EXCEPTIONAL EVENTS DEMONSTRATION FOR 2022 $PM_{2.5}$ EXCEEDANCES AT HARRISON COUNTY, TRAVIS COUNTY, AND KLEBERG COUNTY

February 7, 2025

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
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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 event rule, 40 Code of Federal Regulations (CFR) §50.14, as well as guidance to implement the requirements of the FCAA regarding exceptional events. States are required to identify air quality monitoring data potentially affected by exceptional events by flagging the data submitted into the EPA Air Quality System (AQS) database. If EPA concurs with this demonstration, the flagged data will not be eligible for consideration when making NAAQS compliance determinations.

This document discusses the Texas Commission on Environmental Quality (TCEQ) proposed exceptional event day flags for $PM_{2.5}$, occurring on various dates in 2022, in Harrison County (Karnack monitor), Travis County (Austin Webberville monitor), and Kleberg County (National Seashore monitor). This demonstration shows that concentration of fine particulate matter ($PM_{2.5}$) at three air monitoring sites in Harrison County, Travis County, and Kleberg County, respectively, were impacted by exceptional events on 23 days in 2022.

The $PM_{2.5}$ measurements on the proposed exceptional event days are listed below in Table 1-1: *Proposed Exceptional Events in 2022*. 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 2022

EE Group	Date	Monitor Site	Exceedance Concentration (μg/m^3)	Type of Event	Tier
Group 1	1/1/2022	National Seashore	30.0	High Winds	1
Group 2	1/21/2022	Karnack	98.2	Prescribed Fire	1
Group 2	1/22/2022	Karnack	47.9	Prescribed Fire	1
Group 2	1/23/2022	Karnack	33.0	Prescribed Fire	1
Group 3	3/25/2022	National Seashore	30.5	Wildfire – U.S.	1
Group 4	4/11/2022	National Seashore	21.7	High Wind, Fire - Mexico/Central America	2
Group 4	4/12/2022	National Seashore	21.8	High Wind, Fire - Mexico/Central America	2
Group 4	4/13/2022	National Seashore	27.7	High Wind, Fire - Mexico/Central America	1

EE Group	Date	Monitor Site	Exceedance Concentration (μg/m³)	Type of Event	Tier
Group 5	5/6/2022	National Seashore	21.8	Fire - Mexico/Central America	2
Group 5	5/7/2022	National Seashore	23.1	Fire - Mexico/Central America	2
Group 6	5/20/2022	Austin Webberville Rd	27.8	Fire - Mexico/Central America	2
Group 6	5/20/2022	National Seashore	26.6	Fire - Mexico/Central America	2
Group 7	6/11/2022	National Seashore	23.6	African Dust	2
Group 7	6/12/2022	National Seashore	48.5	African Dust	1
Group 7	6/13/2022	Karnack	39.0	African Dust	1
Group 7	6/13/2022	Austin Webberville Rd	30.8	African Dust	1
Group 7	6/13/2022	National Seashore	36.4	African Dust	1
Group 7	6/14/2022	Karnack	33.4	African Dust	1
Group 7	6/14/2022	National Seashore	29.8	African Dust	1
Group 7	6/15/2022	Karnack	27.1	African Dust	1
Group 7	6/15/2022	National Seashore	38.5	African Dust	1
Group 7	6/16/2022	Karnack	27.0	African Dust	1
Group 7	6/16/2022	Austin Webberville Rd	34.8	African Dust	1
Group 7	6/16/2022	National Seashore	46.0	African Dust	1
Group 7	6/17/2022	Austin Webberville Rd	25.5	African Dust	2
Group 7	6/17/2022	National Seashore	28.8	African Dust	1
Group 8	7/16/2022	National Seashore	27.3	African Dust	1
Group 8	7/17/2022	Karnack	26.0	African Dust	1
Group 8	7/17/2022	Austin Webberville	29.1	African Dust	2
Group 8	7/17/2022	National Seashore	34.6	African Dust	1
Group 8	7/18/2022	Karnack	29.5	African Dust	1

EE Group	Date	Monitor Site	Exceedance Concentration (µg/m³)	Type of Event	Tier
Group 9	7/21/2022	National Seashore	24.7	African Dust	2

(µg/m³) = micrograms per cubic meter

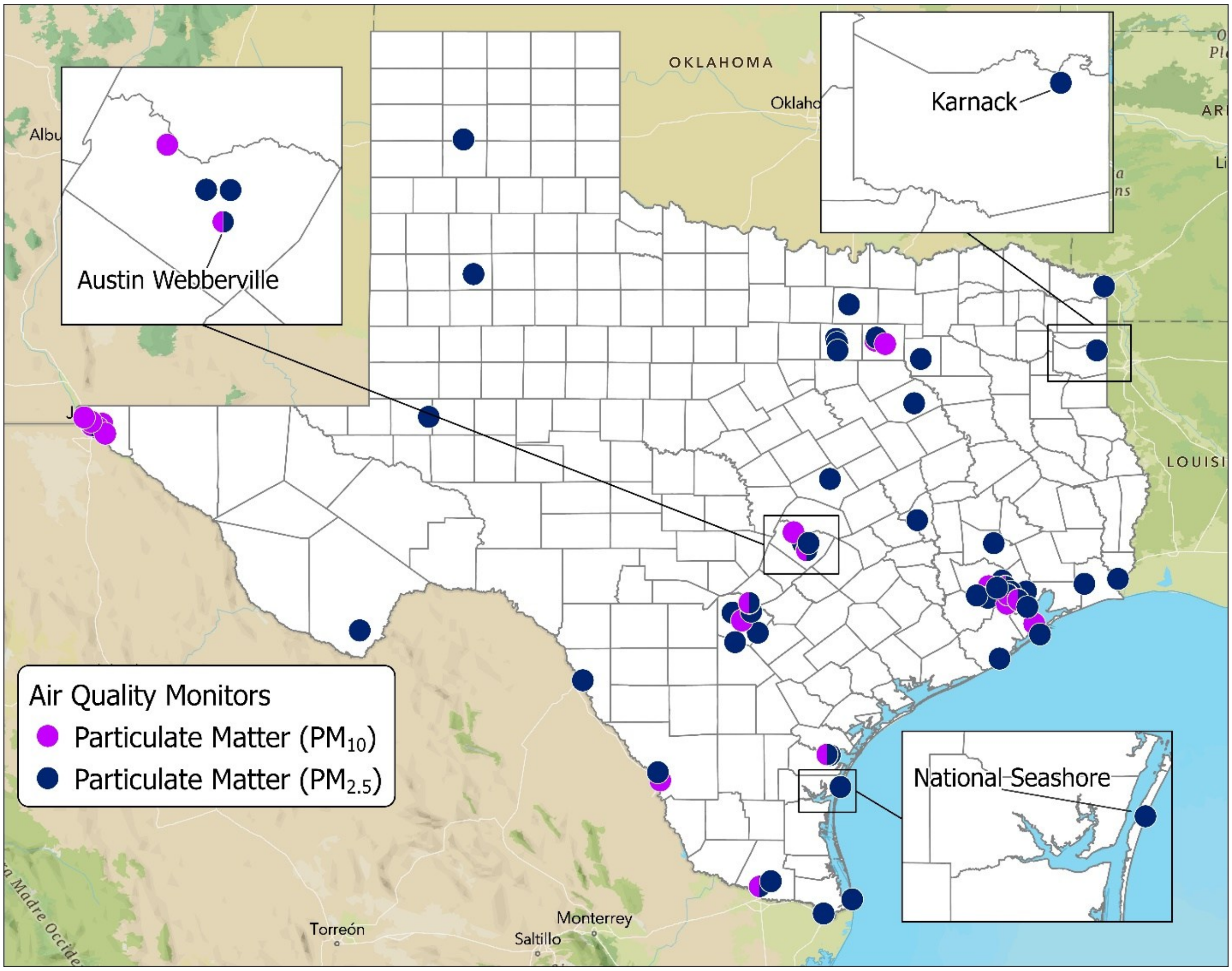

Figure 1-1: Map of Texas with three monitors identified for Exceptional Events

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 $PM_{2.5}$ 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).

Texas is submitting this exceptional events demonstration to exclude certain data from the 2021-2023 timeframe.

1.3 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

40 CFR §50.14(c)(3) Requirement	Demonstration Section
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

TCEQ documents 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 in Table 1-4: *40 CFR §51.930(a) Exceptional Event Demonstration Requirements*.

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

40 CFR §51.930(a) 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
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]

[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

- "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 Regional 6 on October 29, 2024, and December 6, 2024, regarding the demonstration prior to formal submittal. A copy of the initial notification letter is provided below 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 design values 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 relevant 2023 days impacted by exceptional events the details of the events are available in the "Exceptional Events Demonstration For 2023 $PM_{2.5}$ Exceedances at Harrison County, Travis County, and Kleberg County."

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

Monitoring Site	2021-2023 DV without EPA Concurrence (µg/m³)	2021-2023 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 an exceptional event 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.

[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

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. This section describes the 2022 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 nine distinct groups based on single day events or episodes with types of events (Prescribed Fire, African Dust, Fire (Mexico/Central America), 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 the city limits vary from 400 feet in the east/southeast to just above 1,000 feet above sea level on the northwest side as you begin to enter into the Hill Country. Given these large changes in elevation, weather conditions at any one time can differ between various parts of the city and metro area.

Austin has a humid subtropical climate, and this climate is 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 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 annual precipitation in Kleberg County was lower in 2022 (18.32 inches) and 2023 (20.22

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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

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 (mph), 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 (NOAA)'s 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, 2022, High Wind $PM_{2.5}$ Event for the National Seashore Monitor

January 1, 2022, was identified as a high wind day with maximum wind speed of 26.6 mph and maximum wind gust of 46.1 mph in the area. The maximum $PM_{2.5}$ concentration of 40 µg/m^3 at 4:00 p.m. local time was recorded at the National Seashore monitor. The National Weather Service (NWS) forecast **(**Figure B-1**)** summary and TCEQ forecasts (Table C-1) revealed that high winds were expected to affect the area, potentially pushing suspended dust and other particulates to the monitor.

For the weather on this day, Figure A-1, a surface low associated with the 500 mb meridional low was located in north New Mexico. A small surface low was located in northeast Texas with a dry line extending from the low to the southwest and an occluded front extending from the low to the northeast. The surface winds east of the dry line were from the south at 10-15 knots (kts). While to the west of the dry line the wind was from the south at 5 kts. From the analysis of the 500 mb Analysis (6:00 a.m. CDT) charts in Figure A-2, a deep meridional trough extended from the north Contiguous United States (CONUS) to the southwest to the north of the Baha Peninsula. A small ridge was located over New Mexico and a small trough over the Texas Panhandle.

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

Figure 2-1: *Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Jan 1, 2022)* shows the hourly $PM_{2.5}$ concentrations measured at the monitoring site between December 30, 2021, and January 3, 2022, with the hours on January 1, 2022, highlighted in red. As seen in the figure, on January 1st, hourly concentrations increased substantially around 9:00 a.m. CDT and remained clearly elevated until approximately 10:00 p.m. CDT. Figure 2-2: *Continuous Hourly $PM_{2.5}$ and Peak Area Five-Minute Sustained Wind Speed Measurements on January 1, 2022, for the National Seashore monitor (482730314)*, shows that during the early hours of the day, $PM_{2.5}$ concentrations were lower and wind speeds higher. Over the course of the day, $PM_{2.5}$ concentrations rose as local wind speeds decreased. Higher wind speeds that persist prior to a rise in $PM_{2.5}$ concentrations can be an indication that the $PM_{2.5}$ is being transported from a source outside of the area in the vicinity of the National Seashore monitor.

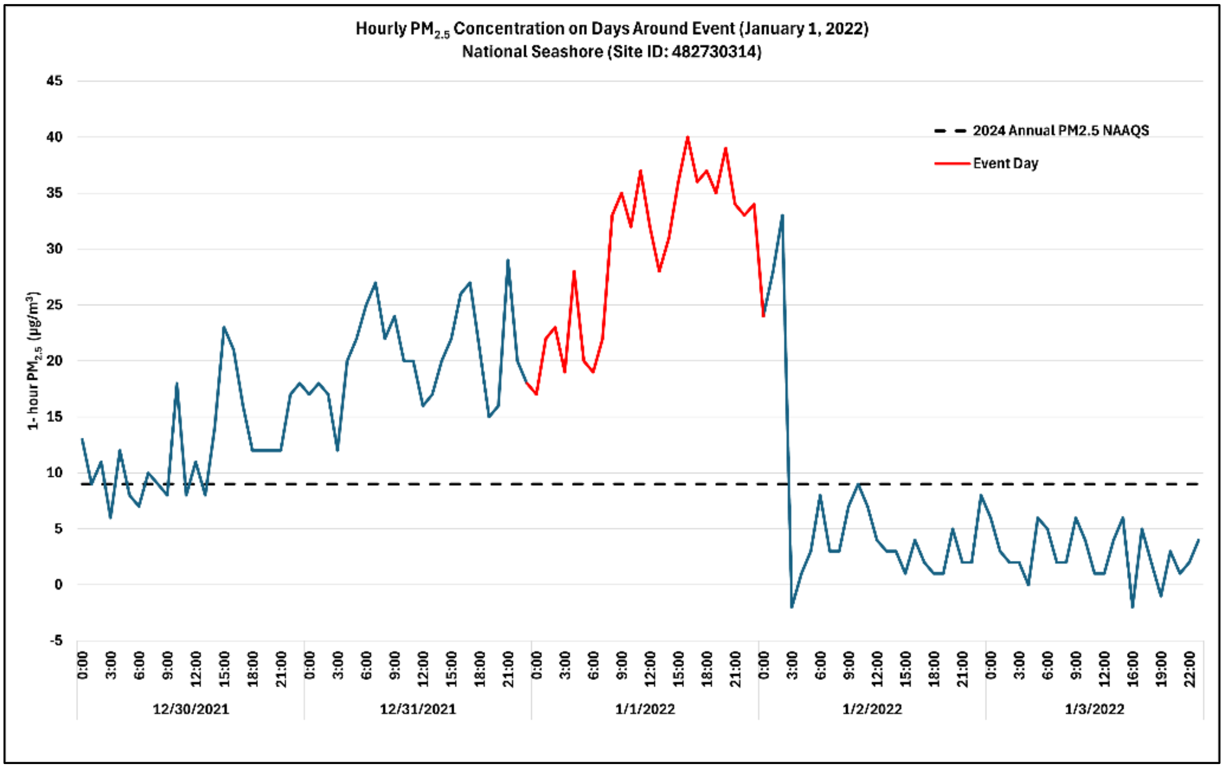


Figure 2-1: Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Jan 1, 2022)

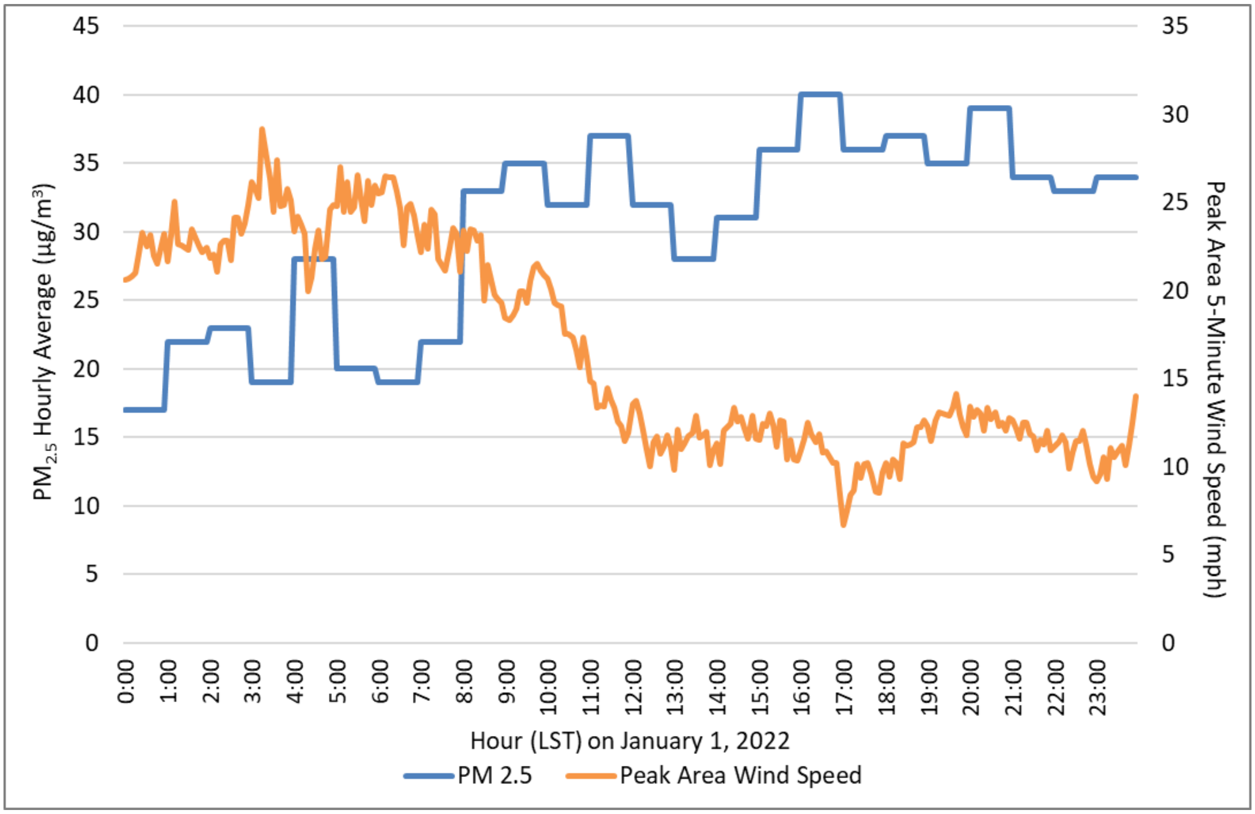


Figure 2-2: Continuous Hourly $PM_{2.5}$ and Peak Area Five-Minute Sustained Wind Speed Measurements on January 1, 2022, for the National Seashore monitor (482730314)

2.5.2 Group 2 – Summary of January 21, January 22, and January 23, 2022, Prescribed Fire $PM_{2.5}$ Event for the Karnack Monitor

Prescribed Fire smoke affected the Karnack monitor on January 21, 22, and 23, 2022. U.S. Fish and Wildlife Service initiated prescribed burning on Caddo Lake National Wildlife Refuge over the weekend (January 21 – January 23, 2022) for habitat and vegetation management. Approximately 400 acres of area was burned, and widespread smoke was reported in the area (See Appendix C: Figure C-1 and Figure C-2 for Group 2) on those days. A strong subsidence inversion at 950 mb led smoke to linger over the Karnack area, as seen in NOAA HMS (Figures A-3 through A-5) for January 21-23, 2022.

The TCEQ forecast (Table C-2) revealed slightly increased fine particulate background levels and development of high-pressure system overhead on January 21, and 22, 2022, which slides to the east on January 23, 2022. This led to limited dispersion of particulate levels due to light winds and limited vertical mixing. From the analysis of the surface charts (Figure A-6 through Figure A-8), a high-pressure ridge extended from the NE CONUS to Texas, bringing stable atmospheric conditions and subsidence over the Karnack area. A warm front extended from the Texas Panhandle to Winnipeg with light northerly wind near Karnack. Texas was still under high pressure with a light northeasterly wind near the Karnack area on January 22, and January 23, 2023.

From the analysis of the 500 mb Analysis (6:00 a.m. CDT) charts (Figure A-9 through A-11), a trough extended over Texas with a west-southwesterly wind at 40-50 kts near Karnack on January 21st. On January 22, 2022, the trough over Texas moved eastward, and the state was under the influence of a ridge. The winds near Karnack were from the west to northwest at 20-25 kts. A cut-off low developed between southern California and the Baha California peninsula.

On January 23, 2022, the ridge over Texas enhanced with west to northwesterly wind at 45 kts near Karnack. The cut-off low between southern California and the Baha California peninsula moved to the south.

Figure 2-3: *Hourly $PM_{2.5}$ Concentrations at the Karnack Monitor on Days around Event (Jan 21, 2022 – Jan 23, 2022)* shows the hourly $PM_{2.5}$ concentrations measured at the monitoring site between January 19, 2022, and January 23, 2022, with the hours on January 21st through January 23rd highlighted in red. As seen in the figure, hourly concentrations increased substantially on event days and remained clearly elevated over the weekend.

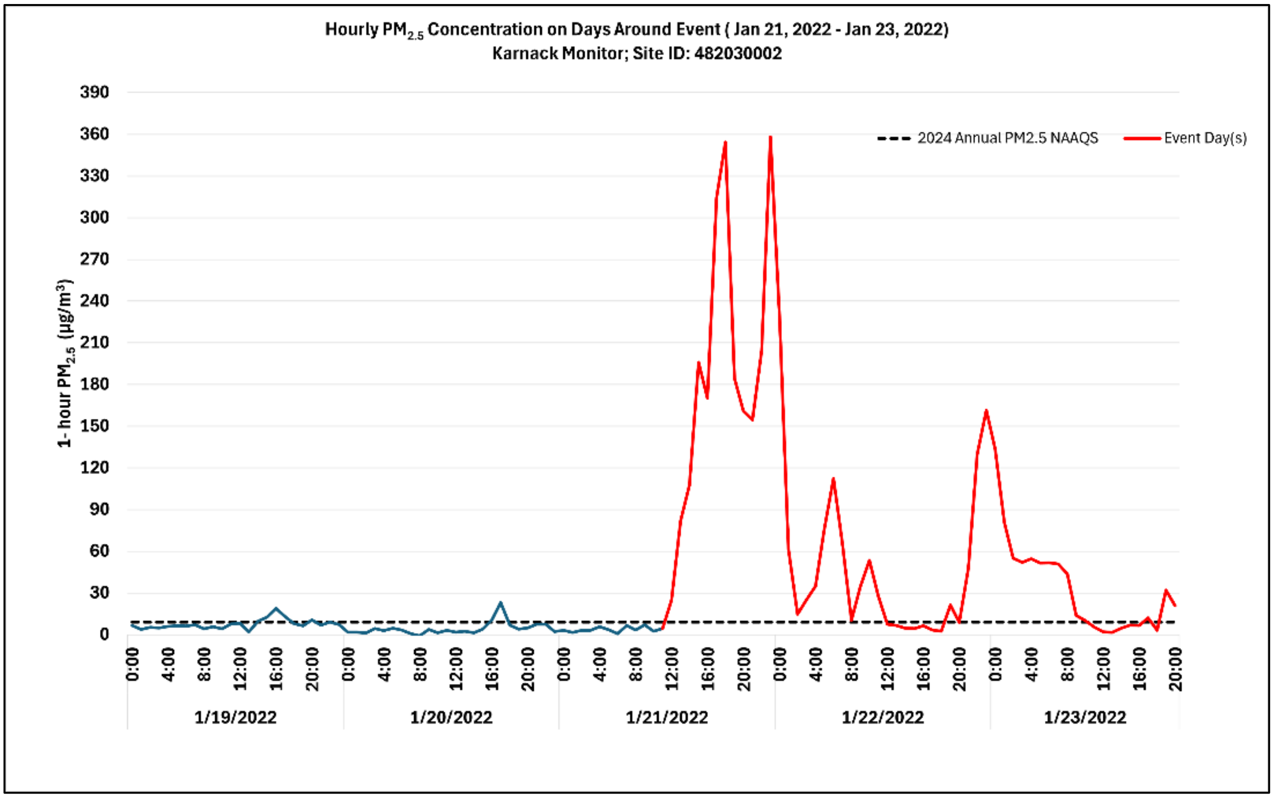


Figure 2-3: Hourly $PM_{2.5}$ Concentrations at the Karnack Monitor on Days around Event (Jan 21, 2022 – Jan 23, 2022)

2.5.3 Group 3 –Summary of March 25, 2022, Wildfire (U.S.) $PM_{2.5}$ Event for the National Seashore Monitor.

Wildfire smoke affected the National Seashore monitoring site on March 25, 2022. The NWS forecast mentioned smoke in the Corpus Christi area due to nearby fires (Figure B-3). Media reports also mentioned two wildfires occurring in Kenedy County near Corpus Christi causing large amounts of smoke to affect the area (Appendix C, Figure C-3 for Group 3). Smoke plumes can be seen traveling towards the monitor on NOAA HMS (Figure A-12) on March 25, 2022. Wind patterns also support the presence of smoke in the area since winds were traveling through the wildfires towards the monitor.

The surface charts in Figure A-13, on March 25, 2022, show relative high pressure over Texas with light surface winds over the Gulf coming from the Southwest. From the analysis of the 500 mb Analysis (6:00 a.m. CDT) charts in Figure A-14, on March 25, 2022, the longwave pattern over the Continental U.S. was meridional with ridging over West CONUS and troughing over East CONUS. The troughing can be seen downstream of Texas, with ridging building in as the major feature at this level. The 12Z vertical sounding from Corpus Christi shows a strong radiation inversion at 6:00 a.m. CDT, which is common overnight and early in the morning. This inversion, and the sounding overall indicates subsidence, or the downward movement of air, generally brought on by high pressure. The 00Z sounding from March 26th (which is 6:00 p.m. CDT on March 25th) also shows atmospheric stability, extremely dry air throughout the column, and backing winds in the lower 3,000 ft of the atmosphere. The dry air and stability indicate a lack of rain during this day. These are conditions that are typical of high pressure and indicate that this monitor had an extremely stable lower atmosphere that was conducive to the accumulation of particulate matter in the area.

Figure 2-4: *Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Mar 25, 2022)* shows the hourly $PM_{2.5}$ concentrations measured at the monitoring site between March 23, 2022, and March 27, 2022, with the hours on March 25, 2022, highlighted in red. As seen in the figure, hourly concentrations increased substantially on the event day at 2:00 a.m. CDT and remained clearly elevated until approximately 3:00 p.m. CDT.

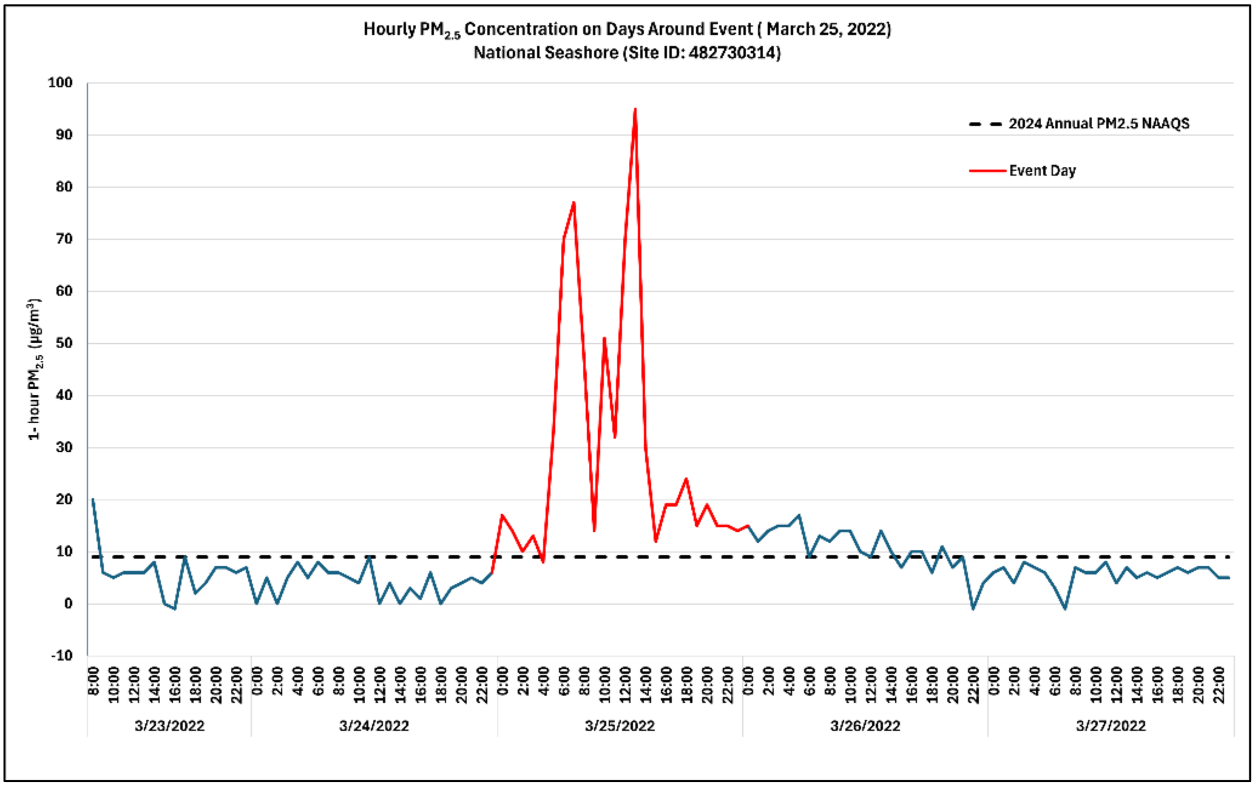


Figure 2-4: Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Mar 25, 2022)

2.5.4 Group 4 – Summary of April 11, April 12, and April 13, 2022, High Wind and Fire (Mexico/Central America) $PM_{2.5}$ Event for the National Seashore Monitor

High wind and fires (Mexico/Central America) affected the National Seashore monitoring site on April 11th through April 13, 2022. Archives from NWS forecast (Figure B-4 through Figure B-6) revealed gusty winds in the Corpus Christi area, which was supported by wind patterns for these days. The TCEQ forecasts (Table C-4) mention that the eastern two-thirds of the state were potentially experiencing smoke traveling from the eastern U.S. and fires from Mexico and Central America from April 11, 2022 through April 13, 2022. Smoke plumes can be seen traveling towards the monitor on NOAA HMS (Figure A-15 through Figure A-17) on April 11-13, 2022.

From the analysis of the surface (6:00 a.m. CDT) charts (Figure A-18 through Figure A-20), a cold front was located over Texas that extended from a low-pressure center over the Great Lakes on April 11th. A strong low-pressure center over Colorado brought relative low pressure over Texas on April 12, 2022. On April 13, 2022, the surface chart indicates that the cold front from the day before was likely a stationary front and did not progress downstream in the prior 24 hours. The large-scale flow patterns drew surface-level smoky air northward from Mexico and the western Gulf due to the strength of the cyclone over the central U.S.

The analysis of the 500 mb Analysis (6:00 a.m. CDT) charts (Figure A-21 through Figure A-23), shows a zonal longwave pattern over the U.S. with troughing over the Western CONUS. This troughing extended from the West Coast to the Midwest United States. On April 12th, the troughing at 500 mb strengthened and remained over the Western half of the CONUS. On April 13, 2022, the longwave trough at 500 mb had progressed downstream a few degrees, with its influence extending into Texas. The sounding at Corpus Christi shows a strong subsidence inversion at 900 mb, with relatively strong sustained winds at the surface at 20 kts from the south. The high winds may have led to increased particulate matter near the monitor, as the inversion, or cap, kept any particulate from dispersing into the upper atmosphere.

Figure 2-5: *Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Apr 11, 2022 – Apr 13, 2022)* shows the hourly $PM_{2.5}$ concentrations measured at the monitoring site between April 9, 2022, and April 15, 2022, with the hours on April 11, 2022, through April 13, 2022, highlighted in red. As seen in the figure, hourly concentrations increased substantially on April 11, 2022, and remained clearly elevated throughout April 13, 2022. In addition to wildfires, April 11-13, 2022, were impacted by high winds too. Because the highest $PM_{2.5}$ concentrations on April 11, 2022, 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 April 11, 2022. For this reason, the plot in *Figure 2-6: Continuous Hourly $PM_{2.5}$ and Peak Area Five-Minute Sustained Wind Speed Measurements on April 13, 2022, for the National Seashore monitor (482730314)* shows data for April 10th in addition to April 11, 2022. Over the course of the two days, wind speeds increased and were highest several hours prior to a spike in $PM_{2.5}$ concentrations. This pattern is indicative of transport of $PM_{2.5}$ from a source outside of the local area. Similar to what was observed on April 11, 2022, the greatest increase in $PM_{2.5}$ concentrations occurred after local winds had risen a few hours prior, as shown in *Figure 2-7: Continuous Hourly $PM_{2.5}$ and Peak Area Five-Minute Sustained Wind Speed Measurements on April 12, 2022, for the National Seashore monitor (482730314)*. This pattern is indicative of transport of $PM_{2.5}$ from a source outside of the local area. As shown in Figure 2-8: *Continuous Hourly $PM_{2.5}$ and Peak Area Five-Minute Sustained Wind Speed Measurements on April 13, 2022, for the National Seashore monitor (482730314)*, $PM_{2.5}$ concentrations stayed relatively stable for most of the day, approximately 25 to 35 $\mu g/m^3$, with concentrations rising with slower wind speeds and falling with faster wind speeds. This pattern continues to support the conclusion drawn for April 11th and 12th, that $PM_{2.5}$ was transferred into the area. If $PM_{2.5}$ was from local sources, a decrease in wind speed would be expected to correspond with a decrease in $PM_{2.5}$ concentrations. This pattern is observed because $PM_{2.5}$ is small and can be transported great distances, and 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 2-9: *Percentage of reported fire instances by the Mexican government, from April 11, 2022, through April 13, 2022*, shows the causes of reported fires in Mexico, with about half of the reported instances classified as unlikely to recur.

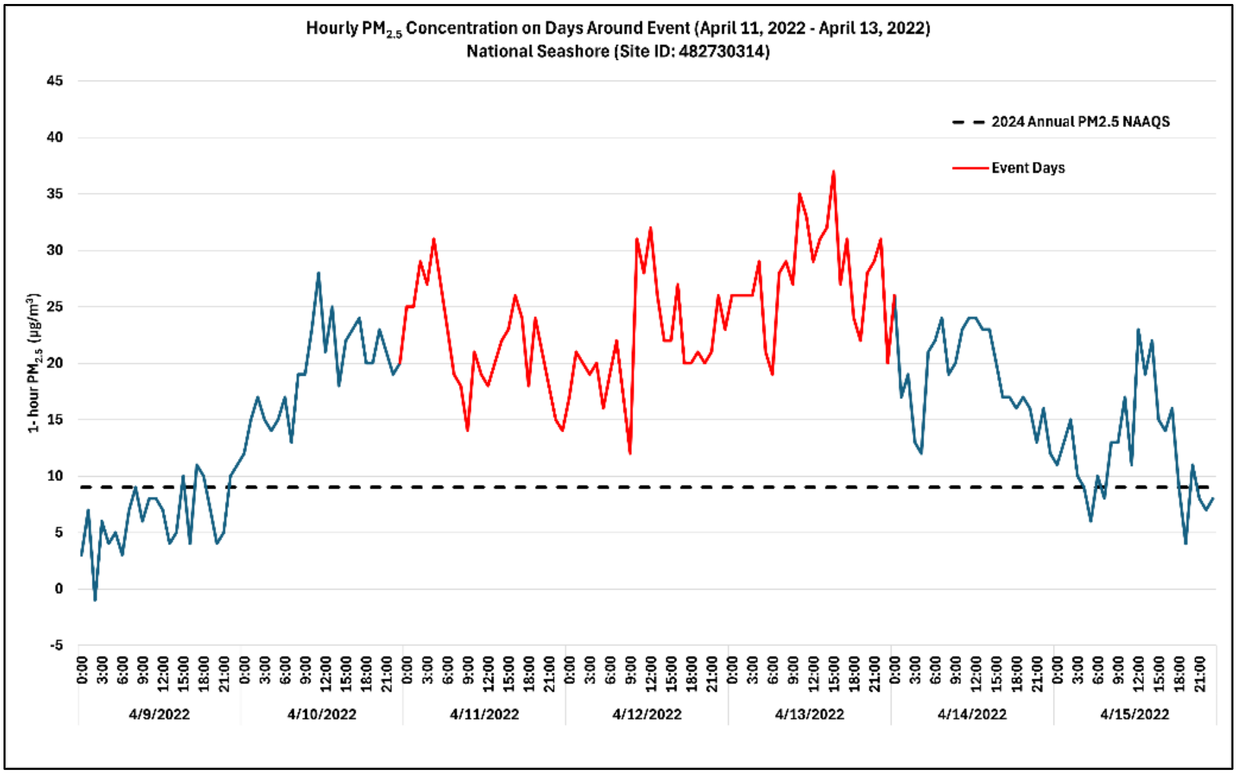


Figure 2-5: Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (Apr 11, 2022 – Apr 13, 2022)

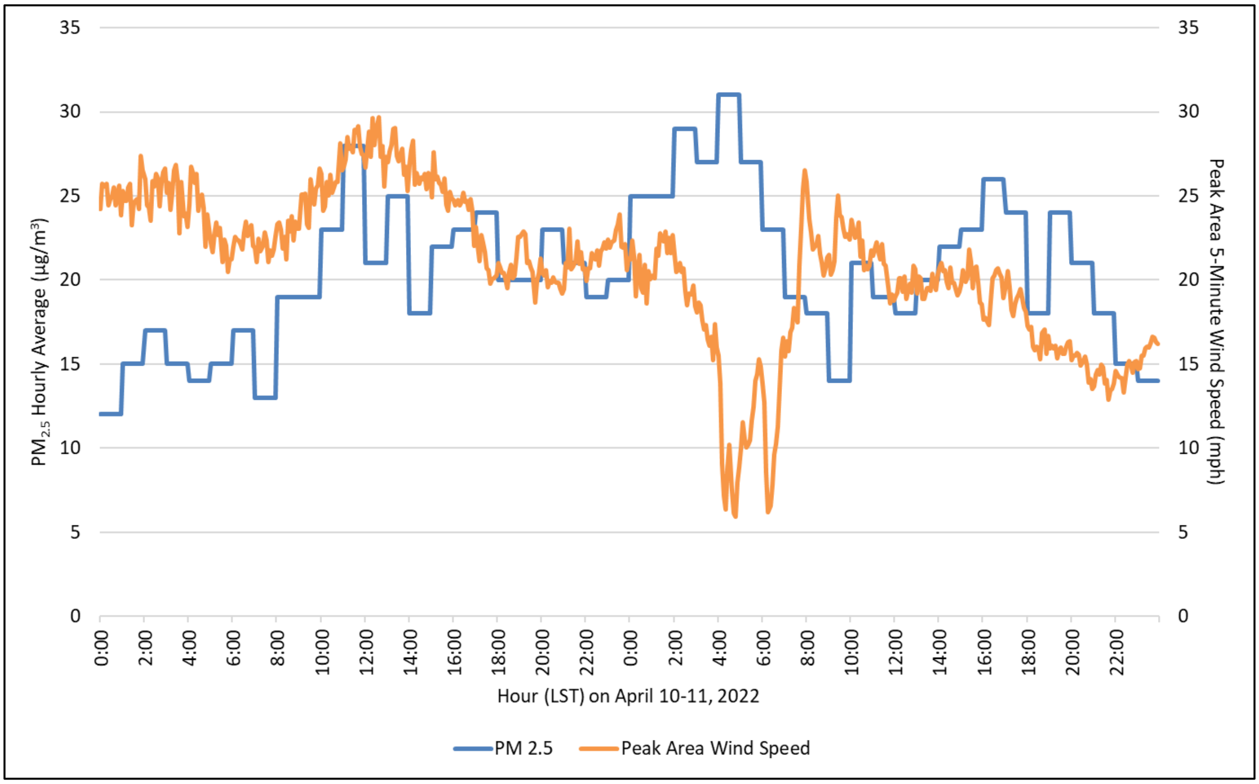


Figure 2-6: Continuous Hourly $PM_{2.5}$ and Peak Area Five-Minute Sustained Wind Speed Measurements on April 11, 2022, for the National Seashore monitor (482730314)

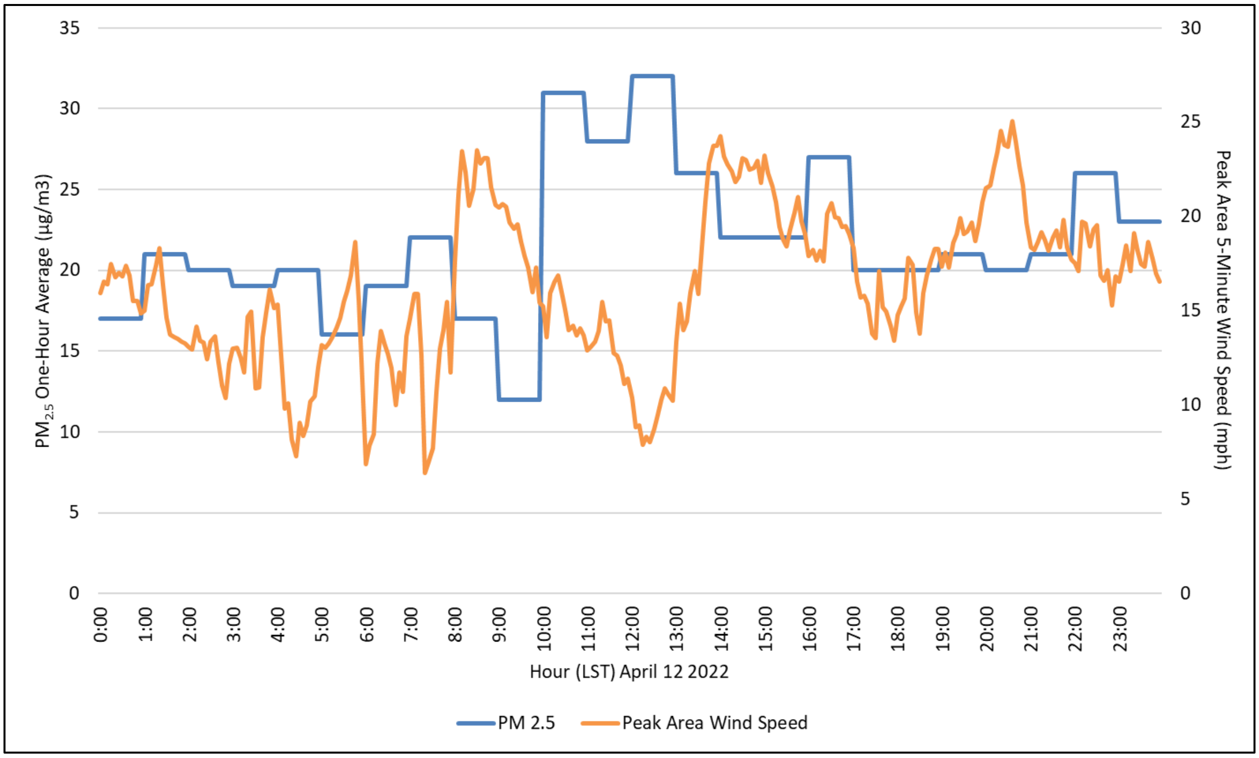


Figure 2-7: Continuous Hourly $PM_{2.5}$ and Peak Area Five-Minute Sustained Wind Speed Measurements on April 12, 2022, for the National Seashore monitor (482730314)

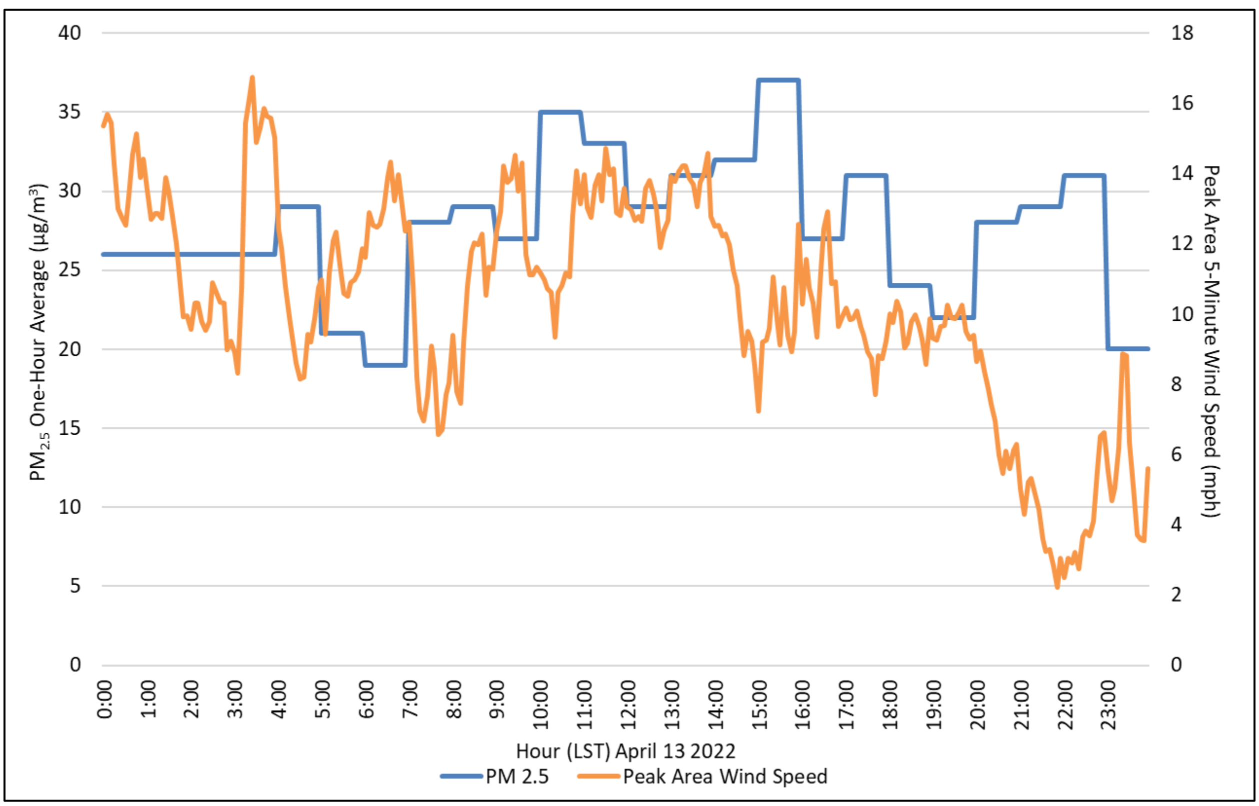


Figure 2-8: Continuous Hourly $PM_{2.5}$ and Peak Area Five-Minute Sustained Wind Speed Measurements on April 13, 2022, for the National Seashore monitor (482730314)

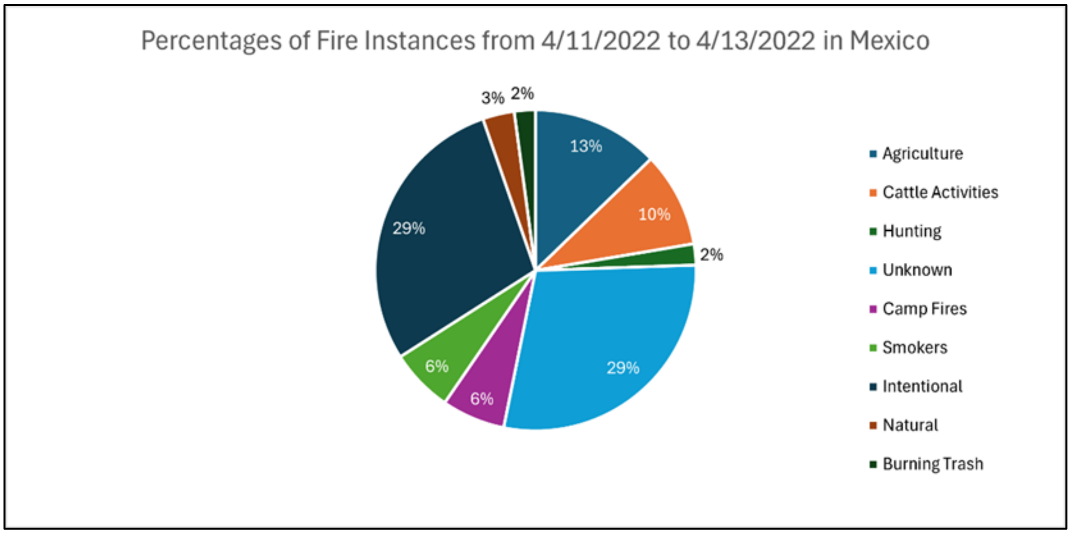


Figure 2-9: Percentage of reported fire instances by the Mexican government, from April 11, 2022, through April 13, 2022

2.5.5 Group 5– Summary of May 6 and May 7, 2022, Fire (Mexico/Central America) $PM_{2.5}$ Event for the National Seashore Monitor

Fires (Mexico/Central America) affected the National Seashore monitoring site on May 6 and 7, 2022. On May 6th and 7th, winds traveled from the Gulf of Mexico through concentrations of smoke towards Corpus Christi area. NWS forecast (Figure B-7 and Figure B-8) mentions breezy to windy conditions. A smoke plume could be seen over the monitoring area and Gulf of Mexico on May 6, and 7, 2022, as shown in NOAA HMS (Figure A-24 and Figure A-25).

From the analysis of the surface charts (Figures A-26 and A-27), on May 6, 2022, the center of the low-pressure associated with the 500 mb meridional trough was located between Tennessee and Missouri. A small low-pressure was centered over northwest Texas with a dry line and cold front extending from the low pressure system. On May 7, 2022, the center of the low-pressure associated with the 500 mb meridional trough was located in the eastern part of Virginia. The cold front in Texas moved to the south becoming a stationary front with the dry line located to the west of the front. The winds were from the south at 5-10 kts, transporting smoky air northward along the coast.

From the analysis of the 500 mb Analysis (6:00 a.m. CDT) charts (Figures A-28 and A-29), on May 6, 2022, a meridional ridge developed over the Rockies upstream of a meridional trough located over the Mississippi Valley. A jet stream with anti-cyclonic motion formed over East Texas on May 6, a condition that suppressed vertical motion in the atmosphere and aided in trapping aerosols near the surface, while surface winds brought them onshore and northward. On May 7, 2022, the meridional ridge and trough system moved eastward, with the trough deepening to form a closed low pressure system over the eastern U.S. On that day, the ridge was centered over the Texas Panhandle, and the jet remained over East Texas.

Figure 2-10: *Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (May 6, 2022- May 7, 2022)* shows the hourly $PM_{2.5}$ concentrations measured at the monitoring site between May 4, 2022, and May 9, 2022, with the hours on May 6, 2022, and May 7, 2022, highlighted in red. As seen in the figure, hourly concentrations increased substantially on early morning of May 6, 2022, and remained clearly elevated approximately until midnight on May 7, 2022. Figure 2-11: *Percentage of reported fire instances by the Mexican government, on May 6, 2022, and May 7, 2022*, shows the causes of reported fires in Mexico, with almost two-thirds of the reported instances classified as unlikely to recur.

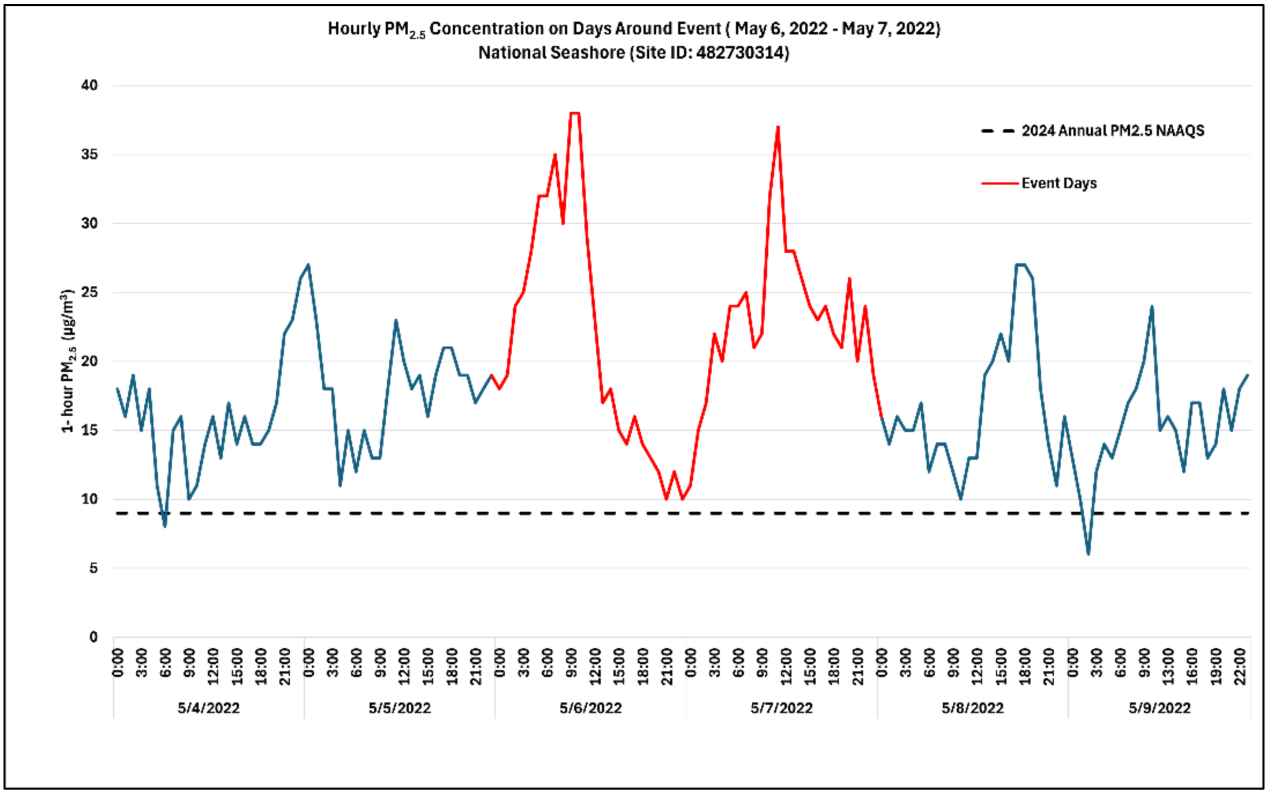


Figure 2-10: Hourly $PM_{2.5}$ Concentrations at the National Seashore Monitor on Days around Event (May 6, 2022- May 7, 2022)

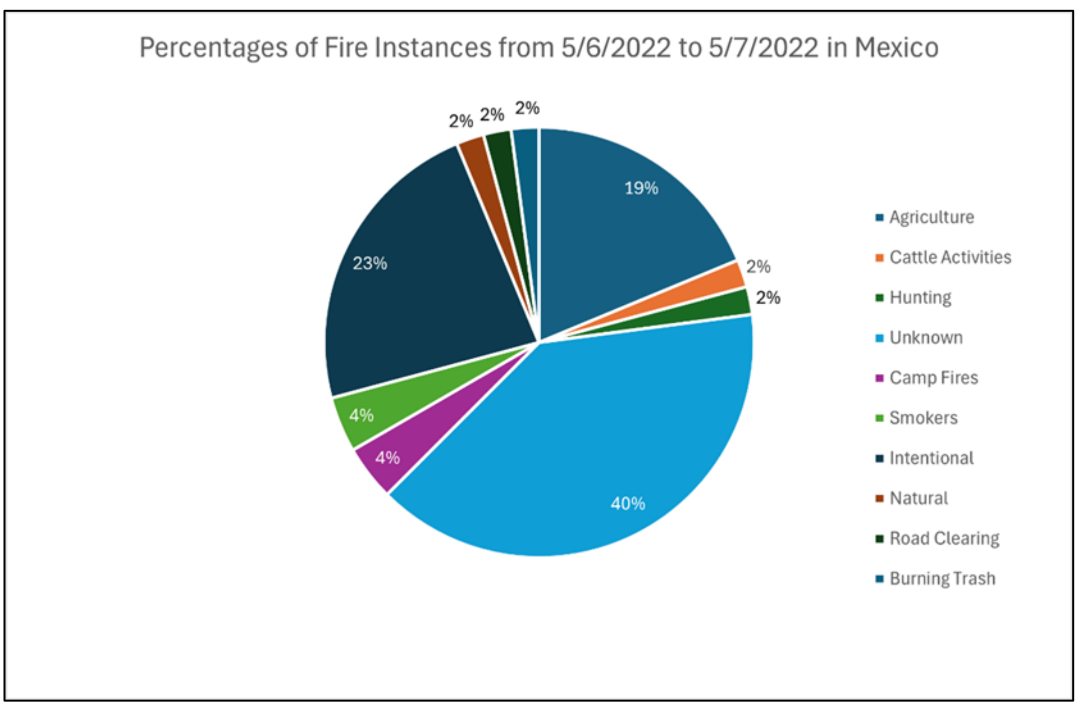


Figure 2-11: Percentage of reported fire instances by the Mexican government, on May 6, 2022, and May 7, 2022

2.5.6 Group 6– Summary of May 20, 2022, Fire (Mexico/Central America) $PM_{2.5}$ Event for the Webberville Monitor and National Seashore Monitor

Fires can be seen throughout West Texas and southern Mexico, with moderate heavy smoke covering both areas, as seen on the NOAA HMS (Figure A-30 and A-31). On May 20th, winds traveled from the Gulf of Mexico through concentrations of smoke towards the Corpus Christi area.

From the analysis of the surface chart (Figure A-32), a dry line associated with a trough stretches over western Texas with surface wind from the south at 10-20 kts. From the analysis of the 500 mb analysis (6:00 a.m. CDT) charts (Figure A-33), on May 20th, a small trough has moved from the previous day from Arizona to New Mexico. From the analysis of the sounding for Lake Charles for May 20th, the surface wind is southerly at 20 kts (Figure A-34), bringing smoke-laden air from the south into Texas.

Figure 2-12: *Hourly $PM_{2.5}$ Concentrations at the Austin Webberville and National Seashore Monitors on Days around Event (May 20, 2022)* shows the hourly $PM_{2.5}$ concentrations measured at the monitoring sites between May 18, 2022, and May 22, 2022, with the hours on May 20, 2022, highlighted in a brown dotted line for the Austin Webberville monitoring site and a red dotted line for the National Seashore monitoring site. As seen in the figure, hourly concentrations increased substantially on the early morning of May 20, 2022, at both the monitors and remained clearly elevated approximately until late night on the event day. Figure 2-13: *Percentage of reported fire instances by the Mexican government, on May 20, 2022*, shows the causes of reported fires in Mexico, with about half of the reported instances classified as unlikely to recur.

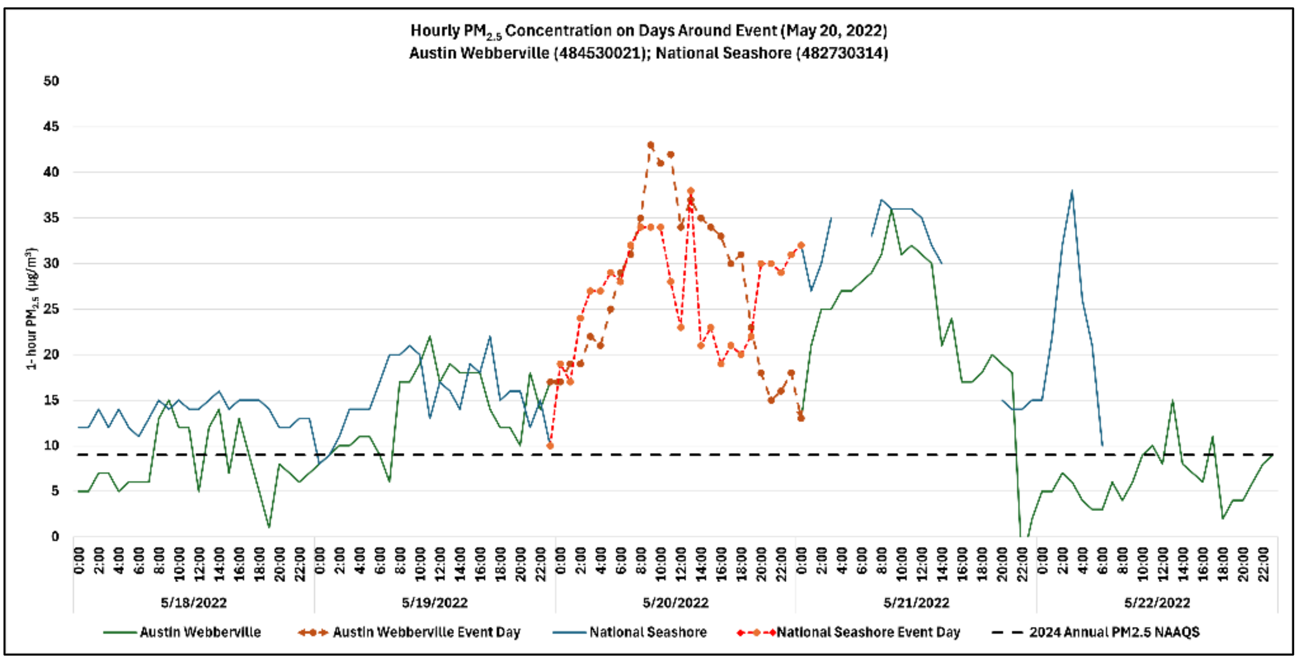


Figure 2-12: Hourly $PM_{2.5}$ Concentrations at the Austin Webberville and National Seashore Monitors on Days around Event (May 20, 2022)

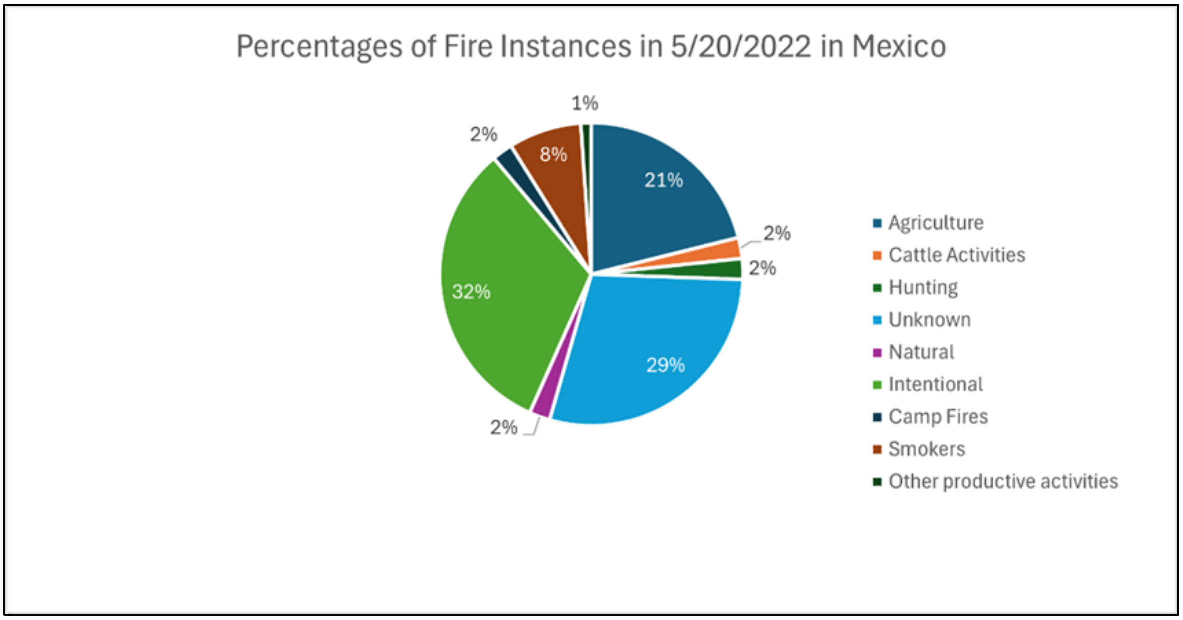


Figure 2-13: Percentage of reported fire instances by the Mexican government, on May 20, 2022

2.5.7 Group 7– Summary of June 11 through June 17, 2022, Saharan Dust $PM_{2.5}$ Event for National Seashore Monitor, Karnack Monitor, and Webberville Monitor

All three monitoring sites were impacted by African dust on various days during a regional event from June 11th through June 17th. The NWS forecast (Figure B-11 through B-15) mentions a Saharan dust plume contributing to hazy conditions. A local media outlet reported Saharan dust and hazy conditions over the region (See Appendix C, Figure C-5 through Figure C-7 for Group 7). The National Seashore monitor was impacted on June 11th and June 12th; all three monitors were impacted on June 13th, and June 16th; the Karnack and National Seashore monitors were impacted on June 14th and June 15th; and Austin Webberville and National Seashore were impacted on June 17th. The wind also traveled from the Gulf to the Corpus Christi area. Moderate Resolution Imaging Spectroradiometer (MODIS) combined Terra and Aqua Multi-Angle Implementation of Atmospheric Correction (MAIAC) Land Aerosol Optical Depth (AOD) images (Figure A-35 and A-36) show a pulse of Saharan dust reached the Americas and Texas area. The concentration increases significantly at these monitoring sites, and there was a rise and fall in the concentrations at all three monitors with the arrival of these pulses. MODIS Combined Aqua and Terra MAIAC AOD images (Figure A-41 through A-45) corroborates the high concentration of dust seen on these areas with flow from Africa.

