TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

El Paso PM_{10} Exceptional Events Demonstration

Socorro Hueco
April 25, 2017
May 2, 2018

10/10/2019

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Introduction

Exceptional events are unusual or naturally occurring events that affect air quality and are not reasonably controllable or preventable. An event may also be caused by human activity that is unlikely to recur at a particular location. Under Section 319 of the Federal Clean Air Act (FCAA), states are responsible for identifying air quality monitoring data affected by an exceptional event and requesting the United States Environmental Protection Agency (EPA) to exclude the data from consideration when determining whether an area is in attainment or nonattainment of a National Ambient Air Quality Standard (NAAQS). EPA has promulgated an exceptional event rule, 40 Code of Federal Regulations (CFR) § 50.14, as well as guidance to implement the requirements of the FCAA regarding exceptional events. States are required to identify air quality monitoring data potentially affected by exceptional events by "flagging" the data submitted into the EPA Air Quality System (AQS) database. If EPA concurs with this demonstration, the flagged data will not be eligible for consideration when making NAAQS compliance determinations.

This document discusses the Texas Commission on Environmental Quality's (TCEQ) two proposed exceptional event day flags for particulate matter of 10 microns or less in aerodynamic diameter (PM_{10}), occurring on April 25, 2017, and May 2, 2018, as listed in Appendix A. These proposed exceptional event flags are for daily average measurements from the Federal Reference Method (FRM) PM_{10} monitor at the Socorro Hueco site. The data being requested for exclusion has regulatory significance and affects the regulatory determination concerning the portion of El Paso County in which the Socorro Hueco air monitoring site is located, which falls just outside the area officially designated as Nonattainment by EPA against the 1987 PM_{10} NAAQS. Maps identifying the El Paso area PM_{10} and particulate matter of 2.5 microns or less in aerodynamic diameter ($PM_{2.5}$) sites, including the Socorro Hueco site, are shown in Figures 1 and 2.

With this demonstration, the TCEQ is providing detailed evidence to support concurrence by the EPA for the PM_{10} exceptional event flags shown in Table A-1 of Appendix A. This document will be posted on the main TCEQ web page beginning on October 10, 2019, for a 30-day public comment period. All comments received will be addressed and submitted to EPA for consideration.

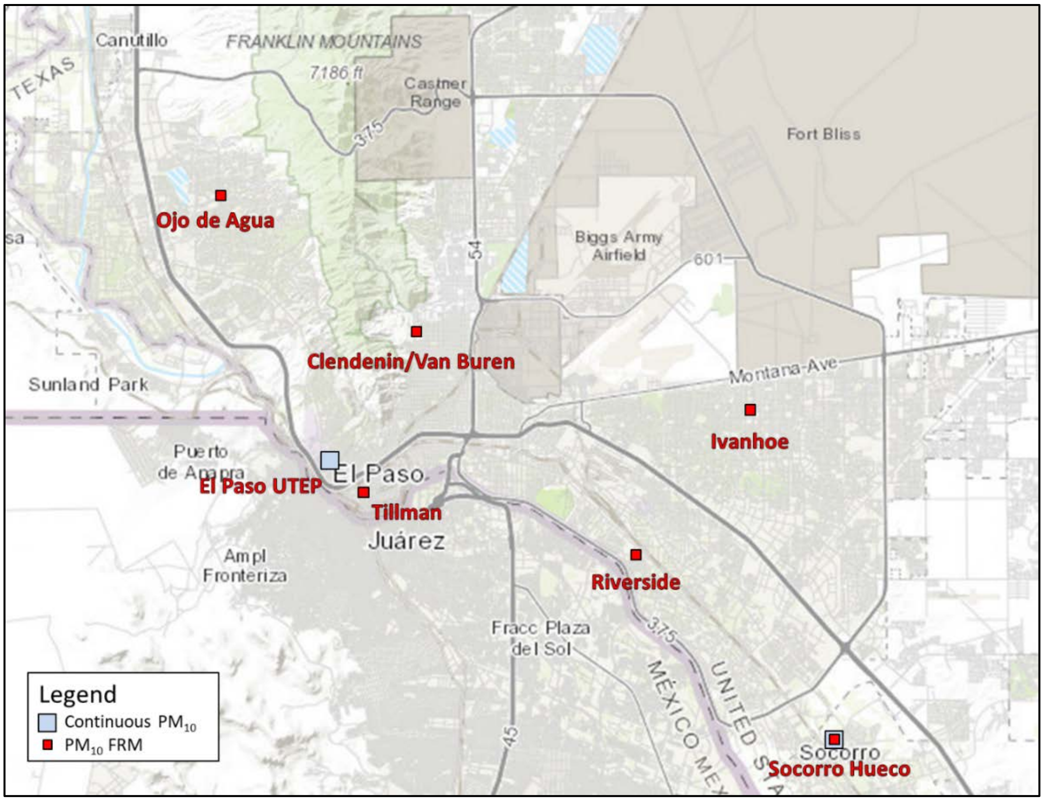

Figure 1. Map of El Paso area PM_{10} monitoring sites referenced in this document.

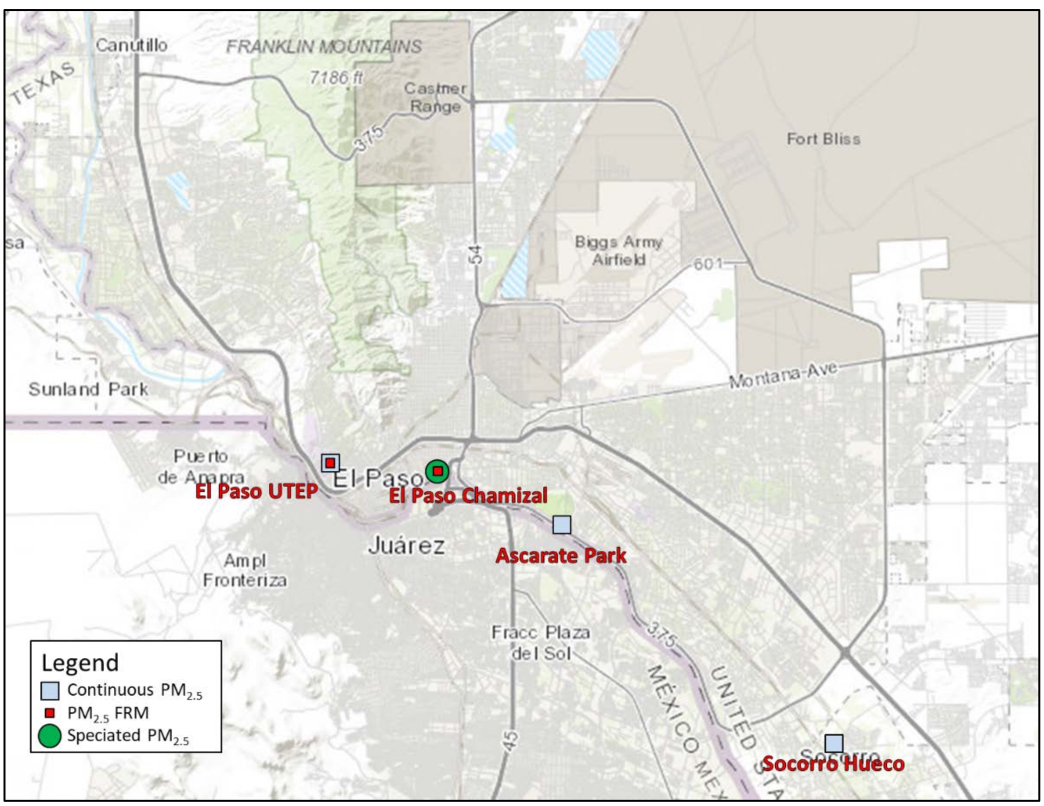

Figure 2. Map of El Paso area $PM_{2.5}$ monitoring sites referenced in this document.

Exceptional Event Definition and Criteria

An exceptional event is defined in 40 CFR § 50.1(j) as "an event(s) and its resulting emissions that affect air quality in such a way that there exists a clear causal relationship between the specific event(s) and the monitored exceedance(s) or violation(s), is not reasonably controllable or preventable, is an event(s) caused by human activity that is unlikely to recur at a particular location or a natural event(s), and is determined by the [EPA] Administrator in accordance with 40 CFR § 50.14 to be an exceptional event". Furthermore, 40 CFR § 50.14(c)(3)(iv) states that the demonstration to justify data exclusion shall include:

1. A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);
2. A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;
3. Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times;
4. A demonstration that the event was both not reasonably controllable and not reasonably preventable; and
5. A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event.

Additionally, 40 CFR § 50.14(c)(3)(v) requires that the state must:

6. Document that the state followed the public comment process and that the comment period was open for a minimum of 30 days;
7. Submit the public comments it received along with its demonstration to the Administrator; and
8. Address in the submission to the Administrator those comments disputing or contradicting factual evidence provided in the demonstration.

These eight requirements must all be satisfied for data to be excluded from regulatory decisions as an exceptional event. Requirements 1 through 5 will be addressed individually in this demonstration document, and documentation for 6 through 8 will be provided as an addendum upon final submittal to EPA.

Mitigation of exceptional events is also required by 40 CFR § 51.930, which reads:

> *A State requesting to exclude air quality data due to exceptional events must take appropriate and reasonable actions to protect public health from exceedances or violations of the national ambient air quality standards. At a minimum, the State must:*
>
> *(1) Provide for prompt public notification whenever air quality concentrations exceed or are expected to exceed an applicable ambient air quality standard;*
>
> *(2) Provide for public education concerning actions that individuals may take to reduce exposures to unhealthy levels of air quality during and following an exceptional event; and*
>
> *(3) provide for the implementation of appropriate measures to protect public health from exceedances or violations of ambient air quality standards caused by exceptional events.*

These requirements will be addressed in the "Mitigation of Exceptional Events" section.

Summary of Approach

The TCEQ used several methods for developing a demonstration that shows the high PM_{10} measurements in question qualify as exceptional events. Example analyses performed by the TCEQ include (among many others):

- evaluating historical trends in PM_{10} and $PM_{2.5}$ data from long-term FRM monitoring sites for a period of over 10 years;
- identifying dust contributions in observed $PM_{2.5}$ concentrations using $PM_{2.5}$ speciation data from El Paso's Chemical Speciation Network (CSN) monitor at Chamizal; and
- tracking blowing dust from primary source areas in Mexico with satellite imagery from the National Oceanic and Atmospheric Administration (NOAA) (NOAA, 2019).

<u>Data and Imagery Used</u>

For the analyses presented in this document, the TCEQ utilized an extensive set of monitoring data, satellite imagery, and air trajectory information. The particulate data are presented in micrograms per cubic meter (µg/m^3) with PM_{10} in standard conditions (SC) adjusted to a standard temperature of 25 degrees centigrade and atmospheric pressure of 760 millimeters of mercury and $PM_{2.5}$ in local conditions (LC) of temperature and pressure measured at the monitor as required for reporting to EPA's AQS database. The satellite imagery includes threechannel composite true color visible imagery with 0.25 kilometer resolution from the NOAA Terra polar orbiting satellite's Moderate Resolution Imaging Spectroradiometer (MODIS) sensor and the Suomi-National Polar orbiting Partnership (Suomi-NPP) satellite's Visible Infrared Imaging Radiometer Suite (VIIRS) sensor.

As detailed in Table 1, the monitoring data include FRM non-continuous PM_{10} and $PM_{2.5}$ daily (i.e., "24-hour average") measurements, non-continuous $PM_{2.5}$ speciated daily measurements, and continuous PM_{10} and $PM_{2.5}$ hourly and daily measurements used for daily reporting of the EPA Air Quality Index (AQI), as well as hourly and daily wind measurements, including National Weather Service (NWS) wind data. All of the data in Table 1 are available in EPA's AQS database (EPA1, 2019) except for the continuous PM_{10} monitors at the El Paso UTEP and Socorro Hueco sites, which are not reported to AQS but otherwise adhere to EPA quality assurance requirements and guidelines.

The air parcel trajectories were produced using the NOAA Applied Research Laboratory (ARL) Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model available on the [ARL HYSPLIT web page](http://ready.arl.noaa.gov/HYSPLIT.php) (http://ready.arl.noaa.gov/HYSPLIT.php) (NOAA ARL, 2019). Times are listed in Mountain Standard Time (MST) and, from some sources, in Coordinated Universal Time (UTC), which is seven hours later than MST.

Table 1. El Paso area PM_{10} and $PM_{2.5}$ monitors with data used for analyses.

Site Name	AQS Site Identifier	AQS Parameter Identifier	POC	Sampler Type
Tillman	481410002	81102	2	PM_{10} FRM non-continuous
Ivanhoe	481410029	81102	1	PM_{10} FRM non-continuous
UTEP	481410037	81102	4	PM_{10} continuous
UTEP	481410037	88101	1	$PM_{2.5}$ FRM non-continuous
UTEP	481410037	88502	3	$PM_{2.5}$ continuous
Riverside	481410038	81102	1	PM_{10} FRM non-continuous
Chamizal	481410044	88101	1	$PM_{2.5}$ FRM non-continuous
Chamizal	481410044	88101	4	$PM_{2.5}$ FRM non-continuous
Chamizal	481410044	88502	5	$PM_{2.5}$ non-continuous speciated
Ascarate	481410055	88502	3	$PM_{2.5}$ continuous
Socorro	481410057	81102	1	PM_{10} FRM non-continuous
Socorro	481410057	81102	2	PM_{10} FRM non-continuous
Socorro	481410057	81102	4	PM_{10} continuous

Site Name	AQS Site Identifier	AQS Parameter Identifier	POC	Sampler Type
Socorro	481410057	88502	3	$PM_{2.5}$ continuous
Clendenin	481410059	81102	1	PM_{10} FRM non-continuous
Van Buren	481410693	81102	1	PM_{10} FRM non-continuous
Ojo de Agua	481411021	81102	1	PM_{10} FRM non-continuous
Ojo de Agua	481411021	81102	2	PM_{10} FRM non-continuous

Abbreviations:

AQS EPA's air quality system database
POC AQS parameter occurrence code to differentiate collocated monitors.
FRM Federal reference method

Analysis Methods

Several methods were used to analyze the data to determine if the proposed events qualify as exceptional events. These methods include time series plots to show trends and events, comparison to statistical percentiles to show relevance, examination of satellite and webcam imagery for evidence of dust plumes, and review of backward-in-time air trajectories for independent confirmation of transport path of the affected air. In addition, daily averages of hourly PM_{10} and $PM_{2.5}$ continuous data were compiled for comparison with non-continuous data and Interagency Monitoring of Protected Visual Environments (IMPROVE) calculated particulate matter components. $PM_{2.5}$ speciation components (IMPROVE, 2019) (Eldred, 2003) were calculated from $PM_{2.5}$ CSN speciation data to confirm the dominance of the soil component in high wind blowing dust events.

The TCEQ also used El Paso area PM_{10} monitoring data on high wind speed non-event days to compare with the high wind dust events. The surrogate days were selected based on daily wind speed and direction comparable to the event days.

Summary of Findings

The information provided in this demonstration document supports the conclusion that the two high PM_{10} daily average measurements proposed as exceptional events (listed in Table A-1 of Appendix A) qualify as exceptional events. The measured PM_{10} concentrations on these days were not reasonably controllable or preventable, were a natural event clearly due to internationally transported dust associated with high winds, and were in excess of normal historical fluctuations. The TCEQ requests EPA's concurrence on these exceptional events and to have these flagged days removed from consideration when making compliance determinations for the annual PM_{10} NAAQS.

Narrative Conceptual Model of Event

El Paso Climate and Particulate Matter Trends

Climate

Much of far West Texas, including the El Paso area, is part of the Chihuahuan Desert, which extends into Arizona, New Mexico, and the Mexican state of Chihuahua. The limited rainfall in this area is highly variable from year to year, with an average of 8.69 inches of rain per year measured at the El Paso Airport over the period from 2000 to 2018, as shown in Figure 3.

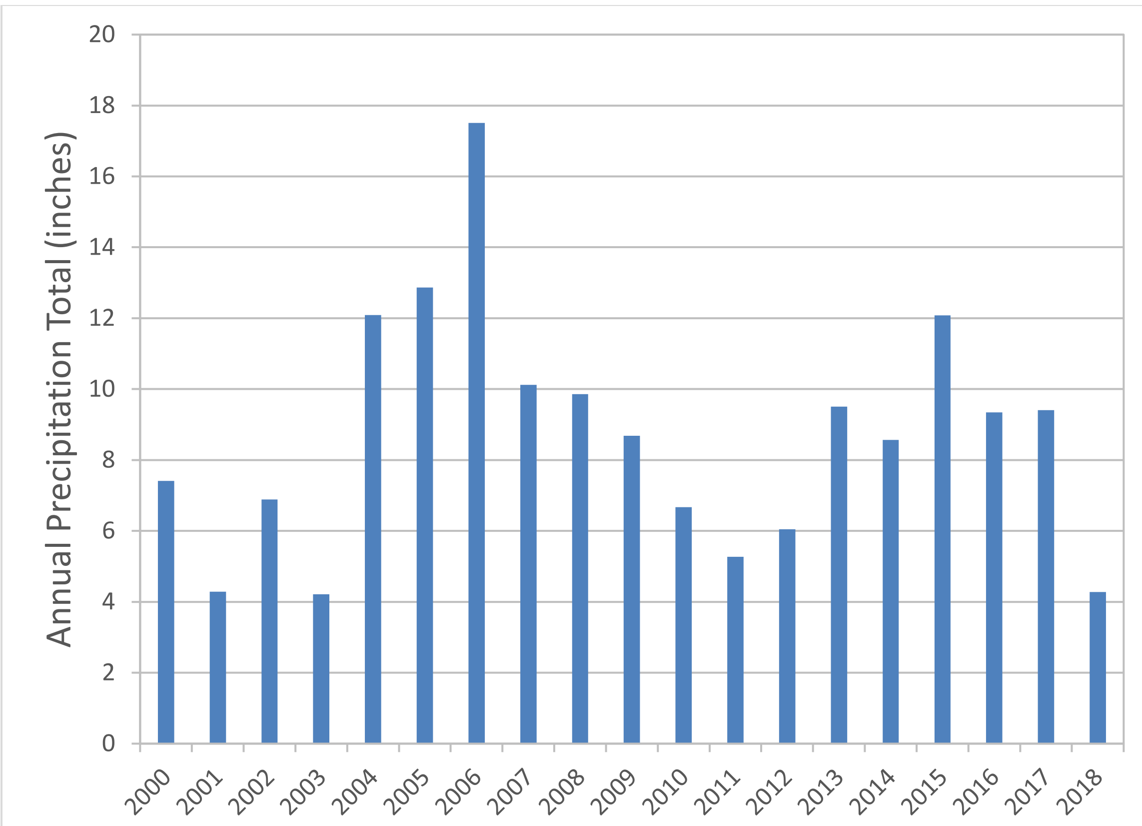

Figure 3. Graph of annual precipitation measured at El Paso International Airport from 2000 through 2018.

A large portion of this scarcely vegetated desert contains dried up lakebeds and playas made up of loose fine soils. These soils can easily be picked up into the air by moderate to high wind gusts of 30 miles per hour (mph) or greater (TCEQ1, 2007). The overall frequency and intensity of the dust storms are highly dependent on weather conditions and the moisture content of the soils. Because similar meteorological trends are expected to continue, it is likely that similar dust storms will continue to occur in future years.

Particulate Matter Air Quality Trends

Trends in the PM_{10} annual maximum 24-hour averages for El Paso show variability year to year since 2006 as they are influenced by dust events coinciding with sampling days. Figure 4 graphs the PM_{10} trends from FRM monitors currently in operation and/or with a long period of record in the El Paso area. Please note the following regarding the gaps in data as displayed in Figure 4:

- The Tillman PM_{10} FRM monitor was deactivated effective April 11, 2013.
- The Ivanhoe, Riverside, Van Buren, and Ojo de Agua PM_{10} FRM data were retroactively invalidated following a 2016 technical systems audit finding that the laboratory performing the gravimetric analysis on samples collected from October 25, 2013, to October 21, 2016, did not use the federally required method. This caused the years 2014, 2015, and 2016 to have less than 75% data return, which were therefore incomplete, resulting in the gap in data for these sites. Note that the Ojo de Agua PM_{10} FRM monitors (both primary and collocated) were officially activated effective April 15, 2013, making the year 2013 incomplete for this site as well.
- The site access agreement for the original Socorro site was unexpectedly terminated by the property owner in early 2012. The site was relocated to the Hueco Elementary School and began operating in late 2012. Consequently, there are no PM_{10} FRM data available at Socorro from January 28 through December 23, 2012. This caused the year 2012 to have less than 75% data return, which was therefore incomplete, resulting in the gap in data for Socorro.

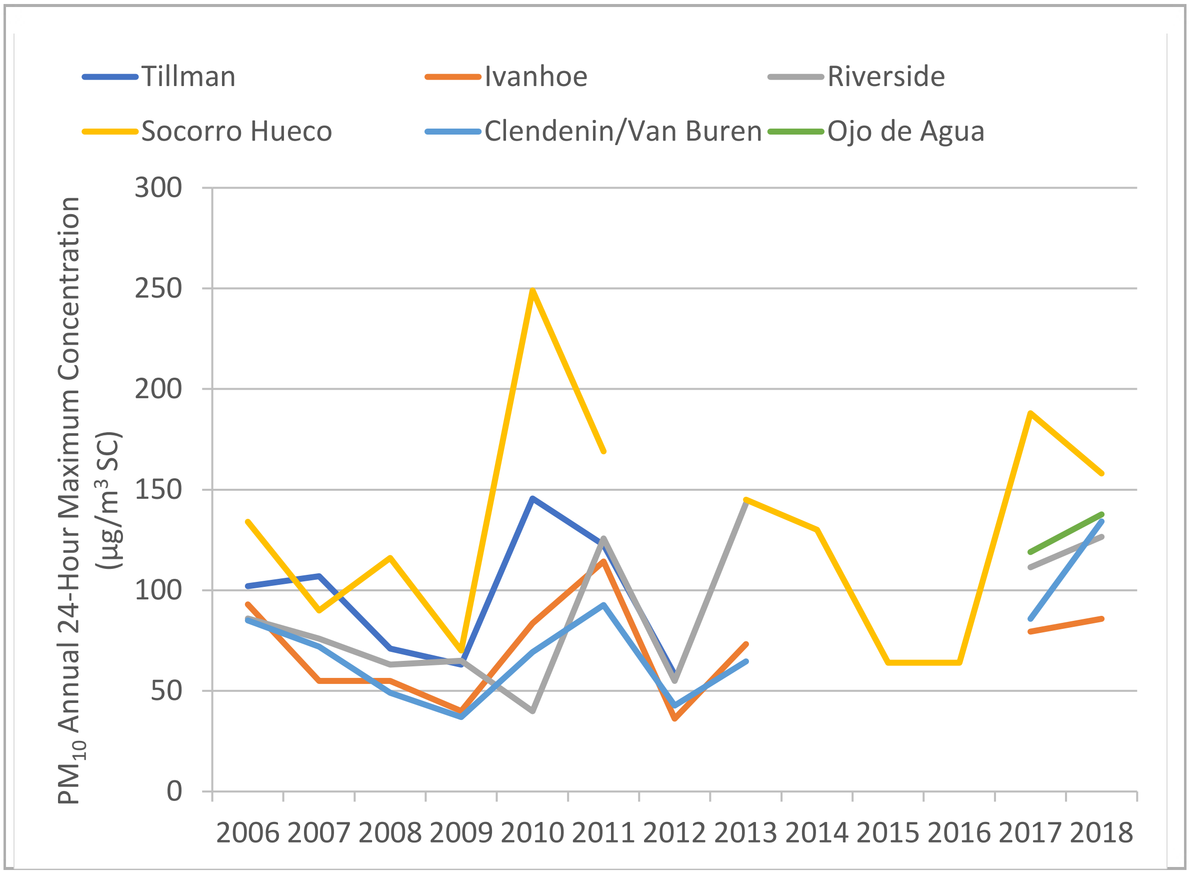

Figure 4. Trends of El Paso PM_{10} annual maximum 24-hour averages for FRM monitoring sites, including exceptional event days.

Overall, annual average $PM_{2.5}$ levels in the El Paso area have been relatively stable since 2006, while the 98th percentile of $PM_{2.5}$ 24-hour average measurements have shown more variability from year to year. Since the 98th percentile of the 24-hour average represents the highest 2 percent of all 24-hour measurements, the presence or absence of dust events on sampling days can greatly influence trend variability. Figure 5 graphically depicts the trends in both the annual and 98th percentile of the 24-hour average using FRM data collected from the Chamizal and UTEP sites.

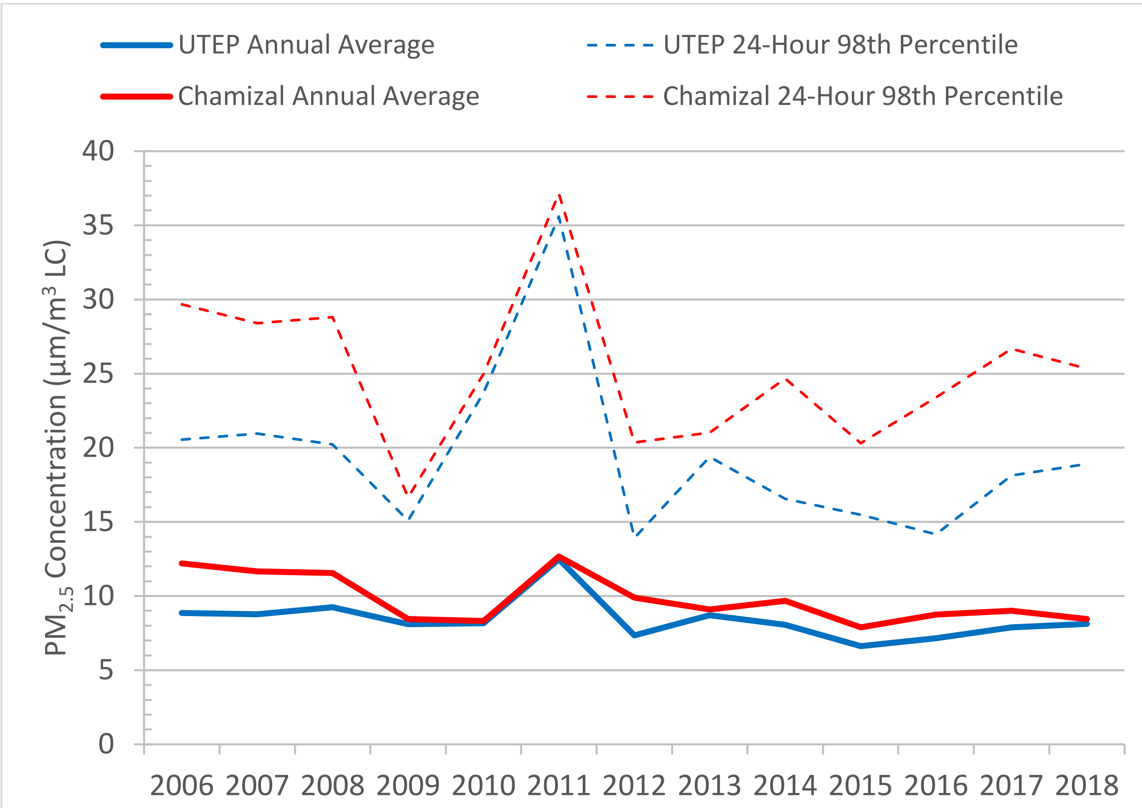

Figure 5. Trends of El Paso $PM_{2.5}$ annual averages and annual 98th percentile of 24-hour averages for long-term FRM monitoring sites, including exceptional event days.

Historically, PM_{10} and $PM_{2.5}$ levels in the El Paso area have been heavily impacted by natural high wind events where large amounts of blowing dust are generated outside of the area and transported into the area. These dust events are most commonly caused by regional high winds associated with large low pressure systems. Less frequently, regional blowing dust from the White Sands area in New Mexico can be transported into the El Paso area and regional blowing dust generated in eastern New Mexico and the Texas Panhandle behind strong cold fronts can also be transported into the El Paso area. These large regional-scale dust storms occur mainly in the spring, but can occur from late October through the winter and spring into early June. On a local scale, high winds from nearby thunderstorms can generate dust that is transported into the El Paso area. These local-scale thunderstorm high wind dust events are most common in June and July. Long-range transport from other types of events also impact particulate matter in the El Paso area, including smoke from forest fires in the Rocky Mountains and haze and smoke accumulated from man-made emissions in the U.S. and Mexico (also known as continental haze). These smoke and haze transport events affect $PM_{2.5}$ levels more than PM_{10} levels because of the inherent small particle sizes, but are relatively rare overall.

