EXCEPTIONAL EVENTS DEMONSTRATION FOR 2023 $PM_{2.5}$ EXCEEDANCES AT HARRISON COUNTY, TRAVIS COUNTY, AND KLEBERG COUNTY

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

SECTION 1: INTRODUCTION AND EXCEPTIONAL EVENT CRITERIA

1.1 OVERVIEW

Exceptional events are unusual or naturally occurring events that affect air quality and are not reasonably controllable or preventable. An exceptional 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 (U.S.) Environmental Protection Agency (EPA) 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 events 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) proposed exceptional event day flags for particulate matter of 2.5 microns or less in aerodynamic diameter ($PM_{2.5}$), also known as fine particulate matter, occurring on various dates in 2023, in Harrison County (Karnack monitor), Travis County (Austin Webberville Rd. monitor), and Kleberg County (National Seashore monitor). This demonstration shows that concentrations of $PM_{2.5}$ at three air monitoring sites in Harrison County, Travis County, and Kleberg County, respectively, were impacted by exceptional events on 18 days in 2023.

The particulate matter measurements on the proposed exceptional event days are listed below in Table 1-1: *Proposed Exceptional Events in 2023*. The event days are also categorized into groups by event type. A map of Texas with the referenced monitors is shown in Figure 1-1: *Map of Texas with three monitors identified for Exceptional Events*, and Table 1-2: *Monitor Details* provides additional information for each monitoring site.

Table 1-1: Proposed Exceptional Events in 2023

EE Group	Date	Site Name	Exceedance Concentration ($\mu g/m^3$)	Type of Event	Tier
Group 1	1/1/2023	Webberville	44.2	Fireworks	1
Group 2	1/3/2023	National Seashore	25.1	Fire – Mexico/Central America	2
Group 3	1/16/2023	National Seashore	24.0	Fire – Mexico/Central America	2
Group 3	1/18/2023	National Seashore	25.3	Fire – Mexico/Central America	2
Group 4	2/14/2023	National Seashore	21.8	Fire – Mexico/Central America	2
Group 5	2/27/2023	Karnack	26.6	Fire – Mexico/Central America, High Winds	1
Group 6	3/2/2023	Webberville	32.9	High Winds, Fire – Mexico/Central America	1
Group 7	3/15/2023	Karnack	39.7	Wildfire – U.S., Prescribed Fire	1

EE Group	Date	Site Name	Exceedance Concentration ($\mu g/m^3$)	Type of Event	Tier
Group 8	5/5/2023	National Seashore	22.2	Fire – Mexico/Central America	2
Group 9	6/13/2023	Webberville	31.5	Fire – Mexico/Central America	1
Group 9	6/14/2023	Webberville	27.4	Fire – Mexico/Central America	2
Group 9	6/14/2023	National Seashore	22.2	Fire – Mexico/Central America	2
Group 9	6/15/2023	Webberville	27.4	Fire – Mexico/Central America	2
Group 10	7/15/2023	National Seashore	24.2	African Dust	2
Group 10	7/16/2023	National Seashore	24.6	African Dust	2
Group 11	7/25/2023	National Seashore	22.3	African Dust	2
Group 11	7/26/2023	National Seashore	26.5	African Dust	2
Group 11	7/27/2023	National Seashore	29.6	African Dust	1
Group 11	7/28/2023	National Seashore	23.3	African Dust	2

($\mu g/m^3$) = micrometers per cubic meter

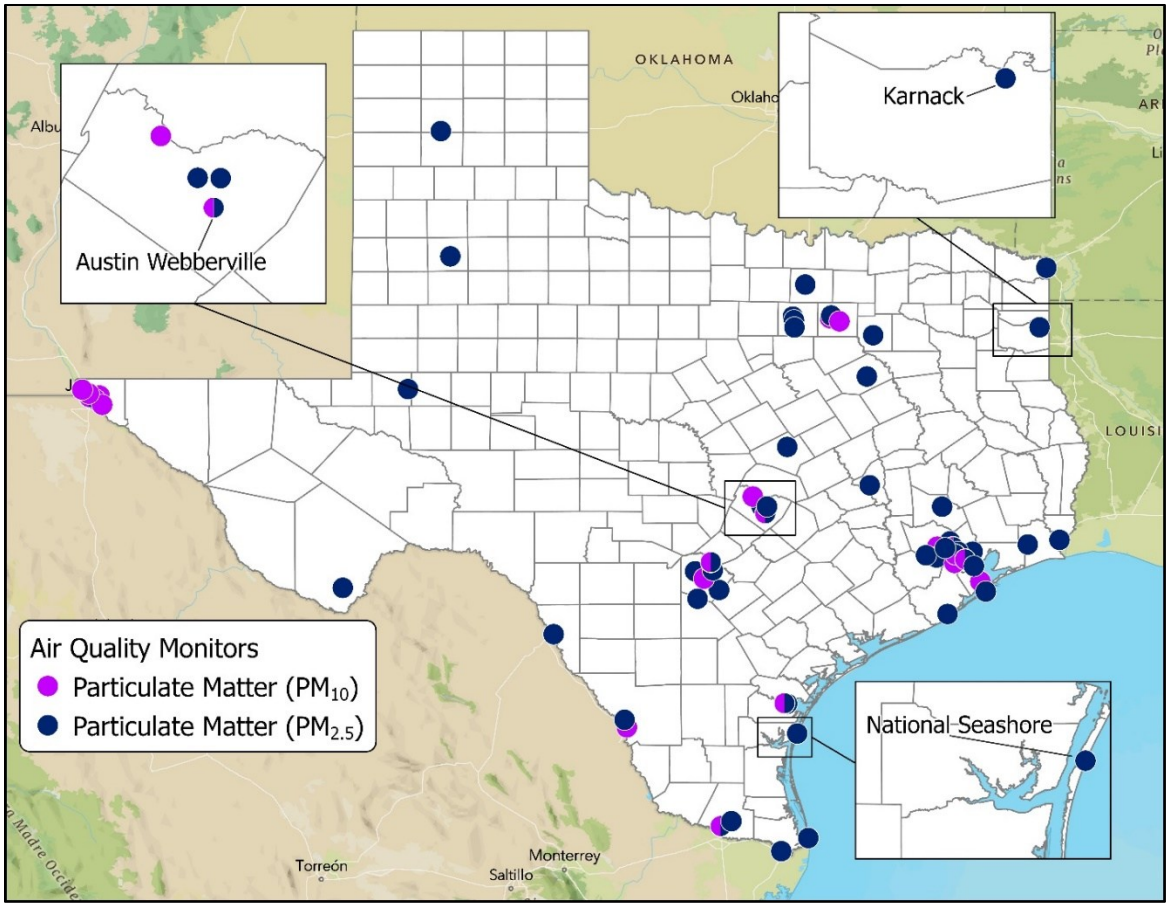

Figure 1-1: Map of Texas with three monitors identified for Exceptional Events

Table 1-2: Monitor Details

Site Name	Karnack	Austin Webberville Rd.*	National Seashore
Air Quality System (AQS) Number	482030002	484530021	482730314
Activation Date	June 30, 2001	September 29, 1999	October 25, 2002
Address	Hwy 134 & Spur 449	2600B Webberville Rd	20420 Park Road
County	Harrison	Travis	Kleberg
Latitude/Longitude	32.6689906, -94.1674541	30.2632109, -94.7128865	27.4224225, -97.3008586
Pollutant Instrumentation	NO_X, O_3, $PM_{2.5}$	PM Coarse, $PM_{2.5}$	$PM_{2.5}$
Meteorological Instrumentation	Temperature, Visibility, Wind, Solar Radiation	Temperature, Wind	Temperature, Wind

*Referred to as "Webberville" in this document

1.2 CLEAN AIR ACT REQUIREMENTS

In 2024, EPA promulgated a lower primary annual $PM_{2.5}$ standard of 9.0 µg/m³. The 2024 primary annual $PM_{2.5}$ standard is met when the three-year average of annual weighted quarterly means is less than or equal to 9.0 µg/m³ (40 CFR §50.20).

1.3 TEXAS IS SUBMITTING THIS EXCEPTIONAL EVENTS DEMONSTRATION TO EXCLUDE CERTAIN DATA FROM THE 2021-2023 TIMEFRAME. EXCEPTIONAL EVENTS RULE REQUIREMENTS

On October 3, 2016, EPA revised its Exceptional Events Rule (EER) (40 Code of Federal Regulations (CFR) §50.14(c)(3)), to specify six fundamental elements that a state's demonstration must contain. Those elements and the parts of this demonstration that fulfill those requirements are shown in Table 1-3: *40 CFR §50.14(c)(3) Exceptional Event Demonstration Requirements*.

Table 1-3: 40 CFR §50.14(c)(3) Exceptional Event Demonstration Requirements

40 CFR §50.14(c)(3) Requirement	Demonstration Section
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).	Section 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.	Section 3
Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times. The Administrator shall not require a State to prove a specific percentile point in the distribution of data.	Section 3
A demonstration that the event was both not reasonably controllable and not reasonably preventable.	Section 4
A demonstration that the event was caused by human activity that is unlikely to recur at a particular location or was a natural event.	Section 5
Documentation that the submitting air agency followed the public comment process.	Section 7

Compliance with the EER mitigation requirements in 40 CFR §51.930 with respect to public notification, public education, and implementation of appropriate measures to protect health is documented in Table 1-4: *40 CFR §51.930 Exceptional Event Demonstration Requirements*.

Table 1-4: 40 CFR §51.930 Exceptional Event Demonstration Requirements

40 CFR §51.930 Requirement	Demonstration Section
Provide for prompt public notification whenever air quality concentrations exceed or are expected to exceed an applicable ambient air quality standard.	Section 6
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.	Section 6

40 CFR §51.930 Requirement	Demonstration Section
Provide for the implementation of appropriate measures to protect public health from exceedances or violations of ambient air quality standards caused by exceptional events	Section 6

EPA has provided several documents and tools that address exceptional events demonstration requirements, including those listed below.

- The 2016 revisions to the 2007 Exceptional Events Rule (U.S. EPA, 2016a)[1]
- "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (U.S. EPA, 2016b)[2]
- "2016 Revisions to the Exceptional Events Rule: Update to Frequently Asked Questions" (U.S. EPA, 2020)[3]
- "Initial Area Designations for the 2024 Revised Primary Annual Fine Particle National Ambient Air Quality Standard" (U.S. EPA, 2024)[4]
- "$PM_{2.5}$ Wildland Fire Exceptional Events Tiering Document" (U.S. EPA, 2024)[5]
- $PM_{2.5}$ Designations Mapping Tool[6]

1.4 INITIAL NOTIFICATION AND FLAGGING DATA IN AQS

The Exceptional Events Rule at 40 CFR §50.14(c)(2) requires an initial notification by the air agency to EPA of a potential exceptional event for which the agency is considering preparing a demonstration. On November 25, 2024, TCEQ submitted an initial notification to EPA Region 6. TCEQ engaged in discussions with EPA Region 6 on October 29, 2024, and December 6, 2024, regarding the demonstration prior to formal submittal. An addendum was sent to EPA Region 6 revising event types for certain dates on December 17, 2024. A copy of the initial notification letter and addendum are provided in Appendix D.

1.5 REGULATORY SIGNIFICANCE

The annual $PM_{2.5}$ design value (DV) is calculated using the 3-year average. The removal of the days impacted by exceptional events from the 2021-2023 have regulatory significance since they impact the 2023 annual $PM_{2.5}$ DVs.

Table 1-5: *2023 DVs for the 2024 Annual $PM_{2.5}$ NAAQS* shows the 2023 design values at each monitor without EPA concurrence and the potential design value if EPA concurs on the proposed exceptional event days. The 2022 days impacted by exceptional events and the details of the events are available in TCEQ's *Exceptional Event Demonstration for 2022 $PM_{2.5}$ Exceedances at Harrison County, Travis County, And Kleberg County.*

[1] https://www.epa.gov/sites/default/files/2018-10/documents/exceptional_events_rule_revisions_2060-as02_final.pdf
[2] https://www.epa.gov/system/files/documents/2023-12/guidance-on-the-preparation-of-ee-wf-ozone.pdf
[3] https://www.epa.gov/sites/default/files/2019-07/documents/updated_faqs_for_exceptional_events_final_2019_july_23.pdf
[4] https://www.epa.gov/system/files/documents/2024-02/pm-naaqs-designations-memo_2.7.2024-_-jg-signed.pdf
[5] https://www.epa.gov/system/files/documents/2024-04/final-pm-fire-tiering-4-30-24.pdf
[6] https://www.epa.gov/air-quality-analysis/pm25-tiering-tool-exceptional-events-analysis

Table 1-5: 2023 DVs for the 2024 Annual $PM_{2.5}$ NAAQS

Monitoring Site	2023 DV without EPA Concurrence (µg/m³)	2023 DV with EPA Concurrence (µg/m³)
Karnack (482030002)	9.5	9.0
Austin Webberville Rd (484530021)	9.3	9.0
National Seashore (482730314)	9.9	9.0

1.6 ACTION REQUESTED

This document meets all EPA documentation standards for exceptional events, and TCEQ requests EPA concurrence that the dates and concentrations shown in Table 1-1 were caused by exceptional events and should be excluded from regulatory decisions for the 2024 annual $PM_{2.5}$ NAAQS. The data being requested for exclusion have regulatory significance and affect the DVs. This demonstration provides detailed evidence to support concurrence by EPA for the $PM_{2.5}$ exceptional events for the days included in the initial notification letter (Appendix D), which shows "r" flag applied for all types.

SECTION 2: NARRATIVE CONCEPTUAL MODEL

2.1 OVERVIEW

This section satisfies the Exceptional Events Rule Requirement at 40 CFR §50.14(c)(3)(iv)(A): "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." Included in this section is a description of the 2023 events and the general meteorological conditions that caused smoke and dust to travel to the three monitoring sites. As identified in Table 1-1, events were categorized into 11 distinct groups based on single day events or episodes with types of events (African Dust, Fires (Mexico/Central America), Fireworks, and High Winds).

2.2 HARRISON COUNTY BACKGROUND

The Karnack monitor is located in Karnack, TX, a small town northeast of Marshall, TX (2023 population: 24,118), which is the largest nearby urbanized area and county seat of Harrison County (2023 population: 70,895). Harrison County is part of the Longview-Marshall, TX, Combined Statistical Area (CSA) located in the heavily forested east Texas Pineywoods region bordering Louisiana. Surface topography of Harrison County is hilly to rolling prairie, The climate of east Texas is humid subtropical with total annual precipitation of 41.98 inches in 2022 and 46.34 inches in 2023, both lower than the 1901-2000 average of 47.15 inches.[7, 8, 9]

2.3 TRAVIS COUNTY BACKGROUND

Austin, TX (2023 population: 979,882) is a major metropolitan area and county seat of Travis County (2023 population: 1,334,961), which straddles the Balcones Fault in the central Texas Hill Country. It is part of the Austin-Round Rock-Georgetown, TX, Metropolitan Statistical Area (MSA) located at the junction of the rolling hills of the Blackland Prairie to the east and the steep cliffs and rock formations of the Edwards Plateau to the west. Elevations within Austin city limits vary from 400 feet in the east/southeast to just above 1,000 feet above sea level in the northwest. Given these large changes in elevation, weather conditions can sometimes differ between various parts of the city and metro area.

Austin has a humid subtropical climate characterized by long, hot summers and short, mild winters, with warm spring and fall transitional periods. Austin averages around 35.5 inches of rainfall per year, with May, October, and June being the wettest months of the year, in that order. Total annual precipitation in Austin was much lower in 2022 (22.52 inches) and 2023 (26.57 inches) than the 1901-2000 average (32.74 inches).[8, 9, 10]

2.4 KLEBERG COUNTY BACKGROUND

The National Seashore monitor is located on Padre Island within the Padre Island National Seashore along the Gulf coast of south Texas in eastern Kleberg County (2023 population: 30,069). The nearest urbanized area is Kingsville, the county seat (2023 population: 24,586). Kleberg County is part of the Corpus Christi-Kingsville-Alice, TX Combined Statistical Area (CSA).

Kleberg County is primarily rural with mostly flat terrain only a few feet above sea level and a humid subtropical climate with long, hot, muggy summers and short, mild winters. Total

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[7] https://tpwd.texas.gov/education/hunter-education/online-course/wildlife-conservation/texas-ecoregions
[8] https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/county/mapping/41/pcp/202206/6/value
[9] https://www.census.gov/quickfacts/fact/table
[10] https://www.weather.gov/media/ewx/climate/ClimateSummary-ewx-Austin.pdf

annual precipitation in Kleberg County was lower in 2022 (18.32 inches) and 2023 (20.22 inches) than the 1901-2000 average (26.82 inches). Most rain falls near the beginning and end of hurricane and tropical storm season, which lasts from June 1 to November 30. The weather on the island can vary widely and change quickly. Typical weather year-round includes average wind speeds that range from 5 to 25 miles per hour, and relative humidity seldom drops below 70%. [8, 9, 11]

2.5 NARRATIVE FOR EACH GROUP OF EVENT DAYS

All weather maps, graphs, and smoke layer maps are included in Appendix A. The National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) forecasts are included in Appendix B. Imagery and data used for the narrative conceptual model comes from multiple sources:

- Weather maps (surface analysis) were downloaded from NOAA NWS Weather Predication Center: https://www.wpc.ncep.noaa.gov/archives/web_pages/wpc_arch/get_wpc_archives.php
- Weather maps (500 millibar (mb) height) were downloaded from NOAA NWS Storm Predication Center: https://www.spc.noaa.gov/obswx/maps/
- Upper air soundings were downloaded either from the University of Wyoming or Plymouth State University: https://weather.uwyo.edu/upperair/sounding.html and https://vortex.plymouth.edu/myowxp/upa/raobplt-a.html
- As part of its Hazard Mapping System (HMS), NOAA produces daily fire and smoke plume maps depicting the location of fires and smoke plumes detected by satellites (NOAA, 2003). The KML files were downloaded from NOAA and displayed on Google Earth: https://www.ospo.noaa.gov/products/land/hms.html#data
- NWS forecasts were downloaded from: https://mesonet.agron.iastate.edu/wx/afos/list.phtml
- Reported fire data from Mexico is archived by the Mexican government and is available at: https://monitor_incendios.cnf.gob.mx/incendios_tarjeta_semanal. The data contains information about fires from each Mexican state, such as the cause of fire and acreage burned.

2.5.1 Group 1 – Summary of January 1, 2023, Fireworks $PM_{2.5}$ Event for the Webberville Monitor

Firework smoke affected the central Texas area in the early morning hours on January 1, 2023. The $PM_{2.5}$ concentration at the Webberville monitor reached 218 µg/m^3 at 1:00 a.m. local time, as seen on the hourly time series in Figure 2-1: *Hourly $PM_{2.5}$ Concentrations at the Webberville Monitor on Days around Event (Jan 1, 2023).*

[11] https://www.nps.gov/pais/planyourvisit/weather.htm

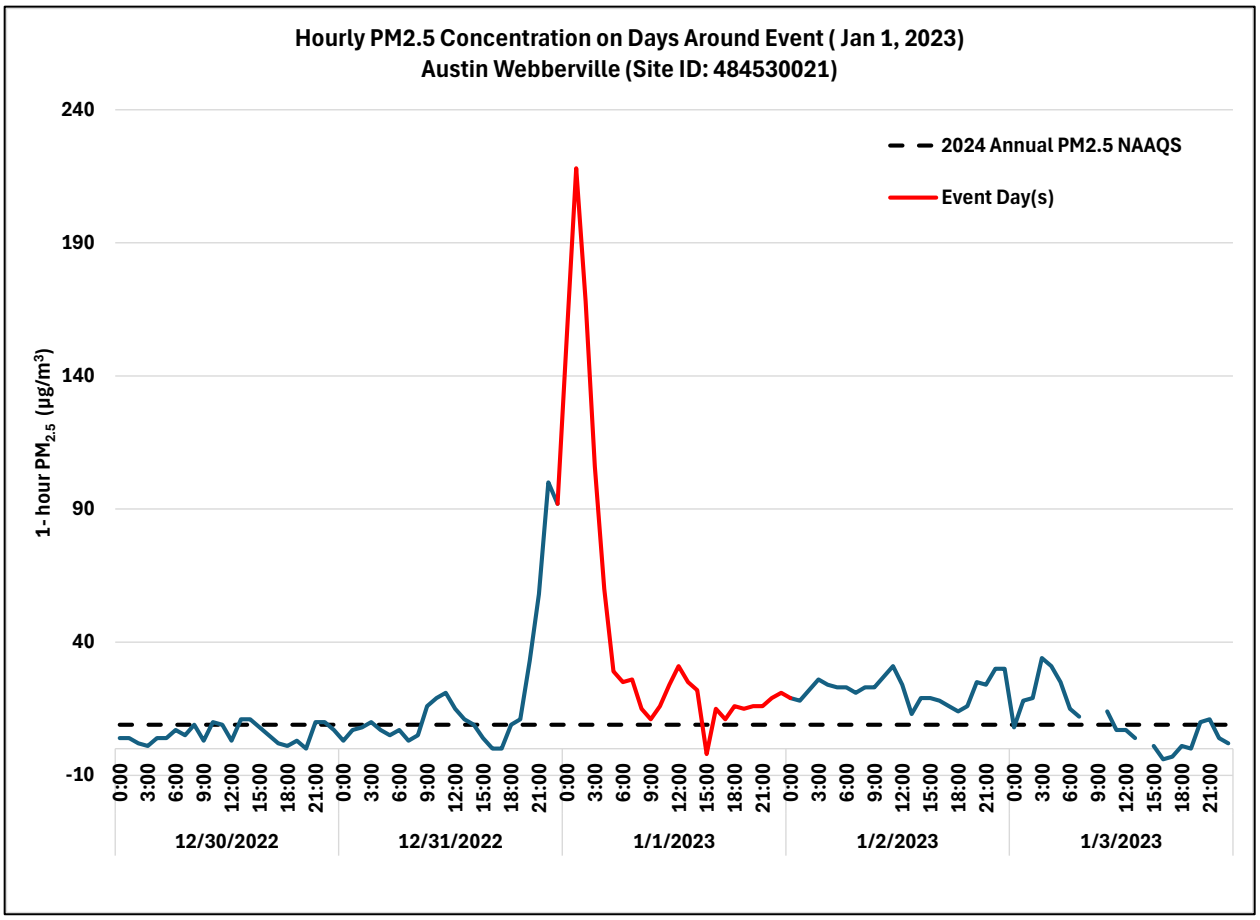


Figure 2-1: Hourly $PM_{2.5}$ Concentrations at the Webberville Monitor on Days around Event (Jan 1, 2023)

On January 1, 2023, a ridge of high pressure extended along the eastern third of the continental U.S. A weak area of low pressure was centered over the panhandles of Texas and Oklahoma. Winds near the Webberville monitor were light and variable (Figure A-1). While there is not an upper-air sounding site located in the immediate area of Webberville, a look at the 6:00 a.m. sounding from Del Rio, Texas (Figure A-2) shows a strong low-level inversion, which limits vertical mixing in the near surface layer, trapping particulate matter associated with New Year's firework activity near the surface. Low visibility was also mentioned in the NWS forecast, due to firework smoke (Figure B-1).

2.5.2 Group 2 – Summary of January 3, 2023, Fire (Mexico/Central America) $PM_{2.5}$ Event for the National Seashore Monitor

$PM_{2.5}$ concentrations were elevated on January 3, 2023, at the National Seashore monitor due to smoke from fires in Mexico/Central America, as shown in Figure 2-2: *Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Jan 3, 2023).*

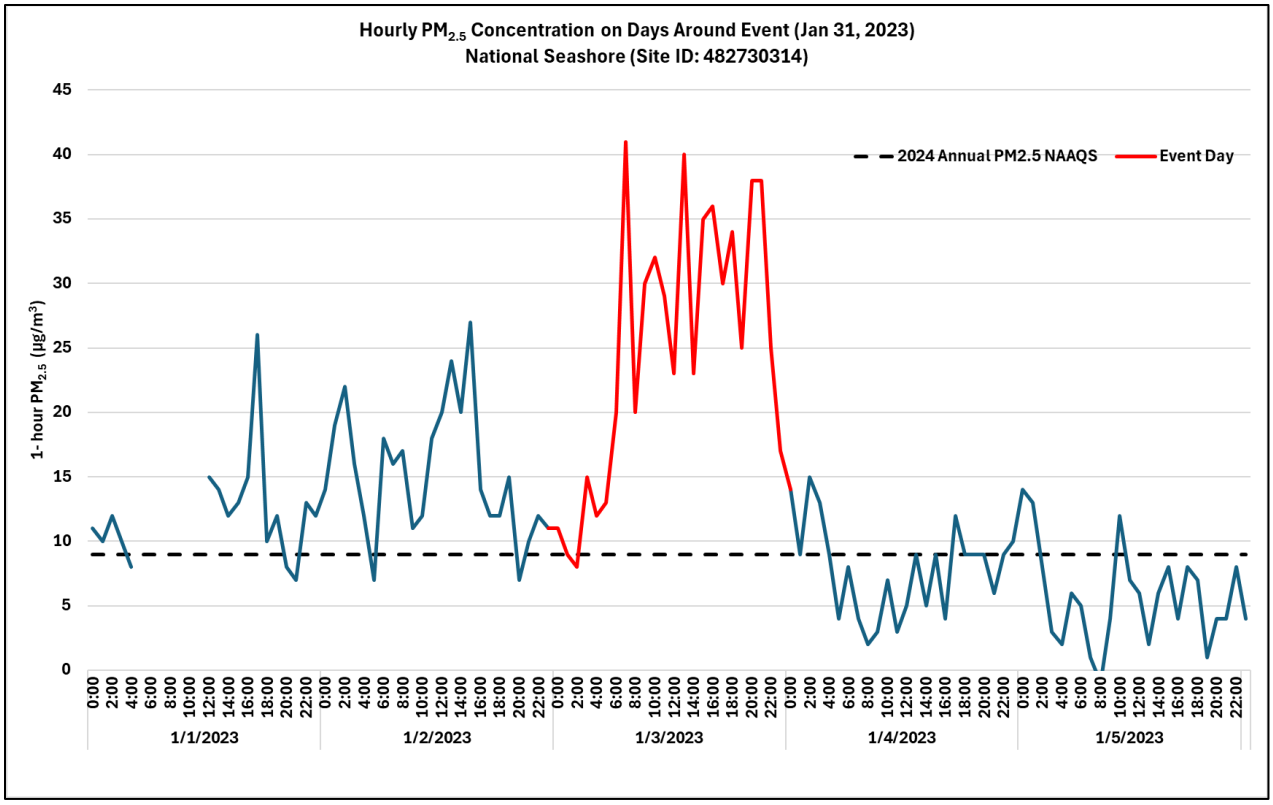


Figure 2-2: Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Jan 3, 2023)

On this day, a cold front extended from northern Missouri south through the Corpus Christi and Brownsville areas of Texas, as seen on the surface weather chart (Figure A-3). Winds in the Corpus Christi area were out of the south around 15 knots. The 500 mb heights chart (Figure A-4) shows a mid-level trough over the central U.S. with a mid-level low pressure system centered over Kansas and Nebraska. Mid-level winds over the National Seashore monitor site were out of the southwest around 50 knots, indicating a subtropical jet enhancing transport aloft from the west and south. These winds at the surface and mid-level transported smoke from fires in Mexico. Light smoke along the south Texas coastline is indicated on the NOAA HMS map, having been ushered out into the Gulf of Mexico ahead of the advancing cold front (Figure A-5). The sounding from Corpus Christi (Figure A-6) shows the southerly and southwesterly winds in the lowest level of the atmosphere along with abundant moisture associated with the flow on to land from the Gulf of Mexico. Figure 2-3: *Percentage of reported fire instances by the Mexican government, on and around January 3, 2023* shows the percentages of reported fire instances in Mexico, most of which are considered to be unlikely to recur.

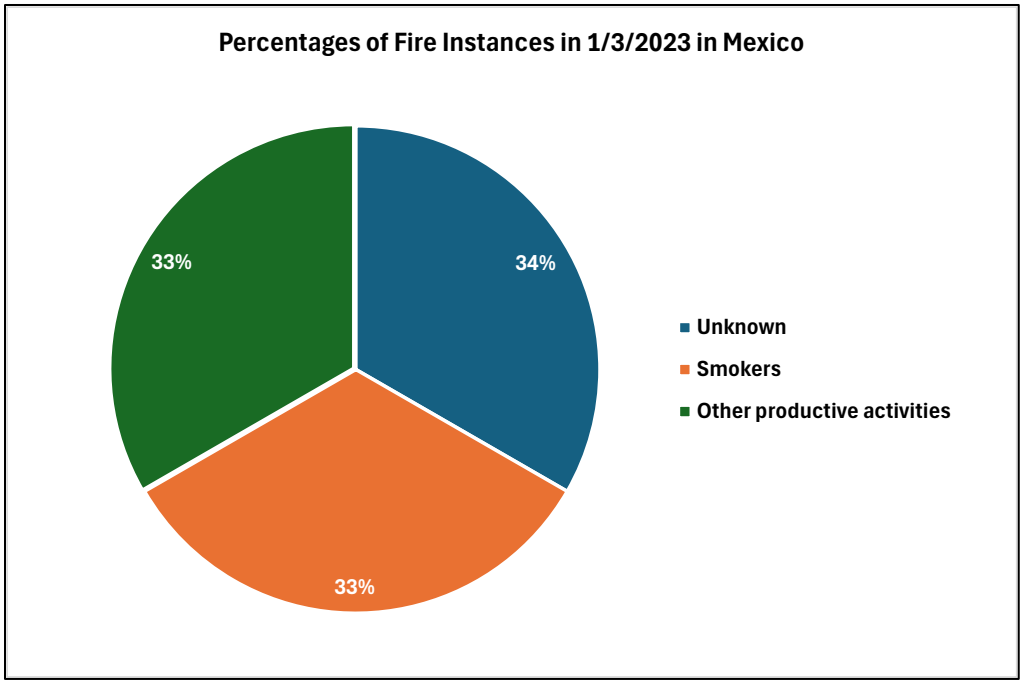


Figure 2-3: Percentage of reported fire instances by the Mexican government, on and around January 3, 2023

2.5.3 Group 3 – Summary of January 16 and January 18, 2023, Fire (Mexico/Central America) $PM_{2.5}$ Event for the National Seashore Monitor

$PM_{2.5}$ concentrations at the National Seashore monitor were elevated between January 16-18, with peak concentrations occurring on the 16th and 18th, as seen in Figure 2-4: *Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Jan 16, 2023, and Jan 18, 2023)*. The elevated concentrations were due to smoke from fires in Mexico/Central America.

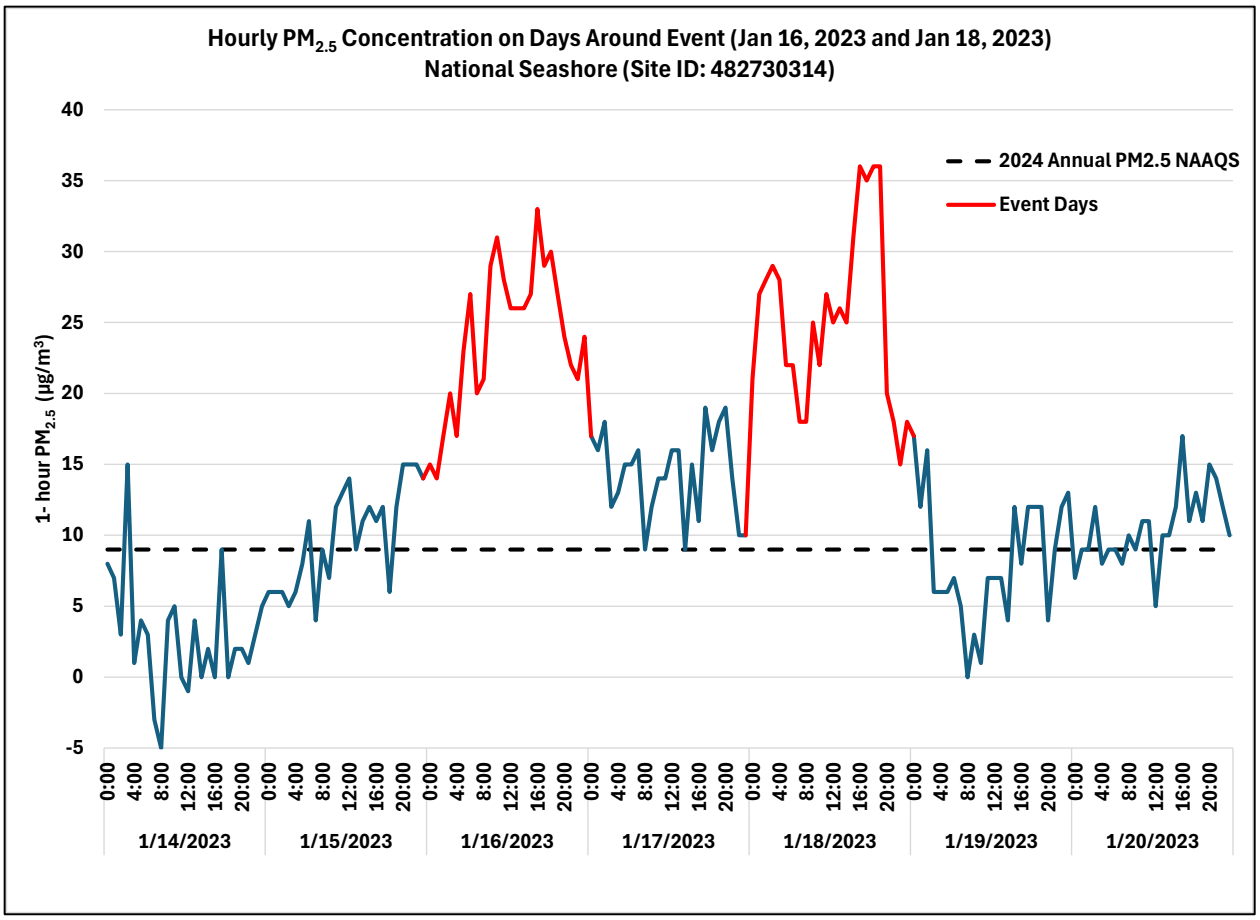


Figure 2-4: Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Jan 16, 2023, and Jan 18, 2023)

On January 16th, there were breezy conditions near the National Seashore monitor site with winds blowing in from the south at 20 knots with higher gusts. A dryline slowly moved towards the coast from the central Texas region as seen in the January 16 surface weather map (Figure A-7). The 500 mb heights chart on January 16th (Figure A-8) shows a strong mid-level jet flowing zonally over the National Seashore monitor area with winds in the 50 knot range. Strong winds near the surface can also be seen in the January 16th sounding (Figure A-9) from Corpus Christi showing winds veering from the south to the southwest with speeds increasing to around 40 knots just above the surface. These strong low-level winds helped transport smoke from fires in Mexico/Central America into the National Seashore monitor area. The sounding shows a capping inversion at 850 mb, which supported the persistence of aerosols near the surface during transport.

Conditions on January 17th were benign over south Texas and the coastal bend areas with a light onshore flow in the National Seashore region, as seen in the January 17th surface weather map (Figure A-10). A cold front can also be seen moving into west Texas. The shortwave trough at the surface over central Texas continued to channel winds and smoke northward from Mexico. The January 17th sounding from Corpus Christi (Figure A-11) shows winds in the lowest layers of the atmosphere have weakened compared to their strength on January 16th.

The surface weather map on January 18th (Figure A-12) shows the previously mentioned cold front moving through the Central Texas area towards the gulf coast with breezy winds out of the south in the Corpus Christi area. A mid-level trough associated with the cold front can also

be seen in the 500 mb heights chart for January 18th (Figure A-13), with winds out of the southwest over the Corpus Christi area. A light smoke layer is indicated on the NOAA hazard map along the south Texas coastline (Figure A-14). The January 18th sounding at Corpus Christi shows winds veering and increasing in speed from the south to the southwest with height. The January 18th surface map (Figure A-16) shows the cold front entering the Corpus Christi area with strong southerly winds just in front of the cold front bringing in air from south with elevated particulates.

Figure 2-5: *Percentage of reported fire instances by the Mexican government, on and around January 16 through January 18, 2023* shows the causes of reported fires in Mexico, almost half are unlikely to recur (camp fires, smokers, and intentional).

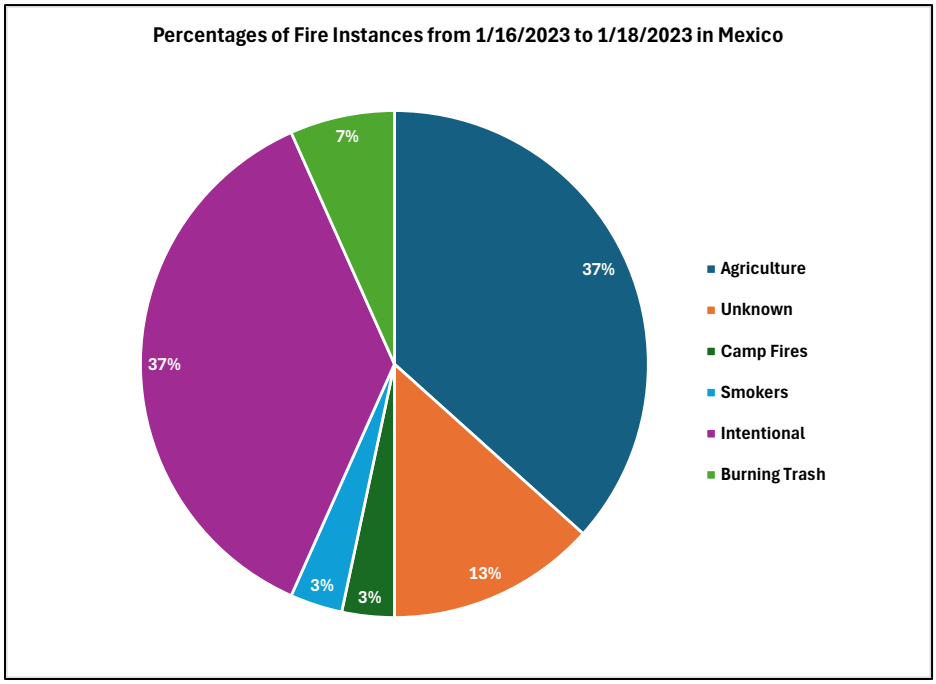


Figure 2-5: Percentage of reported fire instances by the Mexican government, on and around January 16 through January 18, 2023

2.5.4 Group 4 – Summary of February 14, 2023, Fire (Mexico/Central America) $PM_{2.5}$ Event for the National Seashore Monitor

Elevated $PM_{2.5}$ concentrations occurred on February 14, 2023, at the National Seashore monitor due to smoke from fires in Mexico/Central America, as shown in Figure 2-6: *Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Feb 14, 2023)*.

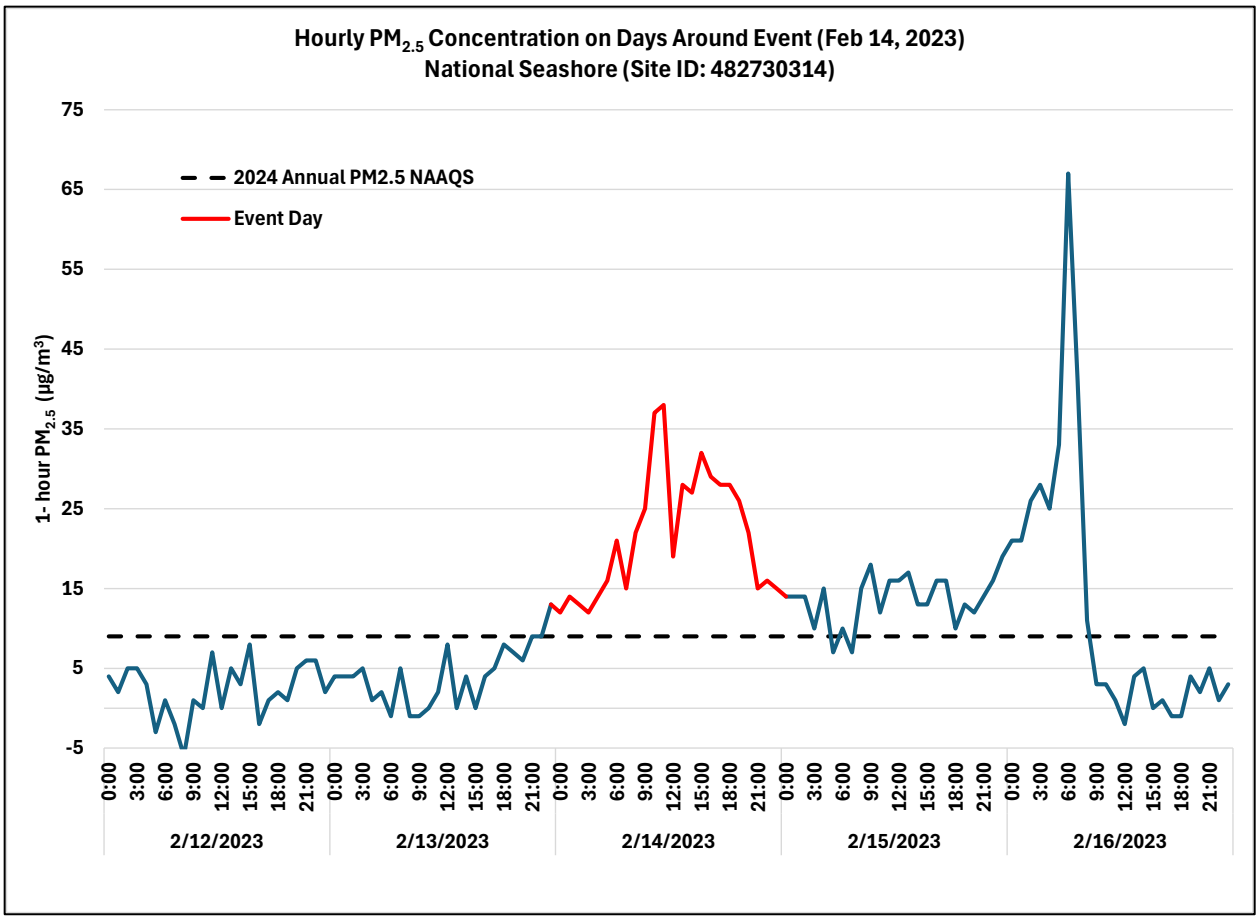


Figure 2-6: Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Feb 14, 2023)

Strong southerly winds can be seen in the Corpus Christi area and just offshore on the morning of February 14th on the surface weather map (Figure A-17). A cold front is also shown southeast across the central Texas area with a strong low-pressure system centered over the Oklahoma panhandle and southeastern Colorado. This low-pressure system and associated trough are also visible on the February 14th 500 mb heights chart (Figure A-18). The Corpus Christi sounding on February 14th also shows strong southerly winds at and just above the surface (Figure A-19). These strong low-level winds transported smoke associated with fires from Mexico into the Corpus Christi area and the National Seashore monitor site. A medium level smoke layer is present over the southern coastline of Texas on the NOAA hazard map (Figure A-20).

2.5.5 Group 5 – Summary of February 27, 2023, Fire (Mexico/Central America) and High Wind $PM_{2.5}$ Event for the Karnack Monitor

The Karnack monitor was impacted by blowing dust and smoke from fires in Mexico/Central America on February 27, 2023. Elevated $PM_{2.5}$ concentrations on this day are shown in Figure 2-7: *Hourly $PM_{2.5}$ Concentrations at the Karnack Monitor on Days around Event (Feb 27, 2023).*

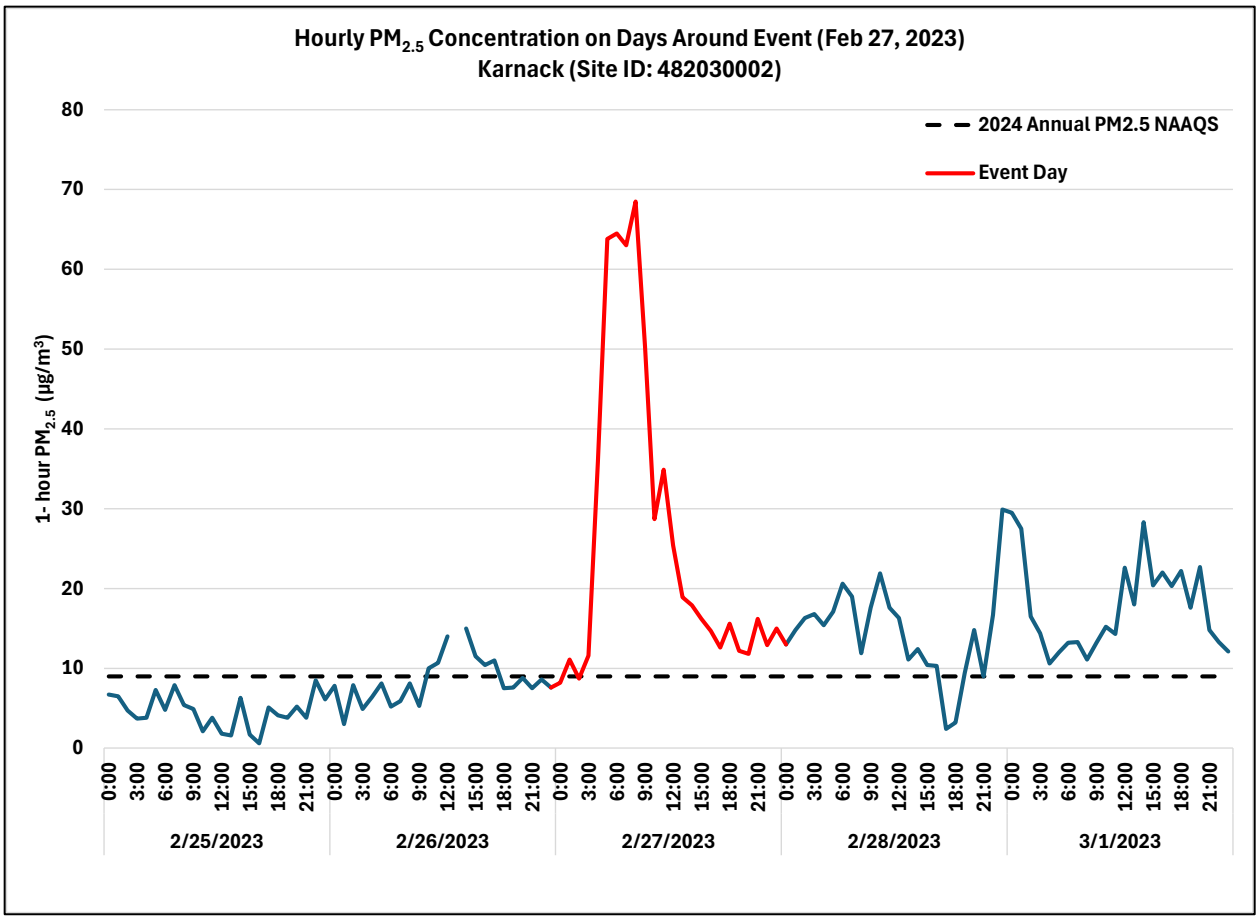


Figure 2-7: Hourly $PM_{2.5}$ Concentrations at the Karnack Monitor on Days around Event (Feb 27, 2023)

On February 27, 2023, the 500 mb chart (Figure A-21) shows a zonal longwave pattern over the U.S. with a low height center over Missouri. This low stacks down to the surface as a low-pressure center seen on the surface chart (Figure A-22). There was a cold front associated with this low-pressure center that had just passed over the Karnack sensor, likely bringing higher sustained surface winds to the area. The rawinsonde sounding at Shreveport (Figure A-23) shows winds that are in-phase throughout the vertical column. This indicates that energy from upper atmospheric winds can be more easily transferred downward through the mid and lower atmosphere. There was a low-level jet present at 850 mb with 60 knot wind speeds. This likely occurred due to the presence of the Subtropical jet at 300 mb with nearly 100 knot wind speeds that were able to mix down in the atmosphere. The high winds due to the low-level jet were able to mix down in the atmosphere, bringing high winds to the surface aided by the cold front. These high surface winds created blowing dust that contributed to the higher concentration of $PM_{2.5}$ at the Karnack sensor. Intense winds and blowing dust were also documented in NWS forecast (Figure B-2) and discussions on February 26, 2023, for West Texas (Figures B-3 and B-4).

Figure 2-8: *Percentage of reported fire instances by the Mexican government, on and around February 27, 2023*, shows the reported fire instances in Mexico, with around half considered to be unlikely to recur.

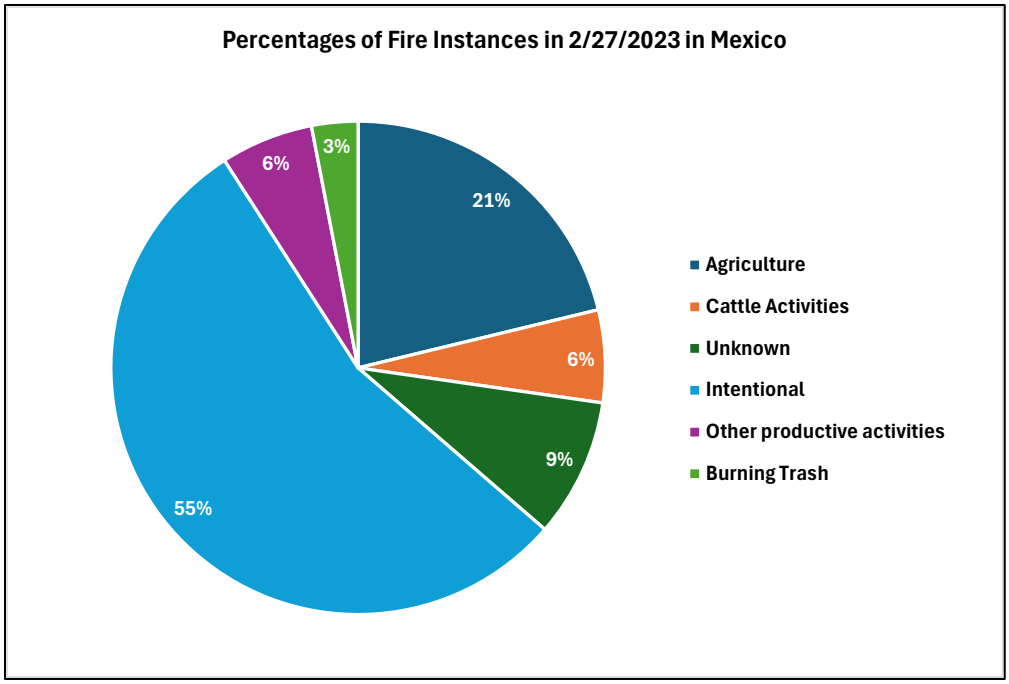


Figure 2-8: Percentage of reported fire instances by the Mexican government, on and around February 27, 2023

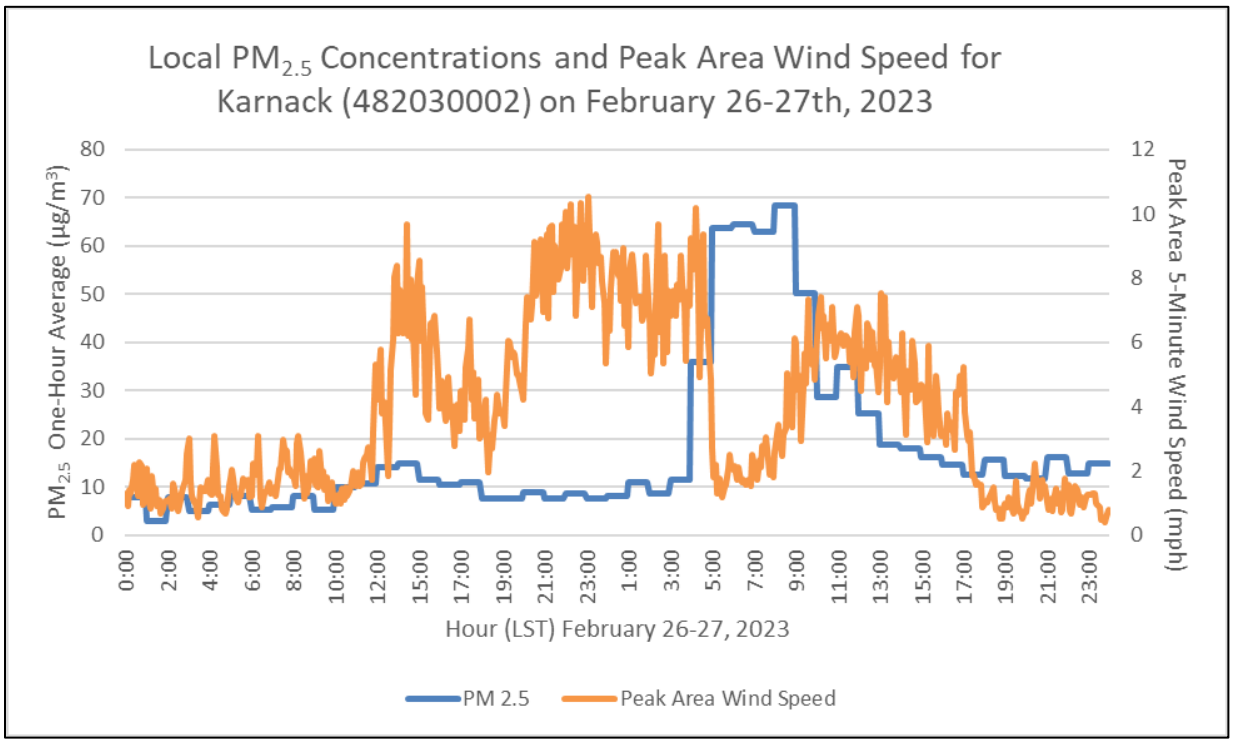


Figure 2-9: Continuous Hourly $PM_{2.5}$ and Peak Area Five-Minute Sustained Wind Speed Measurements on February 26-27th, 2023, for the Karnack monitor (482030002)

Because the highest $PM_{2.5}$ concentrations on February 27, 2023, were in the early hours of the day, it was beneficial to look at wind data from the day prior in addition to the proposed exceptional event date of February 27, 2024. For this reason, the plot in Figure 2-9: *Continuous*

Hourly $PM_{2.5}$ and Peak Area Five-Minute Sustained Wind Speed Measurements on February 26-27th, 2023, for the Karnack monitor (482030002) shows data for February 26 in addition to February 27, 2023. Over the course of the two days, wind speeds increased and were highest several hours prior to the spike in $PM_{2.5}$ concentrations on February 27, 2023. This pattern is indicative of transport of $PM_{2.5}$ from a source outside of the local area.

