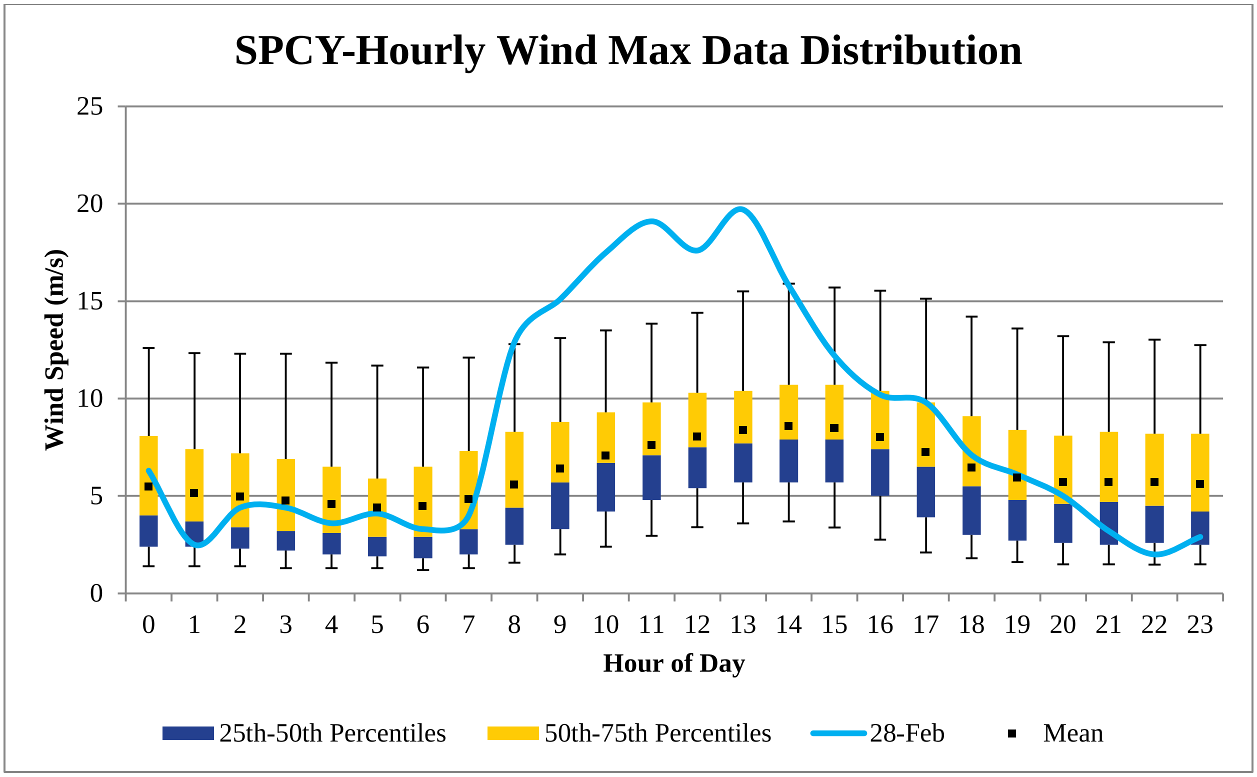


Figure 5-8d. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for February 28, 2012.

5.4 Clear Causal Relationship

A Pacific storm system and cold front passed through New Mexico on February 28, 2013, creating strong winds throughout the border area. As the Pacific cold front moved through New Mexico so did the upper level system deepening the surface low and tightening the pressure gradient (Figure 5-9a-b). The wind direction in the upper atmosphere aligned well with the surface wind direction and diurnal heating of the surface allowed winds aloft to mix downward, increasing the surface wind velocities and providing the turbulence required for widespread vertical mixing and horizontal transport (Figure 5-10).

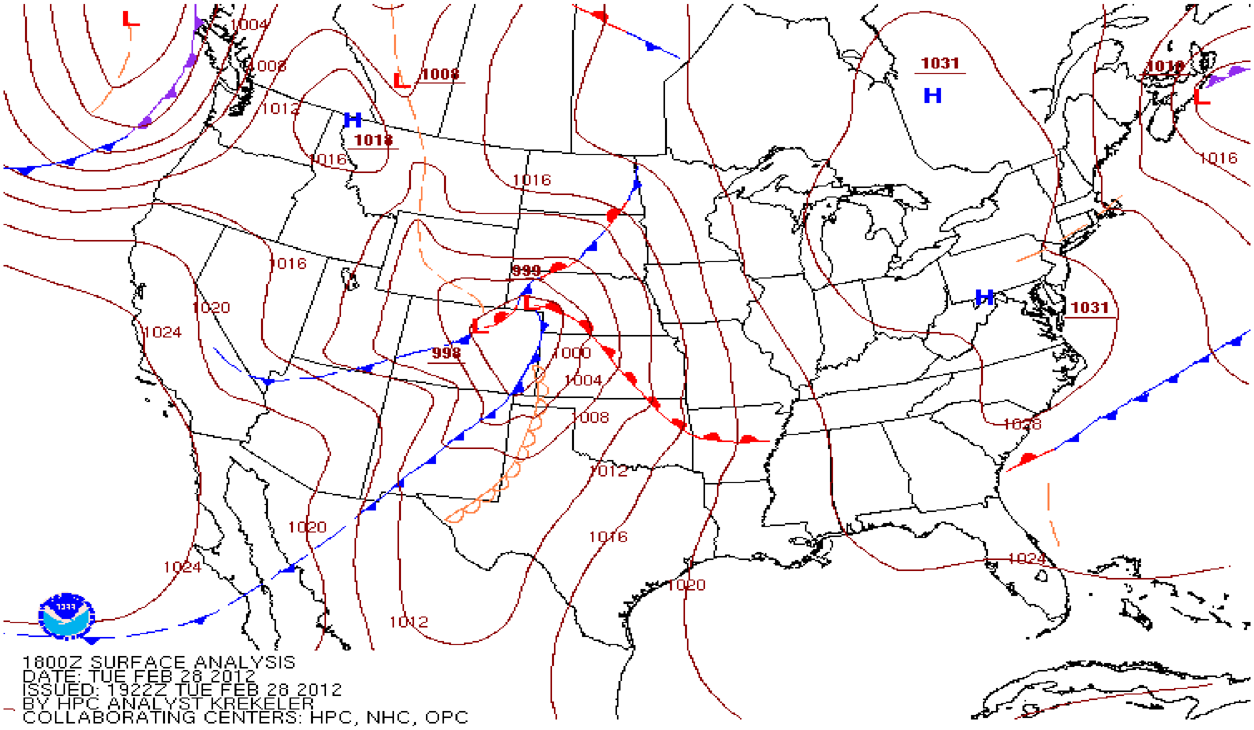


Figure 5-9a. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for February 28, 2012 at the 1100 hour.

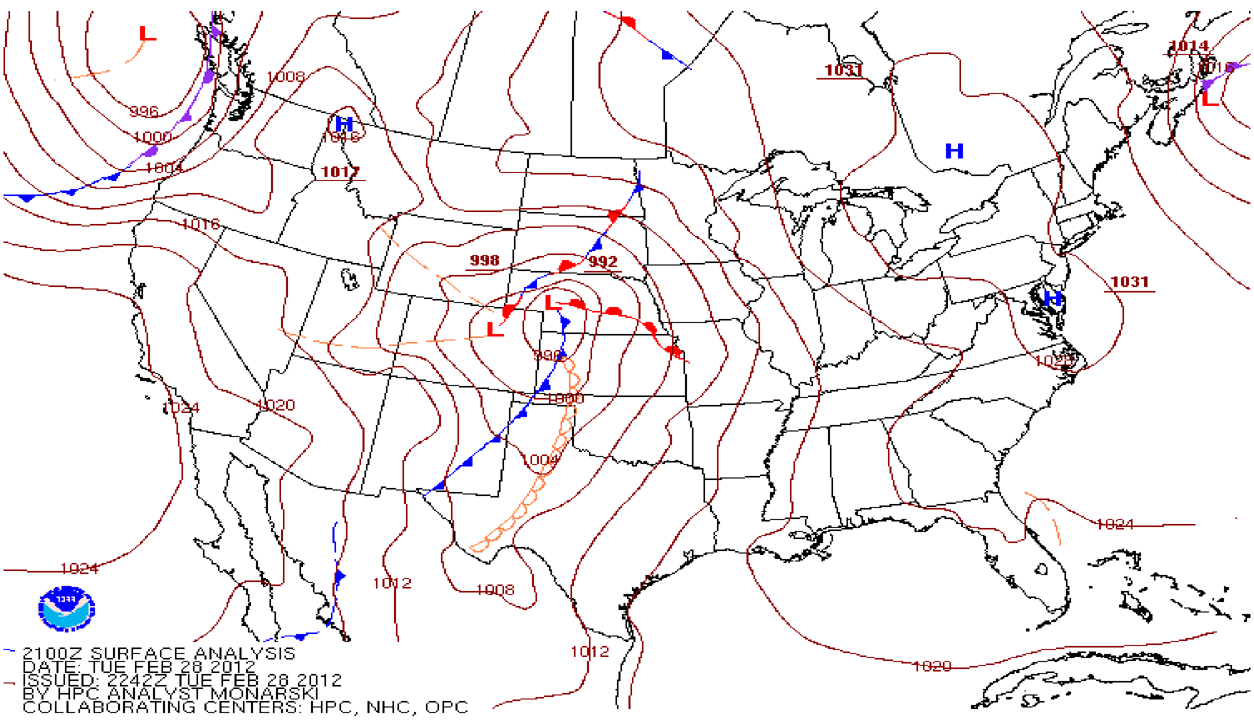


Figure 5-9b. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for February 28, 2012 at the 1400 hour.

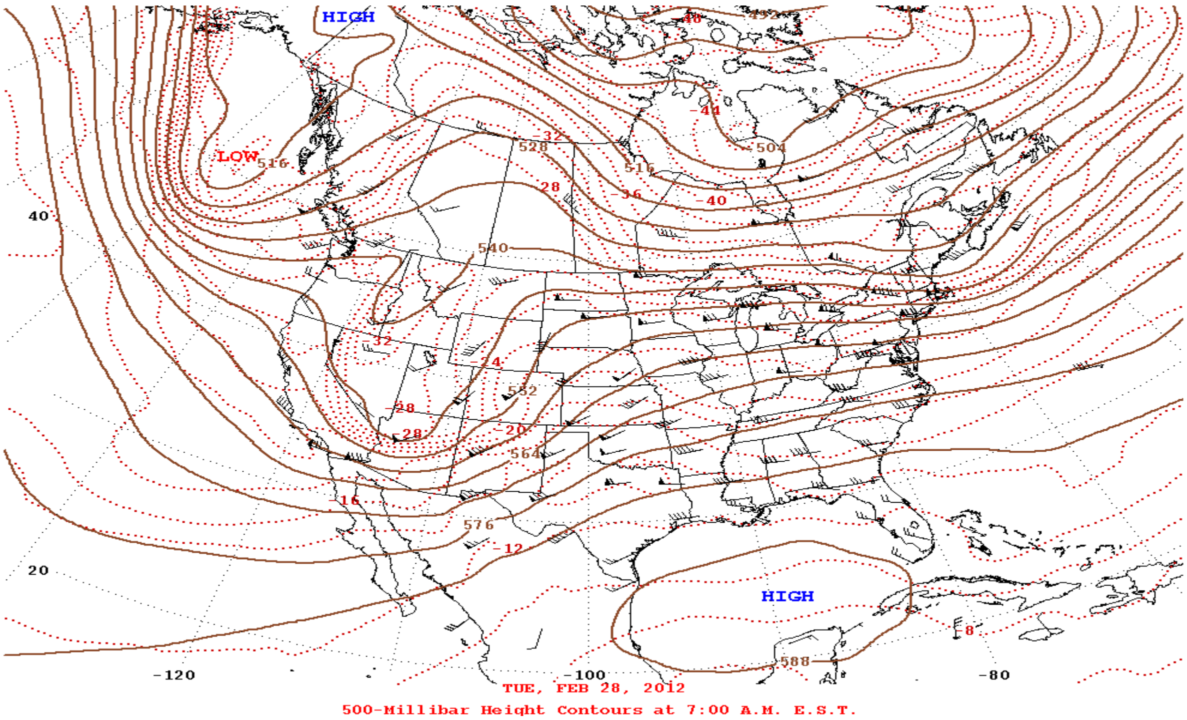


Figure 5-10. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on February 28, 2012.

The weather pattern described above generated strong west/southwest winds beginning at the 0000 hour and lasting through the 2100 hour. Beginning at the 0900 hour, wind speeds exceeded 11.2 m/s at Deming and Santa Teresa as shown in Figure 5-3. Peak wind speeds ranged from 9.8 m/s at Desert View to 14.8 m/s at West Mesa (Figure 5-3). Peak wind gusts ranged from 18 m/s at La Union to 21.8 m/s at Chaparral (Figure 5-4). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 5-11a-e. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (0000-1500 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 5-12a-b). Maximum hourly PM_{10} concentrations ranged from 138 µg/m^3 at Deming to 1937 µg/m^3 at SPCY. Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 5-13).

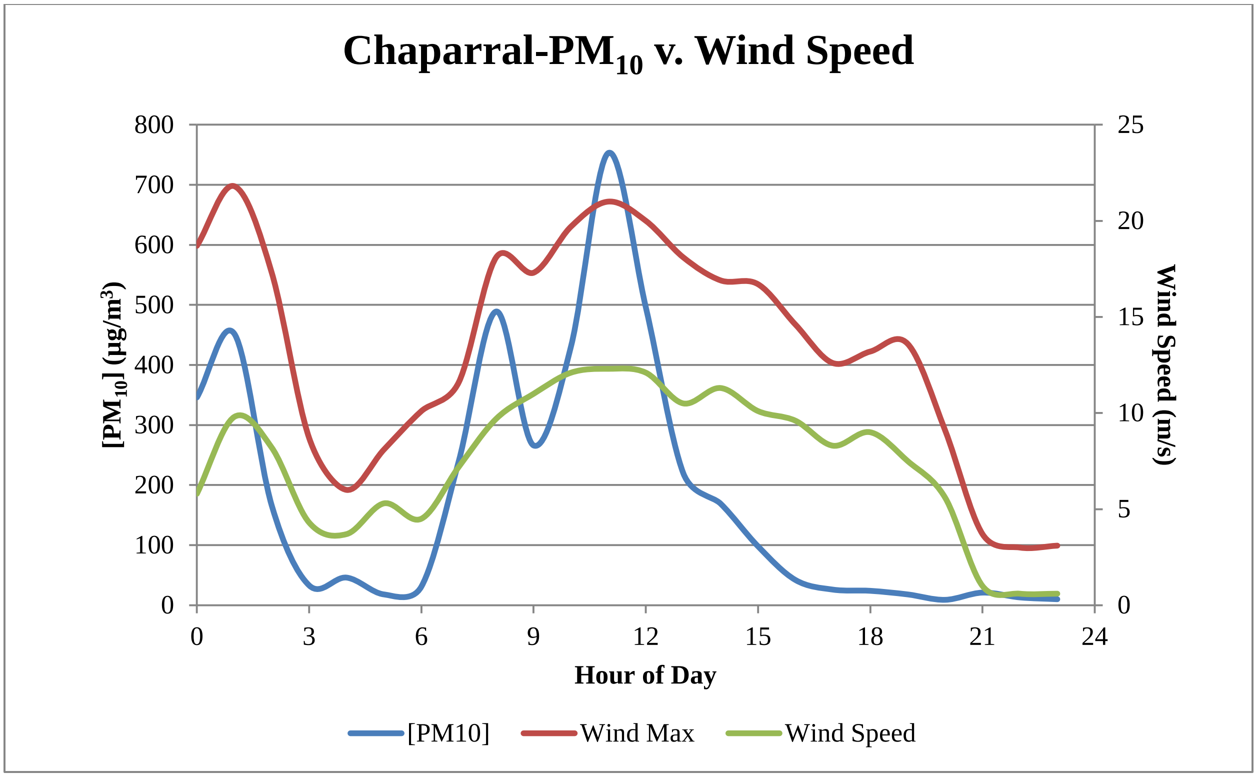


Figure 5-11a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

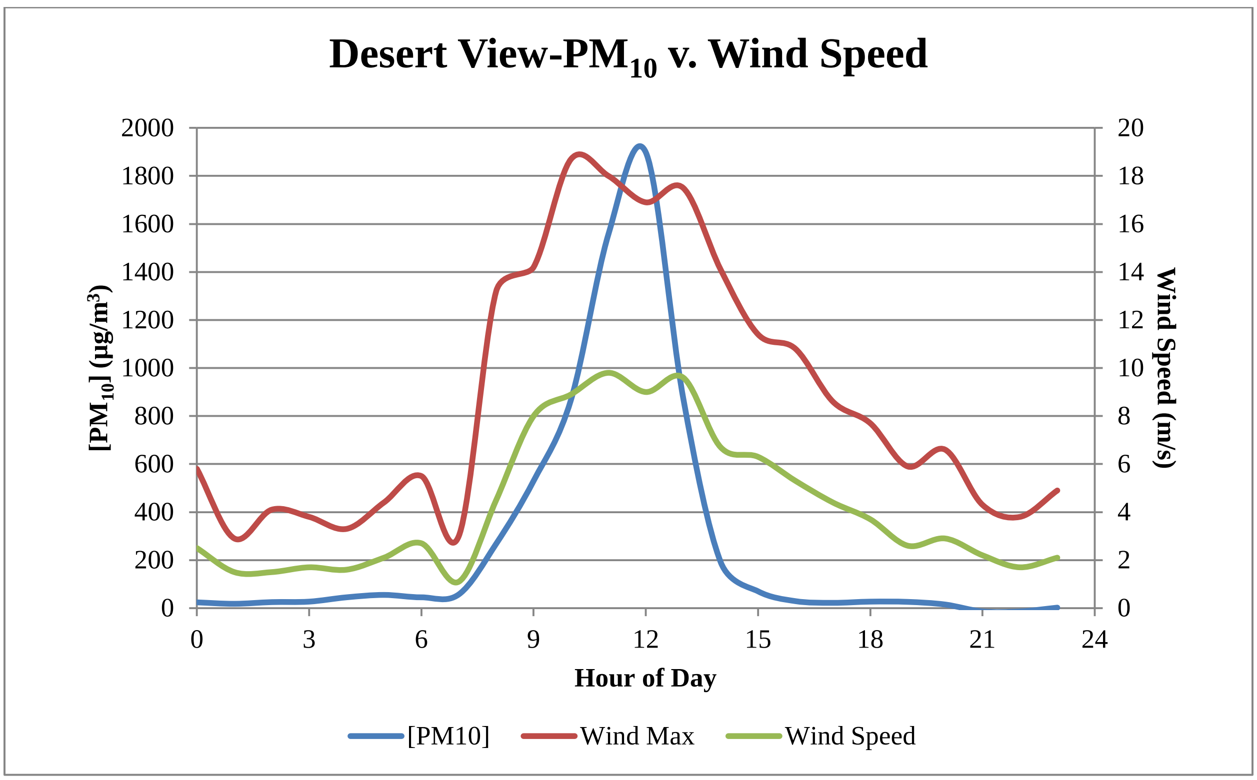


Figure 5-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

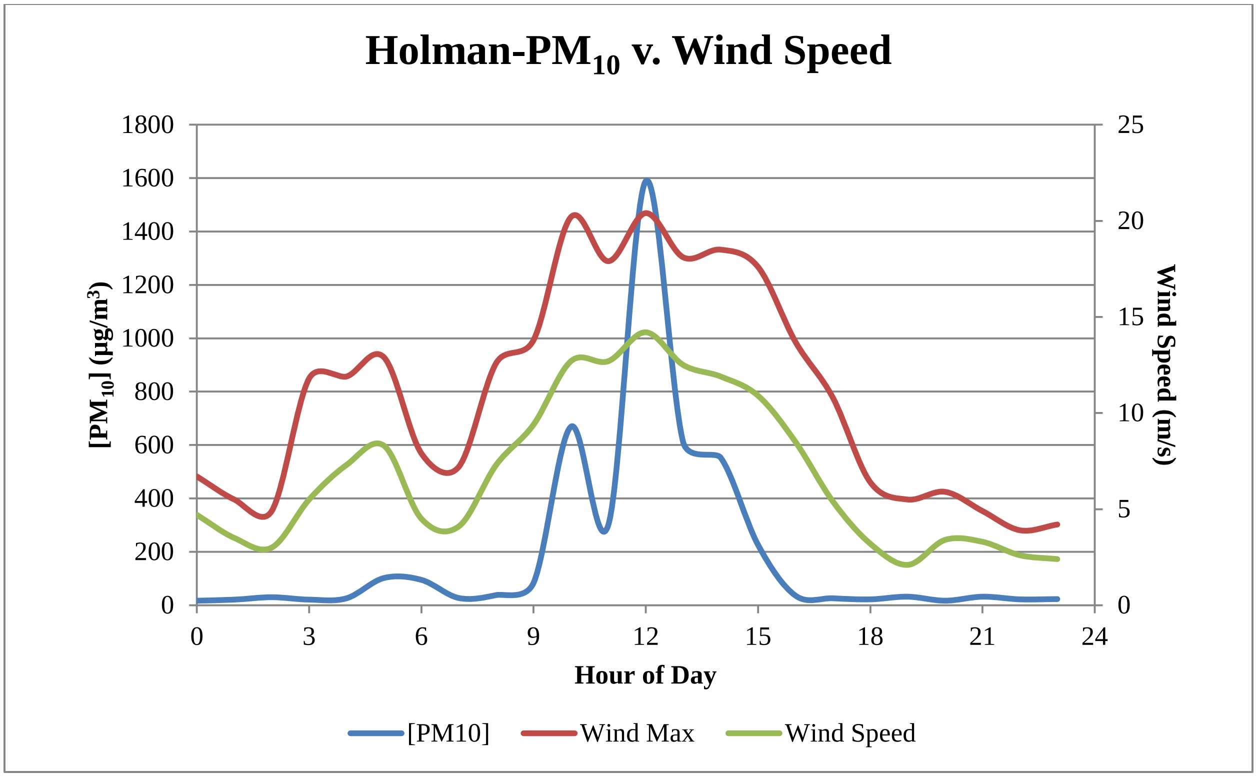


Figure 5-11c. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

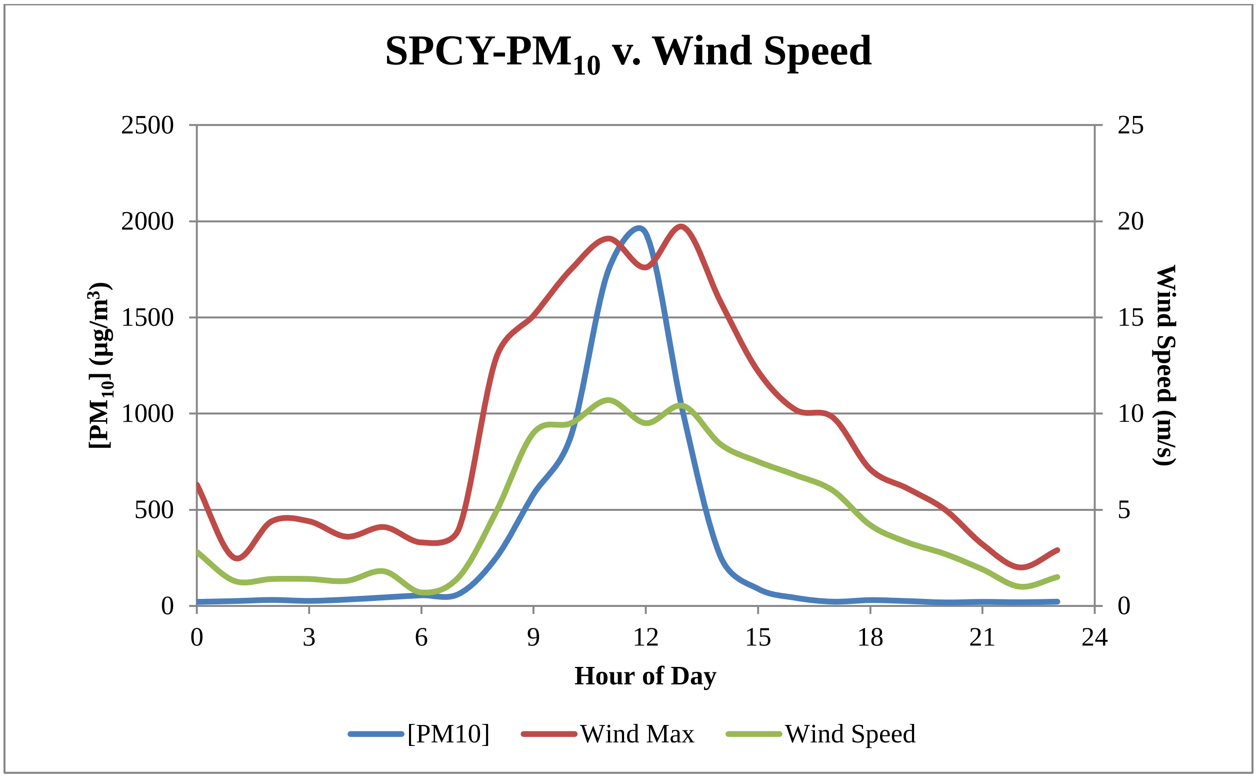


Figure 5-11d. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

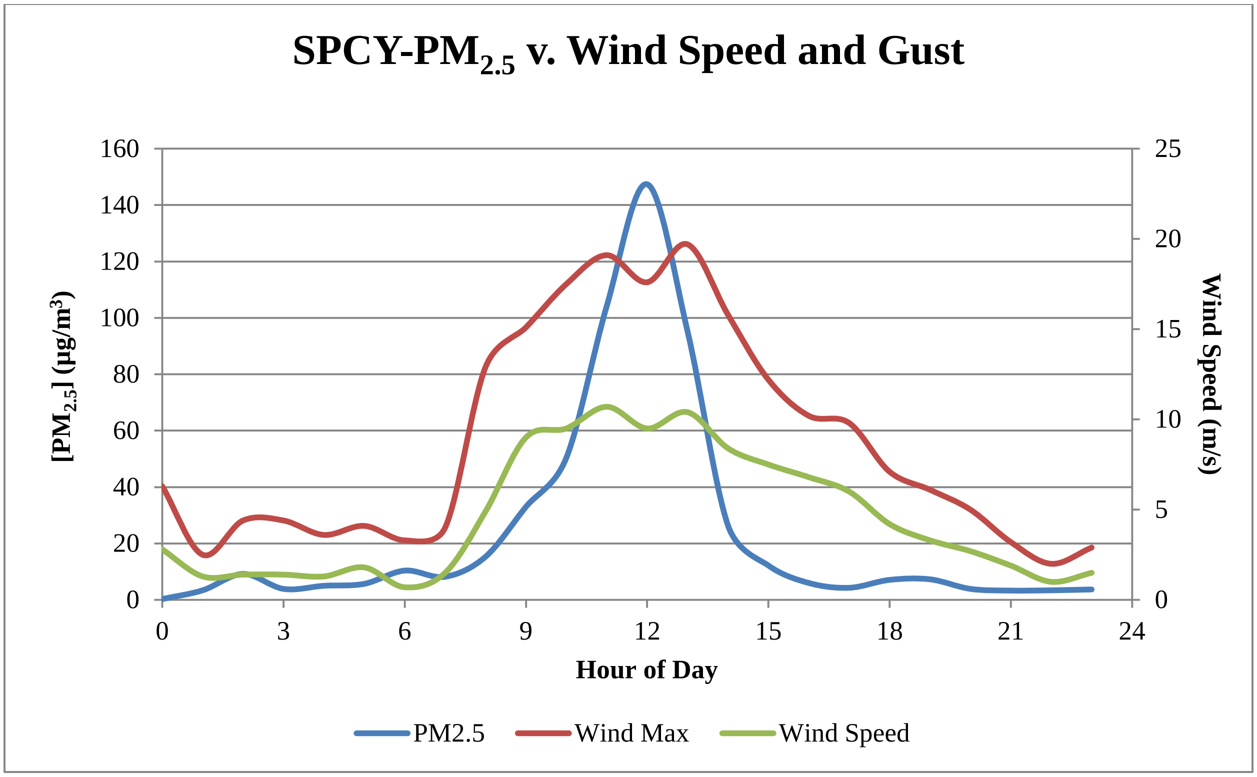


Figure 5-11e. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

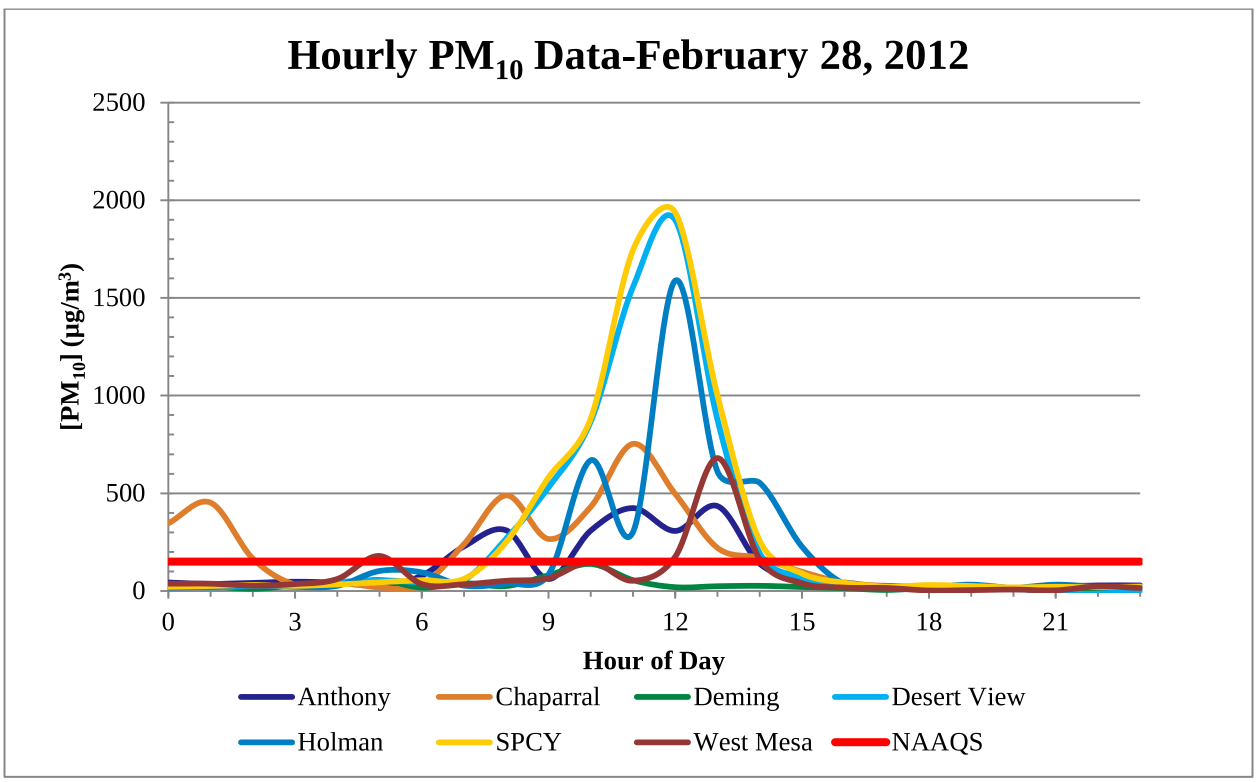


Figure 5-12a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

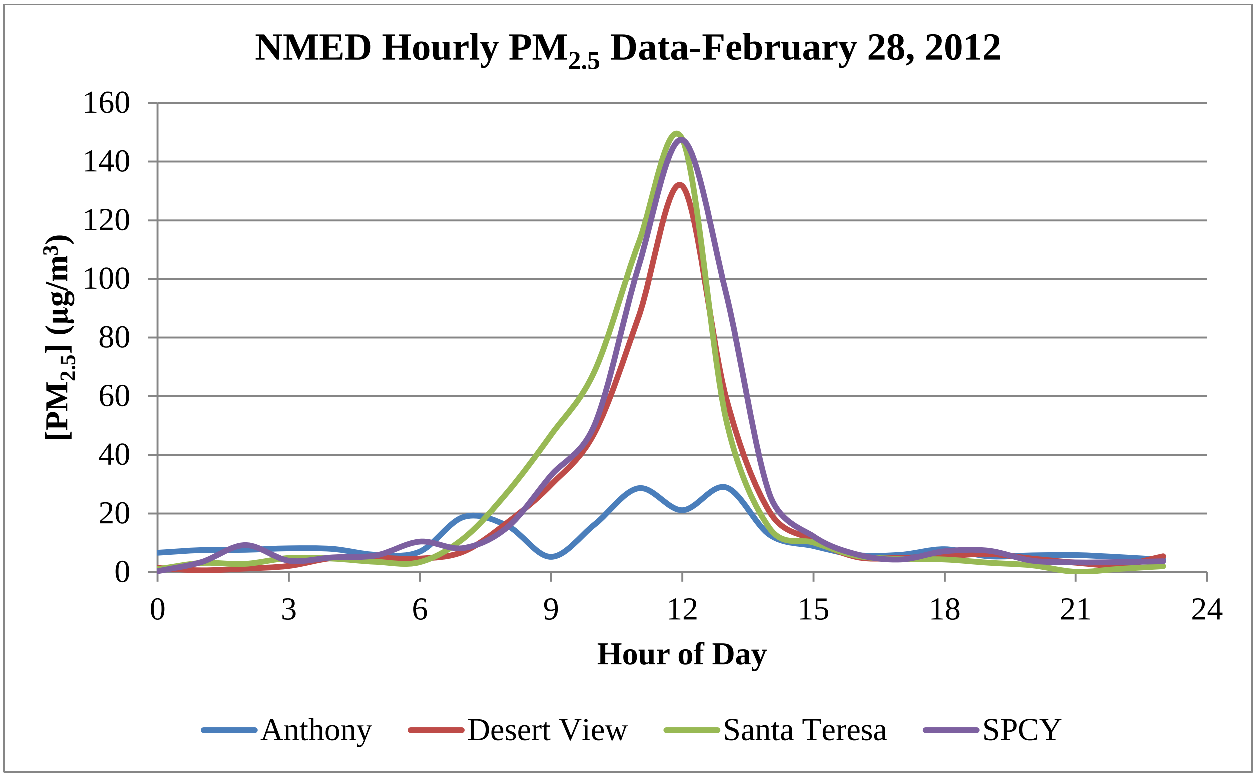


Figure 5-12b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors. Non-FEM hourly $PM_{2.5}$ data.

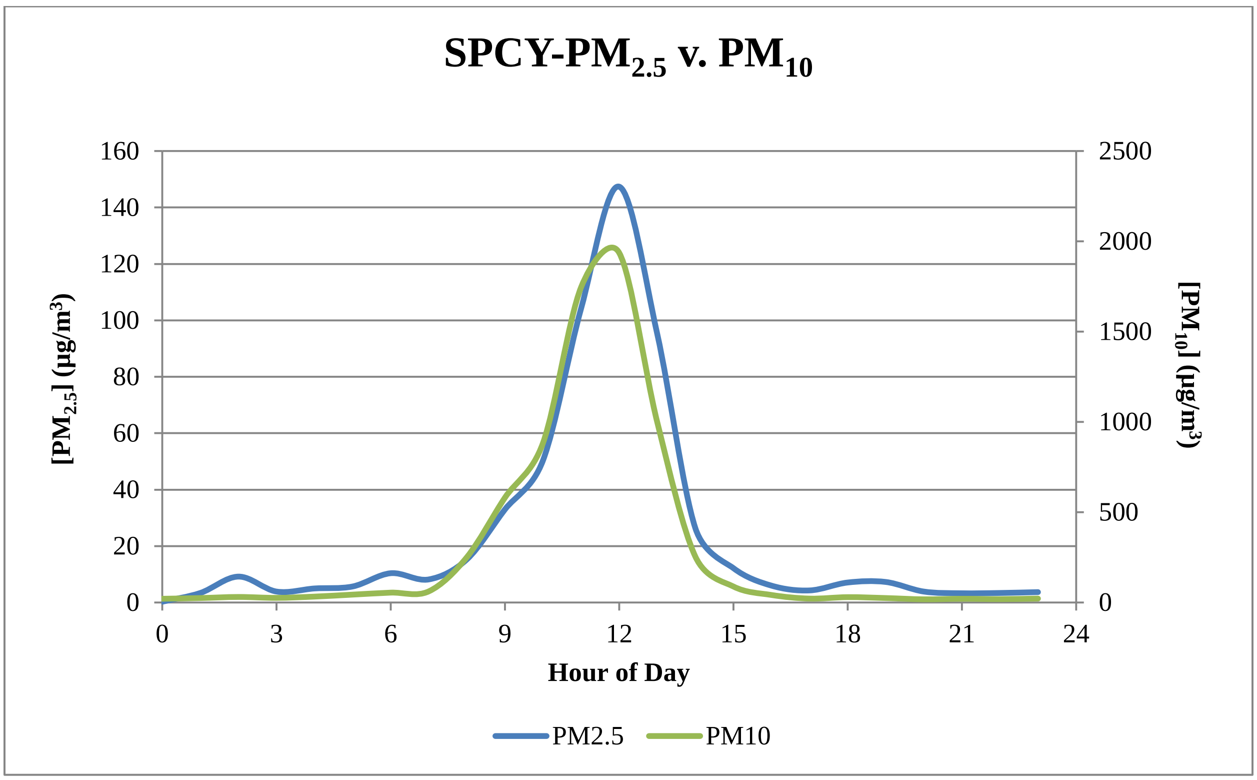


Figure 5-13. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on February 28, 2012.

The National Weather Service issued a wind advisory for February 28, 2012 (see Figure 5-14) and recorded compromised visibility (see Figures 5-15 and 5-16). In addition, satellite imagery (Figures 5-17) recorded significant plumes and windblown dust in the region extending into the Texas and Oklahoma panhandles.

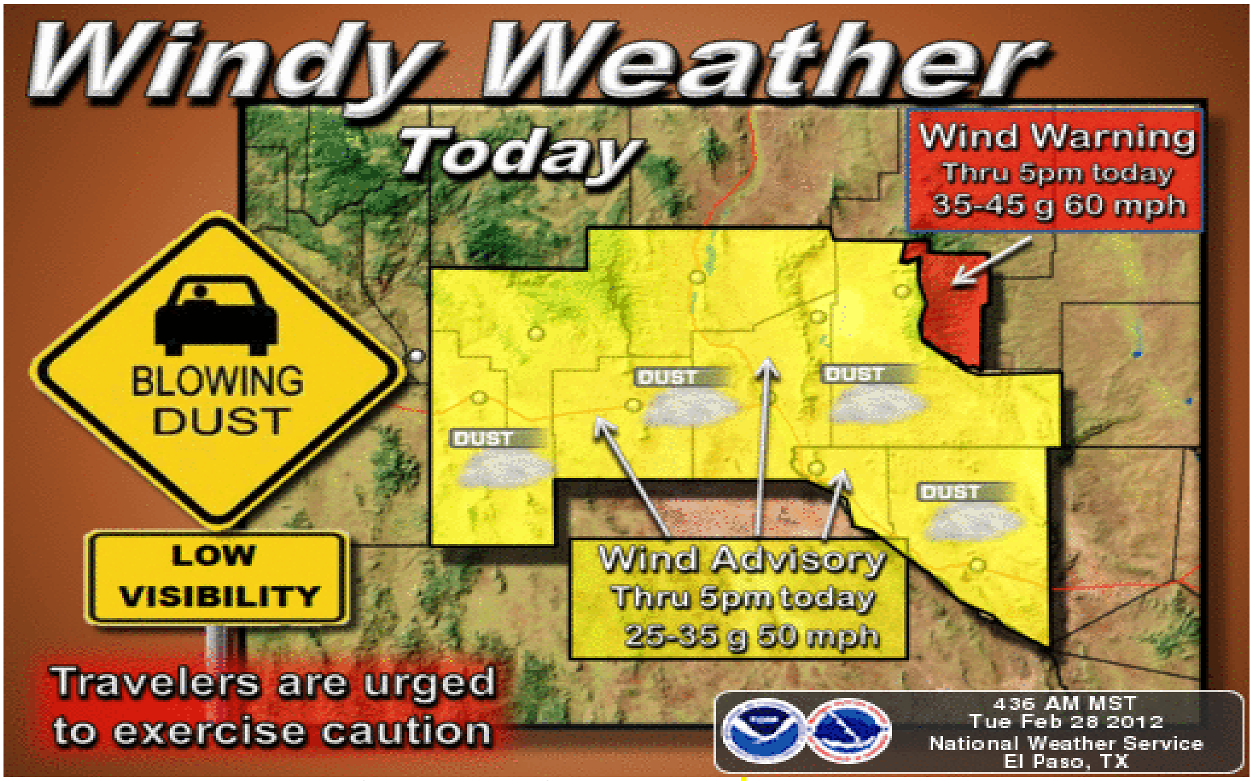


Figure 5-14. National Weather Service forecast illustration for February 28, 2012.

Location	Date	Time (mst)	Wind (mph)	Visibility (mi.)	Weather
Las Cruces	2/28/2012	12:55	W 40 G 48	3	Fair with Haze and Windy
Holloman AFB	2/28/2012	13:55	W 23 G 35	1	Blowing Dust and Breezy
El Paso	2/28/2012	12:51	W 31 G 48	1	Blowing Dust and Windy
Ruidoso	2/28/2012	12:15	SW 35 G 48	0.75	Overcast with Haze and Windy
Roswell	2/28/2012	15:51	W 33 G 45	3	Overcast with Haze and Windy
Marfa, TX	2/28/2012	16:51	W 49 G 59	2	Overcast with Haze and Windy
Alamogordo	2/28/2012	14:55	W 24 G 28	2	Mostly Cloudy with Haze and Breezy
Clovis	2/28/2012	14:55	W 41 G 56	2	Blowing Dust and Windy

Figure 5-15. Wind, Visibility and Weather at area airports and reported by the National Weather Service for February 28, 2012.

Figure 5-16. Decreased visibility looking southwest from Ranger Peak in El Paso toward Cd. Juárez at 2:46 pm (Photo courtesy of TCEQ).

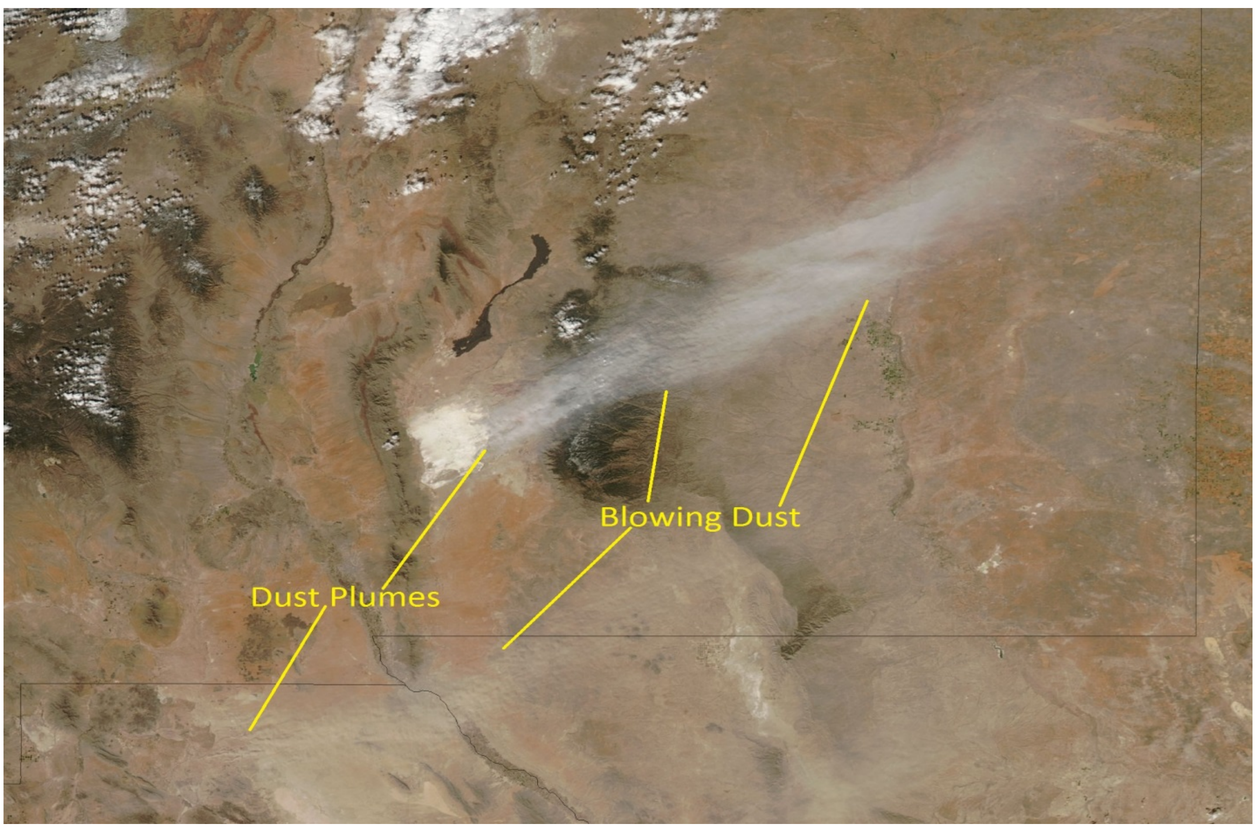


Figure 5-17. Satellite imagery with dust plumes and blowing dust visible on February 28, 2012 (Image courtesy of NASA)

5.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on February 28, 2012.

5.6 Natural Event

The Clear Causal Relationship and not Reasonably Controllable or Preventable analyses show that this was a natural event caused by high wind and blowing dust.

5.7 No Exceedance but for the Event

The SPCY $PM_{2.5}$ monitor detected elevated levels due to blowing dust from 0900 to 1400 hours on February 28, 2012. Although these elevated concentrations do not exceed the 24-hour NAAQS for $PM_{2.5}$, they contribute to an annual exceedance level of 25.7 µg/m^3 for this date. The strong correlation between hourly $PM_{2.5}$, PM_{10} and wind speeds peaks also point to windblown dust affecting the monitor. Previous studies have shown that $PM_{2.5}/PM_{10}$ ratios vary from 0.11 to 0.45 in the Paso del Norte (Arimoto et. al, 2001; Li et al, 2001). The ratios above 0.30 were observed in downtown El Paso and Ciudad Juárez and indicate a heavy impact from mobile sources. The lower ratios were observed in areas with less vehicular traffic and crustal material dominated the PM_{10} fraction. The $PM_{2.5}/PM_{10}$ ratio for the SPCY site was 0.09 for this date ($PM_{2.5}$ Partisol/PM_{10} TEOM). NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

The Chaparral monitor detected blowing dust around the 0700 hour with hourly concentrations heavily impacted until the 1400 hour (As used here heavily impacted means above the 95th percentile). The eight hourly PM_{10} values from 0700-1400 hours alone, nearly exceed the 24-hour average standard at Chaparral [(4028 µg/m^3)/24 = 147 µg/m^3]. By replacing these eight hourly values with the 95th percentile of hourly data at the Chaparral site, the resulting 24-hour average (60 µg/m^3) does not exceed the NAAQS (Table 5-1). The values in red represent the 95th percentile of all hourly data collected at Chaparral, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	346	61
1	452	58
2	166	54
3	33	33
4	46	46
5	18	18
6	31	31
7	240	**92**
8	489	**83**
9	266	**75**
10	431	**83**
11	753	**97**
12	496	**127**
13	220	**181**
14	169	**143**
15	98	98
16	42	42
17	26	26
18	24	24
19	18	18
20	9	9
21	21	21
22	13	13
23	10	10
24-Hour Average	183	**60**

Table 5-1. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Chaparral.

The Holman monitor detected blowing dust around the 1000 hour with hourly concentrations heavily impacted until the 1500 hour. The six hourly PM_{10} values from 1000-1500 hours alone, exceed the 24-hour average standard at Holman [(3949 µg/m^3)/24 = 164 µg/m^3]. By replacing these six hourly values with the 95th percentile of hourly data at the Holman site, the resulting 24-hour average (52 μg/m^3) does not exceed the NAAQS (Table 5-2). The values in red represent the 95th percentile of all hourly data collected at Holman, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	17	17
1	21	21
2	30	30
3	21	21
4	26	26
5	102	102
6	95	85
7	27	27
8	38	38
9	84	84
10	669	**60**
11	302	**73**
12	1589	**88**
13	610	**113**
14	553	**131**
15	226	**132**
16	36	36
17	26	26
18	22	22
19	32	32
20	17	17
21	32	32
22	22	22
23	23	23
24-Hour Average	192	**52**

Table 5-2. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Holman.

The Desert View monitor detected blowing dust around the 0800 hour with hourly concentrations heavily impacted until the 1400 hour. The seven hourly PM_{10} values from 0800-1400 hours alone, exceed the 24-hour average standard at Desert View [(6187 μg/m^3)/24 = 281 μg/m^3]. By replacing these seven hourly values with the 95th percentile of hourly data at the

Desert View site, the resulting 24-hour average (50 µg/m^3) does not exceed the NAAQS (Table 5-3). The values in red represent the 95th percentile of all hourly data collected at Desert View, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	24	24
1	18	18
2	25	25
3	27	27
4	45	45
5	55	55
6	45	45
7	57	57
8	268	**91**
9	530	**91**
10	868	**91**
11	1557	**93**
12	1898	**99**
13	874	**105**
14	192	**132**
15	70	70
16	29	29
17	22	22
18	27	27
19	26	26
20	15	15
21	-14	0
22	-14	0
23	2	2
24-Hour Average	276	**50**

Table 5-3. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Desert View.

The SPCY monitor detected blowing dust around the 0800 hour with hourly concentrations heavily impacted until the 1400 hour. The seven hourly PM_{10} values from 0800-1400 hours alone, exceed the 24-hour average standard at SPCY [(6653 µg/m^3)/24 = 302 µg/m^3]. By replacing these seven hourly values with the 95th percentile of hourly data at the SPCY site, the resulting 24-hour average (62 µg/m^3) does not exceed the NAAQS (Table 5-4). The values in red represent the 95th percentile of all hourly data collected at Sunland Park, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	21	21
1	25	25
2	31	31
3	26	26
4	33	33
5	44	44
6	55	55
7	62	62
8	251	**97**
9	581	**96**
10	884	**102**
11	1746	**111**
12	1937	**144**
13	999	**164**
14	255	**185**
15	89	89
16	42	42
17	22	22
18	30	30
19	25	25
20	18	18
21	21	21
22	19	19
23	22	22
24-Hour Average	301	**62**

Table 5-4. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Sunland Park.

6 HIGH WIND EXCEPTIONAL EVENT: March 2, 2012

6.1 Summary of Event

The passing of a Pacific cold front caused high winds and blowing dust in Doña Ana County resulting in exceedances of the PM_{10} 24-hour NAAQS and the $PM_{2.5}$ annual NAAQS at the Anthony, Chaparral, and SPCY monitoring sites on this date. The FEM TEOM continuous monitors at these sites recorded 24-hour average concentrations of 169, 221, and 251 µg/m^3, respectively. The $PM_{2.5}$ Partisol monitor at SPCY recorded a 24-hour average concentration of 28 µg/m^3. Although no other monitoring site recorded an exceedance on this date, elevated PM_{10} concentrations were measured at Desert View (153 µg/m^3) and West Mesa (122 µg/m^3) monitoring sites (Figure 6-1). The averages in this figure were calculated using PM_{10} FEM TEOM and $PM_{2.5}$ FRM Partisol instrument data for the four days before and after the event. Elevated concentrations were also recorded by the $PM_{2.5}$ non-FEM/FRM TEOMs (Figure 6-2).

As the event unfolded, the wind blew from the west-northwest throughout the border region. These high velocity winds passed over large areas of desert within Arizona and New Mexico. The co-occurrence of high winds and elevated levels of blowing dust, little to no point sources in the area, and the high hourly and daily PM_{10} and $PM_{2.5}$ concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

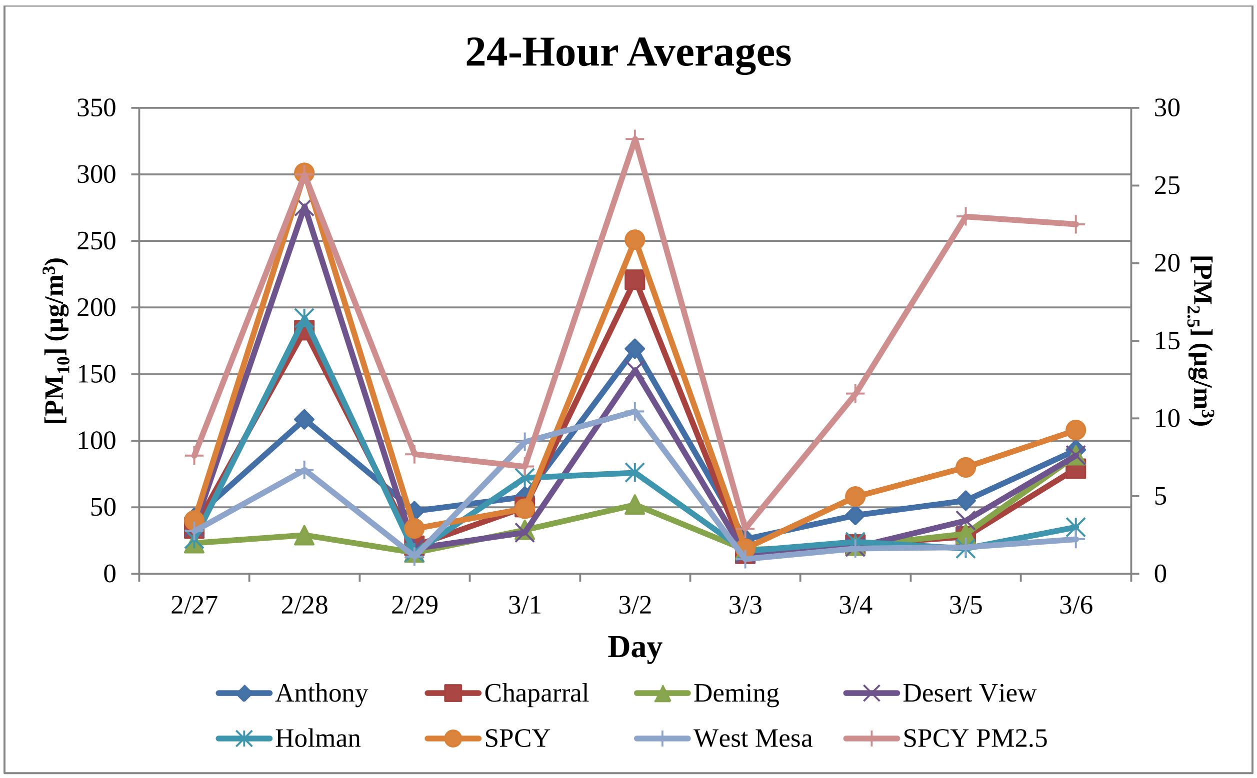


Figure 6-1. PM_{10} 24-hour averages before and after March 2, 2012.

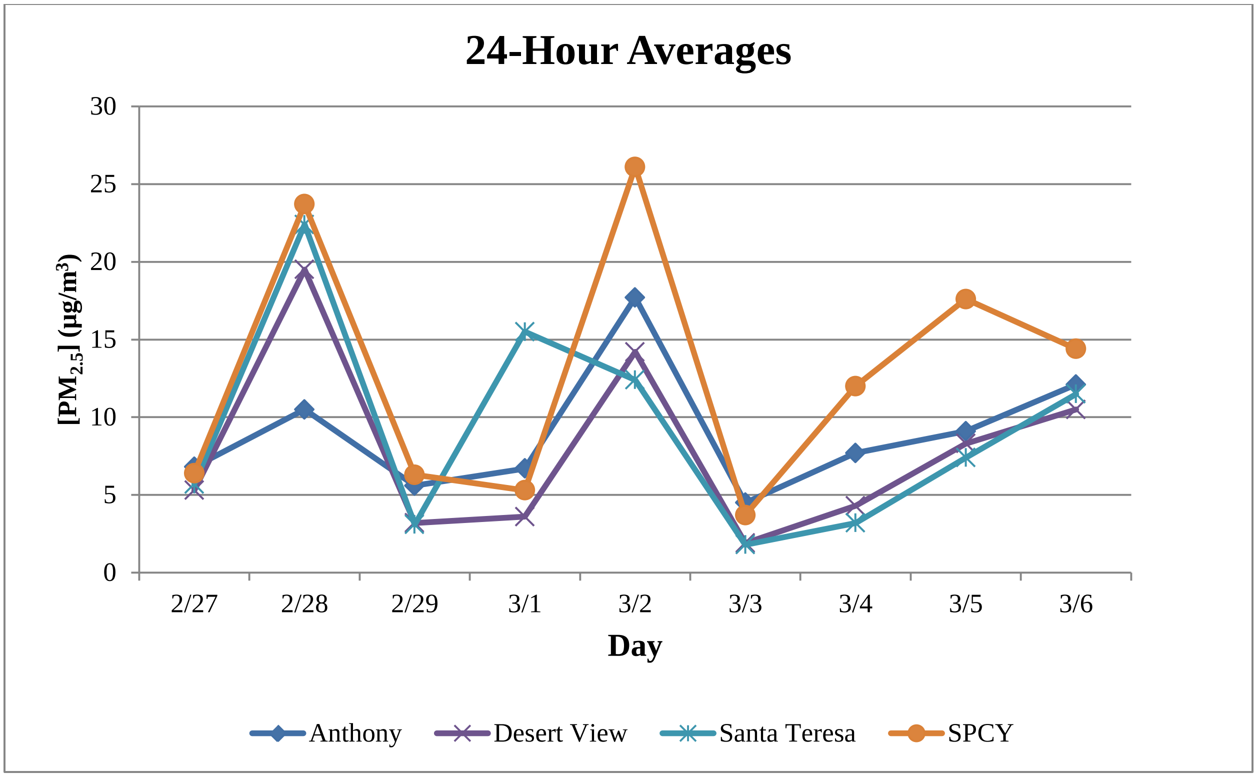


Figure 6-2. $PM_{2.5}$ 24-hour averages before and after March 2, 2012. Non-FEM TEOM Data.

6.2 Is Not Reasonably Controllable or Preventable

6.2.1 Suspected Source Areas and Categories Contributing to the Event

Sources of windblown dust contributing to this exceedance include the natural desert, residential properties, agricultural land and unpaved roads in Arizona and New Mexico. Agricultural tilling and crop planting are not likely to have contributed to this event. City of Las Cruces, City of Deming and Doña Ana and Luna County Ordinances require BACM for any dust producing activities. The largest and most likely sources of windblown dust from the natural desert (see Section 6.2.4 below).

6.2.2 Sustained and Instantaneous Wind Speeds

EPA uses a default entrainment threshold of sustained wind speeds at 11.2 m/s (25 mph) for natural and well controlled anthropogenic sources contributing to natural events caused by high wind and blowing dust (EPA, 2013). Under the Doña Ana and Luna County NEAPs, EPA and NMED agreed that wind gusts exceeding 18 m/s would overwhelm any natural and well-controlled anthropogenic sources and cause windblown dust. On March 2, 2012, sustained wind speeds exceeded EPA's default threshold at five of the eight monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at four of the eight monitoring sites (Figures 6-3 and 6-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 1000 hour and ending at the 1700 hour.

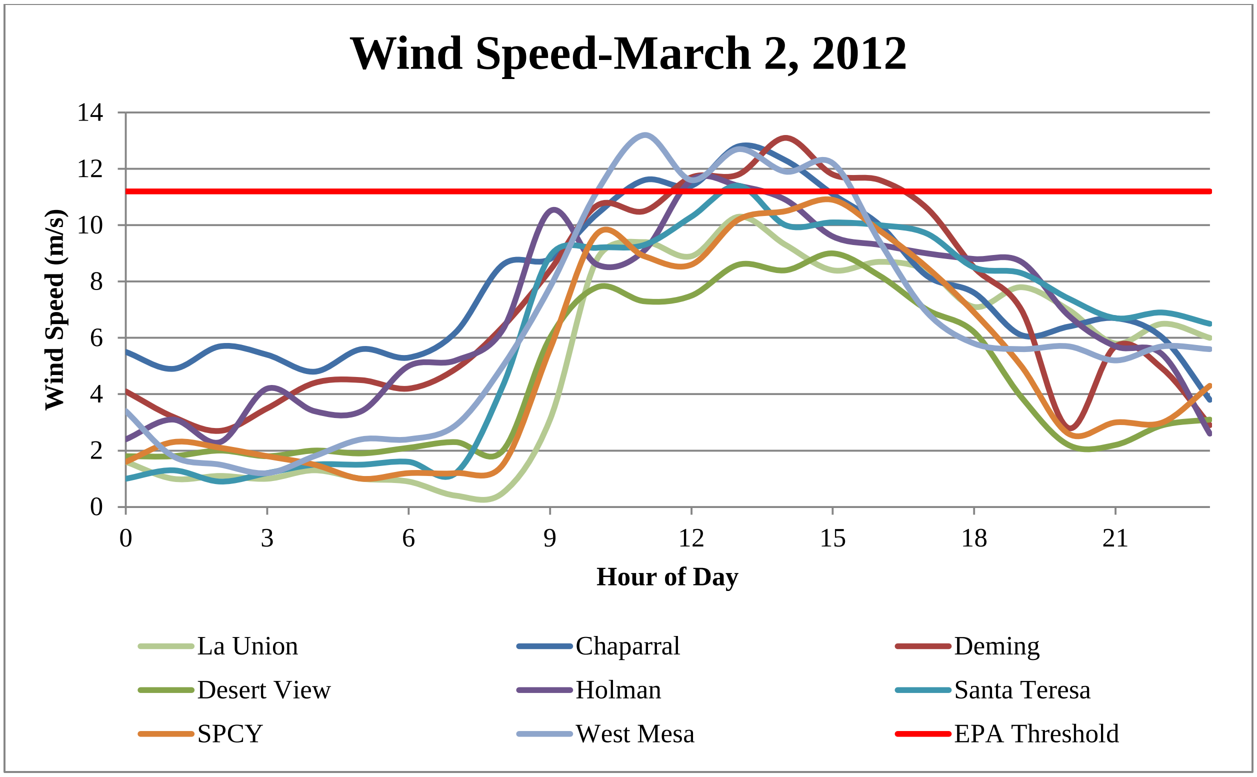


Figure 6-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

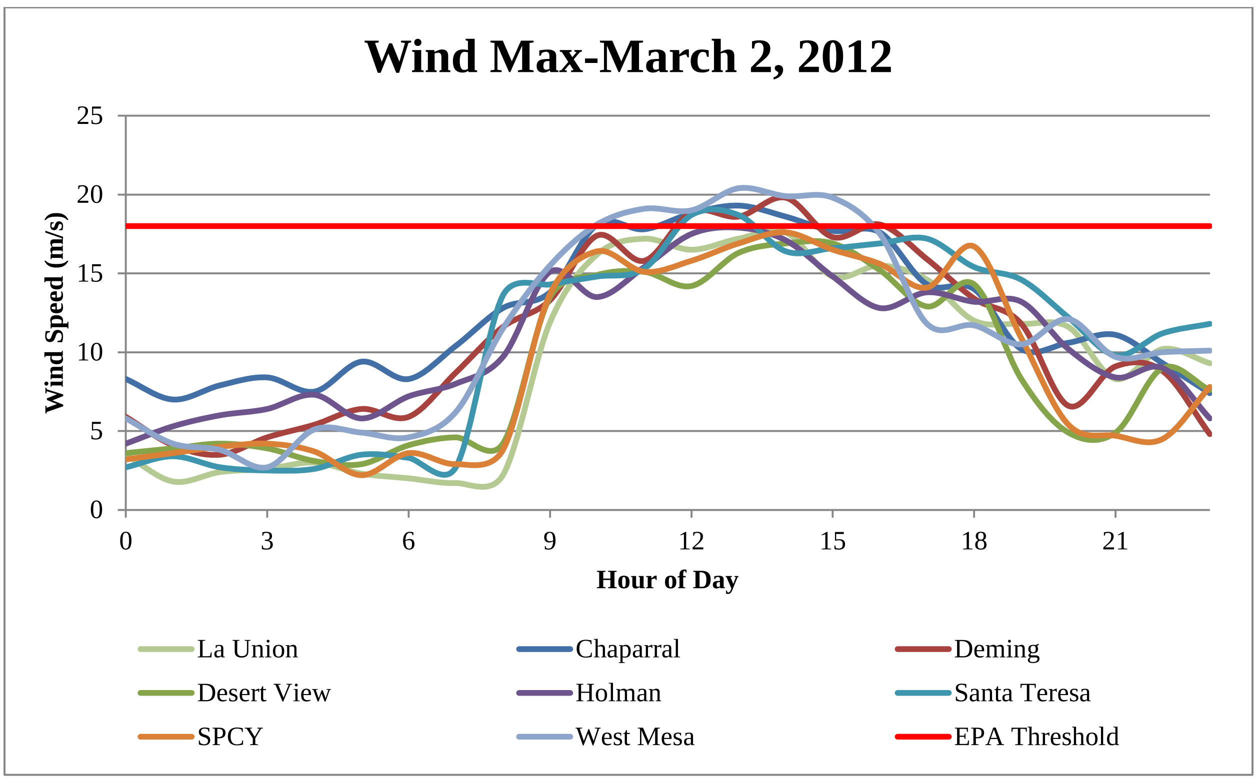


Figure 6-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

6.2.3 Recurrence Frequency

The monitoring sites in Doña Ana and Luna Counties can record exceedances of the PM_{10} NAAQS throughout the year. From 2007-2011 the PM_{10} FEM TEOM monitors recorded 254 exceedances and the PM_{10} FRM Wedding monitors recorded 6 exceedances (Figure A-1). The Deming Airport and Desert View monitoring sites (FEM TEOMs) were established in 2006 and 2007 respectively and do not show exceedances until the year following startup. The SPCY $PM_{2.5}$ FRM Partisol recorded 37 exceedances of the 24-Hour NAAQS from 2007-2011 (Figure A-2). See appendix A for a more in-depth discussion about recurrence frequency and the number of exceedances at each monitoring site.

6.2.4 Controls Analysis

The local ordinances and MOUs adopted under the NEAP direct the implementation of BACM for sources of dust in Doña Ana and Luna Counties. The ordinances regulate disturbed lands, construction and demolition, vacant parking lots and materials handling and transportation. Our investigation did not identify any unusual PM_{10} producing activities on this day, and anthropogenic emissions remained constant before, during and after the event. The most likely source contributing to the event is the natural desert and playas in New Mexico and Arizona. The southern sites in Doña Ana County recorded the highest 24-hour averages in the monitoring network. A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from Arizona to the monitors in southern Doña Ana County. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 6-5). Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in Arizona. NMED concludes that the sources contributing to the event are not reasonably controllable.

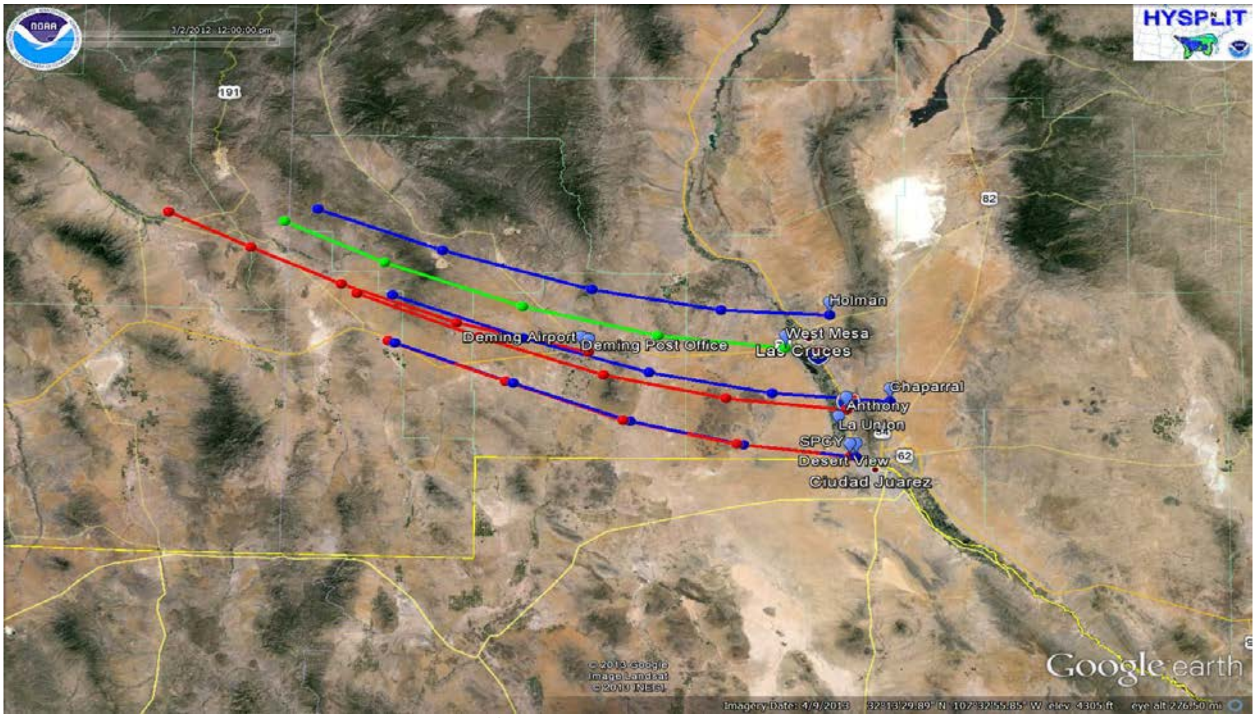


Figure 6-5. HYSPLIT back-trajectory model analysis for March 2, 2012.

6.3 Historical Fluctuations Analysis

6.3.1 Annual and Seasonal 24-hour Average Fluctuations

Since being established, the monitoring sites in Doña Ana and Luna Counties have recorded exceedances of the PM_{10} NAAQS. High winds cause these exceedances and they can occur at any time of year (Figure B-6 through B-13). Most exceedances occur from late winter through early summer (February-June) and are associated with the passage of Pacific cold fronts. High winds caused all recorded exceedances from 2007-2011 and NMED submitted natural events demonstrations to EPA under the NEAP or EER.

Since the 24-hour $PM_{2.5}$ NAAQS was lowered from 65 to 35 µg/m^3 in 2006, the SPCY Partisol monitor has routinely recorded exceedances of the standard. These exceedances occurred throughout the year during high and low wind conditions. In 2009, NMED investigated the cause of the low wind exceedances and found that emissions from Ciudad Juárez, Mexico contribute significantly to elevated concentrations. The high wind exceedances were caused by blowing dust on days when PM_{10} monitors also recorded exceedances.

Appendix B contains a more in-depth discussion about historical fluctuations and charts showing annual and seasonal trends at each monitoring site.

Table B-1 and B-2 show normal historical fluctuations with and without high wind natural events that caused exceedances from 2007-2011. The analysis excludes only those high wind events that resulted in an exceedance. Data for PM_{10} in this table includes FRM Wedding and FEM TEOM measurements and data for $PM_{2.5}$ comes from the FRM Partisol measurements from 2007-2011. The recorded values for this day (169, 221, and 251 µg/m^3) are above the maximum values recorded when no high wind exceedances are included and is above the 95th percentile of all 24-hour averages recorded.

An hourly data distribution analysis was performed for PM_{10} and $PM_{2.5}$ concentrations, wind speeds and wind gusts (Appendices C, D and E). All data used for the PM_{10} distribution charts come from the FEM TEOM monitors and the non-FEM/FRM $PM_{2.5}$ TEOM monitor at SPCY. Overlaying the hourly data for March 2, 2012 on the hourly data distribution plots shows that the values recorded during the high wind event exceed the 95th percentile for PM_{10}, $PM_{2.5}$, wind speed and wind gusts (Figures 6-6a-d through 6-8a-c). The top whiskers of the box and whisker plots represent the 95th percentile of data. The hourly PM_{10} values during the high wind blowing dust storm far exceed the historical 95th percentile of data.

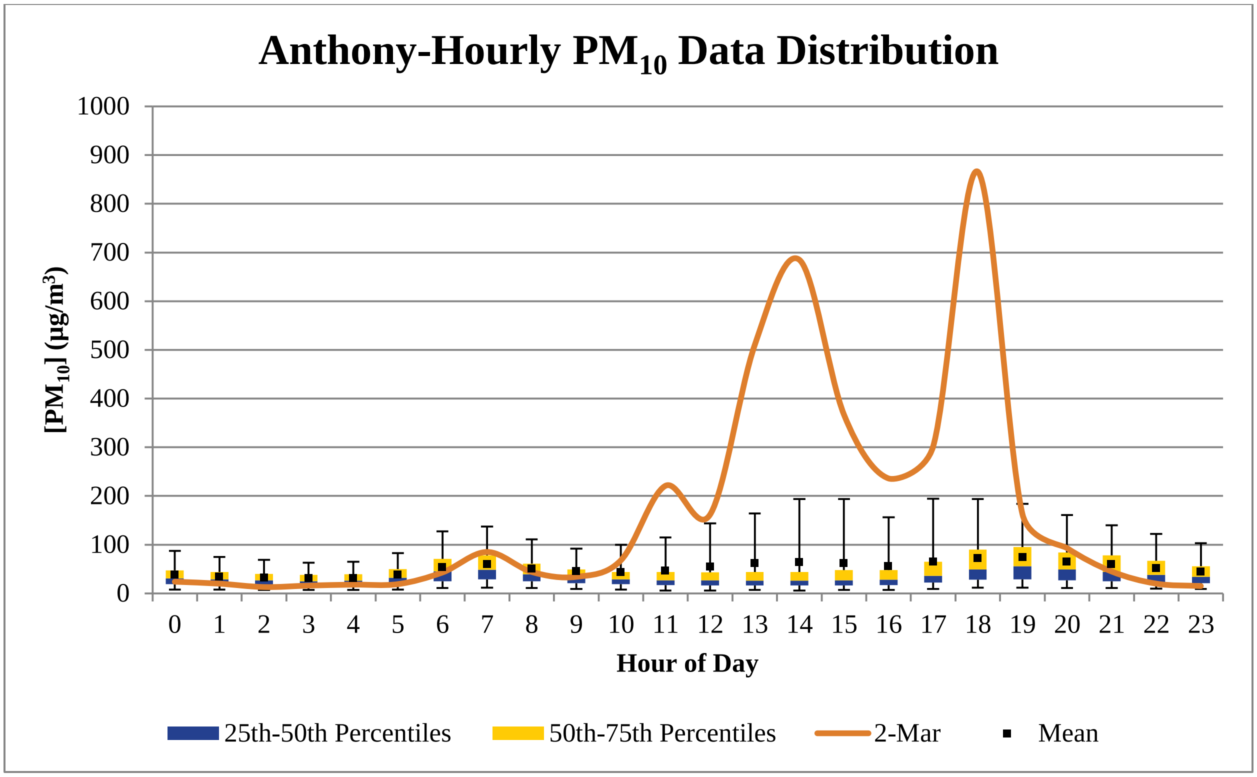


Figure 6-6a. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for March 2, 2012.

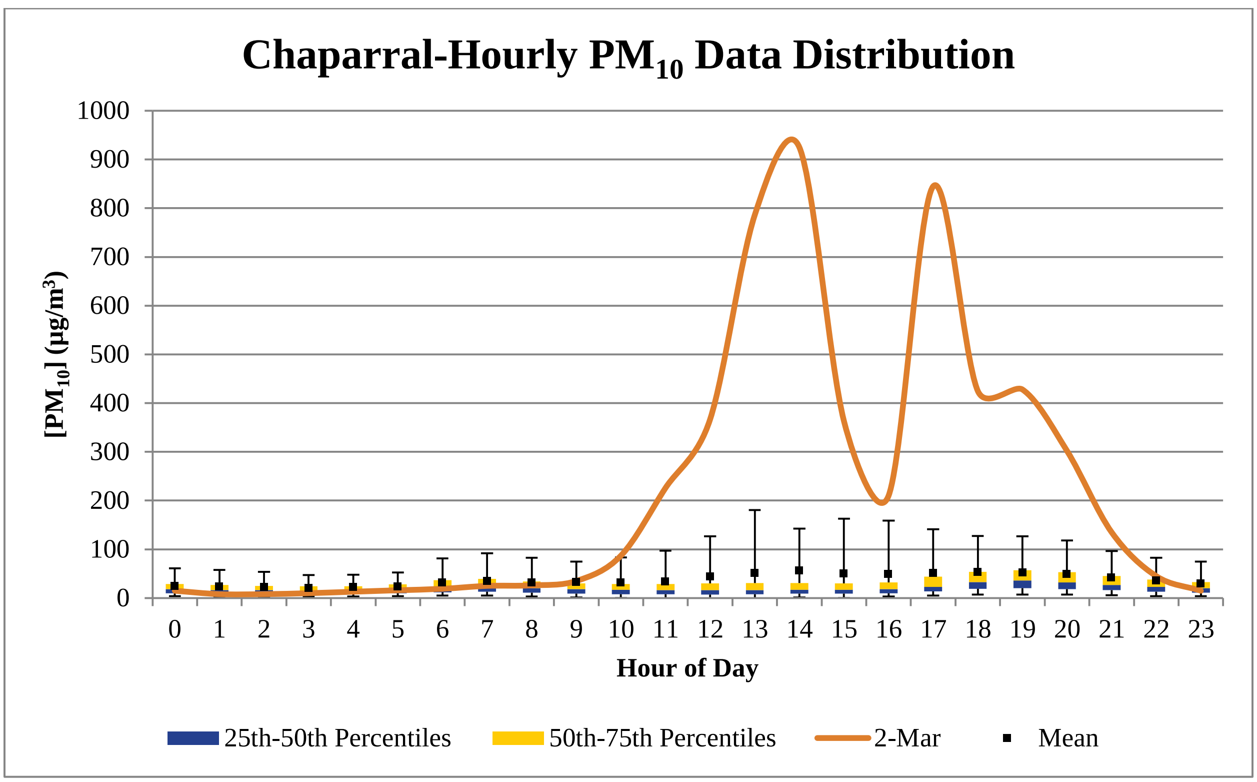


Figure 6-6b. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for March 2, 2012.

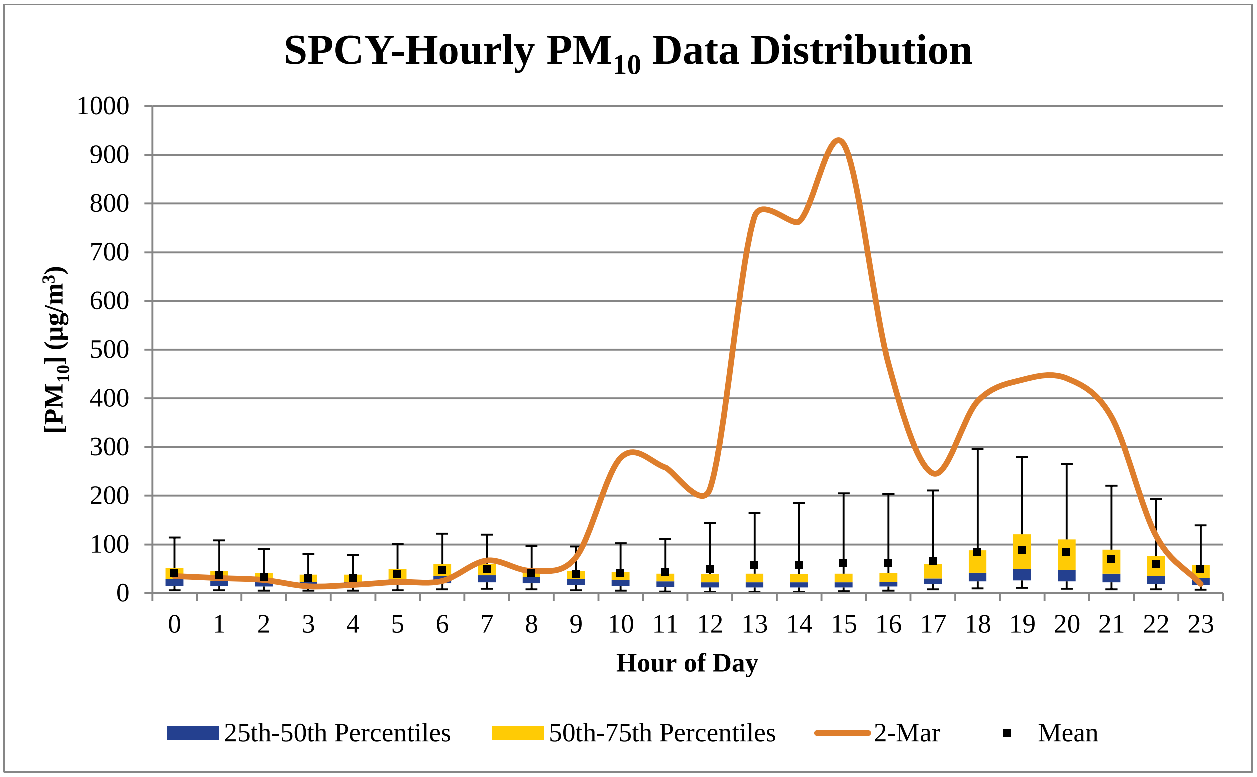


Figure 6-6c. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for March 2, 2012.

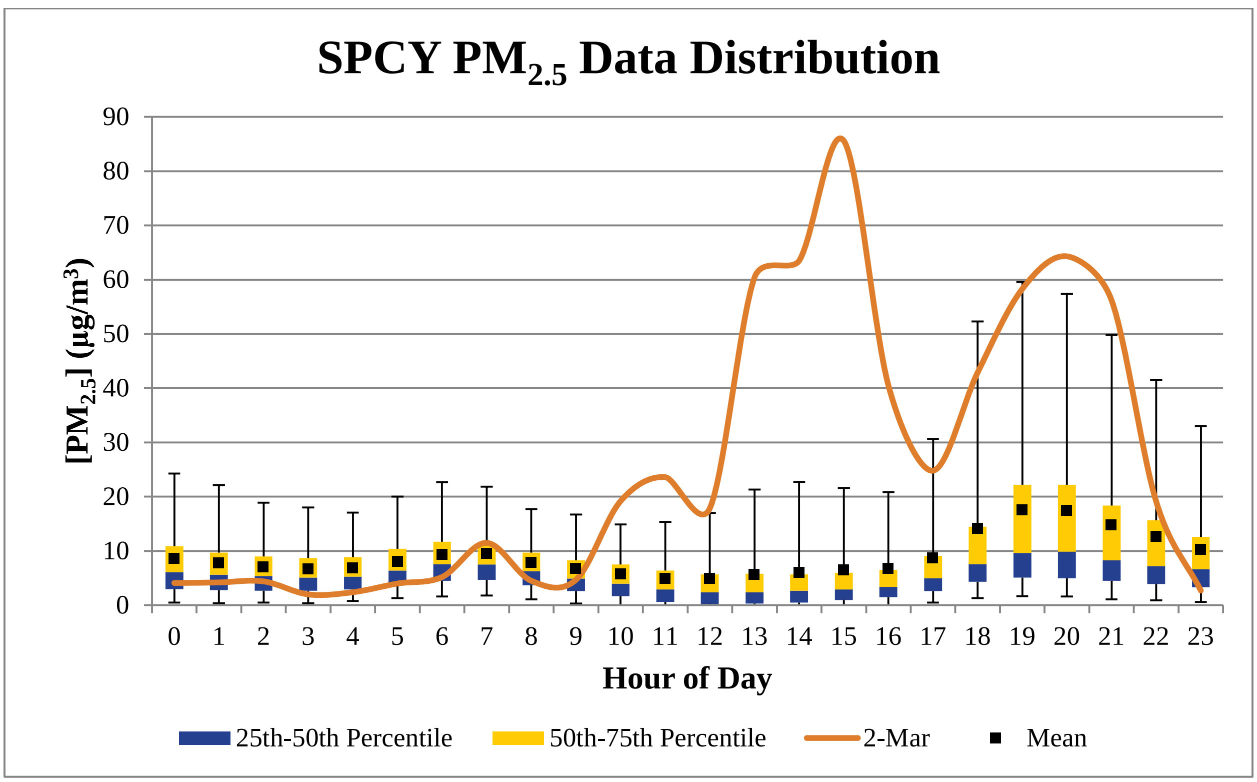


Figure 6-6d. $PM_{2.5}$ hourly data distribution from 2007-2011 overlaid by hourly values for March 2, 2012.

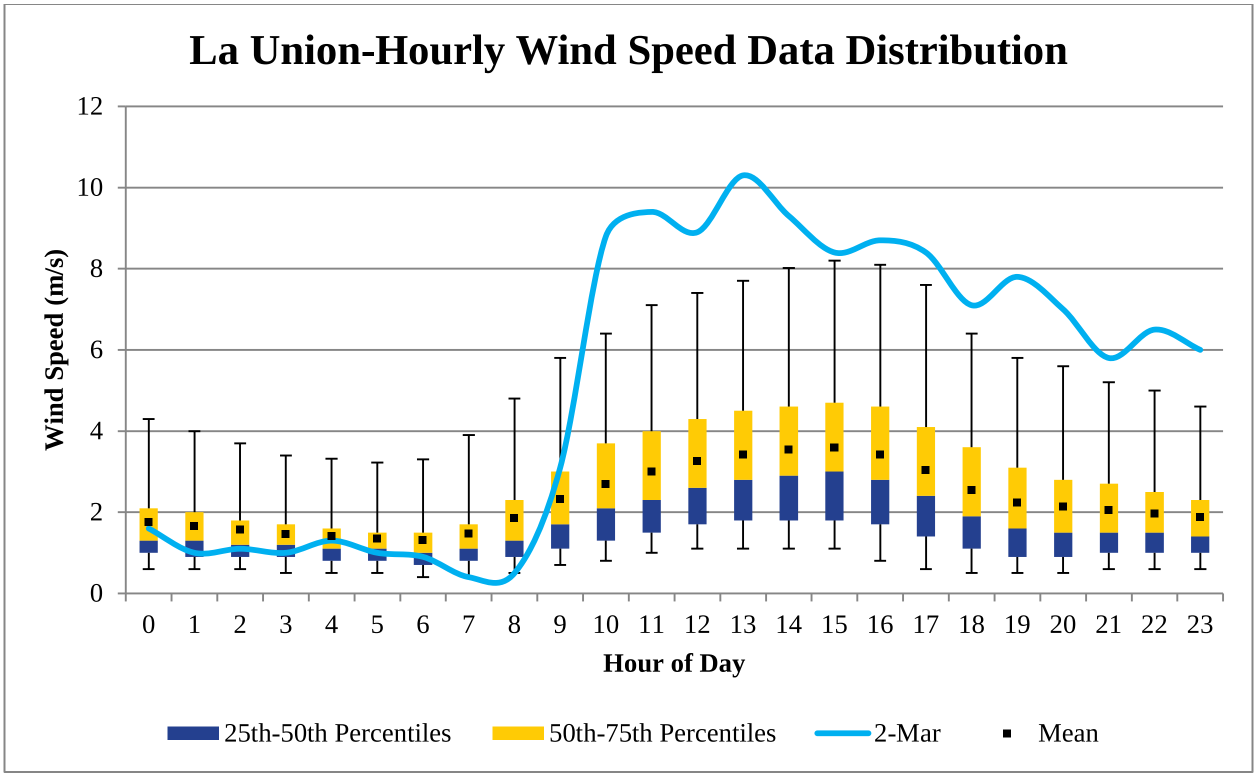


Figure 6-7a. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 2, 2012.

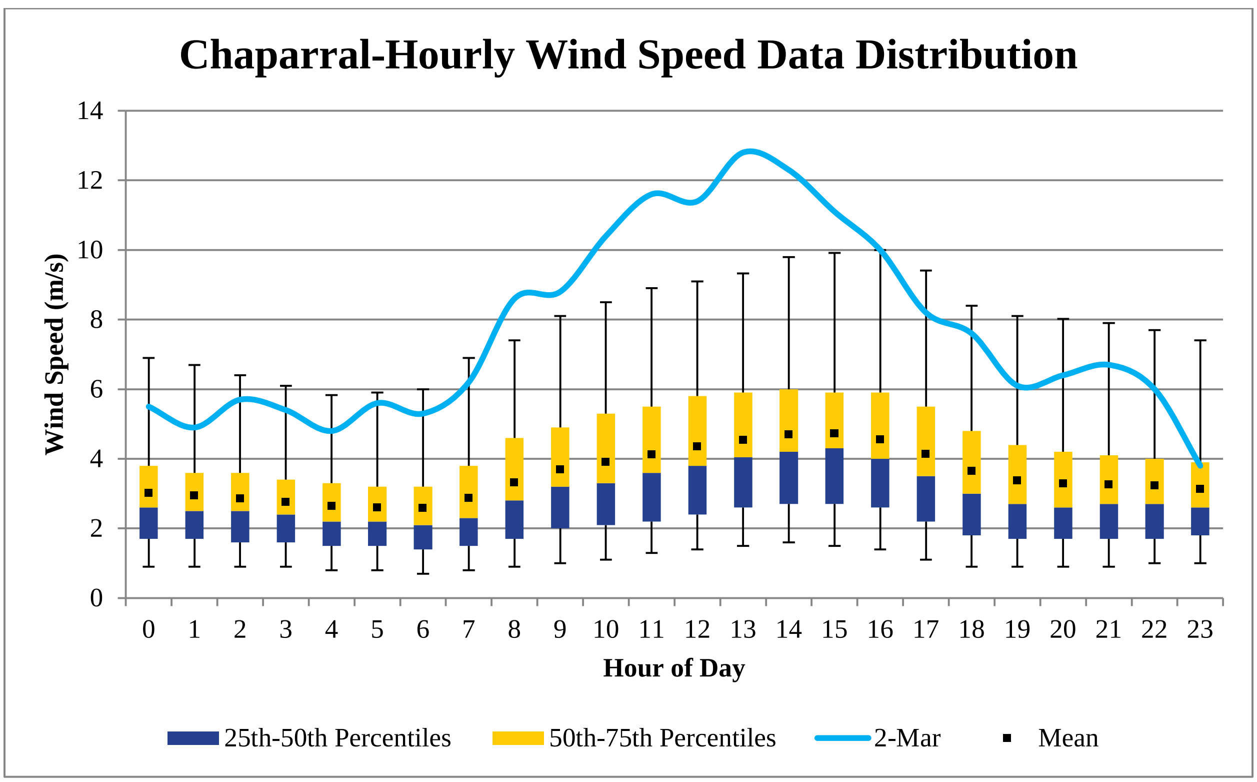


Figure 6-7b. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 2, 2012.

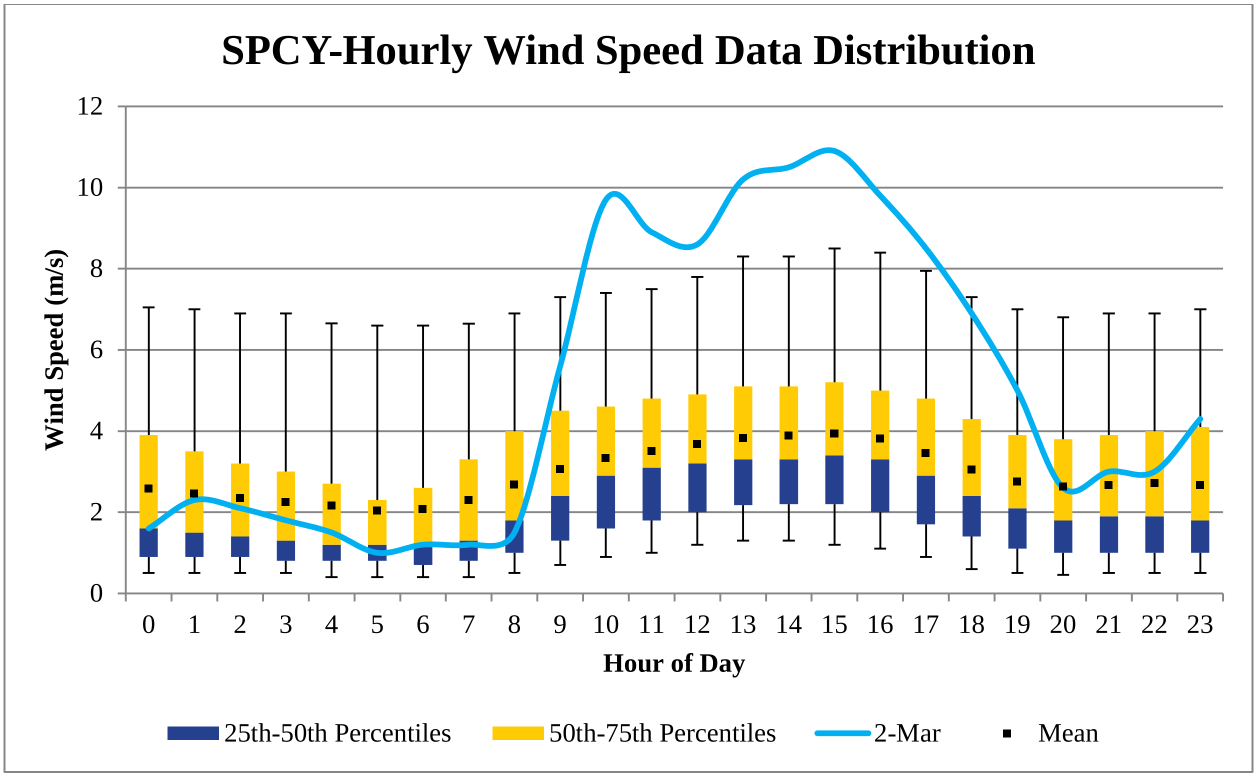


Figure 6-7c. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 2, 2012.

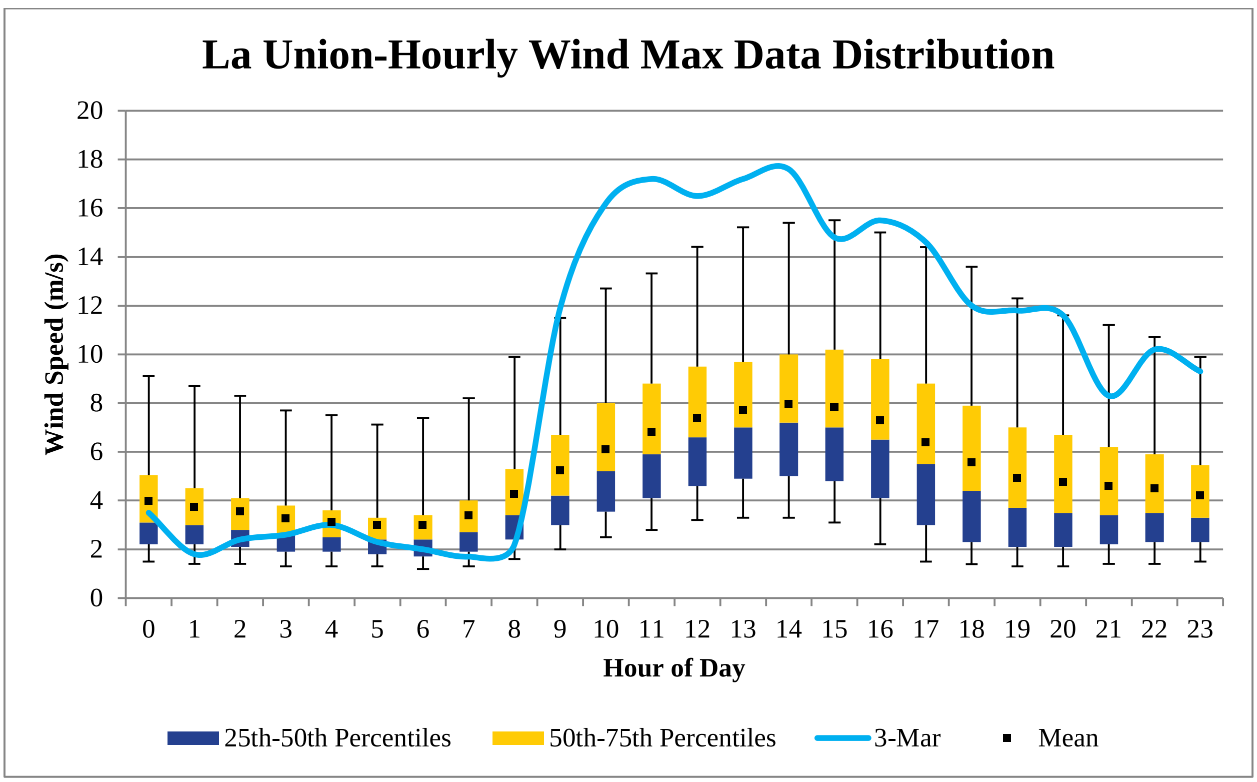


Figure 6-8a. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 2, 2012.

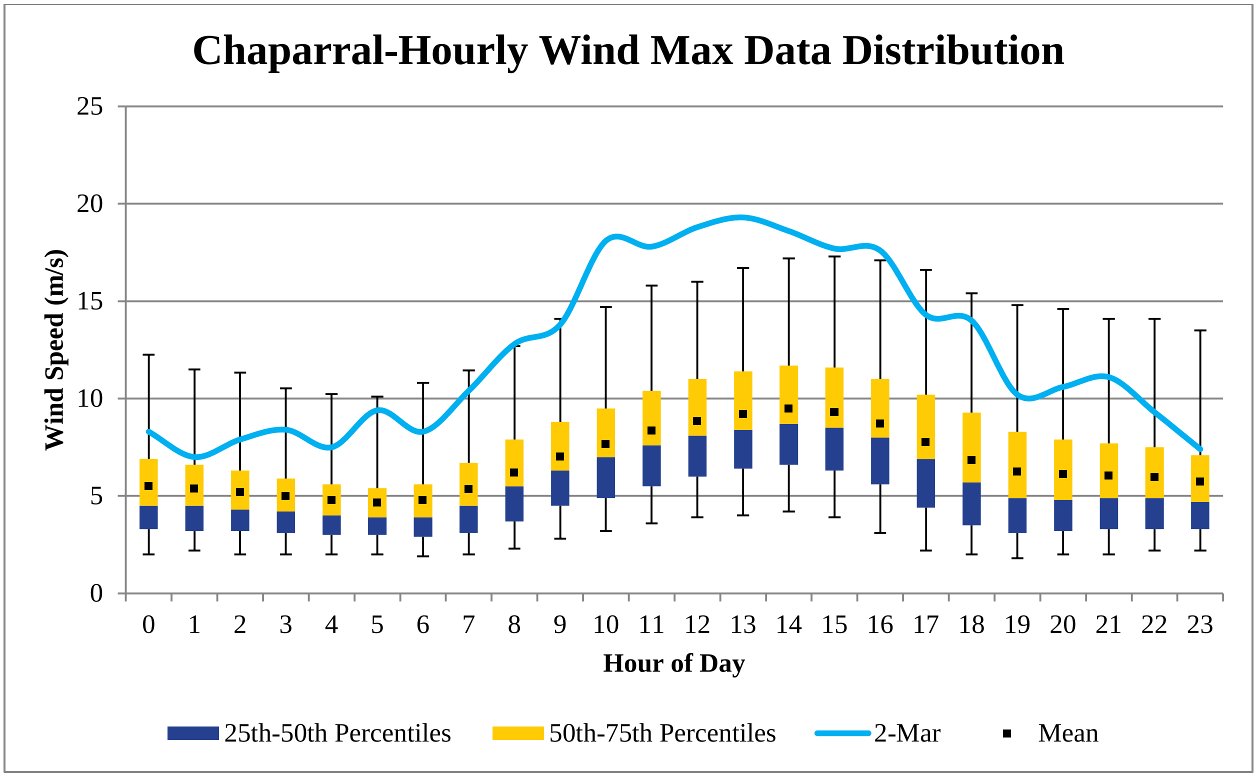


Figure 6-8b. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 2, 2012.

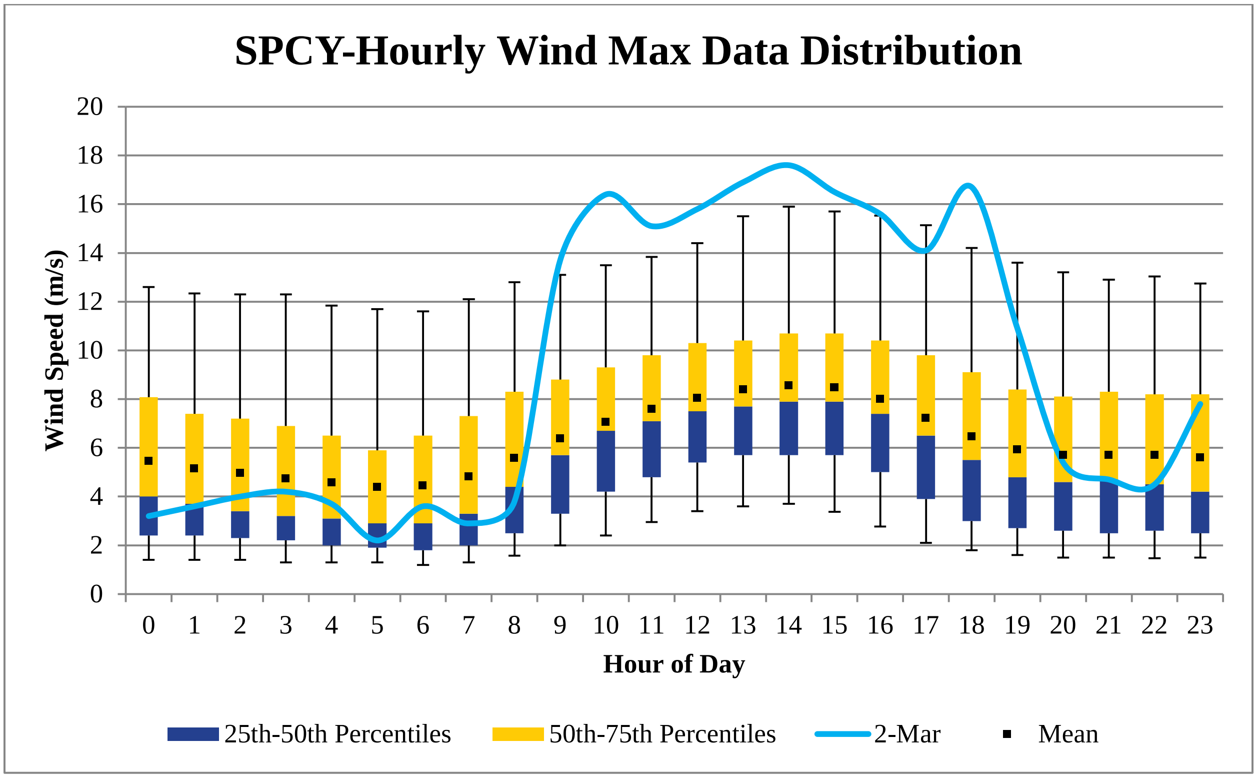


Figure 6-8c. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 2, 2012.

6.4 Clear Causal Relationship

A Pacific storm system and associated surface cold front passed through New Mexico on March 2, 2012. As the Pacific cold front moved through New Mexico a shortwave low pressure surface trough developed over eastern New Mexico, tightening the pressure gradient and increasing surface winds (Figures 6-9a-b). The wind direction in the upper atmosphere aligned fairly well with the surface wind direction and daytime heating of the surface allowed winds aloft to mix downward, further increasing the surface wind velocities and providing the turbulence required for vertical mixing and horizontal transport (Figure 6-10).

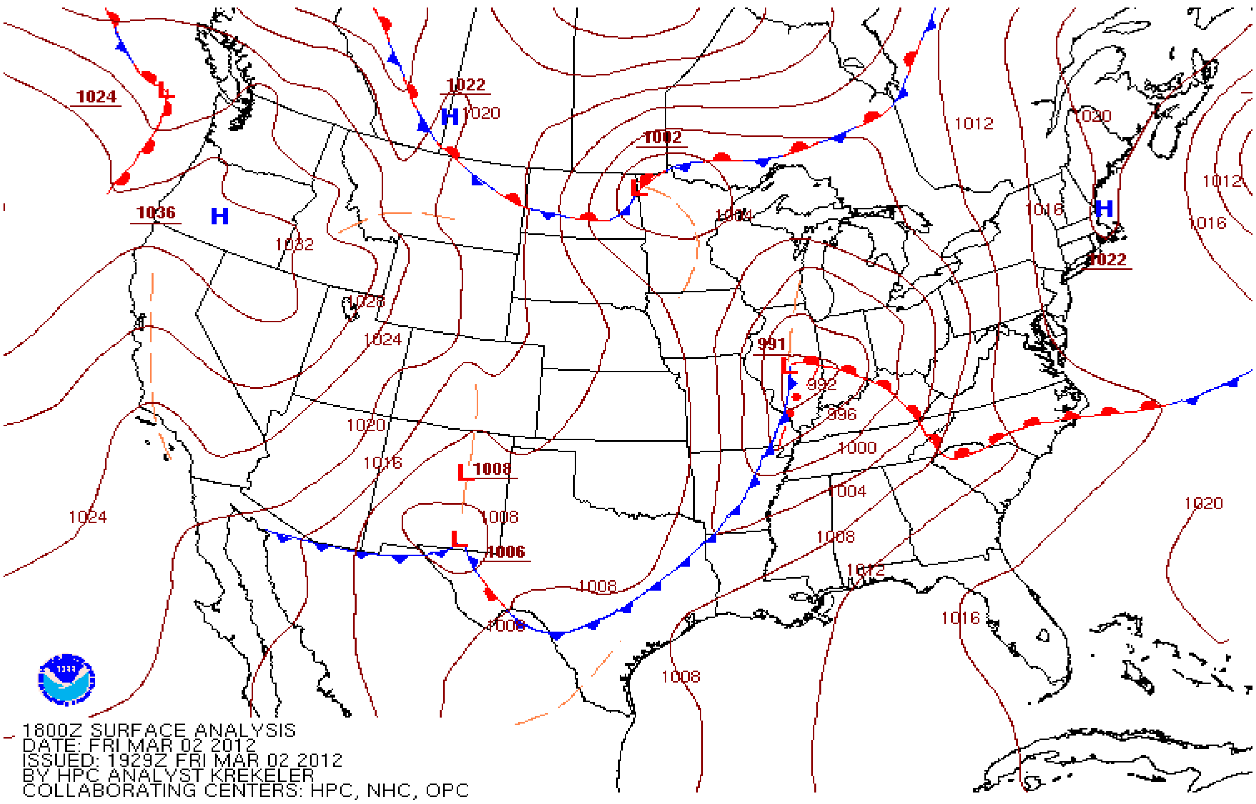


Figure 6-9a. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for March 2, 2012 at the 1800Z hour.

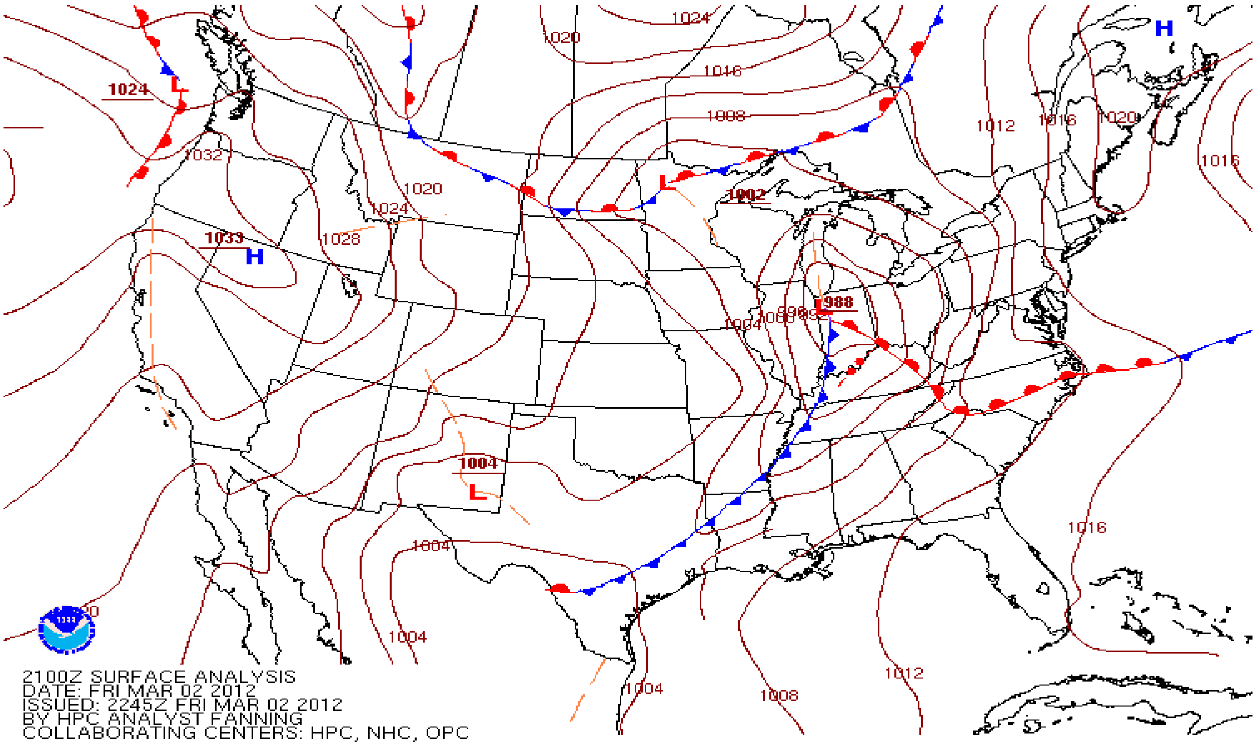


Figure 6-9b. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for March 2, 2012 at the 2100Z hour.

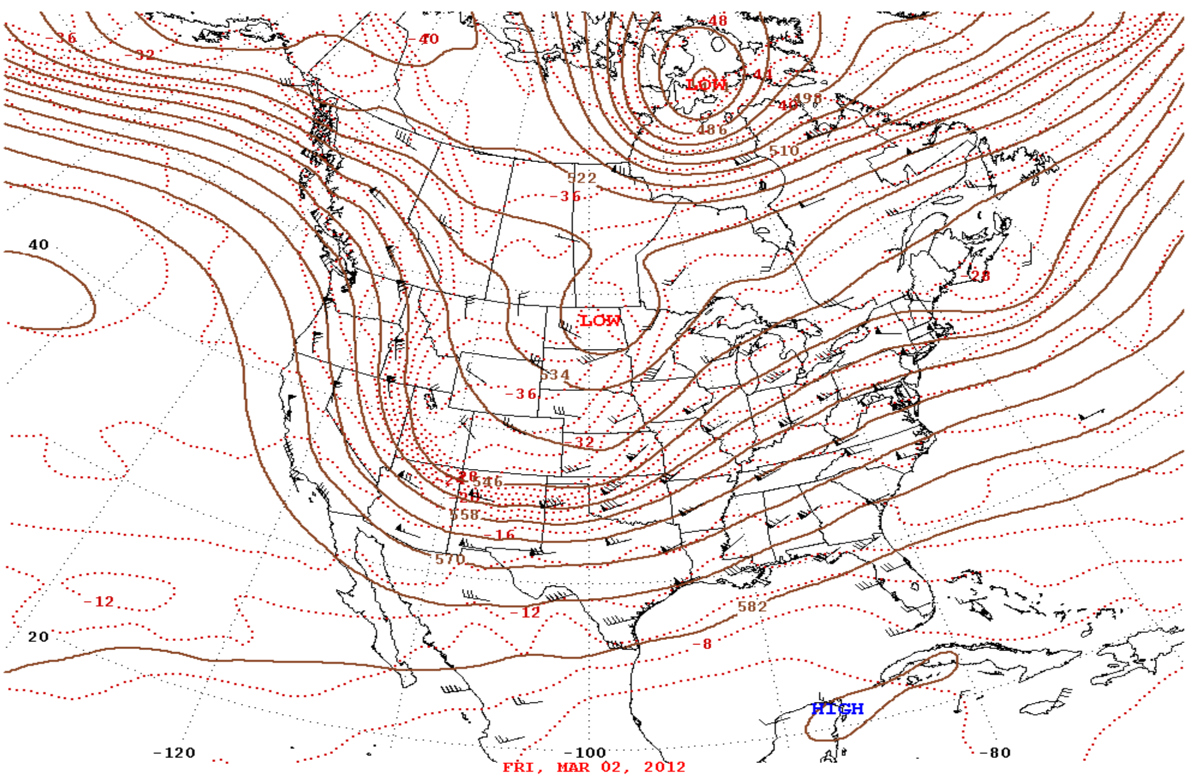


Figure 6-10. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on March 2, 2012.

The weather pattern described above generated strong winds from the west beginning at the 0700 hour and lasting through the 1900 hour. Beginning at the 1000 hour, wind speeds exceeded 11.2 m/s at West Mesa as shown in Figure 6-3. Peak wind speeds ranged from 9 m/s at Desert View to 13.2 m/s at West Mesa (Figure 6- 3). Peak wind gusts ranged from 16.9 m/s at Desert View to 20.4 m/s at West Mesa (Figure 6- 4). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 6-11a-d. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (0900-2100 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 6-12a-b). Peak hourly PM_{10} concentrations ranged from 261 µg/m^3 at Deming to 925 µg/m^3 at Chaparral. Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 6-13).

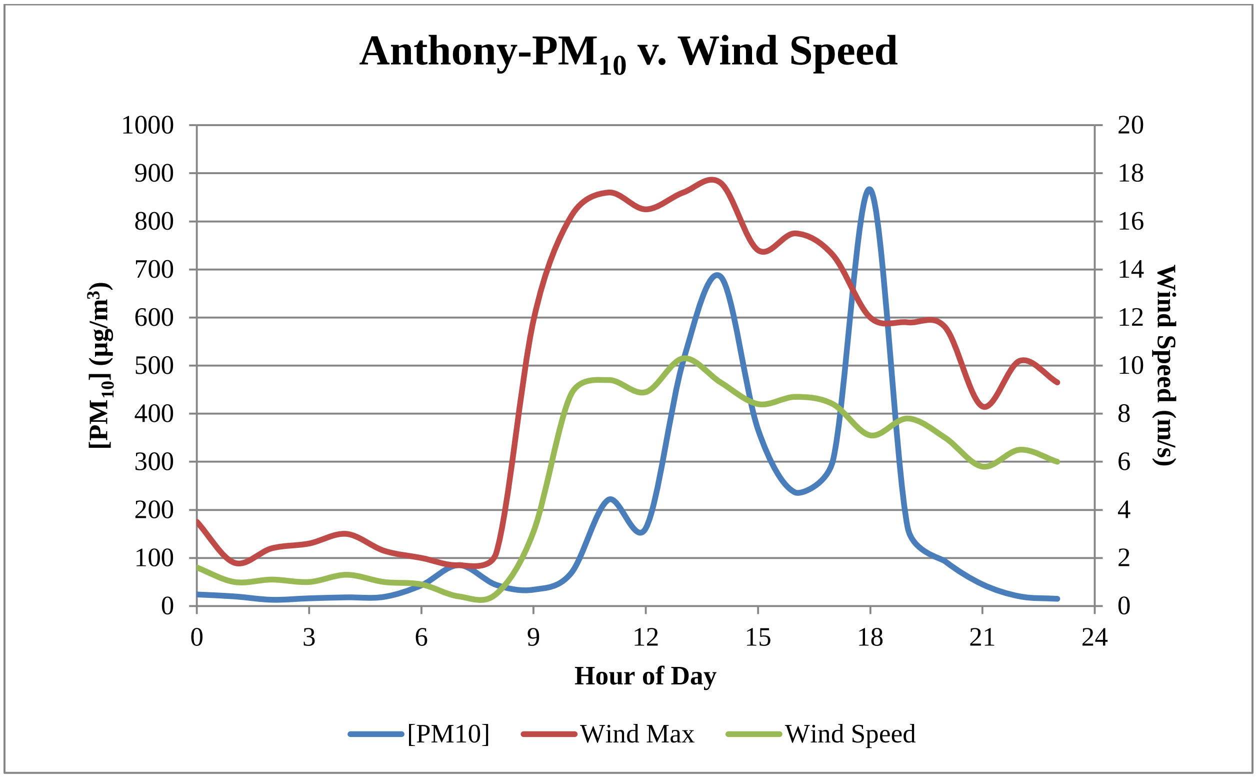


Figure 6-11a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

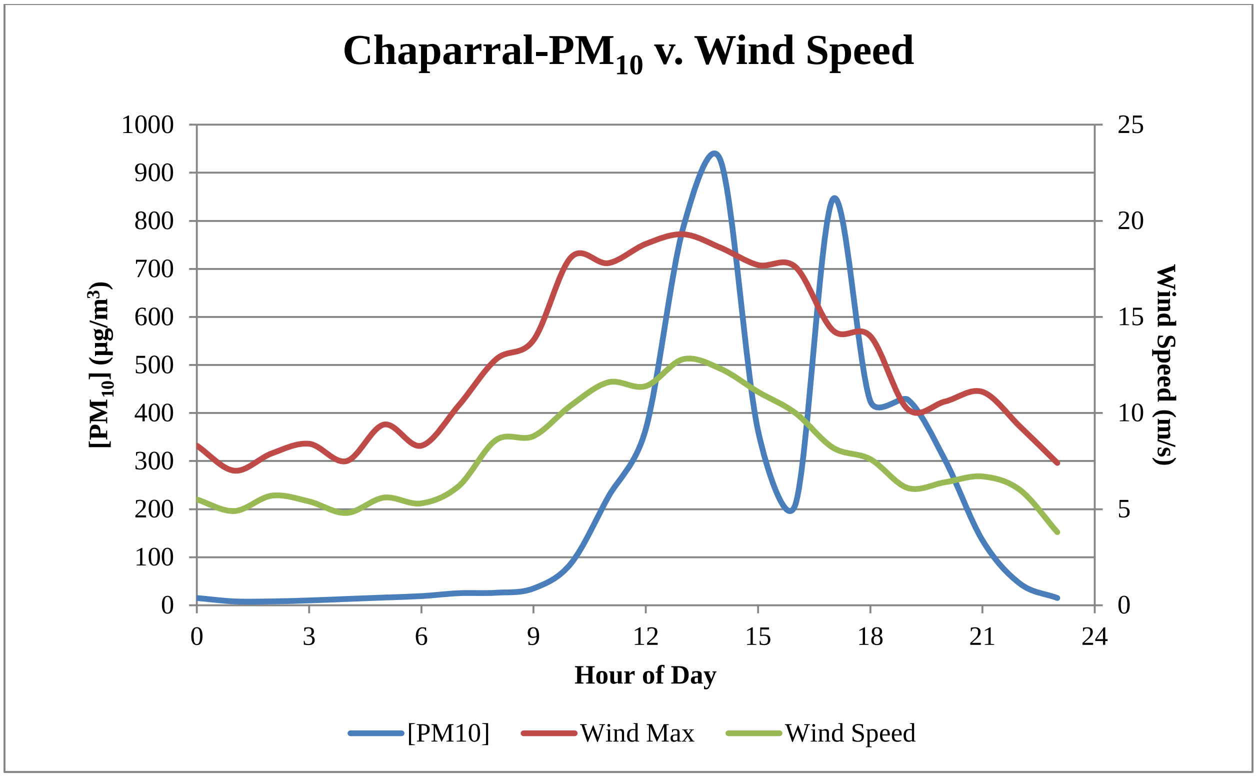


Figure 6-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

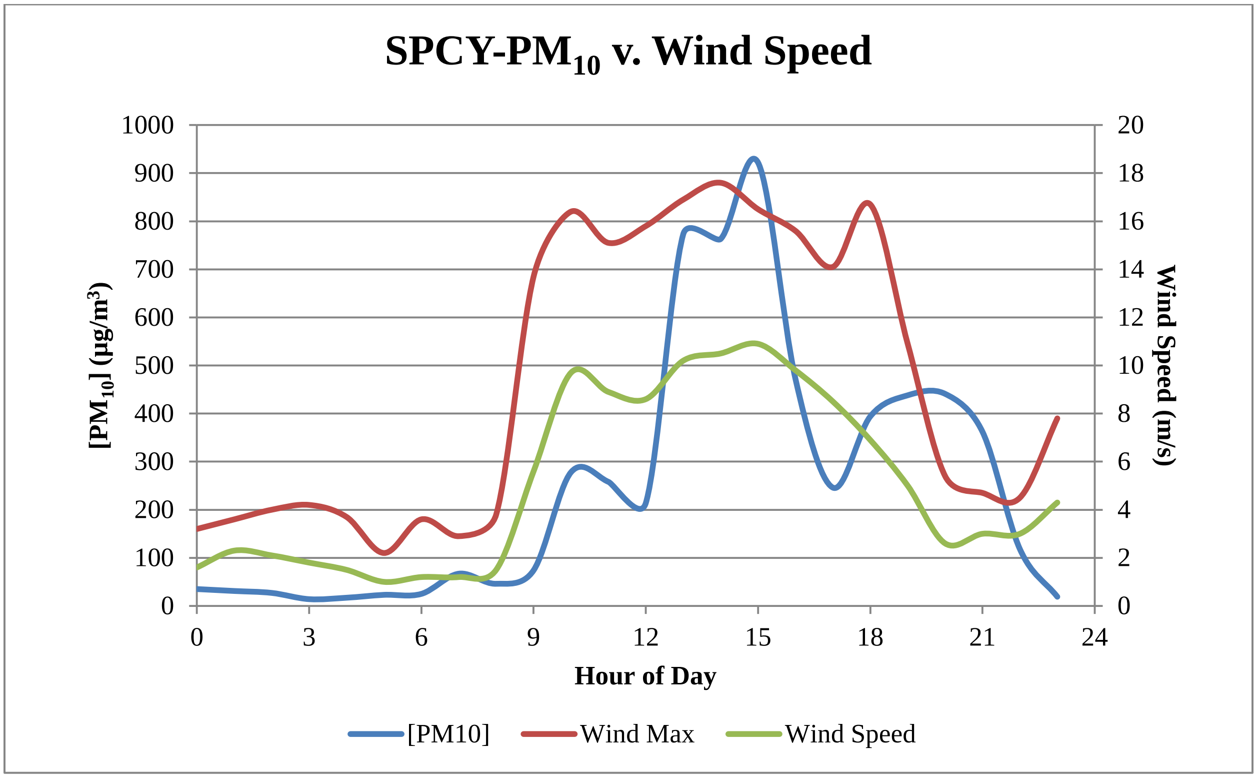


Figure 6-11c. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

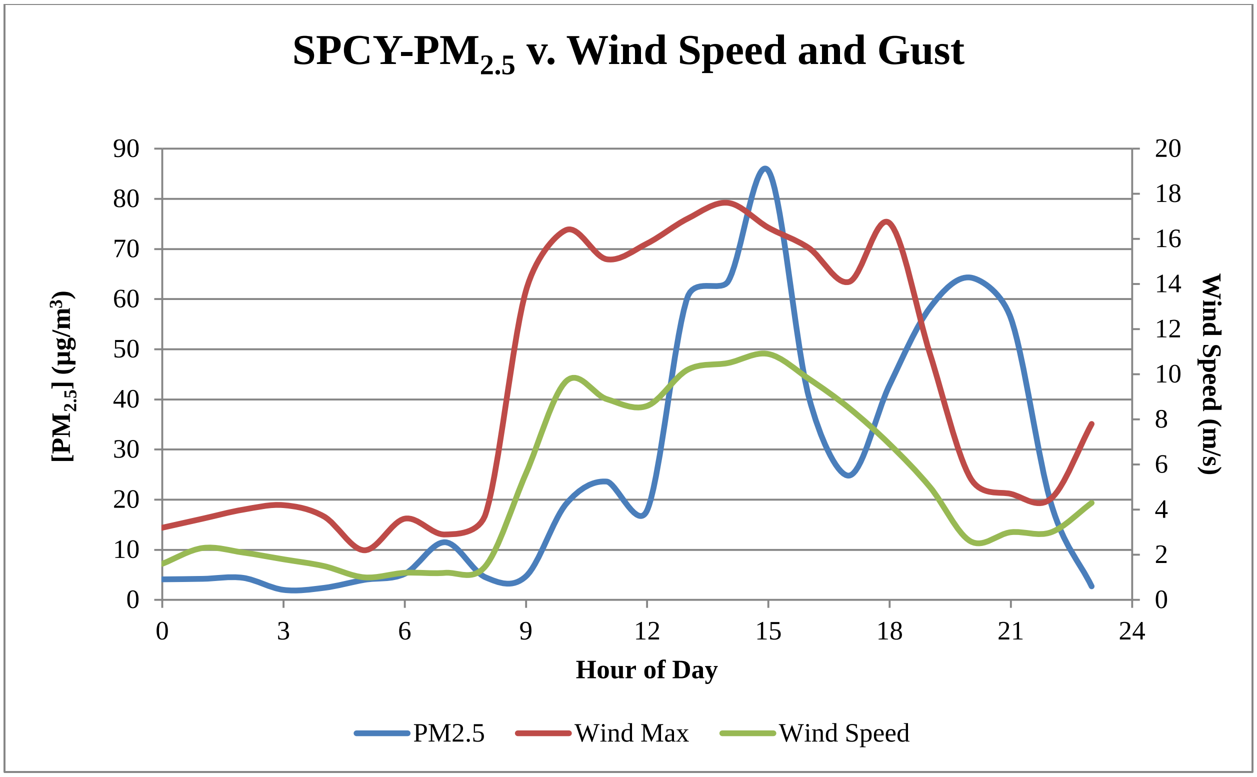


Figure 6-11d. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

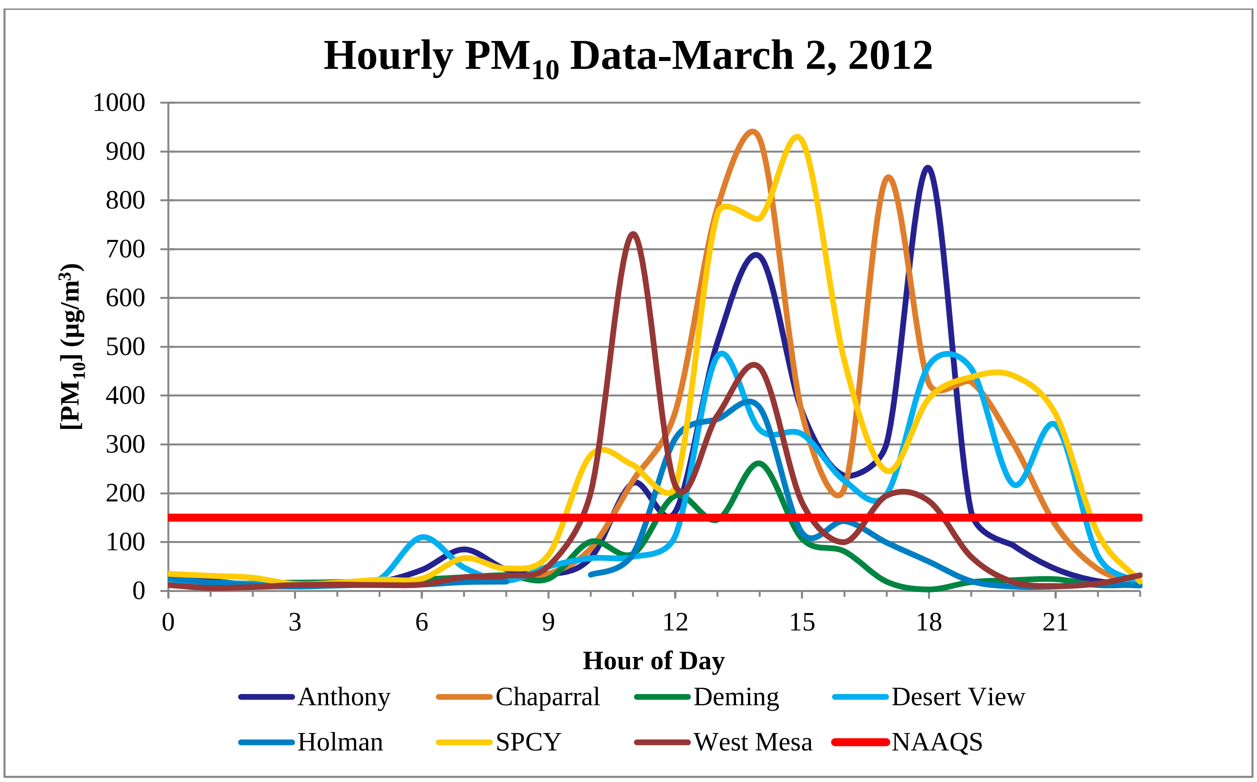


Figure 6-12a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

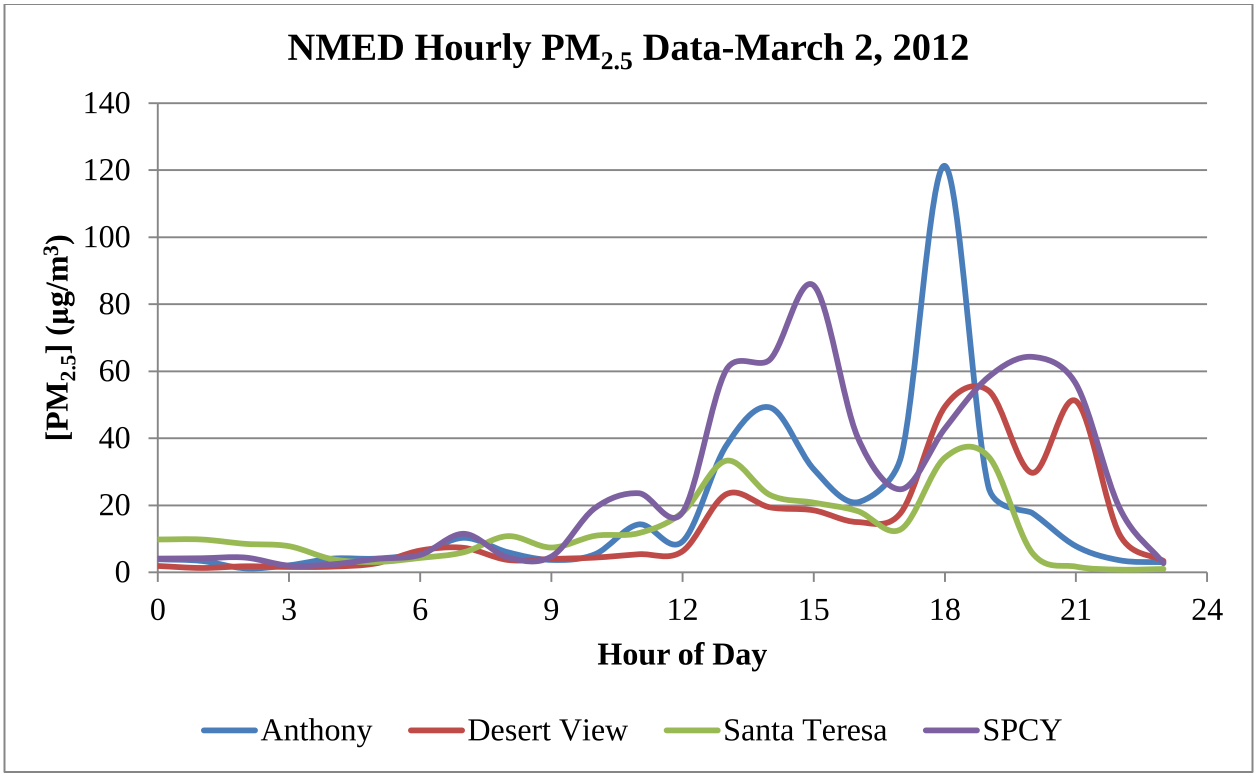


Figure 6-12b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors.

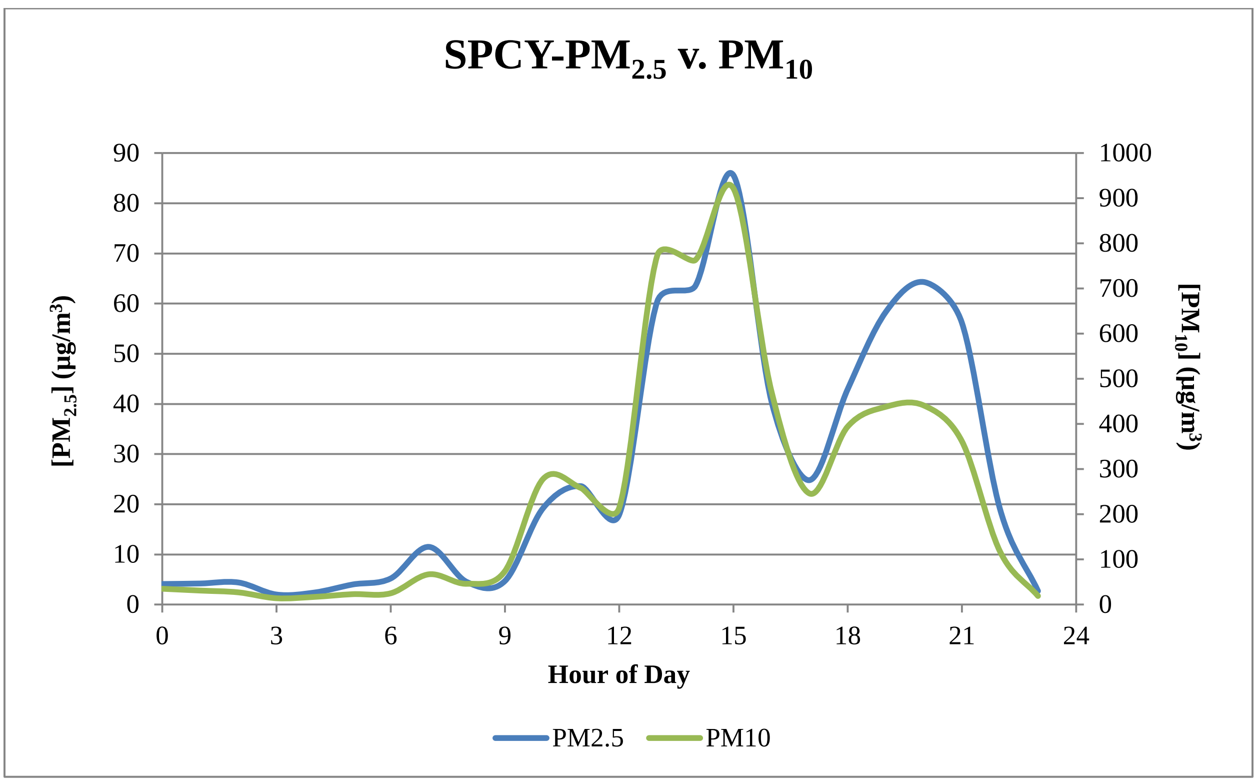


Figure 6-13. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on March 2, 2012.

In addition, the NWS issued a wind advisory for this day, stating that: “The region will experience sustained winds between 25 and 35 mph with stronger gusts. A pacific cold front will keep winds strong and turn them to the northwest during the afternoon.” The graphicast from the NWS illustrates the storm system and expected windy conditions (Figure 6-14).

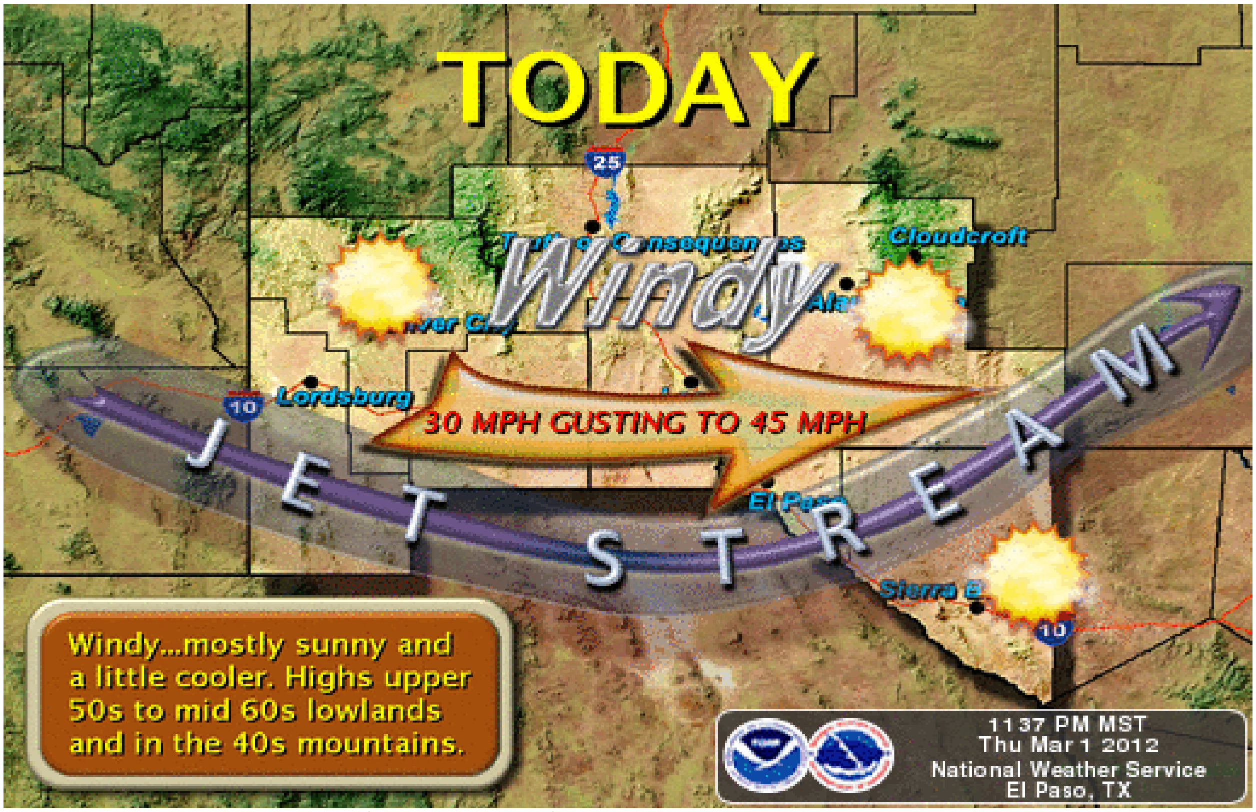


Figure 6-14. National Weather Service forecast illustration for March 2, 2012.

6.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on March 2, 2012.

6.6 Natural Event

The Clear Causal Relationship and not Reasonably Controllable or Preventable analyses show that this was a natural event caused by high wind and blowing dust.

6.7 No Exceedance but for the Event

The SPCY $PM_{2.5}$ monitor detected elevated levels due to blowing dust on March 2, 2012. Although these elevated concentrations do not exceed the 24-hour NAAQS for $PM_{2.5}$, they contribute to an annual exceedance level of 28 µg/m^3 for this date. The strong correlation between hourly $PM_{2.5}$, PM_{10} and wind speeds peaks also point to windblown dust affecting the monitor. Previous studies have shown that $PM_{2.5}/PM_{10}$ ratios vary from 0.11 to 0.45 in the Paso del Norte Airshed (Arimoto et. al, 2001; Li et al, 2001). The ratios above 0.30 were observed in downtown El Paso and Ciudad Juárez and indicate a heavy impact from mobile sources. The lower ratios were observed in areas with less vehicular traffic and crustal material dominated the PM_{10} fraction. The $PM_{2.5}/PM_{10}$ ratio for the SPCY site was 0.11 for this date ($PM_{2.5}$ Partisol/PM_{10} TEOM). NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

The Anthony monitor detected blowing dust around the 1100 hour with hourly concentrations heavily impacted until the 1800 hour (As used here heavily impacted means above the 95th percentile). The eight hourly PM_{10} values from 1100-1800 hours alone, exceed the 24-hour average standard at Anthony [(3349 µg/m^3)/24 = 152 µg/m^3]. By replacing these eight hourly values with the 95th percentile of hourly data at the Anthony site, the resulting 24-hour average (86 µg/m^3) does not exceed the NAAQS (Table 6-1). The values in red represent the 95th percentile of all hourly data collected at Anthony, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	24	24
1	20	20
2	13	13
3	16	16
4	18	18
5	19	19
6	43	43
7	85	85
8	44	44
9	34	34
10	68	68
11	221	**115**
12	162	**144**
13	510	**164**
14	685	**194**
15	367	**194**
16	236	**157**
17	302	**194**
18	866	**194**
19	163	163
20	93	93
21	45	45
22	20	20
23	15	15
24-Hour Average	169	**86**

Table 6-1. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Anthony.

The Chaparral monitor detected blowing dust around the 1000 hour with hourly concentrations heavily impacted until the 2000 hour (As used here heavily impacted means above the 95th percentile). The eleven hourly PM_{10} values from 1000-2000 hours alone, exceed the 24-hour average standard at Chaparral [(5099 µg/m^3)/24 = 232 µg/m^3]. By replacing these eleven hourly values with the 95th percentile of hourly data at the Chaparral site, the resulting 24-hour average (75 µg/m^3) does not exceed the NAAQS (Table 6-2). The values in red represent the 95th percentile of all hourly data collected at Chaparral, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	15	15
1	8	8
2	8	8
3	10	10
4	13	13
5	16	16
6	19	19
7	25	25
8	26	26
9	35	35
10	87	**83**
11	226	**97**
12	367	**127**
13	786	**181**
14	925	**143**
15	363	**163**
16	210	**159**
17	845	**141**
18	425	**127**
19	428	**127**
20	302	**118**
21	135	97
22	45	45
23	15	15
24-Hour Average	221	**75**

Table 6-2. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Chaparral.

The Sunland Park monitor detected blowing dust around the 1000 hour with hourly concentrations heavily impacted until the 2100 hour. The eight hourly PM_{10} values from 1000-1700 hours alone, exceed the 24-hour average standard at Sunland Park [(3926 µg/m^3)/24 = 163 µg/m^3]. By replacing the hourly values impacted by blowing dust with the 95^{th} percentile of hourly data at the Sunland Park site, the resulting 24-hour average (120µg/m^3) does not exceed the NAAQS (Table 6-3). The values in red represent the 95^{th} percentile of all hourly data collected at Sunland Park, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	35	35
1	31	31
2	27	27
3	14	14
4	17	17
5	23	23
6	25	25
7	67	67
8	46	46
9	74	74
10	278	**102**
11	258	**111**
12	214	**144**
13	773	**164**
14	763	**185**
15	922	**205**
16	472	**203**
17	246	**211**
18	394	**296**
19	438	**279**
20	441	**265**
21	362	**221**
22	118	118
23	19	19
24-Hour Average	251	**120**

Table 6-3. 95^{th} percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Sunland Park.

7 HIGH WIND EXCEPTIONAL EVENT: March 7, 2012

7.1 Summary of Event

The passing of a Pacific cold front caused high winds and widespread blowing dust in Doña Ana and Luna Counties resulting in extreme exceedances of the PM_{10} and $PM_{2.5}$ 24-hour NAAQS and the $PM_{2.5}$ annual NAAQS at the Anthony, Chaparral, Deming, Holman, Desert View, Sunland Park, and West Mesa monitoring sites on this date. The FEM TEOM continuous monitors at these sites recorded 24-hour average concentrations of 520, 482, 1098, 313, 656, 610, and 301 µg/m^3, respectively. The FRM Partisol monitor at Sunland Park recorded a 24-hour average concentration of 84.5 µg/m^3 (Figure 7-1). The averages in this figure were calculated using PM_{10} FEM TEOM and $PM_{2.5}$ FRM Partisol instrument data for the four days before and after the event. Elevated concentrations were also recorded by the $PM_{2.5}$ non-FEM/FRM TEOMs (Figure 7-2).

As the event unfolded, the wind blew from the south-southwest throughout the border region. These high velocity winds passed over large areas of desert within New Mexico and Mexico. The co-occurrence of high winds and elevated levels of blowing dust, little to no point sources in the area, and the high hourly and daily PM_{10} and $PM_{2.5}$ concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

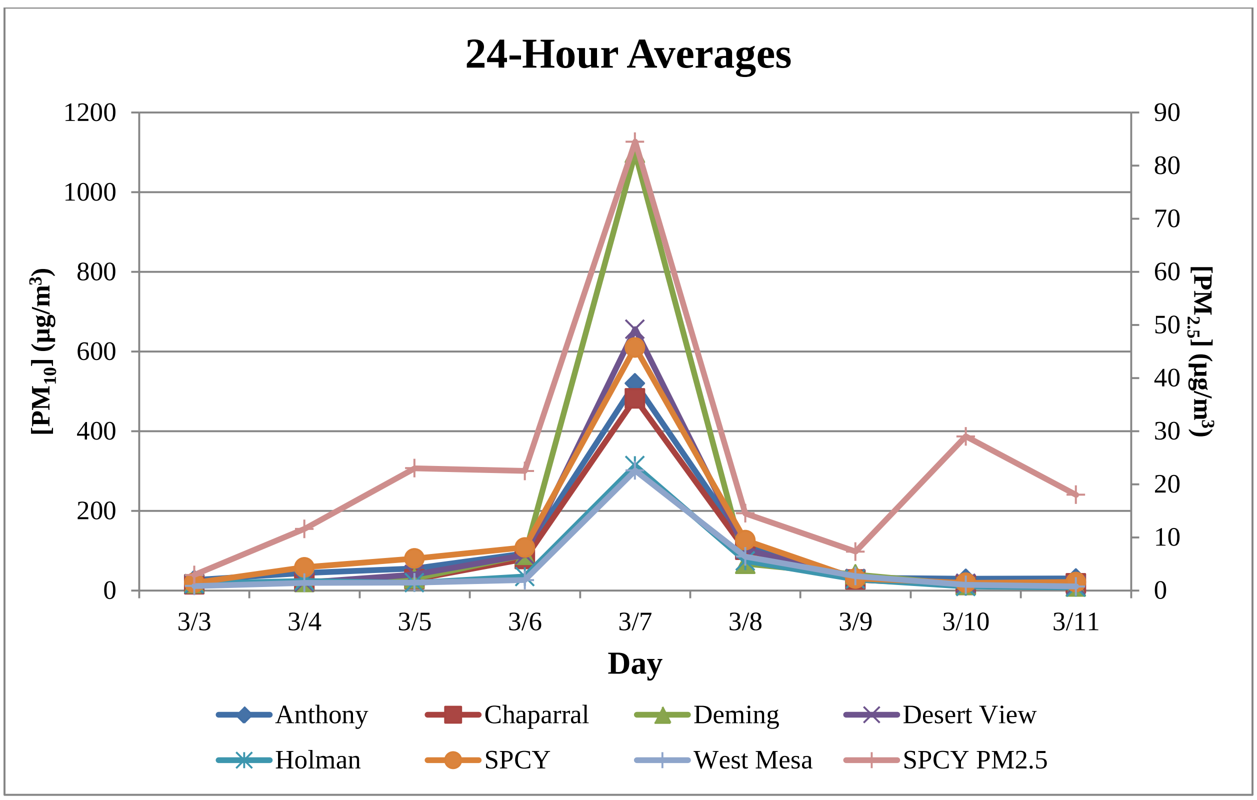


Figure 7-1 PM_{10} 24-hour averages before and after March 7, 2012.

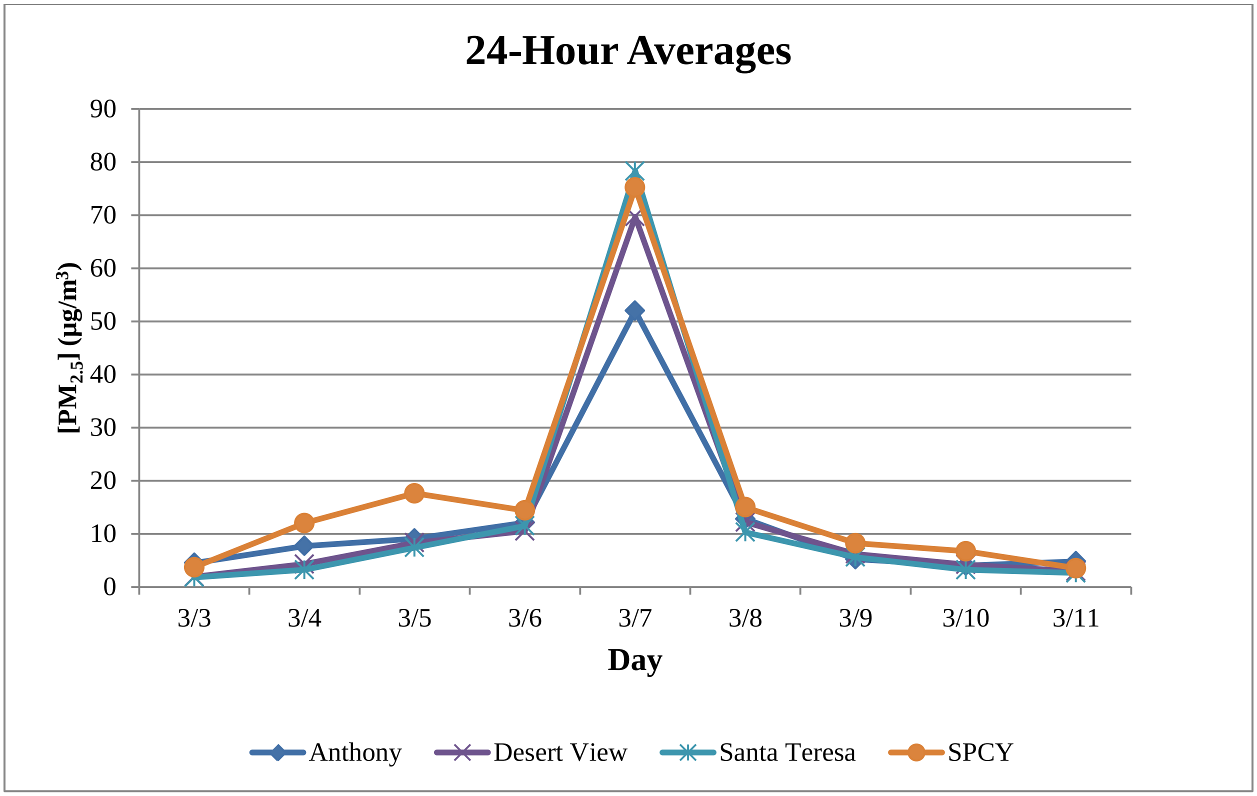


Figure 7-2. $PM_{2.5}$ 24-hour averages before and after March 7, 2012. Non-FEM TEOM Data.

7.2 Is Not Reasonably Controllable or Preventable

7.2.1 Suspected Source Areas and Categories Contributing to the Event

Sources of windblown dust contributing to this exceedance include the natural desert, residential properties, agricultural land and unpaved roads in Mexico and New Mexico. Agricultural tilling and crop planting may have contributed to this event. The City of Las Cruces, City of Deming and Doña Ana and Luna Counties' Ordinances require BACM for any dust producing activities. The largest and most likely sources of windblown dust are the natural desert and the playas of northern Mexico (see Section 7.2.4 below).

7.2.2 Sustained and Instantaneous Wind Speeds

EPA uses a default entrainment threshold of sustained wind speeds at 11.2 m/s (25 mph) for natural and well controlled anthropogenic sources contributing to natural events caused by high wind and blowing dust (EPA, 2013). Under the Doña Ana and Luna County NEAPs, EPA and NMED agreed that wind gusts exceeding 18 m/s would overwhelm any natural and well-controlled anthropogenic sources and cause windblown dust. On March 7, 2012, sustained wind speeds exceeded EPA's default threshold at six of the eight monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at all monitoring sites (Figures 7-3 and 7-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 1000 hour and ending at the 1800 hour.

