3 HIGH WIND EXCEPTIONAL EVENT: January 31, 2011

3.1 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 at the Anthony and SPCY monitoring sites on this date. The FEM TEOM continuous monitors at these sites recorded 24-hour average concentrations of 157 and 177 µg/m^3, respectively. In accordance with the EER and PM $_{2.5}$ annual NAAQS, the AQB flagged this data on EPA's AQS database as a high wind natural event. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured at Chaparral (118 µg/m^3) monitoring sites (Figure 3-1). The averages in this figure were calculated using PM_{10} FEM TEOM instrument data for the four days before and after the event

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} concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

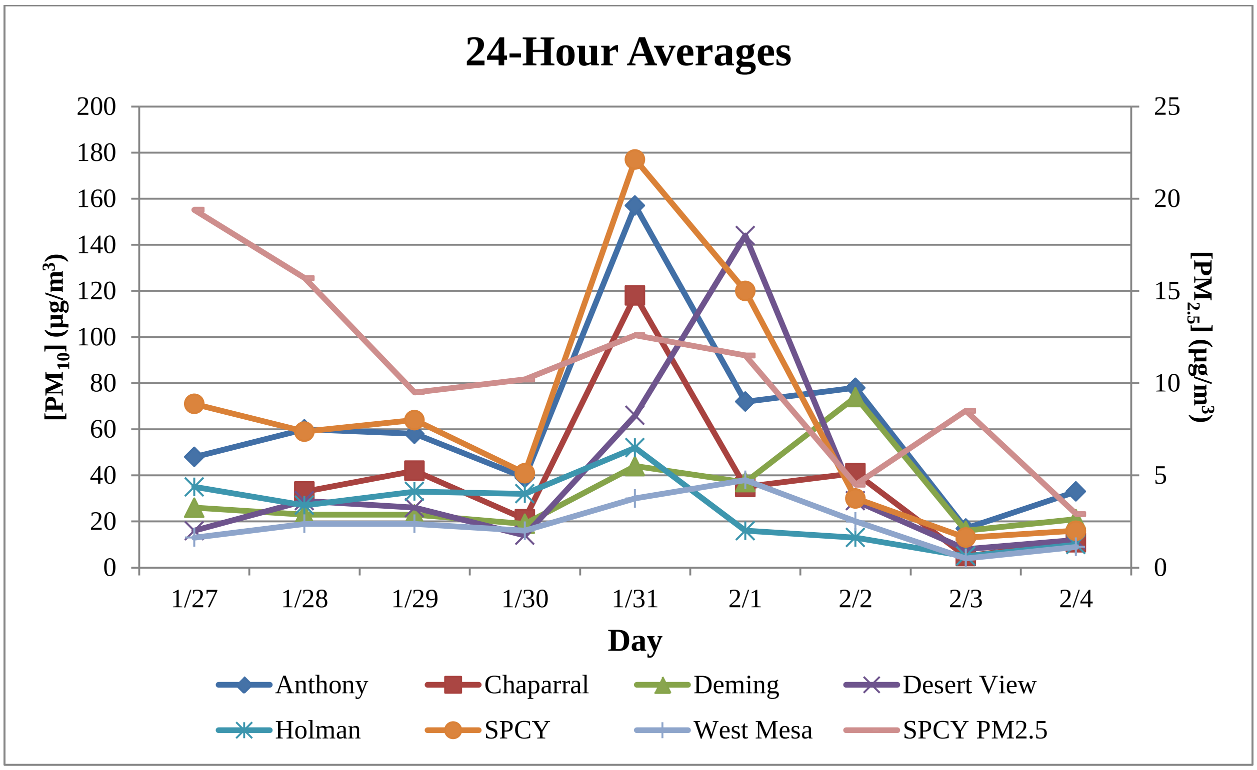

Figure 3-1. PM_{10} and $PM_{2.5}$ 24-hour averages before and after January 31, 2011.

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 Mexico and New Mexico. Doña Ana County Ordinances requires BACM for any dust producing activities. The largest and most likely sources of windblown dust are the natural desert and/or the playas of northern 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 January 31, 2011, sustained wind speeds exceeded EPA's default threshold at one of the seven monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at three of the seven monitoring sites (Figures 3-2 and 3-3). Winds exceeded these thresholds at one or more monitoring sites beginning at the 1330 hour and ending at the 1700 hour.

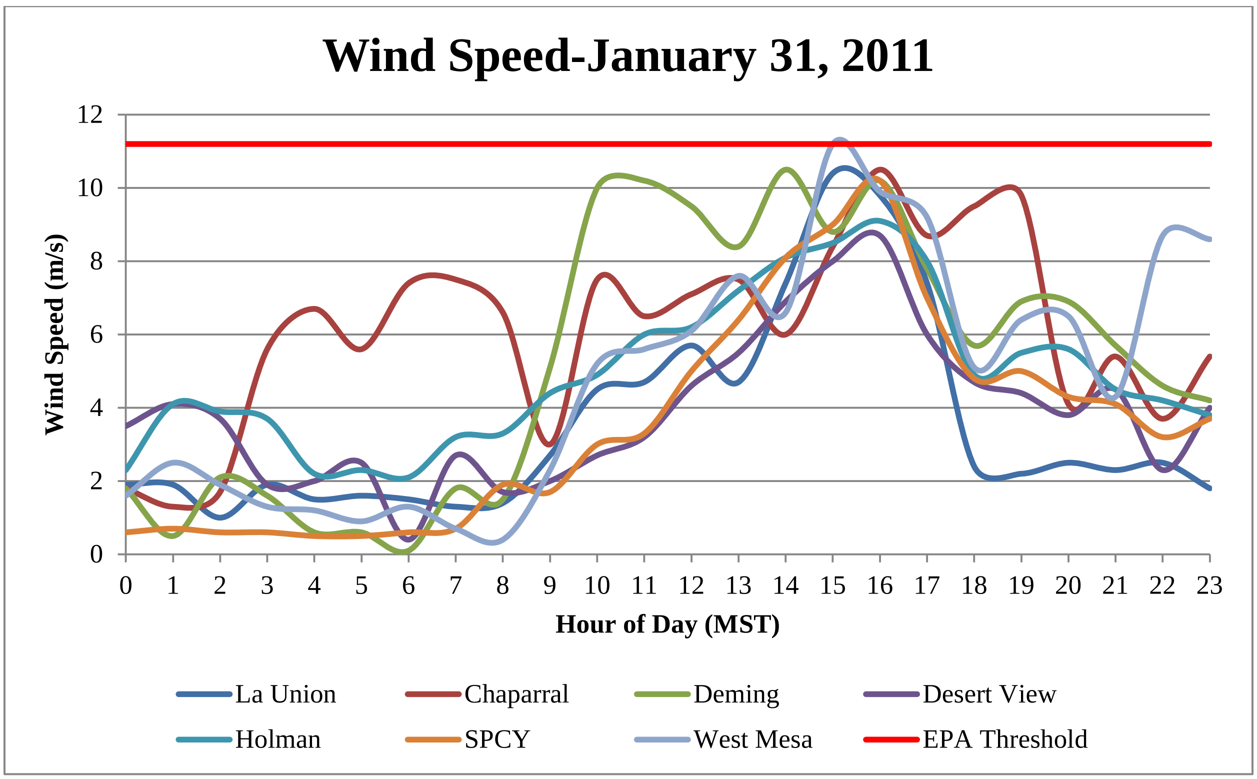

Figure 3-2. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

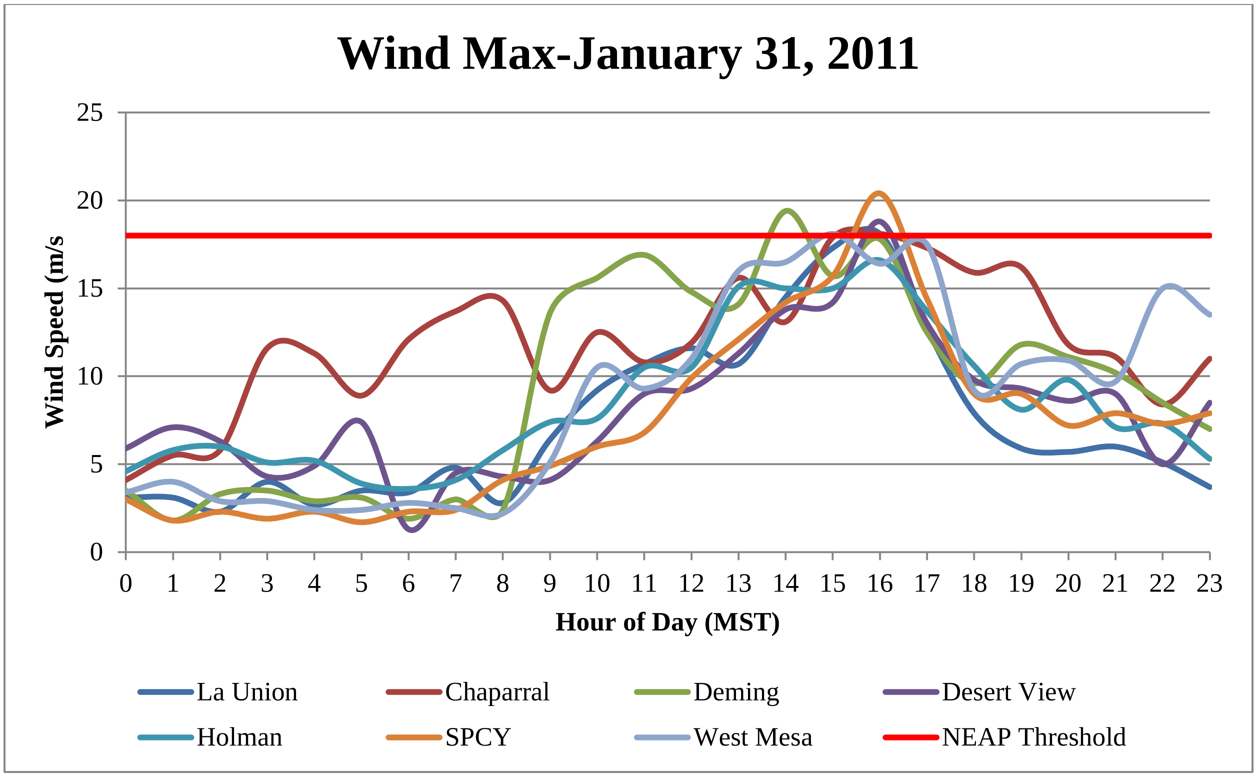

Figure 3-3. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

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 2006-2010 the PM_{10} FEM TEOM monitors recorded 211 exceedances and the PM_{10} FRM Wedding monitors recorded 5 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 (Table 2-1). The SPCY $PM_{2.5}$ FRM Partisol recorded 23 exceedances of the 24-Hour NAAQS from 2006-2010 (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 and playas in New Mexico and northern Mexico. The southern sites in Doña Ana County recorded the highest 24-hour averages in the monitoring. 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 3.4). 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.

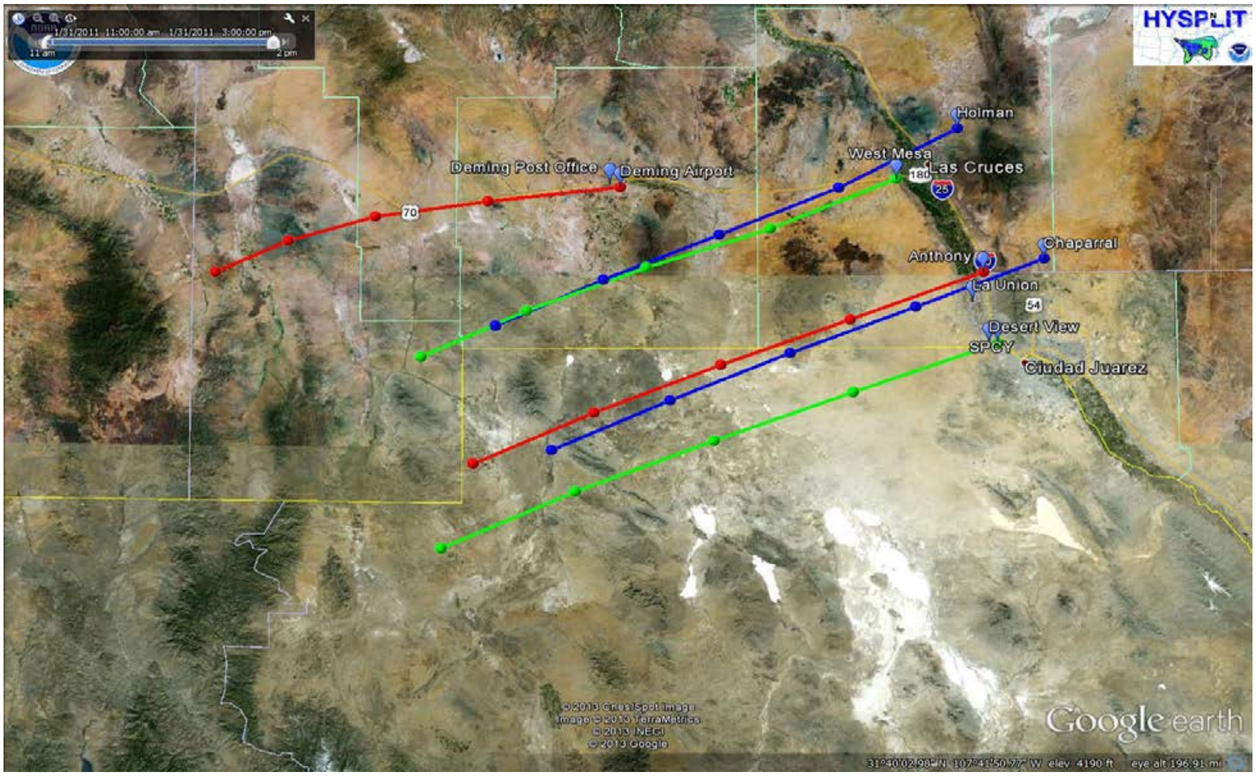

Figure 3-4. HYSPLIT back-trajectory model analysis for January 31, 2011.

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-4 through B-11). 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 2006-2010 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 2006-2010. 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 2006-2010. The recorded values for this day (157(Anthony) and 177(SPCY) $\mu g/m^3$) 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 January 31, 2011 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 3-5a-c through 3-7a-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.

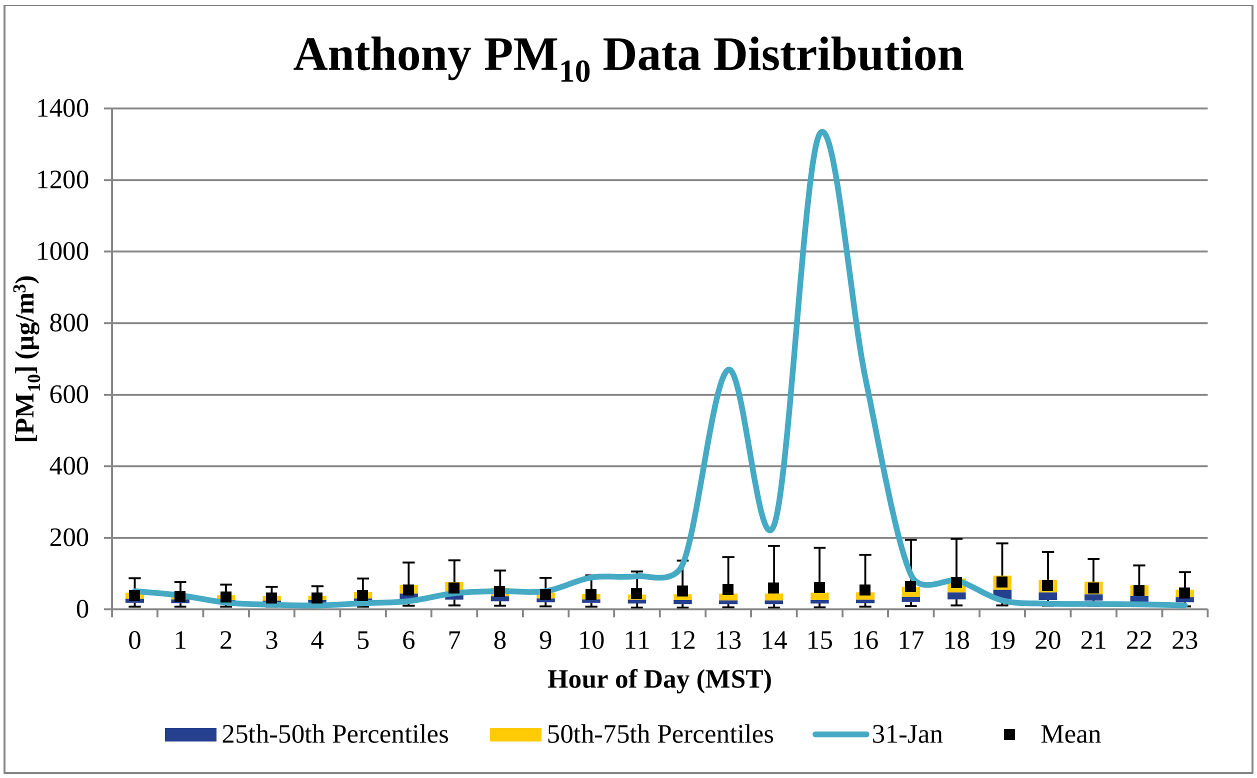

Figure 3-5a. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for January 31, 2011.

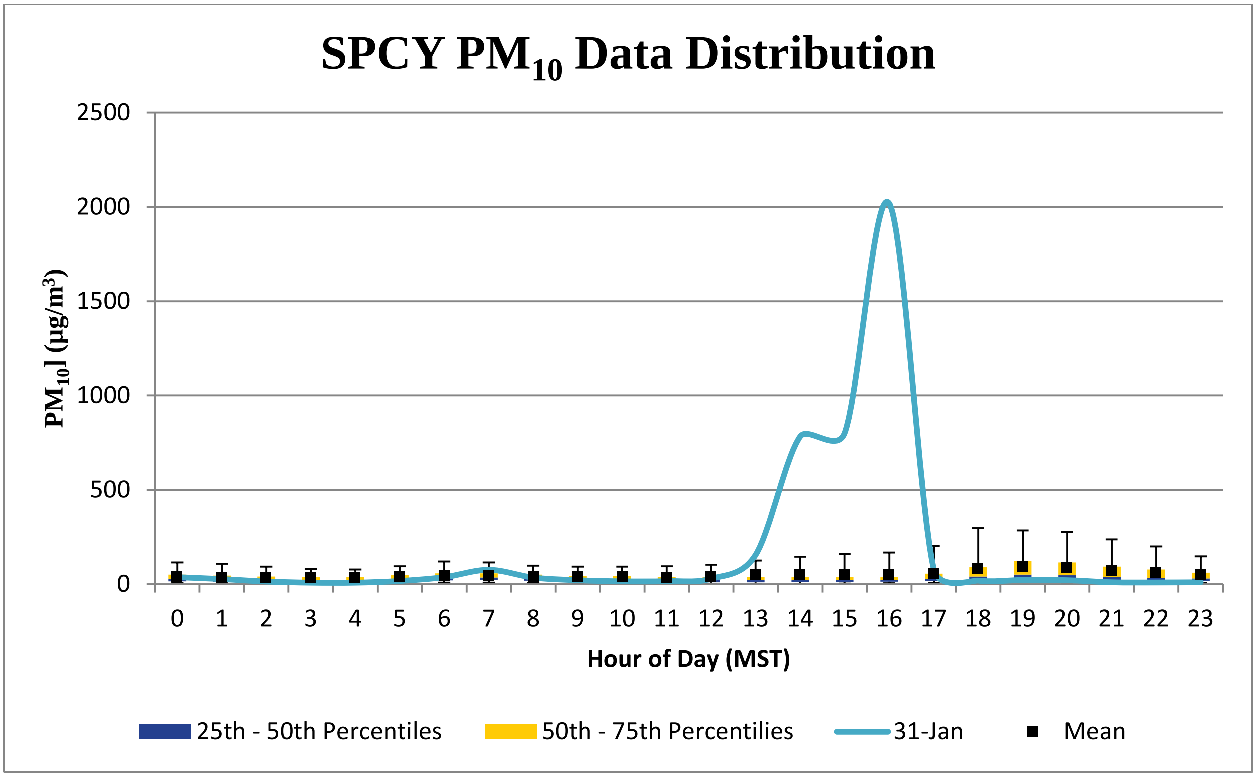

Figure 3-5b. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for January 31, 2011.

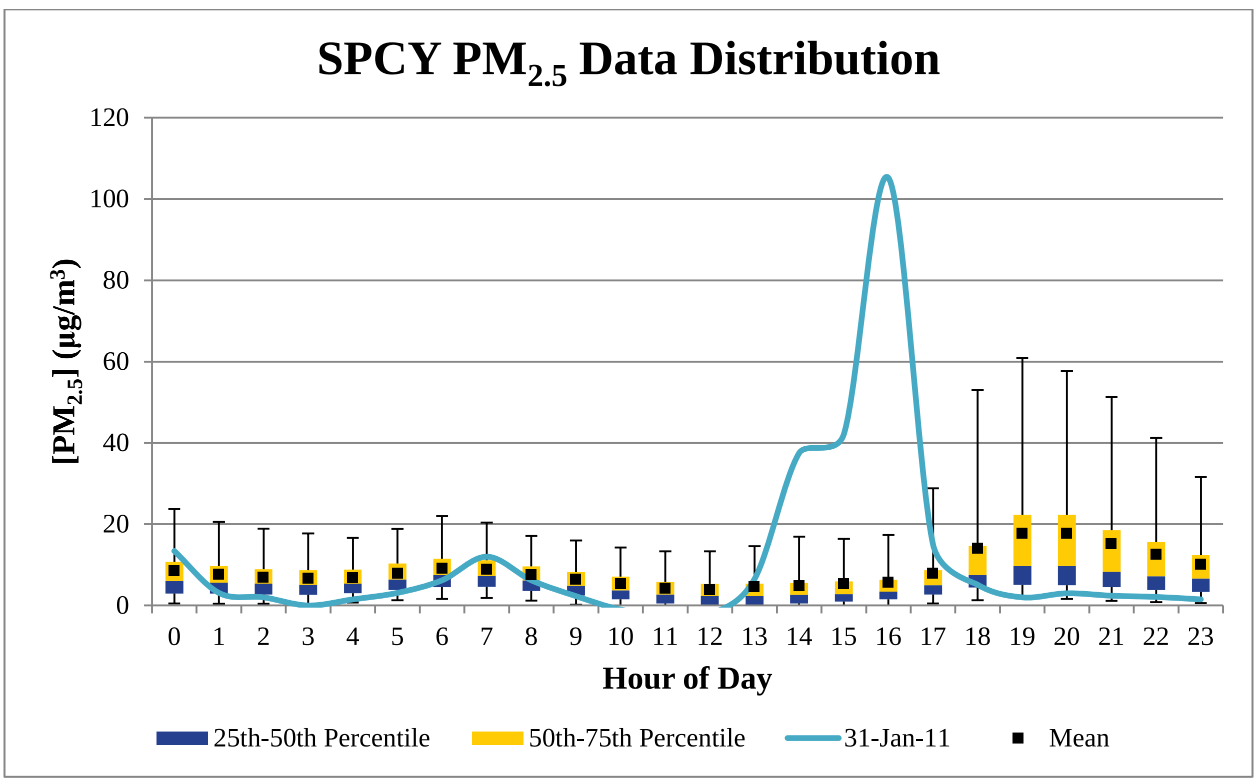

Figure 3-5c. PM_{10} and $PM_{2.5}$ hourly data distribution from 2006-2010 overlaid by hourly values for January 31, 2011.

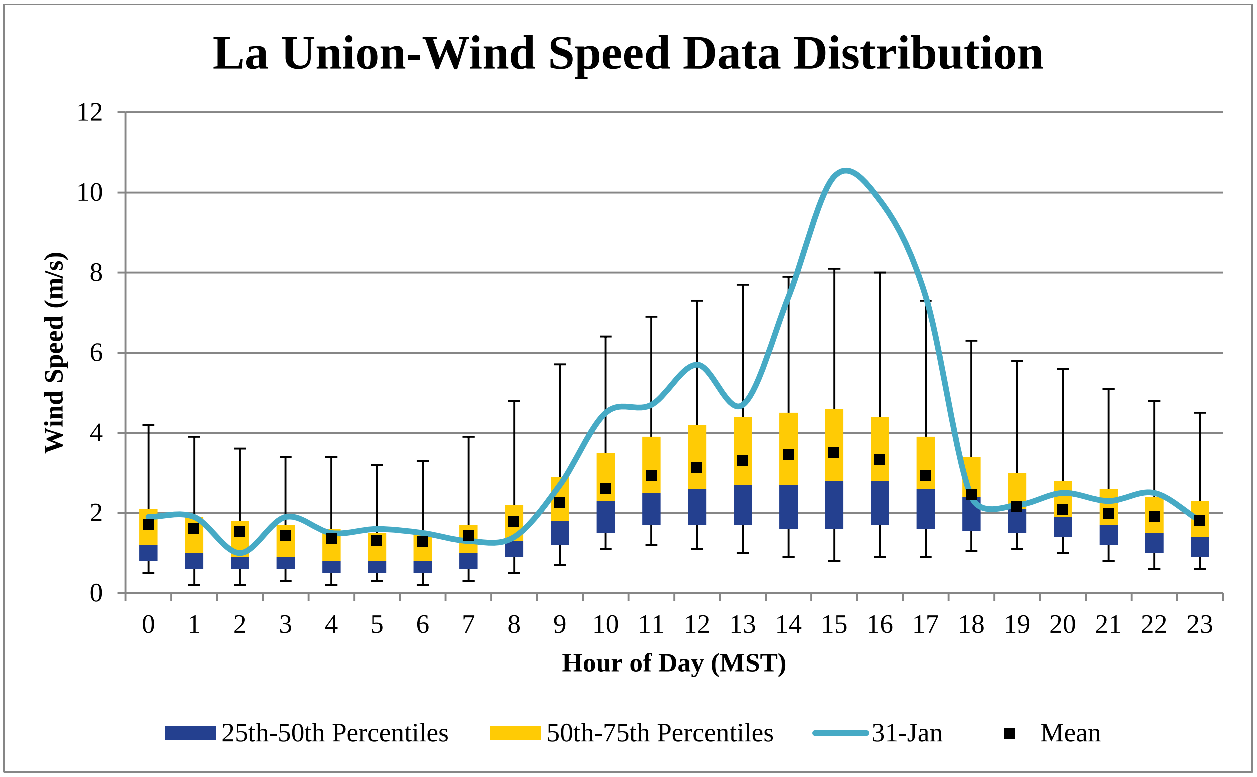

Figure 3-6a. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for January 31, 2011.

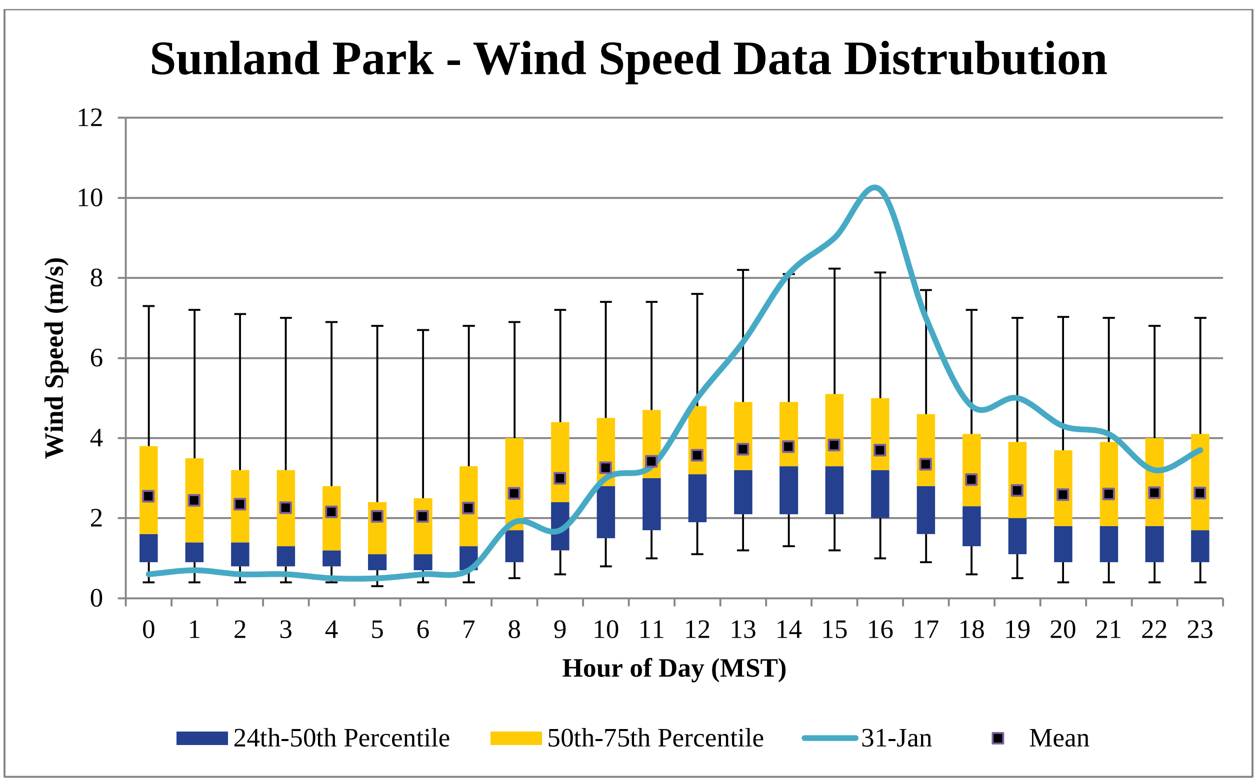

Figure 3-6b. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for January 31, 2011.

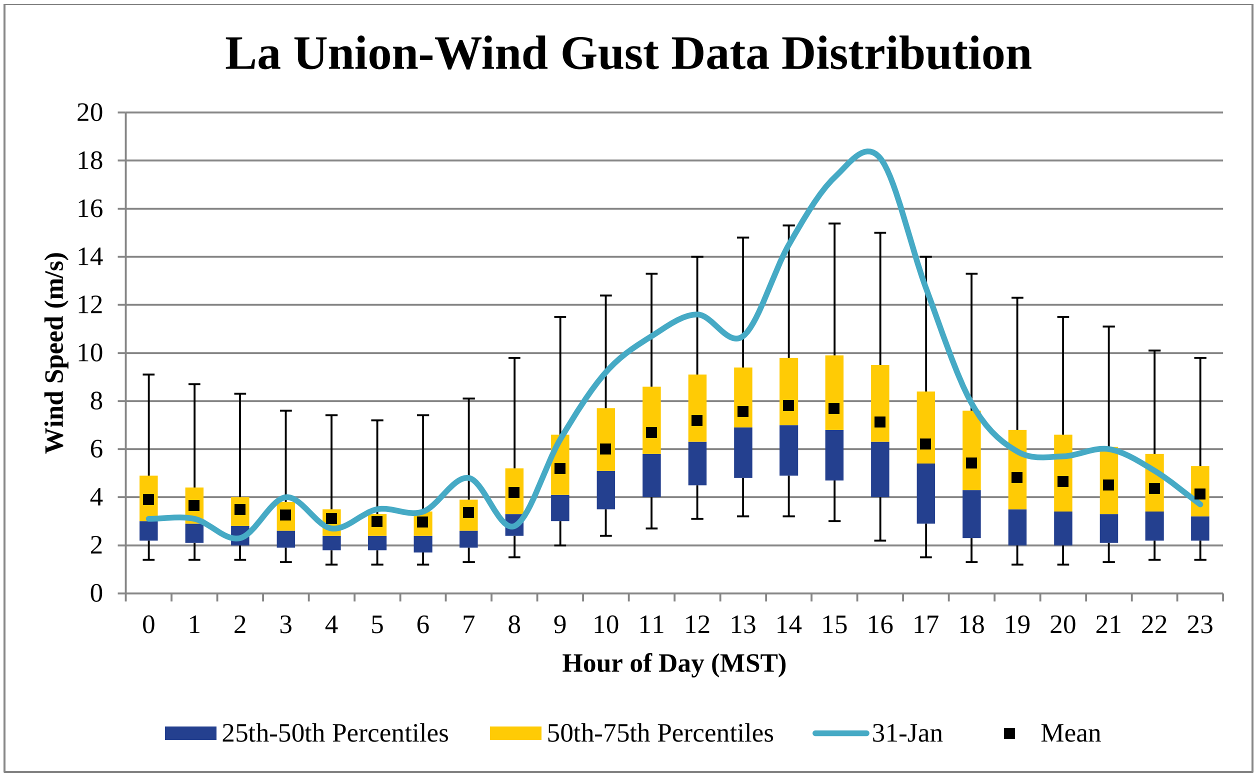

Figure 3-7a. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for January 31, 2011.

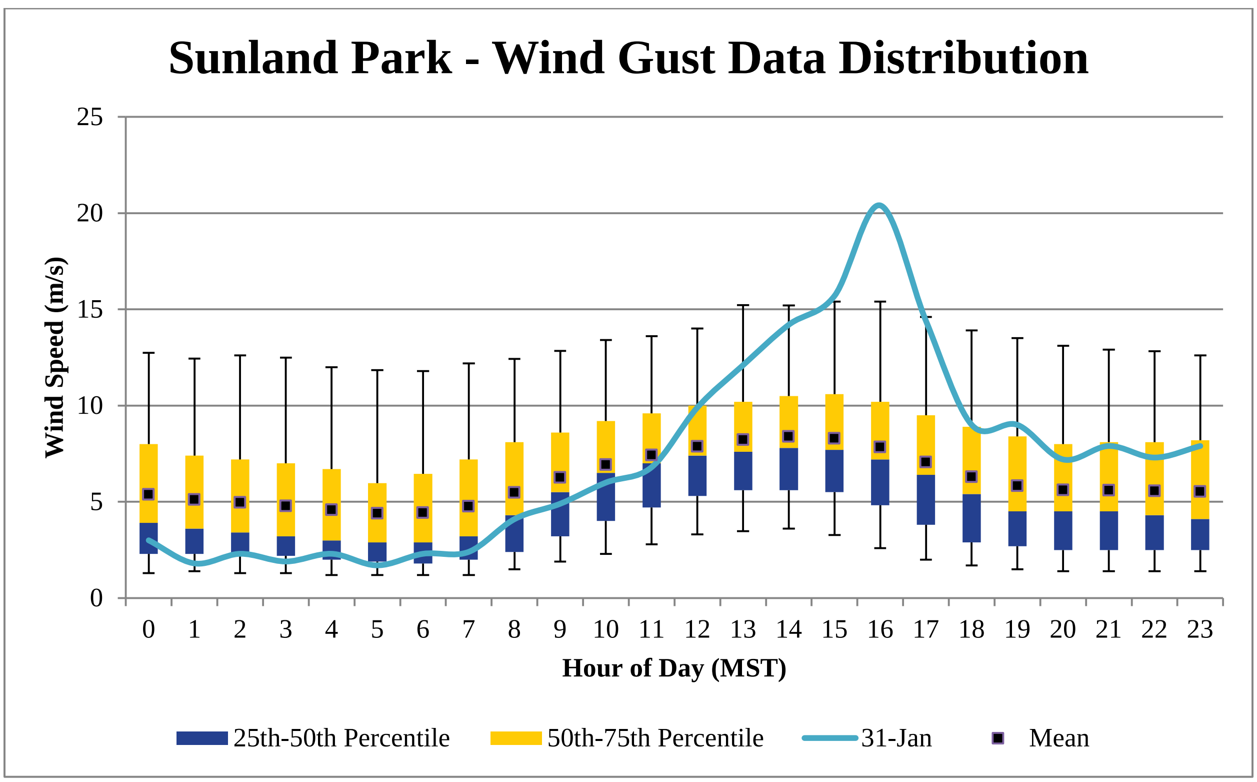

Figure 3-7b. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for January 31, 2011.

3.4 Clear Causal Relationship

A Pacific cold front passed through New Mexico on January 30, 2011. This cold front turned into a stationary front and a warm front covering the eastern half of the state on January 31, 2011. An area of low pressure developed in central New Mexico creating a weak pressure gradient over southeastern Arizona, New Mexico and northern Mexico (Figure 3-8). As the event unfolded the low pressure gradient tightened over southern New Mexico and northern Mexico and surface winds became stronger. Surface winds flow perpendicular to the isobars from high to low pressure. The wind direction in the upper atmosphere aligned with the surface wind direction (Figure 3-9). 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. At the same time as this event was unfolding a surge of cold air came down from the north bringing with it record low temperatures.

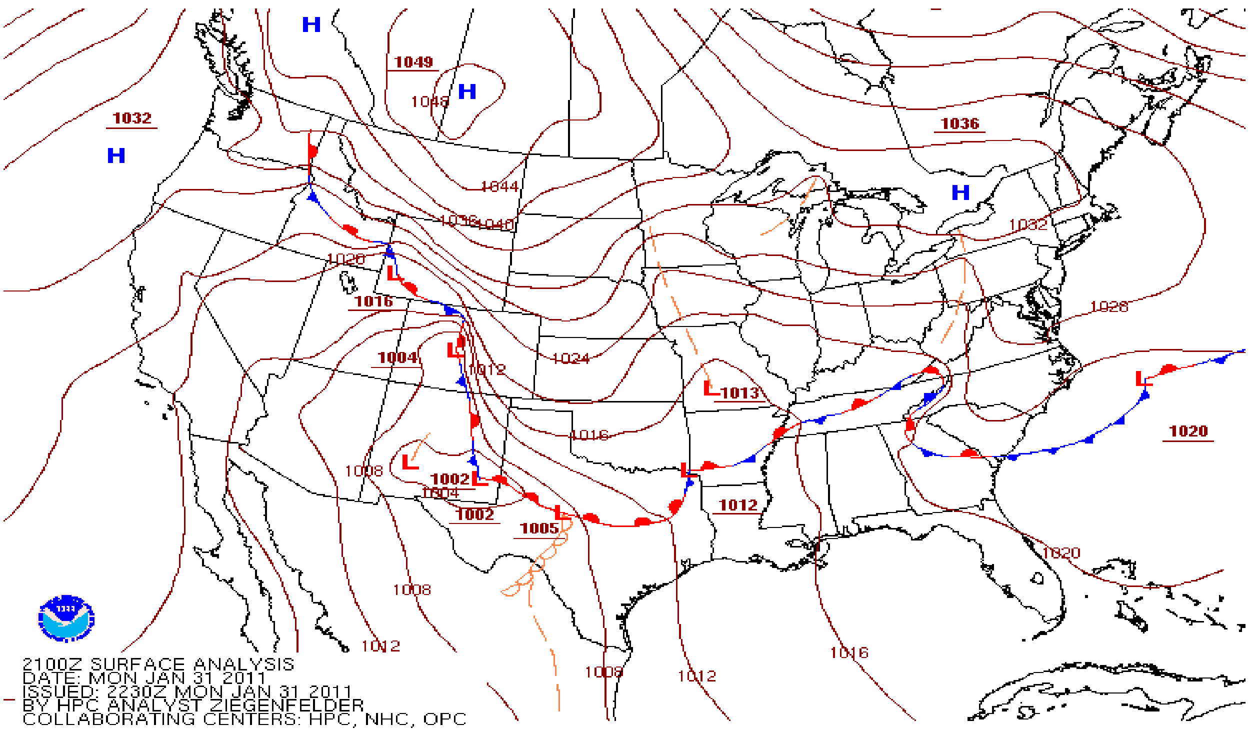

Figure 3-8. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for January 31, 2011 at the 1500 MST hour.

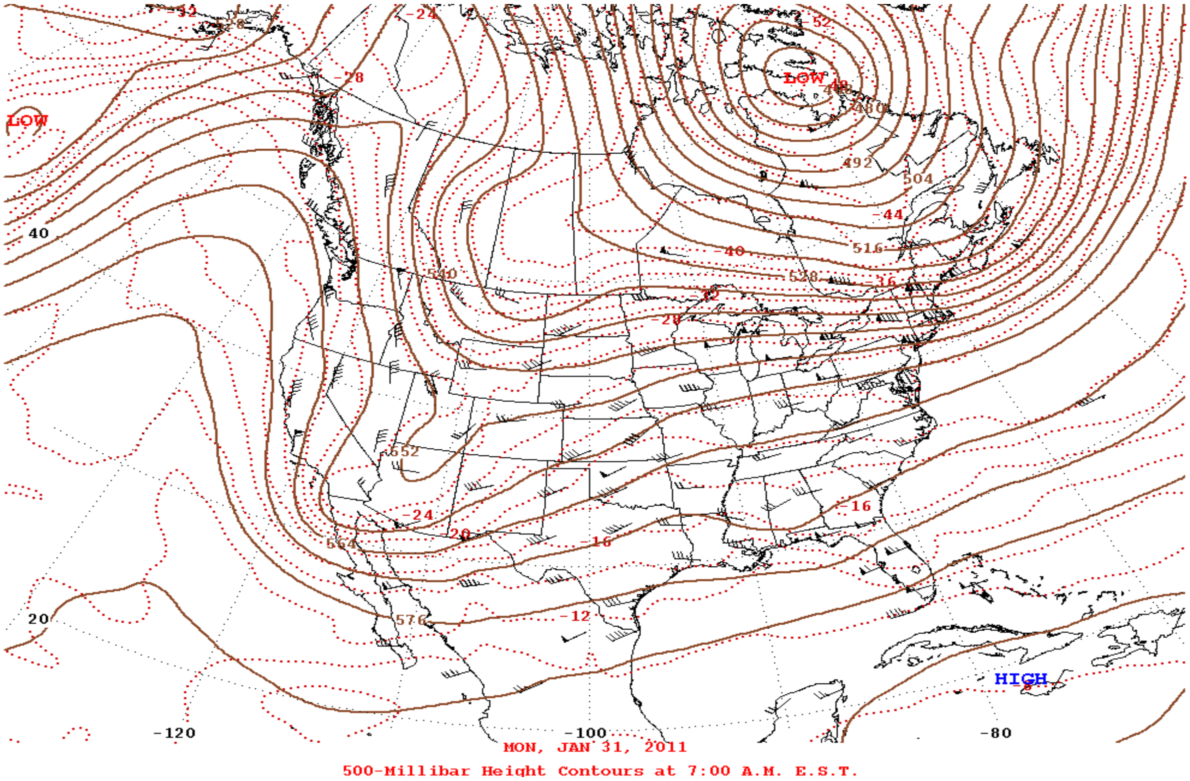

Figure 3-9. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on January 31, 2011.

The weather pattern described above generated strong southwesterly winds beginning at the 1430 hour and lasting through the 1630 hour. Beginning at the 1430 hour, wind speeds exceeded the historical 95th percentile of data at La Union as shown in Figure 3-6a. Peak wind speeds were 11.2 m/s at West Mesa (Figure 3-2). Peak wind gusts ranged from 18.1 m/s at La Union to 20.4 m/s at SPCY (Figure 3-3). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figures 3-10a-d. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (1430-1630 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 3-11a-b). Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM monitors show good correlation of the timing of spikes in concentrations (Figure 3-12).

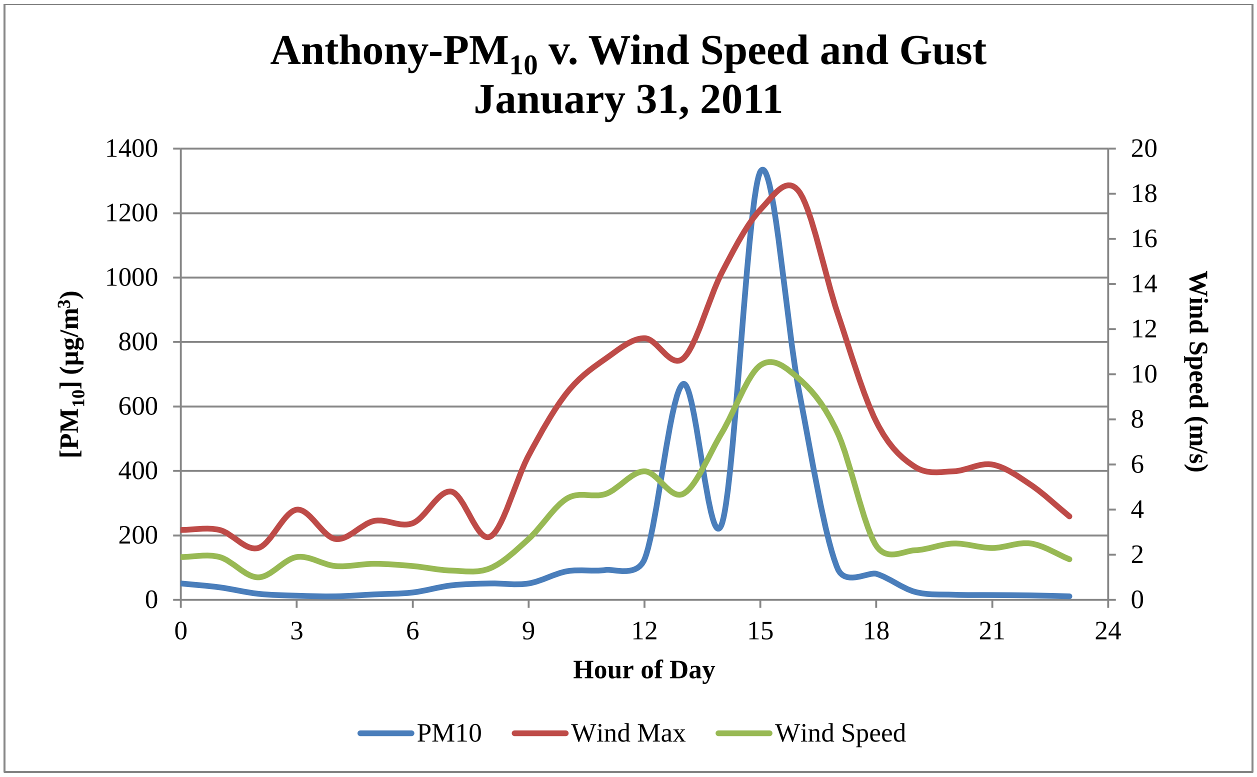

Figure 3-10a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

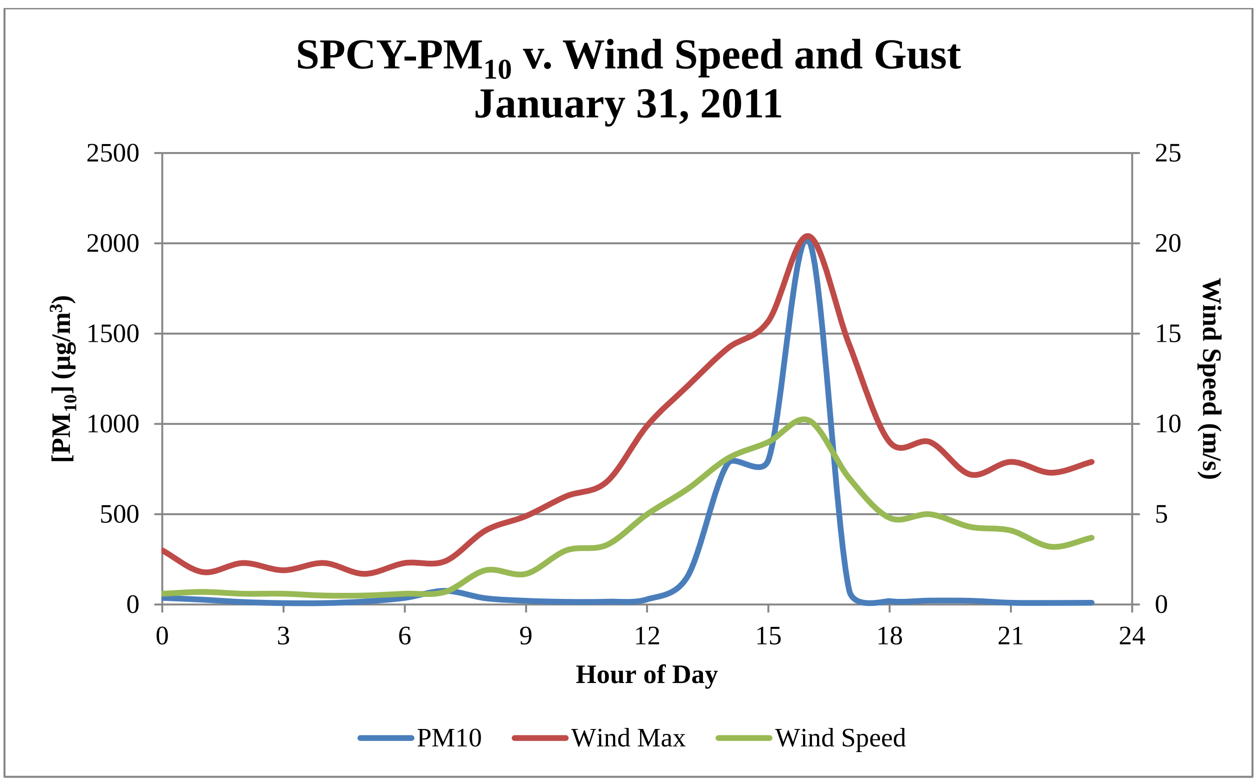

Figure 3-10b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

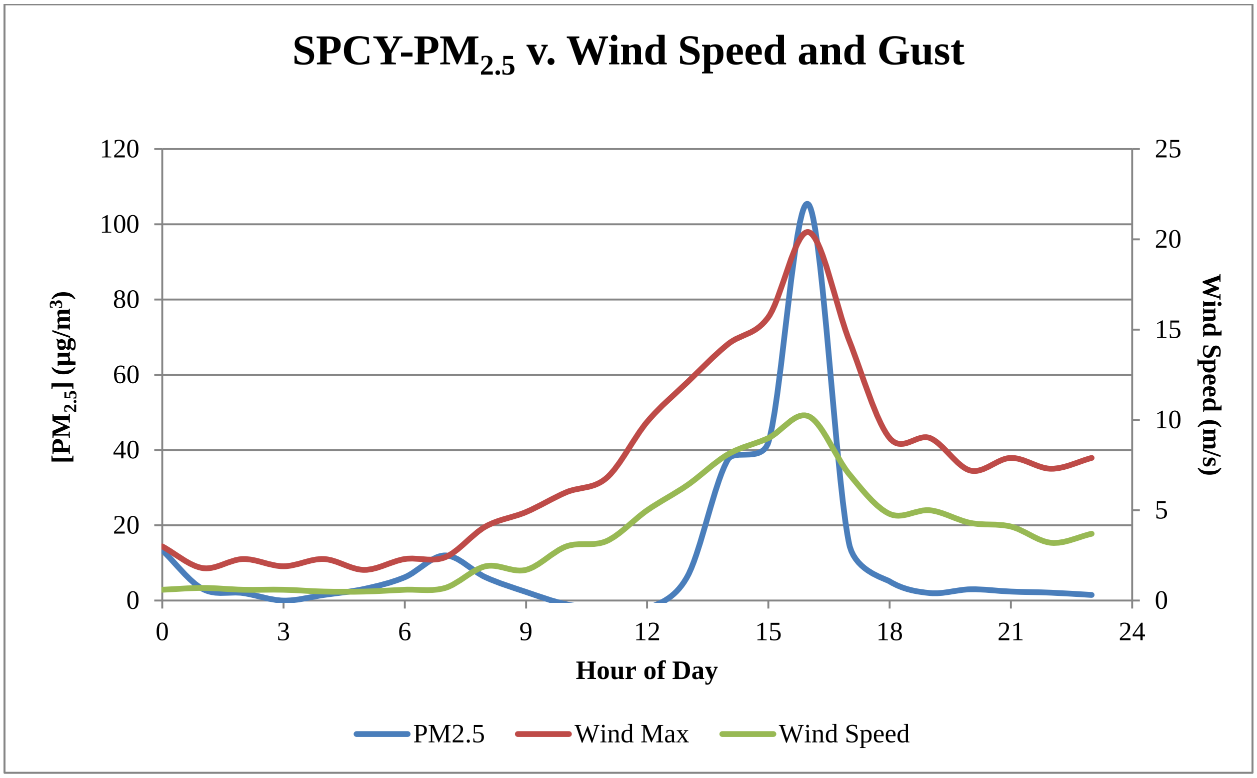

Figure 3-10c. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

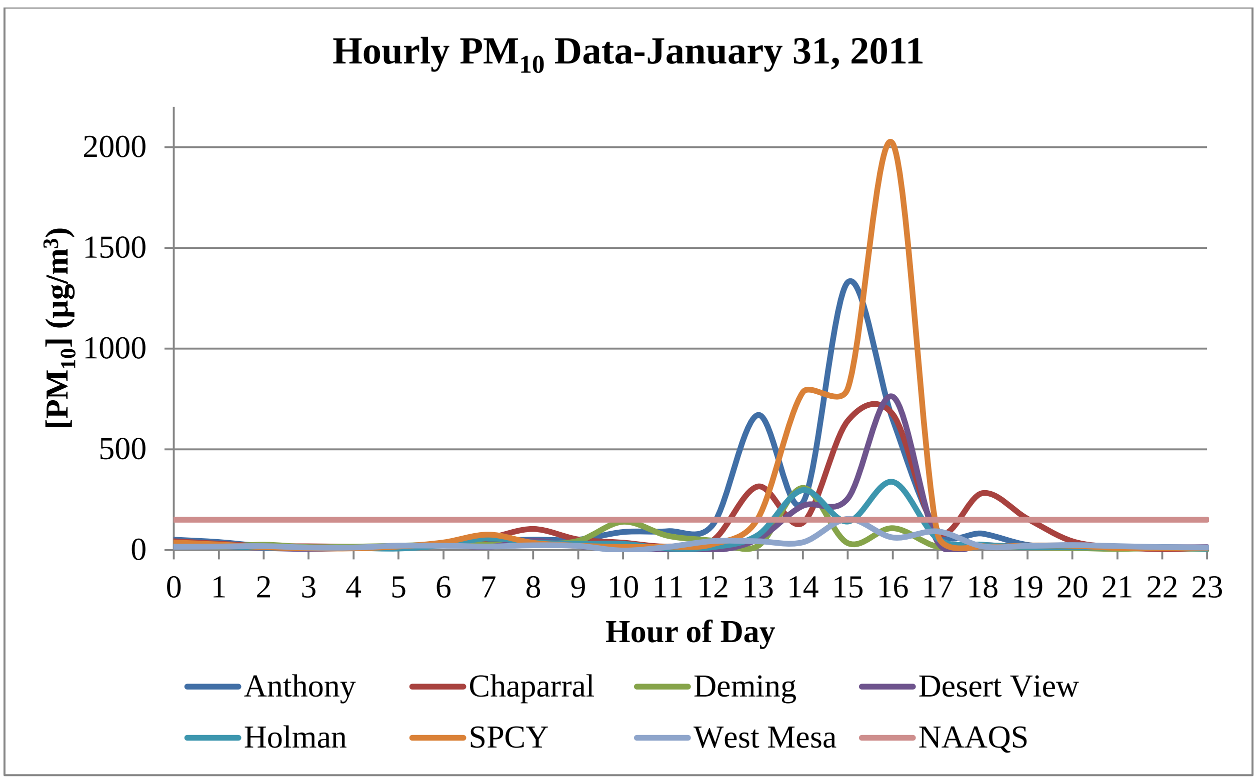

Figure 3-11a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

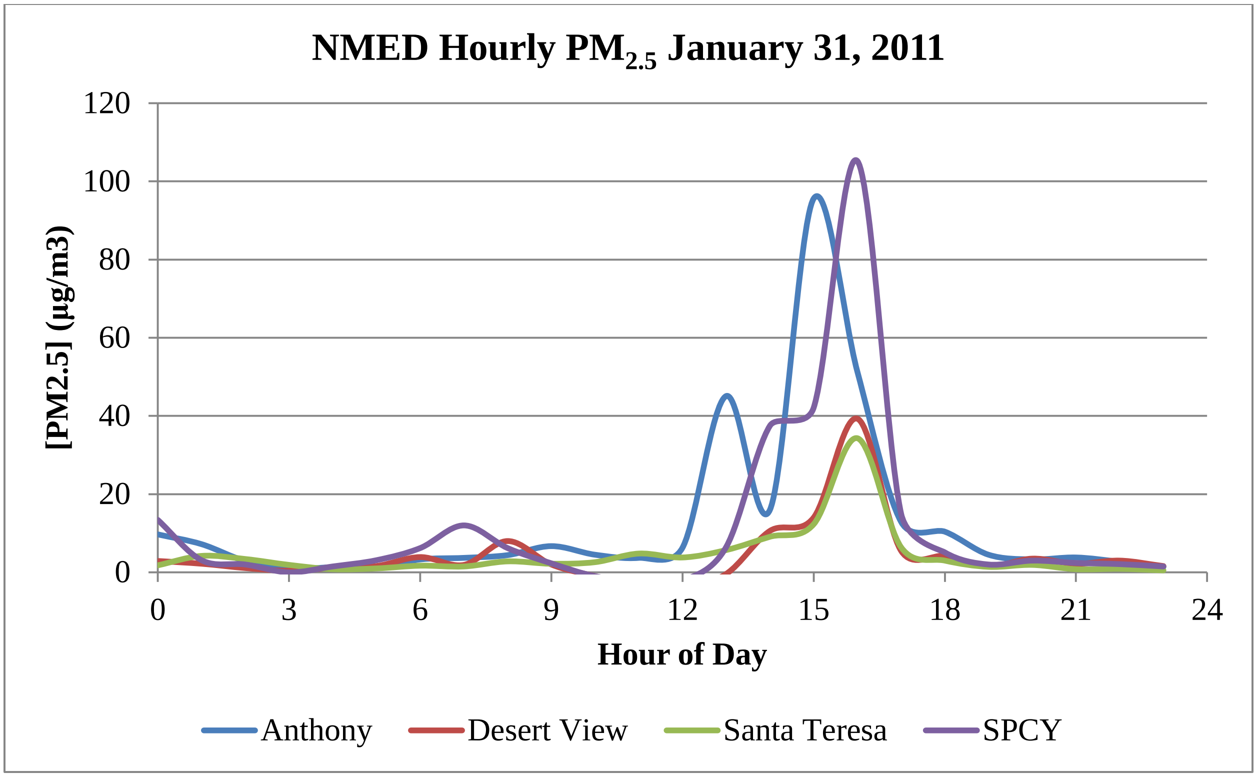

Figure 3-11b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors. Non-FEM hourly $PM_{2.5}$ data.

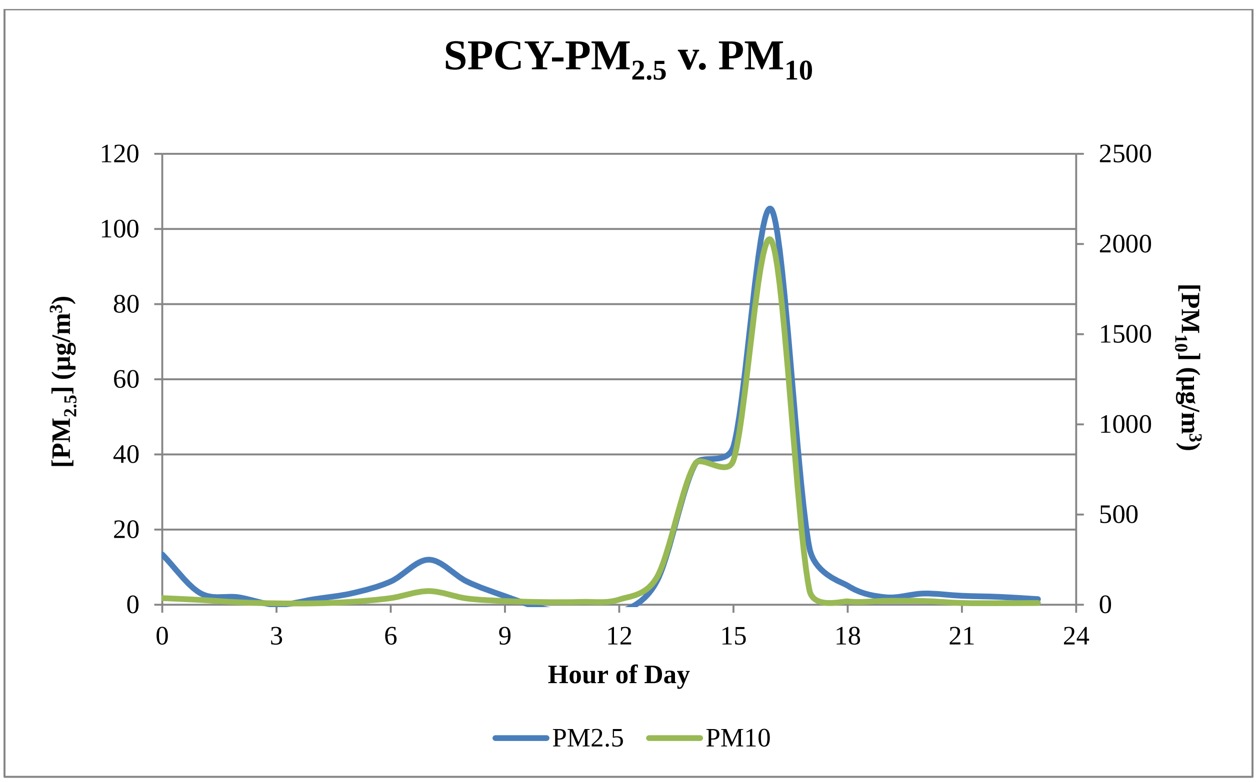

Figure 3-12. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on January 31, 2011.

The New Mexico State Climatologist documented this event on his weather and air quality blog stating the following for January 31, 2011.

> High wind PM in the afternoon. The Sunland Park City Yard station peaked around 3 pm today with a with a PM_{10} concentration of around 2000 µg/m3. PM was high at Chaparral with peak PM_{10} over 600 µg/m3. Big story is the approaching winter storm system complete with precipitation, winds, and very cold temperatures (DuBois, 2011).

The National Weather Service (NWS) also took note of the large storm system that moved through the area and caused high winds and blowing dust on this day in their quarterly newsletter.

> Beginning on January 31 and continuing into early February 2011, a historic winter storm slammed most of the United States from the Rocky Mountains to the east coast with an associated blast of Arctic air plunging southward into the southwest. The initial surge of frigid air first penetrated southern New Mexico and far western Texas on Feb 1 with extremely cold air covering the entire area and much of Arizona by Feb 2. Concurrently an upper-level trough moved eastward across the southern Rockies, producing areas of moderate and heavy snow, especially over northern Otero County (NWS, 2011).

3.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on January 31, 2011.

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 Anthony monitor detected blowing dust around the 1300 hour with hourly concentrations heavily impacted until the 1600 hour (As used here heavily impacted means above the 95th percentile. The four hourly PM_{10} values from 1300-1600 hours alone, nearly exceed the 24-hour average standard at Anthony accounting for 80 percent of the 24-hour average [(670 + 235 + 1329 + 648) µg/m^3 = 2882µg/m^3; (2882 µg/m^3)/24 = 120 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 (67 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 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	Recorded Hourly Data	Substituted Hourly Data
0	51	51
1	39	39
2	19	19
3	13	13
4	11	11
5	17	17
6	23	23
7	45	45
8	51	51
9	51	51
10	89	89
11	93	93
12	126	126
13	670	**172**
14	235	**152**
15	1329	**194**
16	648	**197**
17	97	97
18	81	81
19	25	25
20	16	16
21	15	15
22	14	14
23	11	11
24-Hour Average	157	**67**

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 Anthony.

The SPCY monitor detected blowing dust around the 1400 hour with hourly concentrations heavily impacted until the 1600 hour. The three hourly PM_{10} values from 1400-1700 hours alone, equals the 24-hour average standard at SPCY [(783 + 802 + 2019) µg/m^3 = 3604 µg/m^3; 3604 µg/m^3)/24 = 150 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 (48 µg/m^3) does not exceed the NAAQS (Table3-2). 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	Recorded Hourly Data	Substituted Hourly Data
0	38	38
1	28	28
2	14	14
3	9	9
4	9	9
5	18	18
6	38	38
7	77	77
8	36	36
9	22	22
10	15	15
11	16	16
12	29	29
13	156	156
14	783	**145**
15	802	**160**
16	2019	**168**
17	80	80
18	19	19
19	23	23
20	21	21
21	11	11
22	9	9
23	11	11
24-Hour Average	177	**48**

Table 3-2. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at SPCY.

4 HIGH WIND EXCEPTIONAL EVENT: February 8, 2011

4.1 Summary of Event

The approach of a Pacific cold front and a backdoor 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 Sunland Park monitoring sites on this date. The FEM TEOM continuous monitors at these sites recorded 24-hour average concentrations of 253, 181, 223 and 422µg/m^3 respectively. The FRM Wedding and Partisol monitors at these sites recorded a 24-hour average concentrations of 138 (Anthony), 176 (PM_{10} SPCY) and 47.7 ($PM_{2.5}$ SPCY) µg/m^3. In accordance with the EER, the AQB flagged this data on EPA's AQS database as a high wind natural event. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured at the Deming airport (150 µg/m^3) monitoring site (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 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.

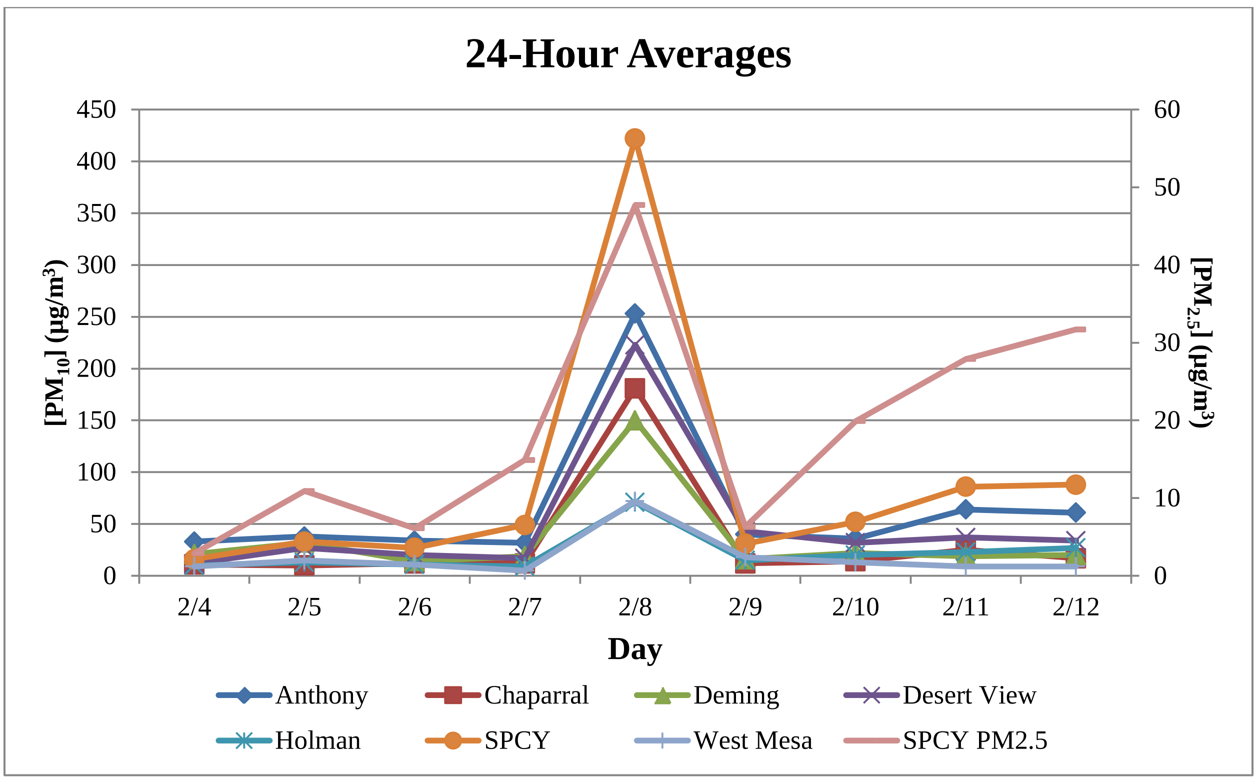

Figure 4-1. PM_{10} and $PM_{2.5}$ 24-hour averages before and after February 8, 2011.

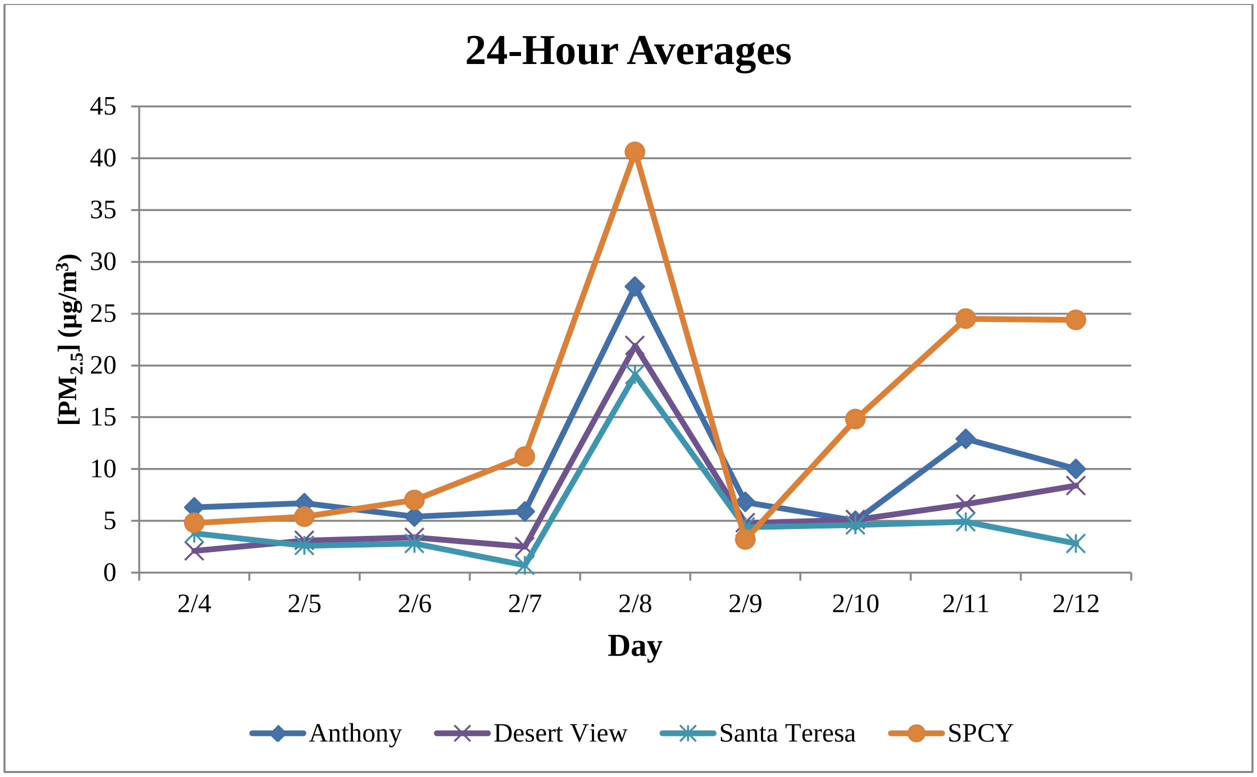

Figure 4-2. $PM_{2.5}$ 24-hour averages before and after February 8, 2011 . Non-FEM TEOM Data.

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 Arizona, Mexico and New Mexico. Agricultural tilling and crop planting may have contributed to this event. The City of Las Cruces and Doña Ana 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 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 8, 2011, sustained wind speeds exceeded EPA's default threshold at four of the seven monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at six of the seven 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 1700 hour.

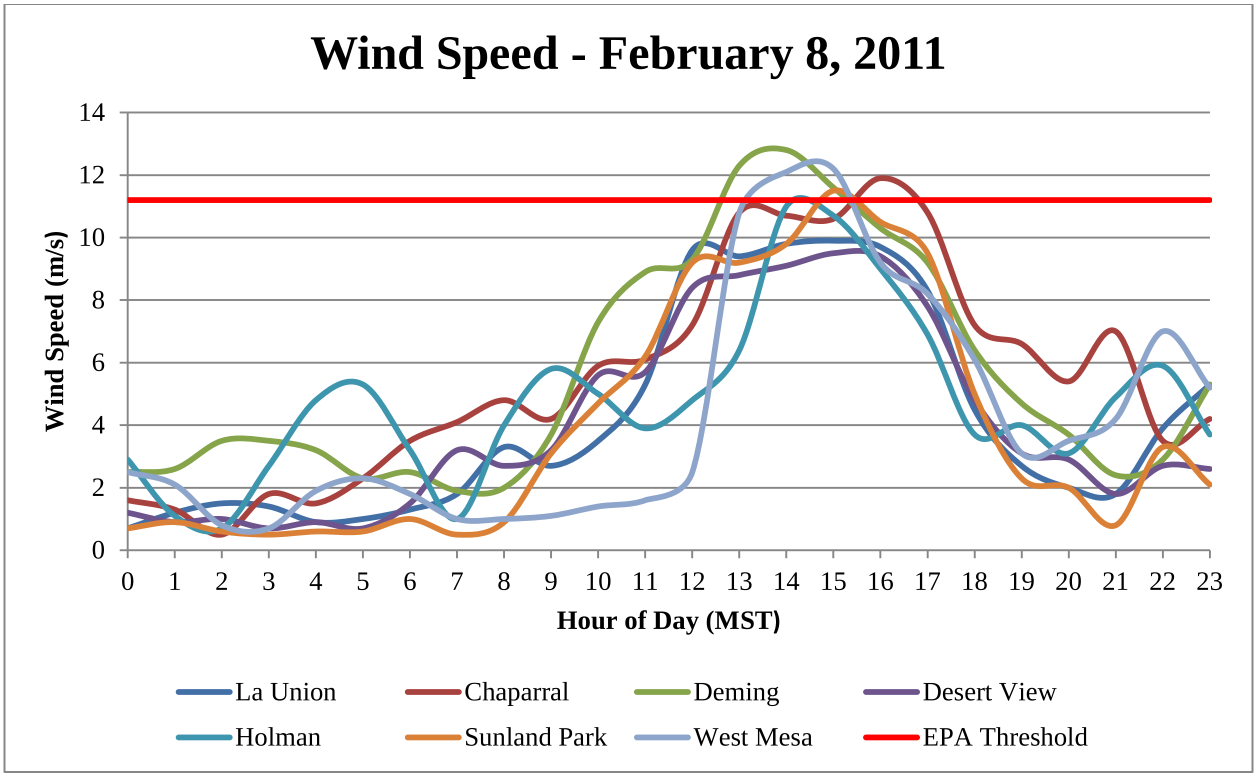

Figure 4-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

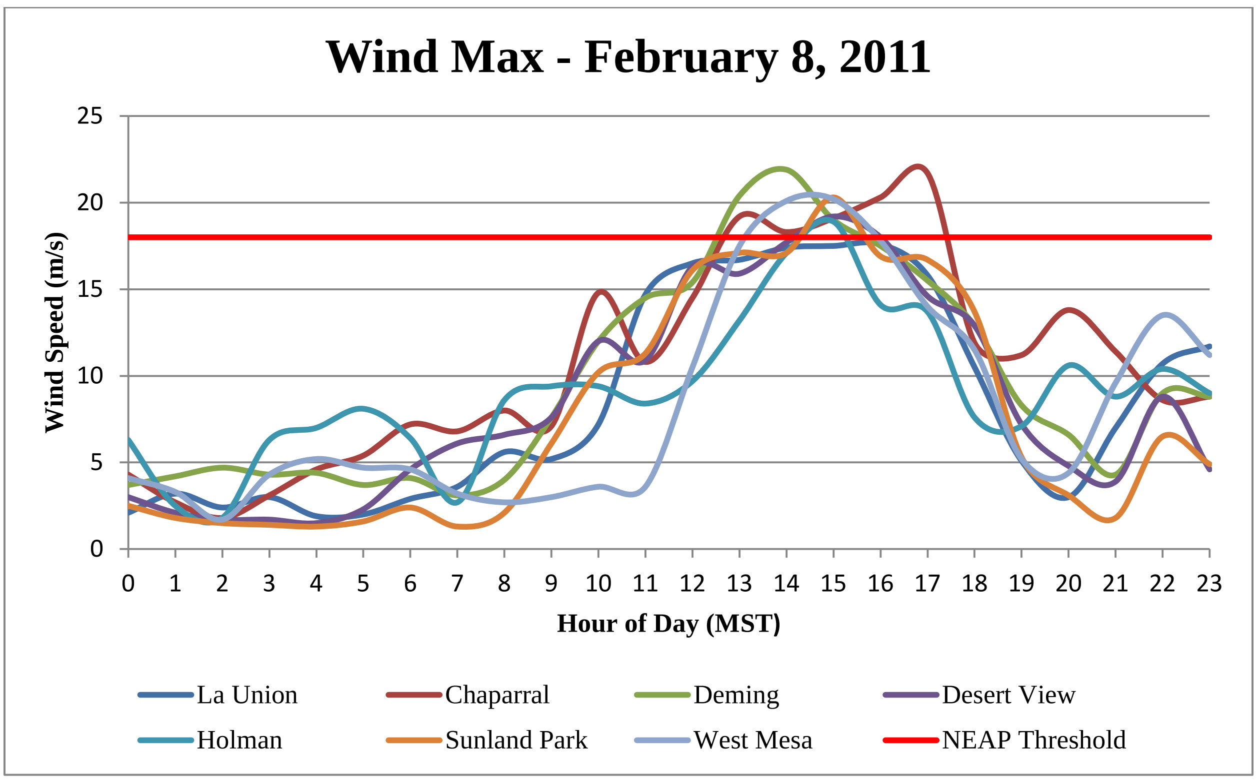

Figure 4-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

4.2.3 Recurrence Frequency

The monitoring sites in Doña Ana and Luna Counties can record exceedances of the PM_{10} NAAQS throughout the year. From 2006-2010 the PM_{10} FEM TEOM monitors recorded 211 exceedances and the PM_{10} FRM Wedding monitors recorded 5 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 (Table 2-1). The SPCY $PM_{2.5}$ FRM Partisol recorded 23 exceedances of the 24-Hour NAAQS from 2006-2010 (Figure A-2). See appendix A for a more in-depth discussion about recurrence frequency and the number of exceedances at each monitoring site.

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 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 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.

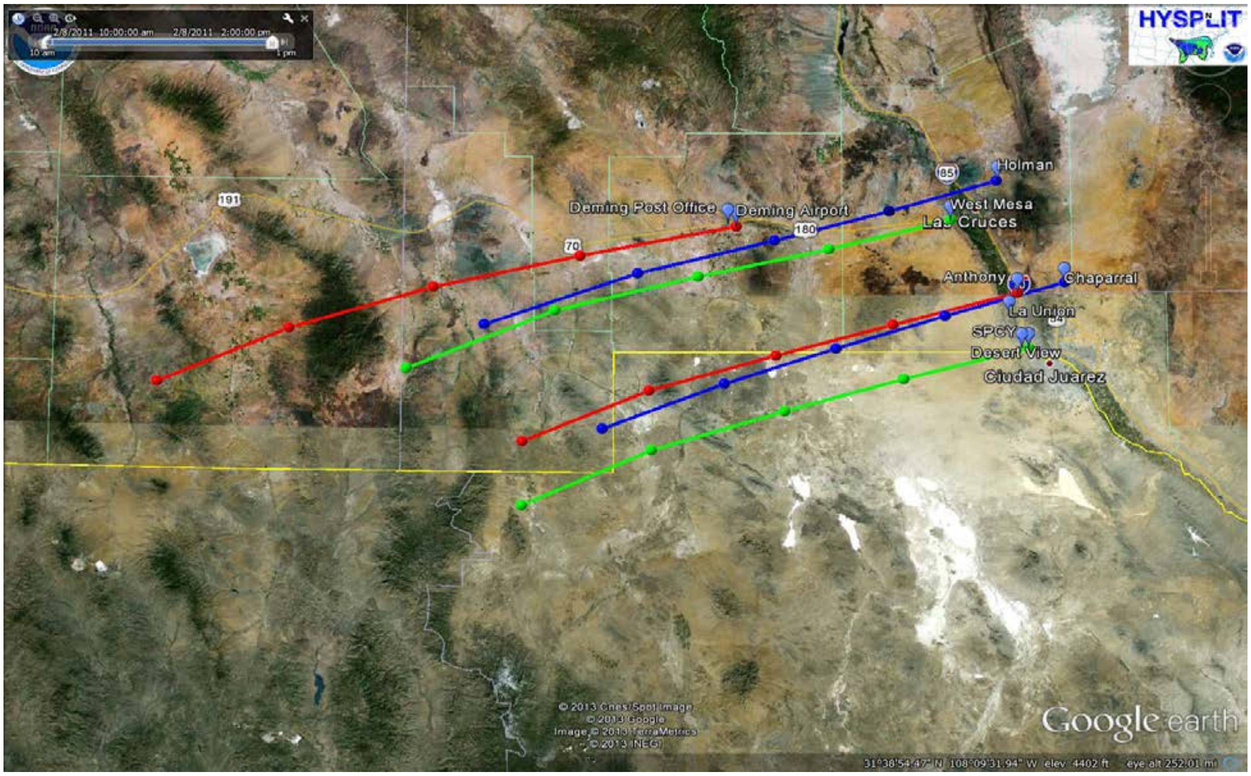

Figure 4-5. HYSPLIT back-trajectory model analysis for February 8, 2011.

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-4 through B-11). 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 2006-2010 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.

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Table B-1 and B-2 show normal historical fluctuations with and without high wind natural events that caused exceedances from 2006-2010. 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 2006-2010. The recorded value for this day (253, 181, 223, and 422 µg/m^3) are above the maximum value recorded when no high wind exceedances are included and is above the 95th 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 8, 2011 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-e through 4-8a-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.

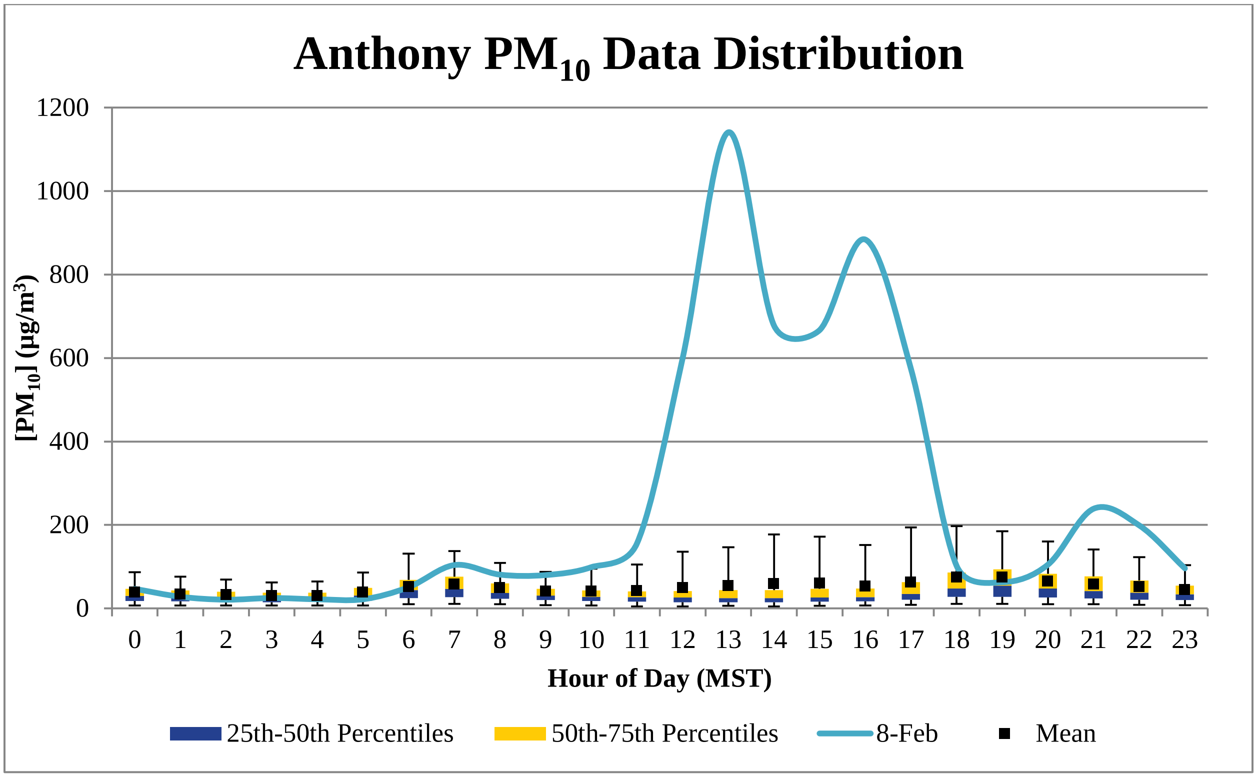

Figure 4-6a. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for February 8, 2011.

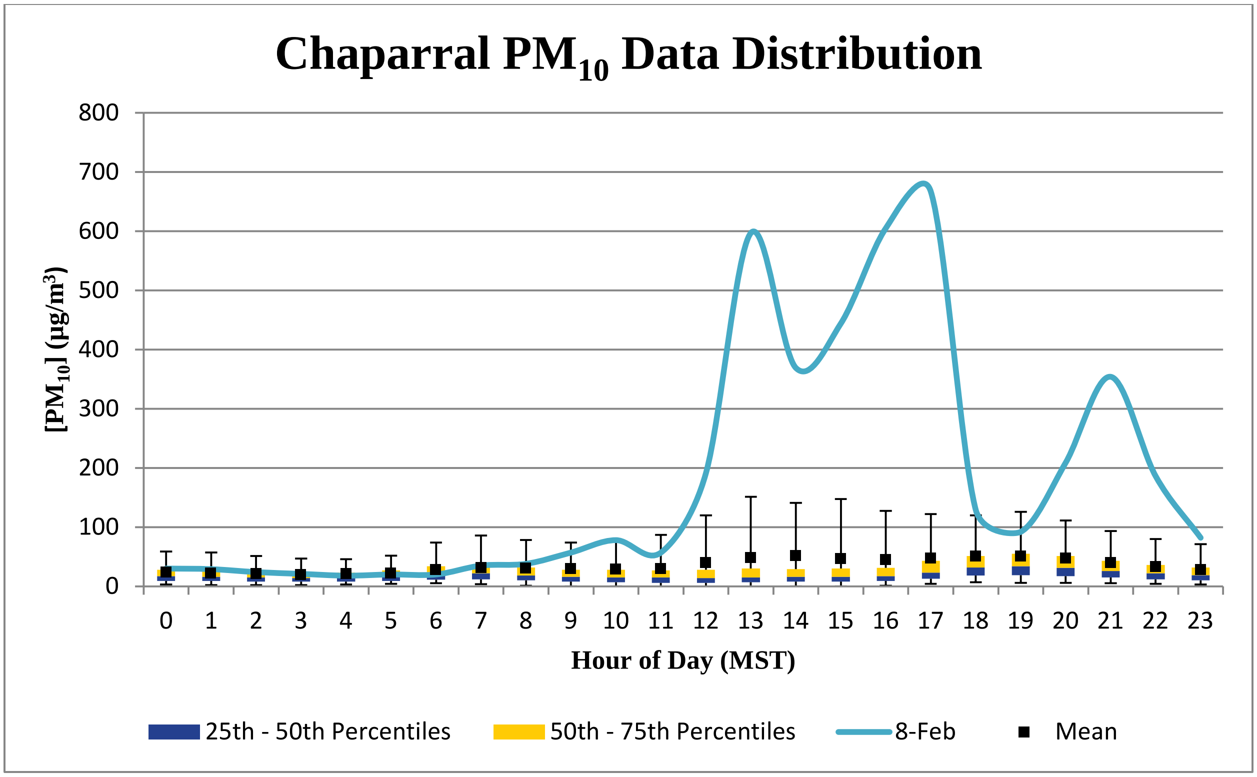

Figure 4-6b. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for February 8, 2011.

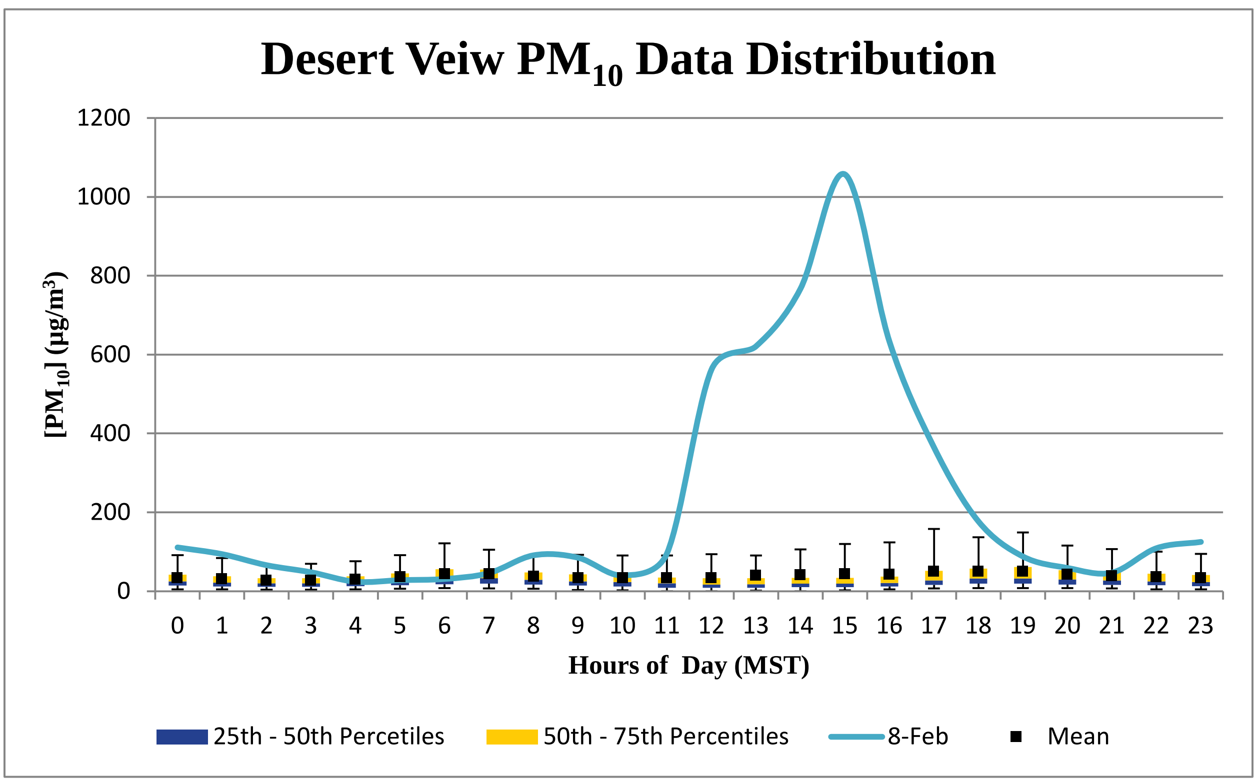

Figure 4-6c. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for February 8, 2011.

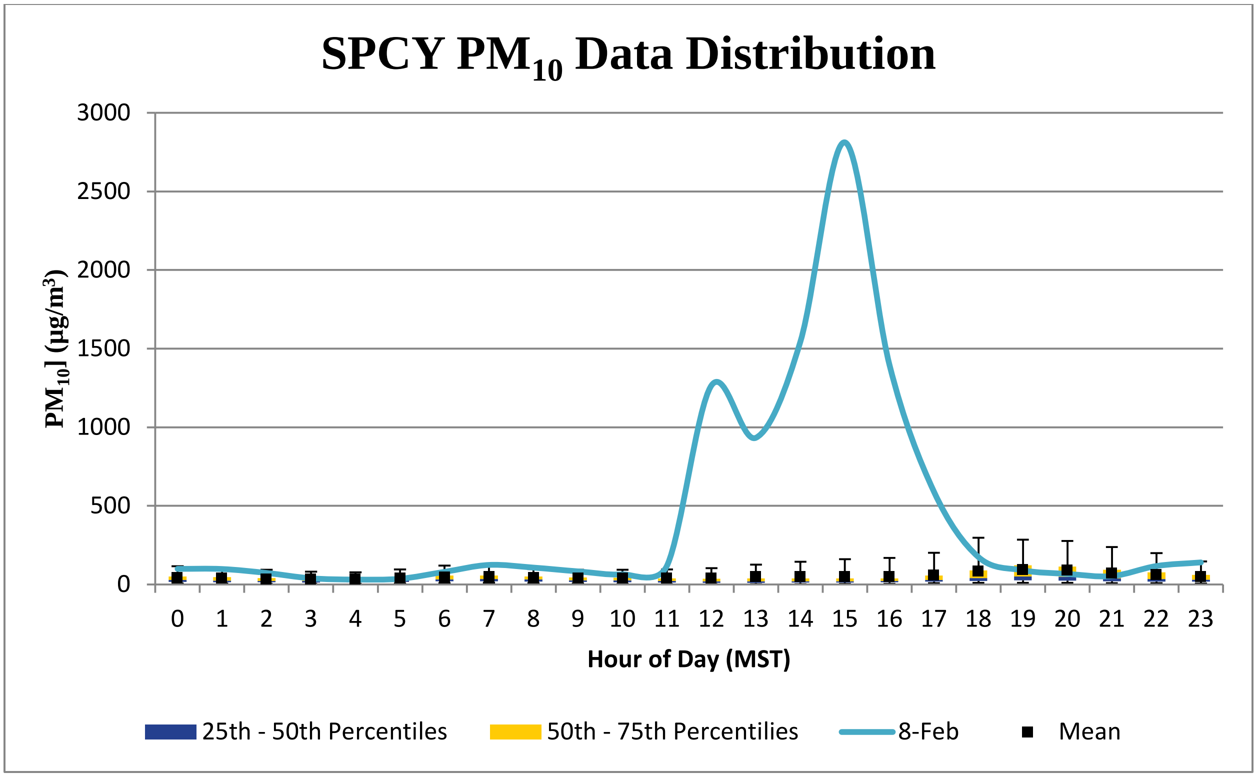

Figure 4-6d. PM$_{10}$ hourly data distribution from 2006-2010 overlaid by hourly values for February 8, 2011.

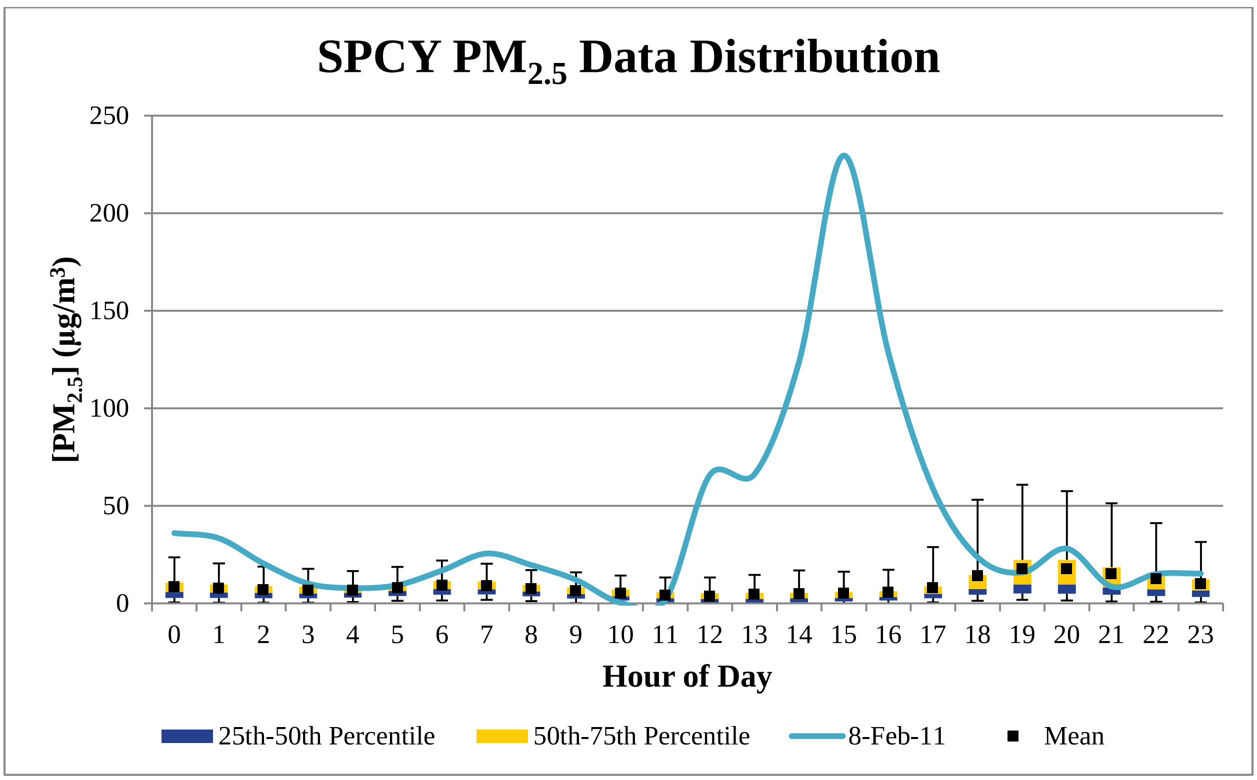

Figure 4-6e. PM$_{2.5}$ hourly data distribution from 2006-2010 overlaid by hourly values for February 8, 2011.

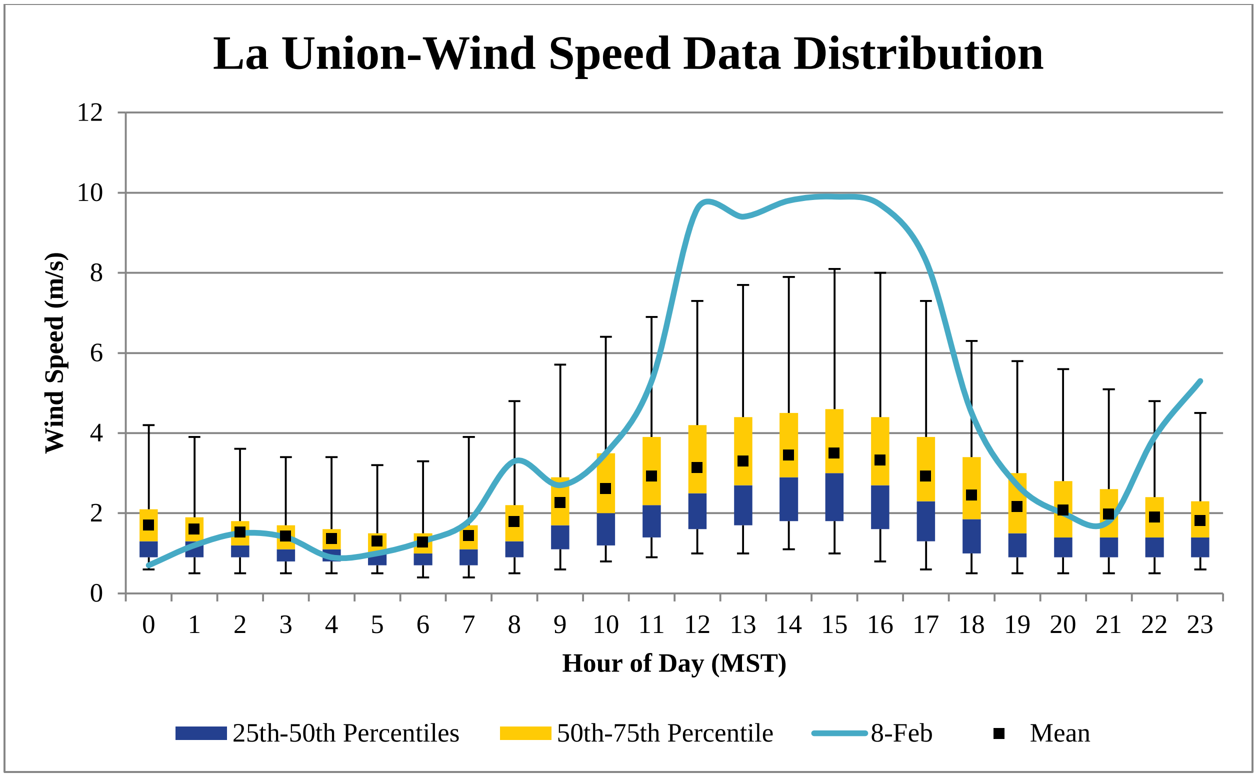

Figure 4-7a. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for February 8, 2011.

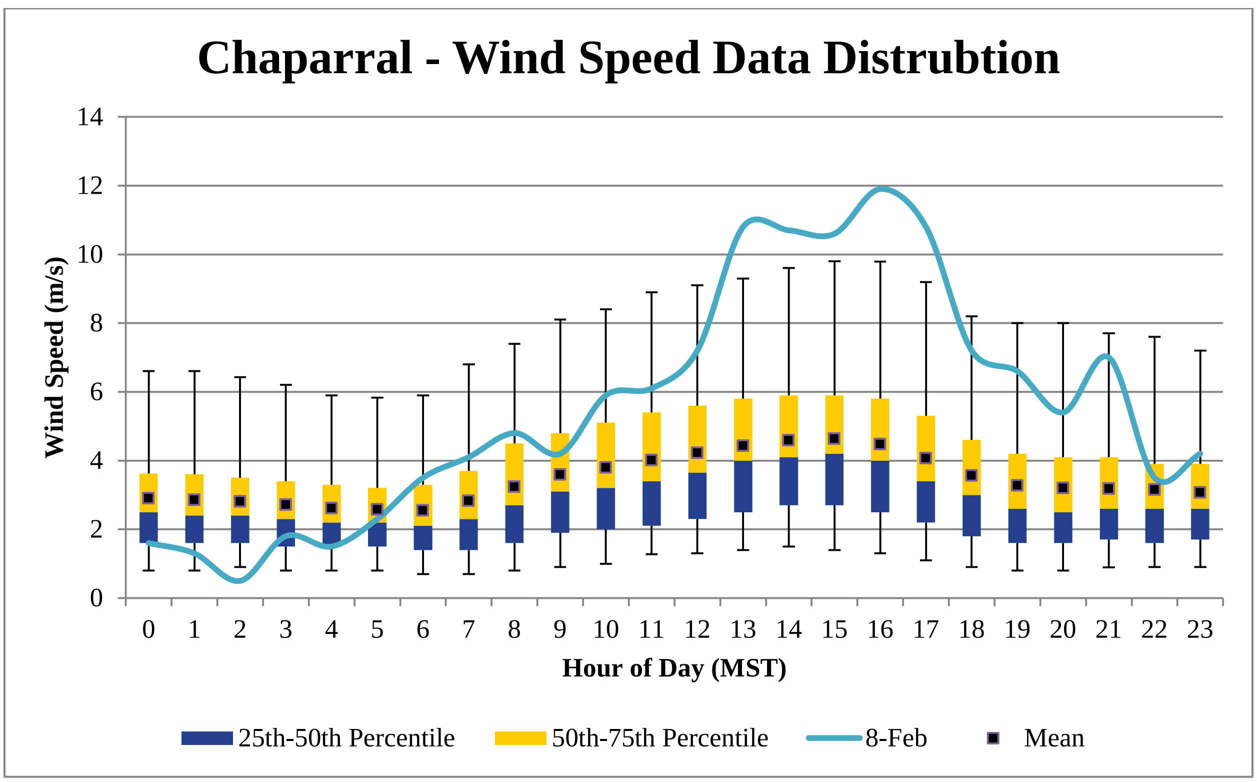

Figure 4-7b. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for February 8, 2011.

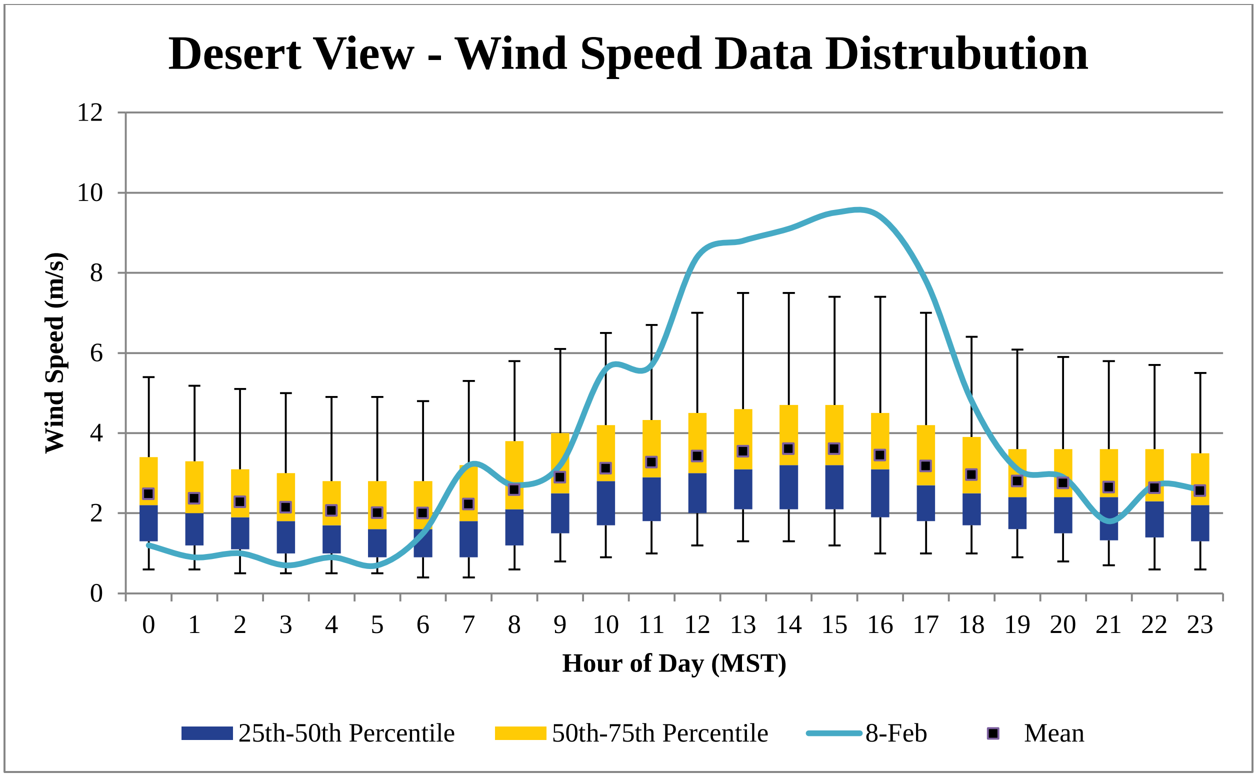

Figure 4-7c. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for February 8, 2011.

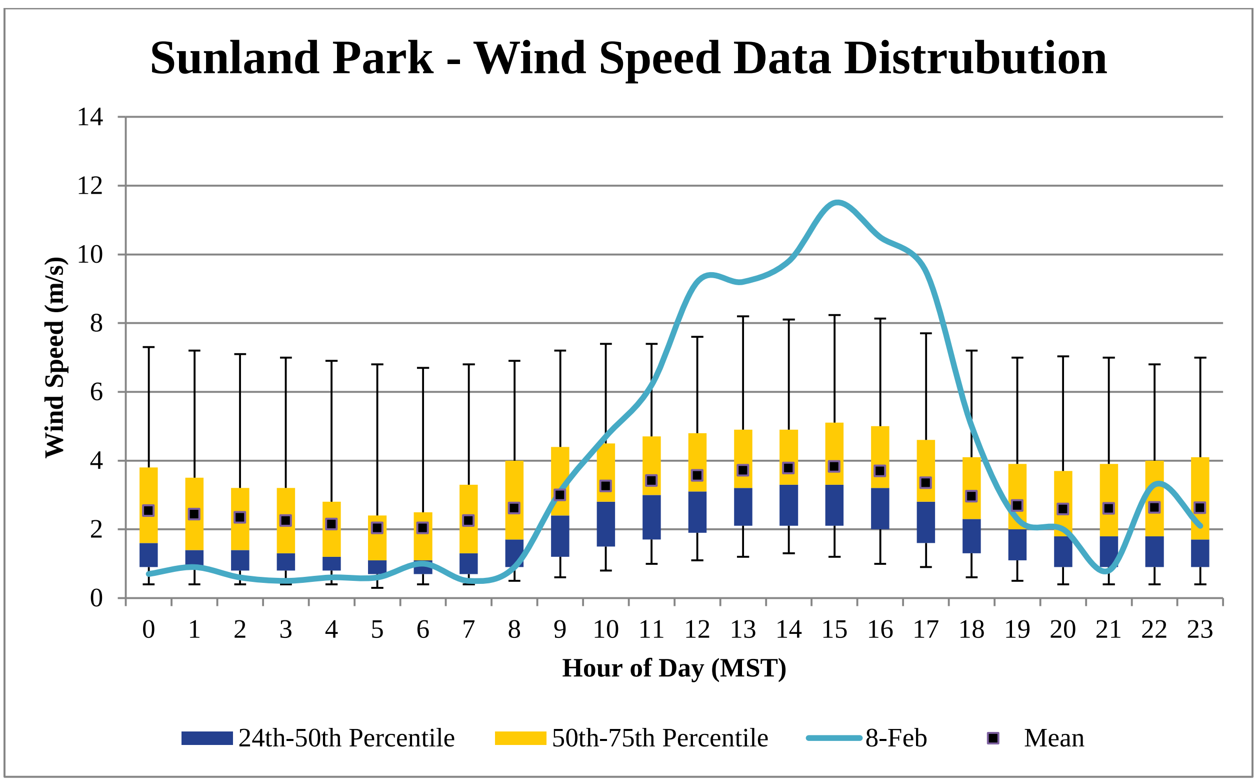

Figure 4-7d. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for February 8, 2011.

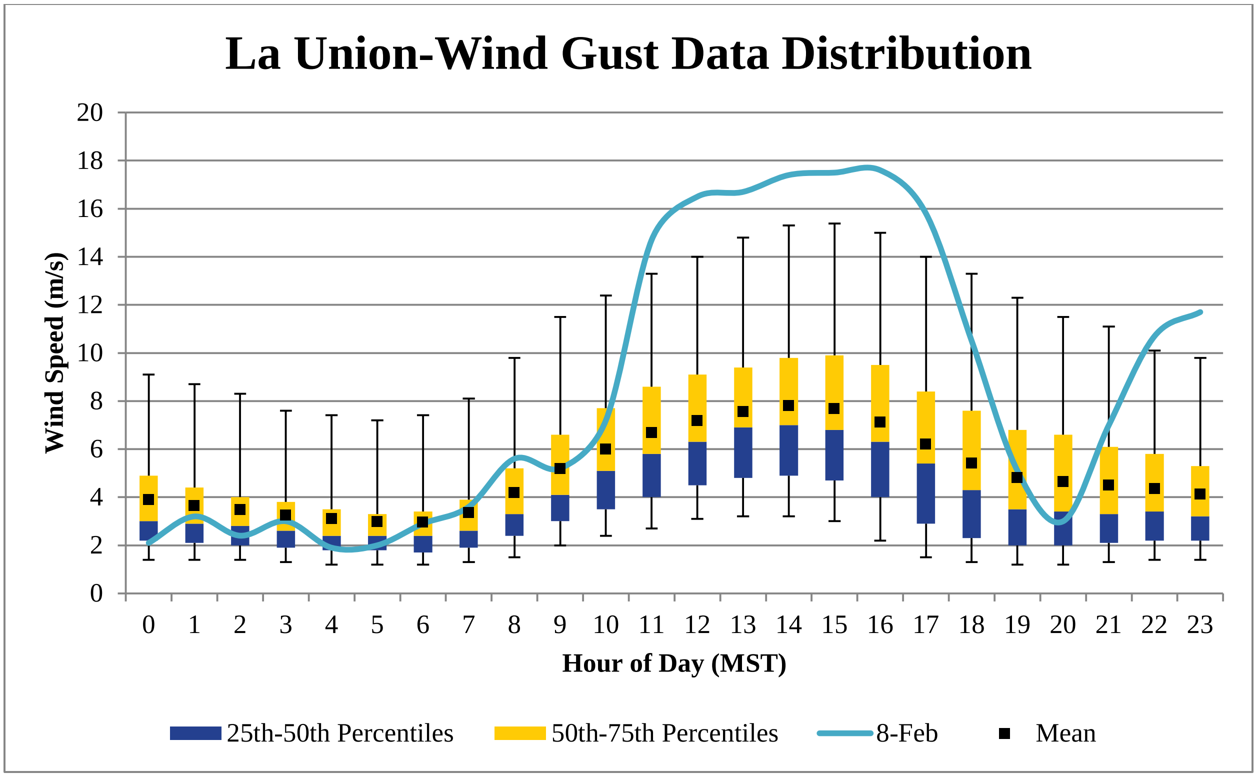

Figure 4-8a. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for February 8, 2011.

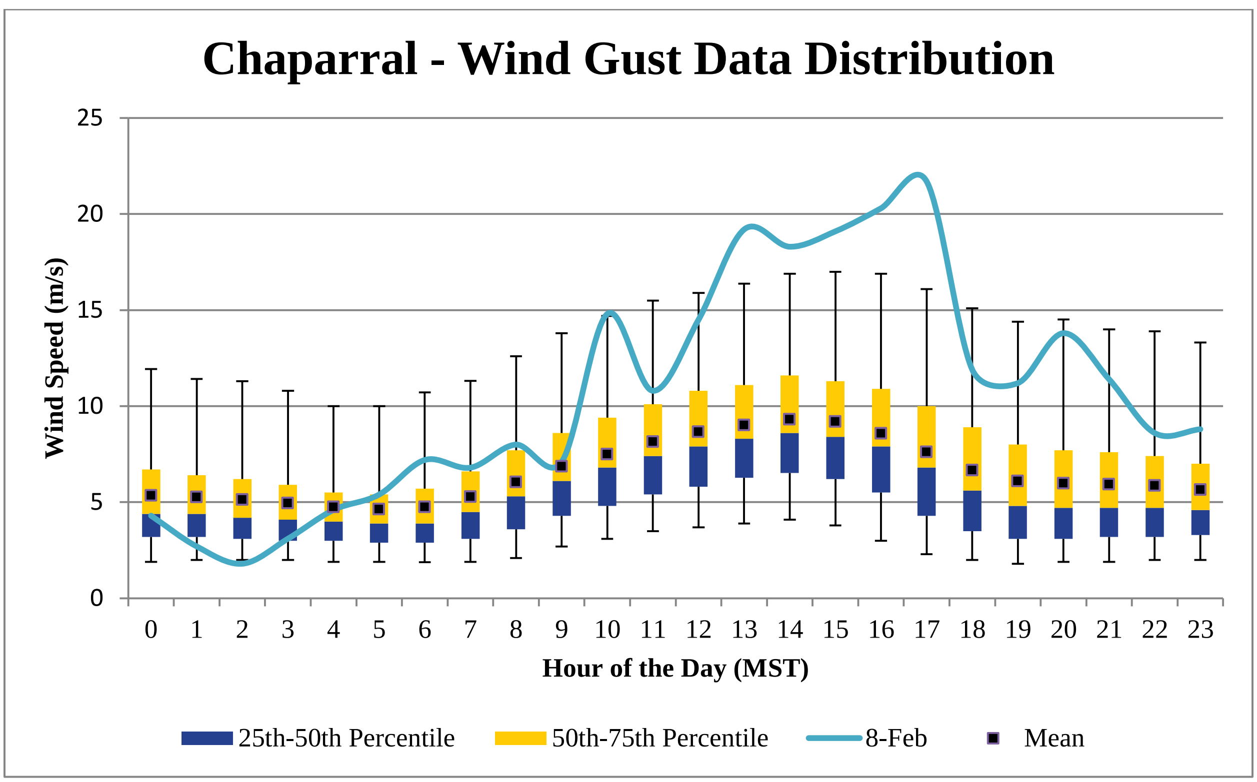

Figure 4-8b. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for February 8, 2011.

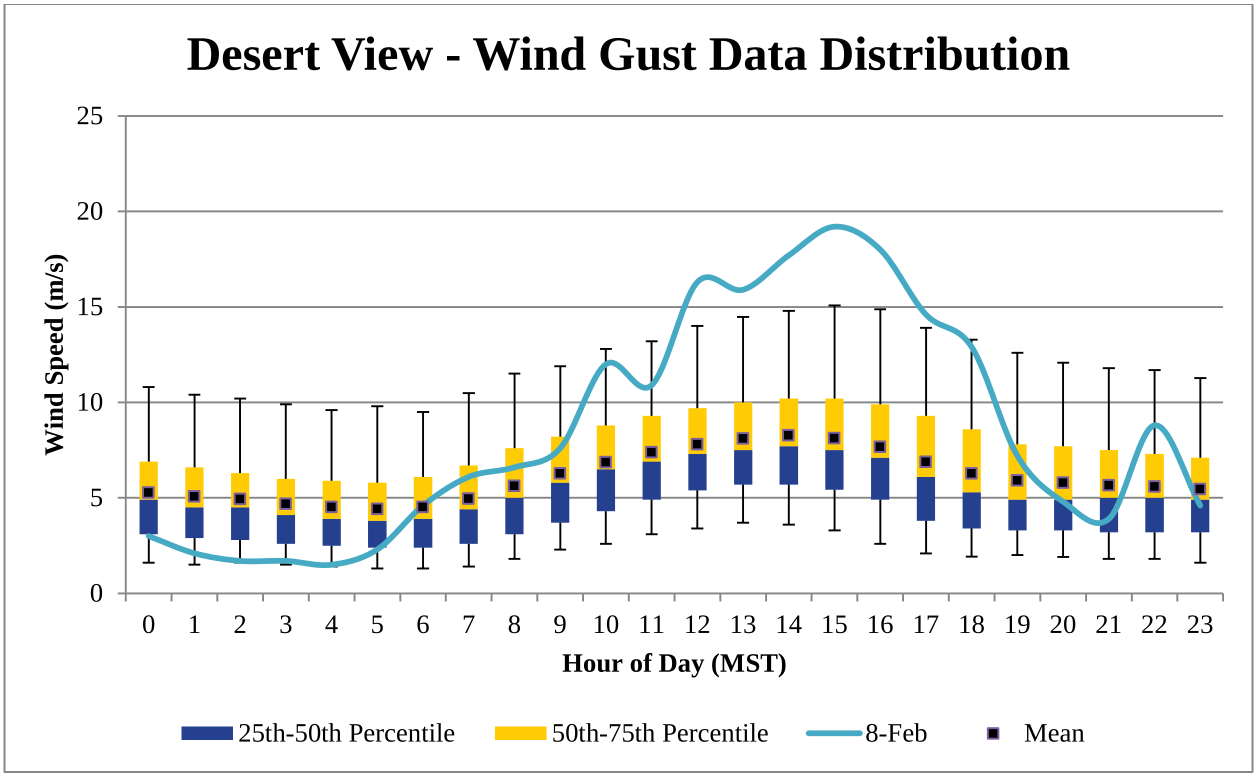

Figure 4-8c. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for February 8, 2011.

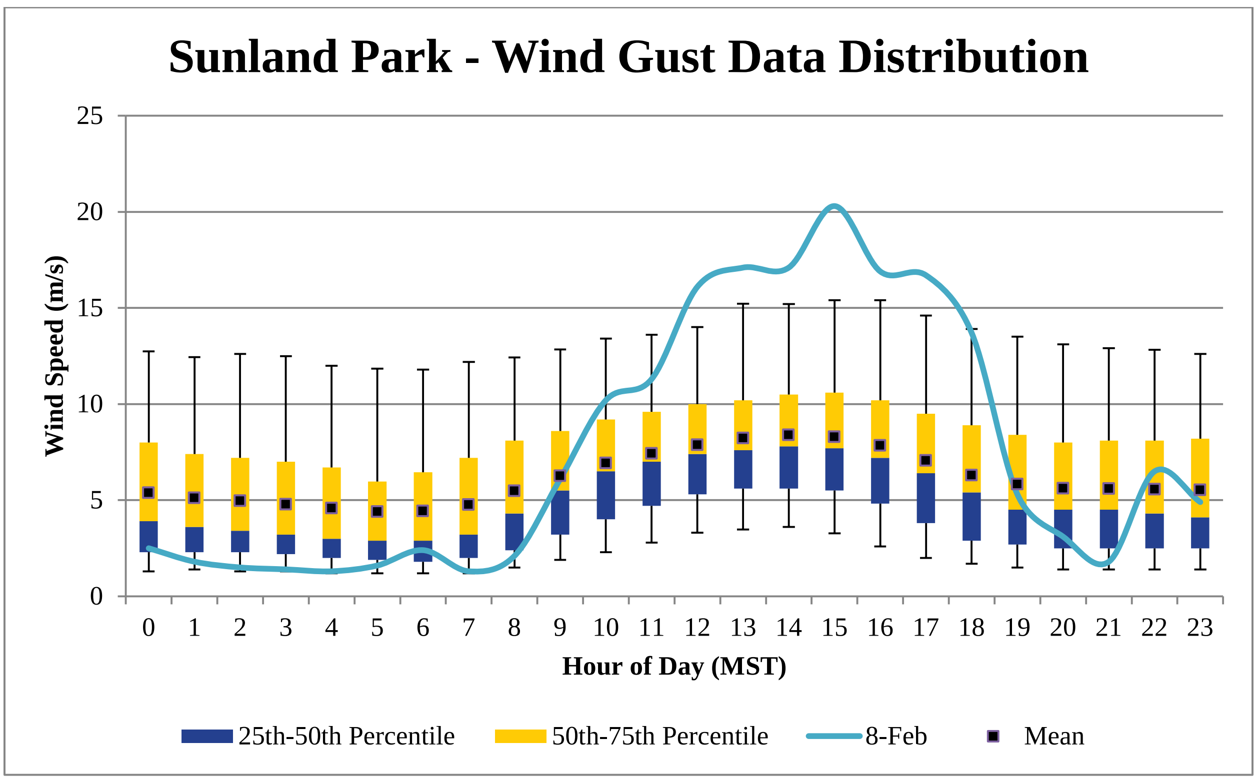

Figure4-8d. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for February 8, 2011.

4.4 Clear Causal Relationship

A Pacific cold front and a backdoor cold front passed through New Mexico on February 8, 2011. The arrival of the cold fronts created a low pressure center in southern New Mexico creating a pressure gradient over south central New Mexico, west Texas and northern Mexico. As the cold fronts converged on south central New Mexico, the pressure gradient tightened and winds became even stronger at the surface (Figure 4-9). Surface winds flow perpendicular to the isobars from high to low pressure. 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.

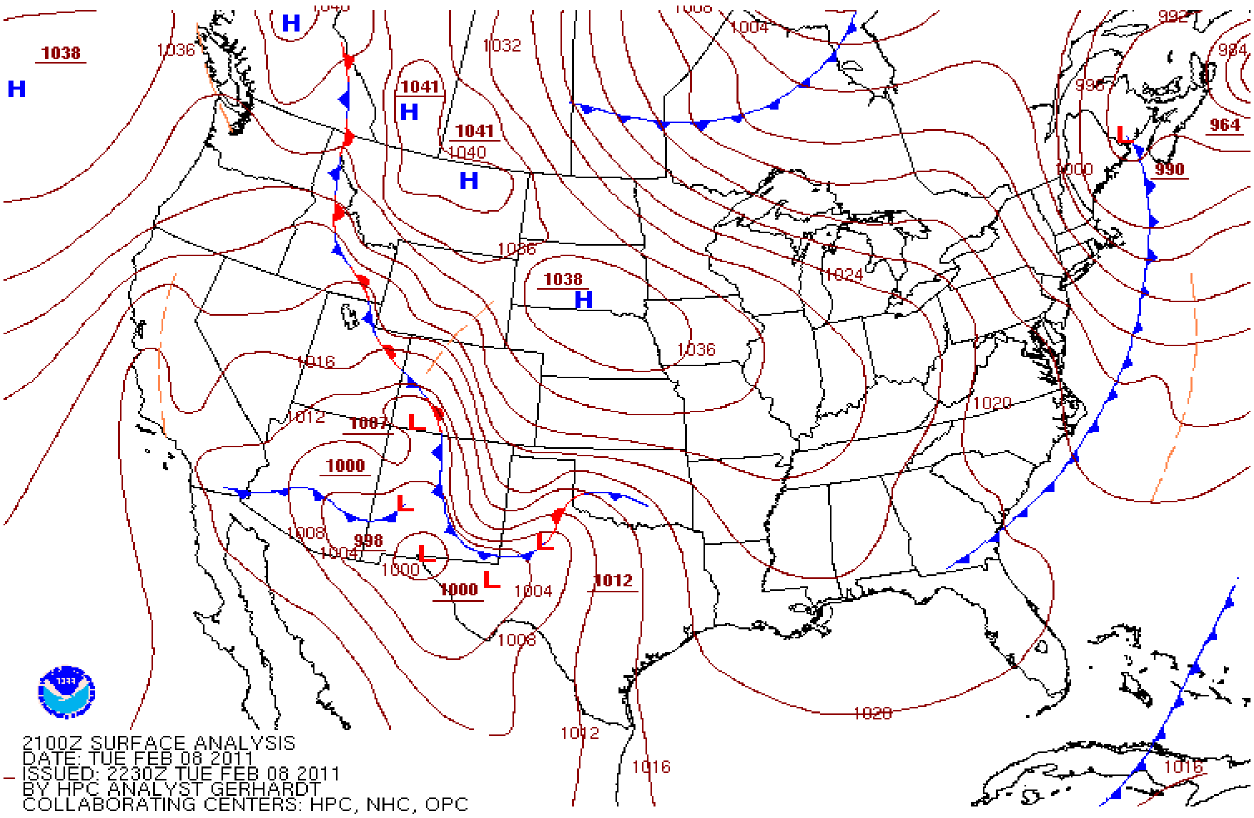

Figure 4-9. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for February 8, 2011at the 1400 MST hour.

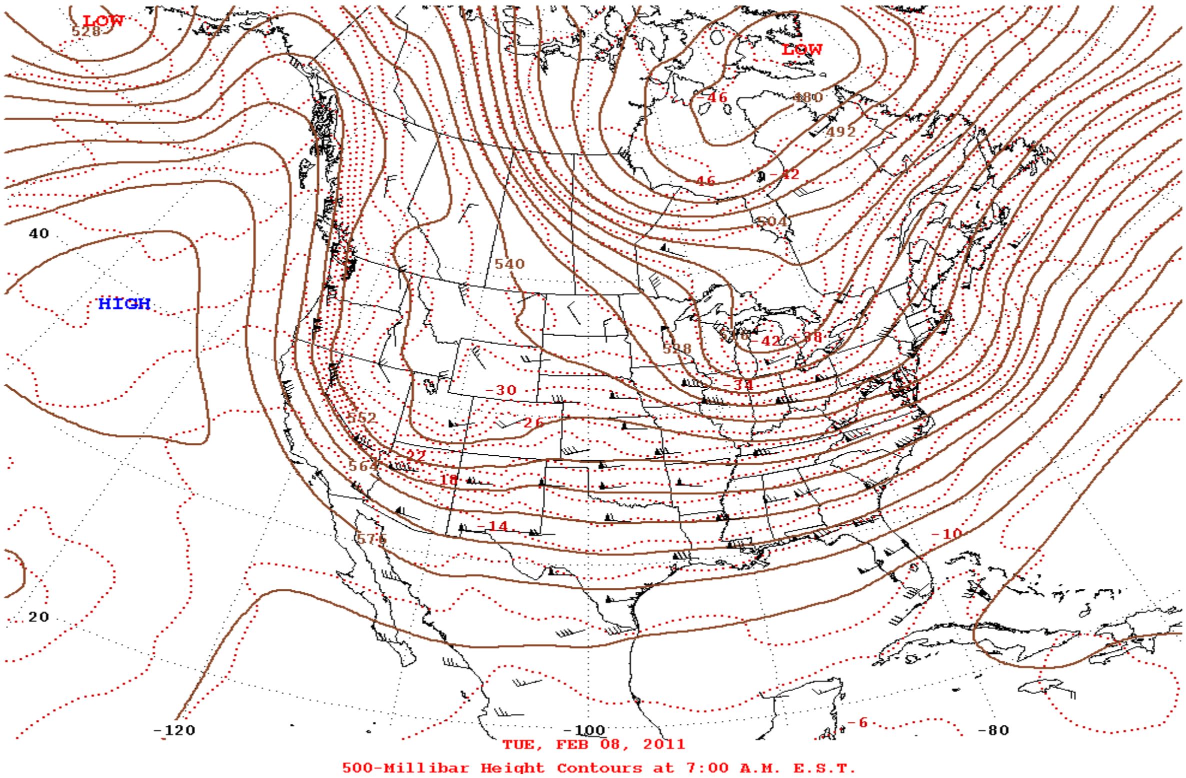

Figure 4-10. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on February 8, 2011.

The weather pattern described above generated strong southwest winds beginning at the 1130 hour and lasting through the 1730 hour. Beginning at the 1130 hour, wind speeds exceeded the historical 95th percentile of data at La Union site as shown in Figure 4-7a. Peak wind speeds ranged from 11.5 m/s at SPCY to 12.8 m/s at Deming (Figure 4-2). Peak wind gusts ranged from 18.3 m/s Chaparral to 21.9 m/s at Deming (Figure 4-3). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figures 4-11a-d. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (1130-1730 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 4-12a-b). 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).

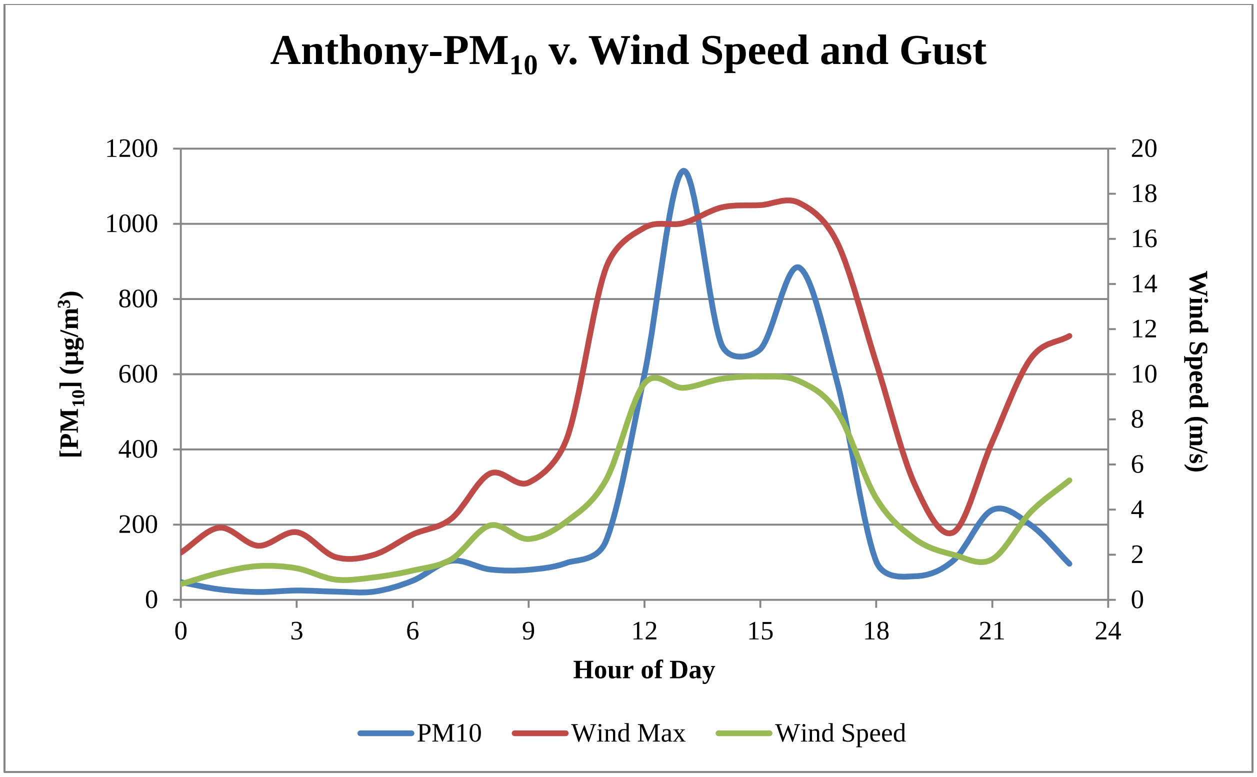

Figure 4-11a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

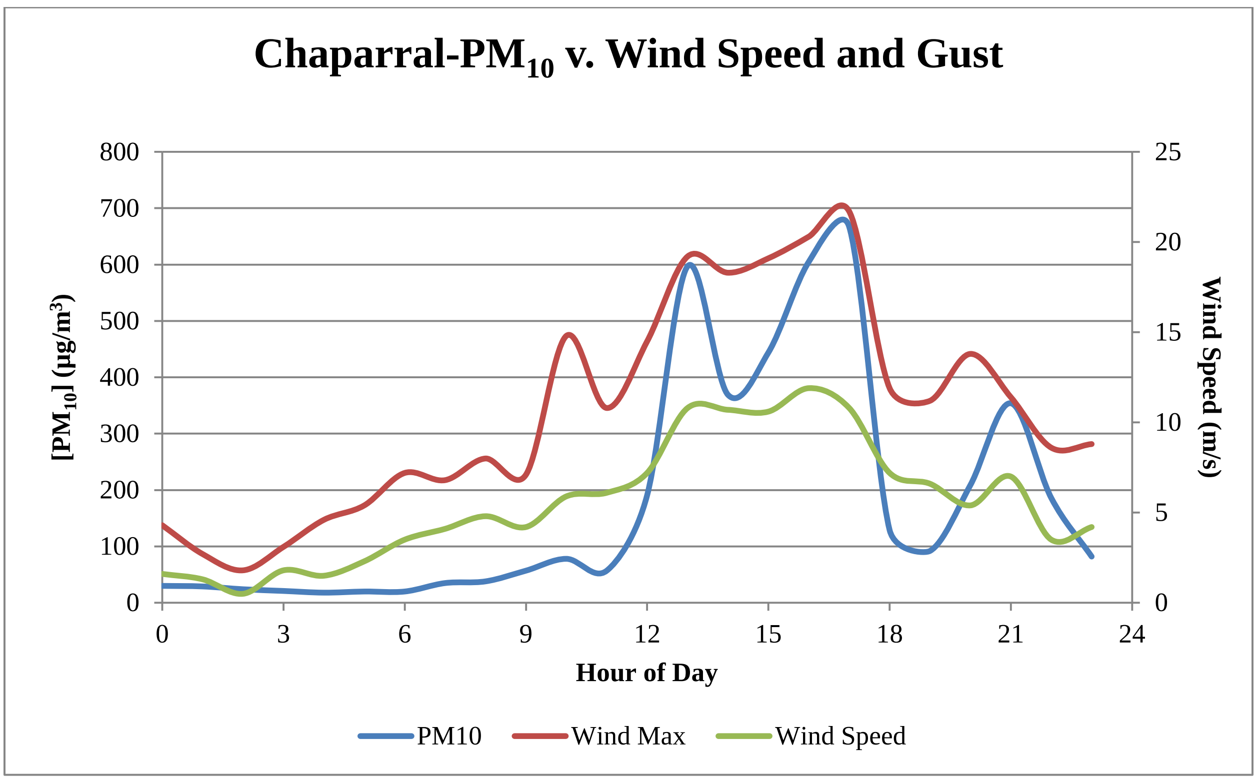

Figure 4-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

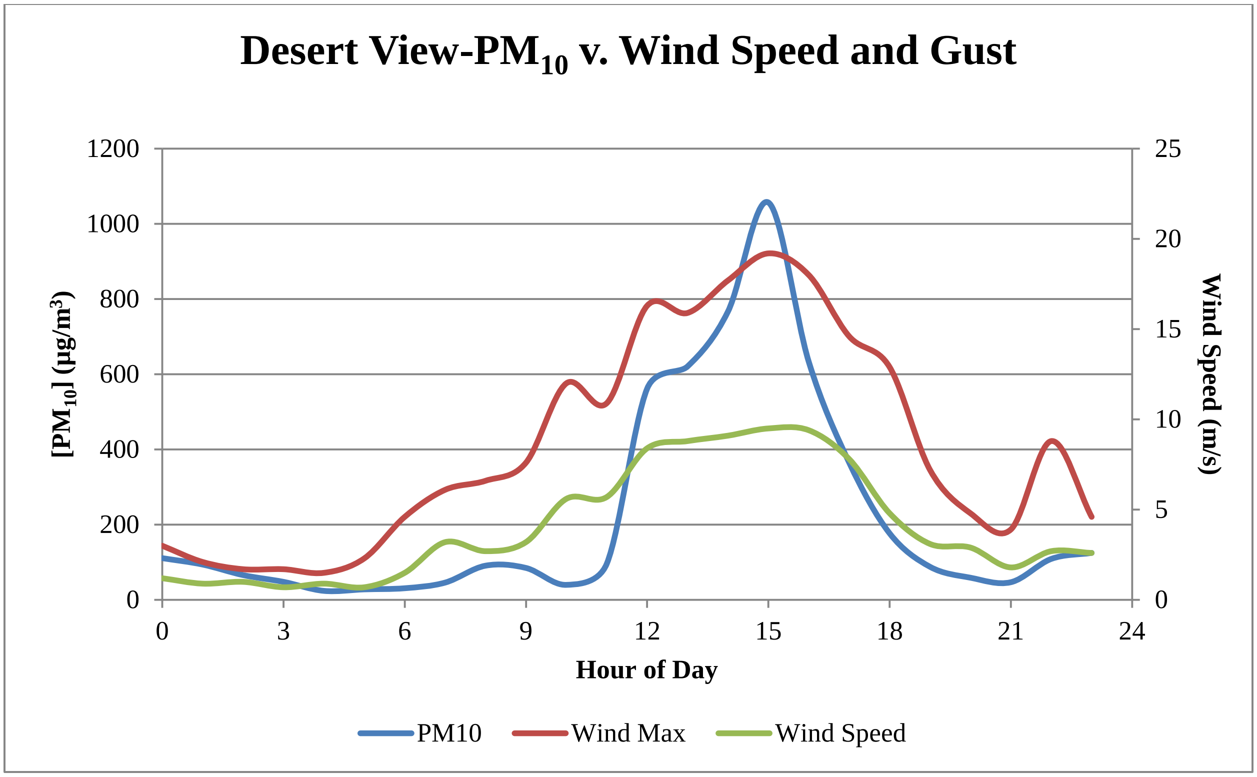

Figure 4-11c. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

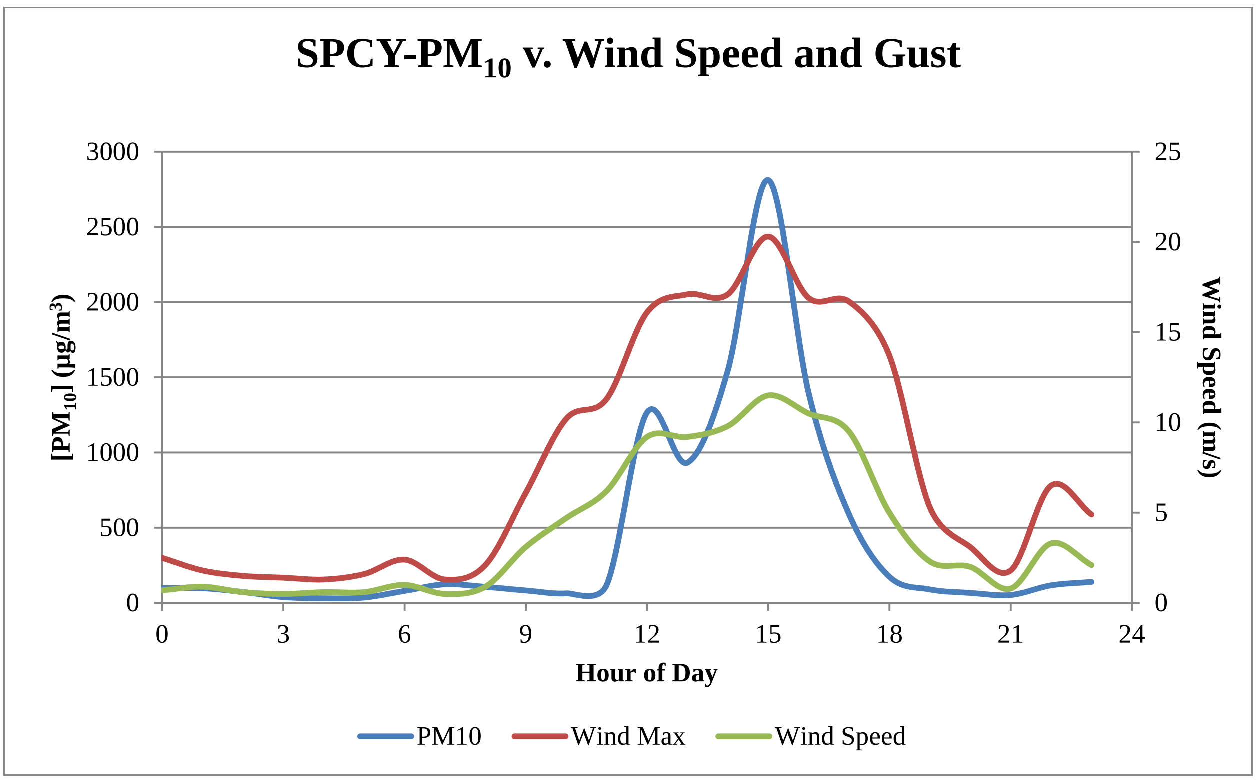

Figure 4-11d. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

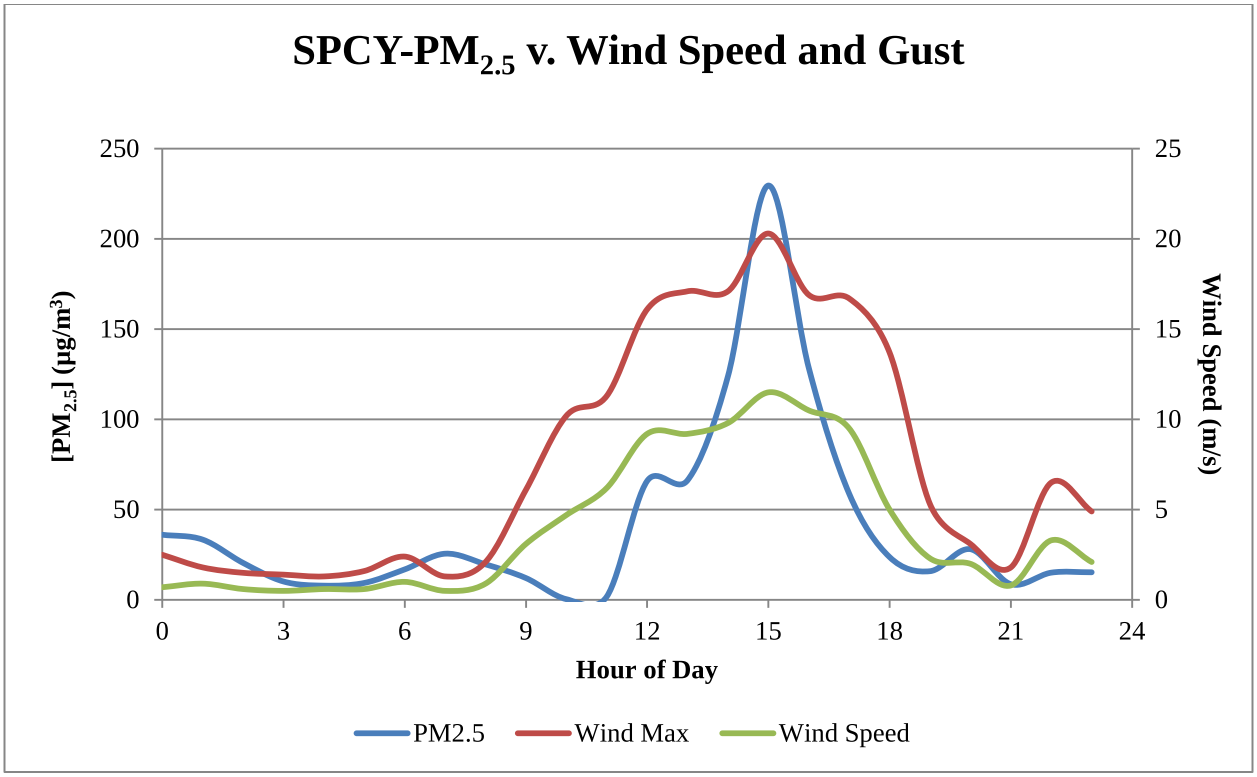

Figure 4-11e. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

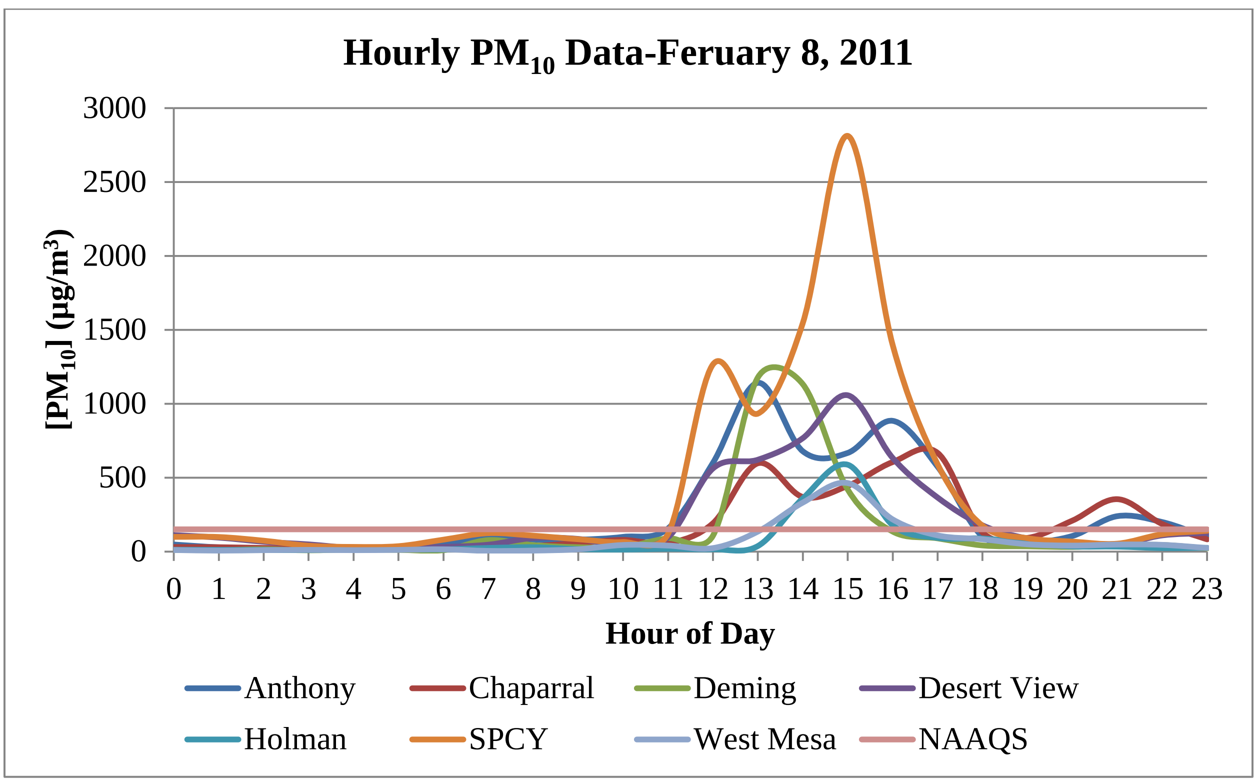

Figure 4-12a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

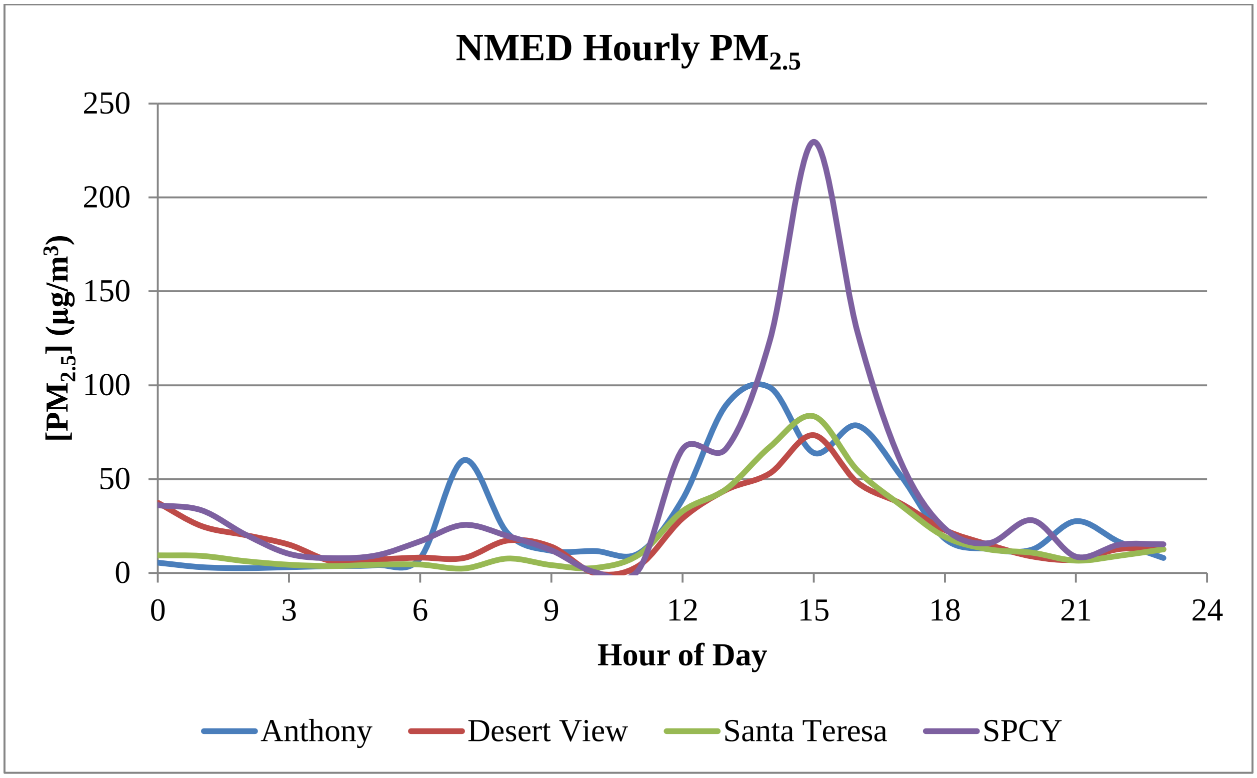

Figure 4-12b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors. Non-FEM hourly $PM_{2.5}$ data.

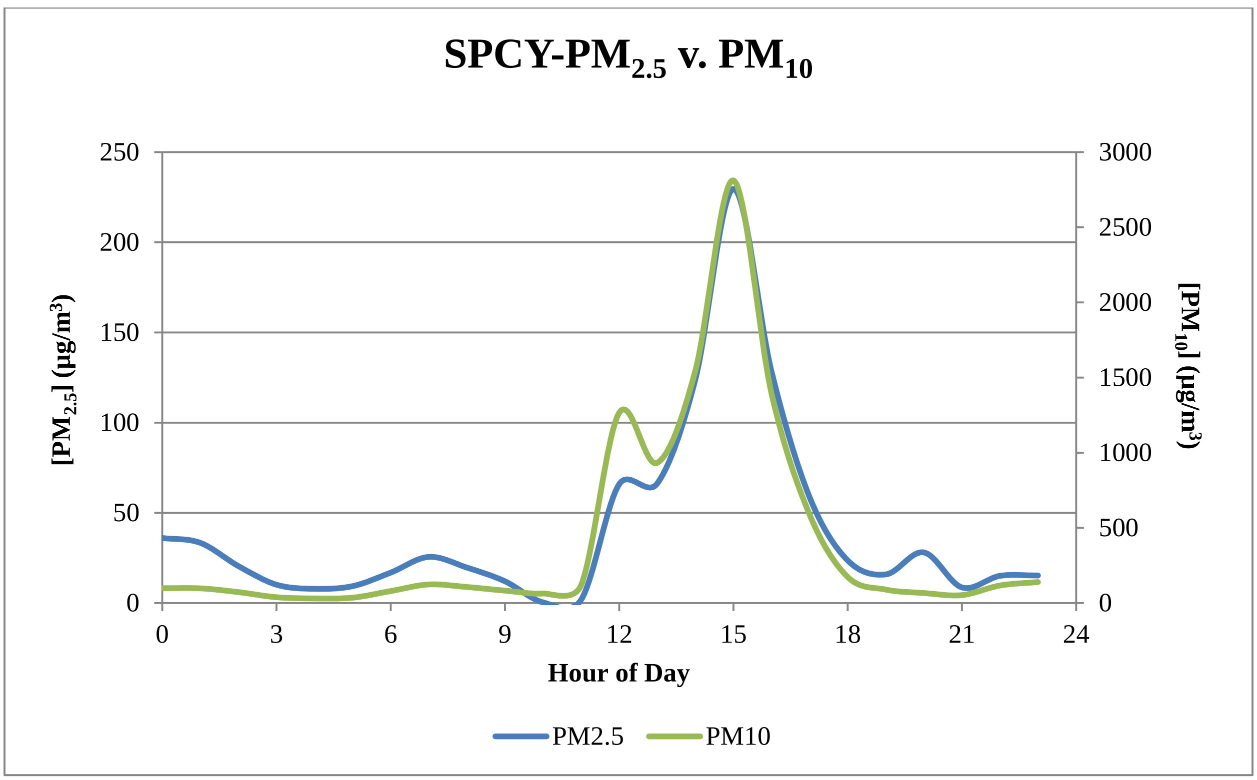

Figure 4-13. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on February 8, 2011.

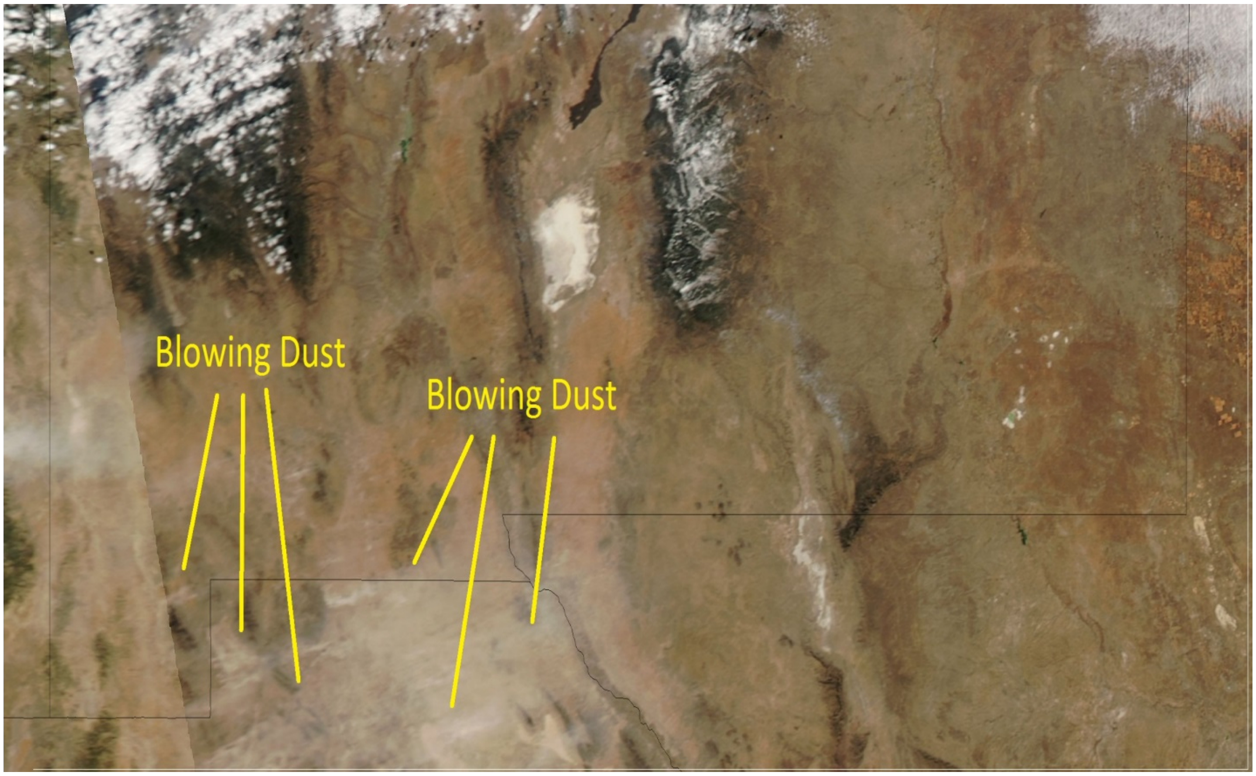

Figure 4-14. Satellite imagery showing blowing dust and dust plumes. Image courtesy of NASA.

The New Mexico AQ Border blog noted that, “High wind dust day occurred this afternoon after a low wind high PM event in the morning. Below is a surface wind forecast for 21 UTC (2 pm) showing widespread high westerly winds” (DuBois, 2011).

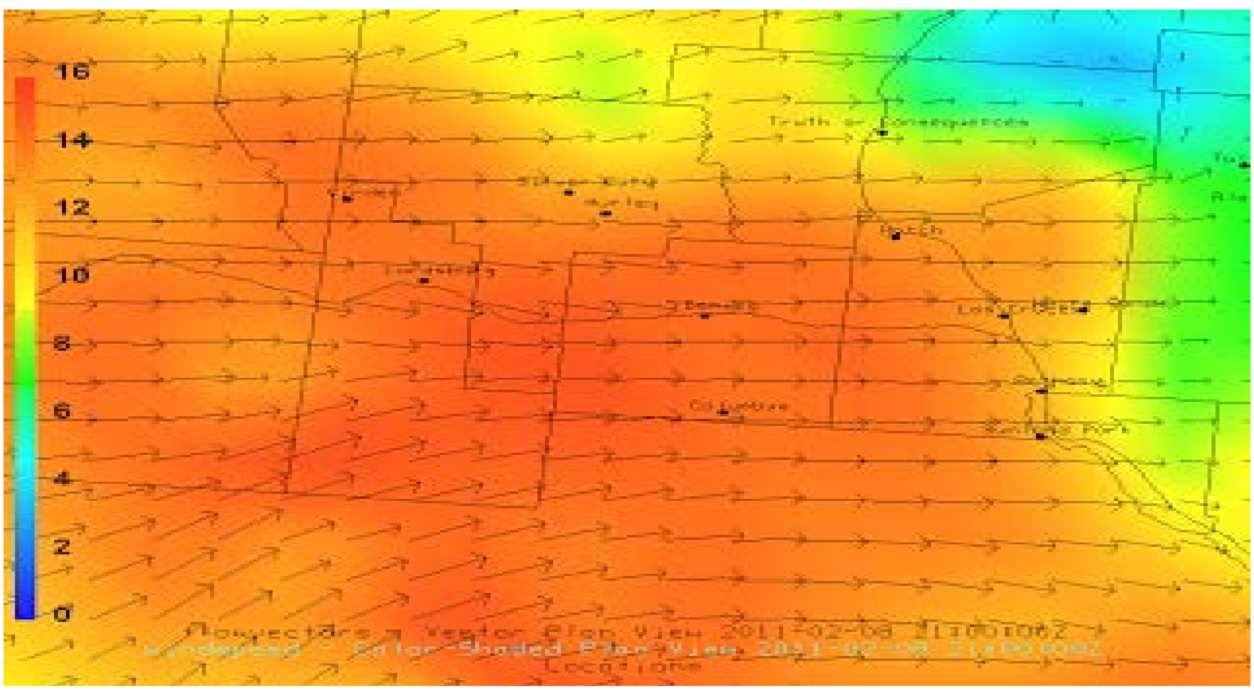

Figure 4-15. Rapid Update Cycle (RUC) wind forecast for 1400 hour on February 8, 2011. (Courtesy of NOAA).

The blog continued to note that the NWS forecast for Las Cruces was "Areas of blowing dust after 11am. Mostly sunny, with a high near 68. Windy, with a southwest wind 11 to 14 mph increasing to between 30 and 33 mph. Winds could gust as high as 45 mph. I'm already seeing the short wave energy in the high upper level winds at the Deming profiler. We have 50 knot (58 mph) winds at 2.5 km" (DuBois, 2011).

4.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on February 8, 2011.

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 Anthony monitor detected blowing dust around the 1100 hour with hourly concentrations heavily impacted until the 1700 hour. The seven hourly PM_{10} values from 1100-1700 hours alone, exceed the 24-hour average standard at Anthony [(156 + 600 + 1141 + 678 + 667 + 884 + 574) µg/m^3 = 4700 µg/m^3; (4700 µg/m^3)/24 = 196 µg/m^3]. By replacing these seven hourly values with the 95th percentile of hourly data at the Anthony site, the resulting 24-hour average (96 µg/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	47	47
1	28	28
2	21	21
3	25	25
4	22	22
5	22	22
6	51	51
7	104	104
8	81	81
9	80	80
10	99	99
11	156	**106**
12	600	**136**
13	1141	**146**
14	678	**177**
15	667	**172**
16	884	**152**
17	574	**194**
18	102	102
19	63	63
20	105	105
21	239	141
22	199	123
23	96	96
24-Hour Average	254	**96**

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 Chaparral monitor detected blowing dust around the 1200 hour with hourly concentrations heavily impacted until the 1700 hour. The six hourly PM10 values from 1200-1700 hours alone, nearly exceed the 24-hour average standard at Chaparral accounting for 80 percent of the 24 hour average [(191+597+369+444+605+667µg/m3 = 2873 µg/m3; (2873 µg/m3)/24 = 119 µg/m3]. These values alone did not exceed the average standard. By replacing these six hourly values with the 95th percentile of hourly data at the Chaparral site, the resulting 24-hour average (77 µg/m3) does not exceed the NAAQS (Table 4-2). 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	30	30
1	29	29
2	24	24
3	21	21
4	18	18
5	20	20
6	20	20
7	35	35
8	38	38
9	57	57
10	78	78
11	57	57
12	191	**120**
13	597	**151**
14	369	**141**
15	444	**147**
16	605	**127**
17	667	**122**
18	129	129
19	92	92
20	209	209
21	354	354
22	186	186
23	82	82
24-Hour Average	181	77

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 Chaparral.

The Desert View monitor detected blowing dust around the 1200hour with hourly concentrations heavily impacted until the 1800 hour. The seven hourly PM_{10} values from 1200-1800 hours alone, exceed the 24-hour average standard at Desert View [(562 + 621 + 767 + 1057 + 633 + 365 + 177) µg/m3 = 4182 µg/m3; (4700 µg/m3)/24 = 174 µg/m3]. By replacing these seven hourly values with the 95th percentile of hourly data at the Desert View site, the resulting 24-hour average (84 µg/m3) does not exceed the NAAQS (Table 4-3). 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	111	111
1	94	94
2	66	66
3	48	48
4	24	24
5	28	28
6	31	31
7	46	46
8	91	91
9	85	85
10	40	40
11	96	96
12	562	**94**
13	621	**91**
14	767	**106**
15	1057	**119**
16	633	**124**
17	365	**158**
18	177	**137**
19	88	88
20	59	59
21	47	47
22	109	109
23	125	125
24-Hour Average	223	**84**

Table 4-3. 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 1200hour with hourly concentrations heavily impacted until the 1800 hour. The seven hourly PM_{10} values from 1200-1800 hours alone, exceed the 24-hour average standard at SPCY [(1266+ 933 + 1546 + 2812 + 1397 + 590 + 174) µg/m3 = 8717 µg/m3; (4700 µg/m3)/24 = 363 µg/m3]. By replacing these seven hourly values with the 95th percentile of hourly data at the SPCY site, the resulting 24-hour average (96 µg/m3) does not exceed the NAAQS (Table 4-4). 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	99	99
1	98	98
2	73	73
3	39	39
4	31	31
5	36	36
6	80	80
7	124	124
8	107	107
9	83	83
10	64	64
11	119	119
12	1266	**104**
13	933	**125**
14	1546	**145**
15	2812	**160**
16	1397	**168**
17	590	**201**
18	174	**296**
19	90	90
20	67	67
21	53	53
22	54	54
23	49	49
24-Hour Average	422	**96**

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

5 HIGH WIND EXCEPTIONAL EVENT: February 20, 2011

5.1 Summary of Event

The passing of a Pacific cold front caused high winds and blowing dust in southern Doña Ana and Luna Counties resulting in exceedances of the PM_{10} 24-hour NAAQS and the $PM_{2.5}$ annual NAAQS at the Anthony, Deming Airport and SPCY monitoring sites on this date. The FEM TEOM continuous monitors at these sites recorded a 24-hour average concentration of 250 and 170 µg/m^3, respectively. The FRM Partisol at SPCY recorded a 24-hour average of 12.8 µg/m^3. In accordance with the EER, the AQB flagged this data on EPA's AQS database as a high wind natural event. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured at Chaparral (139 µg/m^3) and SPCY (148 µg/m^3) monitoring sites (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.

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} concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

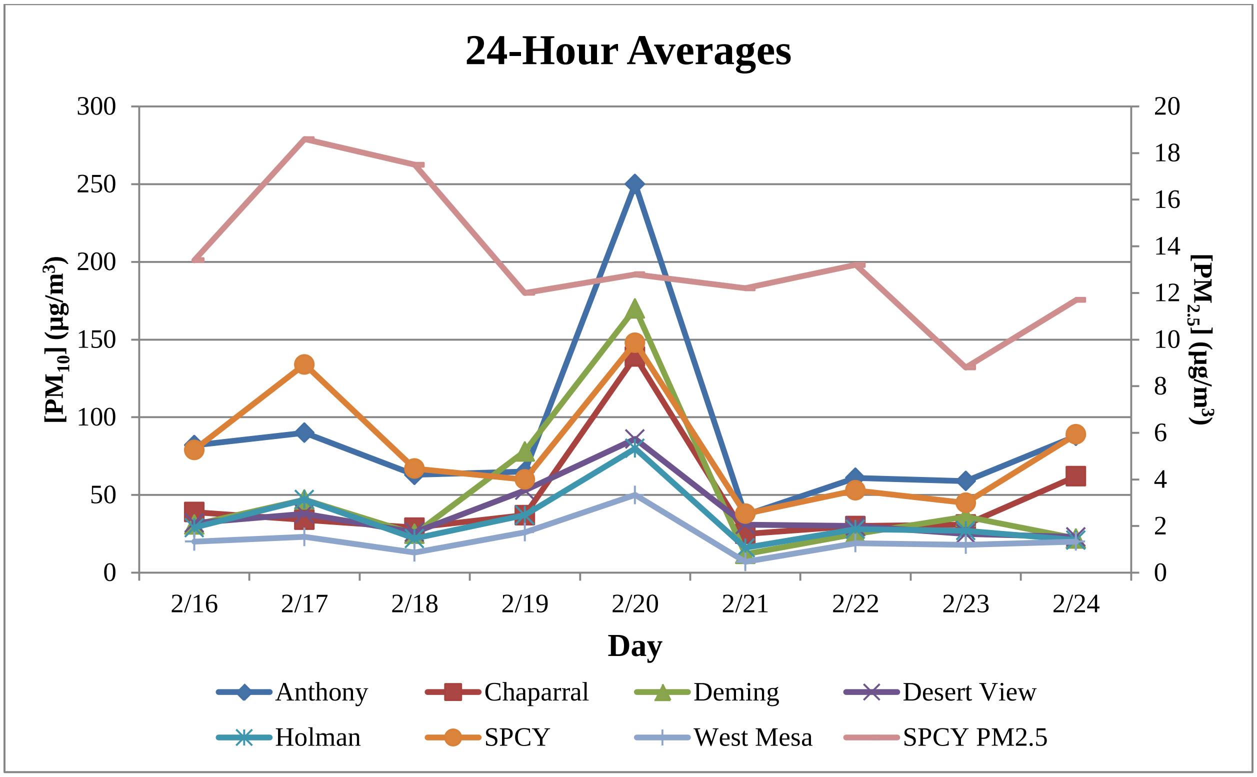

Figure 5-1. PM_{10} and $PM_{2.5}$ 24-hour averages before and after February 20, 2011.

