Prepared for:

Arkansas Department of Energy and Environment
Division of Environmental Quality

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$PM_{2.5}$ 2022 and 2023 Wildfire Exceptional Event Demonstration

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Acronyms and Abbreviations

AQI	Air Quality Index
AQS	EPA's Air Quality System
CFR	Code of Federal Regulations
DEQ	Arkansas Division of Environmental Quality
EED	Exceptional Event Demonstration
EPA	Environmental Protection Agency
FRP	Fire Radiative Power
GOES	Geostationary Operational Environmental Satellite
HMS	NOAA's Hazard Mapping System
HYSPLIT	Hybrid Single Particle Lagrangian Integrated Trajectory
Hr	Hour
HRRR	High-Resolution Rapid Refresh
HRRR-Smoke	HRRR Smoke Model
IMSR	National Interagency Fire Center's Incident Management Situation Report
kts	knots
mb	millibar
MDT	Mountain Daylight Time
MODIS	Moderate-Resolution Imaging Spectroradiometer
NAAPS	Navy Aerosol Analysis and Prediction System
NAAQS	National Ambient Air Quality Standards
NAM	North American Mesoscale Model
NCEP	National Center for Environmental Prediction
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
NWP	Numerical Weather Prediction
$PM_{2.5}$	Particulate Matter less than or equal to 2.5 micrometers in aerodynamic diameter
POC	Parameter Occurrence Code
SLAMS	State and Local Air Monitoring Station
SPC	Storm Prediction Center
$\mu g/m^3$	Micrograms per meter cubed
UTC	Coordinated Universal Time
VIIRS	Visible Infrared Imaging Radiometer Suite

Executive Summary

In accordance with the Code of Federal Regulations (CFR, 40 CFR Part 50.14)[1] which defines the Exceptional Events Rule, the Arkansas Division of Environmental Quality (DEQ) contracted Ramboll Americas Engineering Solutions, Inc. (Ramboll) to prepare a demonstration requesting the exclusion of Particulate Matter less than or equal to 2.5 micrometers in aerodynamic diameter ($PM_{2.5}$) data recorded at various DEQ ambient air monitoring stations that exceeded the 2012 National Ambient Air Quality Standard (NAAQS) for $PM_{2.5}$ from regulatory decisions due to wildfire smoke Exceptional Events that occurred for selected dates in both 2022 and 2023.

Air regulatory agencies may request that exceedances or violations be excluded from ambient monitoring data used to make regulatory decisions. The demonstration that an exceedance or violation is due to exceptional circumstances must include:

1. A narrative conceptual model that describes the event.
2. A demonstration that the event affected air quality in such a way that there is a clear causal relationship between the event and the monitored exceedance.
3. An analysis comparing the event influenced-concentrations to concentrations at the same monitoring station at other times.
4. A demonstration that the event was both not reasonably controllable or preventable.
5. A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event.
6. Documentation that there was a public comment period.

During the spring of 2022 and 2023, monitors at Arkansas measured elevated $PM_{2.5}$ concentrations that were affected by smoke generated by wildfires burning in Mexico—along the Gulf Coast, the Yucatan peninsula and central Mexico. Also, wildfires in Arizona, Texas and New Mexico were the predominant sources of smoke during the summer of 2022. During the summer of 2023, an exceptional Canadian fire season not only impacted Arkansas monitors but also many sites in the entire U.S. Excessive smoke from numerous wildfires burning in Canada, particularly in Quebec, the Northwest Territories, British Columbia, and Alberta, impacted Arkansas and contributed to observed high $PM_{2.5}$ concentrations over a period spanning mid-May to early October.

The total number of exceeding monitor-days in this Exceptional Event Demonstration (EED) in 2022-2023 is 44 monitor-days. This demonstration provided by Ramboll shows that these $PM_{2.5}$ exceedances were due to Exceptional Events caused by wildfire smoke outside of the DEQ's regulatory purview.

This demonstration addresses all required components of a request to exclude data from regulatory decisions as detailed in 40 CFR Part 50.14.

[1] https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-50/section-50.14

1.0 Conceptual Model

According to 40 CFR Part 50.14(c)(3)(iv)(A), a demonstration must have "A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s)".[2] This section presents the narrative conceptual model illustrating that wildfire smoke led to many exceedances of the 2015 $PM_{2.5}$ NAAQS at DEQ monitoring stations.

1.1 Overview

This demonstration includes events that affected $PM_{2.5}$ concentrations both in 2022 and 2023.

During May 2022, there were multiple fires burning over several regions in Mexico. Although there is not as detailed information about these fires as in the U.S., the Mexican program *Coordinación General de Conservación y Restauración* (CONAFOR), part of the Mexican Commission of Forest Management (Comisión Nacional Forestal) keeps annual and monthly statistics of fires in Mexico. During mid-May, Arkansas monitors were impacted by smoke from very intense fires as the total area burned was the largest in Mexico for all 2022 (114,310 hectares [ha]). In addition to the presence of fires, the right weather conditions are important to bring this smoke from Mexico into the U.S.—usually a high-pressure system located over the southeastern U.S. or over the Gulf of Mexico that favors southerly flow into Arkansas. Also, during the summer in 2022, several significant wildfires occurred across Arizona and New Mexico, contributed to a challenging fire season. Some fires include The Midnight Fire near El Rito, New Mexico, which started on June 10 due to lightning, burned approximately 5,292 acres. The Foster Fire in the Peloncillo Mountains of New Mexico began on May 29, was human-caused, and affected around 7,612 acres. In Arizona, the Haywire Fire, northeast of Doney Park near Flagstaff, ignited on June 12 and consumed about 5,303 acres, while the nearby Pipeline Fire, which also began on June 12, burned approximately 26,437 acres. All these fires led to high $PM_{2.5}$ concentrations at Arkansas monitors during the end of the summer.