Figure 2-14: *Hourly $PM_{2.5}$ Concentrations measured at the Karnack, Austin Webberville and National Seashore Monitors on Days around Event (Jun 11, 2022 – Jun 17, 2022)* shows the hourly $PM_{2.5}$ concentrations measured at the monitoring sites between June 9, 2022, and June 20, 2022, with the hours on June 11th and June 12th, highlighted in a red dotted line for the National Seashore monitoring site. Figure 2-11 also shows the hourly $PM_{2.5}$ concentrations measured at the monitoring sites between June 9, 2022, and June 20, 2022, with the hours on June 13th and June 16th, highlighted by the red dotted line for the National Seashore monitoring site, a brown dotted line for the Austin Webberville monitoring site, and a dark orange dotted line for the Karnack monitoring site. As seen in the figure, hourly concentrations increased substantially on event days as the pulse of dust reached the monitors.

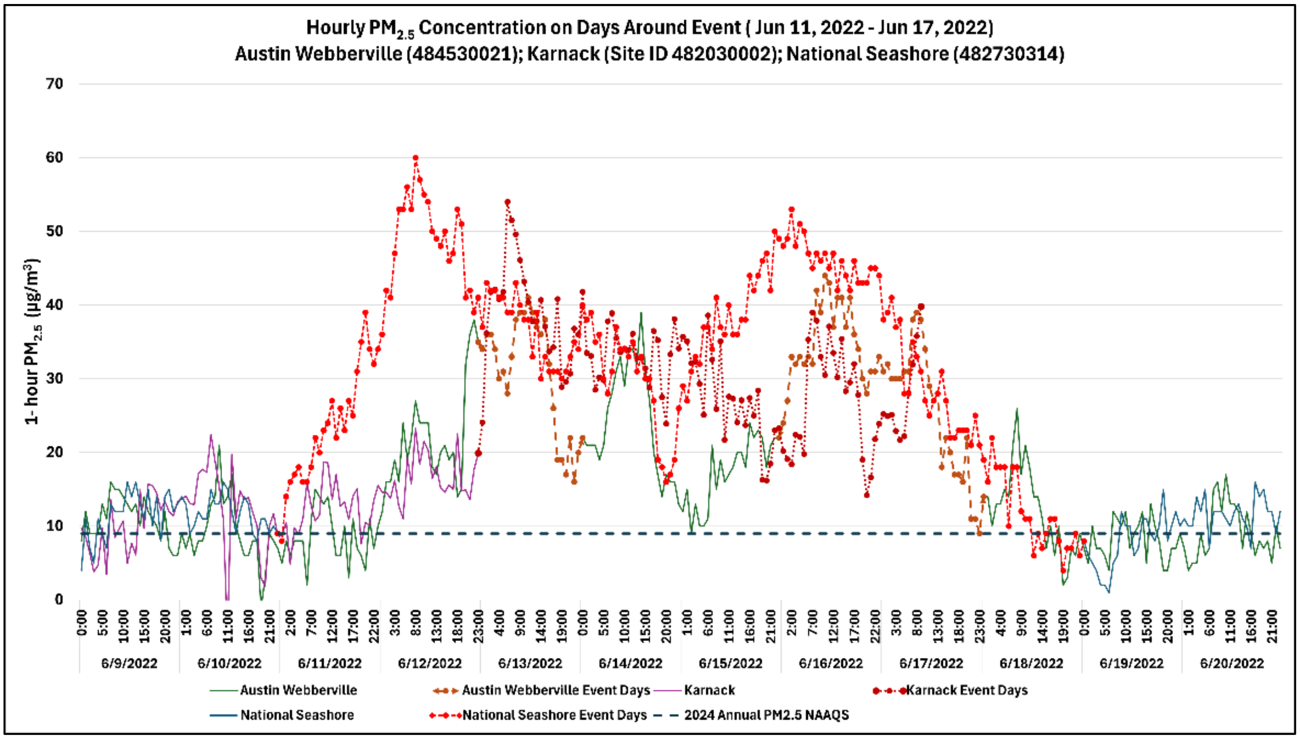


Figure 2-14: Hourly $PM_{2.5}$ Concentrations measured at the Karnack, Austin Webberville and National Seashore Monitors on Days around Event (Jun 11, 2022 – Jun 17, 2022)

The surface chart and 500 mb chart (Figure A-37 through A-40) shows coastal winds from the south at 10 kts, which led to the transport of smoke in the lower atmosphere from Mexico and Central America. On June 11th, the longwave pattern over the continental U.S. was meridional with ridging over the four corner states and East Texas. The continental-tropical airmass over the southwest (high-height center) provided relative atmospheric stability over Texas through its subsidence (downward movement of air). It also brought dry air to the region, which is more conducive to the formation of fires. As the high progressed over Texas on June 12th, stability along with dry air from the continental tropical airmass led to a lack of precipitation that could have reduced any particulate matter in the atmosphere. Winds remained southerly at the surface, allowing the continued transport of smoke to Texas from fires in Central America.

The surface chart, 500 mb chart, and soundings from Corpus Christi and Shreveport (Figure A-46 through A-55) show that on June 13th, a meridional pattern was present over the continental U.S. with ridging over Texas and the southeast region. Winds at this level were from the southeast over the coast of Texas, which aided the transport of Saharan dust in the upper atmosphere coming from the subtropical jet. Both observed rawinsondes (soundings) from Corpus Christi and Shreveport (Figure A-57 through A-62) showed backing winds throughout the atmospheric column. Backing winds, which shift counterclockwise with height, are associated with dynamic sinking. This effect likely aided vertical mixing, bringing the upper-level Saharan dust particles towards the surface.

On June 14th, the ridging at 500 mb had progressed over the Eastern U.S. with continued southeasterly winds over East Texas. This flow continued to aid the transport of upper-level Saharan dust from the tropical jet to Texas. Winds at the surface over East Texas were southerly from 15-20 kts, indicating that gradient-level winds were mixing down to the ground level. The sounding from Corpus Christi showed backing winds, which are associated with downward mixing. The subsidence inversion present on both soundings also indicates sinking air, which likely aided the transport of Saharan dust to the surface.

On June 15th, the ridging over the eastern U.S. strengthened and began to resemble a blocking pattern in the form of a sharp amplitude ridge. The high-height center at 500 mb stacks down to the surface high pressure center over Mississippi, which provided relative high pressure and atmospheric stability to Texas. This stability led to a lack of any significant precipitation over Texas that might have reduced Saharan dust in the lower atmosphere. Backing winds are seen in the lower atmosphere from the Corpus Christi sounding, which continued downward mixing.

On June 16th, the ridging and semi-blocking pattern progressed slightly downstream over the eastern U.S. Similar to June 15th, high heights stack down to the surface over Mississippi providing relative high pressure to Texas. The vertical profile from rawinsonde data at Shreveport shows backing winds in the lower portion of the atmosphere which are associated with downward mixing. The presence of a deep surface-based layer of static stability also indicates subsidence. These factors likely aided the transportation of Saharan dust in the upper atmosphere to the surface.

On June 17th, the former ridge progressed downstream away from the continental U.S., while a second ridge strengthened over Texas, creating a large area of high heights at 500 mb. This stacks down to high-pressure over Texas at the surface, which is associated with atmospheric stability and a lack of rain. The Saharan dust that had been present for the prior 5 days over Texas was still likely being pushed downward by the backing winds throughout the vertical column.

2.5.8 Group 8– Summary of July 16, July 17, and July 18, 2022, Saharan Dust $PM_{2.5}$ Event for the National Seashore Monitor, Karnack Monitor, and Webberville Monitor

Saharan dust impacted National Seashore monitoring site on July 16, 2022; all three monitoring sites on July 17, 2022; and Karnack monitoring site on July 18, 2022. NWS forecast (Figure B-16 and Figure B-17) mentions Saharan dust is expected in the region and expected to contribute to hazy conditions. A local news station also reported Saharan dust impacting the area (See Appendix C, Figure C-8 for Group 8). MODIS Combined Aqua and Terra MAIAC AOD images (Figure A-63 through A-65) corroborate the high concentration of dust seen in these areas with flow from Africa.

The surface chart and 500 mb chart, and soundings from Corpus Christi and Shreveport (Figures A-66 through A-75**)** show that on July 16th, a longwave ridge was in place over central CONUS. There is a large high center over the four corner states and North Texas at this level. There is evidence of a shortwave trough moving just downstream of the ridge peak. This trough stacks down to the low-pressure center over West Kansas. However, this weak, low-pressure center is too far upstream of the National Seashore sensor to have a significant effect in that area. The dominant feature over the South Texas Coast is high pressure and subsidence. This led to a lack of precipitation that day that might have reduced atmospheric PM. Additionally, light variable winds are seen along the coast of Texas. The rawinsonde sounding at 12Z (6:00 a.m. CDT) showed veering winds in the lower atmosphere from the surface up to 750 mb, then backing winds from 750 mb up to the tropopause. There was a radiation inversion at 12Z (6:00 a.m. CDT) which is typical during morning hours. This inversion, or cap, likely broke around 7:00 a.m. CST or 8:00 a.m. CST as the surface temperature reached 28°C, allowing for winds to mix down and bring Saharan dust to the surface.

The longwave pattern over the U.S. on July 17th was similar to the previous day, and the major short-wave trough had progressed downstream by roughly 1-2 degrees. Ridging, high pressure, and subsidence were the major features over Texas. The surface chart shows light variable winds over Texas. Both soundings from Corpus Christi and Shreveport show radiation inversions and backing winds in the lower atmosphere. These inversions likely broke when daytime heating occurred, and Saharan dust from the upper atmosphere was able to be mixed down to the surface. Backing winds and subsidence from the high pressure and ridging contributed to this downward mixing.

On July 18th, the 500 mb chart shows that the longwave ridge and high height center remained in place over the central U.S. The previously mentioned major short-wave trough had progressed downstream roughly 1-2 degrees from July 17th. This trough stacks down to a low-pressure center, seen on the surface chart over Oklahoma and North Texas. The rawinsonde sounding from Shreveport shows a subsidence inversion at roughly 950 mb, indicating sinking air. This likely aided the movement of Saharan dust in the upper atmosphere towards the surface.

Figure 2-15: *Hourly $PM_{2.5}$ Concentrations at the Karnack, Austin Webberville, and National Seashore Monitors on Days around Event (Jul 16, 2022 – Jul 21, 2022)* shows that hourly $PM_{2.5}$ concentrations increased substantially on event days as the pulse of dust and smoke from the fire reached the monitors. As seen in the figure, the hours on July 16 and 17, 2022, are highlighted in the red dotted line for the National Seashore monitoring site; hours on July 17th are highlighted in the brown dotted line for the Austin Webberville monitoring site; and hours for July 17th, and July 18th are highlighted in the dark orange dotted line for the Karnack monitoring site.

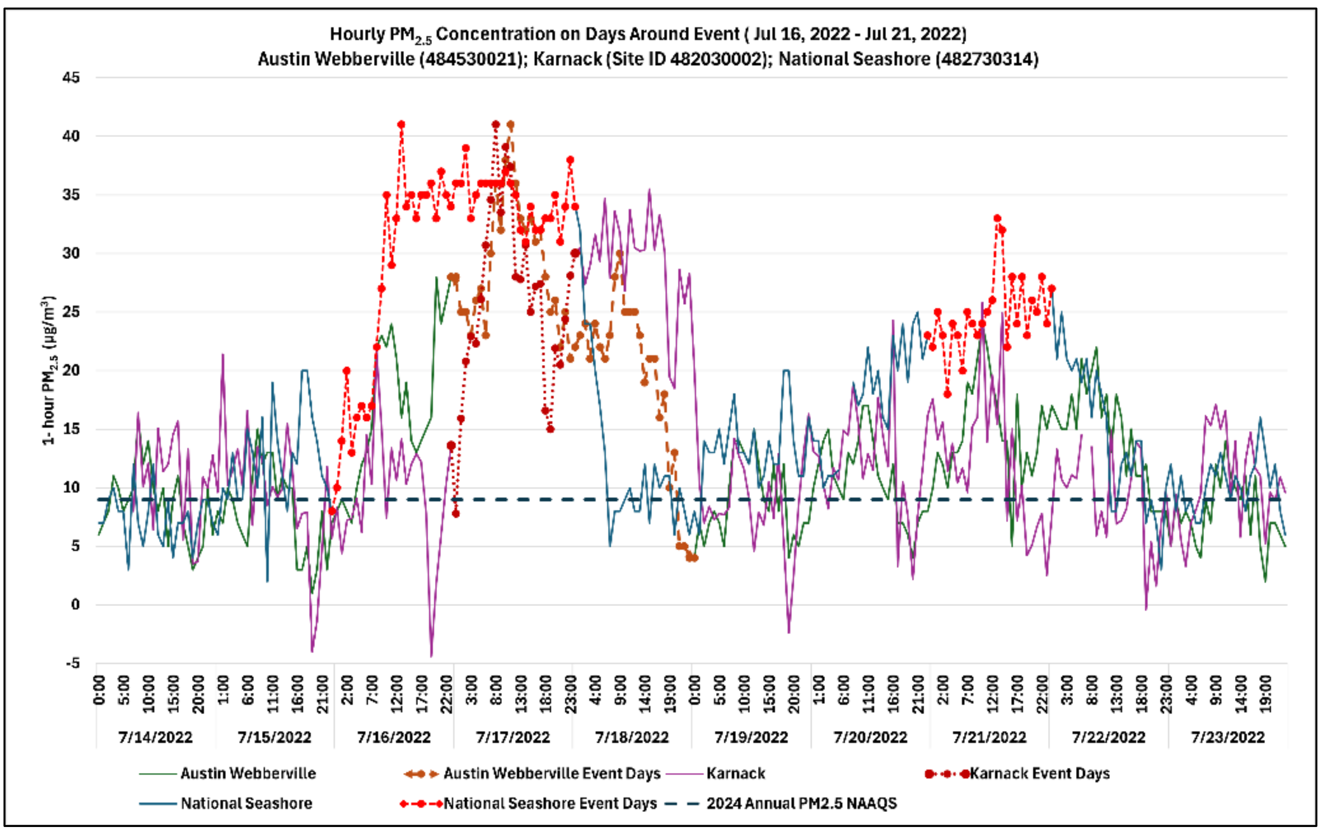


Figure 2-15: Hourly $PM_{2.5}$ Concentrations at the Karnack, Austin Webberville, and National Seashore Monitors on Days around Event (Jul 16, 2022 – Jul 21, 2022)

2.5.9 Group 9– Summary of July 21, 2022, Saharan Dust $PM_{2.5}$ Event for the National Seashore Monitor

The National Seashore monitoring site was impacted by Saharan dust on July 21, 2022. MODIS Combined Aqua and Terra MAIAC AOD images (Figure A-76) corroborates the high concentration of dust seen in these areas with flow from Africa. As seen in Figure 2-12, hourly concentrations indicated by the red dotted line for the National Seashore monitoring site increased substantially on July 21st as the pulse of dust reached the monitor.

The surface chart, 500 mb chart, and sounding (Figure A-77 through A-79) indicate that by July 21st, high center and longwave ridging at 500 mb remained over the central U.S., bringing subsidence over Texas. This subsidence can also be seen on the rawinsonde sounding from Corpus Christi in the form of a subsidence inversion at about 900 mb, with a very dry column of air above. This subsidence, along with backing winds in the vertical profile, indicate downward movement of air. This likely aided the transport of Saharan dust in the upper atmosphere toward the surface and the National Seashore monitor.

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); including support from 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.*[12] 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. 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, 2022 event days, and Tier 1 and Tier 2 thresholds* for *the Karnack Monitor*, Figure 3-2: *24-Hour $PM_{2.5}$ concentrations, 2022 event days and Tier 1 and Tier 2 thresholds for the Austin Webberville Monitor*, and Figure *3-3: 24-Hour $PM_{2.5}$ concentrations, event days and Tier 1 and Tier 2 thresholds for the National Seashore Monitor*, show 24-hour $PM_{2.5}$ concentrations on 2022 event days compared to non-event days relative to the Tier levels for each monitor.

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

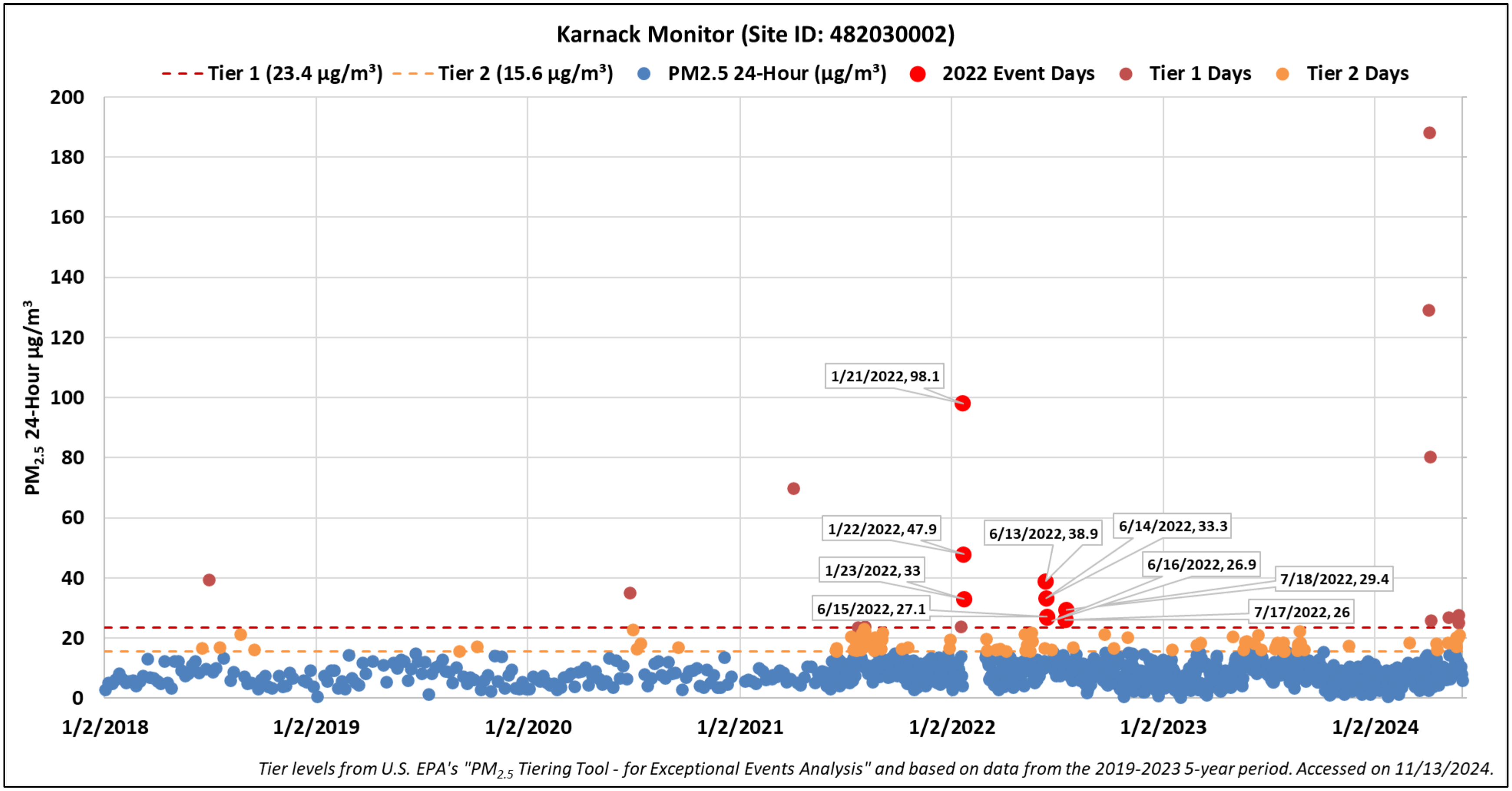


Figure 3-1: 24-Hour $PM_{2.5}$ concentrations, 2022 event days, and Tier 1 and Tier 2 thresholds for the Karnack Monitor

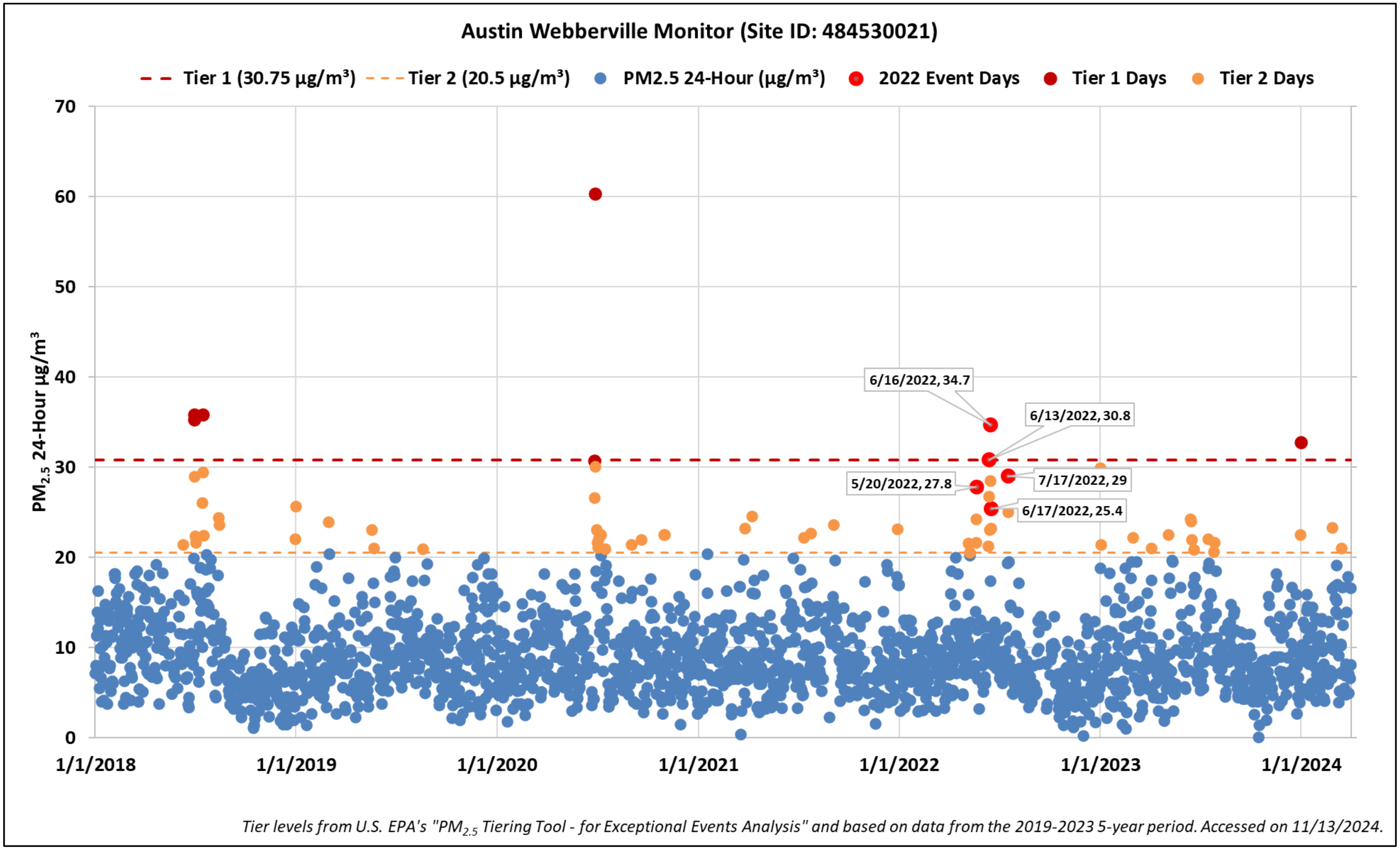
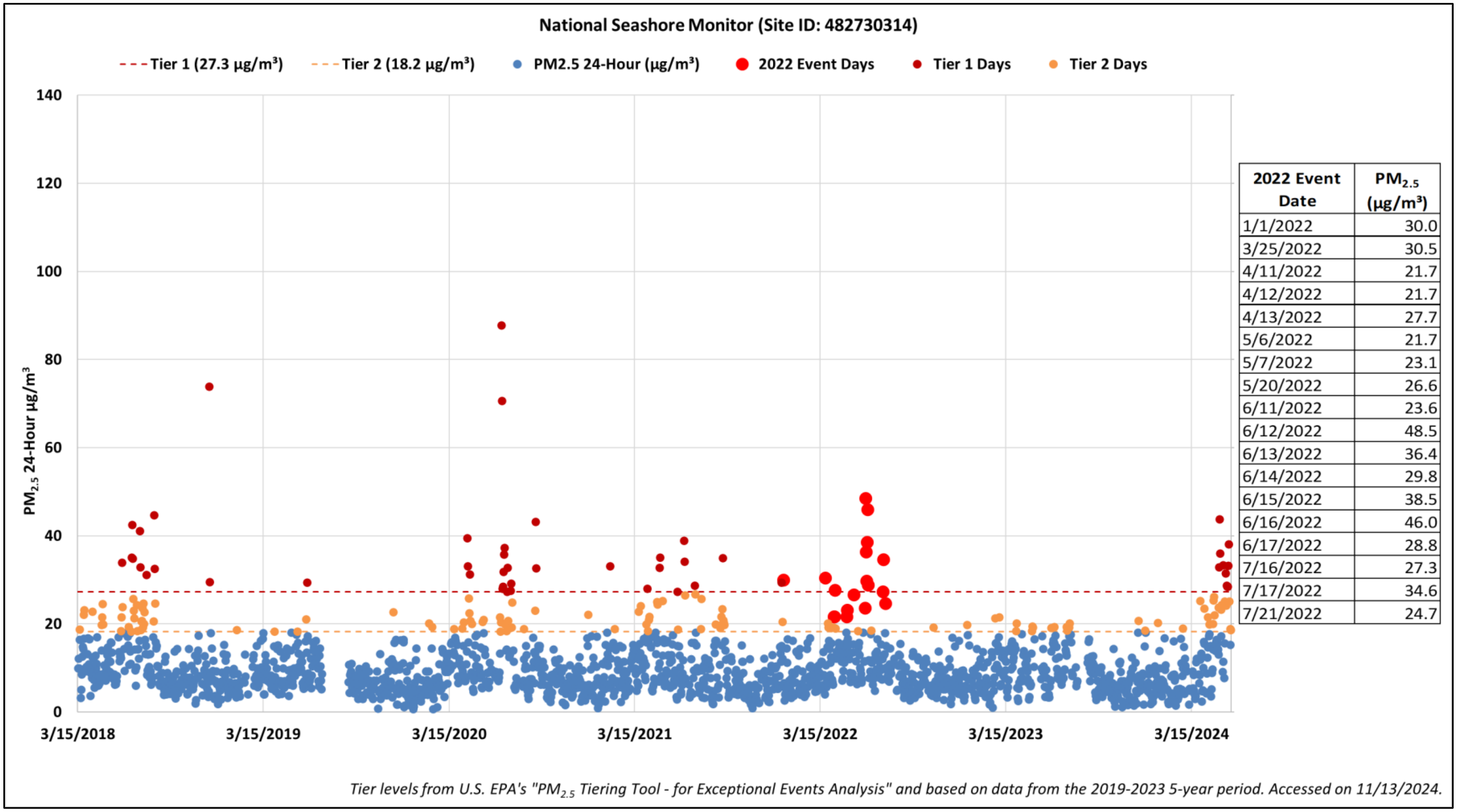


Figure 3-2: 24-Hour $PM_{2.5}$ concentrations, 2022 event days and Tier 1 and Tier 2 thresholds for the Austin Webberville Monitor



2022 Event Date	$PM_{2.5}$ (µg/m³)
1/1/2022	30.0
3/25/2022	30.5
4/11/2022	21.7
4/12/2022	21.7
4/13/2022	27.7
5/6/2022	21.7
5/7/2022	23.1
5/20/2022	26.6
6/11/2022	23.6
6/12/2022	48.5
6/13/2022	36.4
6/14/2022	29.8
6/15/2022	38.5
6/16/2022	46.0
6/17/2022	28.8
7/16/2022	27.3
7/17/2022	34.6
7/21/2022	24.7

Figure 3-3: 24-Hour $PM_{2.5}$ concentrations, 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 day. 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, and 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) run by the National Weather's Service 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 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/.
- Speciation data, when available, from TAMIS.
- 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 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 in the figure captions.

3.2.1 Group 1: Evidence for January 1, 2022, High Wind $PM_{2.5}$ Event for the National Seashore Monitor

January 1, 2022, was impacted by a High Wind event and was identified as a Tier 1 day based on the tiering threshold criteria, as shown in Figure 3-3. As described in the narrative conceptual model, a maximum wind speed of 26.6 mph and a maximum wind gust of 46.1 mph were recorded in the area. The wind was from the direction of the south, and higher wind speed persisted prior to the rise in $PM_{2.5}$ concentrations. This indicates transport from a source outside of the area, as shown in Figure 2-2 of the narrative conceptual model. Back trajectories in Figure 3-4: *HYSPLIT back trajectories from the National Seashore monitoring site on January 1, 2022,* show the transfer of particles from outside, and the yellow dot denotes moderate air quality on this day. Figure 3-5: *Hourly $PM_{2.5}$ concentrations on January 1, 2022, compared to typical concentrations at the National Seashore Monitor* shows higher hourly $PM_{2.5}$ concentrations compared to a typical day on January 1, 2022, suggesting high wind impacted the National Seashore monitor. The National Weather Service (NWS) forecast summary and TCEQ forecasts revealed that high winds were predicted to affect the area, potentially pushing suspended dust and other particulates to the monitor.

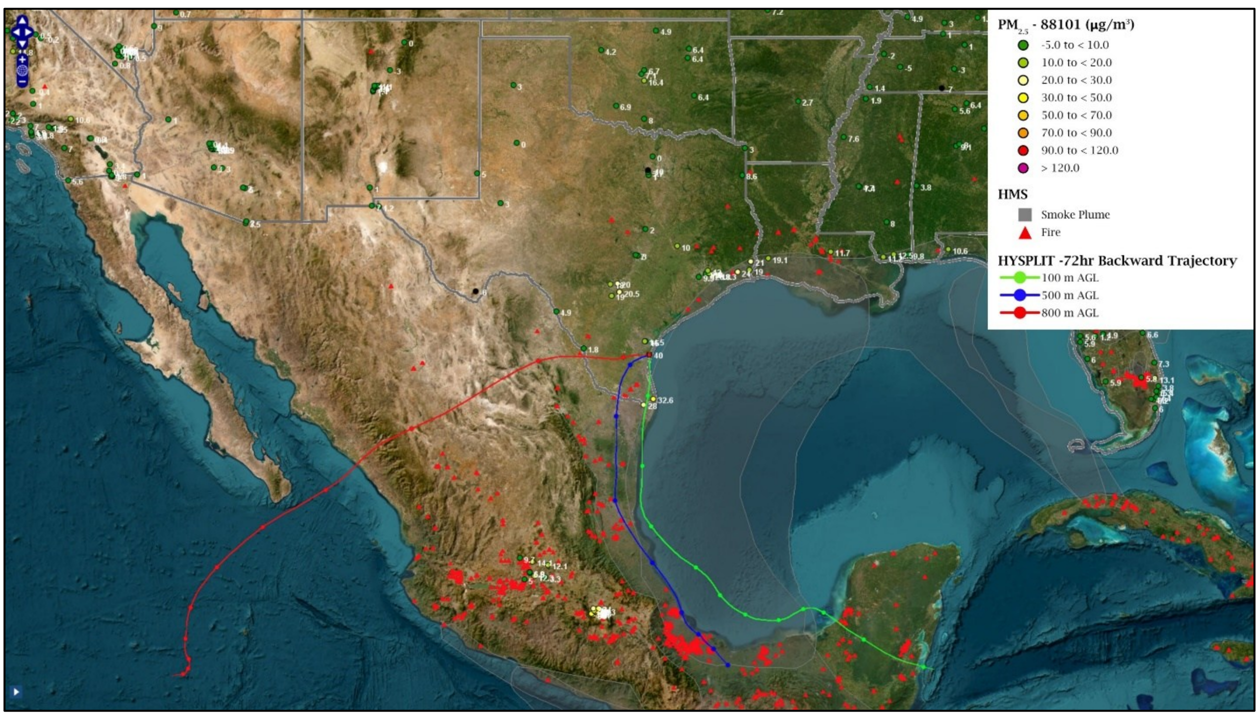


Figure 3-4: HYSPLIT back trajectories from the National Seashore monitoring site on January 1, 2022

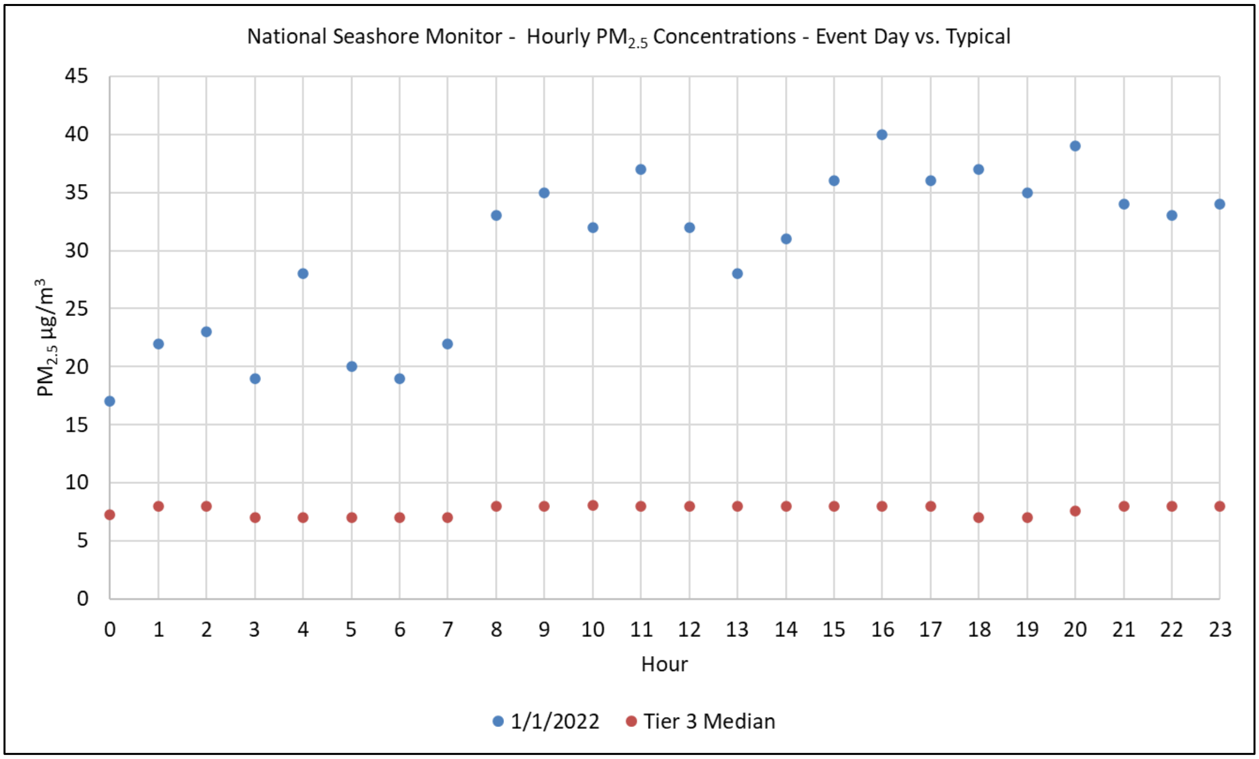


Figure 3-5: Hourly $PM_{2.5}$ concentrations on January 1, 2022, compared to typical concentrations at the National Seashore Monitor

3.2.2 Group 2: Evidence for January 21, January 22, and January 23, 2022, Prescribed Fire $PM_{2.5}$ Event for the Karnack Monitor

All three event days are of the Tier 1 category, and the evidence provided meets the requirement for Tier 1 demonstration. Prescribed fire smoke from the nearby Caddo Lake Wildlife Reserve impacted the Karnack monitor on January 21, 2022. Figure 3-6: *AirNow Navigator with HMS Smoke Plume for January 21, 2022,* shows the AirNow Navigator Data Fusion Tool with the HMS smoke from satellite and the $PM_{2.5}$ 24-hour average for January 21, 2022. With the red dot denoting concentrations in the unhealthy category and the visible smoke plume over the monitor, the evidence clearly indicates smoke was transported to the monitor on January 21, 2022. Additionally, higher smoke concentrations can be seen along the Caddo Lake Wildlife Reserve and monitoring site on the NAPPS model plot (Appendix D, Figure D-1). Figure 3-7: *HYSPLIT back trajectories from the Karnack monitoring site on January 21, 2022,* shows a series of HYSPLIT back-trajectories that were started at the Karnack monitoring site at heights of 100 meters (m), 500 m, and 800 m AGL. All these back trajectories pass over the area of the prescribed fire. Similarly, Figure 3-8: *Hourly $PM_{2.5}$ concentrations on January 21, 2022, compared to typical concentrations at the Karnack Monitor* shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median).

Similarly, prescribed fire smoke from the Caddo Lake Wildlife Reserve impacted the Karnack monitor on January 22, 2022. Figure 3-9: *AirNow Navigator with HMS Smoke Plume for January 22, 2022,* shows a visible smoke plume over the orange dot, denoting concentrations in the moderate category at the monitor, which indicates smoke was transported to the monitor. Hot spots of high smoke surface concentrations can be seen along the monitoring site and Caddo Lake Wildlife Reserve on the NAPPS model plot (Figure D-2 and D-3) for January 22, and January 23, 2022. HYSPLIT back-trajectories (Figure 3-10: *HYSPLIT back trajectories from the Karnack monitoring site on January 22, 2022*) and changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Figure 3-11: *Hourly $PM_{2.5}$ concentrations on*

January 22, 2022, compared to typical concentrations at the Karnack Monitor) clearly shows the smoke was transported to the Karnack monitor on January 22, 2023. Additionally, Figure 3-12: *AirNow Navigator with HMS Smoke Plume for January 23, 2022*, showing a visible smoke plume over the monitor with concentrations in moderate category, HYSPLIT back-trajectories (Figure 3-13: *HYSPLIT back trajectories from the Karnack monitoring site on January 23, 2022*), and event vs non-event data comparison (Figure 3-14: *Hourly $PM_{2.5}$ concentrations on January 23, 2022, compared to typical concentrations at the Karnack Monitor*) clearly shows the smoke was transported to the Karnack monitor on January 23, 2023, from the prescribed fire.

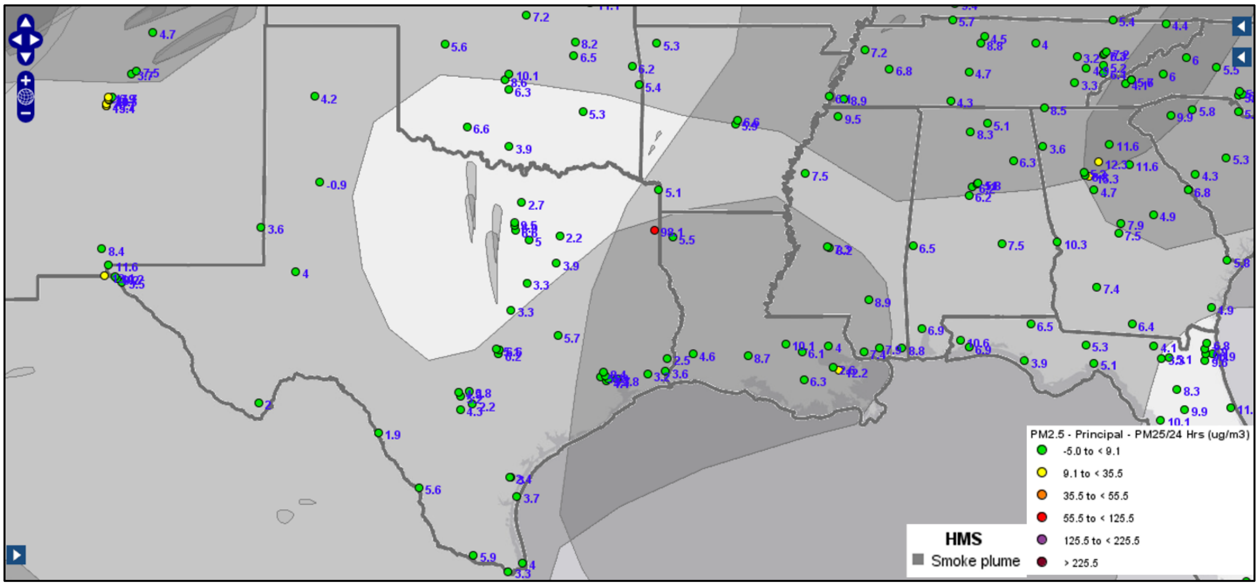


Figure 3-6: AirNow Navigator with HMS Smoke Plume for January 21, 2022

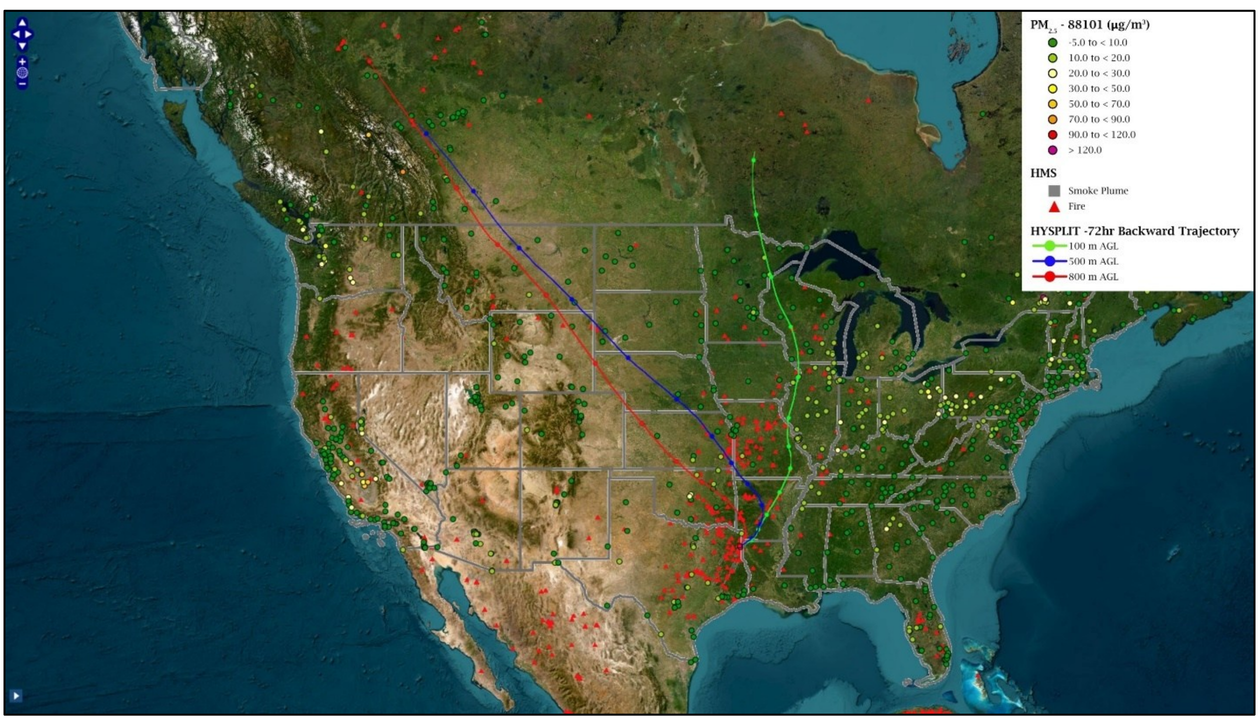


Figure 3-7: HYSPLIT back trajectories from the Karnack monitoring site on January 21, 2022

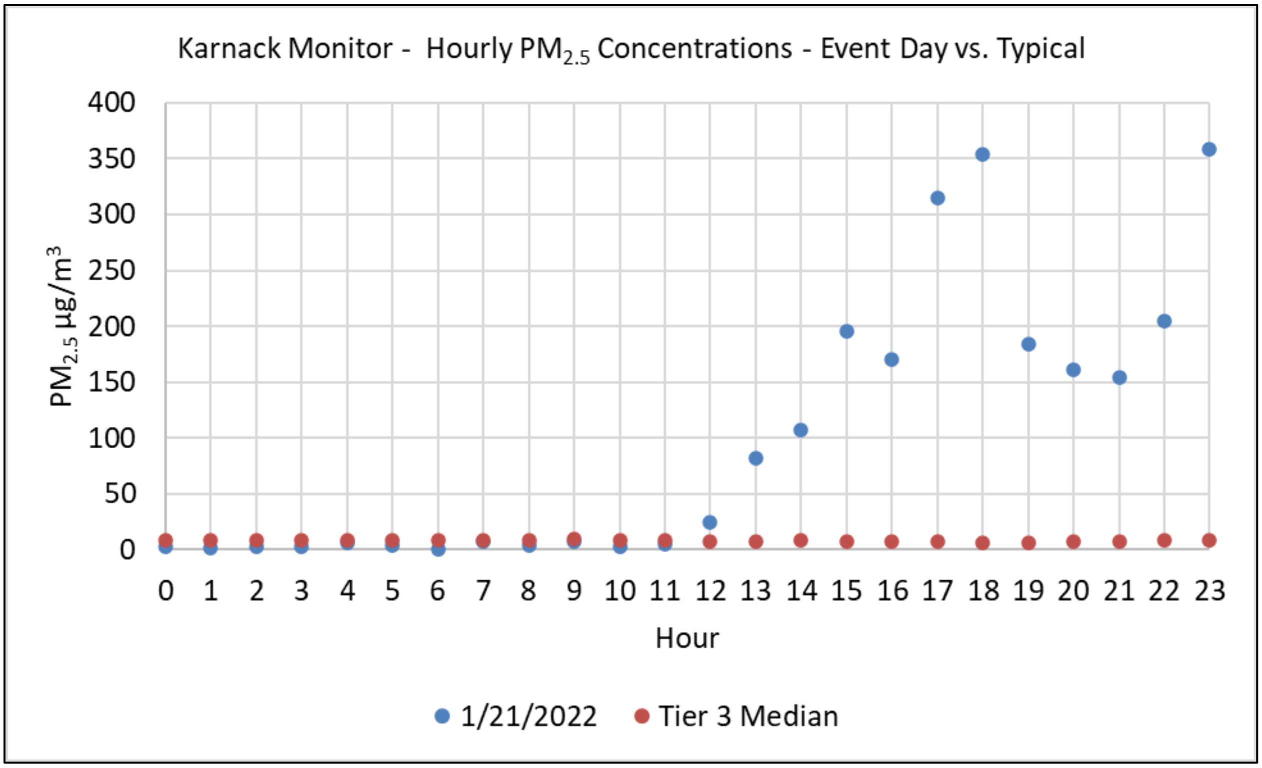


Figure 3-8: Hourly $PM_{2.5}$ concentrations on January 21, 2022, compared to typical concentrations at the Karnack Monitor

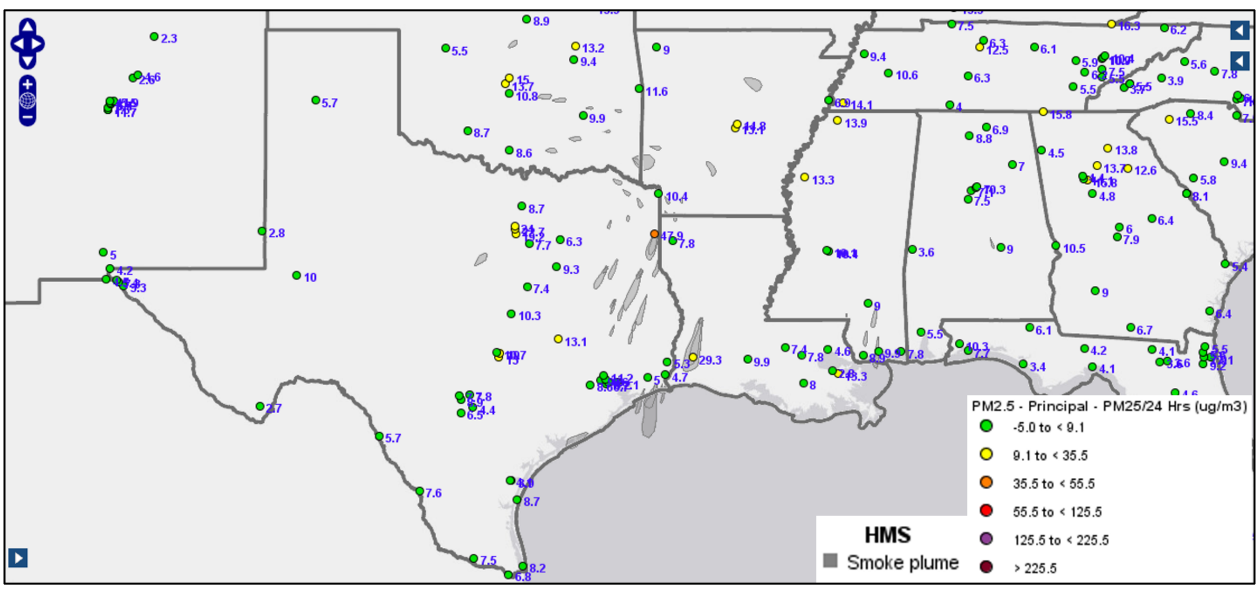


Figure 3-9: AirNow Navigator with HMS Smoke Plume for January 22, 2022

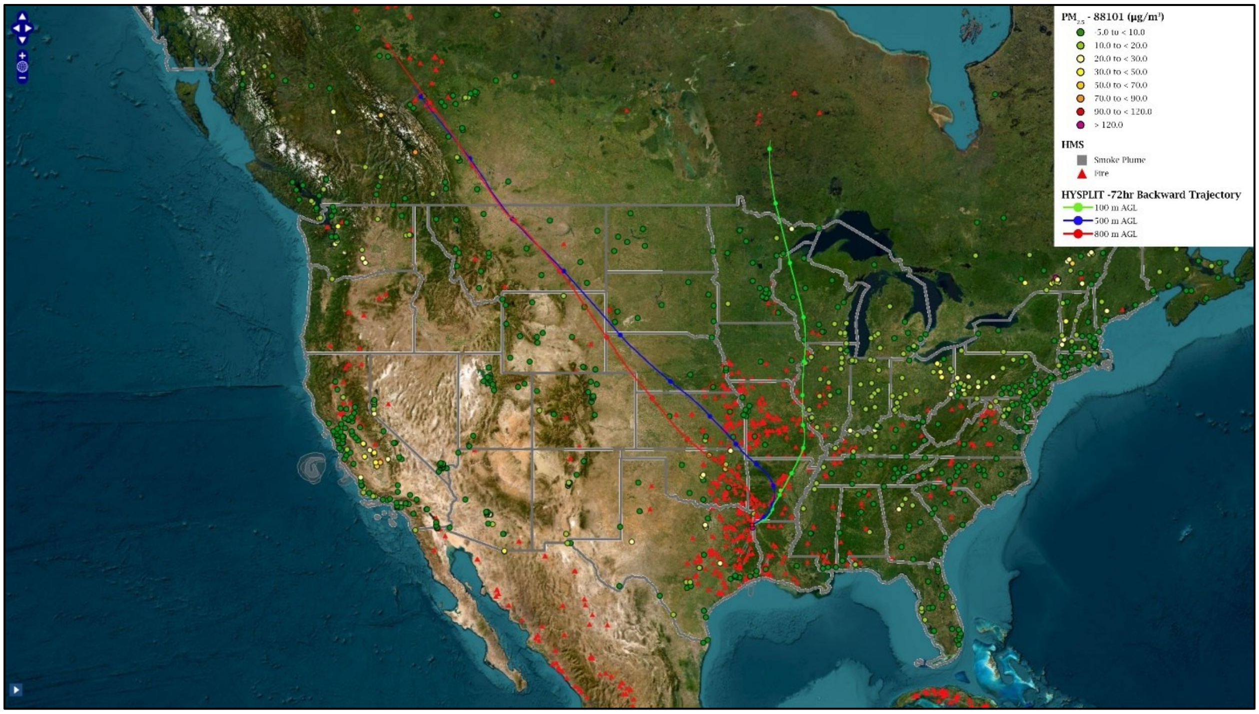


Figure 3-10: HYSPLIT back trajectories from the Karnack monitoring site on January 22, 2022

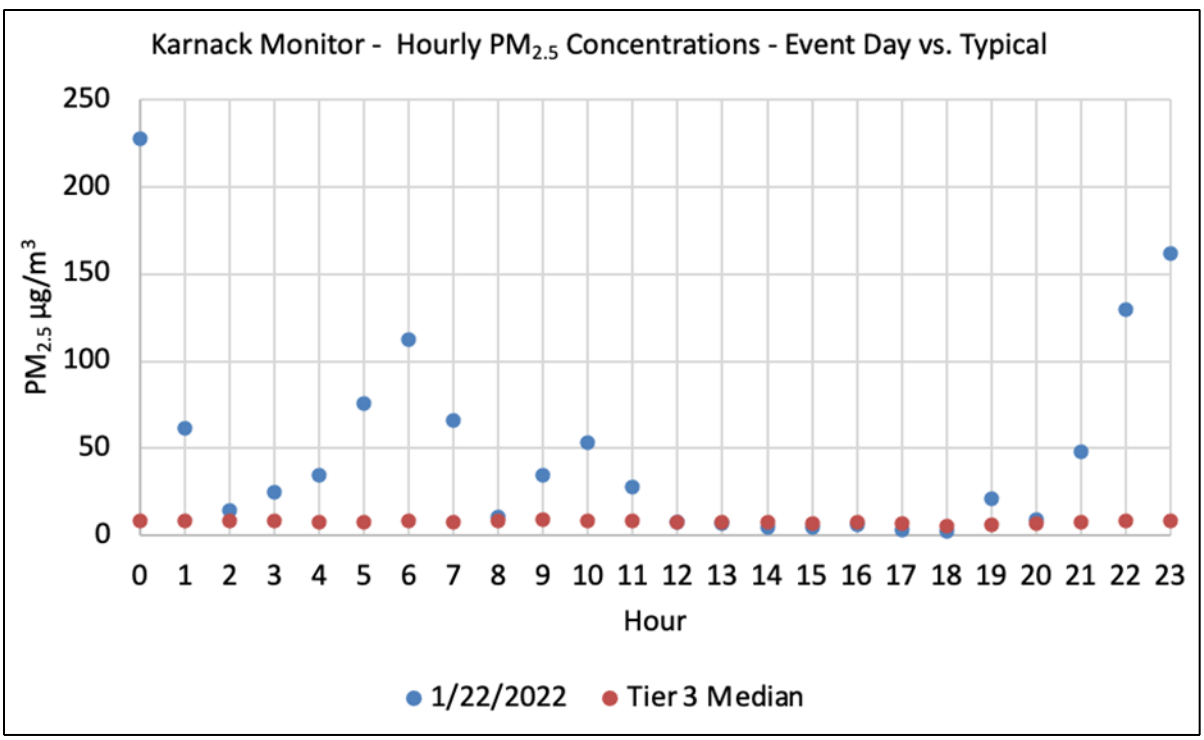


Figure 3-11: Hourly $PM_{2.5}$ concentrations on January 22, 2022, compared to typical concentrations at the Karnack Monitor

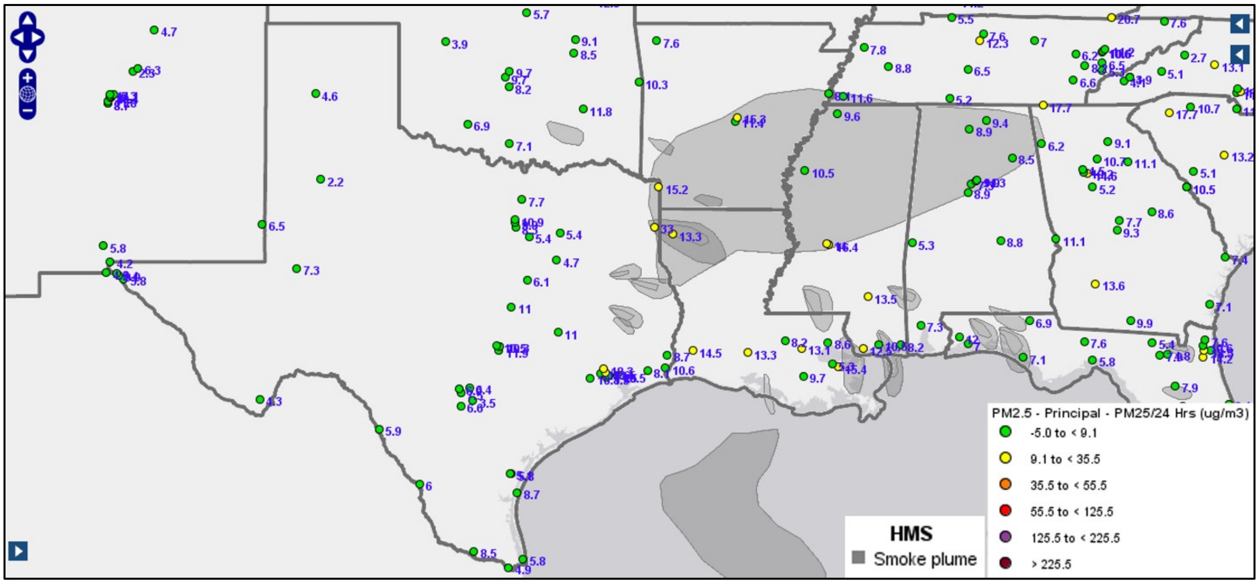


Figure 3-12: AirNow Navigator with HMS Smoke Plume for January 23, 2022

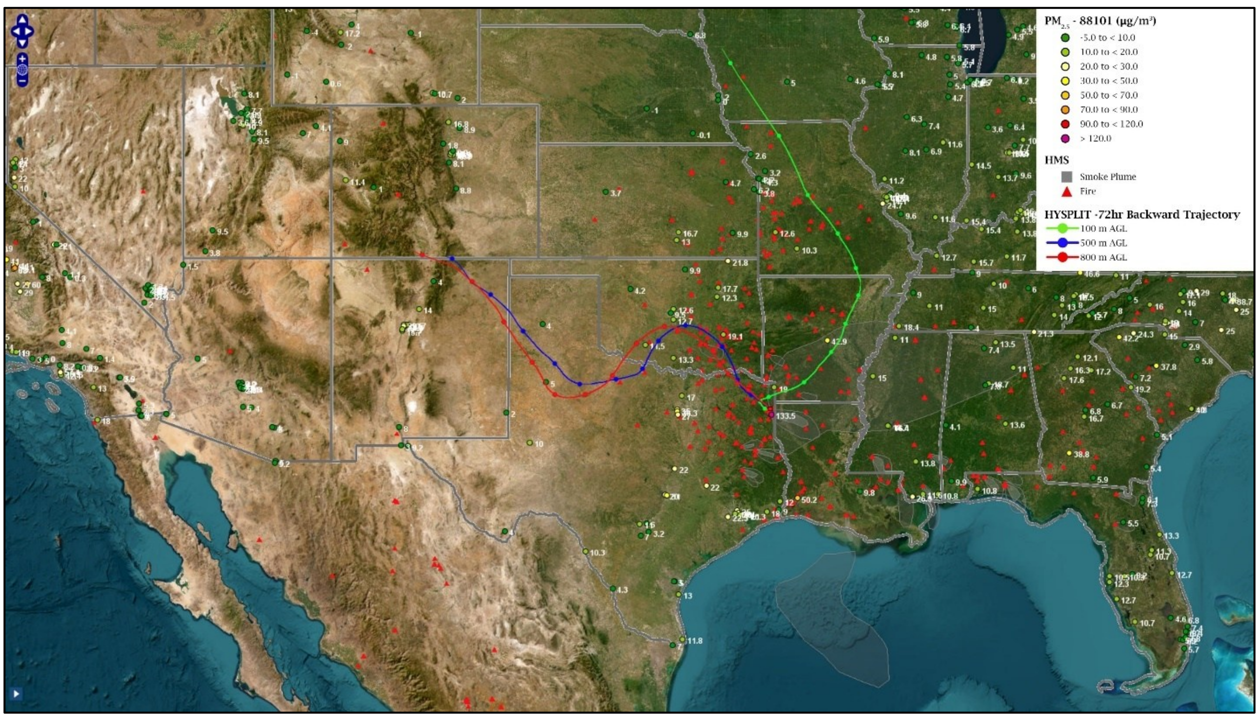


Figure 3-13: HYSPLIT back trajectories from the Karnack monitoring site on January 23, 2022

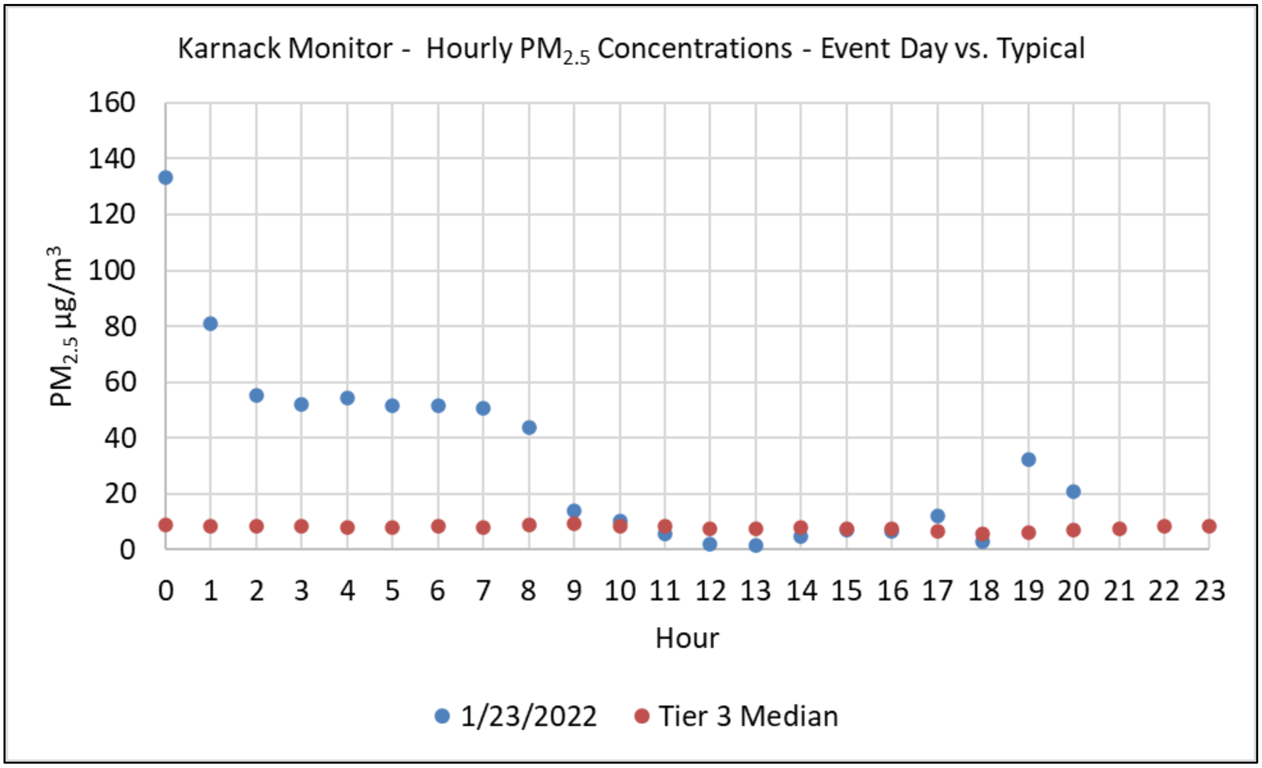


Figure 3-14: Hourly $PM_{2.5}$ concentrations on January 23, 2022, compared to typical concentrations at the Karnack Monitor

3.2.3 Group 3: Evidence for March 25, 2022, Wildfire (U.S.) $PM_{2.5}$ Event for the National Seashore Monitor.

Wildfire-U.S. impacted the National Seashore Monitor on March 25, 2022. This is a Tier 1 day, and the evidence provided meets requirements for a Tier 1 demonstration. Figure 3-15: *AirNow Navigator with HMS Smoke Plume for March 25, 2022,* shows an HMS smoke plume over the National Seashore monitor, with the yellow dot denoting air quality in the moderate category. Additionally, higher smoke surface concentrations can be seen along the Gulf coastline on the NAPPS model plot (Figure D-4). The HYSPLIT back trajectory at 100 m AGL passes through the wildfires, as shown in Figure 3-16: *HYSPLIT back trajectories from the National Seashore monitoring site on March 25, 2022*. Figure 3-17: *Hourly $PM_{2.5}$ concentrations on March 25, 2022, compared to typical concentrations at the National Seashore Monitor* shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median).