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 Mexico and New Mexico. Agricultural tilling and crop planting may have contributed to this event. The City of Deming, 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 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 20, 2011, sustained wind speeds exceeded EPA's default threshold at two of the seven monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at seven of the seven monitoring sites (Figures 5-2 and 5-3). Winds exceeded these thresholds at one or more monitoring sites beginning at the 1100 hour and ending at the 1600 hour.

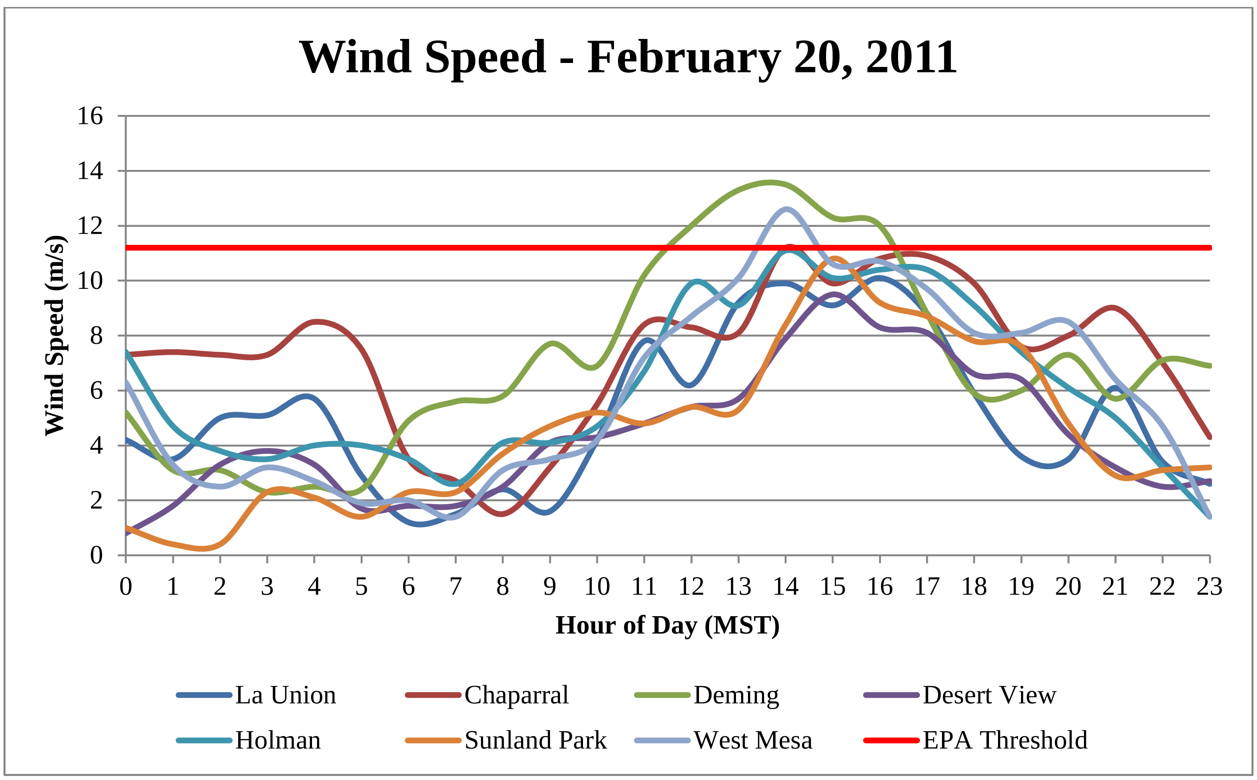

Figure 5-2. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

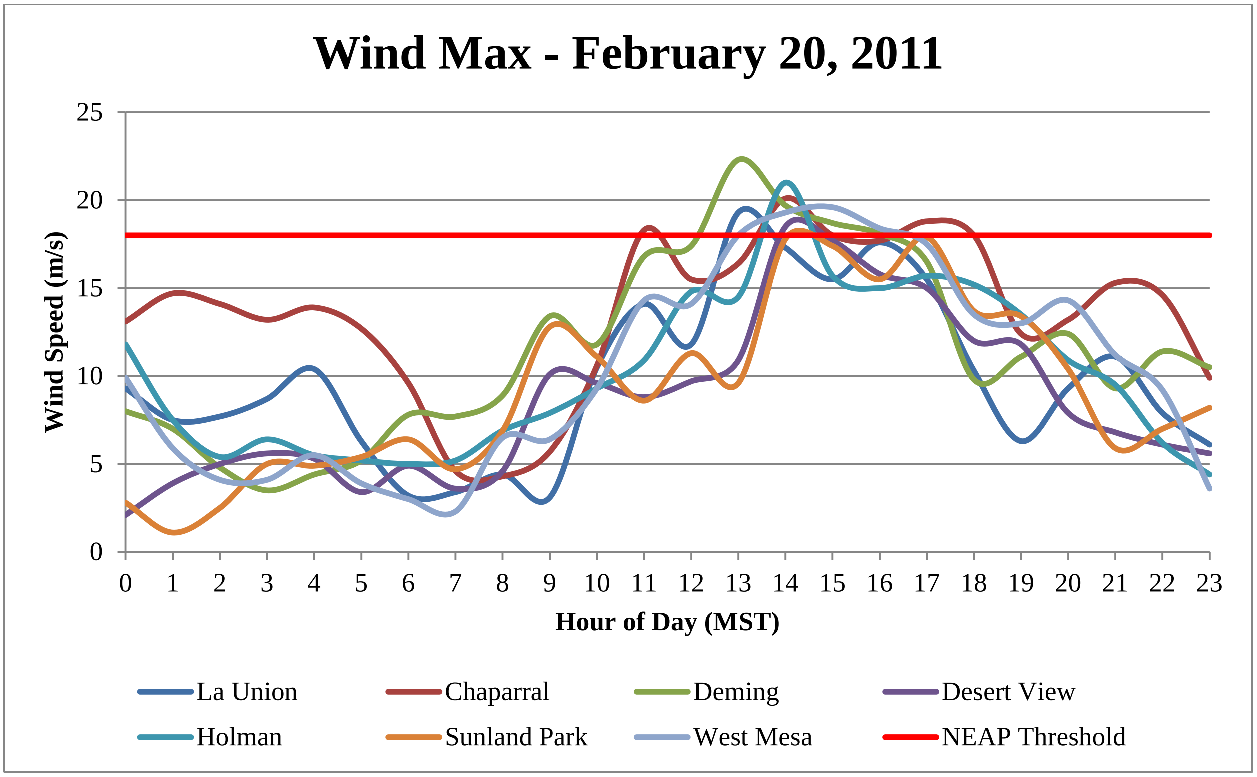

Figure 5-3. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

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 2006-2010 the PM_{10} FEM TEOM monitors recorded 211 exceedances and the PM_{10} FRM Wedding monitors recorded 5 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 (Table 2-1). The SPCY $PM_{2.5}$ FRM Partisol recorded 23 exceedances of the 24-Hour NAAQS from 2006-2010 (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 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 New Mexico 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 5.4).

Costs prohibit controlling dust from the natural desert terrain and falls outside NMED's jurisdiction when it originates in New Mexico and Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

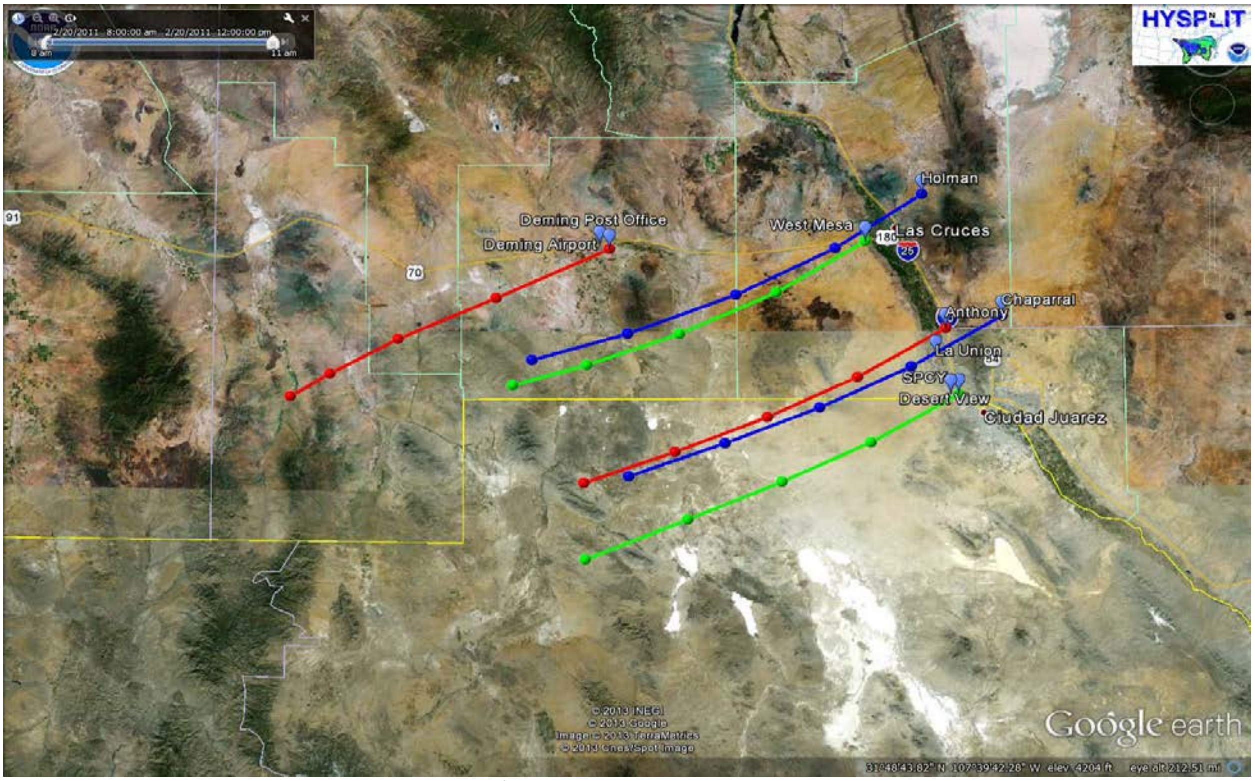

Figure 5-4. HYSPLIT back-trajectory model analysis for February 20, 2011.

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-4 through B-11). 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 2006-2010 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 2006-2010. 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 2006-2010. The recorded values for this day (Anthony-250 and Deming Airport-170 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 20, 2011 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 5-5a-c through 5-7a-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.

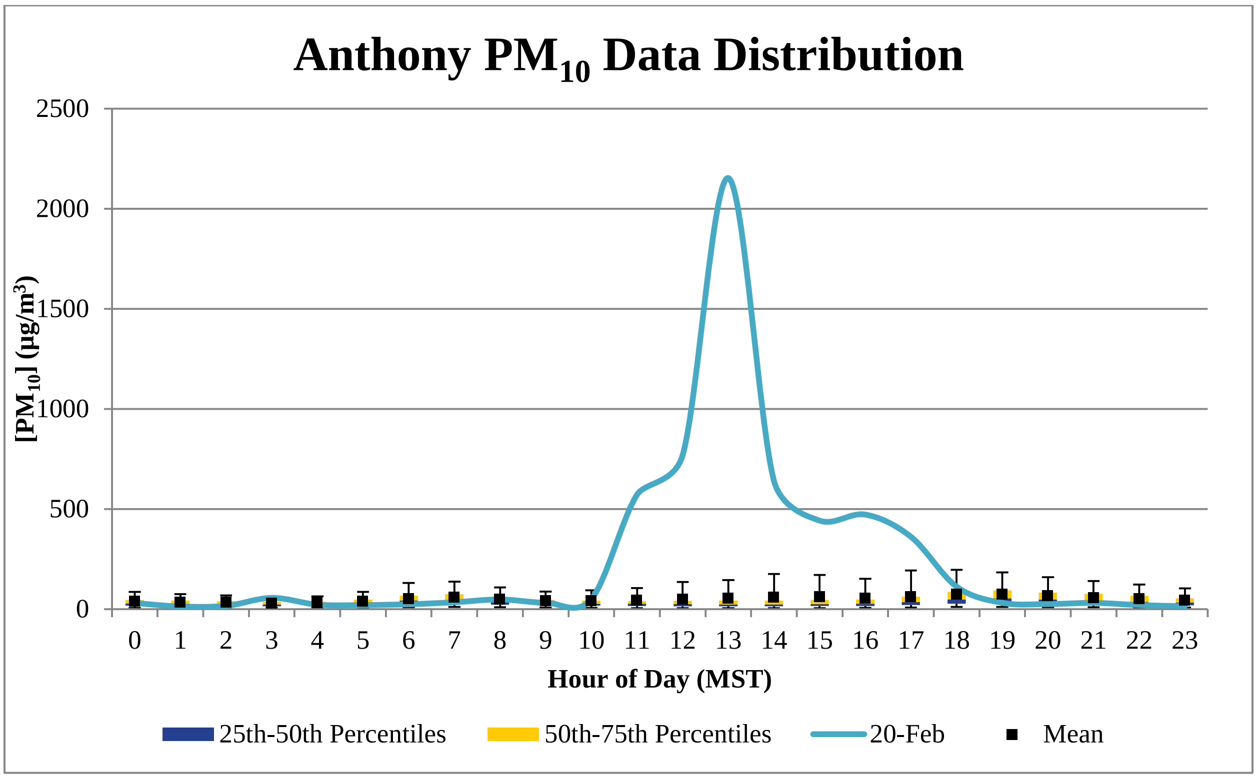

Figure 5-5a. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for February 20, 2011.

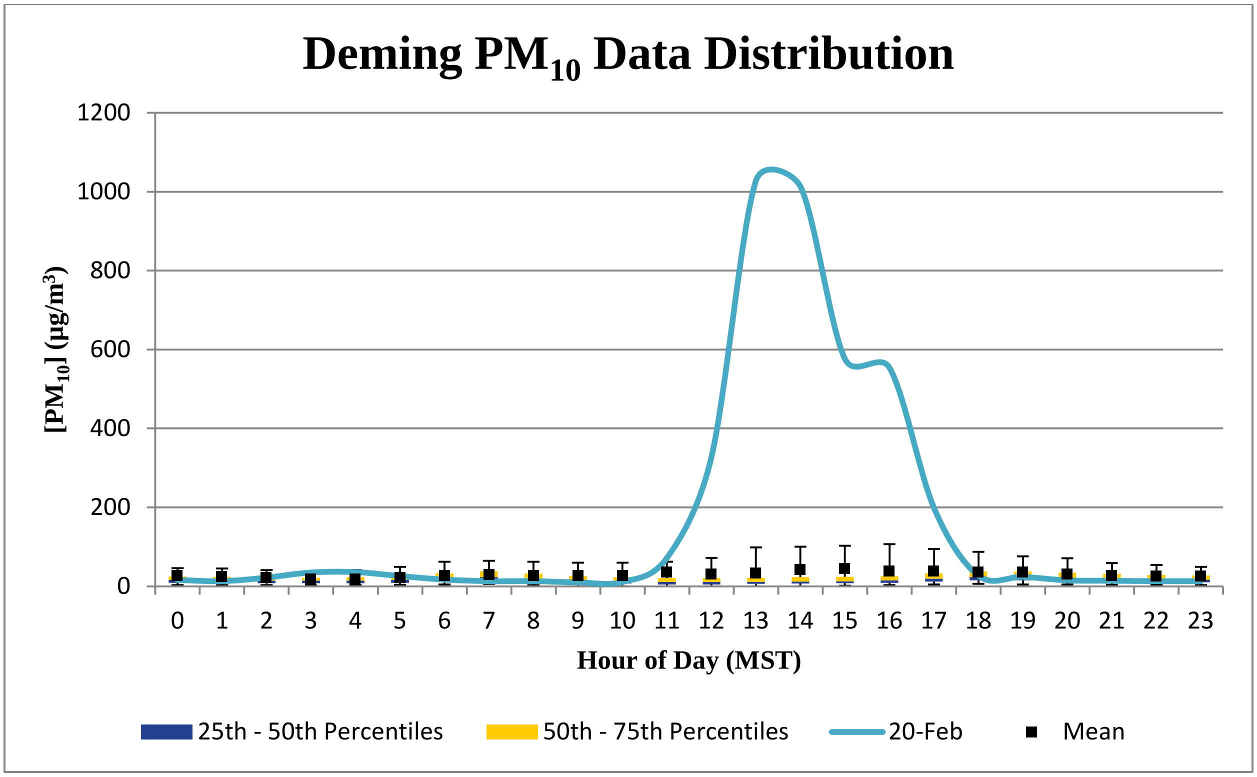

Figure 5-5b. PM_{10} **hourly data distribution from 2006-2010 overlaid by hourly values for February 20, 2011.**

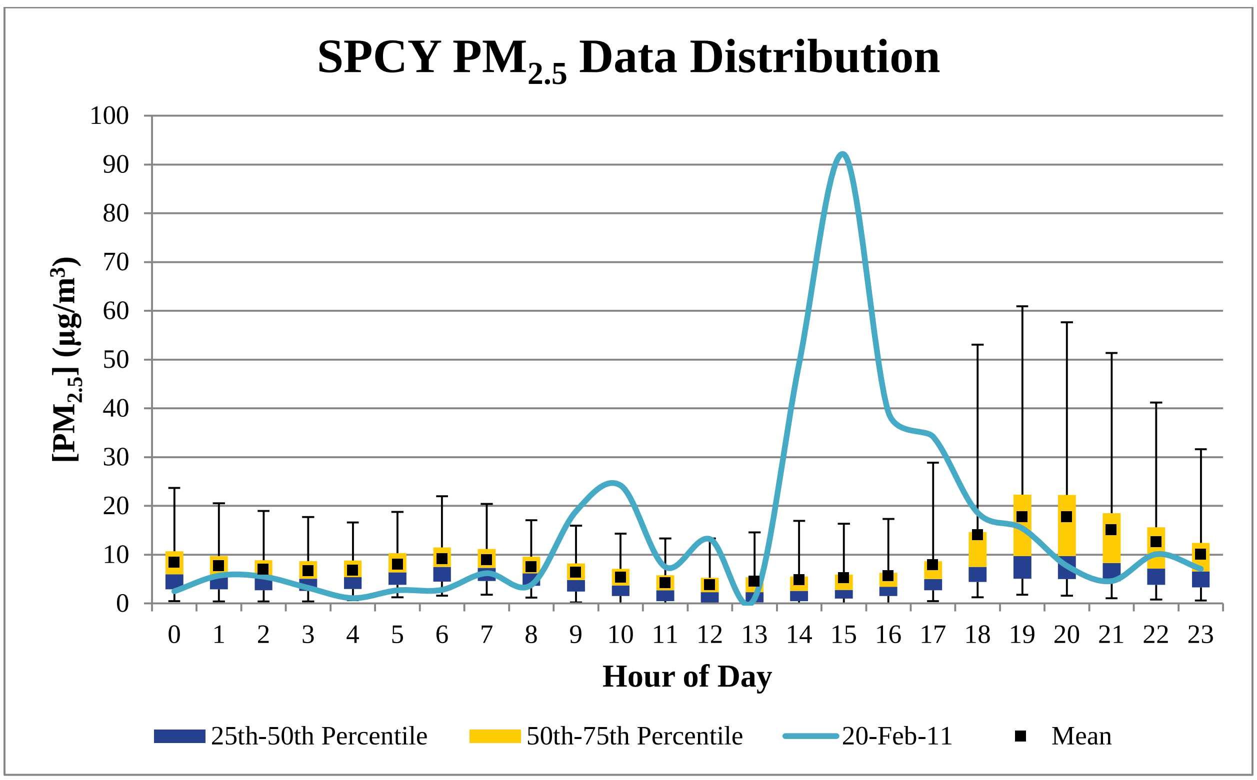

Figure5-5c. $PM_{2.5}$ **hourly data distribution from 2006-2010 overlaid by hourly values for February 20, 2011.**

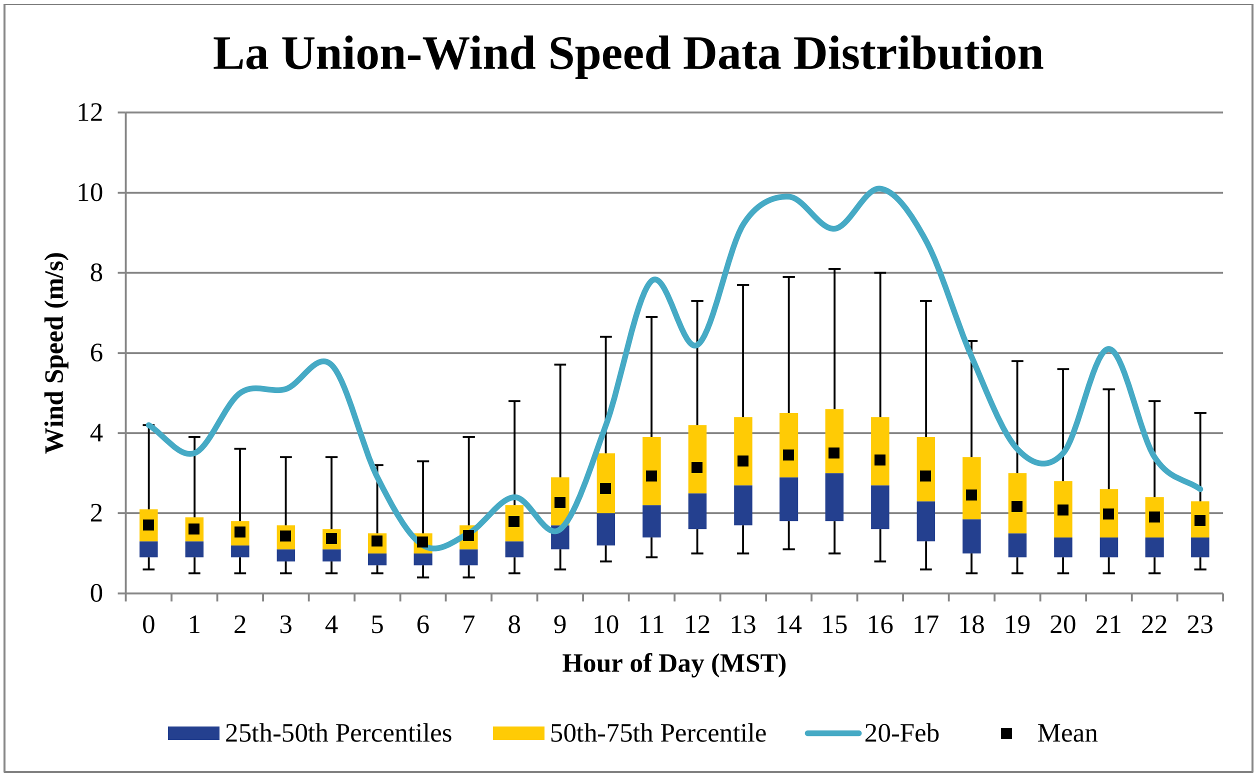

Figure 5-6a. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for February 20, 2011

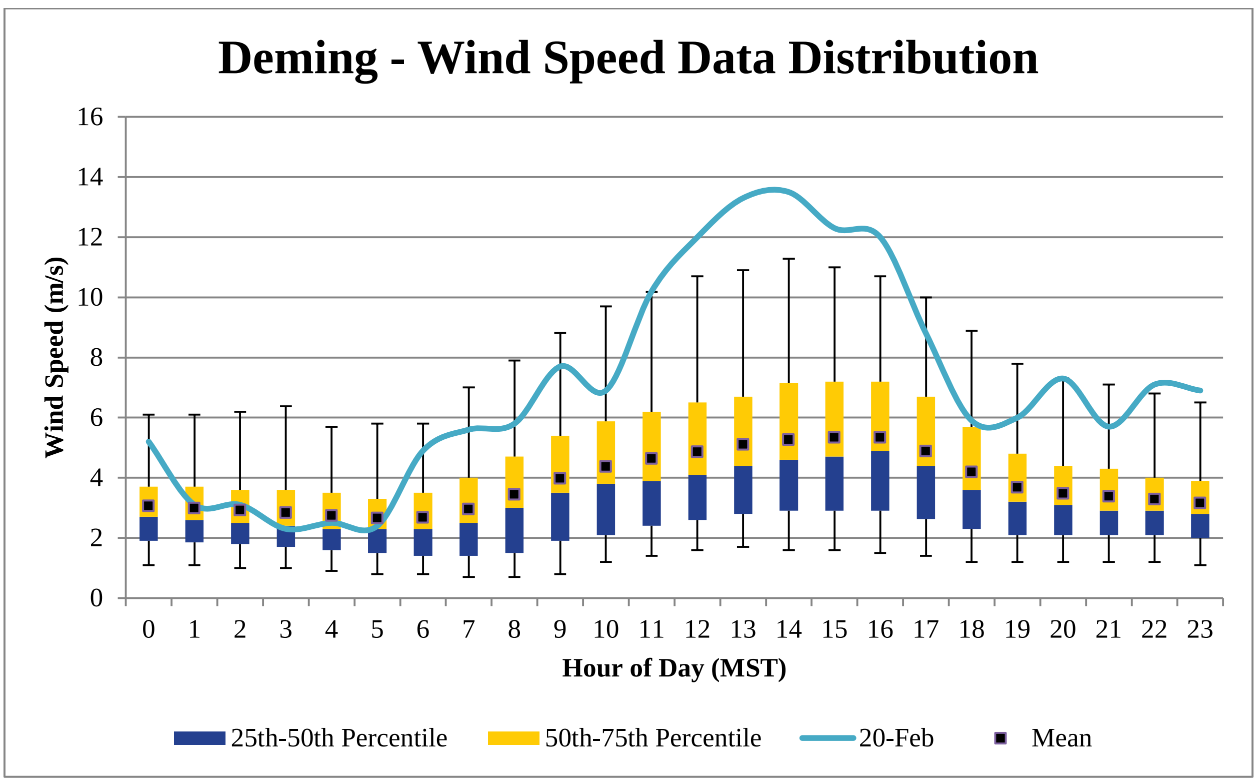

Figure 5-6b. Hourly wind speed data distribution from 2007-2010 overlaid by hourly values for February 20, 2011

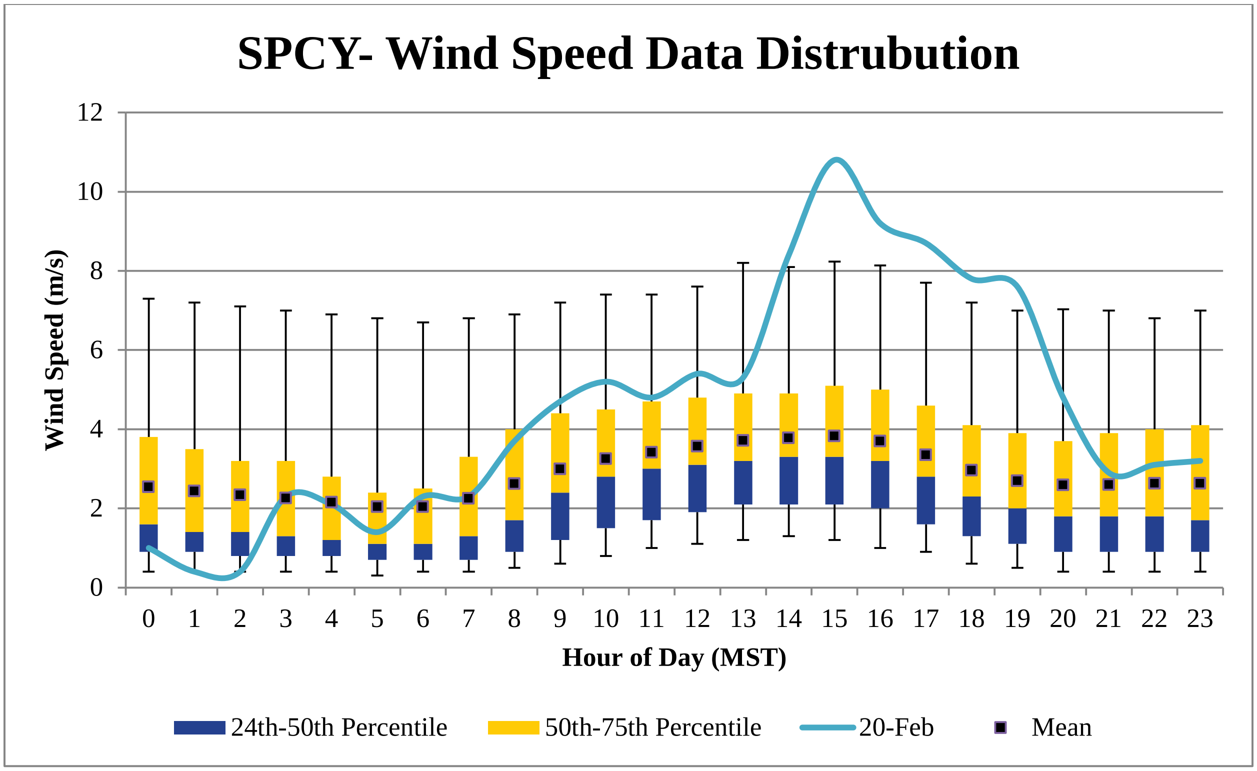

Figure 5-6c. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for February 20, 2011

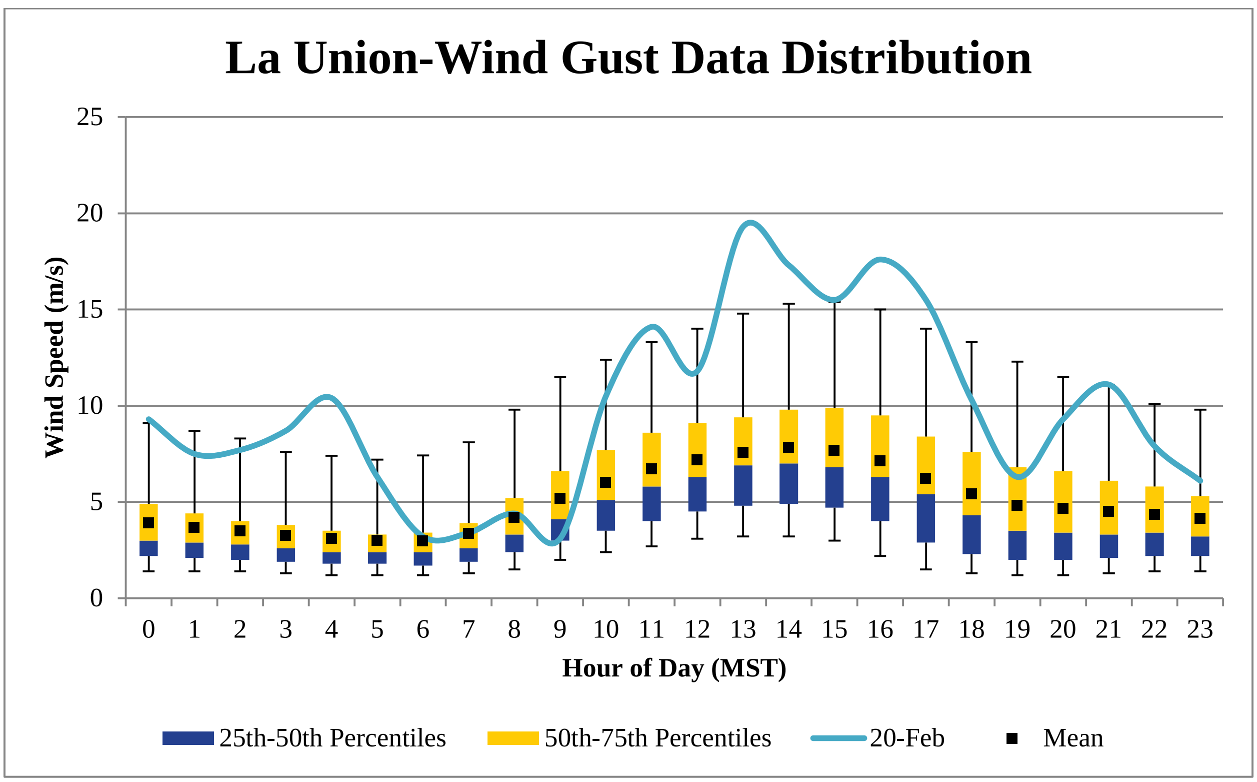

Figure 5-7a. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for February 20, 2011 .

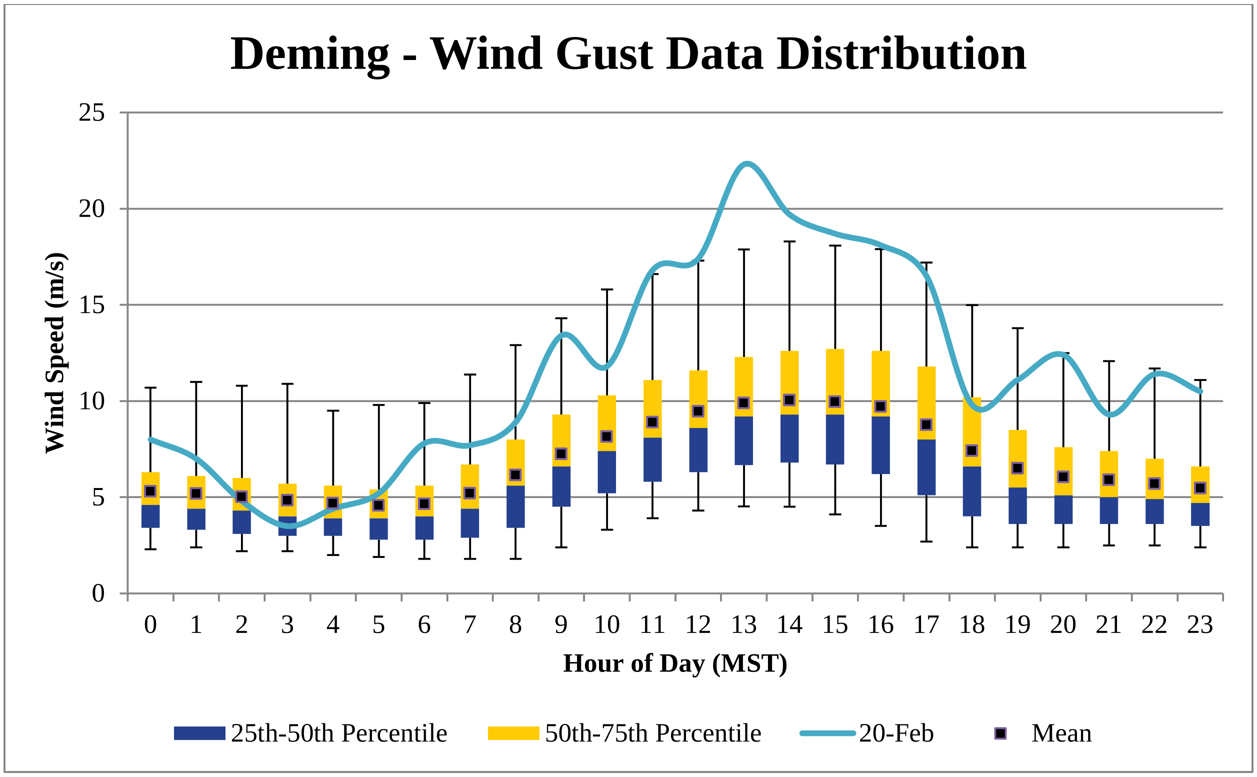

Figure 5-7b. Hourly wind gust data distribution from 2007-2010 overlaid by hourly values for February 20, 2011.

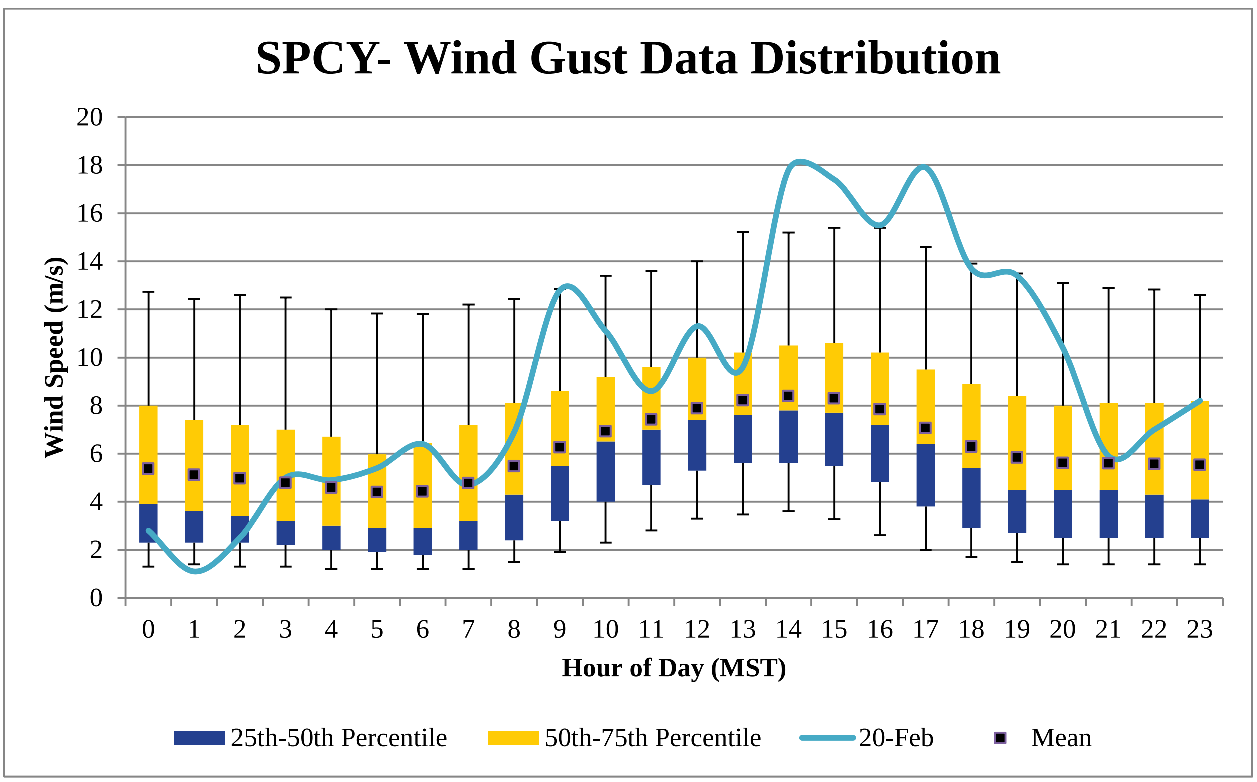

Figure 5-7c. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for February 20, 2011.

5.4 Clear Causal Relationship

A Pacific cold front passed through New Mexico on February 20, 2011. The arrival of the cold front created a low pressure center in eastern New Mexico creating a pressure gradient over southeastern 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 5-8). Surface winds flow perpendicular to the isobars from high to low pressure. The wind direction in the upper atmosphere aligned with the surface wind direction (Figure5-9). 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.

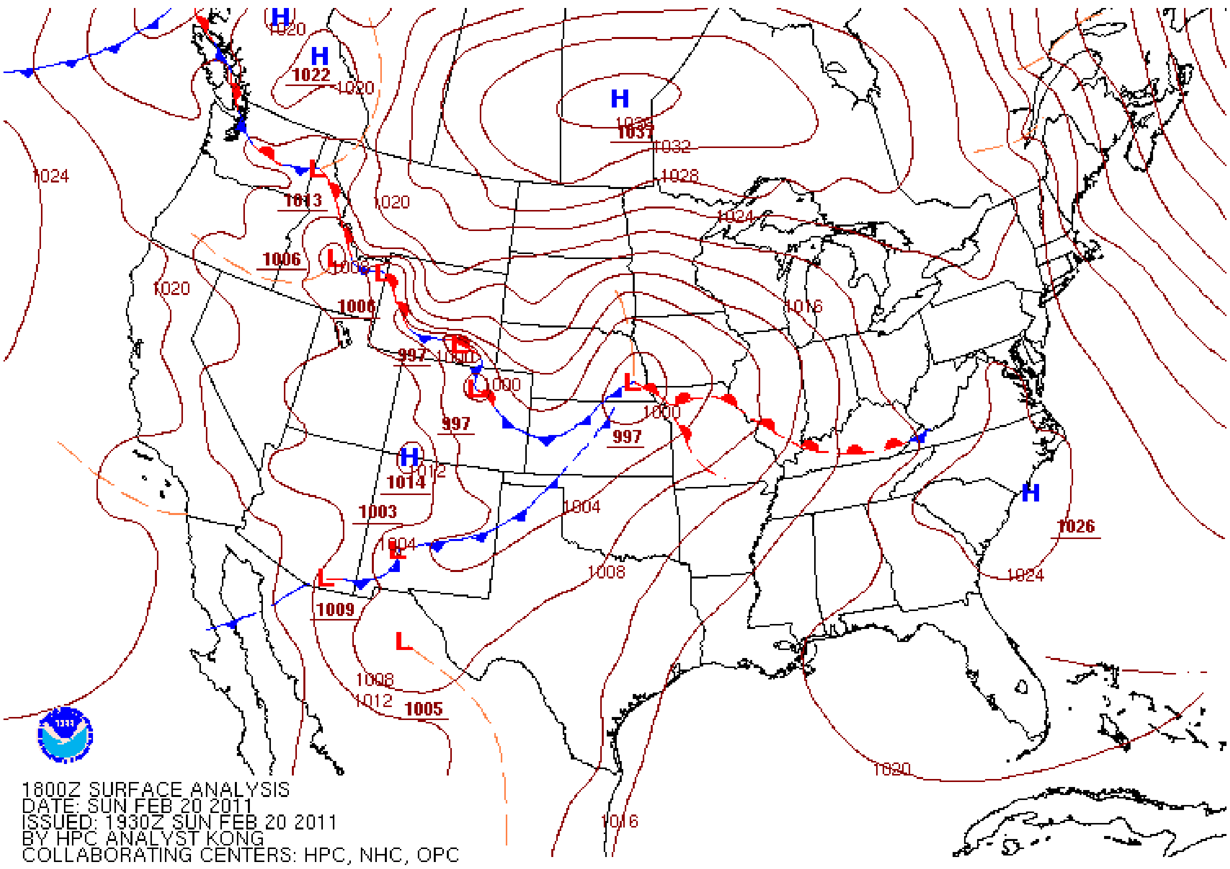

Figure 5-8. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for February 20, 2011 at the 1100 MST hour.

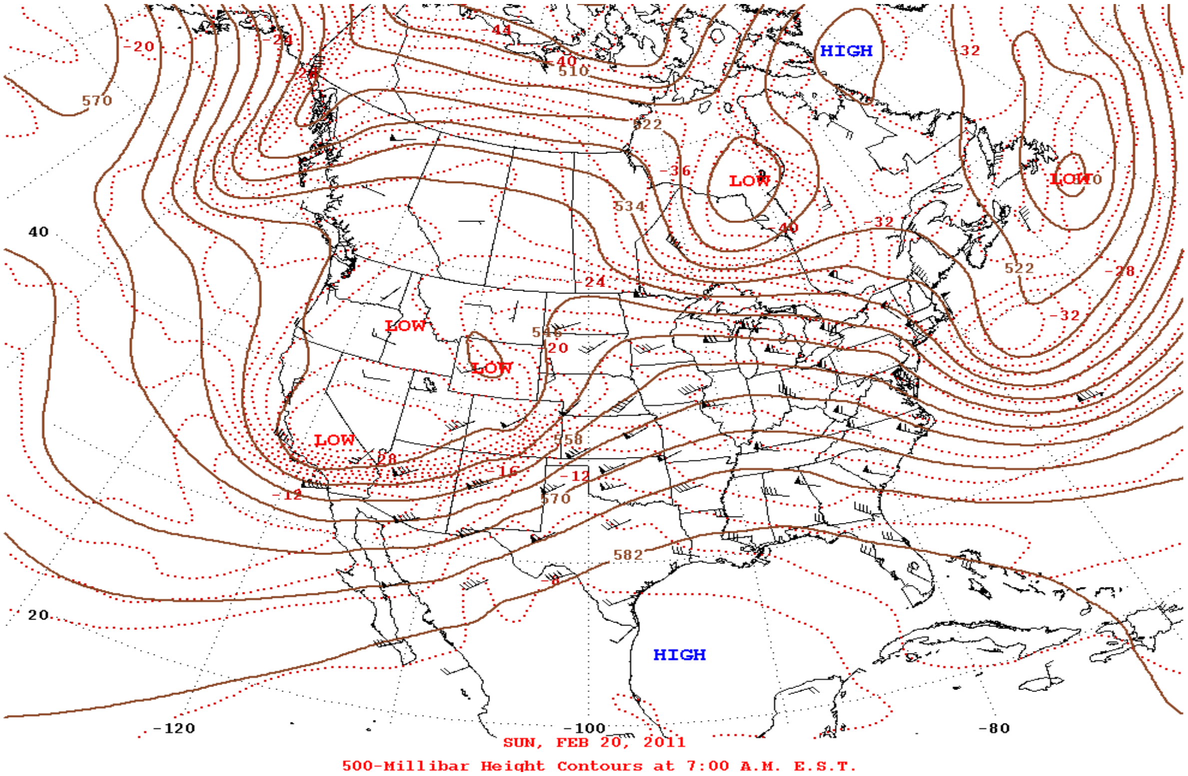

Figure 5-9. Upper air weather map showing geopotential heights (brown lines) at the 500 hour MST on February 20, 2013

The weather pattern described above generated strong southwest winds beginning at the 1100 hour and lasting through the 1630 hour. Beginning at the 1100 hour, wind speeds exceed the historical 95th percentile of data at the Deming monitoring as shown in Figure 5-7b. Peak wind speeds ranged from 11.2 m/s at Chaparral to 13.5 m/s at Deming (Figure 5-2). Peak wind gusts ranged from 18 m/s at Chaparral to 22.3m/s at Deming (Figure 5-3). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 5-10a-c. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} and $PM_{2.5}$ concentrations on this date (1100-1630 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 5-11a-b). Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 5-12).

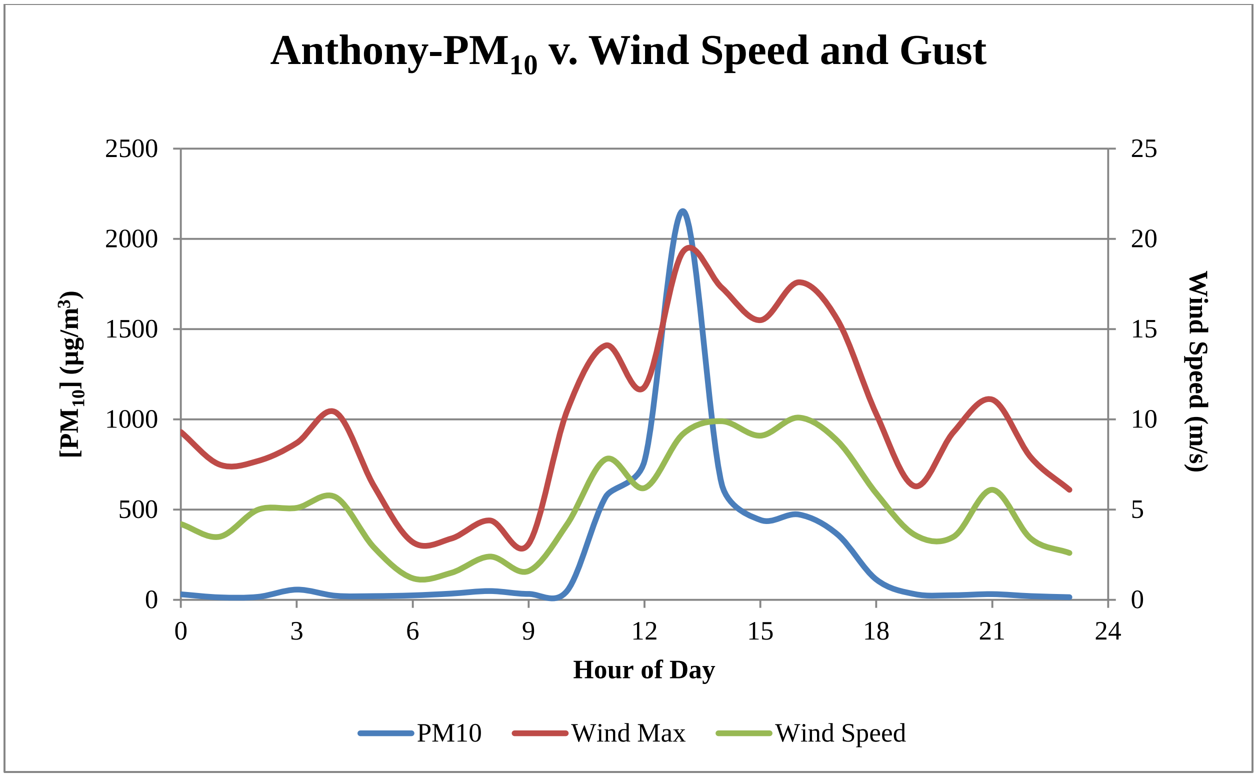

Figure 5-10a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

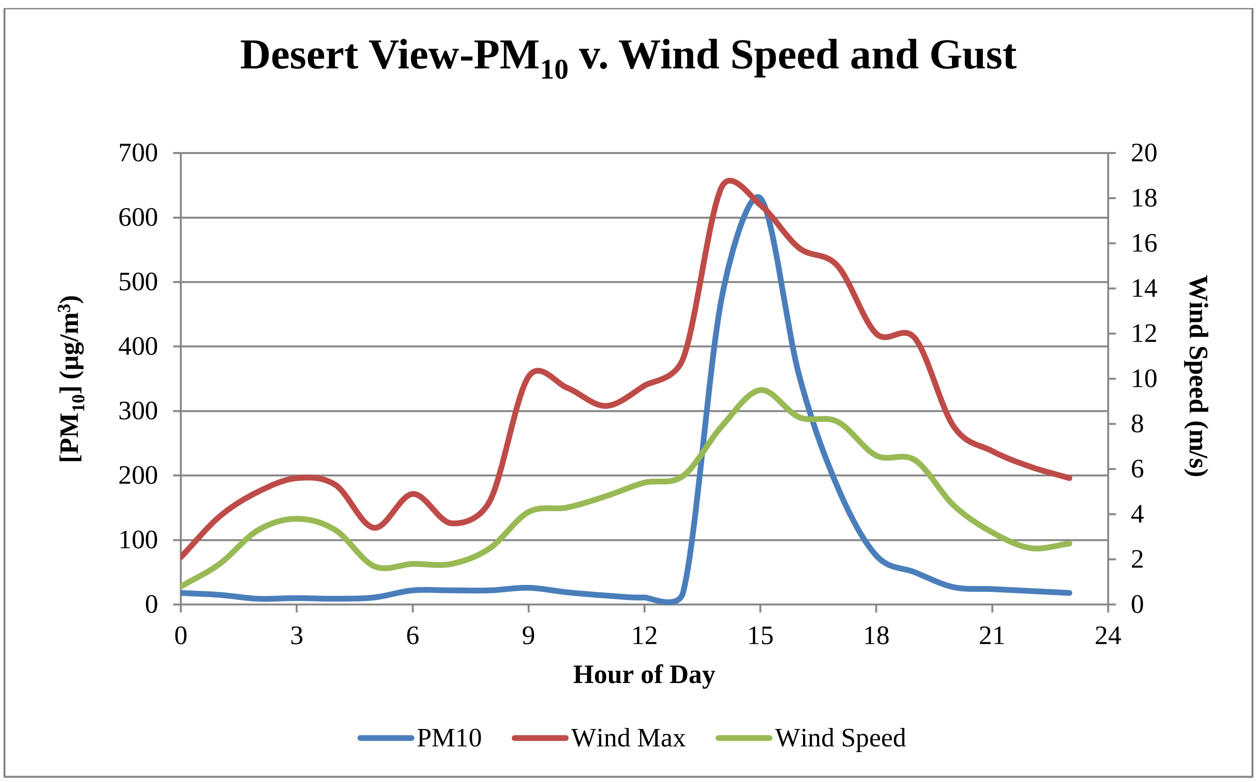

Figure 5-10b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

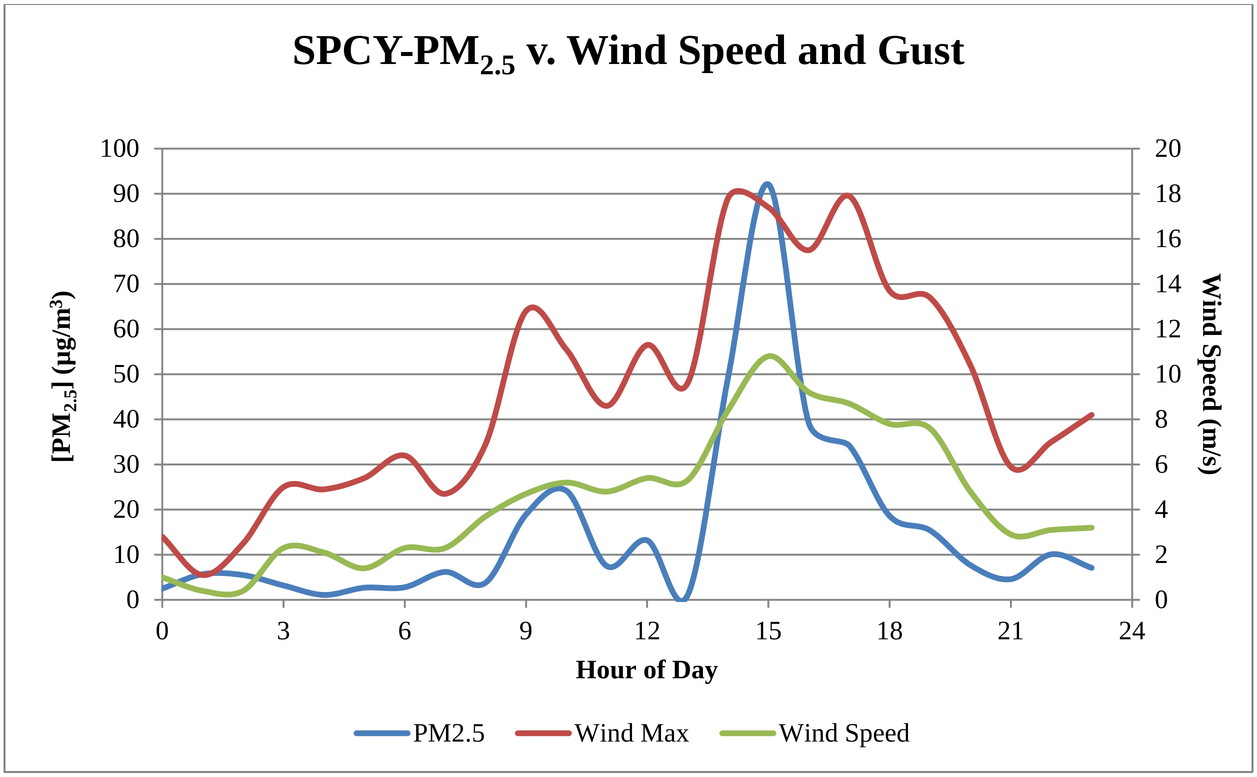

Figure 5-10c. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

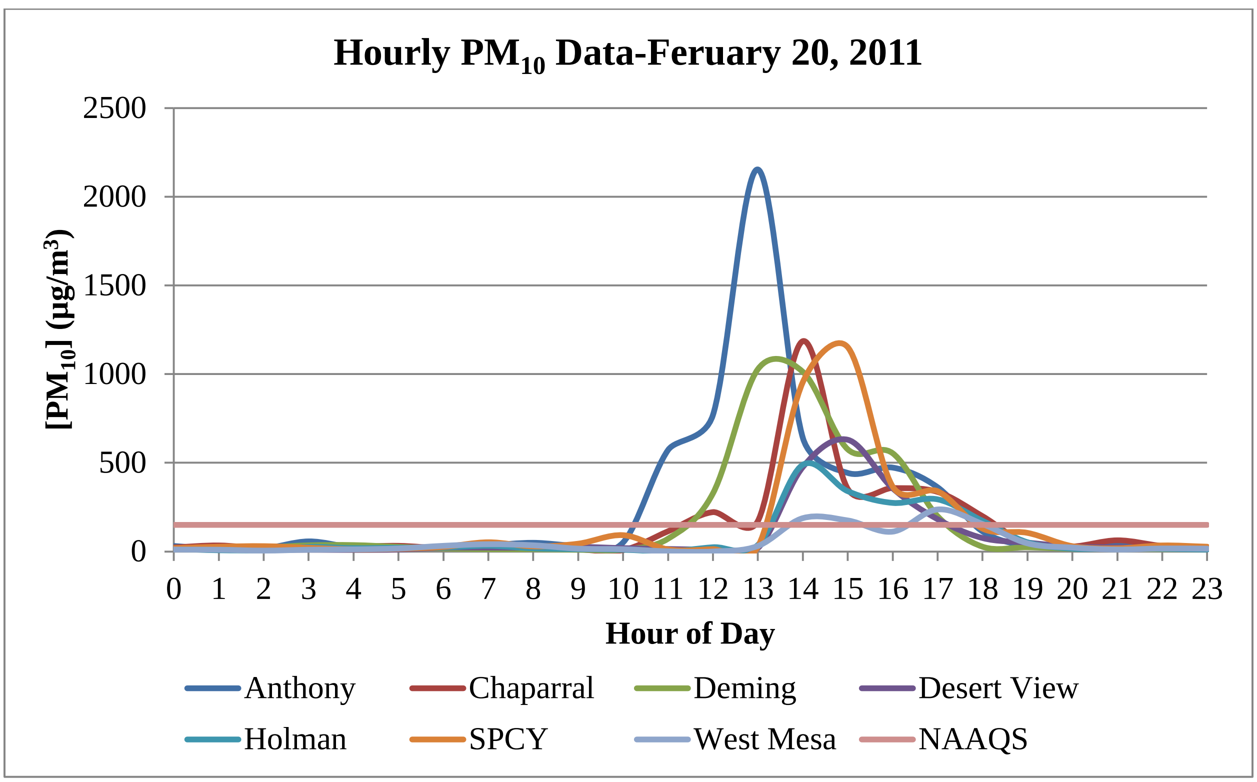

Figure 5-11a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

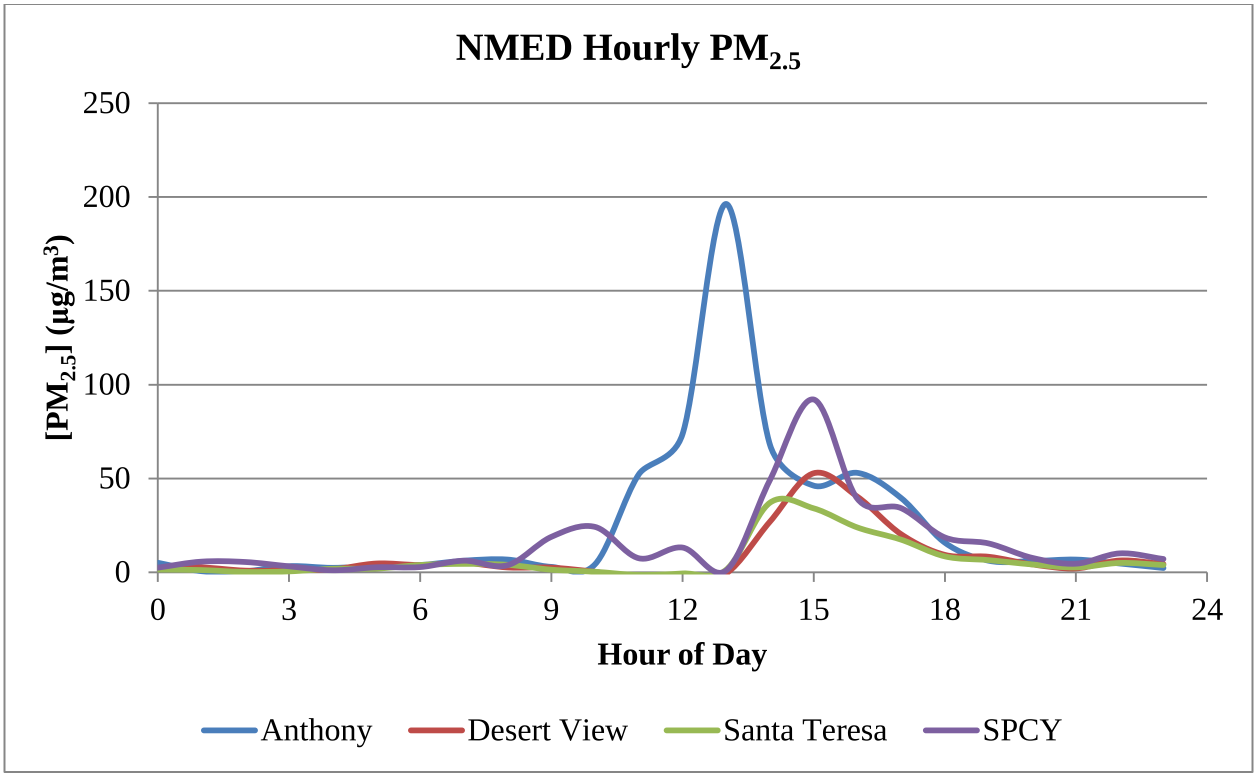

Figure 5-11b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors. Non-FEM hourly $PM_{2.5}$ data.

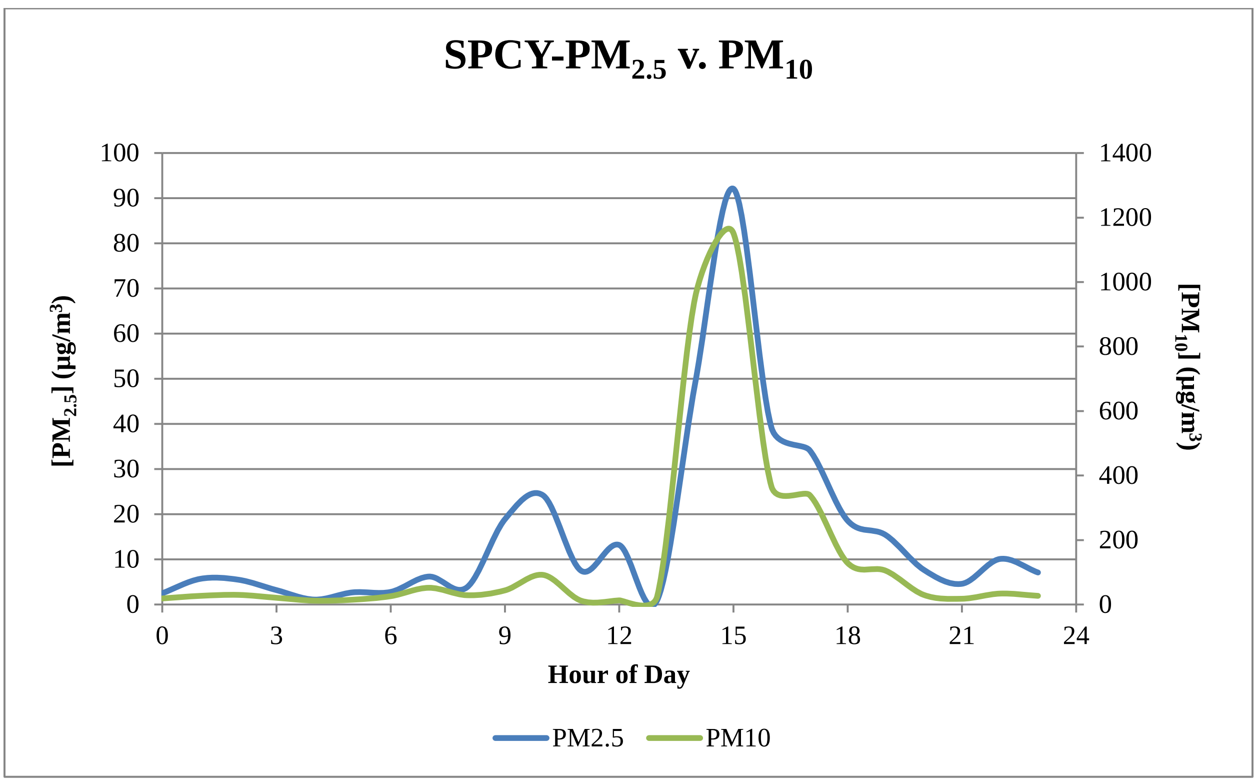

Figure 5-12. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on February 20, 2011.

Sunday, February 20, 2011 – High winds occurred today. We started out with a mild 43F as the low at NMSU and ended with a high of 72F. An upper level trough over us has created a high wind event with very little moisture today. The surface wind forecast for 21 UTC (2 pm) below shows the highest winds along two east-west areas.

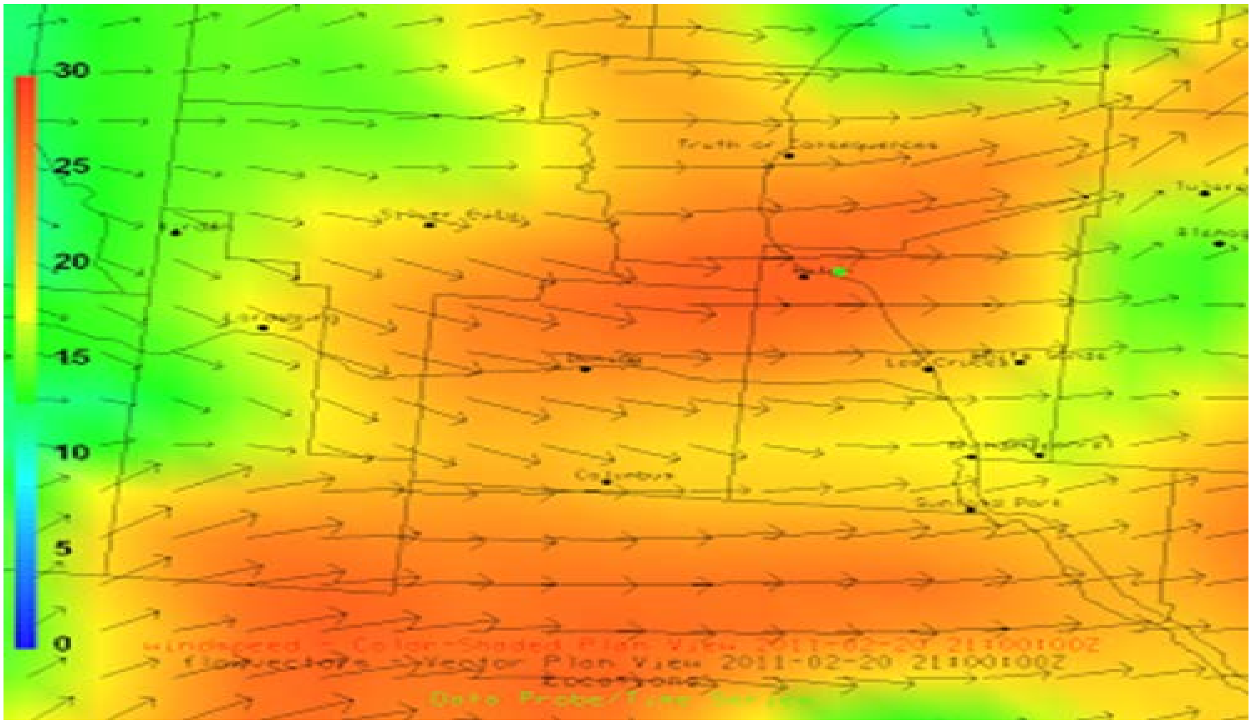

Figure 5-13

The EPA AQI forecast for Sunday showed an area of moderate air quality over the Paso del Norte and far West Texas.

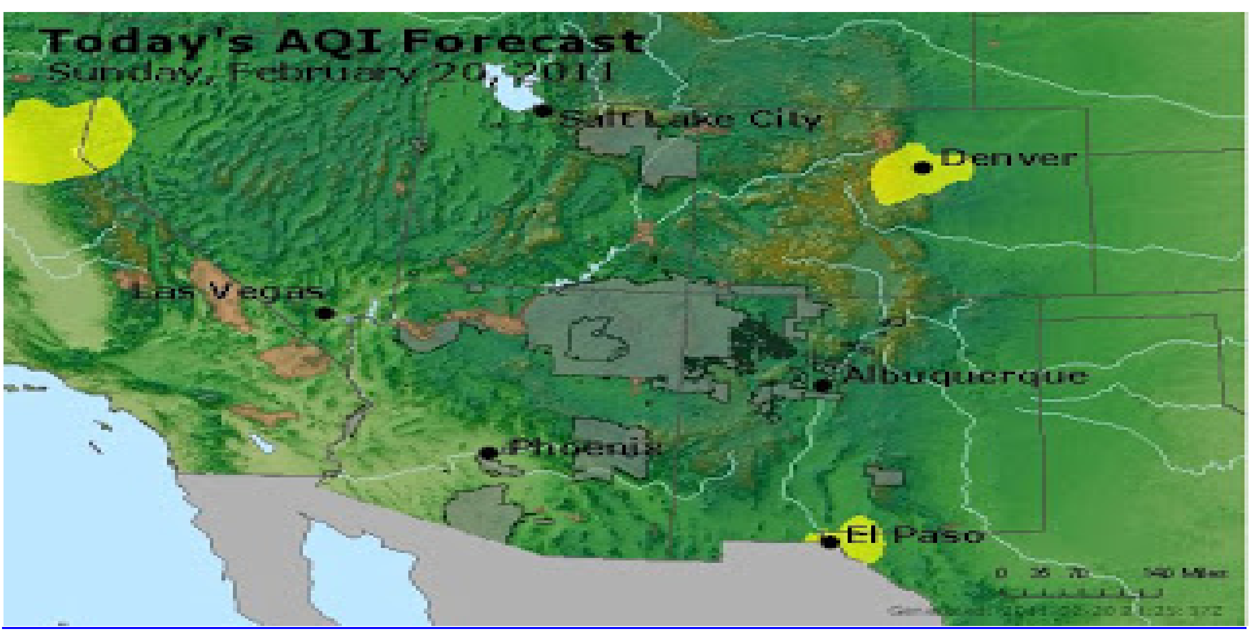

Figure 5-14

At 2:11 pm the Las Cruces Airport AWOS measured a southwest wind of 38 mph with 43 mph gusts. The visibility at the airport at that time was 7 miles. You can see the haze at 2:30 pm today looking toward the southwest over Las Cruces.

Figure 5-15

5.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on February 20, 2011.

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 Anthony monitor detected blowing dust around the 1100 hour with hourly concentrations heavily impacted until the 1700 hour. The seven hourly PM_{10} values from 1100-1400 hours alone, exceed the 24-hour average standard at Anthony [(572+ 770 + 2154 + 641 + 443+443+473+362) µg/m^3 = 5415µg/m^3; (5415/ µg/m^3)/24 = 206 µg/m^3]. By replacing these five hourly values 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 5-1). 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	31	31
1	14	14
2	17	17
3	57	57
4	23	23
5	21	21
6	25	25
7	35	35
8	49	49
9	33	33
10	51	51
11	572	**106**
12	770	**136**
13	2154	**146**
14	641	**177**
15	443	**172**
16	473	**152**
17	362	**194**
18	113	113
19	32	32
20	26	26
21	32	32
22	21	21
23	15	15
24-Hour Average	250	**40**

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 Anthony.

The Deming monitor detected blowing dust around the 1200 hour with hourly concentrations heavily impacted until the 1700 hour. The six hourly PM_{10} values from 1200-1700 hours alone, exceed the 24-hour average standard at Deming [(328+1028+1013+576+554+199) μg/m^3 = 3698μg/m^3; (3698/ μg/m^3)/24 = 184.9 μg/m^3]. By replacing these six hourly values with the 95th percentile of hourly data at the Deming site, the resulting 24-hour average (40 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 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	16	16
1	13	13
2	22	22
3	35	35
4	36	36
5	26	26
6	17	17
7	13	13
8	13	13
9	10	10
10	11	11
11	72	72
12	328	**72**
13	1028	**99**
14	1013	**101**
15	576	**103**
16	554	**107**
17	199	**95**
18	27	27
19	24	24
20	15	15
21	14	14
22	13	13
23	13	13
24-Hour Average	170	**40**

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 Deming.

6 HIGH WIND EXCEPTIONAL EVENT: February 27, 2011

6.1 Summary of Event

The passing of a Pacific cold front caused high winds and blowing dust in southern Doña Anna County resulting in exceedances of the PM_{10} 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 466, 382 and 389 µg/m^3 respectively. The $PM_{2.5}$ FRM at the SPCY site recorded a 24-hour average concentration of 35 µg/m^3. In accordance with the EER and the $PM_{2.5}$ annual NAAQS, the AQB flagged this data on EPA's AQS database as a high wind natural event. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured Desert View (145 µg/m^3) and Holman (119 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.

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 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} concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

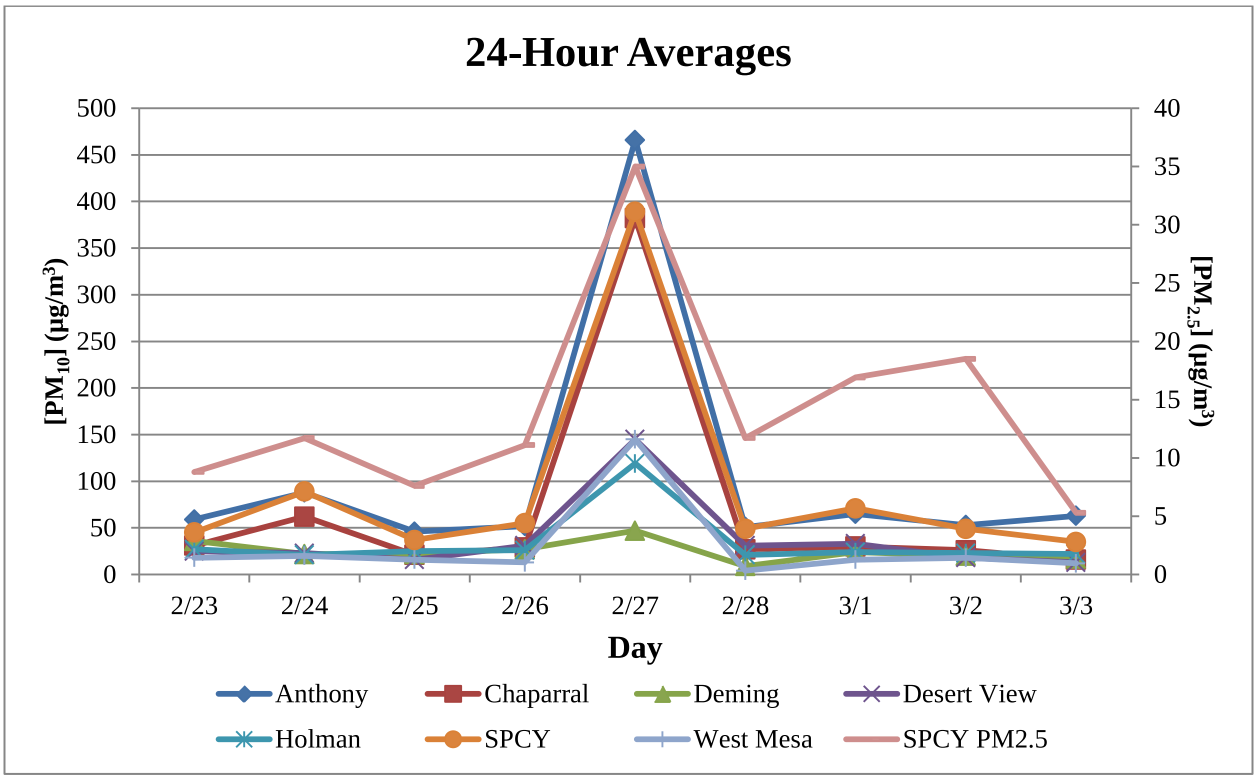

Figure 6-1. PM_{10} and $PM_{2.5}$ 24-hour averages before and after February 27, 2011.

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, Mexico and New Mexico. Agricultural tilling and crop planting may have contributed to this event. Doña Ana 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 northern Mexico (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 February 27, 2011, sustained wind speeds exceeded EPA's default threshold at six of the seven monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at seven of the seven monitoring sites (Figures 6-2 and 6-3). Winds exceeded these thresholds at one or more monitoring sites beginning at the 600 hour and ending at the 1700 hour.

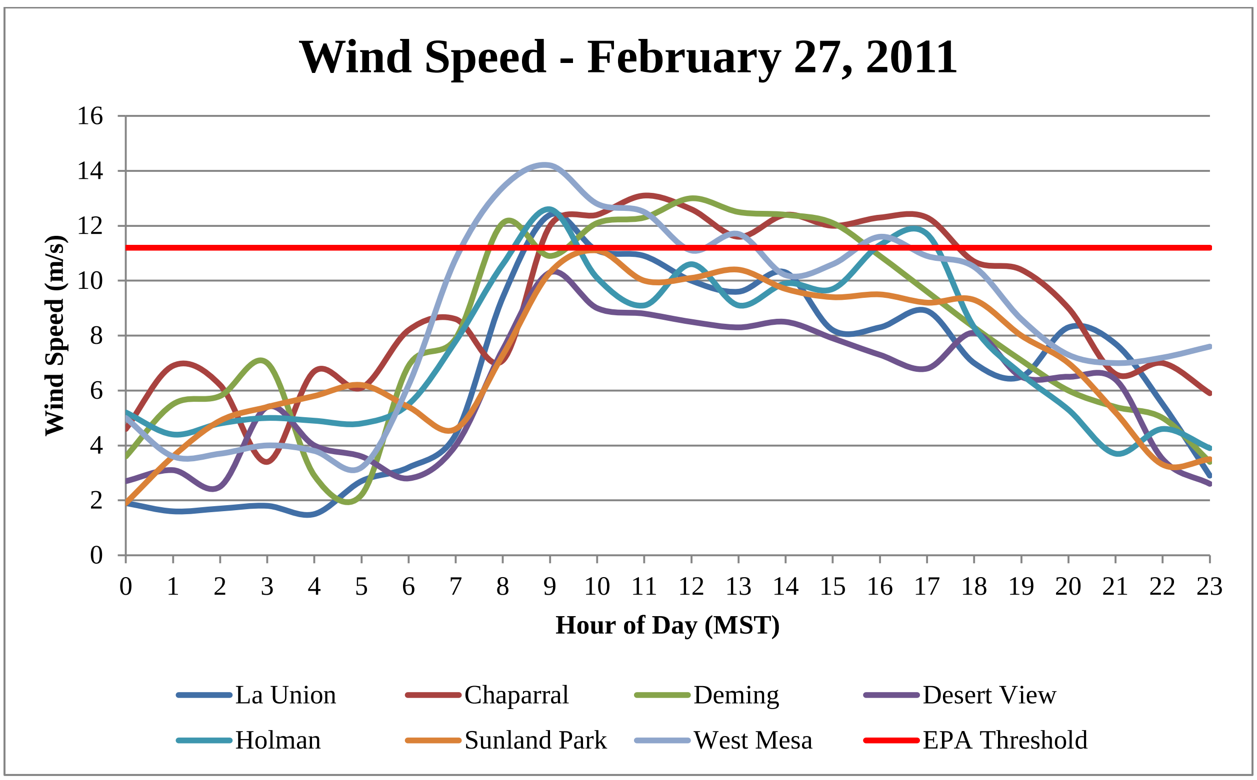

Figure 6-2. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

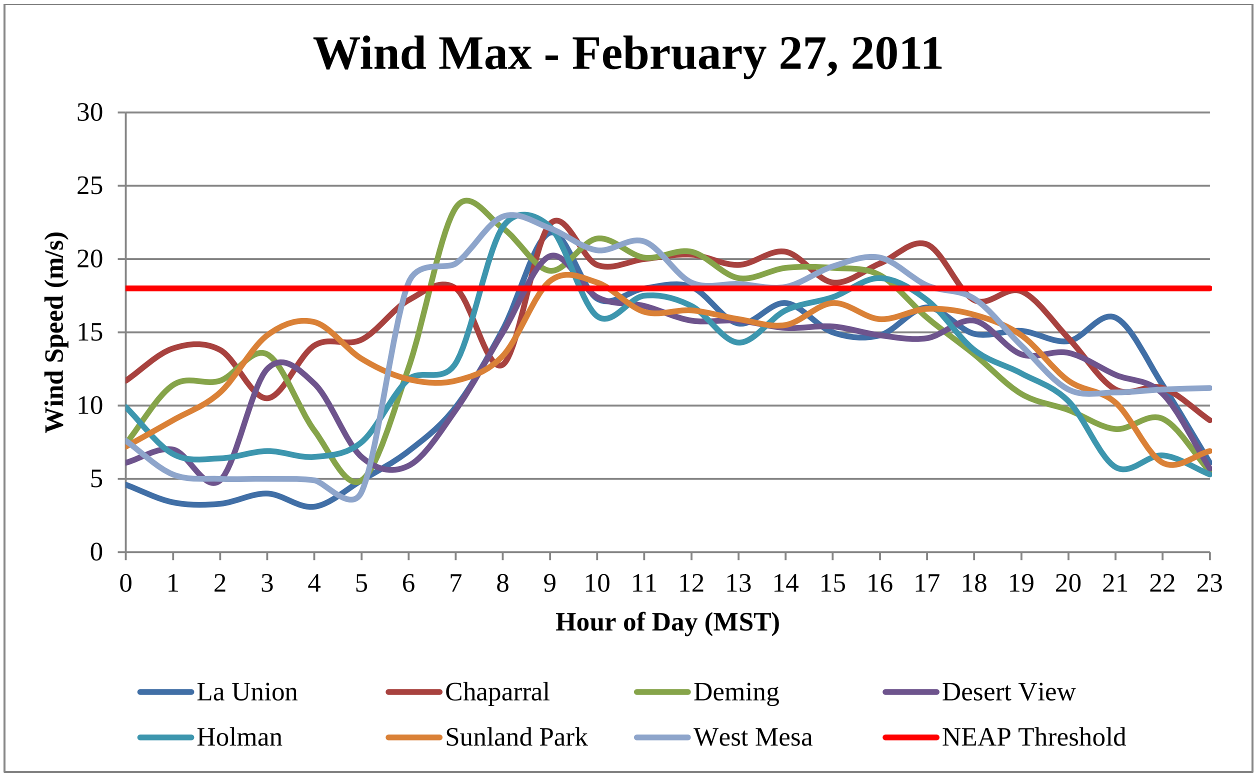

Figure 6-3. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

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 2006-2010 the PM_{10} FEM TEOM monitors recorded 211 exceedances and the PM_{10} FRM Wedding monitors recorded 5 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 (Table 2-1). The SPCY $PM_{2.5}$ FRM Partisol recorded 23 exceedances of the 24-Hour NAAQS from 2006-2010 (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 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 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 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 6-4). 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 6-4. HYSPLIT back-trajectory model analysis for February 27, 2011.

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-4 through B-11). 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 2006-2010 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 2006-2010. 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 2006-2010. The recorded values for this day (Anthony-466, Chaparral- 382 and SPCY-389µg/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 27, 2011 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 6-5a-d through 6-7a-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.

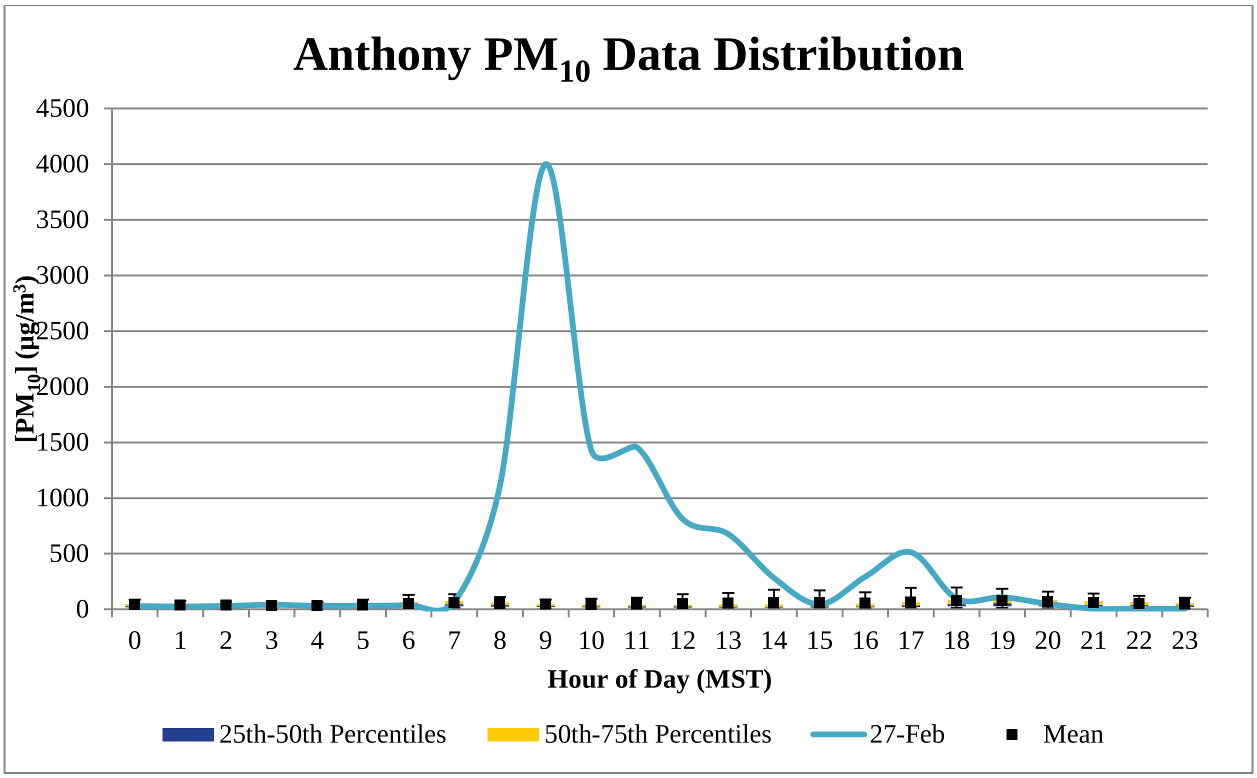

Figure 6-5a. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for February 27, 2011.

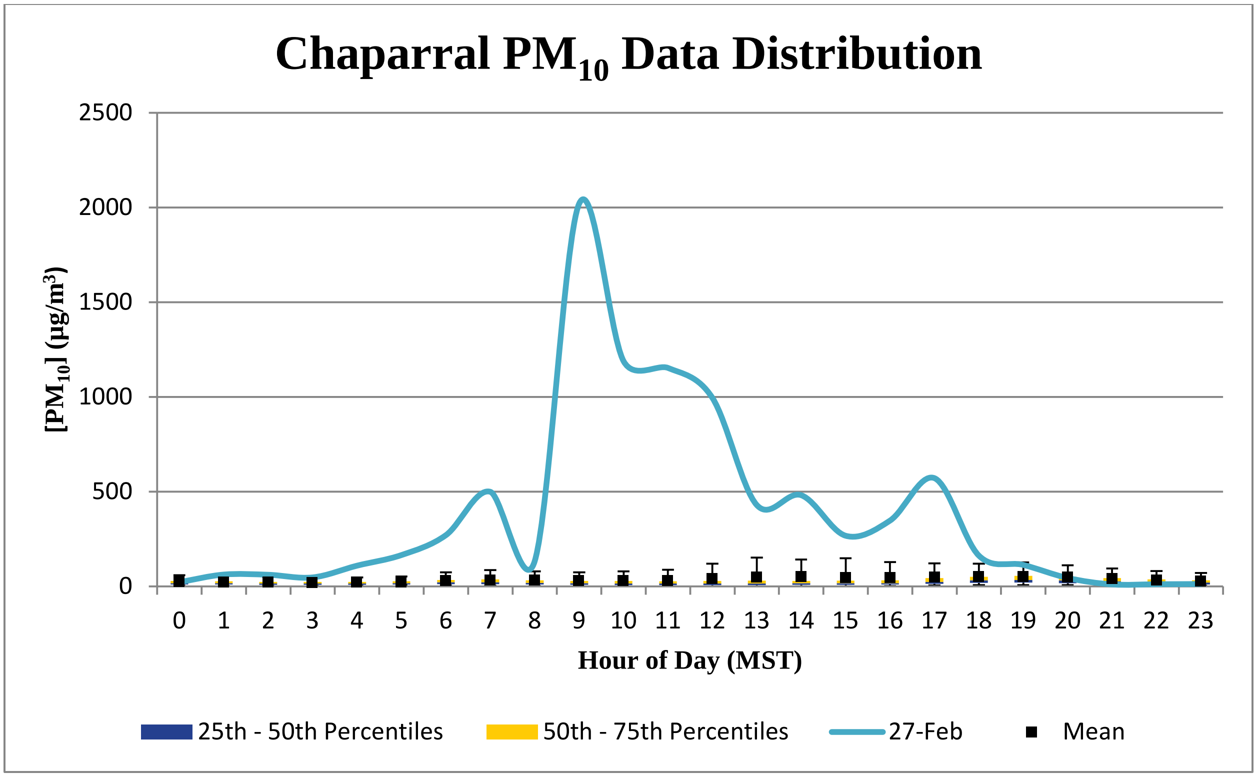

Figure 6-5b. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for February 27, 2011.

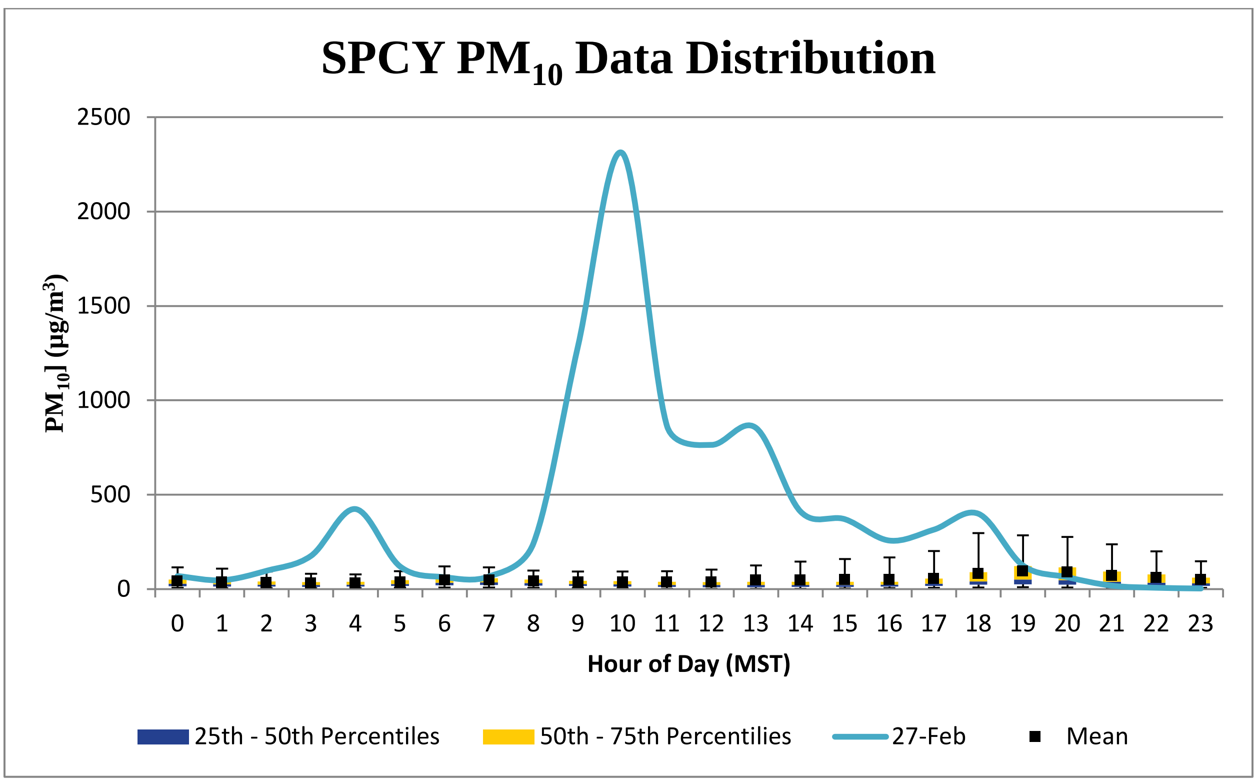

Figure 6-5c. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for February 27, 2011.

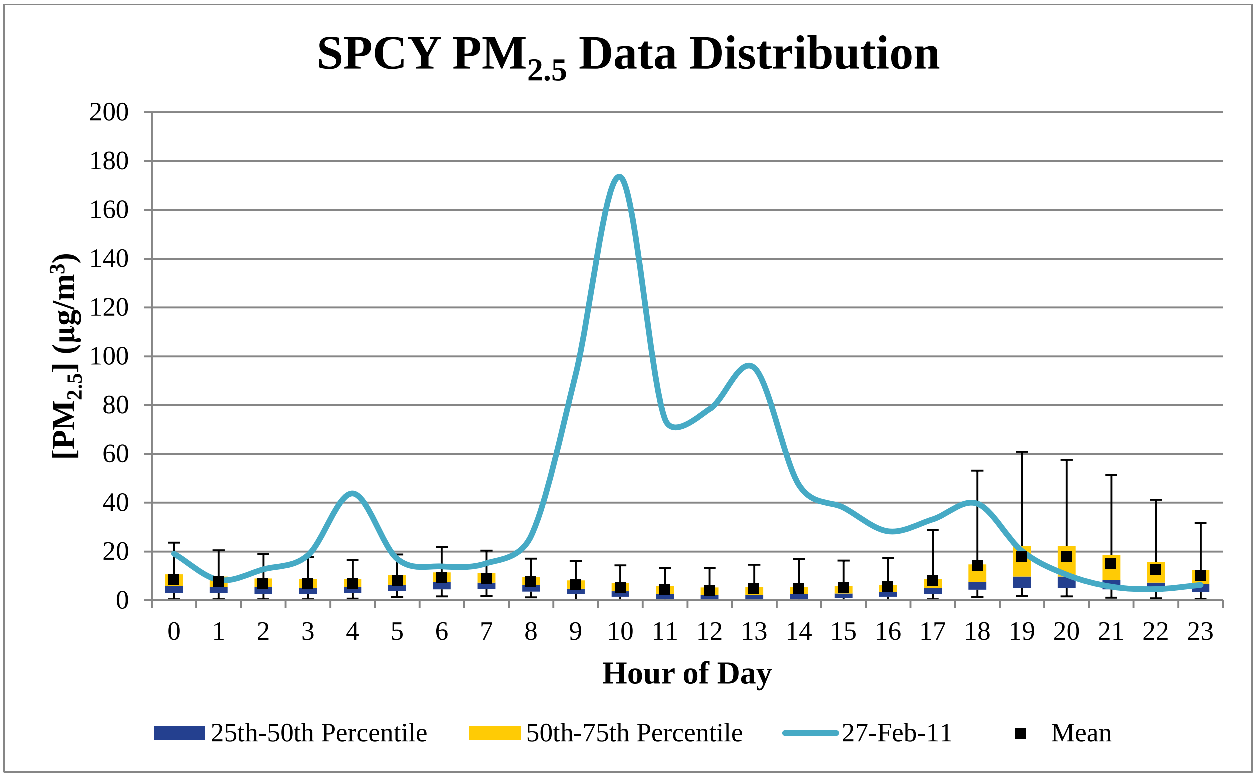

Figure 6-5d. $PM_{2.5}$ hourly data distribution from 2006-2010 overlaid by hourly values for February 27, 2011.

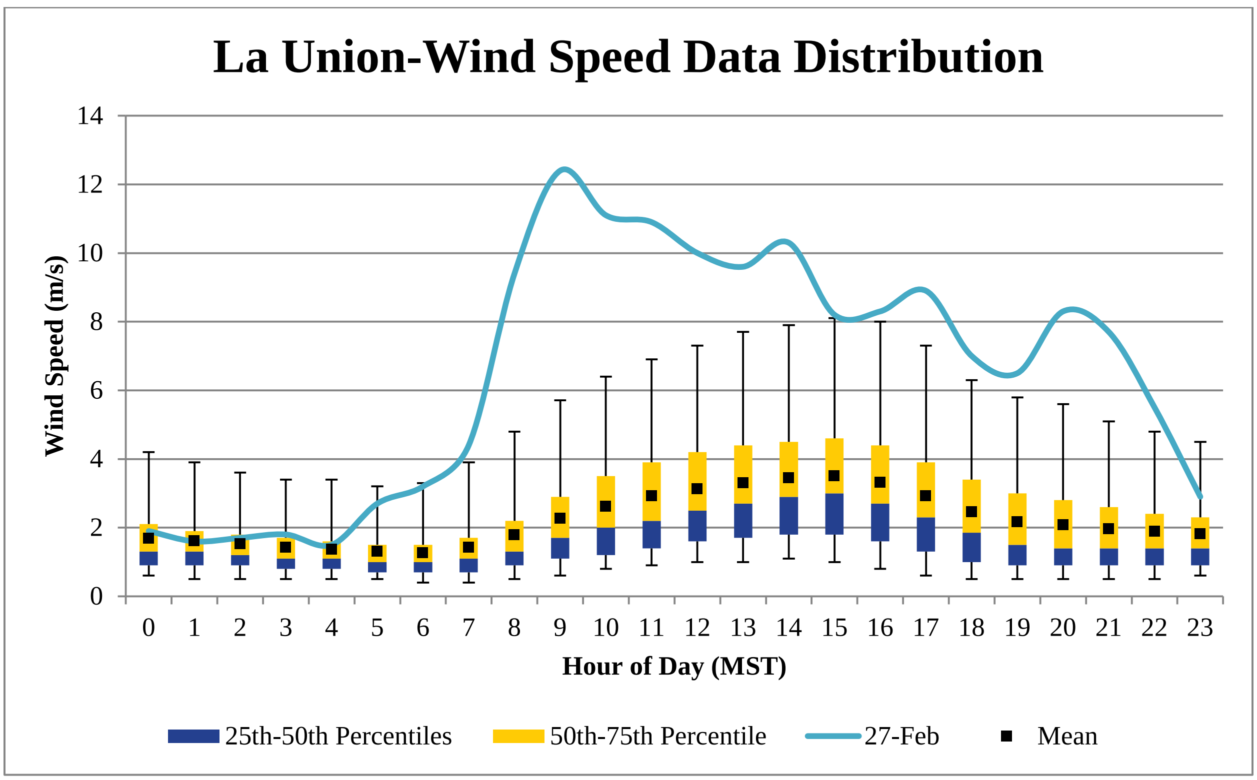

Figure 6-6a. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for February 27, 2011.

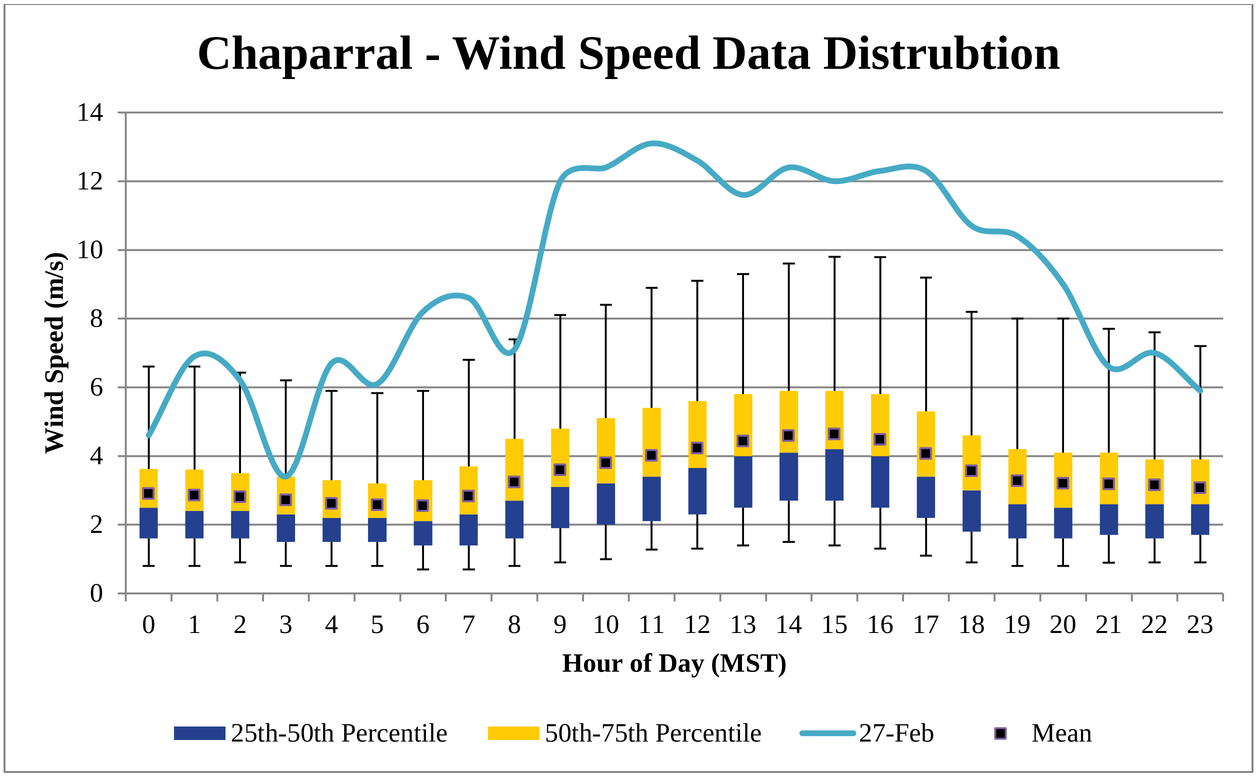

Figure 6-6b. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for February 27, 2011.

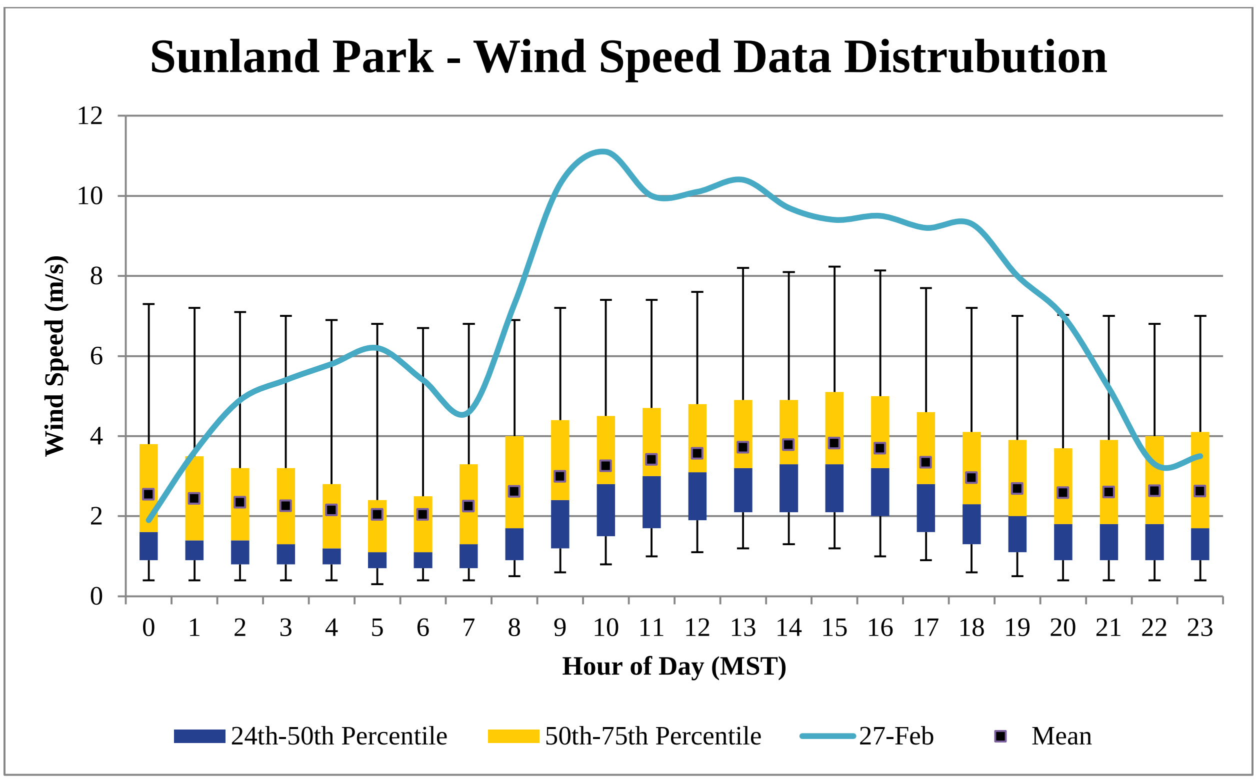

Figure 6-6c. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for February 27, 2011.

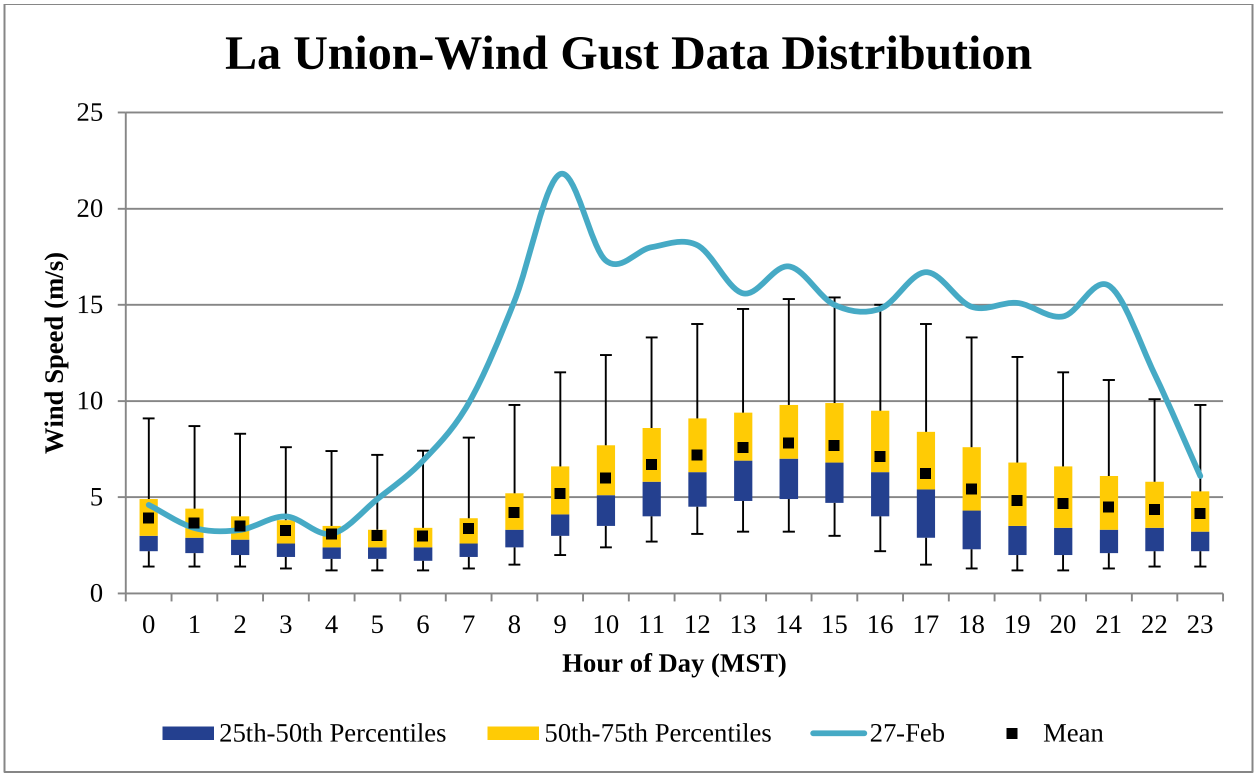

Figure 6-7a. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for February 27, 2011.

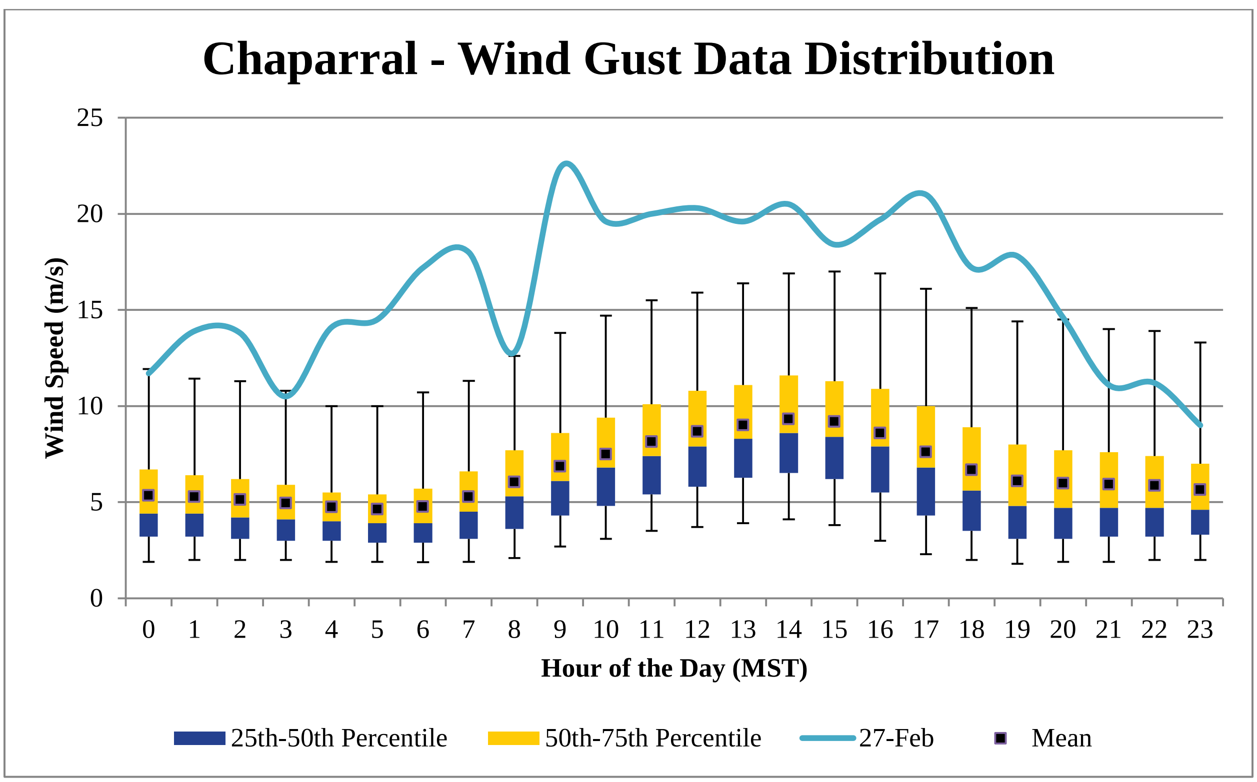

Figure 6-7b. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for February 27, 2011.

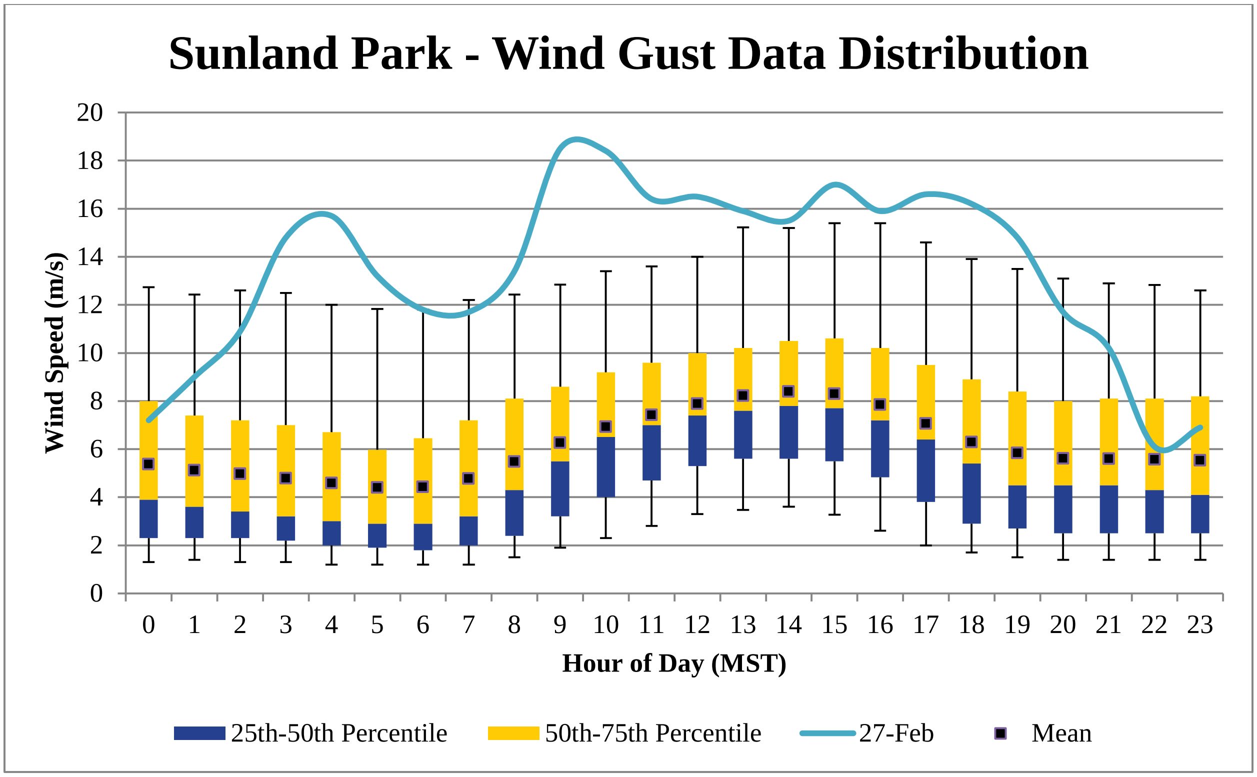

Figure 6-7c. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for February 27, 2011.

6.4 Clear Causal Relationship

A Pacific cold front passed through New Mexico on February 27, 2011. The arrival of the cold front created a low pressure center in north eastern New Mexico creating a pressure gradient over central New Mexico. As the Pacific cold front moved through New Mexico, the pressure gradient tightened and winds became even stronger at the surface (Figure 6-8). Surface winds flow perpendicular to the isobars from high to low pressure. The wind direction in the upper atmosphere aligned with the surface wind direction (Figure 6-9). 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.

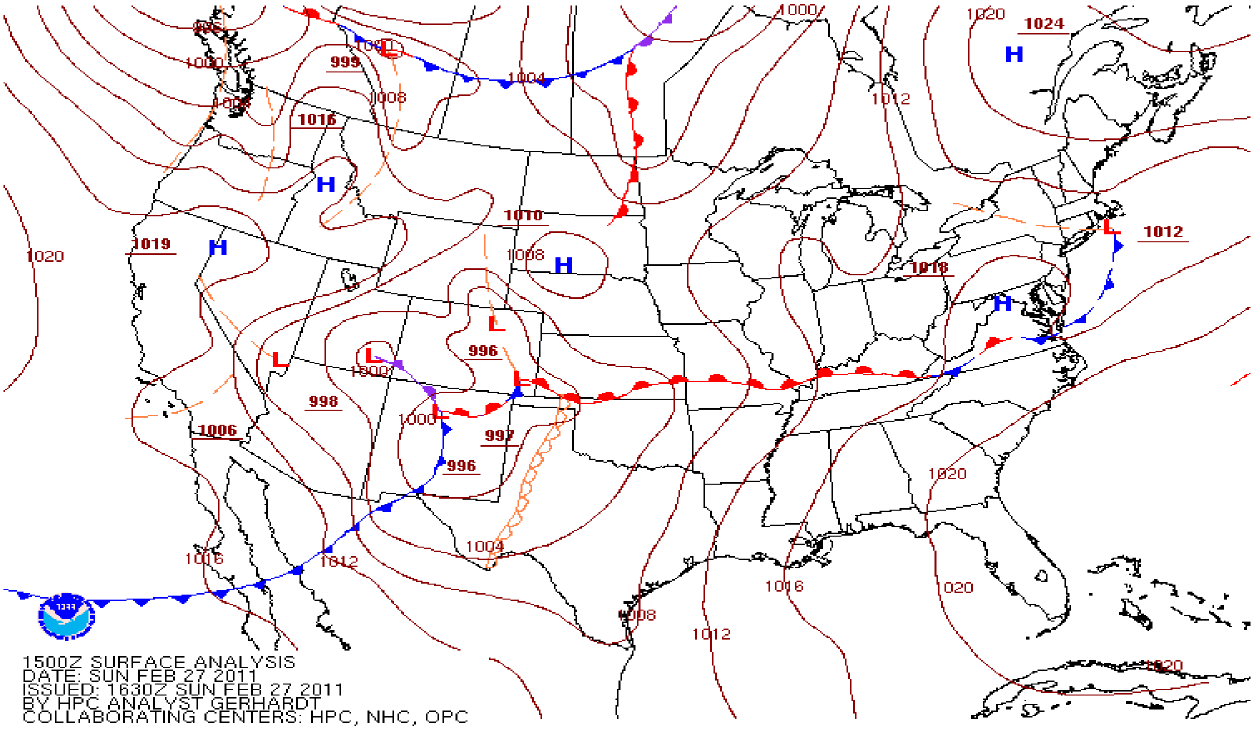

Figure 6-8. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for February 27, 2011 at the 800MST hour.

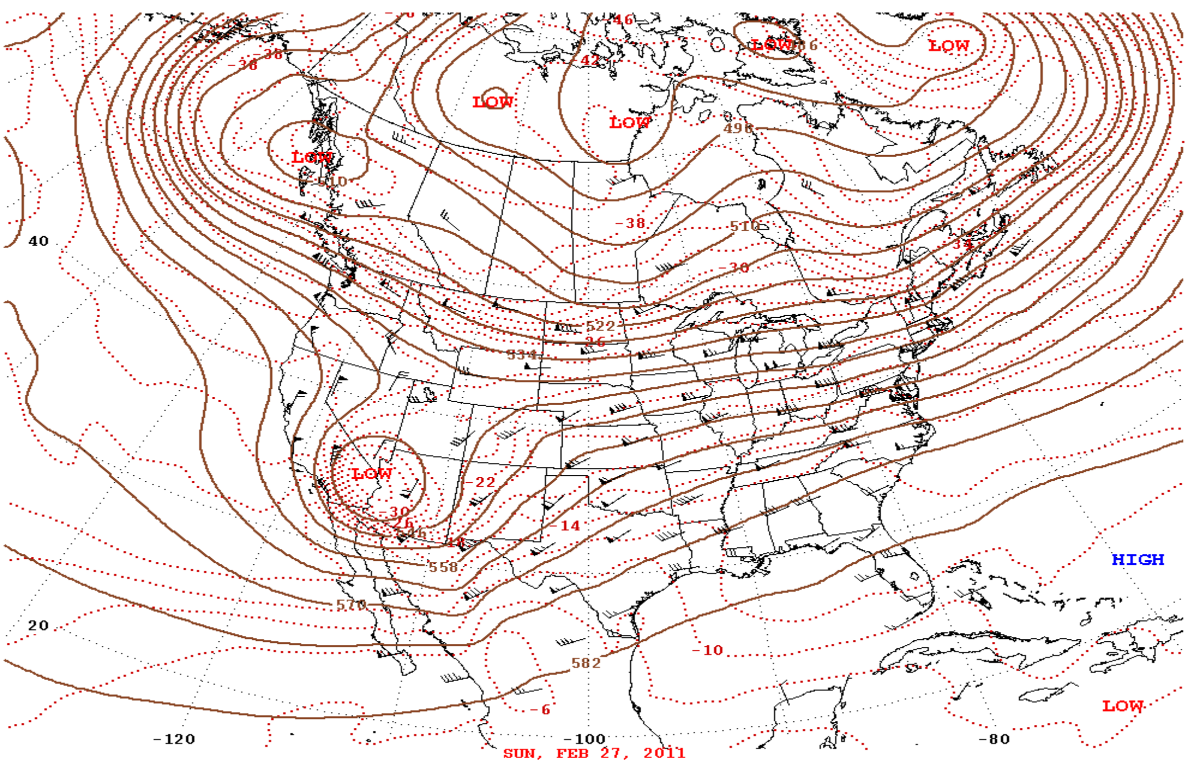

Figure 6-9. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on February 27, 2011.

The weather pattern described above generated strong southwesterly winds beginning at the 600 hour and lasting through the1700 hour. Beginning at the 600 hour, wind speeds exceeded the historical 95th percentile of data at La Union as shown in Figure 6-6a. Peak wind speeds ranged from 11.1m/s at SPCY to13.1 m/s at Chaparral (Figure 6-3). Peak wind gusts ranged from 18 m/s at Chaparral to 22.9 m/s at West Mesa (Figure6-4). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 6-10a-d. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (630-1800 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 6-11a-b). Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 6-12).

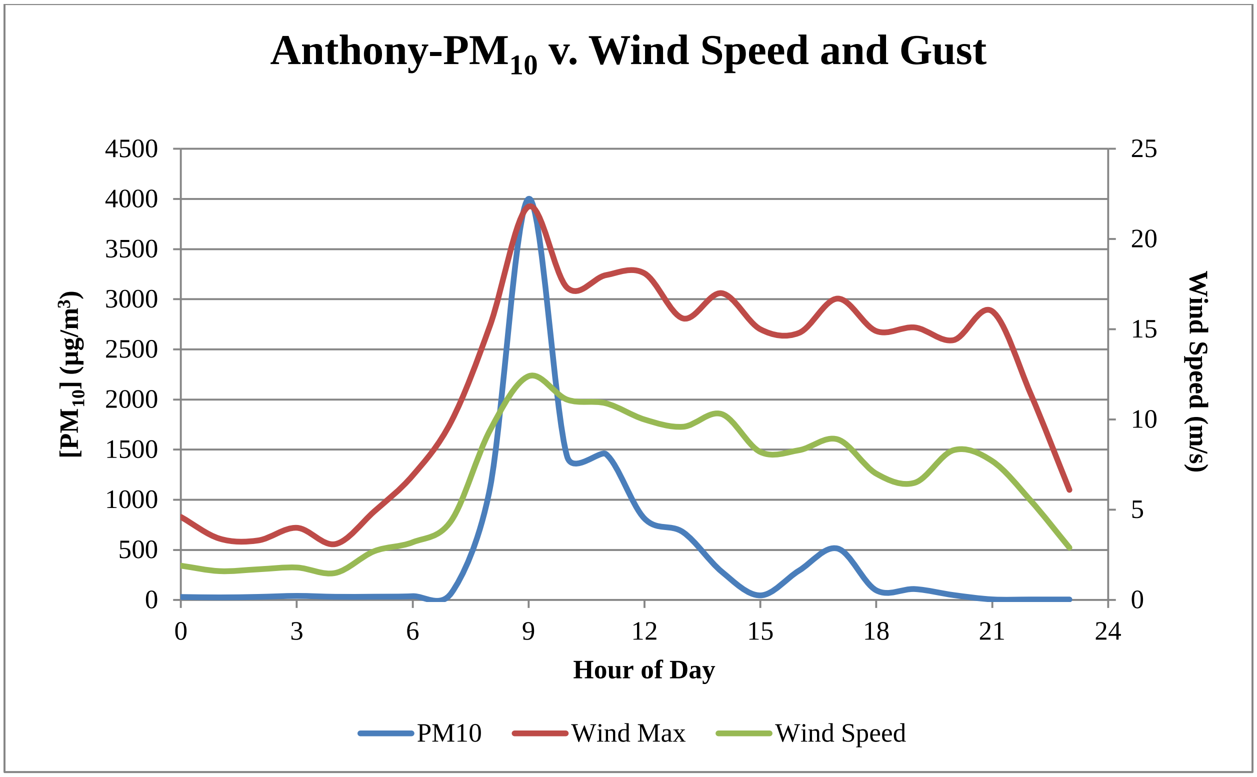

Figure 6-10a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

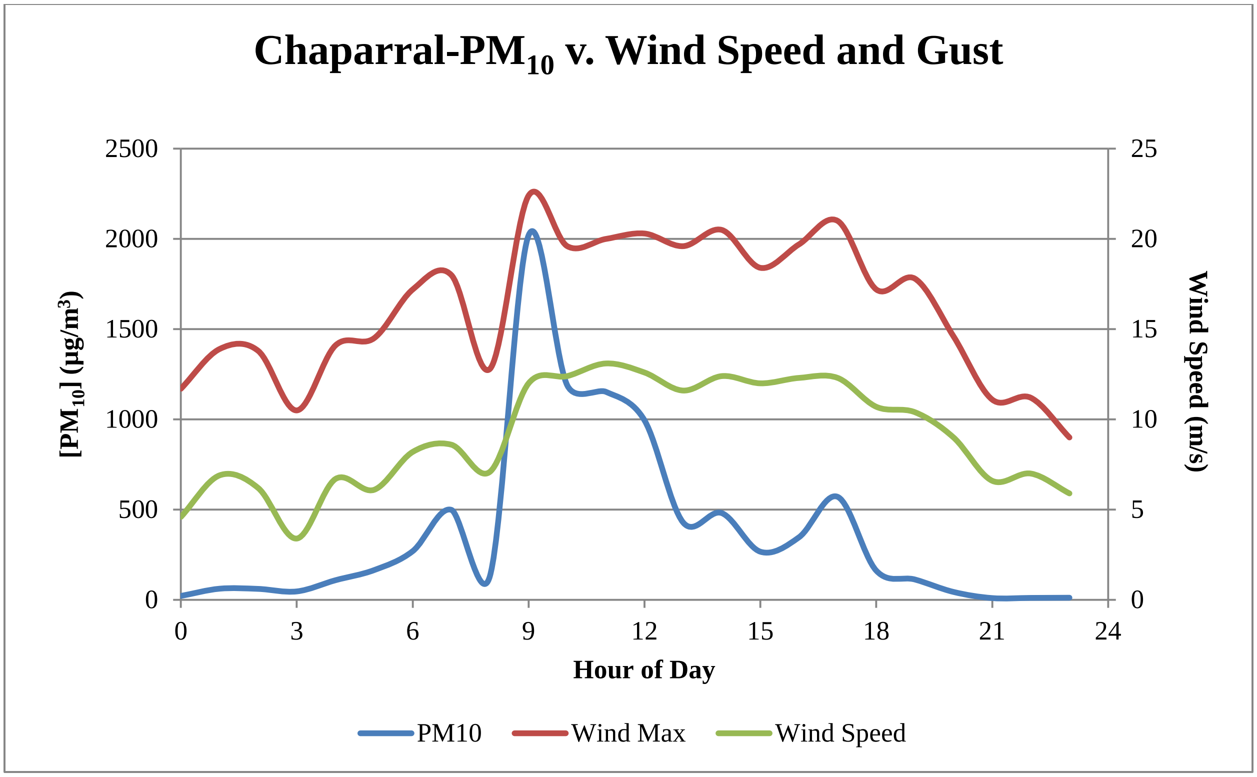

Figure 6-10b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

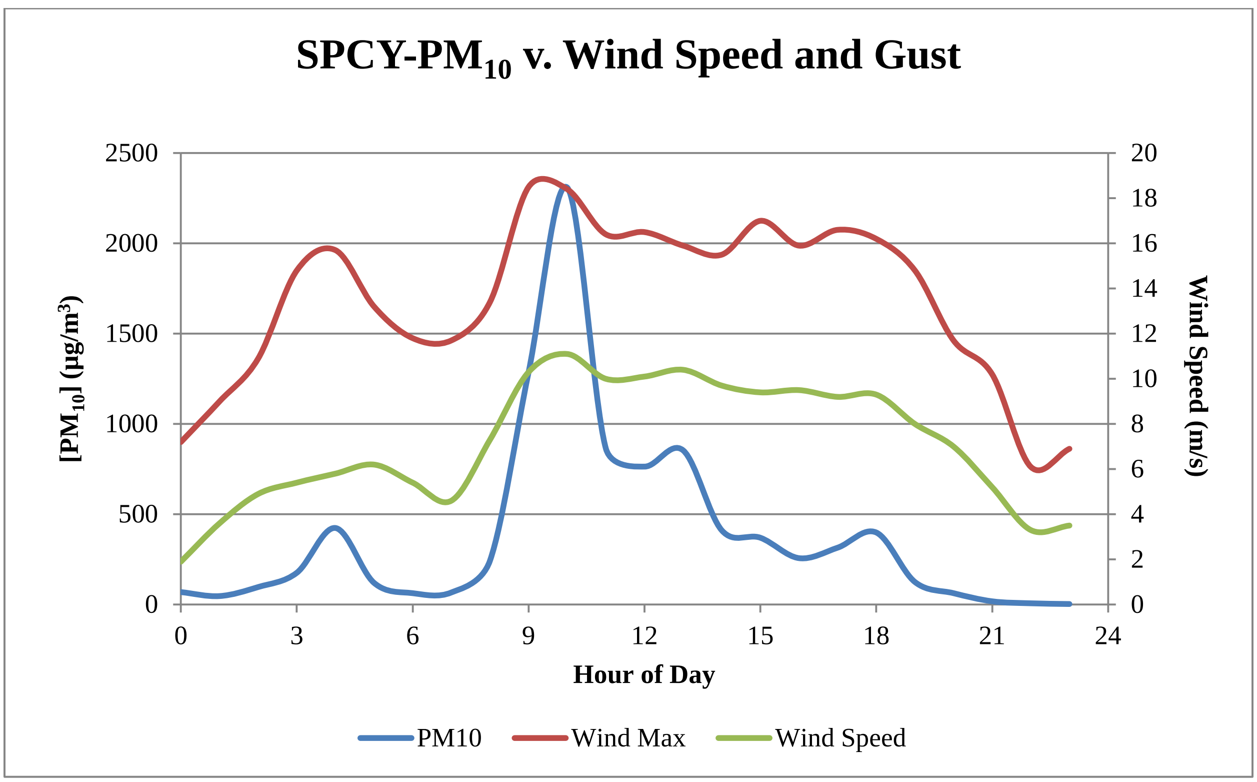

Figure 6-10c. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

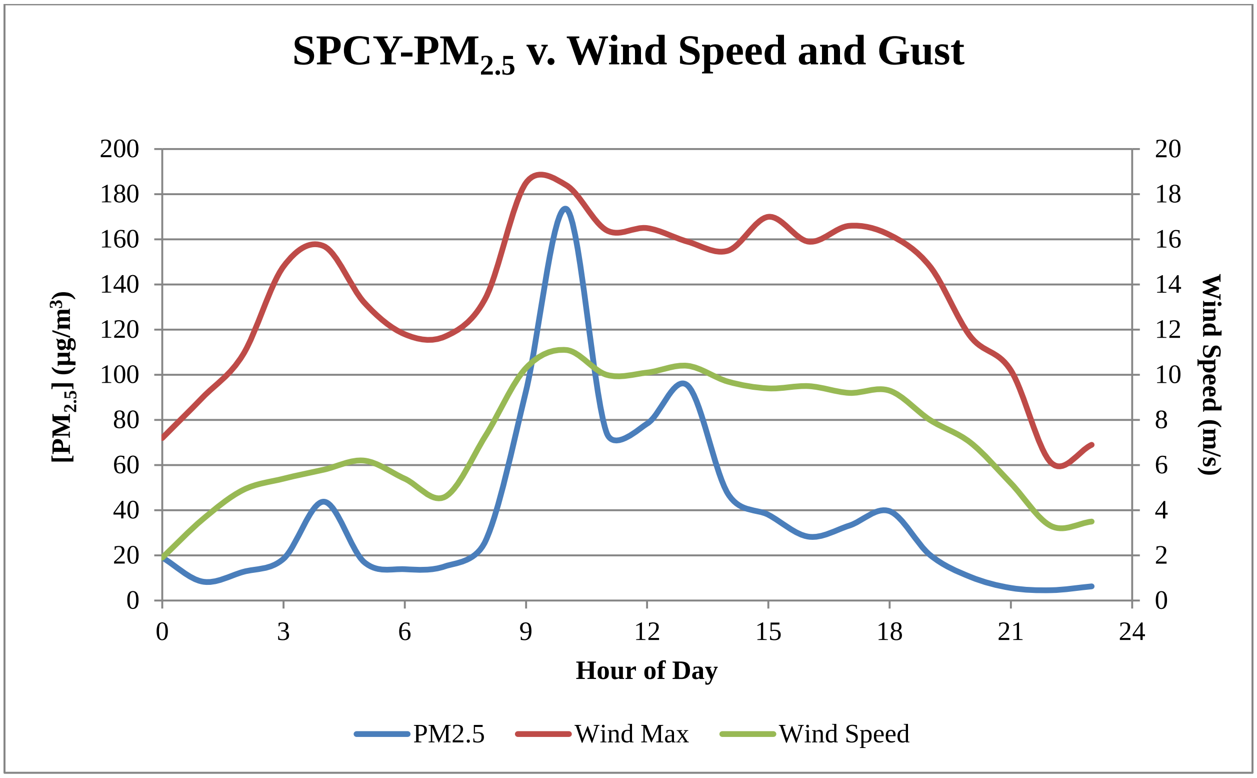

Figure 6-10d. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

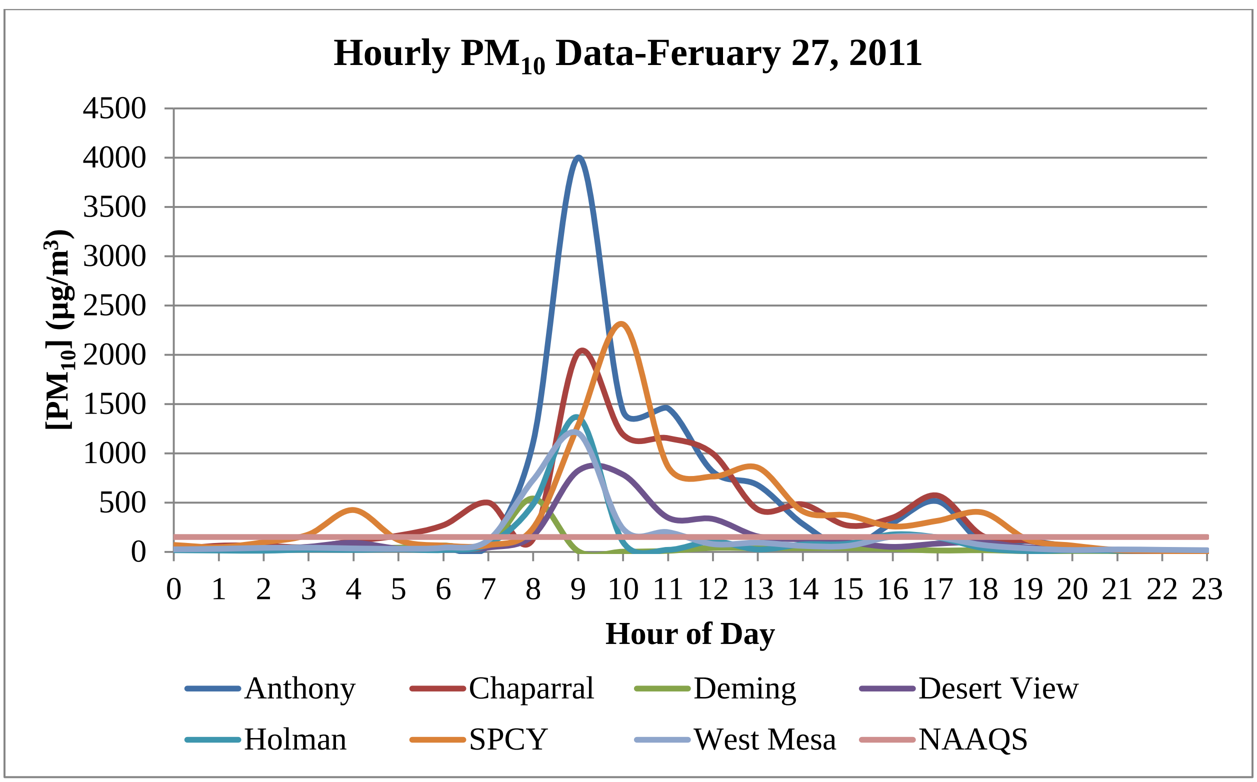

Figure 6-11a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

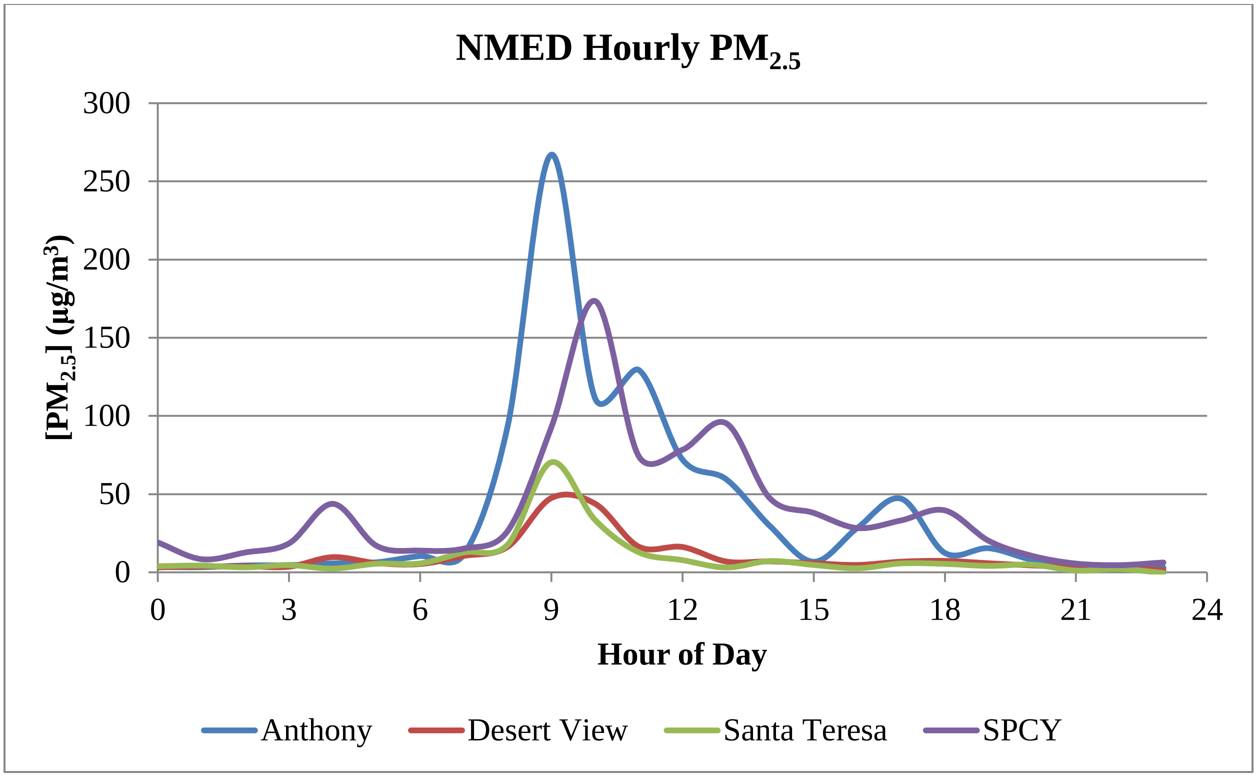

Figure 6-11b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors.

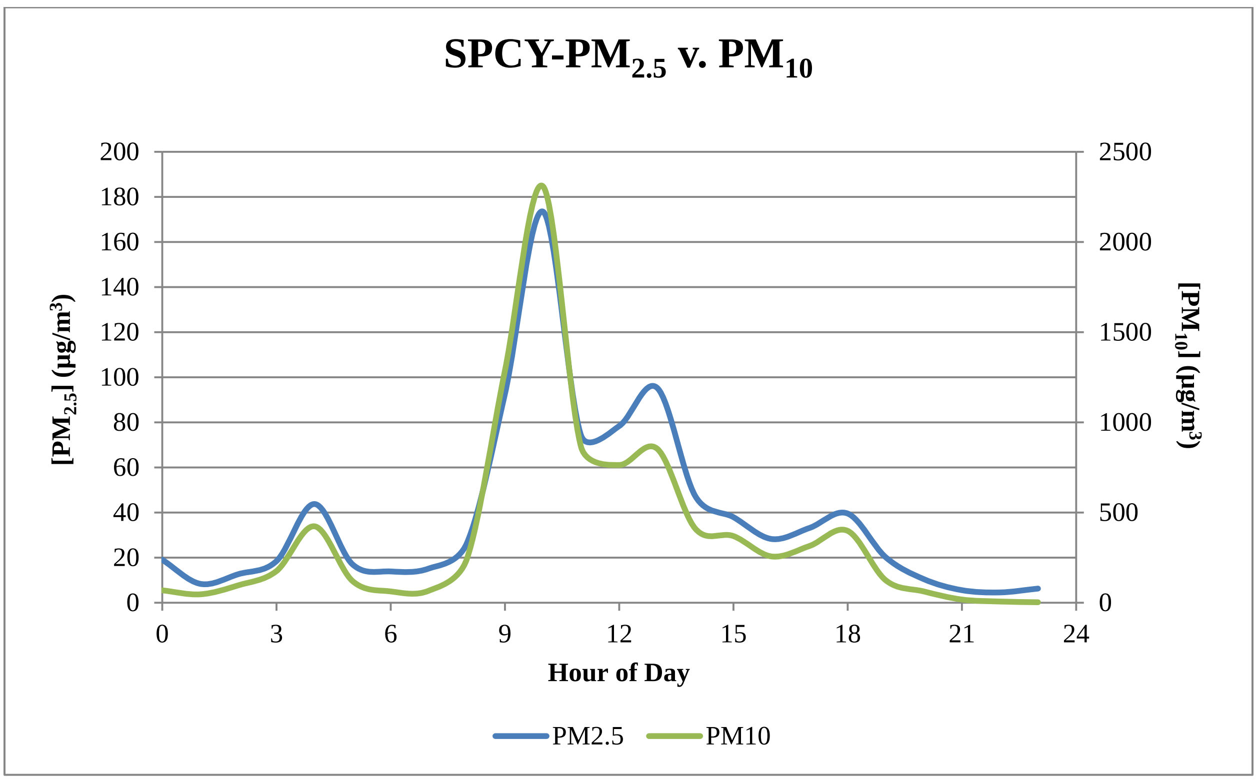

Figure 6-12. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on February 27, 2011.

NASA's MODIS instrument on the Terra satellite passed over New Mexico after the cold front arrived in the border area. Clouds covered NMED's monitoring sites but captured dust plumes and blowing dust over eastern New Mexico and western Texas (Figure 6-13).

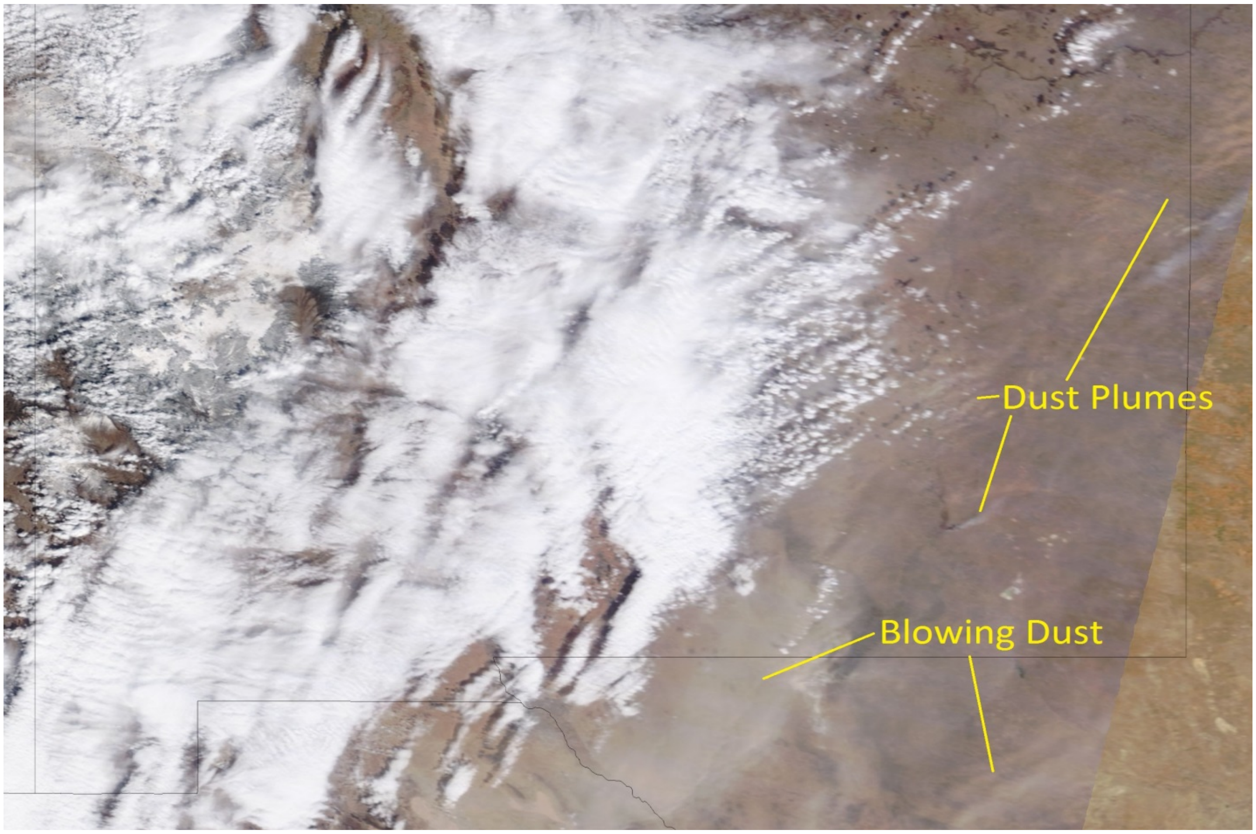

Figure 6-13. Satellite imagery of blowing dust on February 27, 2011. Courtesy of NASA.

6.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on February 27, 2011.

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 Anthony monitor detected blowing dust around the 800 hour with hourly concentrations heavily impacted until the 1700 hour. The nine hourly PM_{10} values from 700-1700 hours alone, exceed the 24-hour average standard at Anthony [(1115 + 4001 + 1428 + 1456 + 812 + 676 + 282 + 293 + 512) µg/m^3 = 10575 µg/m^3; (10575 µg/m^3)/24 = 440µg/m^3]. By replacing these nine hourly values with the 95th percentile of hourly data at the Anthony site, the resulting 24-hour average (76µg/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	30	30
1	26	26
2	31	31
3	41	41
4	32	32
5	33	33
6	38	38
7	69	69
8	1115	**109**
9	4001	**88**
10	1428	**95**
11	1456	**106**
12	812	**136**
13	676	**146**
14	282	**177**
15	46	46
16	293	**152**
17	512	**194**
18	96	96
19	109	109
20	49	49
21	6	6
22	5	5
23	5	5
24-Hour Average	466	**76**

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 900 hour with hourly concentrations heavily impacted until the 1700 hour. The ten hourly PM_{10} values from 900-1800 hours, exceed the 24-hour average standard at Chaparral [(2020 + 1189 + 1153 + 995 + 429 + 481 + 267 + 347 + 571 + 162 $\mu g/m^3$ = 7614 $\mu g/m^3$; (7614 $\mu g/m^3$)/24 = 317$\mu g/m^3$]. By replacing these ten hourly values with the 95th percentile of hourly data at the Chaparral site, the resulting 24-hour average (114$\mu g/m^3$) 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	22	22
1	62	62
2	61	61
3	47	47
4	109	109
5	165	165
6	270	270
7	499	499
8	133	133
9	2020	**74**
10	1189	**79**
11	1153	**87**
12	995	**120**
13	429	**151**
14	481	**141**
15	267	**147**
16	347	**127**
17	571	**122**
18	162	**120**
19	113	113
20	44	44
21	10	10
22	11	11
23	12	12
24-Hour Average	382	**114**

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 SPCY monitor detected blowing dust around the 800 hour with hourly concentrations heavily impacted until the 1800 hour. The eleven hourly PM_{10} values from 800-1700 hours alone, exceed the 24-hour average standard at SPCY [(243 + 1287 + 2309 + 864 + 754 + 854 + 411 + 370 + 257 + 315 + 399) µg/m^3 = 8073µg/m^3; (8073 µg/m^3)/24 = 336µg/m^3]. By replacing these eleven hourly values with the 95th percentile of hourly data at the SPCY site, the resulting 24-hour average (101µg/m^3) does not exceed the NAAQS (Table 6-3). 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	69	69
1	47	47
2	97	97
3	176	176
4	424	424
5	120	120
6	66	66
7	67	67
8	243	**98**
9	1287	**93**
10	2309	**93**
11	864	**95**
12	764	**104**
13	854	**125**
14	411	**145**
15	370	**160**
16	257	**168**
17	315	**201**
18	399	**296**
19	125	125
20	63	63
21	18	18
22	7	7
23	3	3
24-Hour Average	389	**119**

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

7 HIGH WIND EXCEPTIONAL EVENT: March 7, 2011

7.1 Summary of Event

The passing of a backdoor 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, Desert View, Holman, SPCY and West Mesa monitoring sites on this date. The FEM TEOM continuous monitors at these sites recorded 24-hour average concentrations of 462, 410, 714, 348, 467, 626, and 160 µg/m^3, respectively. The PM2.5 FRM Partisol at SPCY recorded a 24-hour average of 61 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 an extreme event affecting the entire border area with all monitoring sites in Doña and Luna Counties recording exceedances on this date (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 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.

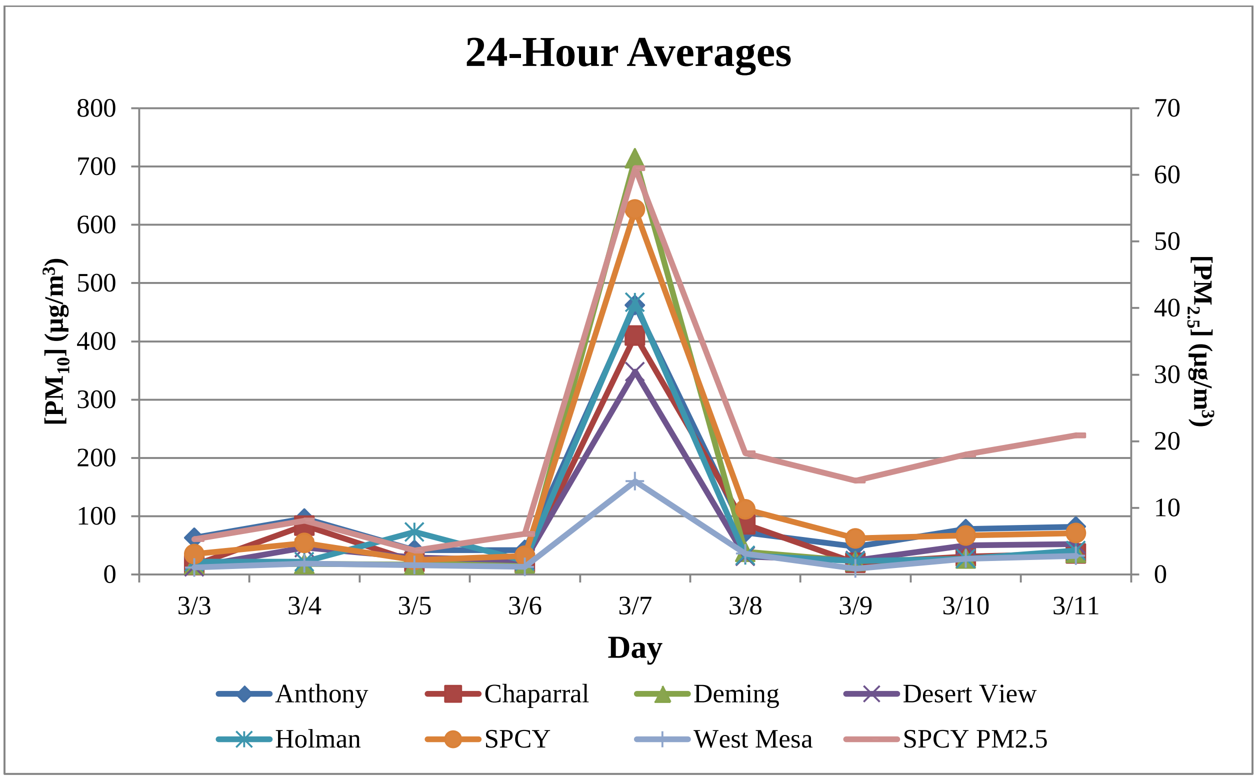

Figure 7-1. PM_{10} and $PM_{2.5}$ 24-hour averages before and after March 7, 2011.

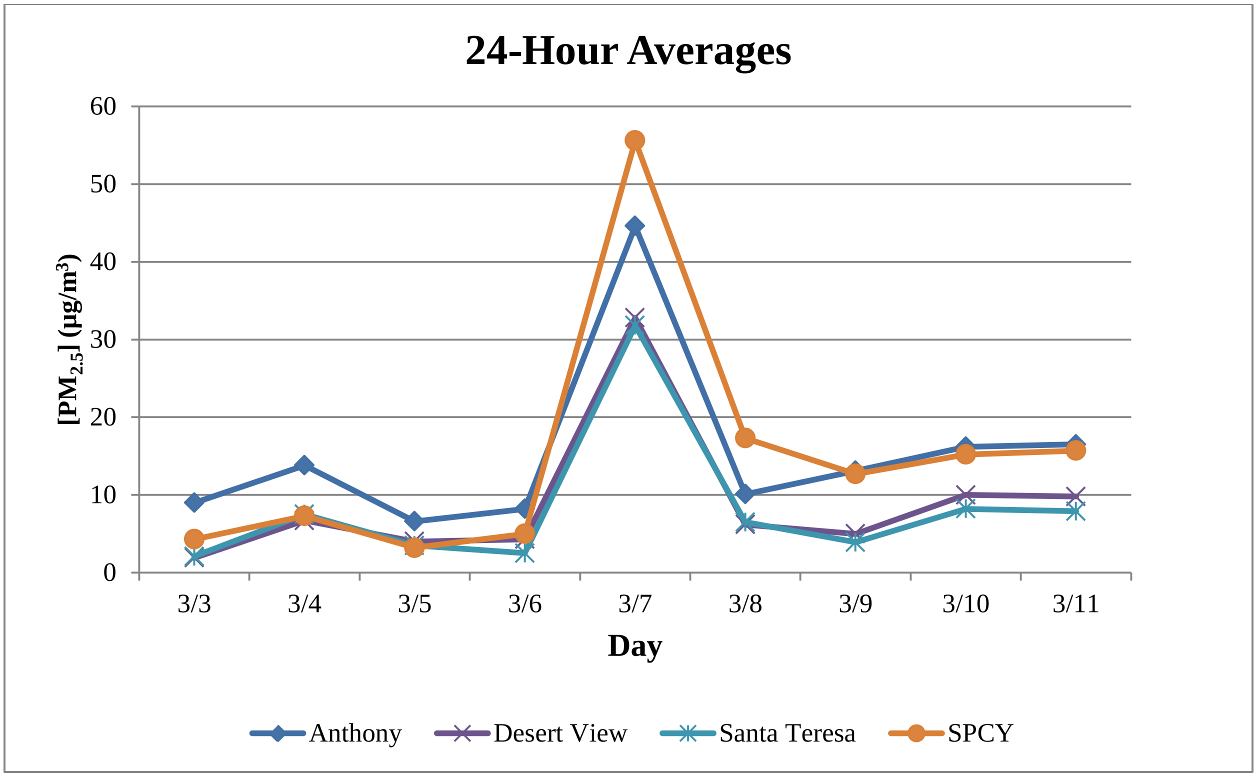

Figure 7-2. $PM_{2.5}$ 24-hour averages before and after March 7, 2011. Non-FEM TEOM Data.

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 Arizona, Mexico and New Mexico. Agricultural tilling and crop planting may have contributed to this event. The City of Las Cruces, City of Deming, Doña Ana and Luna County Ordinances requires BACM for any dust producing activities. The largest and most likely sources of windblown dust are/is the natural desert and/or 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, 2011, sustained wind speeds exceeded EPA's default threshold at seven of the seven monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at seven of the seven 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 1830 hour.

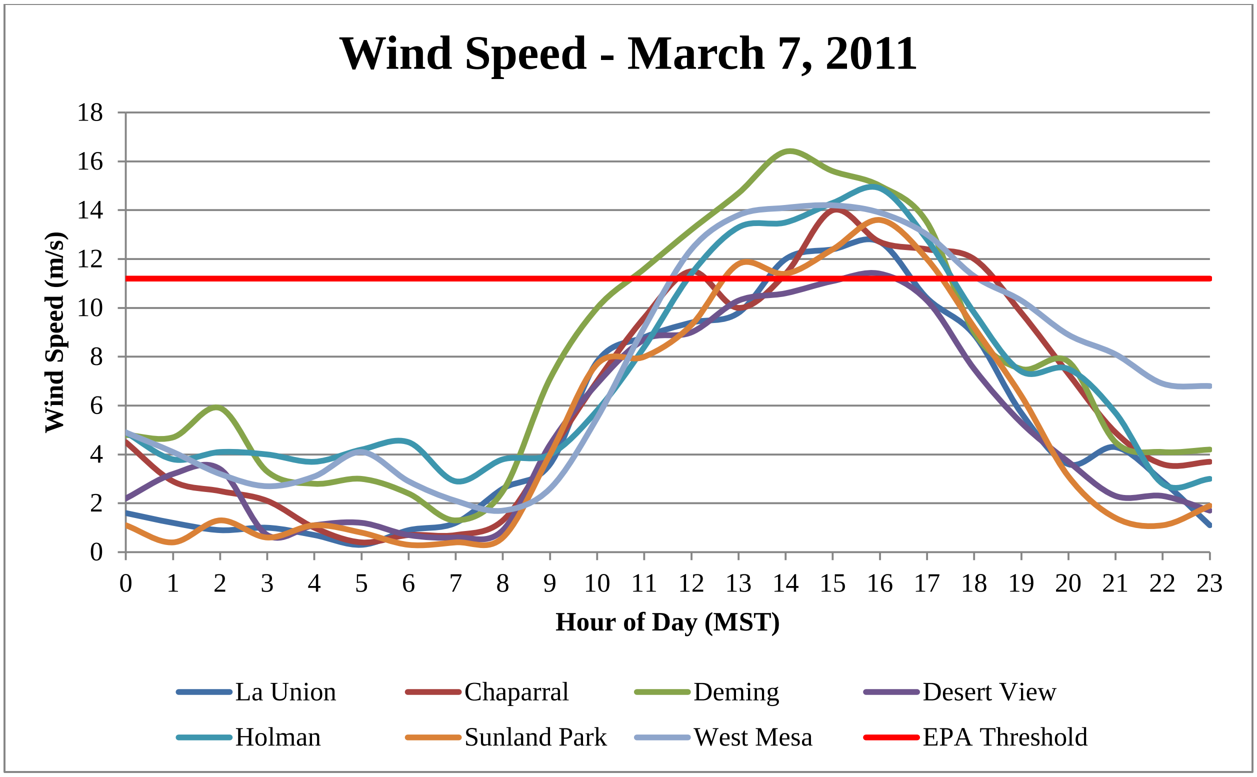

Figure 7-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

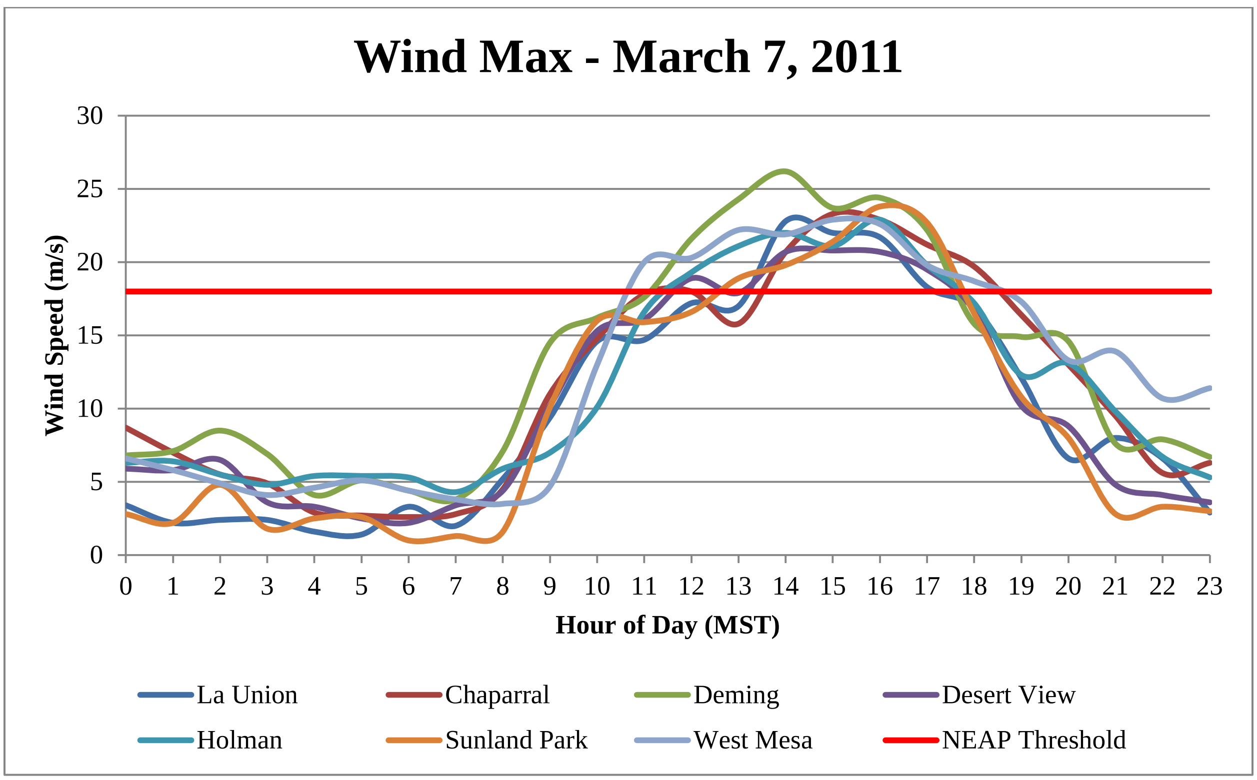

Figure 7-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

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 2006-2010 the PM_{10} FEM TEOM monitors recorded 211 exceedances and the PM_{10} FRM Wedding monitors recorded 5 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 (Table 2-1). The SPCY $PM_{2.5}$ FRM Partisol recorded 23 exceedances of the 24-Hour NAAQS from 2006-2010 (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, Arizona and northern Mexico. The 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 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 Arizona and Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

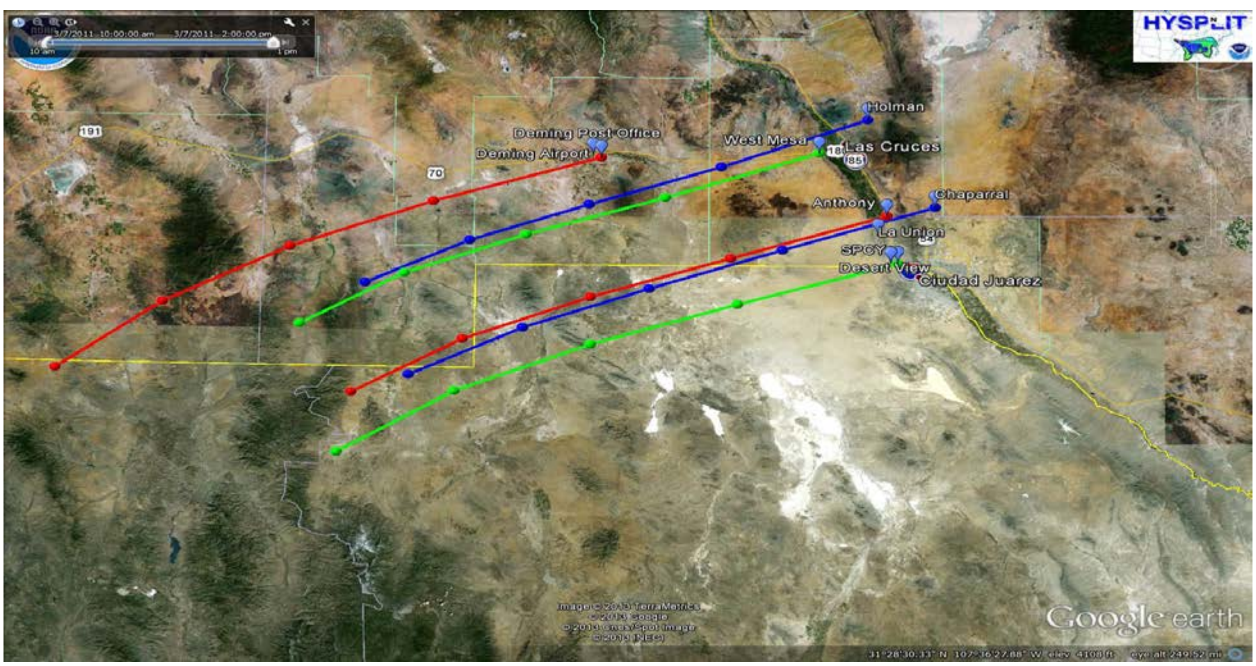

Figure 7-5. HYSPLIT back-trajectory model analysis for March 7, 2011.

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-4 through B-11). 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 2006-2010 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 2006-2010. 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 2006-2010. The recorded values for this day (462, 410, 714, 348, 467, 626, and 160 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 7, 2011 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 7-6a-h through 7-8a-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.