2.5.6 Group 6 – Summary of March 2, 2023, High Winds and Fire (Mexico/Central America) $PM_{2.5}$ Event for the Webberville Monitor

High winds and smoke from fires in Mexico/Central America impacted $PM_{2.5}$ concentrations at the Webberville monitor on March 2, 2023. A sharp increase of measured concentrations occurred around 10 p.m. local time on this date, with a maximum of 102 µg/m³ as shown on the hourly graph in Figure 2-10: *Hourly $PM_{2.5}$ Concentrations at the Webberville Monitor on Days around Event (Mar 2, 2023).*

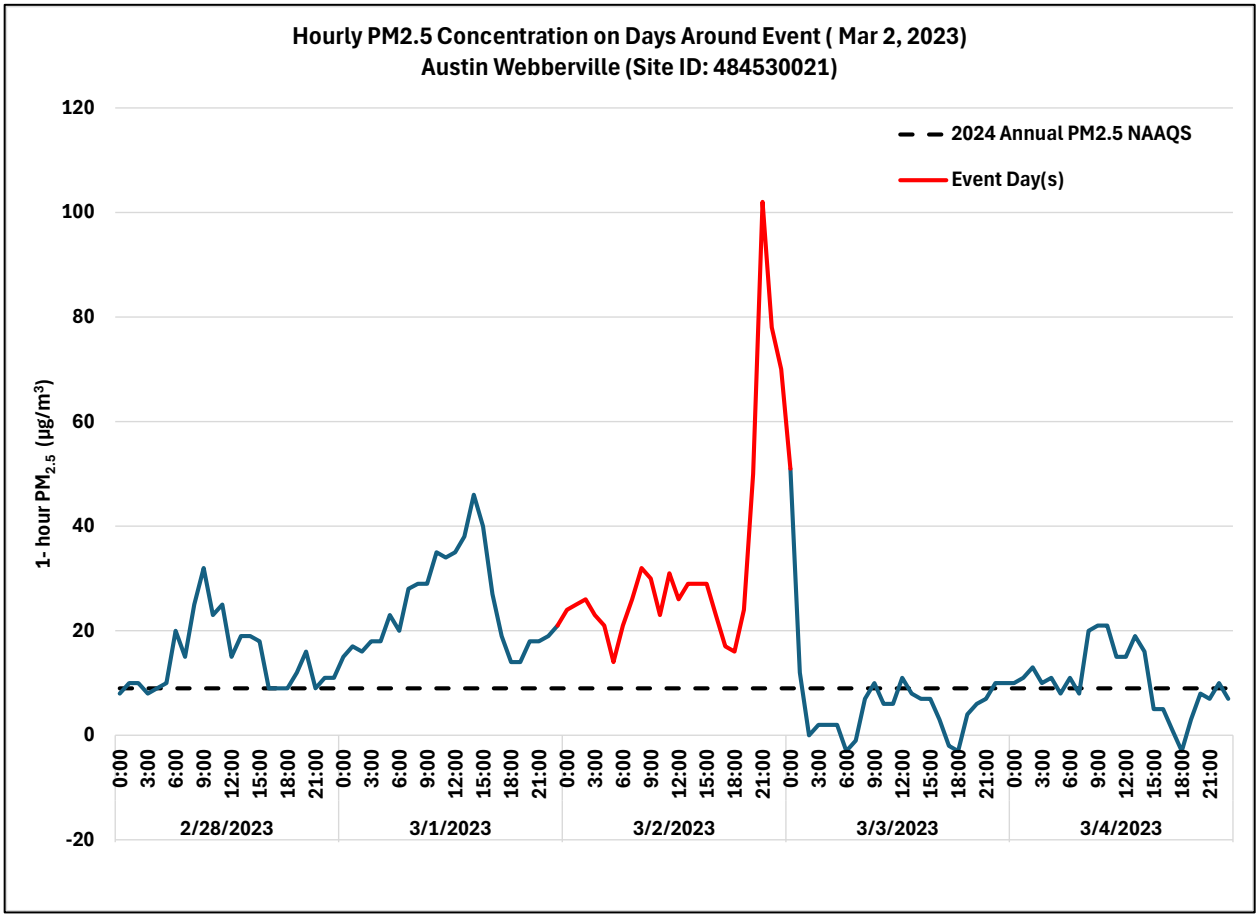


Figure 2-10: Hourly $PM_{2.5}$ Concentrations at the Webberville Monitor on Days around Event (Mar 2, 2023)

On March 2, 2023, the 500 mb chart (Figure A-24) shows a zonal pattern with longwave troughing over the central U.S. There is a major shortwave trough at 500 mb that stacks down to a low-pressure center on the surface. This low-pressure center is associated with a cold front that had previously passed over Texas as seen on the March 3, 2023, surface analysis map (Figure A-25). After this frontal passage occurred in central Texas, high pressure and subsidence began building, pushing air down to the surface. The 500 mb chart (Figure A-26) shows 60 knot winds over Texas, indicating the presence of a jet stream at 300 mb, and possibly a jet max supporting the major short-wave trough. These higher wind speeds likely

lead to high surface wind speeds and blowing dust at the Webberville monitor. The NWS forecast (Figure B-5) also discusses wind gusts in the area between 40-60 miles per hour (mph).

Figure 2-11: *Percentage of reported fire instances by the Mexican government, on and around March 2, 2023*, shows the reported fires in Mexico, with about half not likely to recur (intentional, hunting, camp fires, and smokers).

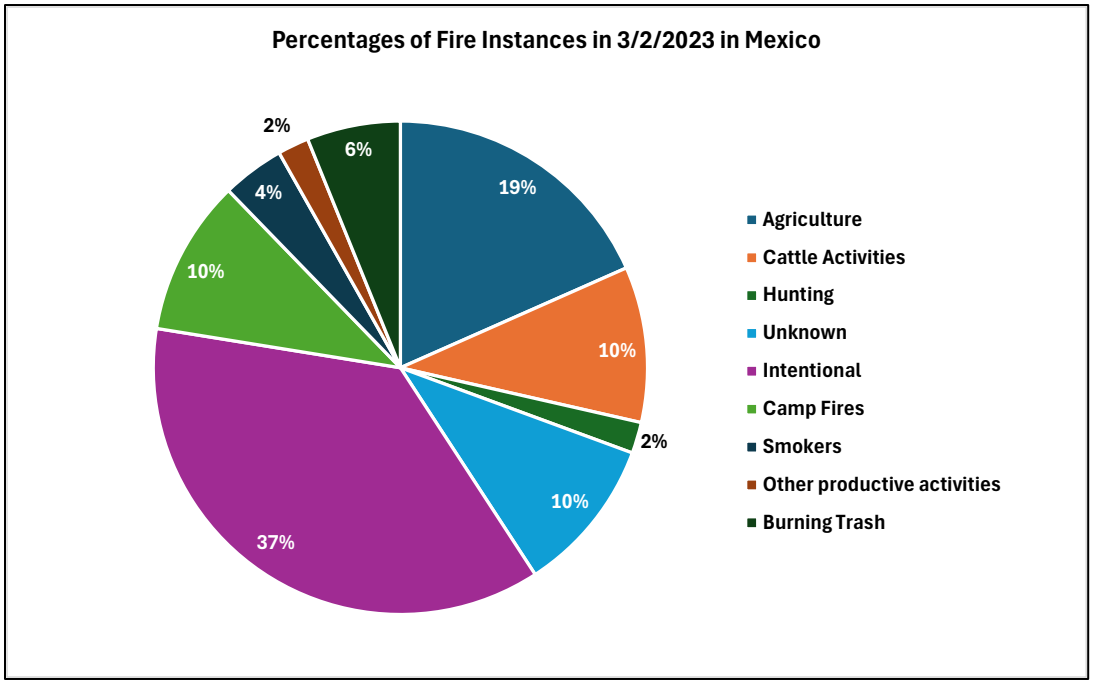


Figure 2-11: Percentage of reported fire instances by the Mexican government, on and around March 2, 2023

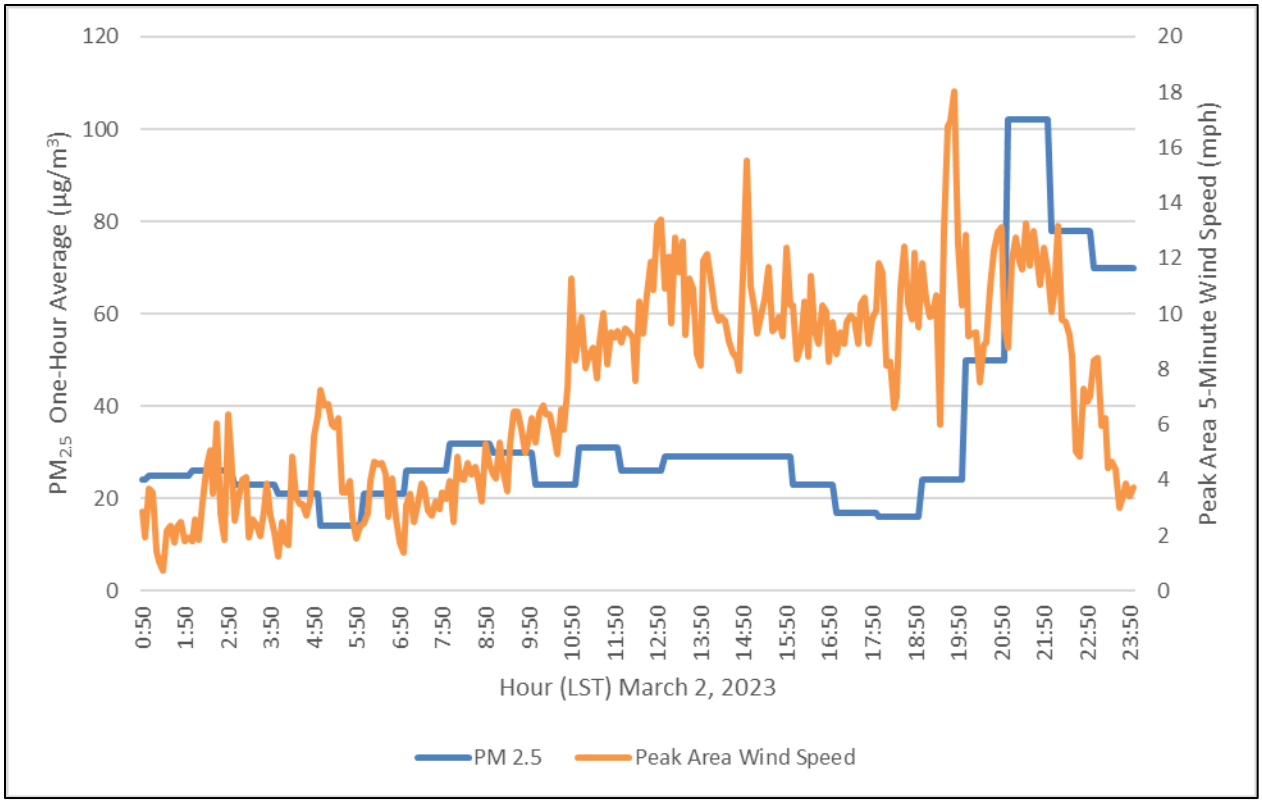


Figure 2-12: Continuous Hourly $PM_{2.5}$ and Peak Area Five-Minute Sustained Wind Speed Measurements on March 2, 2023, at the Webberville monitor

Figure 2-11: *Continuous Hourly $PM_{2.5}$ and Peak Area Five-Minute Sustained Wind Speed Measurements on March 2, 2023, at the Webberville monitor* shows that, locally, five-minute wind speeds were relatively low until approximately 11:00 local standard time (LST). At that time, wind speed increased and remained relatively stable until approximately 22:00 LST when speeds again decreased. Despite the increase in wind speed at approximately 11:00 LST, $PM_{2.5}$ concentrations remained relatively stable until rising at approximately 20:00 LST. Additionally, high winds were recorded on March 2, 2023, elsewhere in the state. This is noteworthy because, although not depicted in Figure 2-8, local winds shifted in direction from the south to the west at around 19:00 LST, and this is when $PM_{2.5}$ concentrations spiked. This fact provides an indication that elevated $PM_{2.5}$ concentrations at the Webberville monitor on March 2, 2023, originated from a source outside of the local area and were transported to the Webberville monitor via high winds that entrained the $PM_{2.5}$ in the air at the original source location. This assessment is further supported by the local, temporal wind pattern at the monitor on March 2, 2023. As displayed in Figure 2-8, the increase in $PM_{2.5}$ concentrations did not occur until several hours later than the time that wind speeds had risen relative to the early portion of the day, which allowed time for particulate matter concentrations to arrive at the monitor.

2.5.7 Group 7 – Summary of March 15, 2023, Prescribed Fire and Wildfire $PM_{2.5}$ (U.S.) Event for the Karnack Monitor

High $PM_{2.5}$ concentrations at the Karnack monitor were due to area prescribed fires and wildfires on March 15, 2023. The maximum concentration on this day was 469 µg/m^3, occurring at 10 a.m., as shown in Figure 2-12: *Hourly $PM_{2.5}$ Concentrations at the Karnack Monitor on Days around Event (Mar 15, 2023).*

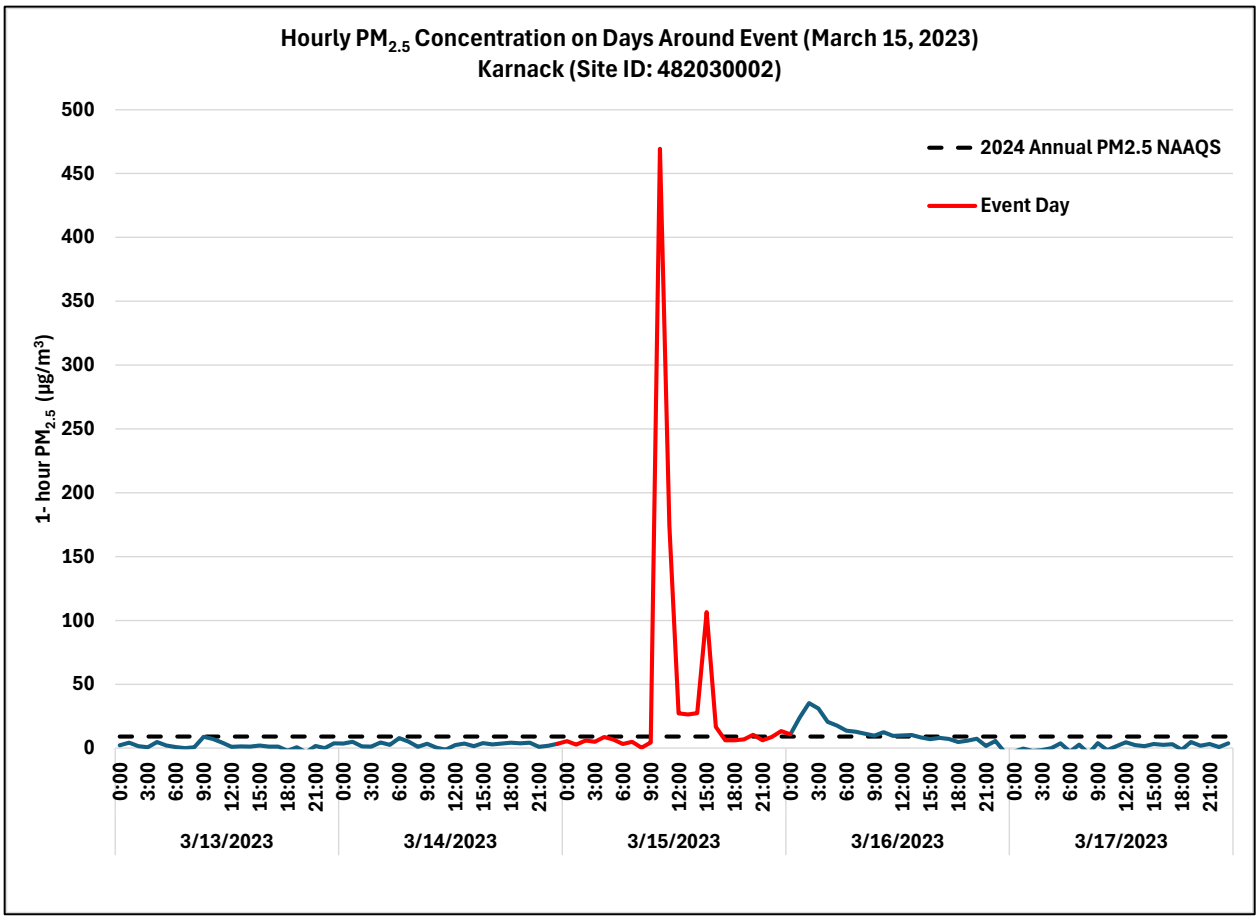


Figure 2-13: Hourly $PM_{2.5}$ Concentrations at the Karnack Monitor on Days around Event (Mar 15, 2023)

The 500 mb pattern (Figure A-26) over the U.S. was zonal on March 15, 2023, and there was ridging over Texas at this level. The surface chart (Figure A-27) shows a high-pressure center over West Virginia that extends its influence over East Texas, and the analysis also shows calm winds in the area. The Shreveport sounding (Figure A-28) shows a subsidence inversion at 825 mb, and a radiation inversion at this surface level. These both indicate high-pressure, subsidence, and stability. With prescribed fires nearby and wildfires upstream of this site (Louisiana—surface winds from the East), the stable conditions and inversion may have hindered any particulate matter from dispersing throughout the atmosphere. Smoke tends to spread over a greater and flatter area under stable atmospheric conditions. A light to medium level smoke layer is present over east Texas on the NOAA hazard map (Figure A-29).

2.5.8 Group 8 – Summary of May 5, 2023, Fire (Mexico/Central America) $PM_{2.5}$ Event for the National Seashore Monitor

The National Seashore Monitor measured elevated $PM_{2.5}$ concentrations on May 5, 2023, due to smoke from fires in Mexico/Central America. Hourly $PM_{2.5}$ concentrations on this day are shown in Figure 2-13: *Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (May 5, 2023).*

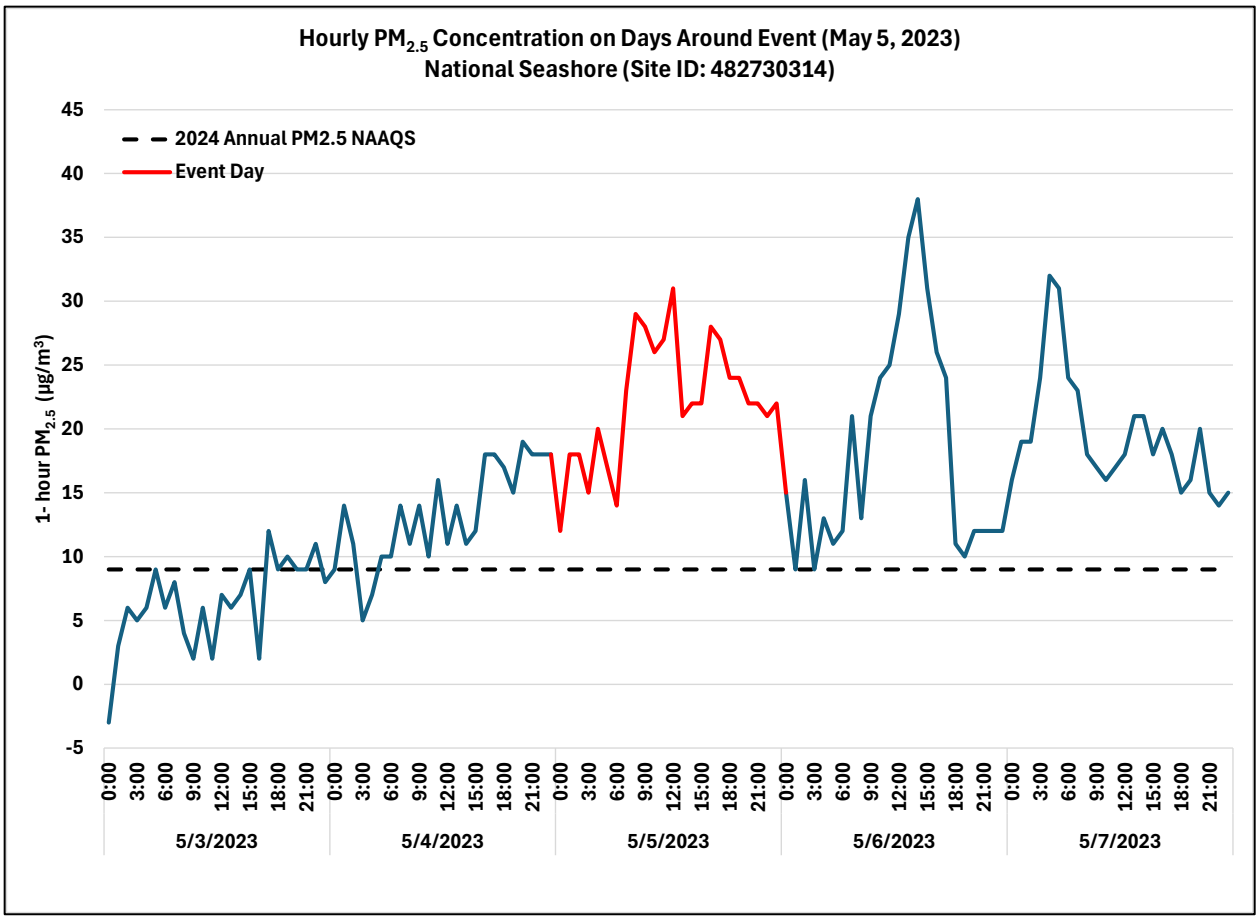


Figure 2-14: Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (May 5, 2023)

The Corpus Christi area saw winds out of the south-southeast on May 5, 2023, as shown on the surface weather map with calm winds in central Texas (Figure A-30). The May 5th 500 mb heights chart (Figure A-31) shows slight ridging over southern and south-central Texas with flow from the southwest in Southern Texas transporting smoke from fires in Mexico into the National Seashores area at the mid-levels. Medium smoke is indicated on the NOAA hazard map over south Texas (Figure A-32). The lowest levels of the May 5th Corpus Christi atmospheric sounding (Figure A-33) indicated light veering winds near the surface allowing for some stagnation in the area and persistence of smoky air at the ground level.

Figure 2-14: *Percentage of reported fire instances by the Mexican government, on and around May 5, 2023,* shows the reported fire types in Mexico on and around this exceptional event day.

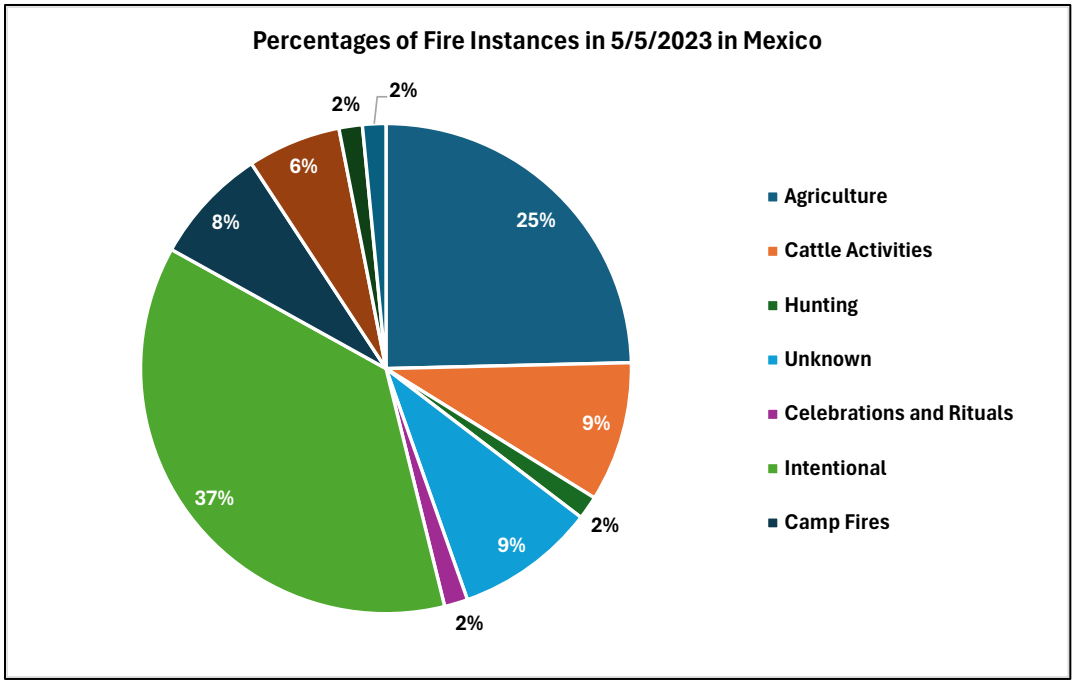


Figure 2-15: Percentage of reported fire instances by the Mexican government, on and around May 5, 2023

2.5.9 Group 9 – Summary of June 13, June 14, and June 15, 2023, Fire (Mexico/Central America) $PM_{2.5}$ Event for the Webberville Monitor and National Seashore Monitor

Elevated concentrations of $PM_{2.5}$ were measured at the Webberville monitor and National Seashore monitor on June 13 through June 15, 2023, due to smoke from fires in Mexico/Central America. Figure 2-15: *Hourly $PM_{2.5}$ Concentrations at the Webberville Monitor and National Seashore Monitor on Days around Event (Jun 13, 2023 – Jun 15, 2023)* shows hourly concentrations at both monitors during this group of days. Medium levels of smoke are shown across central and south Texas on the NOAA Hazards map on June 15, 2023, indicating that smoke has traveled from fires in Mexico (Figure A-34).

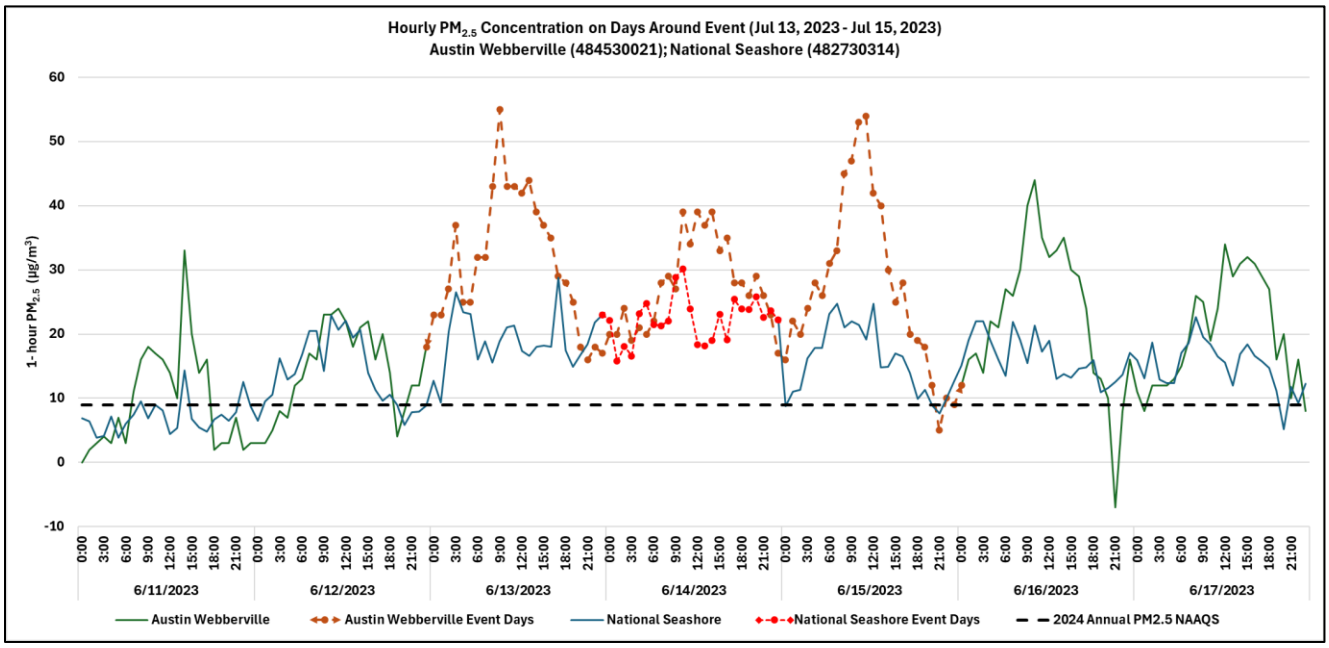


Figure 2-16: Hourly $PM_{2.5}$ Concentrations at the Webberville Monitor and National Seashore Monitor on Days around Event (Jun 13, 2023 – Jun 15, 2023)

On June 13, 2023, a stationary front extended from east to west Texas, and the winds in Central Texas were from the south at 5-10 knots (Figure A-35). On the next day, the winds shifted from the south/southeast at 5-15 knots (Figure A-38). On June 15th, the stationary front in Texas moved further to the north, and winds remained the same (Figure A-41).

There are no observed sounding locations within 200 miles of the Webberville sensor, so the local meteorological effects from June 13-15, 2023, are difficult to analyze. However, all three soundings from Lake Charles do indicate subsidence over Texas due to the presence of subsidence inversions on each day. Subsidence is the downward movement of air that likely brought stability to the lower atmosphere and kept any particulate matter from dissipating into the upper atmosphere. This is corroborated by the weak ridging seen on the 500 mb charts over Texas (Figures A-36, A-39, A-42). Additionally, METAR weather reports at Austin Bergstrom Airport (20 miles West of the Webberville sensor) indicate that the weather conditions were very stable near the surface as there was mist and haze present throughout the three days.[12] This stability likely trapped any smoke or particulate matter in the lower atmosphere.

Figure 2-17: *Percentage of reported fire instances by the Mexican government, on and around June 13 through June 15, 2023*, shows the reported fire types in Mexico on these event days, with around half of the reported fires considered unlikely to recur.

[12] https://www.ogimet.com/metars.phtml.en

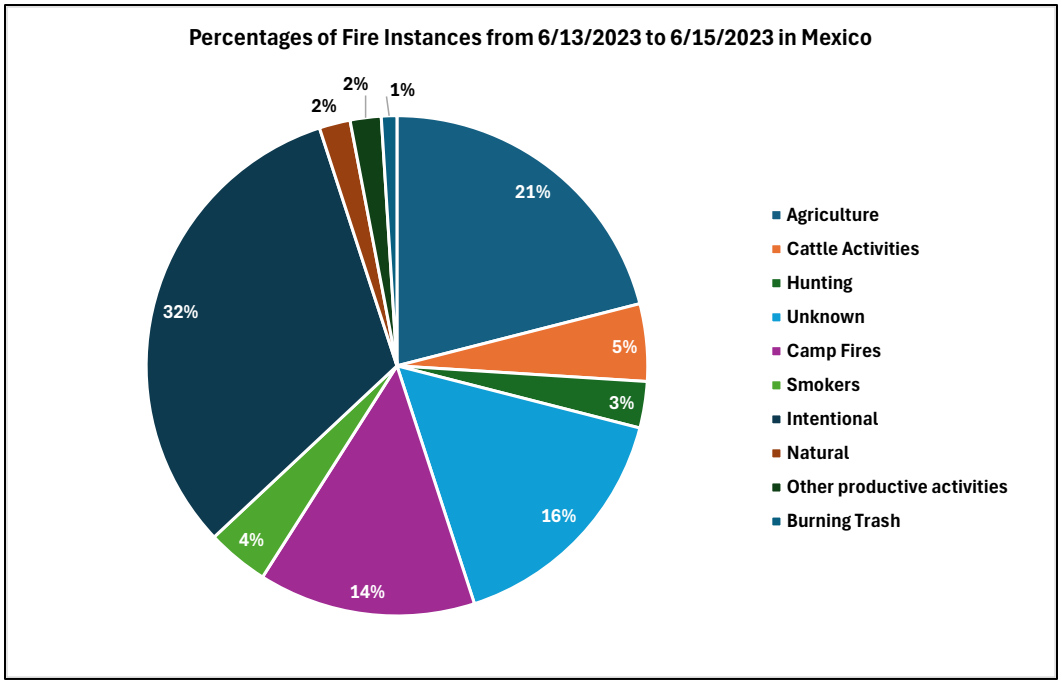


Figure 2-17: Percentage of reported fire instances by the Mexican government, on and around June 13 through June 15, 2023

2.5.10 Group 10 – Summary of July 15 and July 16, 2023, African Dust $PM_{2.5}$ Event for the National Seashore Monitor

The National Seashore monitor was affected by Saharan dust on July 15 and July 16, 2023, which led to elevated $PM_{2.5}$ concentrations on these days, as shown in Figure 2-18: *Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Jul 15, 2023 and Jul 16, 2023).*

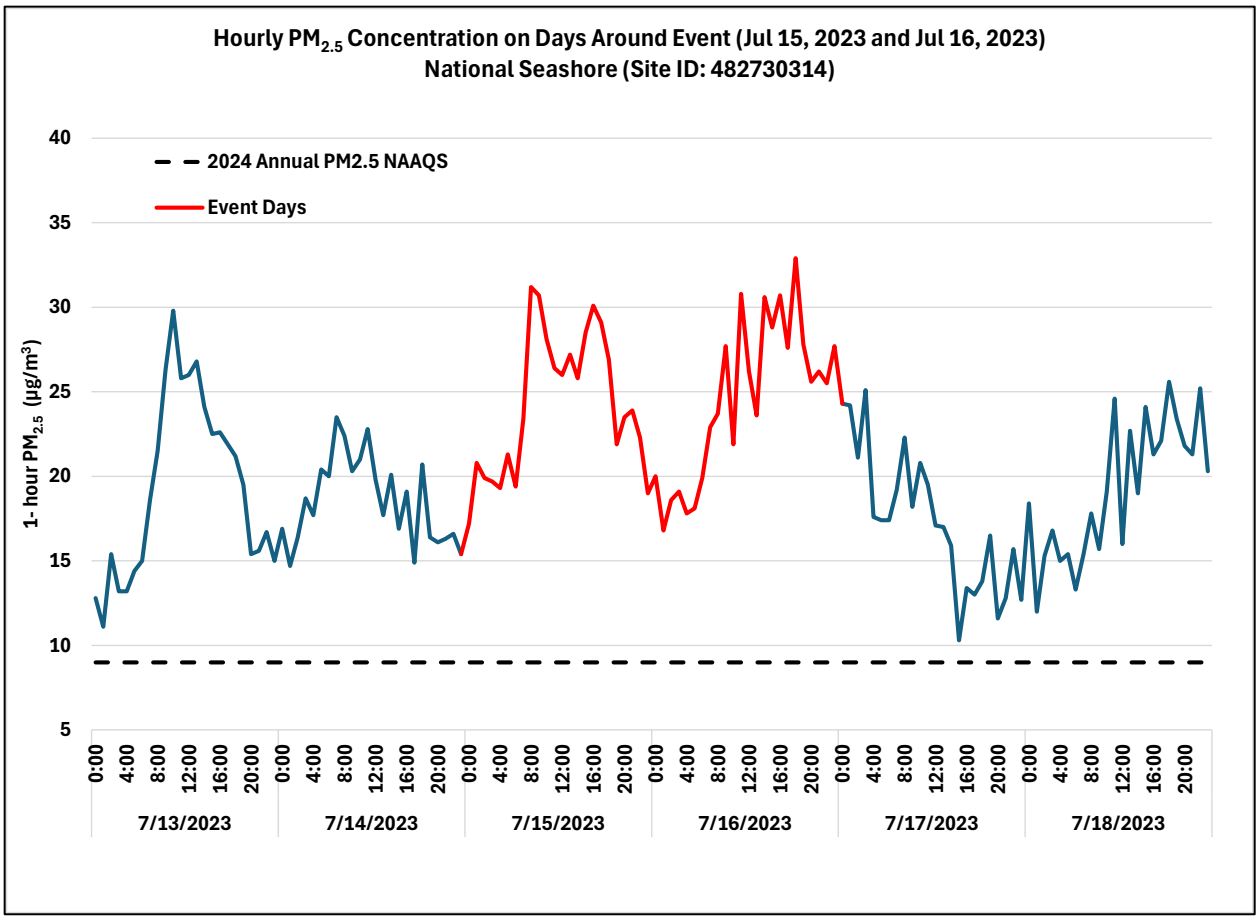


Figure 2-18: Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Jul 15, 2023, and Jul 16, 2023)

The Corpus Christi area saw light winds off of the Gulf of Mexico, as depicted in the July 15th surface weather map (Figure A-44). An area of high pressure is also present over the eastern Gulf of Mexico, with the anticyclone imparting southerly surface winds in south Texas. The 500 mb heights chart on July 15th (Figure A-45) indicates mid-level winds from the east to the west over the coastal bend and south Texas along with east to west winds at the mid-level over southern Florida. This east to west flow at the mid-levels aids in the transport plumes of Saharan dust across from the Atlantic Ocean, across the Caribbean and the Gulf of Mexico and into the coastal bend and southern portions of Texas. The Corpus Christi atmospheric sounding from July 15th (Figure A-46) shows winds out of the south at the surface and backing to winds (indicating subsidence or sinking air) out of the east in the mid-levels. The sounding also depicts a deep layer of dry air. This dry layer, along with the winds out of the east are both associated with a Saharan air layer present in the area.

Weather conditions on July 16th were similar to the 15th. Winds along the coast at the surface were light out of the southeast (Figure A-47). The 500 mb heights chart for July 16th (Figure A-48) shows the flow from east to west continuing at the mid-levels over the coastal bend and south Texas areas. The sounding at Corpus Christi on the 16th (Figure A-49) also continues to show a deep layer of dry air just above the surface along with backing winds, with height, going from southerly at the surface to easterly around 500 mb. These conditions are typically present when the Saharan air layer is present over the National Seashore monitor.

2.5.11 Group 11 – Summary of July 25, July 26, July 27, and July 28, 2023, African Dust $PM_{2.5}$ Event for the National Seashore Monitor

Saharan dust led to elevated concentrations of $PM_{2.5}$ at the National Seashore monitor on July 25 through July 28, 2023, as shown in Figure 2-19: *Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Jul 25, 2023 – Jul 28, 2023)*. The NWS forecast on July 26th and 27th (Figures B-6 and B-7) mentions Saharan dust moving into south Texas, leading to hazy conditions.

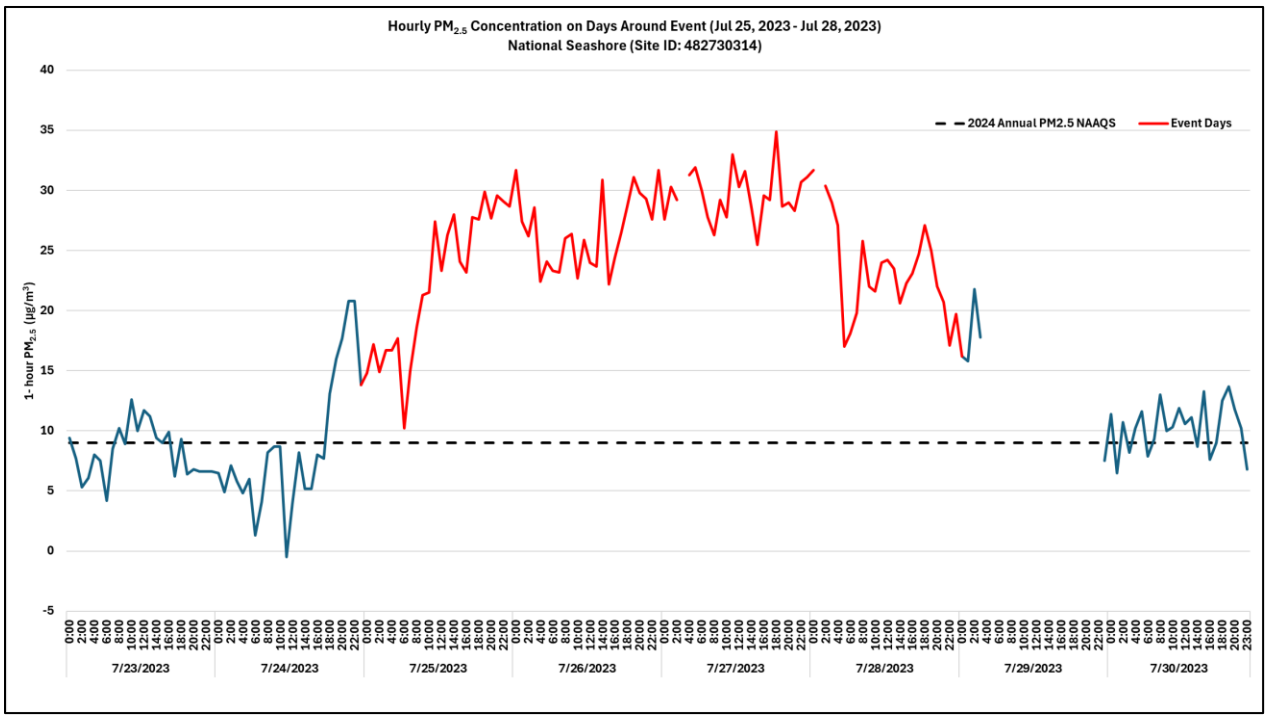


Figure 2-19: Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Jul 25, 2023 – Jul 28, 2023)

On July 25th, a surface area of high pressure was present over the eastern Gulf of Mexico with a weak cold front over the southeast U.S. as seen in the July 25th surface weather map (Figure A-50). A weak area of high pressure can be seen in the mid-levels of the atmosphere over the central part of the Gulf of Mexico in the 500 mb heights chart from July 25th (Figure A-51). A broad area of mid-level ridging can also be seen over the southwest U.S. Circulation around the high pressure over the Gulf of Mexico aided in transporting Saharan dust over the Gulf of Mexico into portions of south Texas and the coastal bend. The July 25th atmospheric sounding at Corpus Christi (Figure A-52) also shows a layer of dry air near the surface and light winds out of the south and southeast, which are typically present when a Saharan air mass is present.

On July 26th, high pressure continued to prevail over the central and eastern Gulf of Mexico, as seen in the July 26th surface weather map (Figure A-53). A weak stationary front was present across the southeast U.S., extending into northeast Texas. Surface monitors near the high-pressure system showed anti-cyclonic circulation around the Gulf of Mexico surface high, transporting Saharan dust into south Texas and the coastal bend. The 500 mb heights chart from July 26th (Figure A-54) shows a mid-level high pressure system centered over the four-corners area with ridging seen over the western two-thirds of Texas. The sounding on July 26th (Figure A-55) indicates winds out of the south in the lower levels, transporting smoke from industrial activity in the Bay of Campeche and Saharan dust from the Gulf of Mexico into the

National Seashore monitor area. The NOAA HMS map indicates medium smoke levels across the Texas coastline (Figure A-56).

A high-pressure system centered over the north-central Gulf of Mexico continued to be the dominating feature in the area as seen in the July 27th surface weather map (Figure A-57). Surface weather observations around the high-pressure system continue to show the anti-cyclonic flow, transporting African dust and smoke associated with industrial activity in the western Gulf of Mexico into the National Seashore area. The Corpus Christi atmospheric sounding on July 27th (Figure A-58) continues to show southerly flow into the area in the lower layers of the atmosphere, as well as a deep layer of dry air, which combined with the southerly winds, are typically seen when a Saharan air mass is influencing conditions at the location.

The high-pressure system over the north-central Gulf of Mexico expanded east and north into Texas and the southeast U.S., as seen on the July 28th surface weather map (Figure A-59). Light southerly winds are present near the National Seashore monitor. The July 28th 500 mb (Figure A-60) and 250 mb height charts (Figure A-61) indicate tropical upper tropospheric trough over northern Mexico and deep south Texas. Circulation around this low-pressure system transported smoke and Saharan dust into the Corpus Christi area. Evidence of the circulation around the mid-upper-level low pressure system are present in the July 28th atmospheric sounding in Corpus Christi (Figure A-62). Light levels of smoke in the area are indicated on the NOAA hazard map for this day (Figure A-63).

SECTION 3: CLEAR CAUSAL RELATIONSHIP

3.1 OVERVIEW

This section satisfies the Exceptional Events Rule Requirements at 40 CFR §50.14(c)(3)(iv)(B) and 40 CFR §50.14(c)(3)(iv)(C): "The event affected air quality in such a way that there exists a clear, causal relationship between the specific event and the monitored exceedance(s) or violations(s); and analyses comparing the claimed event-influenced concentrations to concentrations at the same monitoring site(s) at other times."

The analyses presented in this section vary depending on the event type (Prescribed Fire, Wildland Fire, African Dust, and High Winds Events) as well the tier level, based on observed concentrations, associated with each event day. The analyses include a comparison of the event-related concentration to historical concentrations, evidence that the emissions from the events were transported to the monitor, and evidence that the events related emissions affected the monitor.

TCEQ determined the tier levels for the event days using EPA's *$PM_{2.5}$ Tiering Tool - for Exceptional Events Analysis.*[13] Tiering thresholds, established for each site, are used to classify event days as Tier 1 or Tier 2 or Tier 3 days. All 2023 event days are Tier 1 or Tier 2 days.

- Tier 1 event days are those when monitored $PM_{2.5}$ exceedances or violations are clearly influenced by causal events. Tier 1 event days require fewer pieces of evidence to establish the clear causal relationship. This tier is associated with a $PM_{2.5}$ concentration that is greater than or equal to 1.5x the tiering threshold.
- Tier 2 event days are those with $PM_{2.5}$ concentrations that are less extreme than Tier 1 days but still higher than concentrations on most non-event related concentrations, typically between 1 to 1.5x the tiering threshold. Tier 2 event days require more evidence than Tier 1 days to establish the clear causal relationship.

The determination of the appropriate tiering level began with an analysis of the measured $PM_{2.5}$ air quality associated with the candidate event in relation to historical concentrations. Distinct high levels of monitored 24-hour $PM_{2.5}$ concentrations when compared to historical monthly or annual 24-hour levels of $PM_{2.5}$. TCEQ compared the concentration of each event day to the lesser value with all "Request Exclusion" (R) qualifiers excluded of either (a) the most recent 5-year month-specific 98th percentile for 24-hour $PM_{2.5}$ data, or (b) the minimum annual 98th percentile for 24-hour $PM_{2.5}$ data for the most recent 5-year period.

Figure 3-1: *24-Hour $PM_{2.5}$ concentrations, 2023 event days and Tier 1 and Tier 2 thresholds for the Karnack Monitor*, Figure 3-2: *24-Hour $PM_{2.5}$ concentrations, 2023 event days and Tier 1 and Tier 2 thresholds for the Austin Webberville Monitor*, and Figure 3-3: *24-Hour $PM_{2.5}$ concentrations, 2023 event days and Tier 1 and Tier 2 thresholds for the National Seashore Monitor* illustrate the 24-hour $PM_{2.5}$ concentrations on 2023 event days compared to non-event days relative to the Tier levels for each monitor.