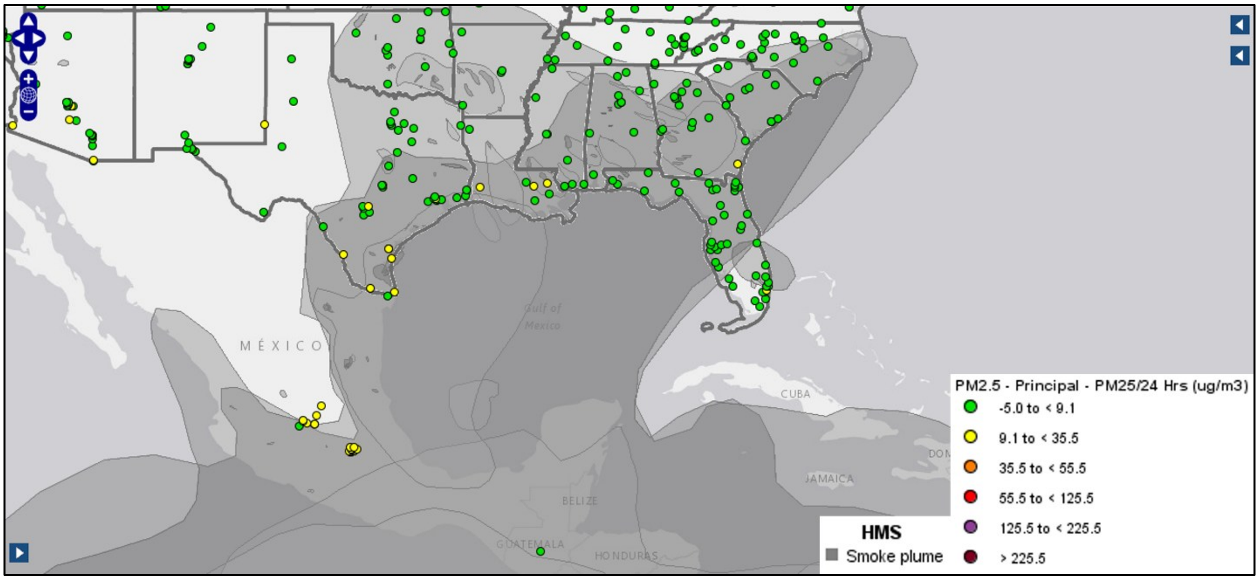


Figure 3-15: AirNow Navigator with HMS Smoke Plume for March 25, 2022

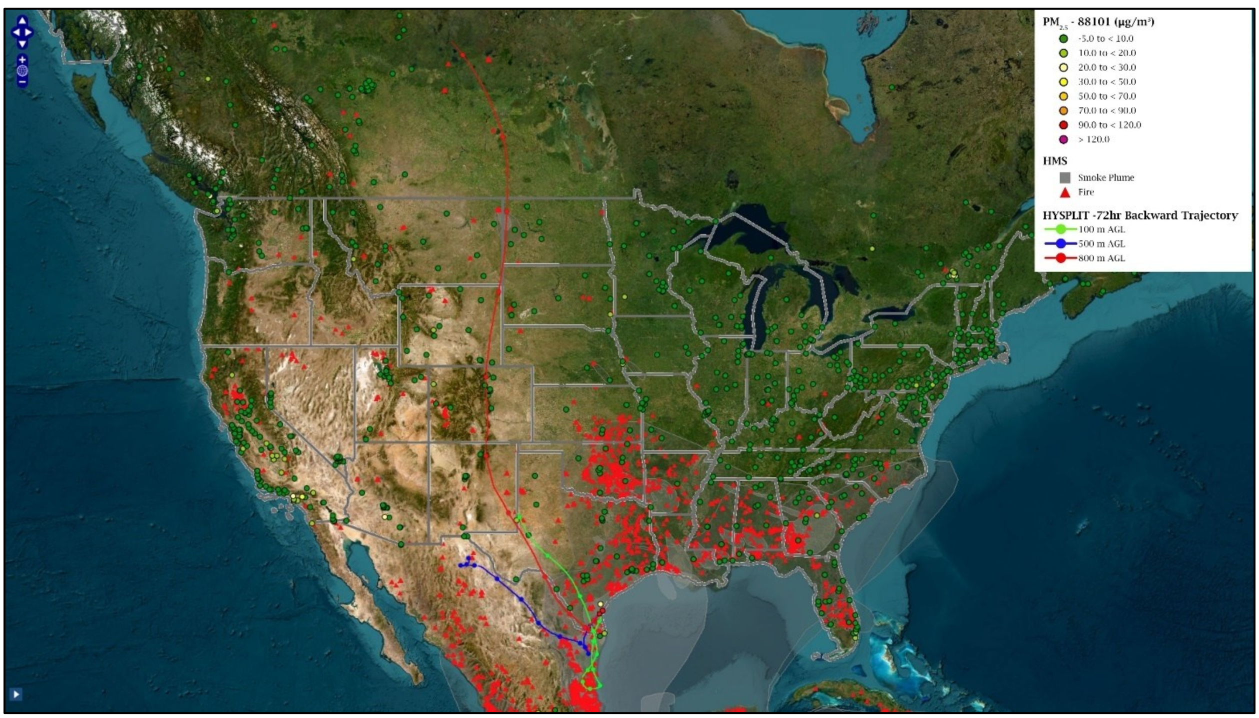


Figure 3-16: HYSPLIT back trajectories from the National Seashore monitoring site on March 25, 2022

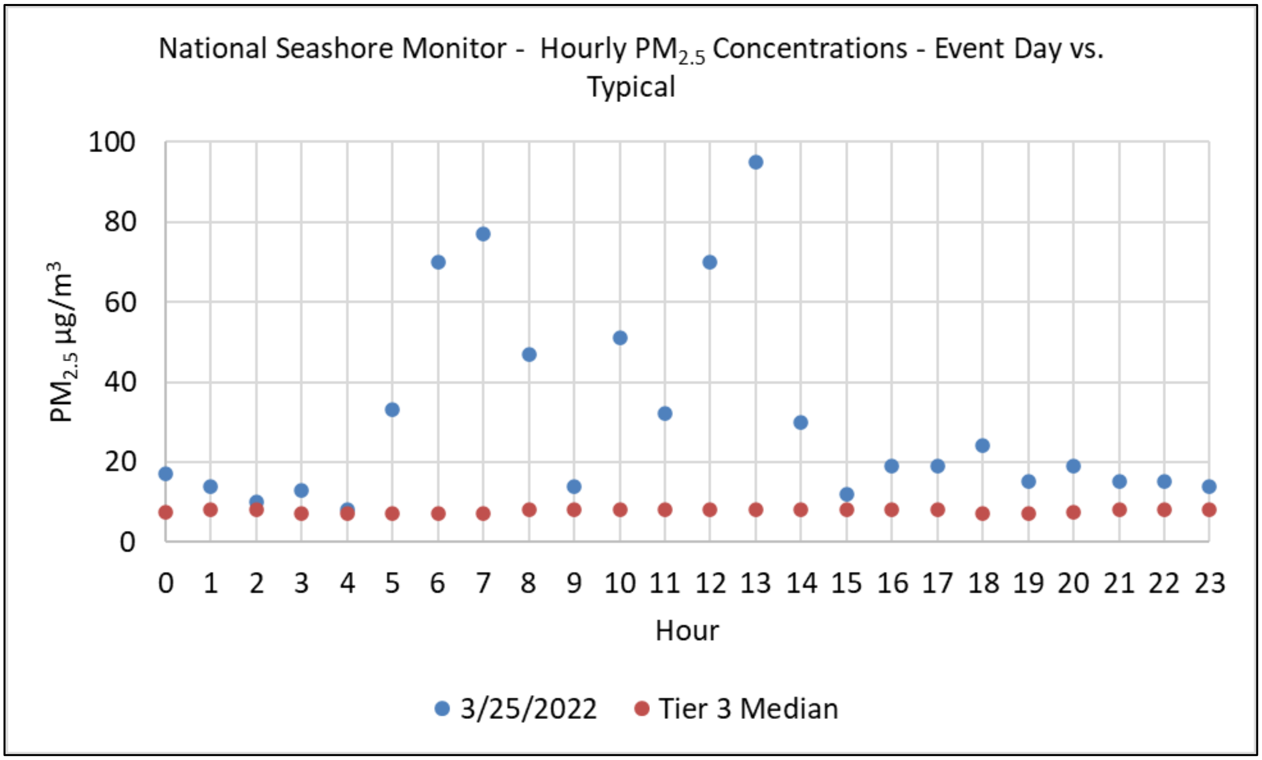


Figure 3-17: Hourly $PM_{2.5}$ concentrations on March 25, 2022, compared to typical concentrations at the National Seashore Monitor

3.2.4 Group 4: Evidence for April 11, April 12, and April 13, 2022, High Wind and Fire (Mexico/Central America) $PM_{2.5}$ Event for the National Seashore Monitor.

High Wind and Fire (Mexico/Central America) impacted the National Seashore monitoring site in April of 2022. April 11th and April 12th were Tier 2 days and April 13th was a Tier 1 day. As discussed in the narrative conceptual model, archives from the NWS forecast revealed gusty winds in the area, which was supported by the wind patterns for these days. Figure 2-6, Figure 2-7, and Figure 2-8 in the narrative conceptual model show a wind pattern indicative of transport of $PM_{2.5}$ from a source outside of the local area, which provides evidence that high wind impacted this monitor.

Additional evidence provided for the fire-related event meets requirements for Tier 1 and Tier 2 demonstrations. Tier 2 demonstrations include HYSPLIT back trajectories to further support that the emissions transported to the monitoring site location.

For the April 11th event, Figure 3-18: *AirNow Navigator with HMS Smoke Plume for April 11, 2022,* shows an HMS smoke plume over the National Seashore monitor, with the yellow dot denoting air quality in the moderate category. Additionally, higher smoke surface concentrations can be seen along the Gulf coastline on the NAPPS model plot (Figure D-5). All the HYSPLIT back trajectories started at the National Seashore monitor and either end or pass through the areas in Mexico with fires, as shown in Figure 3-19: *HYSPLIT back trajectories from the National Seashore monitoring site on April 11, 2022.* HYSPLIT back trajectories starting from each hour from the National Seashore monitor further support transport of smoke from the fires in Mexico, as shown in Figure 3-20: *72-hour HYSPLIT back trajectories starting from each hour on April 11, 2022, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL.* HYSPLIT forward trajectories starting at 72 hours before the event day in Mexico arrives at Texas are shown in Figure 3-21: *HYSPLIT forward trajectories from the areas in Mexico with fires, starting on April 9, 2022.* Figure 3-22: *Hourly $PM_{2.5}$ concentrations on April*

11, 2022, compared to typical concentrations at the National Seashore Monitor shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median).

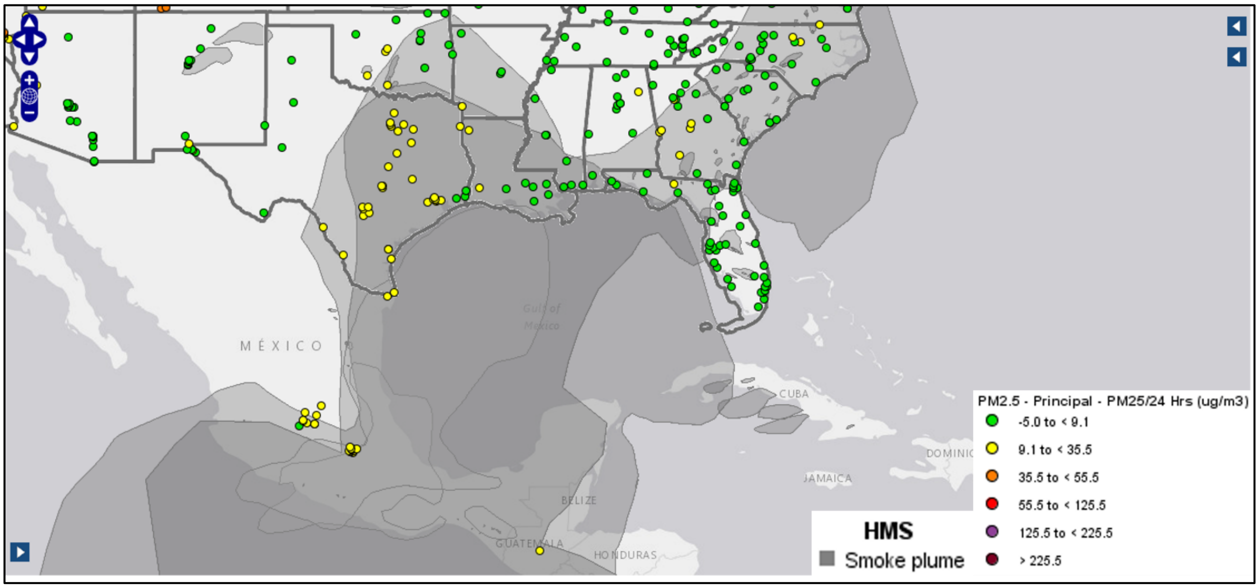


Figure 3-18: AirNow Navigator with HMS Smoke Plume for April 11, 2022

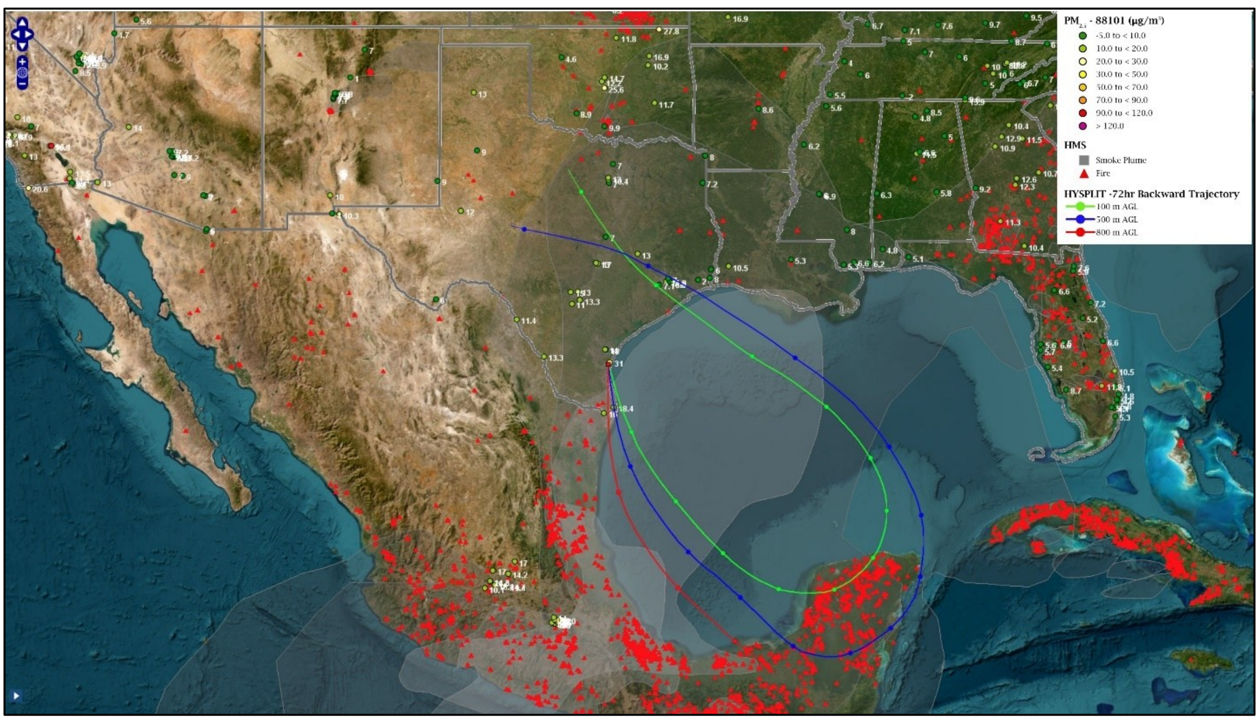


Figure 3-19: HYSPLIT back trajectories from the National Seashore monitoring site on April 11, 2022

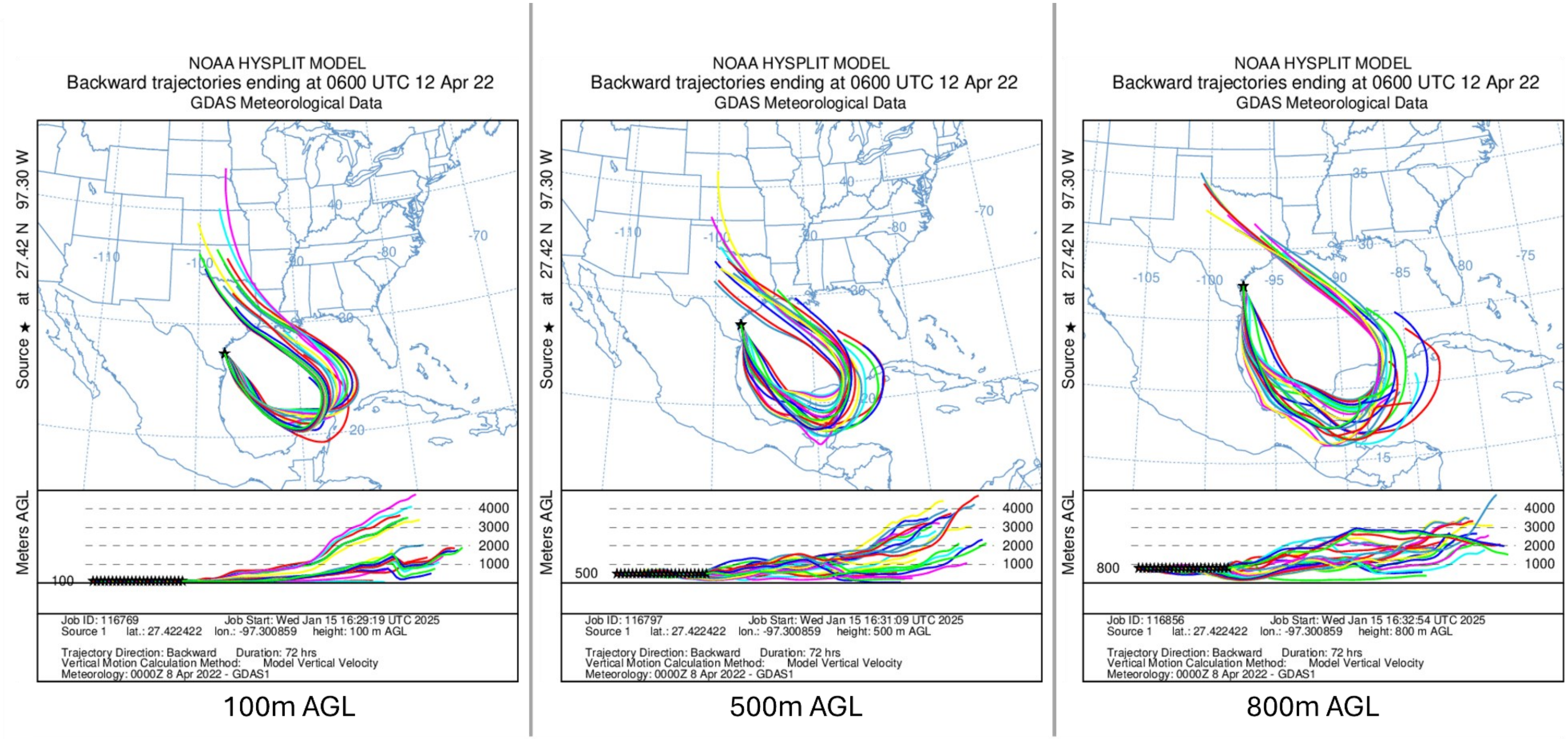


Figure 3-20: 72-hour HYSPLIT back trajectories starting from each hour on April 11, 2022, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL

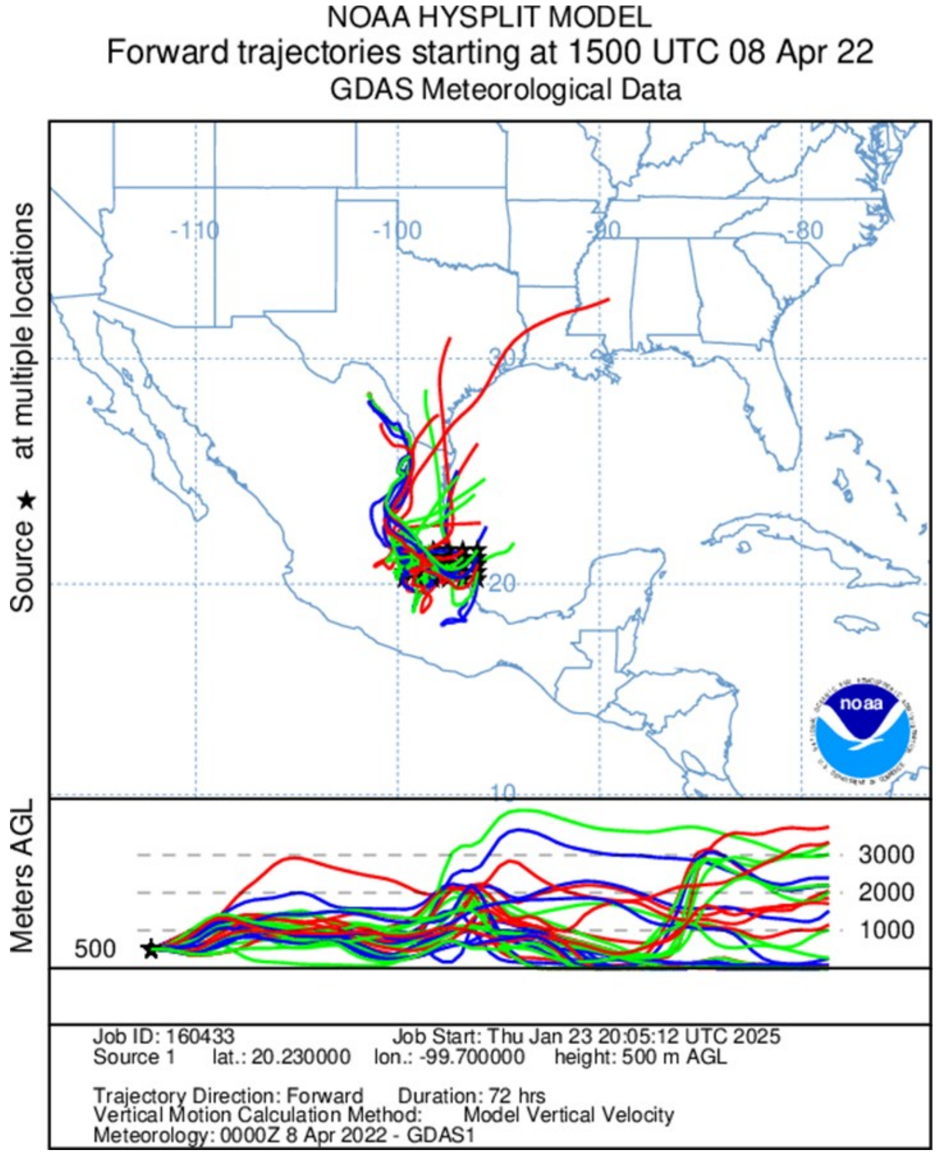


Figure 3-21: HYSPLIT forward trajectories from the areas in Mexico with fires, starting on April 9, 2022

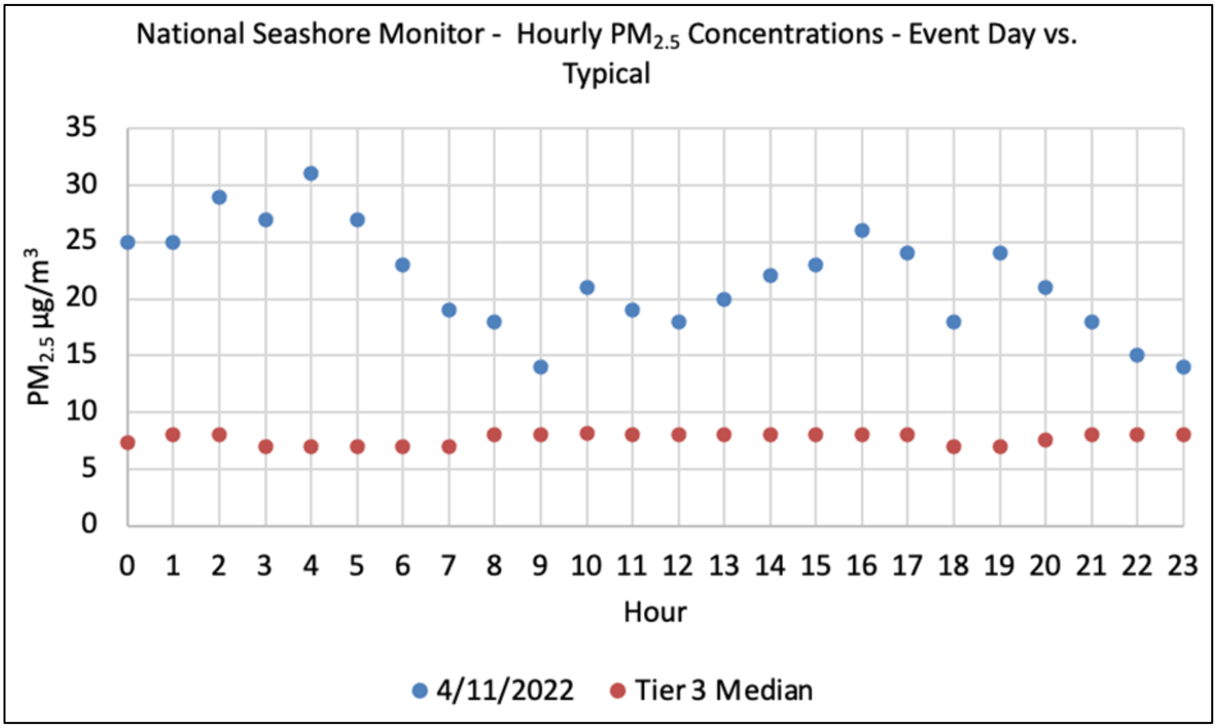


Figure 3-22: Hourly $PM_{2.5}$ concentrations on April 11, 2022, compared to typical concentrations at the National Seashore Monitor

For the April 12th event, Figure 3-23: *AirNow Navigator with HMS Smoke Plume for April 12, 2022,* shows an HMS smoke plume over the National Seashore monitor, with the yellow dot denoting air quality in the moderate category. Additionally, higher smoke surface concentrations can be seen along the Gulf coastline on the NAPPS model plot (Figure D-6). All the HYSPLIT back trajectories started at the National Seashore monitor and either end or pass through the areas in Mexico and Cuba with fires, as shown in Figure 3-24: *HYSPLIT back trajectories from the National Seashore monitoring site on April 12, 2022.* HYSPLIT back trajectories starting from each hour from the National Seashore monitor further support transport of smoke from the fires in Mexico, as shown in Figure 3-25: *72-hour HYSPLIT back trajectories starting from each hour on April 12, 2022, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL.* HYSPLIT forward trajectories starting at 72 hours before the event day in Mexico/Gulf of Mexico arrives at Texas are shown in Figure 3-26: *HYSPLIT forward trajectories from the areas in Mexico with fires, starting on April 9, 2022.* Figure 3-27: *Hourly $PM_{2.5}$ concentrations on April 12, 2022, compared to typical concentrations at the National Seashore Monitor* shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median).

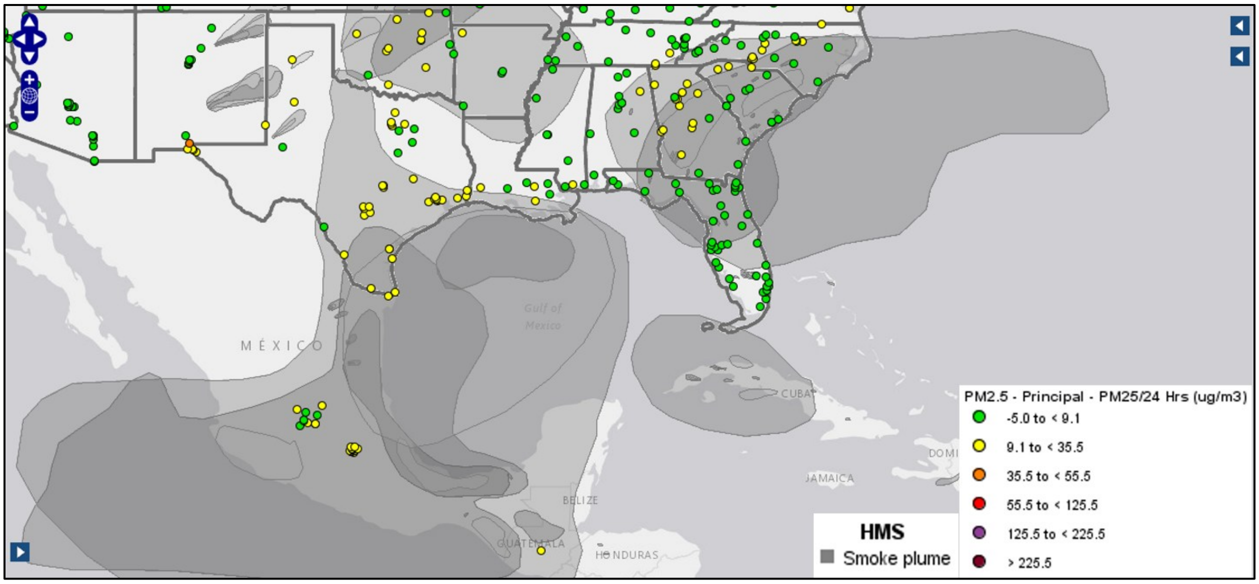


Figure 3-23: AirNow Navigator with HMS Smoke Plume for April 12, 2022

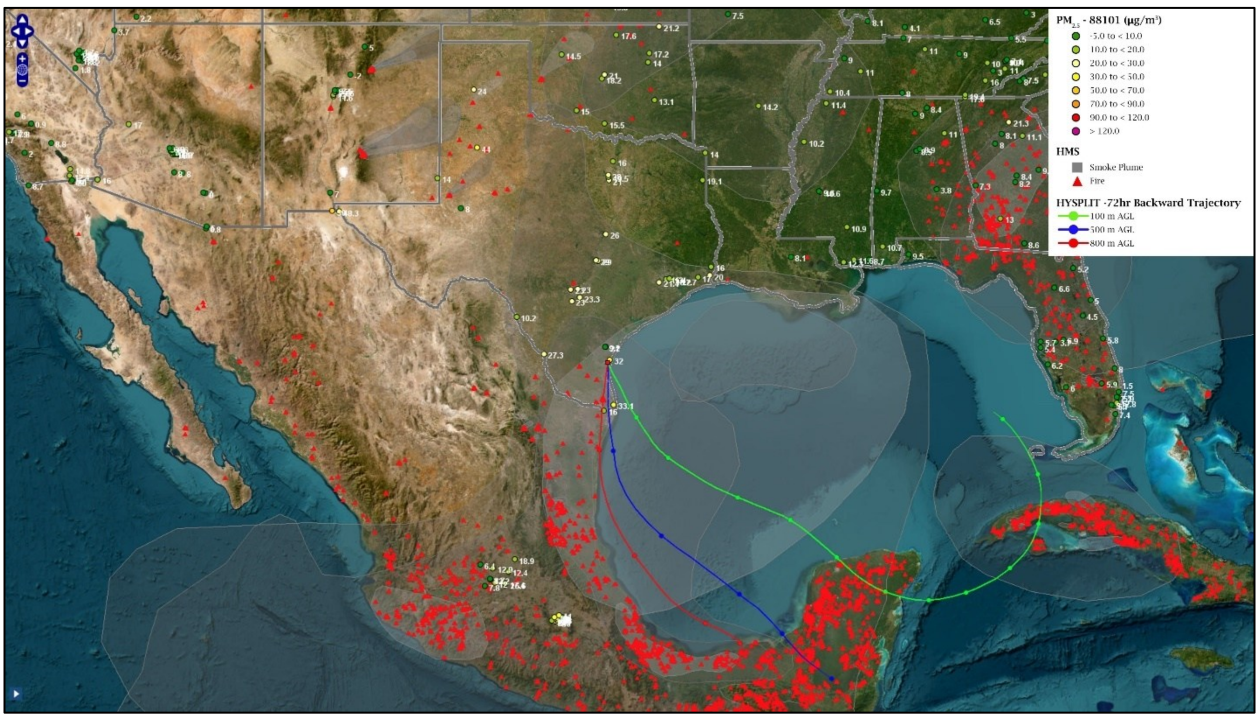


Figure 3-24: HYSPLIT back trajectories from the National Seashore monitoring site on April 12, 2022

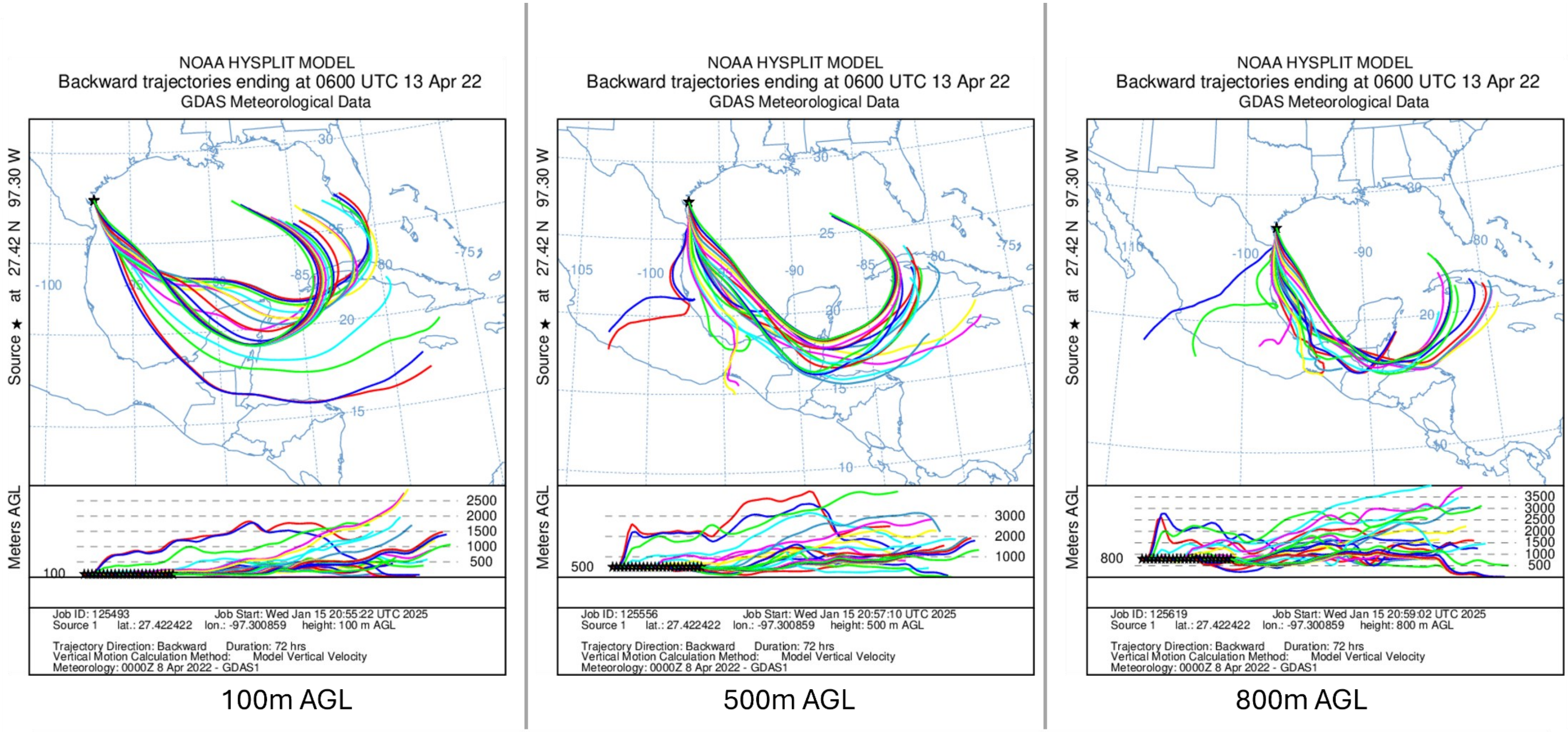


Figure 3-25: 72-hour HYSPLIT back trajectories starting from each hour on April 12, 2022, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL

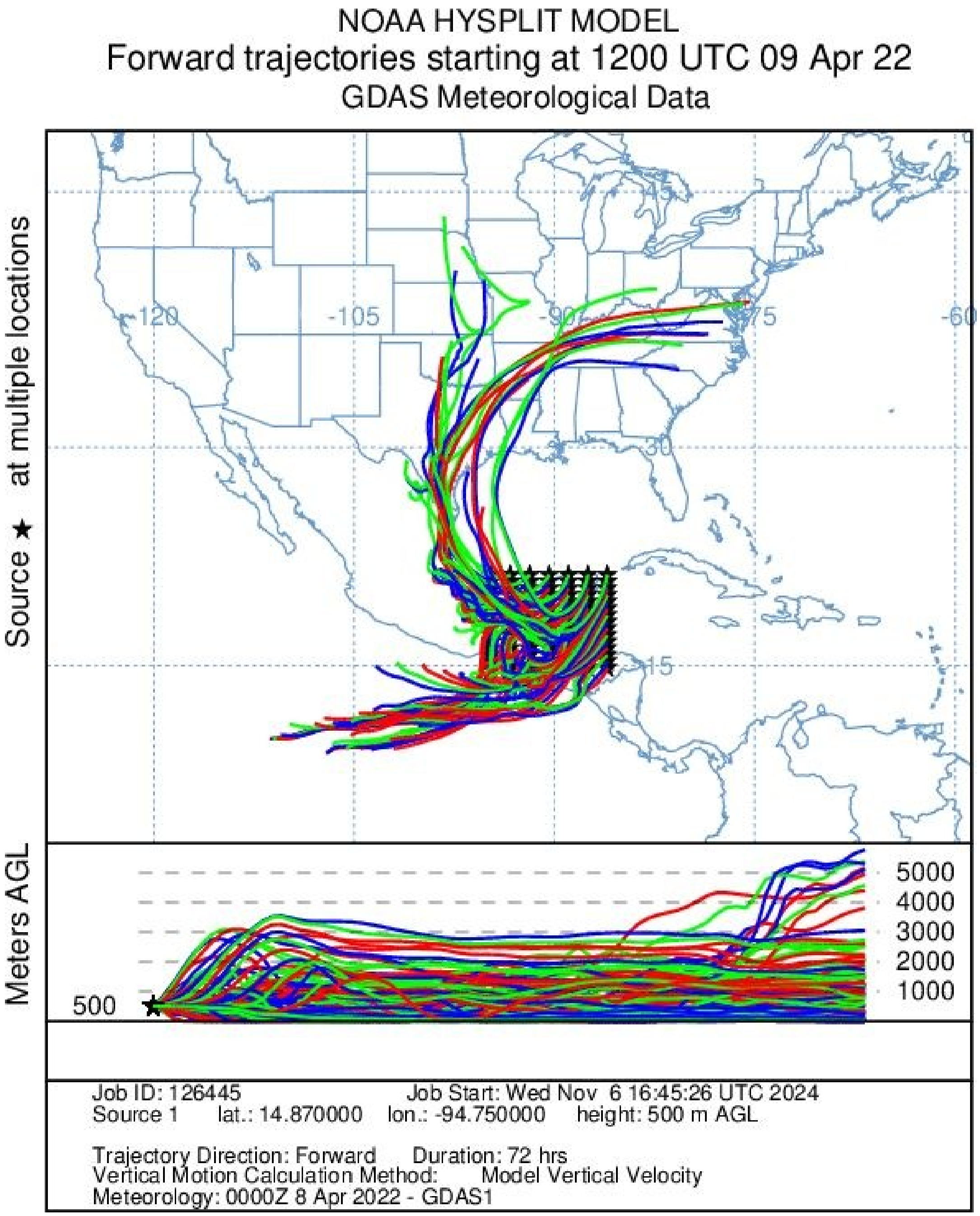


Figure 3-26: HYSPLIT forward trajectories from the areas in Mexico with fires, starting on April 9, 2022

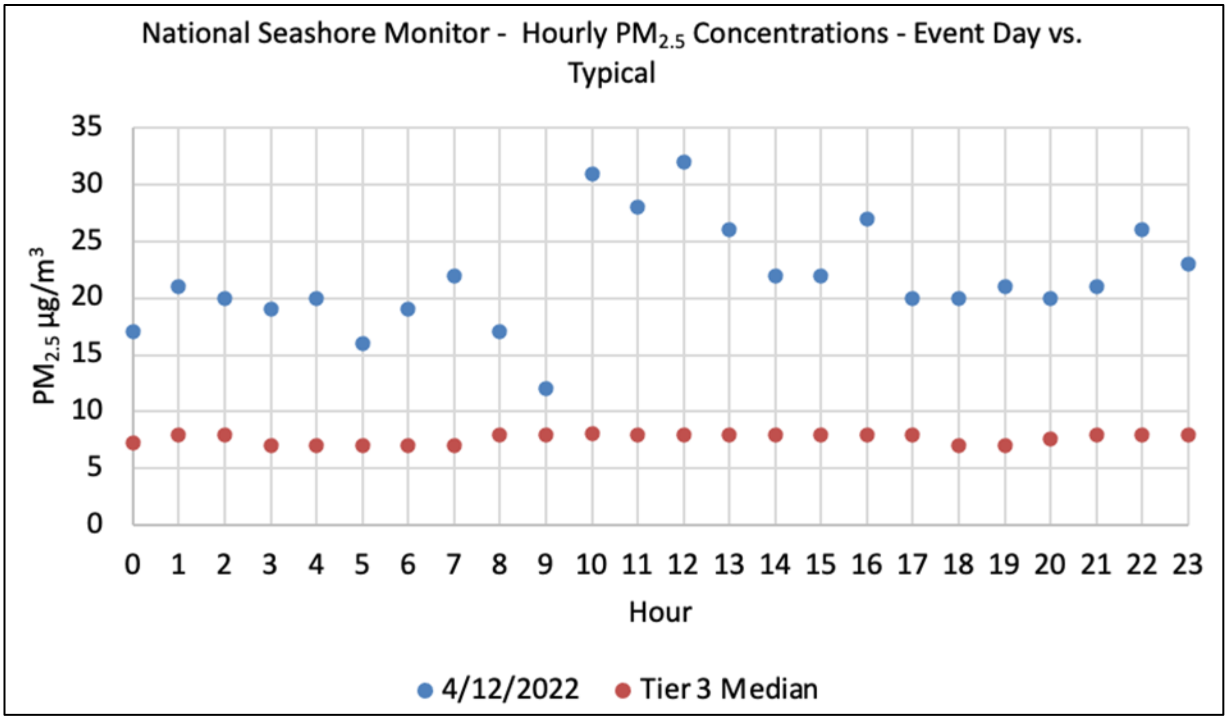


Figure 3-27: Hourly $PM_{2.5}$ concentrations on April 12, 2022, compared to typical concentrations at the National Seashore Monitor

For the April 13th event, Figure 3-28: *AirNow Navigator with HMS Smoke Plume for April 13, 2022,* shows an HMS smoke plume over the National Seashore monitor, with the yellow dot denoting air quality in the moderate category. Additionally, higher smoke surface concentrations can be seen along the Gulf coastline on the NAPPS model plot (Figure D-7). All the HYSPLIT back trajectories start at the National Seashore monitor and either end or pass through the areas in Mexico and Cuba, as shown in Figure 3-29: *HYSPLIT back trajectories from the National Seashore monitoring site on April 13, 2022*. Figure 3-30: *Hourly $PM_{2.5}$ concentrations on April 13, 2022, compared to typical concentrations at the National Seashore Monitor* shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median).

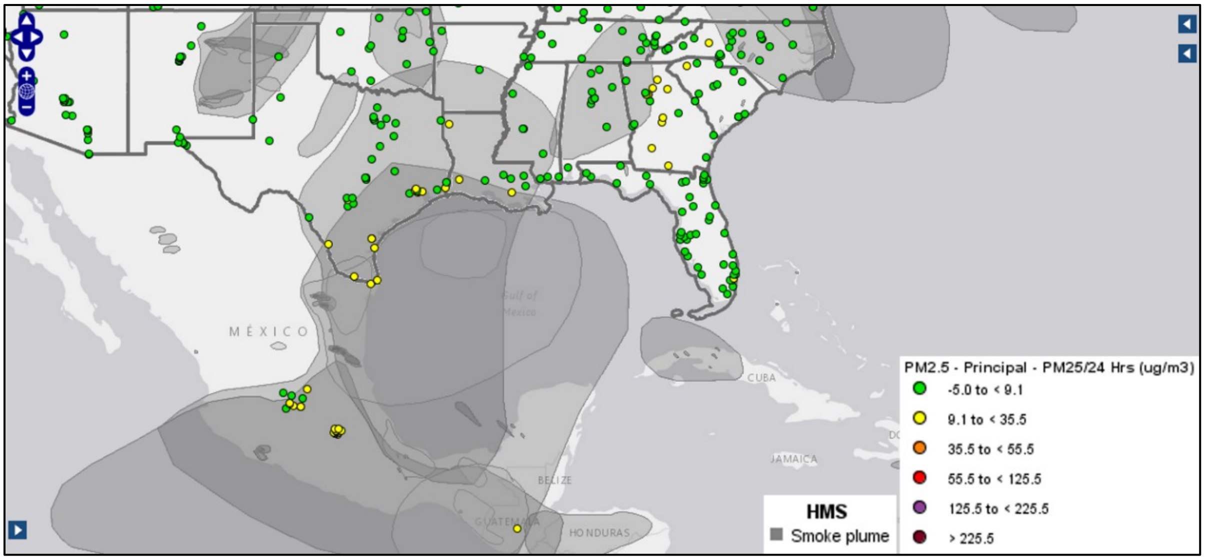


Figure 3-28: AirNow Navigator with HMS Smoke Plume for April 13, 2022

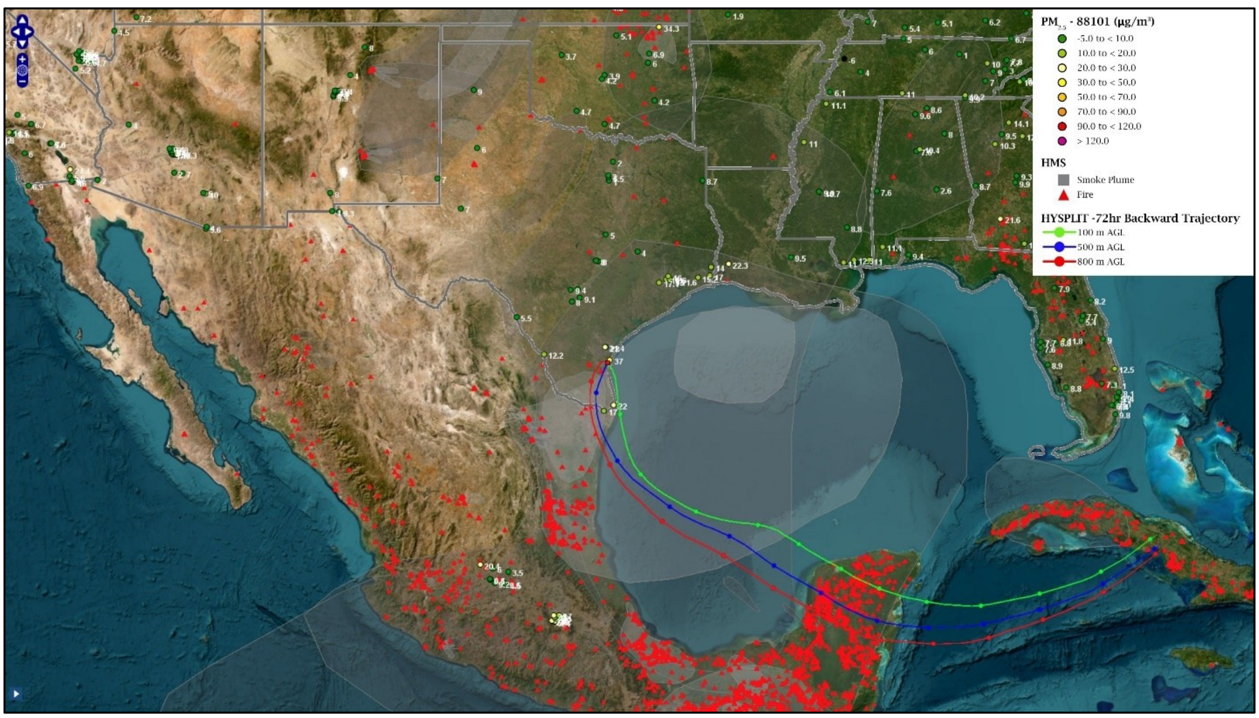


Figure 3-29: HYSPLIT back trajectories from the National Seashore monitoring site on April 13, 2022

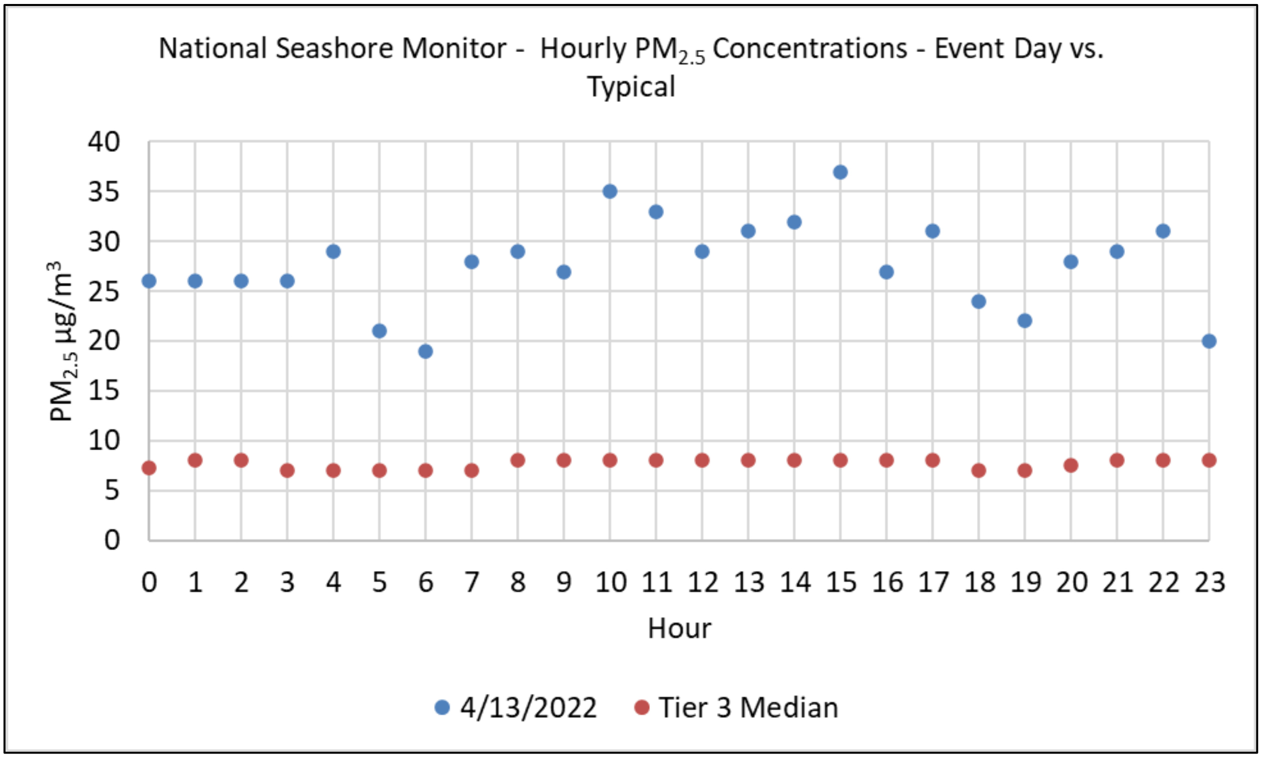


Figure 3-30: Hourly $PM_{2.5}$ concentrations on April 13, 2022, compared to typical concentrations at the National Seashore Monitor

3.2.5 Group 5: Evidence for May 6 and May 7, 2022, Fire (Mexico/Central America) $PM_{2.5}$ Event for the National Seashore Monitor

Fire (Mexico/Central America) impacted the National Seashore monitoring site on May 6 and 7, 2022. The evidence provided meets requirements for Tier 2 demonstrations. Figure 3-31: *AirNow Navigator with HMS Smoke Plume for May 6, 2022,* shows an HMS smoke plume over the National Seashore monitor, with the yellow dot denoting air quality in the moderate category. Additionally, highly elevated smoke surface concentrations can be seen along the Gulf coastline over the monitoring site on the NAPPS model plot (Figure D-8) The HYSPLIT back trajectory at 100 m and 500 m AGL passes through the fires in Mexico, as shown in Figure 3-32: *HYSPLIT back trajectories from the National Seashore monitoring site on May 6, 2022.* HYSPLIT back trajectories starting from each hour from the National Seashore monitor further support transport of smoke from the fires in Mexico, as shown in Figure 3-33: *72-hour HYSPLIT back trajectories starting from each hour on May 6, 2022, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL.* HYSPLIT forward trajectories starting at 72 hours before the event day in Mexico arrived at Texas, as shown in Figure 3-34: *HYSPLIT forward trajectories from the areas in Mexico with fires, starting on May 3, 2022.* Figure 3-35: *Hourly $PM_{2.5}$ concentrations on May 6, 2022, compared to typical concentrations at the National Seashore Monitor* shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median).

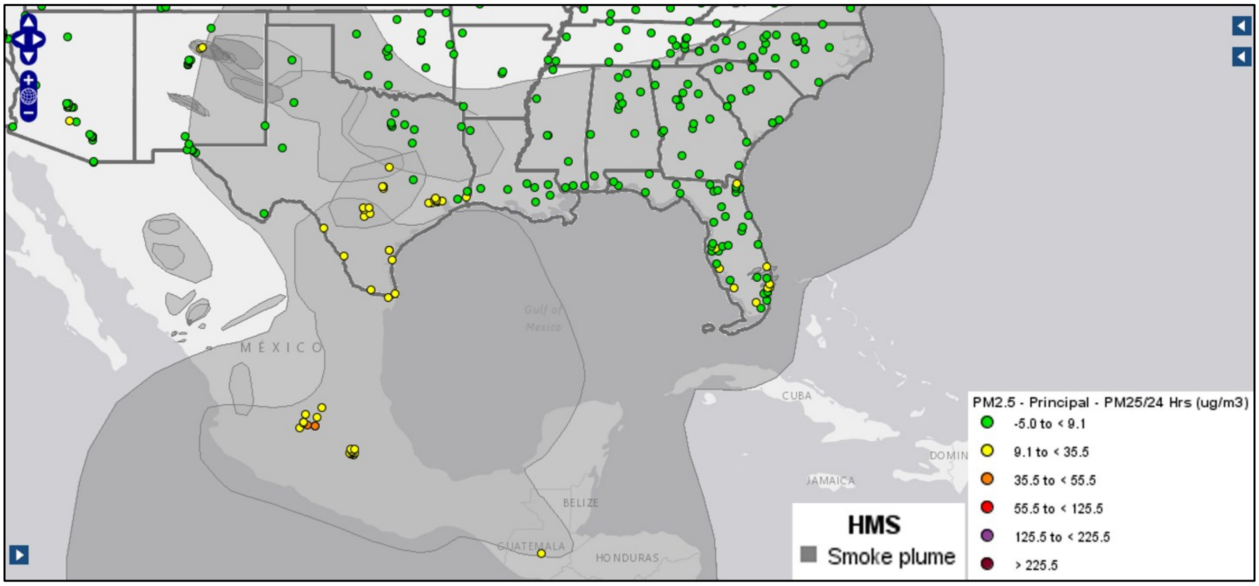


Figure 3-31: AirNow Navigator with HMS Smoke Plume for May 6, 2022

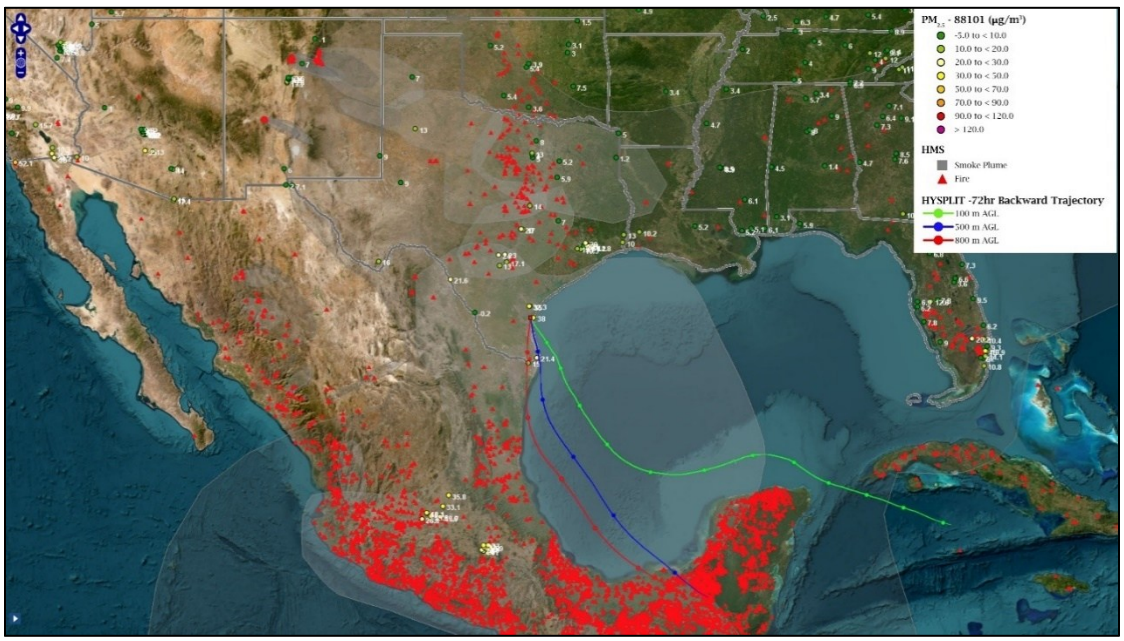


Figure 3-32: HYSPLIT back trajectories from the National Seashore monitoring site on May 6, 2022

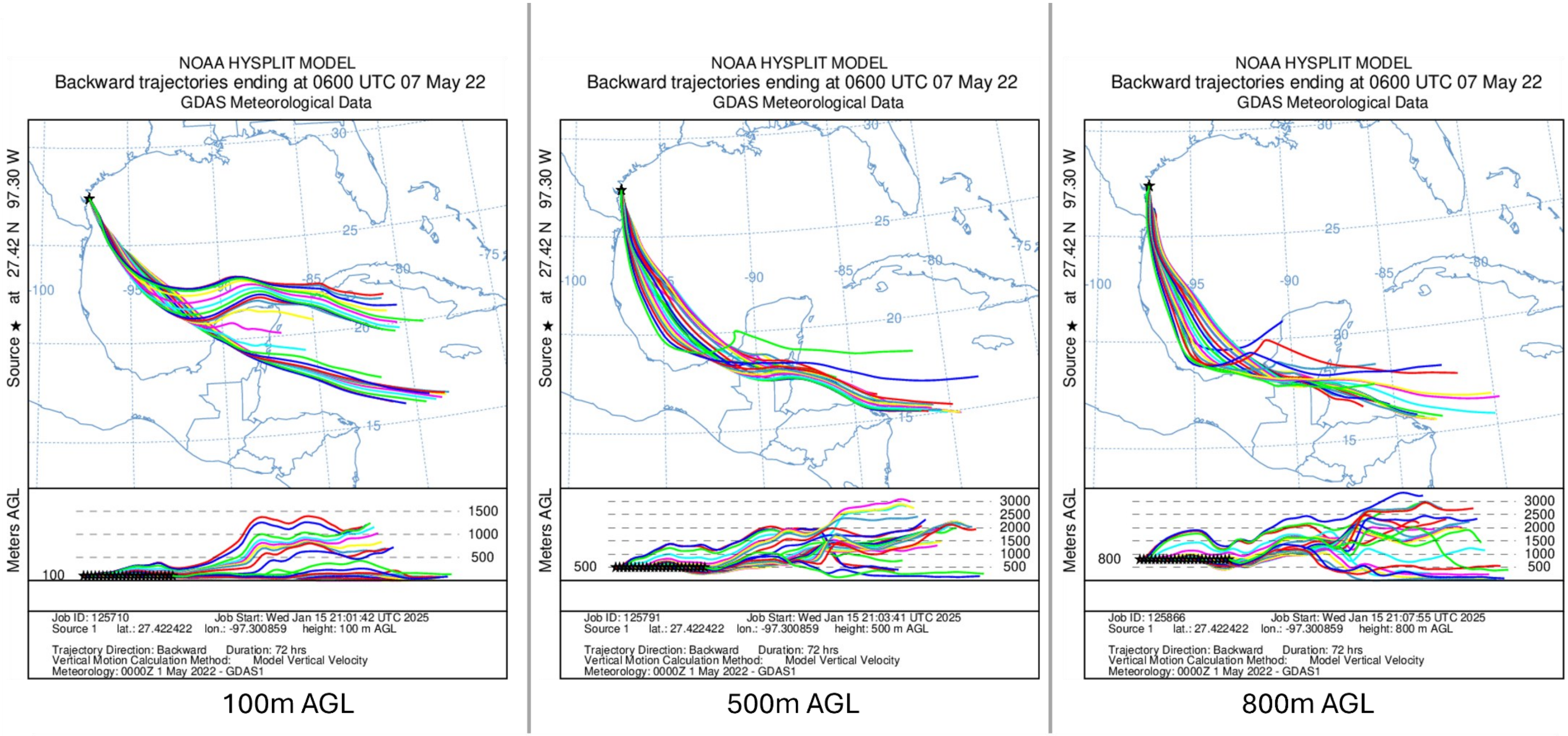


Figure 3-33: 72-hour HYSPLIT back trajectories starting from each hour on May 6, 2022, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL

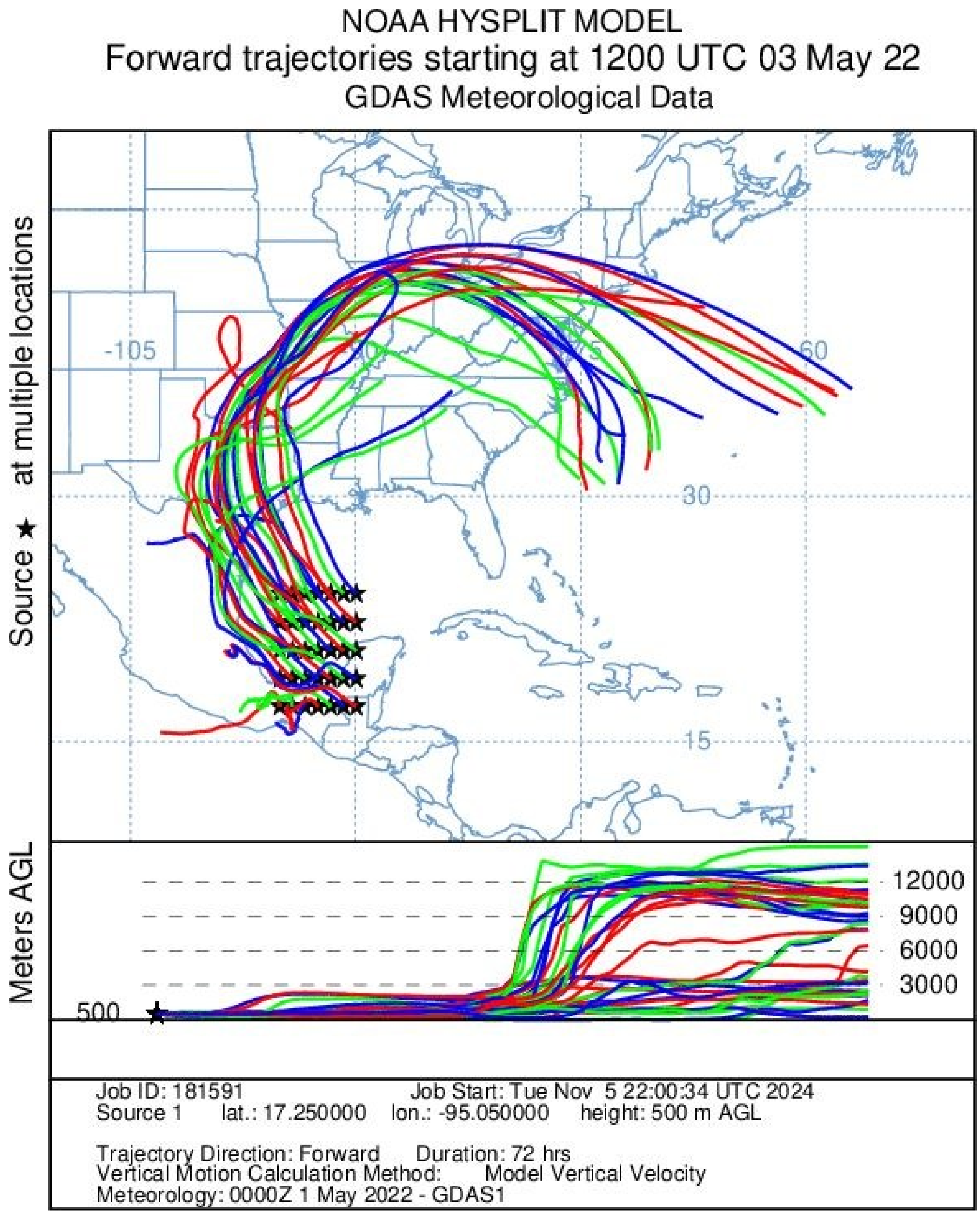


Figure 3-34: HYSPLIT forward trajectories from the areas in Mexico with fires, starting on May 3, 2022

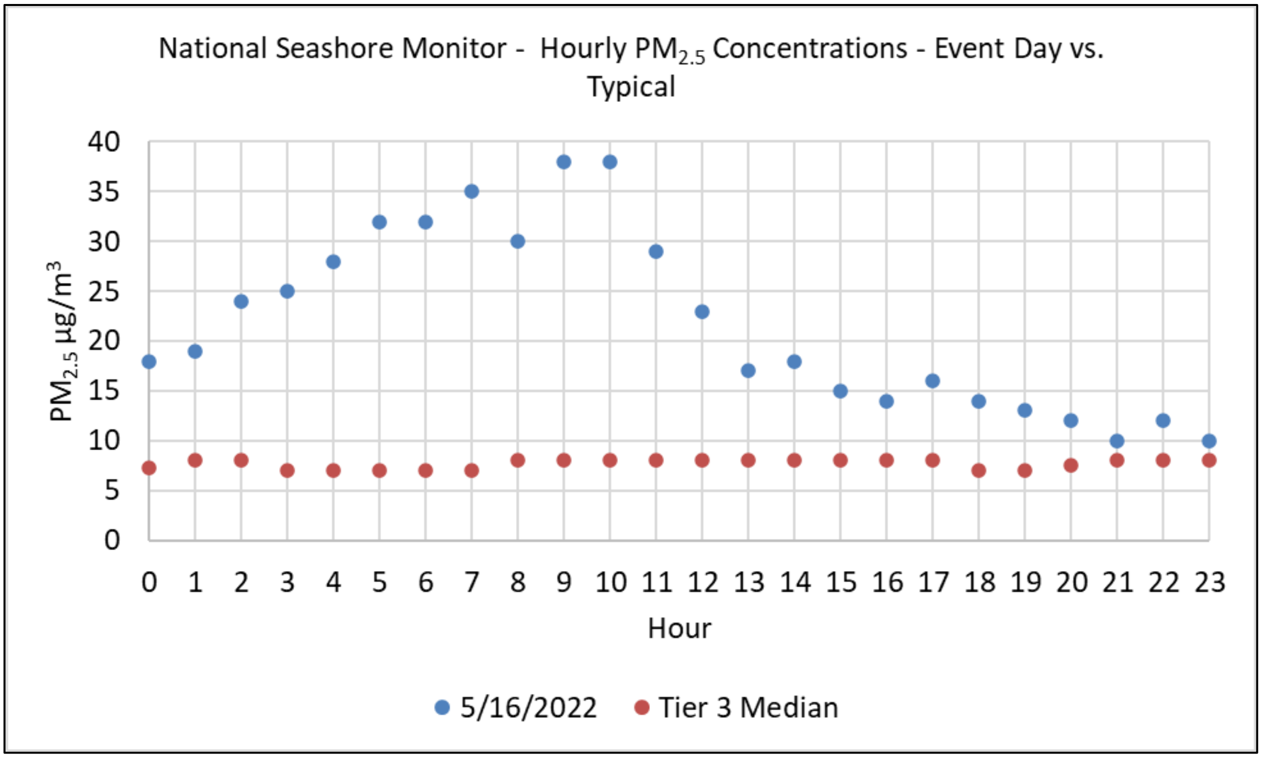


Figure 3-35: Hourly $PM_{2.5}$ concentrations on May 6, 2022, compared to typical concentrations at the National Seashore Monitor

For the May 7, 2022, event, Figure 3-36: *AirNow Navigator with HMS Smoke Plume for May 7, 2022,* shows HMS smoke plume over the National Seashore monitor, with the yellow dot denoting air quality in the moderate category. Additionally, highly elevated smoke concentrations can be seen along the Gulf coastline over the monitoring site on the NAPPS model plot (Figure D-9). The HYSPLIT back trajectory at 100 m and 500 m AGL passes through the fires in Mexico, as shown in Figure 3-37: *HYSPLIT back trajectories from the National Seashore monitoring site on May 7, 2022.* HYSPLIT back trajectories starting from each hour from the National Seashore monitor further support transport of smoke from the fires in Mexico, as shown in Figure 3-38: *72-hour HYSPLIT back trajectories starting from each hour on May 7, 2022, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL.* HYSPLIT forward trajectories starting at 72 hours before the event day from Mexico arrives at Texas are shown in Figure 3-39: *HYSPLIT forward trajectories from the areas in Mexico with fires, starting on May 4, 2022.* Figure 3-40: *Hourly $PM_{2.5}$ concentrations on May 7, 2022, compared to typical concentrations at the National Seashore Monitor* shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median).