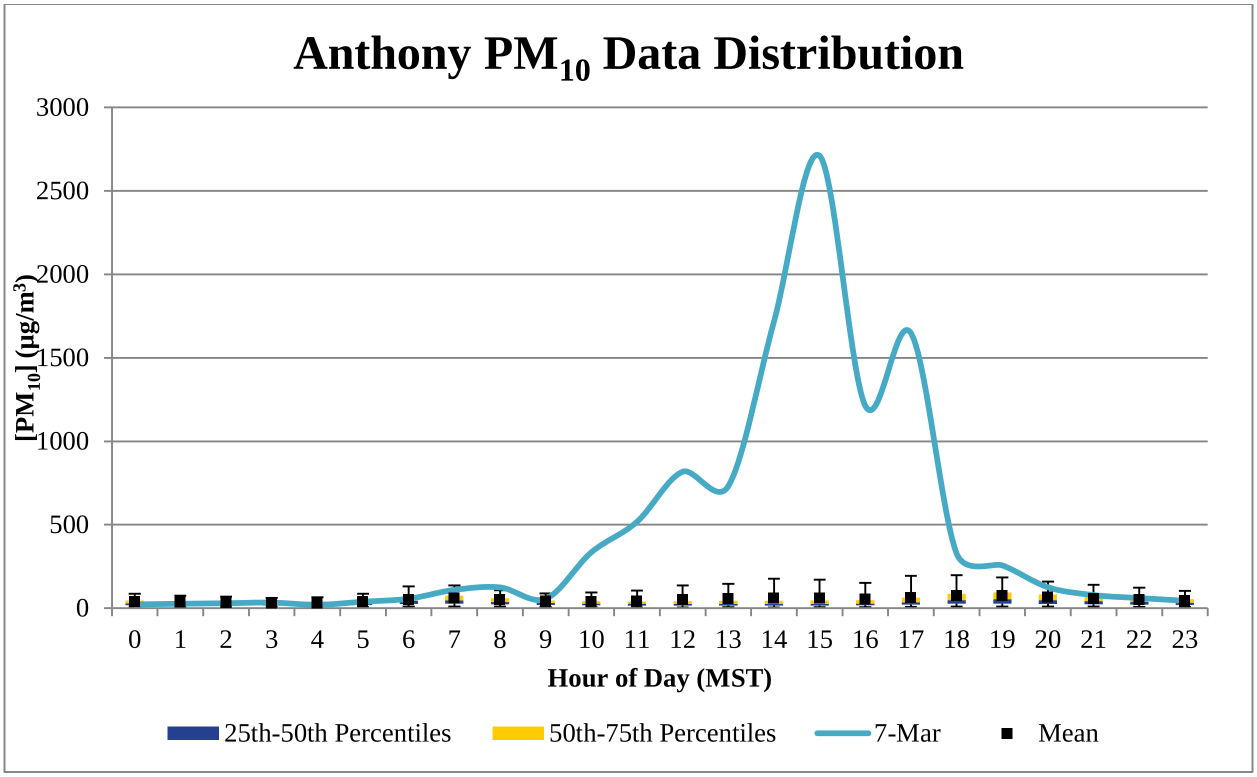

Figure 7-6a. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

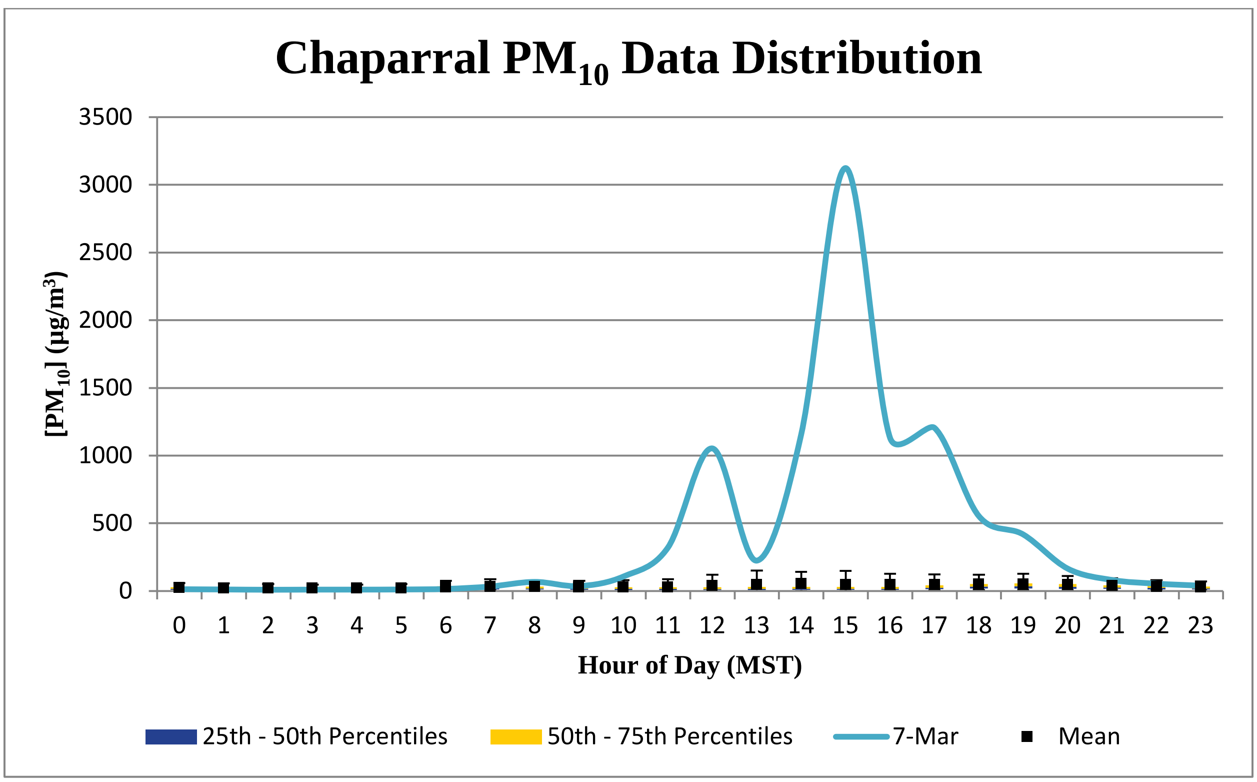

Figure 7-6b. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

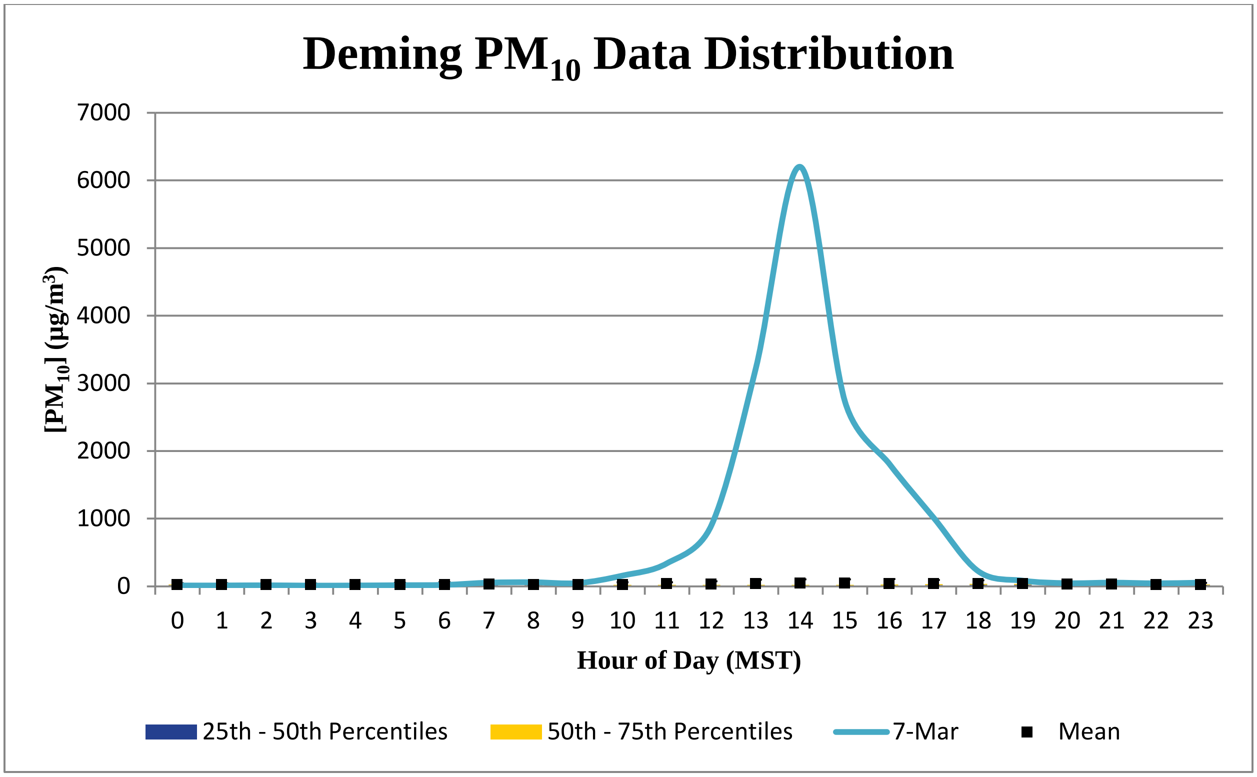

Figure 7-6c. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

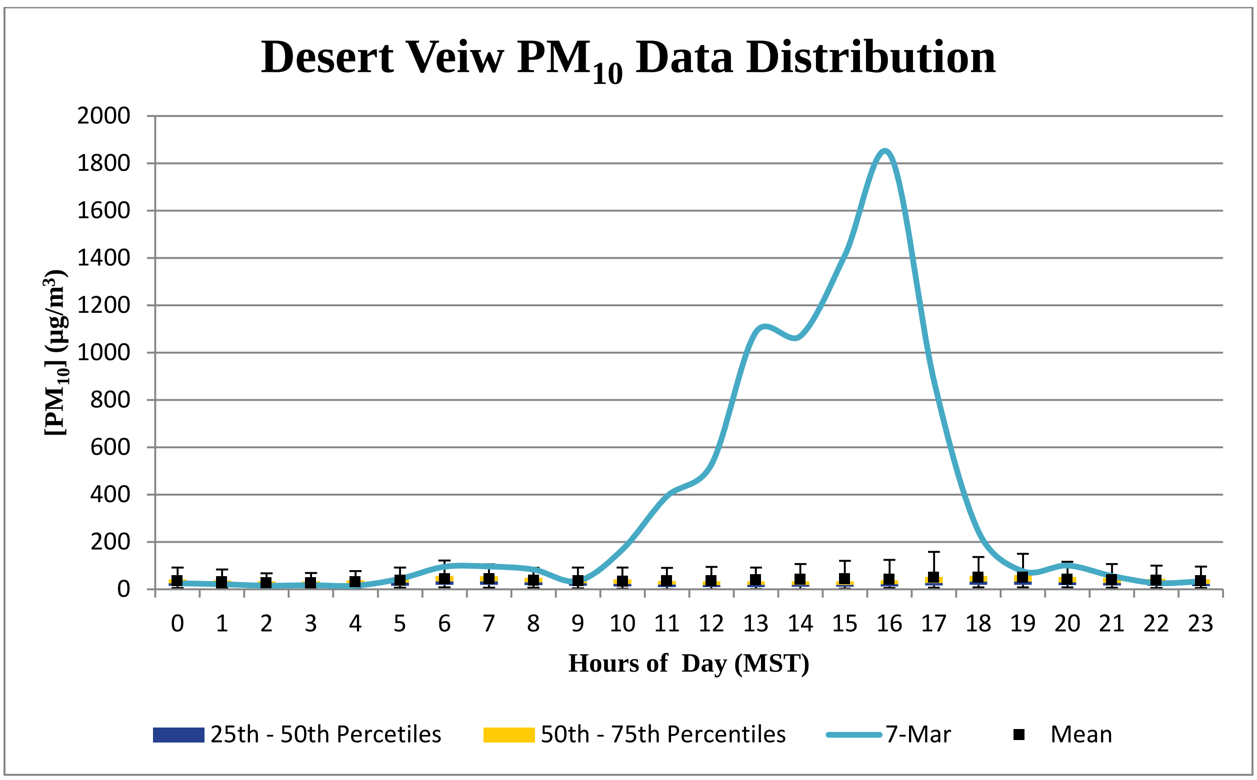

Figure 7-6d. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

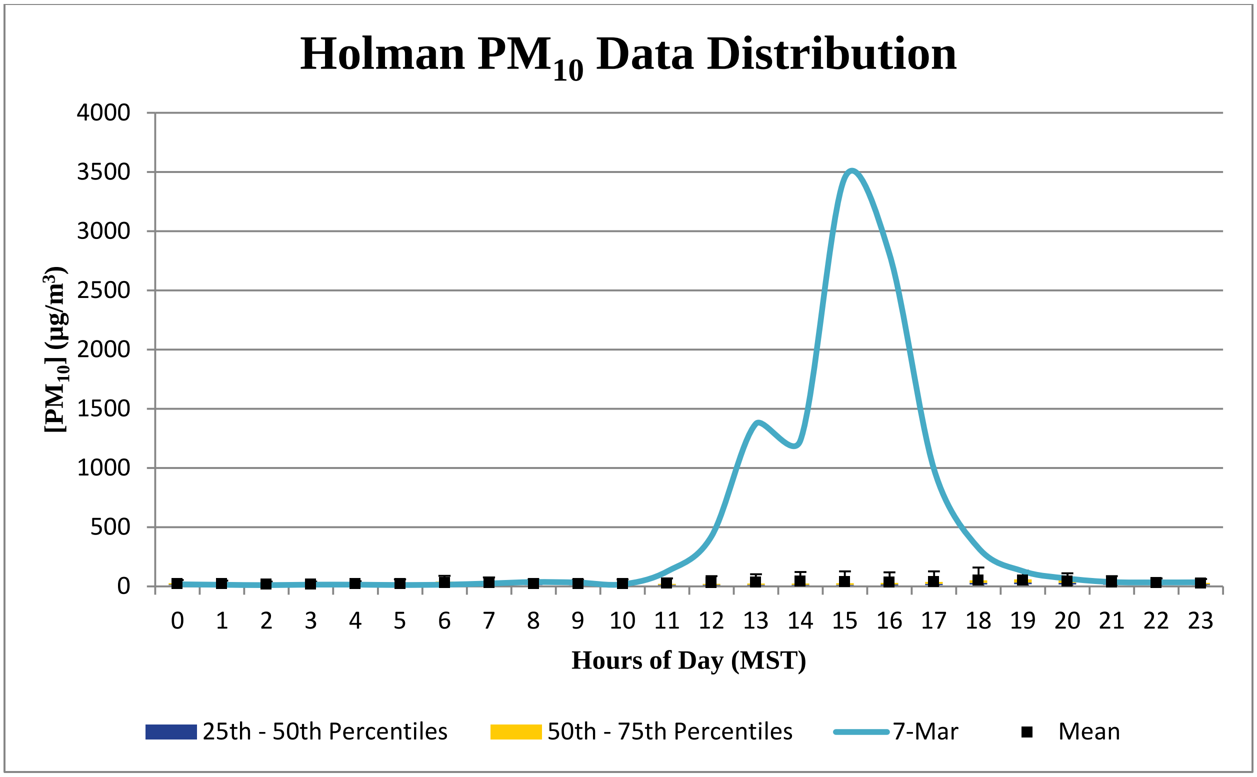

Figure 7-6e. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

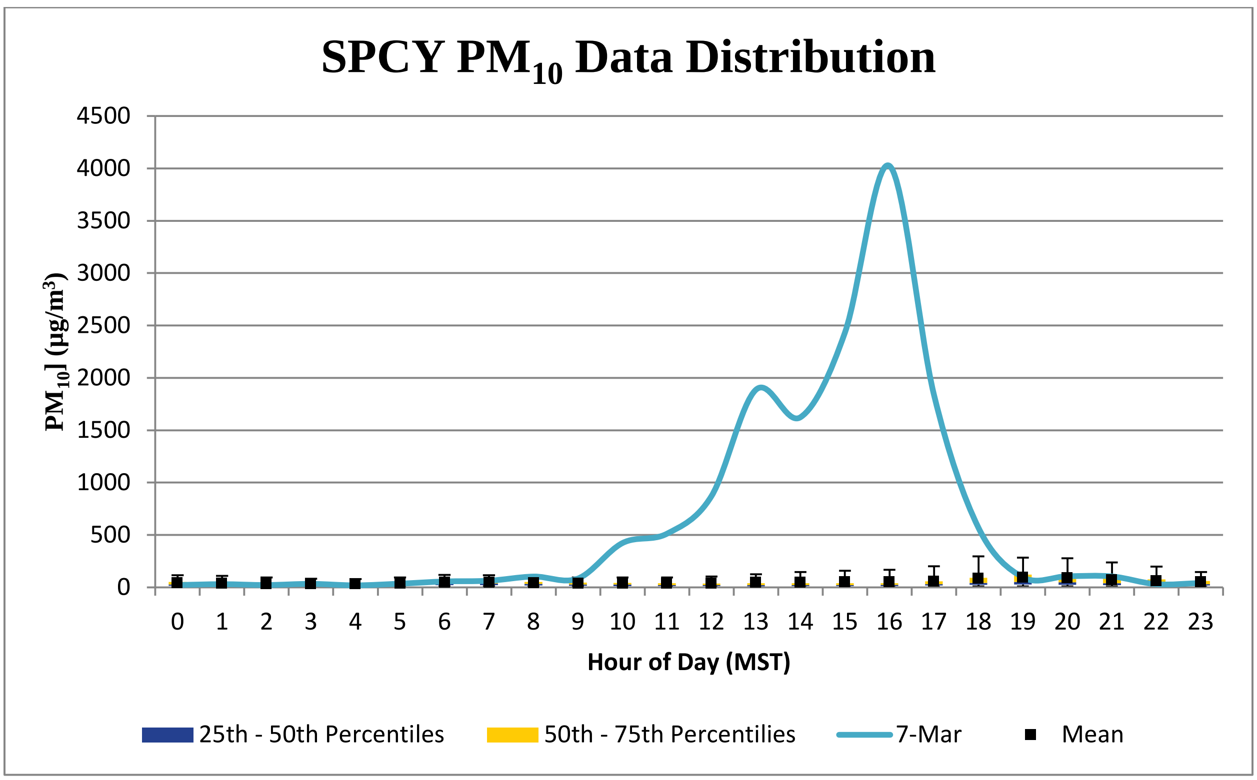

Figure 7-6f. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

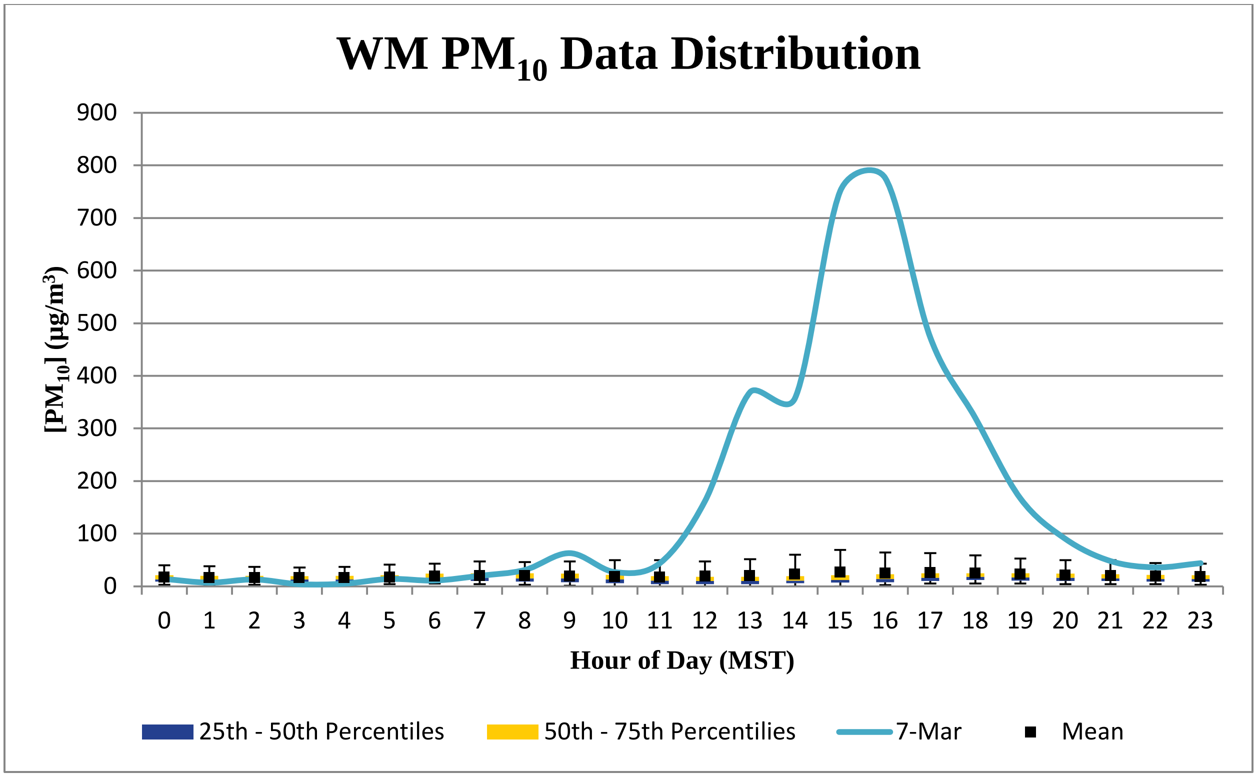

Figure 7-6g. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

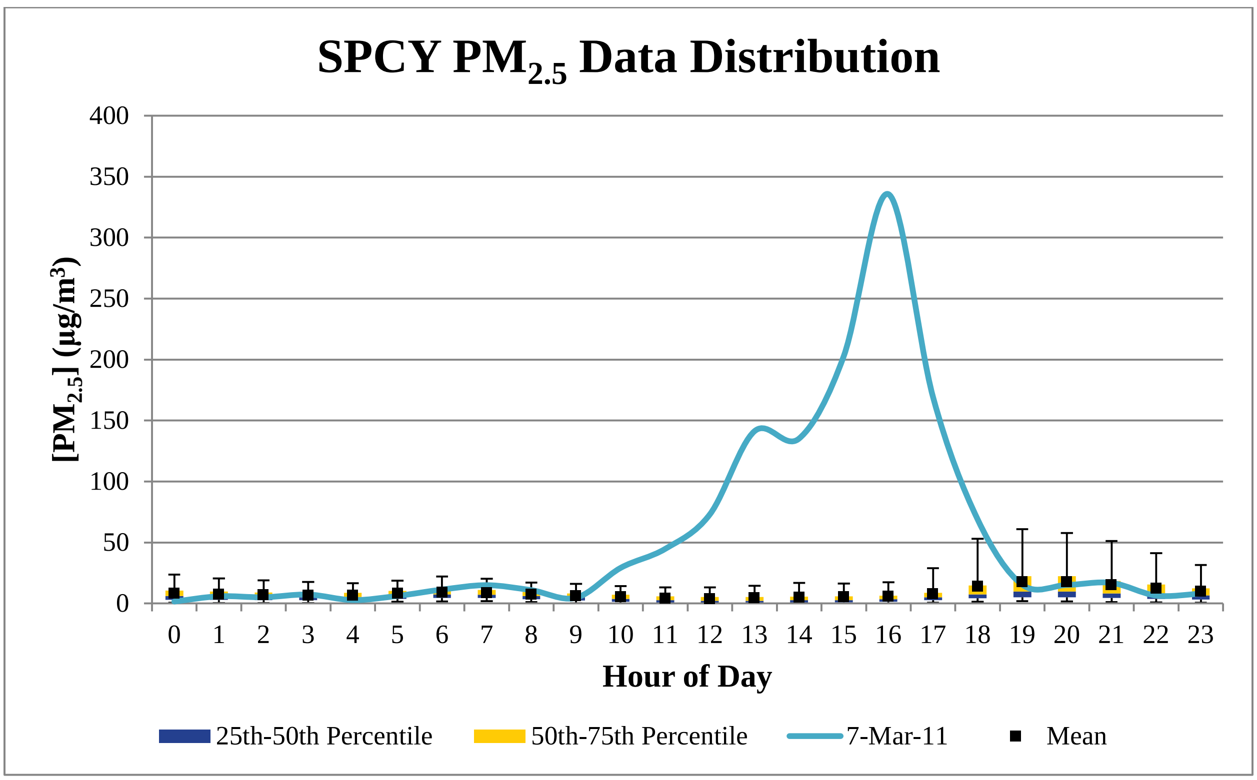

Figure 7-6h. $PM_{2.5}$ hourly data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

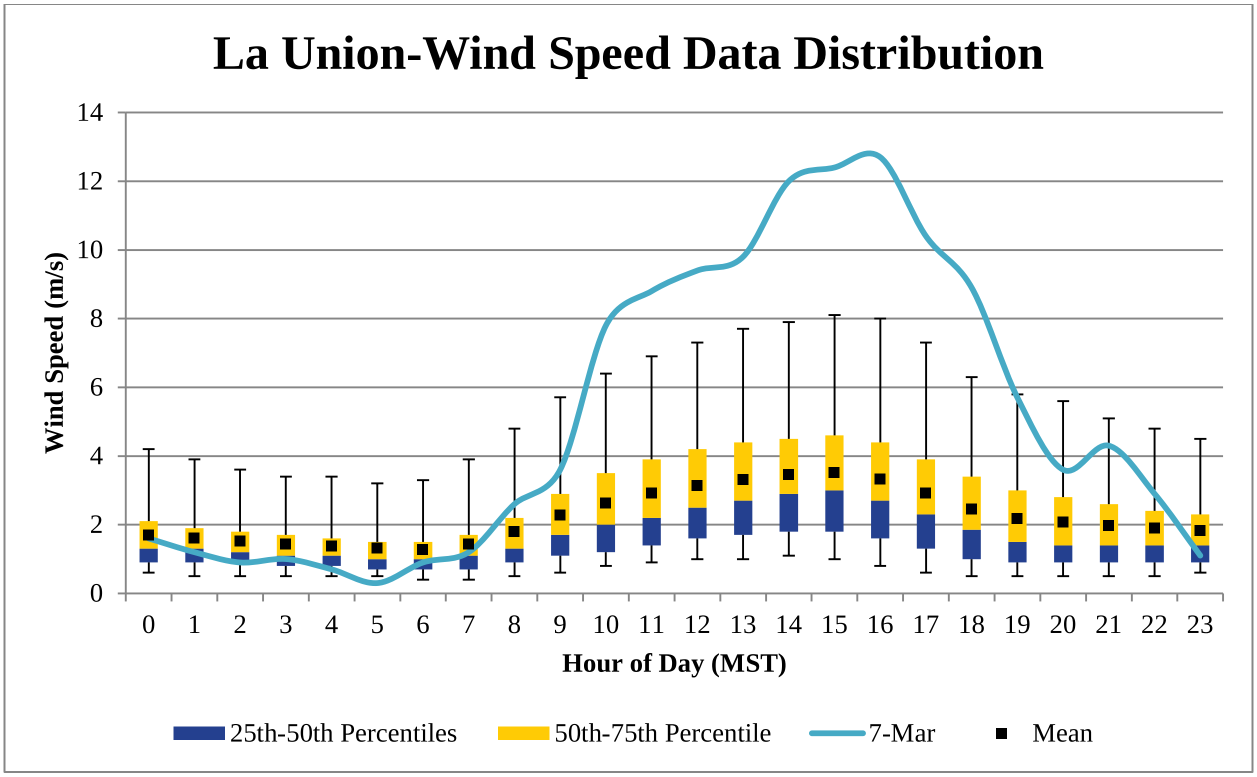

Figure 7-7a. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

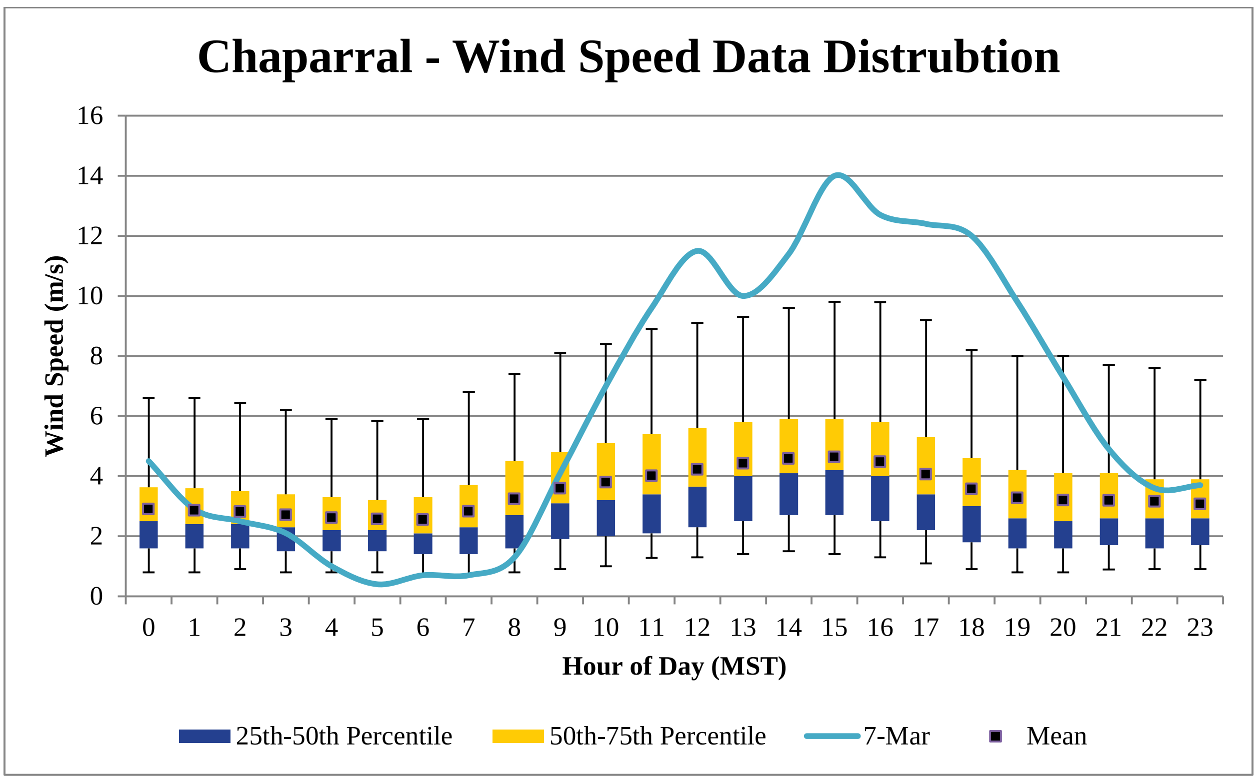

Figure 7-7b. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

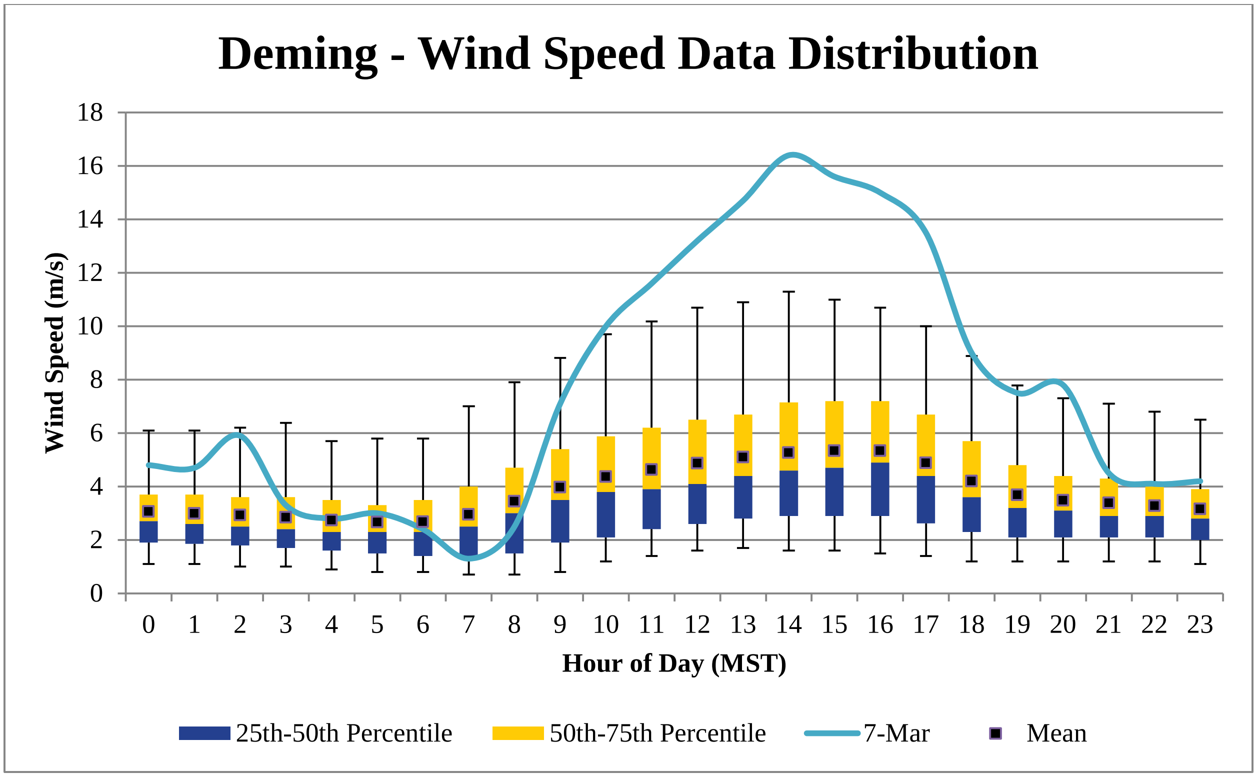

Figure 7-7c. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

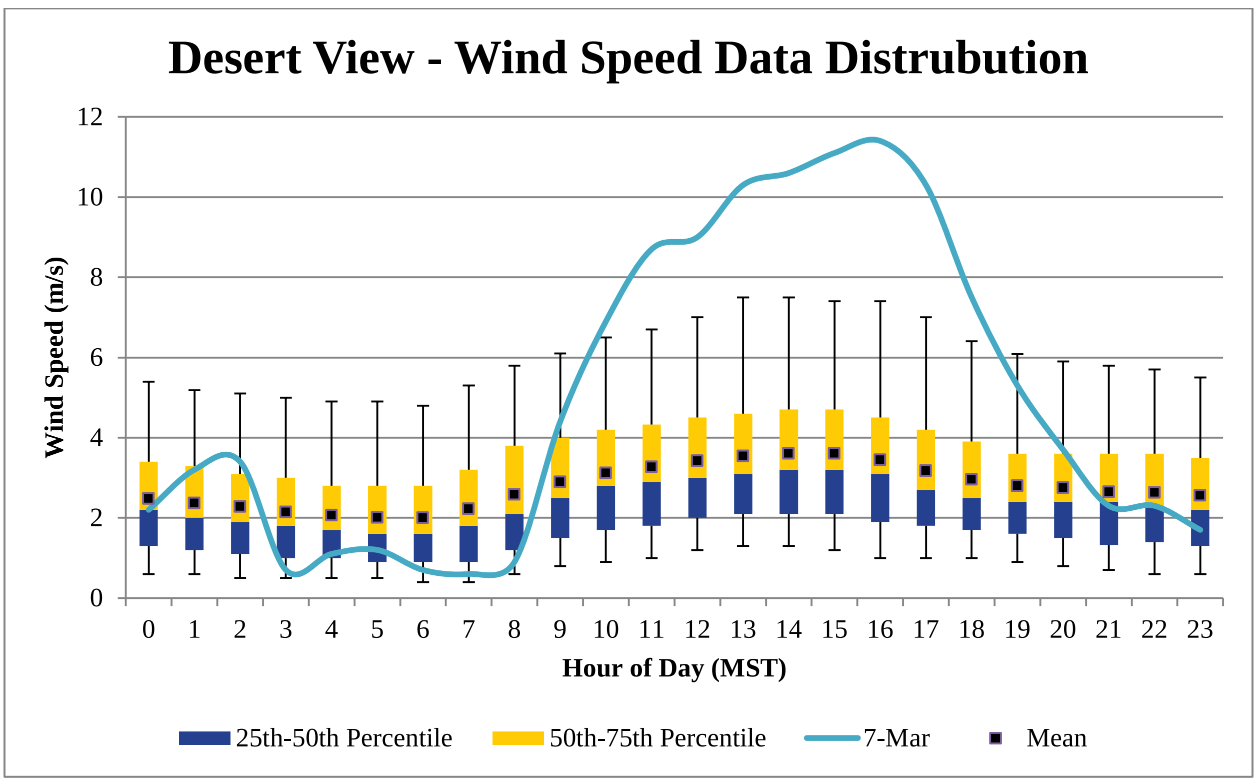

Figure 7-7d. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

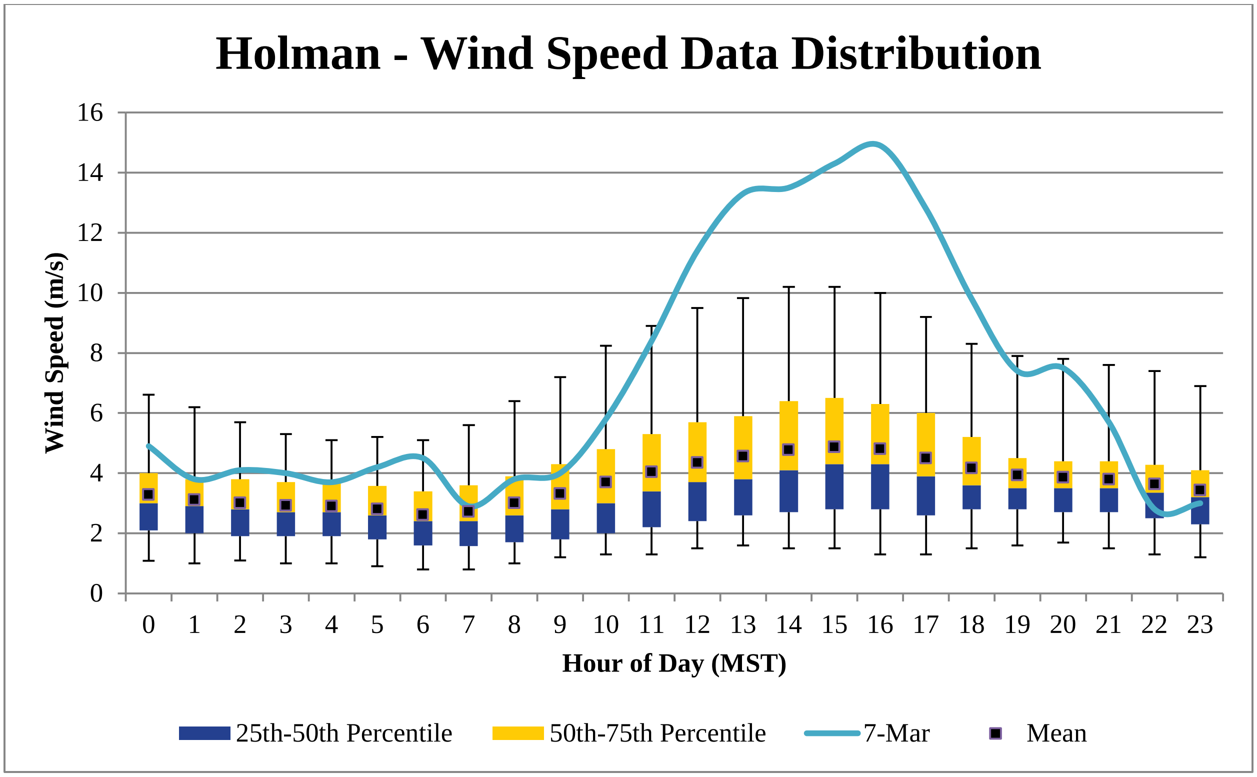

Figure 7-7e. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

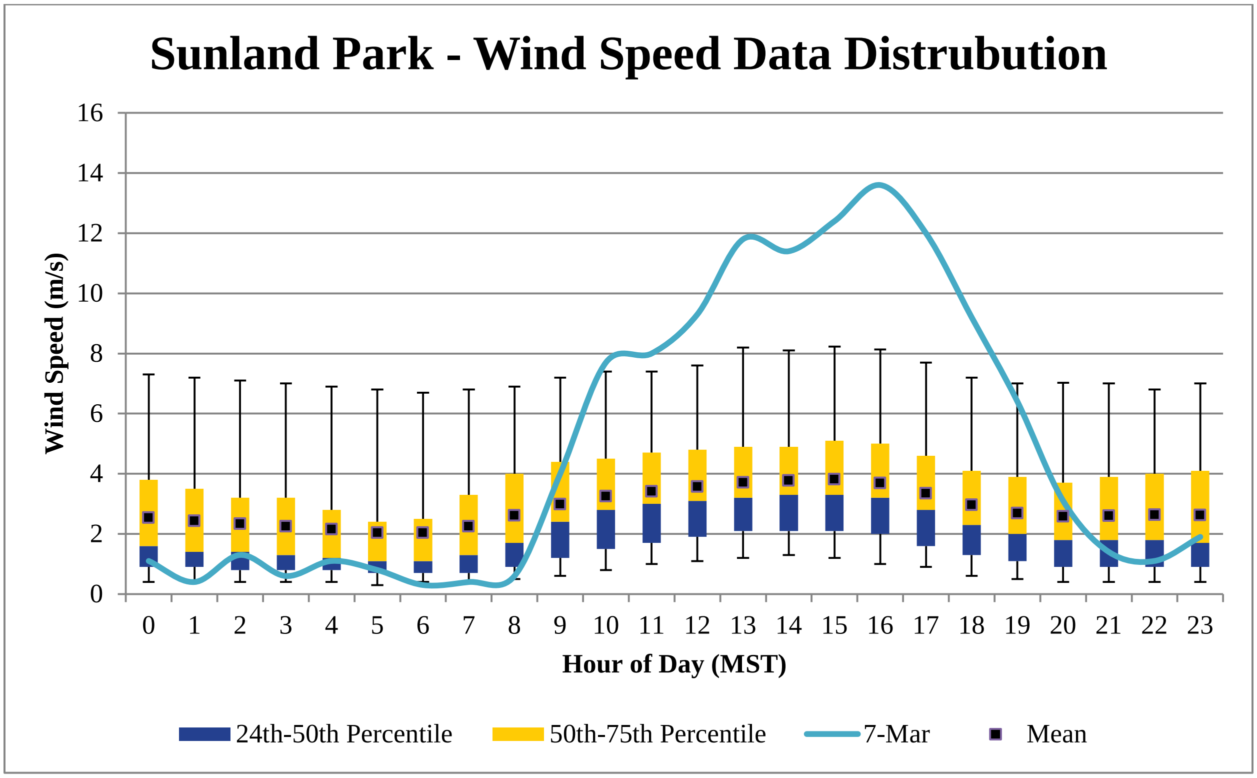

Figure 7-7f. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

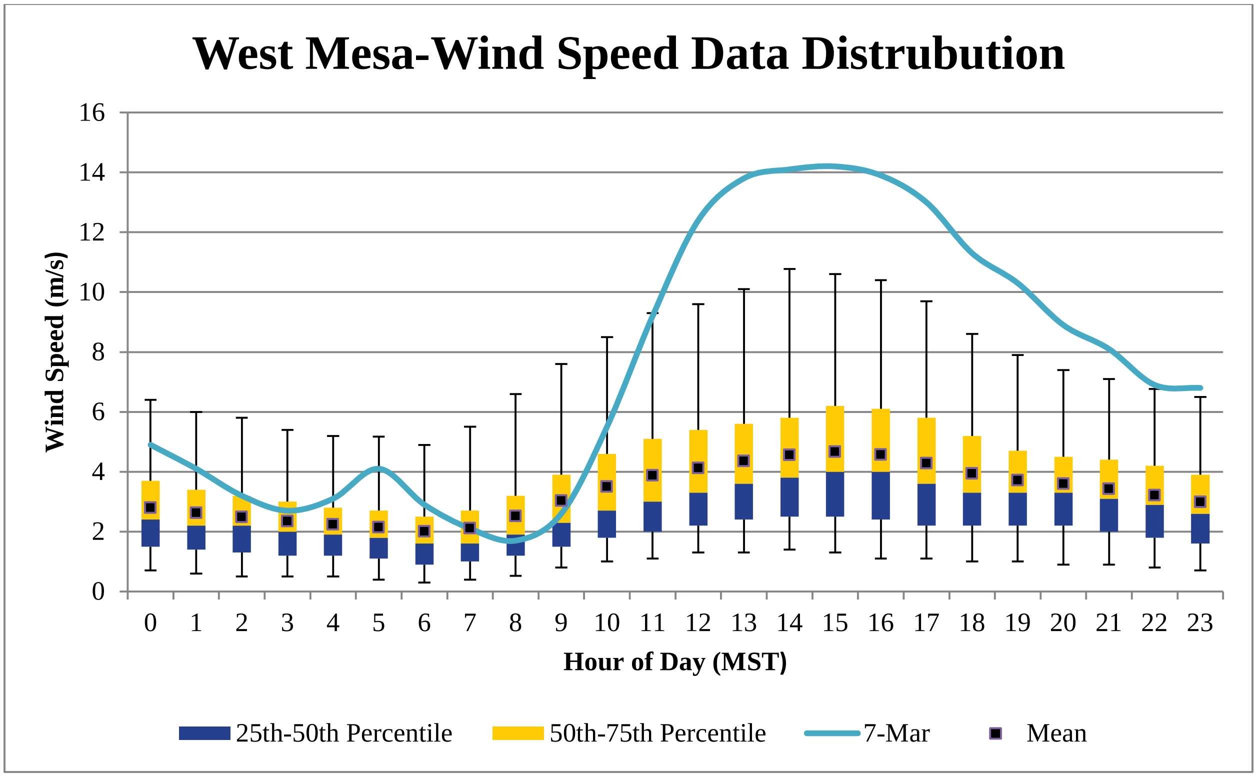

Figure 7-7g. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

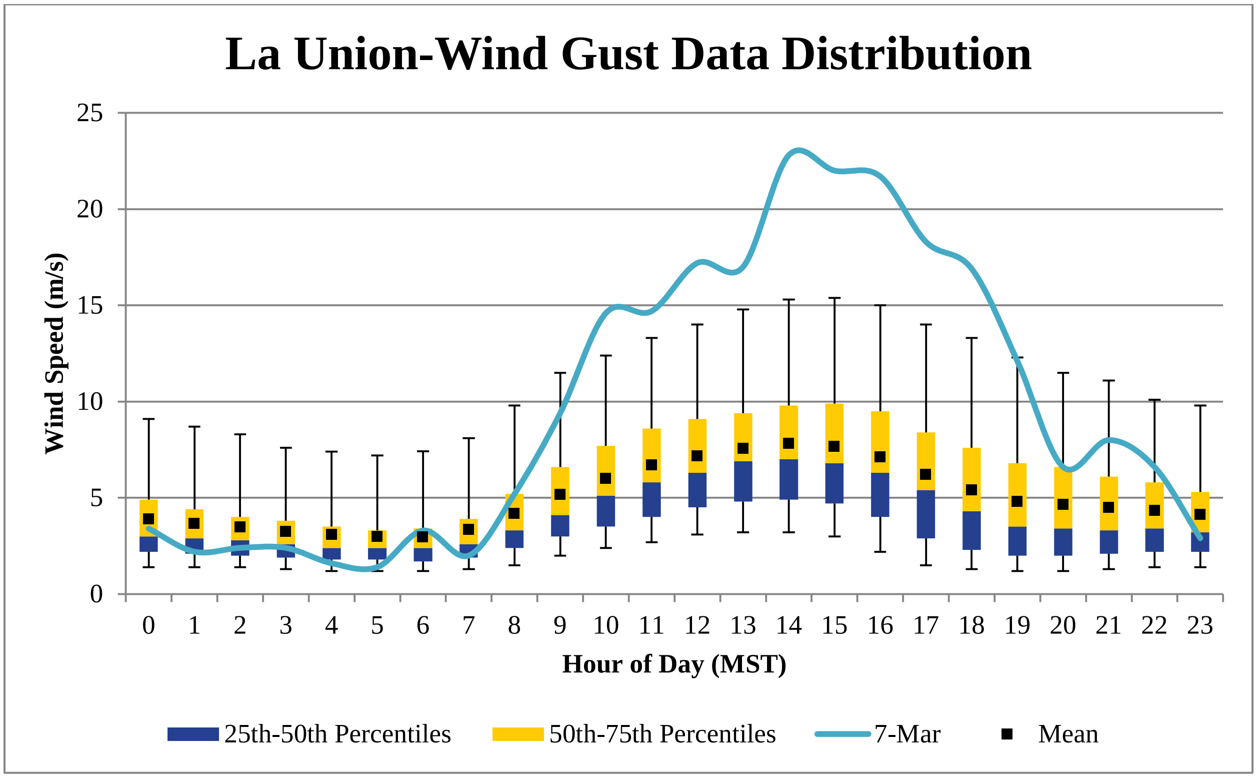

Figure 7-8a. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

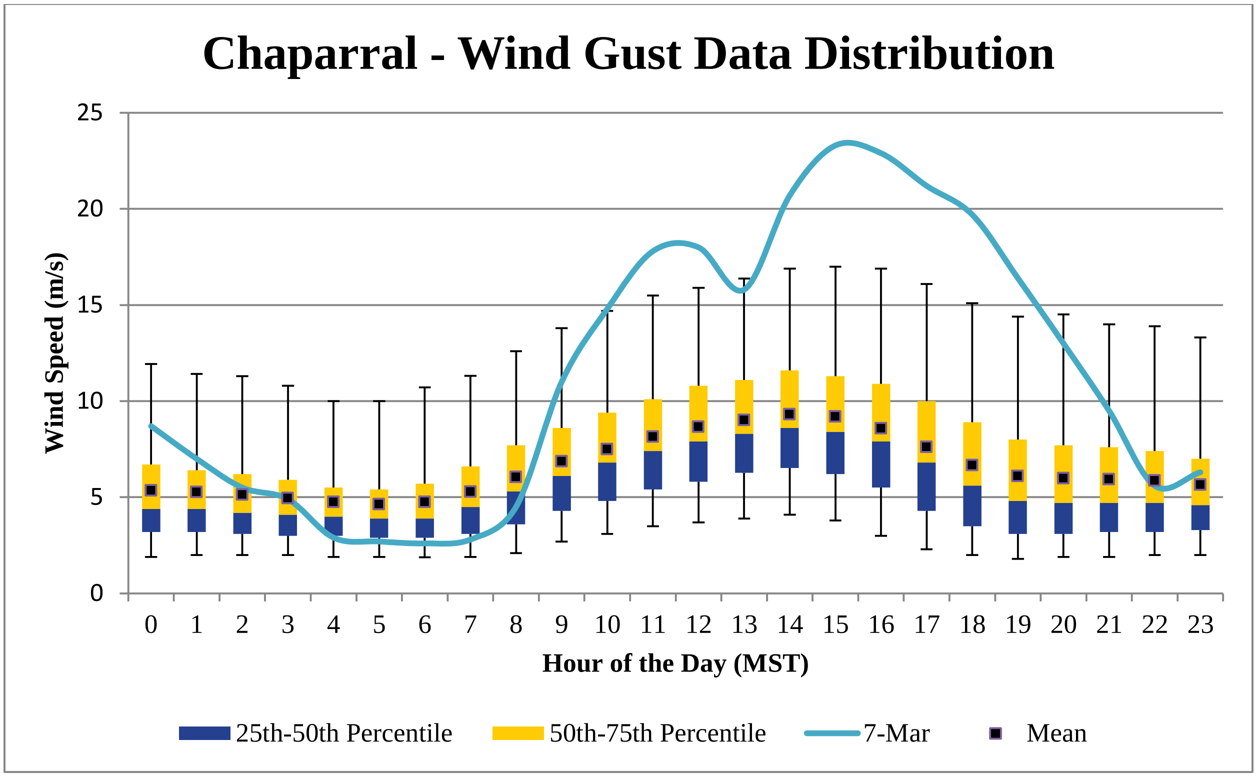

Figure 7-8b. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

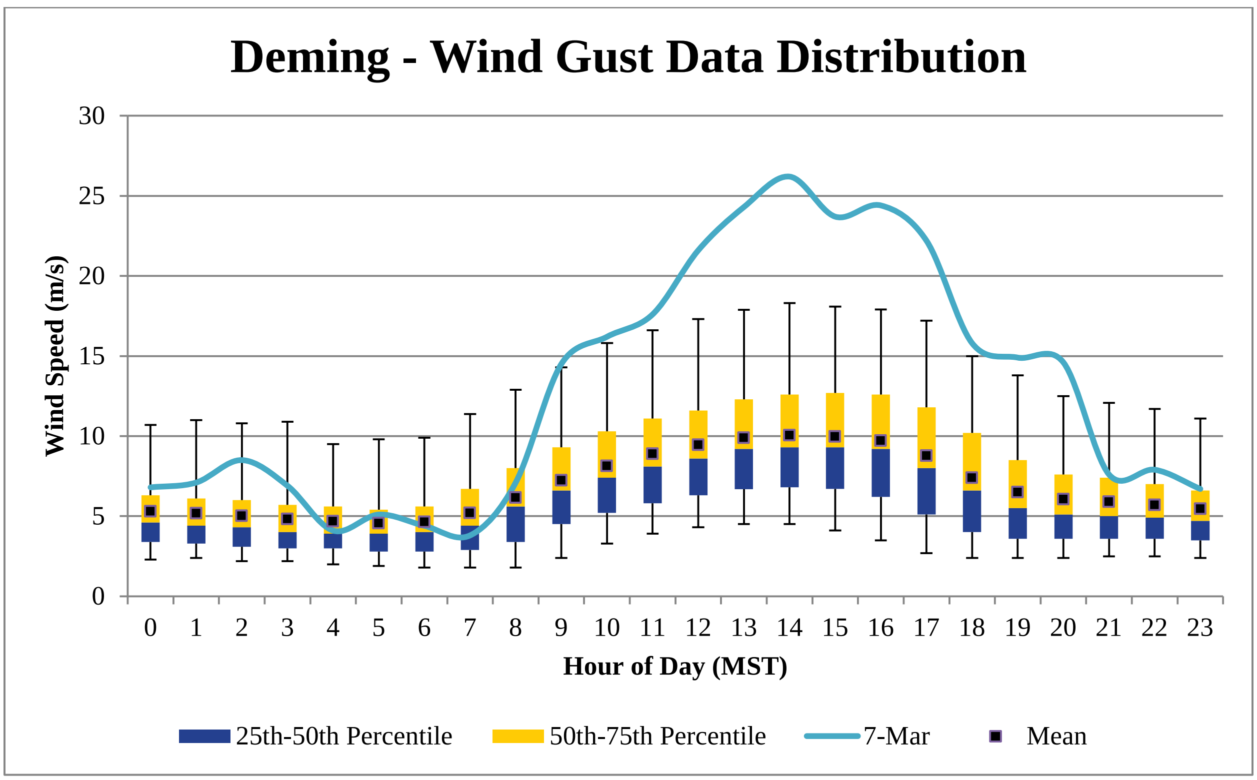

Figure 7-8c. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

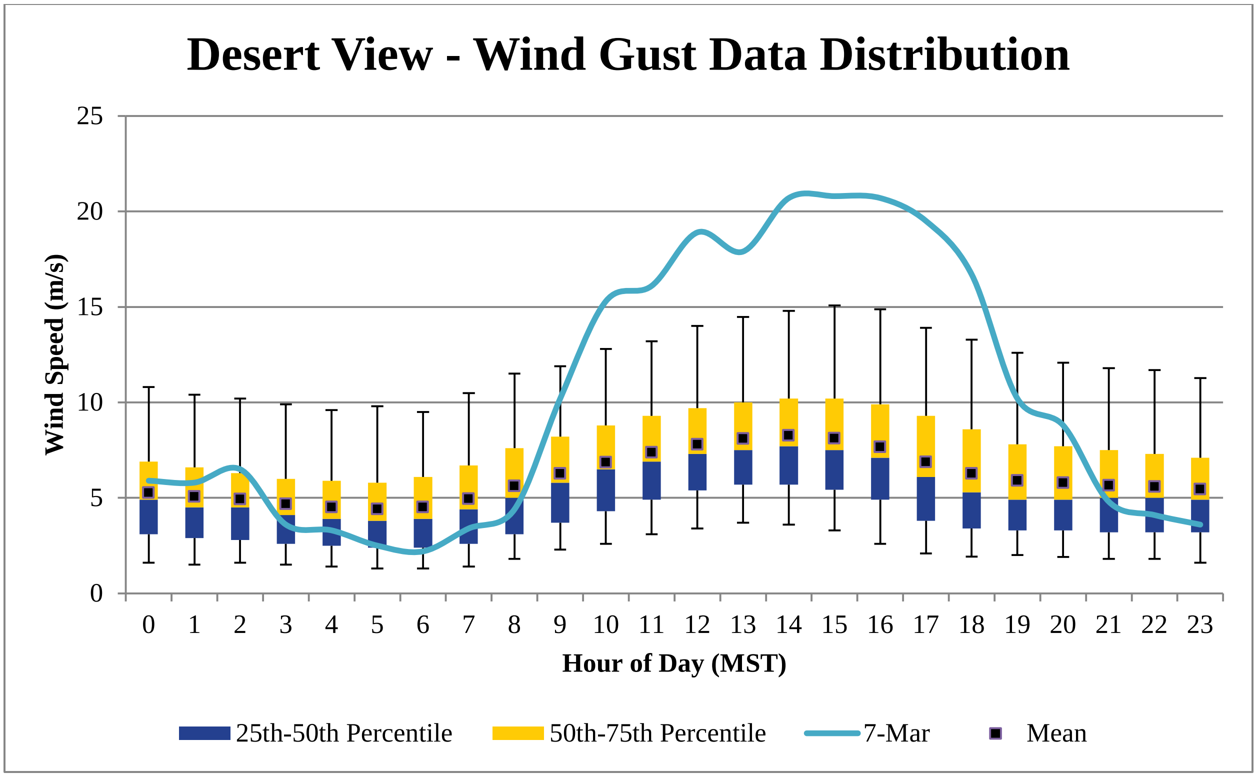

Figure 7-8d. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

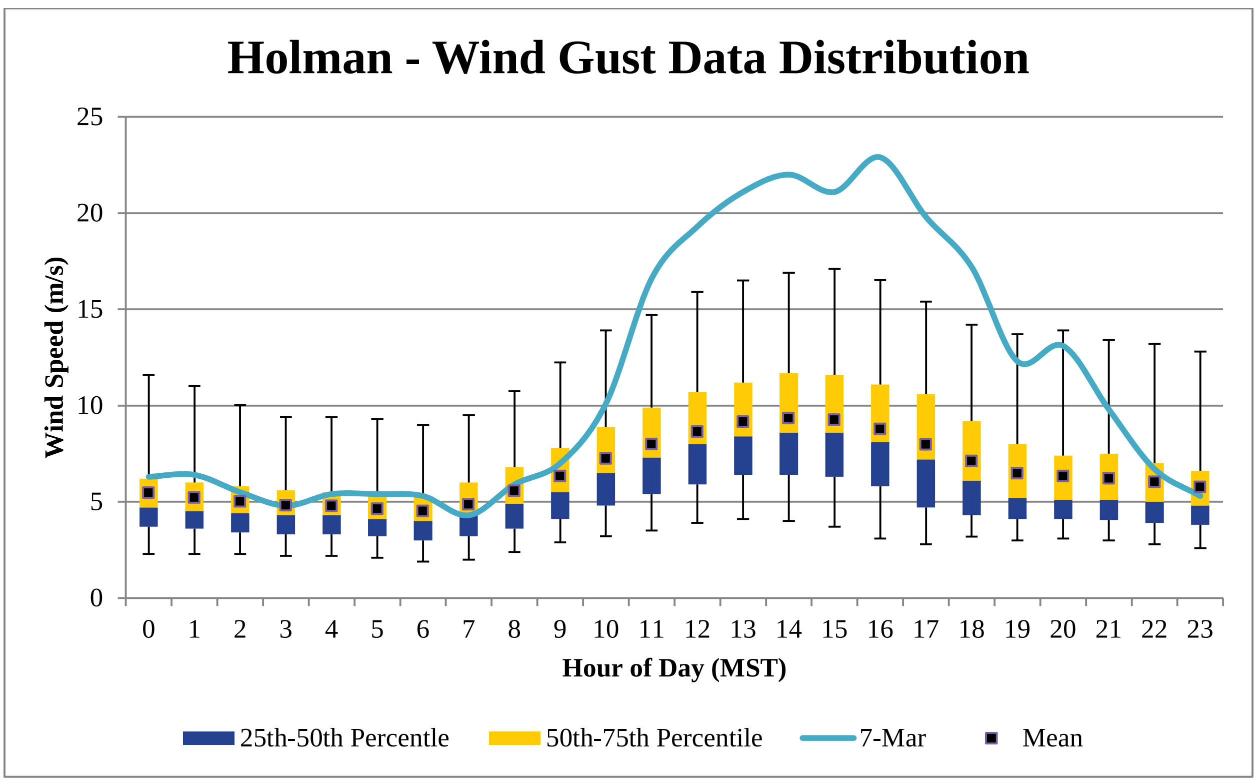

Figure 7-8e. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

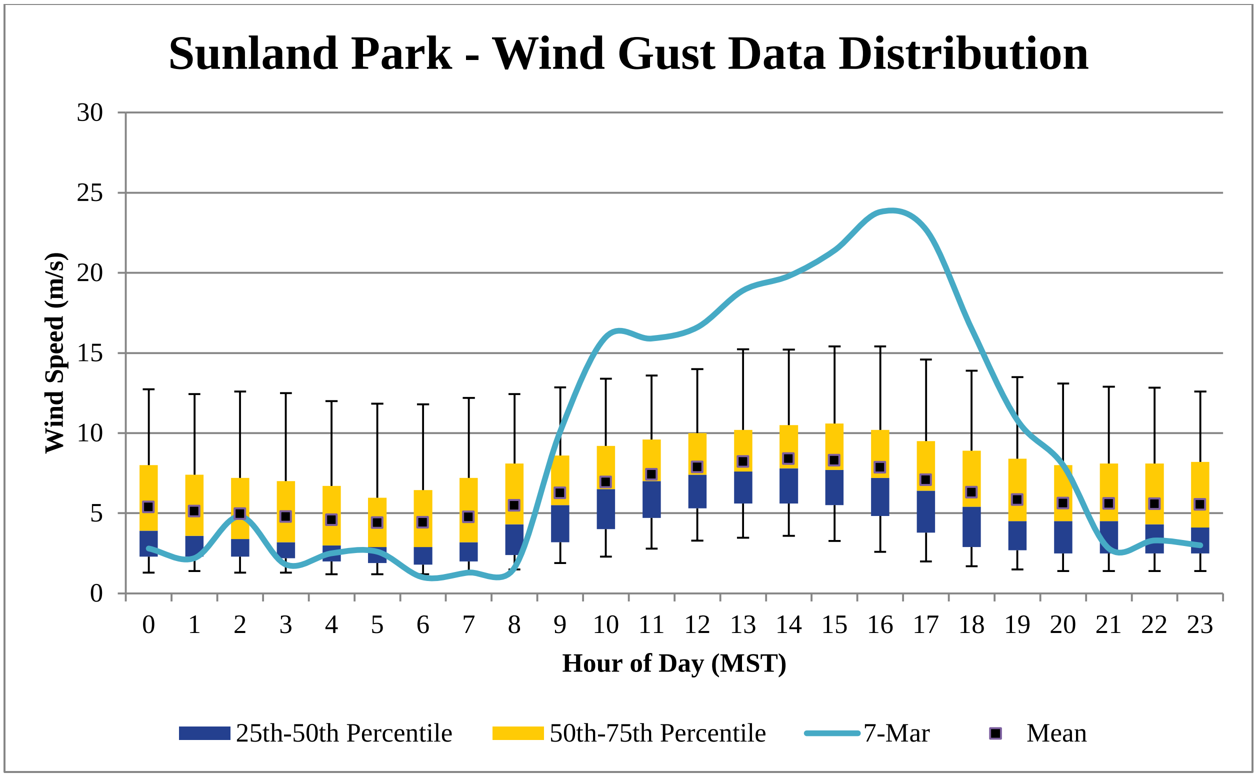

Figure 7-8d. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

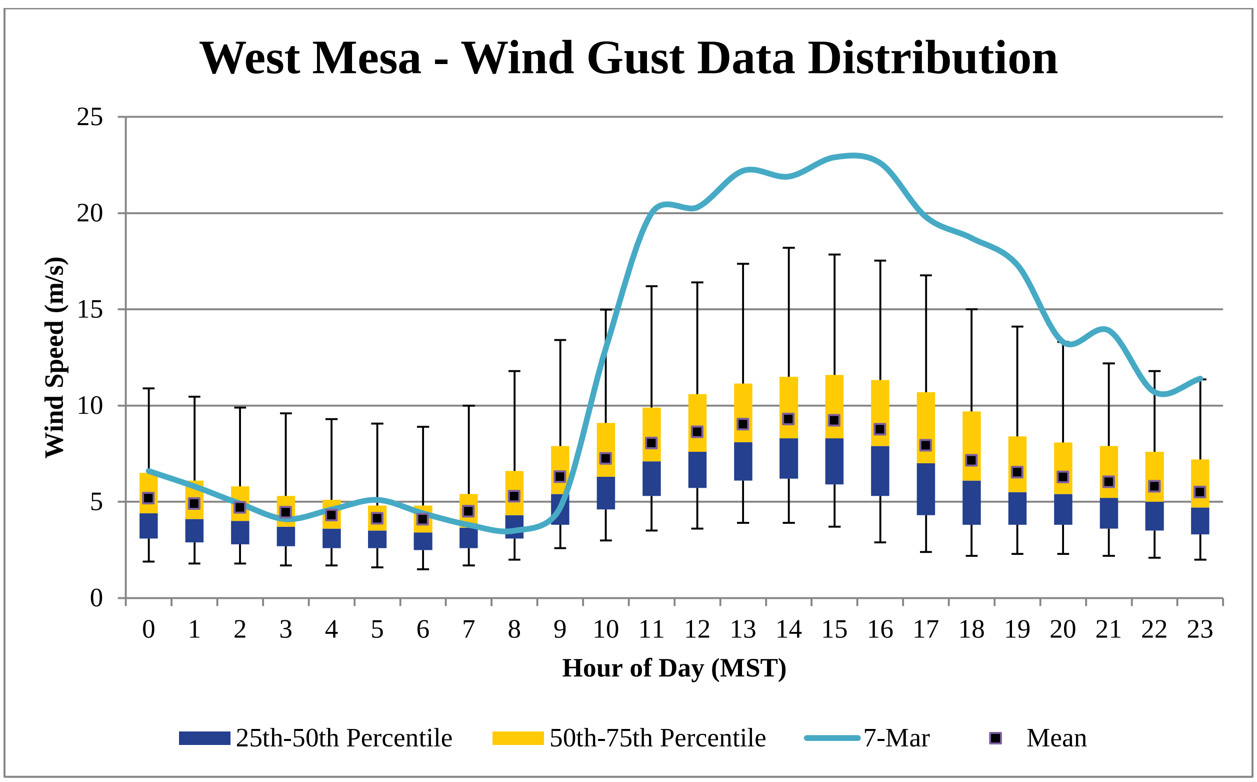

Figure 7-8g. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for March 7, 2011.

7.4 Clear Causal Relationship

A backdoor cold front passed through New Mexico on March 7, 2011. Prior to the arrival of the cold front, a trough formed through central New Mexico and as the event unfolded a low pressure center in central New Mexico created a pressure gradient over south-central New Mexico and northern Mexico. As the back door cold front moved through New Mexico, the pressure gradient tightened and winds became even stronger at the surface (Figure 7-9). Surface winds flow perpendicular to the isobars from high to low pressure. The wind direction in the upper atmosphere aligned with the surface wind direction (Figure 7-10). 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.

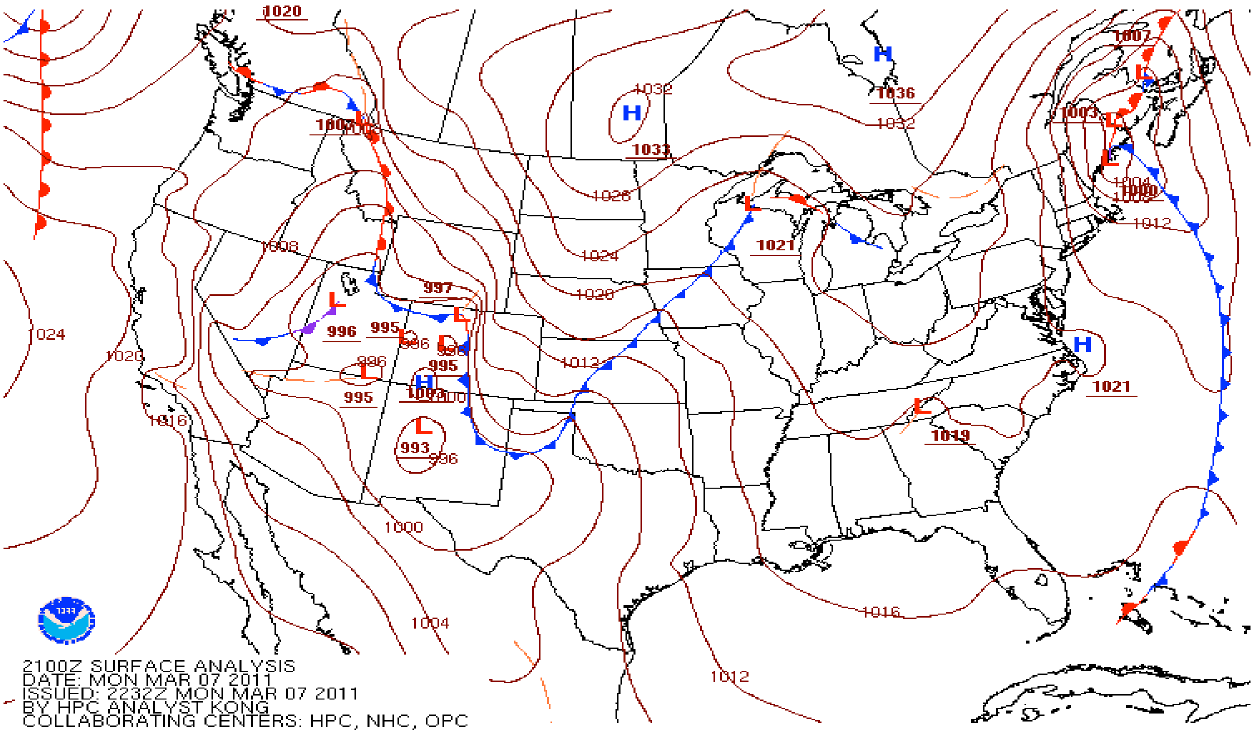

Figure 7-9.. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for March 7, 2011 at the 1400 hour MST.

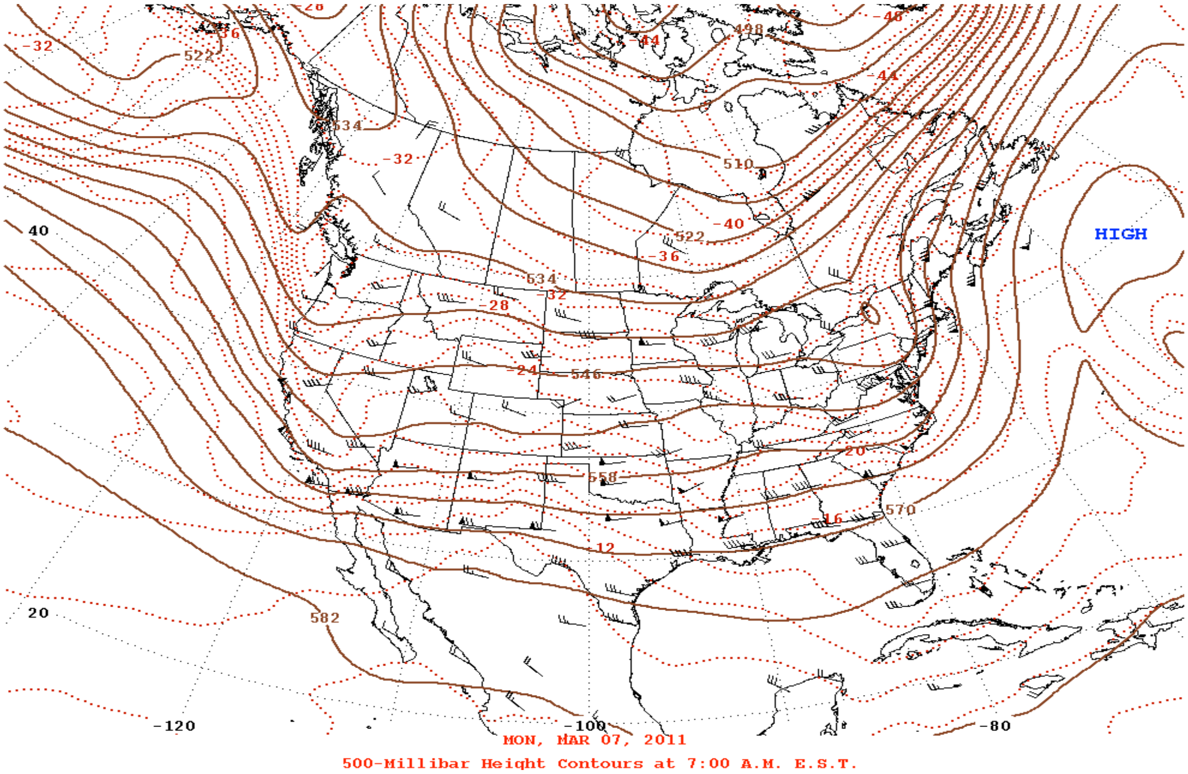

Figure 7-10. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on March 7, 2011.

The weather pattern described above generated strong southwest winds beginning at the 1000 hour and lasting through the 1800 hour. Beginning at the 1000 hour, wind speeds exceeded the historical 95th percentile of data at SPCY as shown in Figure 7-7f. Peak wind speeds ranged from 11.6 m/s to 16.4 m/s at Deming (Figure 7-3). Peak wind gusts ranged from 18 m/s at Chaparral to 26.2 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 (1000-1830 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 7-12a-b). 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).

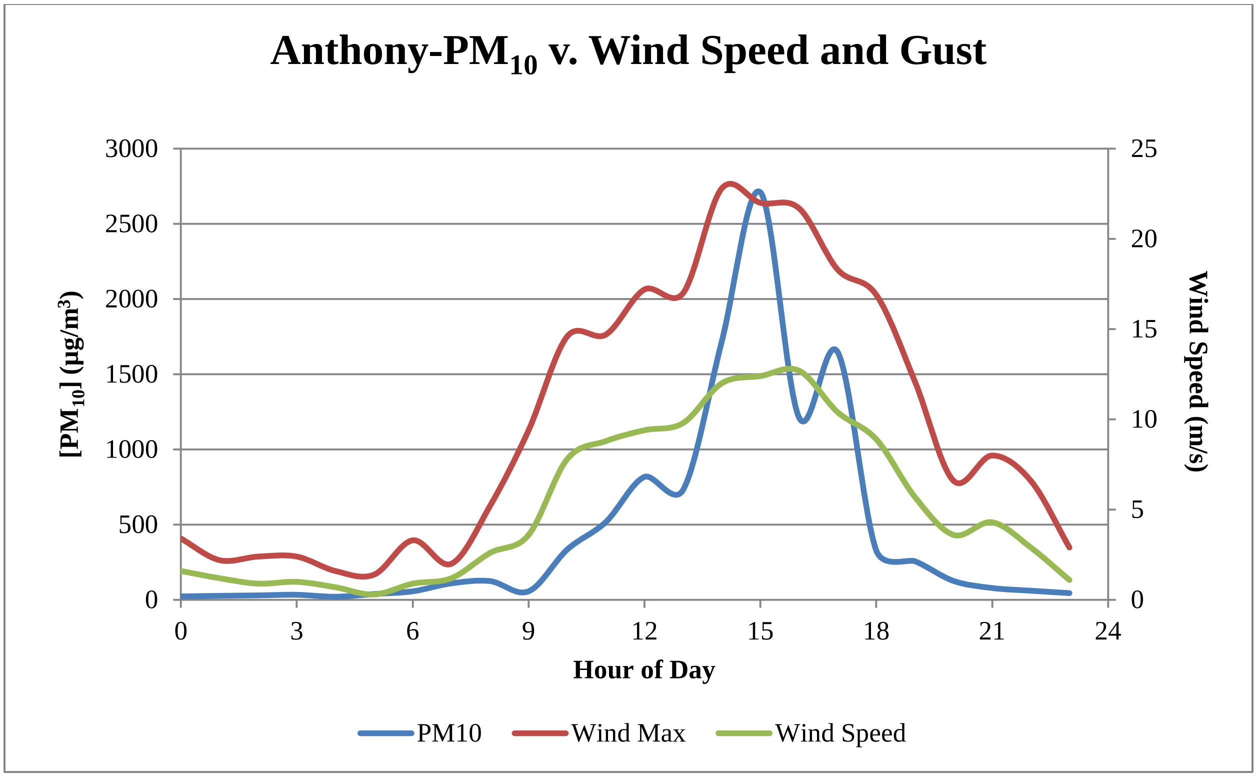

Figure 7-11a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

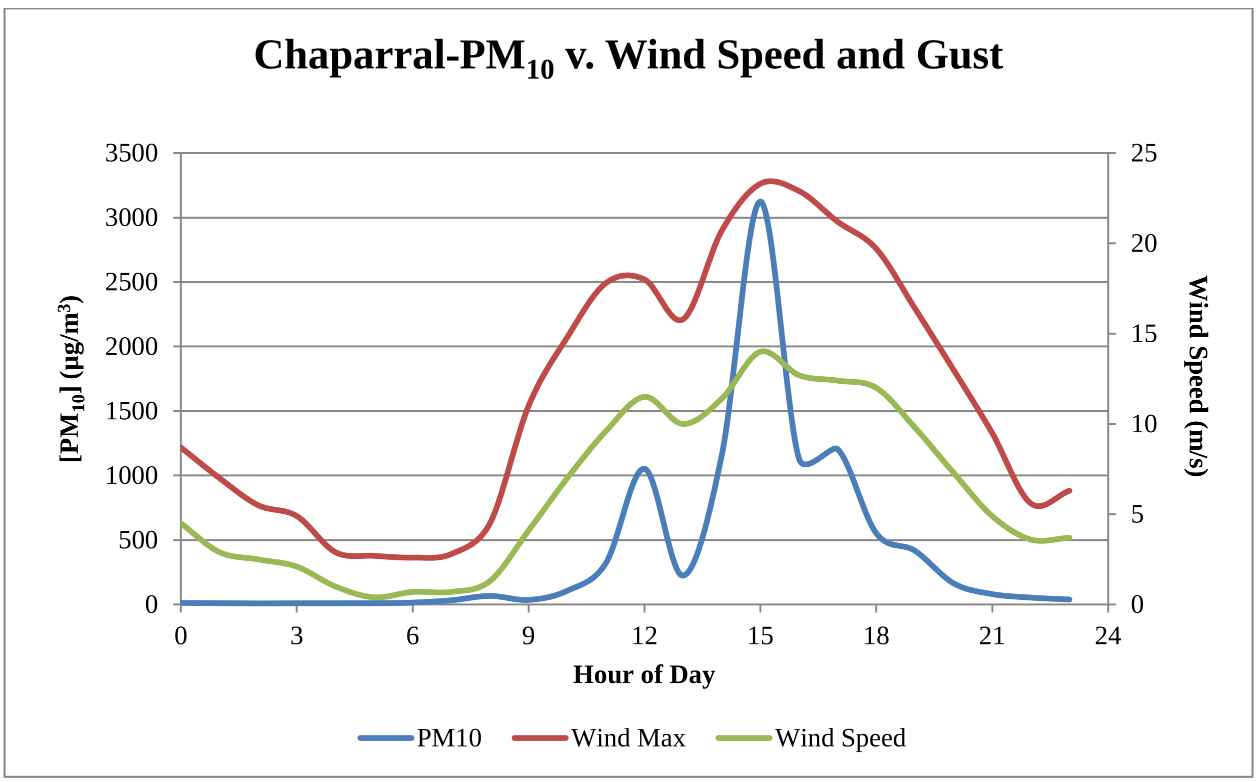

Figure 7-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

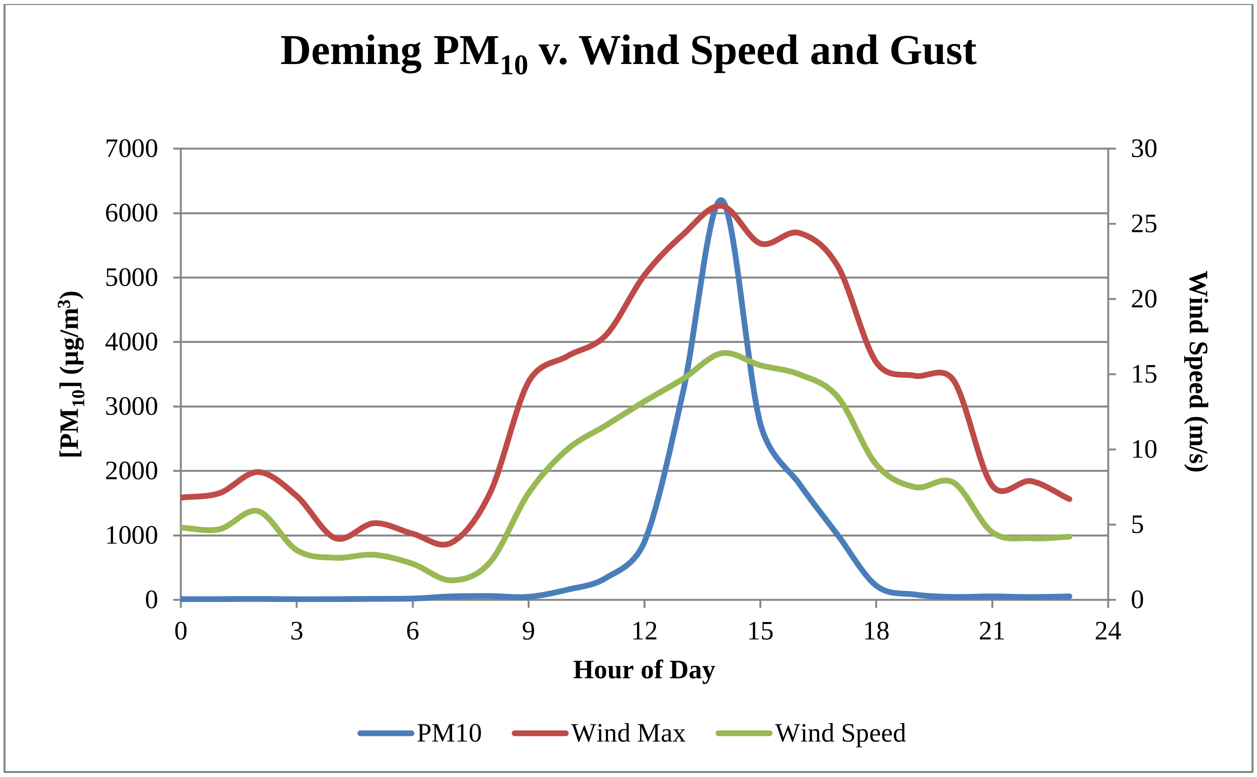

Figure 7-11c. **Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.**

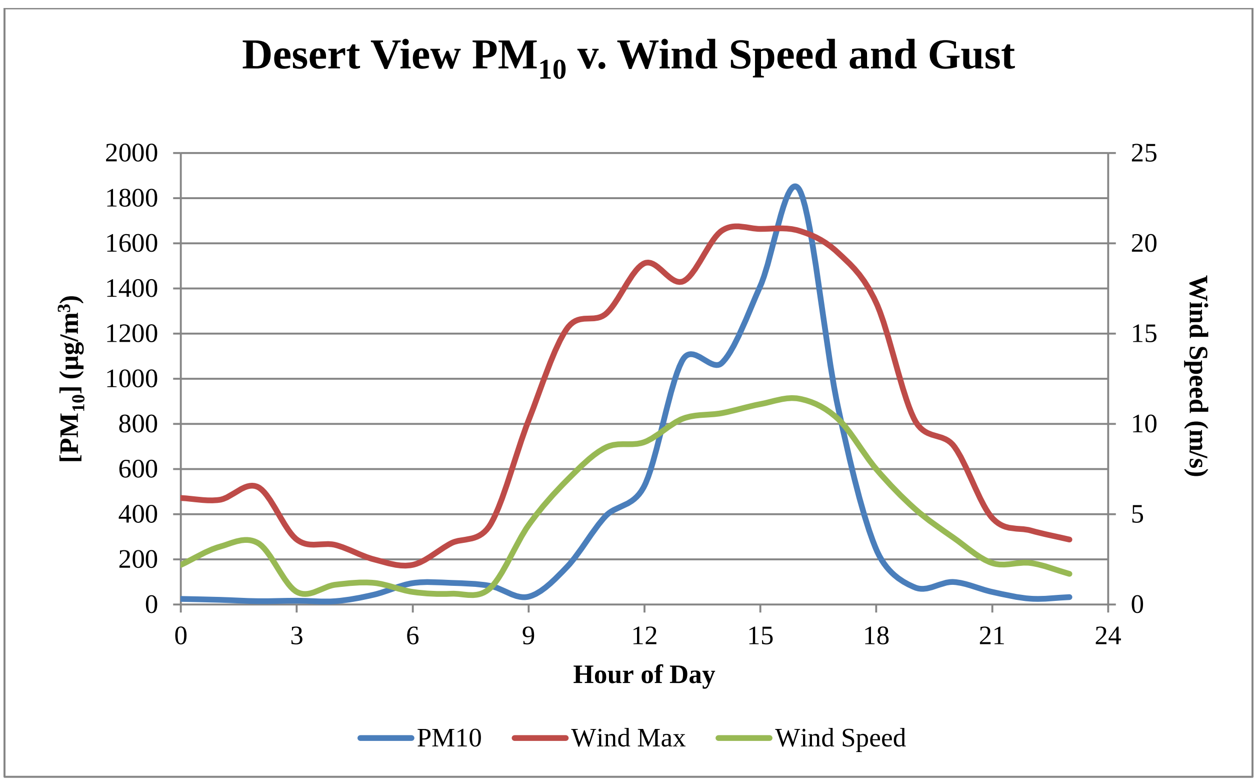

Figure 7-11d. **Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.**

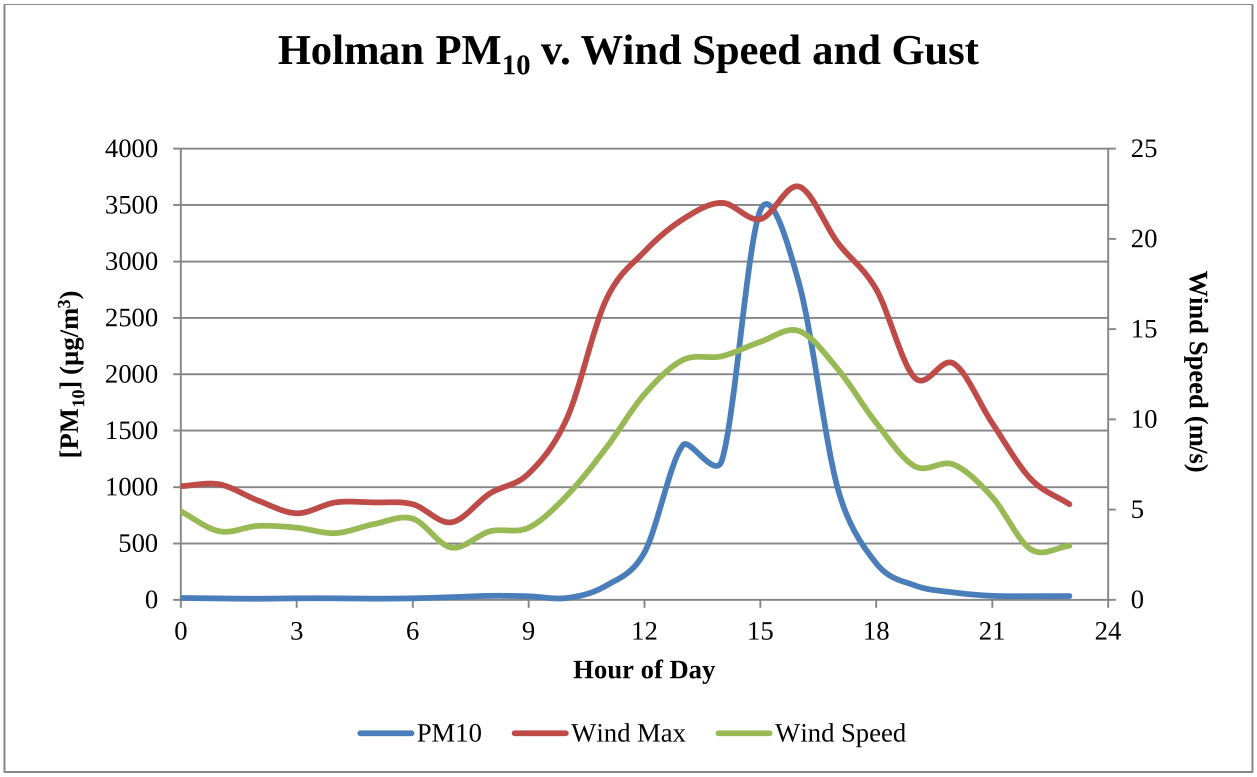

Figure 7-11e. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

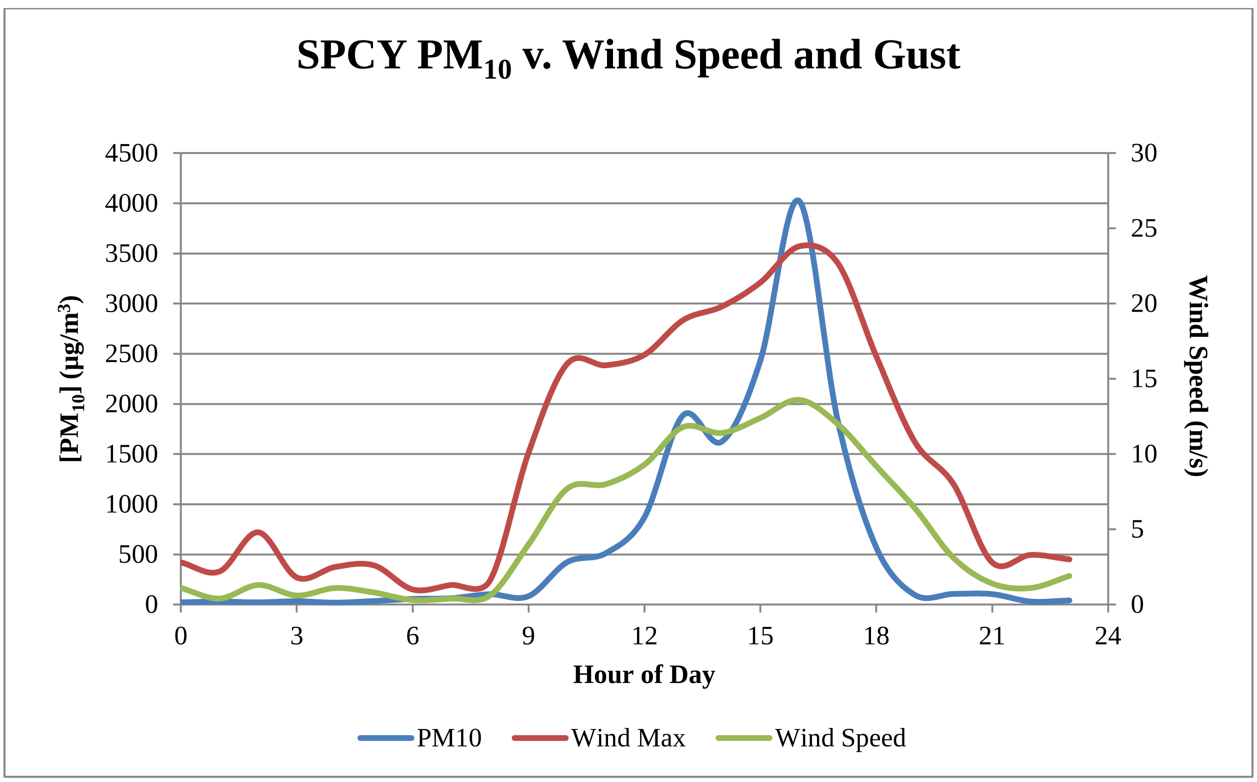

Figure 7-11f. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

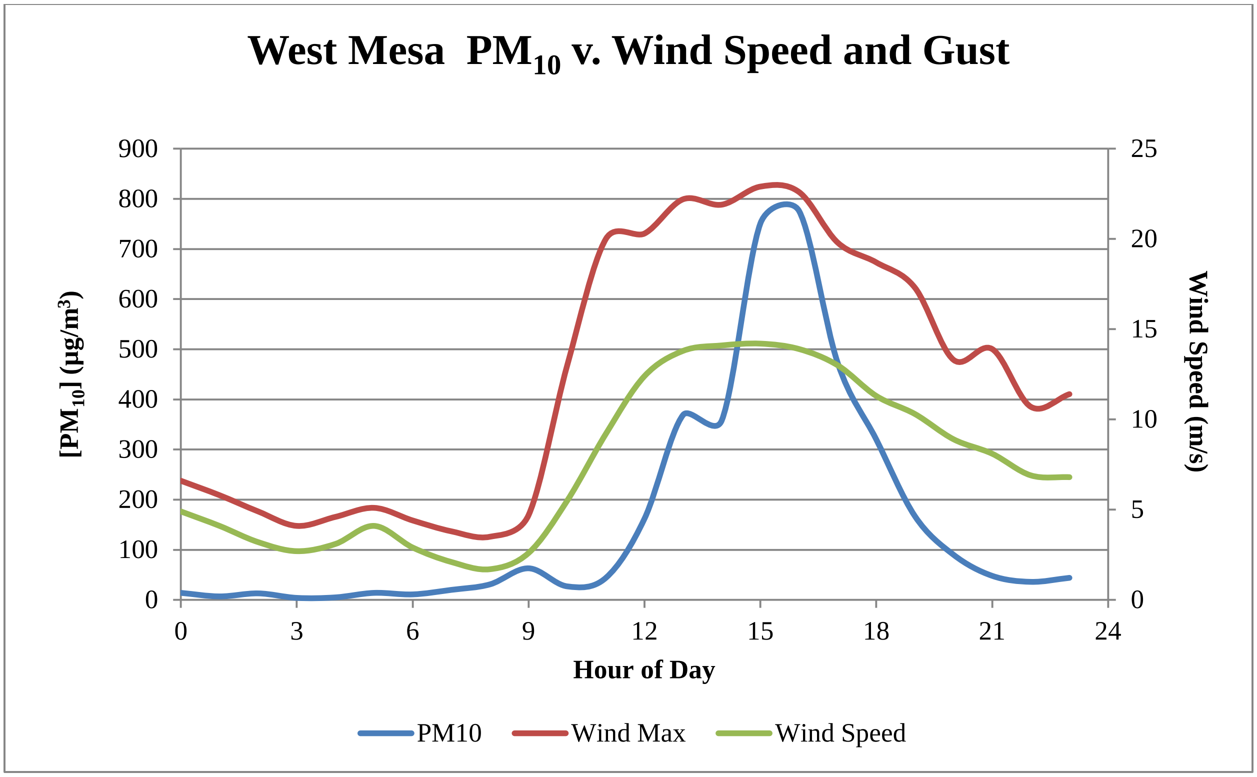

Figure 7-11g. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

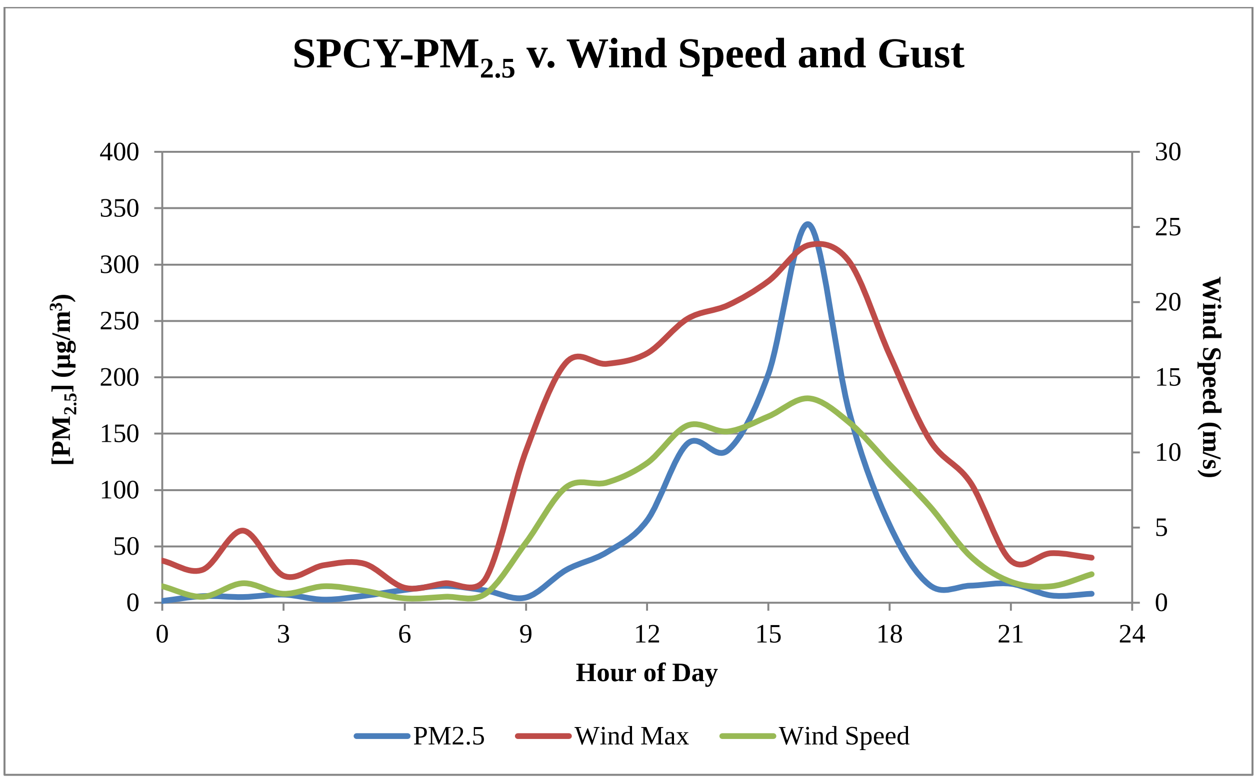

Figure 7-11h. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

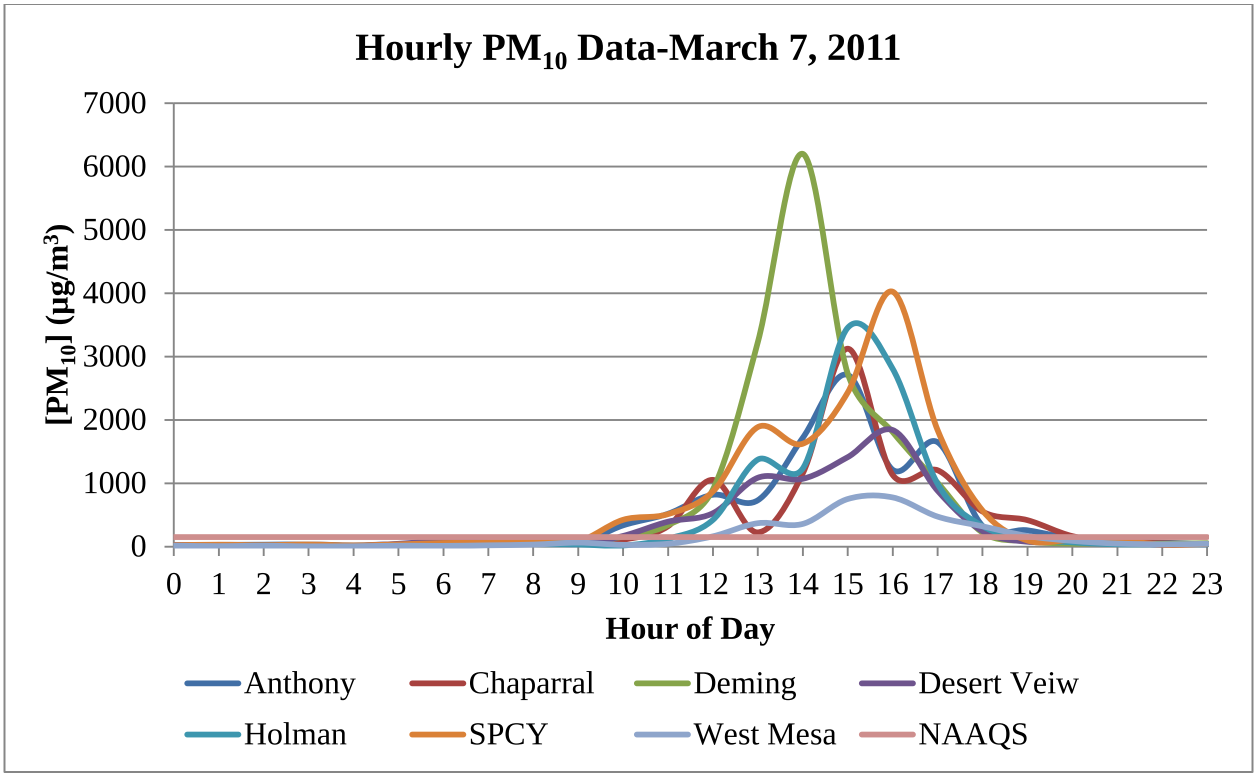

Figure 7-12a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

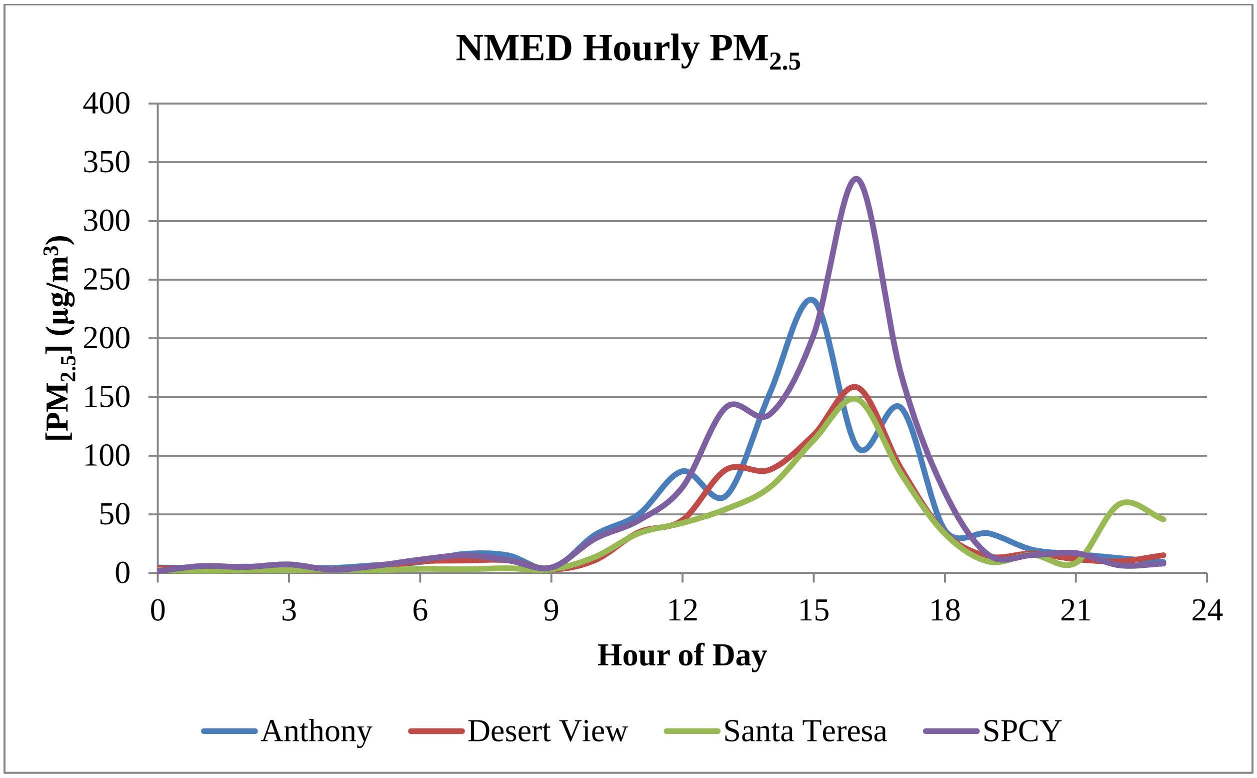

Figure 7-12b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors. Non-FEM hourly $PM_{2.5}$ data.

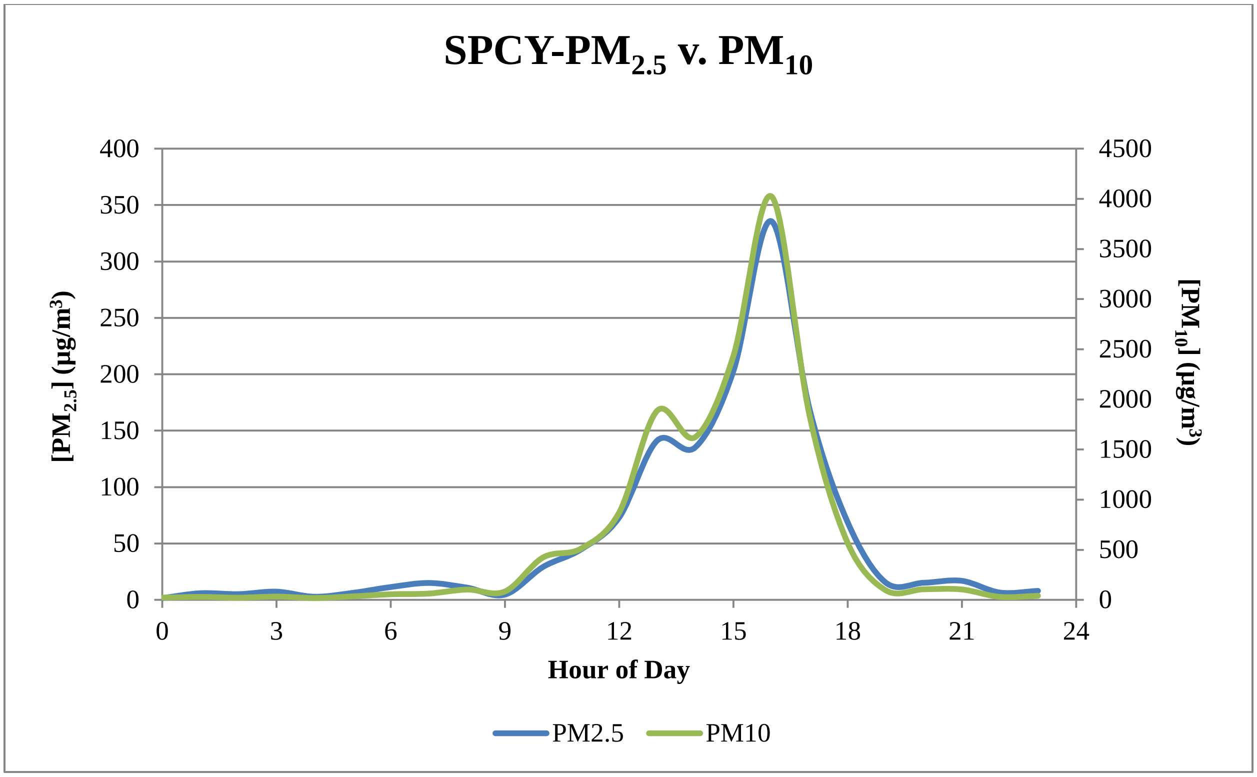

Figure 7-13. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on March 7, 2011.

The New Mexico Air Quality border blog forecasted a high wind and dust alert for this day based on the rapid update cycle model for the afternoon (Figure 7-14). The predicted peak wind speed from the model was around the 1300-1400 hour correlating well with observations at Deming and a couple of hours before the observed peak wind speeds at the 1500-1600 hour in Doña Ana County.

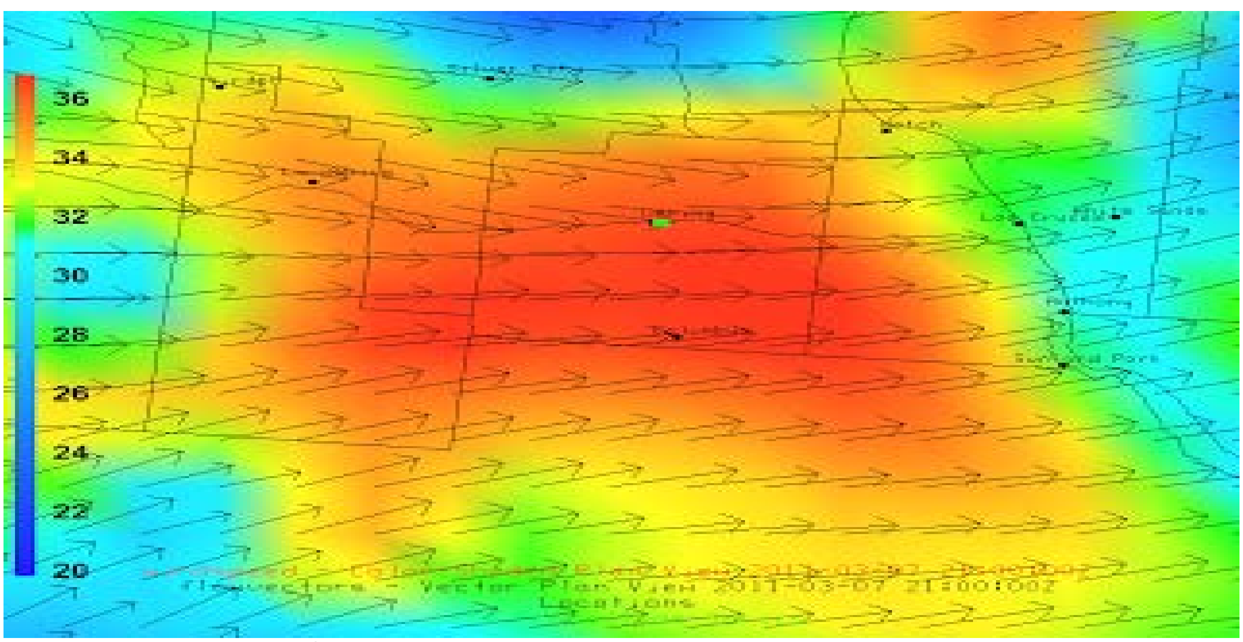

Figure 7-14. RUC 15z model run for March 7, 2011.

The NM AQ Border blog talked about the blowing dust throughout the region with some excerpts from the blog below (DuBois, 2011).

> I noticed that visibility was going down quickly due to dust around 12:30 pm in Las Cruces. As of 1 pm hourly PM10 at SPCY was 871 µg/m3 and PM2.5 was 73 µg/m3. At 3 pm the Deming Airport hourly PM_{10} reached 6200 µg/m^3 with hourly winds of 16 m/s (36 mph) and gusts at 26.2 m/s (59 mph). The hourly averaged $PM_{2.5}$ at NMSU was 80 µg/m^3 at 3 pm today. Visual range decreased to 2 miles at the Las Cruces Airport at 3:50 pm with 28 mph winds and gusts to 43 mph.

The Las Cruces Sun-News also reported on the high wind and blowing dust in the area the following day. Due to reduced visibility the State Police issued an advisory against driving on the interstates and highways in the area (Figure 7-15). NMED also captured pictures of the event from the West Mesa monitoring site looking down into the Mesilla Valley (Figure 7-16).

GUSTY DAY

STEVE MACINTYRE / FOR THE SUN-NEWS

LAS CRUCES RESIDENT Joy Johnstone battles the wind Monday afternoon after shopping for groceries at Albertsons on Telshor Avenue. "The wind here is inevitable," she said. "There's no use complaining because it's part of living in Las Cruces." High winds in the area, with gusts around 50 mph, impacted highway travel. New Mexico State Police discouraged all interstate and other highway travel Monday afternoon due to blowing dust. The high today is expected to reach 69, with no rain in the forecast but plenty of wind, with possible gusts up to 40 mph.

Figure 7-15. Las Cruces Sun-News article March 8, 2011

Figure 7-16. Mesilla Valley on March 7 (top) and March 9 (bottom).

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, 2011.

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 Anthony monitor detected blowing dust around the 1000 hour with hourly concentrations heavily impacted until the 1900 hour. The ten hourly PM_{10} values from 1000-1900 hours alone, exceed the 24-hour average standard at Anthony [(335 + 518 + 818 + 732 + 1718 + 2710 + 1213 + 1648 + 328 + 257) µg/m^3 = 10277 µg/m^3; (10277 µg/m^3)/24 = 428 µg/m^3]. By replacing these ten hourly values with the 95th percentile of hourly data at the Anthony site, the resulting 24-hour average (100 µg/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	23	23
1	27	27
2	30	30
3	34	34
4	21	21
5	39	39
6	57	57
7	110	110
8	125	125
9	57	57
10	335	**95**
11	518	**106**
12	818	**136**
13	732	**146**
14	1718	**177**
15	2710	**172**
16	1213	**152**
17	1648	**194**
18	328	**197**
19	257	**185**
20	126	126
21	79	79
22	61	61
23	45	45
24-Hour Average	462	**100**

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 the1100 hour with hourly concentrations heavily impacted until the 2000 hour. The ten hourly PM_{10} values from 1100-2000 hours alone, exceed the 24-hour average standard at Anthony [(321+1053+224+1157+3124+1131+1205+553+417) $\mu g/m^3$ = 9350 $\mu g/m^3$; (9350 $\mu g/m^3$)/24 = 390$\mu g/m^3$]. By replacing these ten hourly values with the 95th percentile of hourly data at the Chaparral site, the resulting 24-hour average (73 $\mu g/m^3$) does not exceed the NAAQS (Table 7-2). 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	13	13
1	11	11
2	9	9
3	10	10
4	10	10
5	11	11
6	15	15
7	33	33
8	67	67
9	36	36
10	107	107
11	321	**87**
12	1053	**120**
13	224	**151**
14	1157	**141**
15	3124	**147**
16	1131	**127**
17	1205	**122**
18	553	**120**
19	417	**126**
20	165	**111**
21	81	81
22	54	54
23	39	39
24-Hour Average	410	**73**

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 1800 hour. The nine hourly PM_{10} values from 1000-1800 hours alone, exceed the 24-hour average standard at Deming [(158 + 340 + 904 + 3232 + 6200 + 2731 + 1808 + 1008 + 221) µg/m^3 = 16602 µg/m^3; (16602 µg/m^3)/24 = 691 µg/m^3]. By replacing these nine 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 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	12	12
1	12	12
2	15	15
3	10	10
4	12	12
5	16	16
6	21	21
7	54	54
8	60	60
9	48	48
10	158	**60**
11	340	**62**
12	904	**72**
13	3232	**99**
14	6200	**101**
15	2731	**103**
16	1808	**107**
17	1008	**95**
18	221	**87**
19	83	83
20	46	46
21	54	54
22	44	44
23	54	54
24-Hour Average	714	**55**

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 Desert View monitor detected blowing dust around the 1000 hour with hourly concentrations heavily impacted until the 1800 hour. The nine hourly PM_{10} values from 1000-1800 hours alone, exceed the 24-hour average standard at Desert View [(168 + 393 + 527 + 1087 + 1070 + 1412 + 1840 + 882 + 244) $\mu g/m^3$ = 7623 $\mu g/m^3$; (7623 $\mu g/m^3$)/24 = 317$\mu g/m^3$]. By replacing these five hourly values with the 95th percentile of hourly data at the Desert View site, the resulting 24-hour average (73 $\mu g/m^3$) does not exceed the NAAQS (Table 7-4). 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	25	25
1	21	21
2	15	15
3	17	17
4	15	15
5	44	44
6	95	95
7	96	96
8	83	83
9	35	35
10	168	**91**
11	393	**91**
12	527	**94**
13	1087	**91**
14	1070	**106**
15	1412	**119**
16	1840	**124**
17	882	**158**
18	244	**137**
19	76	76
20	100	100
21	56	56
22	26	26
23	33	33
24-Hour Average	348	**73**

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 Desert View.

The Holman monitor detected blowing dust around the 1200 hour with hourly concentrations heavily impacted until the 1800 hour. The Seven hourly PM_{10} values from 1200-1800 hours alone, exceed the 24-hour average standard at Holman [(422+1374+1234+3455+2807+991+324) $\mu g/m^3$ = 10607 $\mu g/m^3$; (10607 $\mu g/m^3$)/24 = 442 $\mu g/m^3$]. By replacing these seven hourly values with the 95th percentile of hourly data at the Holman site, the resulting 24-hour average (60 $\mu g/m^3$) does not exceed the NAAQS (Table 7-5). The values in red represent the 95th percentile of all hourly data collected at 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	13	13
2	10	10
3	14	14
4	14	14
5	11	11
6	14	14
7	24	24
8	36	36
9	32	32
10	17	17
11	125	125
12	422	**85**
13	1374	**102**
14	1234	**122**
15	3455	**125**
16	2807	**118**
17	991	**125**
18	324	**160**
19	128	128
20	66	66
21	36	36
22	33	33
23	34	34
24-Hour Average	467	**60**

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 Holman.

The SPCY monitor detected blowing dust around the 10 hour with hourly concentrations heavily impacted until the 1800 hour. The nine hourly PM_{10} values from 1000-1800 hours alone, exceed the 24-hour average standard at SPCY [(423+512+871+1887+1624+2433+4024+1839+596) $\mu g/m^3$ = 14182 $\mu g/m^3$; (14182 $\mu g/m^3$)/24 = 591 $\mu g/m^3$]. By replacing these nine hourly values with the 95th percentile of hourly data at the SPCY site, the resulting 24-hour average (93 $\mu g/m^3$) does not exceed the NAAQS (Table 7-6). The values in red represent the 95th percentile of all hourly data collected at 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	22	22
1	30	30
2	22	22
3	33	33
4	19	19
5	35	35
6	56	56
7	63	63
8	103	103
9	84	84
10	423	**93**
11	512	**95**
12	871	**104**
13	1887	**125**
14	1624	**145**
15	2433	**160**
16	4024	**168**
17	1839	**201**
18	569	**296**
19	96	96
20	106	106
21	104	104
22	30	30
23	41	41
24-Hour Average	626	**93**

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 SPCY.

The West Mesa monitor detected blowing dust around the 1200 hour with hourly concentrations heavily impacted until the 1800 hour. The eight hourly PM_{10} values from 1200-1800 hours alone, exceed the 24-hour average standard at West Mesa [(162 + 369 + 358 + 751 + 776 + 473 + 320 + 167) µg/m^3 = 3376 µg/m^3; (3376 µg/m^3)/24 = 141 µg/m^3]. By replacing these eight hourly values with the 95th percentile of hourly data at the West Mesa site, the resulting 24-hour average (39 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	14	14
1	7	7
2	13	13
3	4	4
4	5	5
5	14	14
6	11	11
7	20	20
8	31	31
9	63	63
10	27	27
11	44	44
12	162	**47**
13	369	**51**
14	358	**60**
15	751	**69**
16	776	**65**
17	473	**63**
18	320	**59**
19	167	**53**
20	90	90
21	48	48
22	36	36
23	44	44
24-Hour Average	160	**39**

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 21, 2011

8.1 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} 24-hour NAAQS and the $PM_{2.5}$ annual NAAQS at the Anthony and SPCY monitoring sites on this date. The FEM TEOM continuous and Partisol monitors at these sites recorded 24-hour average PM_{10} concentrations of 175 and 182 µg/m^3 and 24-hour average $PM_{2.5}$ concentration of 24 µg/m^3, respectively. In accordance with the EER and the $PM_{2.5}$ annual NAAQS, the AQB flagged this data on EPA's AQS database as a high wind natural event. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured at the Deming Airport (144 µg/m^3), Chaparral (120 µg/m^3), Desert View (128 µg/m3), and Holman (135 µg/m^3) monitoring sites (Figure 8-1). 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.

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.

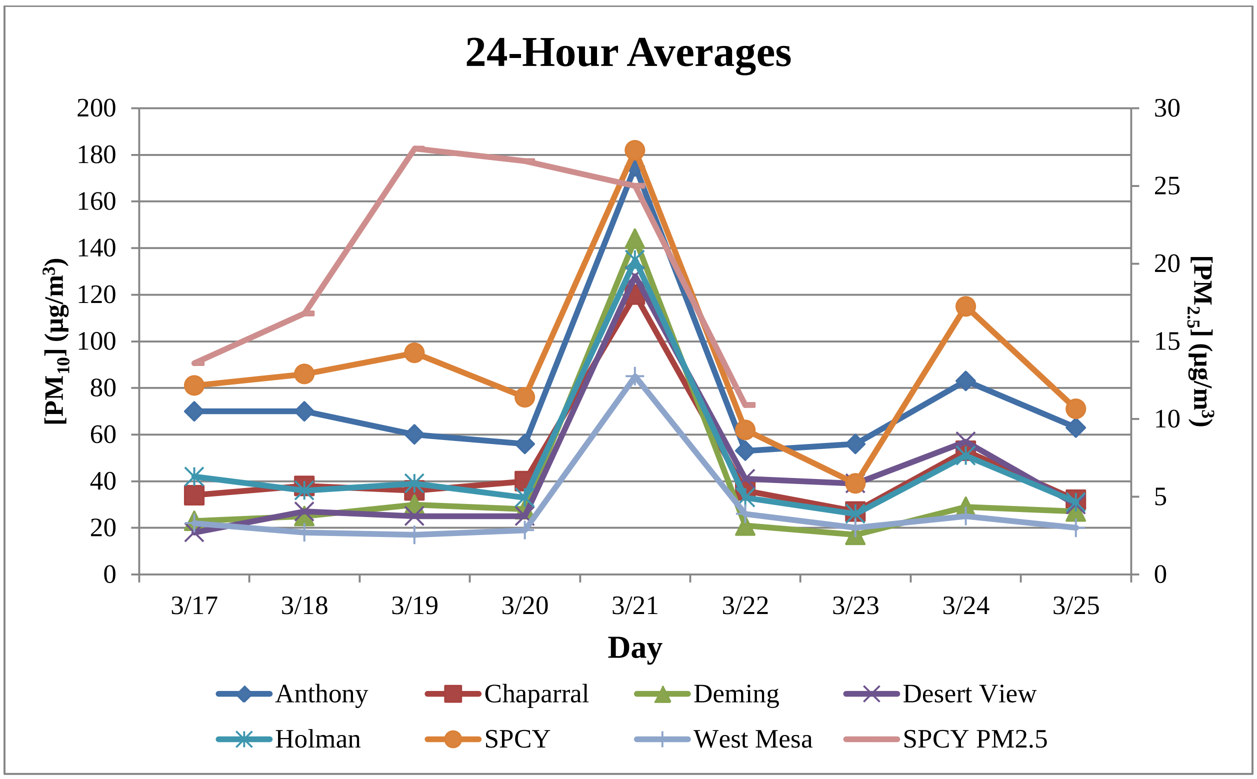

Figure 8-1. PM_{10} and $PM_{2.5}$ 24-hour averages before and after March 21, 2011.

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 Mexico and 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 playas of 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 21, 2011, sustained wind speeds exceeded EPA's default threshold at three of the seven monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at four of the seven monitoring sites (Figures 8-2 and 8-3). Winds exceeded these thresholds at one or more monitoring sites beginning at the 1200 hour and ending at the 1700 hour.

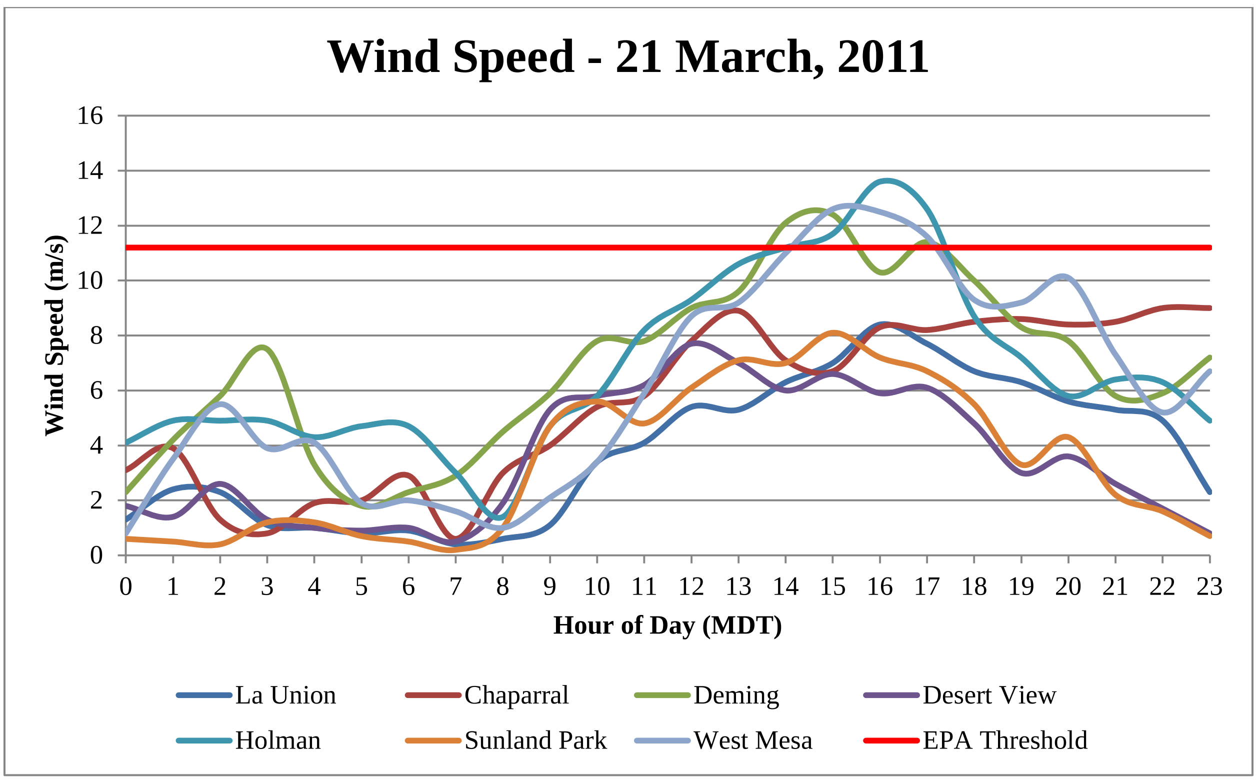

Figure 8-2. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

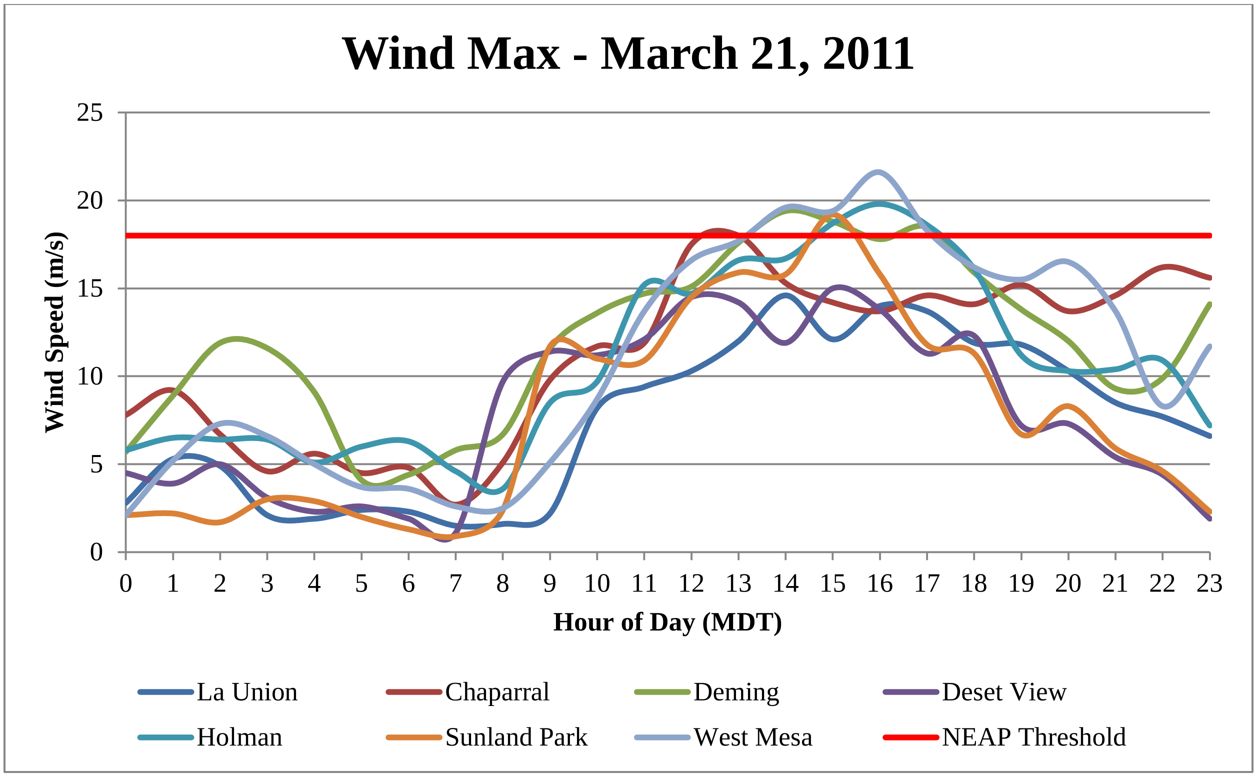

Figure 8-3. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

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 2006-2010 the PM_{10} FEM TEOM monitors recorded 211 exceedances and the PM_{10} FRM Wedding monitors recorded 5 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 (Table 2-1). 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 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 8-4). 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.

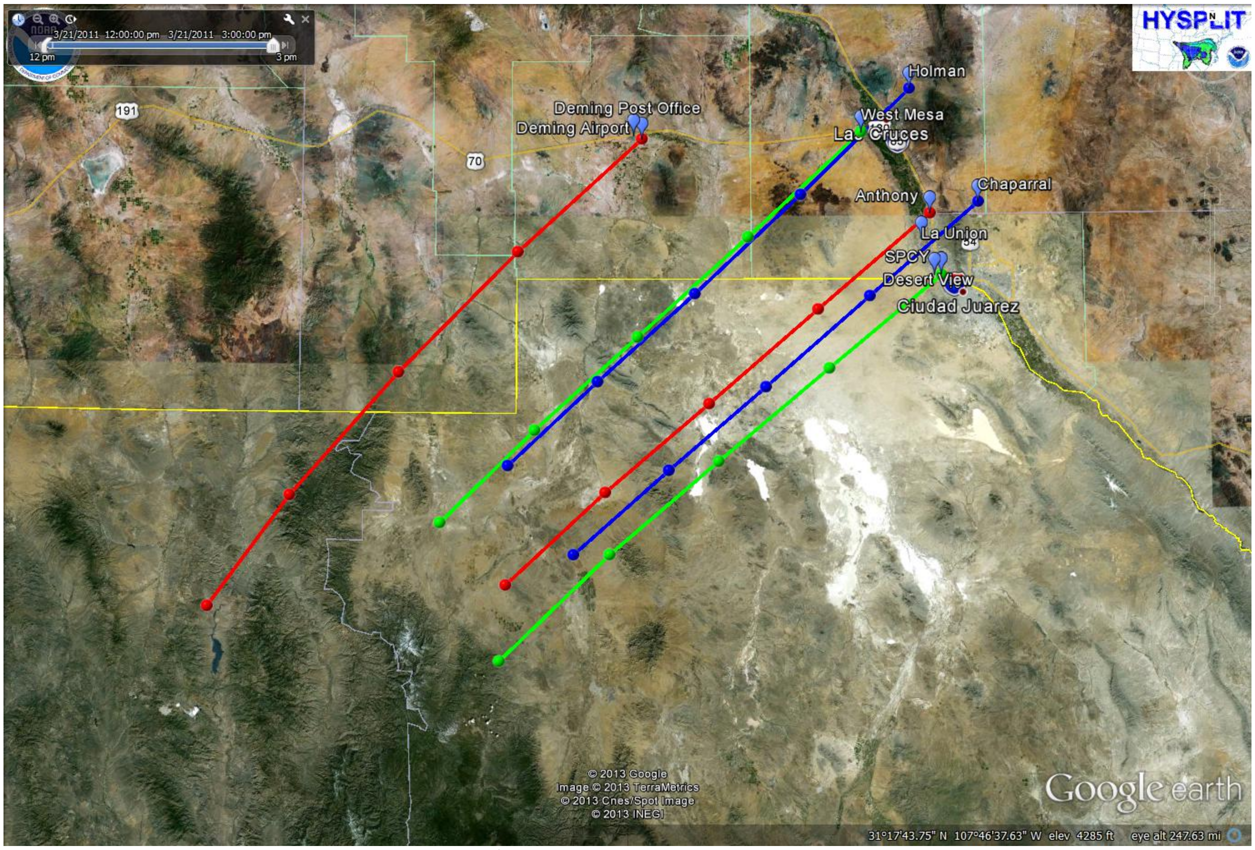

Figure 8-4. HYSPLIT back-trajectory model analysis for March 21, 2011.

8.3 Historical Fluctuations Analysis

8.3.1 <u>Annual and Seasonal 24-hour Average Fluctuations</u>

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-4 through B-11). 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 2006-2010 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 2006-2010. 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 2006-2010. The recorded values for this day (Anthony: 175 µg/m^3 and SPCY: 182 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 21, 2011 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 8-5a through 8-5g). 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.

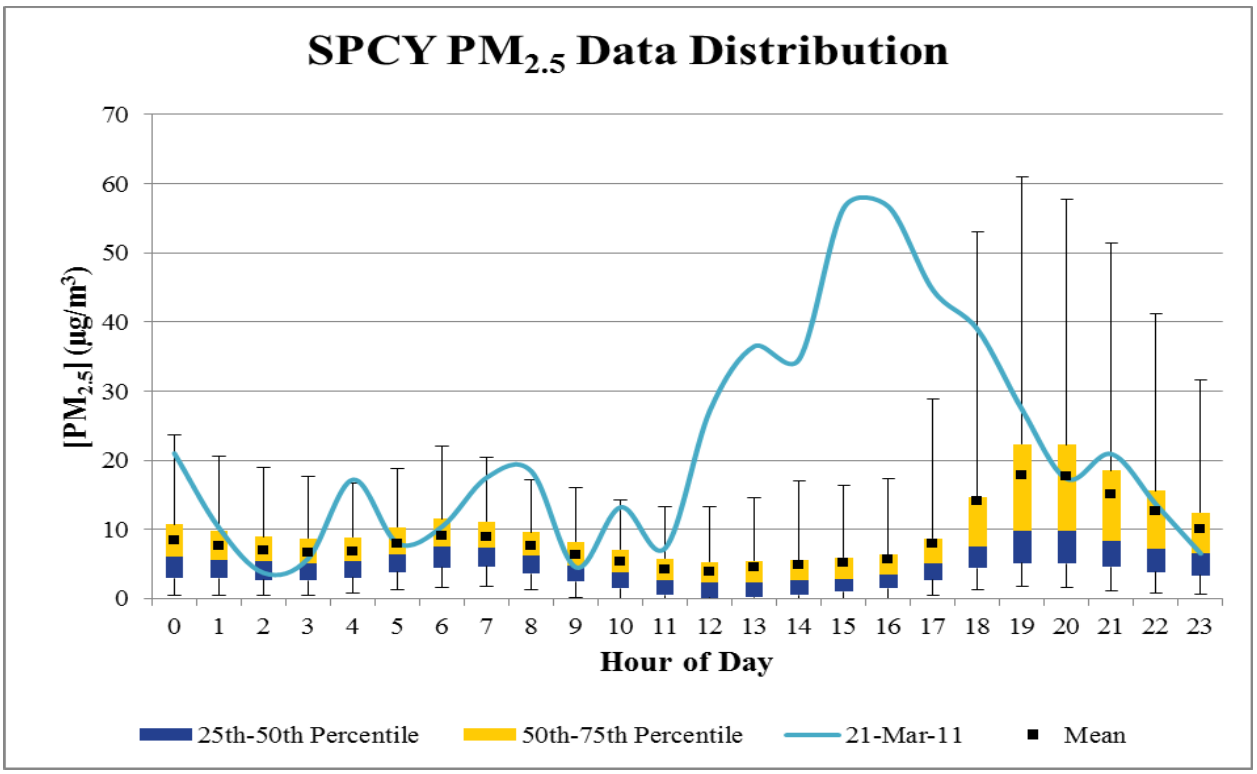

Figure 8-5a. $PM_{2.5}$ hourly data distribution from 2006-2010 overlaid by hourly values for March 21, 2011.

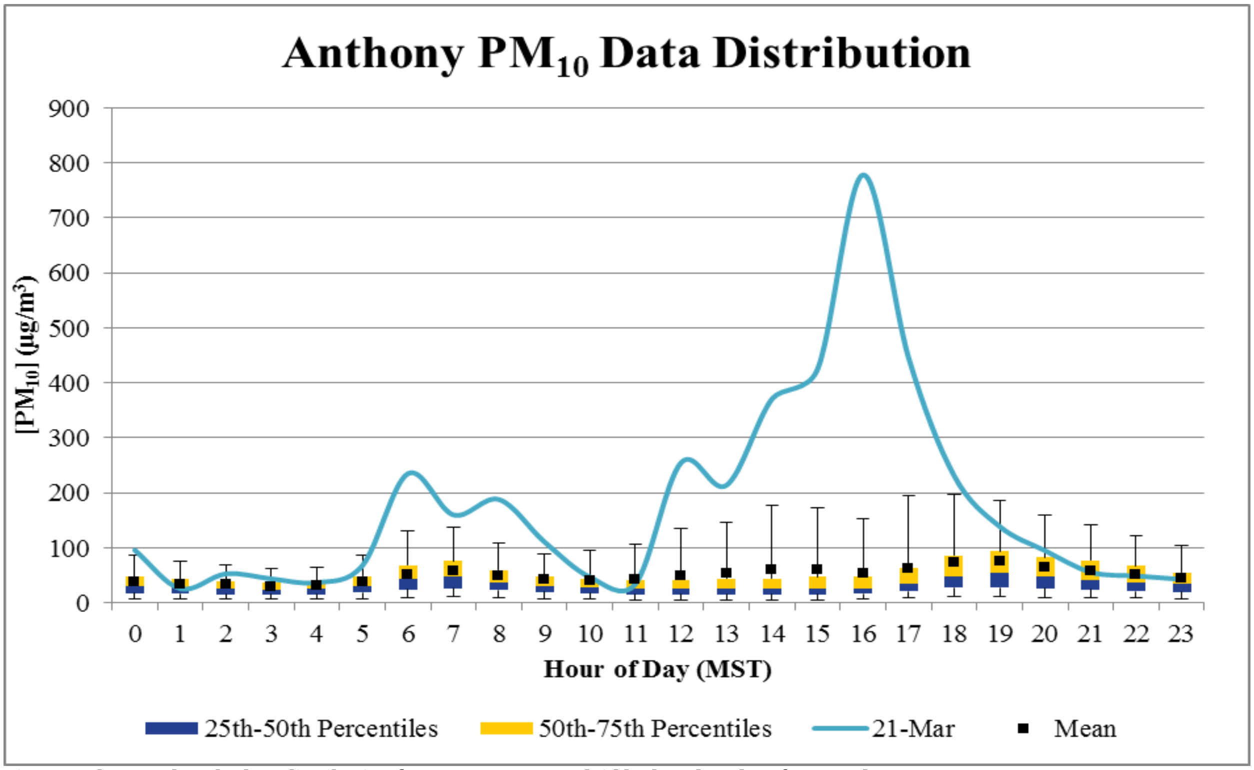

Figure 8-5b. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for March 21, 2011.

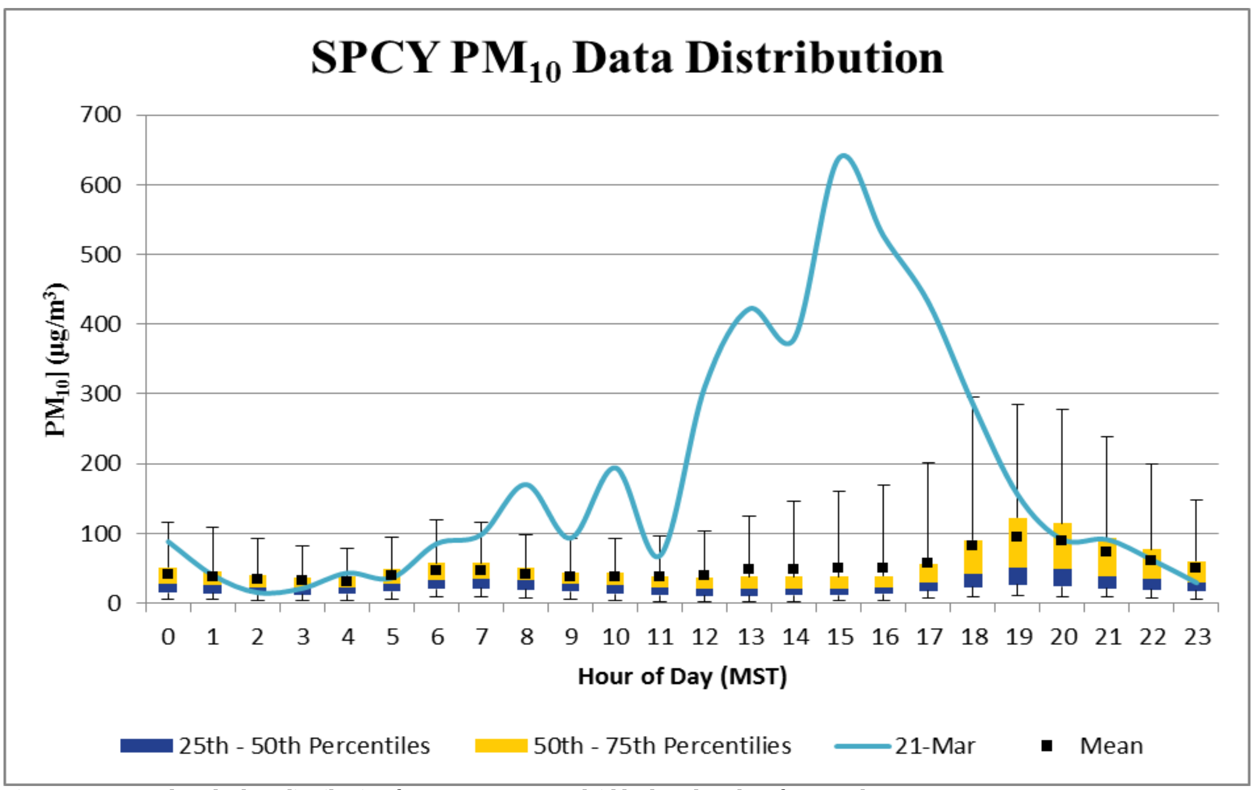

Figure 8-5c. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for March 21, 2011.

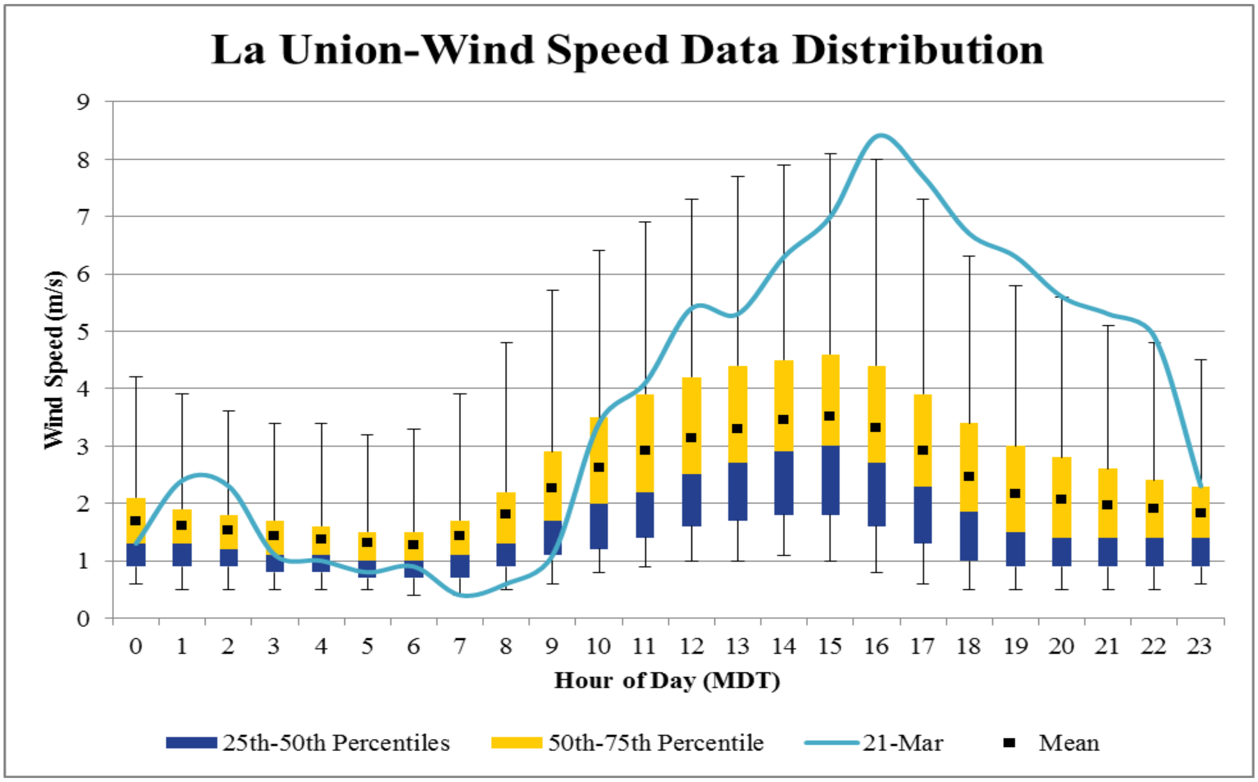

Figure 8-5d. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for March 21, 2011.

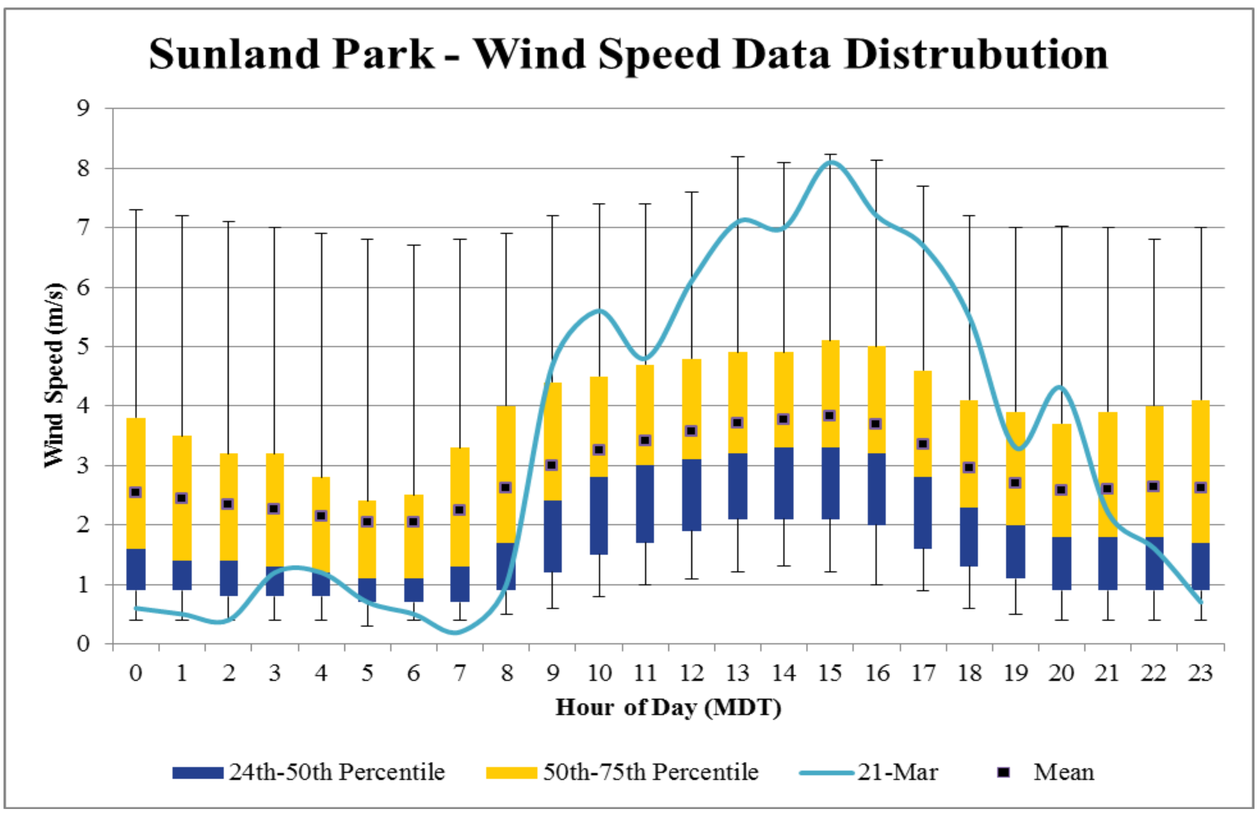

Figure 8-5e. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for March 21, 2011.

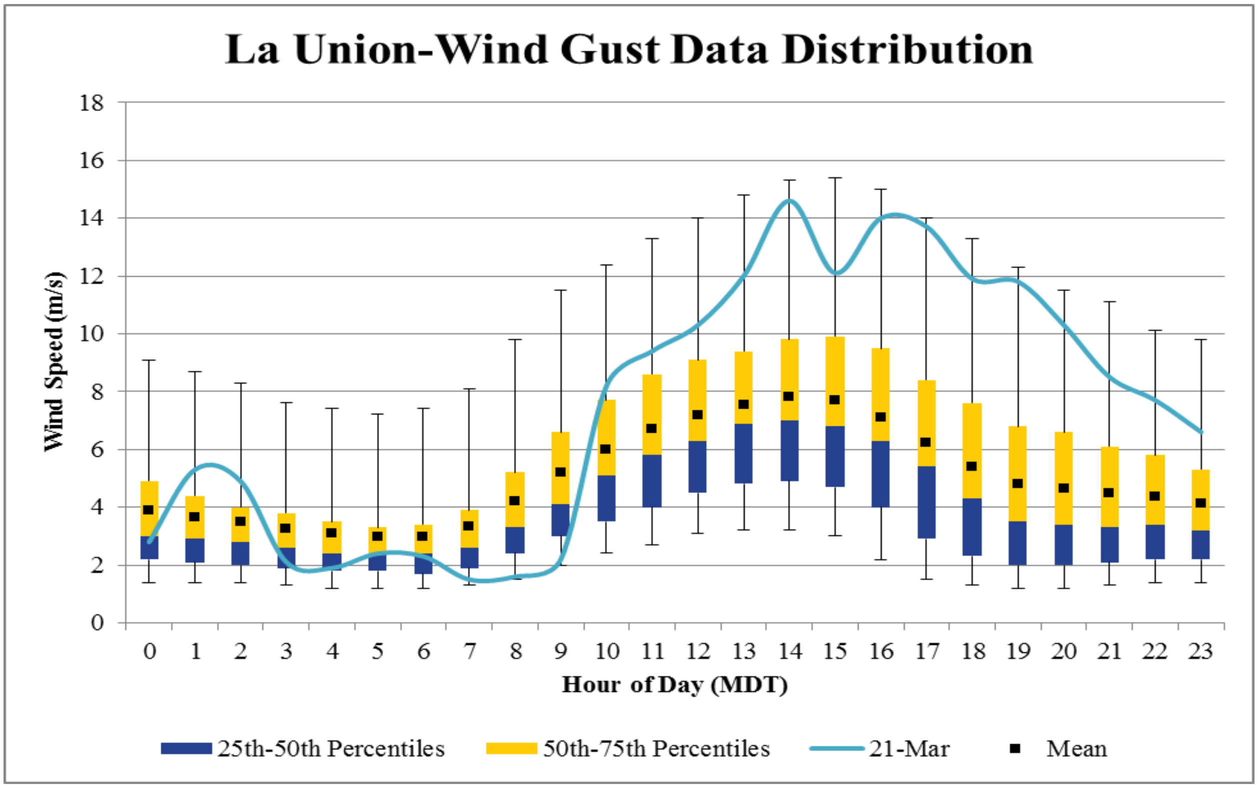

Figure 8-5f. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for March 21, 2011.

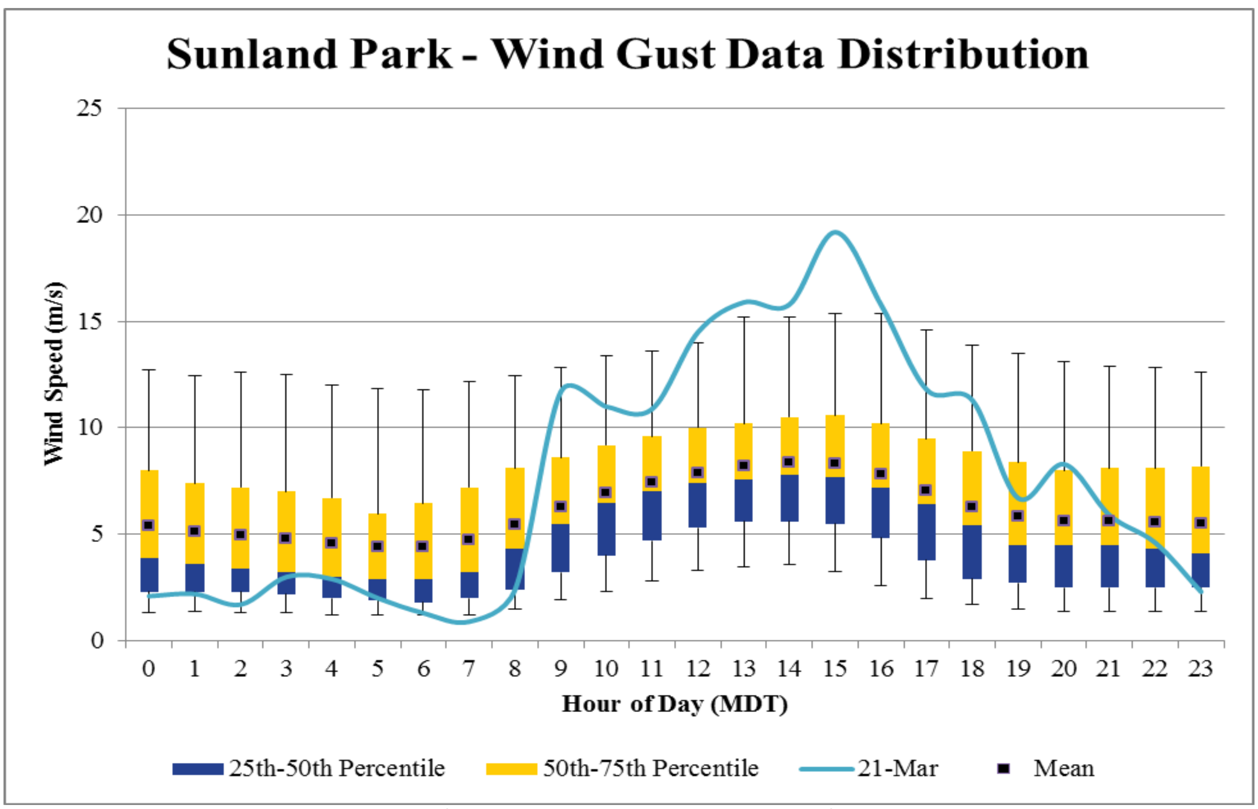

Figure 8-5g. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for March 21, 2011.

8.4 Clear Causal Relationship

A Pacific cold front passed through New Mexico on March 21, 2011. Prior to the arrival of the cold front, the dryline moved eastward across New Mexico into Texas as strong mid-level winds began to mix downward to the surface. As the Pacific cold front moved through New Mexico, a strong pressure gradient formed causing high winds at the surface (Figure 8-6). Surface winds flow perpendicular to the isobars from high to low pressure. The wind direction in the upper atmosphere aligned with the surface wind direction (Figure 8-7). 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.

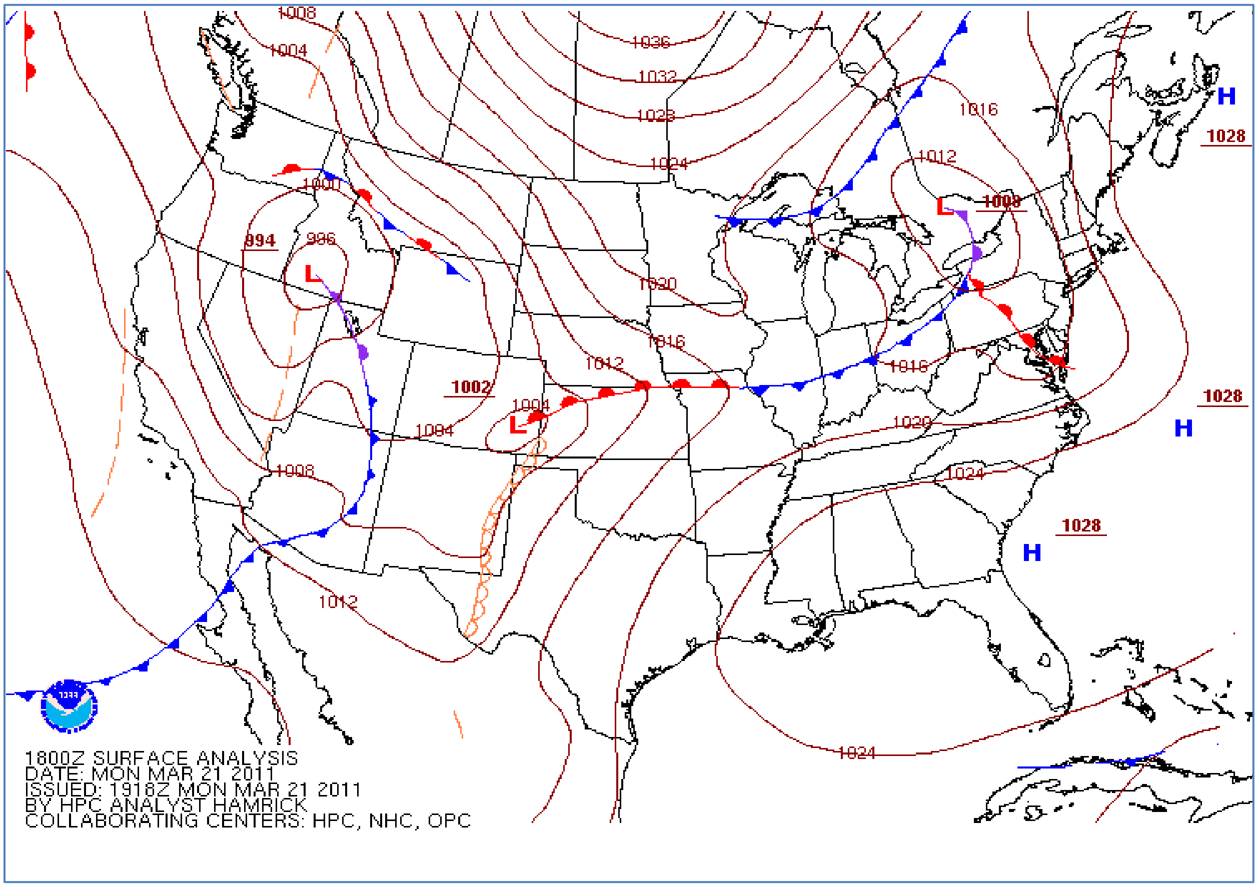

Figure 8-6. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for March 21, 2011 at the 1200. hour.

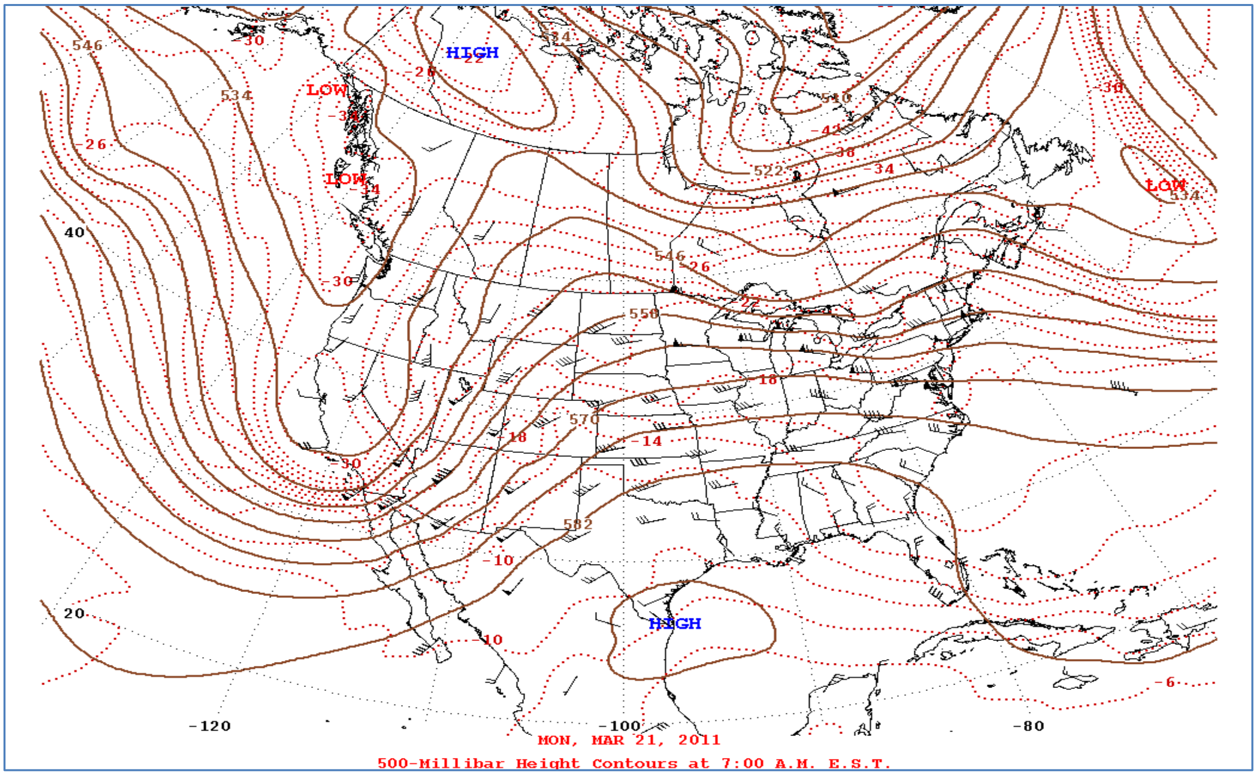

Figure 8-7. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on March 21, 2011.

The weather pattern described above generated strong southwesterly winds beginning at the 1000 hour and lasting through the 2000 hour. Beginning at the 1400 hour, wind speeds exceeded 11.2 m/s at the Deming Airport monitoring site as shown in Figure 8-2. Peak wind speeds ranged from 7.7 m/s at Desert View to 13.6 m/s at Holman (Figure 8-2). Peak wind gusts ranged from 14.6 m/s at La Union to 21.6 m/s at West Mesa (Figure 8-3). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 8-8a-g. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (0600-1800 hours). During these hours, hourly PM_{10} concentrations spiked at all monitoring sites in the network (Figure 8-9a-b). Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM monitors show good correlation of the timing of spikes in concentrations (Figure 8-10).