During the spring of 2023, there were multiple fires burning over several regions in Mexico that impacted $PM_{2.5}$ concentrations at Arkansas monitors. During the period of February 27 to March 1, 2023, fires in Mexico were not as intense as later in the year but still burned 6,538 ha. During April 3, 2023, fires continue to grow every week as the total area burned was 38,594 ha and the number of forest fires incidences was 472, the second largest in the year. During the summer of 2023, Arkansas, as well as much of the U.S., experienced excessive smoke from numerous wildfires burning in Canada, particularly in Quebec, the Northwest Territories, British Columbia, and Alberta, which impacted Arkansas and contributed to observed high $PM_{2.5}$ concentrations over a period spanning mid-May to early October. The period of June 4 to June 8 was a particulate intense fire episode: Wildfires in Quebec, Canada, burned approximately 5.1 million hectares (about 12.6 million acres) between June 1 and June 8, 2023 generating significant smoke that moved into Arkansas and was not caused by a single fire, but hundreds of fires that brough multiple waves of smoke that impacted air quality monitors in Arkansas, leading to 24-hour $PM_{2.5}$ exceedances.

[2] https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-50/section-50.14

The days when monitors at Arkansas experience exceptional events are shown in Table 1-1 for both the 2022 and 2023 wildfire season. The monitor-days in these years caused an increase in the 2023 design value statistics at the affected monitors. The design values for DEQ $PM_{2.5}$ monitors for the 2021-2023 period are shown in Appendix B.

Table 1-1. $PM_{2.5}$ Exceedances During the 2022 and 2023 Exceptional Event Period.

Date	AQS ID	Station Name	$PM_{2.5}$ Exceedance Concentration (µg/m³)
5/11/2022	05-119-0007	PARR	16.6
5/12/2022	05-119-0007	PARR	18.1
5/20/2022	05-119-0007	PARR	15.9
	05-139-0006	El Dorado	17
6/13/2022	05-119-0007	PARR	29.7
	05-139-0006	El Dorado	35.4
6/14/2022	05-119-0007	PARR	33.8
6/15/2022	05-119-0007	PARR	22.9
6/16/2022	05-119-0007	PARR	25.7
	05-139-0006	El Dorado	21.6
6/17/2022	05-119-0007	PARR	21.6
6/18/2022	05-119-0007	PARR	18.2
7/18/2022	05-119-0007	PARR	20.5
7/19/2022	05-119-0007	PARR	25.6
2/27/2023	05-119-0007	PARR	24.4
2/28/2023	05-119-0007	PARR	16.2
3/1/2023	05-119-0007	PARR	18.2
	05-139-0006	El Dorado	19.1
4/3/2023	05-139-0006	El Dorado	13.4
5/22/2023	05-119-0007	PARR	16.7
5/30/2023	05-139-0006	El Dorado	14.8
6/4/2023	05-119-0007	PARR	18.2
6/6/2023	05-119-0007	PARR	23.1
6/7/2023	05-119-0007	PARR	24.6
6/8/2023	05-119-0007	PARR	18.7
	05-139-0006	El Dorado	20.2
7/18/2023	05-119-0007	PARR	21
7/20/2023	05-119-0007	PARR	18.9
7/26/2023	05-119-0007	PARR	20.7
7/27/2023	05-119-0007	PARR	21.3
7/28/2023	05-119-0007	PARR	22.2
7/29/2023	05-139-0006	El Dorado	20.4
8/23/2023	05-119-0007	PARR	18.2
8/24/2023	05-119-0007	PARR	19.3
8/25/2023	05-119-0007	PARR	19.1
	05-139-0006	El Dorado	35.9
8/26/2023	05-119-0007	PARR	18.7
9/8/2023	05-119-0007	PARR	24.7
9/18/2023	05-119-0007	PARR	22.5
9/19/2023	05-119-0007	PARR	22
9/20/2023	05-119-0007	PARR	19.1
9/21/2023	05-119-0007	PARR	17.8
10/3/2023	05-119-0007	PARR	20.5
10/4/2023	05-119-0007	PARR	23.5

1.2 Source Area

During 2022, smoke and wildfire emissions located in Mexico were transported hundreds and thousands of miles north and impacted the south and southeastern U.S., including parts of Arkansas. Figure 1-1 provides a map of Mexican wildfires that potentially impacted Arkansas on May which corresponds to the days listed in Table 1-1 by total area burned (in hectares). The largest fire burned approximately 9,627 hectares and was located in the state of Tamaulipas, with other large fires in Yucatan, Guerrero, Oaxaca, Durango and Nuevo Leon. Appendix A provides a list of Mexican wildfires that could have impacted Arkansas monitors.

Figure 1-2 provides the percentage of area burned in May 2023 by Mexican State and shows that Guerrero (14%), Chiapas (14%), Durango (9%), and Jalisco (8%), each burned relatively large areas.