[13] https://www.epa.gov/air-quality-analysis/pm25-tiering-tool-exceptional-events-analysis

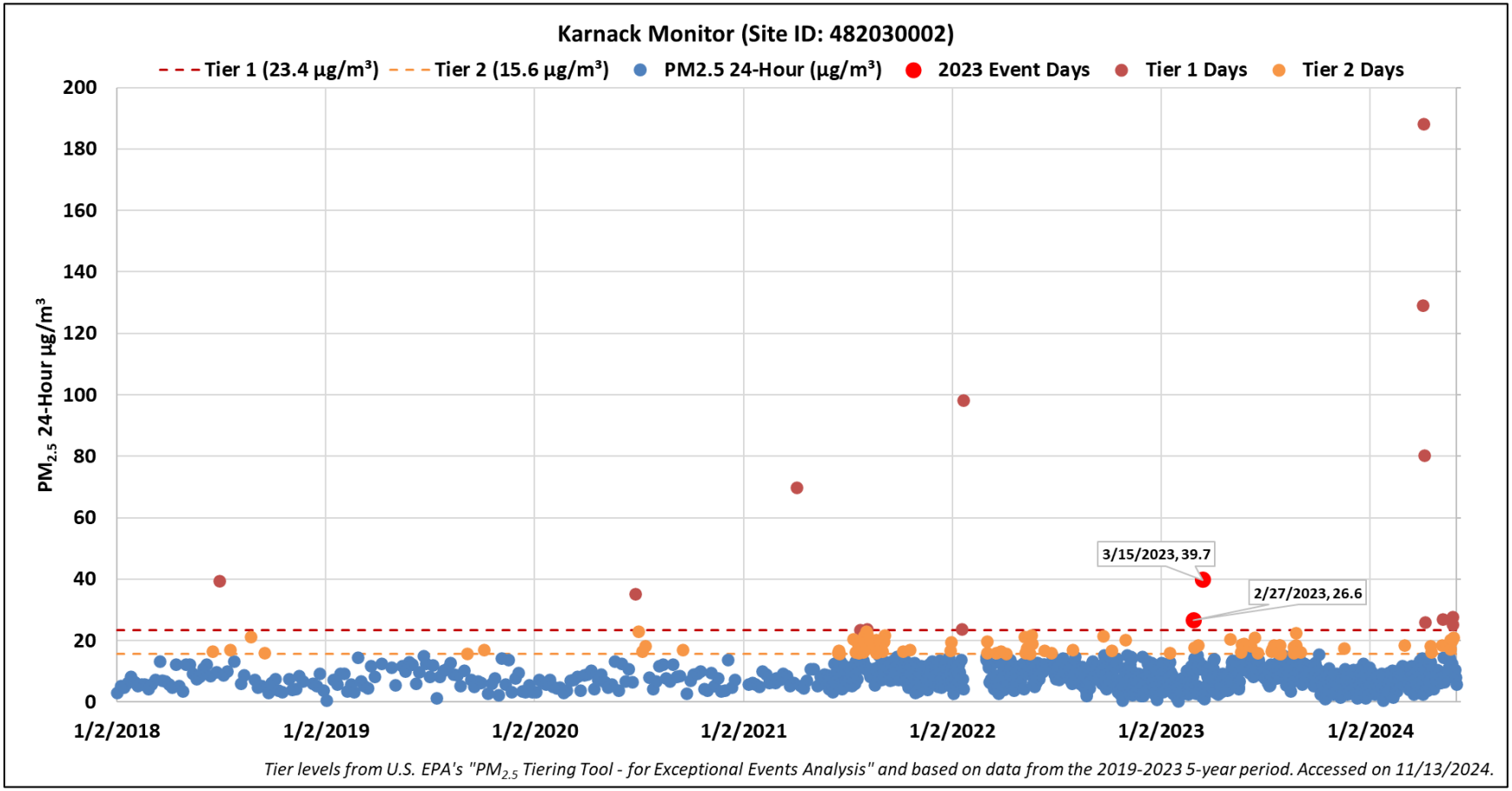


Figure 3-1: 24-Hour $PM_{2.5}$ concentrations, 2023 event days and Tier 1 and Tier 2 thresholds for the Karnack Monitor

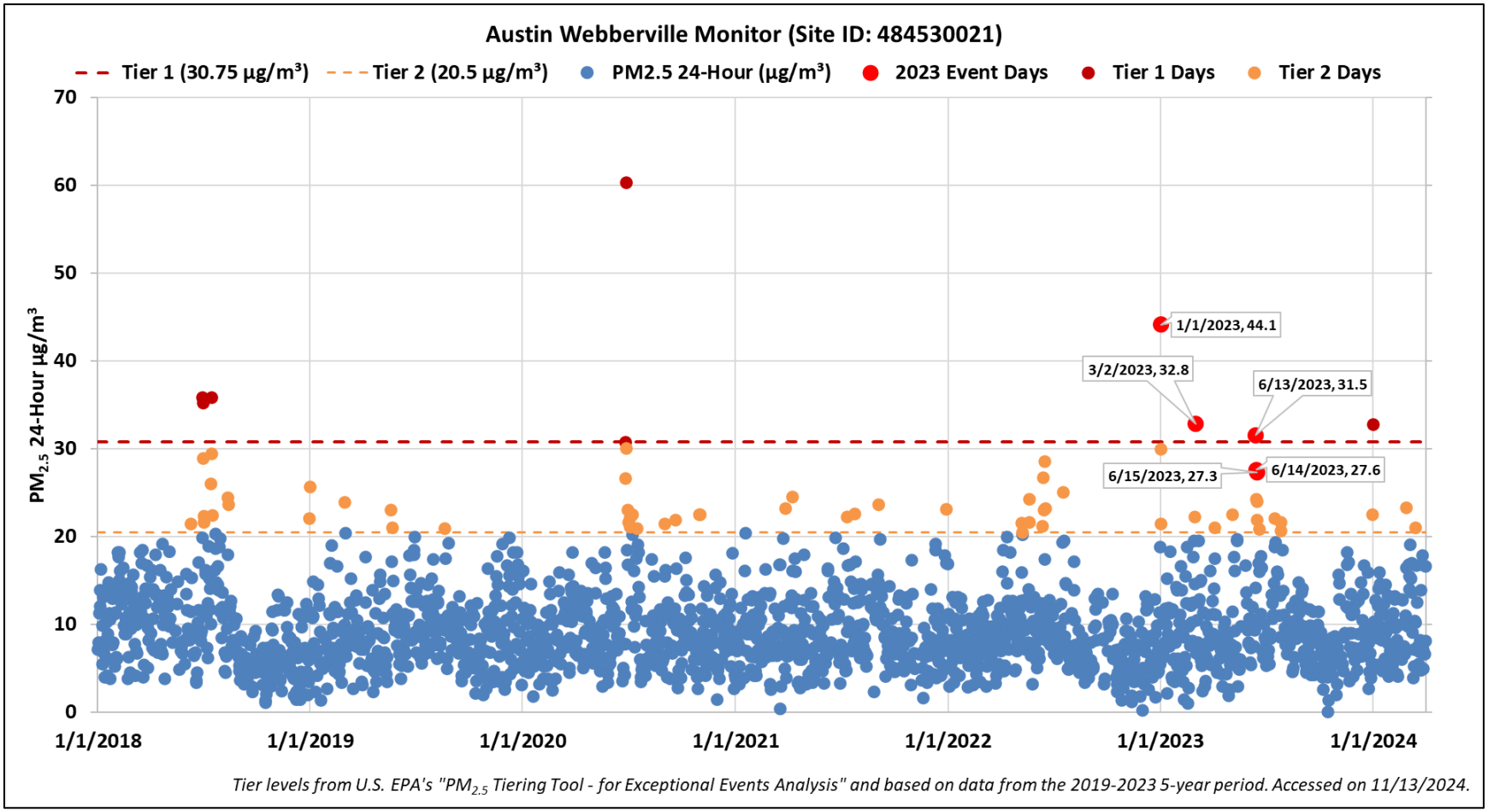
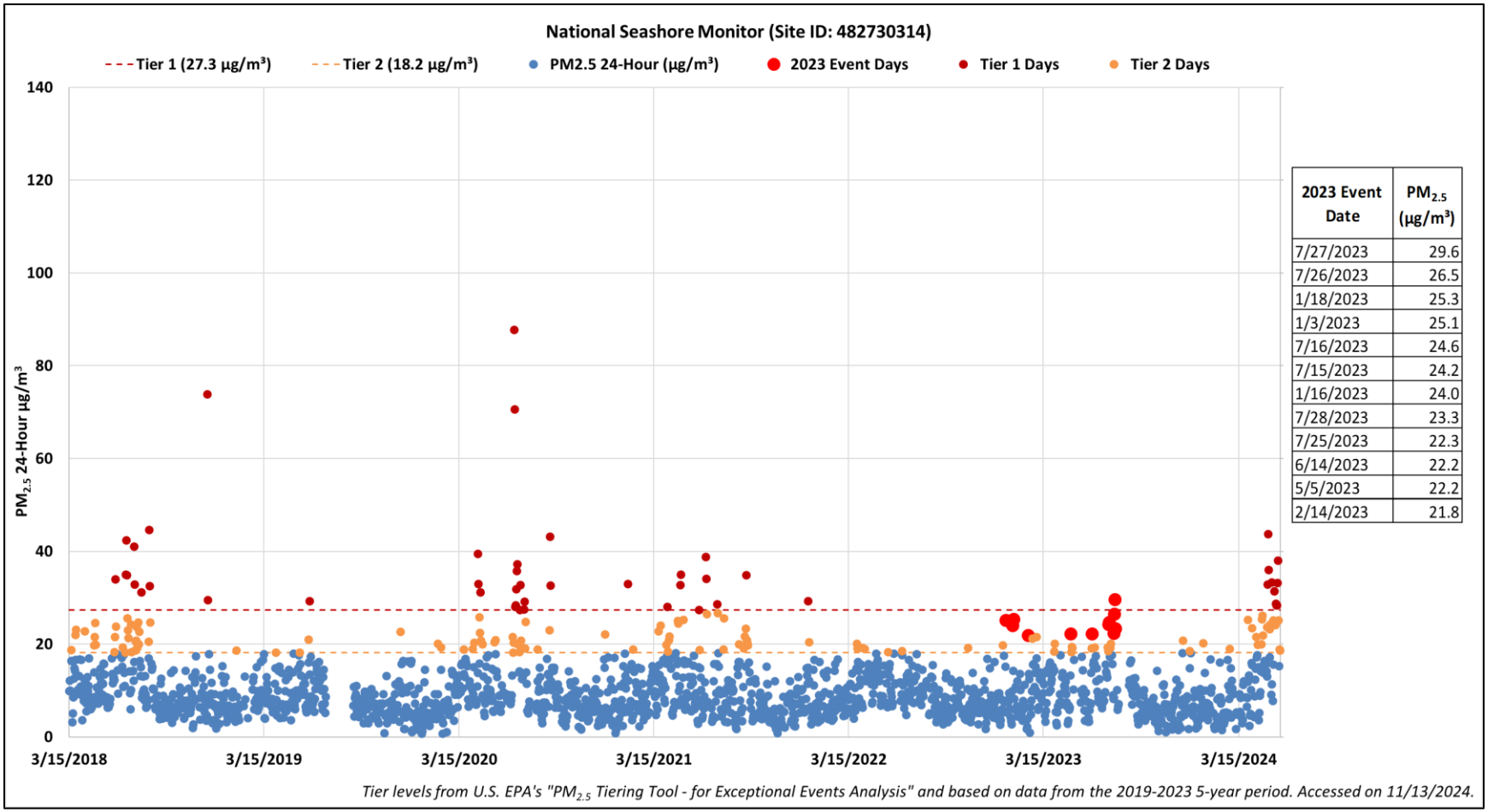


Figure 3-2: 24-Hour $PM_{2.5}$ concentrations, 2023 event days and Tier 1 and Tier 2 thresholds for the Austin Webberville Monitor



2023 Event Date	$PM_{2.5}$ (µg/m³)
7/27/2023	29.6
7/26/2023	26.5
1/18/2023	25.3
1/3/2023	25.1
7/16/2023	24.6
7/15/2023	24.2
1/16/2023	24.0
7/28/2023	23.3
7/25/2023	22.3
6/14/2023	22.2
5/5/2023	22.2
2/14/2023	21.8

Figure 3-3: 24-Hour $PM_{2.5}$ concentrations, 2023 event days and Tier 1 and Tier 2 thresholds for the National Seashore Monitor

3.2 CLEAR CAUSAL EVIDENCE

In addition to Figure 3-1, Figure 3-2, and Figure 3-3, which show 24-hour $PM_{2.5}$ concentrations on event and non-event days at each monitor, additional data are used to demonstrate a clear causal relationship between the $PM_{2.5}$ concentrations observed on an event day and the identified exceptional event. Imagery and data used for the clear causal evidence come from multiple sources:

- Air parcel trajectories were produced using the National Oceanic and Atmospheric Administration (NOAA) Applied Research Laboratory (ARL) HYSPLIT model available on the ARL HYSPLIT webpage: https://www.arl.noaa.gov/hysplit/. HYSPLIT models simulate the dispersion and trajectory of substances transported and dispersed through the atmosphere over local to global scales. The backward trajectory analyses presented in this document were used to determine the origin of air masses and establish source-receptor relationships.
  - For the combined trajectory and fire maps, these trajectories show the modeled path of the air mass from 72 hours arriving at different heights (100 meters, 500 meters, 800 meters above ground level (AGL)) to the monitor and arriving at the hour with the highest concentration on the relevant date. The meteorological data input used for these trajectories comes from the Global Data Assimilation System (GDAS), which is run by the National Weather Service's National Centers for Environmental Prediction (NCEP). Additional information is available at: https://www.ready.noaa.gov/gdas1.php
  - For the ensemble trajectories on Fire-Mexico/Central America event days, a backward trajectory started for each hour of the day is shown, and the duration for each trajectory is 72 hours. The three different plots show the different starting heights (100 meters, 500 meters, and 800 meters AGL). The meteorological data input used is also GDAS.
  - For the dust trajectories from Africa, forward trajectories started from a matrix that was placed over western Africa. With the matrix utility, the user specifies the southwest point and northeast point of a four-sided polygon as well as the time at which trajectories are to be generated. When the matrix utility is run, trajectories for all points within the polygon are simultaneously initiated. In this application, there were approximately 200 trajectory starting points. The duration of each trajectory was 240 to 360 hours (10 to 15 days) depending on how long it took for the air parcels to reach Texas. The meteorological data input used is also GDAS.
  - For forward trajectories on days impacted by fires in Mexico/Central America, trajectories were started 72 hours ahead of the event day at 500 meters AGL using the GDAS meteorological data.
- Hourly $PM_{2.5}$ event concentrations were compared with typical concentrations (Tier III median) for each hour. Data are from Texas Air Monitoring System (TAMIS) files sourced from EPA's Air Quality System (AQS) Raw Data Report: https://www.epa.gov/outdoor-air-quality-data. Data were downloaded on October 31, 2024.
- Smoke plume maps are from the AirNow Fire and Smoke Map: https://fire.airnow.gov/. This map also shows the Air Quality Index (AQI) for each monitor. Additional information about AQI is available on the AirNow website: https://www.airnow.gov/aqi/aqi-basics/.
- Media reports and TCEQ forecast discussions are provided in Appendix C. Media report links are referenced with the figure. TCEQ forecasts for event days are archived and available at: https://amdaftp.tceq.texas.gov/exceptional_events/.
- The Navy Aerosol Analysis and Prediction System (NAAPS) is a global forecast model that predicts the concentrations of sulfate, dust, and smoke aerosols in the troposphere and is a combination of several individual forecast models. Meteorological information is provided by the Navy Operational Global Atmospheric Prediction System (NOGAPS) numerical forecast model, and information on aerosols is provided by individual sulfate, smoke, and dust emissions models. NAAPS model plots showing dust and smoke concentrations at the surface are provided in Appendix D. NAAPS data is available at: https://www.nrlmry.navy.mil/aerosol/index_frame.html

- Various satellite images were downloaded from NASA Worldview: https://worldview.earthdata.nasa.gov/. Imagery details are provided for in the figure captions.

3.2.1 Group 1 – Evidence for January 1, 2023, Fireworks $PM_{2.5}$ Event for the Webberville Monitor

January 1, 2023, was identified as a Tier 1 day at the Webberville Monitor due to fireworks. The 24-hour concentration was 44.1 µg/m³, and Figure 3-4: *Hourly $PM_{2.5}$ Concentrations on January 1, 2023, compared to typical concentrations at the Webberville Monitor* shows the peak concentration of $PM_{2.5}$ shortly after midnight. Peak concentrations correspond to the New Year's Day holiday and the public celebrating with fireworks. There was also a city sponsored firework show on New Year's Day, as reported in the local media (Figure C-1). The use of fireworks during New Year's Day is considered significantly integral as a cultural event, therefore the data on this day should be excluded as allowed under 40 CFR §50.14(b)(2).

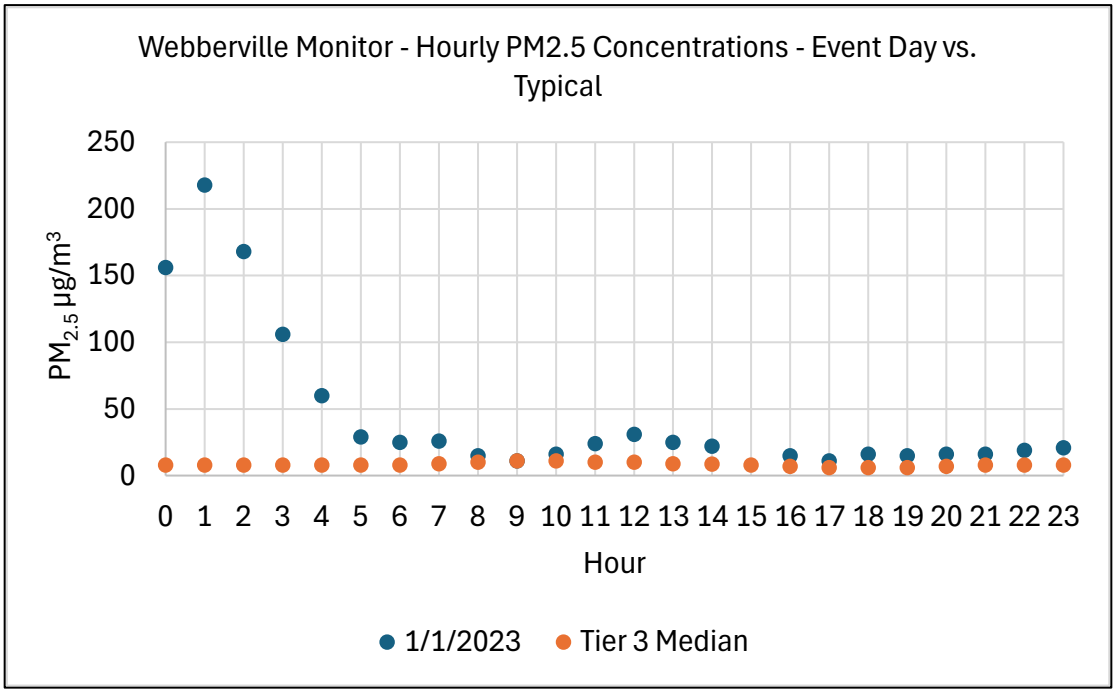


Figure 3-4: Hourly $PM_{2.5}$ Concentrations on January 1, 2023, compared to typical concentrations at the Webberville Monitor

Back trajectories from this monitor (Figure 3-5: *HYSPLIT back trajectories from the Webberville monitoring site on January 1, 2023*) indicate transport along the I-35 corridor and from south Texas; however, much of the smoke at this monitor was local in nature due to fireworks in the area.

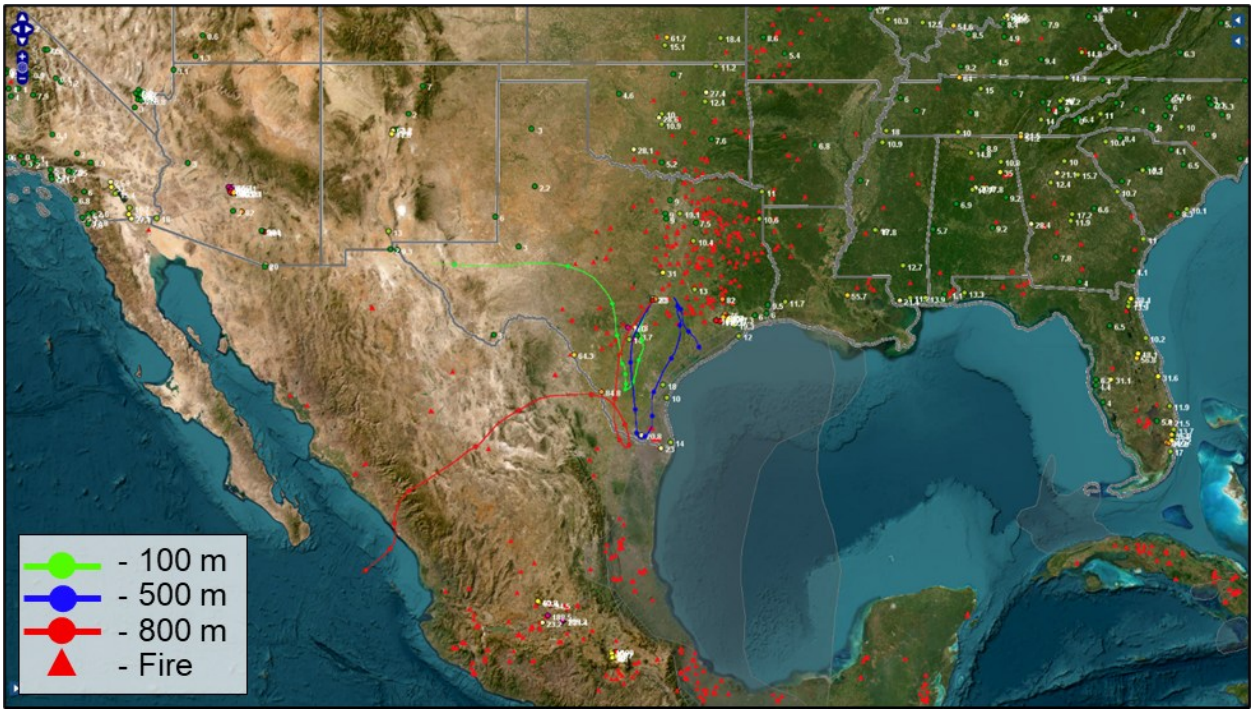


Figure 3-5: HYSPLIT back trajectories from the Webberville monitoring site on January 1, 2023

3.2.2 Group 2 – Evidence for January 3, 2023, Fire (Mexico/Central America) $PM_{2.5}$ Event for the National Seashore Monitor

January 3, 2023, was identified as a Tier 2 day at the National Seashore Monitor. The 24-hour exceedance concentration was 25.1 µg/m^3, with elevated concentrations of $PM_{2.5}$ sustaining through the day, as seen on the hourly concentration graph (Figure 3-6: *Hourly $PM_{2.5}$ Concentrations on January 3, 2023, compared to typical concentrations at the National Seashore Monitor*). The TCEQ forecast (Table C-1) describes elevated background concentrations of particulate matter due to smoke from offshore oil rigs in the Bay of Campeche and seasonal fire activity in Eastern Mexico. Back trajectories (Figure 3-7: *HYSPLIT back trajectories from the National Seashore monitoring site on January 3, 2023,* and Figure 3-8: *72-hour HYSPLIT back trajectories starting from each hour on January 3, 2023, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800m AGL*) and the smoke plume from AirNow (Figure 3-9: *AirNow Navigator with HMS Smoke Plume for January 3, 2023*) support this forecast showing transport of smoke to the Kleberg monitor. Additionally, higher smoke surface concentrations can be seen along the Gulf coastline on the NAAPS model plot (Figure D-1).

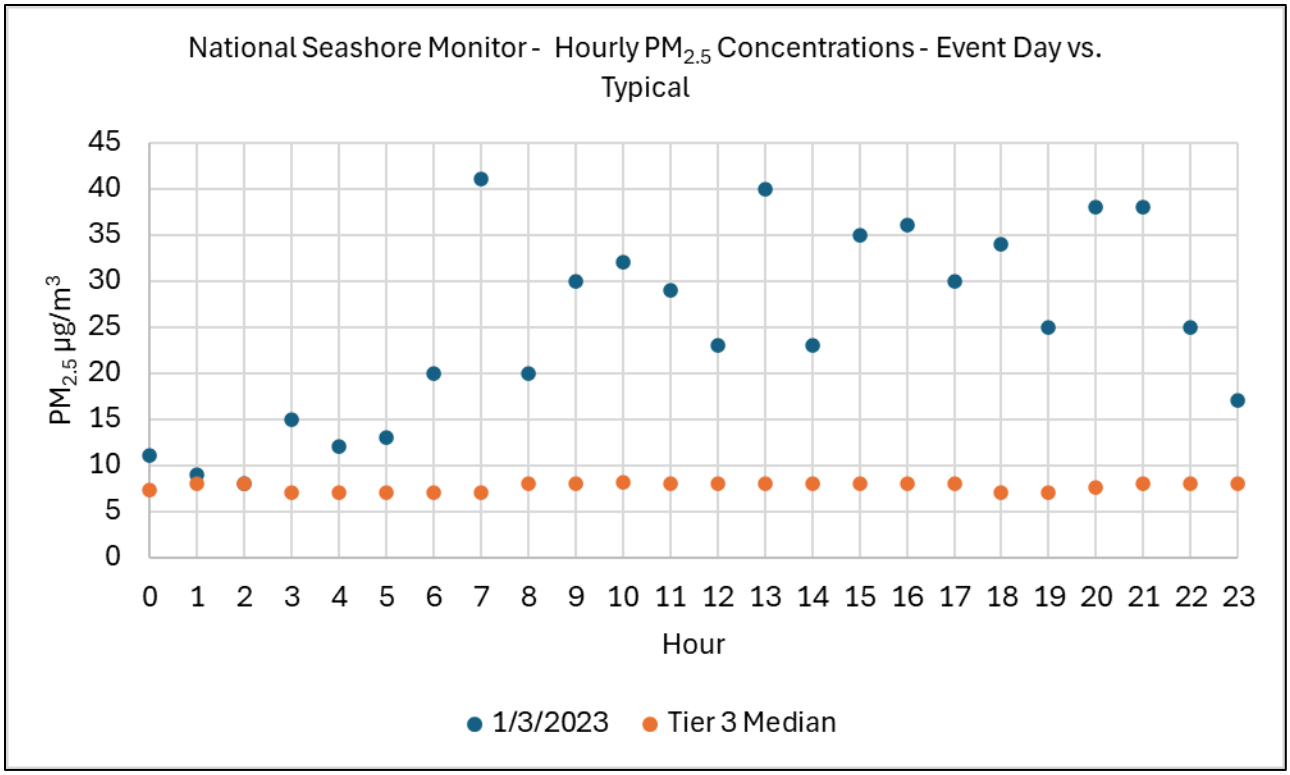


Figure 3-6: Hourly $PM_{2.5}$ Concentrations on January 3, 2023, compared to typical concentrations at the National Seashore Monitor

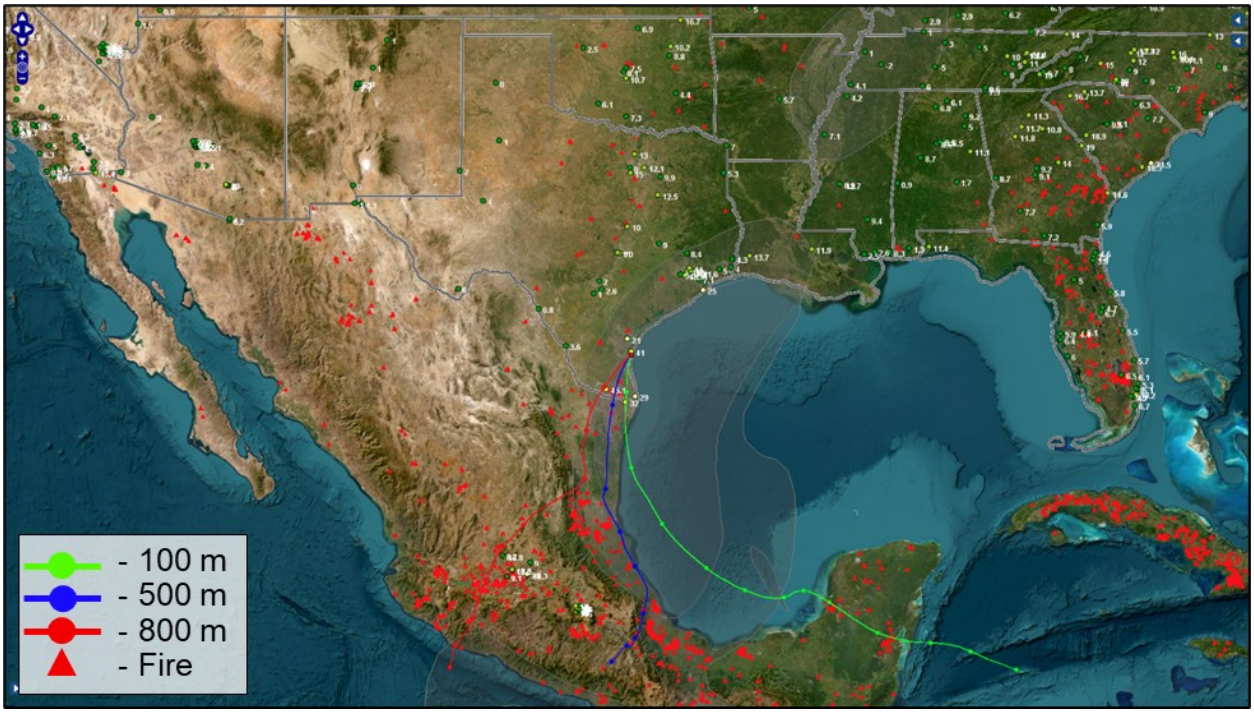


Figure 3-7: HYSPLIT back trajectories from the National Seashore monitoring site on January 3, 2023

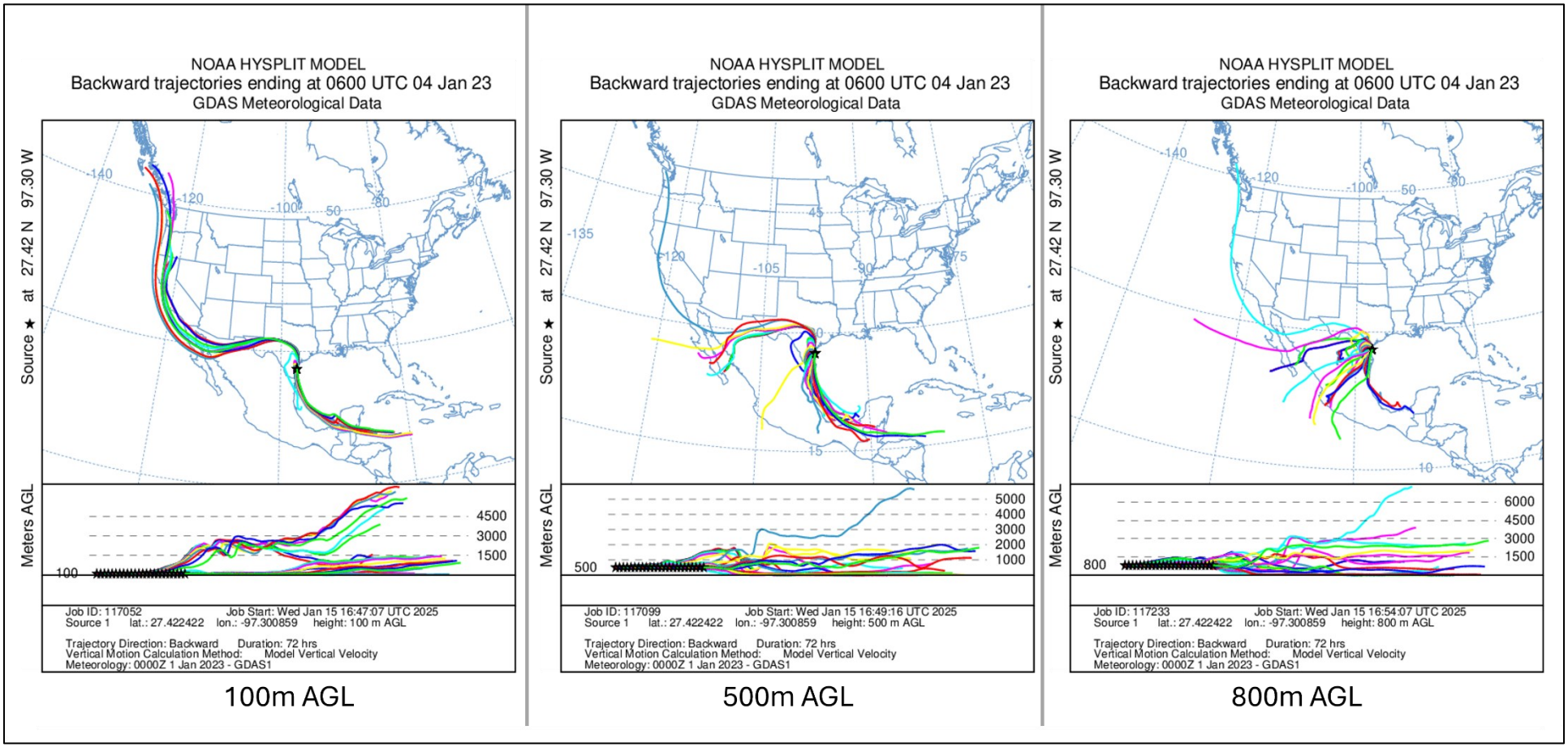


Figure 3-8: 72-hour HYSPLIT back trajectories starting from each hour on January 3, 2023, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL

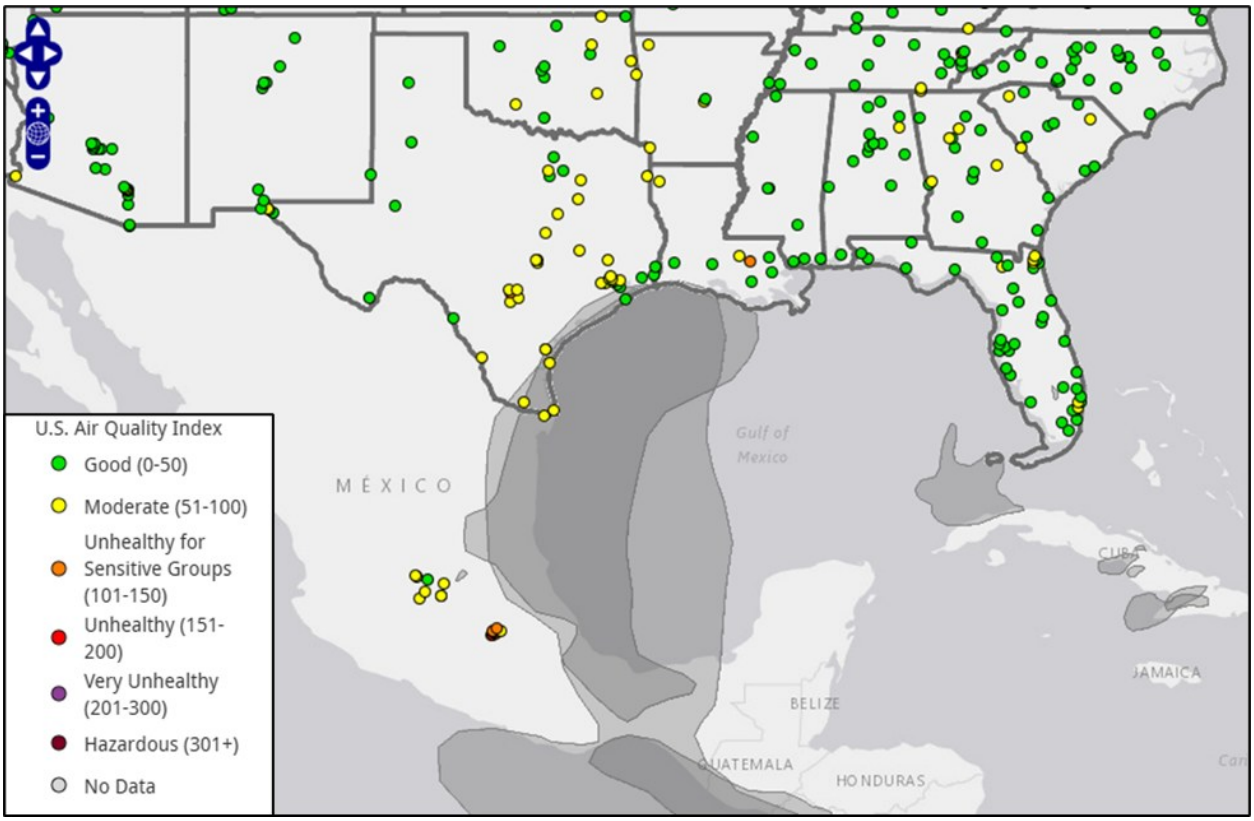


Figure 3-9: AirNow Navigator with HMS Smoke Plume for January 3, 2023

3.2.3 Group 3 – Evidence for January 16 and January 18, 2023, Fire (Mexico/Central America) $PM_{2.5}$ Event for the National Seashore Monitor

January 16 and January 18 are classified as Tier 2 days with 24-hour concentrations of 24.0 $\mu g/m^3$ and 25.3 $\mu g/m^3$, respectively, at the National Seashore monitor. The elevated concentrations were due to smoke from fires in Mexico/Central America, and hourly $PM_{2.5}$ graphs show the elevated concentrations on both days (Figure 3-10: *Hourly $PM_{2.5}$ Concentrations on January 16, 2023, compared to typical concentrations at the National Seashore Monitor* and Figure 3-11: *Hourly $PM_{2.5}$ Concentrations on January 18, 2023, compared to typical concentrations at the National Seashore Monitor*).

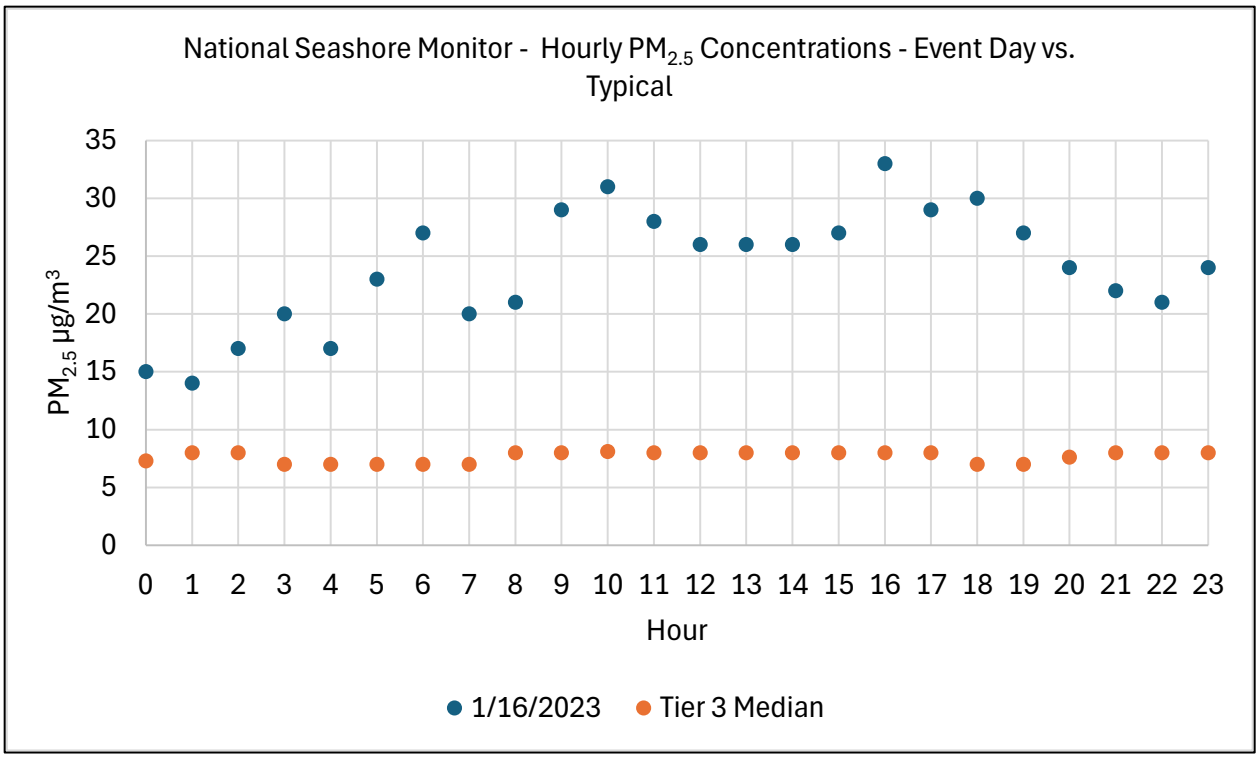


Figure 3-10: Hourly $PM_{2.5}$ Concentrations on January 16, 2023, compared to typical concentrations at the National Seashore Monitor

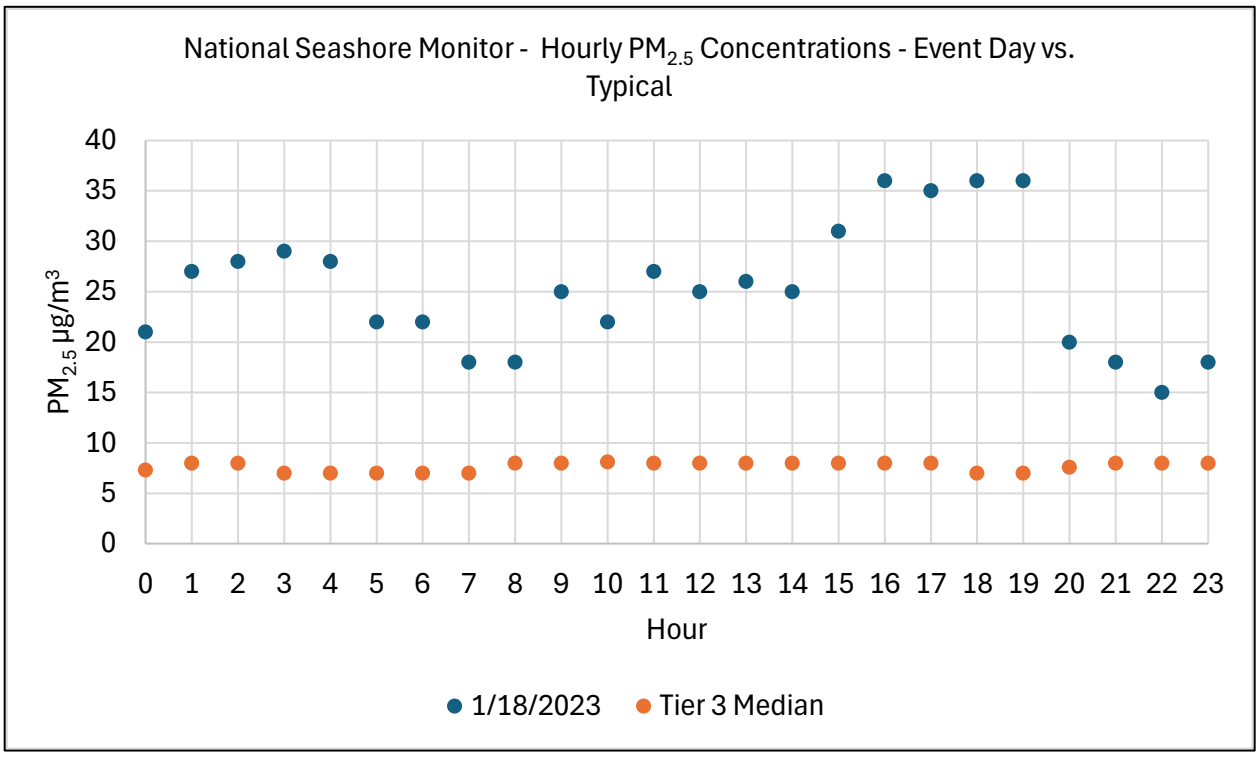


Figure 3-11: Hourly $PM_{2.5}$ Concentrations on January 18, 2023, compared to typical concentrations at the National Seashore Monitor

TCEQ forecasted light amounts of aerosols expanding across Deep South Texas and the southern coastal bend of Texas due to burning and industrial activities across portions of Southern Mexico, Northwest Central America, and the Bay of Campeche (Table C-2). The back trajectories (Figure 3-12: *HYSPLIT back trajectories from the National Seashore monitor on January 16, 2023*, Figure 3-13: *HYSPLIT back trajectories from the National Seashore monitor on January 18, 2023*, Figure 14: *72-hour HYSPLIT back trajectories starting from each hour on January 16, 2023, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL* and Figure 3-15: *72-hour HYSPLIT back trajectories starting from each hour on January 18, 2023, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL*) and smoke plumes (Figure 3-16: *AirNow Navigator with HMS Smoke Plume for January 16, 2023* and Figure 3-17: *AirNow Navigator with HMS Smoke Plume for January 18, 2023*) on these days also show smoke moving into south Texas from these regions. The yellow dots on the smoke plume maps also show the moderate air quality index in south and southeast Texas due to the transported smoke. Haze can also be seen in the satellite image on January 18, 2023, as shown in Figure 3-18: *Satellite images from January 18, 2023, showing hazy conditions in South Texas (Aqua Modis Corrected Reflectance True Color)*. Additionally, higher smoke surface concentrations can be seen along the Gulf coastline on the NAAPS model plot (Figure D-2 and Figure D-3).

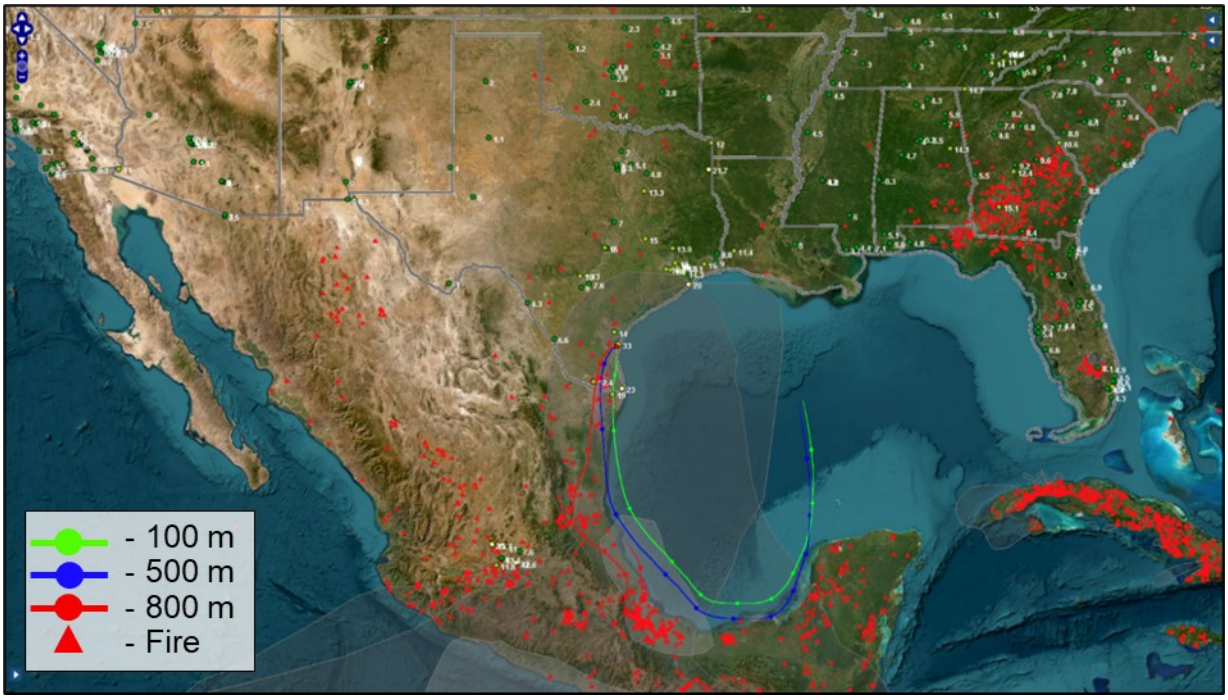


Figure 3-12: HYSPLIT back trajectories from the National Seashore monitor on January 16, 2023

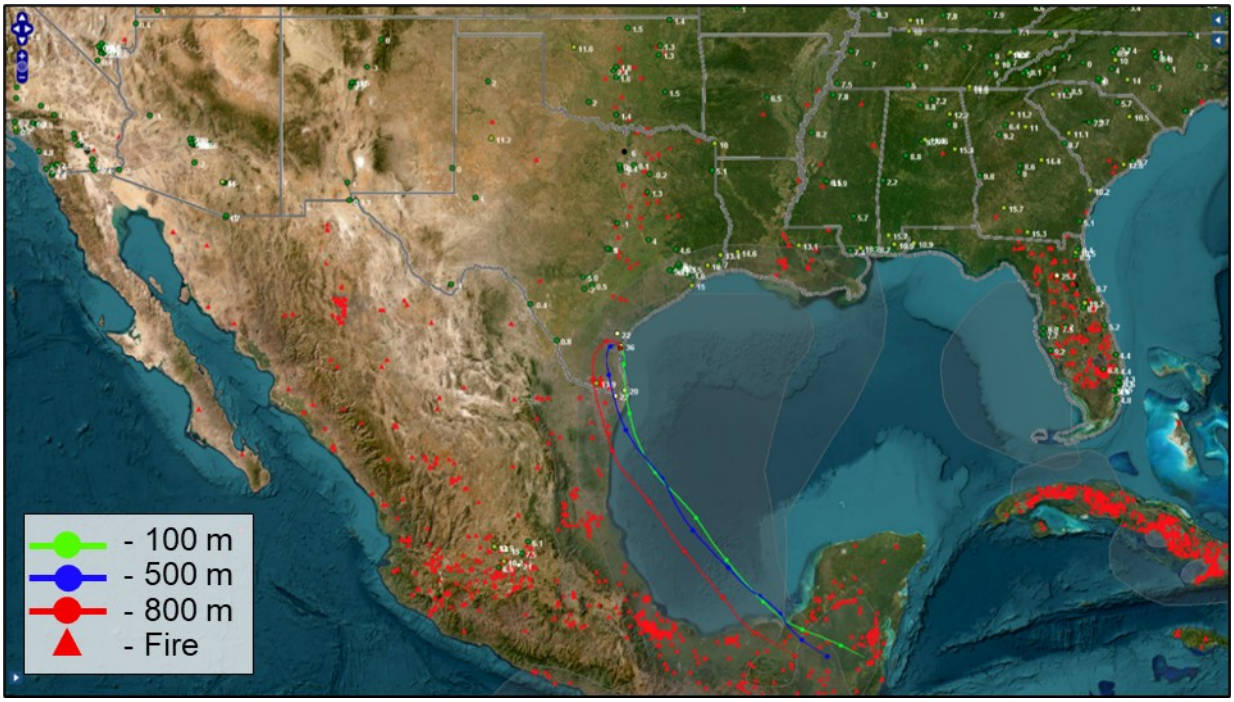


Figure 3-13: HYSPLIT back trajectories from the National Seashore monitor on January 18, 2023

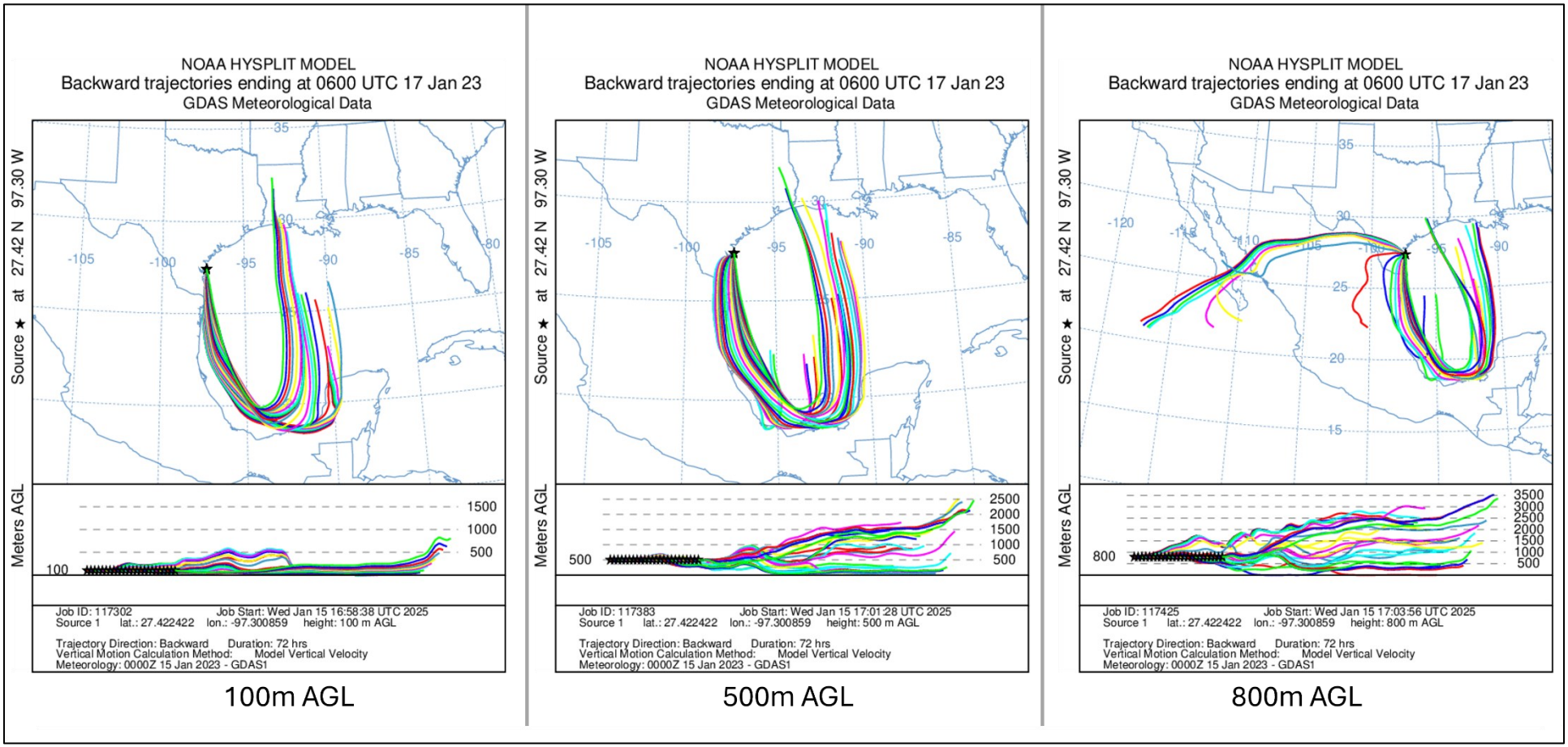


Figure 3-14: 72-hour HYSPLIT back trajectories starting from each hour on January 16, 2023, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL