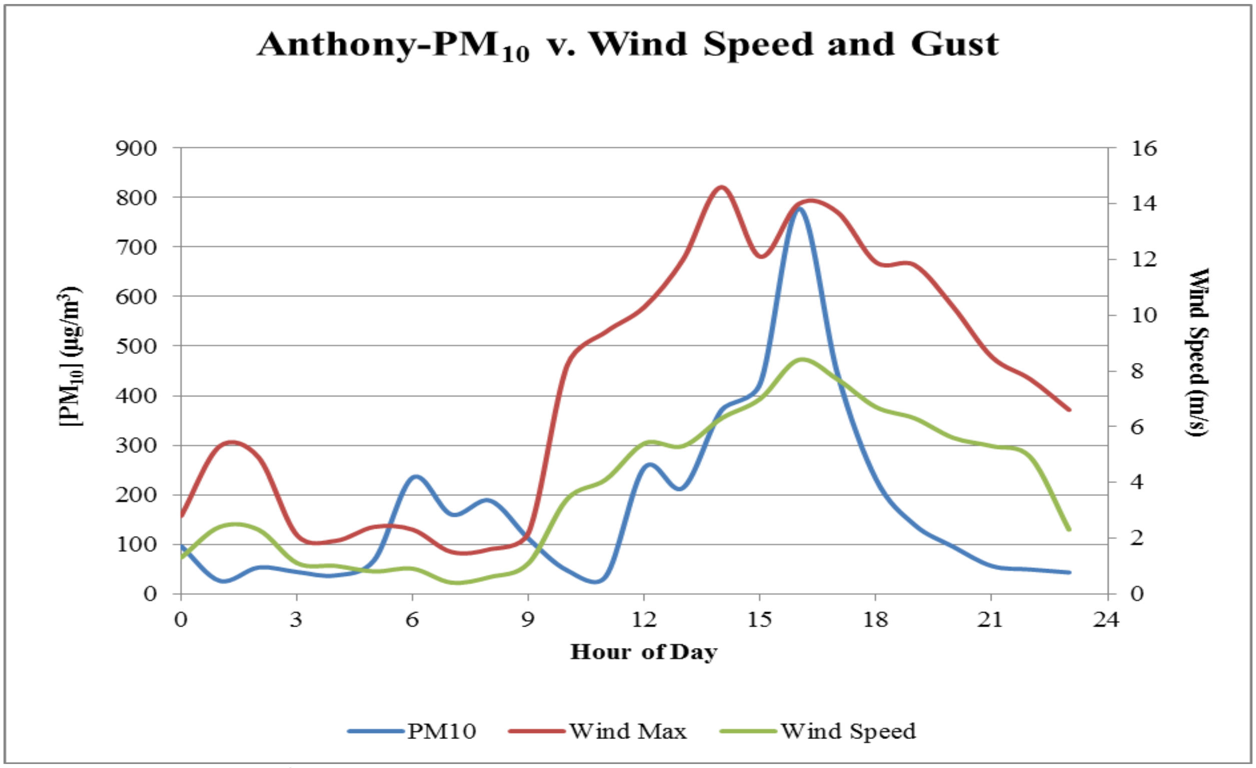

Figure 8-8a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

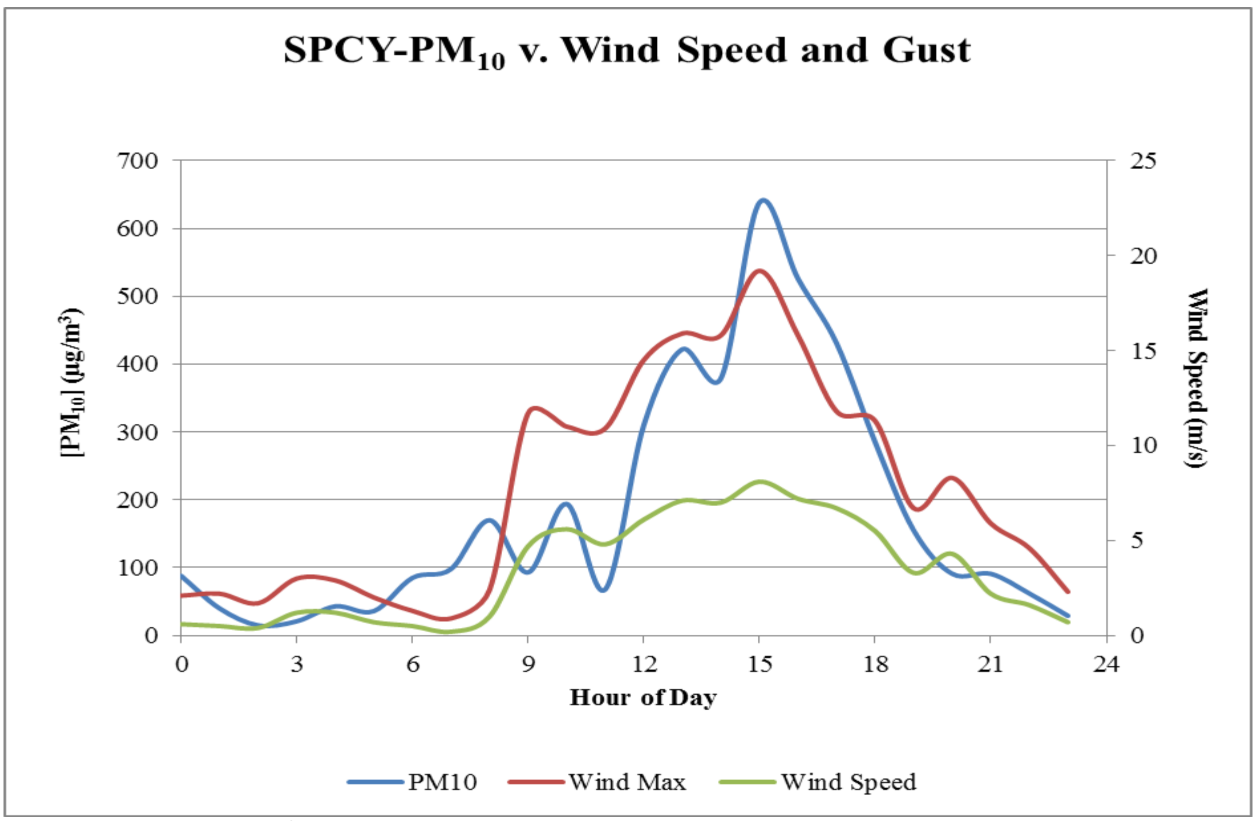

Figure 8-8b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

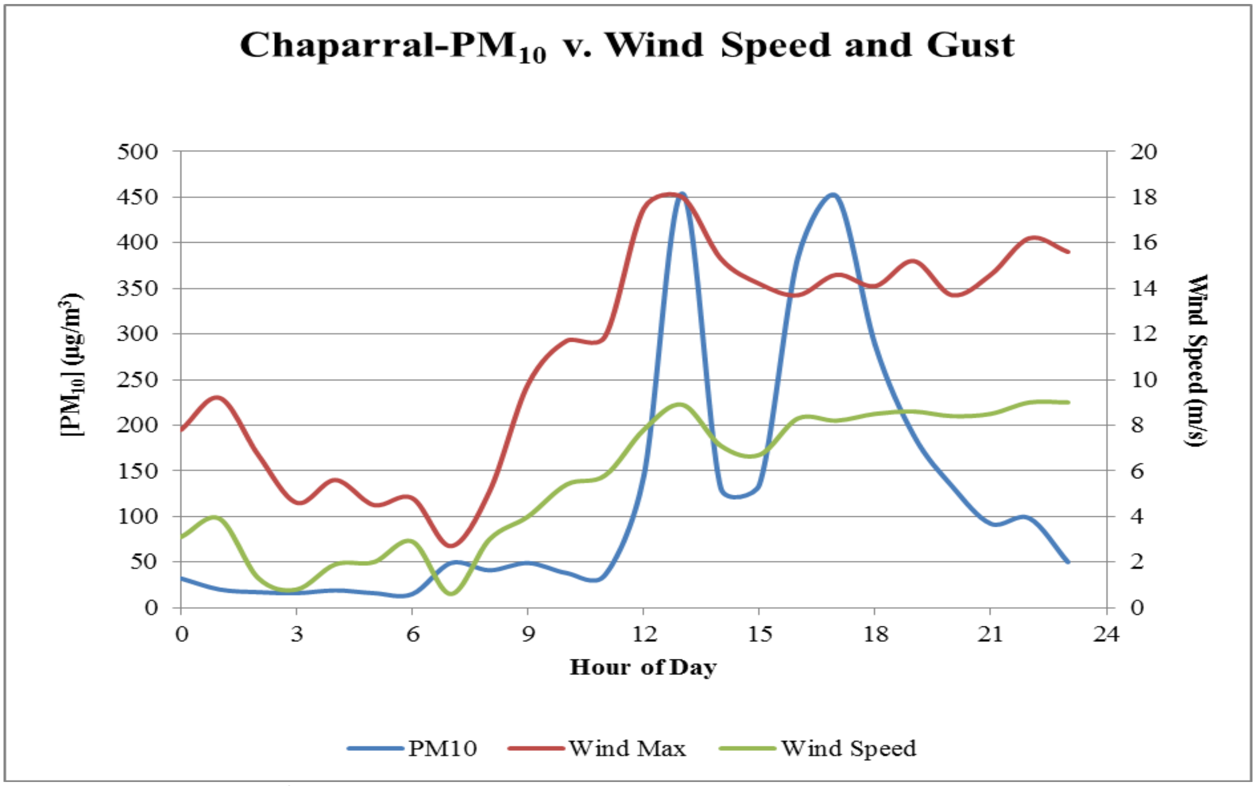

Figure 8-8c. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

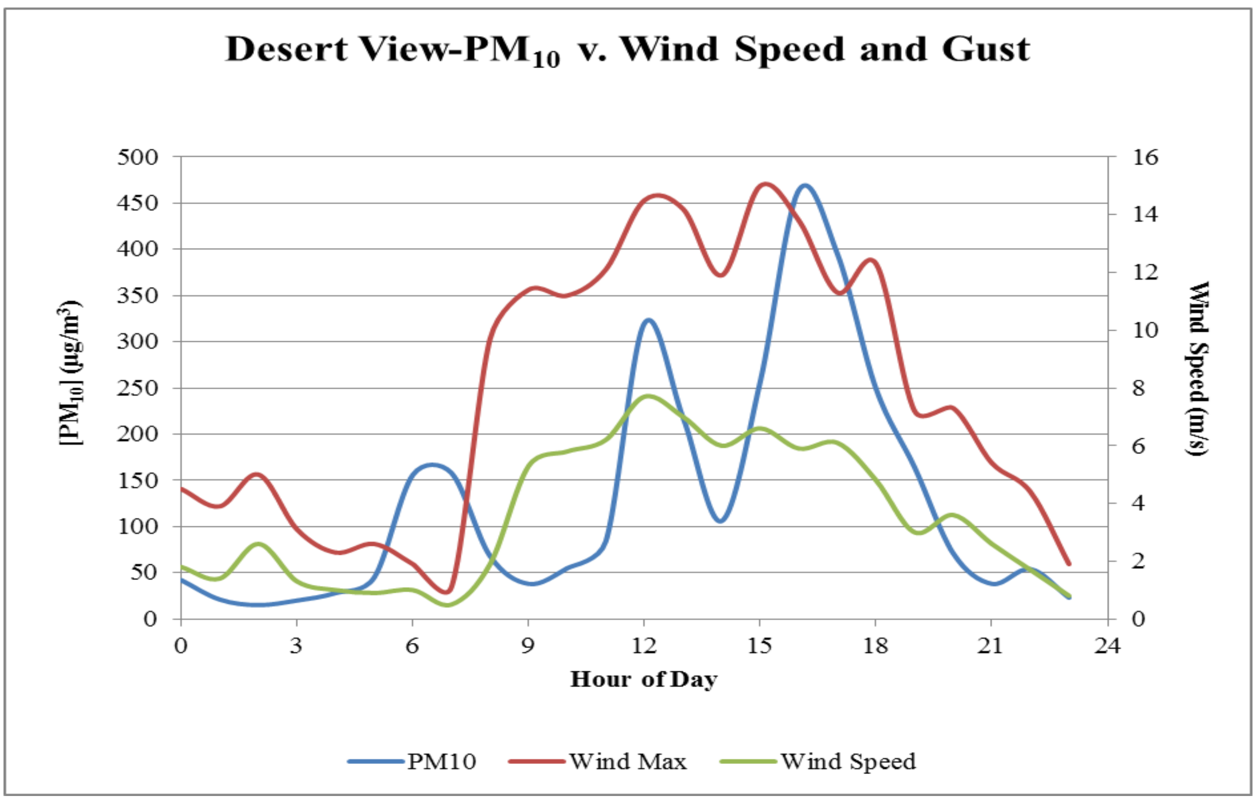

Figure 8-8d. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

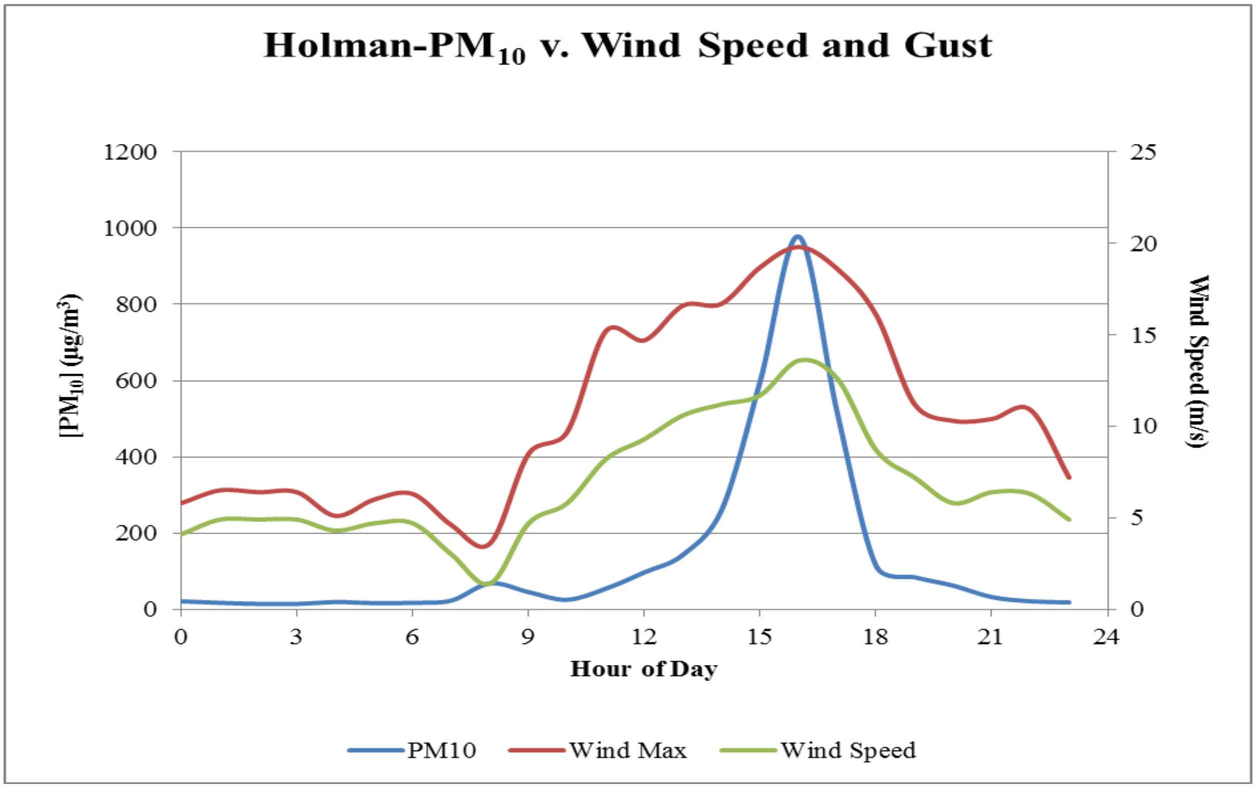

Figure 8-8e. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

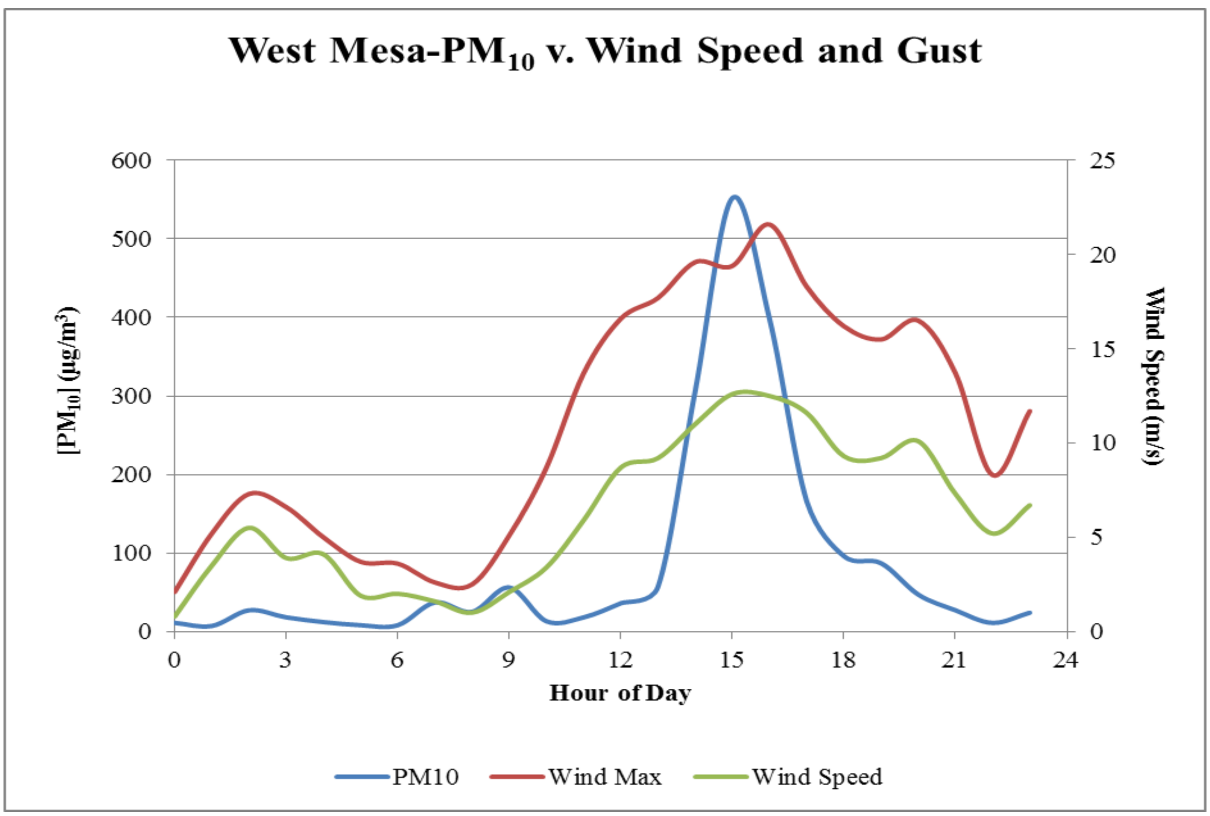

Figure 8-8f. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

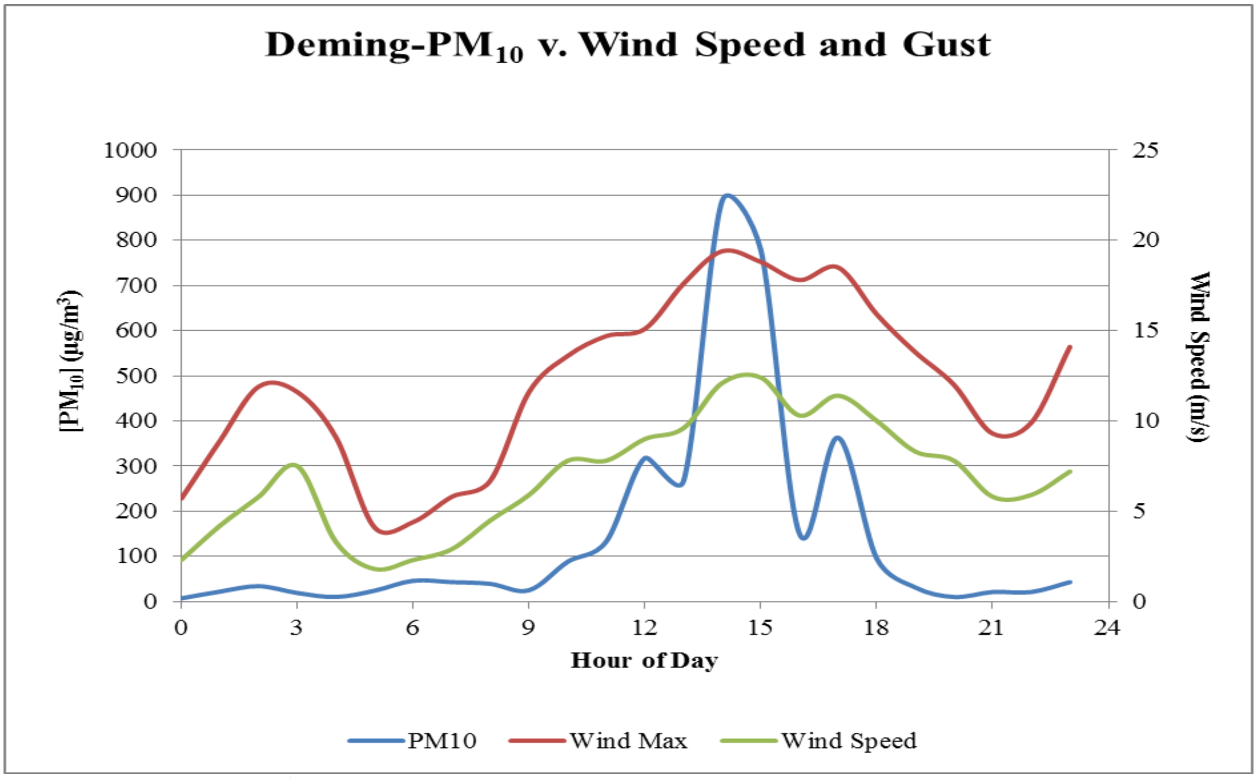

Figure 8-8g. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

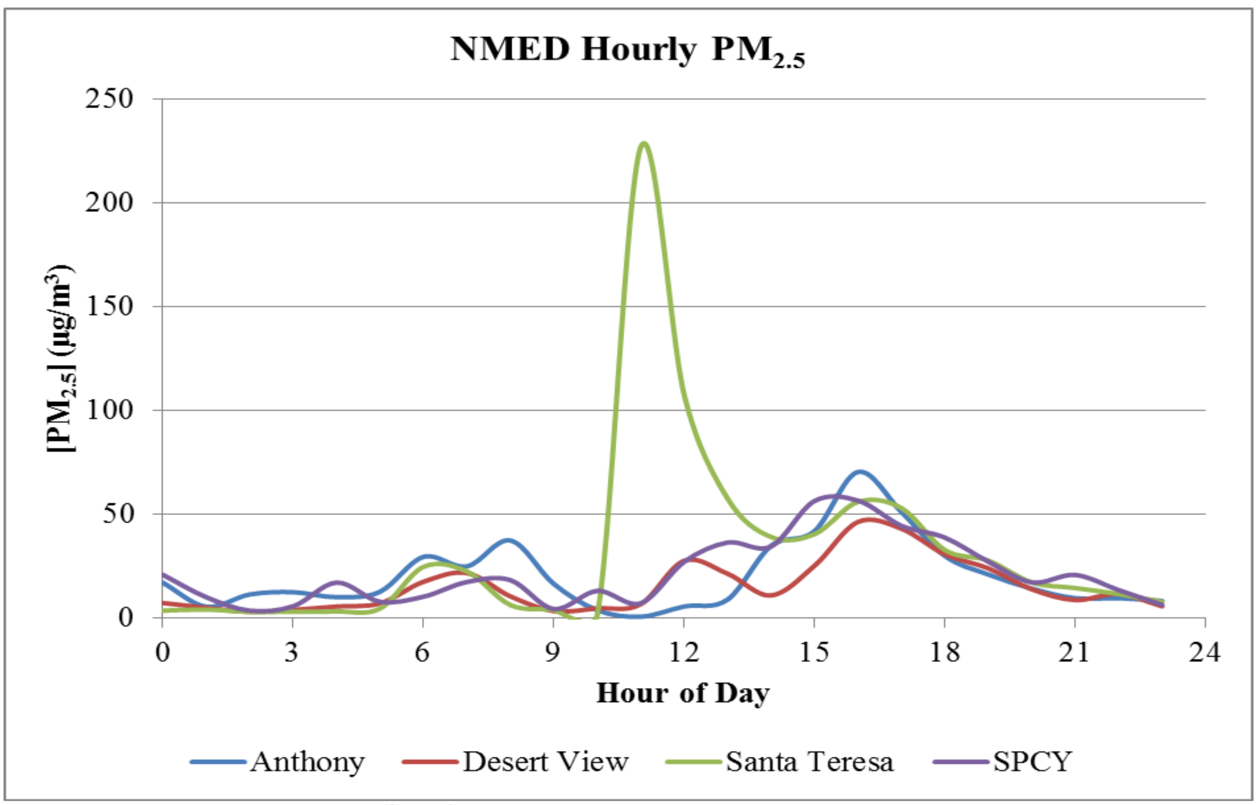

Figure 8-9a. Hourly $PM_{2.5}$ concentrations for Doña Ana and Luna Counties monitors.

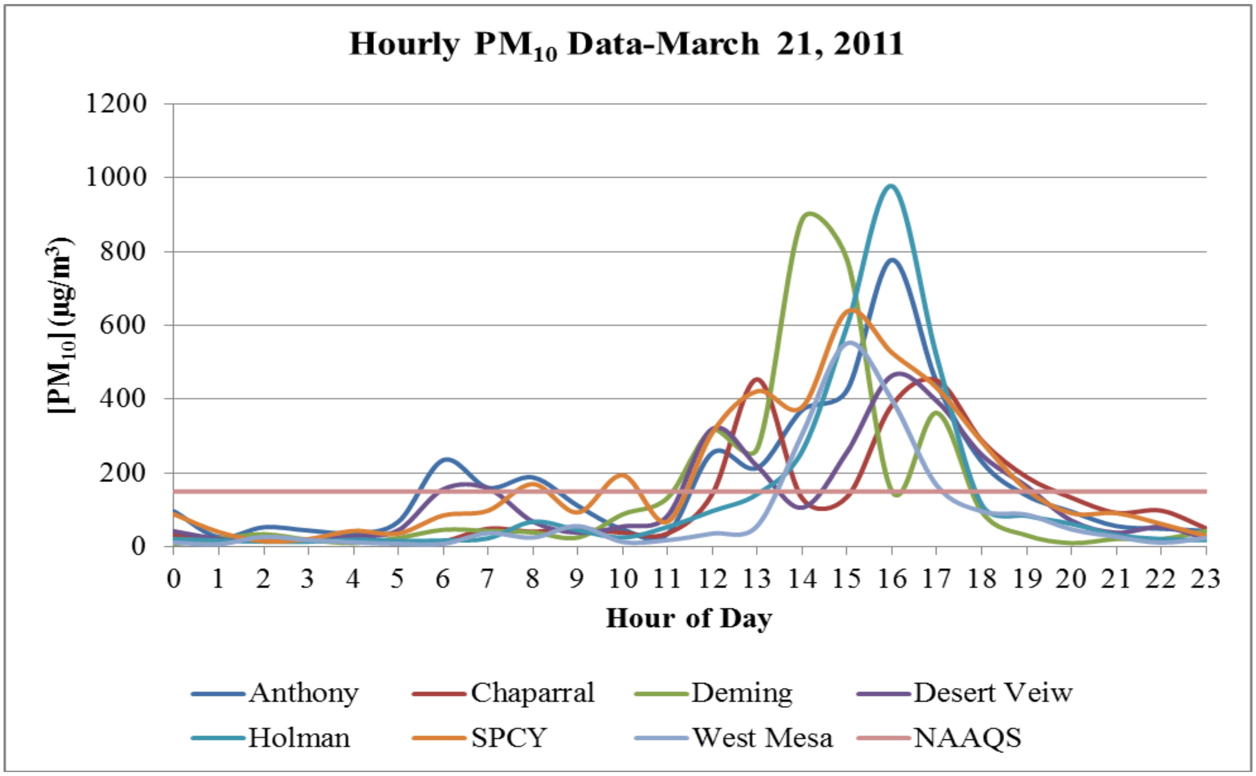

Figure 8-9b. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

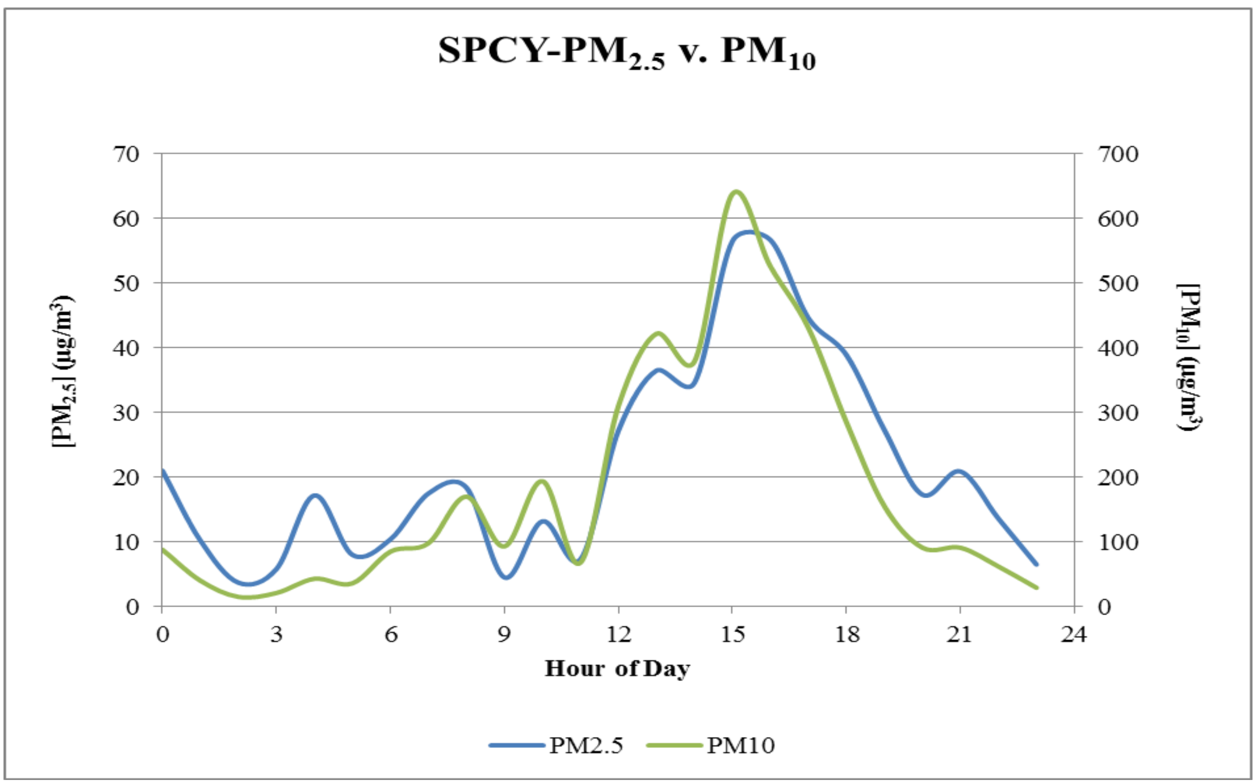

Figure 8-10. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on March 21, 2011.

8.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on March 21, 2011.

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 Anthony monitor detected blowing dust around the 0600 and 0900 hours and then again at the 1200 hour with hourly concentrations heavily impacted until the 1800 hour. By replacing these eight hourly values with the 95th percentile of hourly data at the SPCY site, the resulting 24-hour average (101 µg/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	96	96
1	26	26
2	53	53
3	44	44
4	37	37
5	68	68
6	235	**131**
7	160	**137**
8	188	**109**
9	111	**88**
10	47	47
11	35	35
12	255	**136**
13	214	**146**
14	371	**177**
15	425	**172**
16	778	**152**
17	445	**194**
18	231	**197**
19	139	139
20	95	95
21	56	56
22	49	49
23	43	43
24-Hour Average	175	**101**

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 SPCY monitor detected blowing dust around the 0800 and 1000 hours and then again at the 1200 hour with hourly concentrations heavily impacted until the 1700 hour. By replacing these eight hourly values with the 95th percentile of hourly data at the SPCY site, the resulting 24-hour average (100 µg/m^3) does not exceed the NAAQS (Table 8-2). 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	88	88
1	40	40
2	15	15
3	21	21
4	43	43
5	36	36
6	85	85
7	98	98
8	170	**98**
9	93	93
10	194	**93**
11	68	68
12	310	**104**
13	422	**125**
14	379	**145**
15	638	**160**
16	526	**168**
17	431	**201**
18	285	285
19	155	139
20	91	95
21	91	56
22	62	49
23	29	43
24-Hour Average	182	**100**

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 SPCY.

9 HIGH WIND EXCEPTIONAL EVENT: APRIL 3, 2011

9.1 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 at the Anthony, Chaparral, Deming Airport, Desert View, Holman, and SPCY monitoring sites on this date. The FEM TEOM continuous monitors at these sites recorded 24-hour average concentrations of 273, 295, 252, 192, 175, and 490 $\mu g/m^3$, respectively. The Partisol monitor at SPCY recorded a 24-hour average concentration of 74.5 $\mu g/m^3$. The FRM Wedding monitors at Anthony and SPCY recorded 24-hour average concentrations of 151 $\mu g/m^3$ and 191 $\mu g/m^3$, respectively. 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 except for one (West Mesa: 134 $\mu g/m^3$) recording an exceedance on this date (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-southwesterly direction 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.

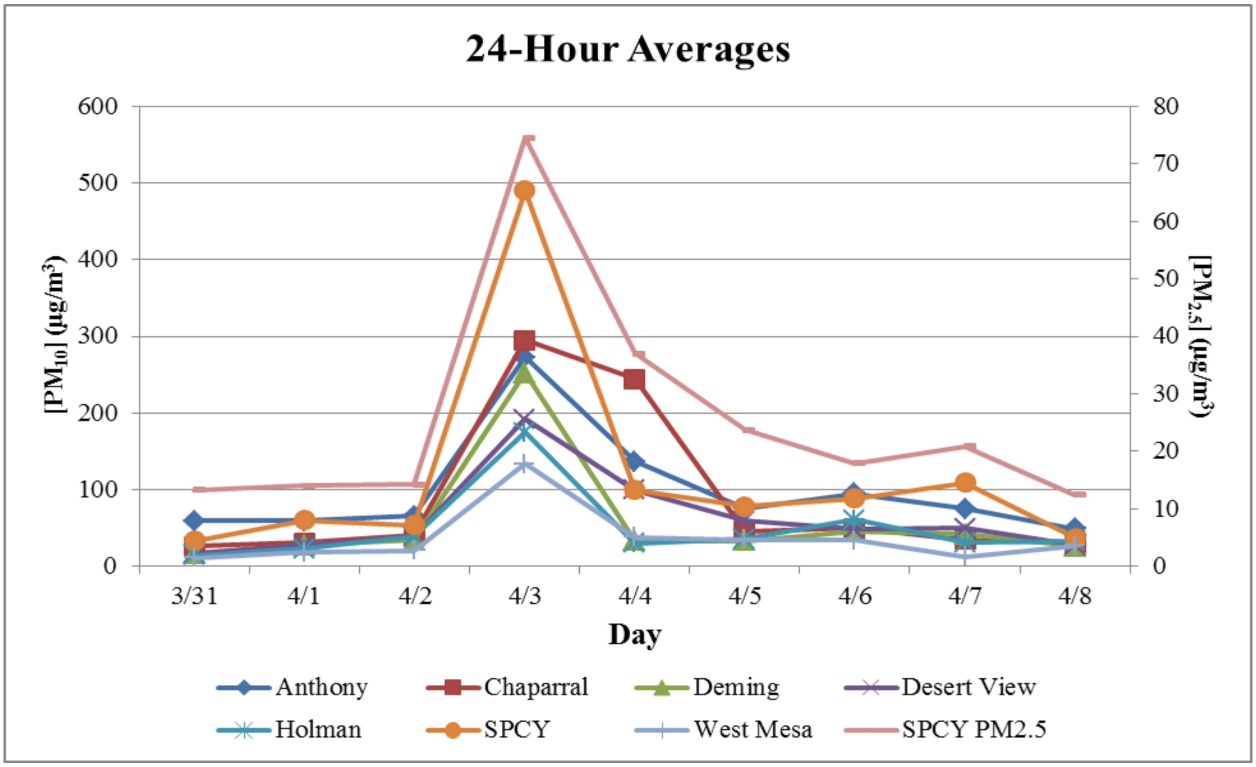

Figure 9-1. PM_{10} and $PM_{2.5}$ 24-hour averages before and after April 3, 2011.

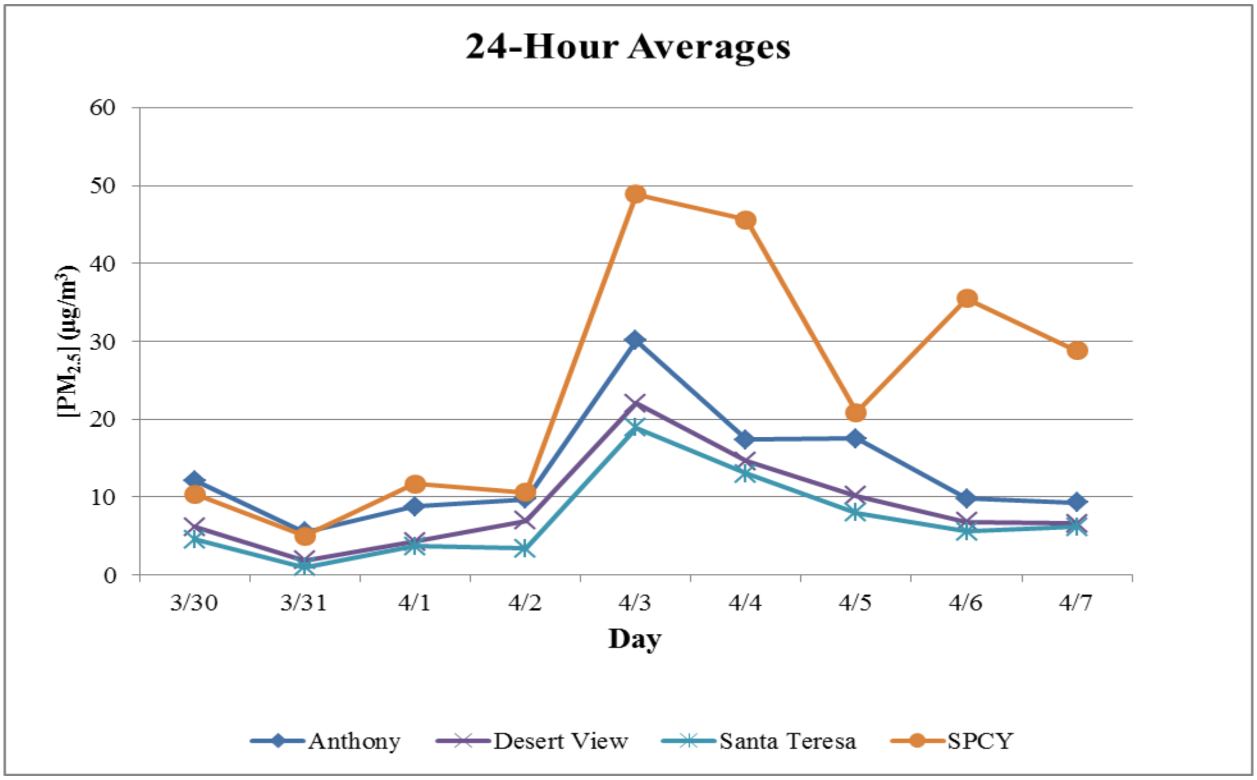

Figure 9-2. $PM_{2.5}$ 24-hour averages before and after April 3, 2011. Non-FEM TEOM Data.

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. 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 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 3, 2011, sustained wind speeds exceeded EPA's default threshold at six of the seven monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at all of the seven monitoring sites (Figures 9-3 and 9-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 1100 hour and ending at the 1700 hour.

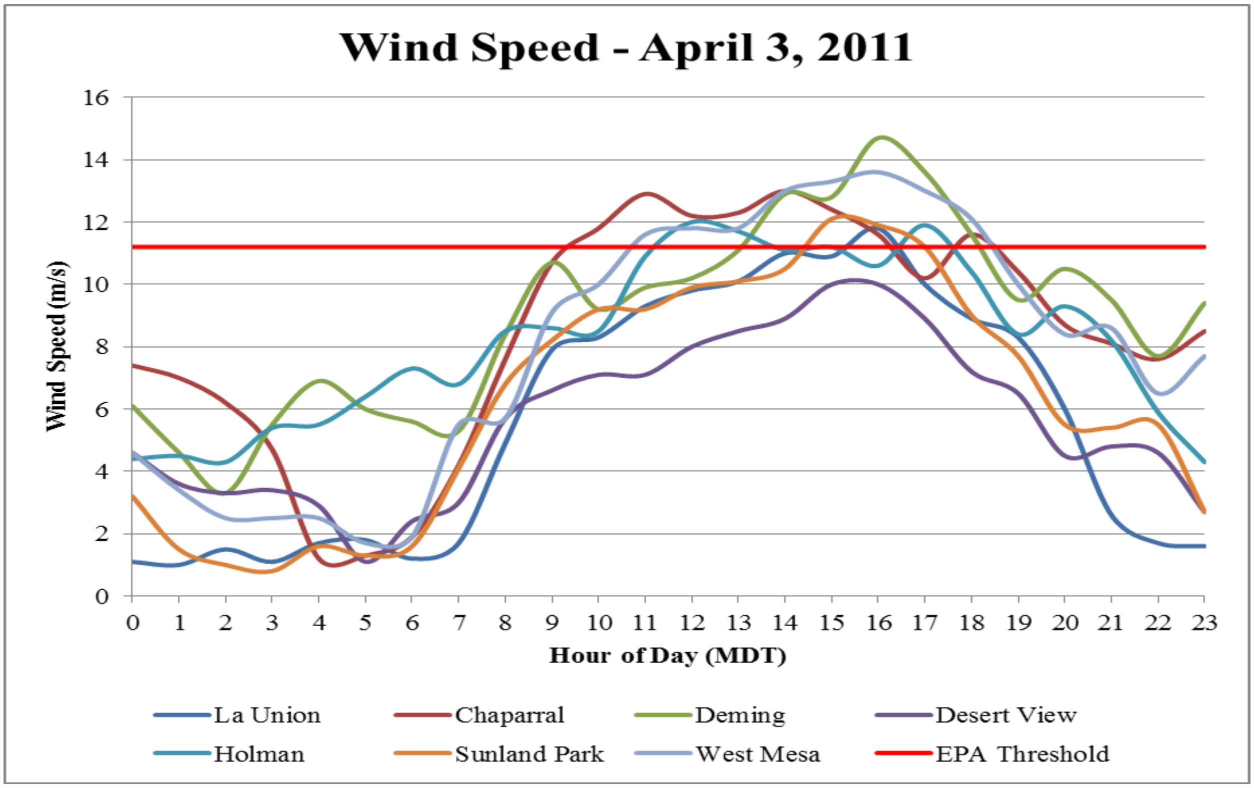

Figure 9-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

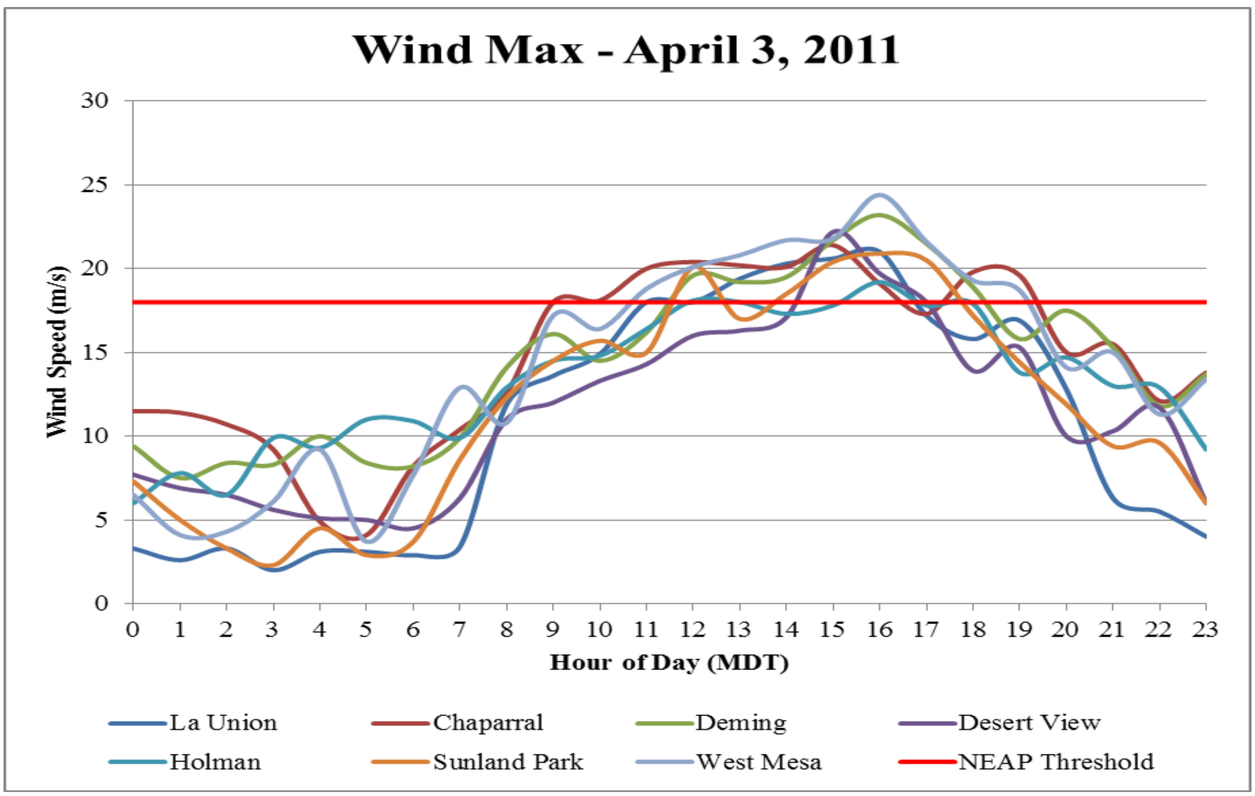

Figure 9-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

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 2006-2010 the PM_{10} FEM TEOM monitors recorded 211 exceedances and the PM_{10} FRM Wedding monitors recorded 5 exceedances (Figure A-2). 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 (Table 2-1). The SPCY $PM_{2.5}$ FRM Partisol recorded 23 exceedances of the 24-Hour NAAQS from 2006-2010 (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 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. 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 and Mexico to the monitors in southern/northern Doña Ana and Luna Counties. 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 Arizona and Mexico. NMED concludes that the sources contributing to the event are not reasonably controllable.

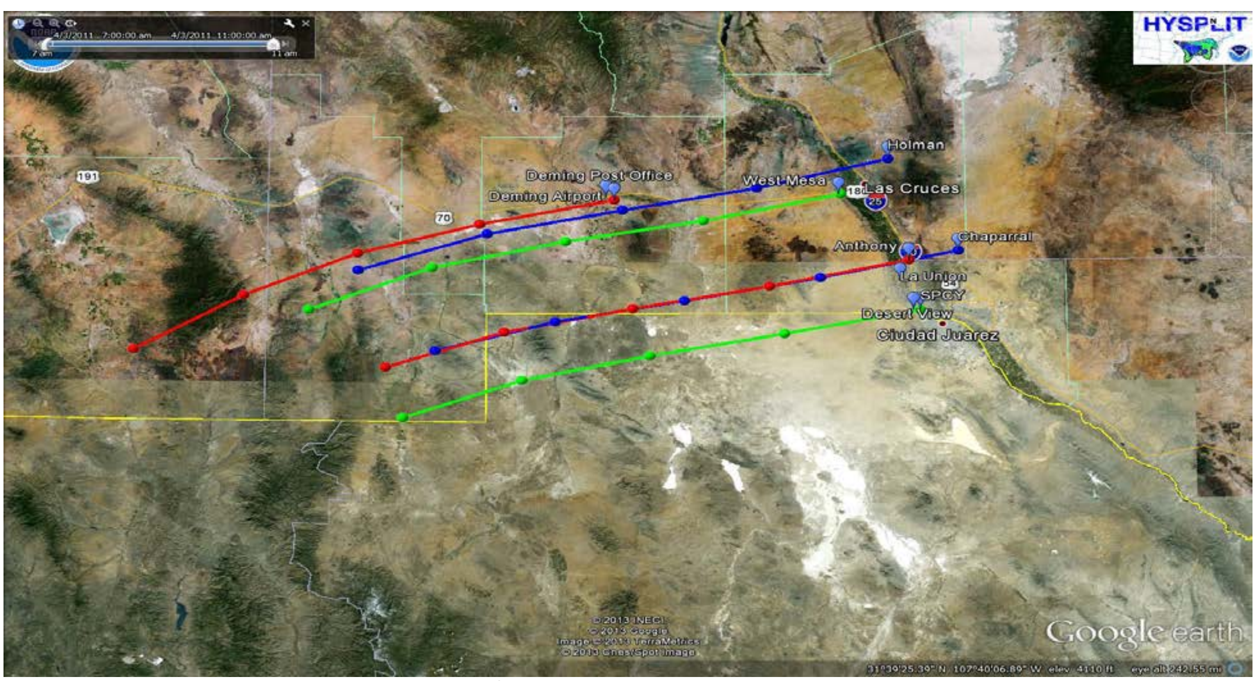

Figure 9-5. HYSPLIT back-trajectory model analysis for April 3, 2011.

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-4 through B-11). 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 2006-2010 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 2006-2010. 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 2006-2010. The recorded values for this day (Anthony: 273 µg/m^3; Chaparral: 295 µg/m^3; Deming Airport: 252 µg/m^3; Desert View: 192 µg/m^3; Holman: 175 µg/m^3; Sunland Park: 490 µg/m^3) are above the maximum values recorded when no high wind exceedances are included and is above the 95th 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 3, 2011 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-g through 9-8a-f). 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.

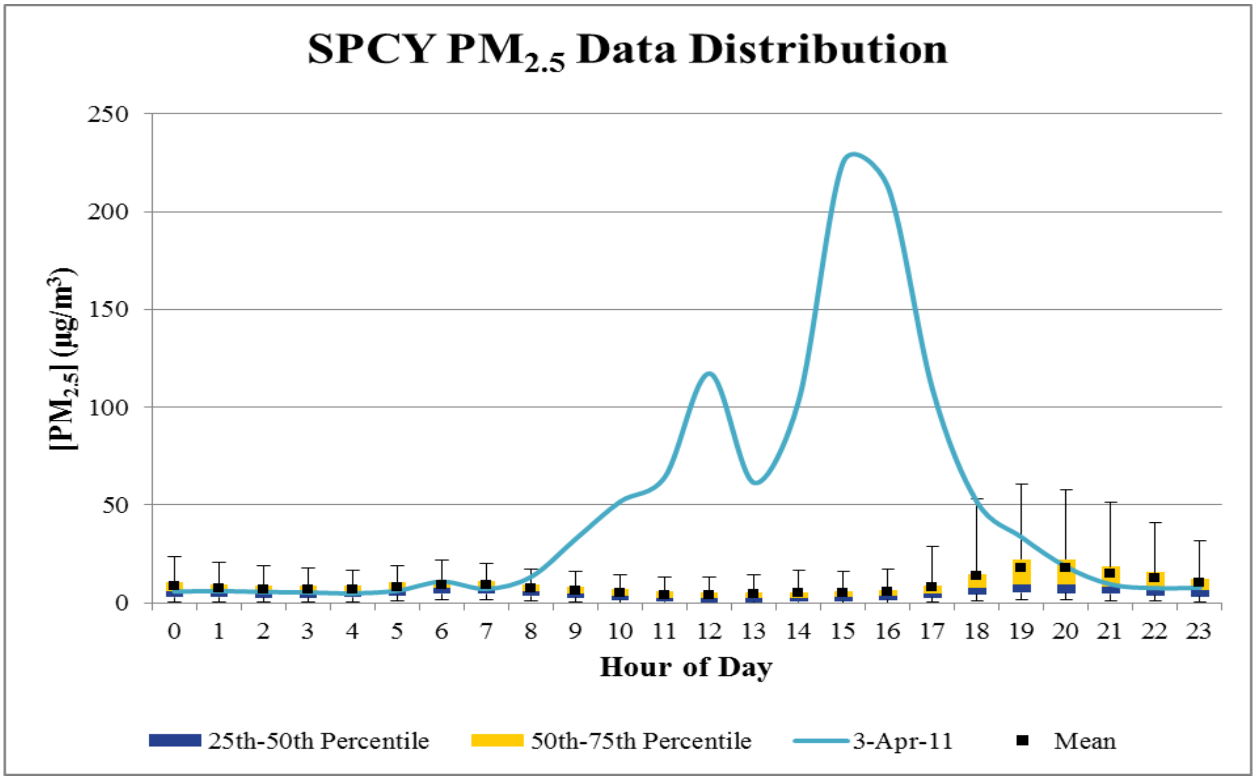

Figure 9-6a. $PM_{2.5}$ hourly data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

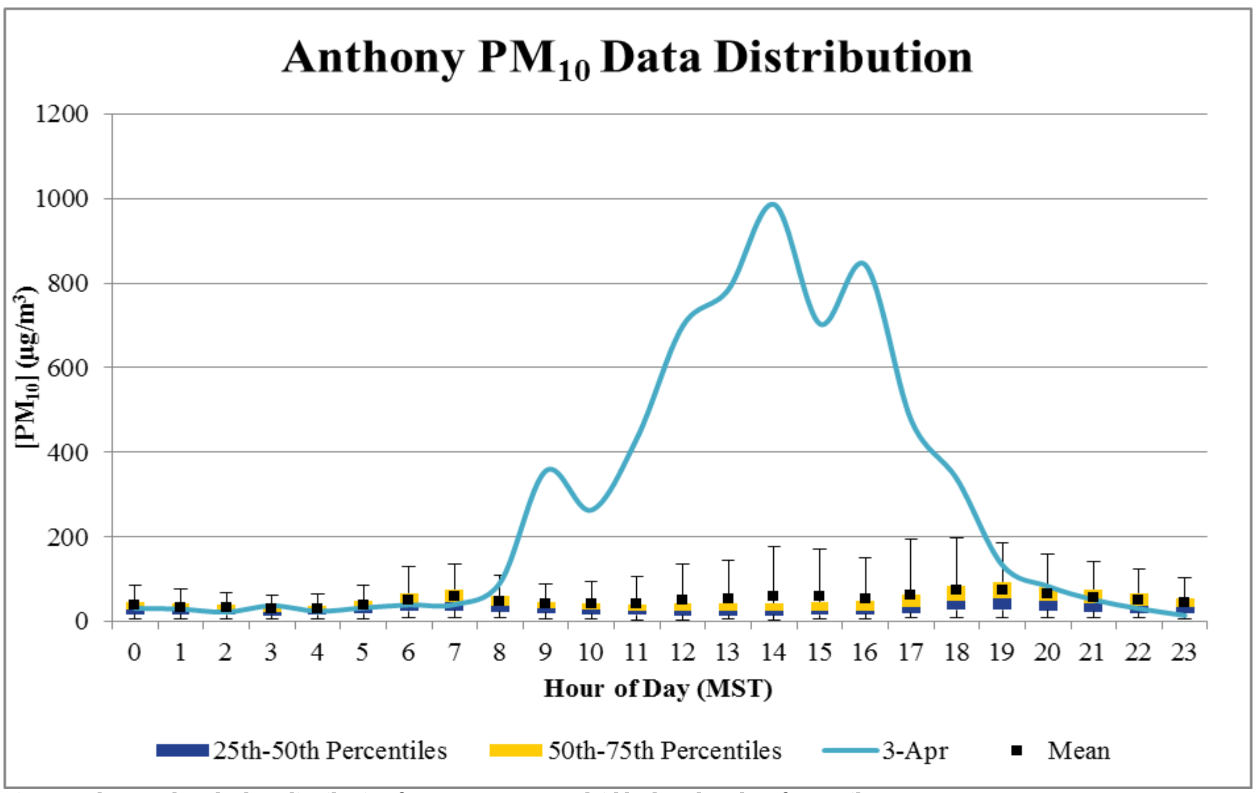

Figure 9-6b. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

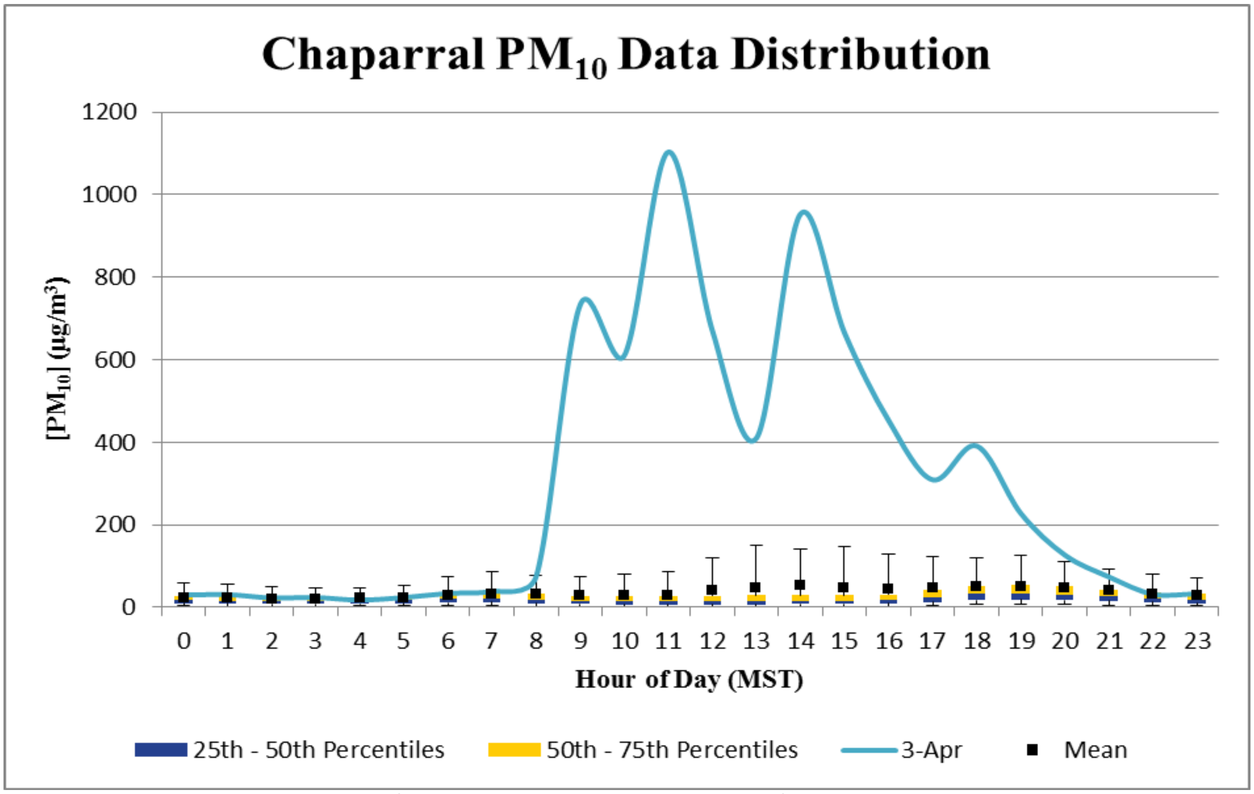

Figure 9-6c. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

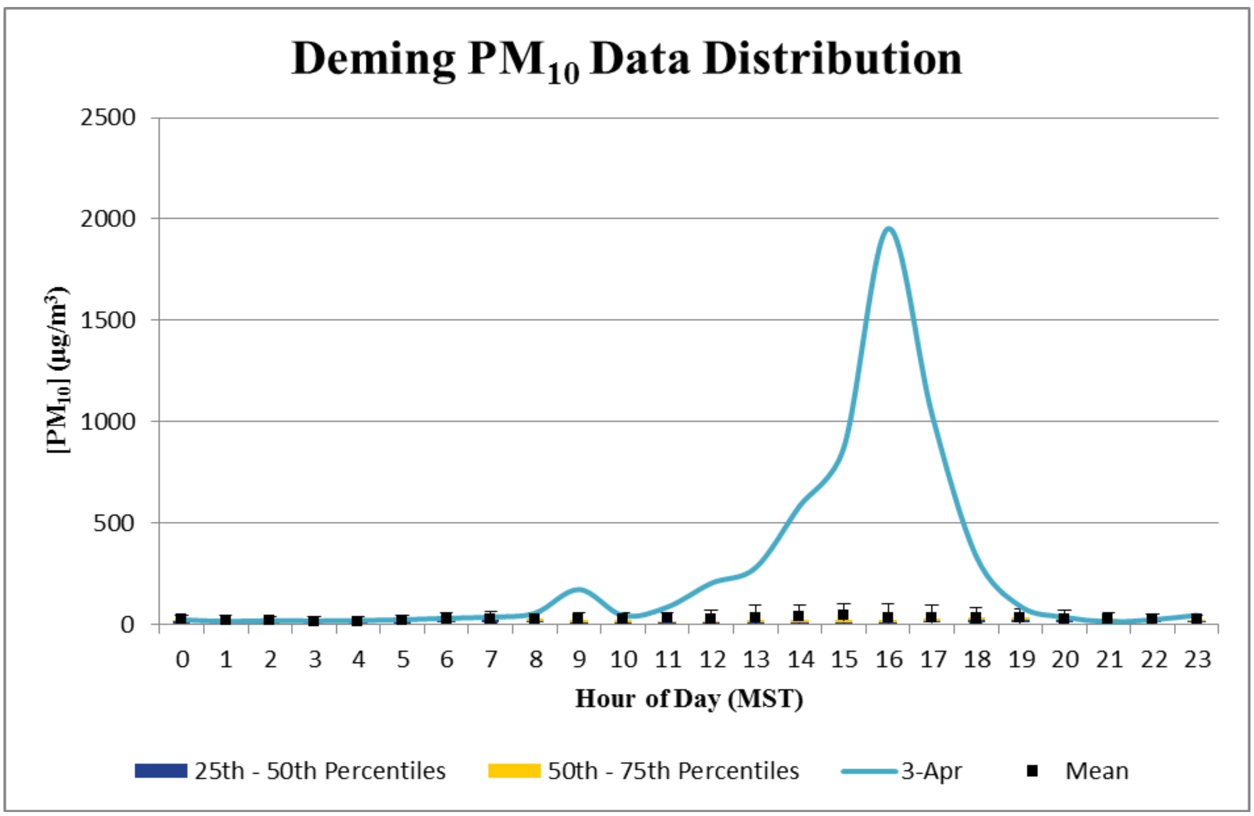

Figure 9-6d. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 3, 2011

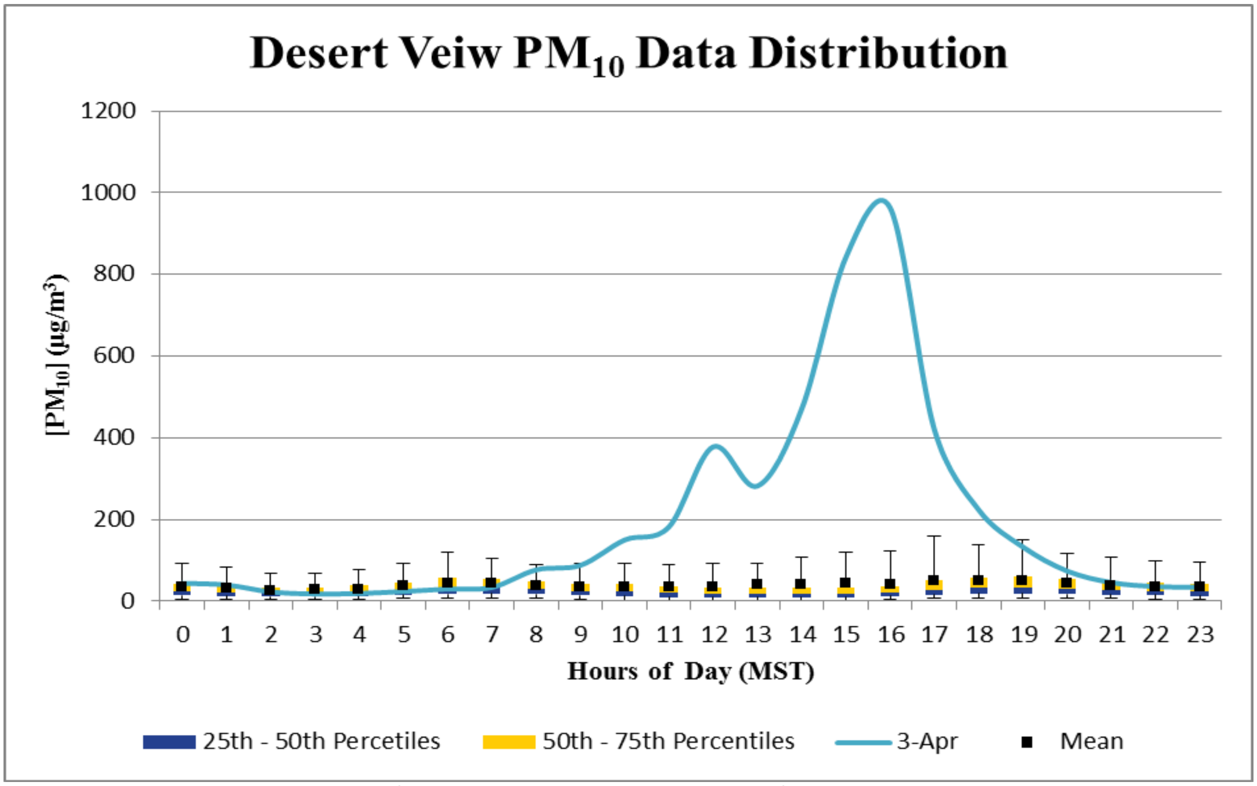

Figure 9-6e. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

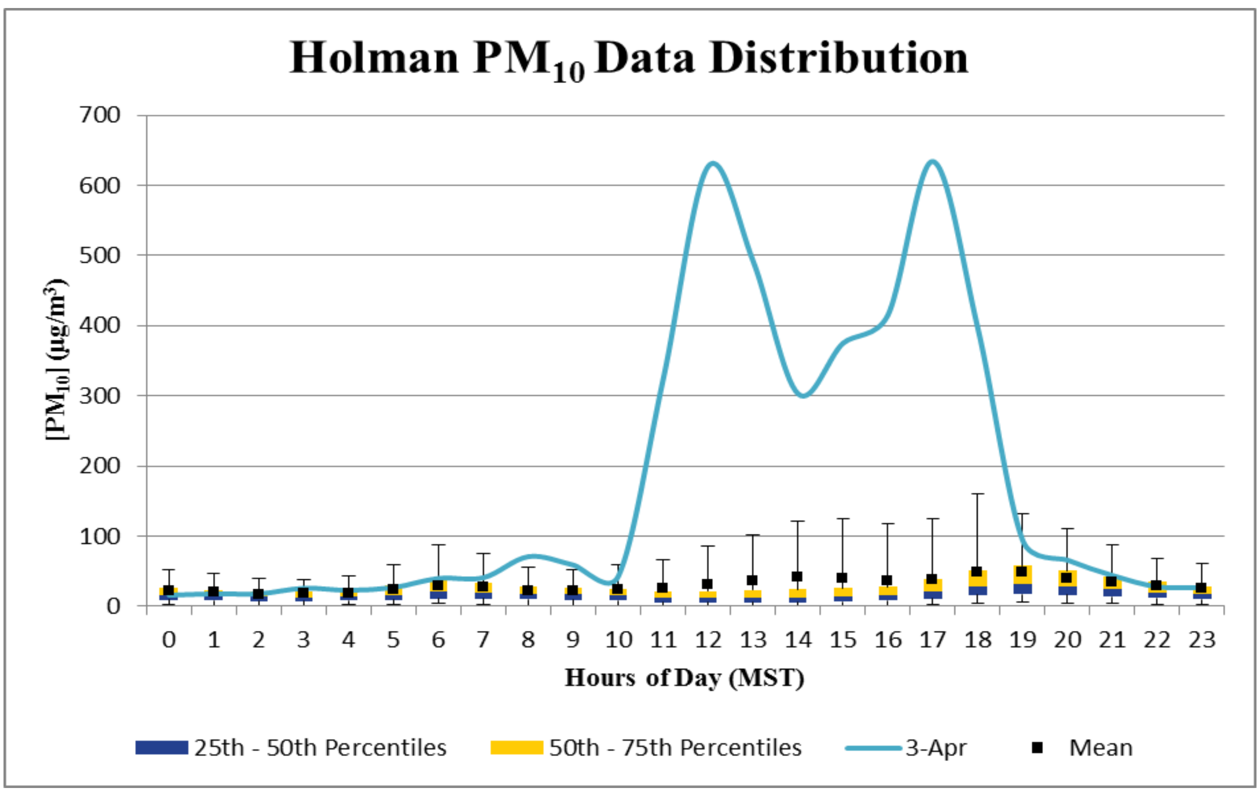

Figure 9-6f. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

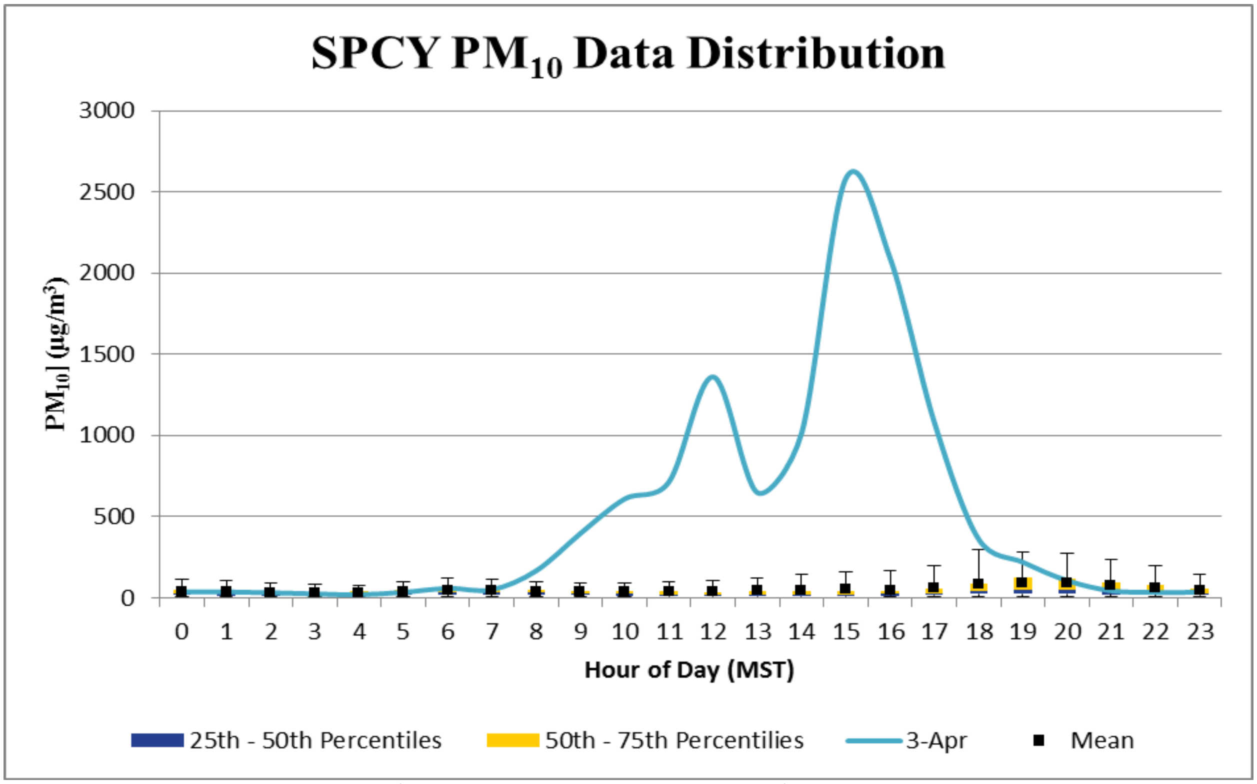

Figure 9-6g. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

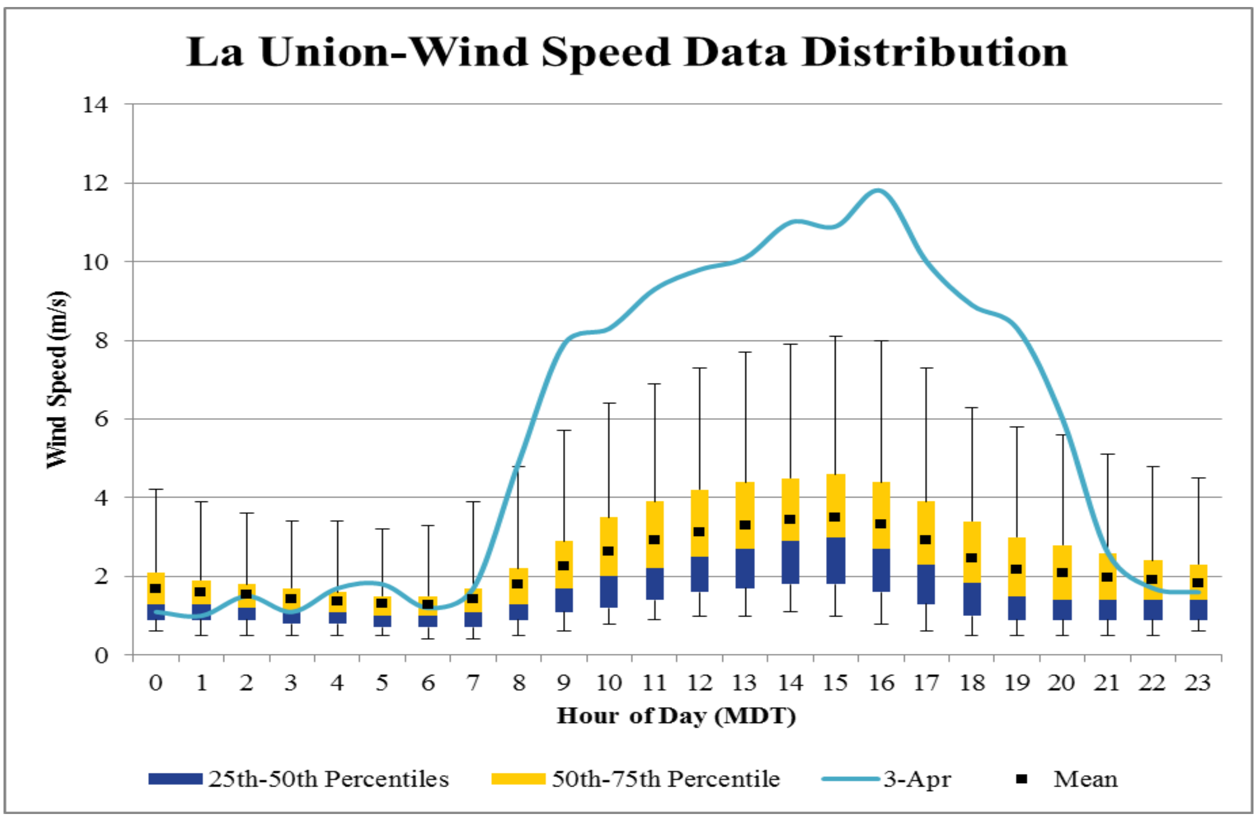

Figure 9-7a. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

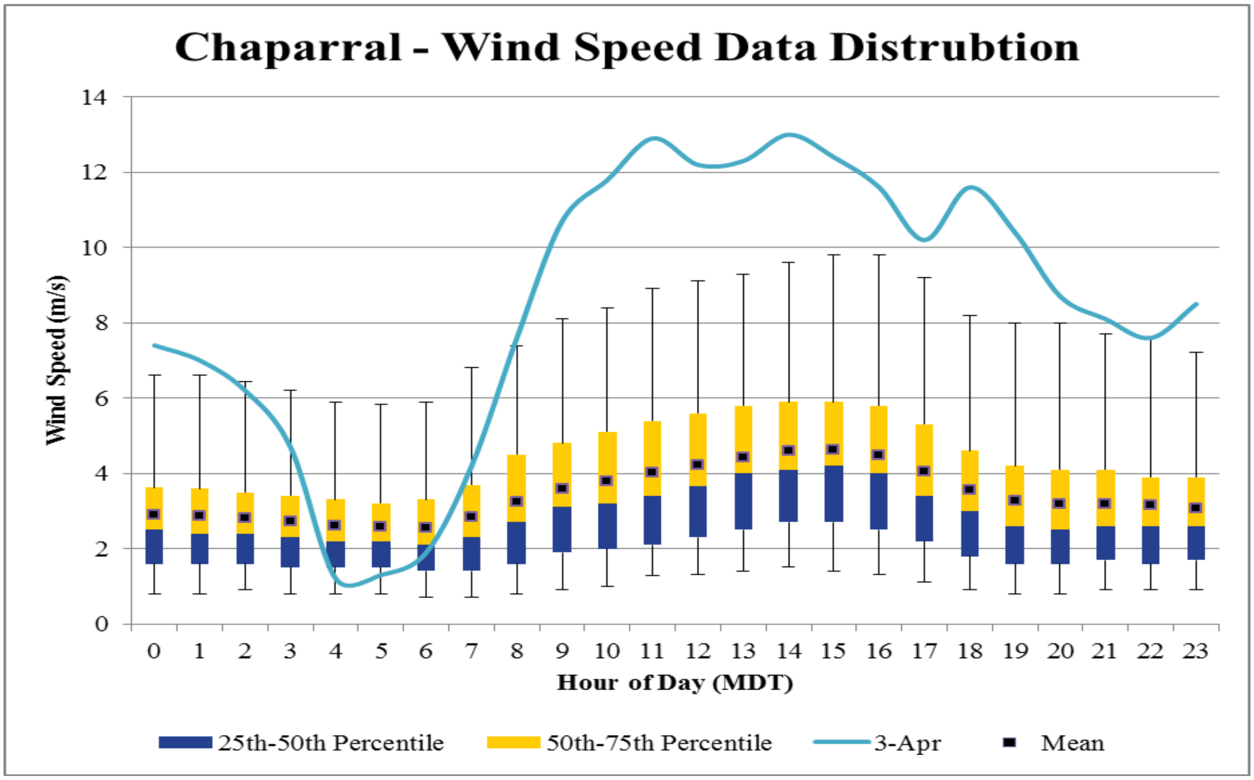

Figure 9-7b. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

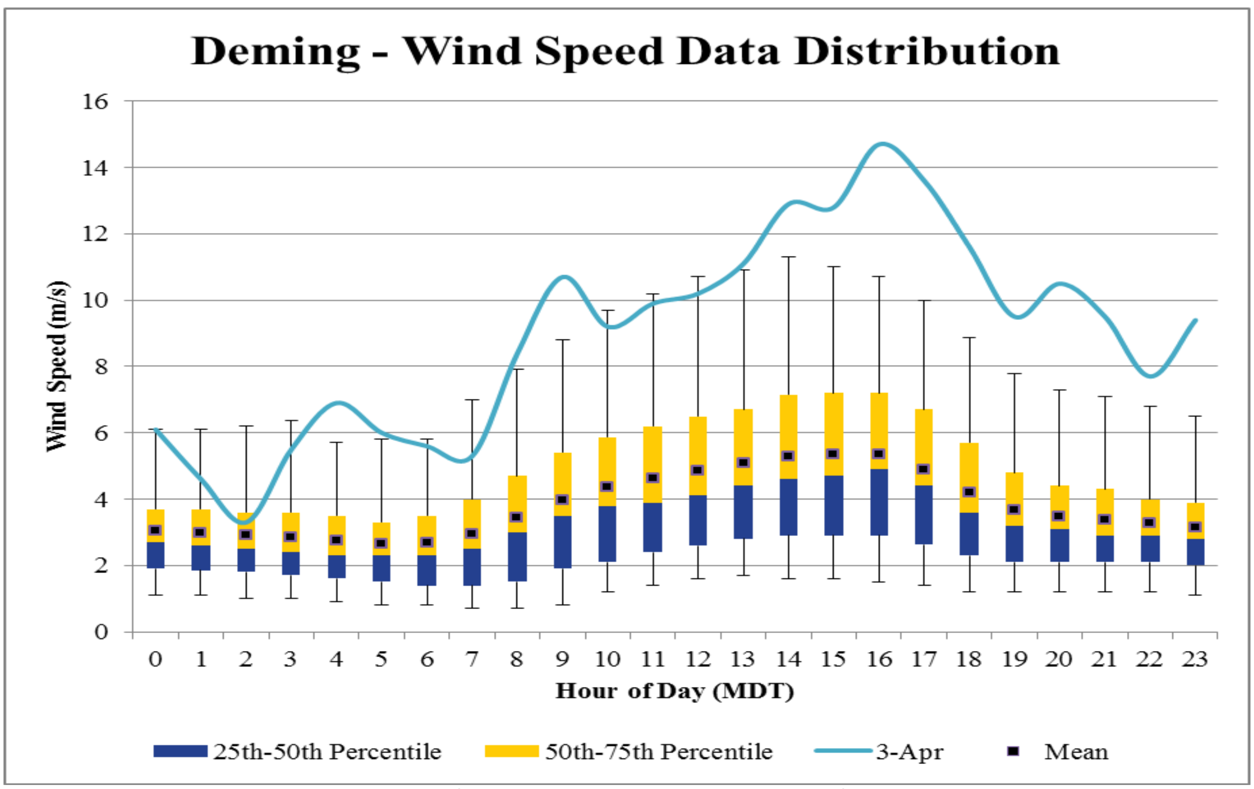

Figure 9-7c. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

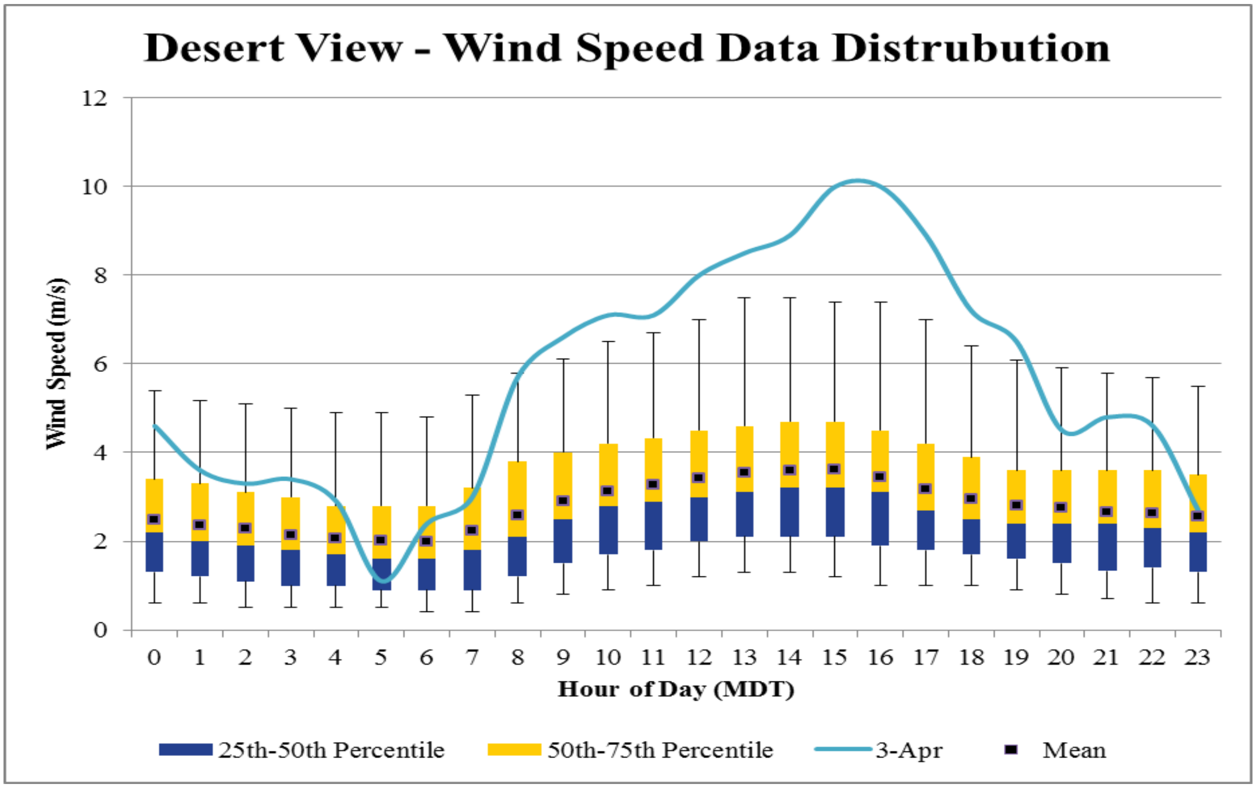

Figure 9-7d. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

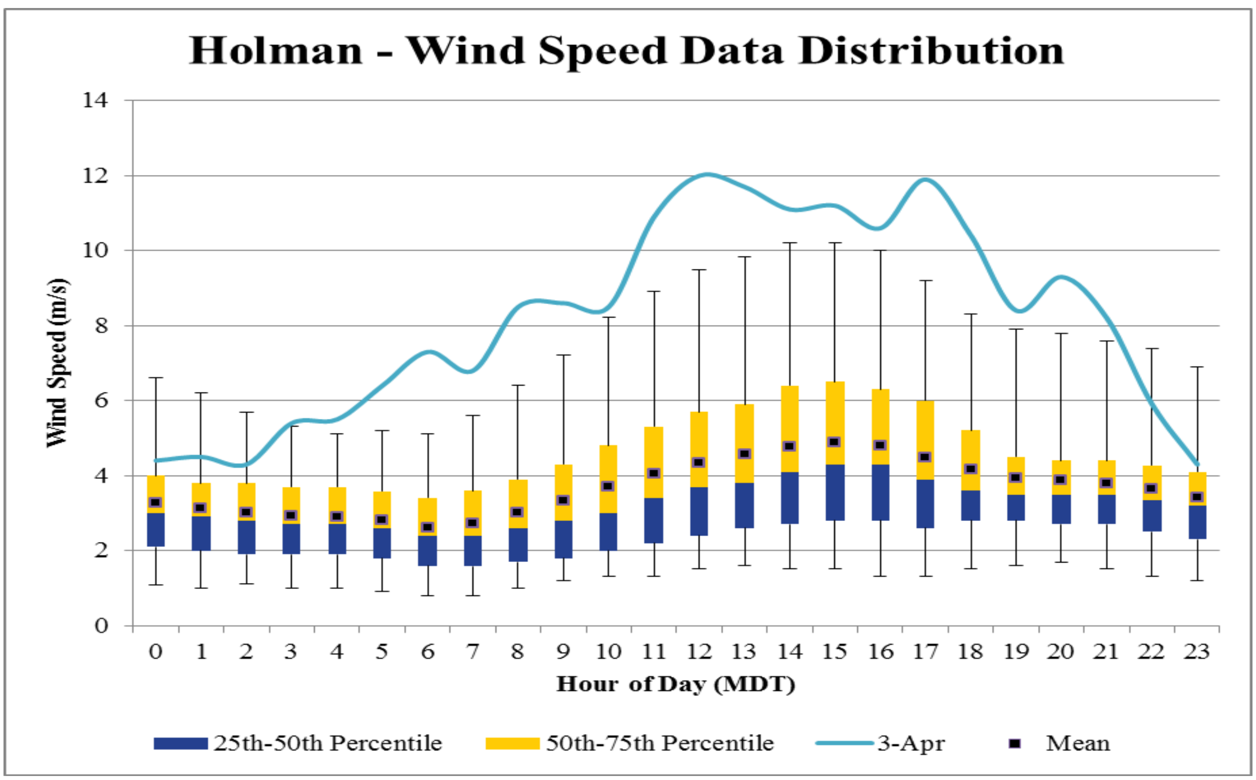

Figure 9-7e. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

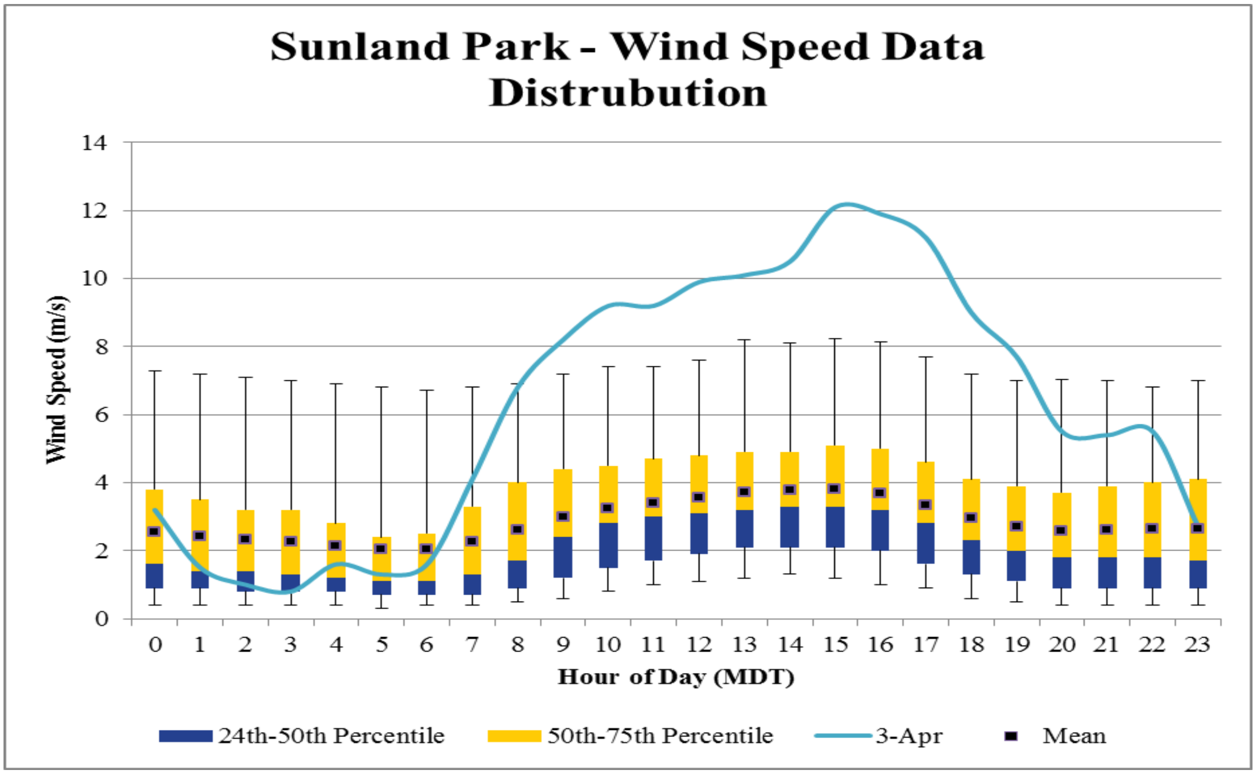

Figure 9-7f. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

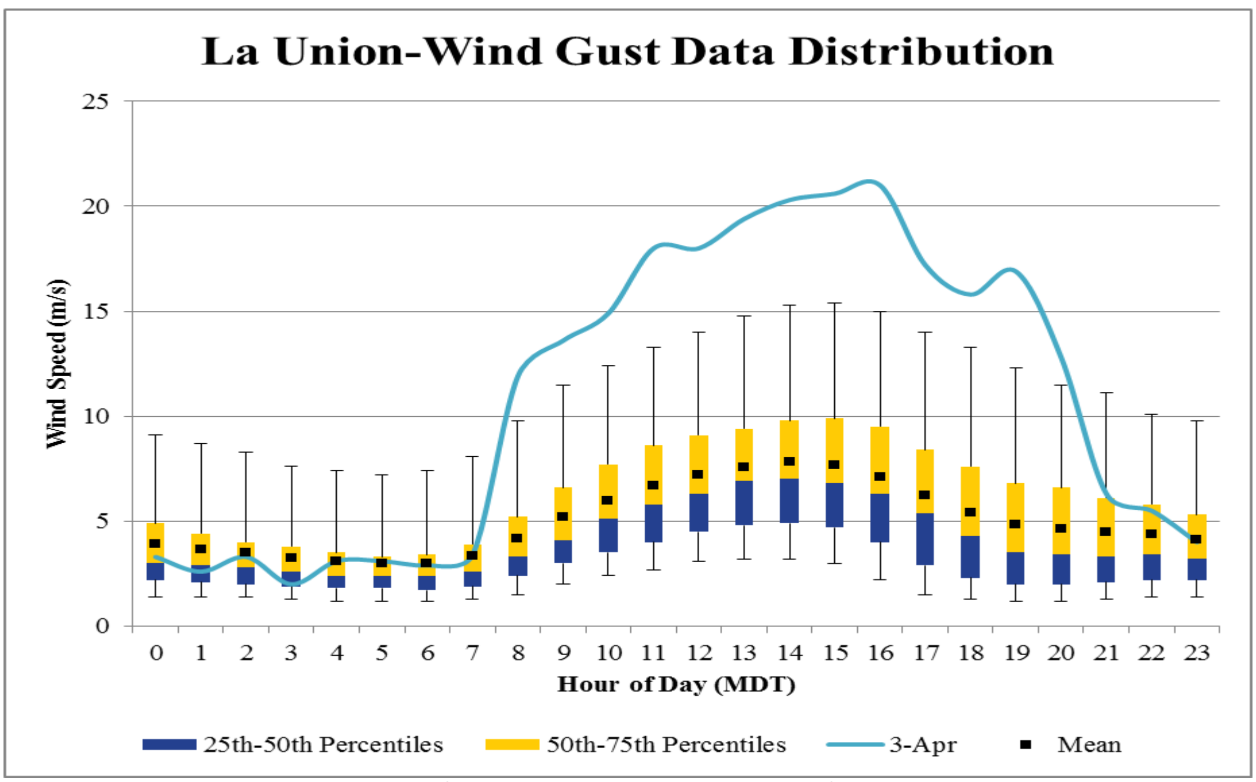

Figure 9-8a. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

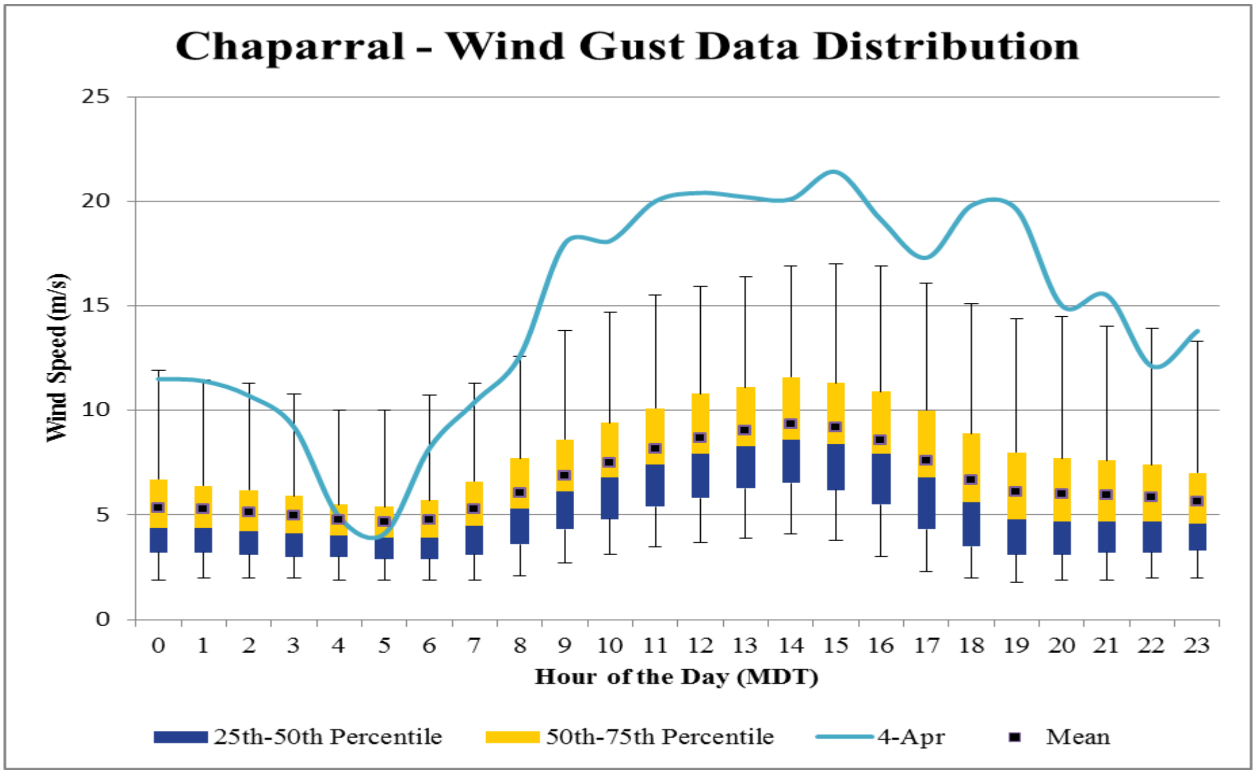

Figure 9-8b. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

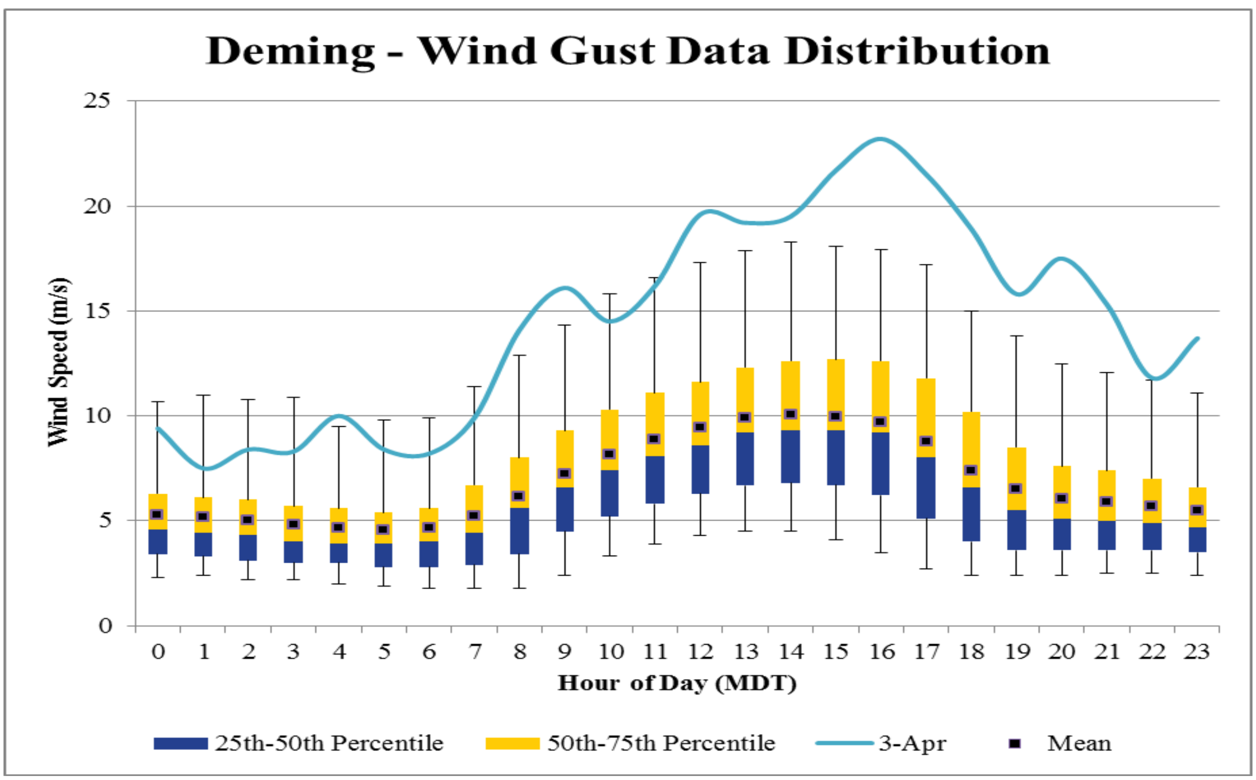

Figure 9-8c. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

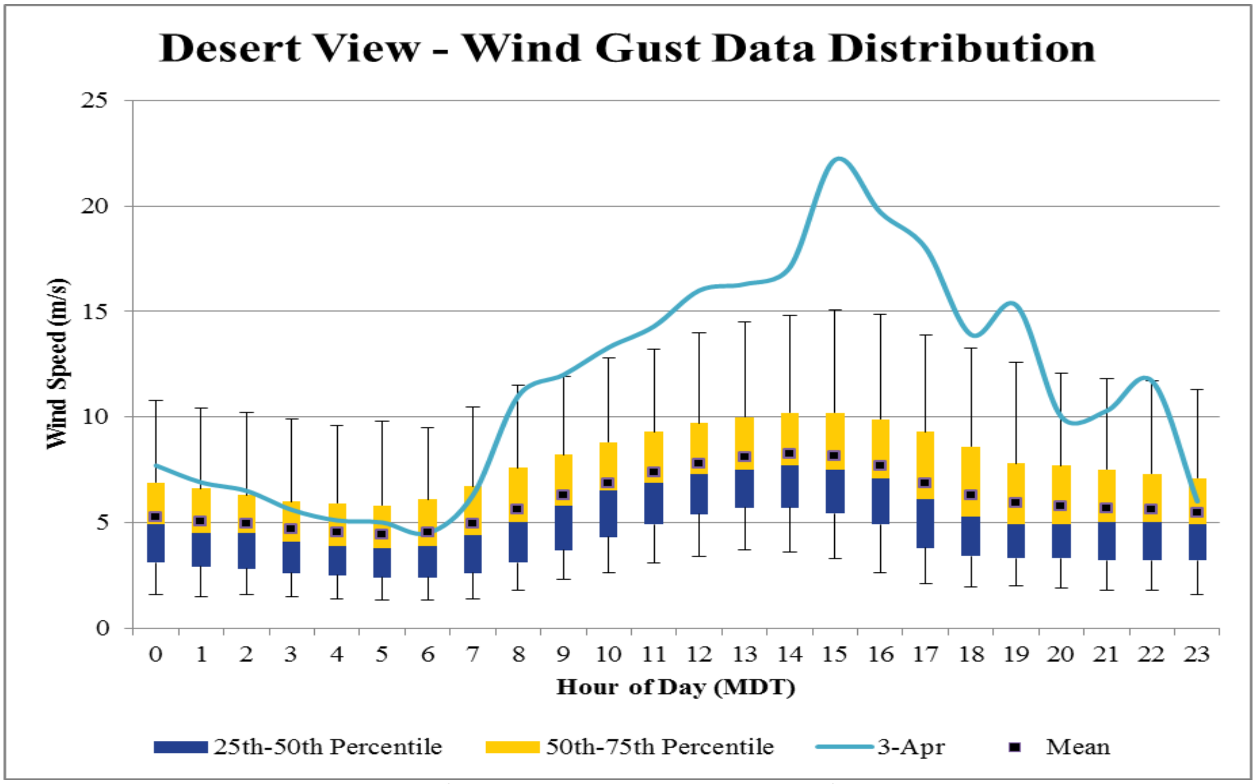

Figure 9-8d. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

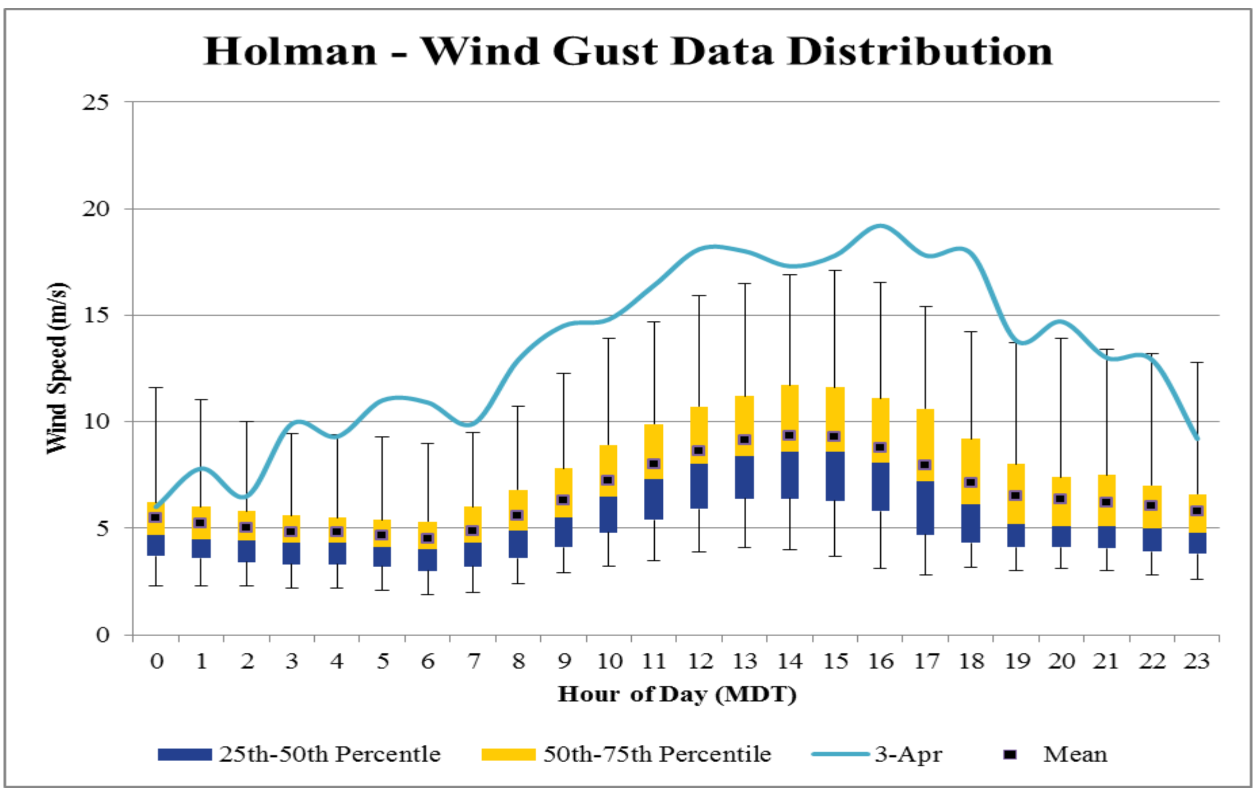

Figure 9-8e. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

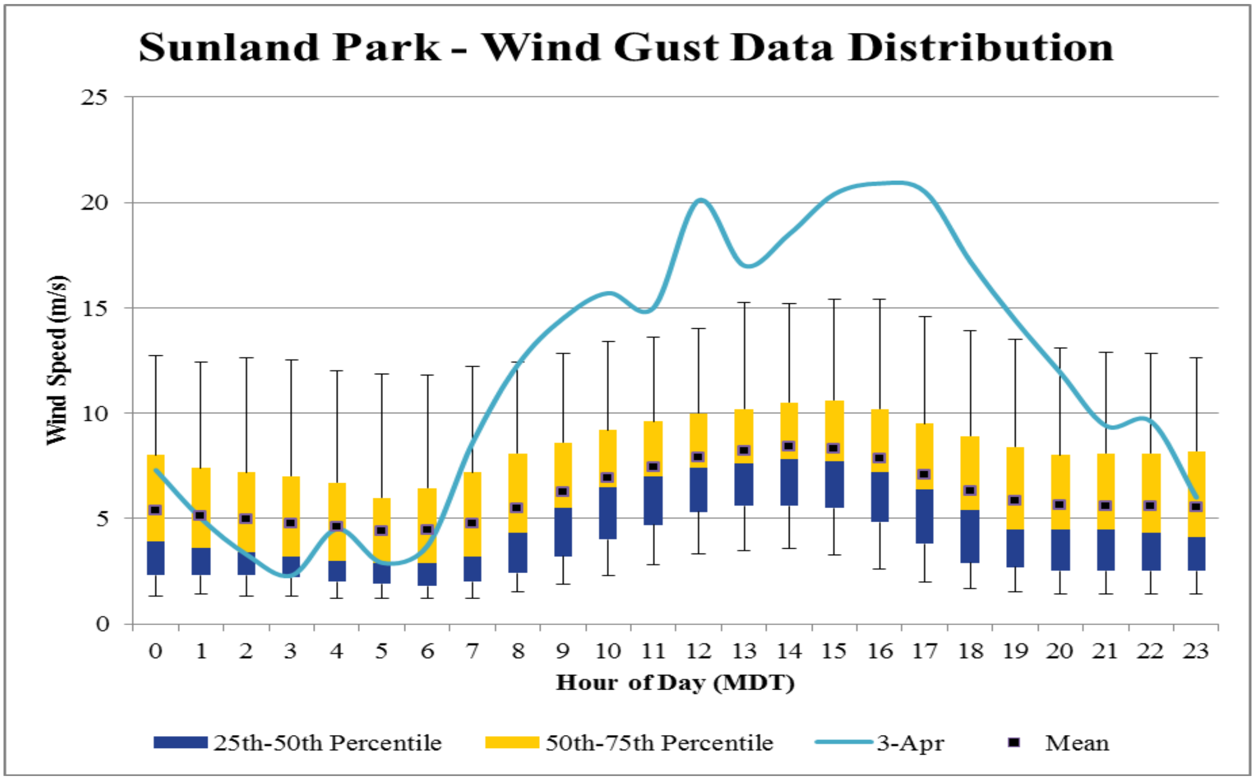

Figure 9-8f. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 3, 2011.

9.4 Clear Causal Relationship

A Pacific cold front passed through New Mexico on April 3, 2011. As the Pacific cold front moved through New Mexico, the pressure gradient formed over southeastern Arizona, southwestern New Mexico and northwestern Chihuahua, Mexico causing high winds at the surface (Figure 9-9). Surface winds flow perpendicular to the isobars from high to low pressure. 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.

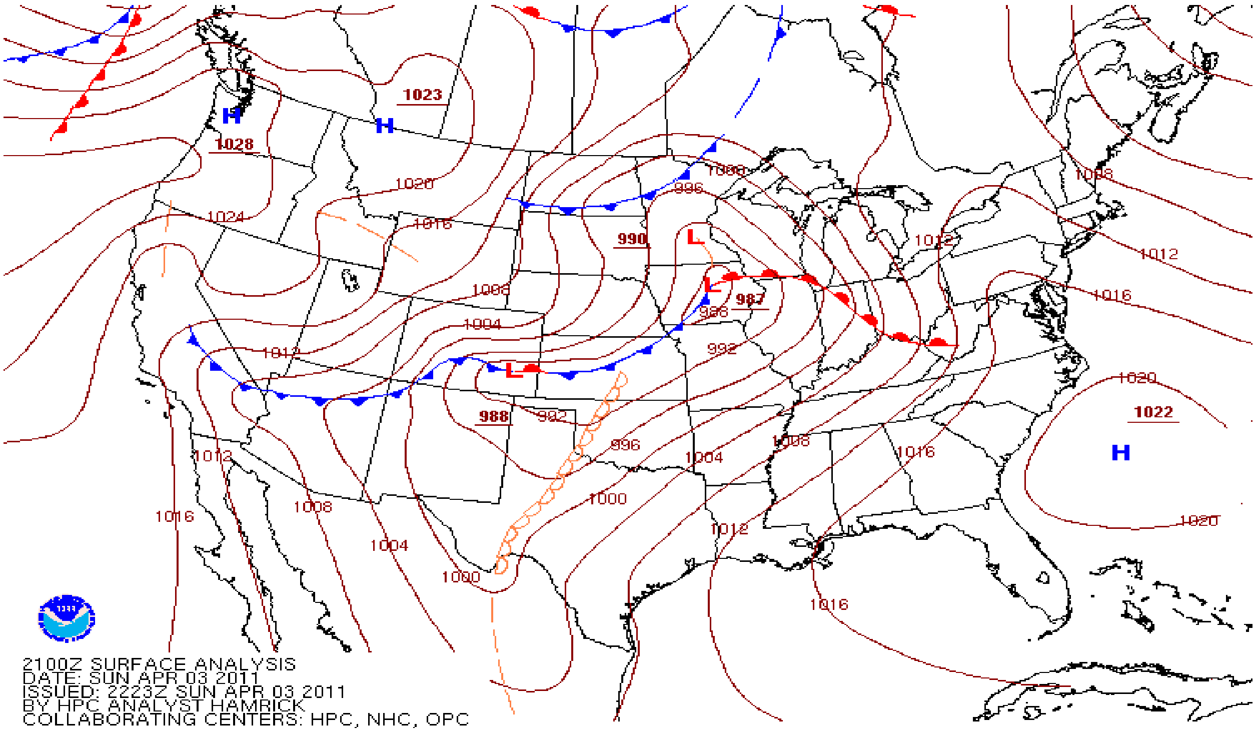

Figure 9-9. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 3, 2011 at the 1400 hour.

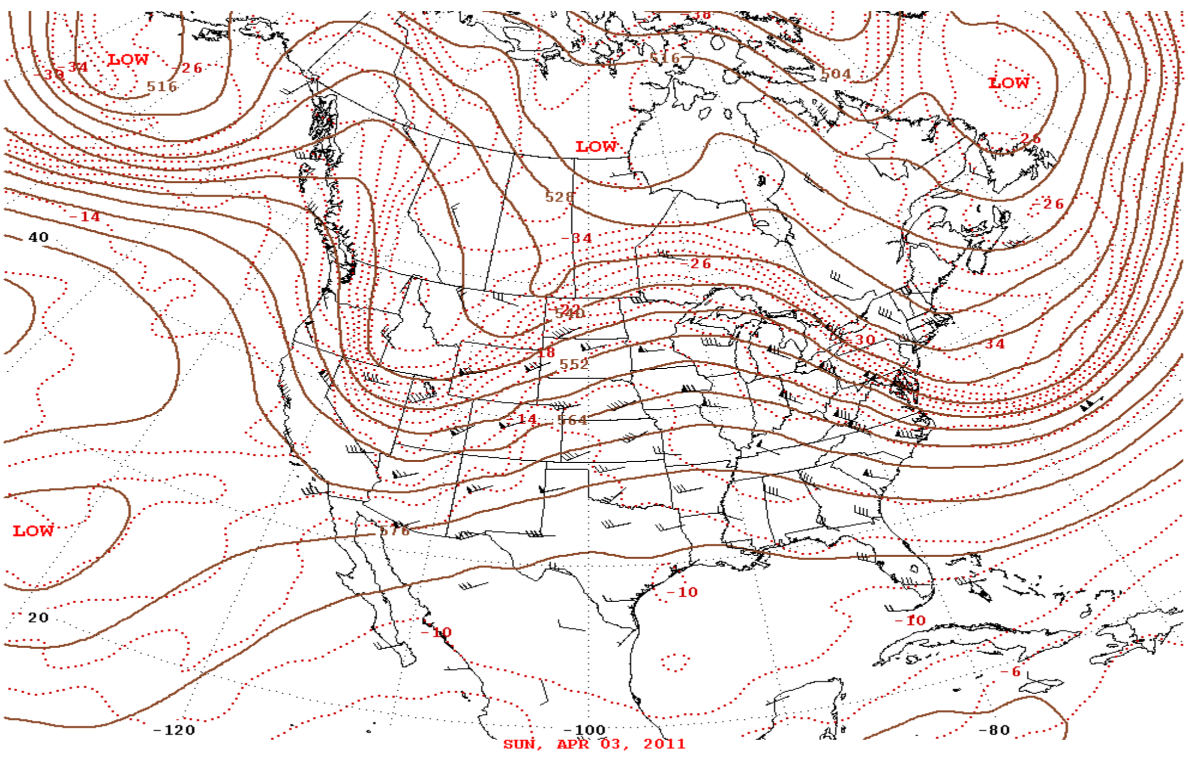

Figure 9-10. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on April 3, 2011.

The weather pattern described above generated strong west-southwesterly winds beginning at the 0900 hour and lasting through the 2100 hour. Beginning at the 1000 hour, wind speeds exceeded 11.2 m/s at Chaparral as shown in Figures 9-7. Peak wind speeds ranged from 10 m/s at Desert View to 14.7 m/s at the Deming Airport (Figure 9-3). Peak wind gusts ranged from 19.2 m/s at Holman to 24.4 m/s at West Mesa (Figure 9-4). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 9-11a-h. As wind speed and wind gusts exceed the 95^{th} percentile of historical data so do hourly PM_{10} concentrations on this date (0800-1900 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 9-12a-b). 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).

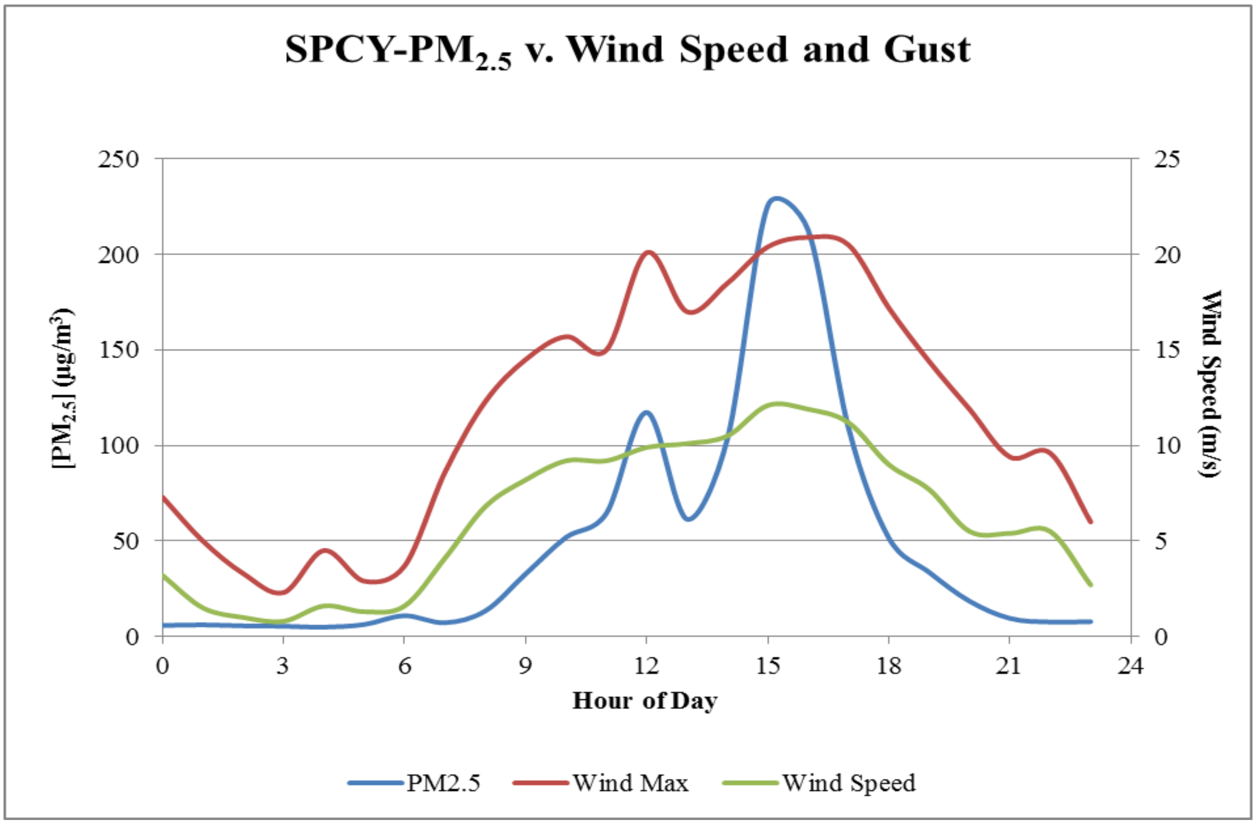

Figure 9-11a. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

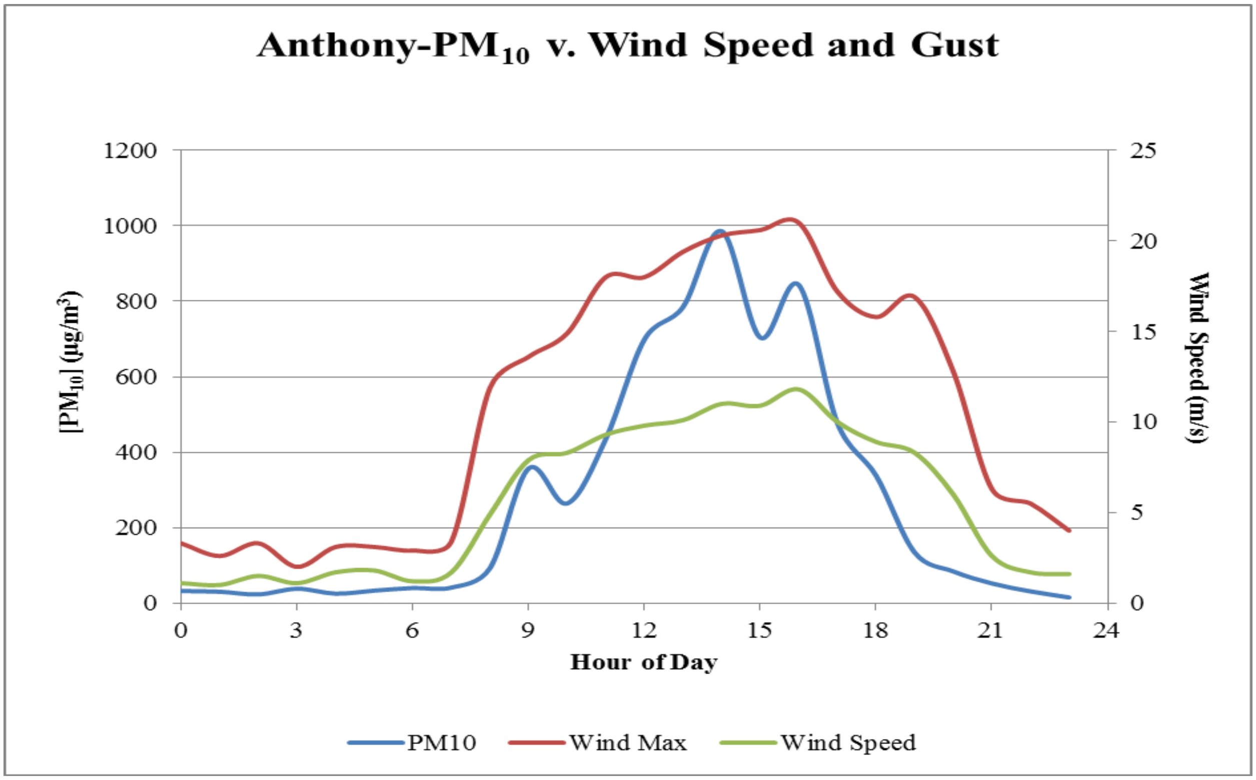

Figure 9-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

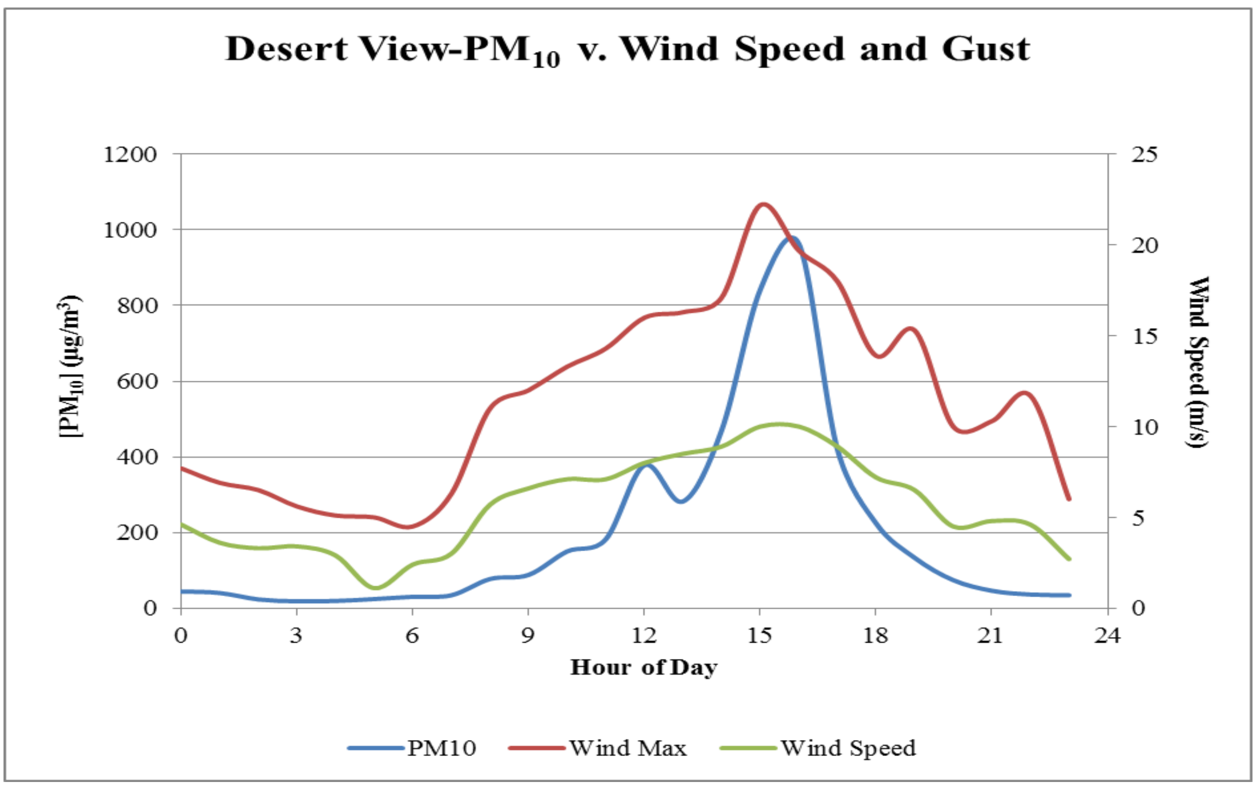

Figure 9-11c. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

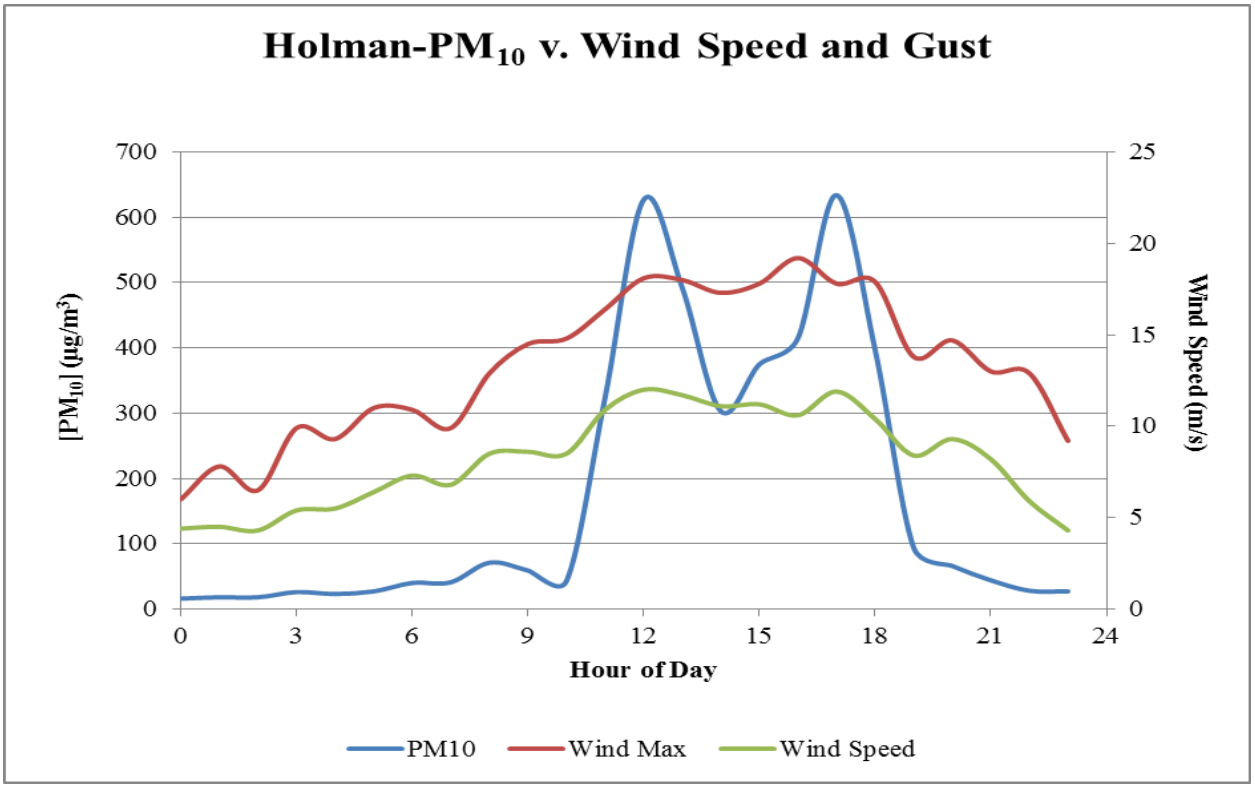

Figure 9-11d. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

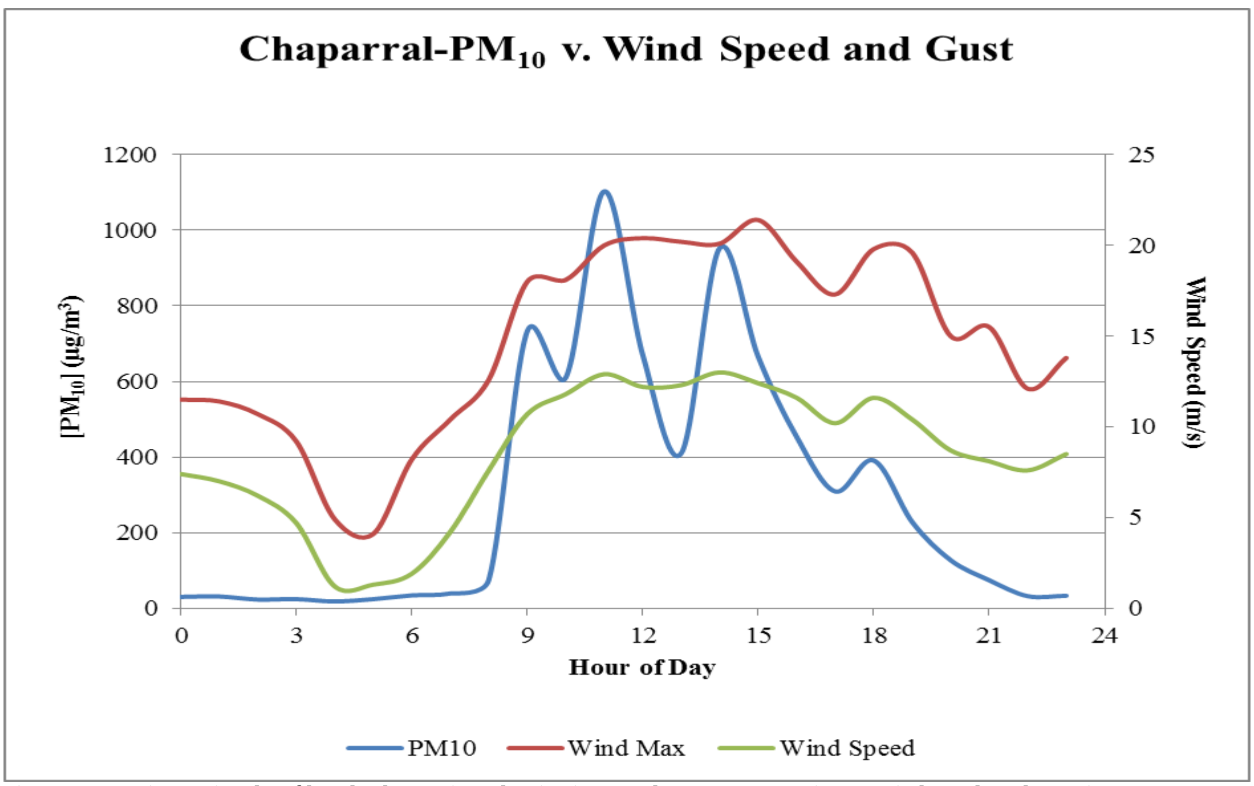

Figure 9-11e. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

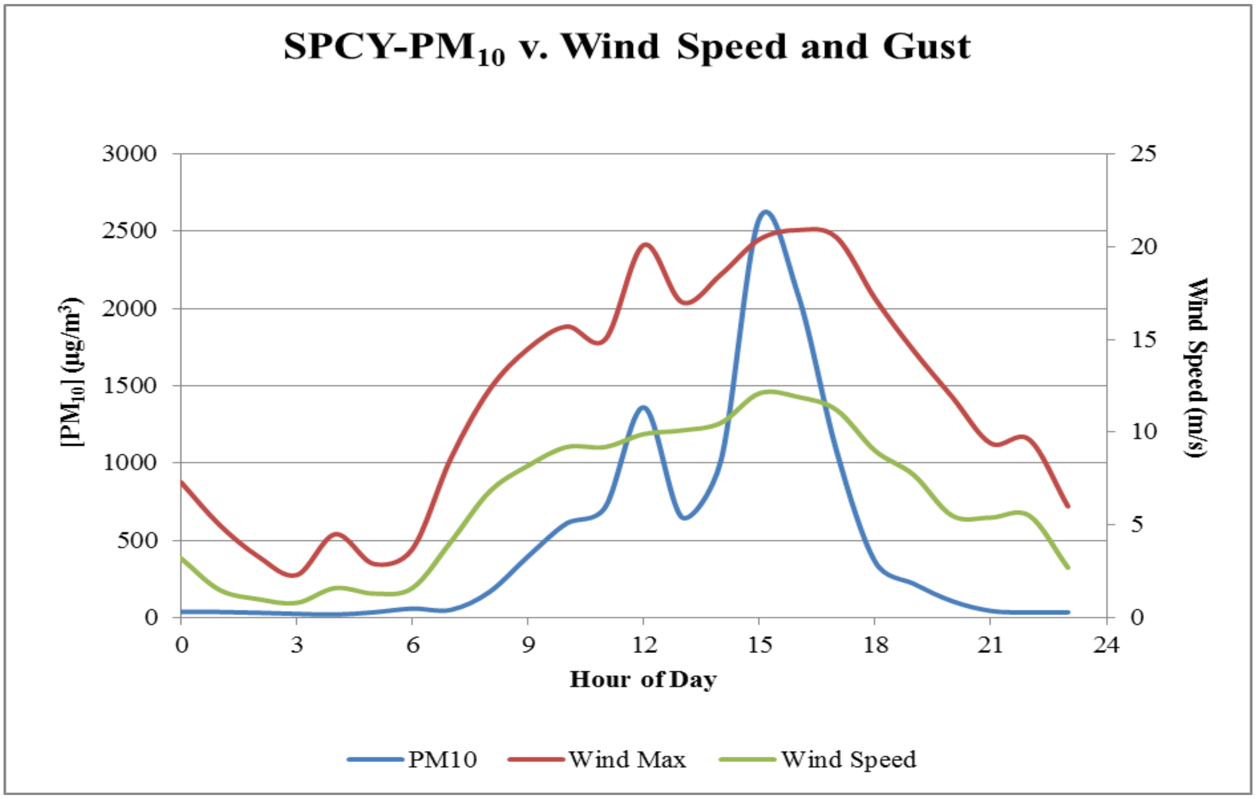

Figure 9-11f. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

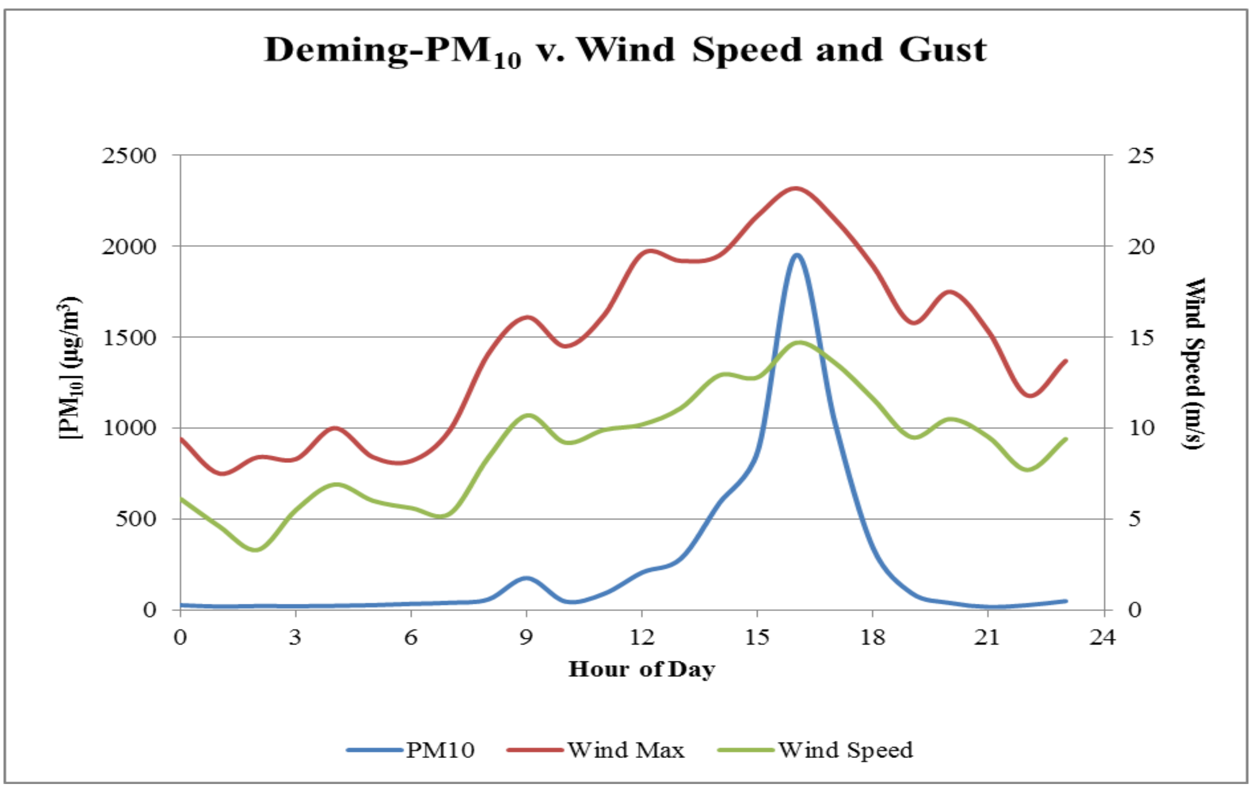

Figure 9-11g. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

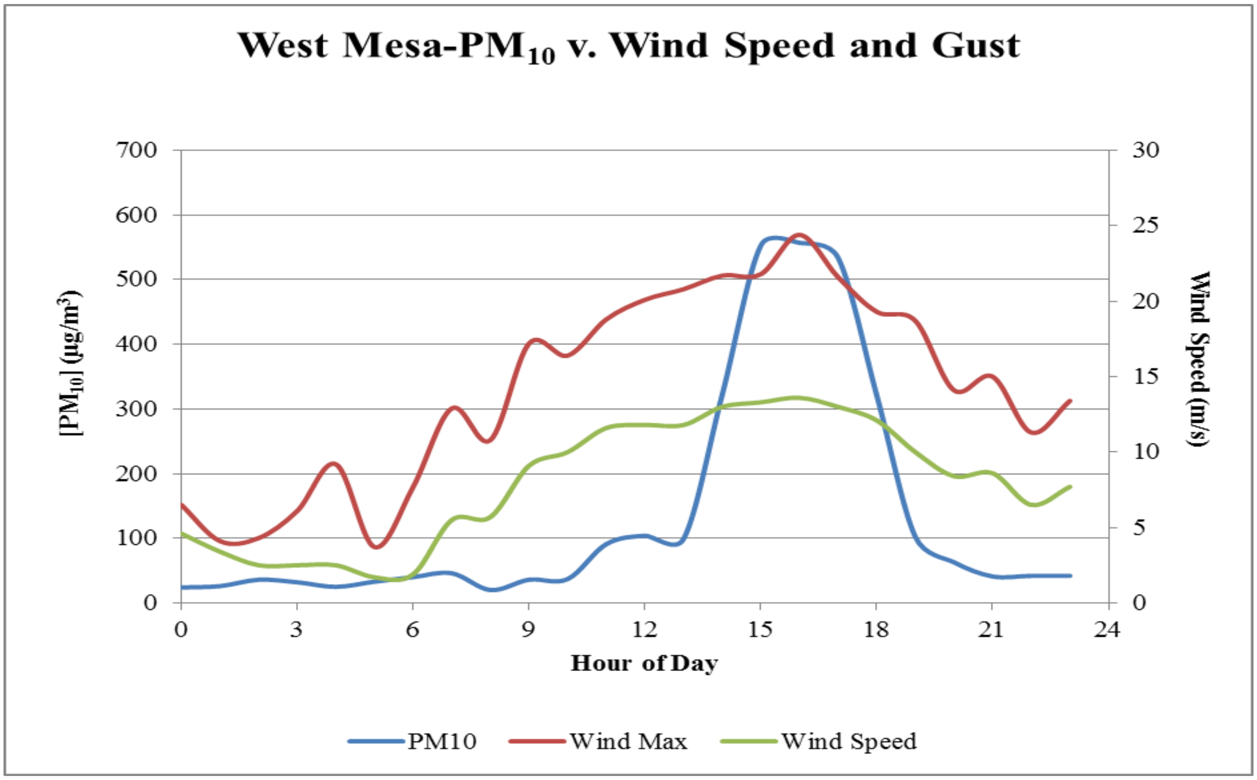

Figure 9-11h. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

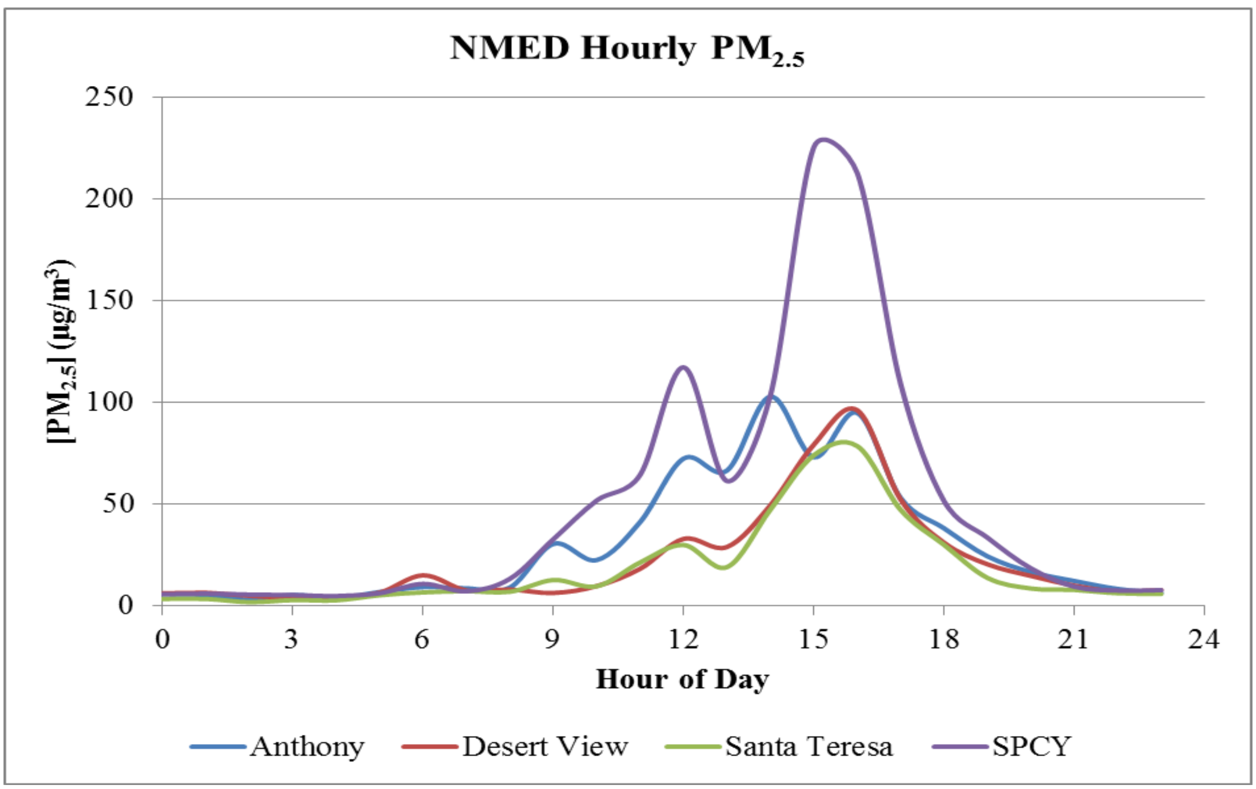

Figure 9-12a. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors.

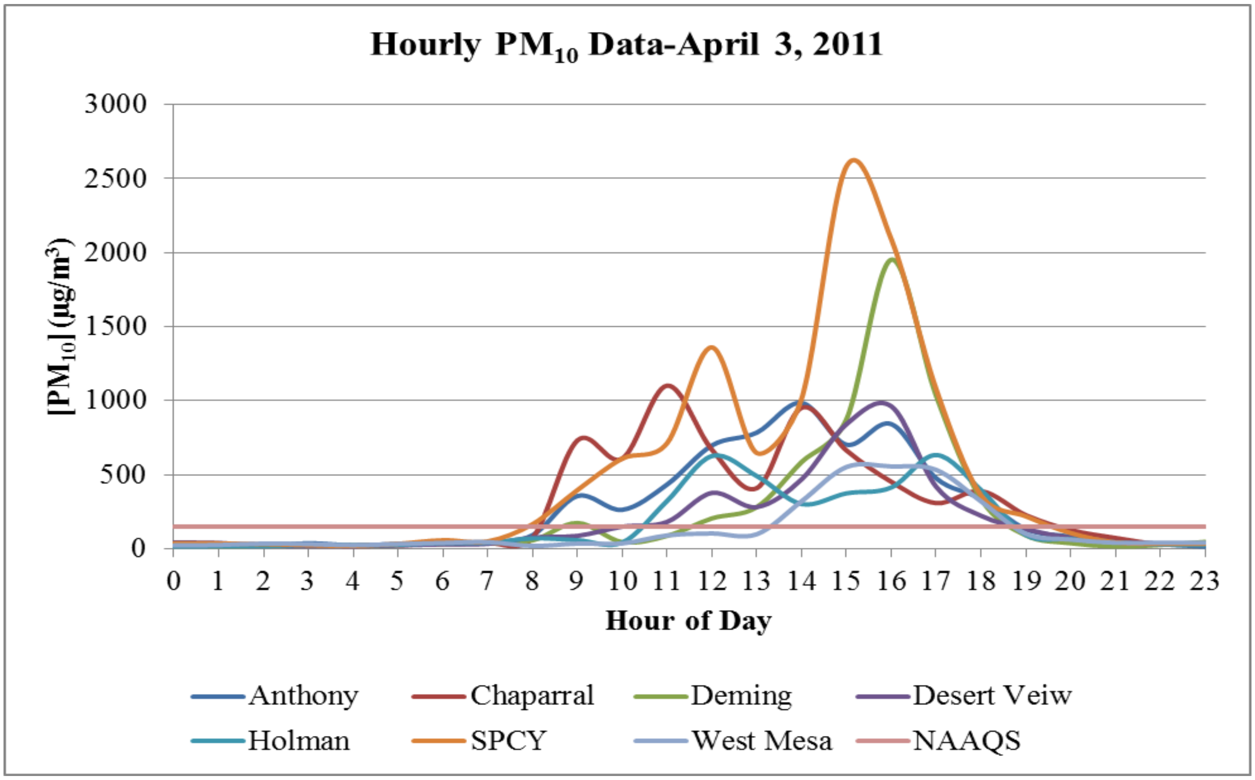

Figure 9-12b. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

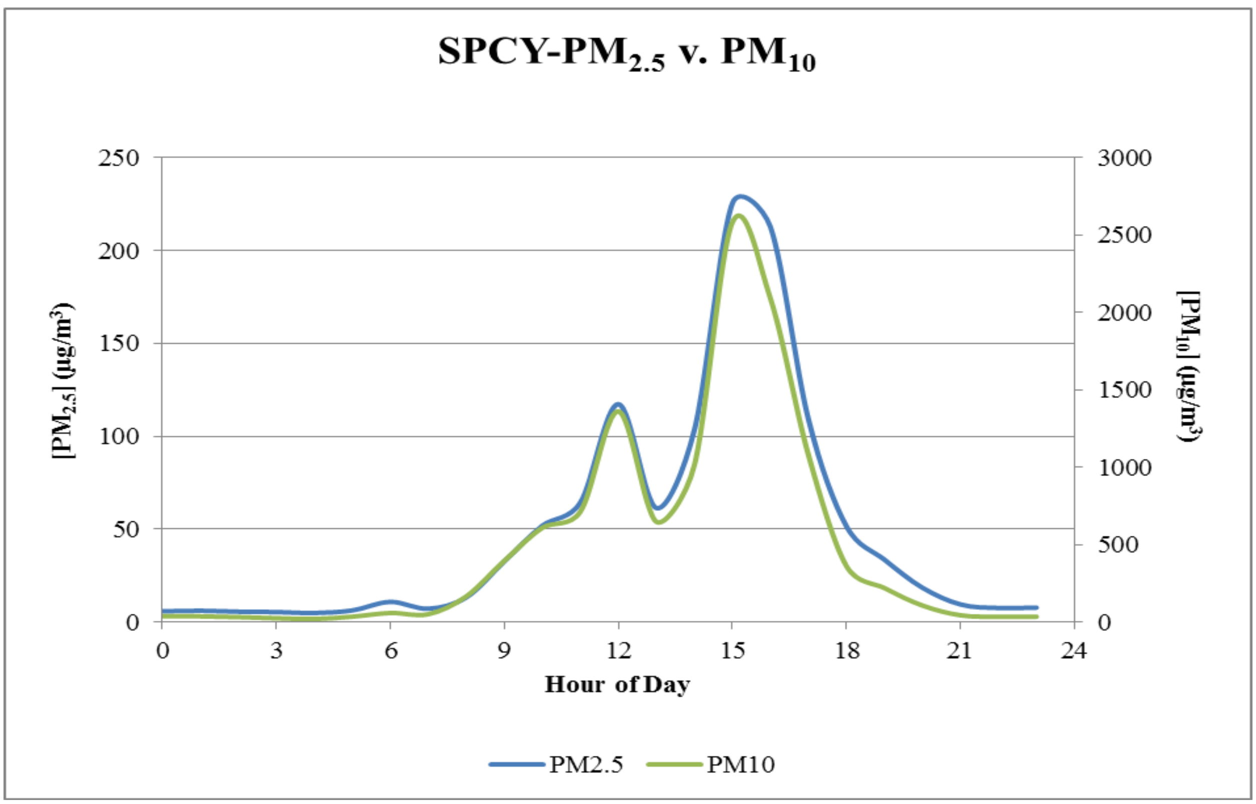

Figure 9-11. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on April 3, 2011.

The New Mexico Border Air Quality Blog labeled the day as a high wind dust event and posted a picture of the resulting haze (DuBois, 2011).

Figure 9-12. Dust obscuring the view of the Organ Mountains from the corner of University and Espina in Las Cruces on April 3, 2011. (Picture courtesy of Dave DuBois)

9.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on April 3, 2011.

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 Anthony monitor detected blowing dust around the 0900 hour with hourly concentrations heavily impacted until the 1800 hour. The ten hourly PM_{10} values from 0900-1800 hours alone, exceed the 24-hour average standard at Anthony [(357 + 264+ 435 + 699 + 785 + 986 + 704 + 843 + 477 + 338) $\mu g/m^3$ = 5888 $\mu g/m^3$; (5888 $\mu g/m^3$)/24 = 245 $\mu g/m^3$]. By replacing these ten hourly values with the 95th percentile of hourly data at the Anthony site, the resulting 24-hour average (89 $\mu g/m^3$) does not exceed the NAAQS (Table 9-1). 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	32	32
1	30	30
2	23	23
3	38	38
4	25	25
5	33	33
6	40	40
7	41	41
8	93	93
9	357	**88**
10	264	**95**
11	435	**106**
12	699	**136**
13	785	**146**
14	986	**177**
15	704	**172**
16	843	**152**
17	477	**194**
18	338	**197**
19	134	134
20	84	84
21	52	52
22	31	31
23	15	15
24-Hour Average	273	**89**

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 Anthony.

The Chaparral monitor detected blowing dust around the 0900 hour with hourly concentrations heavily impacted until the 2000 hour. The eleven hourly PM_{10} values from 0900-1900 hours alone, exceed the 24-hour average standard at Chaparral [(733 + 610+ 1103 + 670 + 410 + 953 + 665 + 453 + 309 + 391 + 228) $\mu g/m^3$ = 6525 $\mu g/m^3$; (6525 $\mu g/m^3$)/24 = 272 $\mu g/m^3$]. By replacing these eleven hourly values with the 95th percentile of hourly data at the Chaparral site, the resulting 24-hour average (77$\mu g/m^3$) does not exceed the NAAQS (Table 9-2). 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	32	32
1	30	30
2	23	23
3	38	38
4	25	25
5	33	33
6	40	40
7	41	41
8	93	93
9	733	**74**
10	610	**79**
11	1103	**87**
12	670	**120**
13	410	**151**
14	953	**141**
15	665	**147**
16	453	**127**
17	309	**122**
18	391	**120**
19	228	**126**
20	84	84
21	52	52
22	31	31
23	15	15
24-Hour Average	295	**77**

Table 9-2. 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 Airport monitor detected blowing dust around the 0900 hour with hourly concentrations heavily impacted until the 1900 hour. The ten hourly PM_{10} values from 0900-1900 hours alone, exceed the 24-hour average standard at Deming [(175 + 88 + 206 + 282 + 587 + 875 + 1953 + 1035 + 338 + 92) µg/m^3 = 5631 µg/m^3; (5631 µg/m^3)/24 = 235 µg/m^3]. By replacing these ten hourly values with the 95th percentile of hourly data at the Deming Airport site, the resulting 24-hour average (54µg/m^3) does not exceed the NAAQS (Table 9-3). 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	26	26
1	18	18
2	21	21
3	20	20
4	22	22
5	26	26
6	33	33
7	39	39
8	58	58
9	175	**60**
10	46	46
11	88	**62**
12	206	**72**
13	282	**99**
14	587	**101**
15	875	**103**
16	1953	**107**
17	1035	**95**
18	338	**87**
19	92	**76**
20	38	84
21	16	52
22	26	31
23	48	15
24-Hour Average	252	**54**

Table 9-3. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Deming Airport.

The Desert View monitor detected blowing dust around the 1000 hour with hourly concentrations heavily impacted until the 1800 hour. The nine hourly PM_{10} values from 1000-1800 hours alone, exceed the 24-hour average standard at Desert View [(150 + 182 + 378+ 282 + 470 + 842 + 963 + 420 + 224) µg/m^3 = 3911 µg/m^3; (3911 µg/m^3)/24 = 163 µg/m^3]. By replacing these nine hourly values with the 95th percentile of hourly data at the Desert View site, the resulting 24-hour average (72 µg/m^3) does not exceed the NAAQS (Table 9-4). 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	44	44
1	40	40
2	23	23
3	18	18
4	19	19
5	24	24
6	30	30
7	34	34
8	77	77
9	88	88
10	150	**91**
11	182	**91**
12	378	**94**
13	282	**91**
14	470	**106**
15	842	**119**
16	963	**124**
17	420	**158**
18	224	**137**
19	133	76
20	74	84
21	46	52
22	36	31
23	34	15
24-Hour Average	192	**72**

Table 9-4. 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 0800 hour with hourly concentrations heavily impacted until the 1800 hour. The ten hourly PM_{10} values from 0800-1800 hours alone, exceed the 24-hour average standard at Holman [(71 + 59+ 324 + 627 + 492+ 303 + 375 + 415 + 634 + 397) µg/m^3 = 3697 µg/m^3; (3697 µg/m^3)/24 = 154 µg/m^3]. By replacing these ten hourly values with the 95th percentile of hourly data at the Holman site, the resulting 24-hour average (63µg/m^3) does not exceed the NAAQS (Table 9-5). 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	16	16
1	18	18
2	18	18
3	26	26
4	23	23
5	27	27
6	40	40
7	41	41
8	71	**55**
9	59	**52**
10	43	43
11	324	**66**
12	627	**85**
13	492	**102**
14	303	**122**
15	375	**125**
16	415	**118**
17	634	**125**
18	397	**160**
19	94	94
20	66	66
21	44	44
22	28	28
23	27	27
24-Hour Average	175	**63**

Table 9-5. 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 0800 hour with hourly concentrations heavily impacted until the 1800 hour. The eleven hourly PM_{10} values from 0800-1800 hours alone, exceed the 24-hour average standard at SPCY [(167 + 397+ 610 + 714 + 1361+ 648 + 1015 + 2583 + 2091 + 1080 + 362) µg/m^3 = 11028 µg/m^3; (11028 µg/m^3)/24 = 460 µg/m^3]. By replacing these ten hourly values with the 95th percentile of hourly data at the SPCY site, the resulting 24-hour average (96µg/m^3) does not exceed the NAAQS (Table 9-6). 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	38	38
1	37	37
2	32	32
3	25	25
4	20	20
5	35	35
6	59	59
7	51	51
8	167	**98**
9	397	**93**
10	610	**93**
11	714	**95**
12	1361	**104**
13	648	**125**
14	1015	**145**
15	2583	**160**
16	2091	**168**
17	1080	**201**
18	362	**296**
19	220	220
20	107	107
21	44	44
22	34	34
23	35	35
24-Hour Average	490	**96**

Table 9-6. 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 4, 2011

10.1 Summary of Event

The Pacific cold front that passed the day before gave way to a backdoor cold front that caused high winds and blowing dust in southern Doña Ana County for the second day in a row. The high winds resulted in exceedances of the PM_{10} 24-hour and $PM_{2.5}$ 24-hour and annual NAAQS at the Chaparral and SPCY monitoring sites on this date. The PM_{10} FEM TEOM continuous monitor at the Chaparral site recorded a 24-hour average concentration of 244 µg/m^3. The $PM_{2.5}$ FRM Partisol monitor at SPCY recorded a 24-hour average concentrations of 37 µg/m^3. In accordance with the EER, the AQB flagged this data on EPA's AQS database as a high wind natural event. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured at Anthony (137 µg/m^3), Desert View (100 µg/m^3), and SPCY (100 µg/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).

As the event unfolded, the wind blew from the north throughout the border region. These high velocity winds passed over large areas of desert within 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.

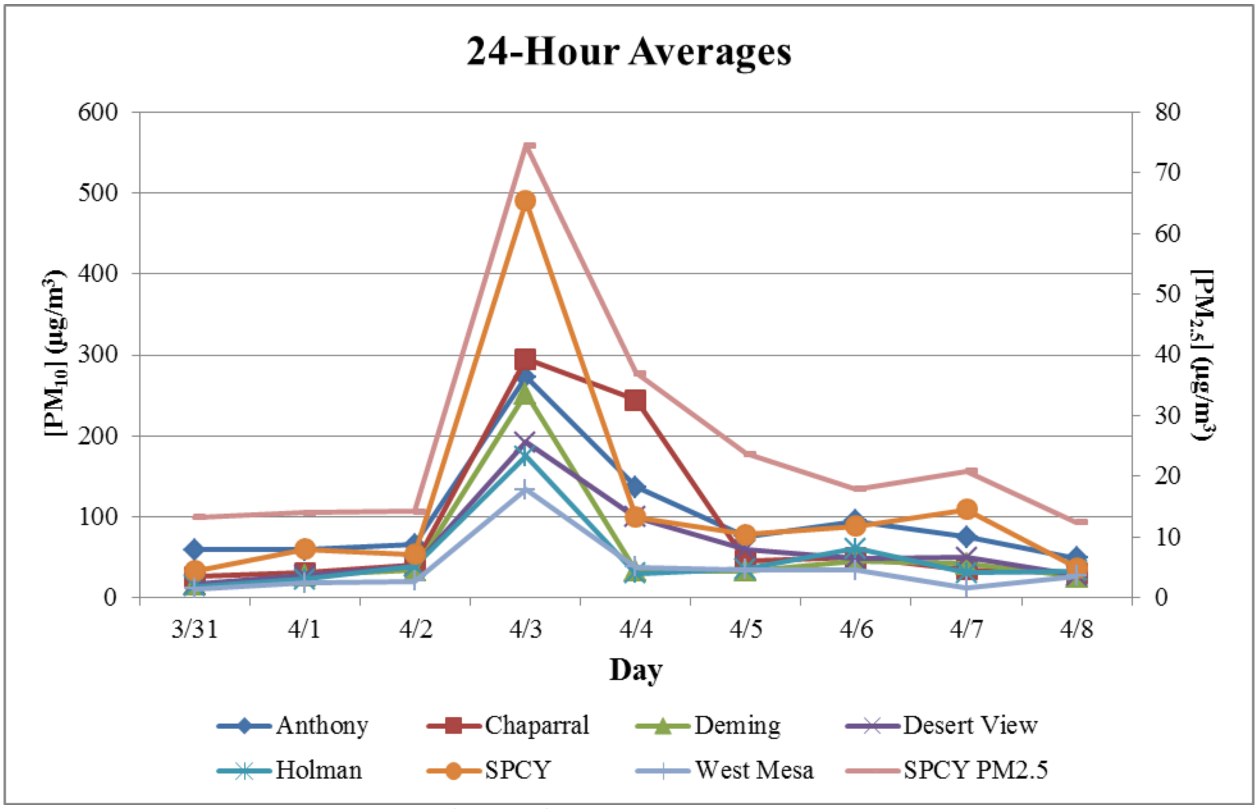

Figure 10-1. PM_{10} and $PM_{2.5}$ 24-hour averages before and after April 4, 2011.

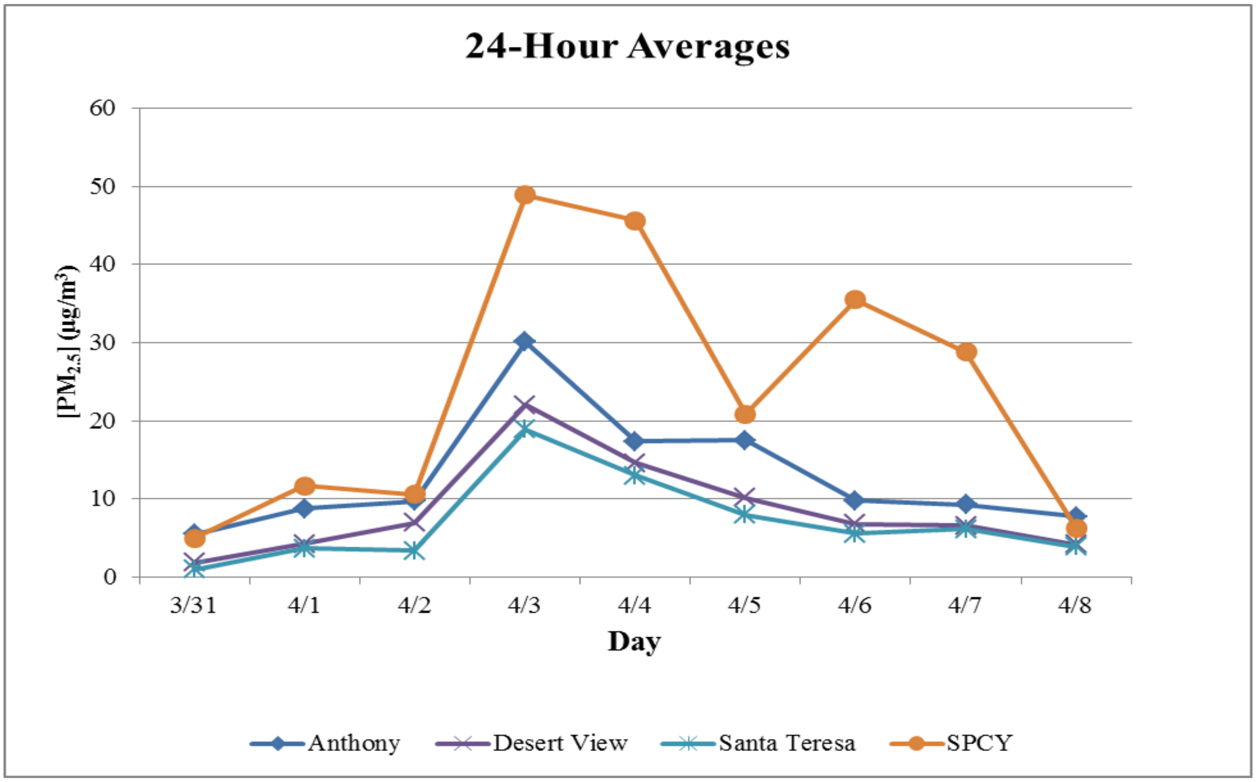

Figure 10-2. $PM_{2.5}$ 24-hour averages before and after April 4, 2011. Non-FEM TEOM Data.

10.2 Is Not Reasonably Controllable or Preventable

10.2.1 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 New Mexico. Doña Ana County Ordinance requires BACM for any dust producing activities. The largest and most likely source of windblown dust is the sand dunes at the White Sands National Monument (see Section 10.2.4 below).

10.2.2 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 4, 2011, sustained wind speeds exceeded EPA's default threshold at one of the seven monitoring sites in southern New Mexico and wind gusts approached exceeding the NEAPs agreed upon threshold at one of the seven monitoring sites (Figures 10-3 and 10-4). Winds exceeded or approached exceeding these thresholds at the one monitoring site beginning at the 0500 hour and ending at the 0800 hour.

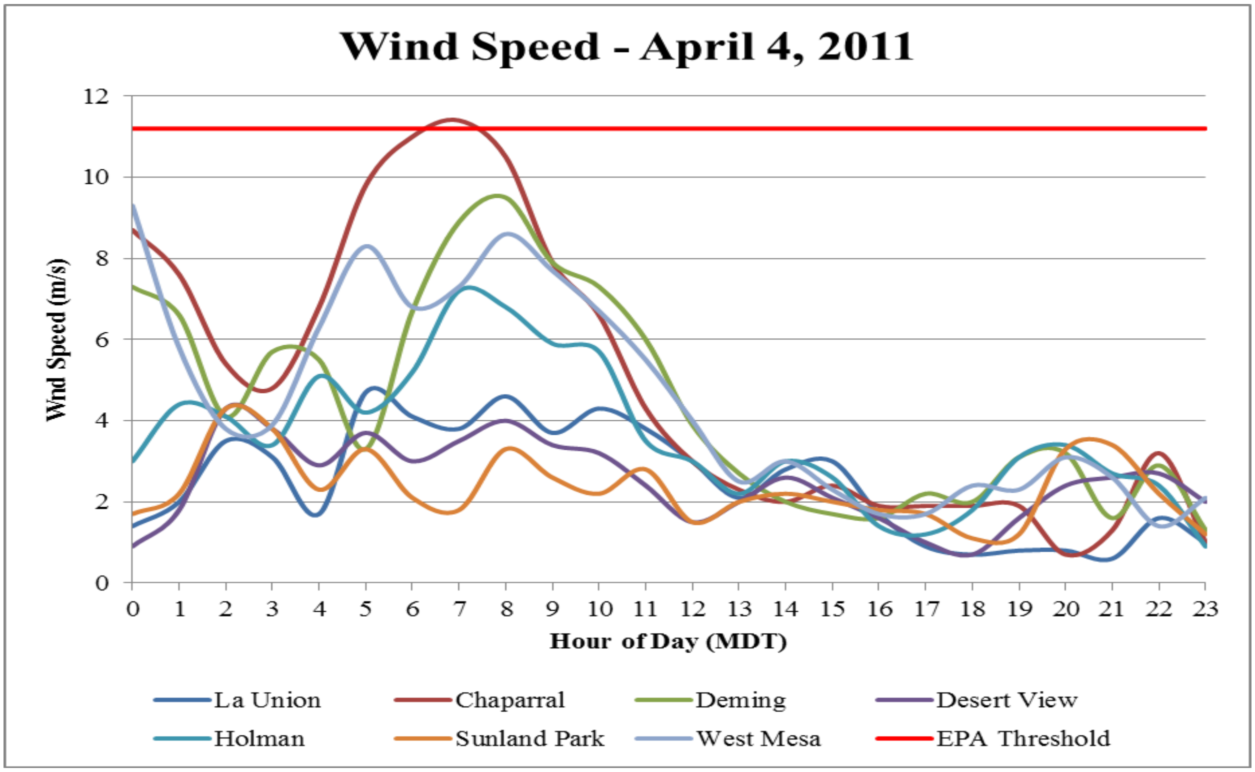

Figure 10-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

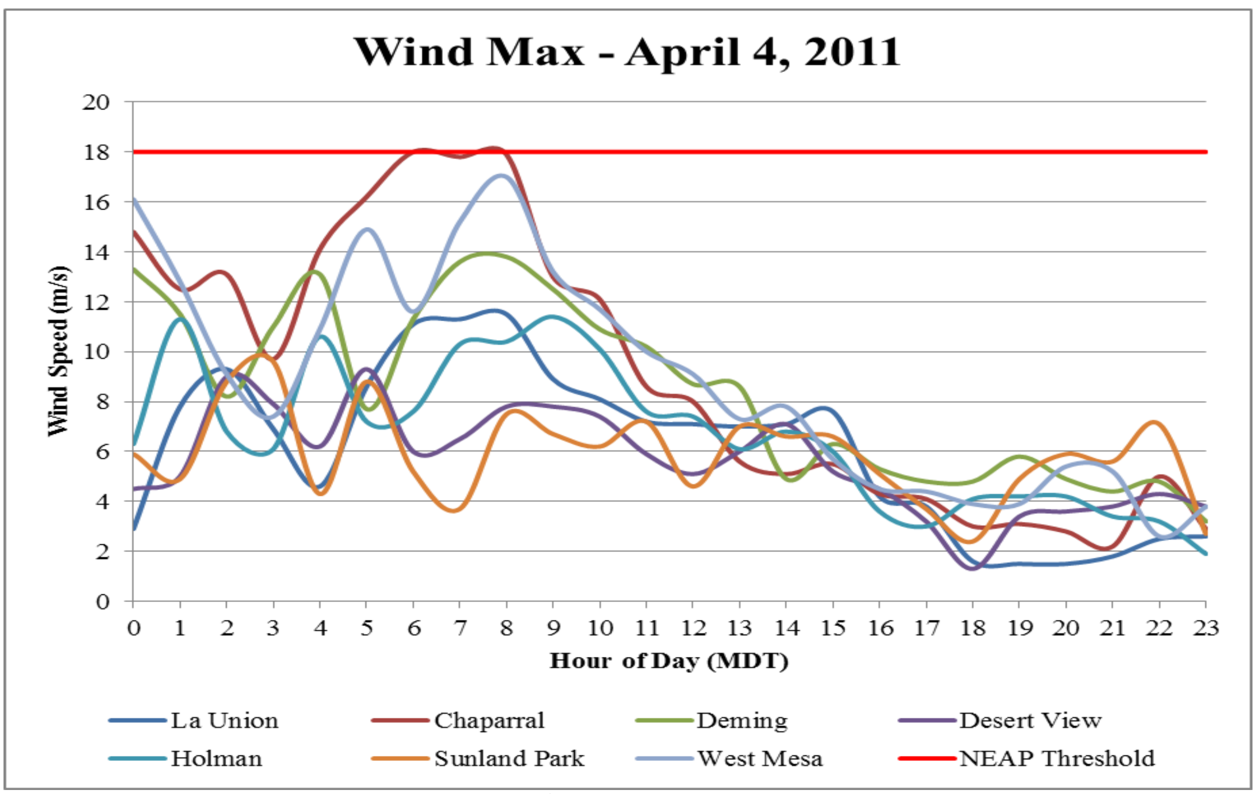

Figure 10-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

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 2006-2010 the PM_{10} FEM TEOM monitors recorded 211 exceedances and the PM_{10} FRM Wedding monitors recorded 5 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 (Table 2-1). The SPCY $PM_{2.5}$ FRM Partisol recorded 23 exceedances of the 24-Hour NAAQS from 2006-2010 (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, playas, and White Sands National Monument in New 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 Arizona and northern New Mexico to the monitors in Luna and Doña Ana Counties. The model starts six hours before the start of elevated PM_{10} concentrations measured during the event (Figure 10-5). NMED concludes that the sources contributing to the event are not reasonably controllable.