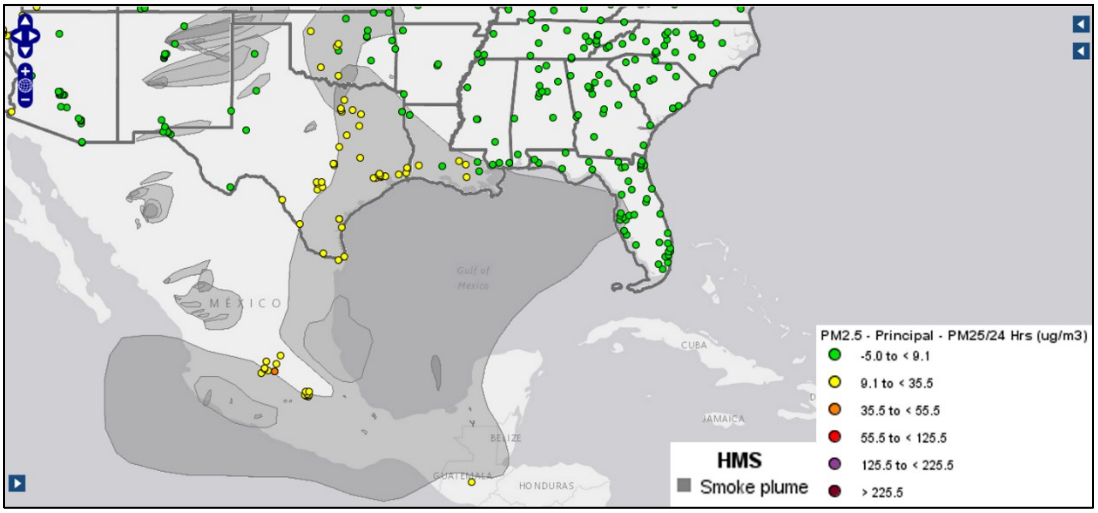


Figure 3-36: AirNow Navigator with HMS Smoke Plume for May 7, 2022

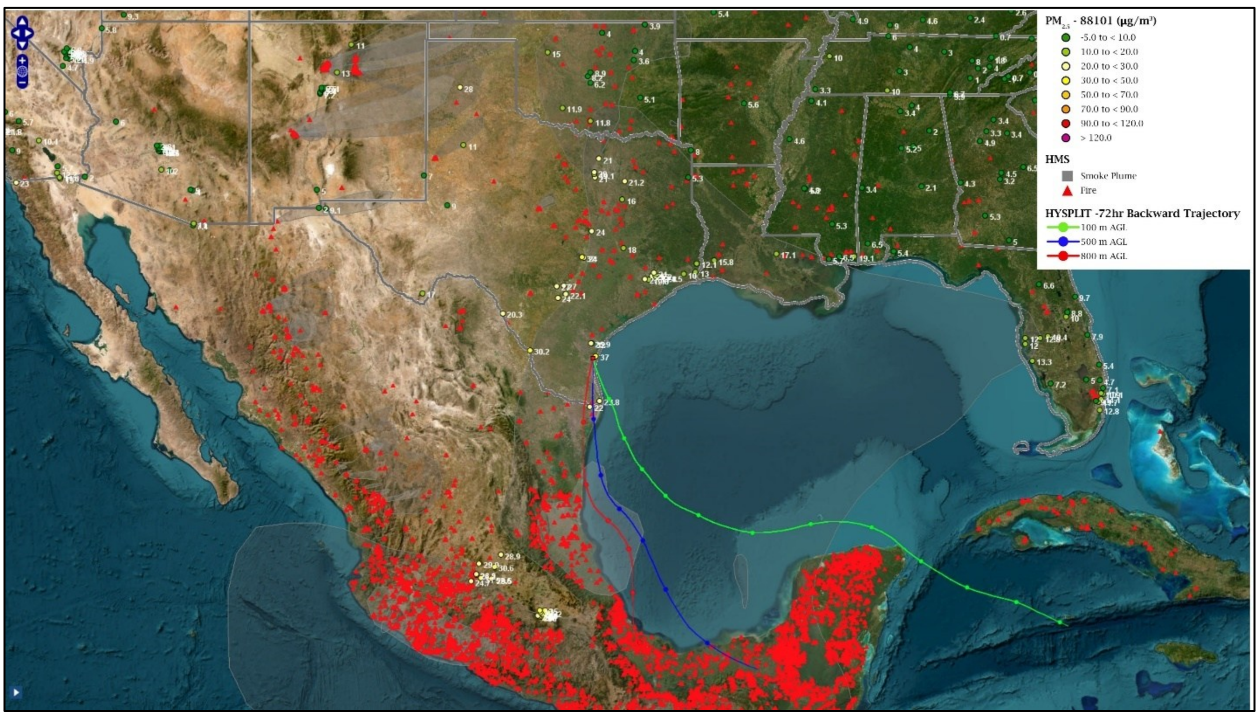


Figure 3-37: HYSPLIT back trajectories from the National Seashore monitoring site on May 7, 2022

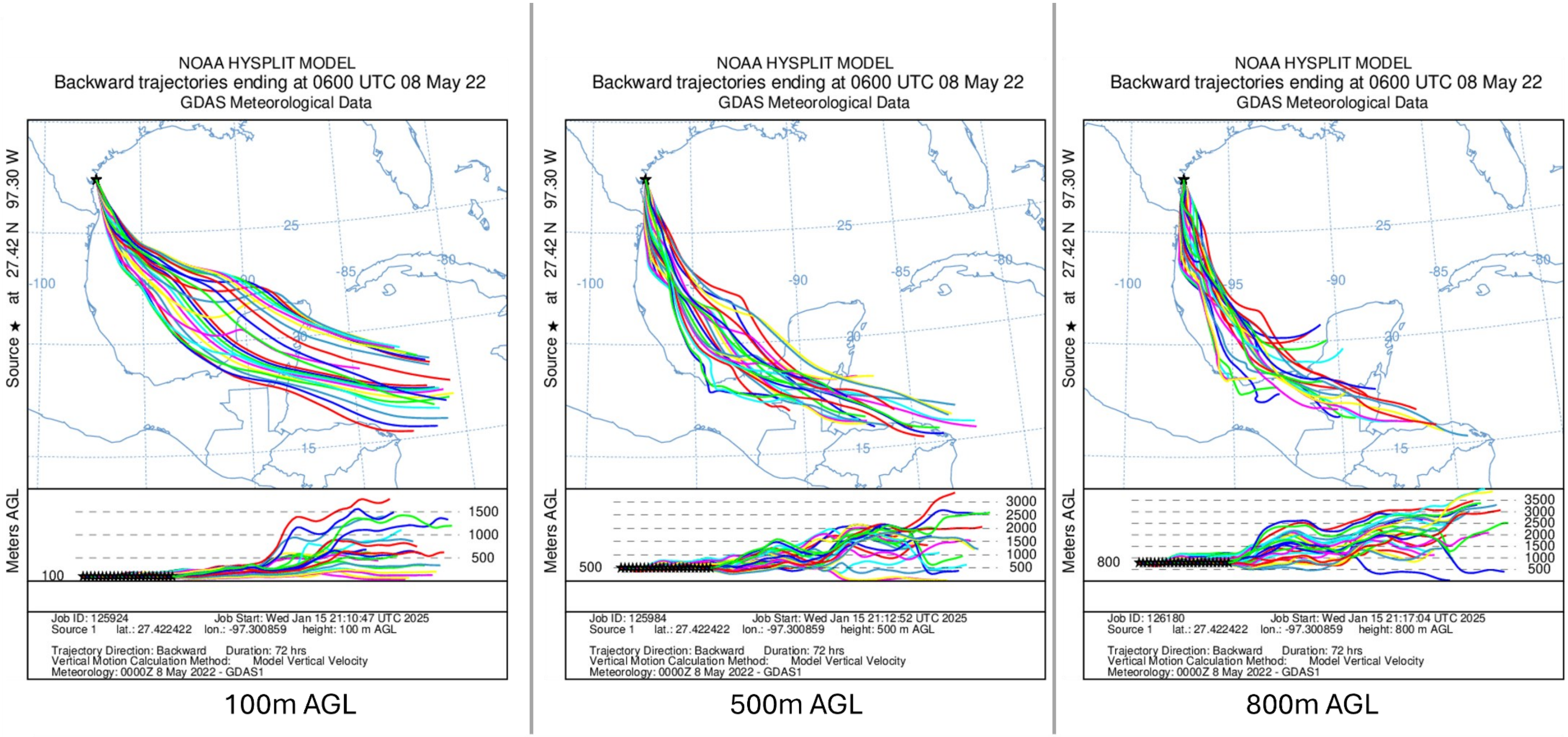


Figure 3-38: 72-hour HYSPLIT back trajectories starting from each hour on May 7, 2022, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL

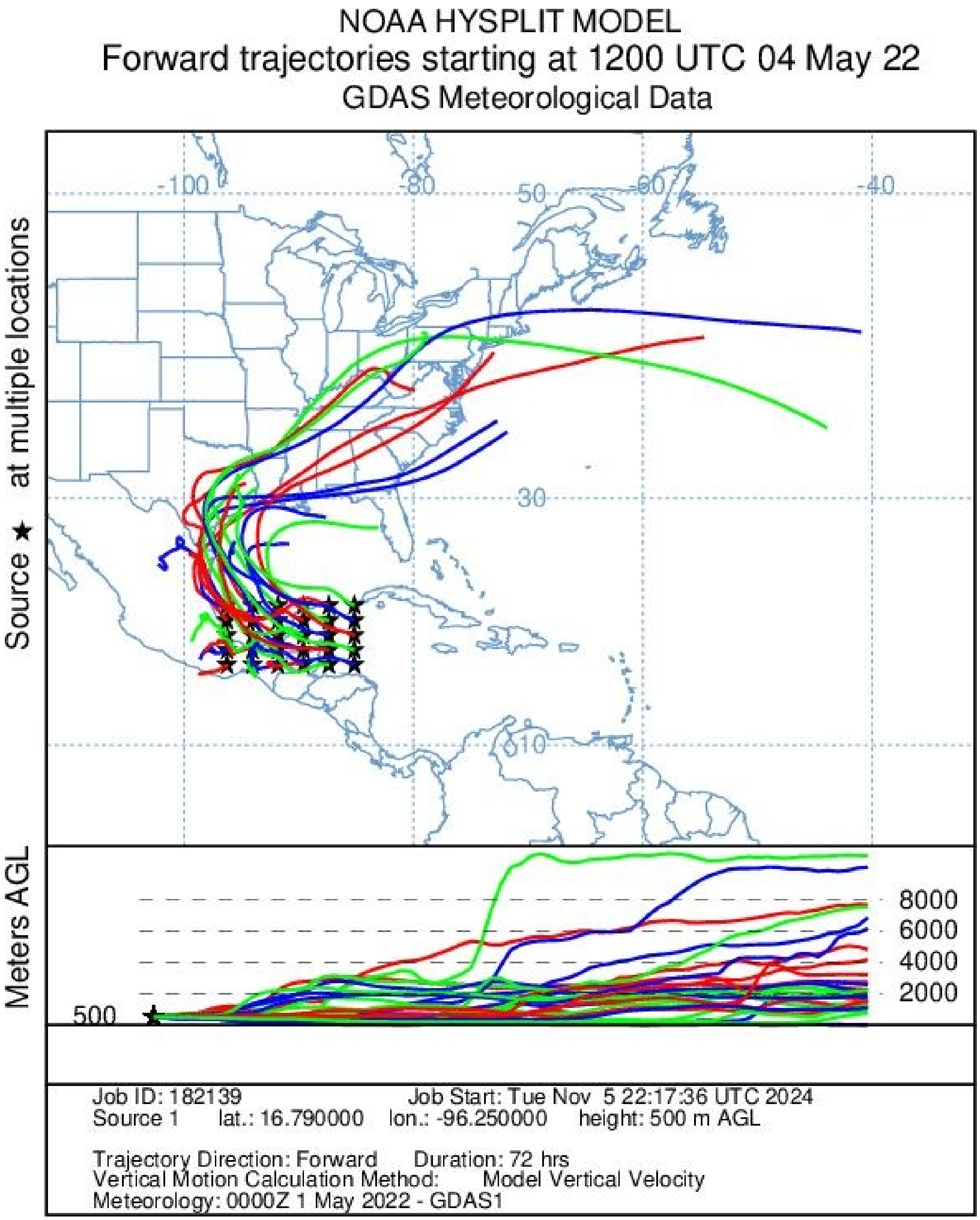


Figure 3-39: HYSPLIT forward trajectories from the areas in Mexico with fires, starting on May 4, 2022

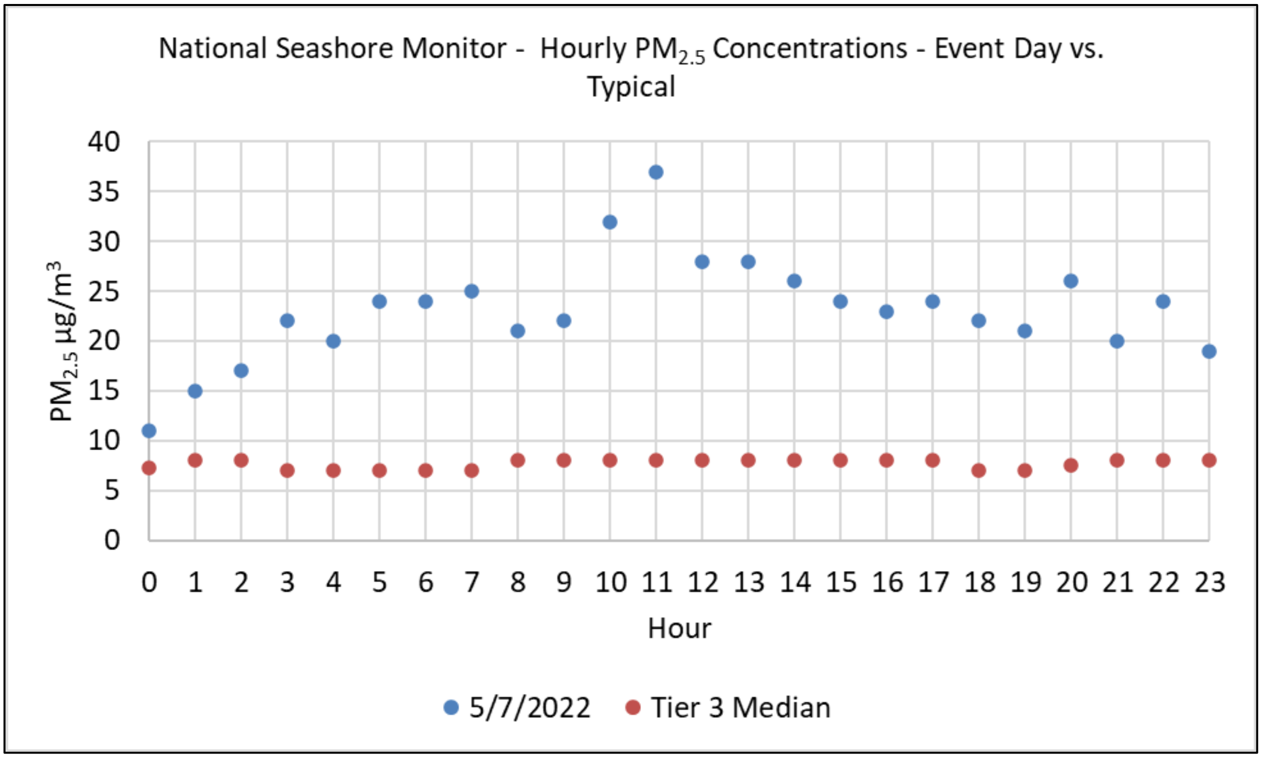


Figure 3-40: Hourly $PM_{2.5}$ concentrations on May 7, 2022, compared to typical concentrations at the National Seashore Monitor

3.2.6 Group 6: Evidence for May 20, 2022, Fire (Mexico/Central America) $PM_{2.5}$ Event for the Webberville Monitor and National Seashore Monitor

Austin Webberville and National Seashore monitoring sites were impacted by fire from Mexico and Central America. The evidence provided meets requirements for Tier 2 demonstrations.

Figure 3-41: *AirNow Navigator with HMS Smoke Plume for May 20, 2022,* shows the HMS smoke plume over the Austin Webberville monitor, with the yellow dot denoting air quality in the moderate category. Additionally, highly elevated smoke surface concentrations can be seen over the monitoring site area on the NAPPS model plot (Figure D-10).The HYSPLIT back trajectory at 100 m and 500 m AGL passes through the area in Mexico with fires, as shown in Figure 3-42: *HYSPLIT back trajectories from the Austin Webberville monitoring site on May 20, 2022.* HYSPLIT back trajectories starting from each hour from the Austin Webberville monitor further support transport of smoke from the fires in Mexico, as shown in Figure 3-43: *72-hour HYSPLIT back trajectories starting from each hour on May 20, 2022, from the Austin Webberville monitoring site at 100m AGL, 500m AGL, and 800 m AGL.* HYSPLIT forward trajectories starting from areas in Mexico with fires at 72 hours before the event day arrived at Texas are shown in Figure 3-44: *HYSPLIT forward trajectories from the areas in Mexico with fires, starting on May 17, 2022.* Figure 3-45: *Hourly $PM_{2.5}$ concentrations on May 20, 2022, compared to typical concentrations at the Webberville Monitor* shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median).

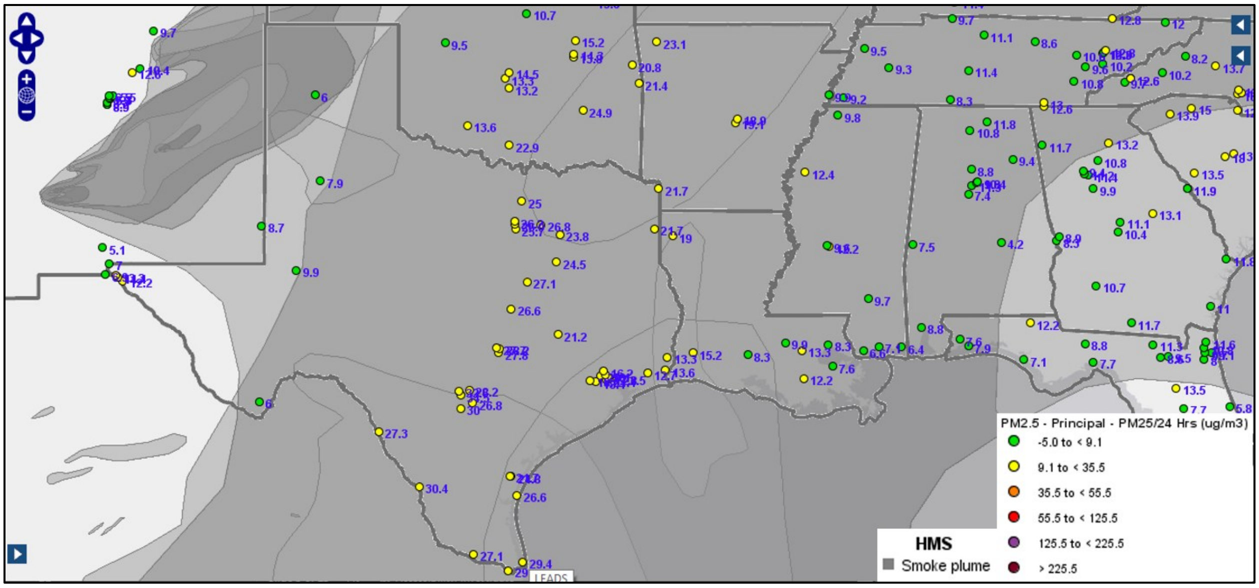


Figure 3-41: AirNow Navigator with HMS Smoke Plume for May 20, 2022

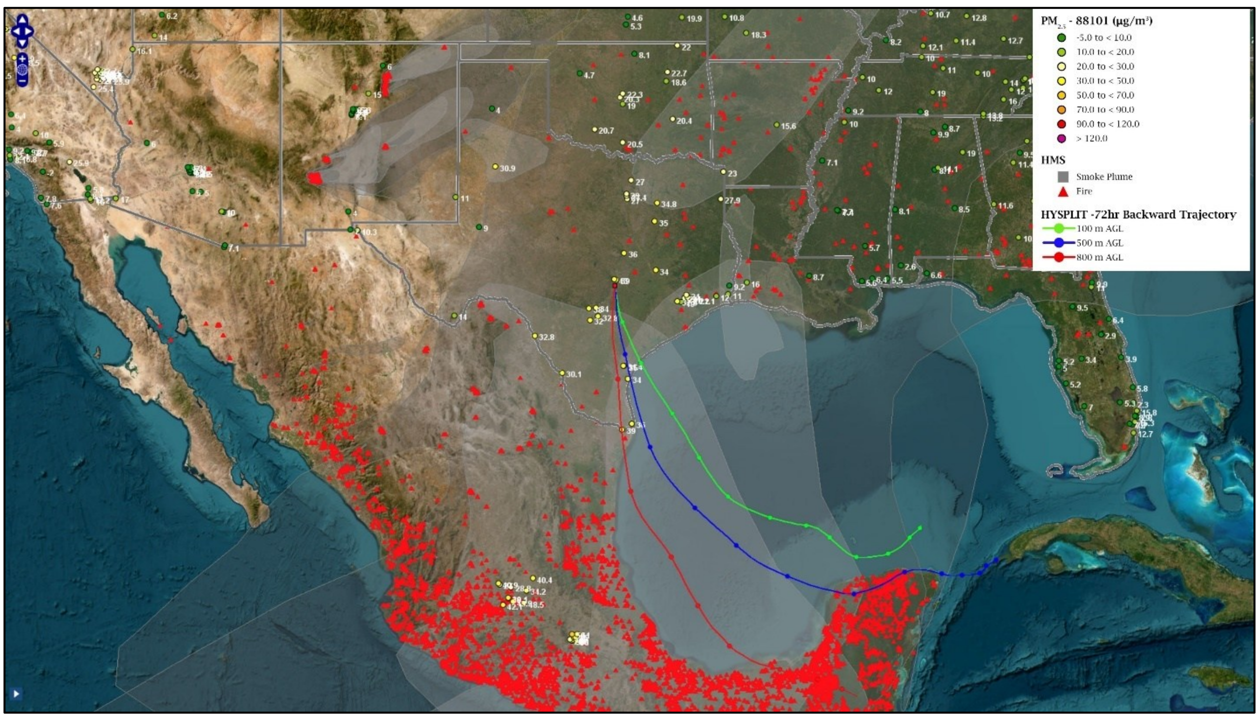


Figure 3-42: HYSPLIT back trajectories from the Austin Webberville monitoring site on May 20, 2022

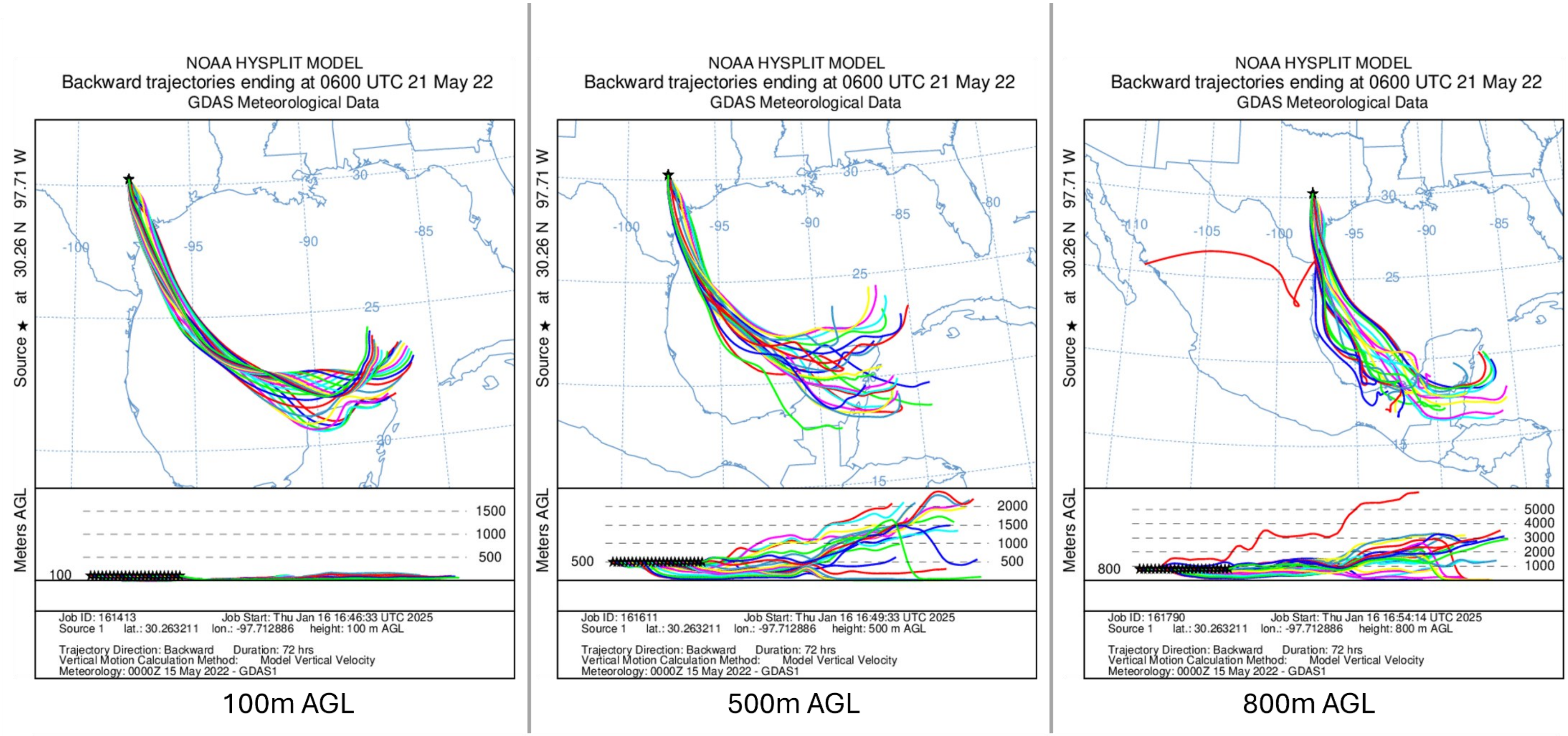


Figure 3-43: 72-hour HYSPLIT back trajectories starting from each hour on May 20, 2022, from the Austin Webberville monitoring site at 100m AGL, 500m AGL, and 800 m AGL

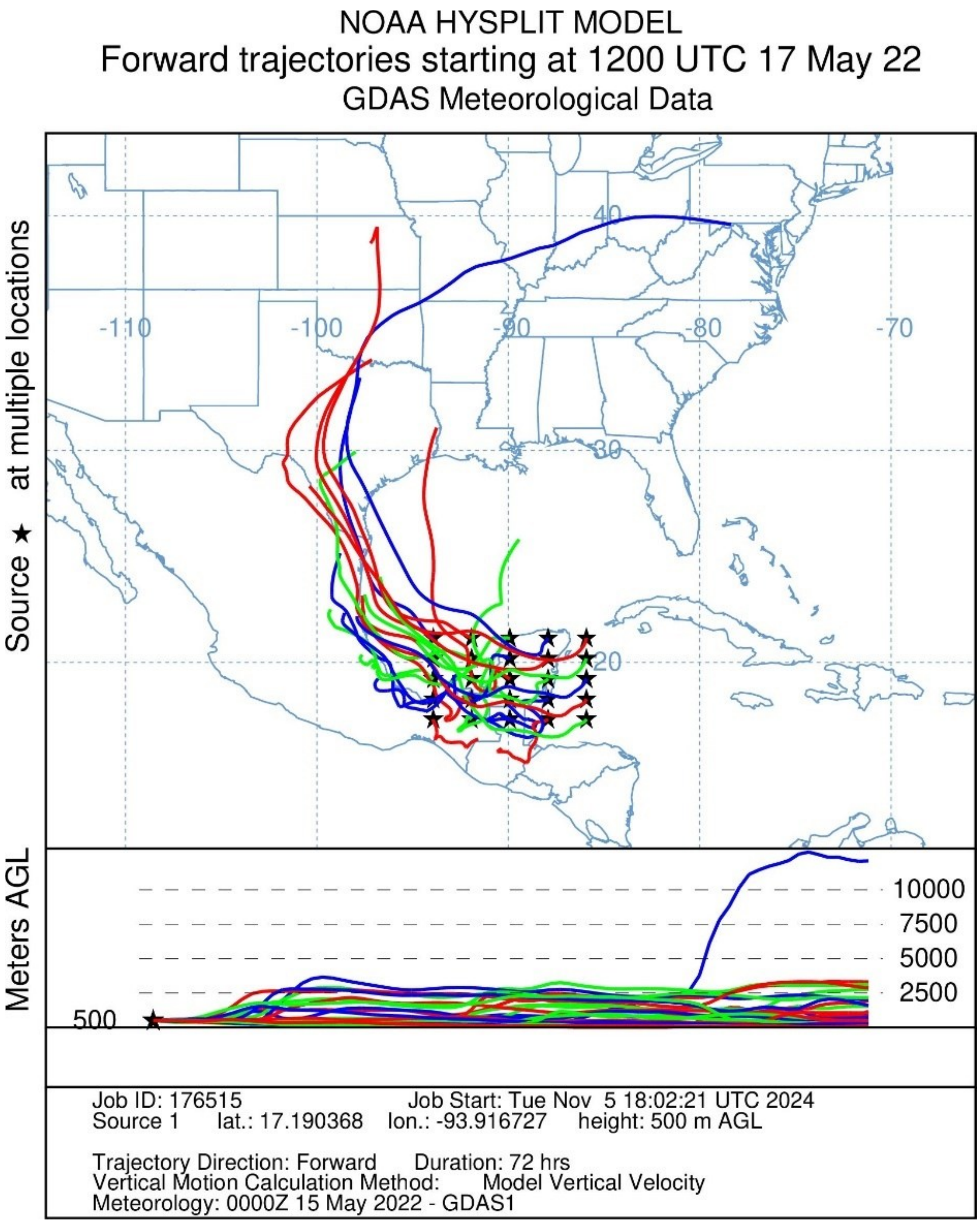


Figure 3-44: HYSPLIT forward trajectories from areas in Mexico with fires, starting on May 17, 2022

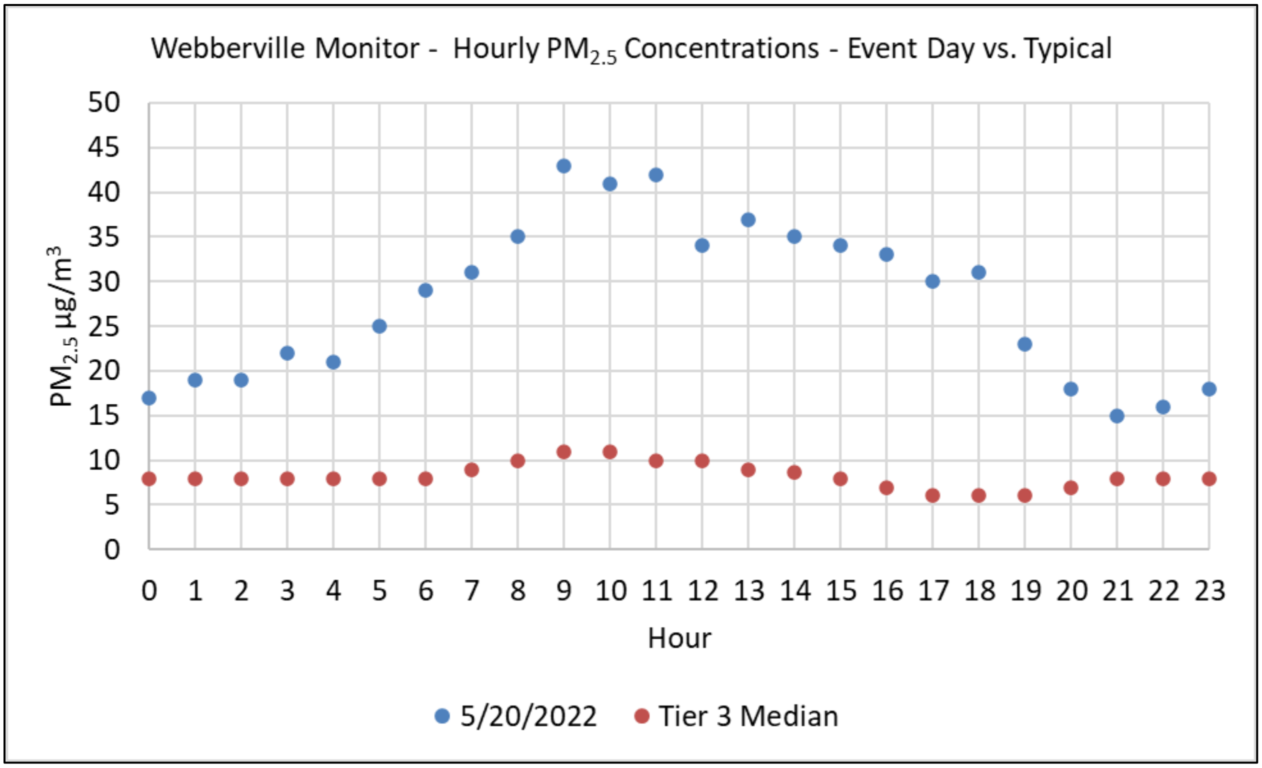


Figure 3-45: Hourly $PM_{2.5}$ concentrations on May 20, 2022, compared to typical concentrations at the Webberville Monitor

Figure 3-46: *AirNow Navigator with HMS Smoke Plume for May 20, 2022, at National Seashore* shows HMS smoke plume over the National Seashore monitor, with the yellow dot denoting air quality in the moderate category. The HYSPLIT back trajectories pass through areas in Mexico with fires, as shown in Figure 3-47: *HYSPLIT back trajectories from the National Seashore monitoring site on May 20, 2022.* HYSPLIT back trajectories starting from each hour from the National Seashore monitor further support transport of smoke from the fires in Mexico, as shown in Figure 3-48: *72-hour HYSPLIT back trajectories starting from each hour on May 20, 2022, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL***.** HYSPLIT forward trajectories starting from areas in Mexico with fires at 72 hours before the event day arrived at Texas are shown in Figure 3-49: *HYSPLIT forward trajectories from the areas in Mexico with fires, starting on May 17, 2022*. Figure 3-50: *Hourly $PM_{2.5}$ concentrations on May 20, 2022, compared to typical concentrations at the National Seashore Monitor* shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median).

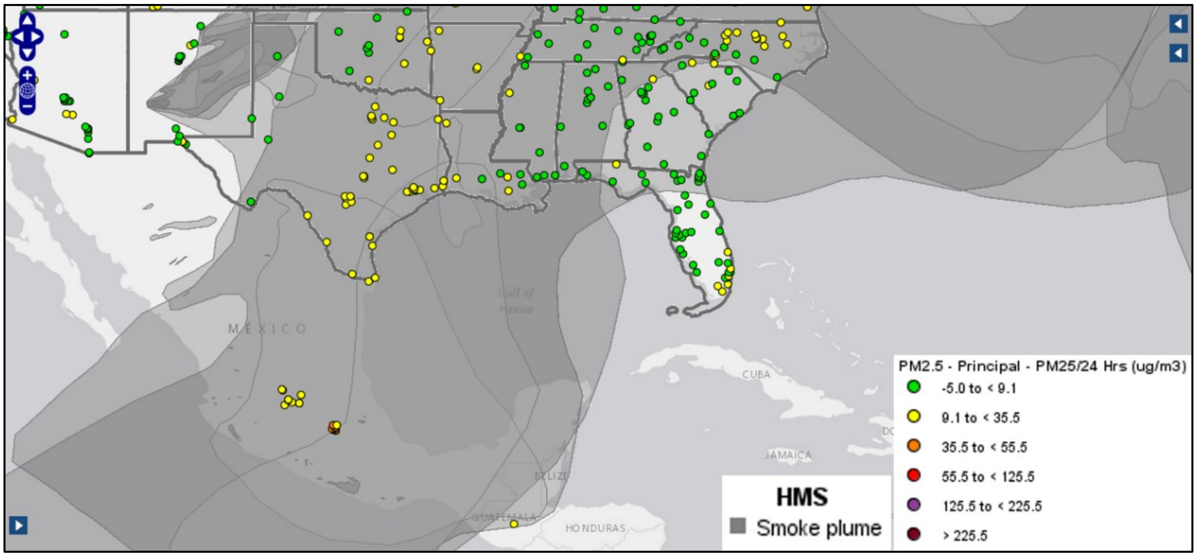


Figure 3-46: AirNow Navigator with HMS Smoke Plume for May 20, 2022, at National Seashore

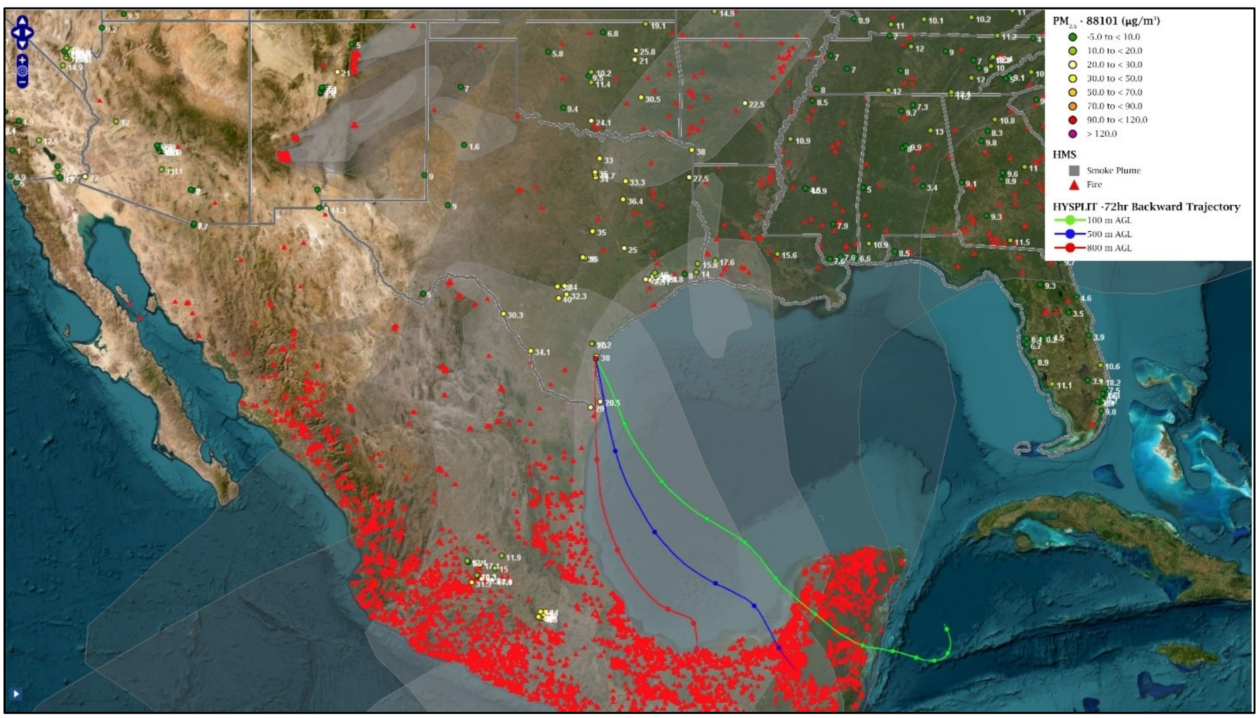


Figure 3-47: HYSPLIT back trajectories from the National Seashore monitoring site on May 20, 2022

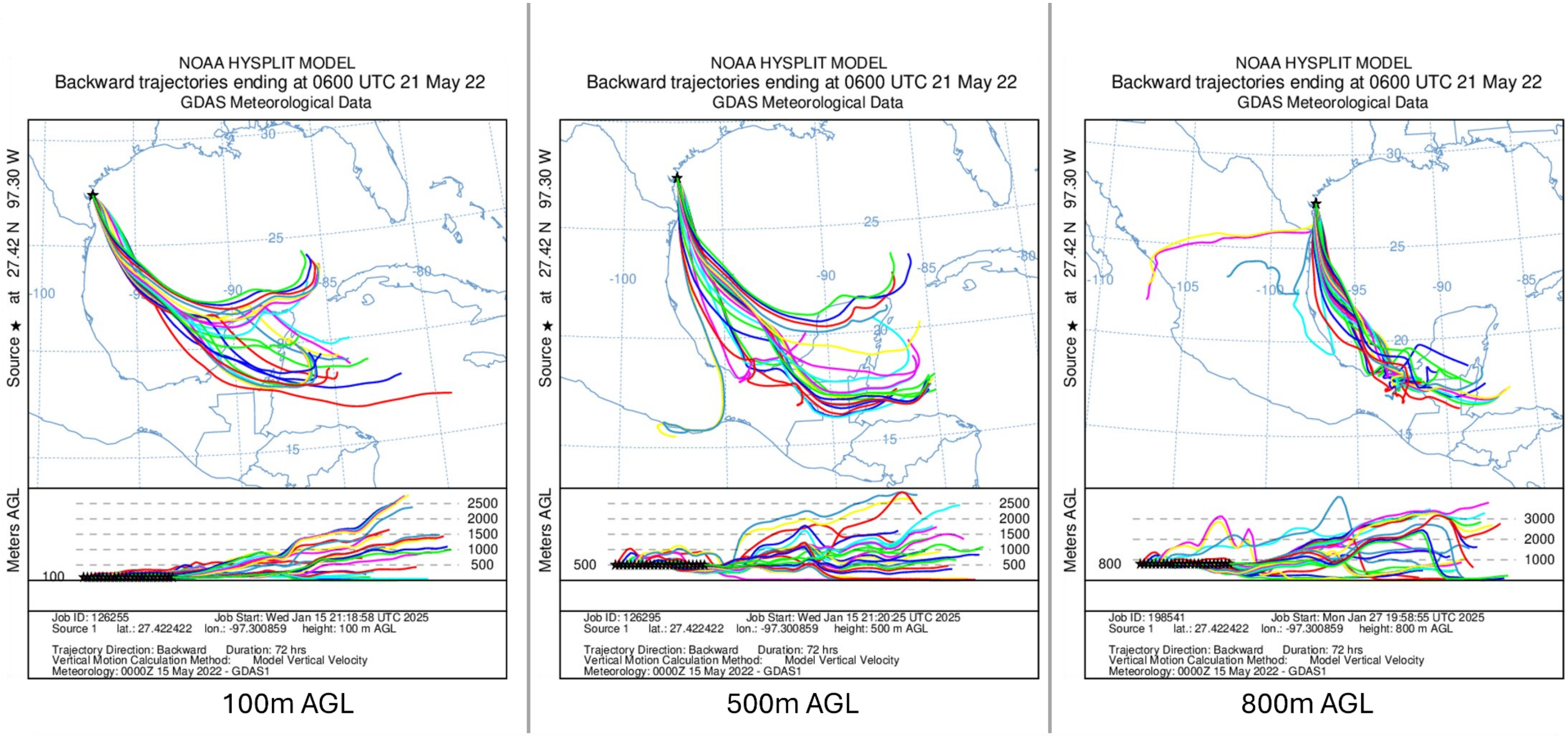


Figure 3-48: 72-hour HYSPLIT back trajectories starting from each hour on May 20, 2022, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL

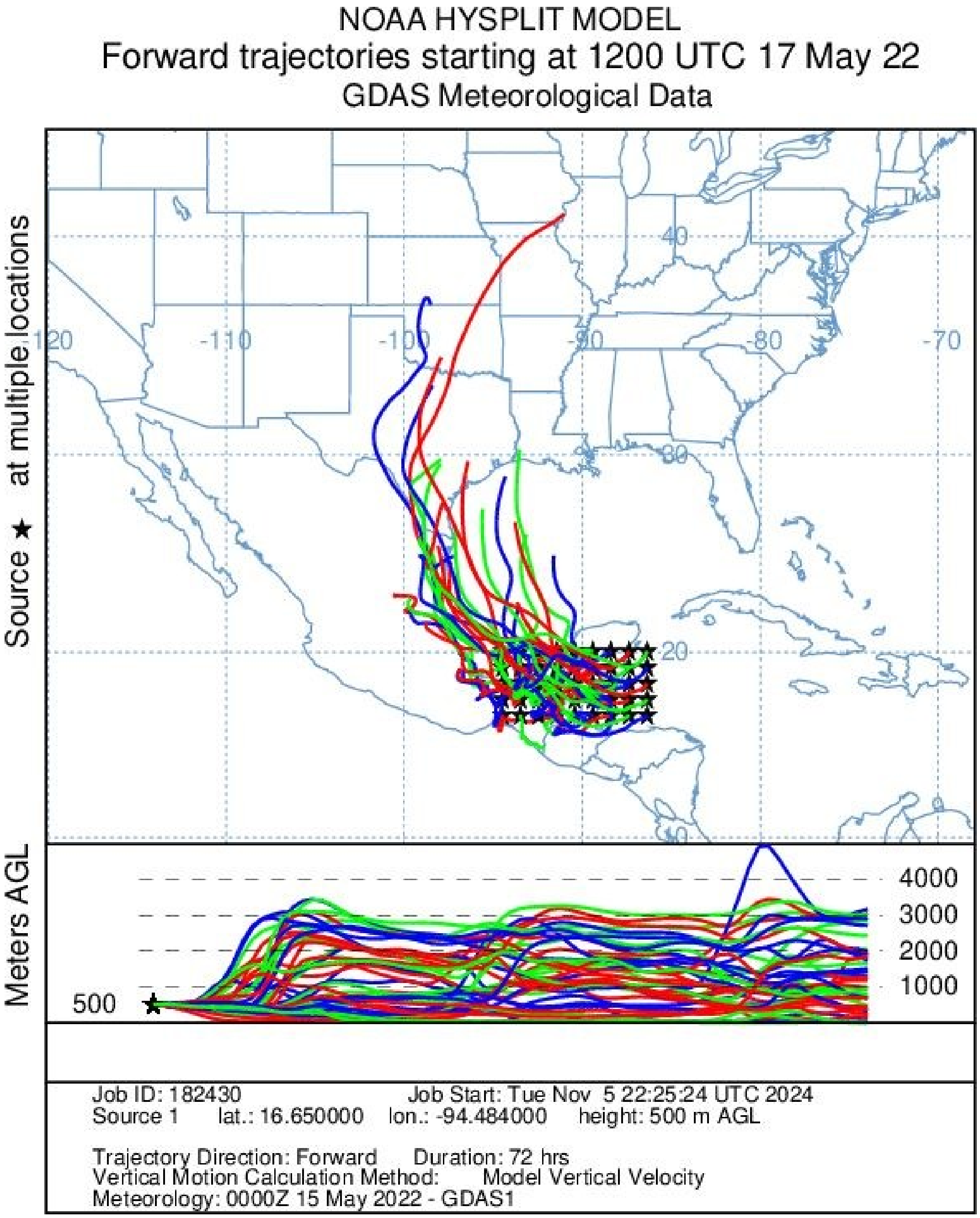


Figure 3-49: HYSPLIT forward trajectories from the areas in Mexico with fires, starting on May 17, 2022

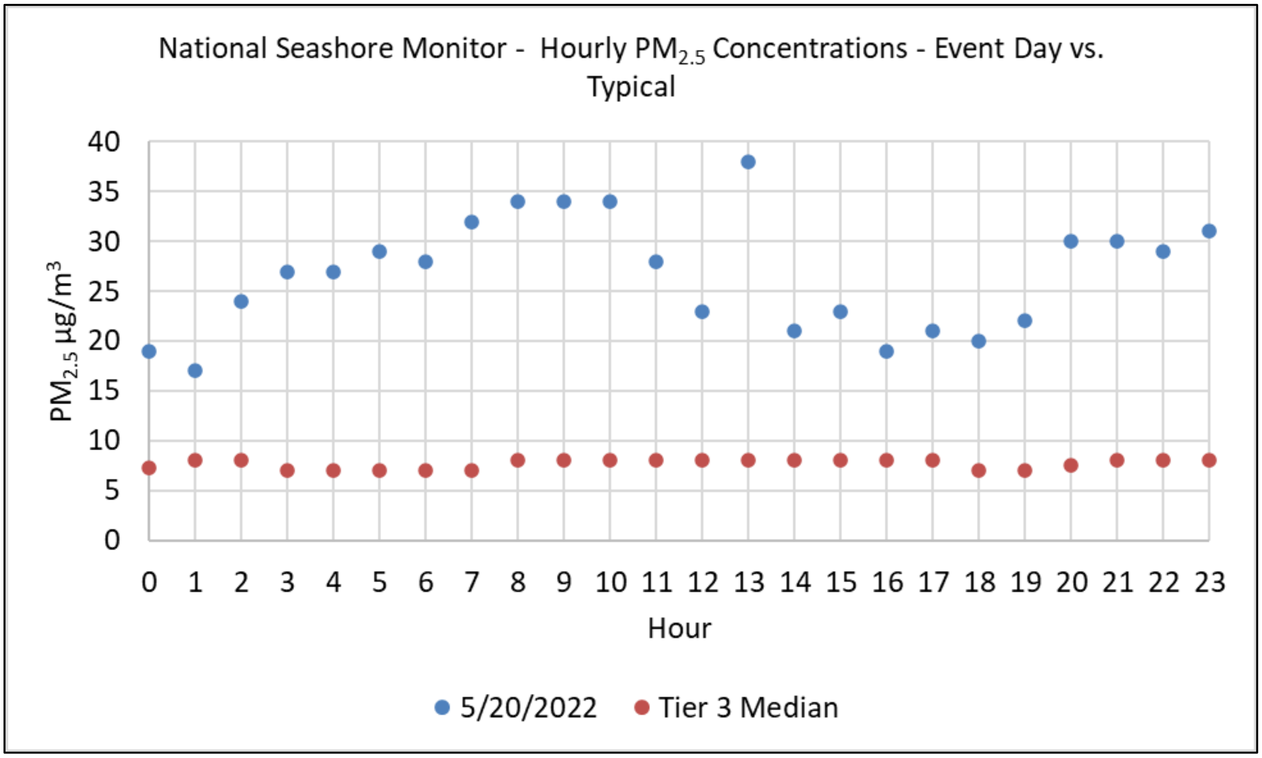


Figure 3-50: Hourly $PM_{2.5}$ concentrations on May 20, 2022, compared to typical concentrations at the National Seashore Monitor

3.2.7 Group 7: Evidence for June 11 through June 17, 2022, Saharan Dust $PM_{2.5}$ Event for the National Seashore Monitor, Karnack Monitor, and Webberville Monitor

All three monitoring sites (Austin Webberville, National Seashore, and Karnack) were impacted by Saharan dust during this episode. The National Seashore monitoring site was impacted from June 11 through June 17, 2022, and except for June 11, 2022, all were identified as Tier 1 days. Similarly, the Austin Webberville site was impacted on June 13, June 16, and June 17, 2022. June 17th was identified as a Tier 2 day for the Austin Webberville site. The Karnack monitoring site was impacted from June 13th through June 16, 2022; and all were identified as Tier 1 days. The evidence provided meets requirements for Tier 1 and Tier 2 demonstrations for the days impacted by Saharan dust.

Figure 3-51: *Aerosol optical depth map from MODIS Terra and Aqua on June 11, 2022,* shows MODIS Aqua and Terra AOD imaging corroborating the high concentration of dust seen in the area, with the yellow dot denoting air quality in moderate category. The HYSPLIT back trajectory at 100 m, 500 m, and 800 m AGL passes through very high concentration of aerosol over the Gulf of Mexico region to the Mexico/Central America with optical depth flow, as seen by reddish color on the image. This is shown in Figure 352: *HYSPLIT back trajectories from the National Seashore monitoring site on June 11, 2022.* HYSPLIT back trajectories starting from each hour from the National Seashore monitor further support transport of dust aerosols, as shown in Figure 3-53: *72-hour HYSPLIT back trajectories starting from each hour on June 11, 2022, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL*. HYSPLIT forward trajectories starting from Western Africa arrive at Texas, as shown in Figure 3-54: *HYSPLIT forward trajectories from Western Africa, starting on May 28, 2022*, which too pass through the high concentrations of aerosols with red optical depth flow traveling from Africa. Figure 3-55: *Hourly $PM_{2.5}$ concentrations on June 11, 2022, compared to typical concentrations at the National Seashore Monitor* shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median).