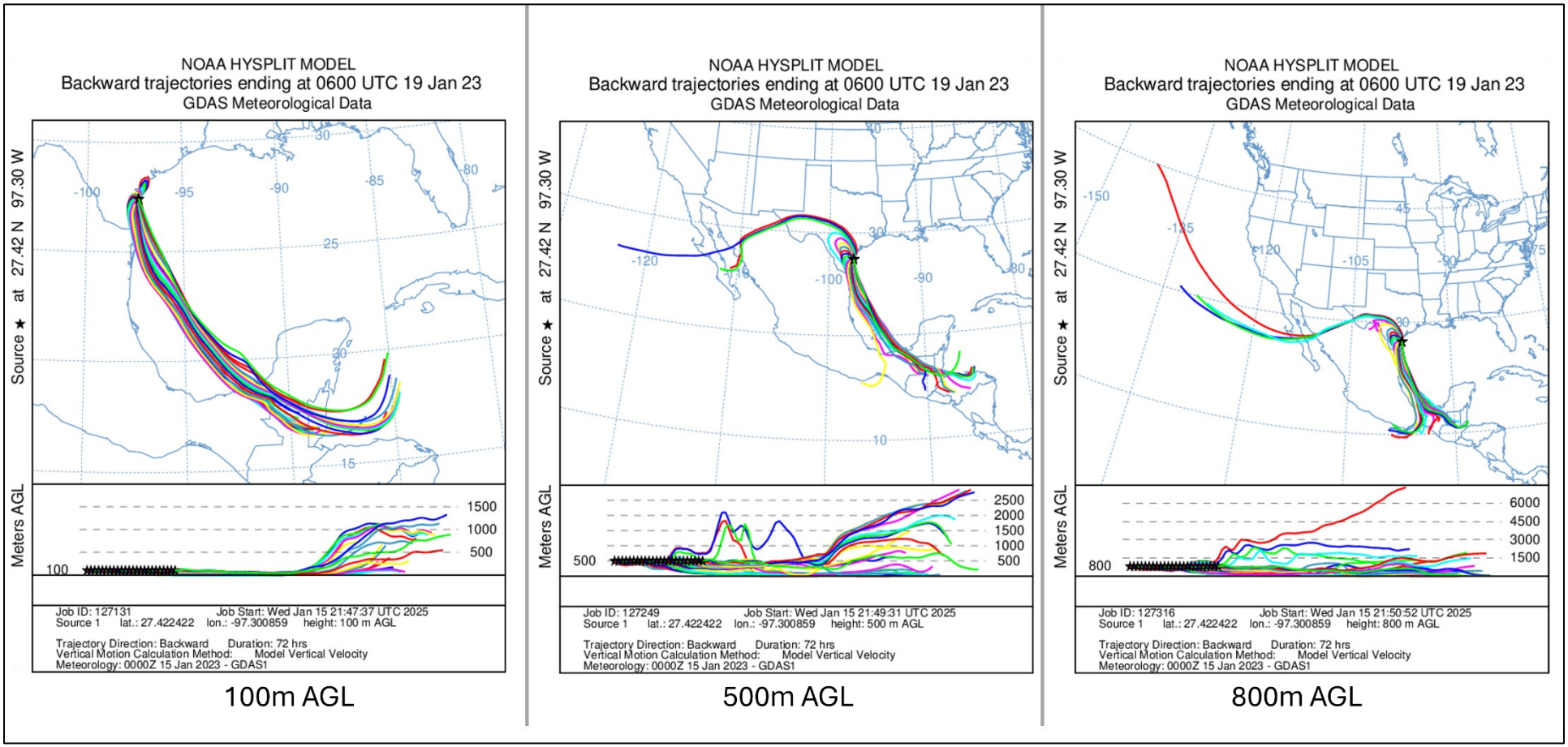


Figure 3-15: 72-hour HYSPLIT back trajectories starting from each hour on January 18, 2023, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL

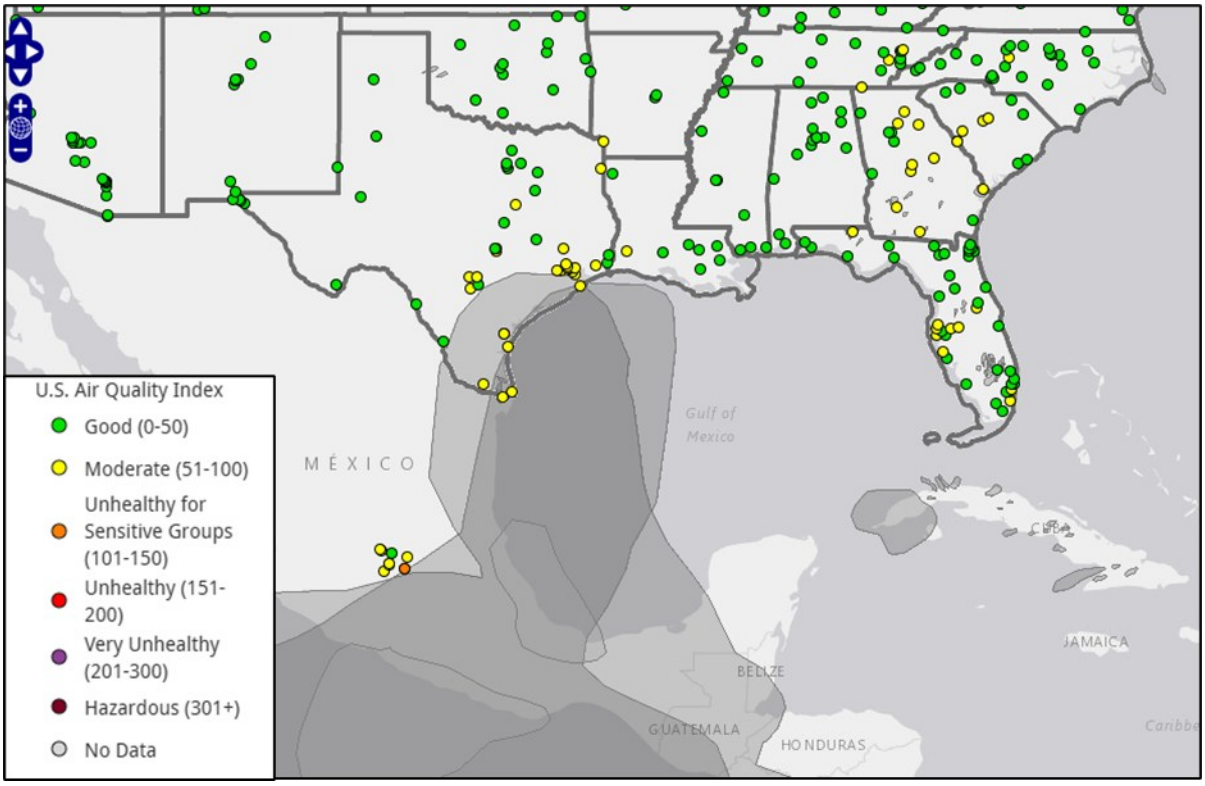


Figure 3-16: AirNow Navigator with HMS Smoke Plume for January 16, 2023

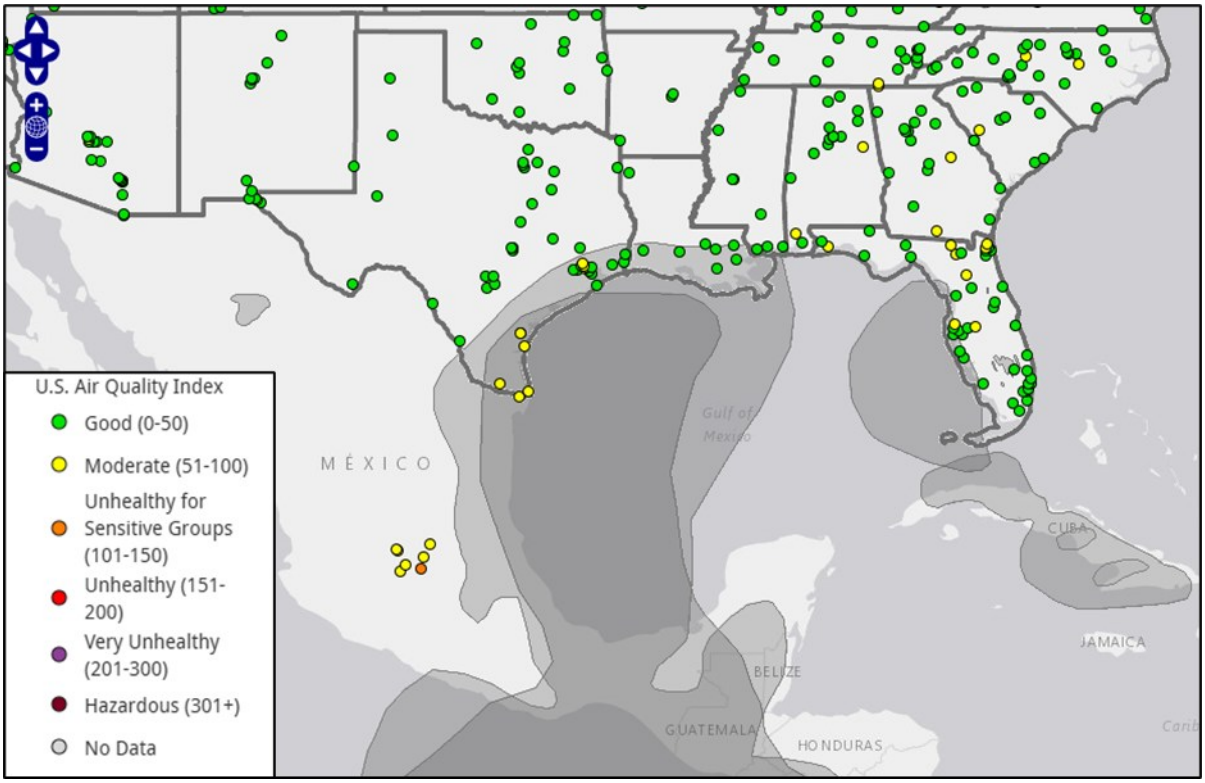


Figure 3-17: AirNow Navigator with HMS Smoke Plume for January 18, 2023

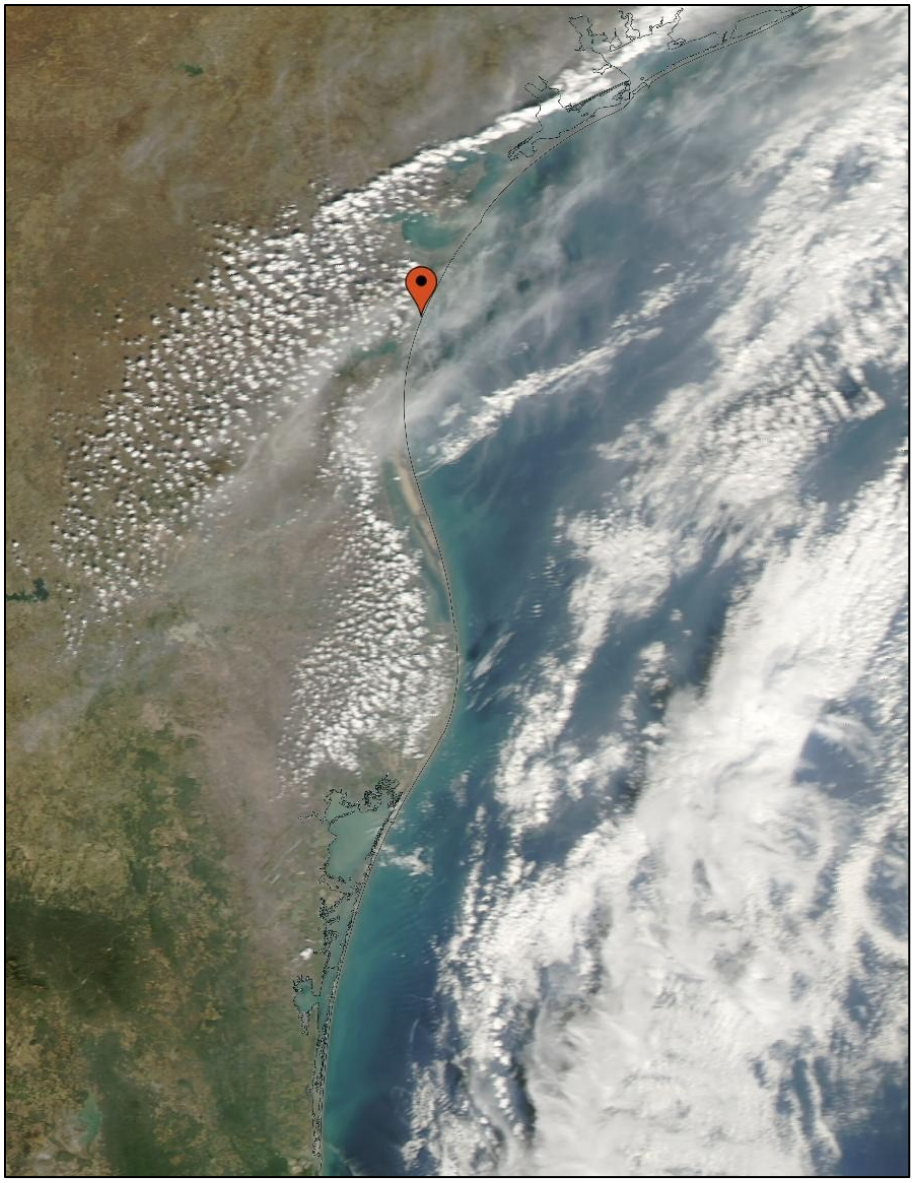


Figure 3-18: Satellite images from January 18, 2023, showing hazy conditions in South Texas with the National Seashore monitor marked in red (Aqua Modis Corrected Reflectance - True Color from Aqua / MODIS)

3.2.4 Group 4 – Evidence for February 14, 2023, Fire (Mexico/Central America) $PM_{2.5}$ Event for the National Seashore Monitor

February 14, 2023, was identified as a Tier 2 day with a 24-hour concentration of 21.8 µg/m^3 at the National Seashore monitor. The elevated concentrations were due to smoke being transported from fires in Mexico, and back trajectories (Figure 3-19: *HYSPLIT back trajectories from the National Seashore monitor on February 14, 2023* and Figure 3-20: *72-hour HYSPLIT back trajectories starting from each hour on February 14, 2023, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL*) show the path of air from Mexico to South Texas. Residual smoke from burning activities in southern Mexico was also mentioned in the TCEQ forecast discussion for this week (Table C-3). The monitors in south Texas had moderate air quality, and a smoke plume can be seen coming from Mexico on the AirNow map (Figure 3-21: *AirNow Navigator with HMS Smoke Plume for February 14, 2023*). Hot spots of high smoke surface concentrations in Mexico can be seen from NAAPS modeling, with elevated concentrations in south Texas (Figure D-4). The elevated $PM_{2.5}$ concentrations on the event day can also be seen on the hourly graph (Figure 3-22: *Hourly $PM_{2.5}$ Concentrations on February 14, 2023, compared to typical concentrations at the National Seashore Monitor*), compared to concentrations on non-event days.

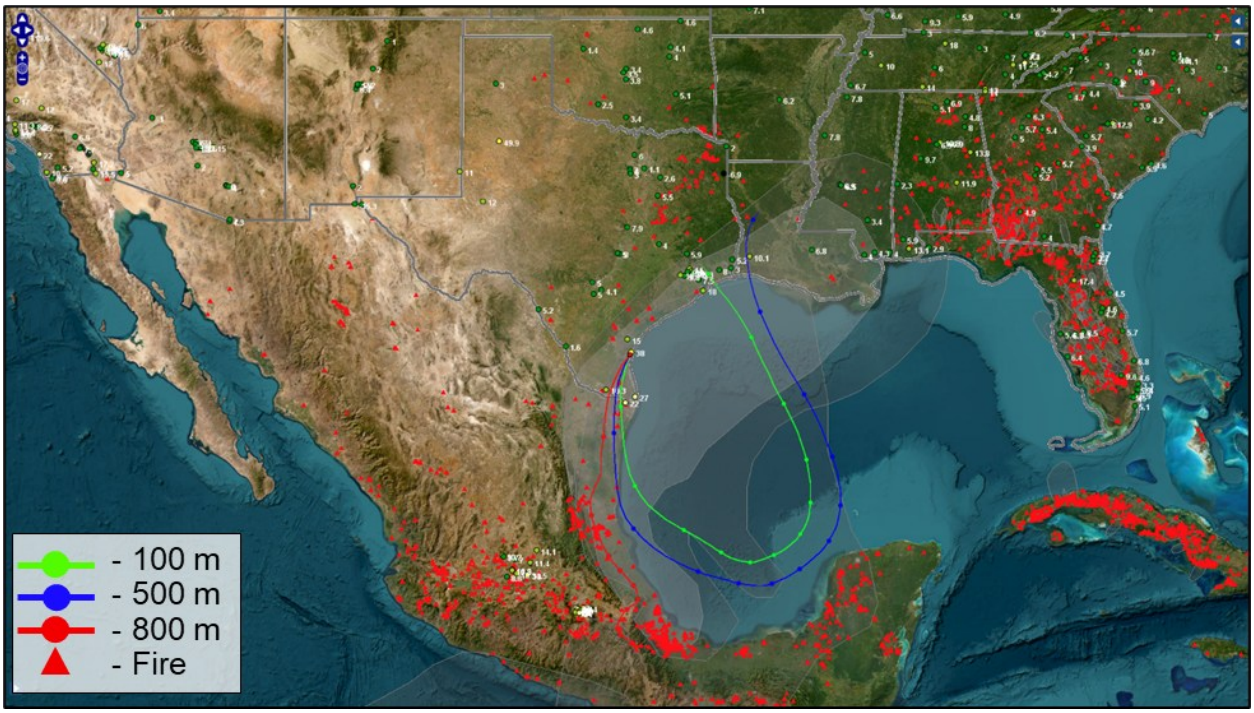


Figure 3-19: HYSPLIT back trajectories from the National Seashore monitor on February 14, 2023

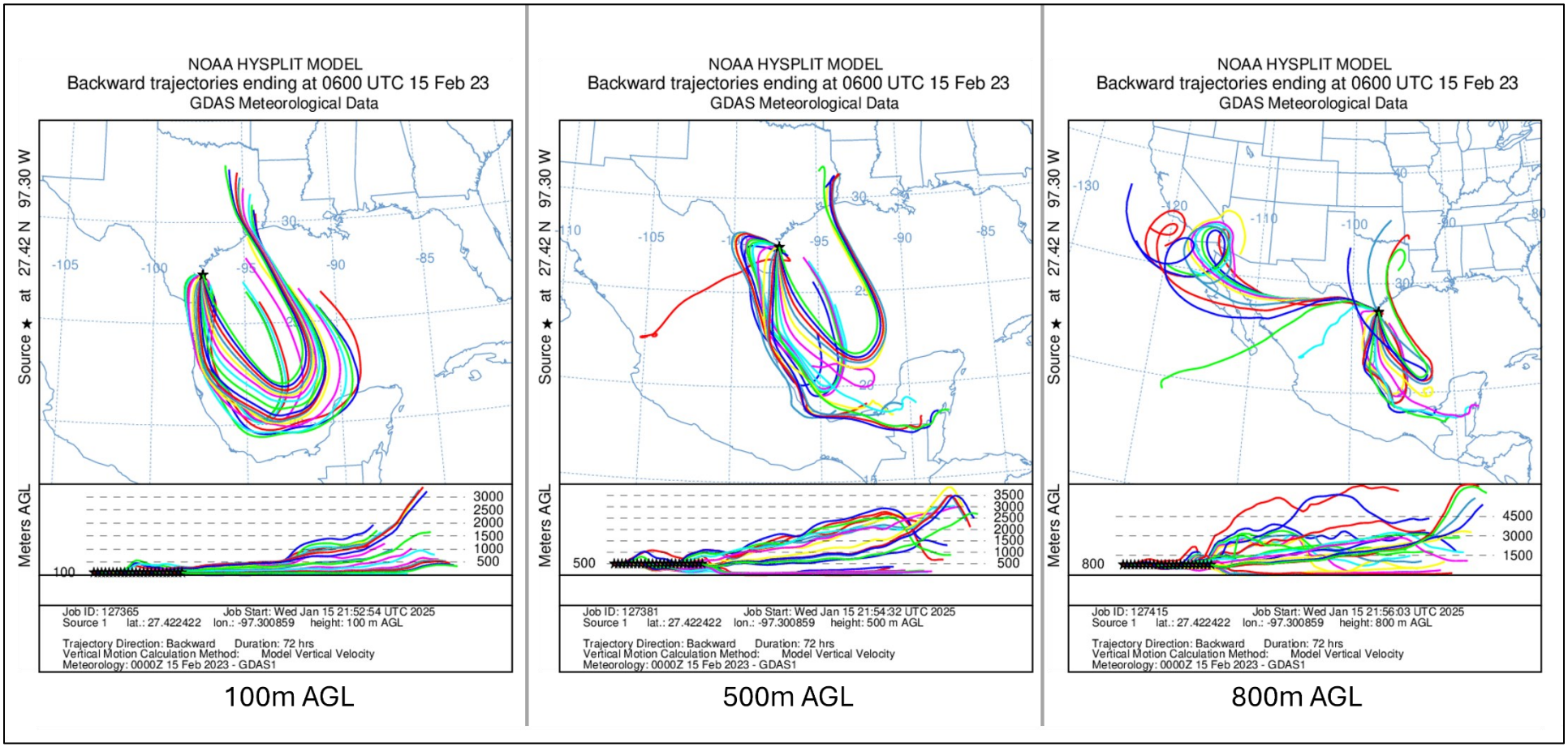


Figure 3-20: 72-hour HYSPLIT back trajectories starting from each hour on February 14, 2023, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL

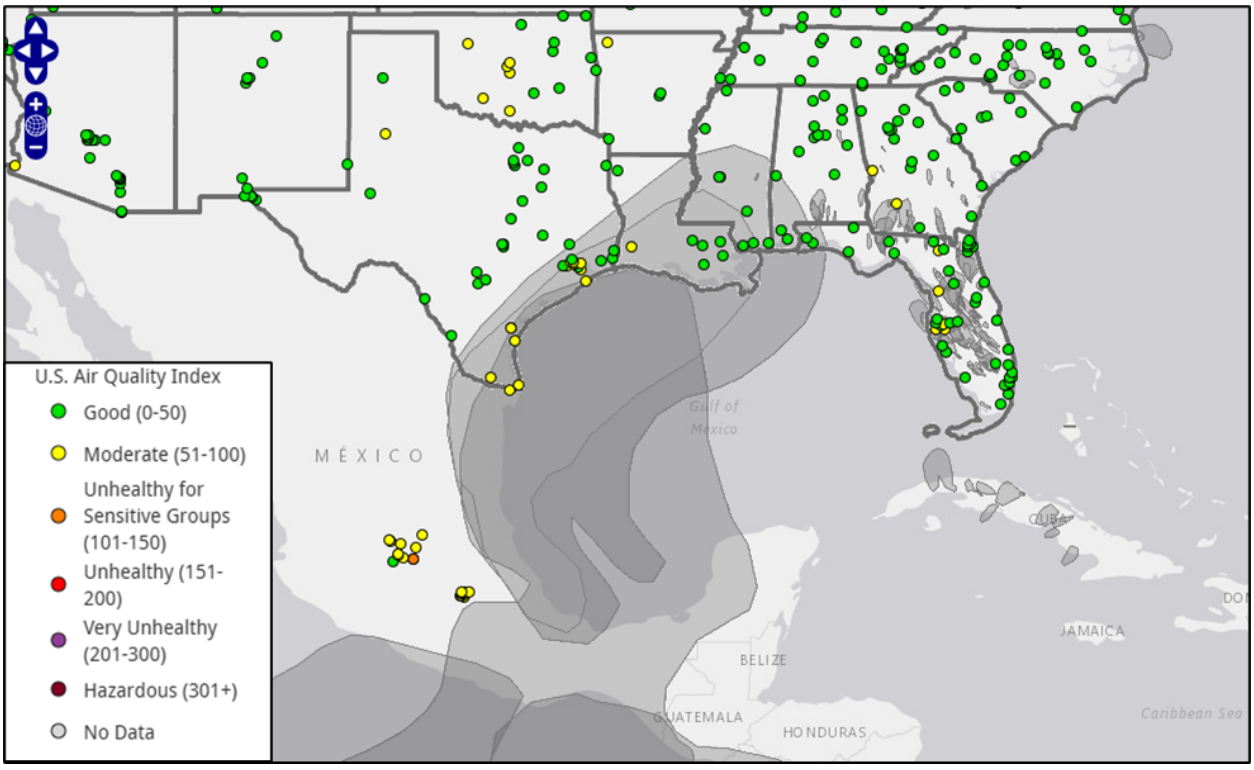


Figure 3-21: AirNow Navigator with HMS Smoke Plume for February 14, 2023

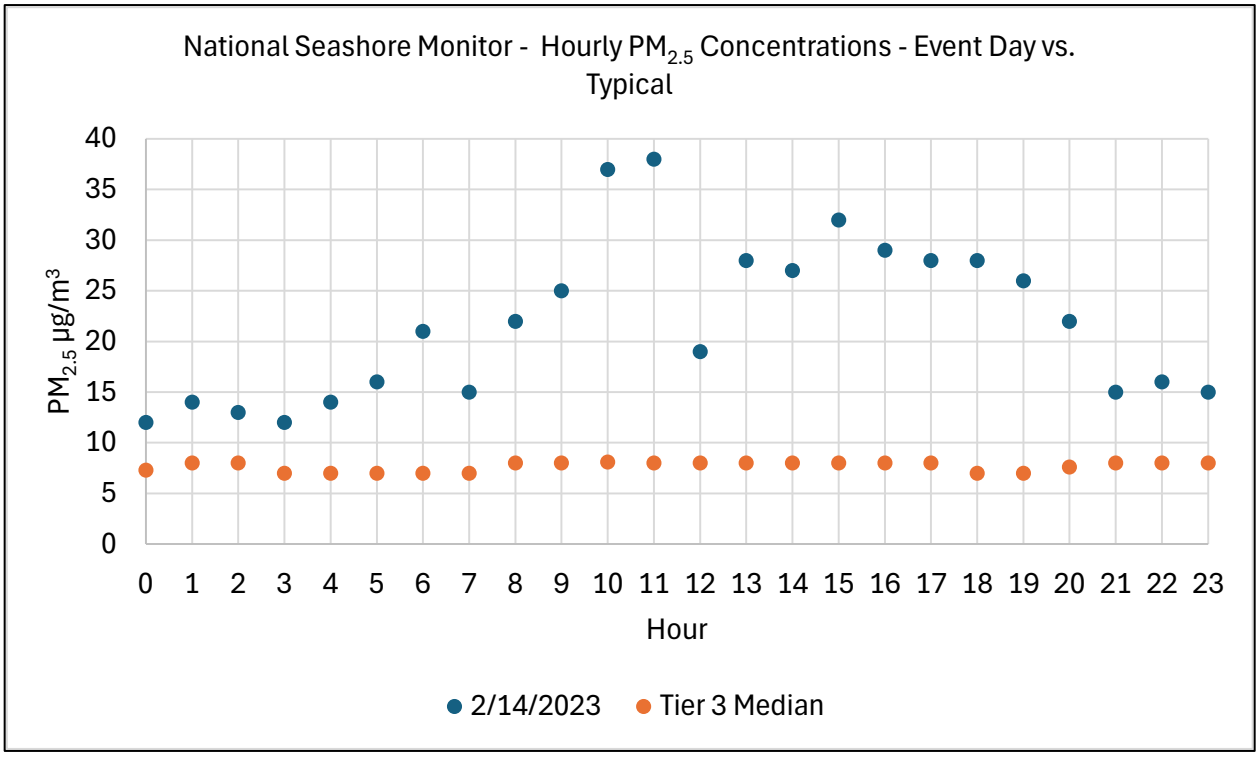


Figure 3-22: Hourly PM2.5 Concentrations on February 14, 2023, compared to typical concentrations at the National Seashore Monitor

3.2.5 Group 5 – Evidence for February 27, 2023, Fire (Mexico/Central America) and High Wind $PM_{2.5}$ Event for the Karnack Monitor

February 27, 2023, was identified as a Tier 1 day at the Karnack monitor due to prescribed fires and high winds. The 24-hour concentration at this monitor was 26.6 µg/m^3, and the elevated concentrations on this event day can be seen compared to concentrations on a non-event day (Figure 3-23: *Hourly $PM_{2.5}$ Concentrations on February 27, 2023, compared to typical concentrations at the Karnack monitor*).

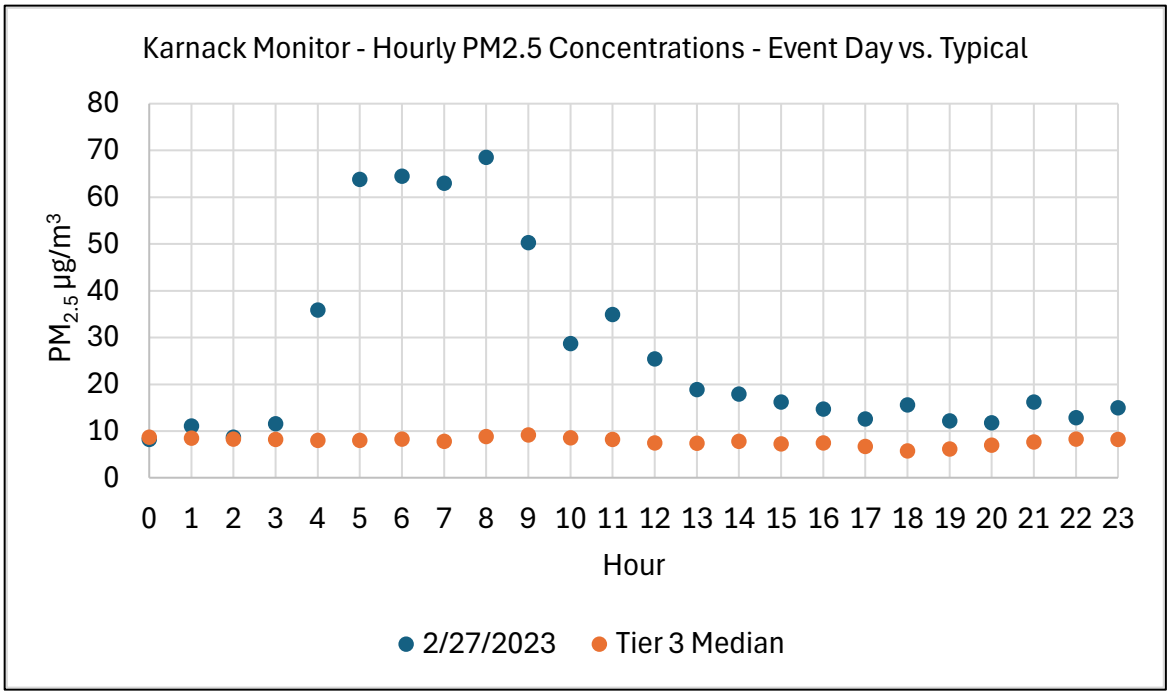


Figure 3-23: Hourly $PM_{2.5}$ Concentrations on February 27, 2023, compared to typical concentrations at the Karnack monitor

As described in the narrative conceptual model, high winds associated with a cold front brought blowing dust and high winds from West Texas during this day. Blowing dust that impacted air quality was also noted in media reports from Dallas and Houston (Figures C-2 and C-3). Also, the TCEQ forecast discussion mentions a sprawling area of thin density smoke/aerosols from seasonal fires and industrial activity in southern Mexico, Central America, and Cuba filtering over Texas, contributing towards elevated fine particulate levels (Table C-4). Back trajectories on this date (Figure 3-24: *HYSPLIT back trajectories from the Karnack monitor on February 27, 2023.*) support these reports, with low level air parcels coming from the south and upper air parcels coming in from the west. According to the NAAPS model plot on this day (Figure D-5), there were high levels of dust surface concentrations in north and west Texas, and medium levels of smoke surface concentration along the Gulf coastline. The AirNow map on this date (Figure 3-25: *AirNow Navigator with HMS Smoke Plume for February 27, 2023*) shows the moderate AQI in north/northeast Texas, with a smoke plume mapped over the east Texas border.

Figure 3-24: HYSPLIT back trajectories from the Karnack monitor on February 27, 2023

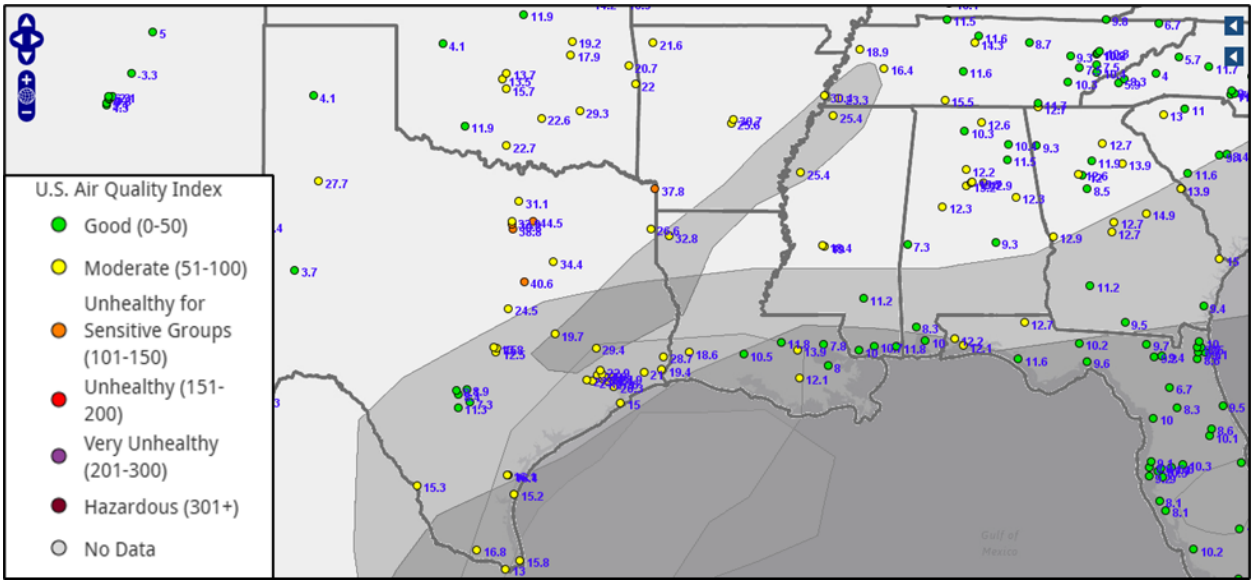


Figure 3-25: AirNow Navigator with HMS Smoke Plume for February 27, 2023

Group 6 – Evidence for March 2, 2023, High Winds and Fire (Mexico/Central America) $PM_{2.5}$ Event for the Webberville Monitor

March 2, 2023, was identified as a Tier 1 day at the Webberville monitor due to high winds and smoke associated with fires in Mexico/Central America. The 24-hour concentration of $PM_{2.5}$ was 32.9 µg/m^3, with a peak concentration of 102 µg/m^3 occurring in the evening time (Figure 3-26: *Hourly $PM_{2.5}$ Concentrations on March 2, 2023, compared to typical concentrations at the Webberville monitor*).

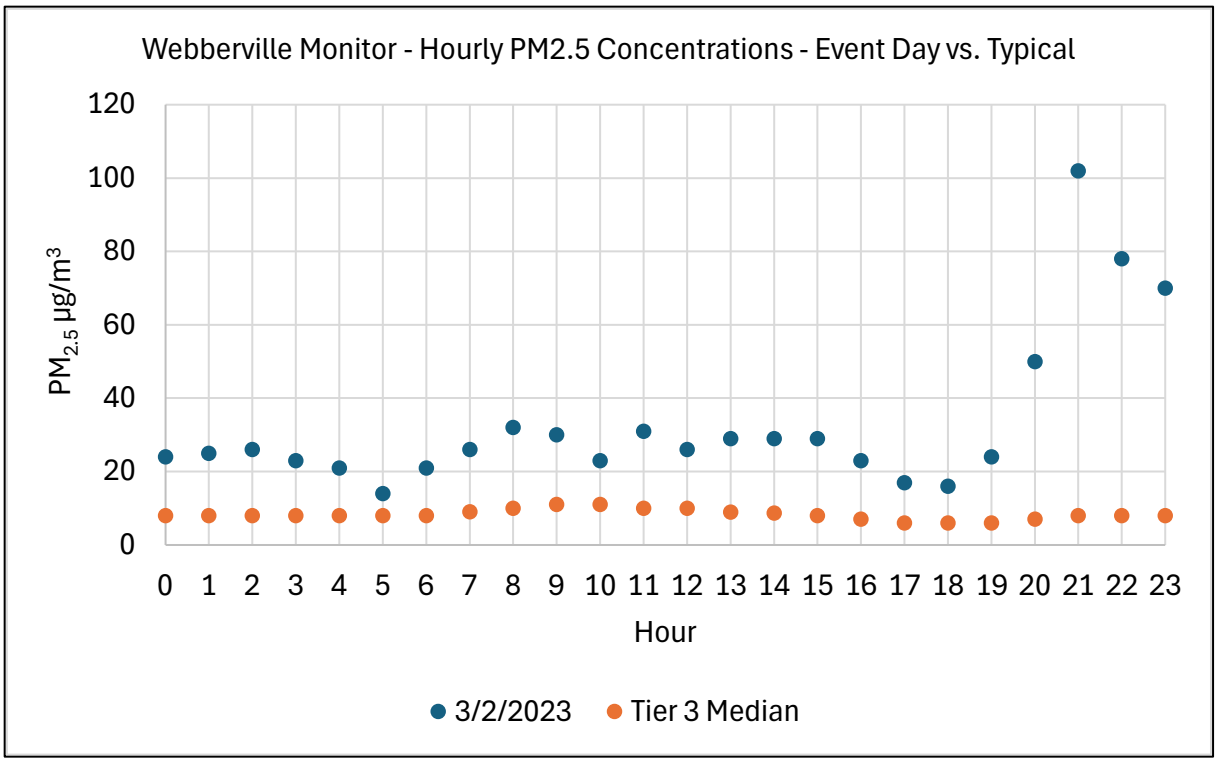


Figure 3-26: Hourly $PM_{2.5}$ Concentrations on March 2, 2023, compared to typical concentrations at the Webberville monitor

The TCEQ forecast discussion for this day (Table C-5) describes elevated background concentrations of $PM_{2.5}$ due to moderate levels of smoke from seasonal fires and industrial activity in southern Mexico, as well as scattered seasonal fires in south/southeast Texas. Later in the day, high winds from a cold front brought blowing dust from West Texas to the monitor, as mentioned in a media report from San Antonio (Figure C-4). This analysis is supported by the back trajectories on this day (Figure 3-27: *HYSPLIT back trajectories from the Webberville monitor on March 2, 2023*), and elevated $PM_{2.5}$ concentrations are seen by the moderate AQI shown at monitors across Central Texas (Figure 3-28: *AirNow Navigator with HMS Smoke Plume for March 2, 2023*). Additionally, elevated dust surface concentrations can be seen in west Texas where the blowing dust originated on the NAAPS model plot, along with elevated smoke concentrations in central Texas (Figure D-6).

Figure 3-27: HYSPLIT back trajectories from the Webberville monitor on March 2, 2023

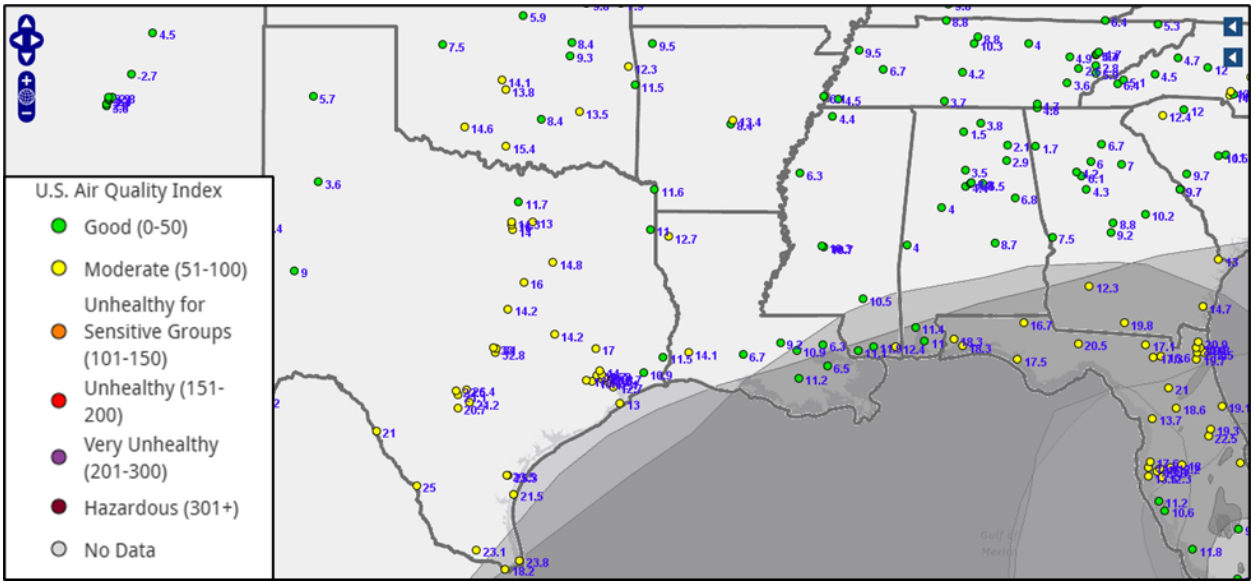


Figure 3-28: AirNow Navigator with HMS Smoke Plume for March 2, 2023

3.2.6 Group 7 – Evidence for March 15, 2023, Prescribed Fires and Wildfire $PM_{2.5}$ (U.S.) Event for the Karnack Monitor

March 15, 2023, was identified as a Tier 1 day at the Karnack monitor due to smoke from prescribed fires. The 24-hour $PM_{2.5}$ concentration was 39.7 µg/m^3, with the average skewed by high $PM_{2.5}$ values between the hours of 10 a.m. to 4 p.m. (Figure 3-29: Hourly *$PM_{2.5}$ Concentrations on March 15, 2023, compared to typical concentrations at the Karnack monitor*)

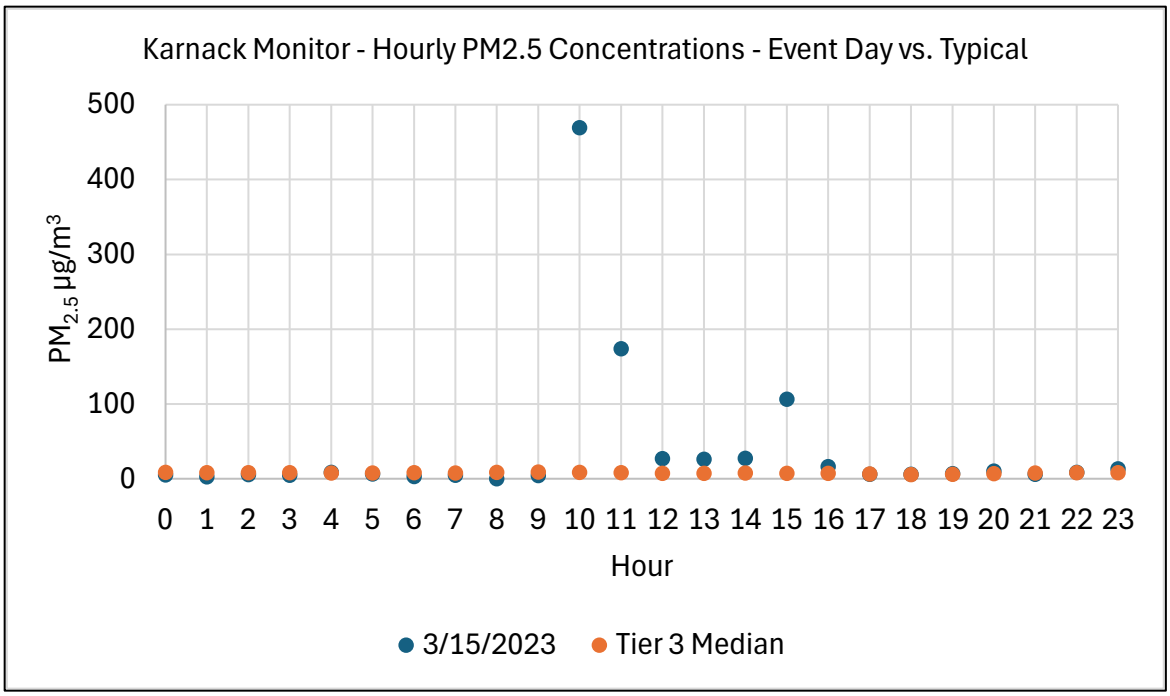


Figure 3-29: Hourly $PM_{2.5}$ Concentrations on March 15, 2023, compared to typical concentrations at the Karnack monitor

The TCEQ forecast discussion mentions residual smoke from seasonal fire activity from the Lower Mississippi River Valley and southeastern Texas, expanding over portions of Northeast Texas (Table C-6). Back trajectories (Figure 3-30: *HYSPLIT back trajectories from the Karnack monitor on March 15, 2023*) show air parcels moving into the monitor area from the Mississippi River Valley through Louisiana, and smoke plumes are shown to be affecting East/Southeast Texas (Figure 3-31: *AirNow Navigator with HMS Smoke Plume for March 15, 2023*). Smoke from nearby prescribed fires can be seen in a satellite image on March 15th (Figure 3-32: *Satellite image from NASA Worldview on March 15, 2023, showing haze around the Karnack monitor (red marker) (corrected reflectance – true color from Terra / MODIS)*). Also, high surface smoke concentrations can be seen across the southern U.S., including Louisiana, on the NAAPS model plot (Figure D-7).

The Karnack monitor is located in a field on the western edge of Caddo Lake National Wildlife Refuge (NWR), managed by the U.S. Fish & Wildlife Service (FWS). Prescribed burning was planned for this week at the refuge, as mentioned in a social media post (Figure C-5). On this particular day, about 211 acres were burned, including an area where the Karnack monitor is located and an area east of the monitor.[14] Additional information about this particular prescribed burn could not be obtained.

[14] confirmed via email from Caddo Lake NWR staff

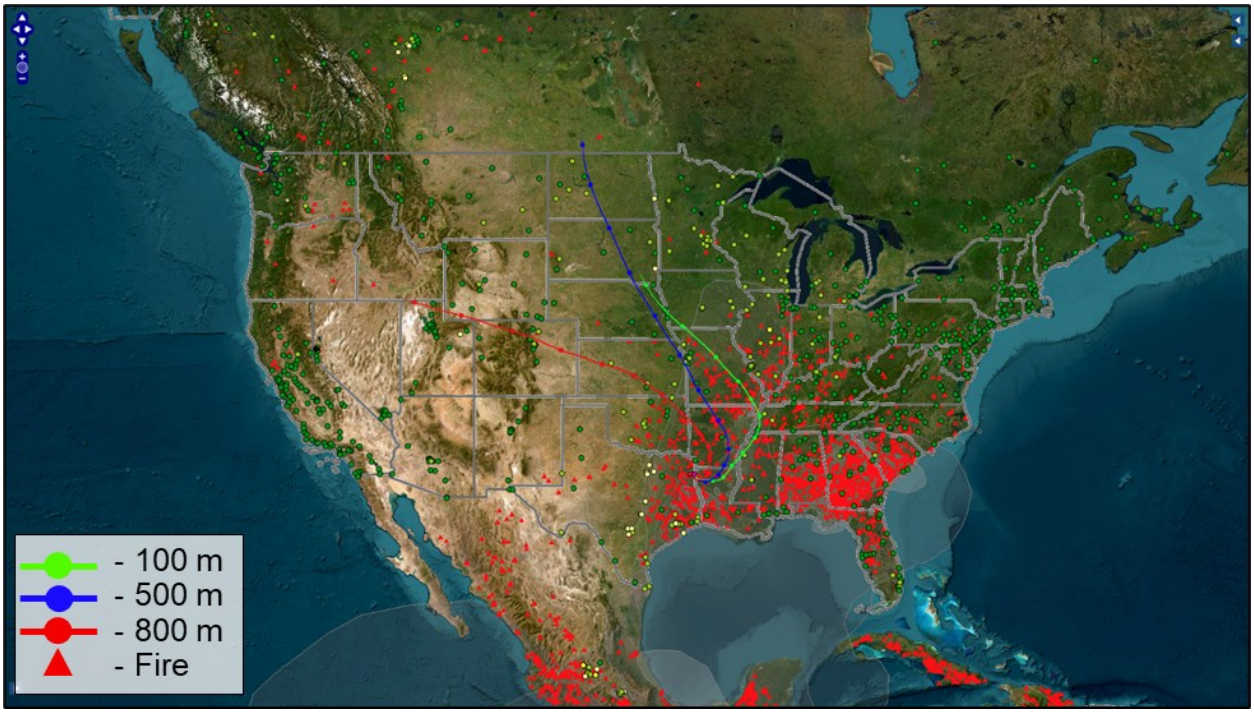


Figure 3-30: HYSPLIT back trajectories from the Karnack monitor on March 15, 2023

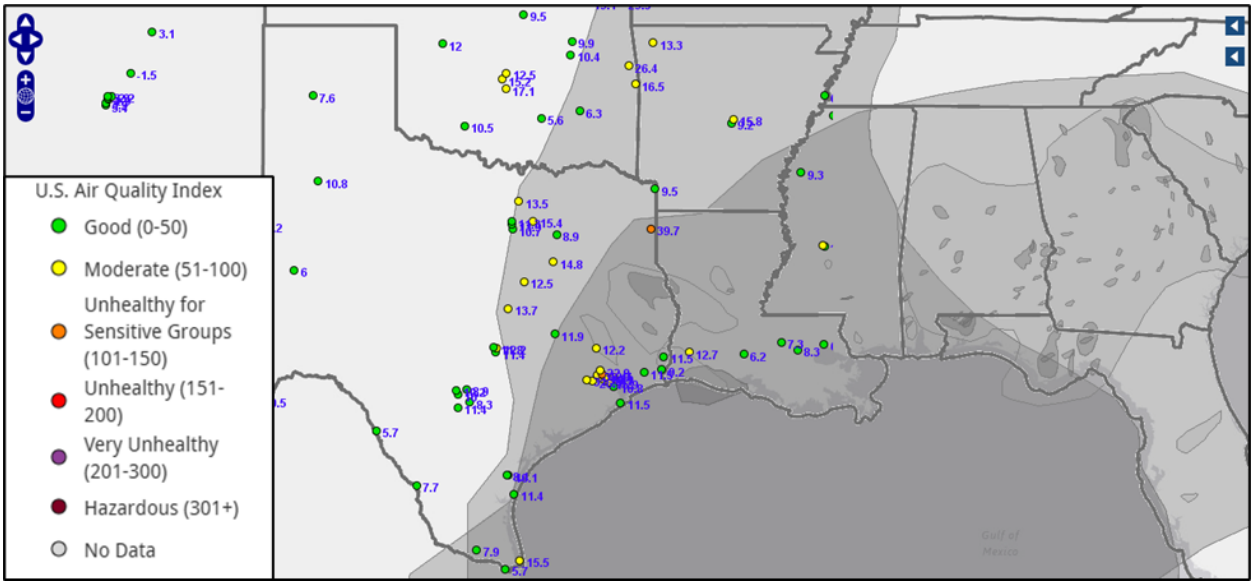


Figure 3-31: AirNow Navigator with HMS Smoke Plume for March 15, 2023

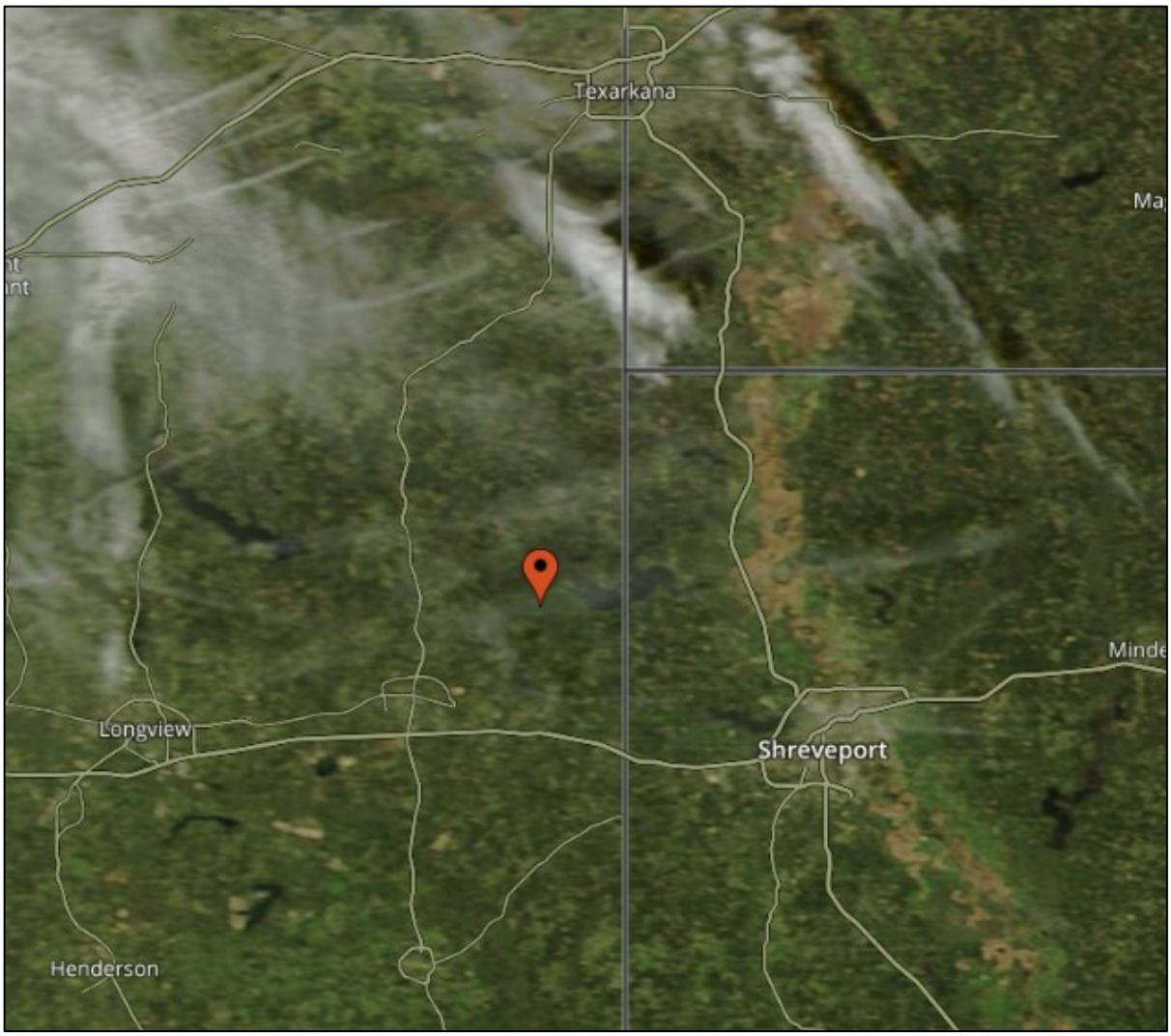


Figure 3-32: Satellite image from NASA Worldview on March 15, 2023, showing haze around the Karnack monitor, marked in red (red marker) (Ccorrected Rreflectance – Ttrue Ccolor from Terra / MODIS)

3.2.7 Group 8 – Evidence for May 5, 2023, Fire (Mexico/Central America) $PM_{2.5}$ Event for the National Seashore Monitor

May 5, 2023, was identified as a Tier 2 day at the National Seashore monitor due to smoke from fires in Mexico/Central America. The 24-hour $PM_{2.5}$ concentration was 22.2 µg/m^3, and hourly concentrations were elevated on this event day compared to a typical/non-event day (Figure 3-33: *Hourly $PM_{2.5}$ Concentrations on May 5, 2023, compared to typical concentrations at the National Seashore Monitor*).