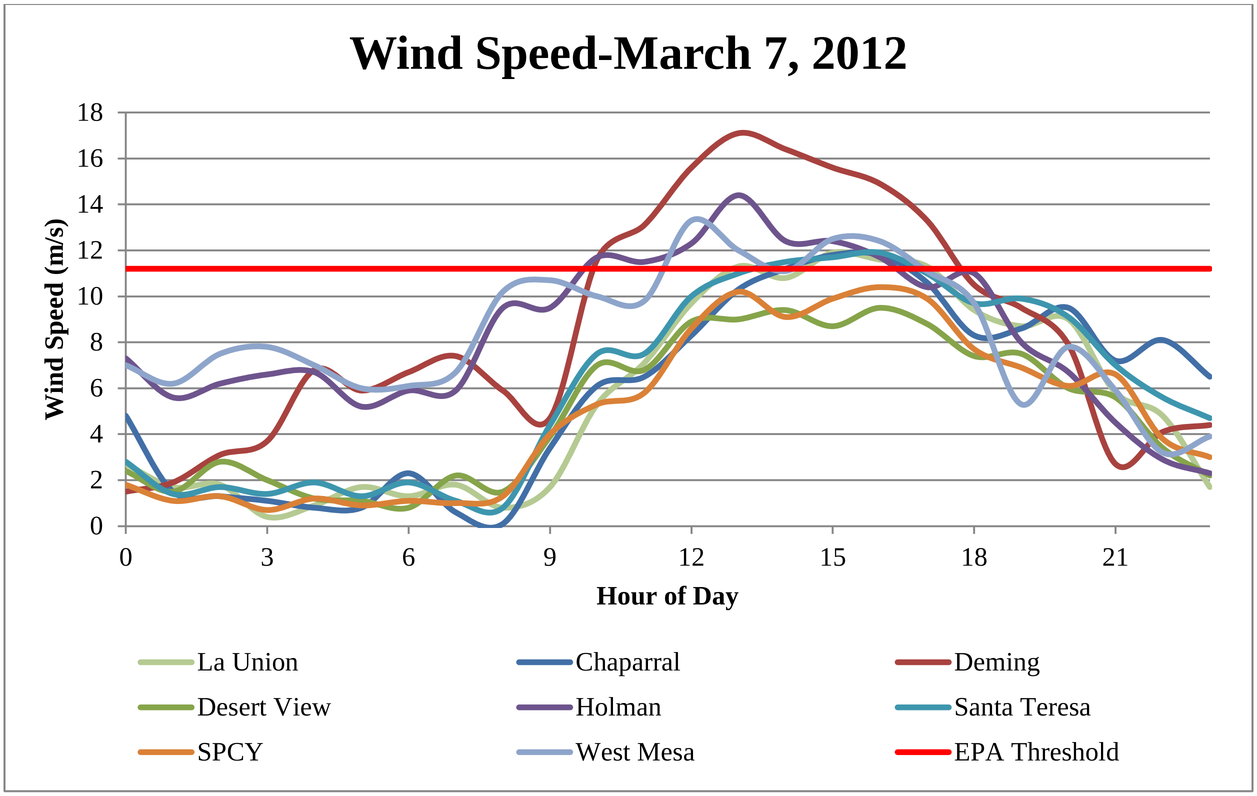


Figure 7-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

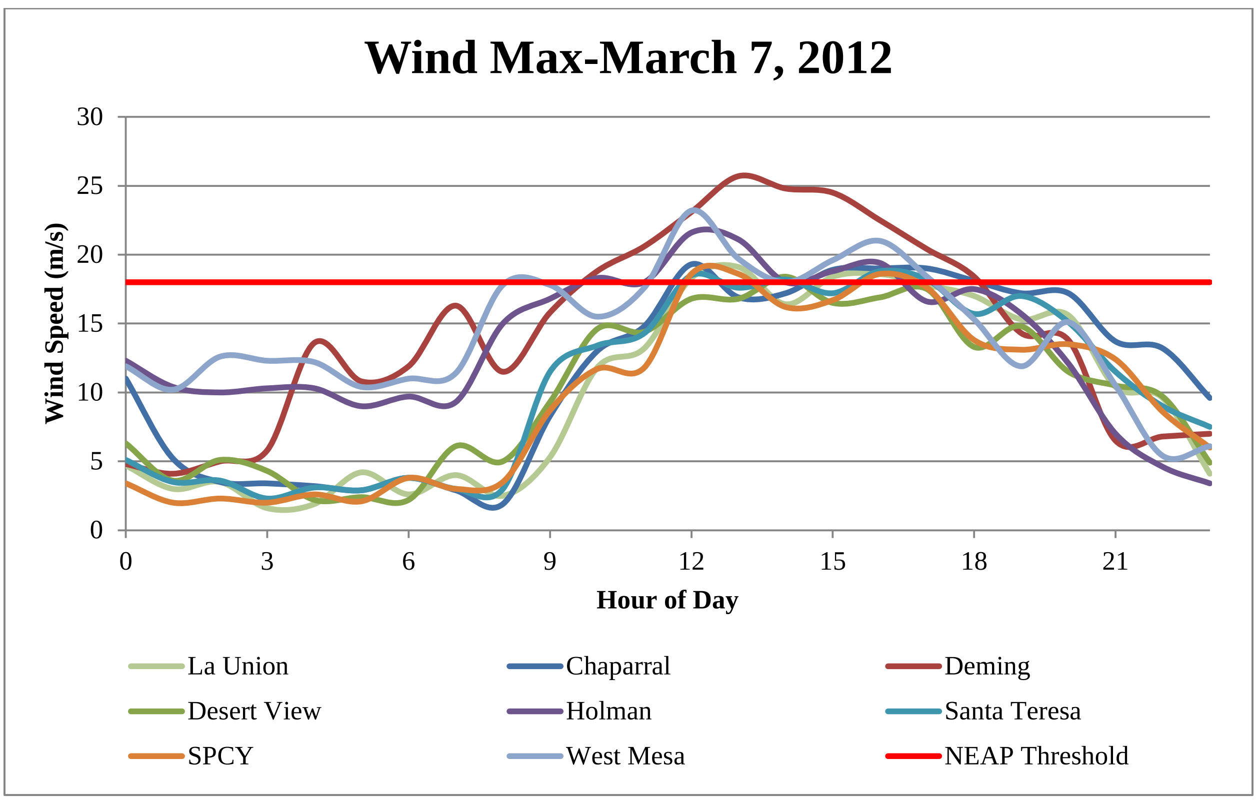


Figure 7-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

7.2.3 Recurrence Frequency

The monitoring sites in Doña Ana and Luna Counties can record exceedances of the PM_{10} NAAQS throughout the year. From 2007-2011 the PM_{10} FEM TEOM monitors recorded 254 exceedances and the PM_{10} FRM Wedding monitors recorded 6 exceedances (Figure A-1). The Deming Airport and Desert View monitoring sites (FEM TEOMs) were established in 2006 and 2007 respectively and do not show exceedances until the year following startup. The SPCY $PM_{2.5}$ FRM Partisol recorded 37 exceedances of the 24-Hour NAAQS from 2007-2011 (Figure A-2). See appendix A for a more in-depth discussion about recurrence frequency and the number of exceedances at each monitoring site.

7.2.4 Controls Analysis

The local ordinances and MOUs adopted under the NEAP direct the implementation of BACM for sources of dust in Doña Ana and Luna Counties. The ordinances regulate disturbed lands, construction and demolition, vacant parking lots and materials handling and transportation. Our investigation did not identify any unusual PM_{10} producing activities on this day, and anthropogenic emissions remained constant before, during and after the event. The most likely source contributing to the event is the natural desert and playas in New Mexico and northern Mexico. A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from Mexico to the monitors in southern and northern Doña Ana and Luna Counties. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 7-5). Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

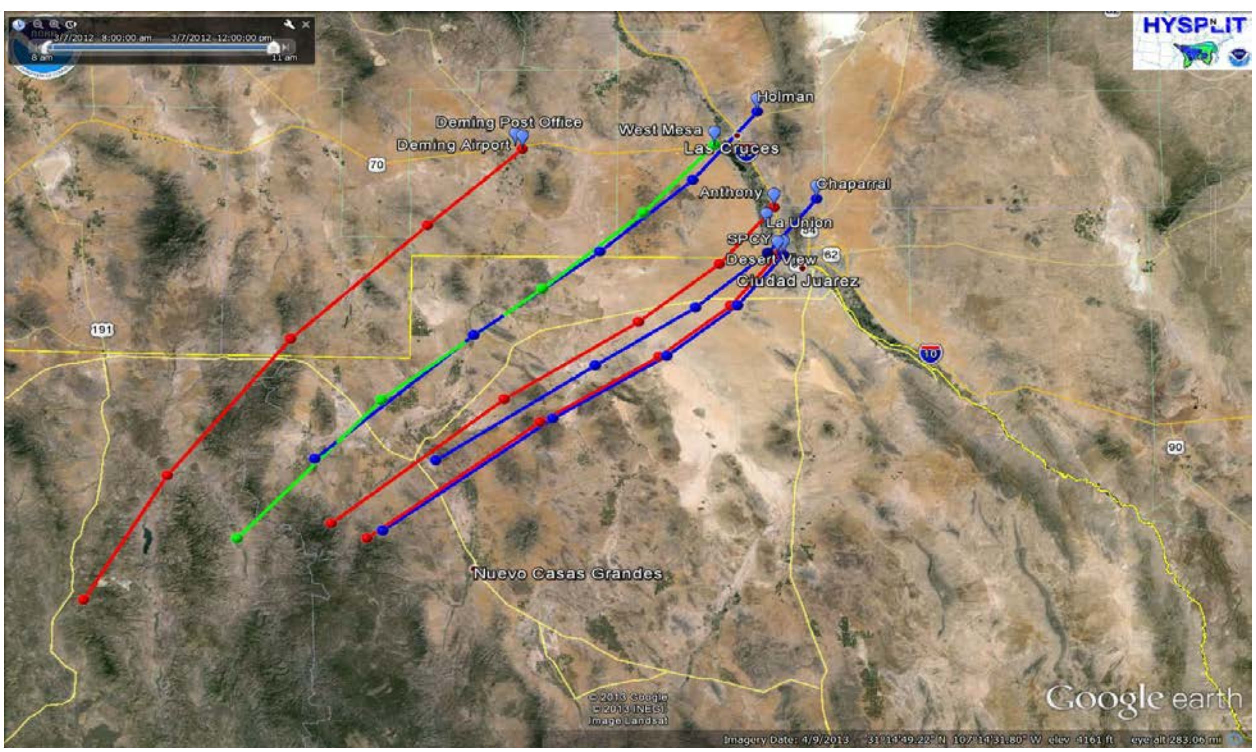


Figure 7-5. HYSPLIT back-trajectory model analysis for March 7, 2012.

7.3 Historical Fluctuations Analysis

7.3.1 Annual and Seasonal 24-hour Average Fluctuations

Since being established, the monitoring sites in Doña Ana and Luna Counties have recorded exceedances of the PM_{10} NAAQS. High winds cause these exceedances and they can occur at any time of year (Figure B-6 through B-13). Most exceedances occur from late winter through early summer (February-June) and are associated with the passage of Pacific cold fronts. High winds caused all recorded exceedances from 2007-2011 and NMED submitted natural events demonstrations to EPA under the NEAP or EER.

Since the 24-hour $PM_{2.5}$ NAAQS was lowered from 65 to 35 µg/m^3 in 2006, the SPCY Partisol monitor has routinely recorded exceedances of the standard. These exceedances occurred throughout the year during high and low wind conditions. In 2009, NMED investigated the cause of the low wind exceedances and found that emissions from Ciudad Juárez, Mexico contribute significantly to elevated concentrations. The high wind exceedances were caused by blowing dust on days when PM_{10} monitors also recorded exceedances.

Appendix B contains a more in-depth discussion about historical fluctuations and charts showing annual and seasonal trends at each monitoring site.

Table B-1 and B-2 show normal historical fluctuations with and without high wind natural events that caused exceedances from 2007-2011. The analysis excludes only those high wind events that resulted in an exceedance. Data for PM_{10} in this table includes FRM Wedding and FEM TEOM measurements and data for $PM_{2.5}$ comes from the FRM Partisol measurements from 2007-2011. The recorded values for this day (522, 483, 1099, 657, 314, 611, 302 µg PM_{10}/m^3 and 84.5 µg $PM_{2.5}/m^3$) are above the maximum values recorded when no high wind exceedances are included and is above the 95^{th} percentile of all 24-hour averages recorded.

An hourly data distribution analysis was performed for PM_{10} and $PM_{2.5}$ concentrations, wind speeds and wind gusts (Appendices C, D and E). All data used for the PM_{10} distribution charts come from the FEM TEOM monitors and the non-FEM/FRM $PM_{2.5}$ TEOM monitor at SPCY. Overlaying the hourly data for March 7, 2012 on the hourly data distribution plots shows that the values recorded during the high wind event exceed the 95^{th} percentile for PM_{10}, $PM_{2.5}$, wind speed and wind gusts (Figures 7-6a-h through 7-8a-g). The top whiskers of the box and whisker plots represent the 95^{th} percentile of data. The hourly PM_{10} values during the high wind blowing dust storm far exceed the historical 95^{th} percentile of data.

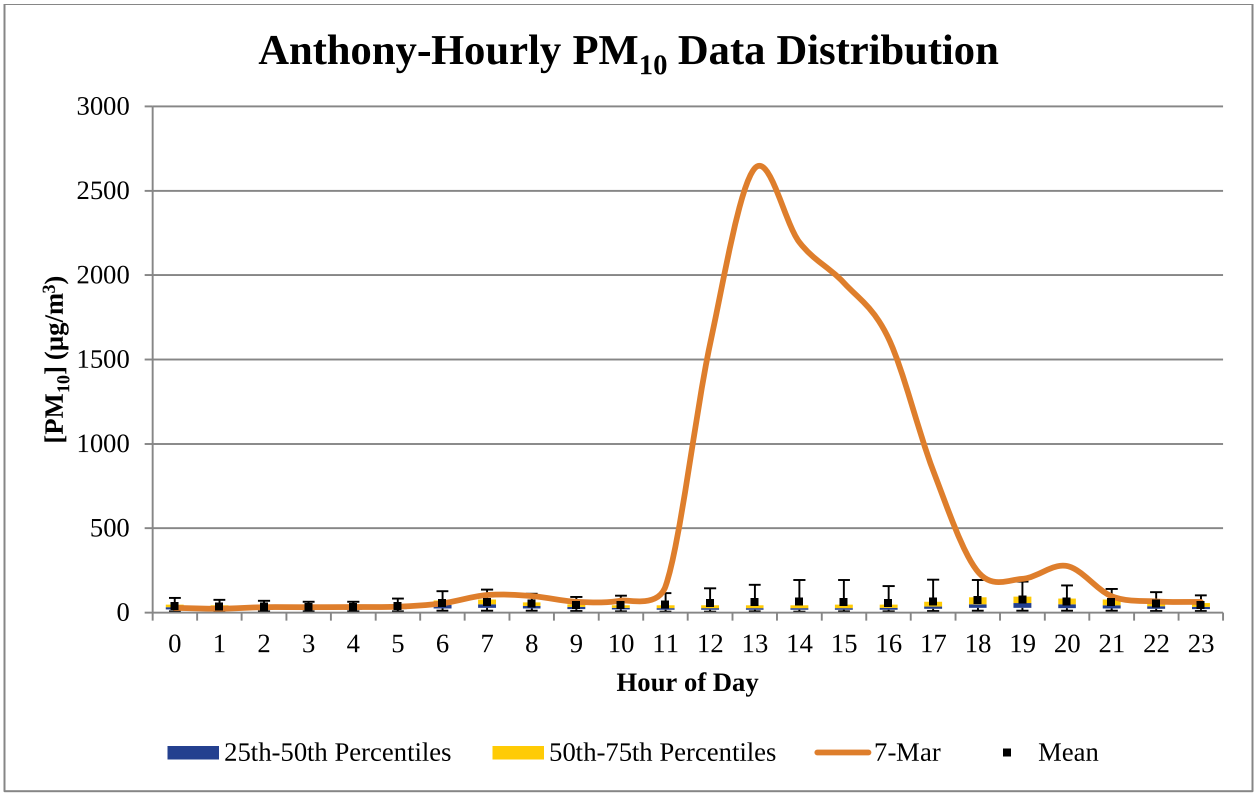


Figure 7-6a. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

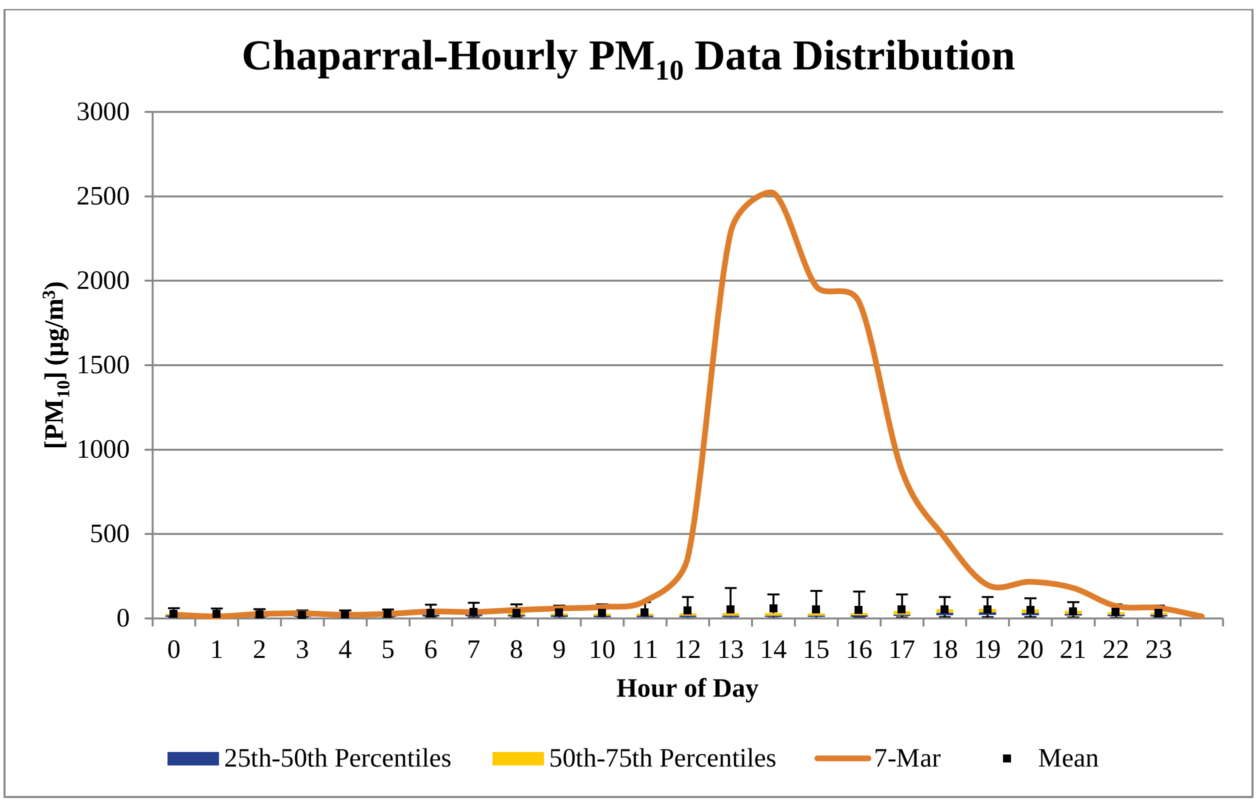


Figure 7-6b. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

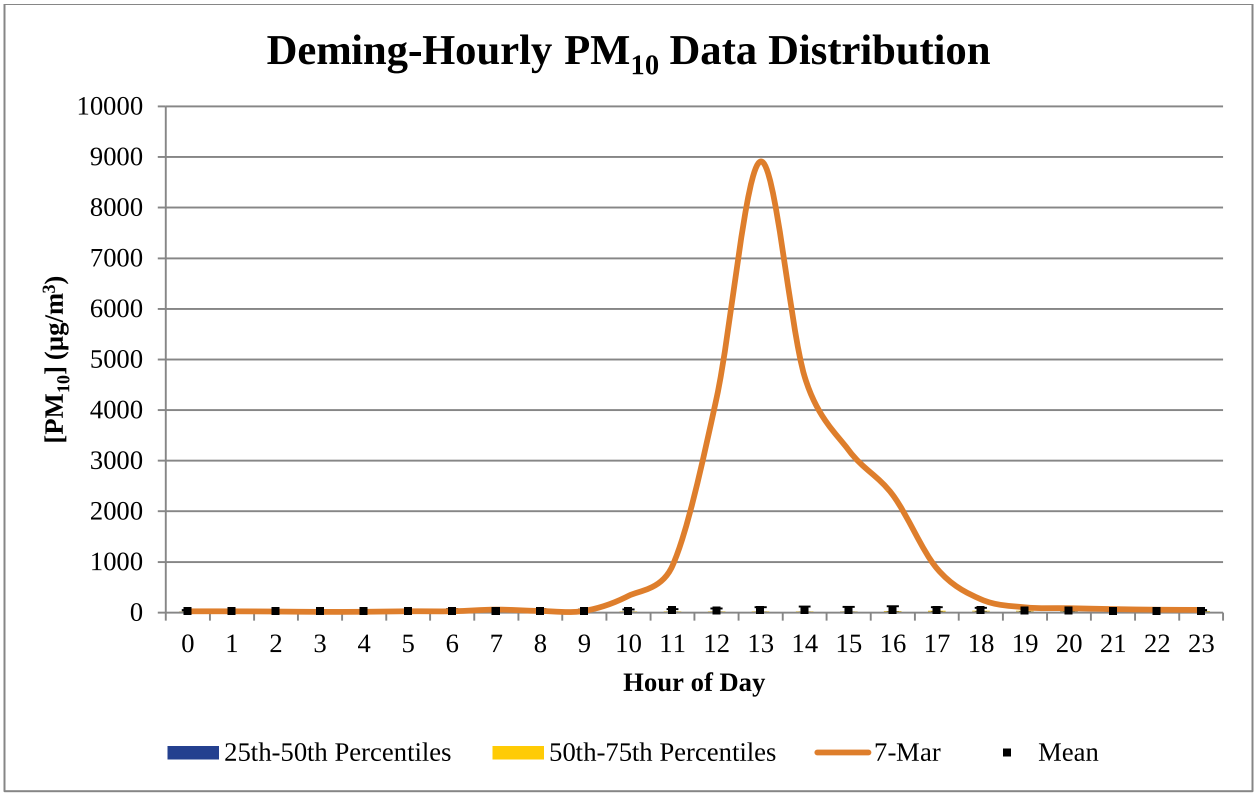


Figure 7-6c. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

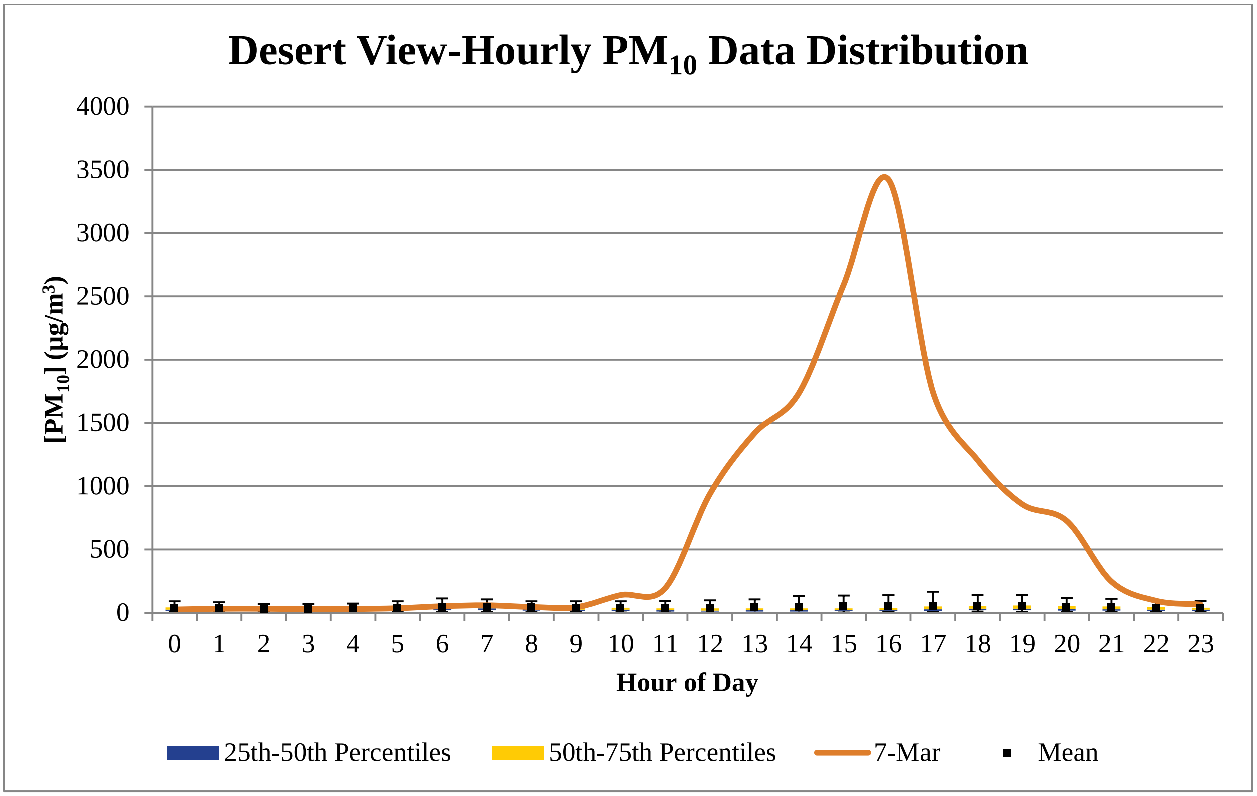


Figure 7-6d. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

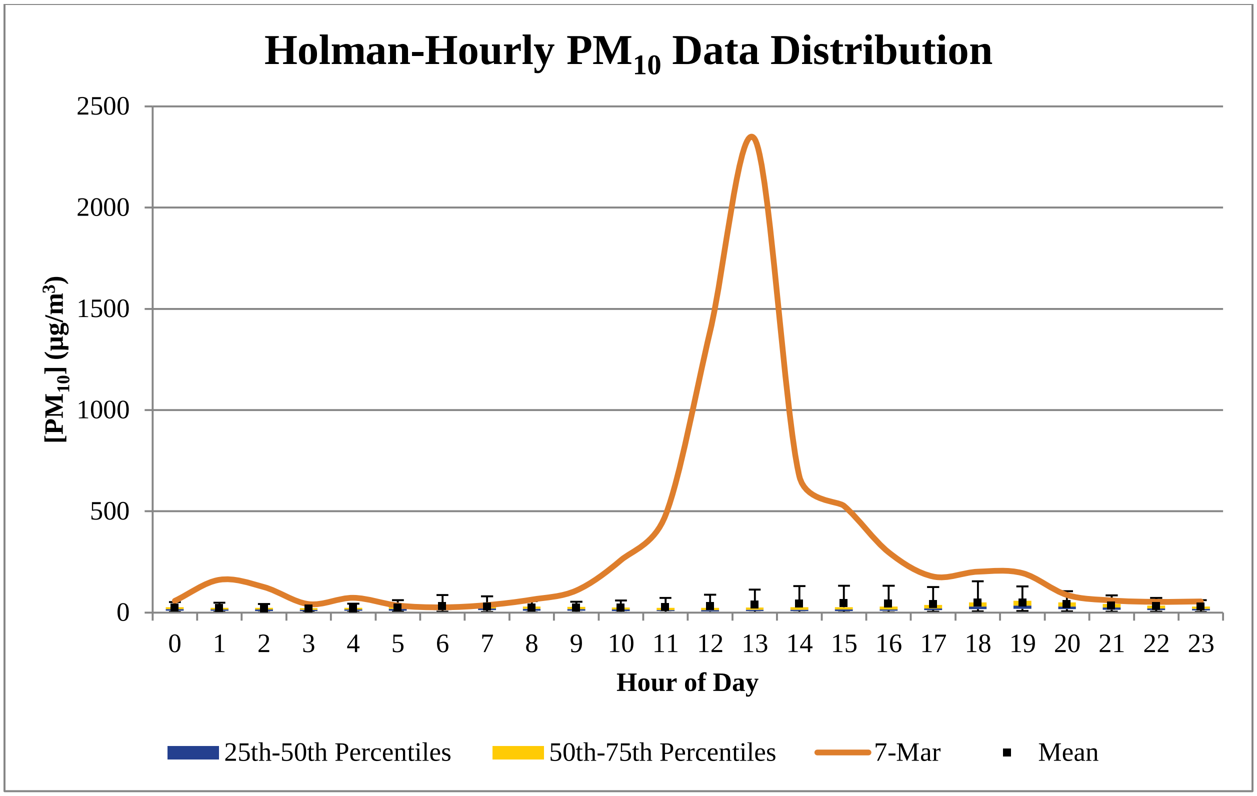


Figure 7-6e. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

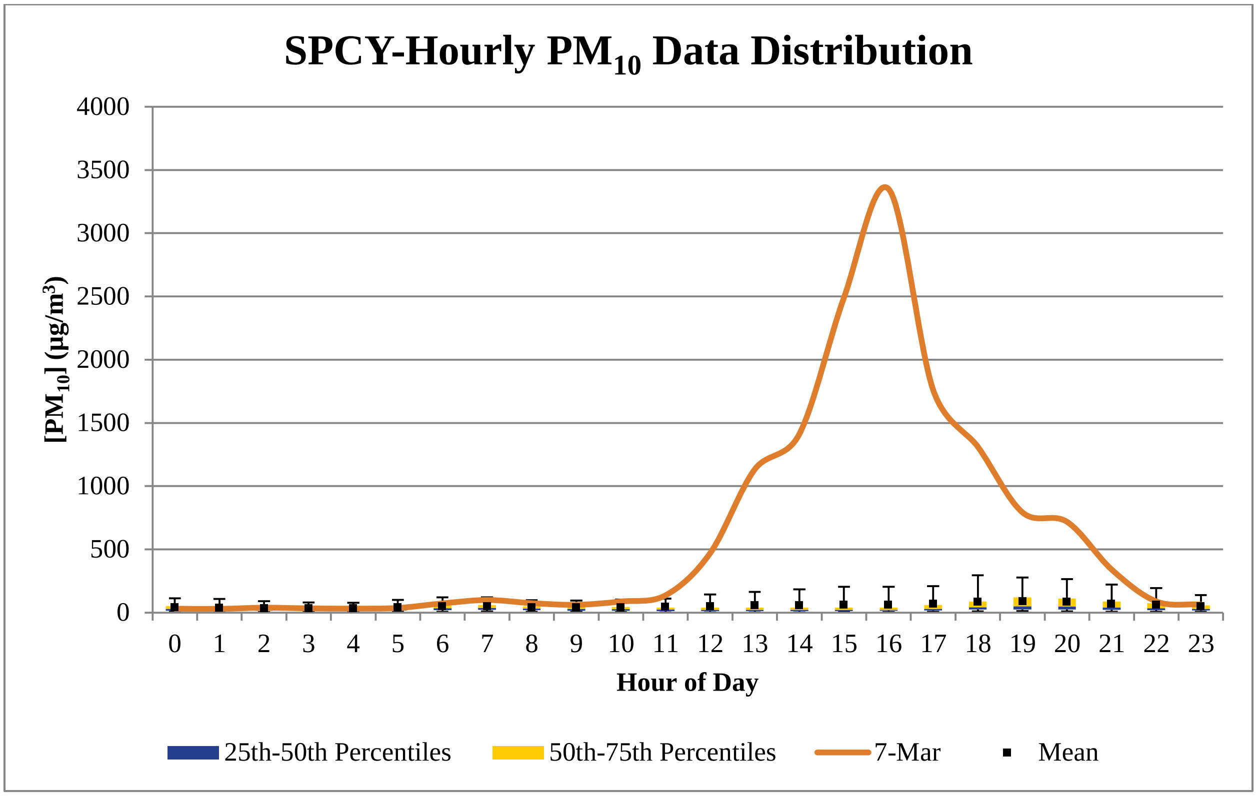


Figure 7-6f. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

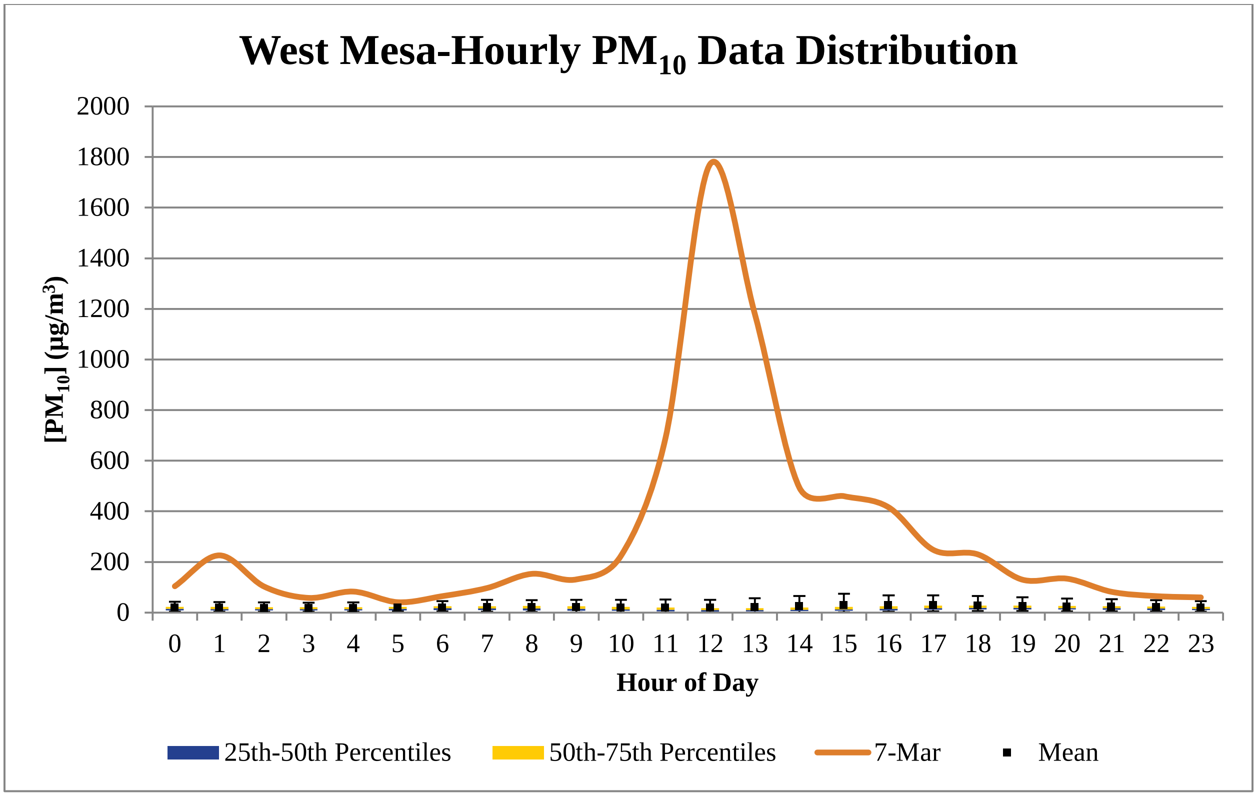


Figure 7-6g. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

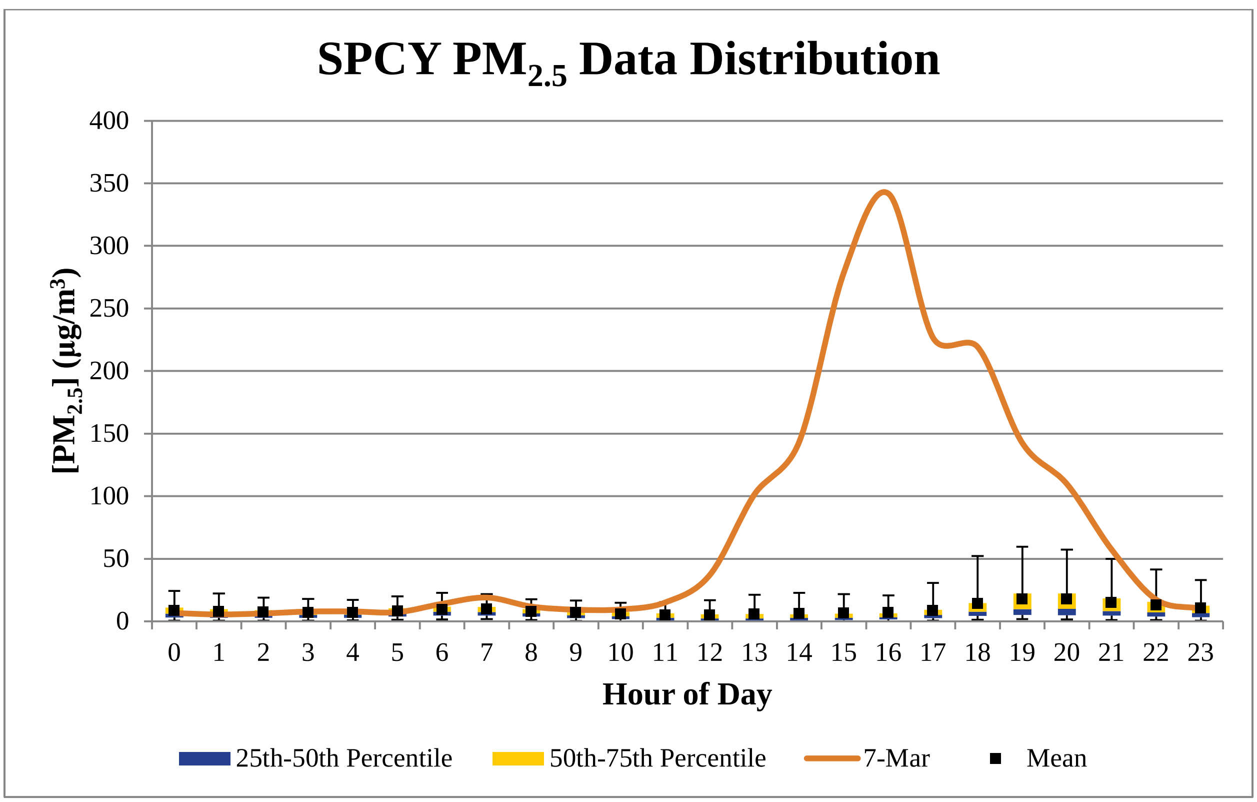


Figure 7-6h. $PM_{2.5}$ hourly data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

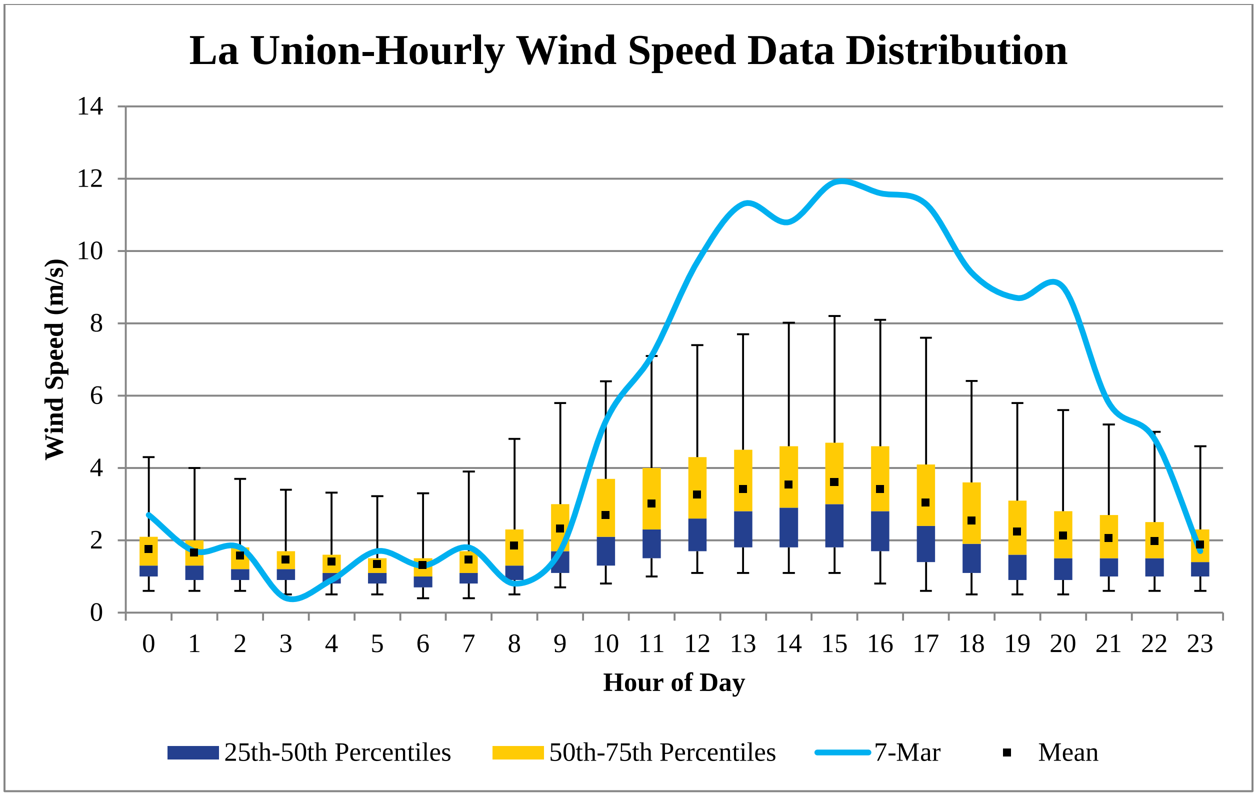


Figure 7-7a. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

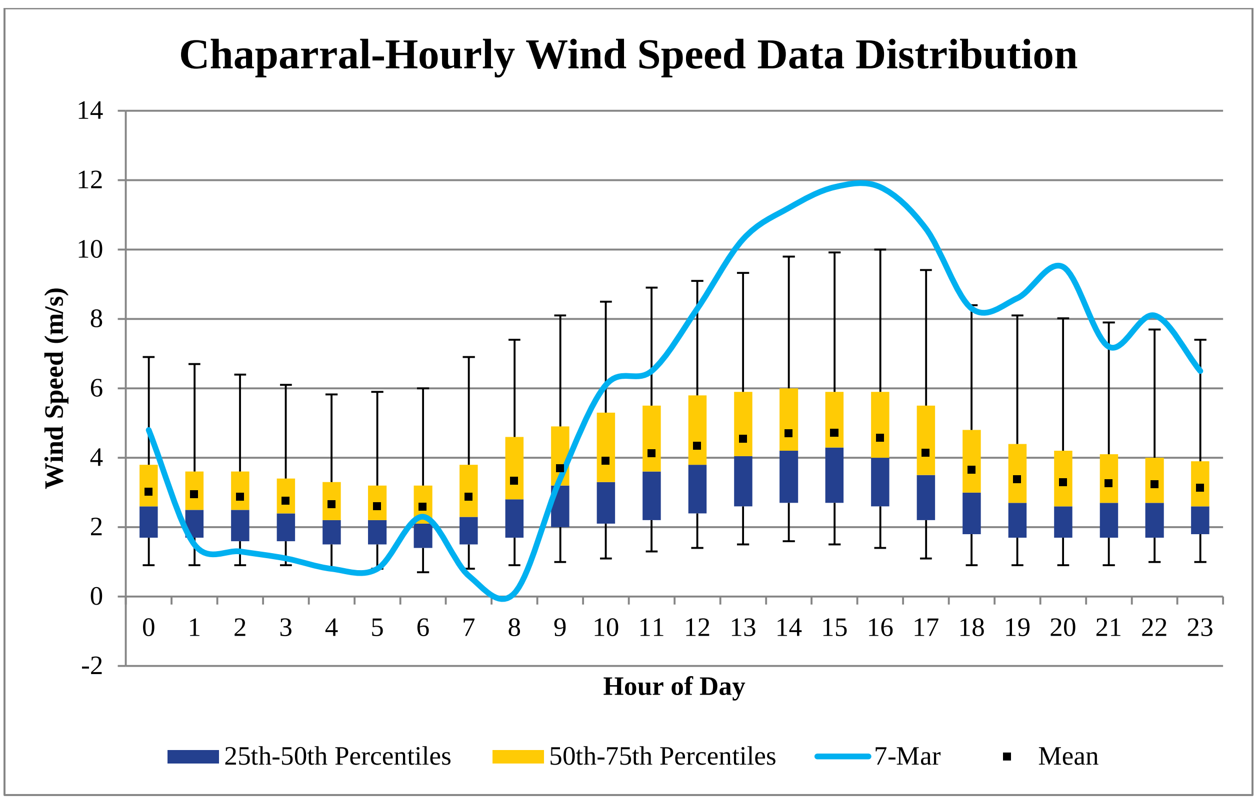


Figure 7-7b. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

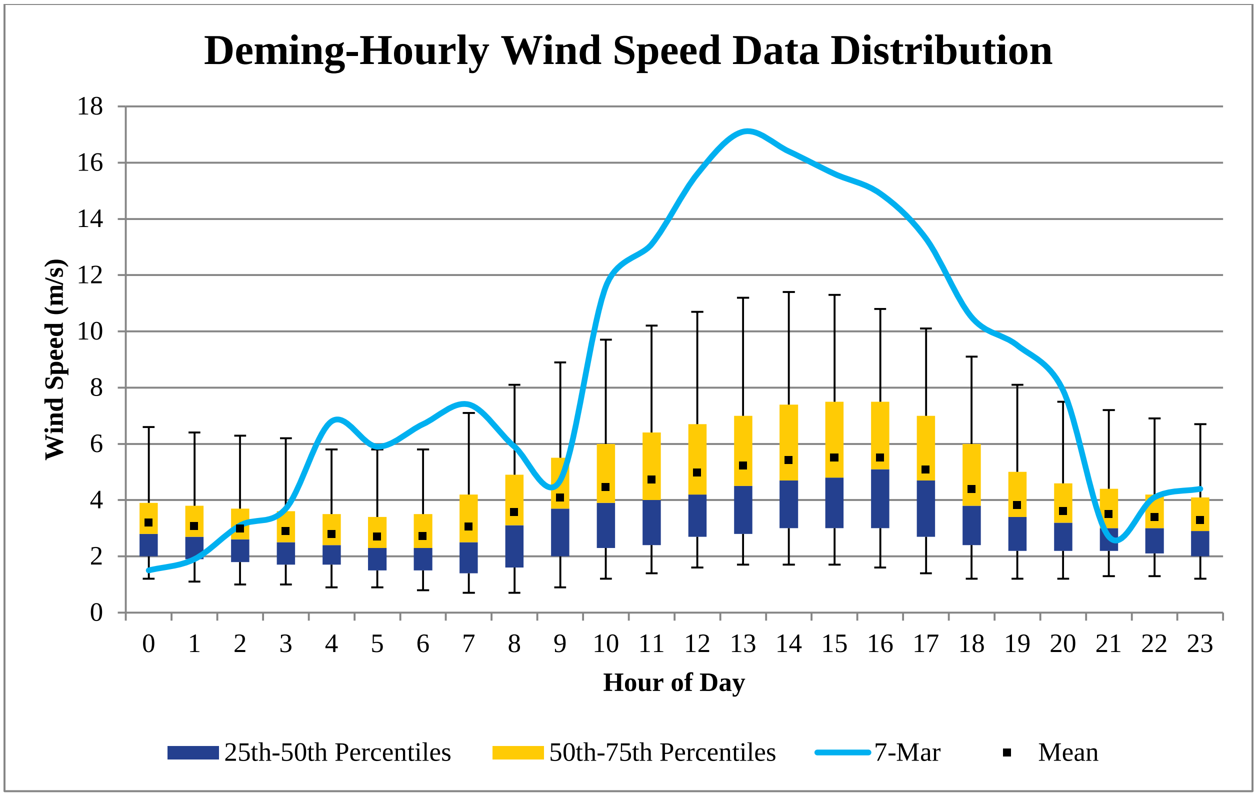


Figure 7-7c. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

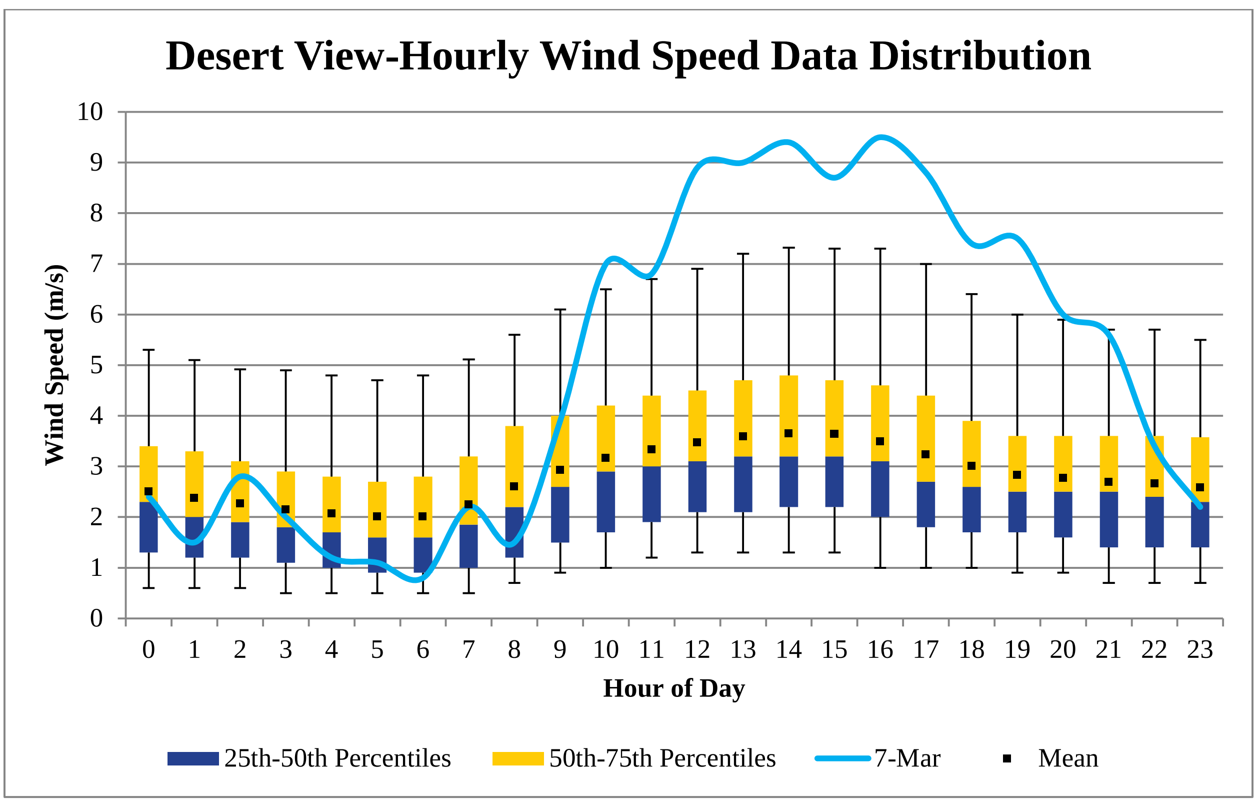


Figure 7-7d. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

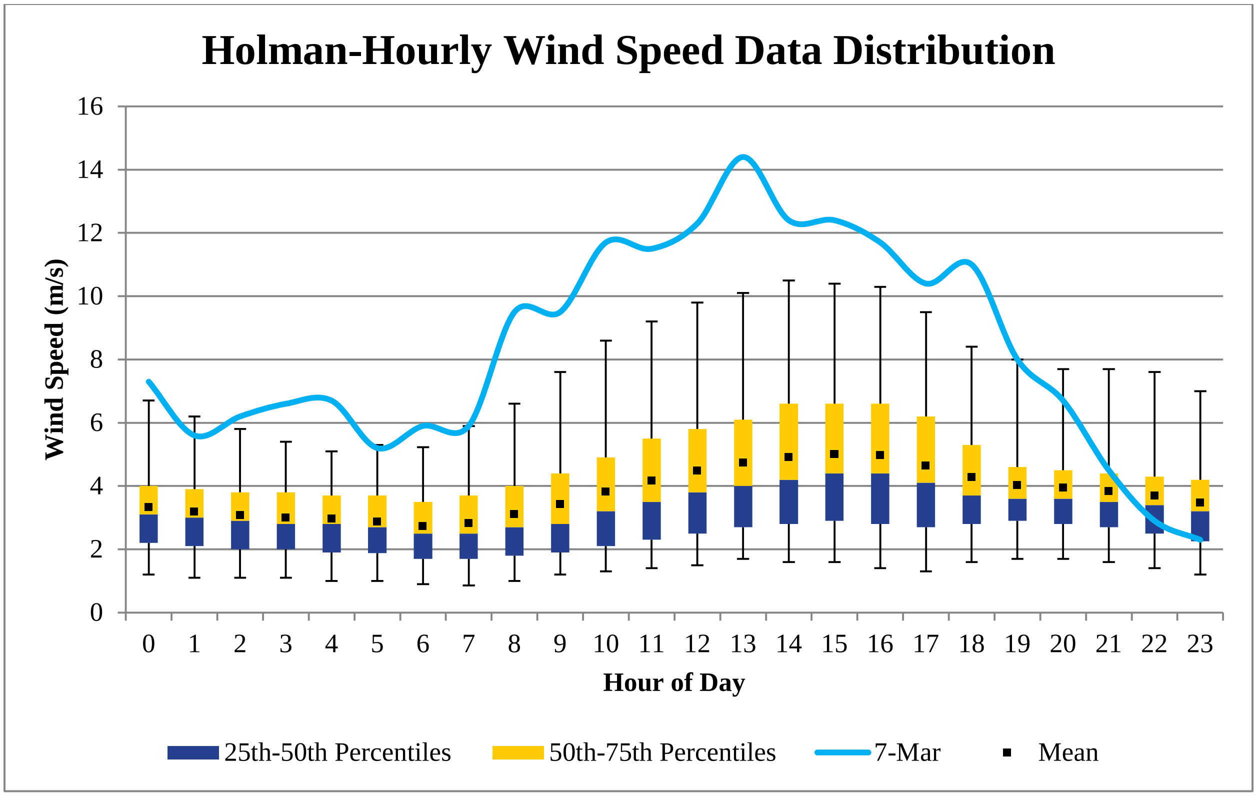


Figure 7-7e. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

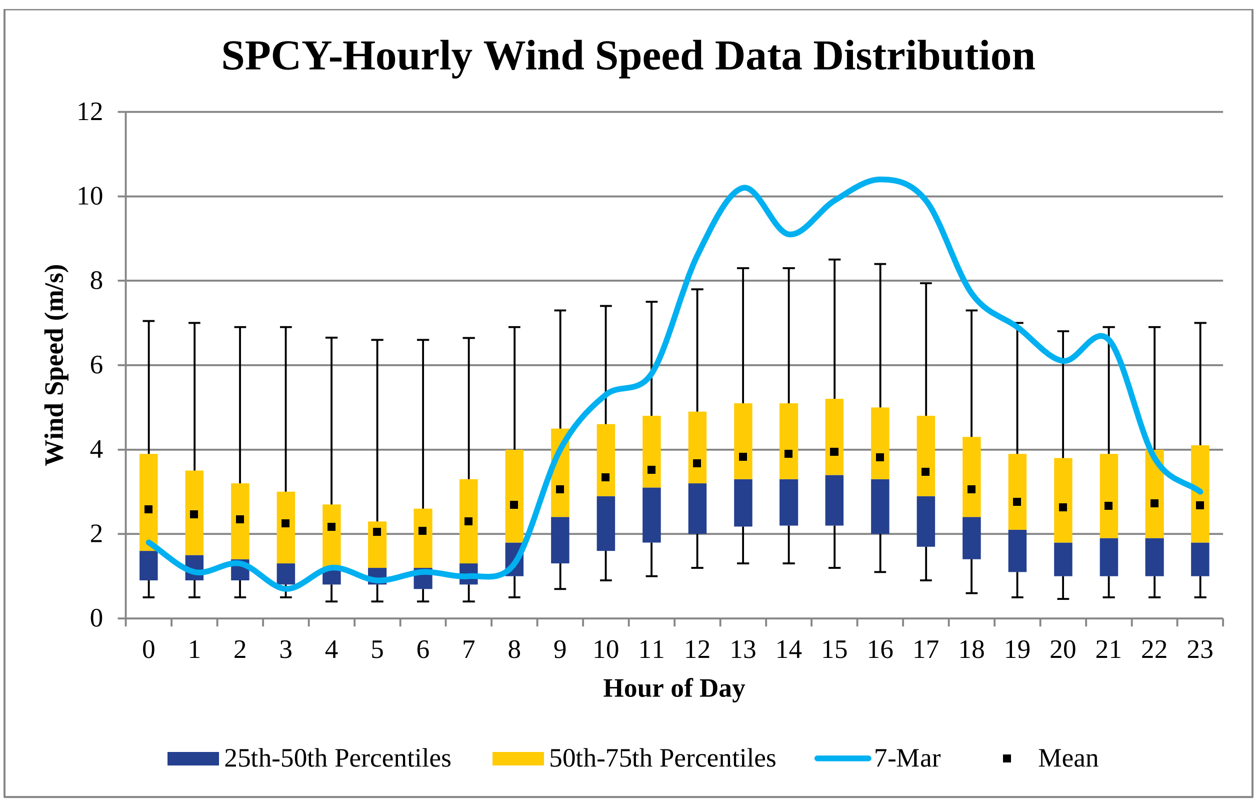


Figure 7-7f. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

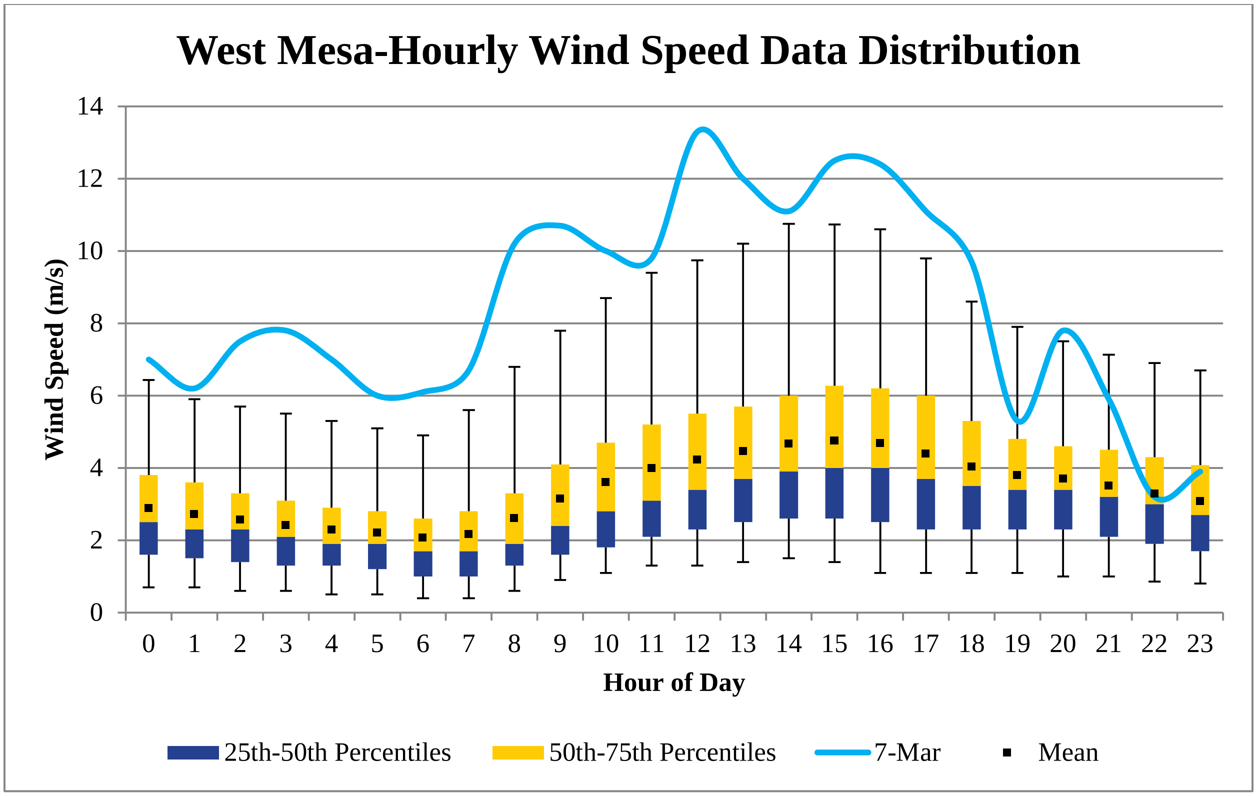


Figure 7-7g. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

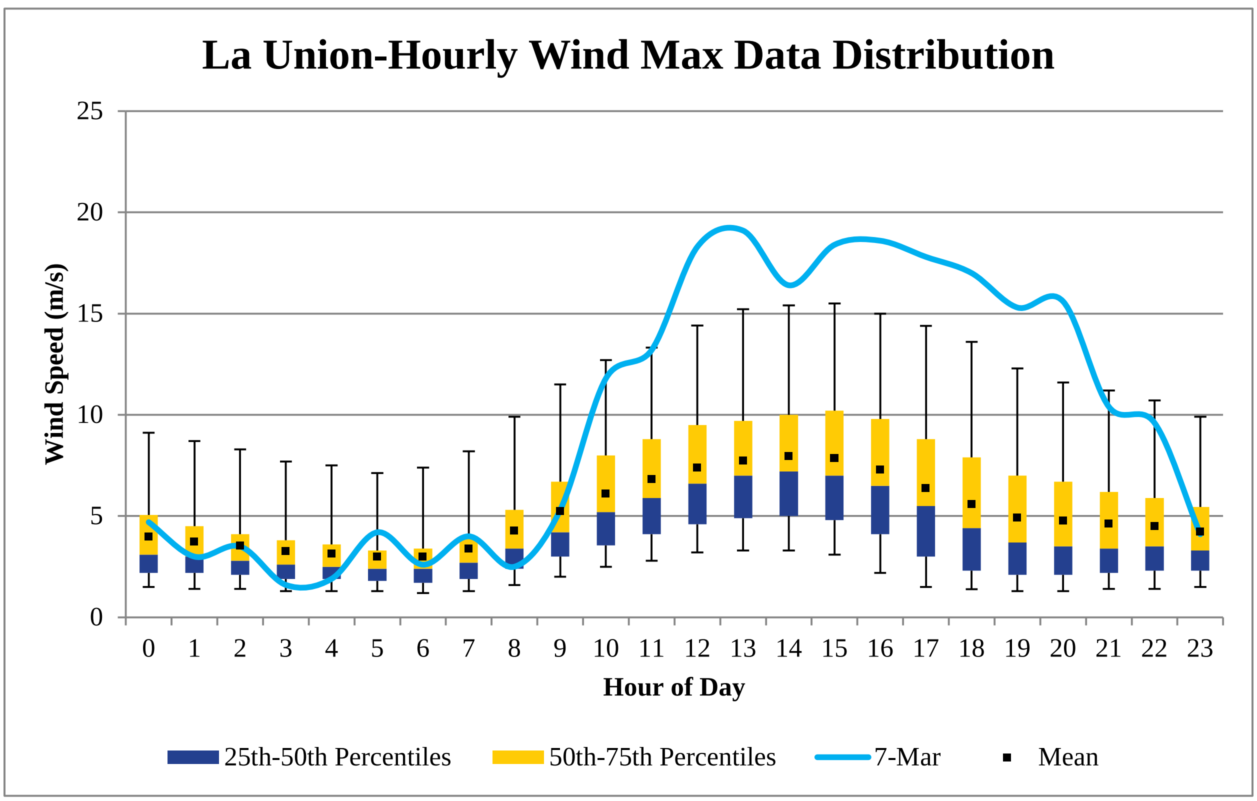


Figure 7-8a. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

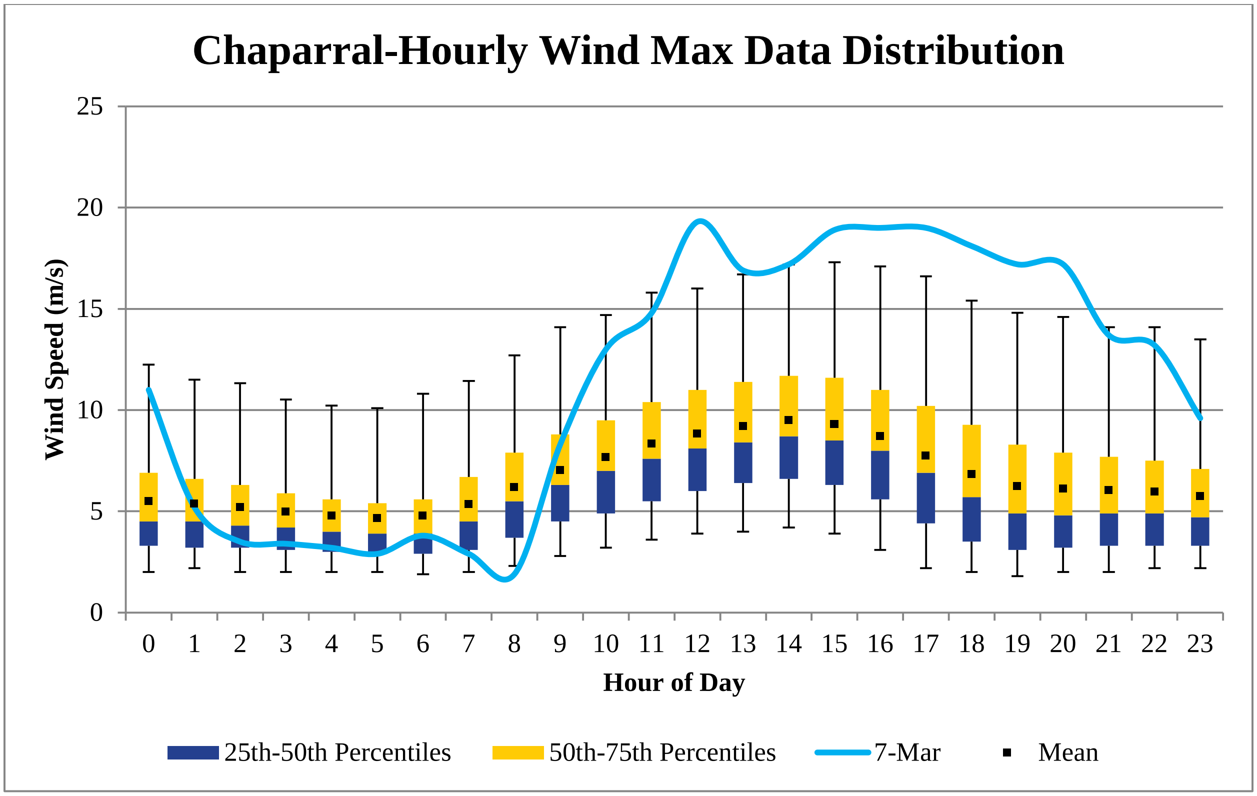


Figure 7-8b. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

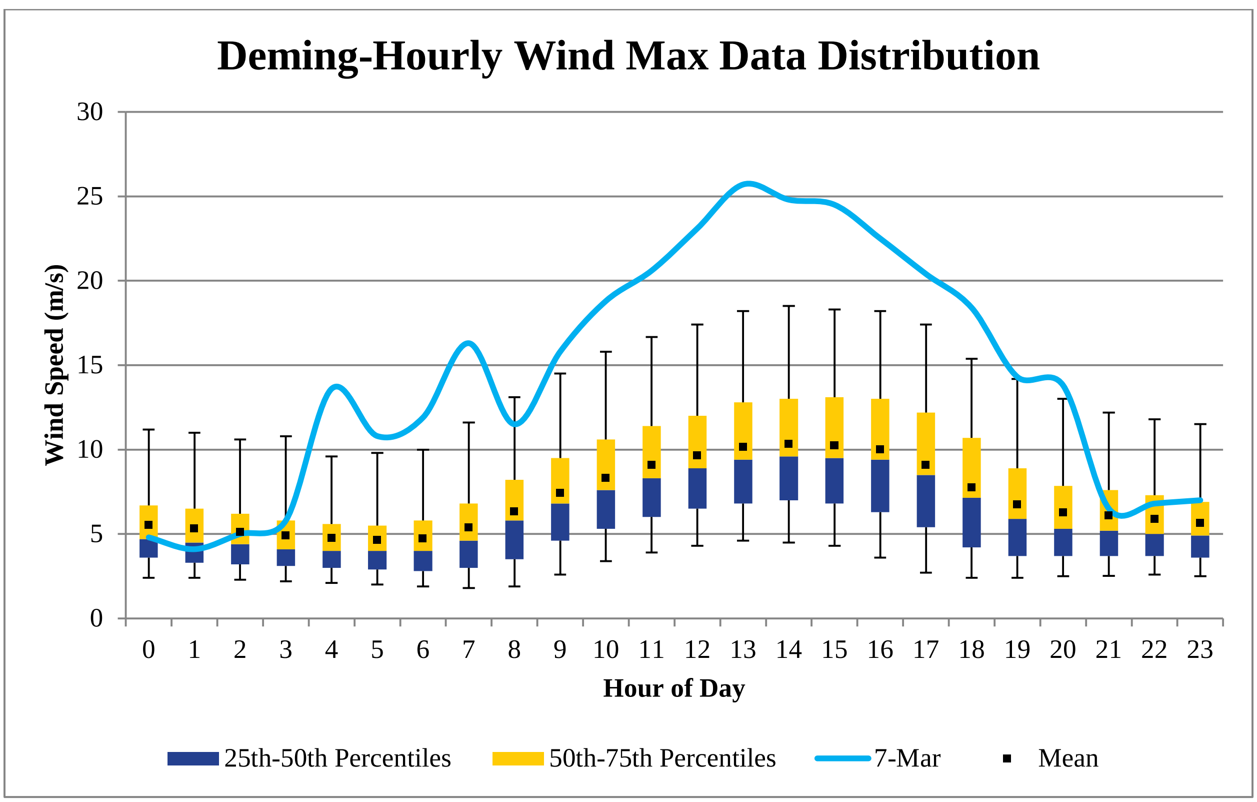


Figure 7-8c. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

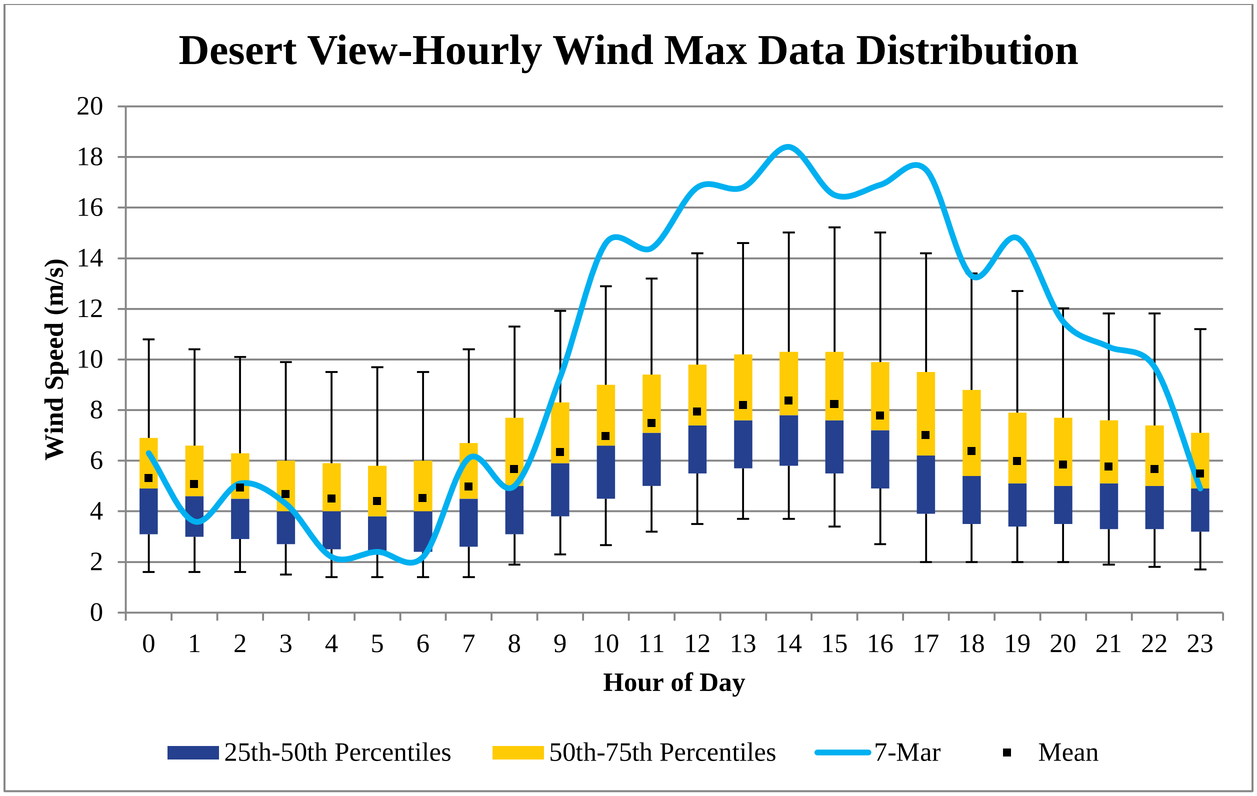


Figure 7-8d. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

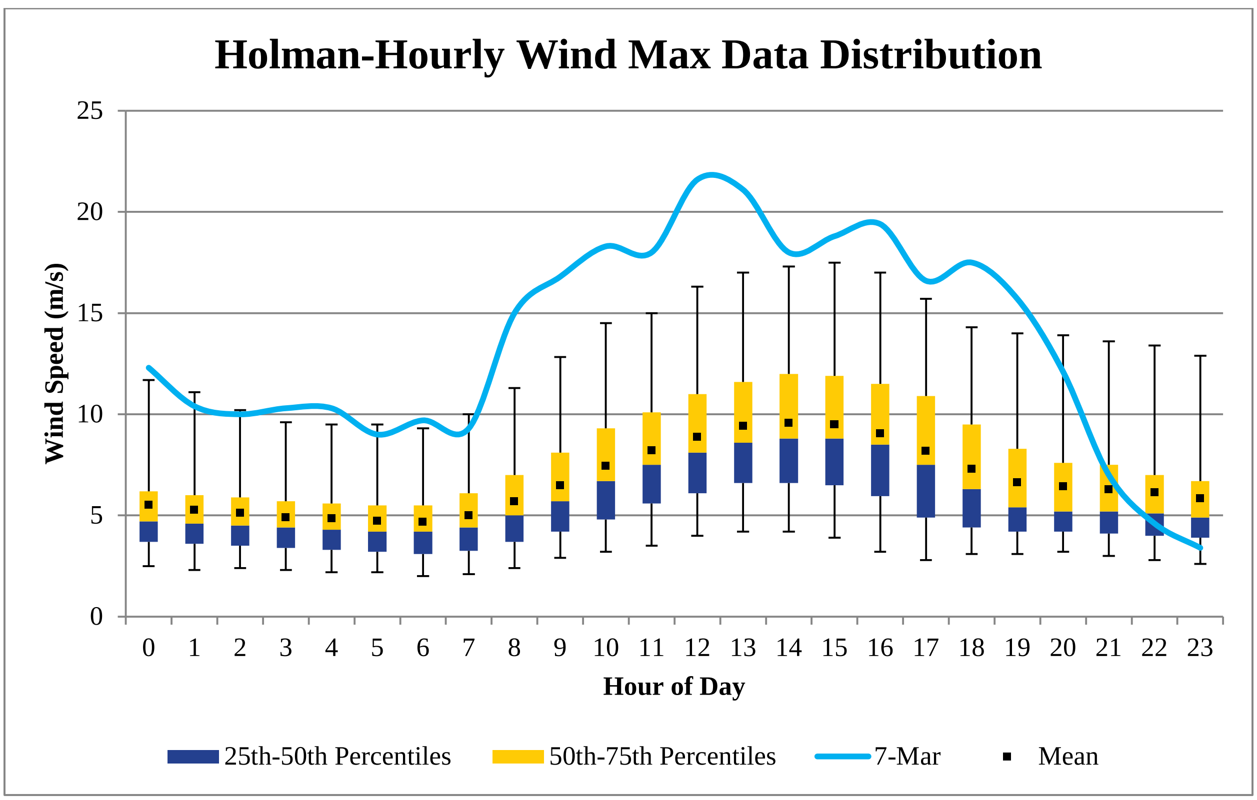


Figure 7-8e. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

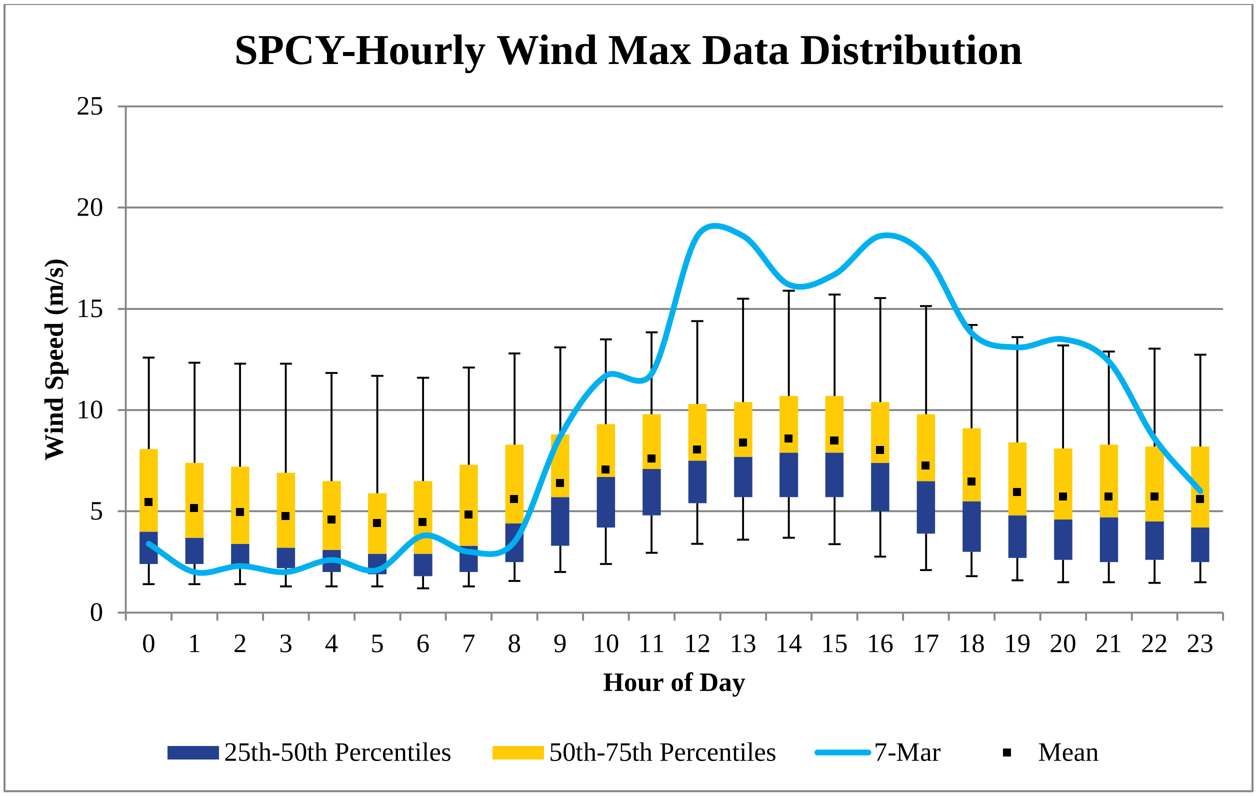


Figure 7-8f. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

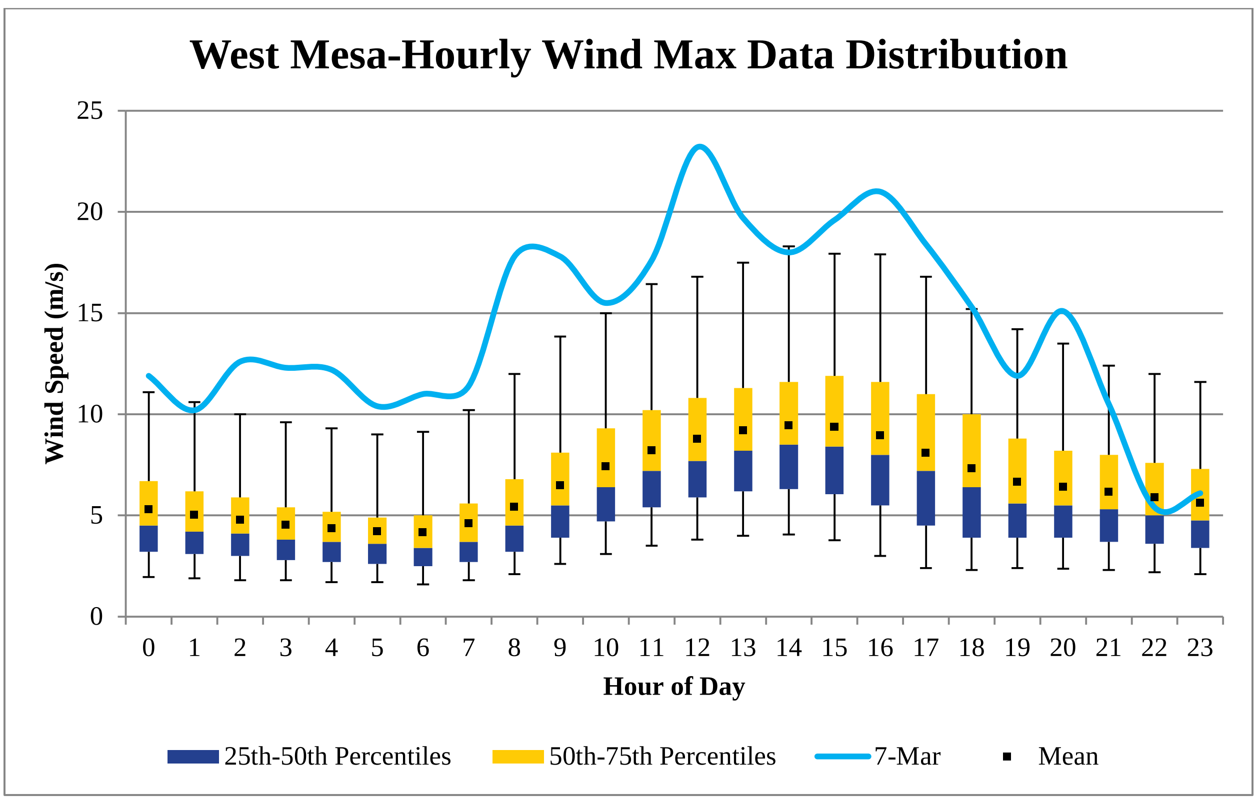


Figure 7-8g. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 7, 2012.

7.4 Clear Causal Relationship

A strong Pacific storm system and cold front passed through New Mexico on March 7, 2012. Prior to the arrival of the system and cold front an area of low pressure developed in northeastern New Mexico (Figure 7-9a). As the Pacific cold front approached New Mexico, a surface trough developed that tightened the pressure gradient and produced strong winds (Figure 7-9b). The wind direction in the upper atmosphere aligned with the surface wind direction and diurnal heating of the surface allowed winds aloft to mix downward, further increasing surface wind velocities and providing the turbulence required for vertical mixing and horizontal transport throughout the region (Figure 7-10).

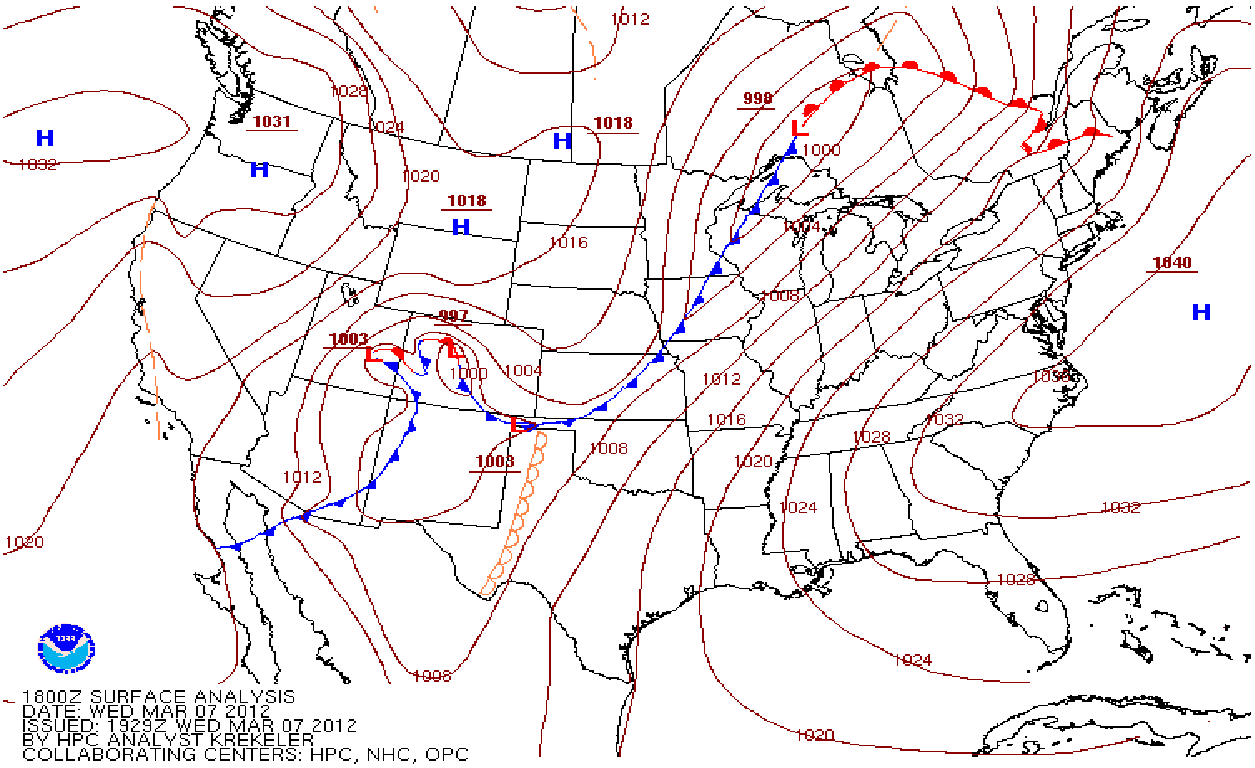


Figure 7-9a. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for March 7, 2012 at the 1100 hour.

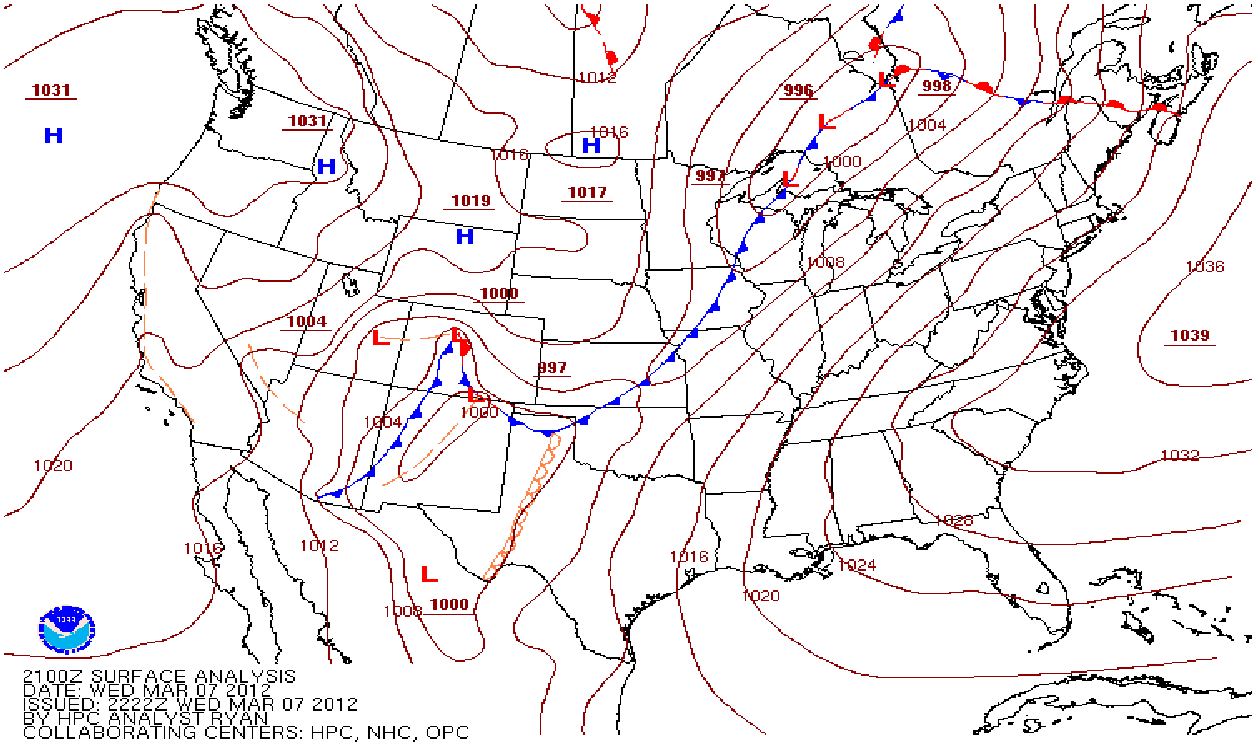


Figure 7-9b. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for March 7, 2012 at the 1400 hour.

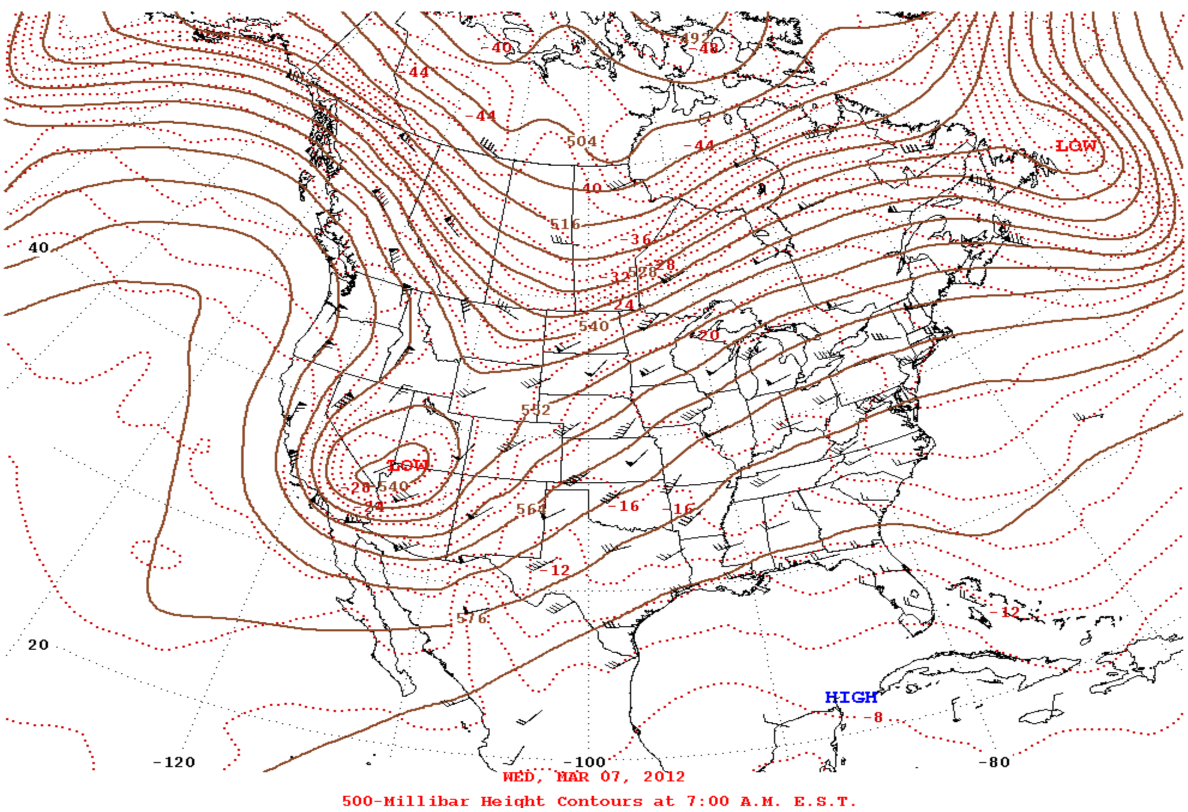


Figure 7-10. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on March 7, 2012.

The weather pattern described above generated strong south-southwesterly winds beginning at the 1000 hour and lasting through the 1800 hour. Beginning at the 1000 hour, wind speeds exceeded 11.2 m/s at Deming and Holman as shown in Figure 7-3. Peak wind speeds ranged from 10.4 m/s at Sunland Park to 17.1 m/s at Deming (Figure 7-3). Peak wind gusts ranged from 18.4 m/s at Desert View to 25.7 m/s at Deming (Figure 7-4). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 7-11a-h. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (1000-2100 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 7-12a-b). Maximum one hour PM_{10} concentrations ranged from 1772 µg/m^3 at West Mesa to 8912 µg/m^3 at Deming. Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 7-13).

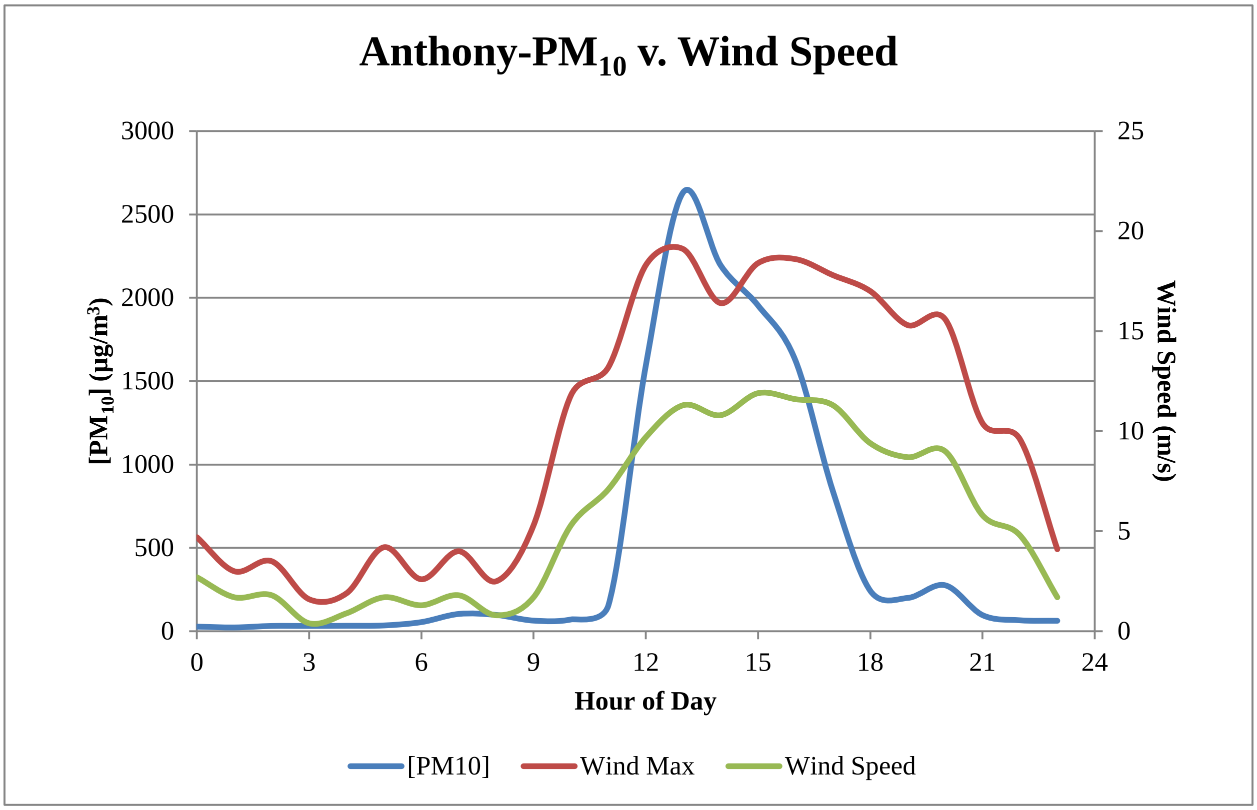


Figure 7-11a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

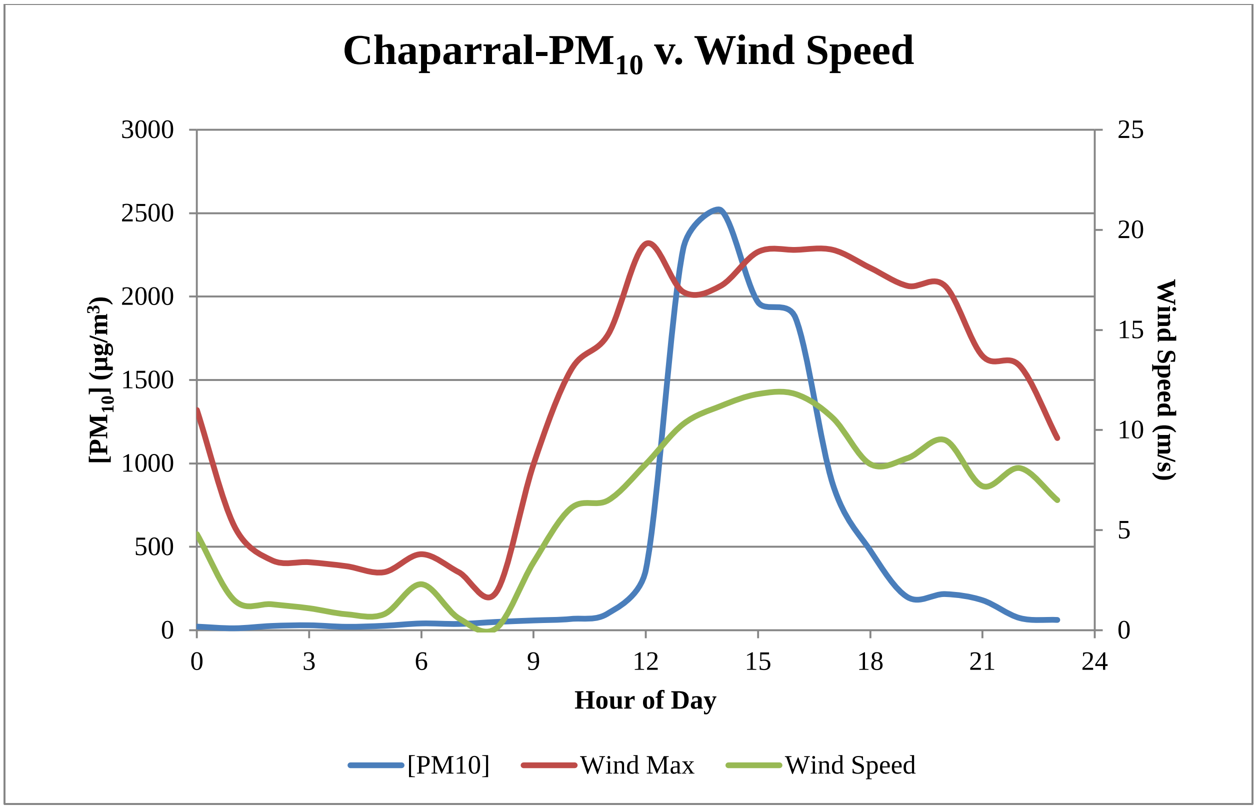


Figure 7-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

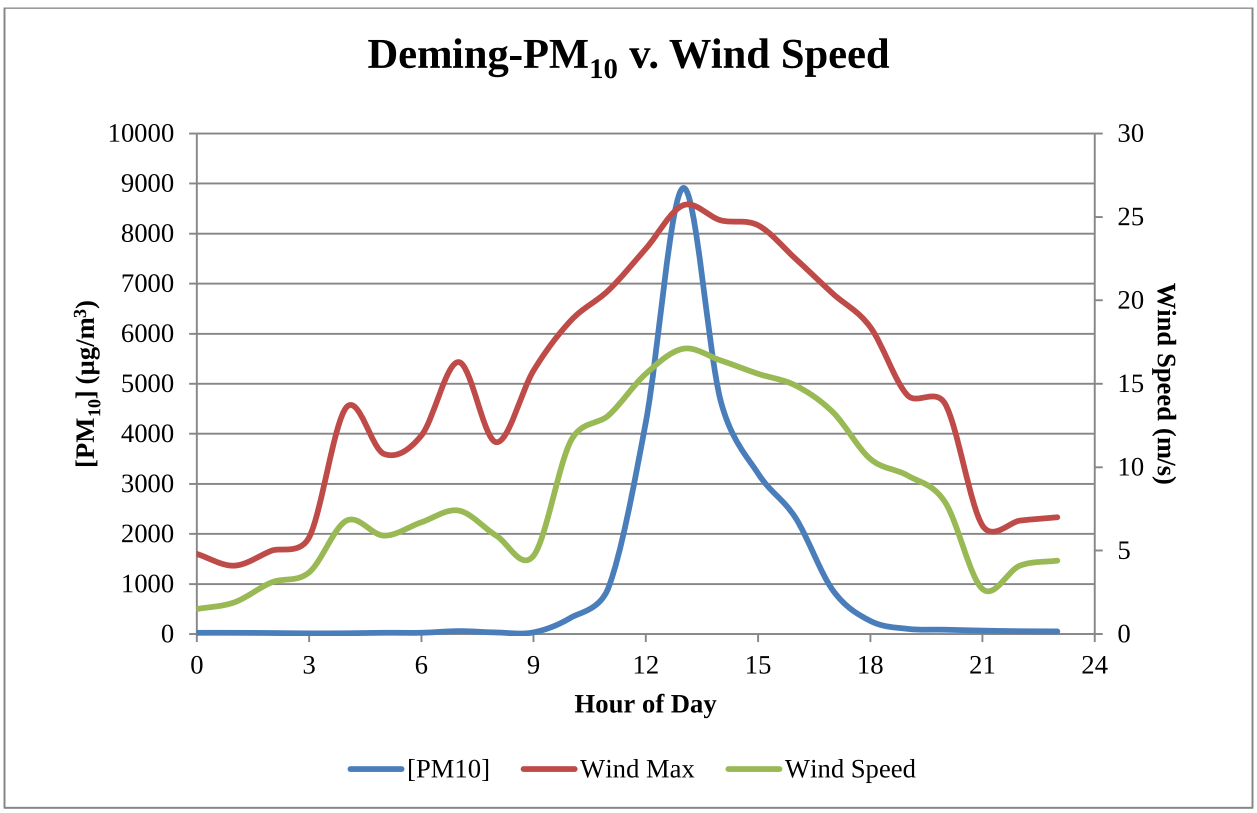


Figure 7-11c. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

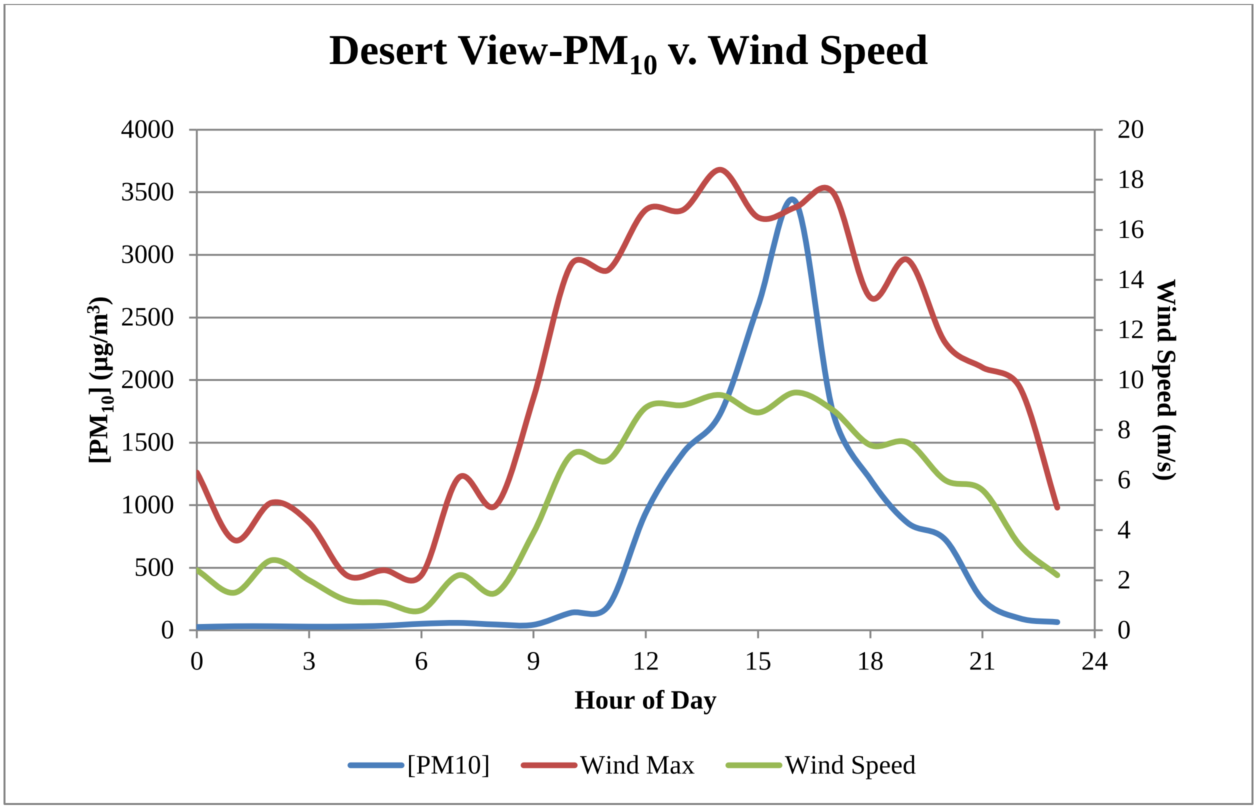


Figure 7-11d. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

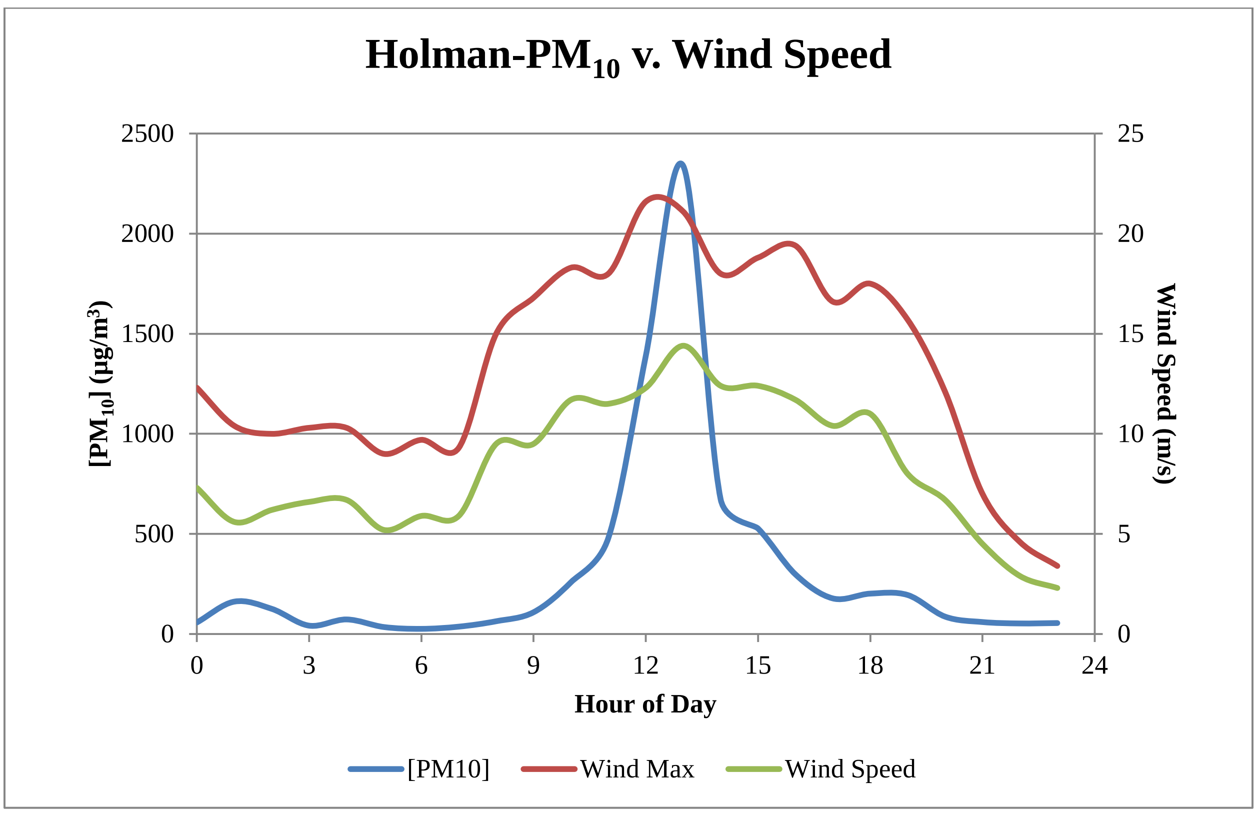


Figure 7-11e. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

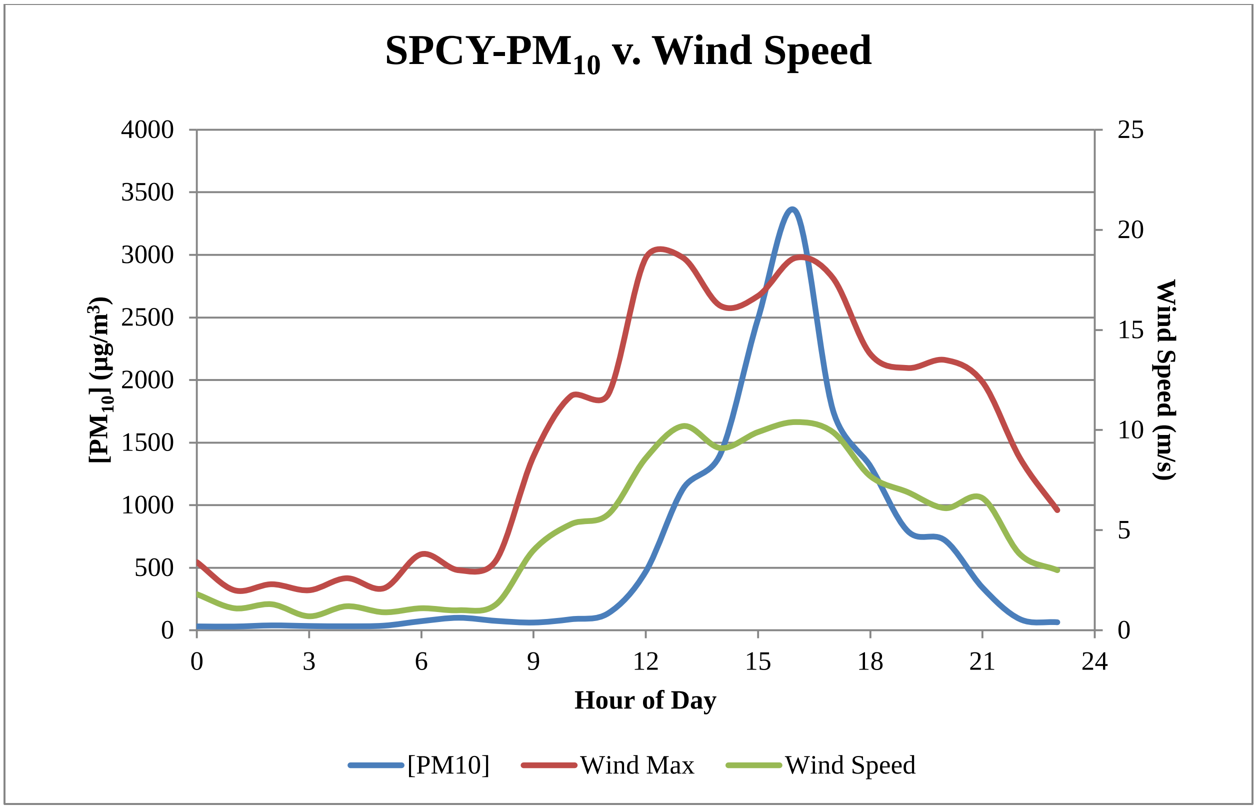


Figure 7-11f. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

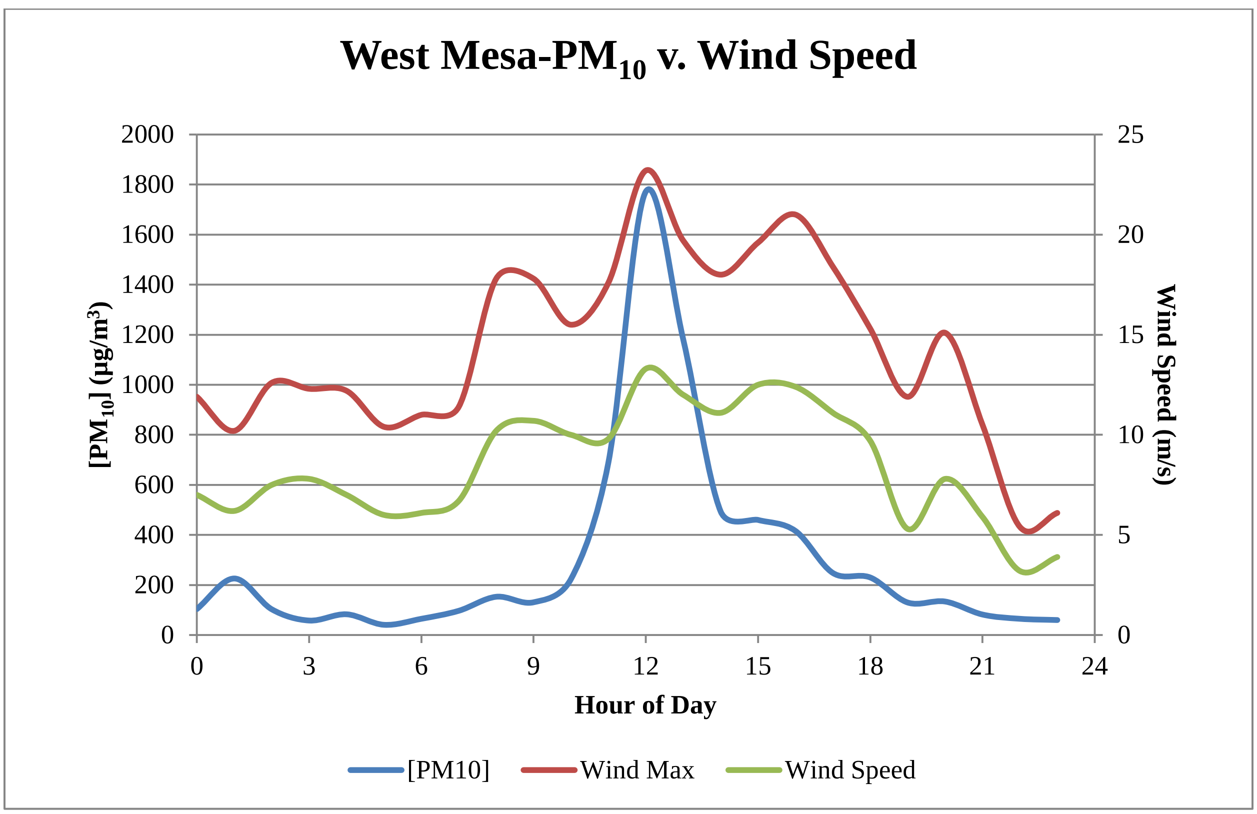


Figure 7-11g. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

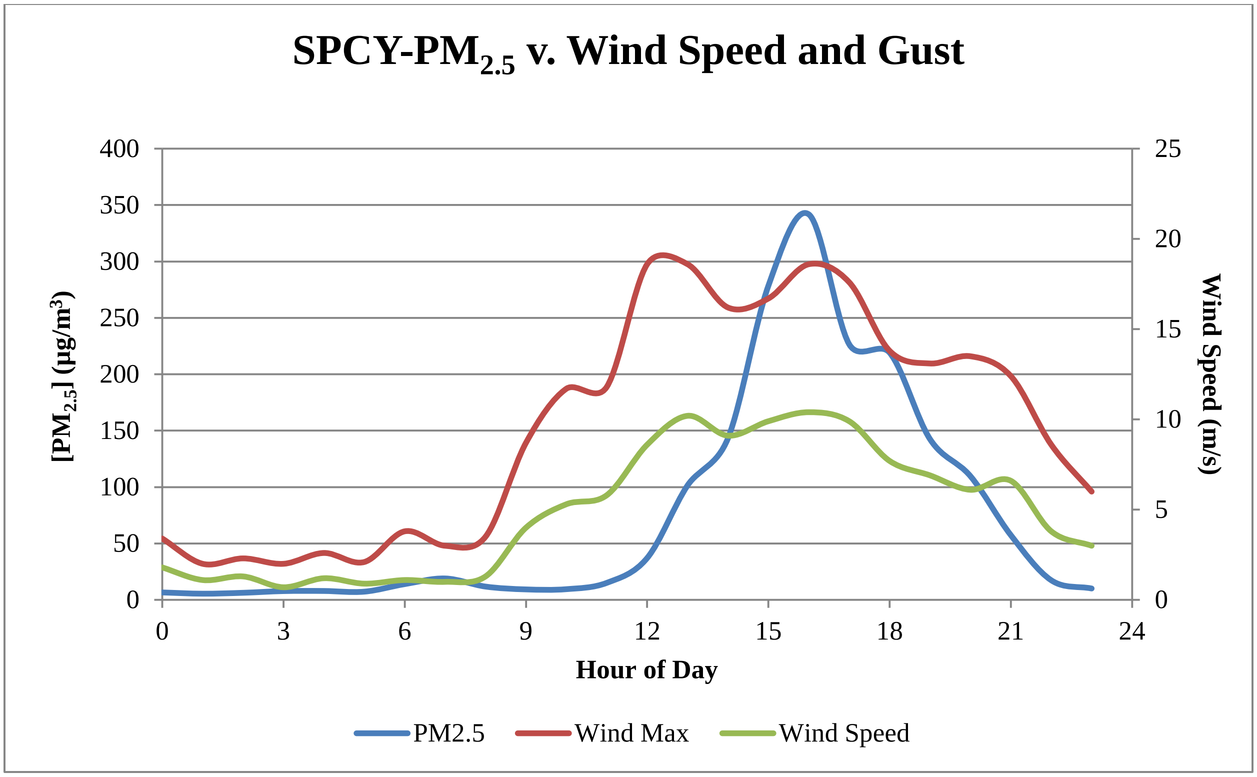


Figure 7-11h. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

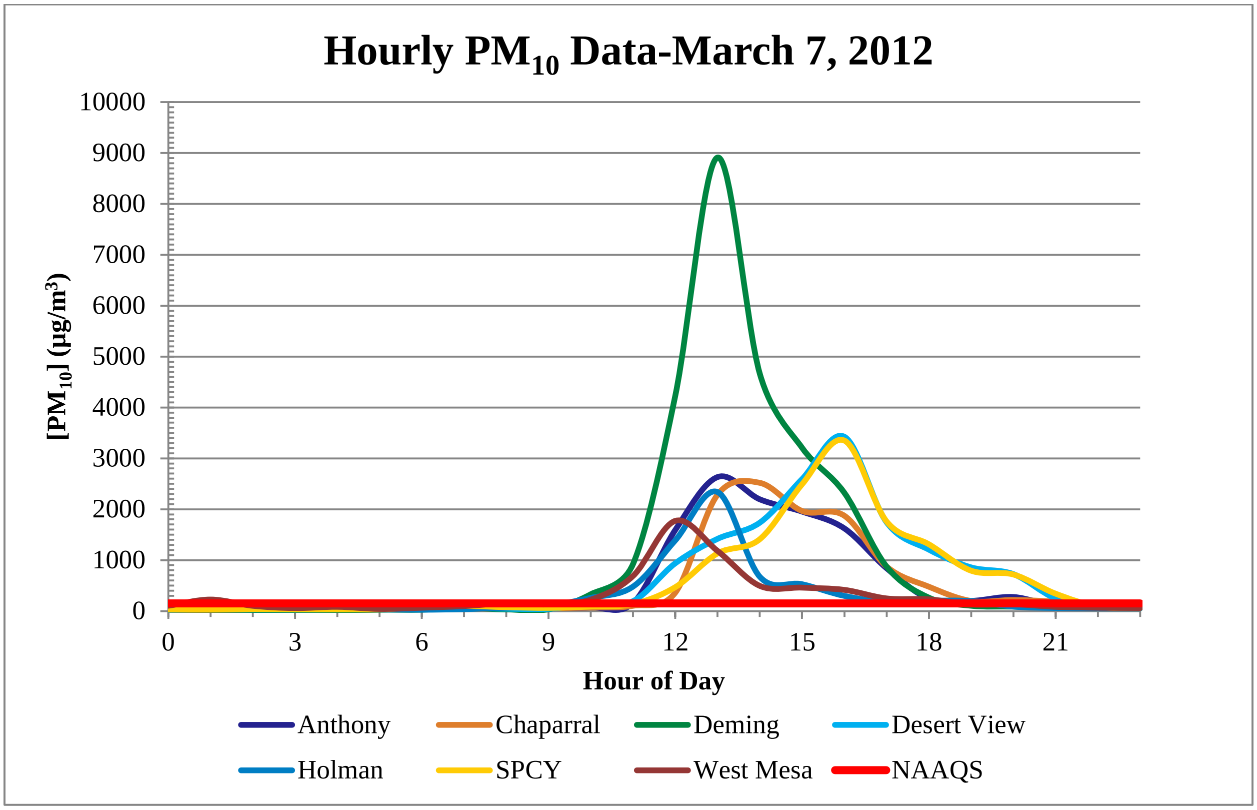


Figure 7-12a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

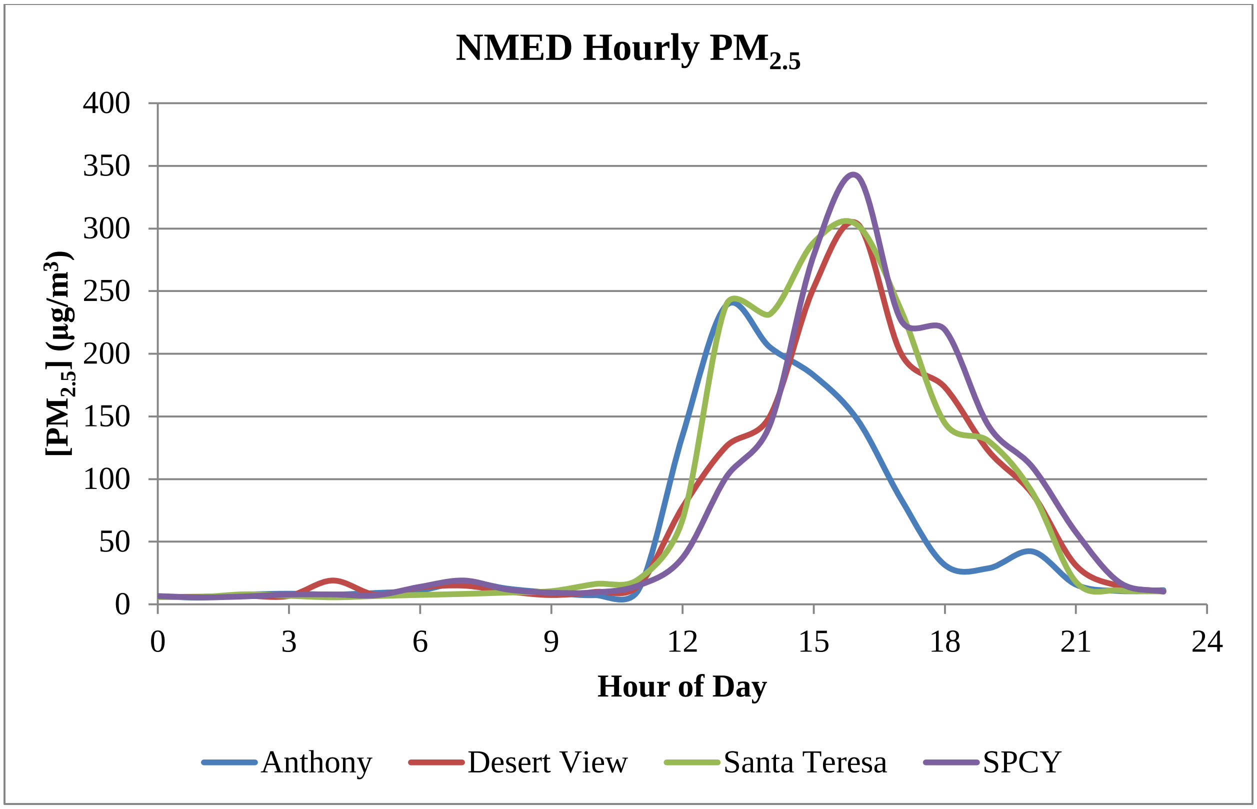


Figure 7-12b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors.

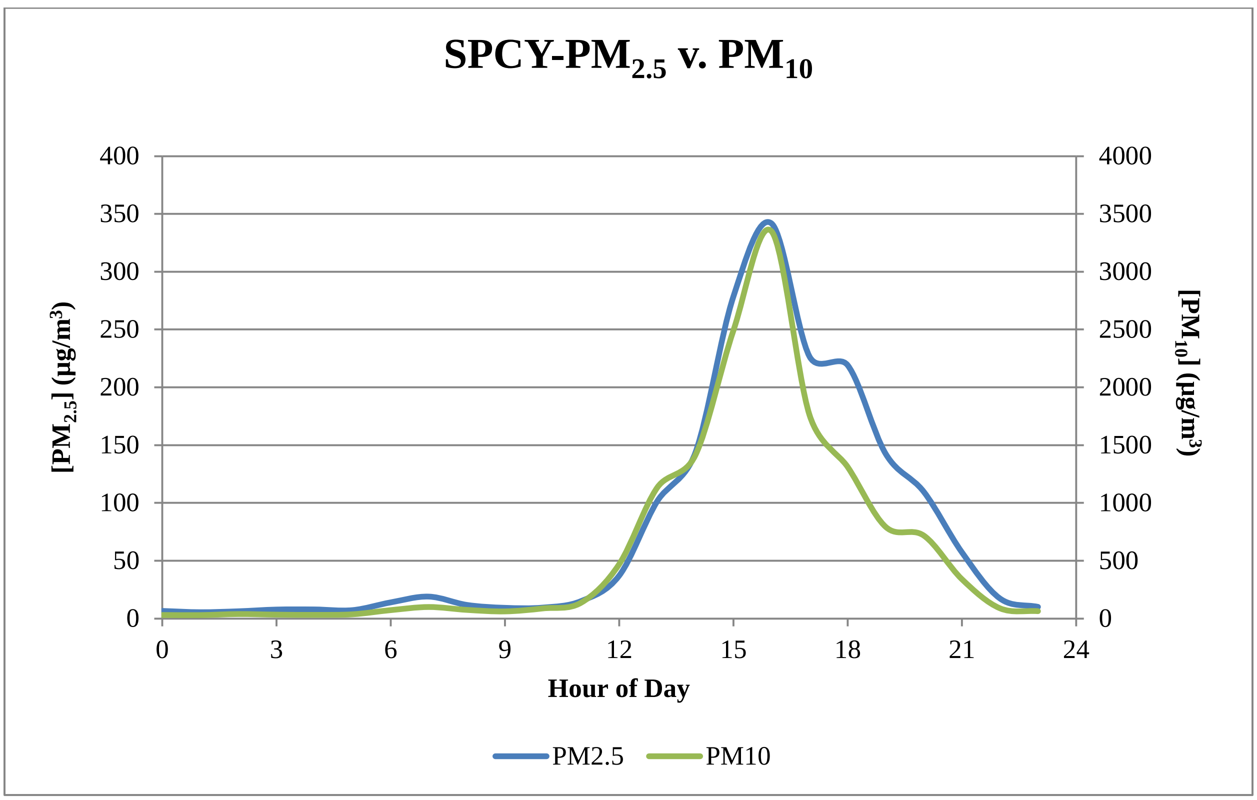


Figure 7-13. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on insert dateMarch 7, 2012.

The NM Border Air Quality Blog reported the following on March 7, 2012:

> 11:45 am: thick dust in Las Cruces with visibility less than a mile and decreasing
>
> 12:00 pm: highway 180 is closed from Hurley to Deming due to low visibility from dust. AQI at the Las Cruces west mesa station reach "Hazardous" level with hourly PM10 concentration of 690 µg/m3.
>
> 2:00 pm: I-10 is now CLOSED from Las Cruces to Lordsburg due to high winds, blowing dust w minimal visibility
>
> 4:30 pm: I-10 CLOSURE EXTENDED Las Cruces to AZ State line. Blowing dust w minimal visibility. Avoid travels until conditions change (DuBois, 2012)

Numerous satellite images captured large plumes of blowing dust covering the borderland and extending from northern Mexico into east-central New Mexico (Figures 7-14 and 7-15).

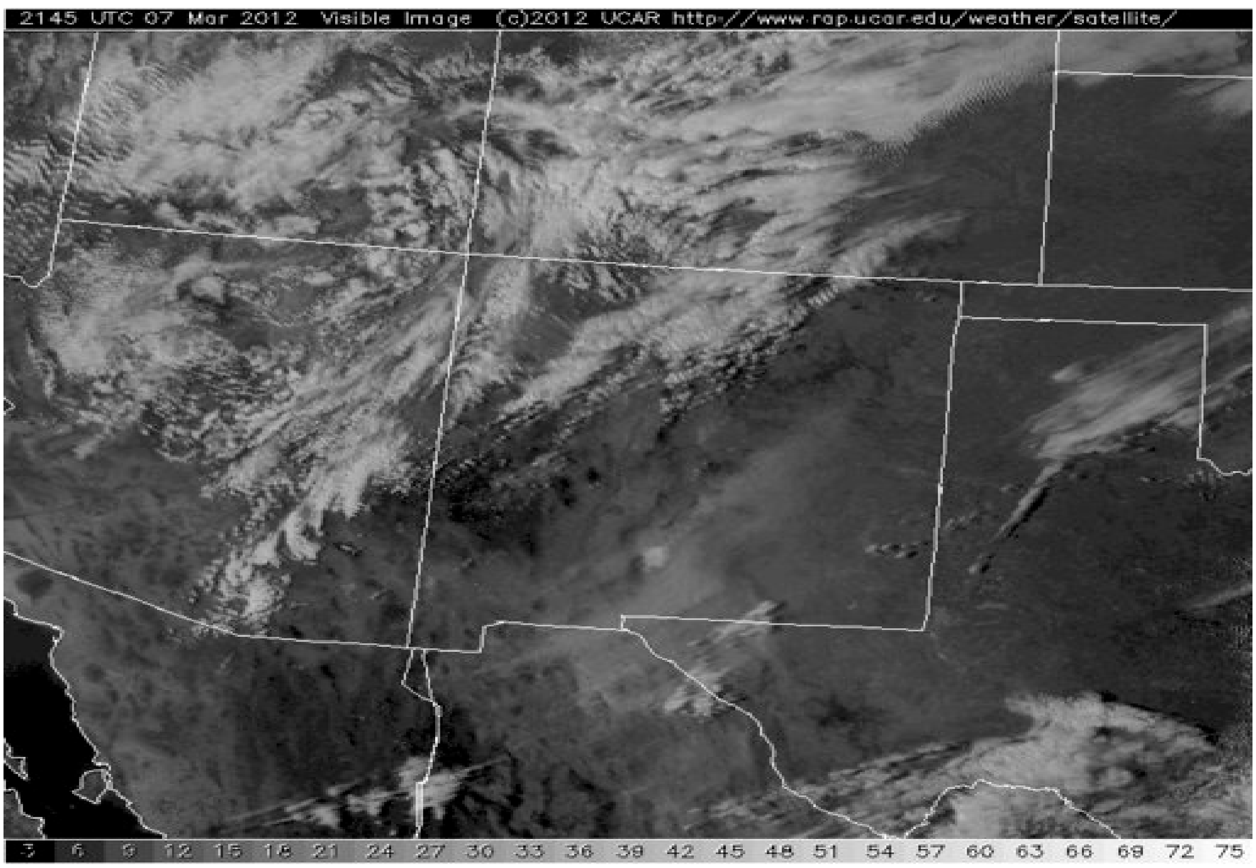


Figure 7-14. GOES Satellite image for March 7, 2012 at 1500h (Courtesy of UCAR and NASA).

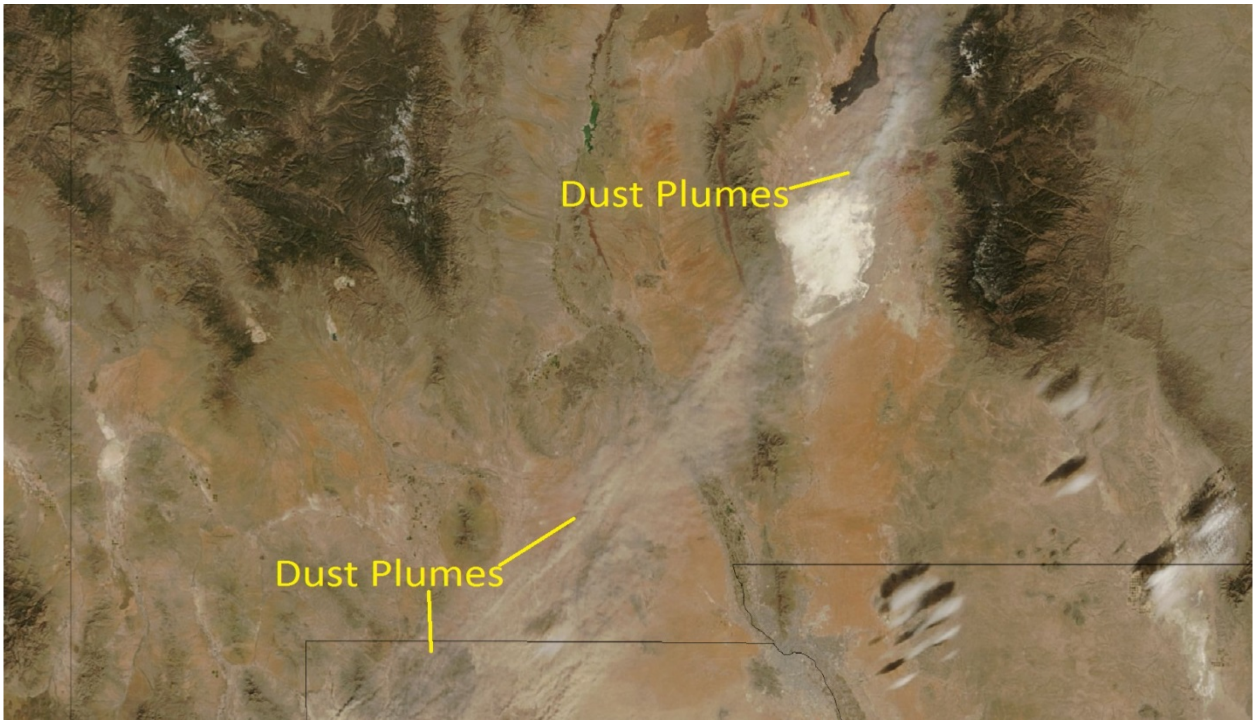


Figure 7-15. MODIS image from the Terra satellite showing dust plumes developing in northern Mexico and southern New Mexico (Image courtesy of NASA).

The NWS forecasted strong wind speeds from 35 to 45 mph with gusts as high as 55 mph with wide spread blowing dust (Figure 7-16).

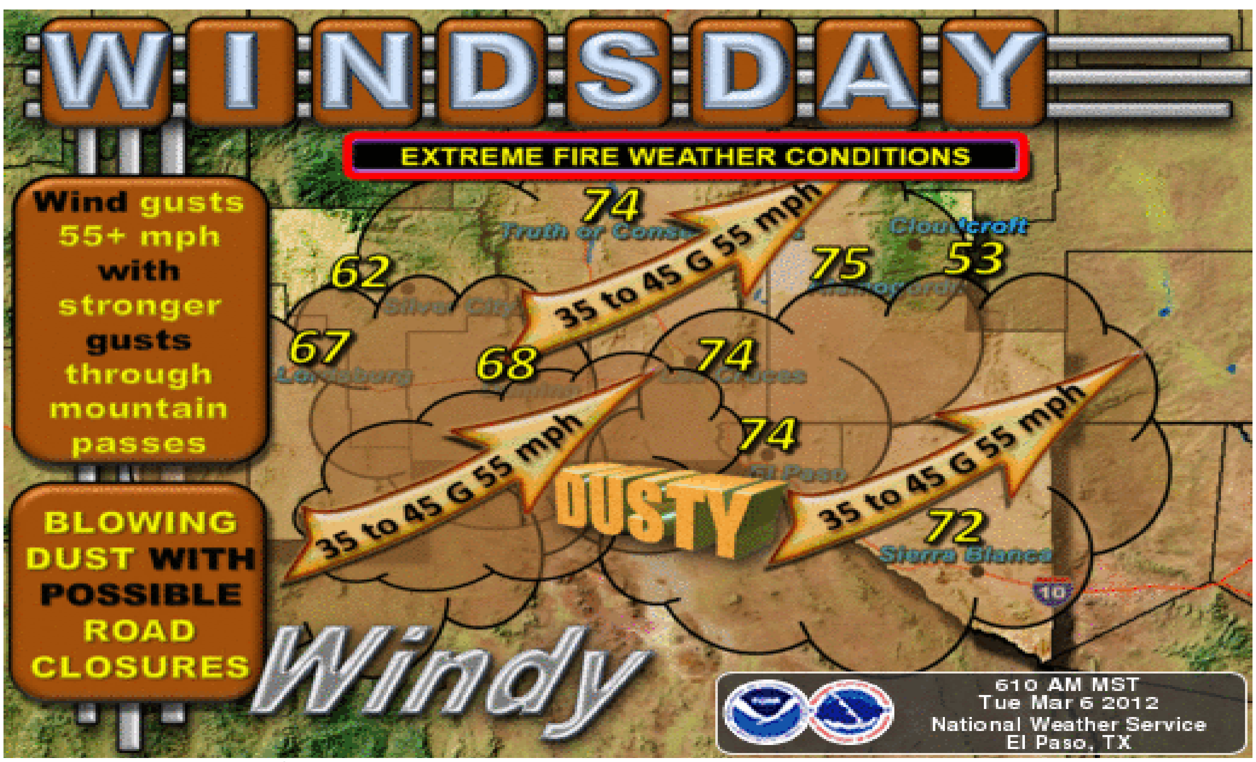


Figure 7-16. NWS graphicast for March 7, 2013.

The NWS also issued high wind warning and blowing dust advisory on this date stating in part:

> ...HIGH WINDS AND BLOWING DUST EXPECTED TODAY AND THIS EVENING ACROSS SOUTHWEST NEW MEXICO AND FAR WEST TEXAS...
>
> BLOWING DUST MAY REDUCE VISIBILITIES TO LESS THAN A MILE IN PARTS OF THE AREA.
>
> IN ADDITION...WINDS THIS STRONG WILL LIFT WIDESPREAD AREAS OF BLOWING DUST...AND COULD SIGNIFICANTLY REDUCE VISIBILITIES THAT MAKE FOR DANGEROUS DRIVING CONDITIONS. SOME PROPERTY DAMAGE MAY ALSO OCCUR (NWS, 2012).

The NWS also reported that visibility dropped to a half of a mile in Deming and El Paso with wind speeds reaching 44 mph and gusts at 53 mph at Deming (Figure 7-17).

Location	Time (mst)	Wind (mph)	Visibility (mi.)	Weather
Alamogordo	14:55	SW 26 G 37	2	Overcast with Haze and Windy
Deming	13:53	SW 44 G 53	0.5	Sky Obscured with Haze and Windy
El Paso	16:51	W 26 G 39	0.5	Dust Storm and Windy
Guadalupe Pass	20:51	W 24 G 38	2.5	Overcast with Haze and Breezy
Holloman	14:55	SW 29 G 44	4	Mostly Cloudy with Haze and Windy
LC	12:35	SW 36 G 52	2	Overcast with Haze and Windy
Roswell	17:51	SW 14	2	Overcast with Haze
Ruidoso	15:15	SW 31 G 51	2.5	Fair with Haze and Windy

Figure 7-17. Reported wind speeds, gusts, visibility and weather conditions. (Courtesy of NWS).

7.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on March 7, 2012.

7.6 Natural Event

The Clear Causal Relationship and not Reasonably Controllable or Preventable analyses show that this was a natural event caused by high wind and blowing dust.

7.7 No Exceedance but for the Event

The SPCY $PM_{2.5}$ monitor detected elevated levels due to blowing dust on March 7, 2012. These elevated concentrations resulted in exceedances of the 24-hour and annual NAAQS for $PM_{2.5}$ (84.5 µg/m^3). The strong correlation between hourly $PM_{2.5}$, PM_{10} and wind speeds peaks also point to windblown dust affecting the monitor. Previous studies have shown that $PM_{2.5}/PM_{10}$ ratios vary from 0.11 to 0.45 in the Paso del Norte Airshed (Arimoto et. al, 2001; Li et al, 2001). The ratios above 0.30 were observed in downtown El Paso and Ciudad Juárez and indicate a heavy impact from mobile sources. The lower ratios were observed in areas with less vehicular traffic and crustal material dominated the PM_{10} fraction. The $PM_{2.5}/PM_{10}$ ratio for the SPCY site was 0.14 for this date ($PM_{2.5}$ Partisol/PM_{10} TEOM). NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

The Anthony monitor detected blowing dust around the 1100 hour with hourly concentrations heavily impacted until the 2000 hour. The two hourly PM_{10} values from 1300-1400 hours alone, far exceed the 24-hour average standard at Anthony [(2633 + 2195) $\mu g/m^3$ = 4828 $\mu g/m^3$; (4828 $\mu g/m^3$)/24 = 201 $\mu g/m^3$]. By replacing the ten hourly values (1100-2000 hour) with the 95th percentile of hourly data at the Anthony site, the resulting 24-hour average (104 $\mu g/m^3$) does not exceed the NAAQS (Table 7-1). The values in red represent the 95th percentile of all hourly data collected at Anthony, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	28	28
1	23	23
2	32	32
3	32	32
4	33	33
5	35	35
6	55	55
7	104	104
8	98	98
9	64	64
10	71	71
11	156	**115**
12	1594	**144**
13	2633	**164**
14	2195	**194**
15	1954	**194**
16	1624	**157**
17	841	**194**
18	243	**194**
19	200	**184**
20	276	**161**
21	97	97
22	66	66
23	63	63
24-Hour Average	520	**104**

Table 7-1. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Anthony.

The Chaparral monitor detected blowing dust around the 1100 hour with hourly concentrations heavily impacted until the 2100 hour. The two hourly PM_{10} values from 1300-1400 hours alone, far exceed the 24-hour average standard at Chaparral [(2287 + 2519) µg/m^3 = 4806 µg/m^3; (4806 µg/m^3)/24 = 200 µg/m^3]. By replacing the eleven hourly values from the 1100-2100 hour with the 95th percentile of hourly data at the Chaparral site, the resulting 24-hour average (84 µg/m^3) does not exceed the NAAQS (Table 7-2). The values in red represent the 95th percentile of all hourly data collected at Chaparral, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	22	22
1	12	12
2	26	26
3	30	30
4	21	21
5	27	27
6	41	41
7	38	38
8	50	50
9	59	59
10	68	68
11	103	**97**
12	362	**127**
13	2287	**181**
14	2519	**143**
15	1966	**163**
16	1873	**159**
17	874	**141**
18	478	**127**
19	198	**127**
20	217	**118**
21	180	**97**
22	73	73
23	62	62
24-Hour Average	482	**84**

Table 7-2. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Chaparral.

The Deming monitor detected blowing dust around the 1000 hour with hourly concentrations heavily impacted until the 2000 hour. The one hourly PM_{10} value at the 1300 hour alone, far exceeds the 24-hour average standard at Deming (8912 µg/m^3)/24 = 371 µg/m^3. By replacing the eleven hourly values from the 1000-2000 hour with the 95th percentile of hourly data at the Deming site, the resulting 24-hour average (62 µg/m^3) does not exceed the NAAQS (Table 7-3). The values in red represent the 95th percentile of all hourly data collected at Deming, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	25	25
1	25	25
2	21	21
3	14	14
4	16	16
5	26	26
6	26	26
7	59	59
8	32	32
9	34	34
10	330	**63**
11	926	**67**
12	4234	**82**
13	8912	**109**
14	4661	**121**
15	3208	**115**
16	2324	**127**
17	874	**106**
18	263	**93**
19	104	**79**
20	87	**74**
21	69	69
22	57	57
23	53	53
24-Hour Average	1098	**62**

Table 7-3. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Deming.

The Holman monitor detected blowing dust around the 0800 hour with hourly concentrations heavily impacted until the 1900 hour. The four hourly PM_{10} values from 1200-1500 hours alone, far exceed the 24-hour average standard at Holman [(1390 + 2338 + 673 + 527) µg/m^3 = 4928 µg/m^3; (4928 µg/m^3)/24 = 205 µg/m^3]. By replacing these eleven hourly values with the 95th percentile of hourly data at the Holman site, the resulting 24-hour average (86 µg/m^3) does not exceed the NAAQS (Table 7-4). The values in red represent the 95th percentile of all hourly data collected at Holman, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	58	58
1	162	162
2	126	126
3	42	42
4	73	73
5	35	35
6	26	26
7	37	37
8	64	**56**
9	109	**54**
10	259	**60**
11	481	**73**
12	1390	**88**
13	2338	**113**
14	673	**131**
15	527	**132**
16	298	**132**
17	178	**126**
18	202	**155**
19	195	**129**
20	87	87
21	60	60
22	53	53
23	55	55
24-Hour Average	314	**86**

Table 7-4. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Holman.

The Desert View monitor detected blowing dust around the 1000 hour with hourly concentrations heavily impacted until the 2100 hour. The two hourly PM_{10} values from 1500-1600 hours alone, far exceed the 24-hour average standard at Desert View [(2593 + 3425) $\mu g/m^3$ = 6018 $\mu g/m^3$; (6018 $\mu g/m^3$)/24 = 250 $\mu g/m^3$]. By replacing the eleven hourly values from the 1000-2100 hour with the 95th percentile of hourly data at the Desert View site, the resulting 24-hour average (83 $\mu g/m^3$) does not exceed the NAAQS (Table 7-5). The values in red represent the 95th percentile of all hourly data collected at Desert View, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	26	26
1	32	32
2	32	32
3	29	29
4	30	30
5	36	36
6	52	52
7	59	59
8	46	46
9	44	44
10	140	**91**
11	195	**93**
12	939	**99**
13	1419	**105**
14	1737	**132**
15	2593	**136**
16	3425	**138**
17	1744	**166**
18	1207	**141**
19	858	**142**
20	726	**120**
21	247	**111**
22	95	95
23	65	65
24-Hour Average	656	**83**

Table 7-5. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Desert View.

The Sunland Park monitor detected blowing dust around the 1100 hour with hourly concentrations heavily impacted until the 2100 hour. The two hourly PM_{10} values from 1500-1600 hours alone, far exceed the 24-hour average standard at Sunland Park [(2491 + 3350) $\mu g/m^3$ = 5841 $\mu g/m^3$; (5841 $\mu g/m^3$)/24 = 243 $\mu g/m^3$]. By replacing the eleven hourly values from the 1100-2100 hour with the 95th percentile of hourly data at the Sunland Park site, the resulting 24-hour average (122 $\mu g/m^3$) does not exceed the NAAQS (Table 7-6). The values in red represent the 95th percentile of all hourly data collected at Sunland Park, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	31	31
1	30	30
2	39	39
3	34	34
4	32	32
5	37	37
6	73	73
7	100	100
8	75	75
9	62	62
10	88	88
11	137	**111**
12	470	**144**
13	1133	**164**
14	1412	**185**
15	2491	**205**
16	3350	**203**
17	1760	**211**
18	1312	**196**
19	793	**279**
20	718	**265**
21	341	**221**
22	89	89
23	64	64
24-Hour Average	610	**122**

Table 7-6. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Sunland Park.

The West Mesa monitor detected blowing dust throughout the day but hourly concentrations were most heavily impacted from the 1000-1800 hour. The four hourly PM_{10} values from 1100-1400 hours alone, exceed the 24-hour average standard at West Mesa [(690 + 1772 + 1181 + 494) μg/m^3 = 4137 μg/m^3; (4137 μg/m^3)/24 = 172 μg/m^3]. By replacing the nine hourly values from the 1000-1800 hour with the 95th percentile of hourly data at the West Mesa site, the resulting 24-hour average (86 μg/m^3) does not exceed the NAAQS (Table 7-7). The values in red represent the 95th percentile of all hourly data collected at West Mesa, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	104	104
1	226	226
2	103	103
3	58	58
4	83	83
5	41	41
6	65	65
7	97	97
8	153	153
9	131	131
10	224	**50**
11	690	**52**
12	1772	**51**
13	1181	**57**
14	494	**66**
15	460	**75**
16	416	**68**
17	248	**68**
18	230	**65**
19	130	130
20	134	134
21	82	82
22	65	65
23	60	60
24-Hour Average	301	**86**

Table 7-7. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at West Mesa.

8 HIGH WIND EXCEPTIONAL EVENT: March 18, 2012

8.1 Summary of Event

The passing of a strong Pacific low pressure system and associated cold front caused high winds and blowing dust in Doña Ana and Luna Counties resulting in exceedances of the PM_{10} and $PM_{2.5}$ 24-hour NAAQS at the Anthony, Chaparral, Deming, Holman, Desert View, and Sunland Park monitoring sites on this date. The PM_{10} FEM TEOM continuous monitors at these sites recorded 24-hour average concentrations of 1739, 1606, 646, 1449, 1691, and 1261 µg/m^3, respectively Figure 8-1). The $PM_{2.5}$ FRM Partisol monitor at the Sunland Park site recorded a 24-hour average concentration of 149.7 µg/m^3. The averages in this figure were calculated using PM_{10} FEM TEOM and $PM_{2.5}$ FRM Partisol instrument data for the four days before and after the event. Elevated concentrations were also recorded by the $PM_{2.5}$ non-FEM/FRM TEOMs (Figure 8-2). This event was widespread with some of the highest hourly and 24-hour averages of PM_{10} and $PM_{2.5}$ ever recorded by NMED.

As the event unfolded, the wind blew from the south-southwest throughout the border region. These high velocity winds passed over large areas of desert within New Mexico and Mexico. The co-occurrence of high winds and elevated levels of blowing dust, little to no point sources in the area, and the high hourly and daily PM_{10} and $PM_{2.5}$ concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

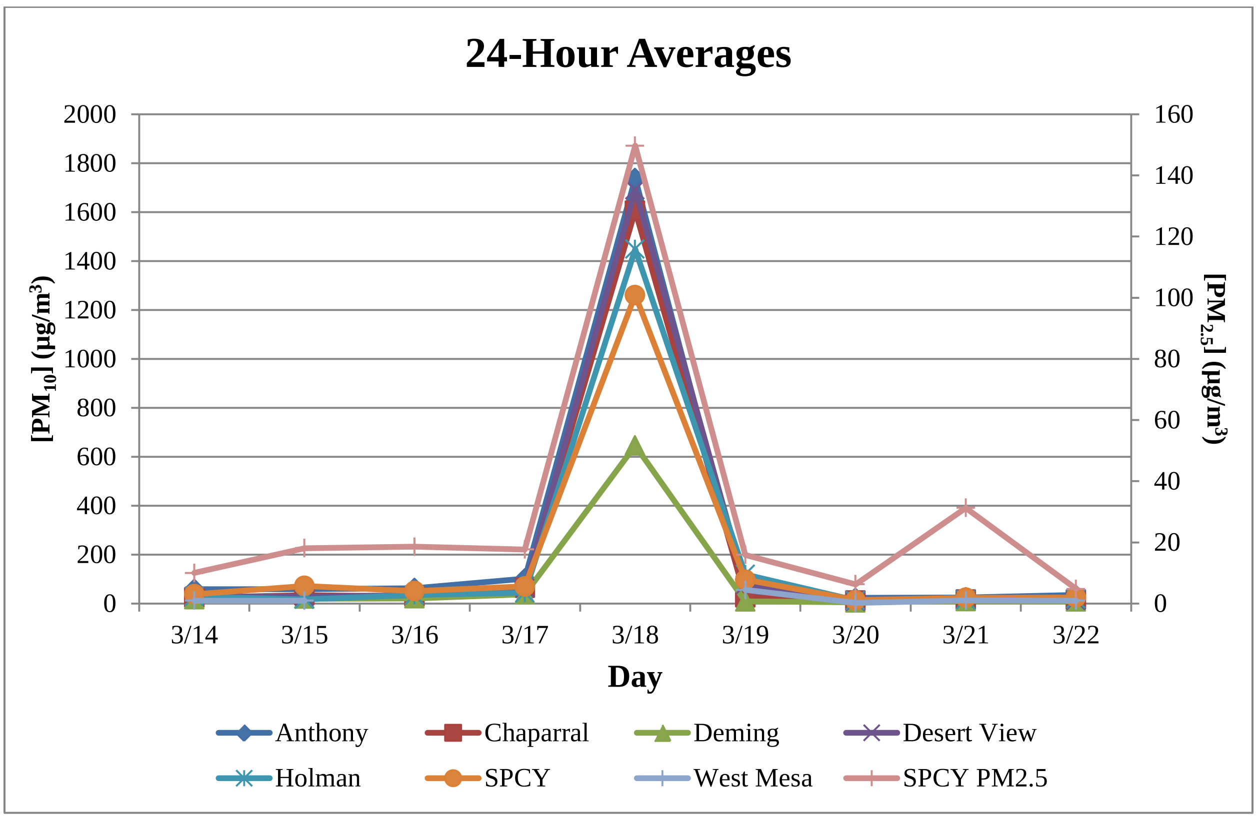


Figure 8-1. PM_{10} 24-hour averages before and after March 18, 2012.

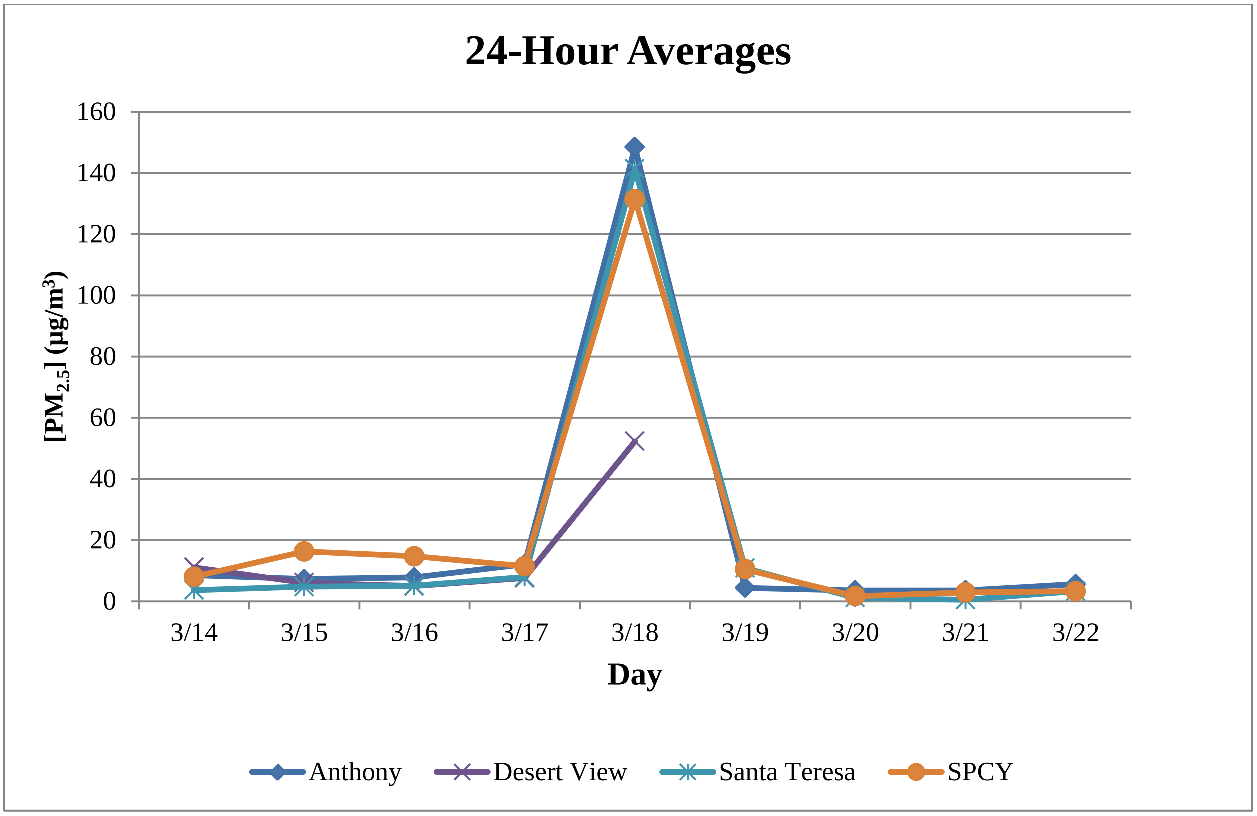


Figure 8-2. $PM_{2.5}$ 24-hour averages before and after March 18, 2012. Non-FEM TEOM Data.