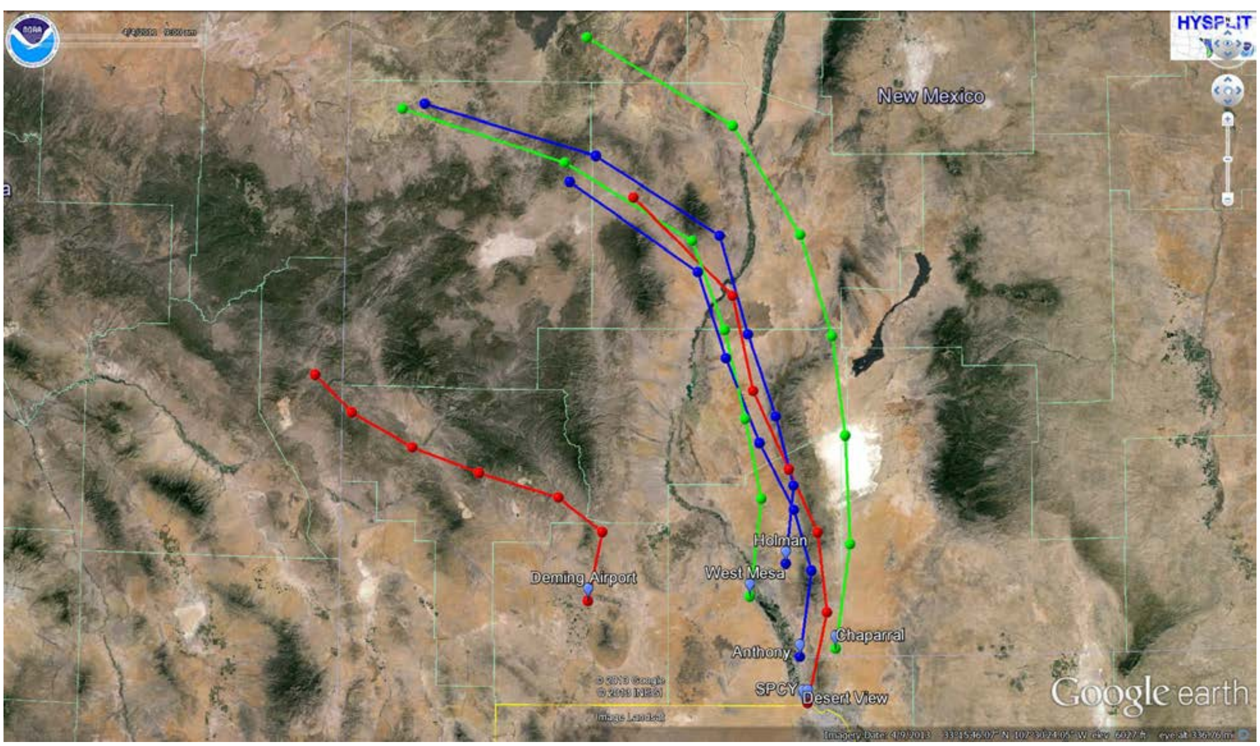

Figure 10-5. HYSPLIT back-trajectory model analysis for April 4, 2011.

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-4 through B-11). 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 2006-2010 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 2006-2010. 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 2006-2010. The recorded value for this day (Chaparral: 244 µg/m^3) is 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 April 4, 2011 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 10-6a-b through 10-8a-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.

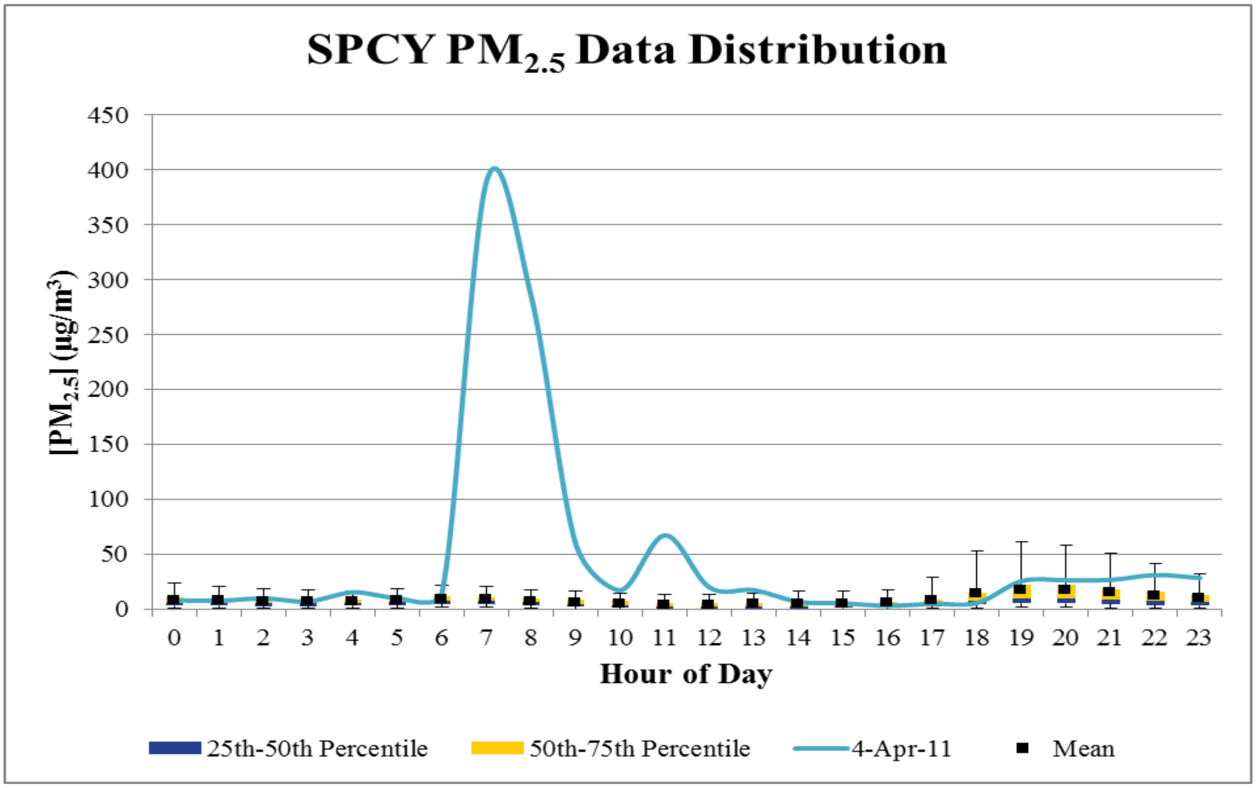

Figure 10-6a. $PM_{2.5}$ hourly data distribution from 2006-2010 overlaid by hourly values for April 4, 2011.

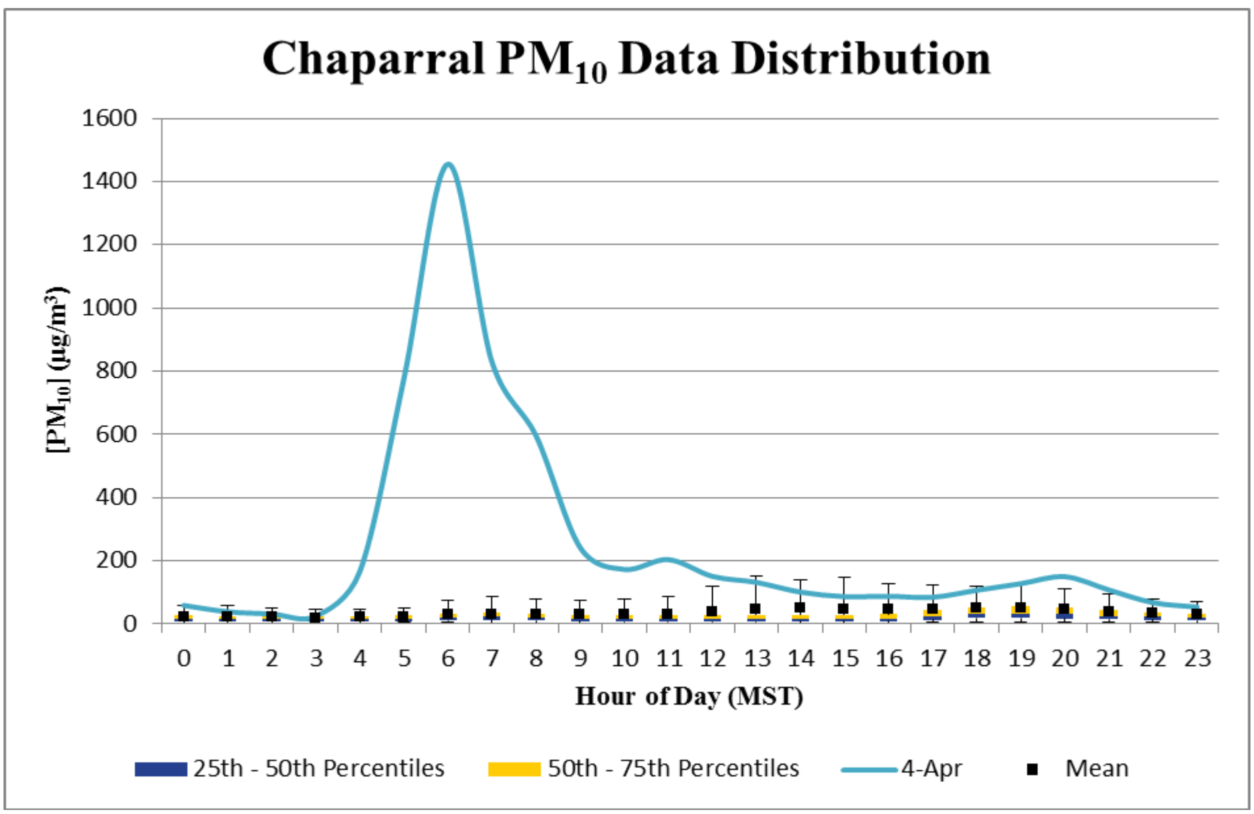

Figure 10-6b. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 4, 2011.

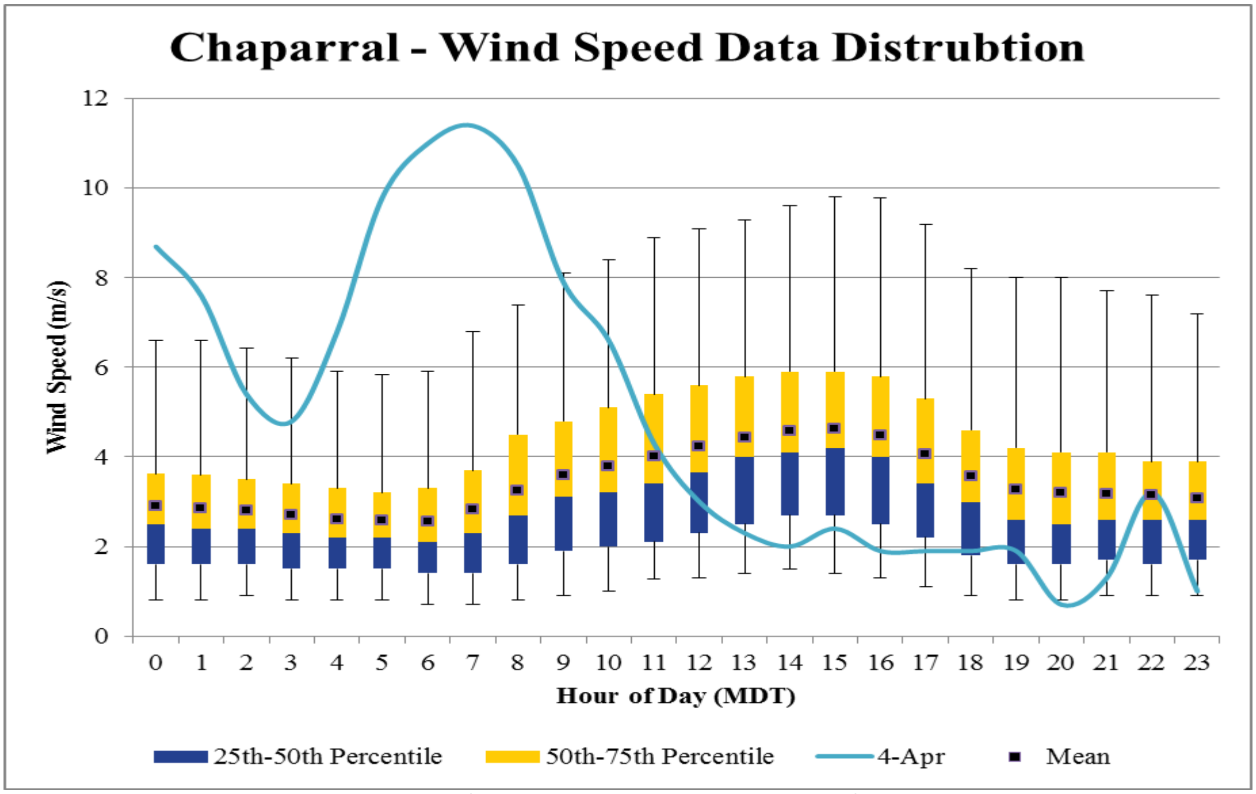

Figure 10-7a. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 4, 2011.

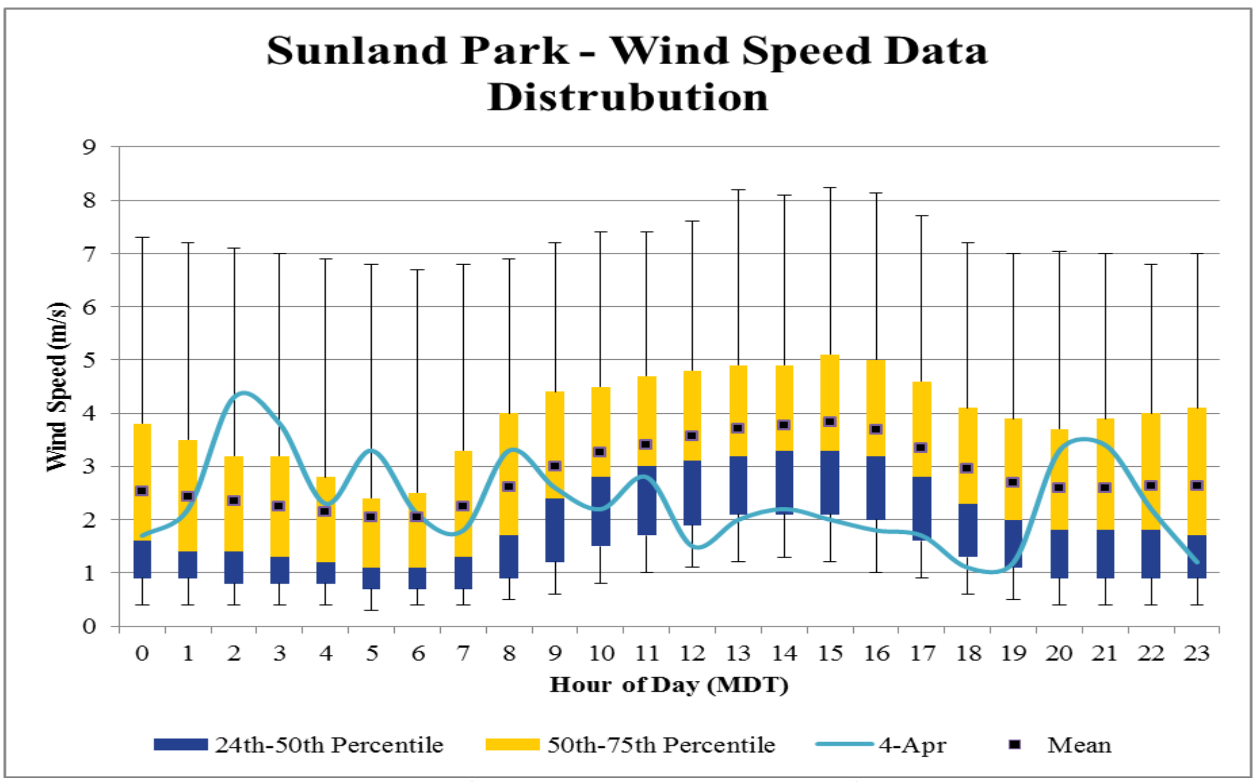

Figure 10-7b. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 4, 2011.

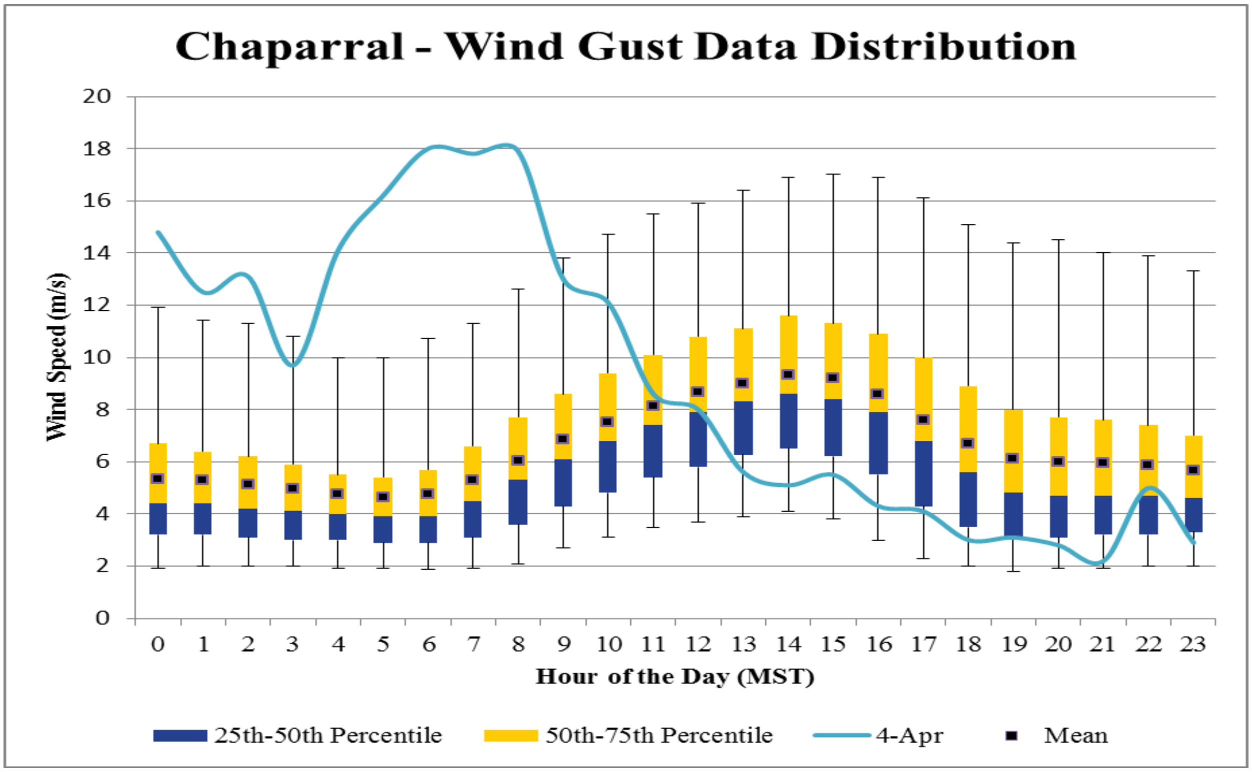

Figure 10-8a. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 4, 2011.

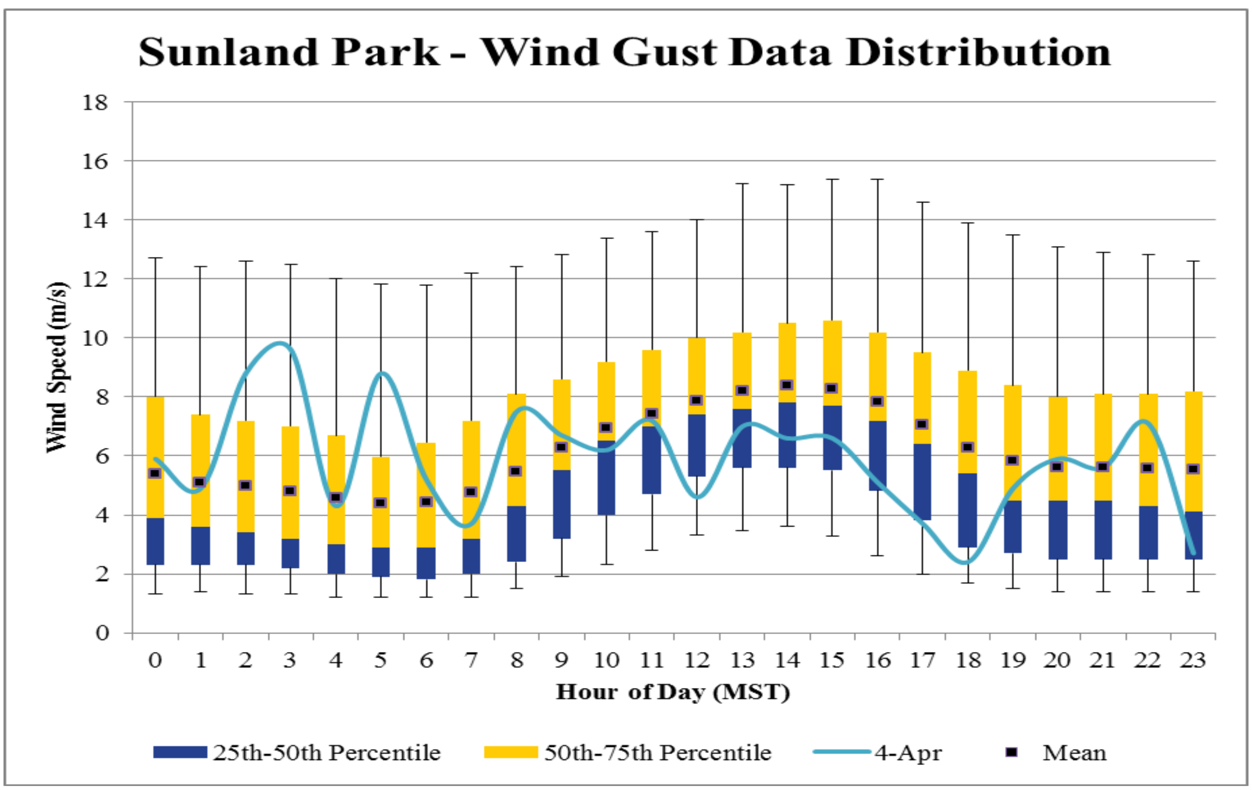

Figure 10-8b. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 4, 2011.

10.4 Clear Causal Relationship

A Pacific cold front passage and a backdoor front the north northeast in the early morning hours on April 4. The pacific cold front started working its way through New Mexico on April 3, 2011 creating a pressure gradient over New Mexico and West Texas. As the Pacific cold front moved through New Mexico and the backdoor front moved in, the pressure gradient tightened and winds became even stronger at the surface (Figure 10-9). Sustained winds of over 20 miles per hour occurred over White Sands National Monument (Figure 10-10) resulting in windblown dust from the sand dunes (NM Border Blog, 2011). Surface winds flow perpendicular to the isobars from high to low pressure. The wind direction in the upper atmosphere aligned with the surface wind direction (Figure 10-11). 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.

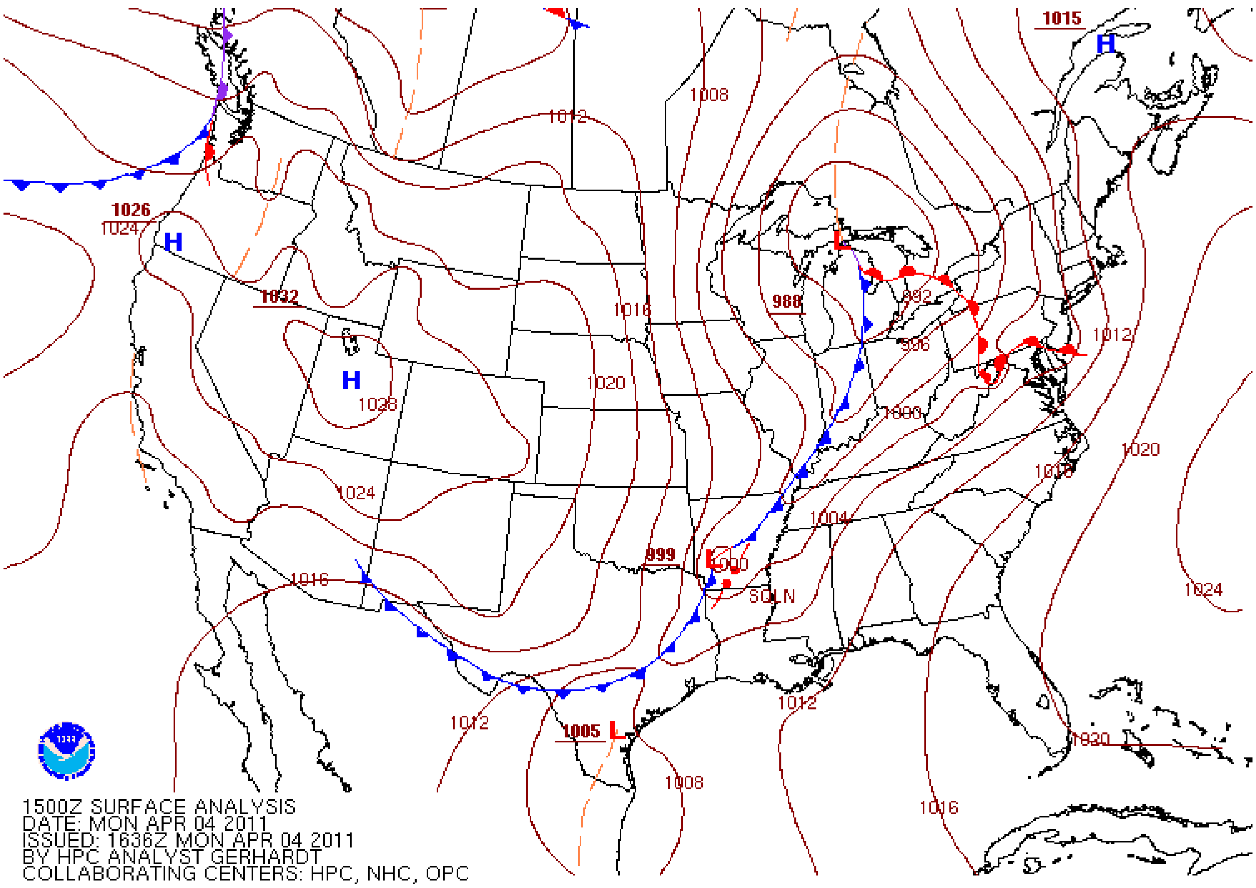

Figure 10-9. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 4, 2011 at the 0900 hour.

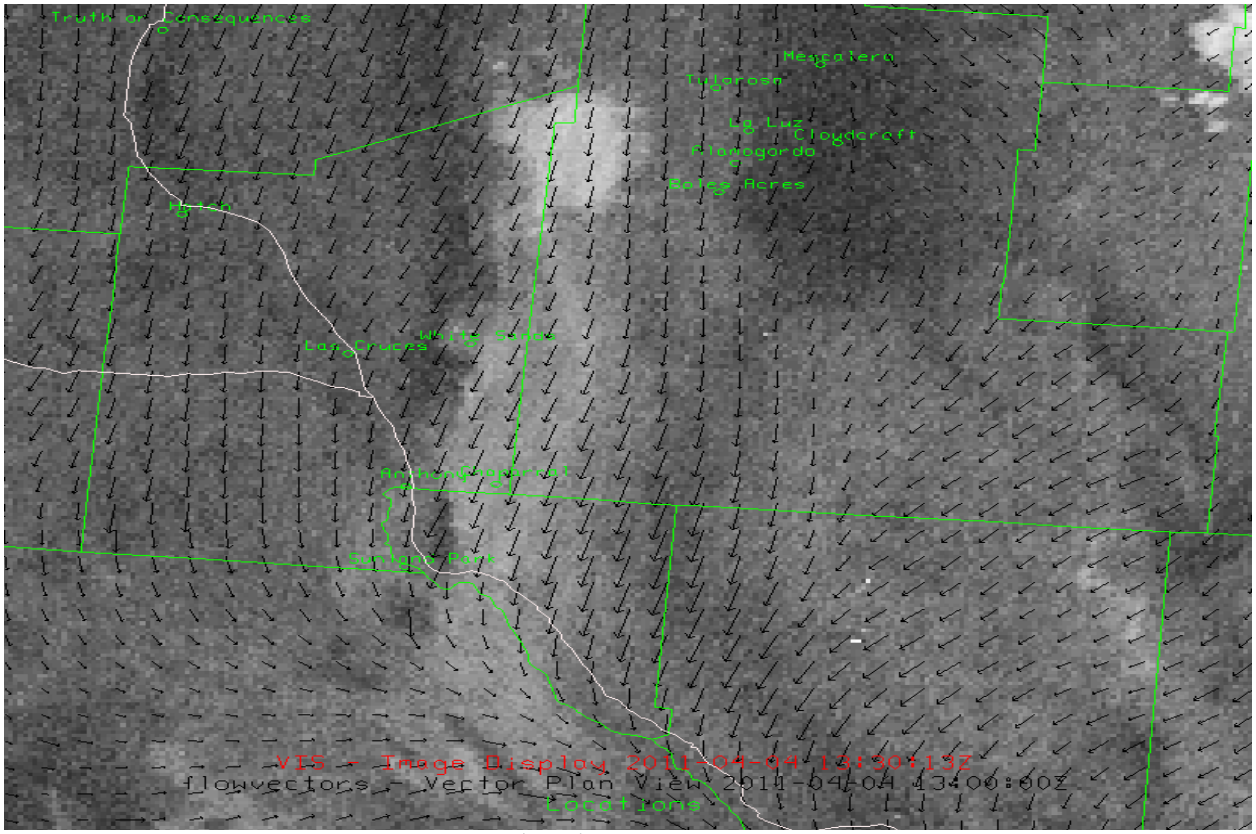

Figure 10-10. Satellite visible image showing the plume of dust from White Sands National Monument on April 4, 2011 at the 7:30 MDT hour (Courtesy of GOES Satellite Image).

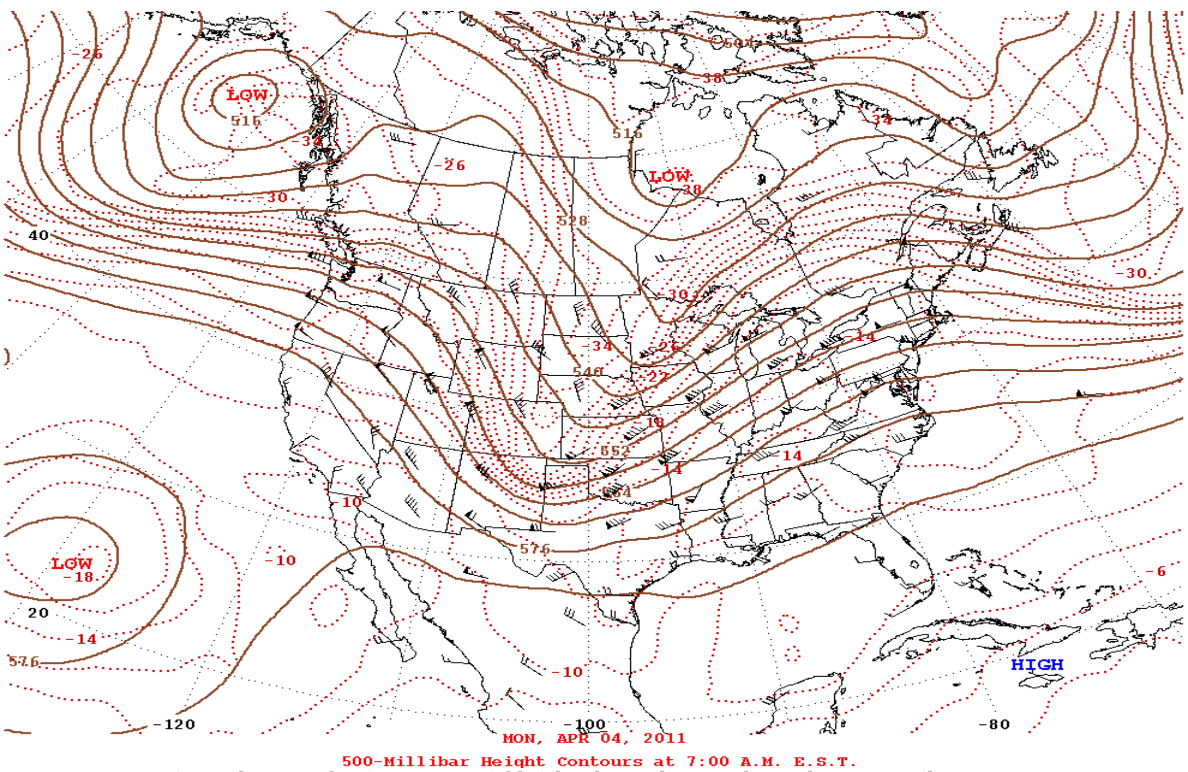

Figure 10-11. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on April 4, 2011.

The weather pattern described above generated strong northwesterly winds beginning at the 0500 hour and lasting through the 0800 hour. Beginning at the 0700 hour, wind speeds exceeded 11.2 m/s at Chaparral as shown. Peak wind speeds ranged from 4.0 m/s at Desert View to 11.4 m/s at Chaparral (Figure 10-3). Peak wind gusts ranged from 9.0 at Desert View m/s to 17.9 m/s at Chaparral (Figure 10-4). 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 10-12a-b. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (0400-1200 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at many of the monitoring sites in the network (Figure 10-13a-b). Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 10-14).

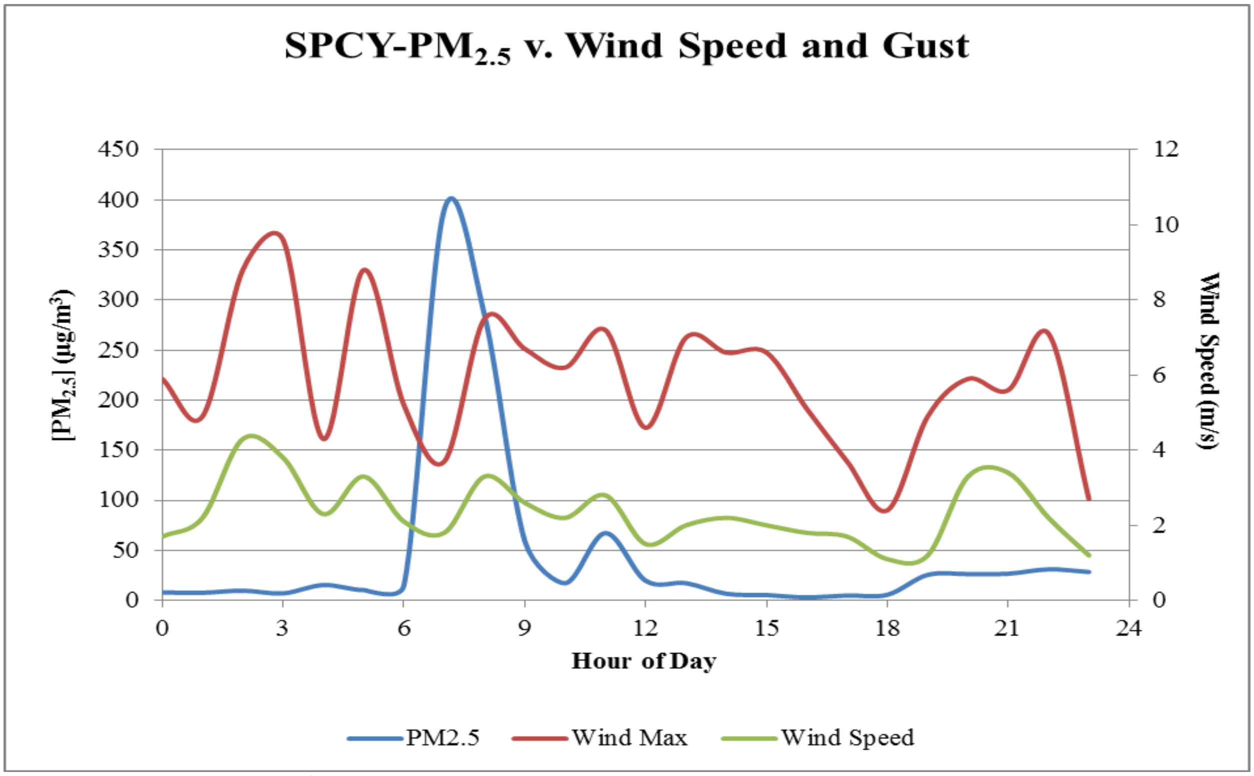

Figure 10-12a. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

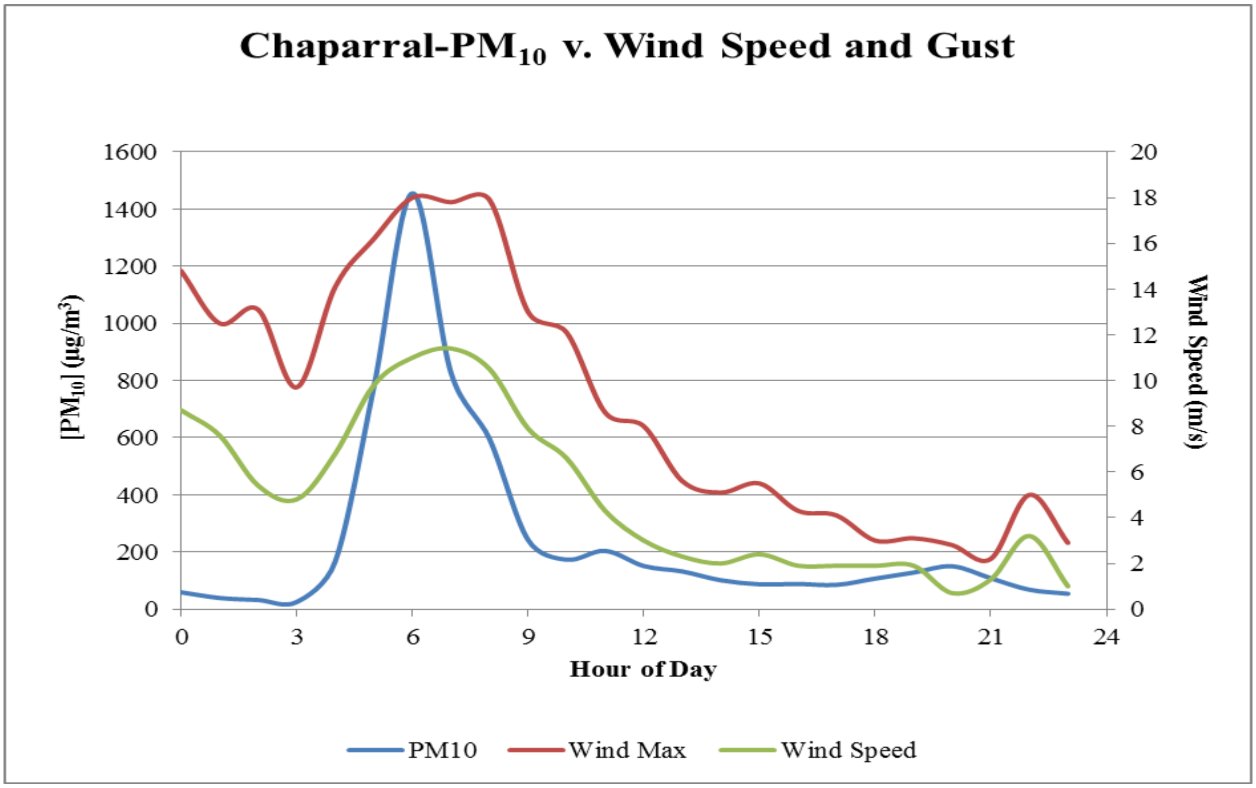

Figure 10-12b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

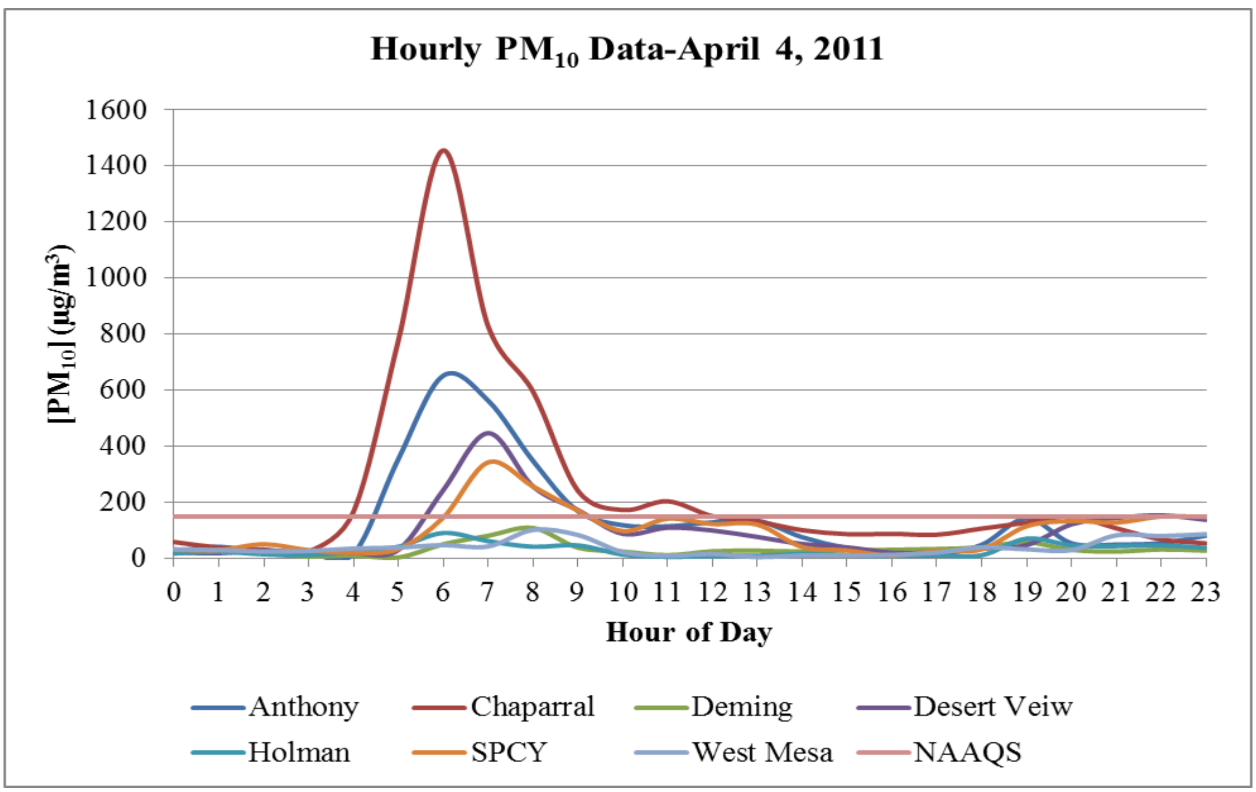

Figure 10-13a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

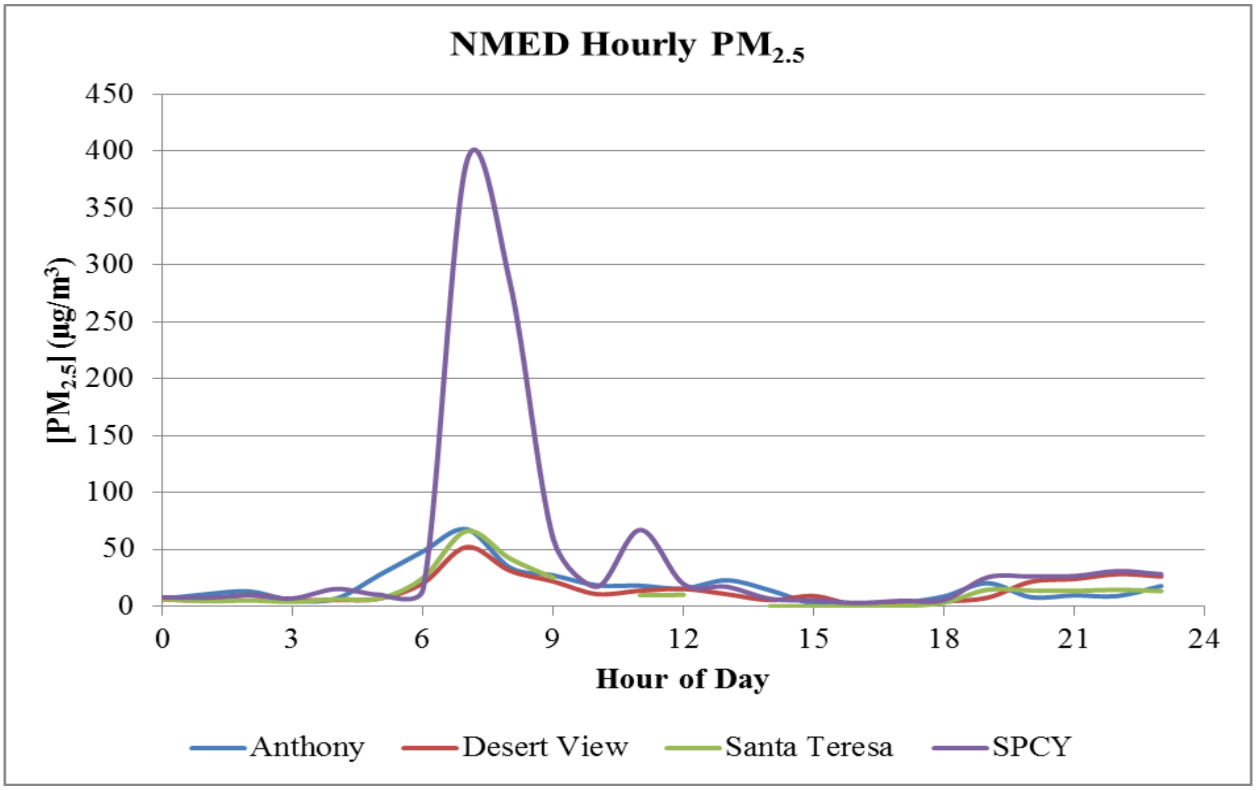

Figure 10-13b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors. Non-FEM hourly $PM_{2.5}$ data.

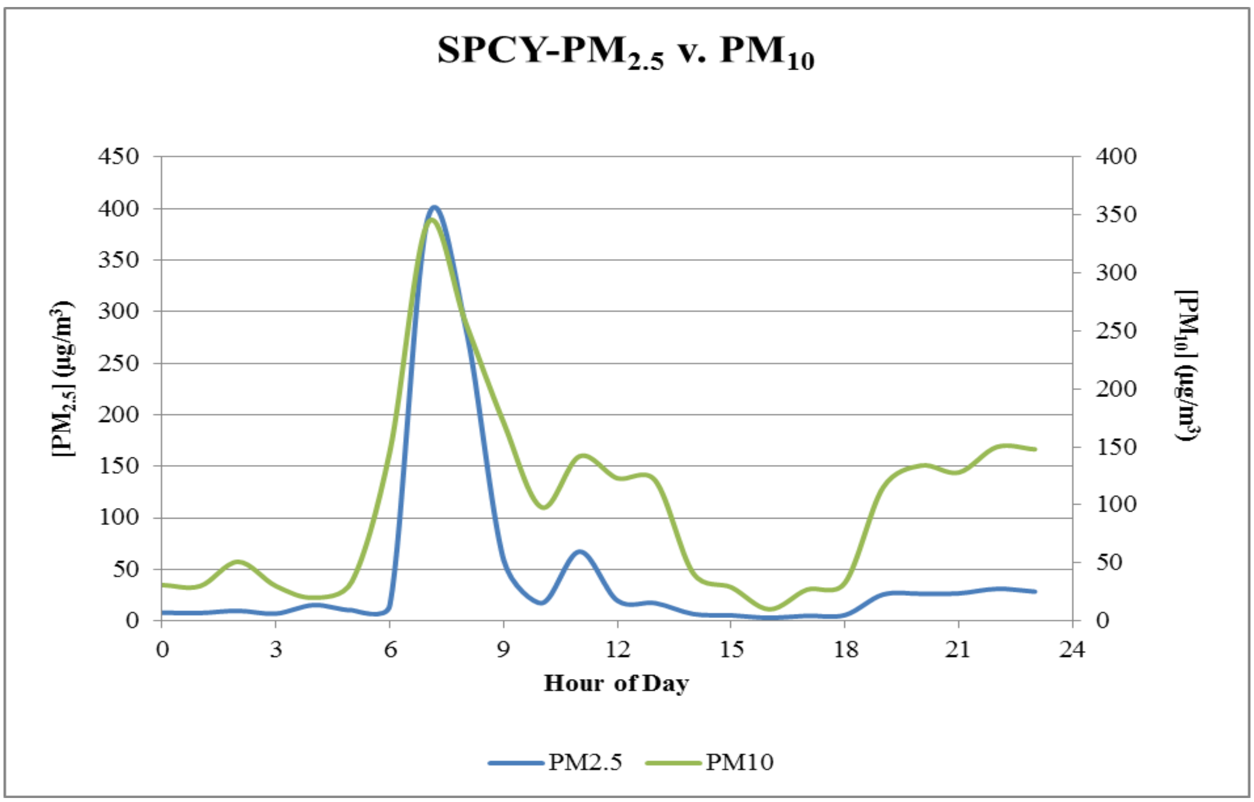

Figure 10-14. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on April 4, 2011.

10.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on April 4, 2011.

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 Chaparral monitor detected blowing dust around the 0400 hour with hourly concentrations heavily impacted until the 1200. The nine hourly PM_{10} values from 0400-1200 hours alone, exceed the 24-hour average standard at Chaparral [(167 + 778 + 1455 + 828 + 595 + 242 + 173 + 204 + 151) $\mu g/m^3$ = 4593 $\mu g/m^3$; (4593 $\mu g/m^3$)/24 = 191 $\mu g/m^3$]. By replacing these nine hourly values with the 95th percentile of hourly data at the Chaparral site, the resulting 24-hour average (82 $\mu g/m^3$) does not exceed the NAAQS (Table 10-1). 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	59	59
1	39	39
2	32	32
3	25	25
4	167	**46**
5	778	**52**
6	1455	**52**
7	828	**86**
8	595	**79**
9	242	**74**
10	173	**79**
11	204	**87**
12	151	**120**
13	132	132
14	101	101
15	87	87
16	88	88
17	85	85
18	107	107
19	128	128
20	150	150
21	108	108
22	68	68
23	54	54
24-Hour Average	199	**82**

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 Chaparral.

11 HIGH WIND EXCEPTIONAL EVENT: April 9, 2011

11.1 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 at the Anthony, Chaparral, Deming Airport, Deming, Desert View, Holman, SPCY, and West Mesa monitoring sites and an exceedance of the $PM_{2.5}$ 24-hour and annual NAAQS at SPCY on this date. The FEM TEOM continuous monitors at these sites recorded 24-hour average concentrations of 353 $\mu g/m^3$ (Anthony), 298 $\mu g/m^3$ (Chaparral), 499 $\mu g/m^3$ (Deming Airport), 252 $\mu g/m^3$ (Desert View), 422 $\mu g/m^3$ (Holman), 368 $\mu g/m^3$ (SPCY), and 231$\mu g/m^3$ (West Mesa). The Partisol monitor at SPCY recorded a 24-hour average concentration of 50.7 $\mu g/m^3$. The FRM Wedding monitors at Anthony, Deming and SPCY recorded 24-hour average concentrations of 153$\mu g/m^3$, 248 $\mu g/m^3$, and 157 $\mu g/m^3$, respectively. 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).

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.

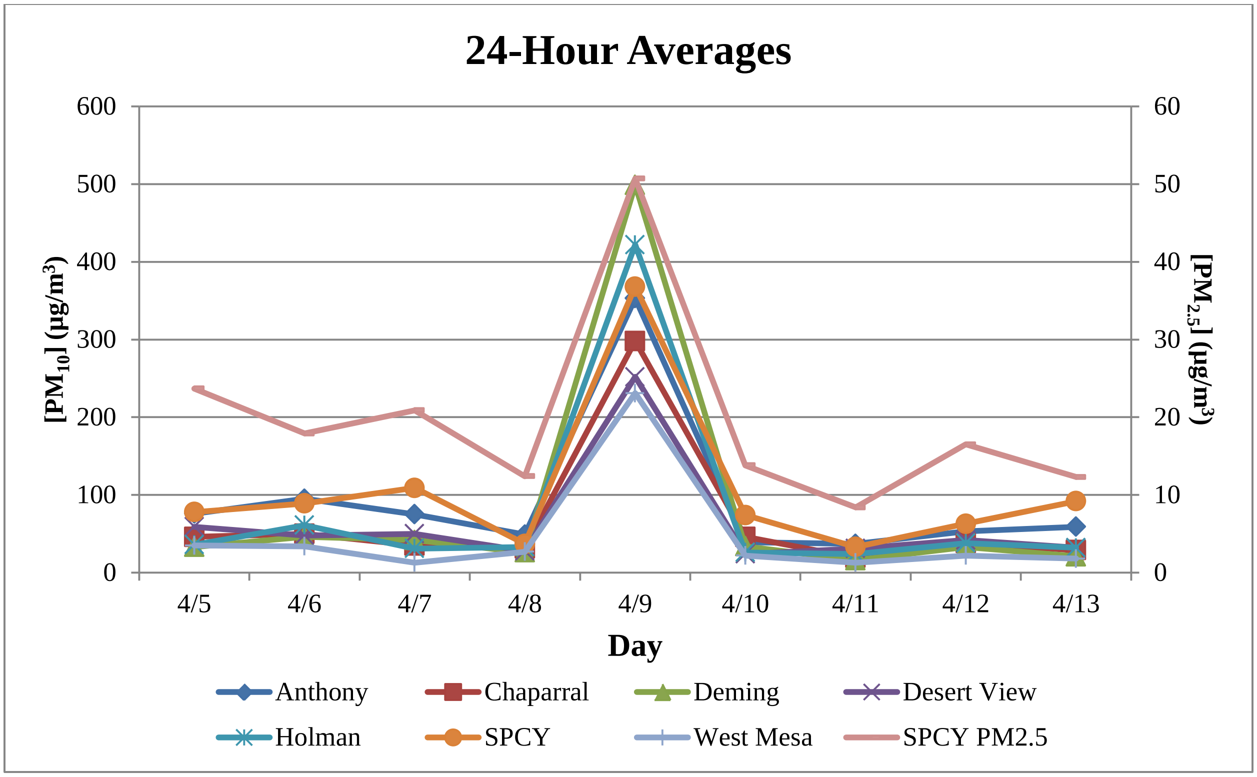

Figure 11-1. PM_{10} and $PM_{2.5}$ 24-hour averages before and after April 9, 2011.

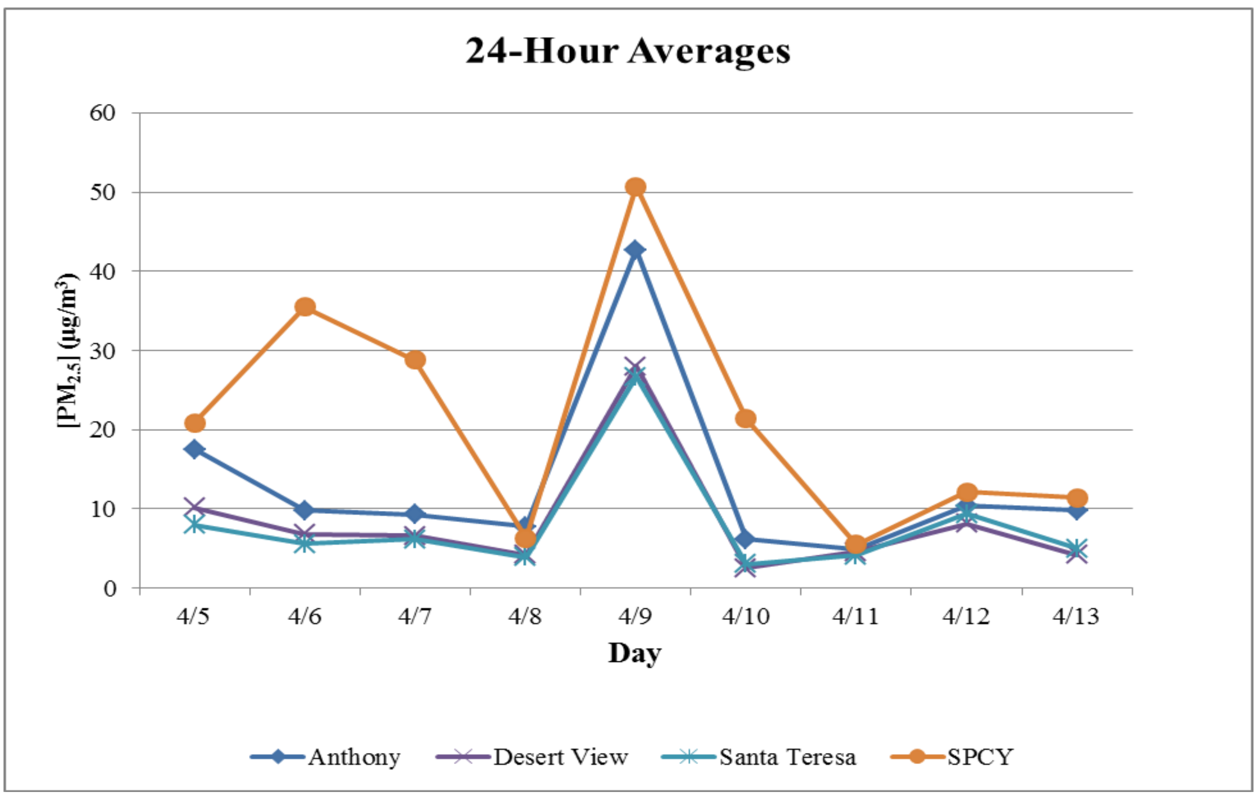

Figure 11-2. $PM_{2.5}$ 24-hour averages before and after April 9 2011. Non-FEM TEOM Data.

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. 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 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 9, 2011, sustained wind speeds exceeded EPA's default threshold at four of the seven monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at six of the seven monitoring sites (Figures 11-3 and 11-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 0900 hour and ending at the 1900 hour.

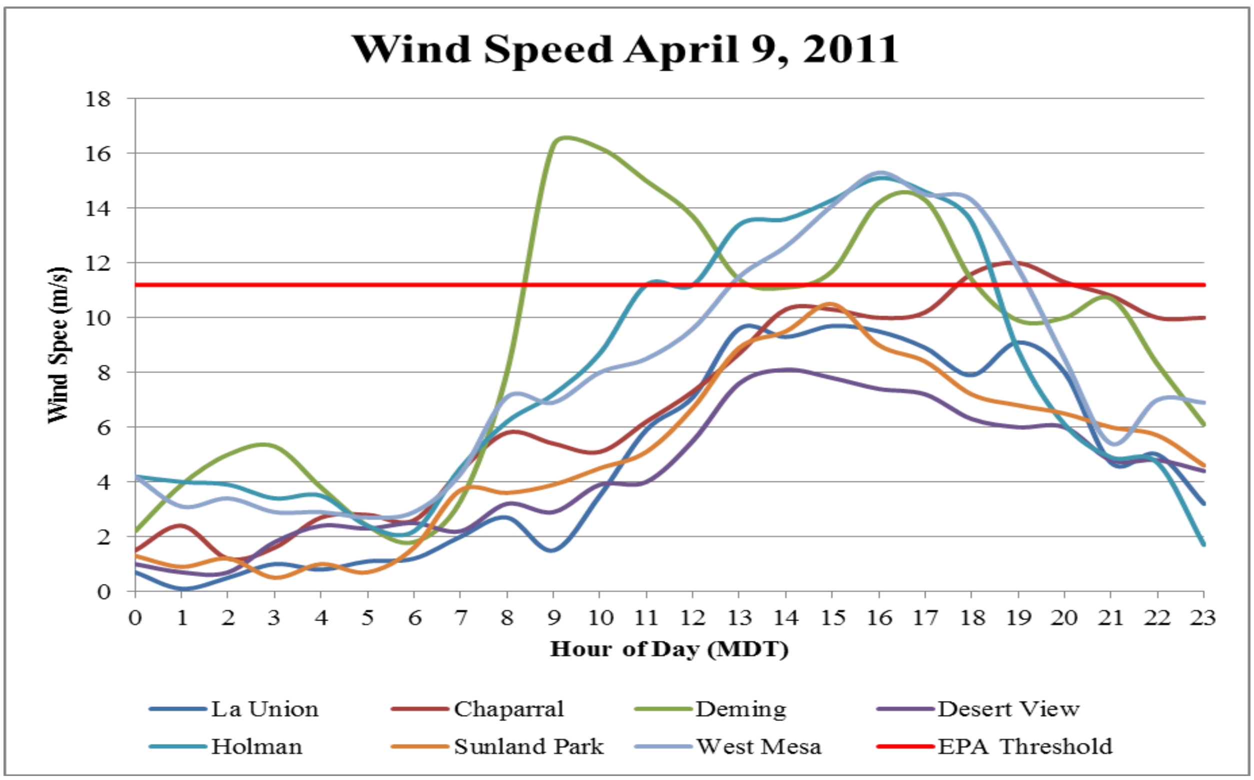

Figure 11-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

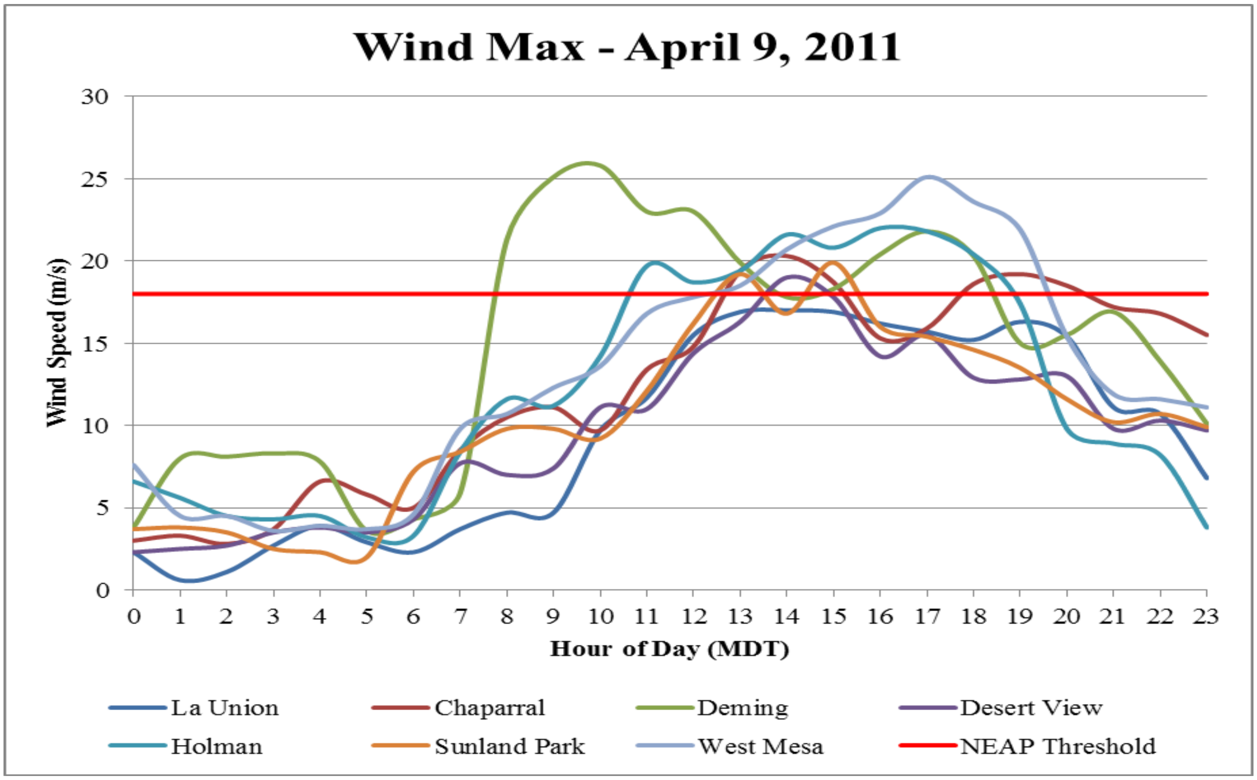

Figure 11-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

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 2006-2010 the PM_{10} FEM TEOM monitors recorded 211 exceedances and the PM_{10} FRM Wedding monitors recorded 5 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 (Table 2-1). The SPCY $PM_{2.5}$ FRM Partisol recorded 23 exceedances of the 24-Hour NAAQS from 2006-2010 (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 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 Doña Ana and Luna Counties. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 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.

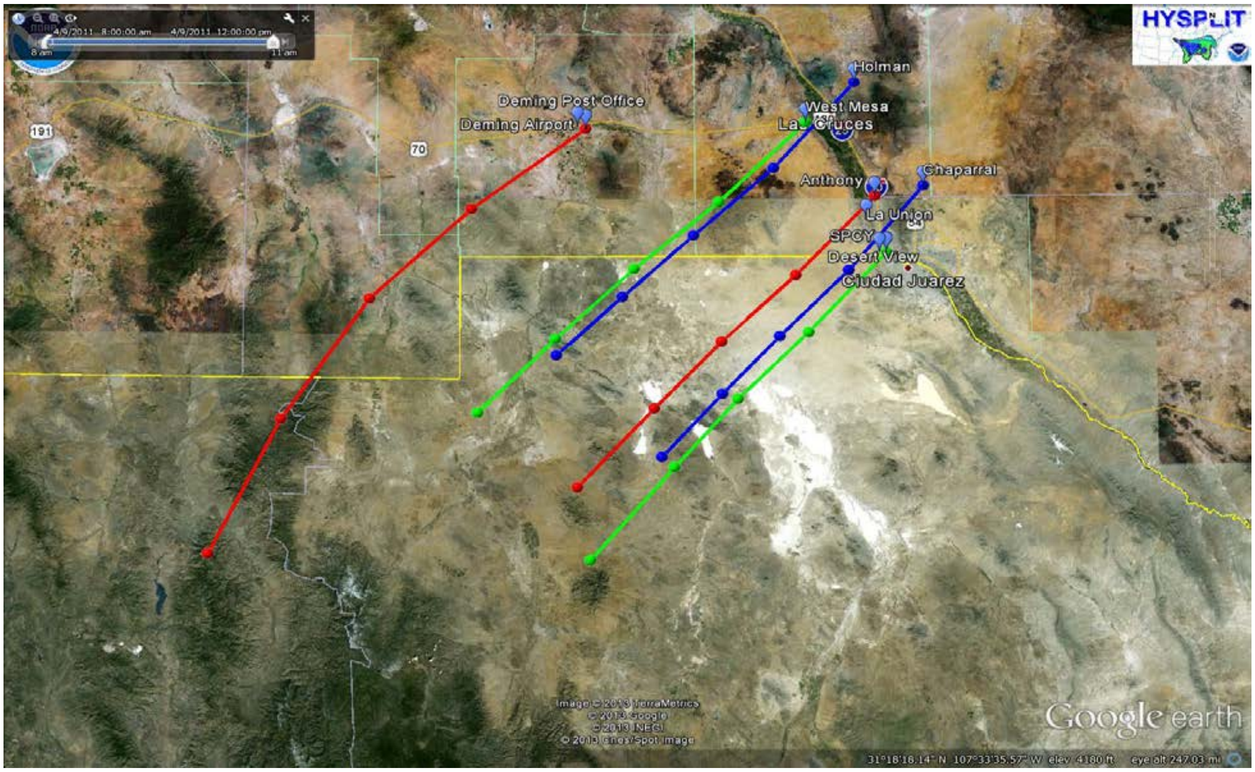

Figure 11-5. HYSPLIT back-trajectory model analysis for April 9, 2011.

11.3 Historical Fluctuations Analysis

11.3.1 Annual and Seasonal 24-hour Average Fluctuations

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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 April 9, 2011 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-h 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.

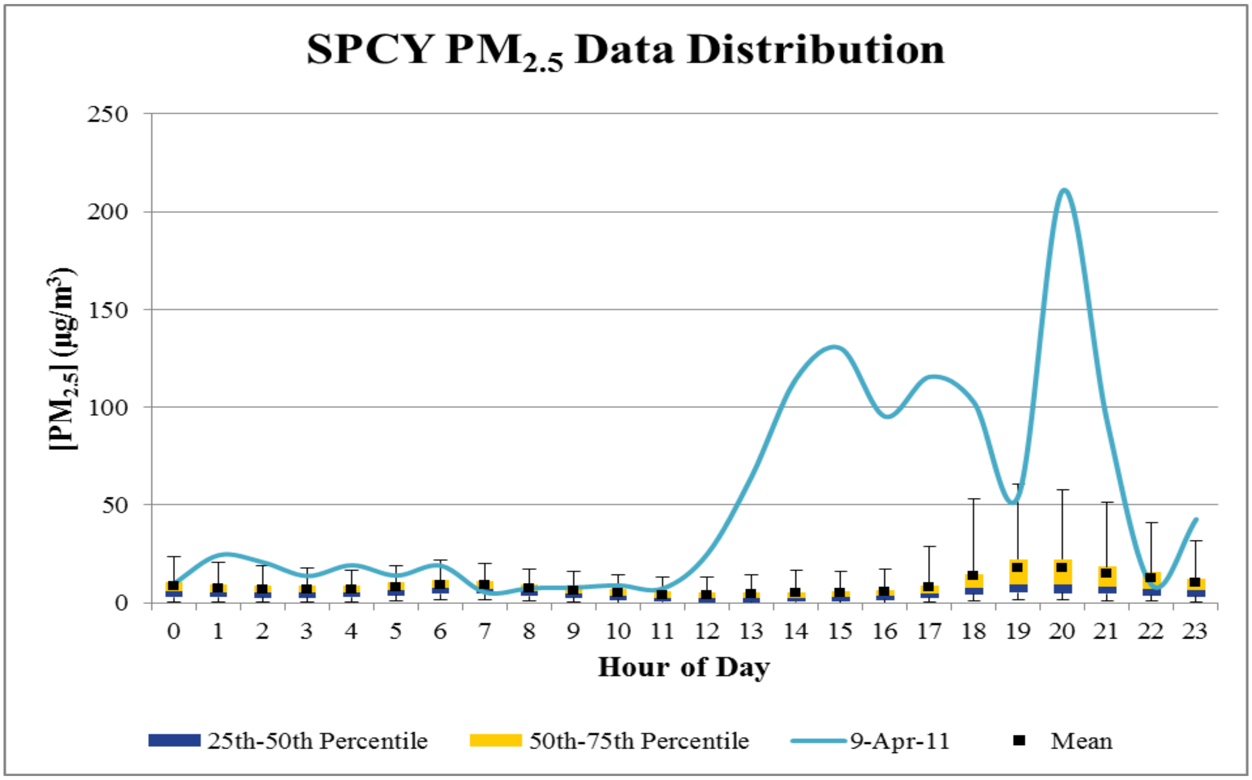

Figure 11-6a. $PM_{2.5}$ hourly data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

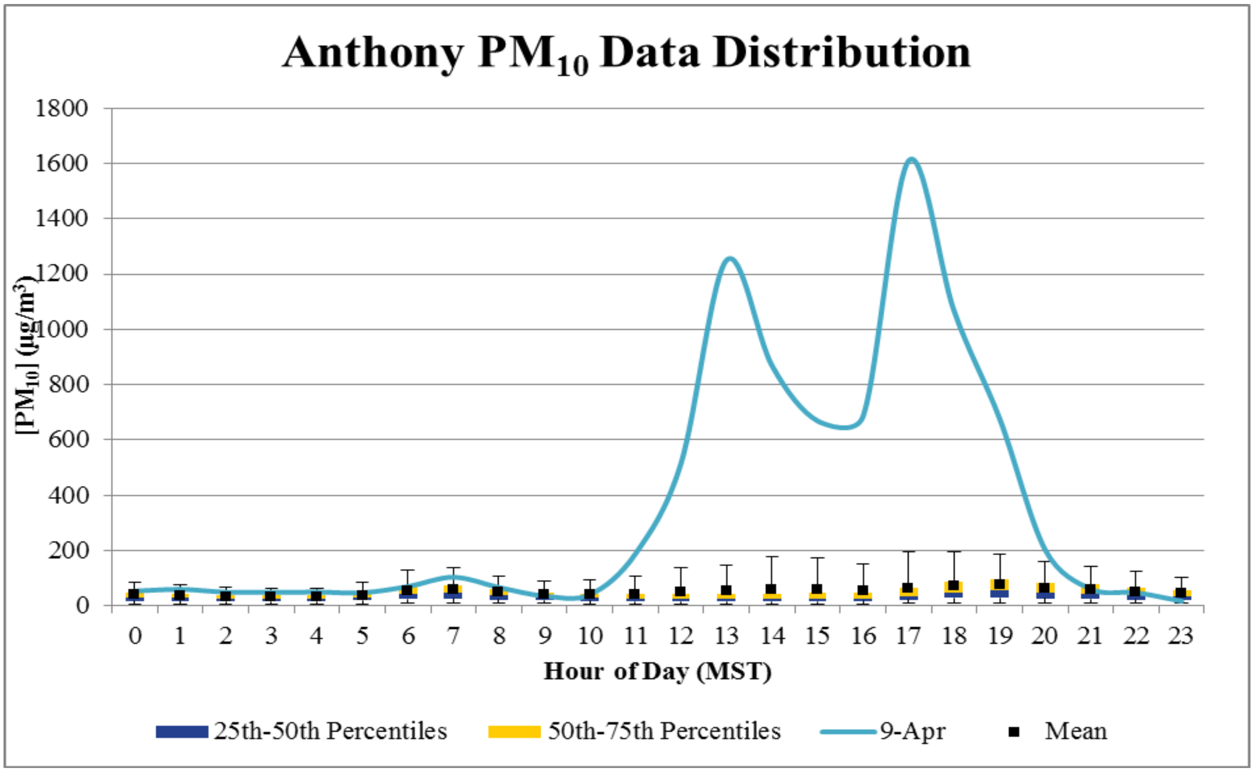

Figure 11-6b. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

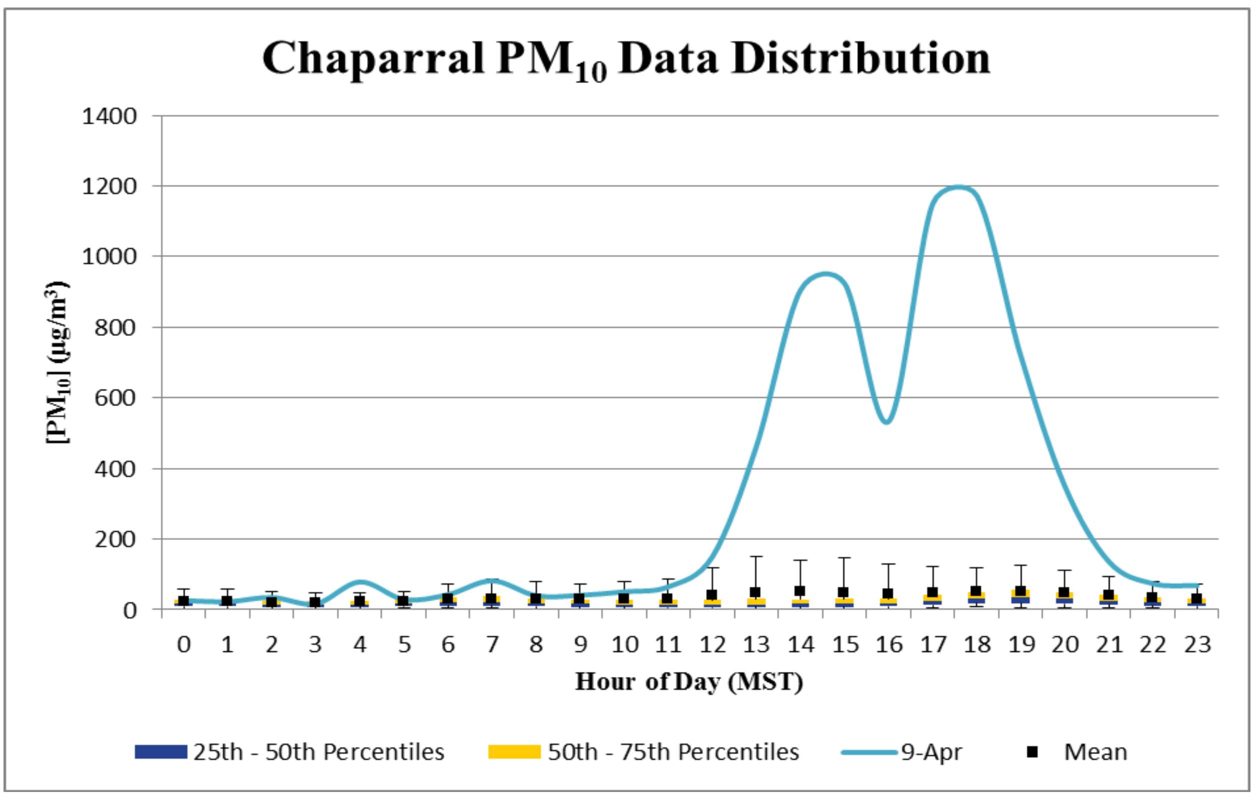

Figure 11-6c. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

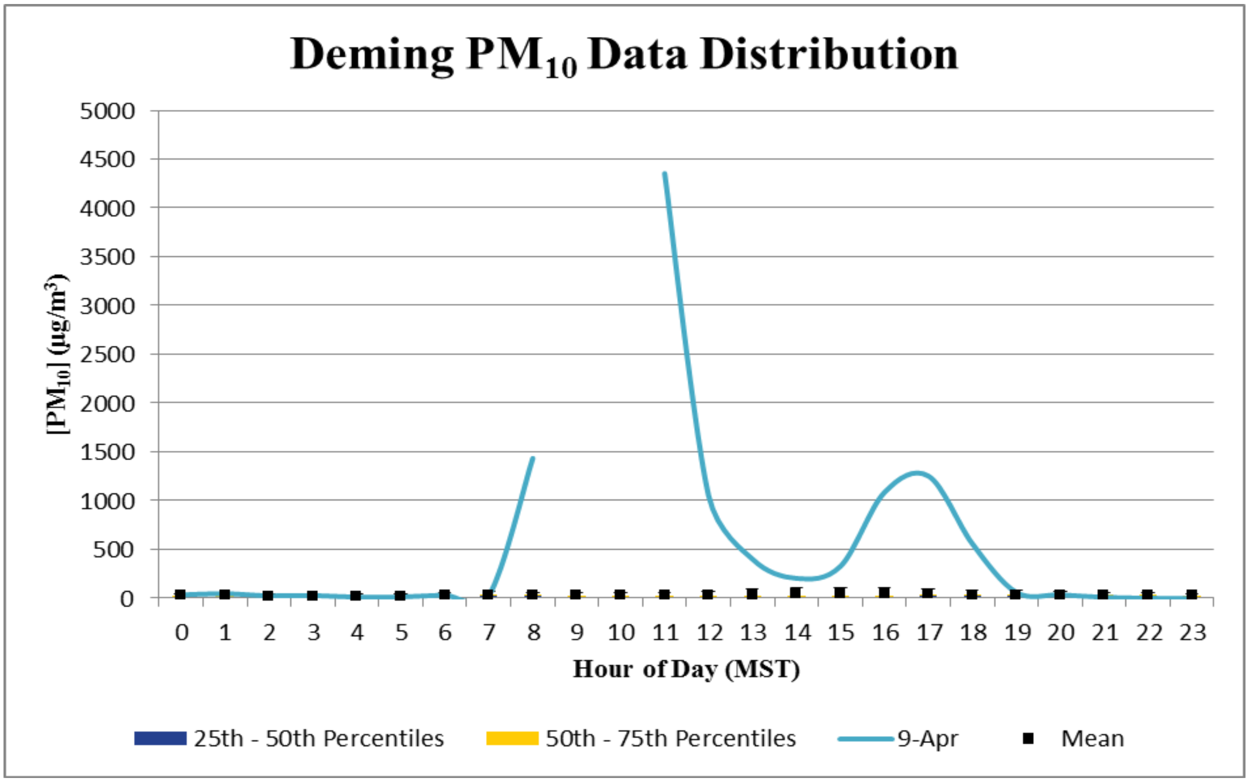

Figure 11-6d. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

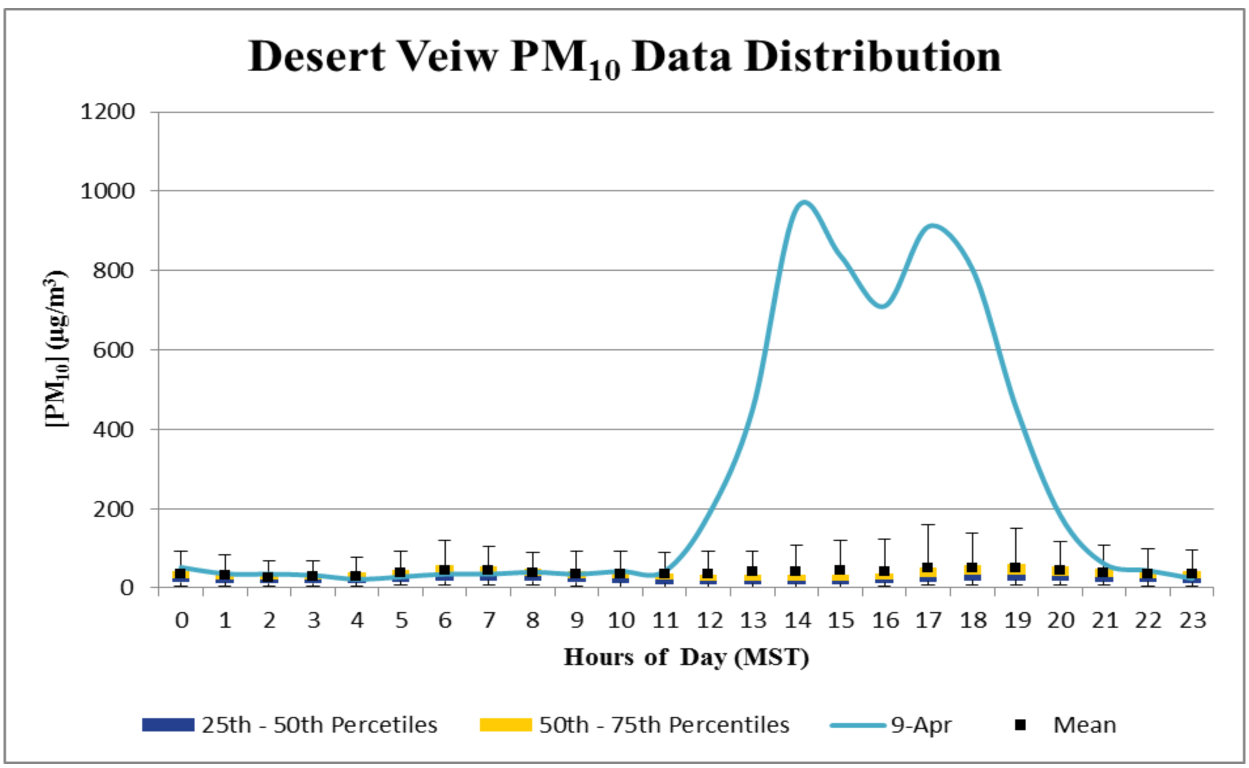

Figure 11-6e. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

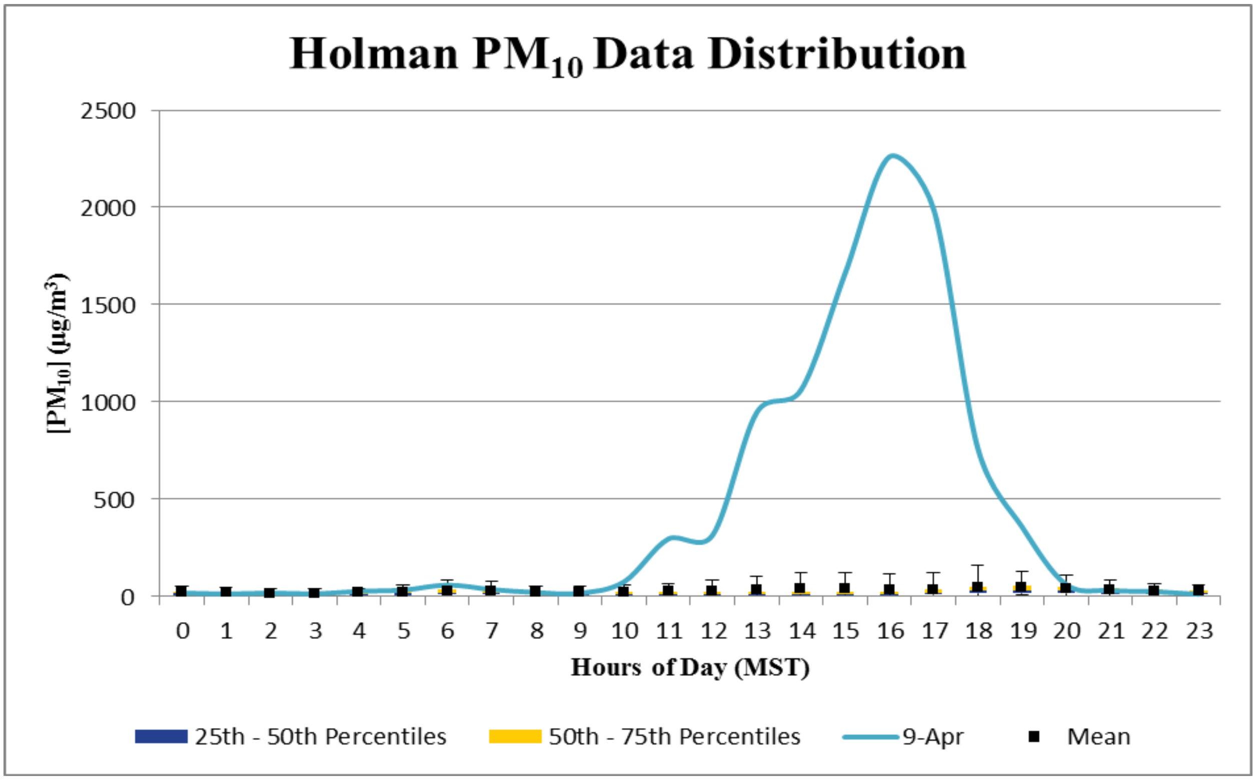

Figure 11-6f. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

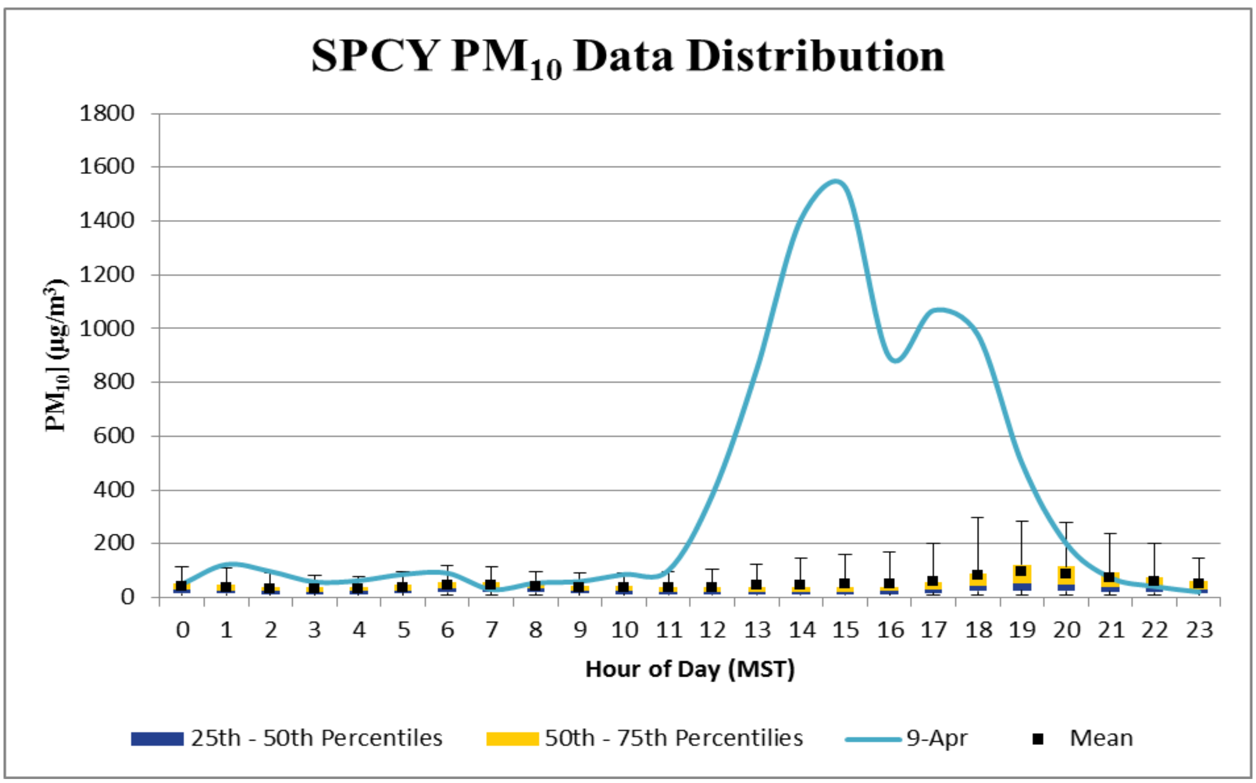

Figure 11-6g. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

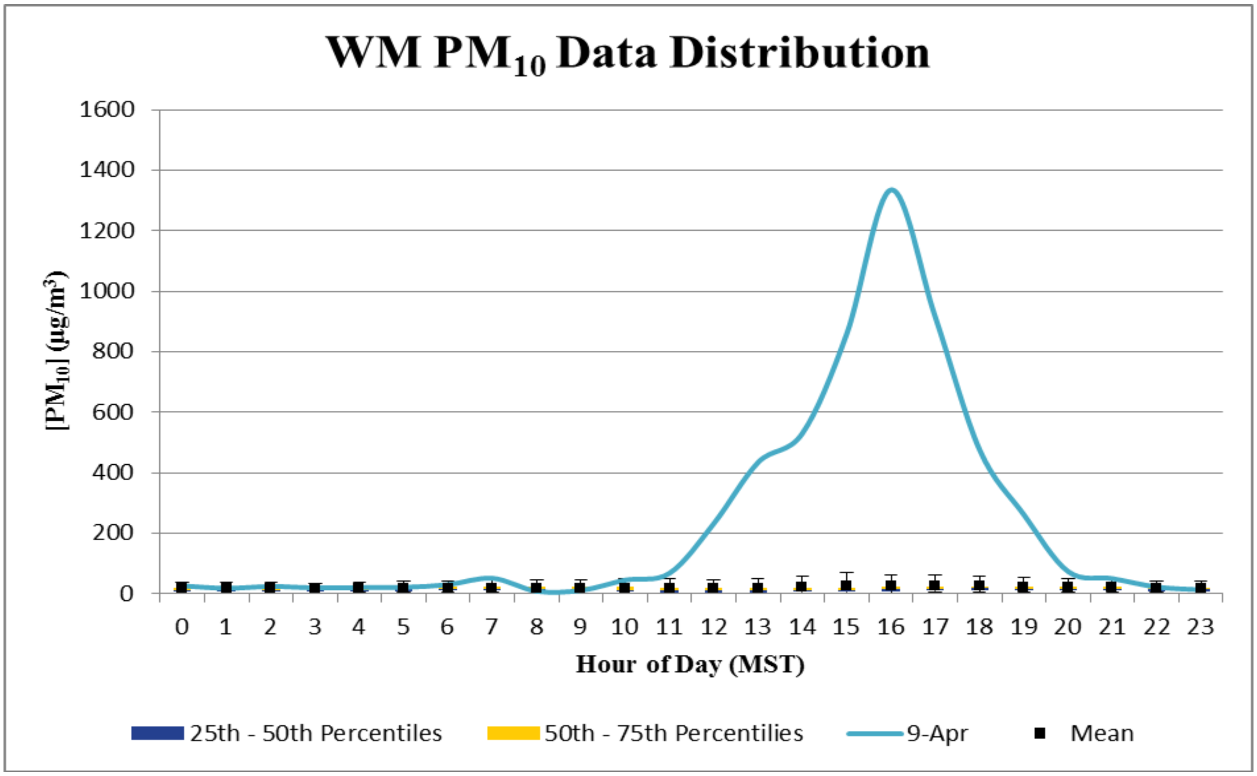

Figure 11-6h. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

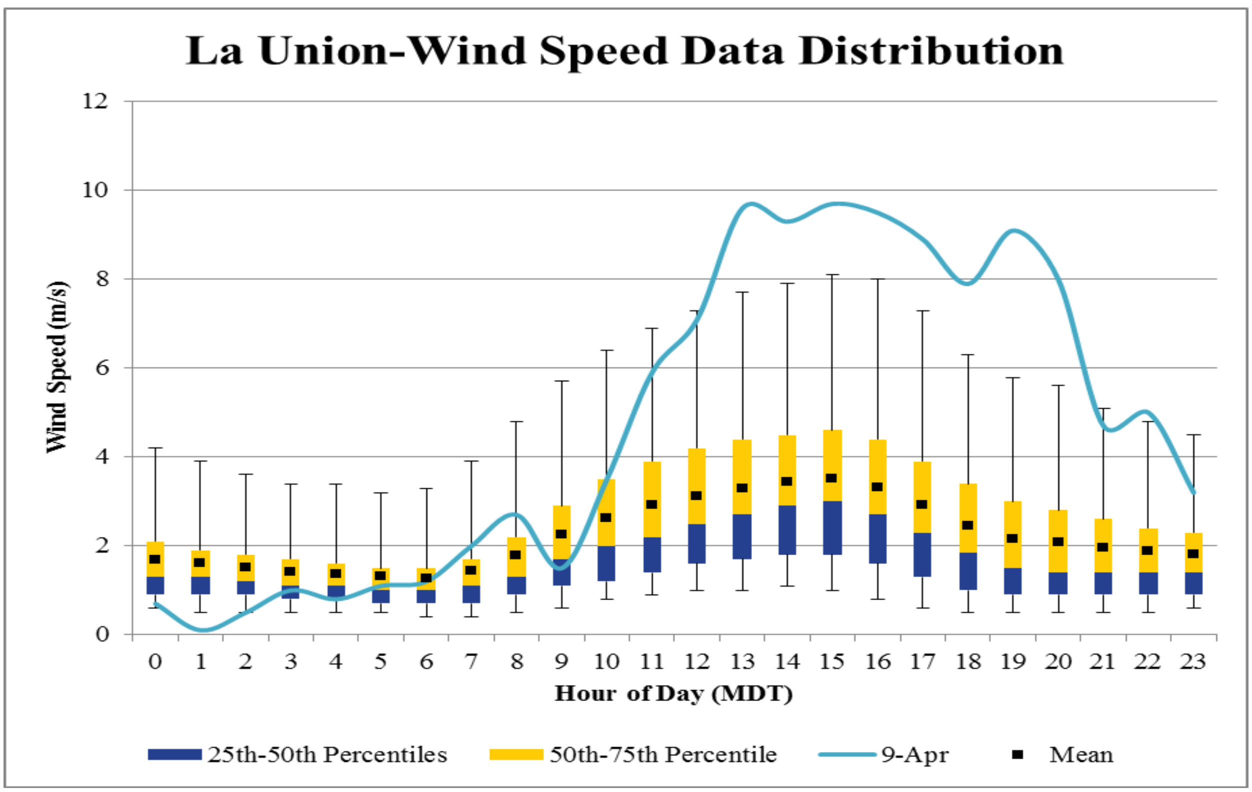

Figure 11-7a. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

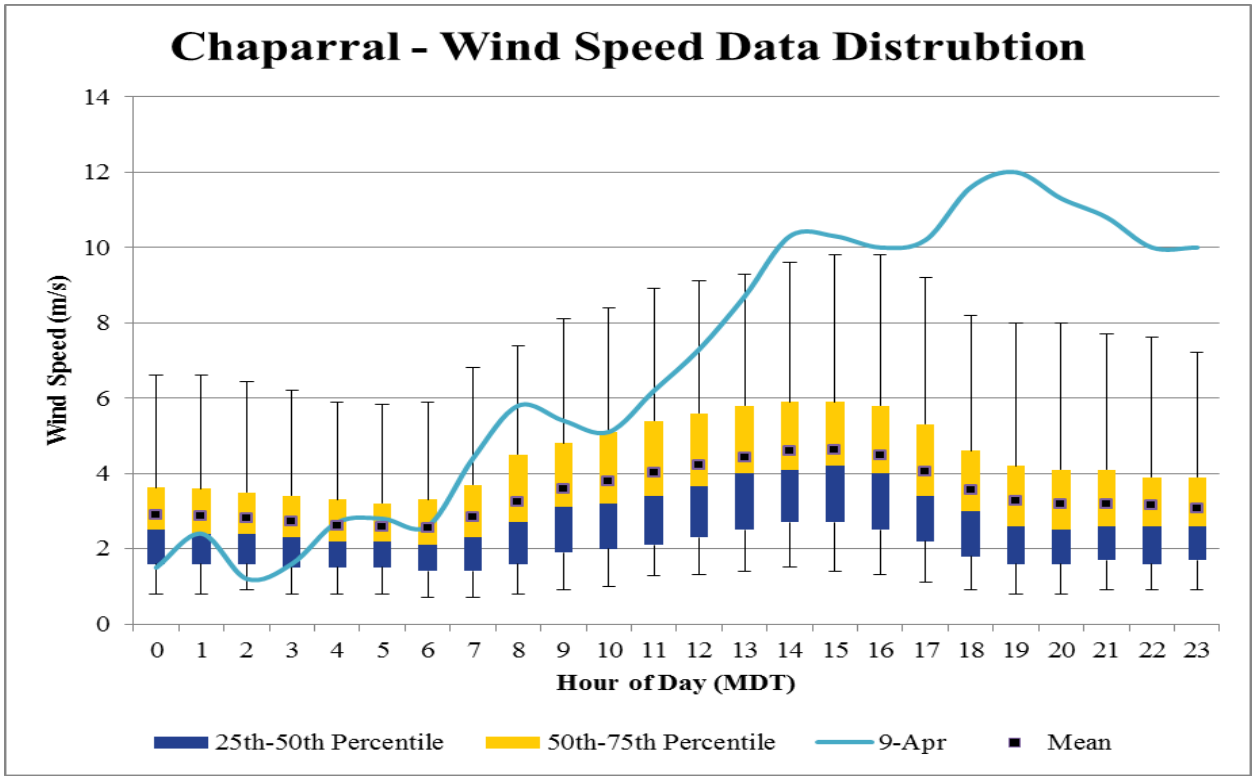

Figure 11-7b. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

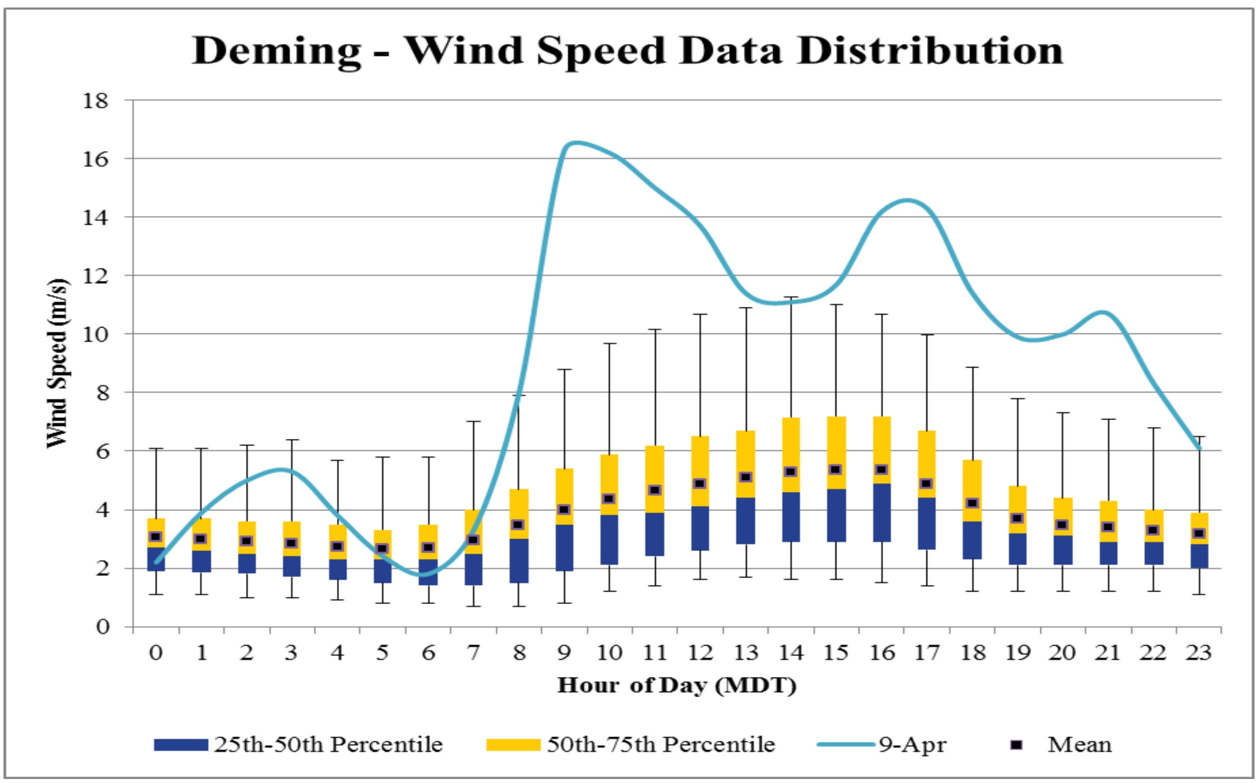

Figure 11-7c. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

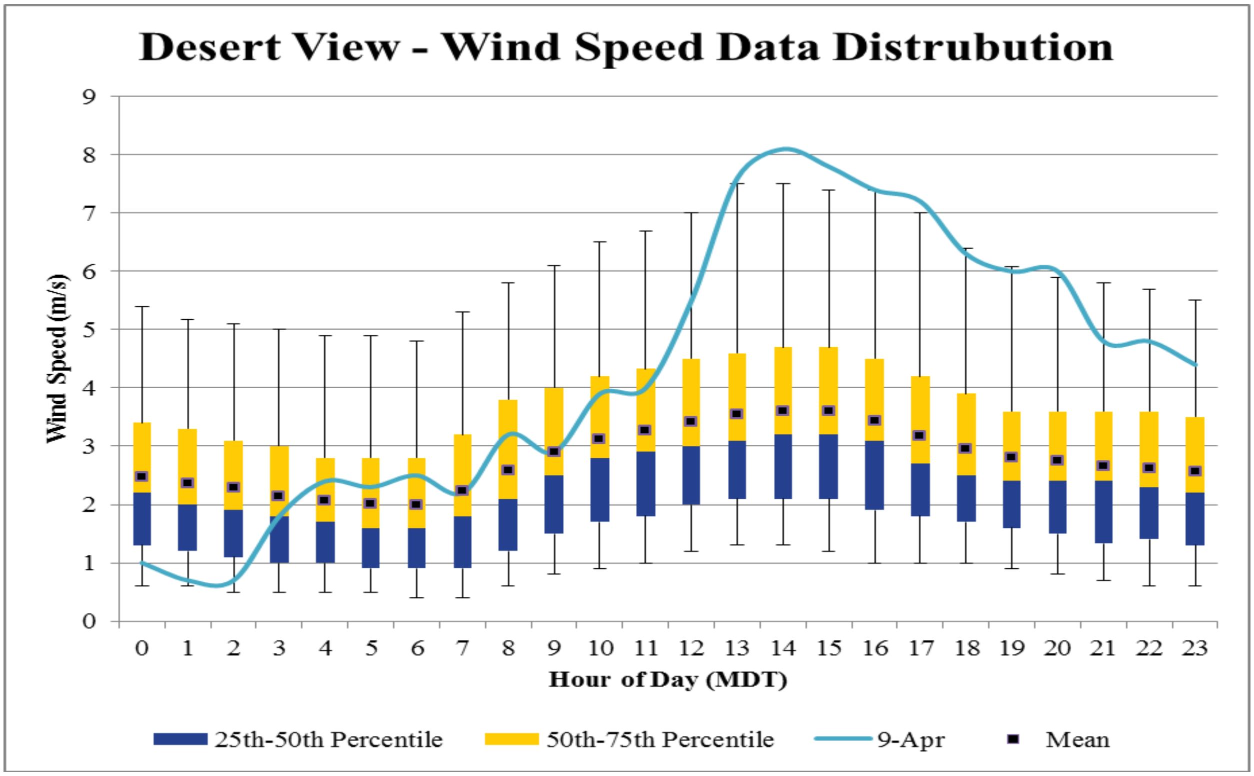

Figure 11-7d. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

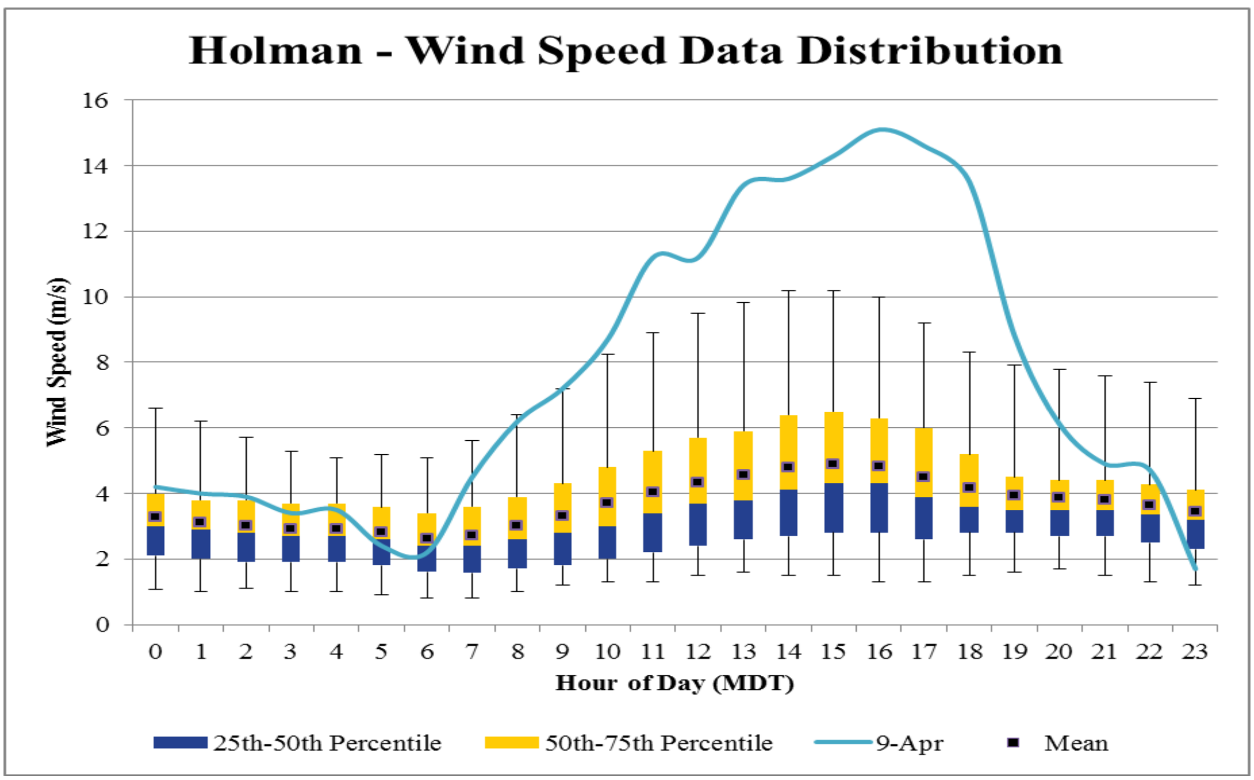

Figure 11-7e. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

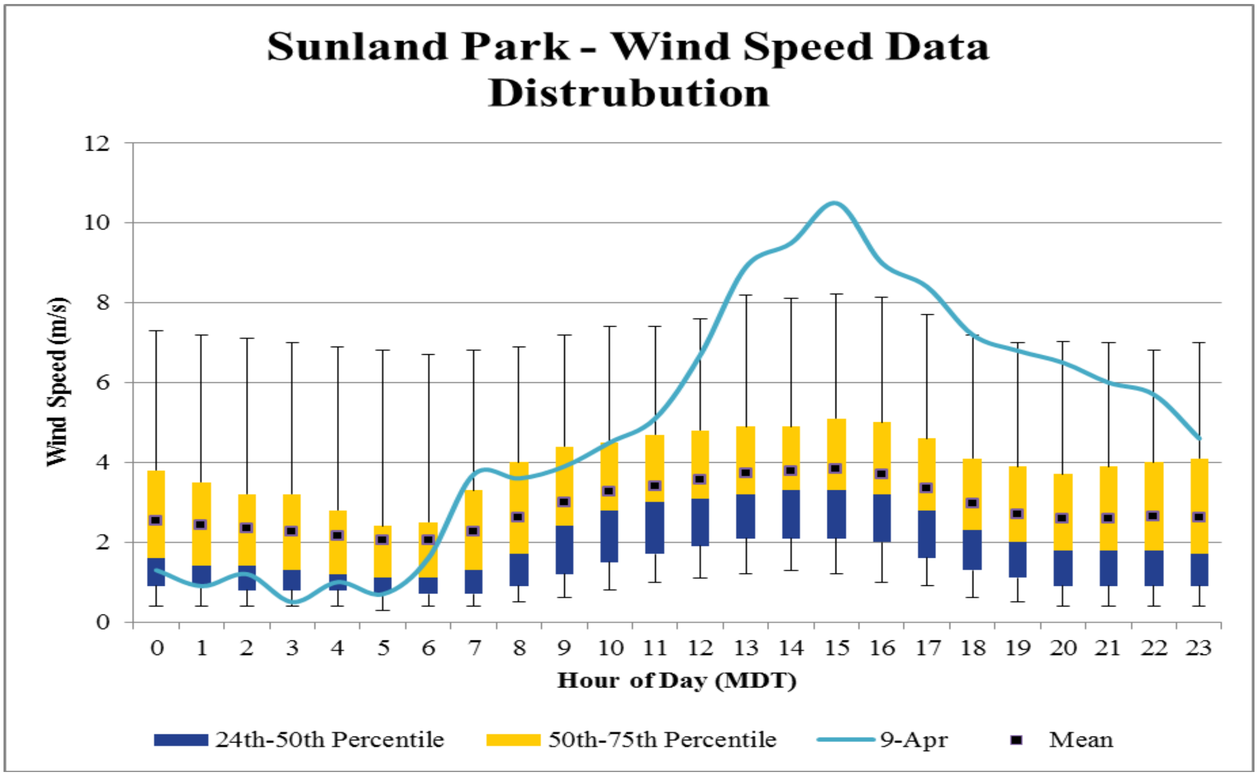

Figure 11-7f. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

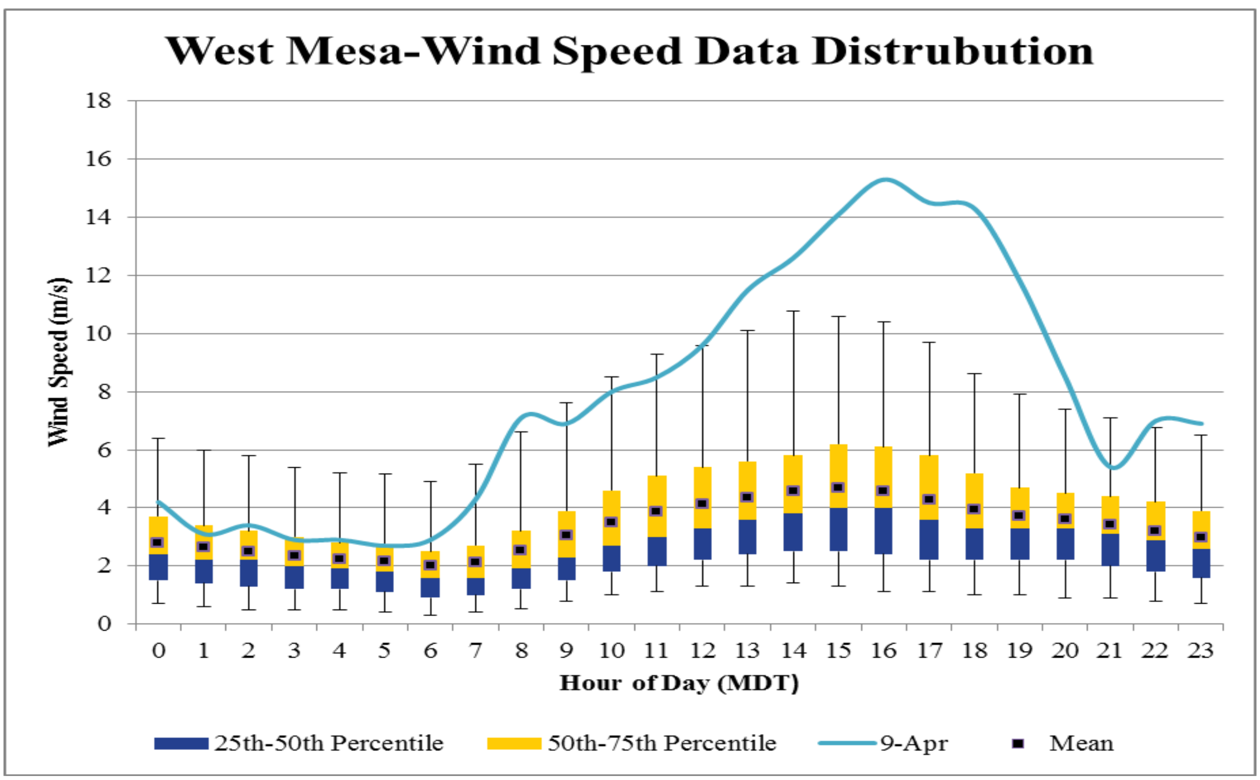

Figure 11-7g. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

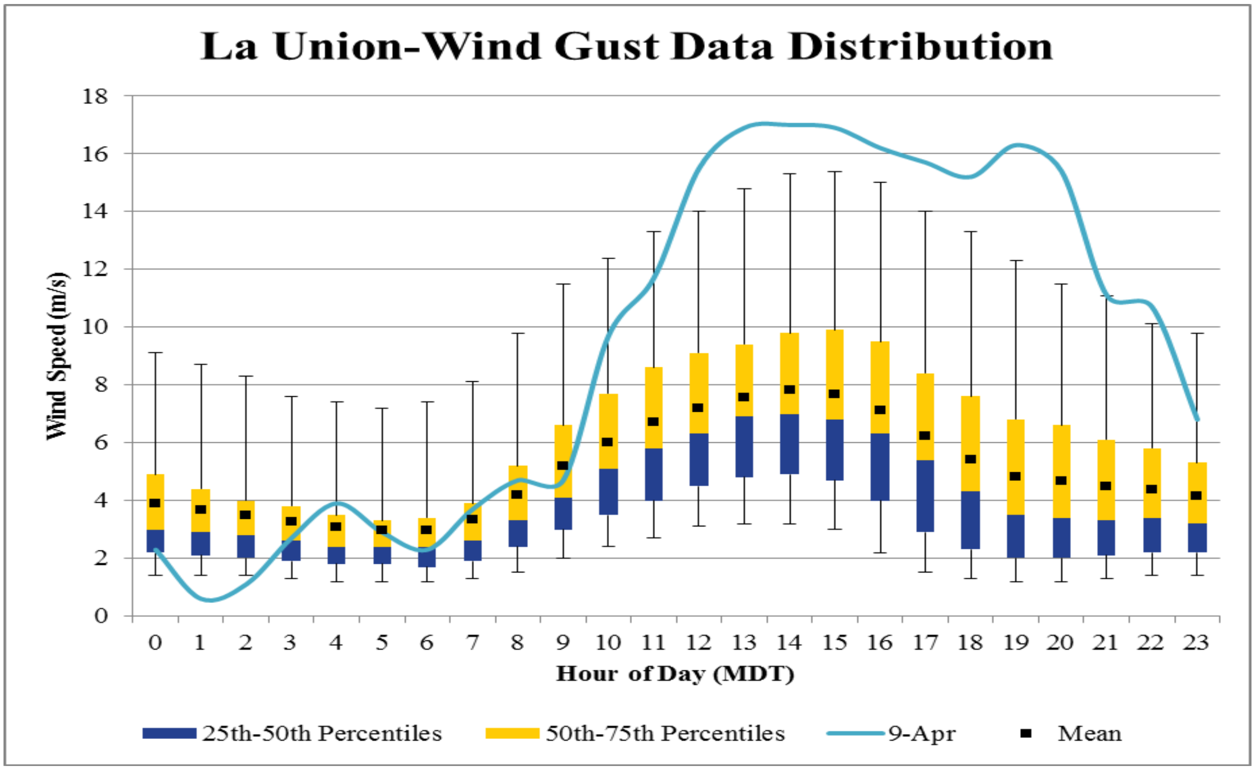

Figure 11-8a. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

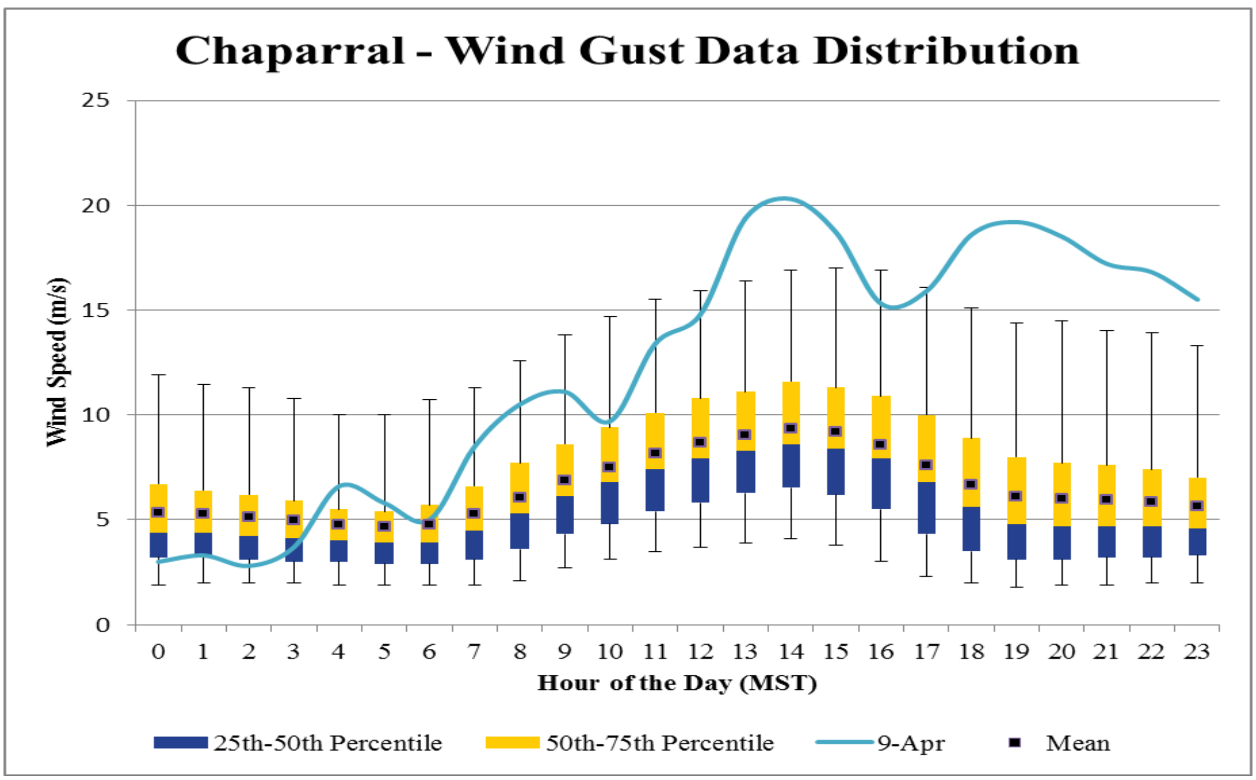

Figure 11-8b. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

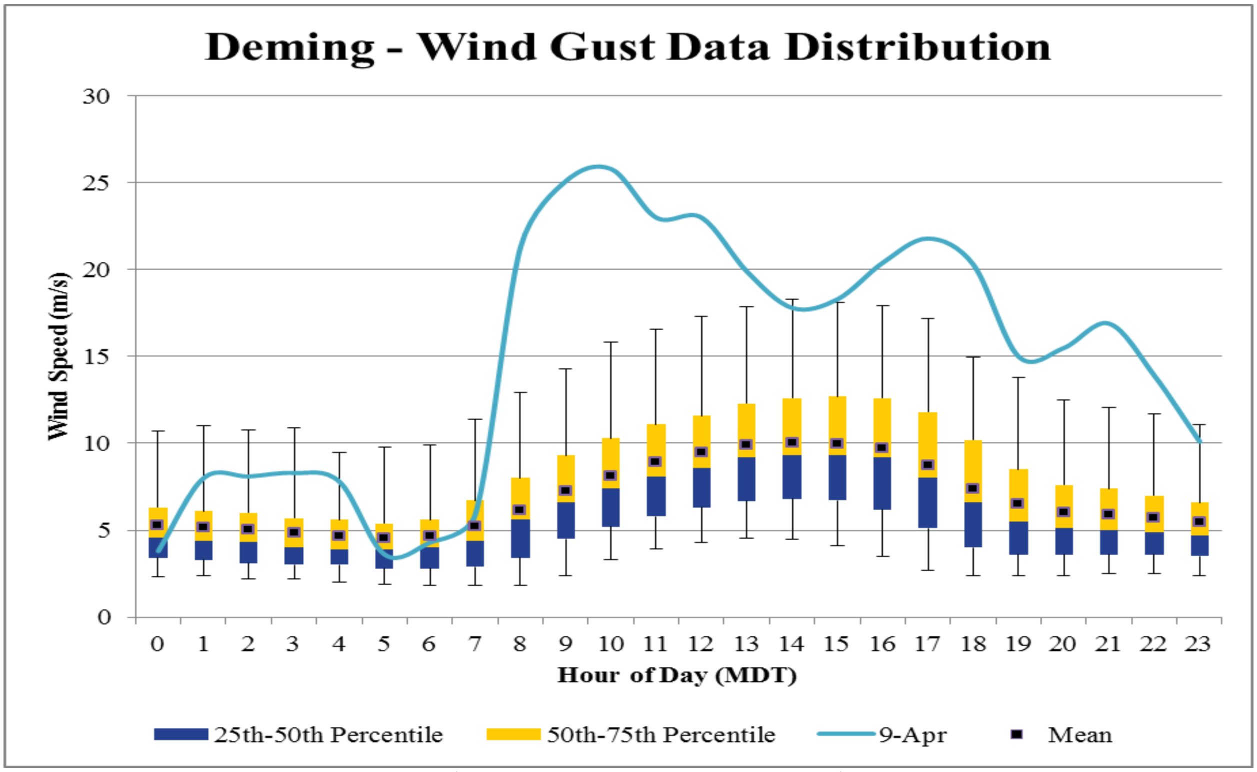

Figure 11-8c. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

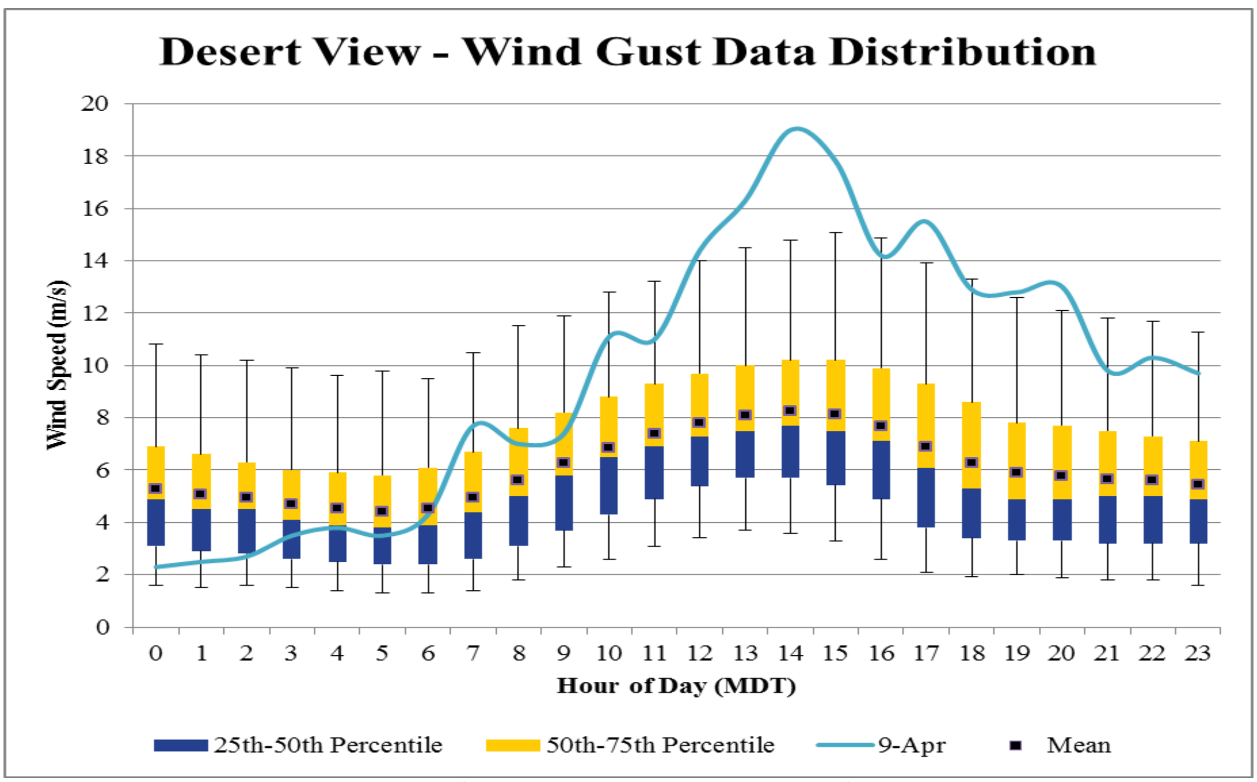

Figure 11-8d. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

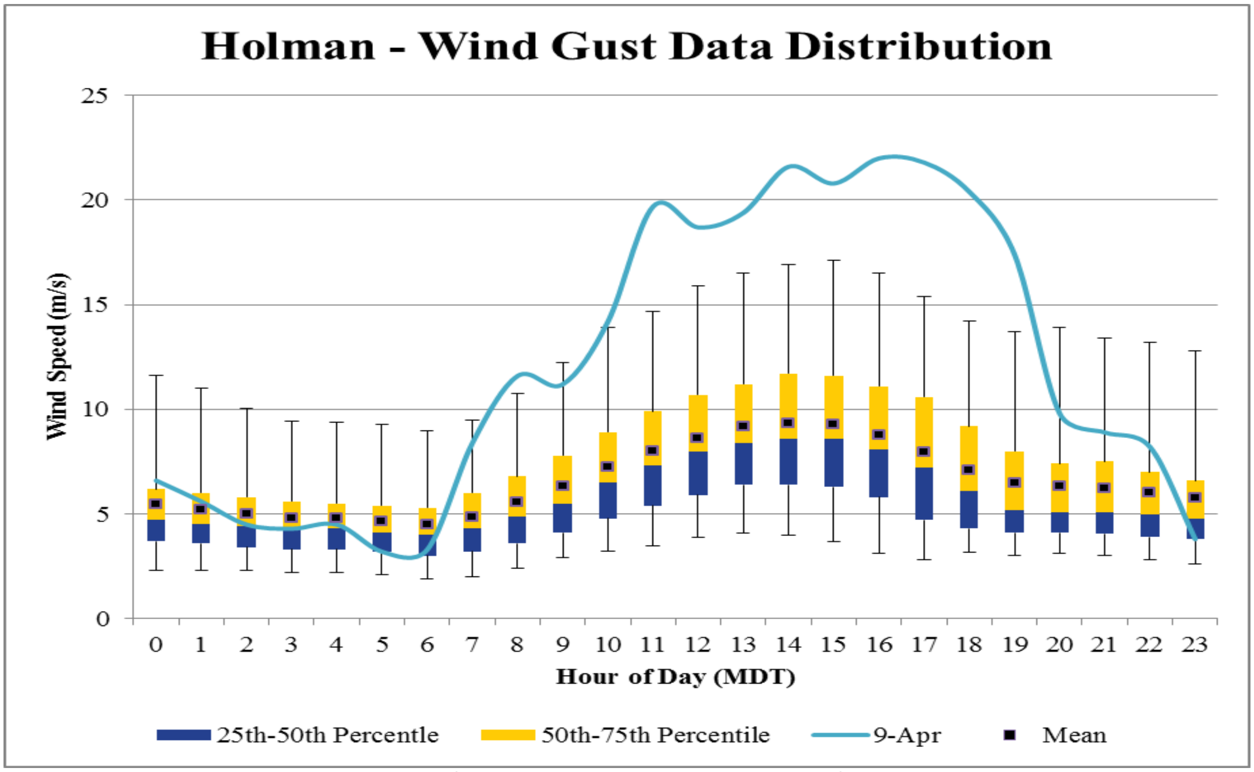

Figure 11-8e. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

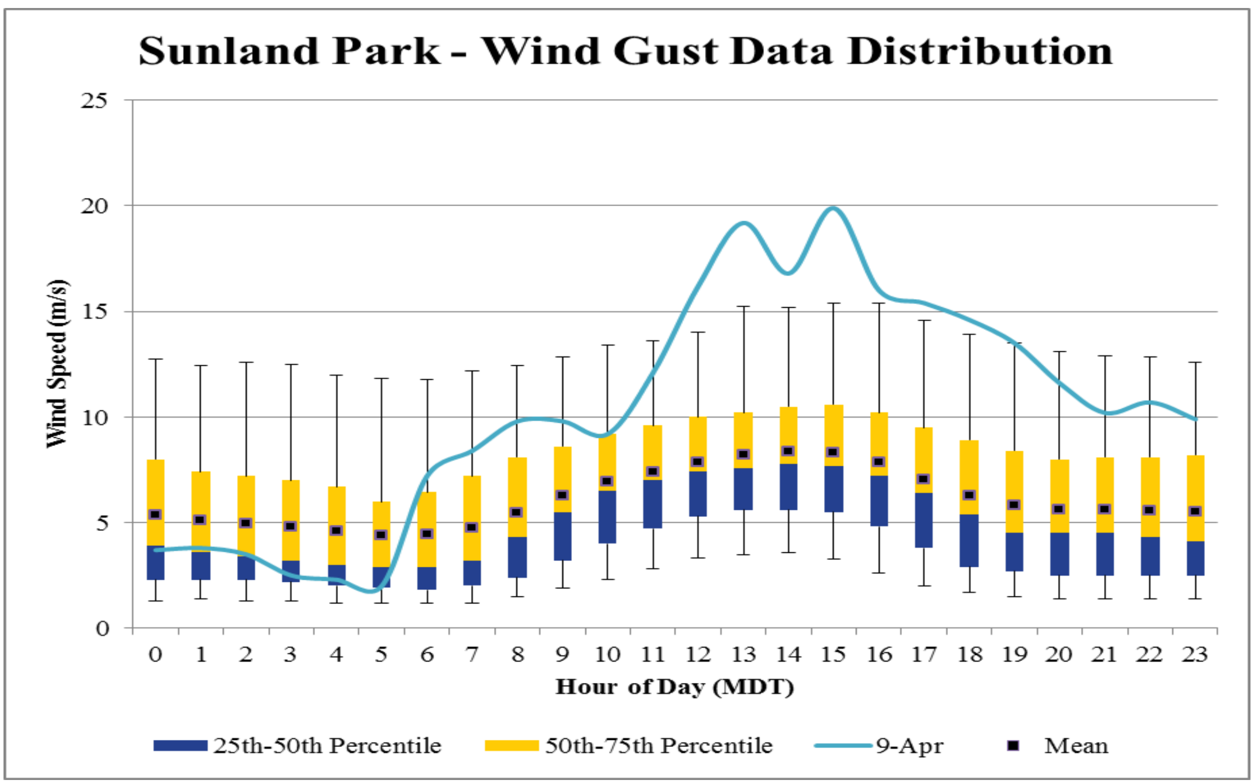

Figure 11-8f. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

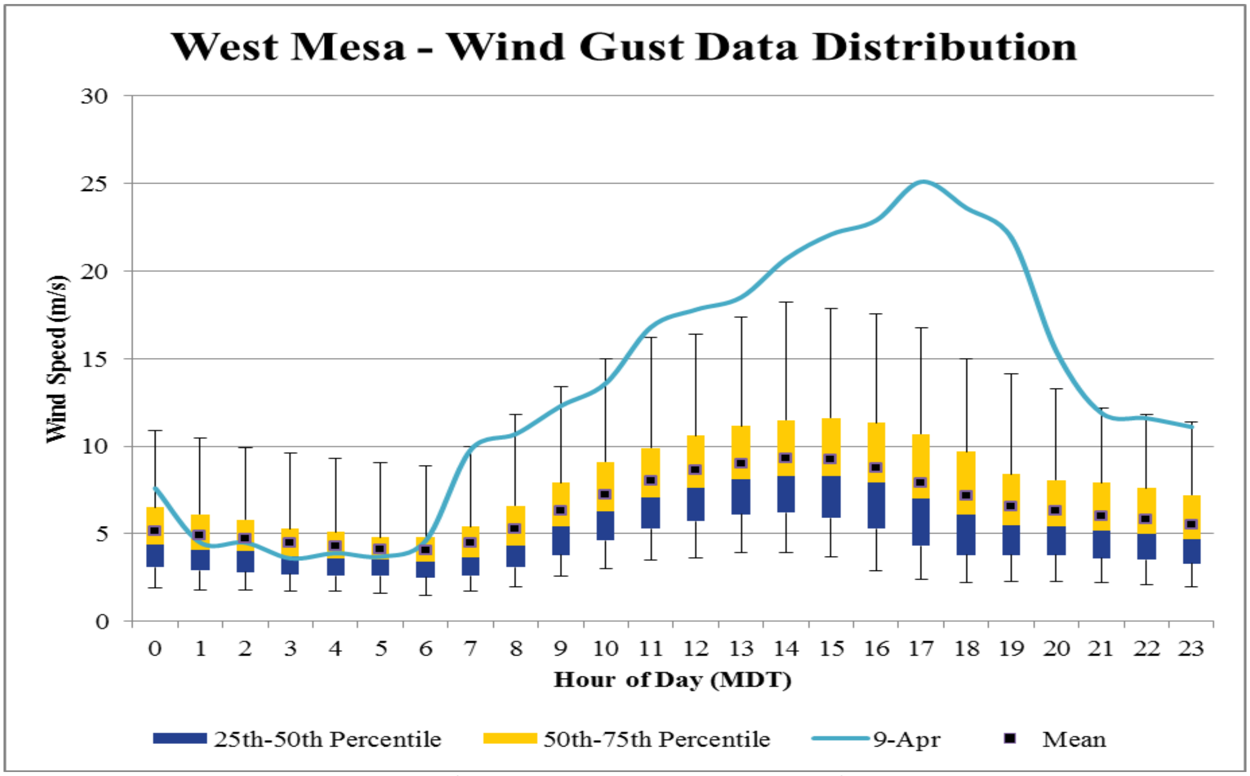

Figure 11-8g. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 9, 2011.

11.4 Clear Causal Relationship

A Pacific cold front approached New Mexico in the early morning hours of April 9, 2011 pushing through Arizona and Utah creating a low pressure trough in southern New Mexico. This front created a tight pressure gradient over much of northern Mexico, Arizona and southern New Mexico. As the system moved toward New Mexico, the pressure gradient tightened and winds became even stronger at the surface (Figure 11-9). Surface winds flow perpendicular to the isobars from high to low pressure. As the day progressed the wind direction in the upper atmosphere aligned with the surface wind direction (Figure 11-10). 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.

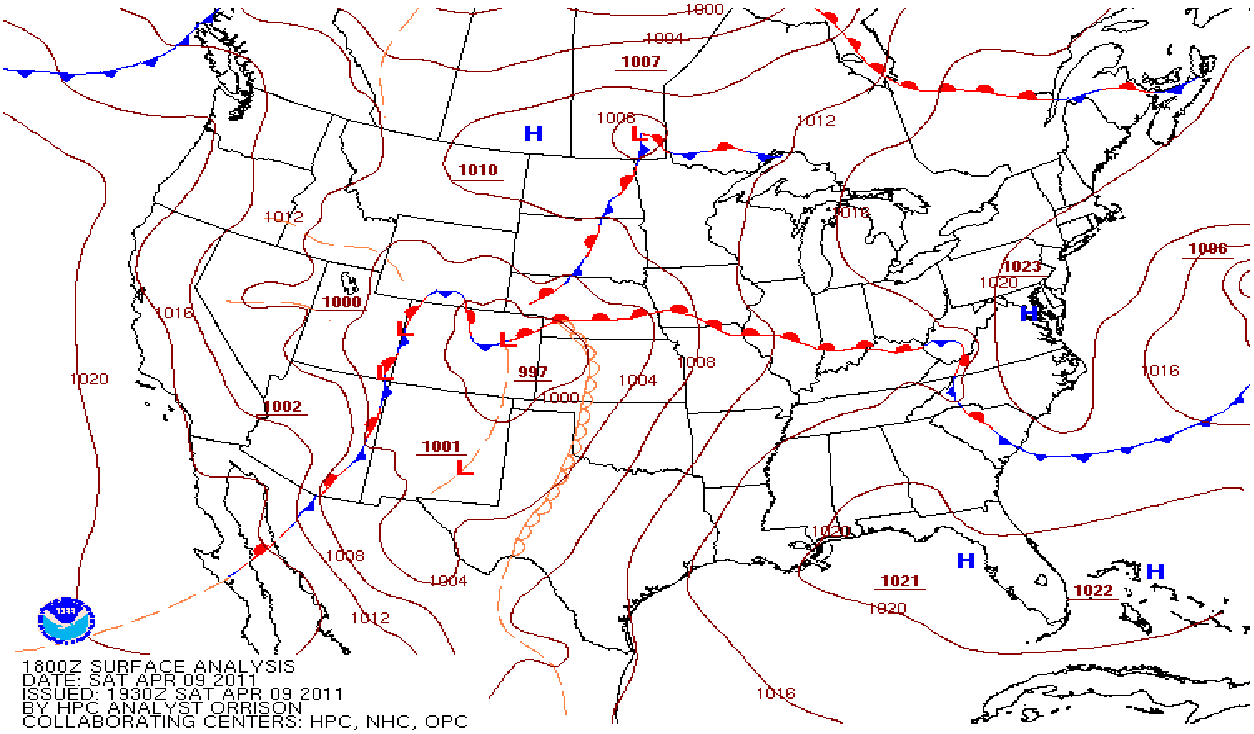

Figure 11-9. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 9, 2011 at the April 9, 2011 hour.

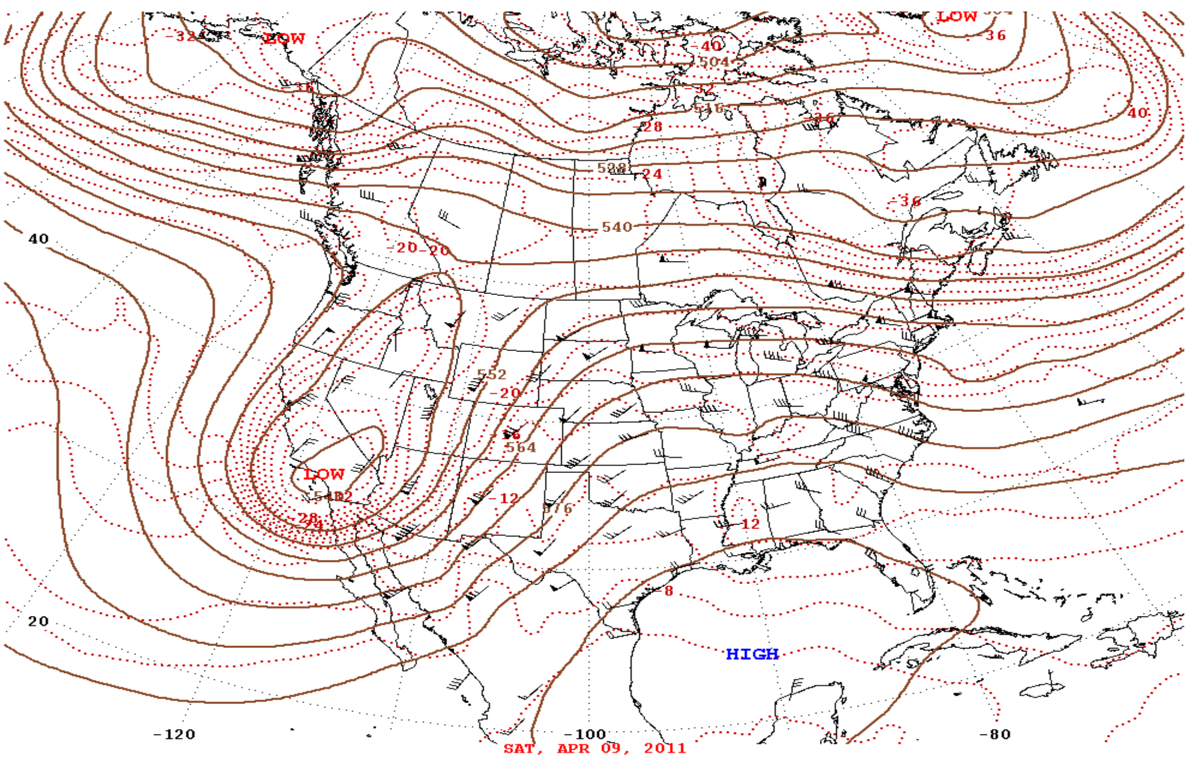

Figure 11-10. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on April 9, 2011.

The weather pattern described above generated strong southwesterly winds beginning at the 0900 hour and lasting through the 1900 hour. Beginning at the 0900 hour, wind speeds exceeded 11.2 m/s or the historical 95th percentile of data at Deming Airport (as shown in Figure 11-7c). Peak wind speeds ranged from 8.1 m/s at Desert View to 16.3 m/s at Deming Airport (Figure 11-3). Peak wind gusts ranged from 17 m/s at Anthony to 25.8 m/s at Deming (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 11-11a-h. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (1100-1900 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 11-12a-b). Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 11-13).

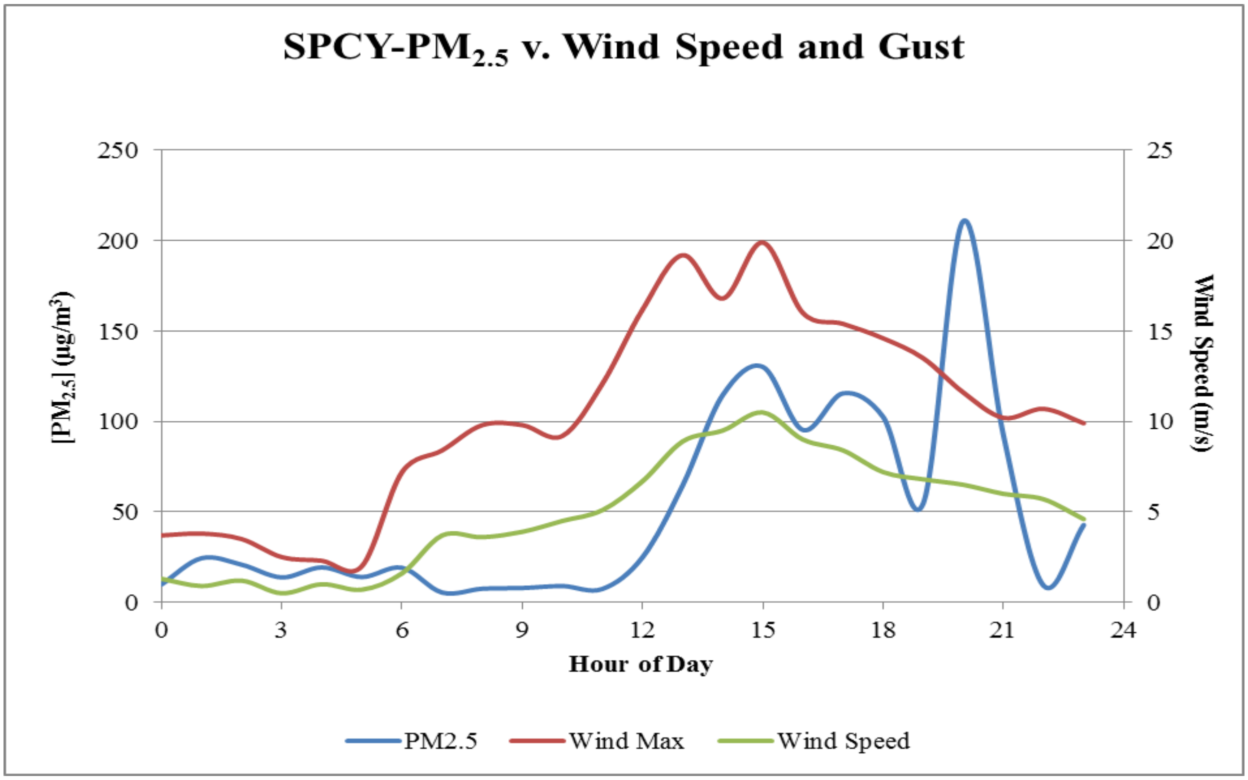

Figure 11-11a. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

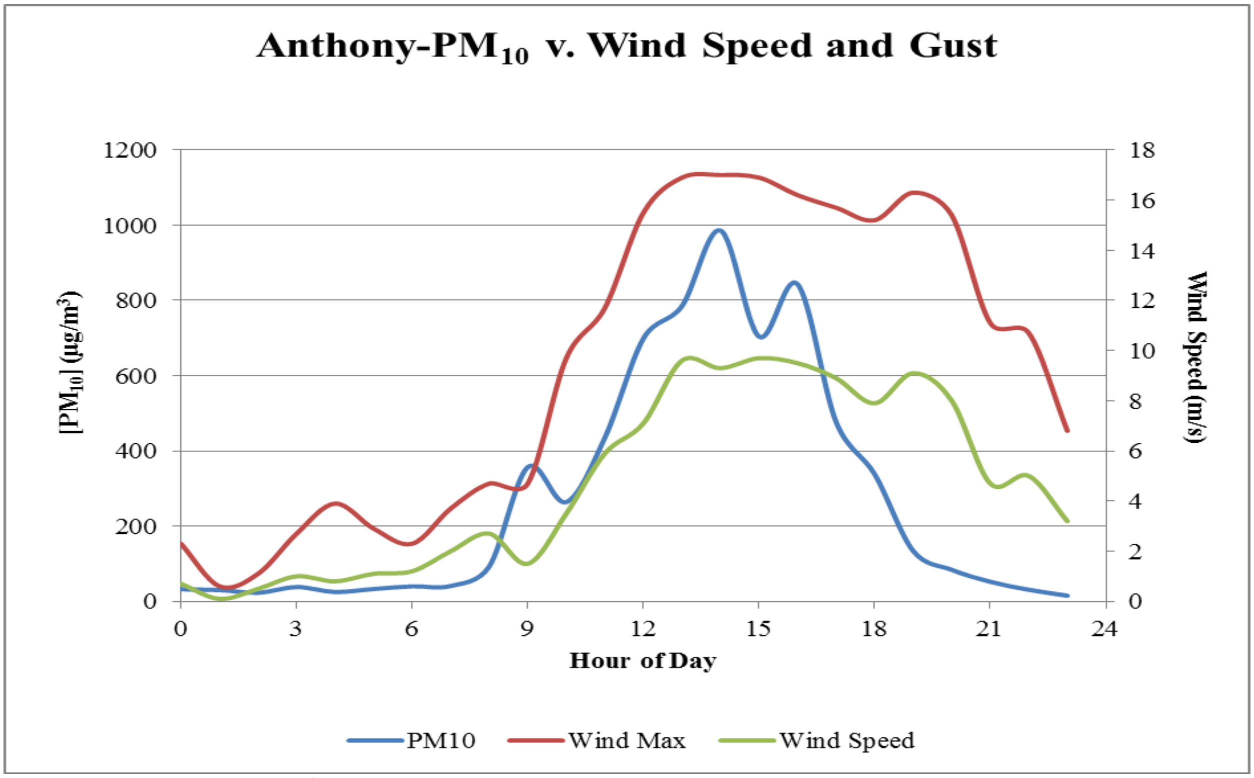

Figure 11-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

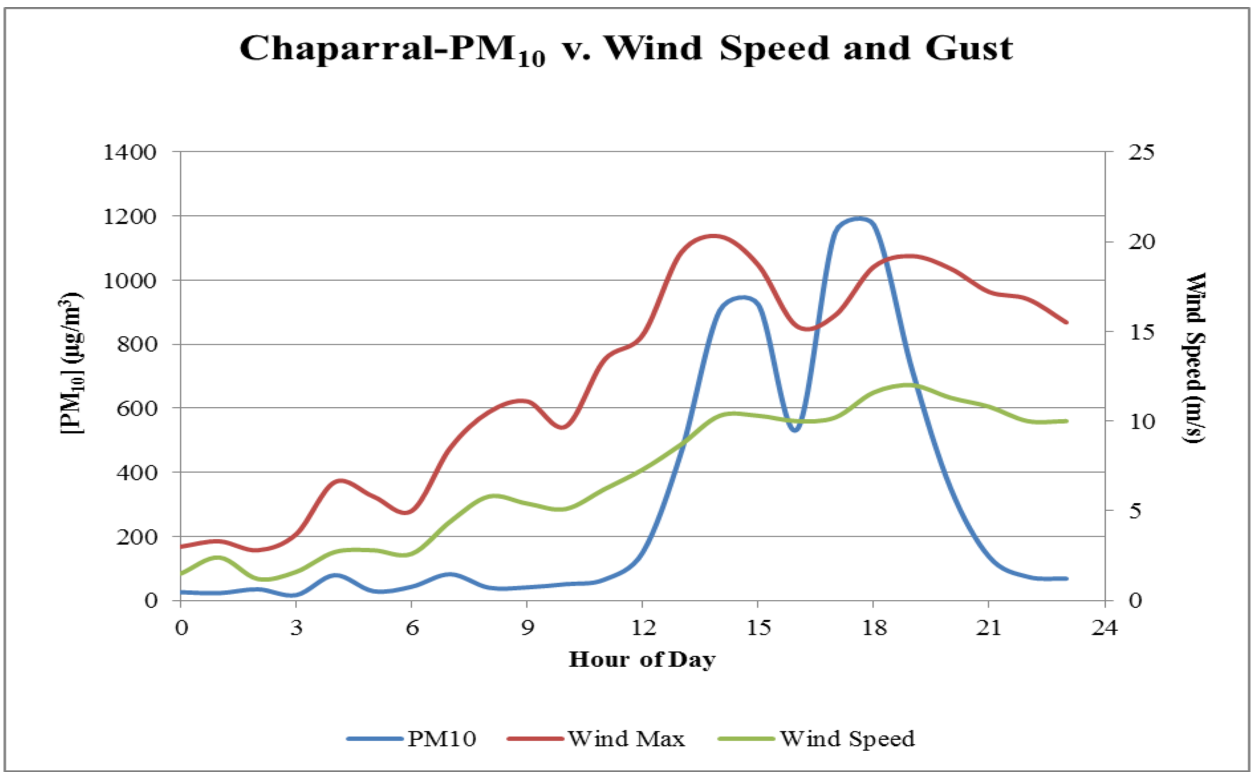

Figure 11-11c. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

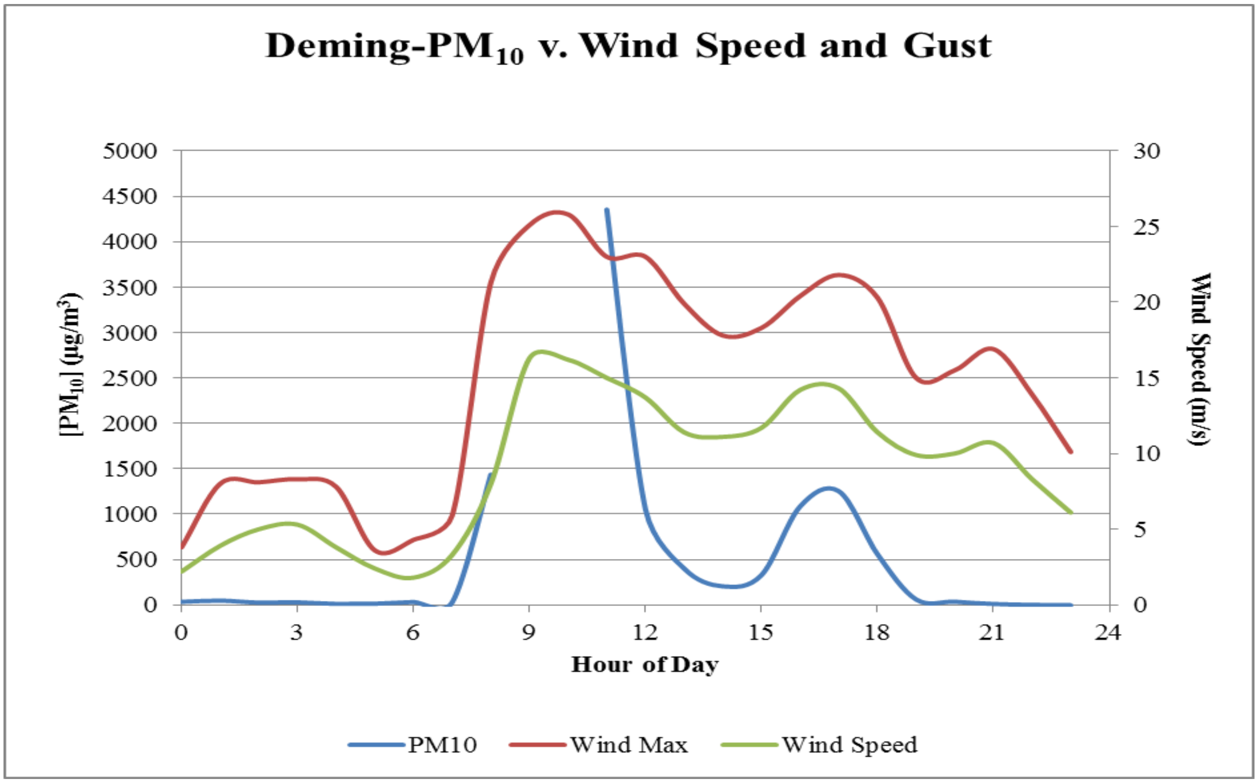

Figure 11-11d. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

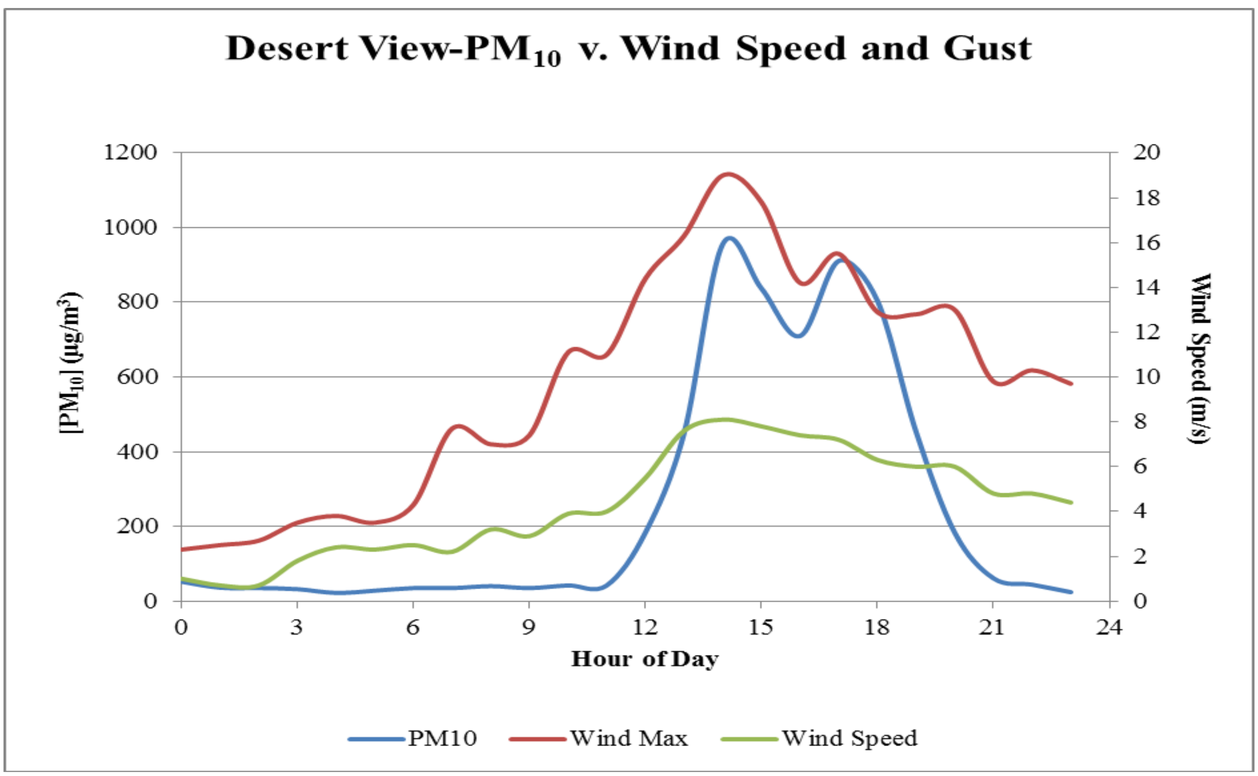

Figure 11-11e. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

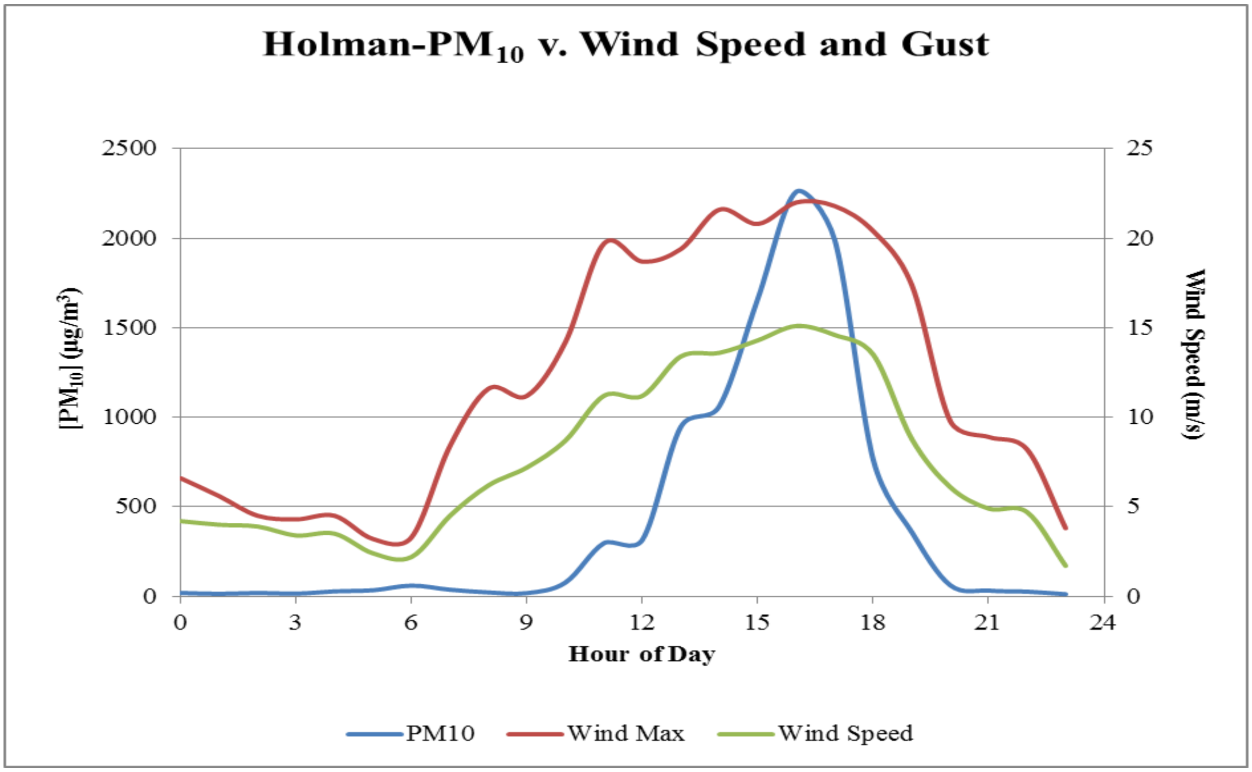

Figure 11-11f. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

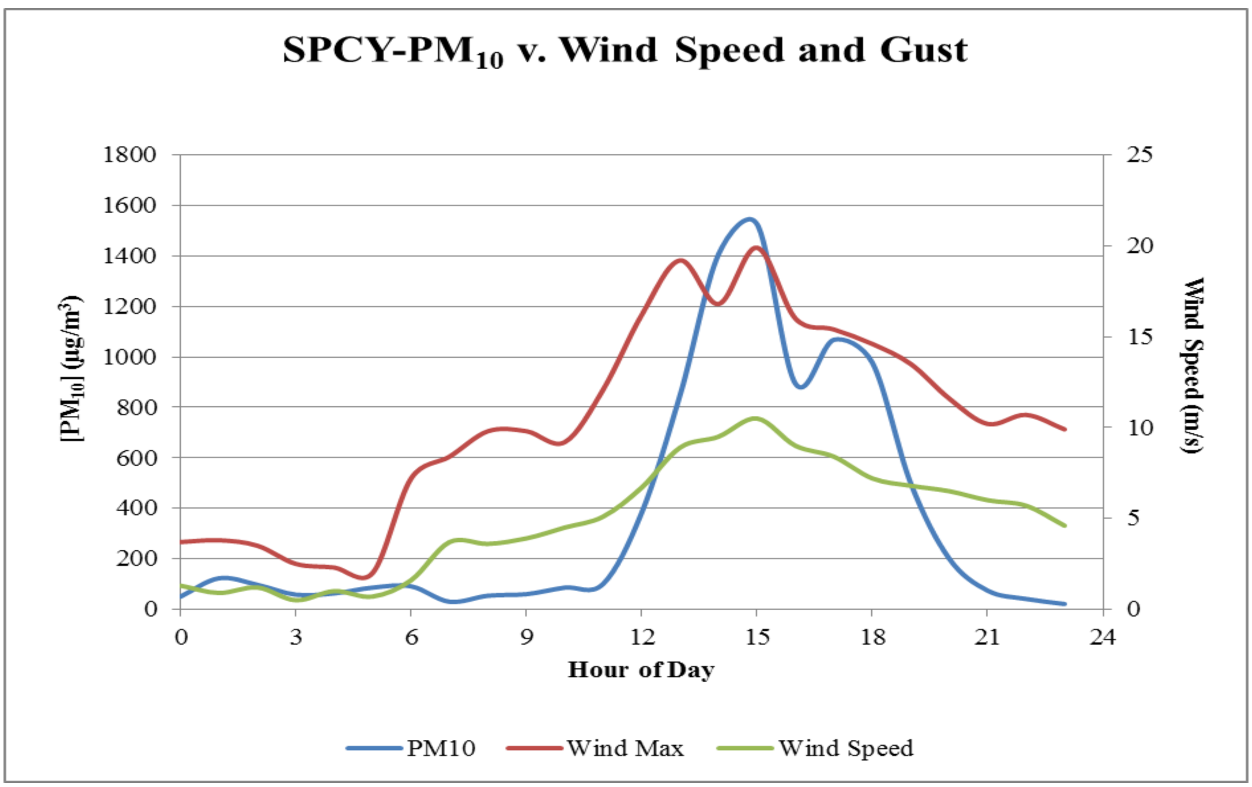

Figure 11-11g. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

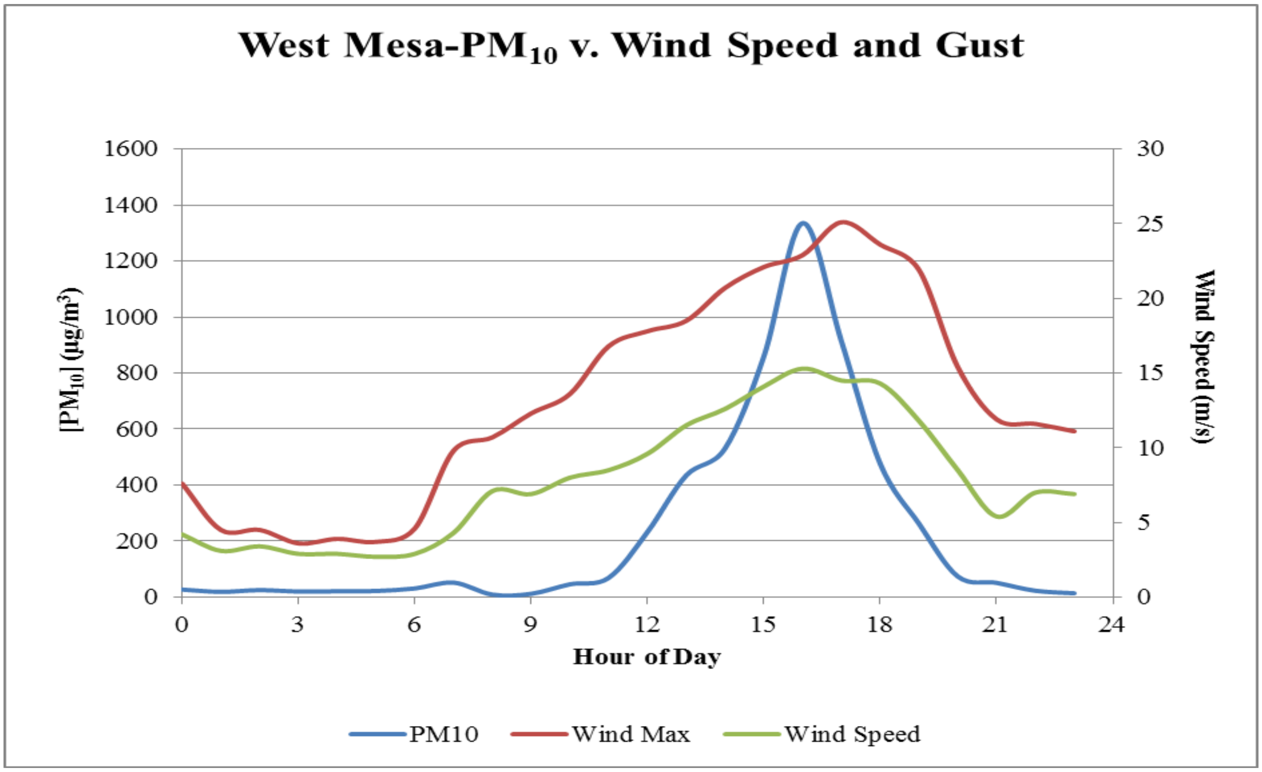

Figure 11-11h. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

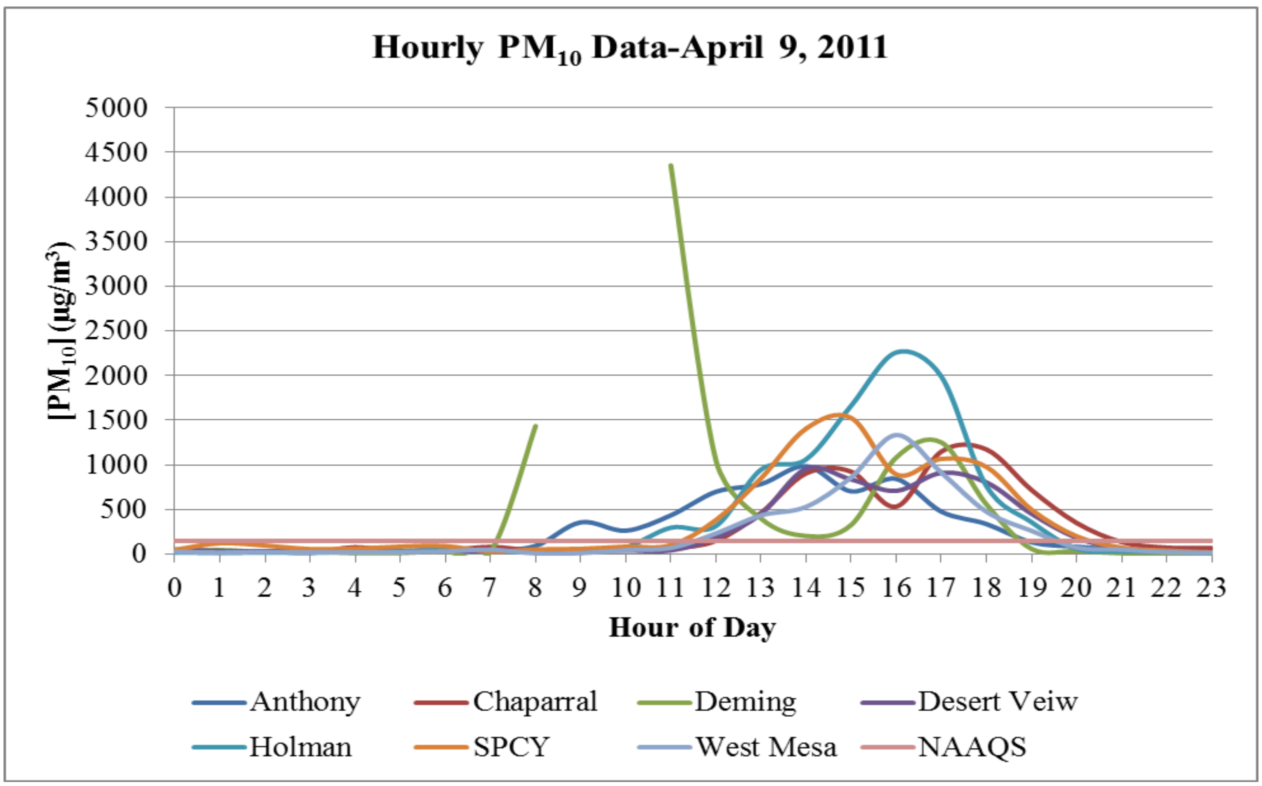

Figure 11-12a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

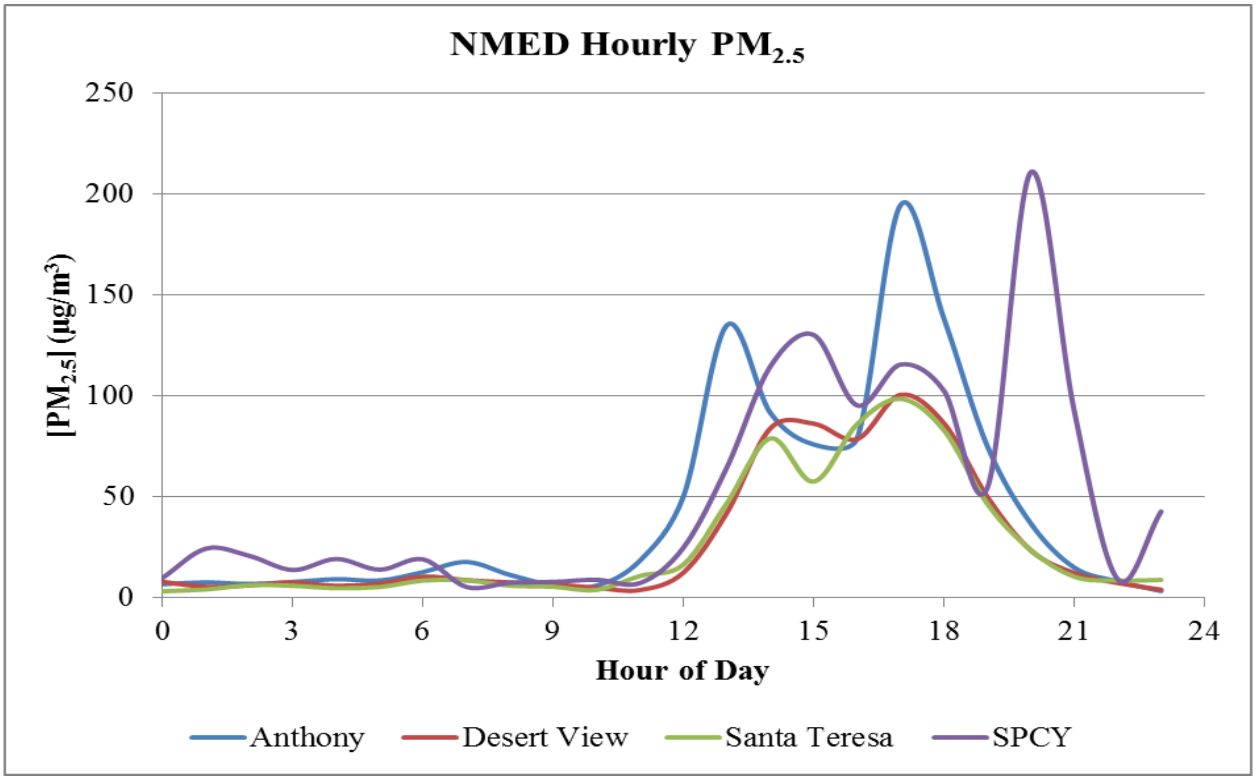

Figure 11-12b. Hourly $PM_{2.5}$ concentrations for Doña Ana and Luna Counties monitors. Non-FEM hourly $PM_{2.5}$ data.