Blowing Dust and Wind

EPA's High Wind Dust Event Guidance (EPA, 2019) suggests using a peak sustained wind speed of 25 mph, at averaging times as short as one minute and as long as one hour, as a threshold for possible blowing dust influence. In El Paso, two-minute sustained wind measurements are available from the NWS weather station at El Paso International Airport, while five-minute and one-hour sustained wind measurements are available from several area TCEQ monitoring sites. Peak wind gust measurements are available from both the NWS weather station and most area TCEQ monitoring sites.

Without the influence of blowing dust, higher wind speeds normally result in particulate concentrations that are dominated by incoming background levels. At higher wind speeds, the impact of local sources becomes substantially diluted, with the dilution in proportion to the wind speed for a given vertical mixing height. Additionally, high winds cause mechanical mixing at night and weaken the formation of nocturnal inversions, thus supporting deeper vertical mixing and lower pollutant concentrations.

An evaluation of El Paso PM_{10} and $PM_{2.5}$ measurements versus peak area sustained hourly wind speeds reveals that an increase in particulate levels is observed when peak area hourly wind speeds reach 25 mph or more, indicating a strong influence from wind-blown dust. Figures 6 and 7 plot El Paso area daily peak sustained hourly wind speeds against El Paso area peak daily PM_{10} FRM averages and peak daily $PM_{2.5}$ FRM averages, respectively. As can be seen in both of these figures, the highest measured PM_{10} and $PM_{2.5}$ concentrations are experienced when peak area hourly wind speeds exceed 25 mph, which is consistent with the EPA high wind threshold for western states including Texas.

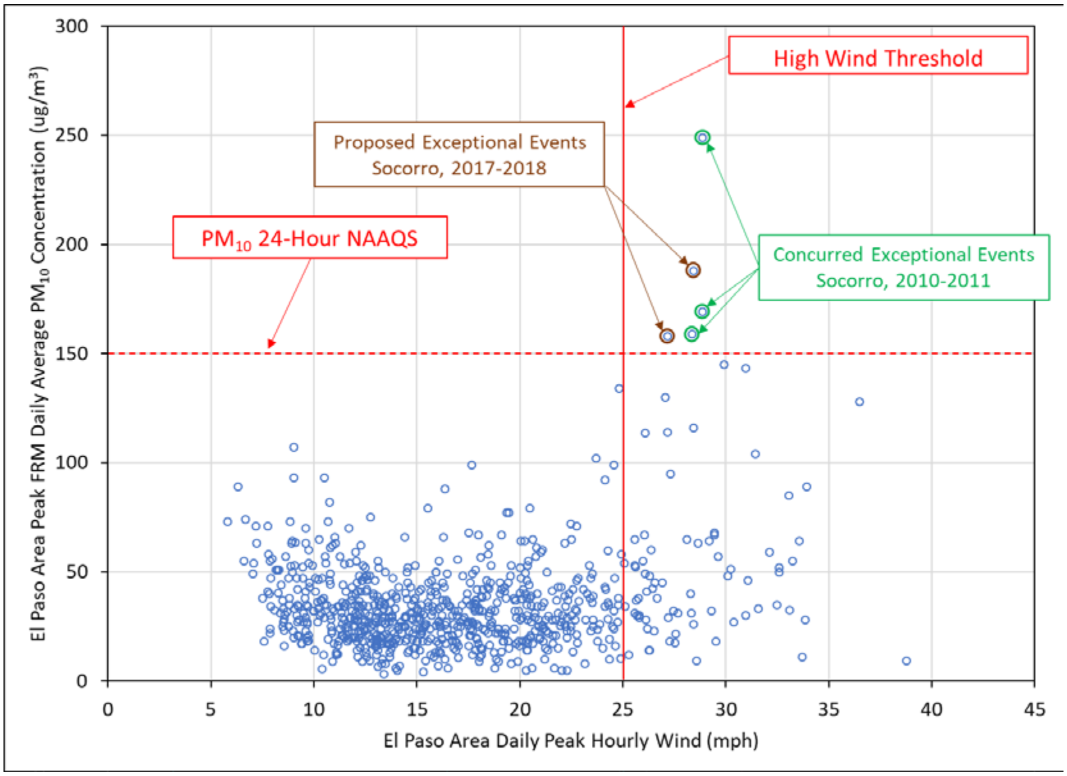

Figure 6. El Paso area daily peak PM_{10} average for FRM measurements versus El Paso area daily peak sustained hourly wind speed for 2006 through 2018. Note the five daily PM_{10} FRM measurements, all of which occurred at the Socorro site, in the upper righthand box bounded by the PM_{10} 24-Hour NAAQS and high wind threshold lines in red. Three of these measurements are approved exceptional events with which EPA has previously concurred; the other two are the proposed exceptional events that are the subject of this demonstration.

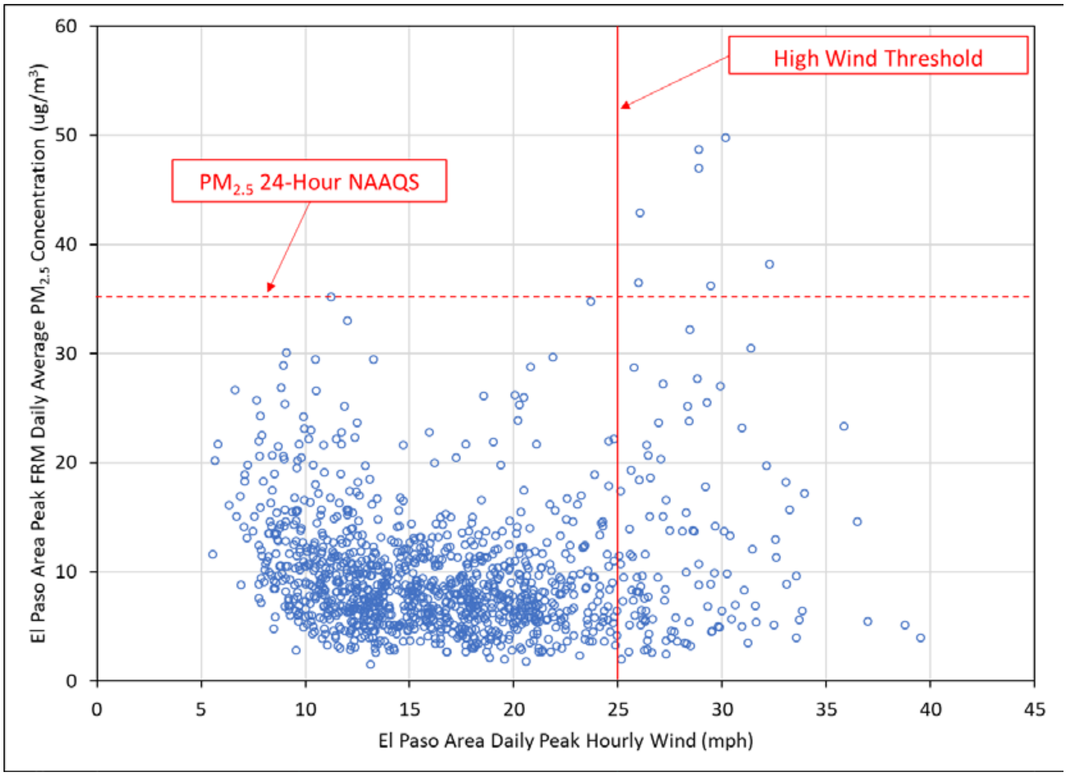

Figure 7. El Paso area daily peak $PM_{2.5}$ average for FRM measurements versus El Paso area daily peak sustained hourly wind speed for 2006 through 2018.

Specific to the Socorro air monitoring site, Figure 8 shows the site's hourly continuous PM_{10} concentrations versus hourly wind speeds for 2017 and 2018. Note the dramatic decrease in the frequency of hourly PM_{10} measurements in the 0-200 µg/m^3 range once hourly winds reach 20 mph (noticeable even as low as 18 mph). For comparison, Figure 9 plots the hourly carbon monoxide concentrations at the Ascarate Park and UTEP monitoring sites (the monitor was moved in January 2018; there is no CO monitor at Socorro) over the same time period, illustrating the impact to concentrations of more localized pollutants that begin to occur at higher wind speeds.

The difference in the relationship with hourly wind speeds between these two pollutants is very pronounced at higher wind speeds. Instead of tailing off to incoming background levels from the effects of dilution as with carbon monoxide, the PM_{10} concentrations actually increase (marked also by the relative absence of lower PM_{10} concentrations) with higher wind speeds, indicating an impact from windblown dust at wind speeds above about 18 mph, with the clearest influence at speeds above 20 mph.

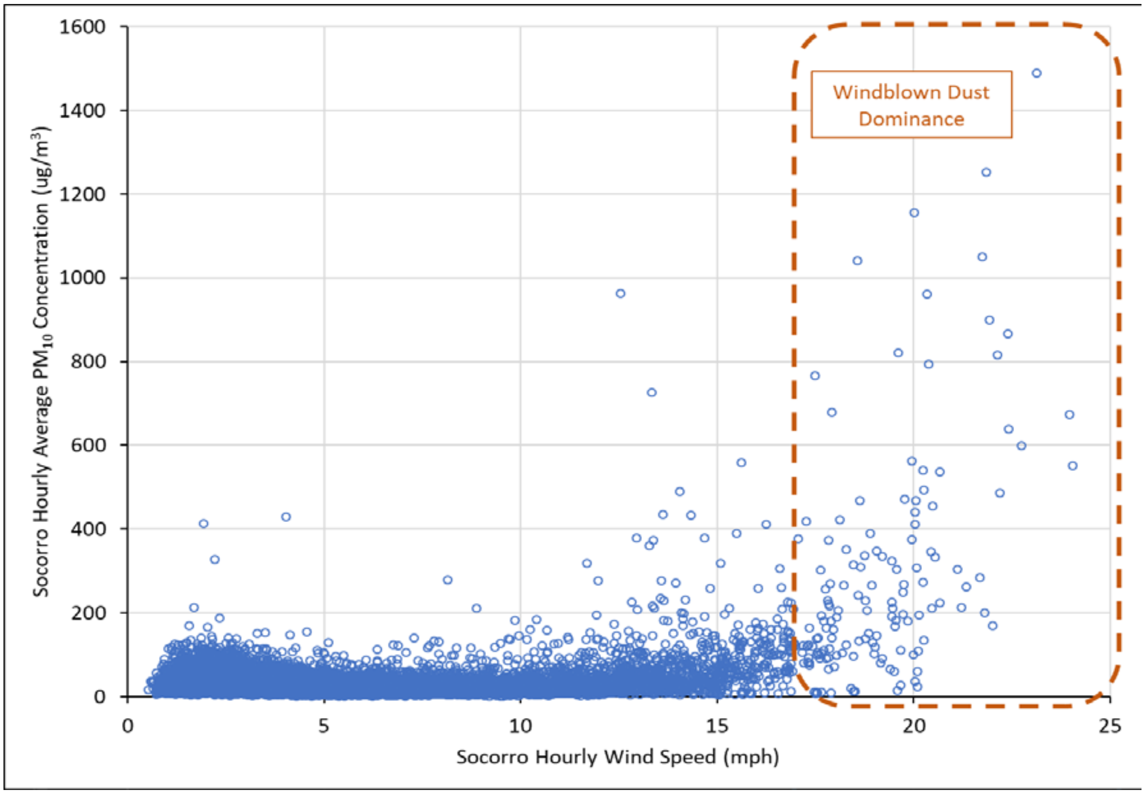

Figure 8. Socorro hourly average continuous PM_{10} concentration versus hourly wind speed for 2017 and 2018.

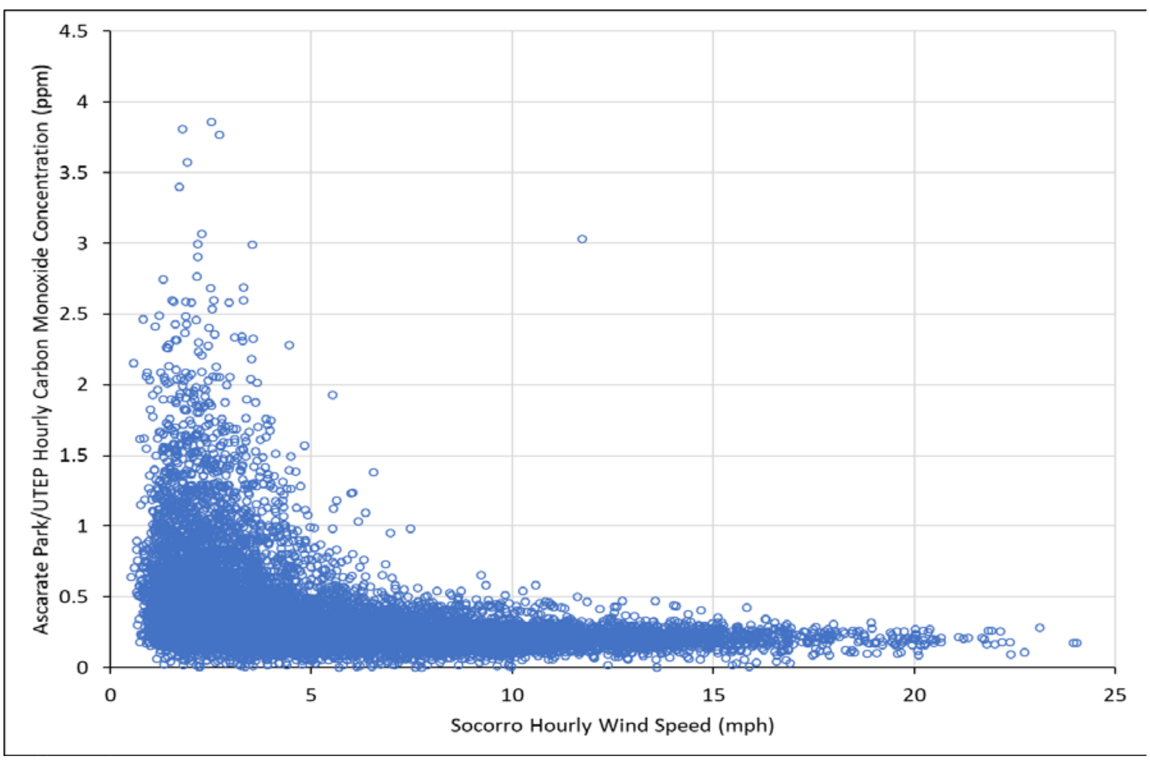

Figure 9. Ascarate Park/UTEP hourly average carbon monoxide concentration versus Socorro hourly wind speed for 2017 and 2018.

Event Summary Information

Both of the event days are characterized by very strong winds associated with large low pressure systems that were generally centered to the north and northeast of the El Paso area. West to southwest winds at peak sustained speeds of 46 and 40 mph along with peak gusts of 57 and 50 mph for the April 25, 2017, and May 2, 2018, events, respectively (as measured by the El Paso International Airport NWS weather station), carried high levels of particulate matter associated with blowing dust into the El Paso area. Evidence to support the impact of the dust events provided in this analysis includes webcam images, satellite imagery, backward-in-time air parcel trajectories, continuous particulate matter data, and wind speed data. An example event day analysis is provided here with detailed analyses for each specific event day provided in Appendices B and C.

Wind and Particulate Measurements

A listing of the flagged particulate matter measurements is provided in Table 2 along with peak wind statistics for each event day. All of the event days had peak sustained winds measured in excess of the suggested 25 mph threshold for blowing dust cited in EPA guidance (EPA, 2019). The wind directions associated with the peak sustained winds during the events were from the west to southwest, consistent with satellite imagery depicting these dust plumes and back trajectory models for the air parcels arriving at the time of the peak particulate matter hourly measurements.

Table 2. El Paso exceptional event flagged 24-hour PM_{10} measurements from 2017 and 2018 with El Paso area peak wind measurements.

Day	Socorro FRM PM_{10} ($\mu g/m^3$ SC)	Peak KELP Wind Gust (mph)	Peak KELP 2-min Wind Speed (mph)	Peak Area 5-min Wind Speed (mph)	Peak Area Hourly Wind Speed (mph)	Peak Socorro Hourly Wind Speed (mph)	Wind Direction at Peak 2-min Speed (degrees)
04/25/2017	188	57	46	33	28	20	250
05/02/2018	158	50	40	31	27	19	270

Note: only flagged particulate matter concentrations are listed in this table. See Table 3 for all available particulate matter measurements on these days. Wind measurements are from the NWS El Paso International Airport weather station ("KELP") and from El Paso area air quality monitoring stations reported to AQS ("Area"), including the Socorro site. The peak wind speeds depicted include sustained two-minute averages ("2-min Wind"), five-minute averages ("5-min Wind"), and hourly averages ("Hourly Wind"). The associated peak wind directions are in degrees clockwise from true north and indicate the direction from which the wind was blowing at the time of the peak sustained two-minute wind speed.

EPA's high winds guidance suggests a minimum sustained wind speed of 25 mph for western states including Texas, or the development of an alternate area-specific high wind threshold at which a dust event will occur. Both of these events meet the strictest definition of this threshold with peak area hourly wind speeds greater than 25 mph and sustained wind speeds at shorter averaging periods of five and two minutes reaching at least 30 and 40 mph, respectively. It is also important to recognize the unique transport component related to these events which impact El Paso. Both of these events were characterized by high winds over a very large area, not just in the immediate El Paso area. As documented by Prospero et al. (2002), Gill et al. (2007), Rivera Rivera et al. (2006) and Novlan et al. (2007), windblown dust source areas have been found to contribute to El Paso dust storm events from variably active natural sources just south of the U.S.-Mexico border. The application of an area-specific high wind threshold would be much more relevant to source areas for these dust events, rather than the El Paso area itself. At best, the measurements from El Paso monitoring sites help to confirm the large scale nature of the high winds and characterize the event impacts on a localized scale immediately surrounding the monitoring sites.

The contribution of Chihuahuan Desert sources in the primarily unpopulated areas of northern Chihuahua, Mexico, to dust events impacting El Paso has been well established in peer-reviewed literature. A study conducted by Novlan et al. (2007) of significant dust events from over 1,000 events in El Paso from 1932 through 2005 observed that advection of blowing dust into the El Paso area can occur at wind speeds of approximately 10 to 20 miles per hour. Rivera Rivera et al. (2006) examined 9 dust events from 2002 and 2003 with the NOAA HYSPLIT model and noted that source area wind speeds for periods associated with dust events were 10 meters per second (m/s) (22 mph) or higher compared to 4 m/s (9 mph) during non-dust events. These studies indicate windblown dust can occur and impact the El Paso area at wind speeds well below 25 mph.

In lieu of actual wind measurements in the dust source areas on the proposed event days, the TCEQ used NOAA Air Resources Laboratory online tools to model wind speeds in the source areas on the event days. Using the highest resolution provided (12 km NAM), the model output provides hourly wind speeds and wind vectors at a 10 meter height. Figures 10 and 11 illustrate the predicted wind speeds in the dust source areas for the flagged event days. When compared with satellite imagery provided in Appendix B and C, these models support the occurrence of windblown dust from the source areas at wind speed averages in the 25 to 35 knots (29 to 40 mph) range.

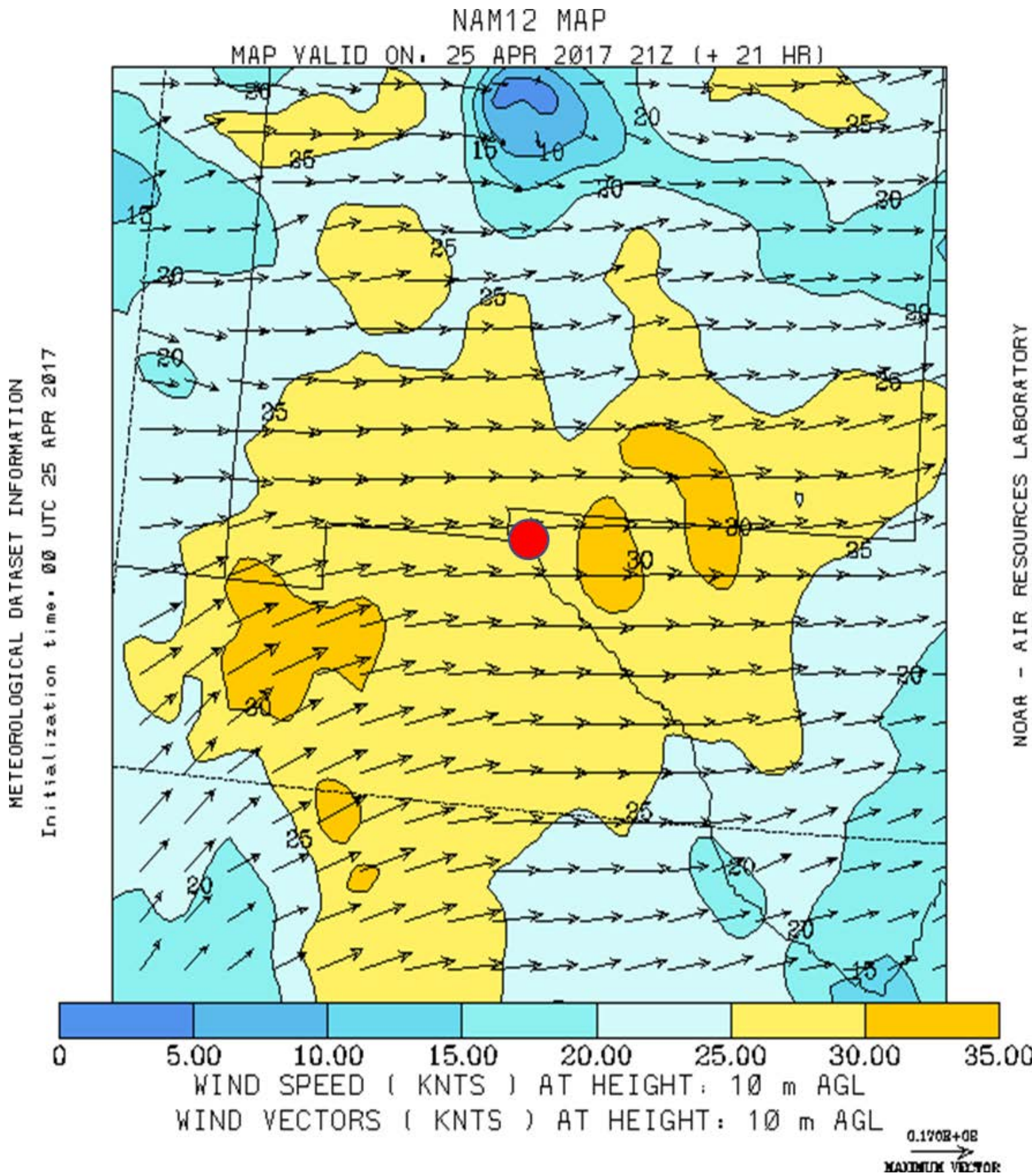

Figure 10. NOAA ARL model wind field in the El Paso area at 1400 MST on April 25, 2017. El Paso International Airport is at the center and is marked with a red circle.

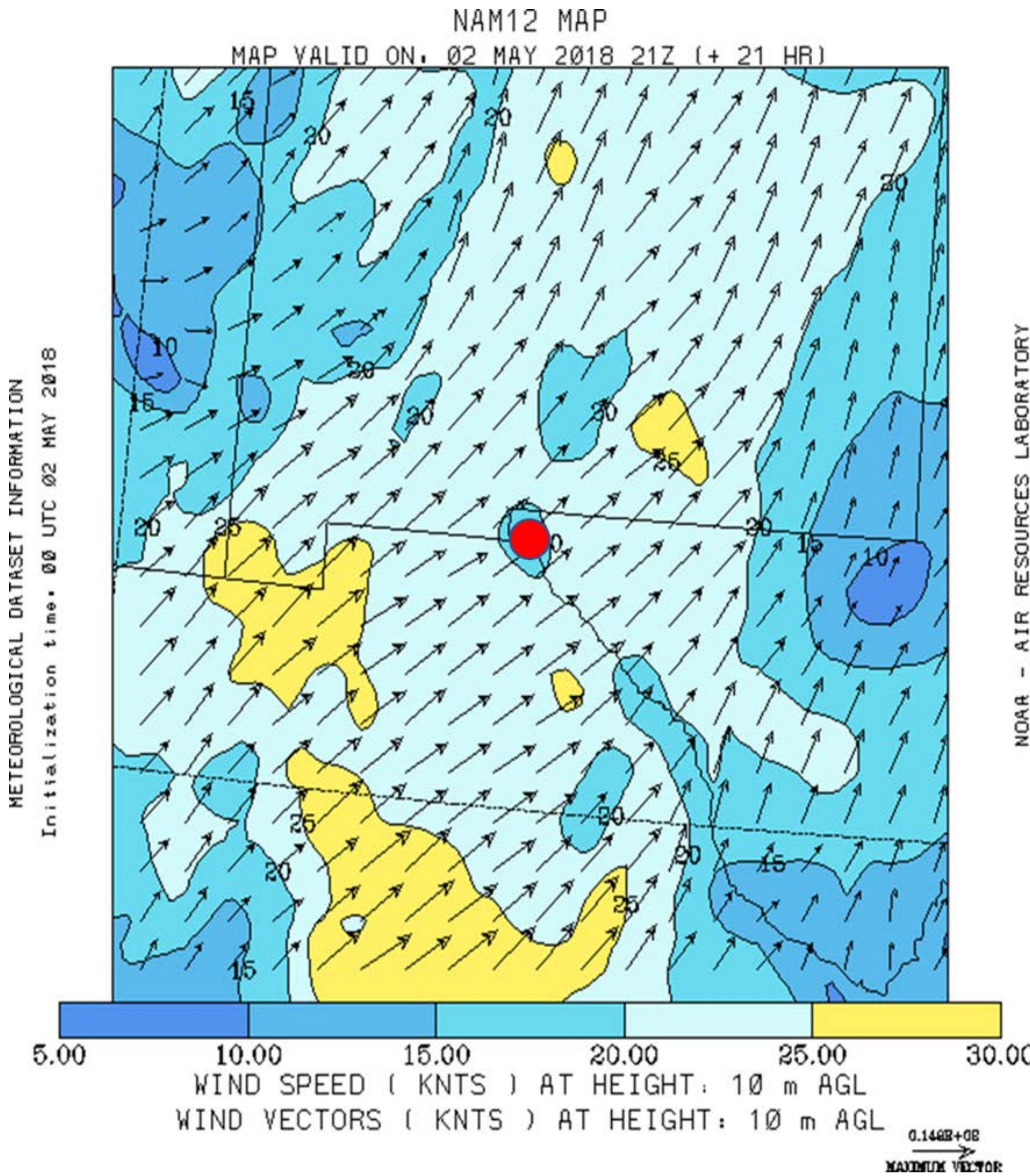

Figure 11. NOAA ARL model wind field in the El Paso area at 1400 MST on May 2, 2018. El Paso International Airport is at the center and is marked with a red circle.

All available continuous and non-continuous El Paso daily average particulate measurements from the event days are provided in Table 3 below. These measurements demonstrate the widespread impact of these dust events on the El Paso region.

Table 3. El Paso area particulate measurements on exceptional event days.

Site	Type	Method	04/25/2017	05/02/2018
Ivanhoe	PM_{10}	FRM	79	86
UTEP	PM_{10}	C	150	159
Riverside	PM_{10}	FRM	111	127
Socorro	PM_{10}	FRM	***188***	***158***
Socorro	PM_{10}	FRQ	124	99
Socorro	PM_{10}	C	166	134
Van Buren	PM_{10}	FRM	86	134
Ojo de Agua	PM_{10}	FRM	119	138
Ojo de Agua	PM_{10}	FRQ	118	120
UTEP	$PM_{2.5}$	FRM	28.0	20.3
UTEP	$PM_{2.5}$	C	21.3	20.6
Chamizal	$PM_{2.5}$	FRM	32.2	27.2
Chamizal	$PM_{2.5}$	FRQ	28.0	21.7
Chamizal	$PM_{2.5}$	CSN	24.7	16.1
Socorro	$PM_{2.5}$	C	not valid	24.3
Ascarate	$PM_{2.5}$	C	45.2	32.1

Notes: ***Italic bold*** highlighting indicates the measurement is proposed as an exceptional event. PM_{10} measurements are in $\mu g/m^3$ SC and $PM_{2.5}$ measurements are in $\mu g/m^3$ LC.