8.2 Is Not Reasonably Controllable or Preventable

8.2.1 Suspected Source Areas and Categories Contributing to the Event

Sources of windblown dust contributing to this exceedance include the natural desert, residential properties, agricultural land and unpaved roads in New Mexico. Agricultural tilling and crop planting may have contributed to this event. The City of Las Cruces, City of Deming and Doña Ana and Luna Counties' Ordinances require BACM for any dust producing activities. The largest and most likely sources of windblown dust are the natural desert and the playas of southern New Mexico and northern Mexico (see Section 8.2.4 below).

8.2.2 Sustained and Instantaneous Wind Speeds

EPA uses a default entrainment threshold of sustained wind speeds at 11.2 m/s (25 mph) for natural and well controlled anthropogenic sources contributing to natural events caused by high wind and blowing dust (EPA, 2013). Under the Doña Ana and Luna County NEAPs, EPA and NMED agreed that wind gusts exceeding 18 m/s would overwhelm any natural and well-controlled anthropogenic sources and cause windblown dust. On March 18, 2012, sustained wind speeds exceeded EPA's default threshold at all of the eight monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at all of the eight monitoring sites (Figures 8-3 and 8-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 0900 hour and ending at the 2100 hour.

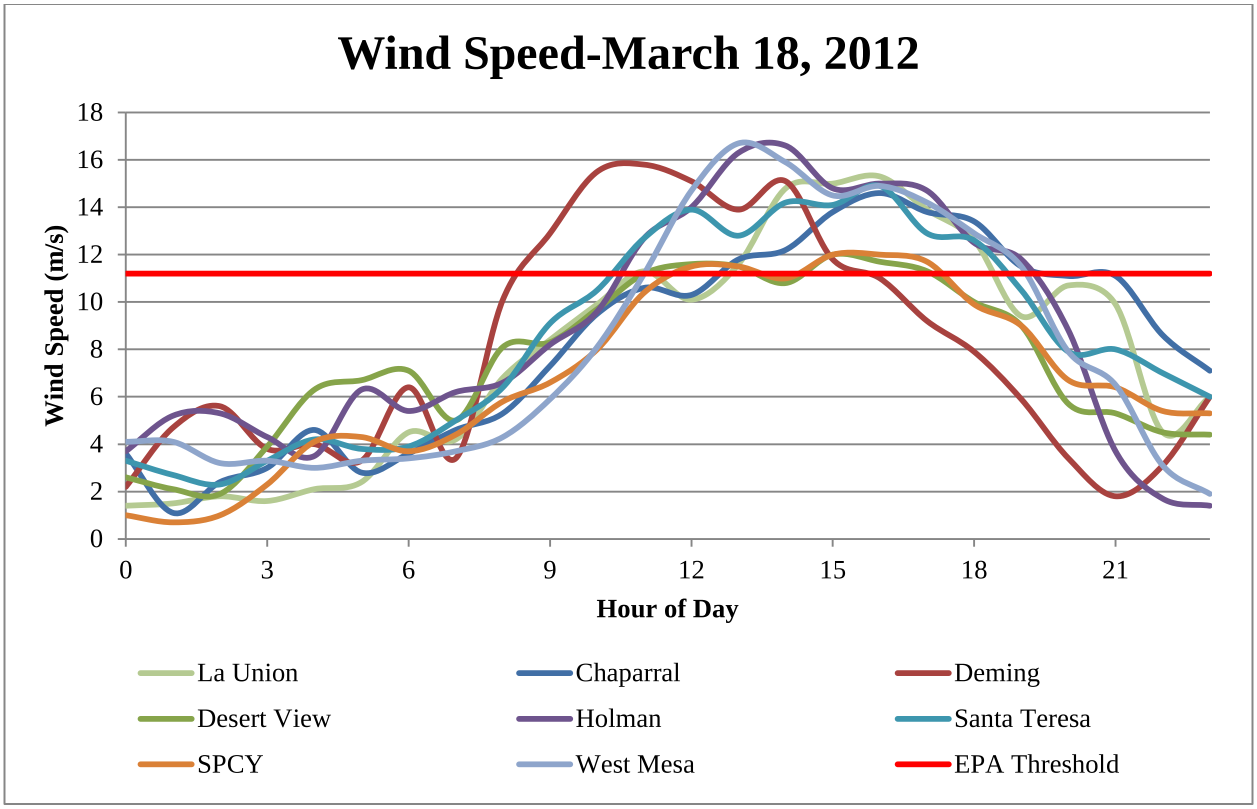


Figure 8-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

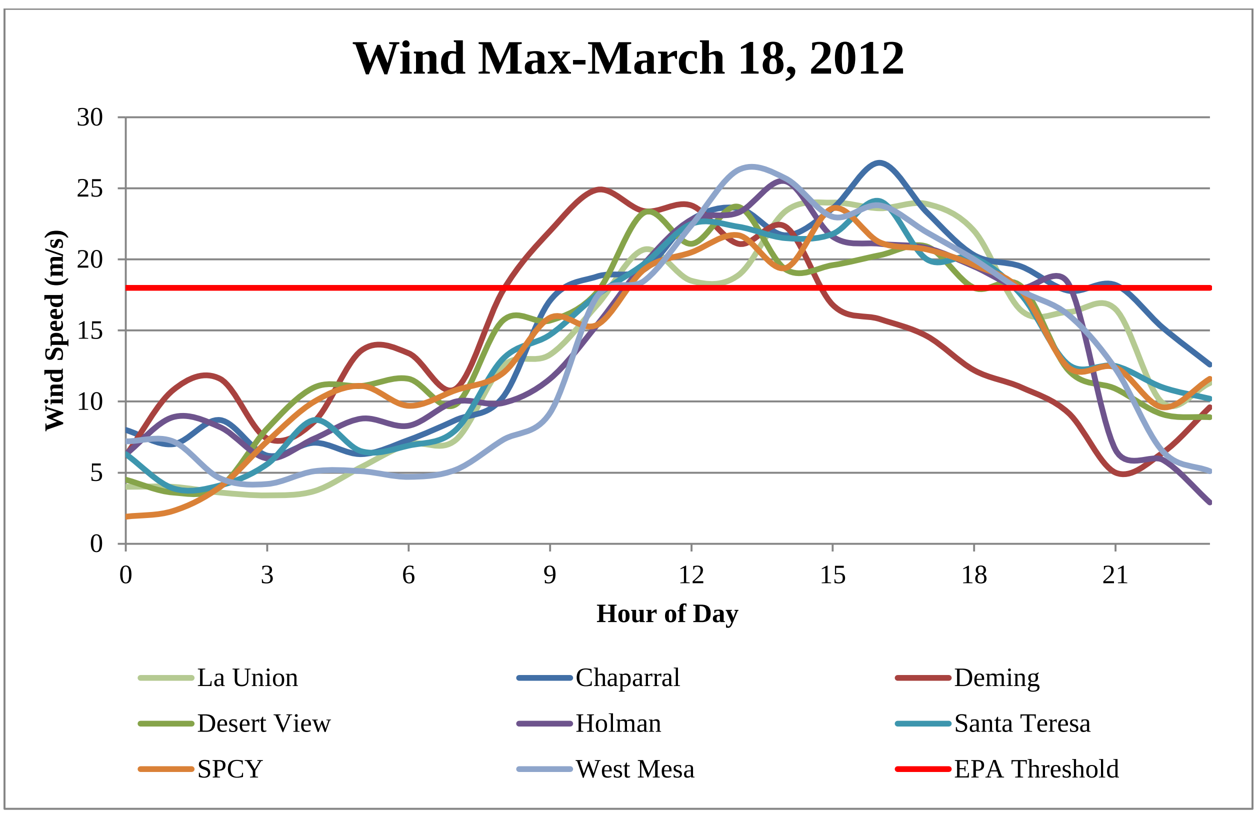


Figure 8-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

8.2.3 Recurrence Frequency

The monitoring sites in Doña Ana and Luna Counties can record exceedances of the PM_{10} NAAQS throughout the year. From 2007-2011 the PM_{10} FEM TEOM monitors recorded 254 exceedances and the PM_{10} FRM Wedding monitors recorded 6 exceedances (Figure A-1). The Deming Airport and Desert View monitoring sites (FEM TEOMs) were established in 2006 and 2007 respectively and do not show exceedances until the year following startup. The SPCY $PM_{2.5}$ FRM Partisol recorded 37 exceedances of the 24-Hour NAAQS from 2007-2011 (Figure A-2). See appendix A for a more in-depth discussion about recurrence frequency and the number of exceedances at each monitoring site.

8.2.4 Controls Analysis

The local ordinances and MOUs adopted under the NEAP direct the implementation of BACM for sources of dust in Doña Ana and Luna Counties. The ordinances regulate disturbed lands, construction and demolition, vacant parking lots and materials handling and transportation. Our investigation did not identify any unusual PM_{10} producing activities on this day, and anthropogenic emissions remained constant before, during and after the event. The most likely source contributing to the event is the natural desert and playas in New Mexico and northern Mexico. A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from Mexico to the monitors in southern and northern Doña Ana and Luna Counties. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 8-5). Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

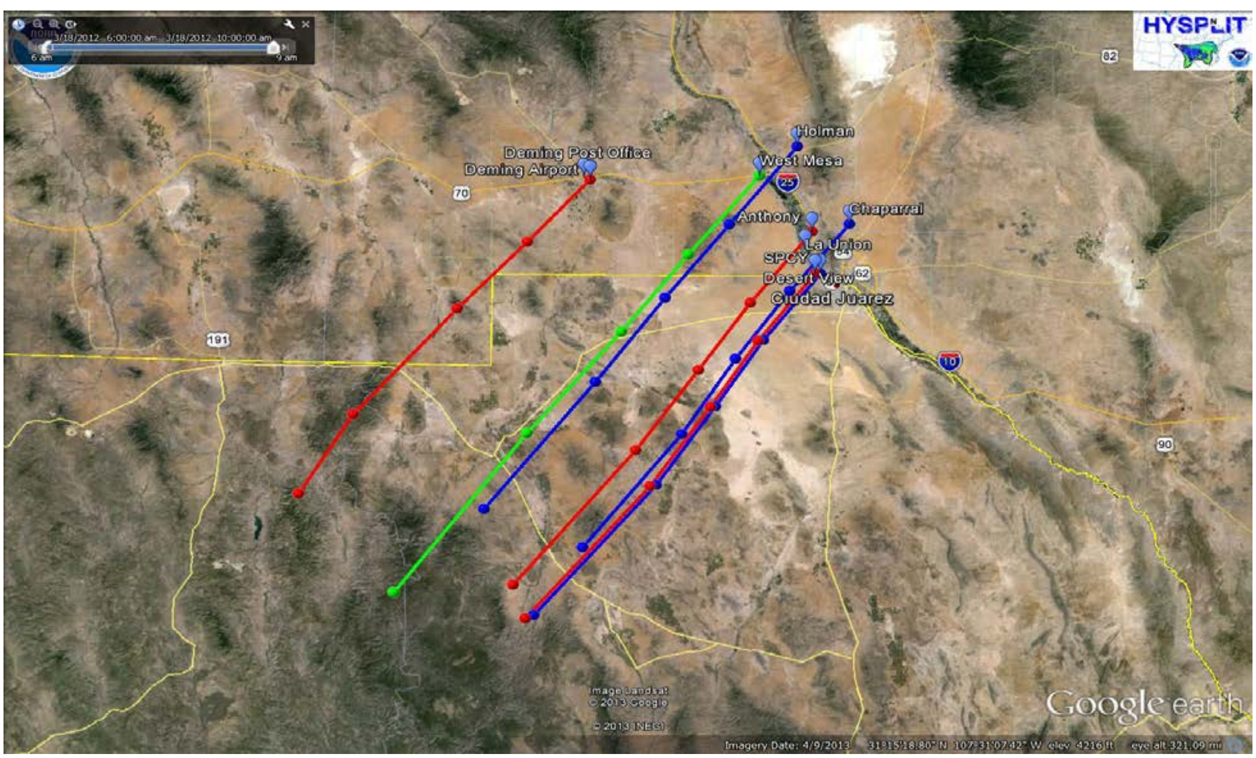


Figure 8-5.HYSPLIT back-trajectory model analysis for March 18, 2012.

8.3 Historical Fluctuations Analysis

8.3.1 Annual and Seasonal 24-hour Average Fluctuations

Since being established, the monitoring sites in Doña Ana and Luna Counties have recorded exceedances of the PM_{10} NAAQS. High winds cause these exceedances and they can occur at any time of year (Figure B-6 through B-13). Most exceedances occur from late winter through early summer (February-June) and are associated with the passage of Pacific cold fronts. High winds caused all recorded exceedances from 2007-2011 and NMED submitted natural events demonstrations to EPA under the NEAP or EER.

Since the 24-hour $PM_{2.5}$ NAAQS was lowered from 65 to 35 µg/m^3 in 2006, the SPCY Partisol monitor has routinely recorded exceedances of the standard. These exceedances occurred throughout the year during high and low wind conditions. In 2009, NMED investigated the cause of the low wind exceedances and found that emissions from Ciudad Juárez, Mexico contribute significantly to elevated concentrations. The high wind exceedances were caused by blowing dust on days when PM_{10} monitors also recorded exceedances.

Appendix B contains a more in-depth discussion about historical fluctuations and charts showing annual and seasonal trends at each monitoring site.

Table B-1 and B-2 show normal historical fluctuations with and without high wind natural events that caused exceedances from 2007-2011. The analysis excludes only those high wind events that resulted in an exceedance. Data for PM_{10} in this table includes FRM Wedding and FEM TEOM measurements and data for $PM_{2.5}$ comes from the FRM Partisol measurements from 2007-2011. The recorded value for this day (1739, 1606, 646, 1449, 1691, and 1261 µg PM_{10}/m^3, and 149.7 µg $PM_{2.5}/m^3$) are above the maximum values recorded when no high wind exceedances are included and is above the 95^{th} percentile of all 24-hour averages recorded.

An hourly data distribution analysis was performed for PM_{10} and $PM_{2.5}$ concentrations, wind speeds and wind gusts (Appendices C, D and E). All data used for the PM_{10} distribution charts come from the FEM TEOM monitors and the non-FEM/FRM $PM_{2.5}$ TEOM monitor at SPCY. Overlaying the hourly data for March 18, 2012 on the hourly data distribution plots shows that the values recorded during the high wind event exceed the 95^{th} percentile for PM_{10}, $PM_{2.5}$, wind speed and wind gusts (Figures 8-6a-g through 8-8a-f). The top whiskers of the box and whisker plots represent the 95^{th} percentile of data. The hourly PM_{10} values during the high wind blowing dust storm far exceed the historical 95^{th} percentile of data.

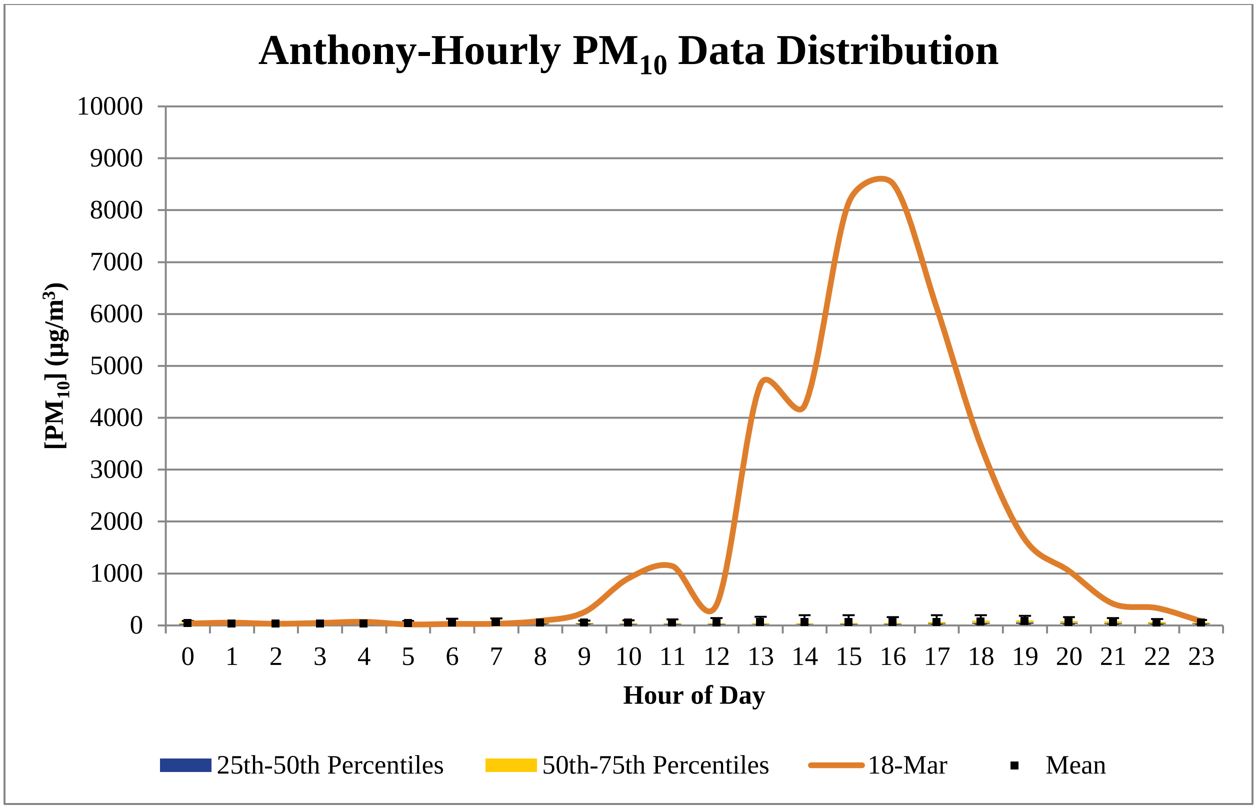


Figure 8-6a. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

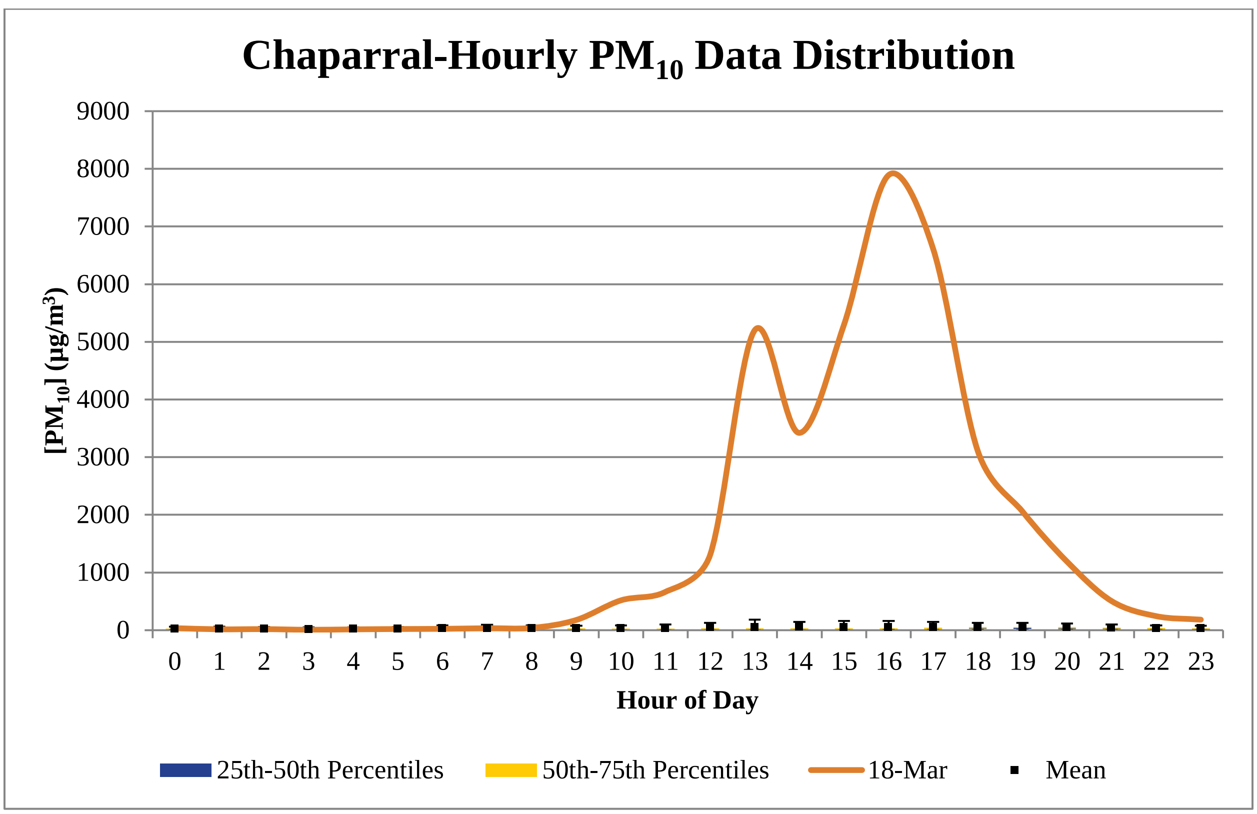


Figure 8-6b. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

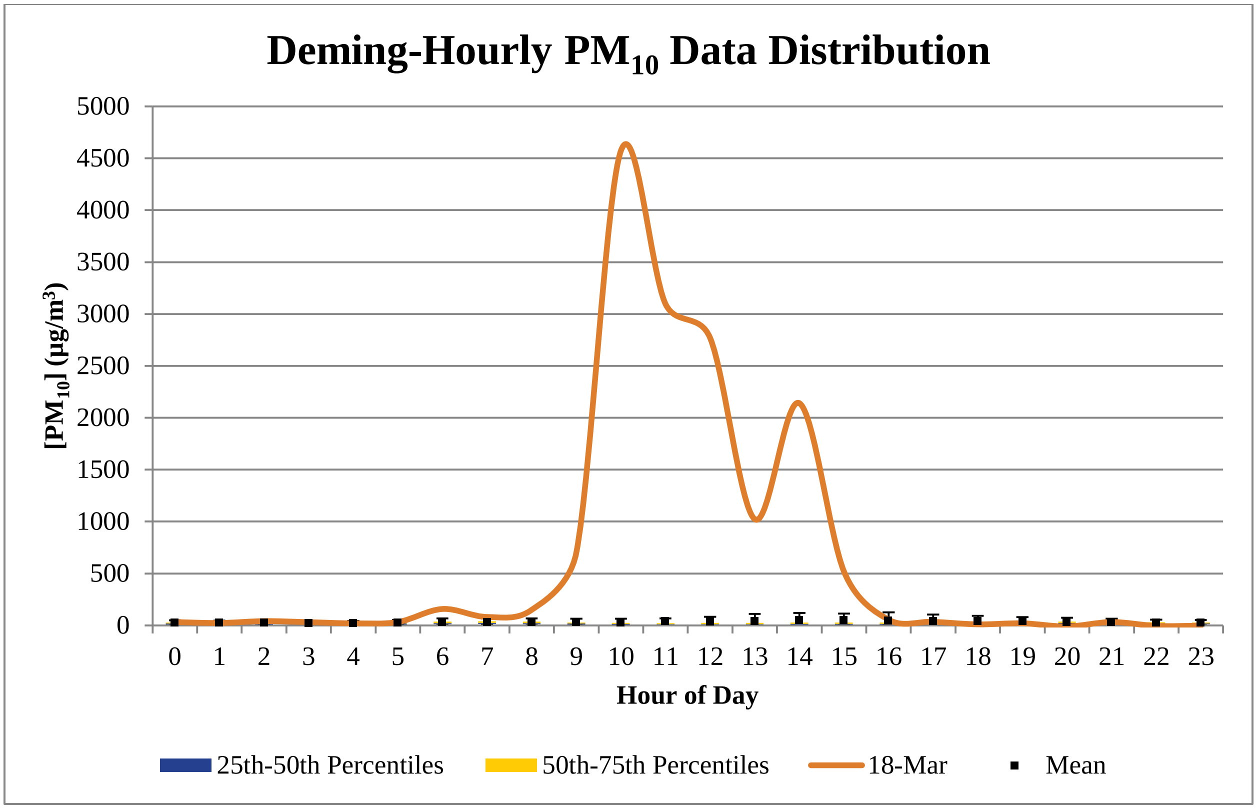


Figure 8-6c. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

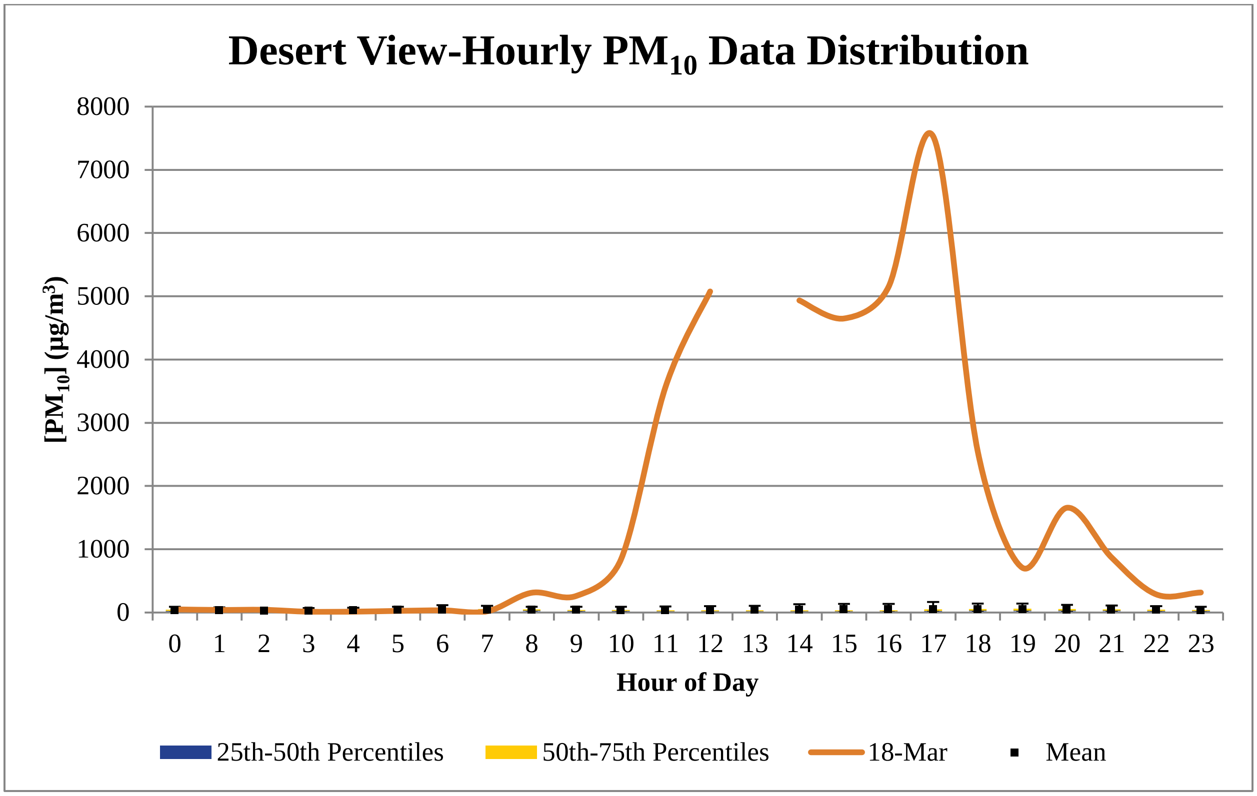


Figure 8-6d. PM10 hourly data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

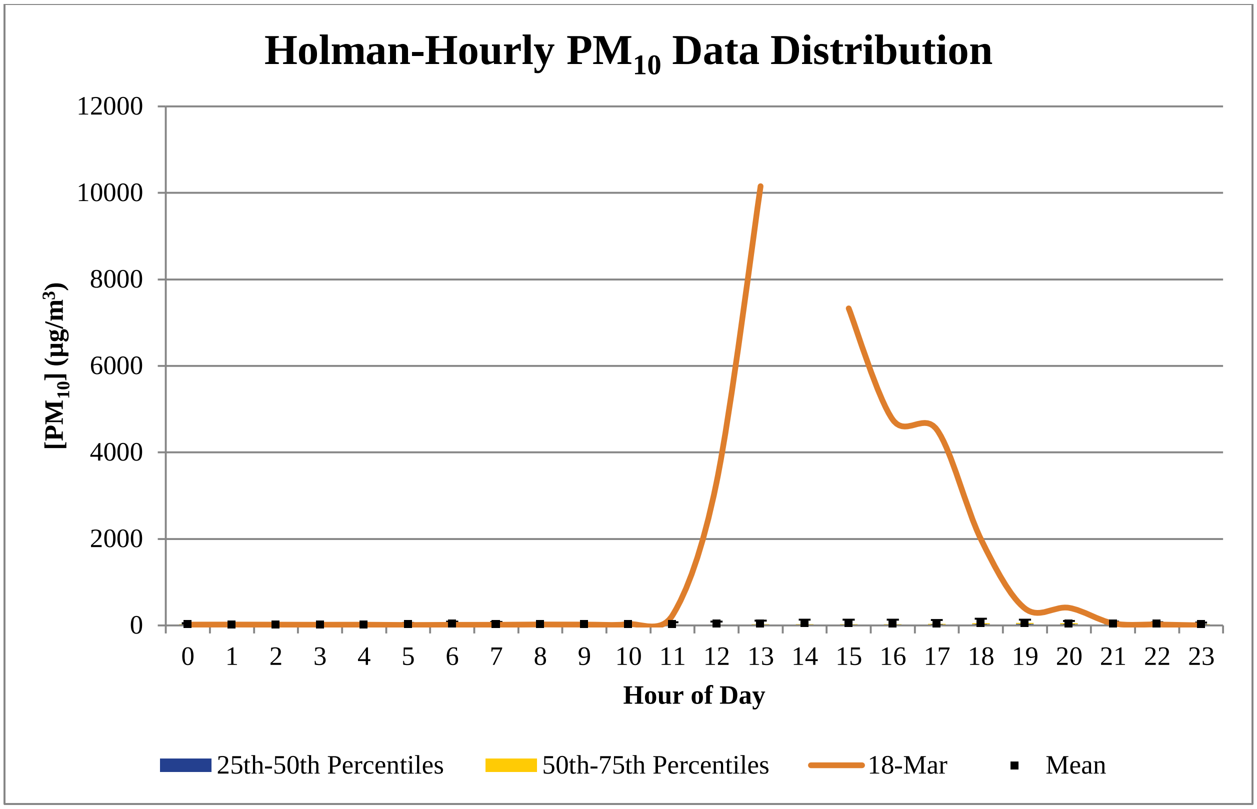


Figure 8-6e. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

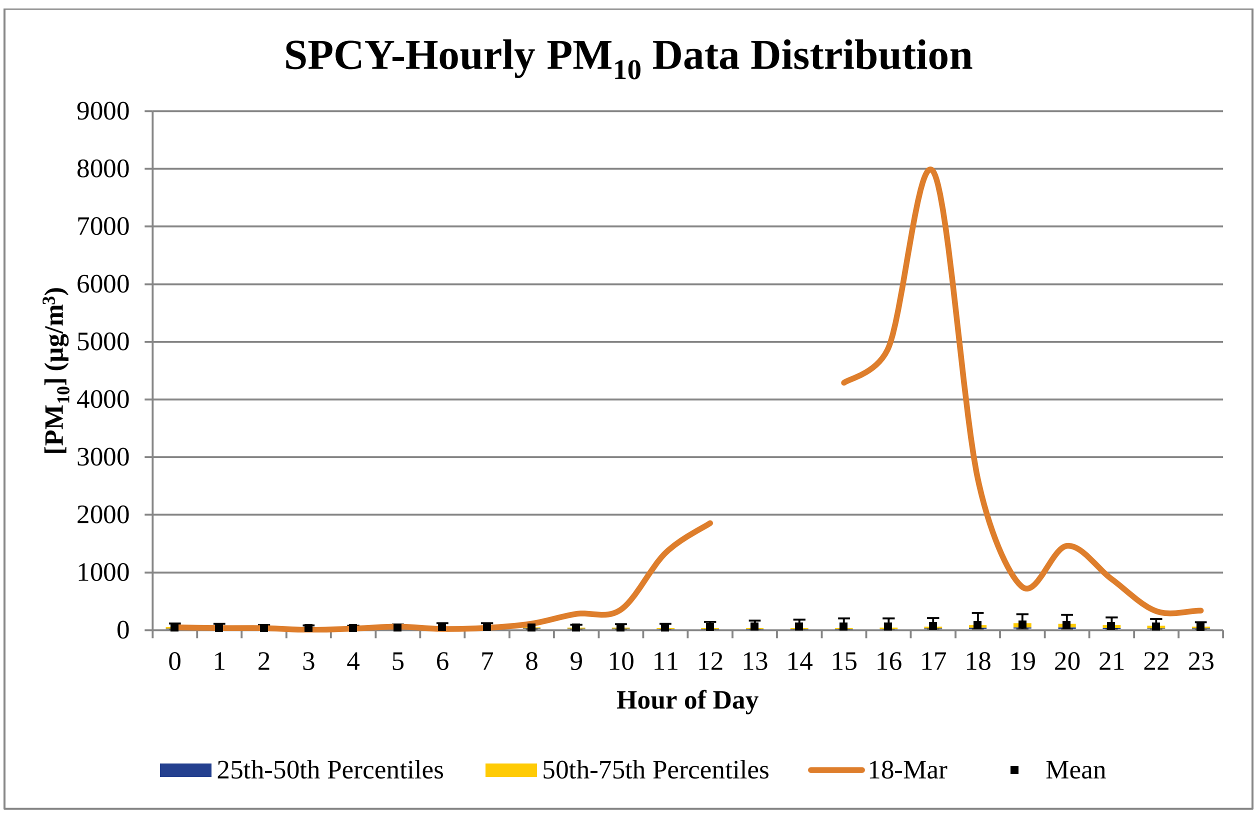


Figure 8-6f. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

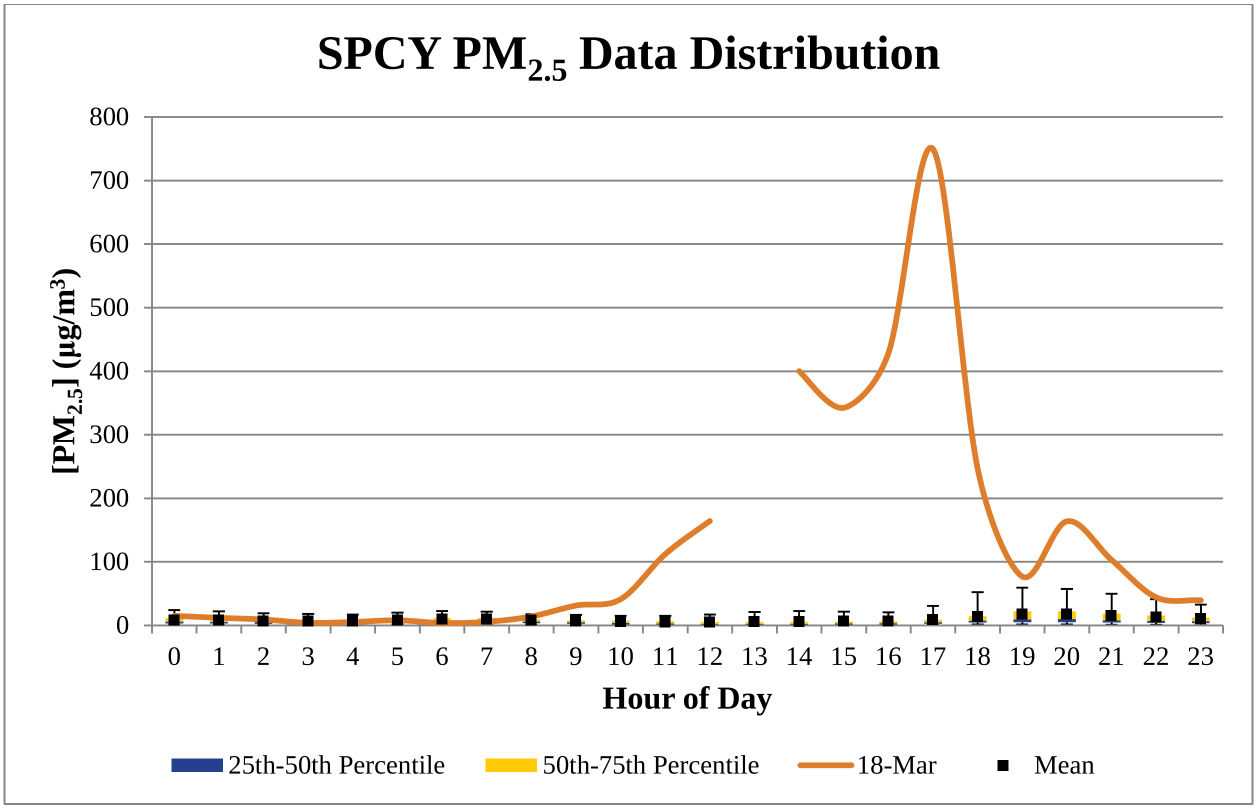


Figure 8-6g. $PM_{2.5}$ hourly data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

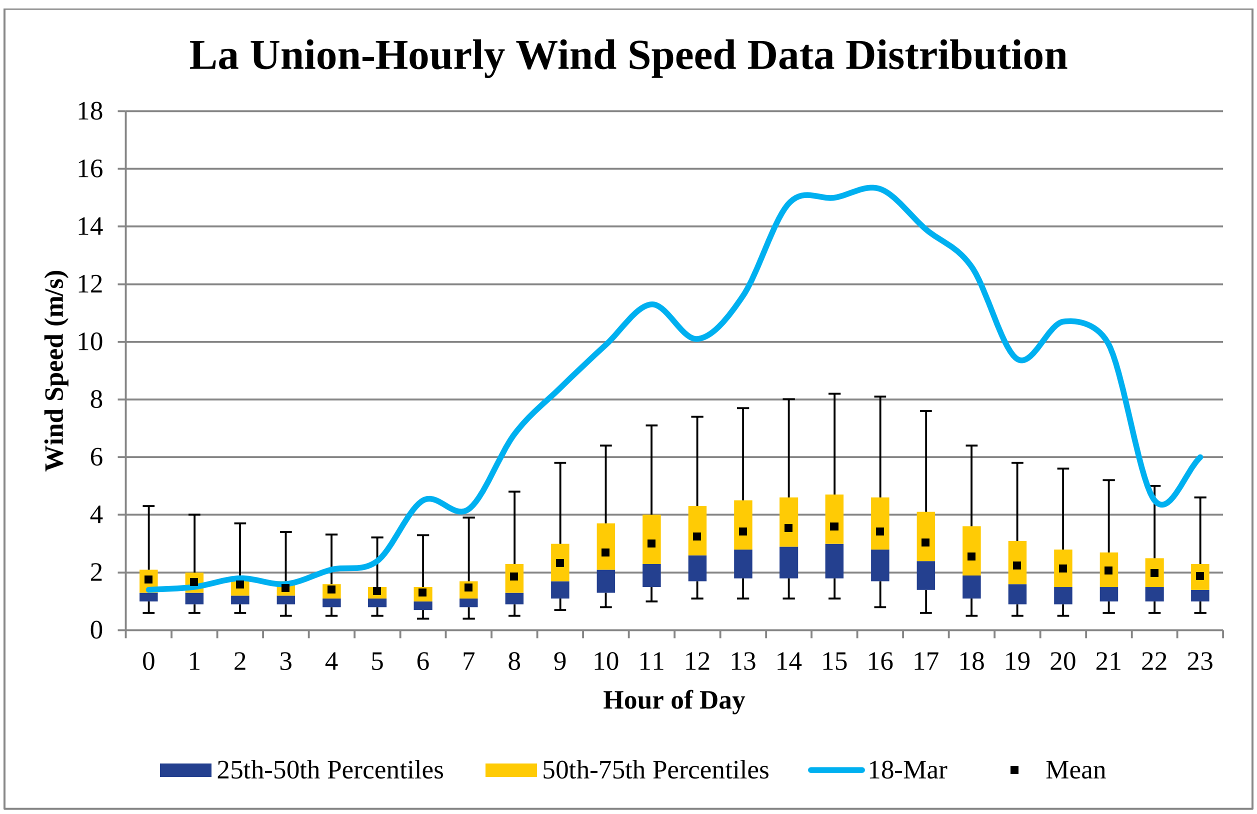


Figure 8-7a. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

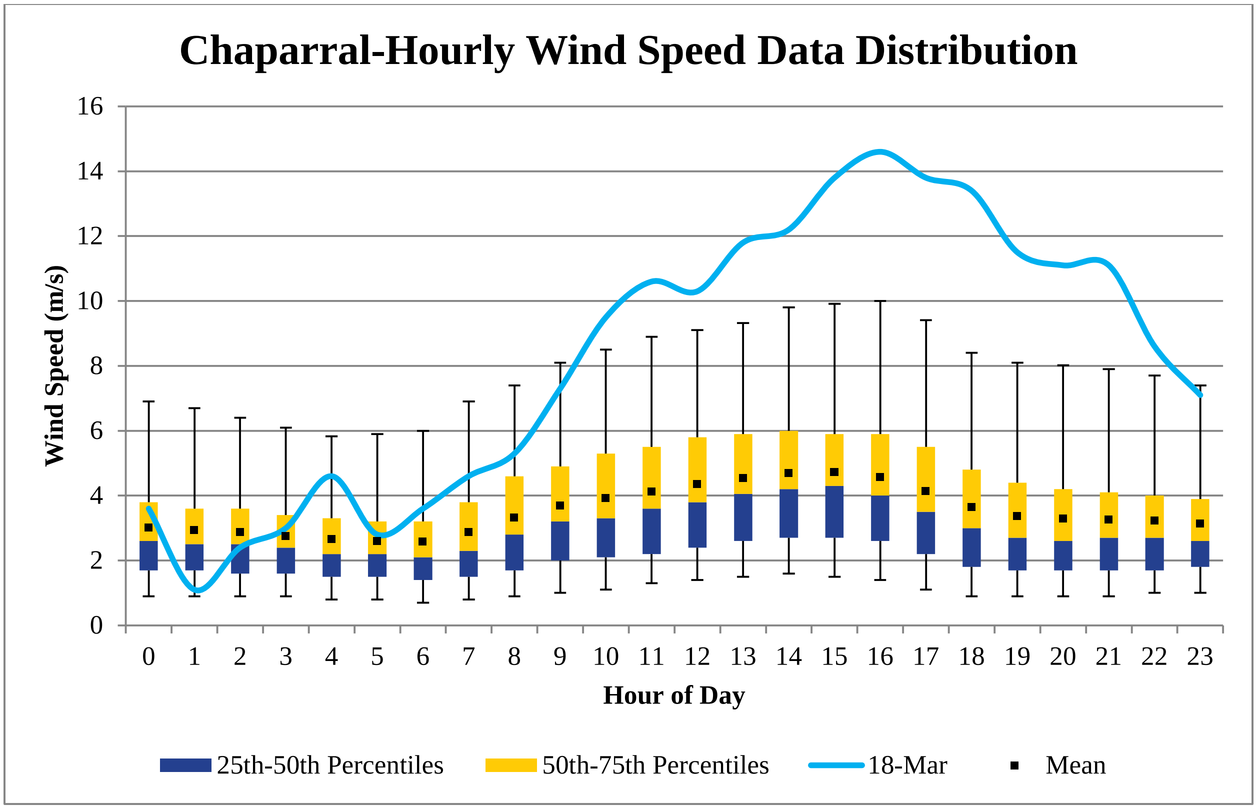


Figure 8-7b. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

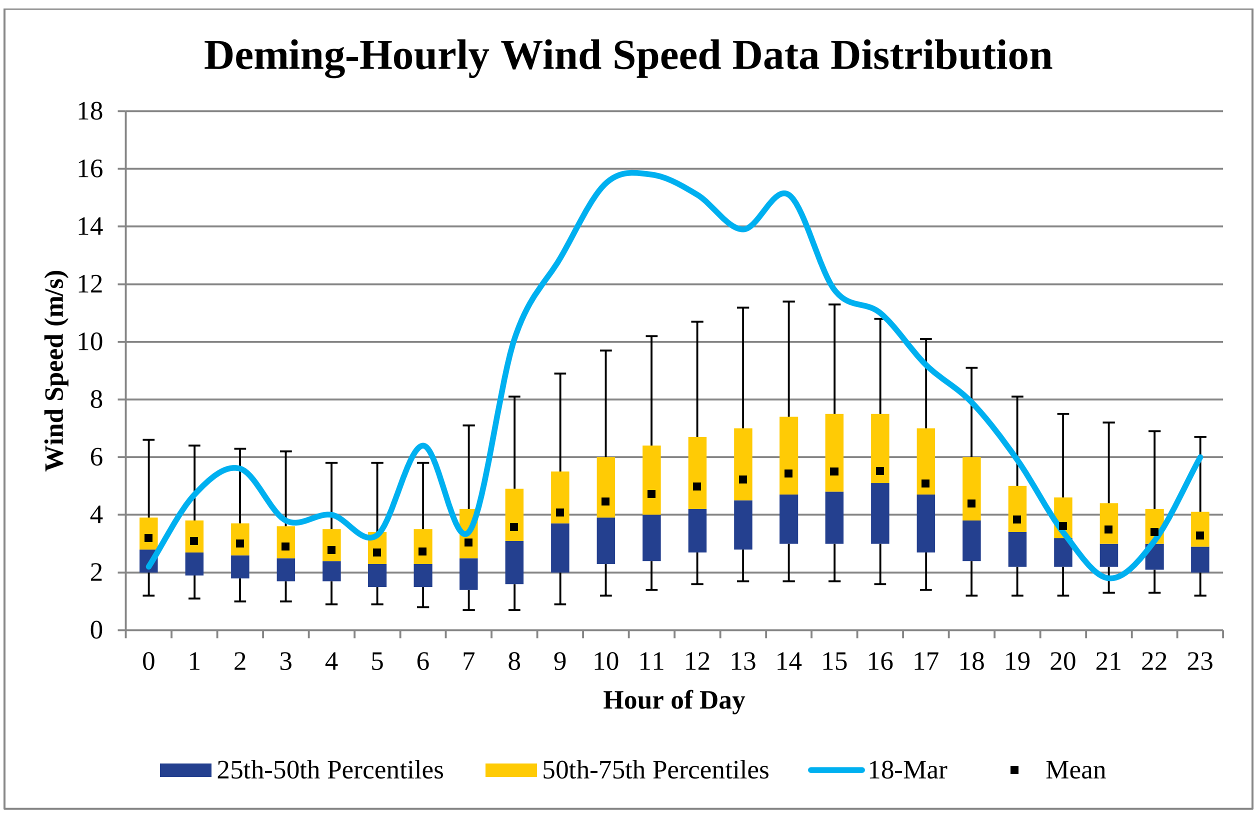


Figure 8-7c. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

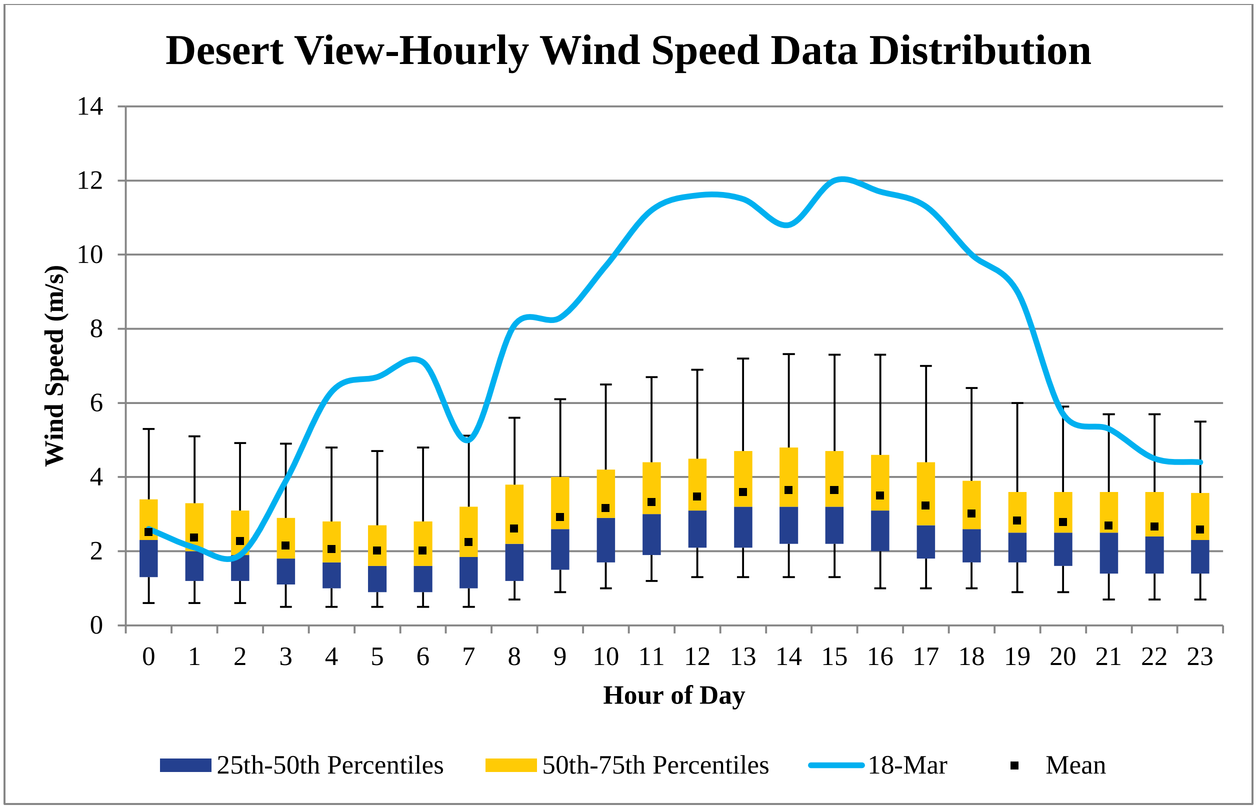


Figure 8-7d. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

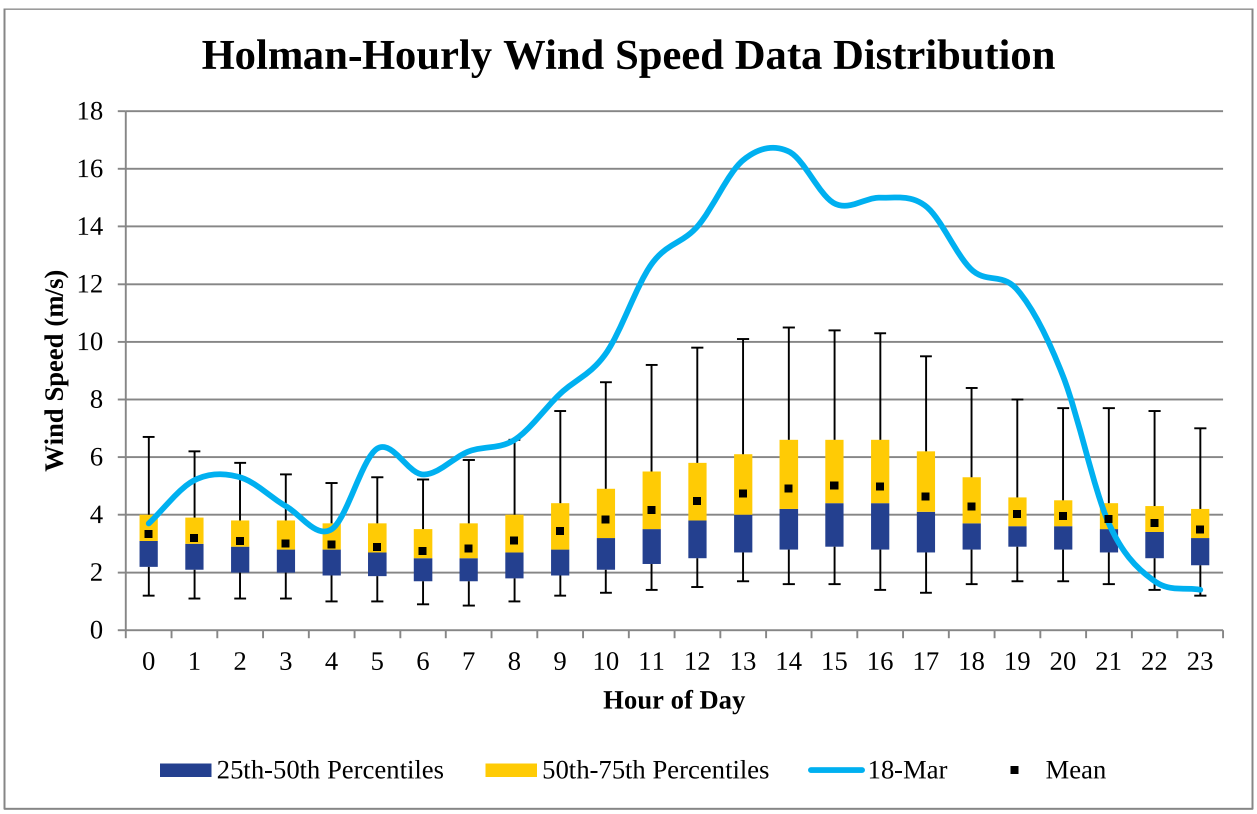


Figure 8-7e. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

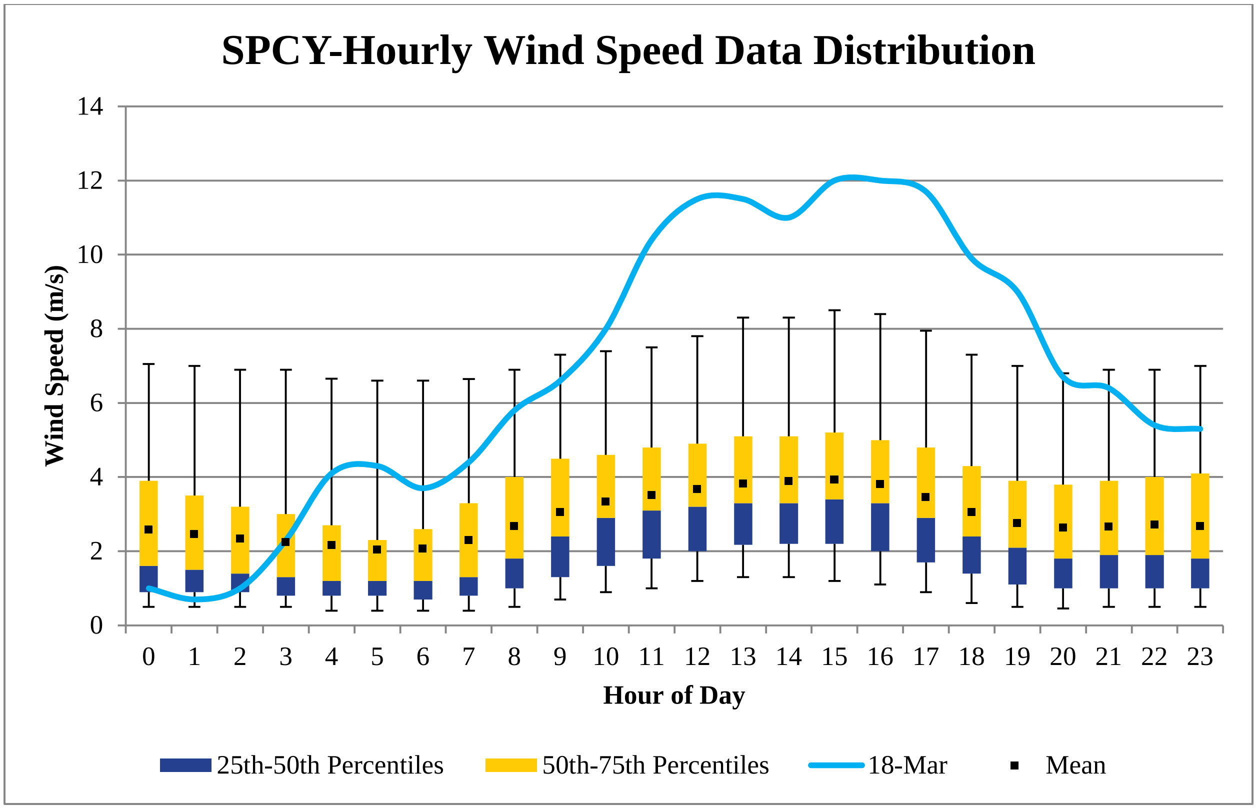


Figure 8-7f. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

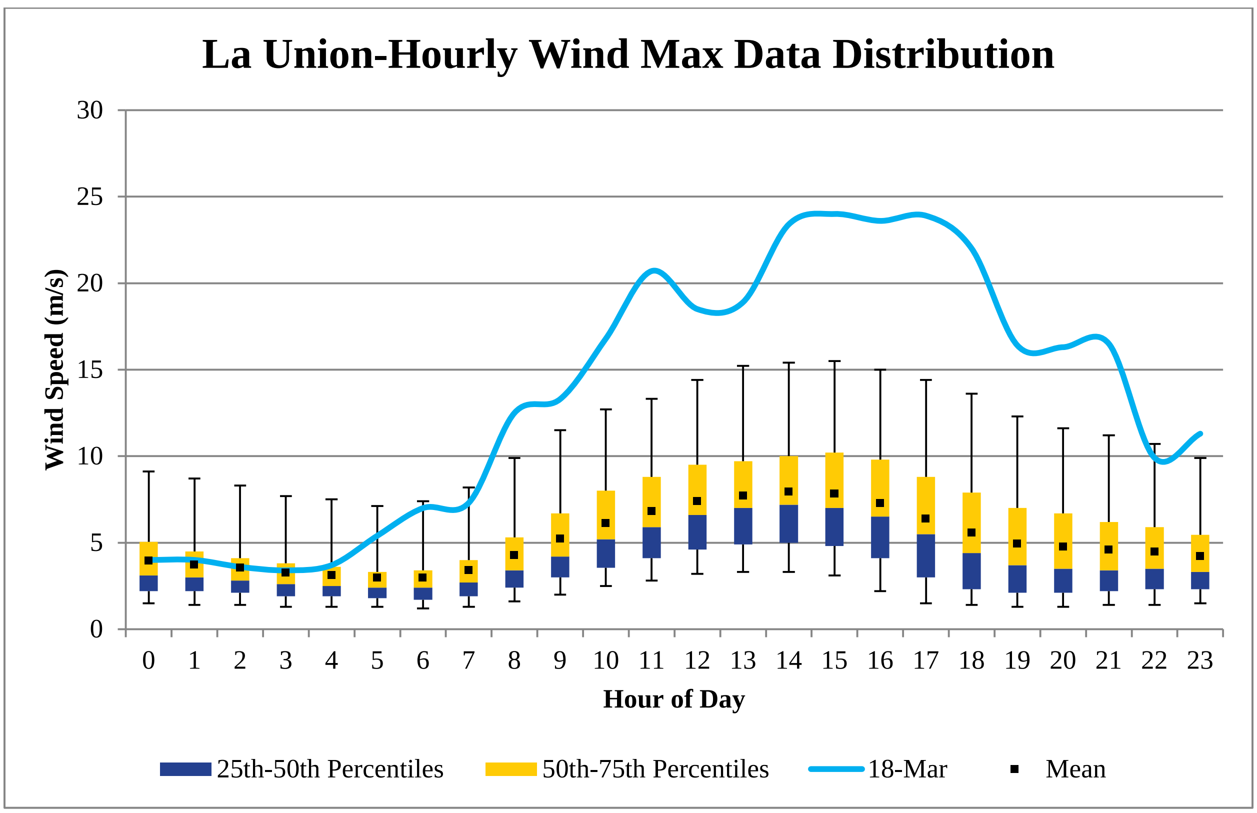


Figure 8-8a. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

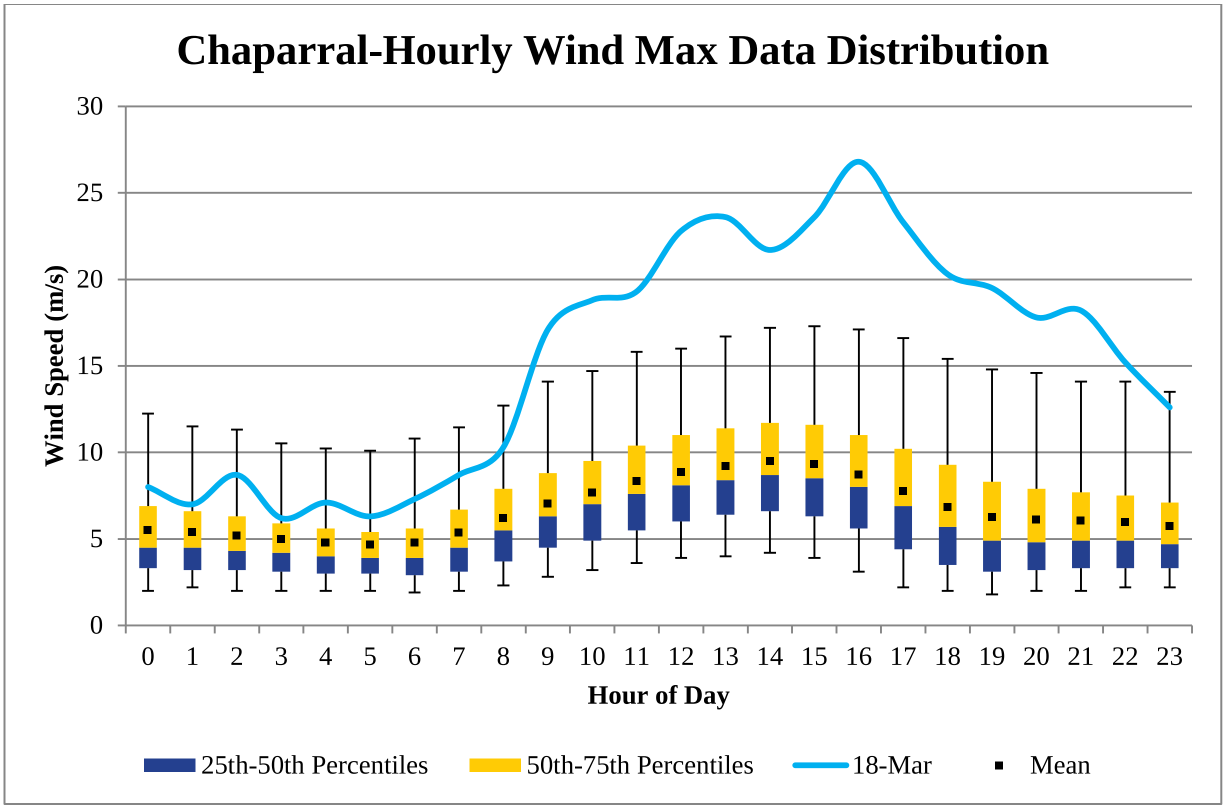


Figure 8-8b. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

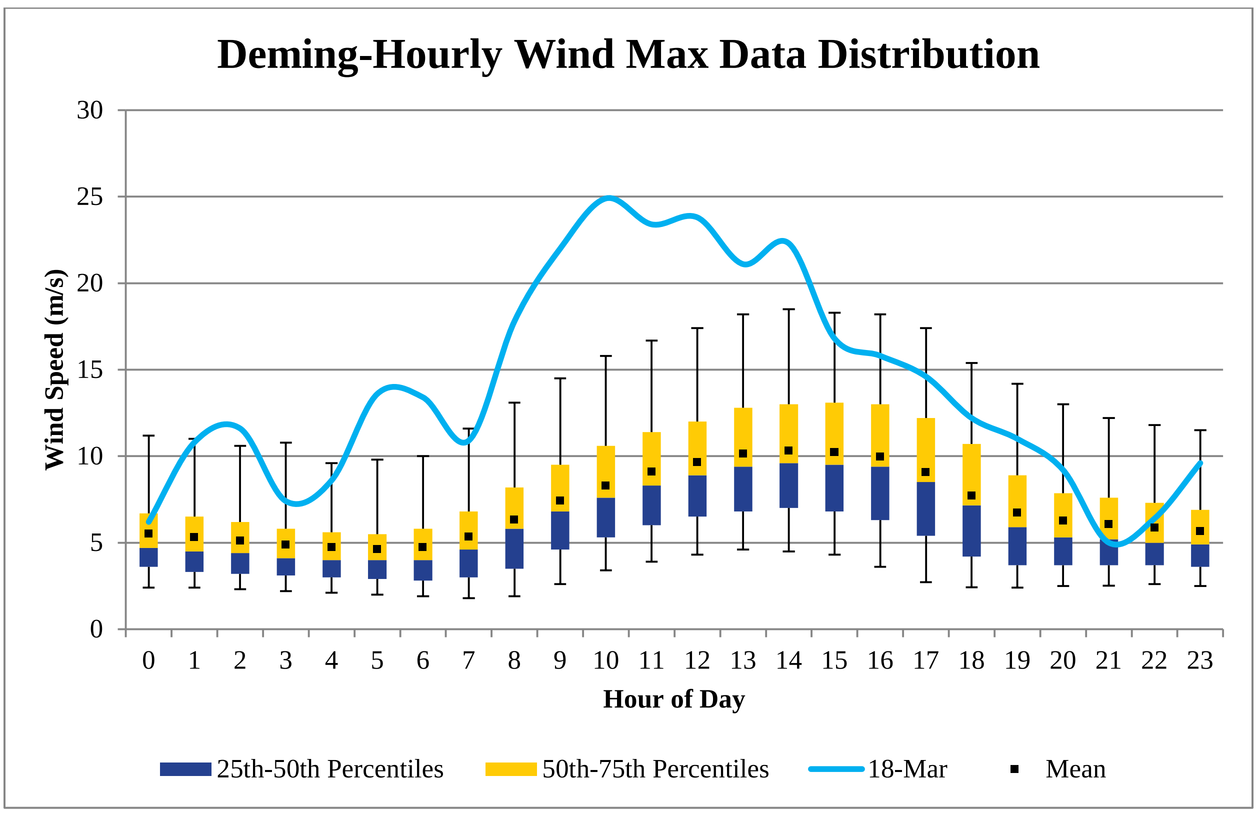


Figure 8-8c. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

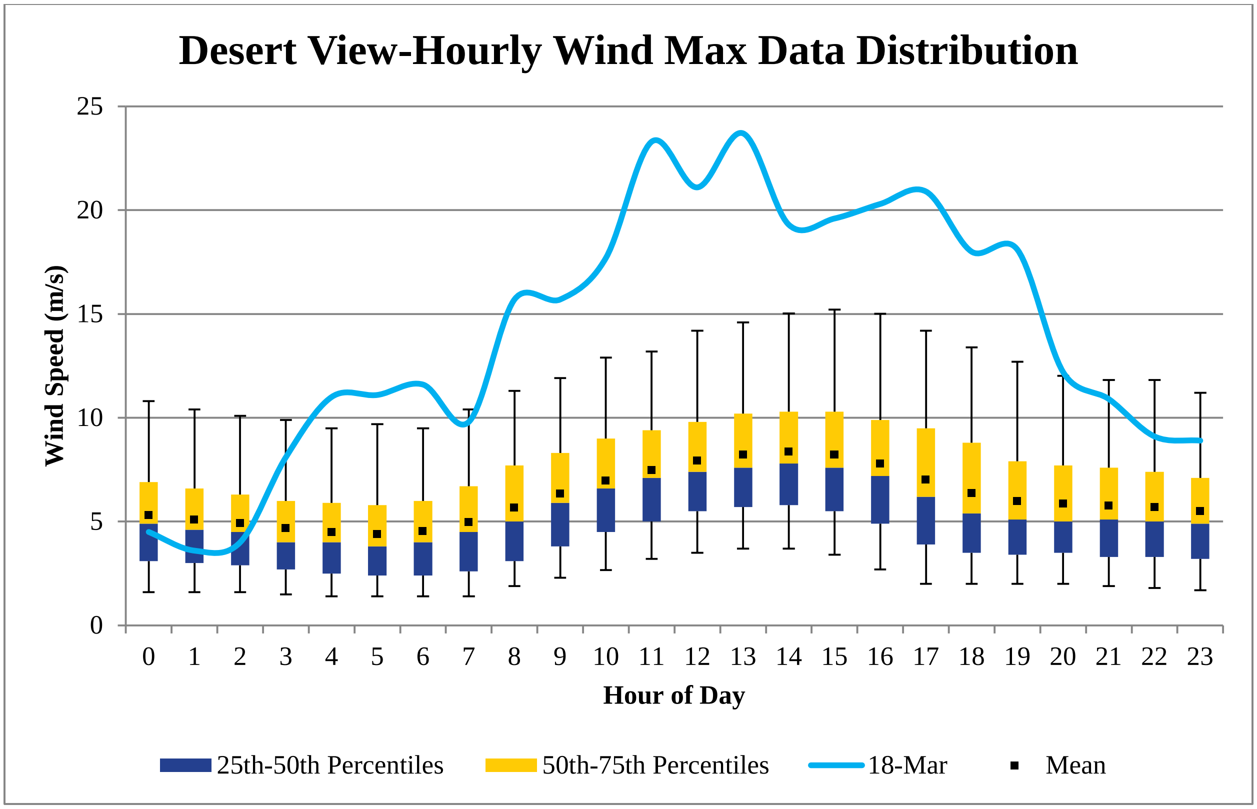


Figure 8-8d. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

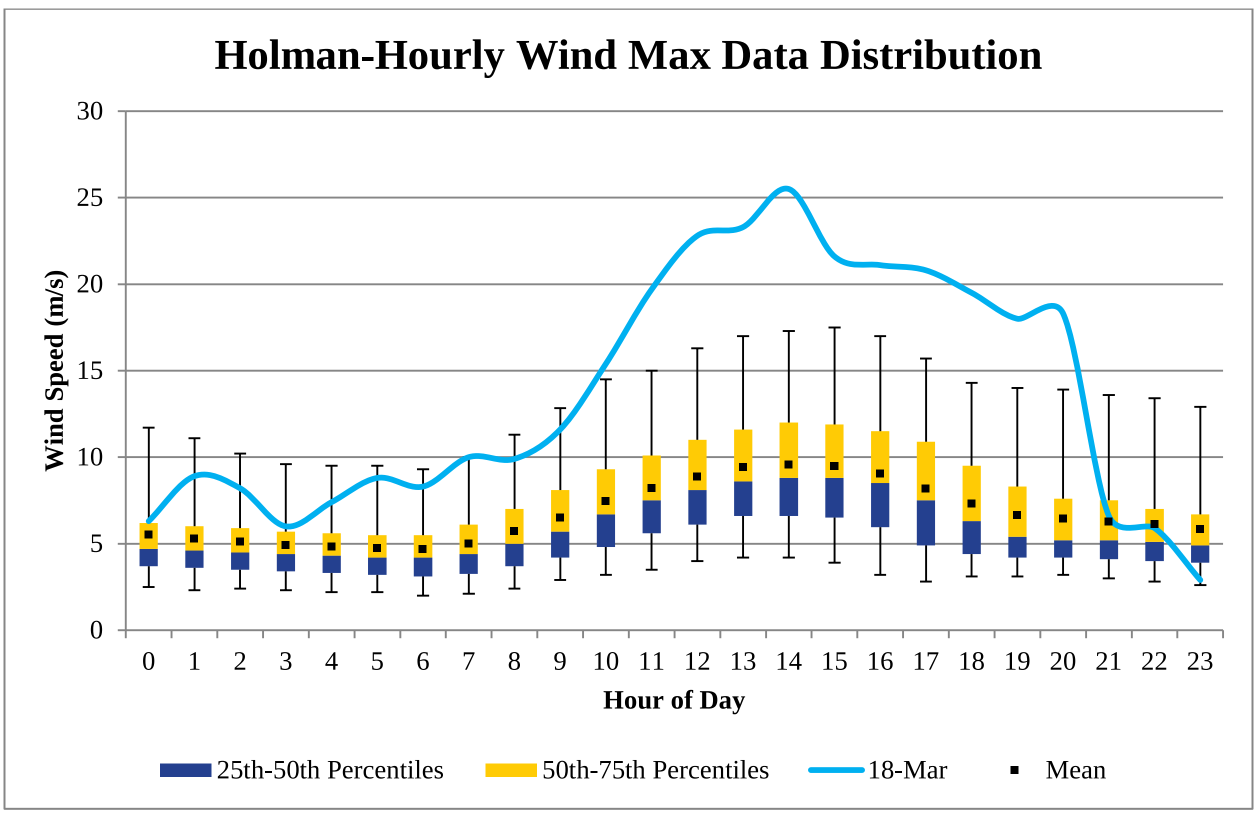


Figure 8-8e. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

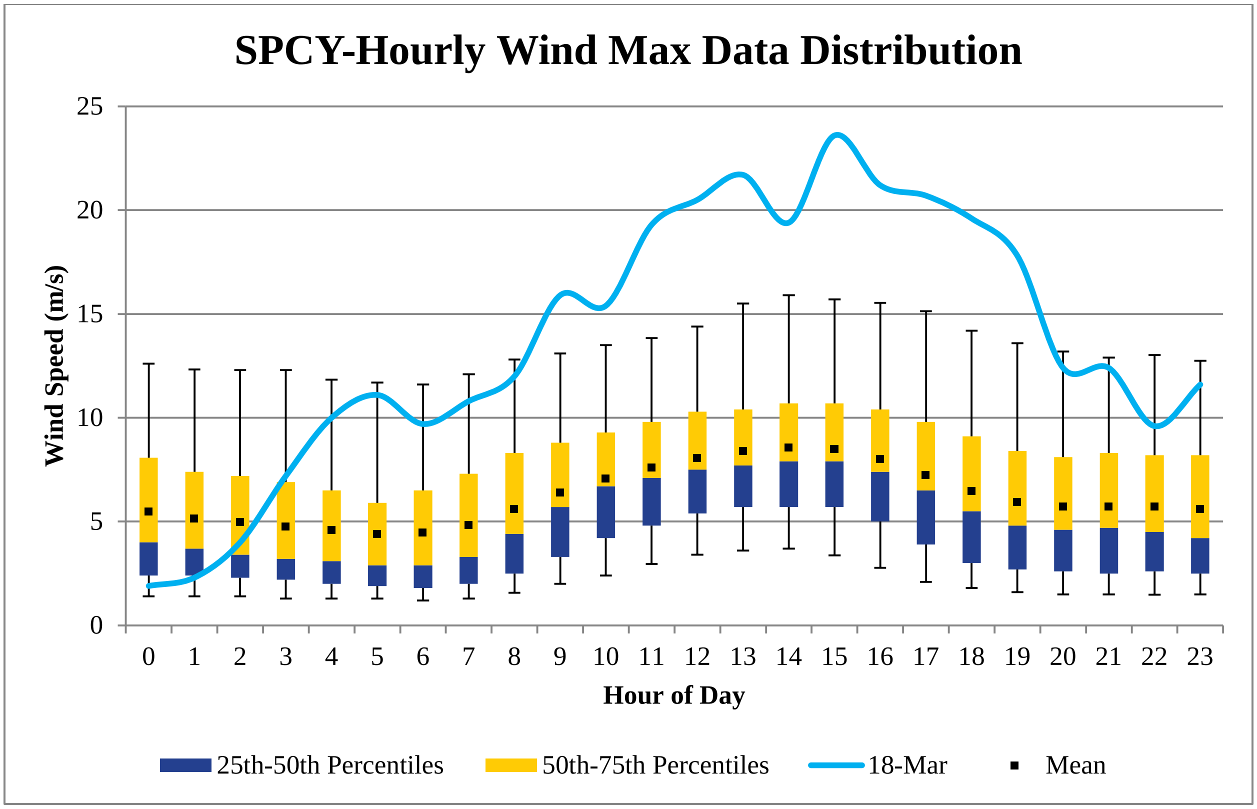


Figure 8-8f. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for March 18, 2012.

8.4 Clear Causal Relationship

A large and strong Pacific storm system and cold front passed through New Mexico on March 18, 2012. As the system approached and moved eastward, a pressure gradient formed over much Arizona and New Mexico increasing surface winds (Figures 8-9a through 8-9B). Strong upper level winds aligned with the surface wind direction and daytime heating of the surface allowed winds aloft to mix downward, increasing the surface wind velocities and providing the turbulence required for vertical mixing and horizontal transport (Figure 8-10). The timing of the upper level system and surface cold front coincided well to create the optimal conditions for strong winds.

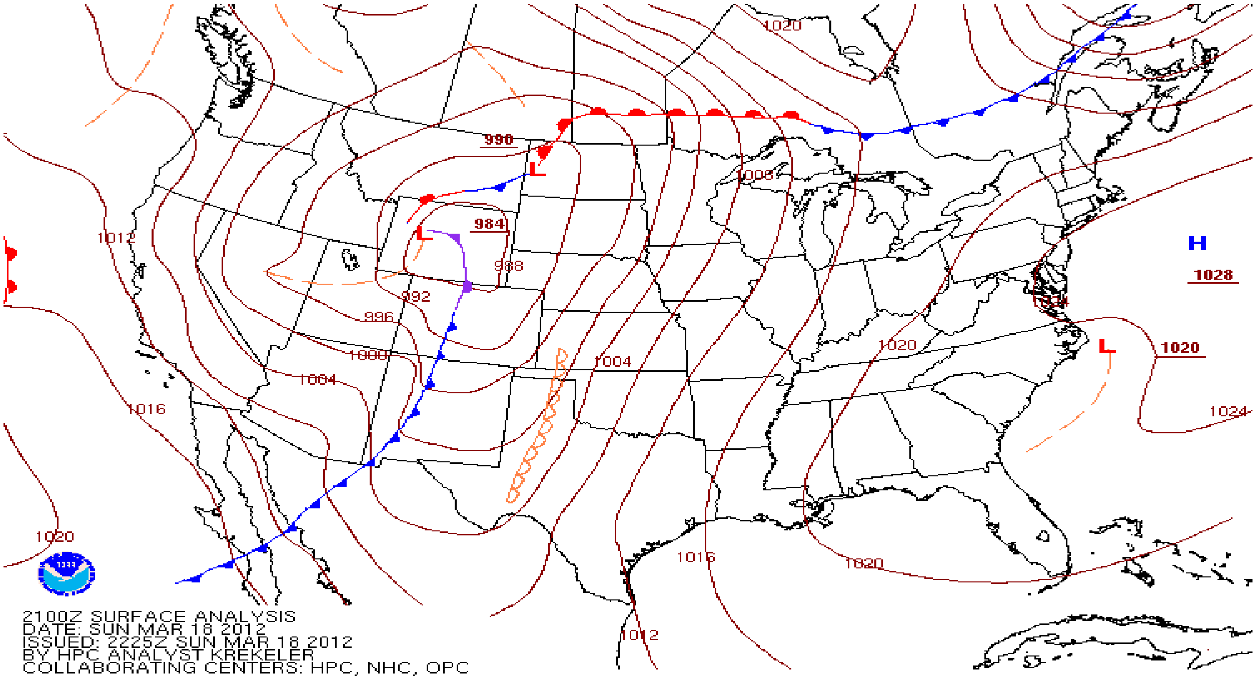


Figure 8-9a. Surface weather map showing frontal and isobars of constant pressure (red lines) for March 18, 2012 at the 1500 hour.

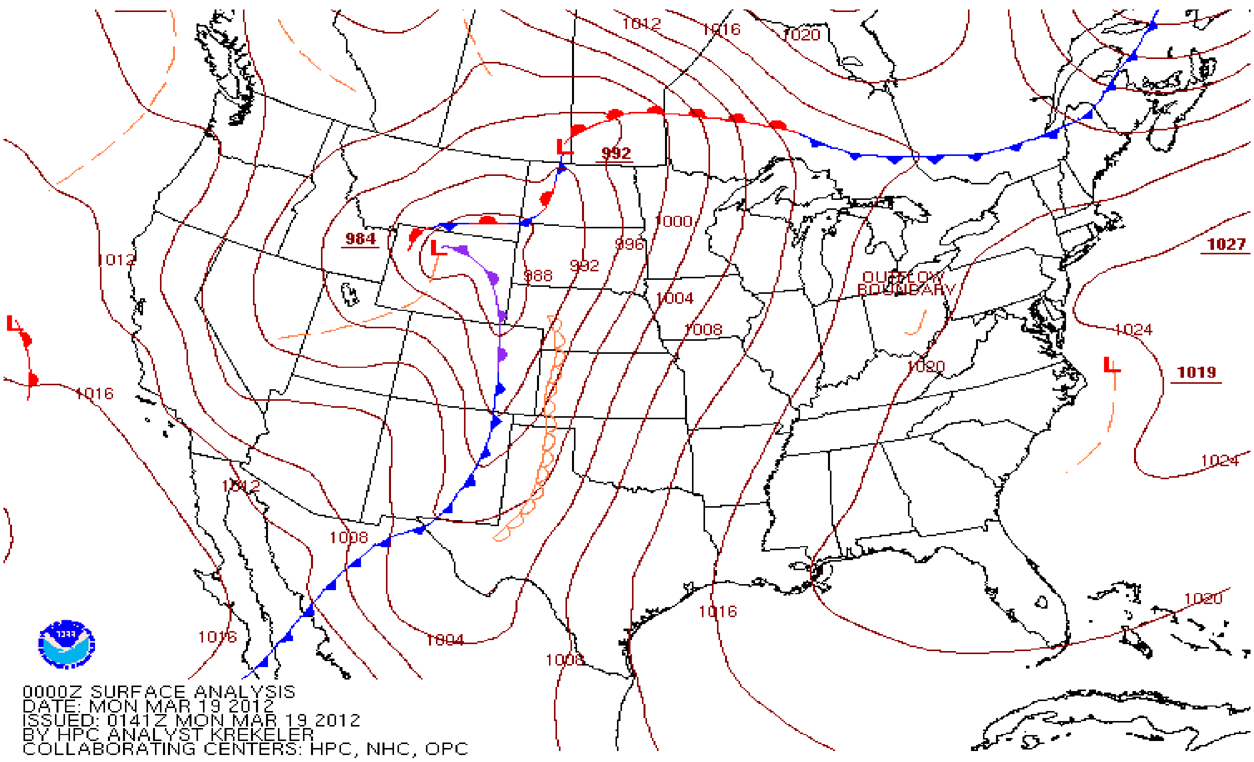


Figure 8-9b. Surface weather map showing frontal/thunderstorm activity and isobars of constant pressure (red lines) for March 18, 2012 at the 1800 hour.

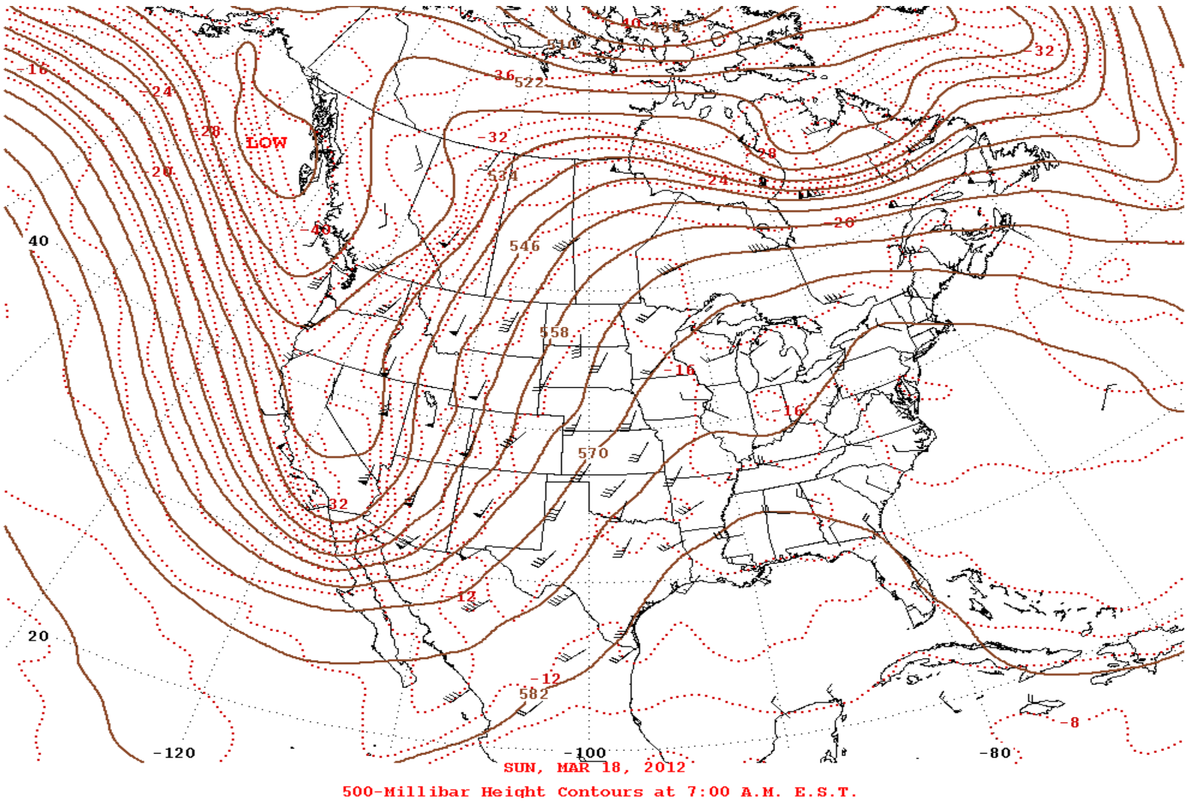


Figure 8-10. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on March 18, 2012.

The weather pattern described above generated strong south-southwesterly winds beginning at the 0330 hour and lasting through the 2200 hour. Beginning at the 0900 hour, wind speeds exceeded 11.2 m/s at Deming as shown in Figure 8-3. Peak wind speeds ranged from 12 m/s at Desert View and SPCY to 16.7 m/s at West Mesa (Figure 8-3). Peak wind gusts ranged from 23.6 m/s at Sunland Park to 26.8 m/s at Chaparral (Figure 8-4). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 8-11a-g. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (0900-2200 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 8-12a-b). Maximum hourly PM_{10} concentrations ranged from 4,573 µg/m^3 at Deming to 10,155 µg/m^3 at Holman. Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 8-13).

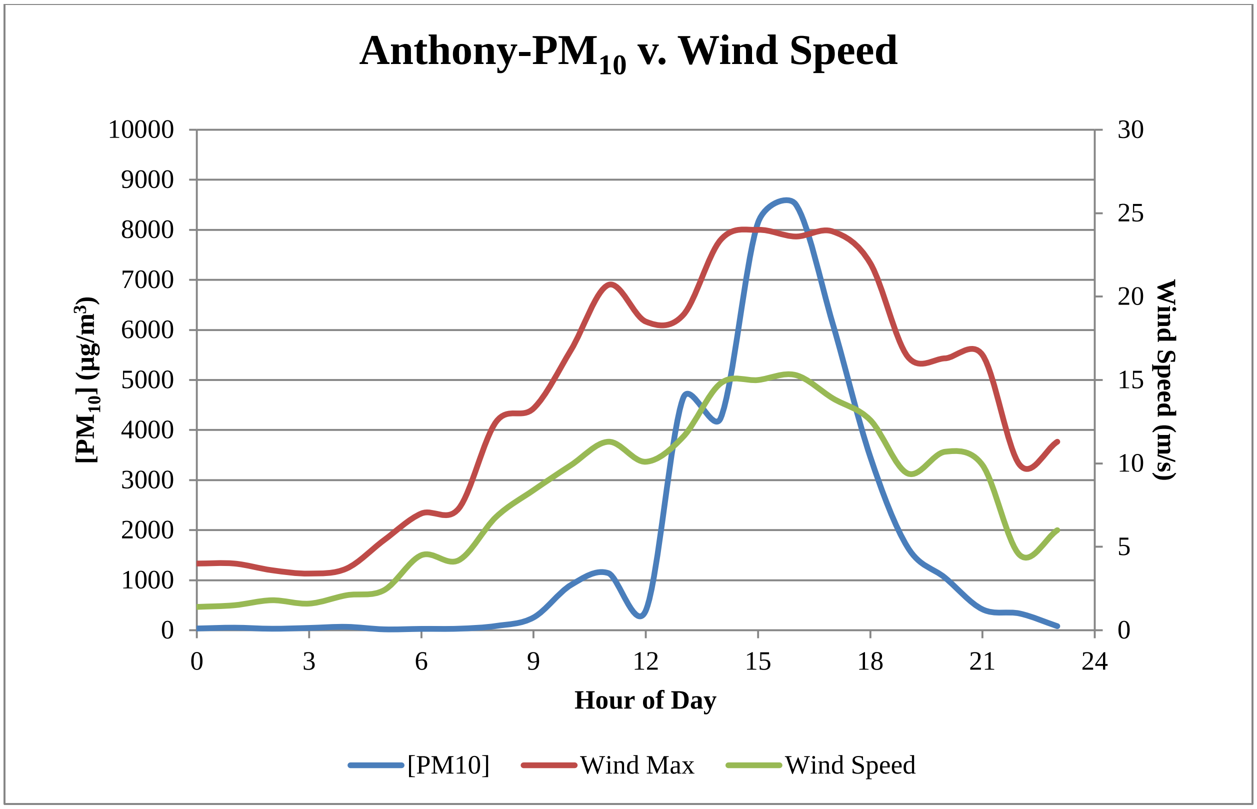


Figure 8-11a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

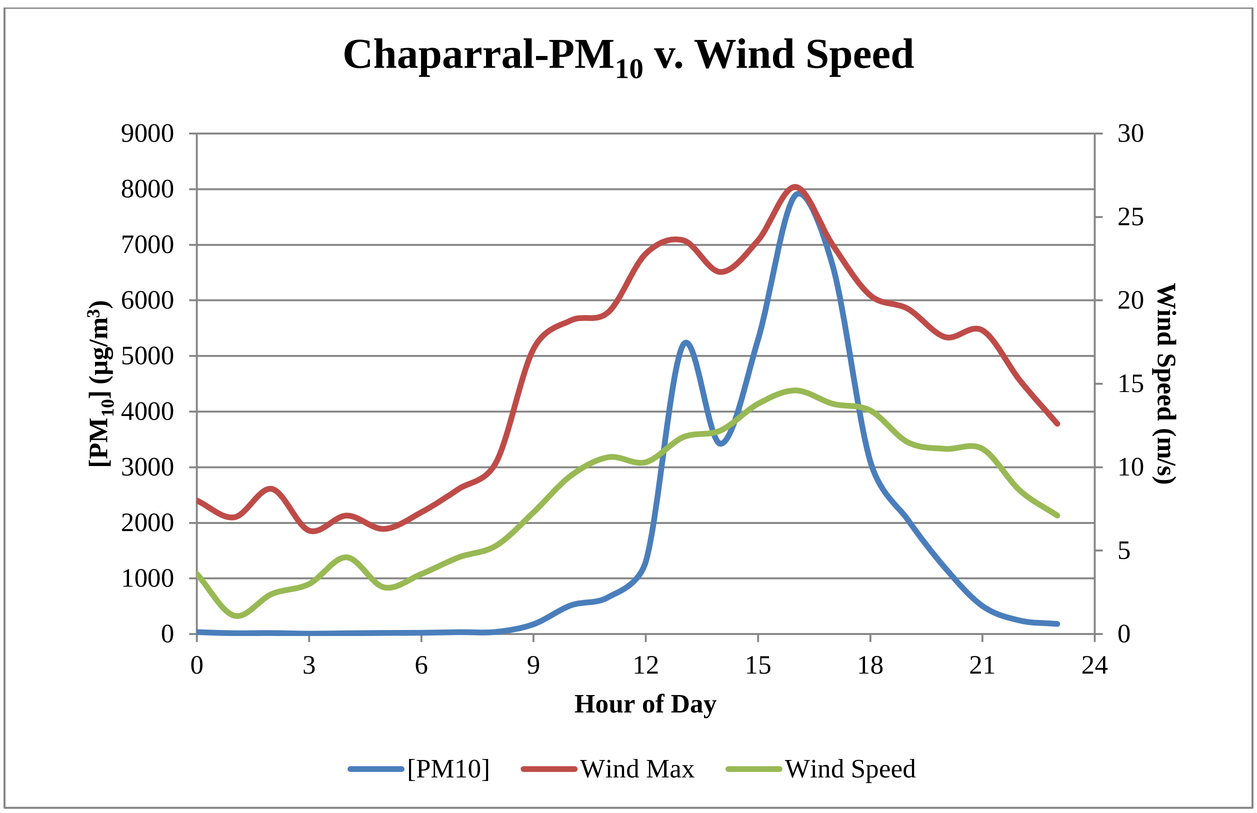


Figure 8-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

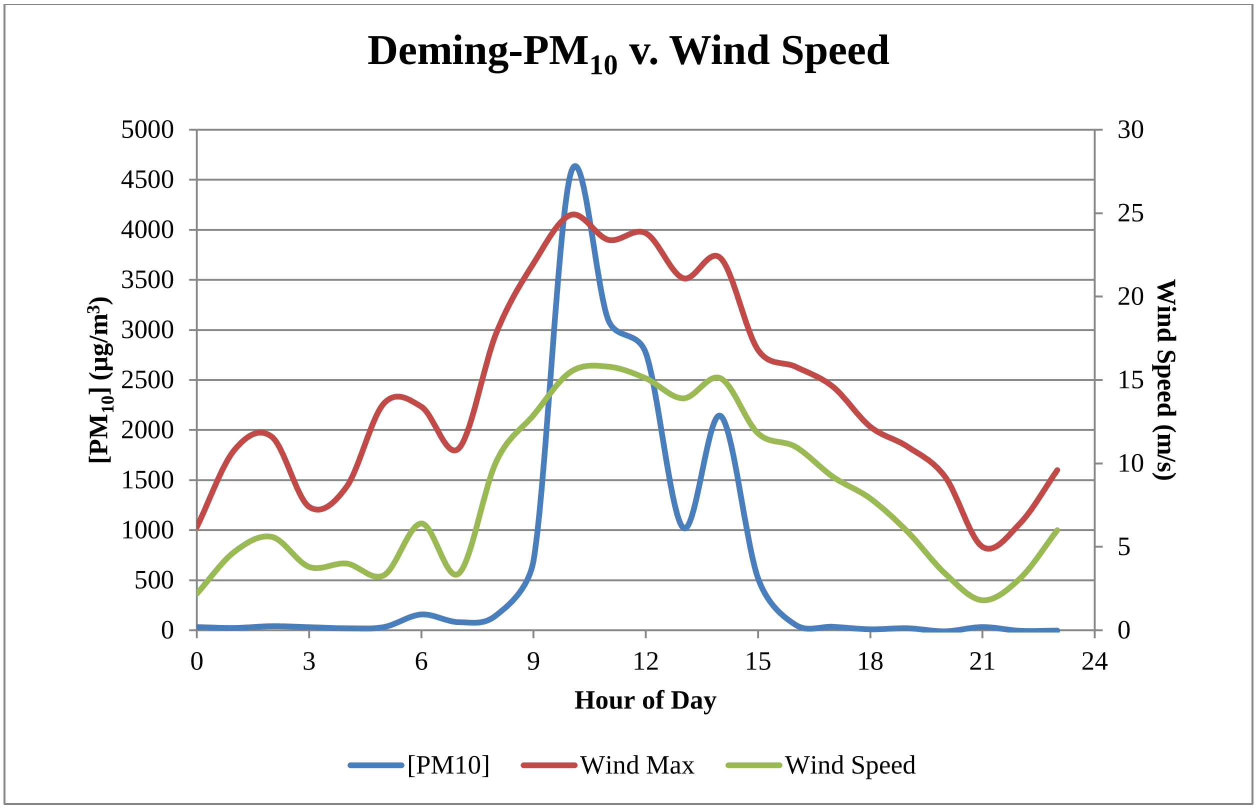


Figure 8-11c.Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

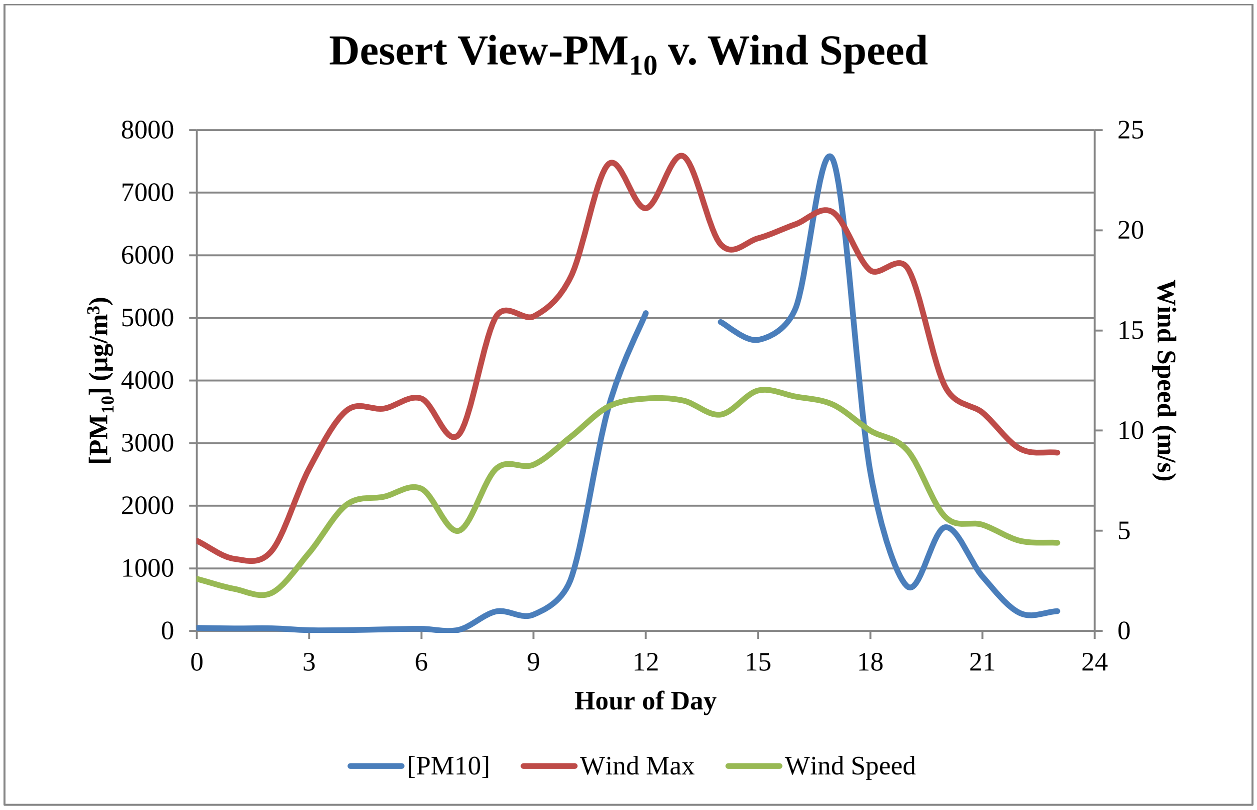


Figure 8-11d. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

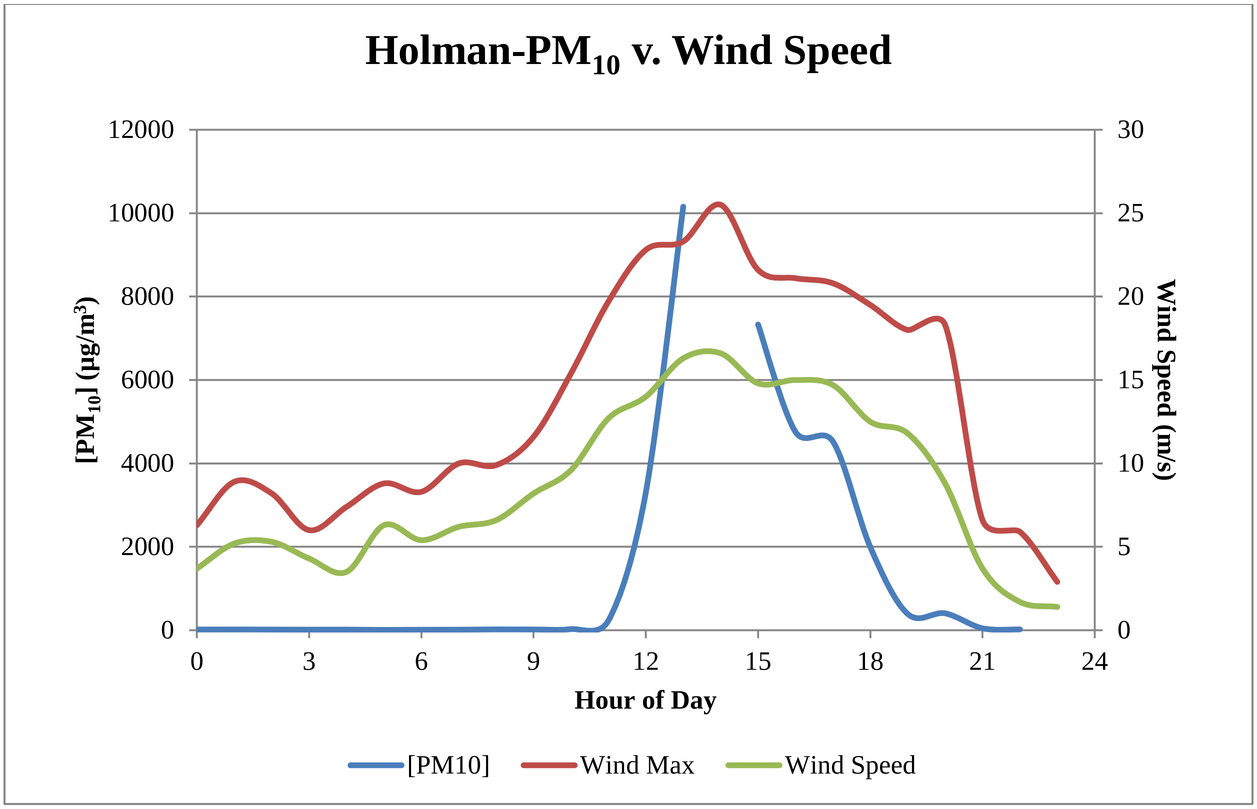


Figure 8-11e. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

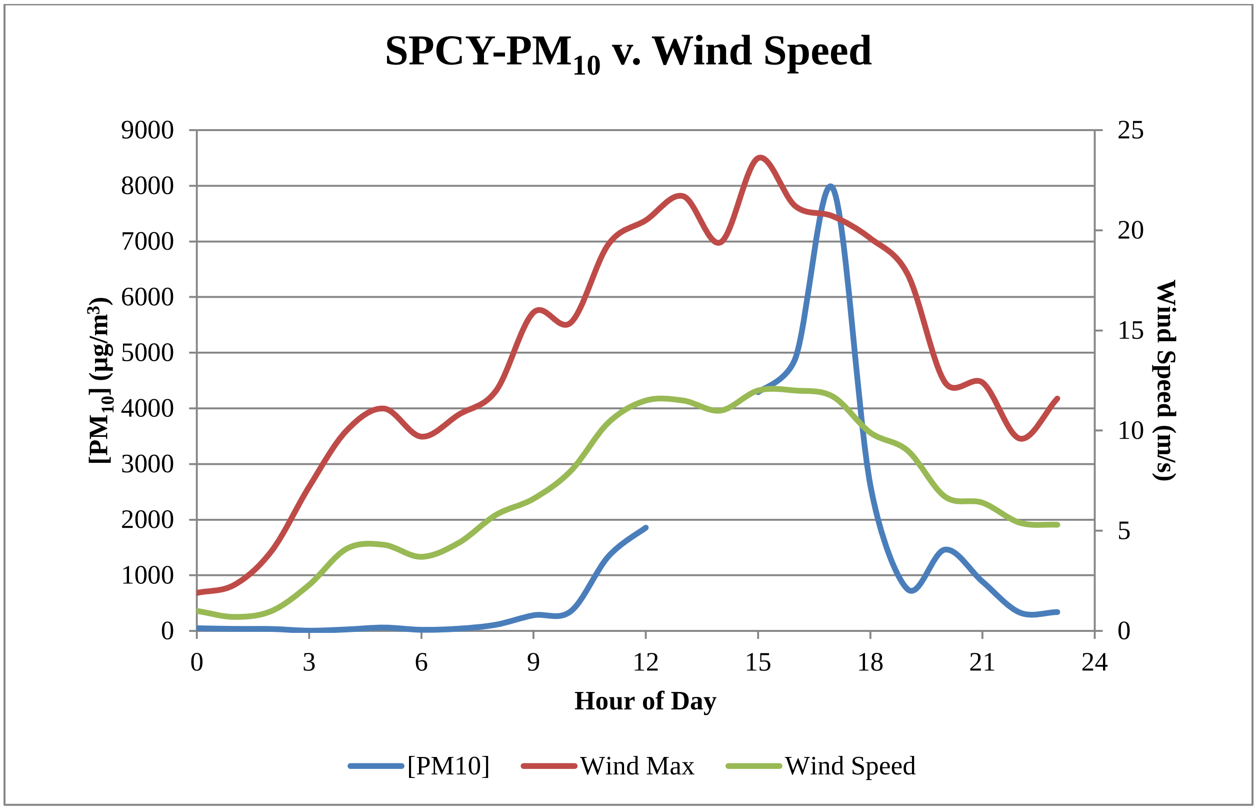


Figure 8-11f. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

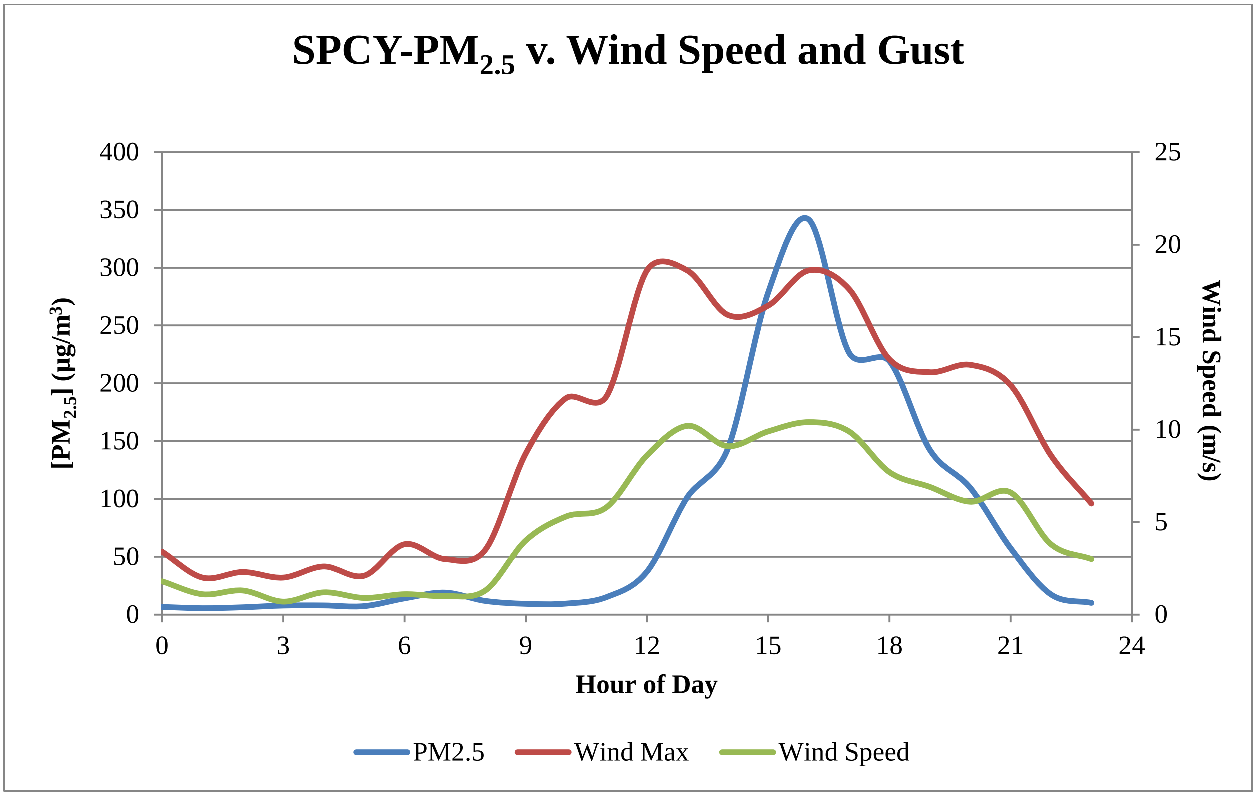


Figure 8-11g. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase.

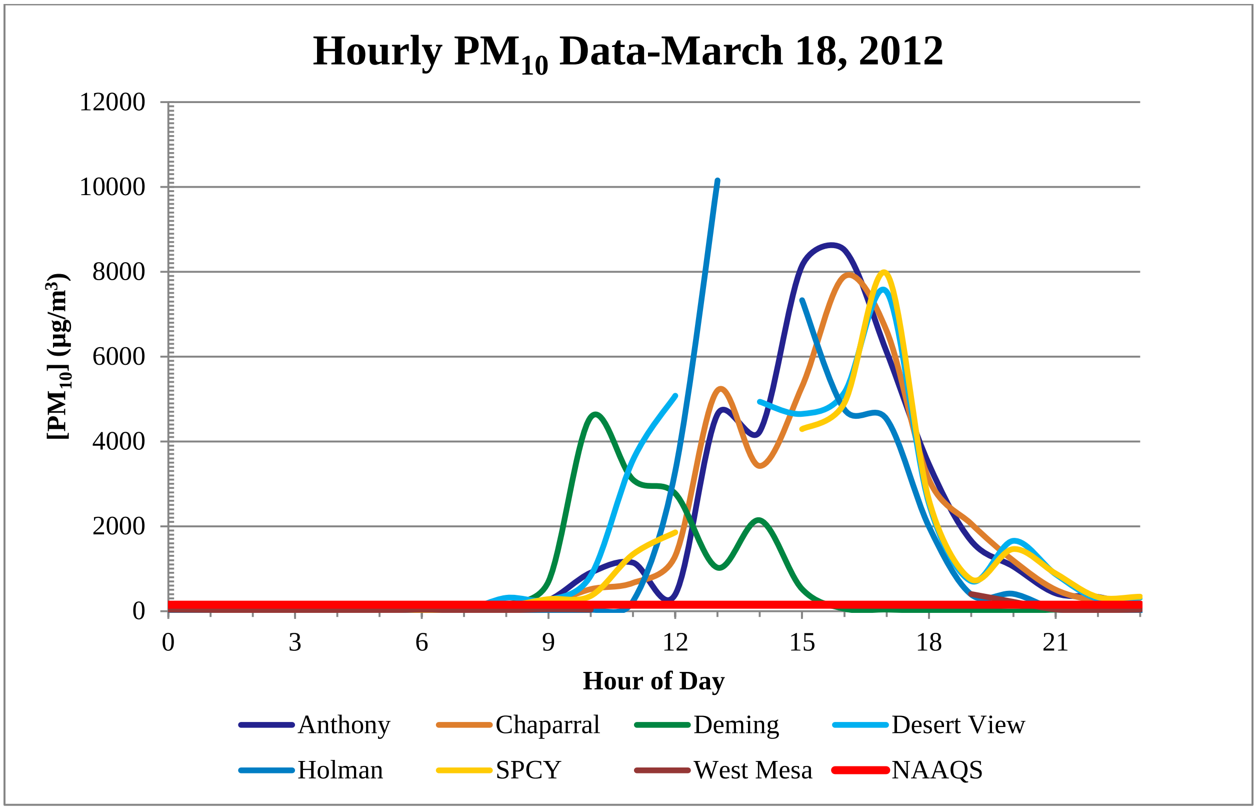


Figure 8-12a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

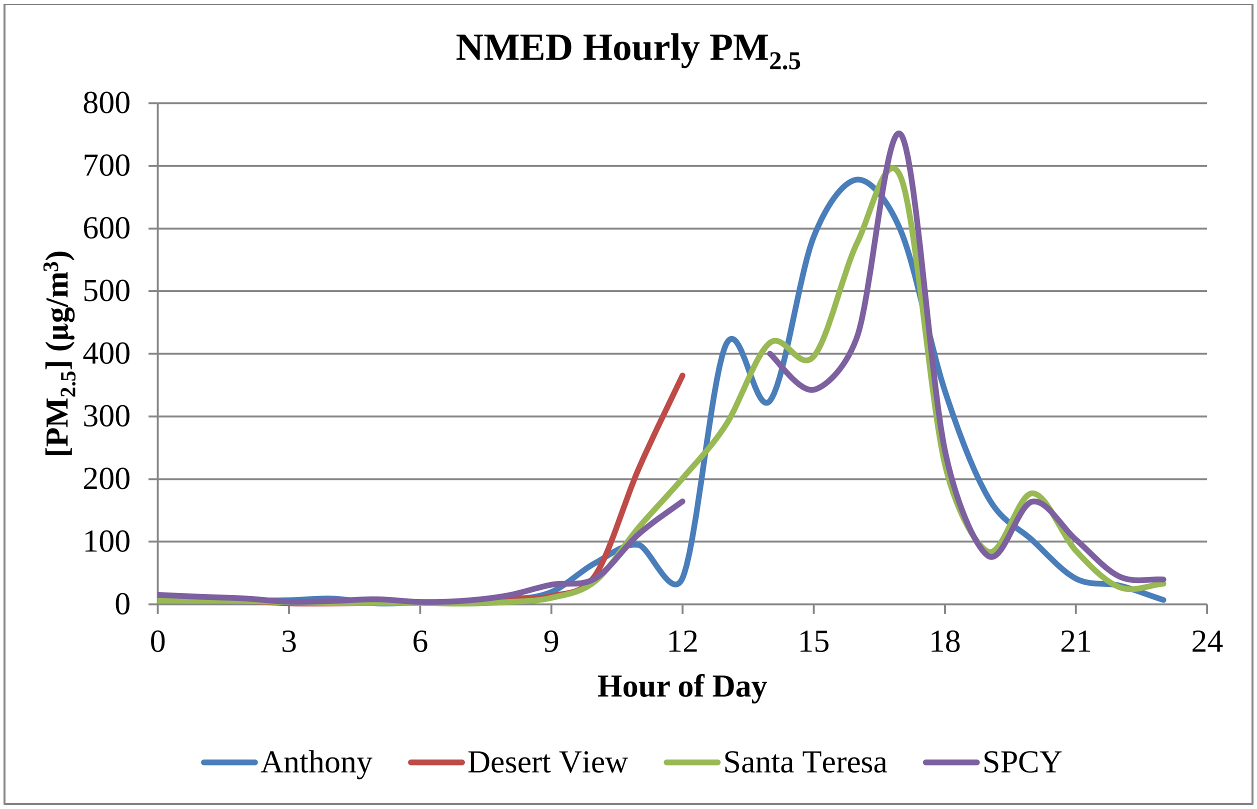


Figure 8-12b. Hourly $PM_{2.5}$ concentrations for Doña Ana and Luna Counties monitors. Non-FEM hourly $PM_{2.5}$ data.

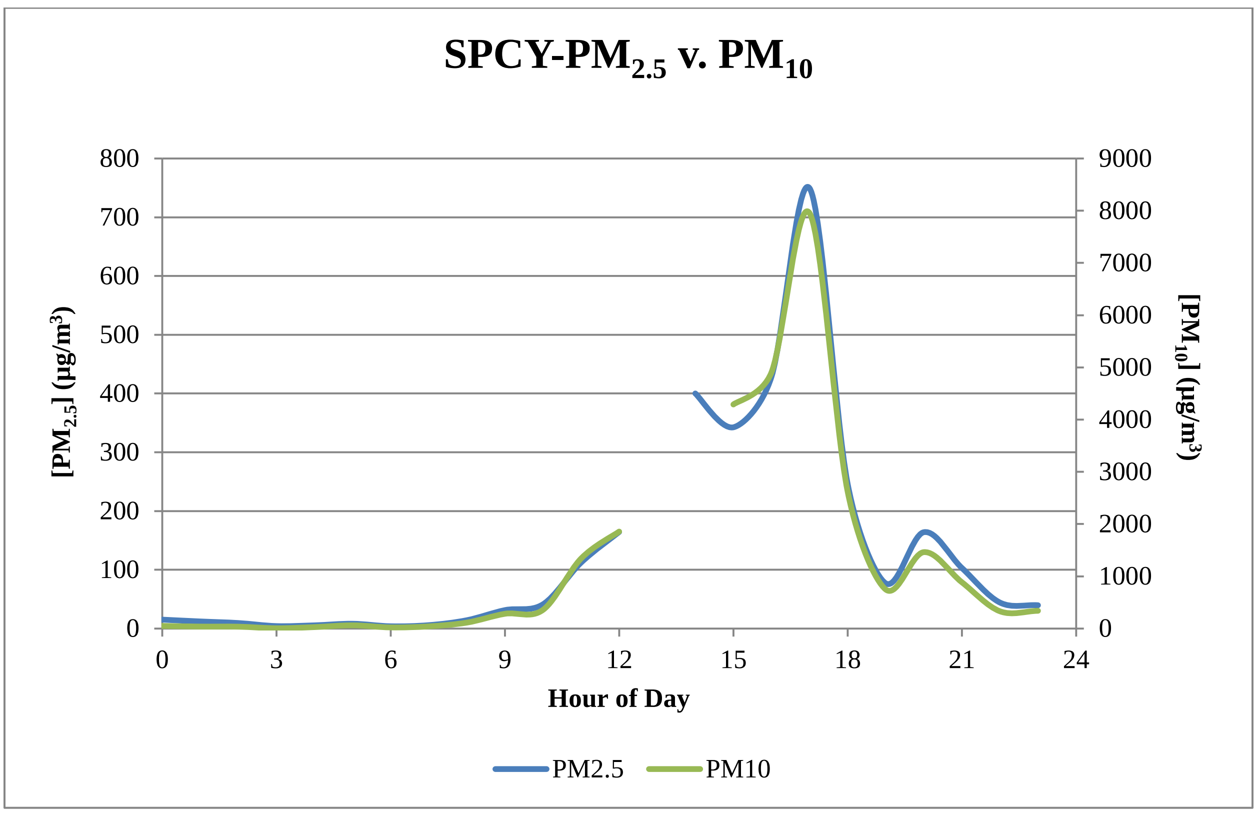


Figure 8-13. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on March 18, 2012.

The NM Border Air Quality Blog reported the following on March 18, 2012:

> Major dust storm - It started off innocent but by noon we're seen winds pick up. Now in the afternoon we're in a major dust storm today along the border. So far NM Hwy 11 and 180 are closed going out of Deming. I-10 is still open but warnings are in place for low visibility in spots. Below is an image I took at 1:46 pm at corner of University and El Paseo [Figure 8-14]. Visibility was estimated at 0.3 miles based on landmarks. Below is a photo of the PM_{10} BAM filter tape from samples taken on this day [Figure 8-15]. Normally the spots are just noticeably brown and some days it is hard to tell if there is a sample (DuBois, 2012).

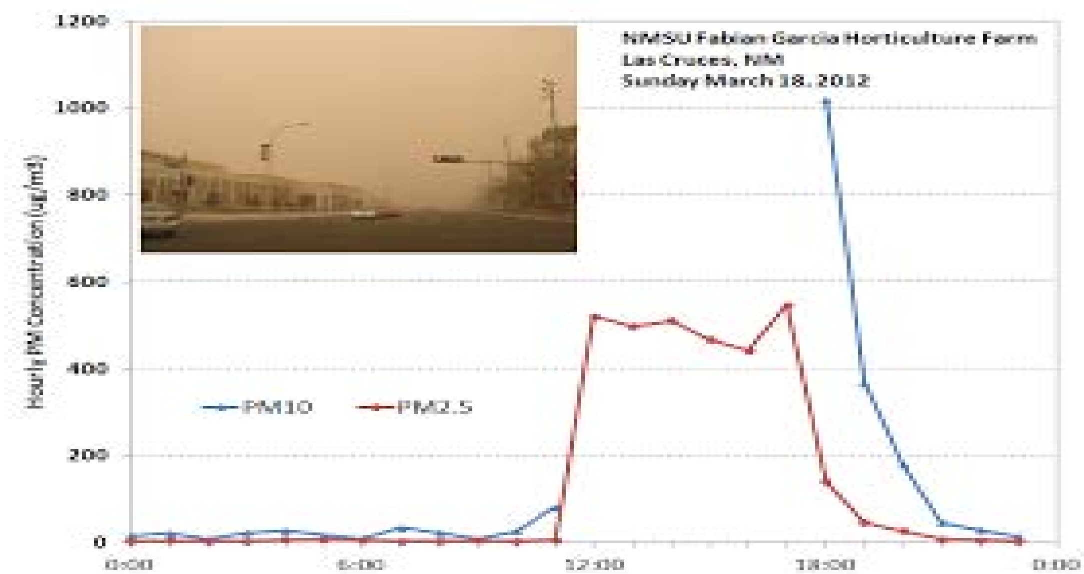


Figure 8-14. View at the corner of University and El Paseo. Photo courtesy of D. DuBois.

Figure 8-15. Photo of the PM_{10} BAM filter tape operated by NMSU. Photo courtesy of D. DuBois.

The NWS issued a high wind warning and blowing dust advisory stating, in part:

> SATURDAY WAS WINDY ACROSS THE REGION AHEAD OF THE STORM SYSTEM...BUT SUNDAY WILL BE MUCH MUCH WINDIER FOR ALL AREAS. WINDS WILL BECOME STRONG BY MID-MORNING WITH POSSIBLY DAMAGING WINDS FOR THE AFTERNOON AND EARLY EVENING HOURS SUNDAY. CONSIDERABLE BLOWING DUST SUNDAY WILL REDUCE VISIBILITY TO LESS THAN A MILE IN SEVERAL AREAS (NWS, 2011).

8.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on March 18, 2012.

8.6 Natural Event

The Clear Causal Relationship and not Reasonably Controllable or Preventable analyses show that this was a natural event caused by high wind and blowing dust.

8.7 No Exceedance but for the Event

The SPCY $PM_{2.5}$ monitor detected elevated levels due to blowing dust on March 18, 2012. These elevated concentrations resulted in exceedances of the 24-hour and annual NAAQS for $PM_{2.5}$ (149.7 $\mu g/m^3$). The strong correlation between hourly $PM_{2.5}$, PM_{10} and wind speeds peaks also point to windblown dust affecting the monitor. Previous studies have shown that $PM_{2.5}/PM_{10}$ ratios vary from 0.11 to 0.45 in the Paso del Norte Airshed (Arimoto et. al, 2001; Li et al, 2001). The ratios above 0.30 were observed in downtown El Paso and Ciudad Juárez and indicate a heavy impact from mobile sources. The lower ratios were observed in areas with less vehicular traffic and crustal material dominated the PM_{10} fraction. The $PM_{2.5}/PM_{10}$ ratio for the SPCY site was 0.12 for this date ($PM_{2.5}$ Partisol/PM_{10} TEOM). NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

The Anthony monitor detected blowing dust around the 0900 hour with hourly concentrations heavily impacted until the 2200 hour. Numerous single hourly PM_{10} values from 1300-1700 hours alone, far exceed the 24-hour average standard at Anthony. The highest hourly value (1600 hour) at Anthony produced a 24-hour average of 354 $\mu g/m^3$ (8516 $\mu g/m^3/24$ = 354 $\mu g/m^3$). By replacing the fourteen hourly values impacted by blowing dust with the 95th percentile of hourly data at the Anthony site, the resulting 24-hour average (110 $\mu g/m^3$) does not exceed the NAAQS (Table 8-1). The values in red represent the 95th percentile of all hourly data collected at Anthony, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	36	36
1	52	52
2	31	31
3	47	47
4	69	69
5	19	19
6	28	28
7	32	32
8	87	87
9	256	**92**
10	906	**100**
11	1141	**115**
12	396	**144**
13	4643	**164**
14	4238	**194**
15	8145	**194**
16	8516	**157**
17	6114	**194**
18	3465	**194**
19	1657	**184**
20	1049	**161**
21	418	**140**
22	334	**122**
23	82	82
24-Hour Average	1739	**110**

Table 8-1. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Anthony.

The Chaparral monitor detected blowing dust around the 0900 hour with hourly concentrations heavily impacted until the 2300 hour. Numerous single hourly PM_{10} values from 1300-1700 hours alone, far exceed the 24-hour average standard at Chaparral. The highest hourly value (1600 hour) at Chaparral produced a 24-hour average of 328 $\mu g/m^3$ (7891 $\mu g/m^3$/24 = 328 $\mu g/m^3$). By replacing these fourteen hourly values with the 95th percentile of hourly data at the Chaparral site, the resulting 24-hour average (83 $\mu g/m^3$) does not exceed the NAAQS (Table 8-2). The values in red represent the 95th percentile of all hourly data collected at Chaparral, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	35	35
1	15	15
2	18	18
3	7	7
4	14	14
5	20	20
6	23	23
7	34	34
8	39	39
9	177	**75**
10	517	**83**
11	665	**87**
12	1305	**127**
13	5202	**181**
14	3421	**143**
15	5296	**163**
16	7891	**159**
17	6610	**141**
18	3106	**127**
19	2059	**127**
20	1189	**118**
21	504	**97**
22	243	**83**
23	182	**75**
24-Hour Average	1606	**83**

Table 8-2. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Chaparral.

The Deming monitor detected blowing dust around the 0600 hour with hourly concentrations heavily impacted until the 1500 hour. The single hourly PM_{10} values at the 1000 hour alone, far exceed the 24-hour average standard at Deming (4573 µg/m^3/24 = 190 µg/m^3). By replacing the ten hourly values impacted by blowing dust with the 95th percentile of hourly data at the Deming site, the resulting 24-hour average (47 µg/m^3) does not exceed the NAAQS (Table 8-3). The values in red represent the 95th percentile of all hourly data collected at Deming, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	32	32
1	23	23
2	41	41
3	31	31
4	20	20
5	32	32
6	158	**66**
7	81	**67**
8	150	**67**
9	700	**63**
10	4573	**63**
11	3096	**67**
12	2769	**82**
13	1023	**109**
14	2141	**121**
15	519	**115**
16	55	55
17	35	35
18	10	10
19	20	20
20	-10	-10
21	32	32
22	-5	-5
23	-3	-3
24-Hour Average	646	**47**

Table 8-3. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Deming.

The Holman monitor detected blowing dust around the 1100 hour with hourly concentrations heavily impacted until the 2000 hour. Numerous single hourly PM_{10} values from 1300-1700 hours alone, far exceed the 24-hour average standard at Holman. The highest hourly value (1300 hour) at Holman produced a 24-hour average of 423 $\mu g/m^3$ (10155 $\mu g/m^3/24$ = 423 $\mu g/m^3$). By replacing the nine hourly values impacted by blowing dust with the 95th percentile of hourly data at the Holman site, the resulting 24-hour average (55 $\mu g/m^3$) does not exceed the NAAQS (Table 8-4). The values in red represent the 95th percentile of all hourly data collected at Holman, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	18	18
1	19	19
2	17	17
3	15	15
4	16	16
5	9	9
6	13	13
7	14	14
8	21	21
9	19	19
10	28	28
11	**232**	**73**
12	**3305**	**88**
13	**10155**	**113**
14		
15	**7330**	**132**
16	**4756**	**132**
17	**4527**	**126**
18	**1996**	**155**
19	**392**	**129**
20	**406**	**106**
21	47	47
22	21	21
23	1	1
24-Hour Average	1449	**55**

Table 8-4. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Holman.

The Desert View monitor detected blowing dust around the 0800 hour with hourly concentrations heavily impacted until the 2300 hour. Numerous single hourly PM_{10} values from 1300-1700 hours alone, far exceed the 24-hour average standard at Desert View. The highest hourly value (1700 hour) produced a 24-hour average of 313 µg/m^3 (7529 µg/m^3/24 = 313 µg/m^3). By replacing the fifteen hourly values impacted by blowing dust with the 95th percentile of hourly data at the Desert View site, the resulting 24-hour average (82 µg/m^3) does not exceed the NAAQS (Table 8-5). The values in red represent the 95th percentile of all hourly data collected at Desert View, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	49	49
1	40	40
2	42	42
3	12	12
4	13	13
5	25	25
6	34	34
7	18	18
8	**312**	**91**
9	**262**	**91**
10	**837**	**91**
11	**3567**	**93**
12	**5077**	**99**
13		
14	**4935**	**132**
15	**4649**	**136**
16	**5150**	**138**
17	**7529**	**166**
18	**2543**	**141**
19	**707**	**142**
20	**1656**	**120**
21	**869**	**111**
22	**286**	**101**
23	**316**	**93**
24-Hour Average	1691	**82**

Table 8-5. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Desert View.

The Sunland Park monitor detected blowing dust around the 0800 hour with hourly concentrations heavily impacted until the 2300 hour. Numerous single hourly PM_{10} values from 1500-1700 hours alone, far exceed the 24-hour average standard at SPCY. The highest hourly value (1700 hour) produced a 24-hour average of 331 µg/m^3 (7955 µg/m^3/24 = 331 µg/m^3). By replacing these fourteen hourly values with the 95th percentile of hourly data at the Sunland Park site, the resulting 24-hour average (118 µg/m^3) does not exceed the NAAQS (Table 8-6). The values in red represent the 95th percentile of all hourly data collected at Sunland Park, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	49	49
1	37	37
2	35	35
3	5	5
4	27	27
5	61	61
6	21	21
7	41	41
8	**113**	**97**
9	**282**	**96**
10	**357**	**102**
11	**1340**	**111**
12	**1856**	**144**
13		
14		
15	**4290**	**205**
16	**4904**	**203**
17	**7955**	**211**
18	**2626**	**296**
19	**748**	**279**
20	**1462**	**265**
21	**886**	**221**
22	**330**	**194**
23	**339**	**139**
24-Hour Average	1261	**118**

Table 8-6. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Sunland Park.

9 HIGH WIND EXCEPTIONAL EVENT: April 1, 2012

9.1 Summary of Event

The passing of a Pacific cold front caused high winds and blowing dust in southern Doña Ana County resulting in an exceedance of the PM_{10} and the $PM_{2.5}$ annual NAAQS at the SPCY monitoring site on this date. The FEM TEOM continuous monitor at this site recorded 24-hour average PM_{10} concentrations of 157 µg/m^3 and the FRM Partisol recorded a 24-hour average $PM_{2.5}$ concentration of 33 µg/m^3. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured at Anthony (96 µg/m^3) and Desert View (138 µg/m^3) monitoring sites (Figure 9-1). The averages in this figure were calculated using PM_{10} FEM TEOM and $PM_{2.5}$ FRM Partisol instrument data for the four days before and after the event. Elevated concentrations were also recorded by the $PM_{2.5}$ non-FEM/FRM TEOMs (Figure 9-2).

As the event unfolded, the wind blew from the west-southwest throughout the border region. These high velocity winds passed over large areas of desert within New Mexico and Mexico. The co-occurrence of high winds and elevated levels of blowing dust, little to no point sources in the area, and the high hourly and daily PM_{10} concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

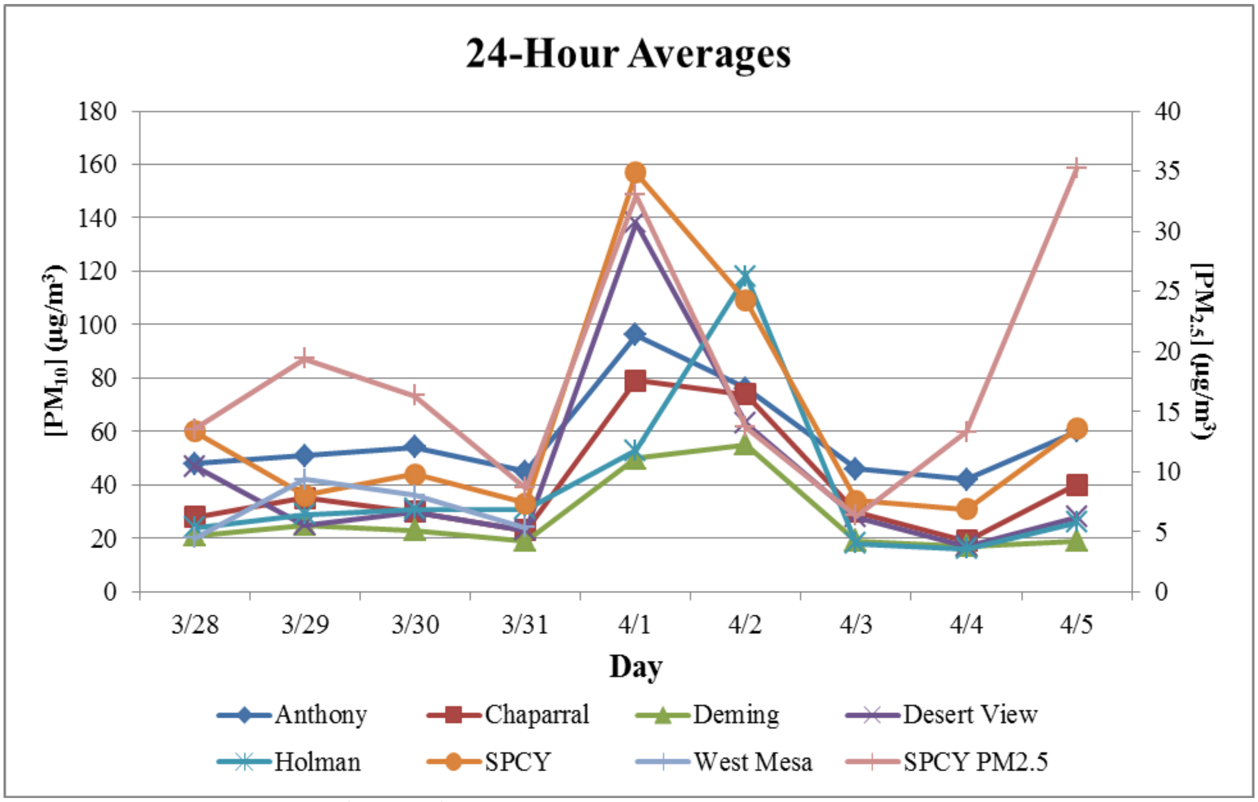


Figure 9-1. PM_{10} 24-hour averages before and after April 1, 2012.

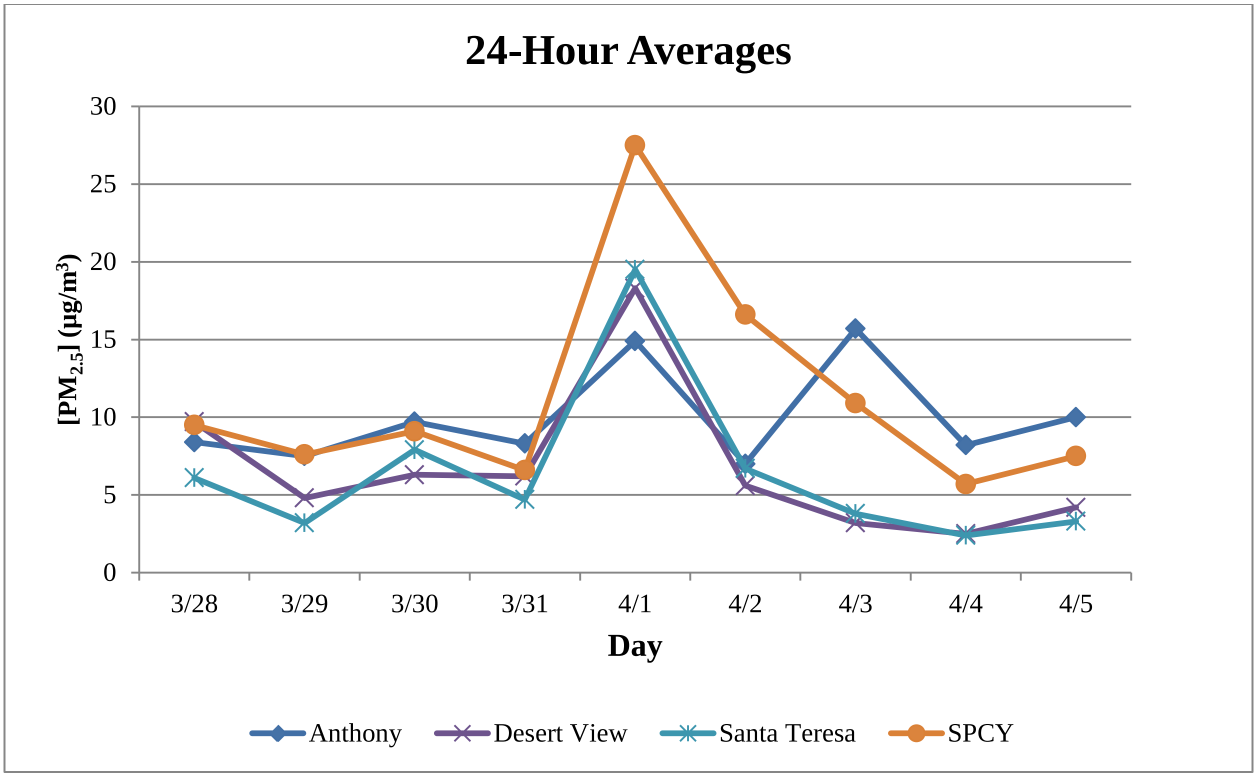


Figure 9-2. $PM_{2.5}$ 24-hour averages before and after April 1, 2012. Non FRM/FEM TEOM data.

9.2 Is Not Reasonably Controllable or Preventable

9.2.1 Suspected Source Areas and Categories Contributing to the Event

Sources of windblown dust contributing to this exceedance include the natural desert, residential properties, agricultural land and unpaved roads in Mexico and New Mexico. Agricultural tilling and crop planting may have contributed to this event. Doña Ana County Ordinance requires BACM for any dust producing activities. The largest and most likely sources of windblown dust are the natural desert and the playas of northern Mexico (see Section 9.2.4 below).

9.2.2 Sustained and Instantaneous Wind Speeds

EPA uses a default entrainment threshold of sustained wind speeds at 11.2 m/s (25 mph) for natural and well controlled anthropogenic sources contributing to natural events caused by high wind and blowing dust (EPA, 2013). Under the Doña Ana and Luna County NEAPs, EPA and NMED agreed that wind gusts exceeding 18 m/s would overwhelm any natural and well-controlled anthropogenic sources and cause windblown dust. On April 1, 2012, sustained wind speeds reached EPA's default threshold at one of the eight monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at three of the eight monitoring sites (Figures 9-3 and 9-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 1300 hour and ending at the 1500 hour.

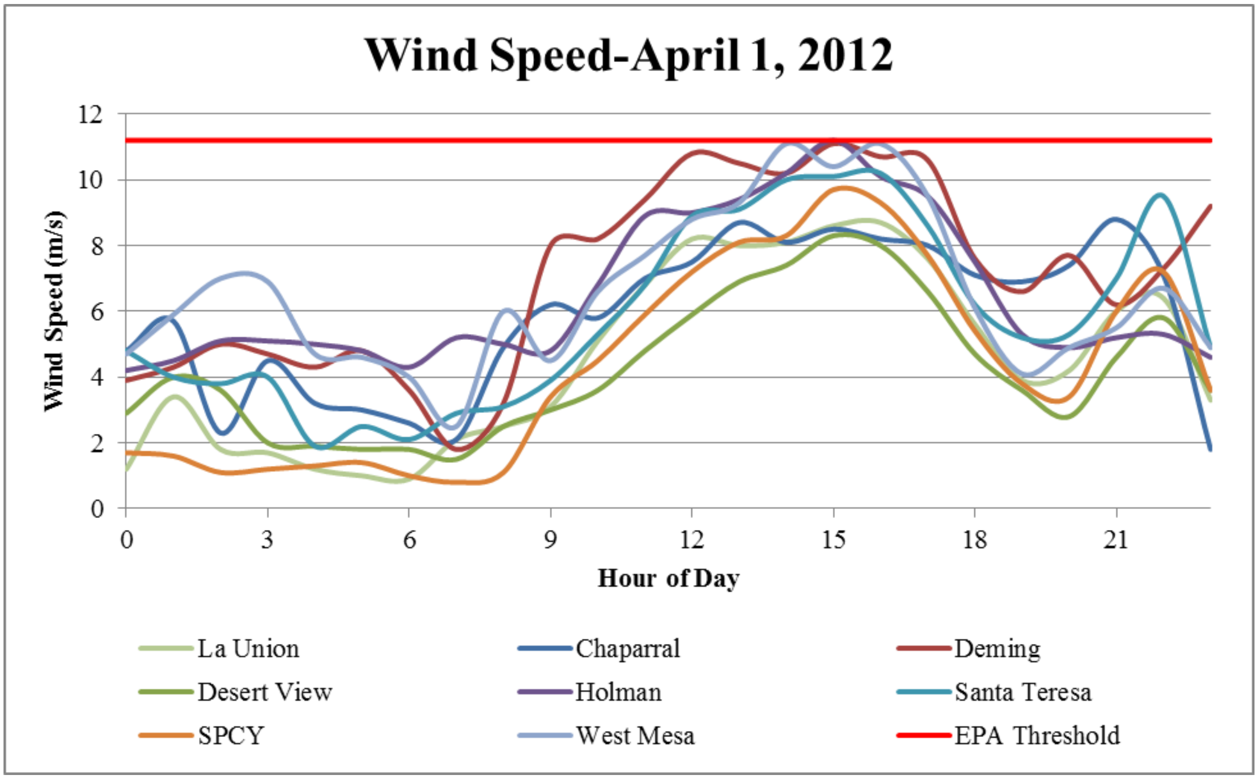


Figure 9-3 Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

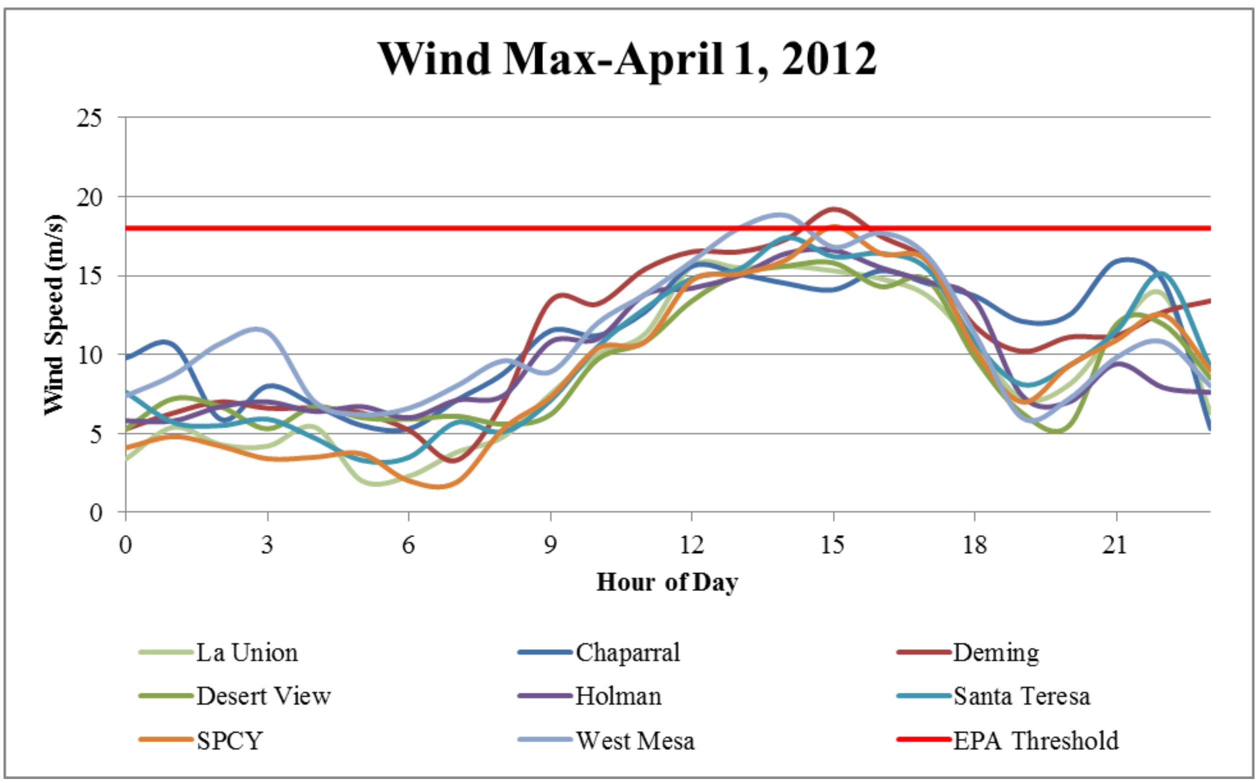


Figure 9-4 Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

9.2.3 Recurrence Frequency

The monitoring sites in Doña Ana and Luna Counties can record exceedances of the PM_{10} NAAQS throughout the year. From 2007-2011 the PM_{10} FEM TEOM monitors recorded 254 exceedances and the PM_{10} FRM Wedding monitors recorded 6 exceedances (Figure A-1). The Deming Airport and Desert View monitoring sites (FEM TEOMs) were established in 2006 and 2007 respectively and do not show exceedances until the year following startup. The SPCY $PM_{2.5}$ FRM Partisol recorded 37 exceedances of the 24-Hour NAAQS from 2007-2011 (Figure A-2). See appendix A for a more in-depth discussion about recurrence frequency and the number of exceedances at each monitoring site.

9.2.4 Controls Analysis

The local ordinances and MOUs adopted under the NEAP direct the implementation of BACM for sources of dust in Doña Ana County. The ordinance regulates disturbed lands, construction and demolition, vacant parking lots and materials handling and transportation. Our investigation did not identify any unusual PM_{10} producing activities on this day, and anthropogenic emissions remained constant before, during and after the event. The most likely source contributing to the event is the natural desert and playas in New Mexico and northern Mexico. The southern sites in Doña Ana County recorded the highest 24-hour averages in the monitoring network. A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from Mexico to the monitors in southern Doña Ana County. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 9-5). Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

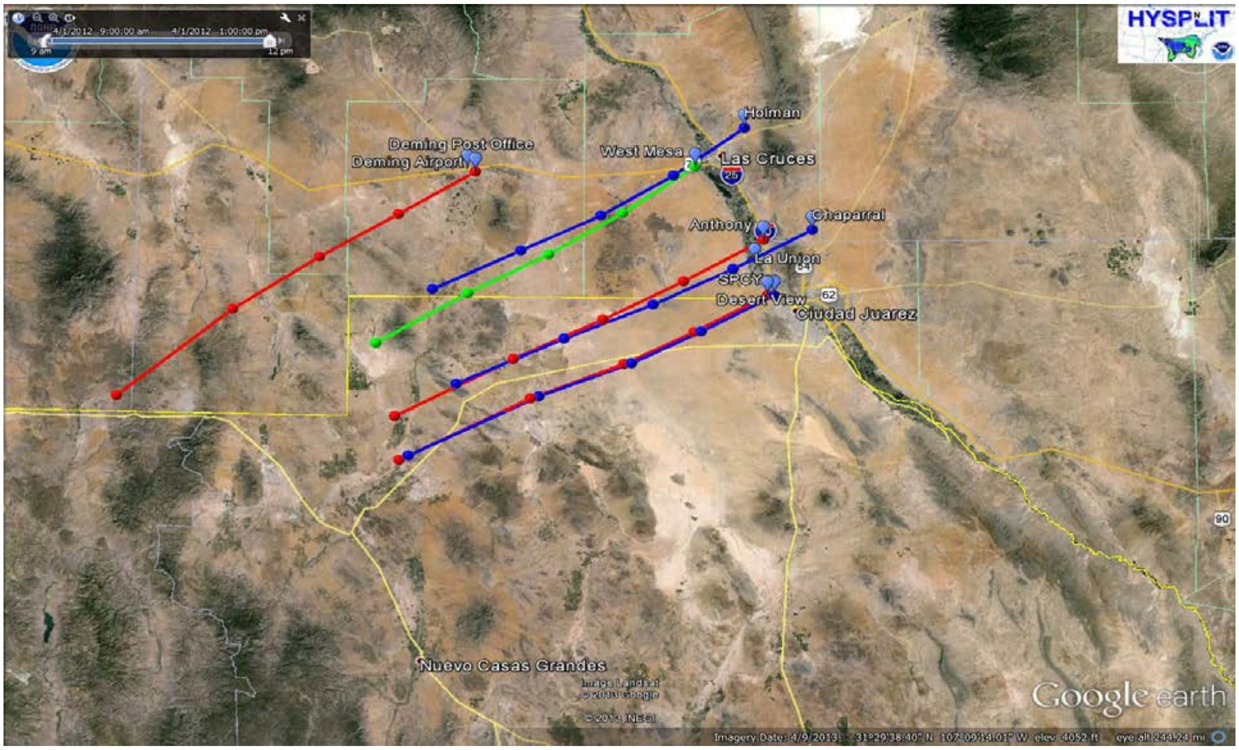


Figure 9-5 HYSPLIT back-trajectory model analysis for April 1, 2012.

9.3 Historical Fluctuations Analysis

9.3.1 Annual and Seasonal 24-hour Average Fluctuations

Since being established, the monitoring sites in Doña Ana and Luna Counties have recorded exceedances of the PM_{10} NAAQS. High winds cause these exceedances and they can occur at any time of year (Figure B-6 through B-13). Most exceedances occur from late winter through early summer (February-June) and are associated with the passage of Pacific cold fronts. High winds caused all recorded exceedances from 2007-2011 and NMED submitted natural events demonstrations to EPA under the NEAP or EER.

Since the 24-hour $PM_{2.5}$ NAAQS was lowered from 65 to 35 µg/m^3 in 2006, the SPCY Partisol monitor has routinely recorded exceedances of the standard. These exceedances occurred throughout the year during high and low wind conditions. In 2009, NMED investigated the cause of the low wind exceedances and found that emissions from Ciudad Juárez, Mexico contribute significantly to elevated concentrations. The high wind exceedances were caused by blowing dust on days when PM_{10} monitors also recorded exceedances.

Appendix B contains a more in-depth discussion about historical fluctuations and charts showing annual and seasonal trends at each monitoring site.

Table B-1 and B-2 show normal historical fluctuations with and without high wind natural events that caused exceedances from 2007-2011. The analysis excludes only those high wind events that resulted in an exceedance. Data for PM_{10} in this table includes FRM Wedding and FEM TEOM measurements and data for $PM_{2.5}$ comes from the FRM Partisol measurements from

2007-2011. The recorded value for this day (157 µg/m^3) is above the maximum value recorded when no high wind exceedances are included and is above the 95th percentile of all 24-hour averages recorded.

An hourly data distribution analysis was performed for PM_{10} and $PM_{2.5}$ concentrations, wind speeds and wind gusts (Appendices C, D and E). All data used for the PM_{10} distribution charts come from the FEM TEOM monitors and the non-FEM/FRM $PM_{2.5}$ TEOM monitor at SPCY. Overlaying the hourly data for April 1, 2012 on the hourly data distribution plots shows that the values recorded during the high wind event exceed the 95th percentile for PM_{10}, $PM_{2.5}$, wind speed and wind gusts (Figures 9-6a-b through 9-8). The top whiskers of the box and whisker plots represent the 95th percentile of data. The hourly PM_{10} values during the high wind blowing dust storm far exceed the historical 95th percentile of data.

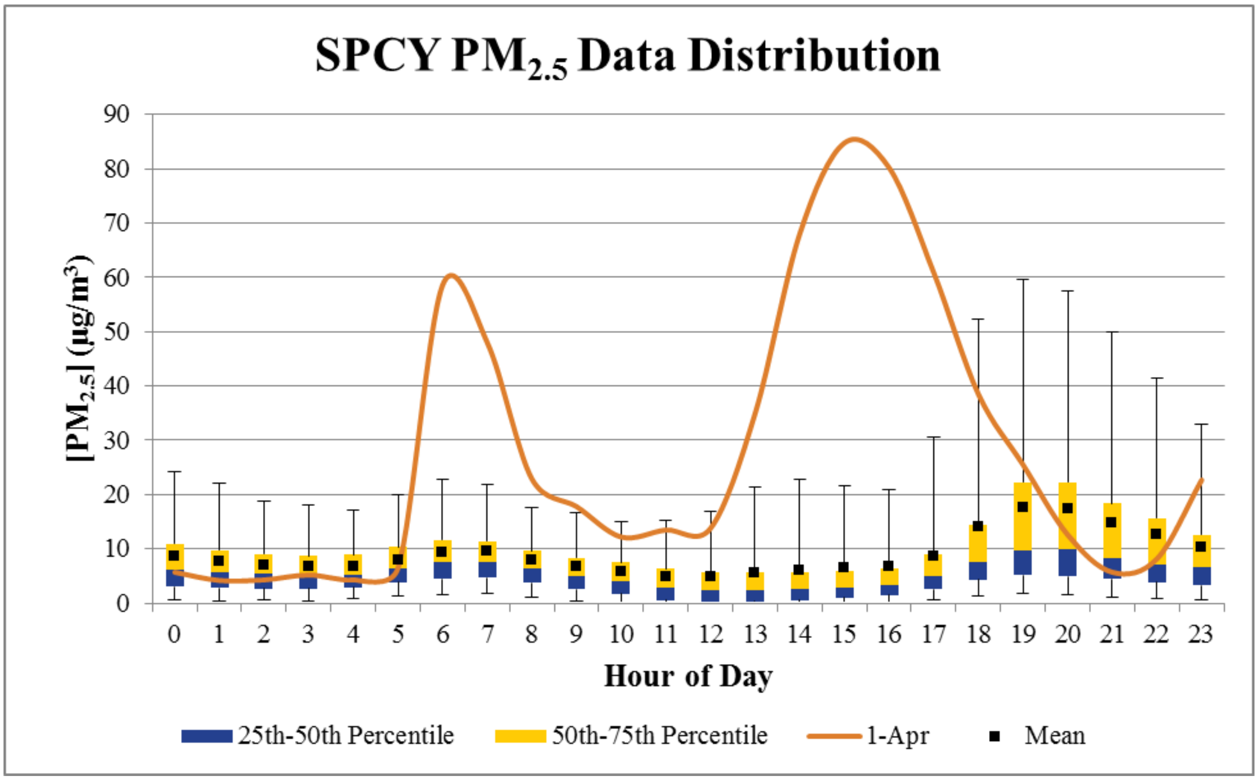


Figure 9-6a $PM_{2.5}$ hourly data distribution from 2007-2011 overlaid by hourly values for April 1, 2012.