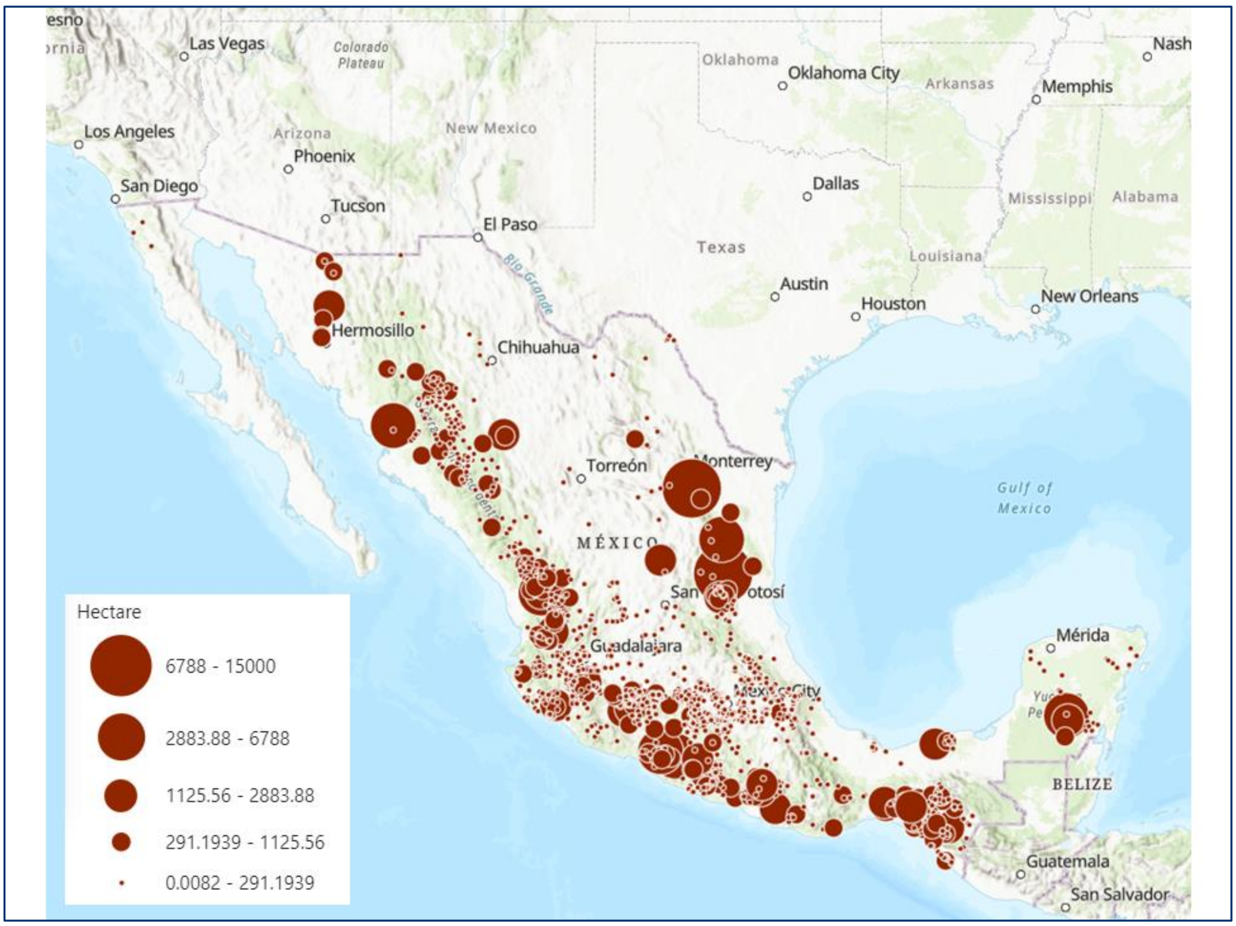

Figure 1-1. Mexican Wildfires scaled by area burned during the 2022 exceedance period.

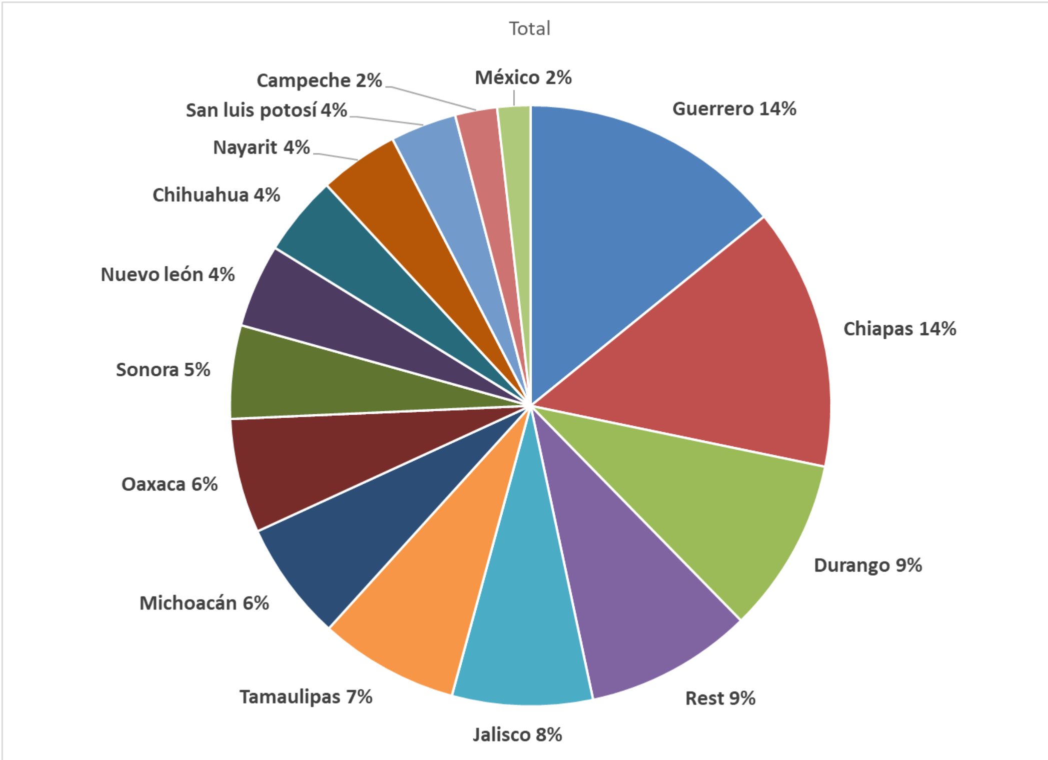

Figure 1-2. Pie chart of area burned by Mexican State in 2022.