Abbreviations:

- PM_{10} Average for 2016 through 2018 including event days
- FRM federal reference method non-continuous monitor
- FRQ federal reference method non-continuous quality control (collocated) monitor
- C continuous monitor
- CSN Reconstructed $PM_{2.5}$ mass from speciated non-continuous monitor

$PM_{2.5}$ CSN speciation data were available from the Chamizal site for both of the event days. A summary of the Chamizal speciation data on the event days is provided in Table 4, including averages for the period from 2016 through 2018 for comparison. The speciation data shows a dominance of the IMPROVE soil component on the exceptional event days as would be expected with transported dust from high winds.

Table 4. Chamizal $PM_{2.5}$ speciation summary for exceptional event days.

	2016-2018*	04/25/2017	05/02/2018
FRM	8.7	32.2	27.2
RM	6.9	24.7	16.1
Soil	2.1	18.6	12.6
AS	1.1	1.3	0.9
AN	0.5	0.6	0.3
OC	2.4	3.8	2.0
Silc	0.4	4.0	2.9
Alum	0.0	1.7	1.1
Iron	0.1	0.8	0.6
Calc	0.3	1.6	0.9

Note: All units are in $\mu g/m^3$ LC.

Abbreviations:

*	Average for 2016 through 2018 including event days
FRM	federal reference method $PM_{2.5}$ concentration
RM	IMPROVE reconstructed $PM_{2.5}$ mass concentration calculated from speciation data
Soil	IMPROVE soil concentration calculated from speciation data
AS	IMPROVE ammonium sulfate concentration calculated from speciation data
AN	IMPROVE ammonium nitrate concentration calculated from speciation data
OC	IMPROVE organic carbon concentration calculated from speciation data
Silc	silicon speciation concentration
Alum	aluminum speciation concentration
Iron	iron speciation concentration
Calc	calcium speciation concentration

Synoptic Weather Maps

Weather maps are helpful for displaying large-scale observation based weather features. On both event days, regional weather maps depict large and intense low pressure systems covering a large region surrounding the El Paso area. These systems produced strong westerly to southwesterly winds, which is consistent with the orientation of dust plumes in northern Mexico seen on satellite imagery. Figure 12 provides an example weather map from the April 25, 2017, event. Wind direction in the El Paso area is indicated by a large arrow. Weather maps along with detailed event summaries for each event day are provided in the appendices.

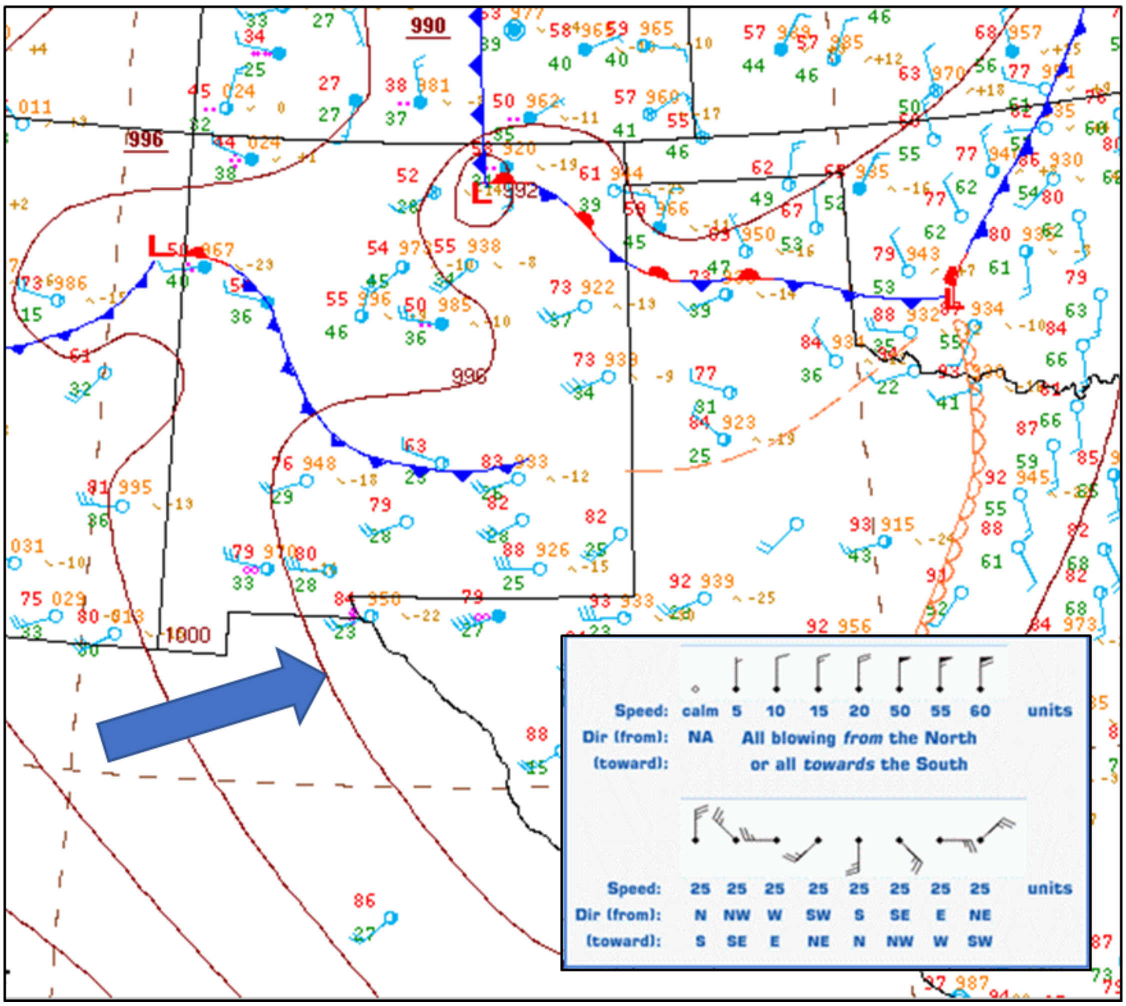

Figure 12. Example regional weather map for April 25, 2017, at 1400 MST showing a large intense low pressure system bringing wide-spread high winds over a large region around the El Paso area. A key to interpreting the wind flags is shown in the lower right of this weather map and a large arrow indicates the wind direction in the El Paso area.

Webcam Images

Webcam imagery illustrates the large-scale nature of these high wind blowing dust events. If dust was coming primarily from local sources, only local dust plumes emanating from local sources would be visible on these images. Instead, the webcam images show a broad, rapid decrease in visibility across the entire horizon with the onset of these events, consistent with the large-scale nature of regional dust plumes. A map of the Ranger Peak webcam location is provided in Figure 13 with webcam images from the April 25, 2017, event day shown in Figure 14 below. In the webcam images, the top frame shows good visibility at 0815 MST just prior to the onset of the blowing dust, and the bottom frame shows very poor visibility near the peak of the blowing dust at 1245 MST. These images dramatically show the impact of the internationally transported regional blowing dust associated with these events.

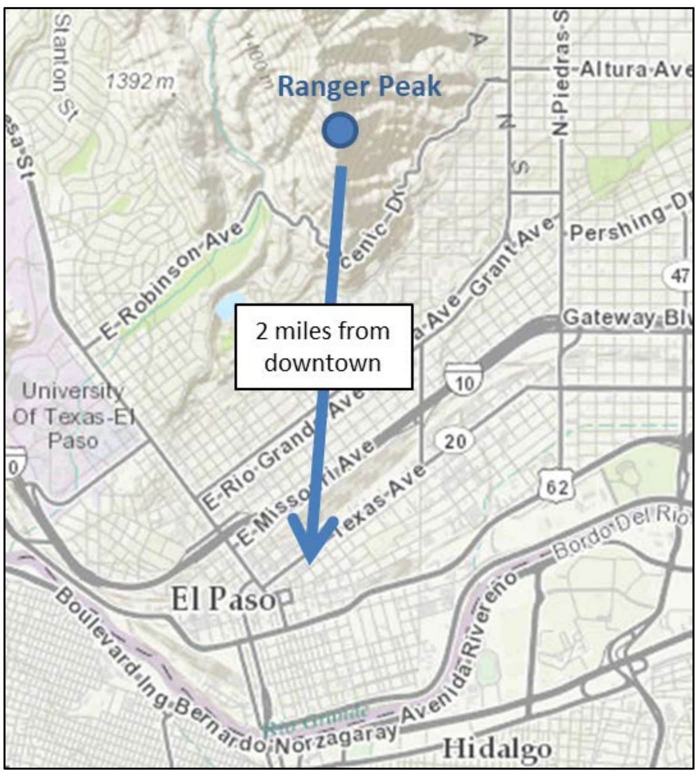

Figure 13. Ranger Peak webcam location showing direction of view and distance from downtown El Paso.

Figure 14. Ranger Peak webcam images for April 25, 2017, looking south-southwest toward downtown El Paso about 2 miles away. The top frame at 0815 MST has good visibility and the bottom frame at 1245 MST shows intense blowing dust.

Satellite Images

Satellite imagery from NOAA provides additional evidence that the dust on the exceptional events days was caused primarily by overwhelming transport from sources outside of Texas. The high resolution true color images show numerous smaller dust plumes emanating from exposed soil areas in the desert of northern Mexico and merging into larger plumes as the dust reaches the El Paso area. There is no evidence of dust plumes originating in the El Paso urban area as would be expected if local dust sources were dominant.

Example Terra satellite images, shown in Figure 15, compare views with minimal dust on April 22, 2017 (three days before the event), to views with intense dust plumes from the April 25, 2017, event. Similar satellite images for both event days are provided in the appendices.

These satellite images clearly show widespread dust emanating from northern Mexico into the El Paso area, causing the observed high particulate concentrations. On these satellite images, clouds appear bright white and usually have distinct edges, whereas dust plumes are characterized by grayish to brownish streaks that do not appear on clear sky images where dust is not present.

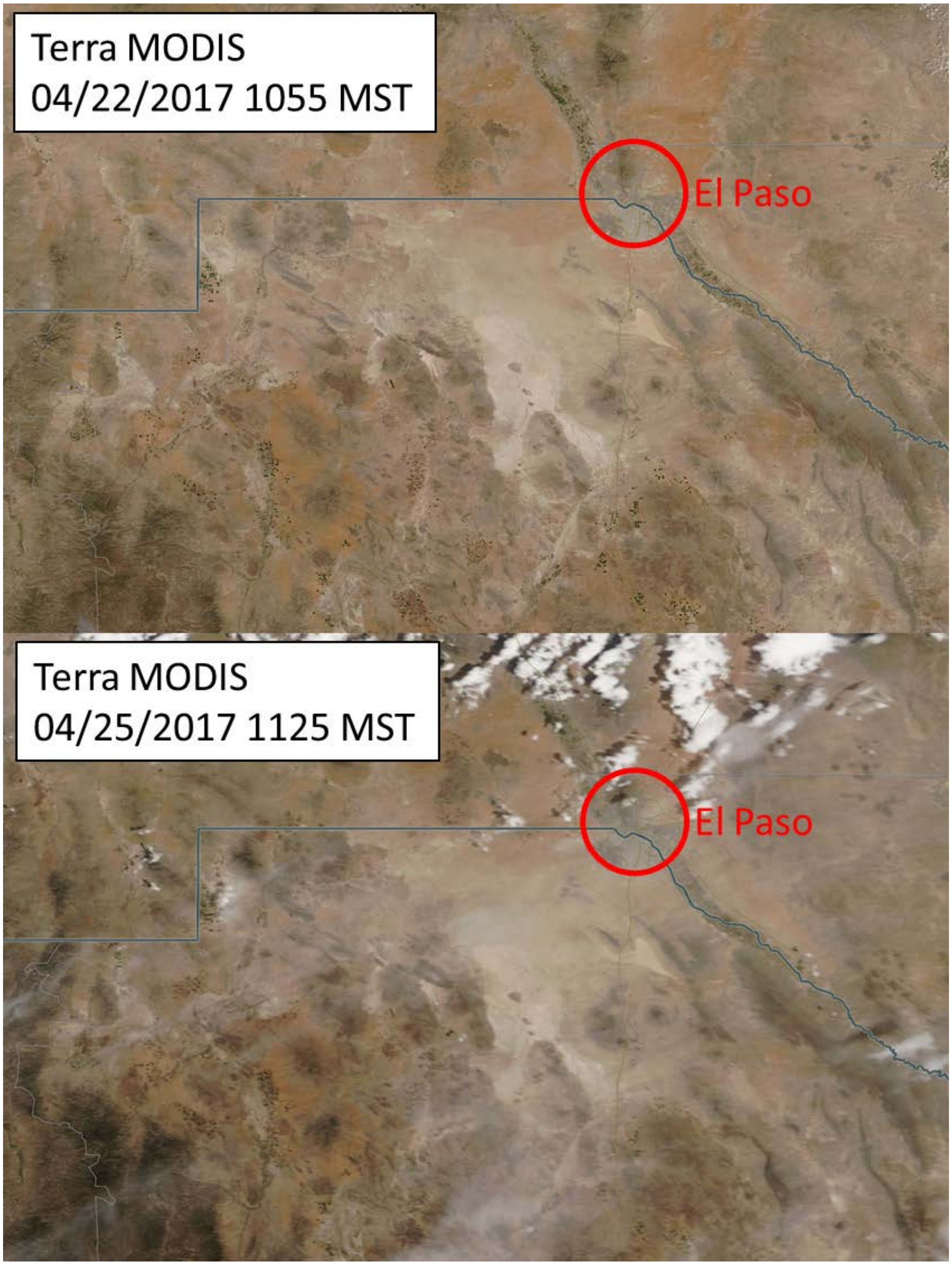

Figure 15. Terra MODIS true color satellite images showing clear and dust-free conditions on April 22, 2017 (top), and widespread dust originating in northern Mexico blowing northeast towards El Paso on April 25, 2017 (bottom).

Backward-In-Time Air Trajectories

Backward-in-time air parcel trajectories were derived using the NOAA HYSPLIT model for each proposed exceptional event occurrence. The trajectories track the air arriving at the time of the highest one-hour average PM_{10} concentration observed at the site on the event day and follow the air backward-in-time for 12 hours. In Figure 16 the air parcel associated with the April 25, 2017, event day is shown to have passed across northern Mexico before arriving in the El Paso area. Trajectories for each proposed exceptional event day are provided in the appendices.

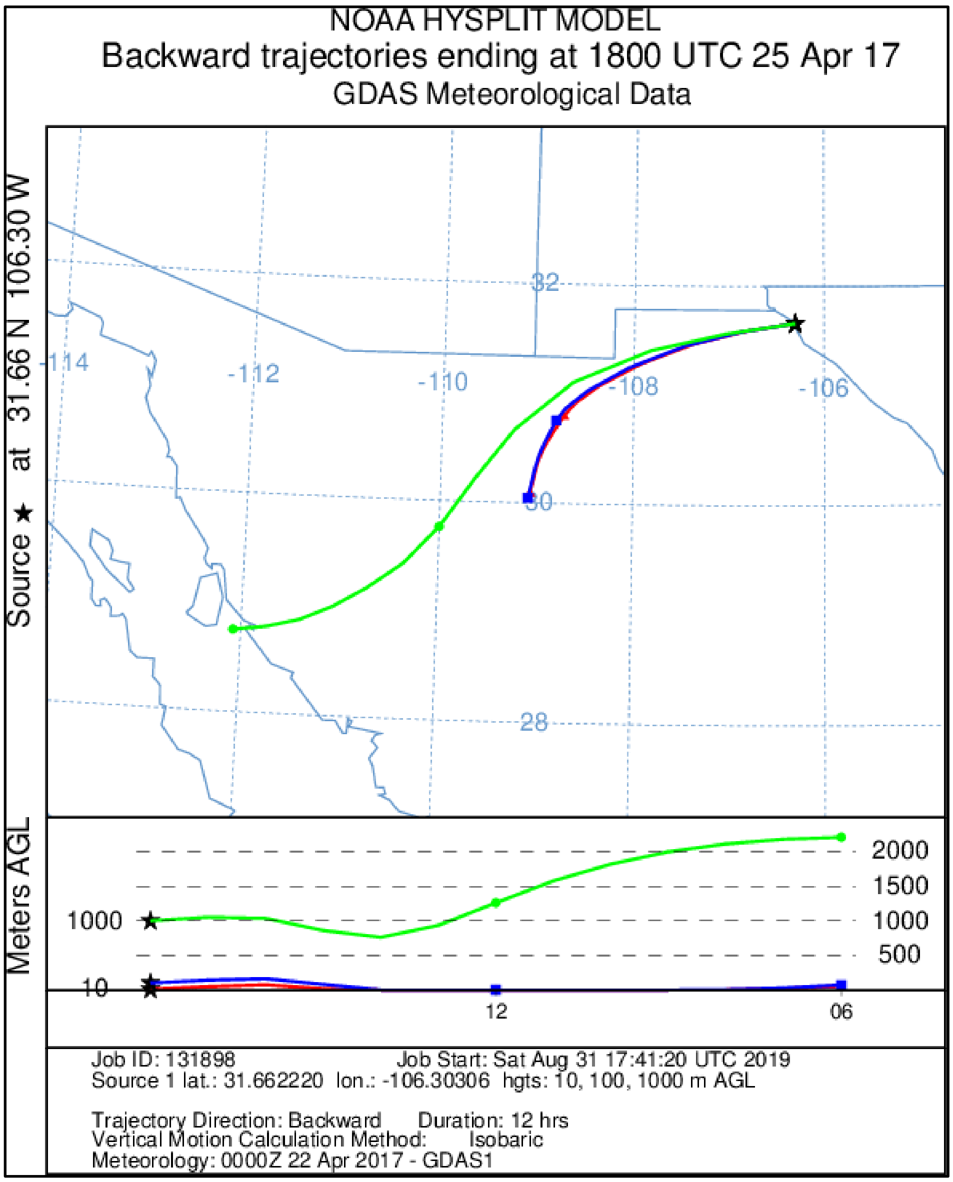

Figure 16. Backward-in-time air trajectory for April 25, 2017.

Maps of Daily Average Particulate Matter

Maps of the daily average PM_{10} and $PM_{2.5}$ concentrations show the spatial distribution of measurements on the event days, with the flagged measurements identified by site name. Example maps from April 25, 2017, are provided in Figure 17 for PM_{10} and in Figure 18 for $PM_{2.5}$. Note the highest measured PM_{10} values occurred along the international border with Mexico. Maps for each event day are included in the appendices.

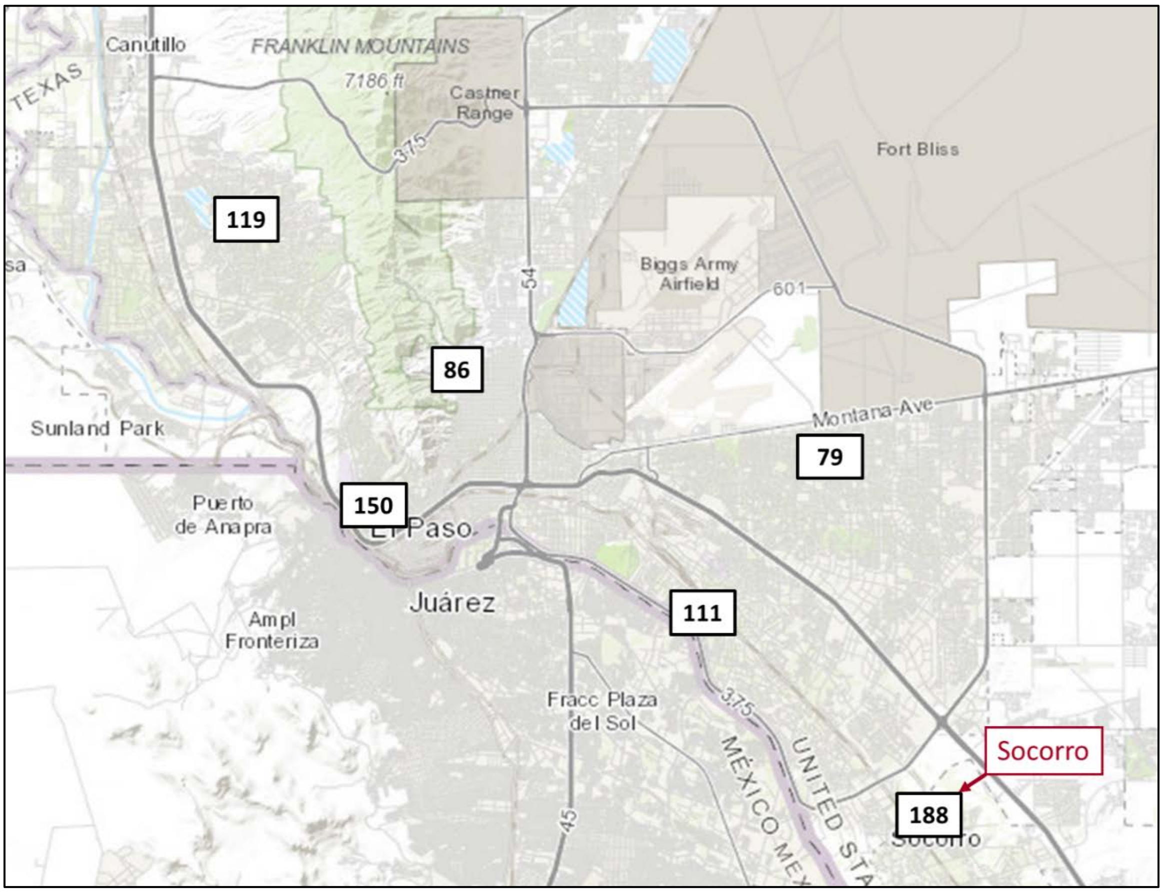

Figure 17. Map of daily average PM_{10} measurements (µg/m^3 SC) on April 25, 2017.

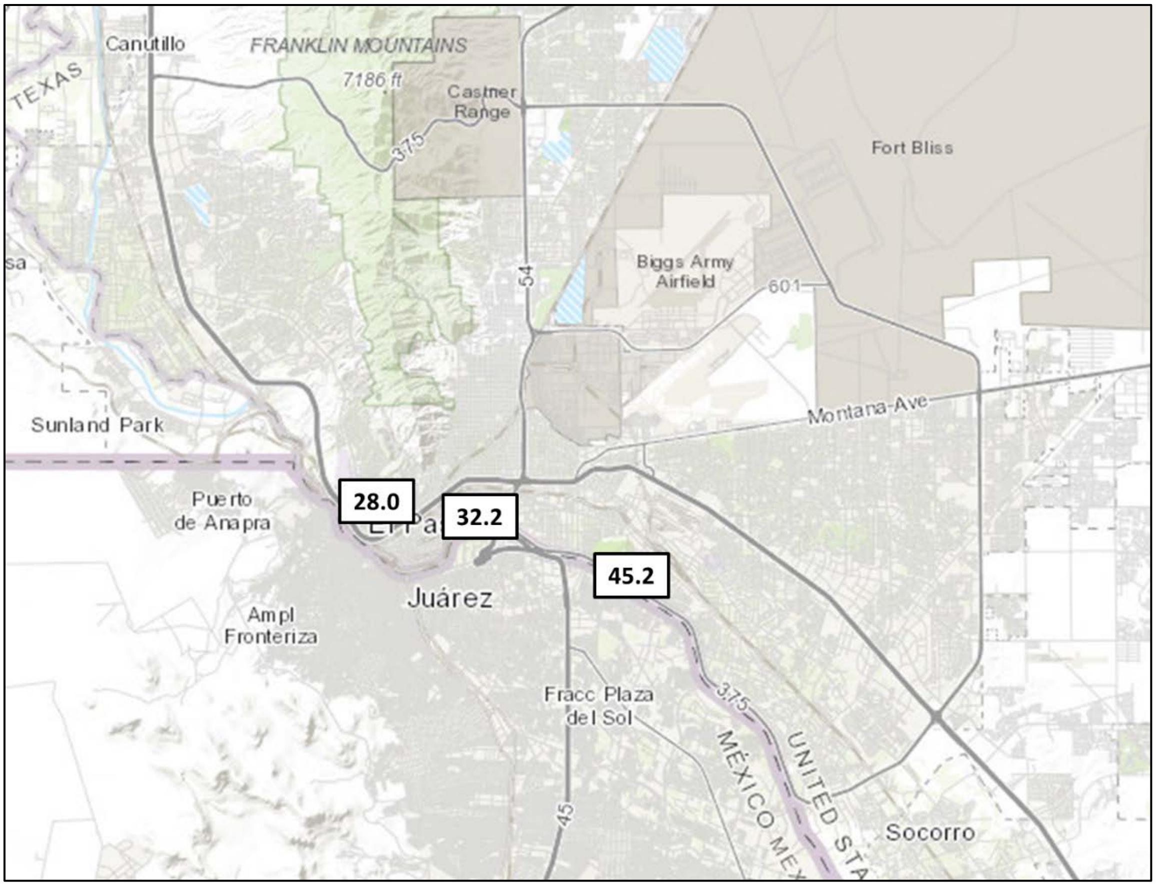

Figure 18. Map of daily average $PM_{2.5}$ measurements ($\mu g/m^3$ LC) on April 25, 2017.

Continuous Data Time Series Graphs

Time series graphs plotting continuous particulate measurements against wind speed measurements illustrate the intense nature of the dust events, with particulate concentrations rising after sustained wind speeds reached 20 to 30 mph or more. Continuous PM_{10} five-minute data along with continuous five-minute peak area sustained wind speeds were plotted for each event day. As can be seen in Figure 19, peak wind speed measurements on April 25, 2017, reached 20 to 25 mph as early as 0400 MST and remained at or above 25 mph for several hours between 0800 MST and 1400 MST. However, the corresponding rise in particulate matter measurements did not begin until after 0900 MST, indicative of a dust source some distance from the monitors. At such high wind speeds, a dust source nearer the monitor locations would have resulted in the measurement of high levels of particulate matter within minutes after the high wind speeds began. A complete set of graphs for each event is presented in the appendices.

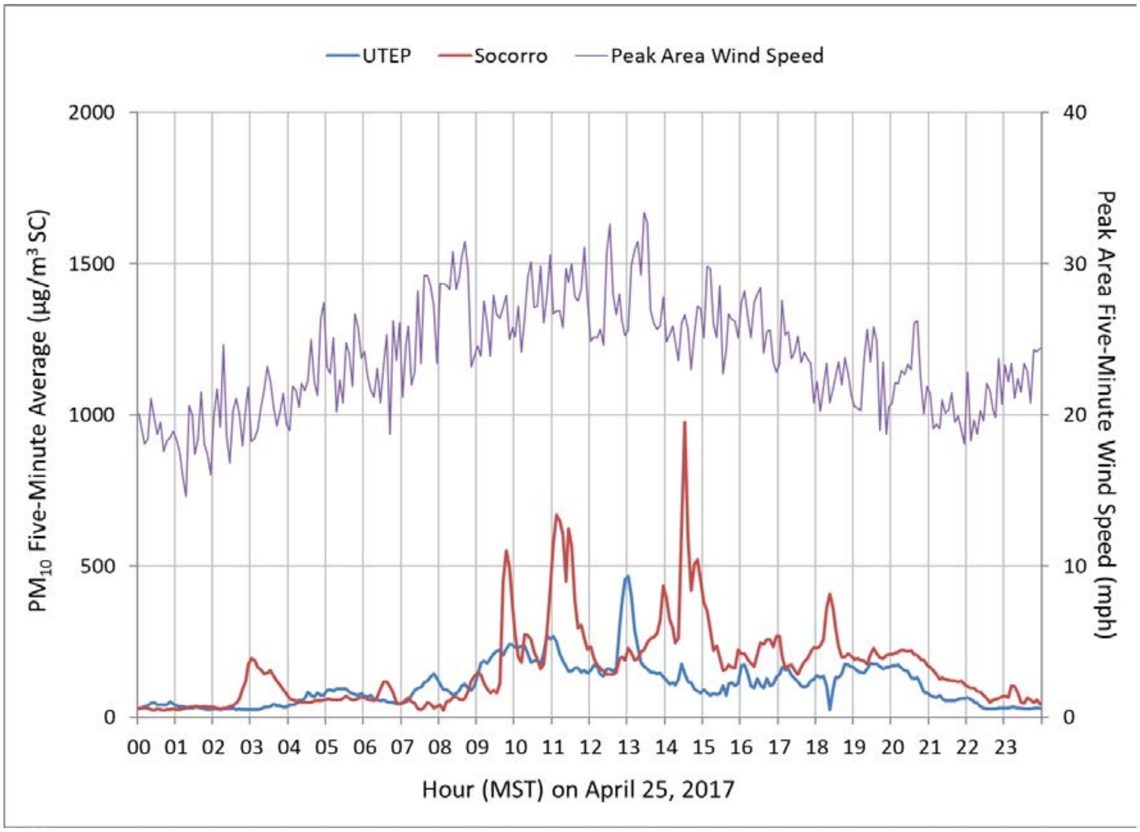

Figure 19. Continuous five-minute PM_{10} and peak area five-minute sustained wind speed measurements on April 25, 2017.