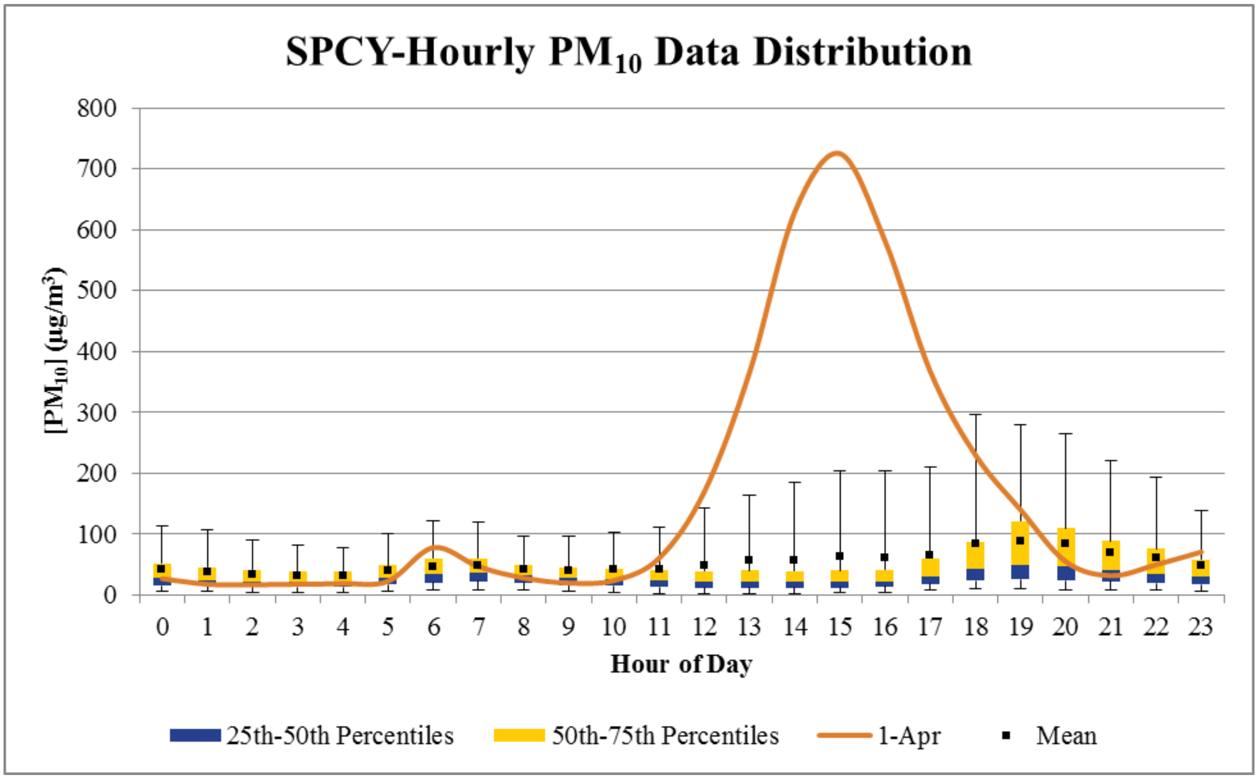


Figure 9-6b PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for April 1, 2012.

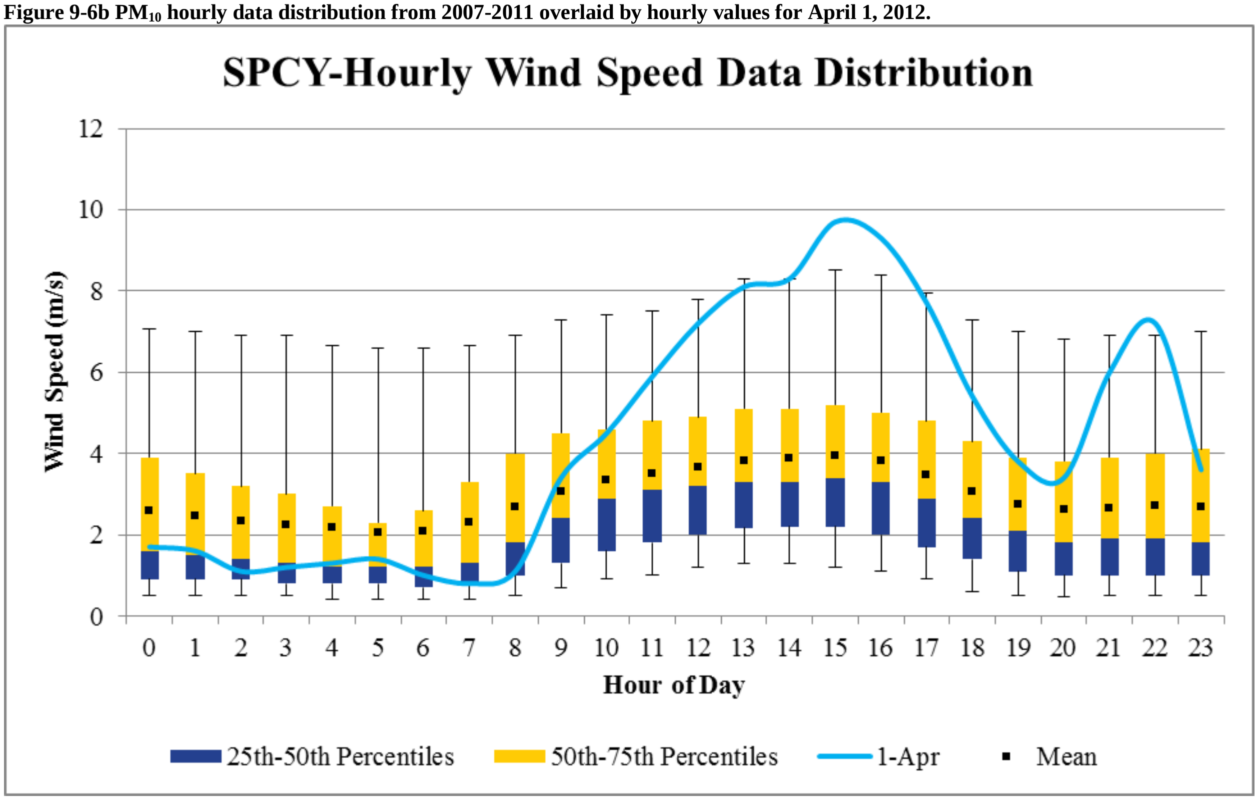


Figure 9-7. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for April 1, 2012.

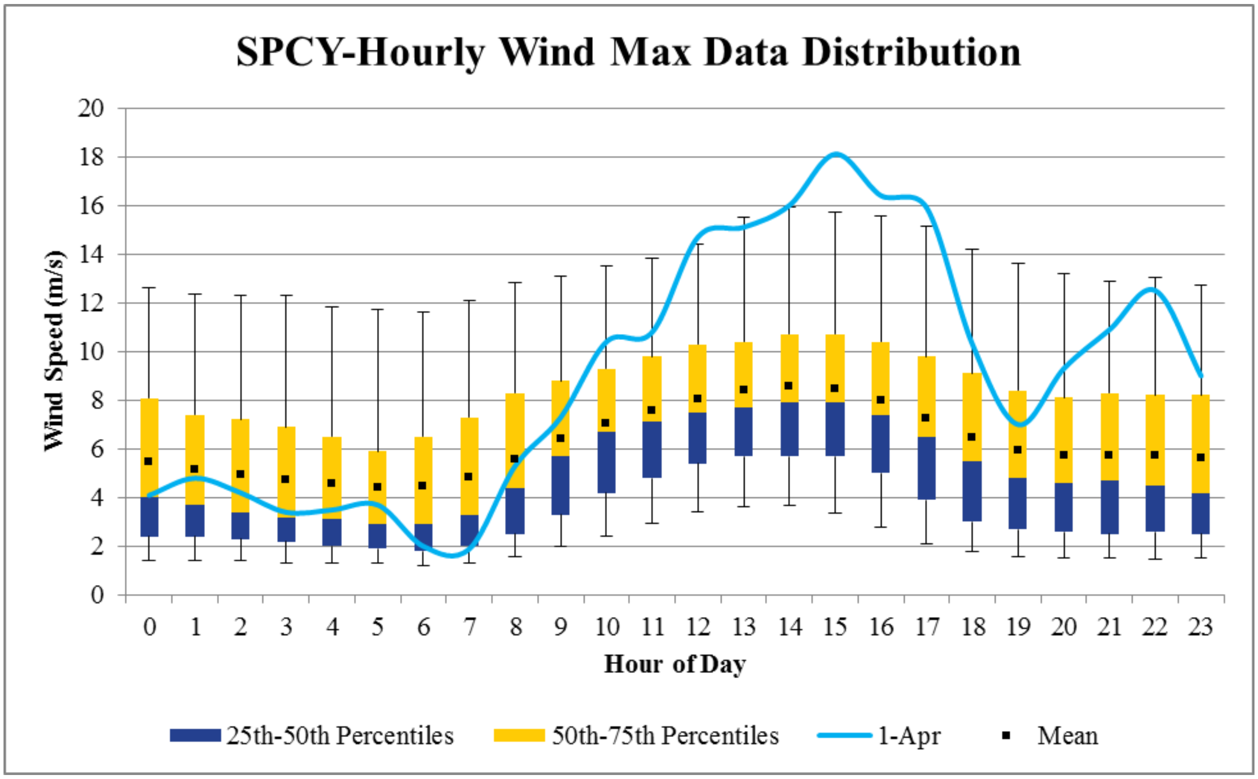


Figure 9-8. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 1, 2012.

9.4 Clear Causal Relationship

A Pacific storm system and cold front approached New Mexico April 1, 2013 creating a low pressure trough in northern New Mexico. The surface level trough over eastern Colorado and northeastern New Mexico tightened the pressure gradient and strengthening surface winds (Figure 9-9). The wind direction in the upper atmosphere aligned with the surface wind direction (Figure 9-10). Diurnal heating of the surface allowed winds aloft to mix downward, increasing the surface wind velocities and provided the turbulence required for vertical mixing and horizontal transport.

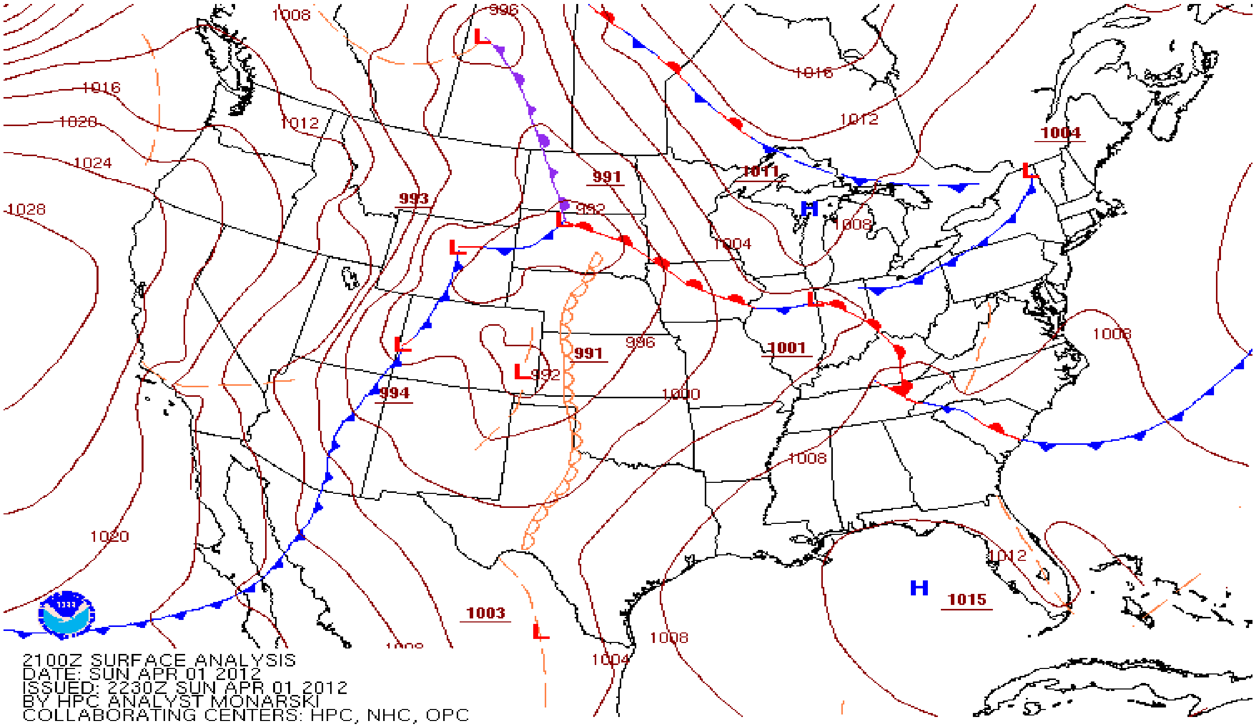


Figure 9-9 Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 1, 2012 at the 1500 hour.

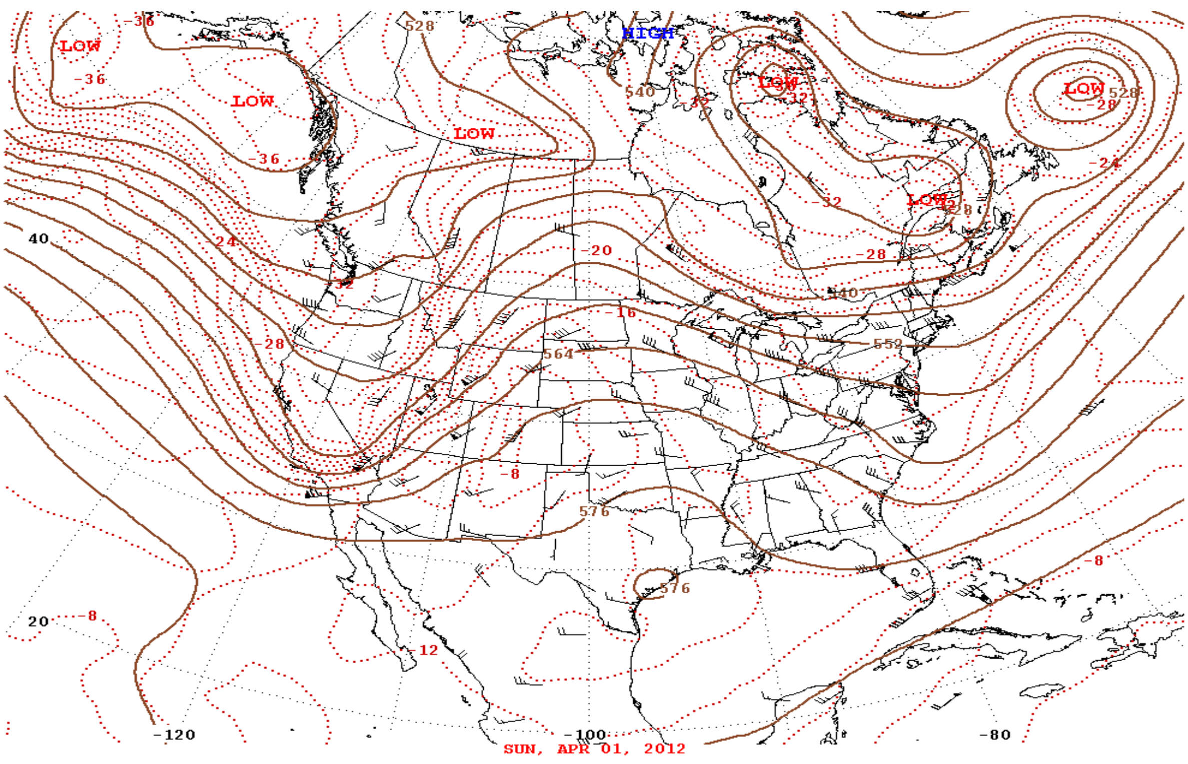


Figure 9-10 Upper air weather map showing geopotential heights (brown lines) at the 500 hour on April 1, 2012

The weather pattern described above generated strong southwesterly winds beginning at the 1200 hour and lasting through the 1700 hour. Beginning at the 1400 hour, wind speeds reached the 11.2 m/s at the West Mesa monitoring site (Figure 9-2). Peak wind speeds ranged from 8.3 m/s at the Desert View monitoring site to 11.2 m/s at the Holman monitoring site (Figure 9-2). Peak wind gusts ranged from 15.6 m/s at La Union to 19.2 m/s at the Deming monitoring site (Figure 9-3). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 9-11a-b. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (1200-1700 hours). During these hours, hourly PM_{10} concentrations spiked at other monitoring sites in the network (Figure 9-12a-b). Maximum on hour PM_{10} concentrations ranged from 179 µg/m^3 at Deming to 725 µg/m^3 at SPCY. Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 9-13).

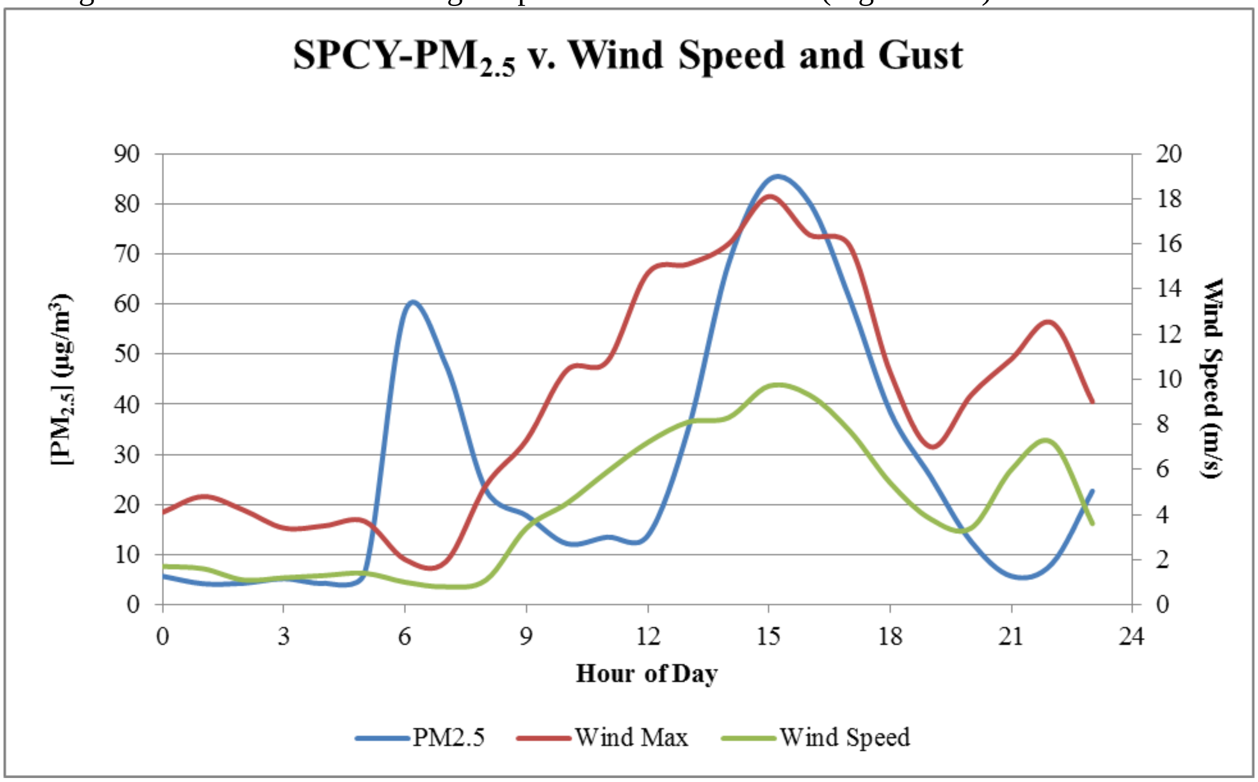


Figure 9-11a. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

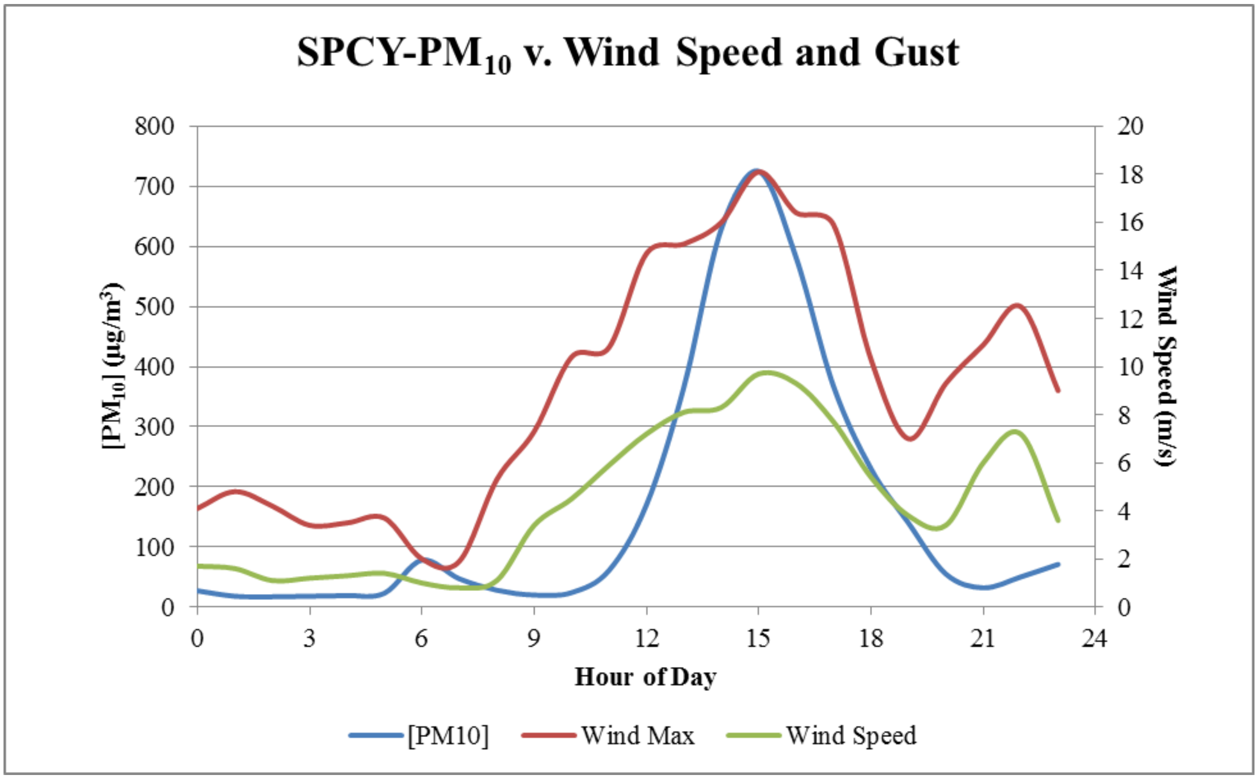


Figure 9-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

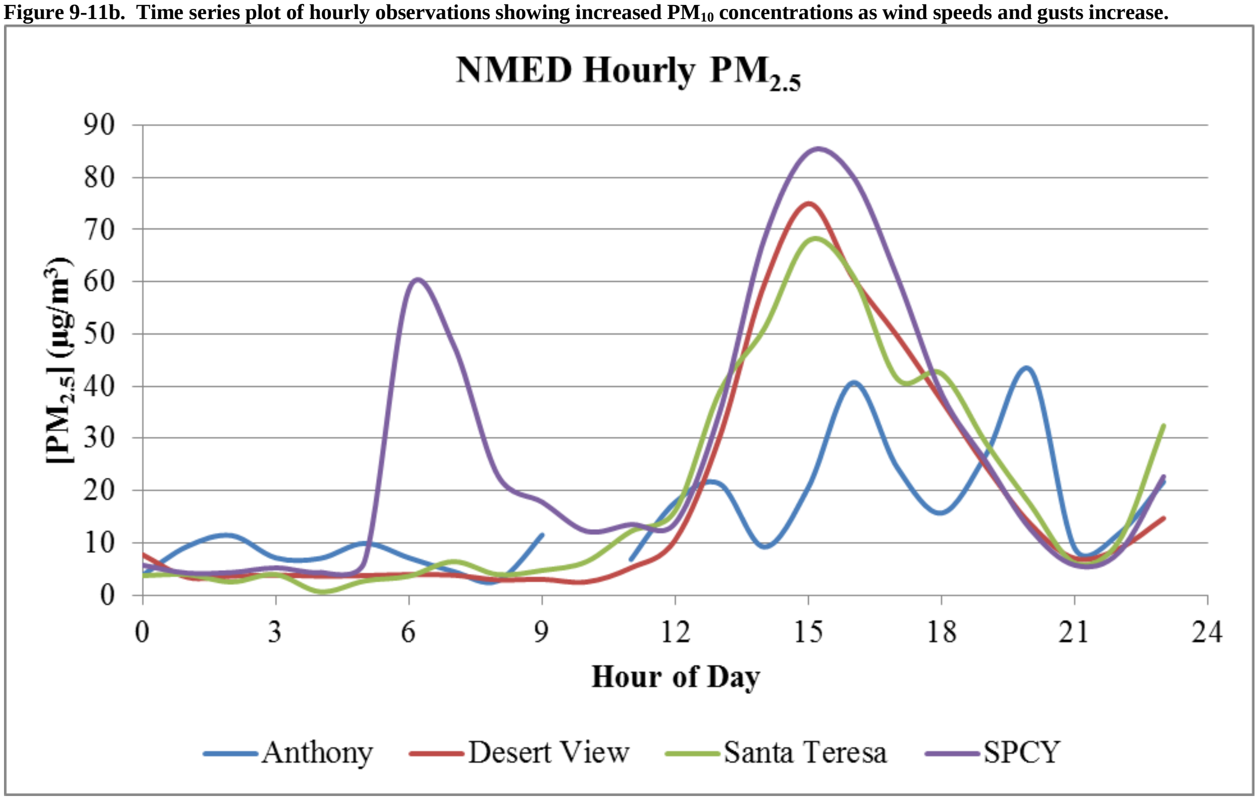


Figure 9-12a Hourly $PM_{2.5}$ concentrations for Doña Ana and Luna Counties monitors. Non-FEM hourly $PM_{2.5}$ data.

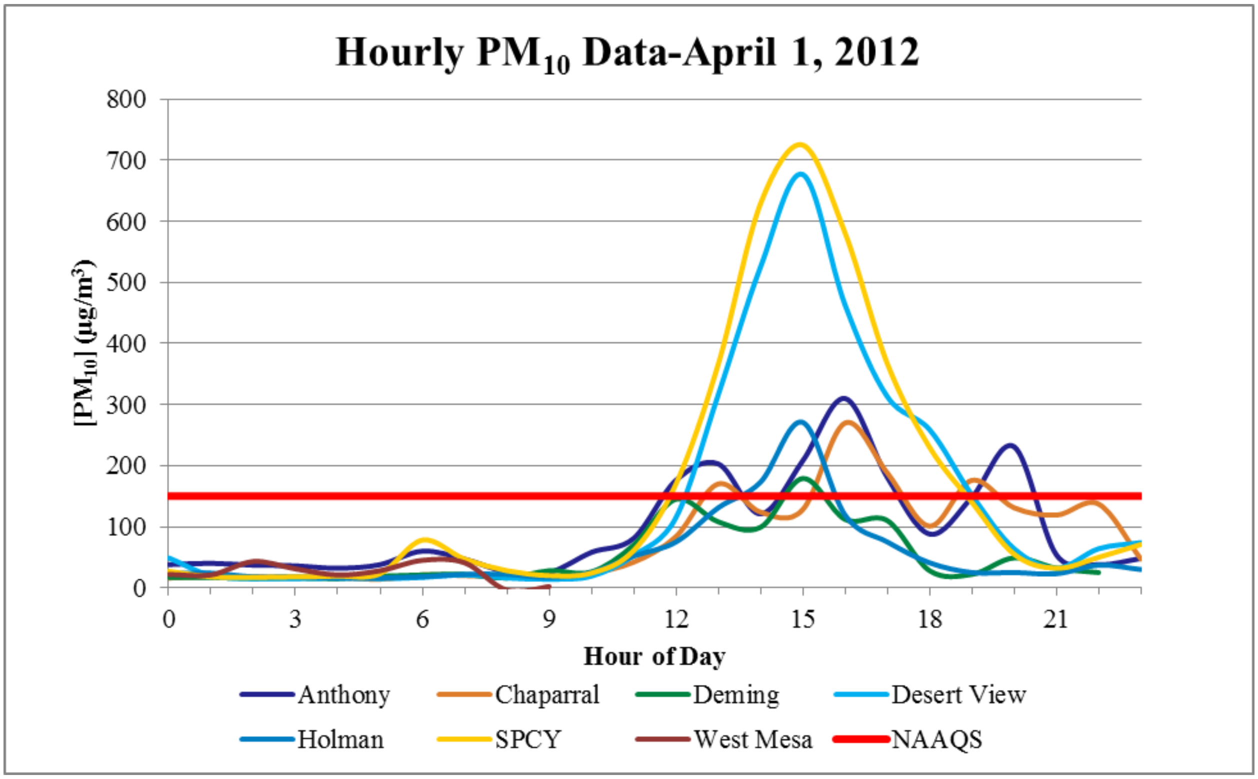


Figure 9-12b Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors. Non-FEM hourly $PM_{2.5}$ data.

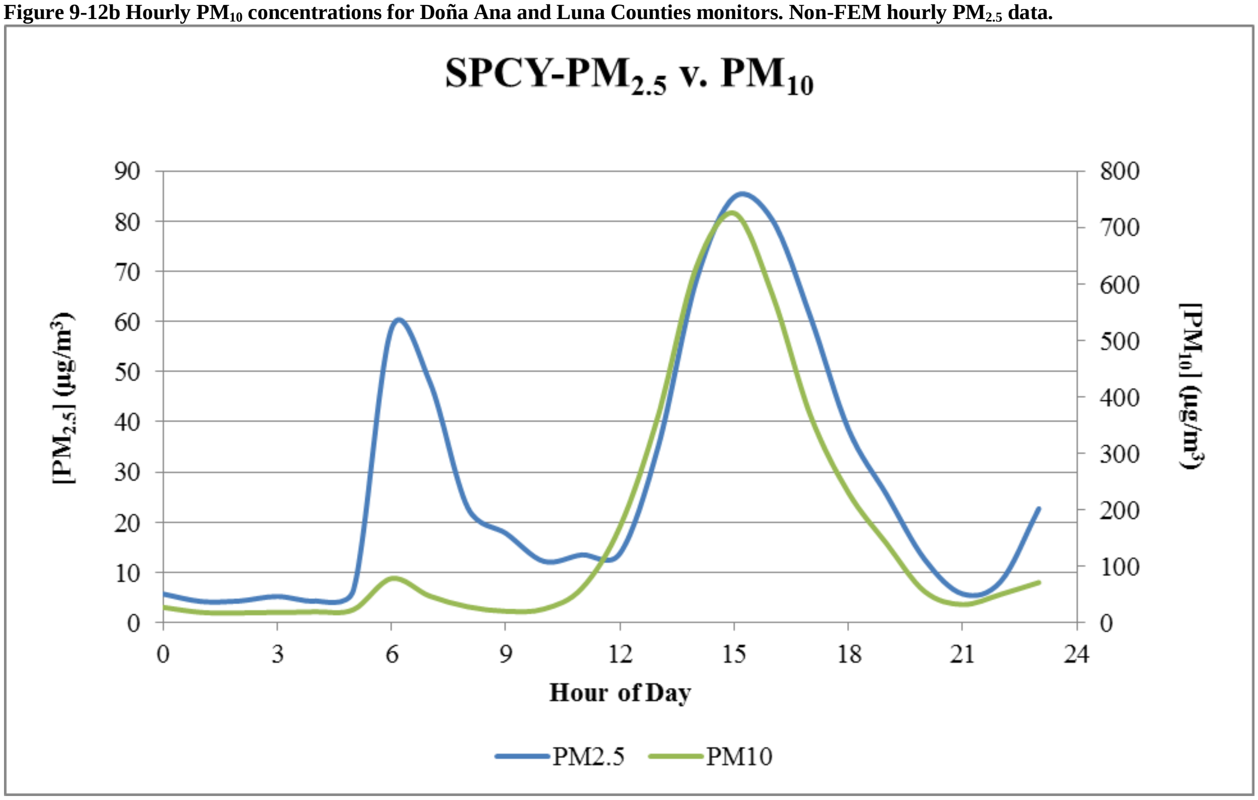


Figure 9-13 Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on April 1, 2012.

The NWS issued a high wind advisory for this date stating in part:

A DEEPENING UPPER LEVEL STORM SYSTEM WILL MOVE INTO THE DESERT SOUTHWEST THIS AFTERNOON. AHEAD OF THIS SYSTEM...STRONG SOUTHWEST TO WEST WINDS WILL INCREASE OVER SOUTHWEST NEW MEXICO IN THE AFTERNOON AND CONTINUE INTO THE EVENING HOURS. SOME BLOWING DUST IS POSSIBLE...ESPECIALLY NEAR THE INTERNATIONAL BORDER (NWS, 2012).

9.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on April 1, 2012.

9.6 Natural Event

The Clear Causal Relationship and not Reasonably Controllable or Preventable analyses show that this was a natural event caused by high wind and blowing dust.

9.7 No Exceedance but for the Event

The SPCY $PM_{2.5}$ monitor detected elevated levels due to blowing dust on April 1, 2012. Although these elevated concentrations do not exceed the 24-hour NAAQS for $PM_{2.5}$, they contribute to an annual exceedance level of 33 $\mu g/m^3$ for this date. The strong correlation between hourly $PM_{2.5}$, PM_{10} and wind speeds peaks also point to windblown dust affecting the monitor. Previous studies have shown that $PM_{2.5}/PM_{10}$ ratios vary from 0.11 to 0.45 in the Paso del Norte Airshed (Arimoto et. al, 2001; Li et al, 2001). The ratios above 0.30 were observed in downtown El Paso and Ciudad Juárez and indicate a heavy impact from mobile sources. The lower ratios were observed in areas with less vehicular traffic and crustal material dominated the PM_{10} fraction. The $PM_{2.5}/PM_{10}$ ratio for the SPCY site was 0.21 for this date ($PM_{2.5}$ Partisol/PM_{10} TEOM). NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

The SPCY monitor detected blowing dust around the 1200 hour with hourly concentrations heavily impacted until the 1700 hour. By replacing these five hourly values with the 95th percentile of hourly data at the SPCY site, the resulting 24-hour average (86.2 µg/m^3) does not exceed the NAAQS (Table 9-1). The values in red represent the 95th percentile of all hourly data collected at SPCY, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	27	22
1	18	21
2	17	18
3	18	28
4	19	31
5	23	31
6	78	46
7	47	56
8	28	49
9	20	26
10	24	24
11	61	44
12	170	**144**
13	366	**164**
14	629	**185**
15	725	**205**
16	581	**203**
17	367	**211**
18	230	230
19	140	156
20	55	10
21	32	9
22	50	14
23	71	7
24-Hour Average	157	**86**

Table 9-1. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at SPCY.

10 HIGH WIND EXCEPTIONAL EVENT: April 7, 2012

10.1 Summary of Event

The passing of a backdoor cold front and small thunderstorms caused high winds and blowing dust in southern Doña Ana County resulting in an exceedance of the PM_{10} NAAQS and the $PM_{2.5}$ annual NAAQS at the Holman and SPCY monitoring sites on this date. The FEM TEOM continuous monitor at the Holman site recorded 24-hour average PM_{10} concentrations of 171 µg/m^3 and the $PM_{2.5}$ FRM Partisol SPCY sites a 24-hour average $PM_{2.5}$ concentration of 16.1 µg/m^3. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured at SPCY (86 µg/m^3), Desert View (80 µg/m^3), and Anthony (88µg/m^3) monitoring sites (Figure 10-1). The averages in this figure were calculated using PM_{10} FEM TEOM and $PM_{2.5}$ FRM Partisol instrument data for the four days before and after the event. Elevated concentrations were also recorded by the $PM_{2.5}$ non-FEM/FRM TEOMs (Figure 10-2). The SPCY $PM_{2.5}$ TEOM did not record any data on this date.

As the event unfolded, the wind blew from the east-northeasterly direction throughout the border region. These high velocity winds passed over large areas of desert within Texas and New Mexico. The co-occurrence of high winds and elevated levels of blowing dust, little to no point sources in the area, and the high hourly and daily PM_{10} and $PM_{2.5}$ concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

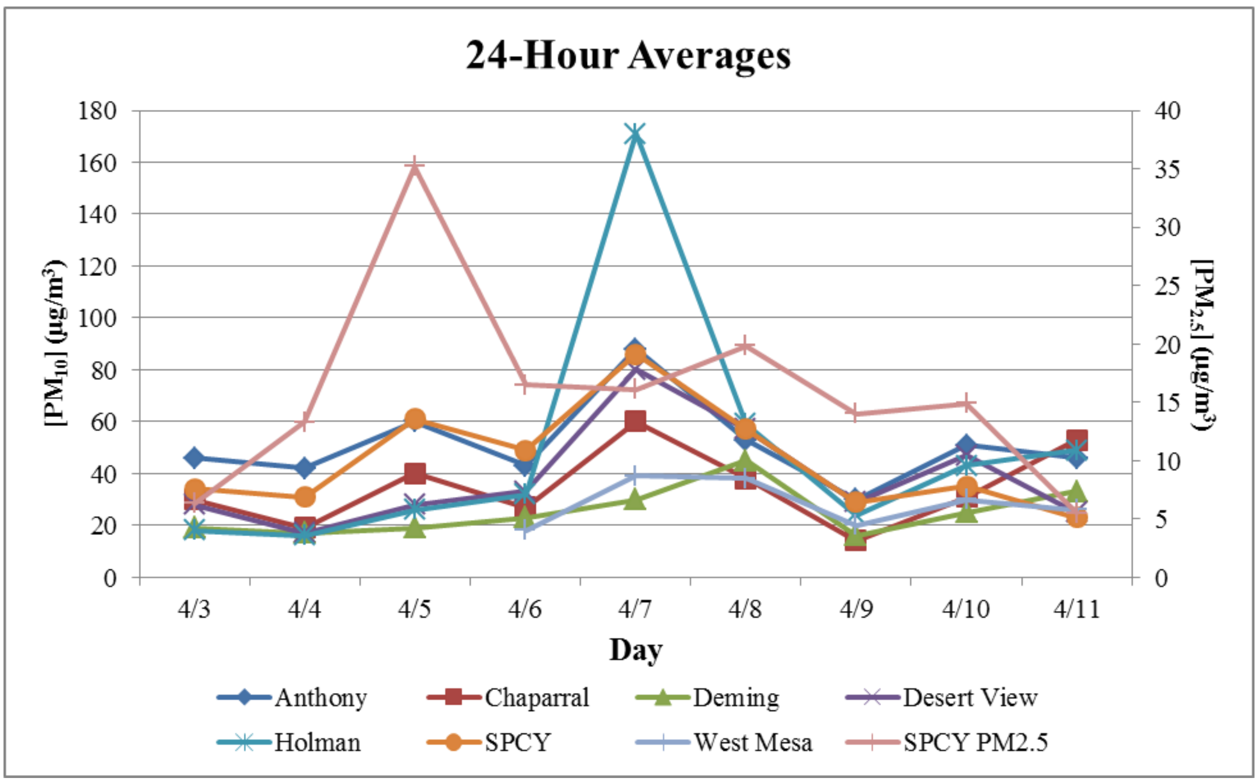


Figure 10-1. PM_{10} 24-hour averages before and after April 7, 2012.

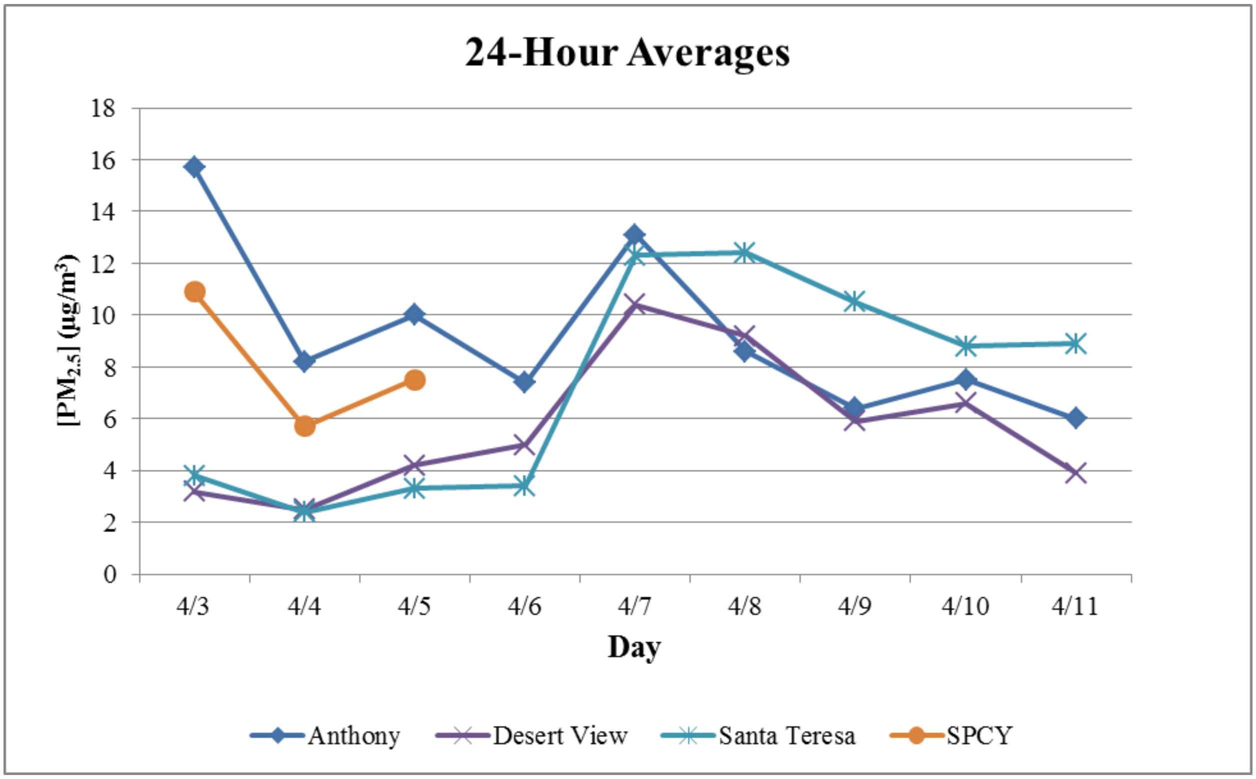


Figure 10-2 $PM_{2.5}$ 24-hour averages before and after April 7, 2012. Non-FEM TEOM Data.

10.2 Is Not Reasonably Controllable or Preventable

10.2.1 <u>Suspected Source Areas and Categories Contributing to the Event</u>

Sources of windblown dust contributing to this exceedance include the natural desert, residential properties, agricultural land and unpaved roads in New Mexico. Agricultural tilling and crop planting may have contributed to this event. City of Las Cruces and Doña Ana County Ordinances require BACM for any dust producing activities. The largest and most likely sources of windblown dust are the natural desert in Texas and New Mexico (see Section 10.2.4 below).

10.2.2 <u>Sustained and Instantaneous Wind Speeds</u>

EPA uses a default entrainment threshold of sustained wind speeds at 11.2 m/s (25 mph) for natural and well controlled anthropogenic sources contributing to natural events caused by high wind and blowing dust (EPA, 2013). Under the Doña Ana and Luna County NEAPs, EPA and NMED agreed that wind gusts exceeding 18 m/s would overwhelm any natural and well-controlled anthropogenic sources and cause windblown dust. On April 7, 2012, sustained wind speeds exceeded EPA's default threshold and wind gusts exceeded the NEAPs agreed upon threshold at the Holman monitoring site only (Figures 10-3 and 10-4). Winds exceeded these thresholds at one or more monitoring sites at the 1600 hour and 2300 hour.

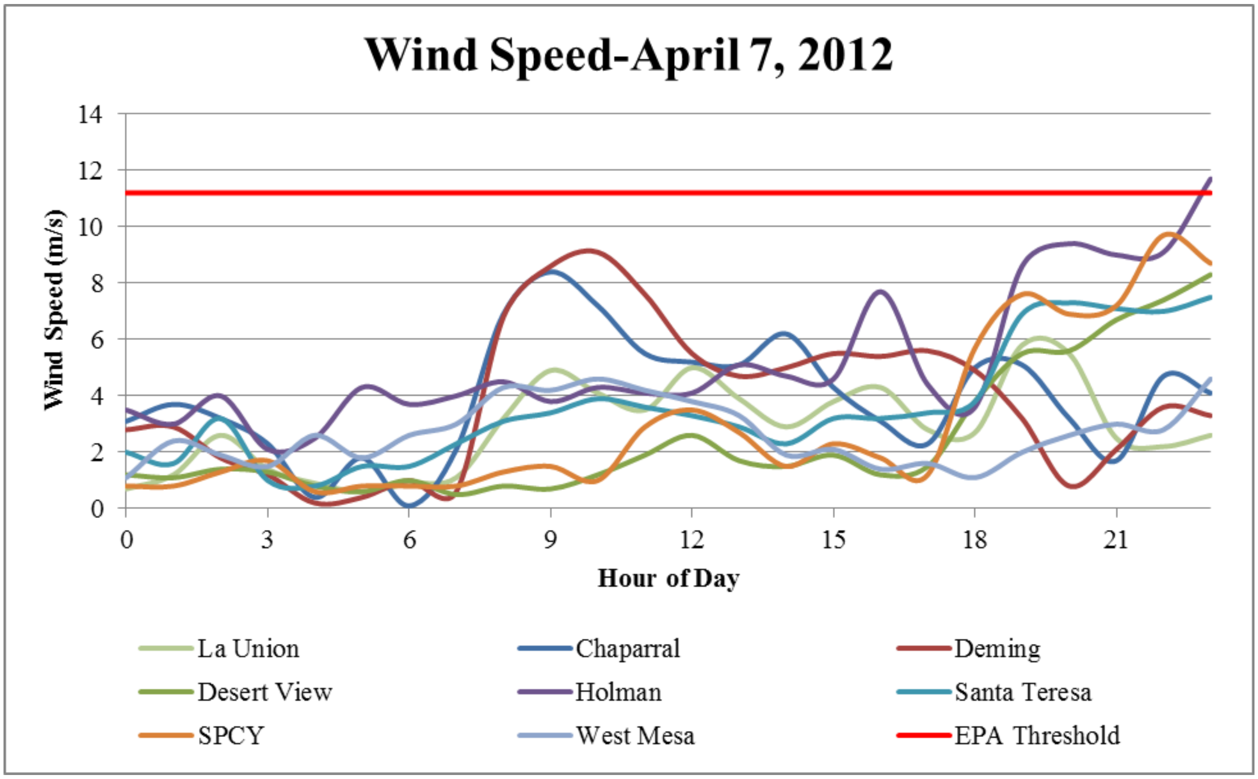


Figure 10-3 Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

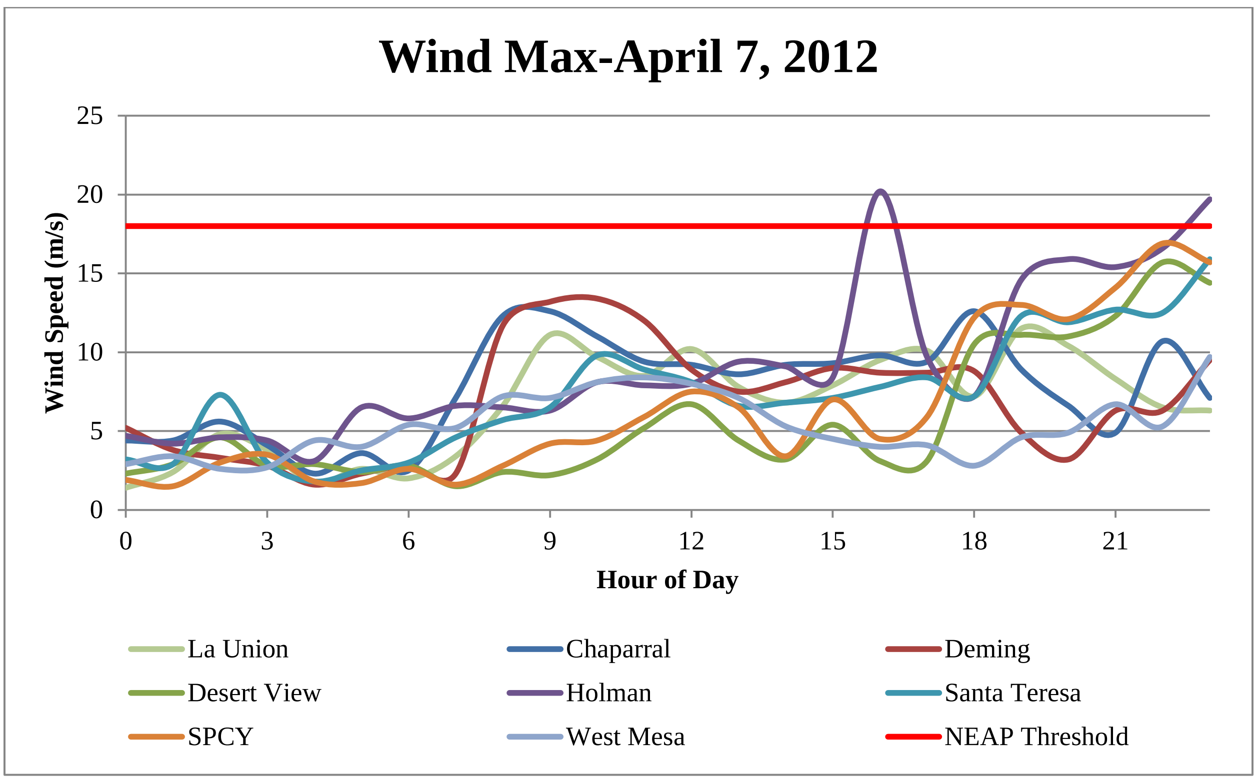


Figure 10-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

10.2.3 Recurrence Frequency

The monitoring sites in Doña Ana and Luna Counties can record exceedances of the PM_{10} NAAQS throughout the year. From 2007-2011 the PM_{10} FEM TEOM monitors recorded 254 exceedances and the PM_{10} FRM Wedding monitors recorded 6 exceedances (Figure A-1). The Deming Airport and Desert View monitoring sites (FEM TEOMs) were established in 2006 and 2007 respectively and do not show exceedances until the year following startup. The SPCY $PM_{2.5}$ FRM Partisol recorded 37 exceedances of the 24-Hour NAAQS from 2007-2011 (Figure A-2). See appendix A for a more in-depth discussion about recurrence frequency and the number of exceedances at each monitoring site.

10.2.4 Controls Analysis

The local ordinances and MOUs adopted under the NEAP direct the implementation of BACM for sources of dust in Doña Ana County. The ordinances regulate disturbed lands, construction and demolition, vacant parking lots and materials handling and transportation. Our investigation did not identify any unusual PM_{10} producing activities on this day, and anthropogenic emissions remained constant before, during and after the event. The most likely source contributing to the event is the natural desert in New Mexico. A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from eastern New Mexico and Texas to the NMED monitors. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 10-5). Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in Texas. NMED concludes that the sources contributing to the event are not reasonably controllable.

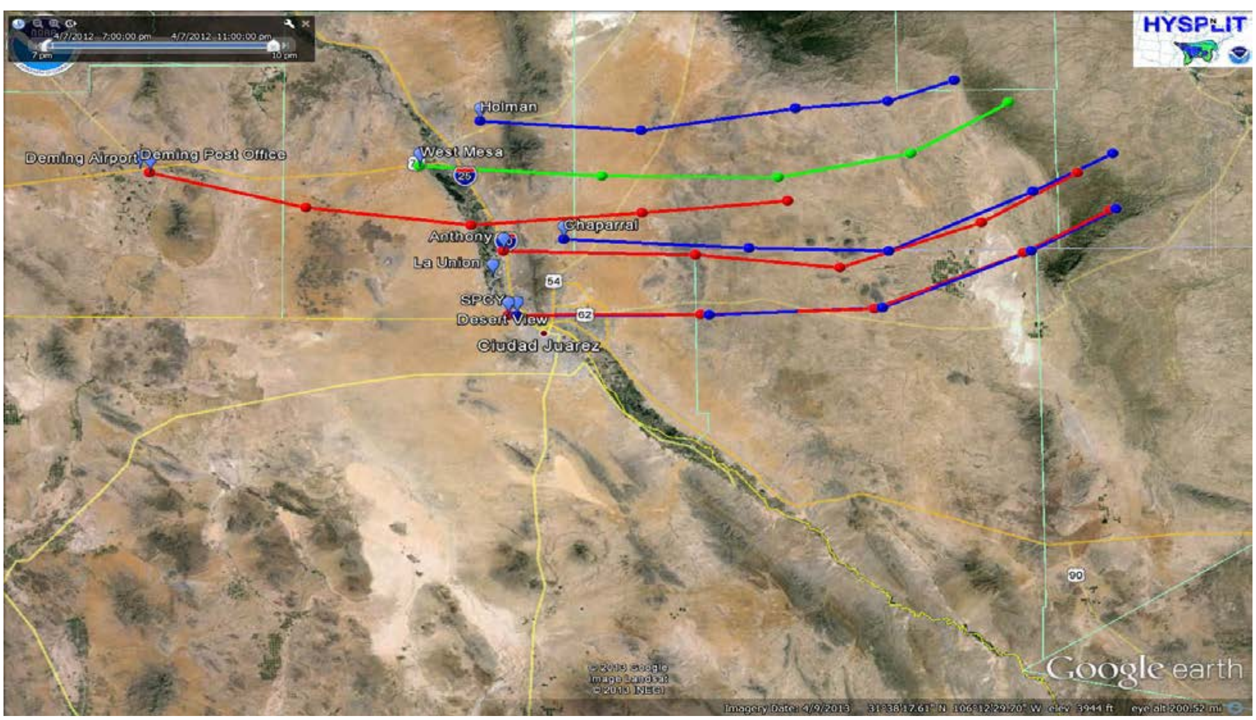


Figure 10-5. HYSPLIT back-trajectory model analysis for April 7, 2012.

10.3 Historical Fluctuations Analysis

10.3.1 Annual and Seasonal 24-hour Average Fluctuations

Since being established, the monitoring sites in Doña Ana and Luna Counties have recorded exceedances of the PM_{10} NAAQS. High winds cause these exceedances and they can occur at any time of year (Figure B-6 through B-13). Most exceedances occur from late winter through early summer (February-June) and are associated with the passage of Pacific cold fronts. High winds caused all recorded exceedances from 2007-2011 and NMED submitted natural events demonstrations to EPA under the NEAP or EER.

Since the 24-hour $PM_{2.5}$ NAAQS was lowered from 65 to 35 µg/m^3 in 2006, the SPCY Partisol monitor has routinely recorded exceedances of the standard. These exceedances occurred throughout the year during high and low wind conditions. In 2009, NMED investigated the cause of the low wind exceedances and found that emissions from Ciudad Juárez, Mexico contribute significantly to elevated concentrations. The high wind exceedances were caused by blowing dust on days when PM_{10} monitors also recorded exceedances.

Appendix B contains a more in-depth discussion about historical fluctuations and charts showing annual and seasonal trends at each monitoring site.

Table B-1 and B-2 show normal historical fluctuations with and without high wind natural events that caused exceedances from 2007-2011. The analysis excludes only those high wind events that resulted in an exceedance. Data for PM_{10} in this table includes FRM Wedding and FEM TEOM measurements and data for $PM_{2.5}$ comes from the FRM Partisol measurements from 2007-2011. The recorded value for this day (157 µg/m^3) is above the maximum value recorded when no high wind exceedances are included and is above the 95^{th} percentile

An hourly data distribution analysis was performed for PM_{10} and $PM_{2.5}$ concentrations, wind speeds and wind gusts (Appendices C, D and E). All data used for the PM_{10} distribution charts come from the FEM TEOM monitors and the non-FEM/FRM $PM_{2.5}$ TEOM monitor at SPCY. Overlaying the hourly data for April 7, 2012 on the hourly data distribution plots shows that the values recorded during the high wind event exceed the 95^{th} percentile for PM_{10}, $PM_{2.5}$, wind speed and wind gusts (Figures 10-6 through 10-8). The top whiskers of the box and whisker plots represent the 95^{th} percentile of data. The hourly PM_{10} values during the high wind blowing dust storm far exceed the historical 95^{th} percentile of data. The $PM_{2.5}$ monitor did not record any data on this date.

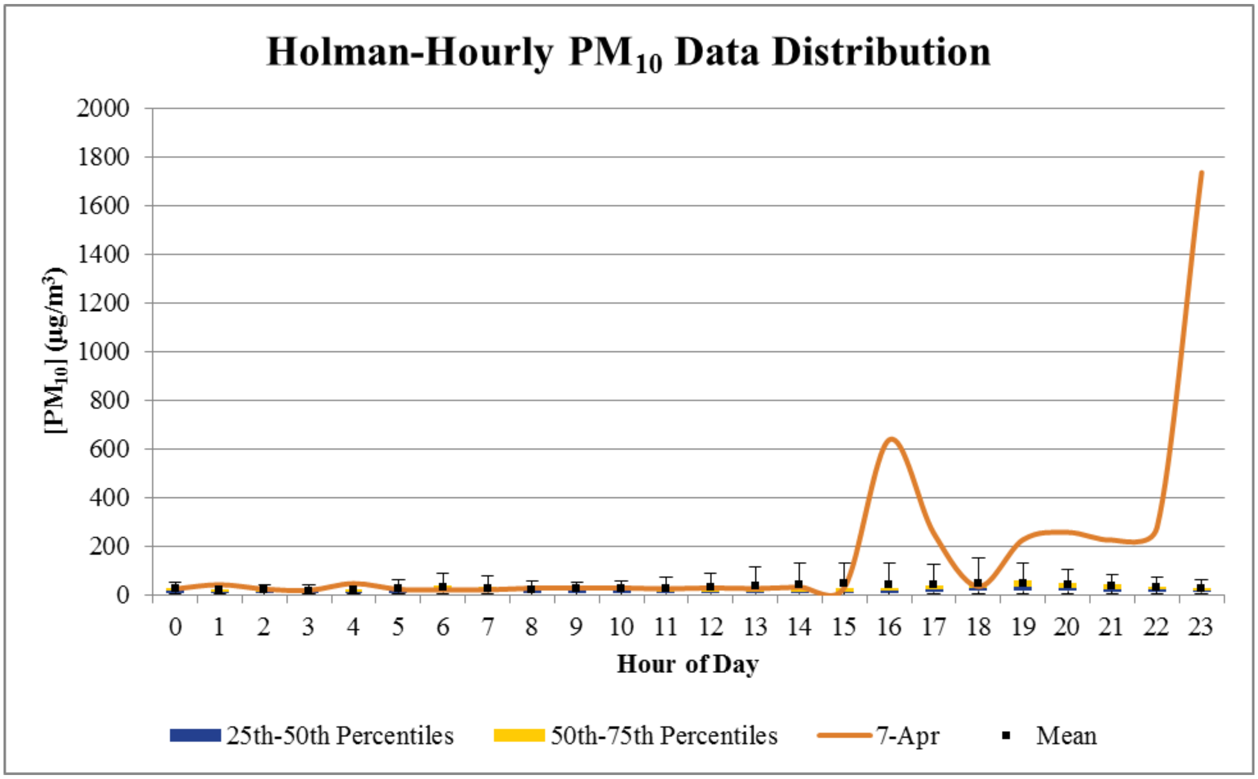


Figure 10-6. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for April 7, 2012.

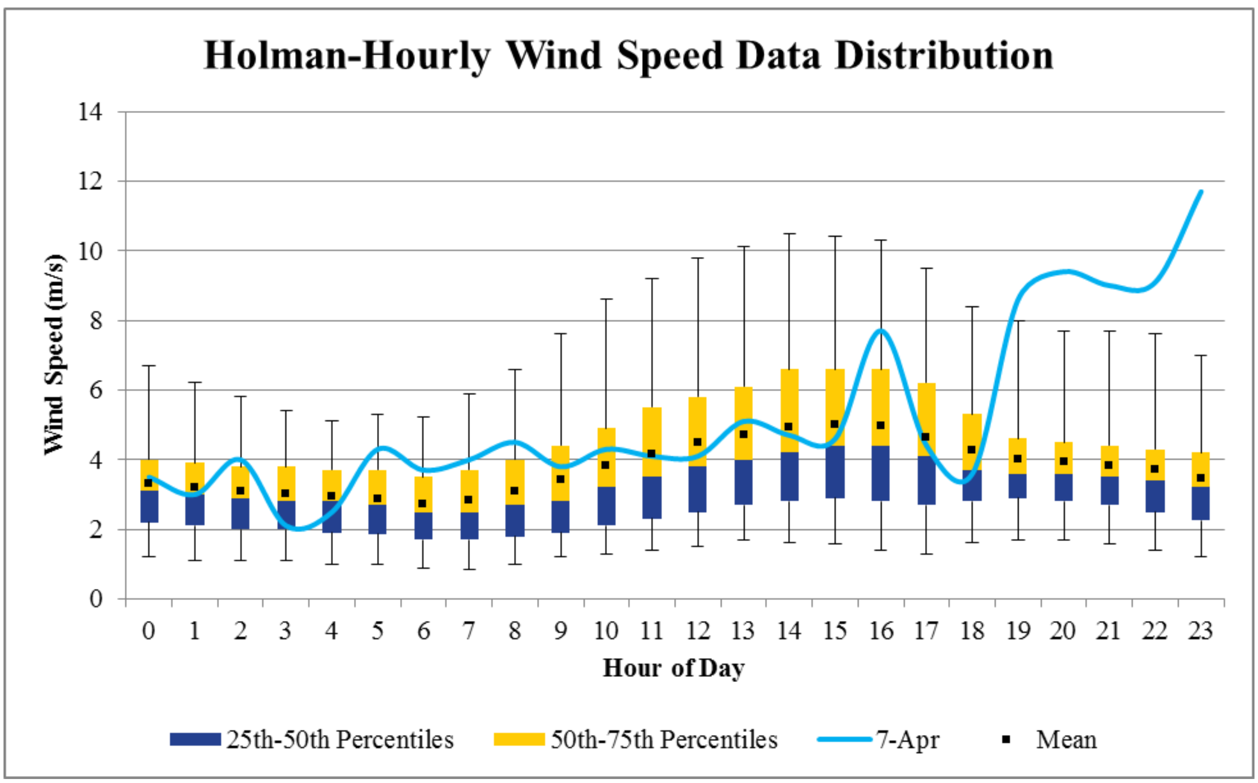


Figure 10-7. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for April 7, 2012.

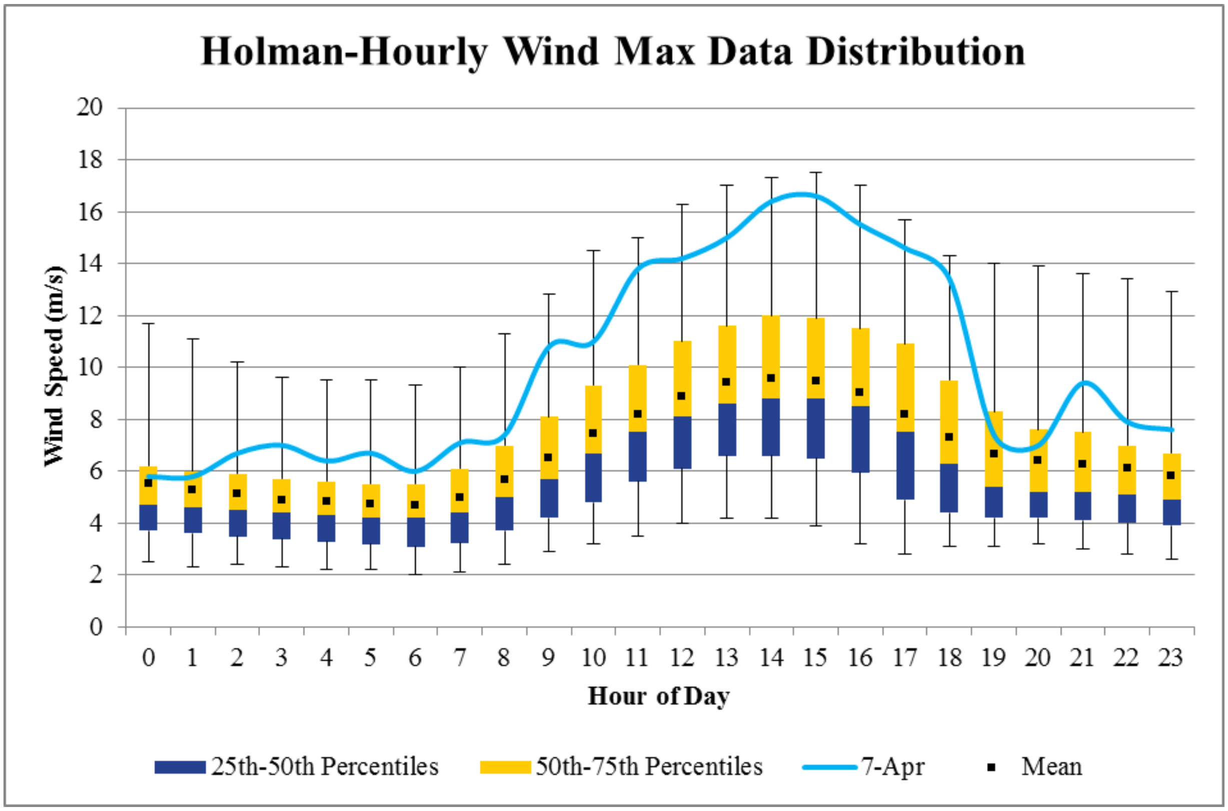


Figure 10-8. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 7, 2012.

10.4 Clear Causal Relationship

A slow moving backdoor cold front passed through New Mexico on April 7, 2012. The front caused some small thunderstorms in the vicinity of Las Cruces, NM. Along with the cold front, a low pressure trough moved through southern New Mexico and Eastern Texas into Mexico creating a pressure gradient over New Mexico. As the backdoor cold front and low pressure trough moved through New Mexico, the pressure gradient tightened and winds became stronger at the surface (Figure 10-9). A high pressure ridge over the Midwest helped to pull in some moisture in the upper atmosphere from the Gulf of Mexico (Figure 10-10). The sporadic thunderstorms that developed produced little to no rain in the area and dry microburst caused the high winds as indicated by the inverted V in the skew-t diagram from the afternoon (Figure 10-11).

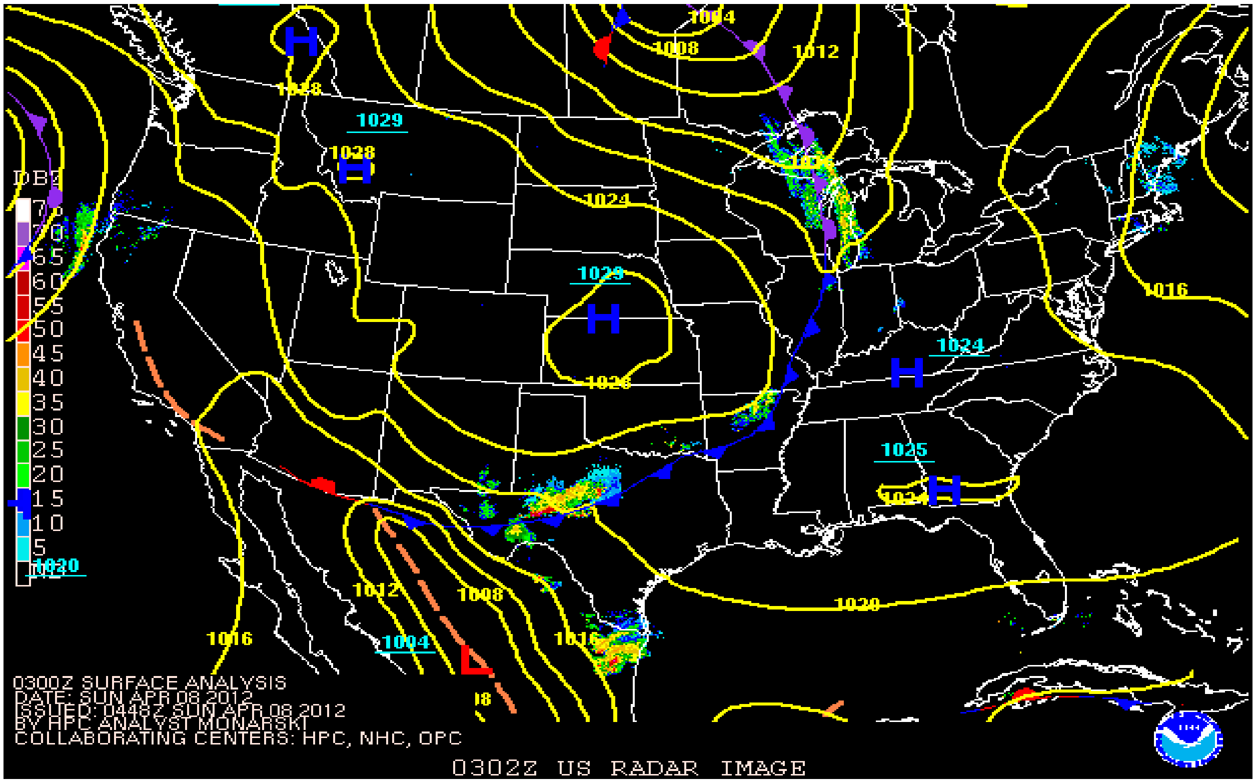


Figure 10-9 Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 7, 2012 at the 0900 hour.

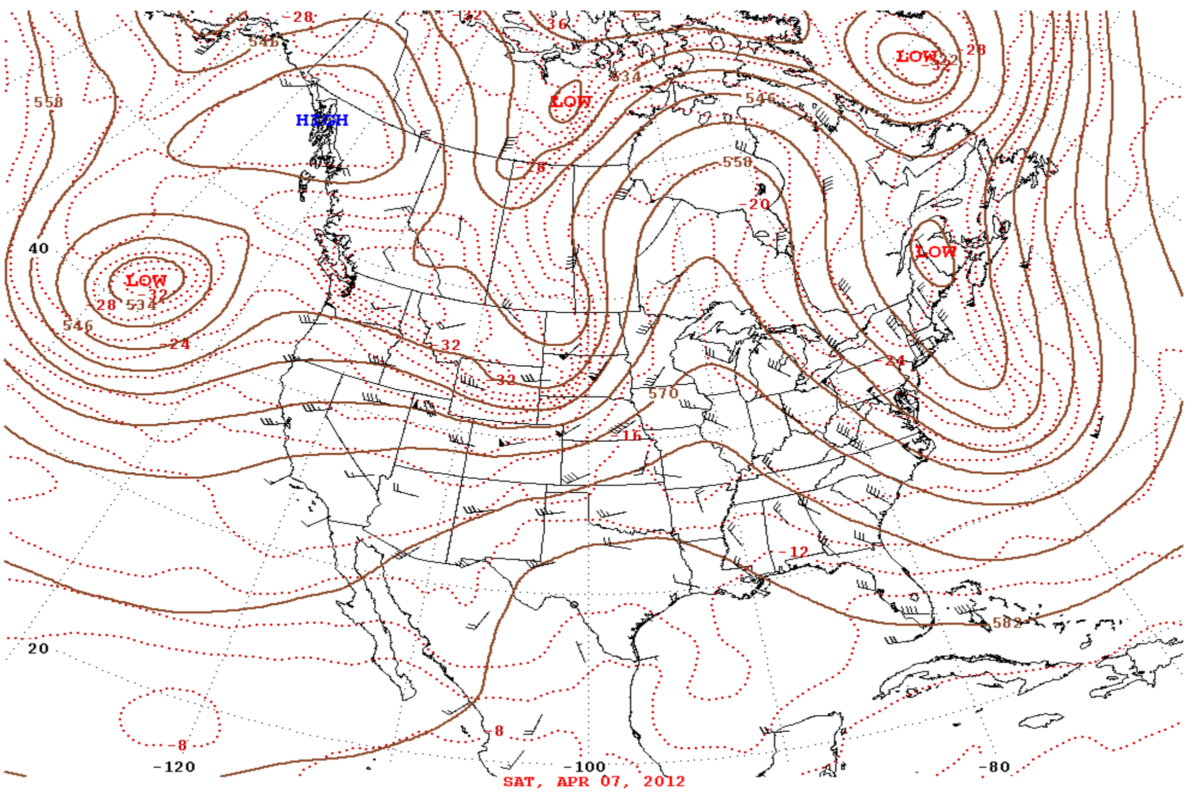


Figure 10-10 Upper air weather map showing geopotential heights (brown lines) at the 500 hour on April 7, 2012.

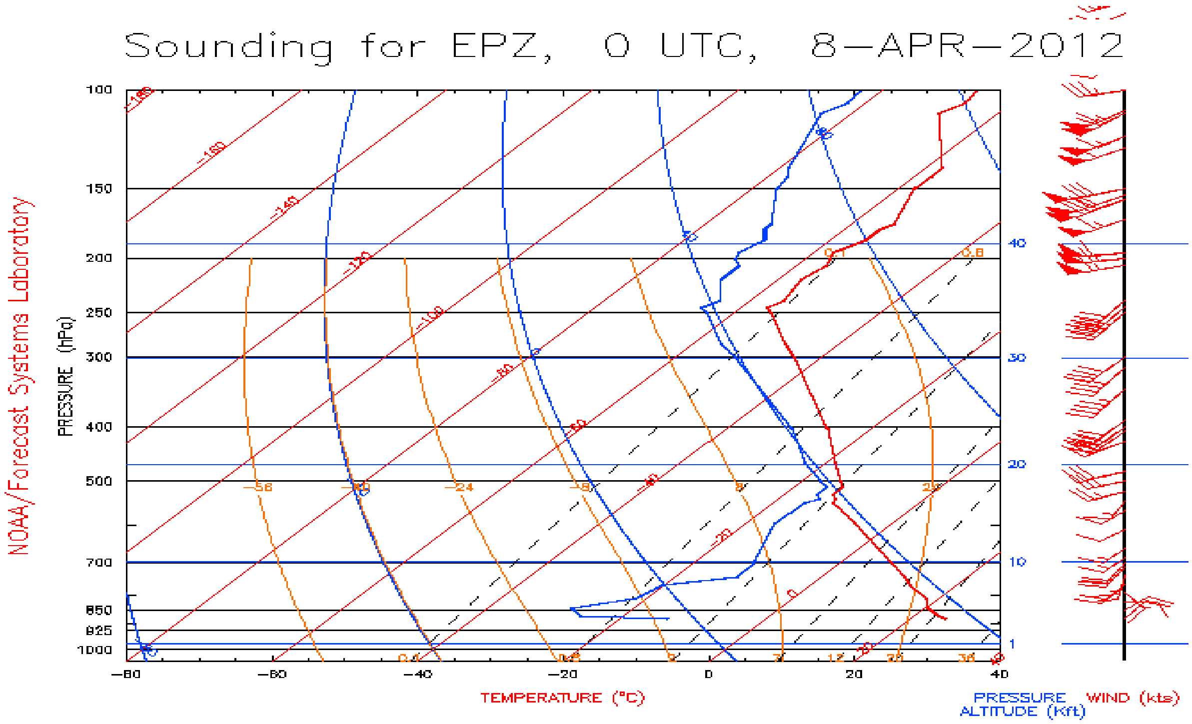


Figure 10-11. Skew-t diagram showing moisture in the upper atmoshpere with dry conditions closer to the surface (Courtesy of NOAA).

The weather pattern described above generated strong and gusty northeasterly winds at the 1600 hour and 2300 hour. At the 2300 hour wind speeds exceeded 11.2 m/s Holman monitoring site (as shown in Figure 10-3). Peak wind speeds ranged from 4.6 m/s at the West Mesa monitoring site to 11.7 m/s at the Holman monitoring site (Figure 10-3). Peak wind gusts ranged from 9.7 m/s at the West Mesa monitoring site to 20.2 m/s at the Holman monitoring site (Figure 10-4). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 10-12. As wind speed and wind gusts exceed the 95^{th} percentile of historical data so do hourly PM_{10} concentrations on this date (1600 and 2300 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at other monitoring sites in the network (Figure 10-13a-b).

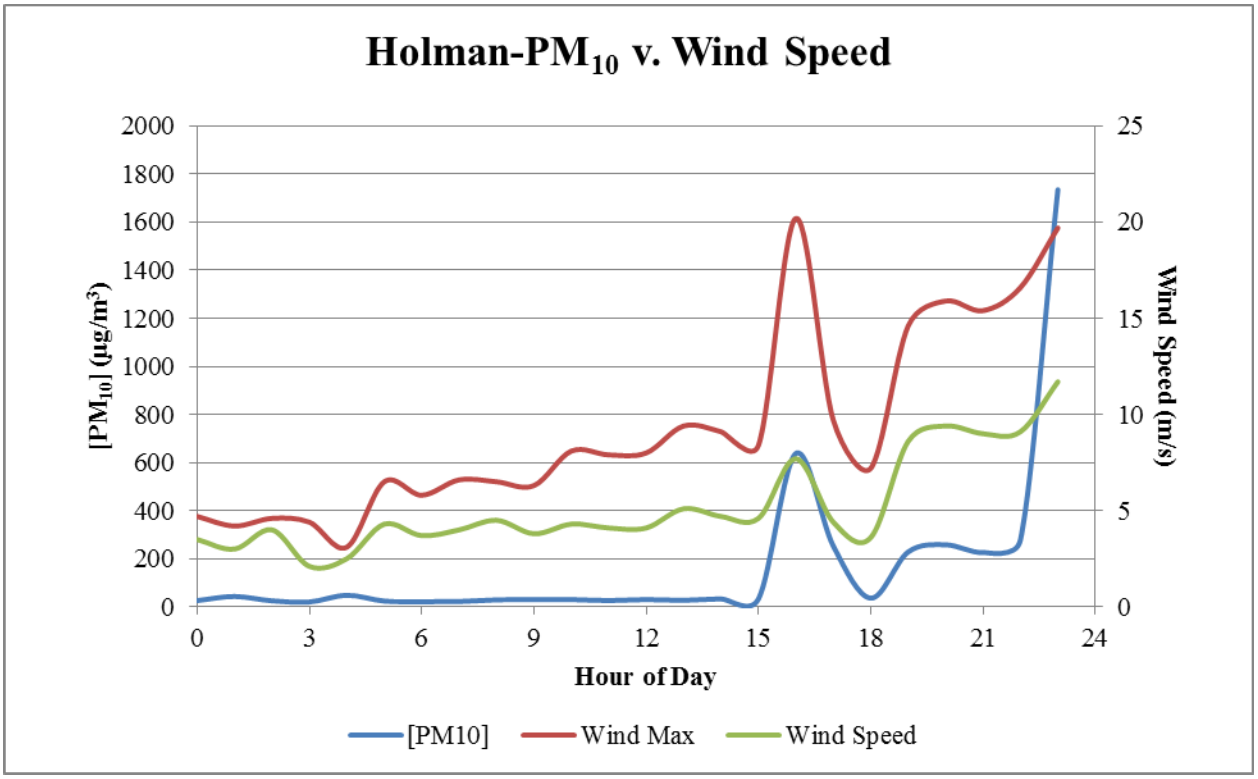


Figure 10-12 Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

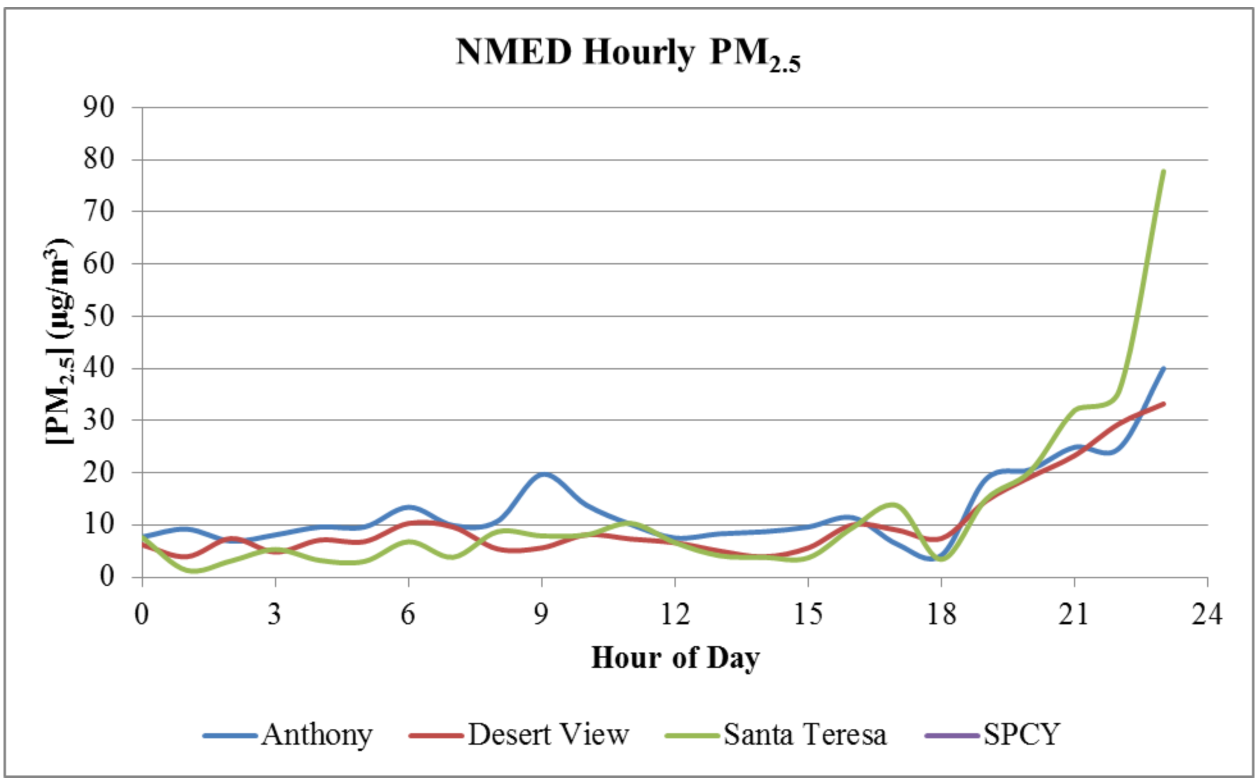


Figure 10-13a. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors. Non-FEM hourly $PM_{2.5}$ data.

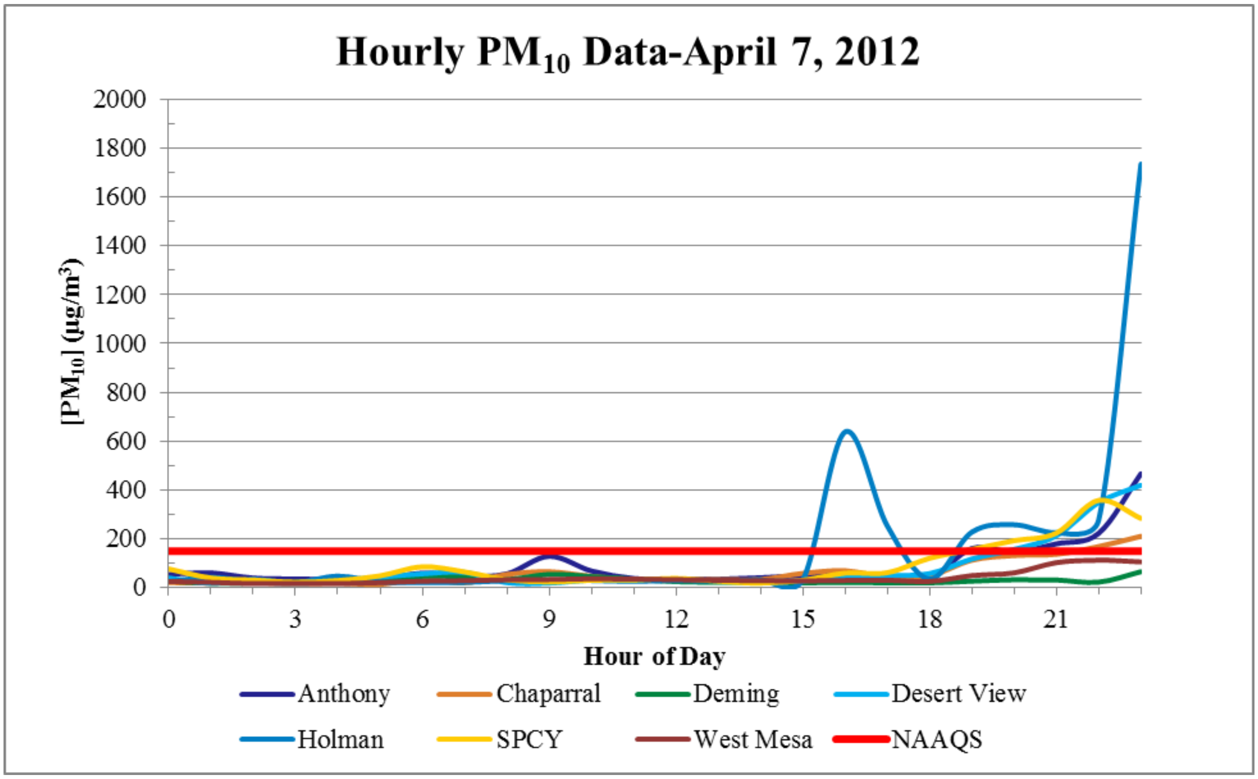


Figure 10-13b. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

10.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on April 7, 2012.

10.6 Natural Event

The Clear Causal Relationship and not Reasonably Controllable or Preventable analyses show that this was a natural event caused by high wind and blowing dust.

10.7 No Exceedance but for the Event

The SPCY $PM_{2.5}$ monitor detected elevated levels due to blowing dust on April 7, 2012. Although these elevated concentrations do not exceed the 24-hour NAAQS for $PM_{2.5}$, they contribute to an annual exceedance level of 16.1 µg/m^3 for this date. The strong correlation between hourly $PM_{2.5}$, PM_{10} and wind speeds peaks also point to windblown dust affecting the monitor. Previous studies have shown that $PM_{2.5}/PM_{10}$ ratios vary from 0.11 to 0.45 in the Paso del Norte Airshed (Arimoto et. al, 2001; Li et al, 2001). The ratios above 0.30 were observed in downtown El Paso and Ciudad Juárez and indicate a heavy impact from mobile sources. The lower ratios were observed in areas with less vehicular traffic and crustal material dominated the PM_{10} fraction. The $PM_{2.5}/PM_{10}$ ratio for the SPCY site was 0.19 for this date ($PM_{2.5}$ Partisol/PM_{10} TEOM). NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

The Holman monitor detected blowing dust around the 1600 hour with hourly concentrations heavily impacted until the 2300 hour. The seven hourly PM_{10} values from 1600-2300 hours alone, exceed the 24-hour average standard at Holman [(638 + 253 + 228 + 258 + 226 + 278 + 1735) µg/m^3 = 3652 µg/m^3; (3652 µg/m^3)/24 = 152 µg/m^3]. By replacing these seven hourly values with the 95th percentile of hourly data at the Holman site, the resulting 24-hour average (51 µg/m^3) does not exceed the NAAQS (Table 10-1). The values in red represent the 95th percentile of all hourly data collected at Holman, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	26	26
1	43	43
2	25	25
3	20	20
4	48	48
5	24	24
6	21	21
7	22	22
8	29	29
9	30	30
10	30	30
11	26	26
12	30	30
13	27	27
14	33	33
15	33	33
16	638	**132**
17	253	**126**
18	36	36
19	228	**129**
20	258	**106**
21	226	**85**
22	278	**73**
23	1735	**62**
24-Hour Average	199	**51**

Table 10-1. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Holman.

11 HIGH WIND EXCEPTIONAL EVENT: April 14, 2012

11.1 Summary of Event

The passing of a Pacific front caused widespread high winds and blowing dust in Doña Ana and Luna Counties resulting in exceedances of the PM_{10} and $PM_{2.5}$ 24-hour NAAQS at all of the monitoring sites in Doña Ana County and at the Deming Airport monitoring site. The FEM TEOM continuous monitors at these sites recorded 24-hour average concentrations of 751 µg/m^3 (Anthony), 803 µg/m^3 (Chaparral), 927 µg/m^3 (Deming Airport), 961µg/m^3 (Desert View), 794 µg/m^3 (Holman), 880 µg/m^3 (SPCY), and 479µg/m^3 (West Mesa). The Partisol monitor at SPCY recorded a 24-hour average concentration of 101.6 µg/m^3. In accordance with the EER, the AQB flagged this data on EPA's AQS database as a high wind natural event. This was a regional event resulting in all the monitoring sites recording an exceedance on this date (Figure 11-1). The averages in this figure were calculated using PM_{10} FEM TEOM and $PM_{2.5}$ FRM Partisol instrument data for the four days before and after the event. Elevated concentrations were also recorded by the $PM_{2.5}$ non-FEM/FRM TEOMs (Figure 11-2). The $PM_{2.5}$ TEOM did not record any data for this day. This event was widespread with hourly and 24-hour averages of PM_{10} and $PM_{2.5}$ far exceeding the standards.

As the event unfolded, the wind blew from the southwesterly direction throughout the border region. These high velocity winds passed over large areas of desert within New Mexico and Mexico. The co-occurrence of high winds and elevated levels of blowing dust, little to no point sources in the area, and the high hourly and daily PM_{10} and $PM_{2.5}$ concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

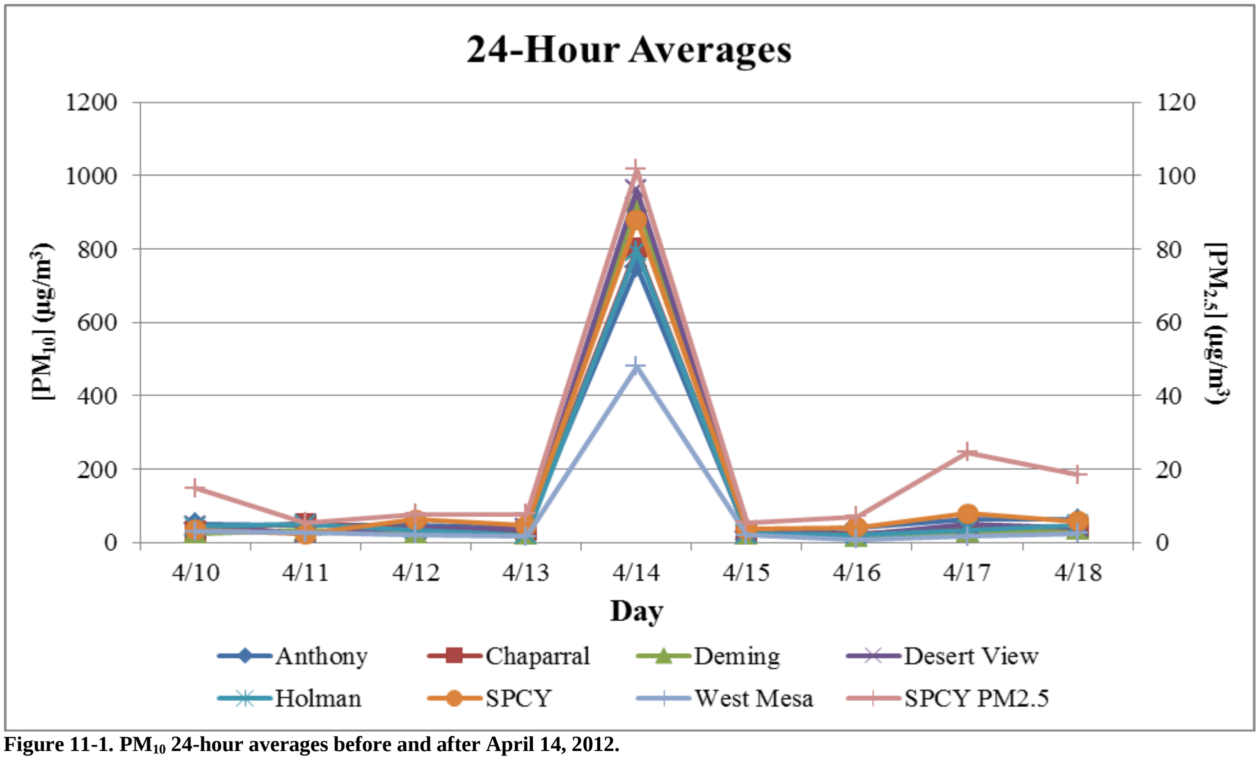


Figure 11-1. PM_{10} 24-hour averages before and after April 14, 2012.

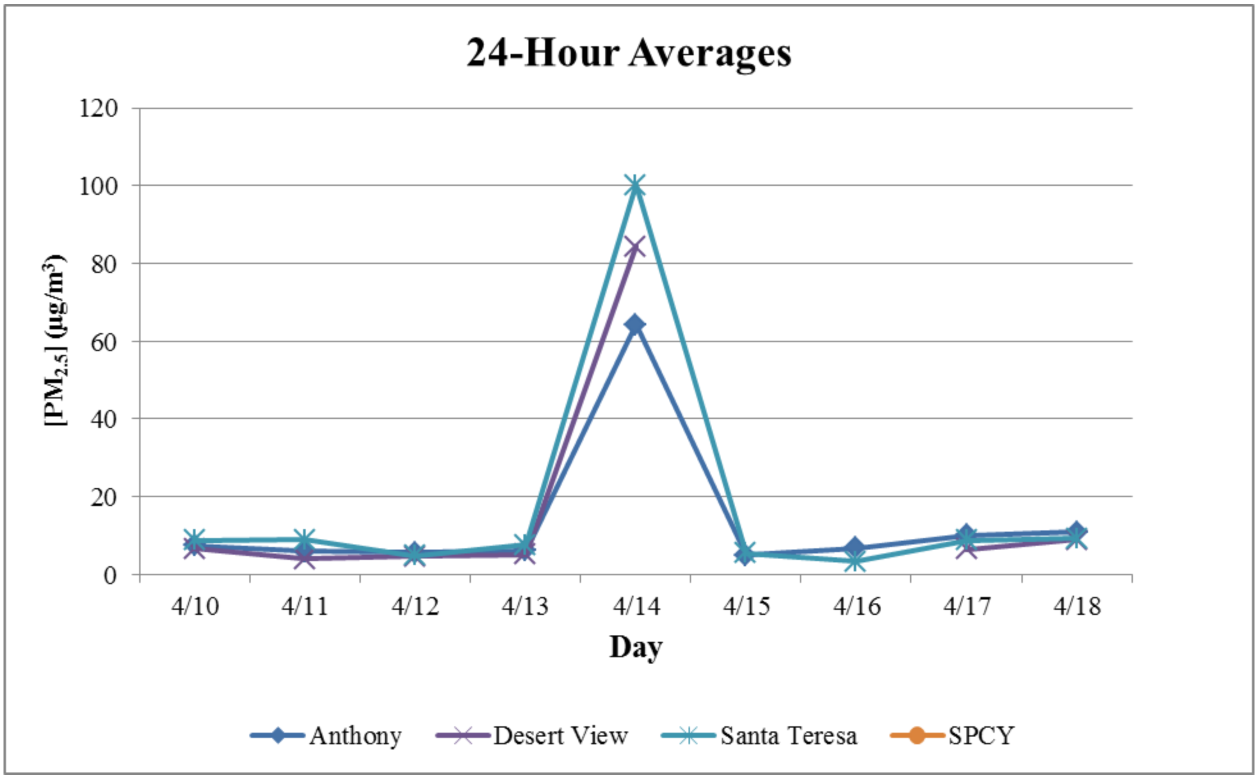


Figure 11-2 $PM_{2.5}$ 24-hour averages before and after April 14, 2012. Non-FEM TEOM Data.

11.2 Is Not Reasonably Controllable or Preventable

11.2.1 Suspected Source Areas and Categories Contributing to the Event

Sources of windblown dust contributing to this exceedance include the natural desert, residential properties, agricultural land and unpaved roads in Mexico and New Mexico. Agricultural tilling and crop planting may have contributed to this event. City of Las Cruces, City of Deming and Doña Ana and Luna Counties Ordinances require BACM for any dust producing activities. The largest and most likely sources of windblown dust are the natural desert and the playas of northern Mexico (see Section 11.2.4 below).

11.2.2 Sustained and Instantaneous Wind Speeds

EPA uses a default entrainment threshold of sustained wind speeds at 11.2 m/s (25 mph) for natural and well controlled anthropogenic sources contributing to natural events caused by high wind and blowing dust (EPA, 2013). Under the Doña Ana and Luna County NEAPs, EPA and NMED agreed that wind gusts exceeding 18 m/s would overwhelm any natural and well-controlled anthropogenic sources and cause windblown dust. On April 14, 2014, sustained wind speeds exceeded EPA's default threshold at seven of the eight monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at all of the eight monitoring sites (Figures 11-3 and 11-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 0300 hour and ending at the 1900 hour.

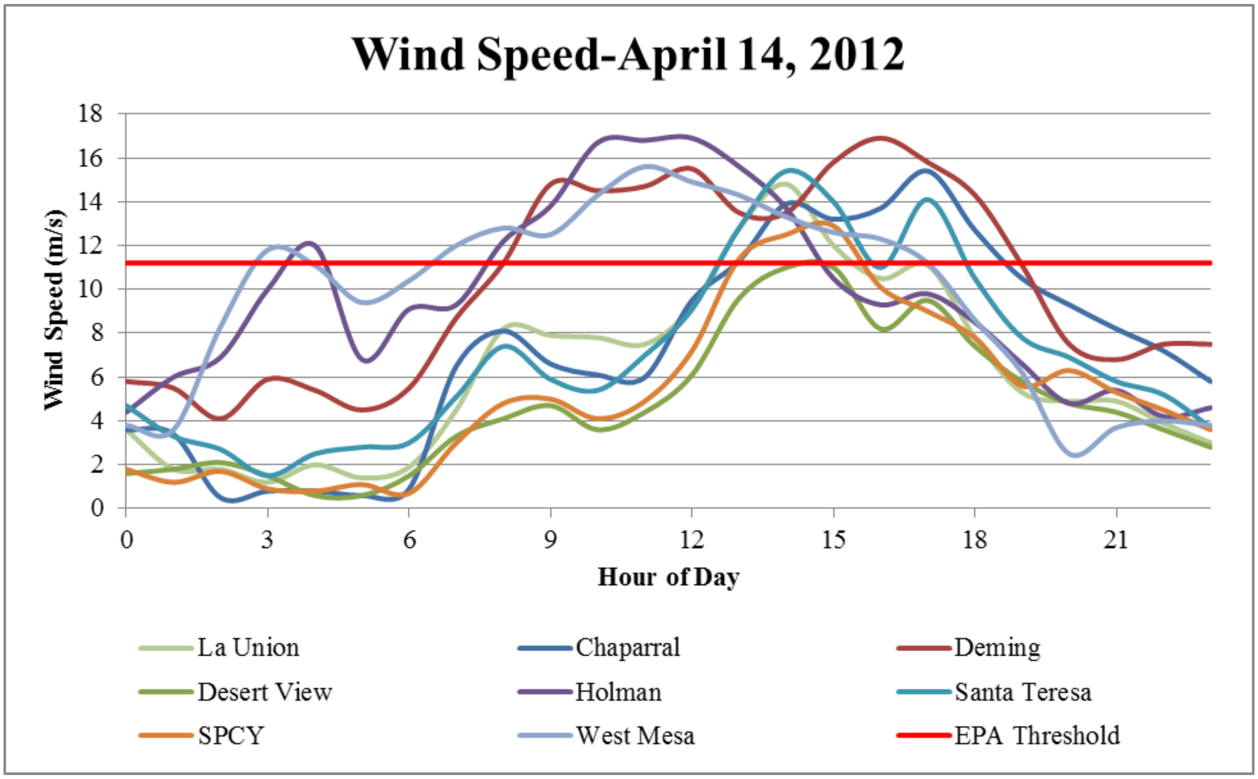


Figure 11-3 Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

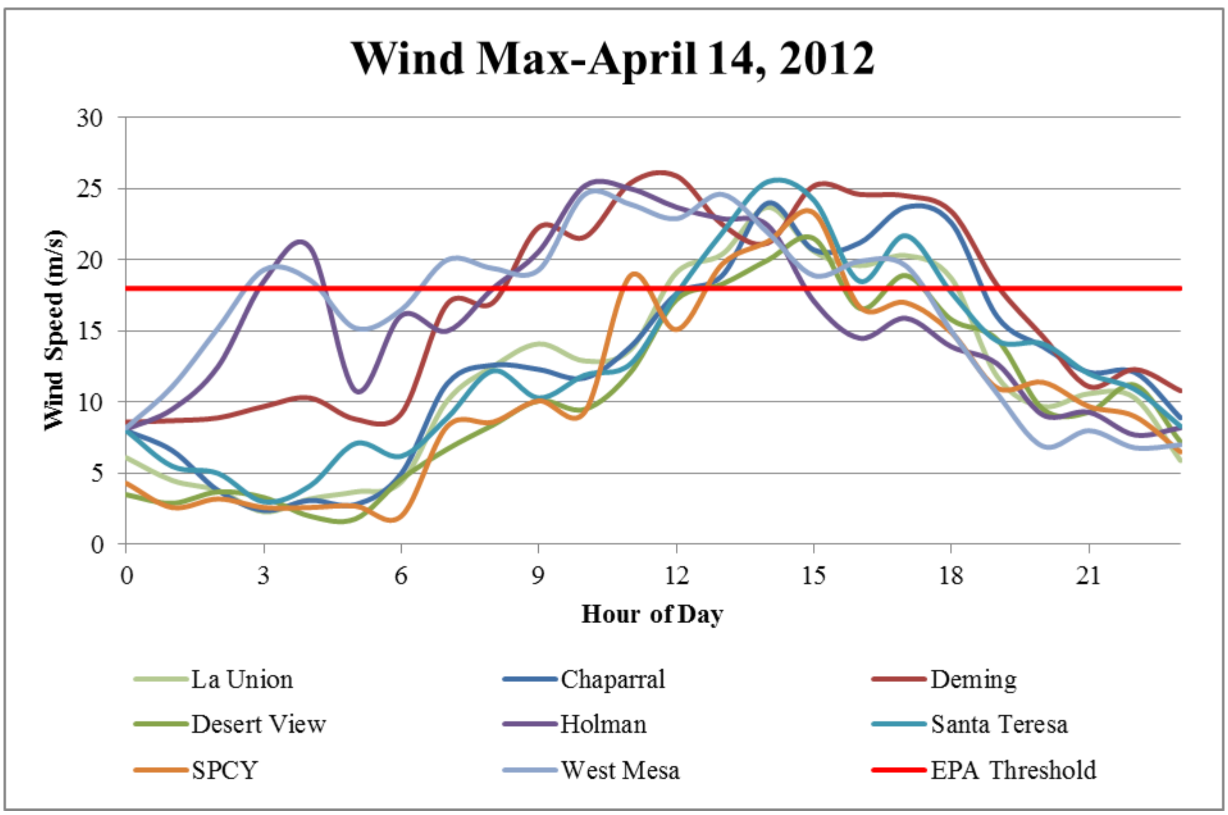


Figure 11-4 Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

11.2.3 Recurrence Frequency

The monitoring sites in Doña Ana and Luna Counties can record exceedances of the PM_{10} NAAQS throughout the year. From 2007-2011 the PM_{10} FEM TEOM monitors recorded 254 exceedances and the PM_{10} FRM Wedding monitors recorded 6 exceedances (Figure A-1). The Deming Airport and Desert View monitoring sites (FEM TEOMs) were established in 2006 and 2007 respectively and do not show exceedances until the year following startup. The SPCY $PM_{2.5}$ FRM Partisol recorded 37 exceedances of the 24-Hour NAAQS from 2007-2011 (Figure A-2). See appendix A for a more in-depth discussion about recurrence frequency and the number of exceedances at each monitoring site.

11.2.4 Controls Analysis

The local ordinances and MOUs adopted under the NEAP direct the implementation of BACM for sources of dust in Doña Ana and Luna Counties. The ordinances regulate disturbed lands, construction and demolition, vacant parking lots and materials handling and transportation. Our investigation did not identify any unusual PM_{10} producing activities on this day, and anthropogenic emissions remained constant before, during and after the event. The most likely source contributing to the event is the natural desert and playas in New Mexico and northern Mexico. The southern and northern sites in Doña Ana County and Deming Airport recorded the highest 24-hour averages in the monitoring network. A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from Mexico to the monitors in southern and northern Doña Ana and Luna Counties. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figures 11-5). Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

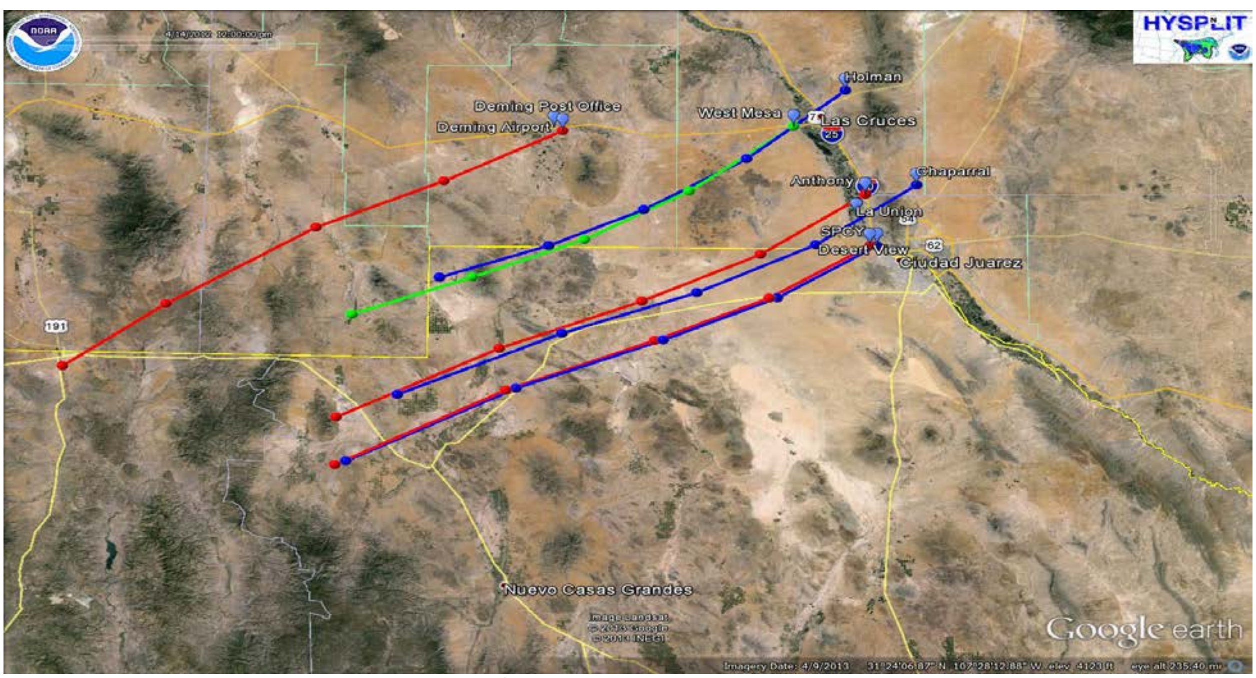


Figure 11-5 HYSPLIT back-trajectory model analysis for April 14, 2012.

11.3 Historical Fluctuations Analysis

11.3.1 Annual and Seasonal 24-hour Average Fluctuations

Since being established, the monitoring sites in Doña Ana and Luna Counties have recorded exceedances of the PM_{10} NAAQS. High winds cause these exceedances and they can occur at any time of year (Figure B-6 through B-13). Most exceedances occur from late winter through early summer (February-June) and are associated with the passage of Pacific cold fronts. High winds caused all recorded exceedances from 2007-2011 and NMED submitted natural events demonstrations to EPA under the NEAP or EER.

Since the 24-hour $PM_{2.5}$ NAAQS was lowered from 65 to 35 µg/m^3 in 2006, the SPCY Partisol monitor has routinely recorded exceedances of the standard. These exceedances occurred throughout the year during high and low wind conditions. In 2009, NMED investigated the cause of the low wind exceedances and found that emissions from Ciudad Juárez, Mexico contribute significantly to elevated concentrations. The high wind exceedances were caused by blowing dust on days when PM_{10} monitors also recorded exceedances.

Appendix B contains a more in-depth discussion about historical fluctuations and charts showing annual and seasonal trends at each monitoring site.

Table B-1 and B-2 show normal historical fluctuations with and without high wind natural events that caused exceedances from 2007-2011. The analysis excludes only those high wind events that resulted in an exceedance. Data for PM_{10} in this table includes FRM Wedding and FEM TEOM measurements and data for $PM_{2.5}$ comes from the FRM Partisol measurements from 2007-2011. The recorded values for this day (Anthony: 751µg/m^3; Chaparral: 803 µg/m^3; Deming: 927 µg/m^3; Holman: 794 µg/m^3; Desert View: 961 µg/m^3; SPCY: 880 µg/m^3; West Mesa: 479 µg/m^3) are above the maximum values recorded when no high wind exceedances are included and is above the 95th percentile of all 24-hour averages recorded.

An hourly data distribution analysis was performed for PM_{10} and $PM_{2.5}$ concentrations, wind speeds and wind gusts (Appendices C, D and E). All data used for the PM_{10} distribution charts come from the FEM TEOM monitors and the non-FEM/FRM $PM_{2.5}$ TEOM monitor at SPCY. Overlaying the hourly data for April 14, 2012 on the hourly data distribution plots shows that the values recorded during the high wind event exceed the 95th percentile for PM_{10}, $PM_{2.5}$, wind speed and wind gusts (Figures 11-6a-g through 11-8a-g). The top whiskers of the box and whisker plots represent the 95th percentile of data. The hourly PM_{10} values during the high wind blowing dust storm far exceed the historical 95th percentile of data.

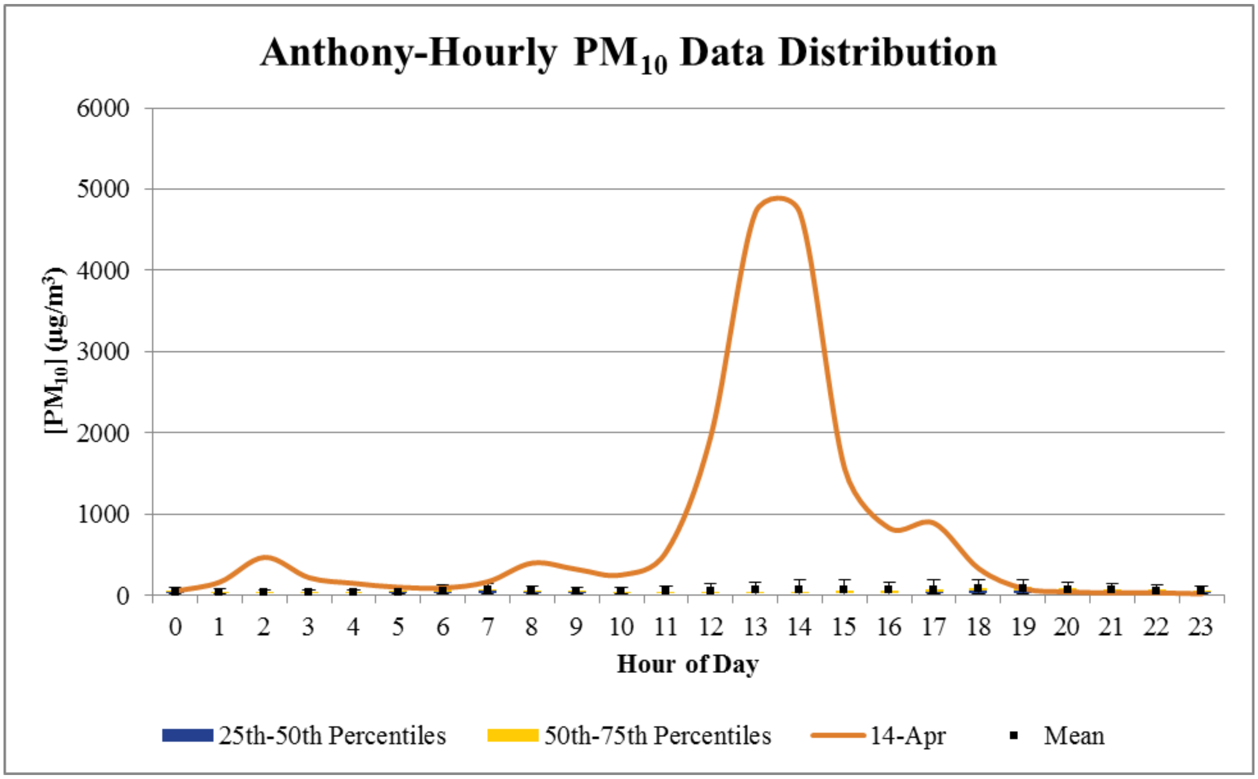


Figure 11-6a PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

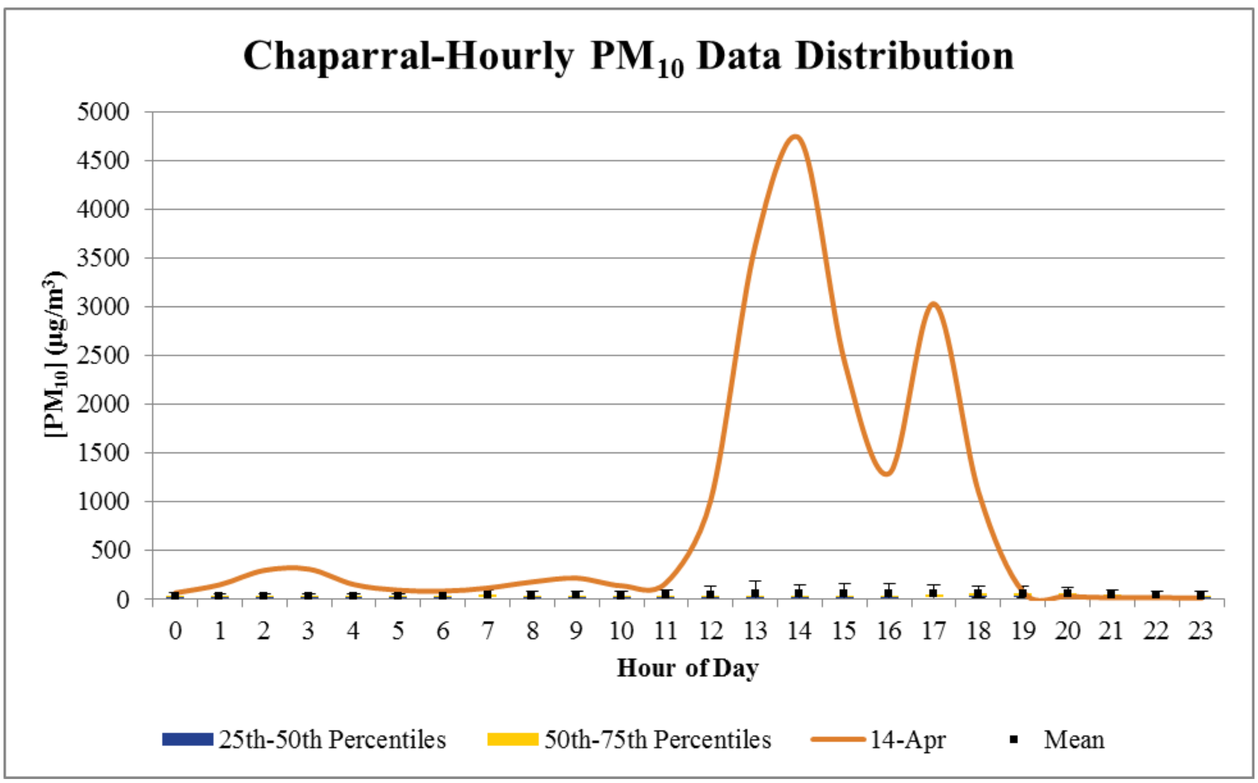


Figure 11-6b PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

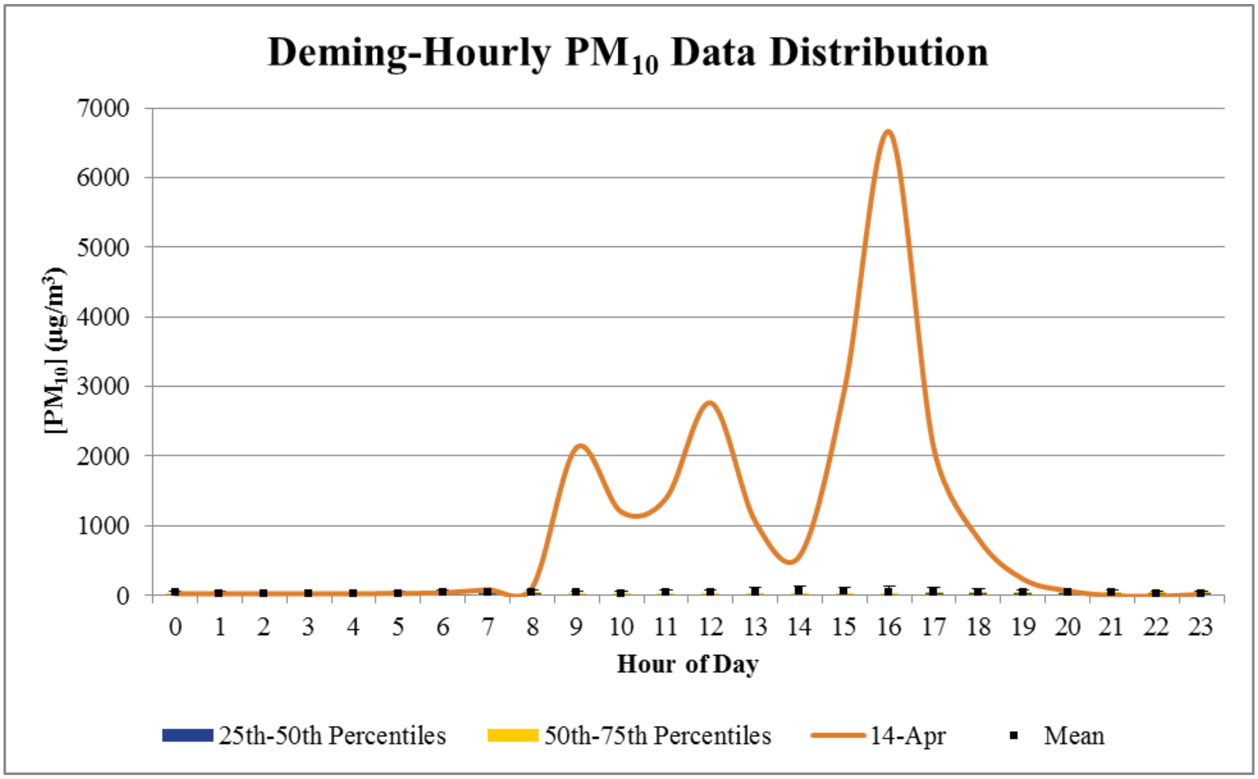


Figure 11-6c PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

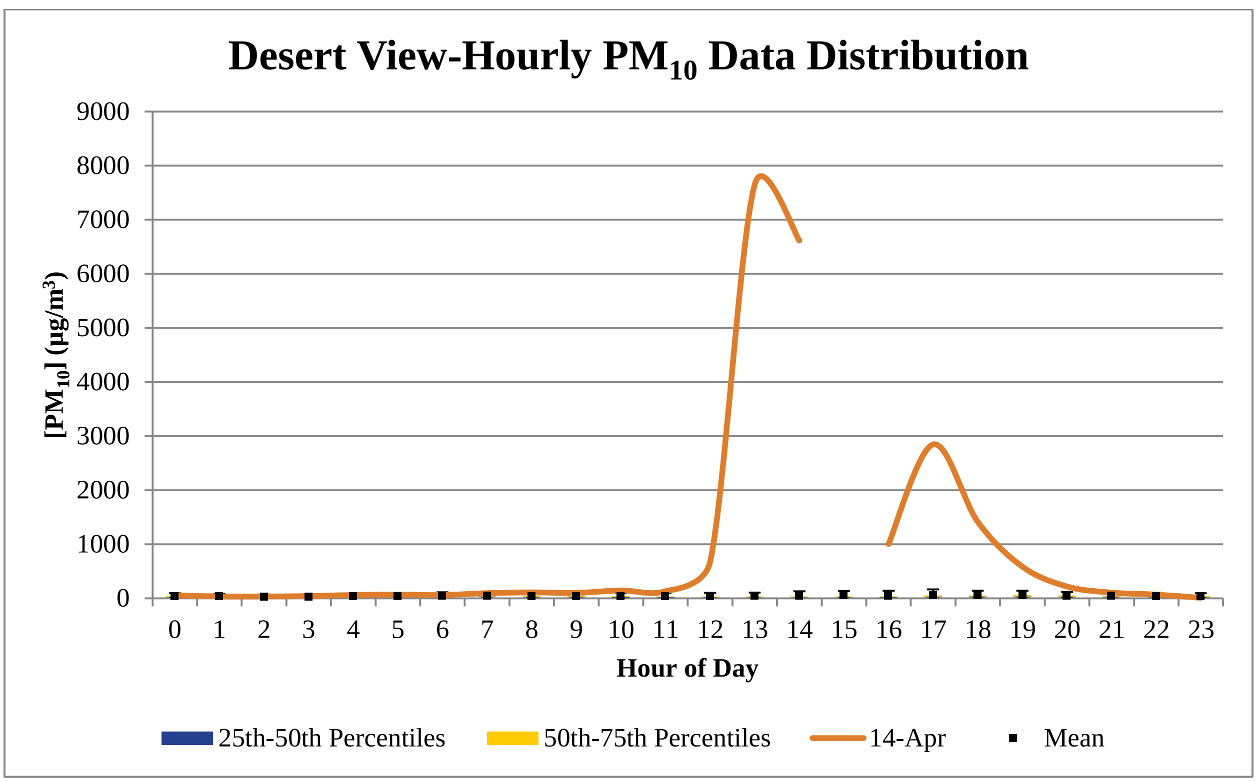


Figure 11-6d PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

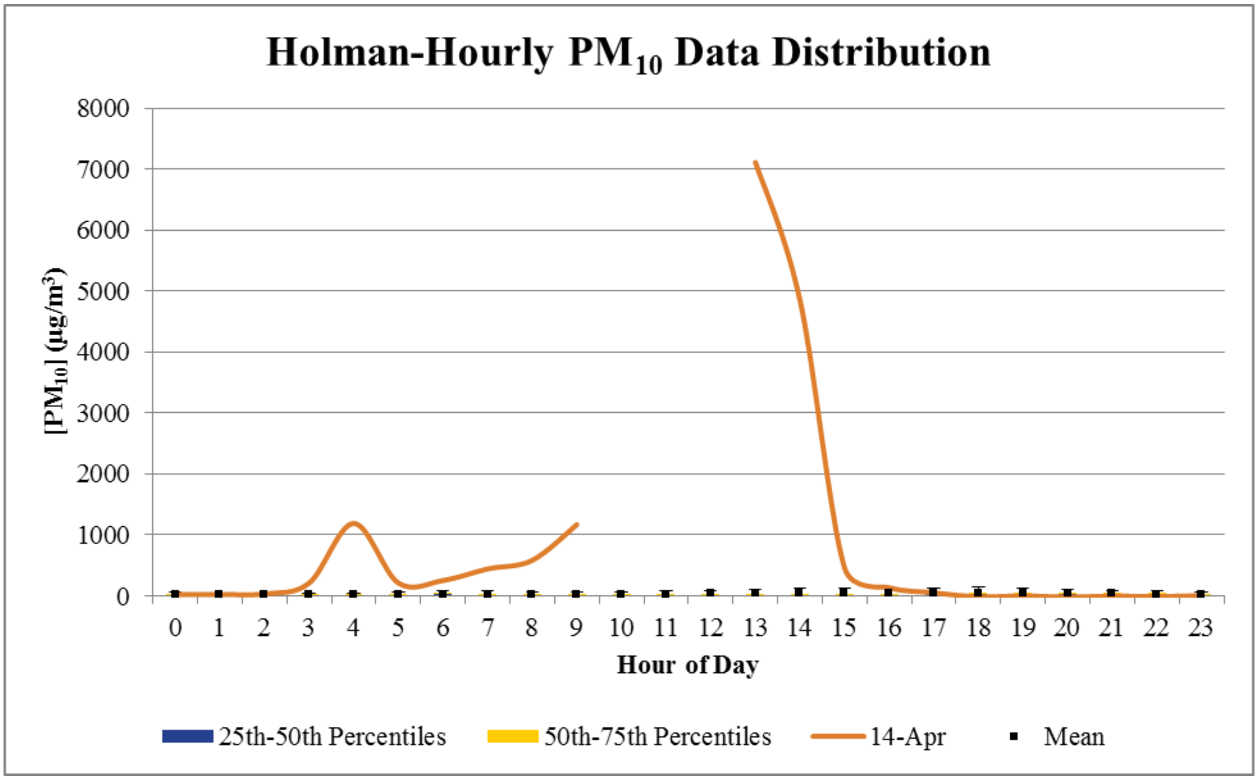


Figure 11-6e PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

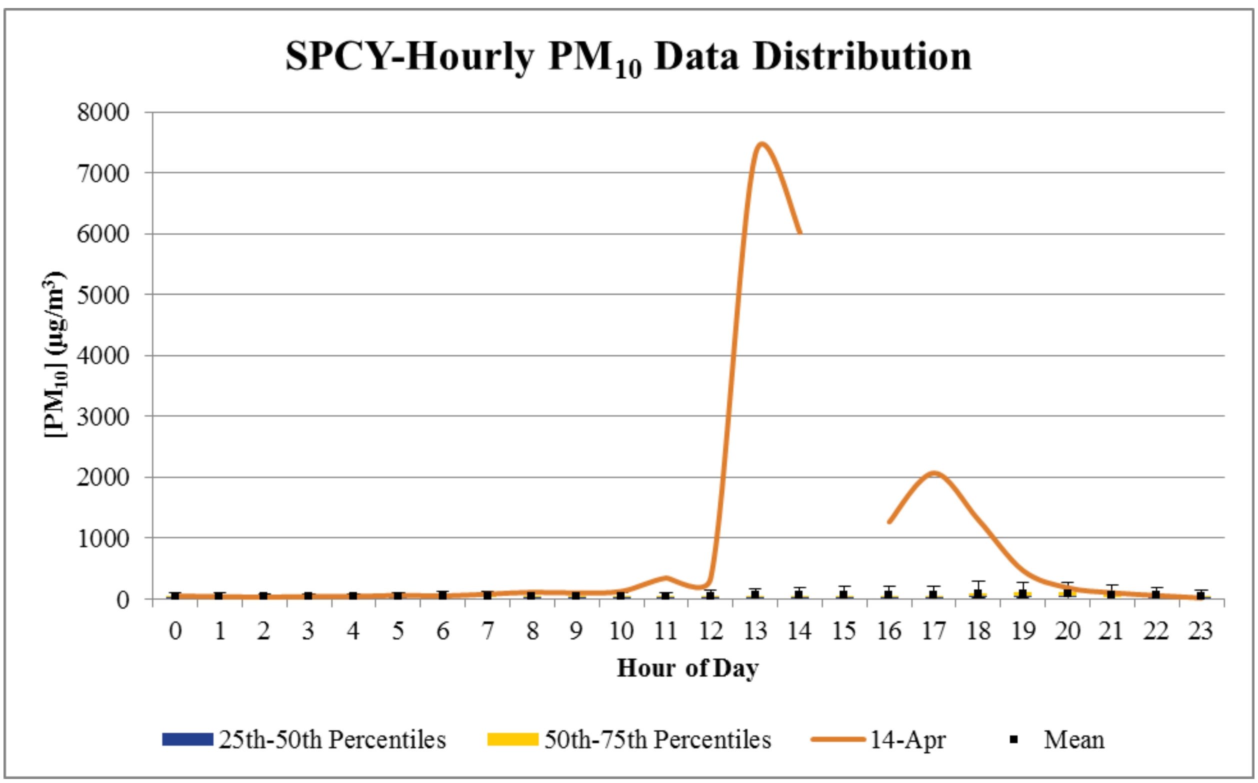


Figure 11-6f PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

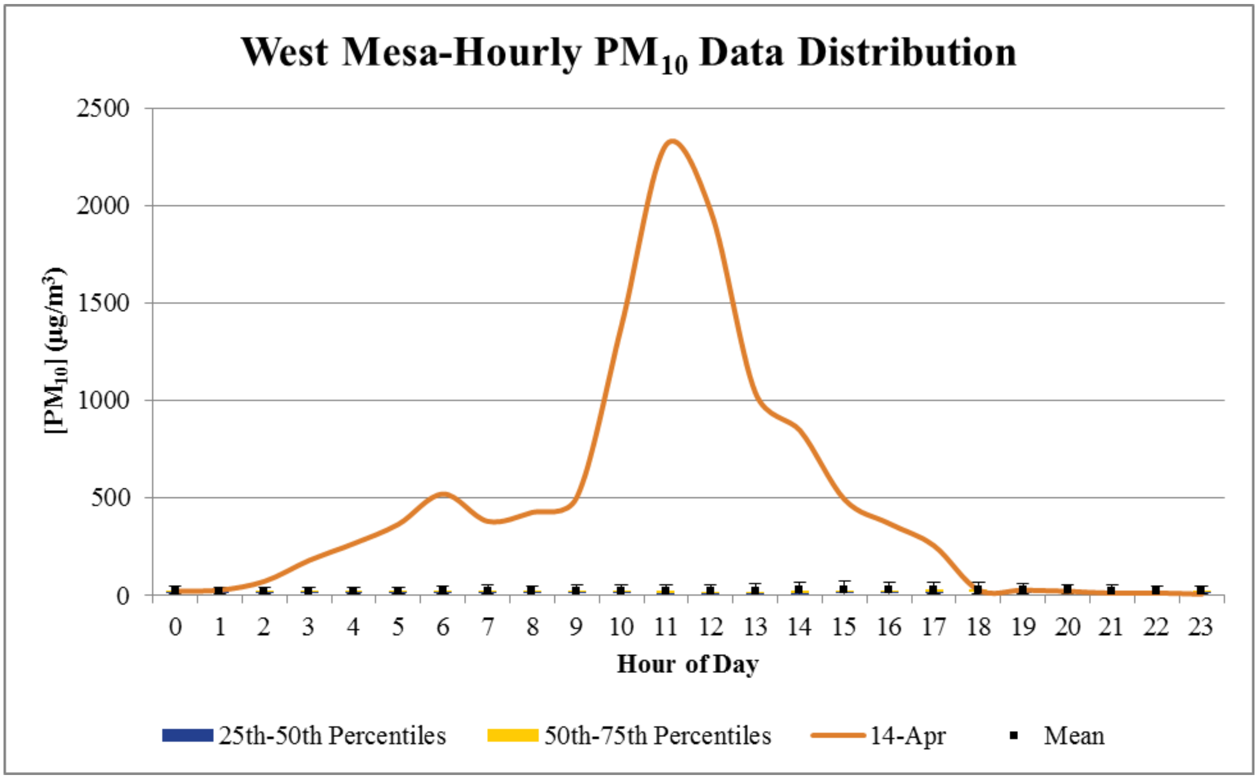


Figure 11-6g PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

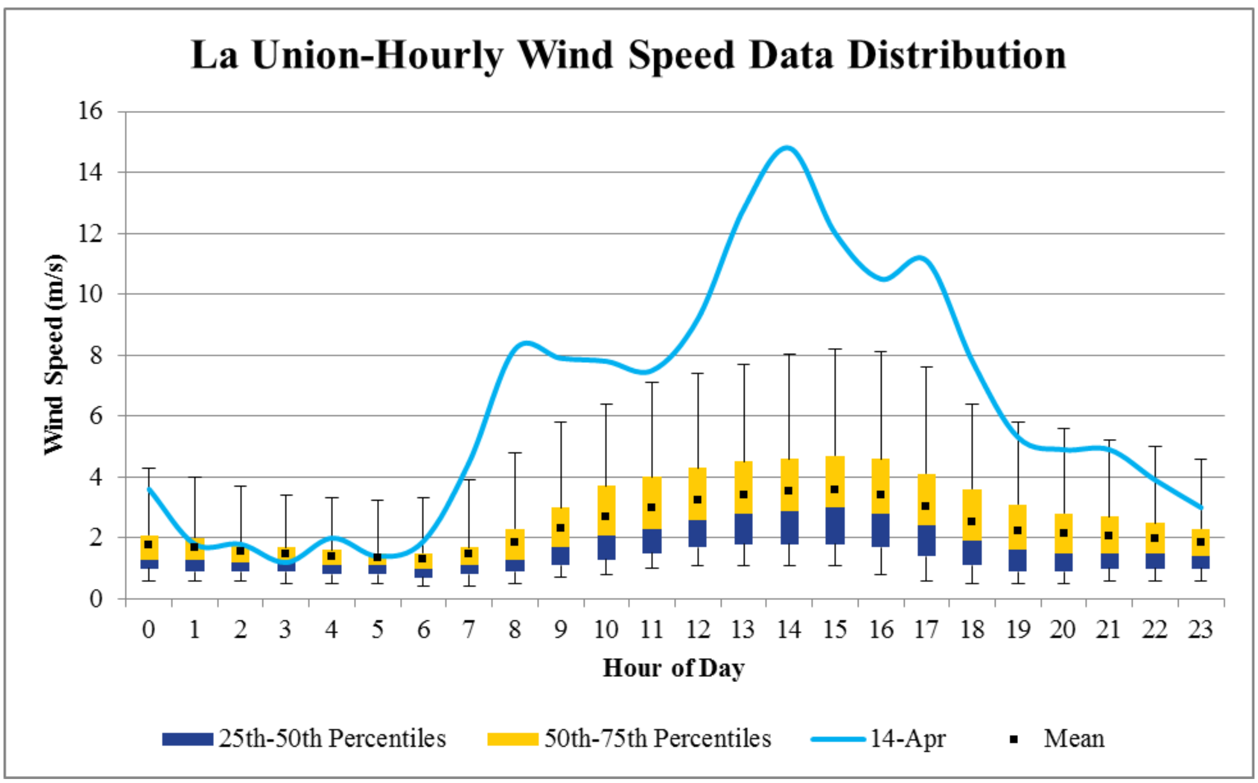


Figure 11-7a Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

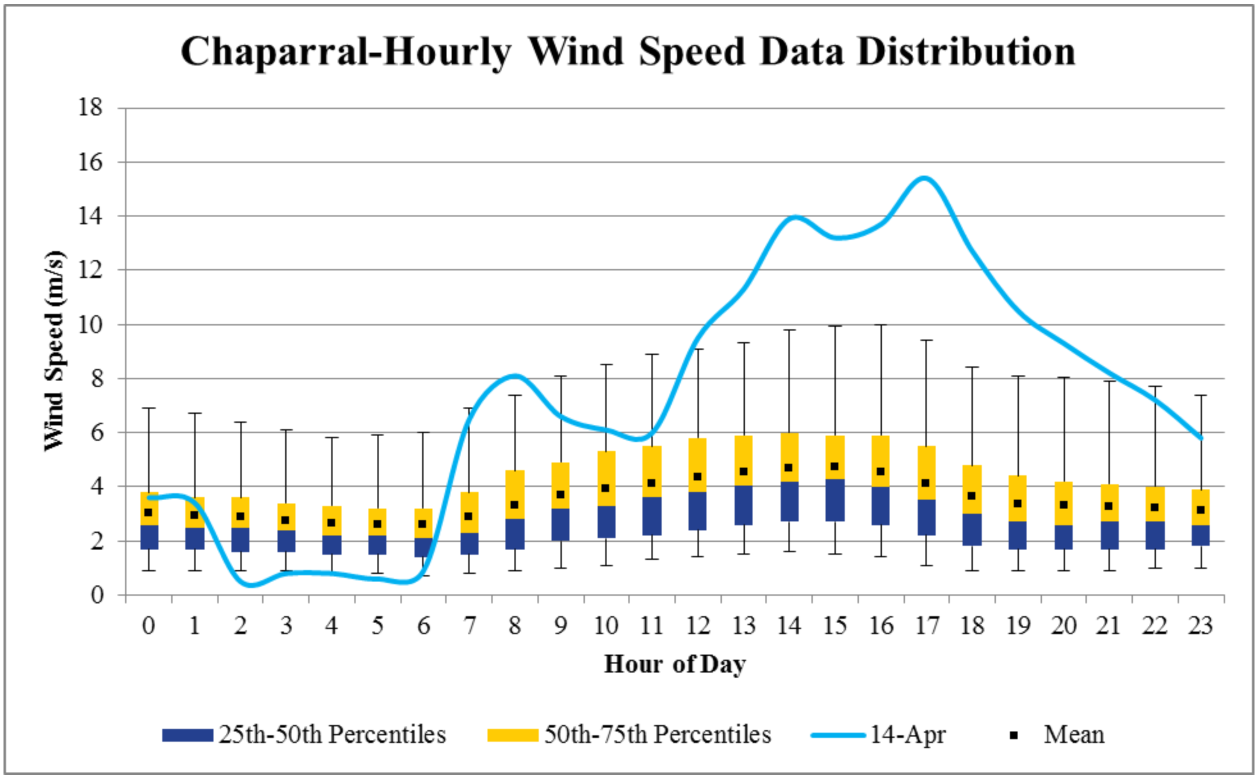


Figure 11-7b Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

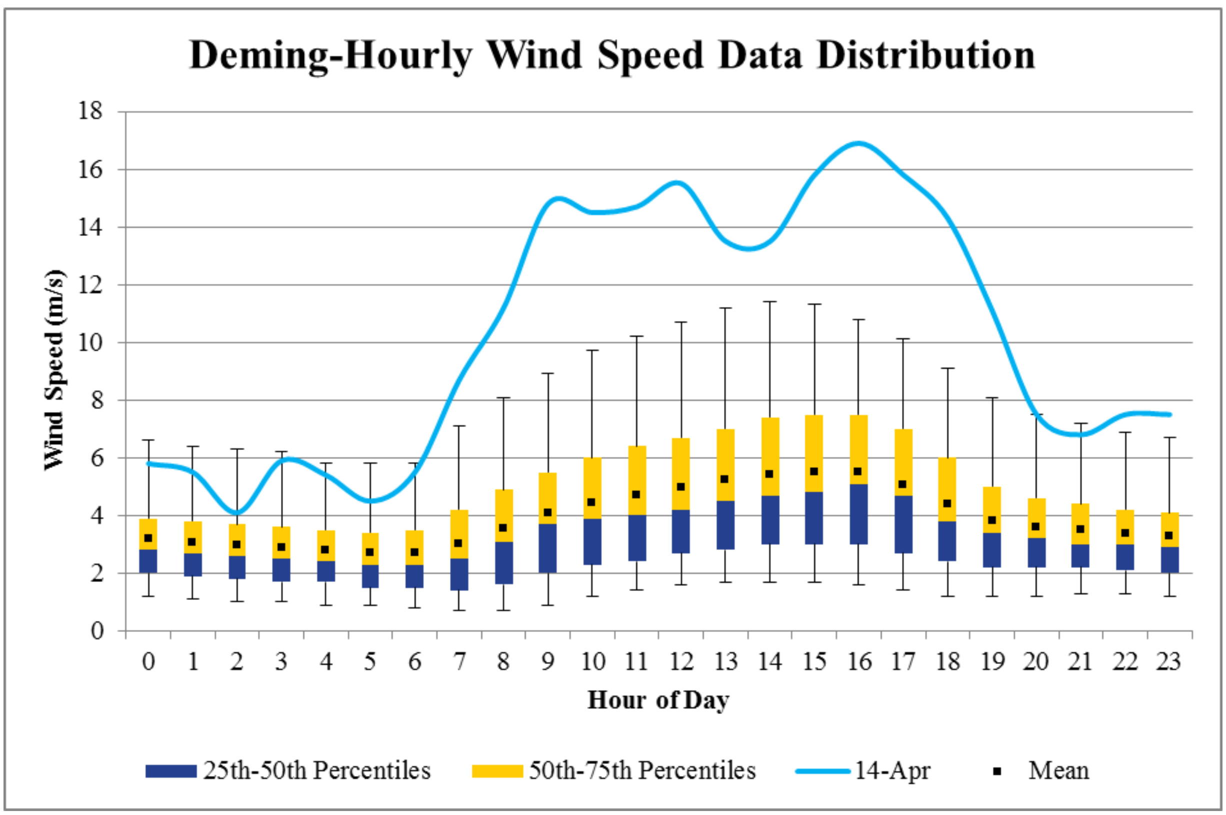


Figure 11-7c Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

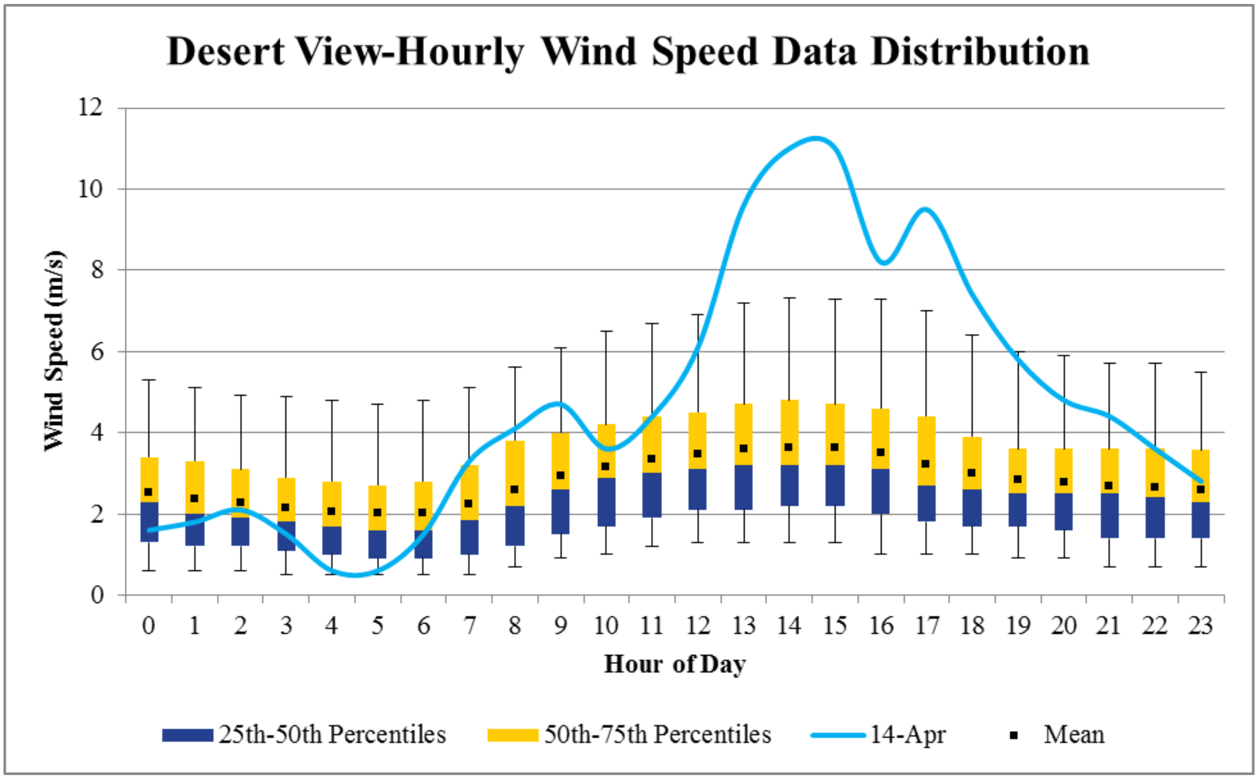


Figure 11-7d Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

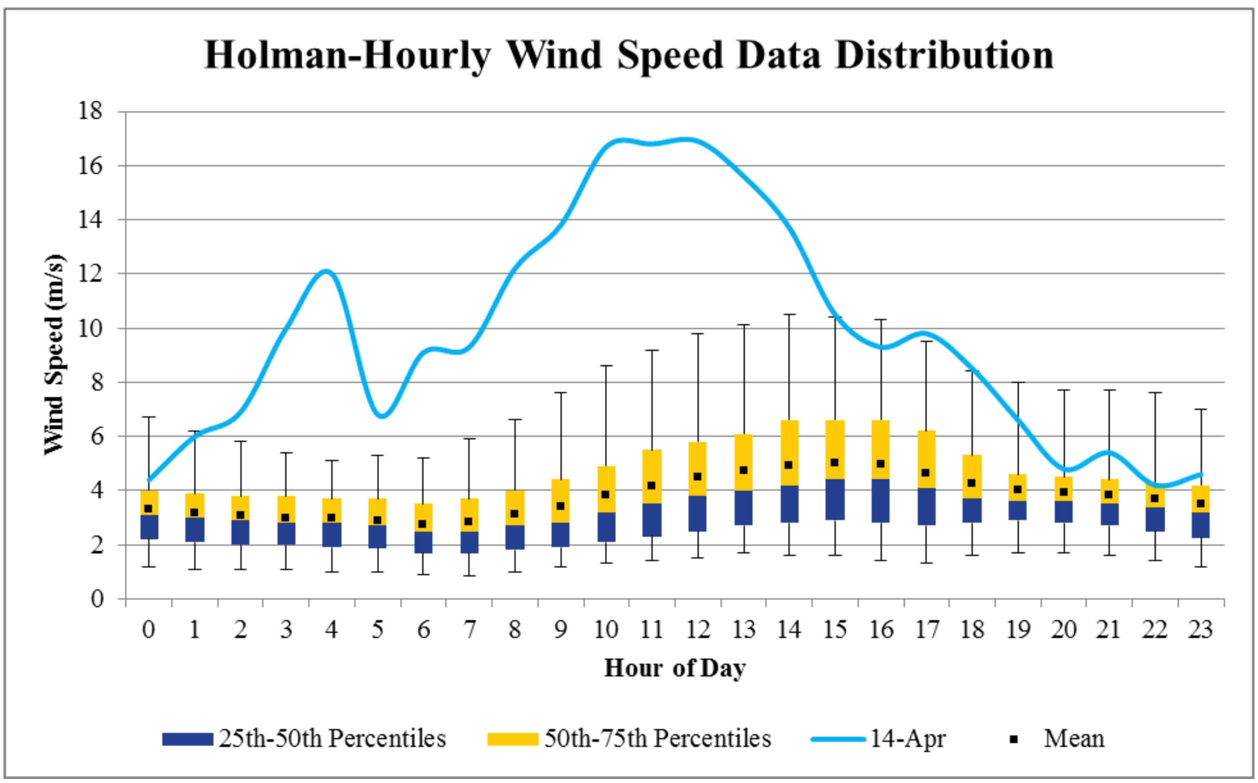


Figure 11-7e Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

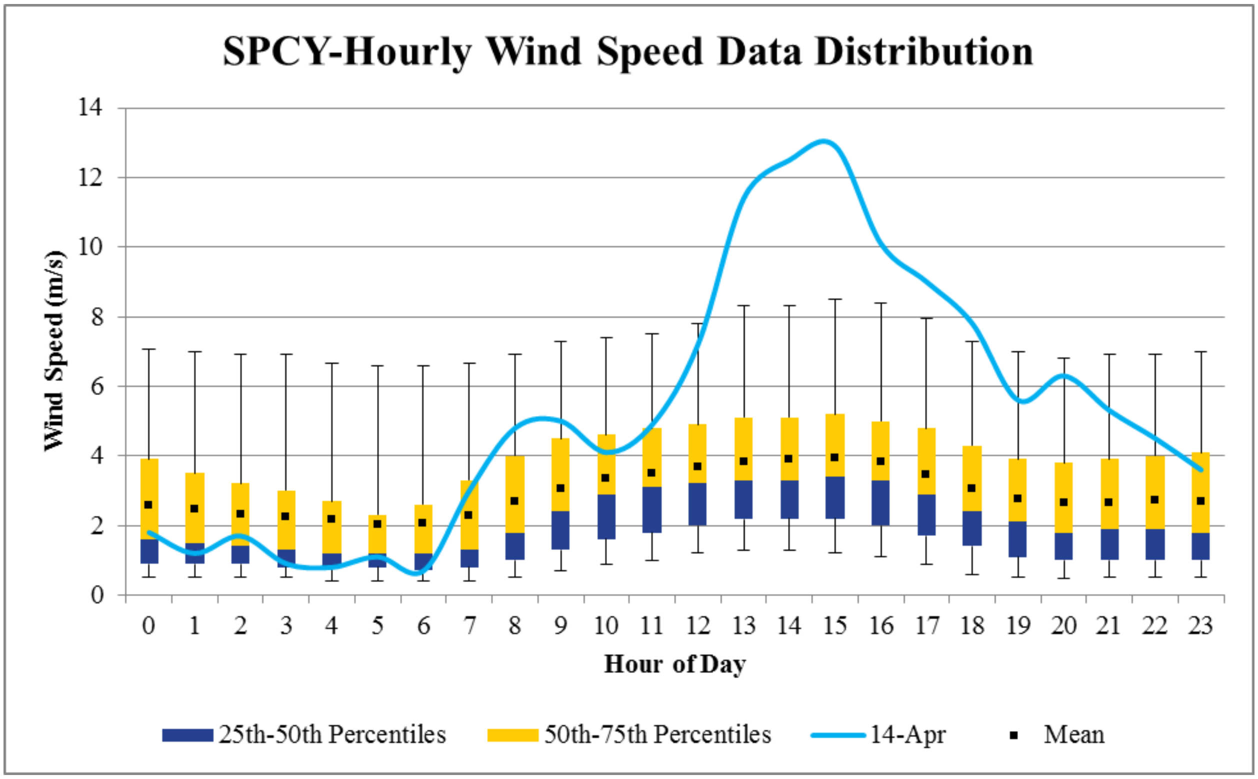


Figure 11-7f Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

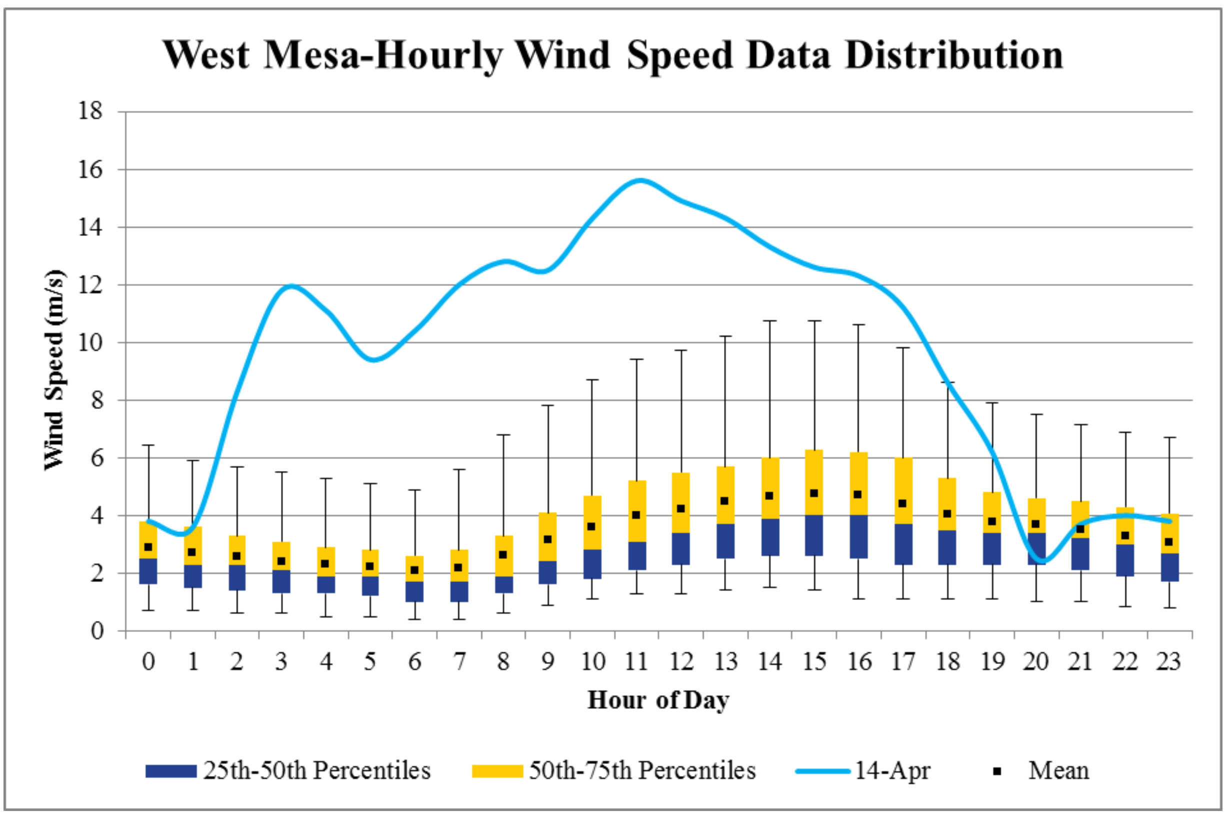


Figure 11-7g Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

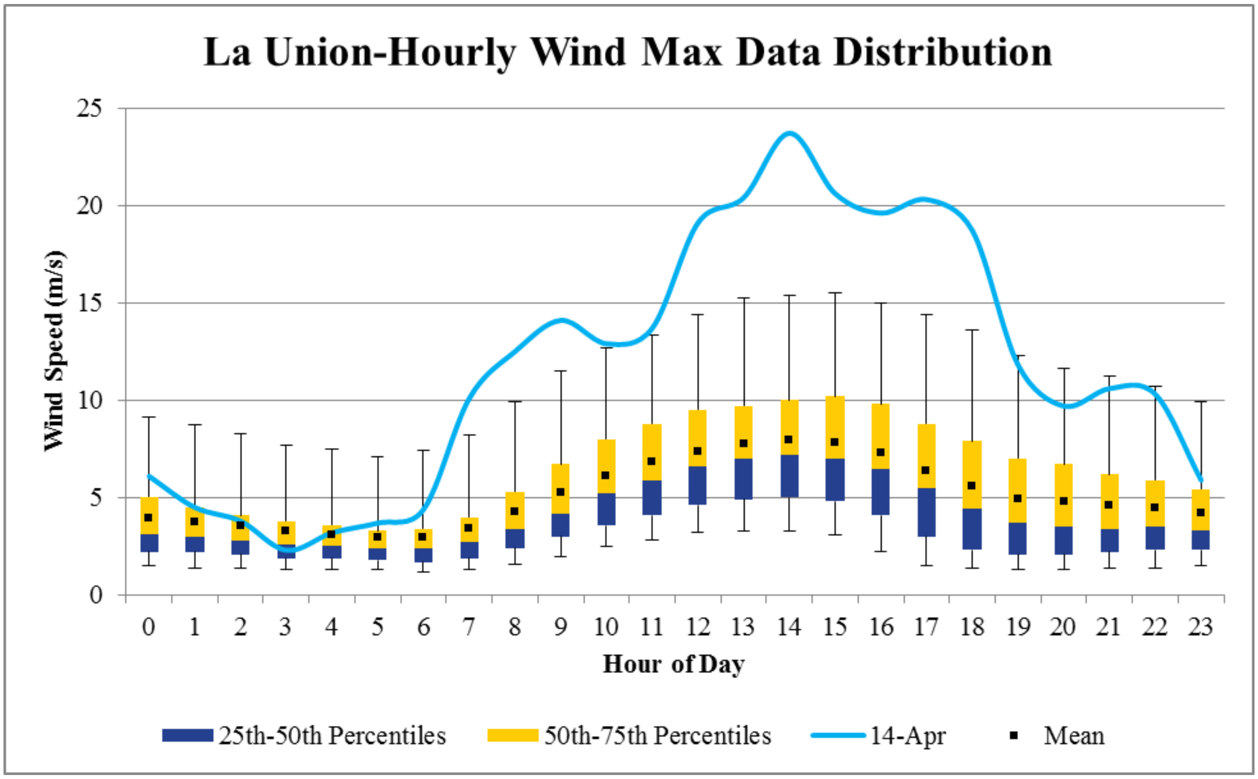


Figure 11-8a Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

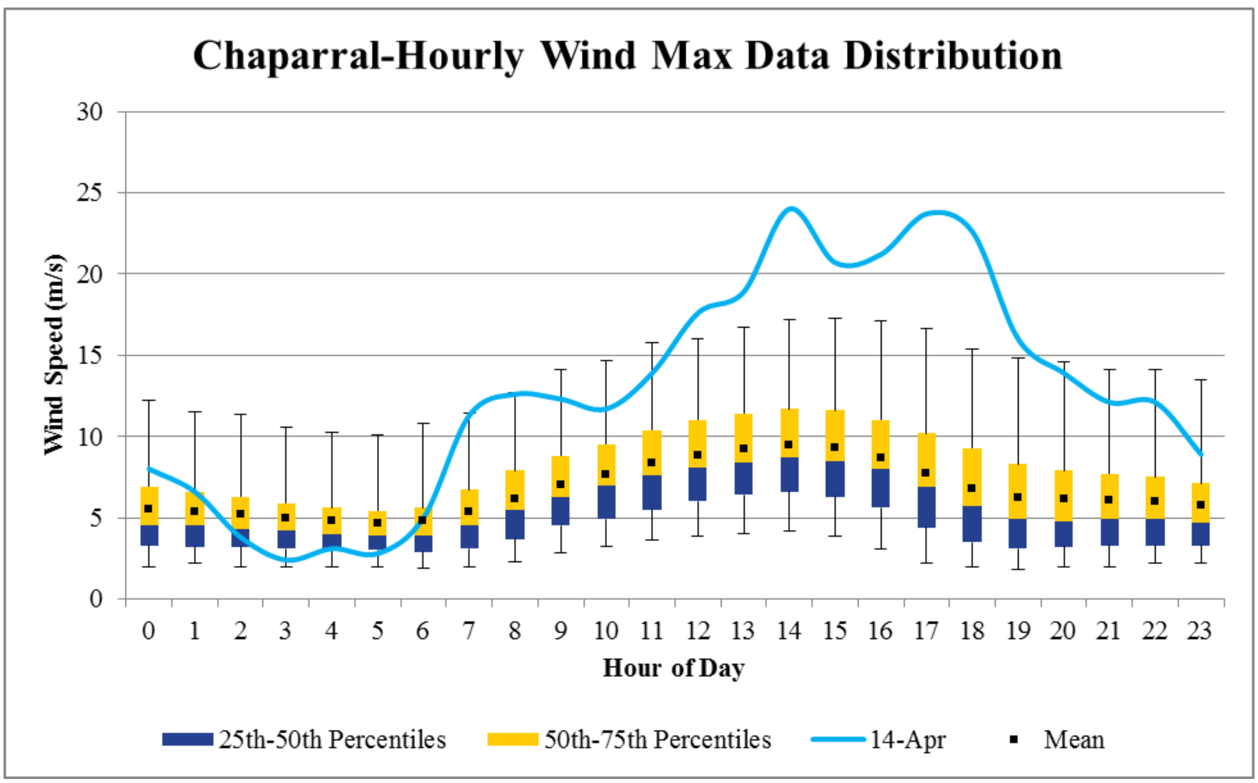


Figure 11-8b Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

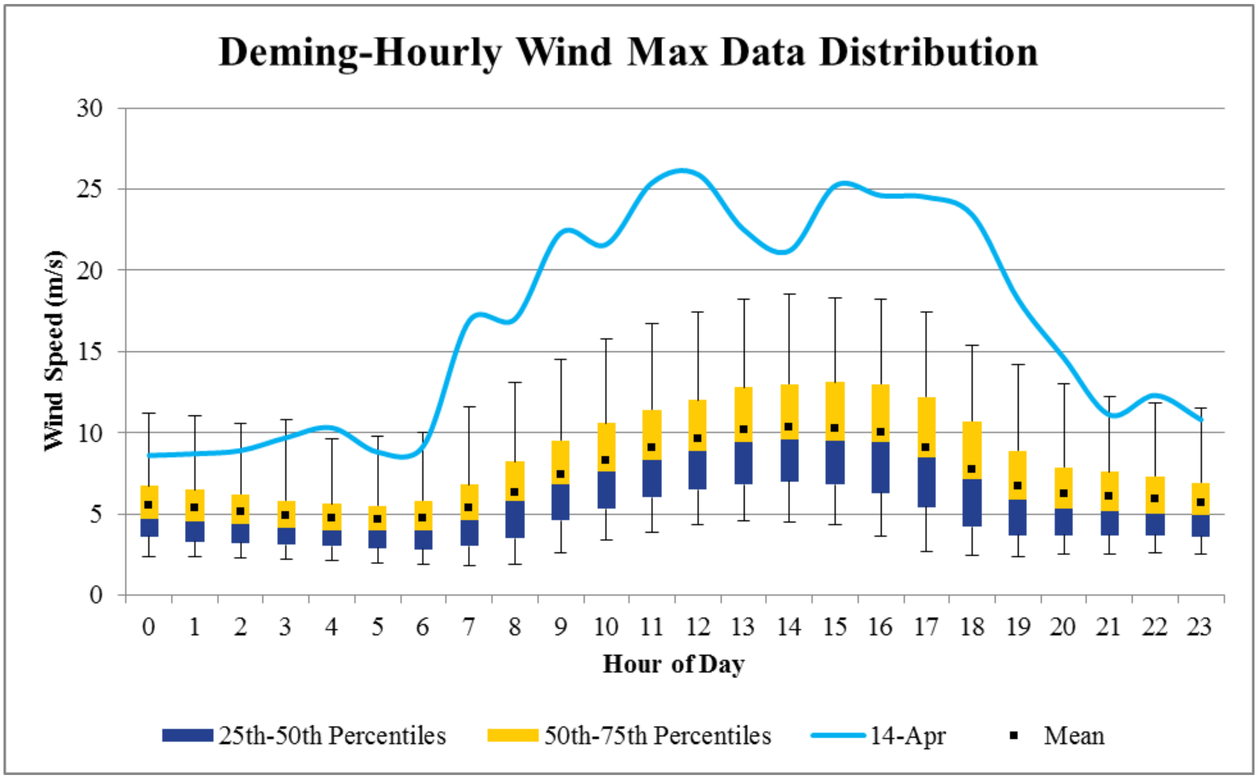


Figure 11-8c Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

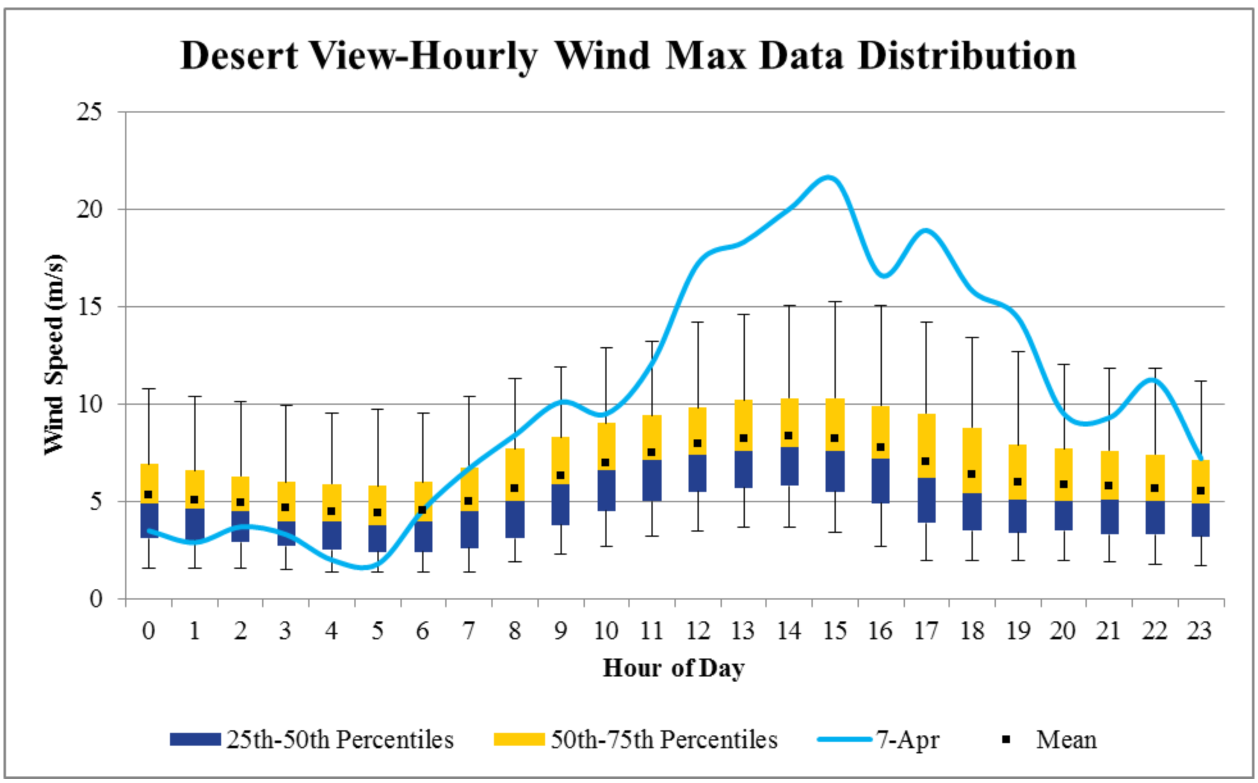


Figure 11-8d Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

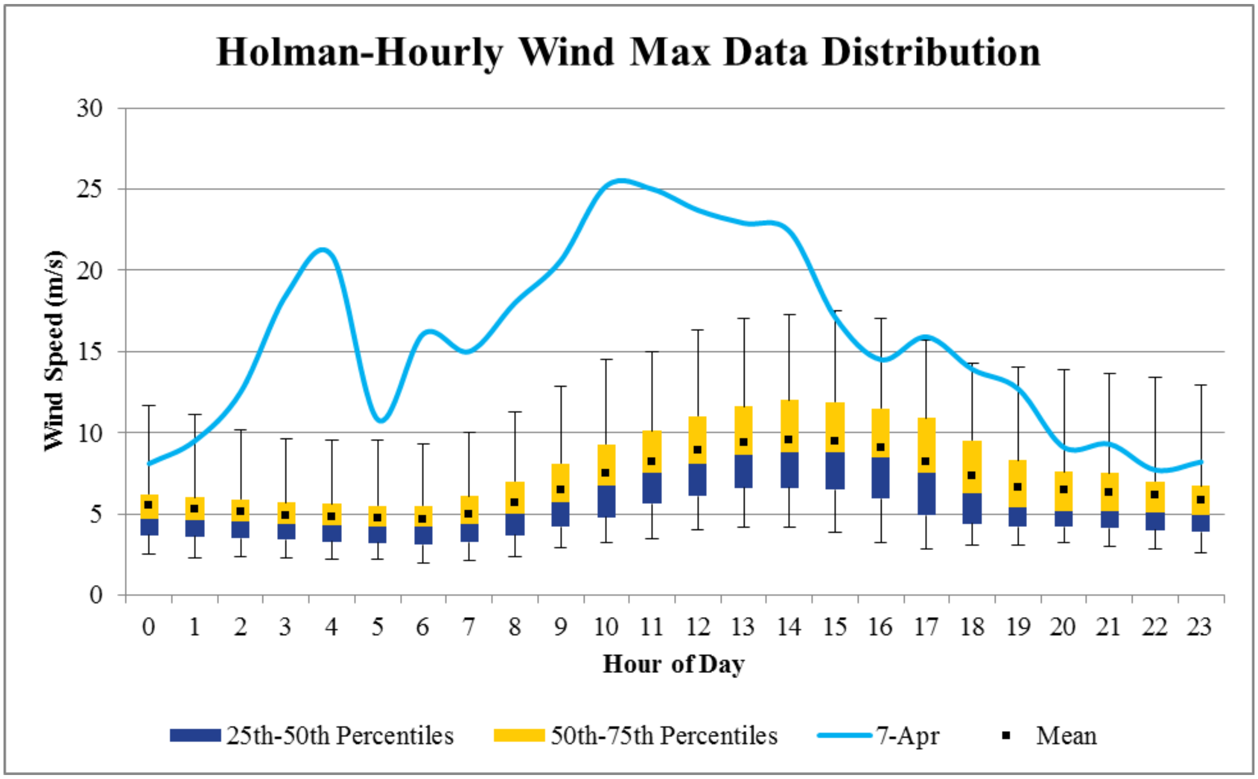


Figure 11-8e Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

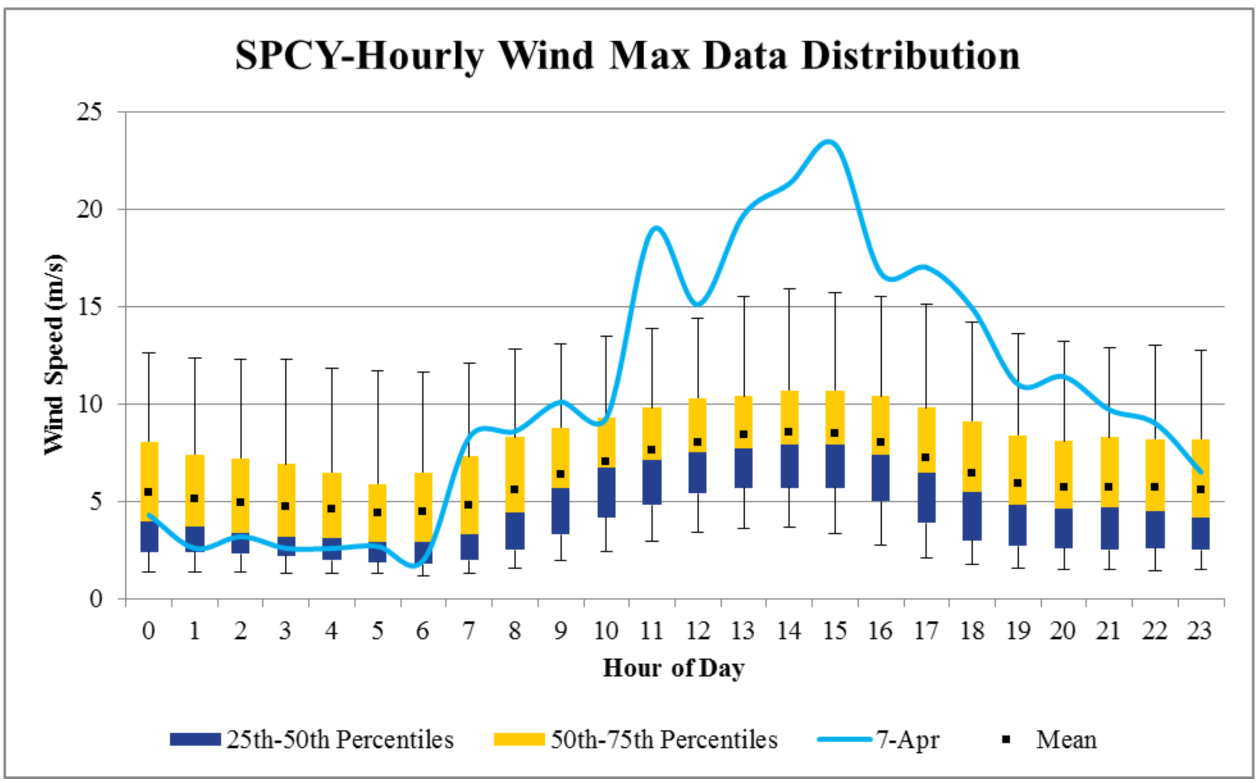


Figure 11-8f Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 14. 2012.