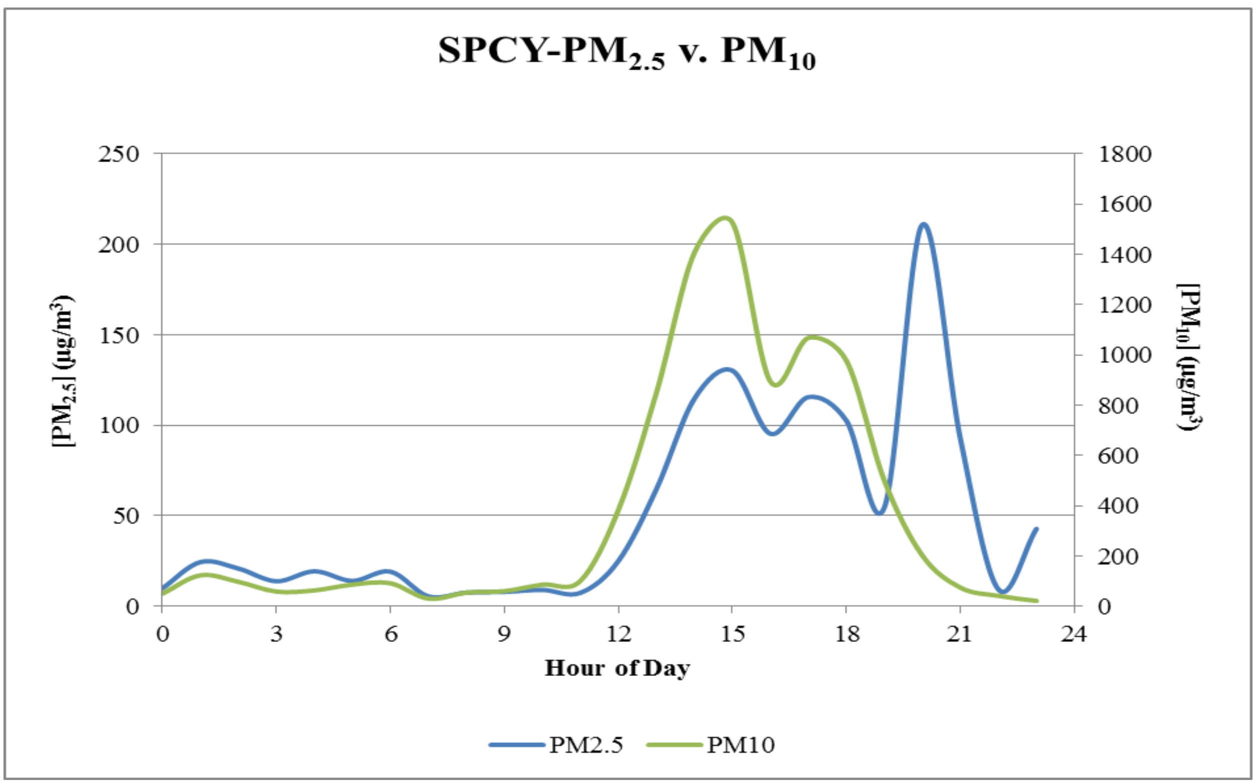

Figure 11-13. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on April 9, 2011.

The NAAPS optical depth model reflects the region-wide dust event that occurred on April 9, 2011 (DuBois, 2011) (Figure 11-14). Figure 11-15 shows that the aerosol optical depth thickness over New Mexico at 6:30 pm on April 9, 2011, varied from 0.4 to 1.0.

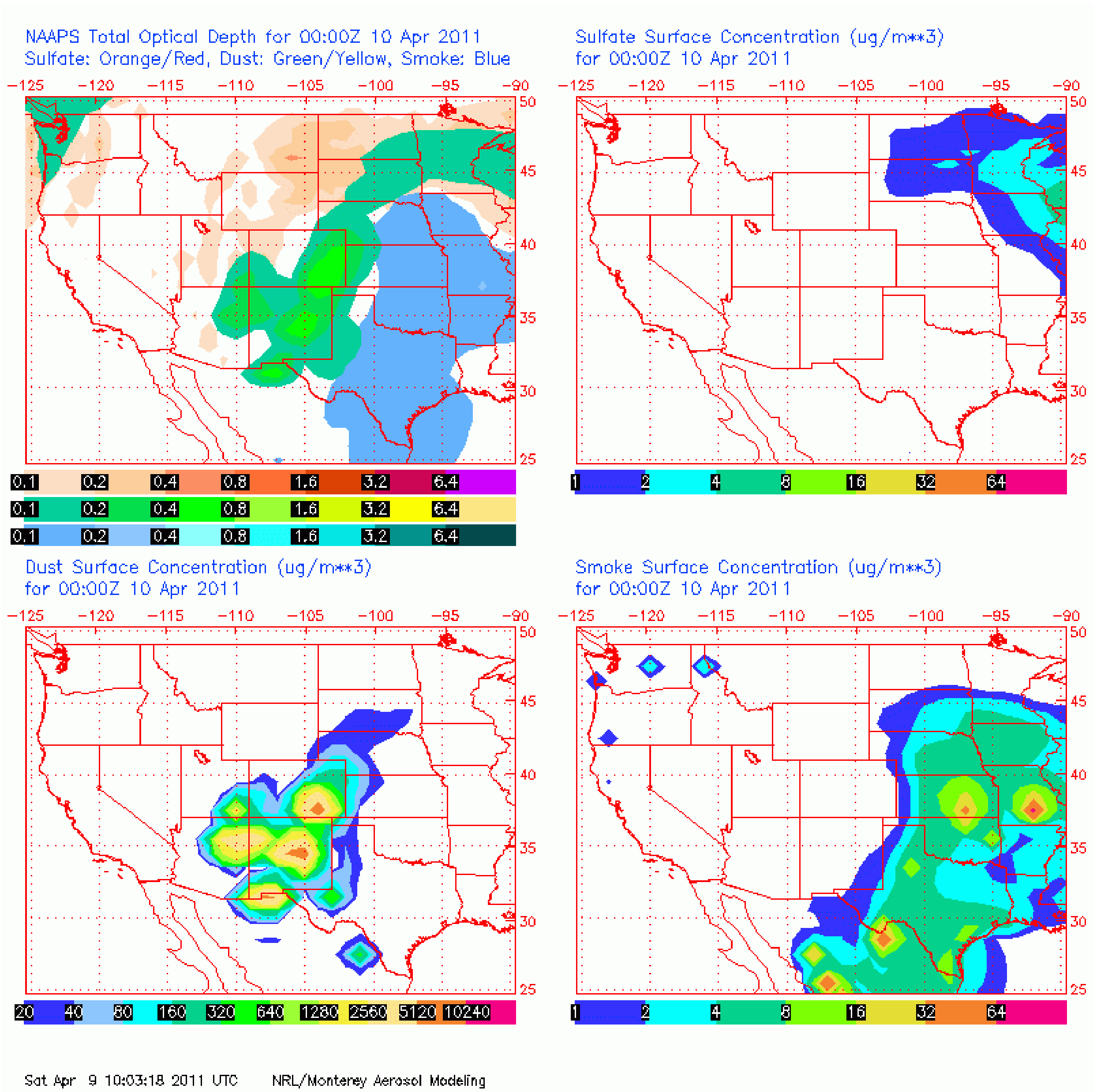

Figure 11-14. Optical Depth model for 6:00 PM MDT (Courtesy of NAAPS)

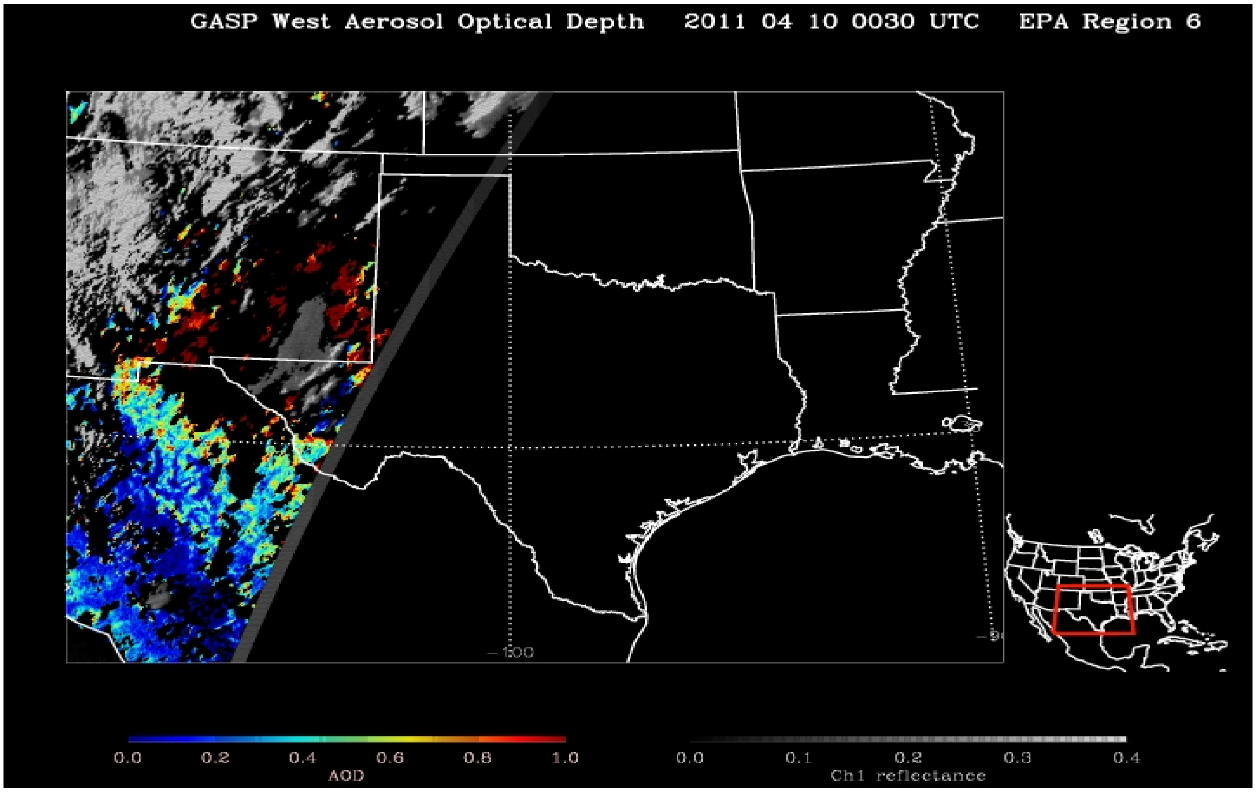

Figure 11-15. GOES West Aerosol Optical Depth model for 6:30 PM MDT (Courtesy of GASP)

11.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on April 9, 2011.

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 Anthony monitor detected blowing dust around the 1100 hour with hourly concentrations heavily impacted until the 1900 hour. The nine hourly PM_{10} values from 1100-1900 hours alone, exceed the 24-hour average standard at Anthony [(189 + 516 + 1250 + 868 + 669 + 686 + 1610 + 1066 + 677) µg/m^3 = 7531 µg/m^3; (7531 µg/m^3)/24 = 314 µg/m^3]. By replacing these nine hourly values with the 95th percentile of hourly data at the site, the resulting 24-hour average (93 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	54	54
1	60	60
2	50	50
3	49	49
4	50	50
5	48	48
6	70	70
7	104	104
8	67	67
9	36	36
10	41	41
11	189	**106**
12	516	**136**
13	1250	**146**
14	868	**177**
15	669	**172**
16	686	**152**
17	1610	**194**
18	1066	**197**
19	677	**185**
20	10	10
21	61	61
22	48	48
23	17	17
24-Hour Average	353	**93**

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 1200 hour with hourly concentrations heavily impacted until the 1900 hour. The ten hourly PM_{10} values from 1200-2100 hours alone, exceed the 24-hour average standard at Chaparral [(150 + 463 + 905 + 924 + 533 + 1149 + 1173 + 719 + 350 + 136) µg/m^3 = 6502 µg/m^3; (6502 µg/m^3)/24 = 271 µg/m^3]. By replacing these ten hourly values with the 95th percentile of hourly data at the site, the resulting 24-hour average (81 µg/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	26	26
1	23	23
2	35	35
3	17	17
4	79	79
5	29	29
6	43	43
7	82	82
8	40	40
9	41	41
10	51	51
11	65	65
12	150	**120**
13	463	**151**
14	905	**141**
15	924	**147**
16	533	**127**
17	1149	**122**
18	1173	**120**
19	719	**126**
20	350	**111**
21	136	**94**
22	74	74
23	68	68
24-Hour Average	298	**81**

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 800 hour with hourly concentrations heavily impacted until the 1900 hour. The nine hourly PM_{10} values from 800-1900 hours alone (900-1000 hour data missing), exceed the 24-hour average standard at Deming [(1435 + 4354 + 1051 + 400 + 204 + 328 + 1084 + 1252 + 558) µg/m^3 = 12101 µg/m^3; (12101 µg/m^3)/24 = 504 µg/m^3]. By replacing these nine hourly values with the 95th percentile of hourly data at the site, the resulting 24-hour average (50 µg/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	34	34
1	47	47
2	25	25
3	28	28
4	11	11
5	13	13
6	32	32
7	27	27
8	1435	**62**
9		60
10		60
11	4354	**62**
12	1051	**72**
13	400	**99**
14	204	**101**
15	328	**103**
16	1084	**107**
17	1252	**95**
18	558	**87**
19	60	60
20	35	35
21	10	10
22	0	0
23	-4	-4
24-Hour Average	499	**50**

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. The nine hourly PM_{10} values from 1200-2000 hours alone, exceed the 24-hour average standard at Desert View [(184 + 450 + 956 + 837 + 710 + 911 + 804 + 453 + 183) $\mu g/m^3$ = 5488 $\mu g/m^3$; (5488 $\mu g/m^3$)/24 = 229 $\mu g/m^3$]. By replacing these nine hourly values with the 95th percentile of hourly data at the site, the resulting 24-hour average (69 $\mu g/m^3$) 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	52	52
1	36	36
2	35	35
3	32	32
4	22	22
5	28	28
6	35	35
7	35	35
8	40	40
9	35	35
10	42	42
11	42	42
12	184	**94**
13	450	**91**
14	956	**106**
15	837	**119**
16	710	**124**
17	911	**158**
18	804	**137**
19	453	**149**
20	183	**116**
21	61	61
22	44	44
23	24	24
24-Hour Average	252	**69**

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 1000 hour with hourly concentrations heavily impacted until the 1900 hour. The ten hourly PM_{10} values from 1000-1900 hours alone, exceed the 24-hour average standard at Holman [(77 + 297 + 316 + 947 + 1062 + 1663 + 2260 + 1990 + 762 + 359) $\mu g/m^3$ = 9733 $\mu g/m^3$; (9733 $\mu g/m^3$)/24 = 406 $\mu g/m^3$]. By replacing these ten hourly values with the 95th percentile of hourly data at the site, the resulting 24-hour average (62 $\mu g/m^3$) 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	19	19
1	14	14
2	19	19
3	15	15
4	28	28
5	34	34
6	60	60
7	37	37
8	22	22
9	18	18
10	77	**42**
11	297	**42**
12	316	**94**
13	947	**91**
14	1062	**106**
15	1663	**119**
16	2260	**124**
17	1990	**158**
18	762	**137**
19	359	**149**
20	62	62
21	32	32
22	26	26
23	12	12
24-Hour Average	422	**62**

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. The nine hourly PM_{10} values from 1100-1900 hours alone, exceed the 24-hour average standard at SPCY [(101 + 383 + 849 + 1407 + 1526 + 894 + 1068 + 977 + 499) µg/m^3 = 7405 µg/m^3; (7405 µg/m^3)/24 = 309 µg/m^3]. By replacing these nine hourly values with the 95th percentile of hourly data at the site, the resulting 24-hour average (113 µg/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	50	50
1	123	123
2	97	97
3	58	58
4	63	63
5	86	86
6	91	91
7	30	30
8	54	54
9	60	60
10	86	86
11	101	**95**
12	383	**104**
13	849	**125**
14	1407	**145**
15	1526	**160**
16	894	**168**
17	1068	**201**
18	977	**296**
19	499	**284**
20	201	201
21	74	74
22	41	41
23	21	21
24-Hour Average	368	**113**

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 1100 hour with hourly concentrations heavily impacted until the 1900 hour. The nine hourly PM_{10} values from 1100-1900 hours alone, exceed the 24-hour average standard at West Mesa [(69 + 233 + 435 + 531 + 860 + 1335 + 914 + 476 + 262) µg/m^3 = 5115 µg/m^3; (5115 µg/m^3)/24 = 213 µg/m^3]. By replacing these nine hourly values with the 95th percentile of hourly data at the site, the resulting 24-hour average (40 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	27	27
1	19	19
2	25	25
3	20	20
4	21	21
5	22	22
6	31	31
7	52	52
8	9	9
9	12	12
10	46	46
11	69	**50**
12	233	**47**
13	435	**51**
14	531	**60**
15	860	**69**
16	1335	**65**
17	914	**63**
18	476	**59**
19	262	**53**
20	74	74
21	51	51
22	23	23
23	14	14
24-Hour Average	231	**40**

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 14, 2011

12.1 Summary of Event

The passing of a Pacific 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 and SPCY monitoring sites on this date. The FEM TEOM continuous monitors at these sites recorded 24-hour average concentrations of 160 $\mu g/m^3$ and 269 $\mu g/m^3$, respectively. The Partisol monitor at SPCY recorded a 24-hour average concentration of 38.2 $\mu g/m^3$. In accordance with the EER, the AQB flagged this data on EPA's AQS database as a high wind natural event. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured at Chaparral (99 $\mu g/m^3$) and Deming Airport (88 $\mu g/m^3$) (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).

As the event unfolded, the wind blew from the northwesterly direction 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.

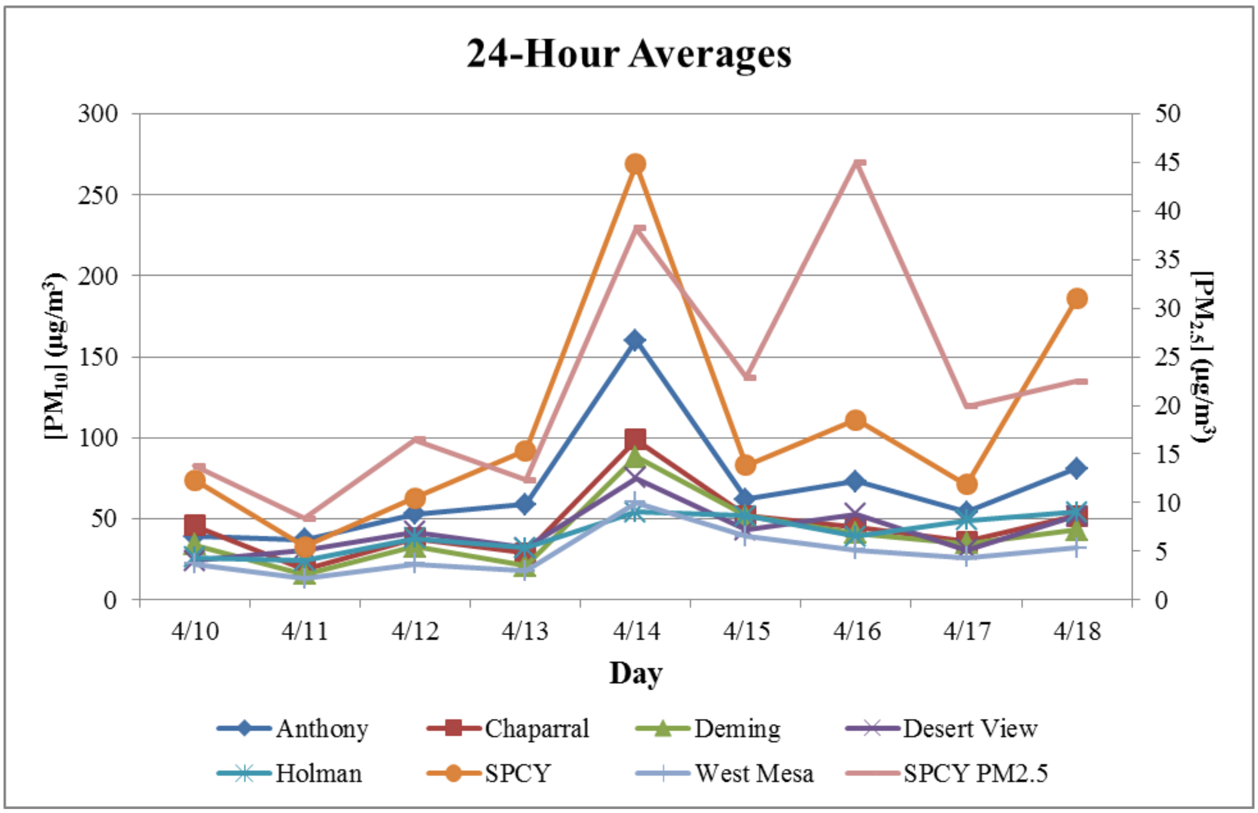

Figure 12-1. PM_{10} and $PM_{2.5}$ 24-hour averages before and after April 14, 2011.

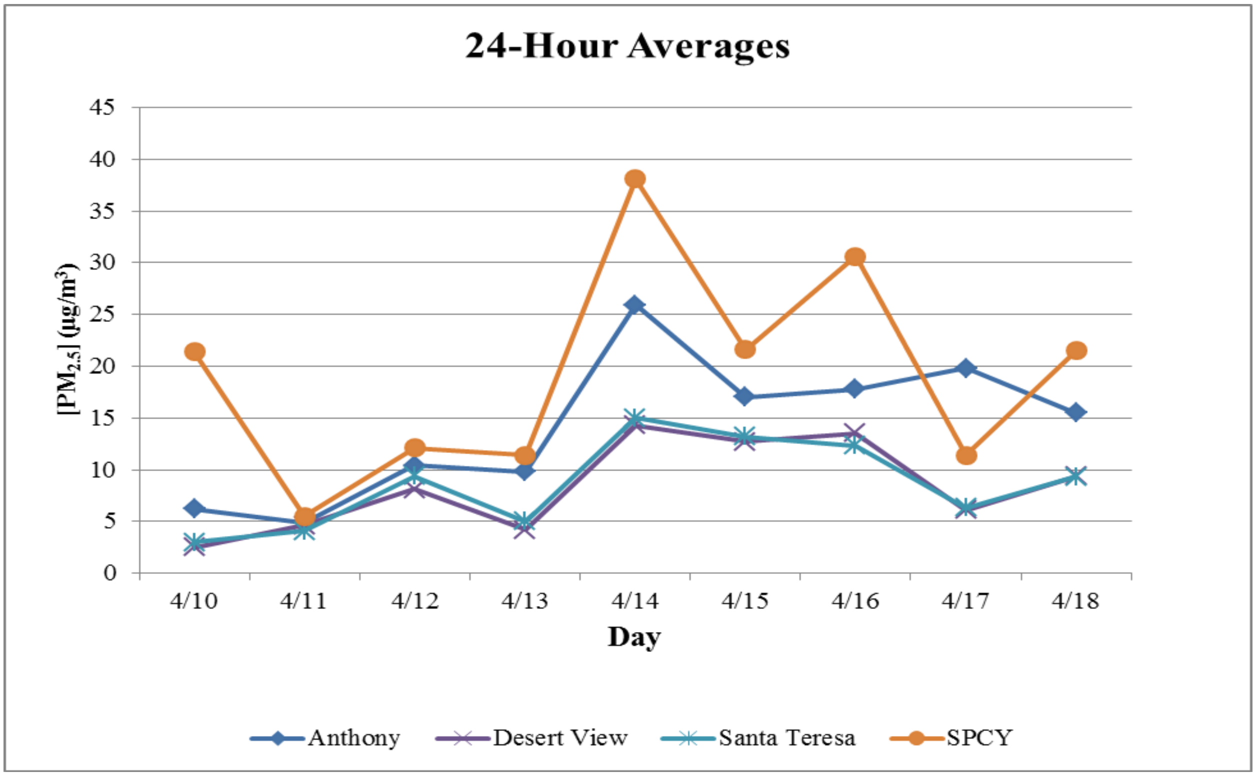

Figure 12-2. $PM_{2.5}$ 24-hour averages before and after April 14, 2011. Non-FEM TEOM Data.

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 Arizona and New Mexico. Doña Ana County Ordinance requires BACM for any dust producing activities. The largest and most likely sources of windblown dust are the natural desert, playas, and sand dunes in Arizona and New 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 14, 2011, sustained wind speeds exceeded EPA's default threshold at two of the seven monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at three of the seven monitoring sites (Figures 12-3 and 12-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 0900 hour and ending at the 1500 hour.

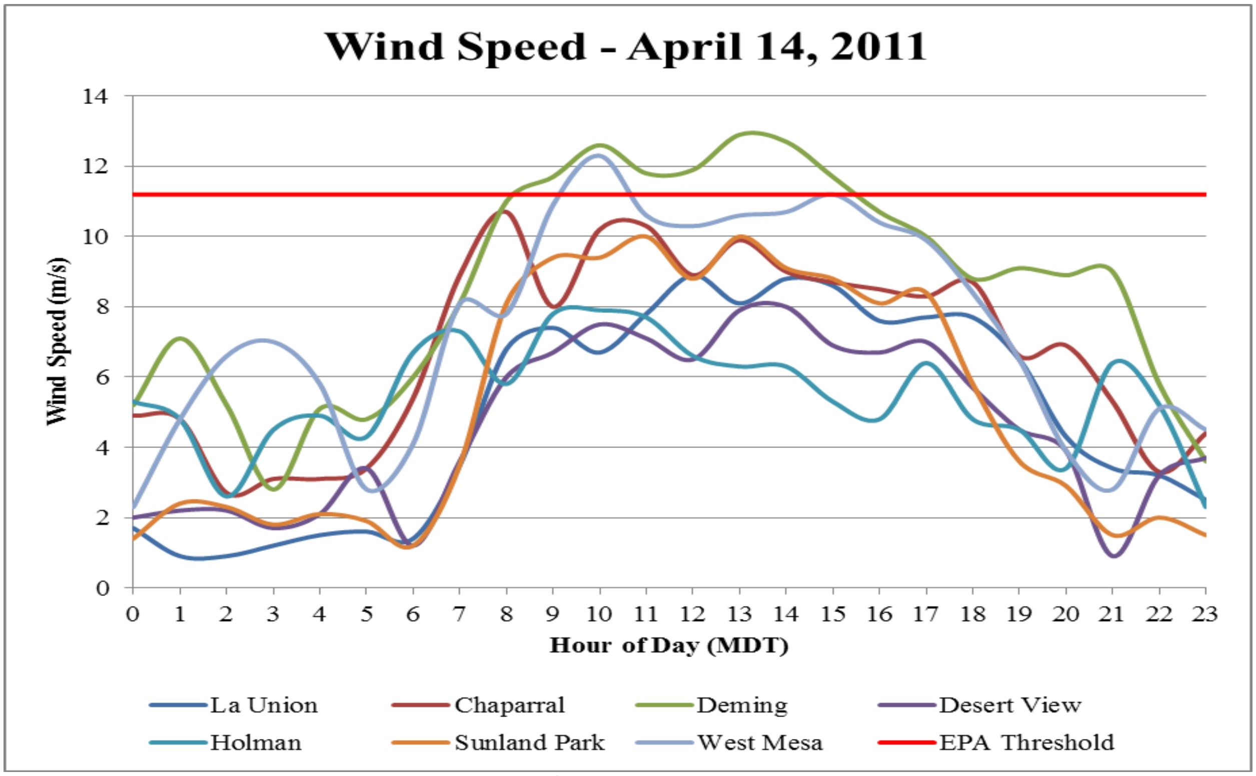

Figure 12-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

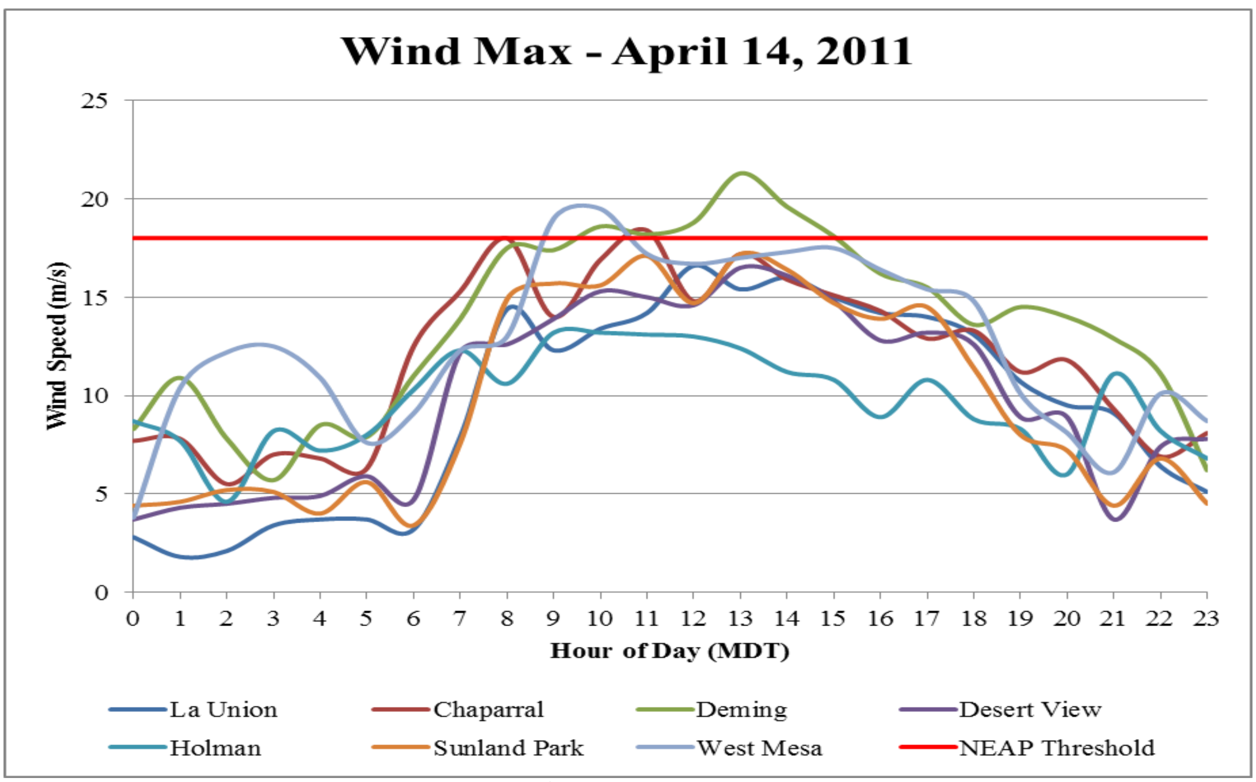

Figure 12-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

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 2006-2010 the PM_{10} FEM TEOM monitors recorded 211 exceedances and the PM_{10} FRM Wedding monitors recorded 5 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 (Table 2-1). The SPCY $PM_{2.5}$ FRM Partisol recorded 23 exceedances of the 24-Hour NAAQS from 2006-2010 (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 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 Arizona. The southern 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 12-5). 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.

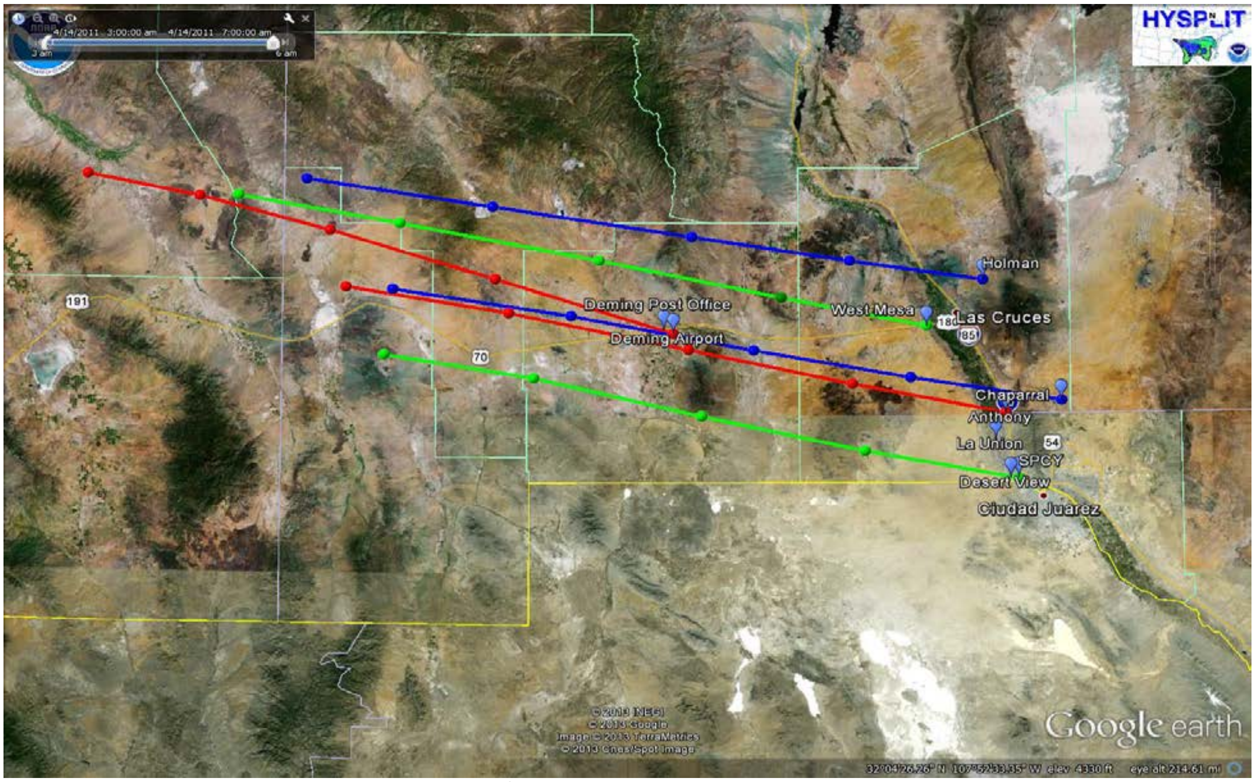

Figure 12-5. HYSPLIT back-trajectory model analysis for April 14, 2011.

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-4 through B-11). 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 2006-2010 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 2006-2010. 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 2006-2010. The recorded values for this day (Anthony: 160 µg/m^3 and Sunland Park: 269 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, 2011 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-c through 12-8a-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.

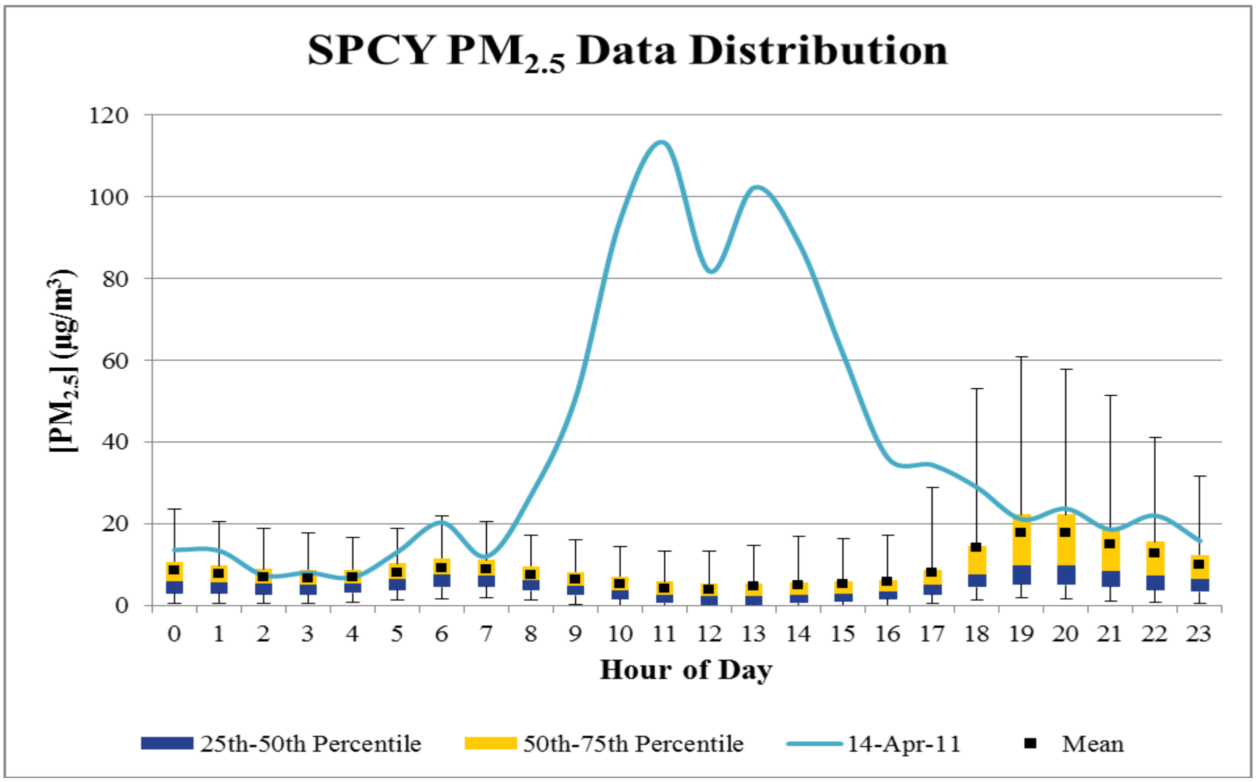

Figure 12-6a. $PM_{2.5}$ hourly data distribution from 2006-2010 overlaid by hourly values for April 14, 2011.

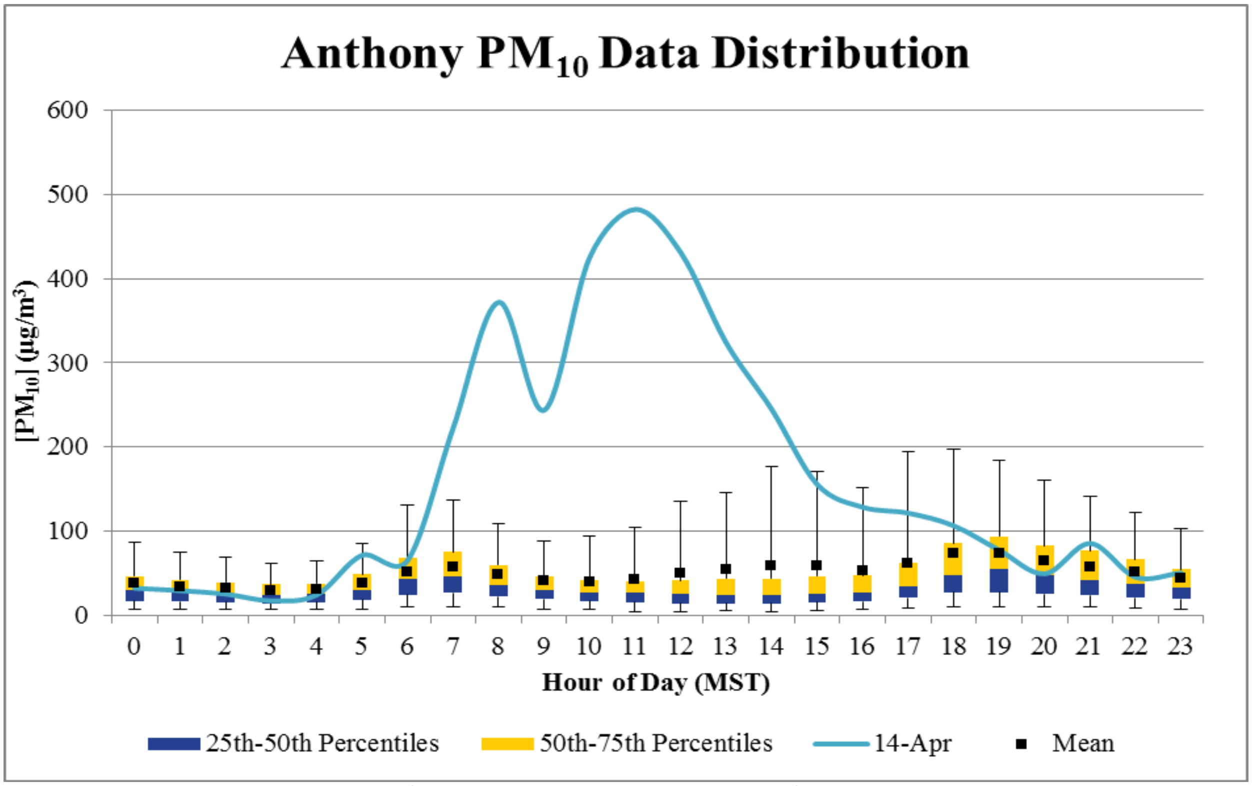

Figure 12-6b. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 14, 2011.

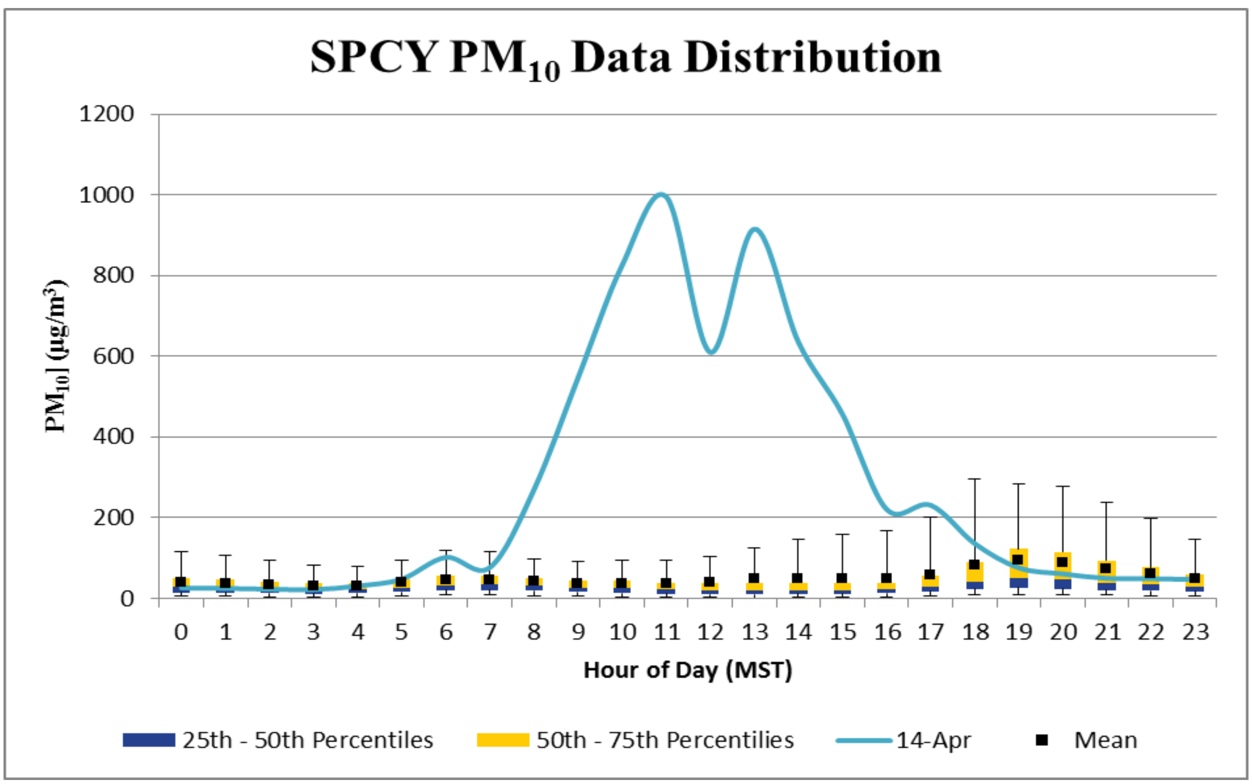

Figure 12-6c. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 14, 2011.

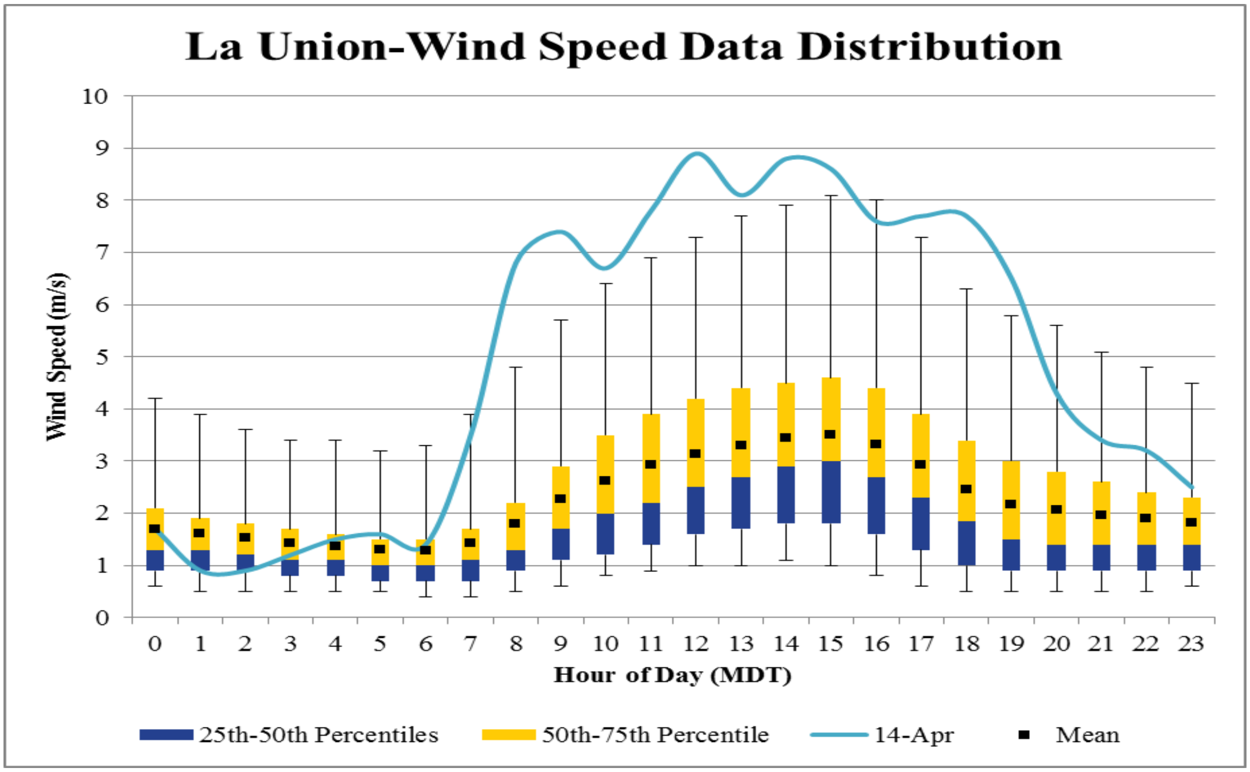

Figure 12-7a. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 14, 2011.

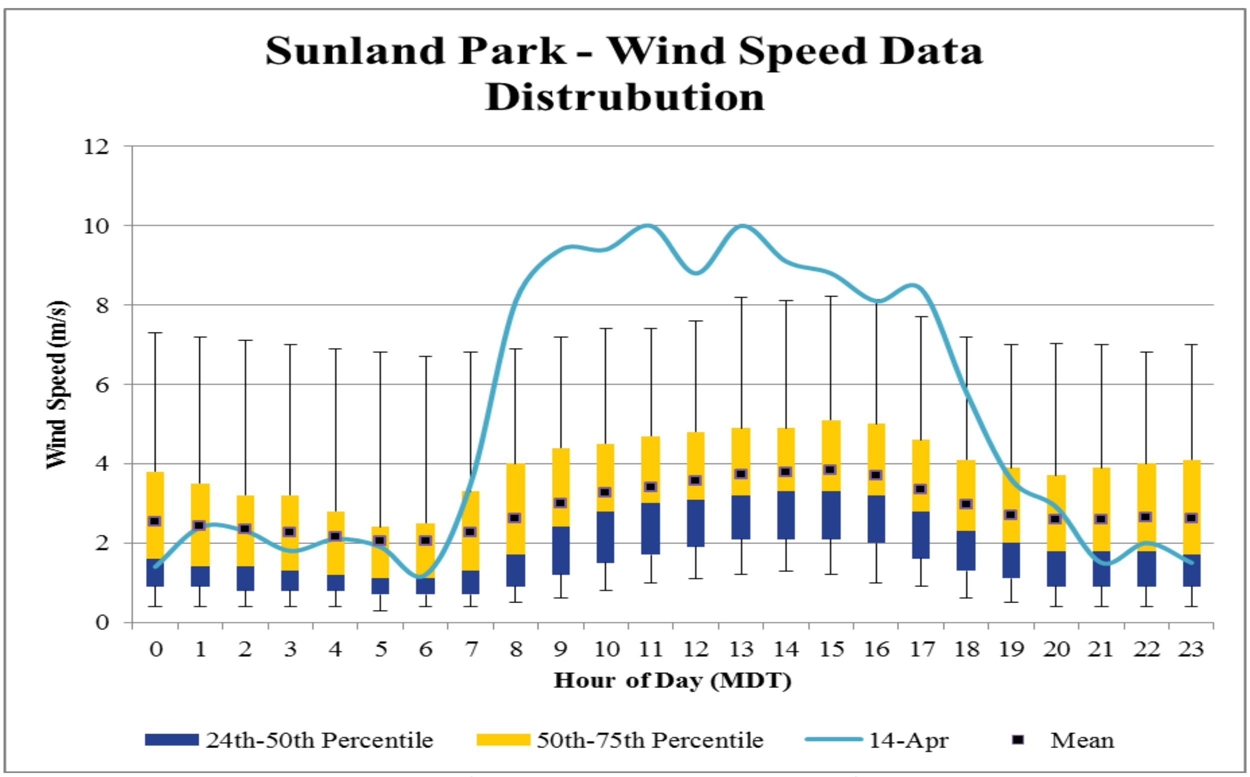

Figure 12-7b. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 14, 2011.

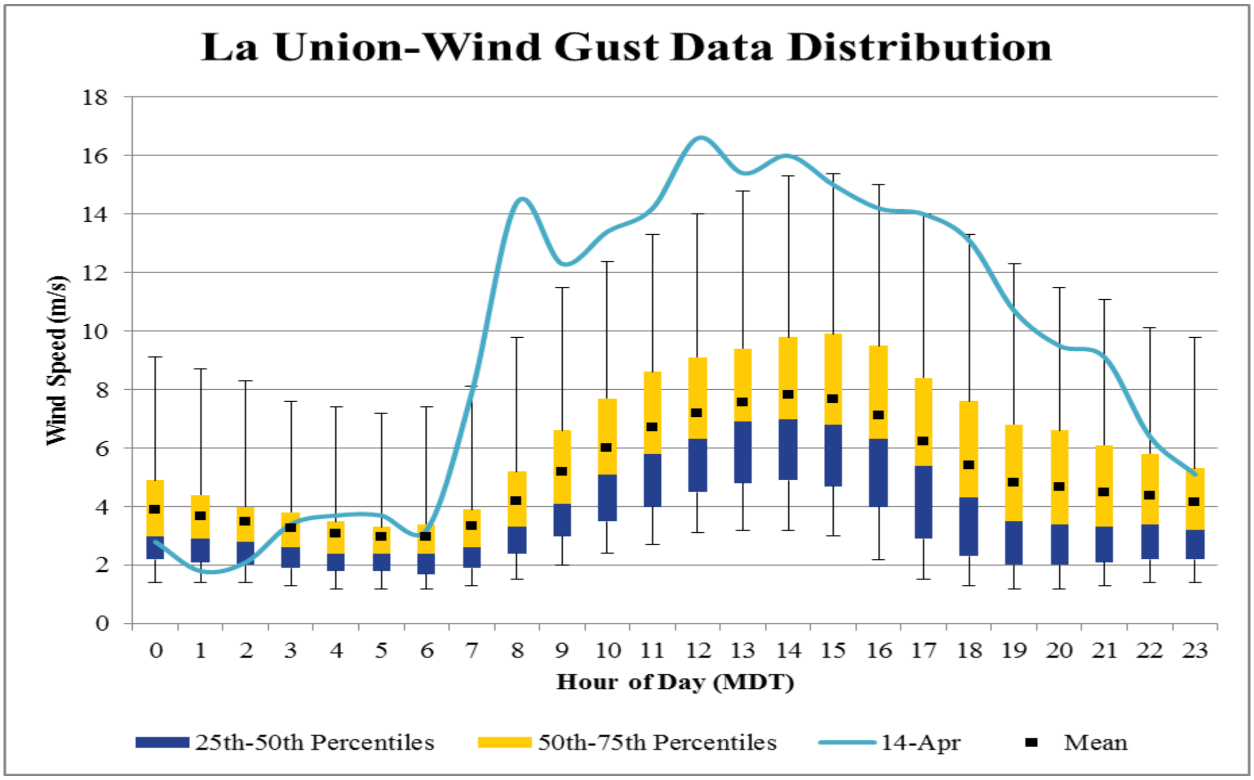

Figure 12-8a. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 14, 2011.

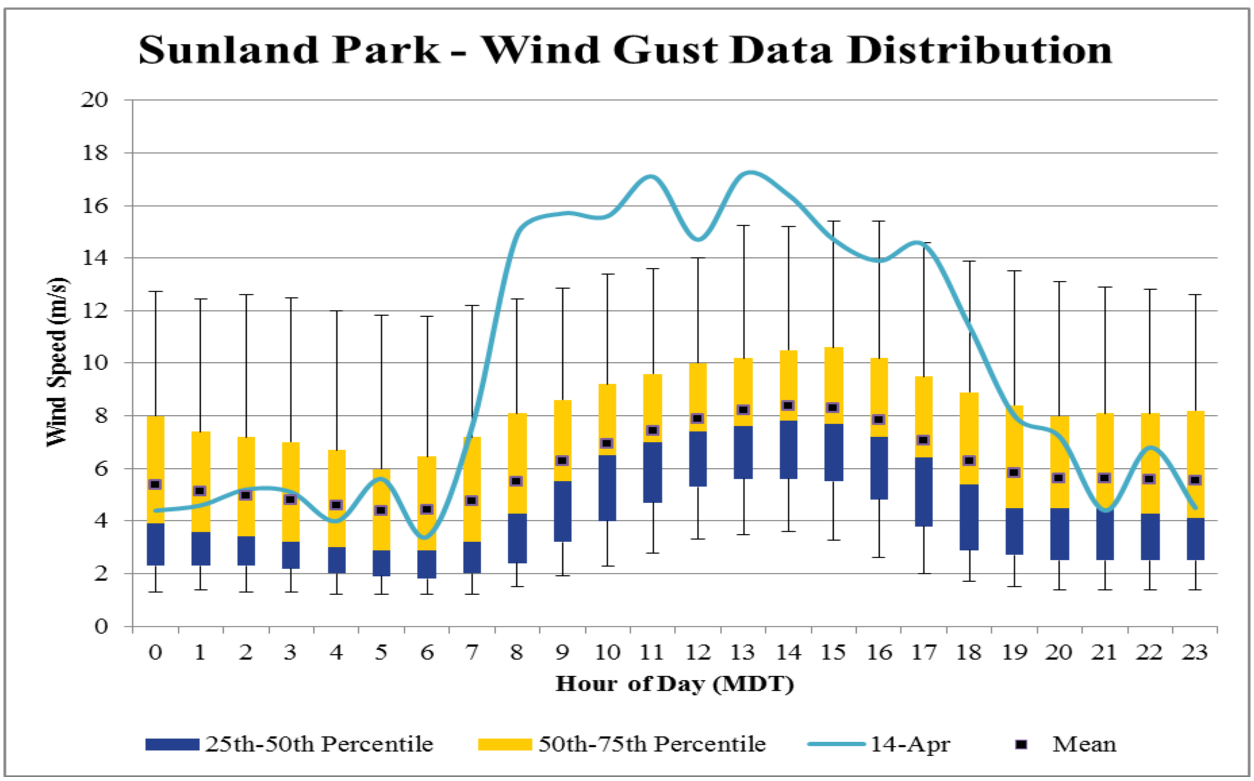

Figure 12-8b. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 14, 2011.

12.4 Clear Causal Relationship

A Pacific cold front arrived in the early morning hours on April 14, 2011 pushing through New Mexico during the mid-morning into the early evening hours. The front created a low pressure gradient over most of the southwest U.S. and northern Mexico. As the front moved through New Mexico, the pressure gradient tightened and winds became even stronger at the surface (Figure 12-9). Surface winds flow perpendicular to the isobars from high to low pressure. The wind direction in the upper atmosphere aligned with the surface wind direction (Figure 12-10). 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.

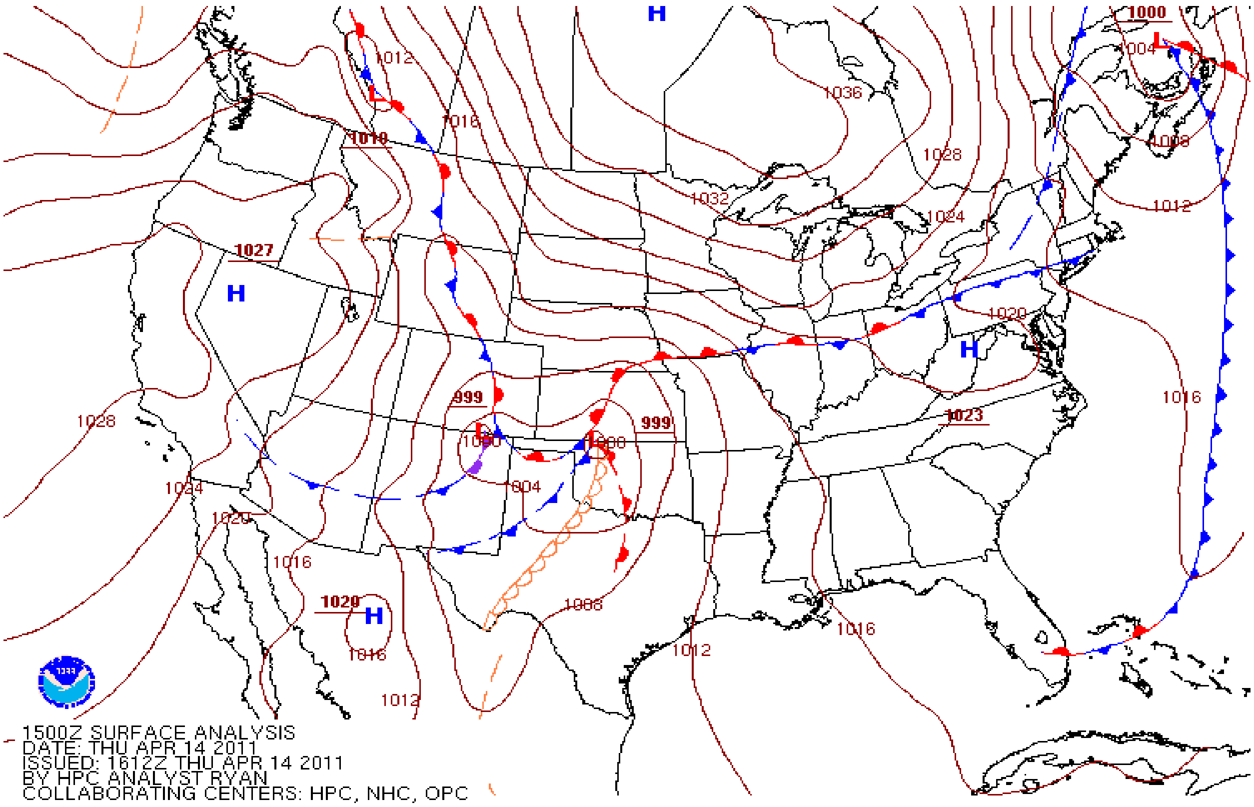

Figure 12-9. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 14, 2011 at the 0900hour.

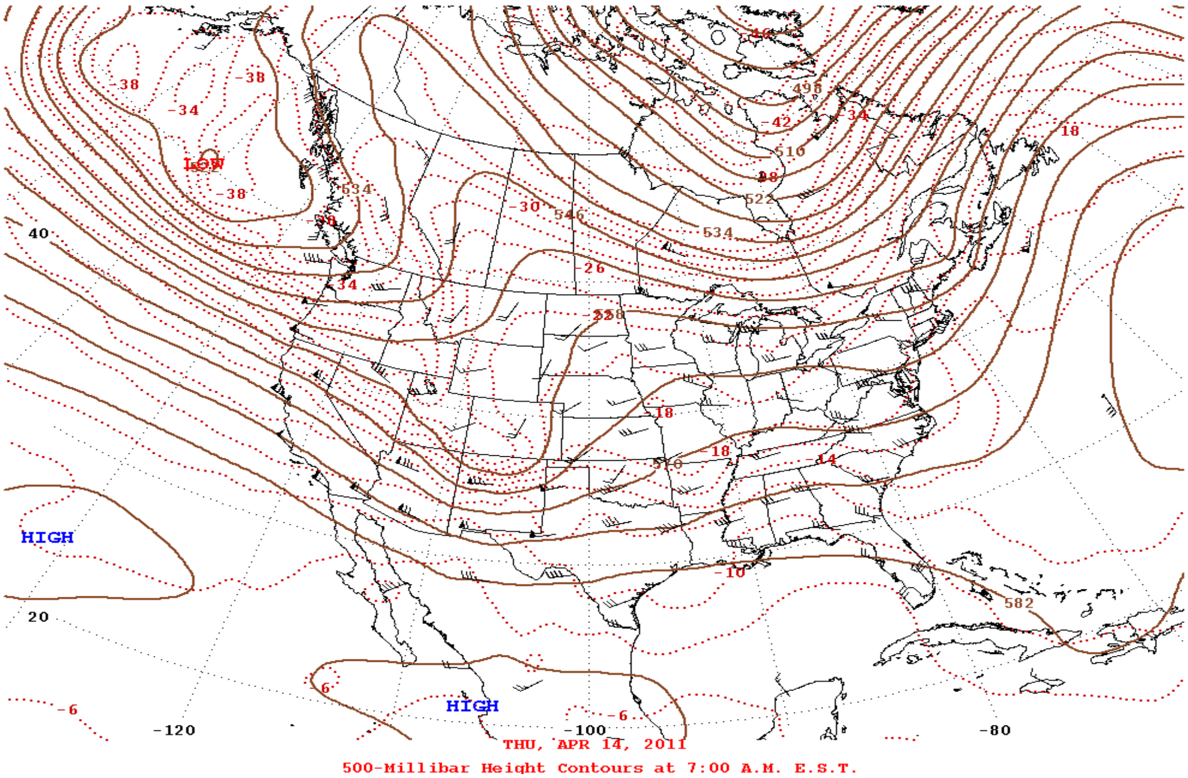

Figure 12-10. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on April 14, 2011.

The weather pattern described above generated strong northwesterly winds beginning at the 0800 hour and lasting through the 1700 hour. Beginning at the 0900 hour, wind speeds exceeded 11.2 m/s at the Deming Airport as shown in Figure 12-3. Peak wind speeds ranged from 7.5 m/s at Desert View to 12.9 m/s at the Deming Airport (Figure 12-3). Peak wind gusts ranged from 13.2 m/s at Holman to 21.3 m/s at the Deming Airport (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-h. As wind speed and wind gusts exceed the 95^{th} 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 12-12a-b). Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 12-13).

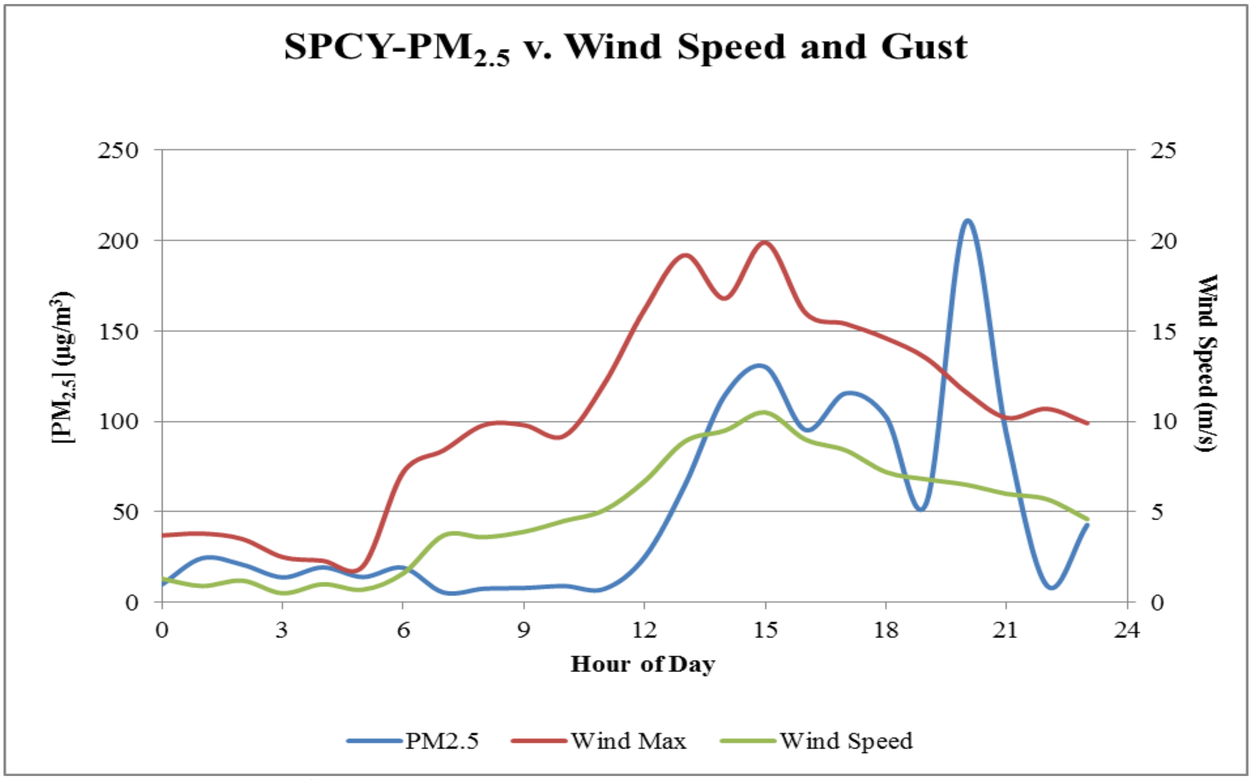

Figure 12-11a. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

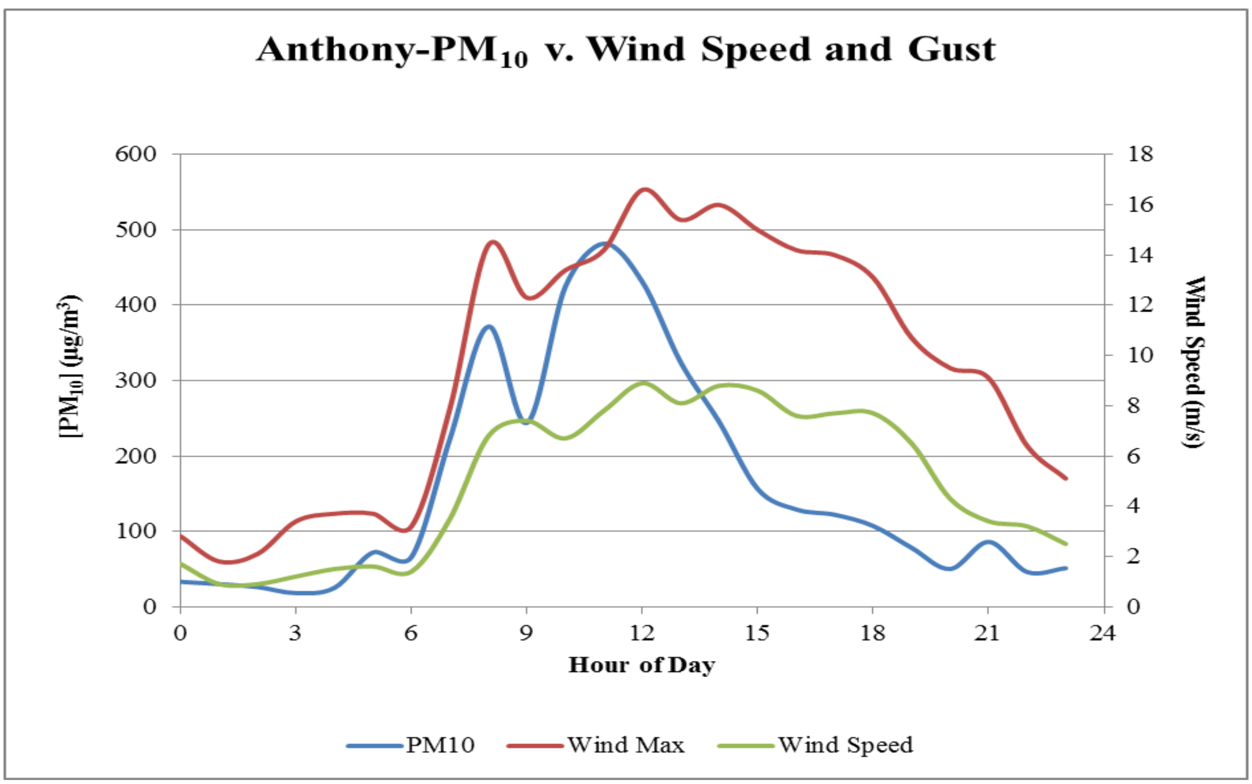

Figure 12-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

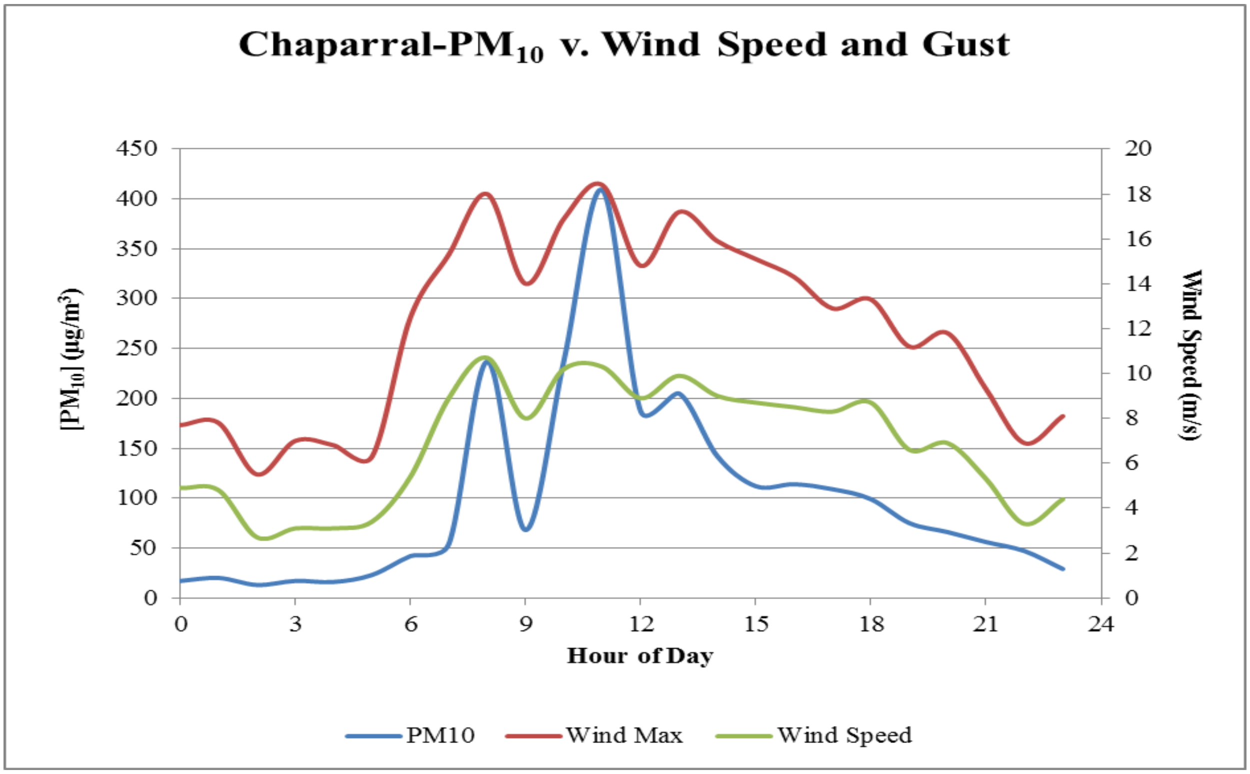

Figure 12-11c. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

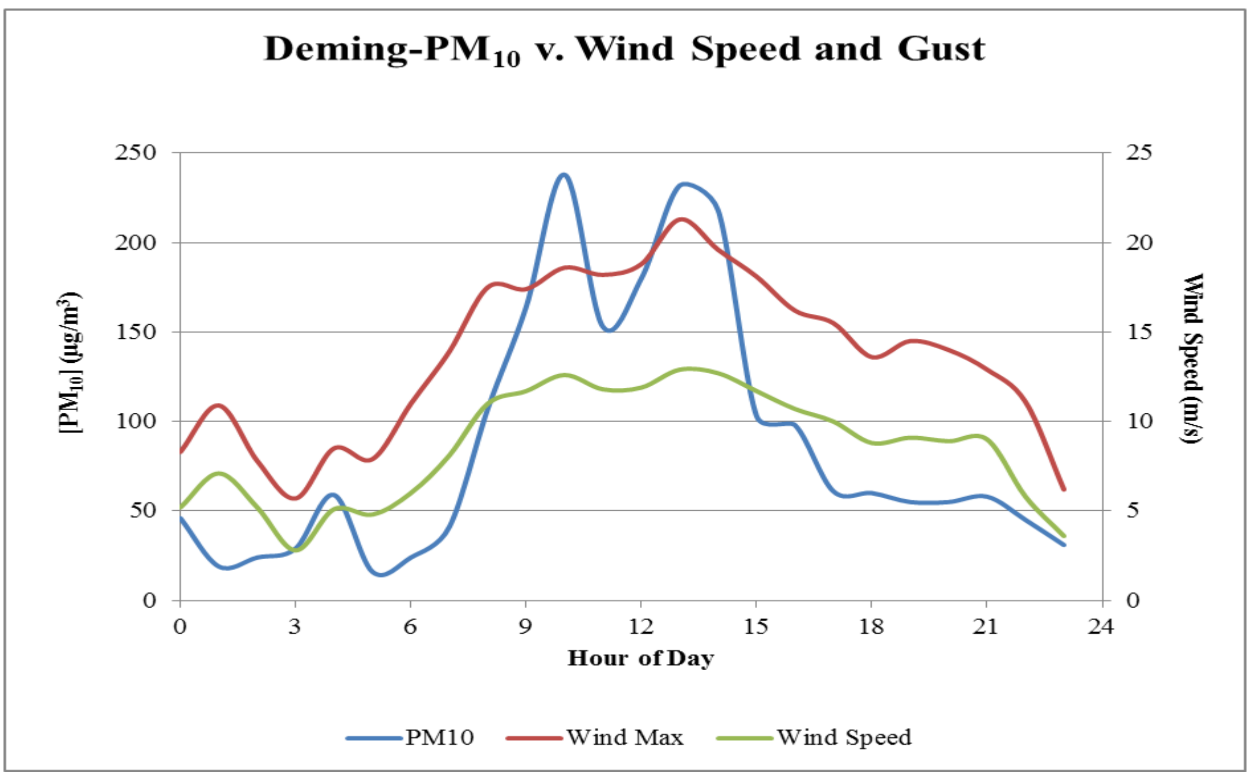

Figure 12-11d. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

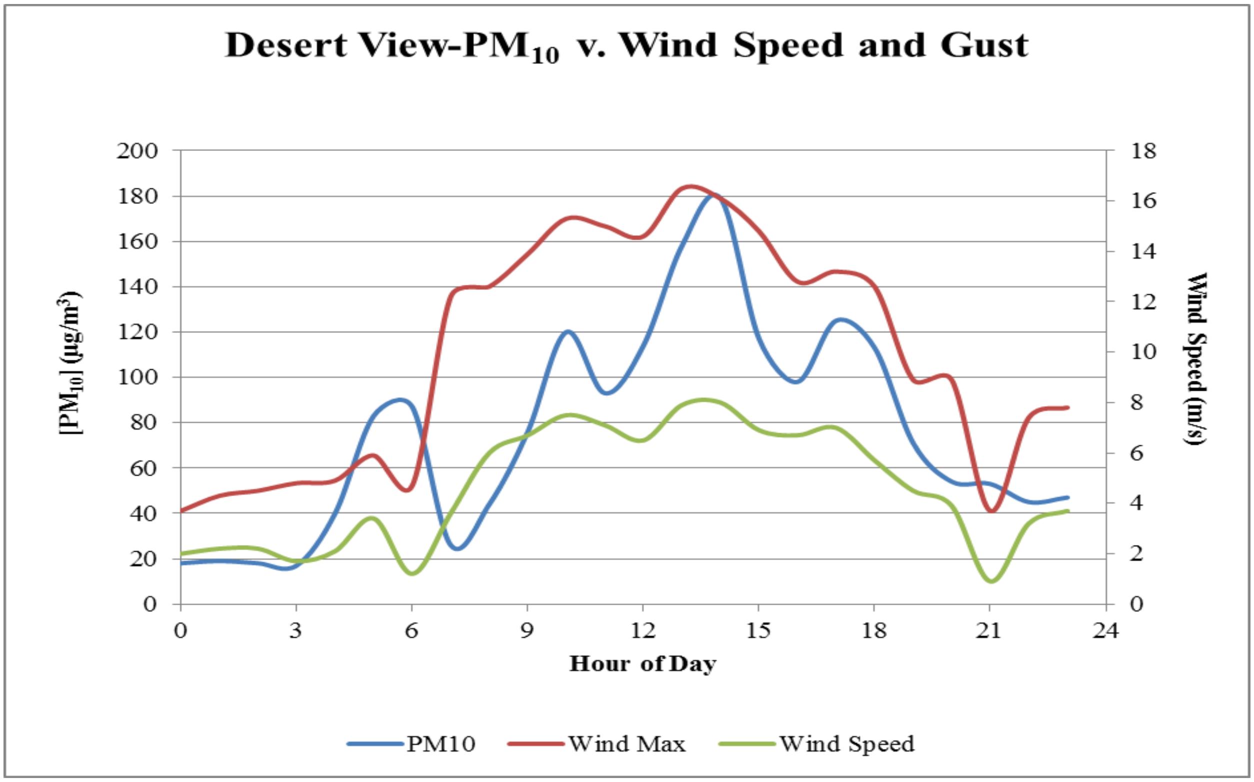

Figure 12-11e. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

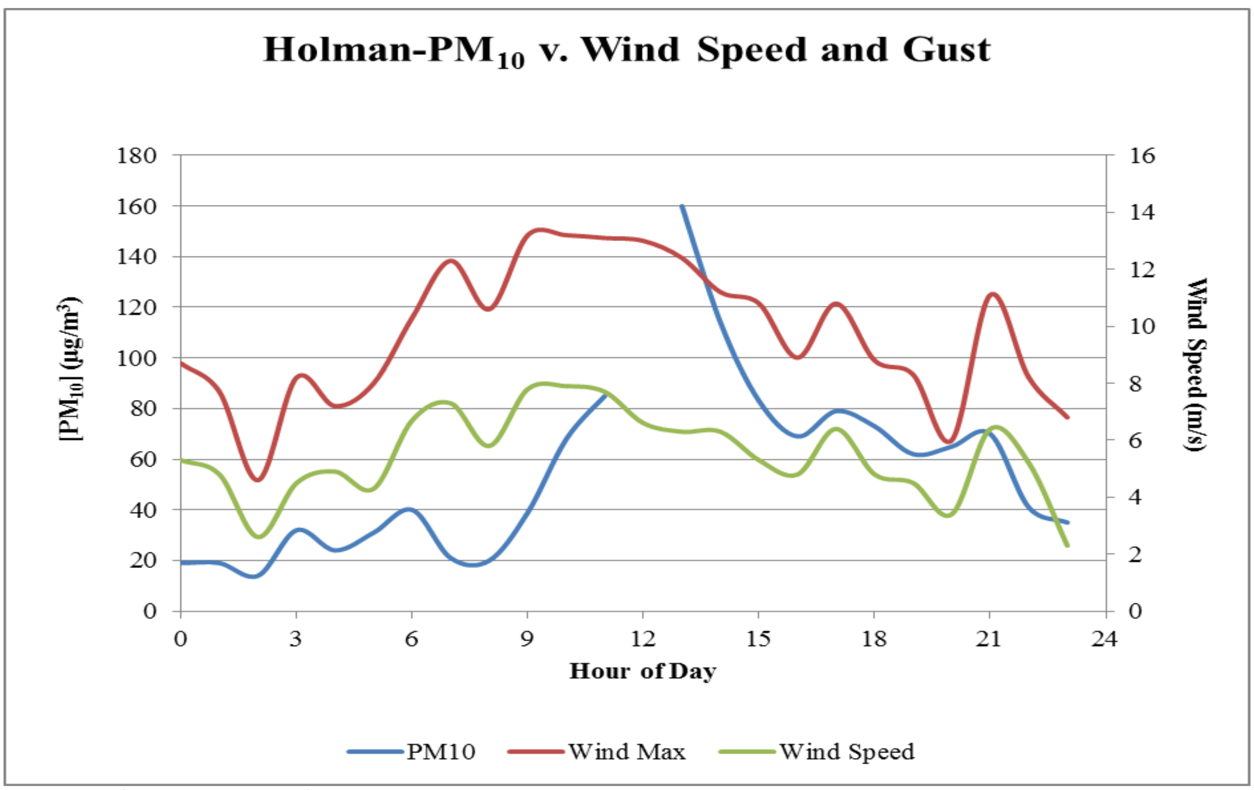

Figure 12-11f. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

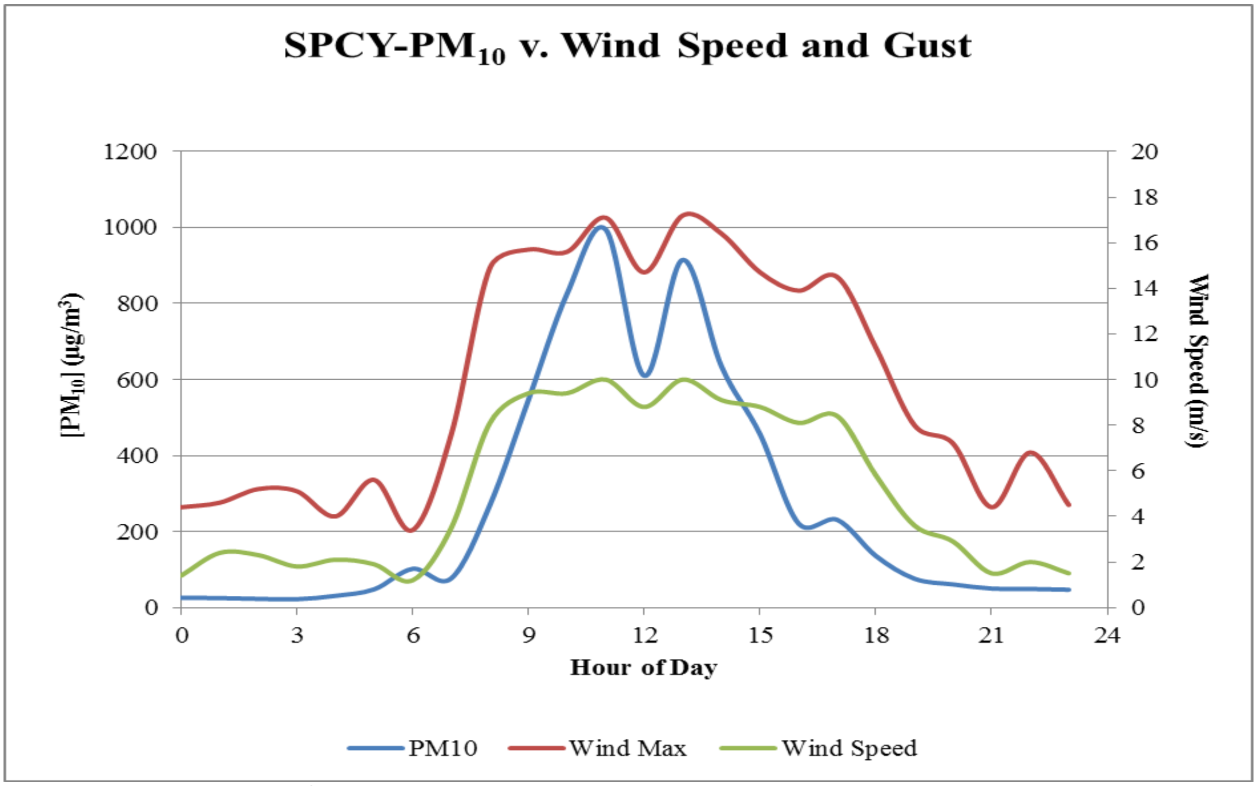

Figure 12-11g. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

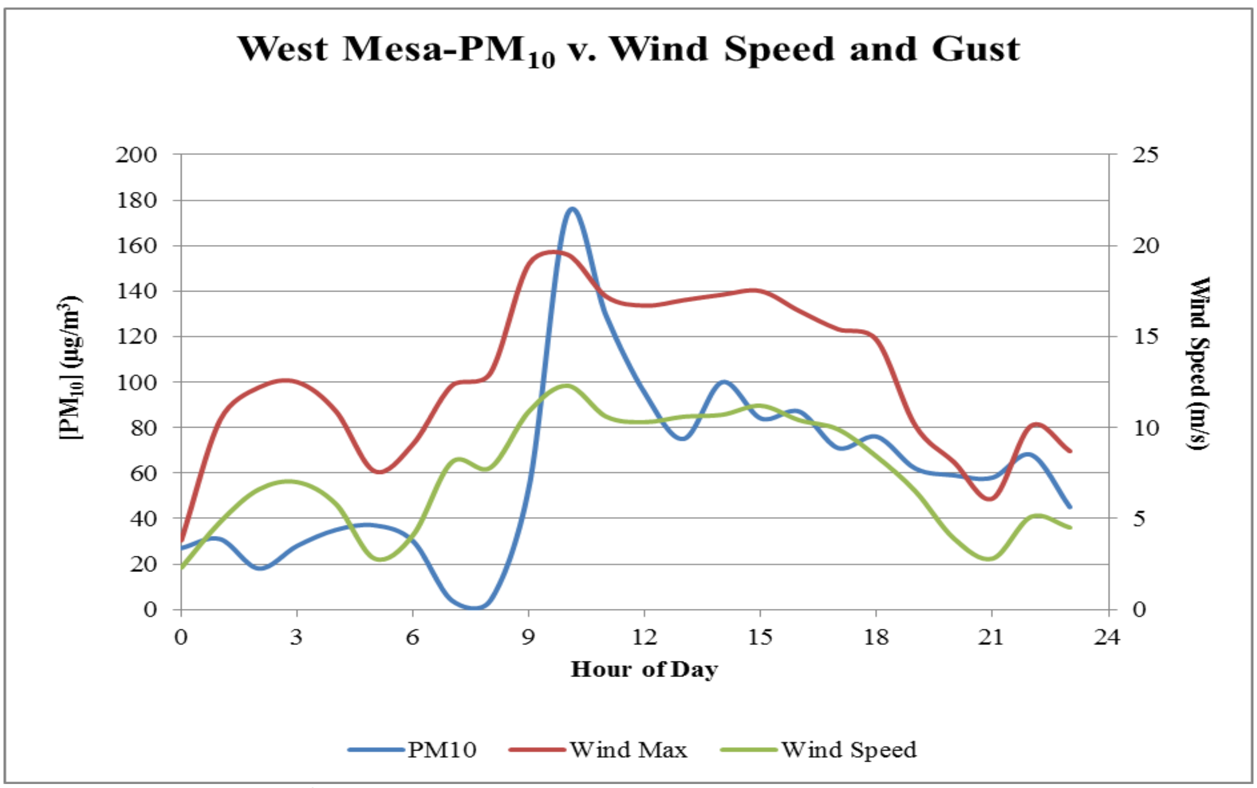

Figure 12-11h. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

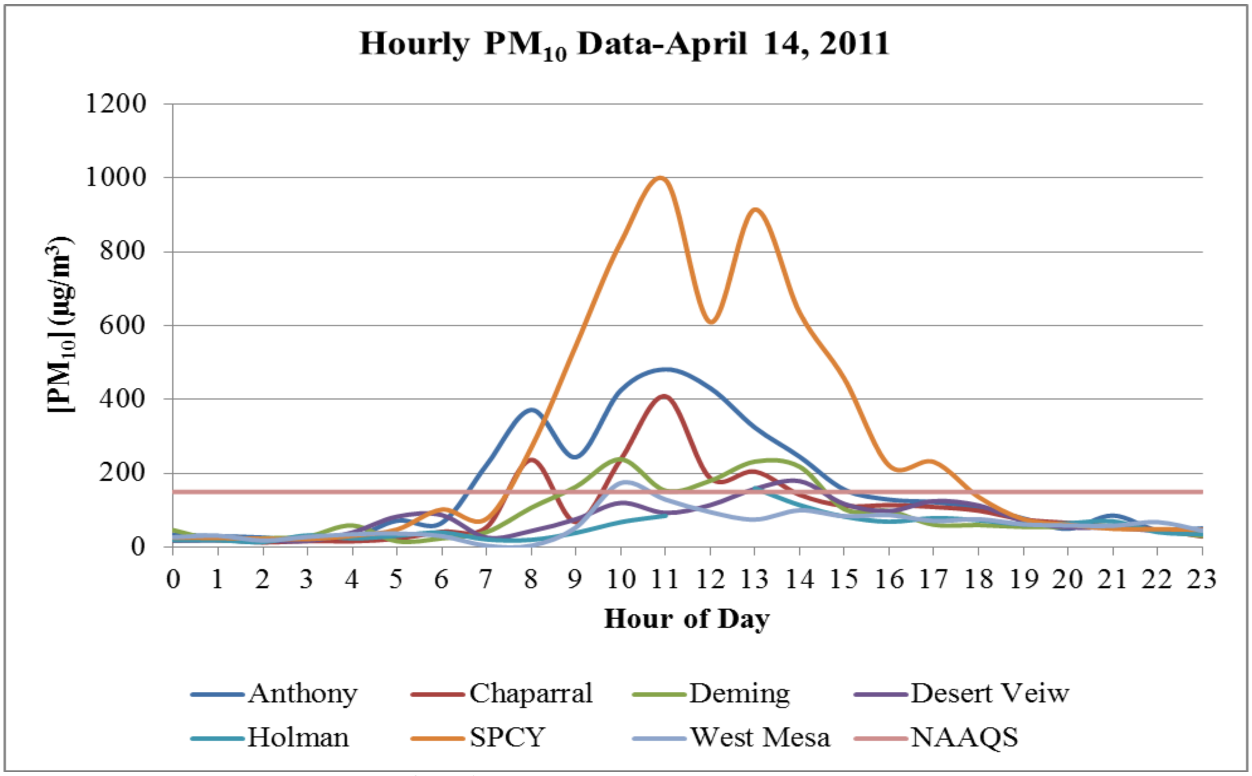

Figure 12-12a. Hourly $PM_{2.5}$ concentrations for Doña Ana and Luna Counties monitors.

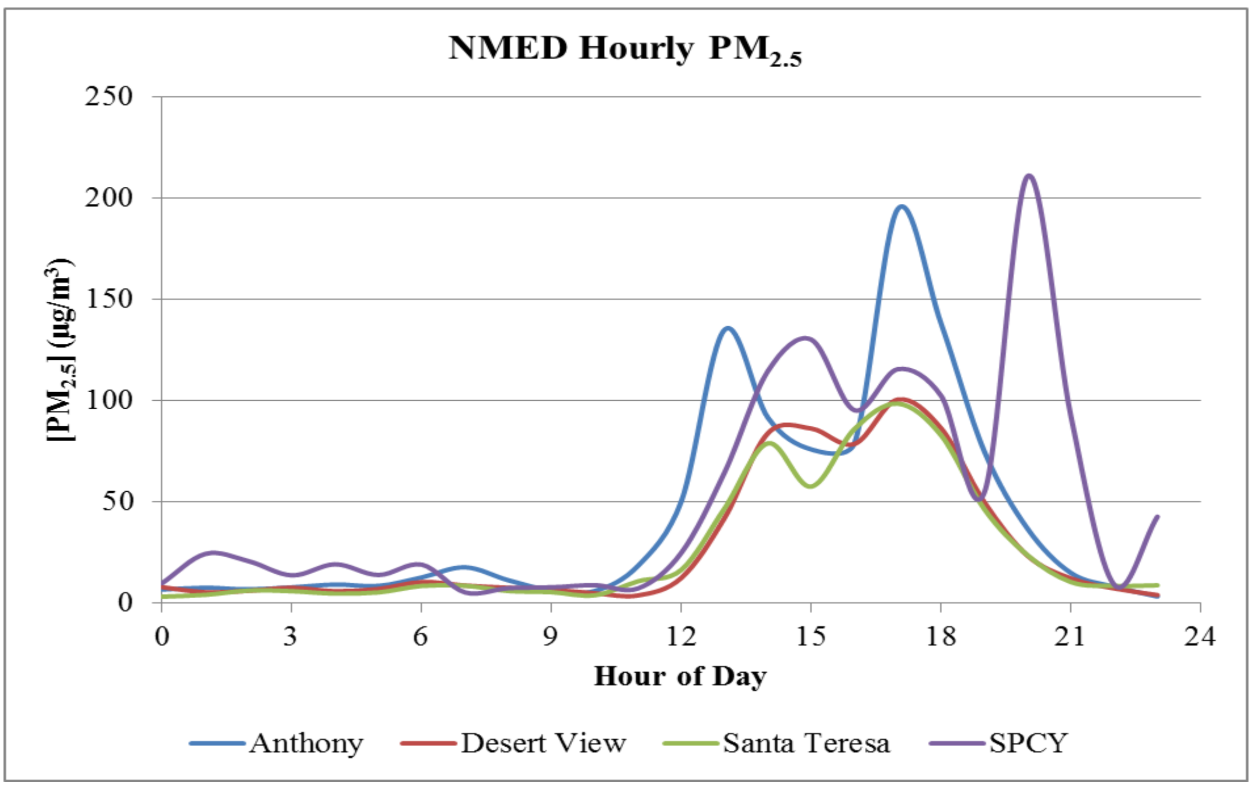

Figure 12-12b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors. Non-FEM hourly $PM_{2.5}$ data.

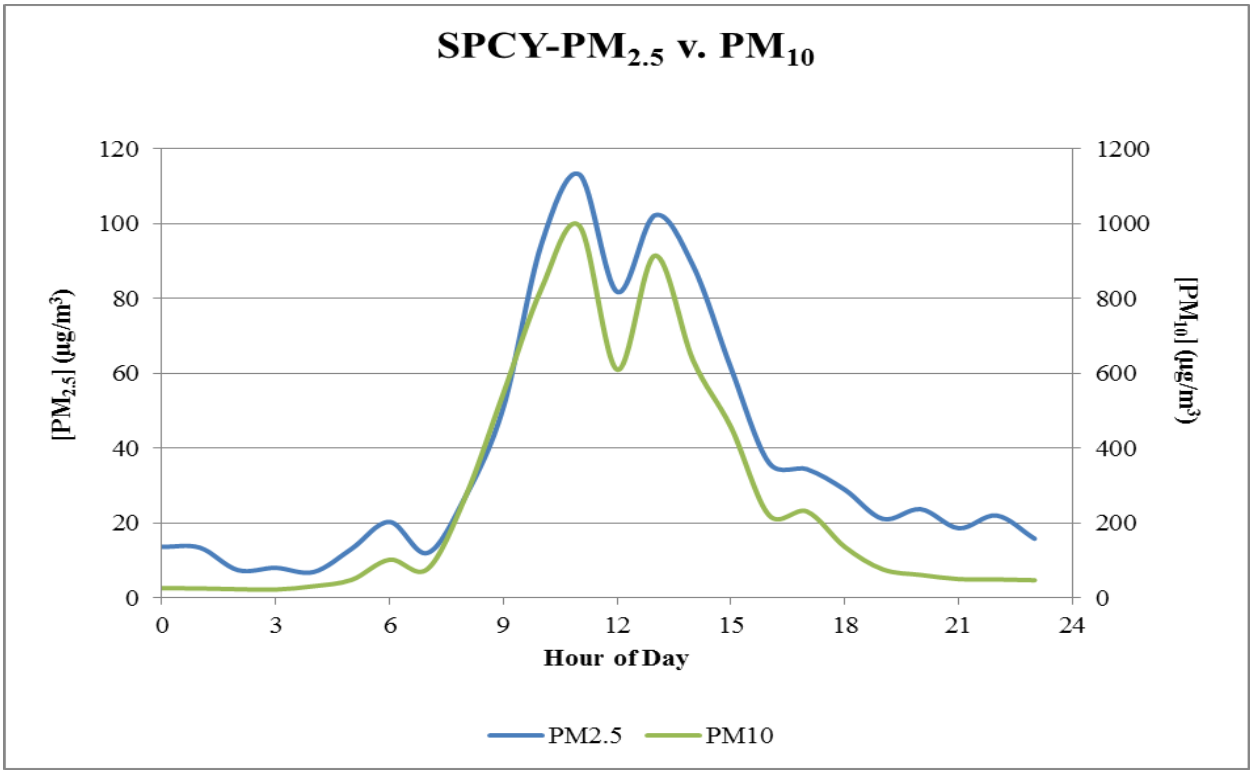

Figure 12-13. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on April 14, 2011.

12.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on April 14, 2011.

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 Anthony monitor detected blowing dust around the 0700 hour with hourly concentrations heavily impacted until the 1400 hour. By replacing these eight hourly values with the 95th percentile of hourly data at the Anthony site, the resulting 24-hour average (87 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	33	33
1	30	30
2	26	26
3	18	18
4	25	25
5	72	72
6	66	66
7	223	**137**
8	372	**137**
9	244	**109**
10	425	**88**
11	482	**95**
12	431	**106**
13	324	**136**
14	245	**146**
15	156	156
16	129	129
17	122	122
18	107	107
19	78	78
20	50	50
21	86	86
22	46	46
23	51	51
24-Hour Average	160	**87**

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 SPCY monitor detected blowing dust around the 0800 hour with hourly concentrations heavily impacted until the 1700 hour. The nine hourly PM_{10} values from 0800-1700 hours alone, exceed the 24-hour average standard at SPCY [(270 + 547 + 826 + 995 + 610 + 915 + 635 + 456 + 221 + 231) µg/m^3 = 5706 µg/m^3; (5706 µg/m^3)/24 = 238µg/m^3]. By replacing these nine 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 12-2). 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	26	26
1	25	25
2	23	23
3	22	22
4	31	31
5	48	48
6	102	102
7	77	223
8	270	**98**
9	547	**93**
10	826	**93**
11	995	**95**
12	610	**104**
13	915	**125**
14	635	**145**
15	456	**160**
16	221	**168**
17	231	**201**
18	136	136
19	76	76
20	61	61
21	50	50
22	49	49
23	47	47
24-Hour Average	269	**86**

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 SPCY.

13 HIGH WIND EXCEPTIONAL EVENT: April 18, 2011

13.1 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 and the $PM_{2.5}$ annual NAAQS at Sunland Park monitoring site on this date. The FEM TEOM continuous monitor at this site recorded a 24-hour average concentration of 186 µg/m^3. The Partisol monitor at this site recorded a 24-hour average concentration of 22.5 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 (Figure 13-1).

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 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.

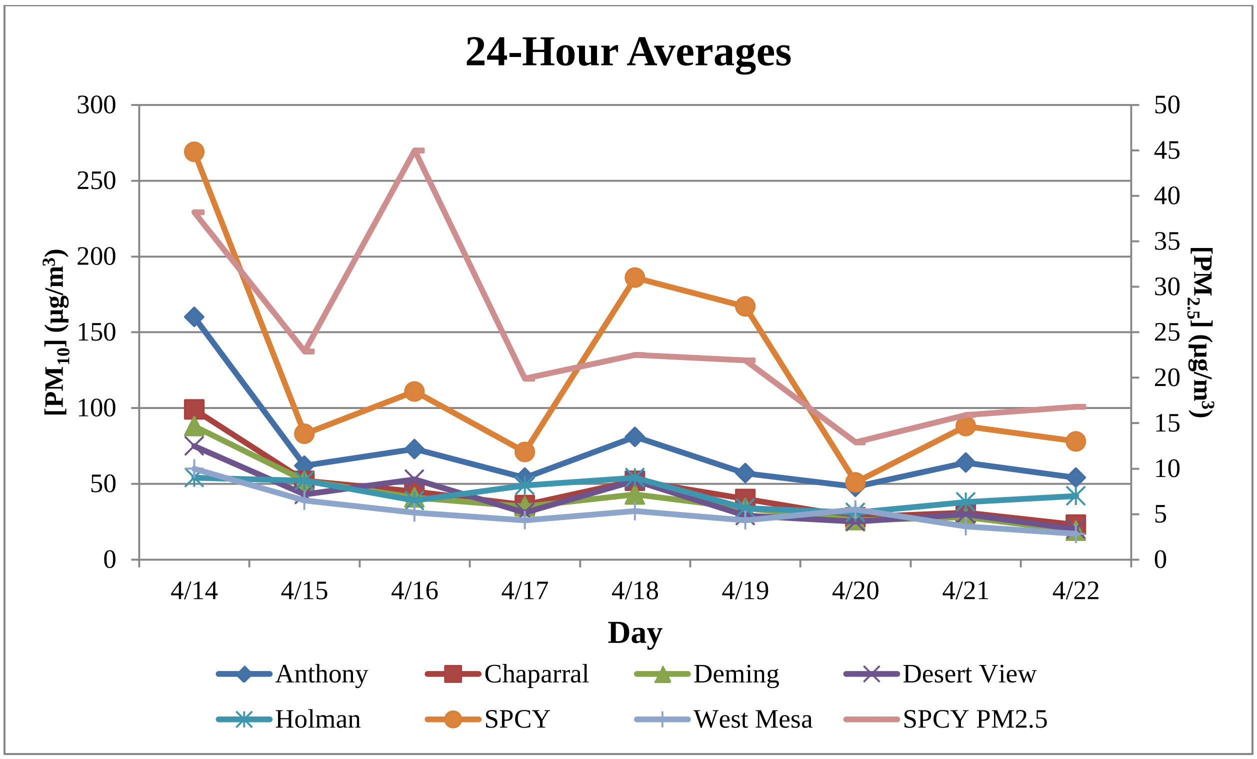

Figure 13-1. PM_{10} and $PM_{2.5}$ 24-hour averages before and after April 18, 2011.

13.2 Is Not Reasonably Controllable or Preventable

13.2.1 <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 Mexico. Doña Ana 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 northern Mexico (see Section 13.2.4 below). International transport of emissions in the early morning hours likely caused the peaks in the early morning hours from the 600-700 hour (see Section 13.3.1 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 April 18, 2011, sustained wind speeds approached but did not exceed EPA's default threshold at three of the seven monitoring sites in southern New Mexico and wind gusts also approached but did not exceed the NEAPs agreed upon threshold at five of the seven monitoring sites (Figures 13-2 and 13-3). However, NMED has also found that a sustained hourly wind speed lasting two hours or more of 6 m/s with instantaneous wind gusts of 12 m/s or more can create blowing dust in the border region (Aaboe, et al., 1998-2007; Saxton et al., 2000). As indicated in Figures 13-2 and 13-3, these conditions were met on April 18, 2011. Winds exceeded these thresholds at one or more monitoring sites beginning at the 0700 hour and ending at the 1900 hour. Five minute wind speeds exceed EPA's default threshold several times throughout the afternoon (Figure 13-4).

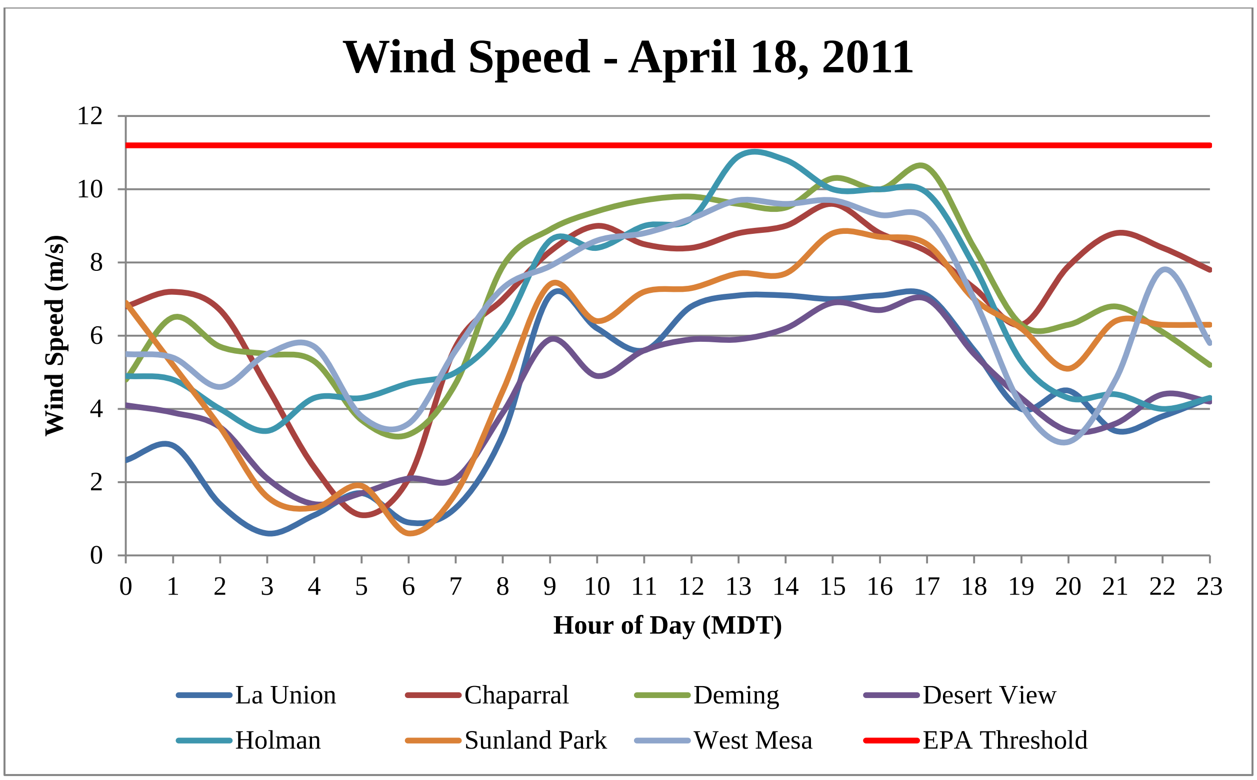

Figure 13-2. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

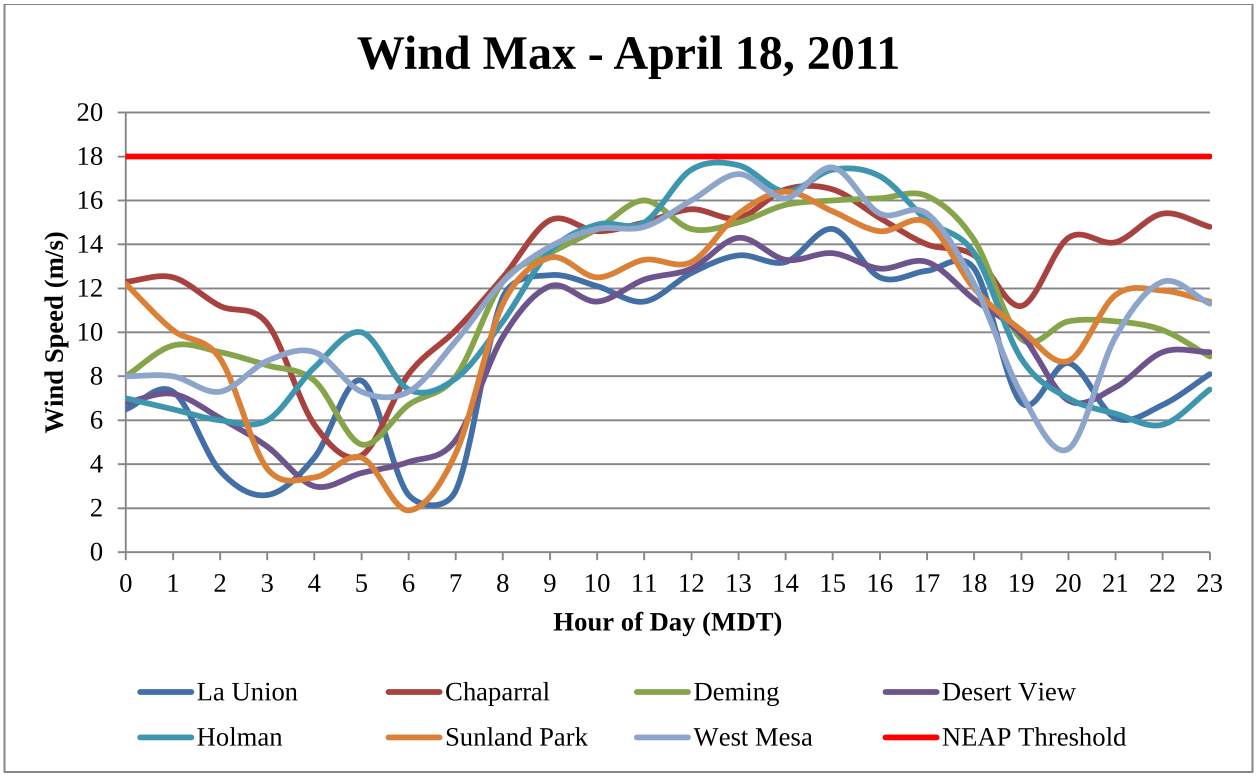

Figure 13-3. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

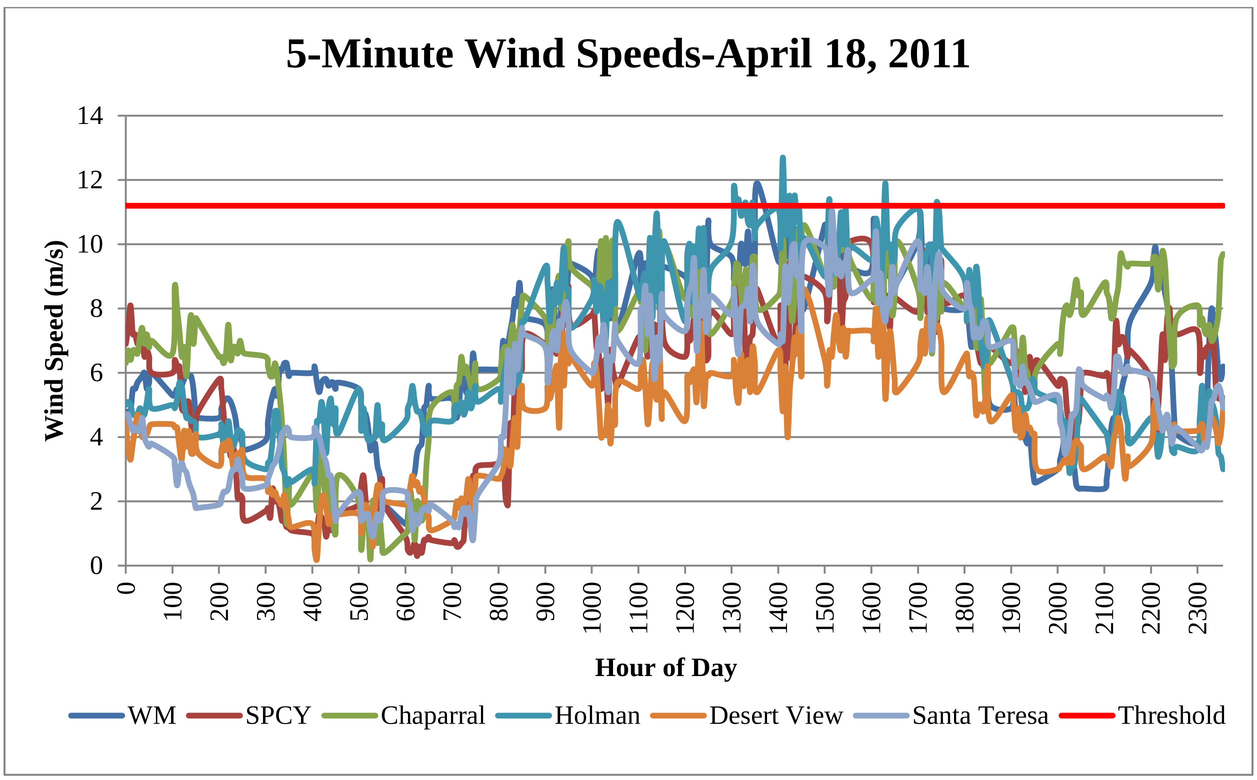

Figure 13-4. Five Minute wind speeds at monitoring sites in Doña Ana County.

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 2006-2010 the PM_{10} FEM TEOM monitors recorded 211 exceedances and the PM_{10} FRM Wedding monitors recorded 5 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 (Table 2-1). The SPCY $PM_{2.5}$ FRM Partisol recorded 23 exceedances of the 24-Hour NAAQS from 2006-2010 (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 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 northern Mexico. It is conceivable that the SPCY site's environs could have affected the particulate monitors (dirt road, aggregate stock piles, construction equipment, and disturbed land), as indicated in the 2012 Technical System Audit (TSA) Report prepared by EPA Region 6. 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 13-5). 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.

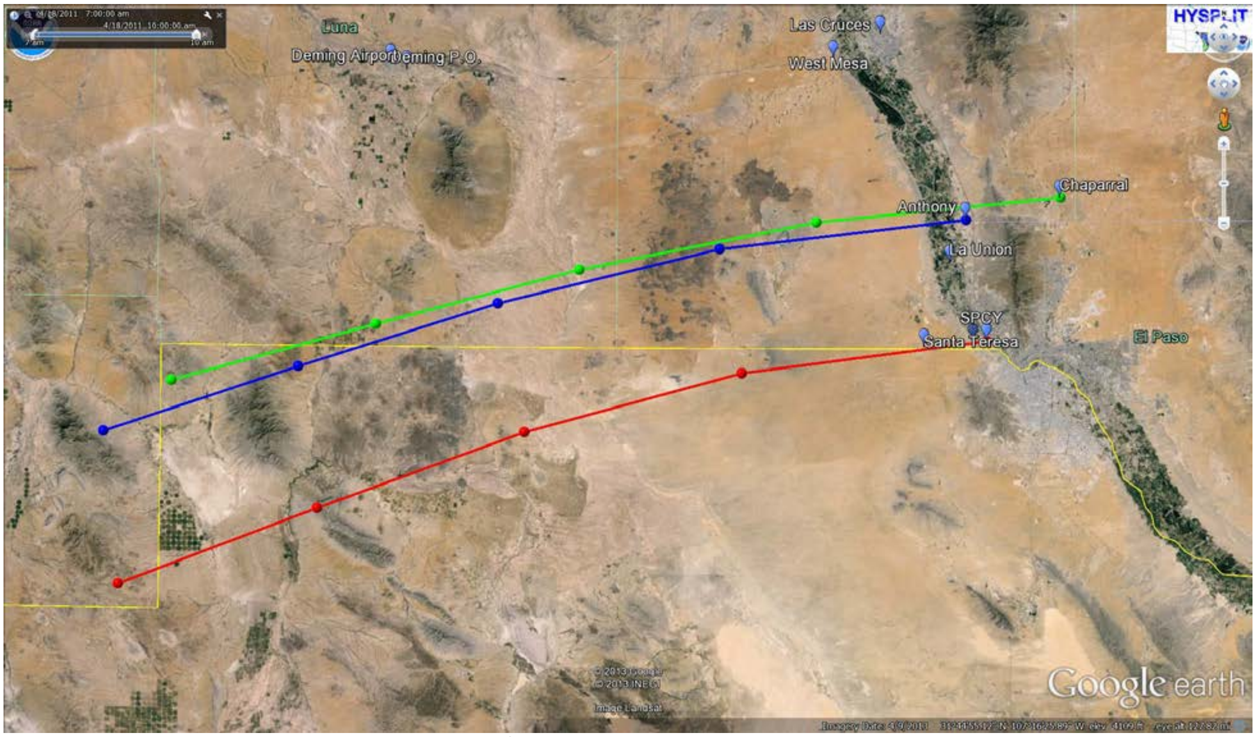

Figure 13-5. HYSPLIT back-trajectory model analysis for April 18, 2011.

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-4 through B-11). 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 2006-2010 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. The early morning spike in concentrations on this date was likely due to international transport.

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 2006-2010. 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 2006-2010. The recorded PM_{10} value for this day (186 µg/m^3) is above the maximum value recorded for all 24-hour averages from 2006-2010.

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 18, 2011 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 13-6a-b through 13-8). 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.

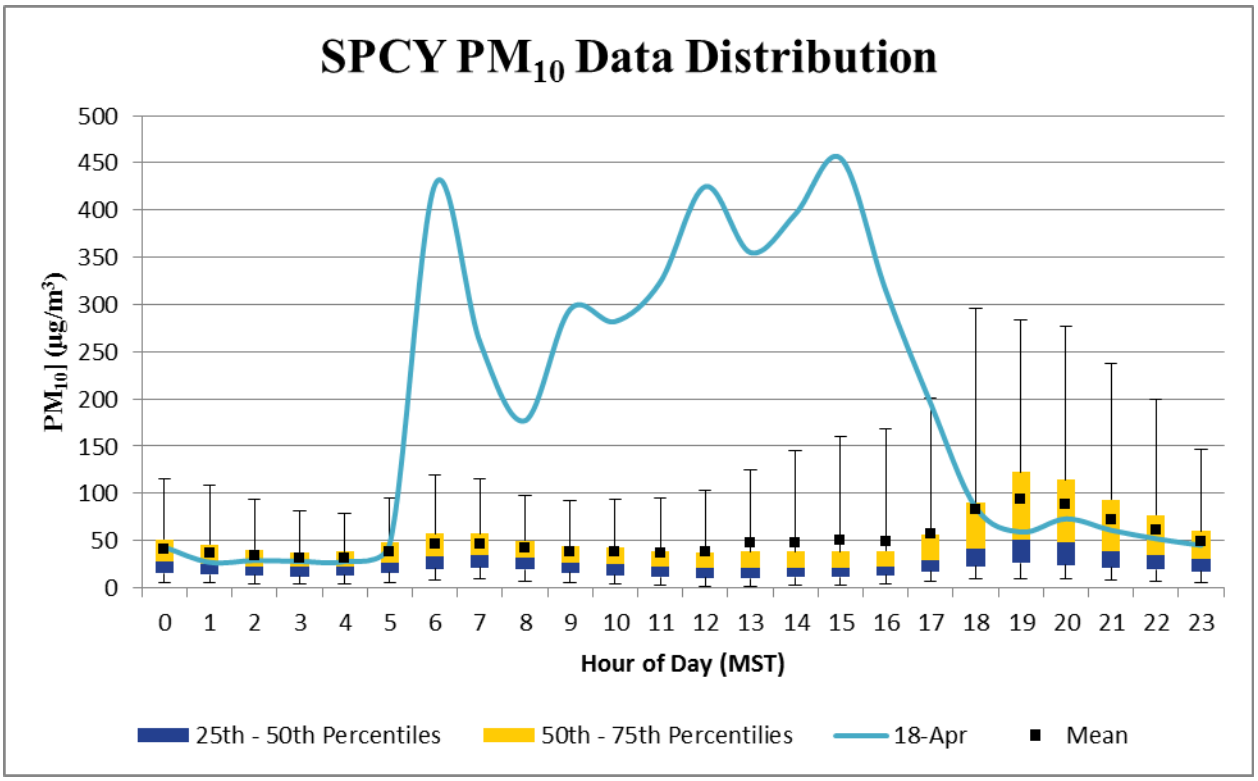

Figure 13-6a. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 18, 2011.

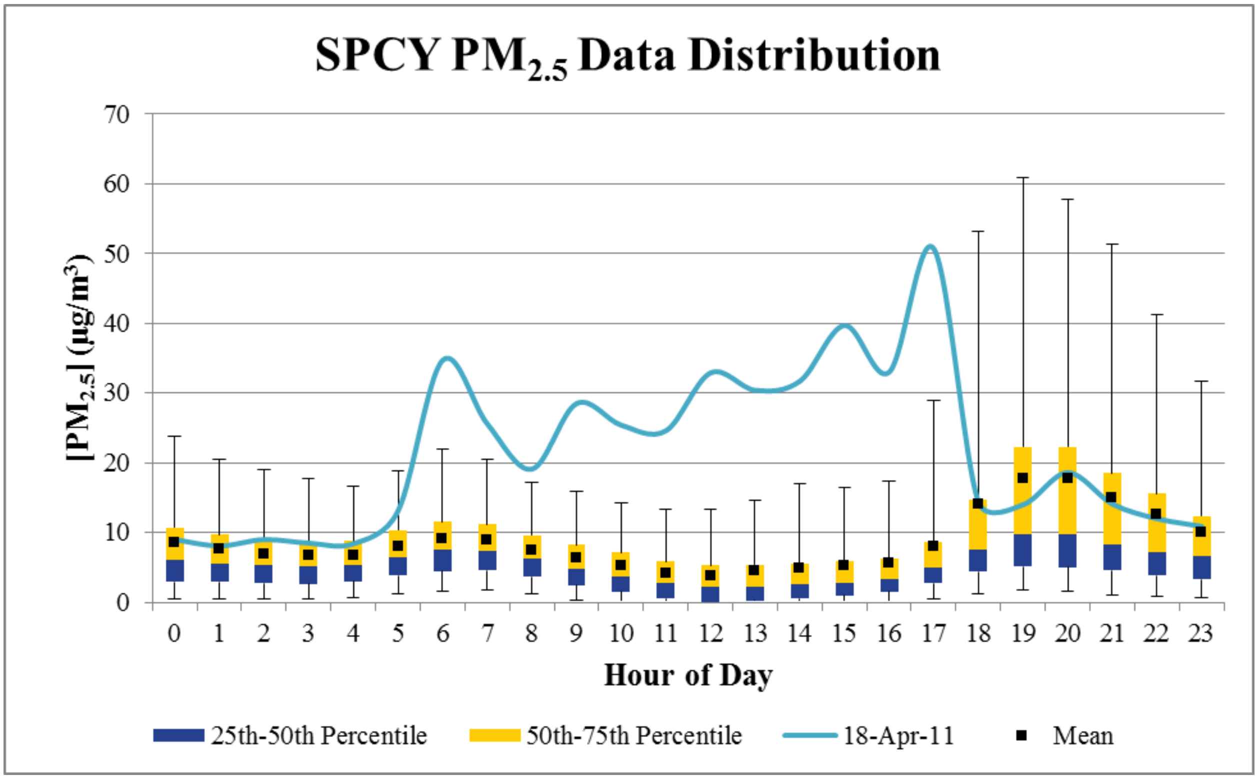

Figure 13-6b. $PM_{2.5}$ hourly data distribution from 2006-2010 overlaid by hourly values for April 18, 2011.

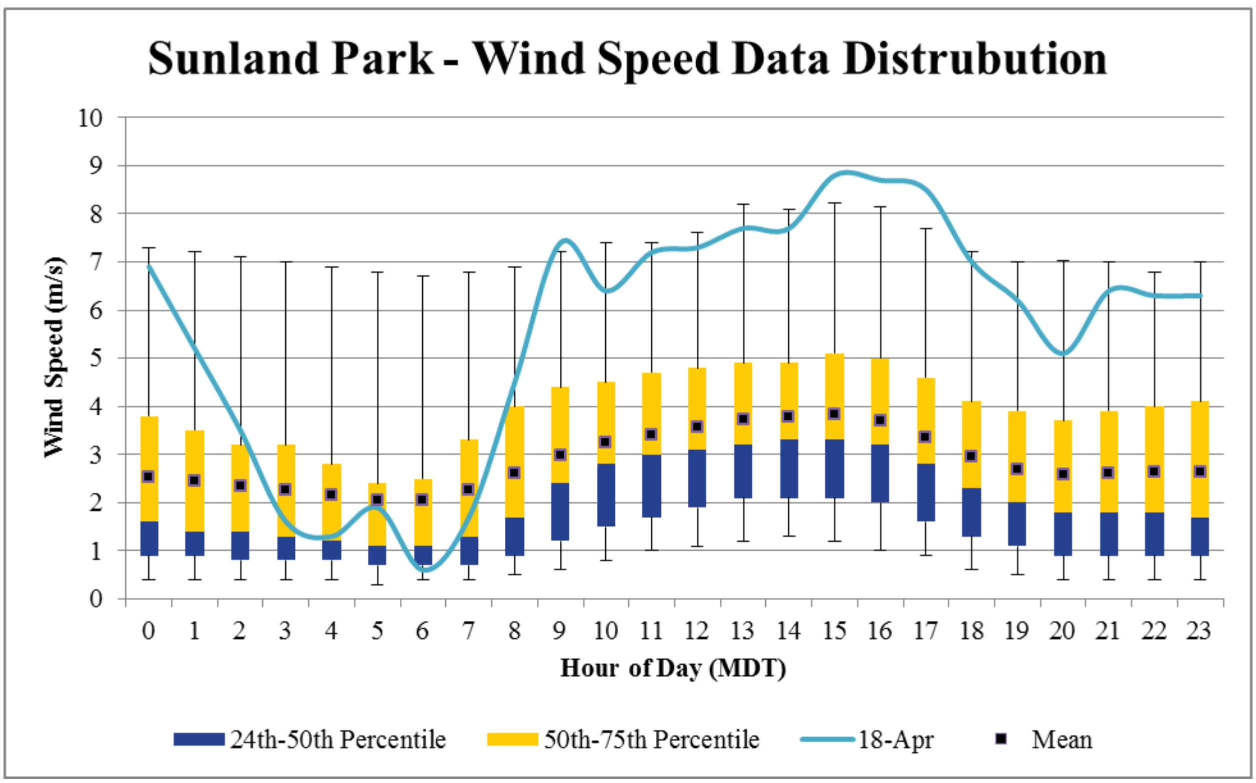

Figure 13-7. Hourly wind speed data distribution from 2006-2010 overlaid by hourly PM_{10} values for April 18, 2011.

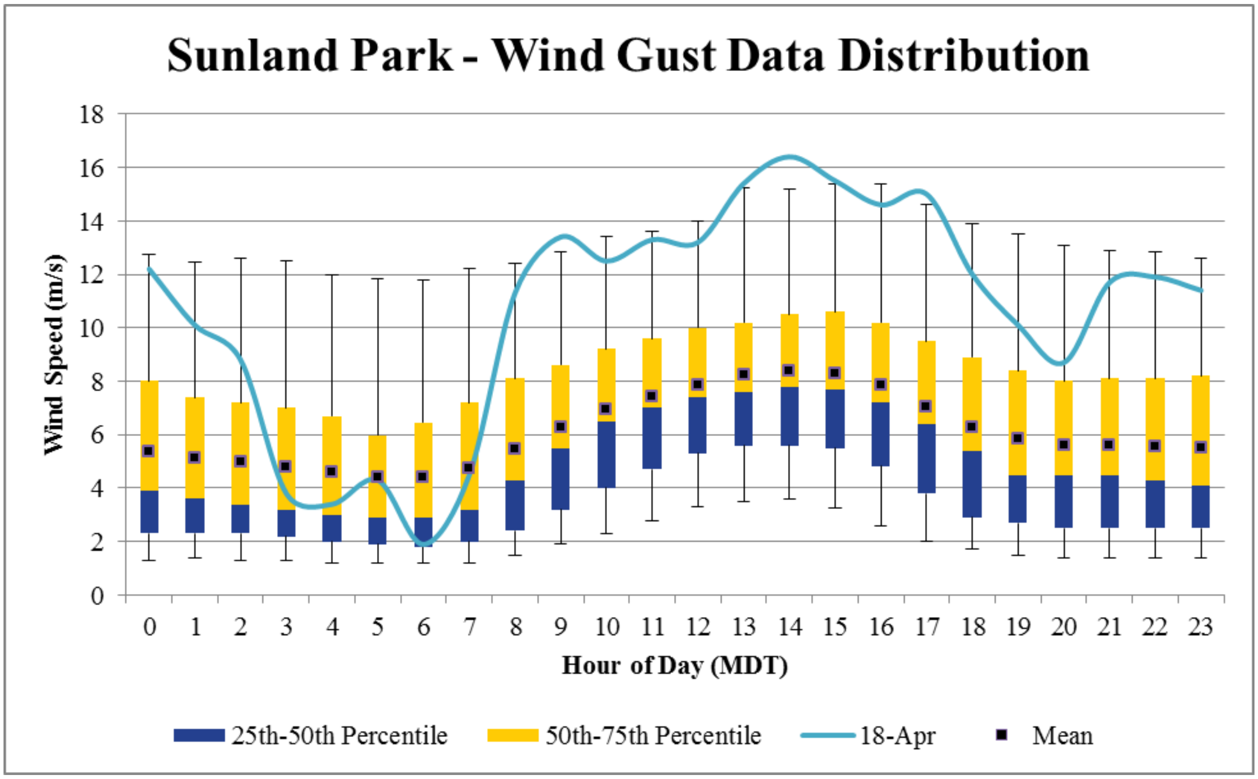

Figure 13-8. Hourly wind gust data distribution from 2006-2010 overlaid by hourly PM_{10} values for April 18, 2011.

13.4 Clear Causal Relationship

A backdoor cold front passed through New Mexico late on the evening of April 17, 2011 and through the early morning hours on April 18, 2011, changing into a stationary front. A warm front from Texas overcame the stationary front and created an area of low pressure in Colorado. The pressure gradient across New Mexico and northern Mexico tightened and surface winds became stronger by the afternoon (Figures 13-9a-f). Surface winds flow perpendicular to the isobars from high to low pressure. A strong westerly flow aloft created a low pressure trough over the eastern half of the state and strengthened the surface low. The wind direction in the upper atmosphere didn't align with the predominate surface wind direction but increased winds as diurnal heating of the surface allowed winds aloft to mix downward (Figure 13-10). These conditions increased the surface wind velocities but did not provided the turbulence required for vertical mixing and horizontal transport over the large areas along the border.

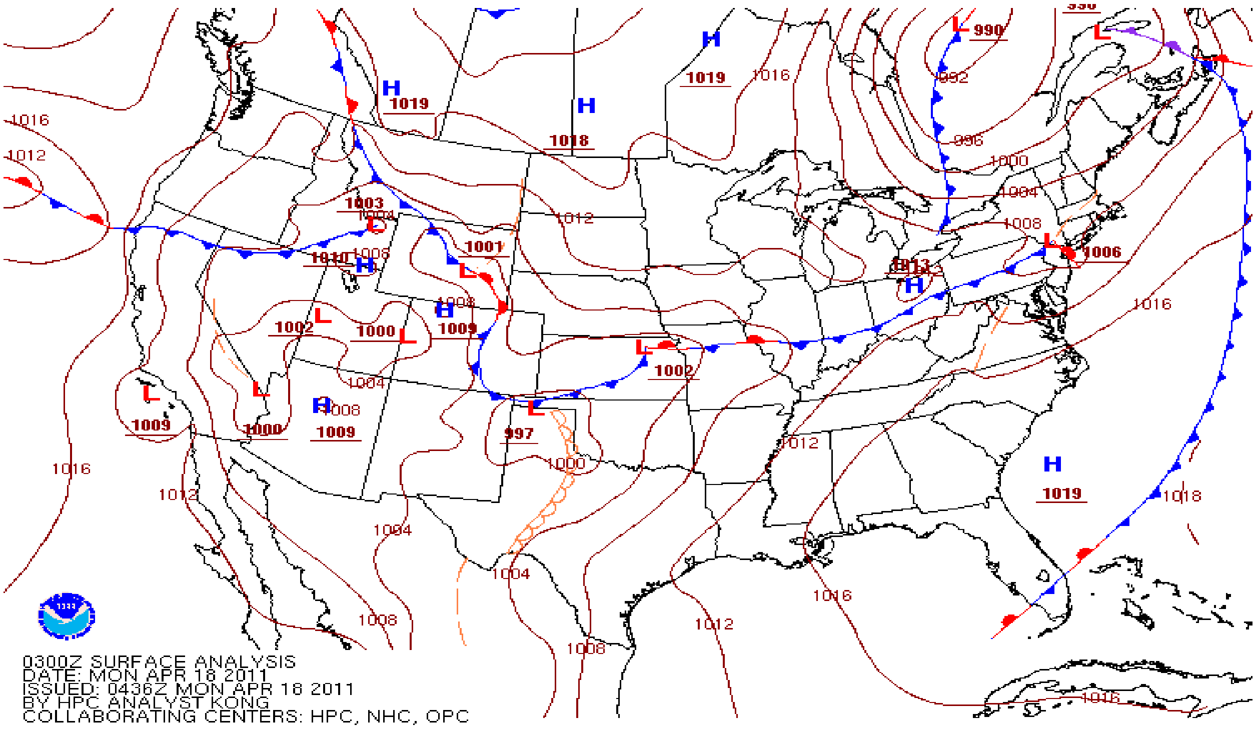

Figure 13-9a. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 17, 2011 at the 2100 hour MST.

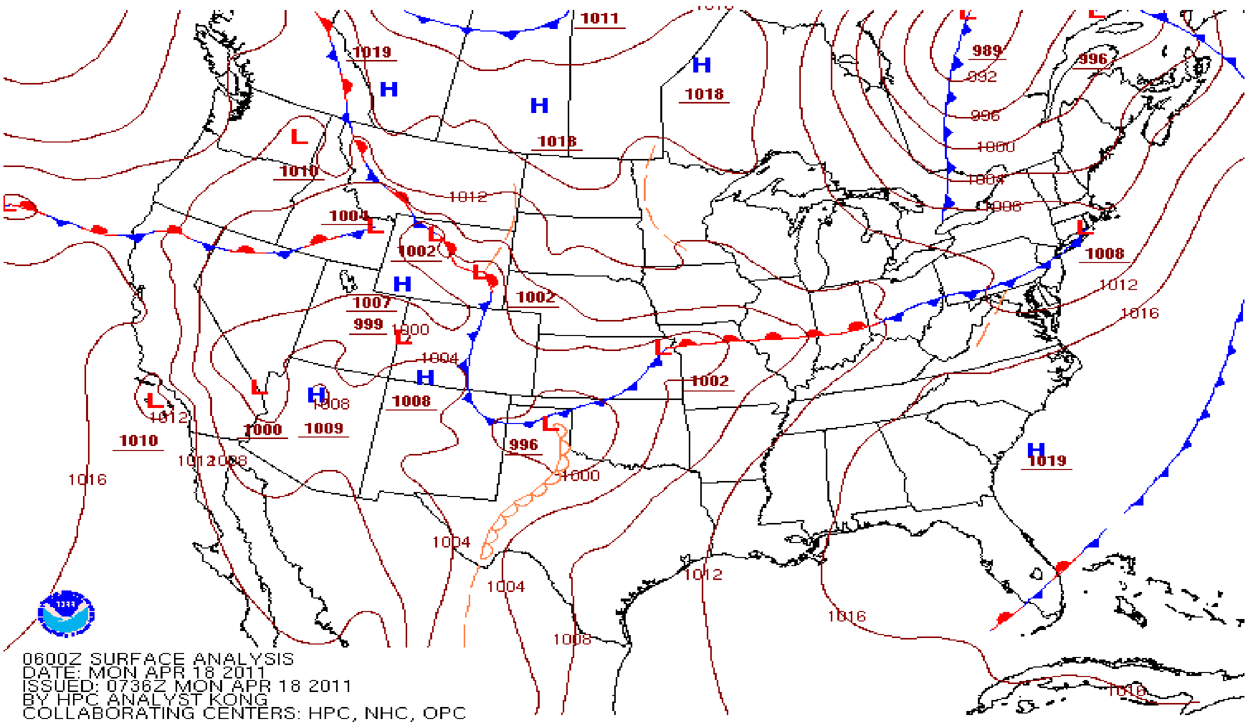

Figure 13-9b. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 18, 2011 at the 0000 hour MST.

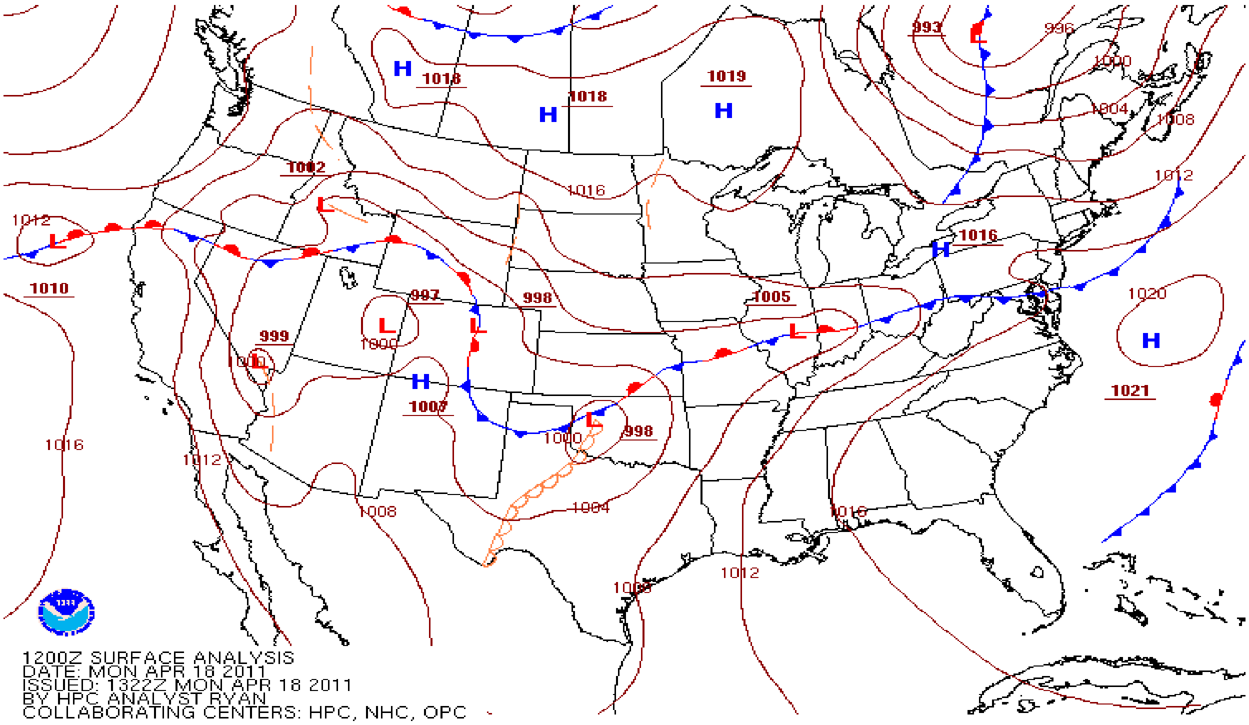

Figure 13-9c. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 18 at the 0600 hour MST.

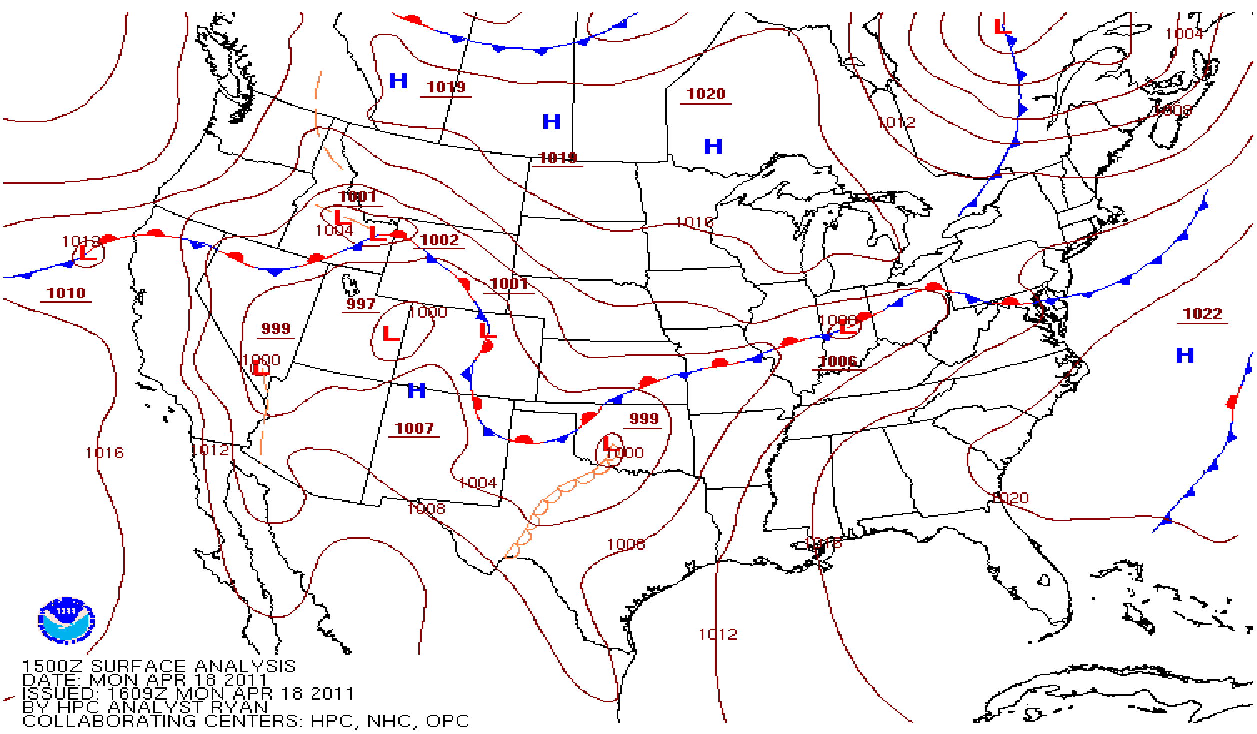

Figure 13-9d. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 18 at the 0900 hour MST.

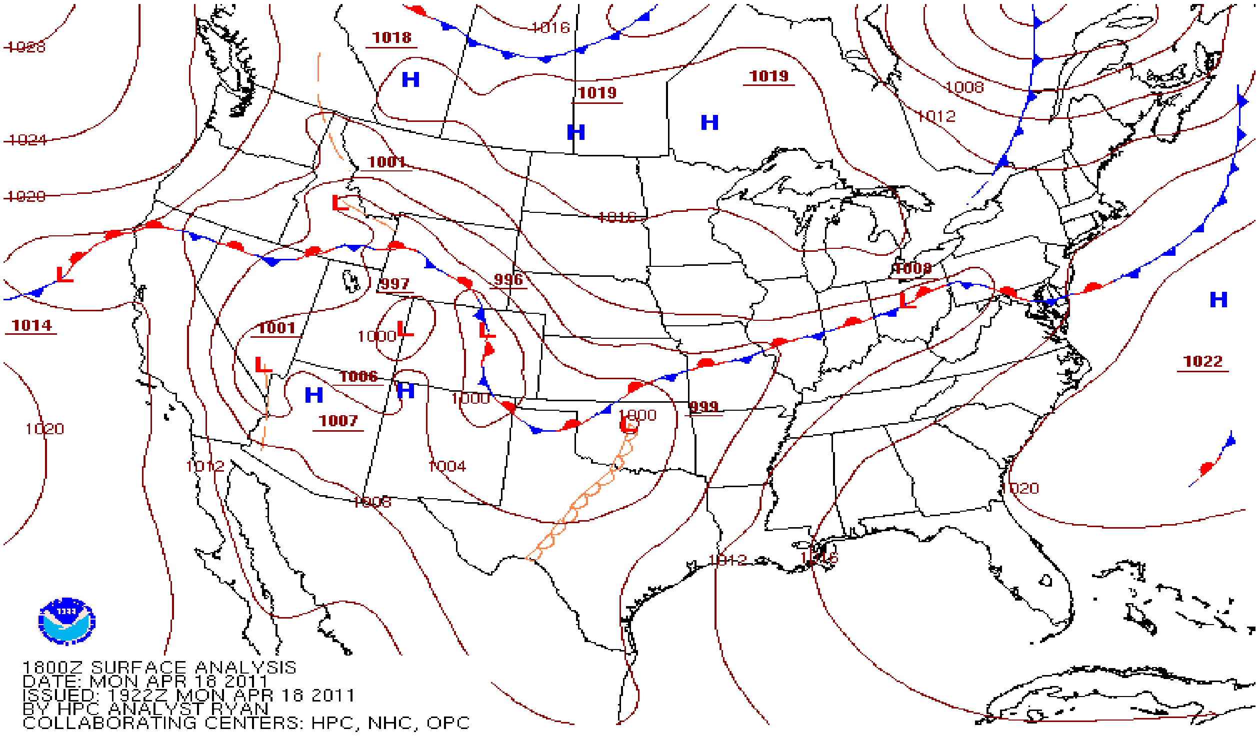

Figure 13-9e. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 18 at the 1200 hour MST.

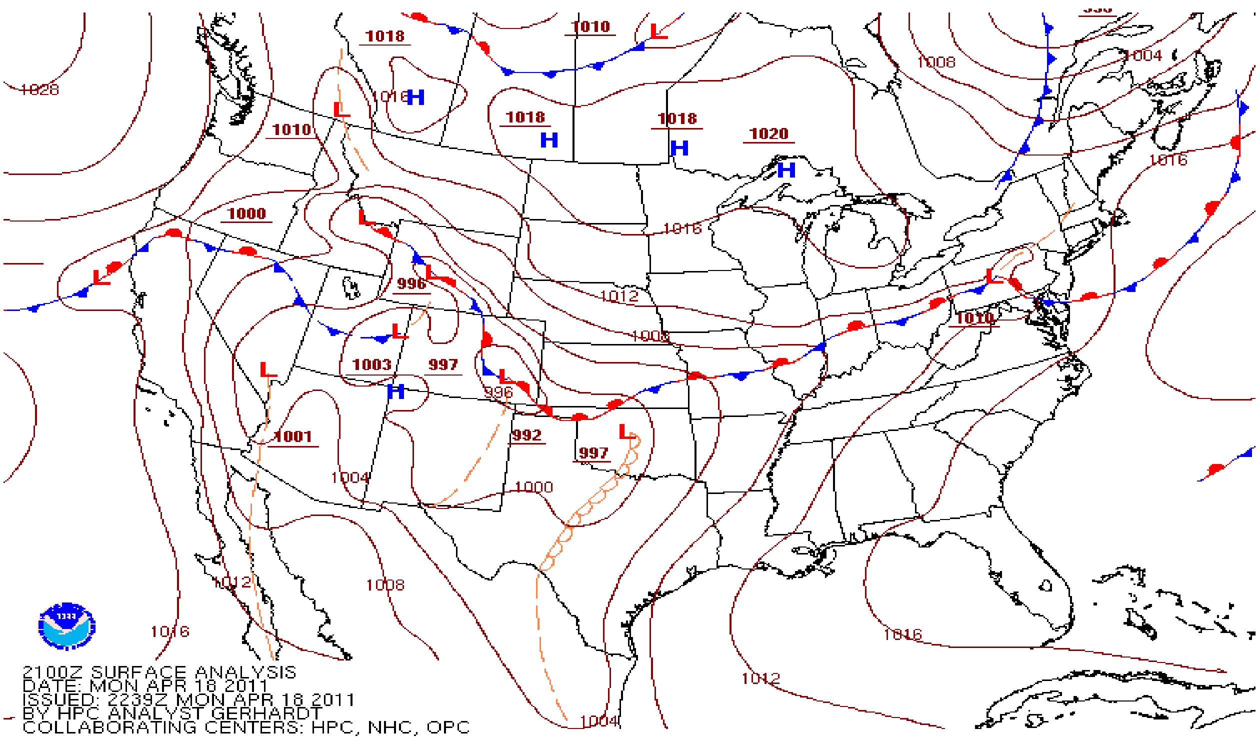

Figure 13-9f. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 18 at the 1500 hour MST.

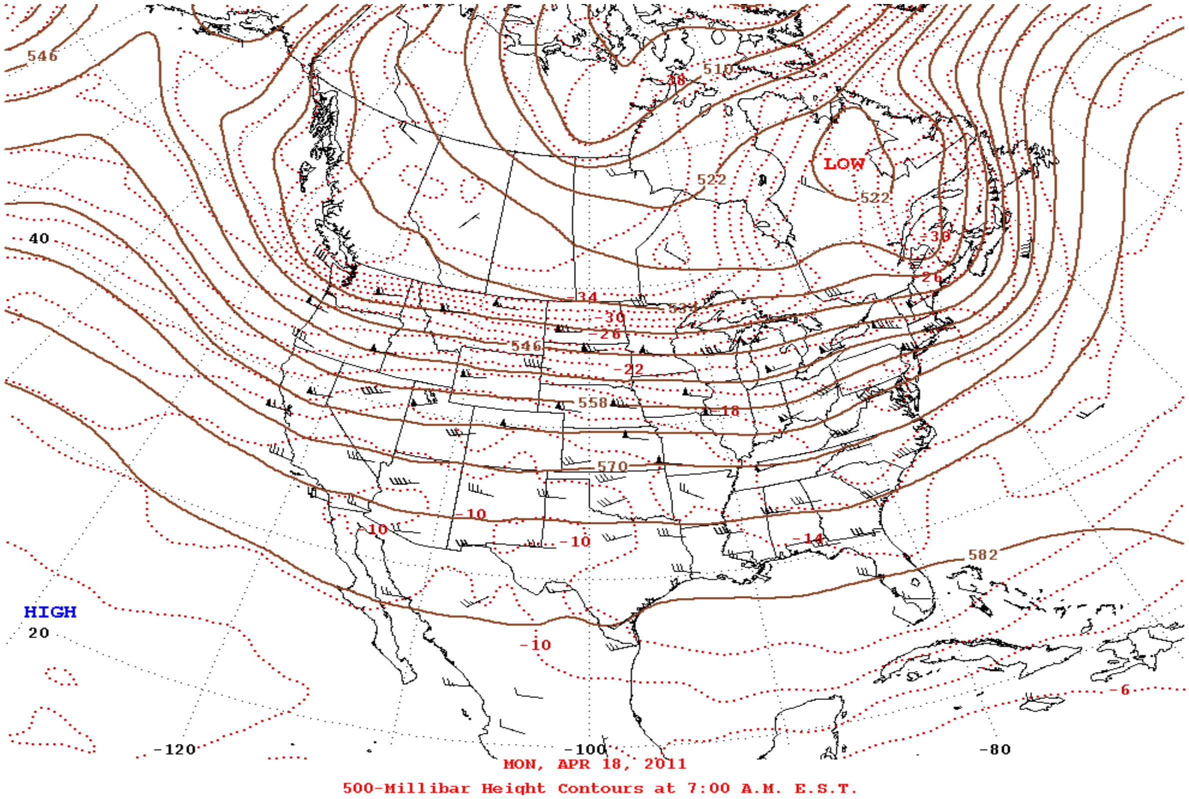

Figure 13-10. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on April 18, 2011.

The weather pattern described above generated strong westerly winds beginning at the 0900 hour and lasting through the 1900 hour. Beginning at the 0800 hour, wind speeds exceeded 6 m/s (see Section 13.2.2) at Deming and Holman. Peak wind speeds ranged from 7 m/s at Desert View to 10.9 m/s at Holman (Figure 13-2). Peak wind gusts ranged from 14.3 m/s at Desert View to 17.6 m/s at Holman (Figure 13-3). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 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 (900-1900 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at SPCY with smaller increases at all monitoring sites in the network (Figure 13-12a-b). Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 13-13).