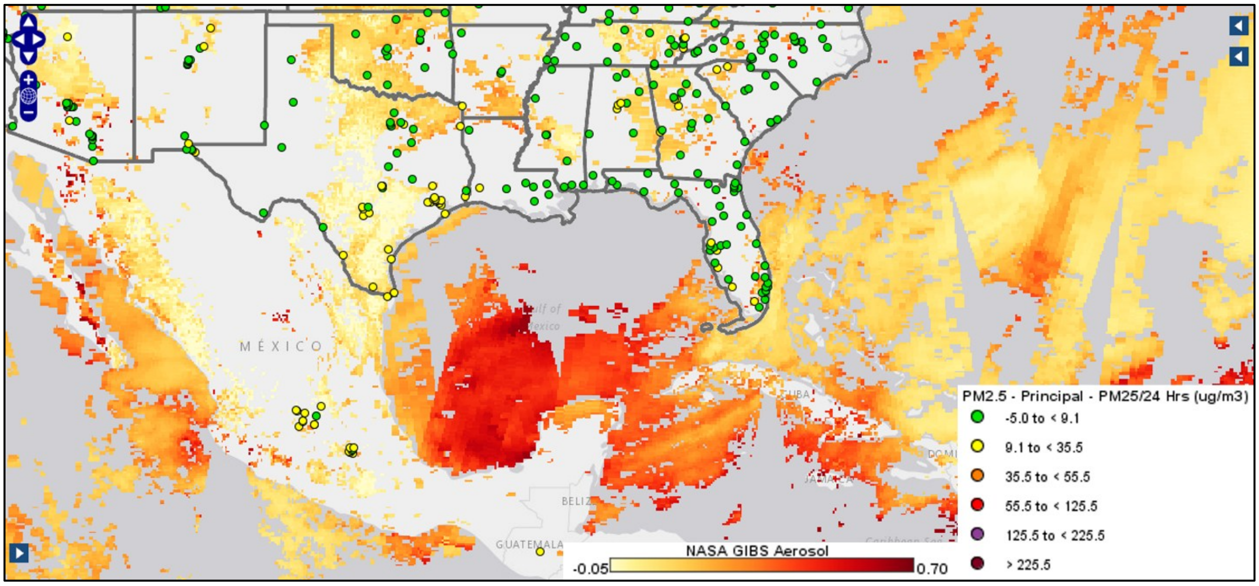


Figure 3-51: Aerosol optical depth map from MODIS Terra and Aqua on June 11, 2022

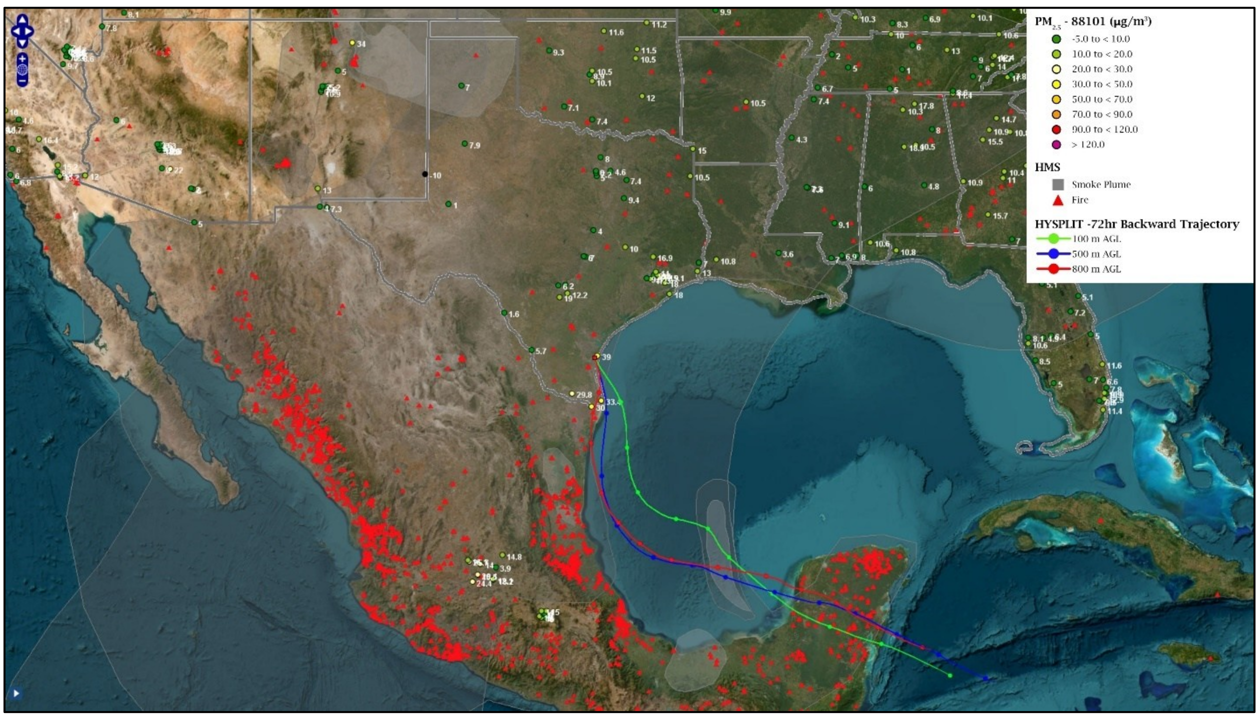


Figure 3-52: HYSPLIT back trajectories from the National Seashore monitoring site on June 11, 2022

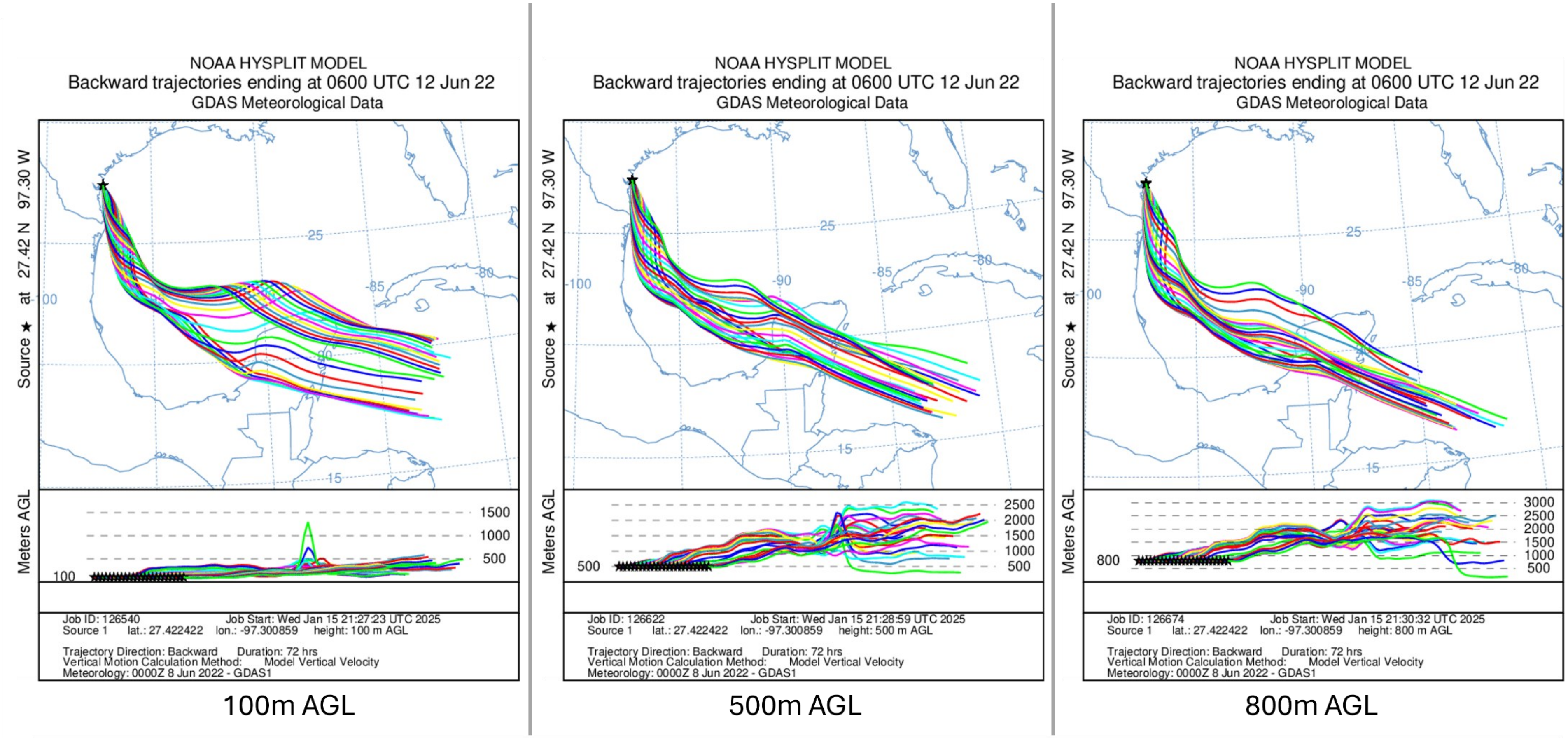


Figure 3-53: 72-hour HYSPLIT back trajectories starting from each hour on June 11, 2022, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL

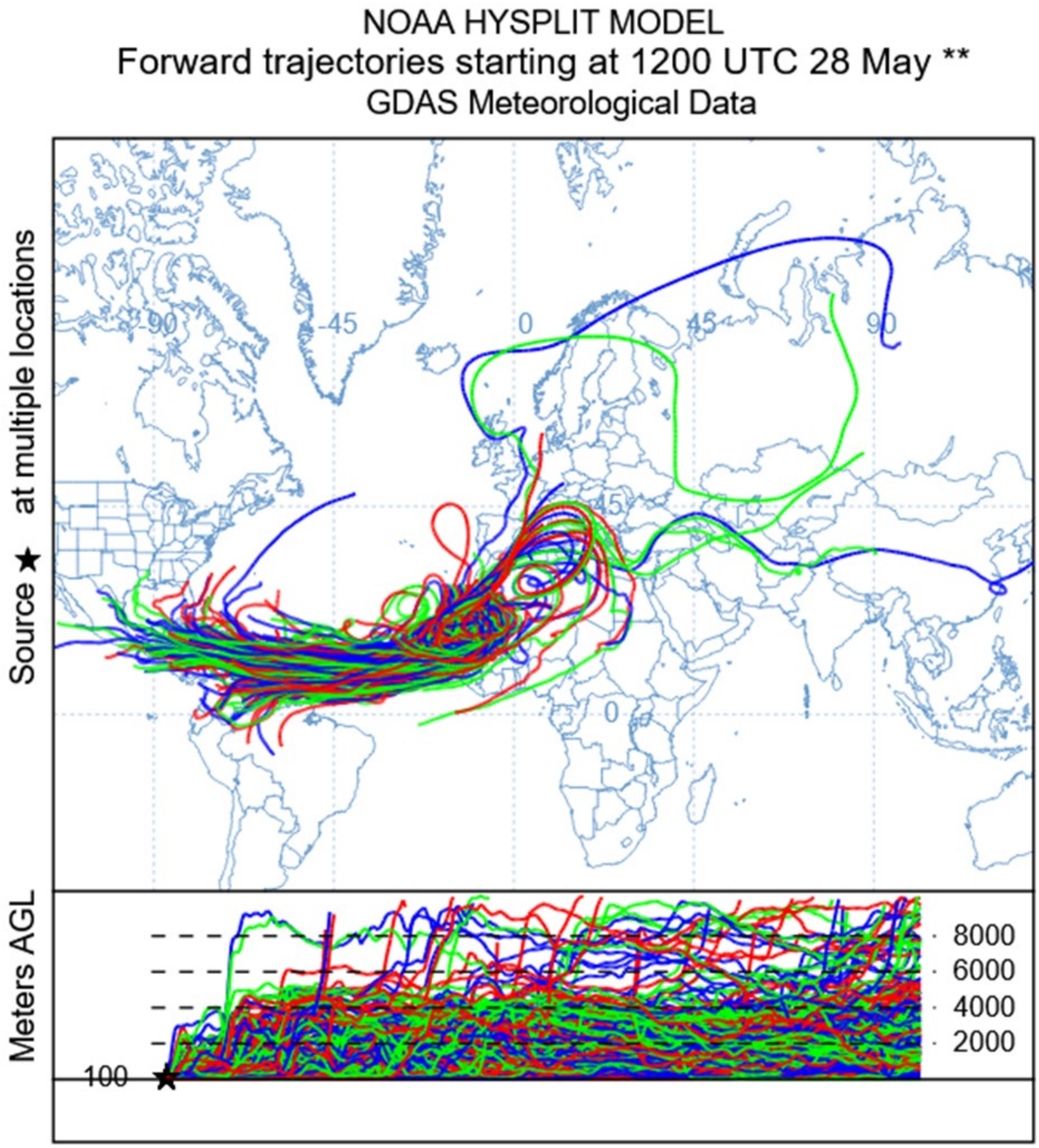


Figure 3-54: HYSPLIT forward trajectories from Western Africa, starting on May 28, 2022

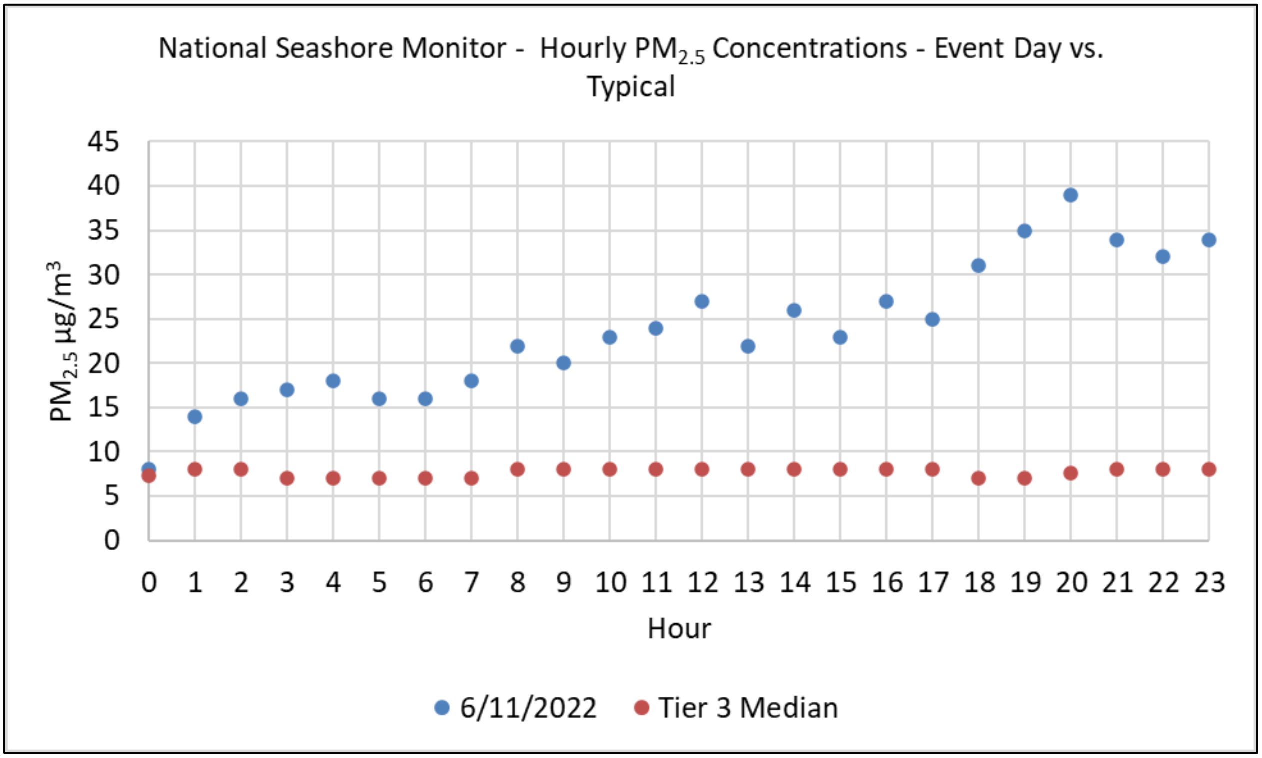


Figure 3-55: Hourly $PM_{2.5}$ concentrations on June 11, 2022, compared to typical concentrations at the National Seashore Monitor

Figure 3-56: *Aerosol optical depth map from MODIS Terra and Aqua on June 12, 2022*, shows a MODIS Aqua and Terra AOD image showing aerosols dust over the National Seashore monitor, with the orange dot denoting air quality in the unhealthy category. The HYSPLIT back trajectories pass through the Gulf of Mexico, as shown in Figure 3-57: *HYSPLIT back trajectories from the National Seashore monitoring site on June 12, 2022*. Figure 3-58: *Hourly $PM_{2.5}$ concentrations on June 12, 2022, compared to typical concentrations at the National Seashore Monitor* shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median).

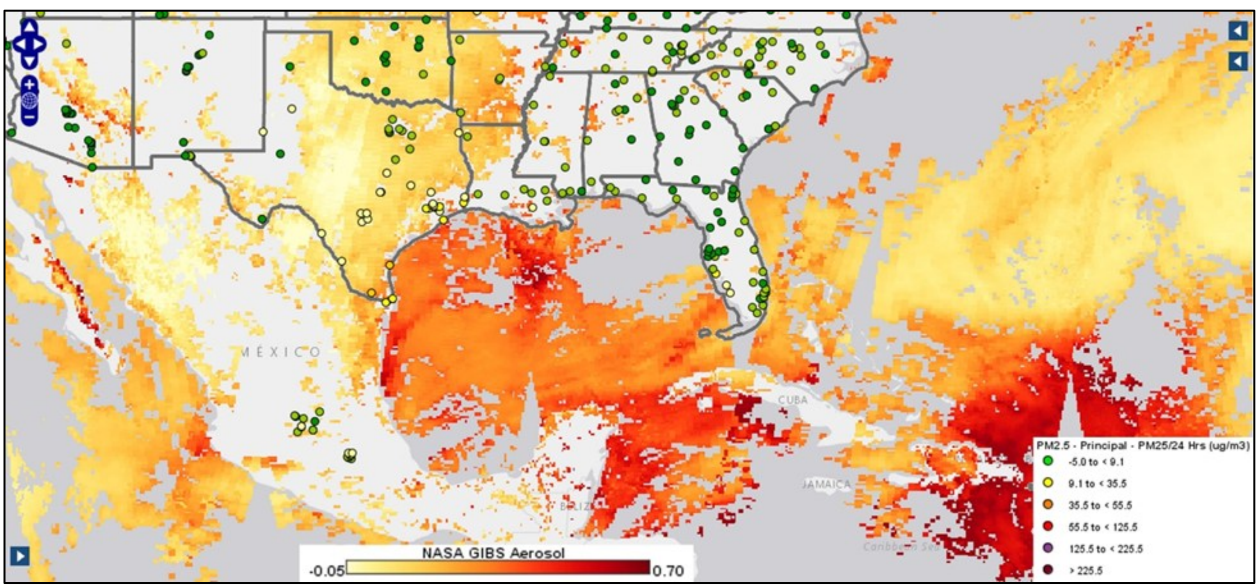


Figure 3-56: Aerosol optical depth map from MODIS Terra and Aqua on June 12, 2022

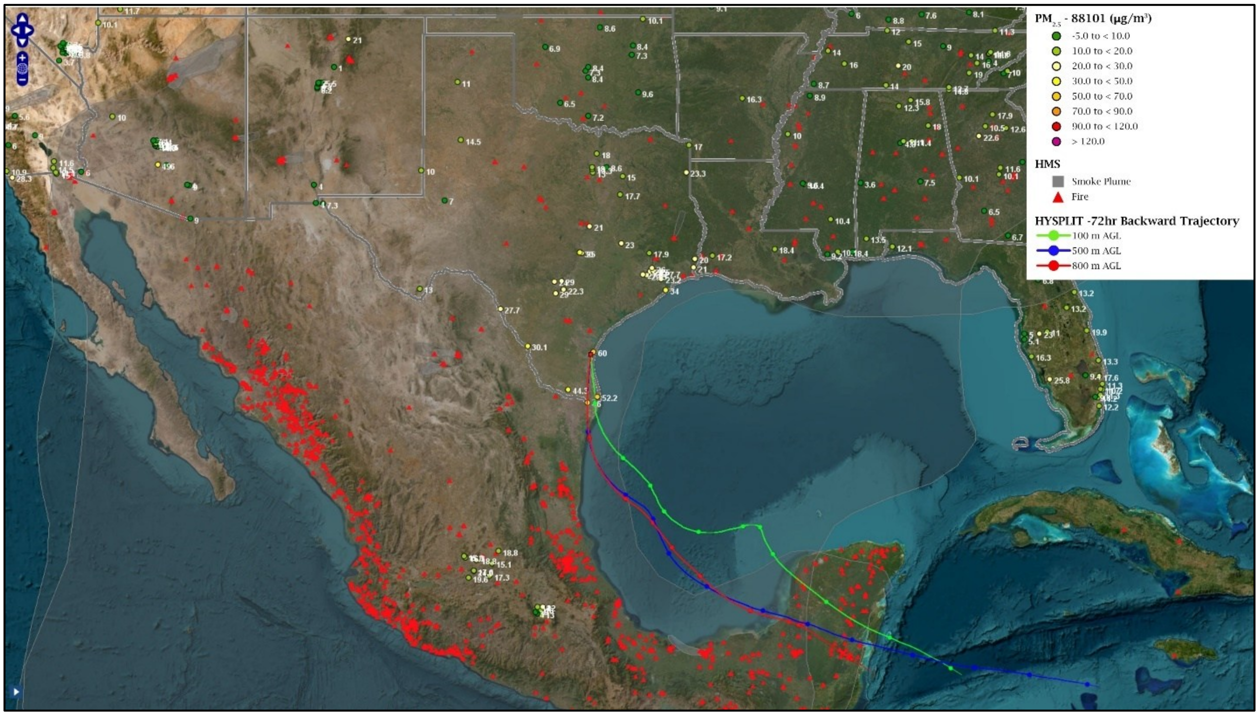


Figure 3-57: HYSPLIT back trajectories from the National Seashore monitoring site on June 12, 2022

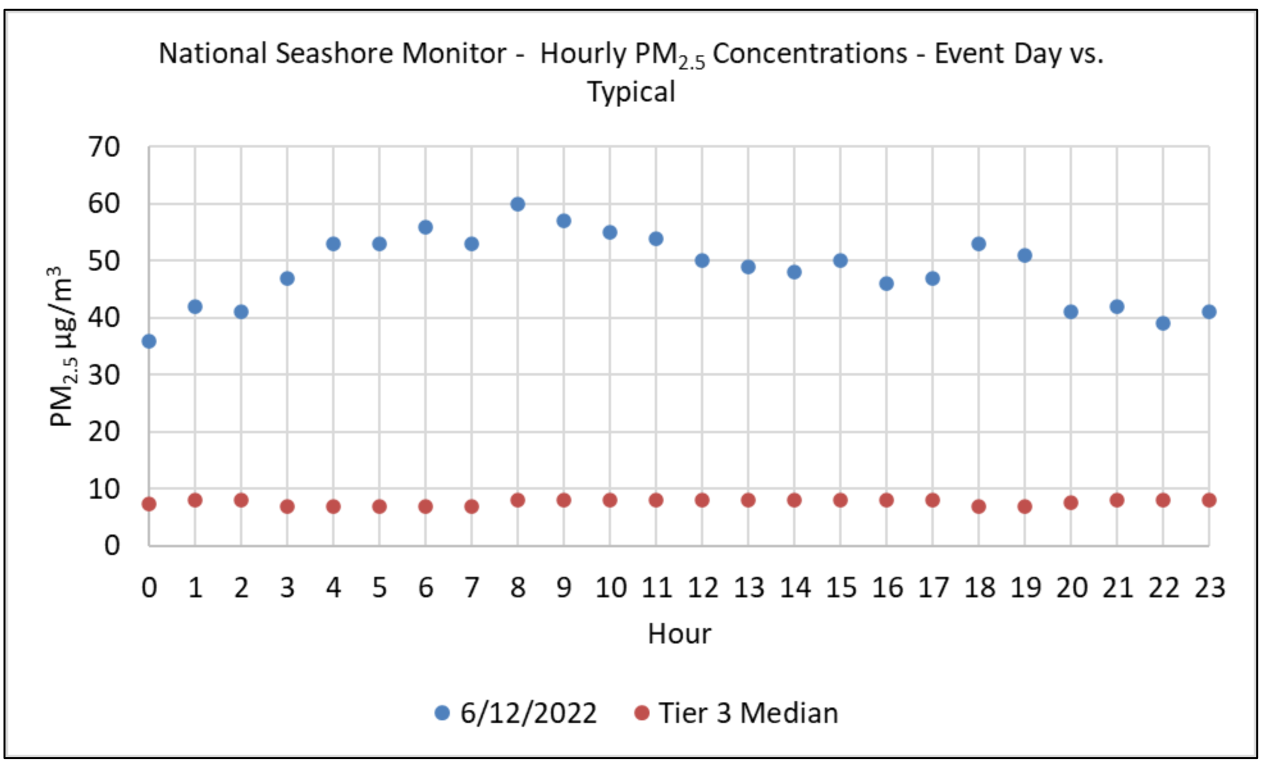


Figure 3-58: Hourly $PM_{2.5}$ concentrations on June 12, 2022, compared to typical concentrations at the National Seashore Monitor

For June 13th, Figure 3-59: *Aerosol optical depth map from MODIS Terra and Aqua on June 13, 2022,* shows MODIS Aqua and Terra AOD image corroborating the high concentration of dust seen in the Karnack and Austin area, with the orange dot denoting air quality in the unhealthy category. The HYSPLIT back trajectory originating from the Karnack monitoring site at 100 m, 500 m, and 800 m AGL passes over the Gulf of Mexico region containing aerosols and leads back to Mexico/Central America. This is shown in Figure 3-60: *HYSPLIT back trajectories from the Karnack monitoring site on June 13, 2022*. HYSPLIT forward trajectories starting from Africa arrive at Texas, as shown in Figure 3-61: *HYSPLIT forward trajectories from Western Africa, starting on May 29, 2022*. Figure 3-62: *Hourly $PM_{2.5}$ concentrations on June 13, 2022, compared to typical concentrations at the Karnack Monitor* shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median). Similarly, Figure 3-63: *HYSPLIT back trajectories from the Austin Webberville monitoring site on June 13, 2022,* and Figure 3-64: *Hourly $PM_{2.5}$ concentrations on June 13, 2022, compared to typical concentrations at the Webberville Monitor* show evidence for the Austin Webberville monitoring site for a Tier 1 demonstration for June 13th.

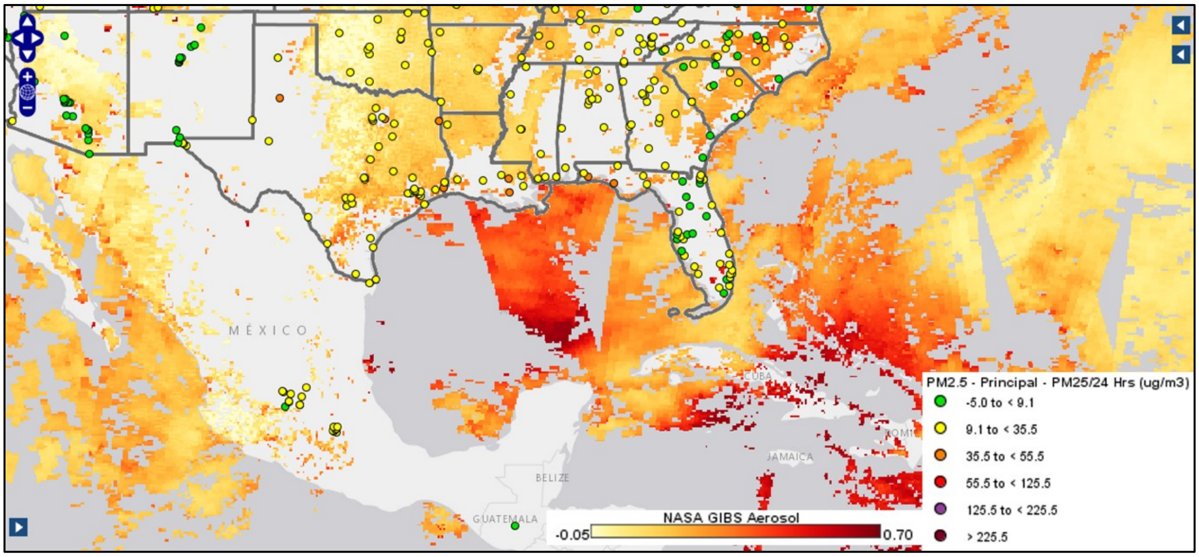


Figure 3-59: Aerosol optical depth map from MODIS Terra and Aqua on June 13, 2022

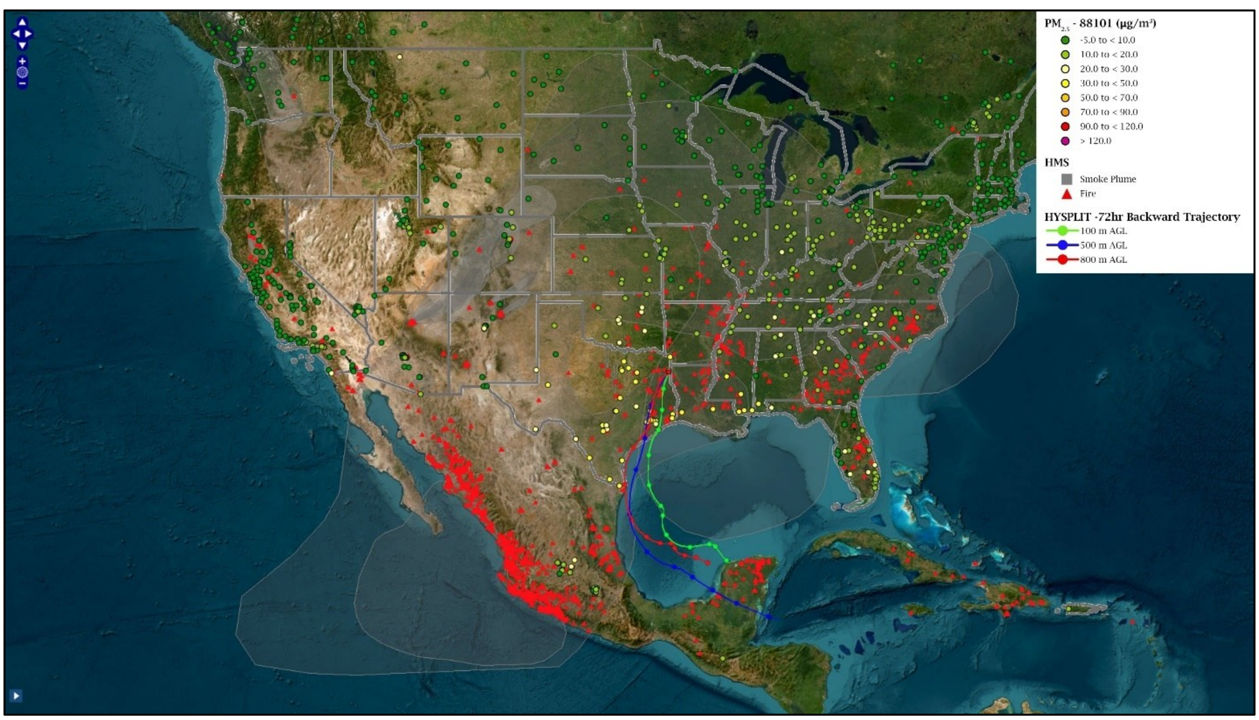


Figure 3-60: HYSPLIT back trajectories from the Karnack monitoring site on June 13, 2022

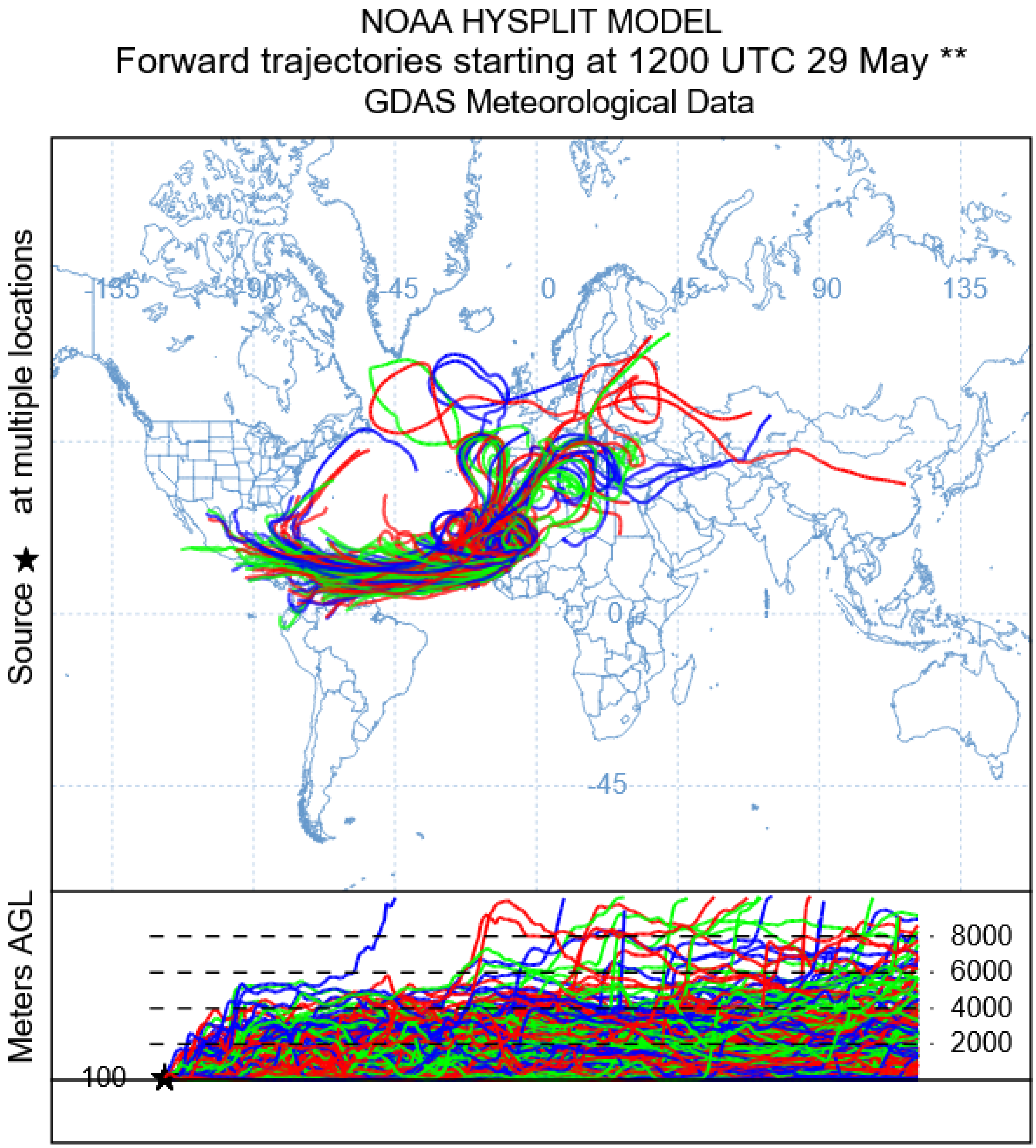


Figure 3-61: HYSPLIT forward trajectories from Western Africa, starting on May 29, 2022

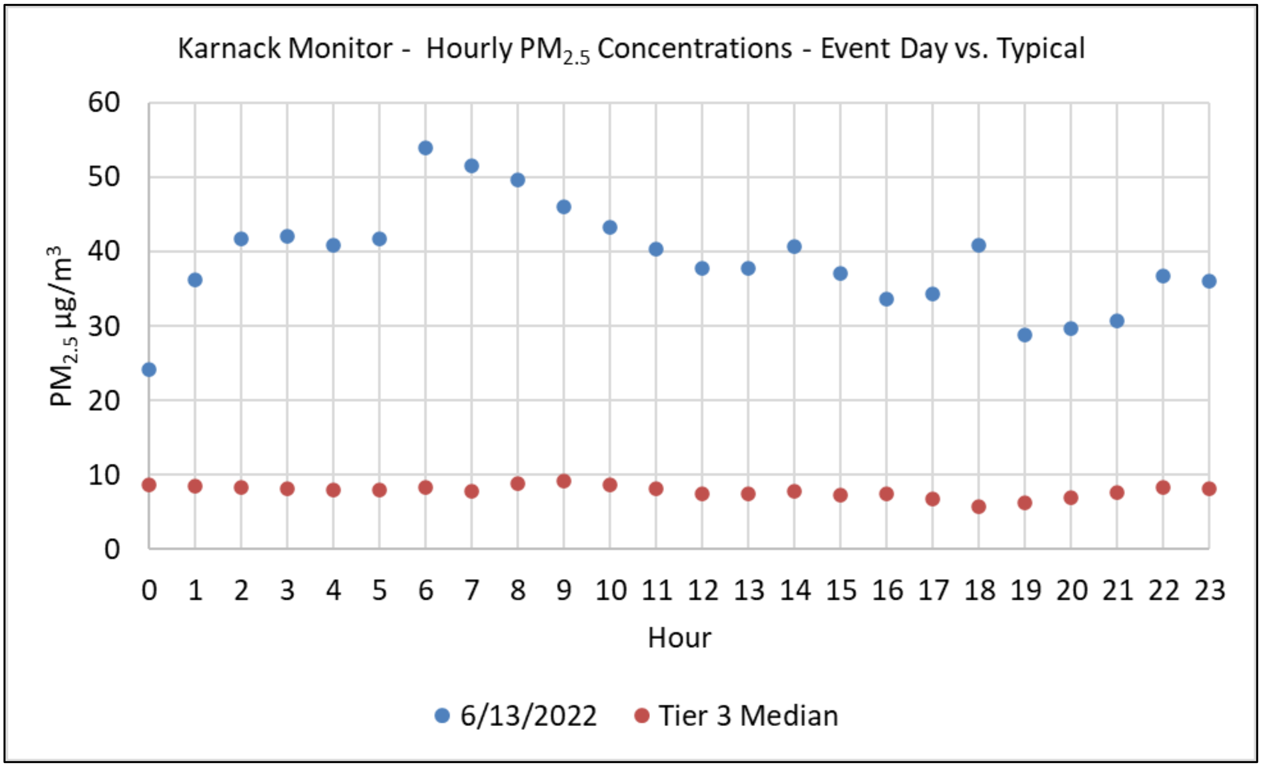


Figure 3-62: Hourly $PM_{2.5}$ concentrations on June 13, 2022, compared to typical concentrations at the Karnack Monitor

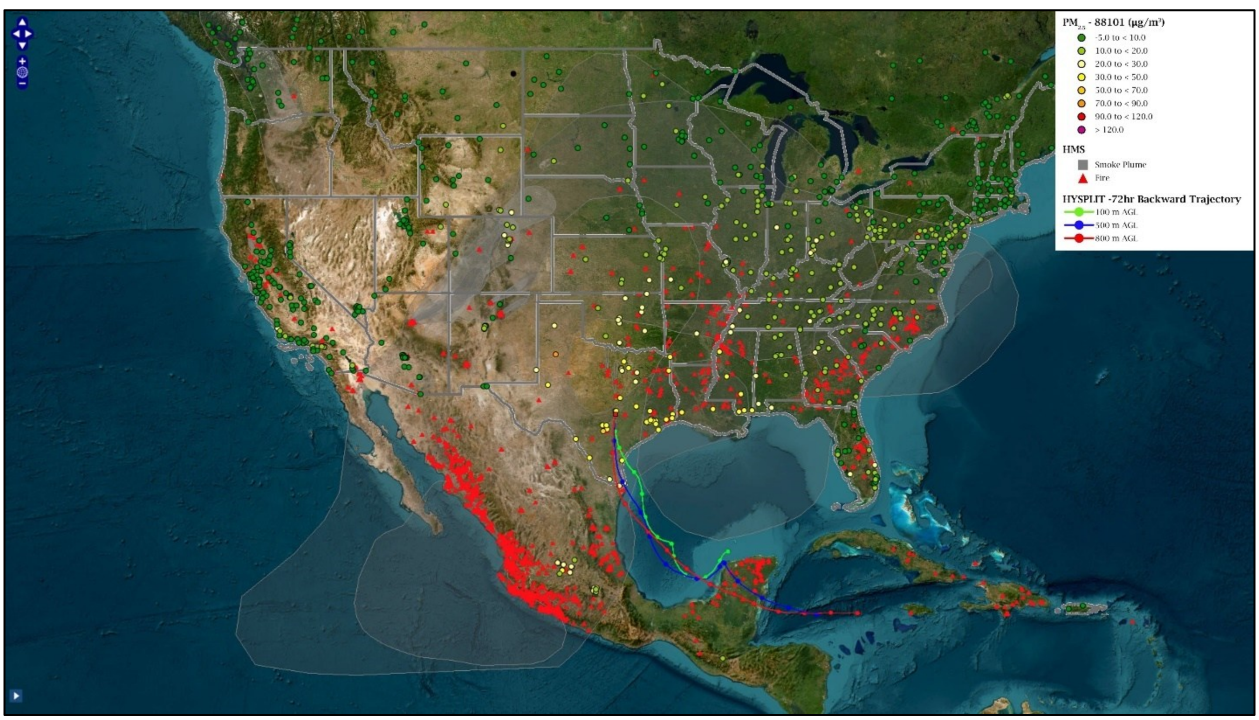


Figure 3-63: HYSPLIT back trajectories from the Austin Webberville monitoring site on June 13, 2022

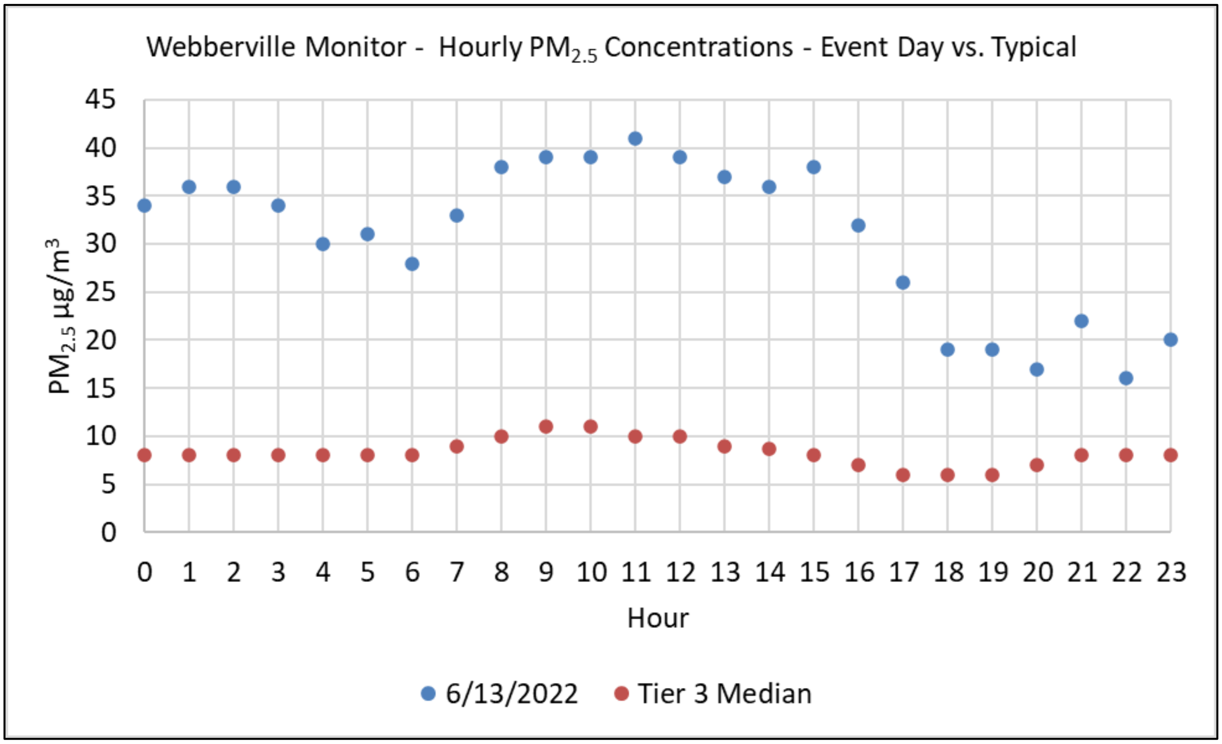


Figure 3-64: Hourly $PM_{2.5}$ concentrations on June 13, 2022, compared to typical concentrations at the Webberville Monitor

For June 13th, Figure 3-59 shows a MODIS Aqua and Terra AOD image corroborating the pulse of Saharan dust traveling from Western Africa and reaching Texas. The yellow dot at the National Seashore monitoring site denotes air quality in the moderate category. The HYSPLIT back trajectory originating from the National Seashore monitoring site at 100 m, 500 m, and 800 m AGL passes over the Gulf of Mexico region to the areas containing high aerosols, as shown in Figure 3-65: *HYSPLIT back trajectories from the National Seashore monitoring site on June 13, 2022*. HYSPLIT forward trajectories starting from Western Africa arrive at Texas, as shown in Figure 3-61. Figure 3-66: *Hourly $PM_{2.5}$ concentrations on June 13, 2022, compared to typical concentrations at the National Seashore Monitor* shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median).

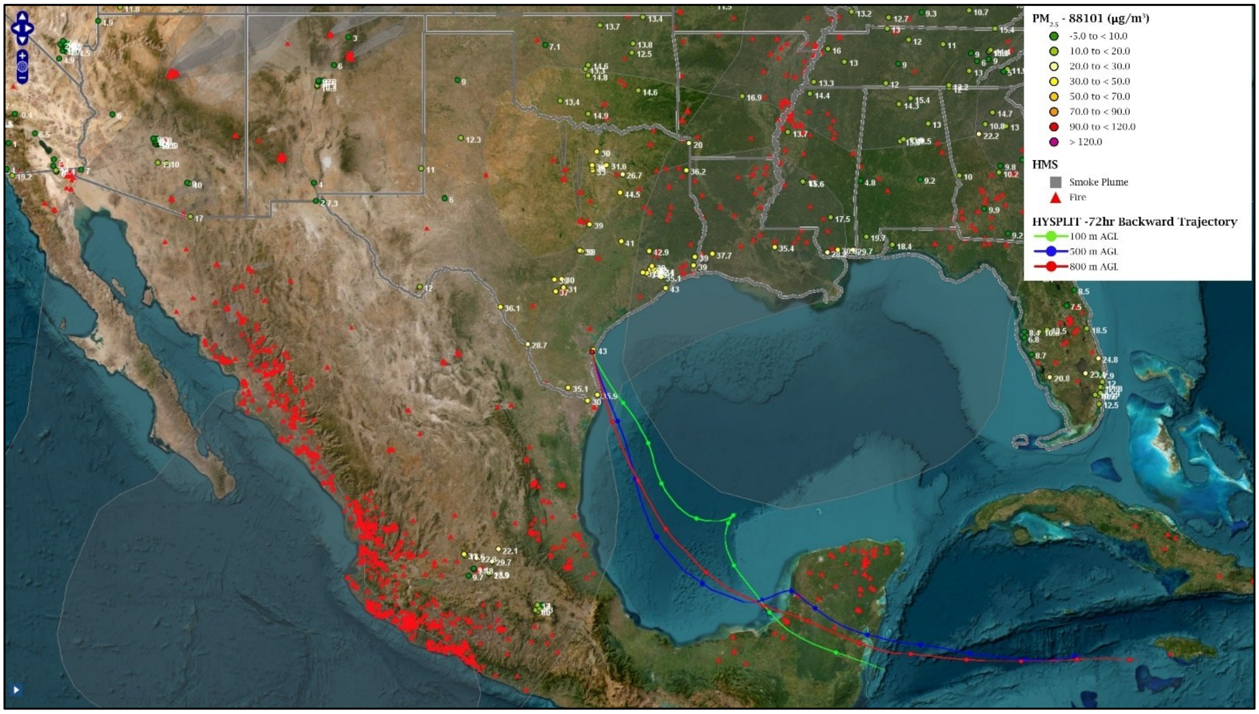


Figure 3-65: HYSPLIT back trajectories from the National Seashore monitoring site on June 13, 2022

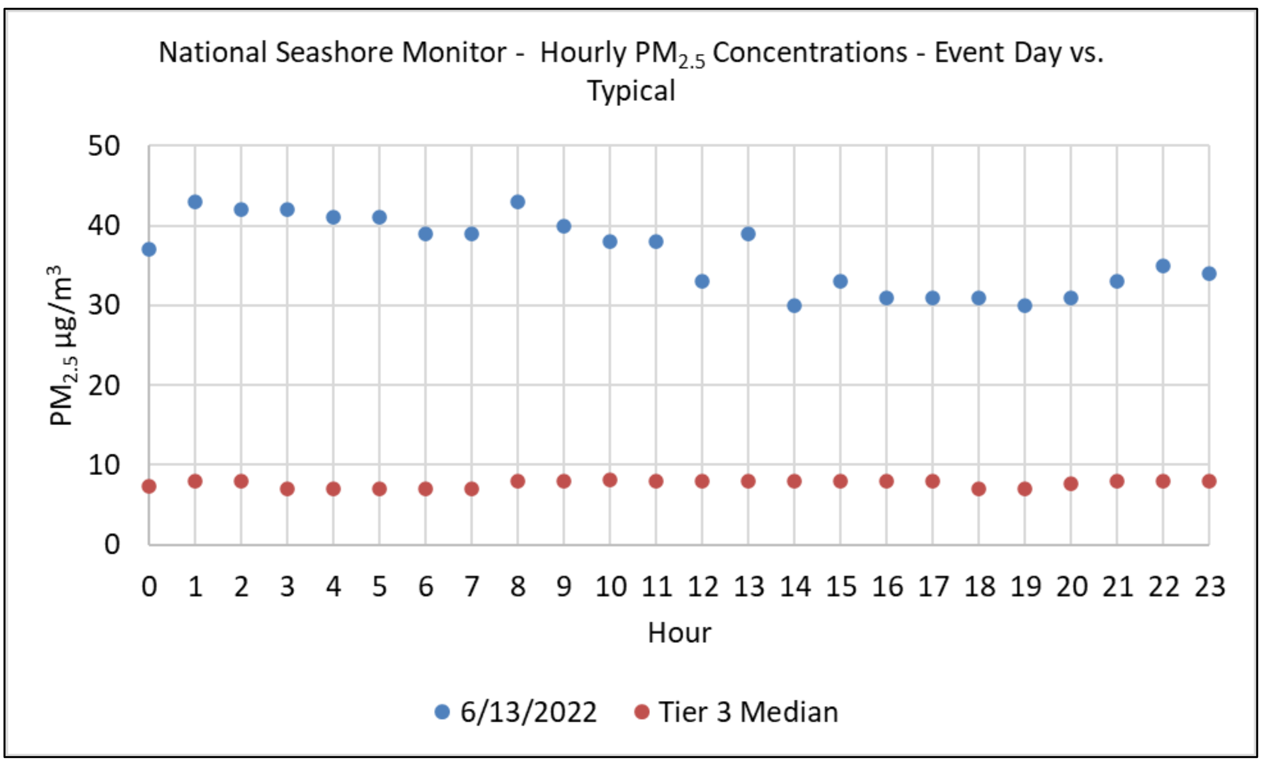


Figure 3-66: Hourly $PM_{2.5}$ concentrations on June 13, 2022, compared to typical concentrations at the National Seashore Monitor

Figure 3-67: *Aerosol optical depth map from MODIS Terra and Aqua on June 14, 2022*, Figure 3-68: *HYSPLIT back trajectories from the Karnack monitoring site on June 14, 2022*, Figure 3-69: *HYSPLIT forward trajectories from Western Africa, starting on May 31, 2022*, and Figure 3-70: *Hourly $PM_{2.5}$ concentrations on June 14, 2022, compared to typical concentrations at the Karnack Monitor* show evidence for the Karnack monitoring site, and Figure 3-67, Figure 3-71: *HYSPLIT back trajectories from the National Seashore monitoring site on June 14, 2022*, and Figure 3-72: *Hourly $PM_{2.5}$ concentrations on June 14, 2022, compared to typical concentrations at the*

National Seashore Monitor show evidence for the National Seashore monitoring site for June 14th. This evidence meets requirements for Tier 1 demonstrations impacted by Saharan dust event.

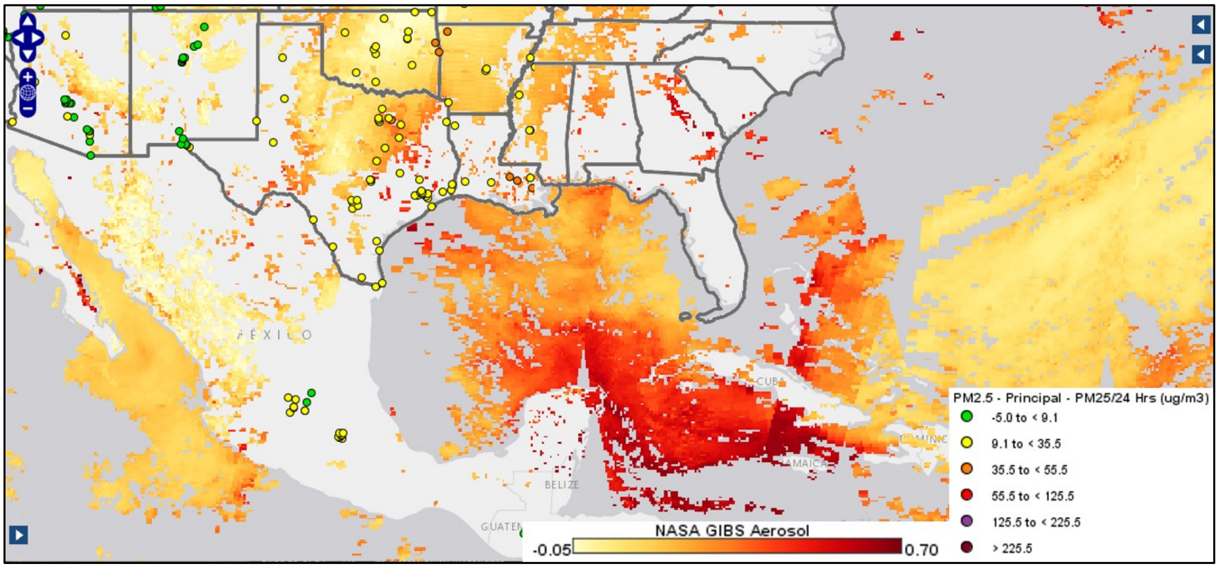


Figure 3-67: Aerosol optical depth map from MODIS Terra and Aqua on June 14, 2022

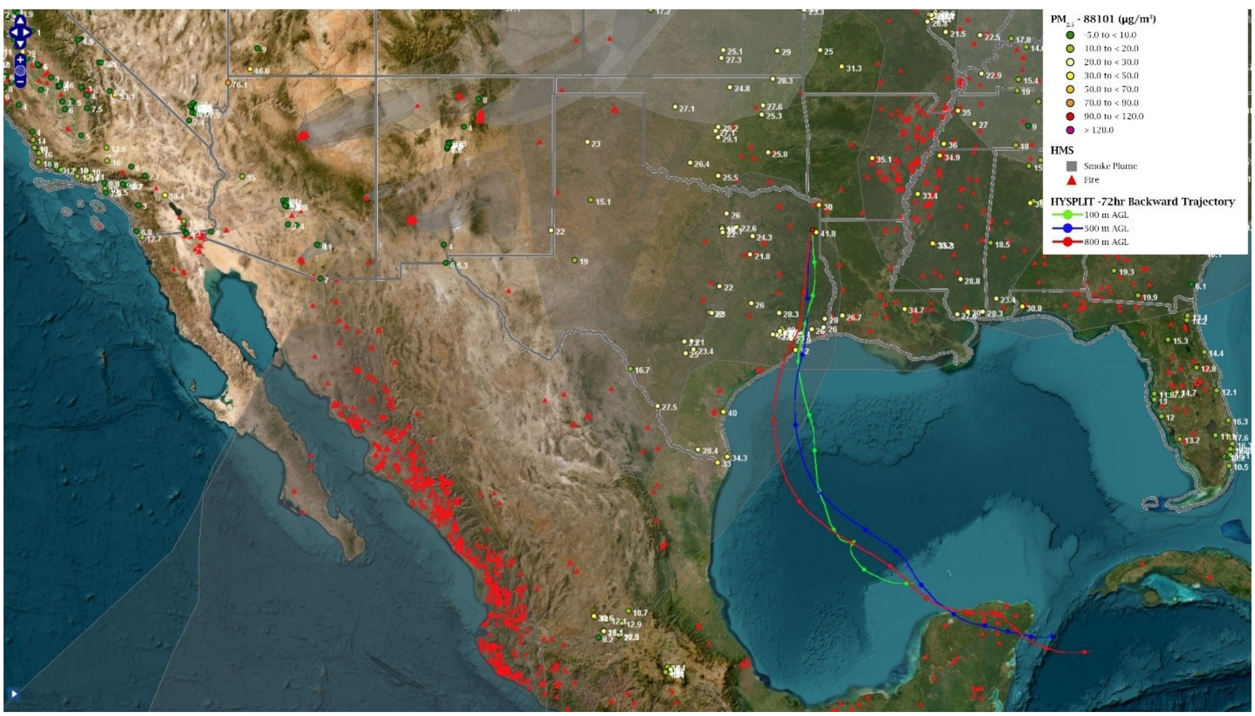


Figure 3-68: HYSPLIT back trajectories from the Karnack monitoring site on June 14, 2022

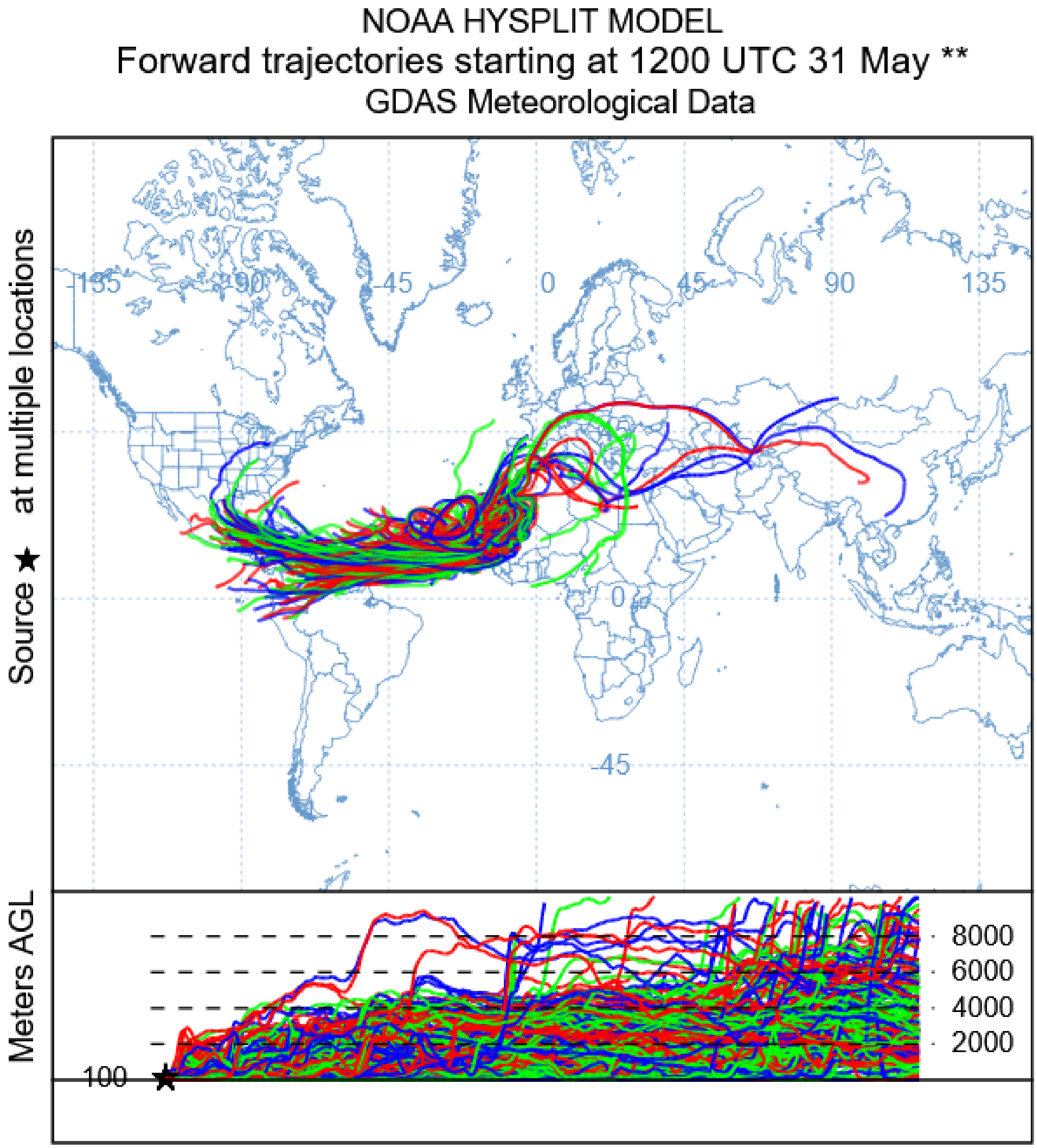


Figure 3-69: HYSPLIT forward trajectories from Western Africa, starting on May 31, 2022

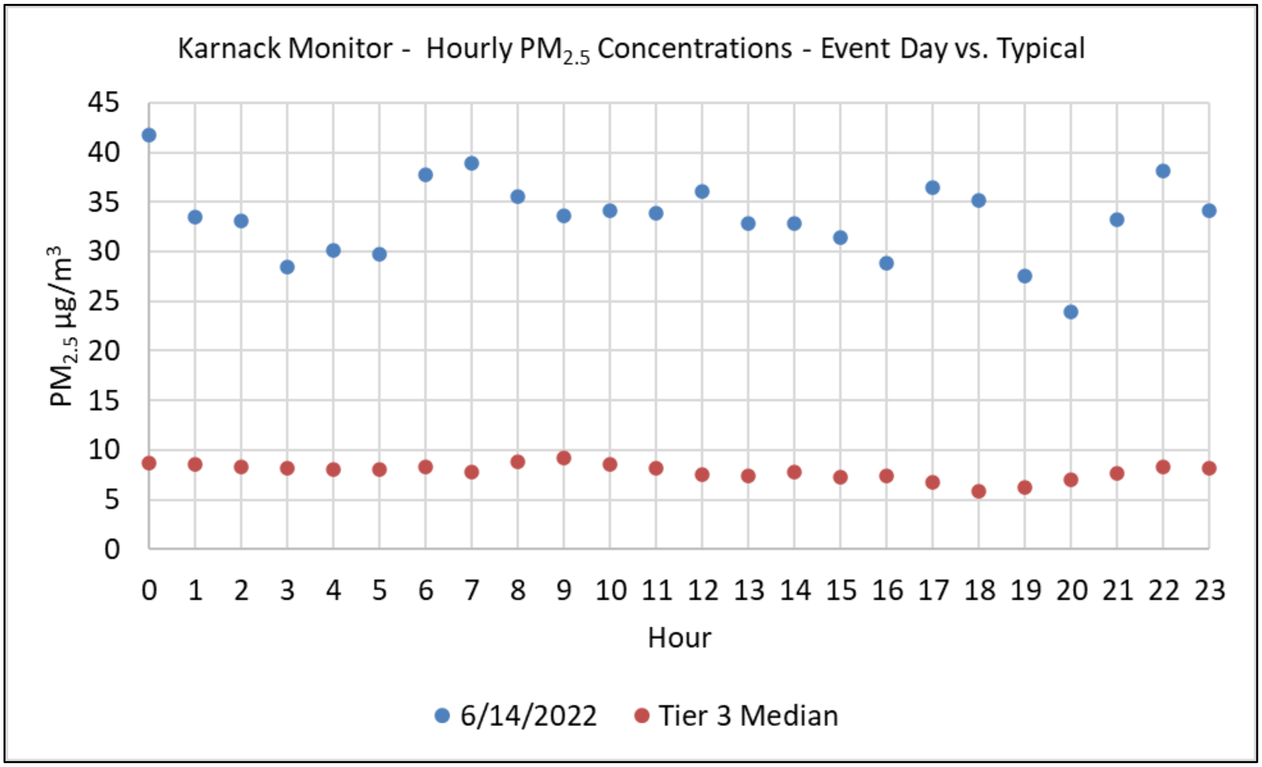


Figure 3-70: Hourly $PM_{2.5}$ concentrations on June 14, 2022, compared to typical concentrations at the Karnack Monitor

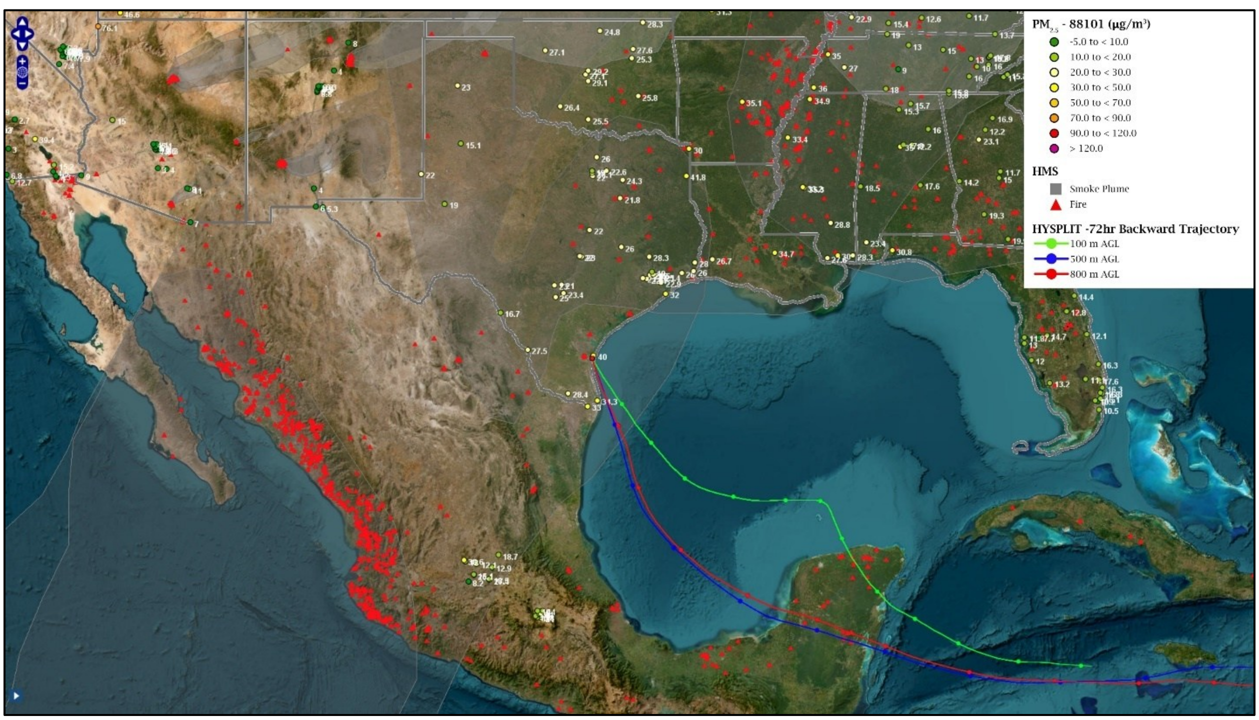


Figure 3-71: HYSPLIT back trajectories from the National Seashore monitoring site on June 14, 2022

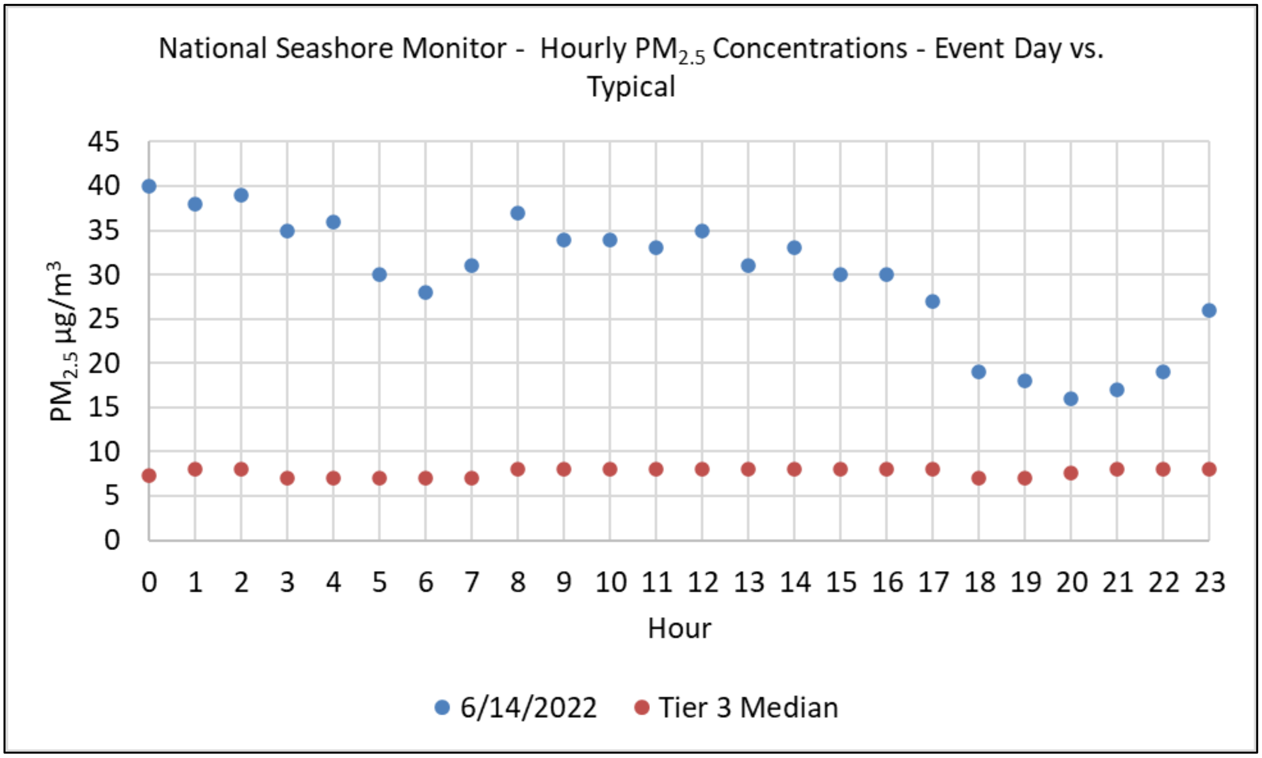


Figure 3-72: Hourly $PM_{2.5}$ concentrations on June 14, 2022, compared to typical concentrations at the National Seashore Monitor

Figure 3-73: *Aerosol optical depth map from MODIS Terra and Aqua on June 15, 2022*, Figure 3-74: *HYSPLIT back trajectories from the Karnack monitoring site on June 15, 2022*, Figure 3-75: *HYSPLIT forward trajectories from Western Africa, starting on June 1, 2022*, and Figure 3-76: *Hourly $PM_{2.5}$ concentrations on June 15, 2022, compared to typical concentrations at the Karnack Monitor* show evidence for the Karnack monitoring site, and Figure 3-73, Figure 3-77: *HYSPLIT back trajectories from the National Seashore monitoring site on June 15, 2022*, and Figure 3-78: *Hourly $PM_{2.5}$ concentrations on June 15, 2022, compared to typical concentrations at the National Seashore Monitor* show evidence for the National Seashore monitoring site for June 15th. This evidence meets the requirements for Tier 1 demonstrations for a day impacted by a Saharan dust event.