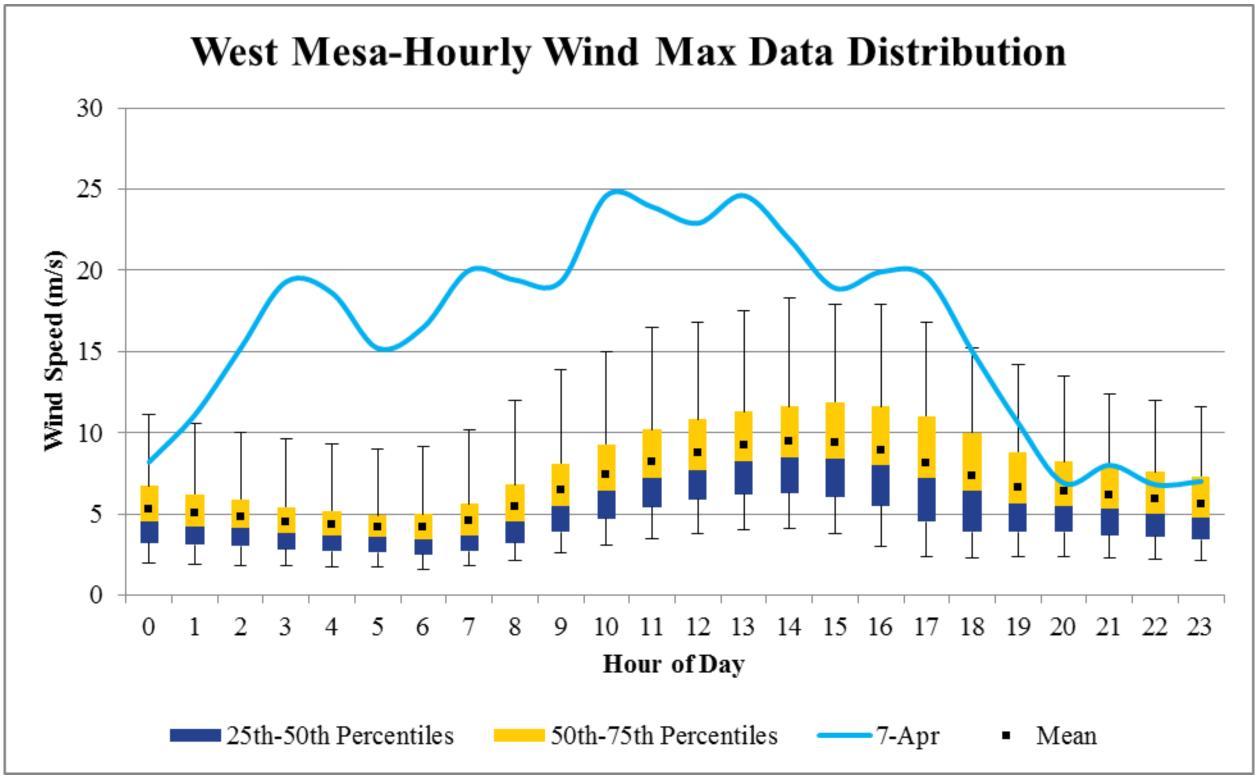


Figure 11-8g Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 14, 2012.

11.4 Clear Causal Relationship

A Pacific cold front and a backdoor stationary front met in the early hours of April 14, 2012 and pushed through New Mexico with a low pressure center along the Colorado- New Mexico border. This front created a pressure gradient over much of Arizona, New Mexico and northern Mexico (Figures 11-9 and 11-10). As the upper level low traveled through the state, the pressure gradient tightened and winds became even stronger at the surface. The wind direction in the upper atmosphere aligned with the surface wind direction (Figure 11-11). Diurnal heating of the surface allowed winds aloft to mix downward, increasing the surface wind velocities and provided the turbulence required for vertical mixing and horizontal transport.

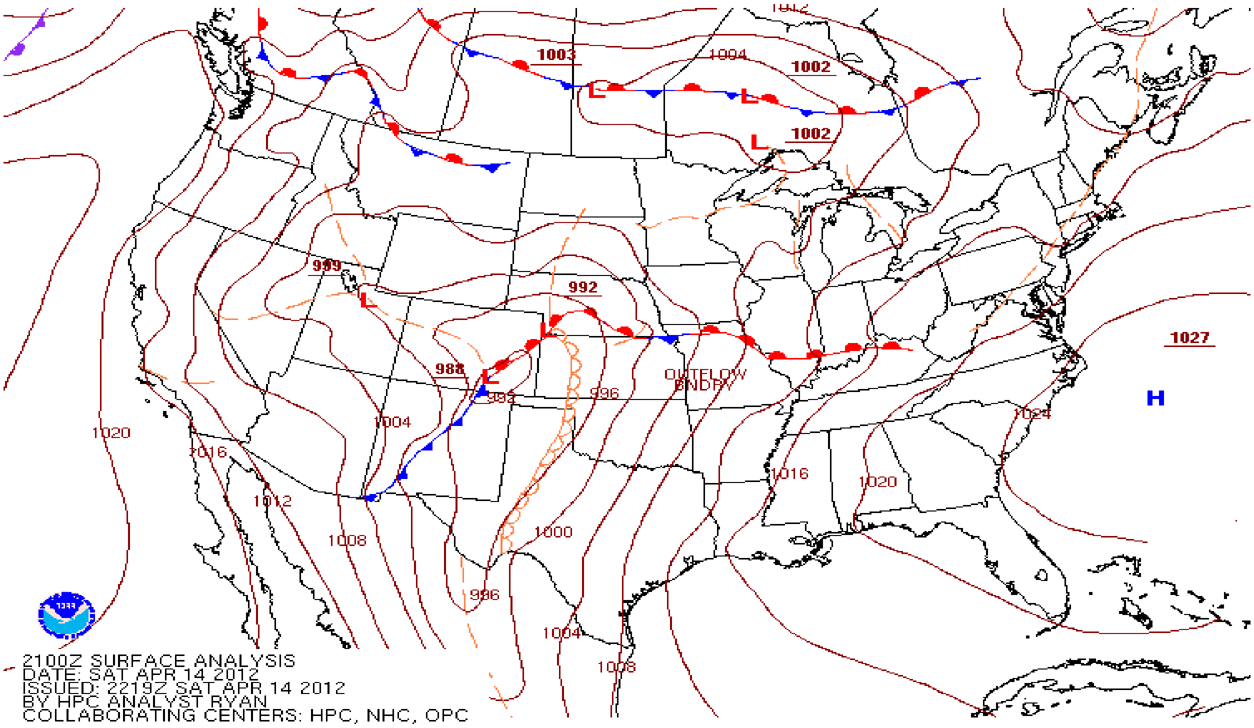


Figure 11-9 Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 14, 2012 at the 1500hour.

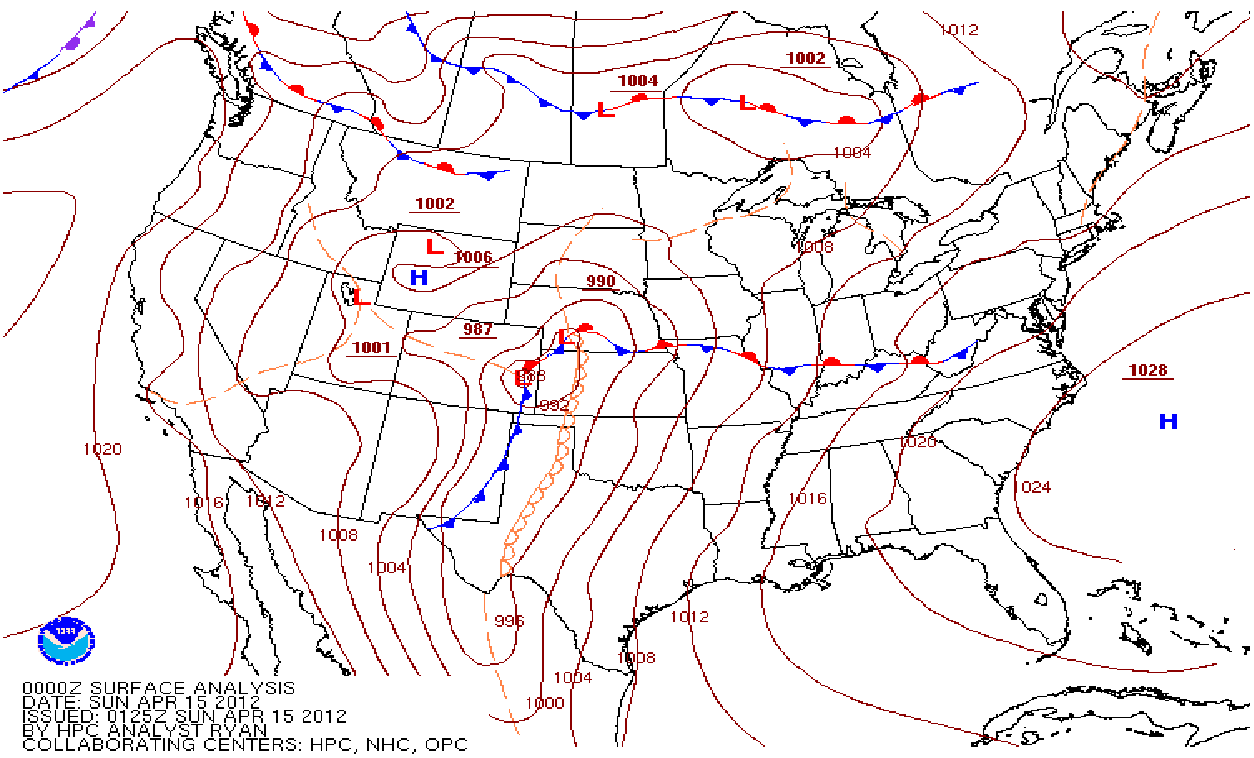


Figure 11-10 Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 14, 2012 at the 1800hour.

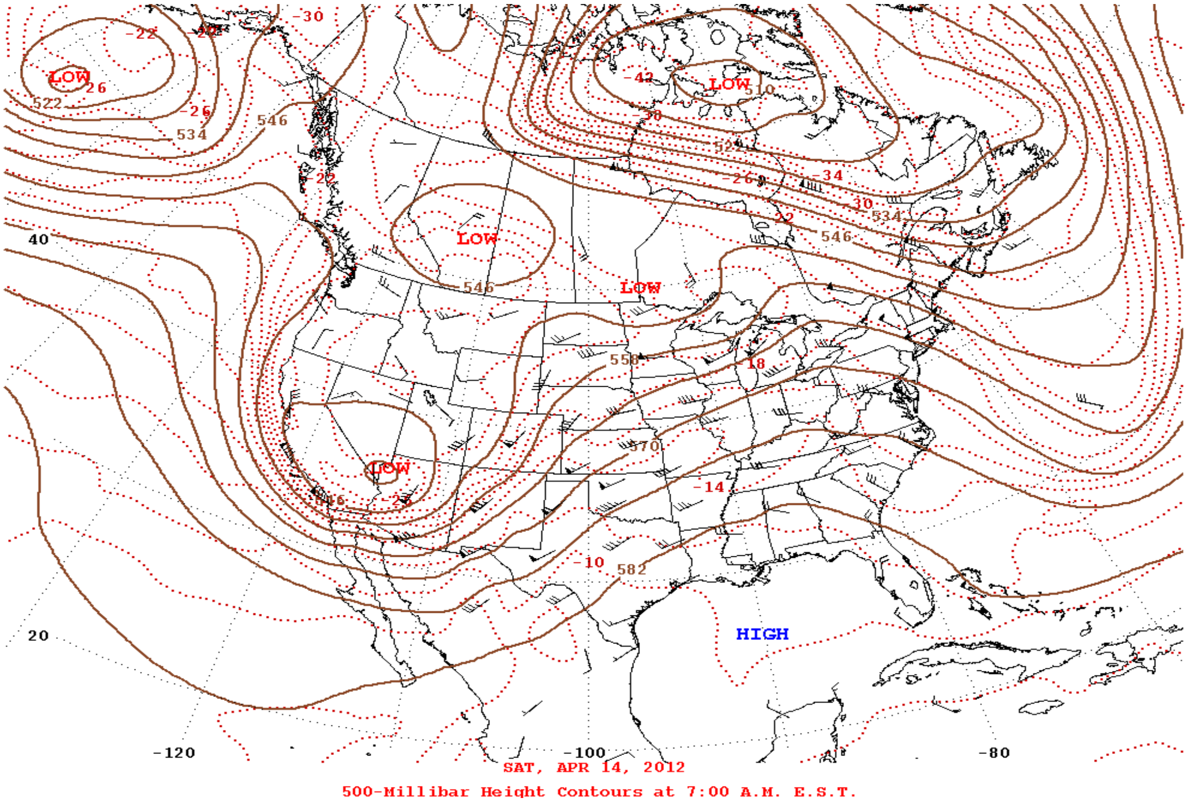


Figure 11-11 Upper air weather map showing geopotential heights (brown lines) at the 500 hour on April 14, 2012.

The weather pattern described above generated strong southwesterly winds beginning at the 0300 hour and lasting through the 1800 hour. Beginning at the 0300 hour, wind speeds exceeded 11.2 m/s at the West Mesa monitoring site as shown in Figure 11-3. Peak wind speeds ranged from 11.0 m/s at the Desert View monitoring site to 16.9 m/s at the Holman and Deming monitoring sites (Figure 11- 3). Peak wind gusts ranged from 21.5 m/s at the Desert View monitoring site to 25.9 m/s at the Deming monitoring site (Figure 11- 4). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 11-12a-g. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (0300-1800 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 11-13a-b). Maximum hourly PM_{10} concentrations range from 2311 μg/m^3 at West Mesa to 7654 μg/m^3 at Desert View.

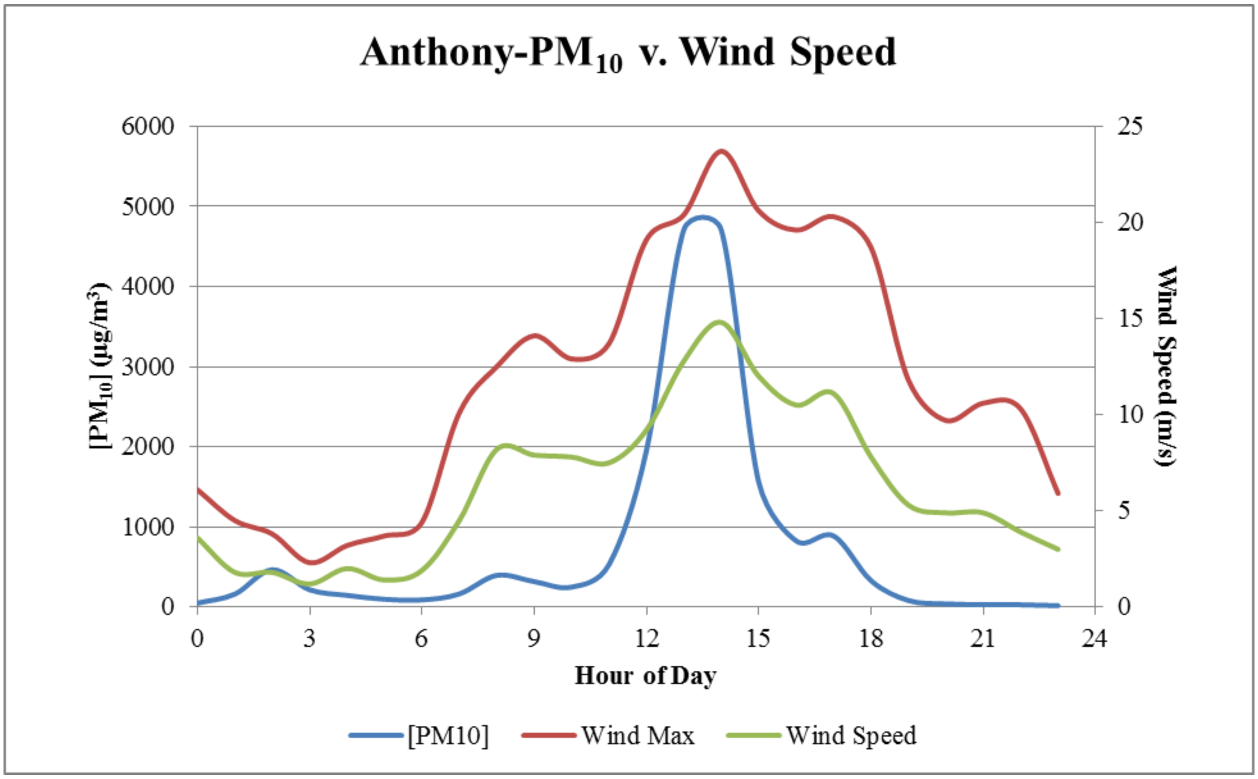


Figure 11-12a Time series plot of hourly observations showing increased PM$_{10}$ concentrations as wind speeds and gusts increase.

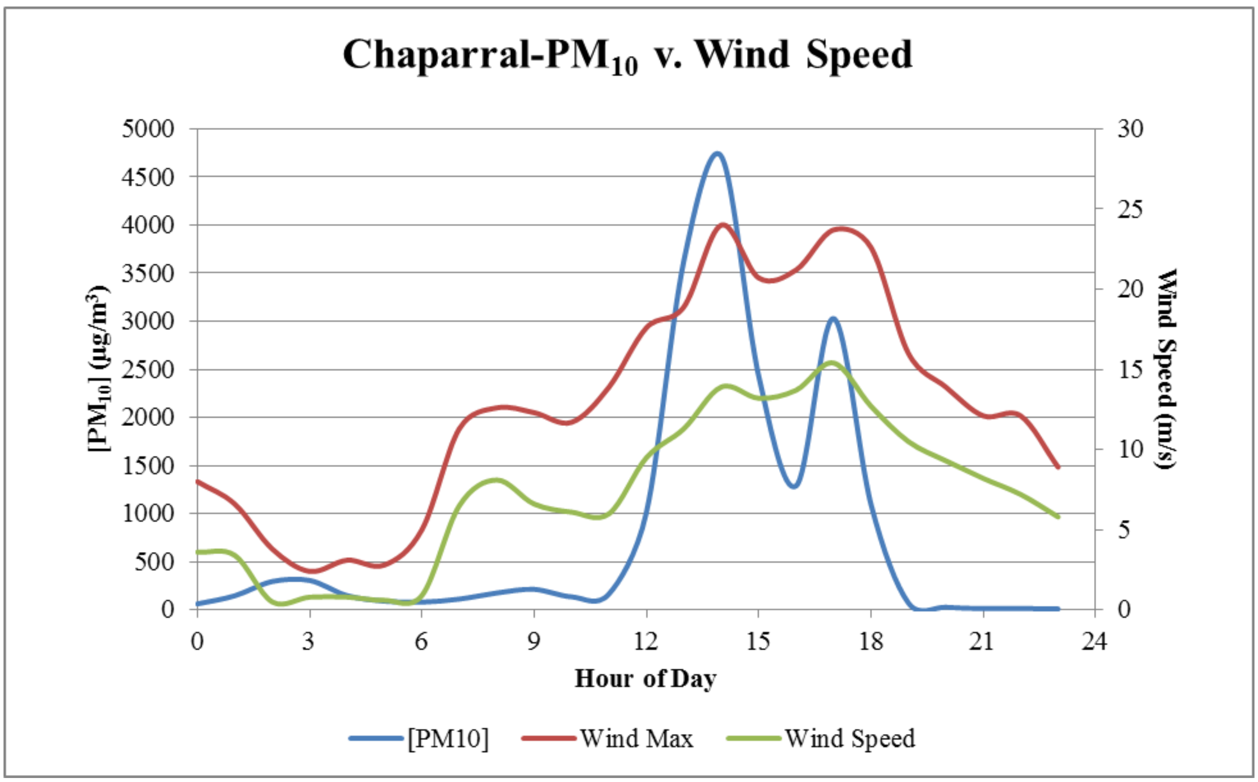


Figure 11-12b. Time series plot of hourly observations showing increased PM$_{10}$ concentrations as wind speeds and gusts increase.

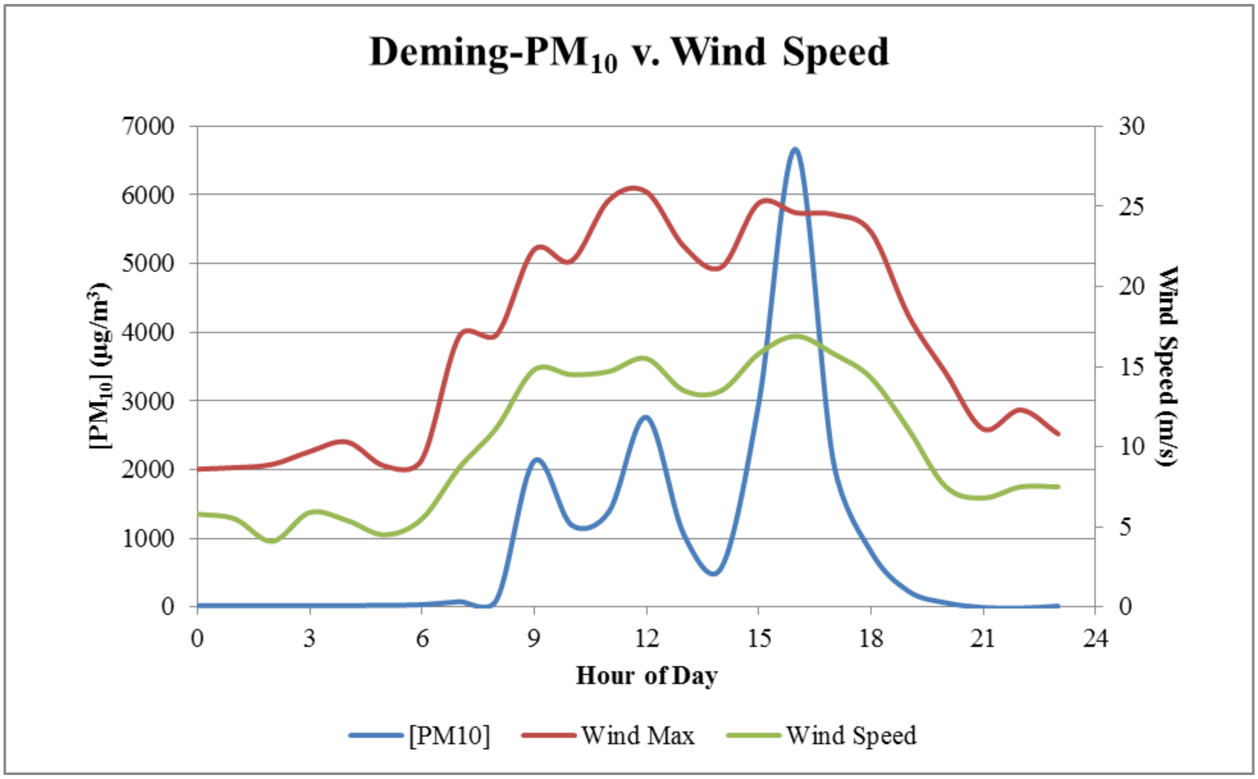


Figure 11-12c. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

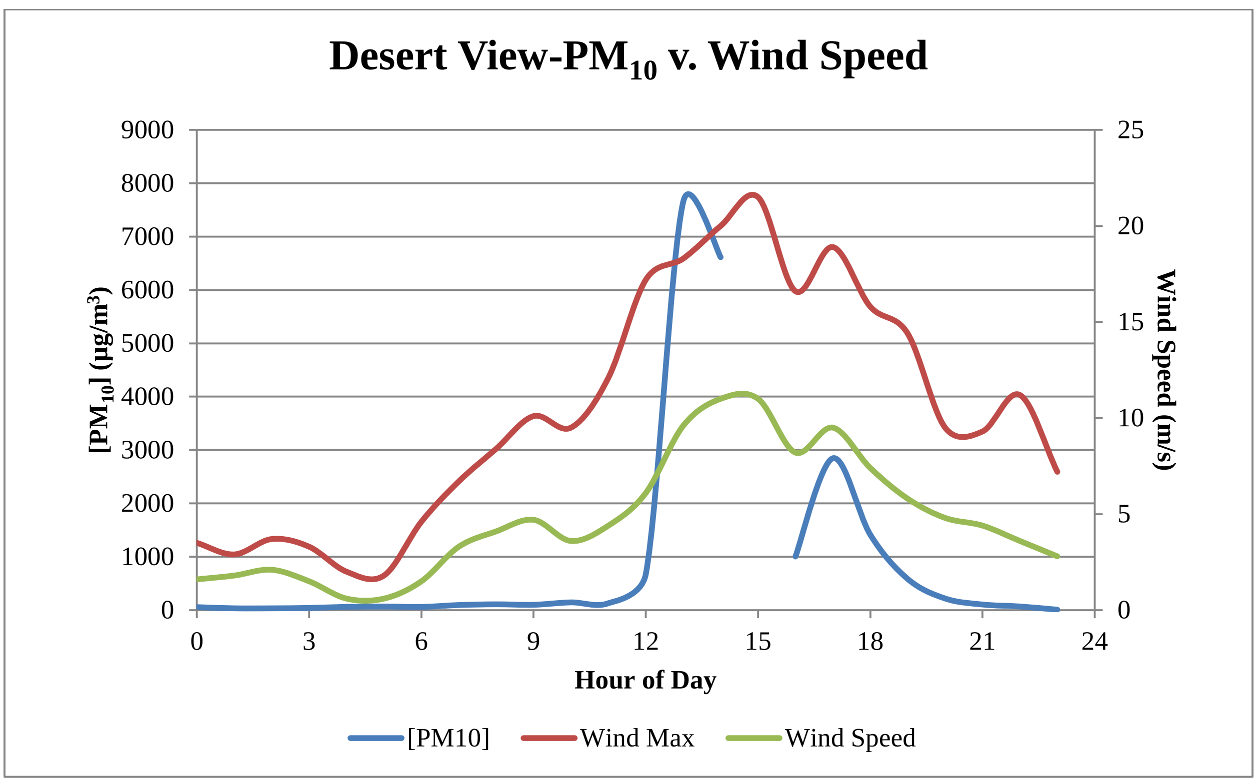


Figure 11-12d. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

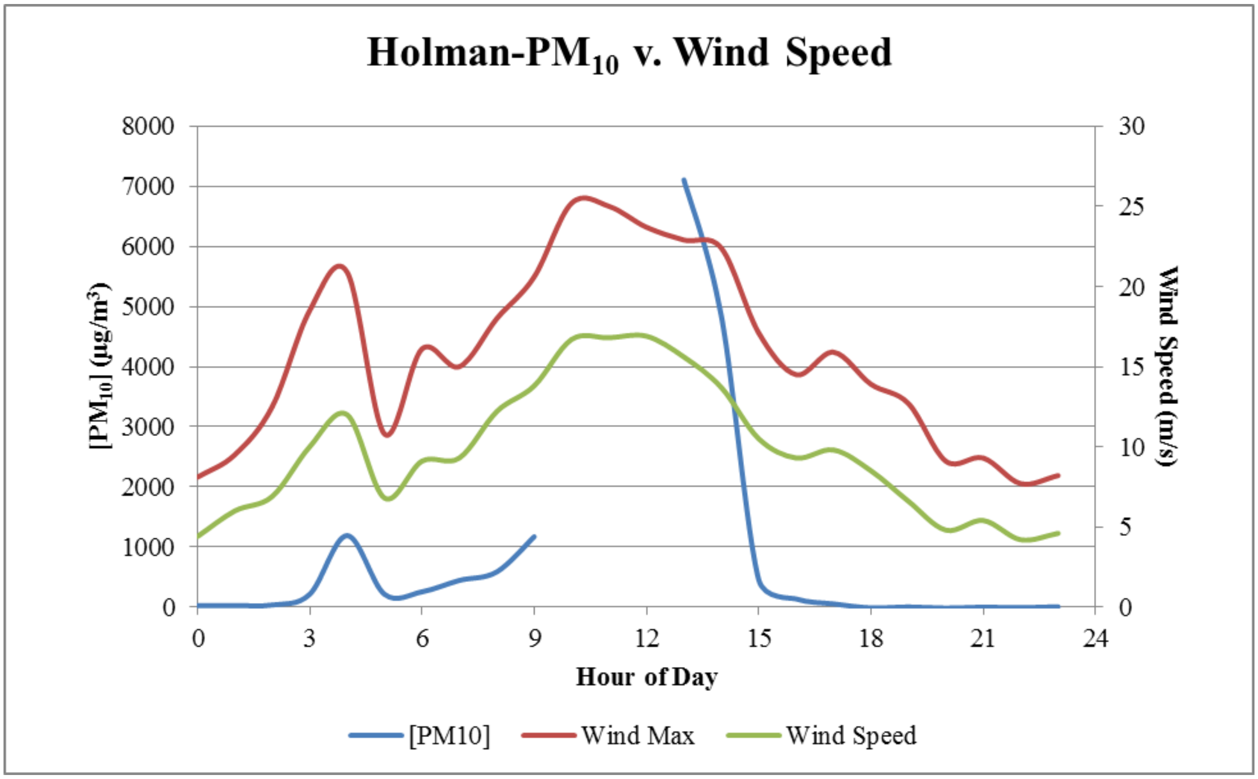


Figure 11-12e. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

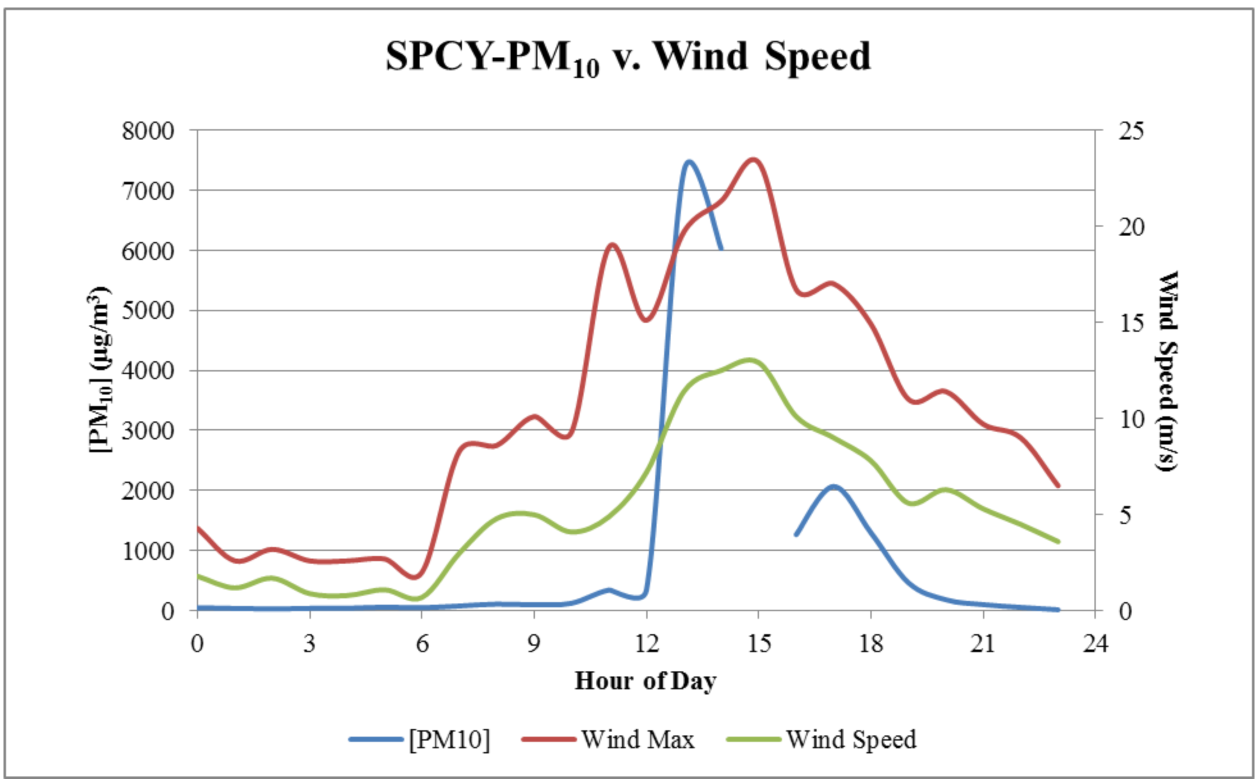


Figure 11-12f. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

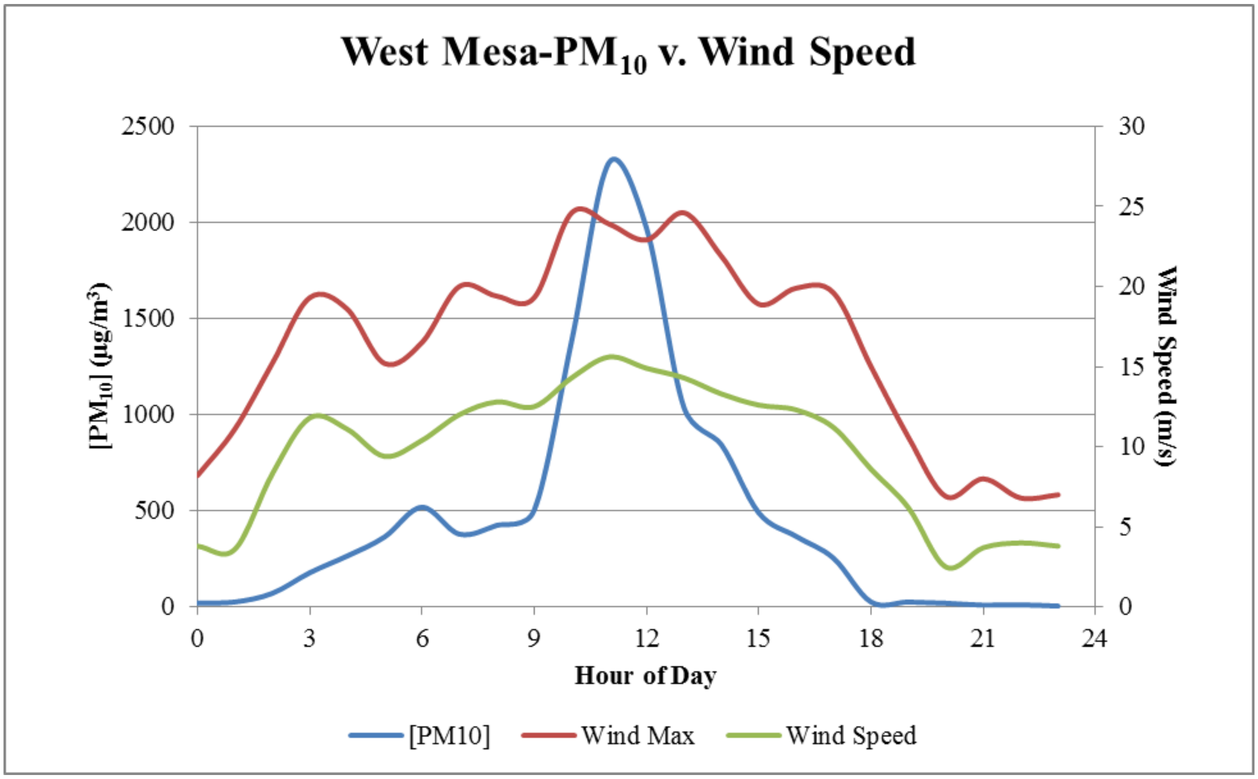


Figure 11-12g. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

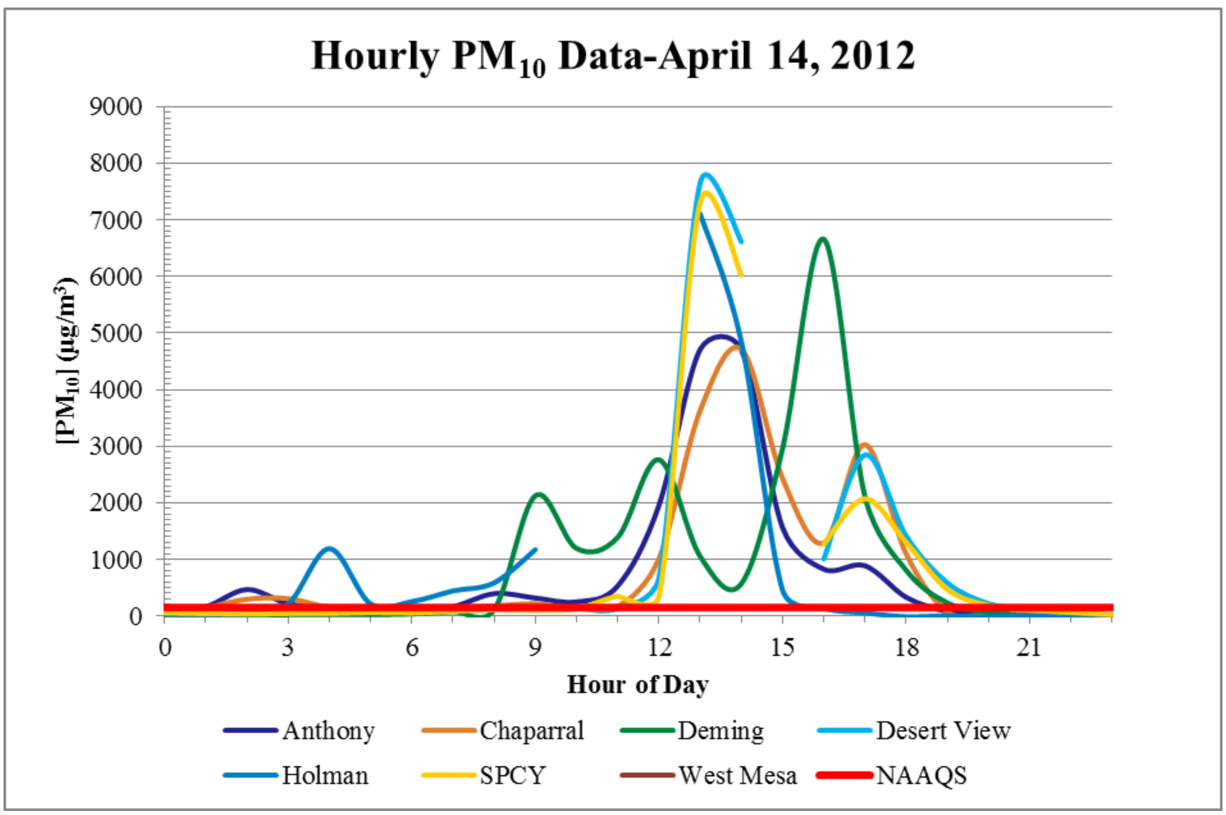


Figure 11-13a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

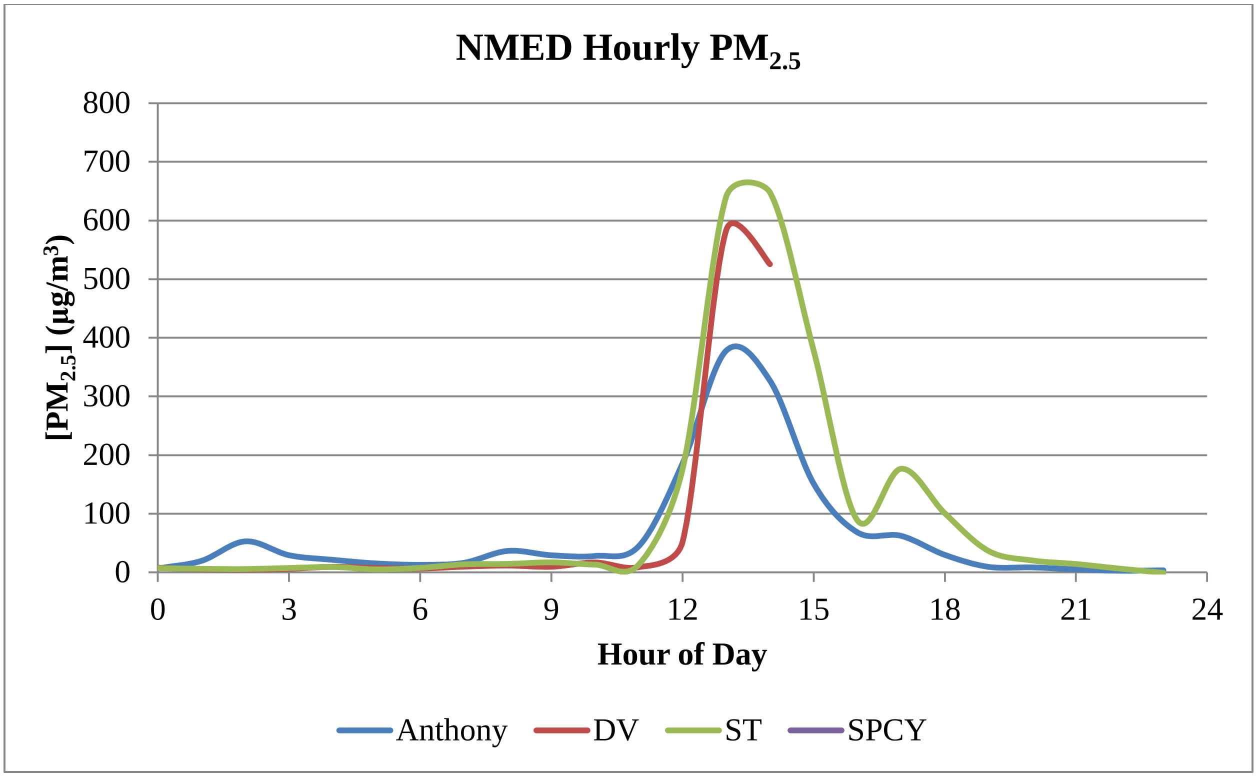


Figure 11-13b. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

The NWS issued a high wind warning, high wind advisory and a blowing dust advisory on this date stating that:

> A LARGE AND VIGOROUS PACIFIC STORM SYSTEM WILL SLOWLY SWING THROUGH THE SOUTHWESTERN U.S. TODAY. THE SYSTEM WILL TIGHTEN PRESSURE GRADIENTS AS IT APPROACHES THIS MORNING INDUCING STRONG WINDS WHICH WILL RESULT IN WIDESPREAD BLOWING DUST. THIS MORNING WINDS WILL STRENGTHEN AS THE SYSTEM NEARS. THESE STRONGER WINDS WILL HELP CREATE AREAS OF DENSE BLOWING DUST THIS AFTERNOON. THE BLOWING DUST AND WIND WILL MAKE DRIVING CONDITIONS VERY HAZARDOUS THIS AFTERNOON AND EVENING. WINDS WILL DIMINISH AFTER SUNSET WHICH WILL ALLOW THE BLOWING DUST TO SETTLE BACK TO THE GROUND (NWS, 2012).

The NM Border Air Quality Blog reported on the event providing pictures (Figure 11-14) and stating:

> The 11 am reading of PM10 at the NMED West Mesa station was 2311 µg/m3, in the hazardous AQI category. The station also had 53 mph wind gusts during that hour. With air quality like it is, it is best to stay at home and limit your outside exposure as much as possible.
>
> The visibility is about 0.75 miles based on this image taken at 1 pm today from my porch on the east side of Las Cruces.

I also see that highways 11 (Deming to Columbus) and 180 (Deming to Silver City) are closed due to blowing dust limiting visibility. There are also warning signs on I-10 west of Las Cruces to the Arizona border due to high winds (DuBois, 2012).

Figure 11-14. View of east Las Cruces at the 1300 hour (Photo courtesy of D. DuBois).

11.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on April 14, 2012.

11.6 Natural Event

The Clear Causal Relationship and not Reasonably Controllable or Preventable analyses show that this was a natural event caused by high wind and blowing dust.

11.7 No Exceedance but for the Event

The SPCY $PM_{2.5}$ monitor detected elevated levels due to blowing dust on April 14, 2012. These elevated concentrations resulted in exceedances of the 24-hour and annual NAAQS for $PM_{2.5}$ (101.6 µg/m^3). The strong correlation between hourly $PM_{2.5}$, PM_{10} and wind speeds peaks also point to windblown dust affecting the monitor. Previous studies have shown that $PM_{2.5}/PM_{10}$ ratios vary from 0.11 to 0.45 in the Paso del Norte Airshed (Arimoto et. al, 2001; Li et al, 2001). The ratios above 0.30 were observed in downtown El Paso and Ciudad Juárez and indicate a heavy impact from mobile sources. The lower ratios were observed in areas with less vehicular traffic and crustal material dominated the PM_{10} fraction. The $PM_{2.5}/PM_{10}$ ratio for the SPCY site was 0.12 for this date ($PM_{2.5}$ Partisol/PM_{10} TEOM). NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

The Anthony monitor detected blowing dust around the 0800 hour with hourly concentrations heavily impacted until the 1800 hour. Two single hourly PM_{10} values (1300 and 1400 hours) alone, exceed the 24-hour average standard at Anthony. The highest hourly value (1300 hour) at Anthony produced a 24-hour average of 196 µg/m^3 (4711 µg/m^3/24 = 196 µg/m^3). By replacing the eleven hourly values impacted by blowing dust with the 95th percentile of hourly data at the Anthony site, the resulting 24-hour average (135 µg/m^3) does not exceed the NAAQS (Table 11-1). The values in red represent the 95th percentile of all hourly data collected at Anthony, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	49	49
1	161	161
2	466	466
3	215	215
4	146	146
5	97	97
6	89	89
7	164	164
8	395	**111**
9	317	**92**
10	249	**100**
11	531	**115**
12	1954	**144**
13	4711	**164**
14	4704	**194**
15	1558	**194**
16	826	**157**
17	887	**194**
18	329	**194**
19	82	82
20	39	39
21	30	30
22	28	28
23	17	17
24-Hour Average	751	**135**

Table 11-1. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Anthony.

The Chaparral monitor detected blowing dust around the 0800 hour with hourly concentrations heavily impacted until the 1800 hour. One single hourly PM_{10} values (1400 hours) alone, exceeds the 24-hour average standard at Chaparral. This hourly value gives a 24-hour average of 196 $\mu g/m^3$ (4715 $\mu g/m^3/24 = 196\ \mu g/m^3$). By replacing the eleven hourly values impacted by blowing dust with the 95th percentile of hourly data at the Chaparral site, the resulting 24-hour average (115 $\mu g/m^3$) does not exceed the NAAQS (Table 11-2). The values in red represent the 95th percentile of all hourly data collected at Chaparral, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	63	63
1	147	147
2	295	295
3	306	306
4	149	149
5	91	91
6	81	81
7	113	113
8	176	**83**
9	214	**75**
10	136	**83**
11	167	**97**
12	1015	**127**
13	3632	**181**
14	4715	**143**
15	2429	**163**
16	1289	**159**
17	3028	**141**
18	1097	**127**
19	72	72
20	28	28
21	14	14
22	15	15
23	10	10
24-Hour Average	803	**115**

Table 11-2. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Chaparral.

The Deming monitor detected blowing dust around the 0900 hour with hourly concentrations heavily impacted until the 1800 hour. One single hourly PM_{10} values (1600 hour) alone, exceeds the 24-hour average standard at Deming. This hourly value gives a 24-hour average of 277 $\mu g/m^3$ (6659 $\mu g/m^3/24 = 277\ \mu g/m^3$). By replacing the ten hourly values impacted by blowing dust with the 95th percentile of hourly data at the Deming site, the resulting 24-hour average (59 $\mu g/m^3$) does not exceed the NAAQS (Table 11-3). The values in red represent the 95th percentile of all hourly data collected at Deming, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	20	20
1	22	22
2	19	19
3	21	21
4	21	21
5	25	25
6	34	34
7	79	79
8	109	109
9	2125	**63**
10	1192	**63**
11	1391	**67**
12	2763	**82**
13	1053	**109**
14	570	**121**
15	2963	**115**
16	6659	**127**
17	2105	**106**
18	807	**93**
19	230	**79**
20	62	62
21	-7	-7
22	-17	-17
23	13	13
24-Hour Average	927	**59**

Table 11-3. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Deming.

The Desert View monitor detected blowing dust around the 1200 hour with hourly concentrations heavily impacted until the 2000 hour. Two single hourly PM_{10} values (1300 and 1400 hours) alone, exceed the 24-hour average standard at Desert View. The highest hourly value (1300 hour) at Desert View gives a 24-hour average of 318 $\mu g/m^3$ (7654 $\mu g/m^3$/24 = 318 $\mu g/m^3$). By replacing the nine hourly values impacted by blowing dust with the 95th percentile of hourly data at the Desert View site, the resulting 24-hour average (96 $\mu g/m^3$) does not exceed the NAAQS (Table 11-4). The values in red represent the 95th percentile of all hourly data collected at Desert View, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	56	56
1	34	34
2	34	34
3	41	41
4	61	61
5	67	67
6	60	60
7	95	95
8	109	109
9	100	100
10	145	145
11	130	130
12	676	**99**
13	7654	**105**
14	6614	**132**
15	n/a	**136**
16	1004	**138**
17	2846	**166**
18	1414	**141**
19	584	**142**
20	218	**120**
21	105	105
22	68	68
23	8	8
24-Hour Average	961	**96**

Table 11-4. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Desert View.

The Holman monitor detected blowing dust around the 0300 hour with hourly concentrations heavily impacted until the 1500 hour. Two single hourly PM_{10} values (1300 and 1400 hours) alone, exceed the 24-hour average standard at Holman. The highest hourly value (1300 hour) at Holman gives a 24-hour average of 296 µg/m^3 (7108 µg/m^3/24 = 296 µg/m^3). By replacing the thirteen hourly values impacted by blowing dust with the 95th percentile of hourly data at the Holman site, the resulting 24-hour average (52 µg/m^3) does not exceed the NAAQS (Table 11-5). The values in red represent the 95th percentile of all hourly data collected at Holman, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	21	21
1	25	25
2	34	34
3	211	**41**
4	1189	**61**
5	212	**67**
6	253	**60**
7	443	**95**
8	584	**109**
9	1171	**100**
10	n/a	**145**
11	n/a	**130**
12	n/a	**99**
13	7108	**105**
14	4846	**132**
15	454	**136**
16	134	134
17	53	53
18	-14	-14
19	1	1
20	-18	-18
21	-2	-2
22	-11	-11
23	5	5
24-Hour Average	794	**52**

Table 11-5. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Holman.

The SPCY monitor detected blowing dust around the 1100 hour with hourly concentrations heavily impacted until the 1900 hour. Two single hourly PM_{10} values (1300 and 1400 hours) alone, exceed the 24-hour average standard at SPCY. The highest hourly value (1300 hour) at SPCY gives a 24-hour average of 304 $\mu g/m^3$ (7310 $\mu g/m^3/24$ = 304 $\mu g/m^3$). By replacing the nine hourly values impacted by blowing dust with the 95th percentile of hourly data at the SPCY site, the resulting 24-hour average (122 $\mu g/m^3$) does not exceed the NAAQS (Table 11-6). The values in red represent the 95th percentile of all hourly data collected at SPCY, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	53	53
1	41	41
2	33	33
3	43	43
4	44	44
5	63	63
6	53	53
7	83	83
8	113	113
9	102	102
10	128	128
11	348	**111**
12	348	**144**
13	7310	**164**
14	6022	**185**
15	n/a	**205**
16	1268	**203**
17	2069	**211**
18	1299	**296**
19	468	**279**
20	186	186
21	105	105
22	60	60
23	20	20
24-Hour Average	880	**122**

Table 11-6. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at SPCY.

The West Mesa monitor detected blowing dust around the 0300 hour with hourly concentrations heavily impacted until the 1700 hour. Two hourly PM_{10} values from 1100-1200 hours alone, exceed the 24-hour average standard at Holman [(2311 + 1971) µg/m^3 = 4282 µg/m^3; (4282 µg/m^3)/24 = 178 µg/m^3]. By replacing the fifteen hourly values impacted by blowing dust with the 95th percentile of hourly data at the West Mesa site, the resulting 24-hour average (43 µg/m^3) does not exceed the NAAQS (Table 11-7). The values in red represent the 95th percentile of all hourly data collected at West Mesa, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	21	21
1	26	26
2	71	71
3	178	**178**
4	265	**265**
5	364	**364**
6	519	**519**
7	379	**379**
8	425	**425**
9	503	**503**
10	1383	**128**
11	2311	**111**
12	1971	**144**
13	1038	**164**
14	845	**185**
15	490	**205**
16	367	**203**
17	254	**211**
18	26	26
19	26	26
20	20	20
21	10	10
22	11	11
23	5	5
24-Hour Average	479	**43**

Table 11-7. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at West Mesa.

12 HIGH WIND EXCEPTIONAL EVENT: April 26, 2012

12.1 Summary of Event

The passing of a Pacific cold front caused high winds and blowing dust in Doña Ana and Luna Counties resulting in exceedances of the PM_{10} and $PM_{2.5}$ 24-hour NAAQS and the $PM_{2.5}$ annual NAAQS at the Anthony, Chaparral, Deming, Holman, Desert View, and Sunland Park monitoring sites on April 26, 2012. The FEM TEOM continuous monitors at Anthony, Chaparral, Deming, Holman, and Desert View sites recorded 24-hour average concentrations of 259, 274, 198, 464, and 408, $\mu g/m^3$, respectively. The FRM Partisol monitor at Sunland Park recorded a 24-hour average concentration of 64.1 $\mu g/m^3$. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured at West Mesa (105 $\mu g/m^3$) (Figure 12-1). The averages in this figure were calculated using PM_{10} FEM TEOM and $PM_{2.5}$ FRM Partisol instrument data for the four days before and after the event. Elevated concentrations were also recorded by the $PM_{2.5}$ non-FEM/FRM TEOMs (Figure 12-2). The PM_{10} and $PM_{2.5}$ TEOM monitors at SPCY did not record data on this date.

As the event unfolded, the wind blew from the Southwest direction throughout the border region. These high velocity winds passed over large areas of desert within Texas, New Mexico and Mexico. The co-occurrence of high winds and elevated levels of blowing dust, little to no point sources in the area, and the high hourly and daily PM_{10} and $PM_{2.5}$ concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

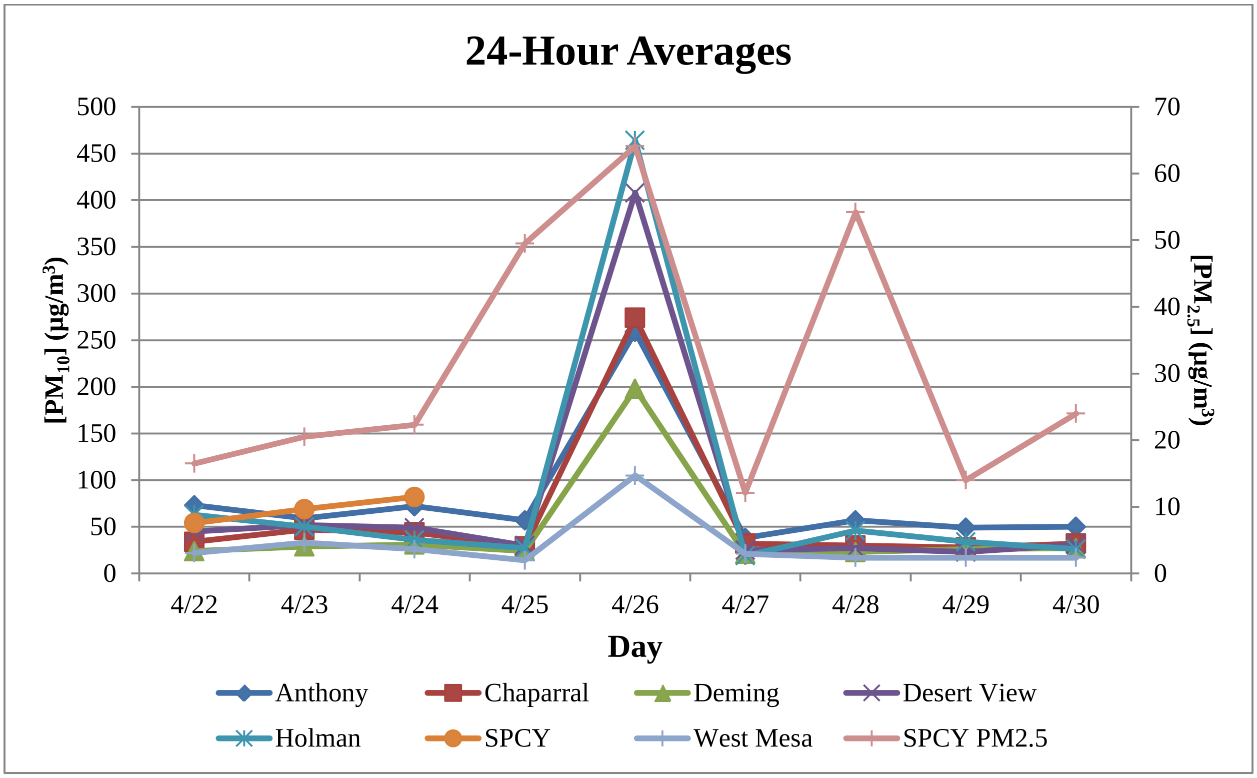


Figure 12-1 PM_{10} 24-hour averages before and after April 26, 2012

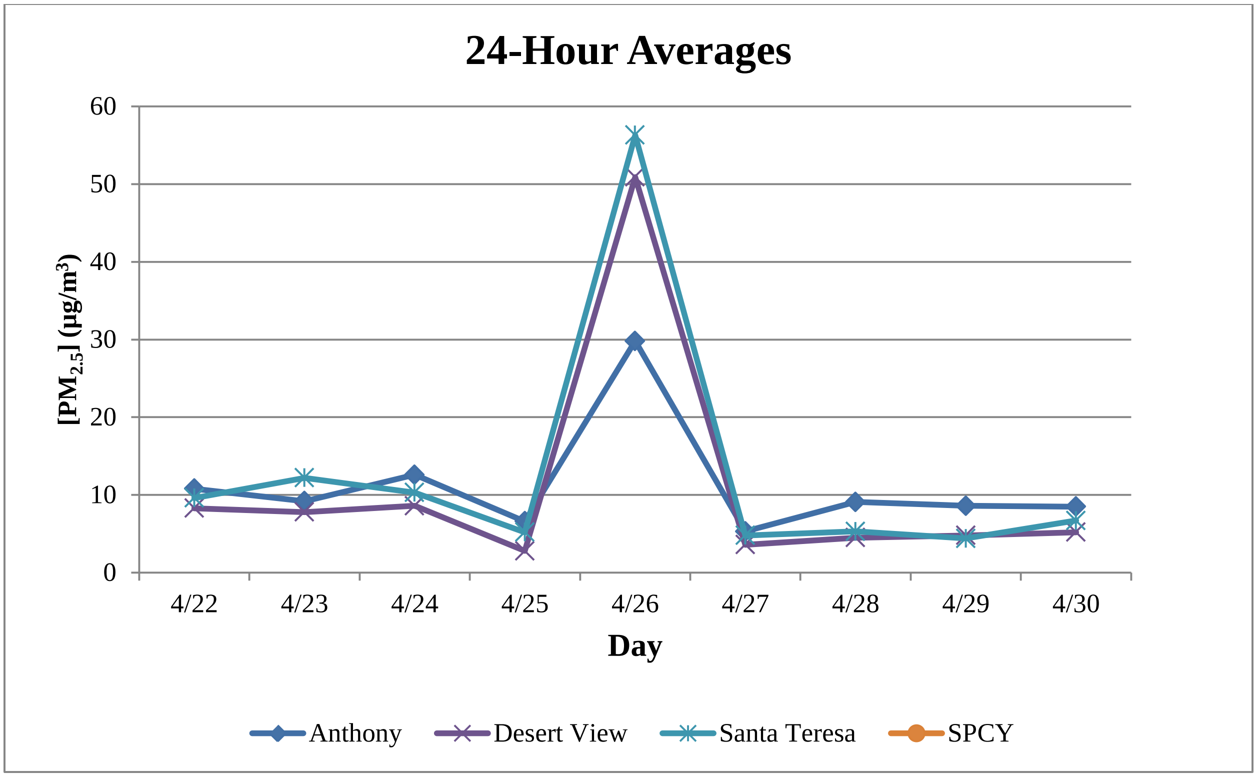


Figure 12-2 $PM_{2.5}$ 24-hour averages before and after April 26, 2012. Non-FEM TEOM Data

12.2 Is Not Reasonably Controllable or Preventable

12.2.1 Suspected Source Areas and Categories Contributing to the Event

Sources of windblown dust contributing to this exceedance include the natural desert, residential properties, agricultural land and unpaved roads in Mexico, Texas, and New Mexico. Agricultural tilling and crop planting may have contributed to this event. City of Las Cruces, City of Deming and Doña Ana and Luna Counties Ordinances requires BACM for any dust producing activities. The largest and most likely sources of windblown dust are the natural desert and the playas of northern Mexico (see Section 12.2.4 below).

12.2.2 Sustained and Instantaneous Wind Speeds

EPA uses a default entrainment threshold of sustained wind speeds at 11.2 m/s (25 mph) for natural and well controlled anthropogenic sources contributing to natural events caused by high wind and blowing dust (EPA, 2013). Under the Doña Ana and Luna County NEAPs, EPA and NMED agreed that wind gusts exceeding 18 m/s would overwhelm any natural and well-controlled anthropogenic sources and cause windblown dust. On April 26, 2012 sustained wind speeds exceeded EPA's default threshold at six of the eight monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at seven of the eight monitoring sites (Figures 12-3 and 12-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 1300 hour and ending at the 1800 hour.

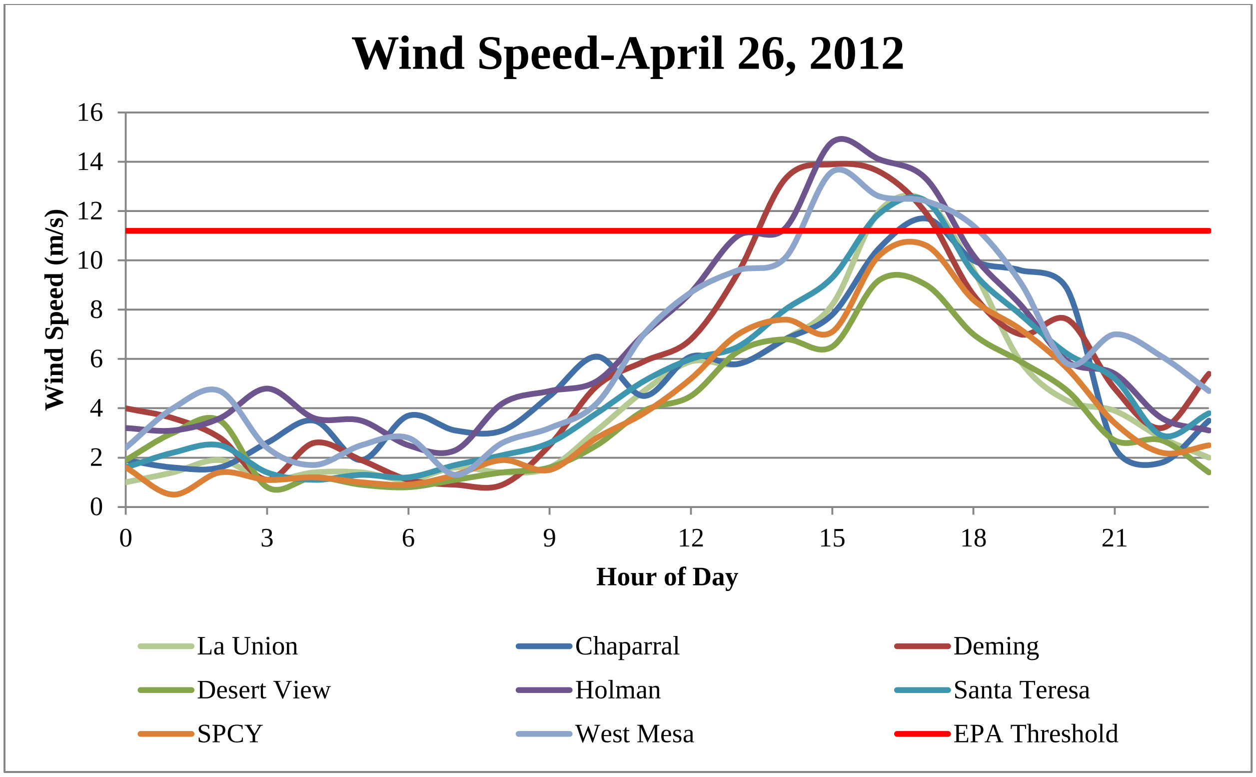


Figure 12-3 Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

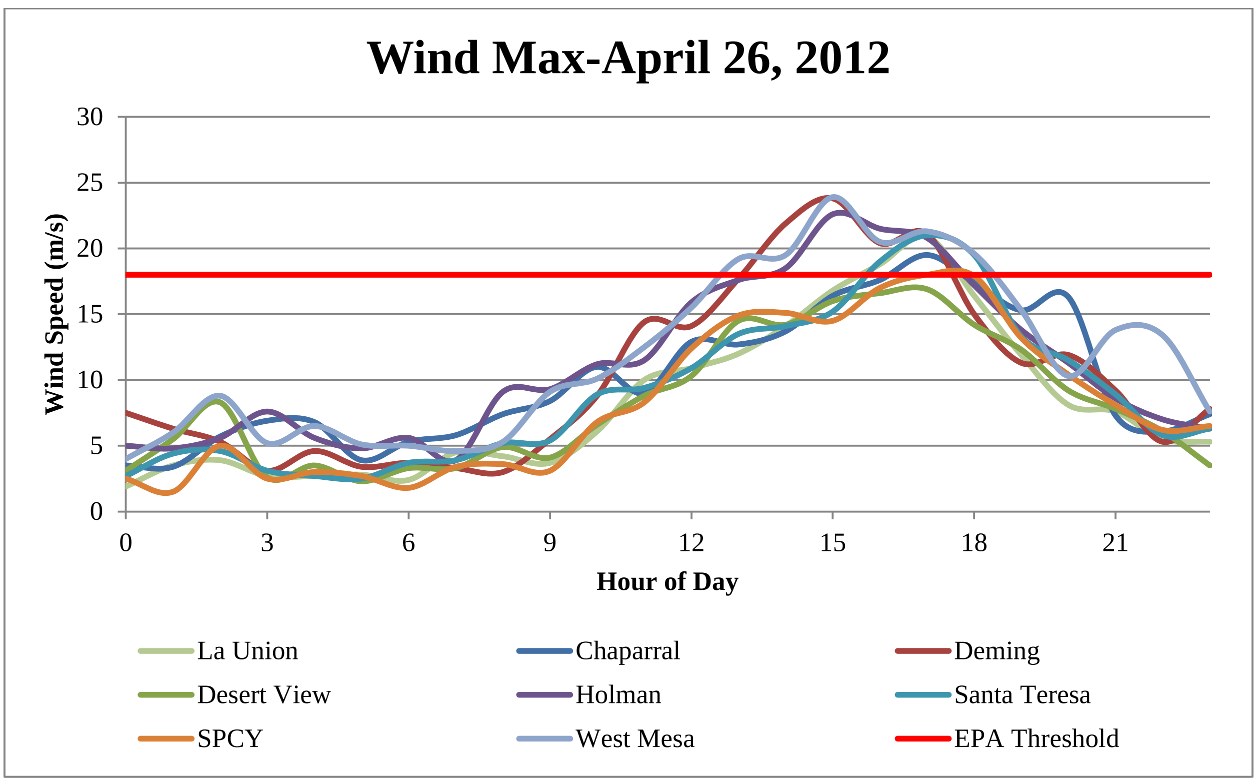


Figure 12-4 Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

12.2.3 Recurrence Frequency

The monitoring sites in Doña Ana and Luna Counties can record exceedances of the PM_{10} NAAQS throughout the year. From 2007-2011 the PM_{10} FEM TEOM monitors recorded 254 exceedances and the PM_{10} FRM Wedding monitors recorded 6 exceedances (Figure A-1). The Deming Airport and Desert View monitoring sites (FEM TEOMs) were established in 2006 and 2007 respectively and do not show exceedances until the year following startup. The SPCY $PM_{2.5}$ FRM Partisol recorded 37 exceedances of the 24-Hour NAAQS from 2007-2011 (Figure A-2). See appendix A for a more in-depth discussion about recurrence frequency and the number of exceedances at each monitoring site.

12.2.4 Controls Analysis

The local ordinances and MOUs adopted under the NEAP direct the implementation of BACM for sources of dust in Doña Ana and Luna Counties. The ordinances regulate disturbed lands, construction and demolition, vacant parking lots and materials handling and transportation. Our investigation did not identify any unusual PM_{10} producing activities on this day, and anthropogenic emissions remained constant before, during and after the event. The most likely source contributing to the event is the natural desert and playas in New Mexico, Texas, Arizona and northern Mexico. A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from Texas and Mexico to the monitors in Doña Ana and Luna Counties. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 12-5). Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in Texas, Arizona and Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

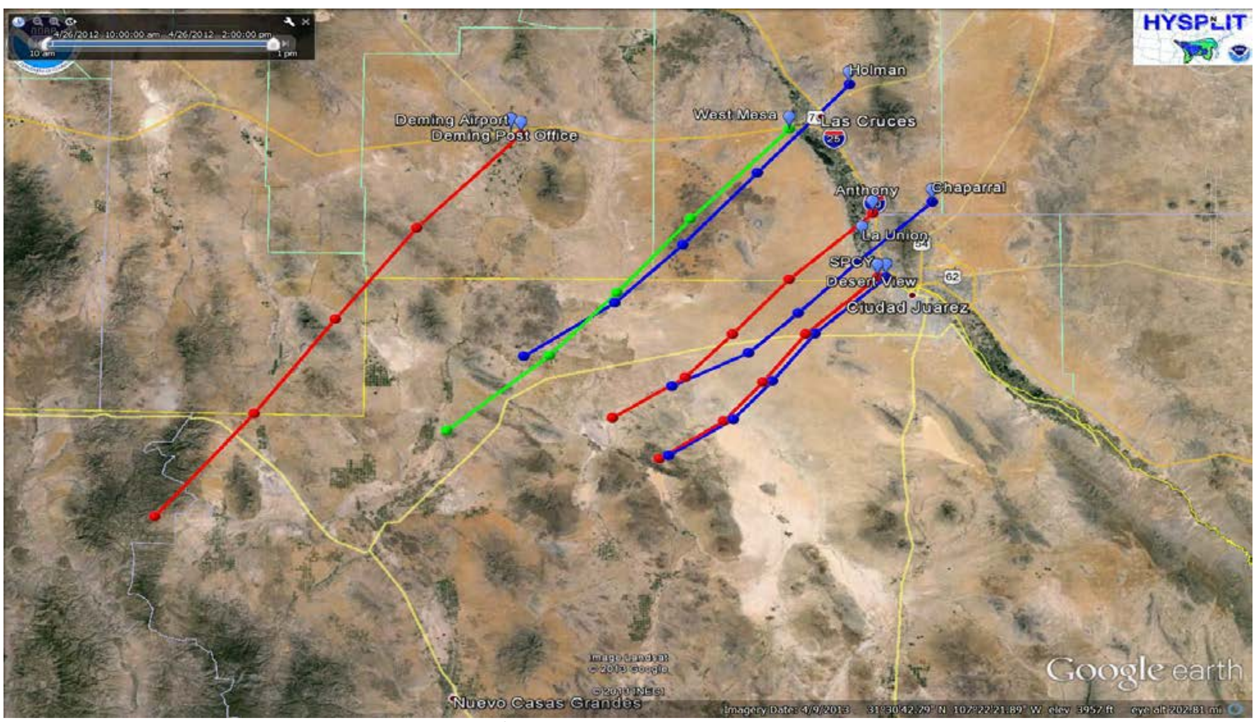


Figure 12-5 HYSPLIT back-trajectory model analysis for April 26, 2012.

12.3 Historical Fluctuations Analysis

12.3.1 Annual and Seasonal 24-hour Average Fluctuations

Since being established, the monitoring sites in Doña Ana and Luna Counties have recorded exceedances of the PM_{10} NAAQS. High winds cause these exceedances and they can occur at any time of year (Figure B-6 through B-13). Most exceedances occur from late winter through early summer (February-June) and are associated with the passage of Pacific cold fronts. High winds caused all recorded exceedances from 2007-2011 and NMED submitted natural events demonstrations to EPA under the NEAP or EER.

Since the 24-hour $PM_{2.5}$ NAAQS was lowered from 65 to 35 µg/m^3 in 2006, the SPCY Partisol monitor has routinely recorded exceedances of the standard. These exceedances occurred throughout the year during high and low wind conditions. In 2009, NMED investigated the cause of the low wind exceedances and found that emissions from Ciudad Juárez, Mexico contribute significantly to elevated concentrations. The high wind exceedances were caused by blowing dust on days when PM_{10} monitors also recorded exceedances.

Appendix B contains a more in-depth discussion about historical fluctuations and charts showing annual and seasonal trends at each monitoring site.

Table B-1 and B-2 show normal historical fluctuations with and without high wind natural events that caused exceedances from 2007-2011. The analysis excludes only those high wind events that resulted in an exceedance. Data for PM_{10} in this table includes FRM Wedding and FEM TEOM measurements and data for $PM_{2.5}$ comes from the FRM Partisol measurements from 2007-2011. The recorded values for this day 259, 274, 198, 464, and 408 µg/m^3 are above the maximum values recorded when no high wind exceedances are included and is above the 95th percentile of all 24-hour averages recorded.

An hourly data distribution analysis was performed for PM_{10} and $PM_{2.5}$ concentrations, wind speeds and wind gusts (Appendices C, D and E). All data used for the PM_{10} distribution charts come from the FEM TEOM monitors and the non-FEM/FRM $PM_{2.5}$ TEOM monitor at SPCY. Overlaying the hourly data for April 26, 2012 on the hourly data distribution plots shows that the values recorded during the high wind event exceed the 95th percentile for PM_{10}, $PM_{2.5}$, wind speed and wind gusts (Figures 12-6a-e through 12-8a-e). The top whiskers of the box and whisker plots represent the 95th percentile of data. The hourly PM_{10} values during the high wind blowing dust storm the historical 95th percentile of data.

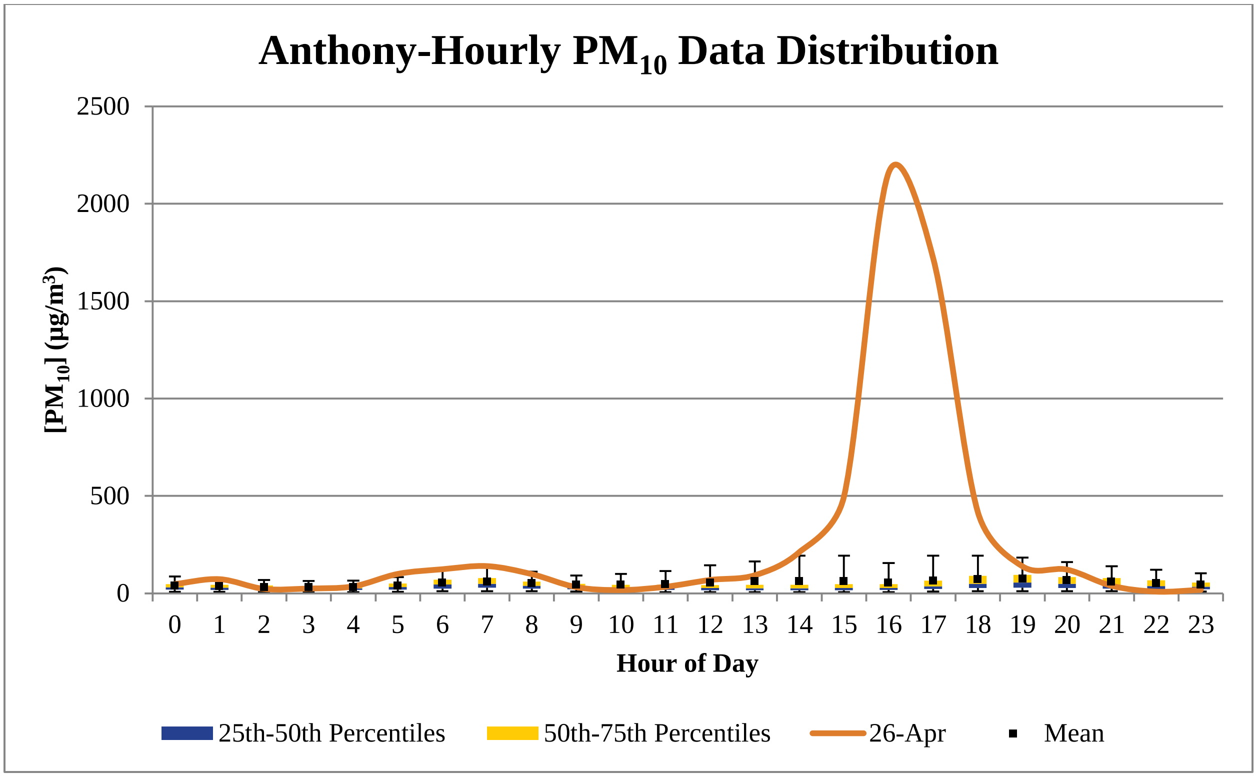


Figure 12-6a. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for April 26, 2012

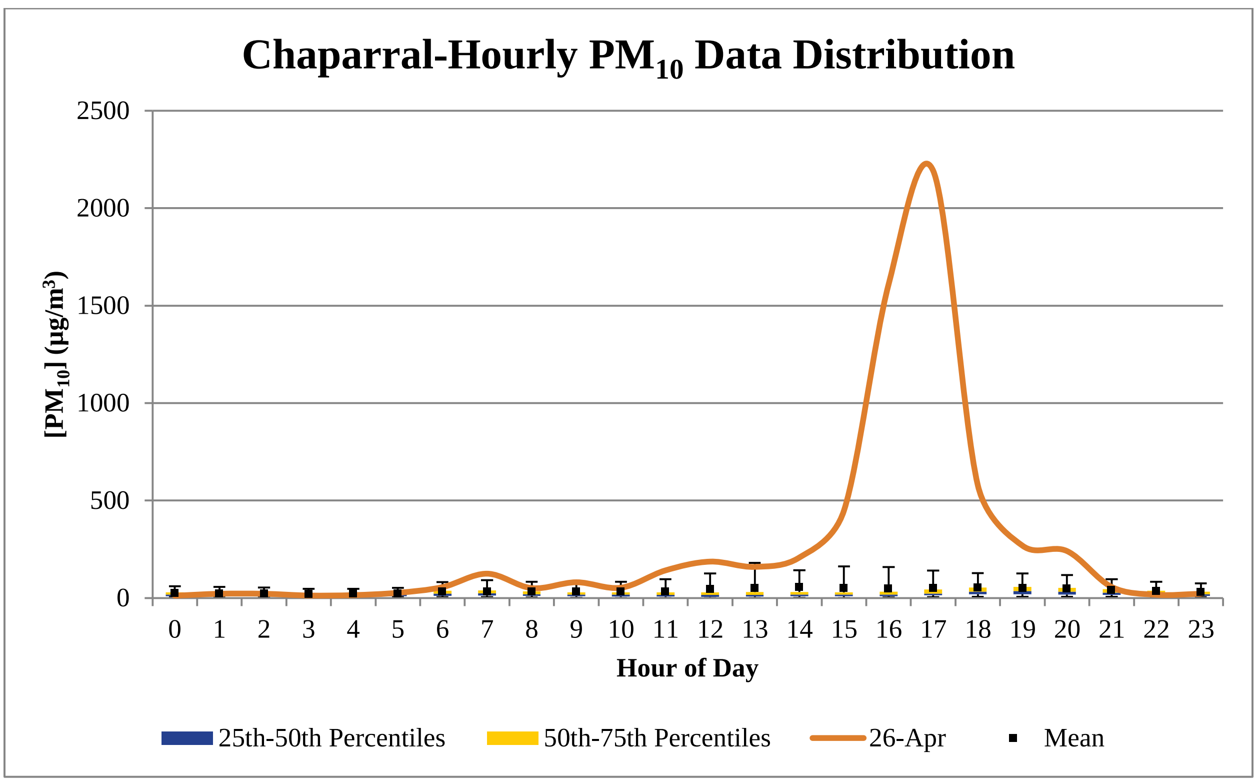


Figure 12-6b. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for April 26, 2012

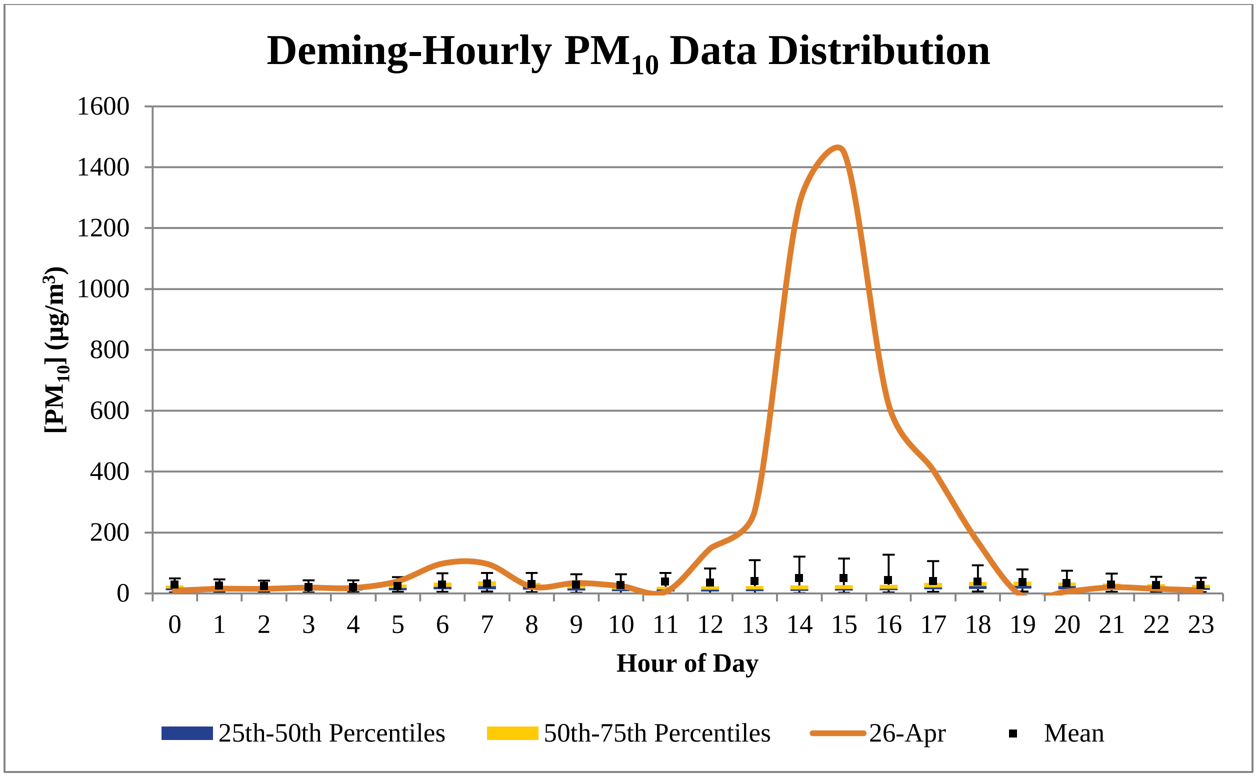


Figure 12-6c. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for April 26, 2012

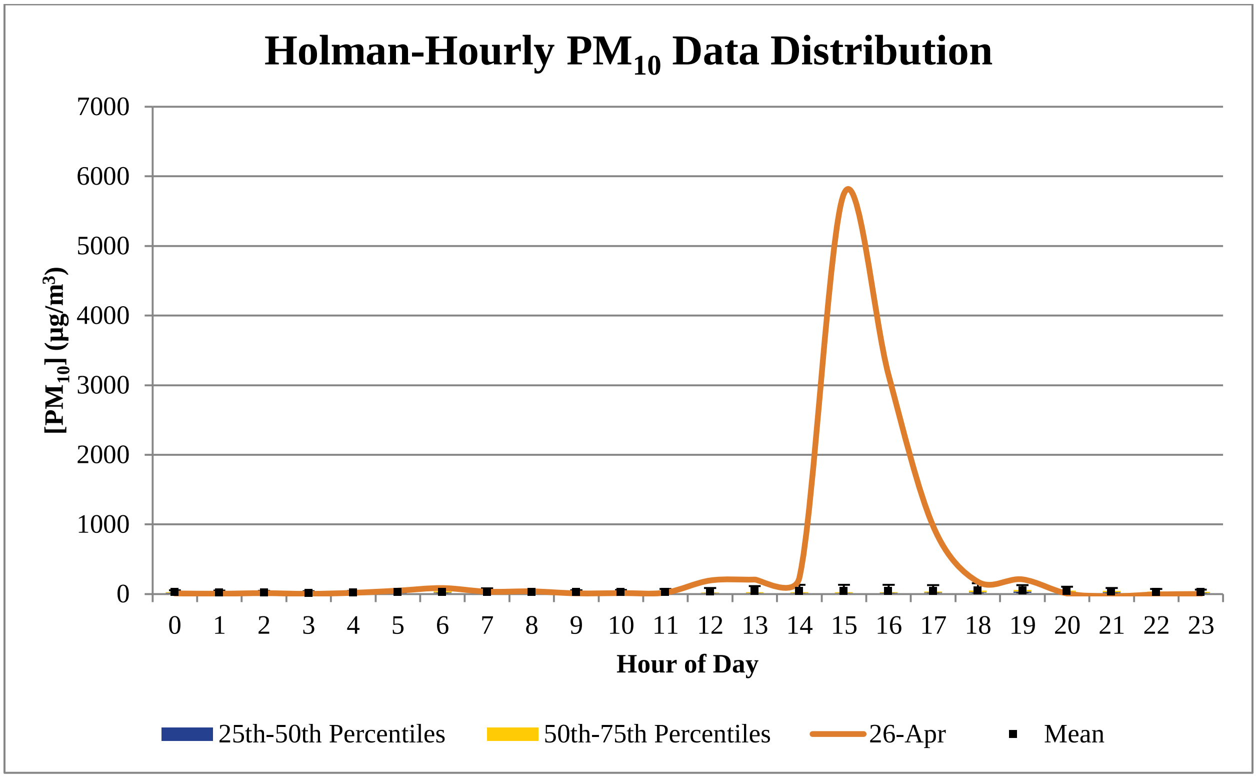


Figure 12-6d. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for April 26, 2012

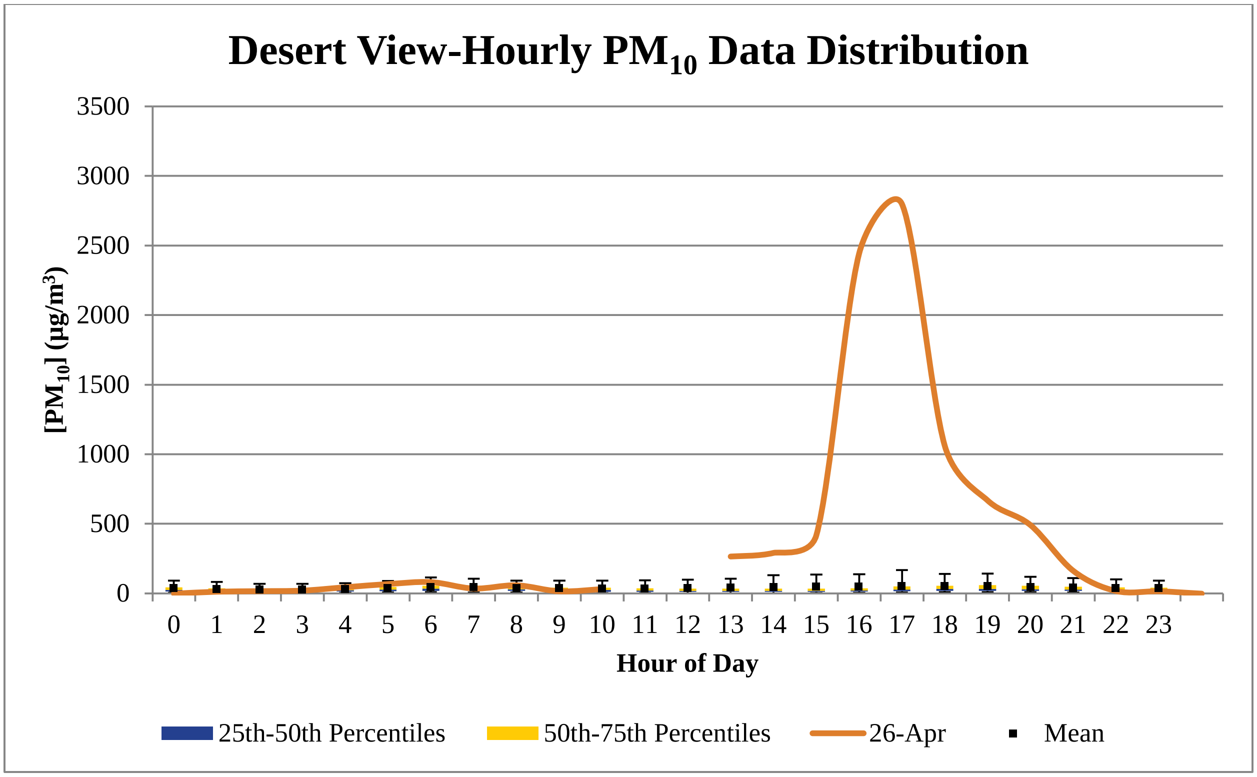


Figure 12-6e PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for April 26, 2012

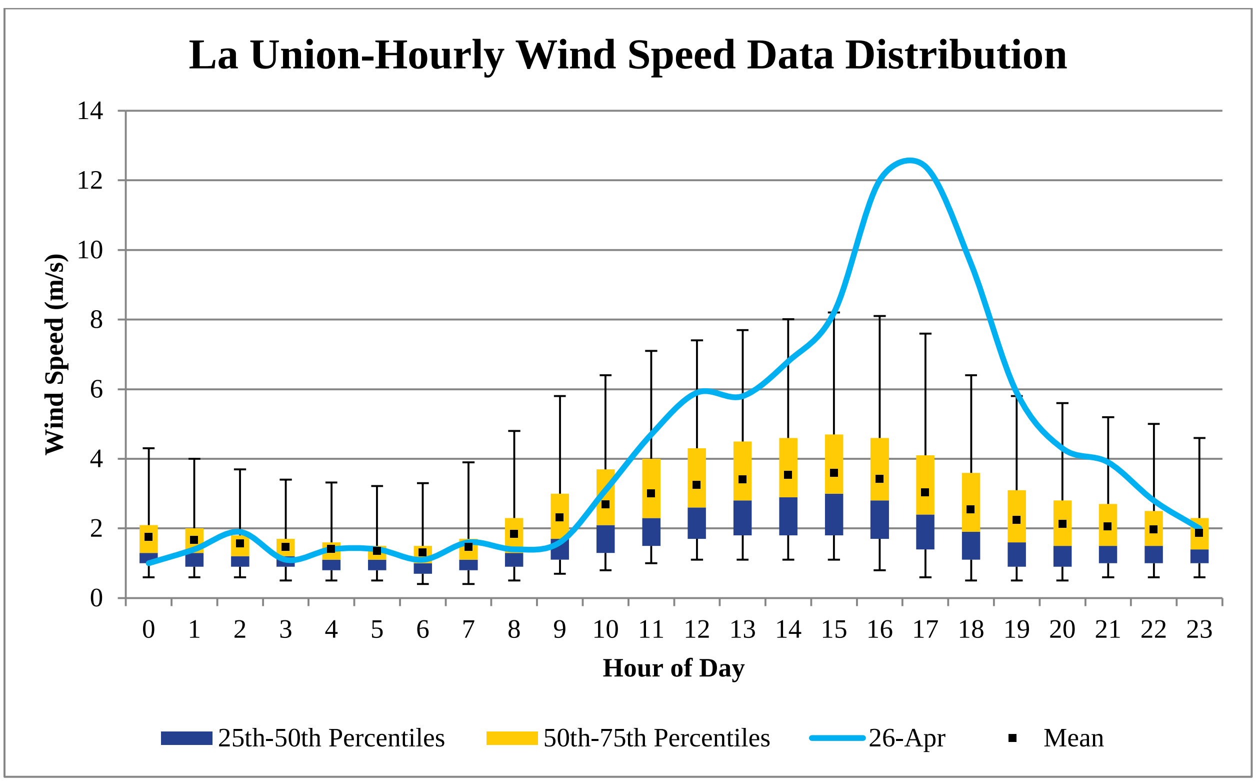


Figure 12-7a. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 26, 2012.

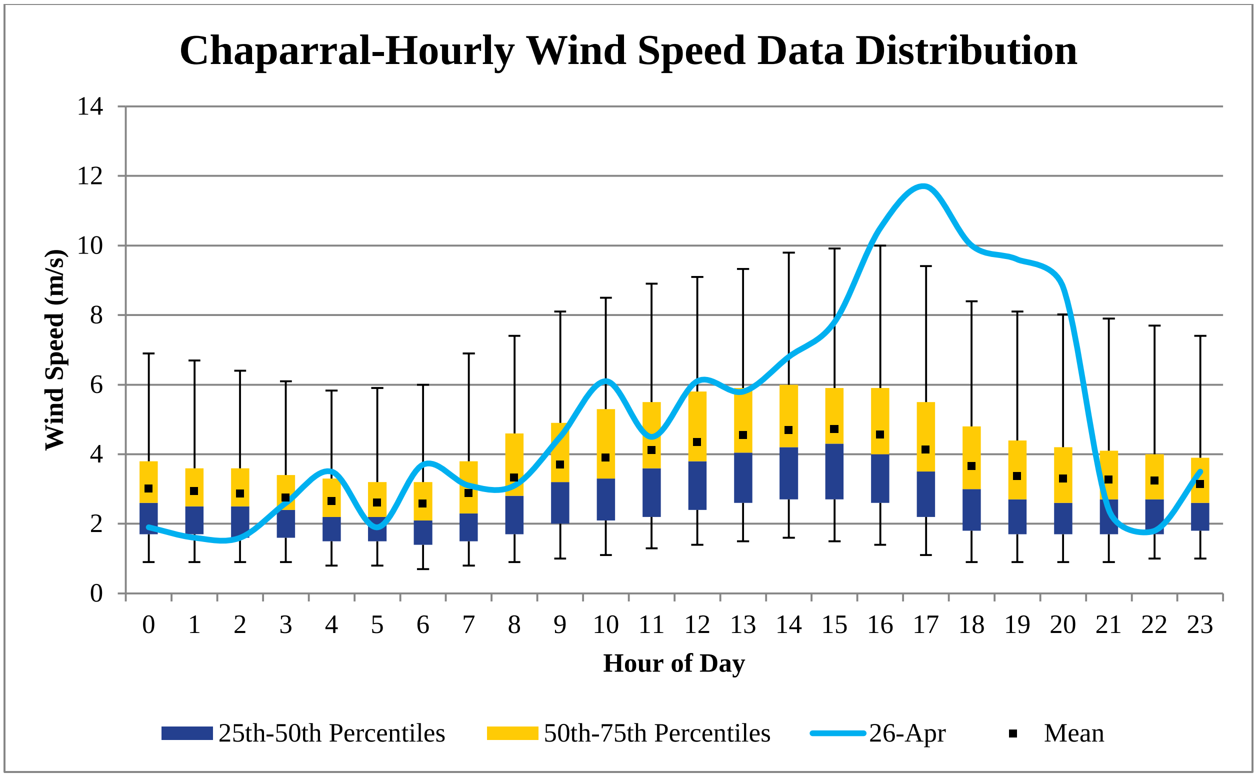


Figure 12-7b. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 26, 2012.

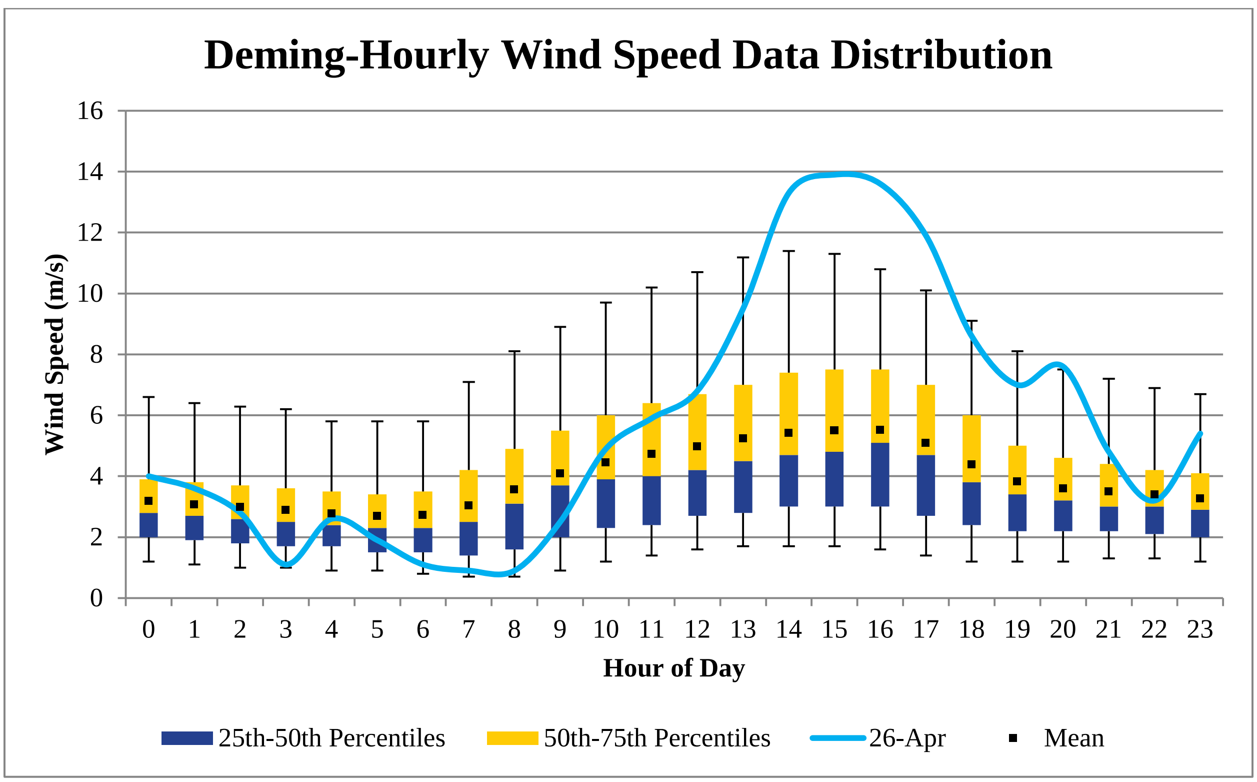


Figure 12-7c. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 26, 2012.

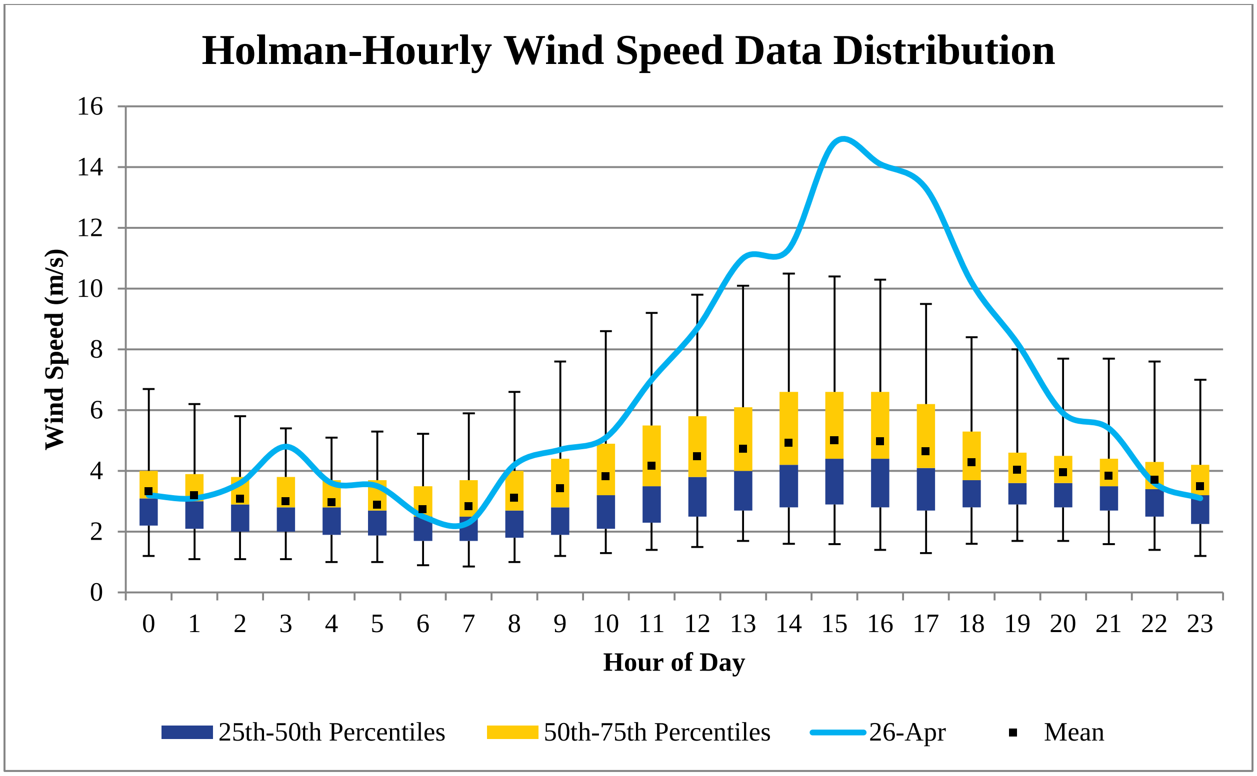


Figure 12-7d Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 26, 2012

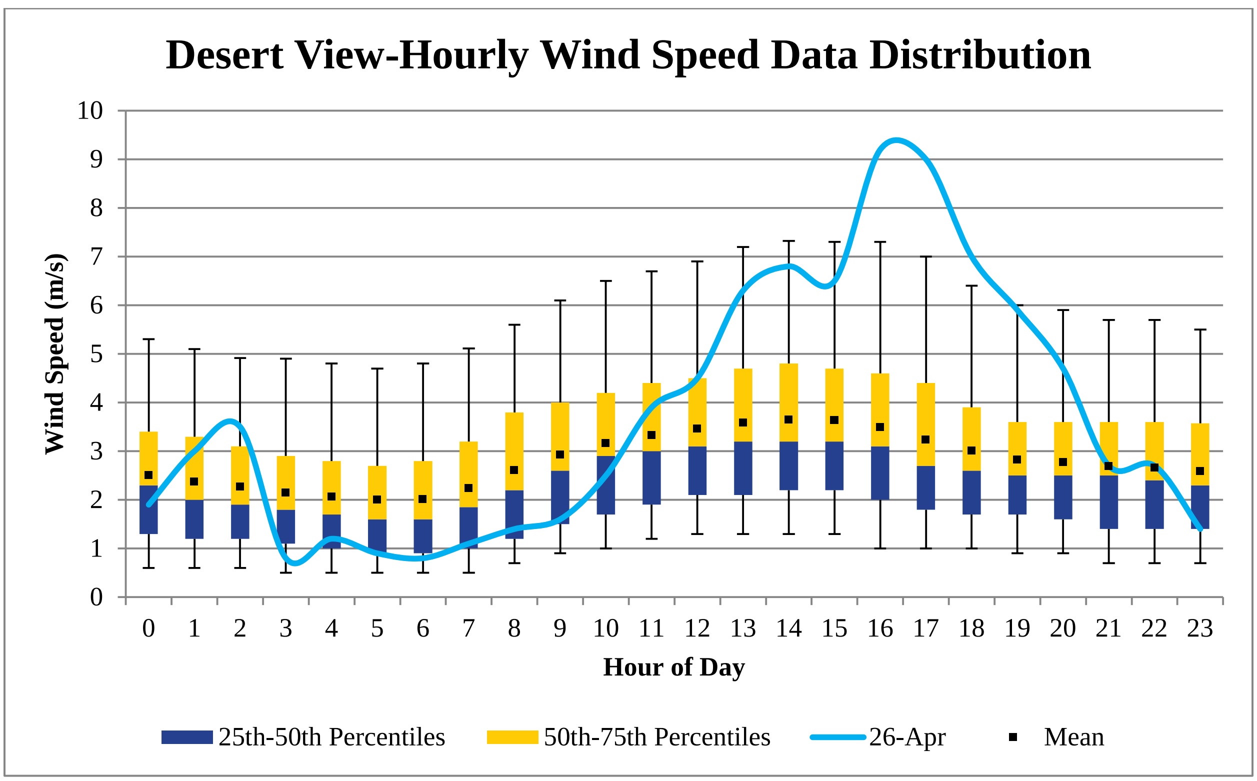


Figure 12-7e Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 26, 2012

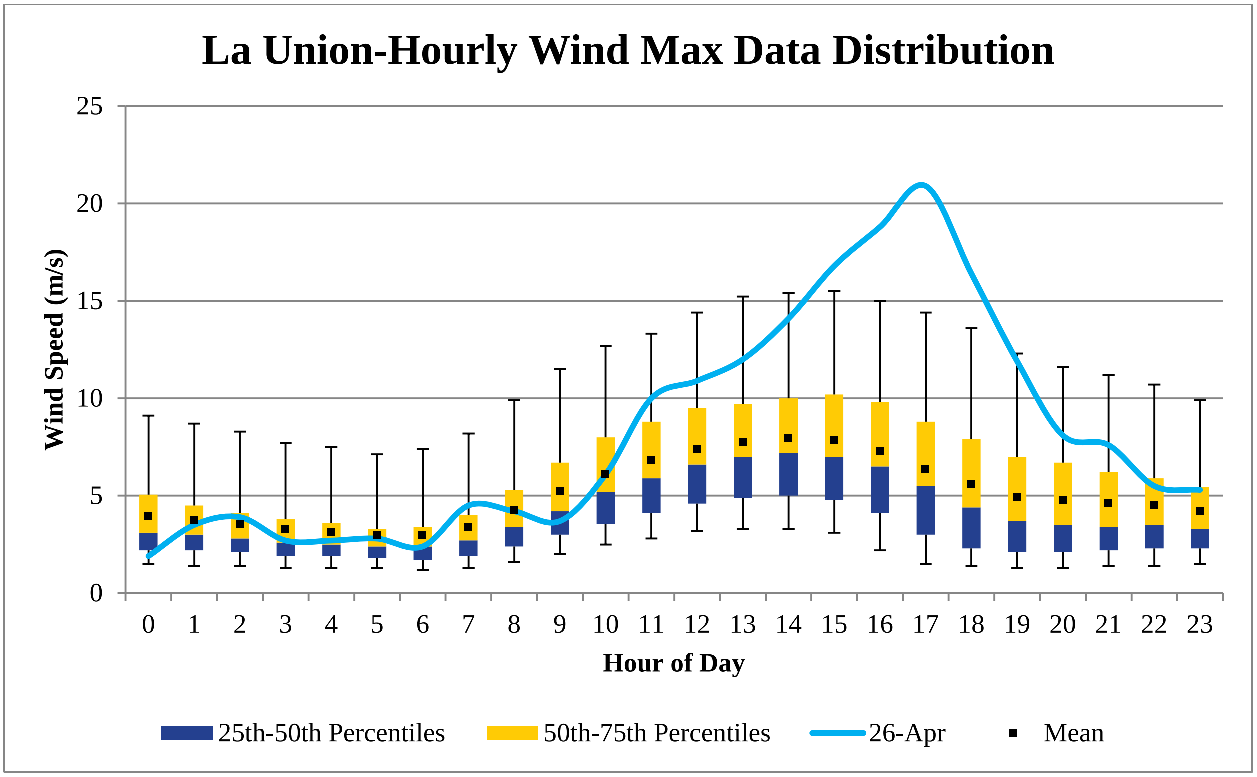


Figure 12-8a. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 26, 2012.

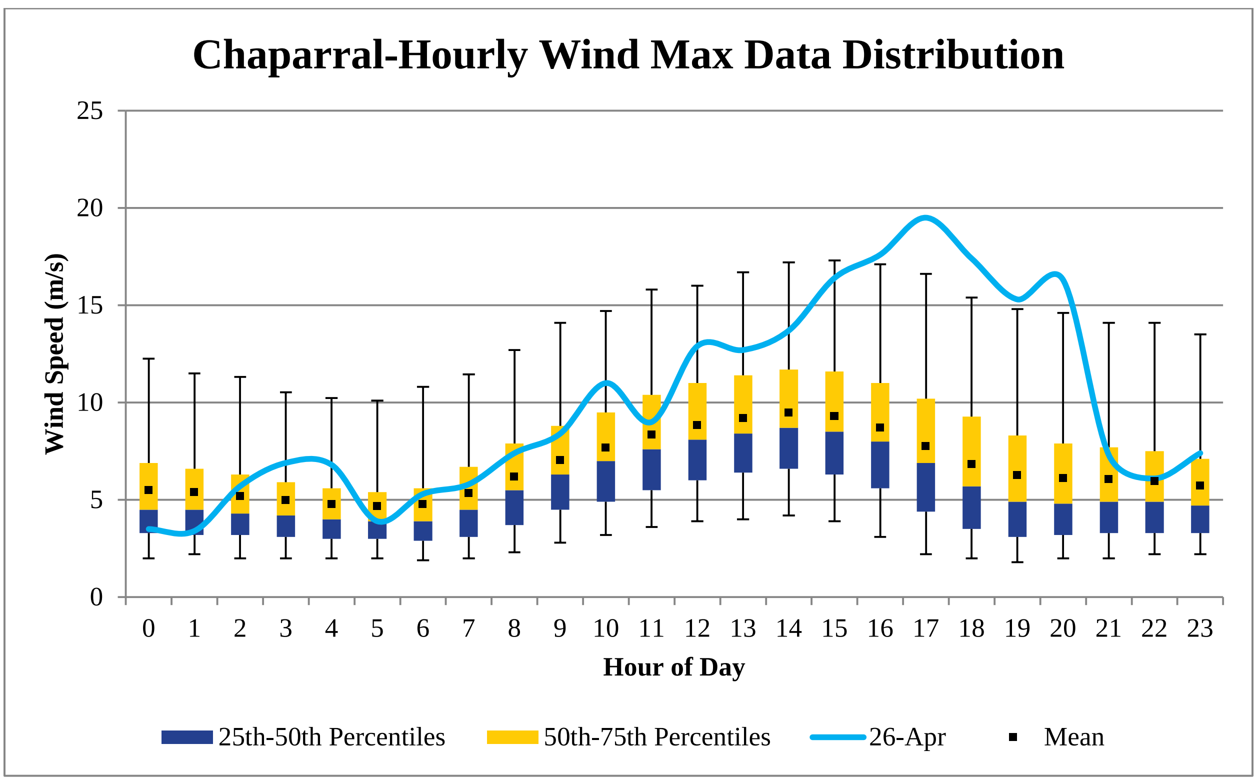


Figure 12-8b. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 26, 2012.

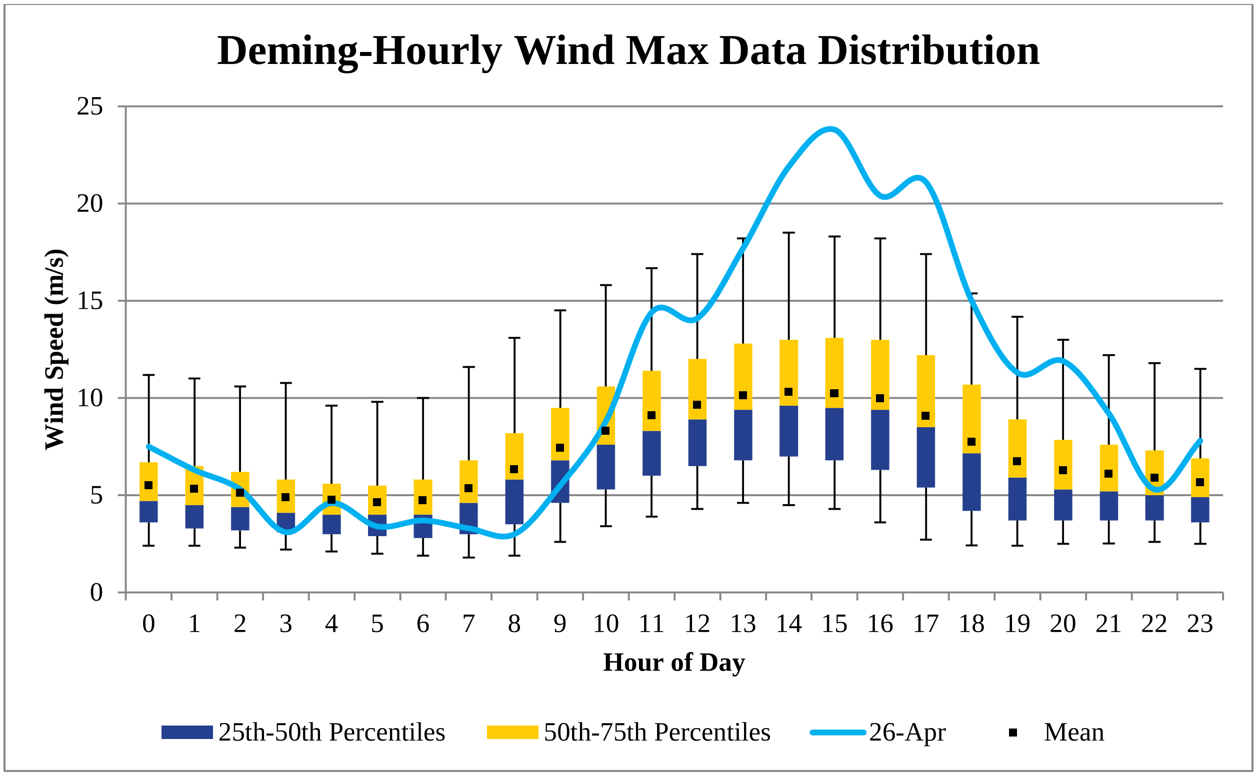


Figure 12-8c. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 26, 2012.

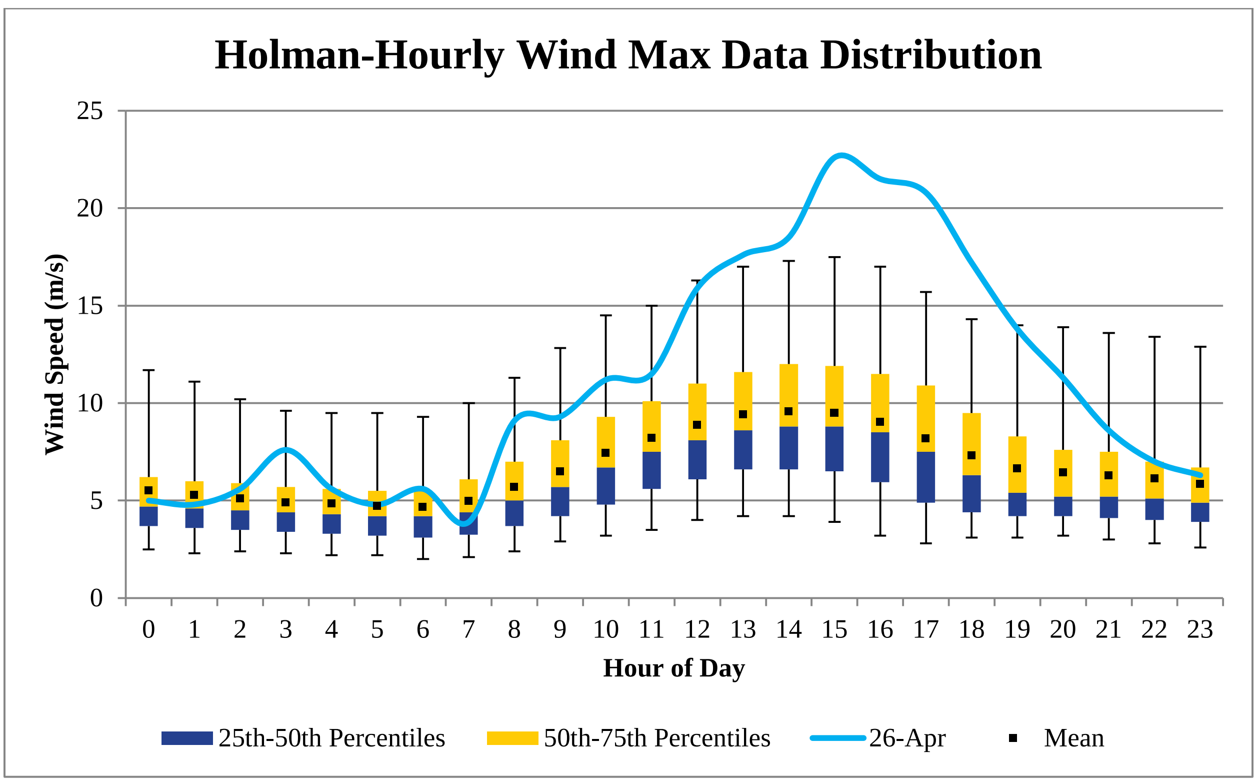


Figure 12-8d. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 26, 2012.

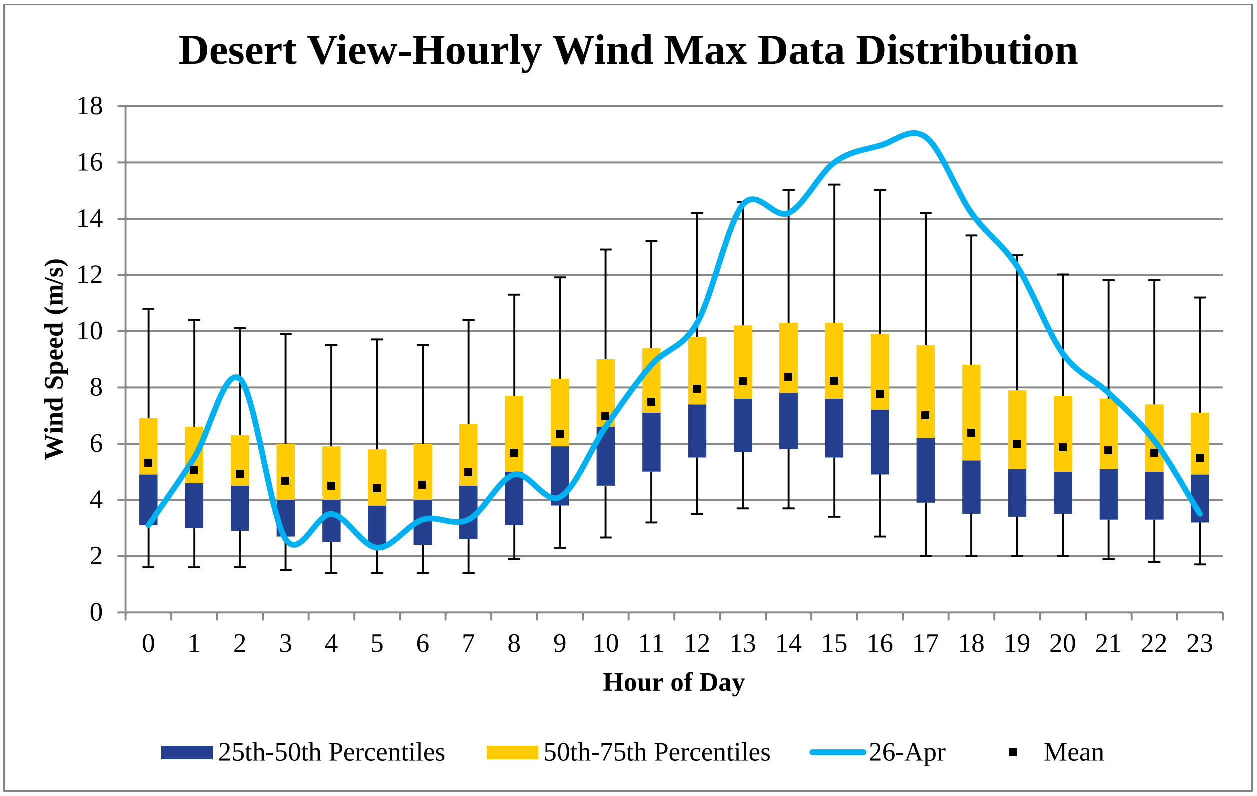


Figure 12-8e. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for April 26, 2012.

12.4 Clear Causal Relationship

A Pacific cold front passed through New Mexico on April 26, 2012 with a low pressure center in northern New Mexico. This system created a pressure gradient over southwestern New Mexico and northern Mexico causing winds to increase (Figure 12-9). As the upper level low pressure system moved toward New Mexico, the upper level wind direction aligned with the surface wind direction and diurnal heating of the surface allowed winds aloft to mix downward, increasing the surface wind velocities and providing the turbulence required for vertical mixing and horizontal transport (Figure 12-10).

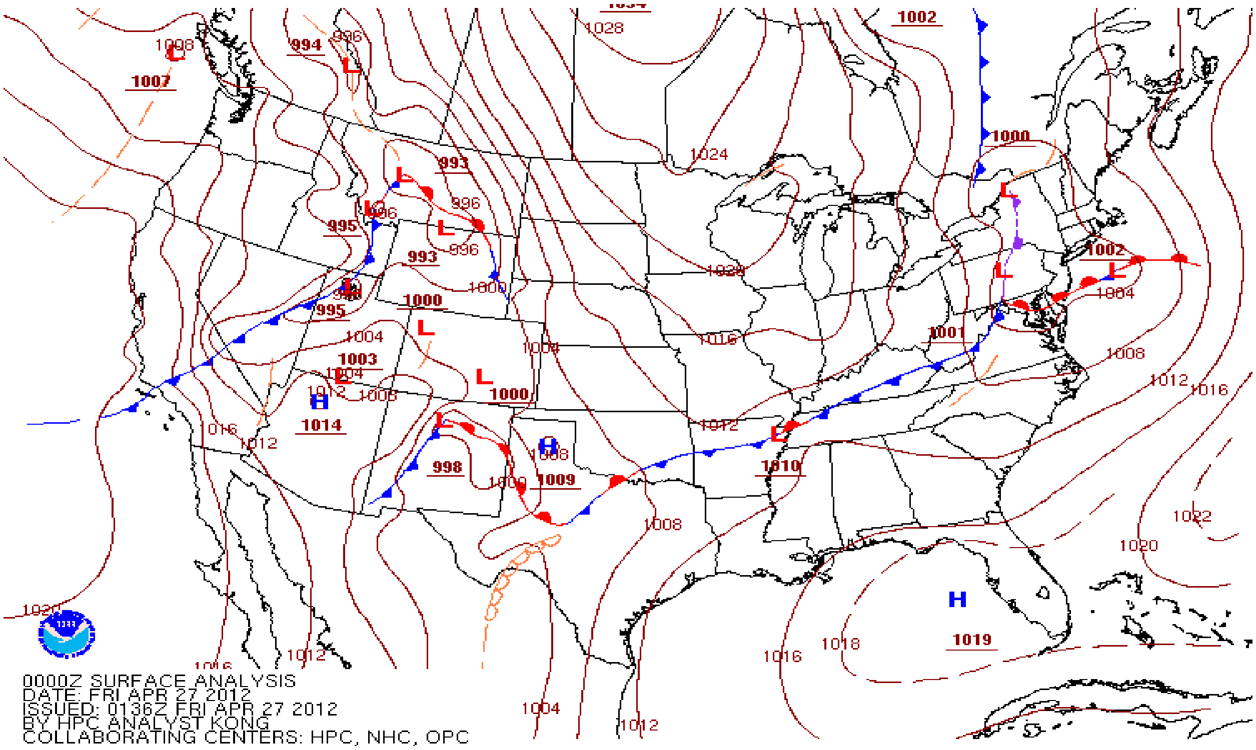


Figure 12-9 Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 26, 2012 at the 1800 hour.

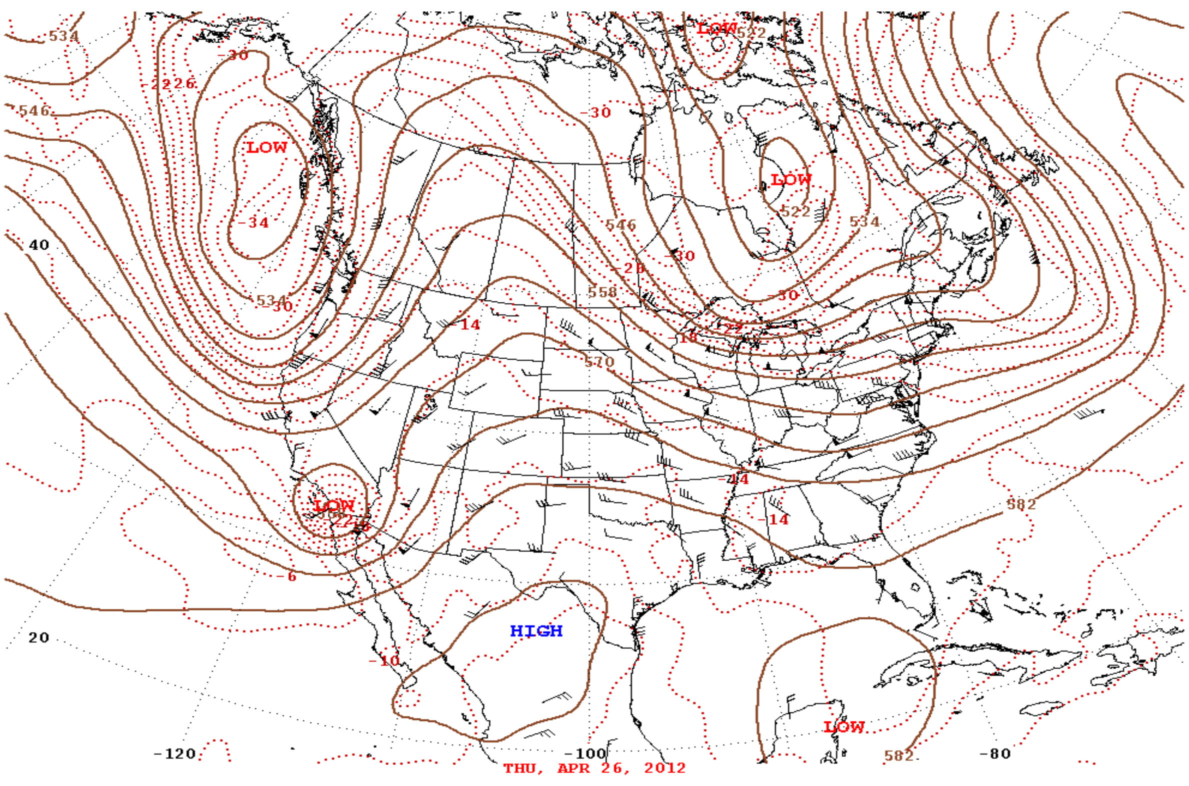


Figure 12-10 Upper air weather map showing geopotential heights (brown lines) at the 500 hour on April 26, 2012.

The weather pattern described above generated strong winds from the Southwest direction beginning at the 1300 hour and lasting through the 1800 hour. Beginning at the 1400 hour, wind speeds exceeded 11.2 m/s at West Mesa monitoring site as shown in Figure 12-3. Peak wind speeds ranged from 14.8 m/s at Holman to 9.2 m/s at the Desert View monitoring site (Figure 12-3). Peak wind gusts ranged from 23.9 m/s at West Mesa to 18 m/s at Desert View (Figure 12-4). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 12-11a-e. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (1300-1800 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 12-12a-b). Maximum hourly PM_{10} concentrations ranged from 958 µg/m^3 at West Mesa to 5752 µg/m^3 at Holman.