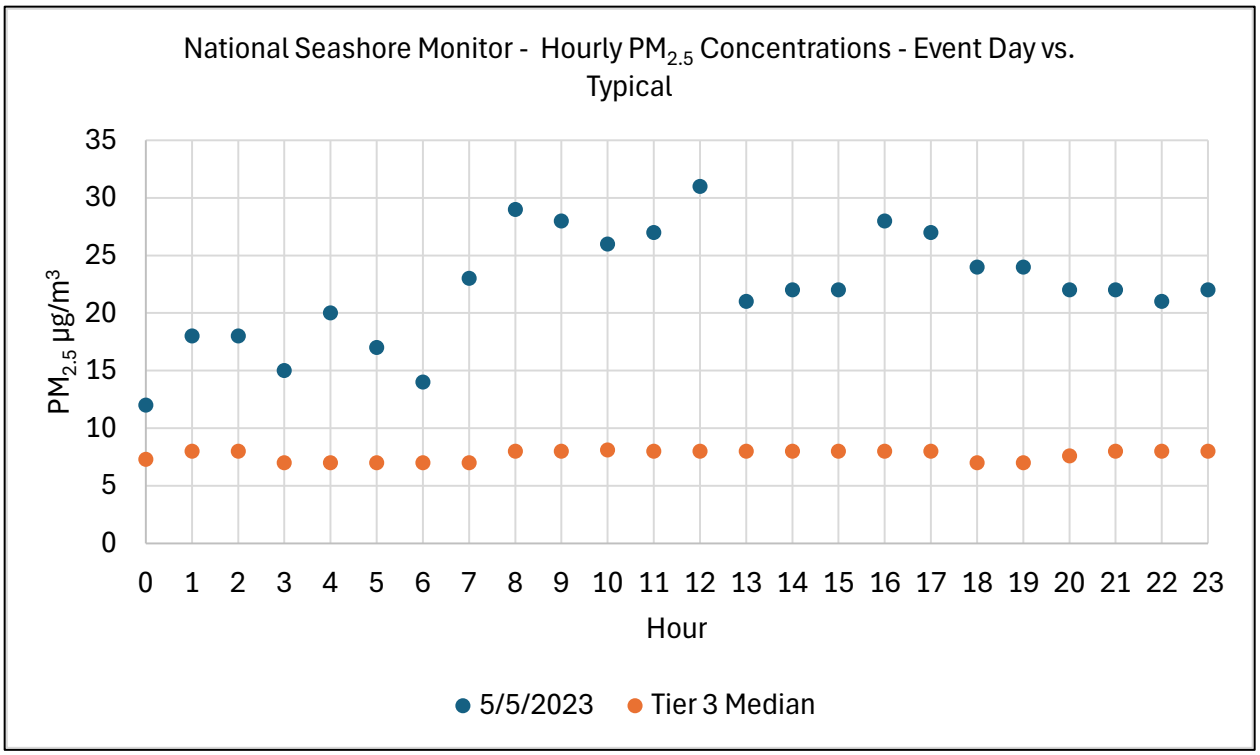


Figure 3-33: Hourly $PM_{2.5}$ Concentrations on May 5, 2023, compared to typical concentrations at the National Seashore Monitor

The TCEQ forecast discussion (Table C-7) mentions a large area of thin to moderate smoke from ongoing fire activity in Mexico and Central America. Air quality impacts were noted in a news release from the City of Corpus Christi due to fire activities in Mexico and Central America (Figure C-6). Also, a media report from San Antonio discussed poor air quality in South Texas due to burning in Mexico (Figure C-7). The back trajectories (Figure 3-34: *HYSPLIT back trajectories on May 5, 2023 from the National Seashore monitor* and Figure 3-35: *72-hour HYSPLIT back trajectories starting from each hour on May 5, 2023, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL*) support transport of smoke into South Texas from the Yucatan Peninsula. High surface smoke concentrations can be seen on the NAAPS model plot (Figure D-8), and high smoke levels also led to a moderate AQI at monitors in South Texas (Figure 3-36: *AirNow Navigator with HMS Smoke Plume for May 5, 2023*).

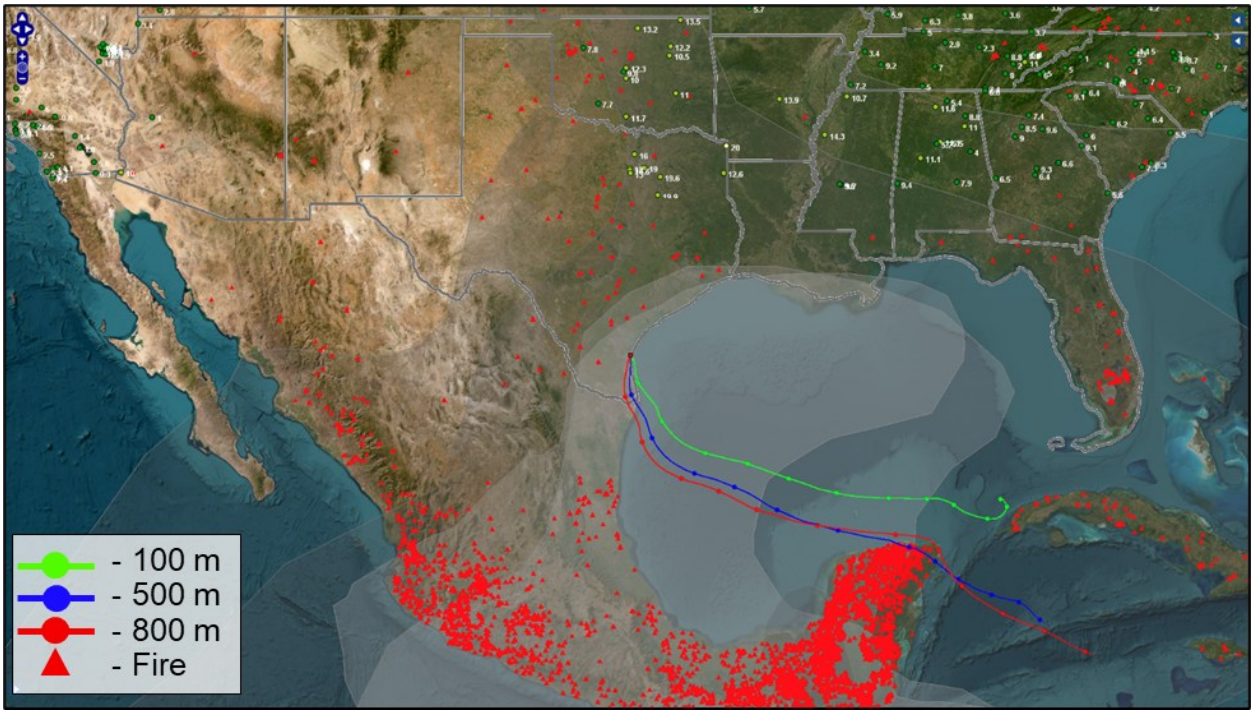


Figure 3-34: HYSPLIT back trajectories on May 5, 2023, from the National Seashore monitor

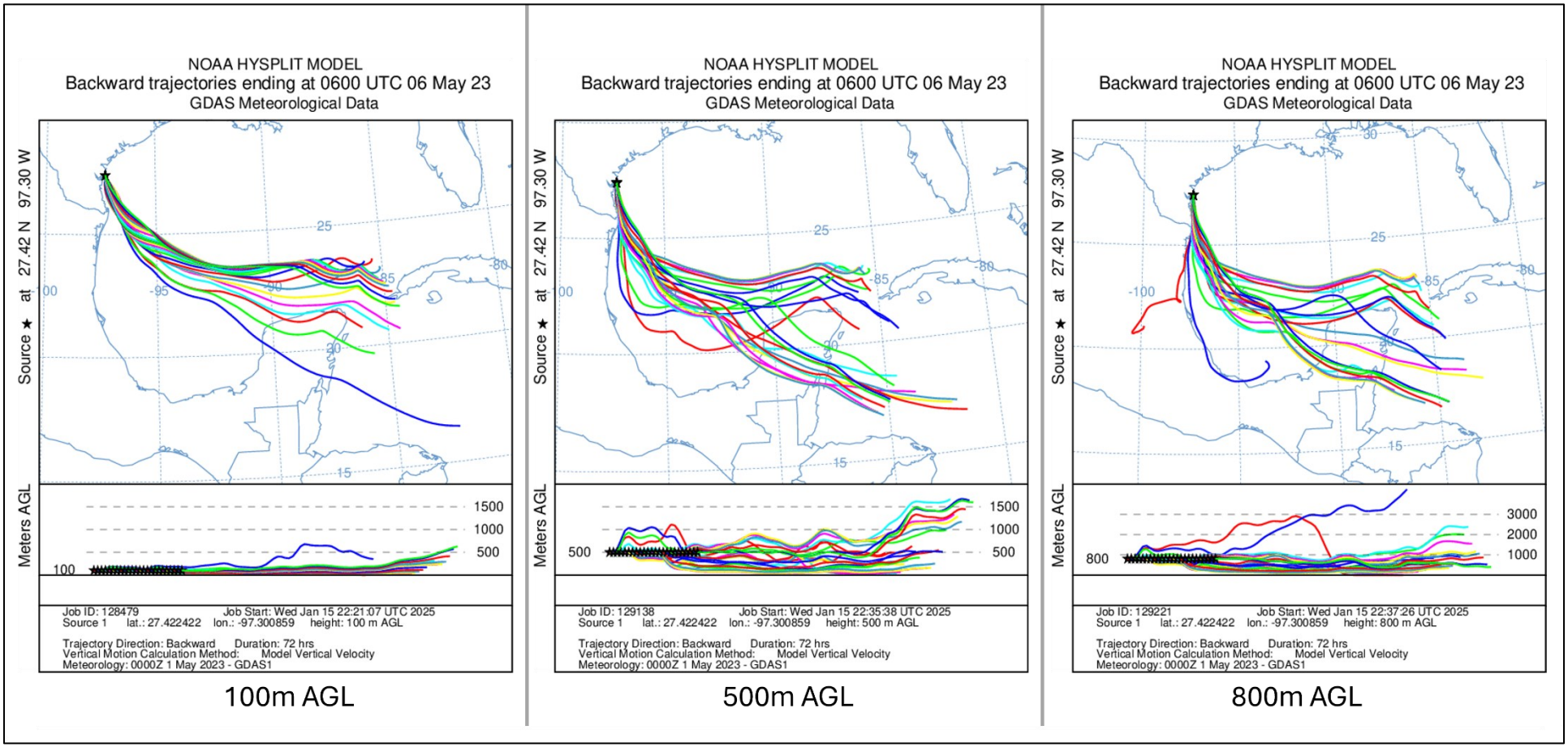


Figure 3-35: 72-hour HYSPLIT back trajectories starting from each hour on May 5, 2023, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL

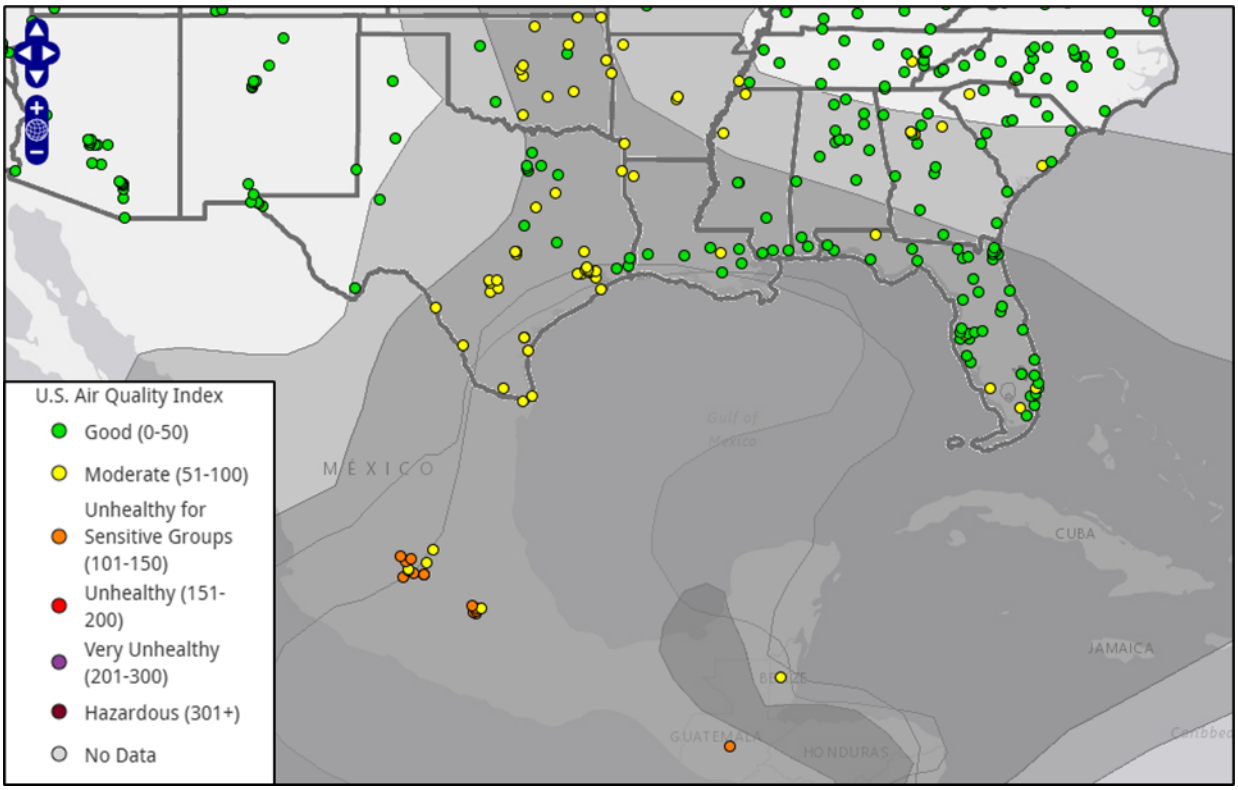


Figure 3-36: AirNow Navigator with HMS Smoke Plume for May 5, 2023

3.2.8 Group 9 – Evidence for June 13, June 14, and June 15, 2023, Fire (Mexico/Central America) $PM_{2.5}$ Event for the Webberville Monitor and National Seashore Monitor

June 13, 2023, was identified as a Tier 1 day, and June 14, 2023, was identified as a Tier 2 day at the Webberville monitor. The 24-hour $PM_{2.5}$ concentrations on these days were 31.5 and 27.6 µg/m^3, respectively. The elevated concentrations were due to burning in Mexico/Central America, and the elevated concentrations can be compared to typical non-event days (Figure 3-37: *Hourly $PM_{2.5}$ Concentrations on June 13, 2023, compared to typical concentrations at the Webberville monitor* and Figure 3-38: *Hourly $PM_{2.5}$ Concentrations on June 14, 2023, compared to typical concentrations at the Webberville monitor*).

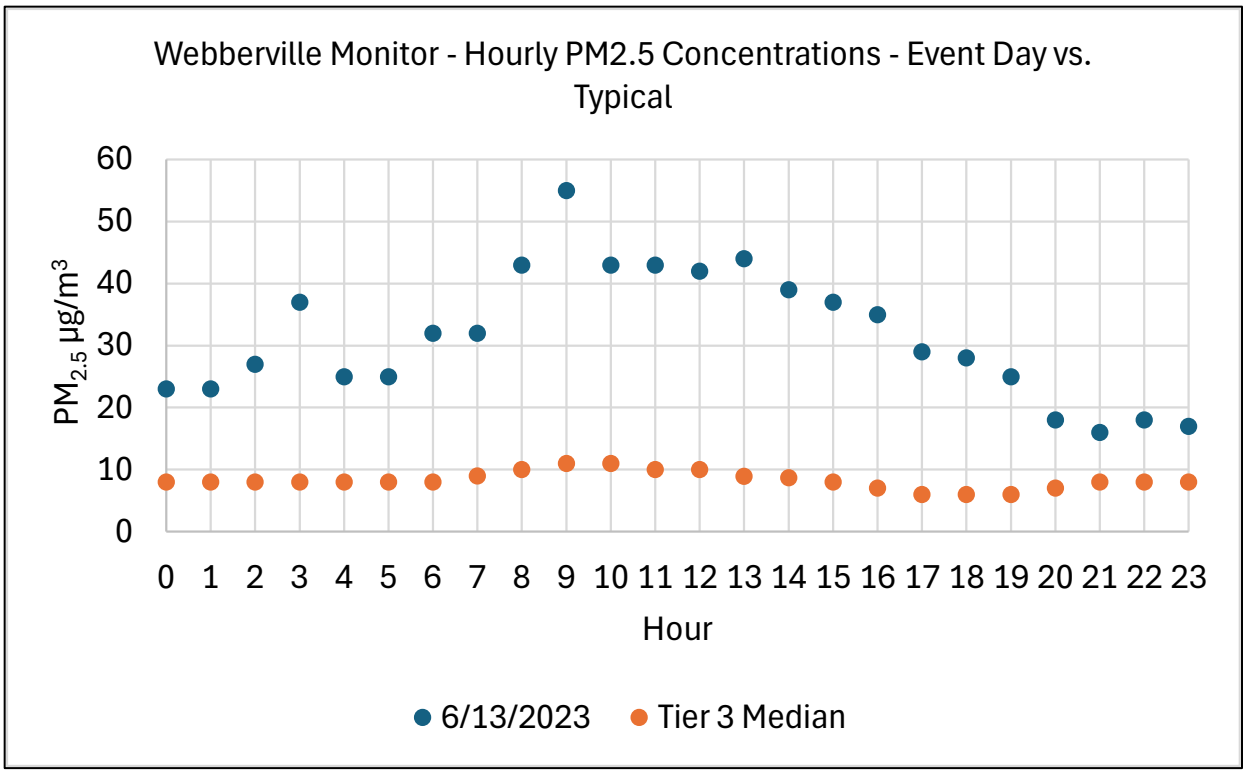


Figure 3-37: Hourly $PM_{2.5}$ Concentrations on June 13, 2023, compared to typical concentrations at the Webberville monitor

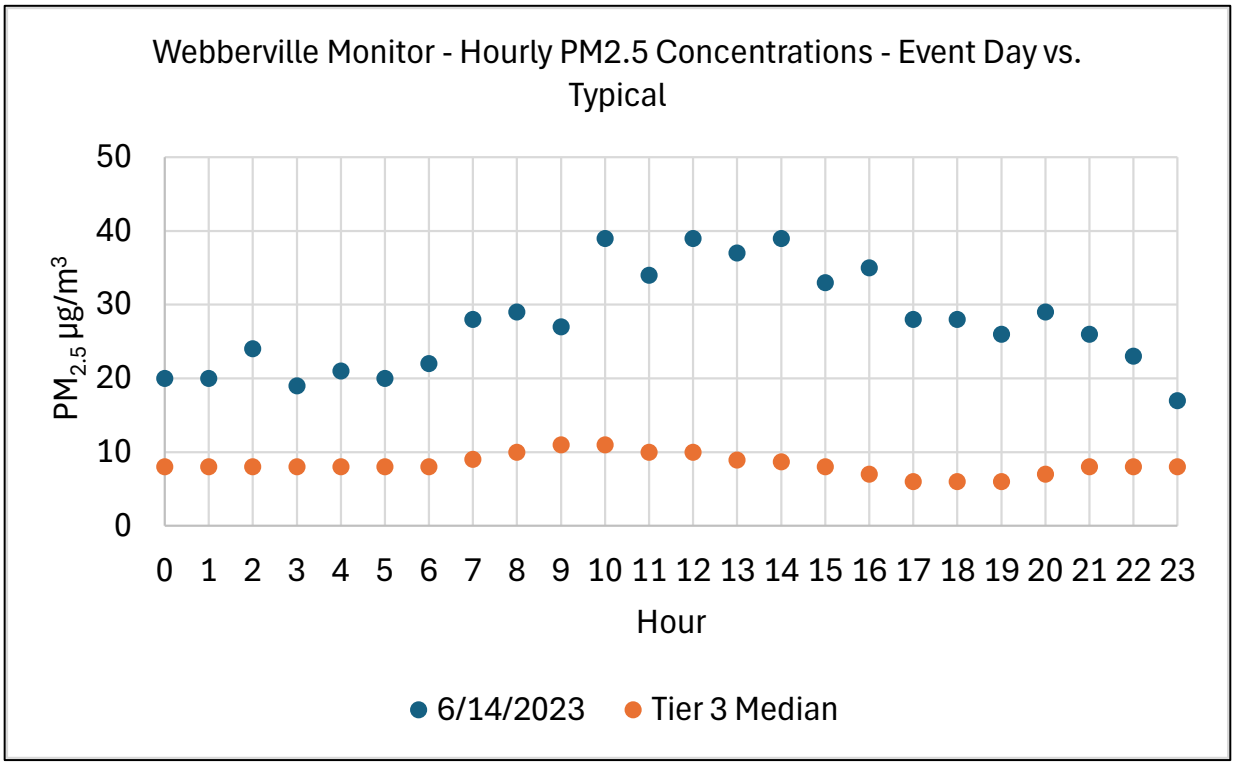


Figure 3-38: Hourly $PM_{2.5}$ Concentrations on June 14, 2023, compared to typical concentrations at the Webberville monitor

The TCEQ forecast discussion for June 13-14, 2023, mentions residual smoke from Mexico (Table C-8). Media reports from San Antonio and Austin (Figures C-6, C-7, C-8) describe haze in Central and South Texas due to burning in Mexico. Back trajectories (Figure 3-39: *HYSPLIT back trajectories from the Webberville monitor on June 13, 2023*, Figure 3-42: *HYSPLIT back trajectories from the Webberville monitor on June 14, 2023*, Figure 3-40: *72-hour HYSPLIT back trajectories starting from each hour on June 13, 2023, from the Webberville monitoring site at 100m AGL, 500m AGL, and 800 m AGL* and Figure 3-43: *72-hour HYSPLIT back trajectories starting from each hour on June 14, 2023, from the Webberville monitoring site at 100m AGL, 500m AGL, and 800 m AGL*) and smoke plumes (Figure 3-41: *AirNow Navigator with HMS Smoke Plume for June 13, 2023* and Figure 3-44: *AirNow Navigator with HMS Smoke Plume for June 14, 2023*) on these two days indicate that smoke was transported into Central Texas from Mexico, and multiple monitors in Texas had moderate AQI for these two days. Additionally, high smoke surface concentrations can be seen in central and south Texas on the NAAPS model plots (Figure D-9 and Figure D-10).

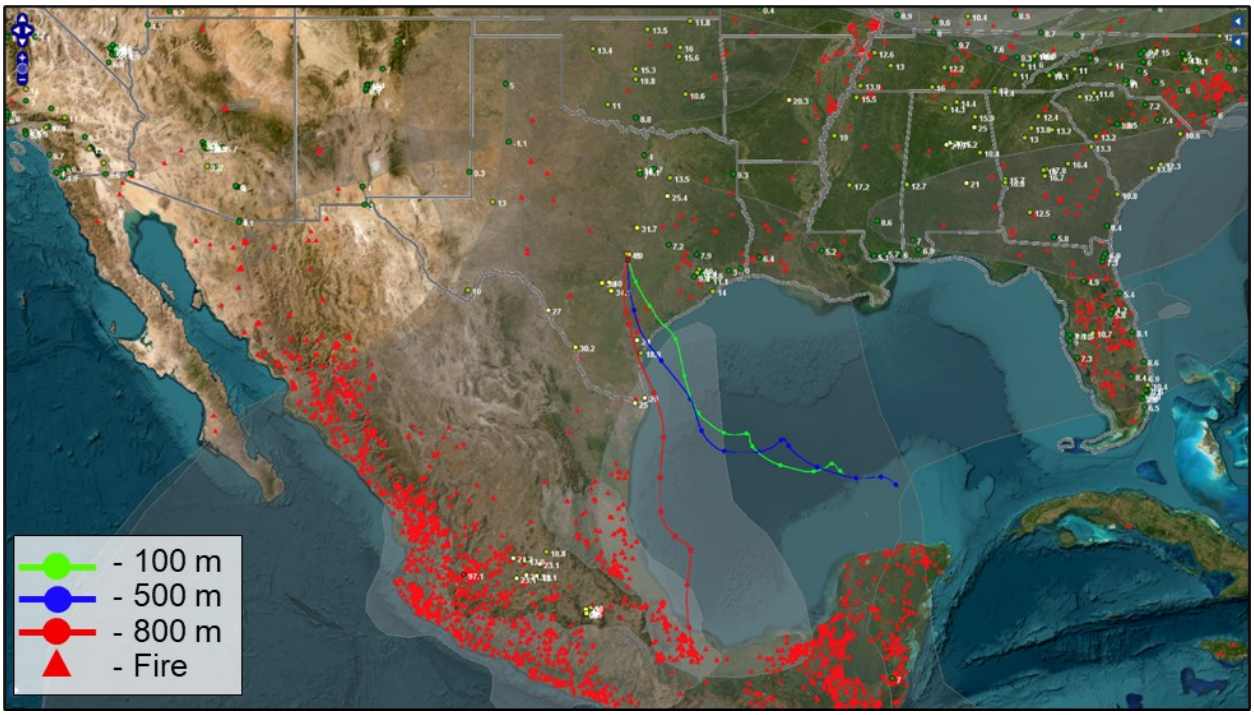


Figure 3-39: HYSPLIT back trajectories from the Webberville monitor on June 13, 2023

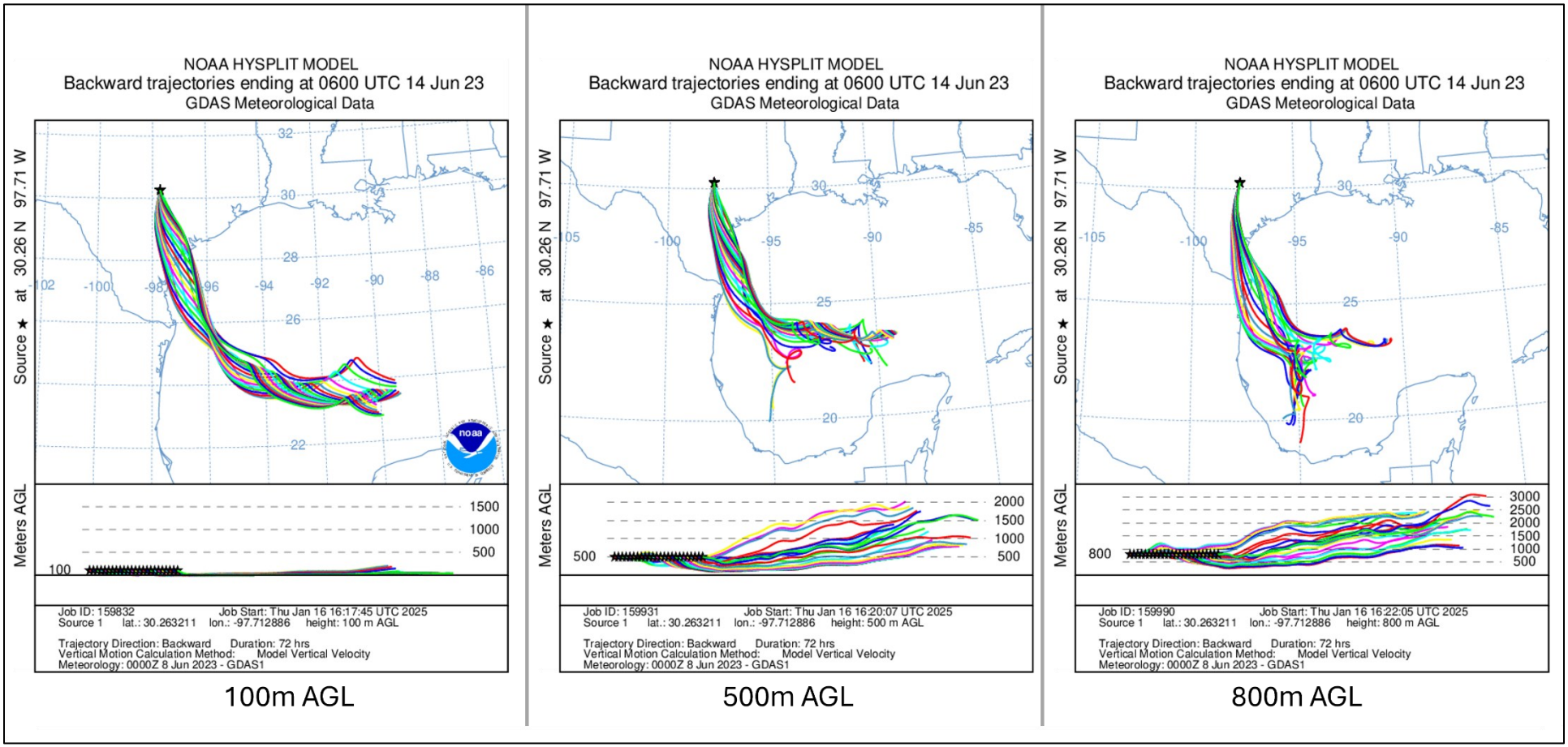


Figure 3-40: 72-hour HYSPLIT back trajectories starting from each hour on June 13, 2023, from the Webberville monitoring site at 100m AGL, 500m AGL, and 800 m AGL

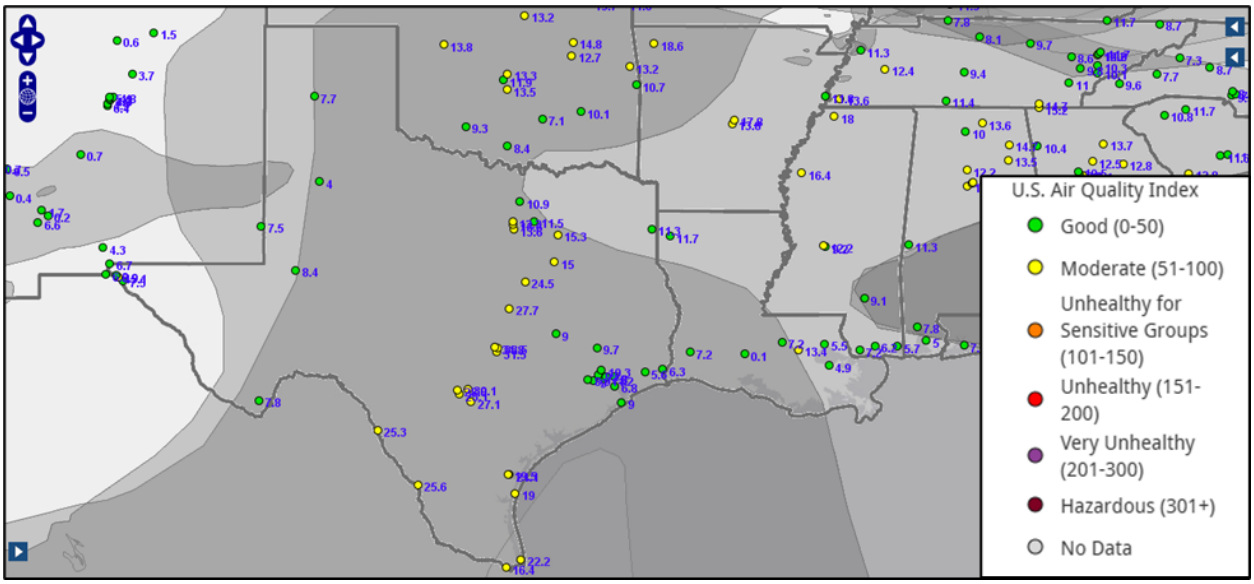


Figure 3-41: AirNow Navigator with HMS Smoke Plume for June 13, 2023

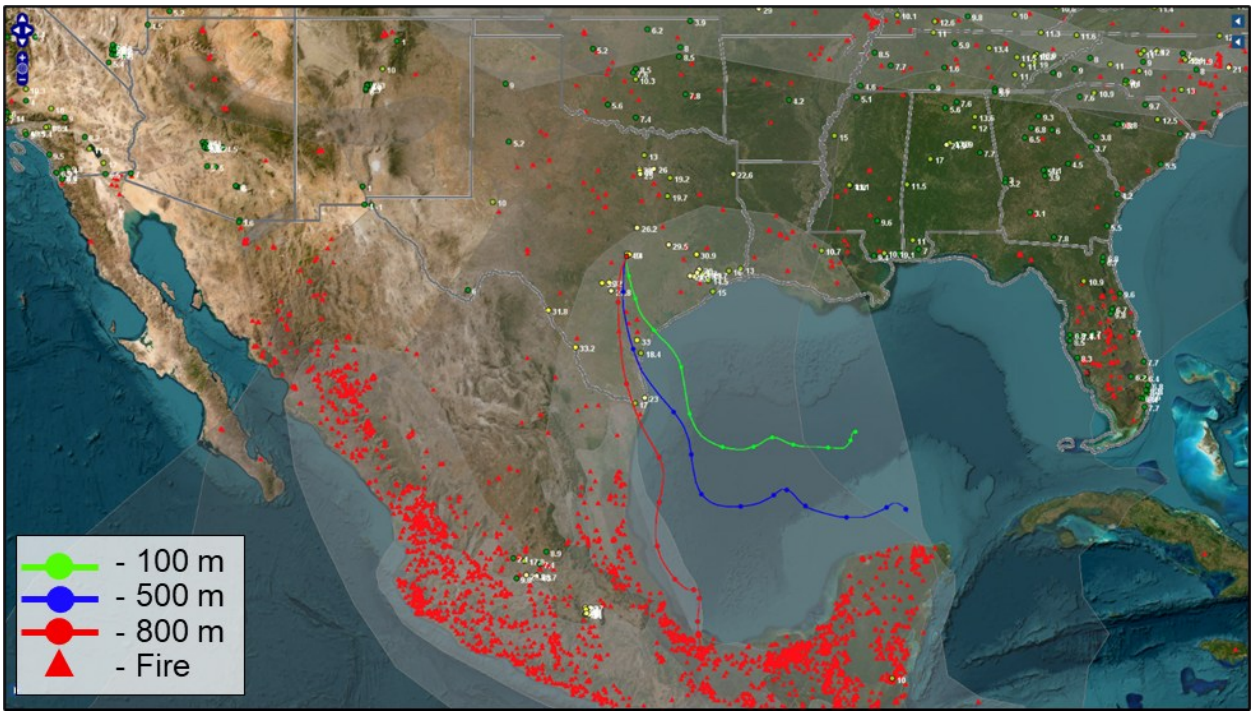


Figure 3-42: HYSPLIT back trajectories from the Webberville monitor on June 14, 2023

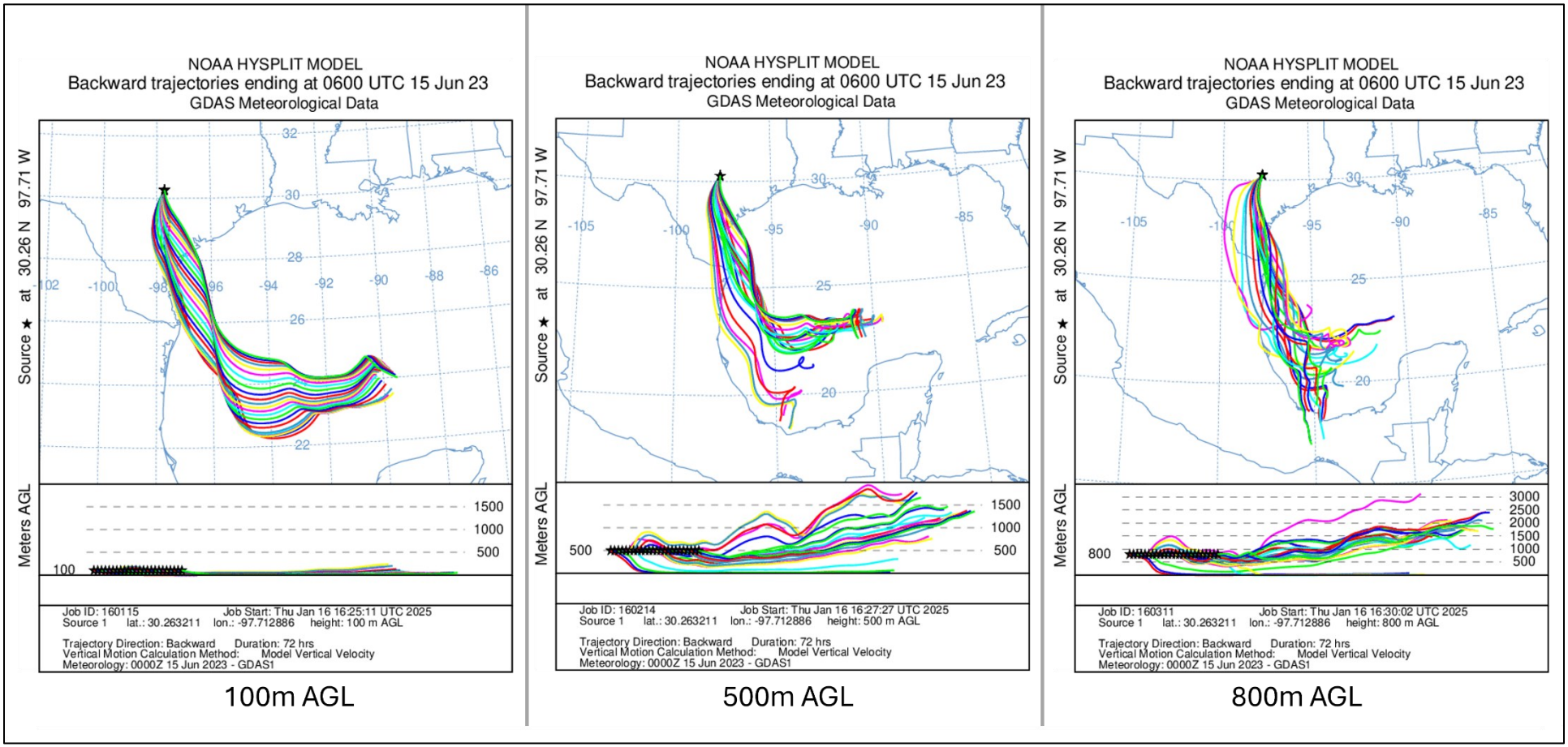


Figure 3-43: 72-hour HYSPLIT back trajectories starting from each hour on June 14, 2023, from the Webberville monitoring site at 100m AGL, 500m AGL, and 800 m AGL

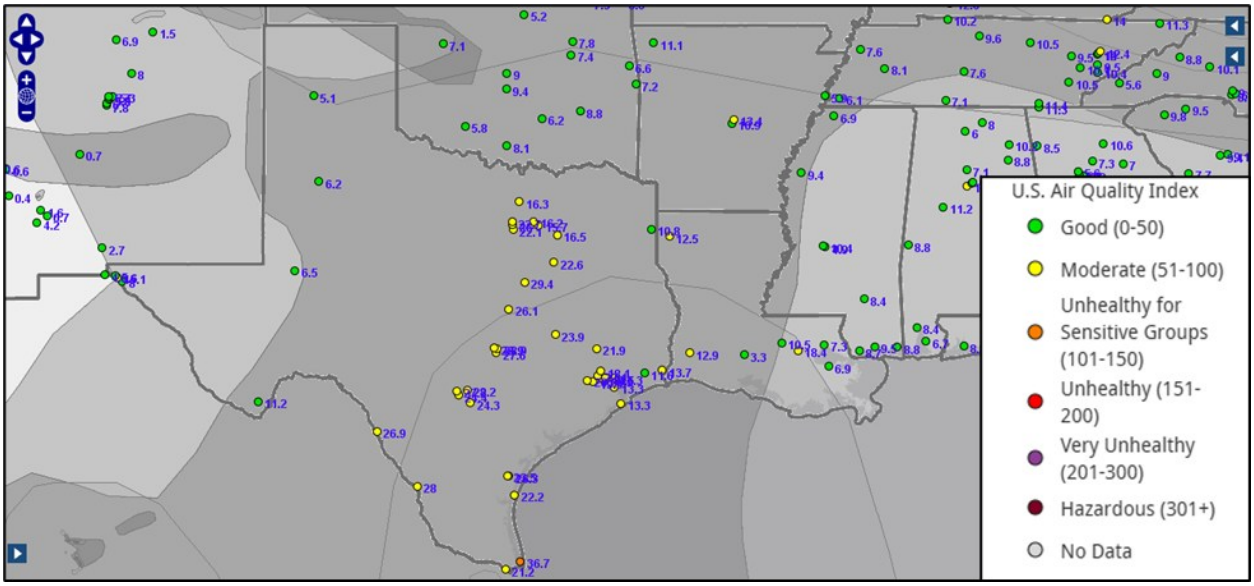


Figure 3-44: AirNow Navigator with HMS Smoke Plume for June 14, 2023

June 14, 2023, was also identified as a Tier 2 day at the National Seashore monitor due to elevated $PM_{2.5}$ concentrations resulting from fires in Mexico/Central America. The 24-hour $PM_{2.5}$ concentration was 22.2 µg/m^3, and hourly concentrations can be compared against a typical/non-event day in Figure 3-45: *Hourly $PM_{2.5}$ Concentrations on June 14, 2023, compared to typical concentrations at the National Seashore monitor*. The back trajectories (Figure 3-46: *HYSPLIT back trajectories from the National Seashore monitor on June 14, 2023*, and Figure 3-47: *72-hour HYSPLIT back trajectories starting from each hour on June 14, 2023, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL*) and smoke plume map (Figure 3-48: *AirNow Navigator with HMS Smoke Plume for June 14, 2023*) from this day show transport of smoke and moderate AQI in the area.

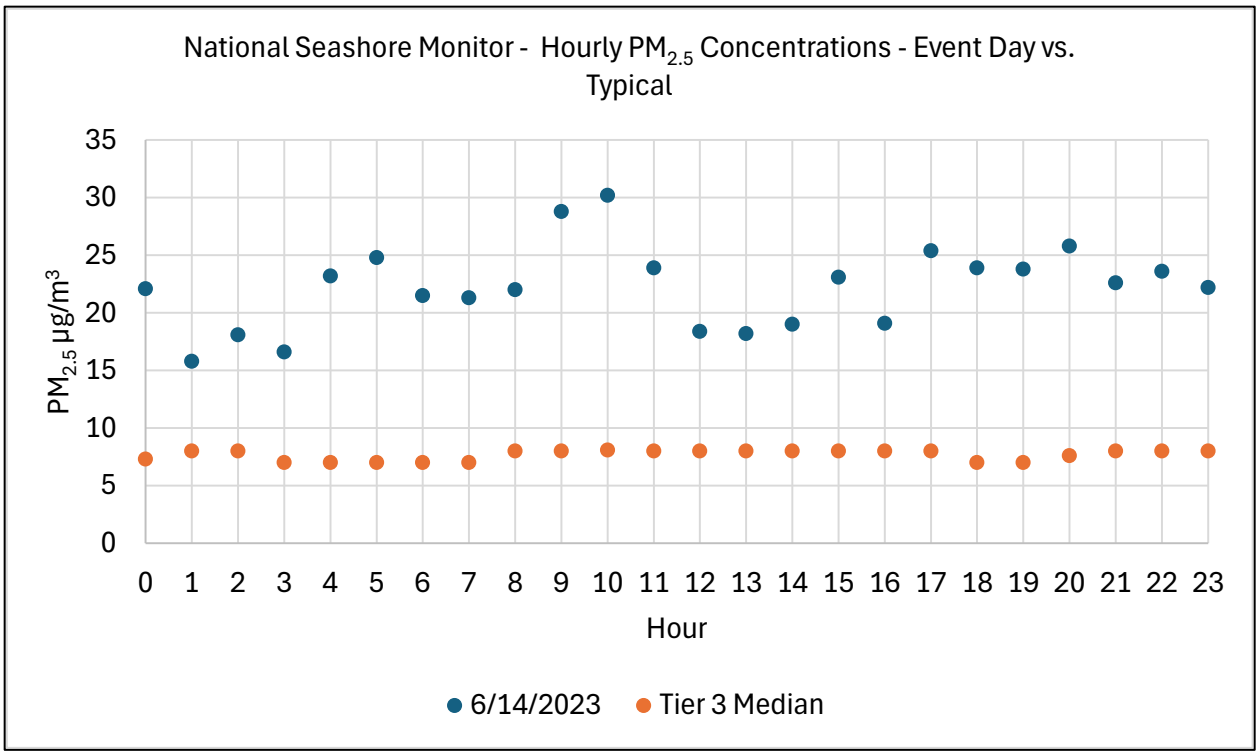


Figure 3-45: Hourly $PM_{2.5}$ Concentrations on June 14, 2023, compared to typical concentrations at the National Seashore monitor

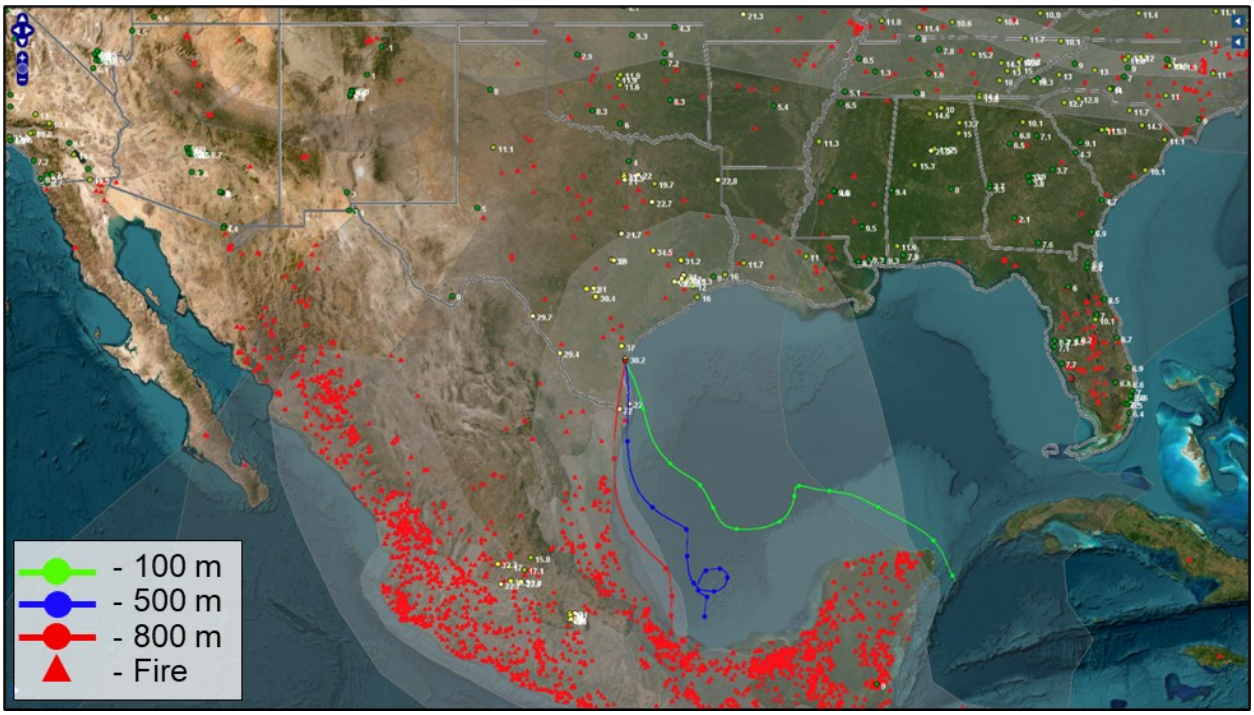


Figure 3-46: HYSPLIT back trajectories from the National Seashore monitor on June 14, 2023

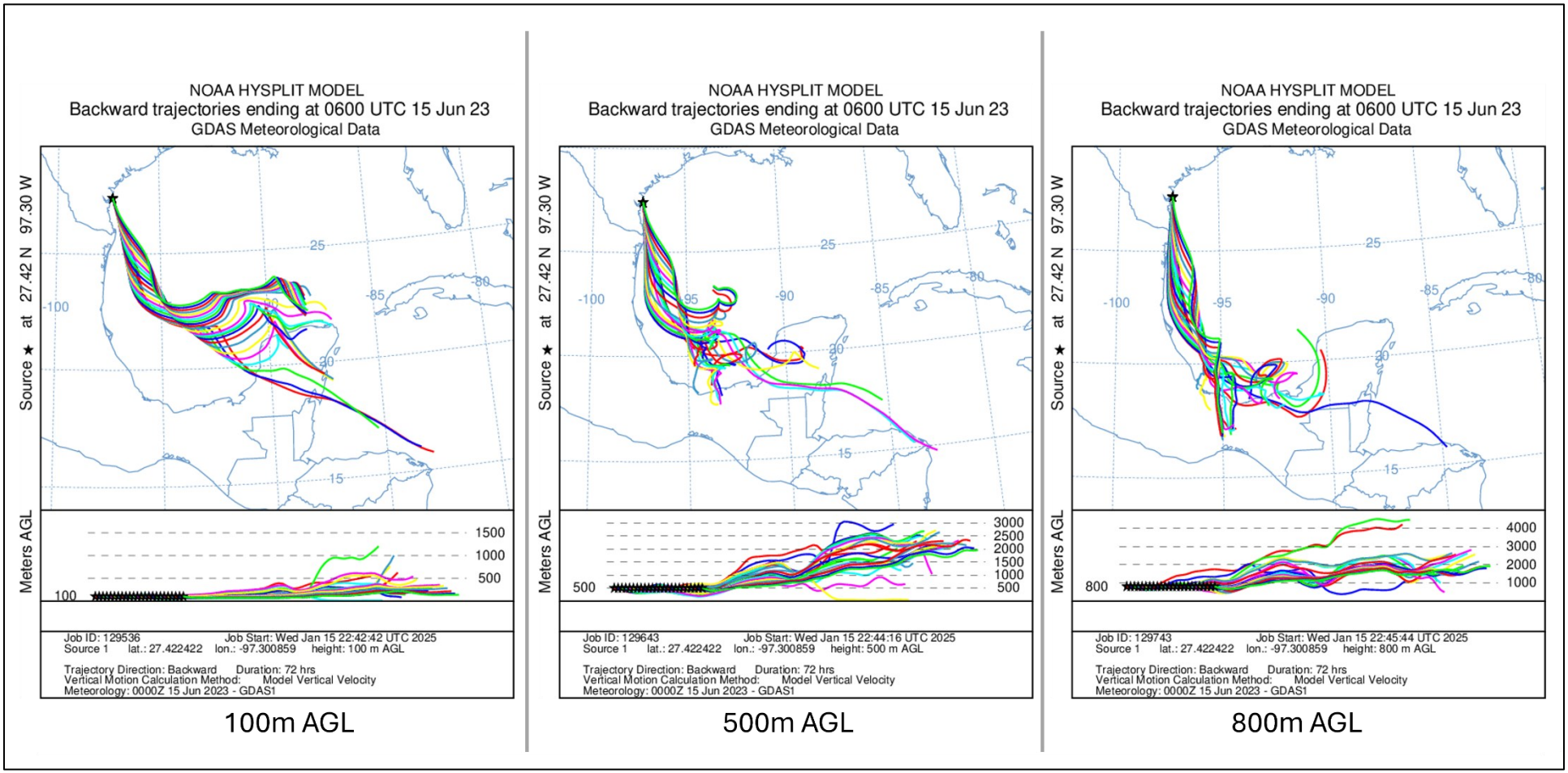


Figure 3-47: 72-hour HYSPLIT back trajectories starting from each hour on June 14, 2023, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL

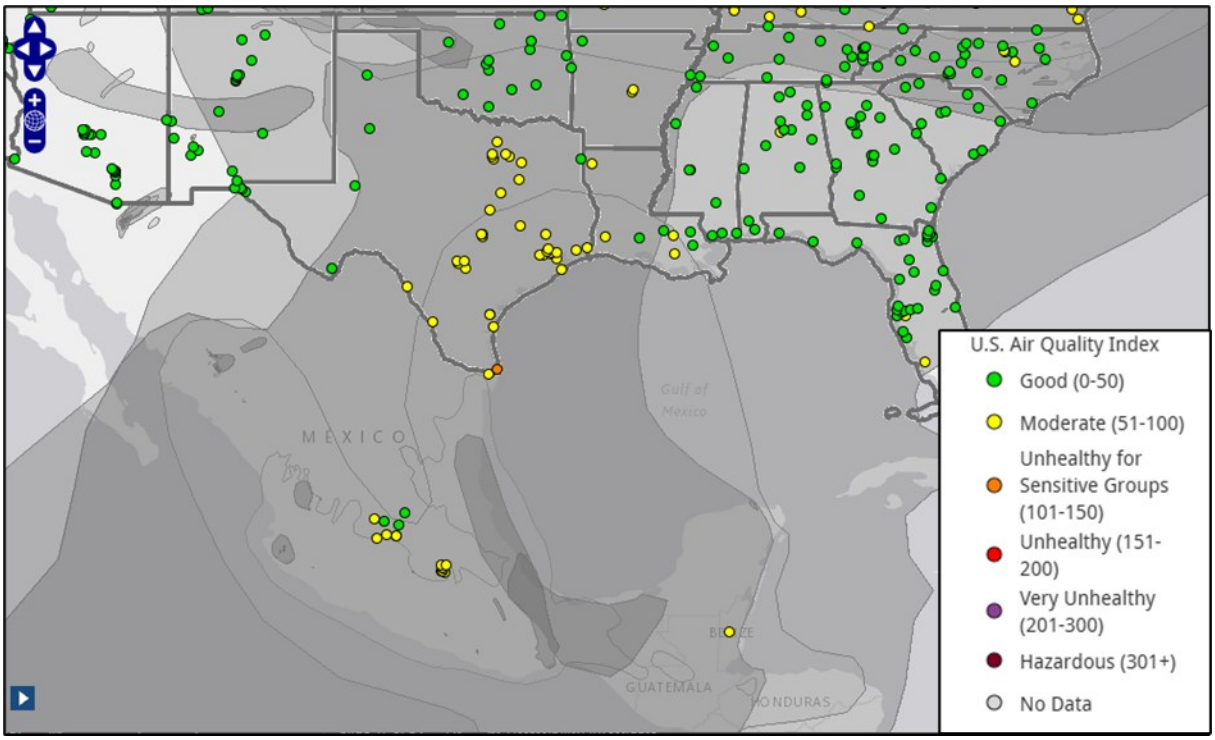


Figure 3-48: AirNow Navigator with HMS Smoke Plume for June 14, 2023

June 15, 2023, was identified as a Tier 2 day at the Webberville monitor due to elevated $PM_{2.5}$ concentrations resulting from smoke associated from fires in Mexico/Central America. The 24-hour $PM_{2.5}$ concentration was 27.4 µg/m^3. Event day hourly concentrations can be compared against typical non-event day concentrations in Figure 3-49: *Hourly $PM_{2.5}$ Concentrations on June 15, 2023, compared to typical concentrations at the Webberville monitor*.