During 2022, smoke and wildfire emissions located in Arizona, Texas and New Mexico were transported hundreds of miles to the eastern U.S. and impacted the southeastern U.S., including parts of Arkansas. Figure 1-3 provides a map of the wildfires in the U.S. that potentially impacted Arkansas from May to July, which corresponds to the days listed in Table 1-1 by total area burned (in hectares). The Hermits Peak Complex in New Mexico was one of the largest fires and burned almost 140,000 hectares from May to August. The second largest fire in New Mexico was the Black Fire that burned more than 130,000 hectares from May to July. The two largest fires in Texas were the Dempsey Fire and the Chalk Mountain fire that affected Arkansas during July 2022. Appendix A provides a list of US wildfires that could have impacted Arkansas monitors.

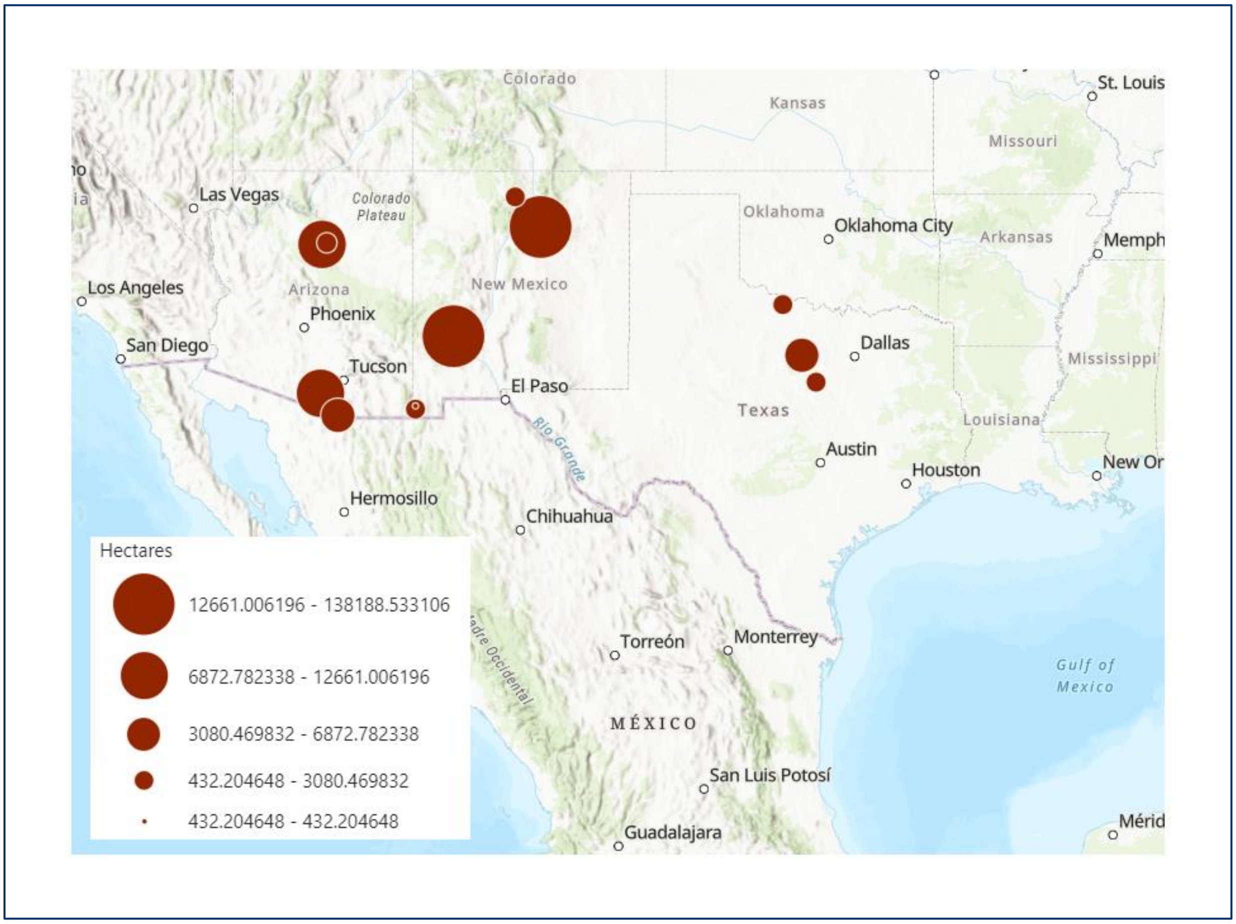

Figure 1-3. U.S. Wildfires scaled by area burned during the 2022 exceedance period.

During 2023, smoke and wildfire emissions located in Mexico were transported hundreds and thousands of miles north and impacted the south and southeastern U.S., including parts of Arkansas. Figure 1-4 provides a map of Mexican wildfires that potentially impacted Arkansas on the period of February to April which corresponds to the days listed in Table 1-1 by total area burned (in hectares). The largest fire burned more than 5,000 ha and was in the state of Sonora, with other large fires located in Chihuahua, Guerrero, Oaxaca, and Campeche. Appendix A provides a list of Mexican wildfires that could have impacted Arkansas monitors.

Figure 1-5 provides the percentage of area burned from February to October 2023 by Mexican State and shows that Guerrero (19%), Jalisco (16%), Oaxaca (10%), and Sonora (8%) each burned relatively large areas.