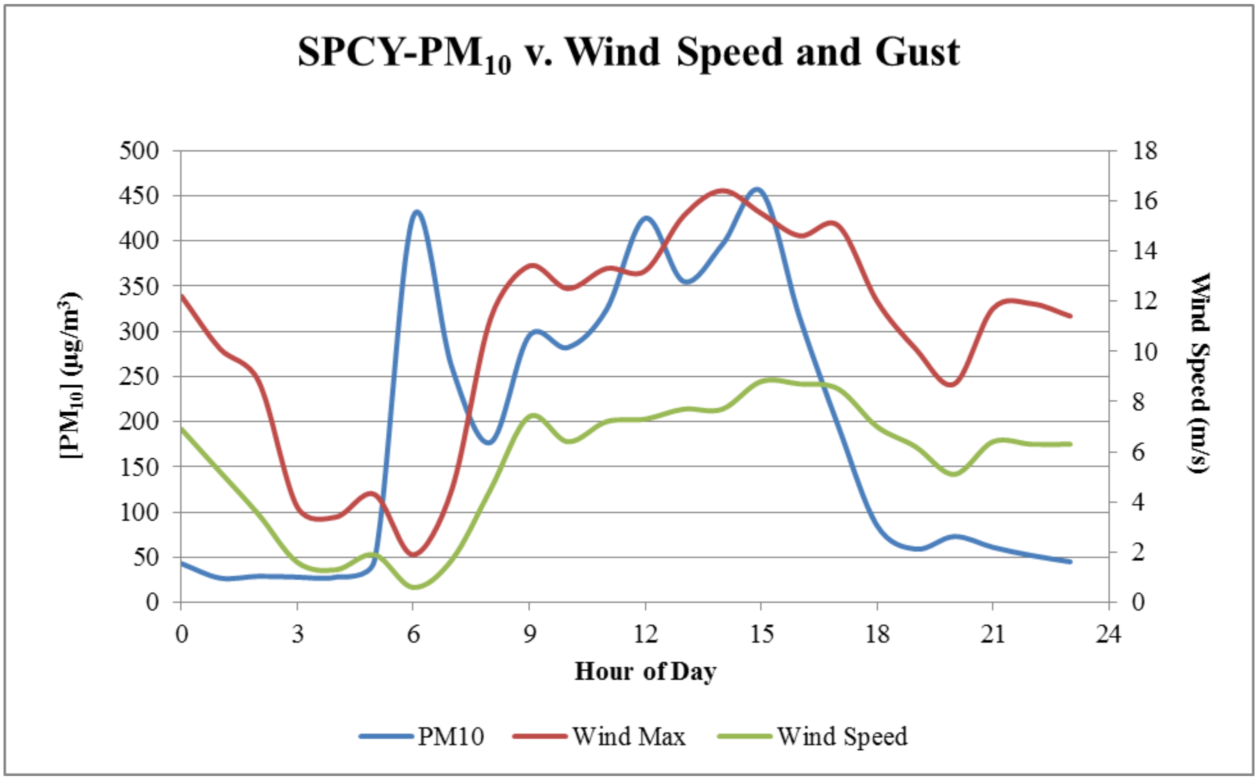

Figure 13-11a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

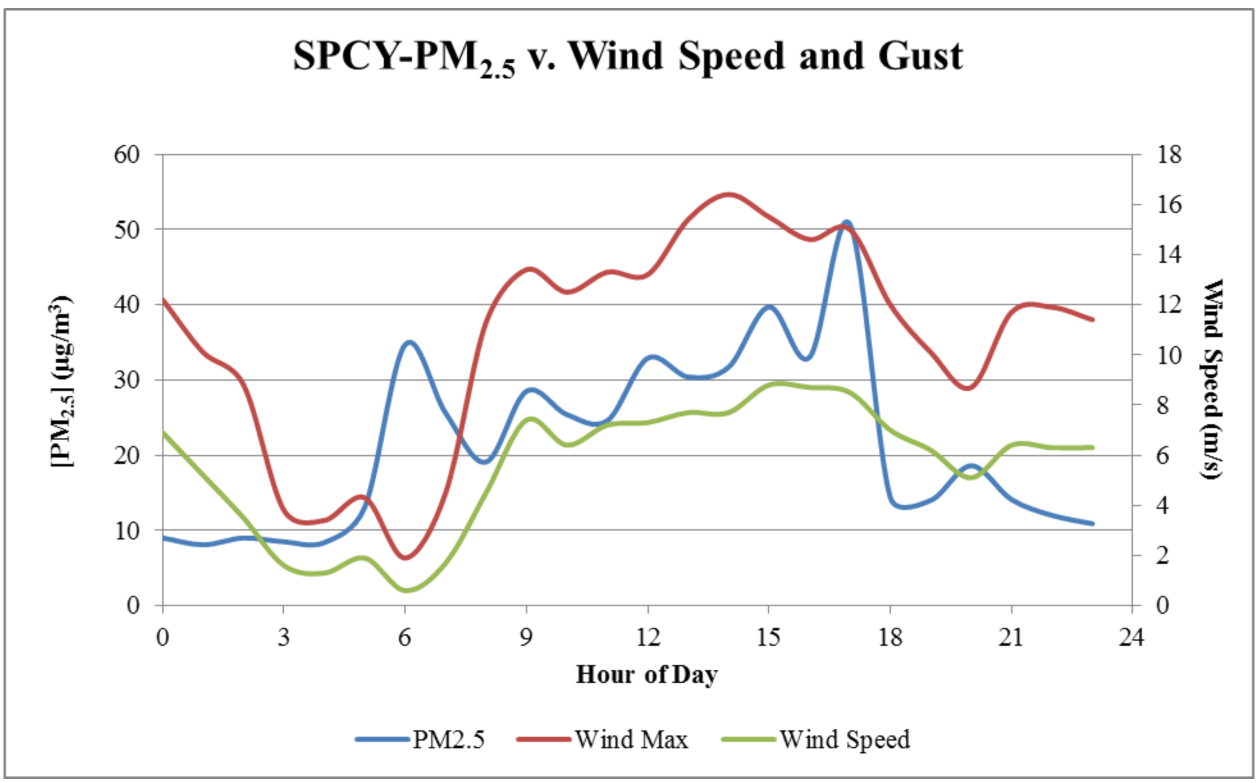

Figure 13-11b. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

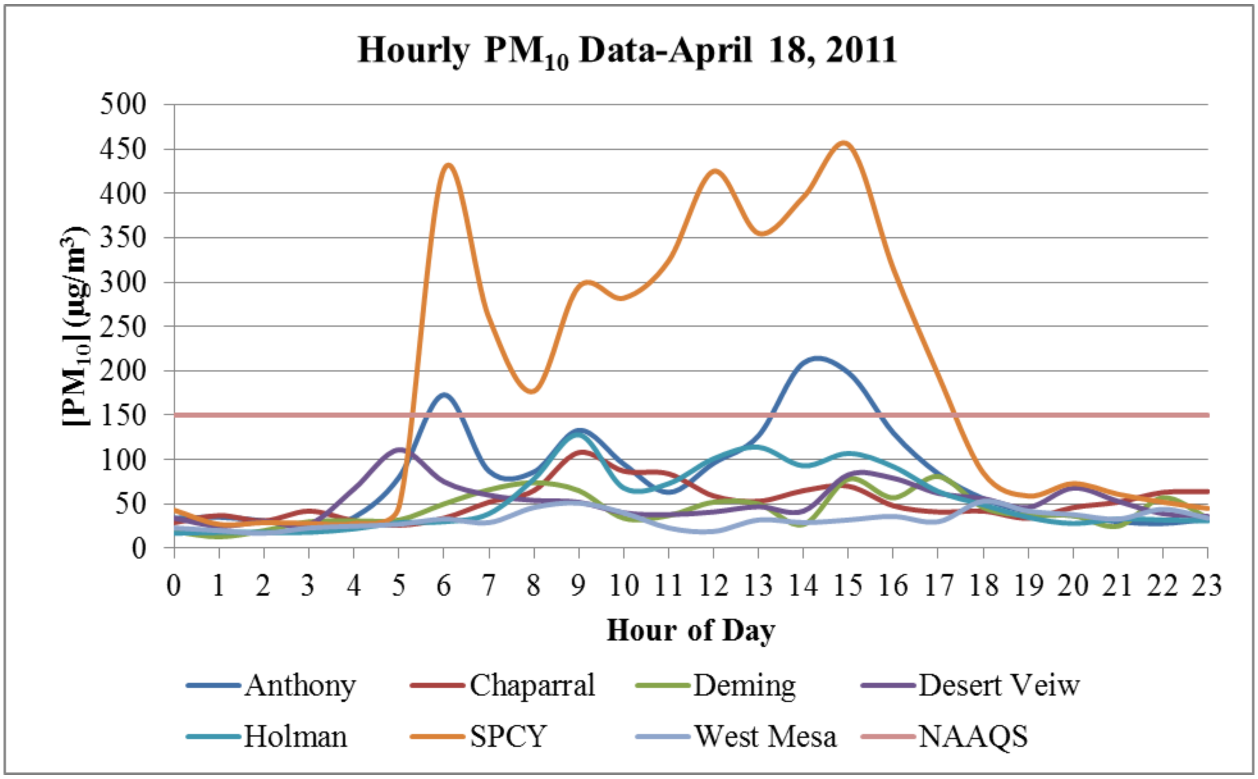

Figure 13-12a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

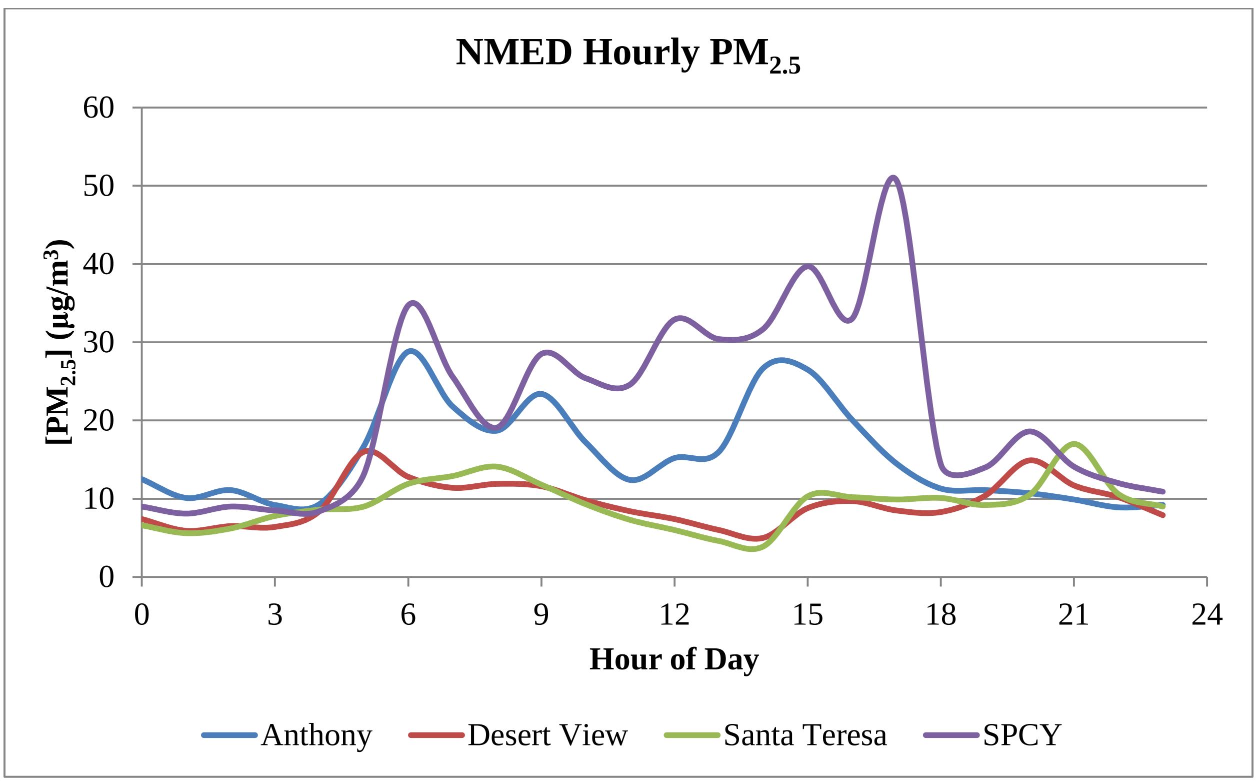

Figure 13-12b. Hourly $PM_{2.5}$ concentrations from Doña Ana County monitors.

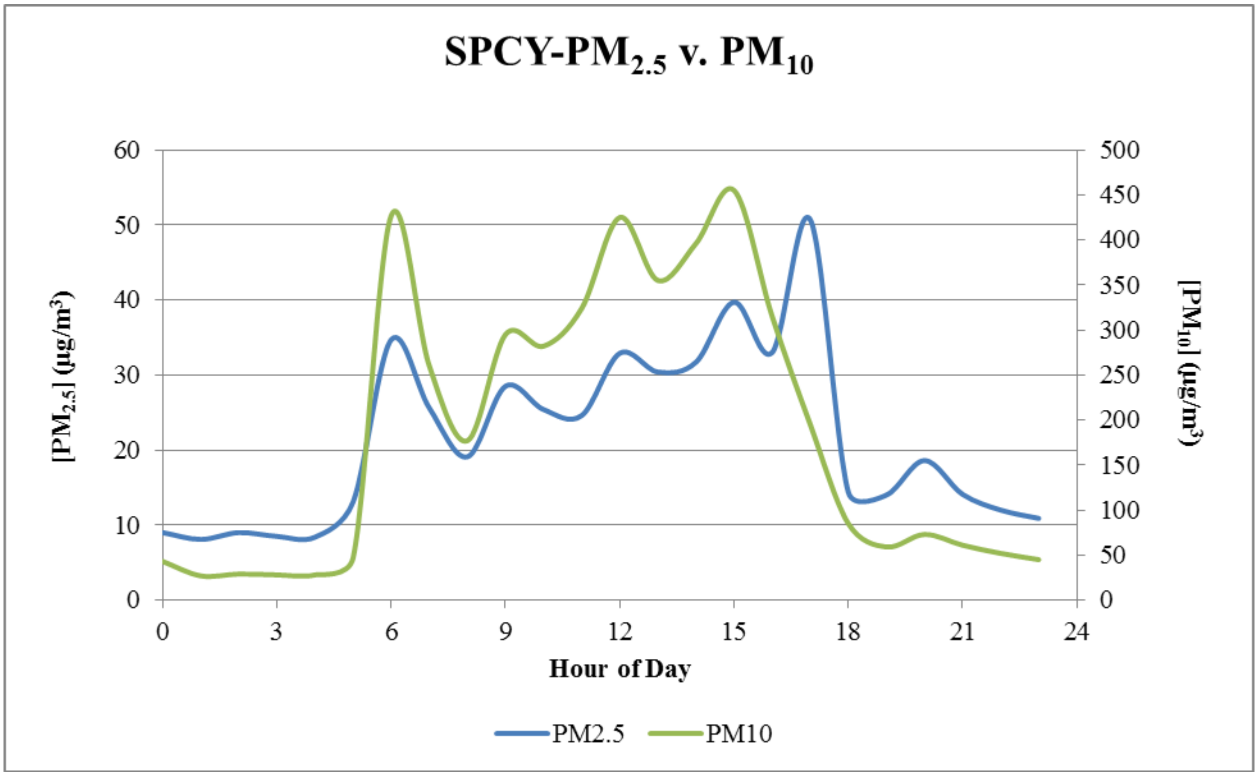

Figure 13-13. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on April 18, 2011.

NOAA’s Rapid Update Cycle (RUC) forecast model predicted high wind speeds from the southwest-west in the evening, with the strongest winds occurring along the border in northern Chihuahua and in southern Hidalgo, Luna and southwestern Doña Ana County (Figure 13-14).

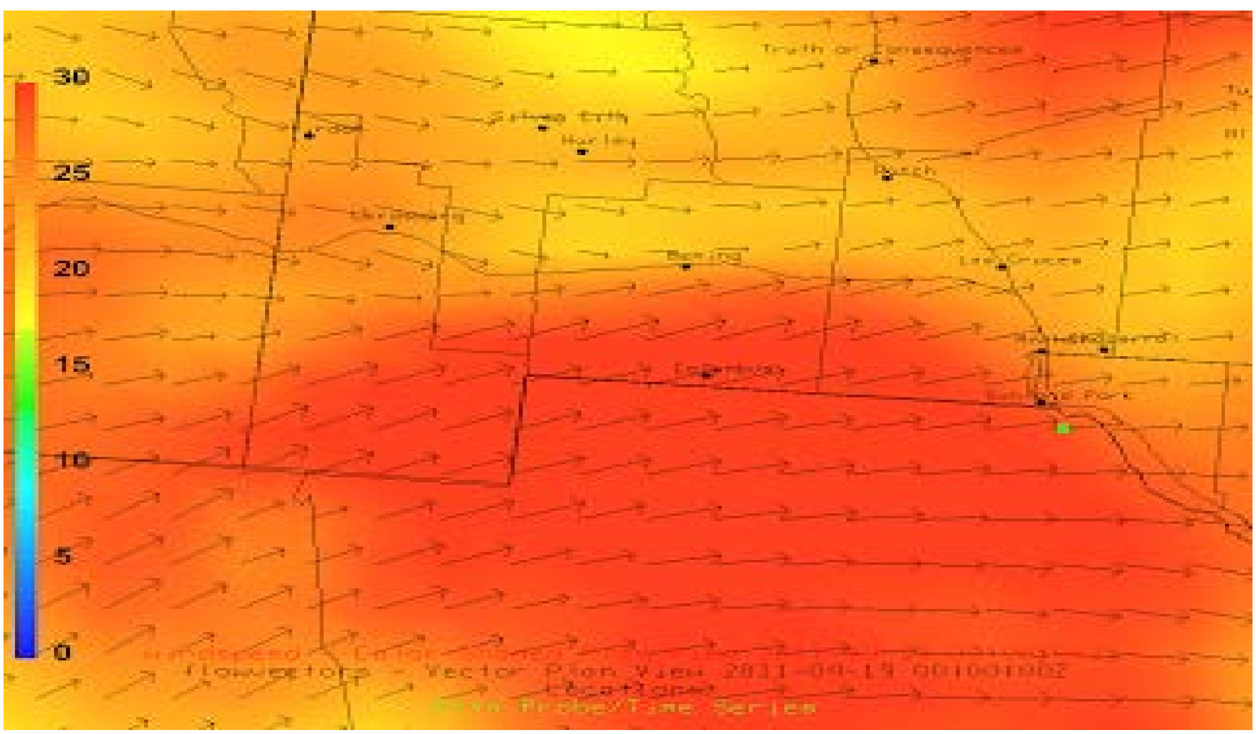

Figure 13-14. NWS RUC model winds for April 18, 2011 at 1800 MDT (NOAA).

The NWS issued a wind advisory from the 1300 to 2000 hour on April 18, 2011 for southwest and south-central New Mexico and far west Texas. The wind advisory included the following statements,

> ...STRONG WINDS AND PATCHY BLOWING DUST WILL OCCUR THIS AFTERNOON...PATCHY BLOWING DUST MAY REDUCE VISIBILITIES TO LESS THAN 3 MILES IN DUST PRONE AREAS OF THE LOWLAND DESERTS (NWS, 2011).

13.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on April 18, 2011.

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 Sunland Park monitor detected blowing dust around the 900 hour with hourly concentrations heavily impacted until the 1600 hour. The 600 and 700 hour data do not correlate with high wind and were likely caused by international transport from Ciudad Juárez. By replacing the remaining nine hourly values with the 95th percentile of hourly data at the Sunland Park site, the resulting 24-hour average (106 µg/m^3) does not exceed the NAAQS (Table 13-1). 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	43	43
1	27	27
2	29	29
3	28	28
4	28	28
5	47	47
6	427	427
7	260	260
8	177	**98**
9	295	**93**
10	282	**93**
11	324	**95**
12	425	**104**
13	355	**125**
14	396	**145**
15	455	**160**
16	315	**168**
17	195	195
18	85	85
19	59	59
20	73	73
21	61	61
22	52	52
23	45	45
24-Hour Average	186	**106**

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 Sunland Park.

14 HIGH WIND EXCEPTIONAL EVENT: April 19, 2011

14.1 Summary of Event

The passing of a backdoor cold front accompanied by rainstorms caused high winds and blowing dust in southern Doña Ana County resulting in an exceedance of the PM_{10} 24-hour NAAQS and the $PM_{2.5}$ annual NAAQS at the Sunland Park monitoring site on this date. The FEM TEOM continuous monitor at this site recorded a 24-hour average concentration of 167 µg/m^3. The FRM Partisol monitor at this site recorded a 24-hour average concentration of 21.9 µg/m^3 (Figure 14-1). In accordance with the EER and the $PM_{2.5}$ annual NAAQS, the AQB flagged this data on EPA's AQS database as a high wind natural event. 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.

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 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.

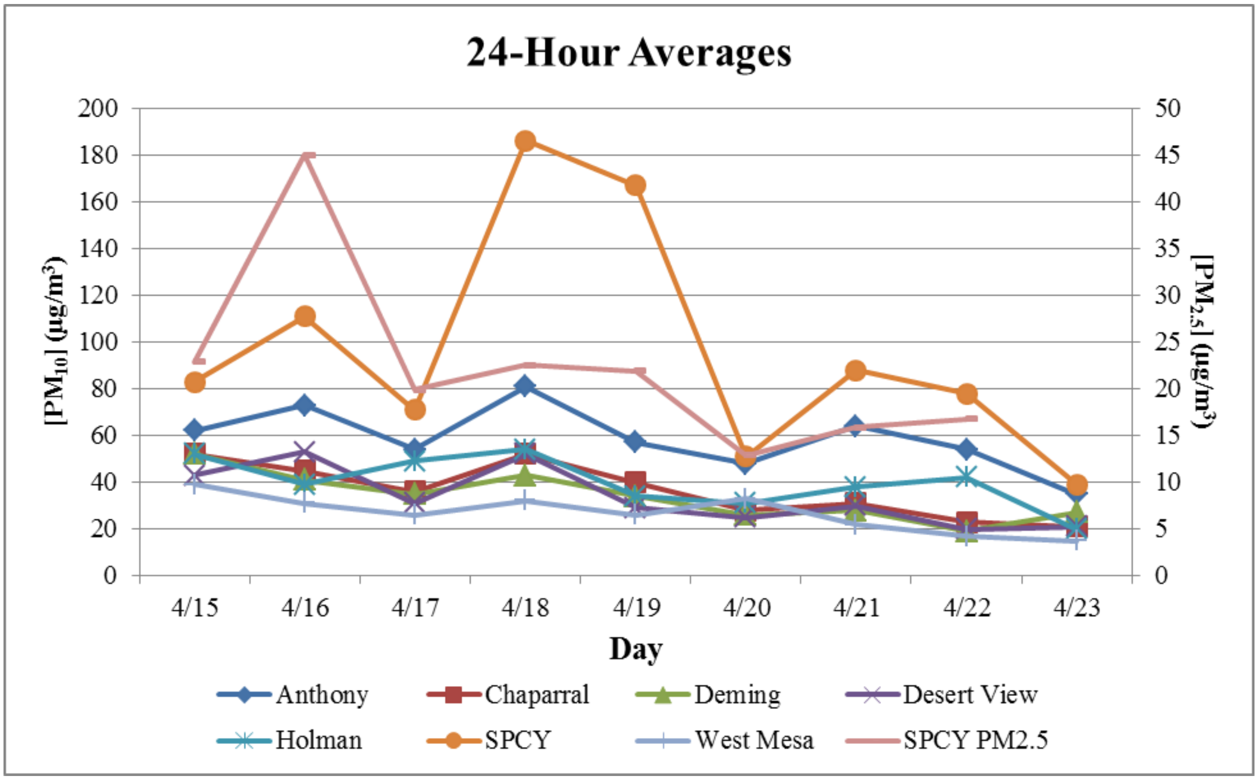

Figure 14-1. PM_{10} and $PM_{2.5}$ 24-hour averages before and after April 19, 2011.

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 Mexico and New Mexico. 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 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 April 19, 2011, sustained wind speeds approached but did not exceed EPA's default threshold at three of the seven monitoring sites in southern New Mexico and wind gusts approached but did not exceed the NEAPs agreed upon threshold at four of the seven monitoring sites. However, NMED has also found that a sustained hourly wind speed lasting two hours or more of 6 m/s with instantaneous wind gusts of 12 m/s or more can create blowing dust in the border region (Aaboe, et al., 1998-2007; Saxton et al., 2000). As indicated in Figures 14-2 and 14-3, these conditions were met on April 19, 2011. Sustained winds exceeded the threshold at six of the seven monitoring sites and wind gusts exceeded the threshold at all of the monitoring sites beginning (Figures 14-2 and 14-3). The NWS El Paso office also noted in their daily climate report that the highest wind speed in their forecast area was 37 mph (16.5 m/s) with a maximum wind gust of 45 mph (20.1 m/s) coming from the west. The climate report does not indicate where these values were recorded.

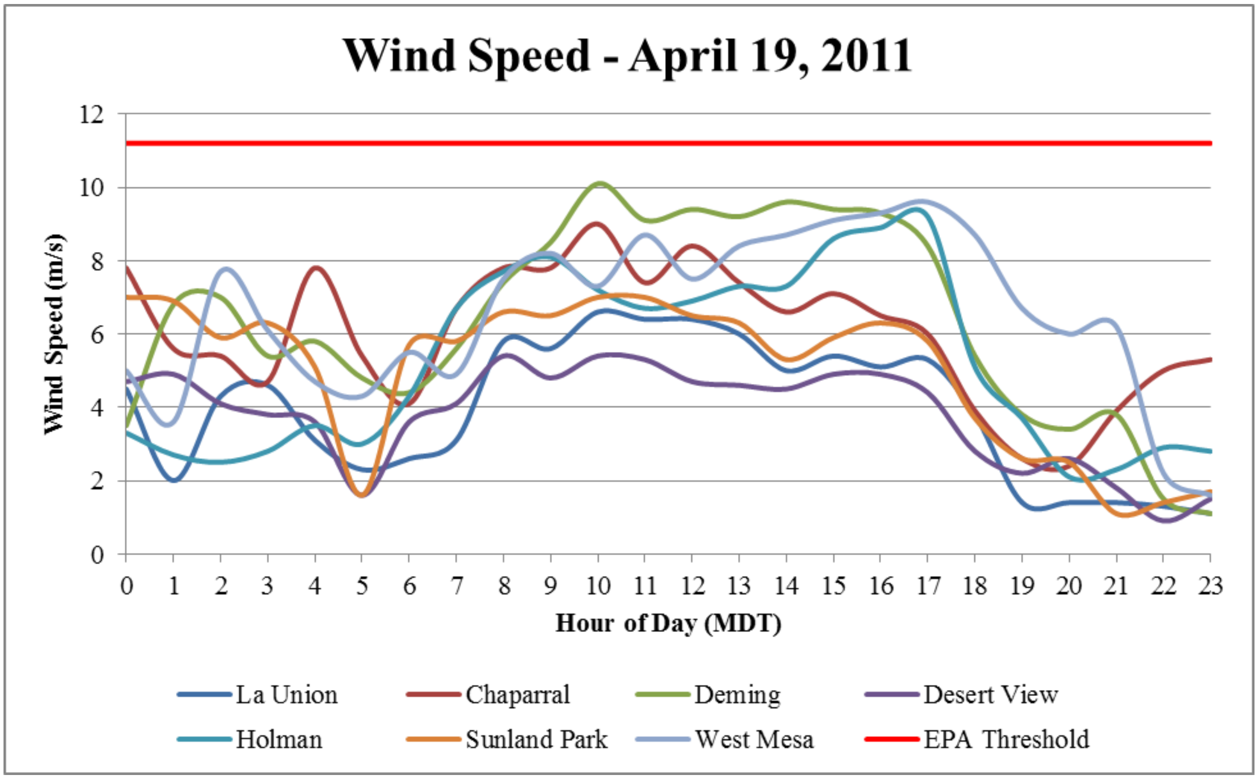

Figure 14-2. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

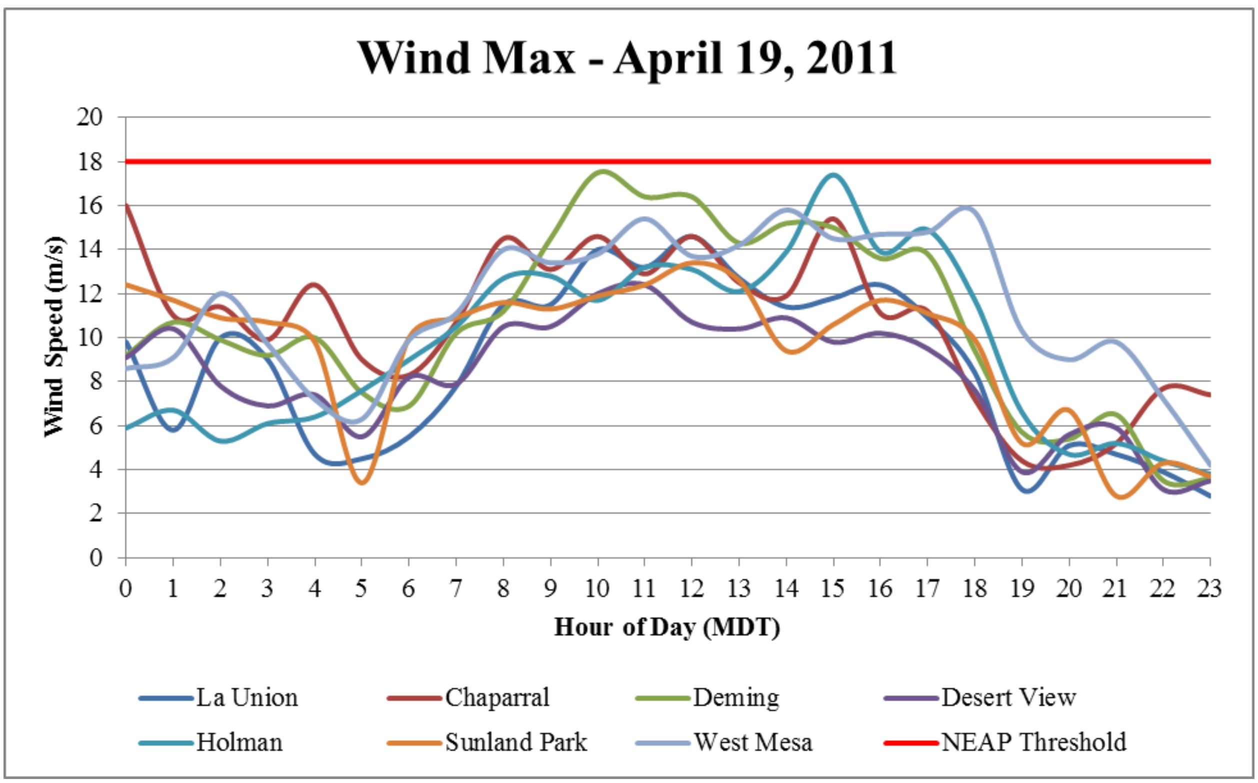

Figure 14-3. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

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 2006-2010 the PM_{10} FEM TEOM monitors recorded 211 exceedances and the PM_{10} FRM Wedding monitors recorded 5 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 (Table 2-1). The SPCY $PM_{2.5}$ FRM Partisol recorded 23 exceedances of the 24-Hour NAAQS from 2006-2010 (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 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 northern Mexico. A back-trajectory analysis using the HYSPLIT (Draxler et al., 2013; Rolph, 2013) model shows that the air masses traveled from northern Mexico, briefly into southern New Mexico, then just south of the New Mexico border to the monitors in southern Doña Ana County. The model starts ten hours before the peak of elevated PM_{10} concentrations measured during the event (Figure 14-4). 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.

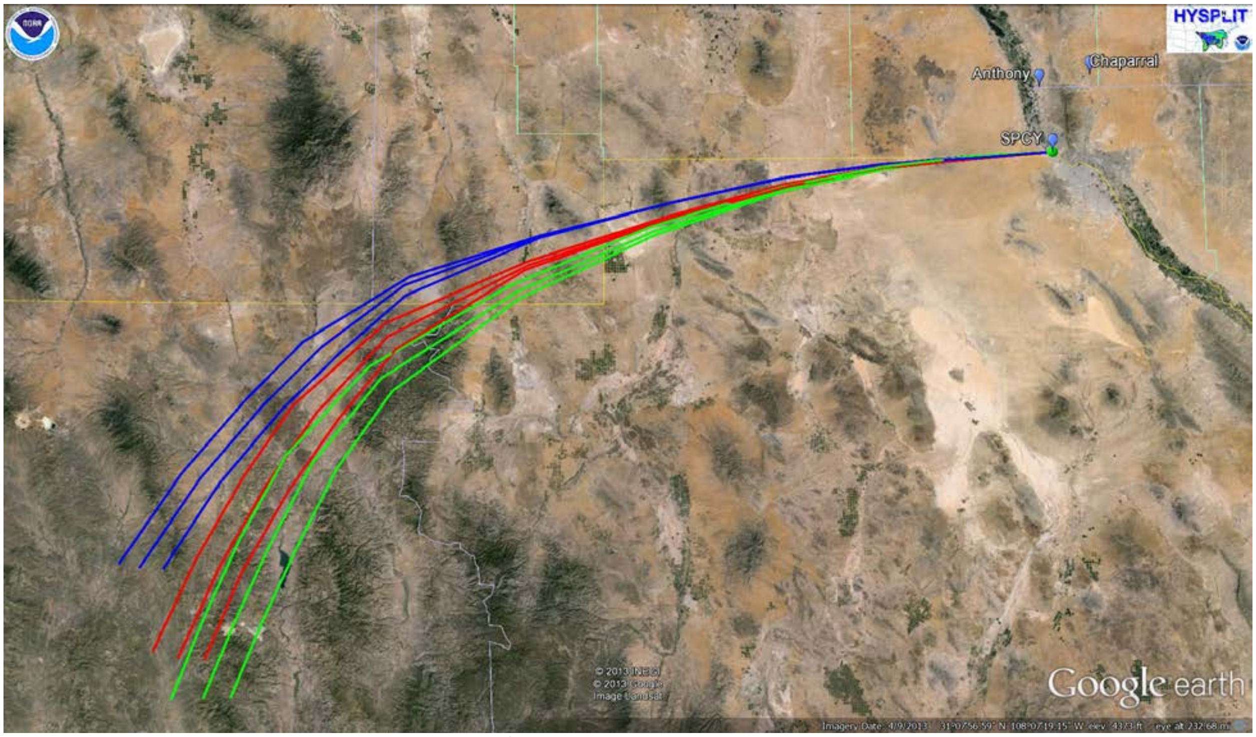

Figure 14-4. HYSPLIT back-trajectory model analysis for April 19, 2011.

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-4 through B-11). 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 2006-2010 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 2006-2010. 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

2006-2010. The recorded value for this day (167 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 19, 2011 on the hourly data distribution plots shows that the values recorded during the high wind event exceed the 95th percentile for PM_{10}, $PM_{2.5}$, and New Mexico-specific wind speed and gust thresholds (Figures 14-5a-b through 14-7). 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. It is conceivable that the SPCY site's environs could have affected the particulate monitors (dirt road, aggregate stock piles, construction equipment, and disturbed land), as indicated in the 2012 Technical System Audit (TSA) Report prepared by EPA 6.

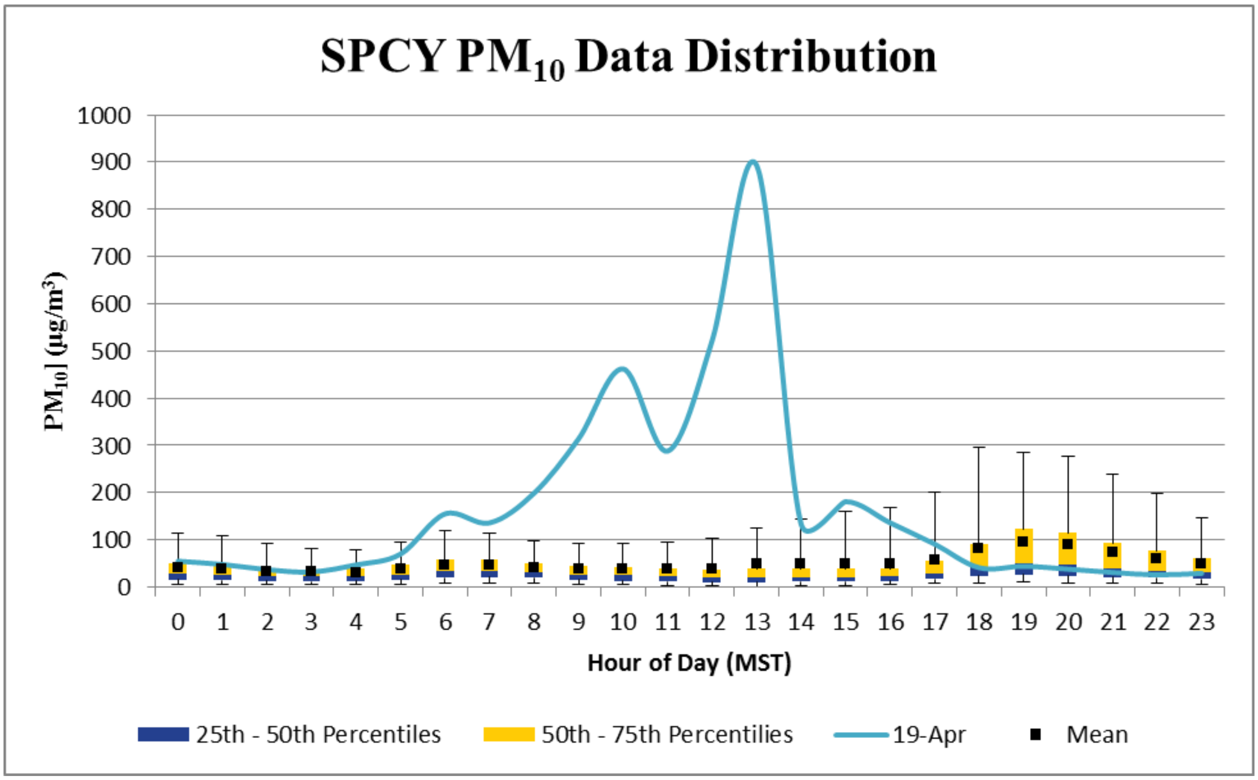

Figure 14-5a. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 19, 2011.

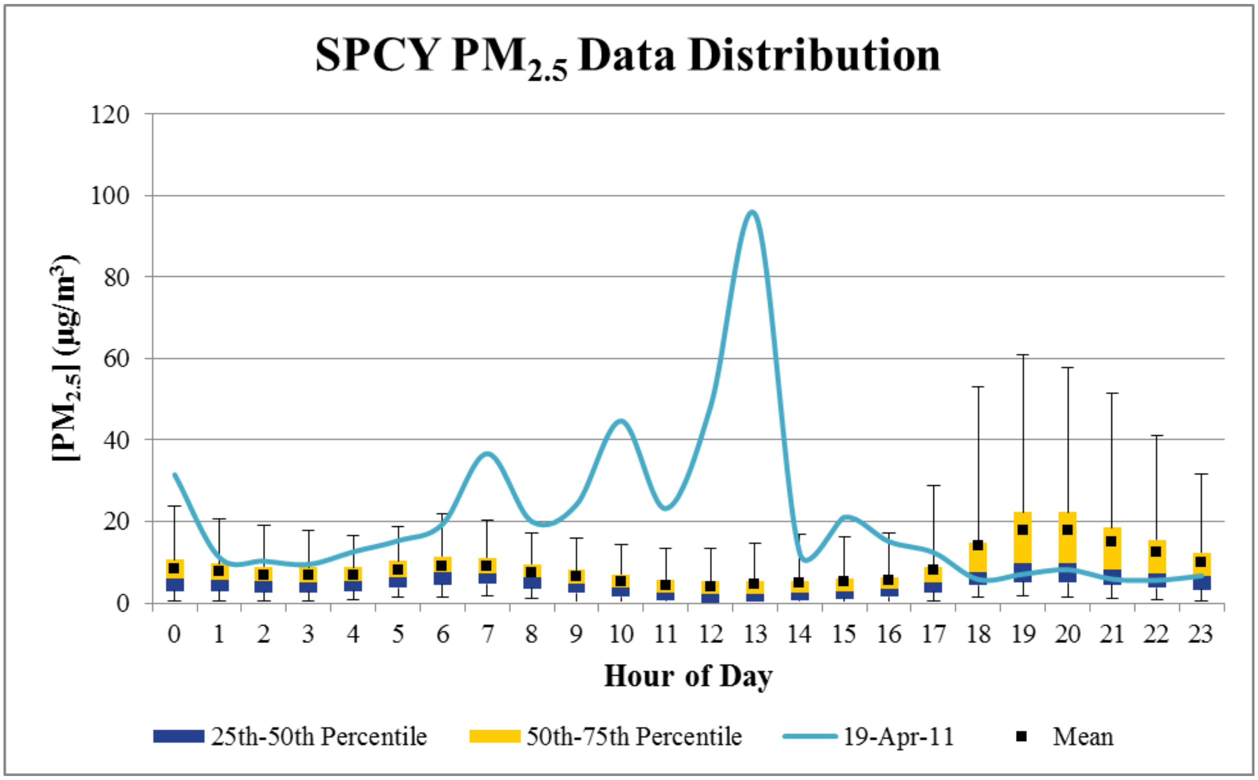

Figure 14-5b. $PM_{2.5}$ hourly data distribution from 2006-2010 overlaid by hourly values for April 19, 2011.

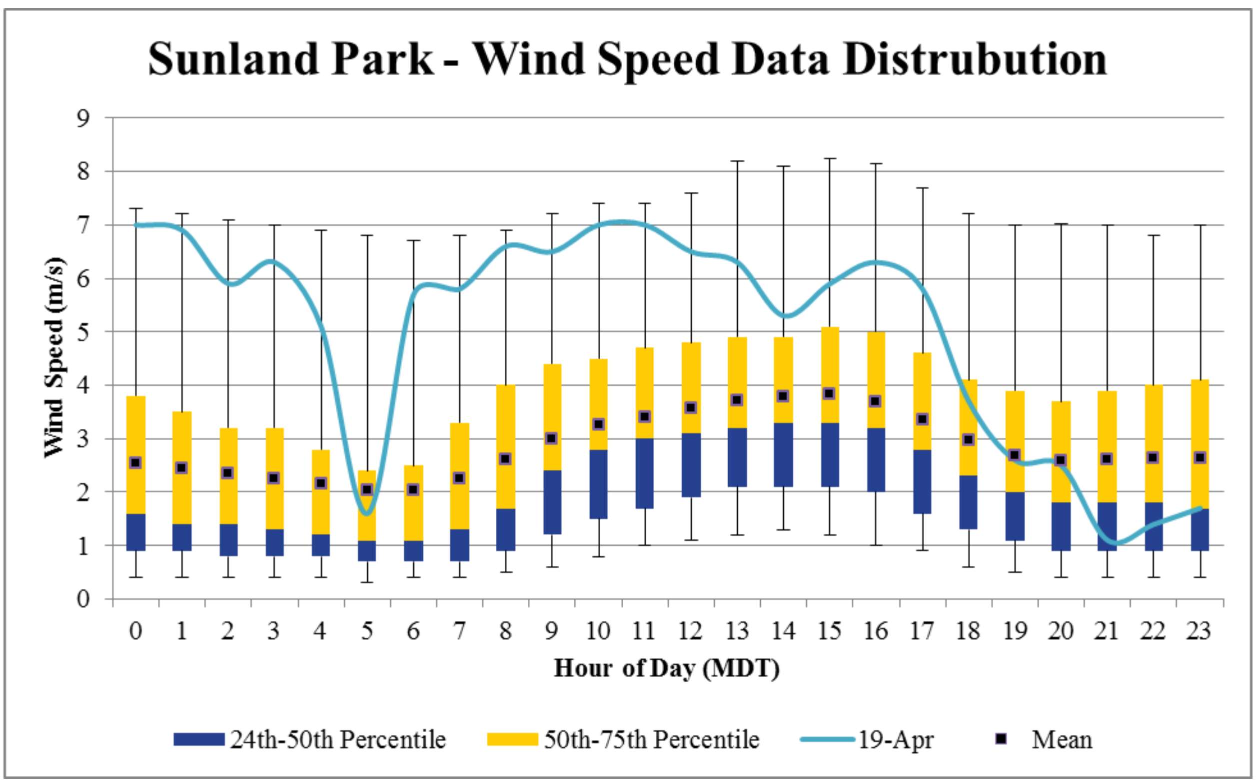

Figure 14-6. Hourly wind speed data distribution from 2006-2010 overlaid by hourly PM_{10} values for April 19, 2011.

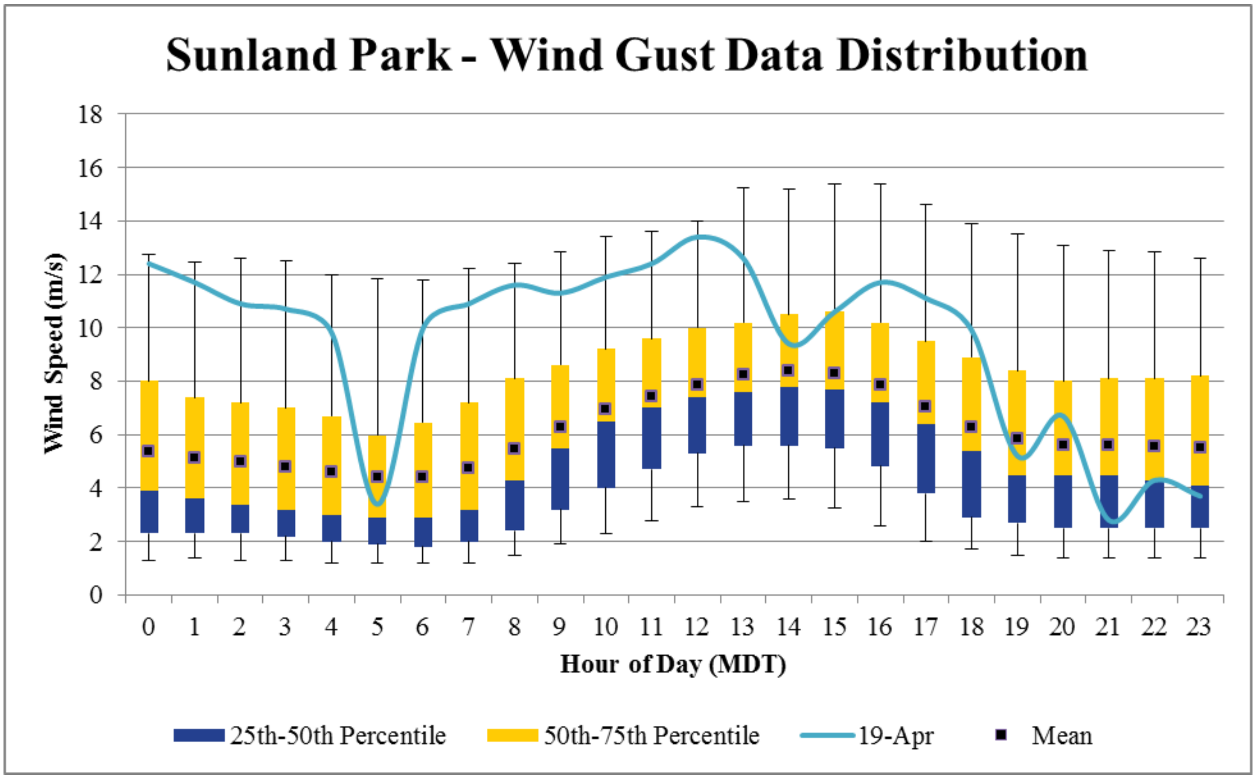

Figure 14-7. Hourly wind gust data distribution from 2006-2010 overlaid by hourly PM_{10} values for April 19, 2011.

14.4 Clear Causal Relationship

A backdoor cold front entered New Mexico on April 19, 2011. As the cold front moved south it stalled in central New Mexico with a low pressure area in northern New Mexico that created a weak pressure gradient over southeastern Arizona, southwestern New Mexico and northern Mexico (Figures 14-8a-c). Surface winds flow perpendicular to the isobars from high to low pressure. The wind direction in the upper atmosphere aligned with the surface wind direction (Figure 14-9). 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.

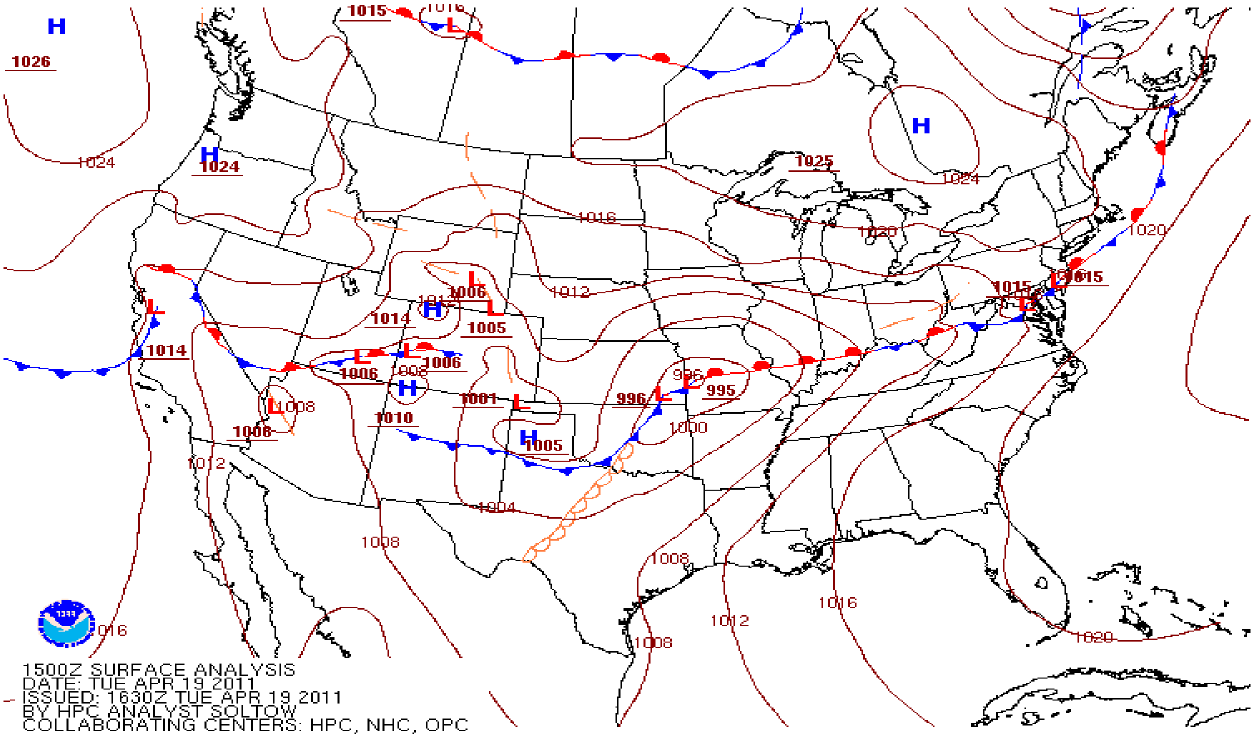

Figure 14-8a. Surface weather map showing frontal/thunderstorm activity and isobars of constant pressure (red lines) for April 19 at the 0900 hour MST.

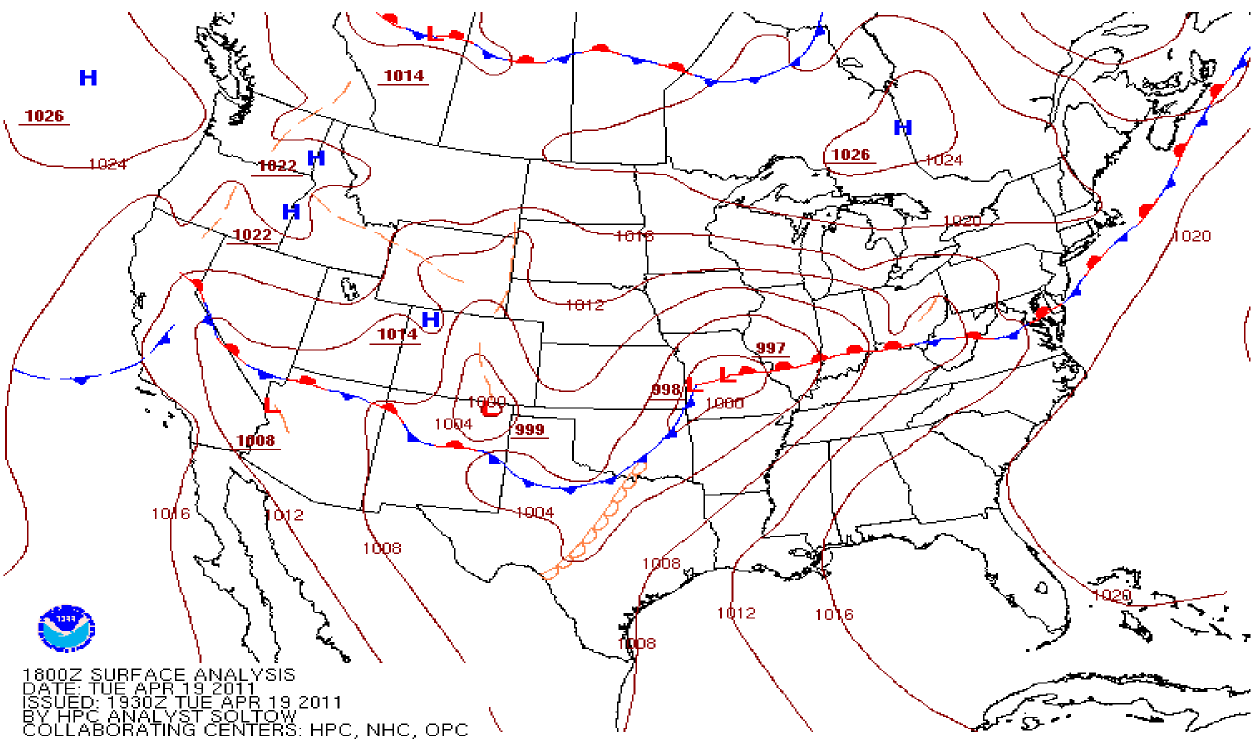

Figure 14-8b. Surface weather map showing frontal/thunderstorm activity and isobars of constant pressure (red lines) for April 19 at the 1200 hour MST.

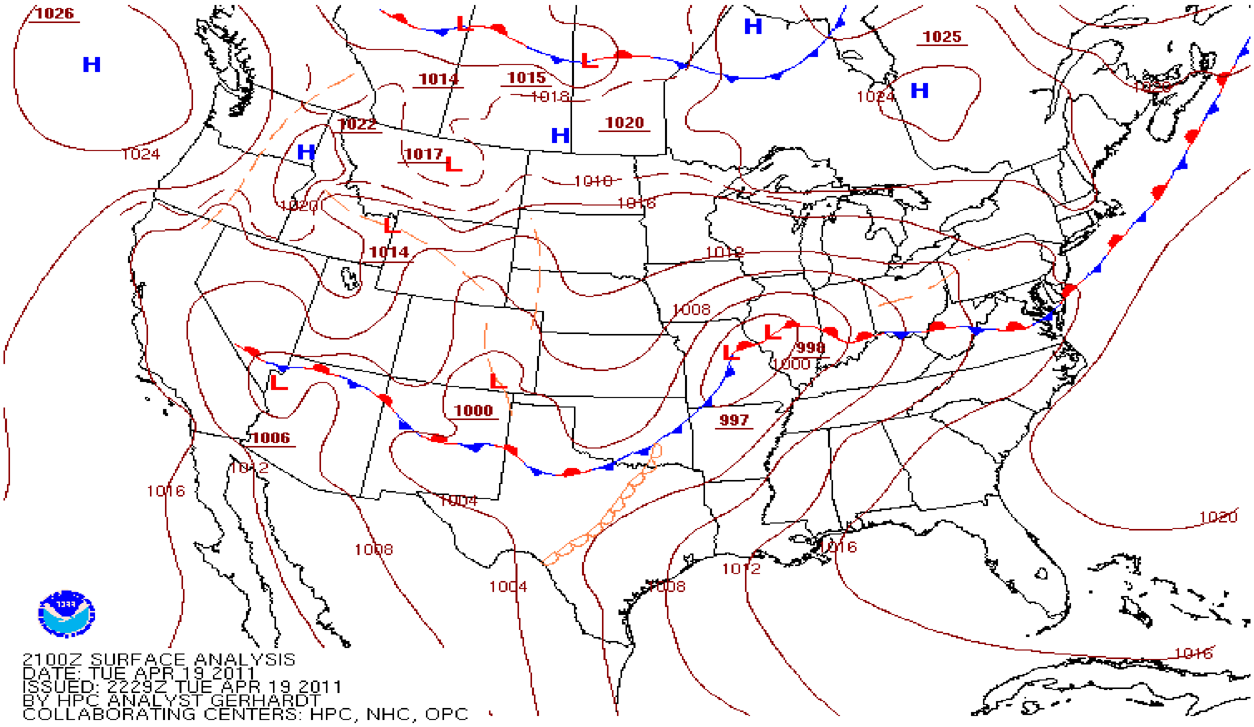

Figure 14-8c. Surface weather map showing frontal/thunderstorm activity and isobars of constant pressure (red lines) for April 19 at the 1500 hour MST.

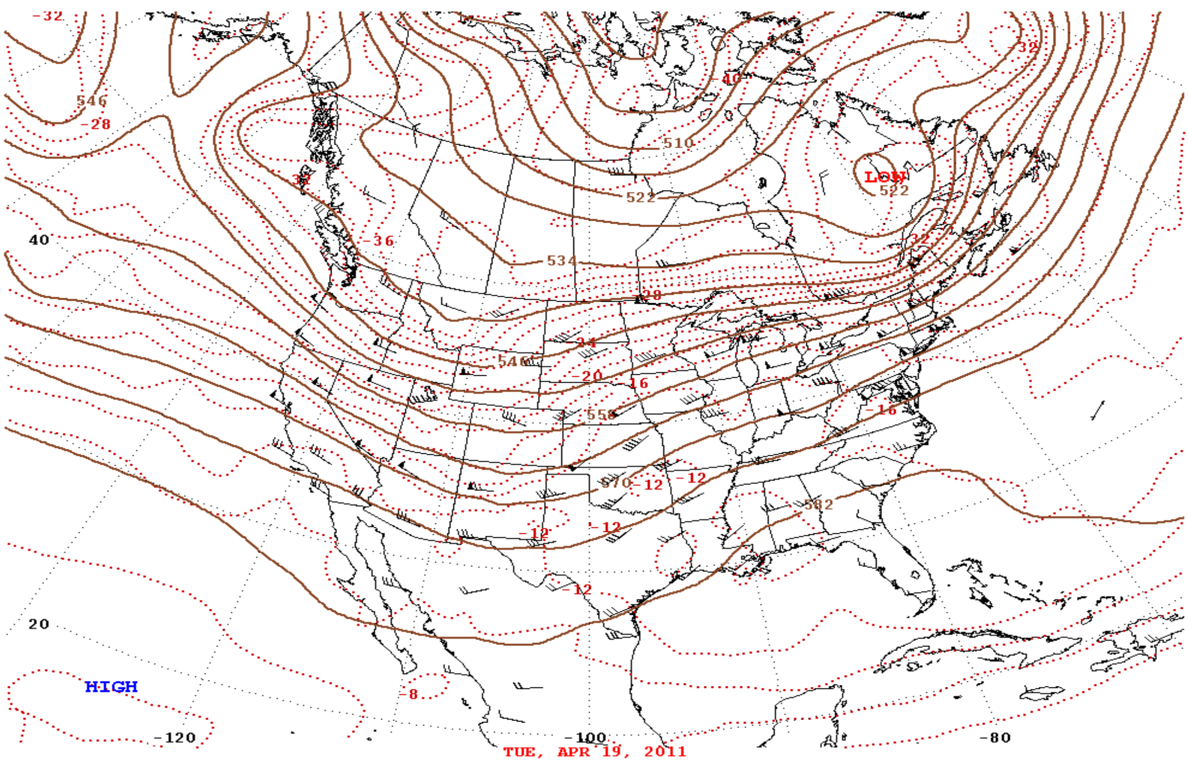

Figure 14-9. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on April 19, 2011.

The weather pattern described above generated strong southwesterly winds beginning at the 0900 hour and lasting through the 1800 hour. From the 0000-0500 hours, and again from the 0900-1800 hours, wind speeds exceeded 6 m/s at Chaparral and Sunland Park as shown in Figure 14-2. Peak wind speeds ranged from 6.6 m/s at La Union to 10.1 m/s at Deming (Figure 14-2). Peak wind gusts ranged from 13.4 m/s at Sunland Park to 17.4 m/s at Holman (Figure 14-3). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plots in Figure 14-10a-b. As wind speed and wind gusts exceed the New Mexico-specific thresholds so do hourly PM_{10} concentrations on this date (0600-1500 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations did not spike at the other monitoring sites in the network, indicating that this was a localized event (Figure 14-11). Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM Monitors show good correlation of the timing of spikes in concentrations (Figure 14-12).

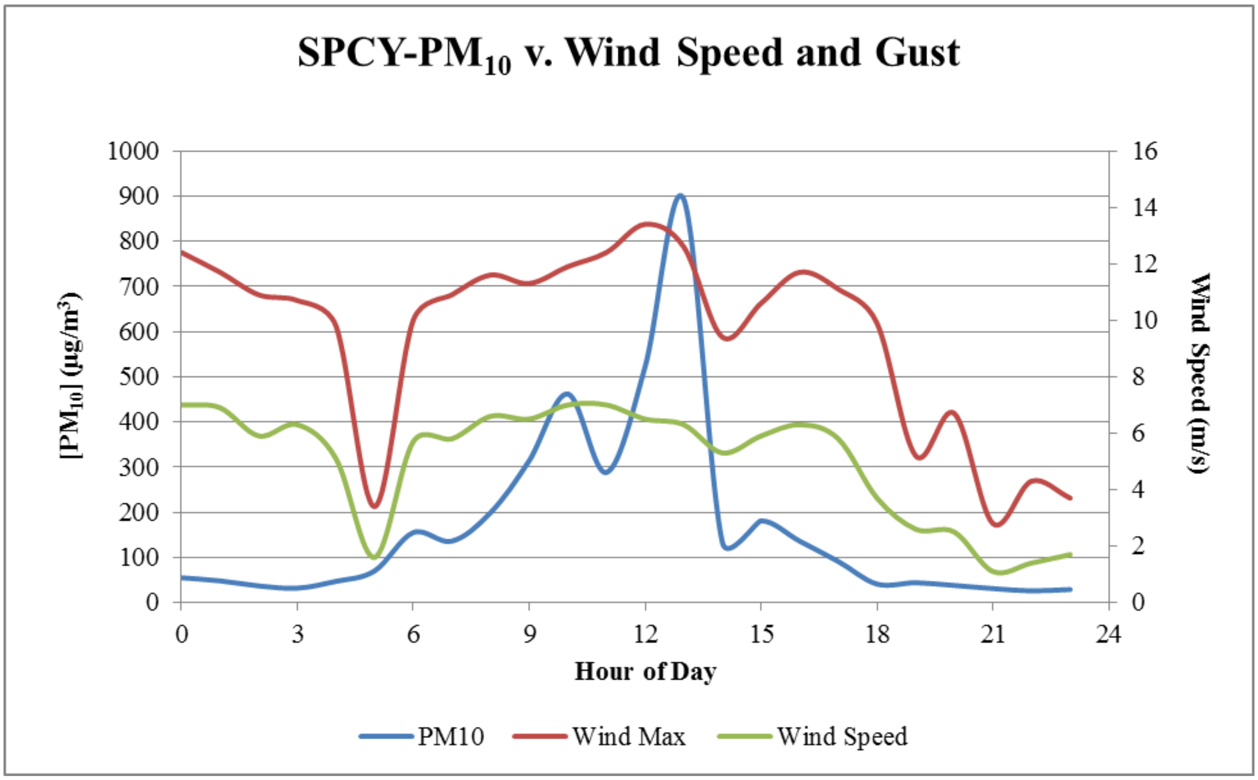

Figure 14-10a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

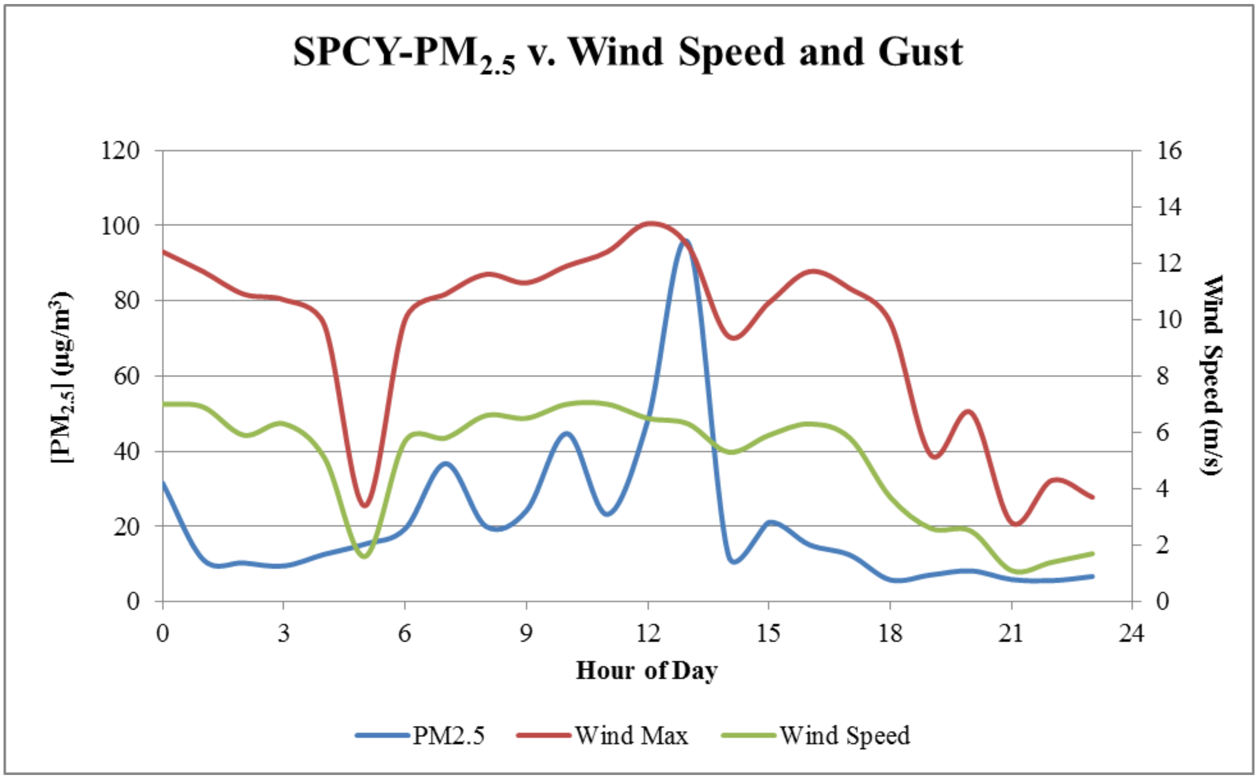

Figure 14-10b. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

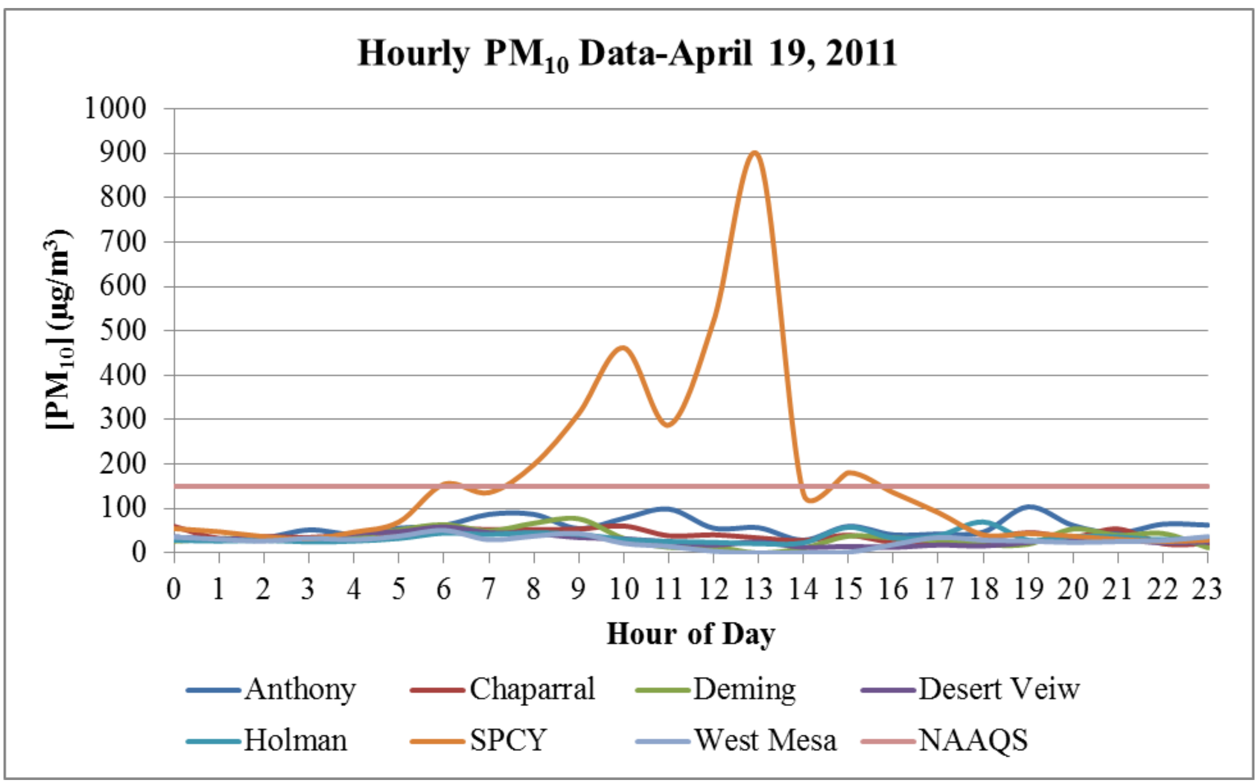

Figure 14-11. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors. Non-FEM hourly $PM_{2.5}$ data.

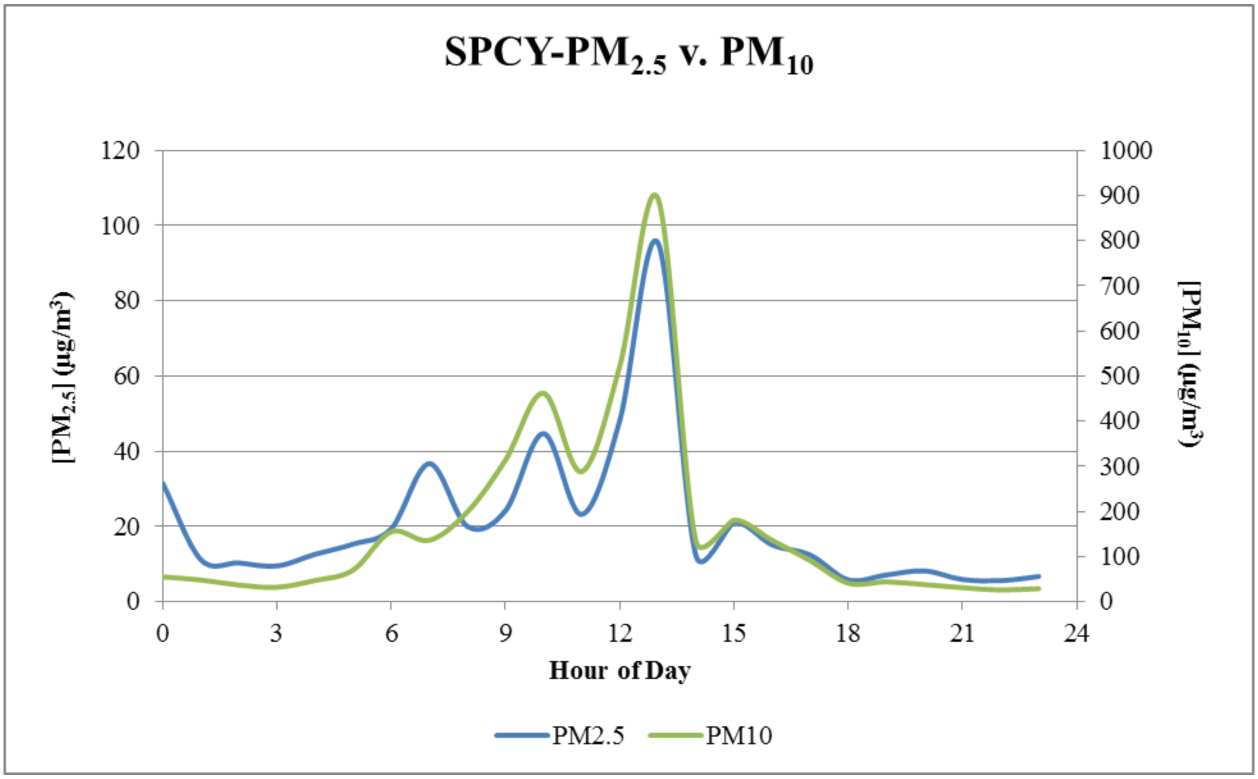

Figure 14-12. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on April 19, 2011.

The NWS El Paso Office issued a Critical Fire Weather Alert on April 19, 2011 forecasting strong winds and noting the following,

> STRONG WINDS ALOFT AND LOW PRESSURE OVER EASTERN NEW MEXICO AND THE TEXAS PANHANDLE WILL CAUSE STRONG WINDS THIS EVENING AND MONDAY.
>
> * WINDS...WEST WINDS AT THE 20-FOOT LEVEL 20 TO 30 MPH WITH GUSTS TO 40 MPH (NWS, 2011).

14.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on April 19, 2011.

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 Sunland Park monitor detected blowing dust around the 0600 hour with hourly concentrations heavily impacted until the 1500 hour. By replacing these ten hourly values with the 95th percentile of hourly data at the Sunland Park site, the resulting 24-hour average (78 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 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	55	55
1	48	48
2	37	37
3	32	32
4	47	47
5	70	70
6	155	**120**
7	136	**115**
8	199	**98**
9	314	**93**
10	462	**93**
11	288	**95**
12	522	**104**
13	893	**125**
14	133	**133**
15	181	**160**
16	136	136
17	91	91
18	41	41
19	44	44
20	38	38
21	31	31
22	26	26
23	29	29
24-Hour Average	167	**78**

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 Sunland Park.

15 HIGH WIND EXCEPTIONAL EVENT: April 24, 2011

15.1 Summary of Event

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 and the $PM_{2.5}$ 24-hour and annual NAAQS at the SPCY site on April 24, 2011. The PM_{10} FEM TEOM continuous monitor and the $PM_{2.5}$ FRM Partisol at this site recorded 24-hour average concentrations of 205 and 27.6 µg/m^3, respectively (Figure 15-1). 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.

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.

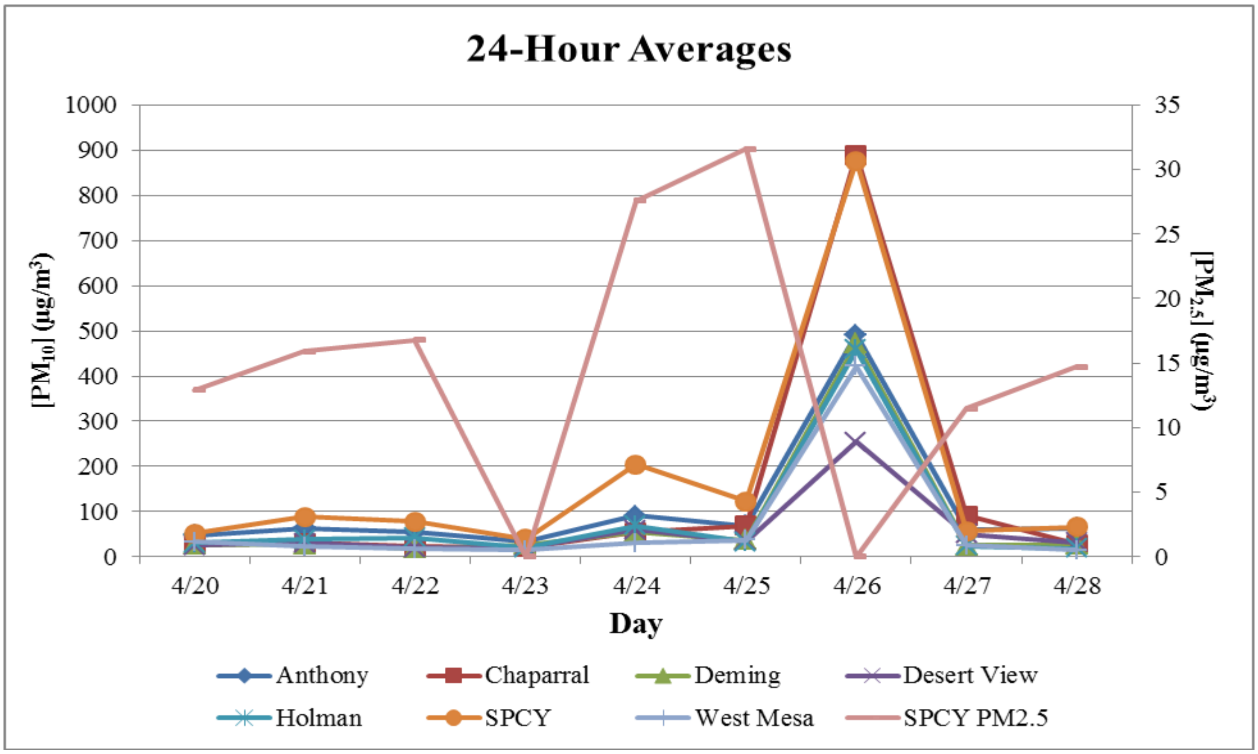

Figure 15-1. PM_{10} and $PM_{2.5}$ 24-hour averages before and after April 24, 2011.

15.2 Is Not Reasonably Controllable or Preventable

15.2.1 <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, and unpaved roads in Mexico and New Mexico. The City of Las Cruces and Doña Ana County Ordinances require BACM for any dust producing activities. The largest and most likely source of windblown dust is 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 April 24, 2011, sustained wind speeds exceeded EPA's default threshold at two of the seven monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at four of the seven monitoring sites (Figures 15-2 and 15-3). Winds exceeded these thresholds at one or more monitoring sites beginning at the 1300 hour and ending at the 1800 hour.

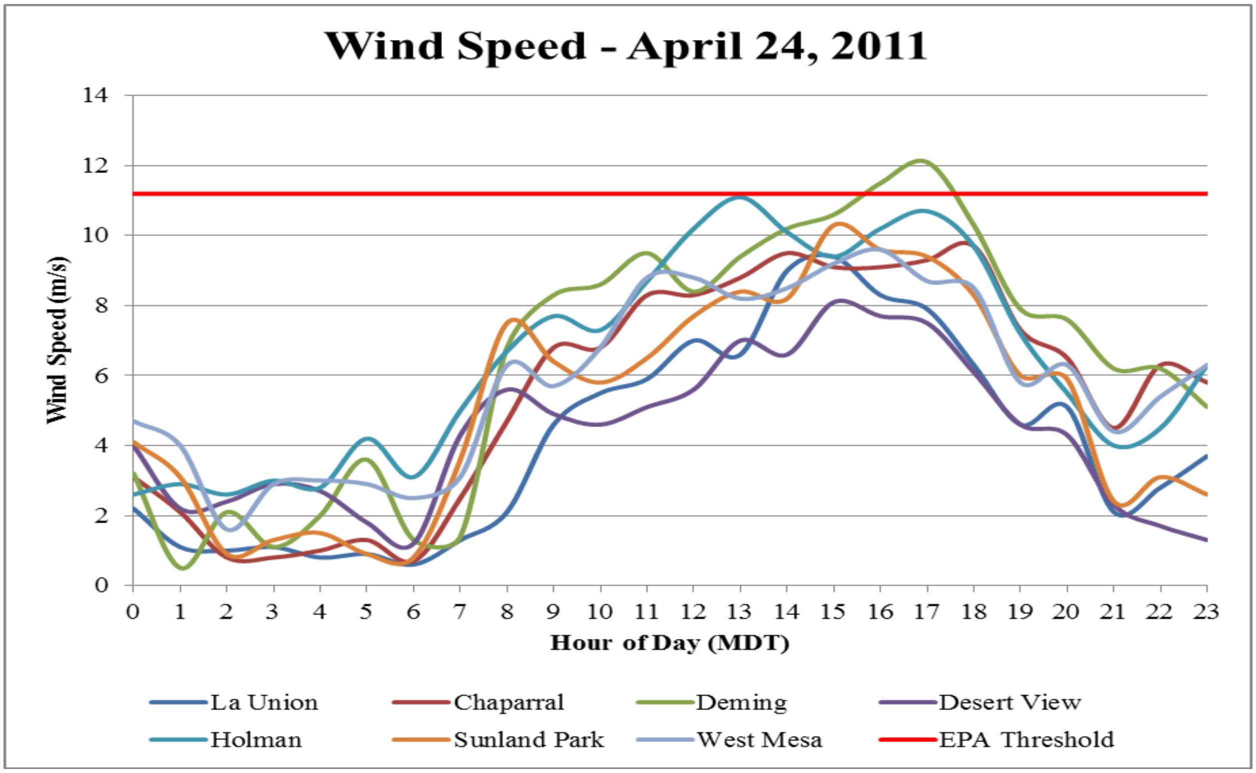

Figure 15-2. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

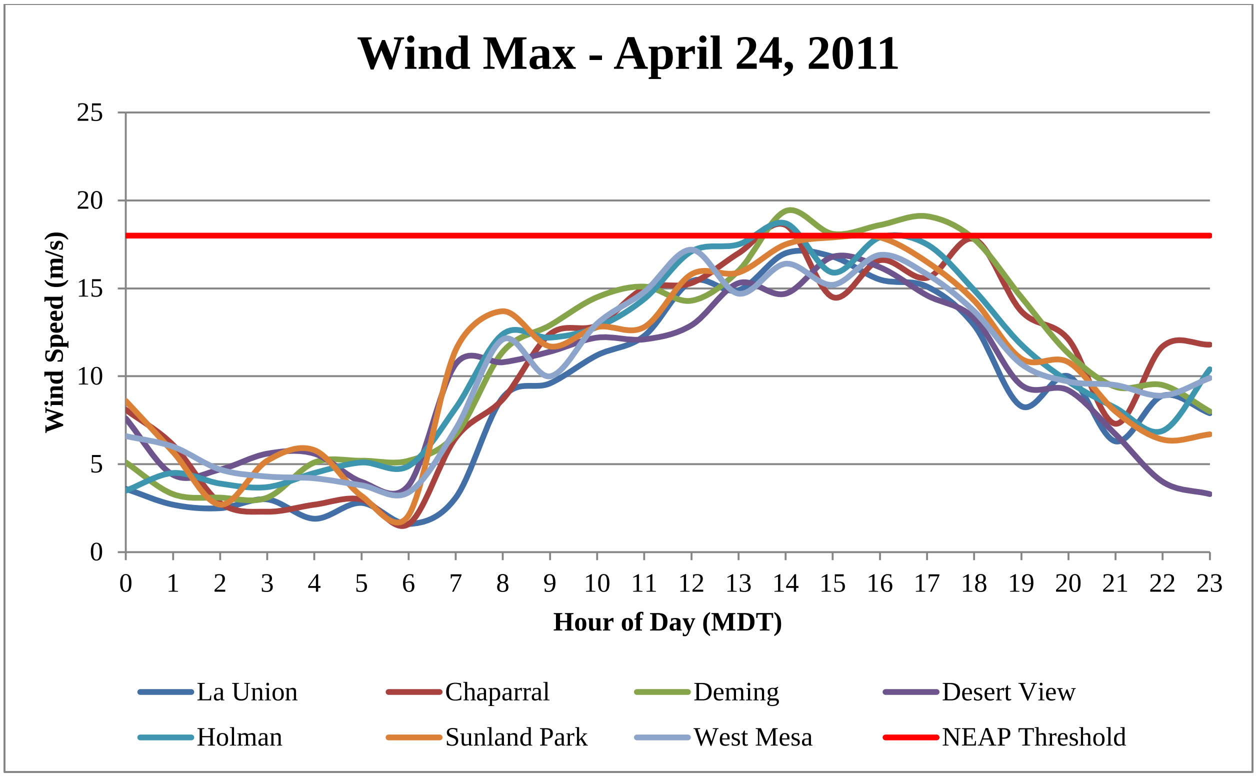

Figure 15-3. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

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 2006-2010 the PM_{10} FEM TEOM monitors recorded 211 exceedances and the PM_{10} FRM Wedding monitors recorded 5 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 (Table 2-1). The SPCY $PM_{2.5}$ FRM Partisol recorded 23 exceedances of the 24-Hour NAAQS from 2006-2010 (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 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 at the SPCY site. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 15-4). 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.

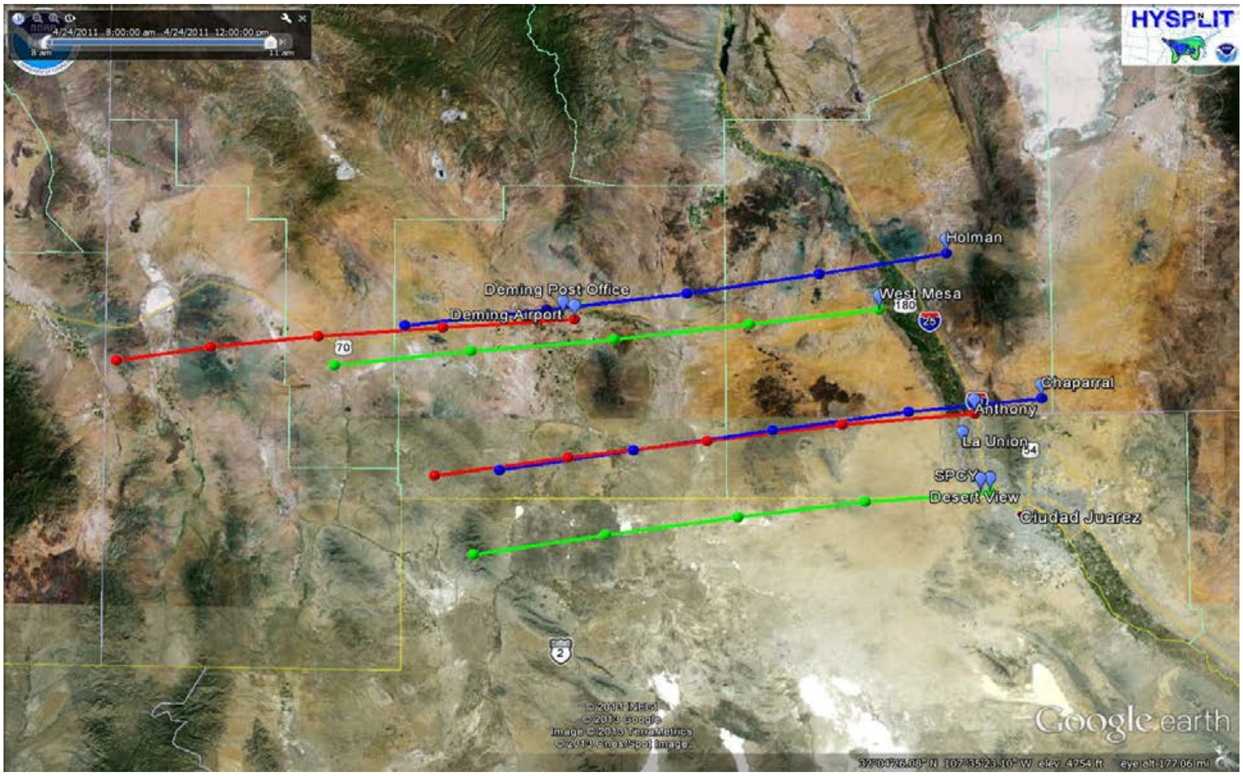

Figure 15-4. HYSPLIT back-trajectory model analysis for April 24, 2011.

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-4 through B-11). 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 2006-2010 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 2006-2010. 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 2006-2010. The recorded value for this day (205 $\mu g/m^3$) is 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 24, 2011 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 15-5a-b through 15-7). 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.

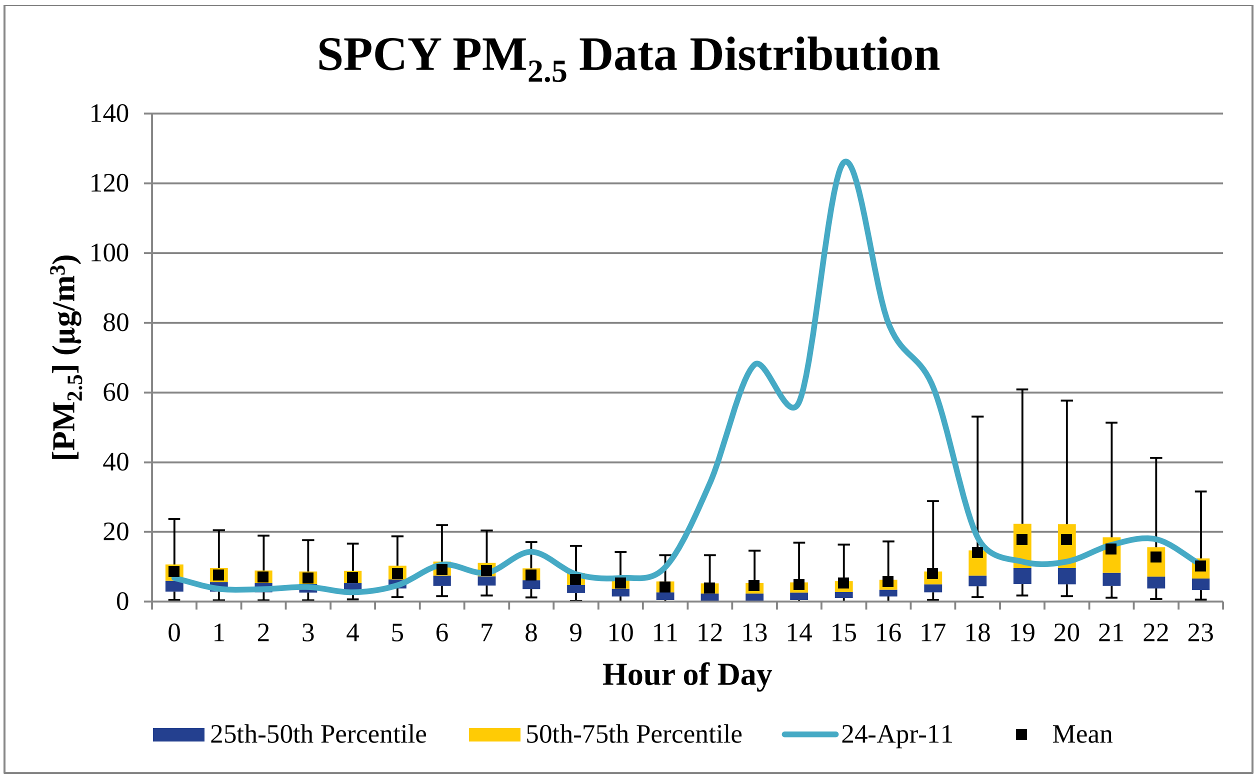

Figure 15-5a. $PM_{2.5}$ hourly data distribution from 2006-2010 overlaid by hourly values for April 24, 2011.

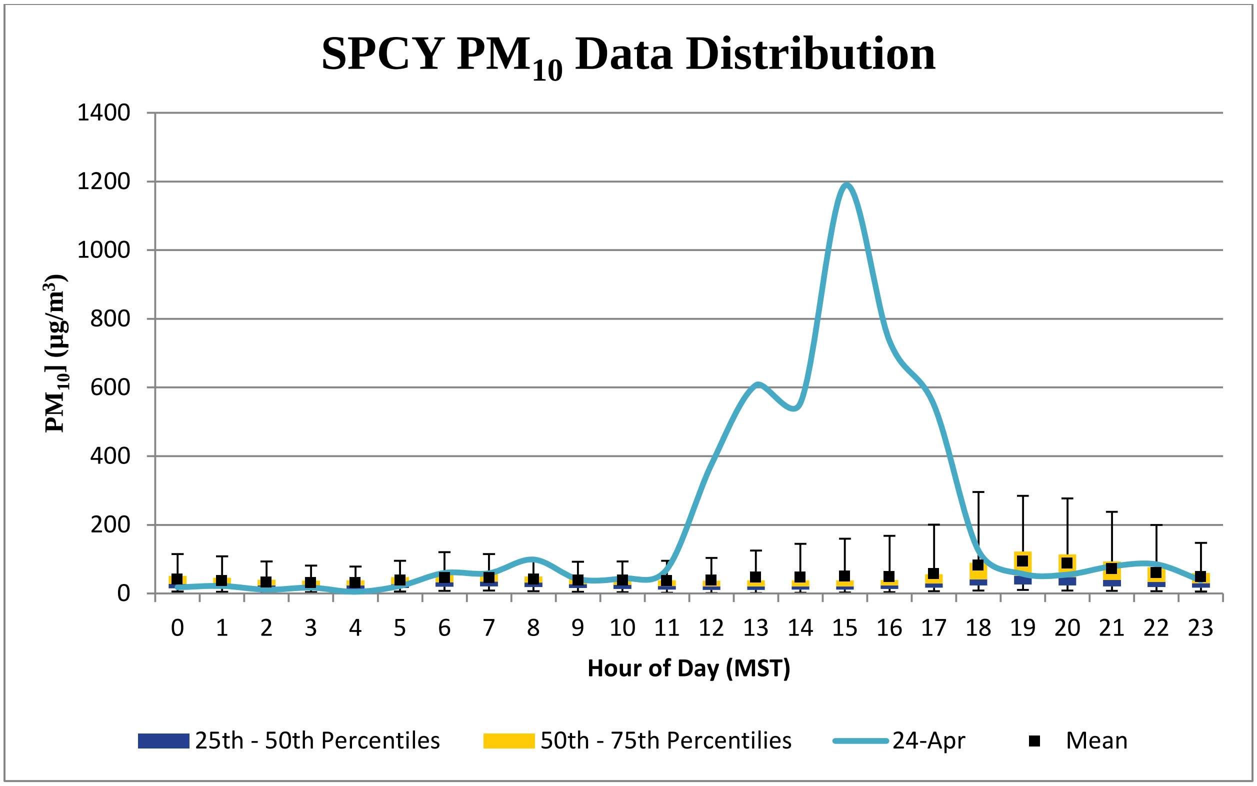

Figure 15-5b. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 24, 2011.

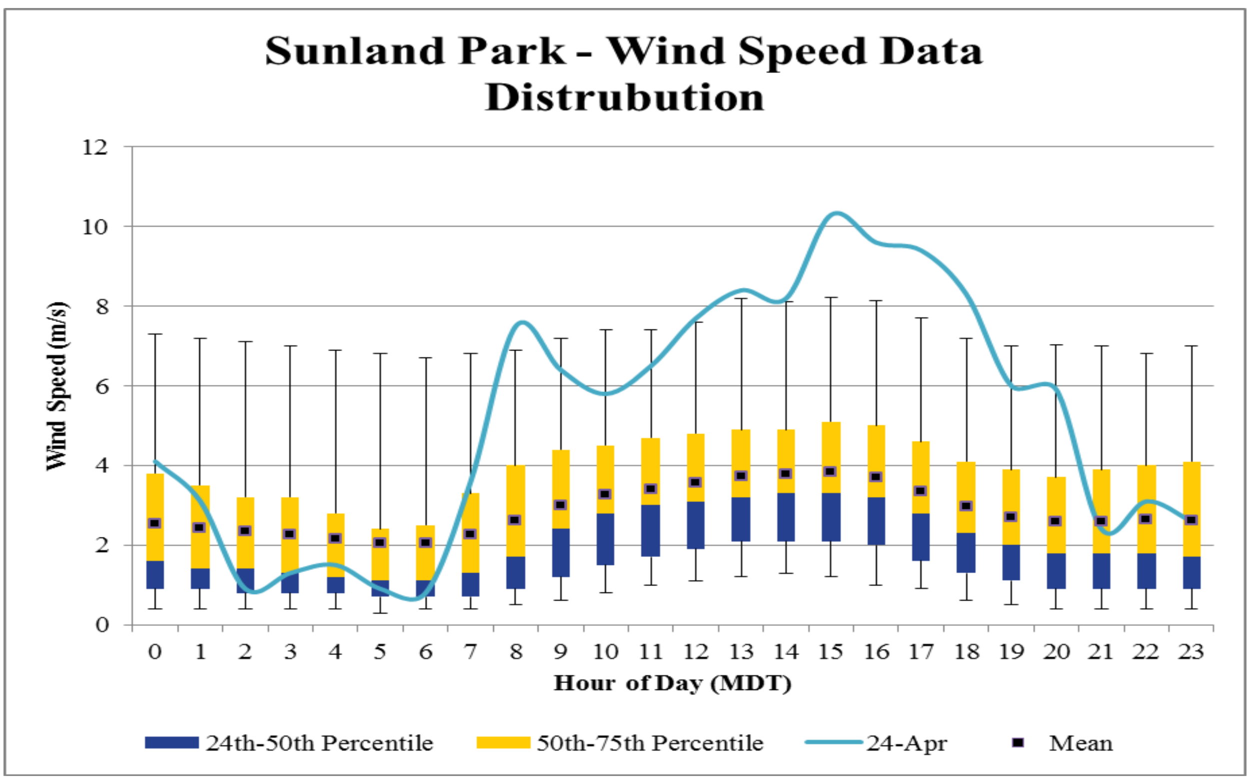

Figure 15-6. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 24, 2011.

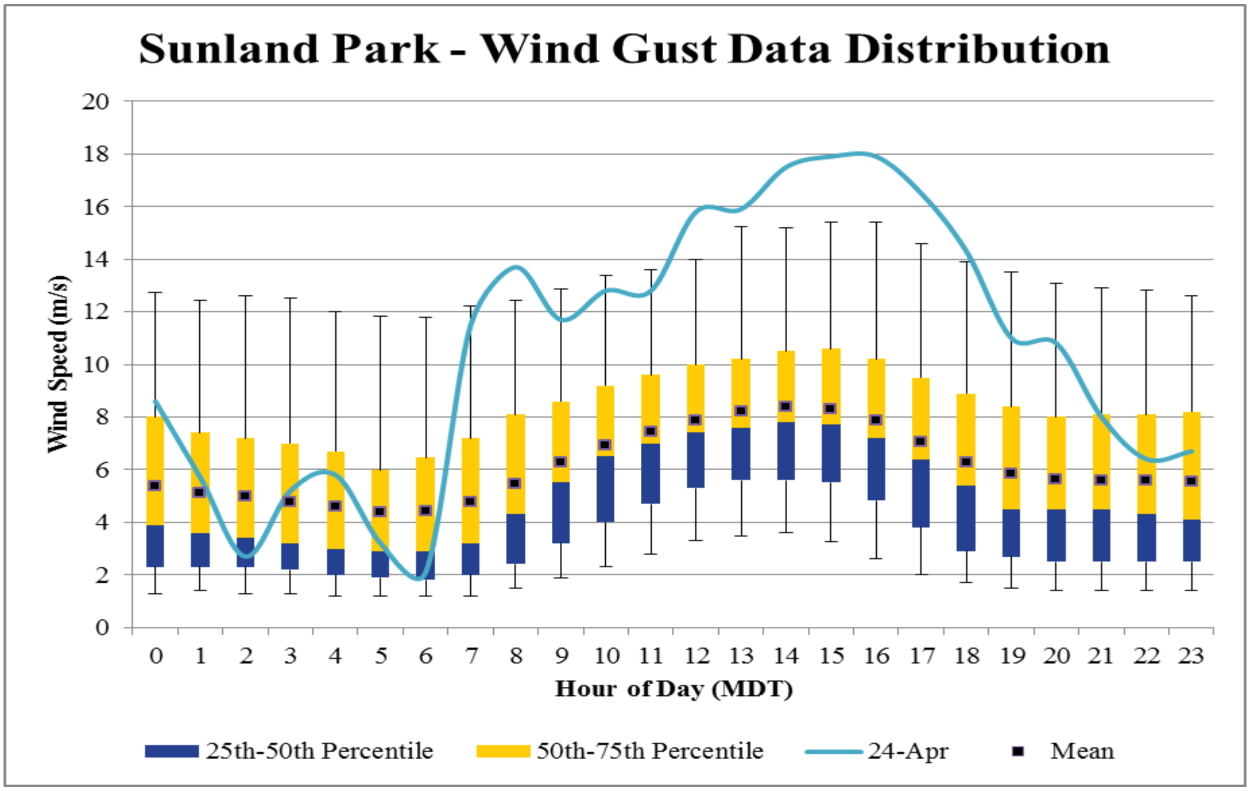

Figure 15-7. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 24, 2011.

Although the only recorded exceedance of the PM_{10} 24-hour NAAQS occurred at the SPCY site, the nearby Desert View site did record hourly values exceeding that site's 95th percentile for PM_{10} from 1500 – 1700 hours on April 24, 2011. It is conceivable that the SPCY site's environs could have affected the particulate monitors (dirt road, aggregate stock piles, construction equipment, and disturbed land), as indicated in the 2012 Technical System Audit (TSA) Report prepared by EPA 6.

15.4 Clear Causal Relationship

A stationary front lingered over New Mexico on April 23 into April 24, 2011 (Figures 15-8a-b). As the day progressed, the stationary front slowly moved to the eastern part of the state, creating low pressure centers over the north-central area of the state and just south of the southeast corner of the New Mexico – Texas border. At the time the SPCY monitor first recorded high winds and PM_{10} concentrations, the stationary front had transformed almost completely to a warm front over Texas, creating low pressure centers over the northeast and southeast corners of New Mexico, creating a pressure gradient over New Mexico, Arizona and northern Mexico. As the stationary front moved eastward through New Mexico, the pressure gradient tightened and winds became stronger at the surface (Figure 15-8c). Surface winds flow perpendicular to the isobars from high to low pressure. The wind direction in the upper atmosphere aligned with the surface wind direction (Figure 15-9). 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.

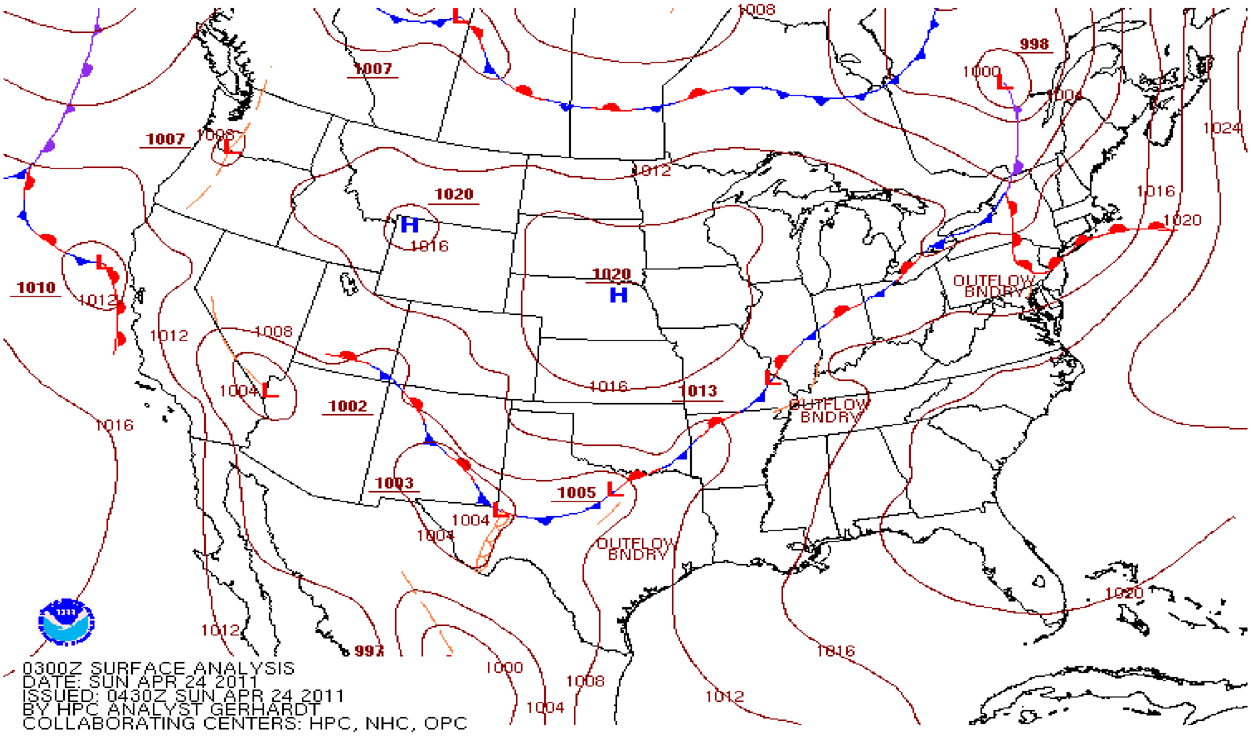

Figure 15-8a. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 23, 2011 at the 2100 hour.

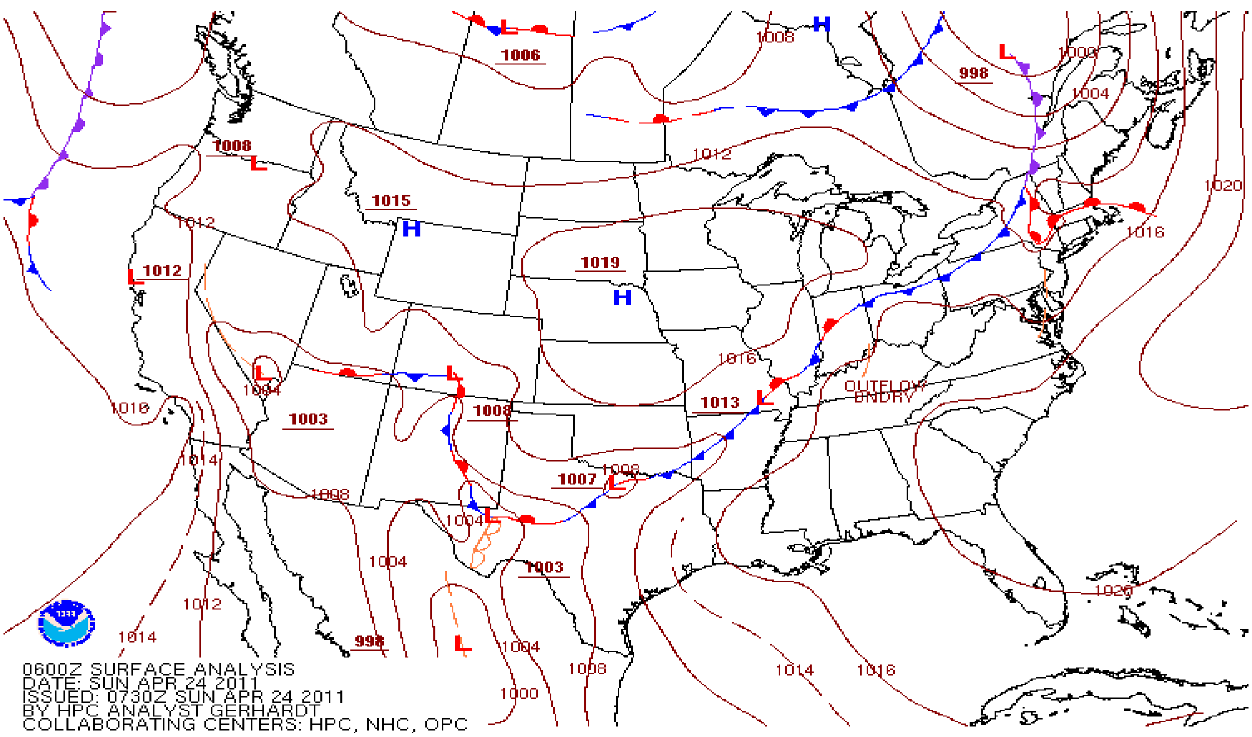

Figure 15-8b. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 24, 2011 at the 0000 hour.

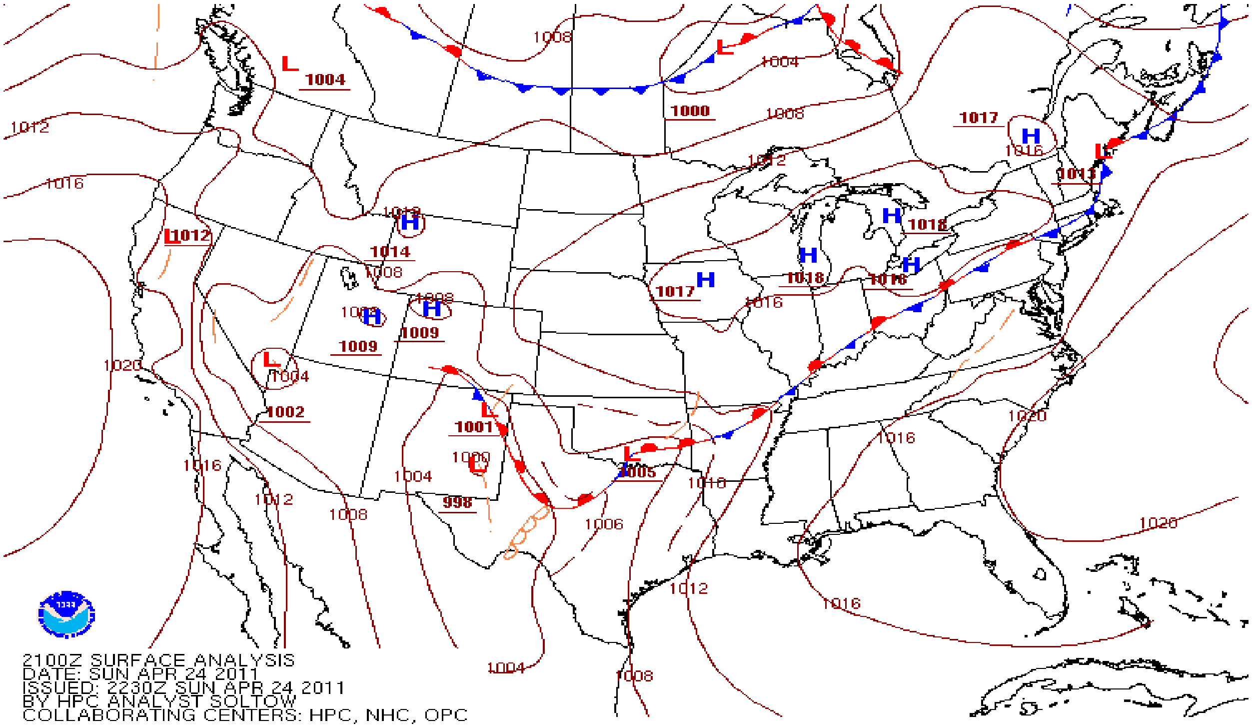

Figure 15-8c. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 24, 2011 at the 1500 hour.

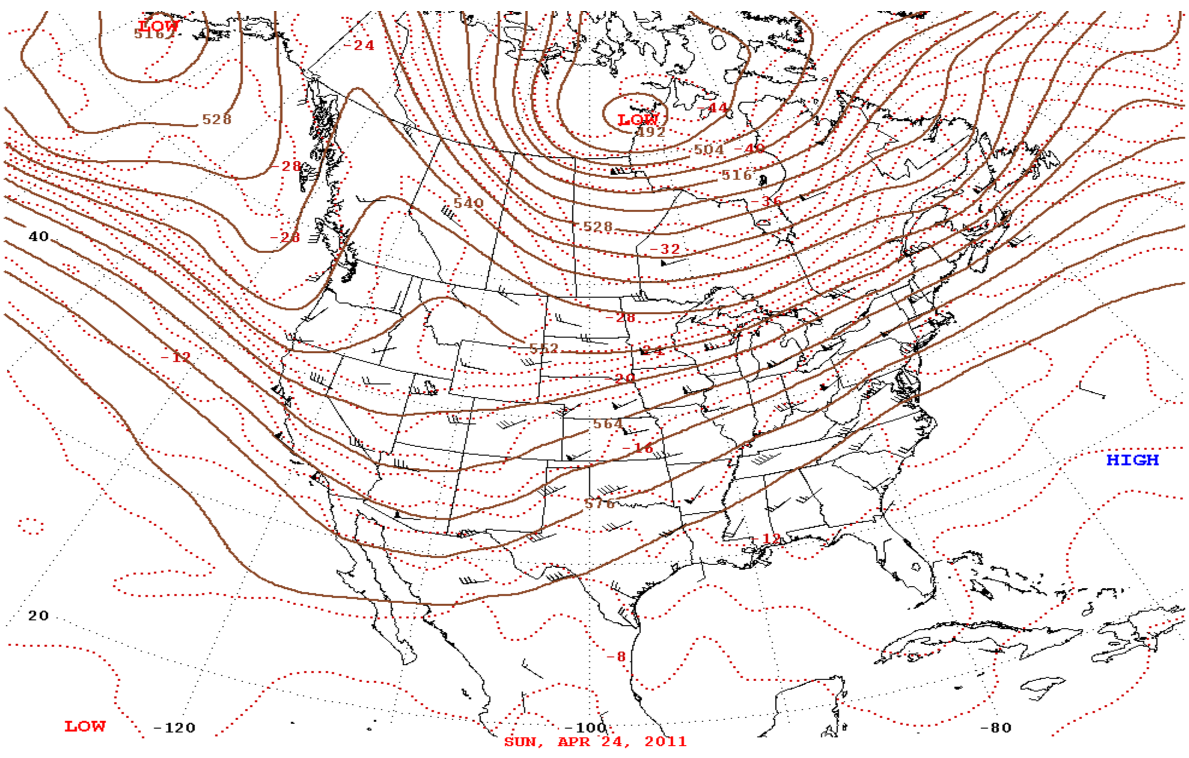

Figure 15-9. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on April 24, 2011.

The weather pattern described above generated strong westerly winds beginning at the 1200 hour and lasting through the 1800 hour. Beginning at the 1200 hour, wind speeds exceeded the historical 95th percentile of data at SPCY as shown in Figure 15-6. Peak wind speeds ranged from 9.4 m/s at La Union to 12.1 m/s at Deming (Figure 15-2). Peak wind gusts ranged from 16.8 m/s at Desert View to 19.4 m/s at Deming (Figure 15-3). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 15-10a-b. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (1200-1800 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 15-11a-b). Hourly data from the SPCY PM_{10} and $PM_{2.5}$ TEOM monitors show good correlation of the timing of spikes in concentrations (Figure 15-12).

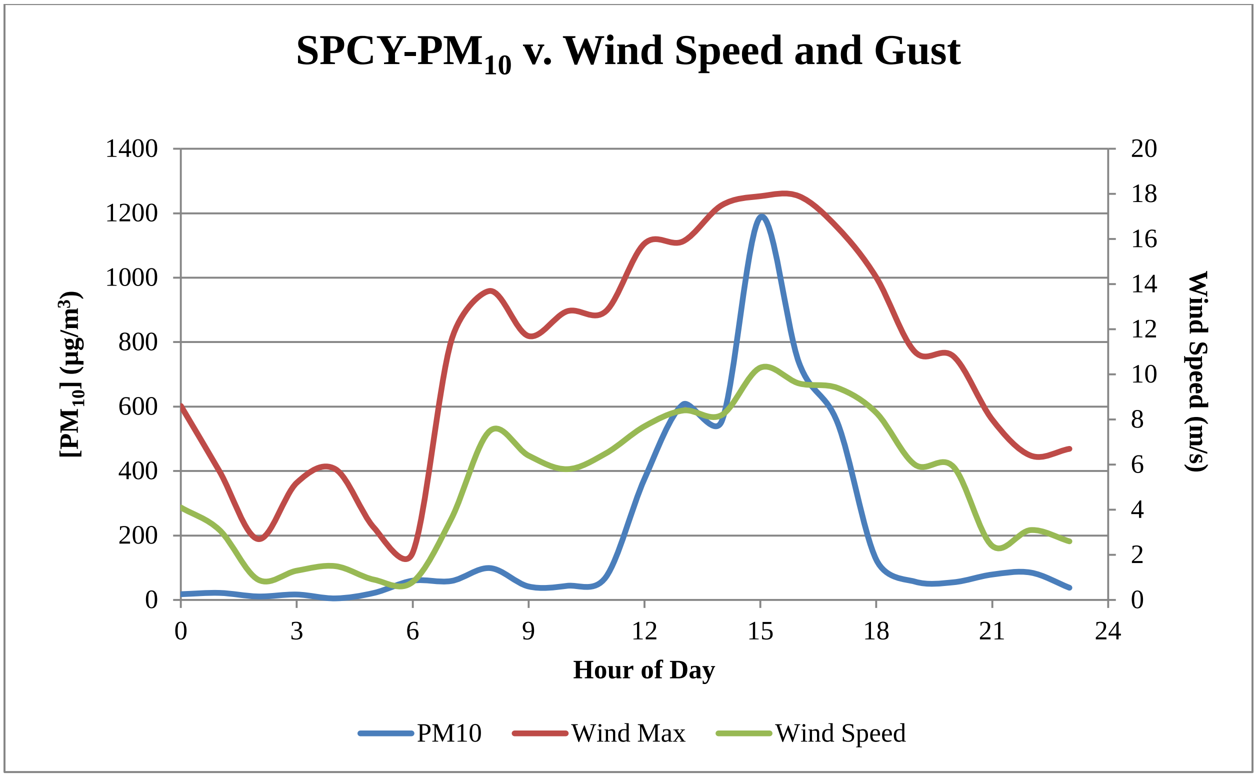

Figure 15-10a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

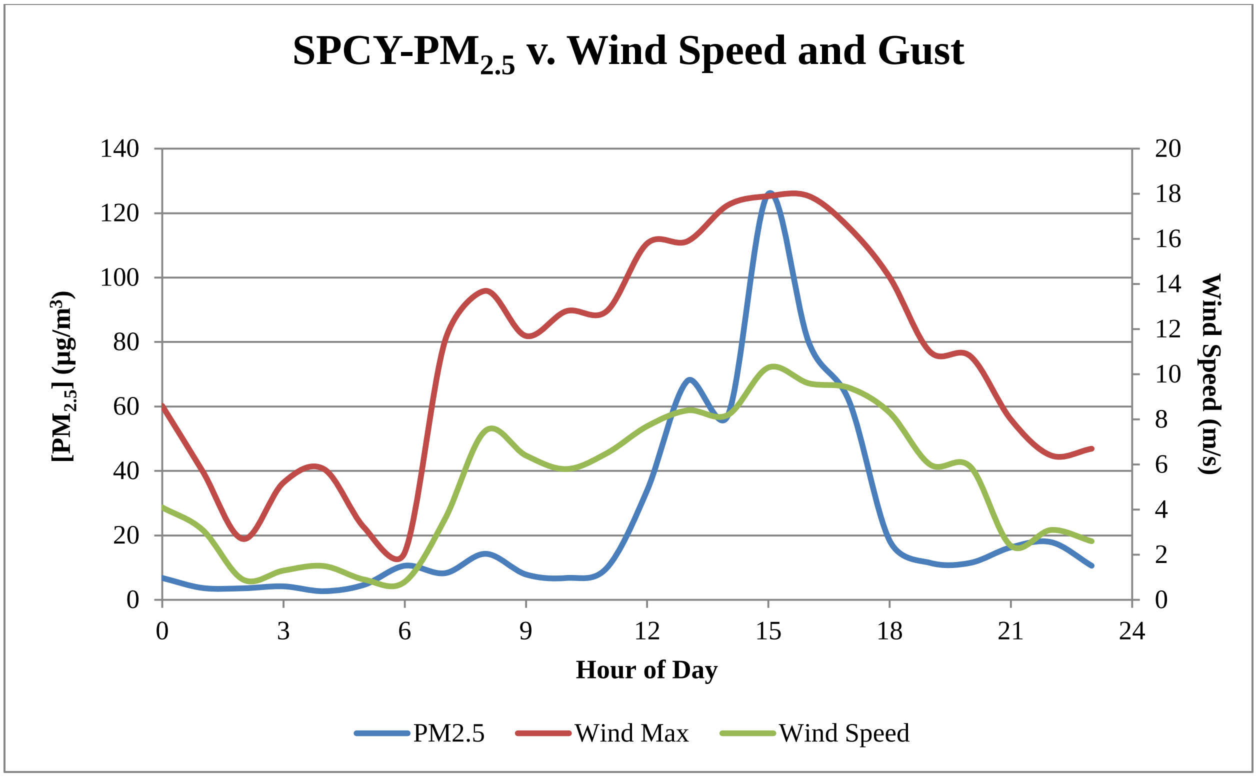

Figure 15-10b. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase.

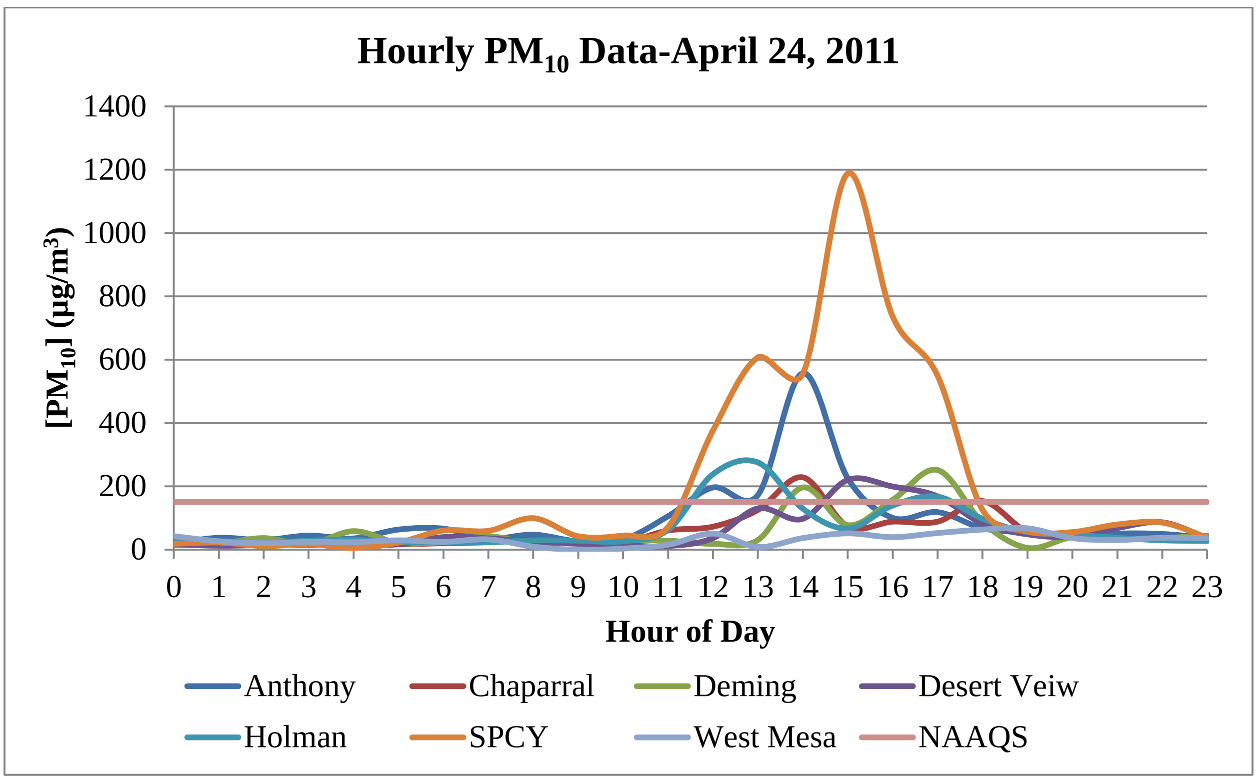

Figure 15-11a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

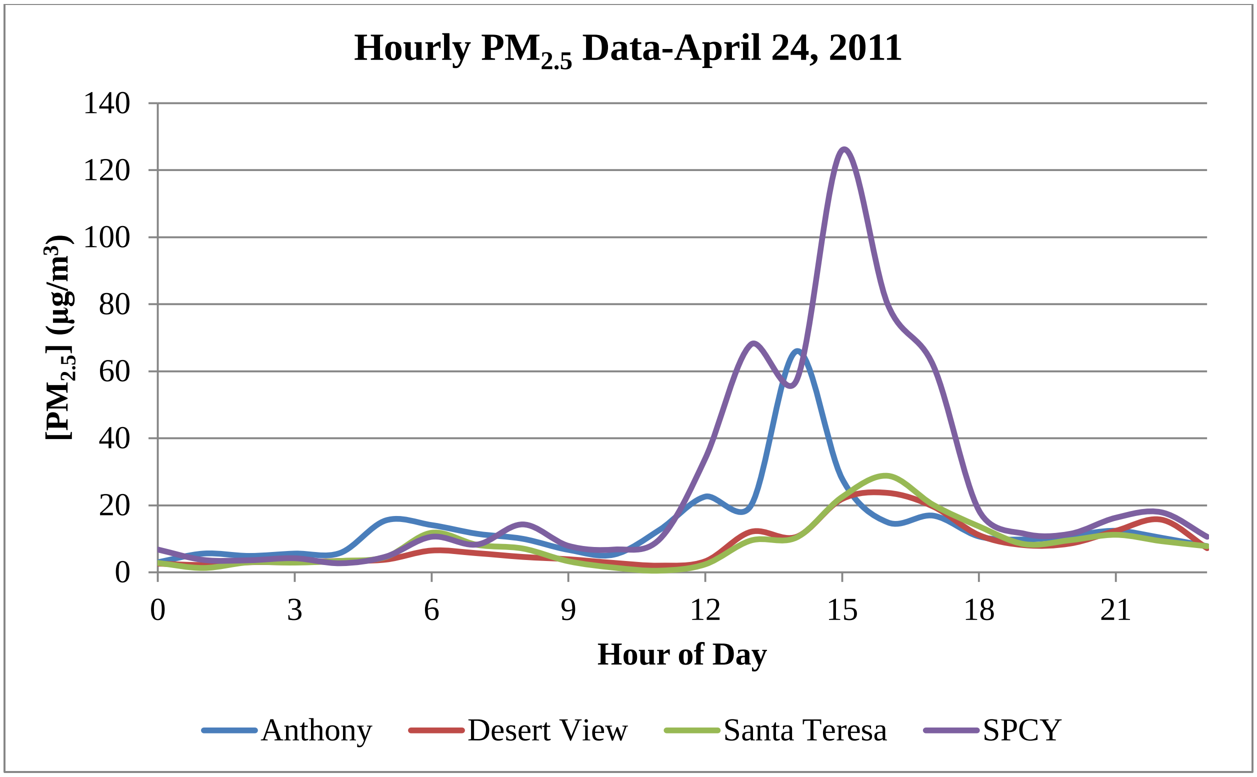

Figure 15-11b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors.

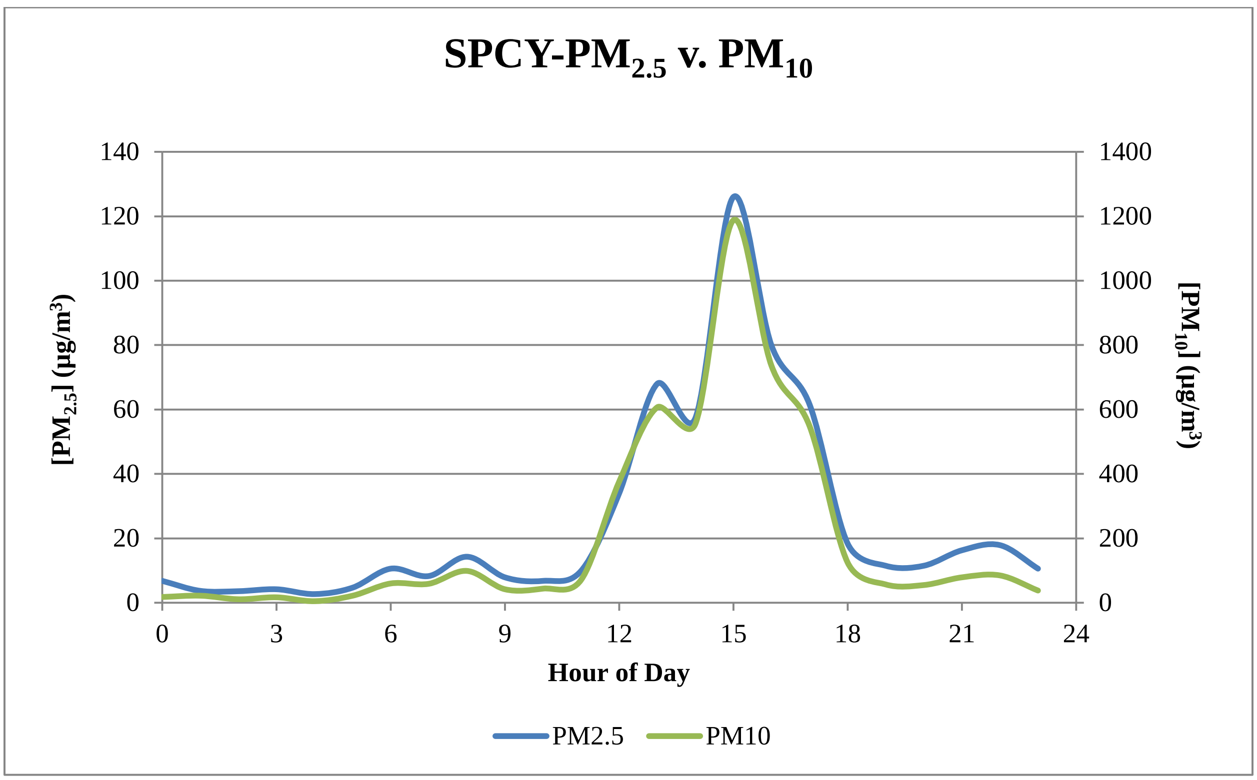

Figure 15-12. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on April 24, 2011.

The NWS issued a Red Flag Warning for most of far west Texas, southwestern and south-central New Mexico covering April 23 and 24, 2011 stating in part,

> A STRONG UPPER LEVEL LOW PRESSURE TROUGH REMAINS FORECAST TO TRACK ACROSS THE INTER MOUNTAIN WEST AND SOUTHERN ROCKY MOUNTAINSTHIS WEEKEND. THIS WILL BRING INCREASING WINDS ALOFT OVER OUR AREA...WHILE CREATING LOWER SURFACE PRESSURE TO OUR NORTHEAST AND STRENGTHENING PRESSURE GRADIENT OVER THE REGION AS A RESULT.
>
> CONTINUED MOSTLY SUNNY TO PARTLY CLOUDY SKIES...WILL ALLOW MIX DOWN OF THESE WINDS. THIS WILL MEAN GUSTY AFTERNOON WINDS FOR MOST AREAS. THE STRONG WINDS...COMBINED WITH VERY LOW RELATIVE HUMIDITIES AND VERY HIGH TO EXTREME FIRE DANGERS...WILL CONTINUE TO CREATE CRITICAL FIRE CONDITIONS FOR OUR AREA THROUGH THIS WEEKEND. OUR AREA REMAINS IN AN EXISTING STATE OF EXTREME DROUGHT.
>
> * WIND...WEST-SOUTHWEST WINDS AT THE 20-FOOT LEVEL 15 TO 25 MPH WITH GUSTS AS HIGH AS 35 MPH. FOR SUNDAY...20 TO 30 MPH WINDS WITH GUSTS AS HIGH AS 45 MPH ARE EXPECTED(NWS, 2011).

The New Mexico Air Quality Border Blog also noted that the high winds and blowing dust in the region,

> By the end of the day the Abrams fire burned about 5,000 acres and was 40 percent contained. I was at Aguirre Springs in the afternoon and saw the smoke from there. Between the windblown dust and fire the Tularosa basin was hazy today (DuBois, 2011).

15.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on April 24, 2011.

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 monitor detected blowing dust around the 1200 hour with hourly concentrations heavily impacted until the 1700 hour. The six hourly PM_{10} values from 1200-1700 hours alone, exceed the 24-hour average standard at SPCY [(376+607+555+1188+736+549) µg/m^3 = 4011 µg/m^3; (4011 µg/m^3)/24 = 167 µg/m^3]. By replacing these six hourly values with the 95th percentile of hourly data at the SPCY site, the resulting 24-hour average (56 µg/m^3) does not exceed the NAAQS (Table 15-1). 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	18	18
1	22	22
2	11	11
3	17	17
4	5	5
5	22	22
6	60	60
7	59	59
8	99	99
9	42	42
10	44	44
11	71	71
12	376	**104**
13	607	**125**
14	555	**145**
15	1188	**160**
16	736	**168**
17	549	**201**
18	125	125
19	57	57
20	55	55
21	79	79
22	85	85
23	38	38
24-Hour Average	205	**56**

Table 15-1. 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: April 26, 2011

16.1 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 at the Anthony, Chaparral, Deming Airport, Desert View, Holman, Sunland Park, and West Mesa monitoring sites on this date. The FEM TEOM continuous monitors at these sites recorded a 24-hour average concentration of 492, 890, 472, 254, 459, 877, and 422 µg/m^3, respectively. In accordance with the EER, the AQB flagged this data on EPA's AQS database as a high wind natural event. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured at Deming (145 µg/m^3) monitoring site (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.

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 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} concentrations support the assertion that this was an exceptional event, specifically a natural event caused by high wind and blowing dust.

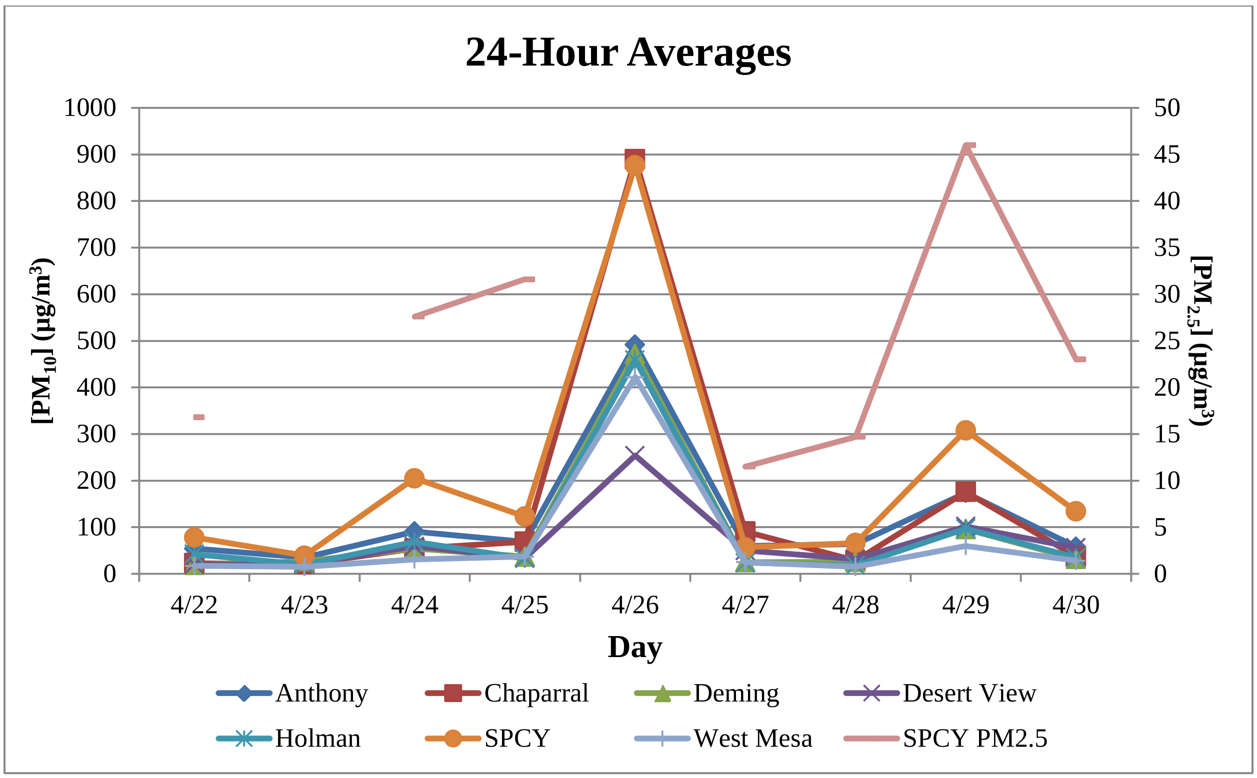

Figure 16-1. PM_{10} and $PM_{2.5}$ 24-hour averages before and after April 26, 2011.

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 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 of Arizona and New 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 April 26, 2013, sustained wind speeds exceeded EPA's default threshold at six of the seven monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at seven of the seven monitoring sites (Figures 16-2 and 16-3). Winds exceeded these thresholds at one or more monitoring sites beginning at the 700 hour and ending at the 2200 hour.

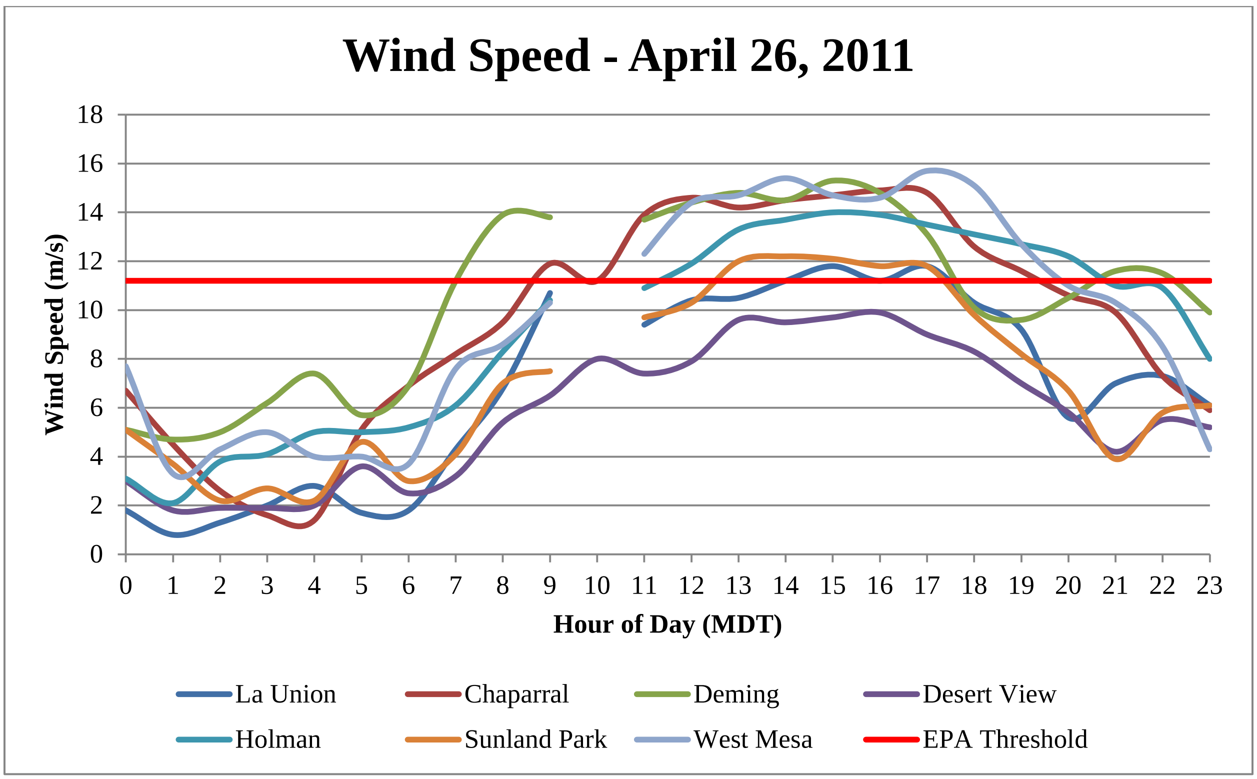

Figure 16-2. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

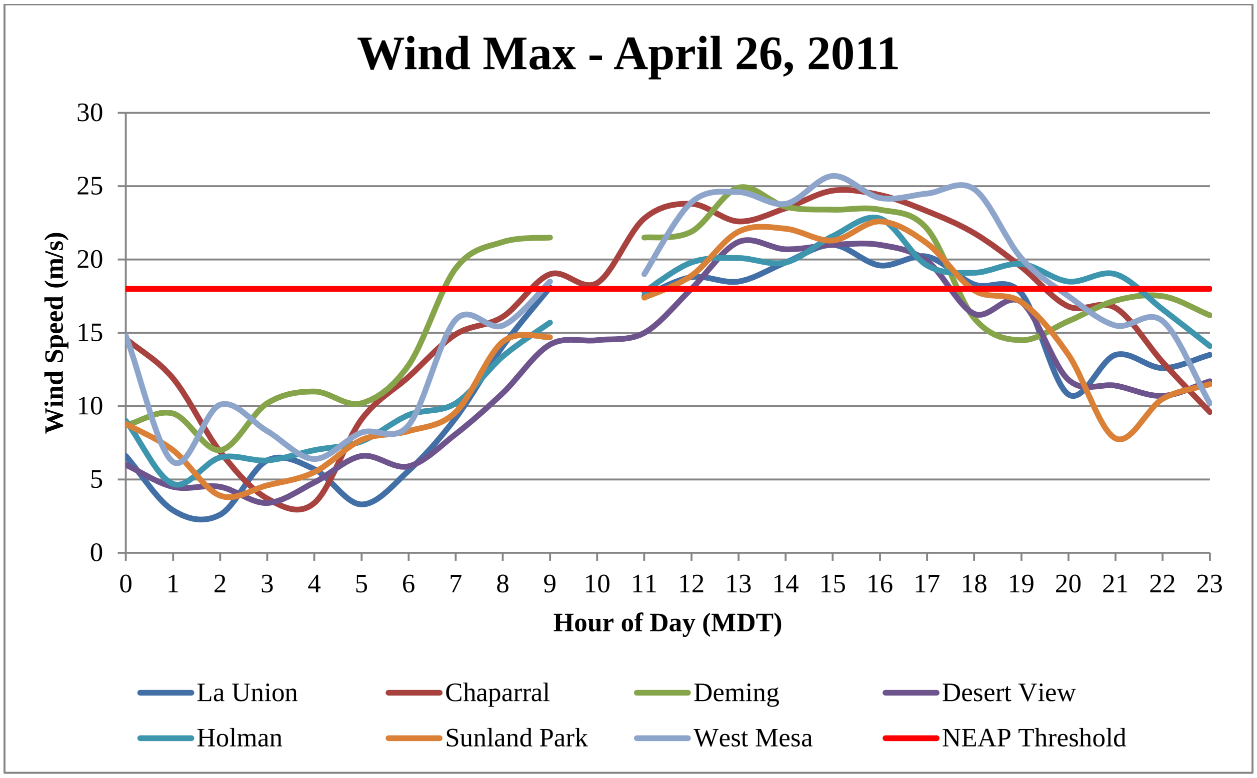

Figure 16-3. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

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 2006-2010 the PM_{10} FEM TEOM monitors recorded 211 exceedances and the PM_{10} FRM Wedding monitors recorded 5 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 (Table 2-1). The SPCY $PM_{2.5}$ FRM Partisol recorded 23 exceedances of the 24-Hour NAAQS from 2006-2010 (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 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. 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 Doña Ana and Luna Counties. The model starts four hours before the start of elevated PM_{10} concentrations measured during the event (Figure 16-4). 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.

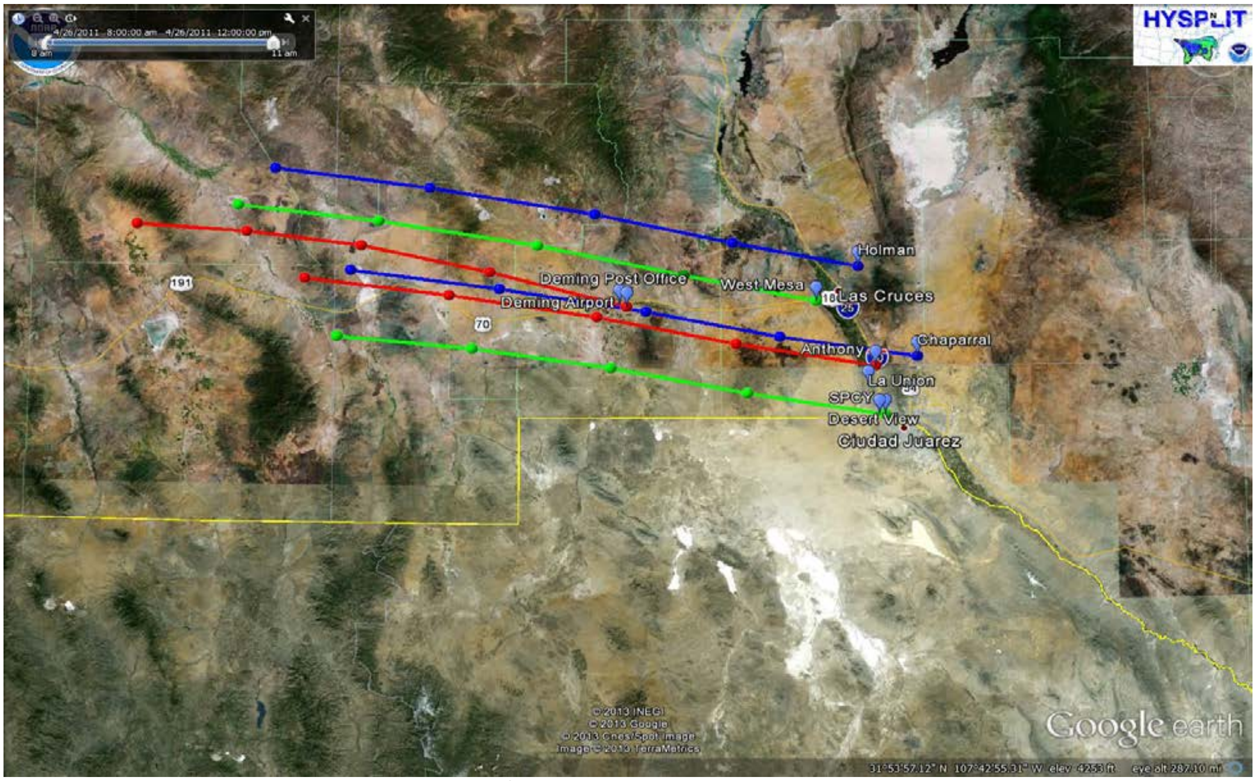

Figure 16-4. HYSPLIT back-trajectory model analysis for April 26, 2011

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-4 through B-11). 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 2006-2010 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 2006-2010. 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 2006-2010. The recorded values for this day (492, 890, 472, 254, 459, 877, and 422 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} 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, 2011 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 16-5a-g through 16-7a-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.

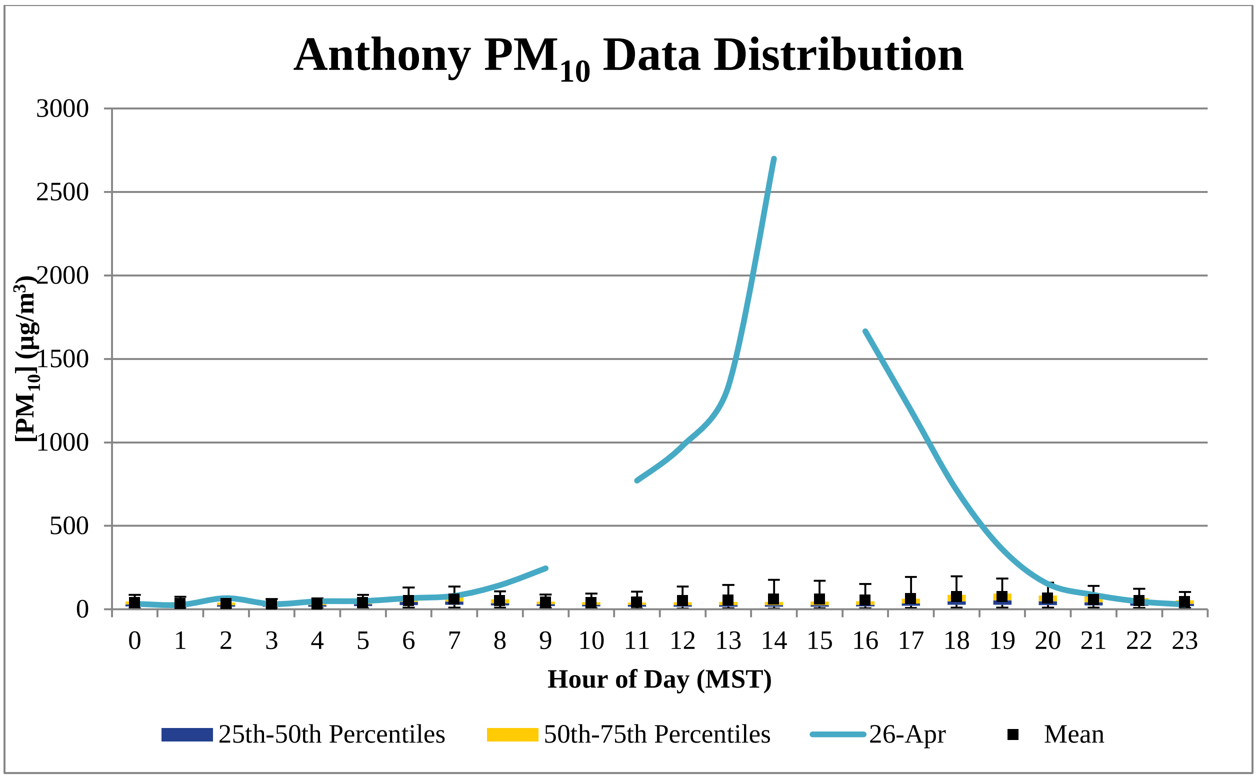

Figure 16-5a. PM_{10} and hourly data distribution from 2006-2010 overlaid by hourly values for April 26, 2011

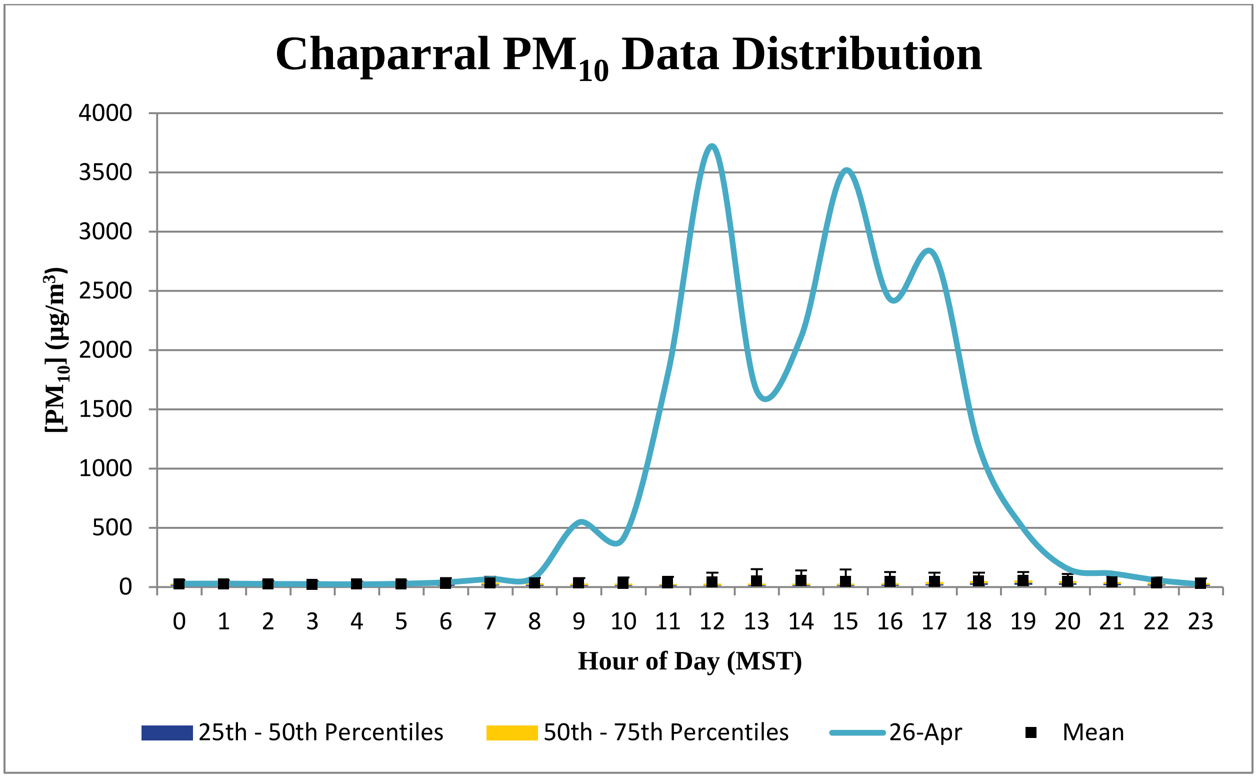

Figure 16-5b. PM_{10} **hourly data distribution from 2006-2010 overlaid by hourly values for April 26, 2011**

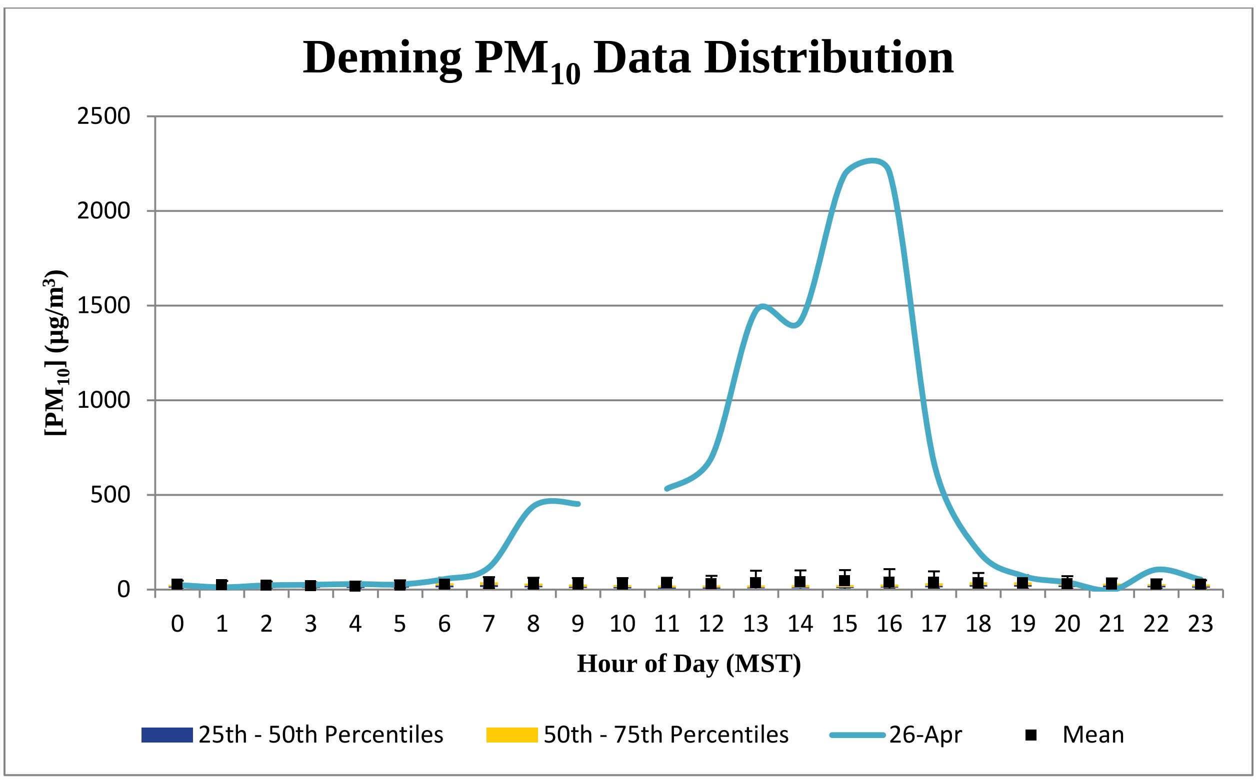

Figure 16-5c. PM_{10} **hourly data distribution from 2006-2010 overlaid by hourly values for April 26, 2011**