Not Reasonably Controllable or Preventable

Per 40 CFR § 50.14(c)(3)(iv), the 2016 Exceptional Event Rule (EER) requires states to demonstrate that the event was both not reasonably controllable and not reasonably preventable (nRCP). However, under 40 CFR § 50.14(b)(5)(iv) states are not required to provide a case-specific justification for a high wind dust event to address the not reasonably preventable criterion. Therefore, only evidence to meet the not reasonably controllable criterion are presented here.

Natural and Anthropogenic Source Contributions

A study of blowing dust plume origins in the Chihuahua Desert area surrounding El Paso based on satellite imagery for 26 episodes from 2001 through 2009 indicated that the origin locations were primarily in northern Mexico and southwestern New Mexico (Baddock, Gill, Bullard, Acosta, & Rivera, 2011). Additionally, Gill et al. (2007) investigated dust source hot spots for multiple dust storm events from 2002 to 2006. Their work found that a huge playa complex within the Lake Palomas region of northern Chihuahua, Mexico, frequently contributed to concentrated plumes of particulate matter that spread into the El Paso/Ciudad Juarez area. Particle size analyses of surface sediment samples from these playas revealed very fine clays and silts with grain sizes in the $PM_{2.5}$ and PM_{10} ranges, including particles as small as 0.2 microns. This study did not find any large blowing dust sources in the immediate El Paso area. The closest blowing dust sources identified were about 30 to 35 miles east-northeast of the El Paso area and these sources would not have been a factor on the proposed exceptional event days since they were not upwind of El Paso on the event days.

El Paso and the Mexican city of Ciudad Juarez are located in a bowl-shaped valley where particulate matter gets trapped by strong temperature inversions and down-sloping winds from surrounding mountains during air stagnation events. Anthropogenic sources that contribute to the elevated particulate matter concentrations during these episodes often include local industrial facilities, automobiles, heating fires, and the combustion of refuse in Ciudad Juarez. Ciudad Juarez has minimal controls on the burning of wood, tires, scrap plastics, and construction debris. In addition, the automobiles in Ciudad Juarez are on average much older than those in El Paso and have greater emissions per vehicle. El Paso and nearby Sunland Park, New Mexico, have strict controls on pollution sources from various combustion types that are considered reasonably available control technology (RACT) or reasonably available control measures (RACM) (TCEQ1, 2007).

An evaluation of the El Paso County particulate matter emissions inventory (EI) reveals the most significant contributions of anthropogenic particulate emissions to be from unpaved roads, commercial construction, paved roads, and road construction, which are sources that do not typically have the potential for an emission event or drastic increases in emissions on a single day. Table 5 shows the 2017 area source and mobile source particulate matter EI for El Paso County as reported for the 2017 National Emissions Inventory, as well as the 2015 to 2017 point-source EI. It is important to note that these emissions inventories are representative of the entire county and not specific to just those areas upwind of area monitors on the event days. Given the proximity of the Socorro monitor to the international border and the wind direction on the flagged event days, impacts from major road construction or commercial construction projects are highly unlikely to have been a major contributor to the measured concentration values.

Table 5. El Paso County particulate matter emissions inventory in tons per year.

Category	**PM_{10}**	**$PM_{2.5}$**
2017 Area Source EI:		
Road Construction	925.42	92.54
Unpaved Roads	5,611.84	558.93
Commercial Construction	4,022.62	402.26
Paved Roads	936.17	229.80
Agricultural Tilling	615.30	123.06
Residential Construction	324.06	32.41
Mining and Quarrying	455.45	55.77
All other area sources	369.87	183.48
2017 Mobile Source EI:		
On-road mobile sources	518.20	236.66
Non-road mobile sources	166.32	159.08
2015 Point Source EI	331.03	272.60
2016 Point Source EI	346.30	284.97
2017 Point Source EI	304.88	196.00

Figure 20 plots the location of point sources in the El Paso area reporting 2017 particulate matter emissions of 5 tons per year or greater relative to the Socorro Hueco monitoring site. Note that none of these sources were upwind of the site on the event days and would not be expected to significantly contribute to measured concentrations given the wind directions on the flagged event days. The number plotted by each point source circle is the PM_{10} annual emission rate in tons per year from the 2017 TCEQ emissions inventory. The blue shading in each point source circle indicates the fraction of the total PM_{10} emitted as $PM_{2.5}$ based on the 2017 $PM_{2.5}$ annual emission rate.

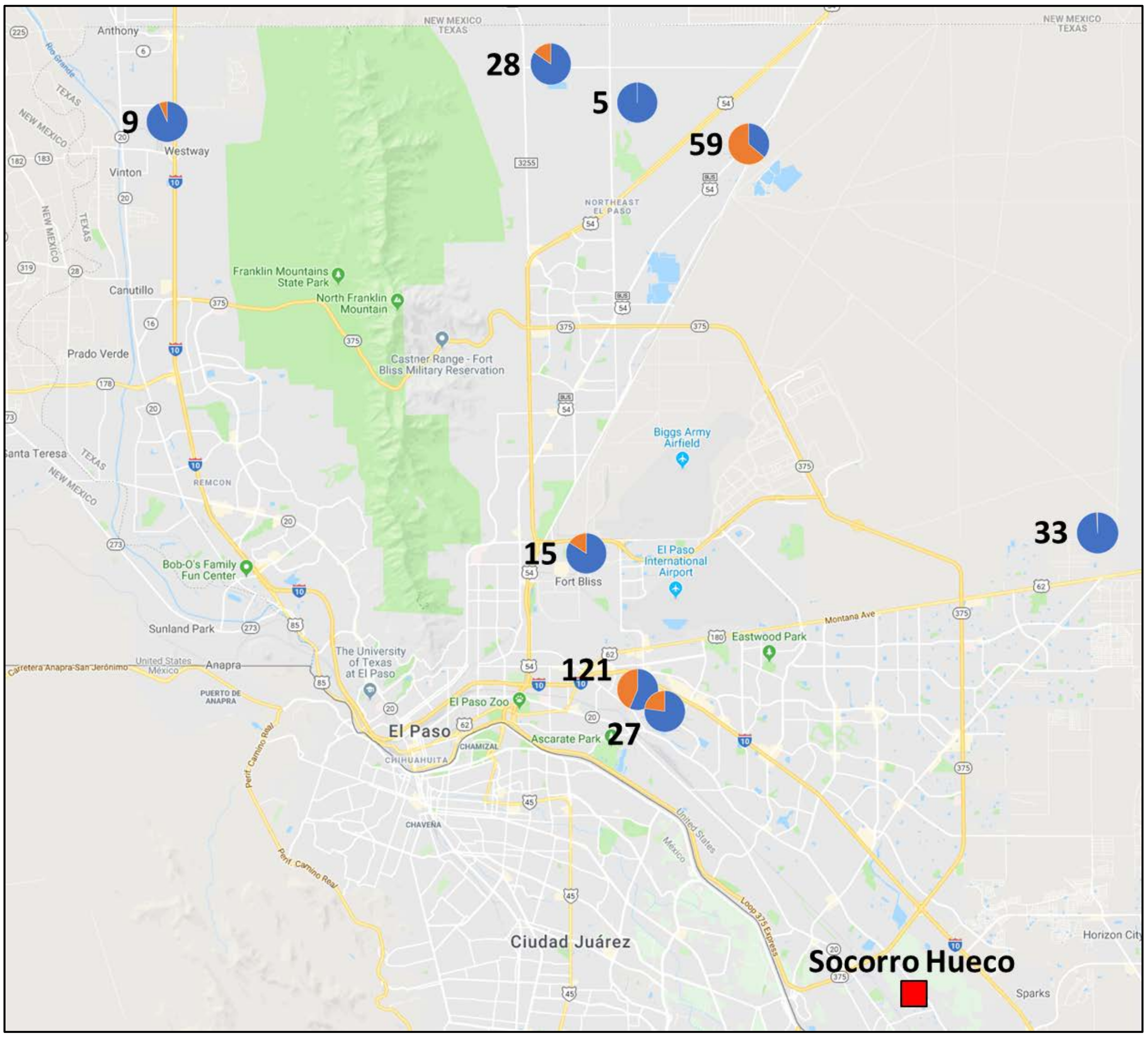

Figure 20. Map of El Paso area significant PM_{10} point source locations, with emissions in tons per year, and the fraction emitted as $PM_{2.5}$ shaded in blue and remainder of PM_{10} in orange. The Socorro Hueco site is shown with a red square and labeled by name.

Local source contributions to measured particulate levels in El Paso are highest with air stagnation conditions. The worst air stagnation conditions occur with light winds and clear skies on winter nights when strong temperature inversions develop and trap locally emitted air pollution in a thin layer near the ground (NOAA NWS, 2019). Since non-continuous measurements are based on the calendar day from midnight to midnight local standard time, the highest calendar day local source impacts occur with two stagnant nights in a row during the months of November through February when inversions are strongest because of colder and drier conditions. Since 2008, there have been no FRM exceedances of the 24-hour $PM_{2.5}$ or PM_{10} standards from air stagnation conditions at the Chamizal, UTEP, and Socorro sites, although local source contributions on these days do impact the annual $PM_{2.5}$ averages.

The Chamizal speciation data show that the IMPROVE organic carbon component is highest with light winds, as would be expected with local contribution during air stagnation, whereas the IMPROVE soil component is highest with high winds. Figure 21 plots the Chamizal IMPROVE organic carbon component versus Chamizal daily peak hourly wind speeds and, in general, indicates that the highest local carbon related emission impacts on $PM_{2.5}$ occur with lower wind speeds. Figure 22 shows the Chamizal IMPROVE soil component versus Chamizal peak hourly wind speeds and demonstrates that the IMPROVE soil component is highest with high winds, as is the case for the $PM_{2.5}$ and PM_{10} concentrations previously shown in Figures 6 and 7. Unlike the $PM_{2.5}$ concentrations, the IMPROVE soil component does not also increase significantly at lower wind speeds, indicating that local dust is not a major contributor to particulate concentrations without high winds. Figure 7 earlier in the demonstration also illustrates the impact of local sources on $PM_{2.5}$ concentrations as evidenced by the slightly elevated measurements when peak hourly wind speeds are lower, between 5 and 10 mph.

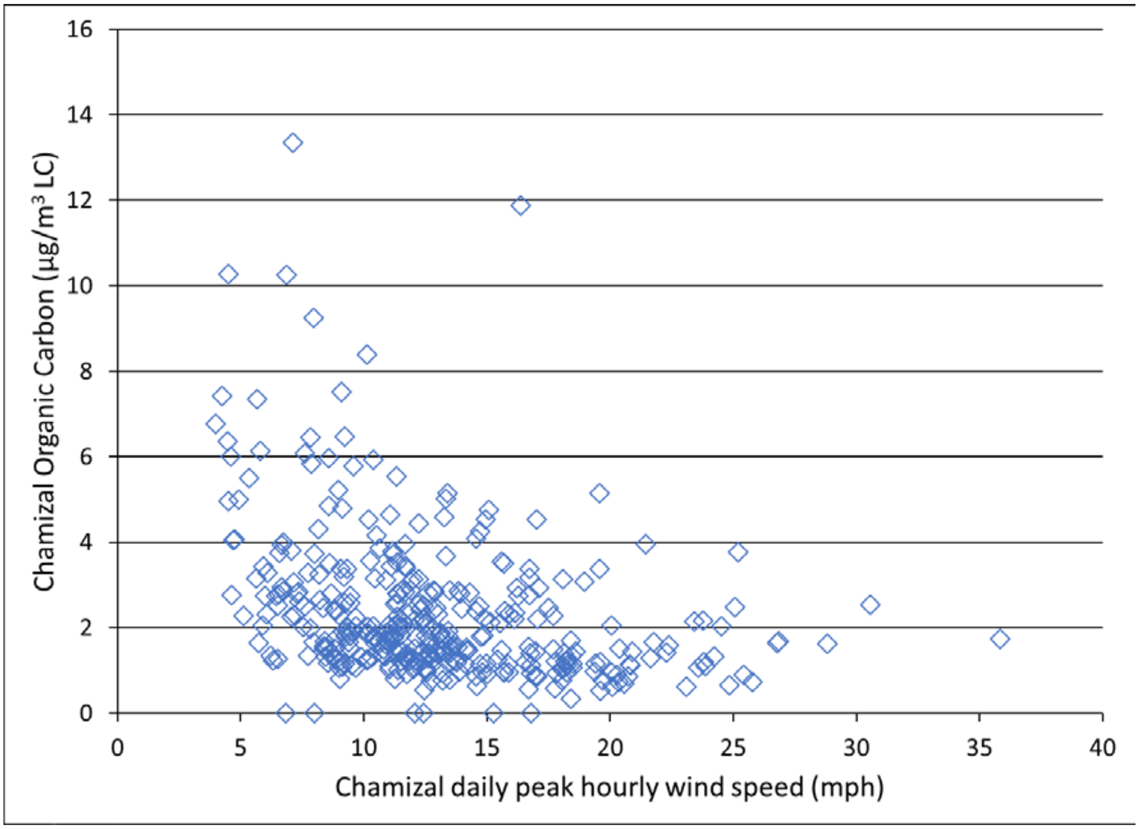

Figure 21. Chamizal $PM_{2.5}$ IMPROVE organic carbon concentration versus Chamizal daily peak hourly wind speed for 2016 through 2018.

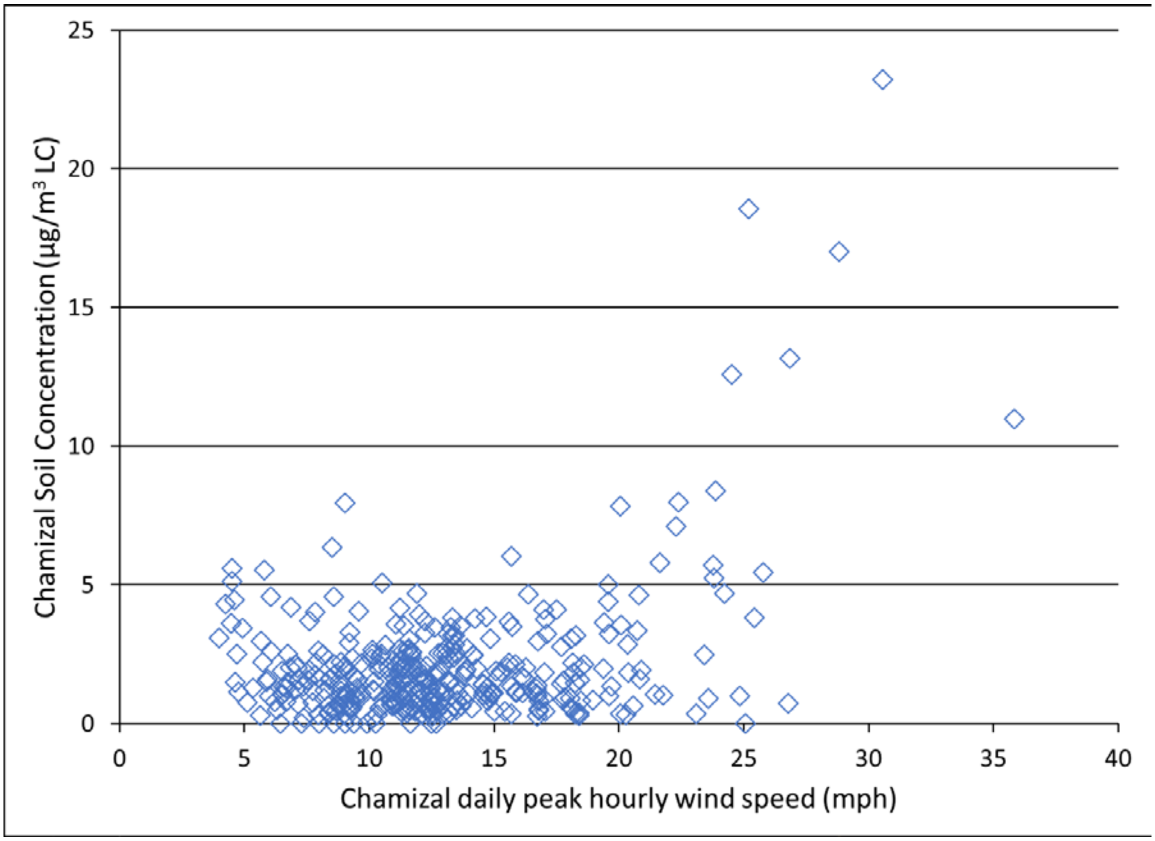

Figure 22. Chamizal $PM_{2.5}$ IMPROVE soil concentration versus Chamizal daily peak hourly wind speed for 2016 through 2018.

The UTEP, Ascarate Park, Chamizal, and Socorro Hueco sites are located near the Rio Grande and thus receive substantial influence on particulate measurements from sources in Mexico whenever winds are from the west to southwest to south. Sources in Mexico cannot be controlled by U.S. regulations. El Paso urban emissions affect these sites when winds are from the east to north to northwest. During air stagnation events, winds are light and variable, allowing emissions from both the U.S. and Mexico to mix and thus affect all sites along the border. With stronger winds, the direction of the wind will more directly indicate the source of any air pollution present. Figure 23 shows wind rose plots for the UTEP, Ascarate Park, Chamizal, and Socorro Hueco sites from 2017 and 2018 to illustrate typical overall wind patterns seen in the El Paso area.

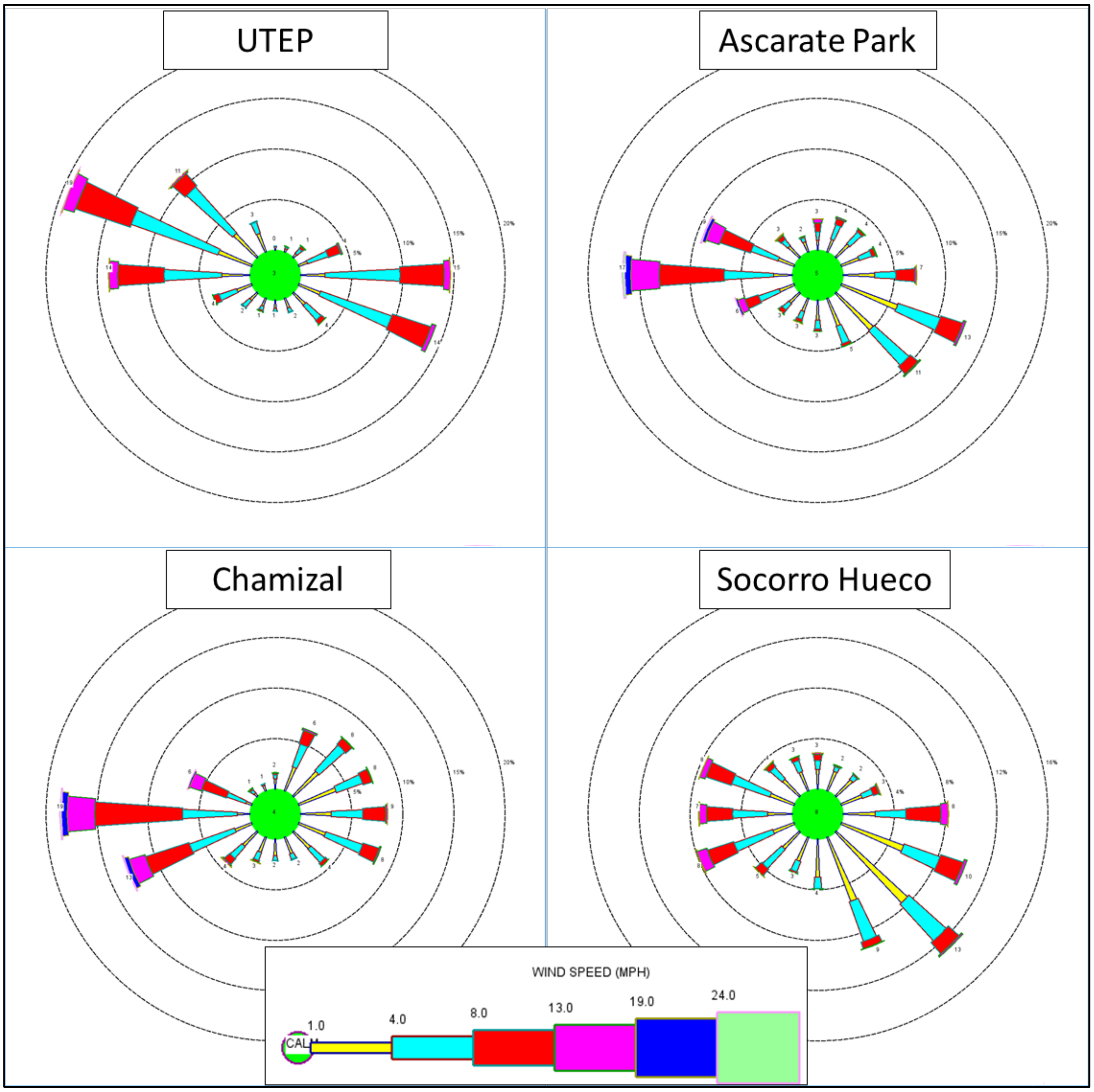

Figure 23. Wind rose plots for the UTEP, Ascarate Park, Chamizal, and Socorro Hueco sites for 2017 and 2018. The length of the wind rose bars indicate the frequency of hourly winds blowing from the direction of the bar toward the site. The width of the bars indicates the hourly wind speeds for the ranges shown in the key.

Attainment Status and Control Measures

The El Paso area has been designated as nonattainment for the 24-hour PM_{10} NAAQS since November 15, 1990, but has been designated as attainment for both the annual and 24-hour $PM_{2.5}$ NAAQS since $PM_{2.5}$ designations were first made on December 17, 2004. The State of Texas adopted State Implementation Plan (SIP) provisions in November 1991 that include regulations on PM_{10} sources in the El Paso area. The EPA approved the El Paso PM_{10} SIP on February 17, 1994. The approved SIP incorporated all nonattainment requirements including RACT and RACM. Additionally, a Memorandum of Understanding (MOU) between the City of El Paso and the Texas Air Control Board (TACB), a predecessor agency of the TCEQ, was incorporated to define the division of responsibility and commitments to carry out the provisions of the rules developed in the 1991 El Paso PM_{10} SIP revision.

On January 25, 2012, the TCEQ adopted a SIP revision to incorporate updates to the PM_{10} control measures and to incorporate a revised Memorandum of Agreement (MOA) between the TCEQ and the City of El Paso to reflect the updated control measures. This SIP revision was approved by EPA on December 14, 2015. The regulations included in the SIP revision are summarized below (the symbol "§" stands for "Section").

- Title 30 Texas Administrative Code (TAC) §111.111(c) established conditions for the use of solid fuel heating devices during periods of atmospheric stagnation in the City of El Paso, including the Fort Bliss Military Reservation.
- Title 30 TAC §111.141 establishes that §111.143 (relating to Materials Handling), §111.145 (relating to Construction and Demolition), §111.147 (relating to Roads, Streets, and Alleys), and §111.149 (relating to Parking Lots), and associated dates of compliance, shall apply to the City of El Paso and portions of the Fort Bliss Military Reservation.
- Title 30 TAC §111.145 establishes measures to control dust emissions related to land clearing and construction, repair, alteration and demolition of structures, roads, streets, alleys, or parking areas of any size in the City of El Paso.
- Title 30 TAC §111.147 establishes measures to control dust emissions on public, industrial, commercial, or private roads, streets, or alleys including application of asphalt, water, or suitable oil or chemicals and mechanical street sweeping. Specific requirements are established for alleys and levee roads within the City of El Paso, including paving new alleys and disallowing use of unpaved existing alleys for residential garbage and recycling collection.

The following summarizes other existing regulations applicable to particulate matter control in the El Paso area.

- Title 30 TAC §111.143 establishes measures to control dust emissions related to the handling, transport, or storage of materials which can create airborne particulate matter including the application of water, chemicals, or coverings on materials stockpiles; use of hoods, fans, and filters to enclose, collect, and clean the emissions of dusty materials; and the covering of all open-bodied trucks, trailers, and railroad cars transporting materials in the City of El Paso.

- Title 30 TAC §111.149 establishes measures to control dust emissions, including appropriate application of asphalt, water, or suitable oil or chemicals for temporary parking lots, parking lots having more than five spaces, and paved parking lots having more than one hundred spaces.
- City of El Paso Municipal Code Chapter 9.38, concerning wood burning, prohibits the operation of a solid fuel heating device within the city of El Paso during a no-burn period, unless an exemption has been obtained.
- City of El Paso Municipal Code Chapter 19.15.020, concerning subdivider responsibility, establishes standards for proposed roads serving new developments, including alleys.
- City of El Paso Municipal Code Chapter 19.15.160 establishes standards for the construction and improvement of alleys.
- City of El Paso Municipal Code Chapter 20.14 establishes standards for the provision of off-street parking, loading and storage, including standards for dust-free surfacing.

Not Reasonably Controllable

The proposed event days were characterized by overwhelming international transport of blowing dust not indicative of local sources. Satellite imagery and back trajectories confirm the transport of large amounts of dust from uncontrollable sources outside of the United States and Texas associated with regional high winds as described throughout this demonstration document.

The EPA High Wind Dust Event Guidance document states that if an area has a SIP or SIP revision that was approved 5 years or less prior to the event that addresses the event-related pollutant and all relevant sources, there is a presumption that controls identified in the applicable plan are reasonable. If the area also meets the high wind threshold on the event days, then it is also presumed that emissions were reasonably controlled. Both of these conditions were met for each event as documented in this demonstration.

nRCP Conclusion

The documentation and analysis presented in this section demonstrates that all identified sources that caused or contributed to the exceedances were reasonably controlled, effectively implemented, and enforced at the time of the event, therefore emissions associated with the high wind dust event were not reasonably controllable or preventable.

Natural Event

Both of the proposed exceptional event flags for 2017 and 2018 are for high wind blowing dust events generated entirely from natural undisturbed lands, which are natural events. These high wind blowing dust events, typically associated with large low pressure systems, impact the El Paso area every year. Satellite and webcam imagery provide visual evidence of intense dust plumes from northern Mexico moving into the El Paso area during these events as previously described. These dust source locations are consistent with a study of blowing dust origin locations in the Chihuahua Desert surrounding El Paso during the period 2001 through 2009 (Baddock, Gill, Bullard, Acosta, & Rivera, 2011).

On the event days when speciation monitoring data were available, the IMPROVE soil component also provides evidence that the elevated particulate concentrations were from natural sources. The Chamizal IMPROVE soil component shown previously in Table 4 ranged from 12.6 to 18.6 $\mu g/m^3$ on the two event days compared to the 95th percentile of 5.3 $\mu g/m^3$ for all sample days during the period from 2016 through 2018 (including high wind dust events). Figure 22 previously showed that all of the IMPROVE soil concentrations over 10 $\mu g/m^3$ were associated with high wind events as would be expected with natural events caused by blowing dust associated with high winds.

Based on the documentation provided in this demonstration, both events qualify as natural events. The exceedances associated with the events meet the regulatory definition of a natural event at 40 CFR 50.14(b)(8). These events transported windblown dust from natural undisturbed lands as documented throughout this demonstration and accordingly, TCEQ has demonstrated that the events were natural events and may be considered for treatment as exceptional events.

Clear Causal Relationship

Analysis

Numerous sources provide evidence that the elevated particulate concentrations on the event days were caused by blowing dust generated by high winds, including wind information, $PM_{2.5}$ speciation data, backward-in-time air parcel trajectories, satellite imagery, and webcam imagery. As previously presented in Figure 8, an analysis of the PM_{10} measurements at Socorro from 2017 and 2018 showed that the highest concentrations occurred when peak hourly wind speeds approached 20 mph. Likewise, the highest IMPROVE calculated $PM_{2.5}$ soil component values occurred with similar peak hourly wind speeds, as demonstrated in Figure 22. A comparison of the chemical speciation data from the Chamizal site, presented in Table 4, confirmed that for the event days the IMPROVE soil component was 6 to 9 times higher than the average IMPROVE soil component for 2016 through 2018.