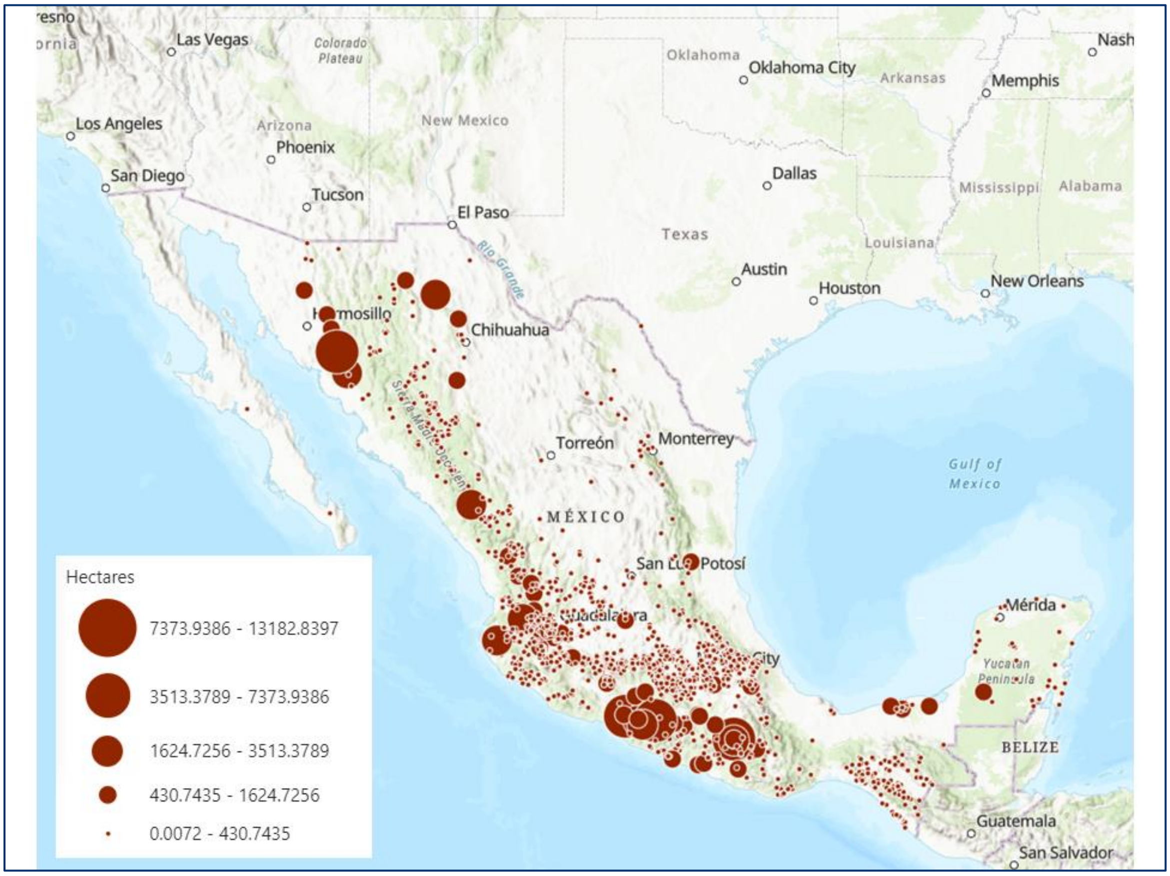

Figure 1-4. Mexican Wildfires scaled by area burned during the 2023 exceedance period.

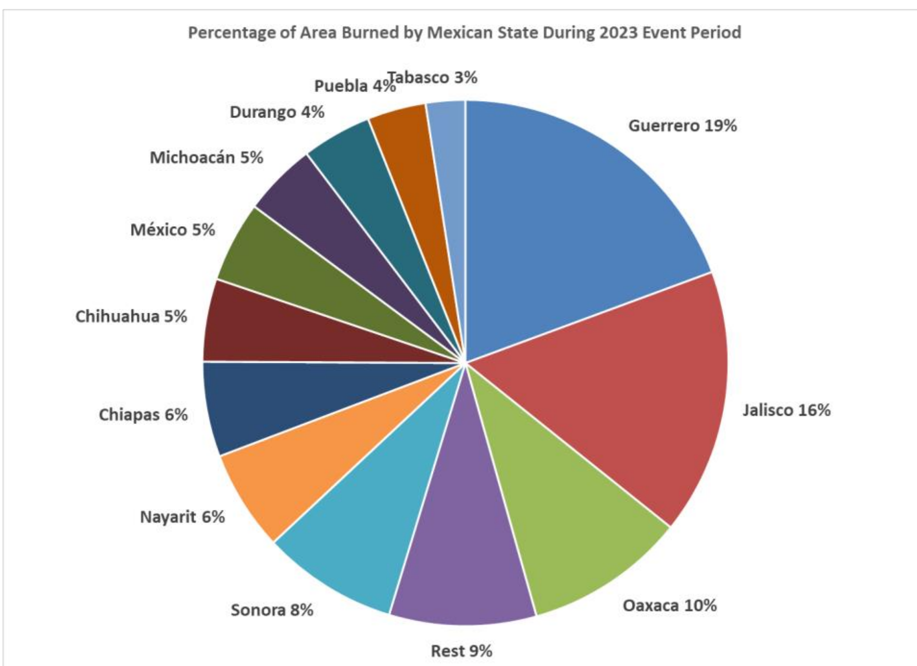

Figure 1-5. Pie chart of area burned by Mexican State in 2023.

During 2023, Canada's wildfire season was unprecedented with over 18 million hectares burned compared to the largest annual value of about 4 million hectares over the last 20 years. Smoke and wildfire emissions from the 2023 Canadian wildfires were transported hundreds and thousands of miles and impacted multiple regions throughout the U.S., including parts of Arkansas. Figure 1-6 provides a map of Canadian wildfires that potentially impacted Arkansas on some of the days listed in Table 1-1 by total area burned (in hectares). The largest fire burned more than one million acres and was in the Quebec province, with other large fires located in the Northwest Territories, British Columbia, and Alberta. Appendix A provides a list of Canadian wildfires that could have impacted Arkansas monitors. Wildfires in the United States were much smaller in 2023 and the $PM_{2.5}$ exceedances listed in Table 1-1 were overwhelmingly due to emissions from Canadian wildfires.