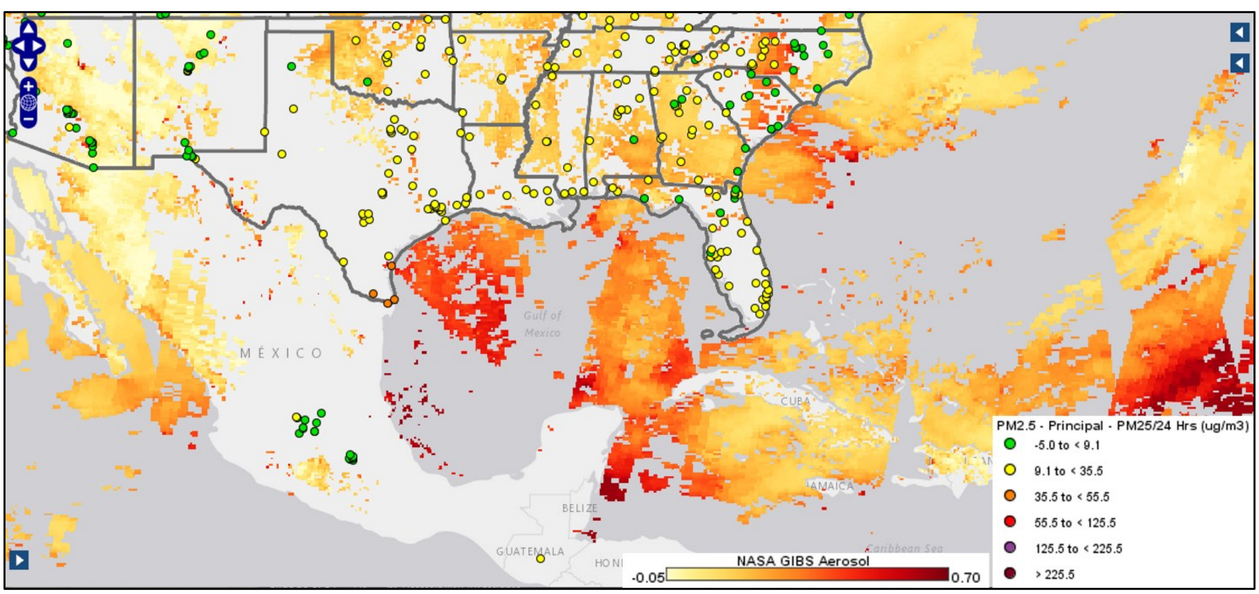


Figure 3-73: Aerosol optical depth map from MODIS Terra and Aqua on June 15, 2022

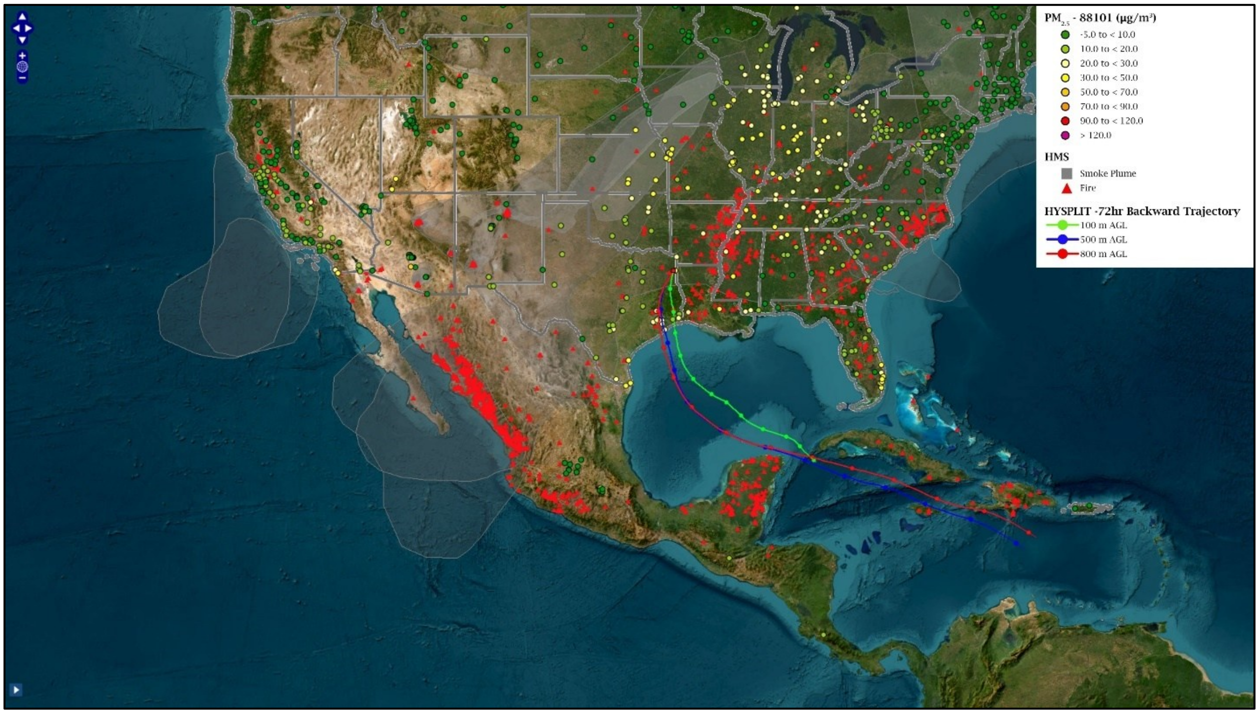


Figure 3-74: HYSPLIT back trajectories from the Karnack monitoring site on June 15, 2022

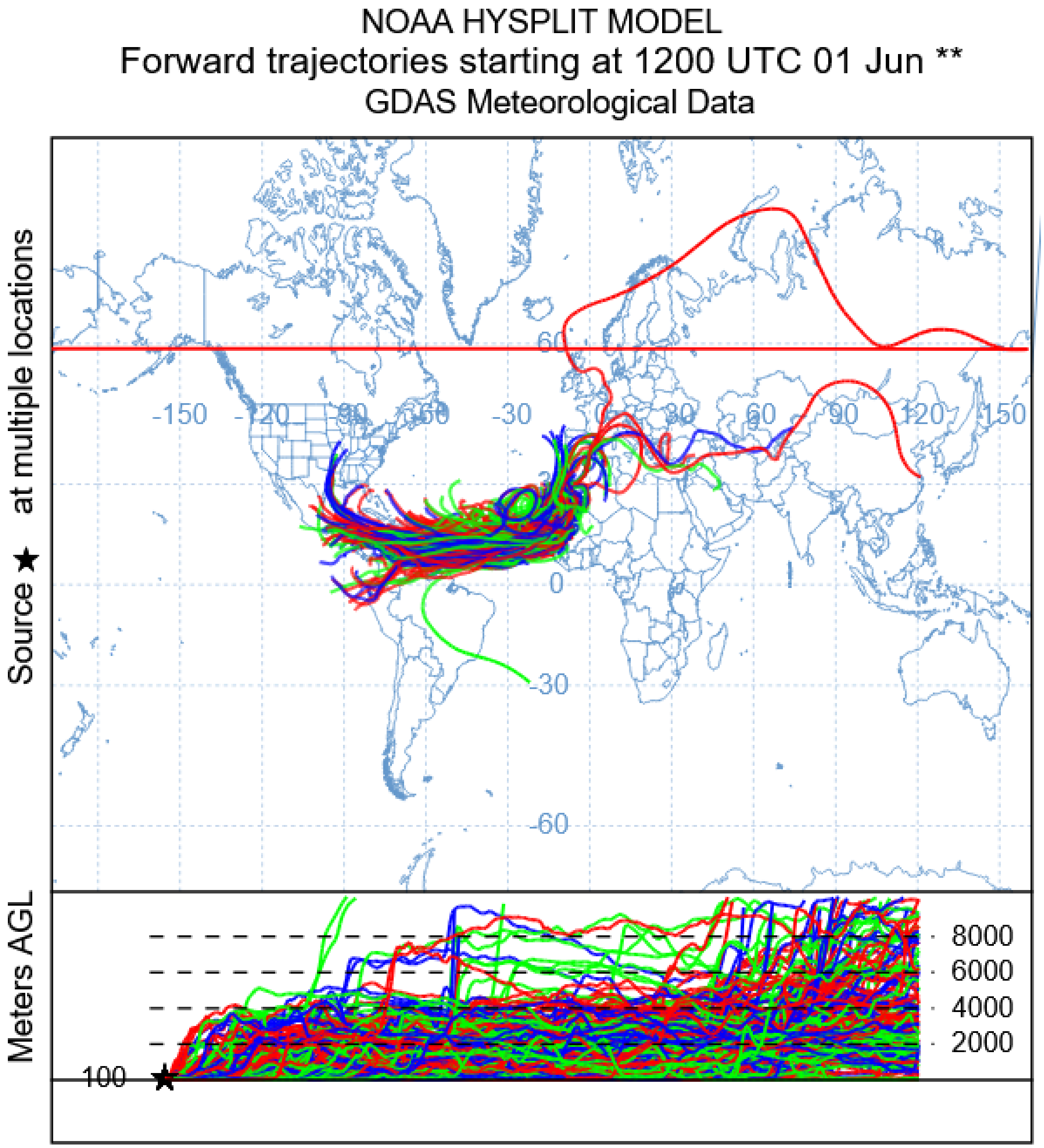


Figure 3-75: HYSPLIT forward trajectories from Western Africa, starting on June 1, 2022

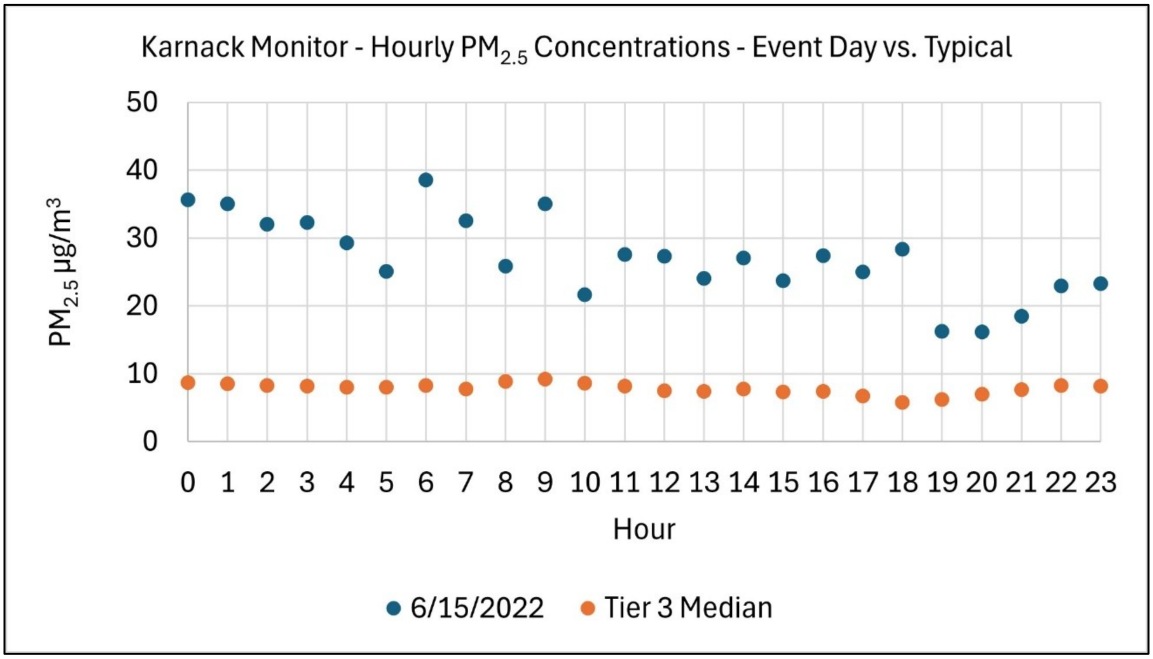


Figure 3-76: Hourly $PM_{2.5}$ concentrations on June 15, 2022, compared to typical concentrations at the Karnack Monitor

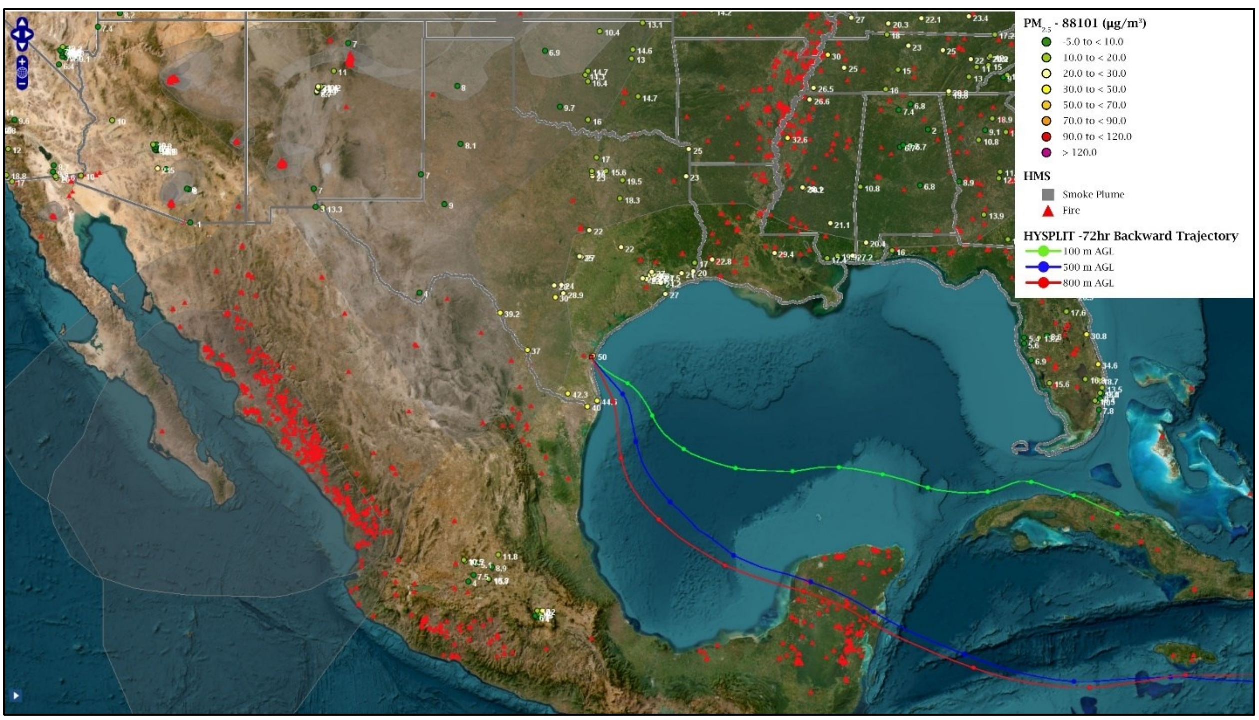


Figure 3-77: HYSPLIT back trajectories from the National Seashore monitoring site on June 15, 2022

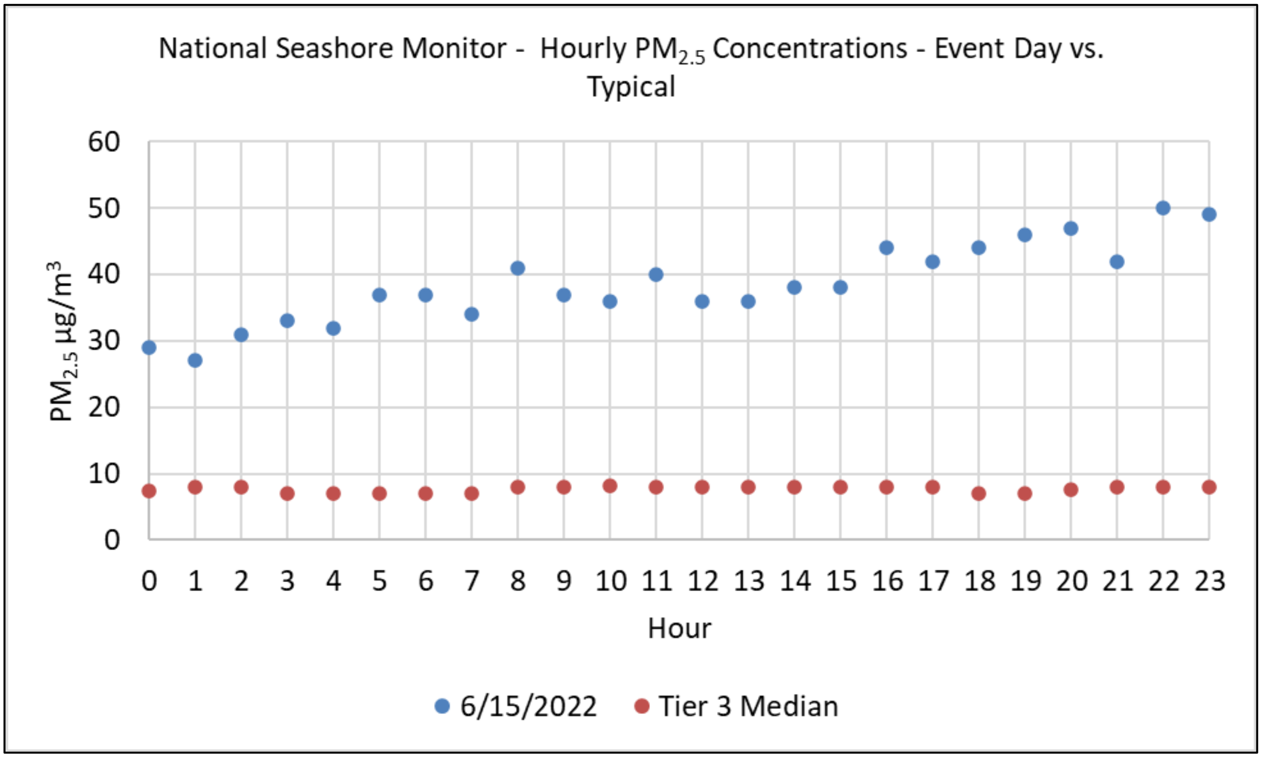


Figure 3-78: Hourly $PM_{2.5}$ concentrations on June 15, 2022, compared to typical concentrations at the National Seashore Monitor

Figure 3-79: Aerosol optical depth map from MODIS Terra and Aqua on June 16, 2022, shows evidence that Saharan dust impacted the Karnack, Austin Webberville, and National Seashore monitors, and air quality ranged from moderate to unhealthy levels. Figure 3-80: *HYSPLIT back trajectories from the Karnack monitoring site on June 16, 2022*, Figure 3-81: *HYSPLIT forward trajectories from Western Africa, starting on June 3, 2022*, and Figure 3-82: *Hourly $PM_{2.5}$ concentrations on June 16, 2022, compared to typical concentrations at the Karnack Monitor* show evidence for the Karnack monitoring site. Figure 3-83: *HYSPLIT back trajectories from the National Seashore monitoring site on June 16, 2022,* and Figure 3-84: *Hourly $PM_{2.5}$ concentrations on June 16, 2022, compared to typical concentrations at the National Seashore Monitor* show evidence for the National Seashore monitoring site. Figure 3-85: *HYSPLIT back trajectories from the Austin Webberville monitoring site on June 16, 2022,* and Figure 3-86: *Hourly $PM_{2.5}$ concentrations on June 16, 2022, compared to typical concentrations at the Webberville Monitor* show evidence for the Austin Webberville monitoring site for June 16th. This evidence meets the requirements for Tier 1 demonstrations for monitors impacted by a Saharan dust event.

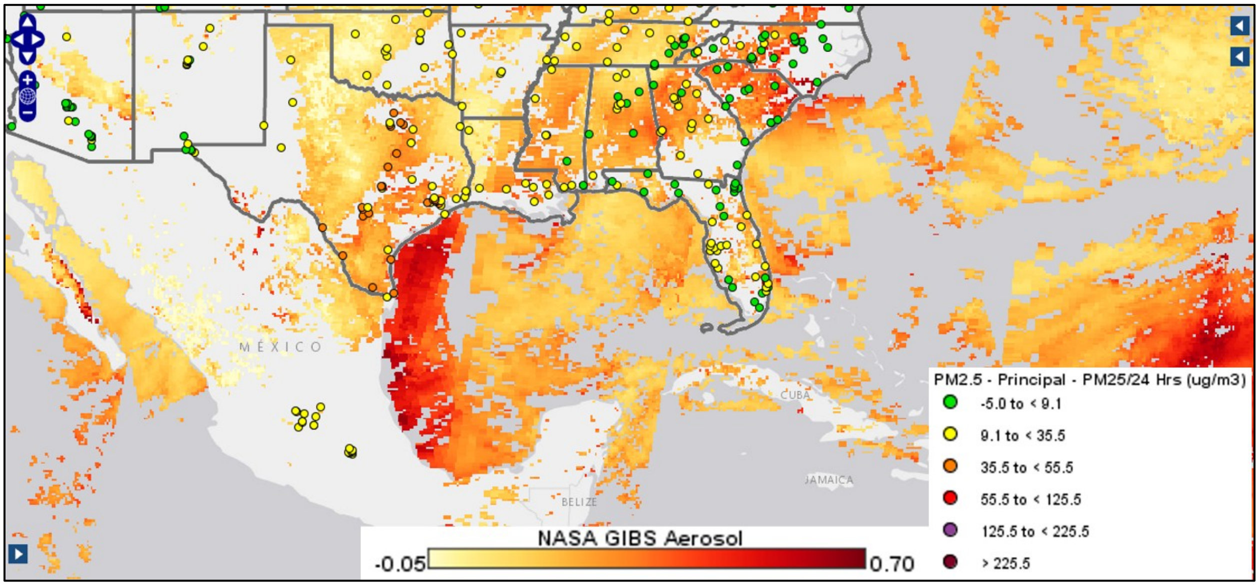


Figure 3-79: Aerosol optical depth map from MODIS Terra and Aqua on June 16, 2022

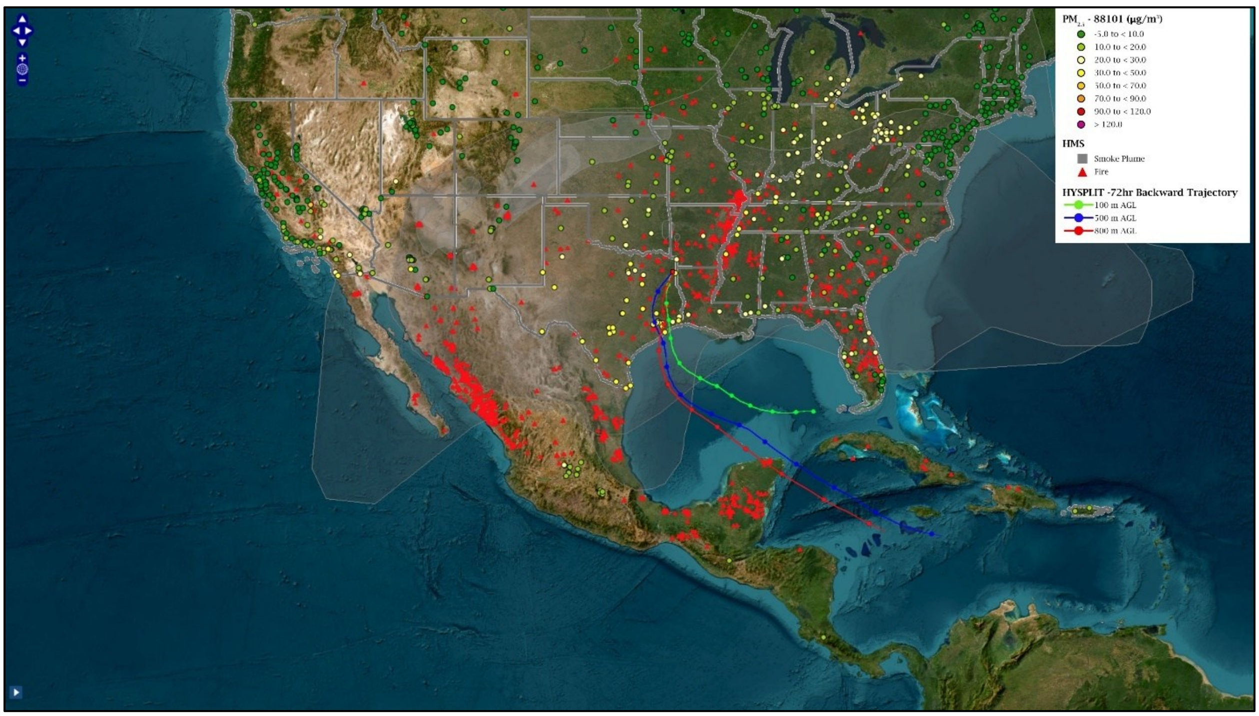


Figure 3-80: HYSPLIT back trajectories from the Karnack monitoring site on June 16, 2022

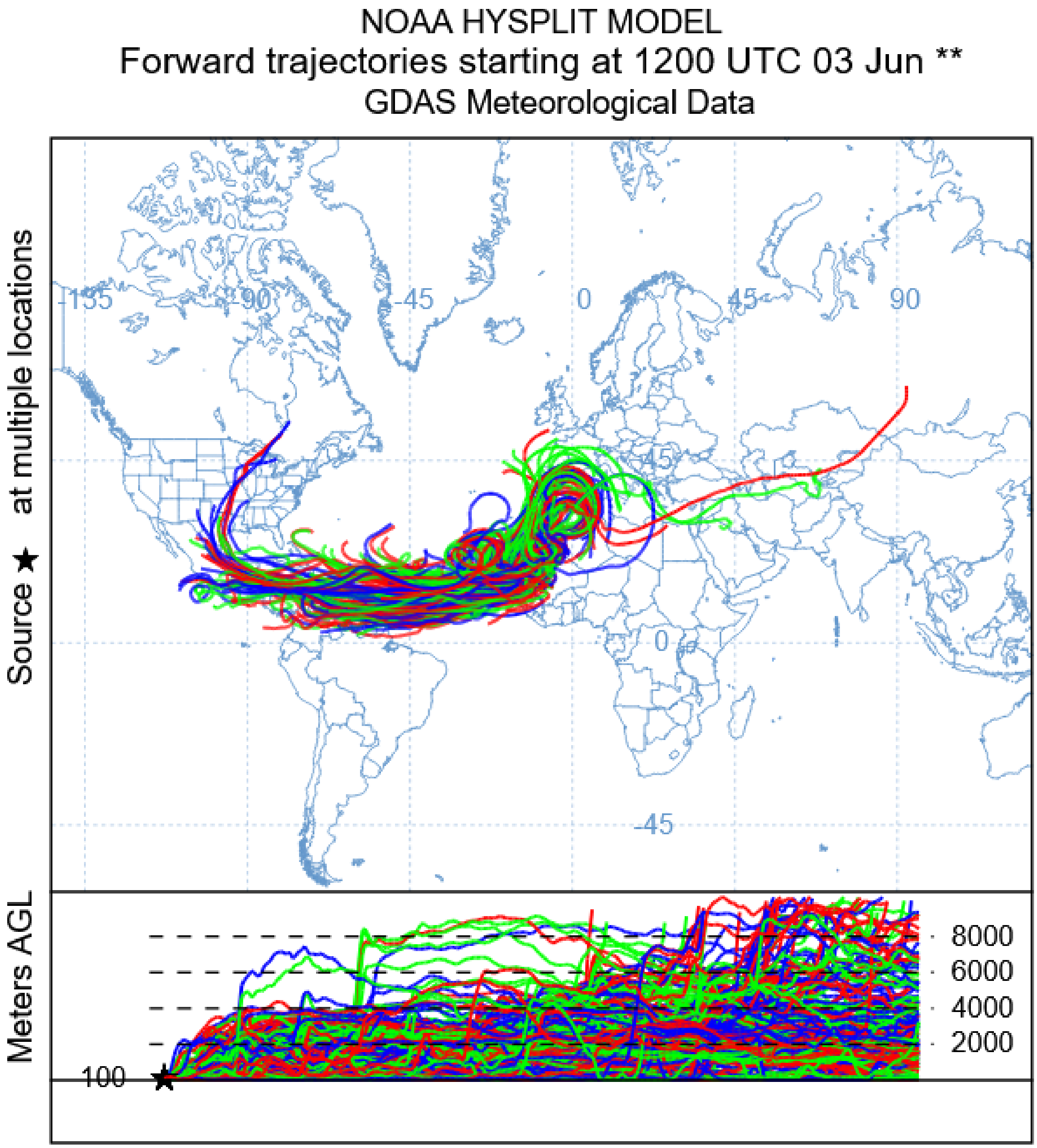


Figure 3-81: HYSPLIT forward trajectories from Western Africa, starting on June 3, 2022

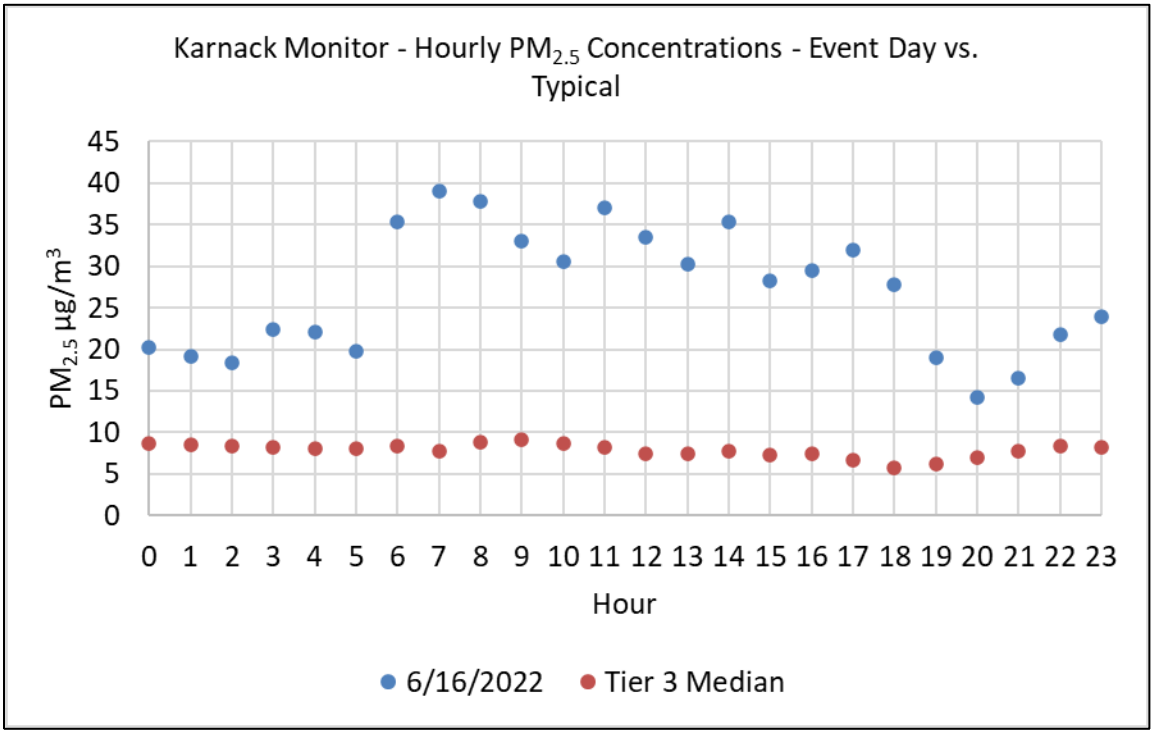


Figure 3-82: Hourly $PM_{2.5}$ concentrations on June 16, 2022, compared to typical concentrations at the Karnack Monitor

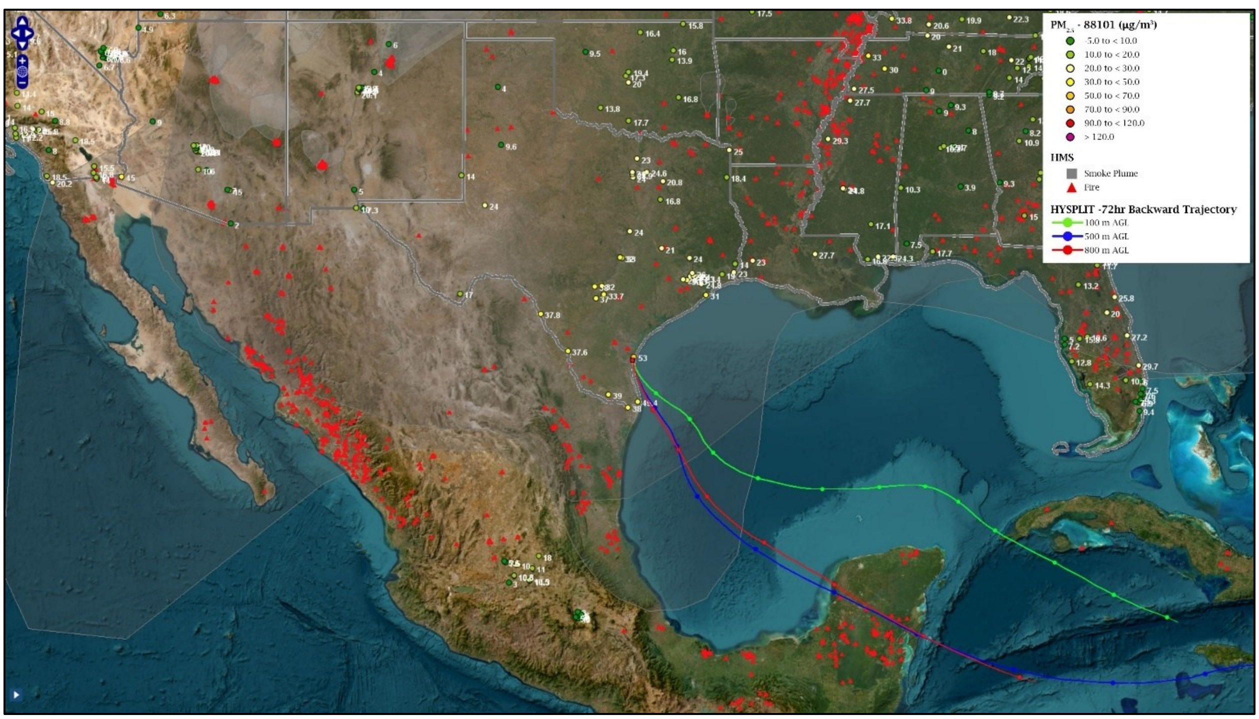


Figure 3-83: HYSPLIT back trajectories from the National Seashore monitoring site on June 16, 2022

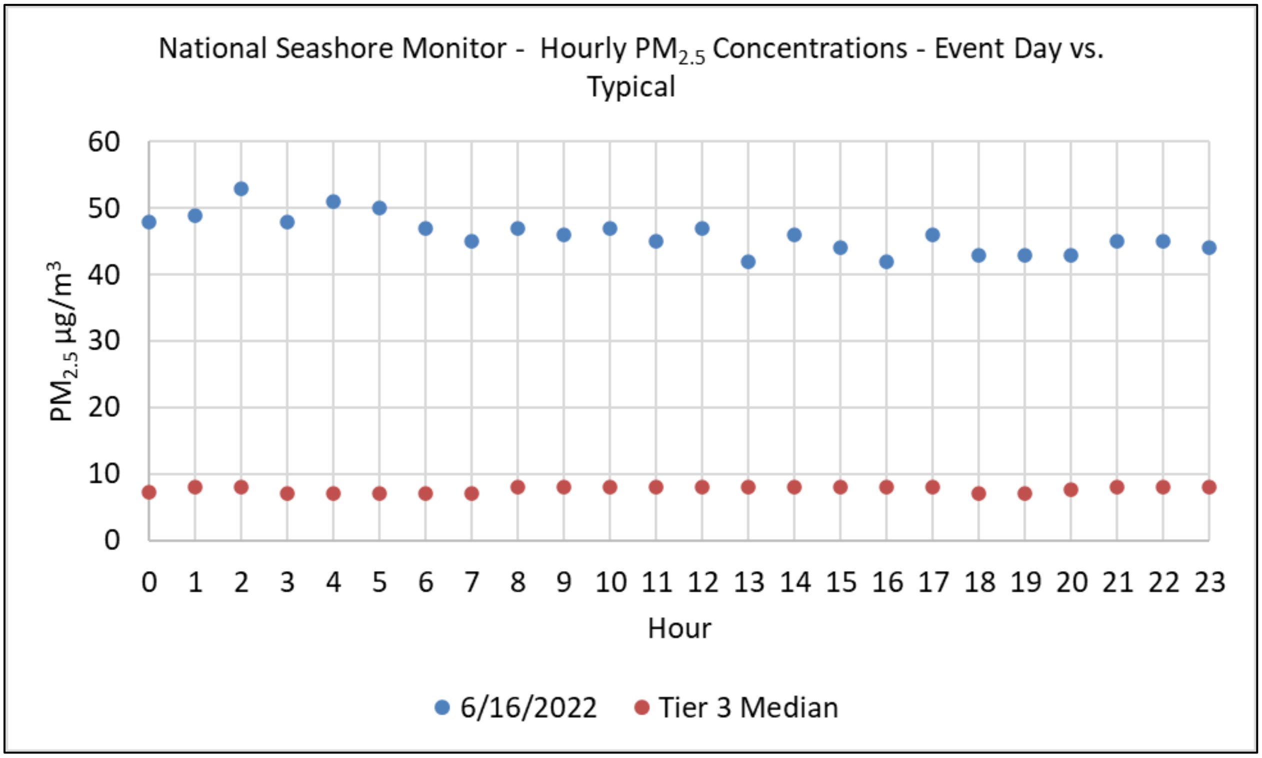


Figure 3-84: Hourly $PM_{2.5}$ concentrations on June 16, 2022, compared to typical concentrations at the National Seashore Monitor

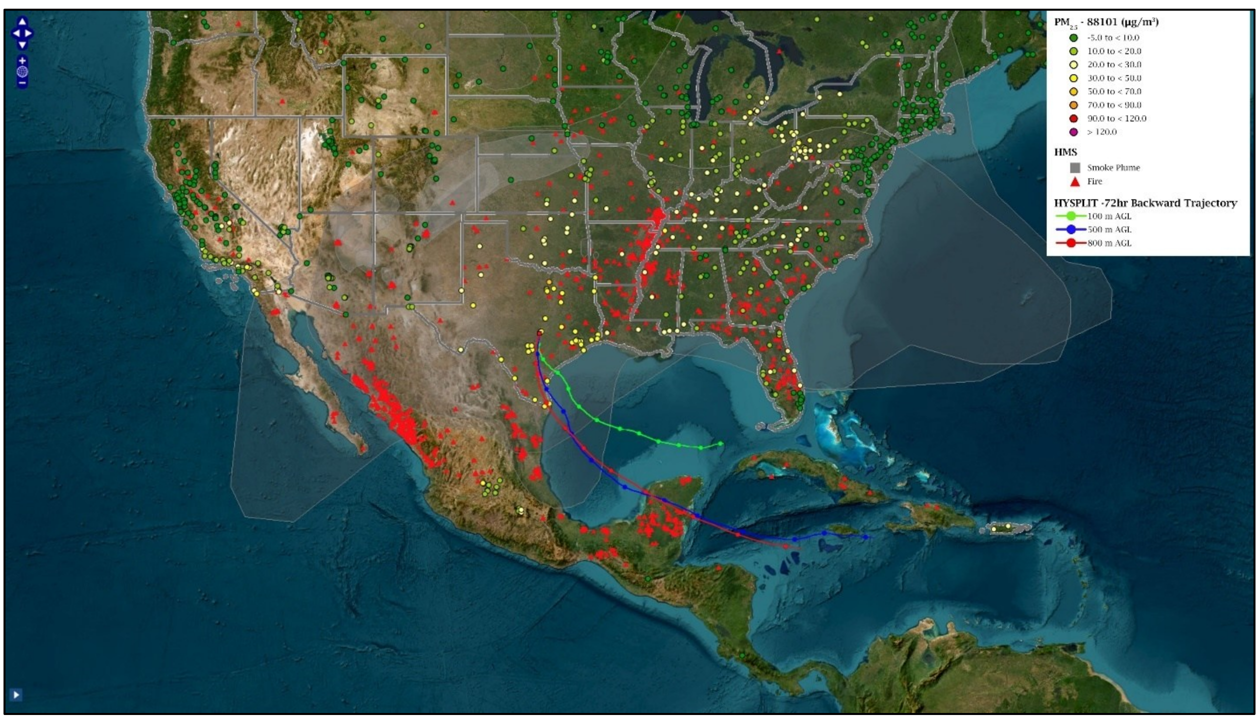


Figure 3-85: HYSPLIT back trajectories from the Austin Webberville monitoring site on June 16, 2022

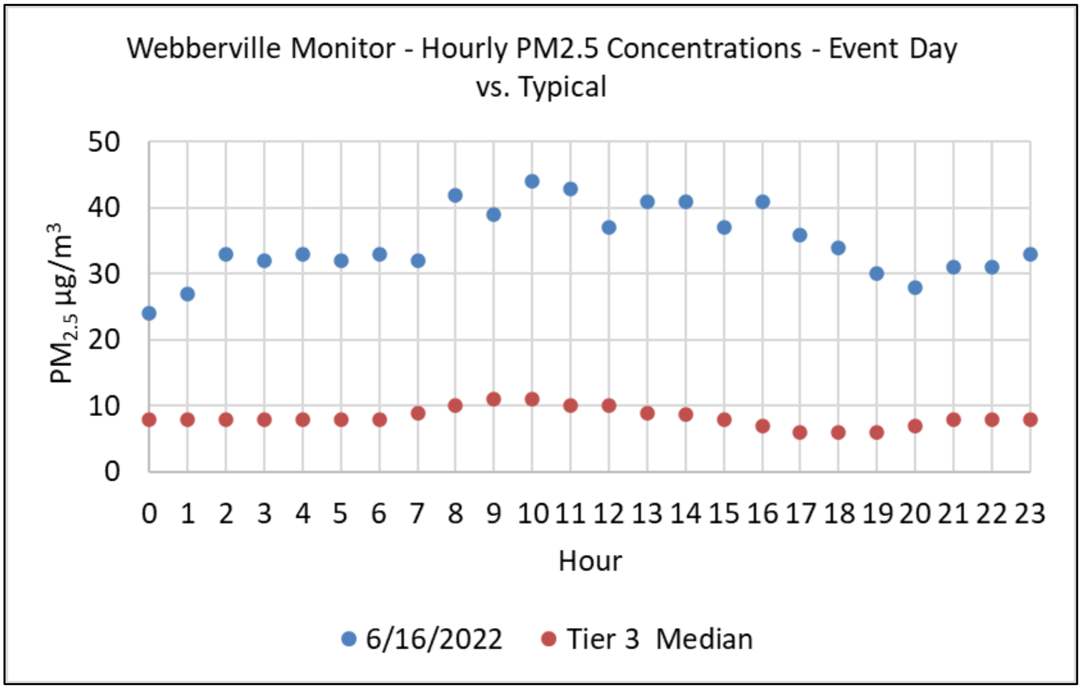


Figure 3-86: Hourly $PM_{2.5}$ concentrations on June 16, 2022, compared to typical concentrations at the Webberville Monitor

Evaluation of speciation data from June 16, 2022, at the Karnack air monitor in Harrison County, the only monitor among the three impacted monitors to have speciation data, showed an influx of Saharan dust entered East Texas. At the Karnack monitor, speciated $PM_{2.5}$ samples are collected every sixth day. Using the mass reconstruction equation proposed by IMPROVE (Figure 3-87: *IMPROVE Mass Reconstruction Equation*), different components of the mass composition are shown in a time-series plot (Figure 3-88: *Reconstructed Mass at the Karnack monitor on June 16, 2022 by category*, left figure), where the components are Soil Dust (Al, Si, Ca, Fe, Ti), Soot (elemental carbon), Organic Matter (organic carbon), Nitrate (NO_3), Sulfate (SO_4) and Salt (chloride).

Components	Calculation	Natural Sources	Anthropogenic Sources
Salt	$1.8 \cdot Chloride$	Ocean spray, dry lakebeds	Chemical manufacturing, lake consumption
Soil Dust	$2.2 \cdot Al + 2.49 \cdot Si + 1.63 \cdot Ca$ $+2.42 \cdot Fe + 1.94 \cdot Ti$	Soil resuspension, dust storms long-range transport	Construction, agriculture, deforestation, unpaved roads
Soot	*Elemental Carbon*	Wildfires	Motor vehicles, wood burning, smoking
Organic Matter	$1.4 \cdot Organic\ Carbon$	Plants, animals, wildfires	Motor vehicles, cooking oils, household cleaners
Nitrate	$1.29 \cdot Nitrate$	Plants, animals	Fertilizer, stock yards, chemical manufacturing
Sulfate	$4.125 \cdot Sulfur$	Volcanism	Coal-fired power plants, chemical manufacturing

Figure 3-87: IMPROVE Mass Reconstruction Equation

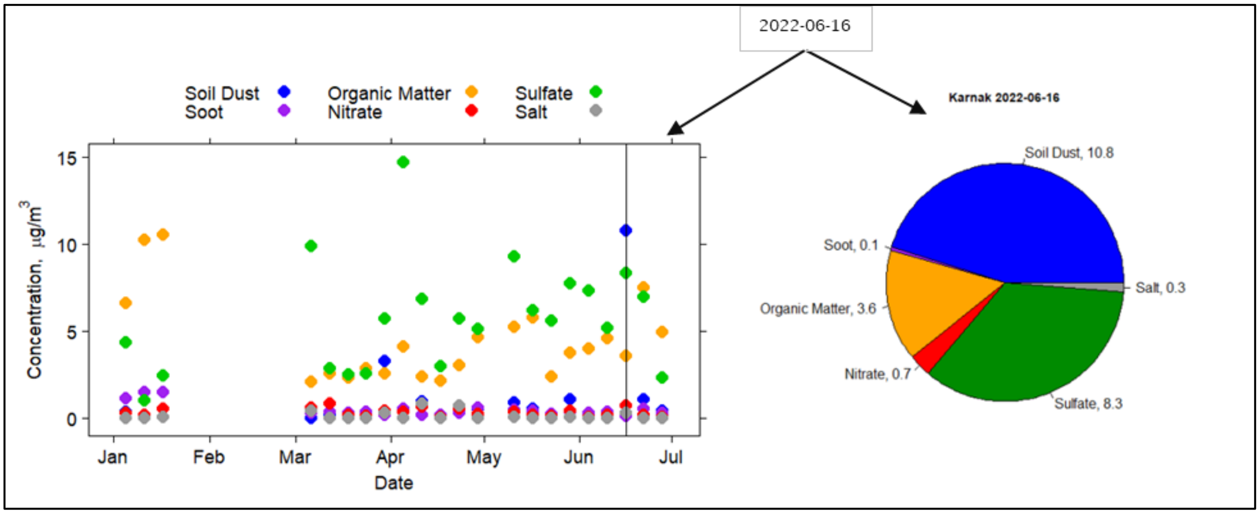


Figure 3-88: Reconstructed Mass at the Karnack monitor on June 16, 2022, by category

In Figure 3-88 (left), the concentration of the soil component stands out on June 16, 2022, relative to other dates in the plot. Also, the daily composition for June 16, 2022, is different from other days, with soil dust being a higher percentage compared to previous days that have more sulfates, suggesting the presence of Saharan dust. The pie plot (Figure 3-88, right) for June 16, 2023, shows that day's composition more clearly.

Figure 3-89: *HYSPLIT back trajectories and aerosol optical depth map for Jun 16, 2022, at the Karnack monitor*, overlays HYSPLIT back trajectories from the Karnack monitor on an aerosol optical depth map from MODIS Terra and Aqua satellites. The figure shows the transport of heavy aerosol concentrations (dark red) from Africa to Texas.

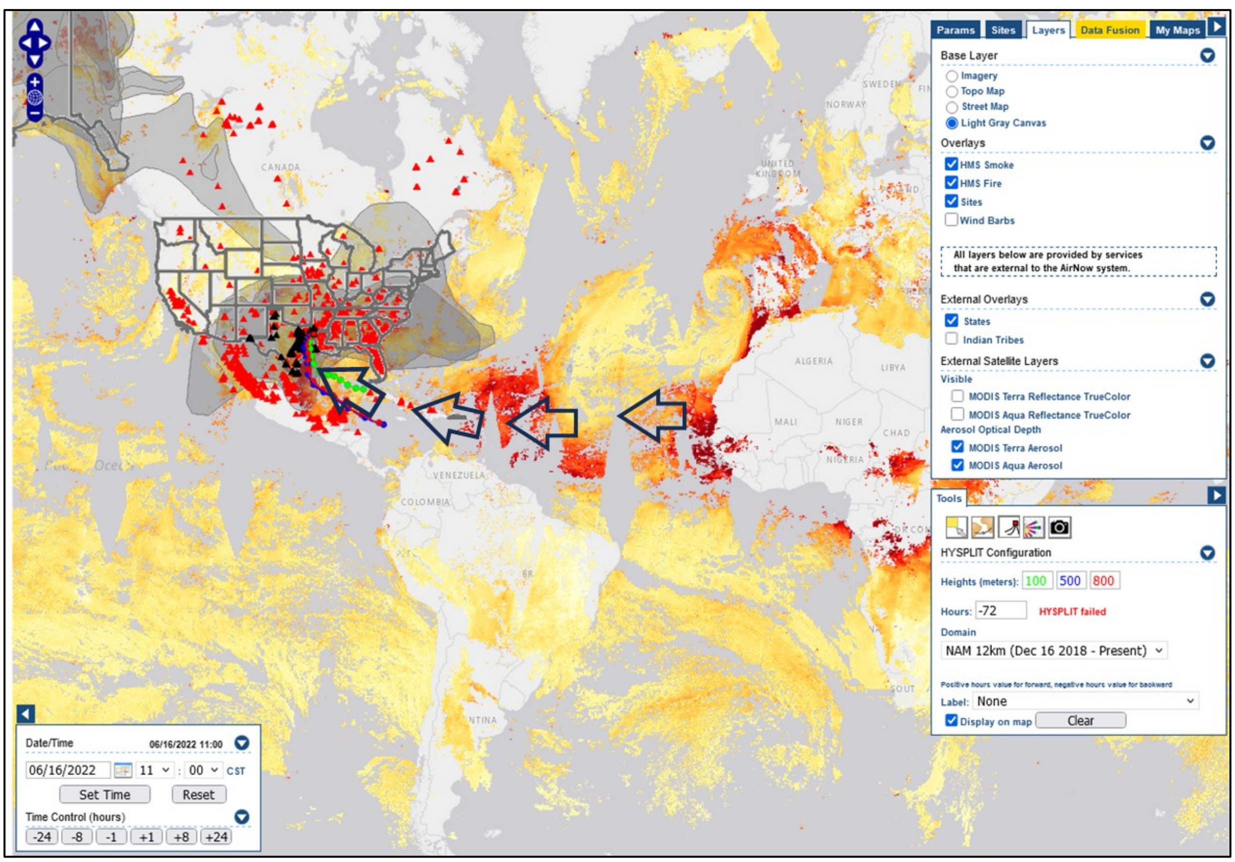


Figure 3-89: HYSPLIT back trajectories and aerosol optical depth map for Jun 16, 2022, at the Karnack monitor

Figure 3-90: *Aerosol optical depth map from MODIS Terra and Aqua on June 17, 2022*, Figure 3-91: *HYSPLIT back trajectories from the National Seashore monitoring site on June 17, 2022*, Figure 3-92: *HYSPLIT forward trajectories from Western Africa, starting on June 3, 2022*, and **Figure 3-93:** *Hourly $PM_{2.5}$ concentrations on June 17, 2022, compared to typical concentrations at the National Seashore Monitor* show evidence for the National Seashore monitoring site for June 17, 2022. This evidence meets the requirements for Tier 1 demonstration for a Saharan dust event. June 17, 2022, was identified as a Tier 2 day for the Austin Webberville monitoring site. Figure 3-90, Figure 3-94: *HYSPLIT back trajectories from the Austin Webberville monitoring site on June 17, 2022*, Figure 3-95: *72-hour HYSPLIT back trajectories starting from each hour on June 17, 2022, from the Austin Webberville monitoring site at 100m AGL, 500m AGL, and 800 m AGL*, Figure 3-96: *Hourly $PM_{2.5}$ concentrations on June 17, 2022, compared to typical concentrations at the Webberville Monitor*, and Figure 3-92, which presents HYSPLIT forward trajectories from Africa showing dust reaching Texas, provide evidence that meets the requirements for a Tier 2 demonstration for a day impacted by a Saharan dust event.