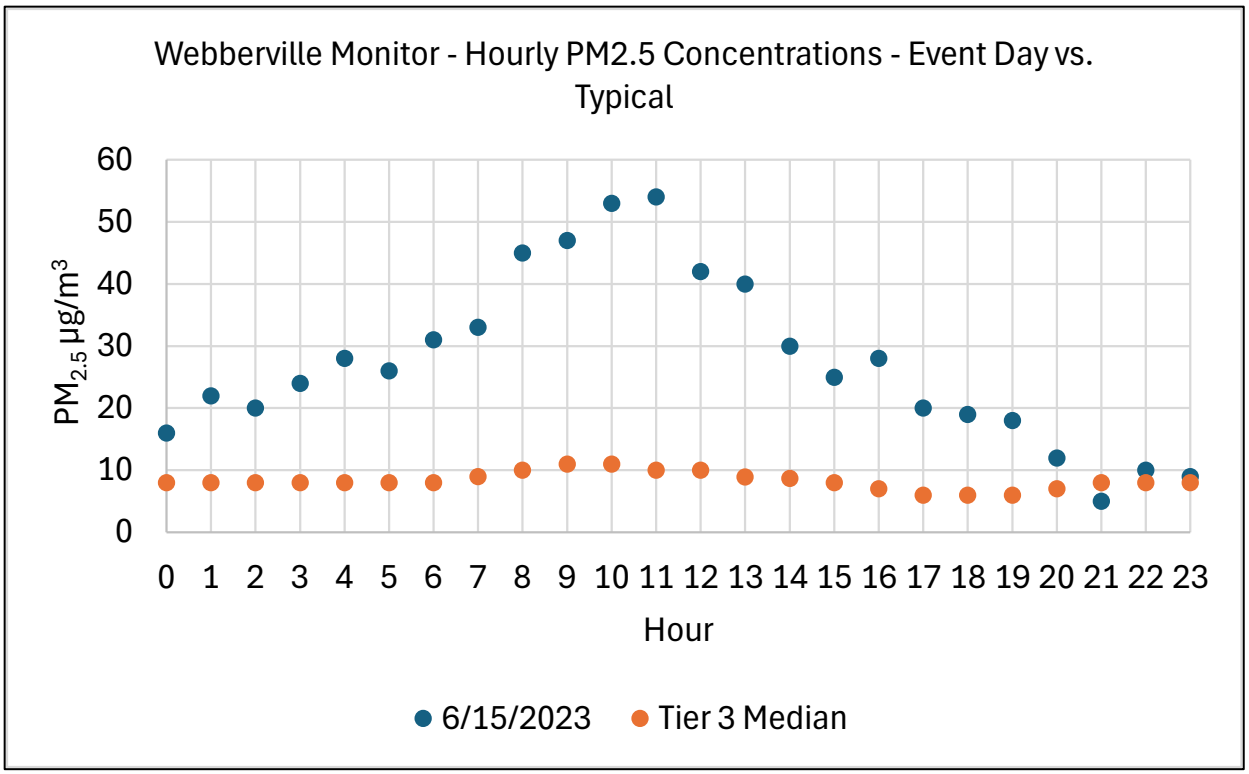


Figure 3-49: Hourly $PM_{2.5}$ Concentrations on June 15, 2023, compared to typical concentrations at the Webberville monitor

Back trajectories in Figure 3-50: *HYSPLIT back trajectories from the Webberville monitor on June 15, 2023*, show transport of air from Mexico and smoke plumes (Figure 3-51: *AirNow Navigator with HMS Smoke Plume for June 15, 2023* and Figure 3-52: *72-hour HYSPLIT back trajectories starting from each hour on June 15, 2023, from the Webberville monitoring site at 100m AGL, 500m AGL, and 800 m AGL*) led to moderate AQI in central and south Texas. The satellite image on June 15, 2023 (Figure 3-53: *Satellite image of haze along the Mexico and Texas coast on June 15, 2023 (Aqua/Modis Corrected Reflectance True Color)*) shows hazy skies along the coastline and into Central Texas. The NAAPS model plot reflects high smoke surface concentrations in central and south Texas on this day (Figure D-11). The TCEQ forecast discusses smoke from fires in Mexico and Central America merging with smoke from the Canadian wildfires, in addition to aerosols from industrial activities in Mexico (Table C-8).

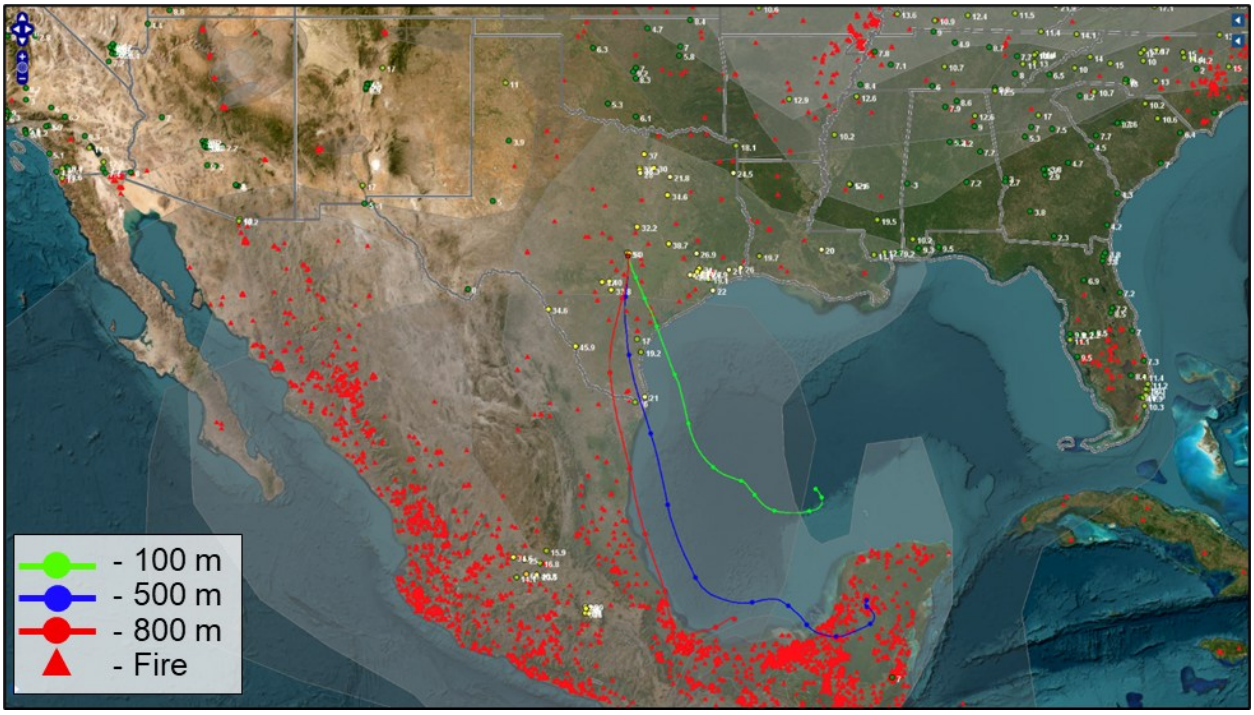


Figure 3-50: HYSPLIT back trajectories from the Webberville monitor on June 15, 2023

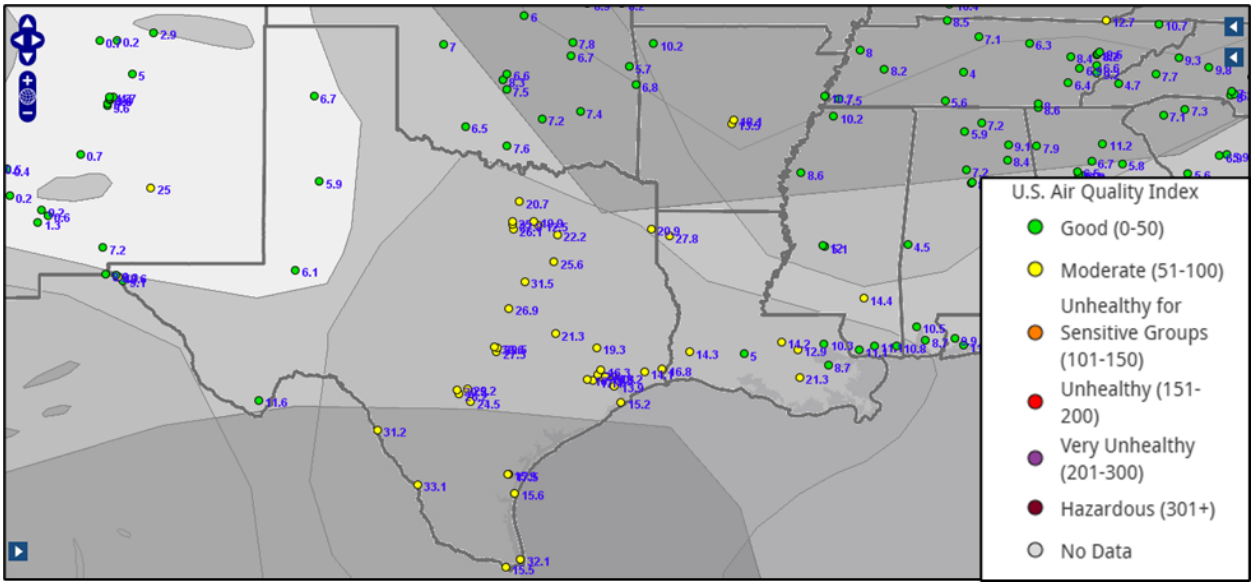


Figure 3-51: AirNow Navigator with HMS Smoke Plume for June 15, 2023

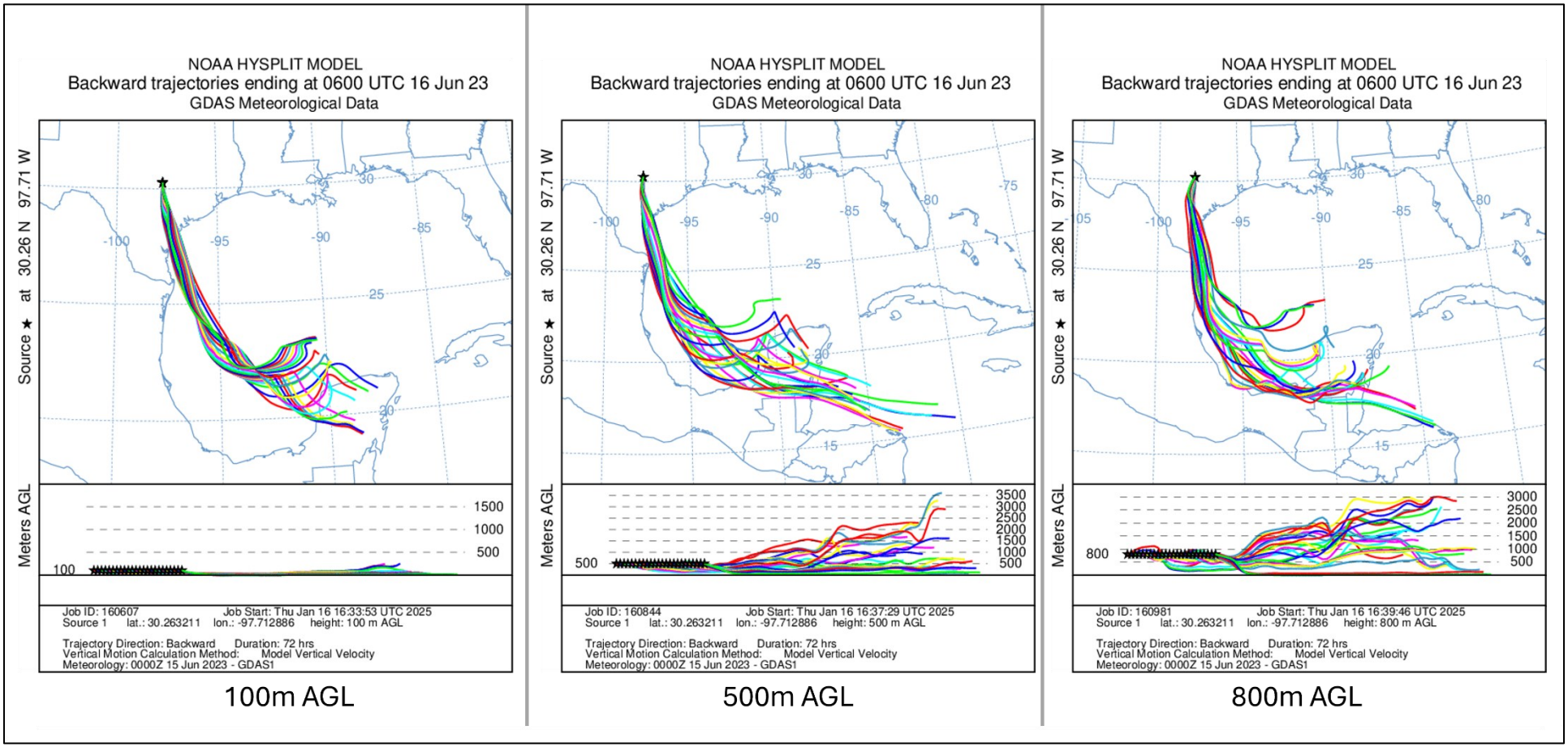


Figure 3-52: 72-hour HYSPLIT back trajectories starting from each hour on June 15, 2023, from the Webberville monitoring site at 100m AGL, 500m AGL, and 800 m AGL

Figure 3-53: Satellite image of haze along the Mexico and Texas coast on June 15, 2023 (Corrected Reflectance - True Color from Aqua / MODIS)

3.2.9 Group 10 – Evidence for July 15 and July 16, 2023, African Dust $PM_{2.5}$ Event for the National Seashore Monitor

July 15 and July 16, 2023, were identified as Tier 2 days at the National Seashore monitor due to Saharan dust. The 24-hour $PM_{2.5}$ concentrations were 24.2 µg/m^3 and 24.6 µg/m^3, respectively.

Hourly concentrations on July 15th can be compared against typical/non-event day in Figure 3-54: *Hourly $PM_{2.5}$ Concentrations on July 15, 2023, compared to typical concentrations at the National Seashore monitor*. Back trajectories (Figure 3-55: *HYSPLIT back trajectories from the National Seashore monitor on July 15, 2023*) and aerosol optical depth (Figure 3-56: *Aerosol optical depth map from MODIS Terra and Aqua on July 15, 2023*) show transport of dust over the Caribbean Sea, through the Gulf of Mexico into Texas. Forward trajectories from Western Africa (starting two weeks before event day) show transport of dust across the Atlantic into North America (Figure 3-57: *HYSPLIT forward trajectories from Western Africa, starting on July 1, 2023*). TCEQ forecasted (Table C-9) a light to moderate density plume of Saharan dust continuing to build over South-Central Texas. Saharan dust was also mentioned in media reports on these two days (Figures C-9 and C-10).

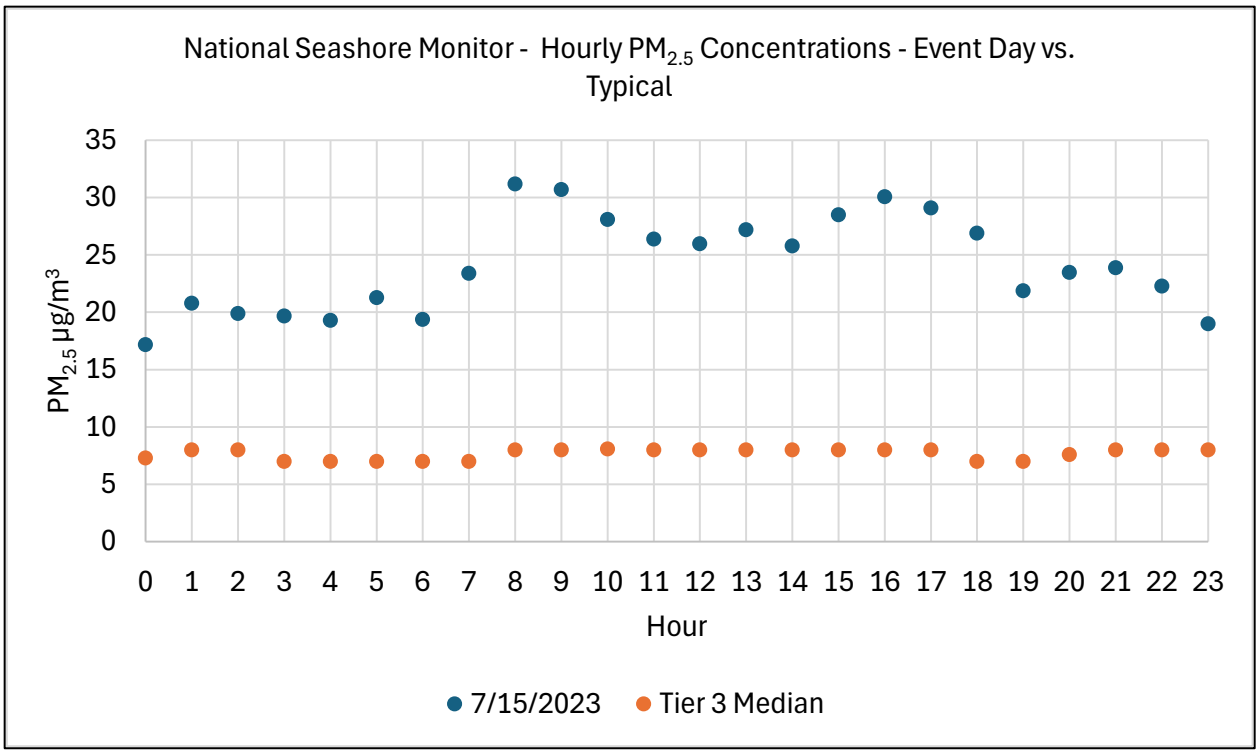


Figure 3-54: Hourly $PM_{2.5}$ Concentrations on July 15, 2023, compared to typical concentrations at the National Seashore monitor

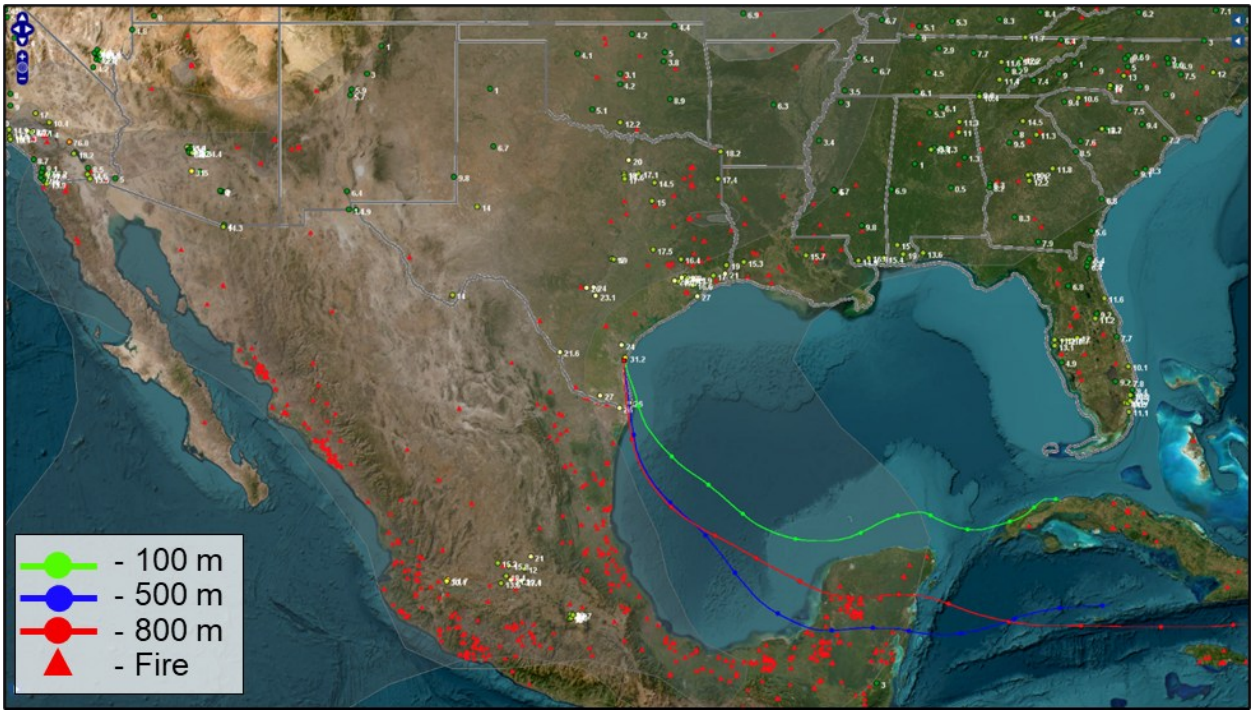


Figure 3-55: HYSPLIT back trajectories from the National Seashore monitor on July 15, 2023

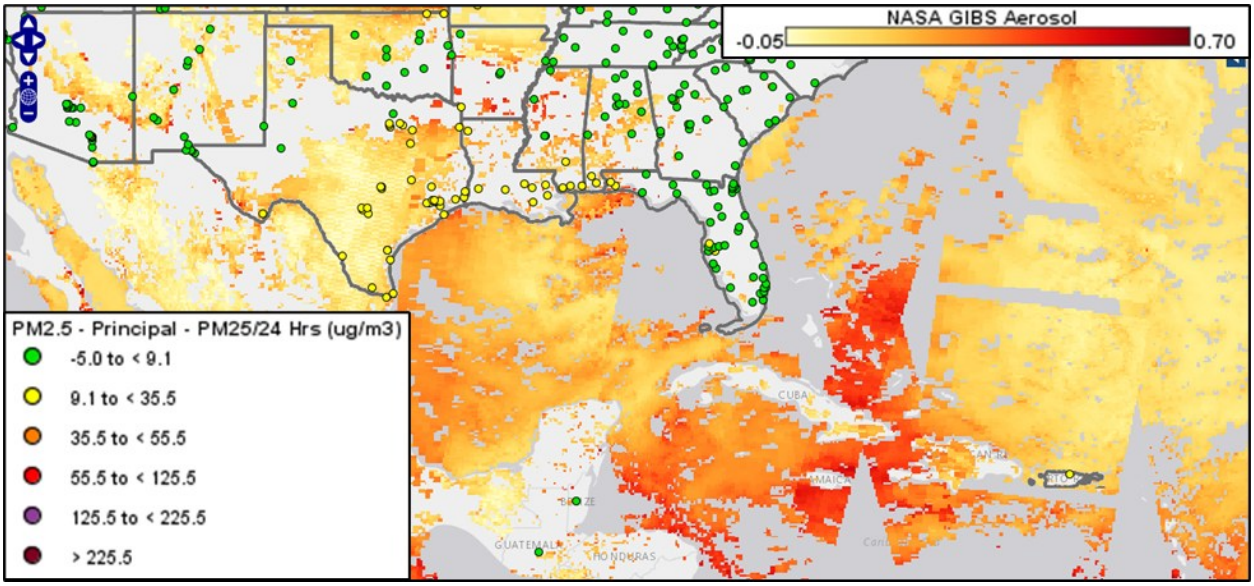


Figure 3-56: Aerosol optical depth map from Terra and Aqua / MODIS on July 15, 2023

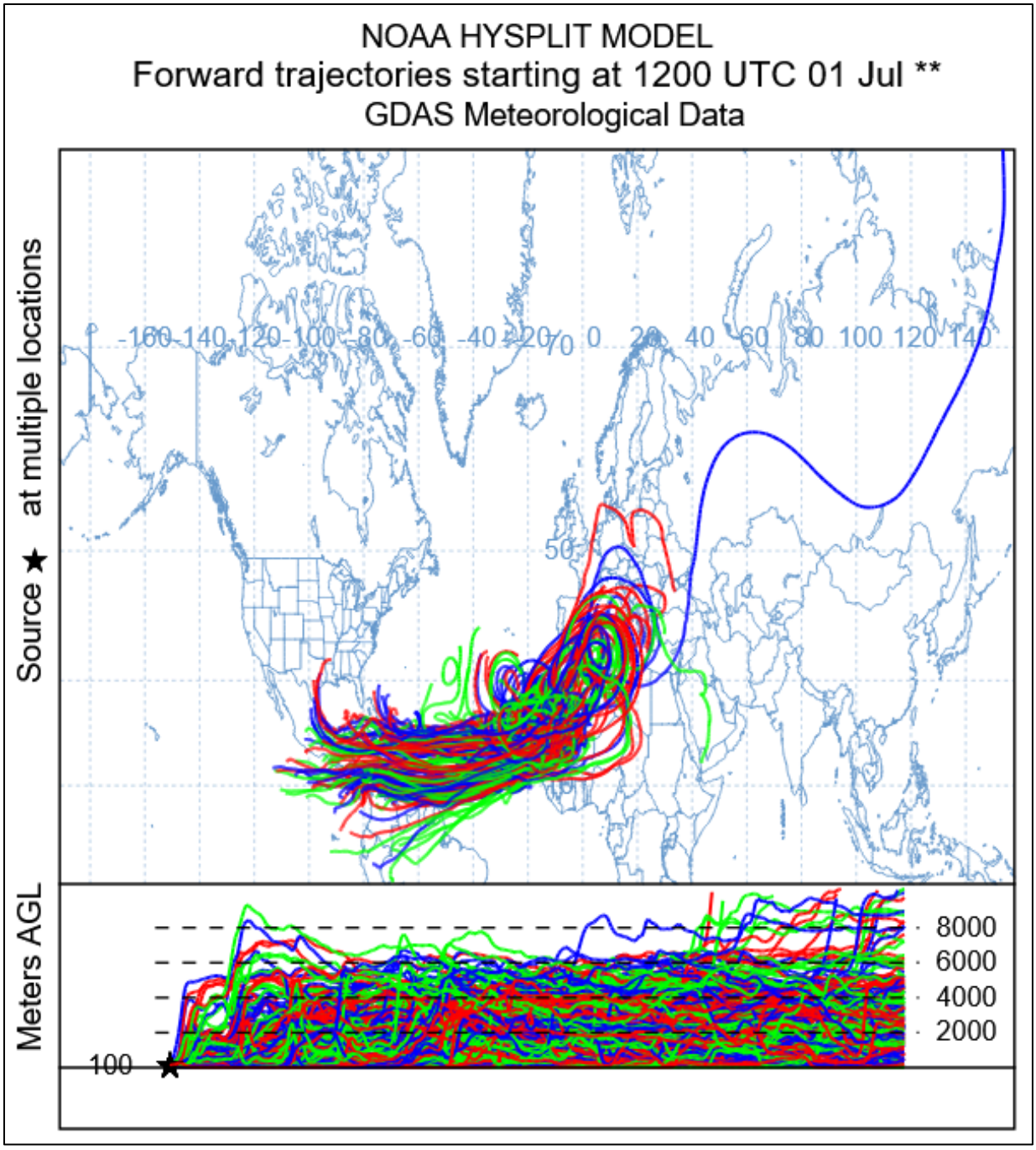


Figure 3-57: HYSPLIT forward trajectories from Western Africa, starting on July 1, 2023

Hazy conditions from Saharan dust continued on July 16, 2023, with elevated hourly concentrations of $PM_{2.5}$ (Figure 3-58: *Hourly $PM_{2.5}$ Concentrations on July 16, 2023, compared to typical concentrations at the National Seashore monitor*). Back trajectories and aerosol optical depth also continue to show transport of dust to the National Seashore monitor (Figure 3-59: *HYSPLIT back trajectories from the National Seashore monitor on July 16, 2023* and Figure 3-60: *Aerosol optical depth map from MODIS Terra and Aqua on July 16, 2023*). Forward trajectories from Western Africa show transport of Saharan dust into North America in Figure 3-61: *HYSPLIT forward trajectories from Western Africa, starting on July 2, 2023*. The dust can be seen on visible satellite imagery being transported off the coast of Africa a few weeks before

this grouping of exceptional events (Figure 3-62: *Dust transported off the western coast of Africa, image from July 6, 2023 (Corrected Reflectance - True Color from Aqua / MODIS)*). TCEQ also forcasted Saharan dust continuing to impact most spots in Texas at varying intensities (Table C-9).

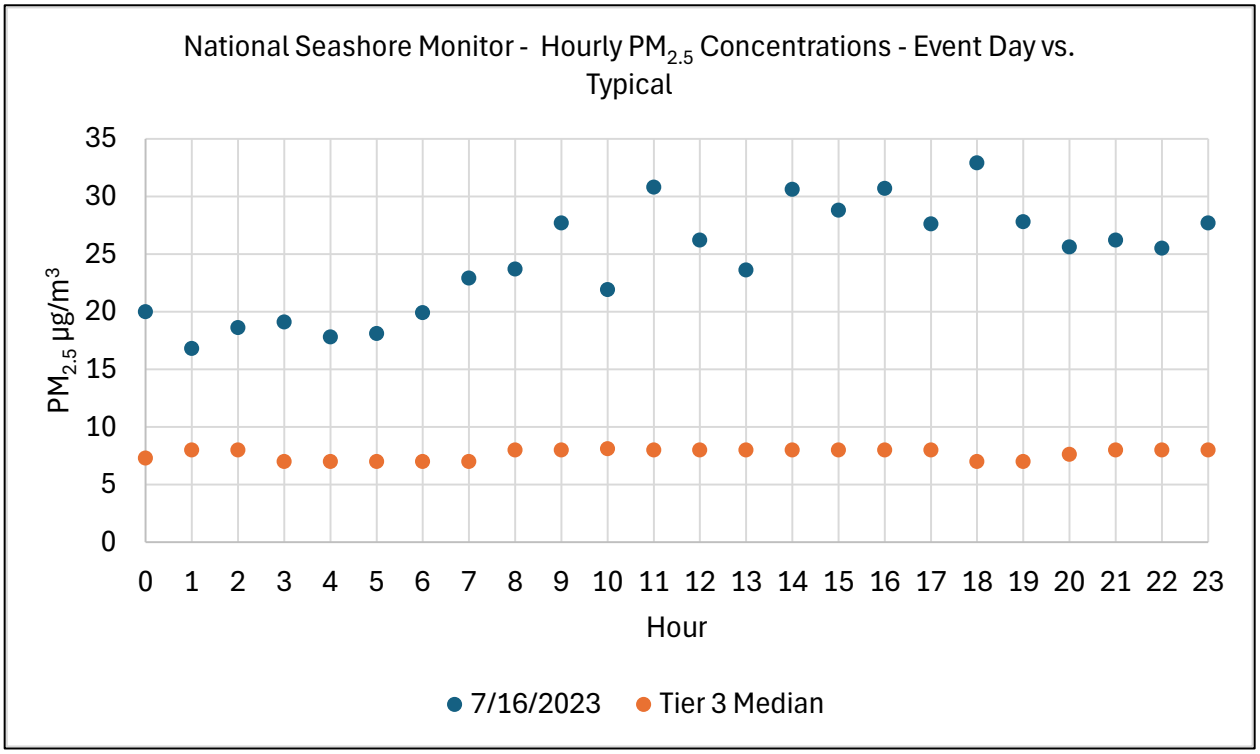


Figure 3-58: Hourly $PM_{2.5}$ Concentrations on July 16, 2023, compared to typical concentrations at the National Seashore monitor

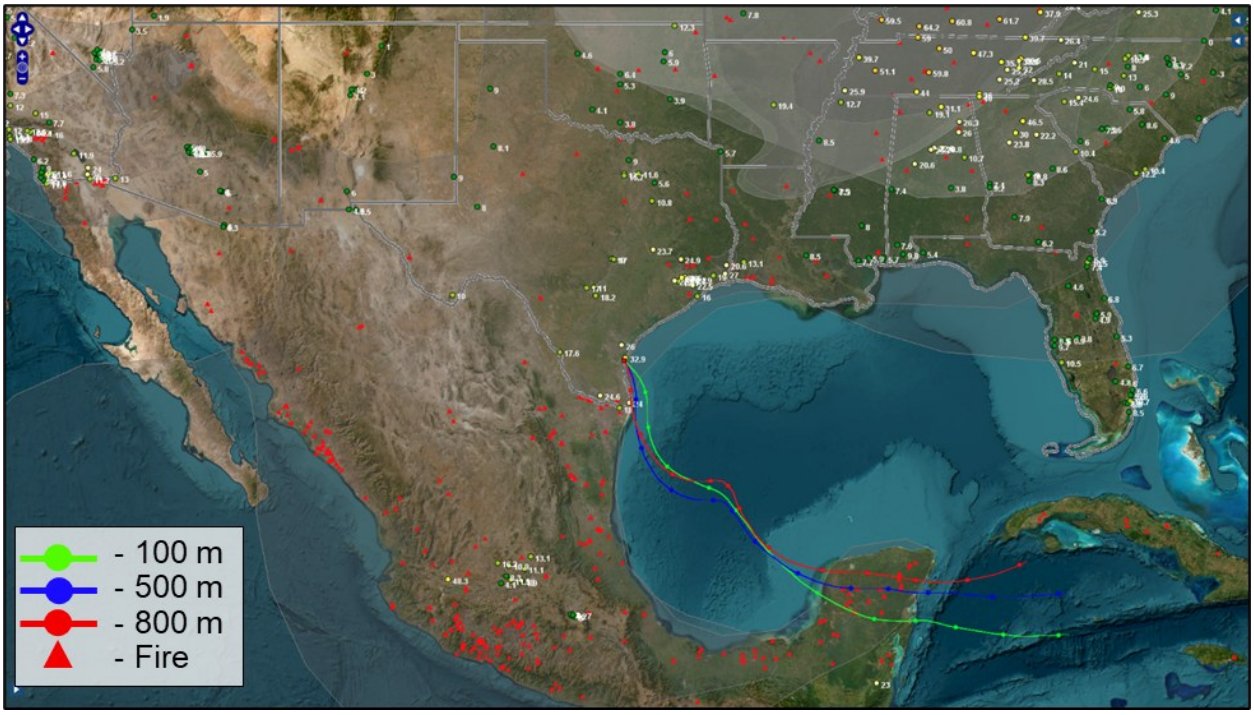


Figure 3-59: HYSPLIT back trajectories from the National Seashore monitor on July 16, 2023

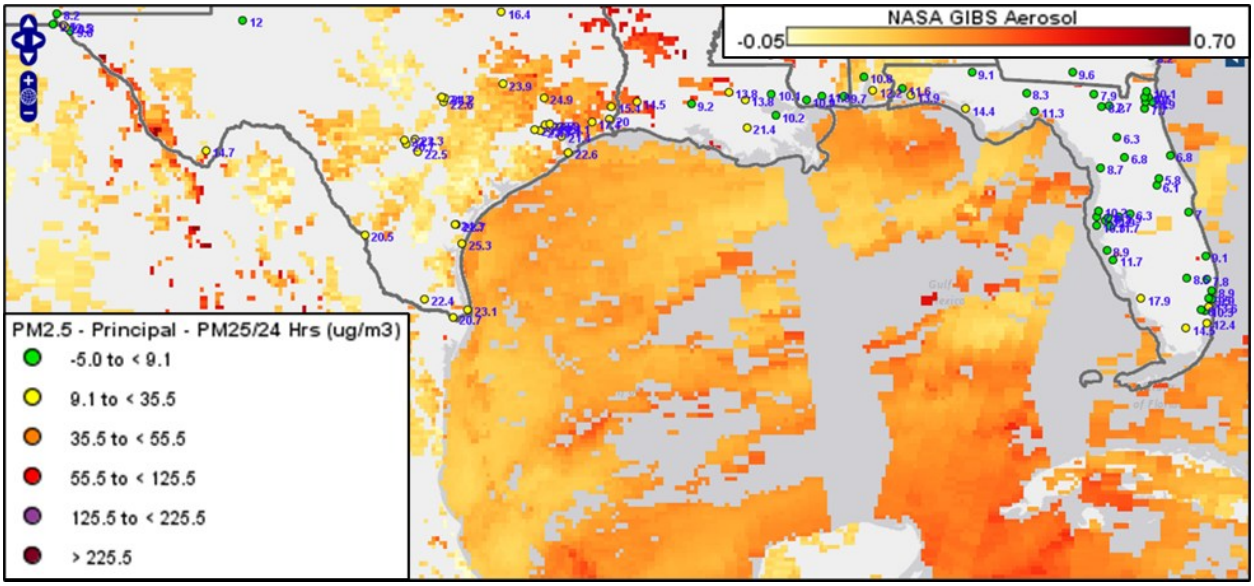


Figure 3-60: Aerosol optical depth map from Terra and Aqua / MODIS on July 16, 2023

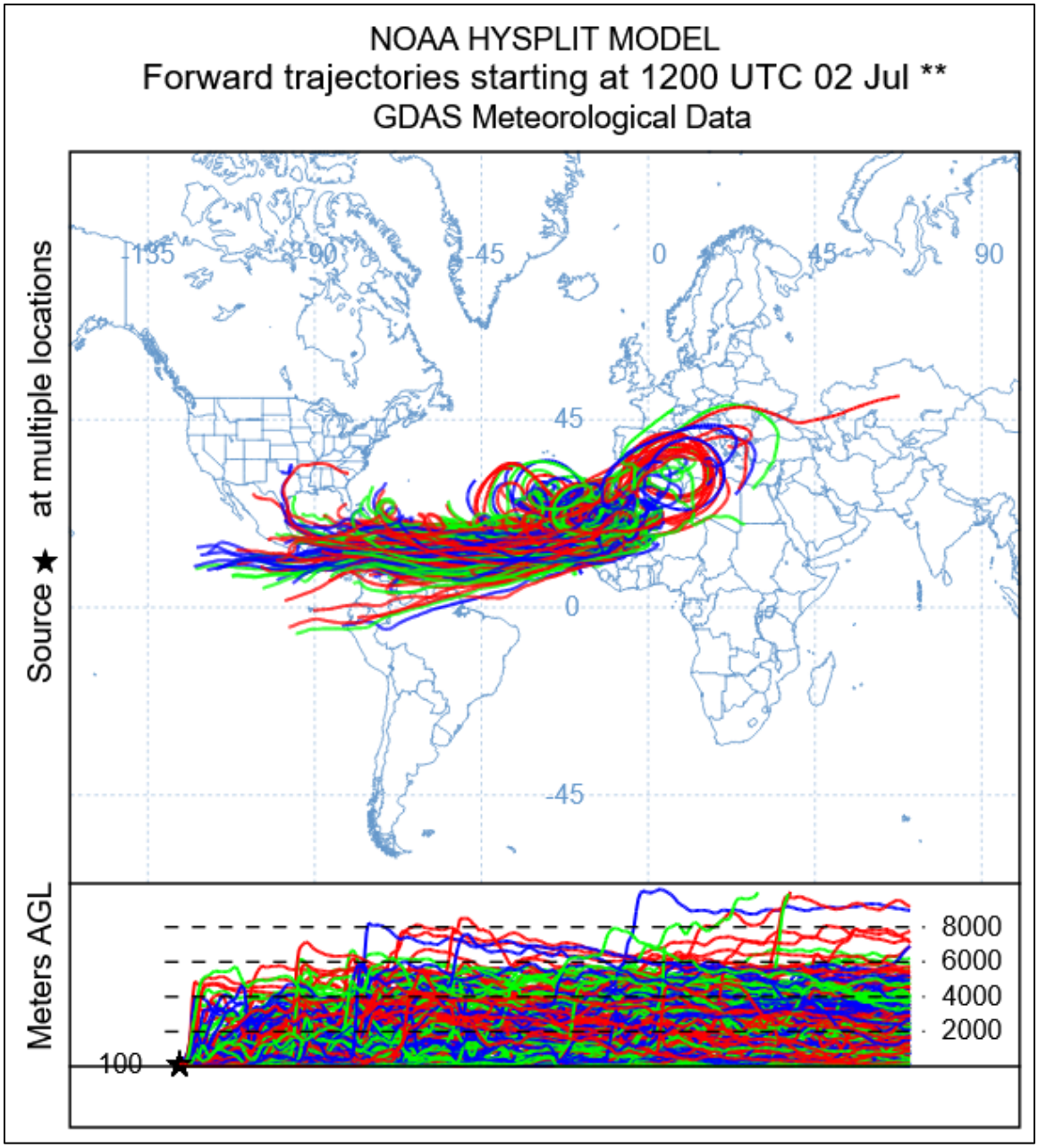


Figure 3-61: HYSPLIT forward trajectories from Western Africa, starting on July 2, 2023

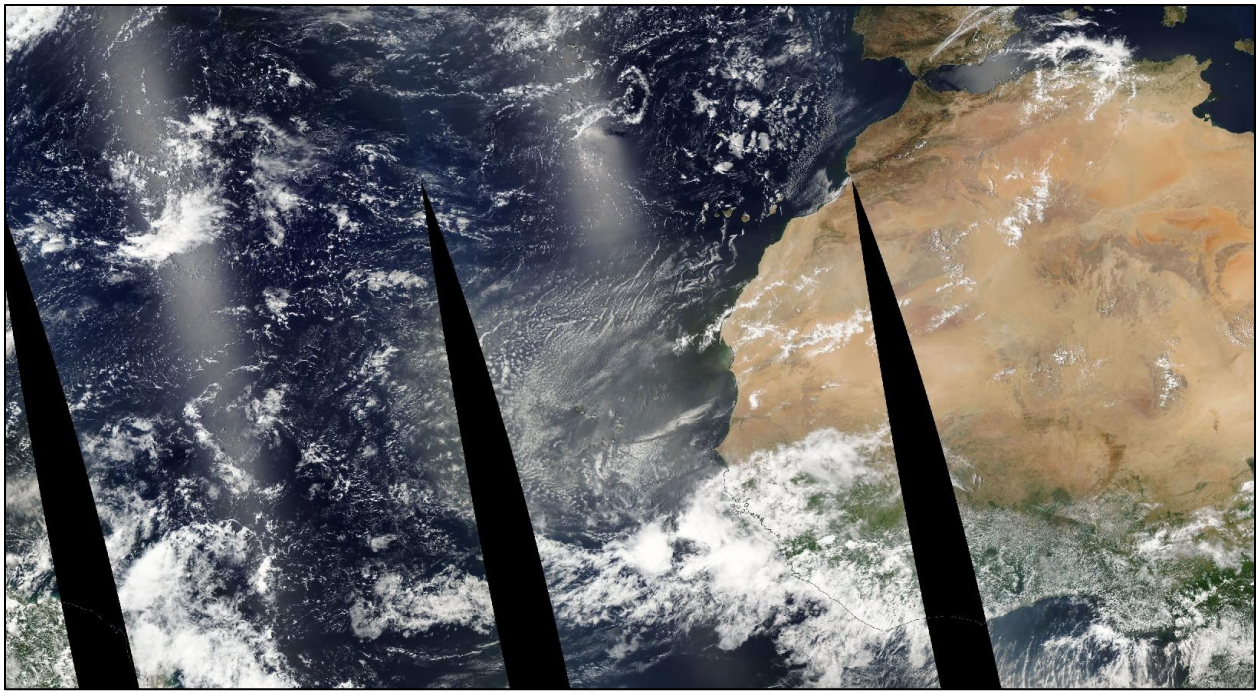


Figure 3-62: Dust transported off the western coast of Africa, image from July 6, 2023 (Corrected Reflectance - True Color from Aqua / MODIS)

3.2.10 Group 11 – Evidence for July 25, July 26, July 27, and July 28, 2023, African Dust $PM_{2.5}$ Event for the National Seashore Monitor

July 25, July 26, and July 28, 2023, were identified as Tier 2 days at the National Seashore monitor, with 24-hour $PM_{2.5}$ concentrations of 22.3 µg/m^3, 26.5 µg/m^3, and 23.3 µg/m^3, respectively. July 27, 2023, was identified as a Tier 1 day with a 24-hour $PM_{2.5}$ concentration of 29.6 µg/m^3. These elevated concentrations were a result of Saharan dust.

For July 25th, elevated concentrations of $PM_{2.5}$ can be compared against a typical/non-event day in Figure 3-63: *Hourly $PM_{2.5}$ Concentrations on July 25, 2023, compared to typical concentrations at the National Seashore Monitor*. Back trajectories (Figure 3-64: *HYSPLIT back trajectories from the National Seashore monitor on July 25, 2023*) show movement of air from the Caribbean, into the Gulf of Mexico and the Texas coastline. The TCEQ forecast for this day mentions a large area of light residual smoke from the Canadian wildfires as well as a moderate to heavy density plume of Saharan dust arriving to Texas (Table C-10). A media report from San Antonio also mentions Saharan dust arriving in the area (Figure C-13). The aerosol optical depth map (Figure 3-65: *Aerosol optical depth map from MODIS Terra and Aqua on July 25, 2023*) shows high readings of aerosols in the Gulf of Mexico, with moderate AQI in south and central Texas.