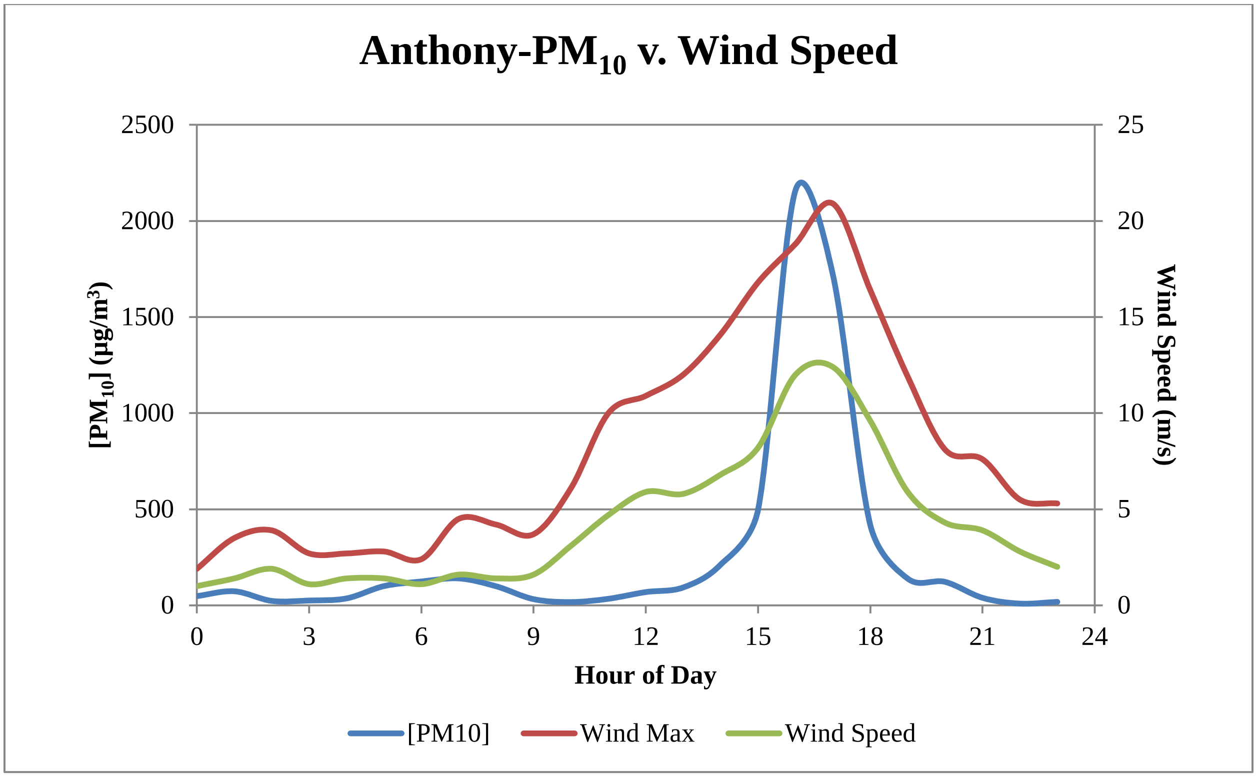


Figure 12-11a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

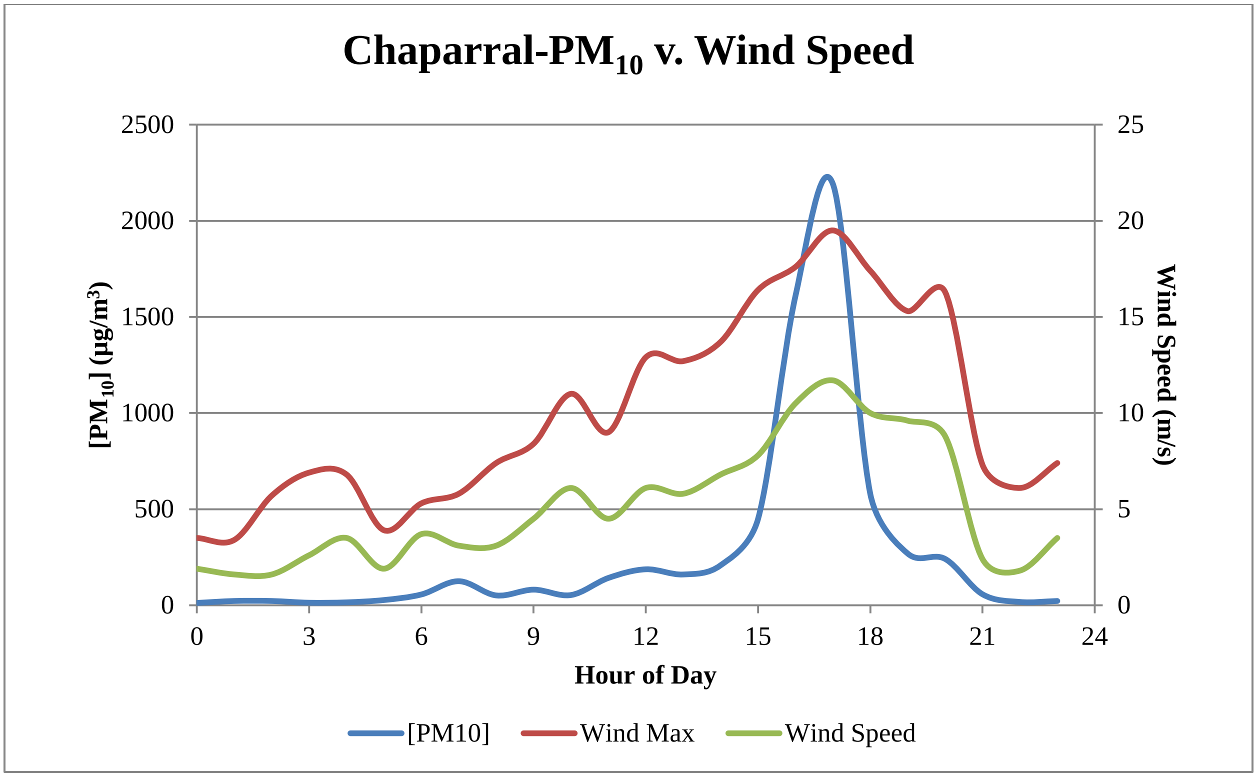


Figure 12-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

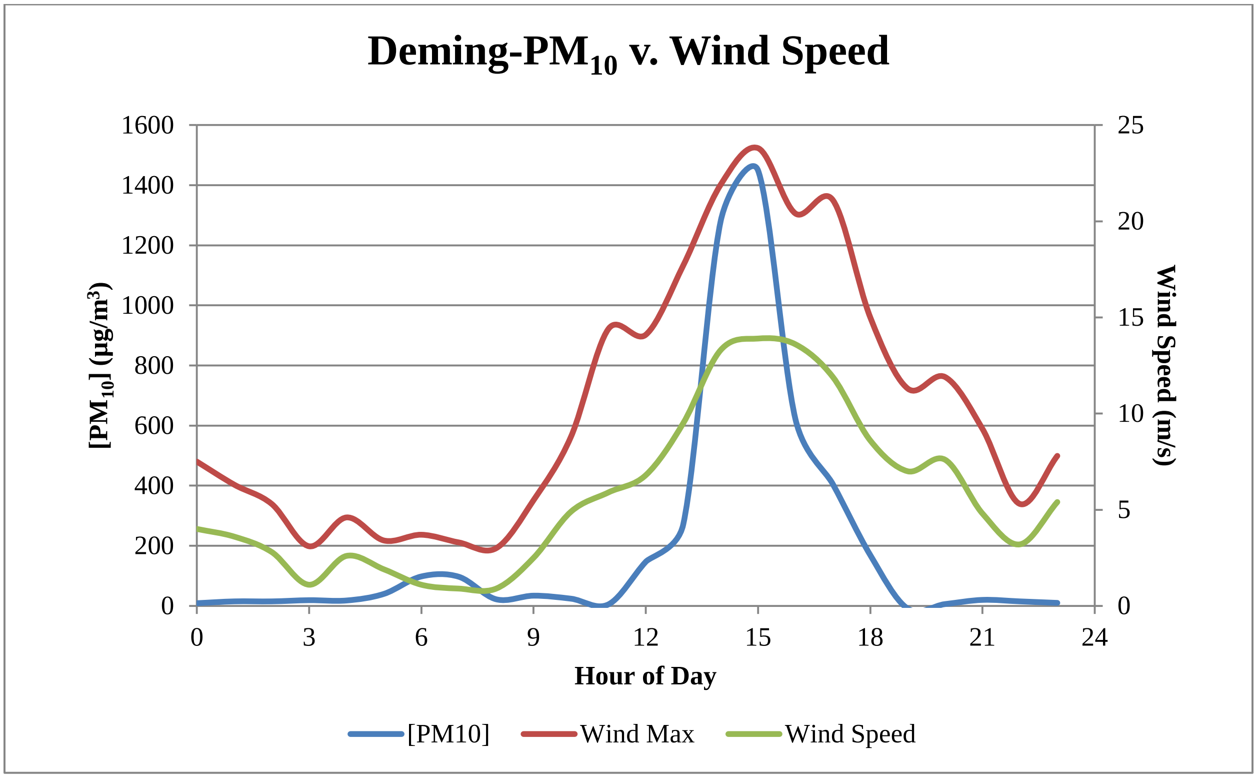


Figure 12-11c. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

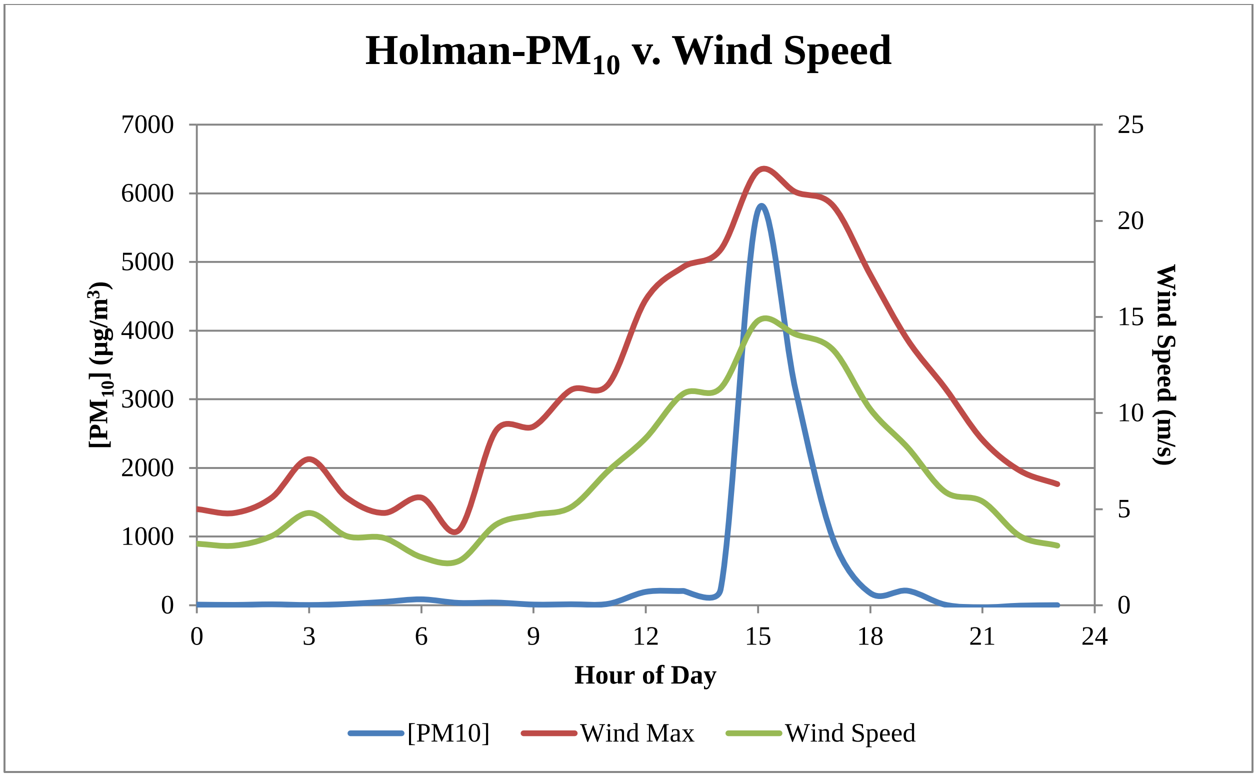


Figure 12-11d Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

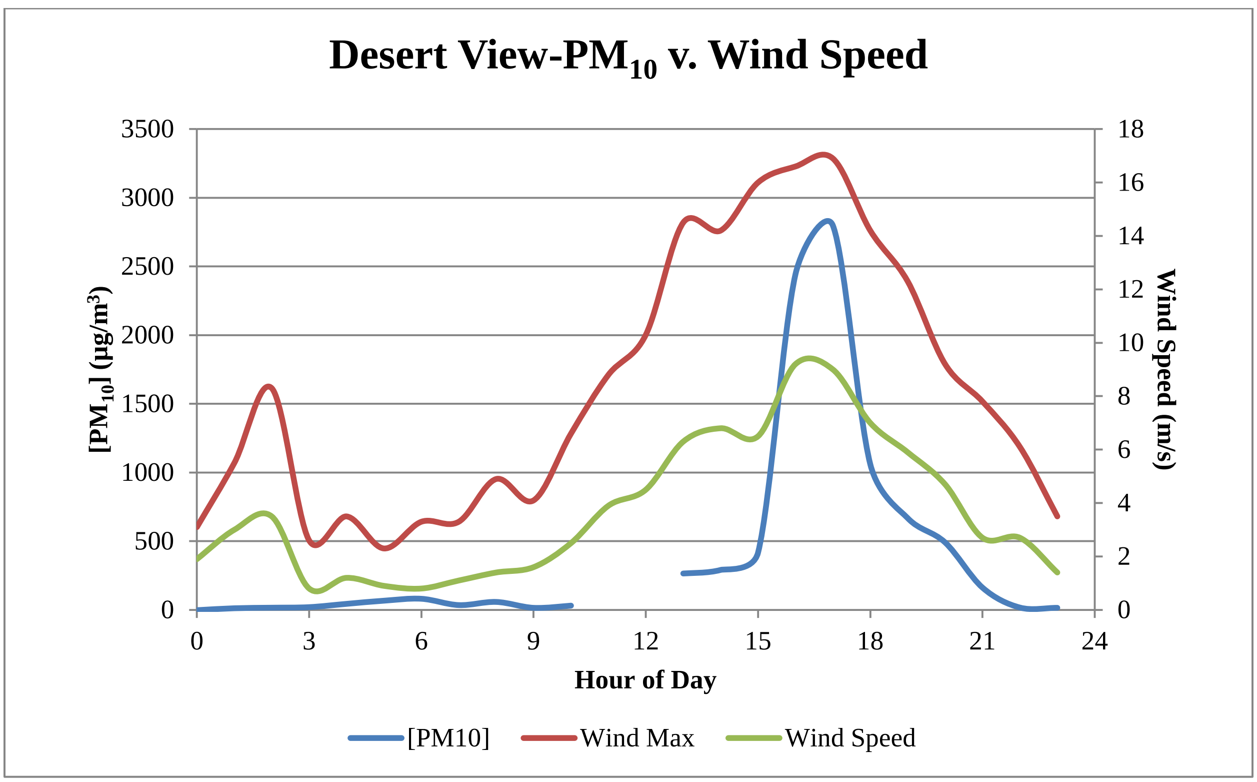


Figure 12-11e Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

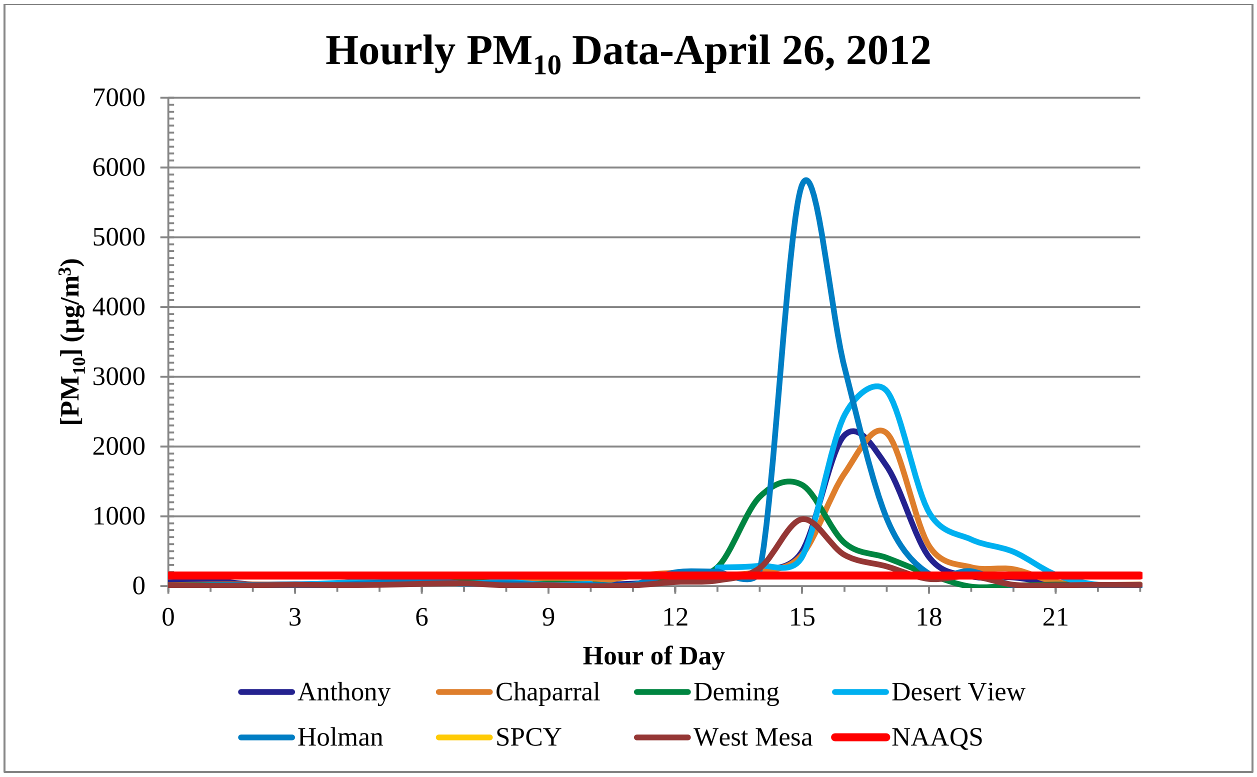


Figure 12-12a Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

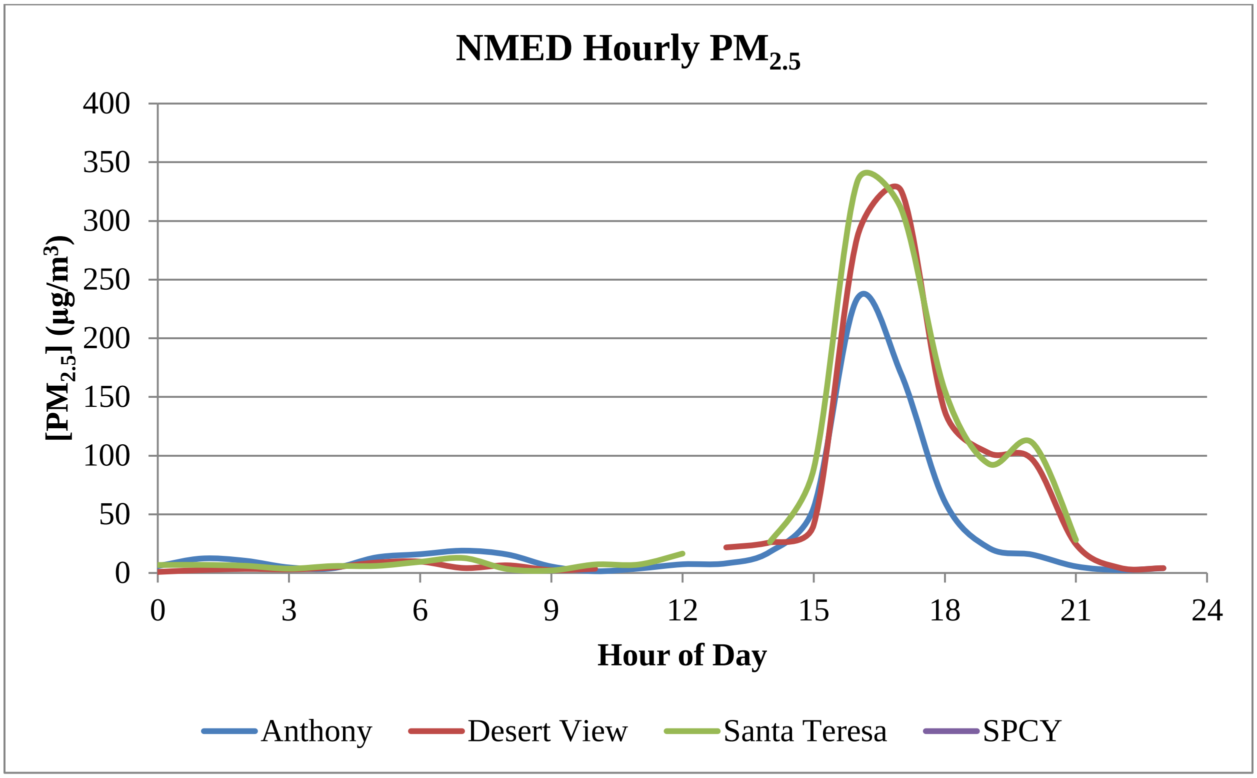


Figure 12-12b Hourly $PM_{2.5}$ concentrations for Doña Ana and Luna Counties monitors. Non-FEM hourly $PM_{2.5}$ data.

NASA GEOS IR and visible satellite imagery shows the blowing dust in the following two figures Figure 12-13a-b

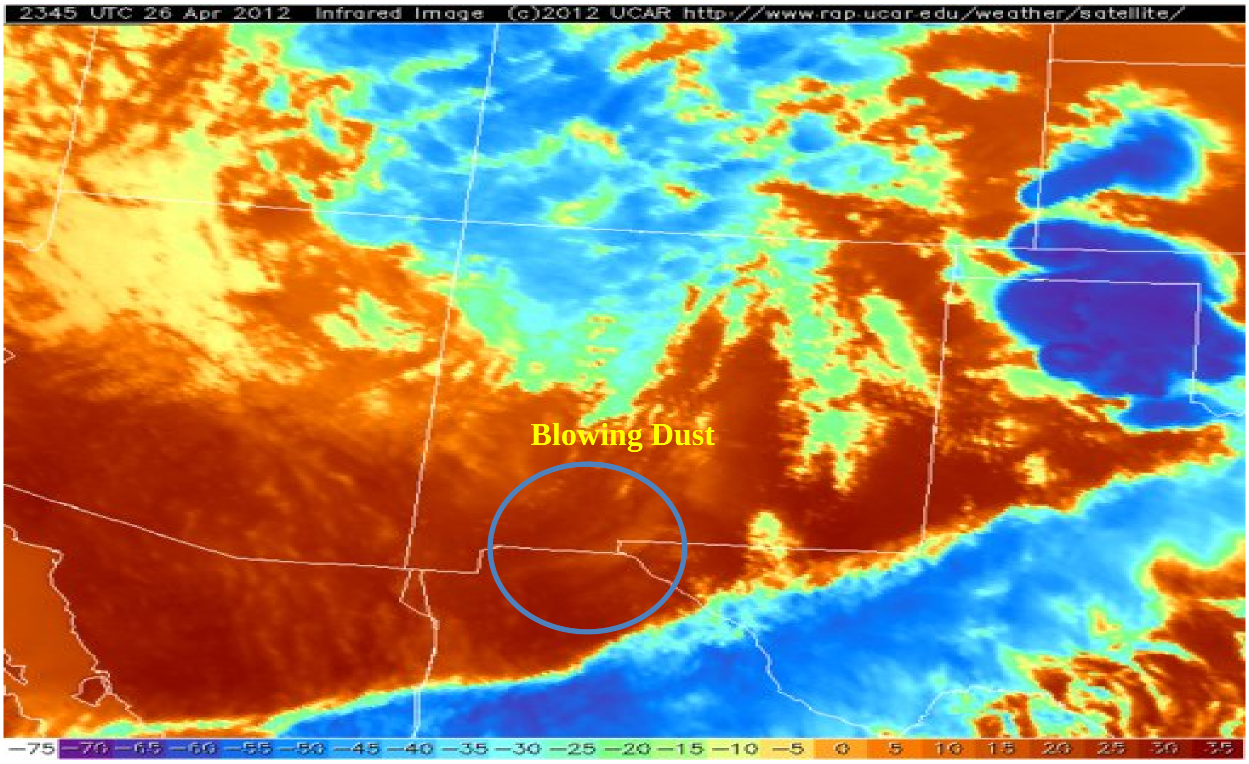


Figure 12-13a NASA GEOS satellite IR at 1745 hour on April 26, 2012. (Image courtesy of UCAR).

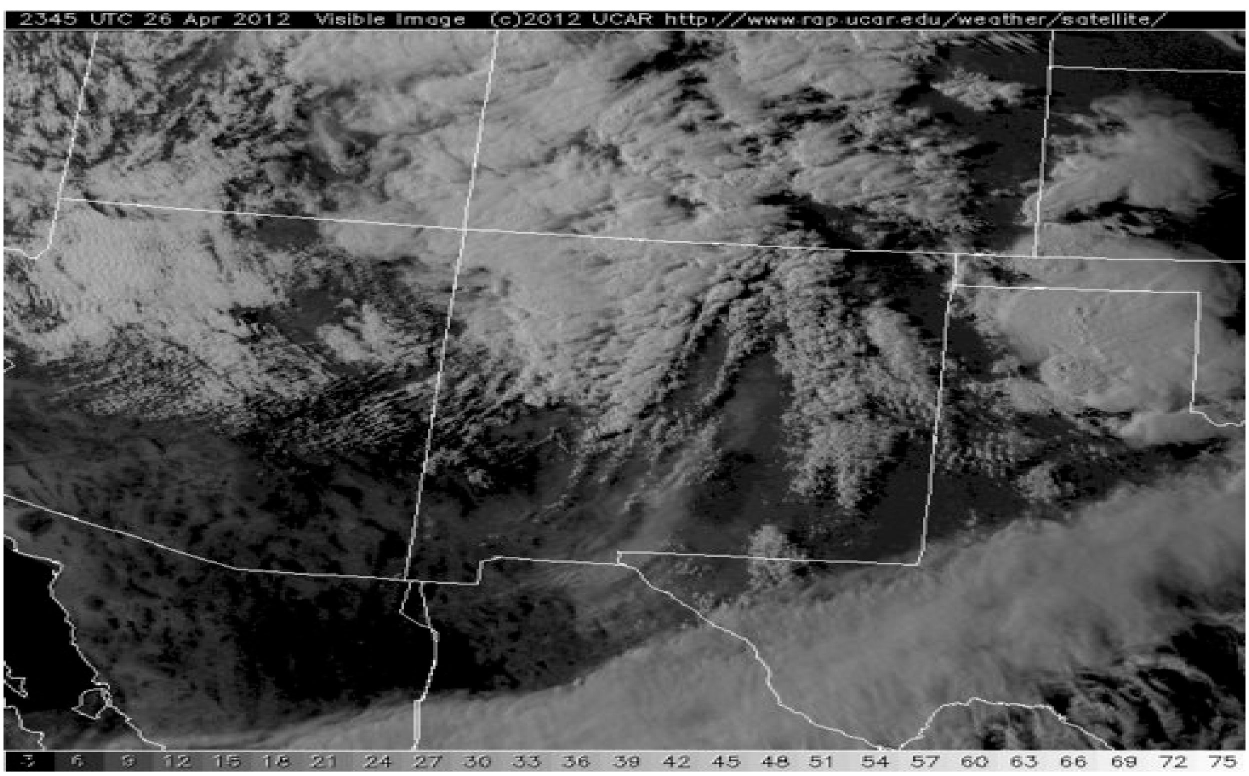


Figure 12-13b GEOS Visible image at 1745 hour on April 26, 2012 (Image courtesy of UCAR).

The NWS issued a high wind warning and blowing dust advisory on this date stating in part:

> THE STRONG WINDS WILL CAUSE AREAS OF BLOWING DUST WITH POOR VISIBILITY OF LESS THAN A MILE...ESPECIALLY IN THE INTERSTATE 10 CORRIDOR BETWEEN LAS CRUCES AND LORDSBURG. WINDS AND DUST WILL GRADUALLY DIMINISH DURING THE EVENING (NWS, 2012).

12.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on April 26, 2012.

12.6 Natural Event

The Clear Causal Relationship and not Reasonably Controllable or Preventable analyses show that this was a natural event caused by high wind and blowing dust.

12.7 No Exceedance but for the Event

The SPCY $PM_{2.5}$ monitor detected elevated levels due to blowing dust on April 26, 2012. These elevated concentrations resulted in exceedances of the 24-hour and annual NAAQS for $PM_{2.5}$ (64.1 µg/m^3). The strong correlation between hourly $PM_{2.5}$, PM_{10} and wind speeds peaks also point to windblown dust affecting the monitor. Previous studies have shown that $PM_{2.5}/PM_{10}$ ratios vary from 0.11 to 0.45 in the Paso del Norte Airshed (Arimoto et. al, 2001; Li et al, 2001). The ratios above 0.30 were observed in downtown El Paso and Ciudad Juárez and indicate a heavy impact from mobile sources. The lower ratios were observed in areas with less vehicular traffic and crustal material dominated the PM_{10} fraction. No PM_{10} data is available for a ratio calculation on this date. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

The Anthony monitor detected blowing dust around the 1500 hour with hourly concentrations heavily impacted until the 1800 hour. The four hourly PM_{10} values from 1500-1800 hours alone, exceed the 24-hour average standard at Anthony [(497 + 2159 + 1720 + 418) µg/m^3 = 4794 µg/m^3; (4794 µg/m^3)/24 = 199 µg/m^3]. By replacing these four hourly values with the 95th percentile of hourly data at the Anthony site, the resulting 24-hour average (91 µg/m^3) does not exceed the NAAQS (Table 12-1). The values in red represent the 95th percentile of all hourly data collected at Anthony, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	48	48
1	73	73
2	23	23
3	25	25
4	36	36
5	100	100
6	124	124
7	140	140
8	99	99
9	32	32
10	17	17
11	34	34
12	69	69
13	93	93
14	212	**212**
15	497	**194**
16	2159	**157**
17	1720	**194**
18	418	**194**
19	139	139
20	122	122
21	39	39
22	9	9
23	18	18
24-Hour Average	259	**91**

Table 12-1 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Anthony.

The Chaparral monitor detected blowing dust around the 1500 hour with hourly concentrations heavily impacted until the 2000 hour. The six hourly PM_{10} values from 1500-2000 hours alone, exceed the 24-hour average standard at Chaparral [(449 + 1609 + 2192 + 579 + 269 + 241) µg/m^3 = 5339 µg/m^3; (5339 µg/m^3)/24 = 222 µg/m^3]. By replacing these six hourly values with the 95th percentile of hourly data at the Chaparral site, the resulting 24-hour average (87 µg/m^3) does not exceed the NAAQS (Table 12-2). The values in red represent the 95th percentile of all hourly data collected at Chaparral, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	12	12
1	22	22
2	22	22
3	13	13
4	15	15
5	27	27
6	56	56
7	125	125
8	51	51
9	81	81
10	53	53
11	142	142
12	187	187
13	160	160
14	208	208
15	449	**163**
16	1609	**159**
17	2192	**141**
18	579	**127**
19	269	**127**
20	241	**118**
21	57	57
22	17	17
23	22	22
24-Hour Average	274	**87**

Table 12-2 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Chaparral.

The Deming monitor detected blowing dust around the 1300 hour with hourly concentrations heavily impacted until the 1700 hour. The five hourly PM_{10} values from 1300-1700 hours alone, exceed the 24-hour average standard at Deming [(271 + 1280 + 1449 + 621 + 405) µg/m^3 = 4026 µg/m^3; (4026 µg/m^3)/24 = 167 µg/m^3]. By replacing these five hourly values with the 95th percentile of hourly data at the Deming site, the resulting 24-hour average (55 µg/m^3) does not exceed the NAAQS (Table 12-3). The values in red represent the 95th percentile of all hourly data collected at Deming, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	9	9
1	15	15
2	15	15
3	19	19
4	18	18
5	40	40
6	98	98
7	97	97
8	22	22
9	34	34
10	24	24
11	5	5
12	147	147
13	271	**109**
14	1280	**121**
15	1449	**115**
16	621	**127**
17	405	**106**
18	169	169
19	-9	-9
20	6	6
21	20	20
22	15	15
23	10	10
24-Hour Average	198	**55**

Table 12-3 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Deming.

The Holman monitor detected blowing dust around the 1200 hour with hourly concentrations heavily impacted until the 1900 hour. One hourly PM_{10} value (1500 hour) alone, exceeds the 24-hour average standard at Holman [(5752 µg/m^3)/24 = 239 µg/m^3]. By replacing the eight hourly values impacted by blowing dust with the 95th percentile of hourly data at the Holman site, the resulting 24-hour average (53 µg/m^3) does not exceed the NAAQS (Table 12-4). The values in red represent the 95th percentile of all hourly data collected at Holman, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	9	9
1	5	5
2	13	13
3	3	3
4	18	18
5	49	49
6	86	86
7	34	34
8	39	39
9	10	10
10	14	14
11	21	21
12	195	**88**
13	208	**113**
14	234	**131**
15	5752	**132**
16	3144	**132**
17	974	**126**
18	177	**155**
19	211	**129**
20	8	8
21	-31	-31
22	-6	-6
23	1	1
24-Hour Average	464	**53**

Table 12-4 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Holman.

The Desert View monitor detected blowing dust around the 1300 hour with hourly concentrations heavily impacted until the 2000 hour. Two hourly PM_{10} values from 1600-1700 hours alone, exceed the 24-hour average standard at Desert View [(2443 + 2798) $\mu g/m^3$ = 5241 $\mu g/m^3$; (5241 $\mu g/m^3$)/24 = 218 $\mu g/m^3$]. By replacing the eight hourly values impacted by blowing dust with the 95th percentile of hourly data at the Desert View site, the resulting 24-hour average (75 $\mu g/m^3$) does not exceed the NAAQS (Table 12-5). The values in red represent the 95th percentile of all hourly data collected at Desert View, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	-2	-2
1	12	12
2	16	16
3	20	20
4	44	44
5	67	67
6	81	81
7	35	35
8	58	58
9	15	15
10	31	31
11		
12		
13	265	**105**
14	291	**132**
15	417	**136**
16	2443	**138**
17	2798	**166**
18	1060	**141**
19	668	**142**
20	491	**120**
21	162	162
22	17	17
23	15	15
24-Hour Average	408	**75**

Table 12-5 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Desert View.

13 HIGH WIND EXCEPTIONAL EVENT: May 23, 2012

13.1 Summary of Event

The passing of a Pacific cold front caused high winds and blowing dust in Doña Ana and Luna Counties resulting in exceedances of the PM_{10} 24-hour NAAQS and the $PM_{2.5}$ annual NAAQS at the Holman and Sunland Park monitoring sites on this date. The FEM TEOM continuous monitors at Holman and Sunland Park recorded 24-hour average concentrations of 214 and 163µg/m^3, respectively. The FRM Partisol monitor at Sunland Park recorded a 24-hour average concentration of 23.2 µg/m^3. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured at Anthony (115 µg/m^3), Chaparral (121 µg/m^3), and Desert View (143µg/m^3) monitoring sites (Figure 13-1). The averages in this figure were calculated using PM_{10} FEM TEOM and $PM_{2.5}$ FRM Partisol instrument data for the four days before and after the event. Elevated concentrations were also recorded by the $PM_{2.5}$ non-FEM/FRM TEOMs (Figure 13-2). The $PM_{2.5}$ TEOM at SPCY did not record data on this date.

As the event unfolded, the wind blew from the west throughout the border region. These high velocity winds passed over large areas of desert within Arizona, New Mexico and Mexico. The co-occurrence of high winds and elevated levels of blowing dust, little to no point sources in the area, and the high hourly and daily PM_{10} and $PM_{2.5}$ concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

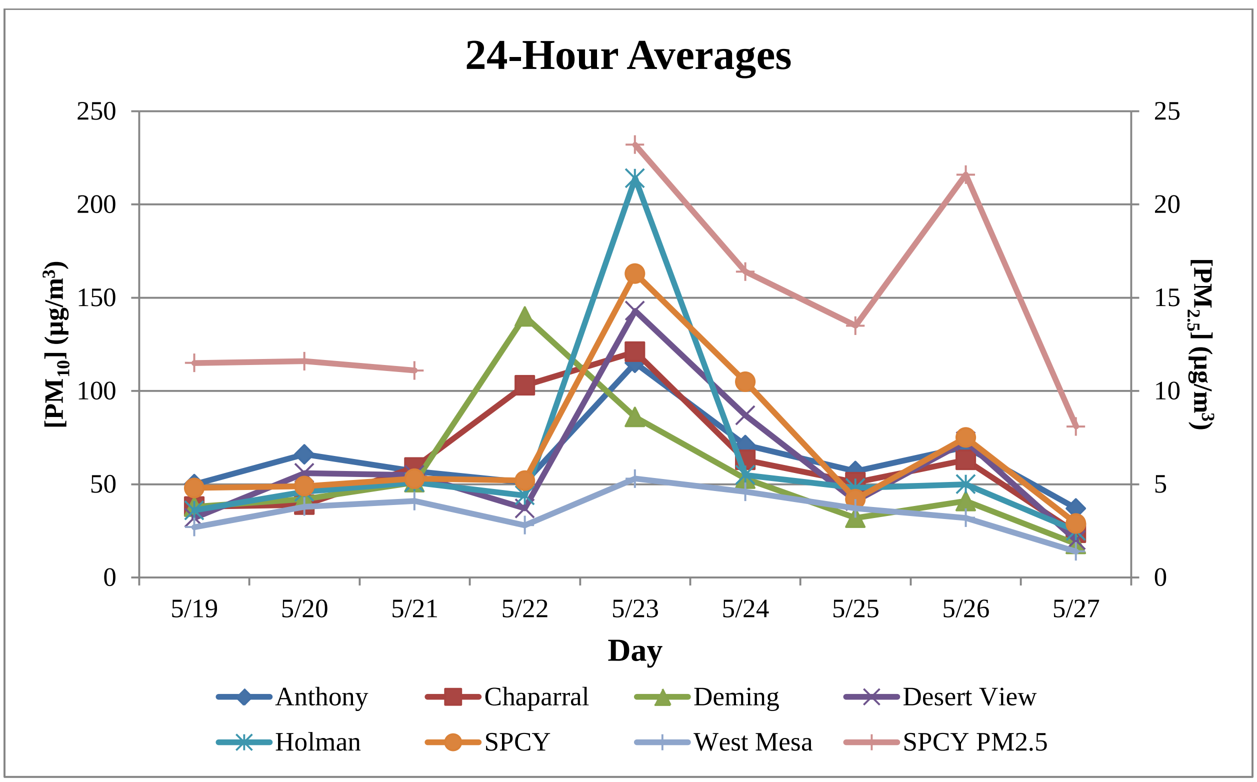


Figure 13-1. PM_{10} 24-hour averages before and after May 23, 2012

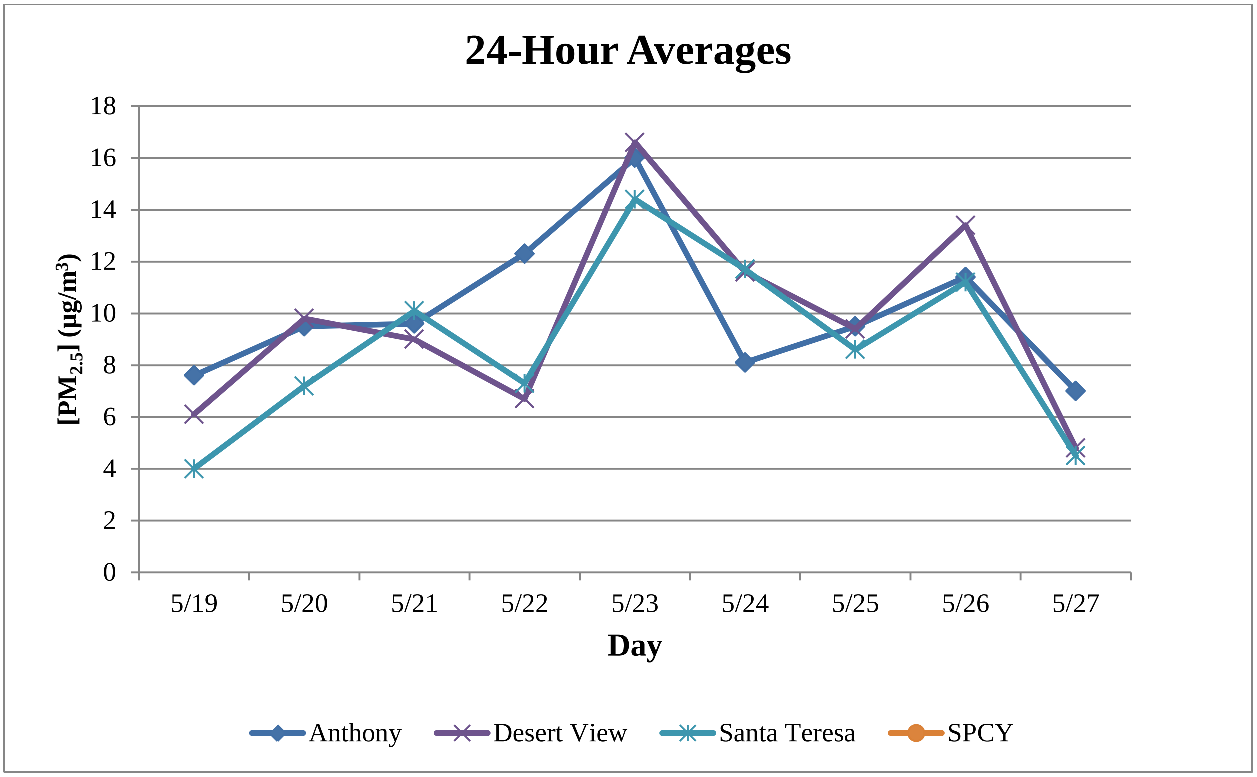


Figure 13-2 $PM_{2.5}$ 24-hour averages before and after May 23, 2012. Non-FEM TEOM Data.

13.2 Is Not Reasonably Controllable or Preventable

13.2.1 Suspected Source Areas and Categories Contributing to the Event

Sources of windblown dust contributing to this exceedance include the natural desert, residential properties, agricultural land and unpaved roads in Mexico, Arizona and New Mexico. City of Las Cruces, City of Deming and Doña Ana and Luna County Ordinances require BACM for any dust producing activities. The largest and most likely sources of windblown dust are the natural desert and the playas of New Mexico and northern Mexico (see Section 13.2.4 below).

13.2.2 Sustained and Instantaneous Wind Speeds

EPA uses a default entrainment threshold of sustained wind speeds at 11.2 m/s (25 mph) for natural and well controlled anthropogenic sources contributing to natural events caused by high wind and blowing dust (EPA, 2013). Under the Doña Ana and Luna County NEAPs, EPA and NMED agreed that wind gusts exceeding 18 m/s would overwhelm any natural and well-controlled anthropogenic sources and cause windblown dust. On May 23, 2012, sustained wind speeds exceeded EPA's default threshold at three of the eight monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at five of the eight monitoring sites (Figures 13-3 and 13-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 1100 hour and ending at the 1800 hour.

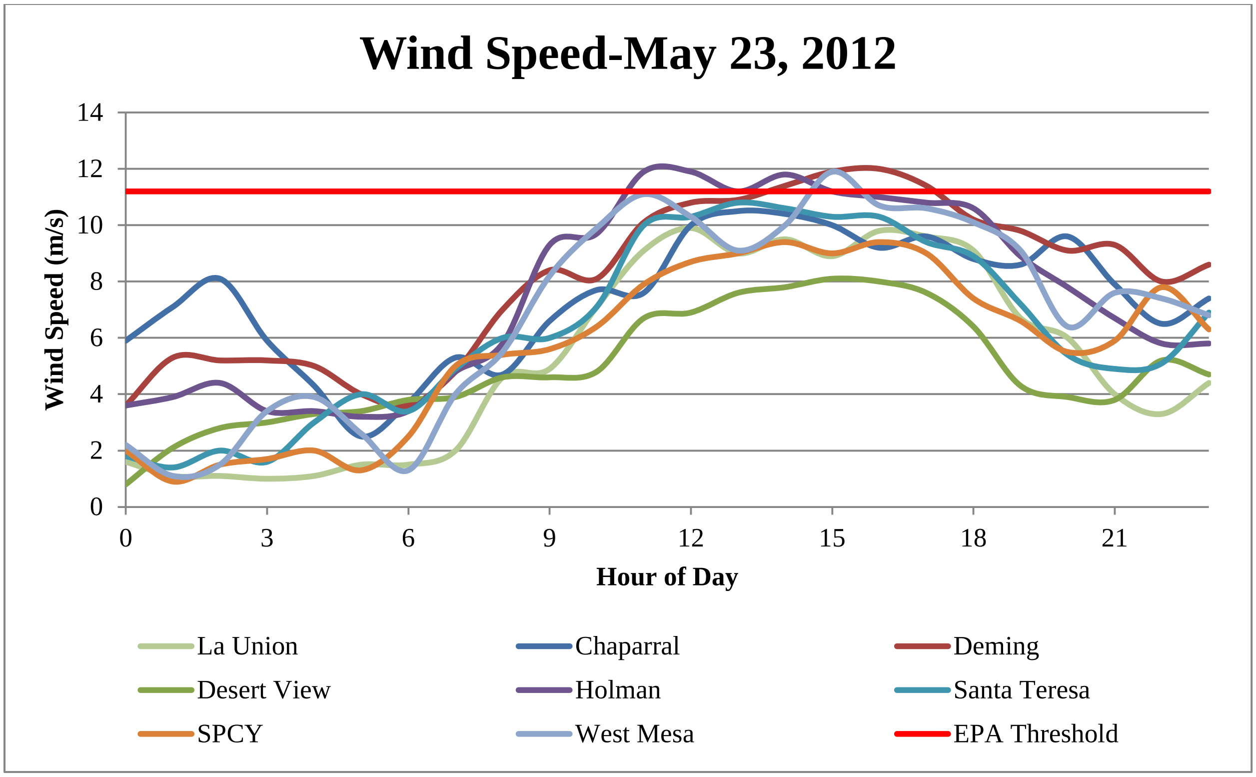


Figure 13-3 Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

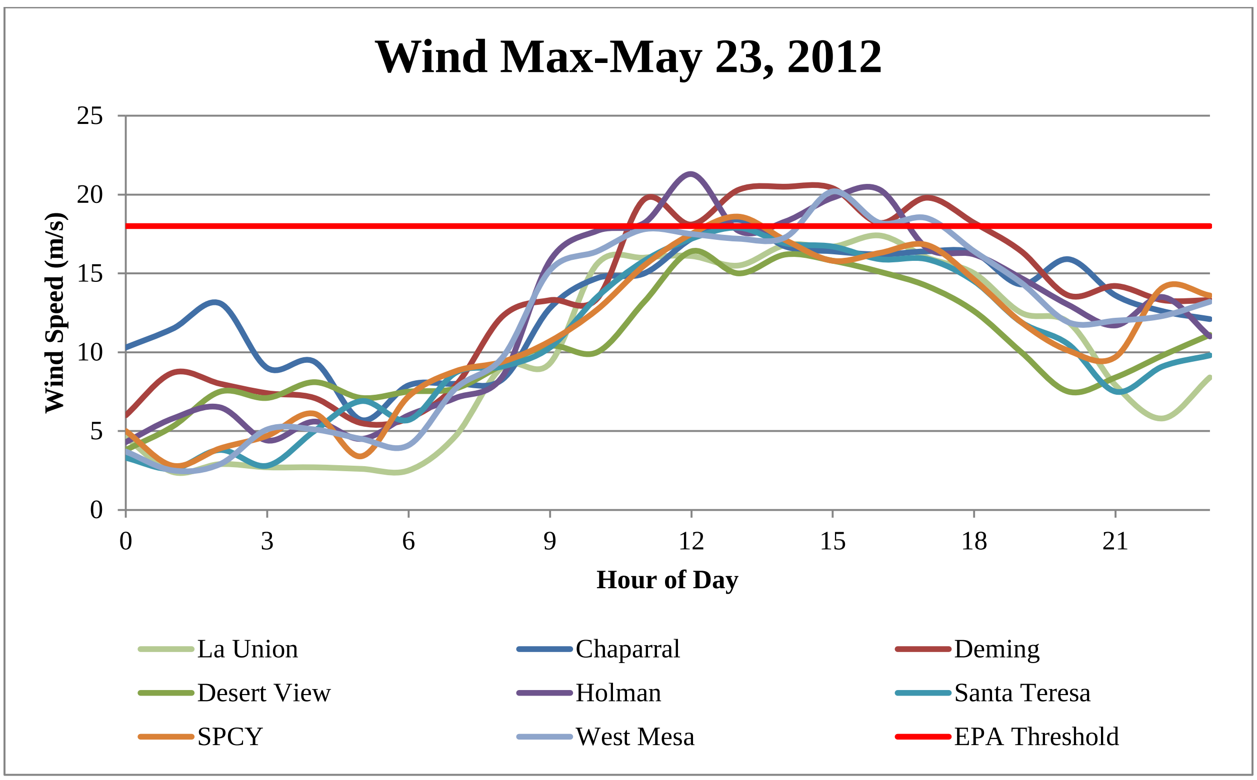


Figure 13-4 Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

13.2.3 Recurrence Frequency

The monitoring sites in Doña Ana and Luna Counties can record exceedances of the PM_{10} NAAQS throughout the year. From 2007-2011 the PM_{10} FEM TEOM monitors recorded 254 exceedances and the PM_{10} FRM Wedding monitors recorded 6 exceedances (Figure A-1). The Deming Airport and Desert View monitoring sites (FEM TEOMs) were established in 2006 and 2007 respectively and do not show exceedances until the year following startup. The SPCY $PM_{2.5}$ FRM Partisol recorded 37 exceedances of the 24-Hour NAAQS from 2007-2011 (Figure A-2). See appendix A for a more in-depth discussion about recurrence frequency and the number of exceedances at each monitoring site.

13.2.4 Controls Analysis

The local ordinances and MOUs adopted under the NEAP direct the implementation of BACM for sources of dust in Doña Ana and Luna Counties. The ordinances regulate disturbed lands, construction and demolition, vacant parking lots and materials handling and transportation. Our investigation did not identify any unusual PM_{10} producing activities on this day, and anthropogenic emissions remained constant before, during and after the event. The most likely source contributing to the event is the natural desert and playas in New Mexico, Arizona and northern Mexico. A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from Arizona and Mexico to the monitors in Doña Ana and Luna Counties. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 13-5). Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in Arizona and Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

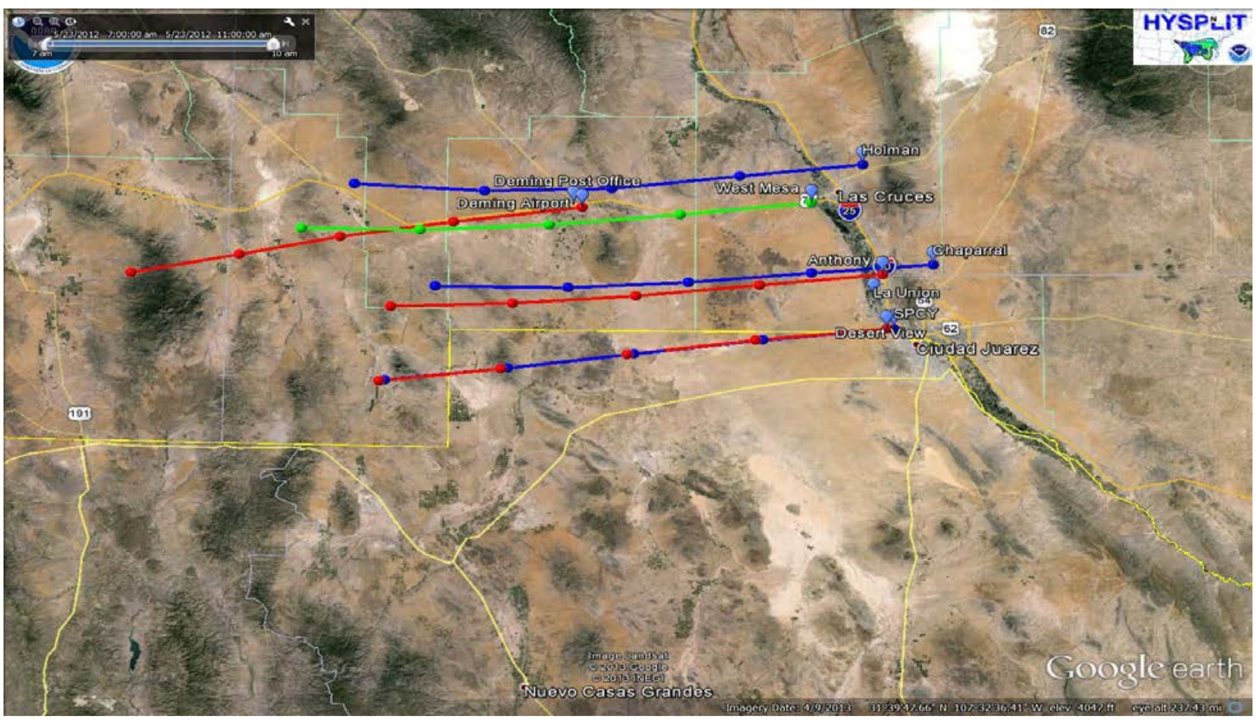


Figure 13-5 HYSPLIT back-trajectory model analysis for May 23, 2012

13.3 Historical Fluctuations Analysis

13.3.1 Annual and Seasonal 24-hour Average Fluctuations

Since being established, the monitoring sites in Doña Ana and Luna Counties have recorded exceedances of the PM_{10} NAAQS. High winds cause these exceedances and they can occur at any time of year (Figure B-6 through B-13). Most exceedances occur from late winter through early summer (February-June) and are associated with the passage of Pacific cold fronts. High winds caused all recorded exceedances from 2007-2011 and NMED submitted natural events demonstrations to EPA under the NEAP or EER.

Since the 24-hour $PM_{2.5}$ NAAQS was lowered from 65 to 35 $\mu g/m^3$ in 2006, the SPCY Partisol monitor has routinely recorded exceedances of the standard. These exceedances occurred throughout the year during high and low wind conditions. In 2009, NMED investigated the cause of the low wind exceedances and found that emissions from Ciudad Juárez, Mexico contribute significantly to elevated concentrations. The high wind exceedances were caused by blowing dust on days when PM_{10} monitors also recorded exceedances.

Appendix B contains a more in-depth discussion about historical fluctuations and charts showing annual and seasonal trends at each monitoring site.

Table B-1 and B-2 show normal historical fluctuations with and without high wind natural events that caused exceedances from 2007-2011. The analysis excludes only those high wind events that resulted in an exceedance. Data for PM_{10} in this table includes FRM Wedding and FEM TEOM measurements and data for $PM_{2.5}$ comes from the FRM Partisol measurements from 2007-2011. The recorded values for this day (214 and 163$\mu g/m^3$) are above the maximum values recorded when no high wind exceedances are included and is above the 95th percentile of all 24-hour averages recorded.

An hourly data distribution analysis was performed for PM_{10} and $PM_{2.5}$ concentrations, wind speeds and wind gusts (Appendices C, D and E). All data used for the PM_{10} distribution charts come from the FEM TEOM monitors and the non-FEM/FRM $PM_{2.5}$ TEOM monitor at SPCY. Overlaying the hourly data for May 23, 2012 on the hourly data distribution plots shows that the values recorded during the high wind event exceed the 95th percentile for PM_{10}, wind speed and wind gusts (Figures 13-6a-b through 13-8a-b). The top whiskers of the box and whisker plots represent the 95th percentile of data. The hourly PM_{10} values during the high wind blowing dust storm far exceed the historical 95th percentile of data.

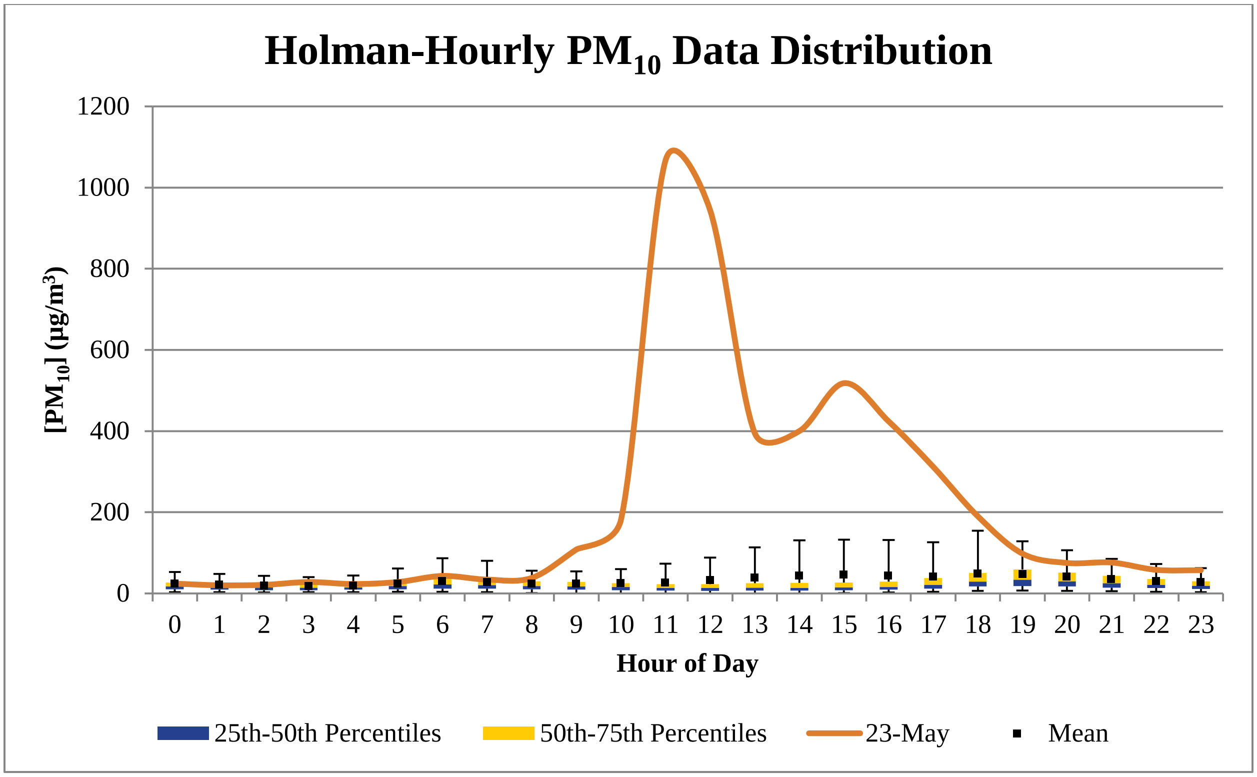


Figure 13-6a PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for May 23, 2012.

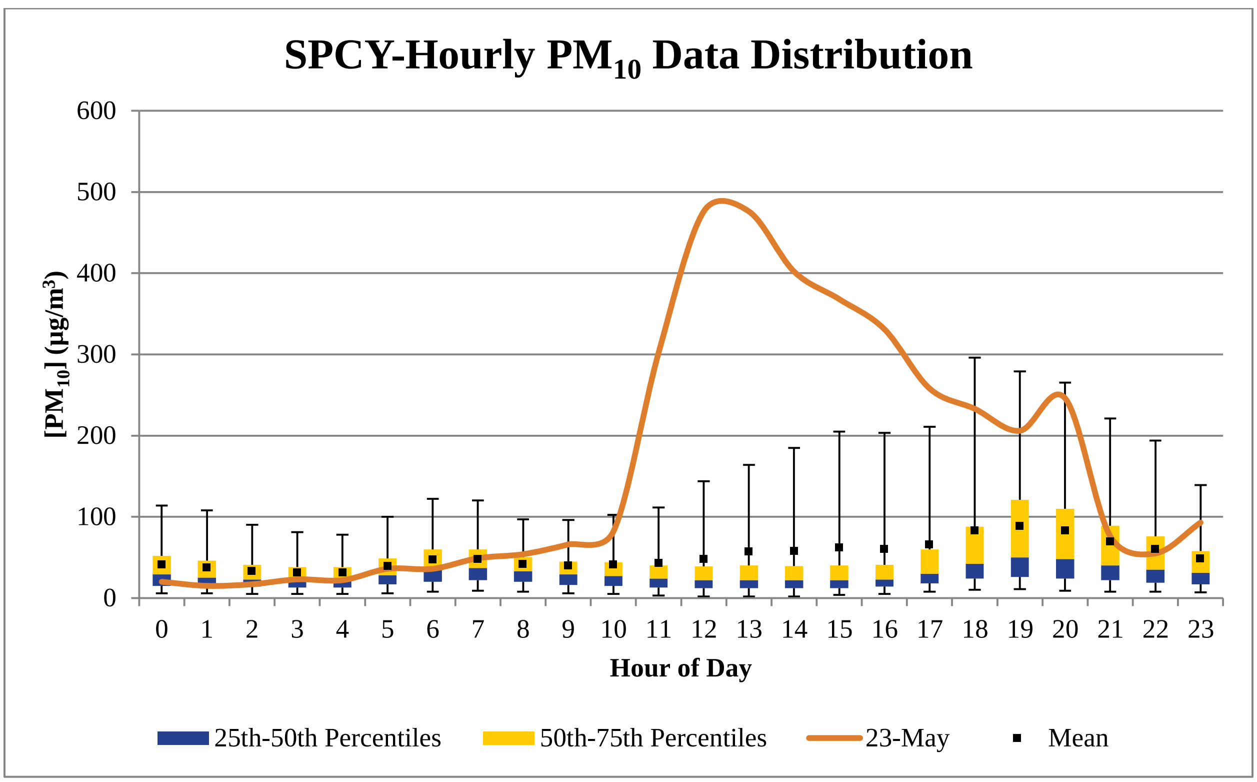


Figure 13-6b PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for May 23, 2012.

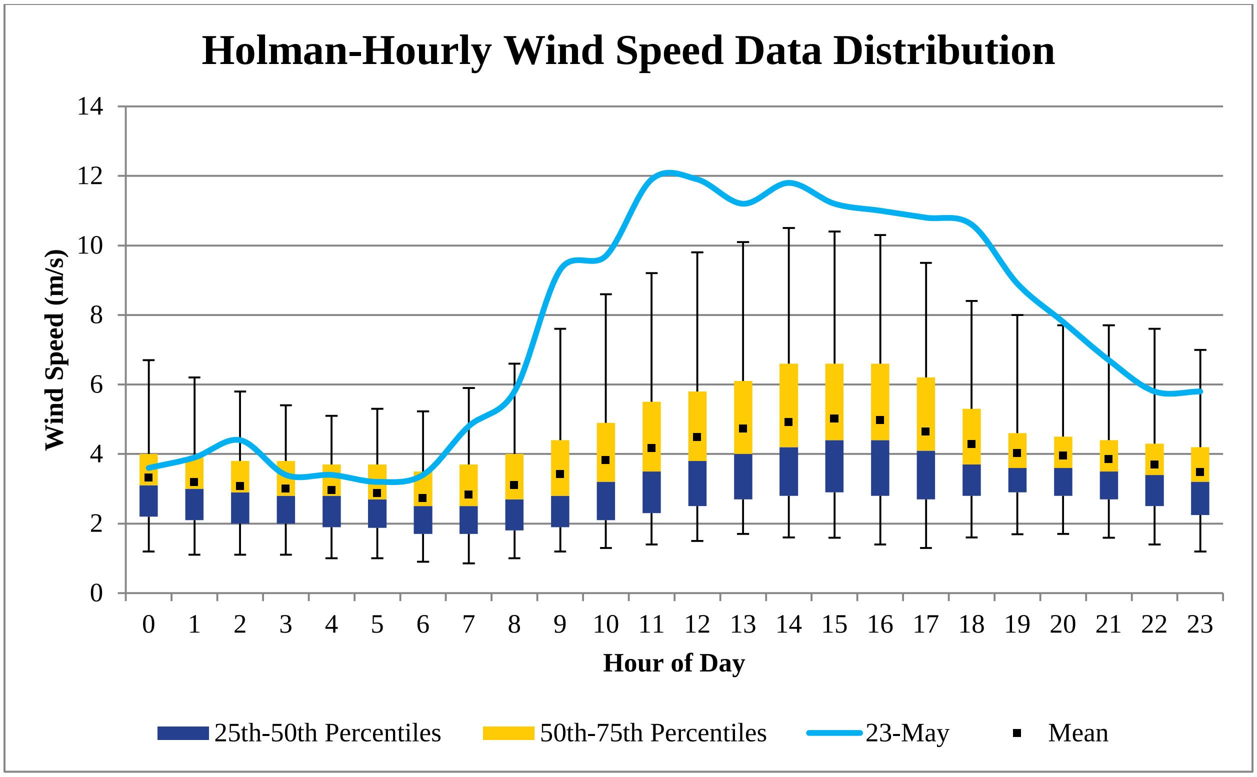


Figure 13-7a Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for May 23, 2012

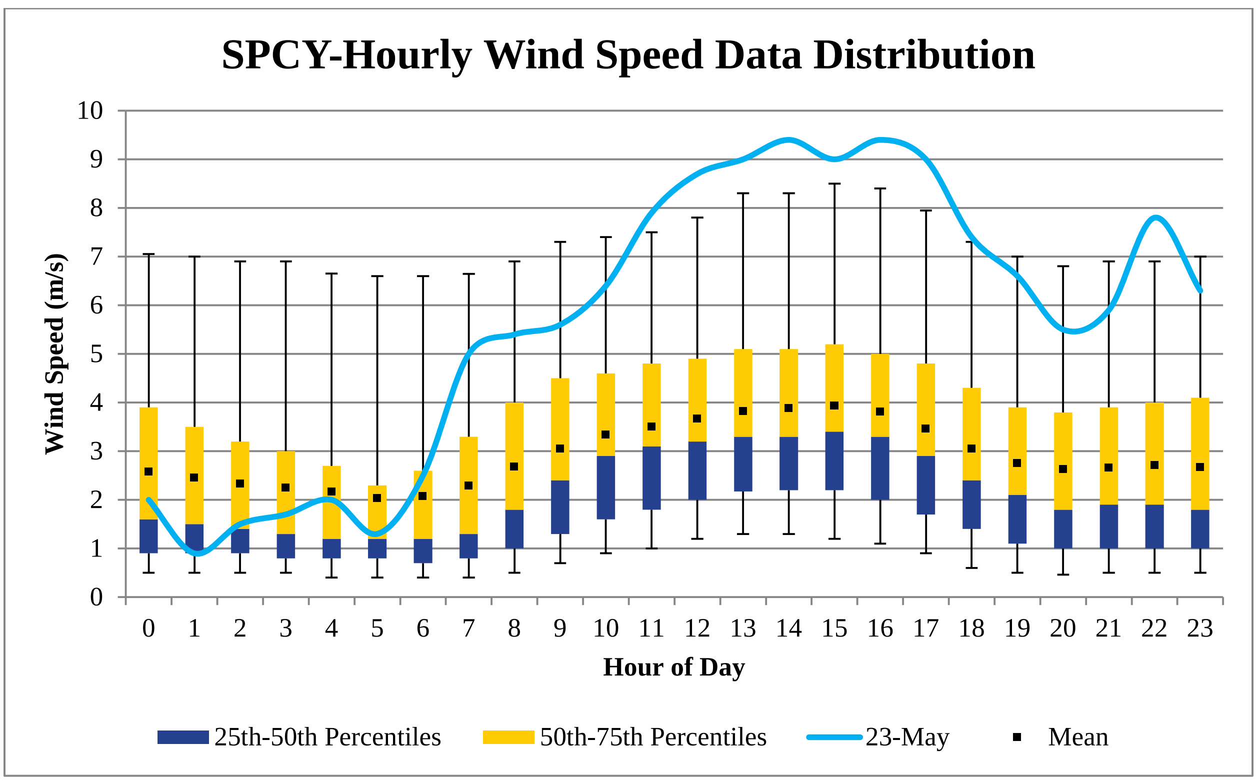


Figure 13-7b Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for May 23, 2012

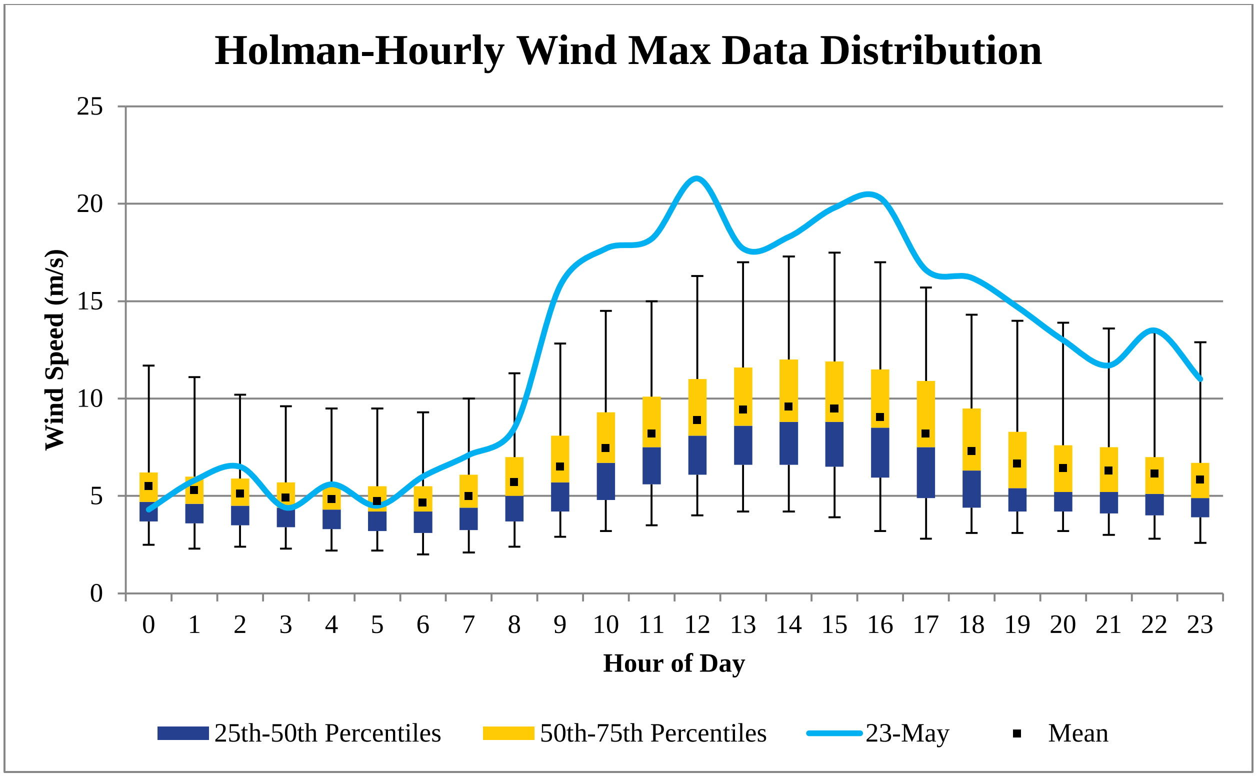


Figure 13-8a Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for May 23, 2012.

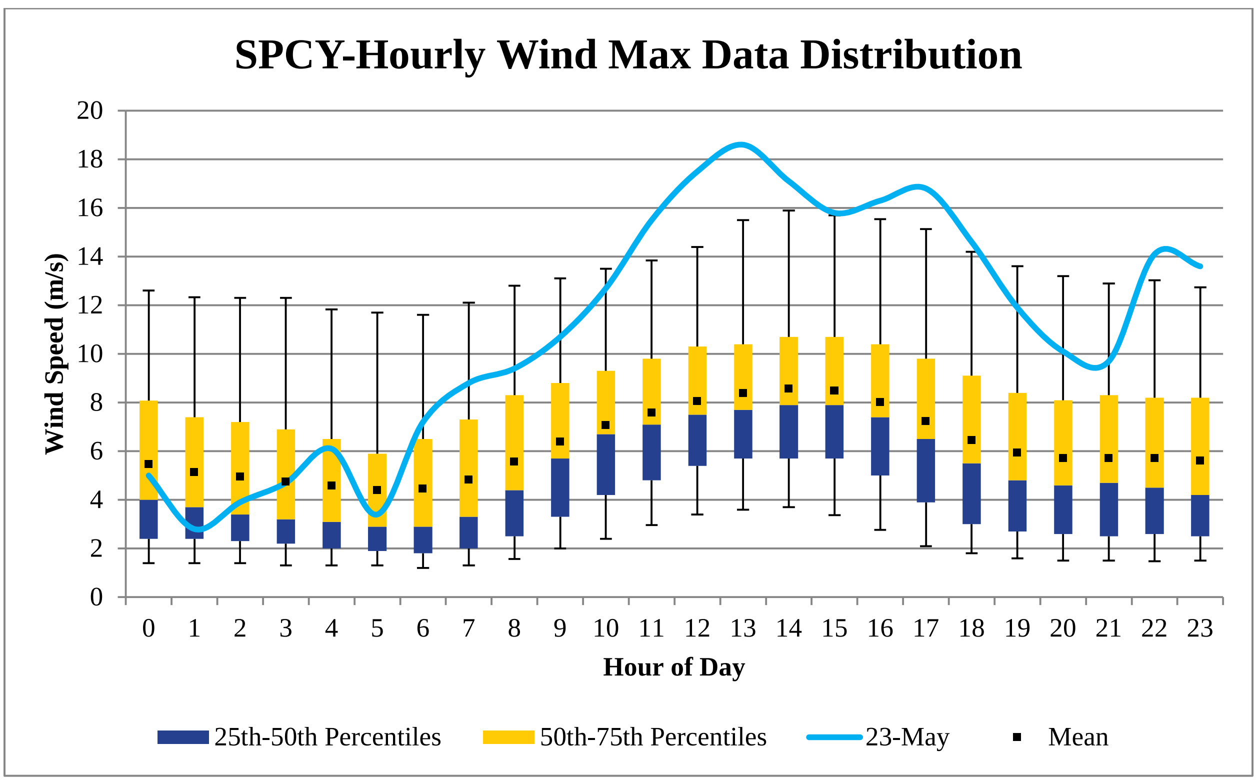


Figure 13-8b Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for May 23, 2012.

13.4 Clear Causal Relationship

A Pacific cold front approached New Mexico on May 23, 2012. The cold front stalled out prior to arriving becoming a stationary front north of New Mexico with a deep surface low in Colorado (Figure 13-9). The upper level system combined with the surface low to create a pressure gradient and increase wind speeds. Diurnal heating of the surface allowed winds aloft to mix downward, increasing the surface wind velocities and provided the turbulence required for vertical mixing and horizontal transport (Figure 13-10).

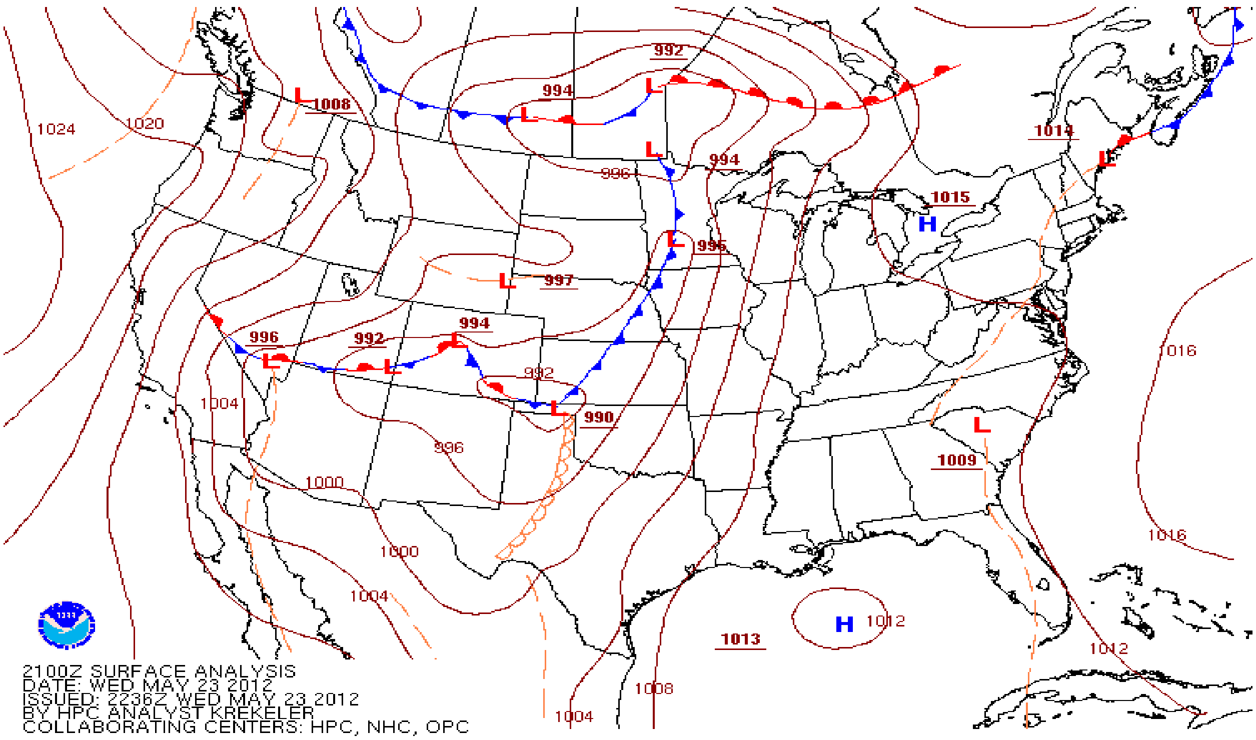


Figure 13-9 Surface weather map showing frontal activity and isobars of constant pressure (red lines) for May 23, 2012 at the 1500 hour.

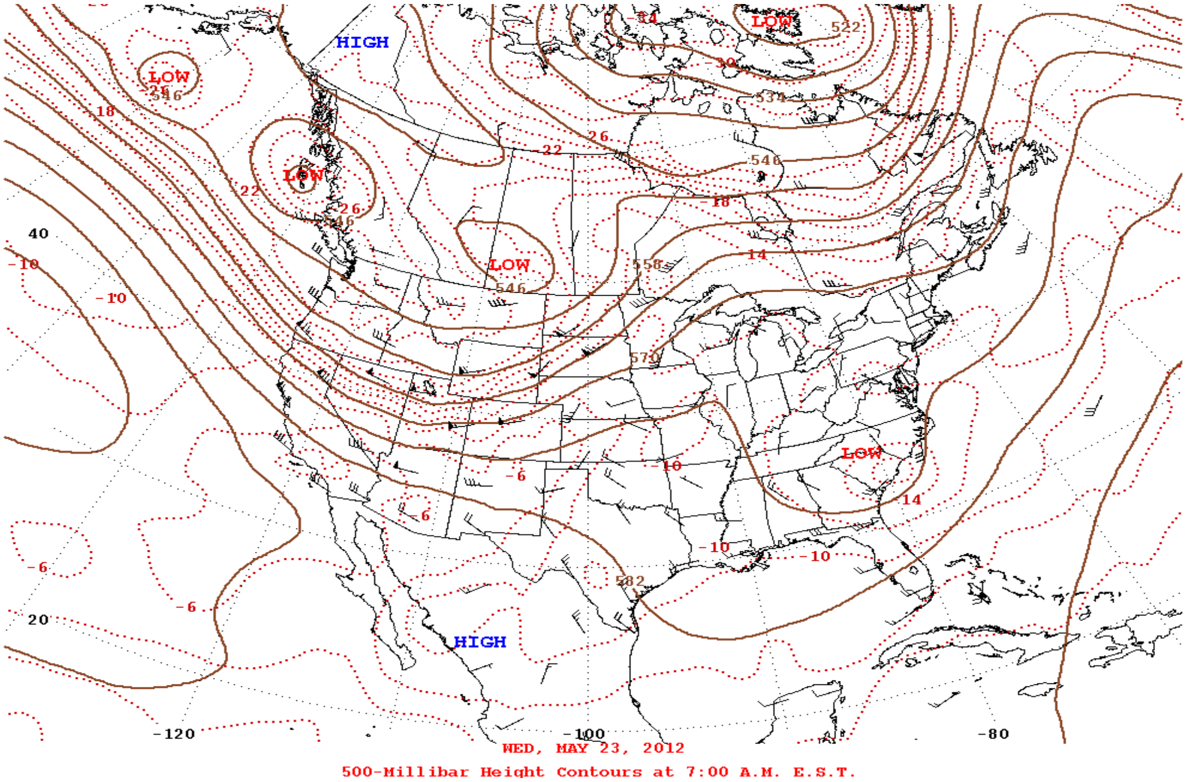


Figure 13-10 Upper air weather map showing geopotential heights (brown lines) at the 500 hour on May 23, 2012.

The weather pattern described above generated strong winds from the West direction beginning at the 1000 hour and lasting through the 1700 hour. Beginning at the 1000 hour, wind speeds exceeded 11.2 m/s or the historical 95th percentile of data at Holman monitoring site as shown in Figure 13-3. Peak wind speeds ranged from 8.1 m/s at Desert View monitoring site to 12 m/s at the Holman site (Figure 13-3). Peak wind gusts ranged from 16.4 m/s at Desert View to 21.3 m/s at Holman (Figure 13-4). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 13-11a-b. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (1000-1700 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 13-12a-b). Maximum hourly PM_{10} concentrations ranged from 142 µg/m^3 at West Mesa to 1067 µg/m^3 at Holman.

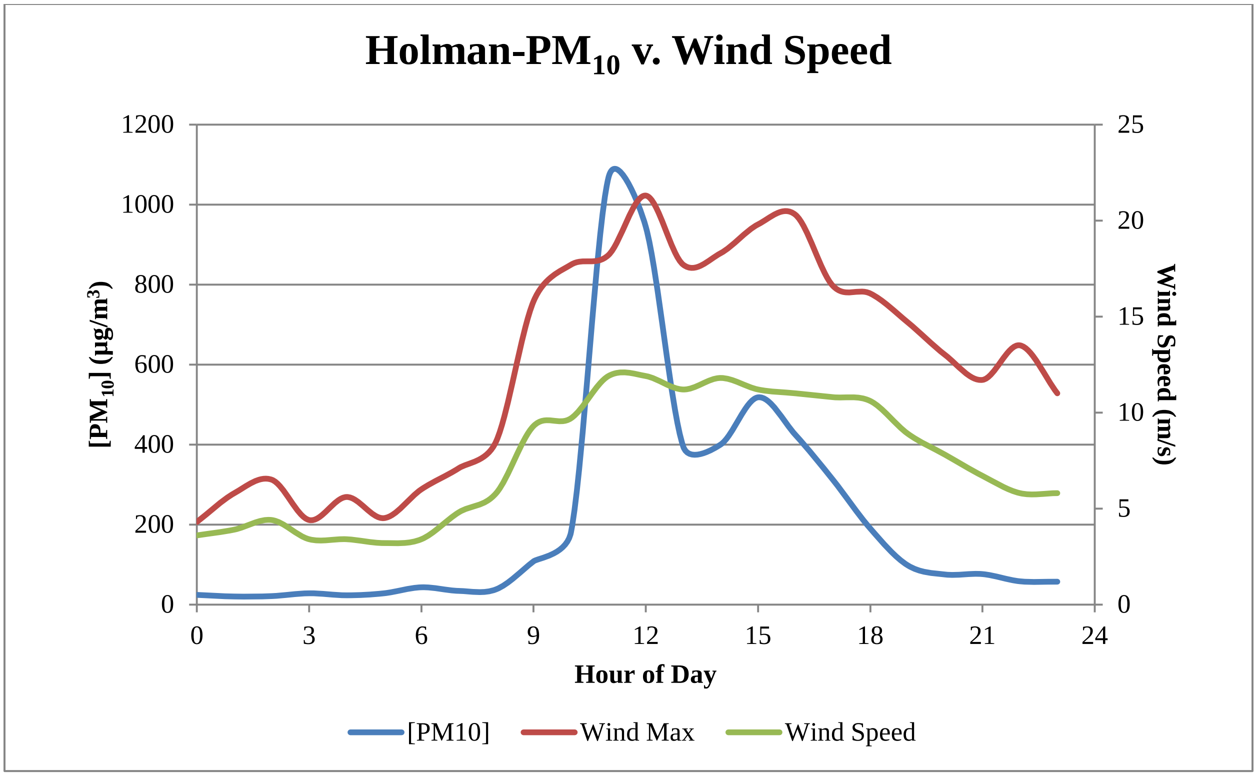


Figure 13-11a Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

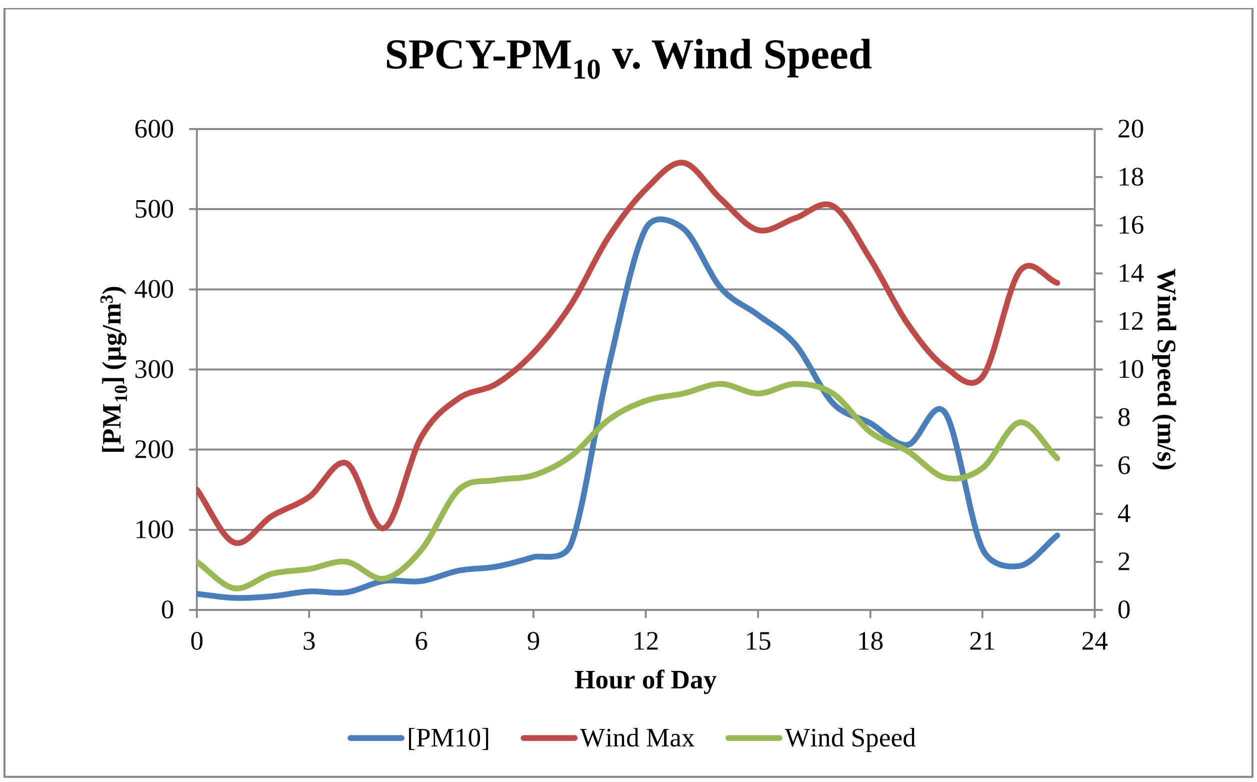


Figure 13-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

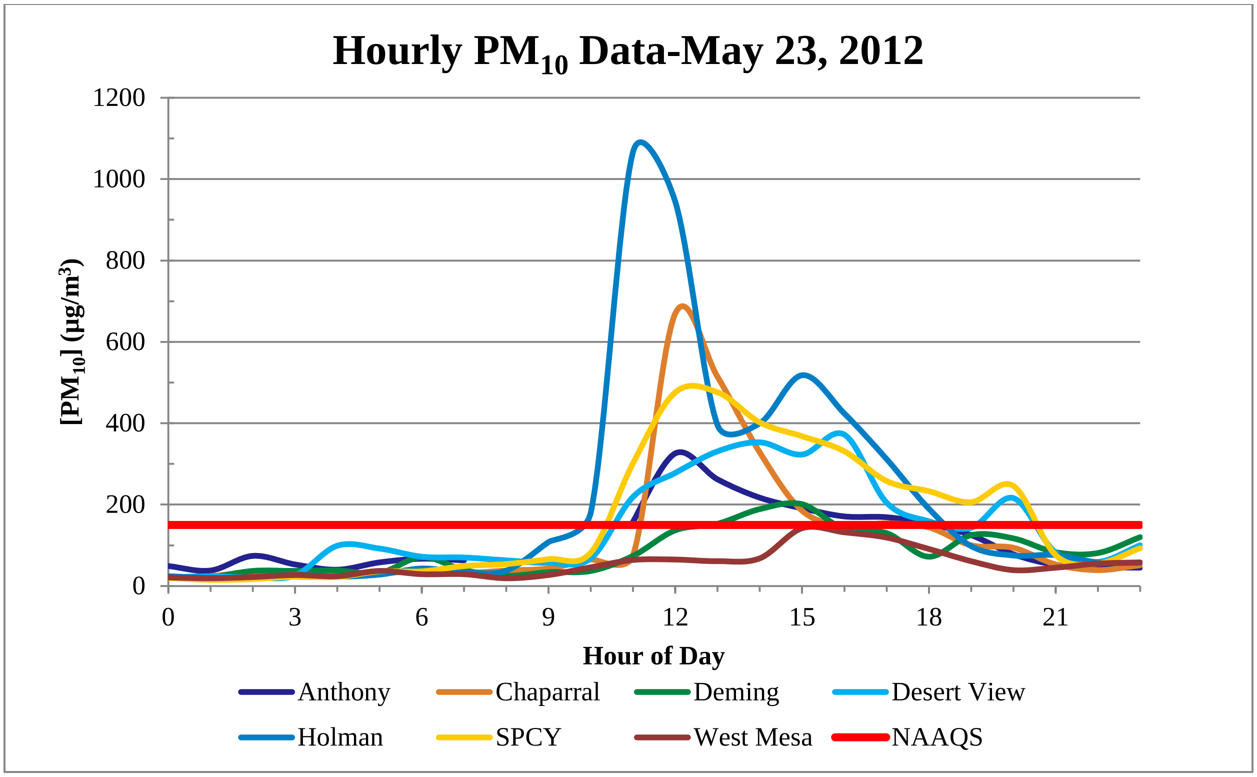


Figure 13-12a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

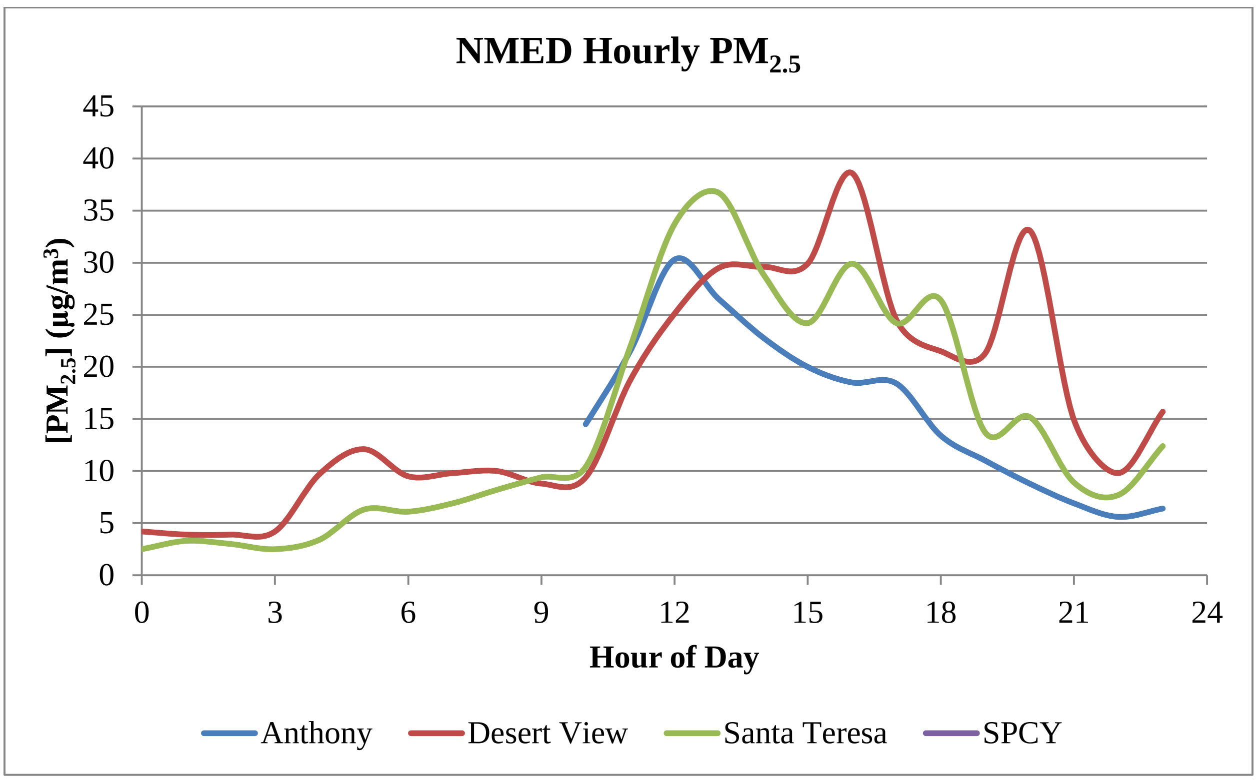


Figure 13-12b. Hourly $PM_{2.5}$ concentrations for Doña Ana and Luna Counties monitors. Non-FEM hourly $PM_{2.5}$ data.

The NM Border AQ Blog posted a notice for this day, and reported: "The AQI forecast for today shows an area of Unhealthy for Sensitive Groups (orange) over the Paso del Norte due to PM10. I am assuming that it is due to windblown dust" (DuBois, 2012).

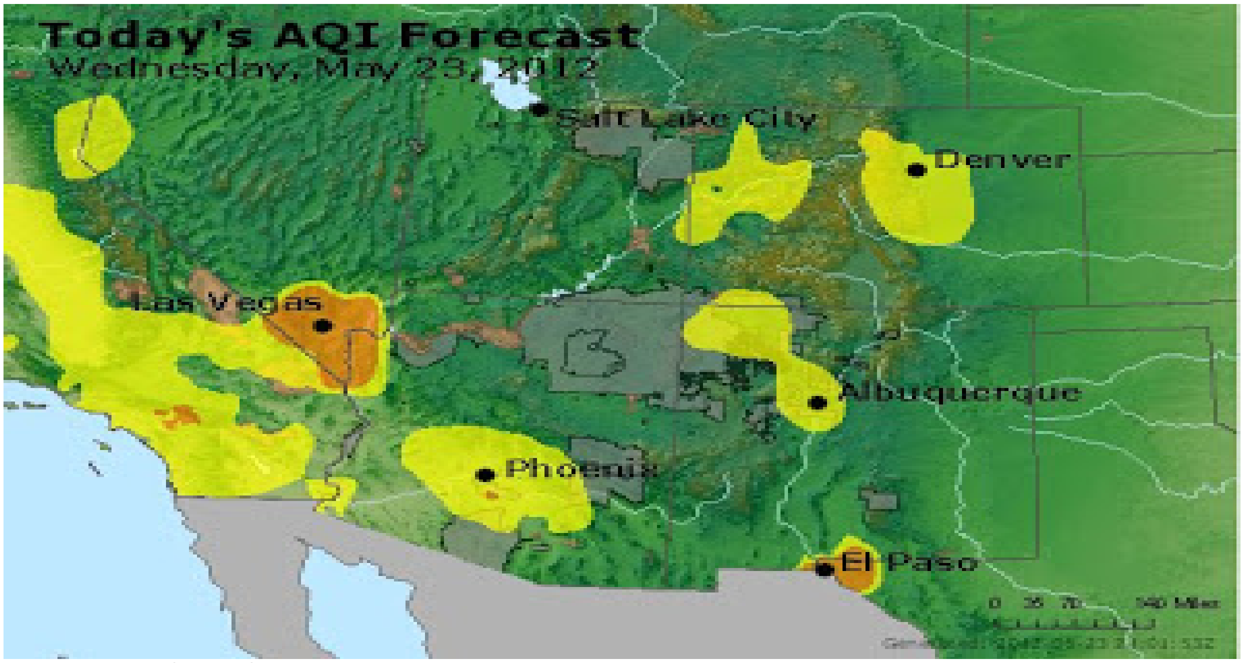


Figure 13-13 AQI forecast for May 23, 2012

Satellite imagery captured dust plumes in the four corners area and northern Mexico on this date. Large amounts of smoke from the Whitewater Baldy wildfire covered central and eastern New Mexico and west Texas (Figure 13-14).

The NWS issued a high wind advisory on this date stating in part:

> WEST WINDS WILL HAVE SUSTAINED SPEEDS AROUND 30 MPH WITH GUSTS TO 50 MPH...RESULTING IN BLOWING DUST OVER MUCH OF THE AREA. VISIBILITIES WILL BE UNDER A MILE OVER ISOLATED LOCATIONS ...ESPECIALLY ALONG PORTIONS OF INTERSTATE 10 BETWEEN EL PASO AND LAS CRUCES AND AROUND DEMING AND LORDSBURG. BLOWING DUST IS ALSO POSSIBLE ALONG THE RIO GRANDE VALLEY NEAR I-25 IN VICINITY OF HATCH (NWS, 2012).

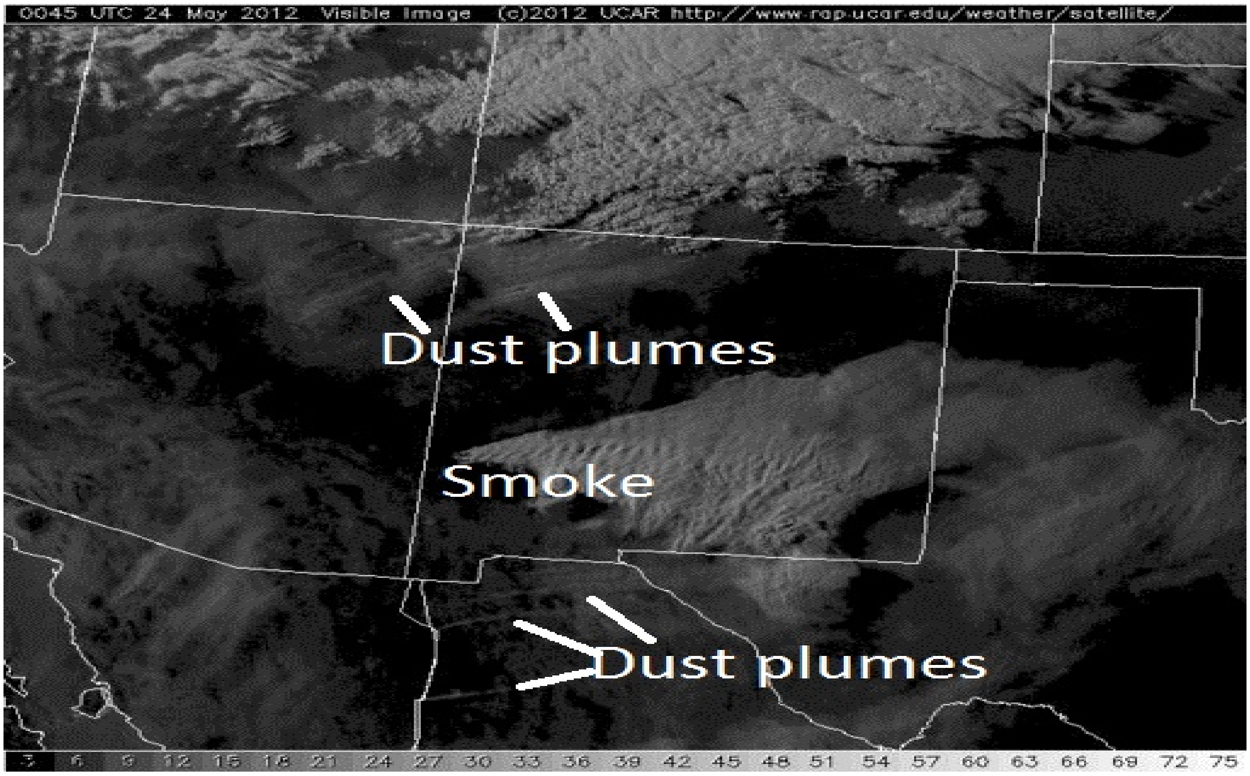


Figure 13-14. GOES satellite imagery for the 1845 hour on May 23, 2013 (Image courtesy of UCAR).

13.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on May 23, 2012.

13.6 Natural Event

The Clear Causal Relationship and not Reasonably Controllable or Preventable analyses show that this was a natural event caused by high wind and blowing dust.

13.7 No Exceedance but for the Event

The SPCY $PM_{2.5}$ monitor detected elevated levels due to blowing dust on May 23, 2012. Although these elevated concentrations do not exceed the 24-hour NAAQS for $PM_{2.5}$, they contribute to an annual exceedance level of 23.2 µg/m^3 for this date. The strong correlation between hourly $PM_{2.5}$, PM_{10} and wind speeds peaks also point to windblown dust affecting the monitor. Previous studies have shown that $PM_{2.5}/PM_{10}$ ratios vary from 0.11 to 0.45 in the Paso del Norte Airshed (Arimoto et. al, 2001; Li et al, 2001). The ratios above 0.30 were observed in downtown El Paso and Ciudad Juárez and indicate a heavy impact from mobile sources. The lower ratios were observed in areas with less vehicular traffic and crustal material dominated the PM_{10} fraction. The $PM_{2.5}/PM_{10}$ ratio for the SPCY site was 0.14 for this date ($PM_{2.5}$ Partisol/PM_{10} TEOM). NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

The Holman monitor detected blowing dust around the 1000 hour with hourly concentrations heavily impacted until the 1700. The eight hourly PM_{10} values from 1000-1700 hours alone, exceed the 24-hour average standard at Holman [(181 + 1067 + 944 + 395 + 400 + 518 + 424 + 312) $\mu g/m^3$ = 4241 $\mu g/m^3$; (4241 $\mu g/m^3$)/24 = 176 $\mu g/m^3$]. By replacing these eight hourly values with the 95th percentile of hourly data at the Holman site, the resulting 24-hour average (74 $\mu g/m^3$) does not exceed the NAAQS (Table 13-1). The values in red represent the 95th percentile of all hourly data collected at Anthony, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	24	24
1	20	20
2	21	21
3	28	28
4	23	23
5	28	28
6	43	43
7	34	34
8	38	38
9	108	108
10	181	**60**
11	1067	**73**
12	944	**88**
13	395	**113**
14	400	**131**
15	518	**132**
16	424	**132**
17	312	**126**
18	190	190
19	98	98
20	75	75
21	76	76
22	58	58
23	57	57
24-Hour Average	214	**74**

Table 13-1 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Holman.

The Sunland Park monitor detected blowing dust around the 1100 hour with hourly concentrations heavily impacted until the 1600 hour. By replacing these six hourly values with the 95th percentile of hourly data at the Sunland Park site, the resulting 24-hour average (108 µg/m^3) does not exceed the NAAQS (Table 13-2). The values in red represent the 95th percentile of all hourly data collected at Sunland Park, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	20	20
1	15	15
2	17	17
3	23	23
4	22	22
5	36	36
6	36	36
7	49	49
8	54	54
9	66	66
10	82	82
11	302	**111**
12	476	**144**
13	476	**164**
14	402	**185**
15	368	**205**
16	331	**203**
17	258	258
18	233	233
19	206	206
20	246	246
21	76	76
22	55	55
23	93	93
24-Hour Average	164	**108**

Table 13-2. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Sunland Park.

14 HIGH WIND EXCEPTIONAL EVENT: June 15, 2012

14.1 Summary of Event

Thunderstorms caused high winds and blowing dust in Doña Ana and Luna Counties resulting in an exceedance of the PM_{10} and $PM_{2.5}$ 24-hour NAAQS and the $PM_{2.5}$ annual NAAQS at the Anthony, Deming, Desert View, and Sunland Park on this date. The FEM TEOM continuous monitors at Anthony, Deming, and Desert View recorded 24-hour average concentrations of 167, 215, 203 $\mu g/m^3$, respectively. The FRM Partisol monitor at Sunland Park recorded a 24-hour average concentration of 22 $\mu g/m^3$. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured at Chaparral (99 $\mu g/m^3$), Holman (75 $\mu g/m^3$), Sunland Park (143 $\mu g/m^3$), and West Mesa (75 $\mu g/m^3$) (Figure 14-1). The averages in this figure were calculated using PM_{10} FEM TEOM and $PM_{2.5}$ FRM Partisol instrument data for the four days before and after the event. Elevated concentrations were also recorded by the $PM_{2.5}$ non-FEM/FRM TEOMs (Figure 14-2).

As the event unfolded, the wind blew from the Southwest direction throughout the border region. These high velocity winds passed over large areas of desert within Texas, New Mexico and Mexico. The co-occurrence of high winds and elevated levels of blowing dust, little to no point sources in the area, and the high hourly and daily PM_{10} and $PM_{2.5}$ concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

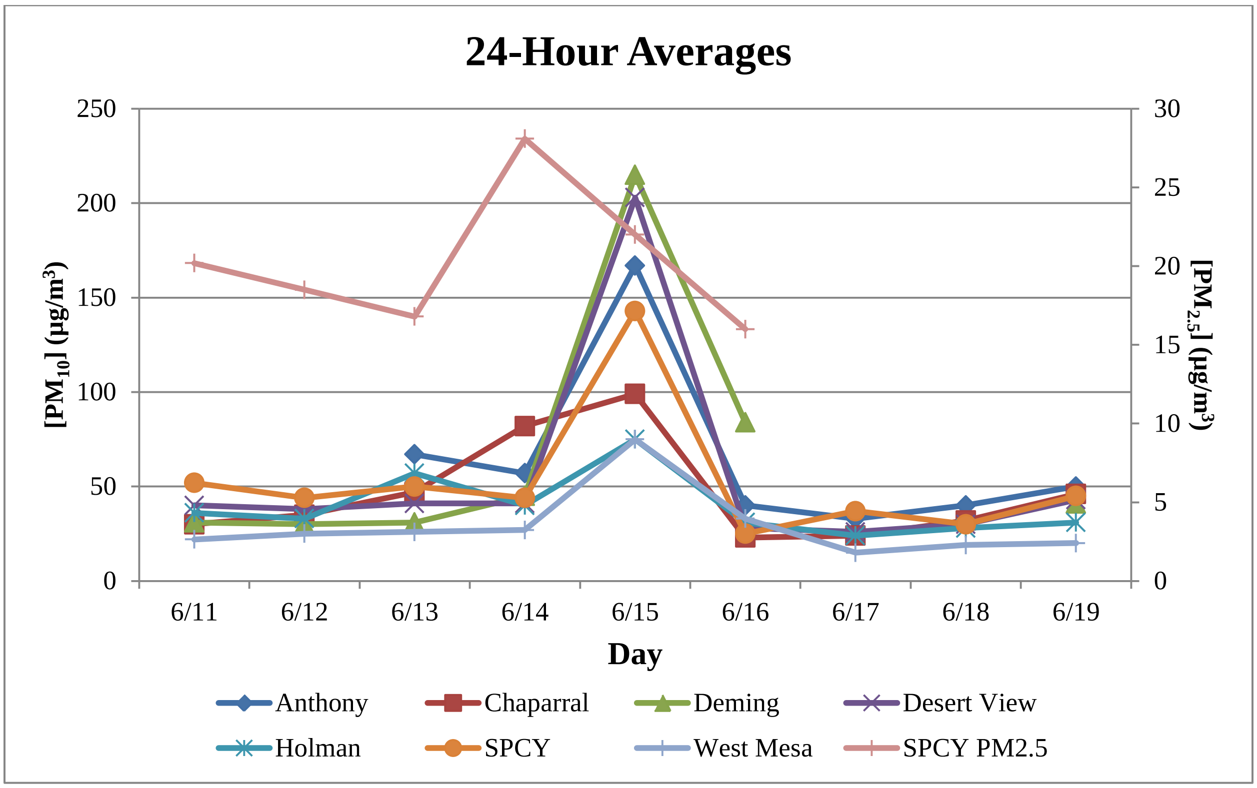


Figure 14-1 PM_{10} 24-hour averages before and after June 15, 2012.

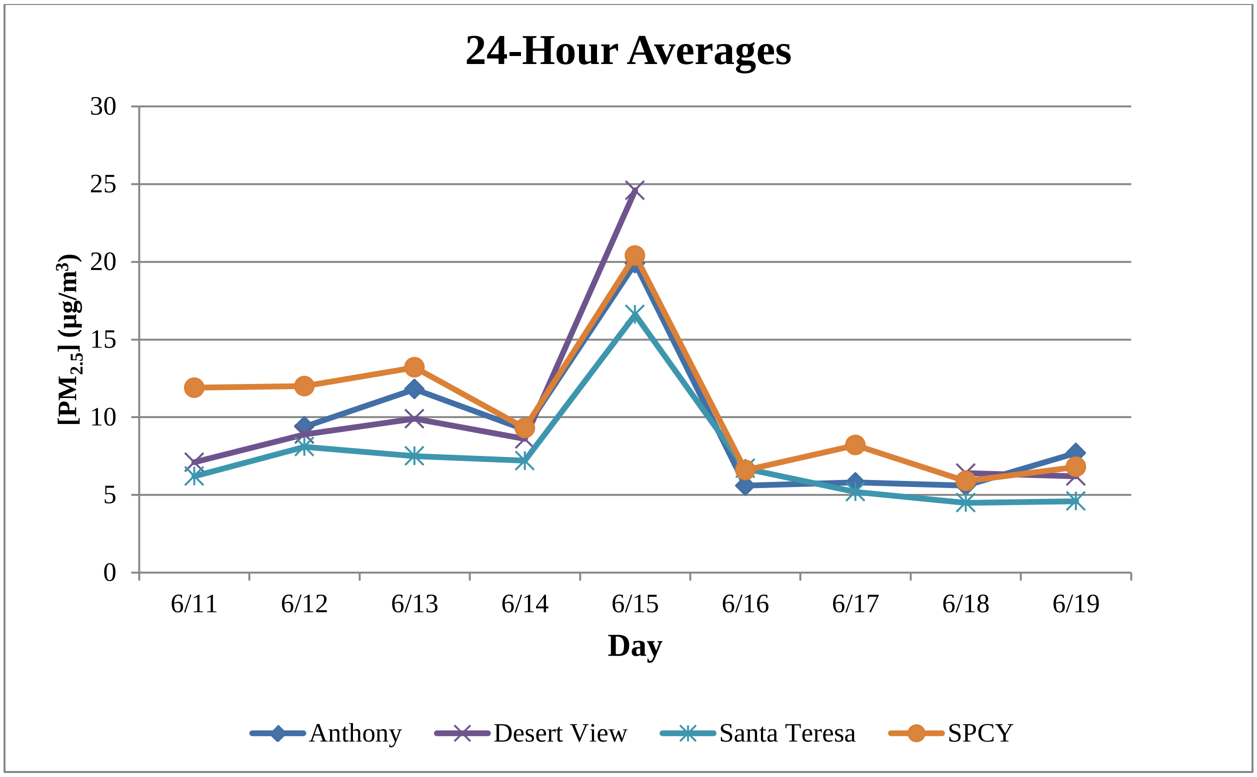


Figure 14-2 $PM_{2.5}$ 24-hour averages before and after June 15, 2012. Non-FEM TEOM Data.

14.2 Is Not Reasonably Controllable or Preventable

14.2.1 Suspected Source Areas and Categories Contributing to the Event

Sources of windblown dust contributing to this exceedance include the natural desert, residential properties, agricultural land and unpaved roads in Texas, Mexico and New Mexico. City of Las Cruces, City of Deming and Doña Ana and Luna Counties Ordinances requires BACM for any dust producing activities. The largest and most likely sources of windblown dust are the natural desert and the playas of northern Mexico (see Section 14.2.4 below).

14.2.2 Sustained and Instantaneous Wind Speeds

EPA uses a default entrainment threshold of sustained wind speeds at 11.2 m/s (25 mph) for natural and well controlled anthropogenic sources contributing to natural events caused by high wind and blowing dust (EPA, 2013). Under the Doña Ana and Luna County NEAPs, EPA and NMED agreed that wind gusts exceeding 18 m/s would overwhelm any natural and well-controlled anthropogenic sources and cause windblown dust. On June 15, 2012, sustained wind speeds exceeded EPA's default threshold at two of the eight monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at six of the eight monitoring sites (Figures 14-3 and 14-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 1700 hour and ending at the 2100 hour.

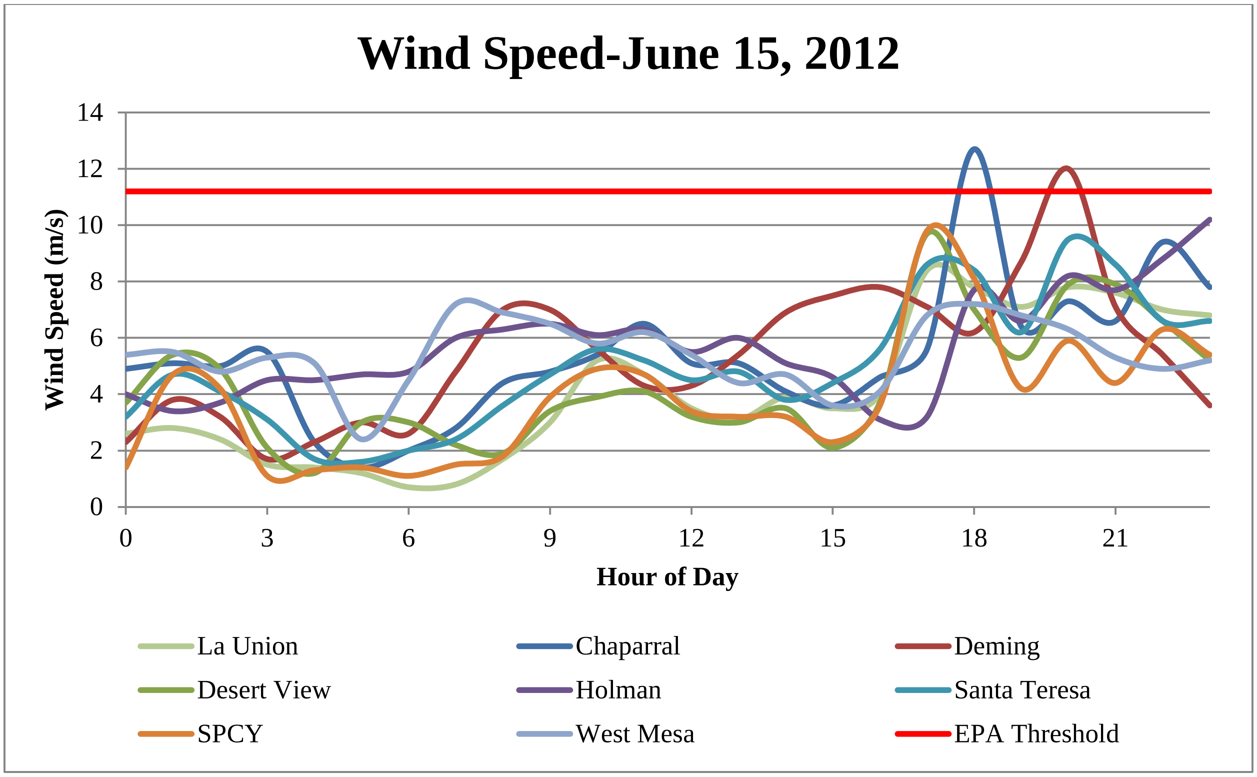


Figure 14-3 Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

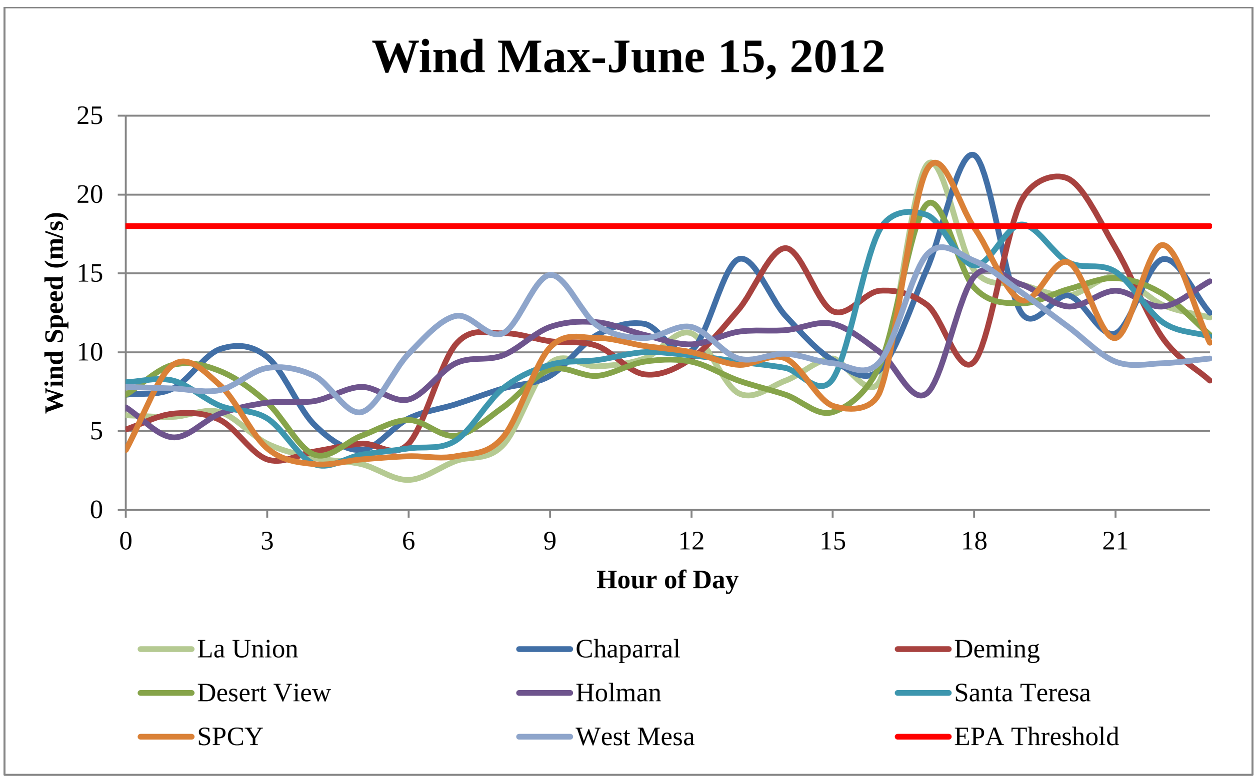


Figure 14-4 Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

14.2.3 Recurrence Frequency

The monitoring sites in Doña Ana and Luna Counties can record exceedances of the PM_{10} NAAQS throughout the year. From 2007-2011 the PM_{10} FEM TEOM monitors recorded 254 exceedances and the PM_{10} FRM Wedding monitors recorded 6 exceedances (Figure A-1). The Deming Airport and Desert View monitoring sites (FEM TEOMs) were established in 2006 and 2007 respectively and do not show exceedances until the year following startup. The SPCY $PM_{2.5}$ FRM Partisol recorded 37 exceedances of the 24-Hour NAAQS from 2007-2011 (Figure A-2). See appendix A for a more in-depth discussion about recurrence frequency and the number of exceedances at each monitoring site.

14.2.4 Controls Analysis

The local ordinances and MOUs adopted under the NEAP direct the implementation of BACM for sources of dust in Doña Ana and Luna Counties. The ordinances regulate disturbed lands, construction and demolition, vacant parking lots and materials handling and transportation. Our investigation did not identify any unusual PM_{10} producing activities on this day, and anthropogenic emissions remained constant before, during and after the event. The most likely source contributing to the event is the natural desert and playas in New Mexico, Texas, Arizona and northern Mexico. A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from Texas, Arizona and Mexico to the monitors in Doña Ana and Luna Counties. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 4-5). Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in Texas, Arizona and/or Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

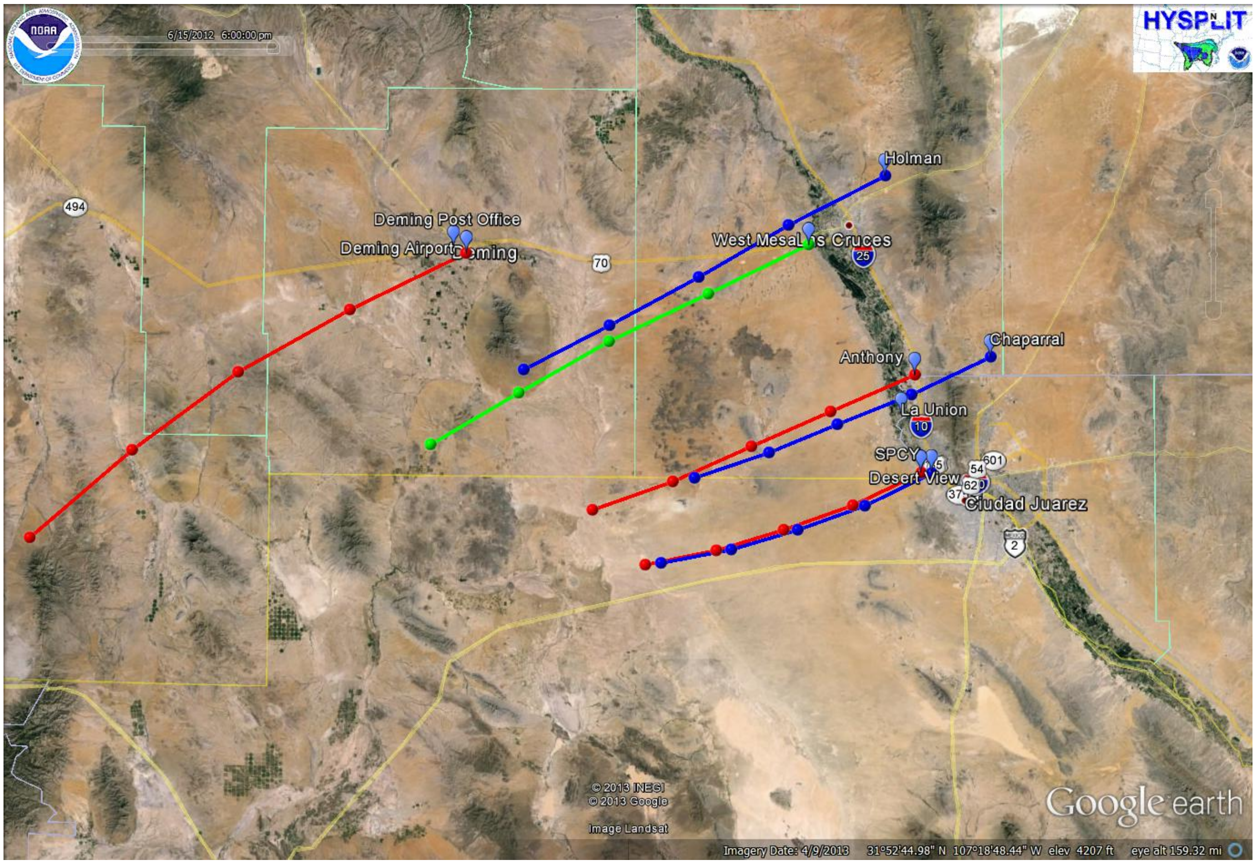


Figure 14-5 HYSPLIT back-trajectory model analysis for June 15, 2012.

14.3 Historical Fluctuations Analysis

14.3.1 Annual and Seasonal 24-hour Average Fluctuations

Since being established, the monitoring sites in Doña Ana and Luna Counties have recorded exceedances of the PM_{10} NAAQS. High winds cause these exceedances and they can occur at any time of year (Figure B-6 through B-13). Most exceedances occur from late winter through early summer (February-June) and are associated with the passage of Pacific cold fronts. High winds caused all recorded exceedances from 2007-2011 and NMED submitted natural events demonstrations to EPA under the NEAP or EER.

Since the 24-hour $PM_{2.5}$ NAAQS was lowered from 65 to 35 µg/m^3 in 2006, the SPCY Partisol monitor has routinely recorded exceedances of the standard. These exceedances occurred throughout the year during high and low wind conditions. In 2009, NMED investigated the cause of the low wind exceedances and found that emissions from Ciudad Juárez, Mexico contribute significantly to elevated concentrations. The high wind exceedances were caused by blowing dust on days when PM_{10} monitors also recorded exceedances.

Appendix B contains a more in-depth discussion about historical fluctuations and charts showing annual and seasonal trends at each monitoring site.

Table B-1 and B-2 show normal historical fluctuations with and without high wind natural events that caused exceedances from 2007-2011. The analysis excludes only those high wind events that resulted in an exceedance. Data for PM_{10} in this table includes FRM Wedding and FEM TEOM measurements and data for $PM_{2.5}$ comes from the FRM Partisol measurements from 2007-2011. The recorded values for this day (167, 215, 203 µg/m^3) are above the maximum values recorded when no high wind exceedances are included and is above the 95th percentile of all 24-hour averages recorded.

An hourly data distribution analysis was performed for PM_{10} and $PM_{2.5}$ concentrations, wind speeds and wind gusts (Appendices C, D and E). All data used for the PM_{10} distribution charts come from the FEM TEOM monitors and the non-FEM/FRM $PM_{2.5}$ TEOM monitor at SPCY. Overlaying the hourly data for June 15, 2012 on the hourly data distribution plots shows that the values recorded during the high wind event exceed the 95th percentile for PM_{10}, $PM_{2.5}$, wind speed and wind gusts (Figures 14-6a-d through 14-8a-c). The top whiskers of the box and whisker plots represent the 95th percentile of data. The hourly PM_{10} values during the high wind blowing dust storm far exceed the historical 95th percentile of data.

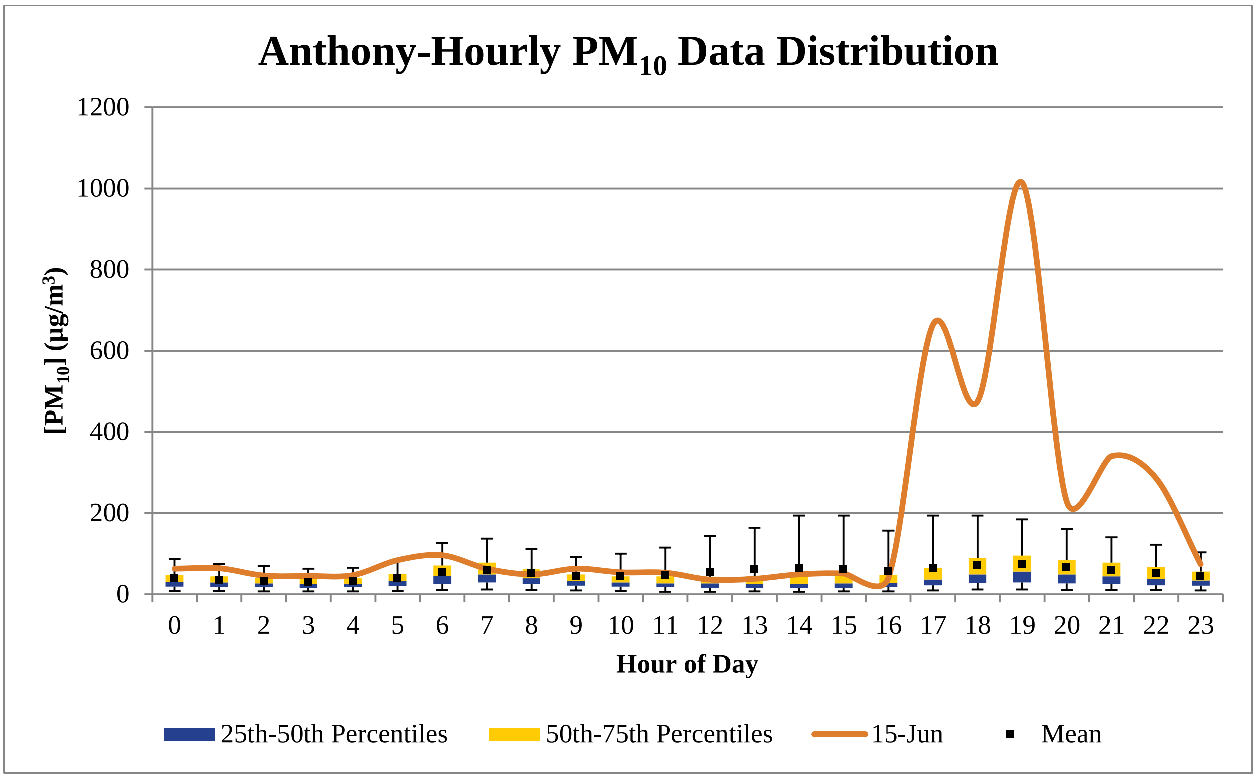


Figure 14-6 PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for June 15, 2012.

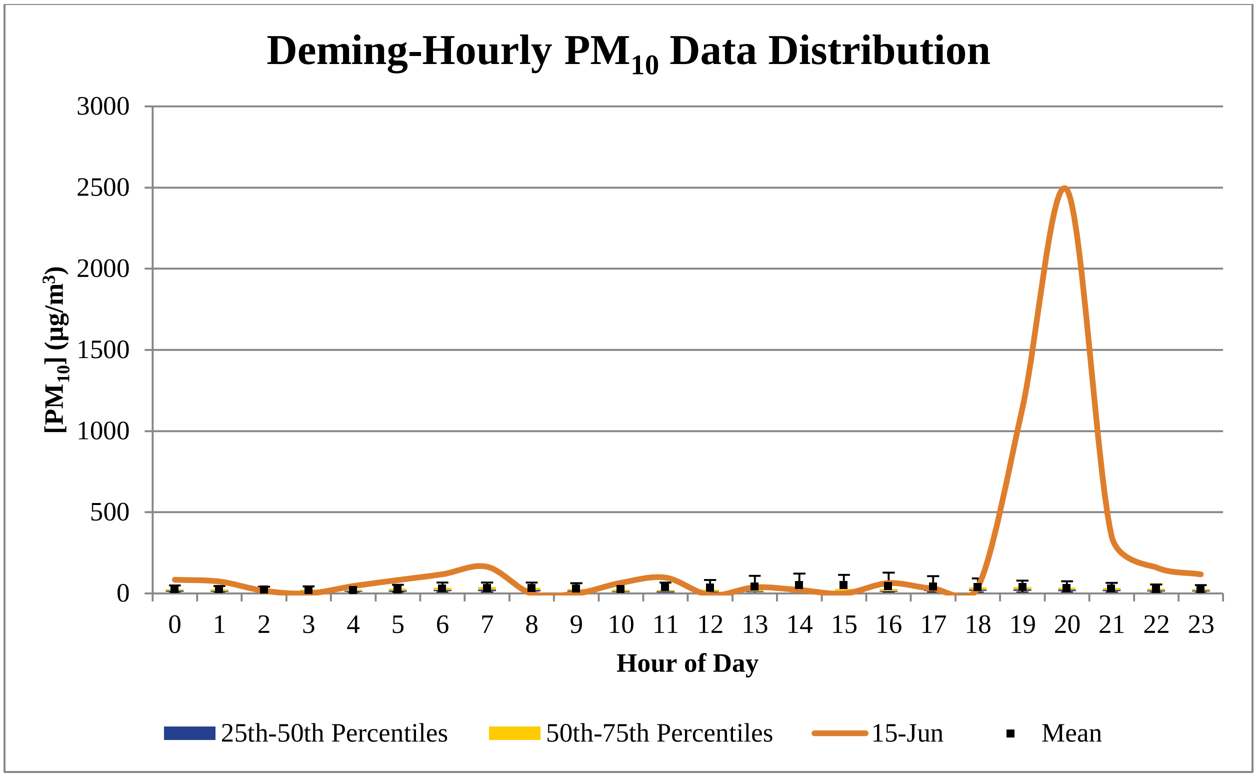


Figure 14-6b PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for June 15, 2012.

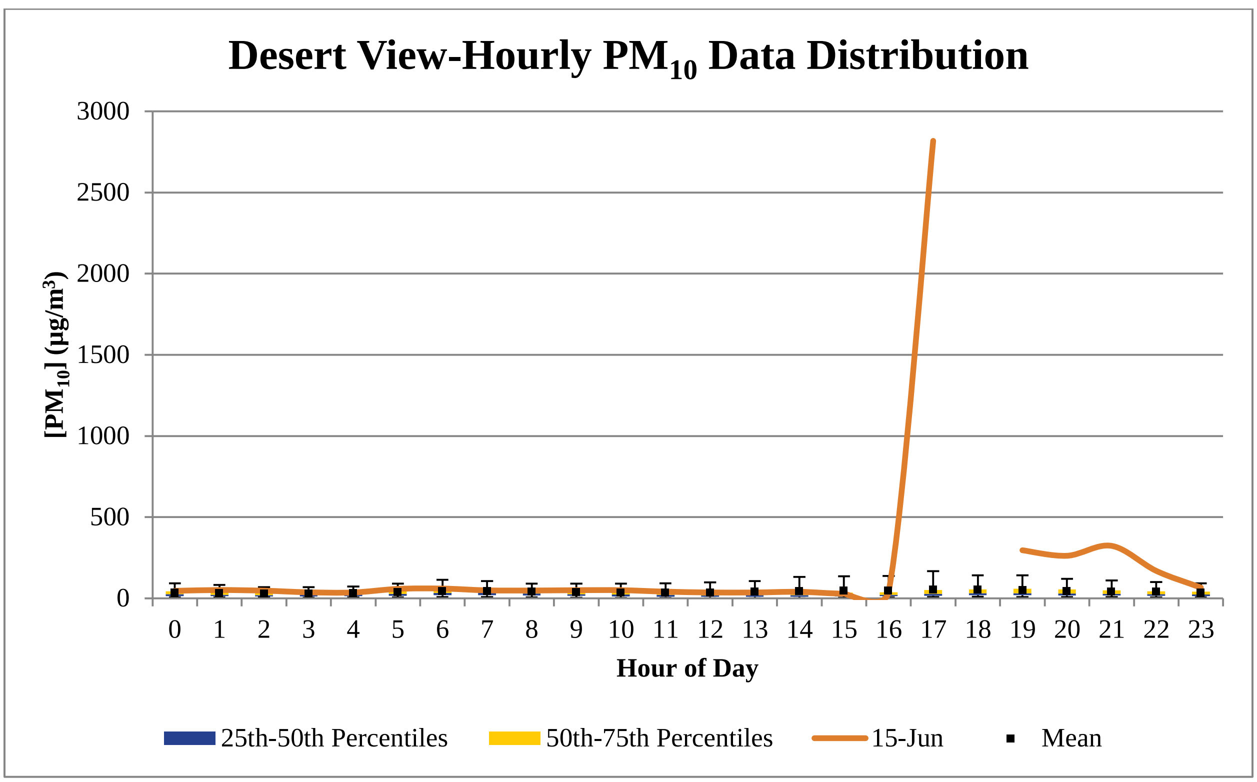


Figure 14-6c PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for June 15, 2012.

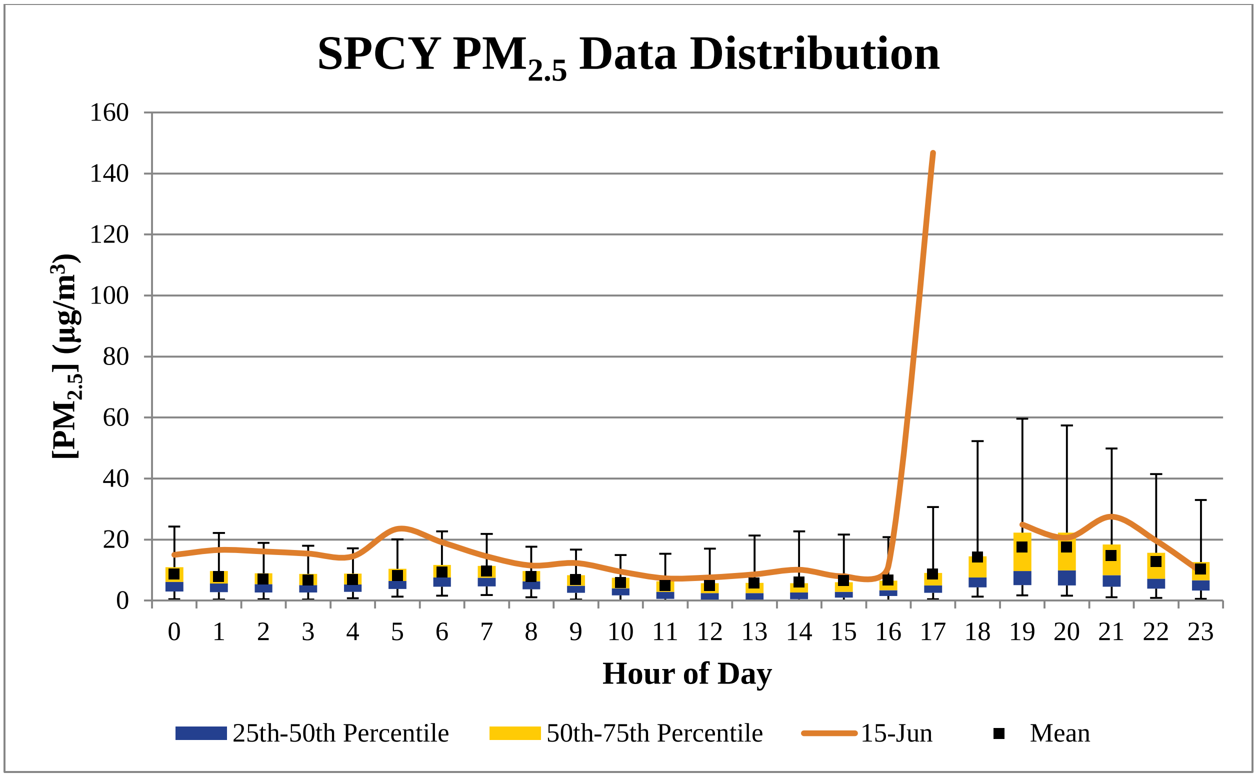


Figure 14-6d $PM_{2.5}$ hourly data distribution from 2007-2011 overlaid by hourly values for June 15, 2012.

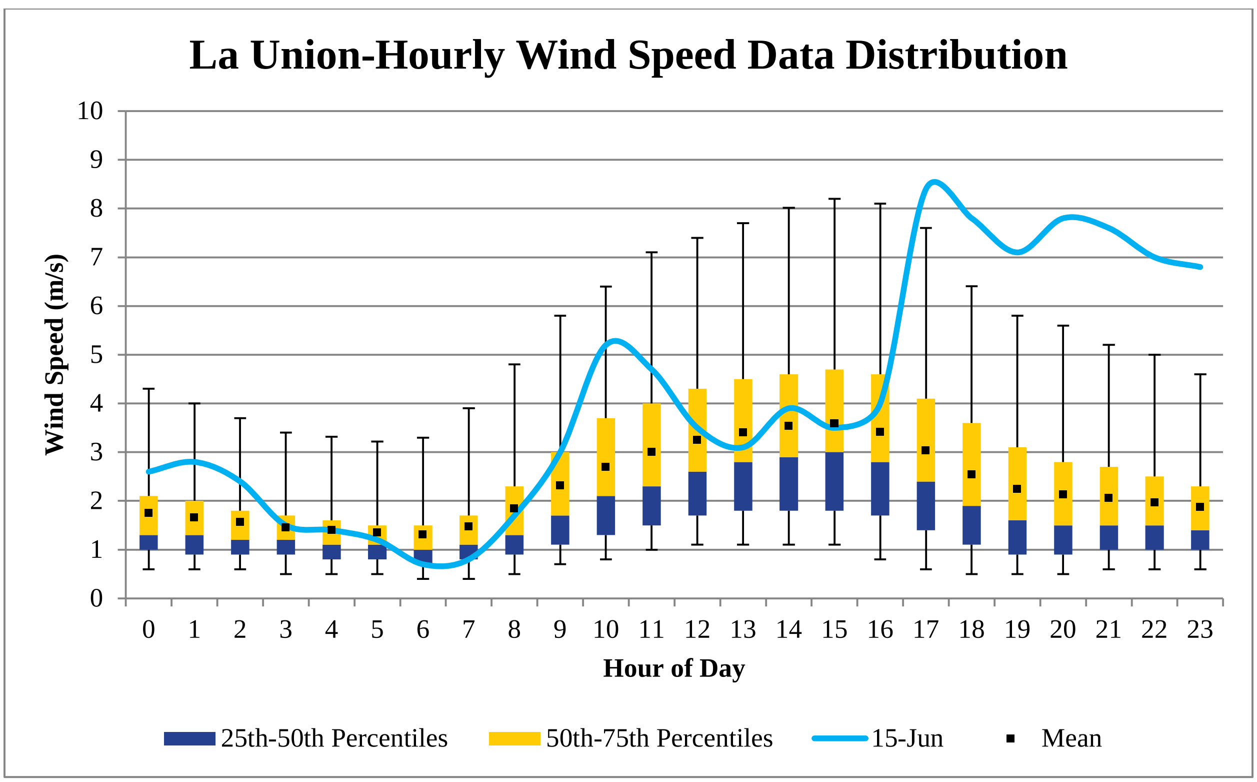


Figure 14-7a Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for June 15, 2012.

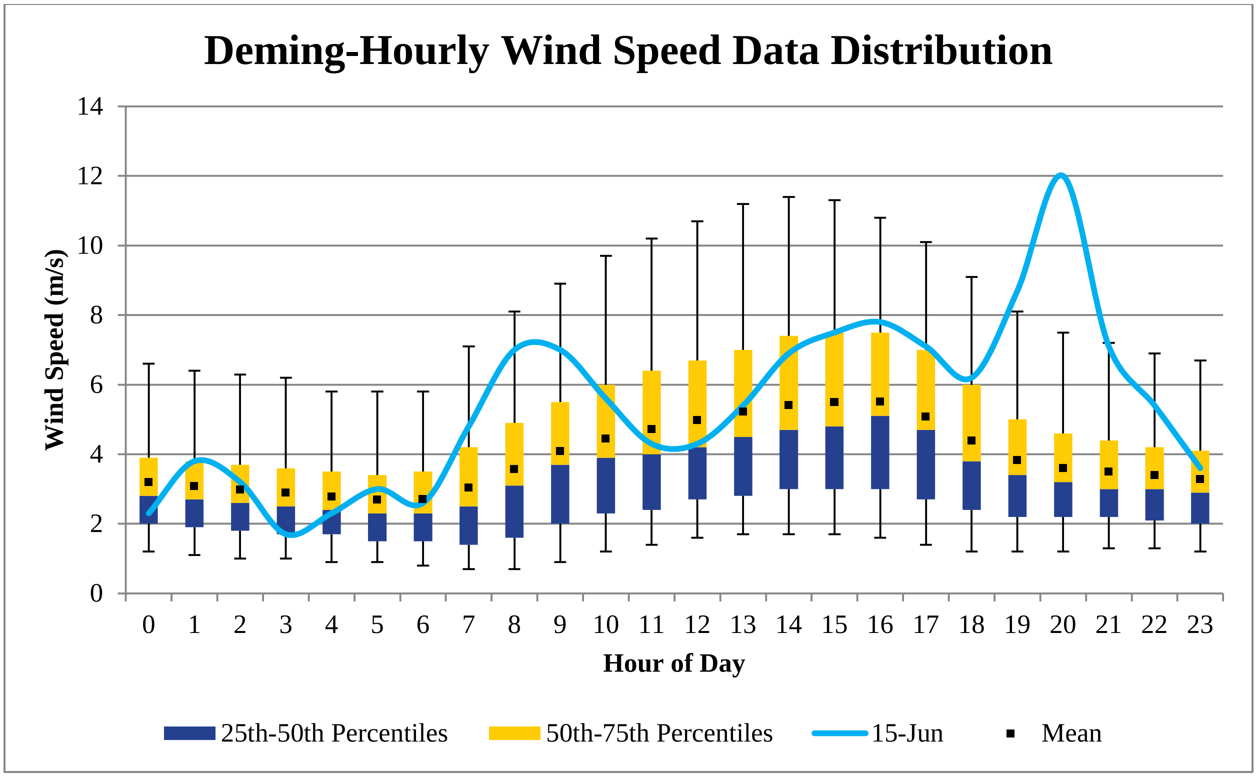


Figure 14-7b Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for June 15, 2012.

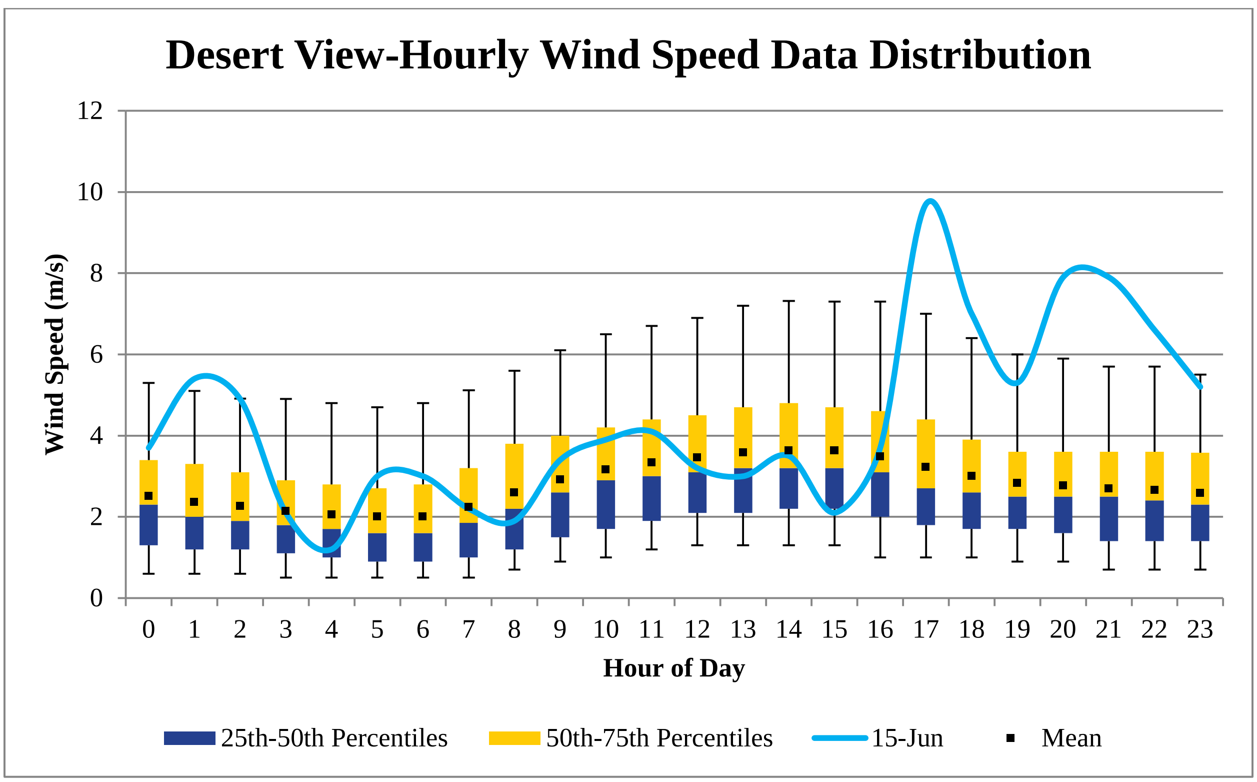


Figure 14-7c Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for June 15, 2012.

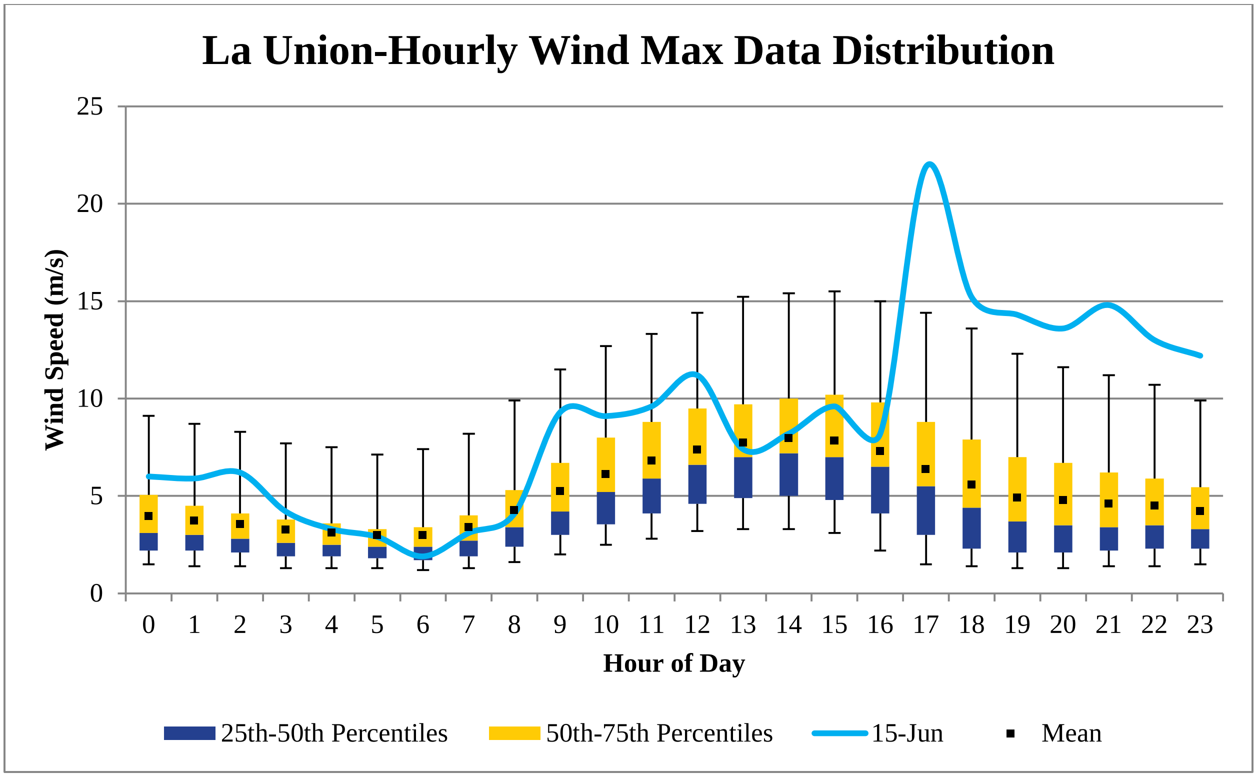


Figure 14-8a Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for June 15, 2012.

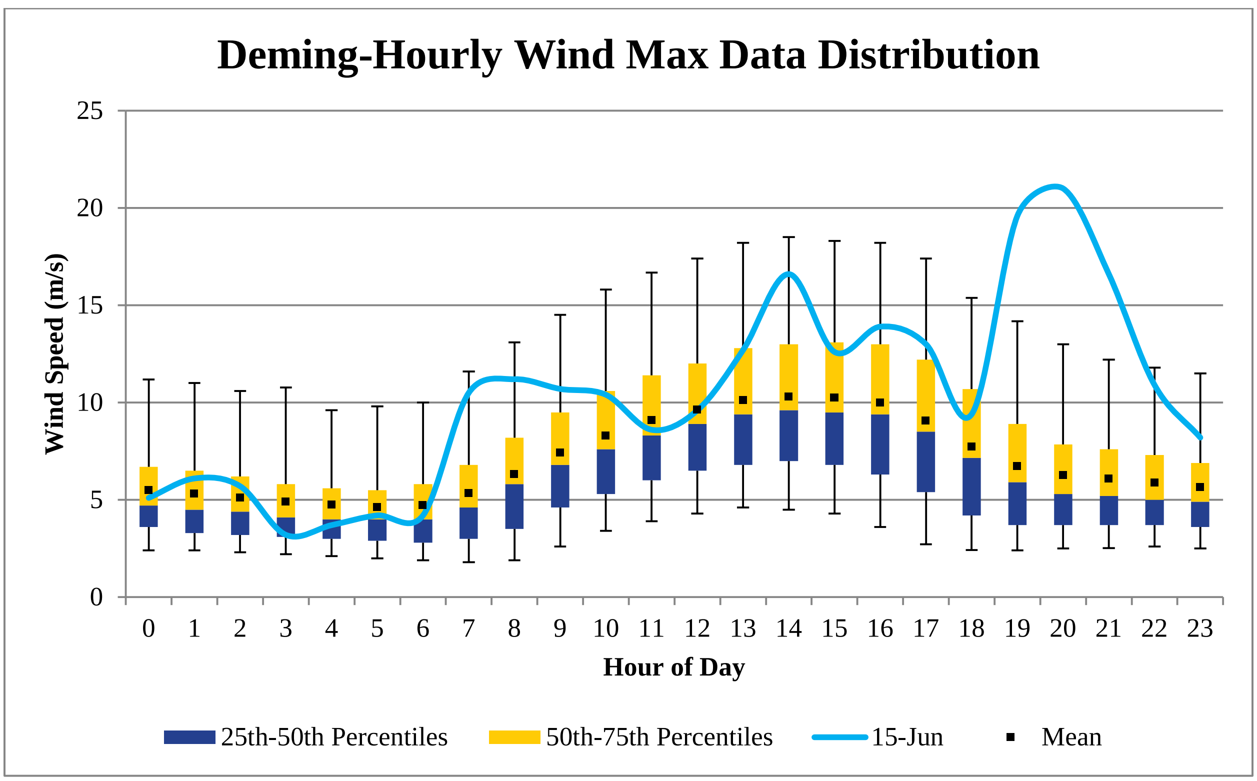


Figure 14-8b Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for June 15, 2012.

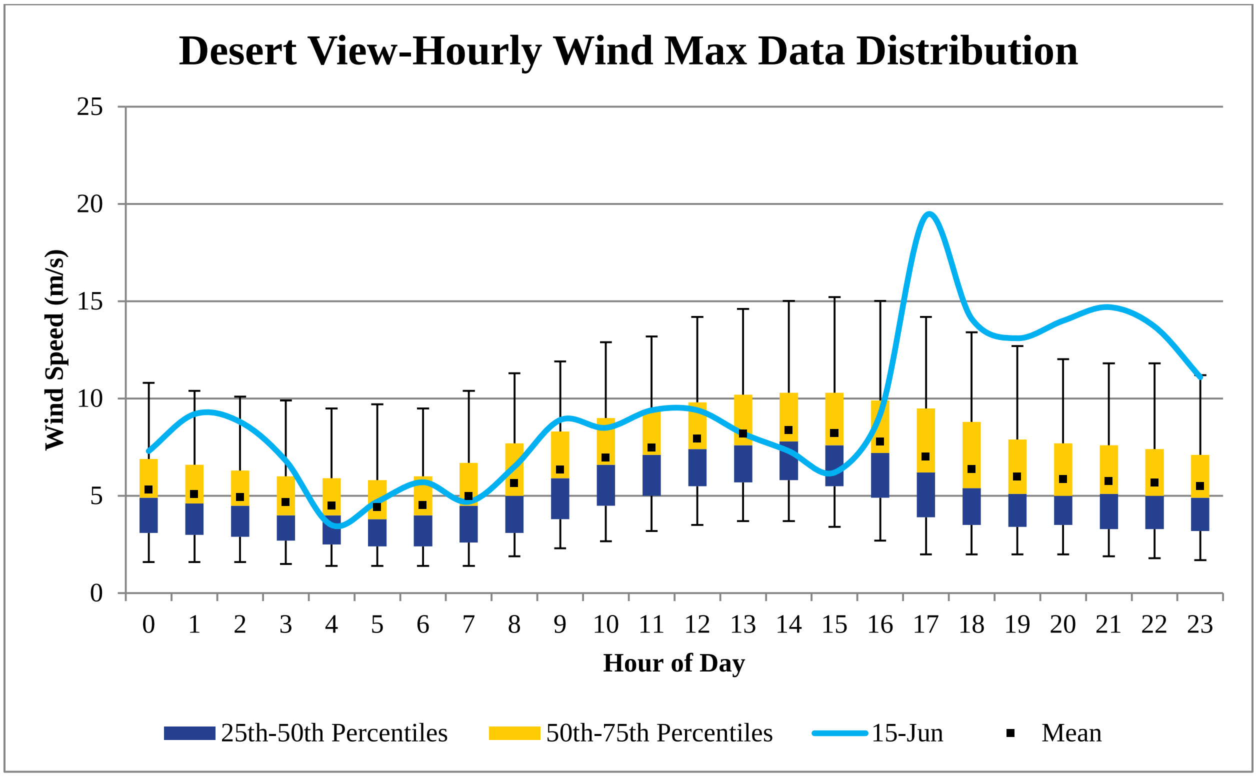


Figure 14-8c Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for June 15, 2012.

14.4 Clear Causal Relationship

Severe thunderstorms caused high winds and blowing dust on June 15, 2012. Moisture was present in the upper atmosphere all along the border (Figure 14-9). Day time heating allowed for convection and forming thunderstorms in the afternoon (Figure 14-10). The windy conditions were caused by a dry microburst or combination of dry microburst and outflow boundary winds as there was less moisture in lower levels of the atmosphere (Figure 14-11).

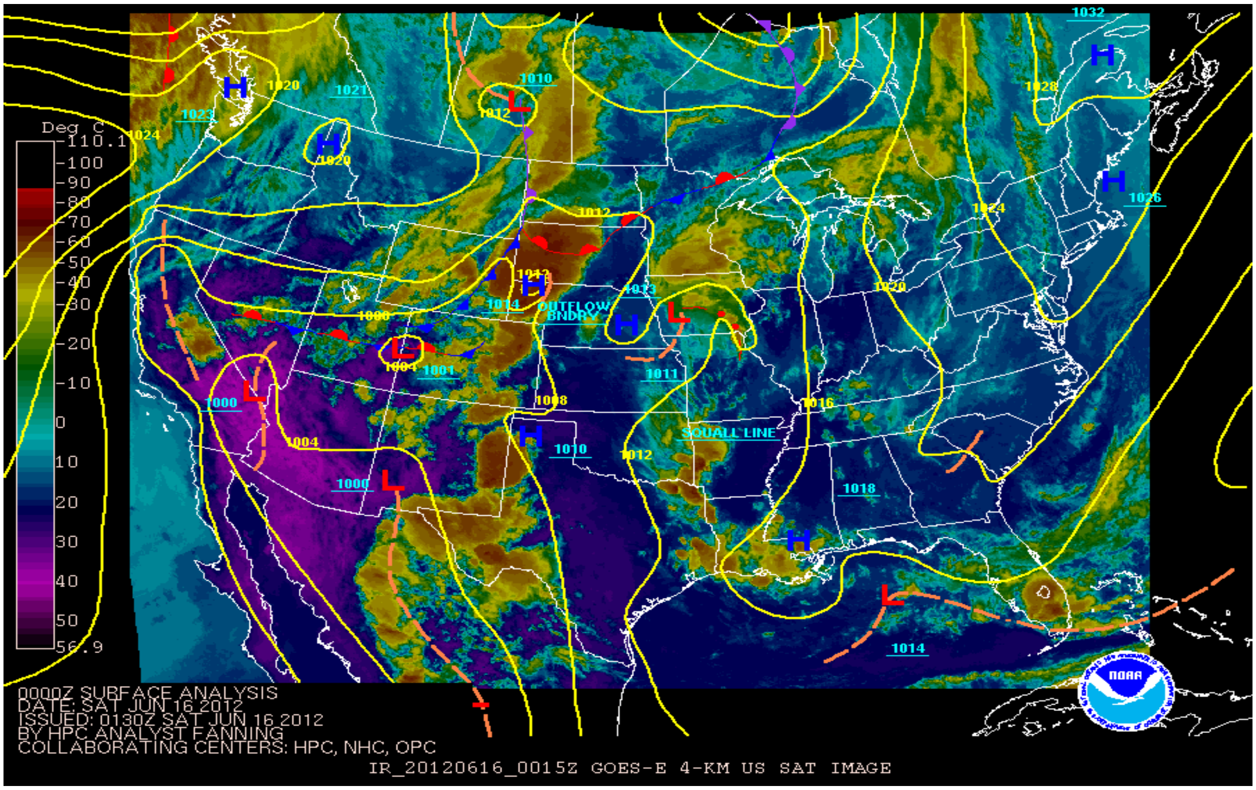


Figure 14-9. Surface weather map with IR imagery showing moisture in the region at the 1800 hour on June 15, 2012.

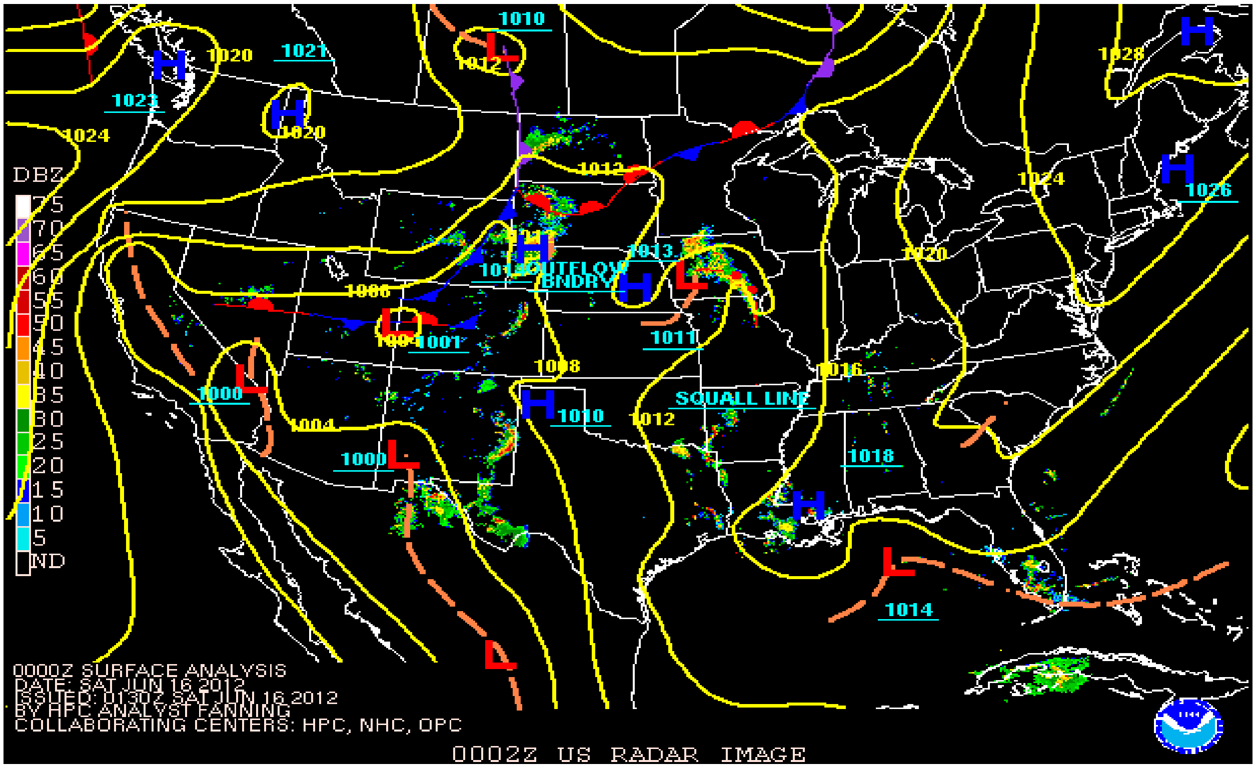


Figure 14-10 Surface weather map with radar images showing thuderstorm activity for June 15, 2012 at the 1800 hour.