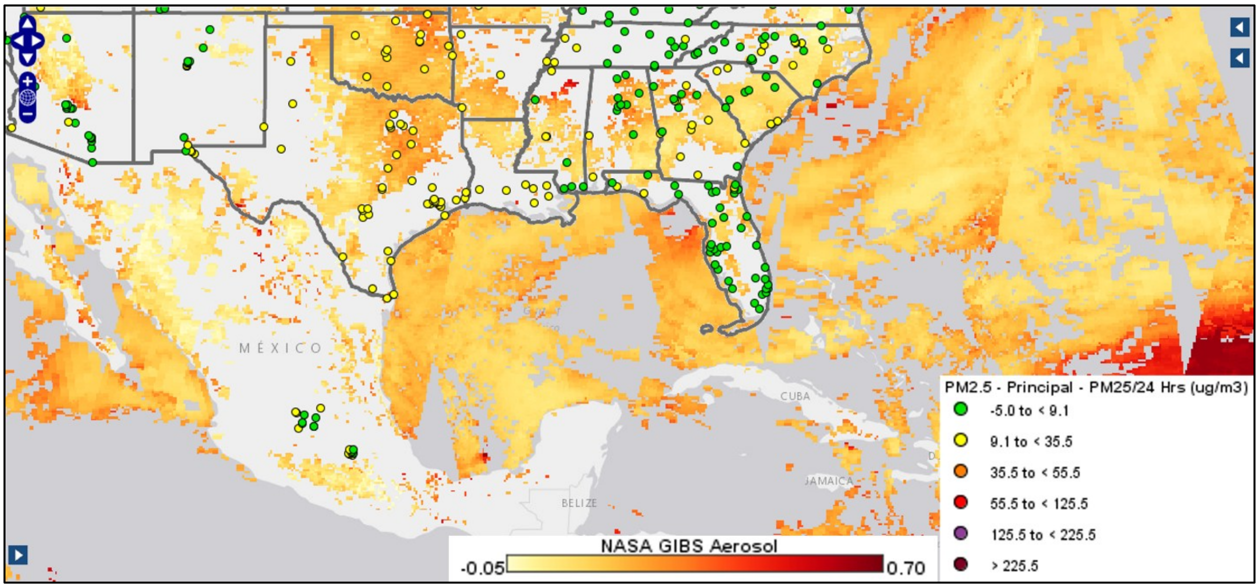


Figure 3-90: Aerosol optical depth map from MODIS Terra and Aqua on June 17, 2022

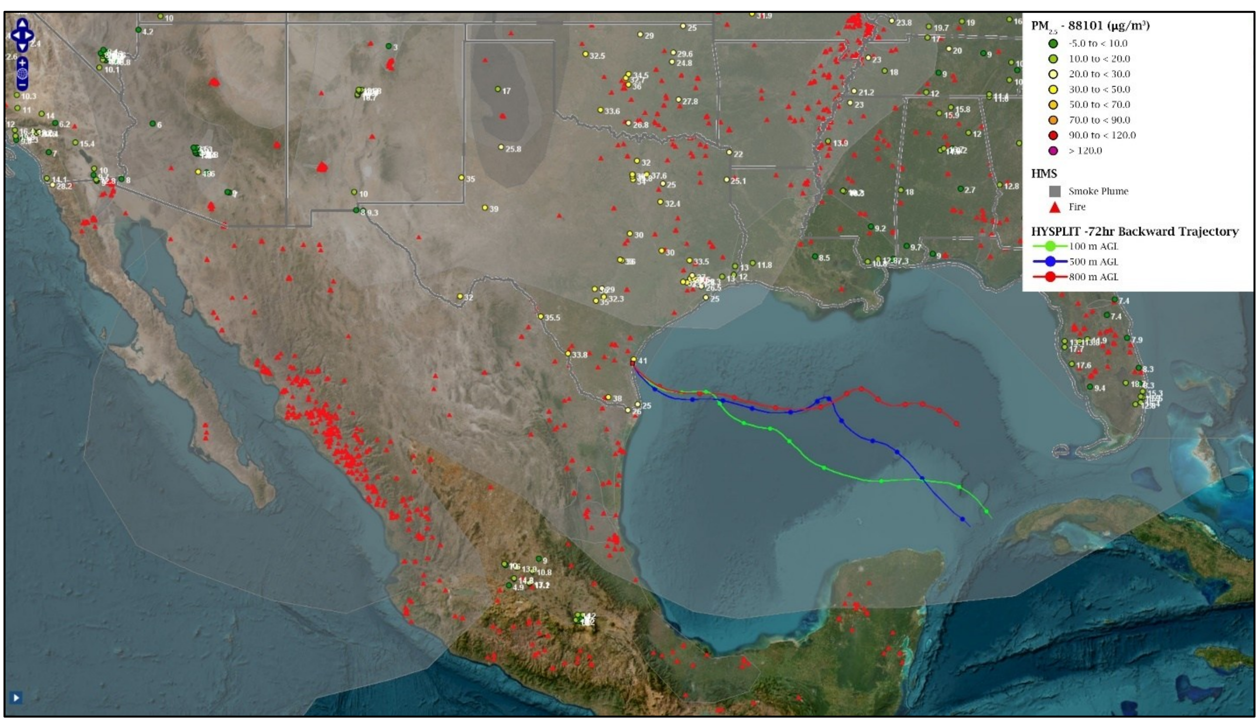


Figure 3-91: HYSPLIT back trajectories from the National Seashore monitoring site on June 17, 2022

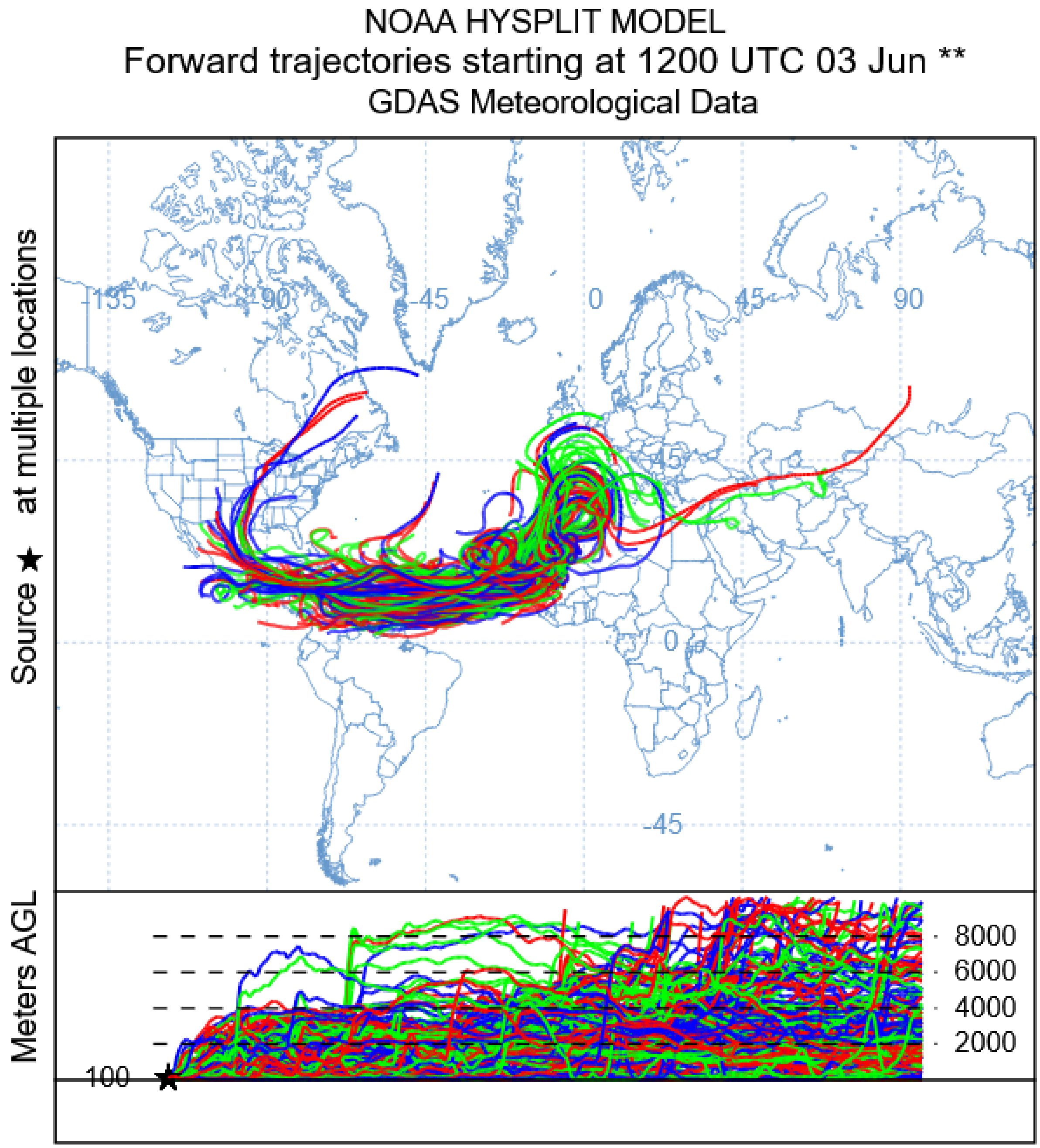


Figure 3-92: HYSPLIT forward trajectories from Western Africa, starting on June 3, 2022

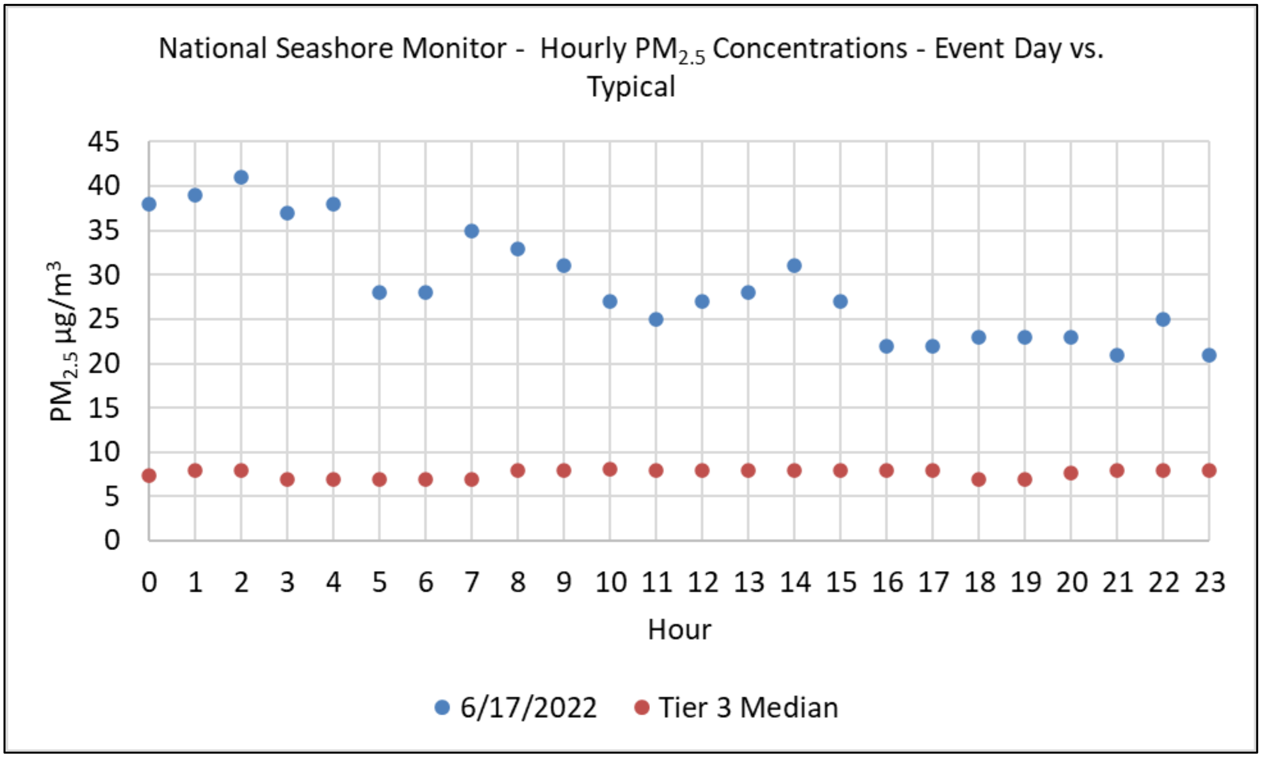


Figure 3-93: Hourly $PM_{2.5}$ concentrations on June 17, 2022, compared to typical concentrations at the National Seashore Monitor

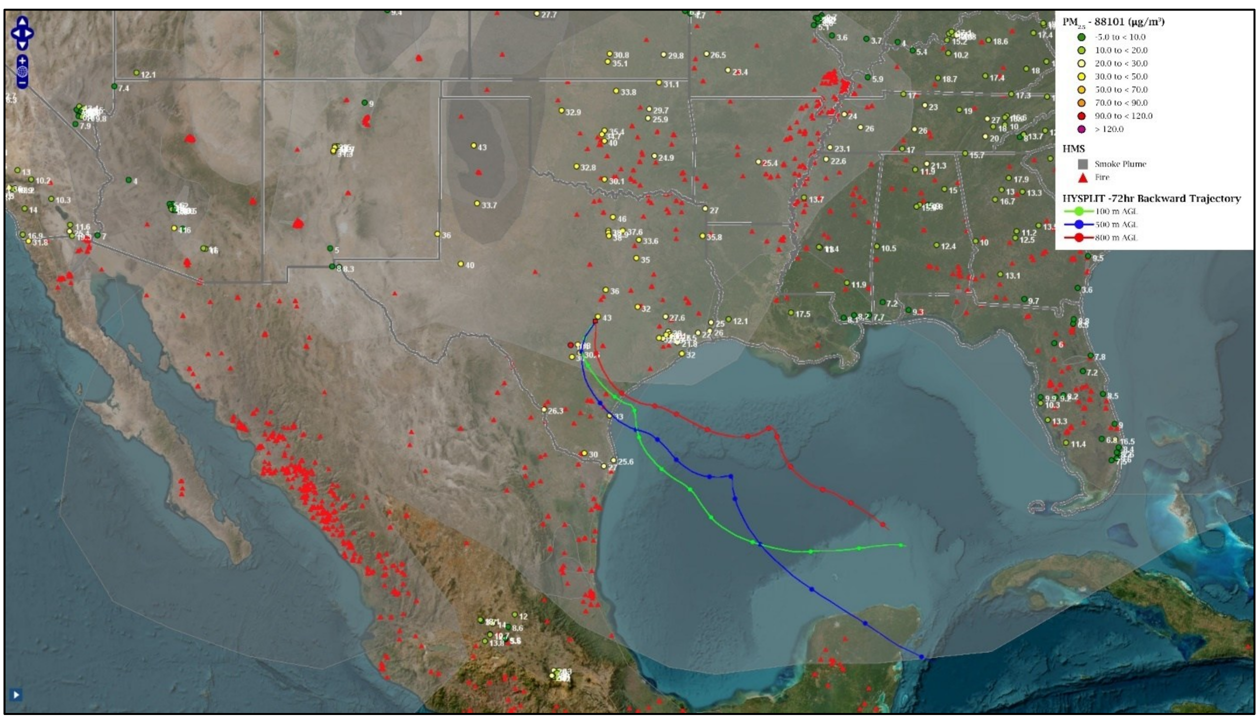


Figure 3-94: HYSPLIT back trajectories from the Austin Webberville monitoring site on June 17, 2022

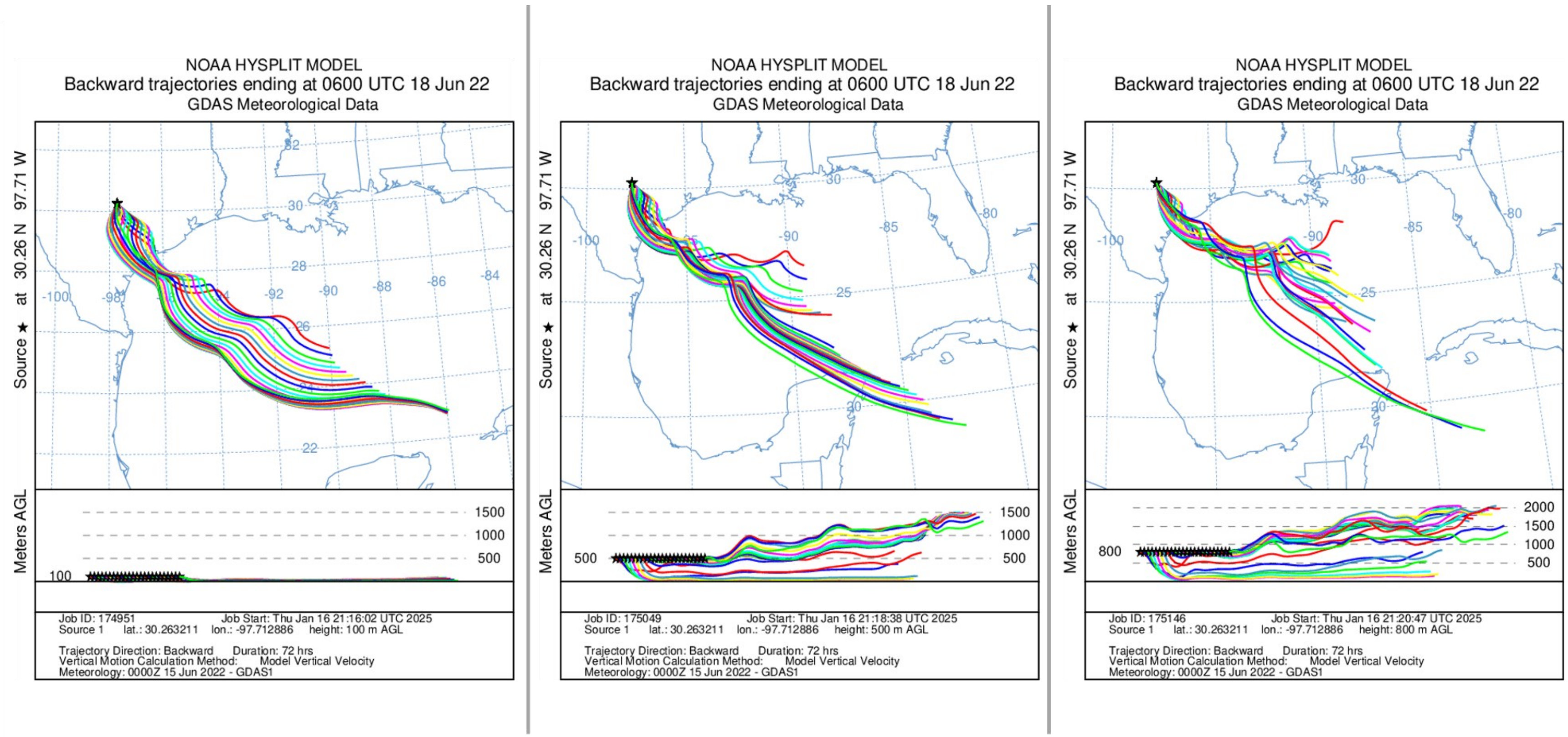


Figure 3-95: 72-hour HYSPLIT back trajectories starting from each hour on June 17, 2022, from the Austin Webberville monitoring site at 100m AGL, 500m AGL, and 800 m AGL

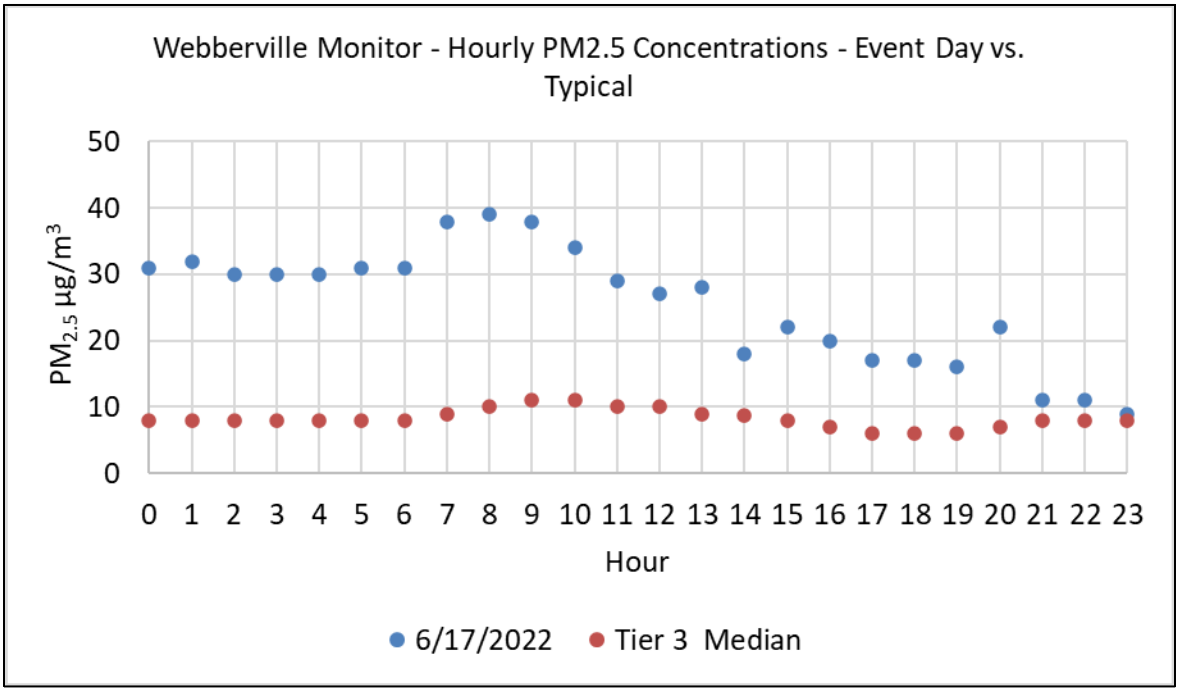


Figure 3-96: Hourly $PM_{2.5}$ concentrations on June 17, 2022, compared to typical concentrations at the Webberville Monitor

3.2.8 Group 8: Evidence for July 16, July 17, and July 18, 2022, Saharan Dust $PM_{2.5}$ Event for National Seashore Monitor, Karnack Monitor, and Webberville Monitor

All three monitoring sites (Austin Webberville Rd, National Seashore, and Karnack) were impacted by Saharan dust during this episode. The National Seashore monitoring site was impacted on July 16 and July 17, 2022, and both days were identified as Tier 1 days. Karnack monitoring site was impacted on July 17th and July 18th and were identified as Tier 1 days. Similarly, the Austin Webberville site was impacted on July 17th and was identified as a Tier 2 day. The evidence provided meets requirements for Tier 1 and Tier 2 demonstrations for the days impacted by Saharan dust.

For July 16th**,** Figure 3-97: *Aerosol optical depth map from MODIS Terra and Aqua on July 16, 2022,* shows a MODIS Aqua and Terra AOD image corroborating the high concentration of dust seen over the Gulf of Mexico and the National Seashore monitoring site area, with the yellow dot denoting air quality in the moderate category. The HYSPLIT back trajectory originating from the National Seashore monitoring site at 100 m, 500 m, and 800 m AGL passes over the Gulf of Mexico region containing aerosols and leads to the area beyond Mexico/Central America, as shown in Figure 3-98: *HYSPLIT back trajectories from the National Seashore monitoring site on July 16, 2022*. HYSPLIT Forward trajectories starting from Western Africa arrive at Texas, as shown in Figure 3-99: *HYSPLIT forward trajectories from Western Africa, starting on July 2, 2022*. Figure 3-100: *Hourly $PM_{2.5}$ concentrations on July 16, 2022, compared to typical concentrations at the National Seashore Monitor* shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median).

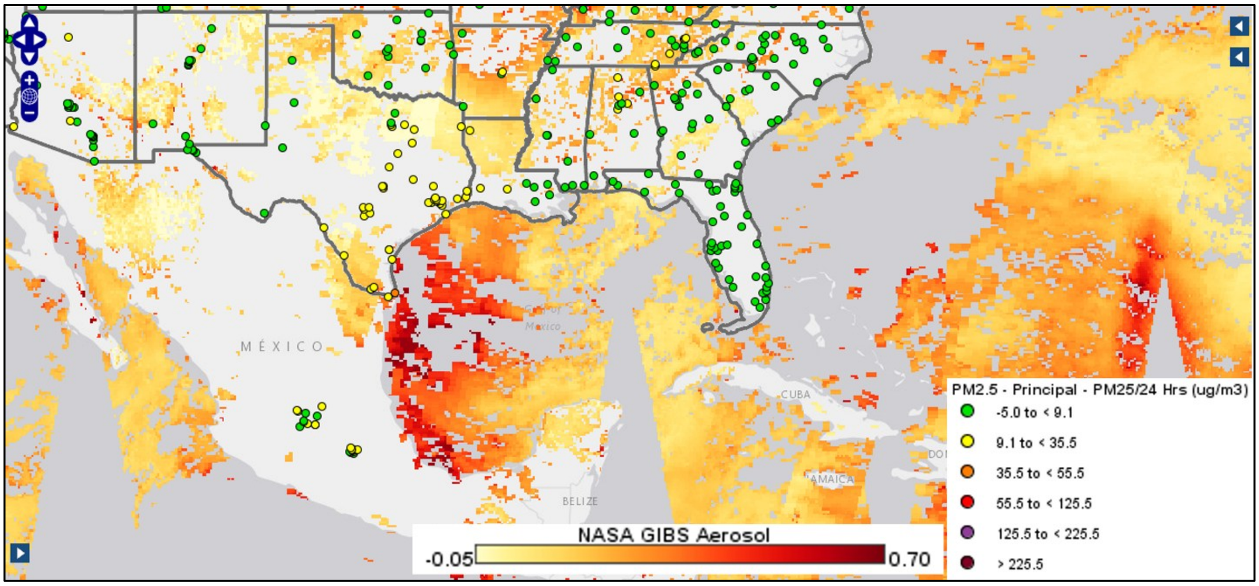


Figure 3-97: Aerosol optical depth map from MODIS Terra and Aqua on July 16, 2022

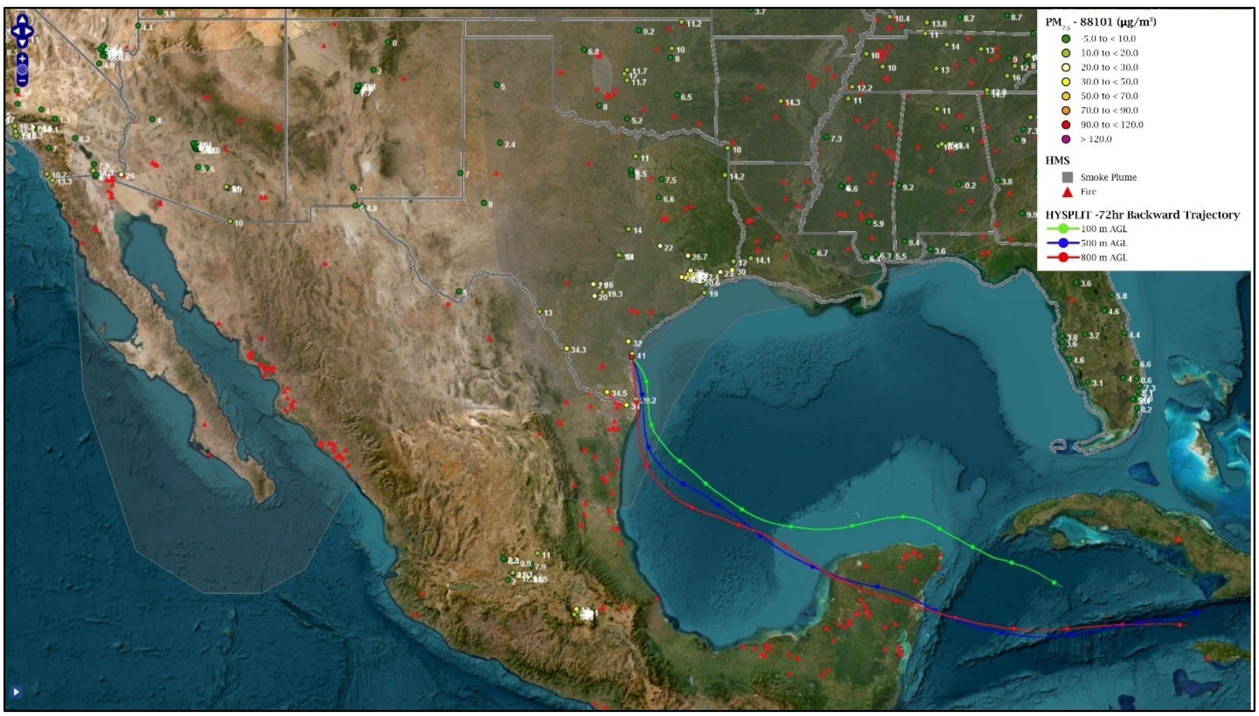


Figure 3-98: HYSPLIT back trajectories from the National Seashore monitoring site on July 16, 2022

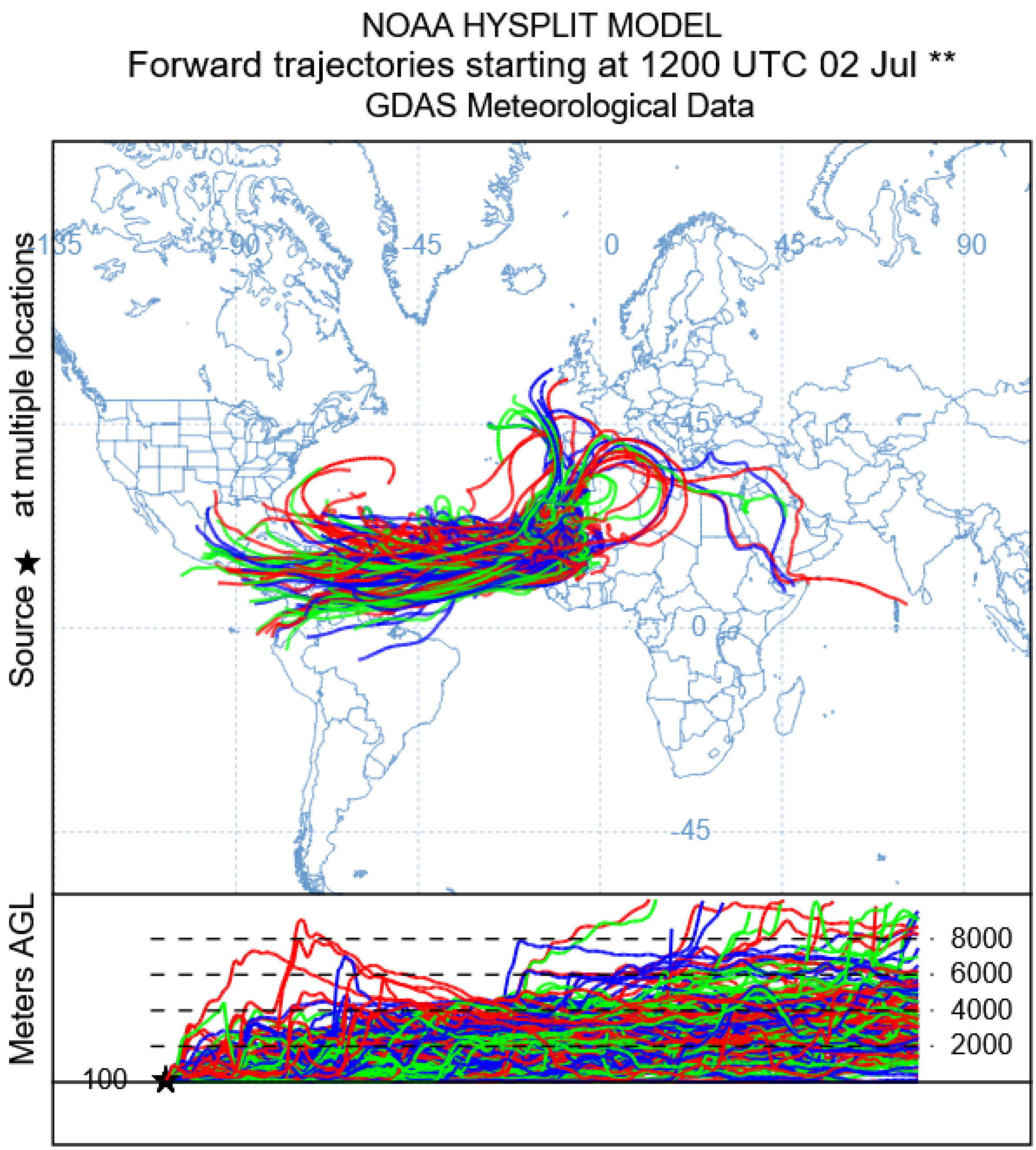


Figure 3-99: HYSPLIT forward trajectories from Western Africa, starting on July 2, 2022

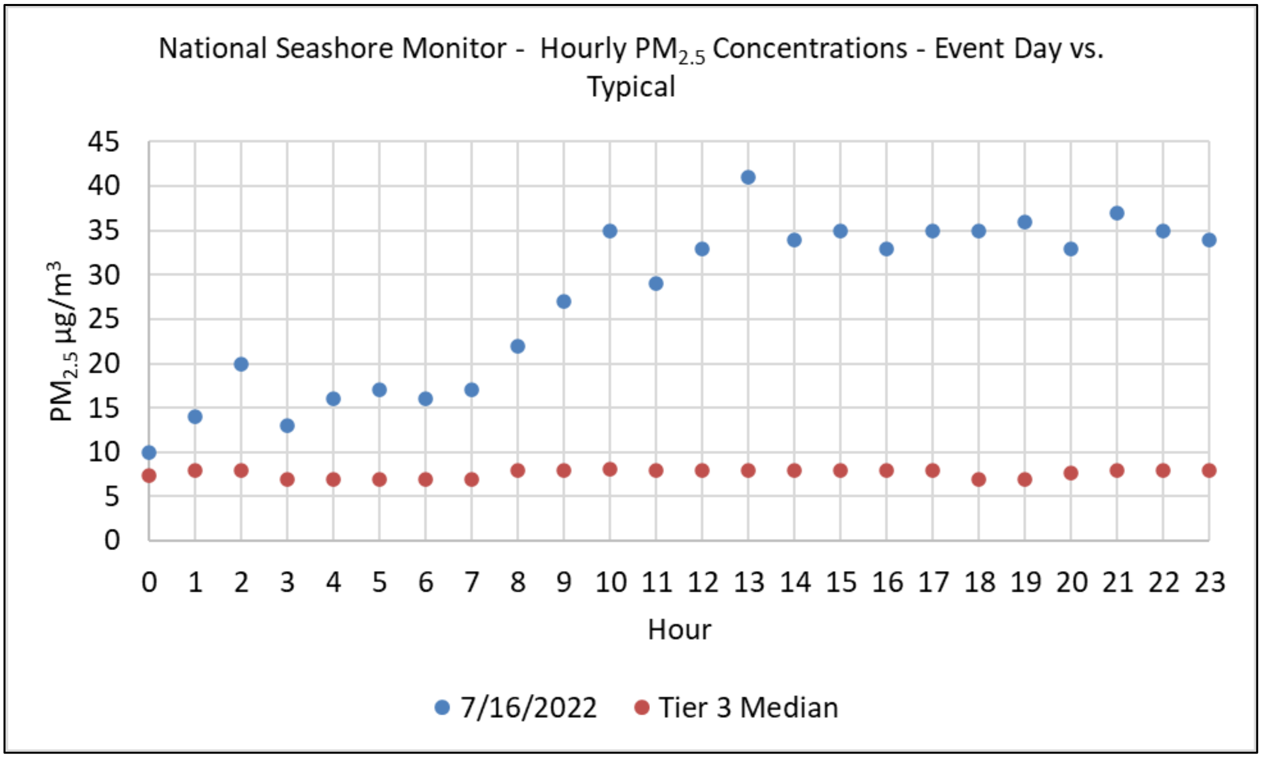


Figure 3-100: Hourly $PM_{2.5}$ concentrations on July 16, 2022, compared to typical concentrations at the National Seashore Monitor

For July 17, Figure 3-101: *Aerosol optical depth map from MODIS Terra and Aqua on July 17, 2022,* shows a MODIS Aqua and Terra AOD image corroborating the high concentration of dust seen over the Gulf of Mexico and the Karnack, National Seashore, and Webberville monitor areas, with the yellow dot denoting air quality in the moderate category in these areas. The HYSPLIT back trajectory originating from the Karnack monitoring site at 100 m, 500 m, and 800 m AGL passes over the Gulf of Mexico region containing aerosols and leads to the area beyond Mexico/Central America, as shown in Figure 3-102: *HYSPLIT back trajectories from the Karnack monitoring site on July 17, 2022*. Figure 3-103: *Hourly $PM_{2.5}$ concentrations on July 17, 2022, compared to typical concentrations at the Karnack Monitor* shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median).

Similarly, Figure 3-104: *HYSPLIT back trajectories from the National Seashore monitoring site on July 17, 2022*, and Figure 3-105: *Hourly $PM_{2.5}$ concentrations on July 17, 2022, compared to typical concentrations at the National Seashore Monitor* shows evidence that the National Seashore monitoring site was impacted by a Saharan dust event on July 17, 2022. HYSPLIT forward trajectories starting from Western Africa arrive at Texas, as shown in Figure 3-106: *HYSPLIT forward trajectories from Western Africa, starting on July 3, 2022,* suggesting travel of aerosol particles to monitoring sites. HYSPLIT back trajectory (Figure 3-107: *HYSPLIT back trajectories from the Austin Webberville monitoring site on July 17, 2022* and Figure 3-108: *72-hour HYSPLIT back trajectories starting from each hour on July 17, 2022, from the Austin Webberville monitoring site at 100m AGL, 500m AGL, and 800 m AGL*), and a graph showing changes in hourly temporal patterns of $PM_{2.5}$ during the event (Figure 3-109: *Hourly $PM_{2.5}$ concentrations on July 17, 2022, compared to typical concentrations at the Webberville Monitor*), with HYSPLIT forward trajectories from Africa (Figure 3-106) provide evidence for a Tier 2 demonstration for the Austin Webberville monitoring site for July 17th.

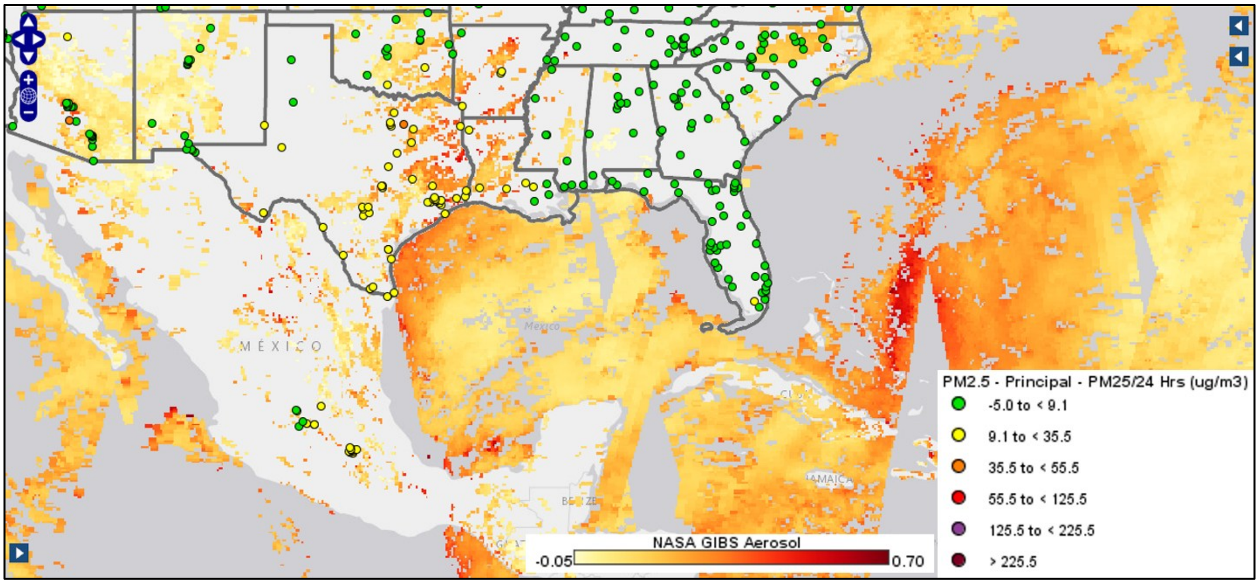


Figure 3-101: Aerosol optical depth map from MODIS Terra and Aqua on July 17, 2022

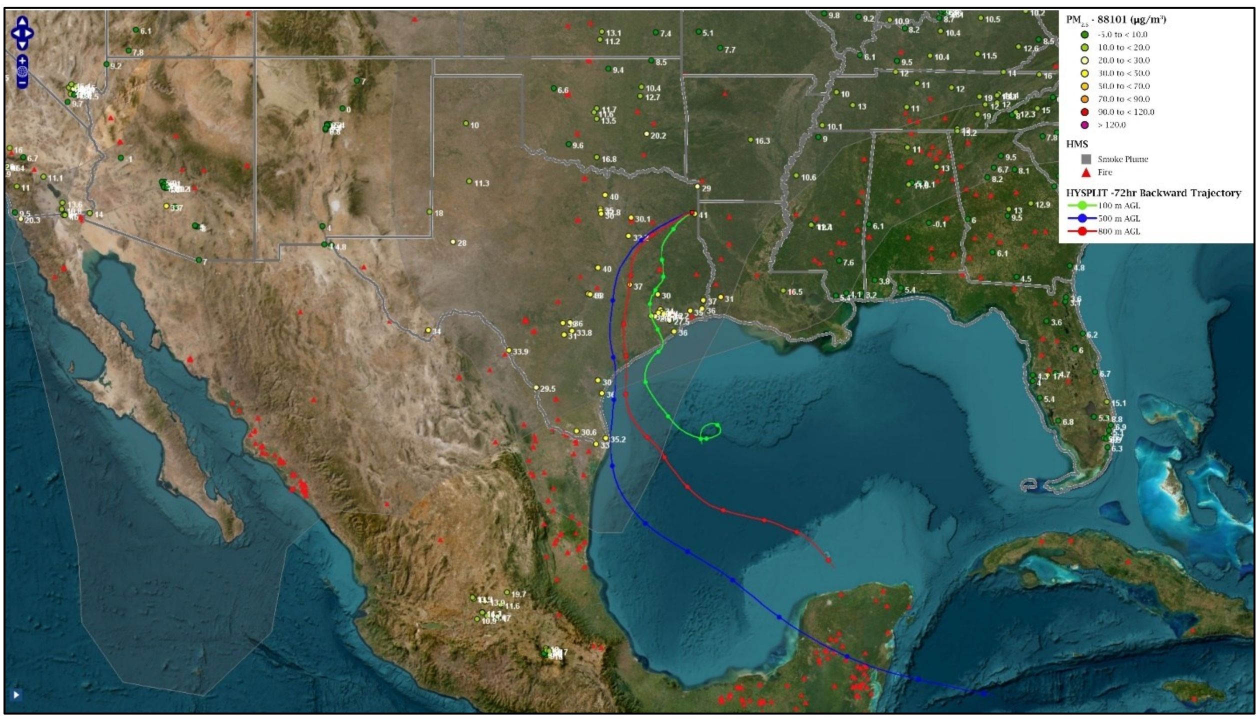


Figure 3-102: HYSPLIT back trajectories from the Karnack monitoring site on July 17, 2022

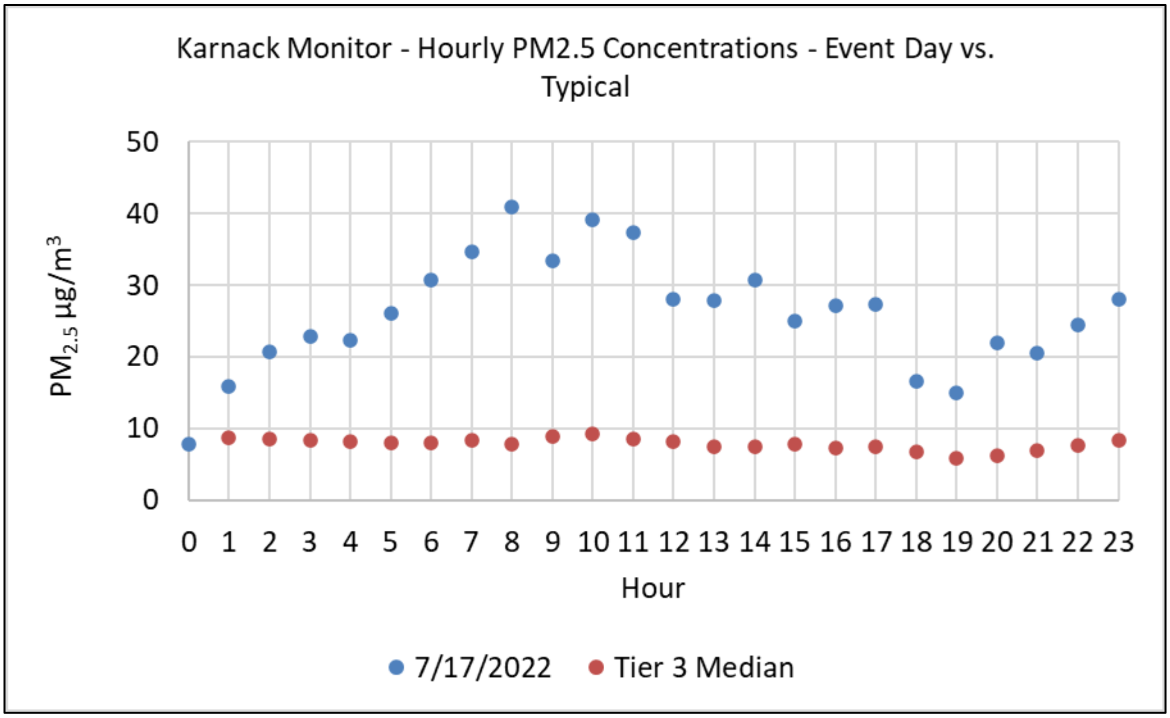


Figure 3-103: Hourly $PM_{2.5}$ concentrations on July 17, 2022, compared to typical concentrations at the Karnack Monitor

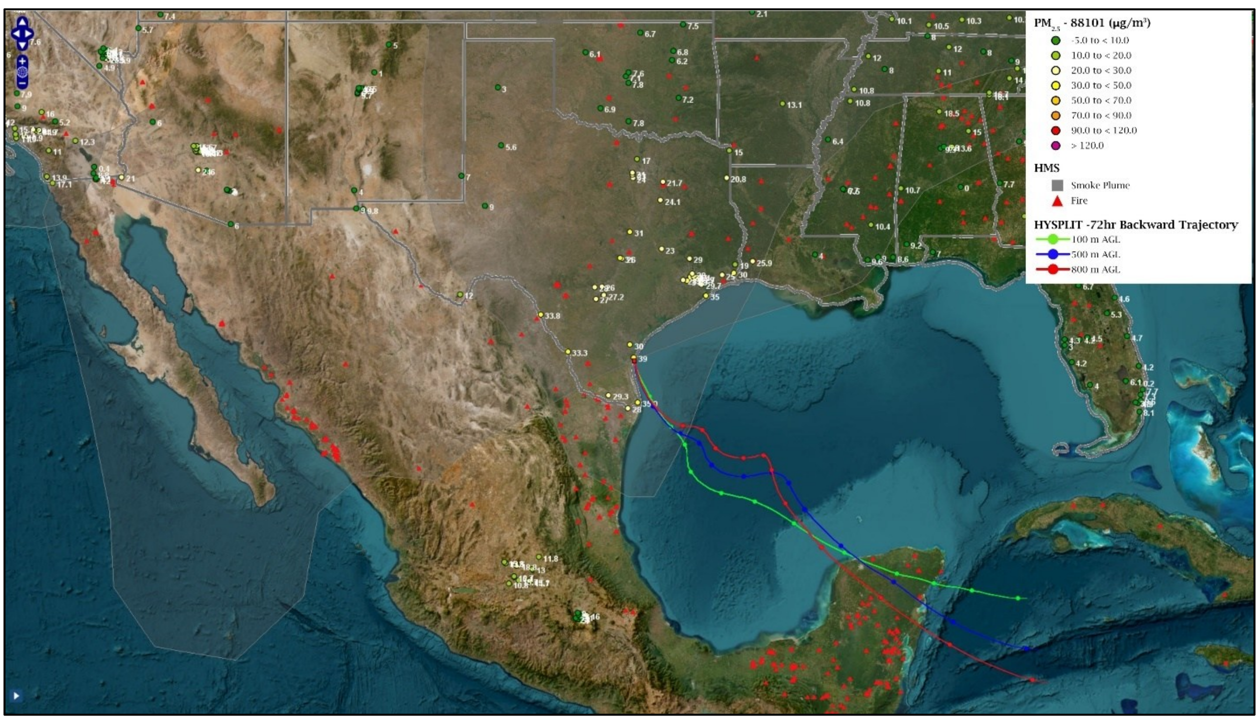


Figure 3-104: HYSPLIT back trajectories from the National Seashore monitoring site on July 17, 2022

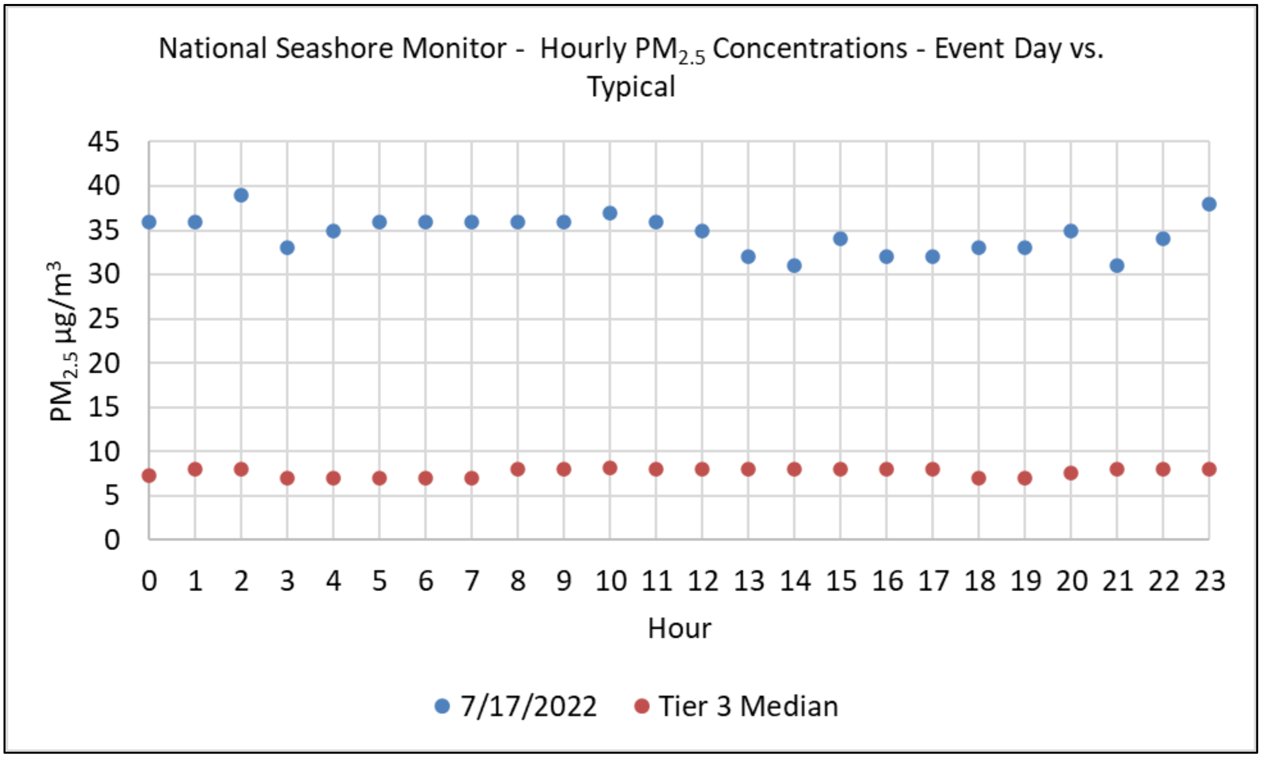


Figure 3-105: Hourly $PM_{2.5}$ concentrations on July 17, 2022, compared to typical concentrations at the National Seashore Monitor

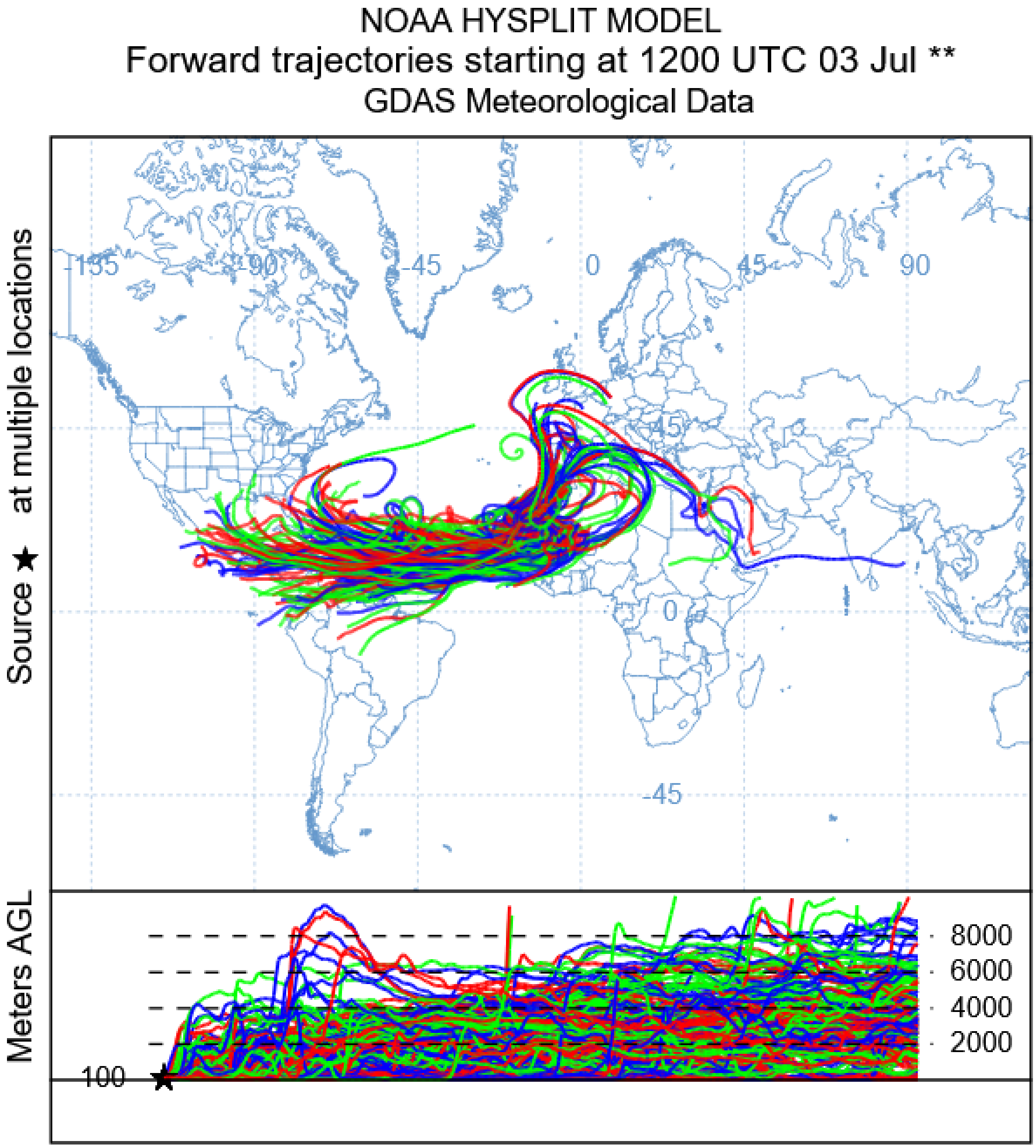


Figure 3-106: HYSPLIT forward trajectories from Western Africa, starting on July 3, 2022

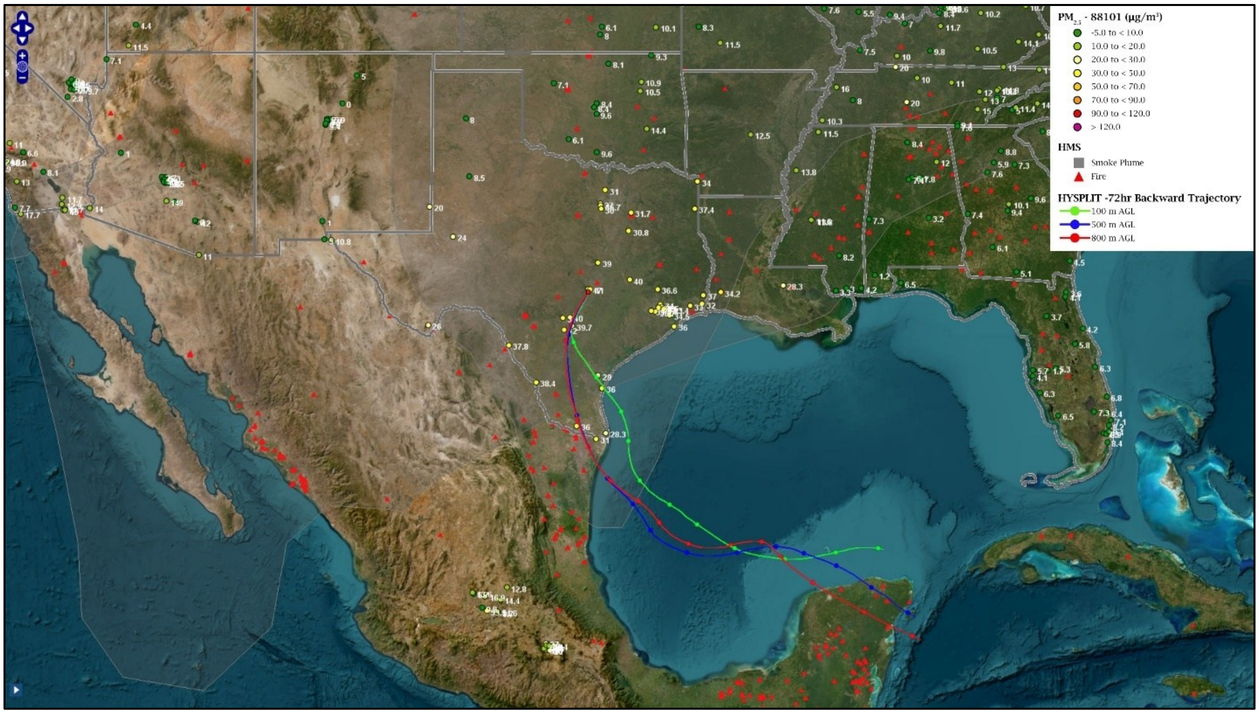


Figure 3-107: HYSPLIT back trajectories from the Austin Webberville monitoring site on July 17, 2022

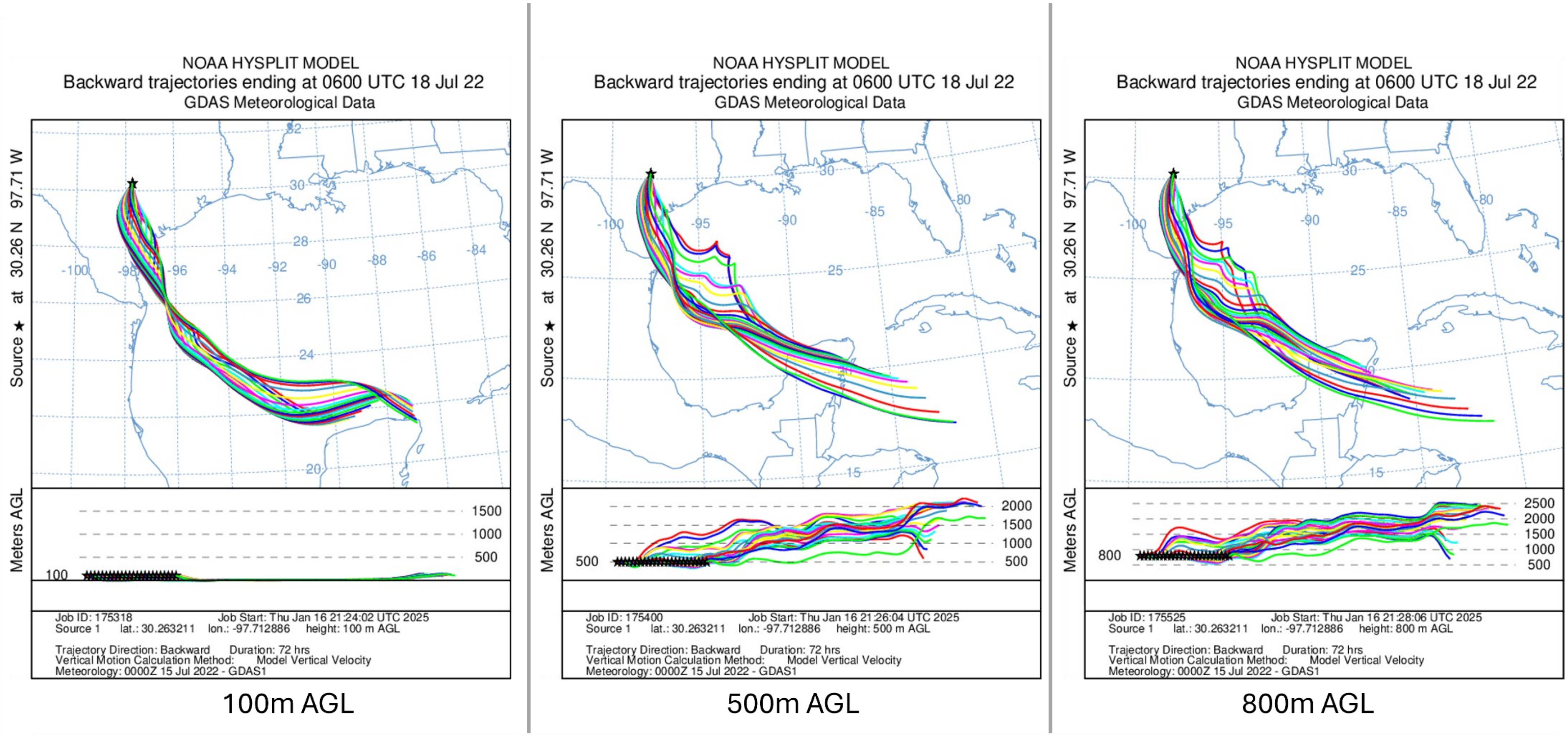


Figure 3-108: 72-hour HYSPLIT back trajectories starting from each hour on July 17, 2022, from the Austin Webberville monitoring site at 100m AGL, 500m AGL, and 800 m AGL

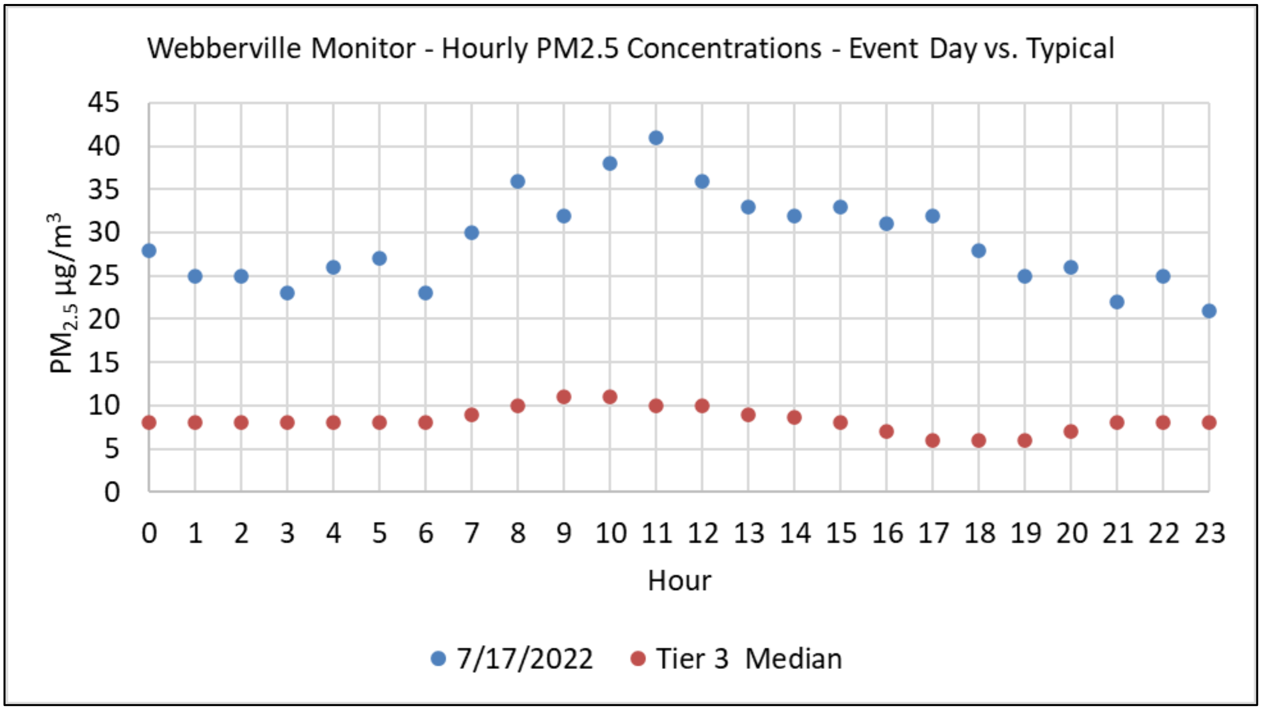


Figure 3-109: Hourly $PM_{2.5}$ concentrations on July 17, 2022, compared to typical concentrations at the Webberville Monitor

MODIS Aqua and Terra AOD image, with the yellow dot denoting moderate air quality (Figure 3-110: *Aerosol optical depth map from MODIS Terra and Aqua on July 18, 2022*), HYSPLIT back trajectories showing air parcels passing over the Gulf of Mexico and beyond Mexico/Central America on the Saharan dust path (Figure 3-111: *HYSPLIT back trajectories from the Karnack monitoring site on July 18, 2022*), HYSPLIT forward trajectories from Western Africa showing aerosols reaching Texas (Figure 3-112: *HYSPLIT forward trajectories from Western Africa, starting on July 4, 2022*), and $PM_{2.5}$ concentrations showing evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median) (Figure 3-113: *Hourly $PM_{2.5}$ concentrations on July 18, 2022 compared to typical concentrations at the Karnack Monitor*) provide evidence for a Tier 1 demonstration for the Karnack monitoring site for July 18th that a Saharan dust event impacted the monitor.