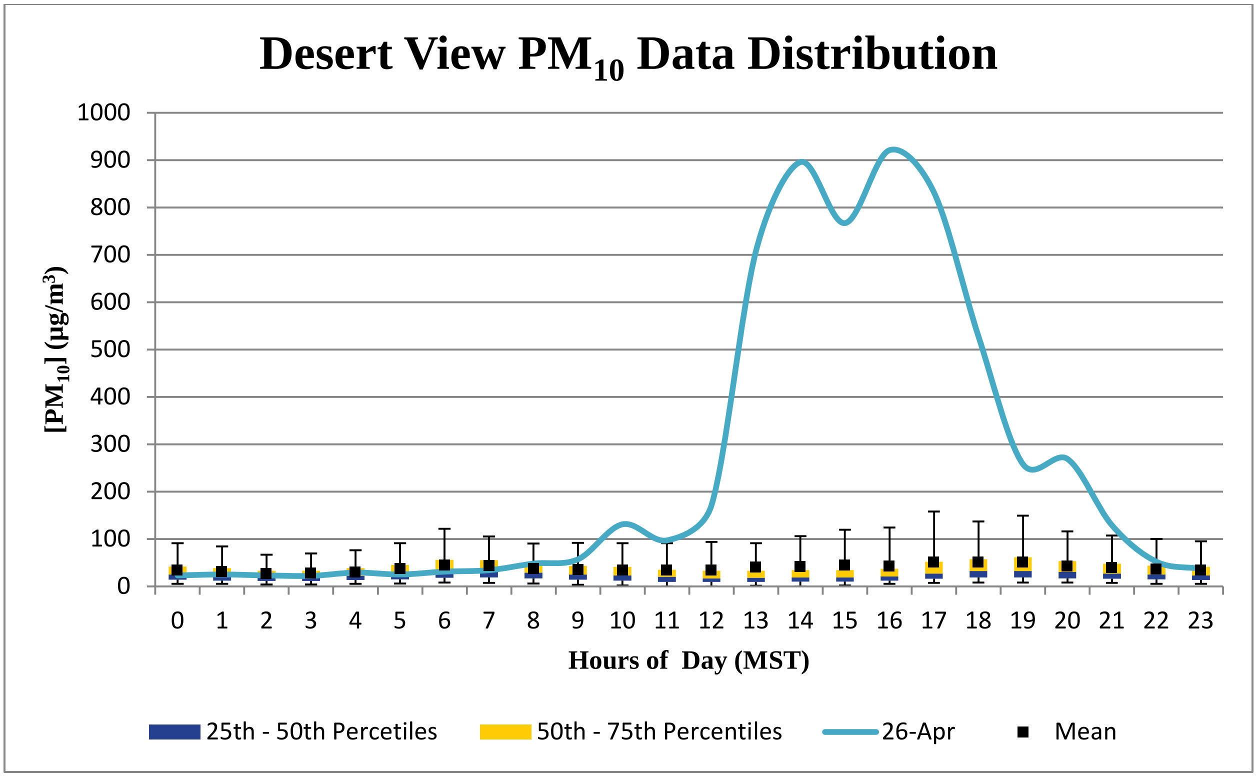

Figure 16-5d. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

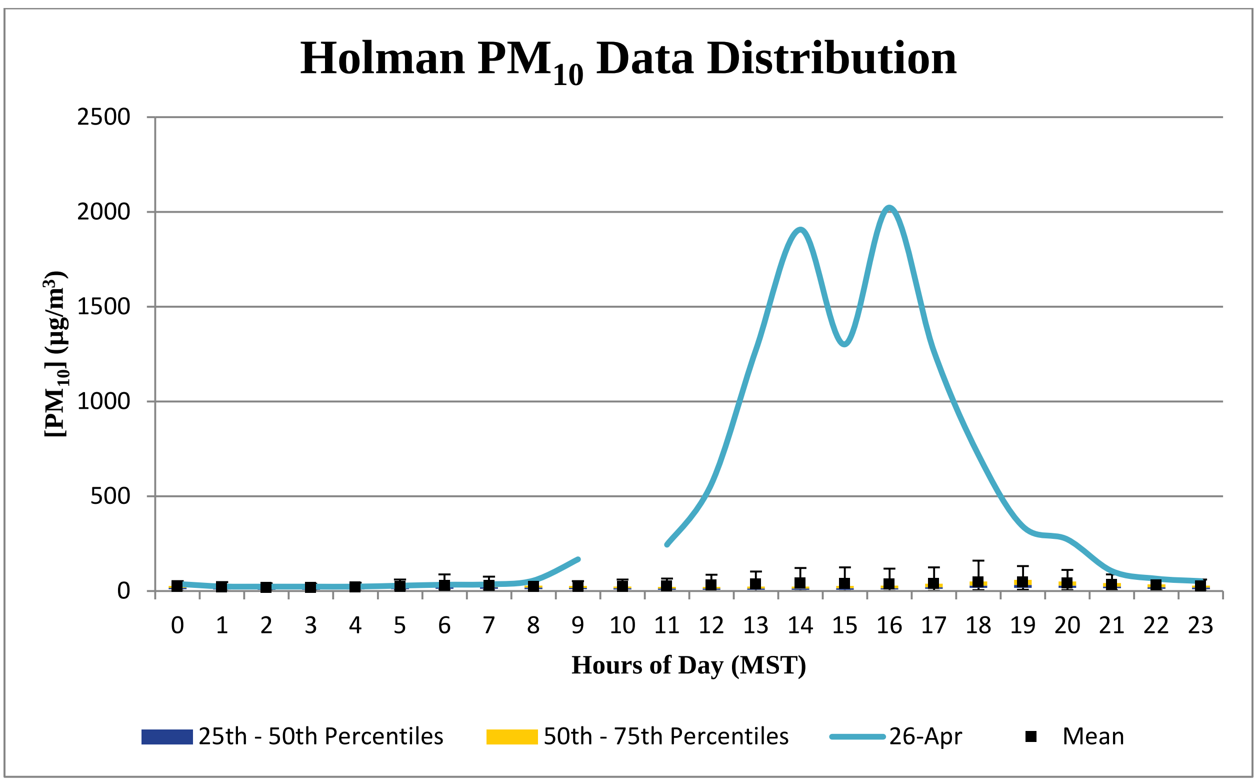

Figure 16-5e. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

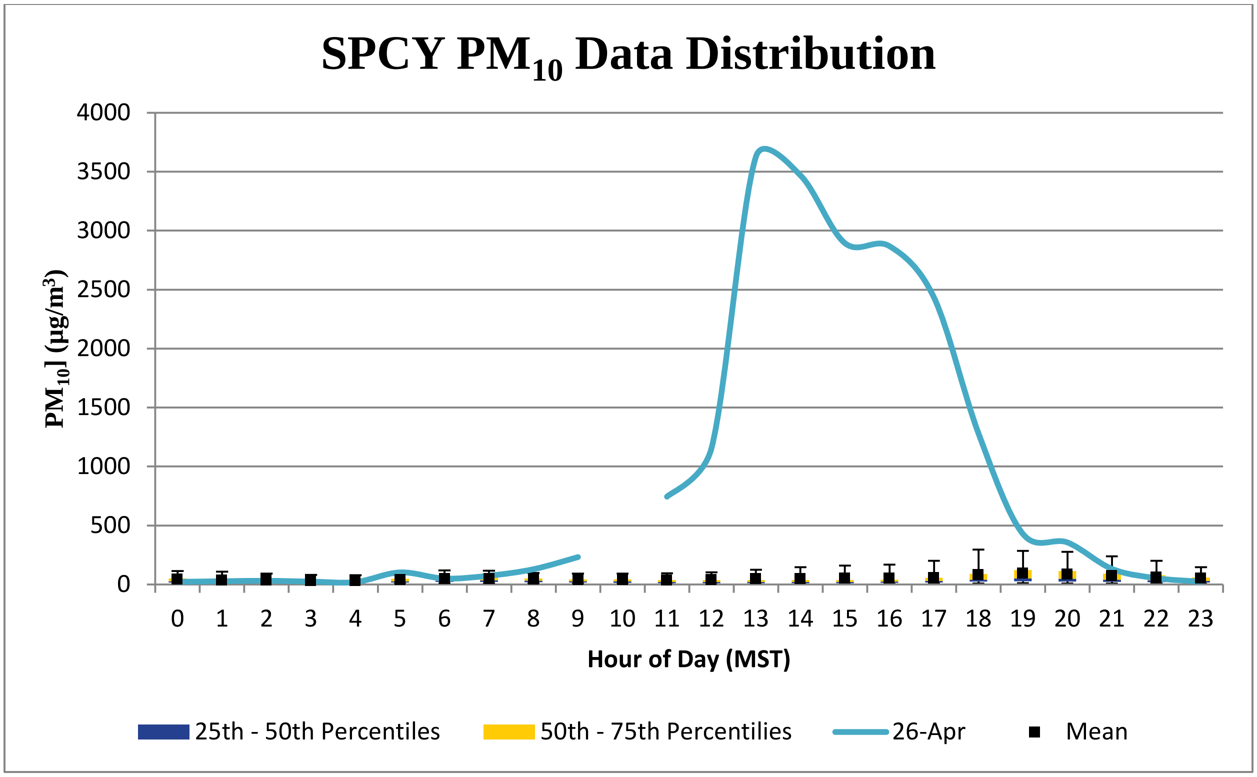

Figure 16-5f. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

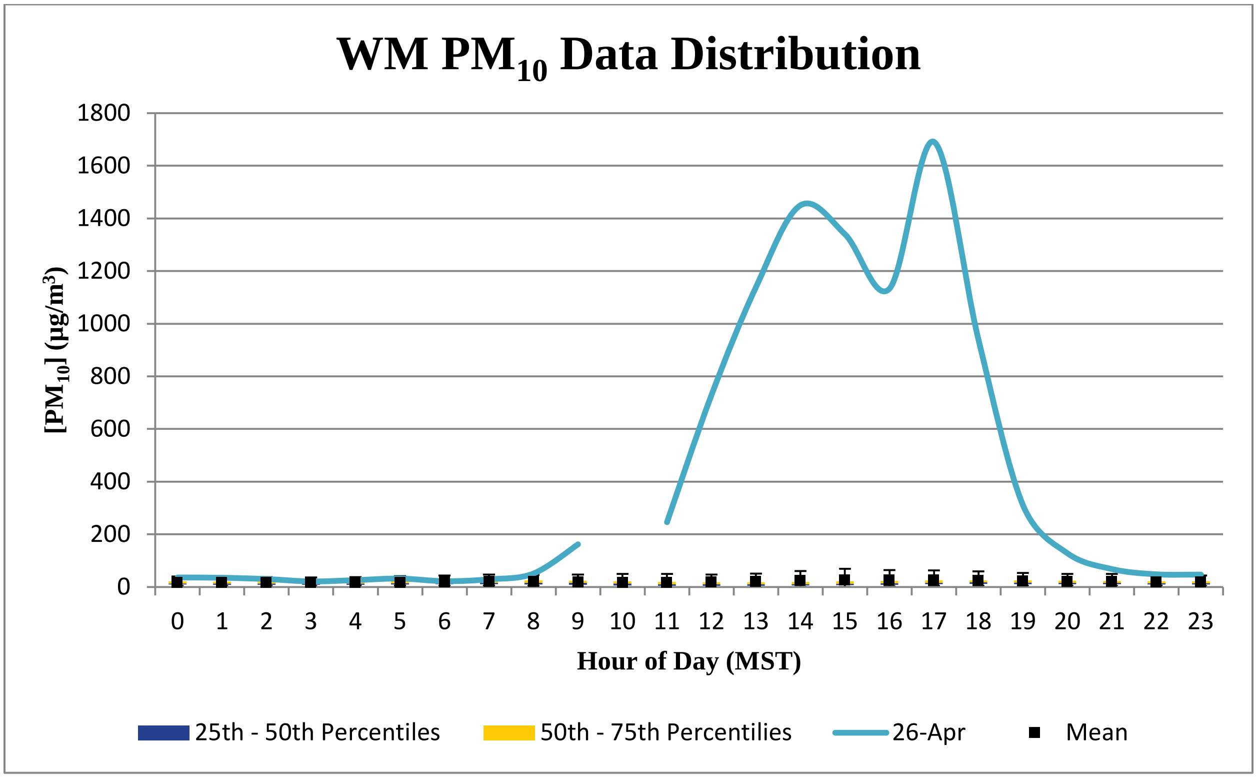

Figure 16-5g. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

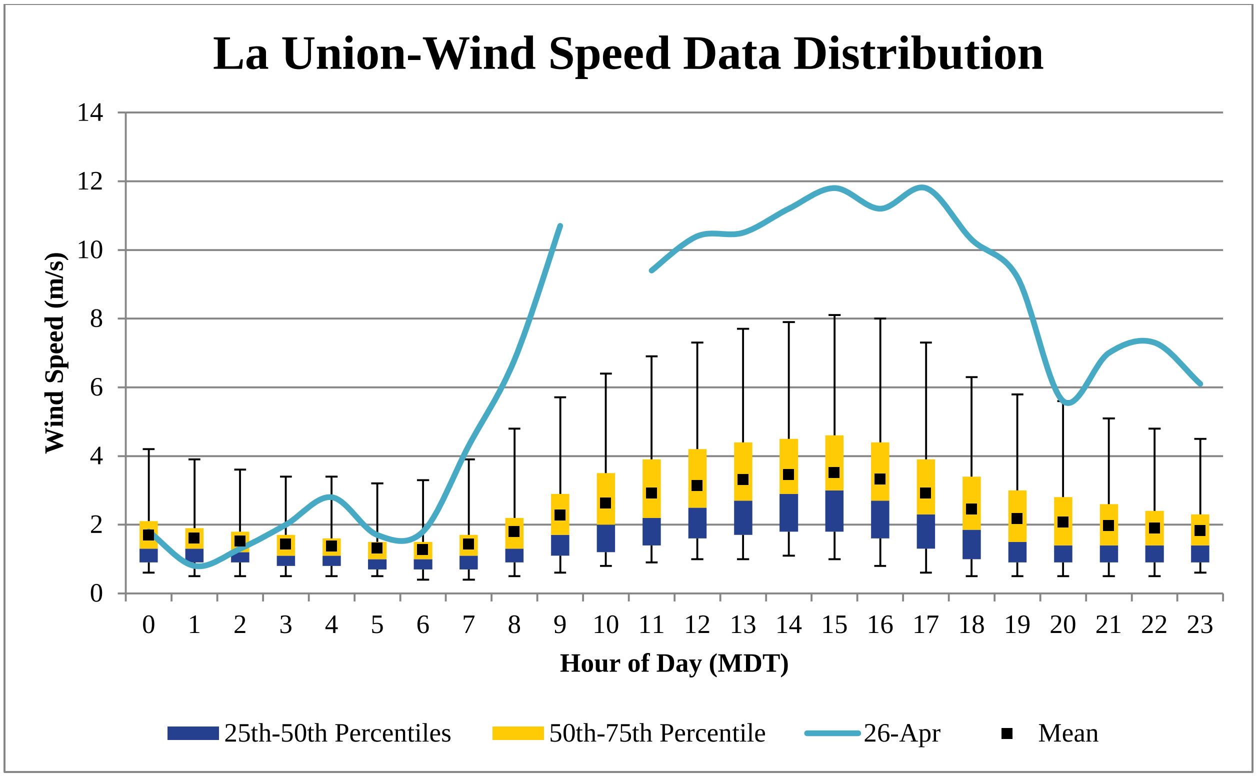

Figure 16-6a. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

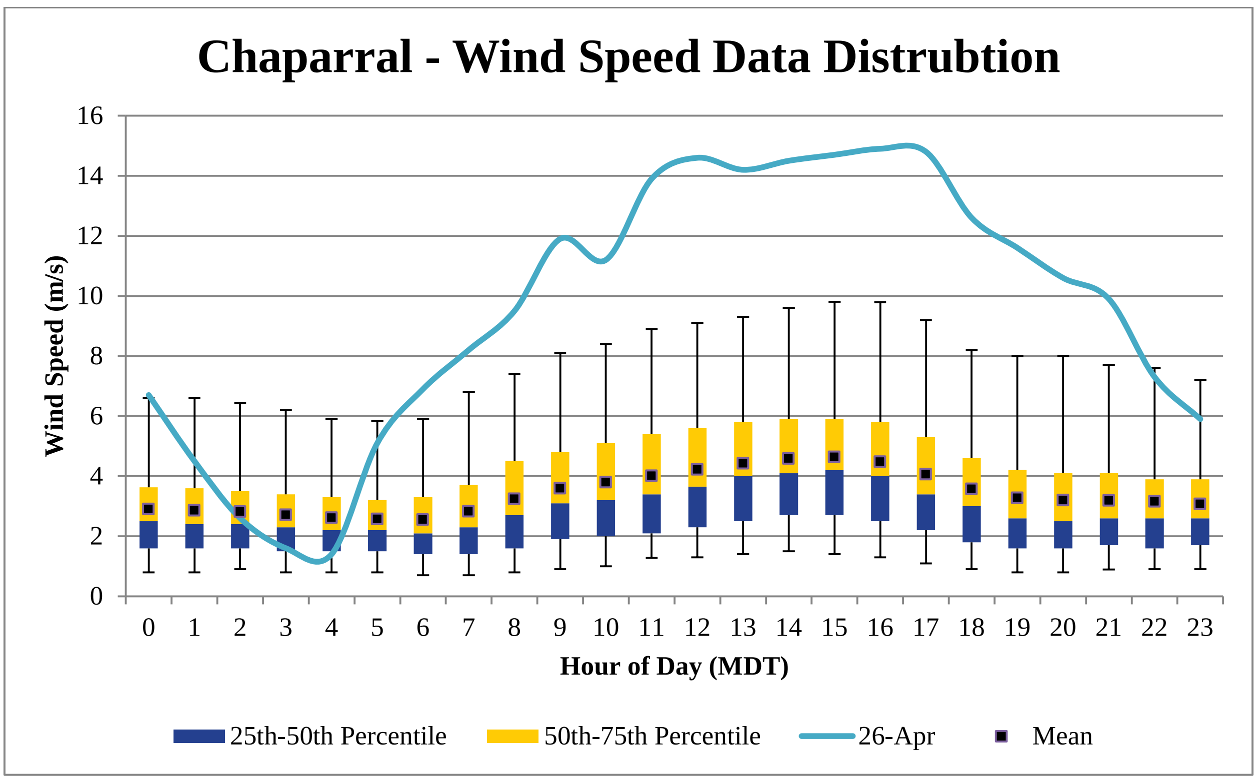

Figure 16-6b. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

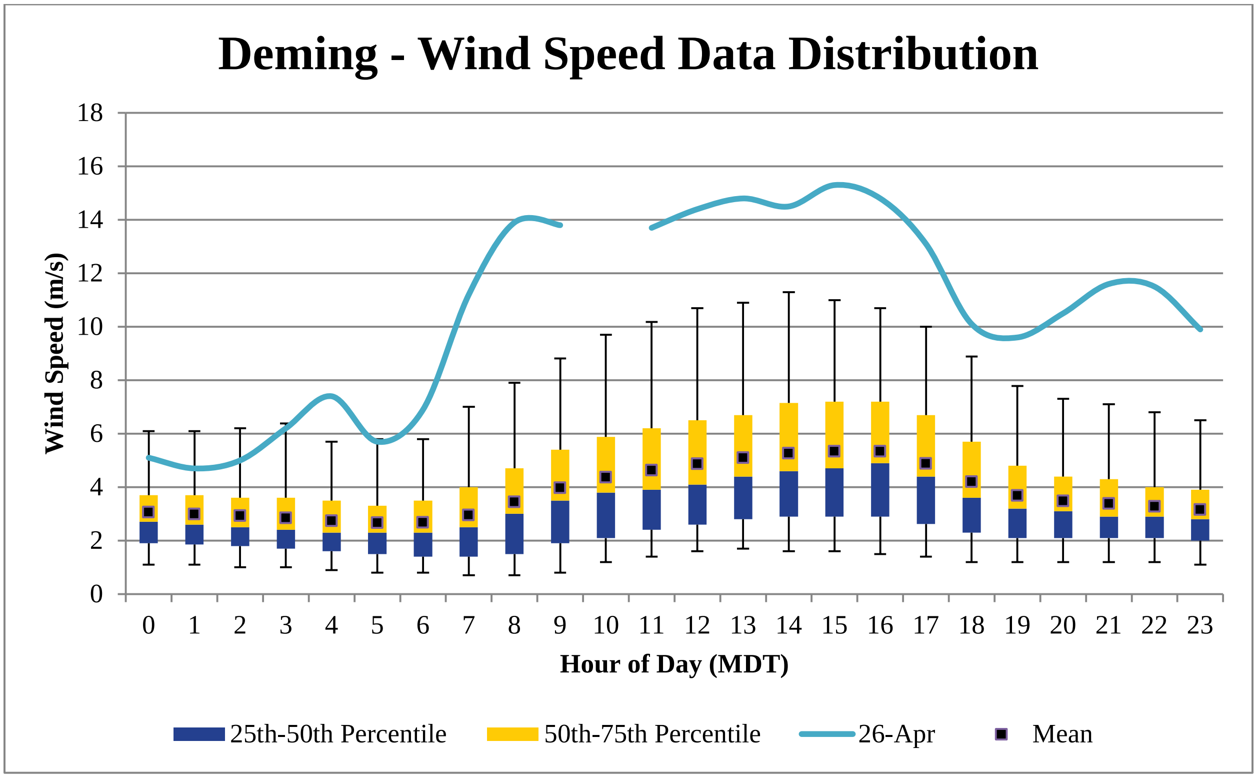

Figure 16-6c. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

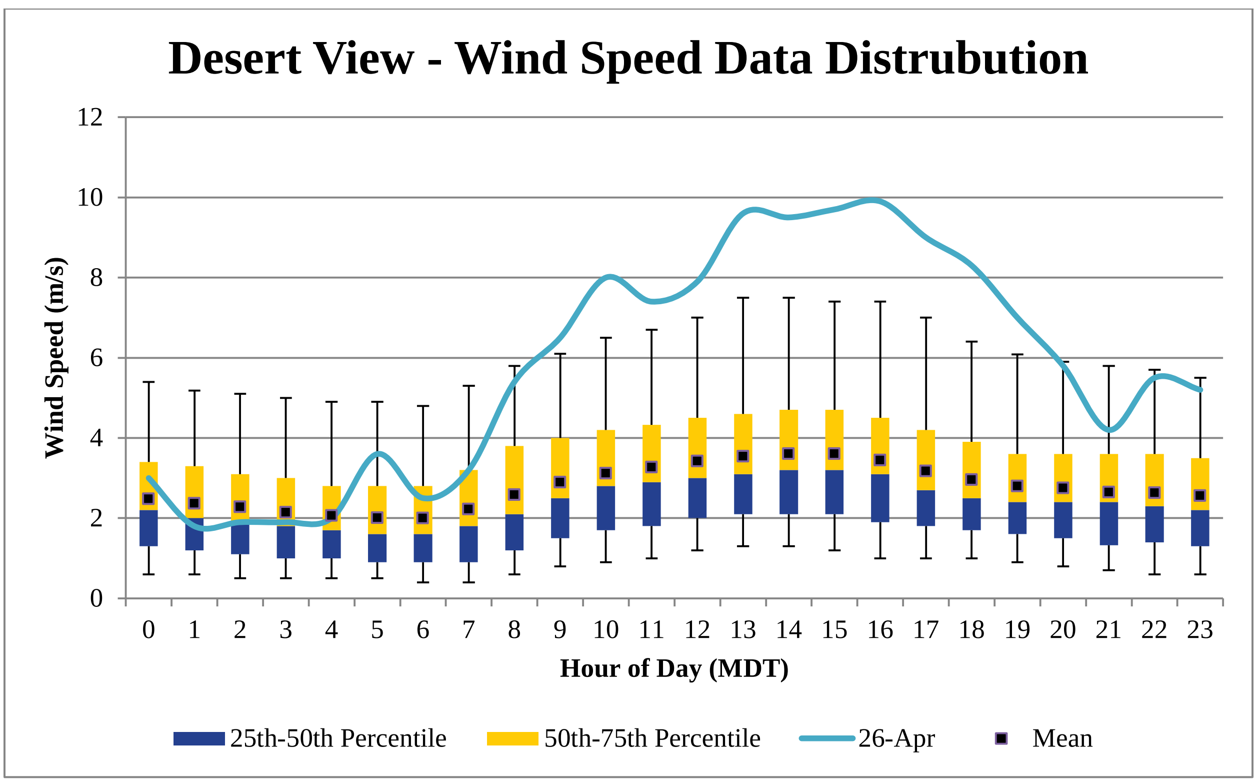

Figure 16-6d. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

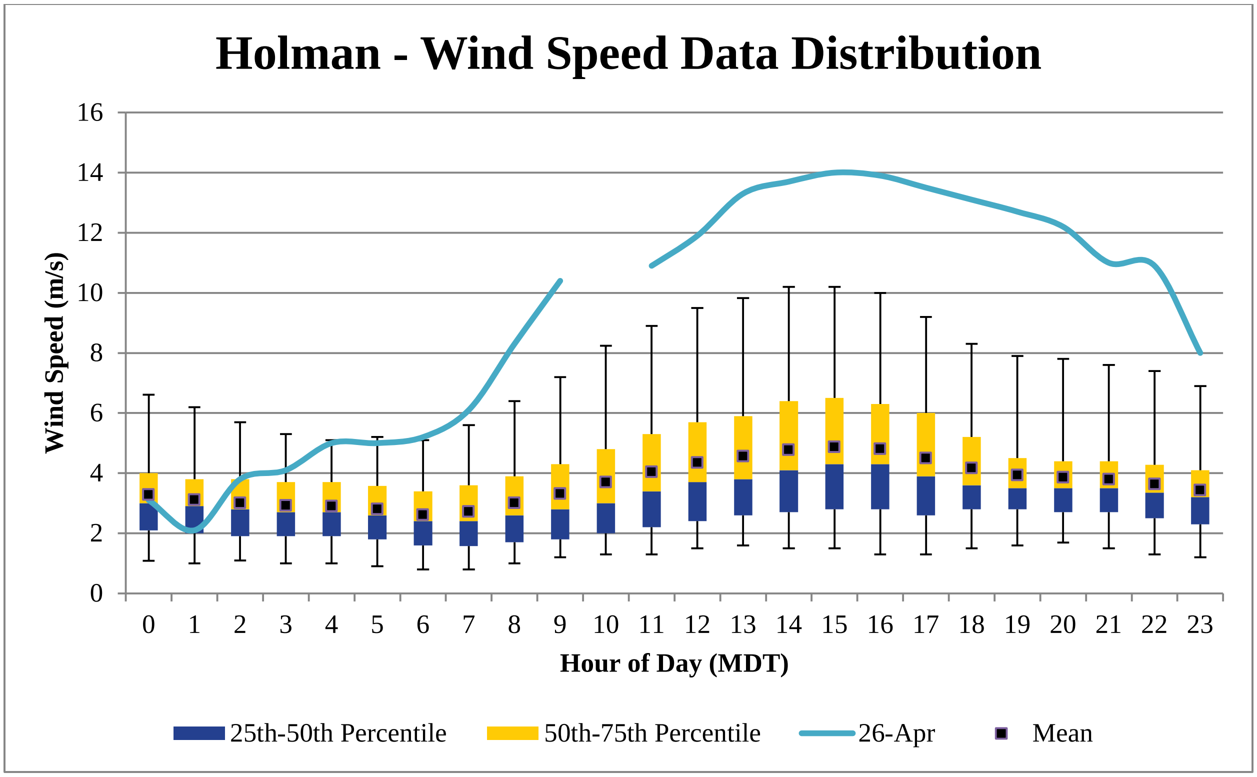

Figure 16-6e. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

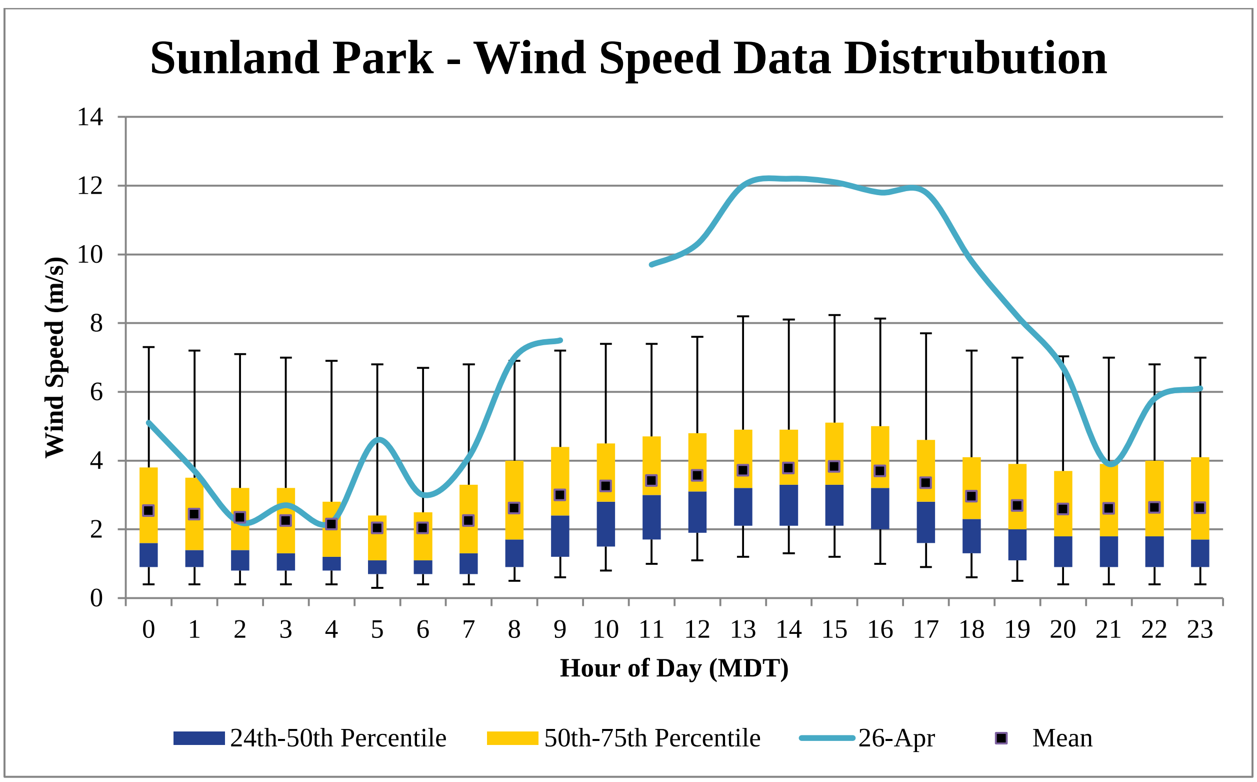

Figure 16-6f. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

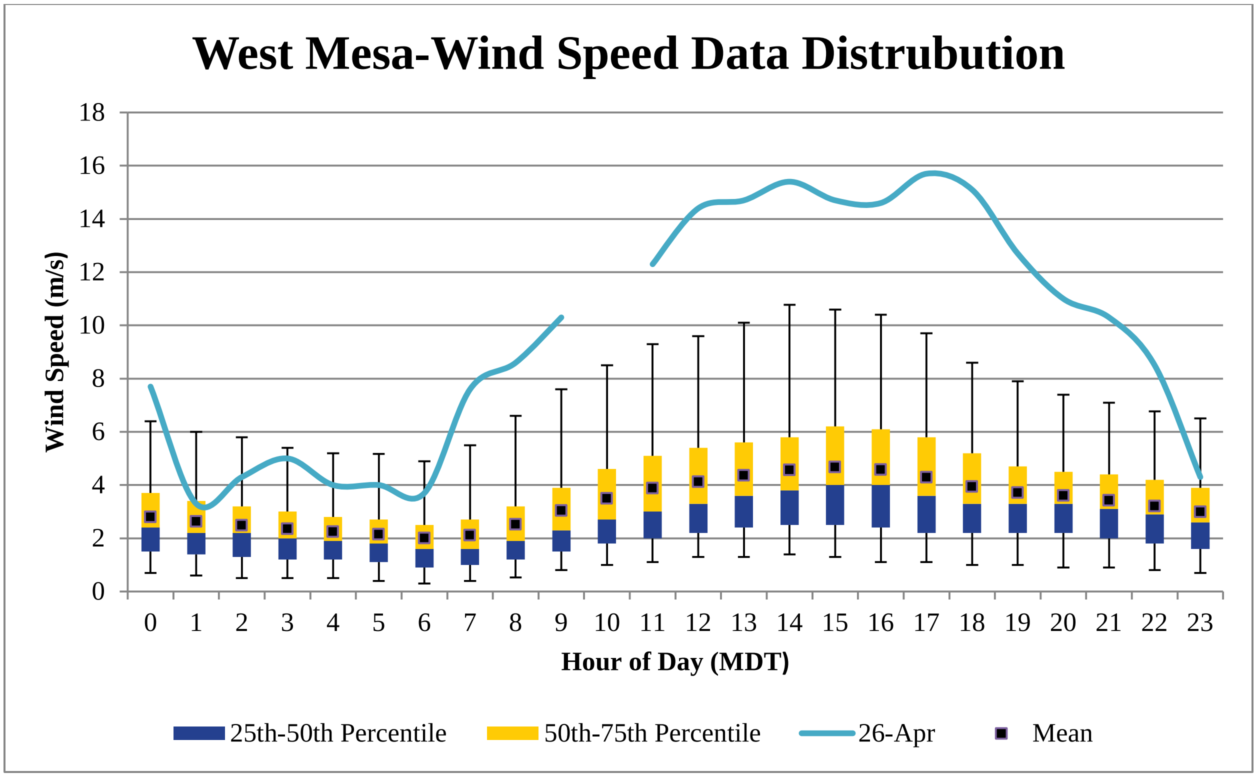

Figure 16-6g. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

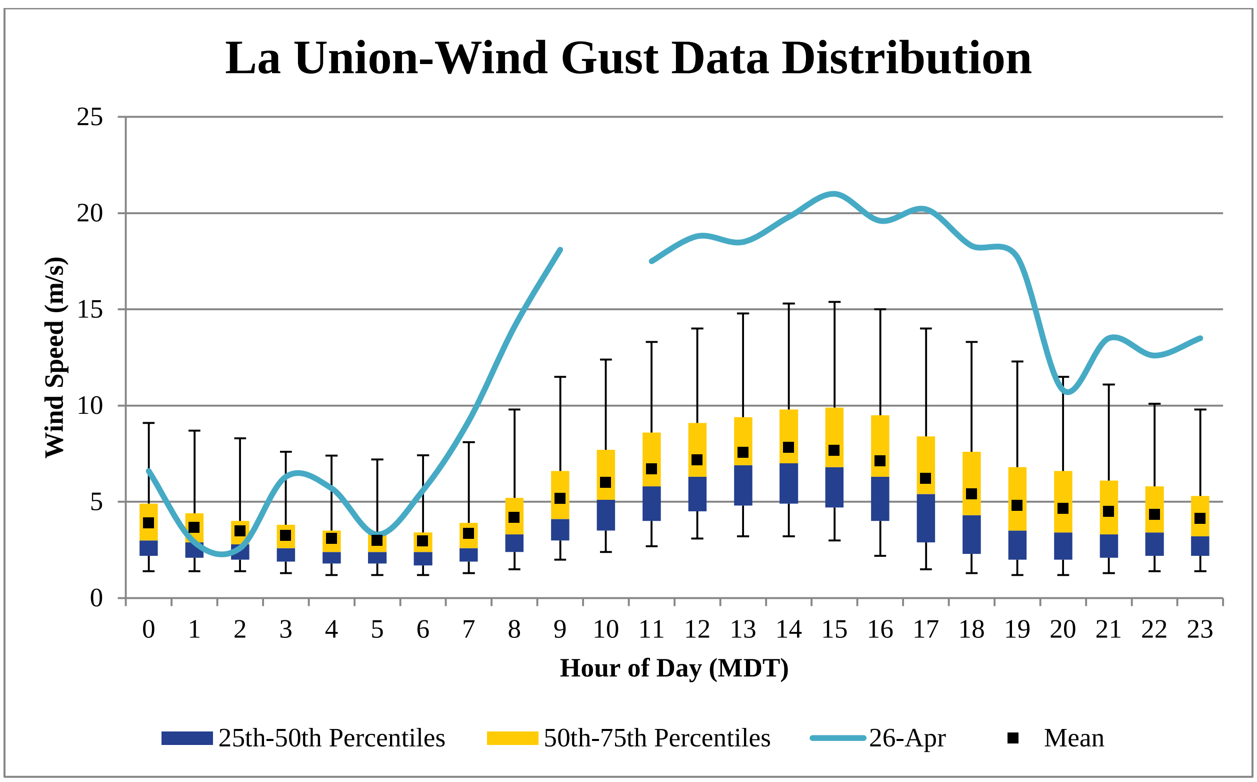

Figure 16-7a. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

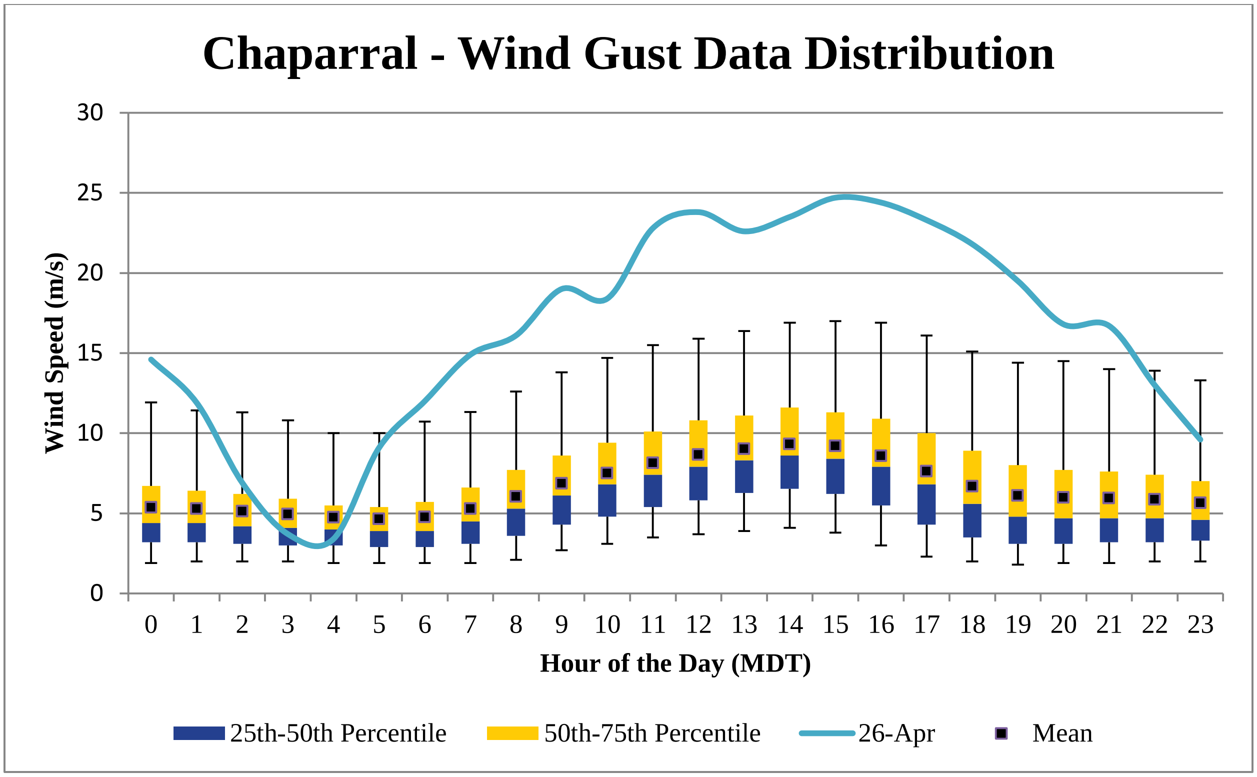

Figure 16-7b. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

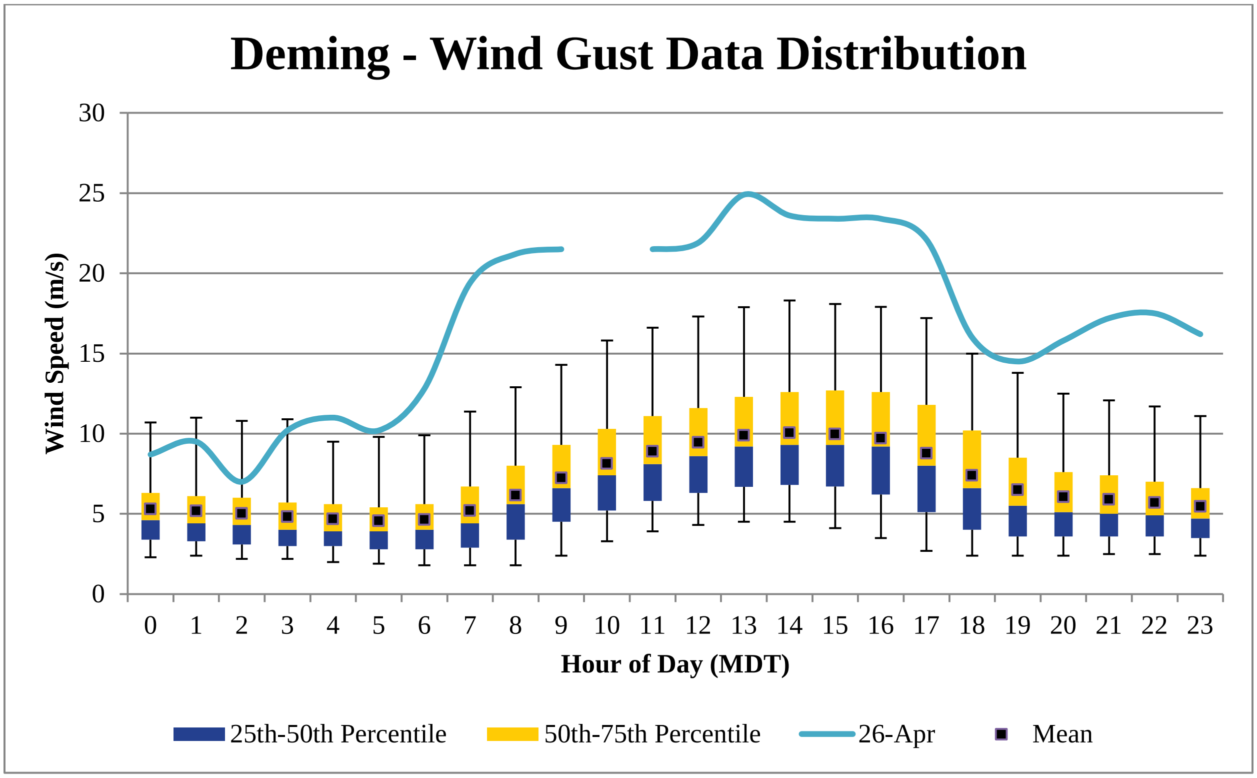

Figure 16-7c. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

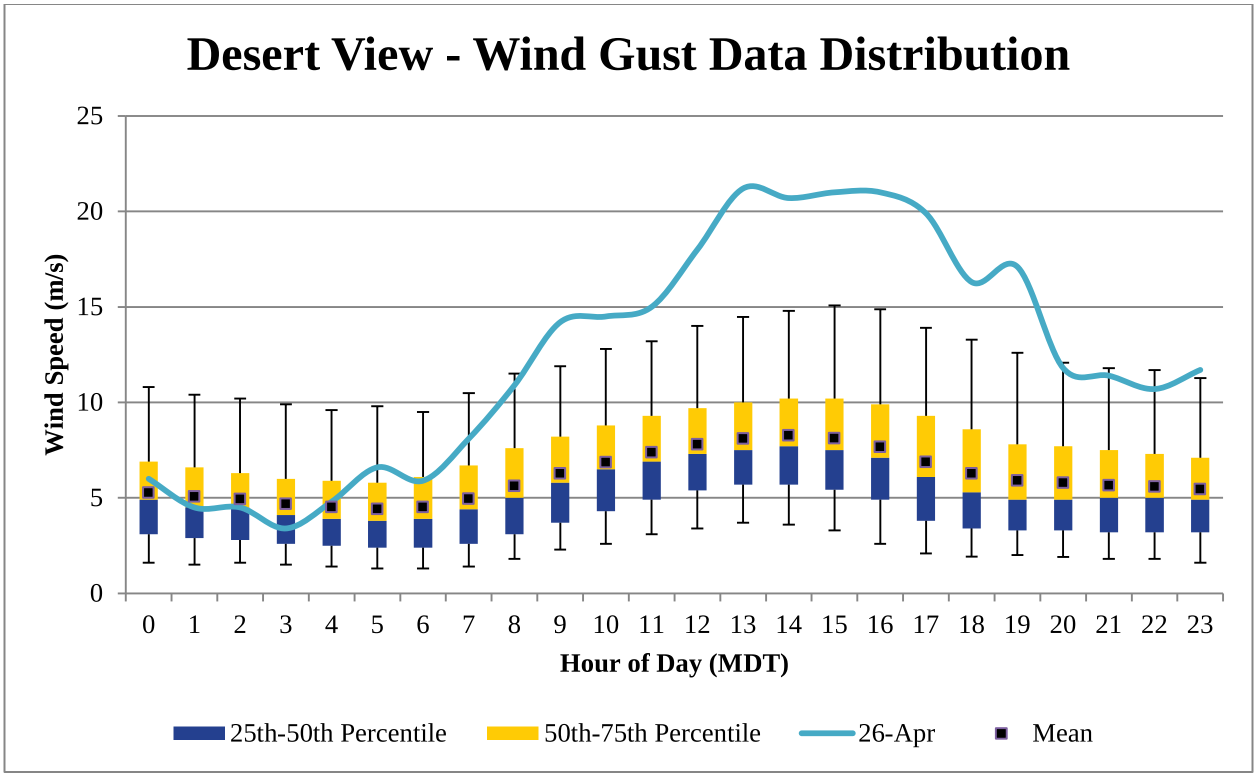

Figure 16-7d. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

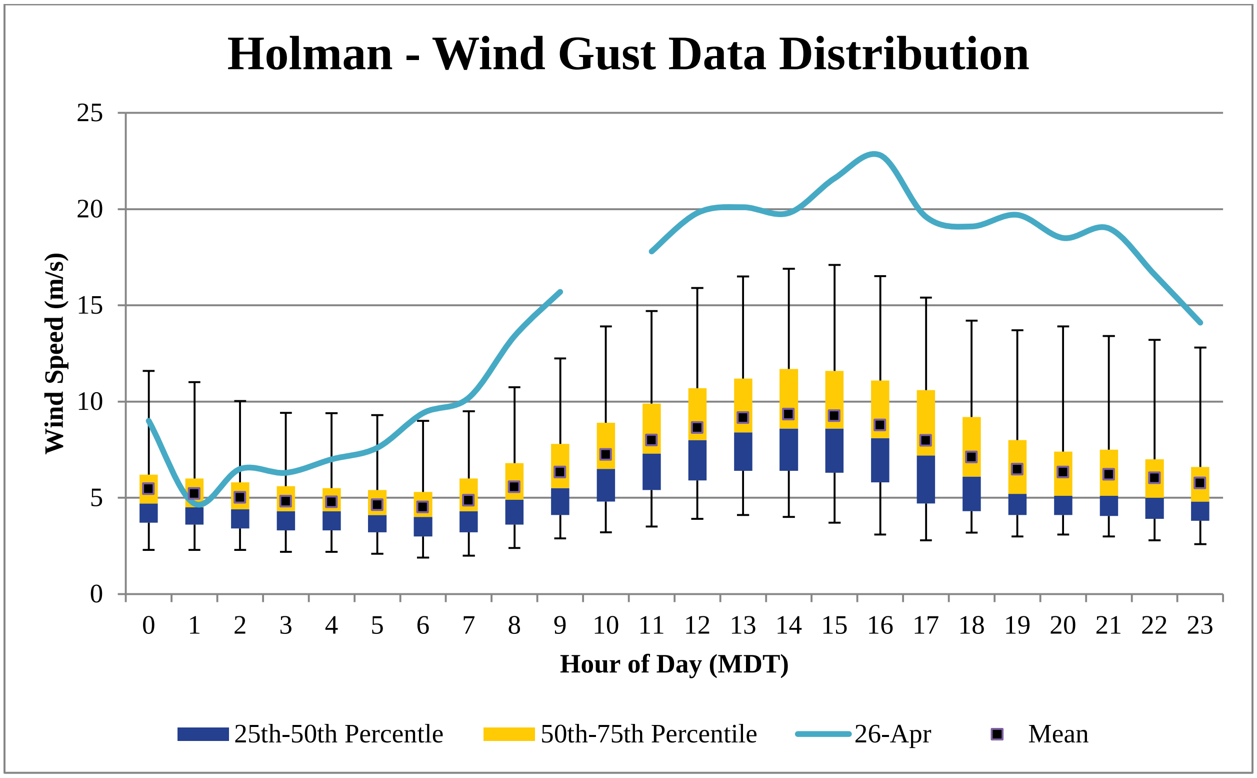

Figure 16-7e. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

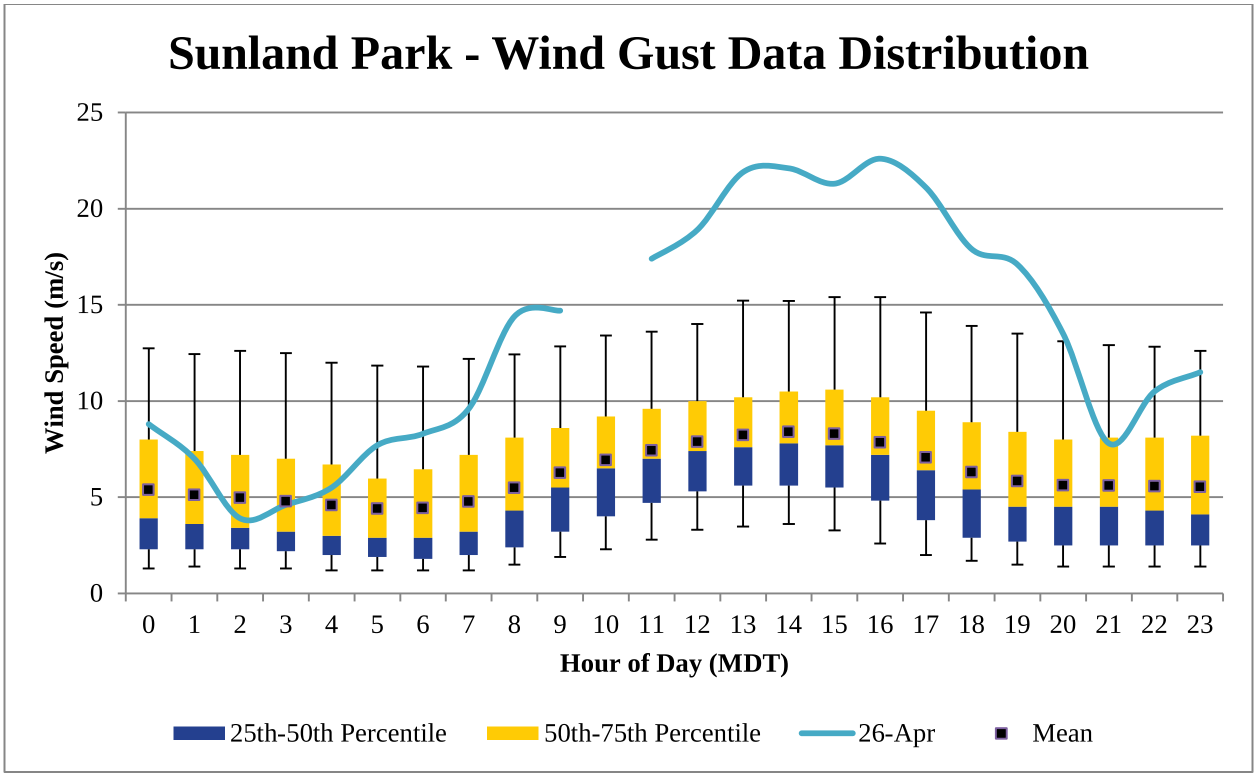

Figure 16-7f. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

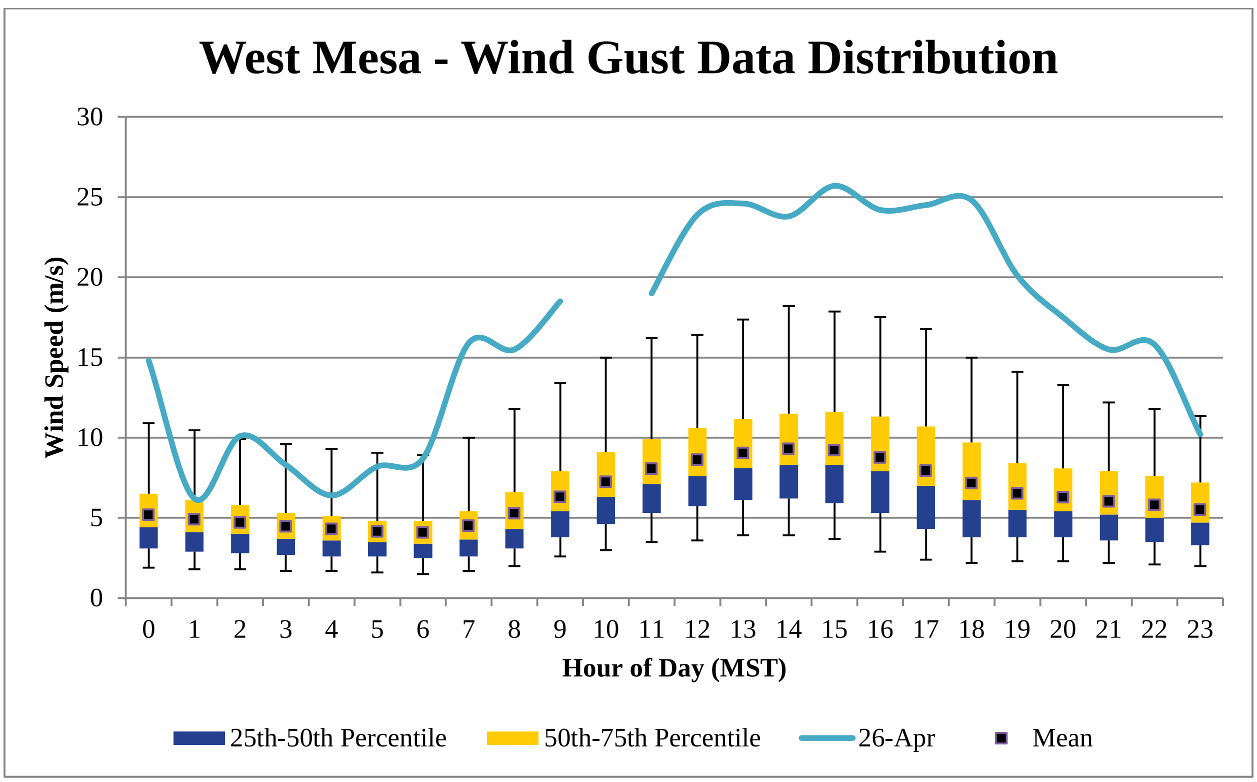

Figure 16-7g. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 26, 2011.

16.4 Clear Causal Relationship

A Pacific cold front passed through New Mexico on April 26, 2011. The surface low pressure traversed the Colorado-New Mexico border creating a pressure gradient over southeastern Arizona, 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 16-8). Surface winds flow perpendicular to the isobars from high to low pressure. The wind direction in the upper atmosphere aligned with the surface wind direction (Figure 16-9). 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.

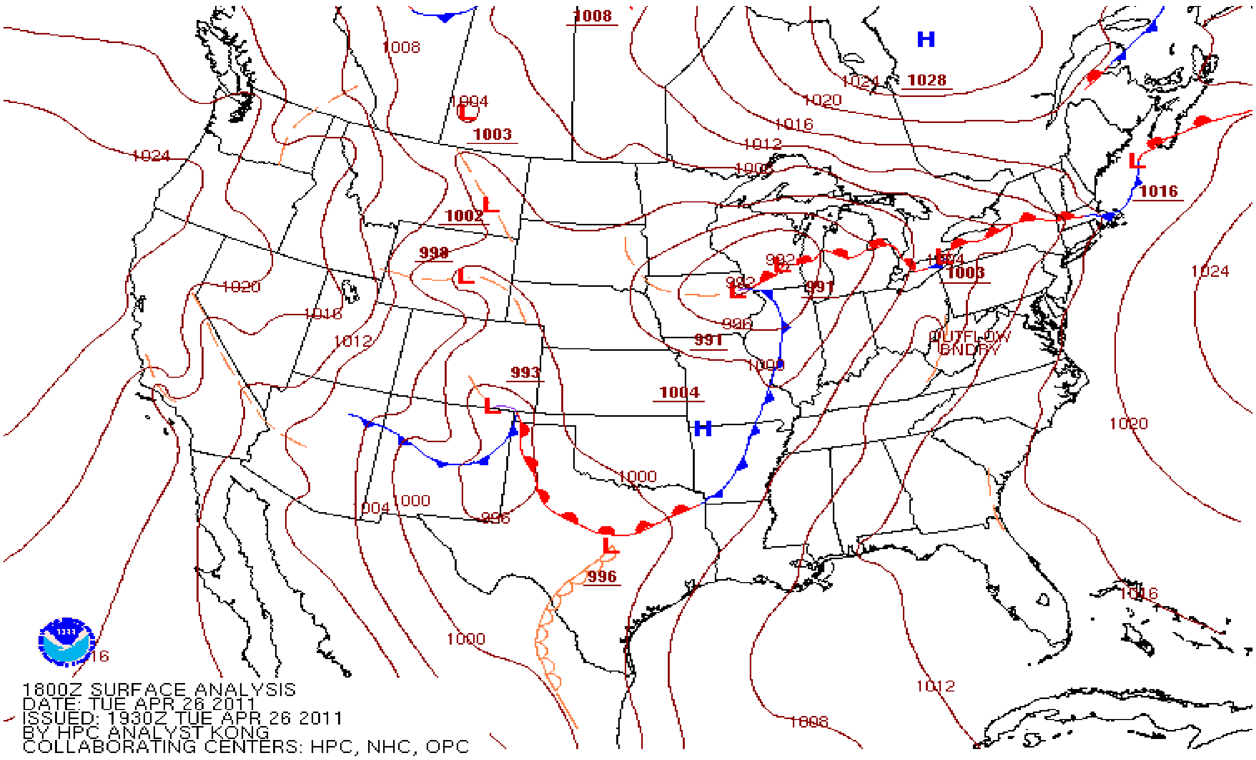

Figure 16-8. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 26, 2011 at the 1200 hour.

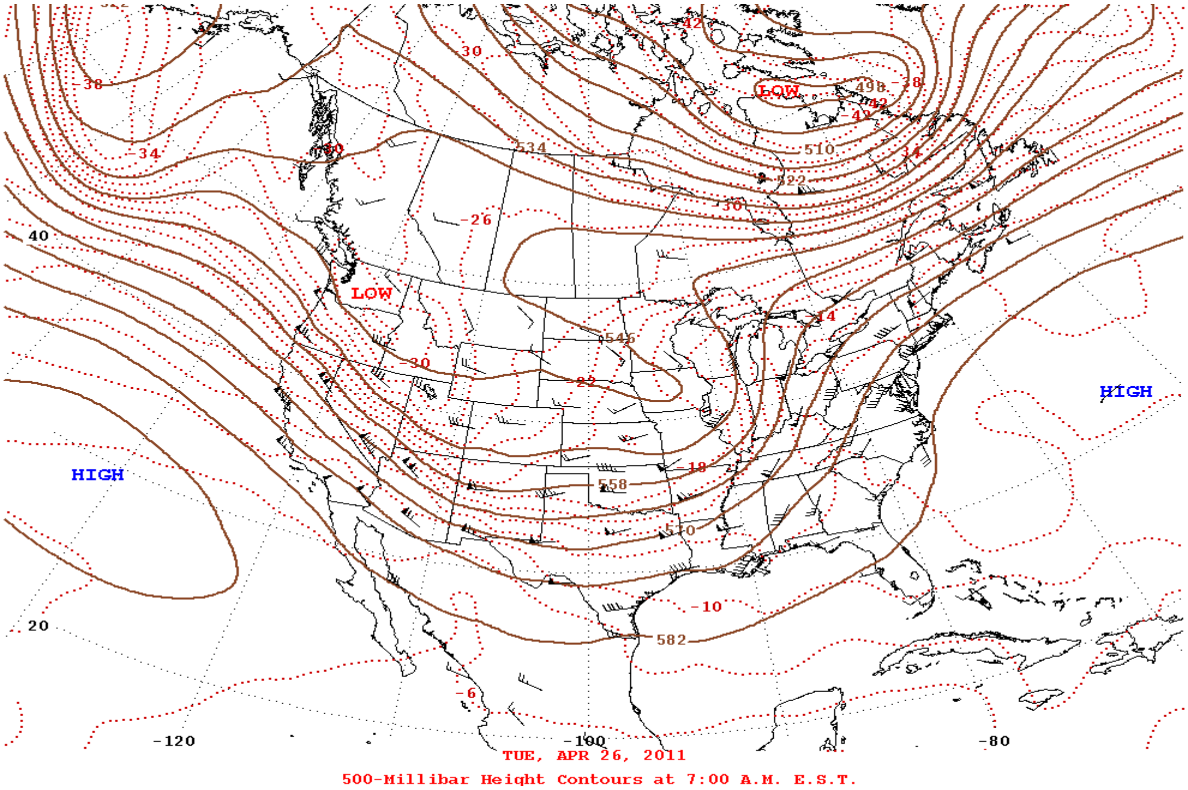

Figure 16-9. Upper air weather map showing geopotential heights (brown lines) at the 500 hour on April 26, 2011.

The weather pattern described above generated strong winds from the west beginning at the 400 hour and lasting through the 2300 hour. Beginning at the 400 hour, wind speeds exceeded 11.2 m/s or the historical 95th percentile of data at the Deming site as shown in Figure 16-6c. Peak wind speeds ranged from 9.9 m/s at Desert View to 15.7 m/s at West Mesa (Figure 16-2). Peak wind gusts ranged from 21.3 m/s at Sunland Park to 25.7m/s at West Mesa (Figure 16-3). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figure 16-10a-g. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (700-2100 hours). During these hours, hourly PM_{10} concentrations spiked at all monitoring sites in the network (Figure 16-11).

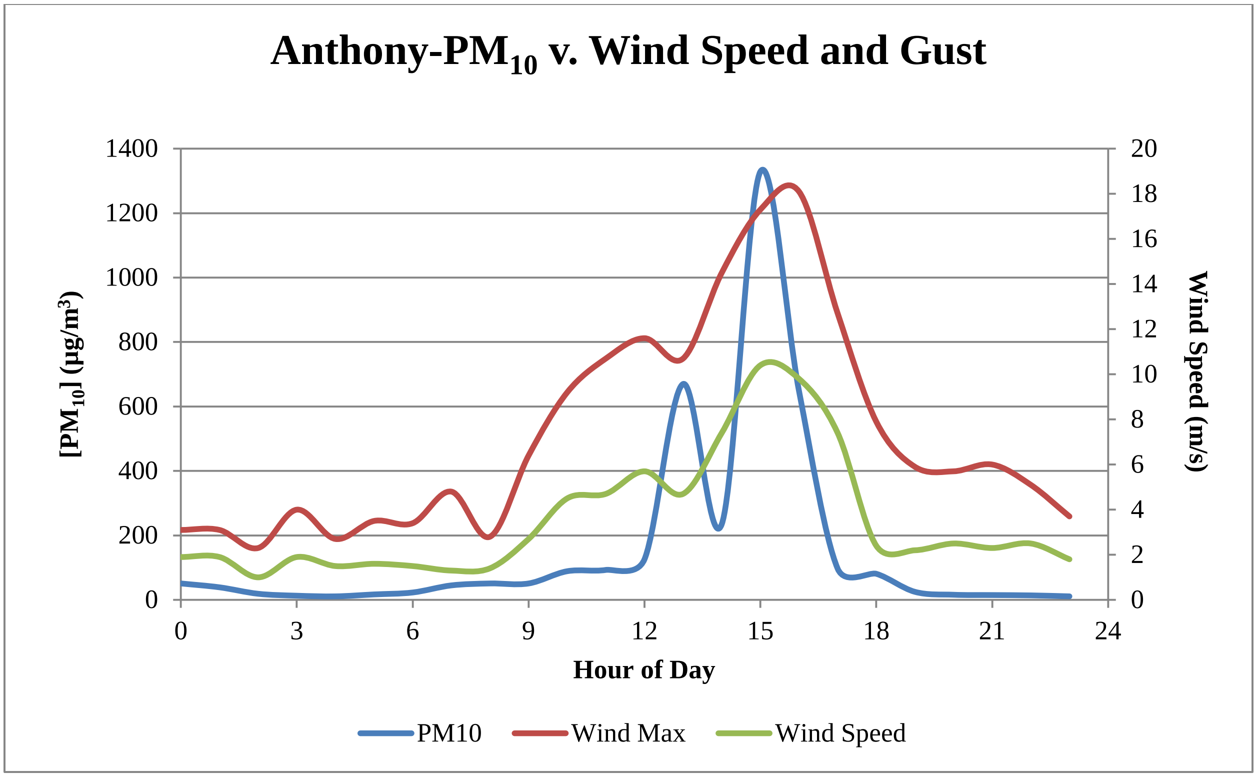

Figure 16-10a. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

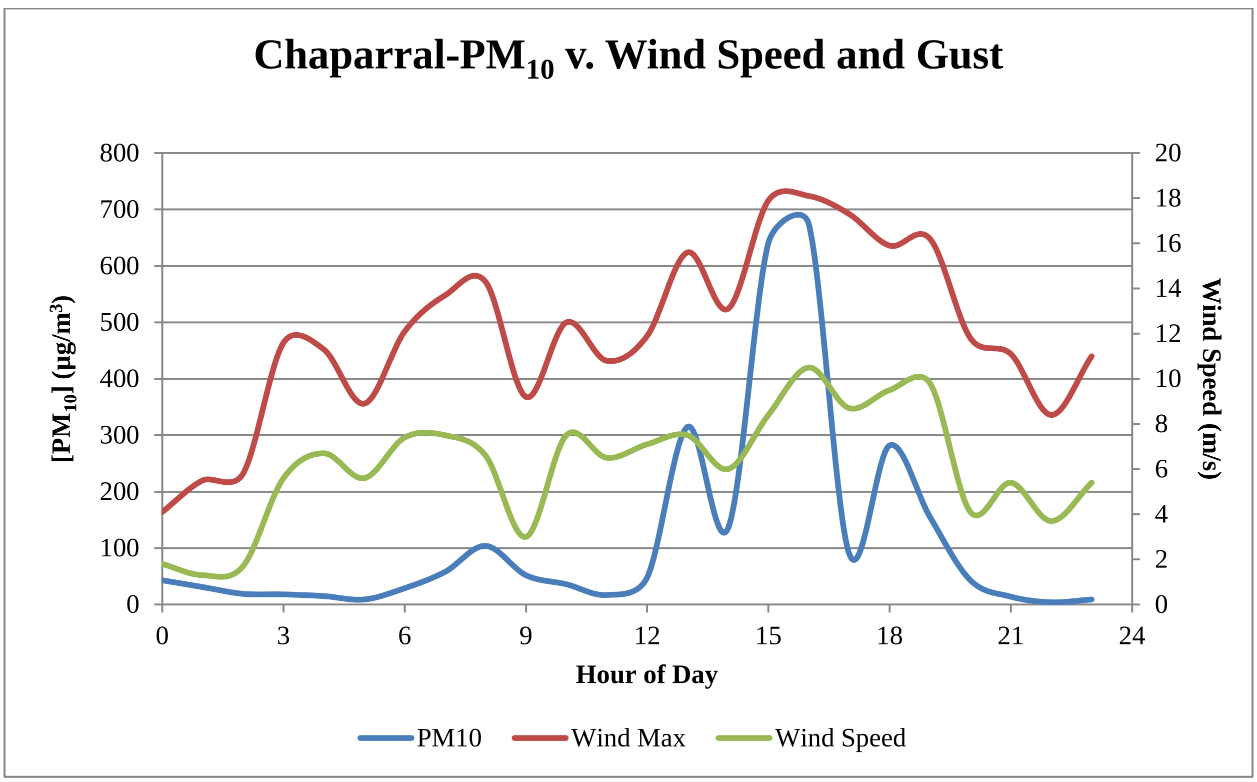

Figure 16-10b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

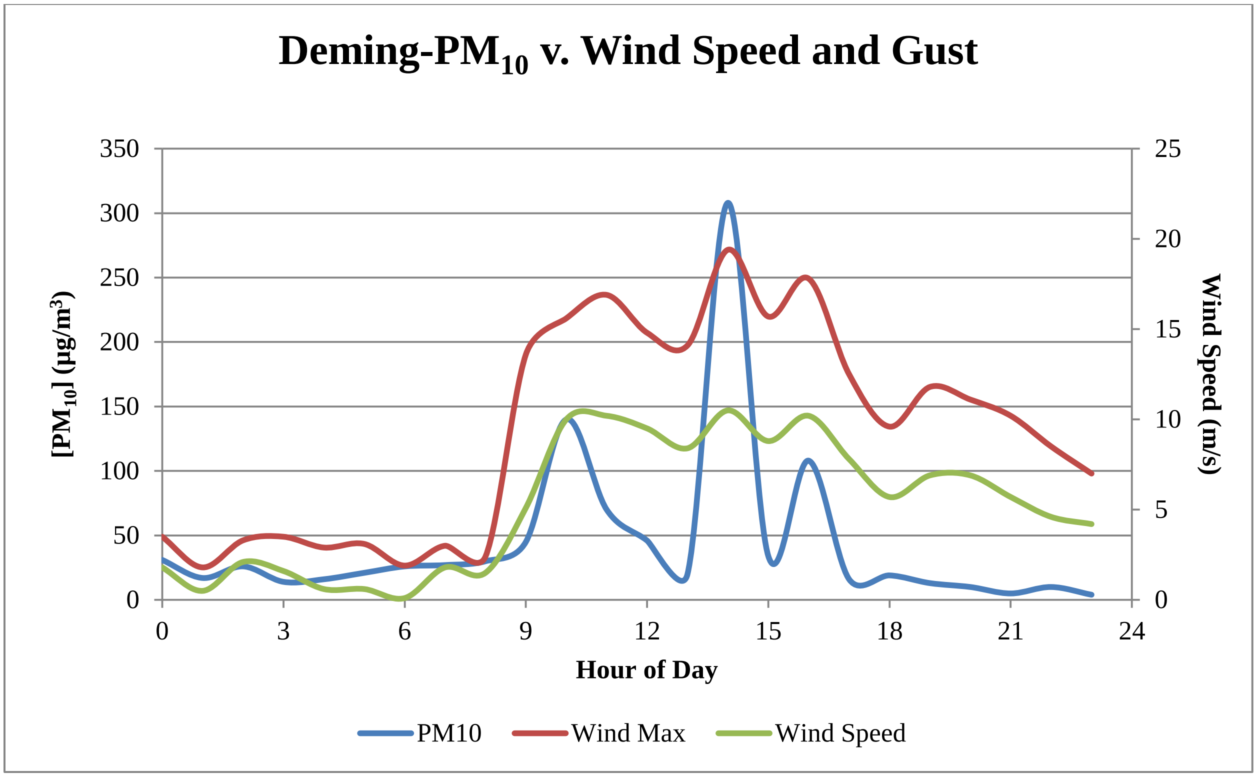

Figure 16-10c. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

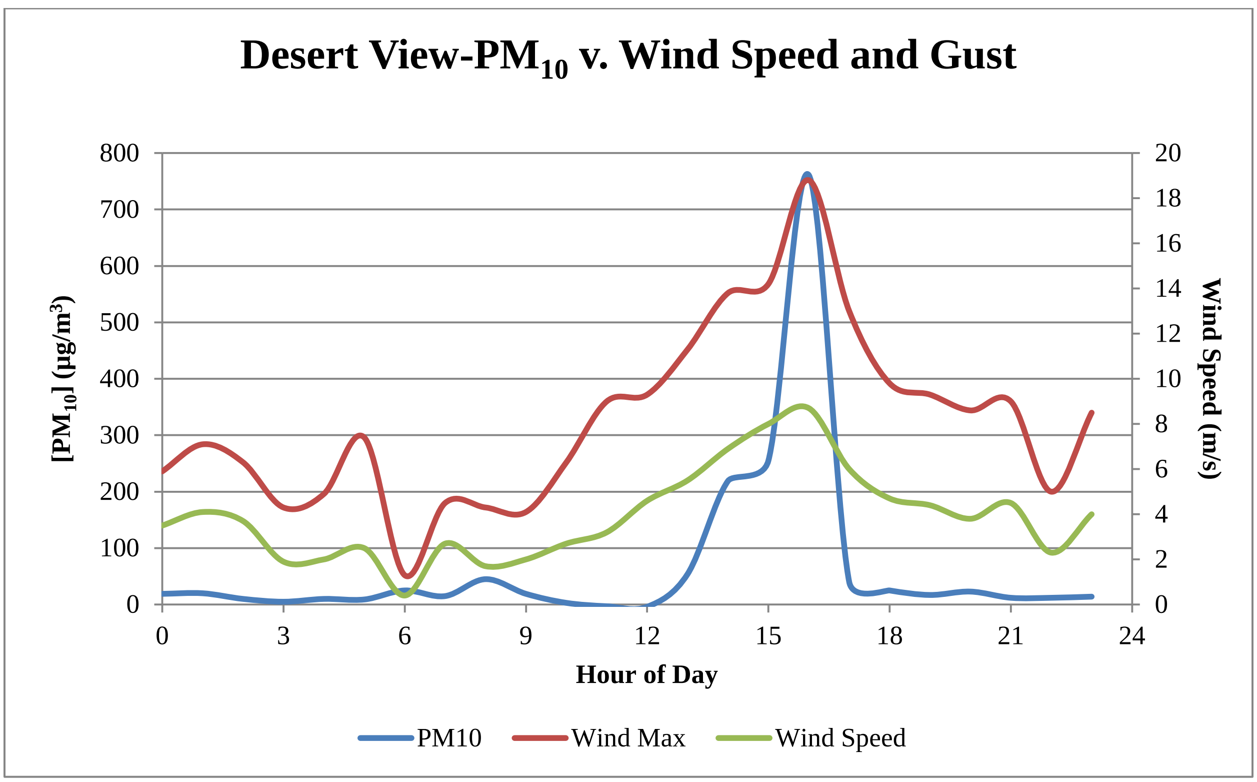

Figure 16-10d. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

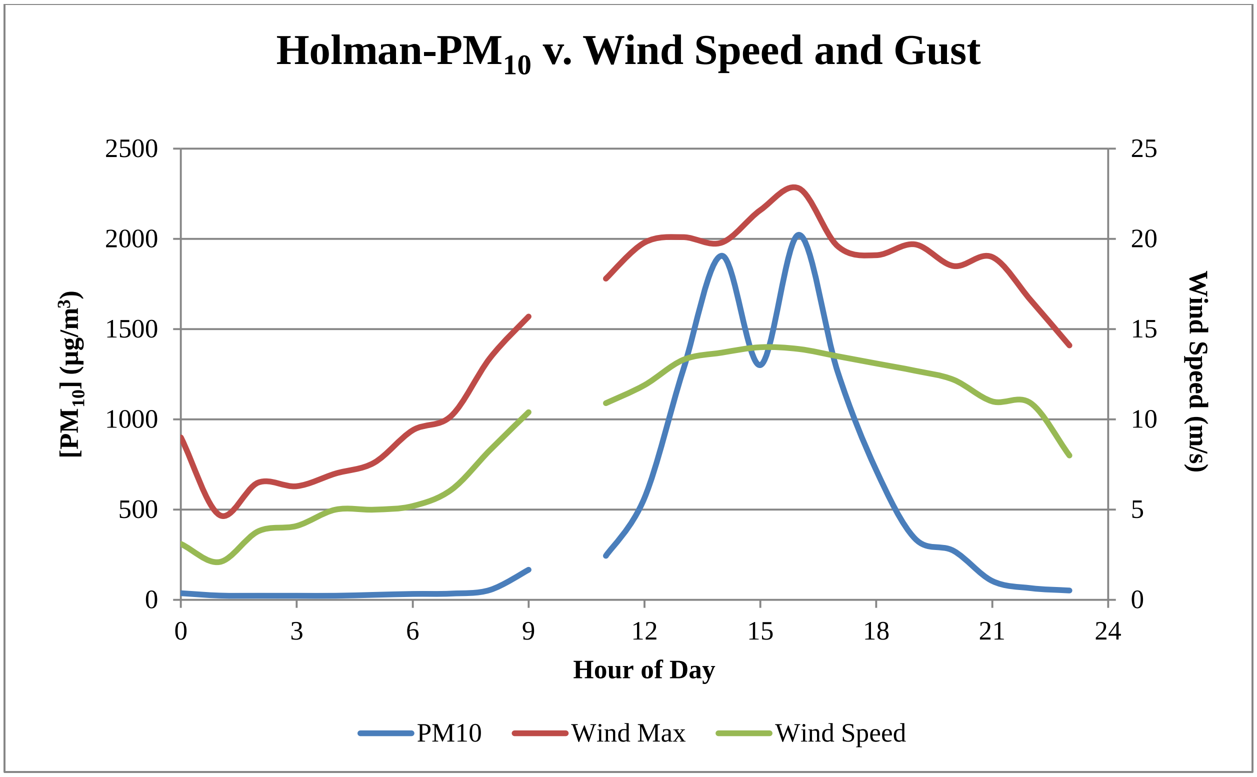

Figure 16-10e. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

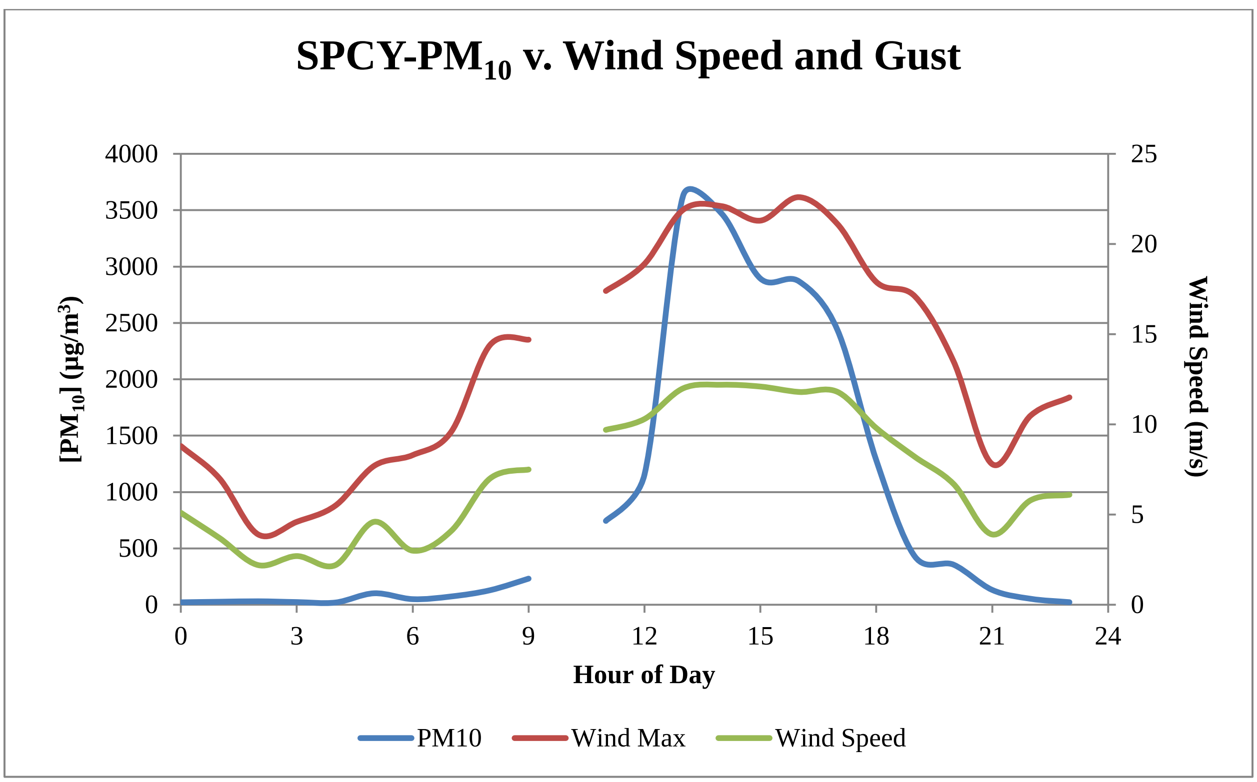

Figure 16-10f. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

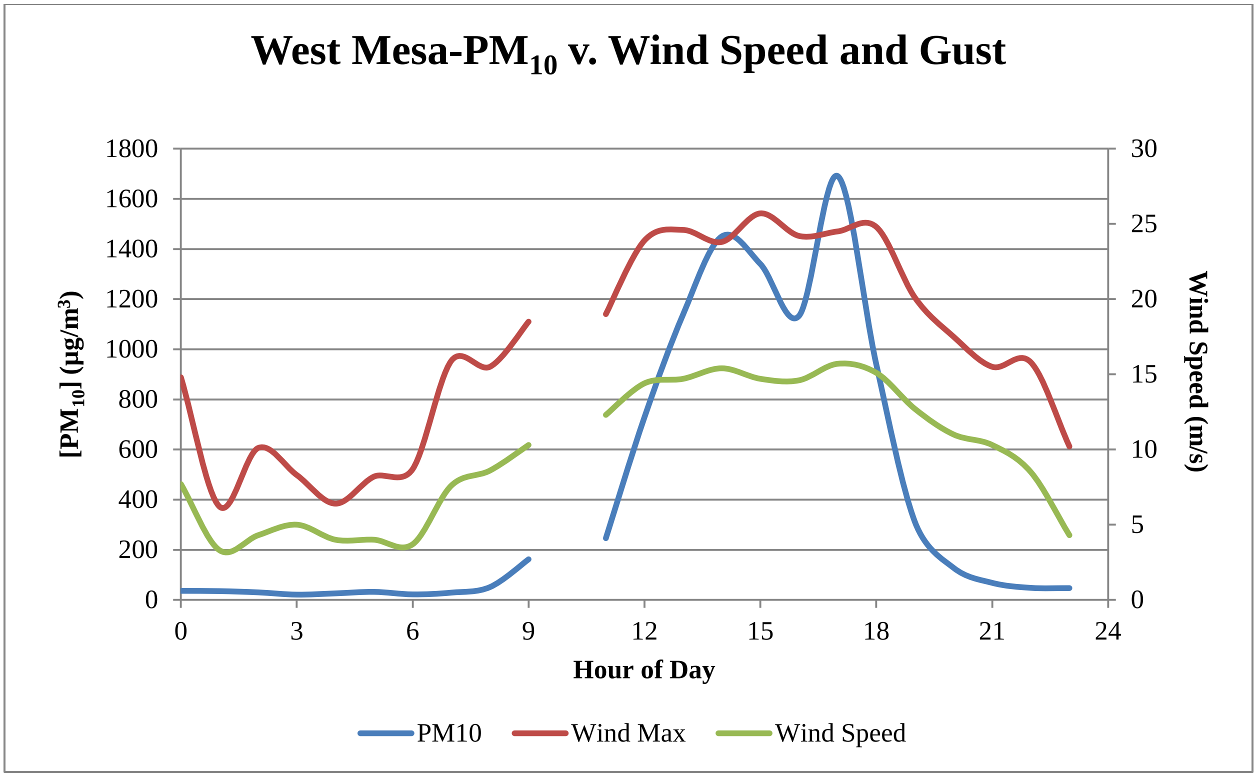

Figure 16-10g. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

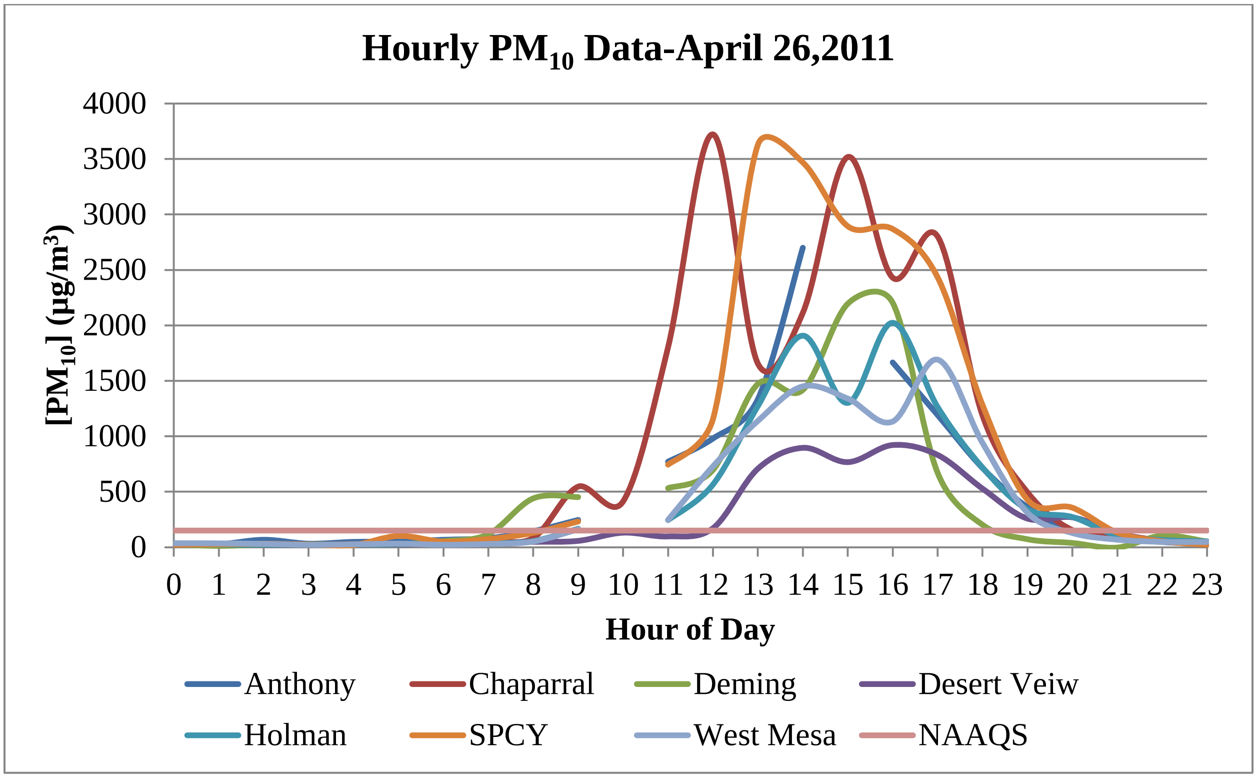

Figure 16-11. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

Contemporary reports and modeling results support these claims. The NM Border AQ Blog posted a dust alert for this day, and reported (DuBois, 2011):

> I expect to see a high wind dust event today. This morning's NWS forecasts show winds to increase to the 38 to 41 mph range in the afternoon. At 10 am it's already windy and can see a dust cloud moving in from the west with gusts in the 30 mph range in Las Cruces. The NWS expects wind gusts to be up to 55 mph later today.

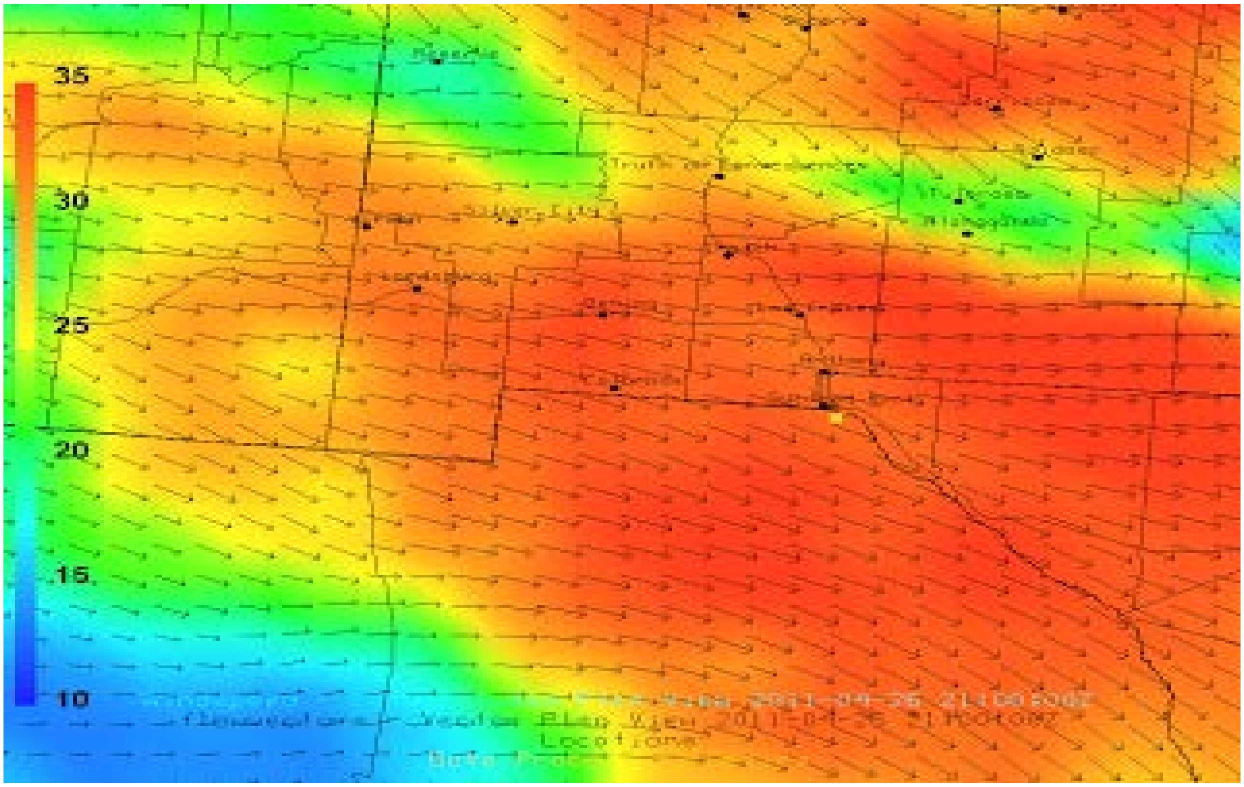

Figure 16-12. April 26, 2011 NOAA RUC Model for winds at the 1500 hour.

The NWS issued a blowing dust advisory and a high wind warning for much of the borderland on this date stating that:

> STRONG WINDS AND BLOWING DUST TO DEVELOP ACROSS SOUTHERN NEW MEXICO AND FAR WEST TEXAS THIS AFTERNOON…
>
> ...ANOTHER PACIFIC TROUGH AND SURFACE FRONT PASS THROUGH THE AREA THIS EVENING. AHEAD OF THIS SYSTEM...WINDS WILL BEGIN INCREASING LATE THIS MORNING...AND BY MID AFTERNOON WEST WINDS WILL REACH THEIR STRONGEST SPEEDS WITH CONSIDERABLE BLOWING DUST. AFTER THE FRONT PASSES THIS EVENING THE BLOWING DUST WILL END AND WINDS WILL BEGIN TO TURN NORTHWEST AND DIMINISH.
>
> * LOCATION...ALL OF SOUTHWEST...SOUTH CENTRAL NEW MEXICO AND FAR WEST TEXAS. THE HIGHEST WIND SPEEDS ARE EXPECTED ALONG THE

SOUTHERN DESERT FROM LORDSBURG TO EL PASO.

* WINDS...WILL INCREASE TO WEST TO 35 TO 45 MPH SUSTAINED WITH SOME GUSTS OF 55 TO 60 MPH.

* IMPACTS...BLOWING DEBRIS AND BLOWING DUST. POSSIBLE POWER LINE DAMAGE AND OUTAGES. DRIVING MAY BE DIFFICULT DUE TO STRONG CROSS WINDS. VISIBILITIES WILL BE REDUCED TO LESS THAN ONE MILE IN DESERT AREAS...ESPECIALLY ALONG THE I-10 CORRIDOR INTO WEST TEXAS. EXTREMELY CRITICAL FIRE WEATHER CONDITIONS MAKE LARGE FIRE GROWTH POSSIBLE (NWS, 2011).

16.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on April 26, 2011.

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 Anthony monitor detected blowing dust around the 800 hour with hourly concentrations heavily impacted until the 1900 hour. The 10 hourly PM_{10} values from 800-1900 hours alone, exceed the 24-hour average standard at Anthony [(145 + 246 + 771 + 980 + 1335 + 2700 + 1666 + 1192 + 714 + 360) µg/m^3 = 10109 µg/m^3; (10109 µg/m^3)/24 = 421 µg/m^3]. By replacing these ten hourly values with the 95th percentile of hourly data at the Anthony site, the resulting 24-hour average (100 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 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	33	33
1	27	27
2	67	67
3	32	32
4	48	48
5	50	50
6	67	67
7	81	81
8	145	**109**
9	246	**88**
10		
11	771	**106**
12	980	**136**
13	1335	**146**
14	2700	**177**
15		
16	1666	**152**
17	1192	**194**
18	714	**197**
19	360	**185**
20	152	152
21	87	87
22	47	47
23	29	29
24-Hour Average	492	**100**

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 Anthony.

The Chaparral monitor detected blowing dust around the 900 hour with hourly concentrations heavily impacted until the 1900 hour. The eleven hourly PM_{10} values from 900-1900 hours alone, exceed the 24-hour average standard at Chaparral [(546 + 413 + 1802 + 3722 + 1655 + 2113 + 3518 + 2430 + 2802 + 1187 + 495) µg/m^3 = 20683 µg/m^3; (20683 µg/m^3)/24 = 861 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 (80 µg/m^3) does not exceed the NAAQS (Table 16-2). 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	28	28
1	29	29
2	26	26
3	25	25
4	23	23
5	28	28
6	40	40
7	67	67
8	84	84
9	546	**74**
10	413	**79**
11	1802	**87**
12	3722	**120**
13	1655	**151**
14	2113	**141**
15	3518	**147**
16	2430	**127**
17	2802	**122**
18	1187	**120**
19	495	**126**
20	154	154
21	114	114
22	58	58
23	22	22
24-Hour Average	890	**80**

Table 16-2. 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 700 hour with hourly concentrations heavily impacted until the 1800. The eleven hourly PM_{10} values from 700-1800 hours alone, exceed the 24-hour average standard at Deming [(117 + 440 + 452 + 532 + 697 + 1472 + 1418 + 2195 + 2204 + 671 + 202) µg/m^3 = 10400 µg/m^3; (10400 µg/m^3)/24 = 433 µg/m^3]. By replacing these eleven hourly values with the 95th percentile of hourly data at the Deming site, the resulting 24-hour average (59 µg/m^3) does not exceed the NAAQS (Table 16-3). 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	24	24
1	12	12
2	22	22
3	25	25
4	29	29
5	27	27
6	55	55
7	117	**65**
8	440	**62**
9	452	**60**
10		
11	532	**62**
12	697	**72**
13	1472	**99**
14	1418	**101**
15	2195	**103**
16	2204	**107**
17	671	**95**
18	202	**87**
19	72	72
20	38	38
21	-3	-3
22	105	105
23	52	52
24-Hour Average	472	59

Table 16-3. **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. The nine hourly PM_{10} values from 1200-2000 hours alone, exceed the 24-hour average standard at Desert View [(171 + 708 + 896 + 767 + 921 + 832 + 528 + 258 + 269) µg/m^3 = 5350 µg/m^3; (5350 µg/m^3)/24 = 222 µg/m^3]. By replacing these nine hourly values with the 95th percentile of hourly data at the Desert View site, the resulting 24-hour average (77 µg/m^3) does not exceed the NAAQS (Table 16-4). 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	23	23
1	25	25
2	23	23
3	22	22
4	29	29
5	25	25
6	31	31
7	34	34
8	48	48
9	57	57
10	131	91
11	97	91
12	171	**94**
13	708	**91**
14	896	**106**
15	767	**119**
16	921	**124**
17	832	**158**
18	528	**137**
19	258	**149**
20	269	**116**
21	129	129
22	52	52
23	37	37
24-Hour Average	254	**77**

Table 16-4. 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 900 hour with hourly concentrations heavily impacted until the 2000. The eleven hourly PM_{10} values from 900-2000 hours alone, exceed the 24-hour average standard at Holman [(167 + 244 + 565 + 1273 + 1907 + 1301 + 2023 + 1264 + 718 + 340 + 272)] µg/m^3 = 10074 µg/m^3; (10074 µg/m^3)/24 = 419 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 (73 µg/m^3) does not exceed the NAAQS (Table 16-5). 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	37	37
1	24	24
2	23	23
3	23	23
4	23	23
5	28	28
6	33	33
7	35	35
8	55	55
9	167	**52**
10		
11	244	**66**
12	565	**85**
13	1273	**102**
14	1907	**122**
15	1301	**125**
16	2023	**118**
17	1264	**125**
18	718	**160**
19	340	**132**
20	272	**111**
21	105	105
22	65	65
23	52	52
24-Hour Average	459	**73**

Table 16-5. **95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at Holman.**

The Sunland Park monitor detected blowing dust around the 800 hour with hourly concentrations heavily impacted until the 2000. The eleven hourly PM_{10} values from 800-2000 hours alone, exceed the 24-hour average standard at Sunland Park [(232 + 744 + 1155 + 3629 + 3469 + 2894 + 2869 + 2434 + 1282 + 428)] µg/m^3 = 19136 µg/m^3; (19136 µg/m^3)/24 = 797 µg/m^3]. By replacing these eleven hourly values with the 95th percentile of hourly data at the Sunland Park site, the resulting 24-hour average (117 µg/m^3) does not exceed the NAAQS (Table 16-6). 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	22	22
1	27	27
2	31	31
3	24	24
4	20	20
5	102	102
6	50	50
7	74	74
8	129	129
9	232	**93**
10		
11	744	**95**
12	1155	**104**
13	3629	**125**
14	3469	**145**
15	2894	**160**
16	2869	**168**
17	2434	**201**
18	1282	**296**
19	428	**284**
20	356	356
21	132	132
22	53	53
23	23	23
24-Hour Average	877	**117**

Table 16-6. **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 around the 800 hour with hourly concentrations heavily impacted until the 2000 hour. The eleven hourly PM_{10} values from 800-2000 hours alone, exceed the 24-hour average standard at West Mesa [(162 + 246 + 729 + 1139 + 1450 + 1340 + 1133 + 1691 + 940 + 311 + 128)] µg/m^3 = 9269 µg/m^3; (9269µg/m^3)/24 = 386 µg/m^3]. By replacing these eleven hourly values with the 95th percentile of hourly data at the West Mesa site, the resulting 24-hour average (46 µg/m^3) does not exceed the NAAQS (Table 16-7). 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	36	36
1	35	35
2	30	30
3	21	21
4	26	26
5	32	32
6	22	22
7	29	29
8	51	51
9	162	**47**
10		
11	246	**50**
12	729	**47**
13	1139	**51**
14	1450	**60**
15	1340	**69**
16	1133	**65**
17	1691	**63**
18	940	**59**
19	311	**53**
20	128	**50**
21	68	68
22	48	48
23	47	47
24-Hour Average	422	**46**

Table 16-7. 95th percentile of data substituted for those hours when windblown dust was the most intense does not result in an exceedance at West Mesa.

17 HIGH WIND EXCEPTIONAL EVENT: April 29, 2011

17.1 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, and Sunland Park monitoring sites on April 29, 2011. The FEM TEOM continuous monitors at these sites recorded 24-hour average concentrations of 174, 176, and 308 µg/m^3, respectively. The FRM Partisol monitor at Sunland Park recorded a 24-hour average $PM_{2.5}$ concentration of 46 µg/m^3. In accordance with the EER and the $PM_{2.5}$ annual NAAQS, the AQB flagged this data on EPA's AQS database as a high wind natural event. Although no other monitoring sites recorded an exceedance on this date, elevated PM_{10} concentrations were measured at Deming Airport (96 µg/m^3), Desert View (102 µg/m^3), and Holman (97 µg/m^3) monitoring sites (Figure 17-1). 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 17-2).

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 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.

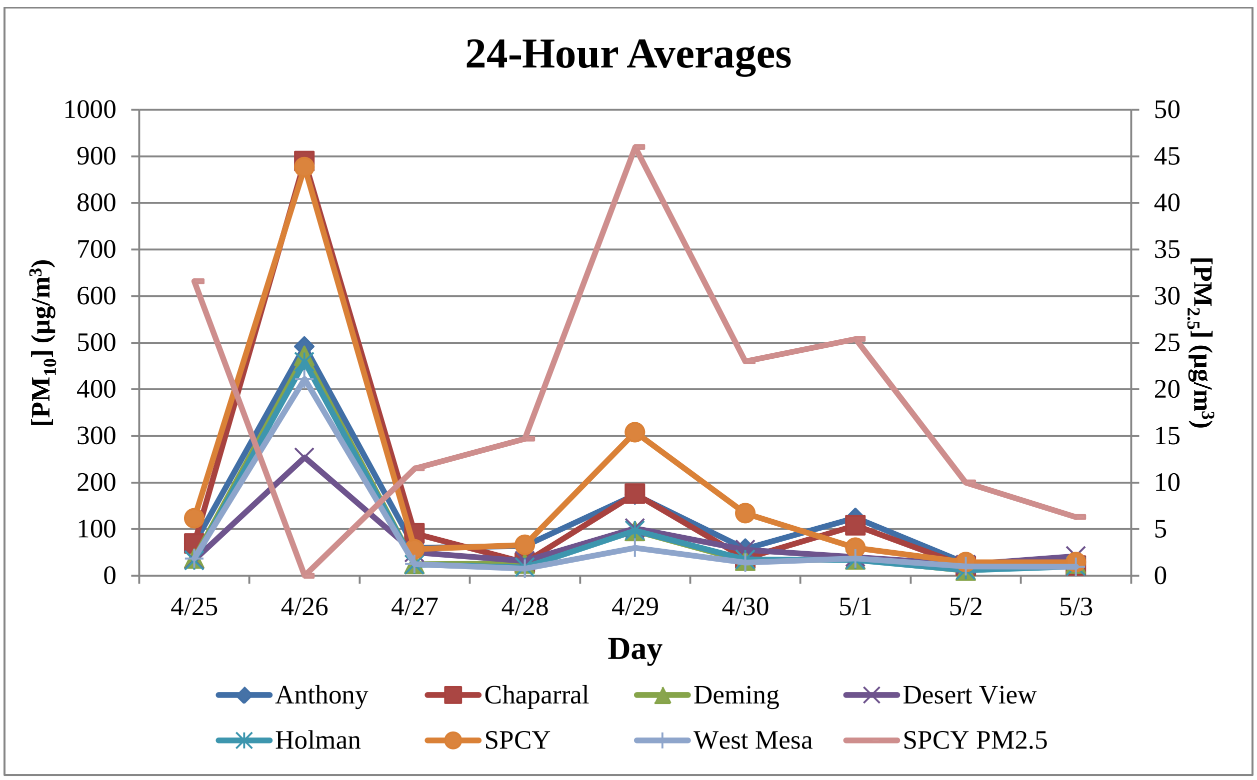

Figure 17-1. PM_{10} and $PM_{2.5}$ 24-hour averages before and after April 29, 2011.

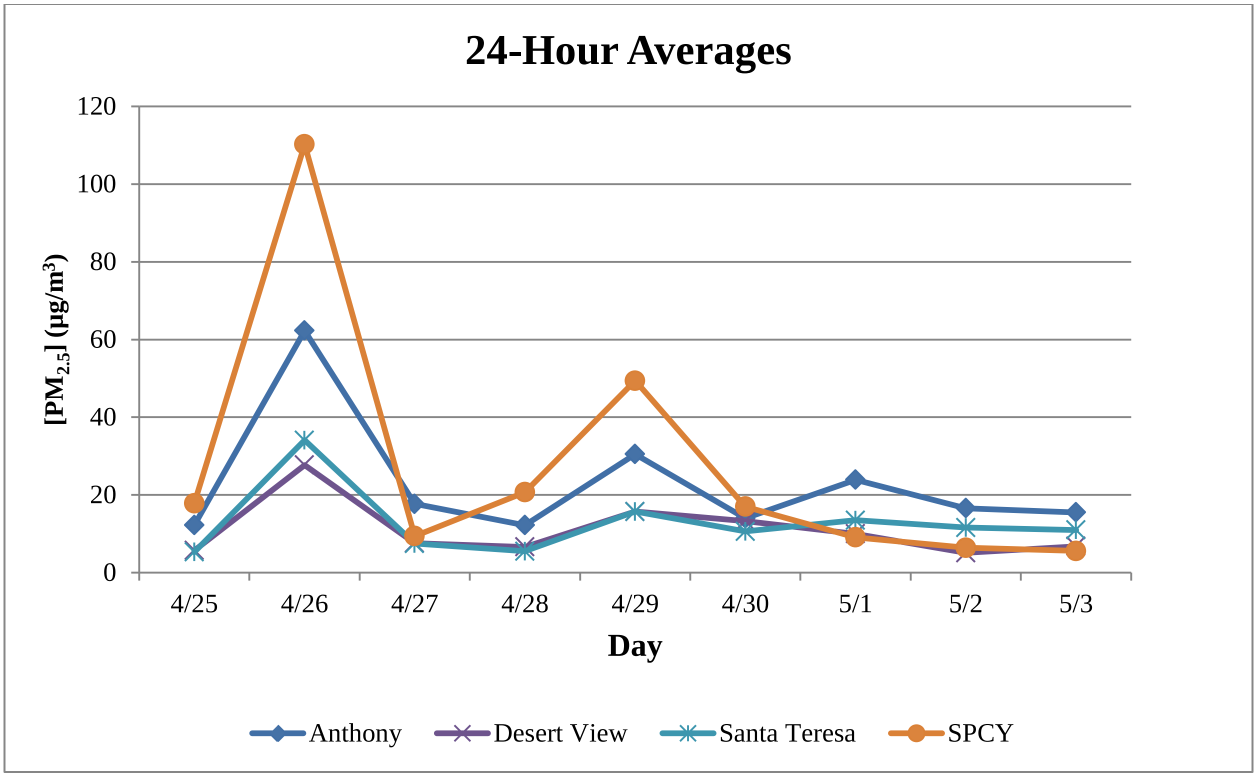

Figure 17-2. $PM_{2.5}$ 24-hour averages before and after April 29, 2011. Non-FEM TEOM Data.

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, 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 of Arizona and New Mexico and the playas of northern Mexico (see Section 17.2.4 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 April 29, 2011, sustained wind speeds exceeded EPA's default threshold at five of the seven monitoring sites in southern New Mexico and wind gusts exceeded the NEAPs agreed upon threshold at seven of the seven monitoring sites (Figures 17-3 and 17-4). Winds exceeded these thresholds at one or more monitoring sites beginning at the 1100 hour and ending at the 1900 hour.

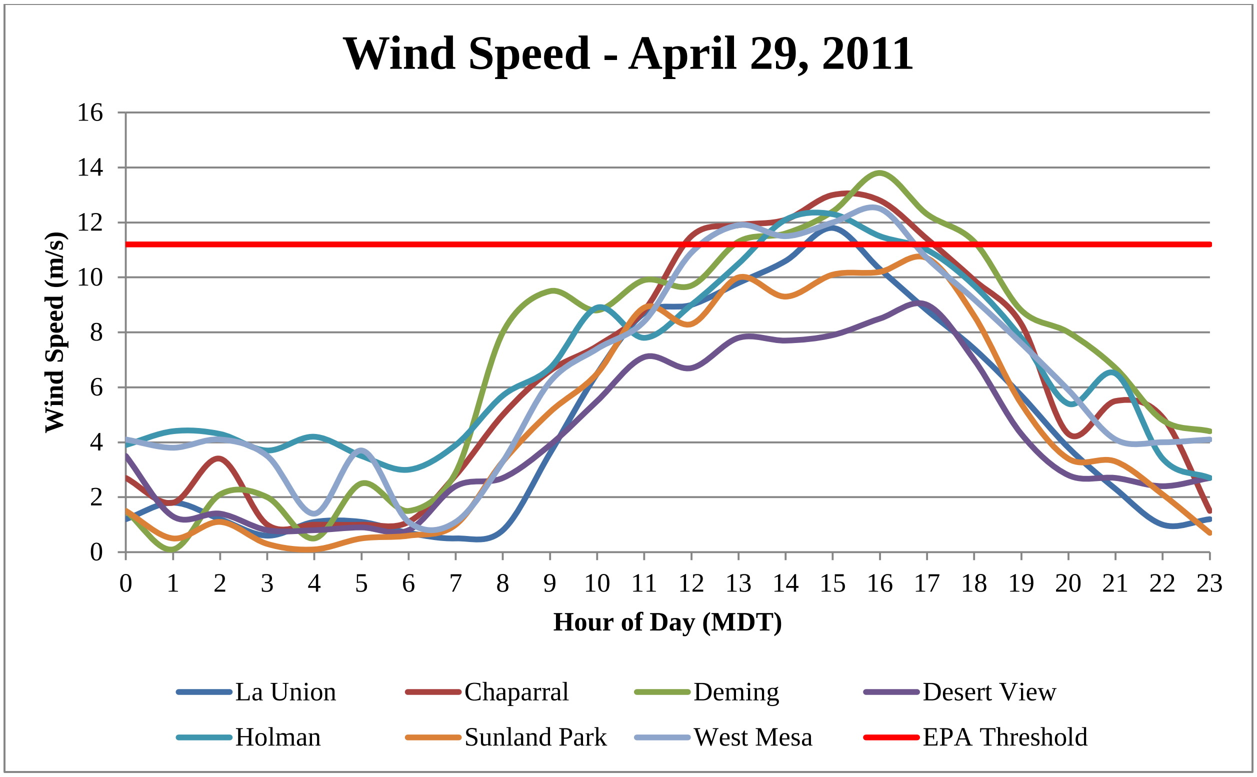

Figure 17-3. Sustained wind speeds at monitoring sites in Doña Ana and Luna Counties.

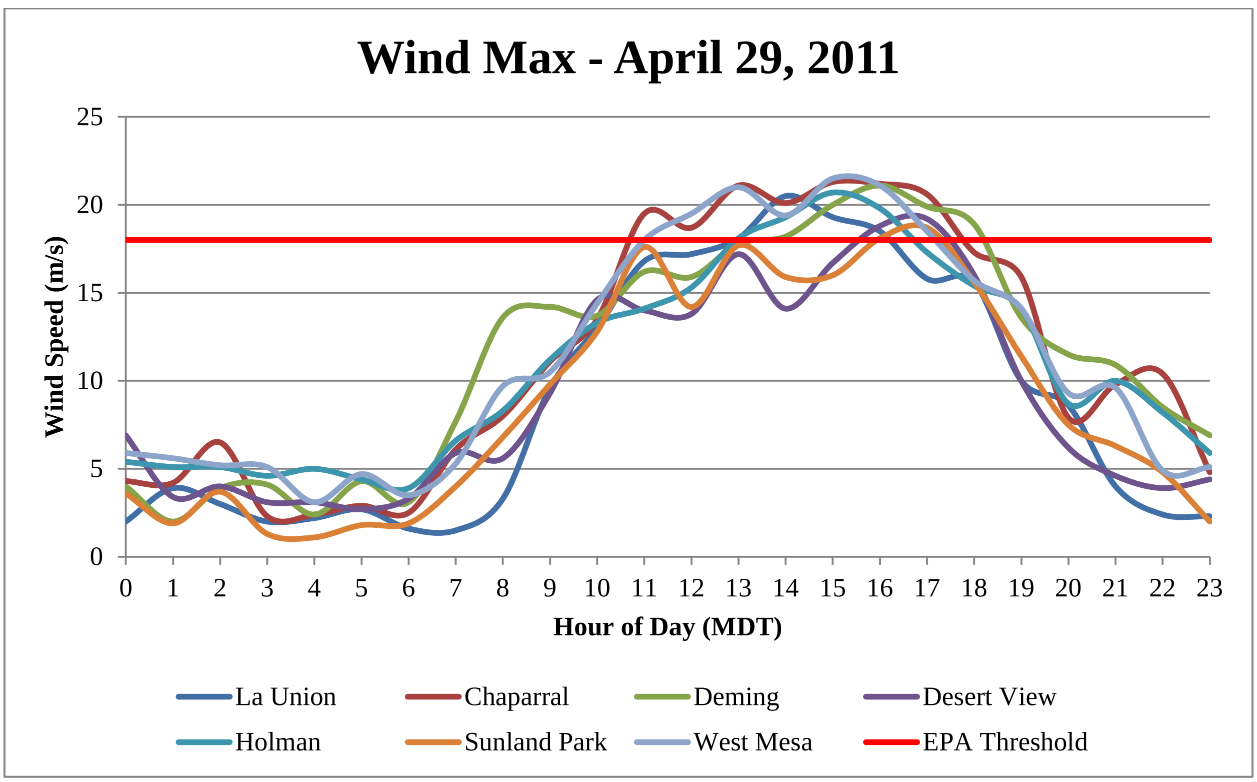

Figure 17-4. Maximum wind gusts at monitoring sites in Doña Ana and Luna Counties.

17.2.3 Recurrence Frequency

The monitoring sites in Doña Ana and Luna Counties can record exceedances of the PM_{10} NAAQS throughout the year. From 2006-2010 the PM_{10} FEM TEOM monitors recorded 211 exceedances and the PM_{10} FRM Wedding monitors recorded 5 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 (Table 2-1). The SPCY $PM_{2.5}$ FRM Partisol recorded 23 exceedances of the 24-Hour NAAQS from 2006-2010 (Figure A-2). See appendix A for a more in-depth discussion about recurrence frequency and the number of exceedances at each monitoring site.

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, Arizona 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 Arizona and 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 17-5). 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.

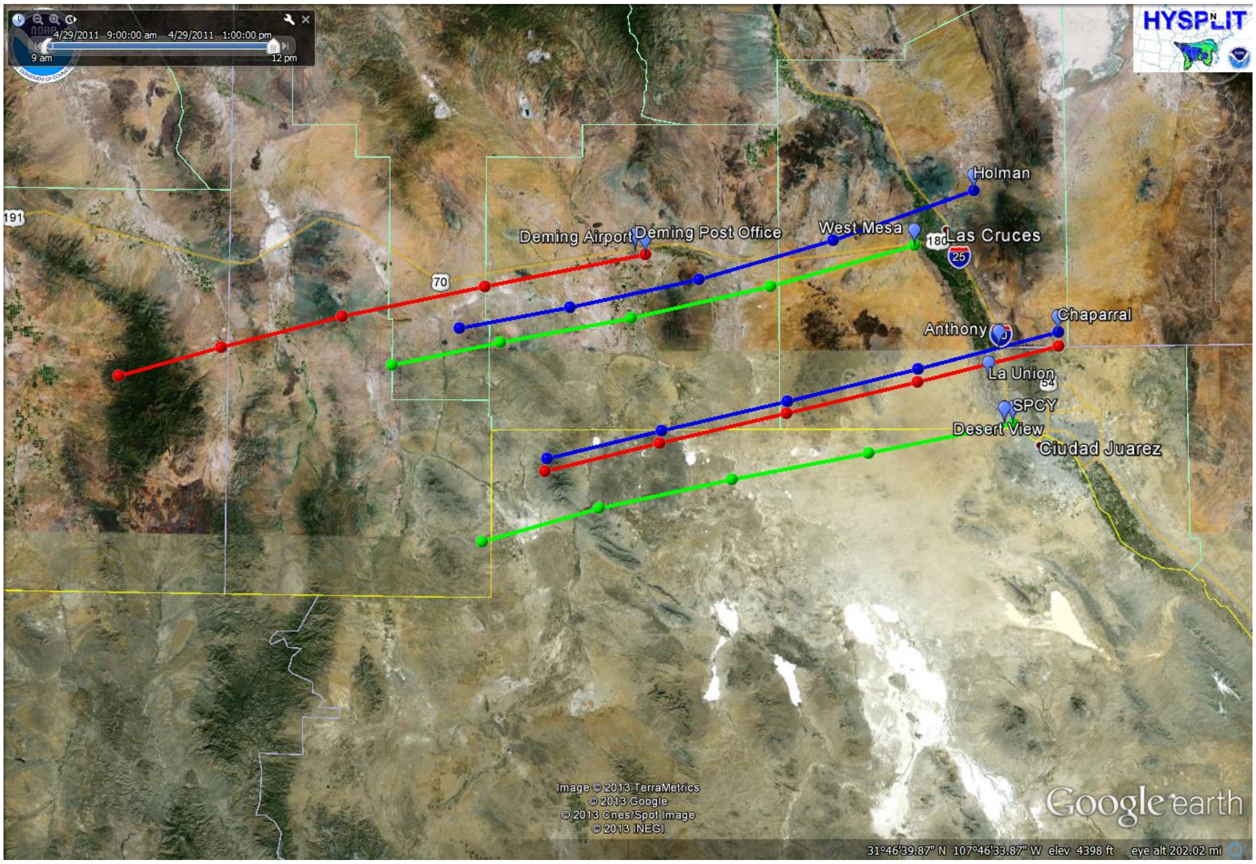

Figure 17-5. HYSPLIT back-trajectory model analysis for April 29, 2011.

17.3 Historical Fluctuations Analysis

17.3.1 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-4 through B-11). 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 2006-2010 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 2006-2010. 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 2006-2010. The recorded values for this day (174, 176, and 308 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 29, 2011 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 17-6a-d through 17-8a-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.

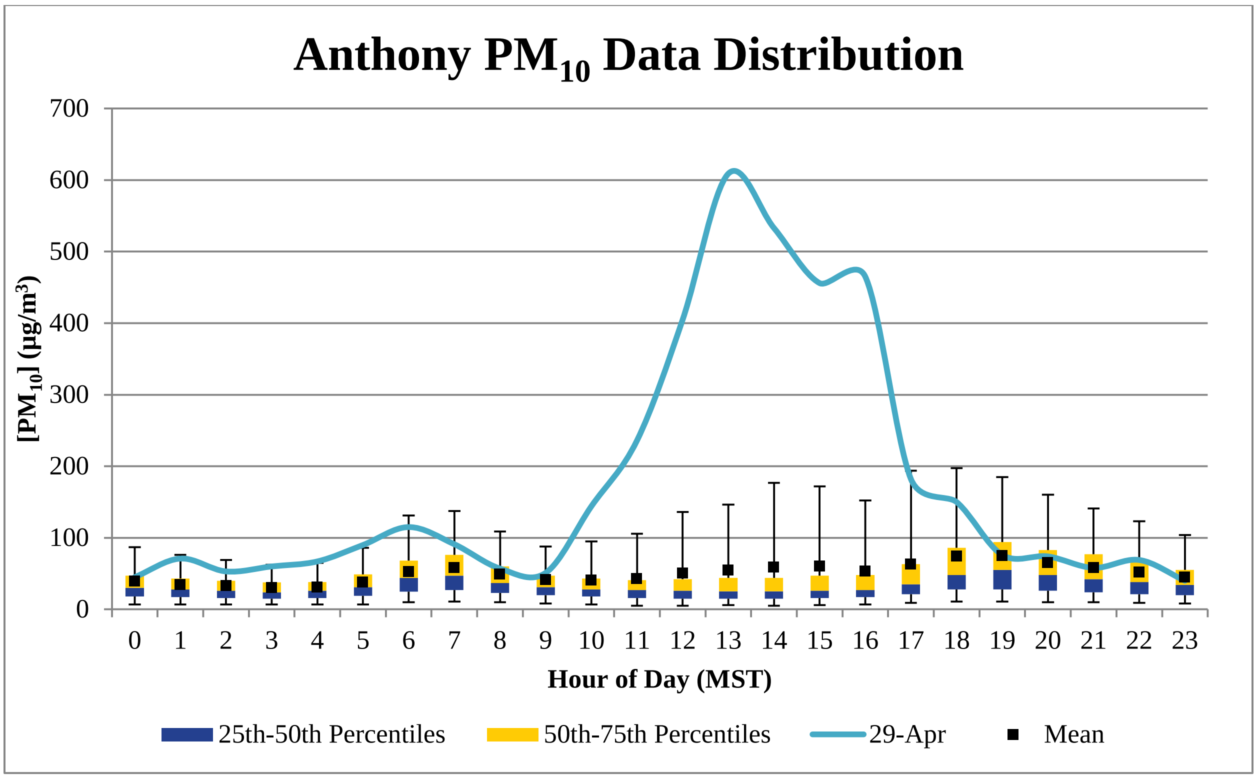

Figure 17-6a. PM10 hourly data distribution from 2006-2010 overlaid by hourly values for April 29, 2011.

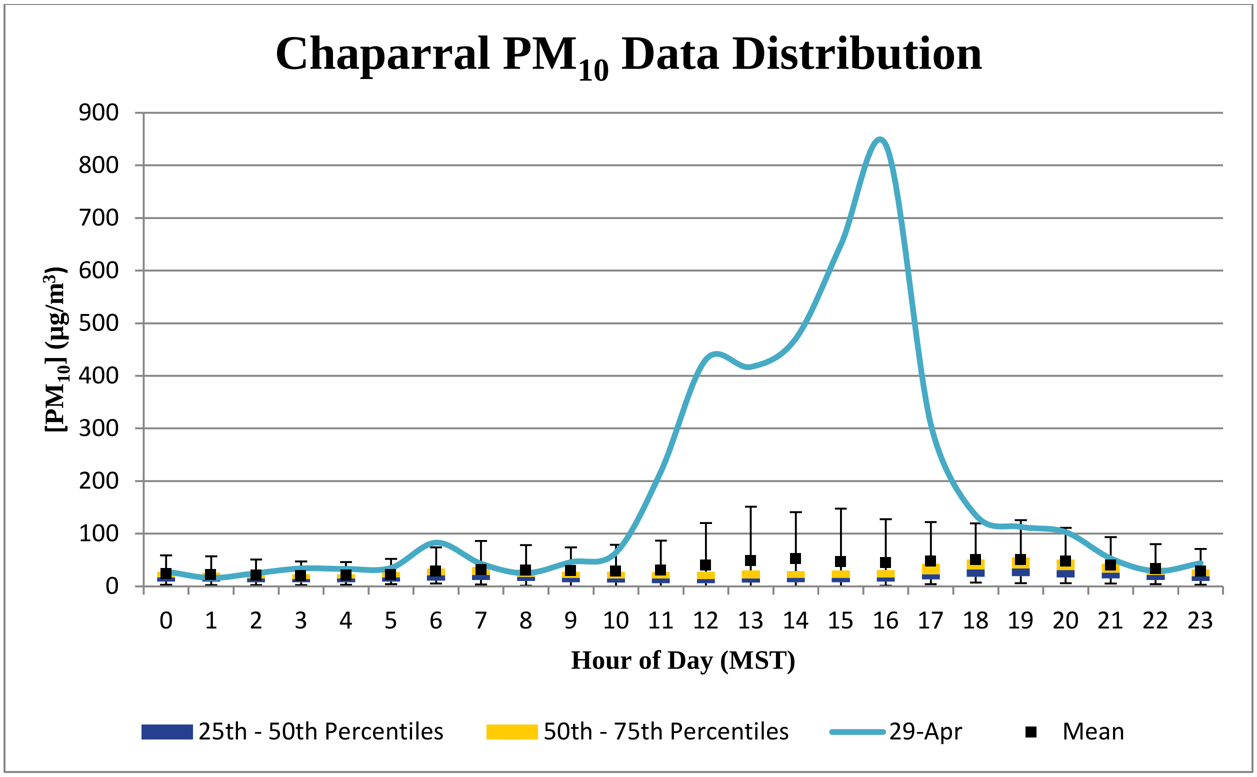

Figure 17-6b. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 29, 2011.

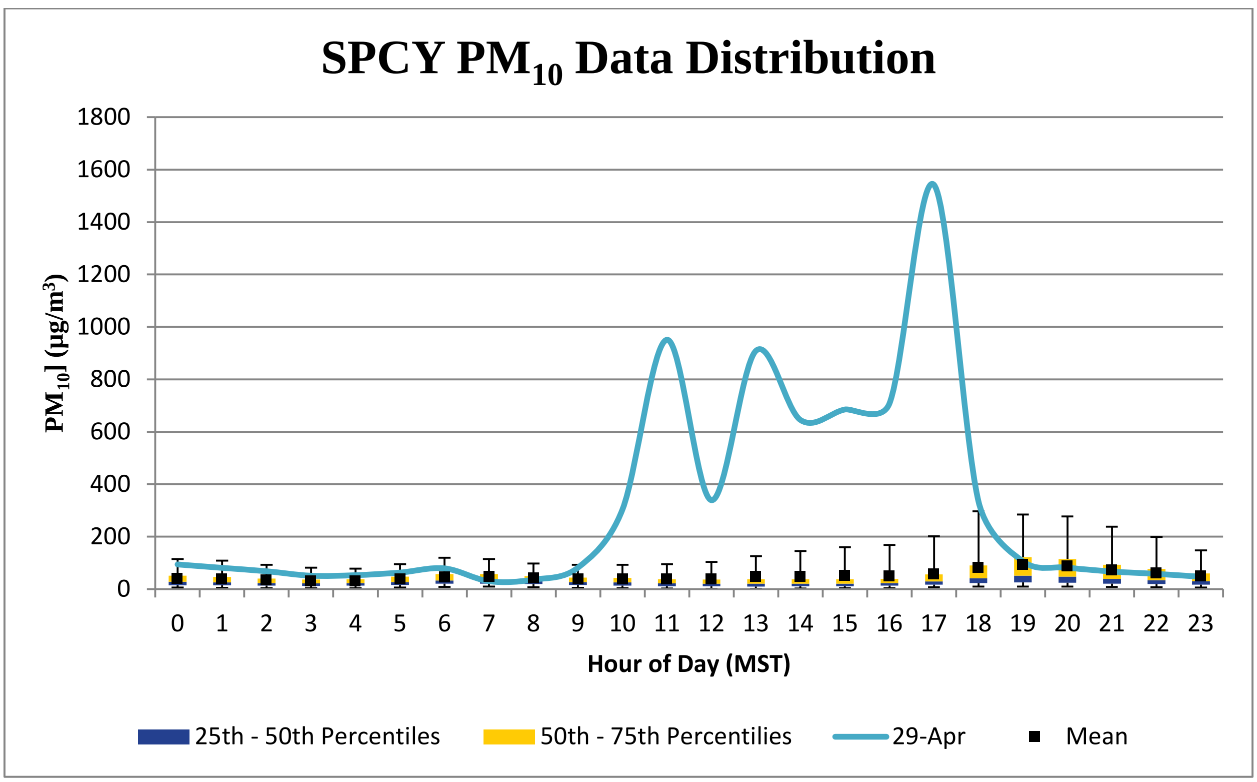

Figure 17-6c. PM_{10} hourly data distribution from 2006-2010 overlaid by hourly values for April 29, 2011.

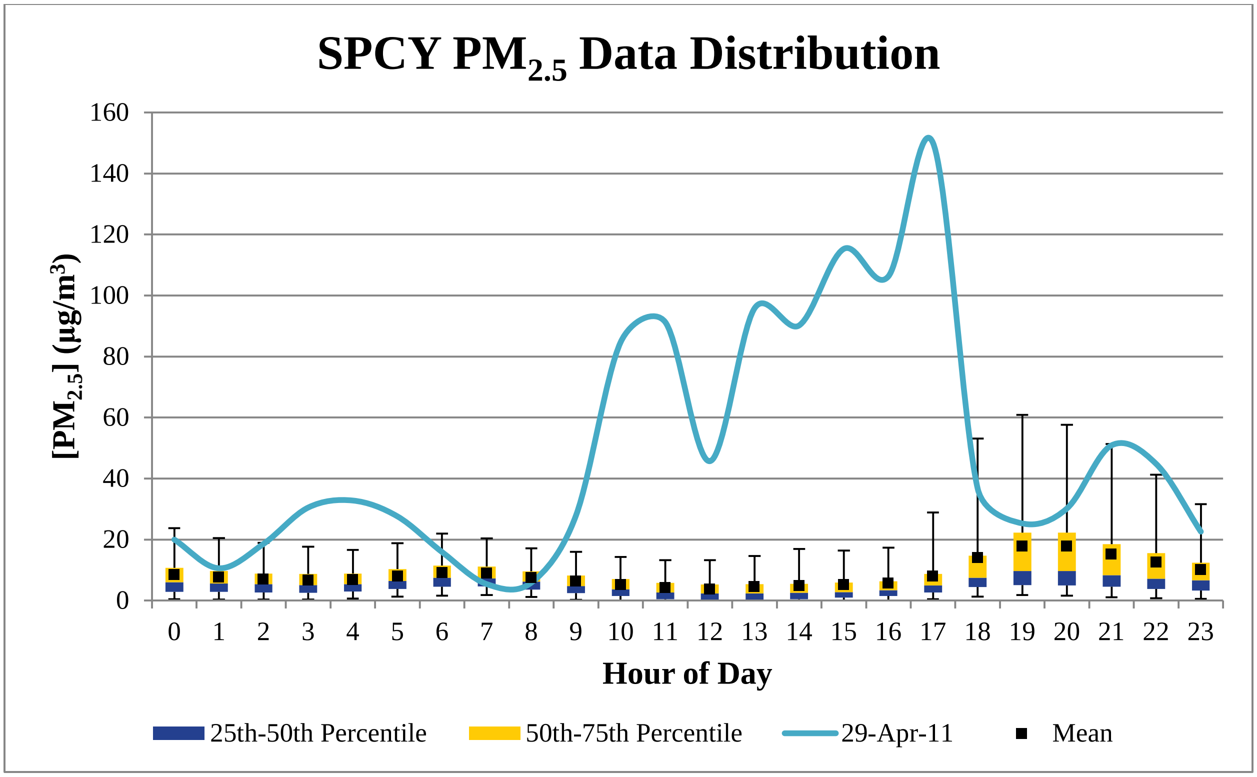

Figure 17-6d. $PM_{2.5}$ hourly data distribution from 2006-2010 overlaid by hourly values for April 29, 2011.

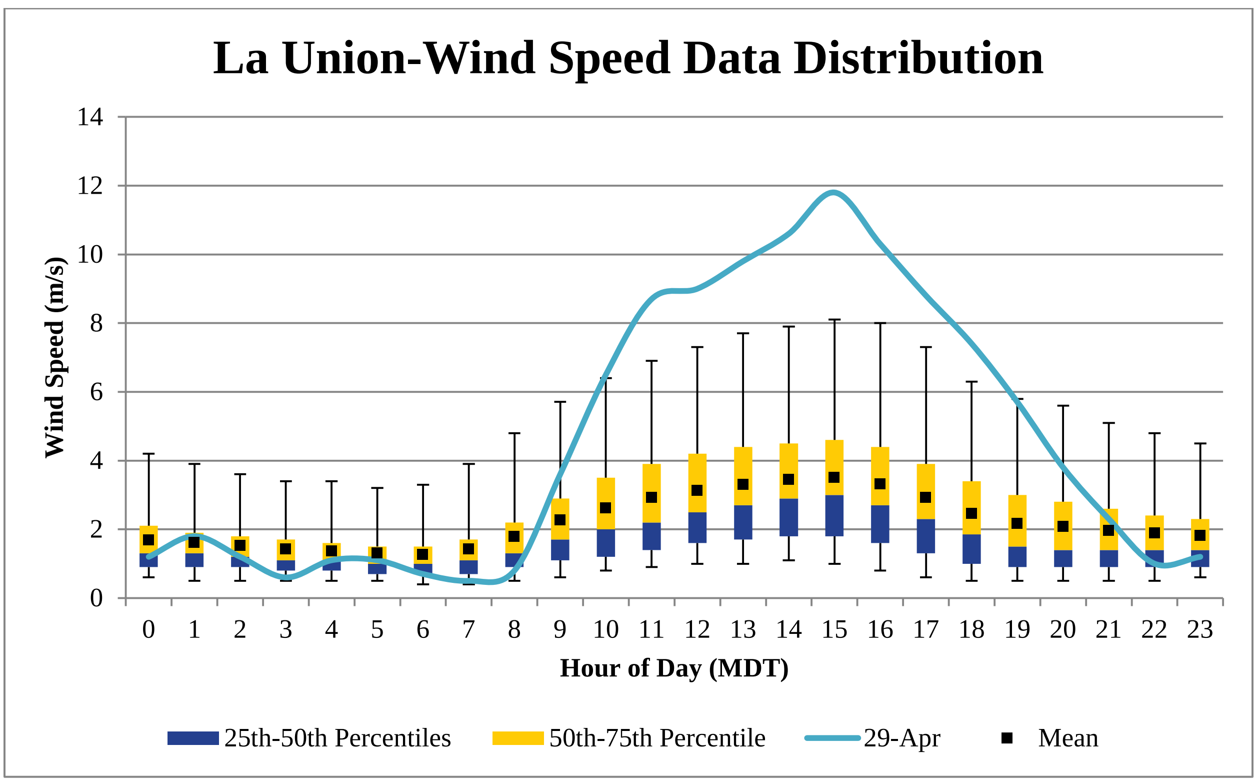

Figure 17-7a. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 29, 2011.

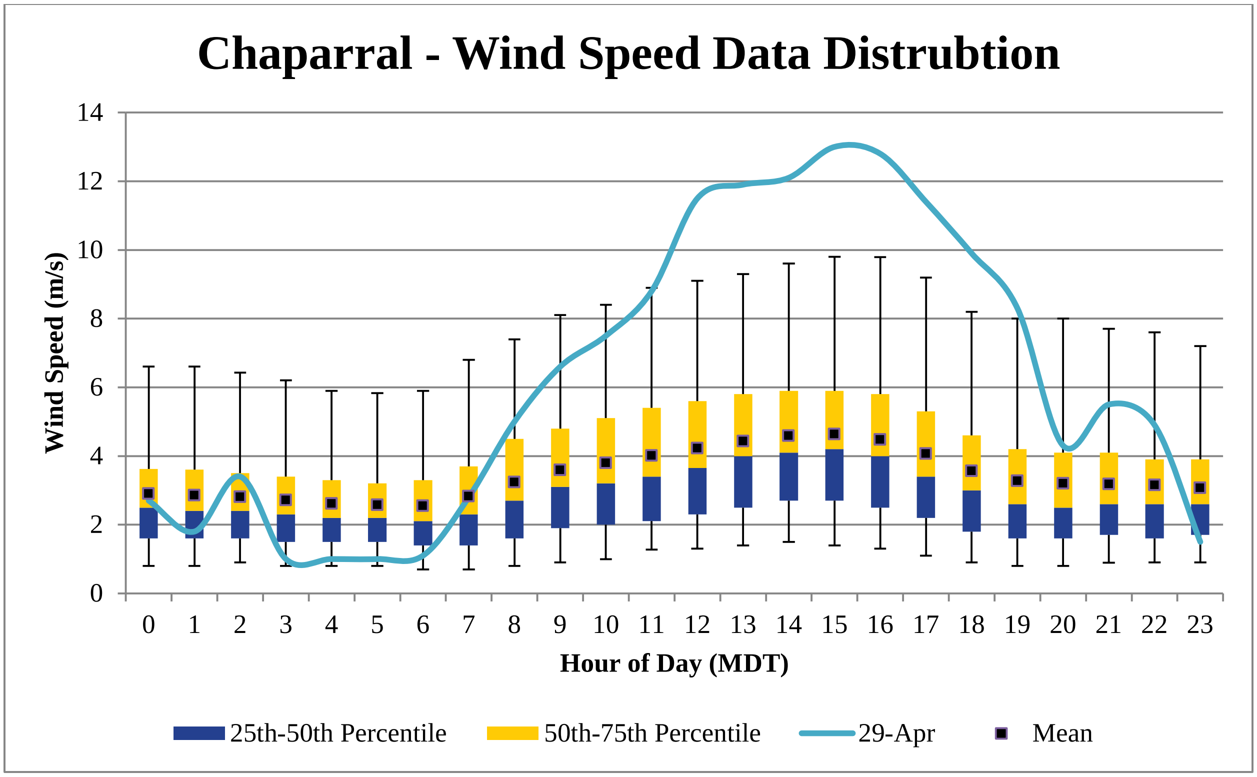

Figure 17-7b. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 29, 2011.

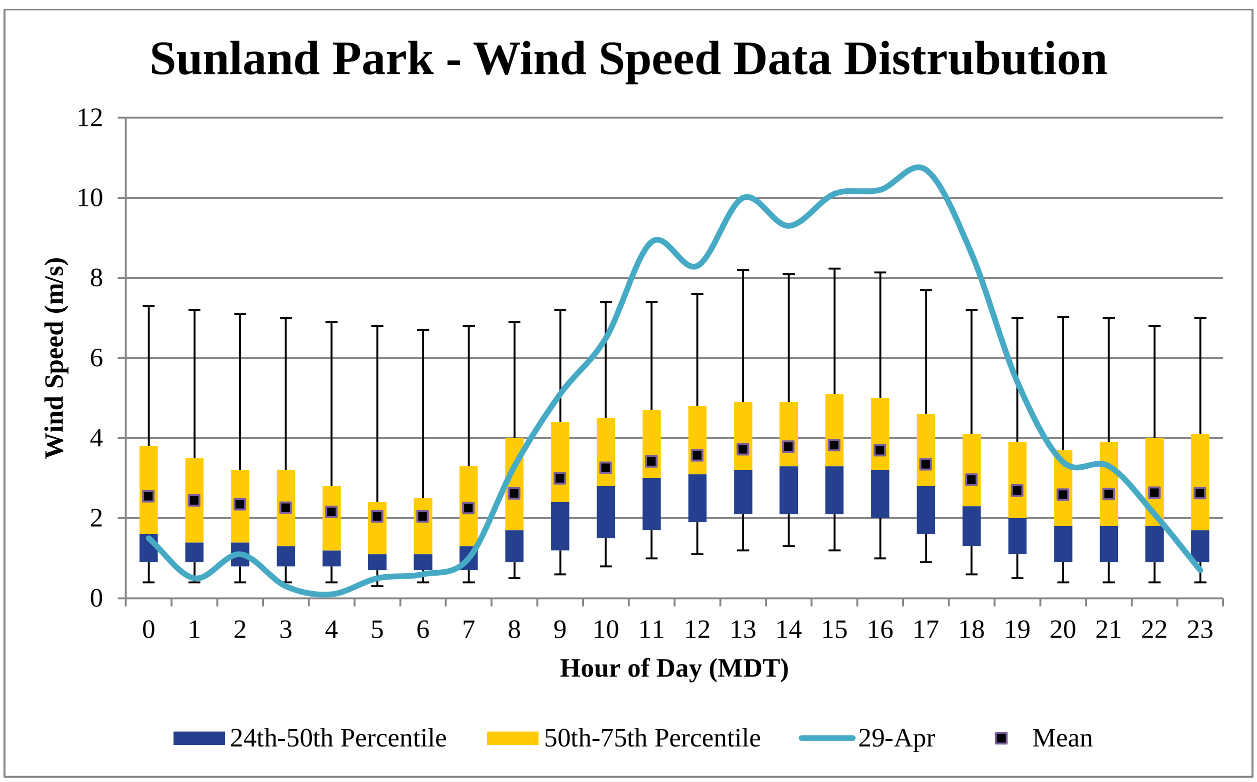

Figure 17-7c. Hourly wind speed data distribution from 2006-2010 overlaid by hourly values for April 29, 2011.

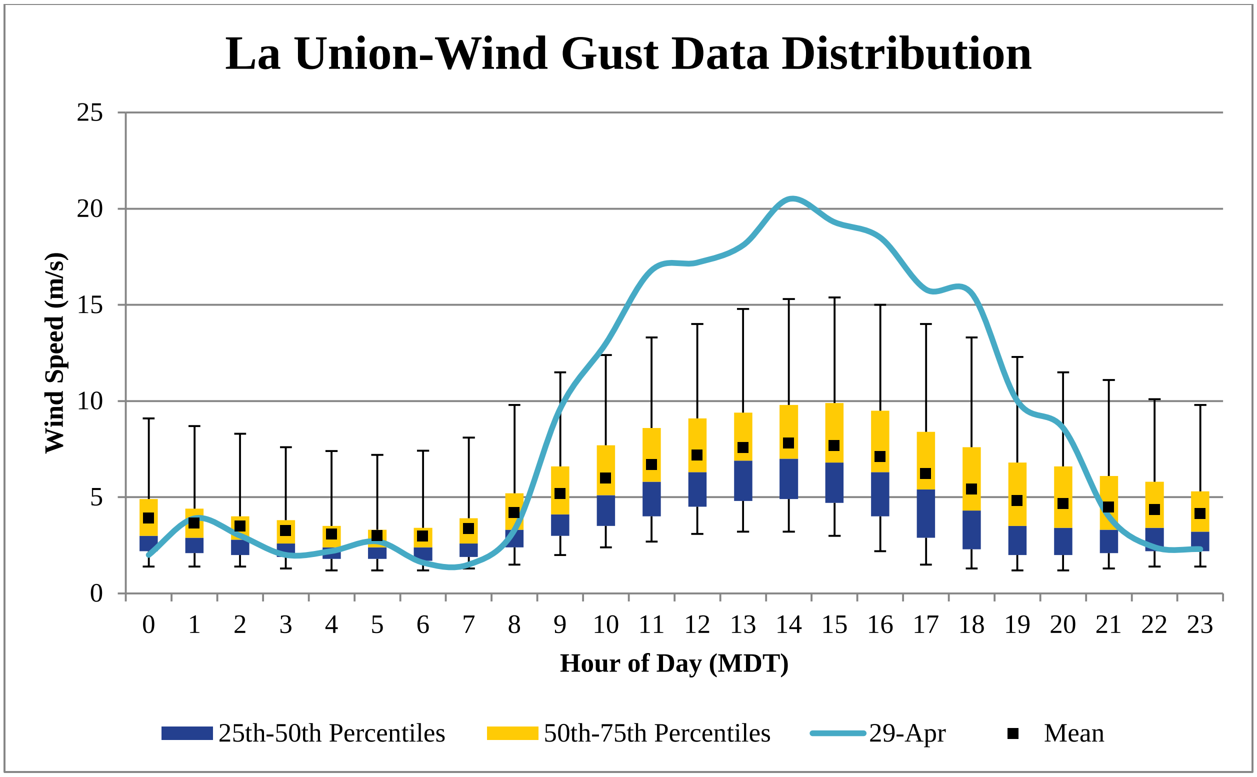

Figure 17-8a. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 29, 2011.

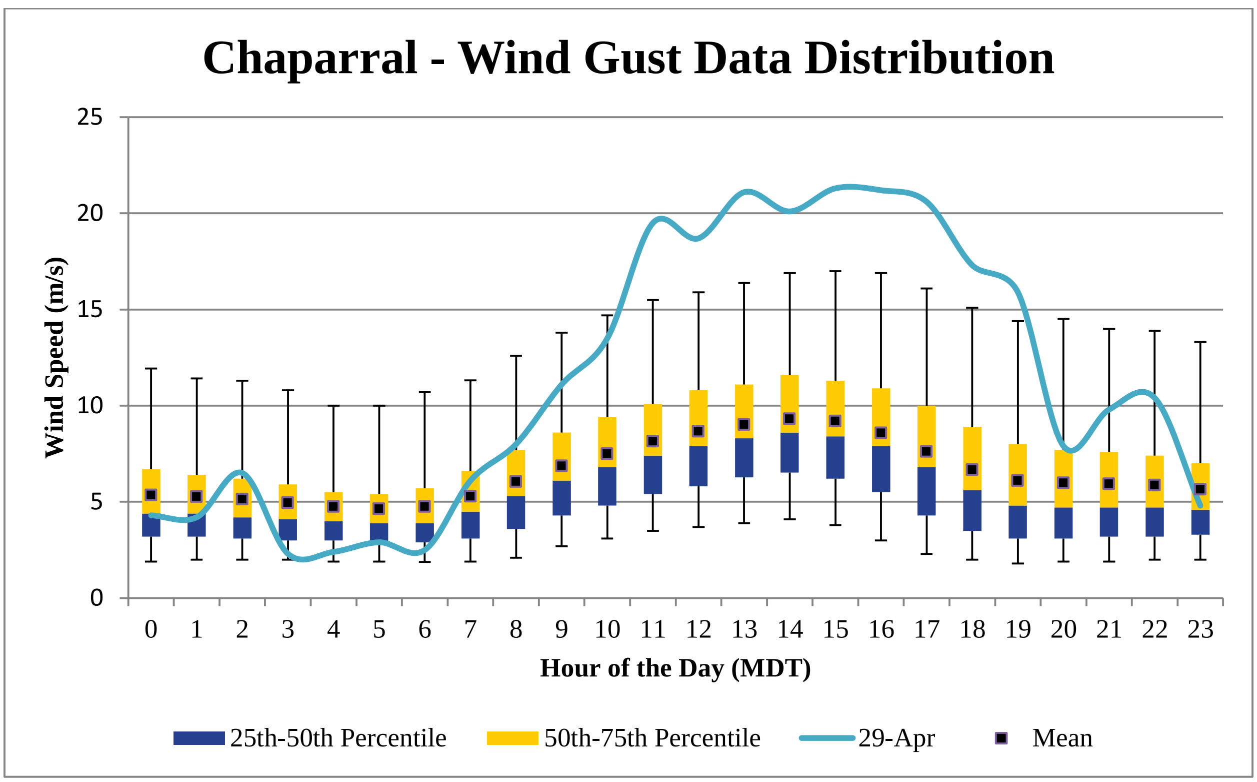

Figure 17-8b. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 29, 2011.

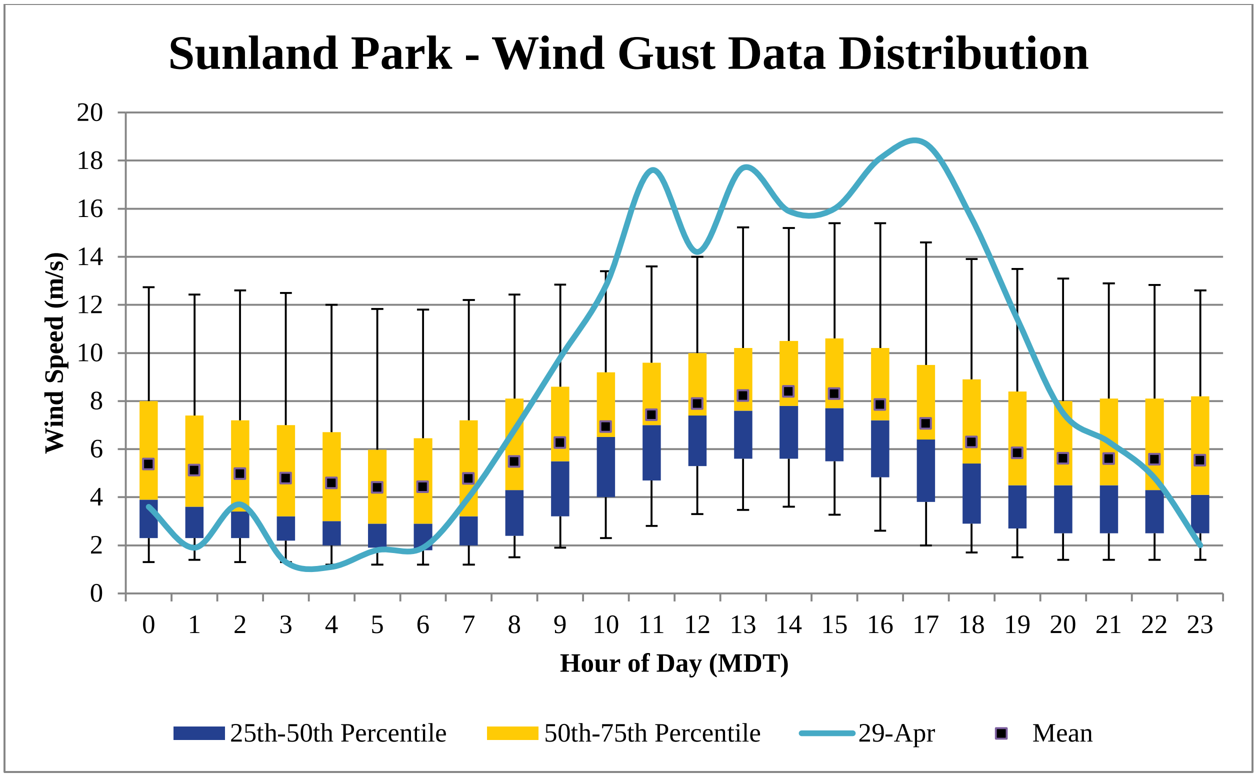

Figure 17-8c. Hourly wind gust data distribution from 2006-2010 overlaid by hourly values for April 29, 2011.

17.4 Clear Causal Relationship

A Pacific cold front passed through New Mexico on April 29, 2011. Prior to the arrival of the cold front, a stationary front in northern New Mexico created a low pressure center in eastern New Mexico creating a pressure gradient over southeastern Arizona, 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). Surface winds flow perpendicular to the isobars from high to low pressure. The wind direction in the upper atmosphere aligned with the surface wind direction (Figure 17-10). 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.

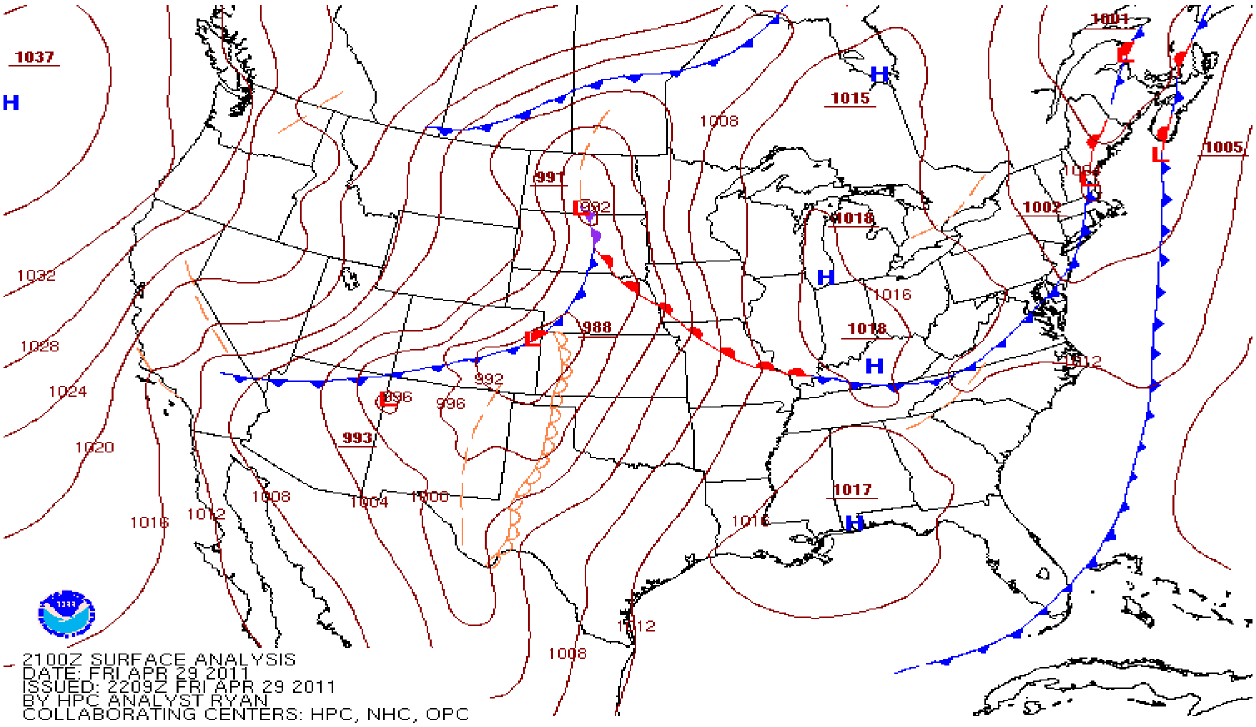

Figure 17-9. Surface weather map showing frontal activity and isobars of constant pressure (red lines) for April 29, 2011 at the 1800 hour.

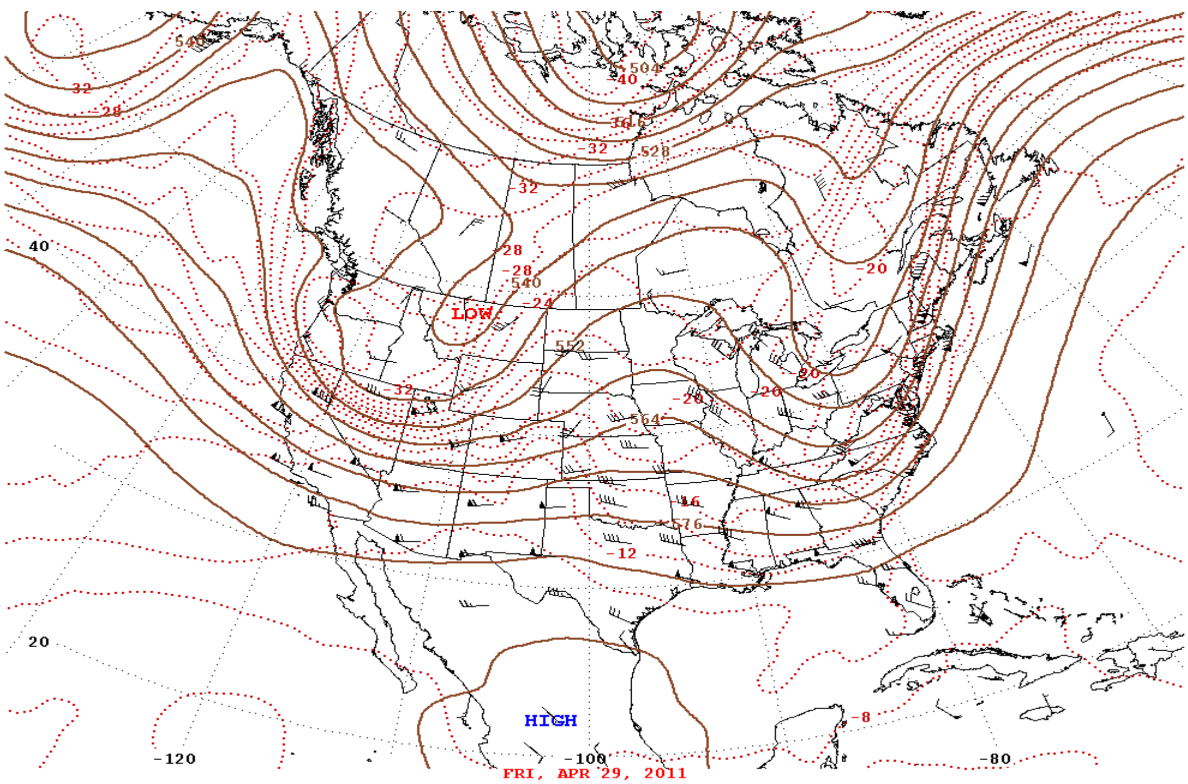

Figure 17-10. **Upper air weather map showing geopotential heights (brown lines) at the 500 hour on April 29, 2011**

The weather pattern described above generated strong winds from the Southwest direction beginning at the 1100 hour and lasting through the 1900 hour. Beginning at the 1100 hour, wind speeds exceeded 11.2 m/s or the historical 95th percentile of data at the Chaparral monitoring site as shown in Figure 17-3. Peak wind speeds ranged from 14 m/s at Deming site to 9 m/s at Desert View monitoring site (Figure 17-3). Peak wind gusts ranged from 21 m/s at West Mesa to 18 m/s at Desert View (Figure 17-4). Blowing dust caused elevated levels of PM_{10} during the same period as high winds as demonstrated by the time series plot in Figures 17-11a-d. As wind speed and wind gusts exceed the 95th percentile of historical data so do hourly PM_{10} concentrations on this date (900-1900 hours). During these hours, hourly PM_{10} and $PM_{2.5}$ concentrations spiked at all monitoring sites in the network (Figure 17-12a-b). 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).

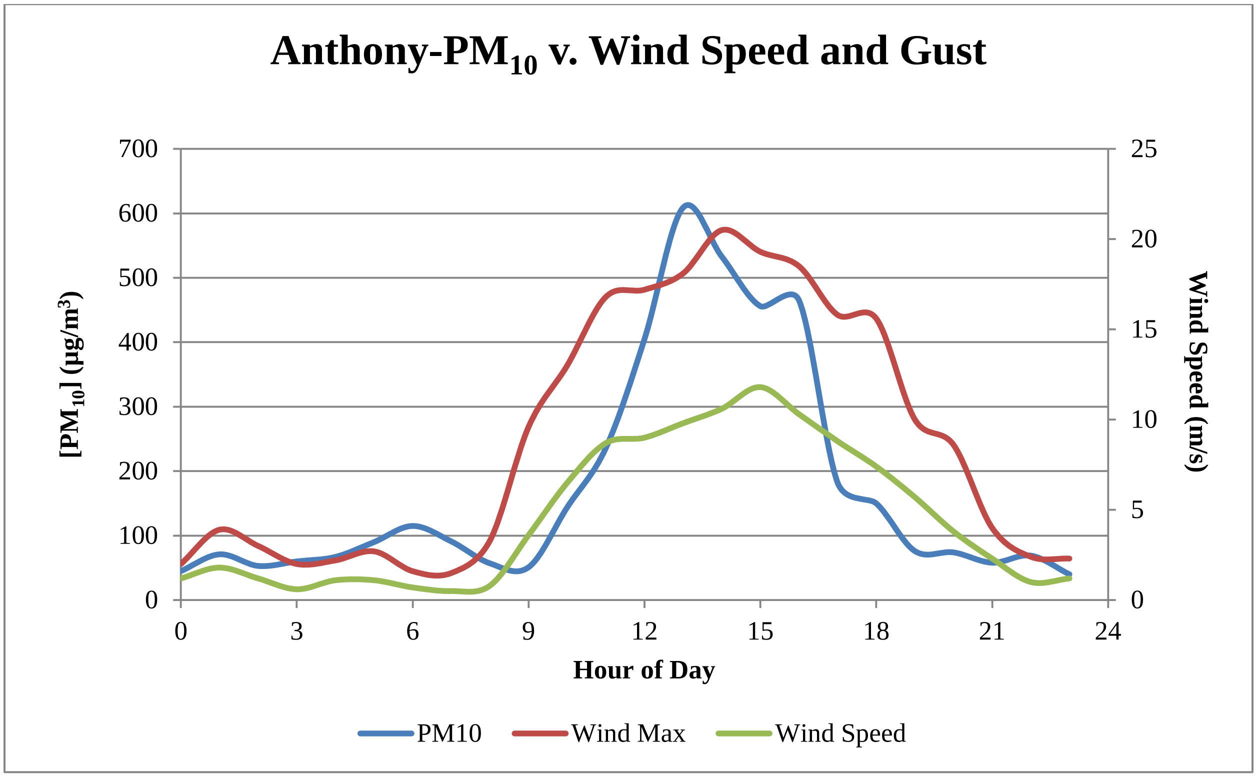

Figure 17-11a. Time series plot of hourly observations showing increased PM10 concentrations as wind speeds and gusts increase.

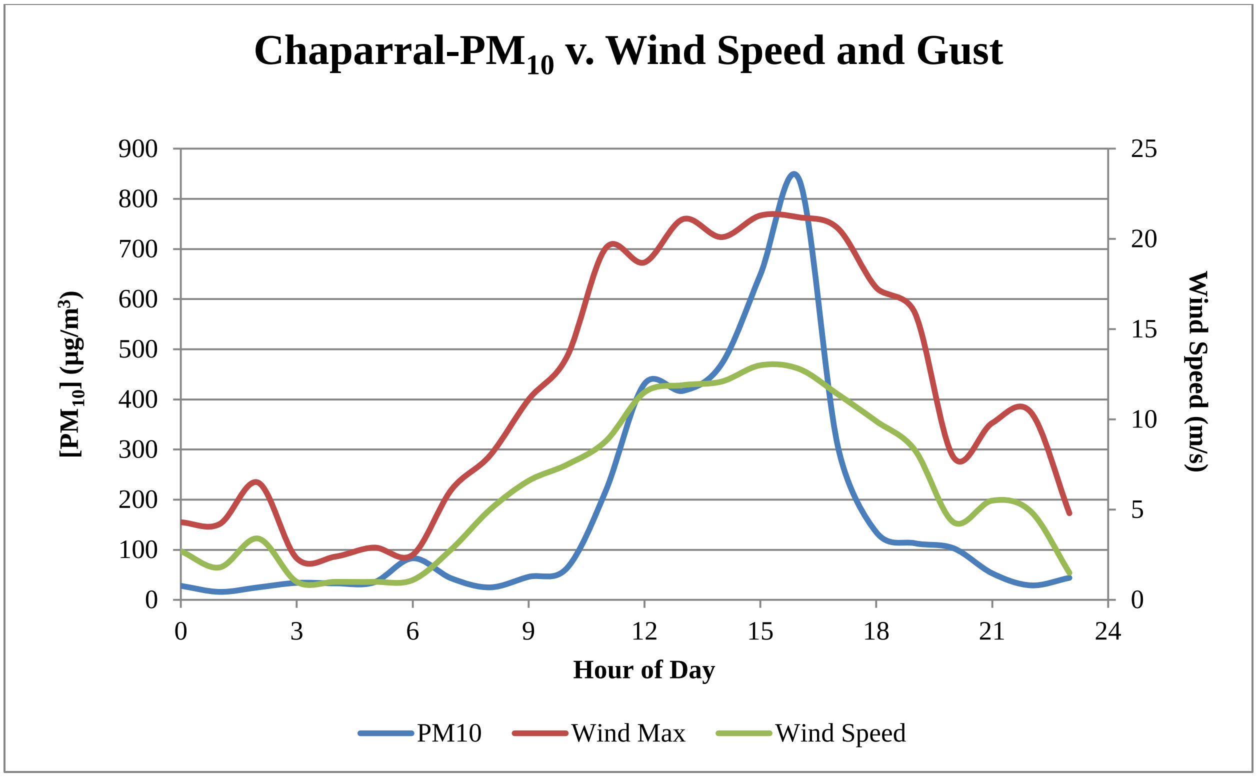

Figure 17-11b. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

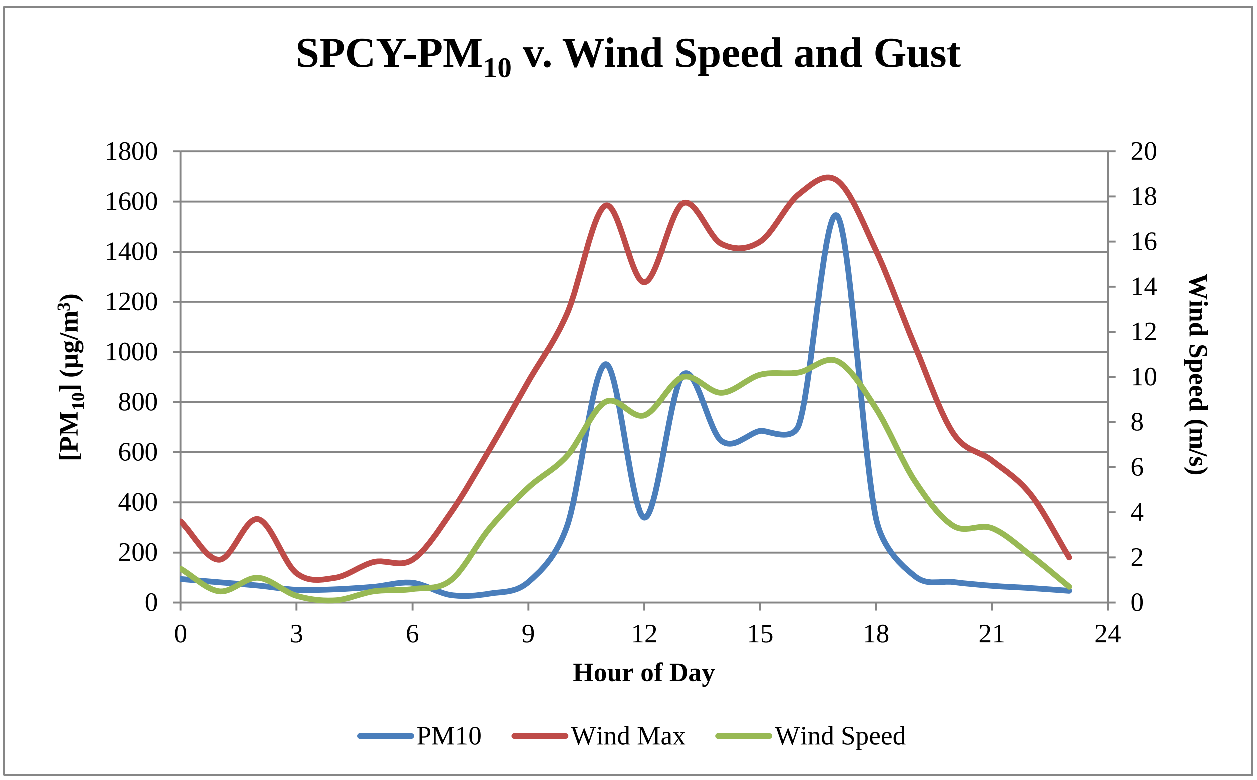

Figure 17-11c. Time series plot of hourly observations showing increased PM_{10} concentrations as wind speeds and gusts increase.

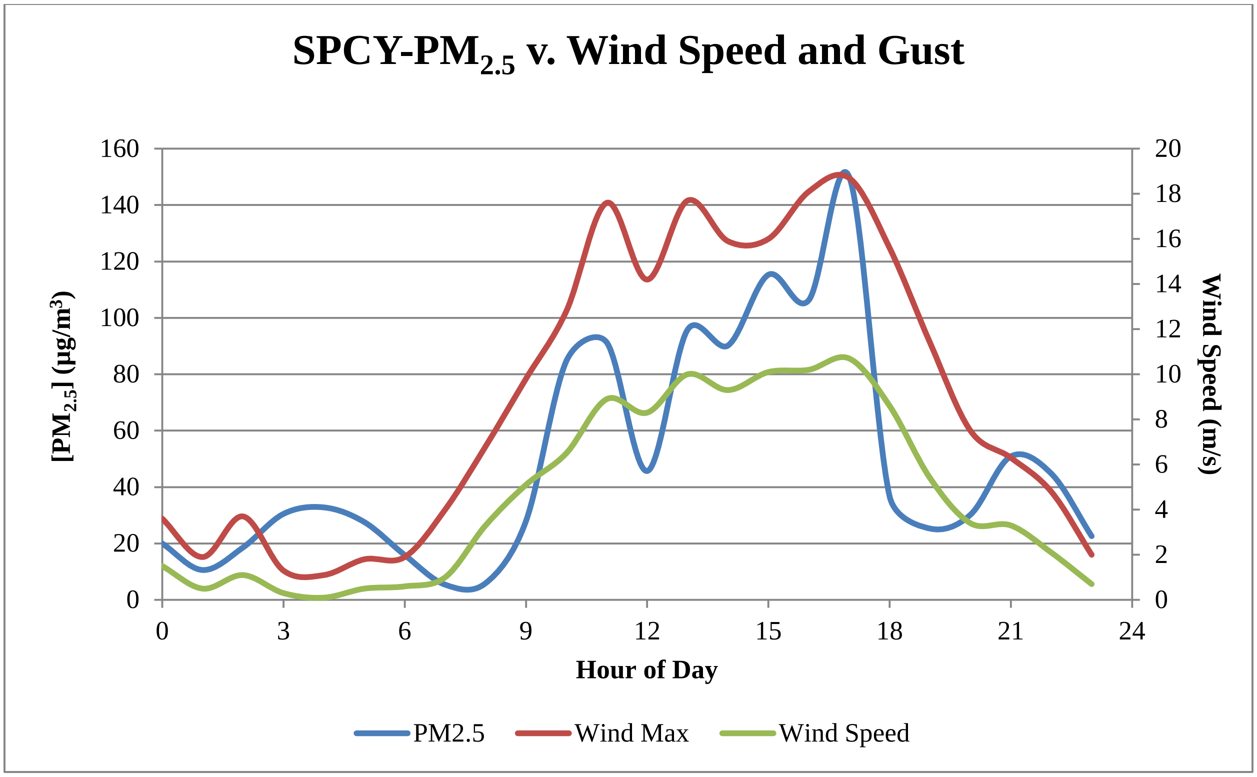

Figure 17-11d. Time series plot of hourly observations showing increased $PM_{2.5}$ concentrations as wind speeds and gusts increase. Non-FEM hourly $PM_{2.5}$ data.

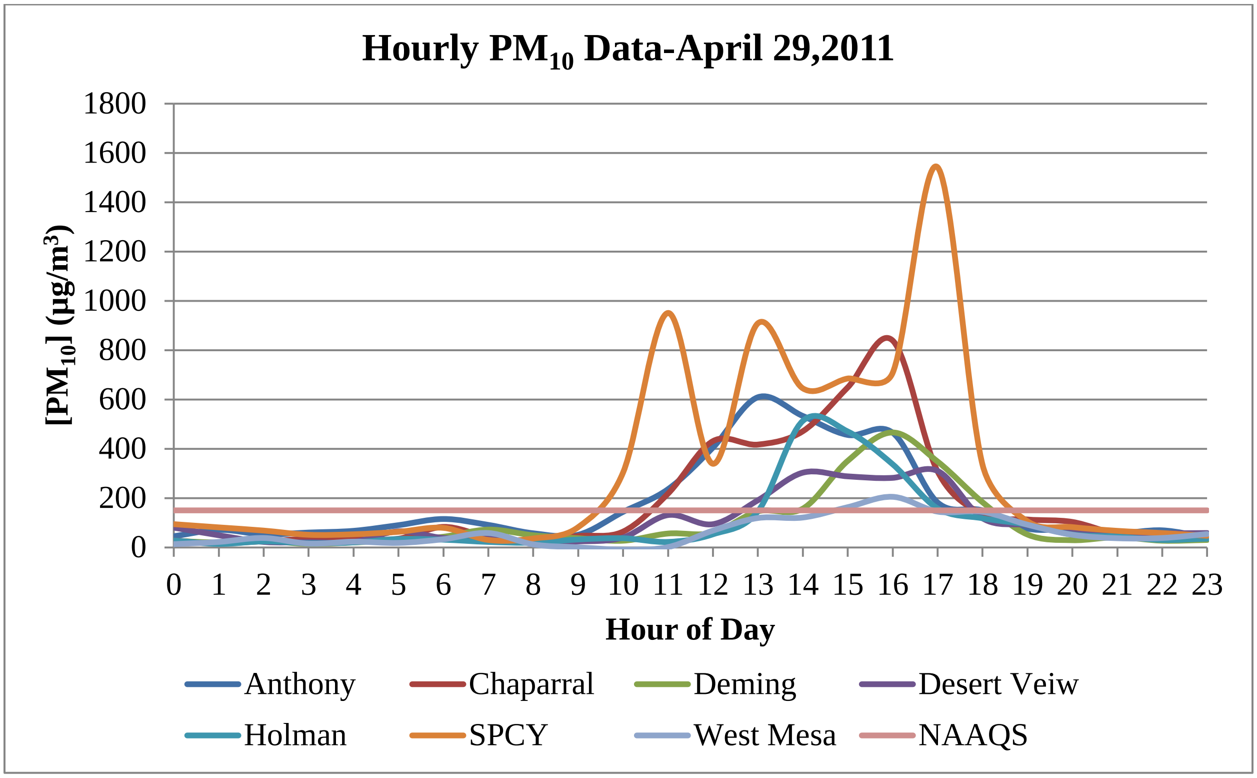

Figure 17-12a. Hourly PM_{10} concentrations for Doña Ana and Luna Counties monitors.

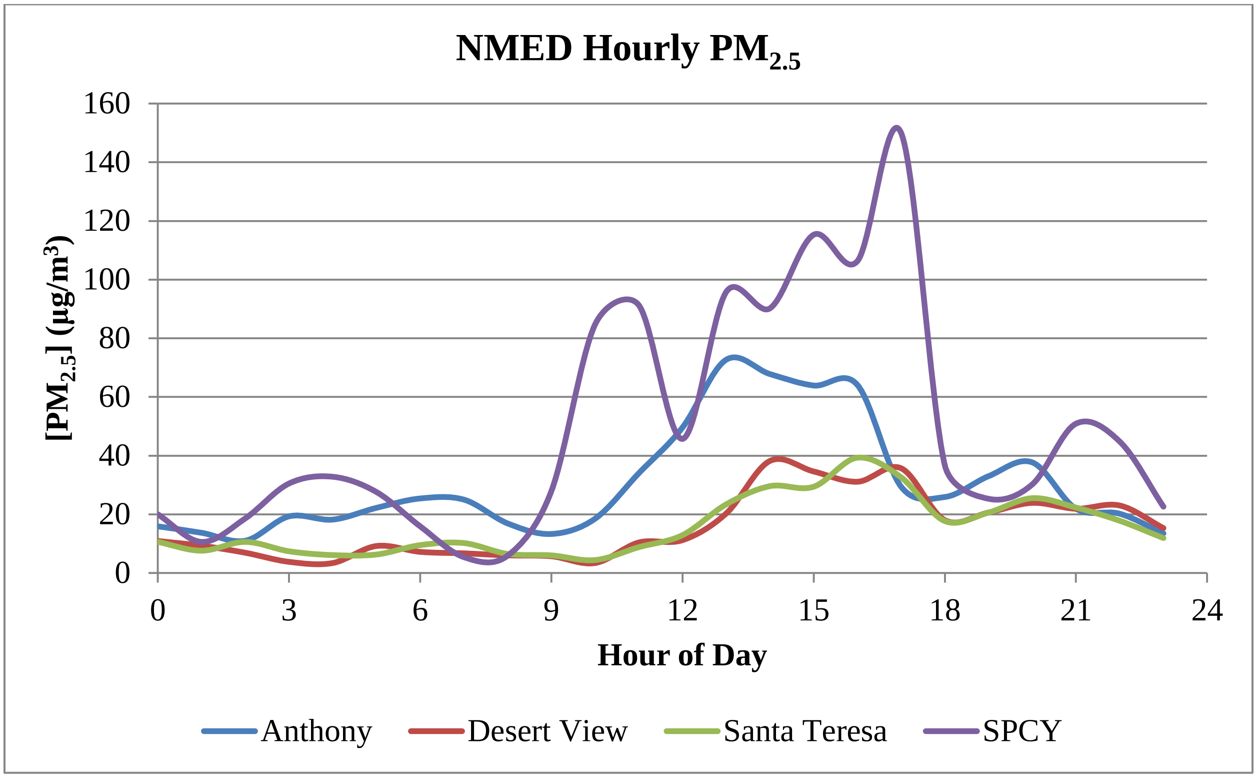

Figure 17-12b. Hourly $PM_{2.5}$ concentrations for Doña Ana County monitors. Non-FEM hourly $PM_{2.5}$ data.

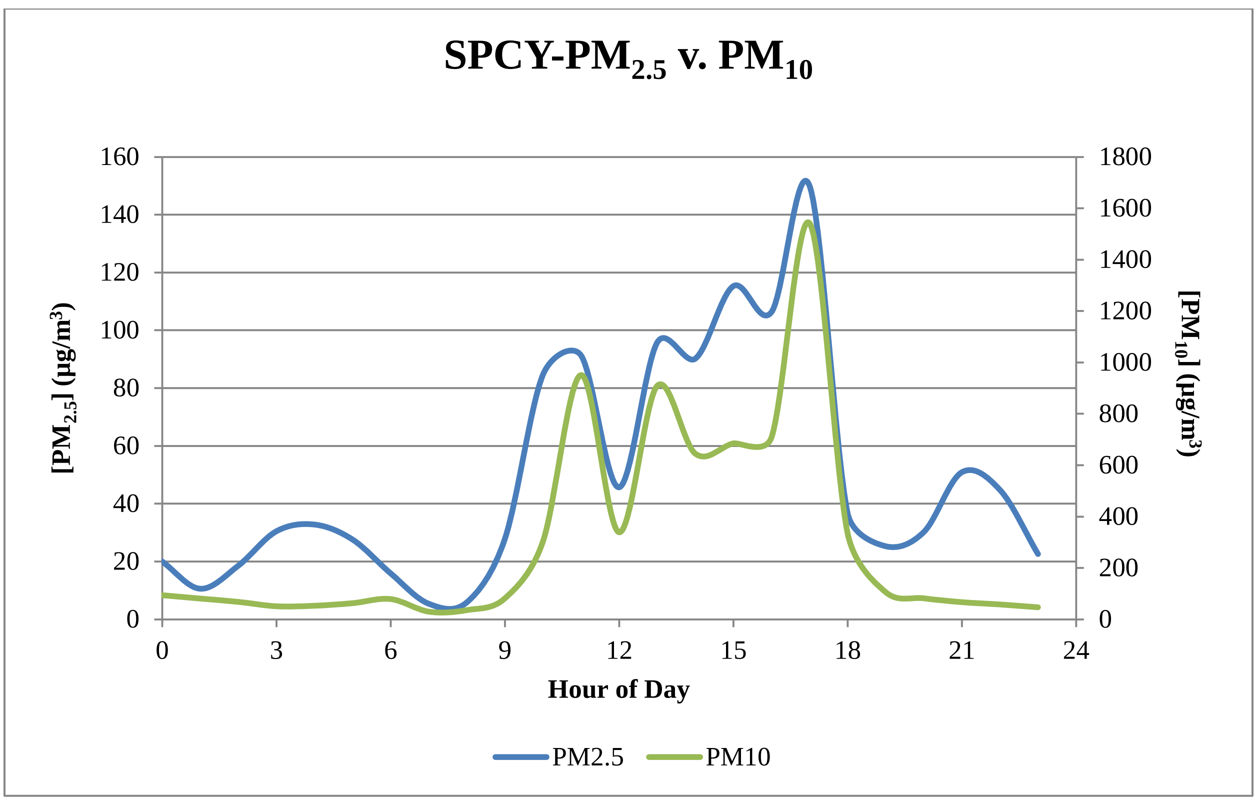

Figure 17-13. Hourly PM_{10} and $PM_{2.5}$ concentrations for the SPCY monitoring site on April 29, 2011.

Contemporary reports and modeling results support these claims. The NM Border AQ Blog reported:

> Turning out to be a dust day after all. Not as bad as Monday but winds are picking up quite a bit of dust. I can see the gypsum flying off of White Sands from GOES. Several wildfires are also blowing smoke plumes in the region. One is in the Gila Wilderness and the others are along the Arizona/Mexico border (DuBois, 2011).

The NWS issued a wind advisory for the border area on this date stating in part:

...STRONG WINDS AND BLOWING DUST RETURN TO THE REGION TODAY...

AN UPPER TROUGH WILL MOVE OVER THE GREAT BASIN TODAY AND ALLOW SURFACE WINDS ACROSS SOUTHERN NEW MEXICO AND FAR WEST TEXAS TO BECOME QUITE STRONG. WINDS WILL BEGIN INCREASING BY NOON AND REACH THEIR MAXIMUM SPEEDS BY LATE AFTERNOON. WIND SPEEDS WILL BEGIN TO DIMINISHING AFTER SUNSET BUT REMAIN BREEZY MOST OF THE NIGHT. BLOWING DUST WILL ALSO ACCOMPANY THESE WINDS...AND VISIBILITIES ACROSS THE DESERT AREAS MAY OCCASIONALLY DROP TO ONE MILE. SATURDAY WILL BE ANOTHER WINDY DAY...WITH ANOTHER WIND ADVISORY LIKELY.

* WINDS...SOUTHWEST WINDS WILL INCREASE TO 25 TO 35 MPH WITH GUSTS TO NEAR 50 MPH THIS AFTERNOON.

* VISIBILITY...BLOWING DUST WILL ACCOMPANY THESE WINDS ACROSS DESERT AREAS. REDUCED VISIBILITY TO 3 TO 5 MILES WILL BE LIKELY WITH LOCALLY DUST PRONE AREAS REDUCED BELOW ONE MILE.

* IMPACTS...DRIVING MAY BE DIFFICULT DUE TO STRONG CROSS WINDS. BLOWING DUST WILL REDUCE VISIBILITIES TO 3 TO 5 MILES WITH SOME AREAS DOWN TO LESS THAN ONE MILE...ESPECIALLY ALONG THE I-10 CORRIDOR FROM WEST TEXAS TO LORDSBURG. EXTREMELY CRITICAL FIRE WEATHER CONDITIONS MAKE LARGE FIRE GROWTH POSSIBLE (NWS, 2011).

17.5 Affects Air Quality

The historical fluctuations and clear causal relationship analyses prove that the event in question affected air quality on April 29, 2011.

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 Anthony 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 Anthony site, the resulting 24-hour average (99 µg/m^3) does not exceed the NAAQS (Table 17-1). 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	45	45
1	71	71
2	53	53
3	60	60
4	67	67
5	90	90
6	115	115
7	91	91
8	57	57
9	51	51
10	144	144
11	236	**106**
12	405	**136**
13	609	**146**
14	533	**177**
15	456	**172**
16	465	**152**
17	182	182
18	150	150
19	76	76
20	74	74
21	58	58
22	69	69
23	40	40
24-Hour Average	174	**99**

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 Anthony.

The Chaparral monitor detected blowing dust around the 1100 hour with hourly concentrations heavily impacted until the 1700 hour. By replacing these seven 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 17-2). 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	28	28
1	16	16
2	25	25
3	34	34
4	33	33
5	35	35
6	83	83
7	43	43
8	25	25
9	46	46
10	64	64
11	218	**87**
12	431	**120**
13	417	**151**
14	471	**141**
15	649	**147**
16	839	**127**
17	308	**122**
18	135	135
19	113	113
20	103	103
21	53	53
22	29	29
23	44	44
24-Hour Average	176	**75**

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 Chaparral.

The Sunland Park 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 Sunland Park [(93 + 95 + 104 + 125 + 145 + 160 + 168 + 201) $\mu g/m^3$ = 6083 $\mu g/m^3$; (6083 $\mu g/m^3$)/24 = 253 $\mu g/m^3$]. By replacing these eight hourly values with the 95th percentile of hourly data at the Sunland Park site, the resulting 24-hour average (100 $\mu g/m^3$) does not exceed the NAAQS (Table 17-3). The values in red represent the 95th percentile of all hourly data collected at Sunland Park site, 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	94	94
1	81	81
2	68	68
3	51	51
4	53	53
5	63	63
6	79	79
7	30	30
8	36	36
9	82	82
10	304	**93**
11	951	**95**
12	339	**104**
13	909	**125**
14	645	**145**
15	685	**160**
16	708	**168**
17	1542	**201**
18	335	335
19	106	106
20	82	82
21	67	67
22	58	58
23	47	47
24-Hour Average	308	**100**

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 Sunland Park.