Satellite imagery, such as those previously presented in Figure 15, provides compelling evidence of the relationship between these high wind dust plumes and measured concentrations. The satellite images for each day show dust being generated over northern Mexico with high winds and being transported toward El Paso in an east-northeastward orientation. Backward-in-time air trajectories (NOAA ARL, 2019) corroborate the visual evidence from satellite images and confirm that the air arriving at the hour of the peak particulate concentration for each event came from northern Mexico.

Additional wind data, back trajectories, visible satellite imagery, and webcam imagery providing further evidence of the causal relationship for each event day are presented in Appendices B and C.

Occurrence and Geographic Extent of the Event

In addition to the descriptions of weather conditions, photographic webcam images of the area, satellite imagery, and maps of PM concentrations presented in the narrative conceptual model, special weather statements and media coverage information are provided in Figures 24 through 26 to contribute additional supporting documentation establishing the occurrence and geographical extent of these events.

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HWOEPZ

Hazardous Weather Outlook
National Weather Service El Paso Tx/Santa Teresa NM
410 AM MDT Tue Apr 25 2017

NMZ401>417-TXZ418>424-261330-
Upper Gila River Valley-Southern Gila
Highlands/Black Range-Southern Gila Foothills/Mimbres Valley-
Southwest Desert/Lower Gila River Valley-Lowlands of the Bootheel-
Uplands of the Bootheel-Southwest Desert/Mimbres Basin-Eastern Black
Range Foothills-Sierra County Lakes-Northern Dona Ana County-
Southern Dona Ana County/Mesilla Valley-Central Tularosa Basin-
Southern Tularosa Basin-West Slopes Sacramento Mountains Below 7500
Feet-Sacramento Mountains Above 7500 Feet-East Slopes Sacramento
Mountains Below 7500 Feet-Otero Mesa-Western El Paso County-
Eastern/Central El Paso County-Northern Hudspeth Highlands/Hueco
Mountains-Salt Basin-Southern Hudspeth Highlands-Rio Grande Valley
of Eastern El Paso/Western Hudspeth Counties-Rio Grande Valley of
Eastern Hudspeth County-410 AM MDT Mon Apr 24 2017

This Hazardous Weather Outlook is for portions of south central
New Mexico, southwest New Mexico, and southwest Texas.

.DAY ONE...Today and Tonight

Windy with winds gusting around 50 to 60 mph resulting in areas of
blowing dust with the visibility under a mile across some locations.
The high winds may also cause some property damage.