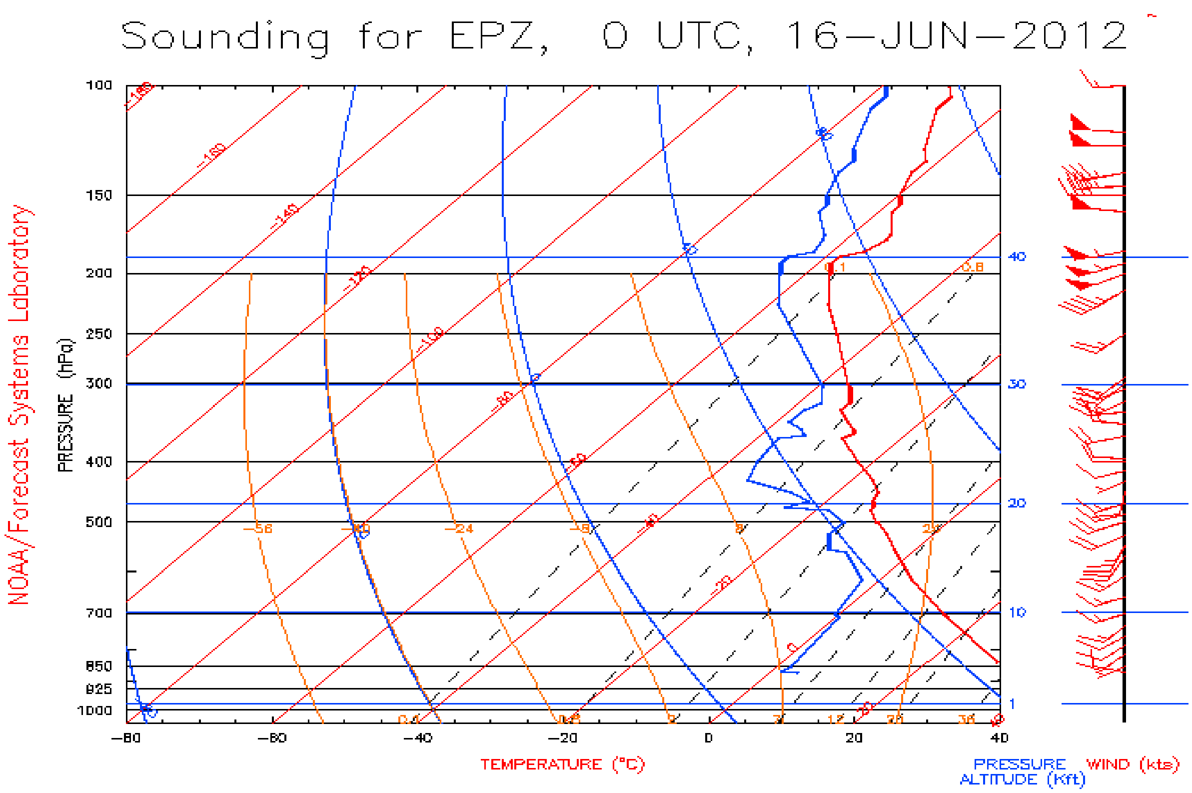


Figure 14-11. Skewt plot showing temperature and relative humidity at the 1800 hour on June 15, 2012.

The weather pattern described above generated strong winds from the Southwest direction beginning at the 1700 hour and lasting through the 2100 hour. Beginning at the 1800 hour, wind speeds exceeded 11.2 m/s at the Chaparral monitoring site as shown in Figure 14-3. Peak wind speeds ranged from 12.7 m/s at Chaparral to 7.2 m/s at West Mesa (Figure 14-3). Peak wind gusts ranged from 16.2 m/s at West Mesa to 22.5 m/s at Chaparral (Figure 14-4). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 14-12a-d. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (1600-2100 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 14-13a-b). Maximum hourly PM_{10} concentrations ranged from 271 µg/m^3 at West Mesa to 2818 µg/m^3 at Desert View. Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 14-14).

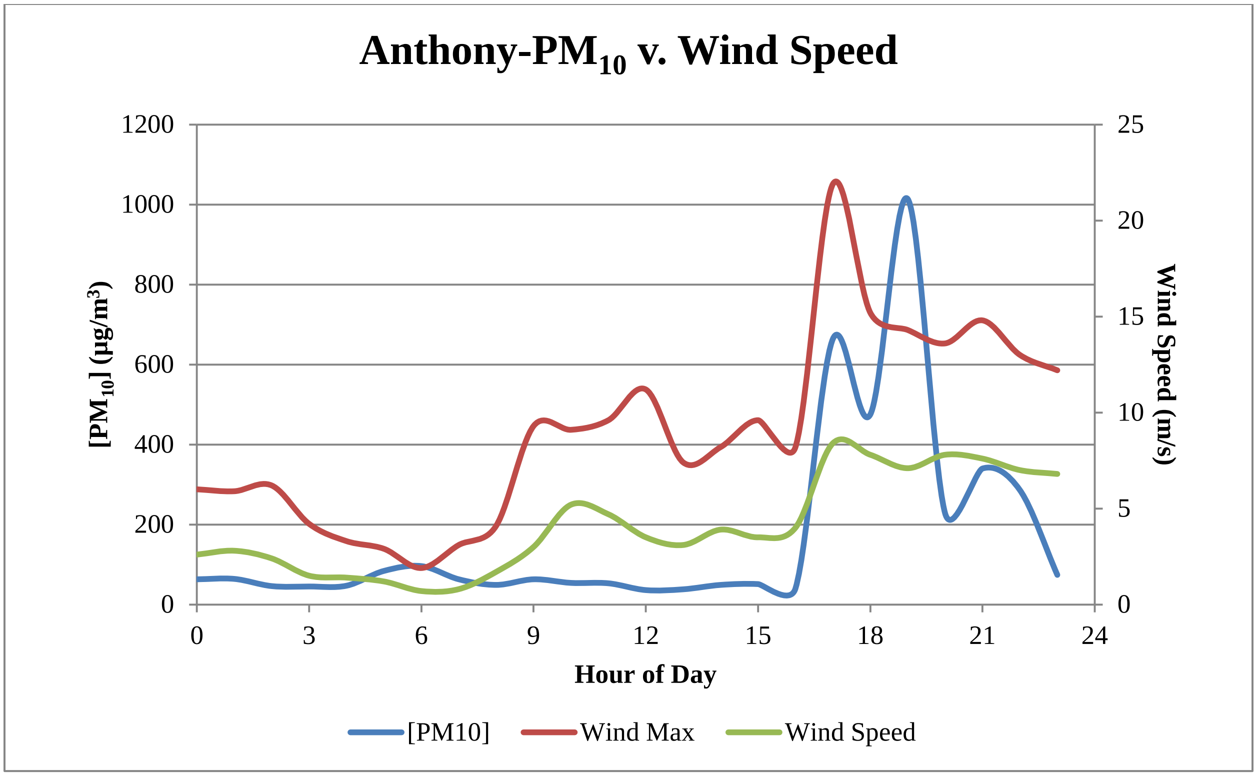


Figure 14-12a Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

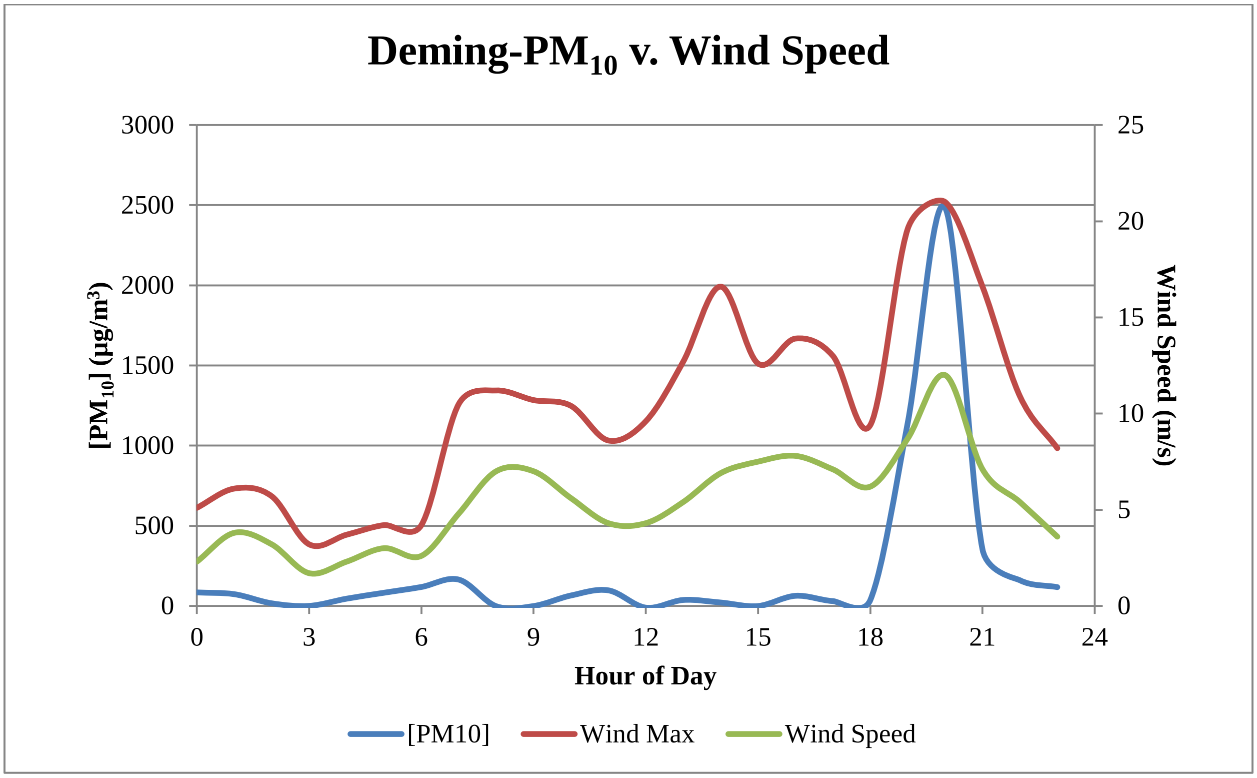


Figure 14-12b Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

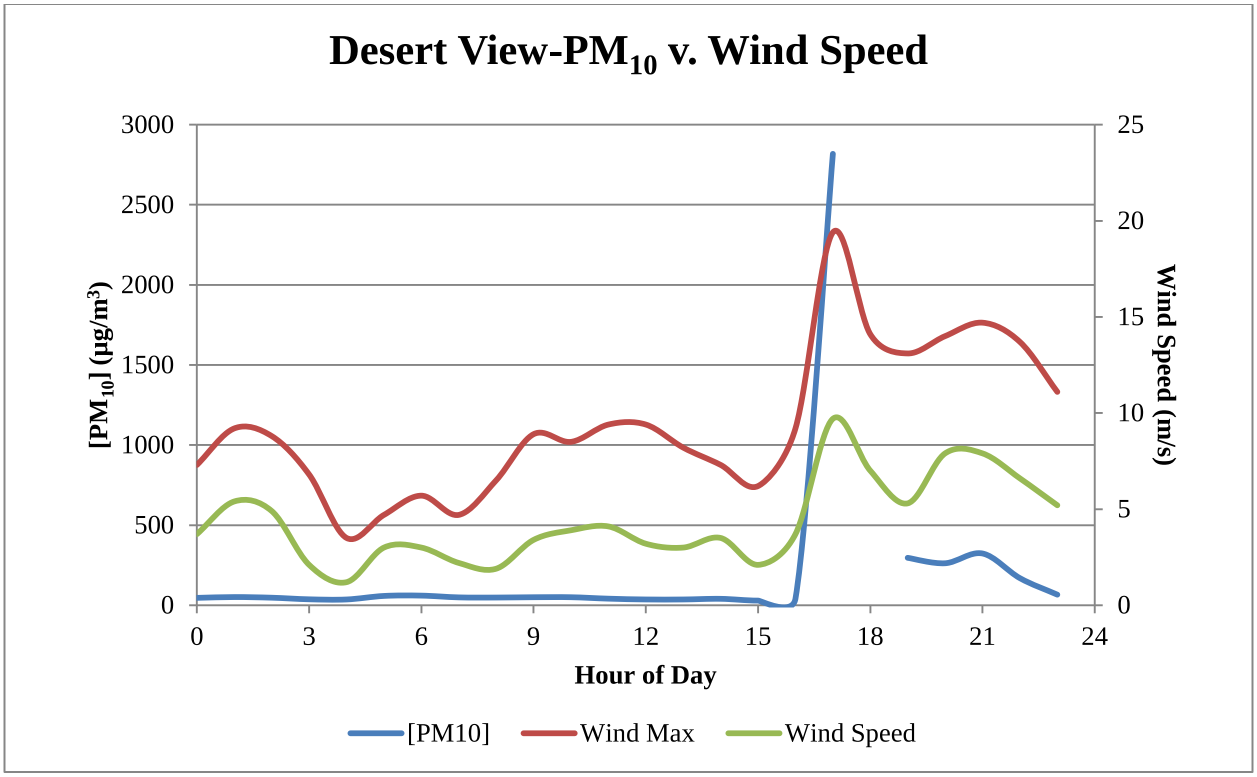


Figure 14-12c Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

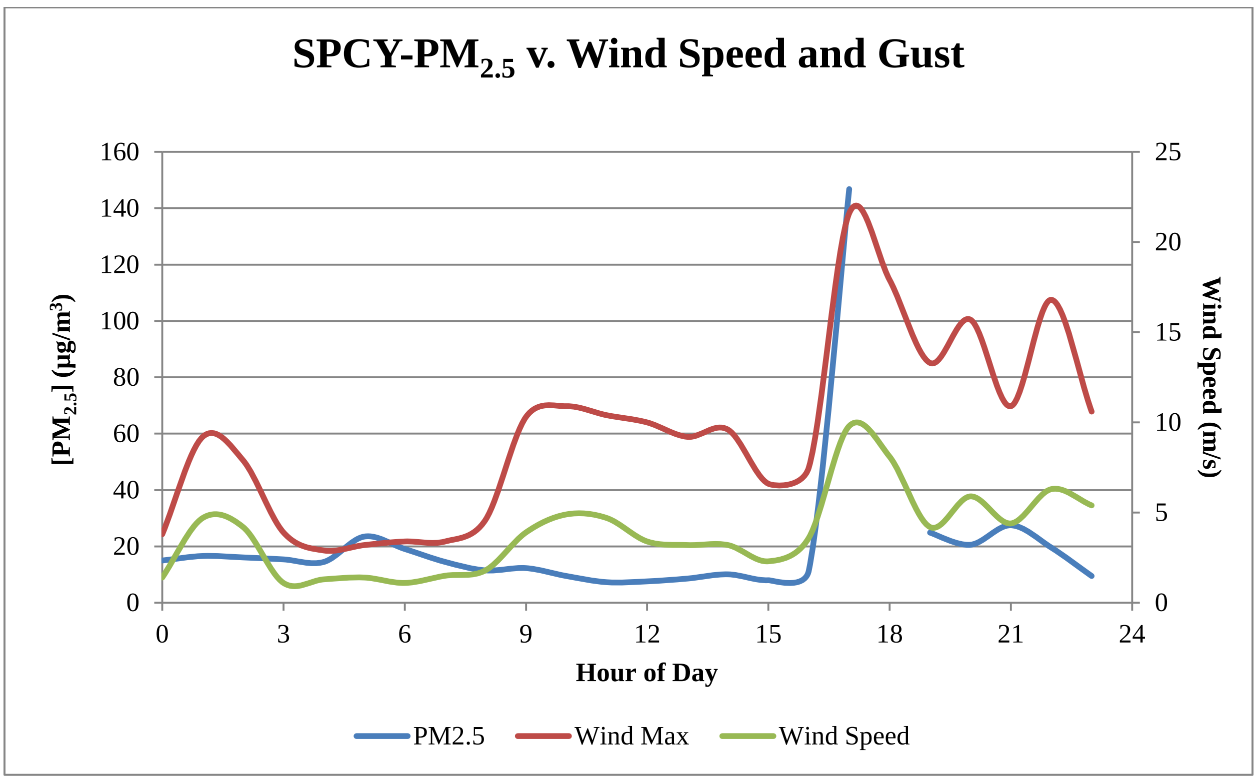


Figure 14-12d Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

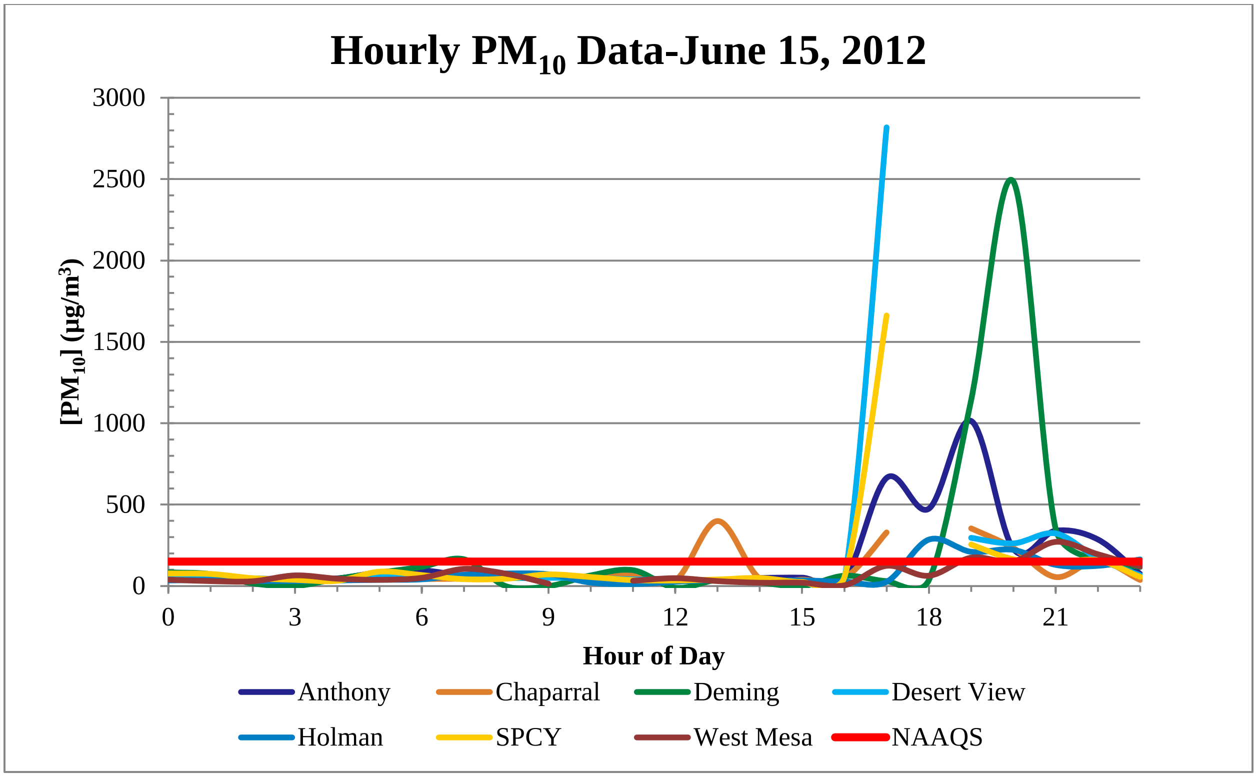


Figure 14-13a Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

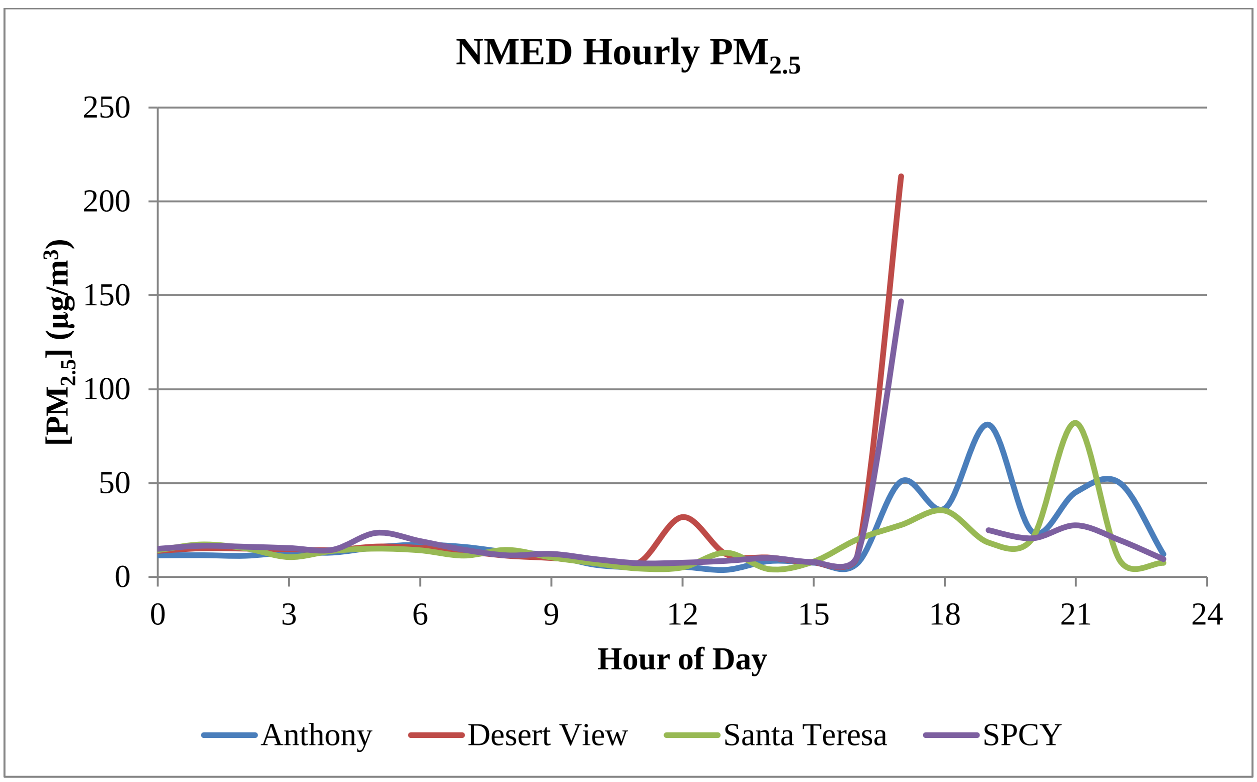


Figure 14-13b Hourly $PM_{2.5}$ concentrations for Doña Ana and Luna Counties monitors. Non-FEM hourly $PM_{2.5}$ data

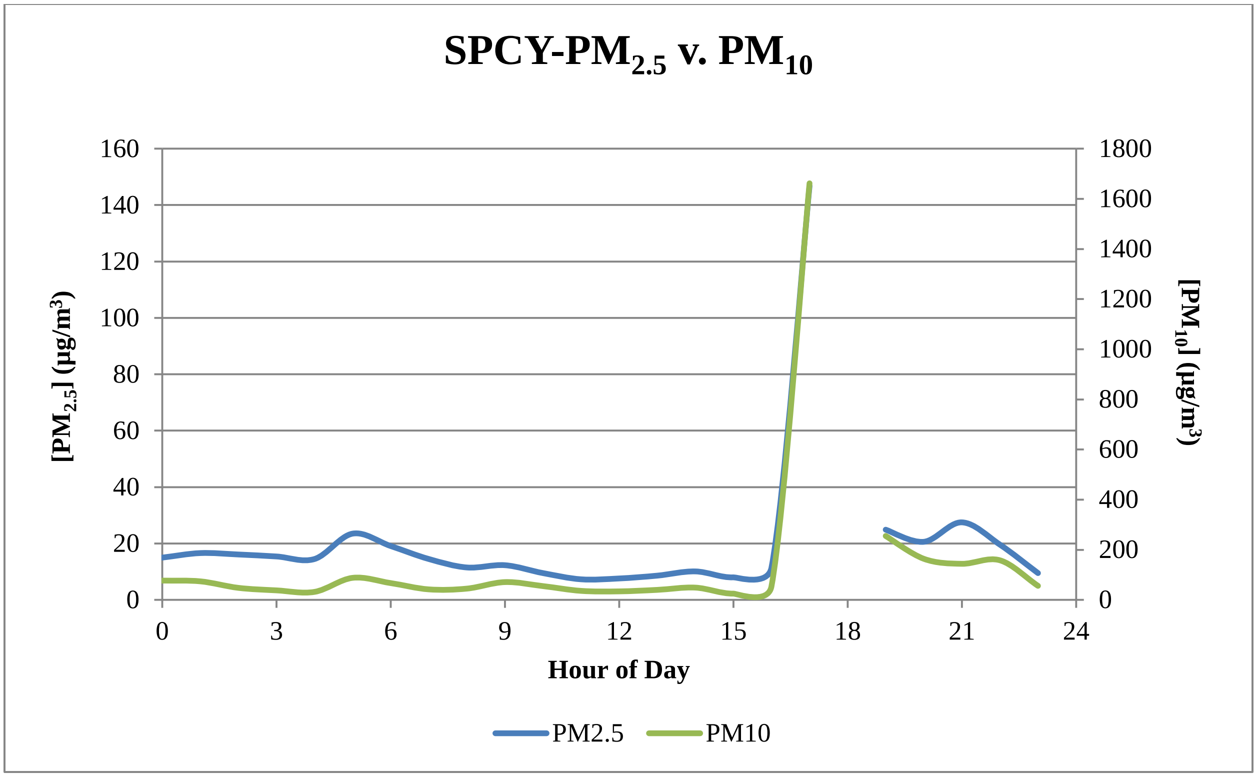


Figure 14-14 Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitor on June 15, 2012

The NWS Southwest Weather Bulletin noted that June 15 saw, "severe thunderstorms produce an 82 mph wind gusts over White Sands Missile Range with gusts near 70 mph at El Paso" (NWS, 2012).

14.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on June 15, 2012.

14.6 Natural Event

The Clear Causal Relationship and not Reasonably Controllable or Preventable analyses show that this was a natural event caused by high wind and blowing dust.

14.7 No Exceedance but for the Event

The SPCY $PM_{2.5}$ monitor detected elevated levels due to blowing dust on June 15, 2012. Although these elevated concentrations do not exceed the 24-hour NAAQS for $PM_{2.5}$, they contribute to an annual exceedance level of 22 µg/m^3 for this date. The strong correlation between hourly $PM_{2.5}$, PM_{10} and wind speeds peaks also point to windblown dust affecting the monitor. Previous studies have shown that $PM_{2.5}/PM_{10}$ ratios vary from 0.11 to 0.45 in the Paso del Norte Airshed (Arimoto et. al, 2001; Li et al, 2001). The ratios above 0.30 were observed in downtown El Paso and Ciudad Juárez and indicate a heavy impact from mobile sources. The lower ratios were observed in areas with less vehicular traffic and crustal material dominated the PM_{10} fraction. The $PM_{2.5}/PM_{10}$ ratio for the SPCY site was 0.15 for this date ($PM_{2.5}$ Partisol/PM_{10} TEOM). NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

The Anthony monitor detected blowing dust around the 1700 hour with hourly concentrations heavily impacted until the 2200 hour. By replacing these six hourly values with the 95th percentile of hourly data at the Anthony site, the resulting 24-hour average (83 µg/m^3) does not exceed the NAAQS (Table 14-1). The values in red represent the 95th percentile of all hourly data collected at Anthony, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	**Recorded Hourly Data**	**Substituted Hourly Data**
0	63	63
1	64	64
2	46	46
3	45	45
4	47	47
5	84	84
6	96	96
7	63	63
8	49	49
9	63	63
10	54	54
11	53	53
12	36	36
13	38	38
14	49	49
15	51	51
16	40	40
17	664	**194**
18	475	**194**
19	1014	**184**
20	228	**161**
21	340	**140**
22	286	**122**
23	74	74
24-Hour Average	167	**83**

Table 14-1. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Anthony.

The Deming monitor detected blowing dust around the 1900 hour with hourly concentrations heavily impacted until the 2200 hour. The four hourly PM_{10} values from 1900-2200 hours alone, exceed the 24-hour average standard at Anthony [(1141+2485+352+160) µg/m^3 = 4138 µg/m^3; (4138 µg/m^3)/24 = 172 µg/m^3]. By replacing these four hourly values with the 95th percentile of hourly data at the Anthony site, the resulting 24-hour average (54 µg/m^3) does not exceed the NAAQS (Table 14-2). The values in red represent the 95th percentile of all hourly data collected at Anthony, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	84	84
1	73	73
2	16	16
3	0	0
4	45	45
5	82	82
6	118	118
7	164	164
8	-2	-2
9	-1	-1
10	65	65
11	97	97
12	-11	-11
13	37	37
14	21	21
15	-1	-1
16	63	63
17	30	30
18	36	36
19	1141	**79**
20	2485	**74**
21	352	**65**
22	160	**55**
23	117	117
24-Hour Average	215	**54**

Table 14-2. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Deming.

The Desert View monitor detected blowing dust around the 1700 hour with hourly concentrations heavily impacted until the 2200 hour. The five hourly PM_{10} values from 1700-2200 hours alone, exceed the 24-hour average standard at Desert View [(2818 + 296 + 262 + 323 + 169) µg/m^3 = 3868 µg/m^3; (3868 µg/m^3)/24 = 161 µg/m^3]. By replacing these six hourly values with the 95th percentile of hourly data at the Desert View site, the resulting 24-hour average (66 µg/m^3) does not exceed the NAAQS (Table 14-3). The values in red represent the 95th percentile of all hourly data collected at Anthony, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	46	46
1	51	51
2	47	47
3	37	37
4	36	36
5	58	58
6	60	60
7	49	49
8	48	48
9	50	50
10	50	50
11	41	41
12	36	36
13	36	36
14	40	40
15	29	29
16	41	41
17	2818	**166**
18		**141**
19	296	**142**
20	262	**120**
21	323	**111**
22	169	**101**
23	66	66
24-Hour Average	203	**66**

Table 14-3. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Desert View.

15 HIGH WIND EXCEPTIONAL EVENT: November 10, 2012

15.1 Summary of Event

The passing of a Pacific cold front caused high winds and blowing dust in southern Doña Ana County resulting in exceedances of the PM_{10} and $PM_{2.5}$ 24-hour NAAQS at the Anthony, Chaparral, Desert View and SPCY monitoring sites on this date. The FEM TEOM continuous monitors at this sites recorded 24-hour average concentrations of 469, 396, 230 and 331µg/m^3, respectively. The $PM_{2.5}$ FRM Partisol at SPCY recorded a 24-hour average of 42.2 µg/m^3 (Figure15-1). The averages in this figure were calculated using PM_{10} FEM TEOM and $PM_{2.5}$ FRM Partisol instrument data for the four days before and after the event. Elevated concentrations were also recorded by the $PM_{2.5}$ non-FEM/FRM TEOMs (Figure 15-2).

As the event unfolded, the wind blew from the southwest throughout the border region. These high velocity winds passed over large areas of desert within New Mexico and Mexico. The co-occurrence of high winds and elevated levels of blowing dust, little to no point sources in the area, and the high hourly and daily PM_{10} and $PM_{2.5}$ concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

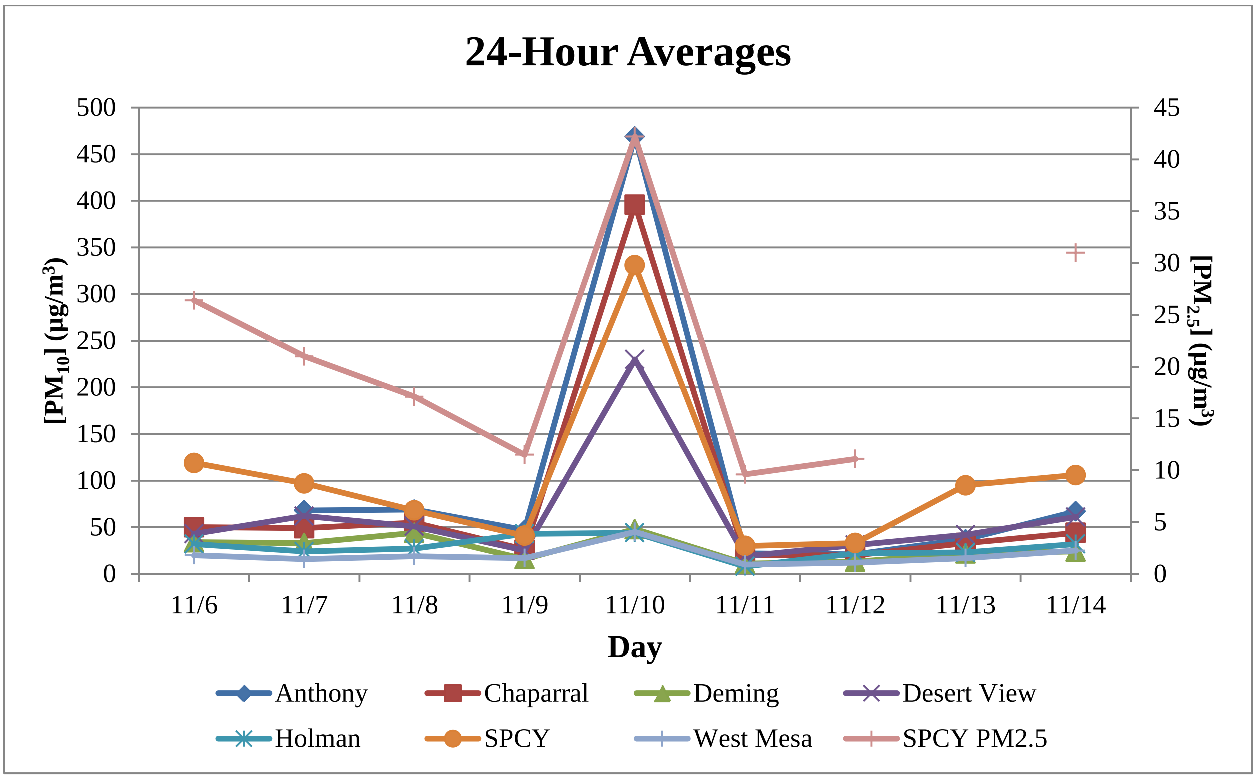


Figure 15-1. PM_{10} 24-hour averages before and after November 10, 2012.

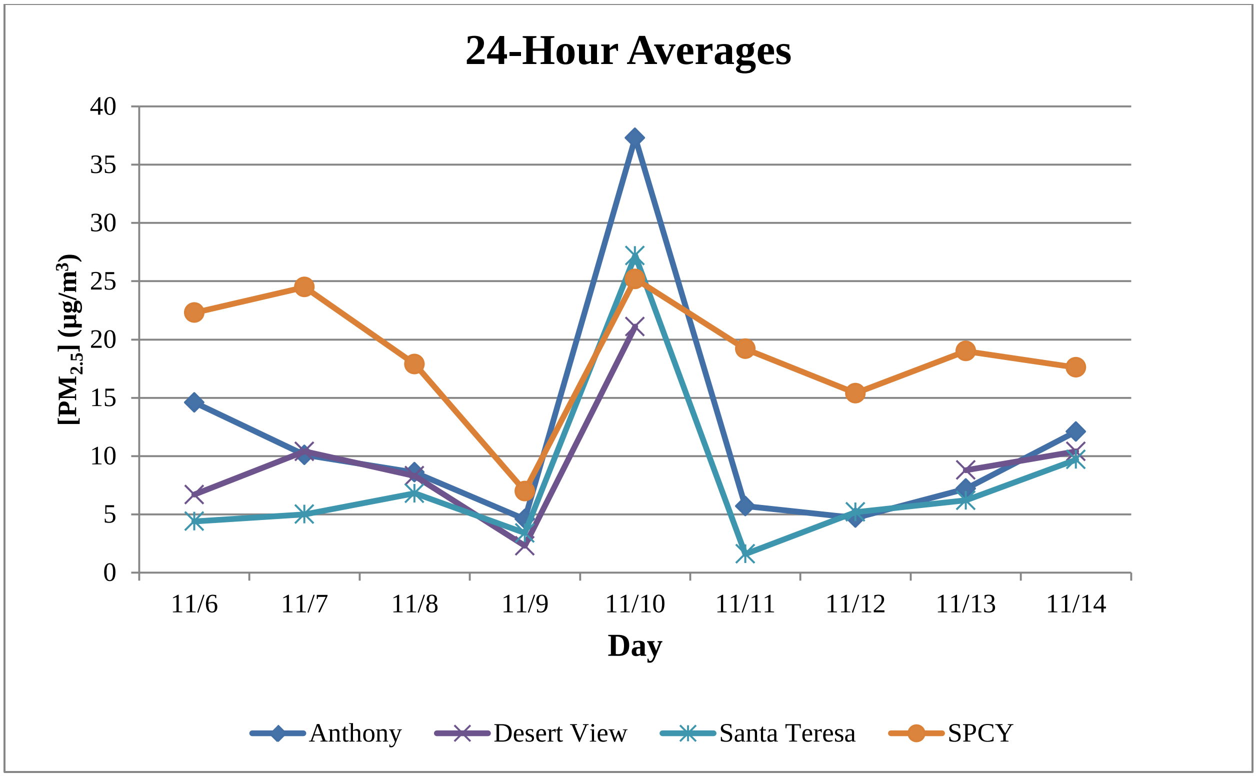


Figure 15-2. $PM_{2.5}$ 24-hour averages before and after November 10, 2012. Non-FEM TEOM Data.

15.2 Is Not Reasonably Controllable or Preventable

15.2.1 Suspected Source Areas and Categories Contributing to the Event

Sources of windblown dust contributing to this exceedance include the natural desert, residential properties, agricultural land and unpaved roads in northern Mexico and New Mexico. City of Las Cruces and Doña Ana County Ordinance require BACM for any dust producing activities. The largest and most likely sources of windblown dust are the natural desert and the playas of northern Mexico (see Section 15.2.4 below).

15.2.2 Sustained and Instantaneous Wind Speeds

EPA uses a default entrainment threshold of sustained wind speeds at 11.2 m/s (25 mph) for natural and well controlled anthropogenic sources contributing to natural events caused by high wind and blowing dust (EPA, 2013). Under the Doña Ana and Luna County NEAPs, EPA and NMED agreed that wind gusts exceeding 18 m/s would overwhelm any natural and well-controlled anthropogenic sources and cause windblown dust. On November 10, 2012, sustained wind speeds exceeded EPA's default threshold at seven of the eight monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at all eight monitoring sites (Figures 15-3 and 15-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 0900 hour and ending at the 1400 hour.

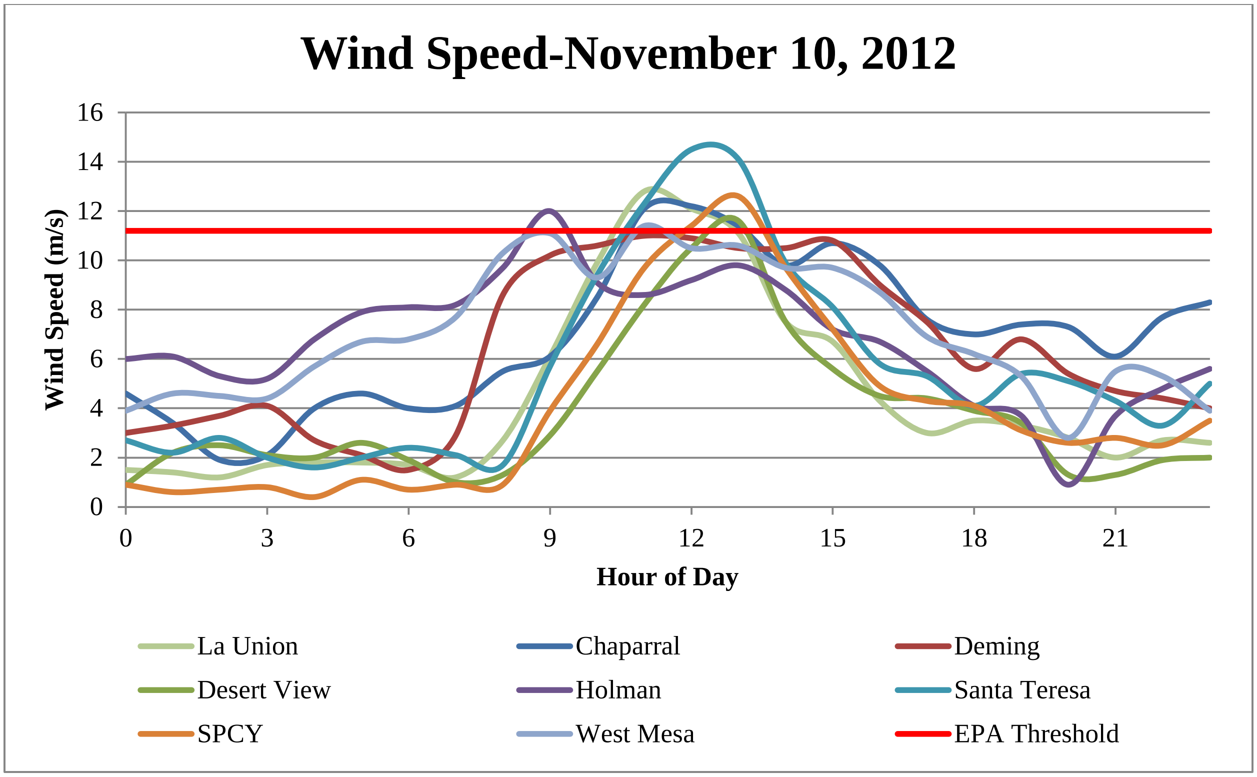


Figure 15-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

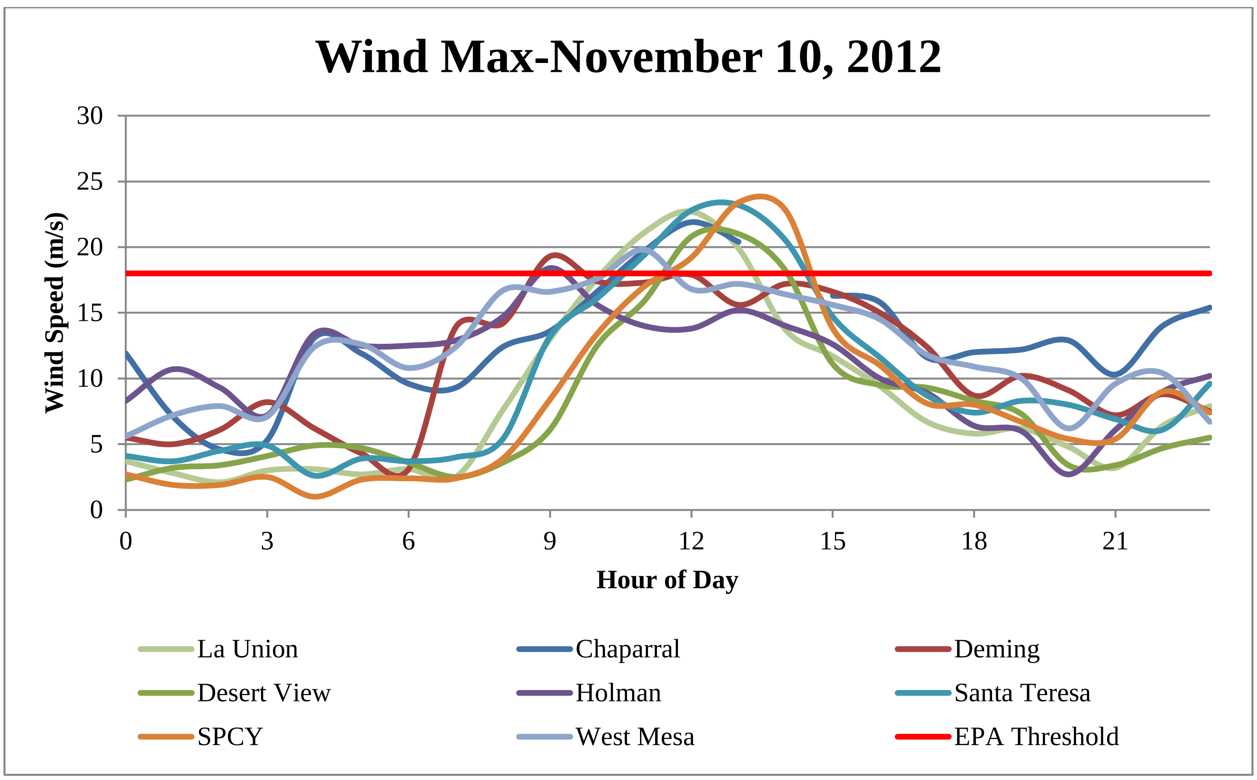


Figure 15-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

15.2.3 Recurrence Frequency

The monitoring sites in Doña Ana and Luna Counties can record exceedances of the PM_{10} NAAQS throughout the year. From 2007-2011 the PM_{10} FEM TEOM monitors recorded 254 exceedances and the PM_{10} FRM Wedding monitors recorded 6 exceedances (Figure A-1). The Deming Airport and Desert View monitoring sites (FEM TEOMs) were established in 2006 and 2007 respectively and do not show exceedances until the year following startup. The SPCY $PM_{2.5}$ FRM Partisol recorded 37 exceedances of the 24-Hour NAAQS from 2007-2011 (Figure A-2). See appendix A for a more in-depth discussion about recurrence frequency and the number of exceedances at each monitoring site.

15.2.4 Controls Analysis

The local ordinances and MOUs adopted under the NEAP direct the implementation of BACM for sources of dust in Doña Ana County. The ordinances regulate disturbed lands, construction and demolition, vacant parking lots and materials handling and transportation. Our investigation did not identify any unusual PM_{10} producing activities on this day, and anthropogenic emissions remained constant before, during and after the event. The most likely source contributing to the event is the natural desert and playas in New Mexico and northern Mexico. The southern sites in Doña Ana County recorded the highest 24-hour averages in the monitoring network. A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from Mexico to the monitors in southern Doña Ana County. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 15-5). Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

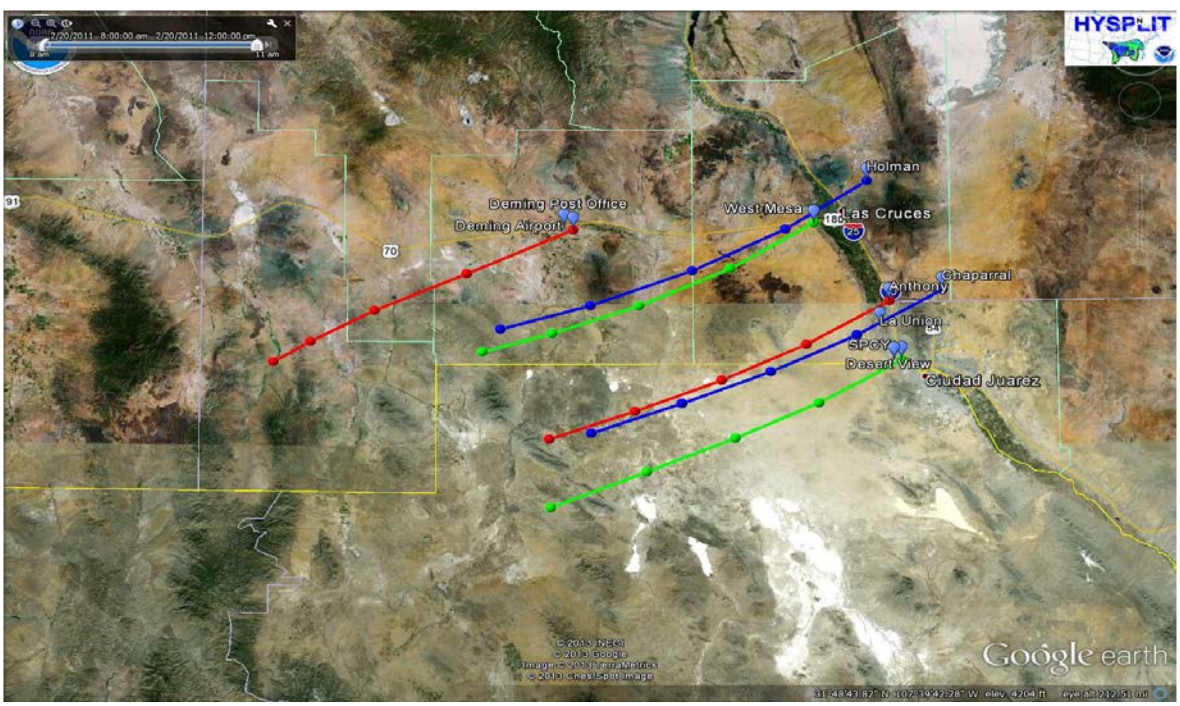


Figure 15-5. HYSPLIT back-trajectory model analysis for November 10, 2012.

15.3 Historical Fluctuations Analysis

15.3.1 Annual and Seasonal 24-hour Average Fluctuations

Since being established, the monitoring sites in Doña Ana and Luna Counties have recorded exceedances of the PM_{10} NAAQS. High winds cause these exceedances and they can occur at any time of year (Figure B-6 through B-13). Most exceedances occur from late winter through early summer (February-June) and are associated with the passage of Pacific cold fronts. High winds caused all recorded exceedances from 2007-2011 and NMED submitted natural events demonstrations to EPA under the NEAP or EER.

Since the 24-hour $PM_{2.5}$ NAAQS was lowered from 65 to 35 µg/m^3 in 2006, the SPCY Partisol monitor has routinely recorded exceedances of the standard. These exceedances occurred throughout the year during high and low wind conditions. In 2009, NMED investigated the cause of the low wind exceedances and found that emissions from Ciudad Juárez, Mexico contribute significantly to elevated concentrations. The high wind exceedances were caused by blowing dust on days when PM_{10} monitors also recorded exceedances.

Appendix B contains a more in-depth discussion about historical fluctuations and charts showing annual and seasonal trends at each monitoring site.

Table B-1 and B-2 show normal historical fluctuations with and without high wind natural events that caused exceedances from 2007-2011. The analysis excludes only those high wind events that resulted in an exceedance. Data for PM_{10} in this table includes FRM Wedding and FEM TEOM measurements and data for $PM_{2.5}$ comes from the FRM Partisol measurements from 2007-2011. The recorded values for this day (469, 396, 230 and 331 µg/m^3) are above the maximum values recorded when no high wind exceedances are included and is above the 95th percentile of all 24-hour averages recorded.

An hourly data distribution analysis was performed for PM_{10} and $PM_{2.5}$ concentrations, wind speeds and wind gusts (Appendices C, D and E). All data used for the PM_{10} distribution charts come from the FEM TEOM monitors and the non-FEM/FRM $PM_{2.5}$ TEOM monitor at SPCY. Overlaying the hourly data for November 10, 2012 on the hourly data distribution plots shows that the values recorded during the high wind event exceed the 95th percentile for PM_{10}, $PM_{2.5}$, wind speed and wind gusts (Figures 15-6a-e through 15-8a-d). The top whiskers of the box and whisker plots represent the 95th percentile of data. The hourly PM_{10} values during the high wind blowing dust storm far exceed the historical 95th percentile of data.

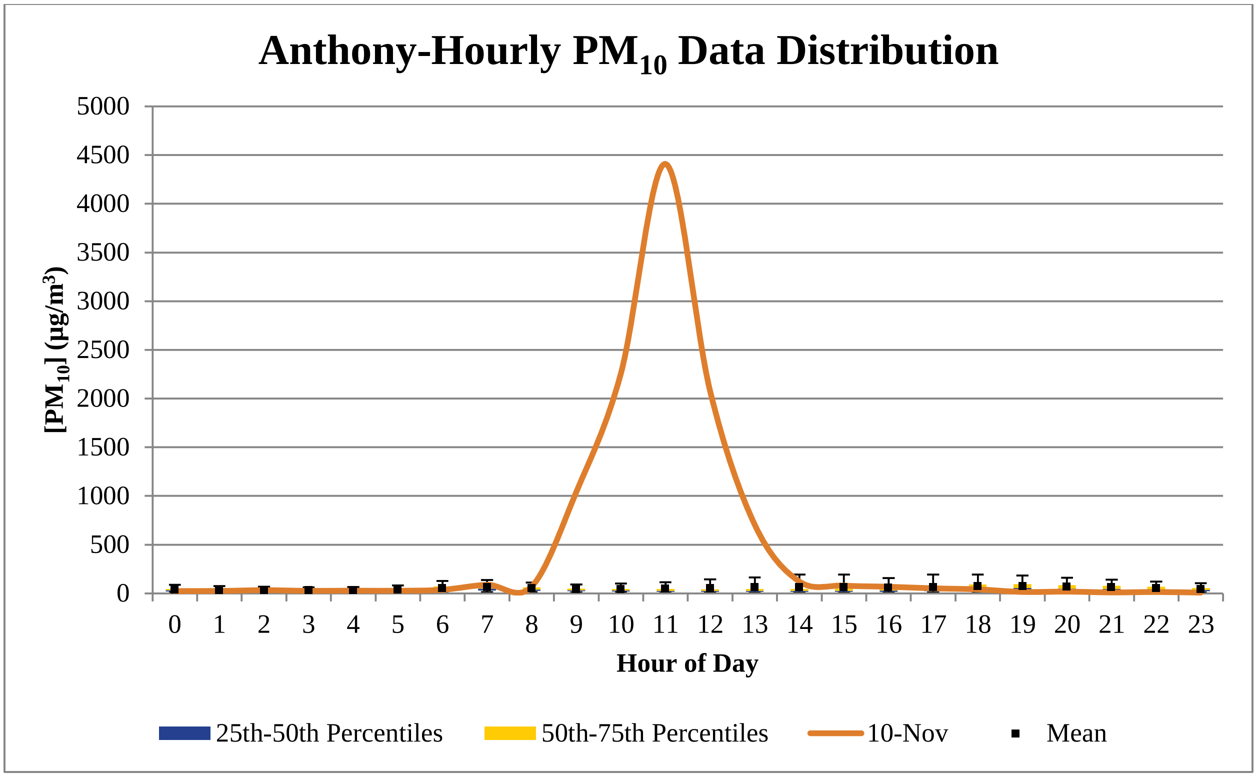


Figure 15-6a. **PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for November 10, 2012.**

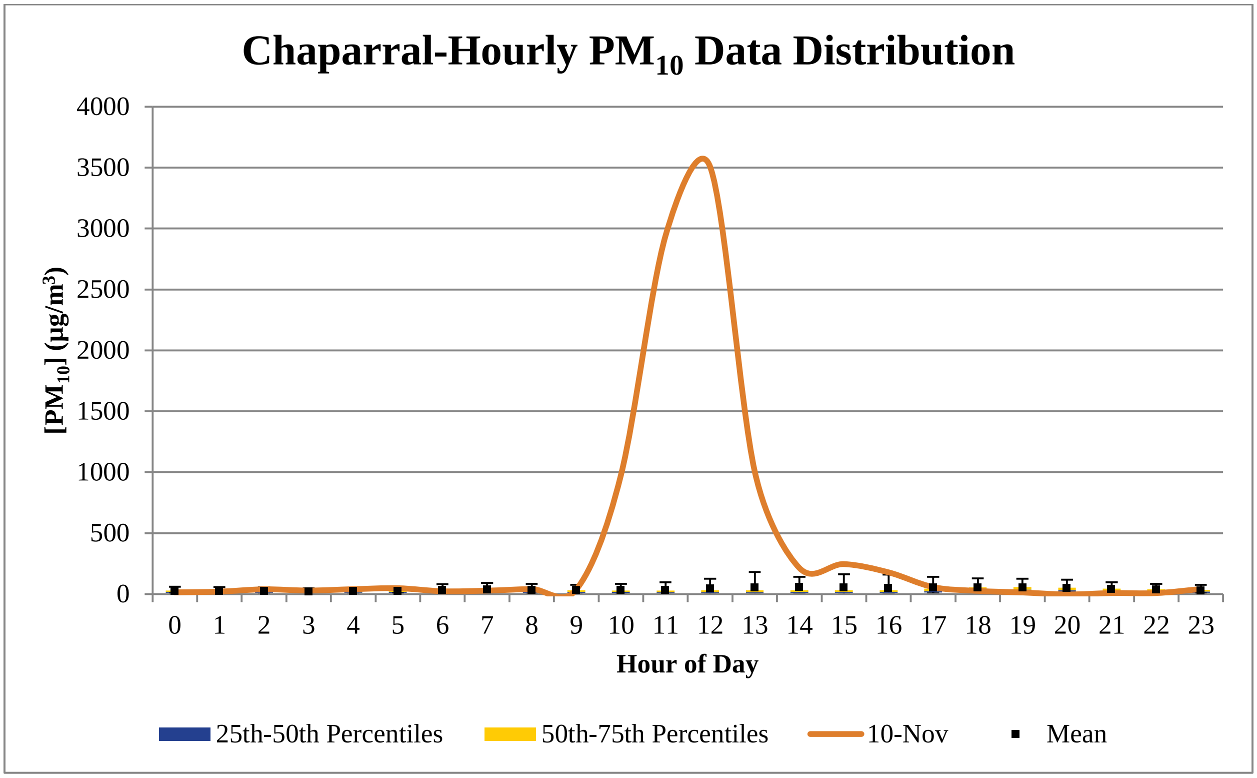


Figure 15-6b. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for November 10, 2012.

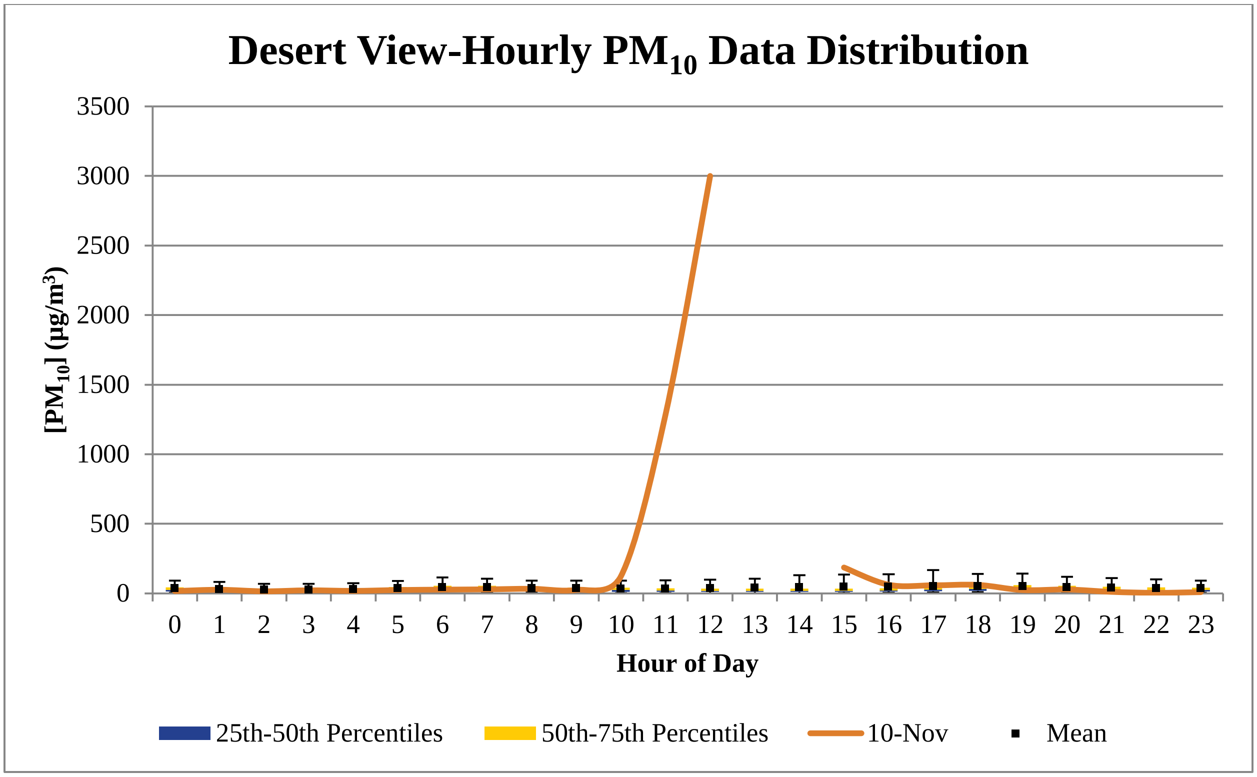


Figure 15-6c. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for November 10, 2012.

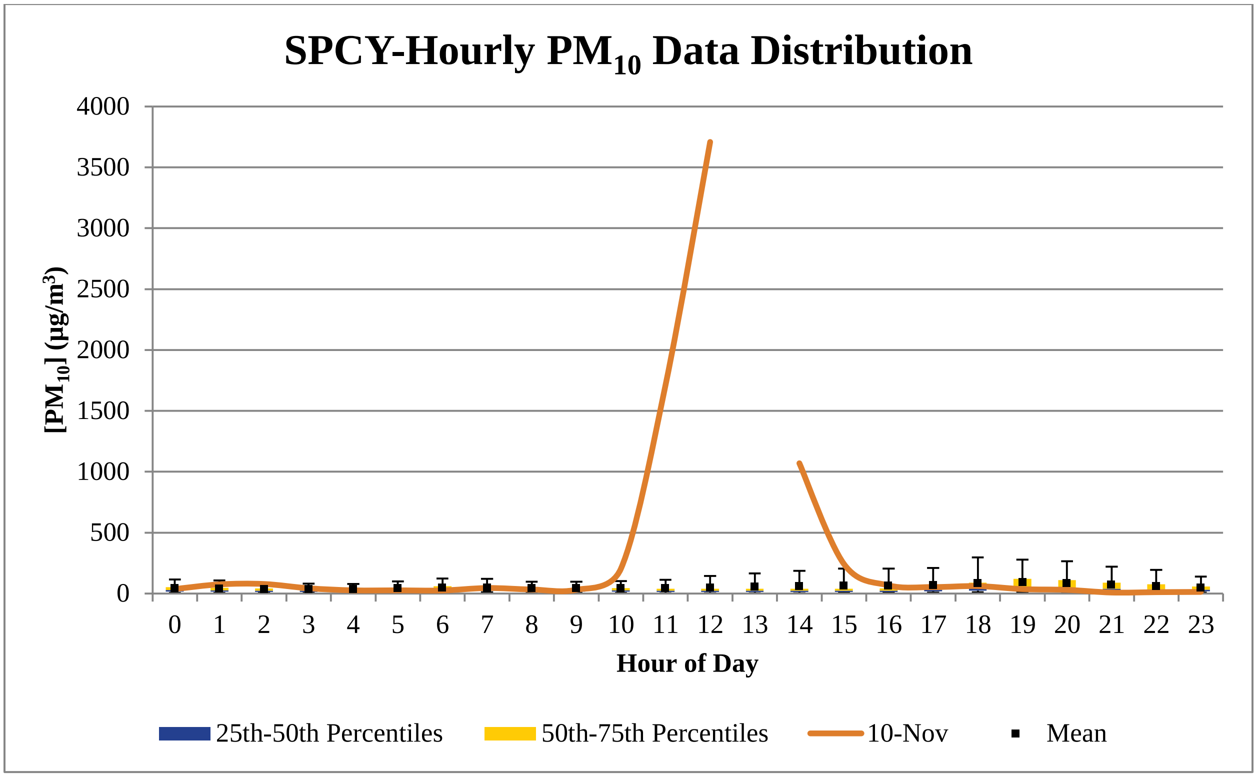


Figure 15-6d. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for November 10, 2012.

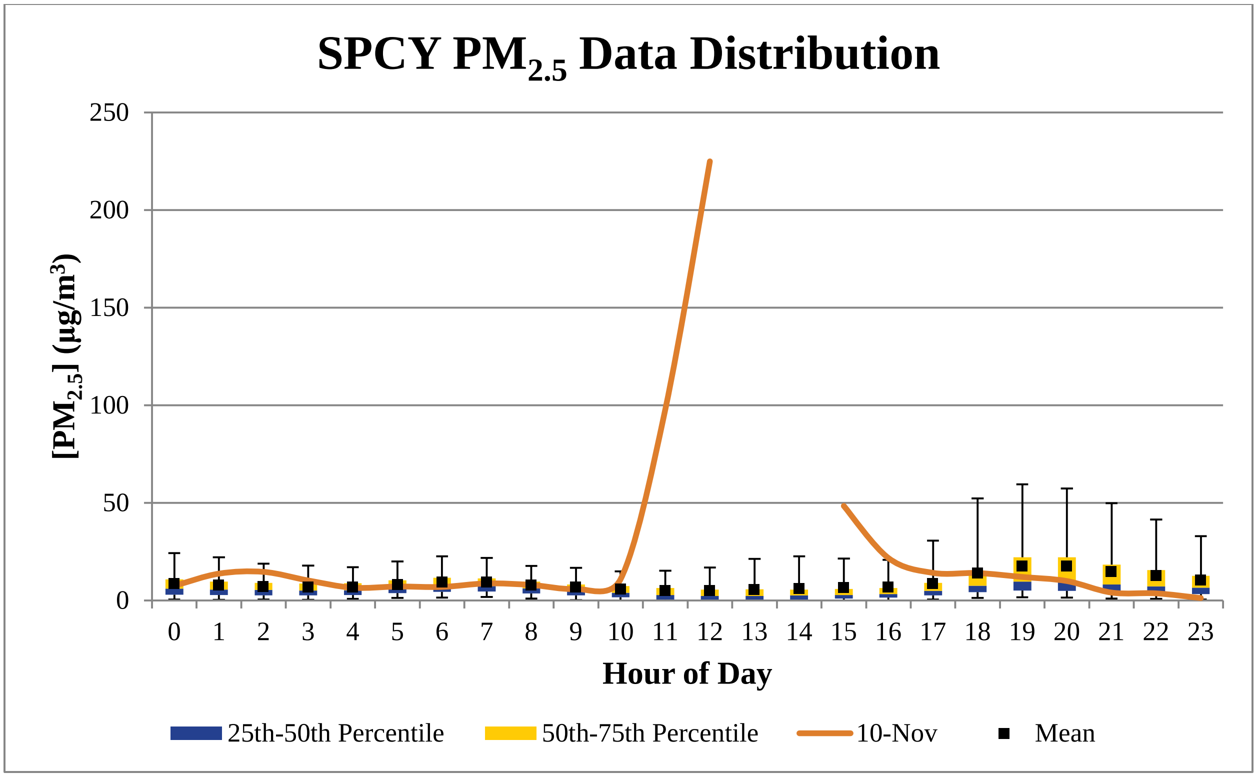


Figure 15-6e. $PM_{2.5}$ hourly data distribution from 2007-2011 overlaid by hourly values for November 10, 2012.

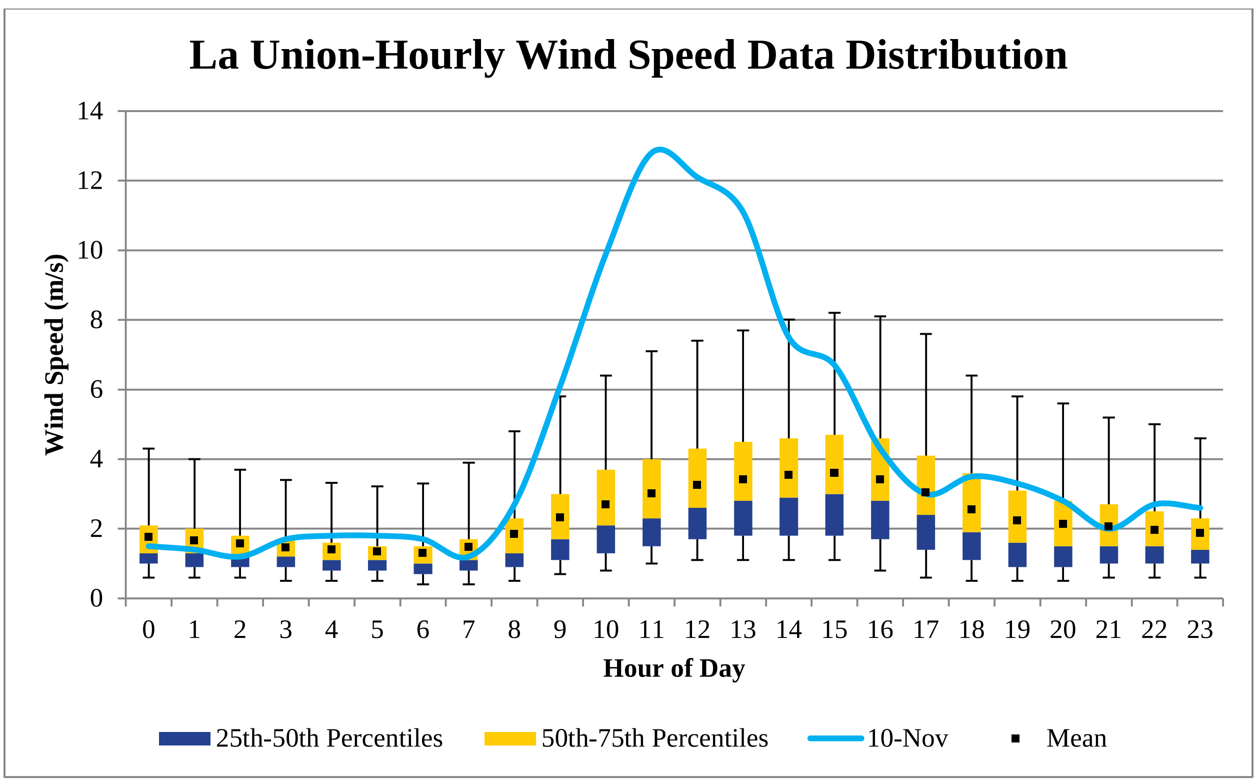


Figure 15-7a. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for November 10, 2012.

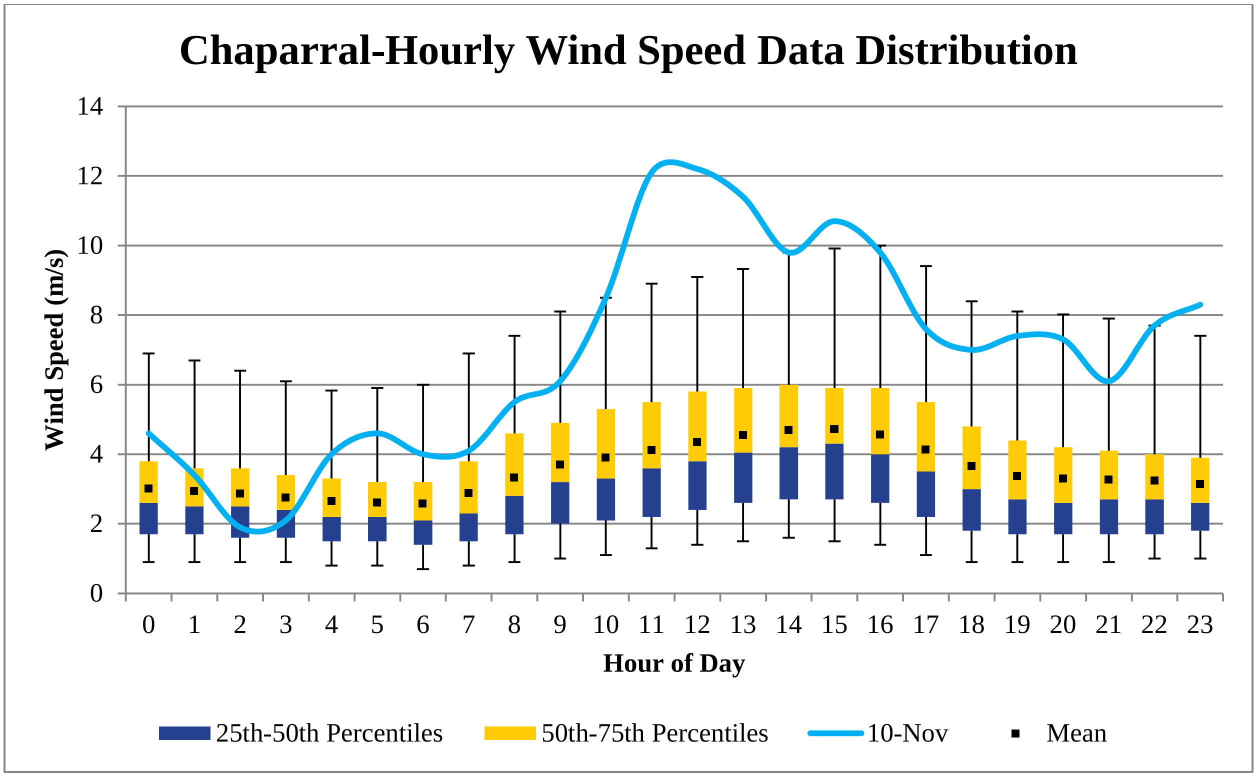


Figure 15-7b. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for November 10, 2012.

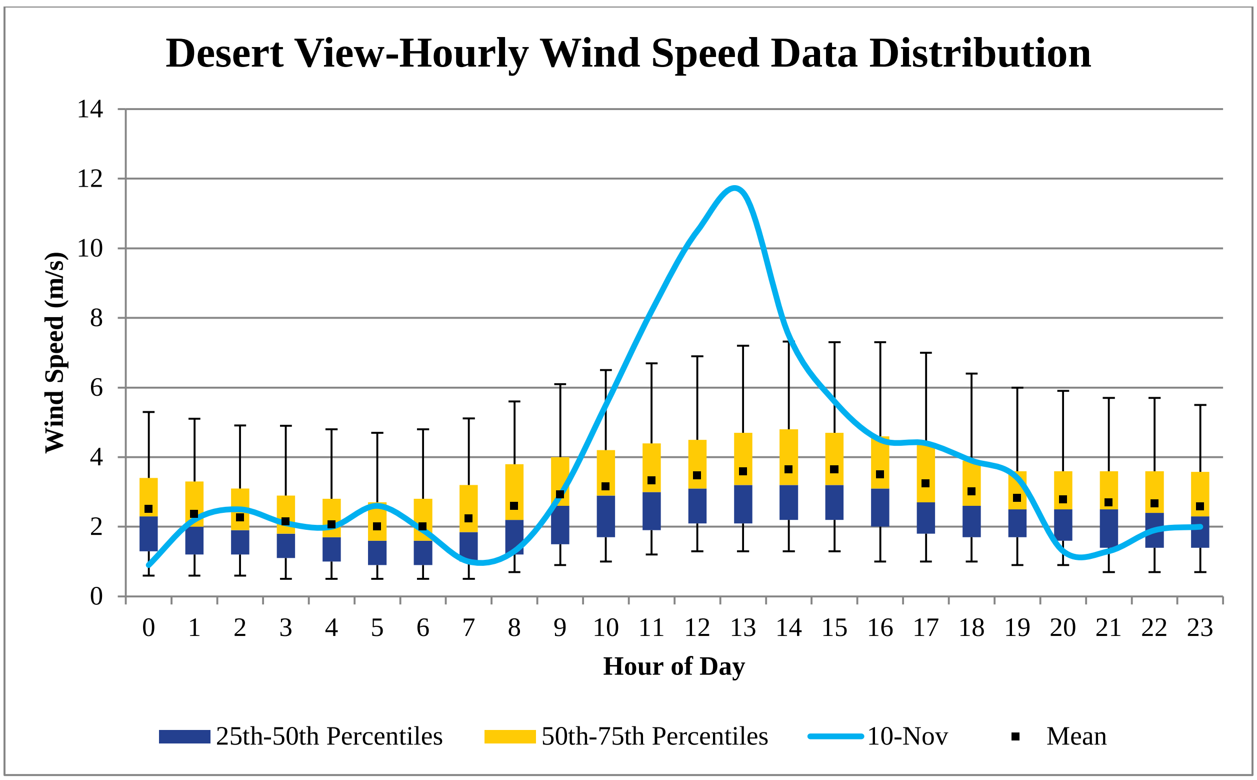


Figure 15-7c. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for November 10, 2012.

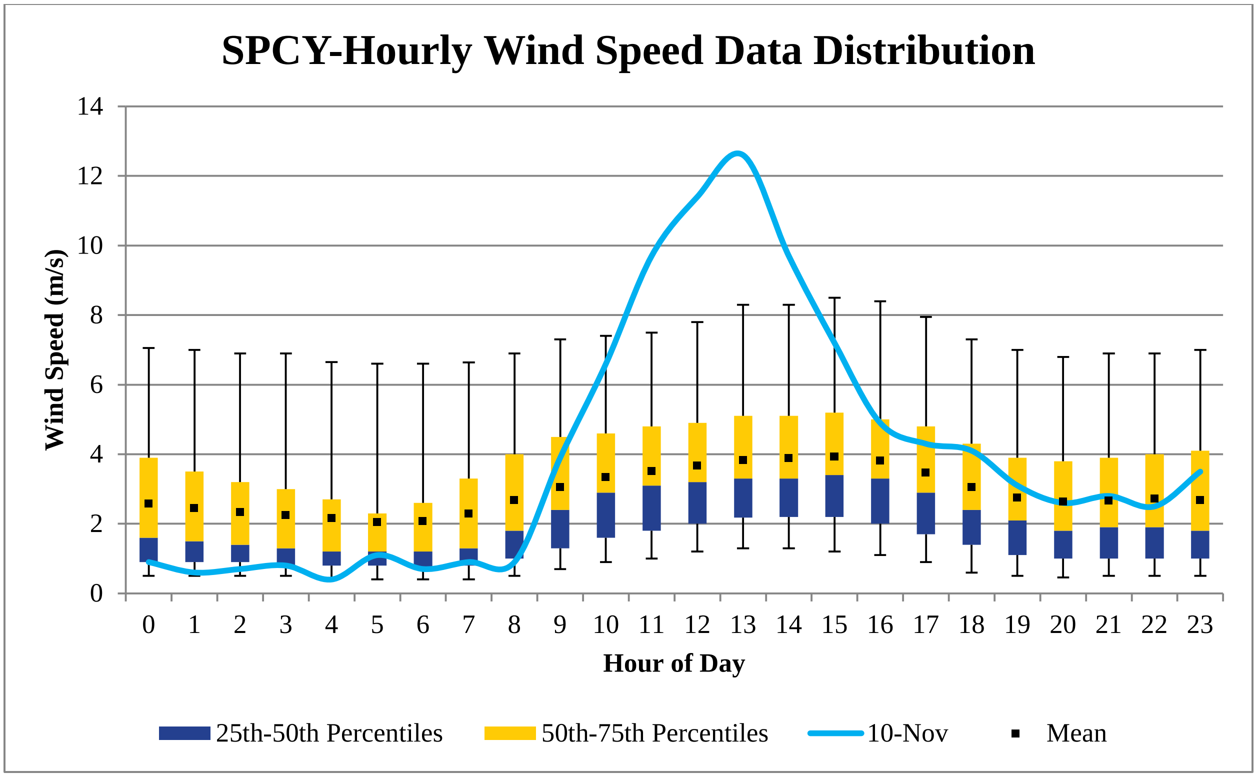


Figure 15-7d. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for November 10, 2012.

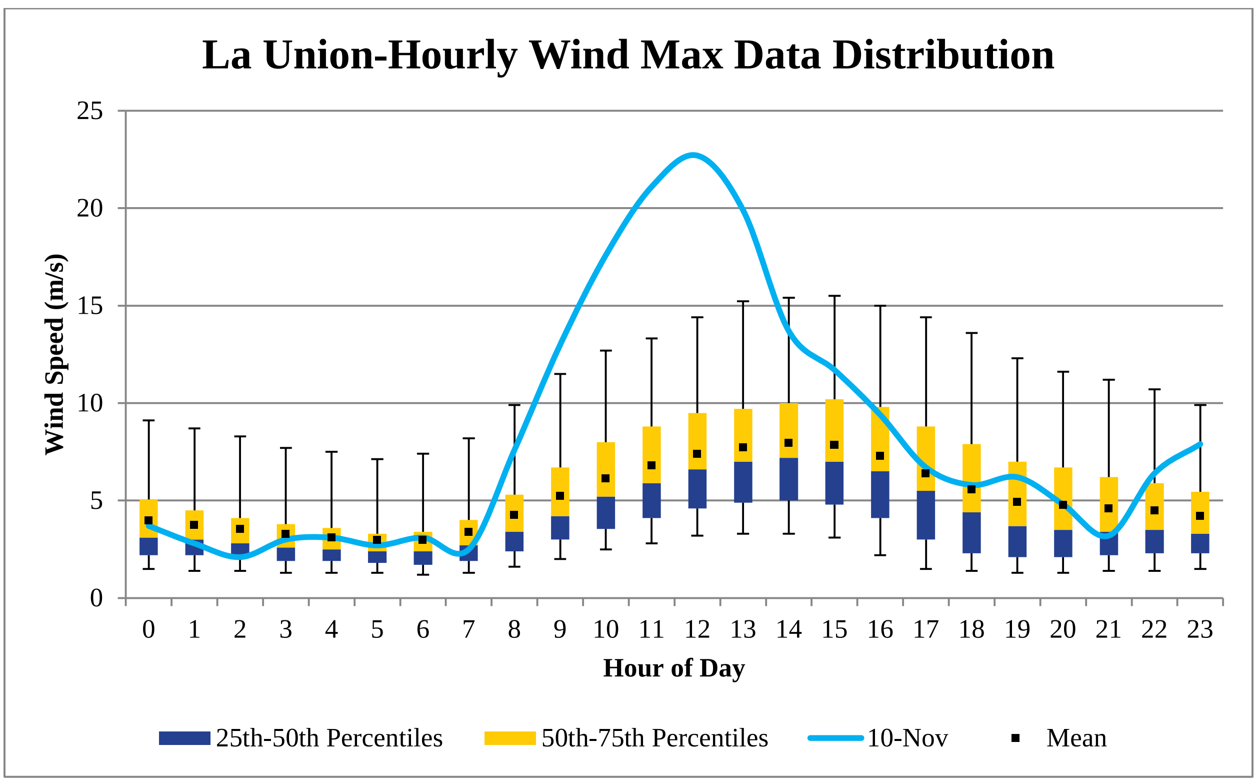


Figure 15-8a. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for November 10, 2012

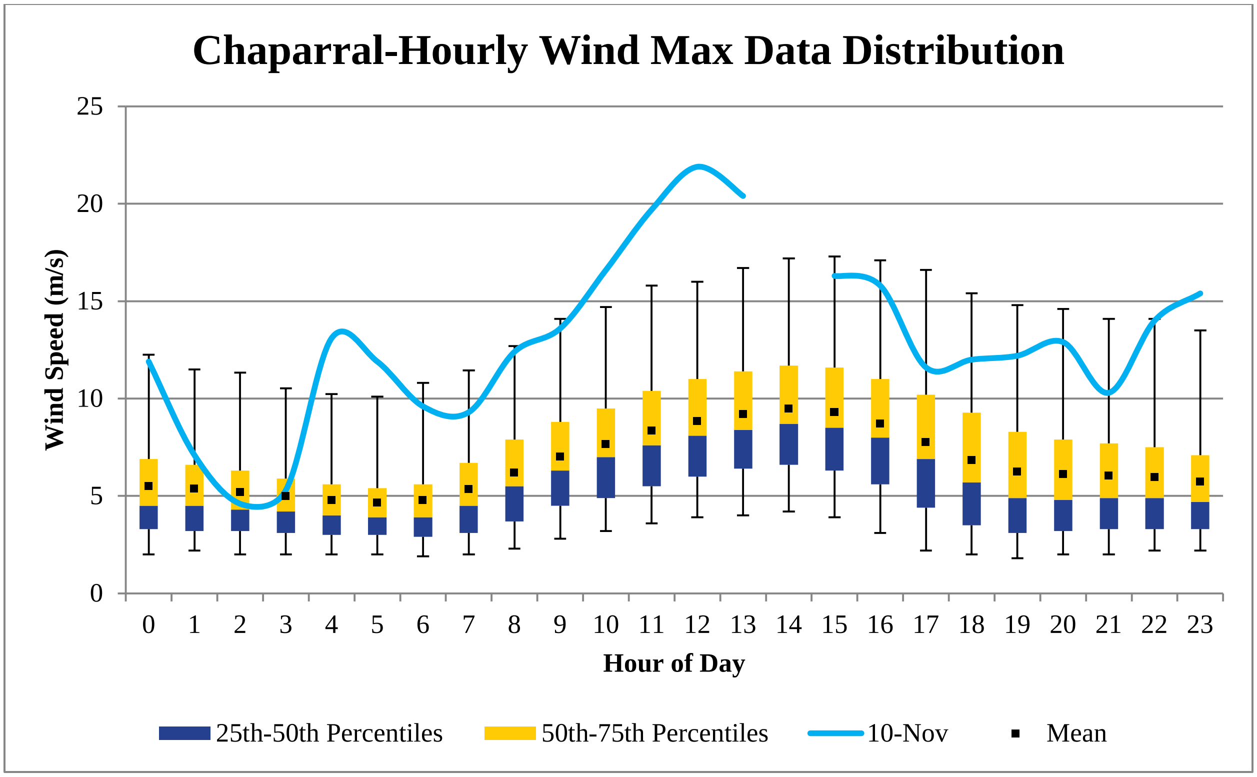


Figure 15-8b. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for November 10, 2012

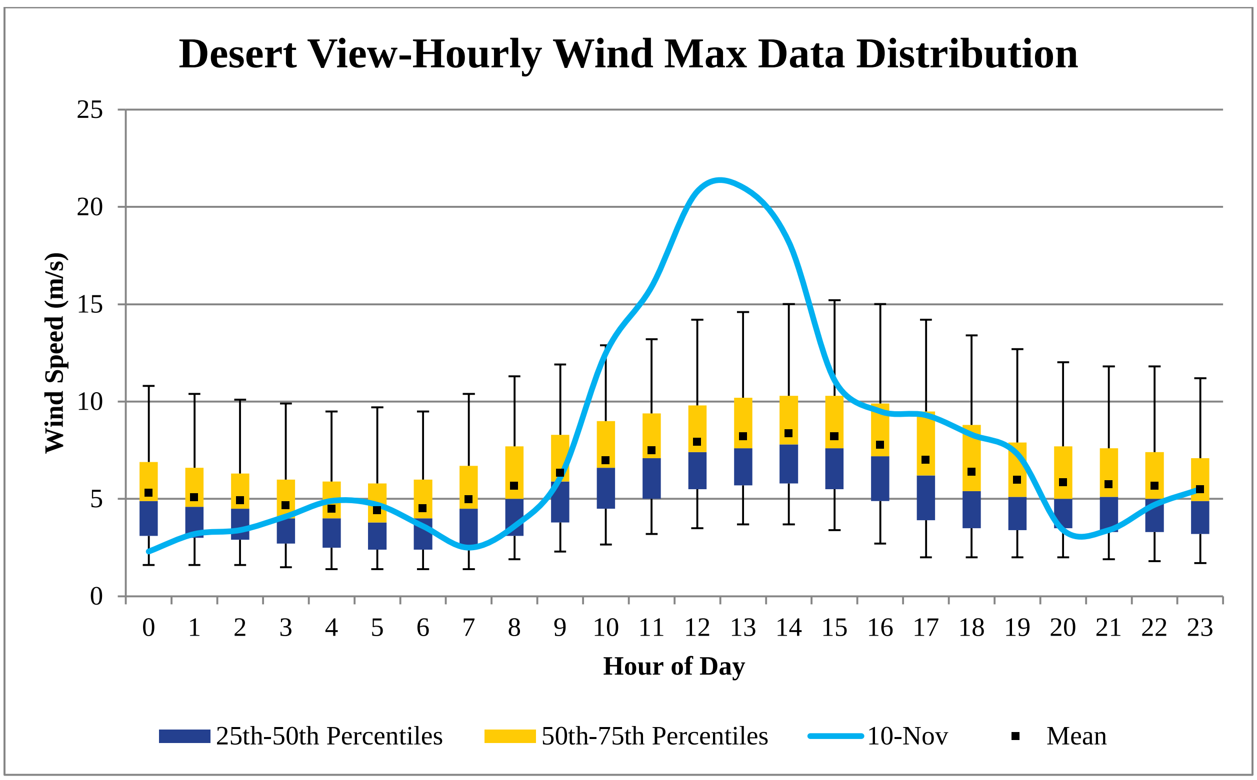


Figure 15-8c. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for November 10, 2012

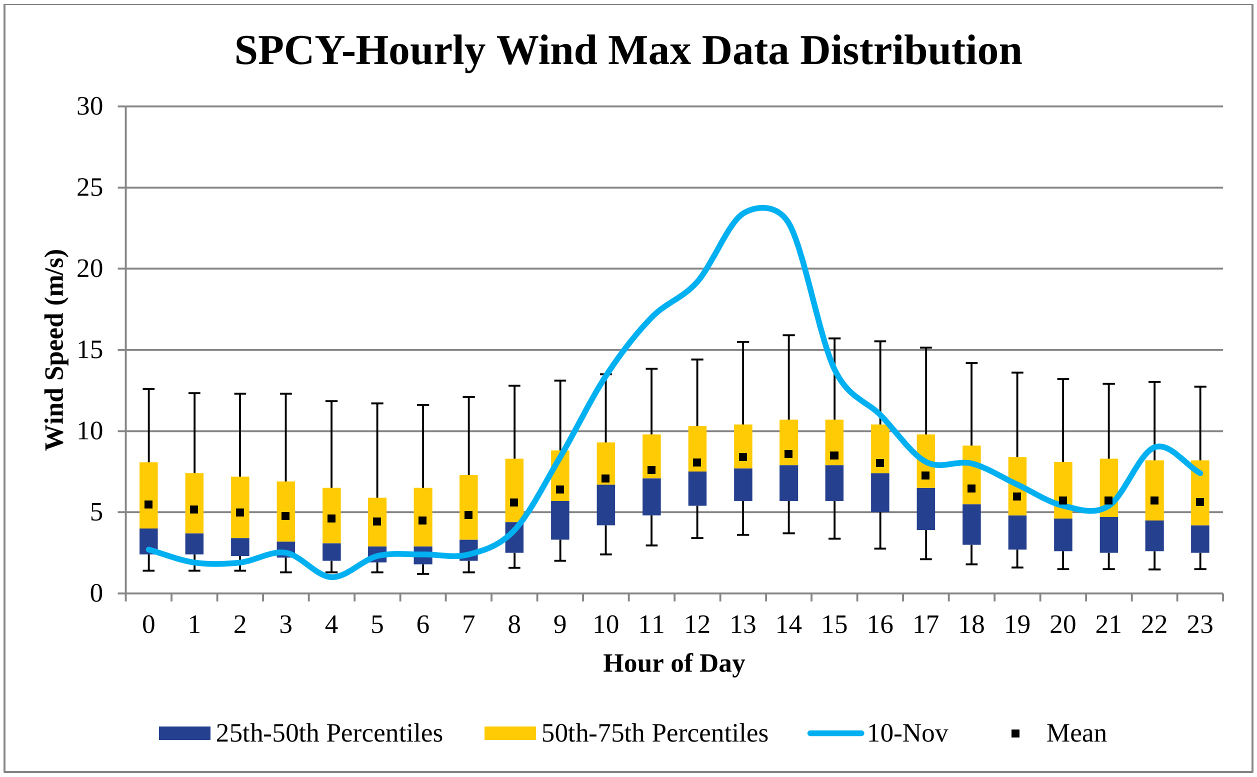


Figure 15-8d. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for November 10, 2012.

15.4 Clear Causal Relationship

A deep Pacific storm system and strong cold front passed through New Mexico on November 10, 2012. As the cold front move eastward through New Mexico a trough formed in the eastern part of the state with a low pressure center in eastern New Mexico creating a pressure gradient over southwestern New Mexico and northern Mexico. As the Pacific cold front moved through New Mexico and approached, the pressure gradient tightened and winds became even stronger at the surface (Figure 15-9). The wind direction in the upper atmosphere aligned with the surface wind direction Diurnal heating of the surface allowed winds aloft to mix downward, increasing the surface wind velocities and provided the turbulence required for vertical mixing and horizontal transport (Figure 15-10).

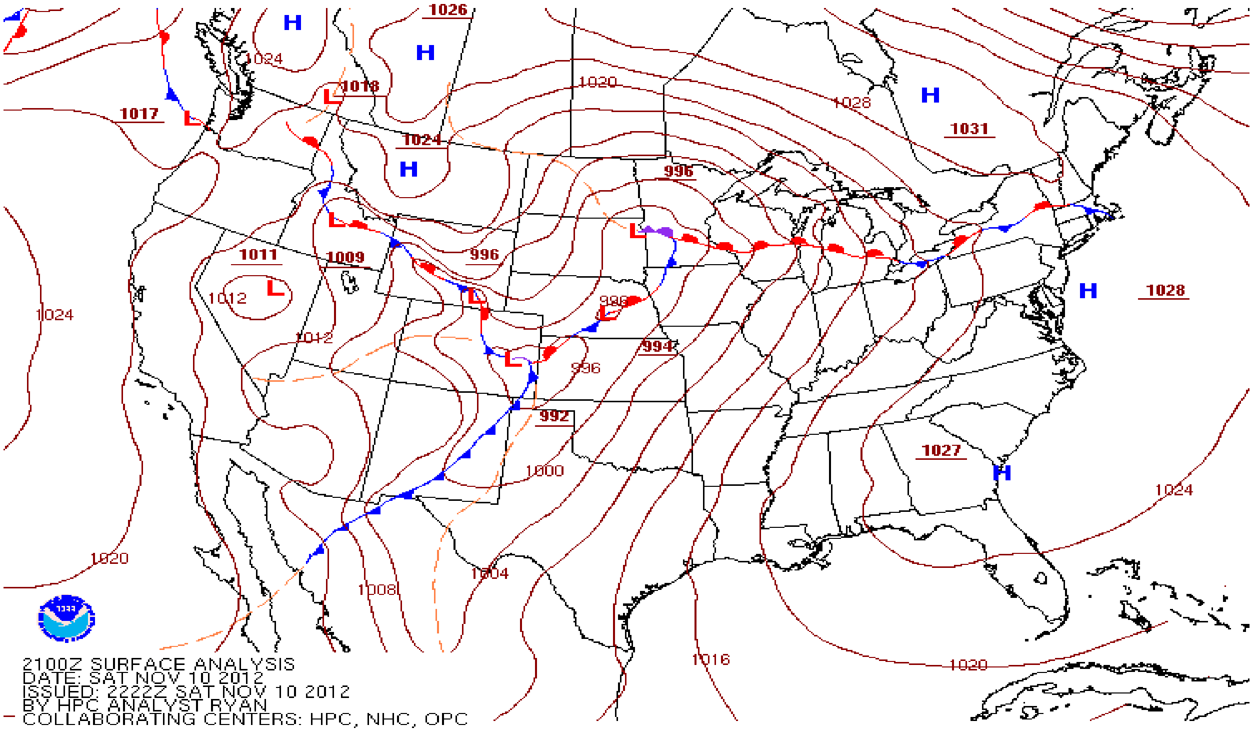


Figure 15-9. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for November 10, 2012 at the 1400 MST hour.

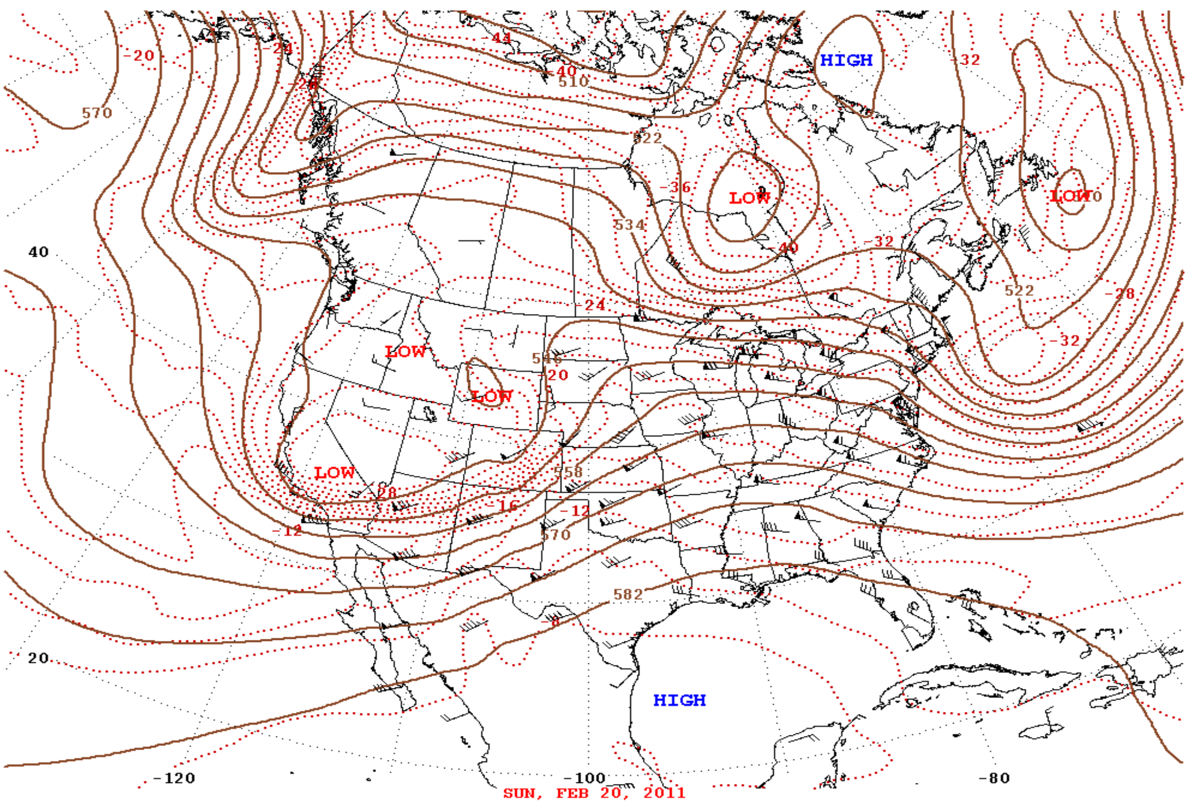


Figure 15-10. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on November 10, 2012.

The weather pattern described above generated strong southwesterly winds beginning at the 0700 hour and lasting through the 1700 hour. Beginning at the 0900 hour, wind speeds exceeded the historical 95th percentile of data at La Union as shown in Figure 15-7a. Peak wind speeds ranged from 11 m/s at Deming to 14.5 m/s at Santa Teresa (Figure 15-3). Peak wind gusts ranged from 19.3 m/s at Deming to 23.4 m/s at SPCY (Figure 15-4). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 15-11a-e. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (0900-1700 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 15-12a-b). Maximum hourly PM_{10} concentrations ranged from 154 µg/m^3 to 4409 µg/m^3 at Anthony. Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 15-13).

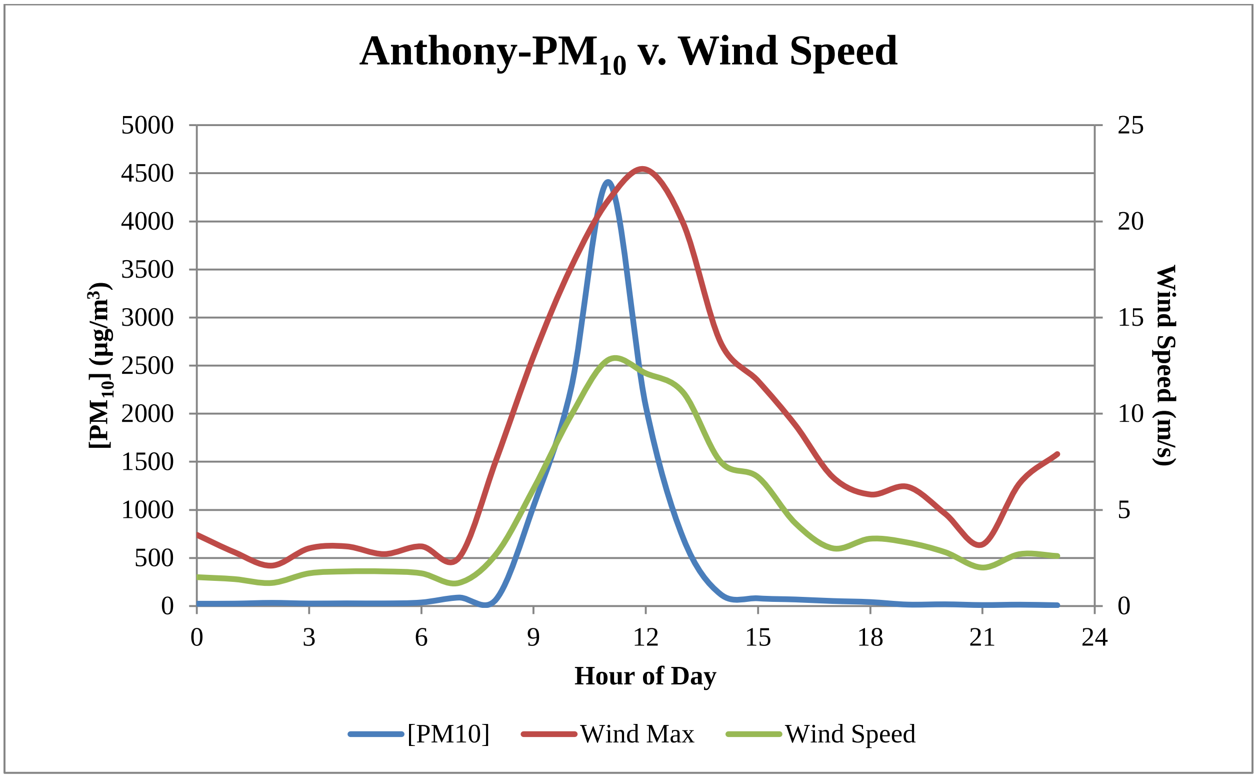


Figure 15-11a . Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

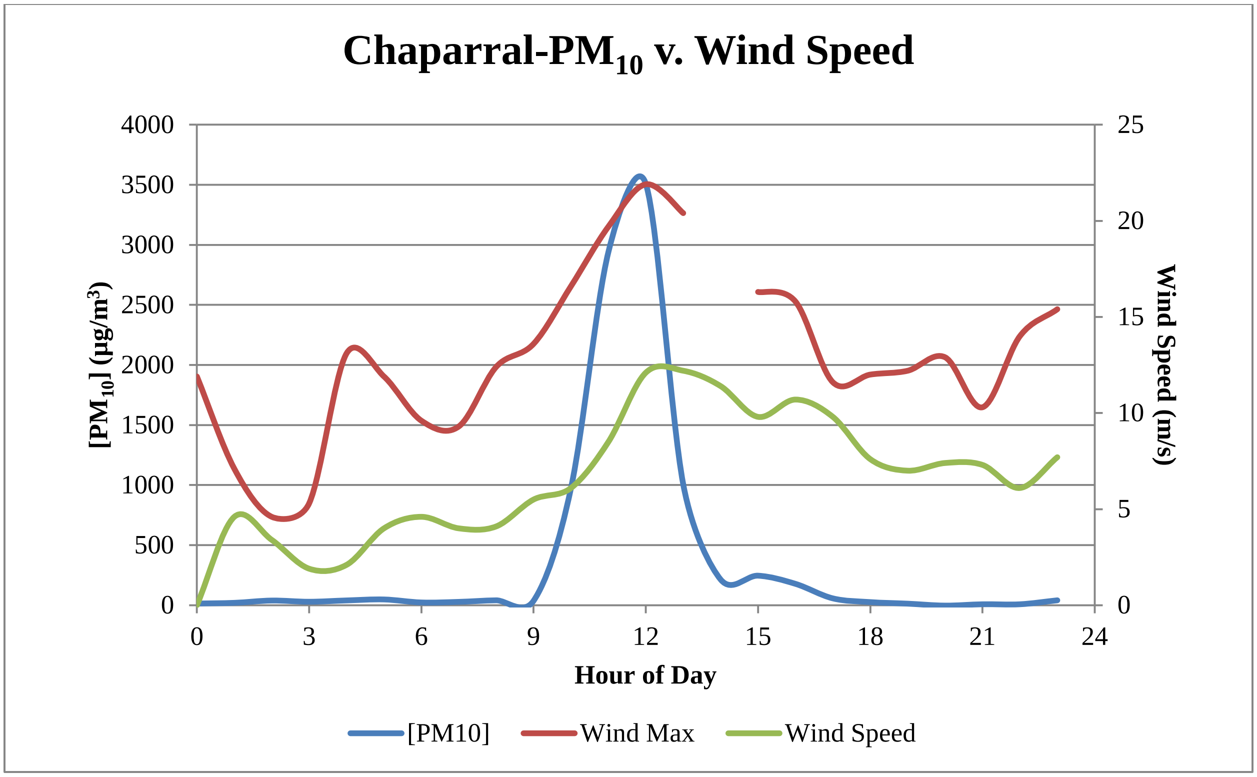


Figure 15-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

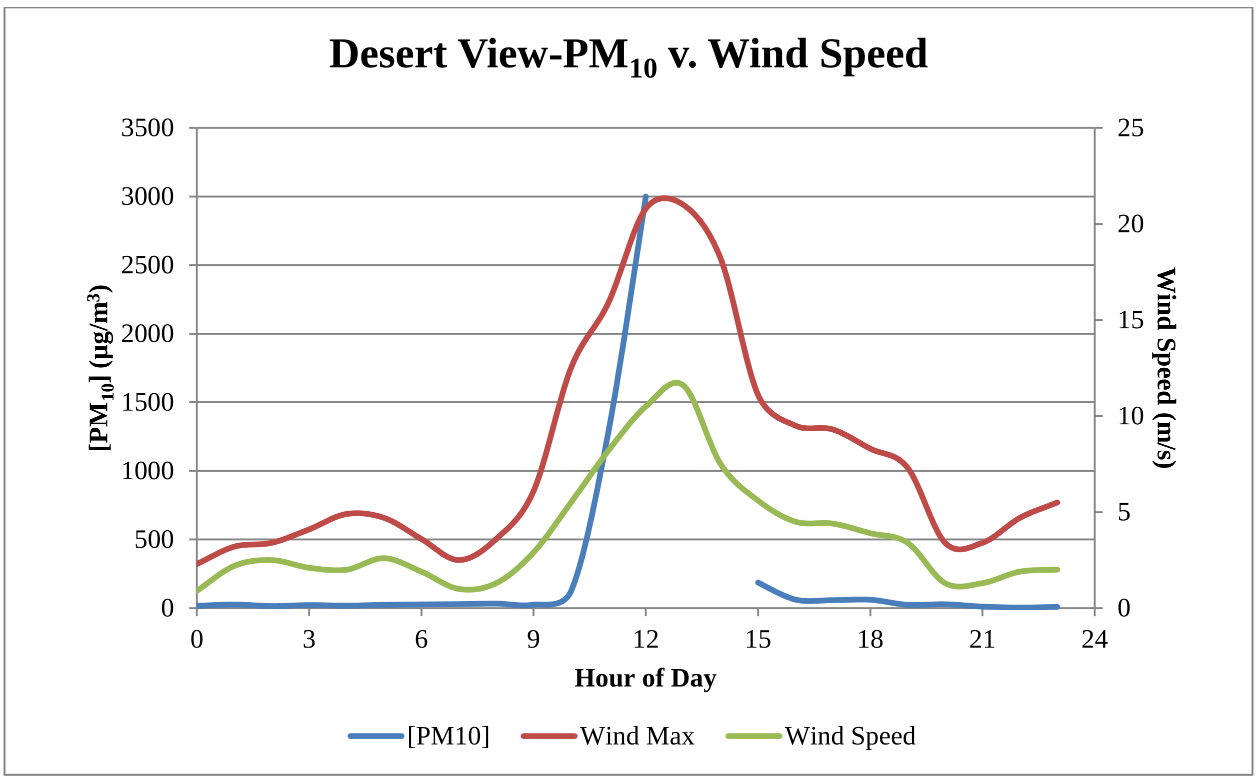


Figure 15-11c. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

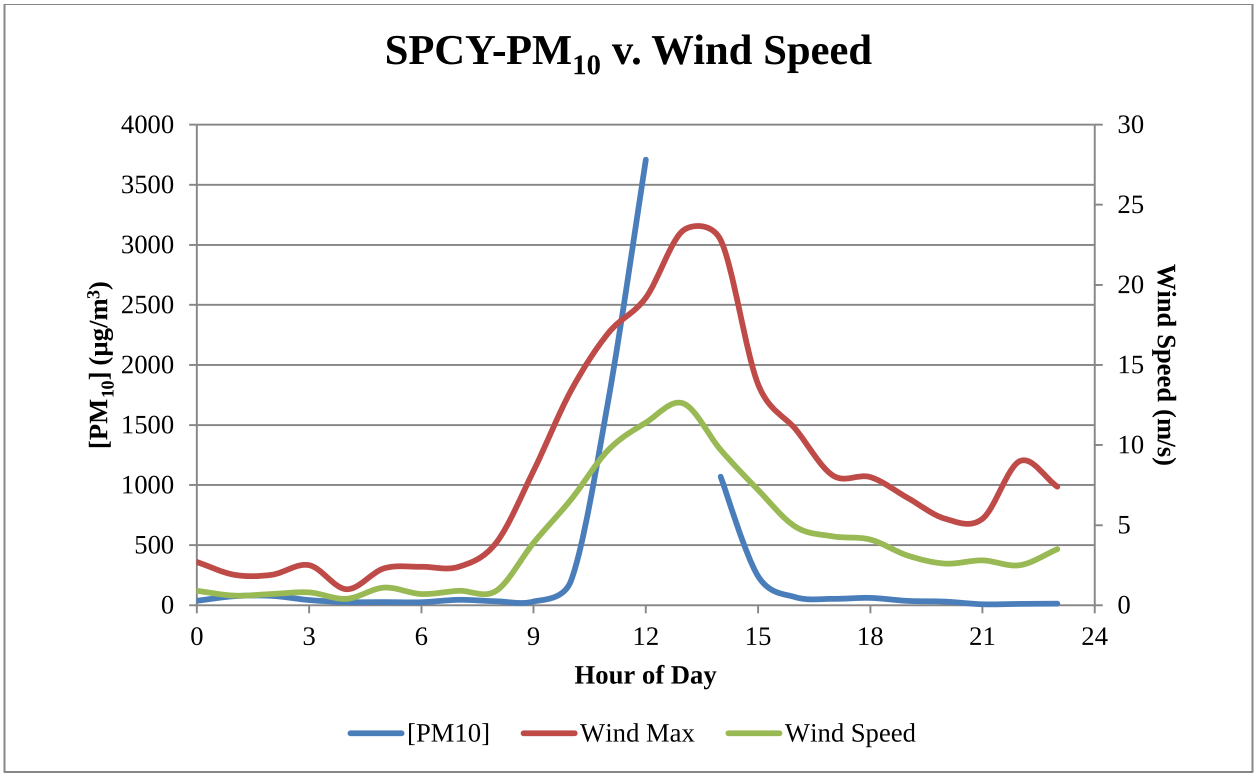


Figure 15-11d. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

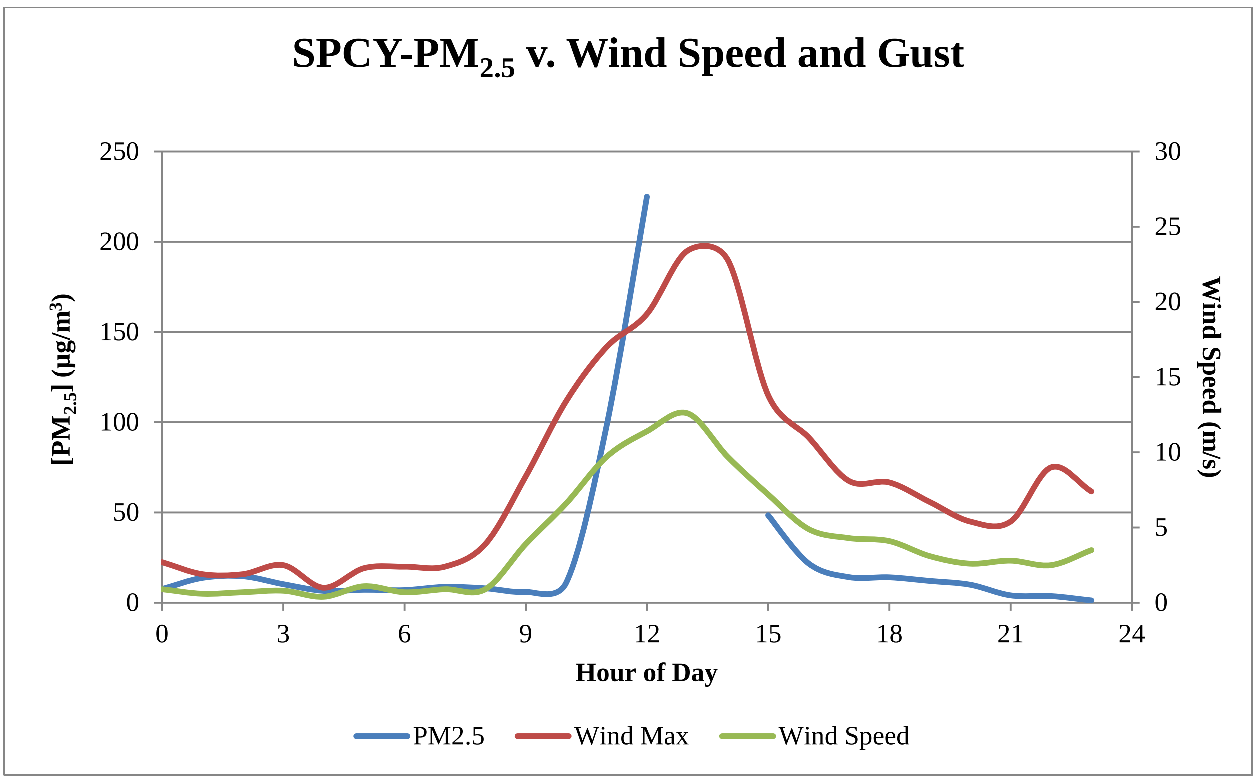


Figure 15-11e Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

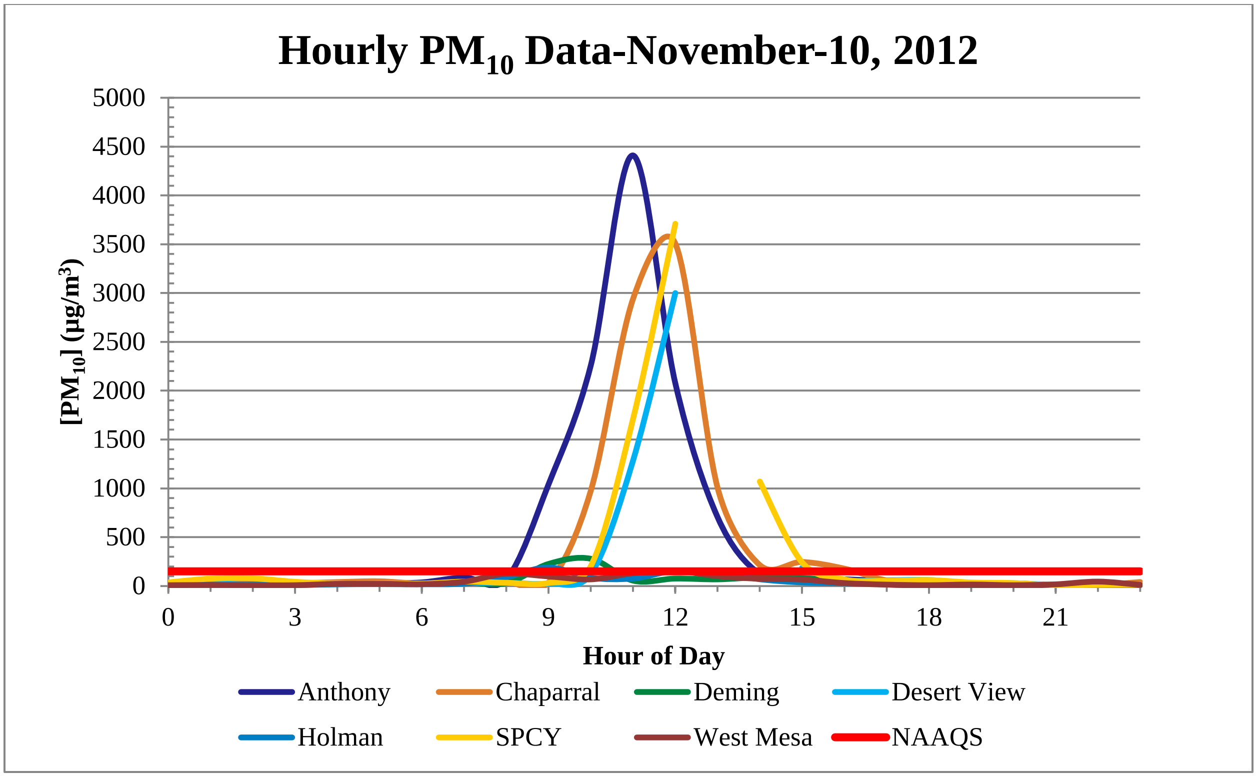


Figure 15-12a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors

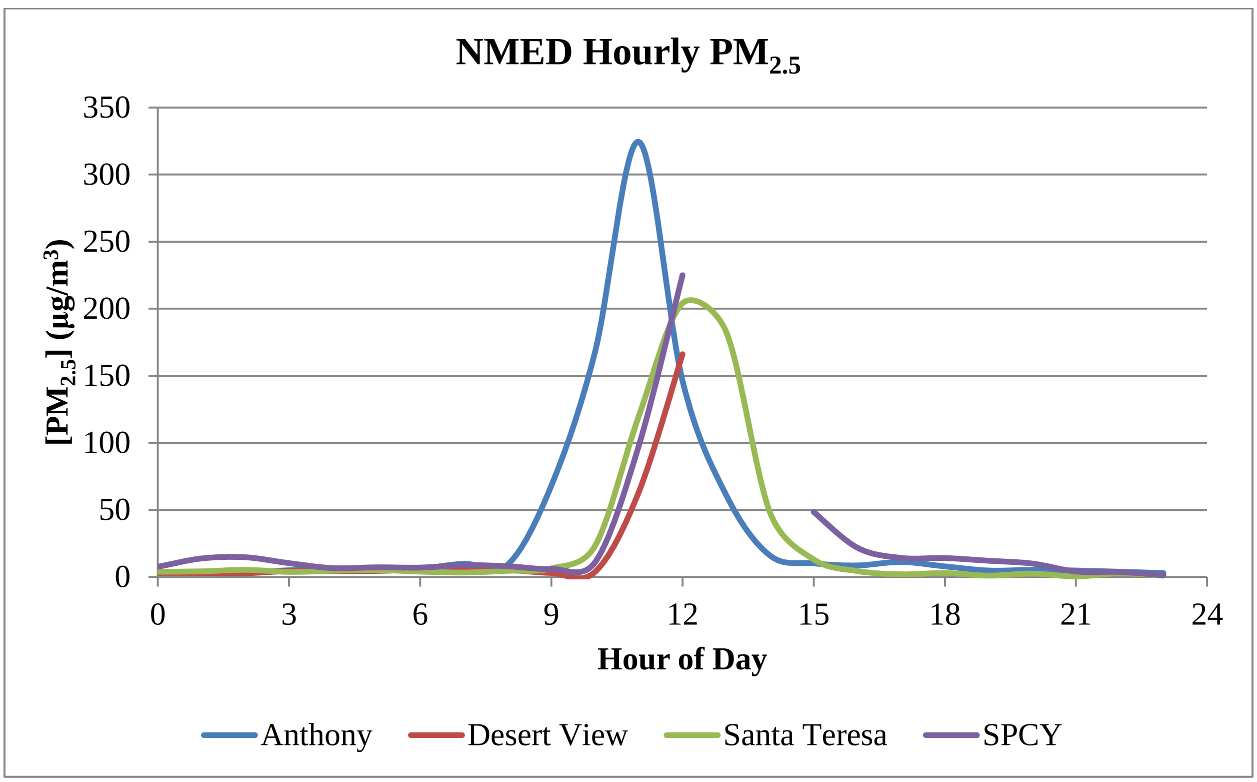


Figure 15-12b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors. Non-FEM hourly $PM_{2.5}$ data.

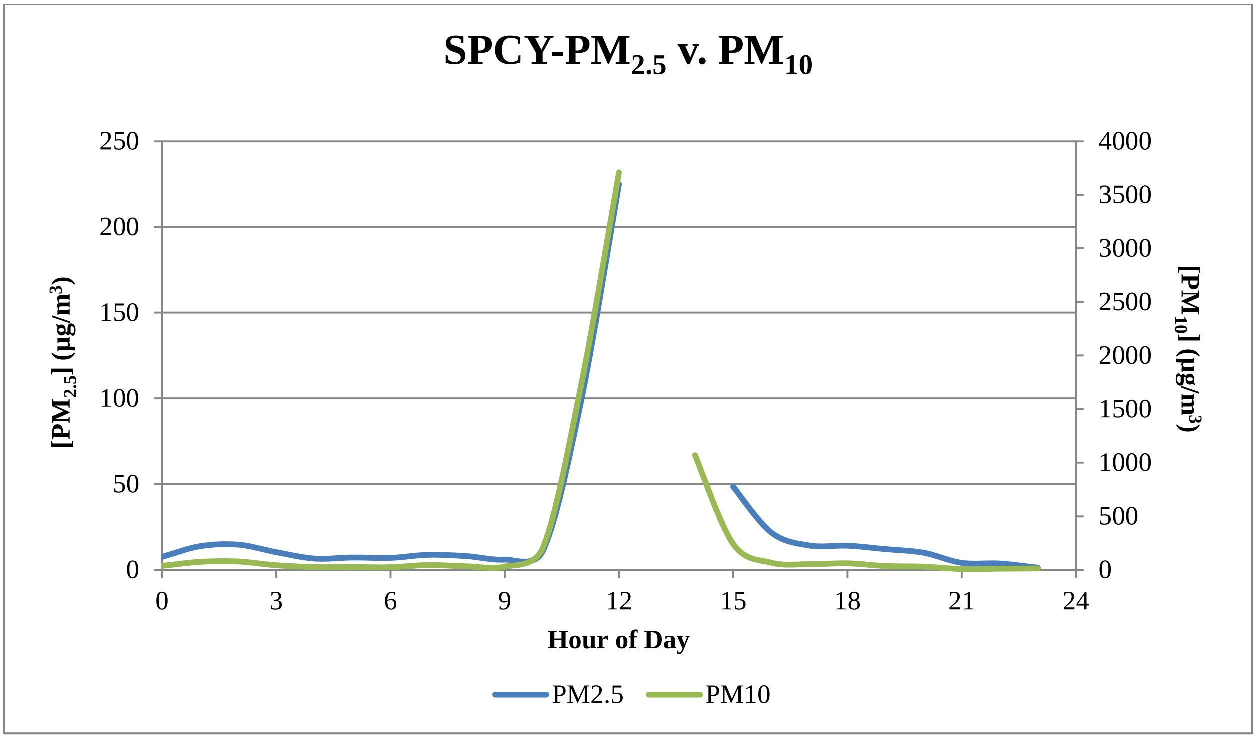


Figure 15-13. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on November 10, 2012.

Satellite imagery clearly shows dust plumes originating in northern Mexico east of the boot heel area. The MODIS instrument on the Aqua satellite captured the image below around the 1100 hour (Figure 15-14).

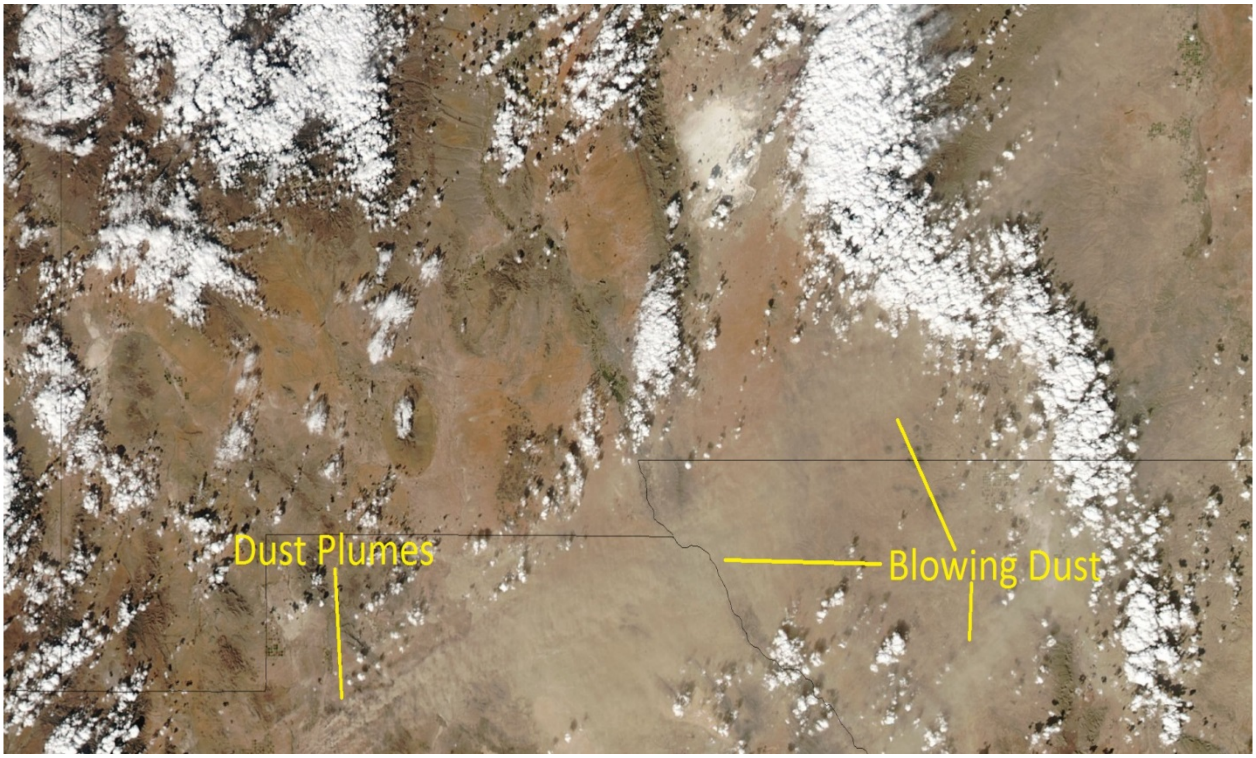


Figure 15-14. Satellite imagery capturing the dust plumes and resulting blowing dust on November 10, 2012 (Image courtesy of NASA).

The NWS issued a hazardous weather outlook on November 9, 2012 noting:

> DAYS TWO THROUGH SEVEN...SATURDAY THROUGH THURSDAY
>
> ON SATURDAY WE WILL SEE EVEN STRONG WINDS WITH WIDESPREAD AREAS OF BLOWING DUST. ROAD CLOSURE DO TO LOW VISIBILITIES WILL BE POSSIBLE SATURDAY AFTERNOON (NWS, 2012).

On November 10, 2012 the NWS issued a high wind warning stating in part:

> …BRINGING STRONG WINDS AND BLOWING DUST TO THE REGION. WINDS WILL GUST AROUND 60 MPH OVER THE HIGHER MOUNTAINS WITH GUSTS AROUND 50 MPH ACROSS THE DESERTS. BLOWING DUST WILL REDUCE VISIBILITIES TO LESS THAN A MILE OVER A FEW LOCATIONS (NWS, 2012).

15.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on November 10, 2012.

15.6 Natural Event

The Clear Causal Relationship and not Reasonably Controllable or Preventable analyses show that this was a natural event caused by high wind and blowing dust.

15.7 No Exceedance but for the Event

The SPCY $PM_{2.5}$ monitor detected elevated levels due to blowing dust on November 10, 2012. These elevated concentrations resulted in exceedances of the 24-hour and annual NAAQS for $PM_{2.5}$ (42.2 µg/m^3). The strong correlation between hourly $PM_{2.5}$, PM_{10} and wind speeds peaks also point to windblown dust affecting the monitor. Previous studies have shown that $PM_{2.5}/PM_{10}$ ratios vary from 0.11 to 0.45 in the Paso del Norte Airshed (Arimoto et. al, 2001; Li et al, 2001). The ratios above 0.30 were observed in downtown El Paso and Ciudad Juárez and indicate a heavy impact from mobile sources. The lower ratios were observed in areas with less vehicular traffic and crustal material dominated the PM_{10} fraction. The $PM_{2.5}/PM_{10}$ ratio for the SPCY site was 0.13 for this date ($PM_{2.5}$ Partisol/PM_{10} TEOM). NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

The Anthony monitor detected blowing dust around the 0900 hour with hourly concentrations heavily impacted until the 1300 hour. The 1100 hour alone, exceeds the 24-hour average standard at Anthony (4409 µg/m^3)/24 = 184 µg/m^3]. By replacing the five hourly values impacted by blowing dust with the 95^{th} percentile of hourly data at the Anthony site, the resulting 24-hour average (83 µg/m^3) does not exceed the NAAQS (Table 15-1). The values in red represent the 95^{th} percentile of all hourly data collected at Anthony, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	24	24
1	25	25
2	33	33
3	26	26
4	28	28
5	27	27
6	37	37
7	88	88
8	70	70
9	1041	**92**
10	2259	**100**
11	4409	**115**
12	2076	**144**
13	705	**164**
14	122	122
15	80	80
16	68	68
17	52	52
18	41	41
19	15	15
20	18	18
21	10	10
22	14	14
23	8	8
24-Hour Average	469	**58**

Table 15-1 95^{th} percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Anthony.

The Chaparral monitor detected blowing dust around the 1000 hour with hourly concentrations heavily impacted until the 1600 hour. The 1100 and 1200 hourly PM_{10} values from hours alone, exceed the 24-hour average standard at Chaparral [(2941+3507) μg/m^3 = 6448μg/m^3; (6448 μg/m^3)/24 = 269 μg/m^3]. By replacing the seven hourly values impacted by blowing dust with the 95th percentile of hourly data at the Chaparral site, the resulting 24-hour average (62 μg/m^3) does not exceed the NAAQS (Table 15-2). The values in red represent the 95th percentile of all hourly data collected at Chaparral, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	14	14
1	20	20
2	39	39
3	29	29
4	40	40
5	48	48
6	23	23
7	28	28
8	41	41
9	37	37
10	976	**100**
11	2941	**115**
12	3507	**144**
13	1006	**164**
14	214	**160**
15	246	**161**
16	178	**163**
17	57	57
18	26	26
19	13	13
20	-3	-3
21	8	8
22	8	8
23	41	41
24-Hour Average	396	**62**

Table 15-2. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Chaparral.

The Desert View monitor detected blowing dust around the 1100 hour with hourly concentrations heavily impacted until the 1500 hour. The five hourly PM_{10} values from 1400-1800 hours alone, exceed the 24-hour average standard at Desert View [(269 + 547 + 871 + 347 + 1959) µg/m^3 = 3993 µg/m^3; (3993 µg/m^3)/24 = 166 µg/m^3]. By replacing these five hourly values impacted by blowing dust with the 95th percentile of hourly data at the Anthony site, the resulting 24-hour average (70 µg/m^3) does not exceed the NAAQS (Table 15-3). The values in red represent the 95th percentile of all hourly data collected at Desert View, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	17	17
1	26	26
2	15	15
3	22	22
4	18	18
5	24	24
6	27	27
7	29	29
8	33	33
9	25	25
10	123	123
11	1285	**93**
12	3000	**99**
13		
14		
15	186	**136**
16	62	62
17	58	58
18	61	61
19	24	24
20	28	28
21	11	11
22	4	4
23	9	9
24-Hour Average	230	**39**

Table 15-3 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Desert View.

The SPCY monitor detected blowing dust around the 1000 hour with hourly concentrations heavily impacted until the 1500 hour. The 1000 and 1100 hour PM_{10} values alone exceed the 24-hour average standard at SPCY [(1712+3709) μg/m^3 = 5421 μg/m^3; (5421 μg/m^3)/24 = 226 μg/m^3]. By replacing the five hourly values impacted by blowing dust with the 95th percentile of hourly data at the SPCY site, the resulting 24-hour average (60 μg/m^3) does not exceed the NAAQS (Table 15-4). The values in red represent the 95th percentile of all hourly data collected at SPCY, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	37	37
1	75	75
2	78	78
3	43	43
4	26	26
5	26	26
6	25	25
7	45	45
8	33	33
9	31	31
10	204	**102**
11	1712	**111**
12	3709	**144**
13		0
14	1070	**185**
15	242	**205**
16	67	67
17	53	53
18	61	61
19	36	36
20	30	30
21	8	8
22	11	11
23	13	13
24-Hour Average	331	**60**

Table 15-4. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at SPCY.

16 HIGH WIND EXCEPTIONAL EVENT: December 14, 2012

16.1 Summary of Event

The passing of a Pacific cold front caused high winds and blowing dust in southern Doña Ana County resulting in an exceedance of the PM_{10} NAAQS and the $PM_{2.5}$ annual NAAQS at the SPCY monitoring site on this date. The PM_{10} FEM TEOM continuous monitor and $PM_{2.5}$ FRM Partisol monitor at this site recorded a 24-hour average concentration of 199 µg/m^3 and 16.5 µg/m^3, respectively (Figure 16-1). The averages in this figure were calculated using PM_{10} FEM TEOM and $PM_{2.5}$ FRM Partisol instrument data for the four days before and after the event. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured at Anthony (111 µg/m^3) and Desert View (136 µg/m3). Elevated concentrations were also recorded by the $PM_{2.5}$ non-FEM/FRM TEOMs (Figure 16-2).

As the event unfolded, the wind blew from the southwest throughout the border region. These high velocity winds passed over large areas of desert within New Mexico and Mexico. The co-occurrence of high winds and elevated levels of blowing dust, little to no point sources in the area, and the high hourly PM_{10} concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

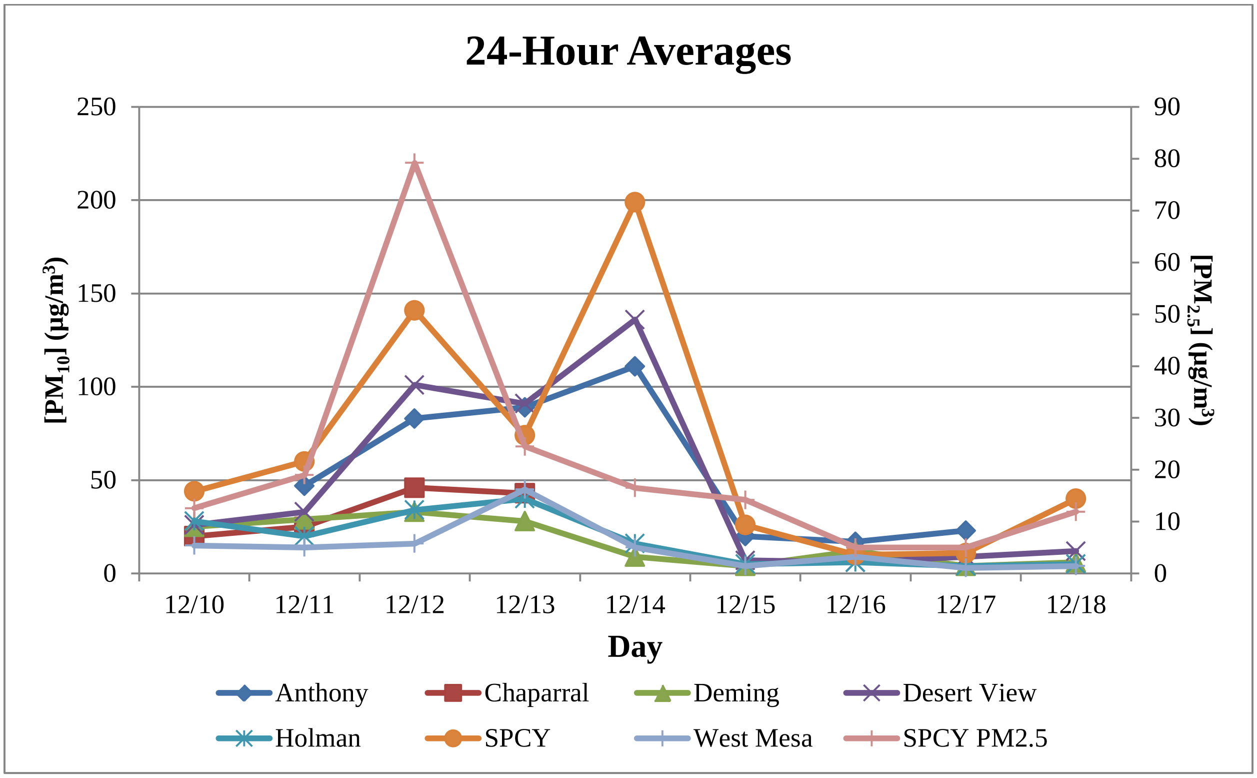


Figure 16-1. PM_{10} 24-hour averages before and after December 14, 2012.

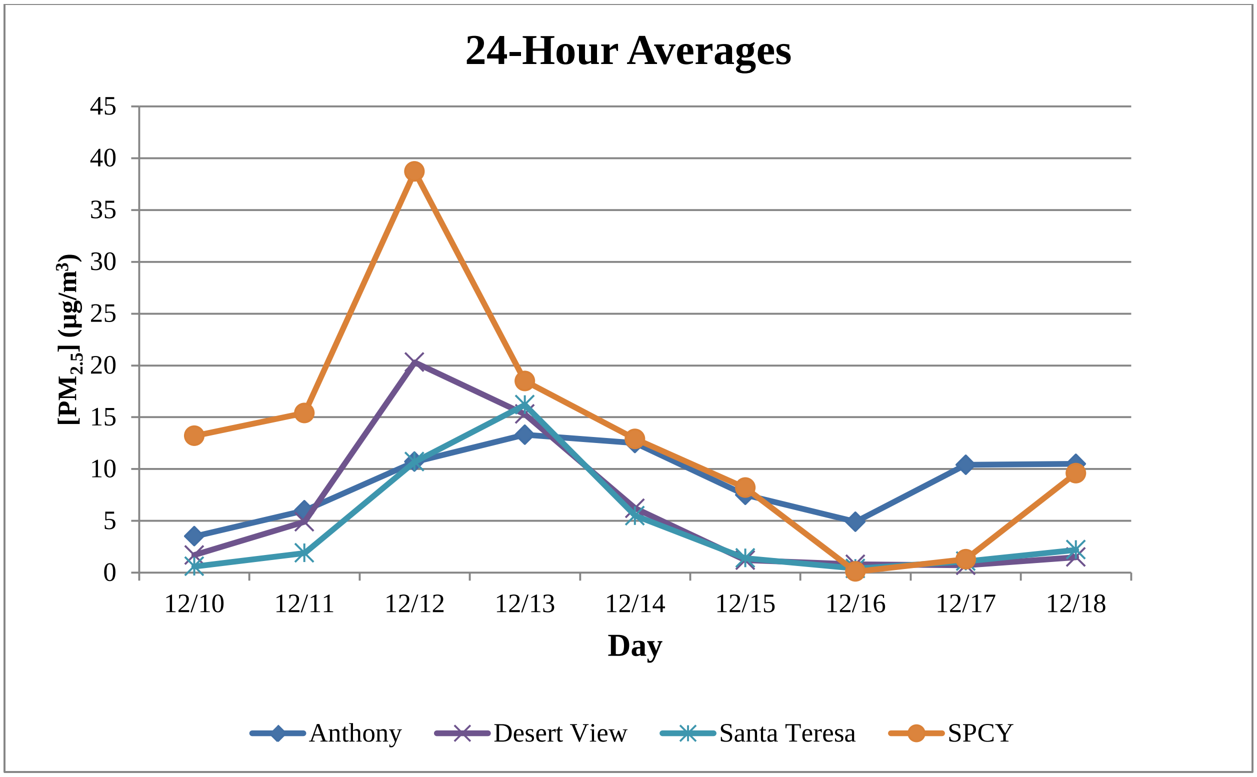


Figure 16-2. $PM_{2.5}$ 24-hour averages before and after December 14, 2012. Non-FEM TEOM Data.

16.2 Is Not Reasonably Controllable or Preventable

16.2.1 Suspected Source Areas and Categories Contributing to the Event

Sources of windblown dust contributing to this exceedance include the natural desert, residential properties, agricultural land and unpaved roads in Mexico and New Mexico. Doña County Ordinances requires BACM for any dust producing activities. The largest and most likely sources of windblown dust are the natural desert and the playas of northern Mexico (see Section 16.2.4 below).

16.2.2 Sustained and Instantaneous Wind Speeds

EPA uses a default entrainment threshold of sustained wind speeds at 11.2 m/s (25 mph) for natural and well controlled anthropogenic sources contributing to natural events caused by high wind and blowing dust (EPA, 2013). Under the Doña Ana and Luna County NEAPs, EPA and NMED agreed that wind gusts exceeding 18 m/s would overwhelm any natural and well-controlled anthropogenic sources and cause windblown dust. On December 14, 2012, sustained wind speeds exceeded EPA's default threshold at four of the eight monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at six of the eight monitoring sites (Figures 16-3 and 16-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 1000 hour and ending at the 1600 hour.

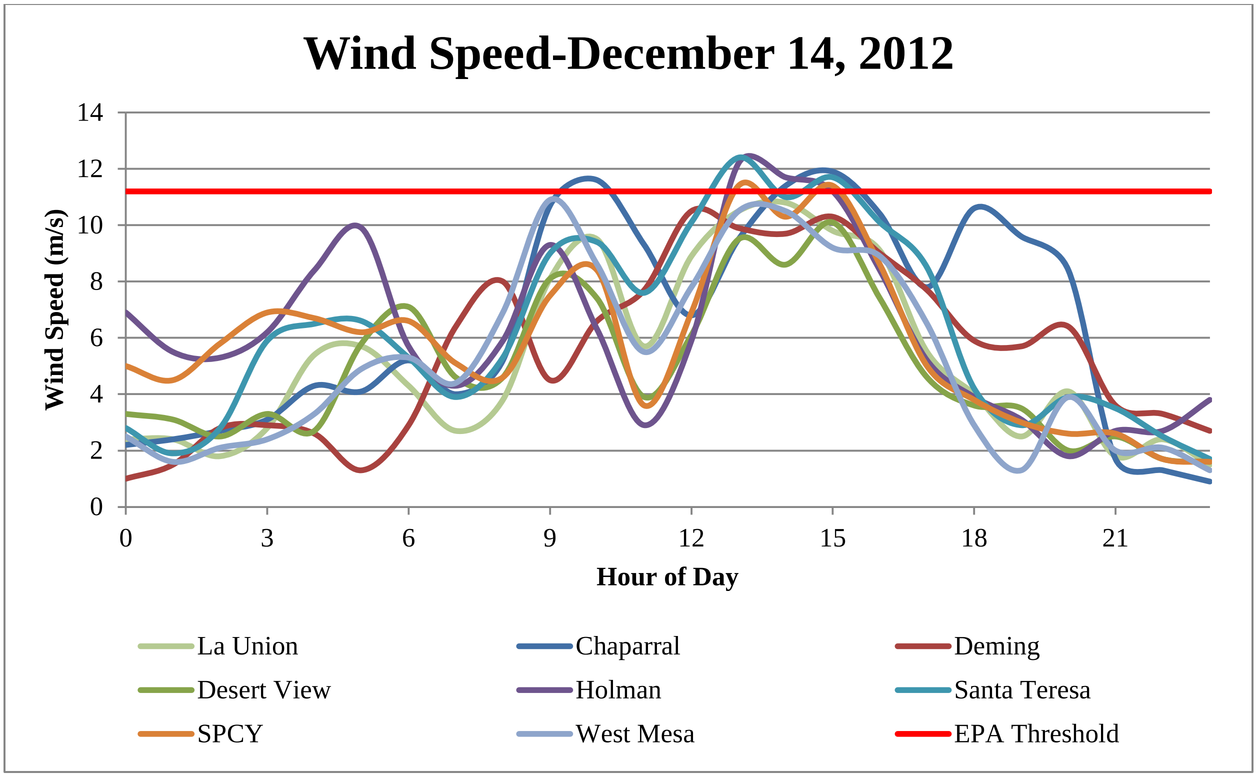


Figure 16-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

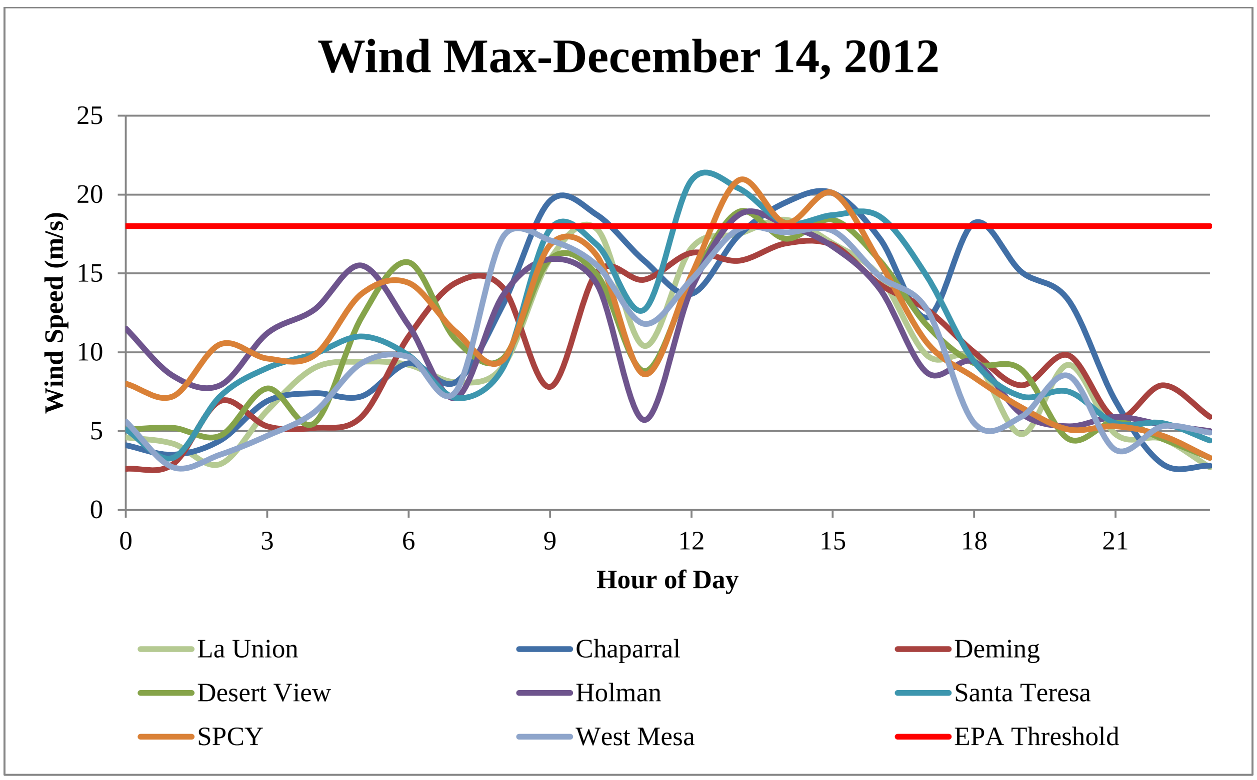


Figure 16-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

16.2.3 Recurrence Frequency

The monitoring sites in Doña Ana and Luna Counties can record exceedances of the PM_{10} NAAQS throughout the year. From 2007-2011 the PM_{10} FEM TEOM monitors recorded 254 exceedances and the PM_{10} FRM Wedding monitors recorded 6 exceedances (Figure A-1). The Deming Airport and Desert View monitoring sites (FEM TEOMs) were established in 2006 and 2007 respectively and do not show exceedances until the year following startup. The SPCY $PM_{2.5}$ FRM Partisol recorded 37 exceedances of the 24-Hour NAAQS from 2007-2011 (Figure A-2). See appendix A for a more in-depth discussion about recurrence frequency and the number of exceedances at each monitoring site.

16.2.4 Controls Analysis

The local ordinances and MOUs adopted under the NEAP direct the implementation of BACM for sources of dust in Doña Ana County. The ordinances regulate disturbed lands, construction and demolition, vacant parking lots and materials handling and transportation. Our investigation did not identify any unusual PM_{10} producing activities on this day, and anthropogenic emissions remained constant before, during and after the event. The most likely source contributing to the event is the natural desert and playas in New Mexico and northern Mexico. A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from Mexico to the monitors in southern Doña Ana County. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 16-5). Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

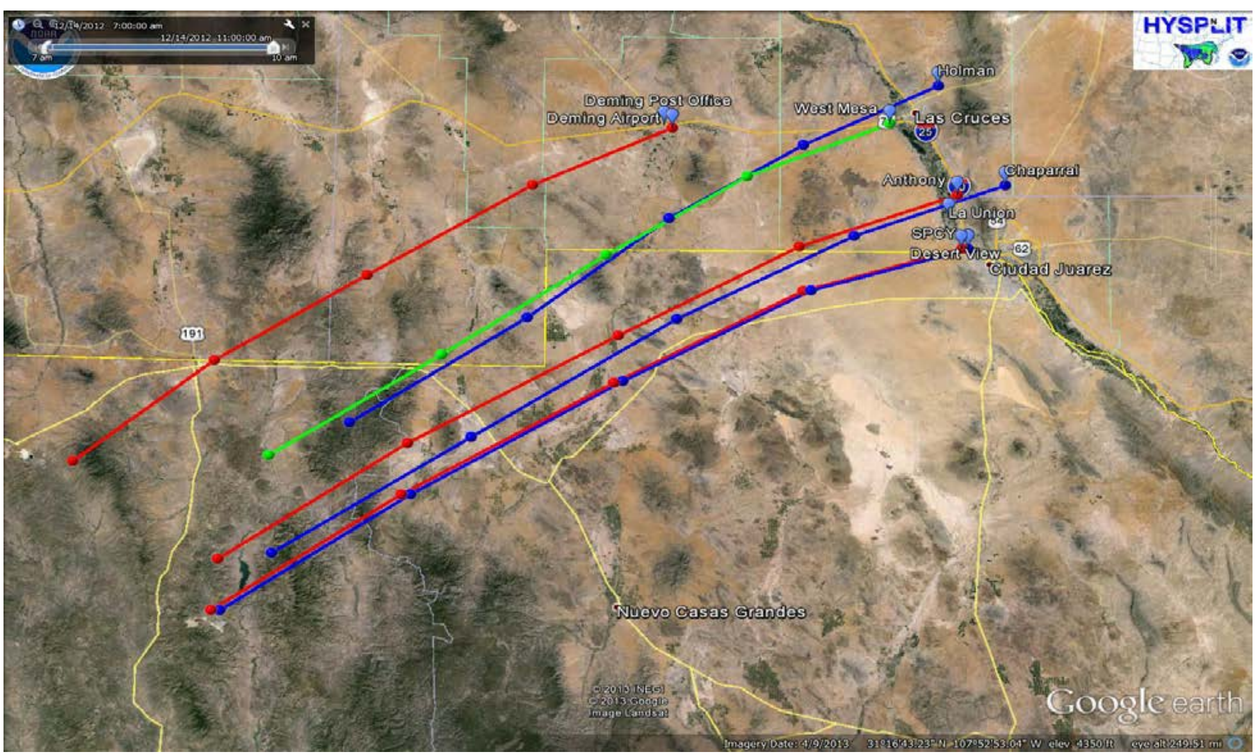


Figure 16-5. HYSPLIT back-trajectory model analysis for December 14, 2012.

16.3 Historical Fluctuations Analysis

16.3.1 Annual and Seasonal 24-hour Average Fluctuations

Since being established, the monitoring sites in Doña Ana and Luna Counties have recorded exceedances of the PM_{10} NAAQS. High winds cause these exceedances and they can occur at any time of year (Figure B-6 through B-13). Most exceedances occur from late winter through early summer (February-June) and are associated with the passage of Pacific cold fronts. High winds caused all recorded exceedances from 2007-2011 and NMED submitted natural events demonstrations to EPA under the NEAP or EER.

Since the 24-hour $PM_{2.5}$ NAAQS was lowered from 65 to 35 µg/m^3 in 2006, the SPCY Partisol monitor has routinely recorded exceedances of the standard. These exceedances occurred throughout the year during high and low wind conditions. In 2009, NMED investigated the cause of the low wind exceedances and found that emissions from Ciudad Juárez, Mexico contribute significantly to elevated concentrations. The high wind exceedances were caused by blowing dust on days when PM_{10} monitors also recorded exceedances.

Appendix B contains a more in-depth discussion about historical fluctuations and charts showing annual and seasonal trends at each monitoring site.

Table B-1 and B-2 show normal historical fluctuations with and without high wind natural events that caused exceedances from 2007-2011. The analysis excludes only those high wind events that resulted in an exceedance. Data for PM_{10} in this table includes FRM Wedding and FEM TEOM measurements and data for $PM_{2.5}$ comes from the FRM Partisol measurements from 2007-2011. The recorded value for this day (199 µg/m^3) is above the maximum value recorded when no high wind exceedances are included and is above the 95th percentile of all 24-hour averages recorded.

An hourly data distribution analysis was performed for PM_{10} and $PM_{2.5}$ concentrations, wind speeds and wind gusts (Appendices C, D and E). All data used for the PM_{10} distribution charts come from the FEM TEOM monitors and the non-FEM/FRM $PM_{2.5}$ TEOM monitor at SPCY. Overlaying the hourly data for December 14, 2012 on the hourly data distribution plots shows that the values recorded during the high wind event exceed the 95th percentile for PM_{10}, $PM_{2.5}$, wind speed and wind gusts (Figures 16-6a-b through 16-8) The top whiskers of the box and whisker plots represent the 95th percentile of data. The hourly PM_{10} values during the high wind blowing dust storm far exceed the historical 95th percentile of data.

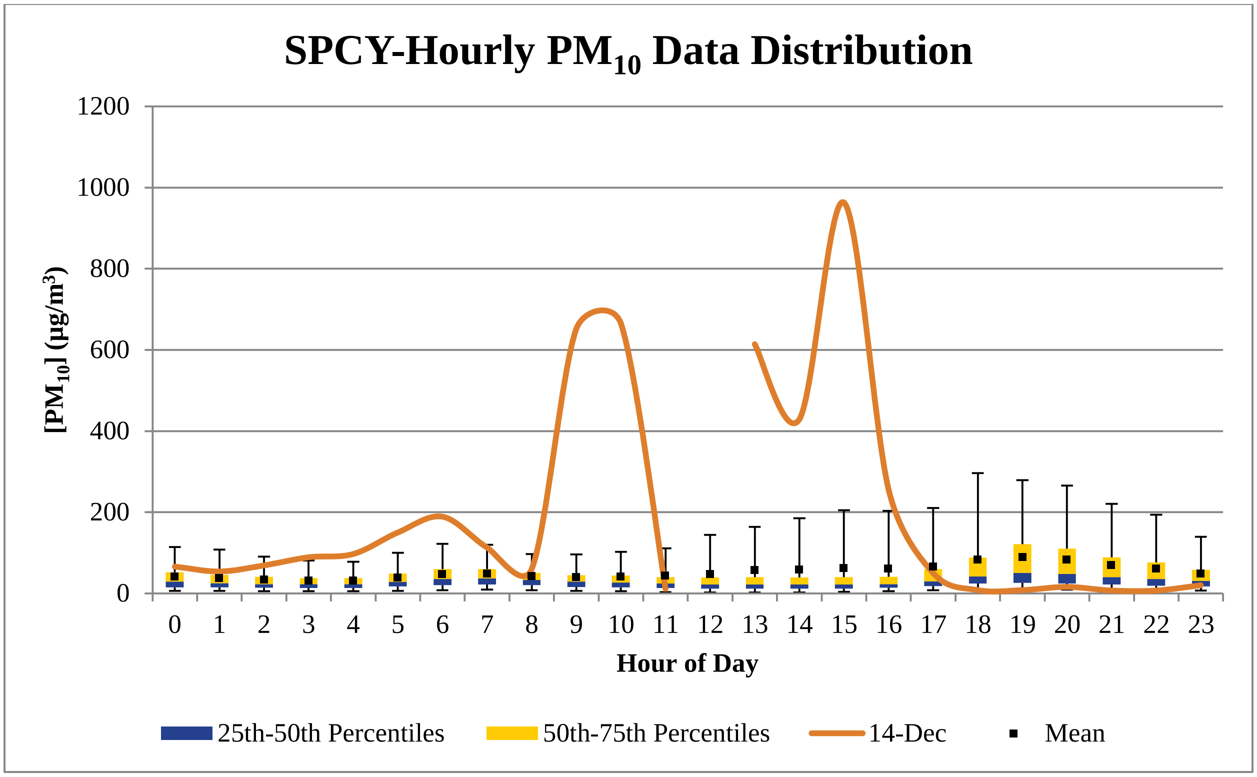


Figure 16-6a. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for December 14, 2012.