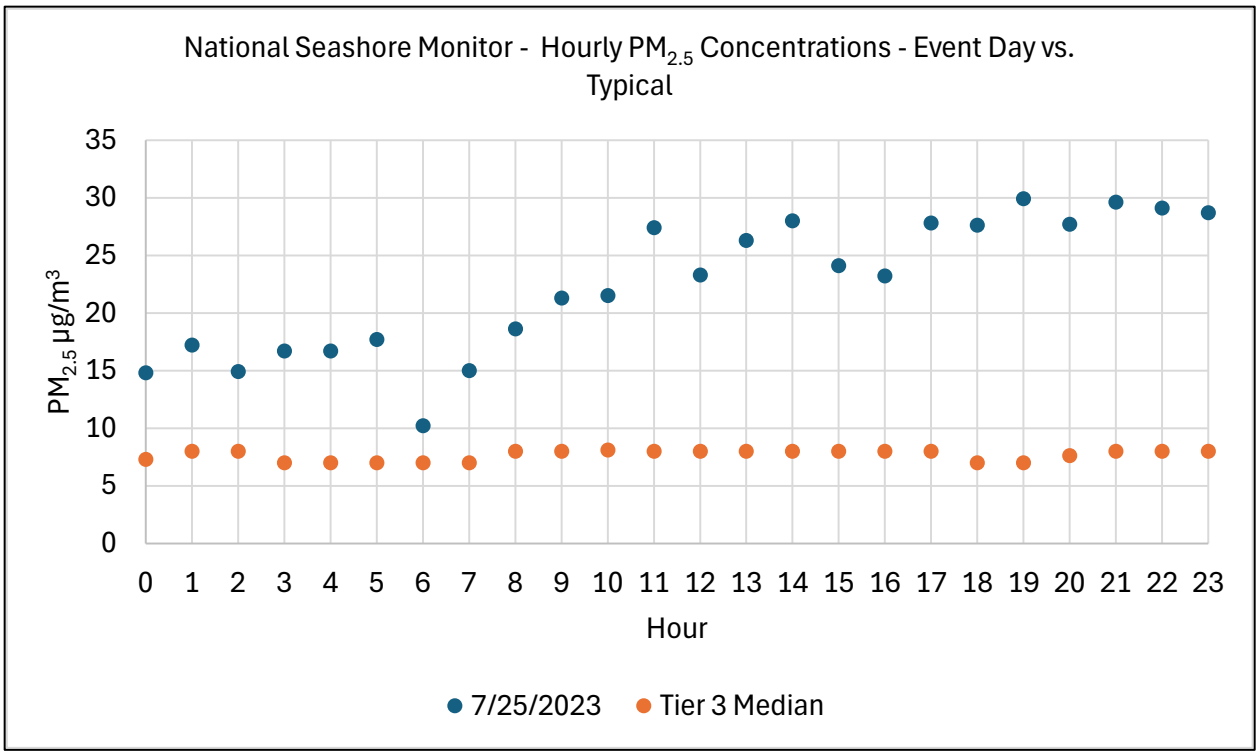


Figure 3-63: Hourly $PM_{2.5}$ Concentrations on July 25, 2023, compared to typical concentrations at the National Seashore Monitor

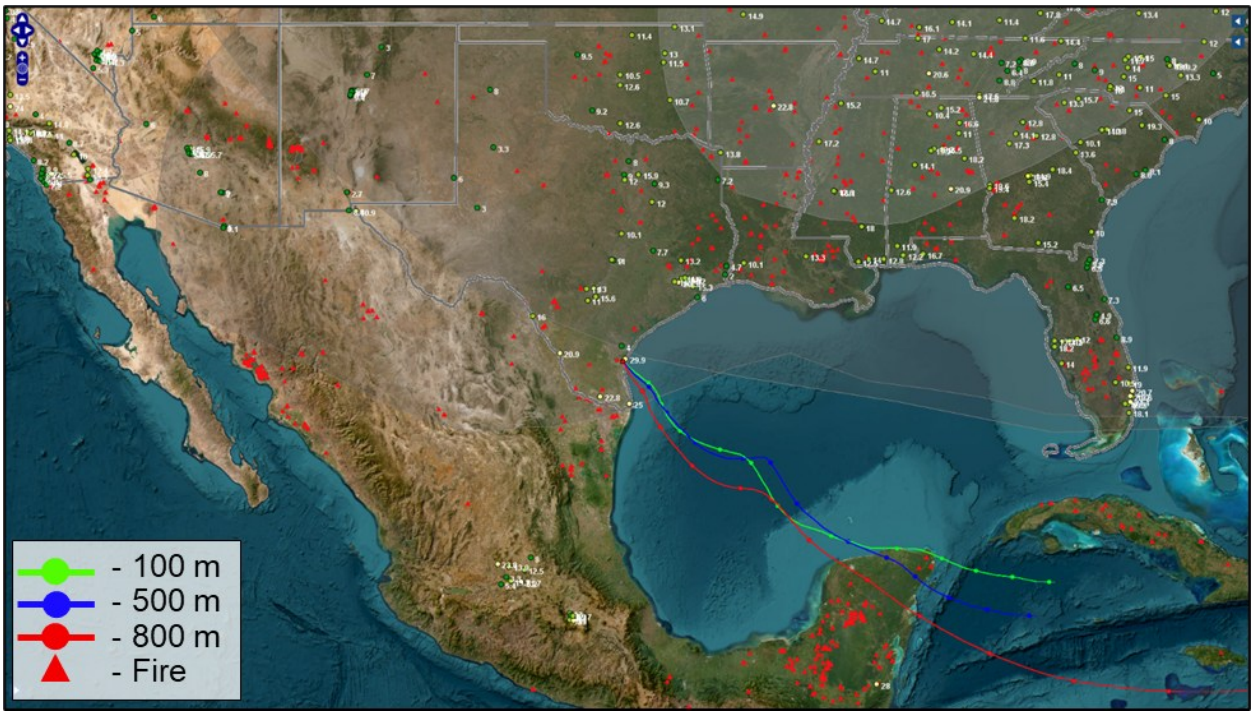


Figure 3-64: HYSPLIT back trajectories from the National Seashore monitor on July 25, 2023

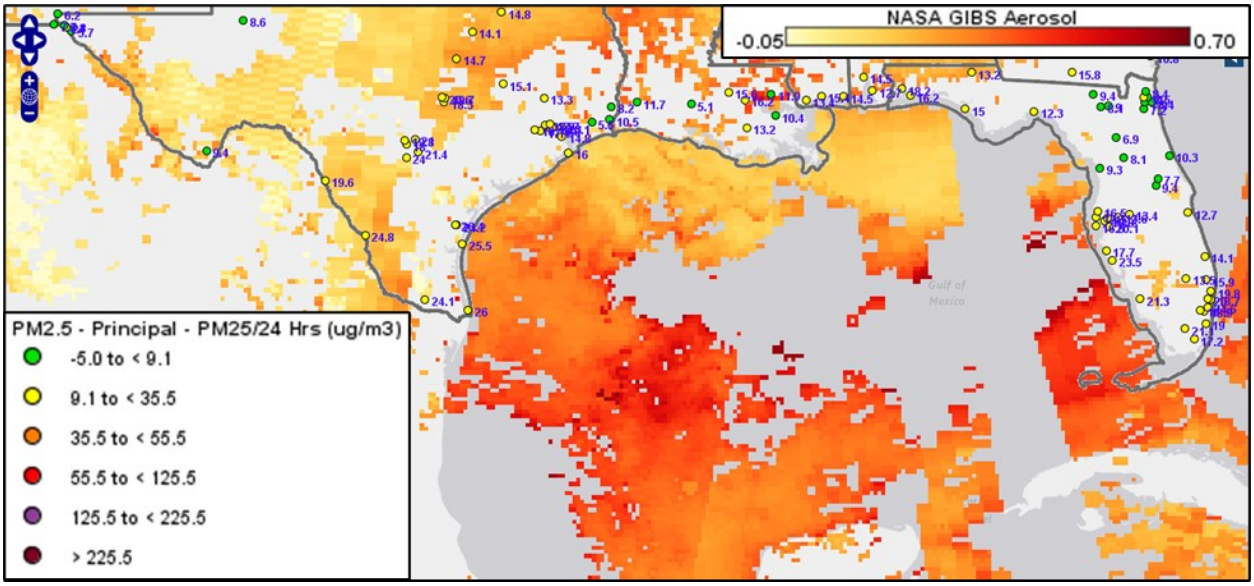


Figure 3-65: Aerosol optical depth map from Terra and Aqua / MODIS on July 25, 2023

For July 26th, elevated concentrations of $PM_{2.5}$ can be compared against a typical/non-event day in Figure 3-66: *Hourly $PM_{2.5}$ Concentrations on July 26, 2023, compared to typical concentrations at the National Seashore monitor*. The TCEQ forecast discusses residual smoke from the Canadian wildfires with light amounts reaching the surface, and the Saharan dust plume was expected to continue to build (Table C-10). Media reports from San Antonio and Corpus Christi describe the Saharan dust moving into Texas and causing hazy conditions (Figures C-12 and C-13). Back trajectories (Figure 3-67: *HYSPLIT back trajectories from the National Seashore monitor on July 26, 2023*) show movement of air from the Caribbean into the Gulf of Mexico and the Texas coastline. The aerosol optical depth map (Figure 3-68: *Aerosol optical depth map from MODIS Terra and Aqua on July 26, 2023*) shows high readings of aerosols in the Gulf of Mexico, with moderate AQI in south and central Texas.

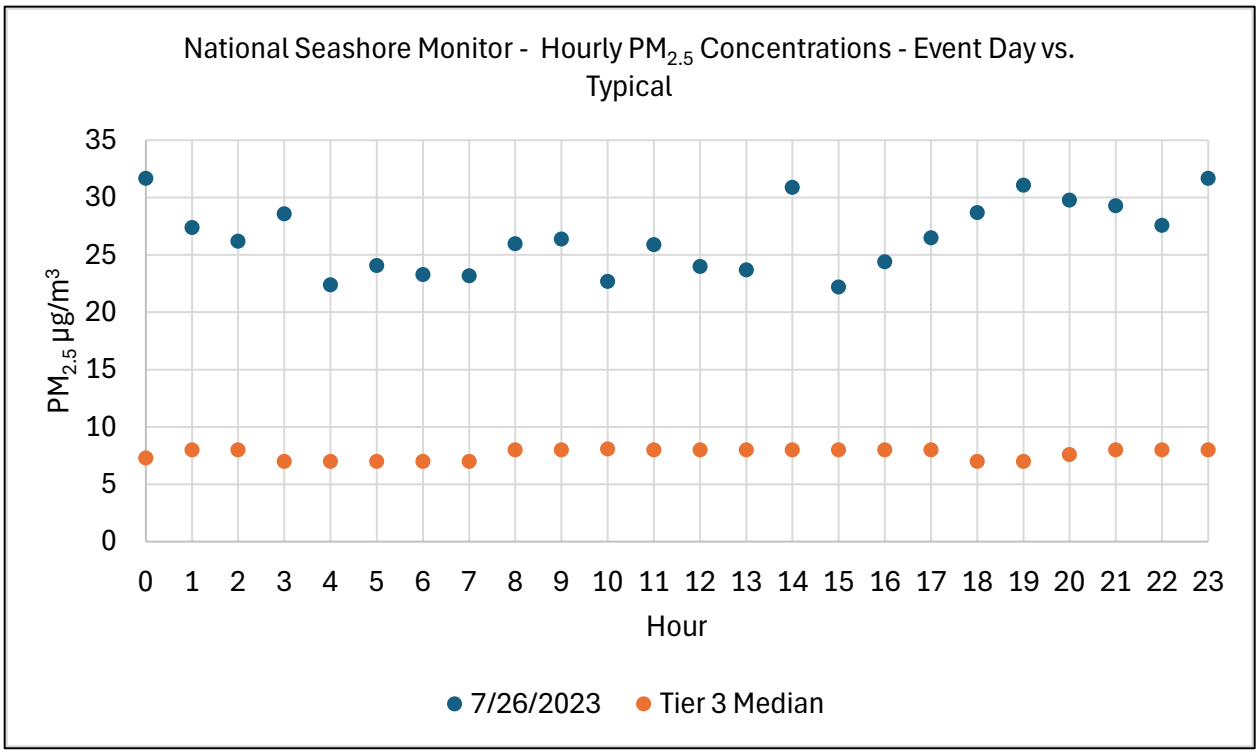


Figure 3-66: Hourly $PM_{2.5}$ Concentrations on July 26, 2023, compared to typical concentrations at the National Seashore monitor

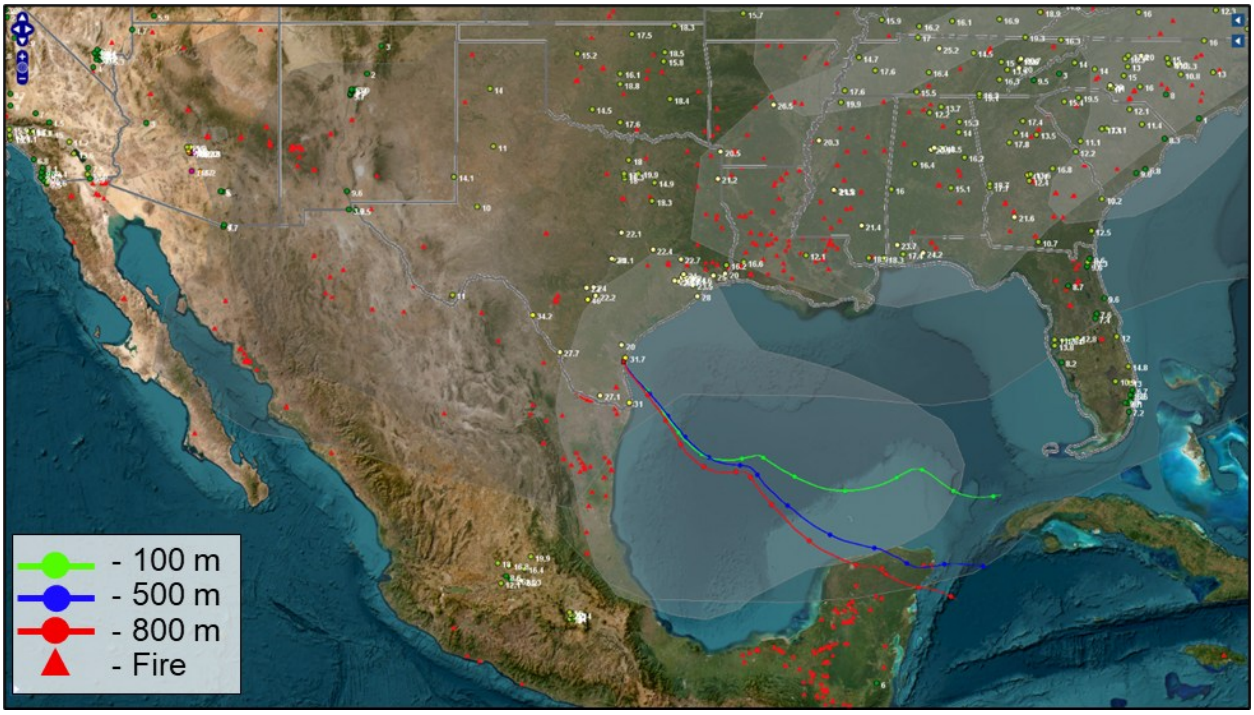


Figure 3-67: HYSPLIT back trajectories from the National Seashore monitor on July 26, 2023

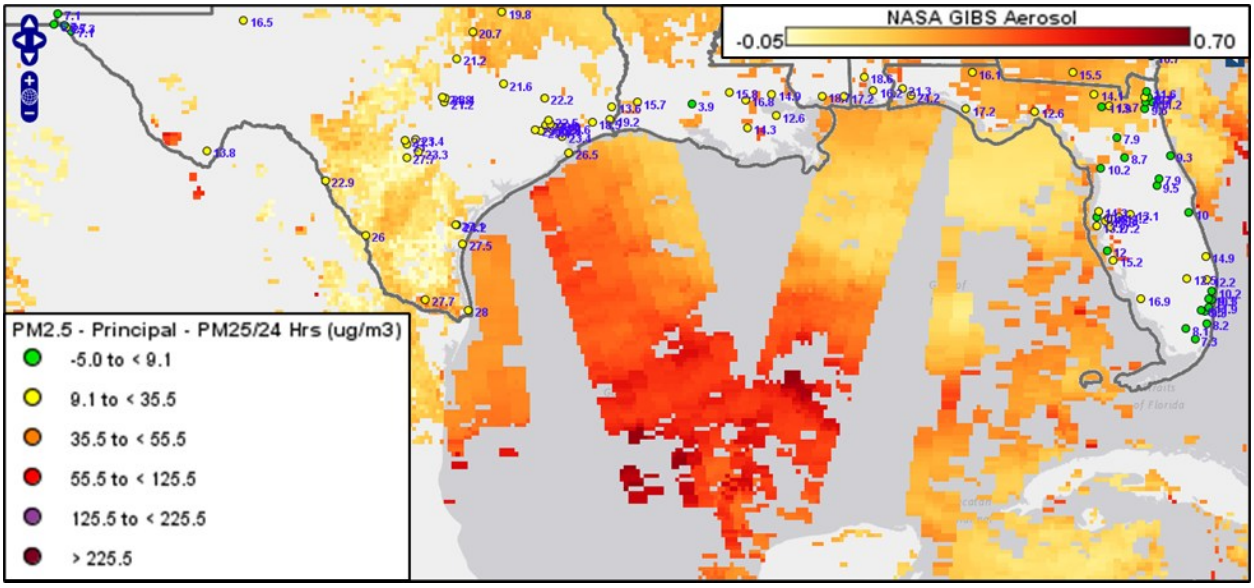


Figure 3-68: Aerosol optical depth map from Terra and Aqua / MODIS on July 26, 2023

For July 27th, elevated concentrations of $PM_{2.5}$ can be compared against a typical/non-event day in Figure 3-69: *Hourly $PM_{2.5}$ Concentrations on July 27, 2023, compared to typical concentrations at the National Seashore monitor*. The TCEQ forecast mentions Saharan dust continuing to move over the entire state with varying intensities (Table C-10). Back trajectories (Figure 3-70: *HYSPLIT back trajectories from the National Seashore monitor on July 27, 2023*) show movement of air from the Gulf of Mexico and to the Texas coastline. The aerosol optical depth map (Figure 3-71: *Aerosol optical depth map from MODIS Terra and Aqua on July 27, 2023*) shows high readings of aerosols in the Gulf of Mexico, with moderate AQI in south and central Texas.

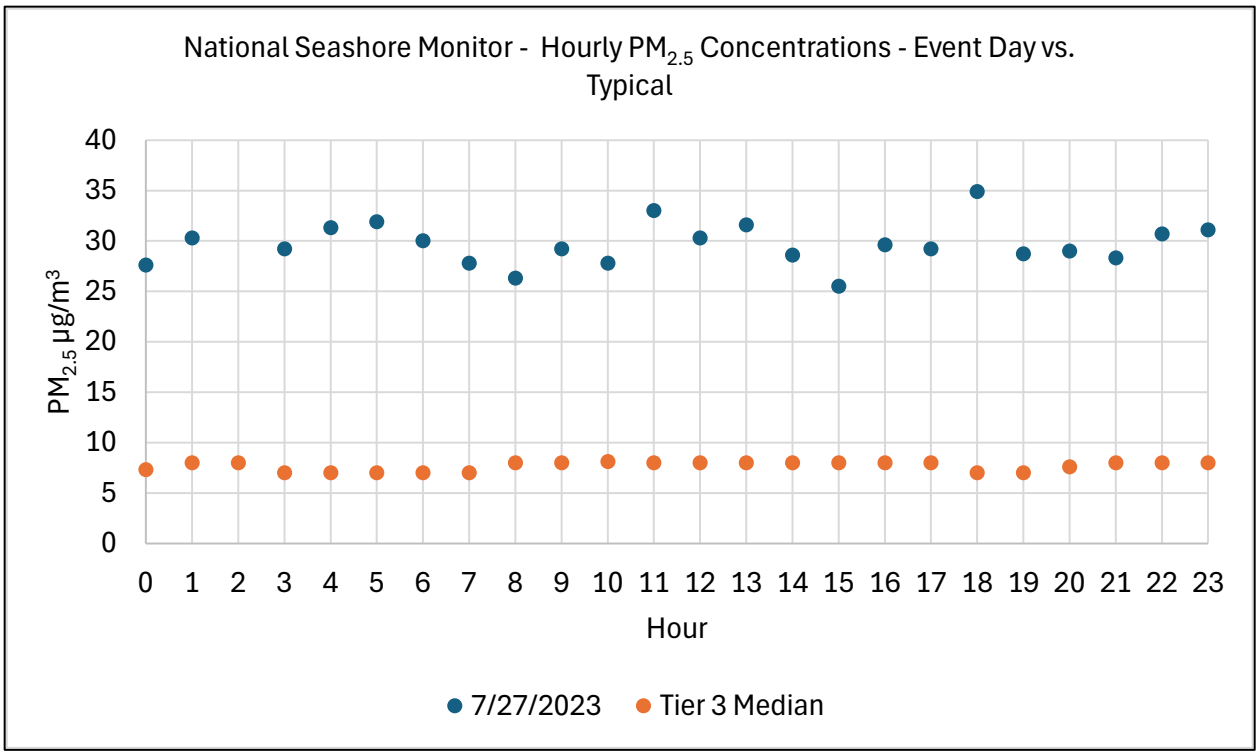


Figure 3-69: Hourly $PM_{2.5}$ Concentrations on July 27, 2023, compared to typical concentrations at the National Seashore monitor

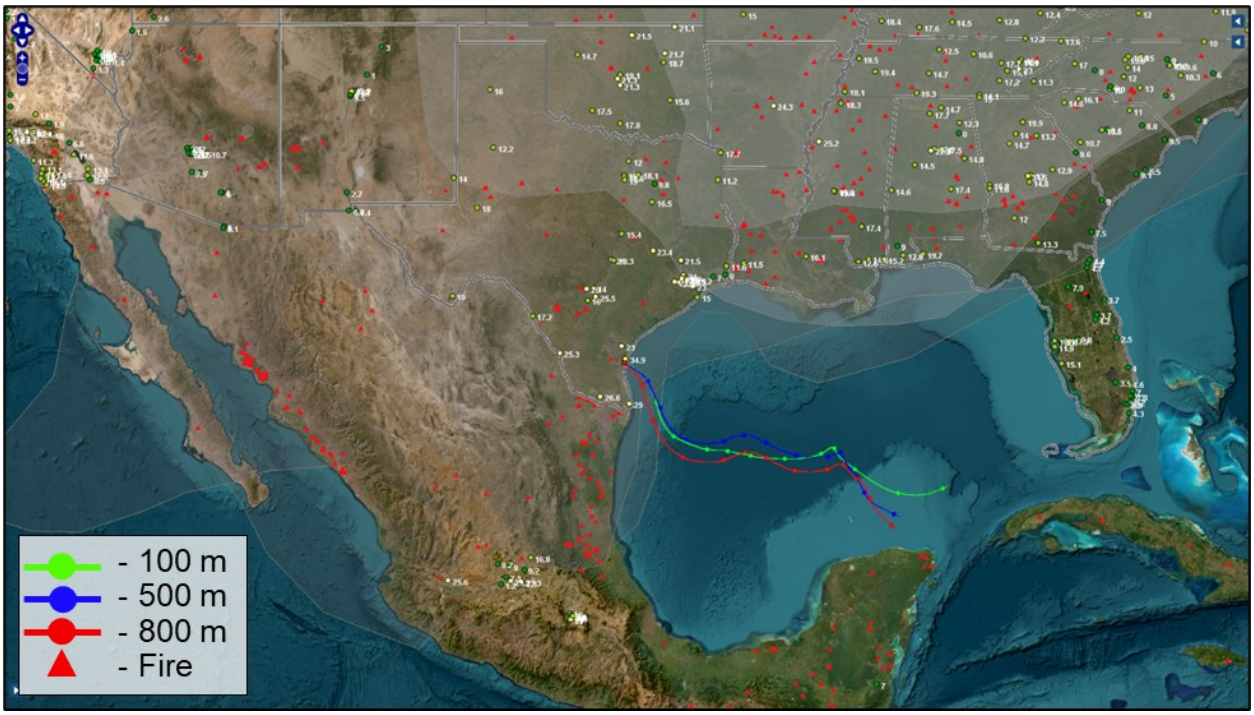


Figure 3-70: HYSPLIT back trajectories from the National Seashore monitor on July 27, 2023

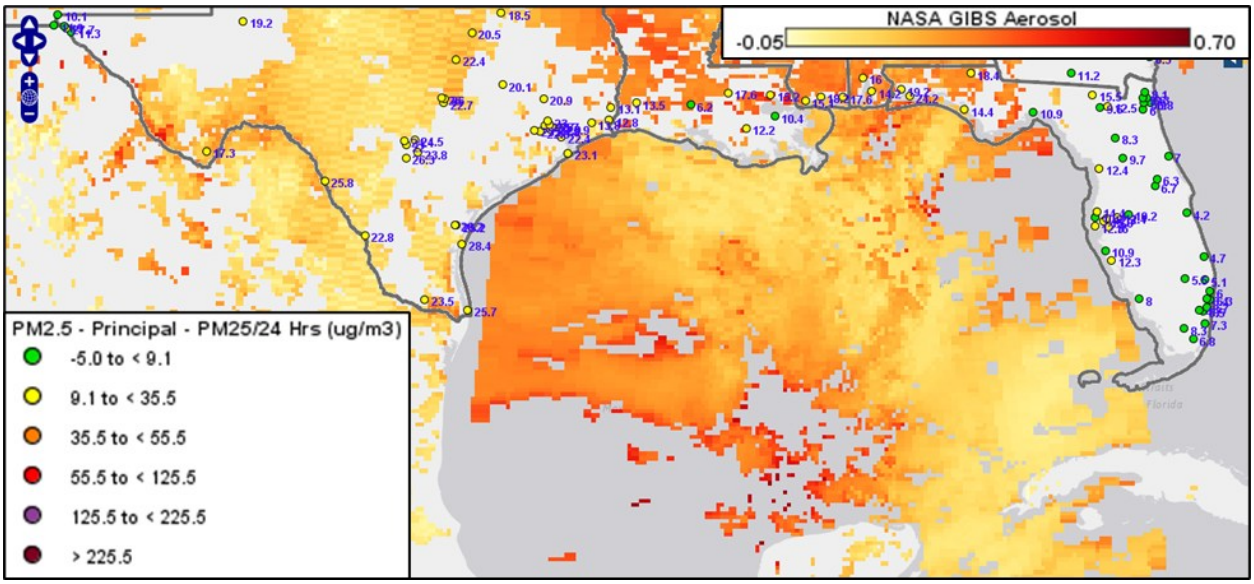


Figure 3-71: Aerosol optical depth map from Terra and Aqua / MODIS on July 27, 2023

For July 28th, elevated concentrations of $PM_{2.5}$ can be compared against a typical/non-event day in Figure 3-72: *Hourly $PM_{2.5}$ Concentrations on July 28, 2023, compared to typical concentrations at the National Seashore monitor*. Back trajectories (Figure 3-73: *HYSPLIT back trajectories from the National Seashore monitor on July 28, 2023*) show movement of air from the Gulf of Mexico and to the Texas coastline, transporting Saharan dust to the area. The TCEQ forecast mentions Saharan dust persisting over the state at varying intensities (Table C-10). A media report from Houston describes Saharan dust in the area and where it comes from (Figure C-16). The aerosol optical depth map (Figure 3-44: *Aerosol optical depth map from MODIS Terra and Aqua on July 28, 2023*) shows moderate readings of aerosols in the Gulf of Mexico, with moderate AQI in south and central Texas.

The dust can be seen on visible satellite imagery being transported off the coast of Africa a few weeks before this grouping of exceptional events (Figure 3-75: *Dust transported off the western coast of Africa, image from July 14, 2023 (Corrected Reflectance - True Color from Aqua / MODIS)*). Forward trajectories from Africa (Figure 3-76: *HYSPLIT forward trajectories from Western Africa, starting on July 10, July 11, July 12, and July 13, 2023*) show that air parcels travelled over the Atlantic ocean into North America.

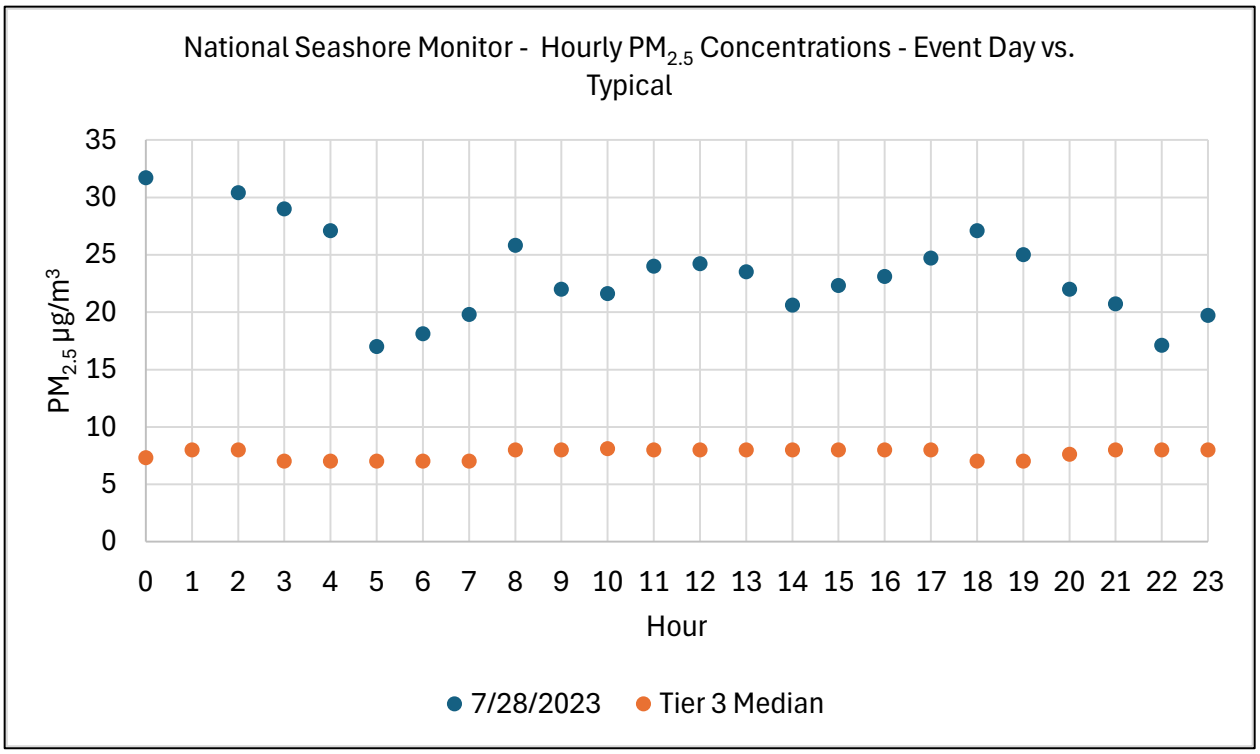


Figure 3-72: Hourly $PM_{2.5}$ Concentrations on July 28, 2023, compared to typical concentrations at the National Seashore monitor

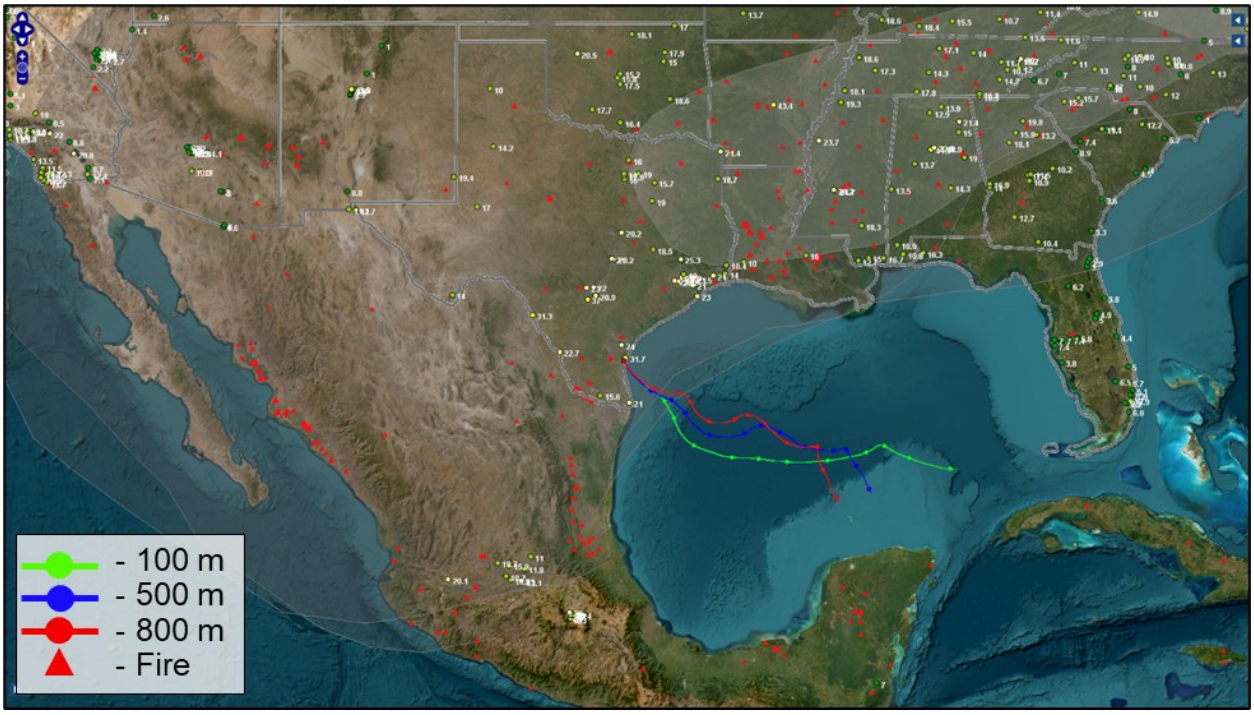


Figure 3-73: HYSPLIT back trajectories from the National Seashore monitor on July 28, 2023

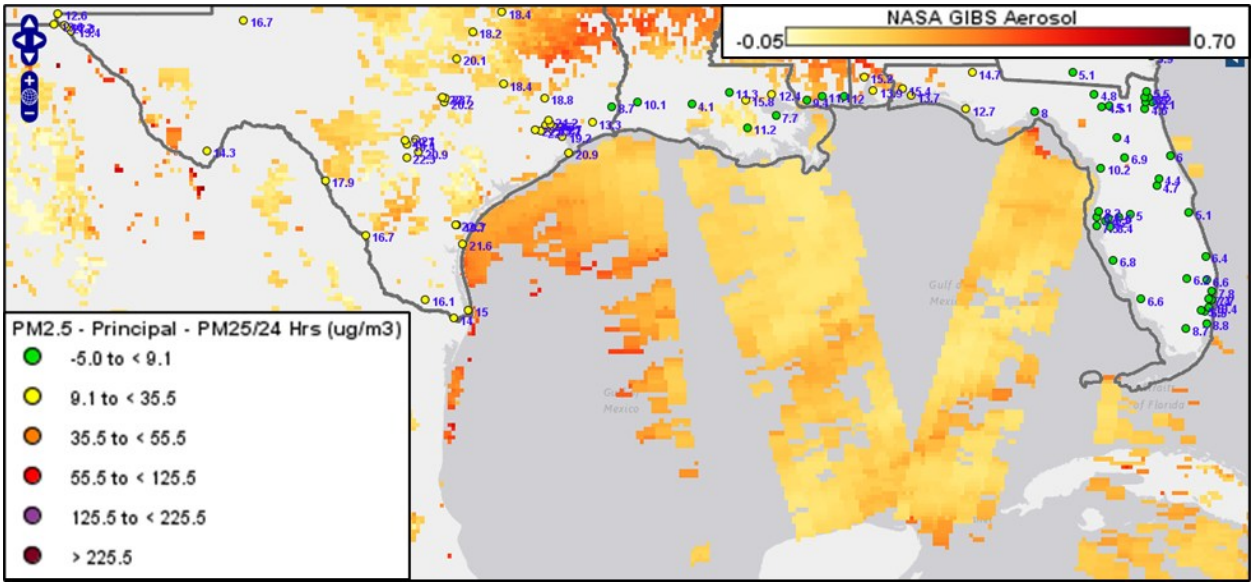


Figure 3-74: Aerosol optical depth map from Terra and Aqua / MODIS on July 28, 2023

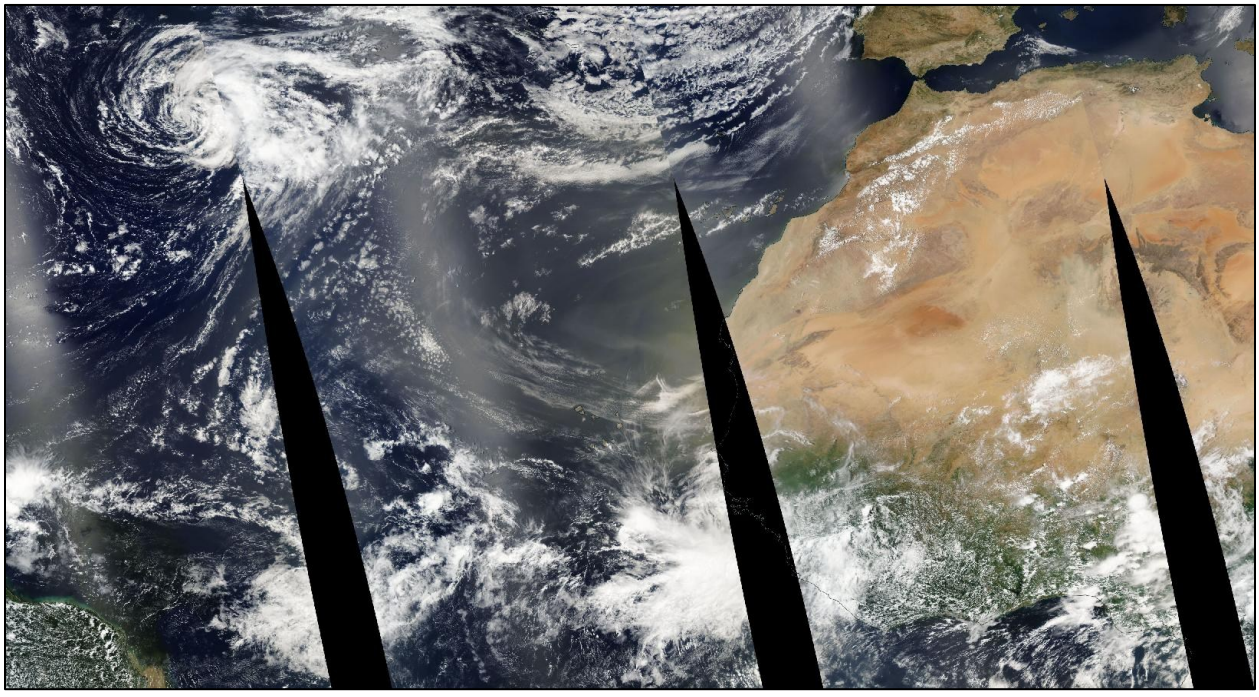


Figure 3-75: Dust transported off the western coast of Africa, image from July 14, 2023 (Corrected Reflectance - True Color from Aqua / MODIS)

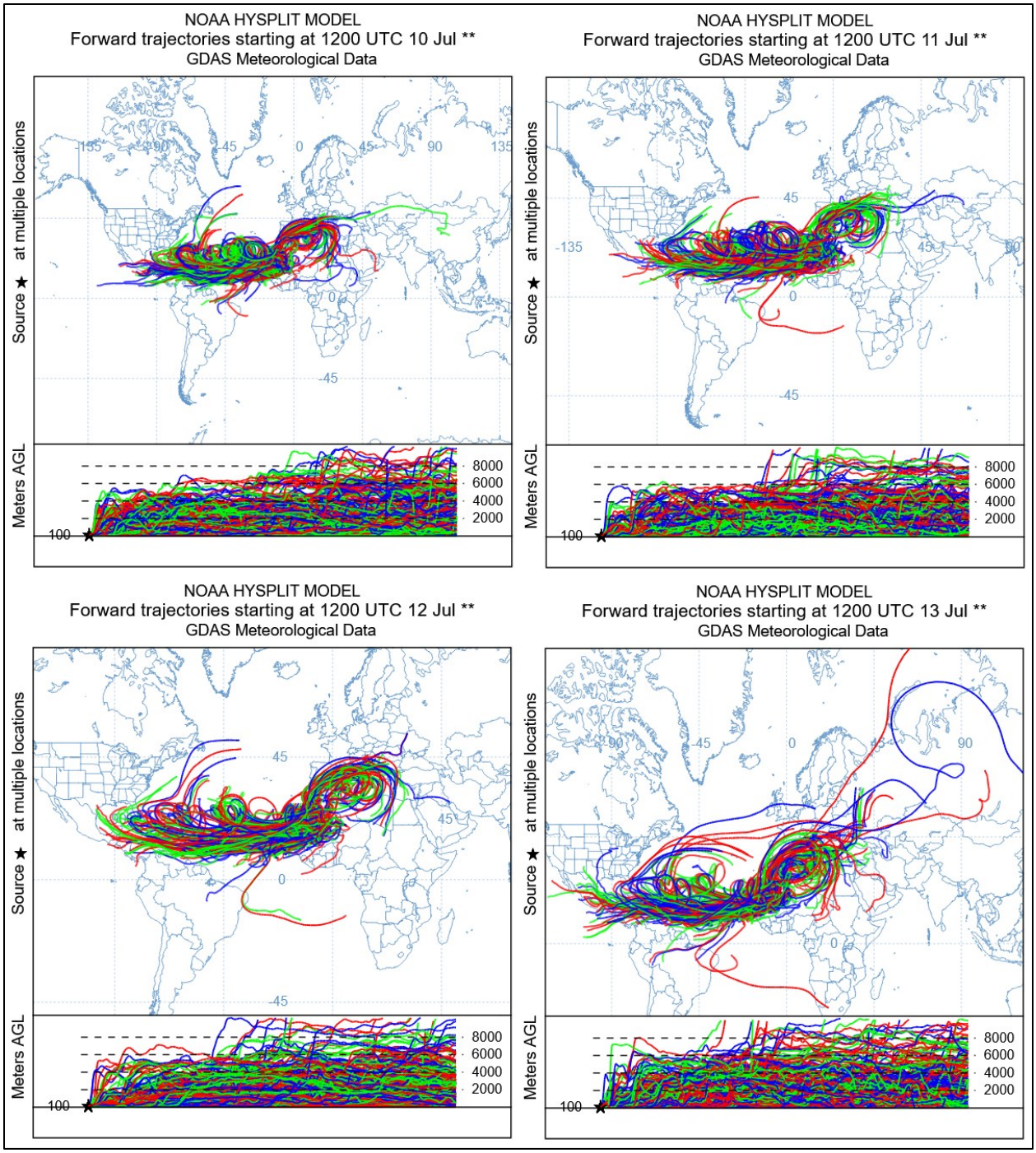


Figure 3-76: HYSPLIT forward trajectories from Western Africa, starting on July 10, July 11, July 12, and July 13, 2023

SECTION 4: NOT REASONABLY CONTROLLABLE OR NOT REASONABLY PREVENTABLE

4.1 OVERVIEW

This section satisfies the Exceptional Events Rule Requirements at 40 CFR §§50.14(c)(3)(iv)(A), 50.1(j), 50.14(c)(3)(iv)(D), and 50.14(b)(4): "The event was caused by a natural event; an exceptional event is one that is not reasonably controllable or preventable."

4.2 NATURAL AND ANTHROPOGENIC SOURCE CONTRIBUTIONS

Stationary point source emissions data are collected annually from sites that meet the reporting requirements of 30 Texas Administrative Code (TAC) §101.10, and the emissions data are compiled in TCEQ's State of Texas Environmental Electronic Reporting System (STARS). STARS fine particulate matter ($PM_{2.5}$) emissions data are presented for each county. Emissions for other sectors from the 2020 National Emissions Inventory (NEI) are presented for each county.[15]

The wind rose at each monitor is from the EPA *PM2.5 Designations Mapping Tool.*[16] The wind rose shows the general wind direction and speed for each monitor during the period from 2021 to 2023. The circular format of the wind rose shows the direction the winds blew from and the length of each "spoke" around the circle shows how often the wind blew from that direction.[17]

4.2.1 Harrison County

The Karnack monitor is located in Harrison County, in the city of Karnack, TX. The major point sources of $PM_{2.5}$ (as defined in 40 CFR §§51.165 and 51.166) are located in south/southeast Harrison County (Figure 4-1: *Point Sources in and around Harrison County, from 2022*); however, a majority of the $PM_{2.5}$ emissions are non-point, as shown in Table 4-1: *Emission Inventory in Harrison County, from 2020*.

[15] https://www.epa.gov/air-emissions-inventories/2020-national-emissions-inventory-nei-data
[16] https://experience.arcgis.com/experience/a2ca272ce9fc4019a88ce35b863e2cab
[17] https://www.epa.gov/sites/default/files/2019-01/documents/how_to_read_a_wind_rose.pdf

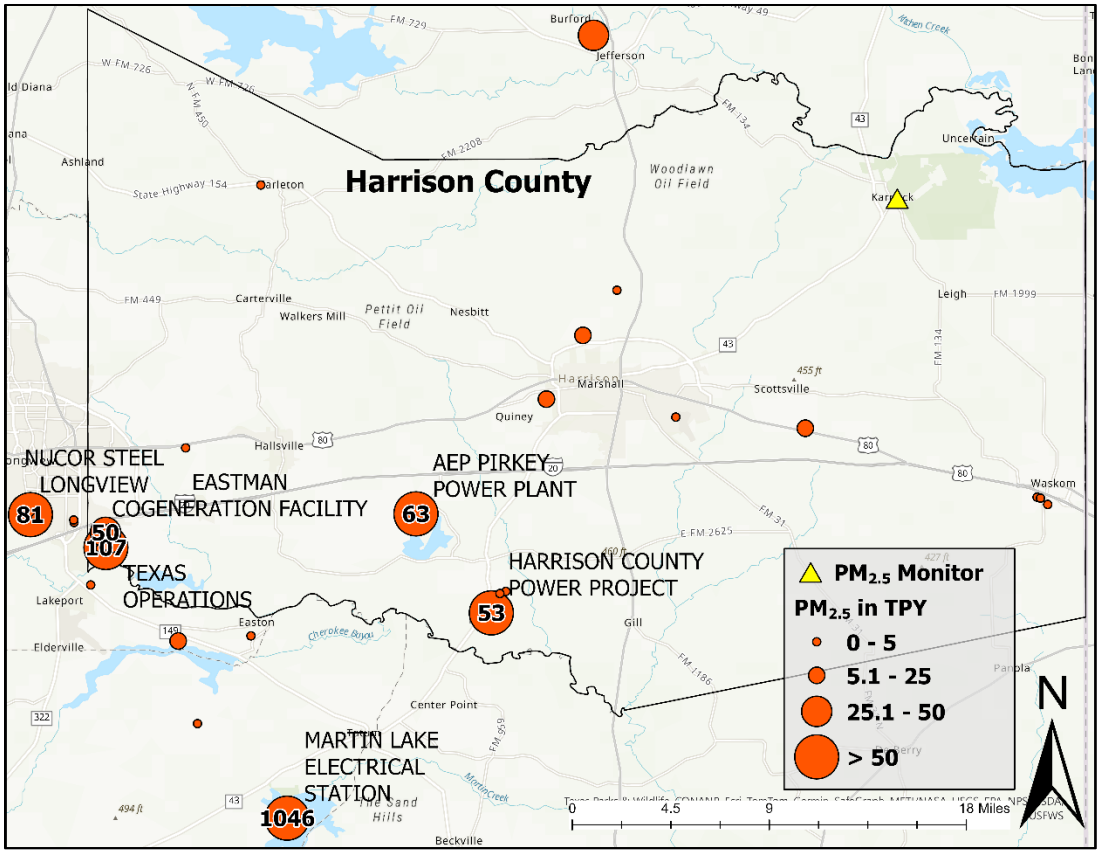


Figure 4-1: Point Sources in and around Harrison County, from 2022

Table 4-1: Emission Inventory in Harrison County, from 2020

Emissions Categories	Emissions (tons per year)
On-road	40.92
Nonroad	18.64
Nonpoint	1,031.62
Point	398.65
Total	1,489.82

Figure 4-2: *2021-2023 Wind Rose at the Karnack Monitor* shows that at the Karnack monitor, a higher percentage of winds are coming from the south/southwest direction.

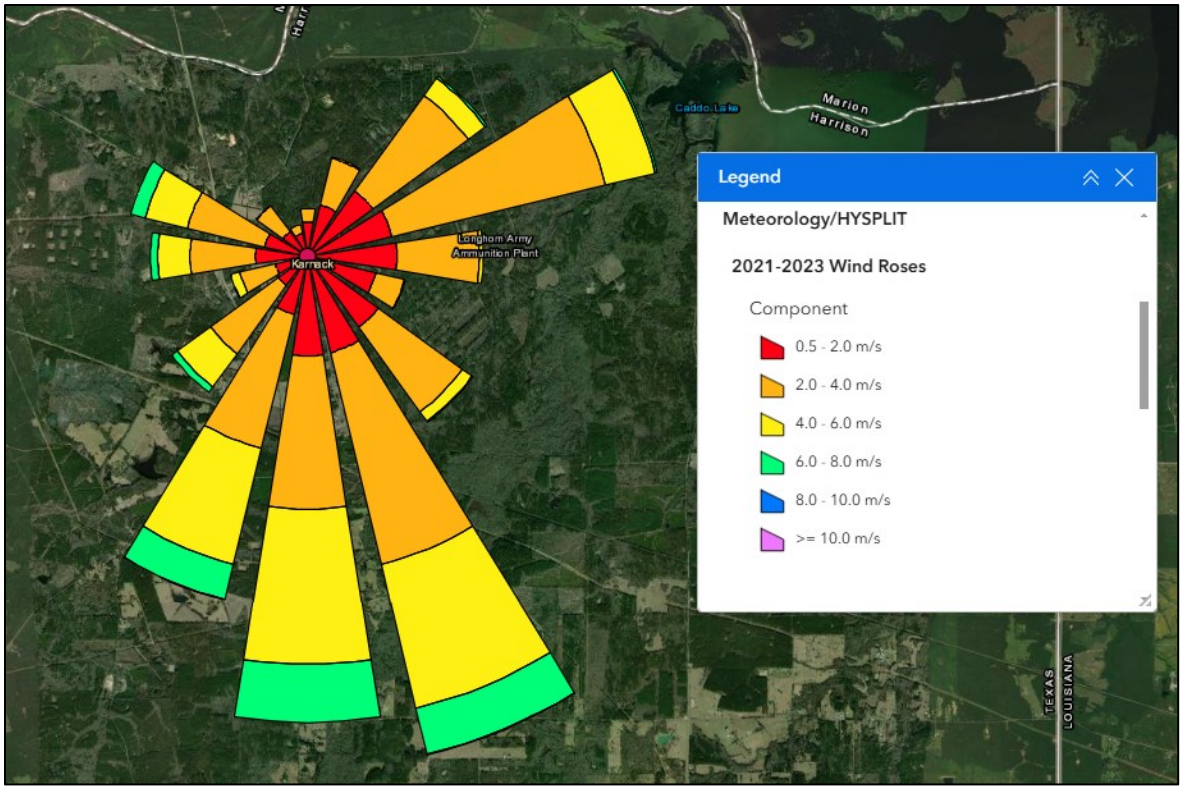


Figure 4-2: 2021-2023 Wind Rose at the Karnack Monitor

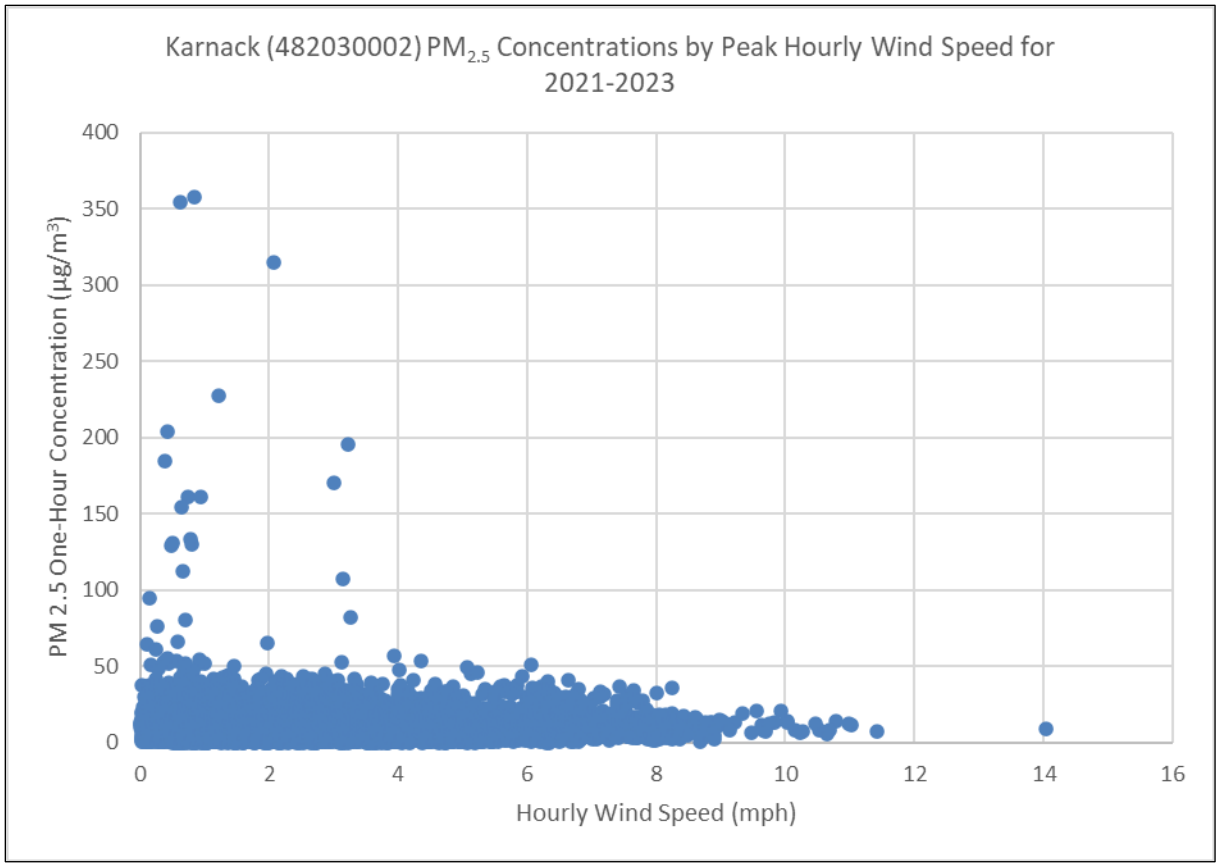


Figure 4-3: Hourly Average Continuous $PM_{2.5}$ Concentration by Hourly Wind Speed for 2021, 2022, and 2023 at the Karnack Monitor

Figure 4-3: *Hourly Average Continuous $PM_{2.5}$ Concentration by Hourly Wind Speed for 2021, 2022, and 2023 at the Karnack Monitor* displays hourly wind speeds at the Karnack monitor plotted against $PM_{2.5}$ concentrations at the same monitor. The pattern in Figure 4-3 shows that the highest $PM_{2.5}$ concentrations were recorded when hourly wind speeds were relatively low. This pattern is believed to be due to the fact that $PM_{2.5}$, due to its small size, can be transported great distances where local wind conditions are less of a factor than wind conditions at the point from which the $PM_{2.5}$ was initially entrained in the air.