The combination of strong winds...warm temperatures and low humidity
will also create critical fire weather conditions.
```

Figure 24. Hazardous Weather Outlook message issued by the NWS El Paso office on April 25, 2017, concerning the anticipated blowing dust.

Borderland residents under wind, blowing dust advisories

by Jamel Valencia

Tuesday, April 25th 2017

(Credit: MGN Online)

EL PASO, Texas (KFOX14) — The winds began picking up Tuesday morning in south central El Paso.

Strong wind gusts picked up at Ascarate Park.

A high wind warning for El Paso and Dona Ana counties go into effect at noon and expire at 8 p.m.

Trees and athletic nets in the park were blowing around.

Weather experts recommend bringing in patio furniture are outdoor objects that can be picked up during windy days with 50 to 60 mph gusts.

The winds may also cause property and even building damage and blow down trees and power lines over a few areas.

A blowing dust advisory will also go in to effect at noon.

Blowing dust will reduce the visibility to less than a mile over many locations causing dangerous driving conditions.

Figure 25. Media report on April 25, 2017, reporting on the high wind and blowing dust alerts issued by the NWS, which included a High Wind Warning and Blowing Dust Advisory.

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HWOEPZ

Hazardous Weather Outlook
National Weather Service El Paso Tx/Santa Teresa NM
740 AM MDT Wed May 2 2018

NMZ401>417-TXZ418>424-031345-
Upper Gila River Valley-Southern Gila
Highlands/Black Range-Southern Gila Foothills/Mimbres Valley-
Southwest Desert/Lower Gila River Valley-Lowlands of the Bootheel-
Uplands of the Bootheel-Southwest Desert/Mimbres Basin-Eastern Black
Range Foothills-Sierra County Lakes-Northern Dona Ana County-
Southern Dona Ana County/Mesilla Valley-Central Tularosa Basin-
Southern Tularosa Basin-West Slopes Sacramento Mountains Below 7500
Feet-Sacramento Mountains Above 7500 Feet-East Slopes Sacramento
Mountains Below 7500 Feet-Otero Mesa-Western El Paso County-
Eastern/Central El Paso County-Northern Hudspeth Highlands/Hueco
Mountains-Salt Basin-Southern Hudspeth Highlands-Rio Grande Valley
of Eastern El Paso/Western Hudspeth Counties-Rio Grande Valley of
Eastern Hudspeth County-
740 AM MDT Wed May 2 2018

This Hazardous Weather Outlook is for portions of south central
New Mexico, southwest New Mexico, and southwest Texas.

.DAY ONE...Today and Tonight
Winds gusting around 50 mph most areas this afternoon and this
evening. Wind gusts may exceed 60 mph over isolated
locations...mainly along eastern facing mountain slopes and through
mountain passes. Blowing dust may reduce the visibility to less than
2 miles over a few locations including along portions of Interstate
10 between El Paso and las Cruces and also around Deming and
Lordsburg.

A few showers and thunderstorms will be possible this afternoon,
around the Gila Wilderness region. Any showers or storms that
develop will produce little rainfall, but may produce gusty winds
and "dry" lightning strikes.
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Figure 26. Hazardous Weather Outlook message issued by the NWS El Paso office on May 2, 2018, concerning the upcoming blowing dust.

Transport of Event Emissions to the Relevant PM Monitor

Evidence to demonstrate that the high wind dust events transported PM to the Socorro Hueco monitor, including analysis of continuous PM and meteorological data, HYSPLIT back-trajectories, satellite imagery, and maps of PM concentrations, are provided in the narrative conceptual model and Appendices B and C.

Spatial Relationship Between the Event, PM Sources, Transport of Emissions, and Recorded Concentrations

Information to help establish the relevant spatial relationships during the event, including area maps of the origin of the high wind dust event, wind direction, anthropogenic/natural PM source locations, monitor locations, and measured PM concentrations are discussed throughout the demonstration document.

Temporal Relationship Between the High Wind and Elevated PM Concentrations

The continuous data time series plots in the narrative conceptual model and Appendices B and C establish the concurrent relationship between the high winds and elevated PM concentrations for both events.

Speciation Data: Chemical Composition and/or Size Distribution

Speciation data profiles shown in Table 4 provide supporting evidence that the particulate compositions were different than "normal" compositions on the event days. Specifically, a significant portion of the PM on both event days was comprised of crustal material that included components consistent with natural soils.

Comparison of Event-Affected Days to Other High Wind Days without Elevated Concentrations

To illustrate the impact these windblown dust events have on the El Paso area versus local anthropogenic dust, the TCEQ conducted an analysis comparing the event days to other high wind days without elevated PM_{10} concentrations in 2017 and 2018. Specifically, this comparative analysis focused on identifying days with wind speed and wind direction measurements comparable to event days, but without visible evidence of widespread blowing dust on webcam imagery. Late fall through spring days with peak area hourly wind speeds above 25 mph, daily resultant wind directions representing a west to southwesterly flow, and a daily wind direction standard deviation of less than 40 degrees (to ensure non-varying winds comparable to the event days) were targeted for the analysis. Webcam imagery from Ranger Peak recorded during the hour with the highest daytime continuous PM_{10} measurement at Socorro was then reviewed for the presence of visible dust. Finally, daily average particulate matter measurements were evaluated for those days without visible dust in the El Paso area. Table 6 provides four representative days where wind speed, wind direction, and wind direction standard deviation are comparable to the event days. Figures 27 through 30 provide the corresponding Ranger Peak webcam images. On each of the identified days, the daily average PM_{10} measurements were significantly less than each of the flagged event days when windblown dust plumes were advecting out of northern Mexico. This analysis provides additional supporting evidence that measured concentrations on the flagged event days were not the result of local anthropogenic sources in the El Paso area, but were instead caused by the long range transport of widespread dust from Mexico.

Table 6. Socorro Hueco particulate matter and El Paso area wind measurements on days with high winds but low particulate matter concentrations.

Day	PM_{10} FRM	PM_{10} C	WDR	PkWnd	StDev	Pk1HrPM_{10}C	Hour
04/25/17	188	166	261	28	21	468	1100-1200 MST
05/02/18	158	134	254	27	38	434	1800-1900 MST
01/21/17	--	11	273	34	32	27	1600-1700 MST
03/06/17	--	35	261	33	31	99	0900-1000 MST
04/08/18	49	46	282	30	20	113	1200-1300 MST
12/26/18	--	17	248	35	29	12	1600-1700 MST

Notes:

The two shaded rows at the top of the table are the flagged event days for comparison. A "--" indicates that a non-continuous PM_{10} FRM sample was not scheduled for that day.

Abbreviations:

PM_{10} FRM – non-continuous FRM daily average in µg/m³ LC at Socorro.

PM_{10} C - continuous daily average in µg/m³ LC at Socorro.

WDR - daily wind direction resultant in degrees from north at Socorro.

PkWnd - peak area 1-hour average wind speed in mph.

StDev – wind direction standard deviation at Socorro.

Pk1HrPM_{10}C – peak continuous hourly PM_{10} measurement at Socorro.

Hour – hour of peak continuous hourly PM_{10} measurement in MST.

Figure 27. Ranger Peak webcam image showing no evidence of widespread dust plumes in the El Paso area at 1616 MST on January 21, 2017, during the hour with the highest daytime PM_{10} concentration at Socorro.

Figure 28. Ranger Peak webcam image showing no evidence of widespread dust plumes in the El Paso area at 0931 MST on March 6, 2017, during the hour with the highest daytime PM_{10} concentration at Socorro.

Figure 29. Ranger Peak webcam image showing no evidence of widespread dust plumes in the El Paso area at 1222 MST on April 8, 2018, during the hour with the highest daytime PM_{10} concentration at Socorro.

Figure 30. Ranger Peak webcam image showing no evidence of widespread dust plumes in the El Paso area at 1615 MST on December 26, 2018, during the hour with the highest daytime PM_{10} concentration at Socorro.

Assessment of Possible Alternative Causes for the Relevant PM Exceedances or Violations

Figure 20 in the Natural and Anthropogenic Source Contributions section shows that the significant non-event PM sources were not upwind of the Socorro monitor on the event days. Additionally, the nRCP analysis describes the implementation and enforcement of high wind dust control measures that were in place at the time of the events. Collectively, this evidence establishes the unlikelihood of potential anthropogenic causes of the relevant PM exceedances at Socorro.

Comparison of Event-Related Concentrations to Historical Concentrations

The 2016 EER requires that states compare the event-related concentration to historical concentrations. This section was prepared in accordance with the High Wind Dust Event Guidance document (April 4, 2019). The information also serves as an important basis for the clear causal relationship criteria.

<u>Comparison of Concentrations on the Claimed Event Days with Past Historical Data</u>

Figure 31 shows the valid daily measurements of PM_{10} at Socorro for the period from 2014 through 2018 along with the level of the PM_{10} 24-hour NAAQS. The proposed 2017 and 2018 exceptional event days are circled in red. This figure demonstrates that flagged measurements on each event day were well outside of normal historical fluctuations in measured particulate concentrations for the El Paso area.

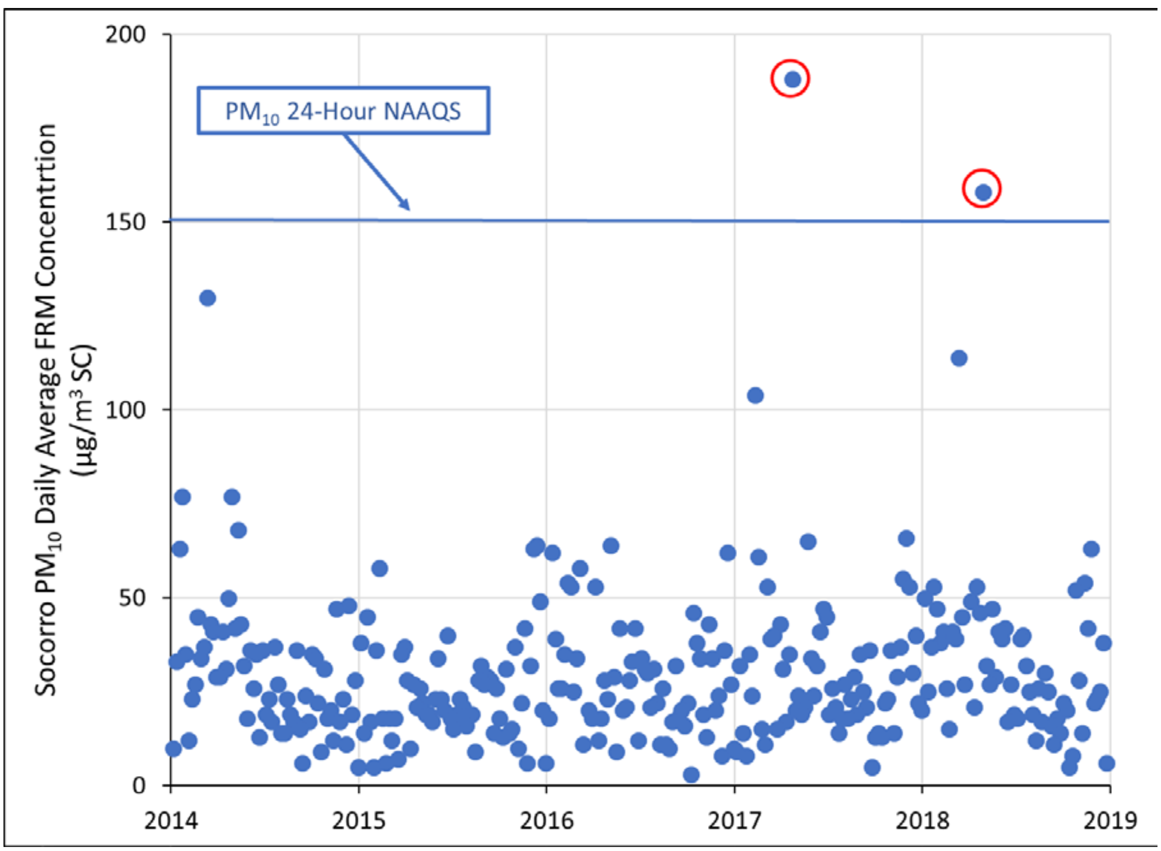

Figure 31. Socorro FRM PM_{10} daily measurements from 2014 through 2018, with proposed exceptional event days circled in red.

Spatial and Temporal Variability of PM_{10} in El Paso

PM_{10} data across El Paso for the days before and after each flagged event day are presented in Tables 7 and 8. This information highlights the significant impacts of windblown dust events associated with specific meteorological conditions on the flagged event days and demonstrates the spatial and temporal variability of PM_{10} in El Paso.

Table 7. El Paso area PM_{10} daily average measurements (μg/m³) by site before and after the April 25, 2017, proposed exceptional event day.

Date	Socorro FRM	Socorro C	Ivanhoe FRM	UTEP C	Riverside FRM	Van Buren FRM	Ojo de Agua FRM
04/19/2017	35	32	15	34	24	19	15
04/20/2017	--	33	--	28	--	--	--
04/21/2017	--	26	--	26	--	--	--
04/22/2017	--	31	--	33	--	--	--
04/23/2017	--	16	--	21	--	--	--
04/24/2017	--	72	--	58	--	--	--
04/25/2017	**188**	**166**	**79**	**150**	**111**	**86**	**119**
04/26/2017	--	31	--	35	--	--	--
04/27/2017	--	64	--	62	--	--	--
04/28/2017	--	76	--	69	--	--	--
04/29/2017	--	14	--	14	--	--	--
04/30/2017	--	10	--	11	--	--	--
05/01/2018	20	19	10	20	16	7	9

Bold shading indicates proposed exceptional event day measurements.
FRM - Federal Reference Method monitor PM_{10} concentration (μg/m³).
C - continuous monitor PM_{10} concentration (μg/m³).
-- - sample collection was not scheduled for listed day.

Table 8. El Paso area PM_{10} daily average measurements (µg/m³) by site before and after the May 2, 2018, proposed exceptional event day.

Date	Socorro FRM	Socorro C	Ivanhoe FRM	UTEP C	Riverside FRM	Van Buren FRM	Ojo de Agua FRM
04/26/2018	46	46	31	49	40	48	36
04/27/2018	--	26	--	43	--	--	--
04/28/2018	--	27	--	40	--	--	--
04/29/2018	--	23	--	29	--	--	--
04/30/2018	--	35	--	36	--	--	--
05/01/2018	--	44	--	40	--	--	--
05/02/2018	**158**	**134**	**86**	**159**	**127**	**134**	**138**
05/03/2018	--	26	--	28	--	--	--
05/04/2018	--	22	--	30	--	--	--
05/05/2018	--	22	--	29	--	--	--
05/06/2018	--	20	--	24	--	--	--
05/07/2018	--	31	--	43	--	--	--
05/08/2018	32	30	17	35	34	43	28

Bold shading indicates proposed exceptional event day measurements.
FRM - Federal Reference Method monitor PM_{10} concentration (µg/m³).
C - continuous monitor PM_{10} concentration (µg/m³).
-- - sample collection was not scheduled for listed day.

Percentile Ranking

The flagged PM_{10} concentrations during the proposed exceptional event days were the two highest measurements during the five year period from 2014 through 2018. During this period there were 302 valid daily measurements, which places the exceptional event days above the 99th percentile at the Socorro Hueco site and demonstrates that the measurements were well above normal historical fluctuations.

Clear Causal Relationship Conclusion

On April 25, 2017, and May 2, 2018, a high wind dust event occurred that generated PM_{10} and resulted in elevated concentrations at the Socorro Hueco monitoring site in El Paso. The monitored PM_{10} concentrations of 188 µg/m³ and 158 µg/m³, respectively, were the two highest measurements during the five year period from 2014 through 2018, placing them within the top one percent of all measurements. The elevated concentrations were the result of widespread and overwhelming blowing dust transported from northern Mexico associated with large low pressure systems featuring strong west-southwesterly winds in El Paso.

The comparisons and analyses, provided in both the narrative conceptual model and clear causal relationship sections of this demonstration, support the TCEQ's position that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored PM_{10} exceedances at the Socorro Hueco monitoring site on April 25, 2017, and May 2, 2018, and thus satisfies the clear causal relationship criteron.

Mitigation of Exceptional Events

Title 40 CFR § 51.930 requires that "a State requesting to exclude air quality data due to exceptional events must take appropriate and reasonable actions to protect public health from exceedances or violations of the national ambient air quality standards." Three specific requirements are described in this regulation and are addressed individually below. Examples of each of the web pages identified below can be found in Appendix D.

Prompt Public Notification

The first requirement is to "provide for prompt public notification whenever air quality concentrations exceed or are expected to exceed an applicable ambient air quality standard." The TCEQ provides ozone, $PM_{2.5}$, and PM_{10} AQI forecasts for the current day and the next three to four days for 15 areas in Texas, including El Paso. These forecasts are available to the public on the Today's Texas Air Quality Forecast web page of the TCEQ Web site (http://www.tceq.texas.gov/airquality/monops/forecast_today.html) (TCEQ2, 2019) and on the EPA AIRNOW Web site (http://airnow.gov/) (EPA3, 2019). The Today's Texas Air Quality web page forecast discussions for each event day are quoted below:

> Tuesday 04/25/2017
> *Strong afternoon winds will generate and transport areas of blowing dust into parts of West Texas and the Panhandle, where the duration and intensity of the dust may be enough for the overall daily PM10 AQI to reach "Unhealthy" levels in the El Paso area and "Moderate" in the Lubbock and Midland-Odessa areas, with highest concentrations in the afternoon and evening hours.*

> Wednesday 05/02/2018
> *Strong afternoon and evening winds should generate and transport at time intense blowing dust into far West Texas and lighter amounts of patchy blowing dust into the Panhandle, possibly raising the daily PM10 AQI to "Unhealthy for Sensitive Groups" in parts of the El Paso area and the upper end of the "Good" range in the Amarillo and Lubbock. Associated elevated PM2.5 levels in far West Texas could also reach the "Moderate" range as well.*

The TCEQ also provides near real-time hourly PM_{10} and $PM_{2.5}$ measurements from monitors across the state, including El Paso, that are available to the public on the Airborne Particulates web page of the TCEQ Web site (https://www.tceq.texas.gov/cgi-bin/compliance/monops/particulates.pl) (TCEQ3, 2019). Finally, the TCEQ publishes an AQI Report on the Air Quality Index Web page of the TCEQ

Web site (https://www.tceq.texas.gov/cgi-bin/compliance/monops/aqi_rpt.pl) (TCEQ4, 2019) that displays the latest and historical daily AQI measurements. These measures allow the public to assess forecast, current, and past PM_{10} and $PM_{2.5}$ air quality levels.

Public Education