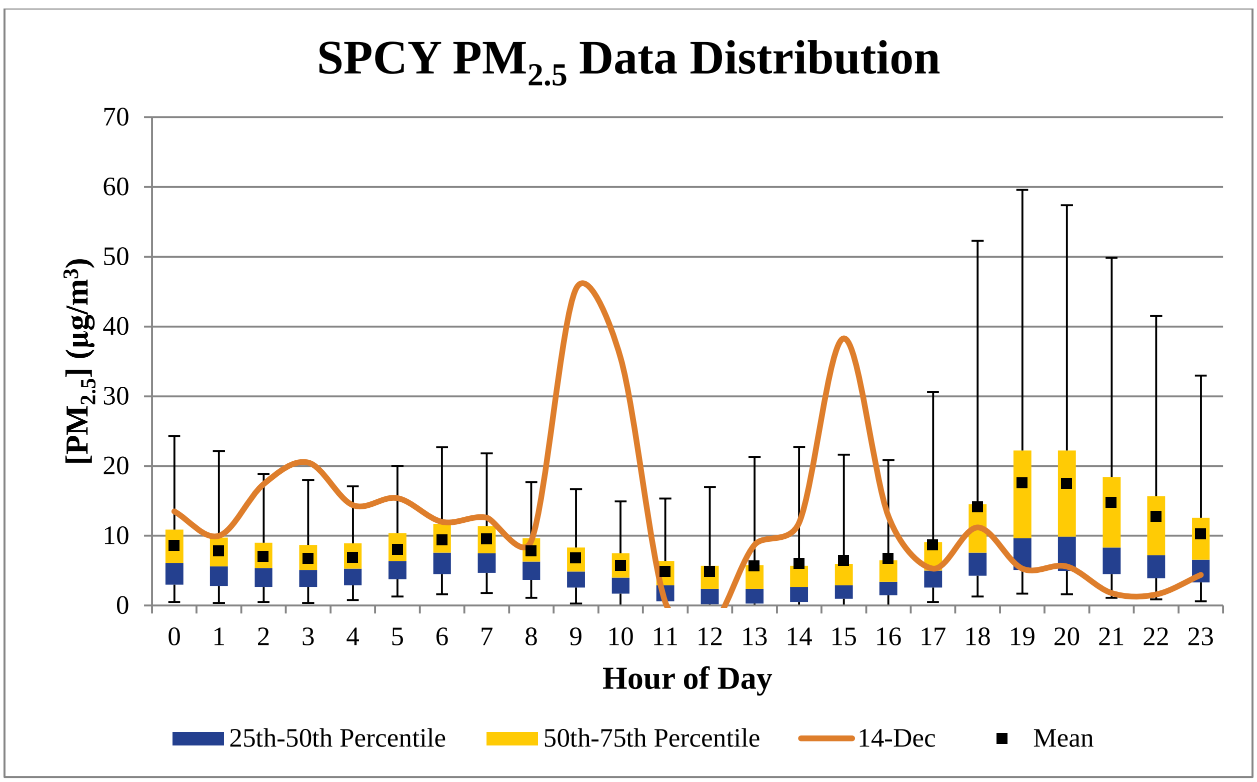


Figure 16-6b. $PM_{2.5}$ hourly data distribution from 2007-2011 overlaid by hourly values for December 14, 2012.

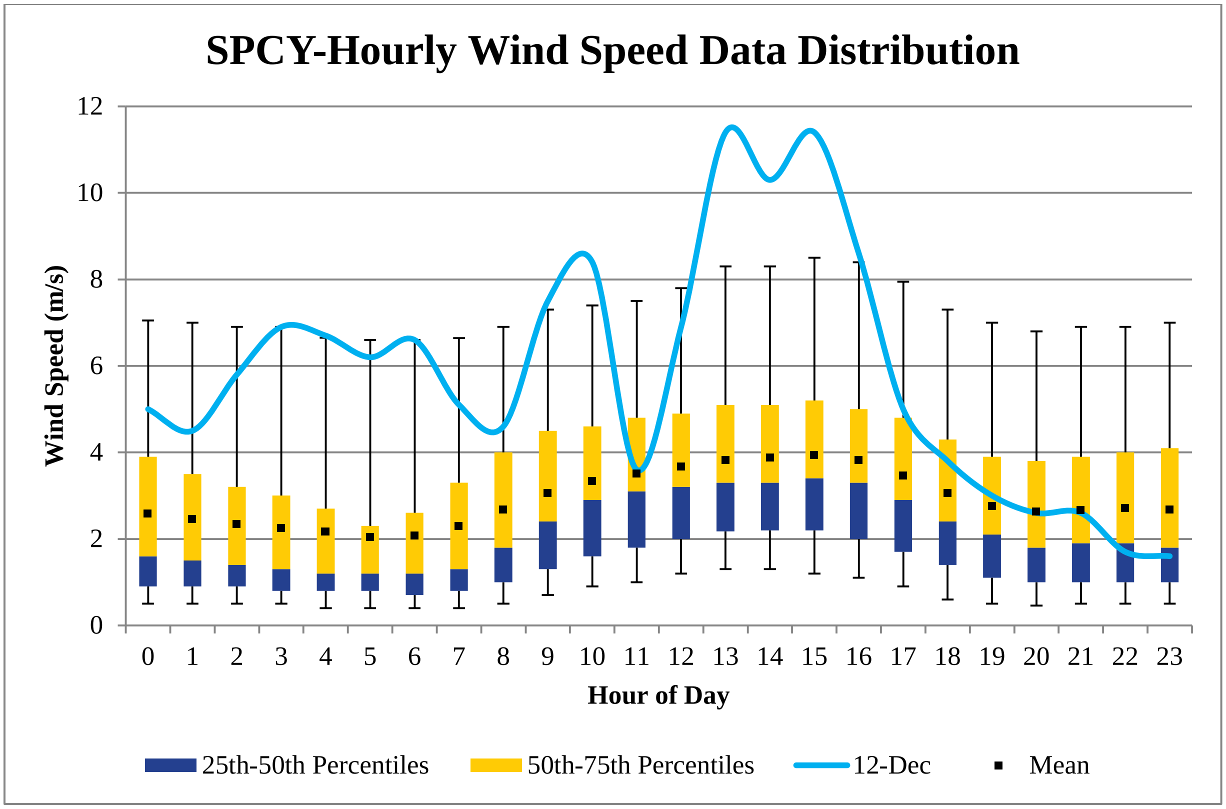


Figure 16-7. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for December 14, 2012.

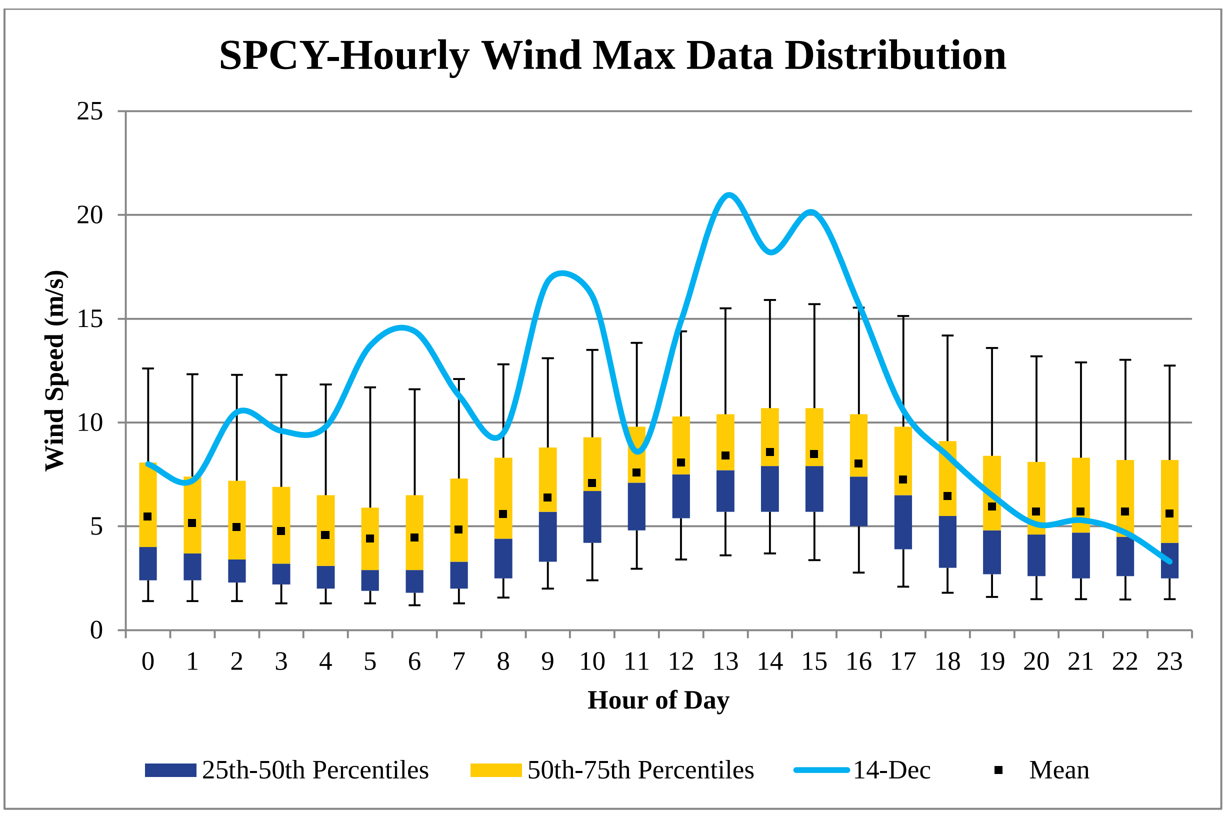


Figure 16-8. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for December 14, 2012.

16.4 Clear Causal Relationship

A strong Pacific storm system and surface cold front passed through New Mexico on December 14, 2012. As the Pacific cold front moved through New Mexico, areas of low pressure in northern New Mexico tightened the pressure gradient increasing surface wind speeds (Figure 16-9). The wind direction in the upper atmosphere aligned well with the surface wind direction. Diurnal heating of the surface allowed winds aloft to mix downward, increasing the surface wind velocities and provided the turbulence required for vertical mixing and horizontal transport (Figure 16-10).

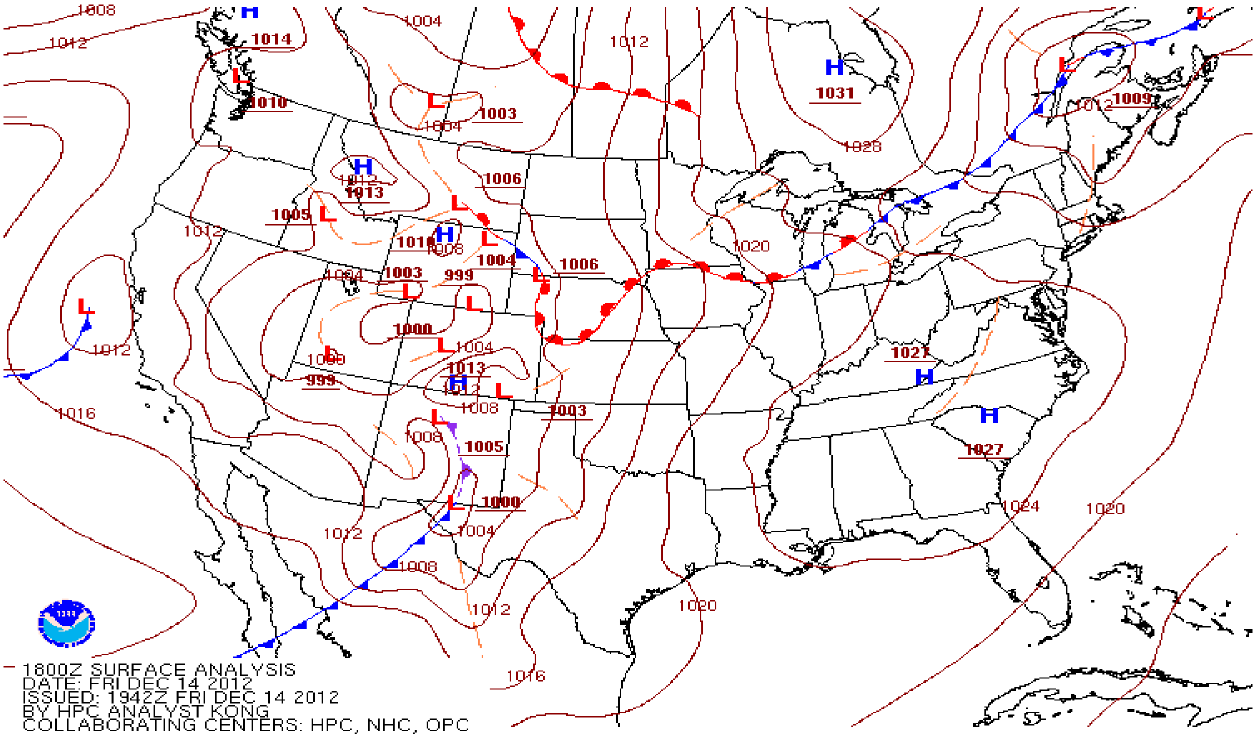


Figure 16-9. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for December 14, 2012 at the 1100 MST hour.

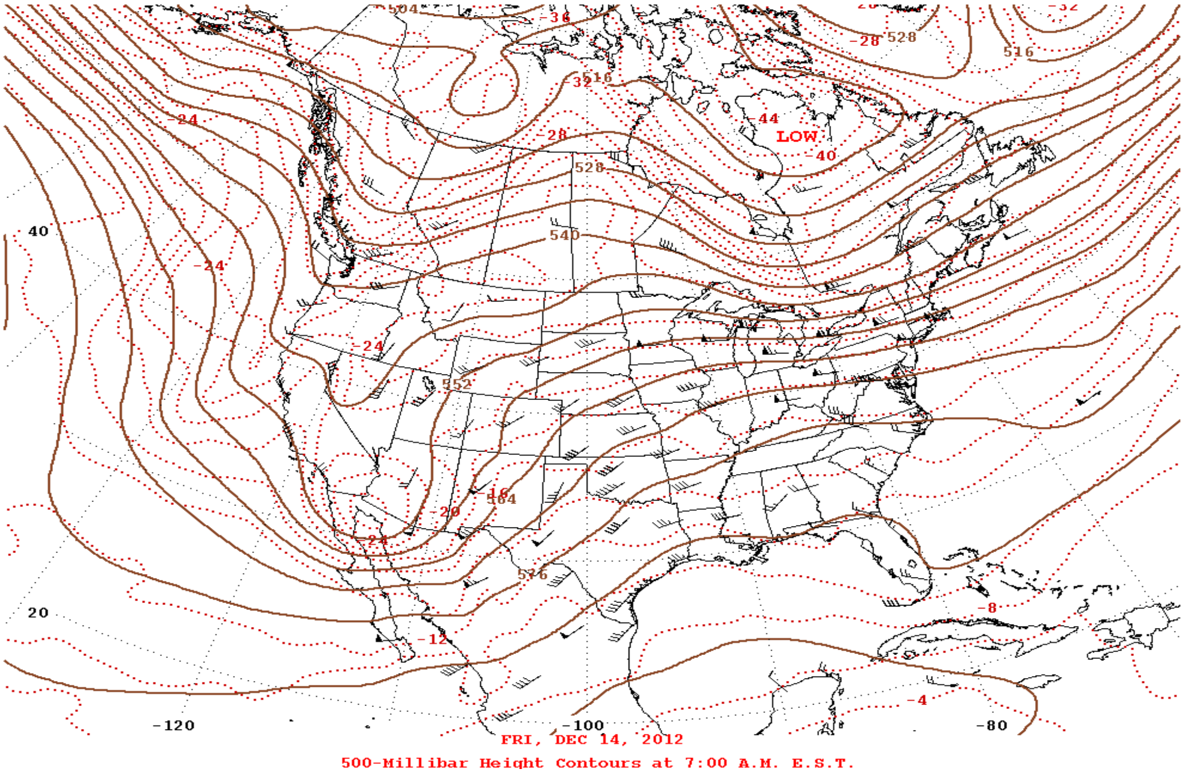


Figure 16-10. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on December 14, 2012.

The weather pattern described above generated strong southwesterly winds beginning at the 0900 hour and lasting through the 1700 hour. Beginning at the 0900 hour, wind speeds exceeded the historical 95th percentile of data at as shown in Figure 16-7. Peak wind speeds ranged from 10.5 m/s at Deming to 12.4 m/s at Santa Teresa (Figure 16-3). Peak wind gusts ranged from 16.9 m/s at Deming to 20.9 m/s at SPCY (Figure 16- 4). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 16-11a-b. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (0900-1700 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 16-12a-b). Maximum hourly PM_{10} concentrations ranged from 51 $\mu g/m^3$ at Deming to 963 $\mu g/m^3$ at SPCY. Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 16-13).

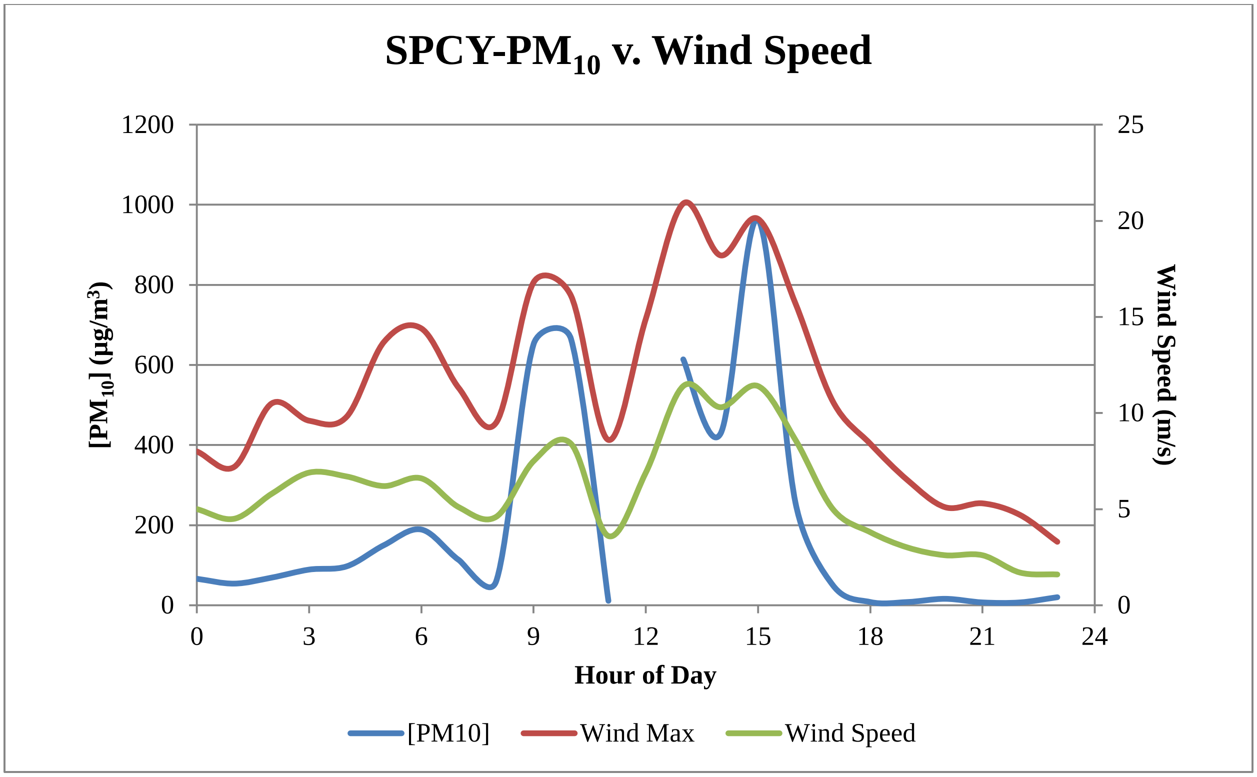


Figure 16-11a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

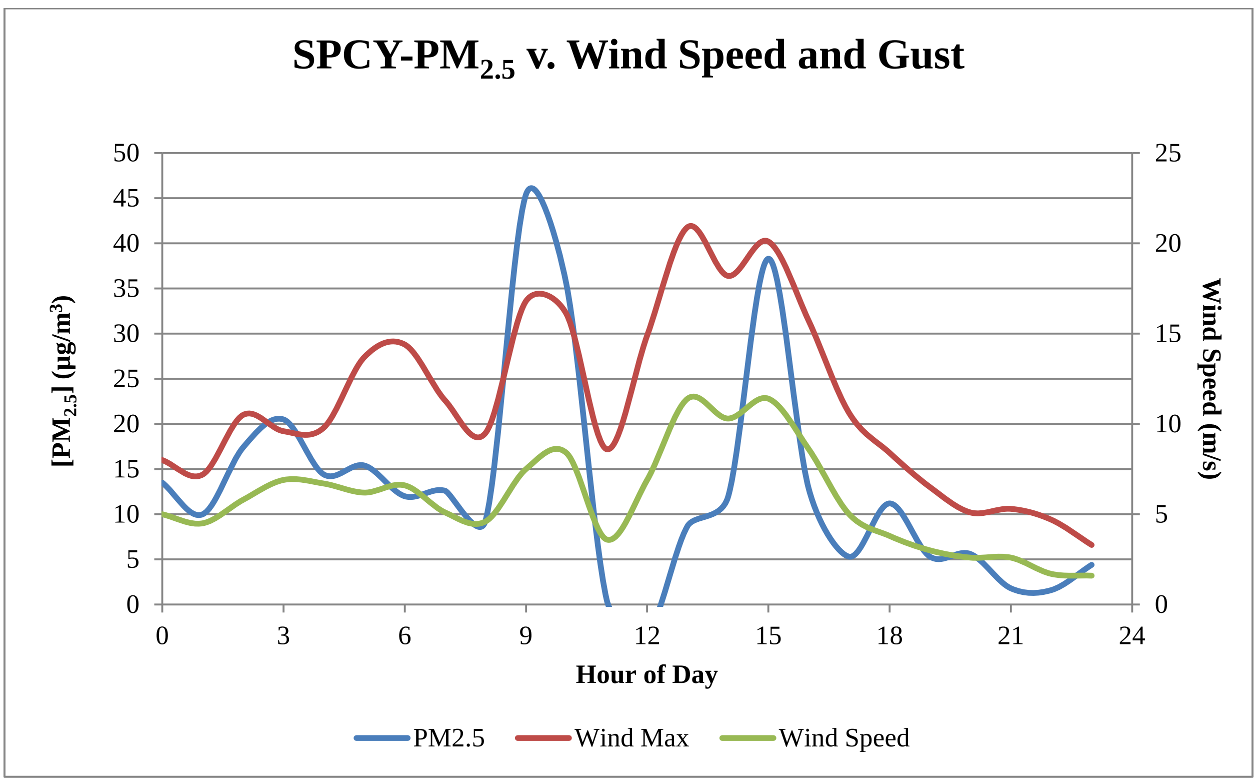


Figure 16-11b. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

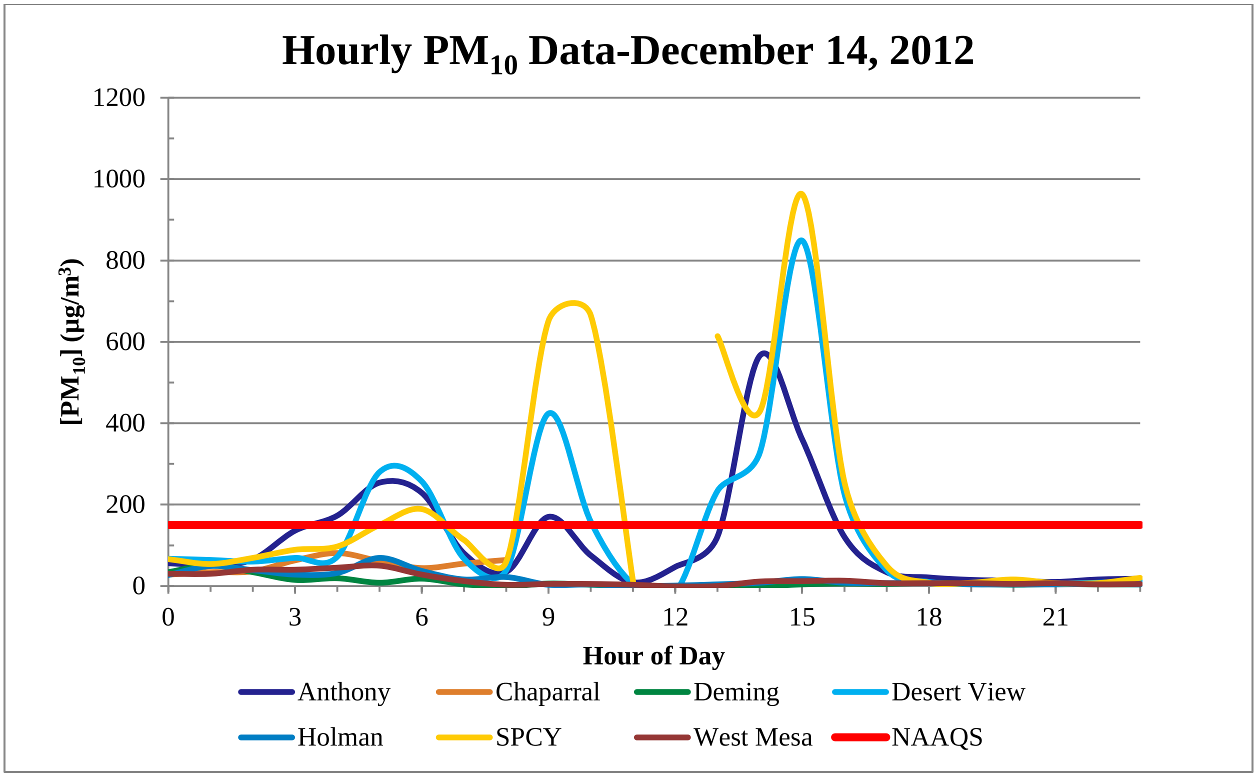


Figure 16-12a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

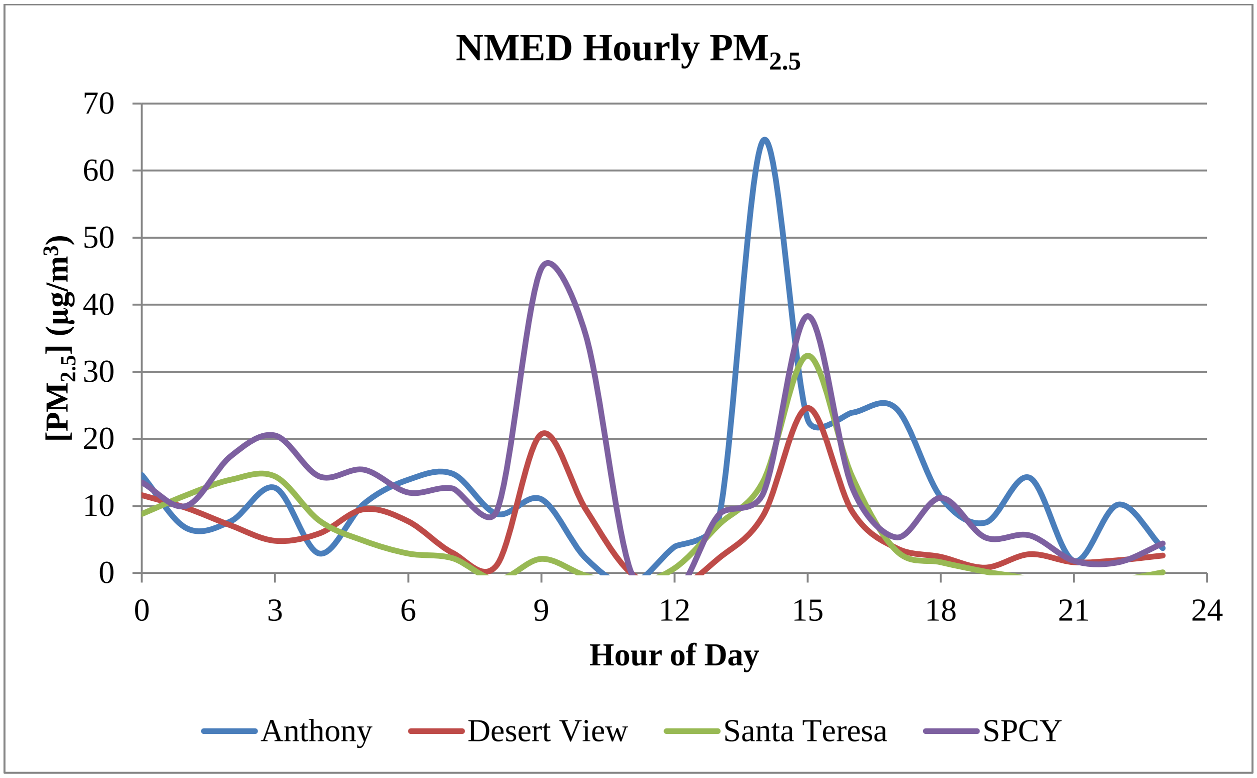


Figure 16-12b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors. Non FEM TEOM Data.

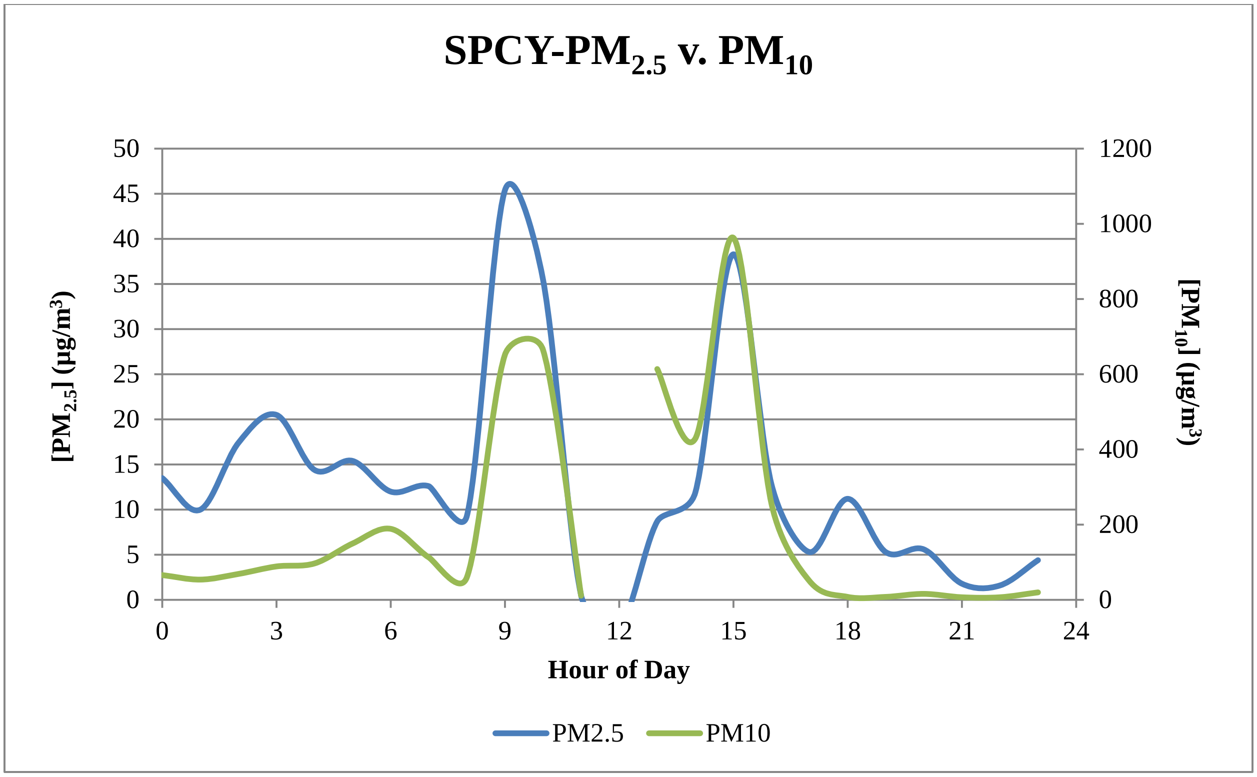


Figure 16-13. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on December 14, 2012.

The NWS issued a high wind warning and blowing dust advisory for this date stating in part:

> WINDS WILL INCREASE ACROSS THE AREA THIS MORNING AHEAD OF A STRONG PACIFIC COLD FRONT. AREAS OF BLOWING DUST WILL INITIALLY BE LIMITED BY SCATTERED RAIN SHOWERS...BUT WILL INCREASE AS THE COLD FRONT MOVES THROUGH AND THE RAIN SHOWERS END IN THE LOWLANDS. SUSTAINED WINDS OF 35 TO 45 MPH WITH GUSTS 50 TO 65 MPH ARE EXPECTED. WINDS WILL STRONGEST IN THE LATE MORNING AND EARLY AFTERNOON HOURS...ESPECIALLY ALONG THE EAST SLOPES OF AREA MOUNTAINS (NWS, 2012)

16.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on December 14, 2012.

16.6 Natural Event

The Clear Causal Relationship and not Reasonably Controllable or Preventable analyses show that this was a natural event caused by high wind and blowing dust.

16.7 No Exceedance but for the Event

The SPCY $PM_{2.5}$ monitor detected elevated levels due to blowing dust on December 14, 2012. Although these elevated concentrations do not exceed the 24-hour NAAQS for $PM_{2.5}$, they contribute to an annual exceedance level of 16.5 µg/m^3 for this date. The strong correlation between hourly $PM_{2.5}$, PM_{10} and wind speeds peaks also point to windblown dust affecting the monitor. Previous studies have shown that $PM_{2.5}/PM_{10}$ ratios vary from 0.11 to 0.45 in the Paso del Norte Airshed (Arimoto et. al, 2001; Li et al, 2001). The ratios above 0.30 were observed in downtown El Paso and Ciudad Juárez and indicate a heavy impact from mobile sources. The lower ratios were observed in areas with less vehicular traffic and crustal material dominated the PM_{10} fraction. The $PM_{2.5}/PM_{10}$ ratio for the SPCY site was 0.08 for this date ($PM_{2.5}$ Partisol/PM_{10} TEOM). NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

The SPCY monitor detected blowing dust around the 0900 hour with hourly concentrations heavily impacted until the 1600 hour. The seven hourly PM_{10} values from 0600-1600 hours alone, nearly exceed the 24-hour average standard at SPCY [(189 + 652 + 665 + 614 + 429+256) µg/m^3 = 2805 µg/m^3; (2805 µg/m^3)/24 = 116 µg/m^3]. By replacing these seven hourly values with the 95th percentile of hourly data at the SPCY site, the resulting 24-hour average (85 µg/m^3) does not exceed the NAAQS (Table 16-1). The values in red represent the 95th percentile of all hourly data collected at SPCY, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	66	66
1	54	54
2	69	69
3	89	89
4	97	97
5	150	150
6	189	189
7	113	113
8	60	60
9	652	**96**
10	665	**102**
11	11	11
12		
13	614	**164**
14	429	**185**
15	963	**205**
16	256	**203**
17	50	50
18	8	8
19	8	8
20	16	16
21	7	7
22	7	7
23	20	20
24-Hour Average	199	**85**

Table 16-1. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at SPCY.

17 HIGH WIND EXCEPTIONAL EVENT: December 19, 2012

17.1 Summary of Event

The passing of a Pacific cold front caused wide spread high winds and blowing dust in southern Doña Ana and Luna Counties resulting in exceedances of the PM_{10} and $PM_{2.5}$ 24-hour NAAQS at the Deming, Desert View, Holman, SPCY and West Mesa sites on this date. The PM_{10} FEM TEOM continuous monitors at these sites recorded 24-hour average concentrations 381, 397, 365, 500 and 352 µg/m^3, respectively (Figure 16-1). The $PM_{2.5}$ FRM Partisol at SPCY recoded a 24-hour average of 49.7 µg/m^3. The averages in this figure were calculated using PM_{10} FEM TEOM and $PM_{2.5}$ FRM Partisol instrument data for the four days before and after the event. The Anthony and Chaparral monitors did not record data on this date. Elevated concentrations were also recorded by the $PM_{2.5}$ non-FEM/FRM TEOMs (Figure 16-2).

As the event unfolded, the wind blew from the west-southwest throughout the border region. These high velocity winds passed over large areas of desert within Arizona, New Mexico and Mexico. The co-occurrence of high winds and elevated levels of blowing dust, little to no point sources in the area, and the high hourly and daily PM_{10} and $PM_{2.5}$ concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

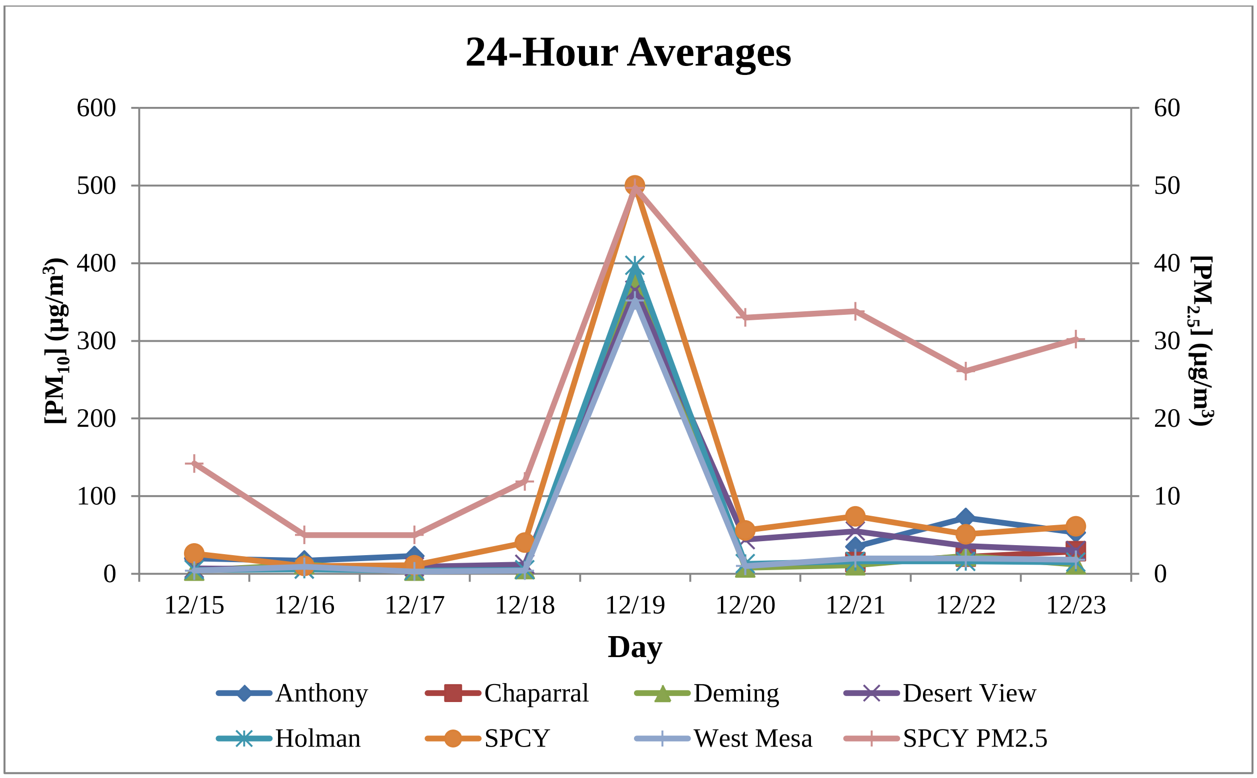


Figure 17-1. PM_{10} 24-hour averages before and after December 19, 2012.

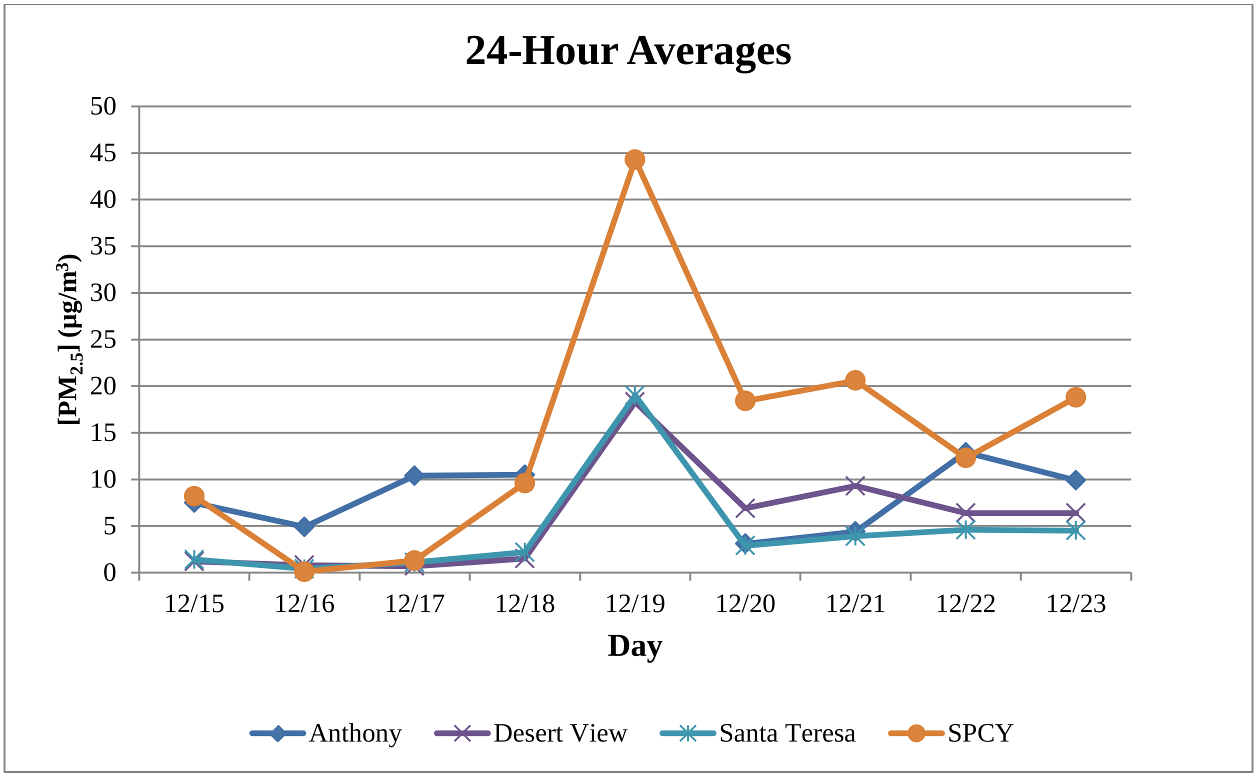


Figure 17-2. $PM_{2.5}$ 24-hour averages before and after December 19, 2012. Non-FEM TEOM Data.

17.2 Is Not Reasonably Controllable or Preventable

17.2.1 Suspected Source Areas and Categories Contributing to the Event

Sources of windblown dust contributing to this exceedance include the natural desert, residential properties, agricultural land and unpaved roads in Arizona, northern Mexico and New Mexico. City of Las Cruces, City of Deming and Doña Ana and Luna Counties Ordinances requires BACM for any dust producing activities. The largest and most likely sources of windblown dust are the natural desert and the playas of northern Mexico (see Section17.2.4 below).

17.2.2 Sustained and Instantaneous Wind Speeds

EPA uses a default entrainment threshold of sustained wind speeds at 11.2 m/s (25 mph) for natural and well controlled anthropogenic sources contributing to natural events caused by high wind and blowing dust (EPA, 2013). Under the Doña Ana and Luna County NEAPs, EPA and NMED agreed that wind gusts exceeding 18 m/s would overwhelm any natural and well-controlled anthropogenic sources and cause windblown dust. On December 19, 2012, sustained wind speeds exceeded EPA's default threshold at all eight monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at all eight monitoring sites (Figures 17-3 and 17-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 0400 hour and ending at the 1500 hour.

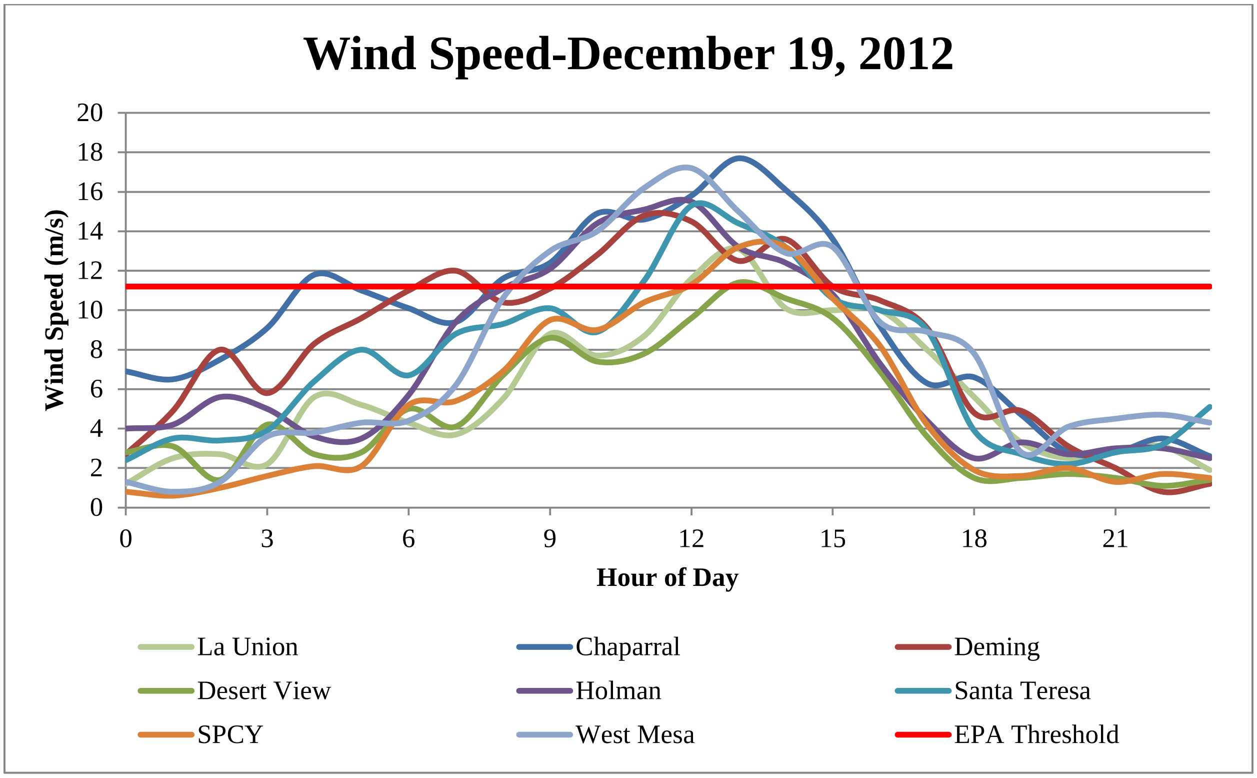
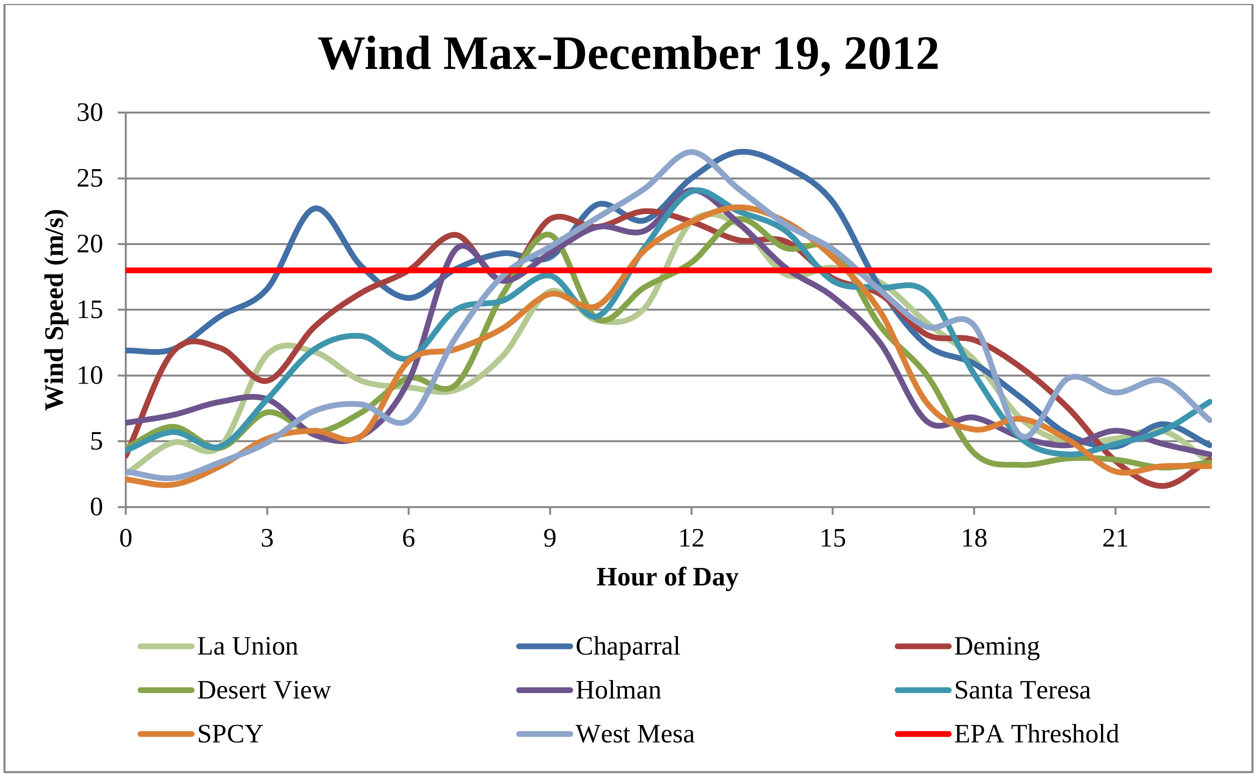


Figure 17-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.



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17.2.4 Controls Analysis

The local ordinances and MOUs adopted under the NEAP direct the implementation of BACM for sources of dust in Doña Ana and Luna Counties. The ordinances regulate disturbed lands, construction and demolition, vacant parking lots and materials handling and transportation. Our investigation did not identify any unusual PM_{10} producing activities on this day, and anthropogenic emissions remained constant before, during and after the event. The most likely source contributing to the event is the natural desert and playas in New Mexico and northern Mexico. The southern sites in Doña Ana County and Deming Airport recorded the highest 24-hour averages in the monitoring network. A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from Arizona and Mexico to the monitors in southern Doña Ana and Luna Counties. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 17-5). Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

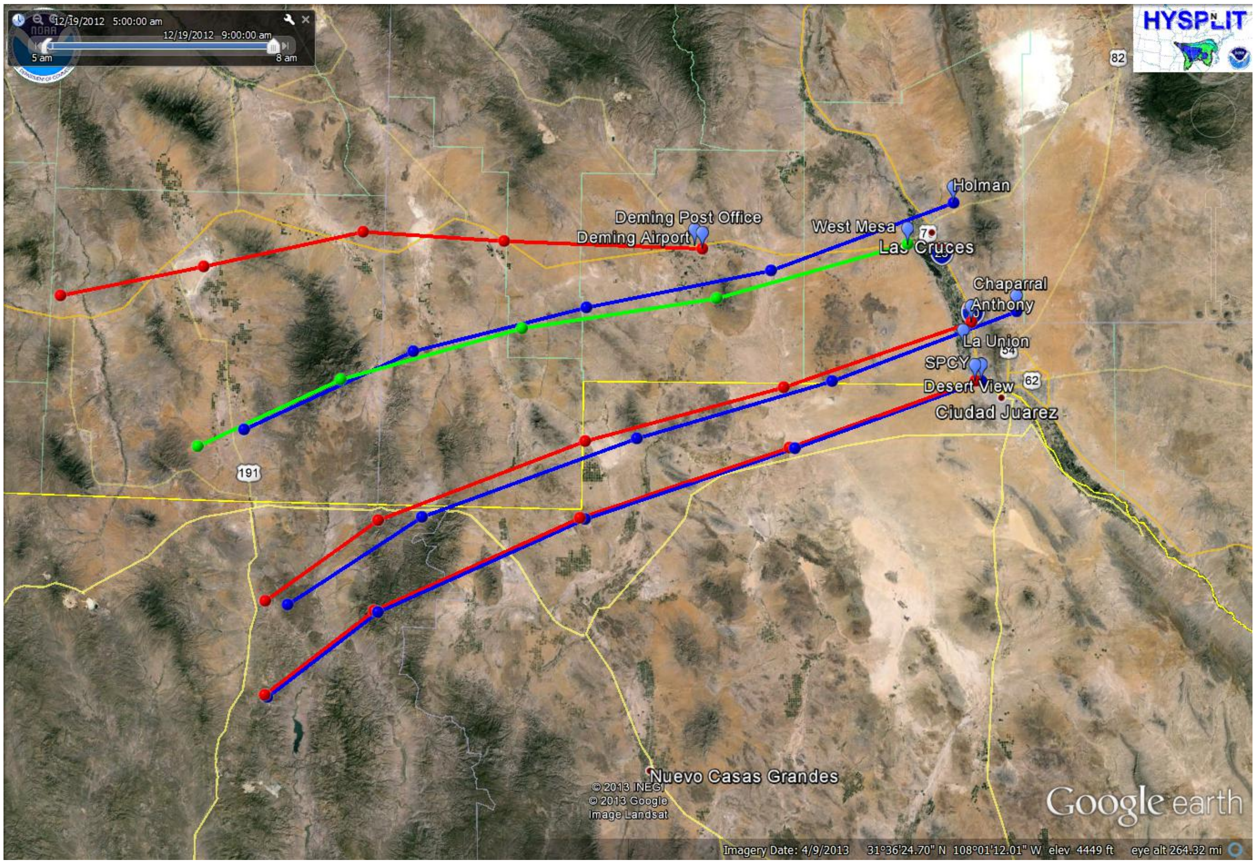

Figure 17-5. HYSPLIT back-trajectory model analysis for December 19, 2012.

17.3 Historical Fluctuations Analysis

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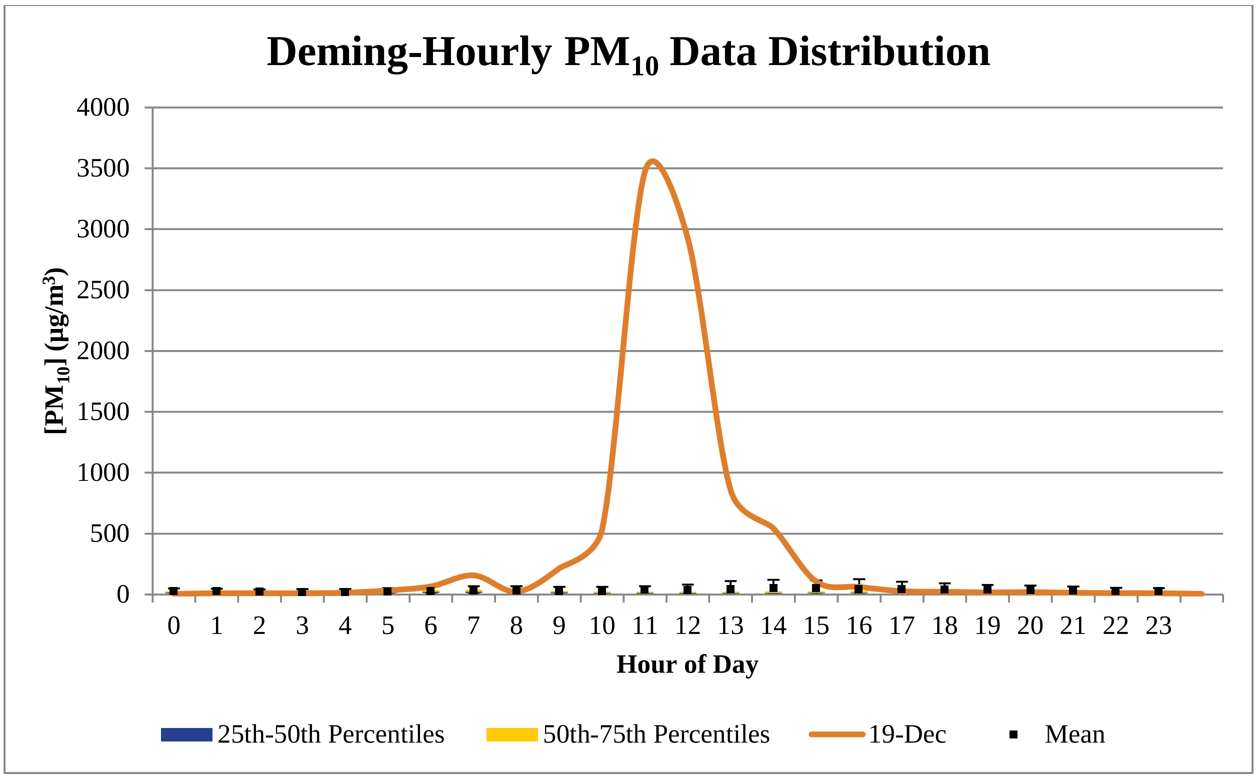

Figure 17-6a. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for December 19, 2012.

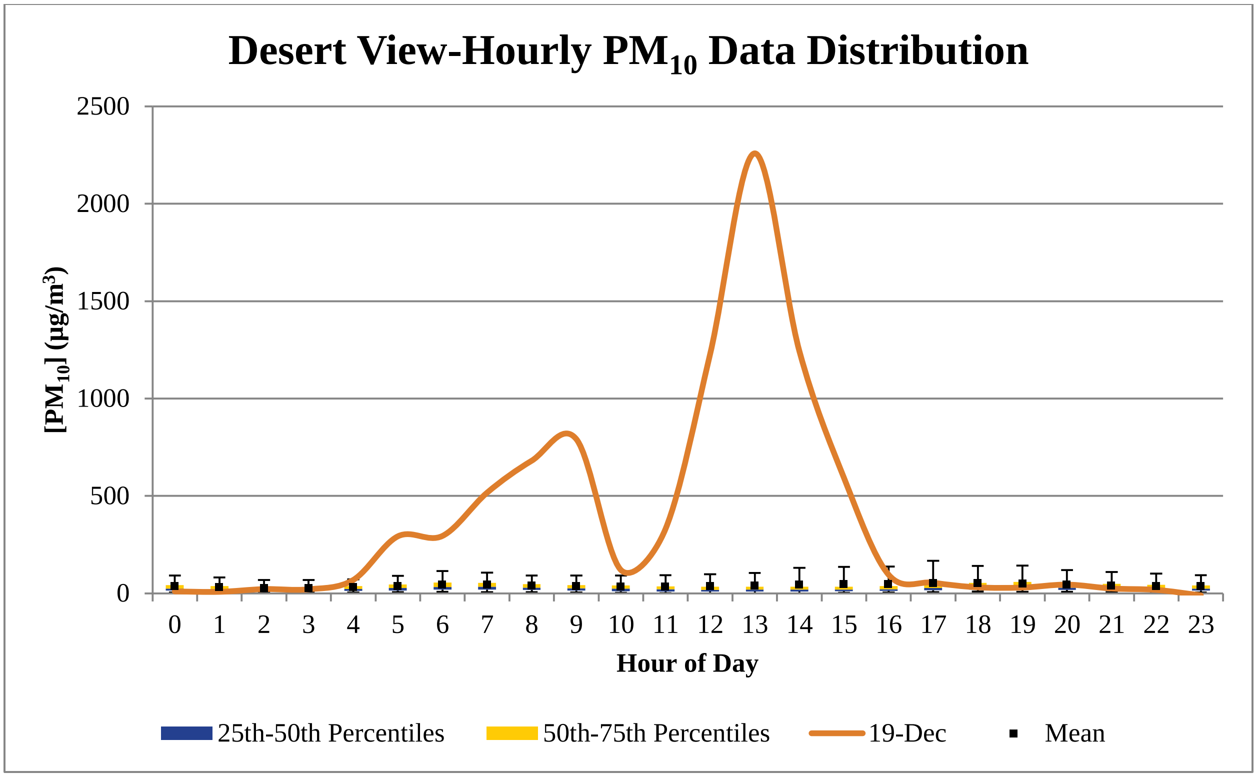

Figure 17-6b. PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for December 19, 2012.

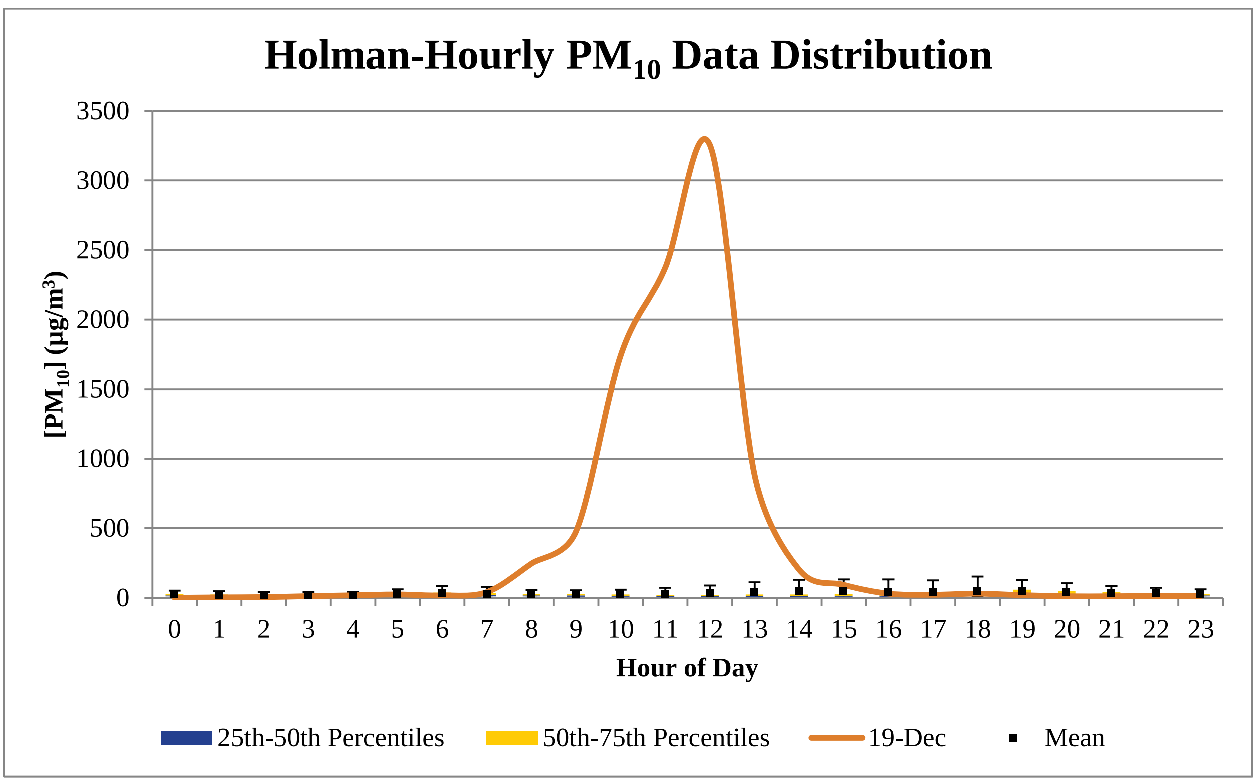

Figure 17-6c PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for December 19, 2012.

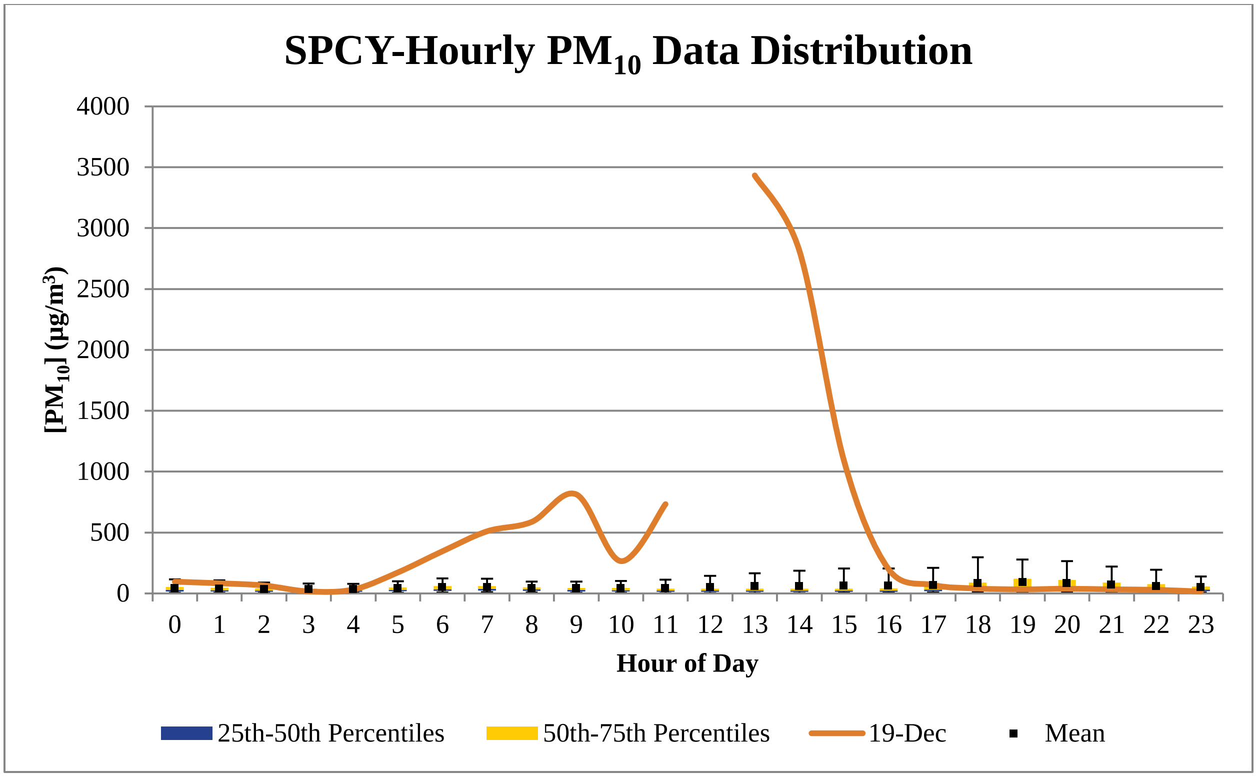

Figure 17-6d PM_{10} and $PM_{2.5}$ hourly data distribution from 2007-2011 overlaid by hourly values for December 19, 2012.

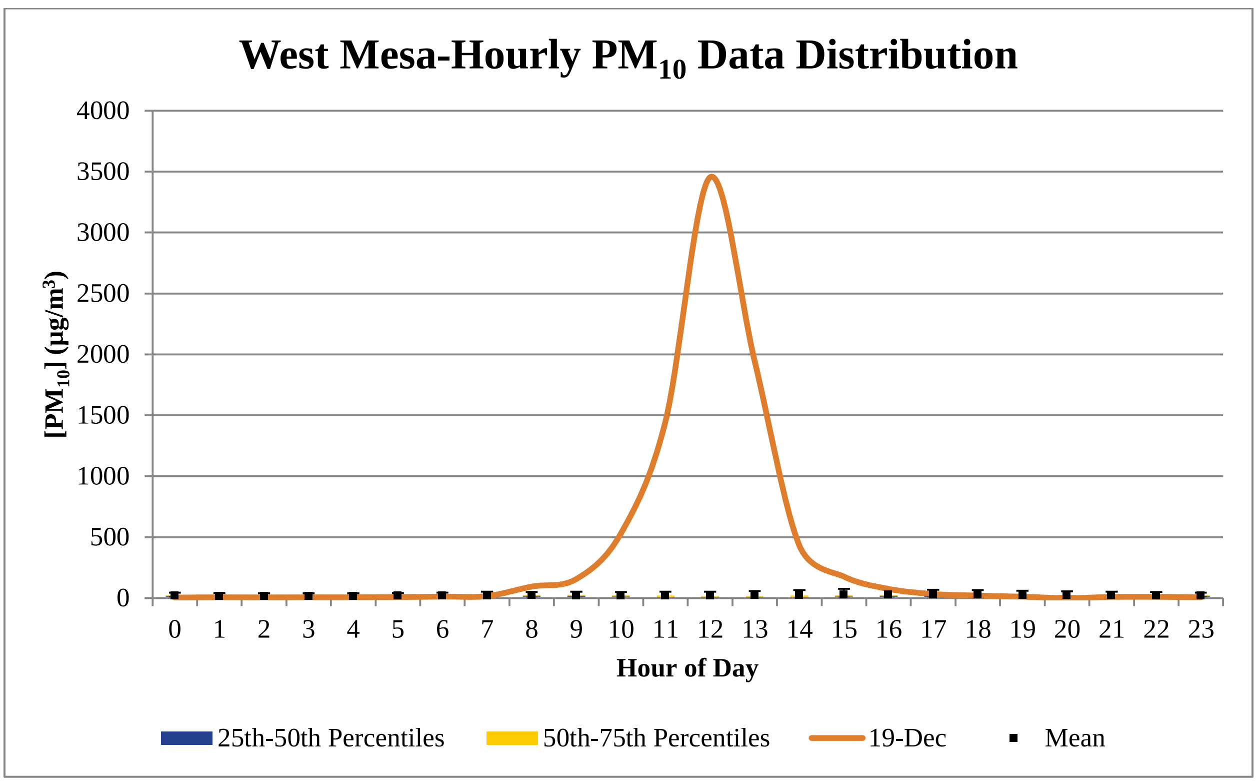

Figure 17-6e PM_{10} hourly data distribution from 2007-2011 overlaid by hourly values for December 19, 2012.

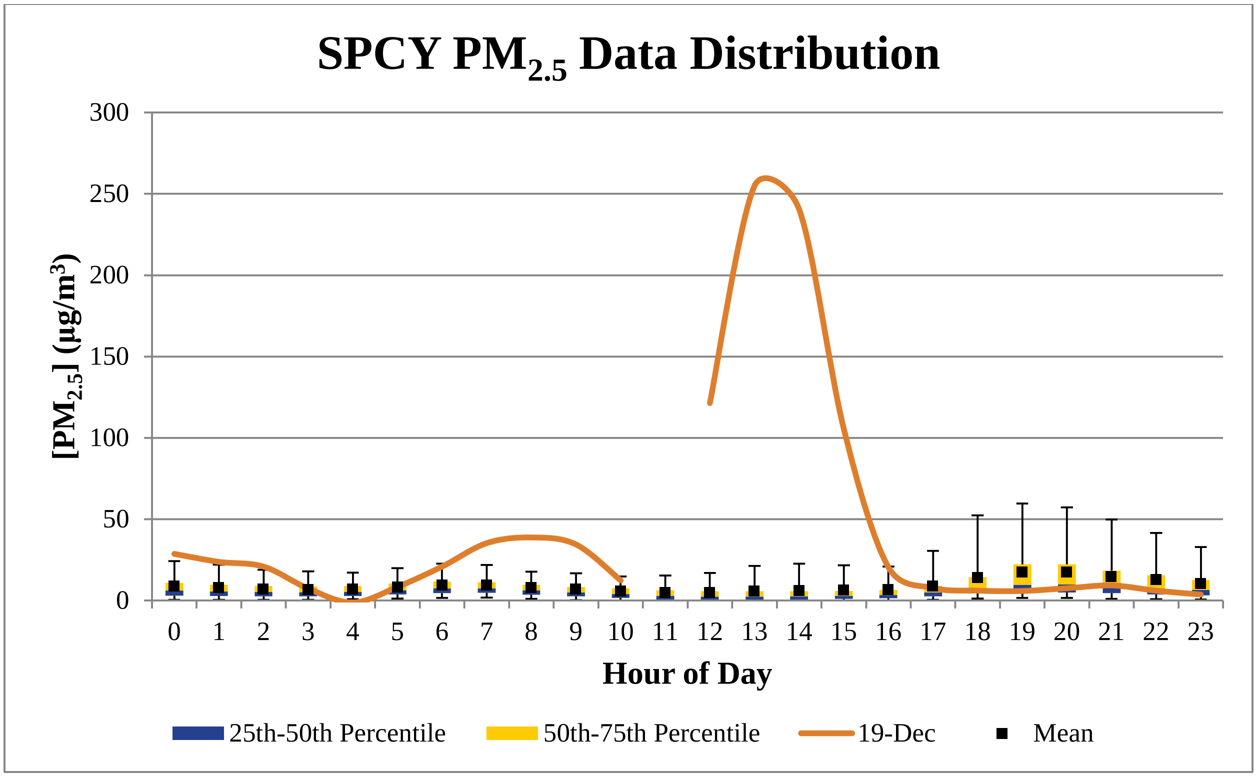

Figure 17-6f. $PM_{2.5}$ hourly data distribution from 2007-2011 overlaid by hourly values for December 19, 2012.

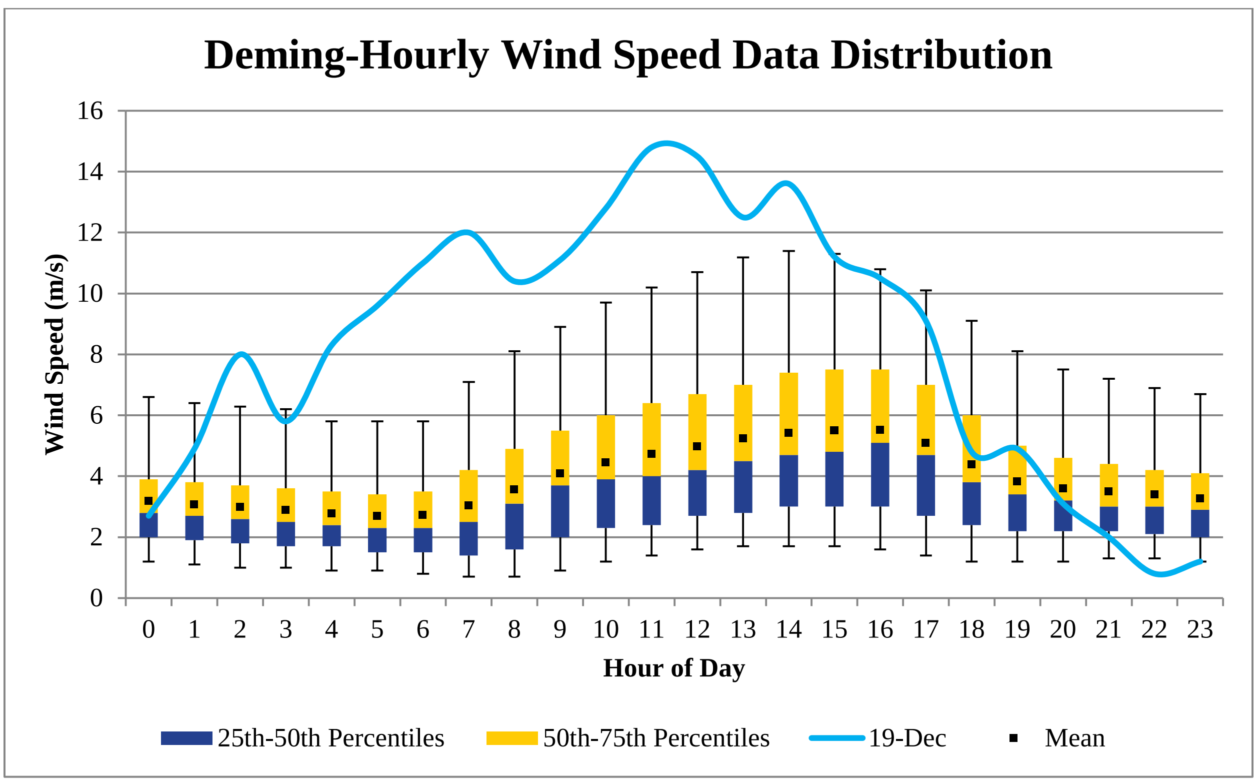

Figure 17-7a. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for December 19, 2012.

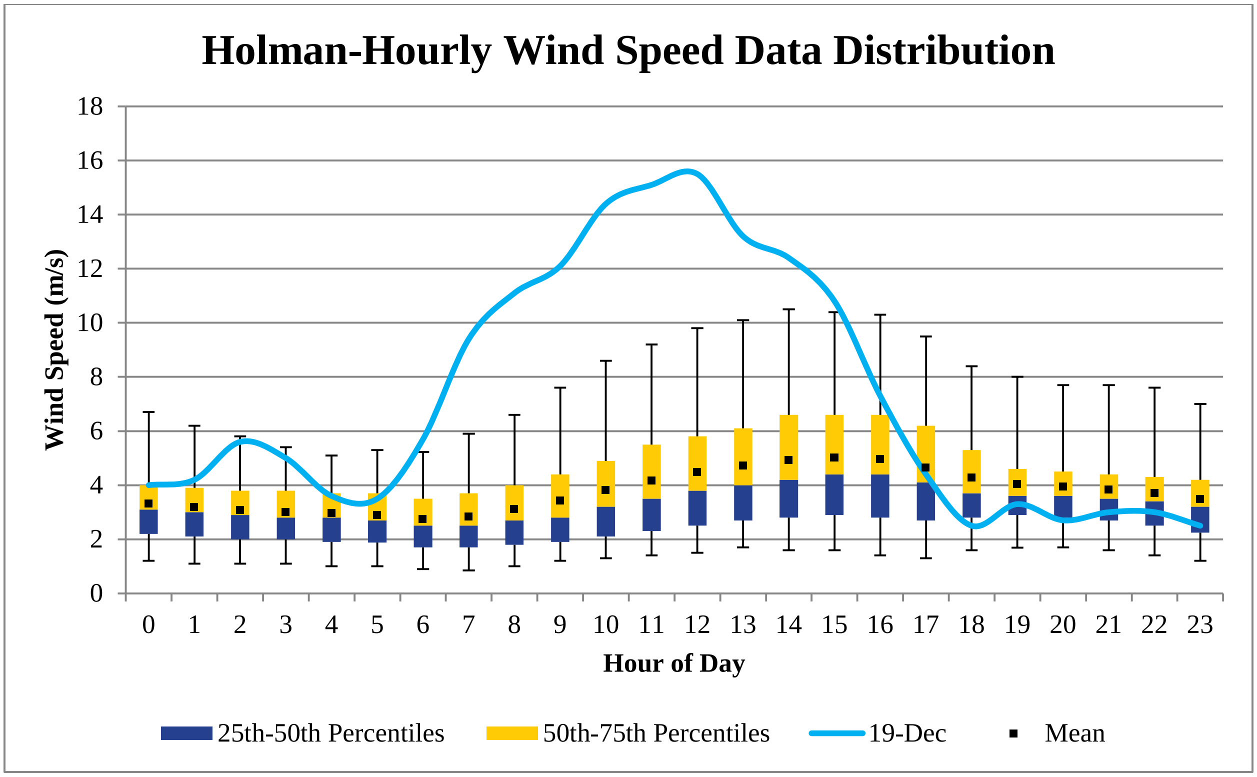

Figure 17-7b. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for December 19, 2012

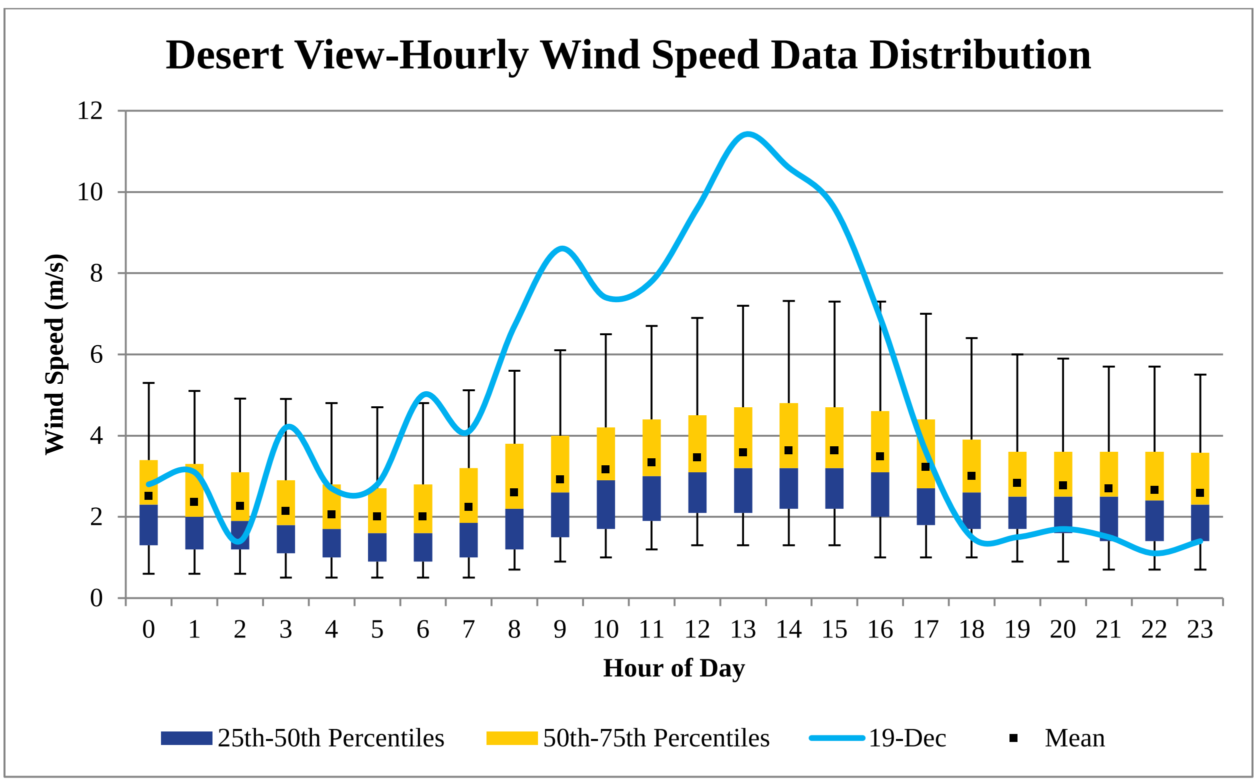

Figure 17-7c. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for December 19, 2012

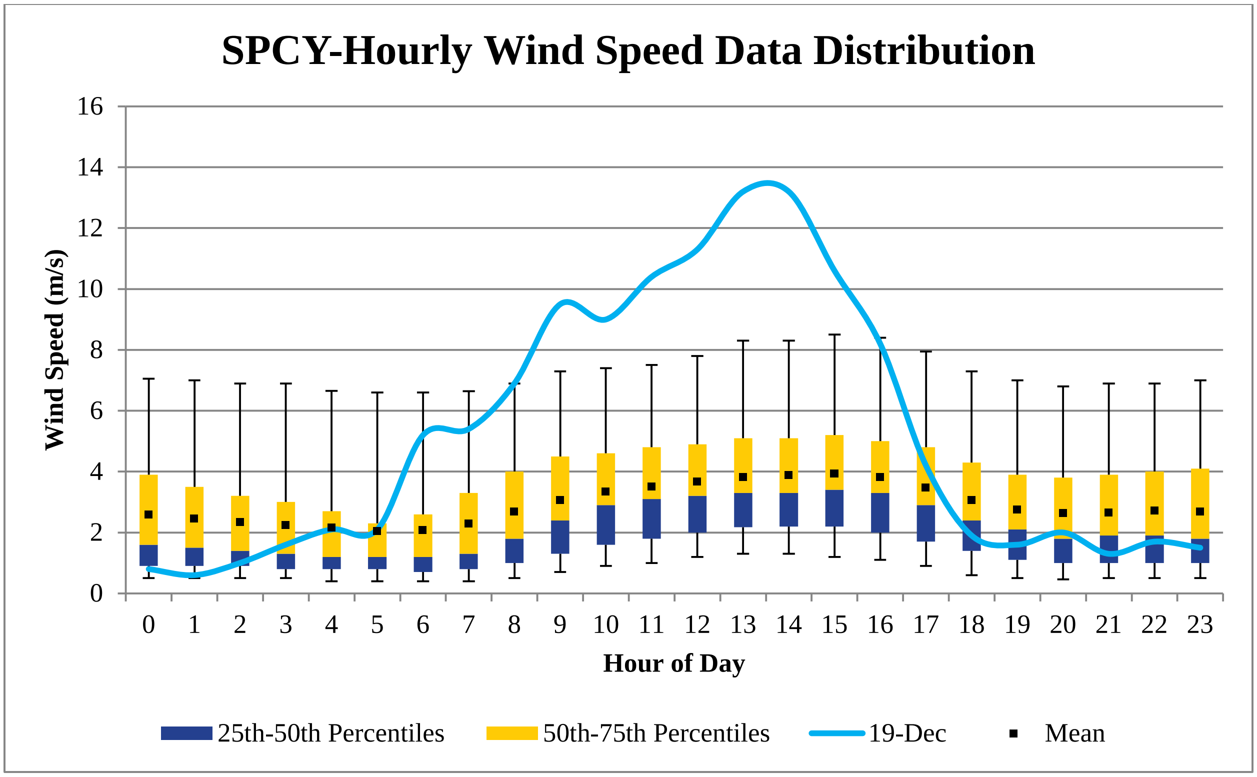

Figure 17-7d. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for December 19, 2012

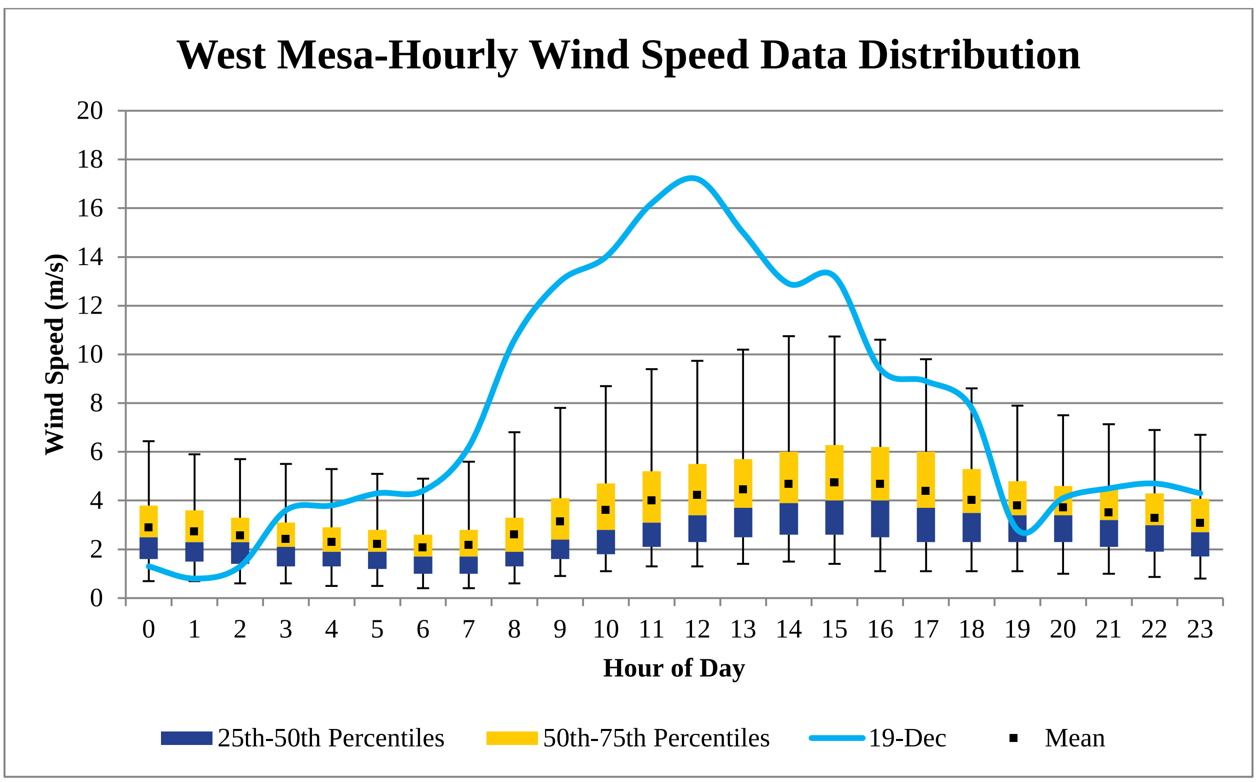

Figure 17-7e. Hourly wind speed data distribution from 2007-2011 overlaid by hourly values for December 19, 2012

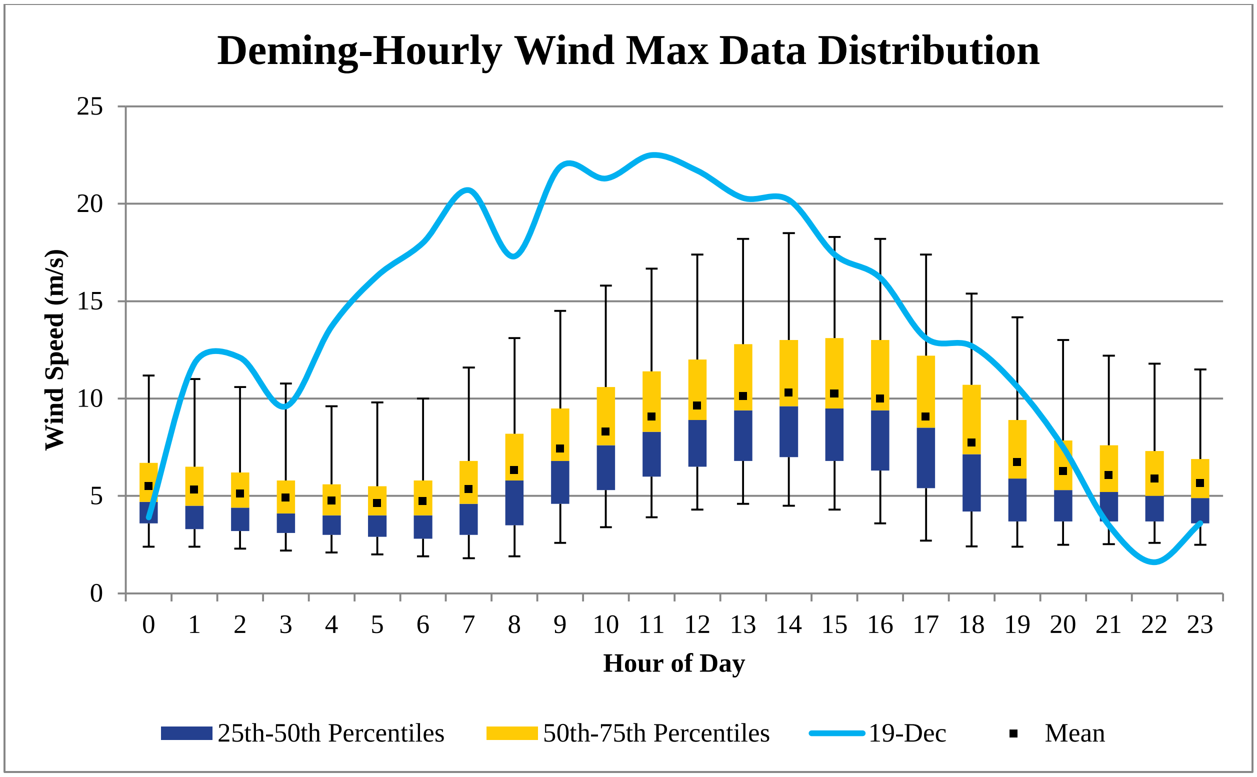

Figure 17-8a. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for December 19, 2012.

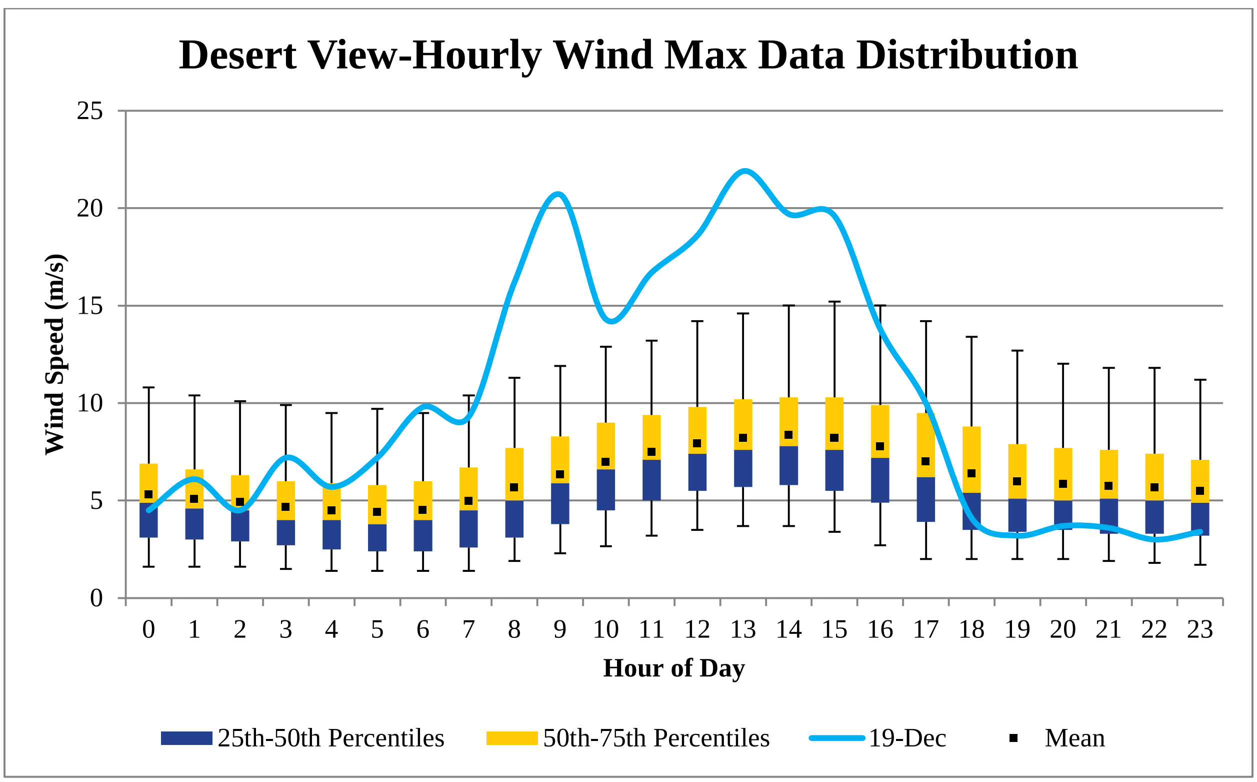

Figure 17-8b. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for December 19, 2012.

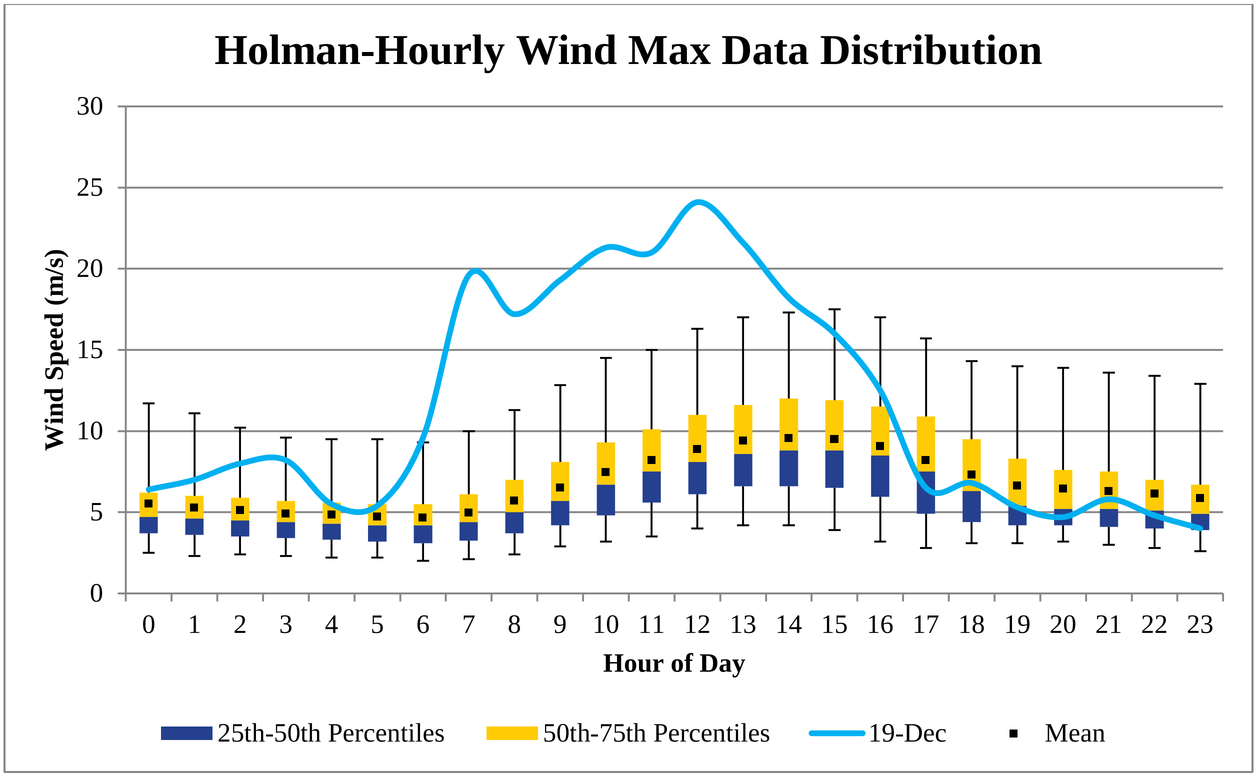

Figure 17-8c. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for December 19, 2012.

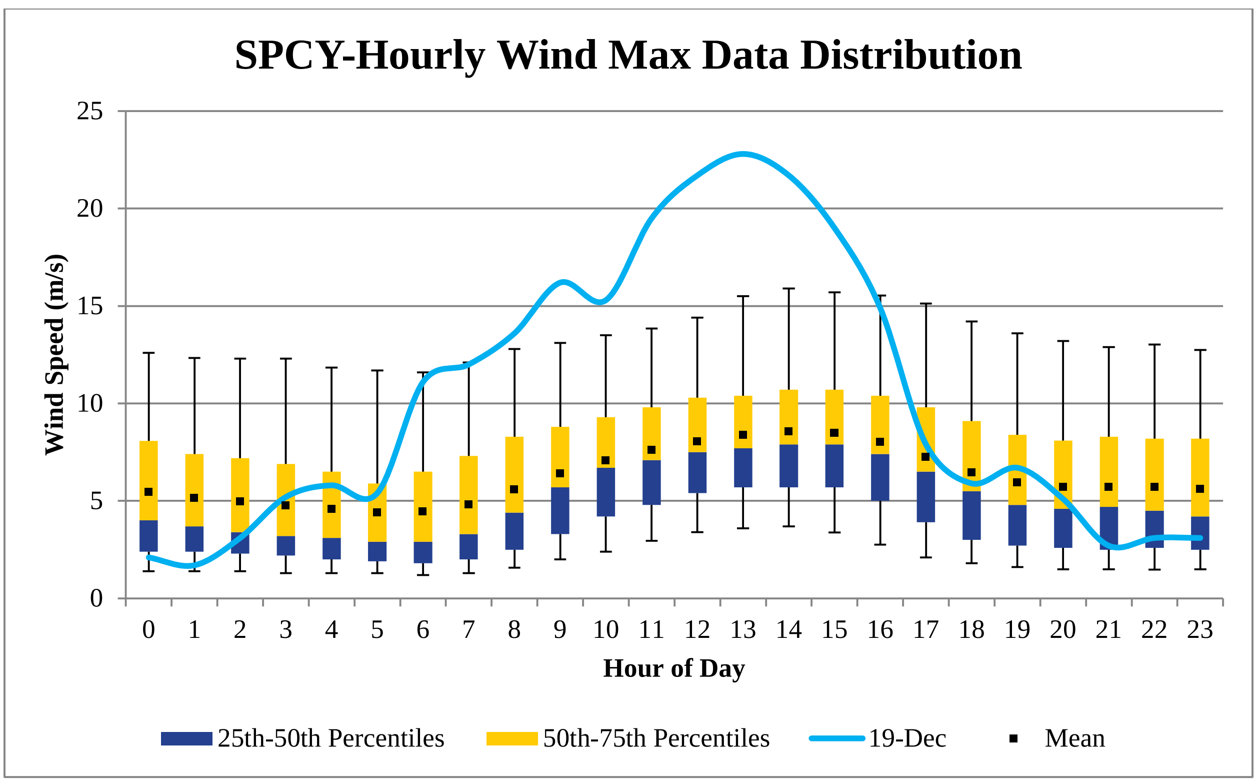

Figure 17-8d. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for December 19, 2012.

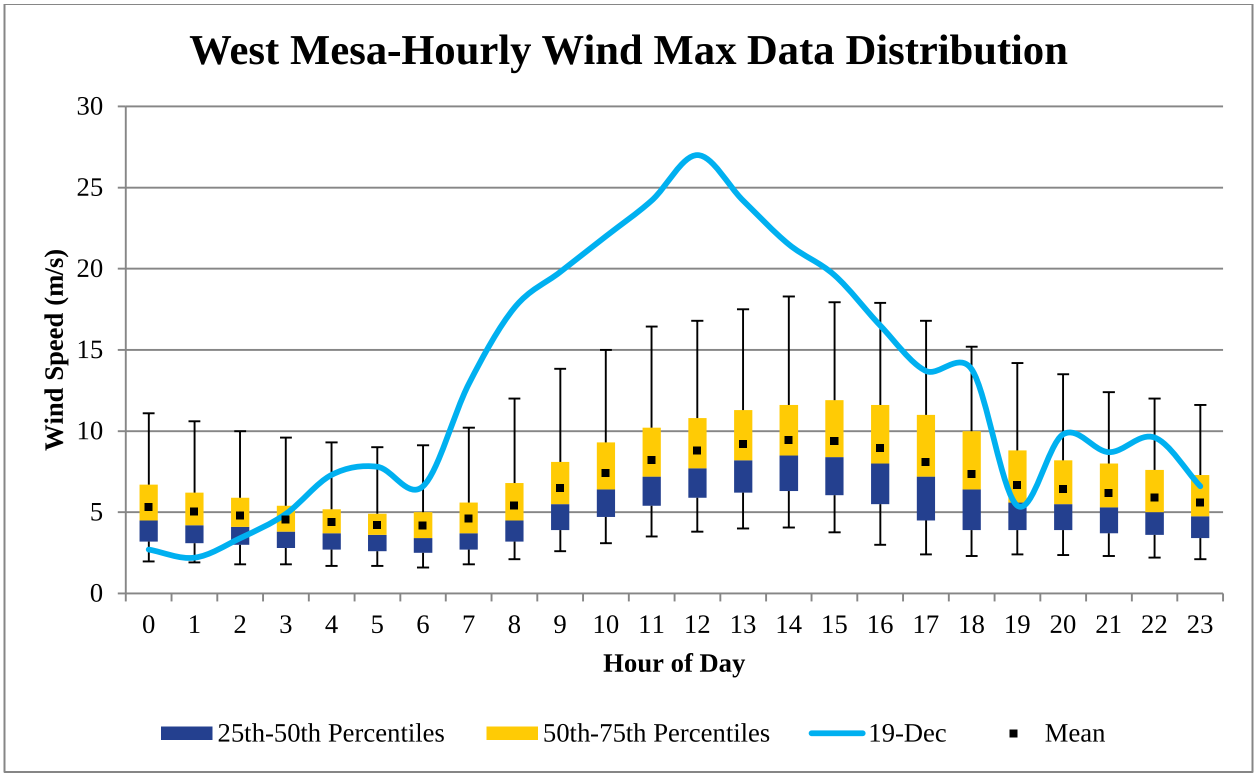

Figure 17-8e. Hourly wind gust data distribution from 2007-2011 overlaid by hourly values for December 19, 2012.

17.4 Clear Causal Relationship

A strong Pacific cold front passed through New Mexico on December 19, 2012. Areas of low surface pressure in northern and northeastern New Mexico created a strong pressure gradient over southwestern New Mexico and northern Mexico. As the Pacific cold front moved through New Mexico, the pressure gradient tightened and winds became even stronger at the surface (Figure 17-9). The wind direction in the upper atmosphere aligned with the surface wind direction and diurnal heating of the surface allowed winds aloft to mix downward, increasing the surface wind velocities and provided the turbulence required for vertical mixing and horizontal transport (Figure 17-10).

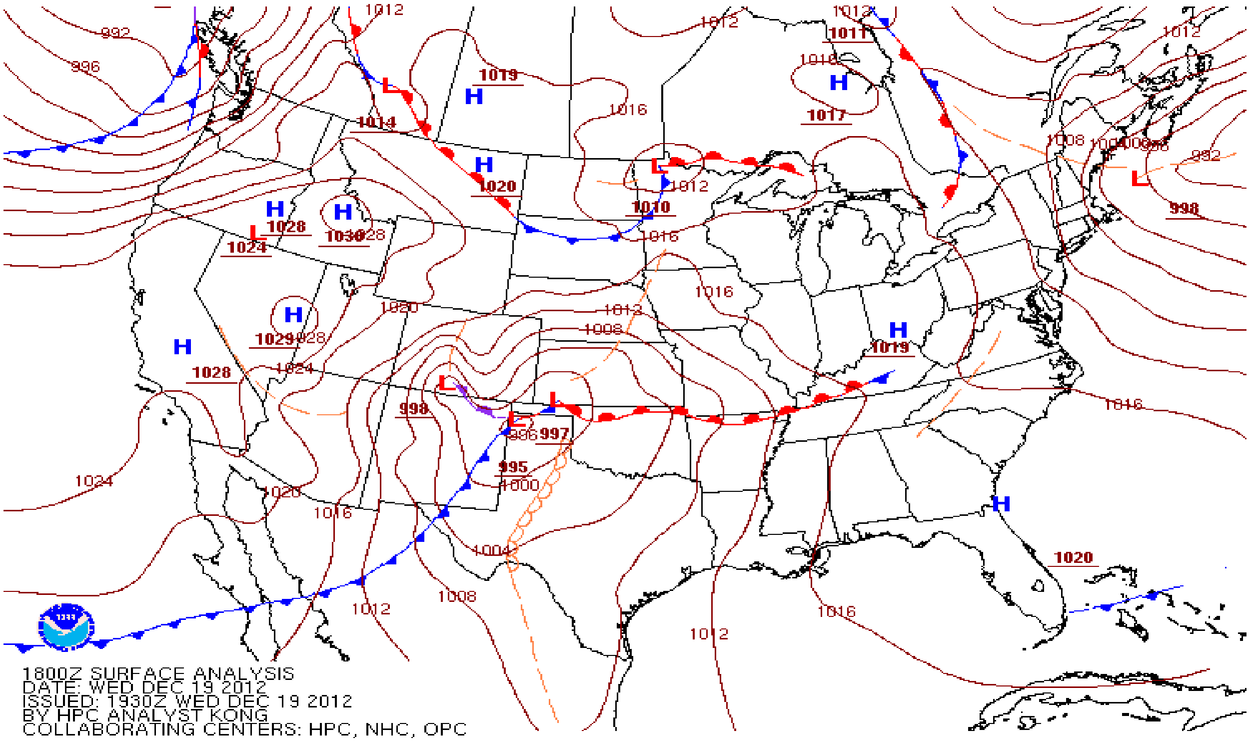

Figure 17-9. Surface weather map showing frontalactivity and isobars of constant pressure (red lines) for December 19, 2012 at the 1100 MST hour.

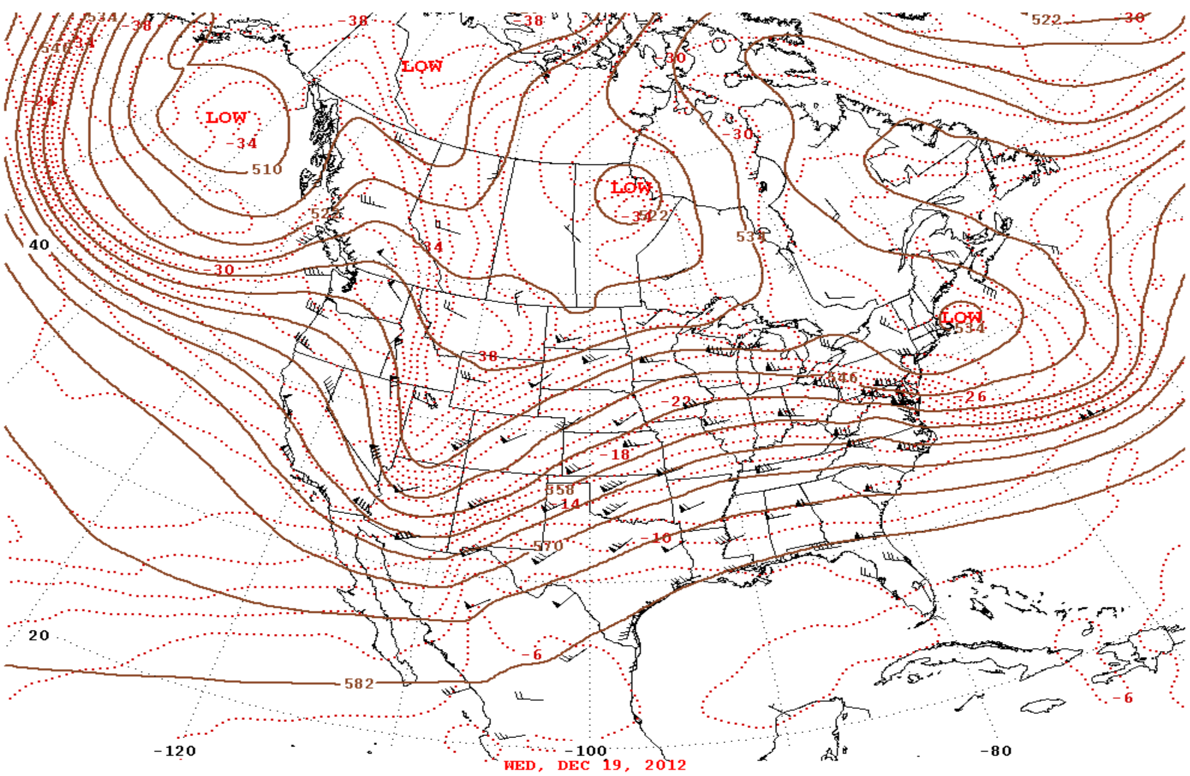

Figure 17-10. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on December 19, 2012.

The weather pattern described above generated strong south westerly winds beginning at the 0400 hour and lasting through the 1600 hour. Beginning at the 0400 hour, wind speeds exceeded 11.2 m/s at Chaparral as shown in Figure 17-3. Peak wind speeds ranged from 11.4 m/s at Desert View to 17.7 m/s at Chaparral (Figure 17-3). Peak wind gusts ranged from 21.7 m/s at La Union to 27 m/s at West Mesa (Figure17-4). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 17-11a-f. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (0200-1600 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 17-12a-b). Maximum hourly PM_{10} concentrations ranged from 2259 µg/m^3 at Desert View to 3475 µg/m^3 at Deming. Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 17-13).

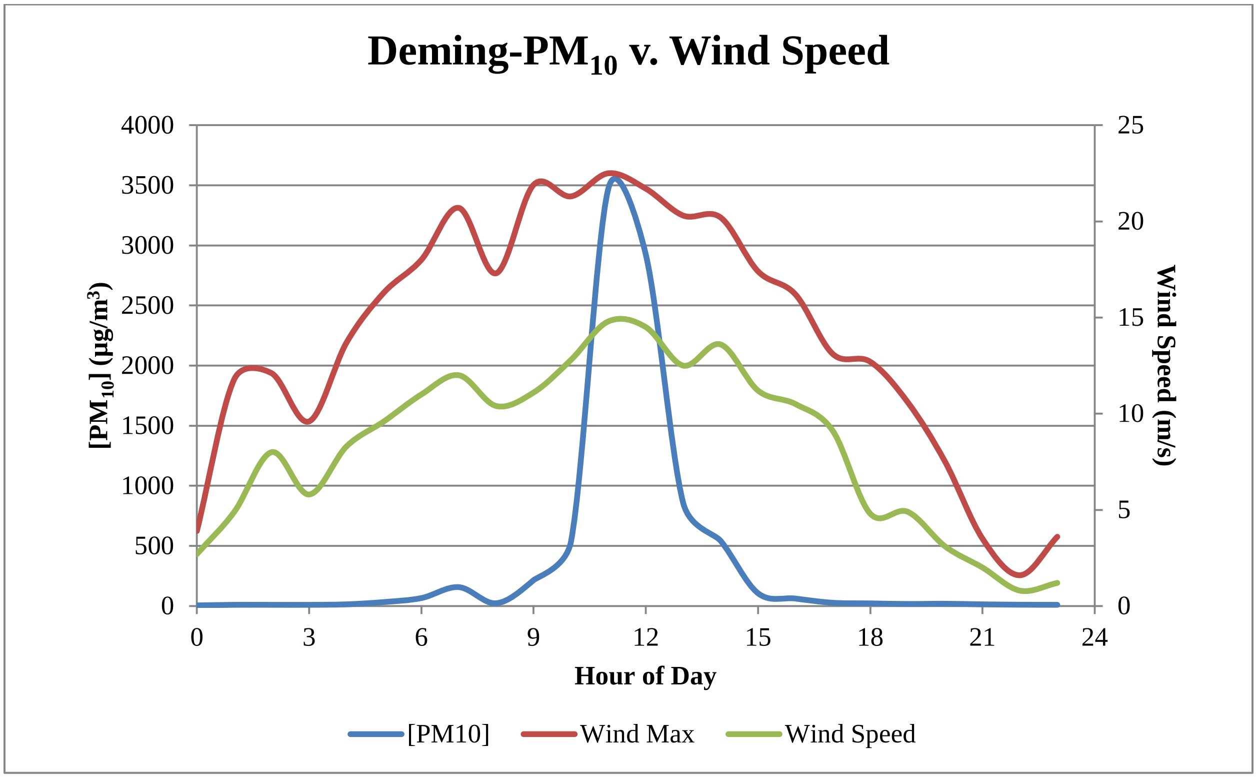

Figure 17-11a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

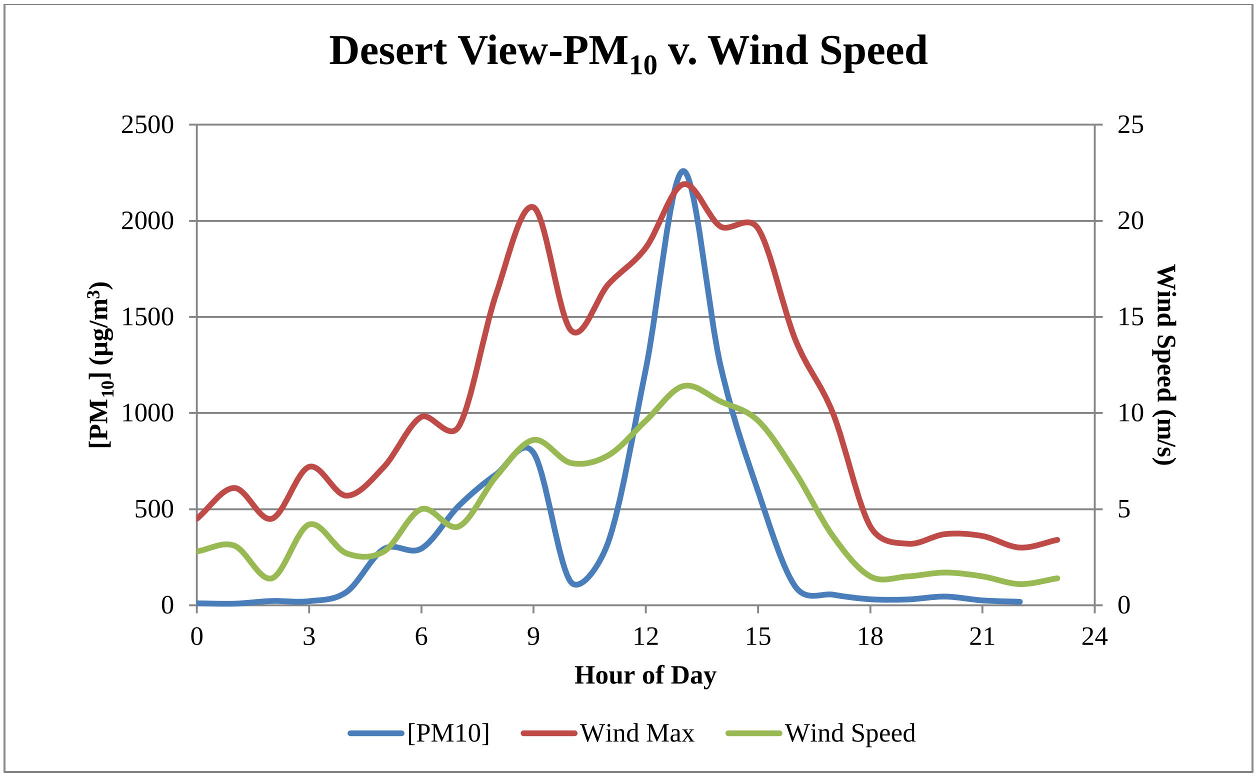

Figure 17-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

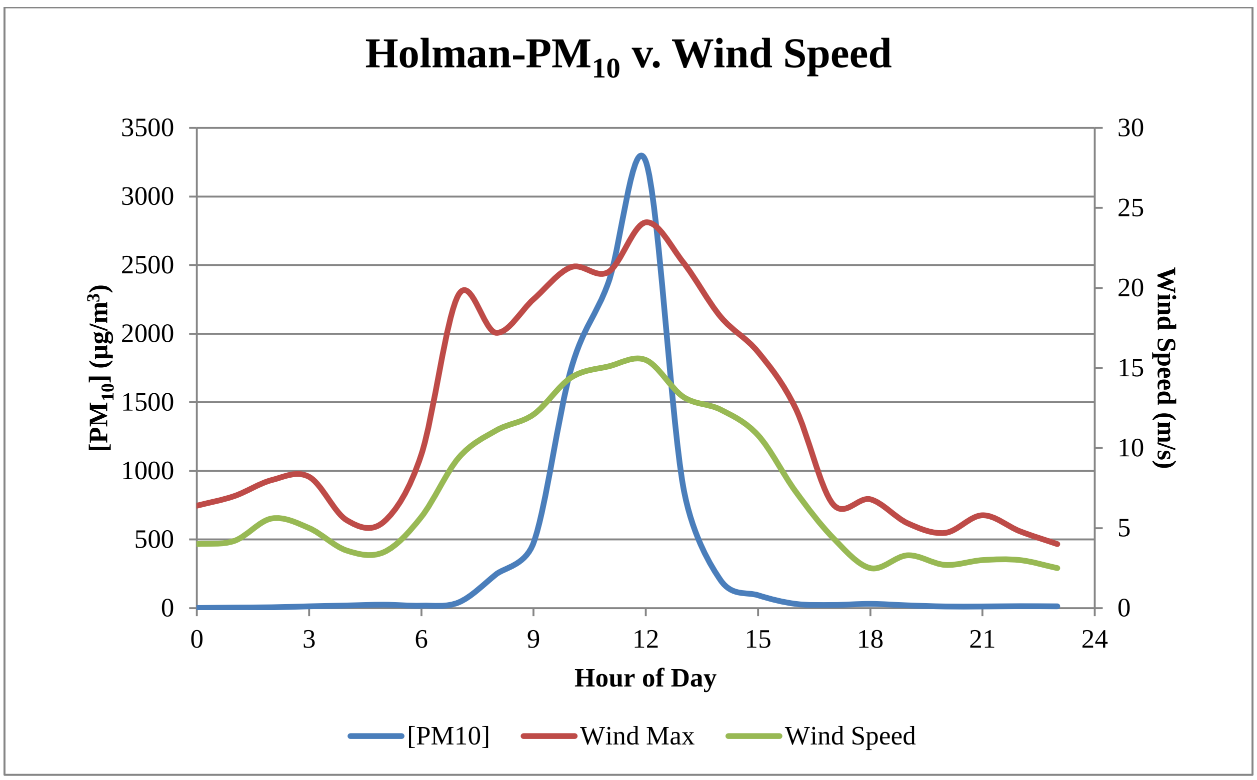

Figure 17- 11c. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

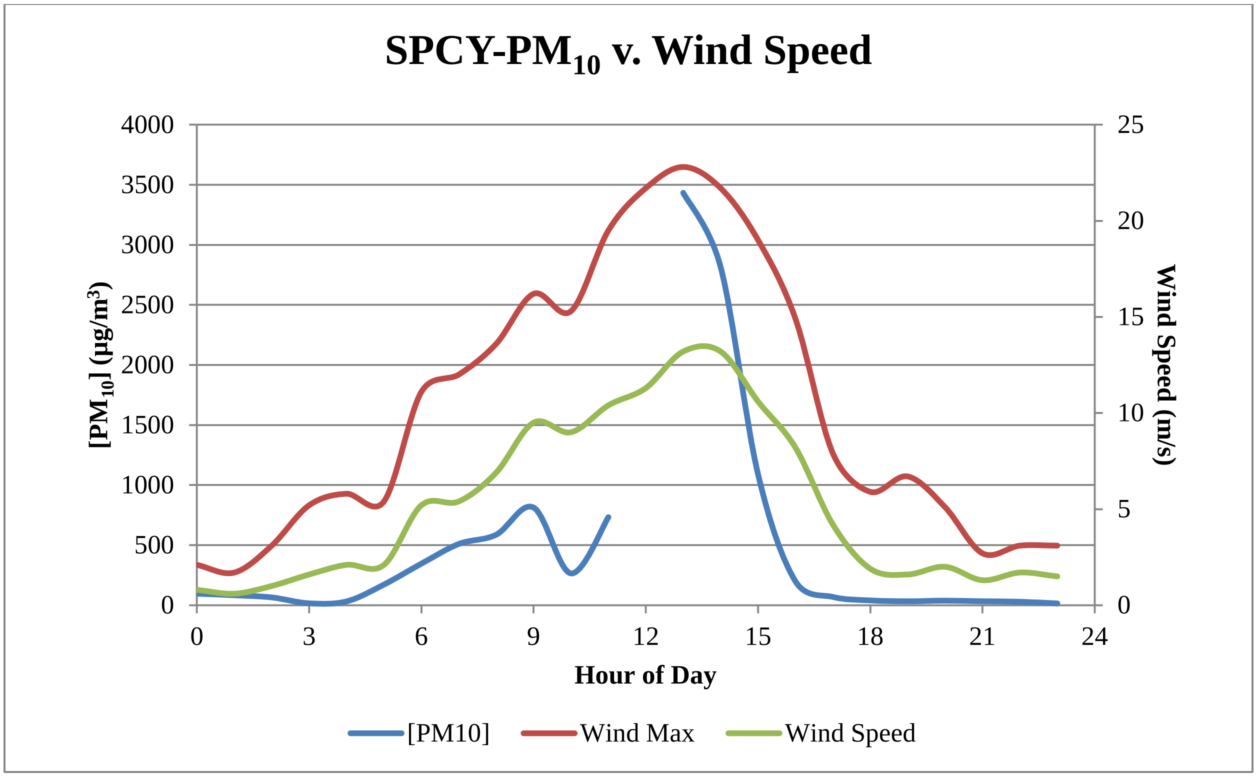

Figure 17- 11d. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

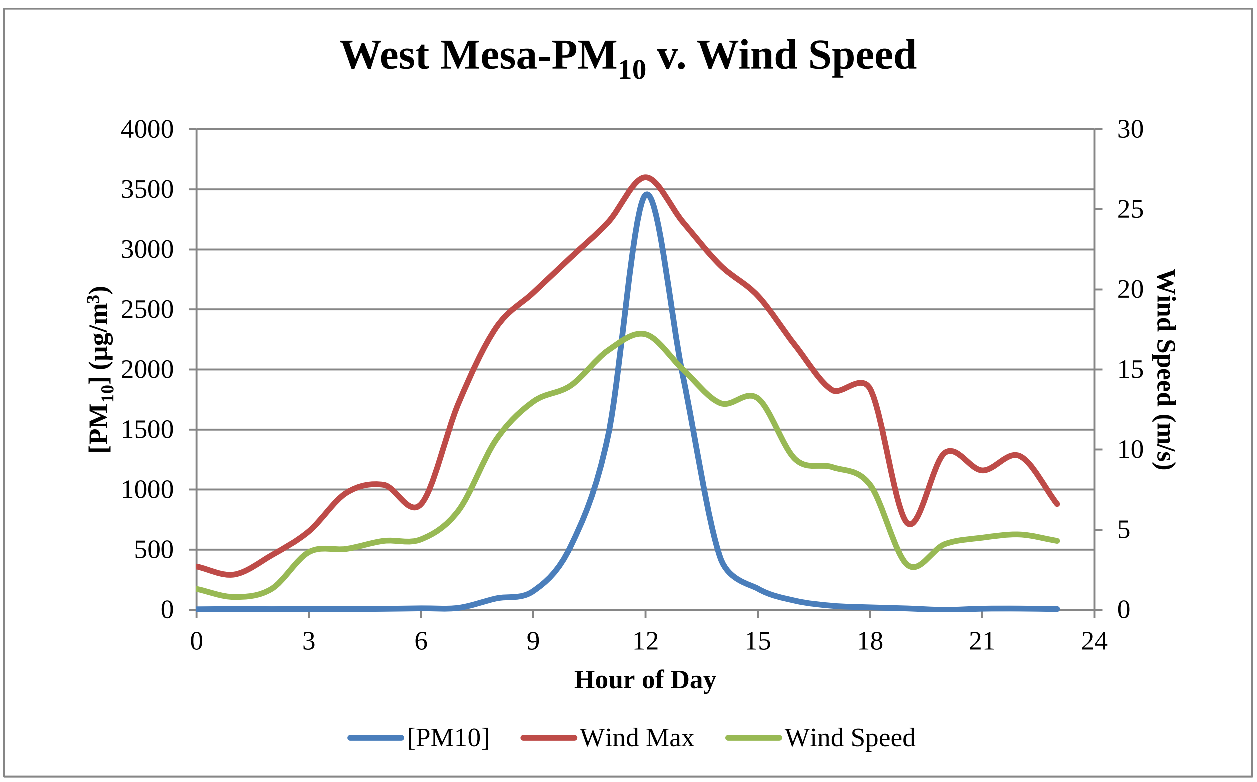

Figure 17- 11e. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

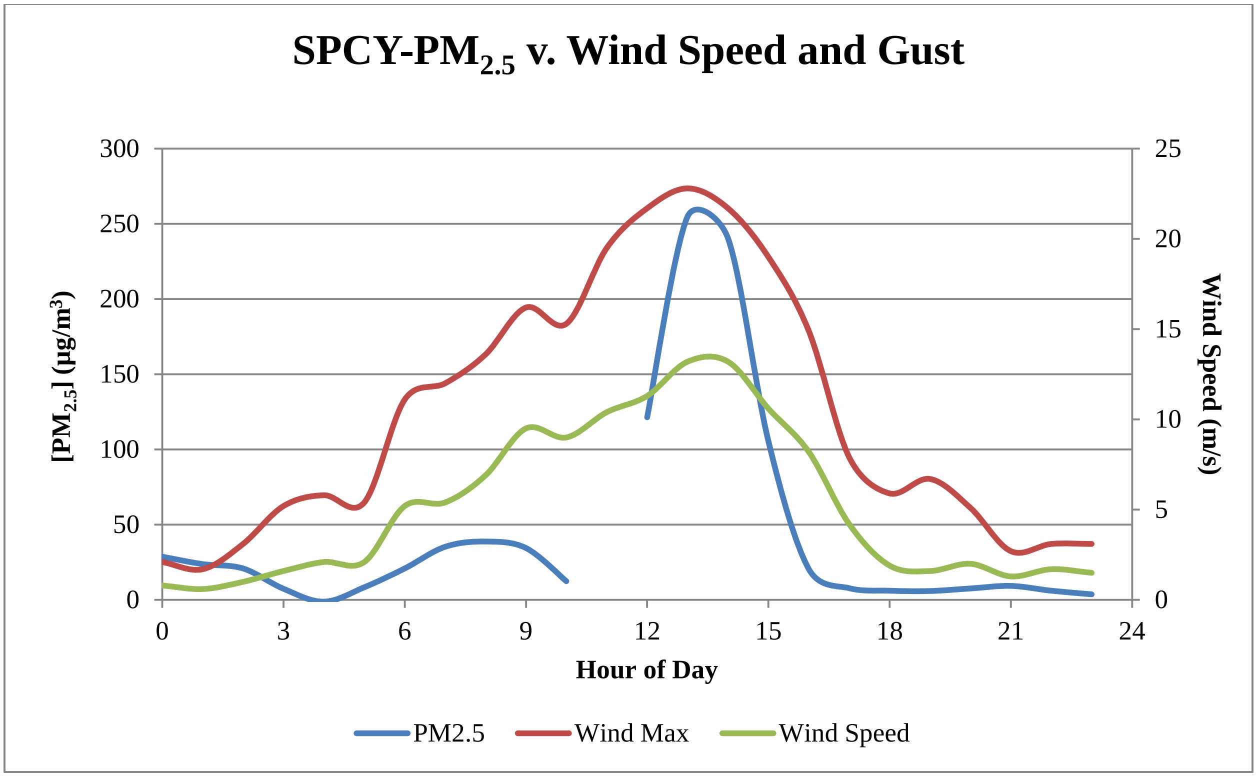

Figure 17-11f Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

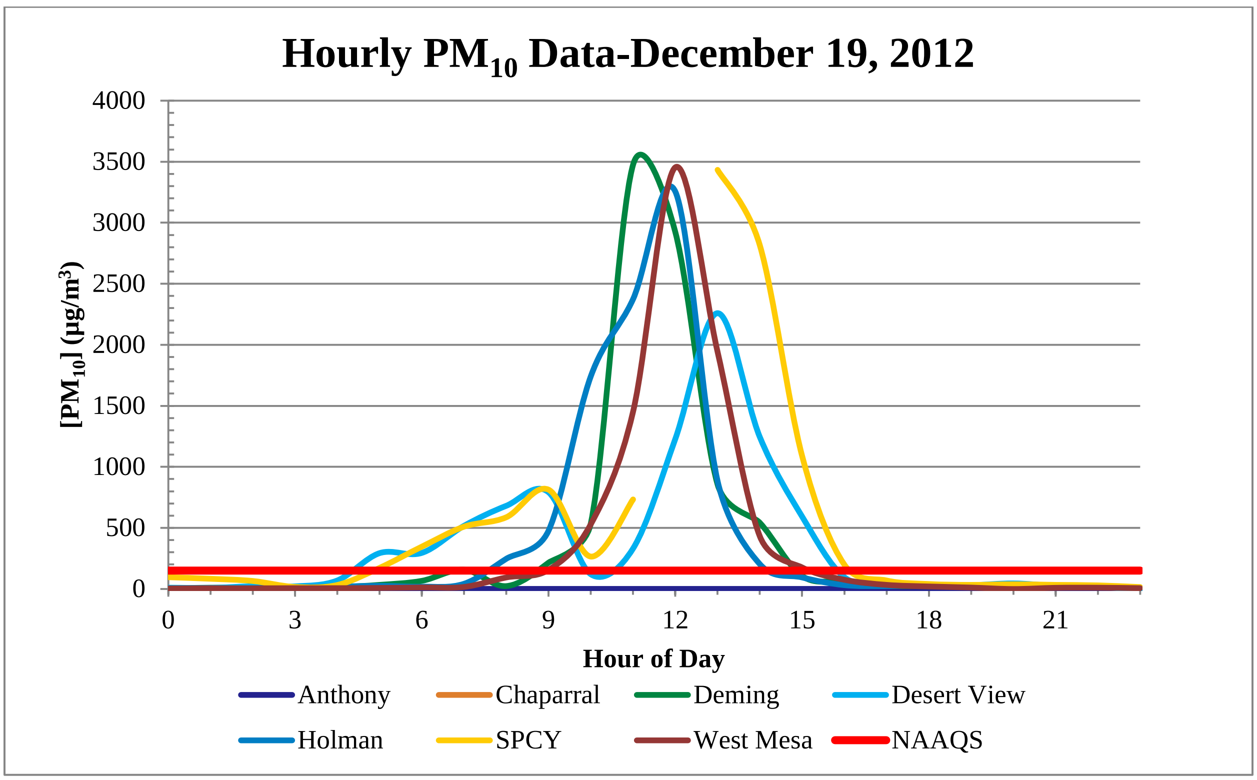

Figure 17-12a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

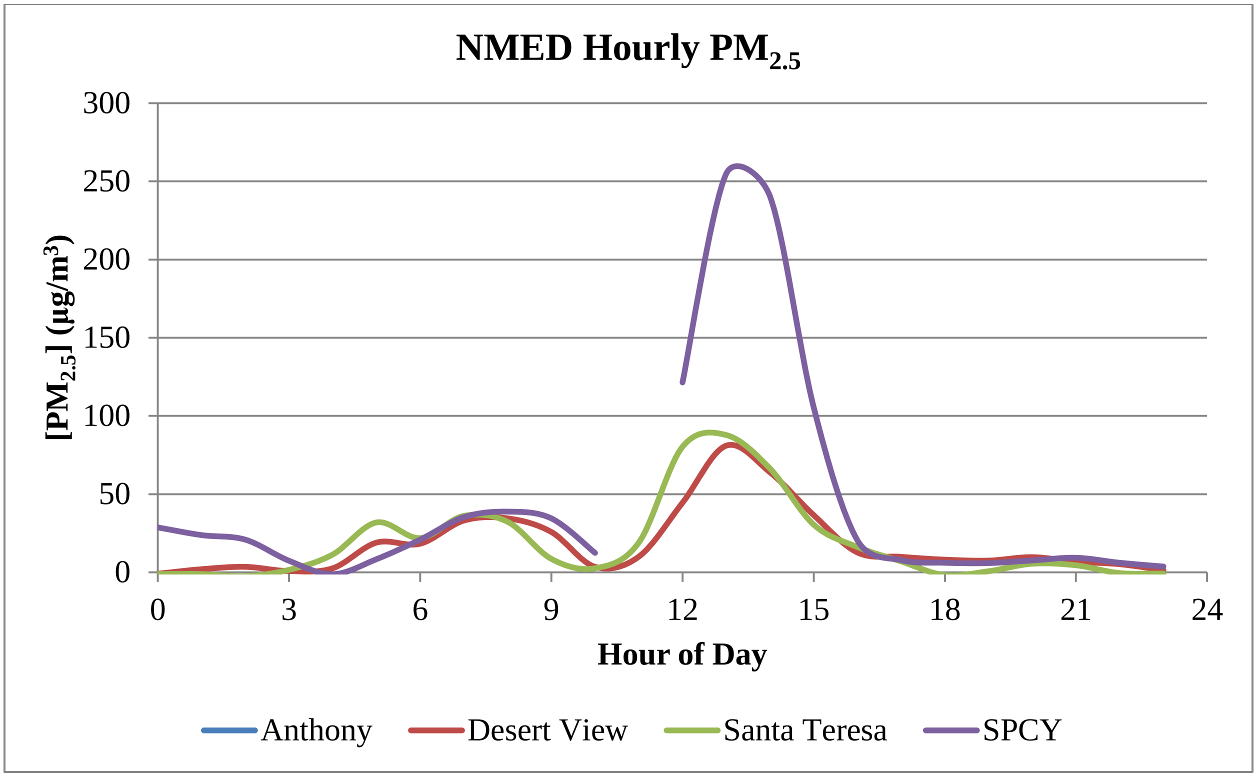

Figure 17-12b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors. Non-FEM hourly $PM_{2.5}$ data.

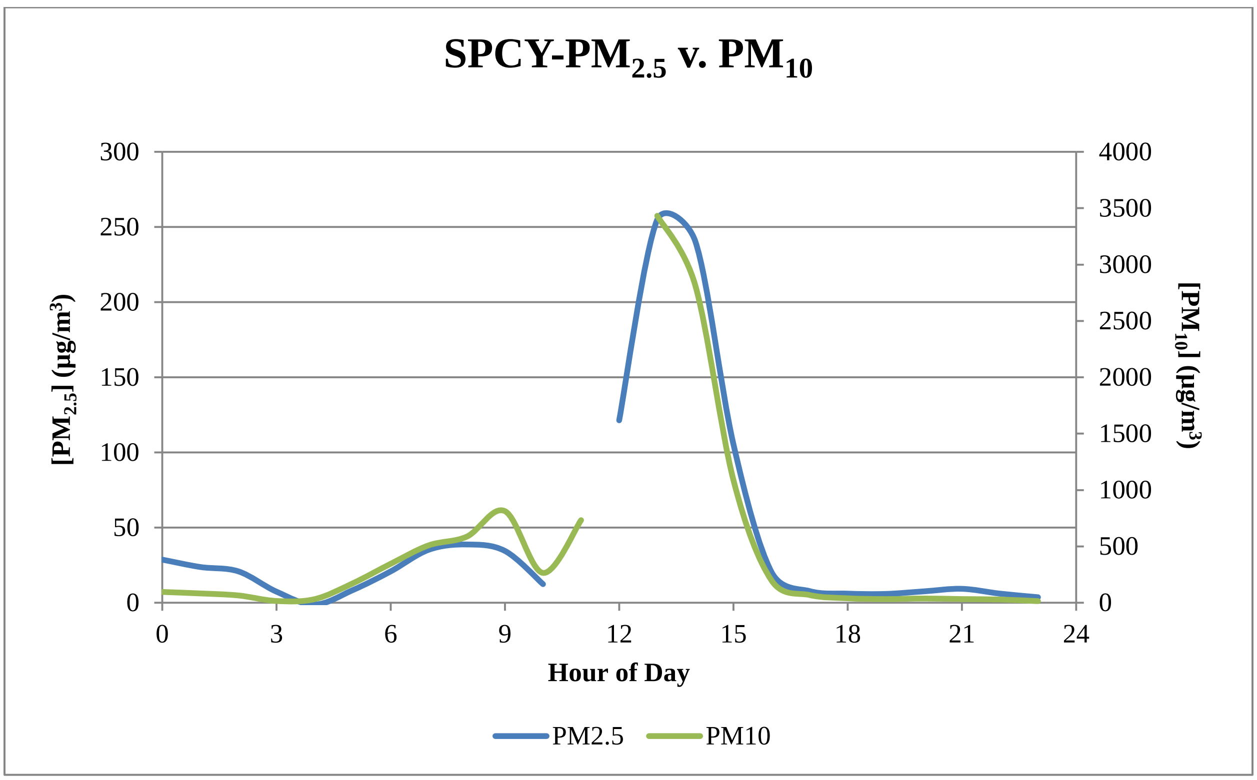

Figure 17-13. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on December 19, 2012.

Numerous news outlets reported on the storm due to the high wind speeds, widespread blowing dust, low visibilities, and property damage that occurred on this date. The Las Cruces Sun-News reported on the expected high winds on December 18 (Figure 17-14).

school. Fifteen fifth graders saw in math.

Winter storm expected to bring wind, little rain

By Steve Ramirez
SRAMIREZ@LCSUN-NEWS.COM

LAS CRUCES — A winter storm is expected to pass through Las Cruces today, generating high winds, but little moisture, weather officials predicted.

"It's a little harder for me to get used to these winter storms," said Rey Gaytan, who recently retired from his government contractor's job at White Sands Missile Range. "My body doesn't adapt to these changes like it used to, and it makes it harder on me. I guess I'll just plan to stay inside (today), with the heater turned up a little bit."

It sounds like pretty good advice. A quick-moving winter storm — although, technically, winter doesn't officially start until Friday — will literally blow through Las Cruces today. "Blow" is the keyword, as sustained winds could reach 40 mph and gusts could howl to 50 mph.

"If you remember last Friday, you can take a little less wind and a little less snow," said Tim Brice, meteorologist with the National Weather Service, in Santa Teresa, comparing today's expected weather conditions to those Friday. "We are expecting strong winds in the lowlands, ... so we're expecting 30 to 40 mile-an-hour winds with gusts maybe to 55."

LCSUN-NEWS.COM

► To see a video and find links to the National Weather Service and other helpful links, visit this story online at www.lcsun-news.com.

Brice added there isn't much moisture with this storm, so the best chance for precipitation is before 8 a.m. A wind advisory begins at 8 a.m. and will continue until 5 p.m. today, and the weather service expects blowing dust, particularly this afternoon when winds will be greater. Blowing dust could reduce visibility to as little as one mile this afternoon.

"Ugh, just what I need," Debbie Palacios said. "I can stand the cold, but not the wind and the cold. That's harsh. I wish I could just curl up in bed and stay there all day."

Today's daytime high is expected to be 10 degrees cooler than Tuesday, but the wind should make that feel even colder. Cooler temperatures will linger into Thursday, with a forecast high of 43 degrees, but the good news is the wind should definitely be less.

Daytime temperatures will rally into the mid to upper 50s through the weekend. But another approaching storm will begin pushing into Las Cruces and southern New Mexico on Monday. On Christmas Day, the high temperature is expected to reach 45, it could be windy again, and there is a 20-percent chance of rain or snow late that day.

The forecast

► **Today:** A 20 percent chance of isolated showers before 8 a.m. Areas of blowing dust after 8 a.m. Otherwise, mostly cloudy, then gradually becoming sunny, with a high near 51. Windy, with a south-to-southwest wind 20 to 25 mph, becoming west at 32 mph to 37 mph in the morning. Winds could gust as high as 50 mph. Mostly clear tonight, with an overnight low near 24. Winds should shift to the north, from 7 mph to 16 mph, with gusts as high as 23 mph.

► **Thursday:** Sunny, with a high near 43. East wind 9 to 13 mph. Mostly clear Thursday night, with a light northeast breeze and an overnight low near 22.

► **Friday:** Sunny, with a high near 51. Northeast wind 5 mph to 8 mph, becoming southeast in the afternoon. Partly cloudy Friday night, with light and variable southeast breezes, and a low near 29.

► **Saturday:** Mostly sunny, with a high near 56. North-to-northwest wind 5 mph to 7 mph, becoming west-to-southwest in the afternoon. Partly cloudy Saturday night, with a low near 34.

► **Sunday:** Mostly sunny, with a high near 60. Partly cloudy Sunday night, with a low near 37.

Source: National Weather Service

Steve Ramirez can be reached at 575-541-5452. Follow him on Twitter @SteveRamirez6

Figure 17-14. Las Cruces Sun News Story from December 18, 2012.

The NWS noted in the Southwestern Weather Bulletin that this day was:

> Very windy with widespread blowing dust and low visibilities across the Borderland. Winds gust to 86 mph at White Sands Missile Range Headquarters with gusts to 71 mph at Fort Bliss and gusts around 65 mph over El Paso, Alamogordo and Mescalero. Elsewhere gusts around 50 mph were widespread. Over White Sands Missile Range the high winds rip off building roofs and break the windows of at least 75 vehicles (NWS, 2012).

A high wind warning was also issued by the NWS for this date stating in part,

> SUSTAINED WIND SPEEDS WILL BE NEAR 40 MPH OVER MUCH OF THE REGION WITH GUSTS EXCEEDING 60 MPH OVER SOME LOCATIONS...ESPECIALLY ALONG EASTERN SLOPES AND THROUGH MOUNTAIN PASSES. THE WINDS WILL PRODUCE AREAS OF BLOWING DUST WITH LOW VISIBILITIES OVER THE DESERTS WITH SNOW AND BLOWING

SNOW EXPECTED TO RESTRICT VISIBILITIES OVER THE HIGHER MOUNTAINS (NWS, 2012).

Satellite imagery captured numerous dust plumes and blowing dust on this date as shown by the MODIS instrument on the Aqua Satellite (Figure 17-15).

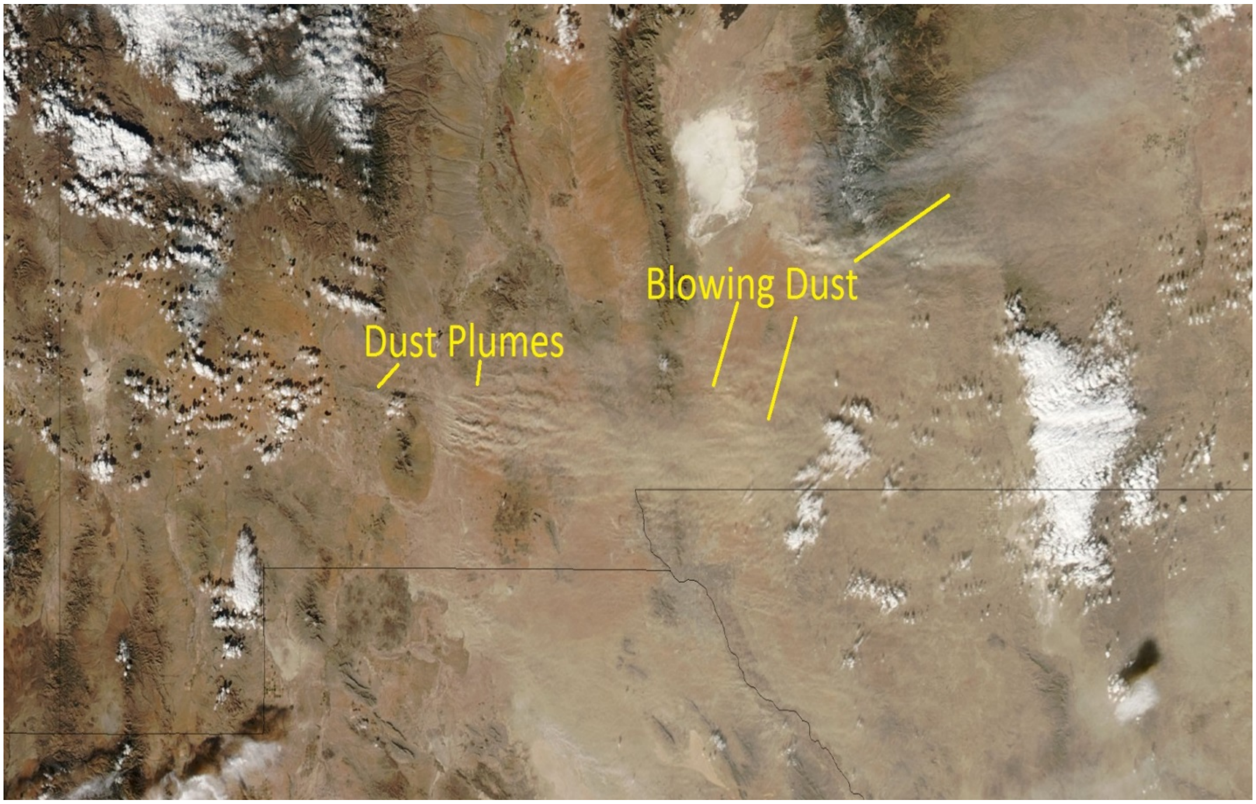

Figure 17-15. Satellite imagery capturing the dust plumes and resulting blowing dust on November 10, 2012 (Image courtesy of NASA).

17.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on December 19, 2012.

17.6 Natural Event

The Clear Causal Relationship and not Reasonably Controllable or Preventable analyses show that this was a natural event caused by high wind and blowing dust.

17.7 No Exceedance but for the Event

The SPCY $PM_{2.5}$ monitor detected elevated levels due to blowing dust on December 19, 2012. These elevated concentrations resulted in exceedances of the 24-hour and annual NAAQS for $PM_{2.5}$ (49.7µg/m^3). The strong correlation between hourly $PM_{2.5}$, PM_{10} and wind speeds peaks also point to windblown dust affecting the monitor. Previous studies have shown that $PM_{2.5}/PM_{10}$ ratios vary from 0.11 to 0.45 in the Paso del Norte Airshed (Arimoto et. al, 2001; Li et al, 2001). The ratios above 0.30 were observed in downtown El Paso and Ciudad Juárez and indicate a heavy impact from mobile sources. The lower ratios were observed in areas with less vehicular traffic and crustal material dominated the PM_{10} fraction. The $PM_{2.5}/PM_{10}$ ratio for the SPCY site was 0.10 for this date ($PM_{2.5}$ Partisol/PM_{10} TEOM). NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

The Deming monitor detected blowing dust around the 0900 hour with hourly concentrations heavily impacted until the 1400 hour. The 1000 and 1100 hourly PM_{10} values hours alone, exceed the 24-hour average standard at Deming [(537+3475) $\mu g/m^3$ = 4012 $\mu g/m^3$; (4012 $\mu g/m^3$)/24 = 167 $\mu g/m^3$]. By replacing the six hourly values impacted by blowing dust with the 95th percentile of hourly data at the Deming site, the resulting 24-hour average (46 $\mu g/m^3$) does not exceed the NAAQS (Table 17-1). The values in red represent the 95th percentile of all hourly data collected at Deming, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	5	5
1	10	10
2	10	10
3	10	10
4	14	14
5	33	33
6	66	66
7	157	157
8	23	23
9	215	**63**
10	537	**63**
11	3475	**67**
12	2923	**82**
13	856	**109**
14	542	**121**
15	106	106
16	62	62
17	27	27
18	22	22
19	17	17
20	19	19
21	14	14
22	11	11
23	10	10
24-Hour Average	381	**46**

Table 17-1. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Deming.

The Desert View monitor detected blowing dust around the 0500 hour with hourly concentrations heavily impacted until the 1500 hour. The three hourly PM_{10} values from 1300-1500 hours alone, exceed the 24-hour average standard at Desert View [(2259 + 1244 + 593) µg/m^3 = 4096 µg/m^3; (3993 µg/m^3)/24 = 170 µg/m^3]. By replacing the ten hourly values impacted by blowing dust with the 95th percentile of hourly data at the Desert View site, the resulting 24-hour average (67 µg/m^3) does not exceed the NAAQS (Table 17-2). The values in red represent the 95th percentile of all hourly data collected at Desert View, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	10	10
1	8	8
2	22	22
3	21	21
4	69	69
5	293	**90**
6	295	**114**
7	517	**106**
8	681	**91**
9	792	**91**
10	120	120
11	331	**93**
12	1229	**99**
13	2259	**105**
14	1244	**132**
15	593	**136**
16	96	96
17	55	55
18	31	31
19	30	30
20	45	45
21	25	25
22	18	18
23	-10	-10
24-Hour Average	365	**67**

Table 17-2. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Desert View.

The Holman monitor detected blowing dust around the 0800 hour with hourly concentrations heavily impacted until the 1400 hour (As used here heavily impacted means above the 95th percentile). The 1200 and 1300 hourly PM_{10} values hours alone, exceed the 24-hour average standard at Holman [(3255+884) µg/m^3 = 4139 µg/m^3; (4139 µg/m^3)/24 = 172 µg/m^3]. By replacing the seven hourly values impacted by blowing dust with the 95th percentile of hourly data at the Holman site, the resulting 24-hour average (40 µg/m^3) does not exceed the NAAQS (Table 17-3). The values in red represent the 95th percentile of all hourly data collected at Holman, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	1	1
1	4	4
2	6	6
3	13	13
4	19	19
5	25	25
6	18	18
7	42	42
8	247	**56**
9	477	**54**
10	1742	**60**
11	2374	**73**
12	3255	**88**
13	884	**113**
14	203	**131**
15	94	94
16	31	31
17	23	23
18	31	31
19	20	20
20	12	12
21	12	12
22	14	14
23	13	13
24-Hour Average	365	40

Table 17-3. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Holman.

The SPCY monitor detected blowing dust around the 0500 hour with hourly concentrations heavily impacted until the 1600 hour. The 1300 and 1400 hourly PM_{10} values hours alone, exceed the 24-hour average standard at SPCY [(3433 + 2815) µg/m^3 = 6248 µg/m^3; (6248 µg/m^3)/24 = 260 µg/m^3]. By replacing the eleven hourly values impacted by blowing dust with the 95th percentile of hourly data at the SPCY site, the resulting 24-hour average (92 µg/m^3) does not exceed the NAAQS (Table 17-4). The values in red represent the 95th percentile of all hourly data collected at SPCY, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	96	96
1	83	83
2	65	65
3	16	16
4	32	32
5	172	**100**
6	346	**122**
7	510	**120**
8	587	**97**
9	813	**96**
10	265	**102**
11	733	**111**
12		**144**
13	3433	**164**
14	2815	**185**
15	1090	**205**
16	199	**203**
17	69	69
18	40	40
19	33	33
20	38	38
21	33	33
22	29	29
23	15	15
24-Hour Average	500	**92**

Table 17-4. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at SPCY.

The West Mesa monitor detected blowing dust around the 0900 hour with hourly concentrations heavily impacted until the 1500 hour. The 1200 hourly PM_{10} value from hour alone, nearly exceeds the 24-hour average standard at West Mesa (3454 µg/m^3)/24 = 144 µg/m^3. By replacing the seven hourly values impacted by blowing dust with the 95th percentile of hourly data at the West Mesa site, the resulting 24-hour average (30 µg/m^3) does not exceed the NAAQS (Table 17-5). The values in red represent the 95th percentile of all hourly data collected at West Mesa, including data affected by high wind blowing dust events in the table below. NMED concludes that without the high wind and blowing dust an exceedance would not have occurred.

Hour of Day (MST)	Recorded Hourly Data	Substituted Hourly Data
0	4	4
1	6	6
2	5	5
3	6	6
4	6	6
5	8	8
6	12	12
7	16	16
8	94	94
9	156	**51**
10	530	**50**
11	1452	**52**
12	3454	**51**
13	1942	**57**
14	431	**66**
15	176	**75**
16	75	75
17	33	33
18	20	20
19	11	11
20	-1	-1
21	9	9
22	10	10
23	6	6
24-Hour Average	352	**30**

Table 17-5. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at West Mesa.