Figure 1-7 provides the percentage of area burned from May to October 2023 by Canadian Province and shows that Quebec (28%), the Northwest Territories (23%), British Columbia (16%), and Alberta (12%) each burned relatively large areas. Park Canada (6%), is the Canadian National Parks system and it reports fire statistics to the Canadian fire database in addition to the Provinces.

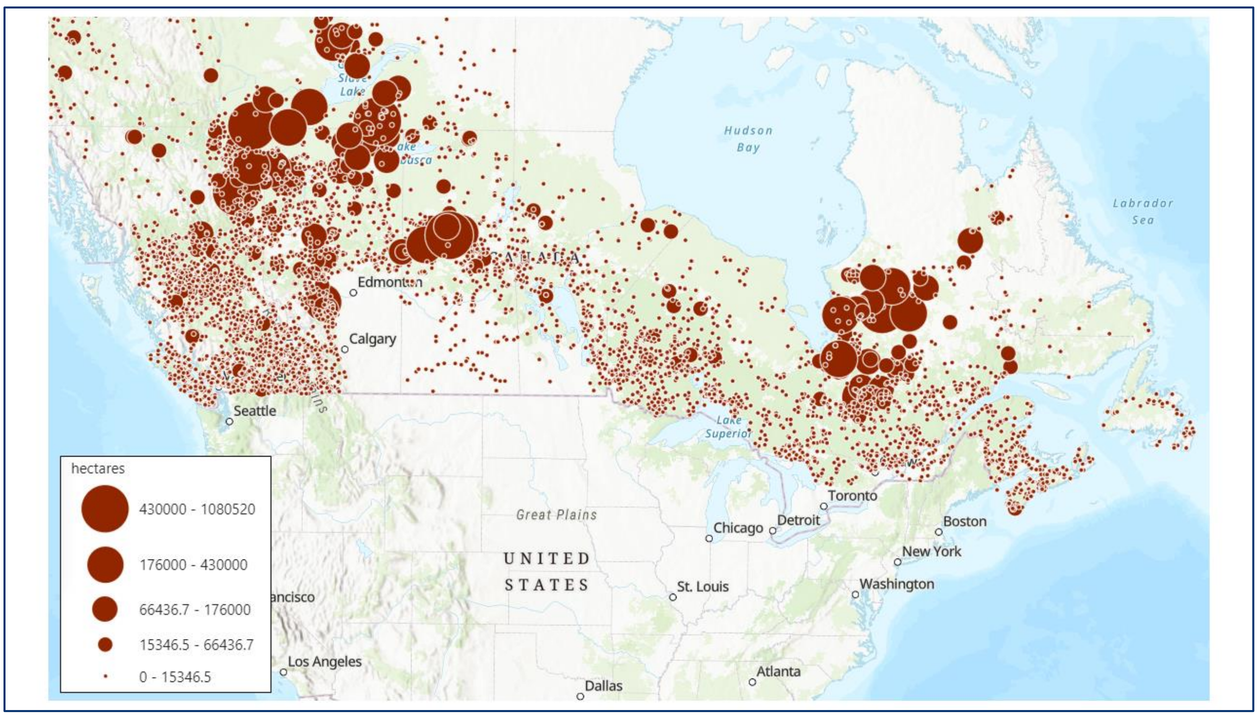

Figure 1-6. Canadian Wildfires scaled by area burned during the 2023 exceedance period.

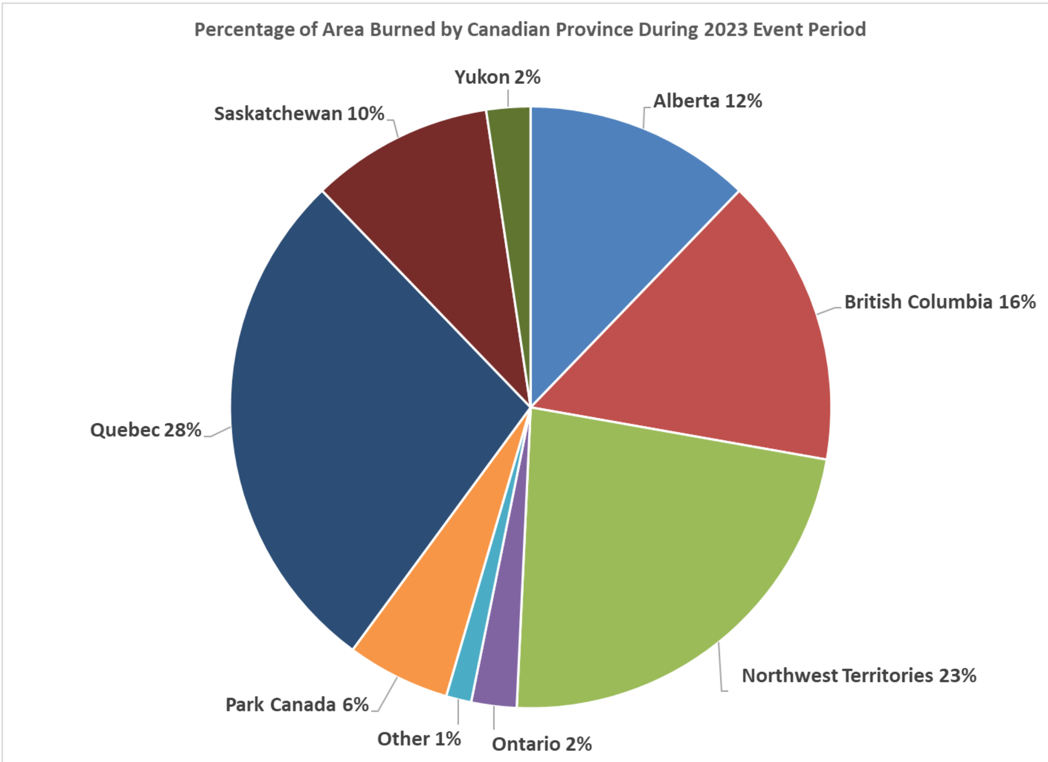

Figure 1-7. Pie chart of area burned by Canadian Province in 2023.