The second requirement is to "provide for public education concerning actions that individuals may take to reduce exposures to unhealthy levels of air quality during and following an exceptional event." Links to TCEQ and EPA Web pages describing recommended actions for individuals to reduce exposure to $PM_{2.5}$ whenever it is high (EPA2, 2019) are included on TCEQ web displays of forecast and measured AQI levels, including TCEQ's Air Pollution from Particulate Matter web page (http://www.tceq.texas.gov/airquality/sip/criteria-pollutants/sip-pm) and EPA's AQI - A Guide to Air Quality and Your Health web page (http://www.airnow.gov/index.cfm?action=aqibasics.aqi). EPA also provides similar links on the AIRNOW Web pages where TCEQ forecasts and current data are displayed.

The TCEQ also pursues outreach and educational opportunities in the El Paso area through work with the Paso Del Norte Joint Advisory Committee and through public informational meetings. The Joint Advisory Committee holds monthly meetings that are open to the public and are attended by TCEQ staff.

Implement Measures to Protect Public Health

The third requirement is to "provide for the implementation of appropriate measures to protect public health from exceedances or violations of ambient air quality standards caused by exceptional events." Since 1991, the TCEQ and the City of El Paso have implemented dust control measures in the El Paso area as part of the PM_{10} SIP and its revisions for El Paso as previously described in more detail under "Attainment Status and Control Measures" in the "Not Reasonably Controllable or Preventable" section.

TCEQ Mitigation Plan

On December 28, 2018, the EPA determined that the TCEQ had met the requirement to develop a Mitigation Plan (https://www.tceq.texas.gov/assets/public/compliance/Texas-Mitigation-Plan-Final.pdf) for El Paso County for $PM_{2.5}$ due to historic recurrences of exceptional events due to high winds. See Treatment of Data Influenced by Exceptional Events, 81 Fed. Reg. 68216, 68272-73 (Oct. 3, 2016) for a list of areas required to develop Mitigation Plans. While the development of this Mitigation Plan was required specifically due to recurrent $PM_{2.5}$

exceptional events, the items included also pertain to PM_{10}. The Mitigation Plan outlines the following components that apply to El Paso County:

- 40 CFR §51.930(a)(1-3) and §51.930(b)(2): Public notification and education programs for affected or potentially affected communities;
- 40 CFR §51.930(b)(2)(ii): Steps to identify, study and implement mitigating measures;
- 40 CFR §51.930(b)(2)(iii): Provisions for review and evaluation of the mitigation plan and its implementation and effectiveness by the air agency and all interested stakeholders (e.g., public and private land owners/managers, air quality, agriculture and forestry agencies, the public).

Conclusion

The information provided in this document demonstrates that the two proposed exceptional event flags for PM_{10} data at the Socorro Hueco site during 2017 and 2018 meet all of the requirements for exceptional events. The elevated levels of PM_{10} transported into the El Paso area on these days were heavily impacted by blowing dust caused by regional high winds, were not reasonably controllable or preventable, and were due to natural events. As indicated by satellite imagery, back trajectories, webcam imagery, and measurement statistics, high wind blowing dust clearly caused exceedances of the 24-hour PM_{10} NAAQS on the proposed days. Measured PM_{10} concentrations on these days were well above the 99^{th} percentile of historical measurements and thus affected air quality in excess of normal historical fluctuations. The TCEQ therefore requests EPA's concurrence on these exceptional event flags and to have the associated measurements removed from consideration when making compliance determinations for the 24-hour PM_{10} NAAQS.

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Appendix A: Proposed El Paso PM_{10} Exceptional Event Flags and Initial Notification

Initial Notification Process

The TCEQ submitted an initial notification to EPA Region 6 and engaged in discussions with its EPA Regional office regarding the demonstration prior to formal submittal. Copies of the initial notification letter and EPA's response are provided below in Figures A-1 and A-2.

Jon Niermann, *Chairman*
Emily Lindley, *Commissioner*
Toby Baker, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

July 23, 2019

Mr. Jeffery J. Robinson
Branch Chief, Air Permits, Monitoring & Grants Branch
U.S. Environmental Protection Agency (EPA) Region 6
1201 Elm Street, Suite 500 (ARPM)
Dallas, TX 75270-2102

Subject: Initial Notification of a Potential Exceptional Event

Dear Mr. Robinson:

This letter serves as formal notification that the Texas Commission on Environmental Quality (TCEQ) will develop and submit a demonstration to exclude 2017 and 2018 PM_{10} air monitoring data influenced by exceptional events pursuant to 40 CFR Parts 50 and 51. This demonstration will address the following high wind dust events which occurred at site 48-141-0057 (Socorro Hueco) for parameter 81102 (PM_{10}):

Date	Type of Event	AQS Flag*	Exceedance Concentration
04/25/2017	High Winds	RJ	188 $\mu g/m^3$
05/02/2018	High Winds	RJ	158 $\mu g/m^3$

**currently entered in AQS as Informational Flag 'IJ - High Winds'*

The data requested for exclusion has regulatory significance and affects the regulatory determination concerning the portion of El Paso County in which the Socorro Hueco air monitoring site is located, which falls just outside the area officially designated as Nonattainment by EPA against the 1987 PM_{10} National Ambient Air Quality Standard (NAAQS). The TCEQ looks forward to working with EPA Region 6 to establish a timeframe for the demonstration.

If you need any additional information, please contact me at (512) 239-0885.

Sincerely,

Cindy Maresh

Cindy Maresh
Manager, Data Management Section, Monitoring Division

P.O. Box 13087 • Austin, Texas 78711-3087 • 512-239-1000 • tceq.texas.gov

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Figure A-1. TCEQ initial notification letter to EPA Region 6 regarding intent to develop this demonstration.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1201 ELM STREET, SUITE 500
DALLAS, TEXAS 75270 – 2102

July 26, 2019

Ms. Cindy Maresh
Manager, Data Management Section, Monitoring Division
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Dear Ms. Maresh:

Thank you for the initial notification letter dated July 23, 2019, regarding the planned submittal of Exceptional Events Demonstrations for particulate matter less than 10 micrometers in diameter (PM_{10}) exceedances which occurred during 2017 and 2018 in the El Paso area. Your letter listed two measurements from the Socorro Hueco monitor (AQS ID 48-141-0057-81102-1) which are in excess of the PM_{10} National Ambient Air Quality Standard level of 150 μm^3. We understand the Texas Commission on Environmental Quality believes the exceedances were caused by High Wind Dust events. The PM_{10} exceedances listed in the letter were:

Date	PM_{10} Measurement $\mu g/m^3$	AQS Flag
4/25/2017	188	rj, high winds
5/2/2018	158	rj, high winds

Please submit the Exceptional Event Demonstrations by November 15, 2019, after a 30-day public notice period. We appreciate all your efforts to run an effective ambient air monitoring program and look forward to reviewing the Demonstrations. Please call Frances Verhalen at 214-665-2172, if you have any questions.

Sincerely,

7/26/2019

X Jeff Robinson

Jeff Robinson

Signed by: JEFFERY ROBINSON

Jeff Robinson
Branch Chief
Air Permits, Monitoring & Grants Branch

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Figure A-2. EPA Region 6 response letter to initial notification for this demonstration.

Proposed El Paso PM_{10} Exceptional Event Flags

Table A-1. Proposed 2017 and 2018 El Paso PM_{10} Exceptional Event Flags.

Date	Site ID	Site Name	POC	PM_{10}	Flag	Flag Description
04/25/2017	481410057	Socorro Hueco	1	188	RJ	High winds – regional blowing dust
05/02/2018	481410057	Socorro Hueco	1	158	RJ	High winds – regional blowing dust

Abbreviations:
Site ID - EPA site identification number
POC - EPA Parameter Occurrence Code
PM_{10} - daily average concentration in micrograms per cubic meter standard conditions ($\mu g/m^3$ SC)

Appendix B: Event Analysis for April 25, 2017

Event Summary

A strong low pressure system centered in southwestern Oklahoma with a secondary surface low in northern New Mexico brought strong west to southwest winds across a large region from New Mexico and Arizona into northern Mexico and West Texas on April 25, 2017. Figure B-1 shows a weather map for April 25, 2017, at 1400 MST provided by NOAA depicting the large low pressure system.

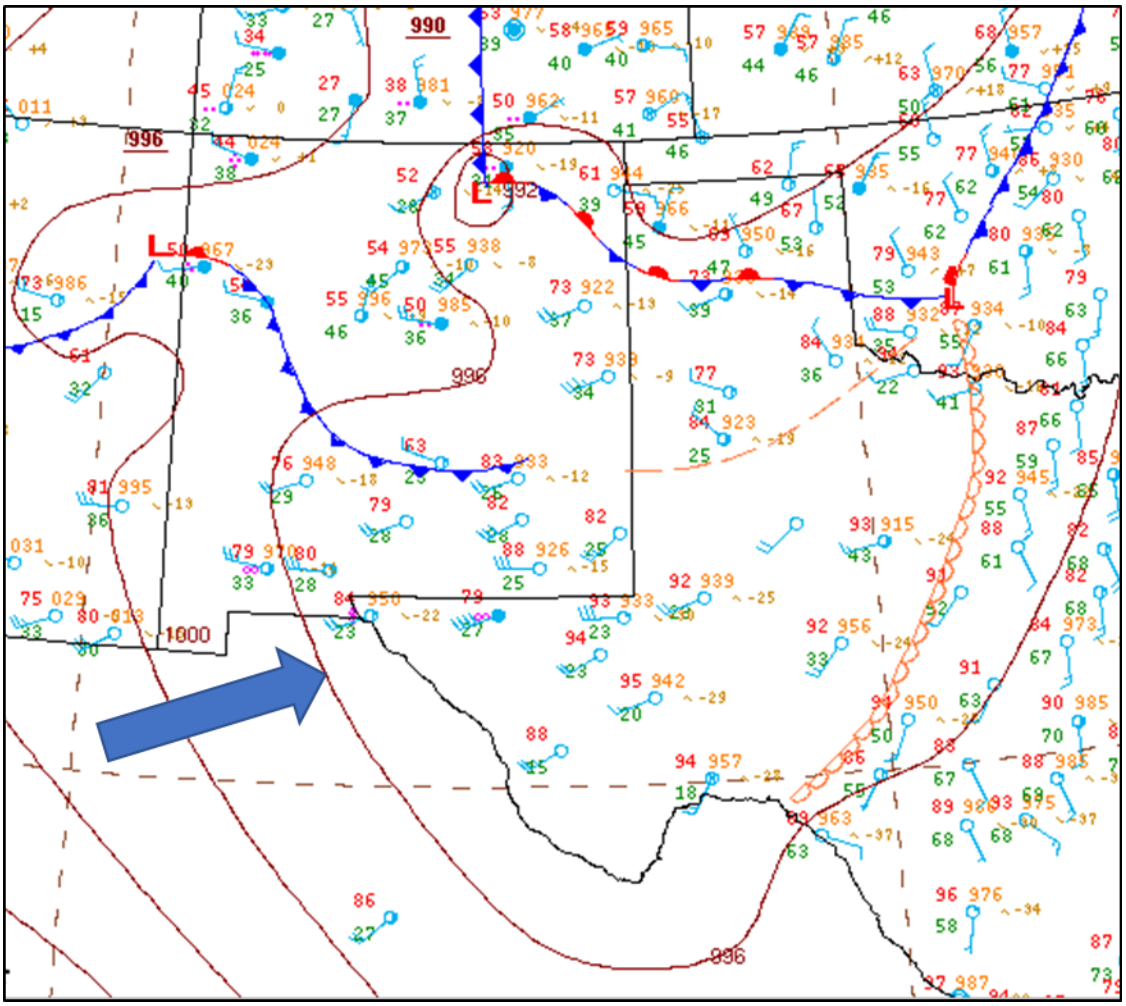


Figure B-1. Regional weather map for 1400 MST on April 25, 2017.

On the weather map, winds are shown in blue with wind blowing along the line toward each weather station indicated by a circle. Barbs at the end of each wind vector indicate the wind speed with a full barb for 10 nautical miles per hour (knots) and a half barb for 5 knots and the wind speed is the sum of the values shown with the individual barbs. Wind direction in the El Paso area is indicated by a large arrow.

High winds associated with the low pressure system generated a large area of blowing dust in northern Mexico that began impacting the El Paso area in the mid-morning and continued in pulses through the afternoon. High particulate matter concentrations were measured across the area from just before 1000 to 1900 MST, peaking between 1100 and 1500 MST. Area peak wind gusts reached 57 mph, peak two-minute sustained winds at the El Paso International Airport reached 47 mph, peak area five-minute sustained winds at TCEQ air monitoring sites reached 33 mph, and peak area hourly sustained winds reached 28 mph.

An exceptional event flag is proposed for the Socorro FRM PM_{10} measurement of 188 $\mu g/m^3$ on this day. The collocated continuous PM_{10} monitor measured a daily average of 166 $\mu g/m^3$ and a peak one-hour average of 468 $\mu g/m^3$ for the hour beginning 1100 MST. The hourly average PM_{10} concentration was above the 24-hour NAAQS of 150 $\mu g/m^3$ for twelve consecutive hours beginning with the 0900 MST hour and the average wind direction during this period was from 263 degrees (west-southwest) at an average speed of 17.5 mph. The peak measured wind gust at Socorro was 44.9 mph and the highest five-minute average wind speed was 25.5 mph.

Webcam Images

The El Paso Ranger Peak webcam provided visual images of the dust impacting the El Paso area on April 25, 2017. A map of the webcam locations was previously presented in Figure 13.

Figure B-2 shows the Ranger Peak webcam views at 0815 MST when dust levels were low compared to the 1245 MST view with intense blowing dust near the peak of the event. Downtown El Paso and the Juarez Mountains are clearly visible in the 0815 MST frame, but are only dimly visible because of the intense blowing dust in the 1245 MST frame.

Figure B-2. El Paso Ranger Peak webcam images for 0815 MST (top) and 1245 MST (bottom) on April 25, 2017.

Satellite Imagery

Satellite imagery visibly illustrates the widespread dust generated by high winds in northern Mexico and blowing east-northeastward into the El Paso area. Figure B-3 shows two true color composite MODIS visible wavelength images of the El Paso area from the polar orbiting Terra satellite. The top image is from a clear day with no dust on April 22, 2017, at approximately 1055 MST. The bottom image is the same view on April 25, 2017, at approximately 1125 MST as the event was beginning when numerous dust plumes began blowing east-northeastward from northern Mexico into the El Paso area. In Figure B-3, El Paso is circled in red in the upper right side of each image and the Texas and Mexico boundaries are marked by blue colored lines.

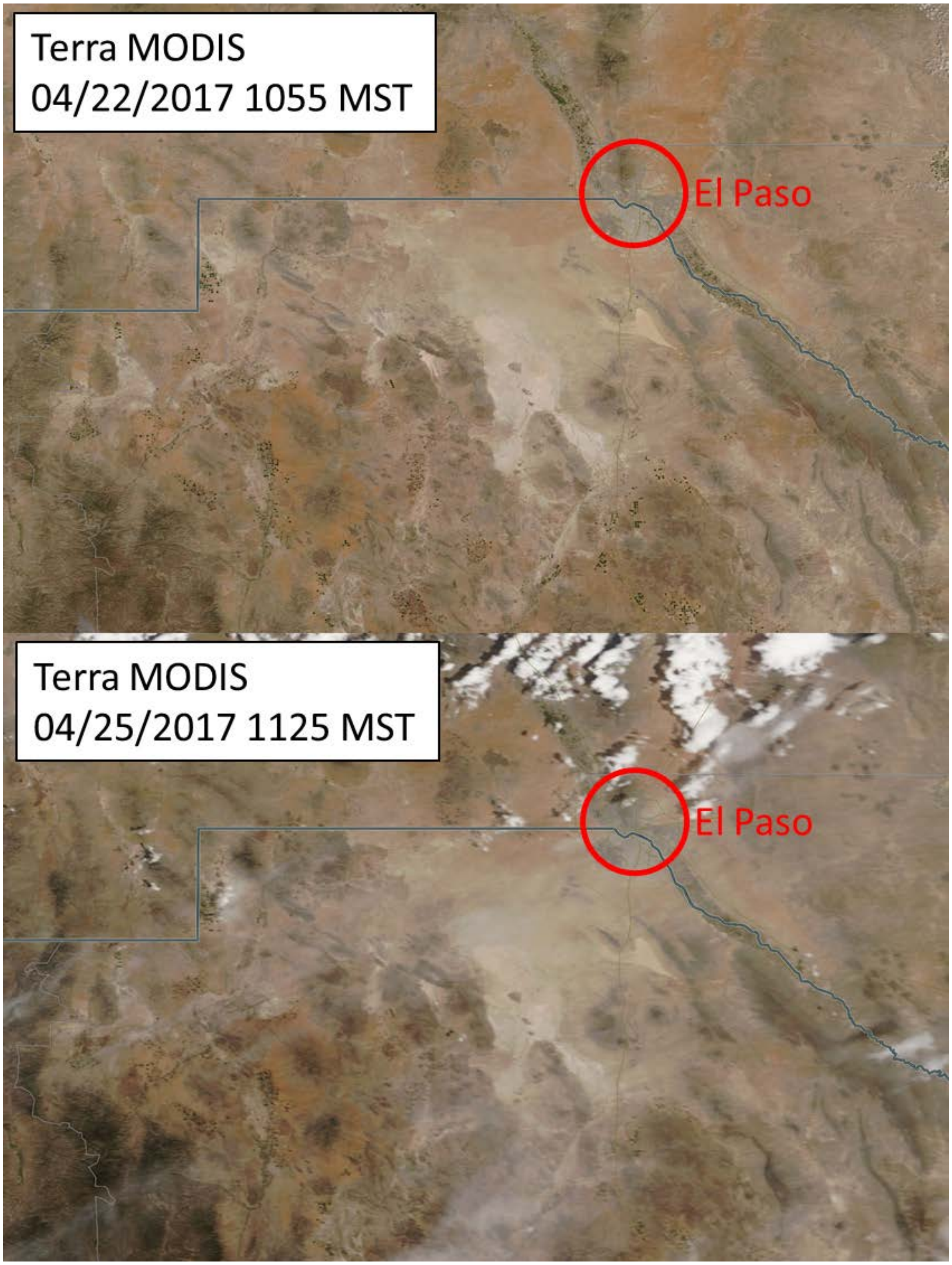


Figure B-3. True color Terra satellite images showing widespread dust plumes originating in northern Mexico blowing towards El Paso at 1125 MST on April 25, 2017, in the bottom frame compared to a dust-free view at 1055 MST on April 22, 2017, in the top frame.

Back Trajectories

Figure B-4 provides HYSPLIT back trajectory paths plotted for air arriving at 10 meters, 100 meters, and 1,000 meters above ground level going backward in time 12 hours showing the approximate path for air arriving air arriving at the Socorro site at 1100 MST (1800 UTC) on April 25, 2017. These trajectories provide evidence that the air arriving at the Socorro site at the time of the highest PM_{10} levels on April 25, 2017, originated from northern Mexico.

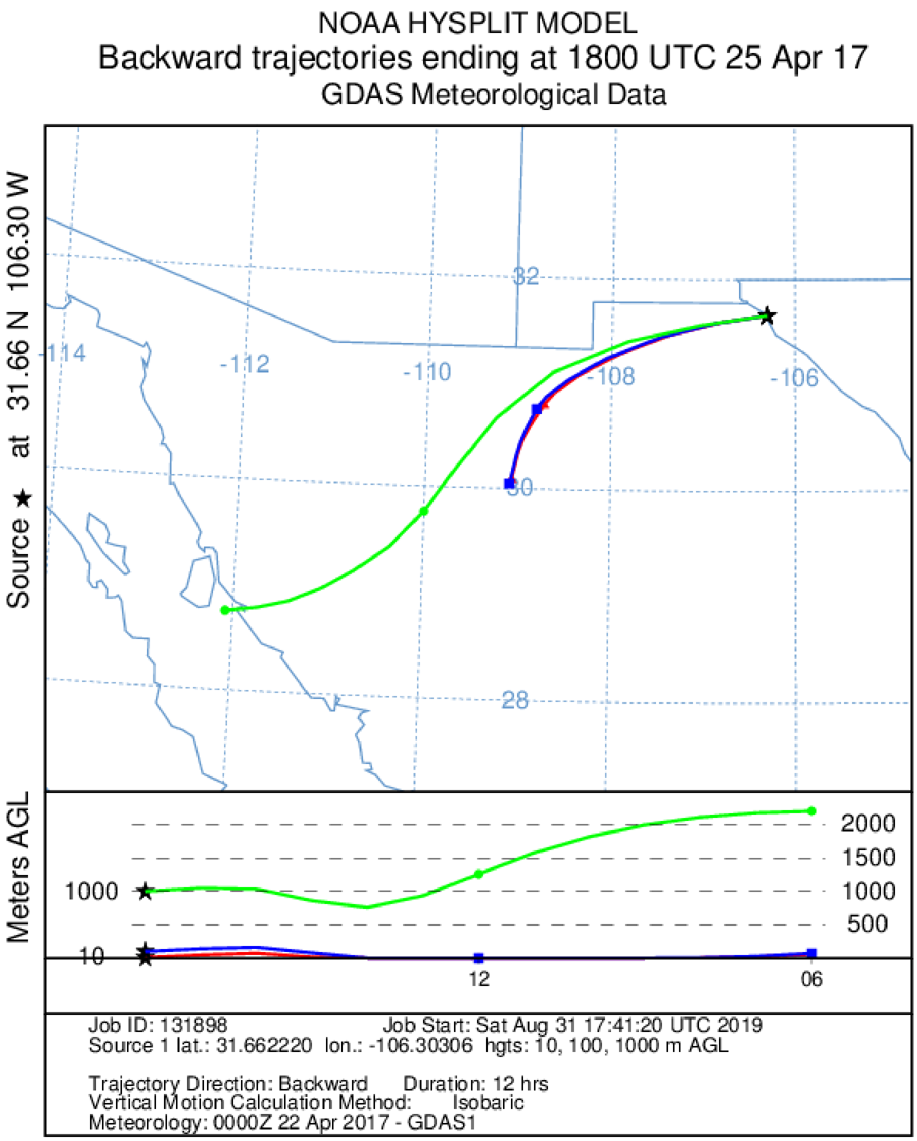


Figure B-4. Backward-in-time air trajectory for April 25, 2017, for air arriving at Socorro at 1100 MST (1800 UTC).

Map Plots of Daily Particulate Matter Data

The following maps display daily average PM_{10} and $PM_{2.5}$ measurements from the April 25, 2017, event. Figure B-5 shows the daily average PM_{10} measurements, including the Socorro measurement proposed as an exceptional event, while Figure B-6 shows the daily average $PM_{2.5}$ measurements. The highest PM_{10} measurements were at sites along the border with Mexico, indicating transport of very high incoming background levels from the west and southwest.

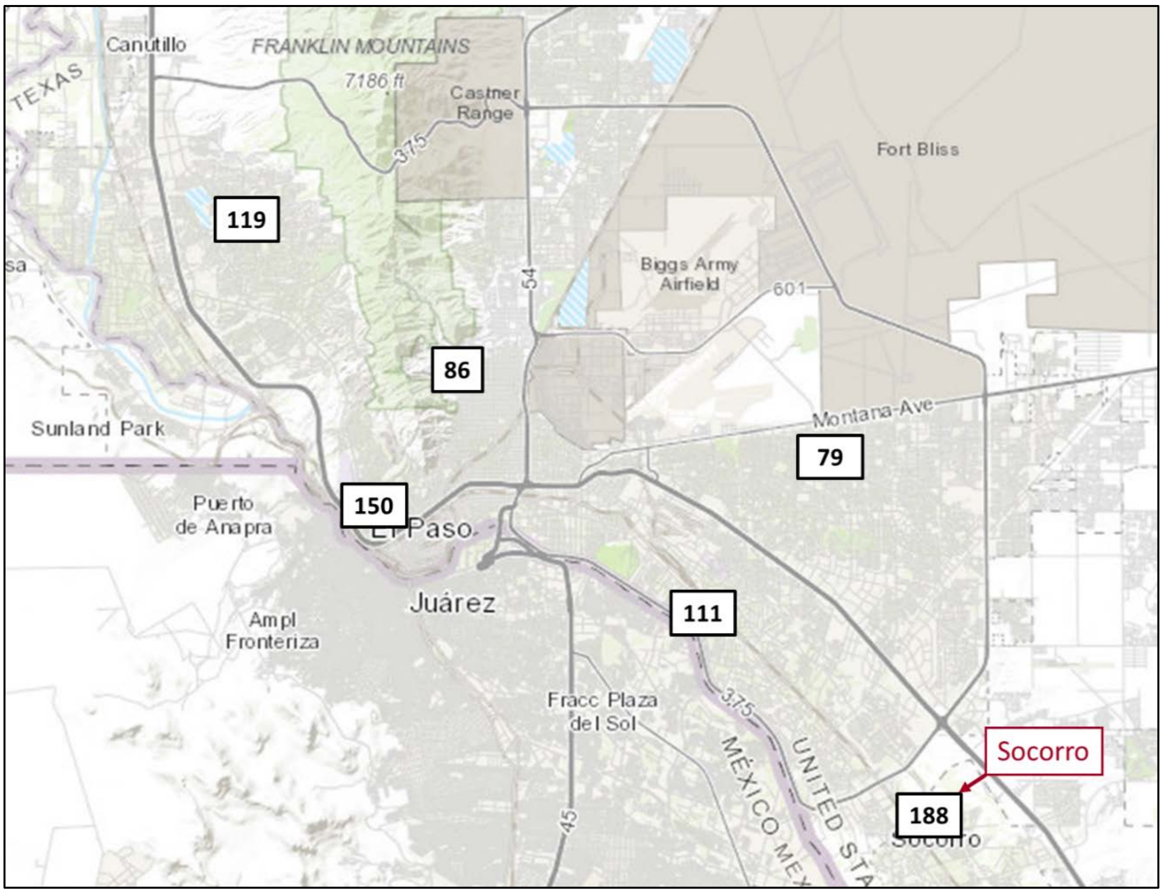


Figure B-5. Map of El Paso area daily average PM_{10} measurements (µg/m³ SC) on April 25, 2017.

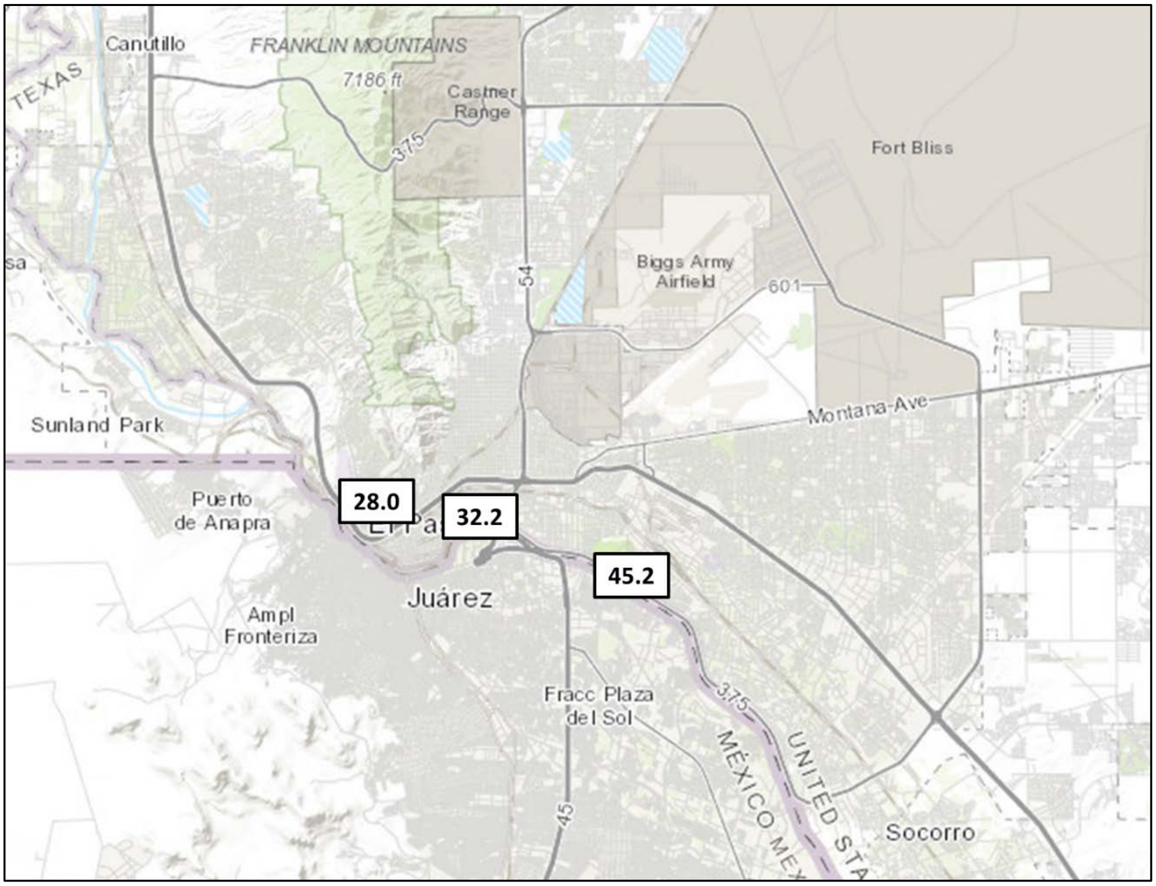


Figure B-6. Map of El Paso area daily average $PM_{2.5}$ measurements (µg/m^3 LC) on April 25, 2017.

Continuous Particulate Matter and Wind Graphs

Figure B-7 plots continuous five-minute PM_{10} data from two sites in the El Paso area against peak sustained five-minute wind speeds for the April 25, 2017, event. The plotted data show relatively strong winds occurring nearly all day, with sustained winds consistently above 20 mph between about 0400 MST and 2100 MST. There is a gradual rise in PM_{10} early in the morning with the first sharp rise and peak at Socorro occurring just before 1000 MST, with another somewhat sustained peak between 1100-1200 MST followed by the highest peak between 1400 MST and 1500 MST. The timing of these sharp rises through the mid-day hours in association with the highest winds is consistent with the arrival of multiple pulses of transported dust plumes.

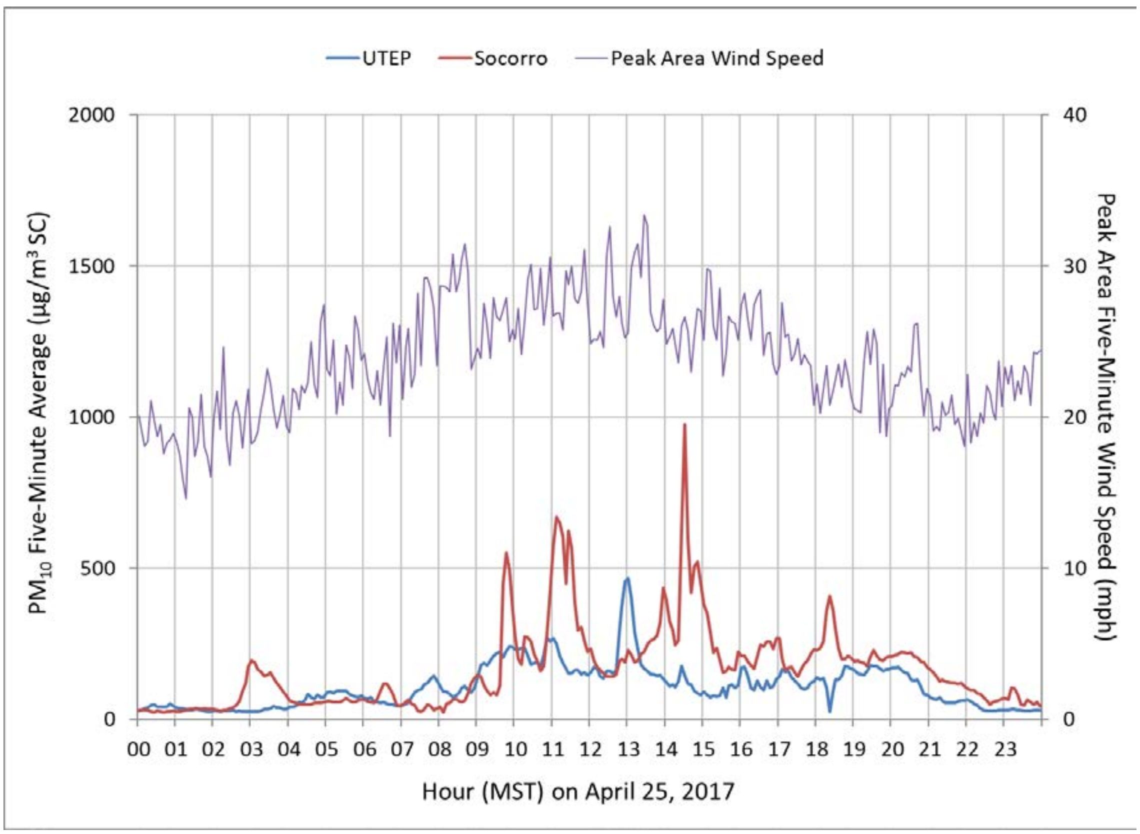


Figure B-7. El Paso five-minute average PM_{10} concentrations from continuous monitors on April 25, 2017.

Appendix C: Event Analysis for May 2, 2018

Event Summary

A strong low pressure system centered over the Oklahoma Panhandle with a secondary surface low in northern New Mexico/southern Colorado brought strong west to southwest winds to portions of New Mexico and West Texas along and just behind an advancing cold front on May 2, 2018. Figure C-1 shows a weather map for May 2, 2018, at 1700 MST provided by NOAA depicting the large low pressure system and cold front.

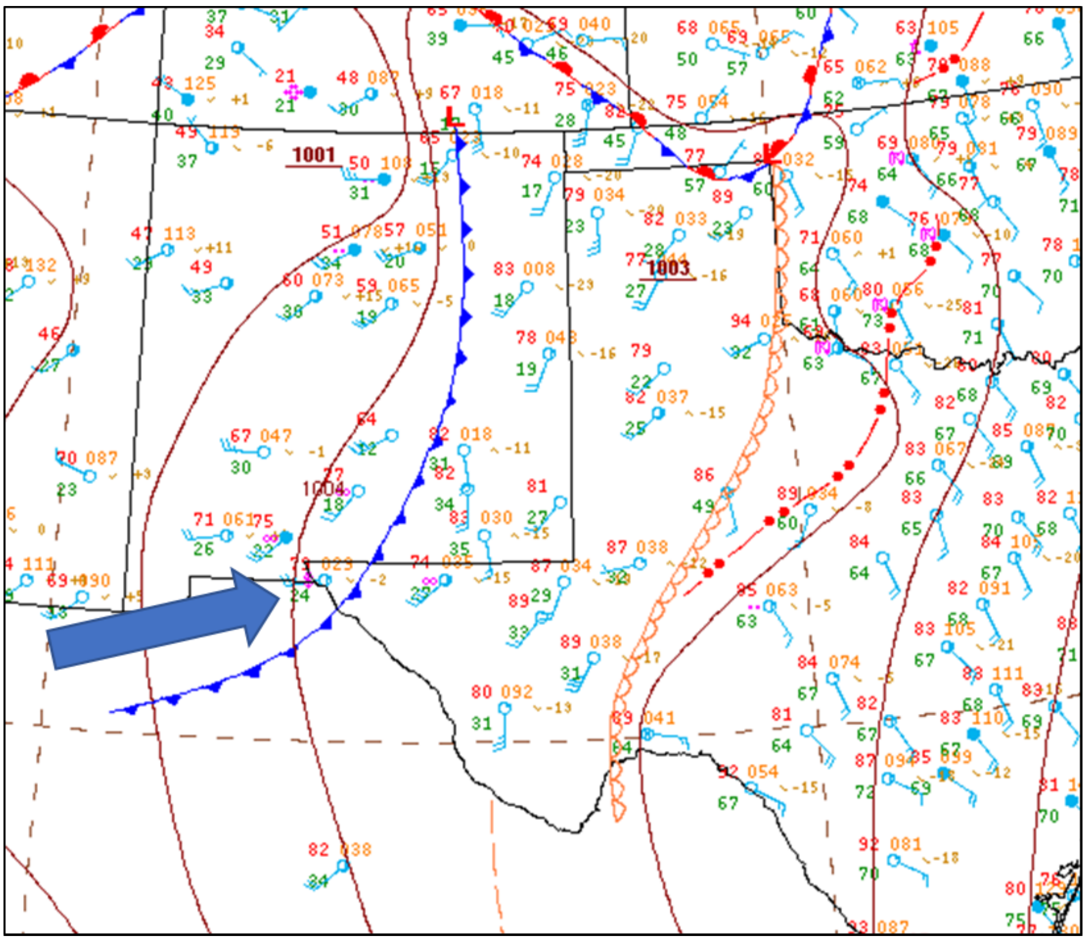


Figure C-1. Regional weather map for 1700 MST on May 2, 2018.

On the weather map, winds are shown in blue with wind blowing along the line toward each weather station indicated by a circle. Barbs at the end of each wind vector indicate the wind speed with a full barb for 10 nautical miles per hour (knots) and a half barb for 5 knots and the wind speed is the sum of the values shown with the individual barbs. Wind direction in the El Paso area is indicated by a large arrow.

High winds associated with the low pressure system and frontal boundary generated a large area of blowing dust in northern Mexico that began impacting the El Paso area in the early afternoon and peaked in intensity by the late afternoon and into the evening with the passage of a strong cold front. High particulate matter concentrations were measured across the area beginning just after 1300 MST and continuing until approximately 2000 MST. Area peak wind gusts reached 50 mph, peak two-minute sustained winds at the El Paso International Airport reached 40 mph, peak area five-minute sustained winds at TCEQ air monitoring sites reached 31 mph, and peak area hourly sustained winds reached 27 mph.

An exceptional event flag is proposed for the Socorro FRM PM_{10} measurement of 158 $\mu g/m^3$ on this day. The collocated continuous PM_{10} monitor measured a daily average of 134 $\mu g/m^3$ and a peak one-hour average of 434 $\mu g/m^3$ for the hour beginning 1800 MST. The hourly average PM_{10} concentration was above the 24-hour NAAQS of 150 $\mu g/m^3$ for seven consecutive hours beginning with the 1300 MST hour, and the average wind direction during this period was from 263 degrees (west-southwest) at an average speed of 14.8 mph. The peak measured wind gust at Socorro was 37.8 mph and the highest five-minute average wind speed was 18.9 mph.

Webcam Images

The El Paso Ranger Peak webcam provided visual images of the dust impacting the El Paso area on May 2, 2018. A map of the webcam locations was previously presented in Figure 13.