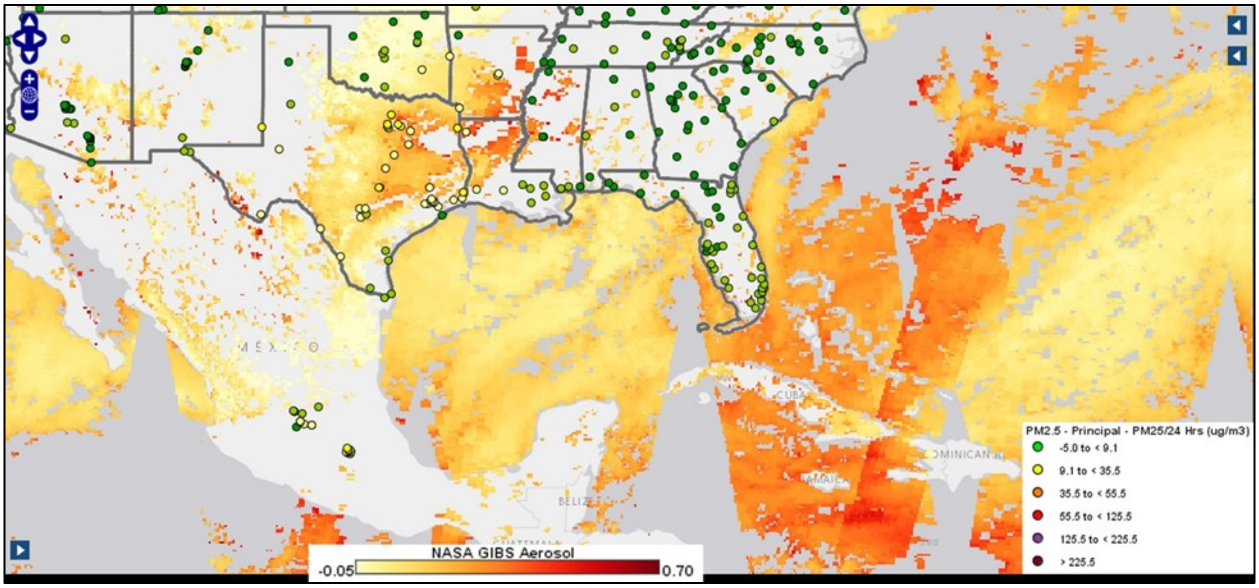


Figure 3-110: Aerosol optical depth map from MODIS Terra and Aqua on July 18, 2022

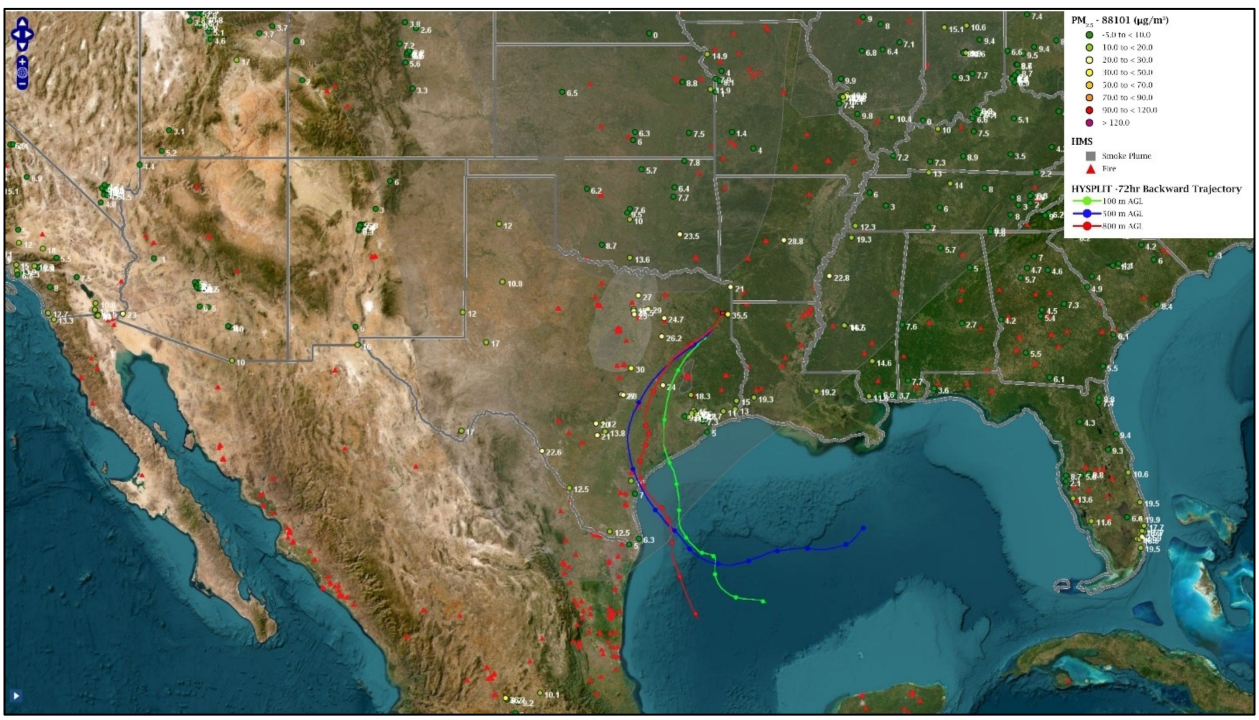


Figure 3-111: HYSPLIT back trajectories from the Karnack monitoring site on July 18, 2022

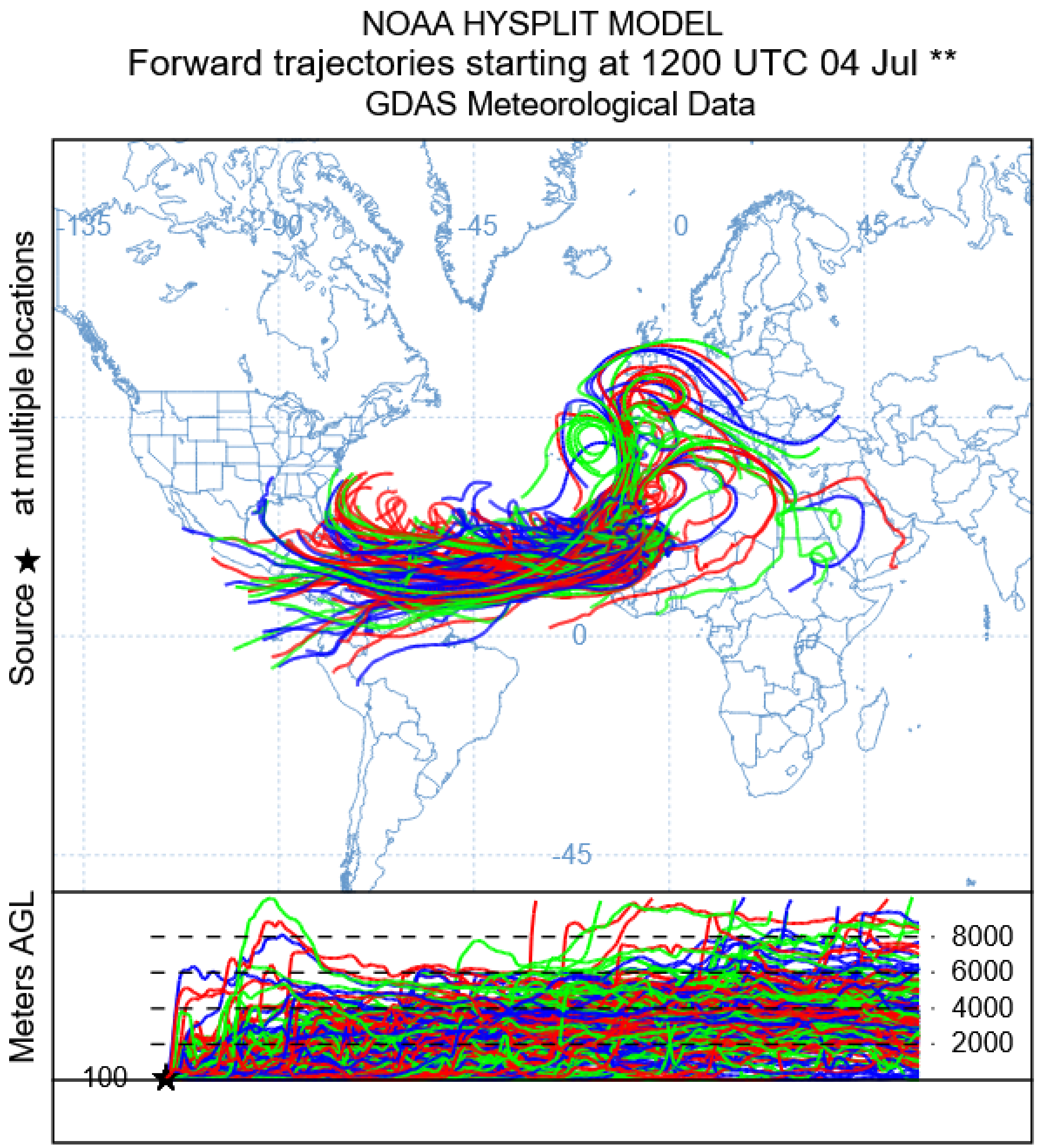


Figure 3-112: HYSPLIT forward trajectories from Western Africa, starting on July 4, 2022

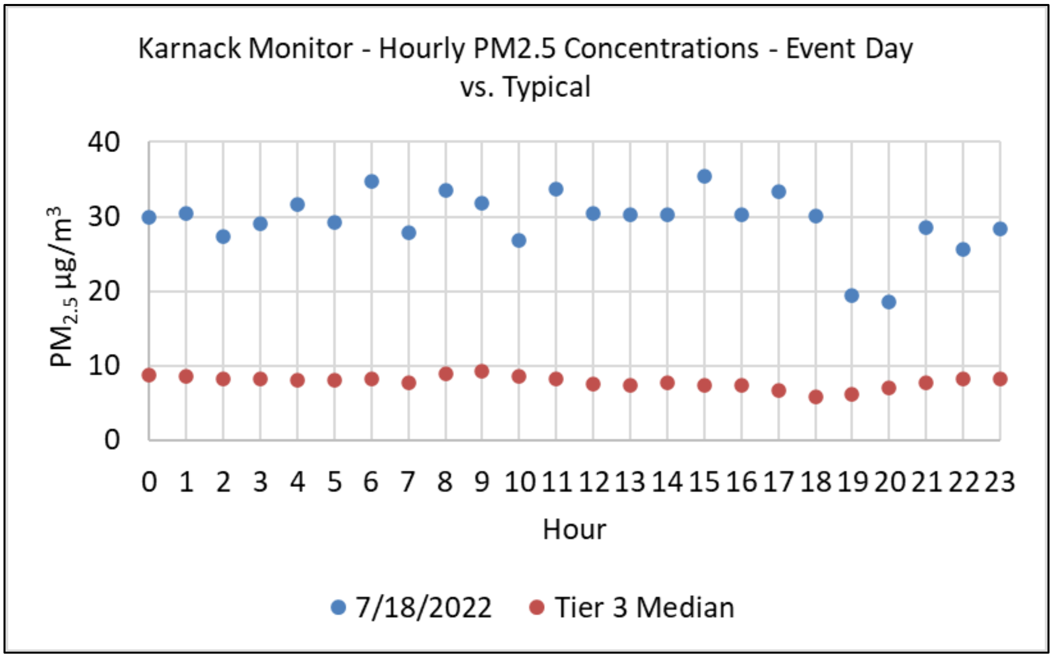


Figure 3-113: Hourly $PM_{2.5}$ concentrations on July 18, 2022, compared to typical concentrations at the Karnack Monitor

3.2.9 Group 9: Evidence for July 21, 2022, Saharan Dust $PM_{2.5}$ Event for the National Seashore Monitor

The National Seashore monitoring site was impacted by Saharan dust on July 21, 2022, and was identified as a Tier 2 day. The MODIS Aqua and Terra AOD image corroborates the high concentration of dust seen in the area, with moderate air quality denoted by the yellow dot (Figure 3-114: *Aerosol optical depth map from MODIS Terra and Aqua on July 21, 2022*). The HYSPLIT back trajectory originating from the National Seashore monitoring site at 100 m, 500 m, and 800 m AGL passes over the Gulf of Mexico region containing aerosols and leads to the area beyond Mexico/Central America, as shown in Figure 3-115: *HYSPLIT back trajectories from the National Seashore monitoring site on July 21, 2022.* HYSPLIT back trajectories starting from each hour from the National Seashore monitor further support transport of aerosols, as shown in Figure 3-116: *72-hour HYSPLIT back trajectories starting from each hour on July 21, 2022, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL*. Figure 3-117: *HYSPLIT forward trajectories from Western Africa, starting on July 7, 2022*, shows HYSPLIT forward trajectories starting from Western Africa and arriving at Texas. Figure 3-118: *Hourly $PM_{2.5}$ concentrations on July 21, 2022, compared to typical concentrations at the National Seashore Monitor* shows evidence of changes in hourly temporal patterns of $PM_{2.5}$ during the event, compared to typical non-event data (Tier 3 Median), which provides evidence for a Tier 2 demonstration that a Saharan dust event impacted the National Seashore monitoring site on July 21st.

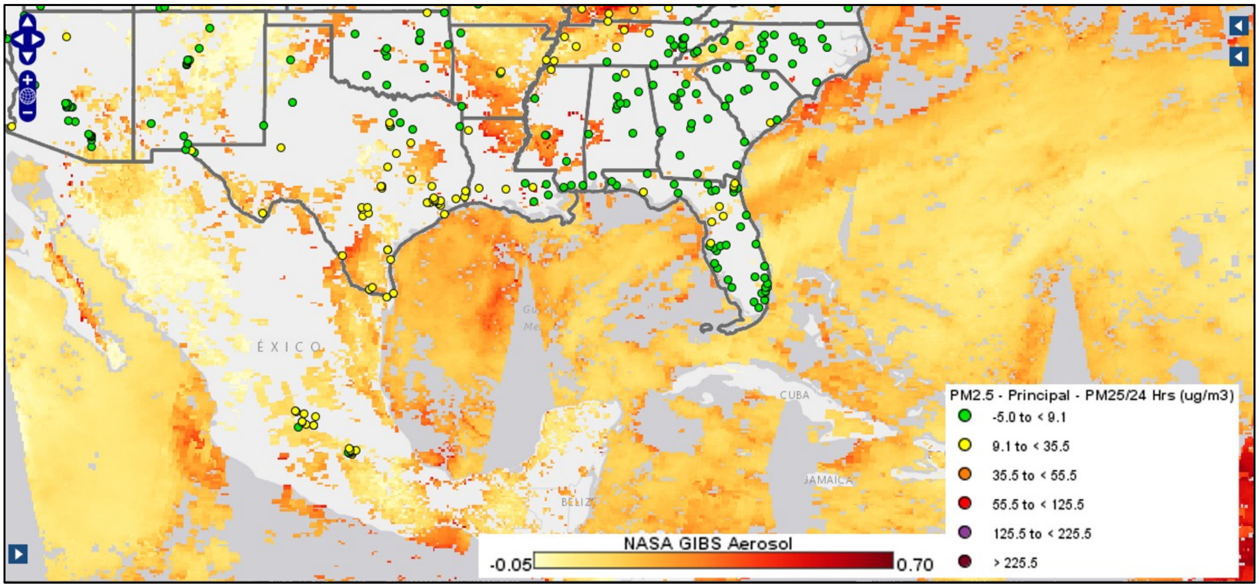


Figure 3-114: Aerosol optical depth map from MODIS Terra and Aqua on July 21, 2022

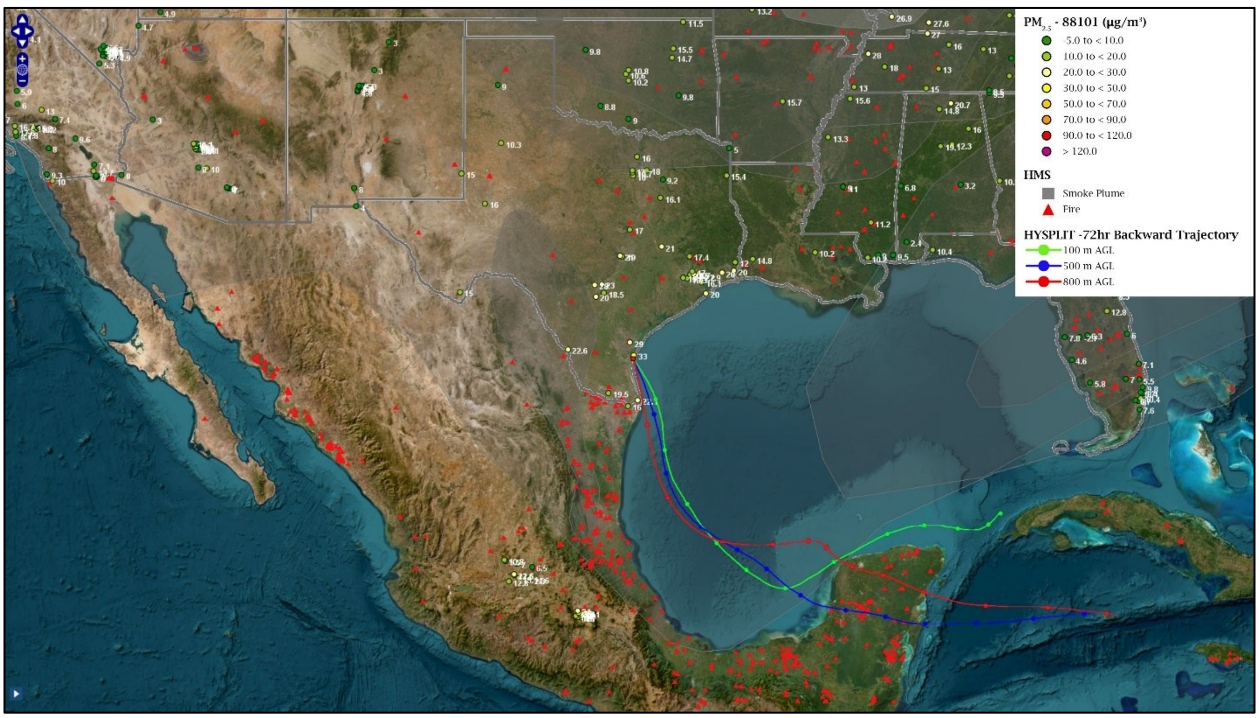


Figure 3-115: HYSPLIT back trajectories from the National Seashore monitoring site on July 21, 2022

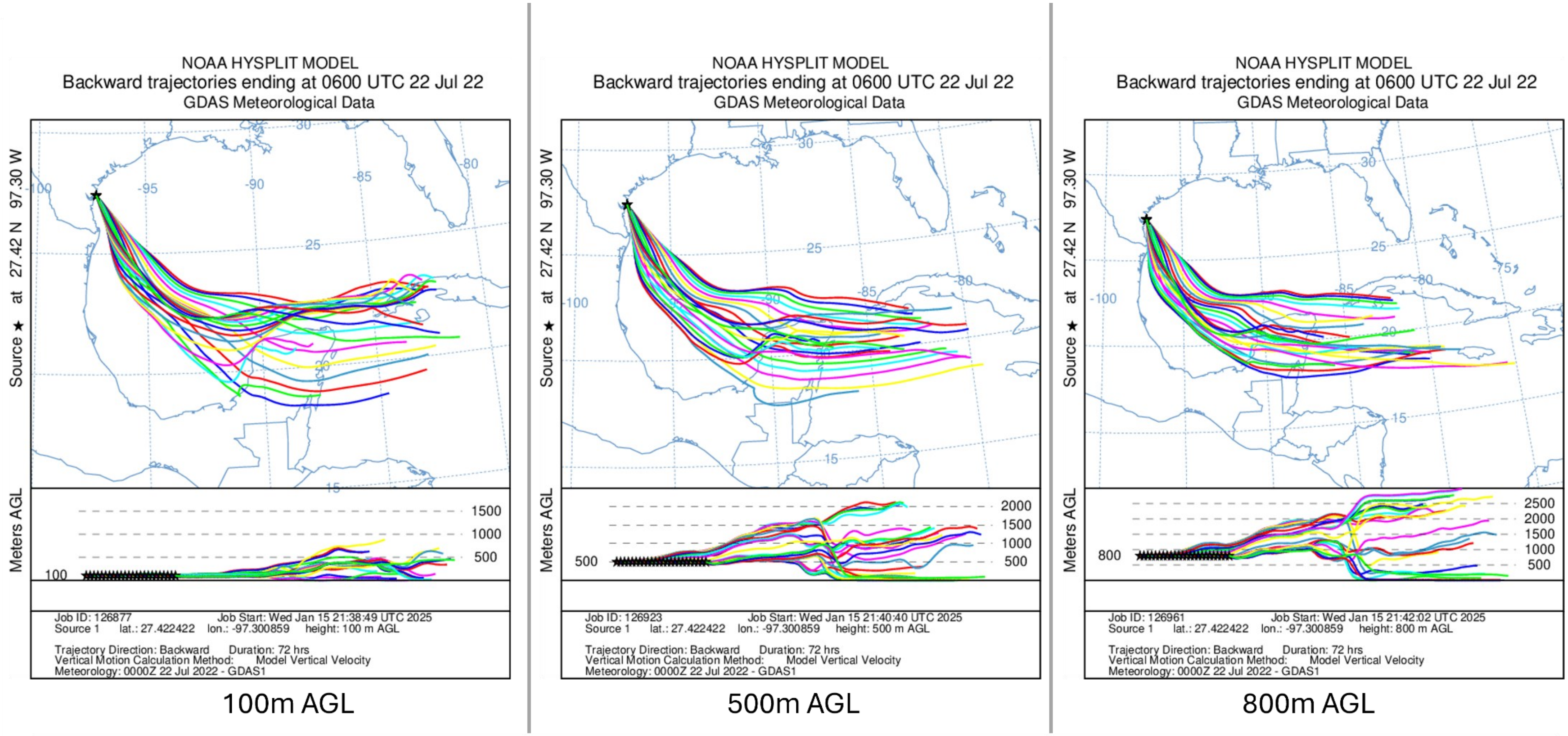


Figure 3-116: 72-hour HYSPLIT back trajectories starting from each hour on July 21, 2022, from the National Seashore monitoring site at 100m AGL, 500m AGL, and 800 m AGL

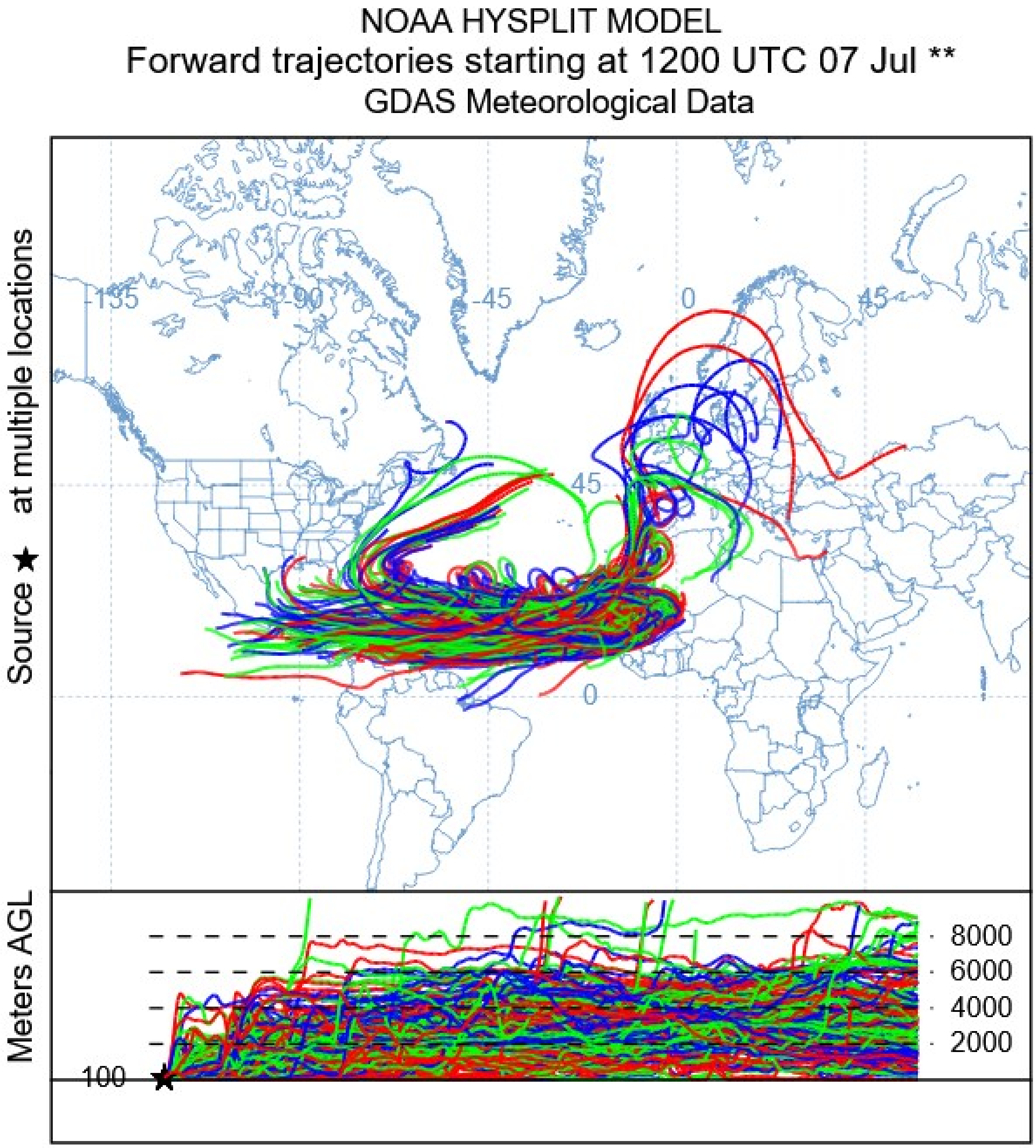


Figure 3-117: HYSPLIT forward trajectories from Western Africa, starting on July 7, 2022

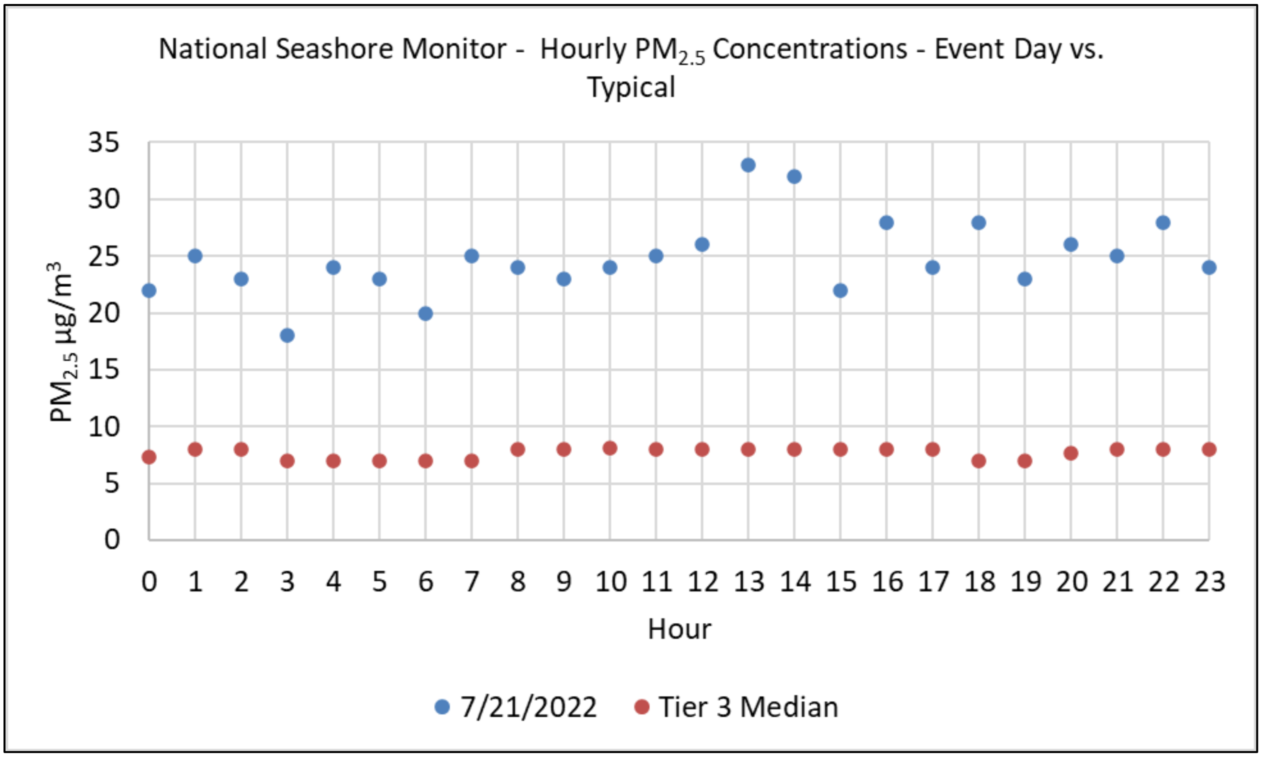


Figure 3-118: Hourly $PM_{2.5}$ concentrations on July 21, 2022, compared to typical concentrations at the National Seashore Monitor

SECTION 4: NOT REASONABLY CONTROLLABLE AND NOT REASONABLY PREVENTABLE

4.1 OVERVIEW

This section satisfies the Exceptional Events Rule Requirements at 40 CFR §50.14(c)(3)(iv)(A), CFR §50.1(j), 40 CFR §50.14(c)(3)(iv)(D), and 40 CFR §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.[13]

The wind rose at each monitor is from the EPA *$PM_{2.5}$ Designations Mapping Tool*.[14] 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.[15]

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.*

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

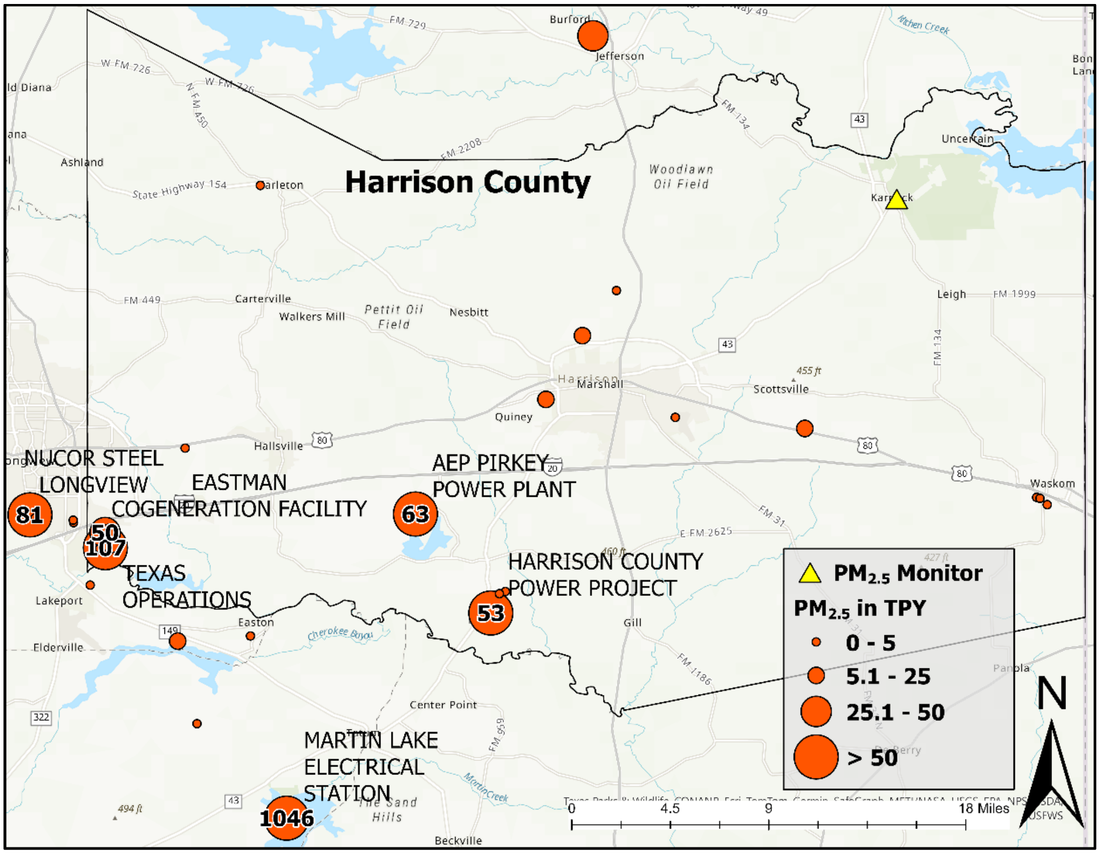


Figure 4-1: Point Sources in and around Harrison County, from 2022

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.

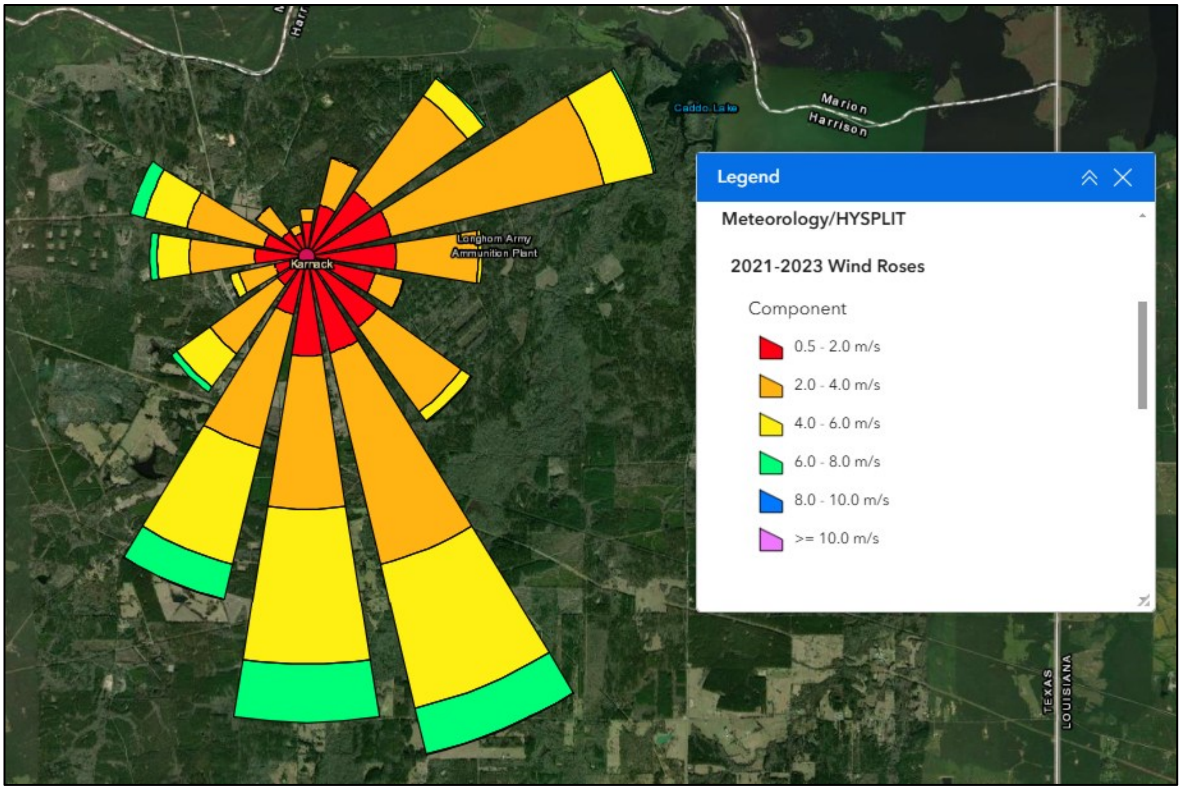


Figure 4-2: 2021-2023 Wind Rose at the Karnack Monitor

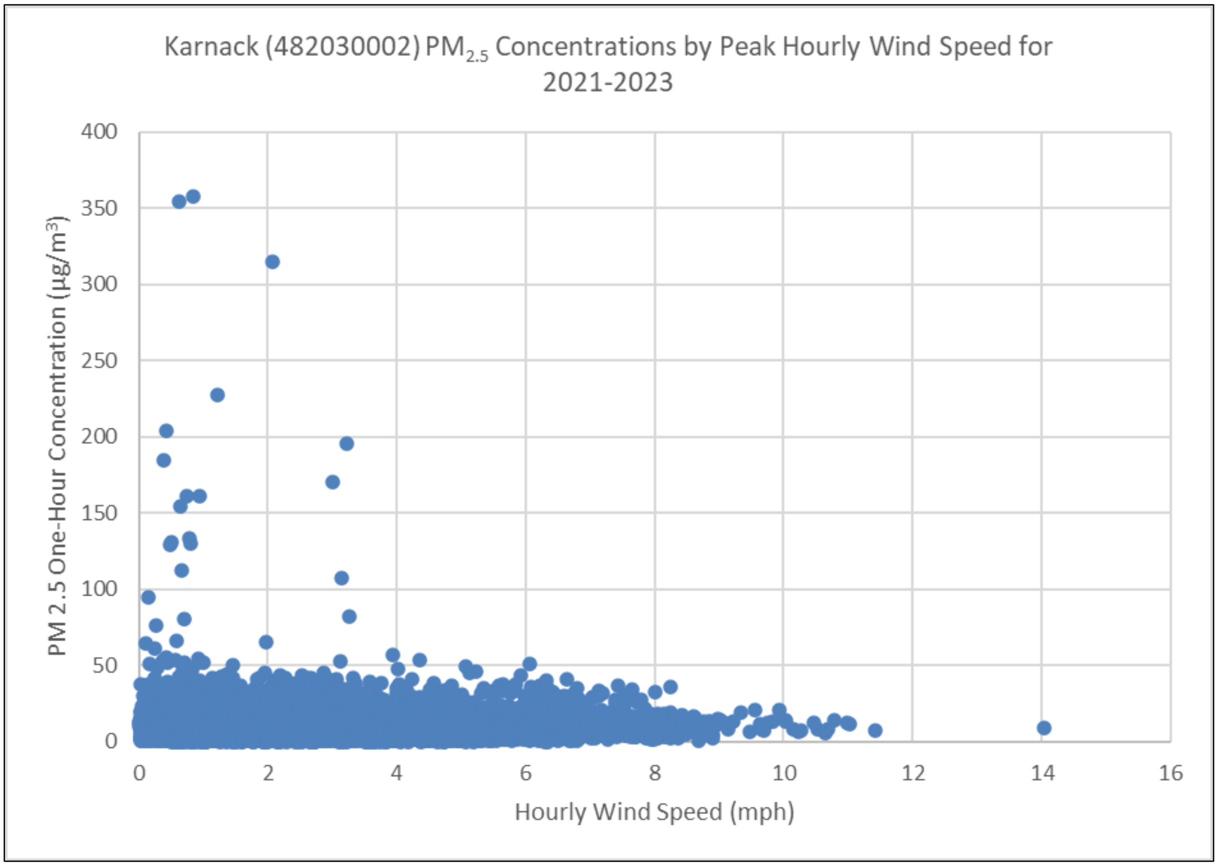


Figure 4-3: Hourly Average Continuous $PM_{2.5}$ Concentration by Hourly Wind Speed for 2021, 2022, and 2023 at the Karnack Monitor

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*.

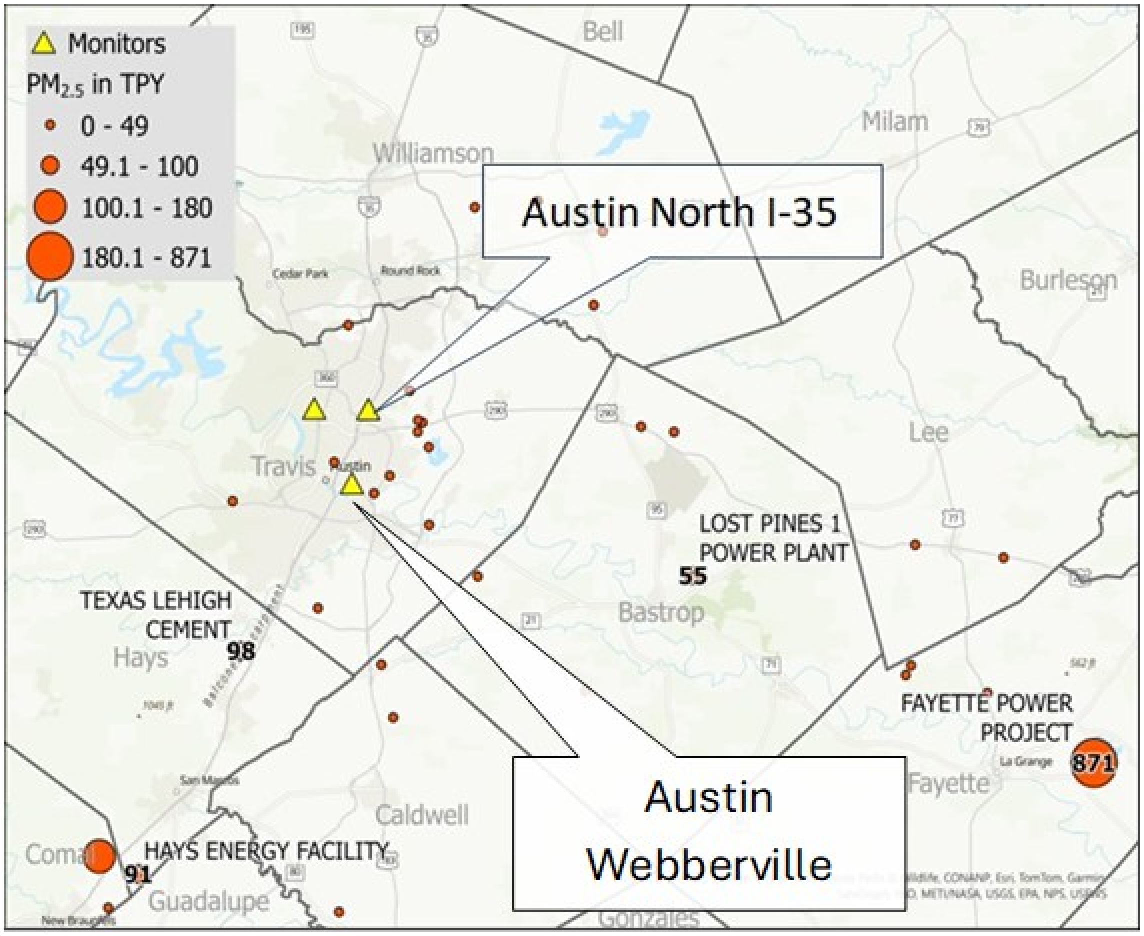


Figure 4-4: Point Sources in and around Travis County, from 2022

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

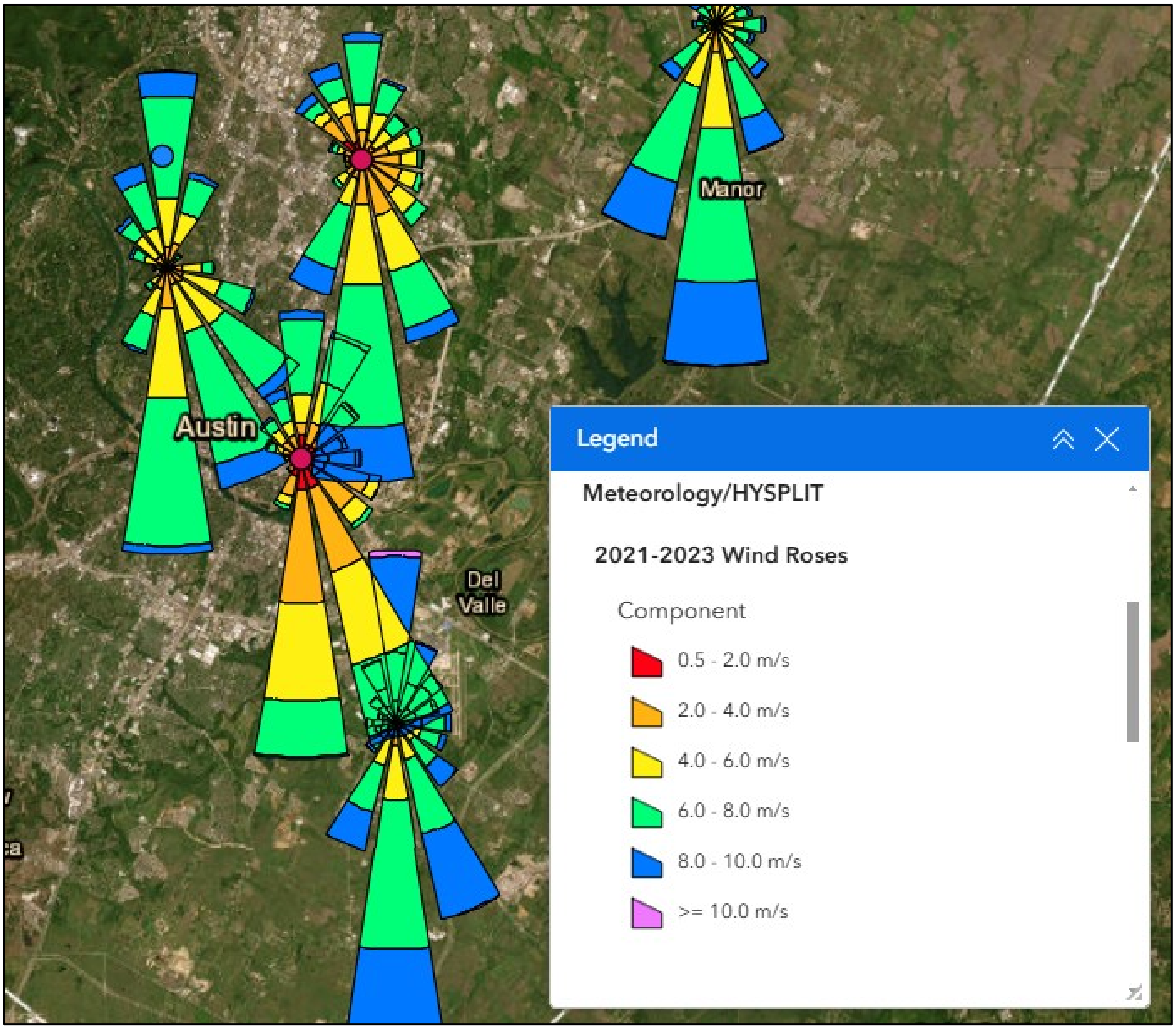


Figure 4-5: 2021-2023 Wind Roses at monitors in and around Travis County

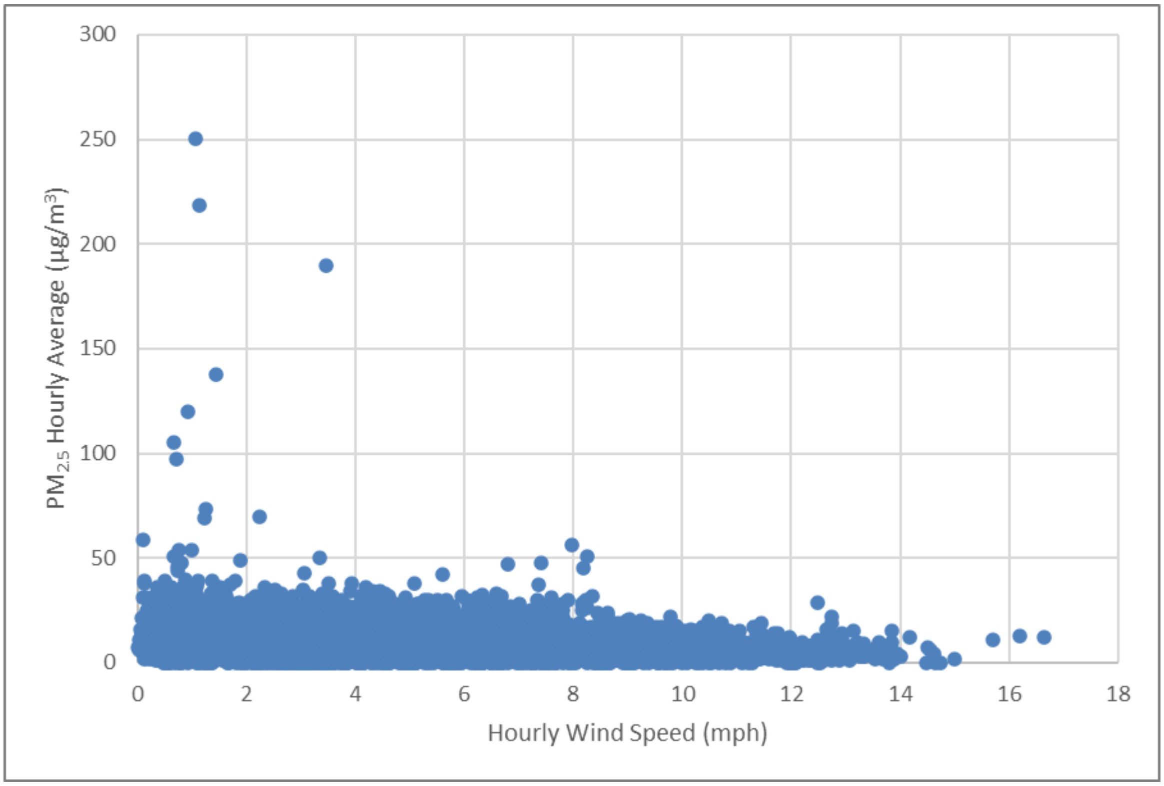


Figure 4-6: Hourly Average Continuous $PM_{2.5}$ Concentration by Hourly Wind Speed for 2021, 2022, and 2023 at the Webberville Monitor

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*.

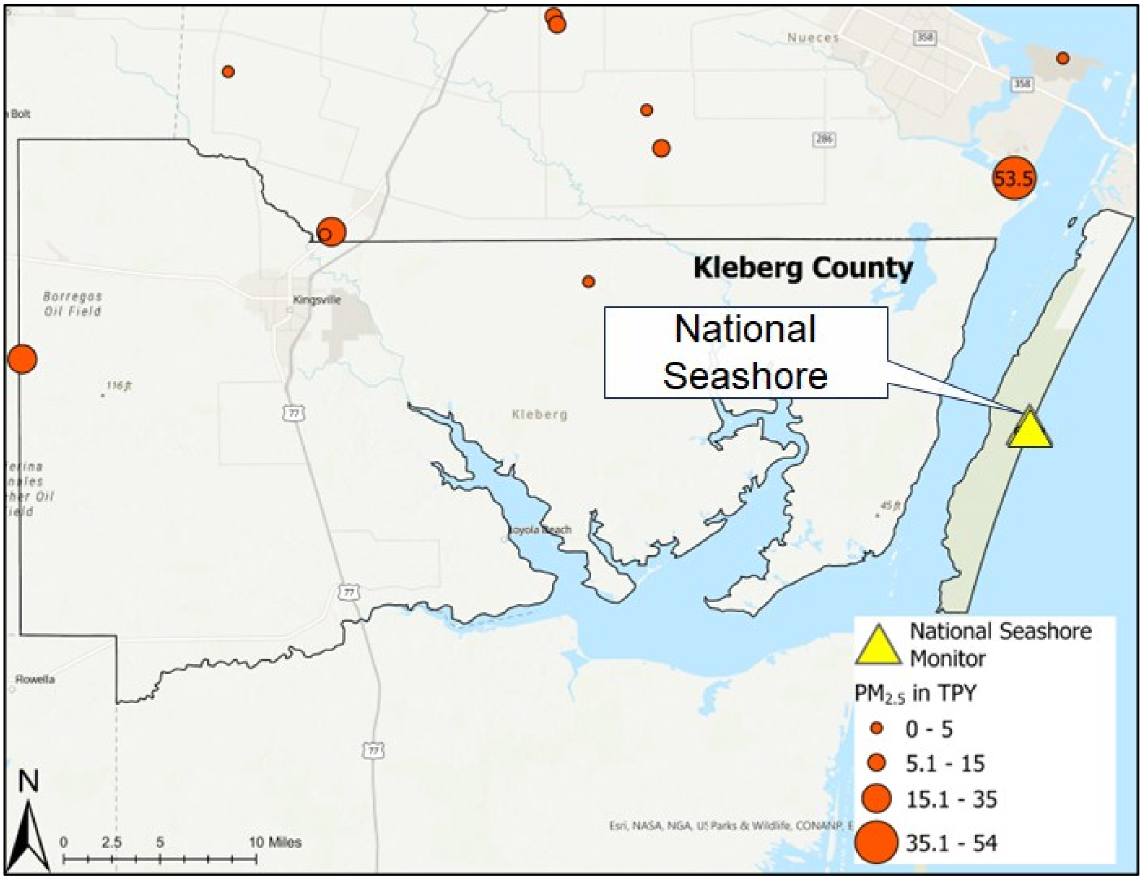


Figure 4-7: Point Sources in and around Kleberg County, from 2022

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

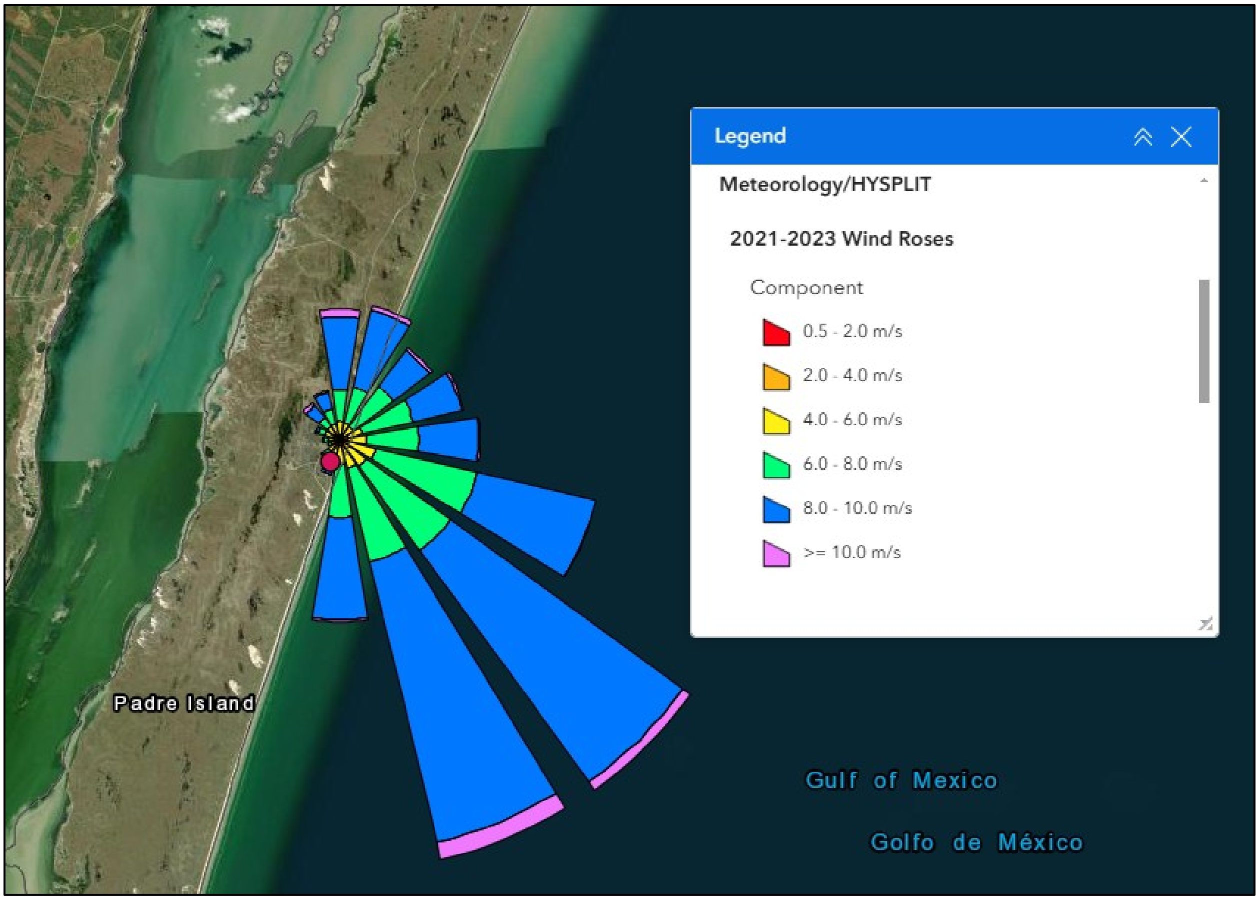


Figure 4-8: 2021-2023 Wind Rose at National Seashore Monitor

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.

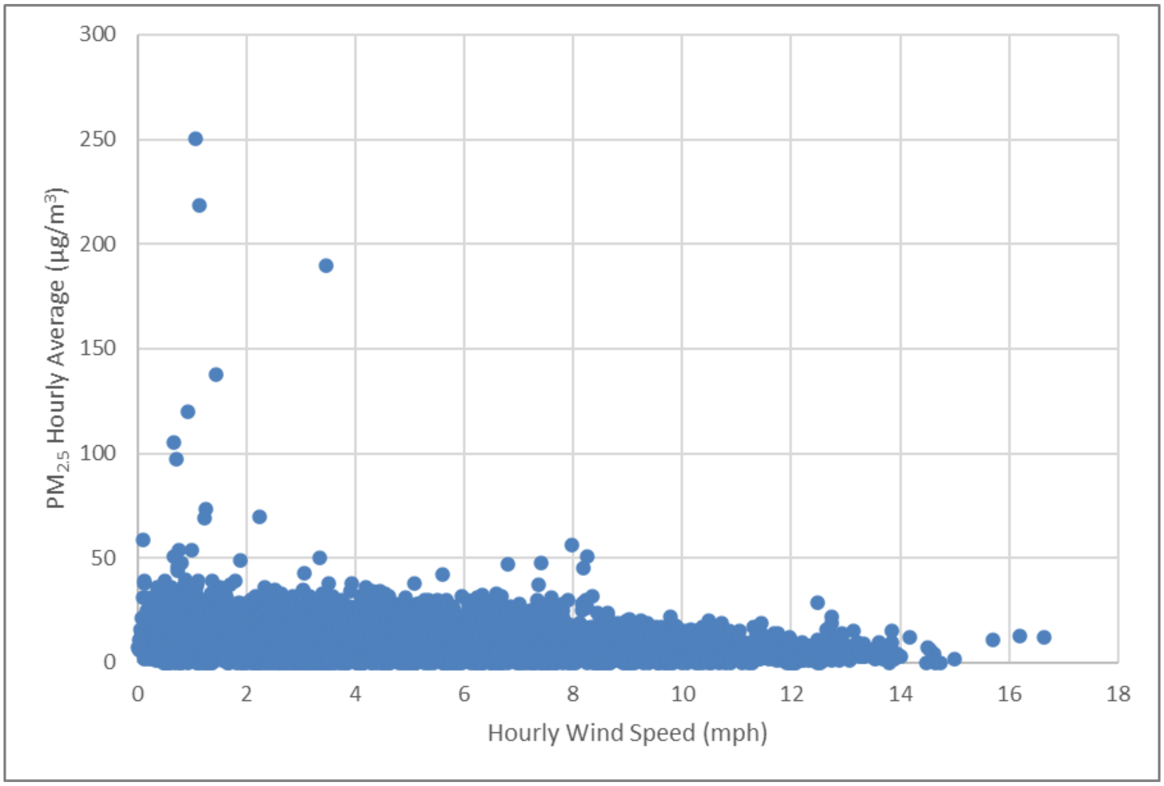


Figure 4-9: Hourly Average Continuous $PM_{2.5}$ concentration by Hourly Wind Speed for 2021, 2022, and 2023 at the National Seashore monitor

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.[16] 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.[17]

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

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

§51.308(f)(2)(iv)(D).[18] 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 PM, 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.[19]
- TFS, 2018. Texas A&M Forest Service Smoke Management Plan.[20]
- TCEQ, 2015. Outdoor Burning in Texas, publication number: RG-049.[21]
- 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.[22]
- Texas Parks and Wildlife Department, 2015. General Plan for Prescribed Burning on Texas Parks and Wildlife Department Lands.[23]
- 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.[24]

4.5 FIRES FROM 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.*

[18] https://tfsweb.tamu.edu/

[19] https://tfsweb.tamu.edu/uploadedFiles/TFSMain/Wildfires_and_Disasters/Contact_Us(3)/Texas%20Wildfire%20Protection%20Plan_May%202023%20Revision.pdf

[20] https://tfsweb.tamu.edu/uploadedFiles/TFS_Main/Manage_Forests_and_Land/Prescribed_Fires/TFS%20SMP.pdf

[21] https://www.tceq.texas.gov/downloads/publications/rg/outdoor-burning-in-texas-rg-49.pdf

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

[23] https://tpwd.texas.gov/publications/pwdpubs/media/pwd_lf_w7000_1818_general_plan_for_burning_on_tpwd_lands.pdf

[24] 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.

Smoke that is attributable to human causes that occur outside of Texas, due to agricultural or industrial burning, are not controllable or preventable by the State of Texas.

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.

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.[25]

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.

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[25] https://www.ldaf.la.gov/land/fire/prescribed-burning

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.[26] 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.

TCEQ independently verified the data in the report and agrees 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 2022 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.[27] In 2022, a total of 6,719 instances of fires were reported with 15 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, Road Clearing, and Illegal Activities. Of the 6,719 fires, 2,198 (33%) fires occurred in protected natural areas and are unlikely to recur. Figure 5-1: *Map of Forest Fires in Mexico in 2022* is a map of all the instances of forest fires reported in 2022. Figure 5-2: *Fires in Mexico in 2022 classified as unlikely or likely to recur based on possible causes* shows that 45% of fires that occurred in 2022 are unlikely to recur based on the possible causes provided and covered a surface area of 286,854.66 hectares where fires are unlikely to recur.[28] 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 2022.

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[26] https://www.tceq.texas.gov/downloads/air-quality/sip/pm/ramboll_mexicanfires.pdf

[27] https://monitor_incendios.cnf.gob.mx/incendios_tarjeta_semanal, accessed on January 27, 2025.

[28] TCEQ classified forest fires that had possible causes of Camp Fires, Intentional, Smokers, Hunters, Natural, Forest Waste, and Illegal Activities as unlikely to recur.

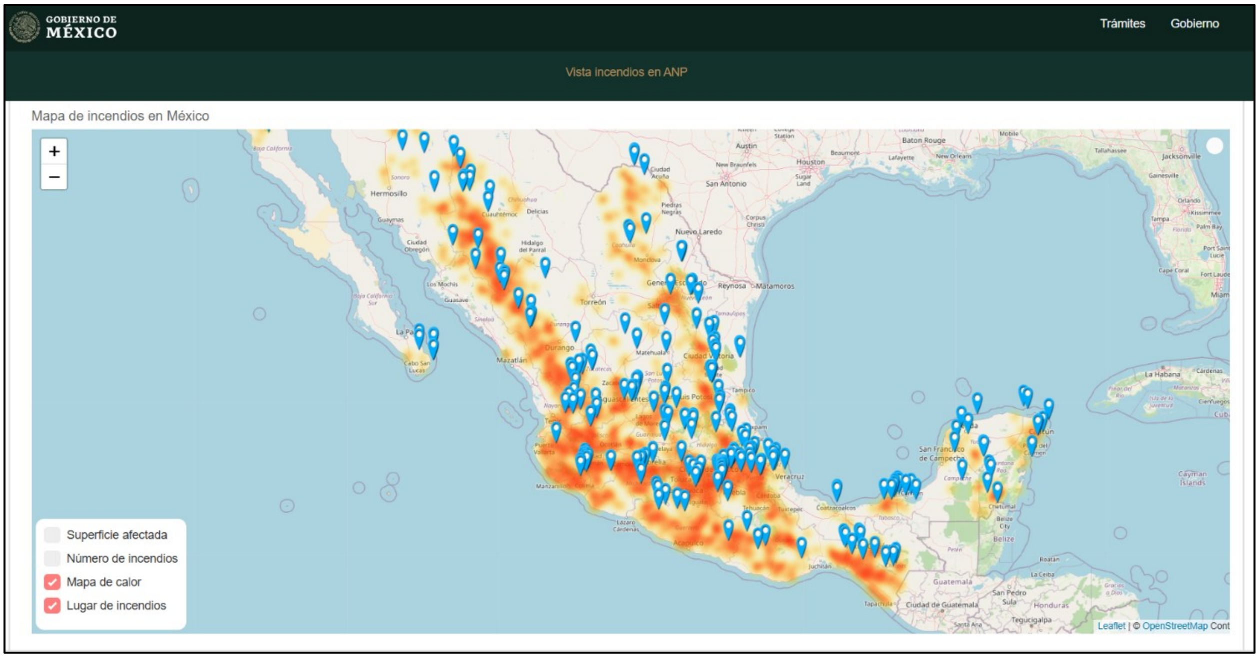

Figure 5-1: Map of Forest Fires in Mexico in 2022

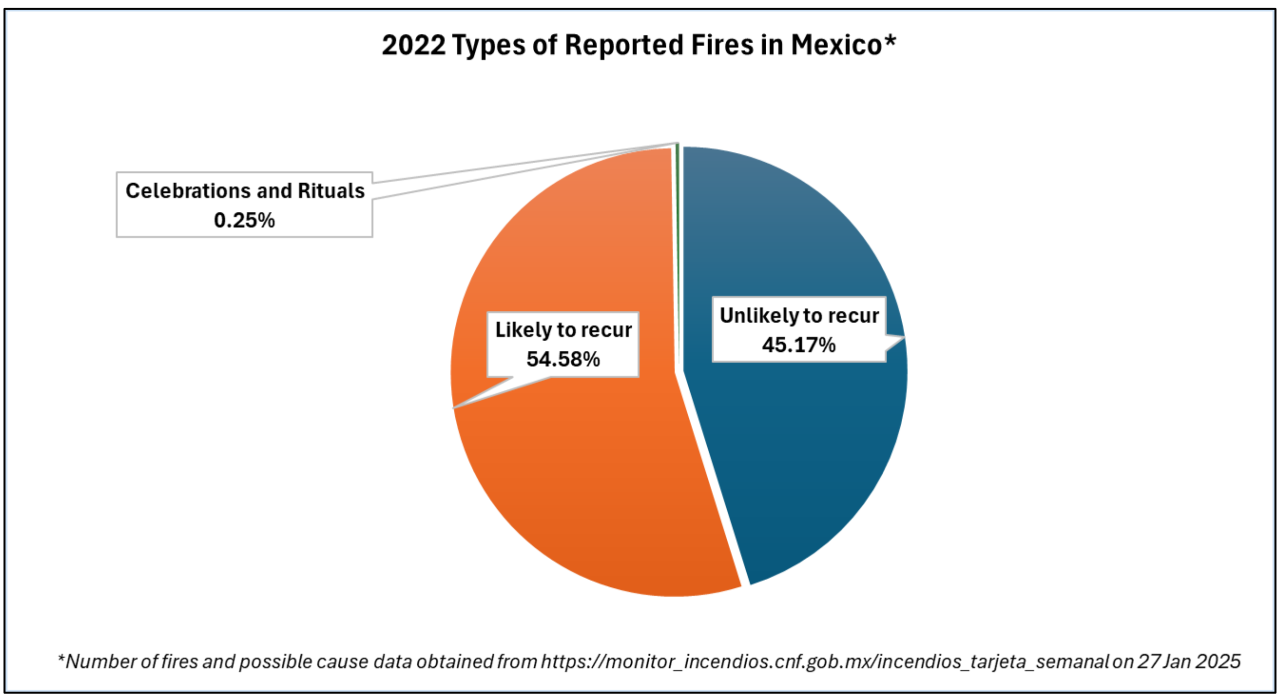

Figure 5-2: Fires in Mexico in 2022 classified as unlikely or likely to recur based on possible causes

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.[29, 30]

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.[31] 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.[32]

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.[33] 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.[34] The webpage also addresses the latest air quality planning for the particulate matter NAAQS.

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29 http://www.tceq.texas.gov/airquality/monops/forecast_today.html
30 http://airnow.gov
31 https://www.tceq.texas.gov/cgi-bin/compliance/monops/select_curlev.pl?user_param=88101
32 https://www.tceq.texas.gov/airquality/monops/data-reports
33 http://www.tceq.texas.gov/airquality/monops/ozone_email.html
34 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.[35]

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.[36]

The Texas Department of Transportation (TxDOT) sponsors the public education and awareness through the Drive Clean Across Texas campaign.[37] 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.[38]

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.[39]

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[35] http://www.tceq.texas.gov/agency/air_main.html
[36] https://www.airnow.gov
[37] http://www.drivecleanacrosstexas.org
[38] http://takecareoftexas.org/air-quality
[39] 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 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 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 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.