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1.3 Affected Region

Several episodes of smoky conditions were present across Arkansas during May to July 2022, and April to October 2023. Figure 1-8 shows a map of the DEC's PM$_{2.5}$ monitor locations that had at least one exceedance due to wildfire smoke. The monitor at PARR had eleven exceptional event days during 2022 and twenty-four during 2023. The monitor at El Dorado had three exceptional event days during 2022 and six during 2023.

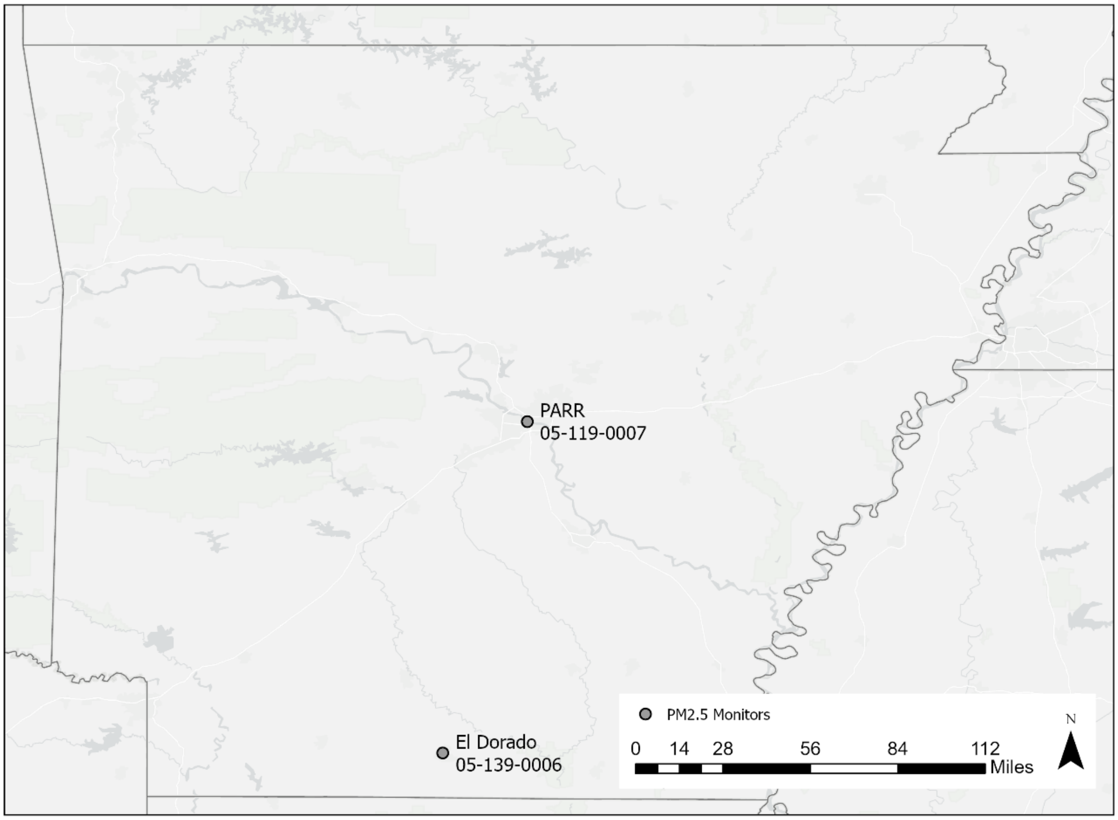

Figure 1-8. PM$_{2.5}$ exceedance monitor locations in Arkansas.

2.0 Clear Causal Relationship and Comparison of Event Influenced Concentration(s) to Concentrations at the Same Monitoring Site at Other Times

The next criteria to address are:

1. the clear causal relationship according to 40 CFR Part 50.14 (c)(3)(iv)(B) that requires:

   "…a clear causal relationship between the specific event and the monitored exceedance or violation" must be in the demonstration to show that the event affected air quality.

2. the comparison with historical concentrations according to 40 CFR Part 50.14 (c)(3)(iv)(C) that requires:

   "…Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times to support the requirement at paragraph (c)(3)(iv)(B) of this section. The Administrator shall not require a State to prove a specific percentile point in the distribution of data".

Note that these two (2) requirements are linked, and both are addressed in this Chapter.

On April 30, 2024, EPA released a new guidance document titled "$PM_{2.5}$ Wildland Fire Exceptional Events Tier Document" (EPA, 2024). This guidance document supplements EPA's 2016 document titled "Guidance on the Preparation of Exceptional Event Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (EPA, 2016). The updated guidance outlines expectations for the "narrative conceptual model" and provides a tiered approach for addressing the "clear causal relationship" criterion within a $PM_{2.5}$ demonstration, recognizing some causal relationships may require fewer pieces of evidence to satisfy the requirements.

- **Tier 1** clear causal analyses are intended for wildland fire events that cause unambiguous $PM_{2.5}$ impacts well above historical 24-hour concentrations, thus requiring less evidence to establish a clear causal relationship.

- **Tier 2** clear causal analyses are likely appropriate when the impacts of the wildland fire on $PM_{2.5}$ concentrations are less distinguishable from historical 24-hour concentrations and require more evidence than Tier 1 analyses.