Figure C-2 shows the Ranger Peak webcam views at 1115 MST when dust levels were low compared to the 1900 MST view with intense blowing dust near the peak of the event. Downtown El Paso and the Juarez Mountains are clearly visible in the 1115 MST frame, but are completely obscured because of the intense blowing dust in the 1900 MST frame.

Figure C-2. El Paso Ranger Peak webcam images for 1115 MST (top) and 1900 MST (bottom) on May 2, 2018.

Satellite Imagery

Satellite imagery for this event is less obvious, due in part to both the increased cloudiness associated with the frontal system and the timing of the most intense dust that occurred early in the evening during the 1800 MST hour, well after the last polar-orbiting high resolution satellite overpass of the day (the Suomi-NPP VIIRS satellite at approximately 1330 MST). However, the VIIRS imagery nevertheless depicts early phases of the dust being generated by high winds in northern Mexico (visible beneath and between areas of cloud cover) and beginning to blow east-northeastward toward the El Paso area. Figure C-3 shows two true color composite Suomi-NPP satellite images. The top image is from a clear day with no dust on May 4, 2018, at approximately 1330 MST (two days after the event). The bottom image is the same view on May 2, 2018, at approximately 1330 MST as blowing dust begins to obscure views of the ground beneath the cloud cover several hours before arriving in El Paso. In Figure C-3, El Paso is circled in red in the upper right side of each image and the Texas and Mexico boundaries are marked by blue colored lines.

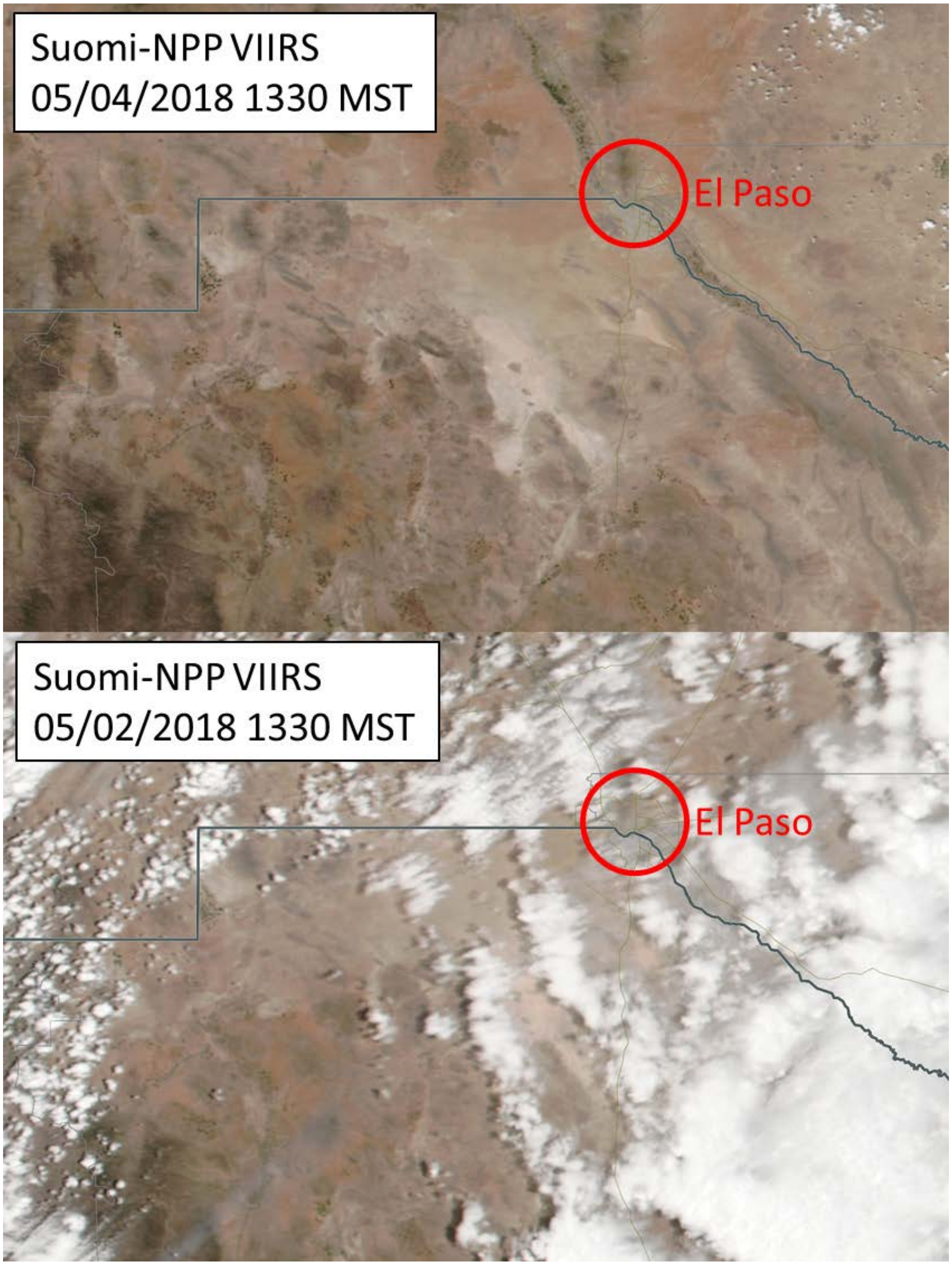


Figure C-3. True color Suomi-NPP VIIRS satellite image evidence of dust plumes originating in northern Mexico blowing towards El Paso at approximately 1330 MST on May 2, 2018, in the bottom frame compared to a dust-free view at approximately 1330 MST on May 4, 2018, in the top frame.

Back Trajectories

Figure C-4 provides HYSPLIT back trajectory paths plotted for air arriving at 10 meters, 100 meters, and 1,000 meters above ground level going backward in time 12 hours showing the approximate path for air arriving air arriving at the Socorro site at 1800 MST on May 2, 2018 (0100 UTC on May 3, 2018). These trajectories provide evidence that the air arriving at the Socorro site at the time of the highest PM_{10} levels on May 2, 2018, originated from northern Mexico.

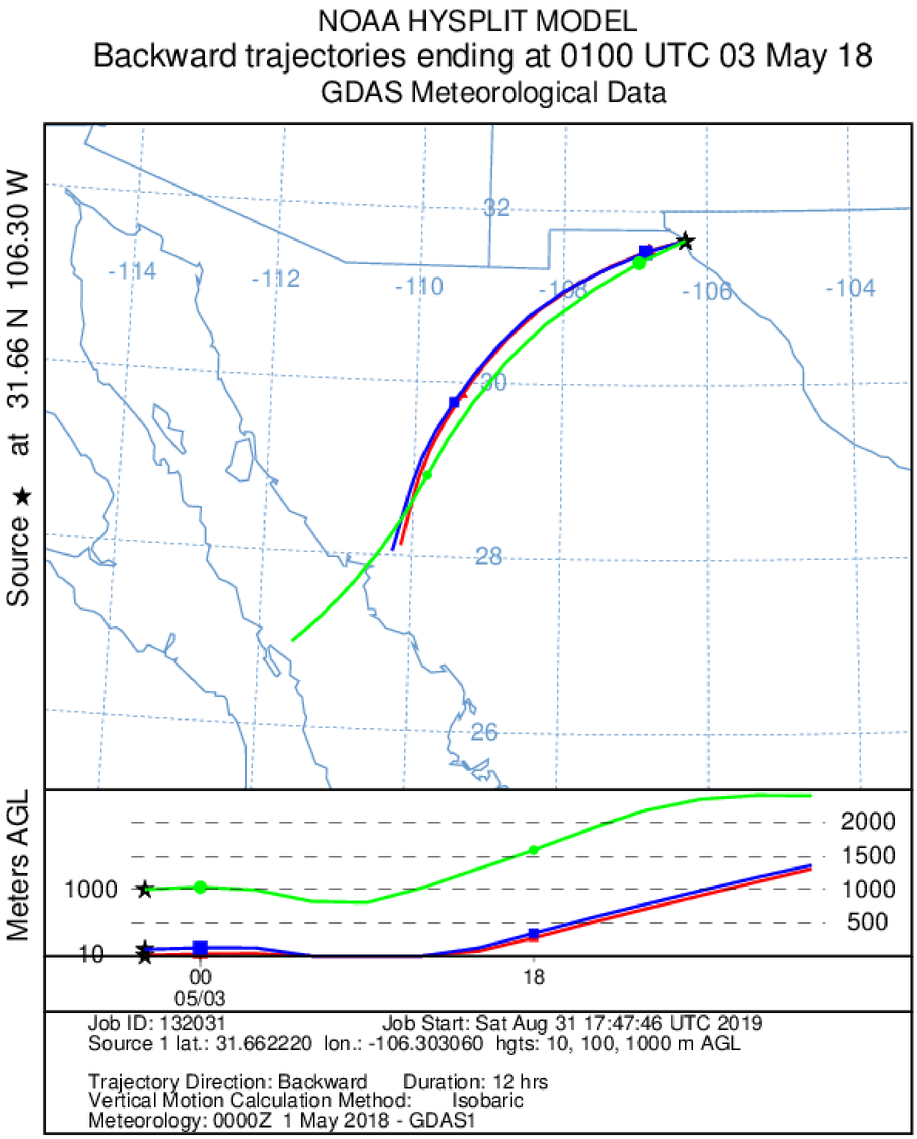


Figure C-4. Backward-in-time air trajectory for May 2, 2018, for air arriving at Socorro at 1800 MST (May 3, 2018, 0100 UTC).

Map Plots of Daily Particulate Matter Data

The following maps display daily average PM_{10} and $PM_{2.5}$ measurements from the May 2, 2018, event. Figure C-5 shows the daily average PM_{10}

measurements, including the Socorro measurement proposed as an exceptional event, while Figure C-6 shows the daily average $PM_{2.5}$ measurements. The highest PM_{10} measurements were at sites along the border with Mexico and decreased moving to the east, indicating transport of very high incoming background levels from the west and southwest.

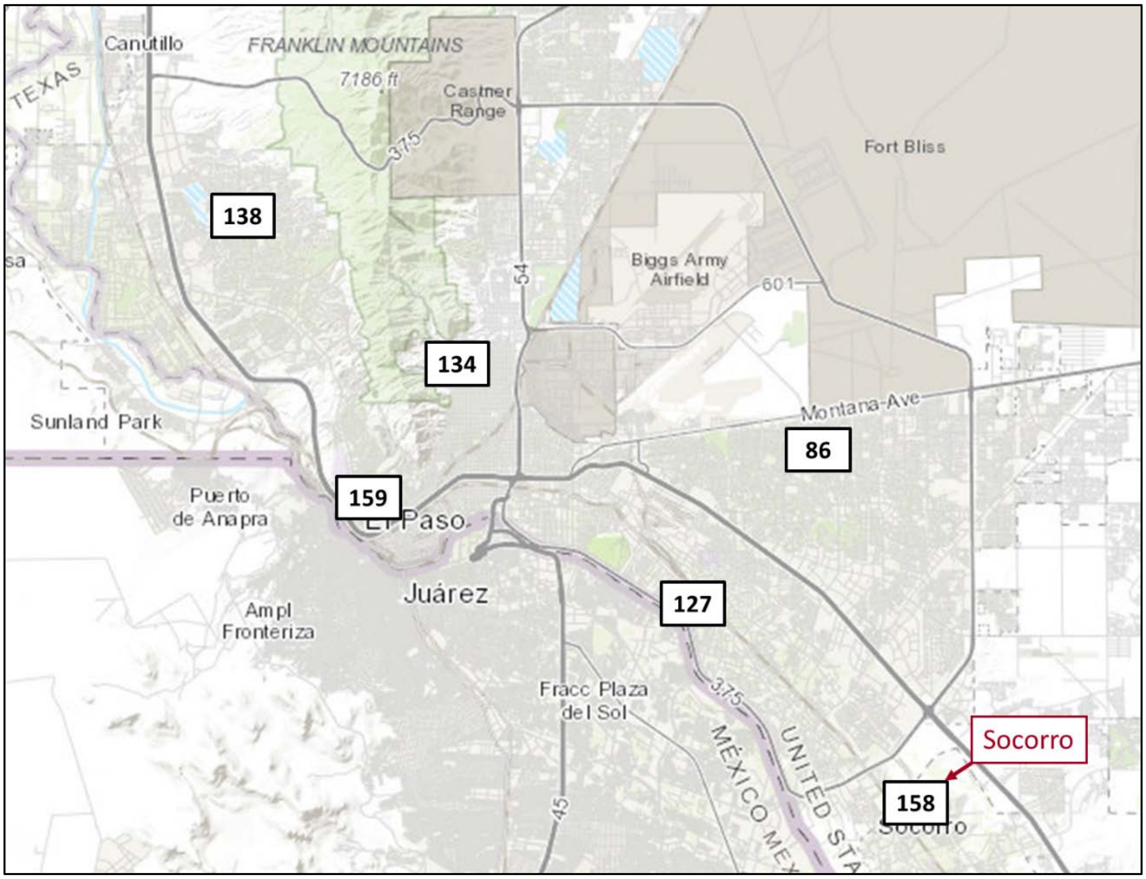


Figure C-5. Map of El Paso area daily average PM_{10} measurements (µg/m^3 SC) on May 2, 2018.

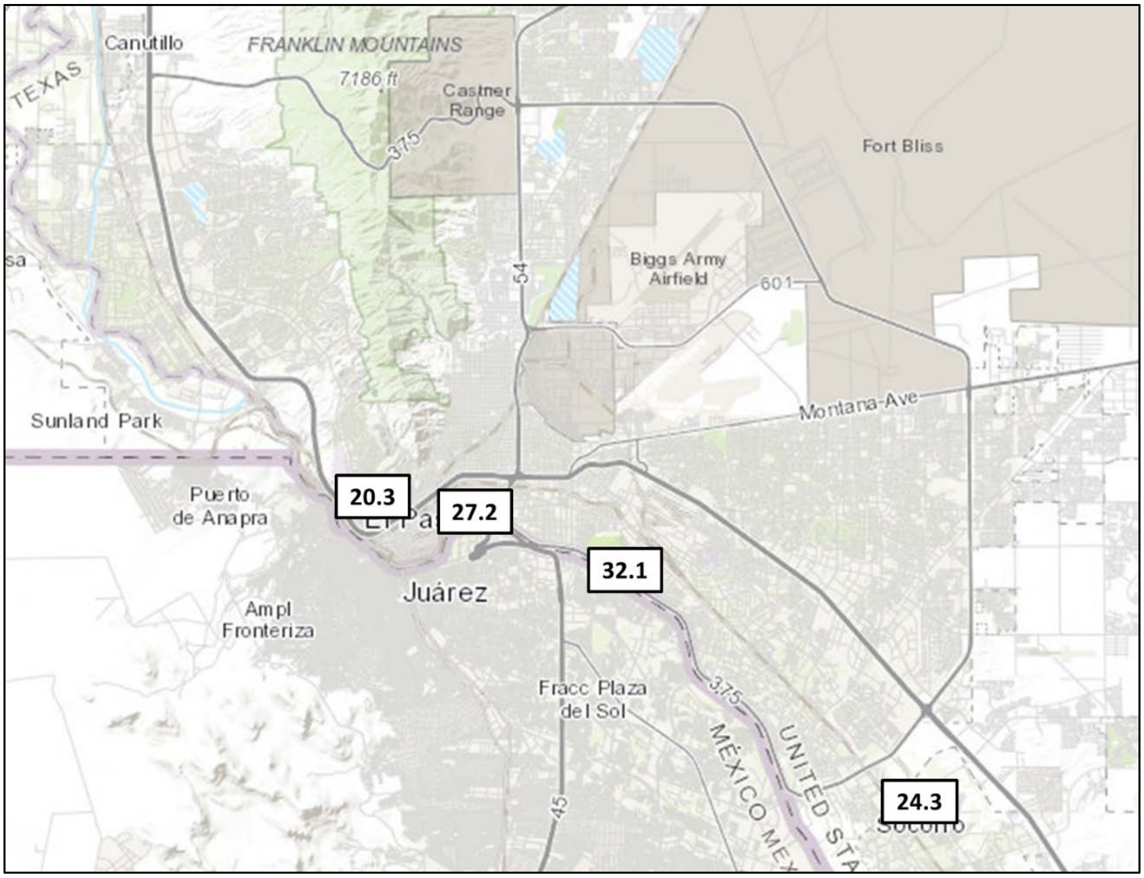


Figure C-6. Map of El Paso area daily average $PM_{2.5}$ measurements (µg/m^3 LC) on May 2, 2018.

Continuous Particulate Matter and Wind Graphs

Figure C-7 plots continuous five-minute PM_{10} data from two sites in the El Paso area against peak sustained five-minute wind speeds for the May 2, 2018, event. The plotted data show a sudden increase in winds around 1300 MST, after which sustained winds remained consistently between 20 and 30 mph until 2000 MST. PM_{10} levels also began to steadily increase beginning at 1300 MST before peaking during the 1800 MST hour when winds were at their peak as well. The coincident timing of PM_{10} levels throughout the afternoon in association with the highest winds is consistent with the arrival of a transported dust plume.

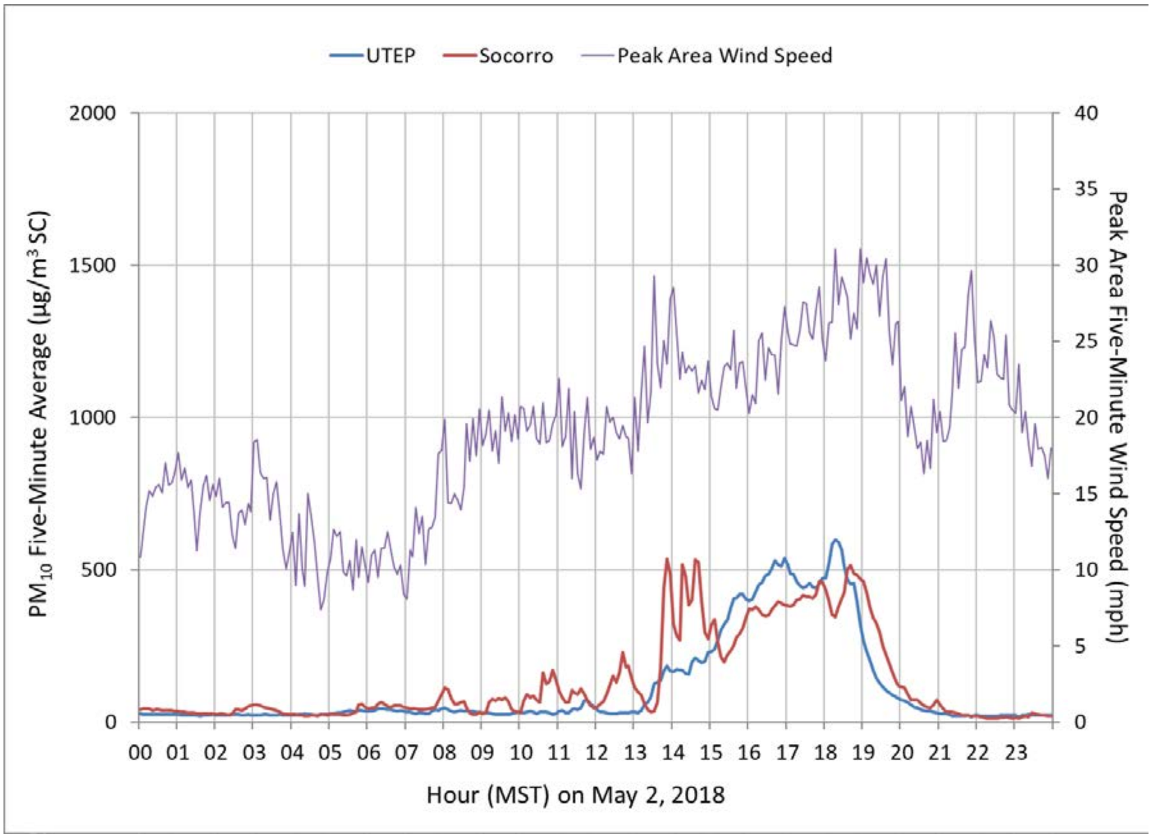
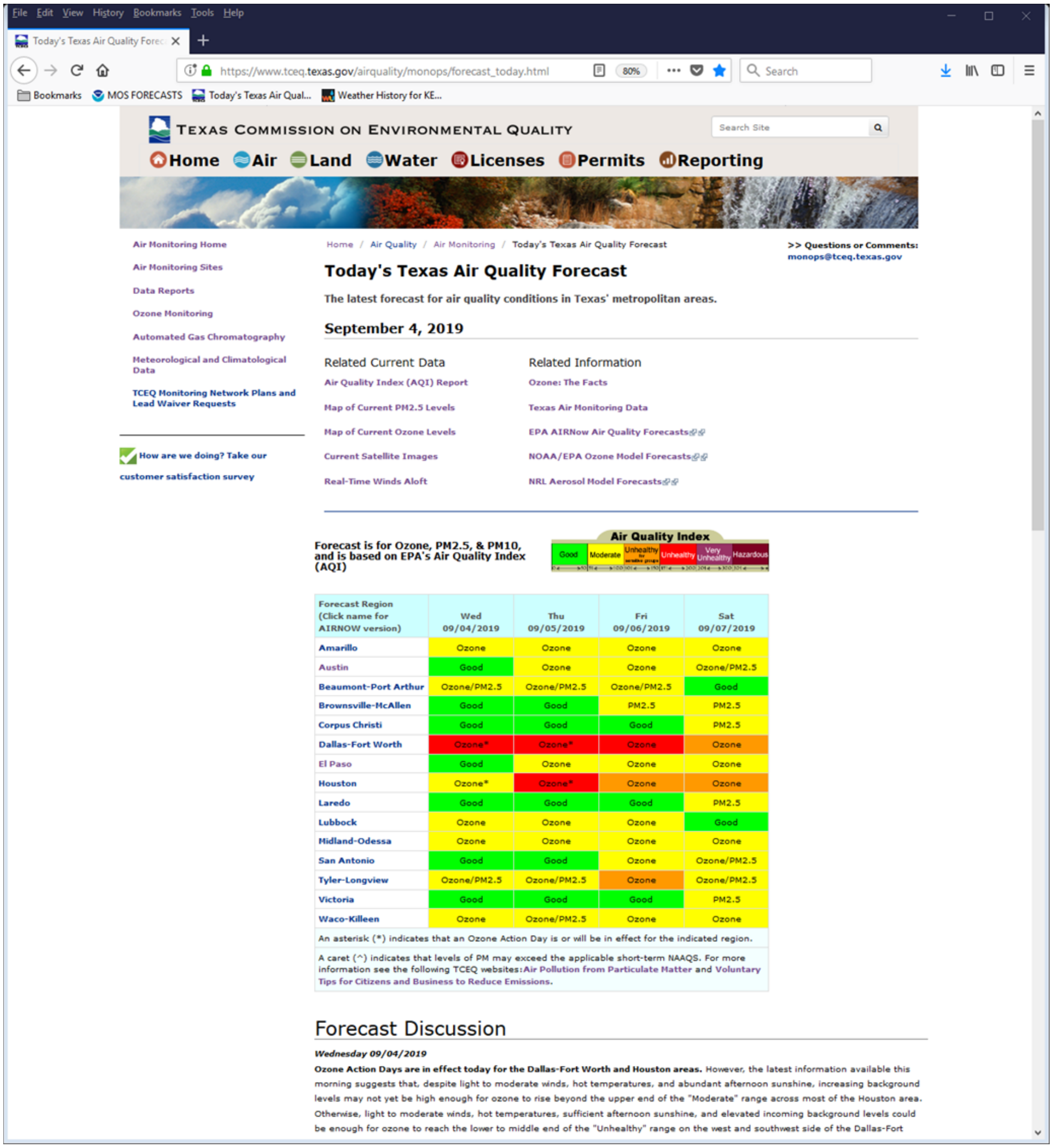


Figure C-7. El Paso five-minute average PM_{10} concentrations from continuous monitors on May 2, 2018.

Appendix D: Web Page Examples

Figures D-1 through D-6 show examples of web pages cited by links in the Mitigation of Exceptional Events section.



Texas Commission on Environmental Quality

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Automated Gas Chromatography
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>> Questions or Comments: monops@tceq.texas.gov

Today's Texas Air Quality Forecast

The latest forecast for air quality conditions in Texas' metropolitan areas.

September 4, 2019

Related Current Data
- Air Quality Index (AQI) Report
- Map of Current PM2.5 Levels
- Map of Current Ozone Levels
- Current Satellite Images
- Real-Time Winds Aloft

Related Information
- Ozone: The Facts
- Texas Air Monitoring Data
- EPA AIRNow Air Quality Forecasts
- NOAA/EPA Ozone Model Forecasts
- NRL Aerosol Model Forecasts

Forecast is for Ozone, PM2.5, & PM10, and is based on EPA's Air Quality Index (AQI)

Air Quality Index: Good, Moderate, Unhealthy for sensitive groups, Unhealthy, Very Unhealthy, Hazardous

Forecast Region (Click name for AIRNOW version)	Wed 09/04/2019	Thu 09/05/2019	Fri 09/06/2019	Sat 09/07/2019
Amarillo	Ozone	Ozone	Ozone	Ozone
Austin	Good	Ozone	Ozone	Ozone/PM2.5
Beaumont-Port Arthur	Ozone/PM2.5	Ozone/PM2.5	Ozone/PM2.5	Good
Brownsville-McAllen	Good	Good	PM2.5	PM2.5
Corpus Christi	Good	Good	Good	PM2.5
Dallas-Fort Worth	Ozone*	Ozone*	Ozone	Ozone
El Paso	Good	Ozone	Ozone	Ozone
Houston	Ozone*	Ozone*	Ozone	Ozone
Laredo	Good	Good	Good	PM2.5
Lubbock	Ozone	Ozone	Ozone	Good
Midland-Odessa	Ozone	Ozone	Ozone	Ozone
San Antonio	Good	Good	Ozone	Ozone/PM2.5
Tyler-Longview	Ozone/PM2.5	Ozone/PM2.5	Ozone	Ozone/PM2.5
Victoria	Good	Good	Good	PM2.5
Waco-Killeen	Ozone	Ozone/PM2.5	Ozone	Ozone

An asterisk (*) indicates that an Ozone Action Day is or will be in effect for the indicated region.

A caret (^) indicates that levels of PM may exceed the applicable short-term NAAQS. For more information see the following TCEQ websites: Air Pollution from Particulate Matter and Voluntary Tips for Citizens and Business to Reduce Emissions.

Forecast Discussion

Wednesday 09/04/2019

Ozone Action Days are in effect today for the Dallas-Fort Worth and Houston areas. However, the latest information available this morning suggests that, despite light to moderate winds, hot temperatures, and abundant afternoon sunshine, increasing background levels may not yet be high enough for ozone to rise beyond the upper end of the "Moderate" range across most of the Houston area. Otherwise, light to moderate winds, hot temperatures, sufficient afternoon sunshine, and elevated incoming background levels could be enough for ozone to reach the lower to middle end of the "Unhealthy" range on the west and southwest side of the Dallas-Fort

Figure D-1. Sample of a portion of the TCEQ Today's Texas Air Quality Forecast webpage.

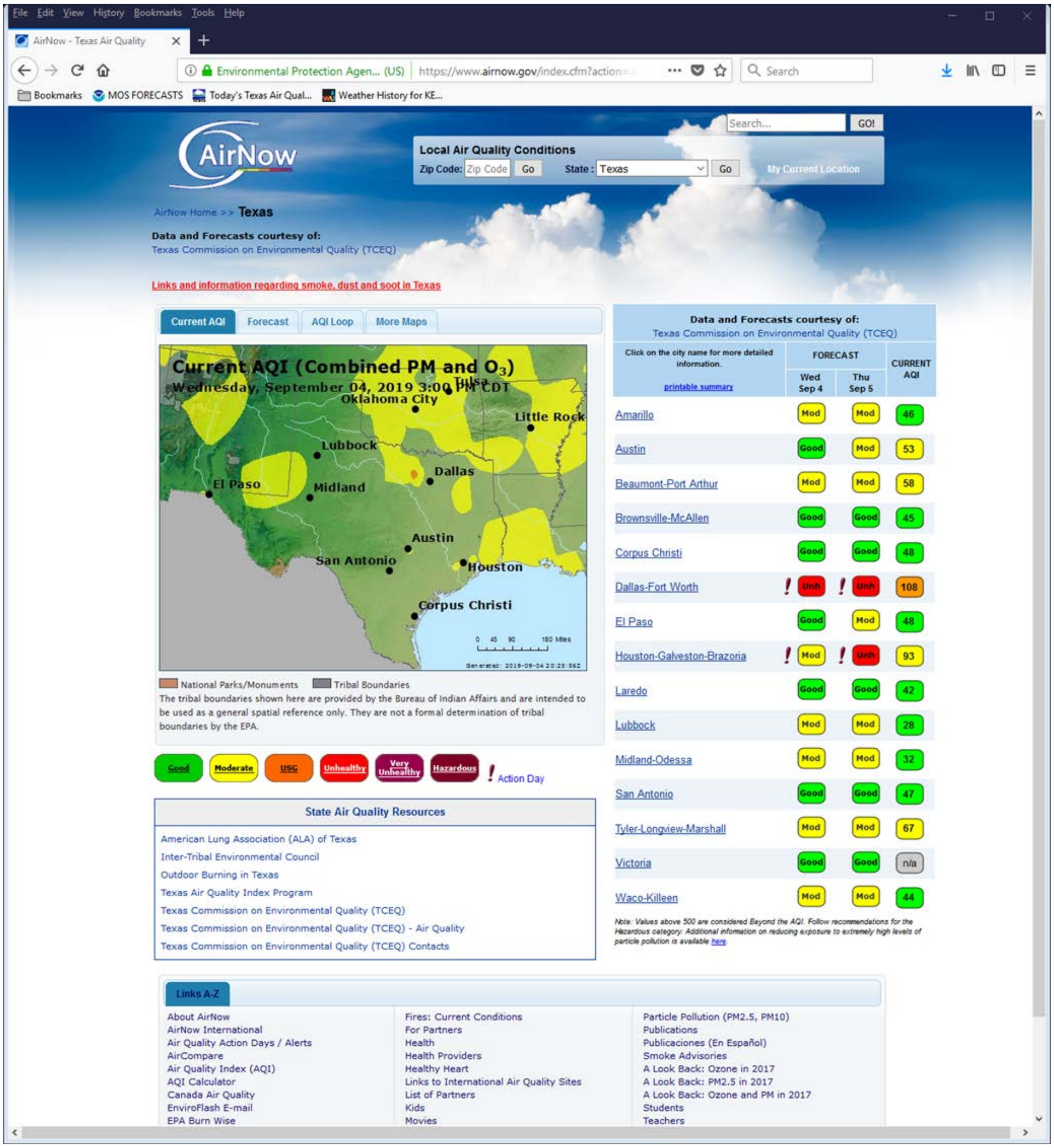


Figure D-2. Sample of the EPA AIRNOW web page.

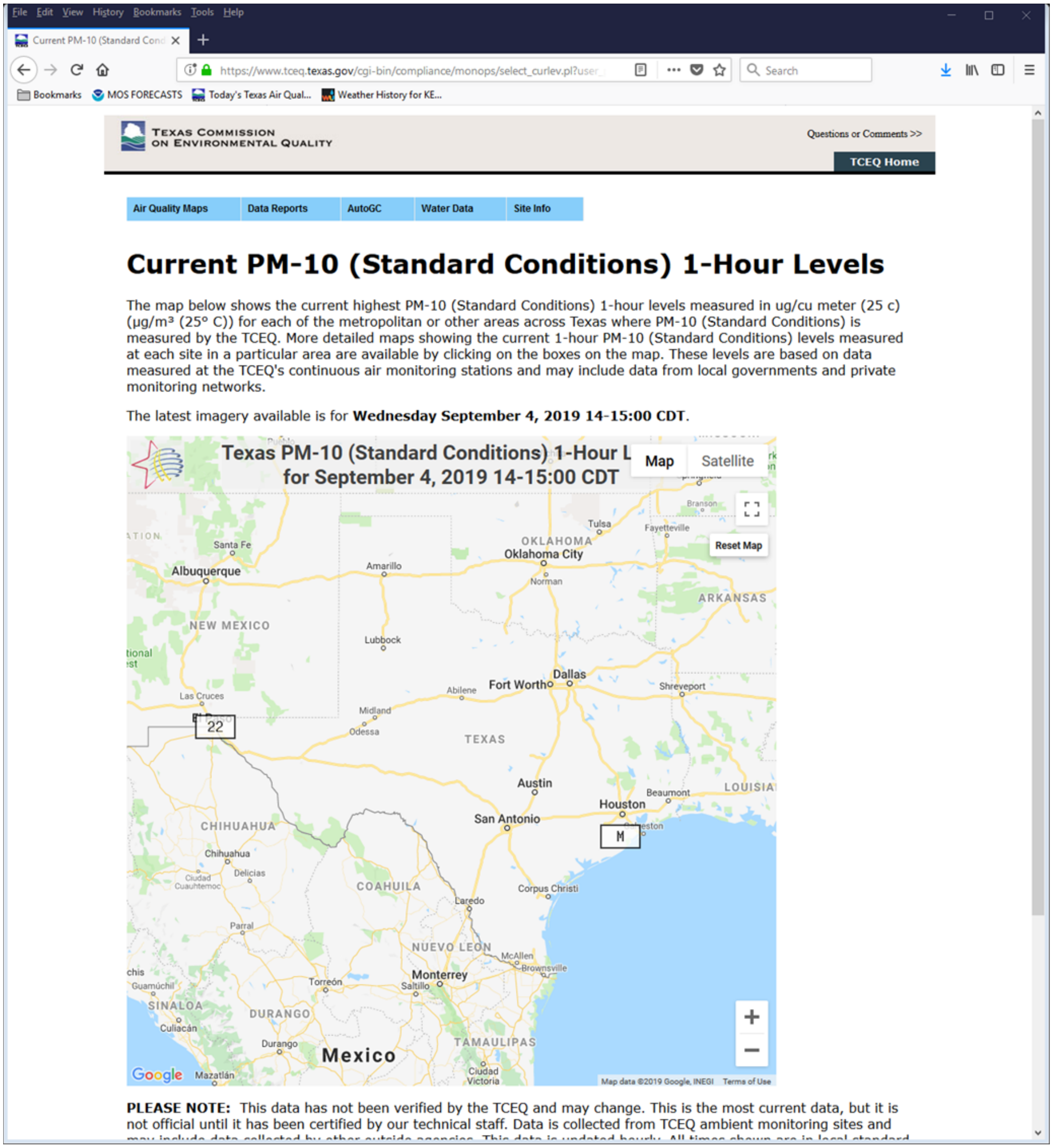
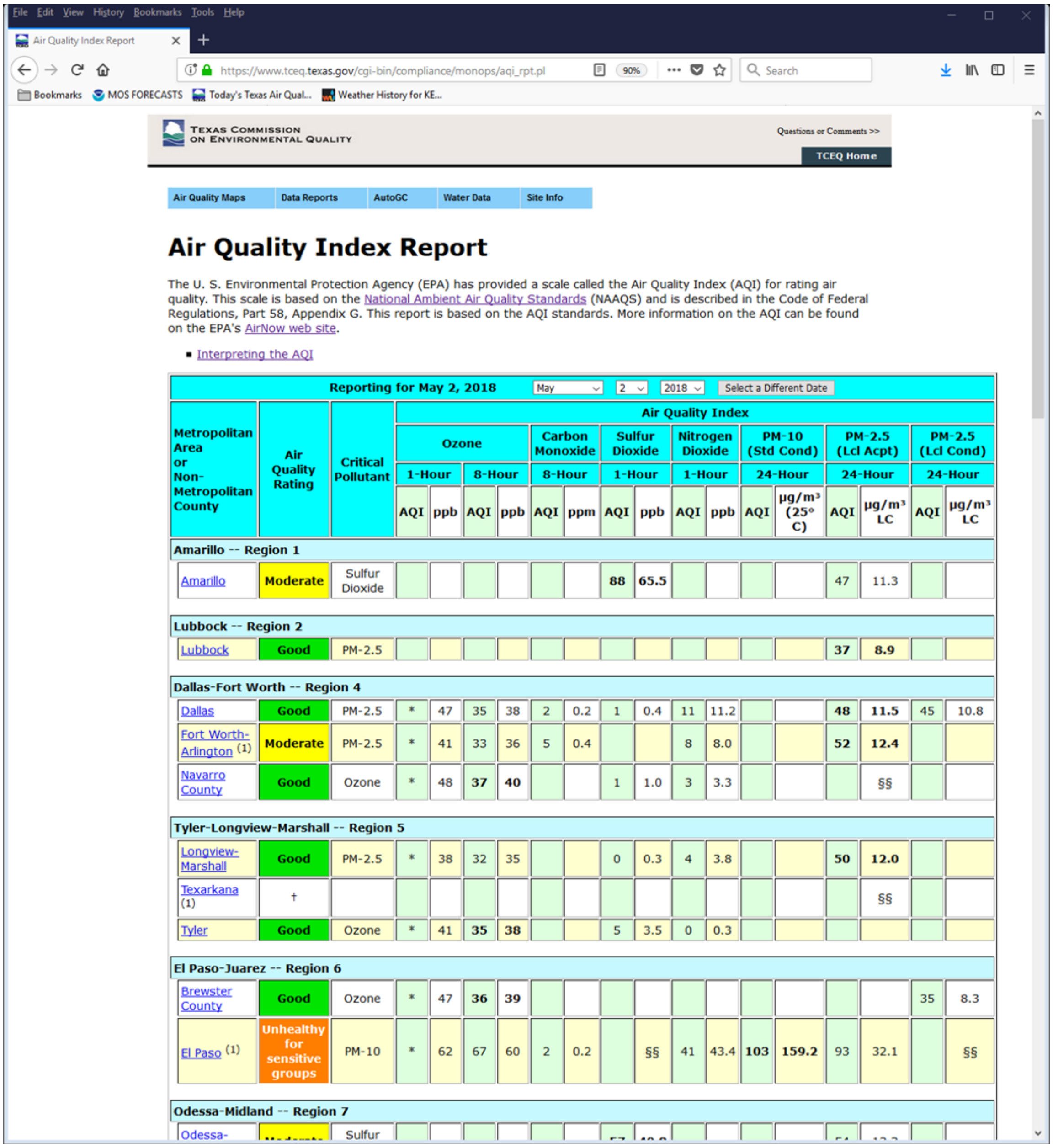


Figure D-3. Sample of the TCEQ map of current PM_{10} levels.



TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

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Air Quality Index Report

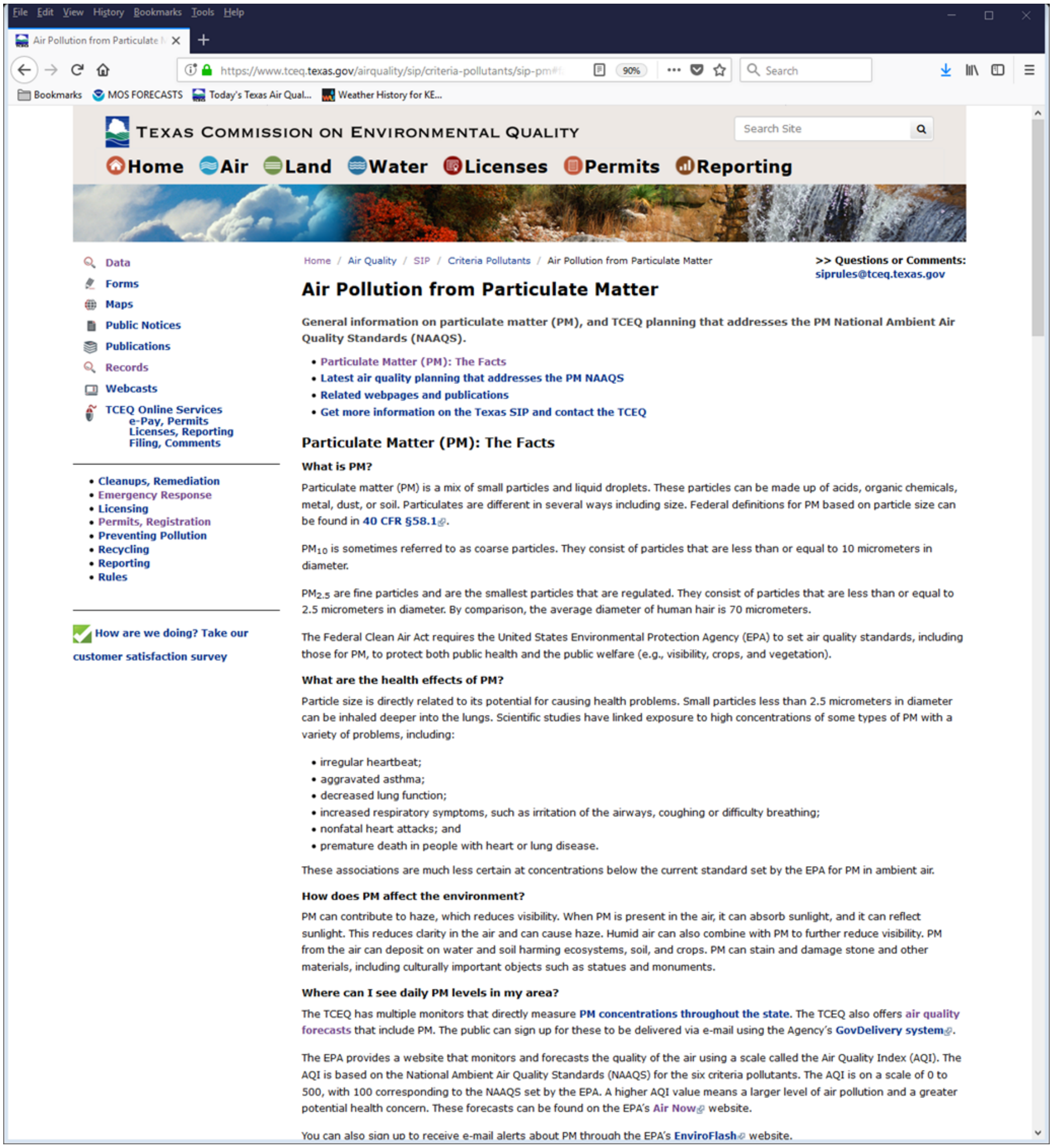
The U. S. Environmental Protection Agency (EPA) has provided a scale called the Air Quality Index (AQI) for rating air quality. This scale is based on the National Ambient Air Quality Standards (NAAQS) and is described in the Code of Federal Regulations, Part 58, Appendix G. This report is based on the AQI standards. More information on the AQI can be found on the EPA's AirNow web site.

- Interpreting the AQI

Reporting for May 2, 2018 — May | 2 | 2018 | Select a Different Date

Metropolitan Area or Non-Metropolitan County	Air Quality Rating	Critical Pollutant	Air Quality Index: Ozone 1-Hour		Ozone 8-Hour		Carbon Monoxide 8-Hour		Sulfur Dioxide 1-Hour		Nitrogen Dioxide 1-Hour		PM-10 (Std Cond) 24-Hour		PM-2.5 (Lcl Acpt) 24-Hour		PM-2.5 (Lcl Cond) 24-Hour	
			AQI	ppb	AQI	ppb	AQI	ppm	AQI	ppb	AQI	ppb	AQI	µg/m³ (25° C)	AQI	µg/m³ LC	AQI	µg/m³ LC
Amarillo -- Region 1																				
Amarillo	Moderate	Sulfur Dioxide							88	65.5					47	11.3		
Lubbock -- Region 2																				
Lubbock	Good	PM-2.5													37	8.9		
Dallas-Fort Worth -- Region 4																				
Dallas	Good	PM-2.5	*	47	35	38	2	0.2	1	0.4	11	11.2			48	11.5	45	10.8
Fort Worth-Arlington (1)	Moderate	PM-2.5	*	41	33	36	5	0.4			8	8.0			52	12.4		
Navarro County	Good	Ozone	*	48	37	40			1	1.0	3	3.3				§§		
Tyler-Longview-Marshall -- Region 5																				
Longview-Marshall	Good	PM-2.5	*	38	32	35			0	0.3	4	3.8			50	12.0		
Texarkana (1)	†															§§		
Tyler	Good	Ozone	*	41	35	38			5	3.5	0	0.3						
El Paso-Juarez -- Region 6																				
Brewster County	Good	Ozone	*	47	36	39											35	8.3
El Paso (1)	Unhealthy for sensitive groups	PM-10	*	62	67	60	2	0.2		§§	41	43.4	103	159.2	93	32.1		§§
Odessa-Midland -- Region 7																				
Odessa-	[illegible]	Sulfur							[illegible]	[illegible]					[illegible]	[illegible]		

Figure D-4. Sample of a portion of the TCEQ Air Quality Index Report, queried for May 2, 2018.



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>> Questions or Comments: siprules@tceq.texas.gov

Air Pollution from Particulate Matter

General information on particulate matter (PM), and TCEQ planning that addresses the PM National Ambient Air Quality Standards (NAAQS).

- Particulate Matter (PM): The Facts
- Latest air quality planning that addresses the PM NAAQS
- Related webpages and publications
- Get more information on the Texas SIP and contact the TCEQ

Particulate Matter (PM): The Facts

What is PM?

Particulate matter (PM) is a mix of small particles and liquid droplets. These particles can be made up of acids, organic chemicals, metal, dust, or soil. Particulates are different in several ways including size. Federal definitions for PM based on particle size can be found in 40 CFR §58.1.

PM_{10} is sometimes referred to as coarse particles. They consist of particles that are less than or equal to 10 micrometers in diameter.

$PM_{2.5}$ are fine particles and are the smallest particles that are regulated. They consist of particles that are less than or equal to 2.5 micrometers in diameter. By comparison, the average diameter of human hair is 70 micrometers.

The Federal Clean Air Act requires the United States Environmental Protection Agency (EPA) to set air quality standards, including those for PM, to protect both public health and the public welfare (e.g., visibility, crops, and vegetation).

What are the health effects of PM?

Particle size is directly related to its potential for causing health problems. Small particles less than 2.5 micrometers in diameter can be inhaled deeper into the lungs. Scientific studies have linked exposure to high concentrations of some types of PM with a variety of problems, including:

- irregular heartbeat;
- aggravated asthma;
- decreased lung function;
- increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing;
- nonfatal heart attacks; and
- premature death in people with heart or lung disease.

These associations are much less certain at concentrations below the current standard set by the EPA for PM in ambient air.

How does PM affect the environment?

PM can contribute to haze, which reduces visibility. When PM is present in the air, it can absorb sunlight, and it can reflect sunlight. This reduces clarity in the air and can cause haze. Humid air can also combine with PM to further reduce visibility. PM from the air can deposit on water and soil harming ecosystems, soil, and crops. PM can stain and damage stone and other materials, including culturally important objects such as statues and monuments.

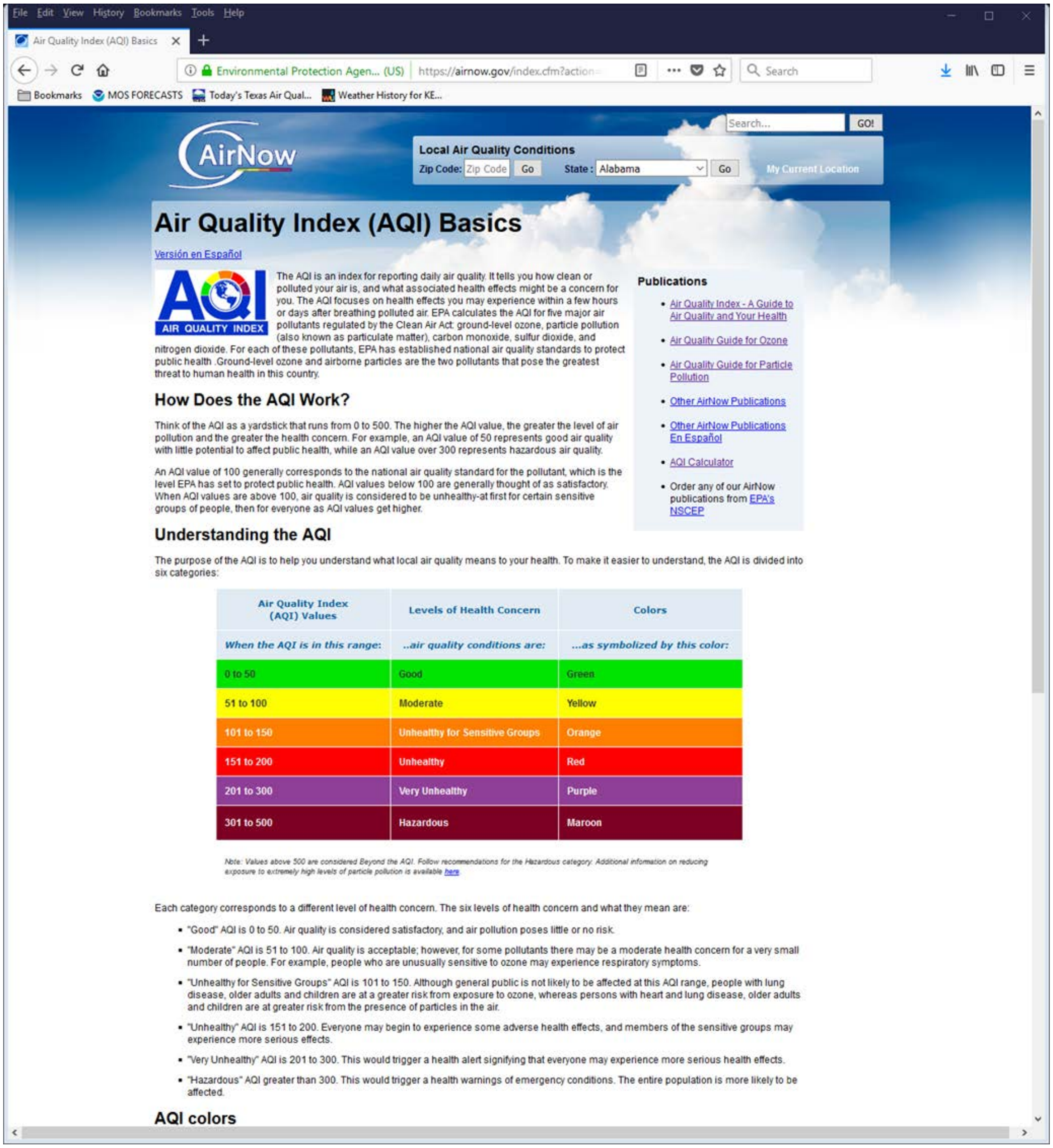
Where can I see daily PM levels in my area?

The TCEQ has multiple monitors that directly measure PM concentrations throughout the state. The TCEQ also offers air quality forecasts that include PM. The public can sign up for these to be delivered via e-mail using the Agency's GovDelivery system.

The EPA provides a website that monitors and forecasts the quality of the air using a scale called the Air Quality Index (AQI). The AQI is based on the National Ambient Air Quality Standards (NAAQS) for the six criteria pollutants. The AQI is on a scale of 0 to 500, with 100 corresponding to the NAAQS set by the EPA. A higher AQI value means a larger level of air pollution and a greater potential health concern. These forecasts can be found on the EPA's Air Now website.

You can also sign up to receive e-mail alerts about PM through the EPA's EnviroFlash website.

Figure D-5. Sample of a portion of the TCEQ particulate matter web page.



File Edit View History Bookmarks Tools Help

Air Quality Index (AQI) Basics

Environmental Protection Agen... (US) https://airnow.gov/index.cfm?action=

Bookmarks MOS FORECASTS Today's Texas Air Qual... Weather History for KE...

AirNow

Local Air Quality Conditions

Zip Code: Go State: Alabama Go My Current Location

Air Quality Index (AQI) Basics

Versión en Español

AQI AIR QUALITY INDEX

The AQI is an index for reporting daily air quality. It tells you how clean or polluted your air is, and what associated health effects might be a concern for you. The AQI focuses on health effects you may experience within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. For each of these pollutants, EPA has established national air quality standards to protect public health .Ground-level ozone and airborne particles are the two pollutants that pose the greatest threat to human health in this country.

How Does the AQI Work?

Think of the AQI as a yardstick that runs from 0 to 500. The higher the AQI value, the greater the level of air pollution and the greater the health concern. For example, an AQI value of 50 represents good air quality with little potential to affect public health, while an AQI value over 300 represents hazardous air quality.

An AQI value of 100 generally corresponds to the national air quality standard for the pollutant, which is the level EPA has set to protect public health. AQI values below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is considered to be unhealthy-at first for certain sensitive groups of people, then for everyone as AQI values get higher.

Publications

- Air Quality Index - A Guide to Air Quality and Your Health
- Air Quality Guide for Ozone
- Air Quality Guide for Particle Pollution
- Other AirNow Publications
- Other AirNow Publications En Español
- AQI Calculator
- Order any of our AirNow publications from EPA's NSCEP

Understanding the AQI

The purpose of the AQI is to help you understand what local air quality means to your health. To make it easier to understand, the AQI is divided into six categories:

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
When the AQI is in this range:	*...air quality conditions are:*	*...as symbolized by this color:*
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

Note: Values above 500 are considered Beyond the AQI. Follow recommendations for the Hazardous category. Additional information on reducing exposure to extremely high levels of particle pollution is available here.

Each category corresponds to a different level of health concern. The six levels of health concern and what they mean are:

- "Good" AQI is 0 to 50. Air quality is considered satisfactory, and air pollution poses little or no risk.
- "Moderate" AQI is 51 to 100. Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people. For example, people who are unusually sensitive to ozone may experience respiratory symptoms.
- "Unhealthy for Sensitive Groups" AQI is 101 to 150. Although general public is not likely to be affected at this AQI range, people with lung disease, older adults and children are at a greater risk from exposure to ozone, whereas persons with heart and lung disease, older adults and children are at greater risk from the presence of particles in the air.
- "Unhealthy" AQI is 151 to 200. Everyone may begin to experience some adverse health effects, and members of the sensitive groups may experience more serious effects.
- "Very Unhealthy" AQI is 201 to 300. This would trigger a health alert signifying that everyone may experience more serious health effects.
- "Hazardous" AQI greater than 300. This would trigger a health warnings of emergency conditions. The entire population is more likely to be affected.

AQI colors

Figure D-6. Sample of a portion of the EPA Air Quality Index guide.