4.2.2 Travis County

The City of Austin is located in Travis County, and the Webberville monitor is located in southwest Austin. There are no major sources of $PM_{2.5}$ emissions in the county, as shown in Figure 4-4: *Point Sources in and around Travis County, from 2022*.

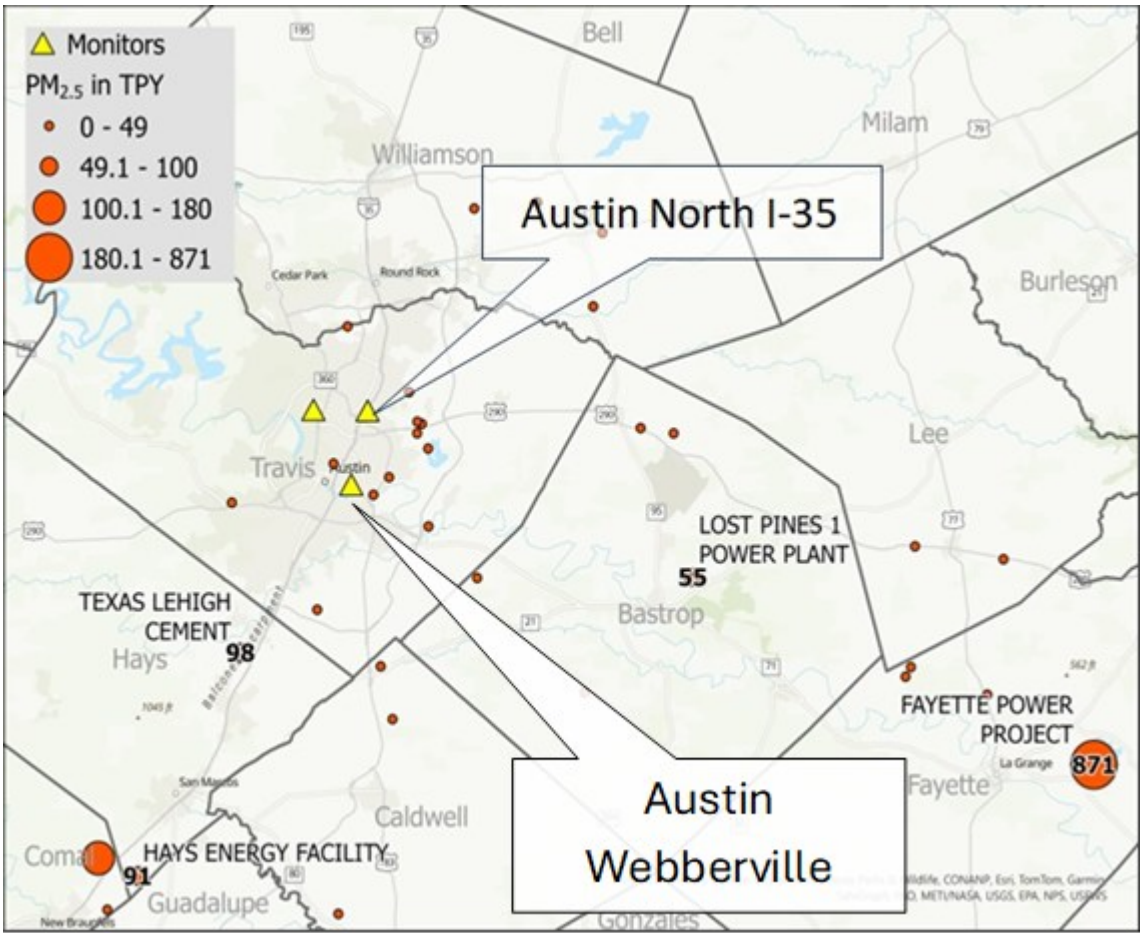


Figure 4-4: Point Sources in and around Travis County, from 2022

The majority of $PM_{2.5}$ emissions in Travis County come from non-point sources (Table 4-2: *Emissions Inventory in Travis County, from 2020*). The majority of the winds at the monitor are southerly (Figure 4-5: *2021-2023 Wind Roses at monitors in and around Travis County*).

Table 4-2: Emissions Inventory in Travis County, from 2020

Emissions Categories	Emissions (tons per year)
On-road	187.10
Nonroad	250.82
Nonpoint	3,652.19
Point	165.86
Total	4,255.97

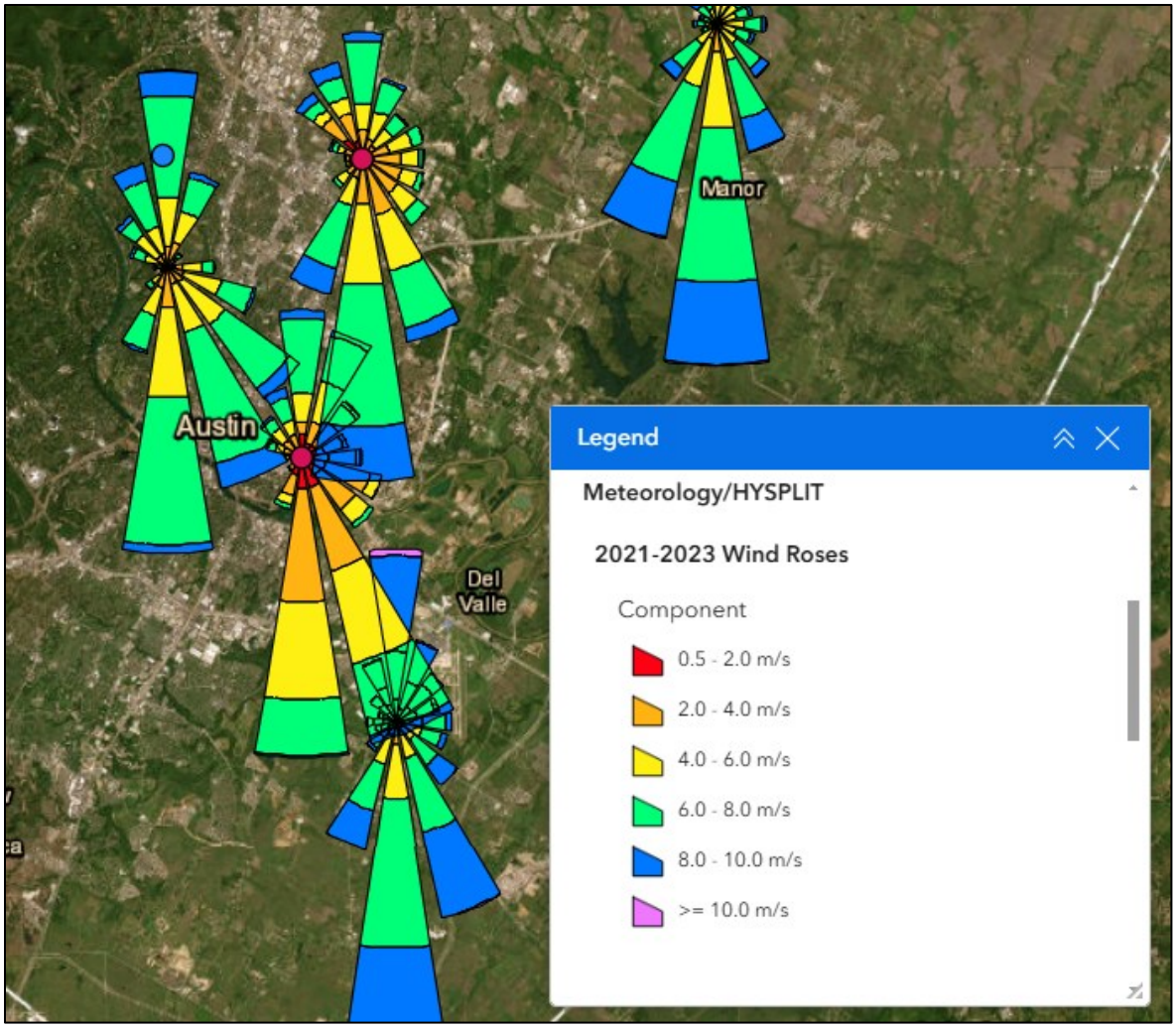


Figure 4-5: 2021-2023 Wind Roses at monitors in and around Travis County

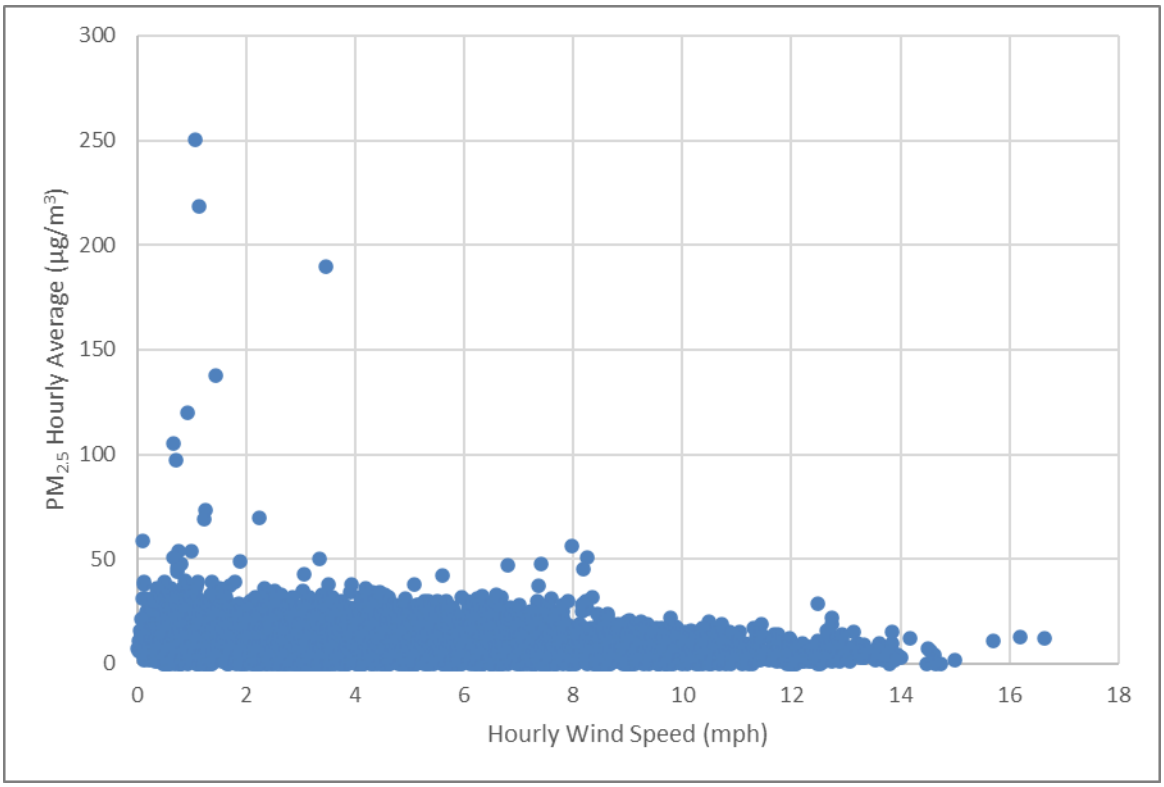


Figure 4-6: Hourly Average Continuous $PM_{2.5}$ Concentration by Hourly Wind Speed for 2021, 2022, and 2023 at the Webberville Monitor

Figure 4-6: *Hourly Average Continuous $PM_{2.5}$ Concentration by Hourly Wind Speed for 2021, 2022, and 2023 at the Webberville Monitor* displays hourly wind speeds at the Webberville monitor plotted against $PM_{2.5}$ concentrations. There is no definitive observable pattern, and this is due to the fact that $PM_{2.5}$, due to its small size, can be transported great distances where local wind conditions are less of a factor than wind conditions at the point from which the $PM_{2.5}$ was initially entrained in the air.

4.2.3 Kleberg County

The National Seashore monitor is located on Padre Island, in east Kleberg County. There are no major point sources of $PM_{2.5}$ in the county, and the closest major source is in Nueces County to the north (Figure 4-7: *Point Sources in and around Kleberg County, from 2022*). Other emission types in this county are low, as shown in Table 4-3: *Emissions Inventory in Kleberg County, from 2020*.

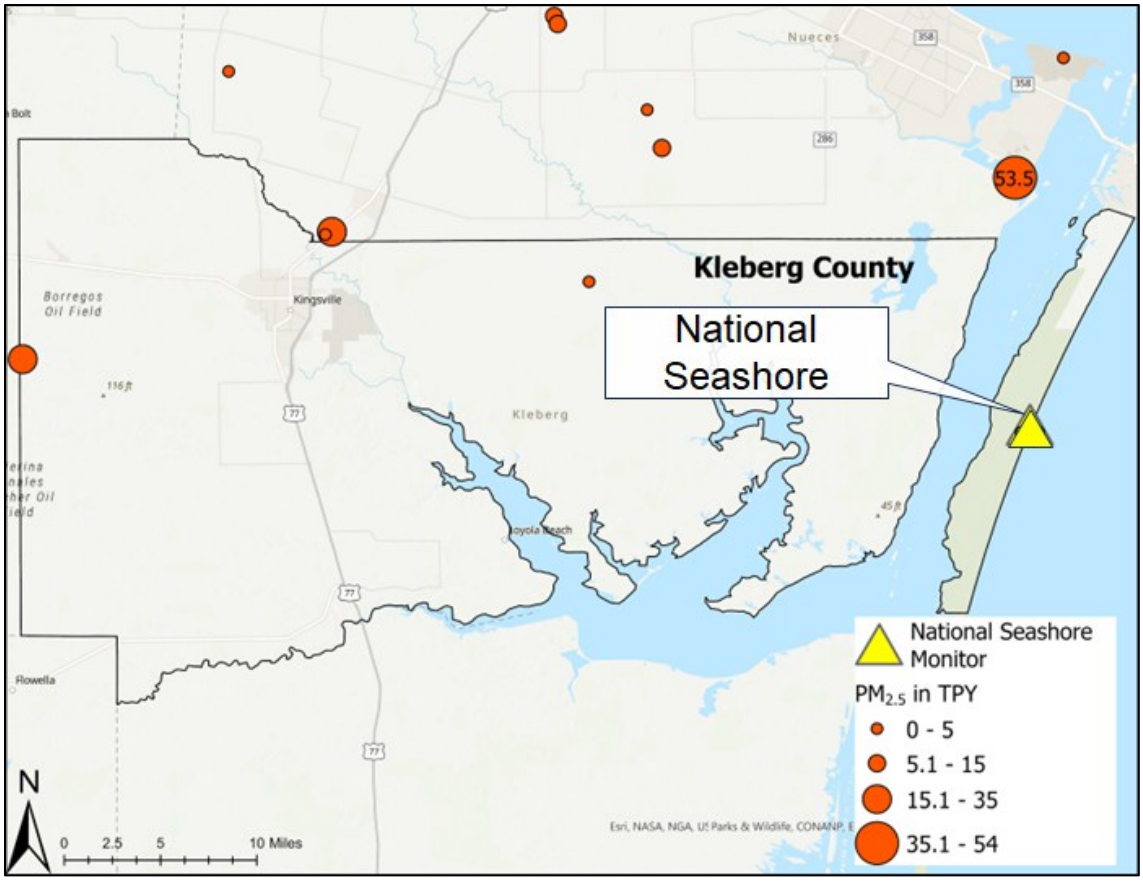


Figure 4-7: Point Sources in and around Kleberg County, from 2022

Table 4-3: Emissions Inventory in Kleberg County, from 2020

Emissions Categories	Emissions (tons per year)
On-road	9.03
Nonroad	11.40
Nonpoint	1,790.62
Point	38.14
Total	1,849.19

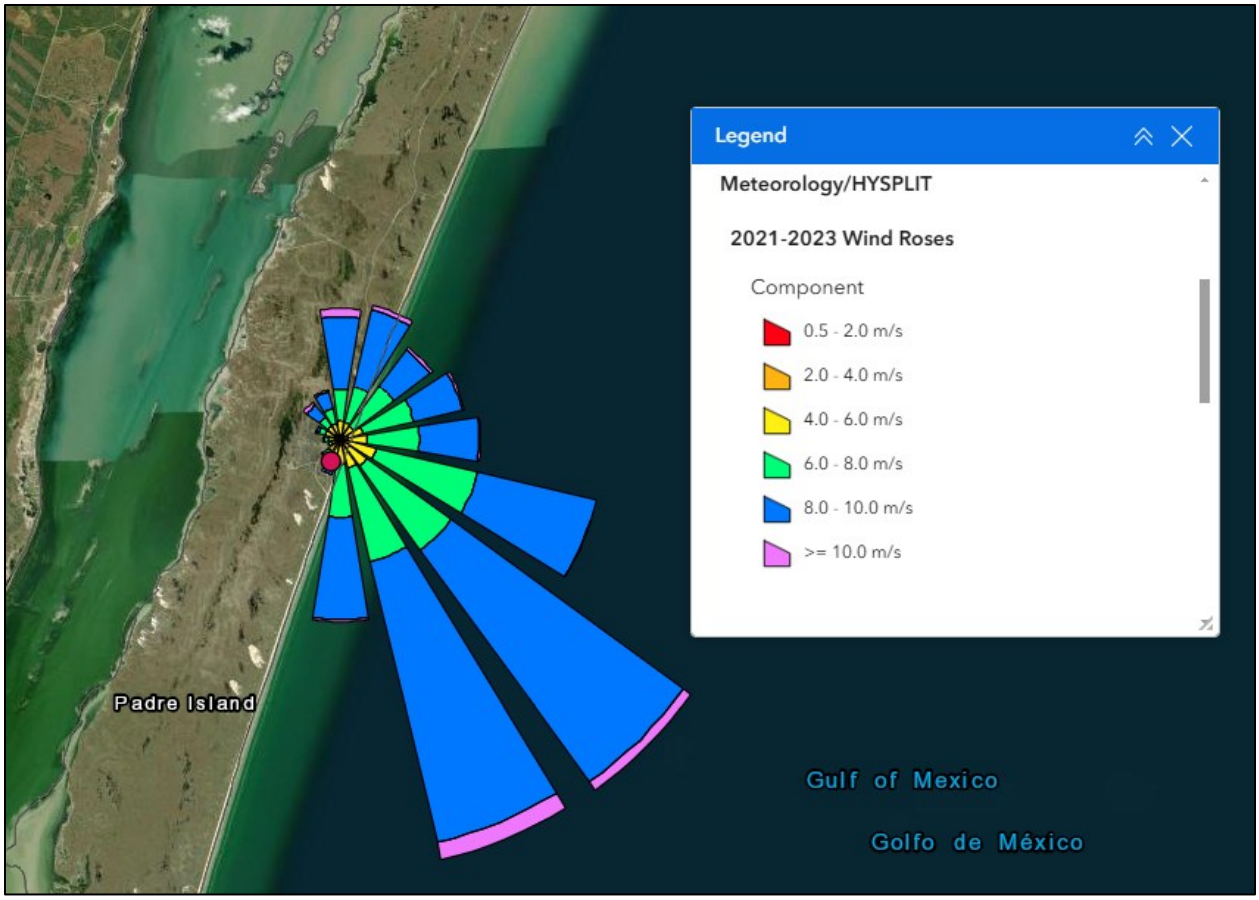


Figure 4-8: 2021-2023 Wind Rose at National Seashore Monitor

Winds at the National Seashore monitor are mainly from the southeast, as shown in Figure 4-8: *2021-2023 Wind Rose at National Seashore Monitor*. Figure 4-9: *Hourly Average Continuous $PM_{2.5}$ concentration by Hourly Wind Speed for 2021, 2022, and 2023 at the National Seashore monitor* displays hourly wind speeds at the National Seashore monitor plotted against $PM_{2.5}$ concentrations at the same monitor. There is no definitive pattern in Figure 4-9, and this is due to the fact that $PM_{2.5}$, due to its small size, can be transported great distances where local wind conditions are less of a factor than wind conditions at the point from which the $PM_{2.5}$ was initially entrained in the air.

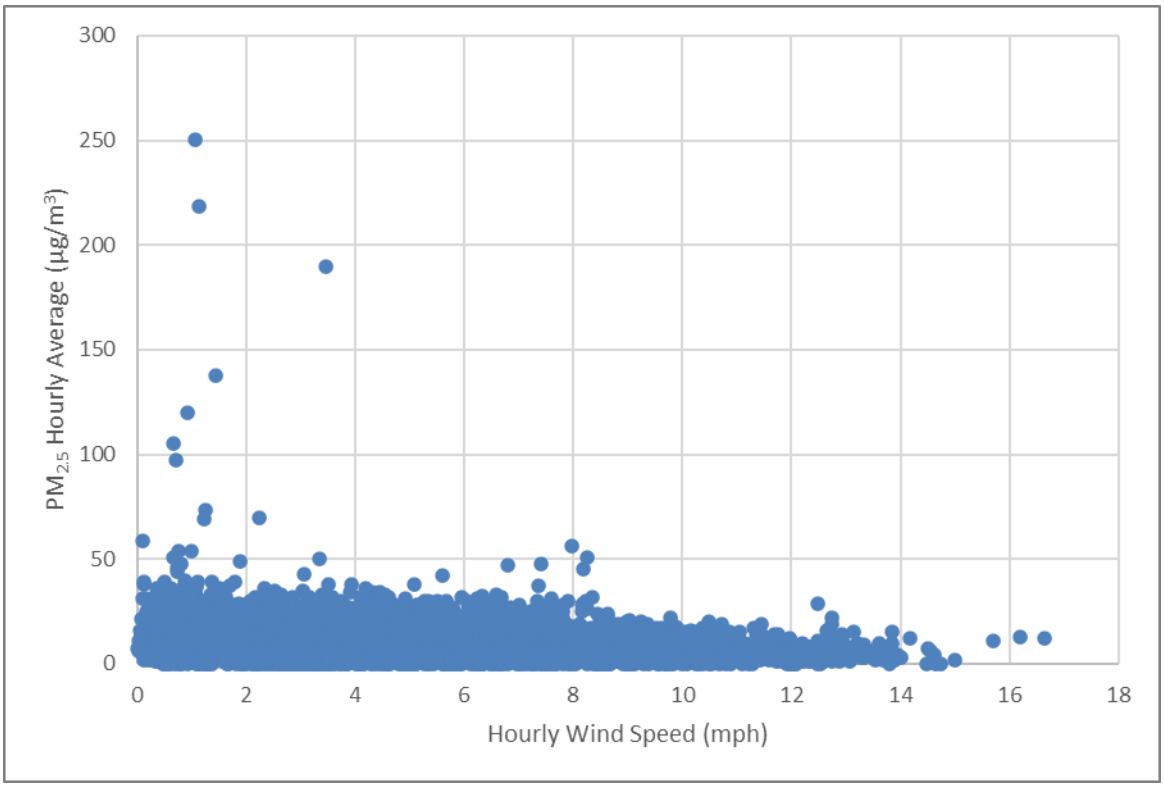


Figure 4-9: Hourly Average Continuous $PM_{2.5}$ concentration by Hourly Wind Speed for 2021, 2022, and 2023 at the National Seashore monitor

4.3 ATTAINMENT STATUS AND CONTROL MEASURES

Harrison, Travis, and Kleberg Counties are currently designated as attainment for the 2012 primary annual $PM_{2.5}$ standard of 12.0 µg/m^3. In February 2024, EPA lowered the primary annual standard to 9.0 µg/m^3, and 2023 design values show that $PM_{2.5}$ concentrations in the aforementioned counties are above the revised standard. In this document, TCEQ demonstrates that the $PM_{2.5}$ concentrations at monitors on dates listed in Table 1-1 were caused by exceptional events and requests that these dates be excluded from regulatory decisions for the 2024 annual $PM_{2.5}$ NAAQS.

As a part of the state implementation plan (SIP) strategy, Texas has established statewide rules to attain or maintain the National Ambient Air Quality Standards for particulate matter (PM). Title 30 TAC §111, Subchapter A includes statewide regulations for visible emissions and PM.[18] These regulations contain control requirements that apply to various sources of PM emissions and monitoring, testing, and recordkeeping requirements for affected sources. Title 30 TAC §111, Subchapter B is a statewide regulation that addresses outdoor burning and is applicable to particulate matter control.[19]

4.4 PRESCRIBED FIRES AND SMOKE MANAGEMENT PLANS

The Texas A&M Forest Service (TFS, formally called Texas Forest Service) coordinates fire and smoke management issues in Texas to address basic smoke management practices for prescribed fire used for agricultural and wildland vegetation management purposes and smoke management programs pursuant to the requirements under the Regional Haze Rule 40 CFR

[18] https://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=5&ti=30&pt=1&ch=111&sch=A
[19] https://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=5&ti=30&pt=1&ch=111&sch=B&rl=Y

§51.308(f)(2)(iv)(D).[20] The 34th Texas Legislature created the TFS in 1915. The legal mandate of the TFS includes the responsibility to "assume direction of all forest interests and all matters pertaining to forestry within the jurisdiction of the state." The TFS has developed a voluntary approach called the Texas Forest Service Smoke Management System, under which all land managers in Texas, including the National Park Service, inform the TFS before performing prescribed burns.

The Regional Haze Rule allows for states to have smoke management programs that are comparable to smoke management plans (SMP) without being certified as SMPs. The following list is documentation that Texas has a structure in place, with rules, communication systems, and data collection to help reduce particulate matter, which reduces visibility. The following are documents, rules, memorandums of understanding, etc., that help establish that Texas has a working smoke management program to help reduce smoke and fires throughout the state. This list is not exhaustive and is only a sample. The documents are updated periodically.

- Texas Forest Service (TFS), 2023. Texas Wildfire Protection Plan.[21]
- TFS, 2018. Texas A&M Forest Service Smoke Management Plan.[22]
- TCEQ, 2015. Outdoor Burning in Texas, publication number: RG-049.[23]
- Texas Administrative Code (TAC), Title 30, Environmental Quality, Part 1, Texas Commission on Environmental Quality, Chapter 111, Control of Air Pollution from Visible Emissions and Particulate Matter, Subchapter B, Outdoor Burning.[24]
- Texas Parks and Wildlife Department, 2015. General Plan for Prescribed Burning on Texas Parks and Wildlife Department Lands.[25]
- Master Cooperative Wildland Fire Management and Stafford Act Response Agreement with U.S. Forest Service, National Park Service, U.S. Fish & Wildlife Service, Bureau of Indian Affairs, Texas Forest Service, and Texas Parks and Wildlife Department, 2015.[26]

4.5 FIRES IN MEXICO/CENTRAL AMERICA AND SAHARAN DUST

Section 40 CFR §50.14 (a)(8)(vii) provides that a state would not be required to provide case-specific justification to support the not reasonably controllable or preventable portion of the rule when the emissions-generating event was outside the state. Specifically, Section 40 CFR §50.14 (a)(8)(vii) states:

> *The Administrator shall not require a State to provide case-specific justification to support the not reasonably controllable or preventable criterion for emissions-generating activity that occurs outside of the State's jurisdictional boundaries within which the concentration at issue was monitored.*

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[20] https://tfsweb.tamu.edu/
[21] https://tfsweb.tamu.edu/uploadedFiles/TFSMain/Wildfires_and_Disasters/Contact_Us(3)/Texas%20Wildfire%20Protection%20Plan_May%202023%20Revision.pdf
[22] https://tfsweb.tamu.edu/uploadedFiles/TFS_Main/Manage_Forests_and_Land/Prescribed_Fires/TFS%20SMP.pdf
[23] https://www.tceq.texas.gov/downloads/publications/rg/outdoor-burning-in-texas-rg-49.pdf
[24] https://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=5&ti=30&pt=1&ch=111&sch=B&rl=Y
[25] https://tpwd.texas.gov/publications/pwdpubs/media/pwd_lf_w7000_1818_general_plan_for_burning_on_tpwd_lands.pdf
[26] https://gacc.nifc.gov/swcc/management_admin/incident_business/docs/25.Texas%20Master%20Agreement.pdf

SECTION 5: HUMAN ACTIVITY UNLIKELY TO RECUR AT A PARTICULAR LOCATION OR NATURAL EVENT

5.1 OVERVIEW

This section satisfies the Exceptional Events Rule Requirement at 40 CFR §50.14(c)(3)(iv)(E): "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."

5.2 AFRICAN DUST – NATURAL EVENT

Based on the documentation provided in Section 3 of this demonstration, the event qualifies as a natural event due to dust originating from the Sahara Desert, which is relatively undisturbed by human activity and has commonly occurring dust storms.

EPA generally considers the emissions of $PM_{2.5}$ from dust events to meet the regulatory definition of a natural event under 40 CFR §50.1(k), defined as one 'in which human activity plays little or no direct causal role.'

Saharan dust impacts monitors in Texas every year, mainly in the summer. The three to six episodes per year are typically intense and characterized by high incoming background levels that last one to three days or more. Satellite imagery provides good visual evidence of African dust moving across the Atlantic Ocean, through the Caribbean, and into the Gulf of Mexico. Figure 5-1: *July 2023 Monthly Average Dust Surface Mass Concentration (MERRA-2)* shows the dust surface mass concentration layer created from a time-averaged 2-dimensional mean data collection from July 2023, obtained from NASA Worldview. The dust layer concentrations are higher along the transport route from Africa through the Caribbean and into Texas.

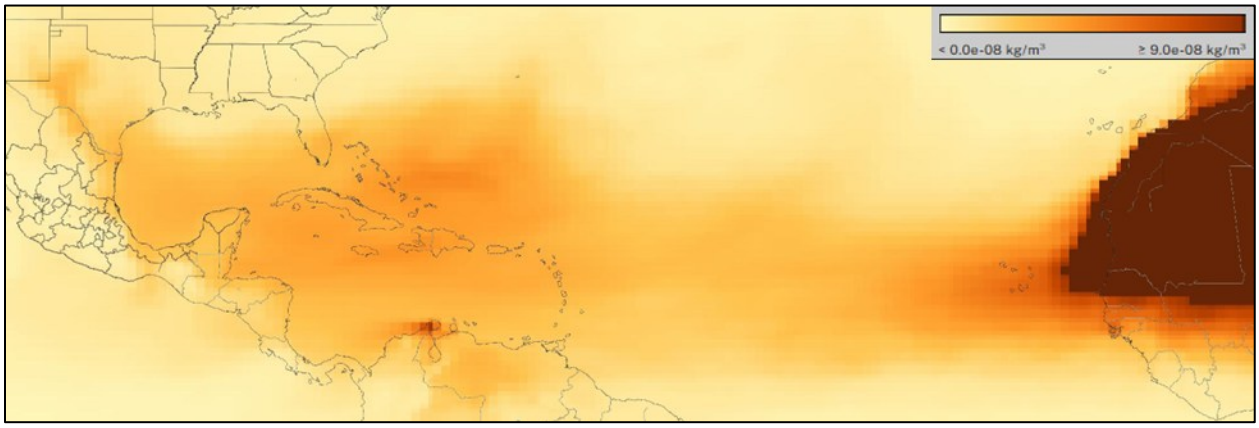

Figure 5-1: July 2023 Monthly Average Dust Surface Mass Concentration (MERRA-2)

The transport of dust can also be seen in speciation data at several monitoring sites in Texas. Iron, aluminum, and silicon are typical components of dust, and their presence indicates dust storms and long-range transport from natural sources (Chow, Judith C. et al., "Mass reconstruction methods for $PM_{2.5}$: a review", 2015)[27]. In Figure 5-2: *Concentration data of aluminum, iron, and silicon from three Texas monitoring sites in 2023*, there are two maximums of these speciated components in July 2023, corresponding to the two Saharan dust exceptional

[27] https://pmc.ncbi.nlm.nih.gov/articles/PMC4449935/

event groups during this month. The speciation data was obtained from the TCEQ TAMIS database. [28]

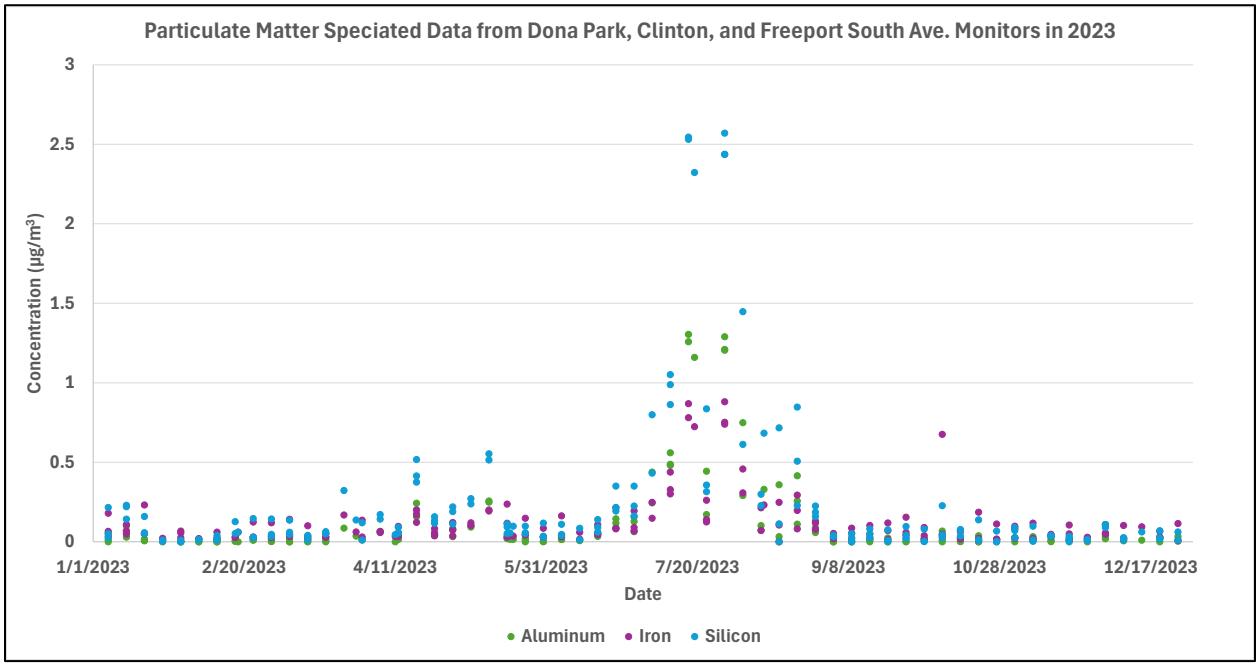

Figure 5-2: Concentration data of aluminum, iron, and silicon from three Texas monitoring sites in 2023

5.3 PRESCRIBED FIRES – HUMAN ACTIVITY UNLIKELY TO RECUR AT A PARTICULAR LOCATION

Prescribed fires are recognized as being caused by human activity, and therefore must satisfy the 'human activity unlikely to recur at a particular location' portion of the rule. Recurrence for prescribed fires is defined by either "the natural fire return interval or the prescribed fire frequency needed to establish, restore and/or maintain a sustainable and resilient wildland ecosystem contained in a multi-year land or resource management plan with a stated objective to establish, restore and/or maintain a sustainable and resilient wildland ecosystem and/or to preserve endangered or threatened species through a program of prescribed fire." Thus, the recurrence frequency for prescribed fire is specific to the ecosystem and resource needs of the affected area.

The Texas A&M Forest Service coordinates prescribed fires and establishes smoke management plans for the state, as described in Section 4.4. Smoke from prescribed fires in other states may impact Texas monitors as well. The prescribed fires impacting monitors in Texas occurred in Texas and Louisiana. Any prescribed fires occurring outside the State of Texas were not reasonably controllable or preventable by the State of Texas and are essentially treated as wildfires in this demonstration. The State of Louisiana maintains robust programs aimed at responding to wildfires and preventing future ones. The Louisiana Department of Agriculture and Forestry maintains information for prescribed burning on its Prescribed Burning webpage.[29]

[28] https://www17.tceq.texas.gov/tamis/index.cfm
[29] https://www.ldaf.la.gov/land/fire/prescribed-burning

Based on the documentation provided in Section 3 of this submittal, the prescribed fire events satisfied the 'human activity unlikely to recur at a particular location' criterion by describing the transitory nature of the fire smoke and the high $PM_{2.5}$ concentration on event days.

5.4 HIGH WINDS – NATURAL EVENT

High wind dust events are considered to be natural events in cases where windblown dust is entirely from natural undisturbed lands in the area or where all anthropogenic sources are reasonably controlled (40 CFR §50.14(b)(5)(ii)). An event involving windblown dust solely from natural undisturbed landscapes is considered a natural event.

Based on the documentation provided in Section 3 of this submittal, the high wind events qualify as a natural event. The exceedances of $PM_{2.5}$ associated with the high wind events listed in Table 1-1 meet the regulatory definition of a natural event at 40 CFR §50.14(b)(8). These events transported windblown dust from natural lands in West Texas and, accordingly, TCEQ has demonstrated that the event is a natural event and may be considered for treatment as an exceptional event.

5.5 FIRES IN MEXICO/CENTRAL AMERICA – HUMAN ACTIVITY UNLIKELY TO RECUR AT A PARTICULAR LOCATION

A recent report titled "*Fires in Mexico as Exceptional Events: Documentation and Implications*" provided evidence that the vast majority of the fires in Mexico are not caused by agricultural burning, and that they do not reoccur at the same location.[30] The evidence includes statistics on the source of fires from the Mexican government and other sources.

A majority of the observed fires are forest fires or burns performed to clear land for development, and these are also not expected to recur at a particular location. Once the forest is burned at a specific location, the biomass is consumed, and the land is not prime for additional fires in the following years. The Global Forest Watch website shows that areas with highest rates of tree loss due to forest fires occur along the east coast of Mexico. Mexican fires show seasonality that follows known climatology with a dry season, typically in the period of January to May, that affects Mexico and Central America. This dry season favors conditions for starting of wildfires.

The report suggests that most of the fires and smoke from fire in Mexico during the dry season should be considered non-recuring and thus should be considered exceptional events as it satisfies that is an event caused by human activity that is unlikely to recur at a particular location or a natural event.

TCEQ downloaded data on the number of reported fires in 2023 and possible causes of these fires from the Gobierno de Mexico's "*Concentrado Nacional de Incendios Forestales*" (Government of Mexico's National Concentration of Forest Fires) webpage.[31] In 2023, a total of 7,611 instances of fires were reported with 14 unique possible causes: Camp fires, Unknown, Intentional, Smokers, Transportation, Agricultural activities, Celebrations and Rituals, Hunters, Cattle Activities, Burning Trash, Natural, Other productive activities, Forest Waste, and Road Clearing. Of the 7,611 fires, 2,334 (31%) fires occurred in protected natural areas and are unlikely to recur. Figure 5-3: *Map of Forest Fires in Mexico in 2023* is a map of all the instances of forest fires reported in 2023. Figure 5-4: *Fires in Mexico in 2023 classified as unlikely or likely to recur based on possible causes* shows that 49% of fires that occurred in 2023 are unlikely to recur based on the possible causes provided and covered a surface area of 405,785.69 hectares

[30] https://www.tceq.texas.gov/downloads/air-quality/sip/pm/ramboll_mexicanfires.pdf
[31] https://monitor_incendios.cnf.gob.mx/incendios_tarjeta_semanal, accessed on January 27, 2025.

where fires are unlikely to recur.[32] It should be noted that the data available on the website is only for forest fires and is therefore only a subset of fires that happened in 2023.

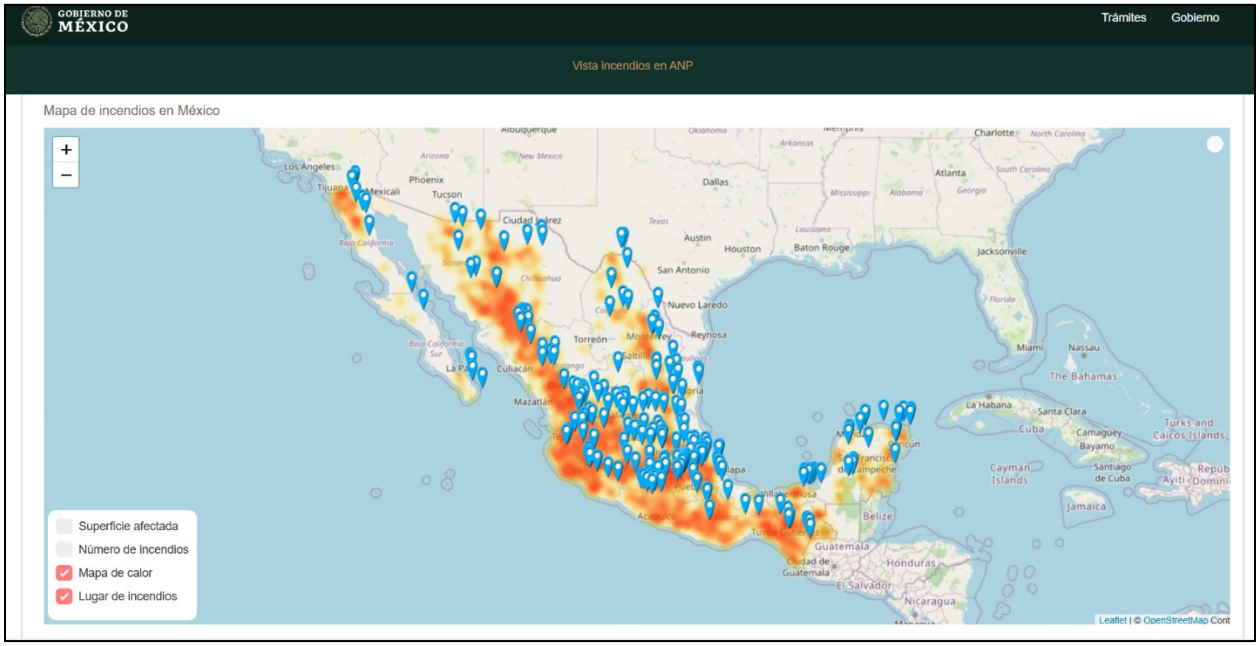

Figure 5-3: Map of Forest Fires in Mexico in 2023

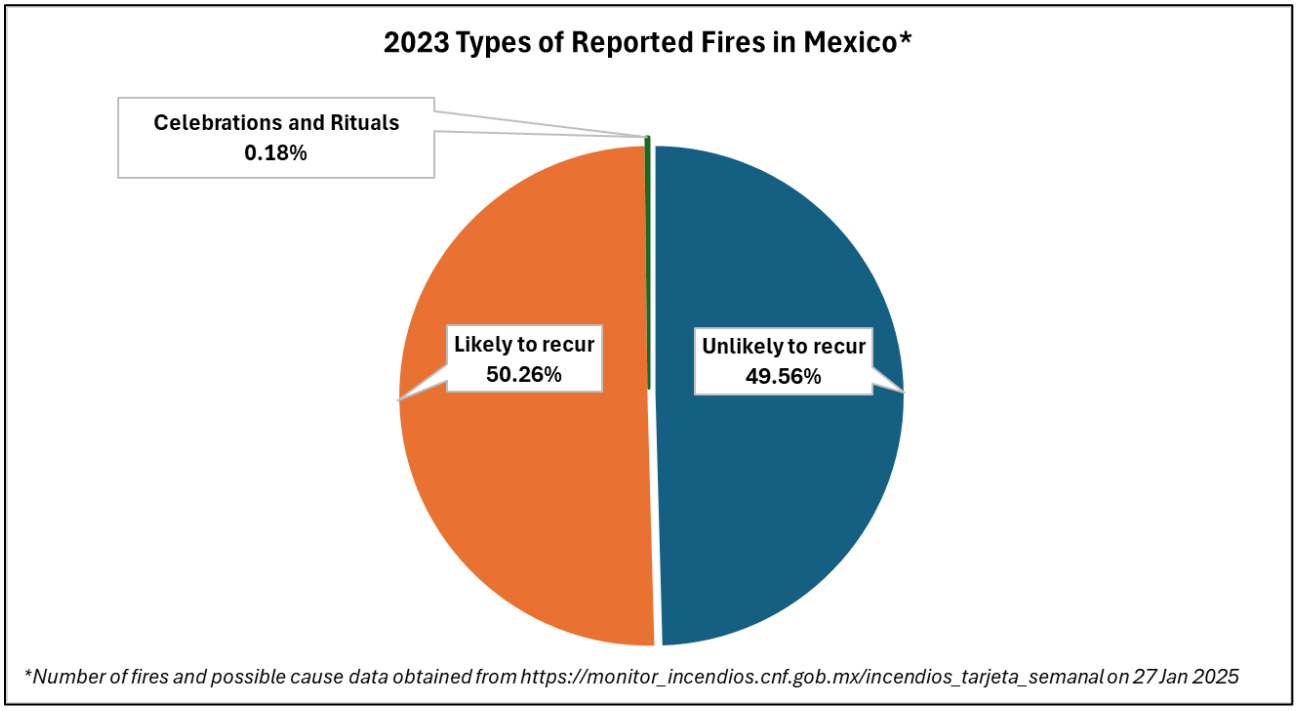

Figure 5-4: Fires in Mexico in 2023 classified as unlikely or likely to recur based on possible causes

[32] TCEQ classified forest fires that had possible causes of Campfires, Intentional, Smokers, Hunters, Natural, and Forest Waste as unlikely to recur.

SECTION 6: PUBLIC NOTIFICATION AND MITIGATION ACTIONS

6.1 OVERVIEW

This section satisfies the requirements in 40 CFR §51.930(a): "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 NAAQS." These are commonly referred to as mitigation actions.

Each of the specific requirements are addressed individually below.

6.2 PROMPT PUBLIC NOTIFICATION

The first mitigation requirement is to "provide for prompt public notification whenever air quality concentrations exceed or are expected to exceed an applicable ambient air quality standard." TCEQ provided (and continues to provide) ozone, fine particulate matter ($PM_{2.5}$), and particulate matter less than or equal to 10 microns in diameter (PM_{10}) Air Quality Index (AQI) forecasts for the current day and the next three days for 14 areas in Texas. These forecasts are available to the public on the Today's Texas Air Quality Forecast webpage of the TCEQ website and on EPA's AirNow website.[33, 34]

TCEQ provides near real-time hourly $PM_{2.5}$ measurements from monitors across the state which the public may access on the Latest Hourly $PM_{2.5}$ Levels webpage of the TCEQ website.[35] TCEQ also publishes an AQI Report for many Texas metropolitan areas on the AQI and Data Reports webpage of the TCEQ website, which displays current and historical daily AQI measurements.[36]

Finally, TCEQ publishes daily updates to its air quality forecast to interested parties through e-mail and social media platforms. Any person wishing to receive these updates may register on the Air Quality Forecast and Ozone Action Day Alerts webpage on the TCEQ website.[37] These measures provide daily and near real-time notification to the public, including the media, of current, expected, and changing air quality conditions.

6.3 PUBLIC EDUCATION

The second mitigation 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." Through its website, TCEQ provides the public with technical, health, personal activity, planning, and legal information and resources concerning particulate matter (PM) pollution. Besides its website, TCEQ publishes daily updates to its air quality forecast to interested parties through e-mail and social media platforms to provide daily and near real-time notification to the public of current, expected, and changing air quality conditions.

TCEQ maintains a particulate matter webpage, which provides important information regarding the health effects of particulate matter, steps that individuals can take to limit particulate matter emissions, and actions they may wish to take to reduce their exposure to higher levels of particulate matter.[38] The webpage also addresses the latest air quality planning for the particulate matter NAAQS.

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[33] http://www.tceq.texas.gov/airquality/monops/forecast_today.html
[34] http://airnow.gov
[35] https://www.tceq.texas.gov/cgi-bin/compliance/monops/select_curlev.pl?user_param=88101
[36] https://www.tceq.texas.gov/airquality/monops/data-reports
[37] http://www.tceq.texas.gov/airquality/monops/ozone_email.html
[38] https://www.tceq.texas.gov/airquality/sip/criteria-pollutants/sip-pm

TCEQ's main Air webpage provides air quality information on topics such as advisory groups, emissions inventories, air quality modeling and data analysis, scientific field studies, state implementation plan (SIP) revisions, air permits, rules, air monitoring data, and how to file complaints.[39]

TCEQ's website provides a hyperlink to the Texas AirNow website operated by EPA. This website links the public to additional information regarding health effects of PM, strategies for reducing one's exposure to PM, and actions that individuals can take to reduce pollution levels.[40]

The Texas Department of Transportation (TxDOT) sponsors the public education and awareness through the Drive Clean Across Texas campaign.[41] The campaign raises awareness about the impact of vehicle emissions on air quality and motivates drivers to take steps to reduce air pollution.

TCEQ sponsors the Take Care of Texas program, which addresses air quality and provides the public with proactive steps to reduce air pollution particularly on days when air quality forecasts are issued predicting greater potential for high PM concentrations.[42]

6.4 IMPLEMENTATION OF 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."

Particulate matter regulations are in place in Title 30 Texas Administrative Code Chapter 111 that are applicable to particulate matter control statewide. These regulations are previously described in Section 4: *Not Reasonably Controllable or Preventable*.

6.5 MITIGATION PLAN REQUIREMENTS

Section 319(b) of the federal Clean Air Act (FCAA) governs the identification of air quality monitoring data as exceptional events and how that data may be excluded from consideration for air quality regulatory purposes. EPA has adopted rules in 40 Code of Federal Regulation (CFR) §§50.14 and 51.930 to implement FCAA, §319, requiring states to adopt and implement mitigation plans in areas with historically documented or known seasonal events.

For $PM_{2.5}$, TCEQ has developed mitigation plans for exceptional events in Harris County and El Paso County that can be found on the TCEQ website.[43]

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[39] http://www.tceq.texas.gov/agency/air_main.html
[40] https://www.airnow.gov
[41] http://www.drivecleanacrosstexas.org
[42] http://takecareoftexas.org/air-quality
[43] https://www.tceq.texas.gov/downloads/air-quality/modeling/exceptional/texas-ee-mitigation-plan-final.pdf

SECTION 7: PUBLIC COMMENT PERIOD

7.1 OVERVIEW

This section satisfies the Exceptional Events Rule Requirement at 40 CFR §50.14(c)(3)(iv)(A), (B), (C): "document that the air agency followed the public comment process and that the comment period was open for a minimum of 30 days, which could be concurrent with the beginning of EPA's initial review period of the associated demonstration provided the air agency can meet all requirements in this paragraph; submit the public comments received along with its demonstration to the Administrator; and address in the submission to the Administrator those comments disputing or contradicting factual evidence provided in the demonstration."

7.2 PUBLIC COMMENT PROCESS

The public comment period for this demonstration opened December 19, 2024, and closed January 21, 2025. During this 30-day comment period, the demonstration was available on TCEQ's website at https://www.tceq.texas.gov/airquality/monops/pm_flags.html. Written comments were accepted via mail or e-mail. All public comments received during the comment period (received or postmarked by 5:00 p.m. CST on January 21, 2025) and changes made in response to the comments are included in Appendix F: *Public Comments*. The final demonstration was revised to incorporate changes made in response to comments received..

SECTION 8: CONCLUSION

This exceptional events demonstration shows that the Karnack, Austin Webberville, and National Seashore monitors were impacted by smoke and dust from a prescribed fire, fires in Mexico and Central America, high winds, fireworks, and African dust. These exceptional events caused the elevated $PM_{2.5}$ concentrations on the dates listed in Table 1-1, as explained in Section 3: *Clear Causal Relationship*.

This demonstration shows that the exceptional events that influenced $PM_{2.5}$ concentrations are consistent with EPA's definition of an exceptional event under the 2016 Exceptional Events Rule. TCEQ requests that EPA concur with the exclusion from regulatory decisions the $PM_{2.5}$ concentration(s) in Table 1-1. The days and sites for which TCEQ is requesting concurrence were impacted by events consistent with EPA's definition of "unusual or naturally occurring events" that can affect air quality but are not reasonably controllable using techniques that tribal, state, or local air agencies may implement in order to attain and maintain the 2024 primary annual $PM_{2.5}$ NAAQS.