- **Tier 3** clear causal analyses should be used for events in which the relationship between the wildland fire and $PM_{2.5}$ 24-hour concentrations are more complicated than a Tier 2 analysis, when 24-hour $PM_{2.5}$ concentrations are near or within the range of historical concentrations, and thus require more evidence to establish the clear causal relationship than Tier 2 or Tier 1.

EPA also developed an online $PM_{2.5}$ Tiering Tool – for Exceptional Events Analysis[3] to determine the appropriate Tier levels. Application of the Tiering Tool for the Arkansas monitor-days in Table 1-1 reveals that all monitor-days qualify as Tier 1 or Tier 2.[4] EPA's guidance for the analyses for a Tier 1 or Tier 2 Exceptional Event Demonstration analysis is provided in Table 2-1. The 2024 guidance document also notes that:

> *"While this document contains example analyses that air agencies may use in their demonstrations, air agencies can also prepare analyses or present documentation not listed or explained in this guidance, provided the information is well-documented, appropriately applied, technically sound, and supports the weight of evidence showing for the Exceptional Events Rule regulatory criteria."*

Table 2-1. Clear causal relationship technical demonstration components recommended for Tier 1 and Tier 2 Demonstration (EPA, 2024).

Tier 1 Analyses Should Include	Tier 2 Analyses Should Include
The tiering threshold used for the event day, which calculation methodology was used, and comparison of the 24-hour PM value to the tiering threshold.	The tiering threshold used for the event day, which calculation methodology was used, and comparison of the 24-hour PM value to the tiering threshold.
Comparison of the fire-influenced exceedance with historical concentrations, by providing two data plots appropriate to the chosen tiering threshold calculation methodology (R qualified data removed, R and I qualified data removed).	Comparison of the fire-influenced exceedance with historical concentrations, by providing two data plots appropriate to the chosen tiering threshold calculation methodology (R qualified data removed, R and I qualified data removed).
Evidence of transport of fire emissions from fire to the monitor (**one** of these): • Trajectories linking fire with the monitor (forward and backward), considering height of trajectories, or • Satellite evidence in combination with surface measurements.	Evidence of transport of fire emissions from fire to the monitor (**one** of these): • Trajectories linking fire with the monitor (forward and backward), considering height of trajectories, or • Satellite evidence in combination with surface measurements.
	Two additional pieces of evidence demonstrating that the fire emissions affected the monitor, as identified for Tier 2 analyses.

This Chapter addresses these two (2) regulatory requirements for each of the thirty-five (35) and the nine (9) exceptional event days at PARR and El Dorado sites respectively.

[3] PM2.5 Tiering Tool - for Exceptional Events Analysis | US EPA

[4] As shown in the following analysis.

2.1 Day-Specific Analyses

This section presents evidence for a clear causal relationship between the wildfires and the specific events and supporting evidence comparing the concentration(s) at the impacted monitors to concentrations at other times under cleaner background conditions (i.e., a historical comparison). As shown in Table 1-1, some event days have multiple exceeding monitors, and some days have a single exceeding monitor. The evidence in this section is organized to first show evidence for a specific day or period (i.e., that may pertain to multiple exceeding monitors; Items #1-7) and is followed by monitor-specific evidence (Items #7-13). The illustrative graphics in this section offer complementary evidence of wildfire smoke influences on the DEQ's $PM_{2.5}$ monitors. Each piece of evidence is described in detail below and then presented sequentially for each day.

1. <u>Weather maps and synoptic description</u>

Two (2) types of plots are shown for 6 AM (12Z) and 6 PM (00Z the following day) Central Standard Time (CST). The upper plots show National Weather Service (NWS) Storm Prediction Center (SPC) 500 millibar (mb) geopotential heights (grey contours, decameter) and air temperature (red contours; °C) with observations from upper air stations that show wind velocity (blue barbs; kts) as well as air temperature (red; °C), dew point temperature (green; °C), and geopotential height (purple; decameter).[5] The lower plots show the corresponding surface analyses from the Weather Prediction Center, which depict synoptic features such as high and low pressure centers, frontal boundaries, and atmospheric ridges/troughs, along with observations from surface-based stations.[6] Each station reports fractional cloud cover (blue shading), wind velocity (blue barbs; kts), air temperature (red; °F), dew point temperature (green; °F), sea level pressure (orange; truncated to 0.1 mb), and three-hour sea level pressure tendency (yellow; 0.1mb). Notable atmospheric conditions are shown with magenta symbols, of particular importance below are the symbols for smoke (vertical + sinusoidal lines) and haze (infinity symbol).

2. <u>NOAA's HMS smoke and fire maps</u>

The NOAA Hazard Mapping System (HMS) Fire and Smoke Product uses satellite data to detect fires and map smoke in near real-time across North America.[7] Each fire point represents an area where satellite sensors detected thermal anomalies, typically associated with active fires. Smoke detection relies on visual analysis using GOES-16 and GOES-17 imagery during daylight hours. The maps apply color scaling based on smoke density: light (gray), medium (yellow), and heavy (brown), and fires are marked as red points. Note that the HMS smoke layers are displayed with transparency and multiple layers are superimposed upon each other which creates a daily integrated product with varying density of the gray, yellow and brown shading. Note that when clouds are present the smoke may not be visible in the satellite images so smoke layers may not be present in the HMS maps even though smoke may still exist. The exceeding $PM_{2.5}$ monitors are highlighted on these maps.

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[5] Storm Prediction Center Forecast Tools (noaa.gov)

[6] WPC Surface Analysis Archive (noaa.gov)

[7] National Oceanic & Atmospheric Administration (NOAA) Hazard Mapping Systems (HMS) Fire and Smoke Product - https://www.ospo.noaa.gov/products/land/hms.html

3. Satellite imagery

AirNow: The satellite visible imagery product was obtained from the AirNow Tech Navigator.[8] The plots show satellite imagery from the Moderate-Resolution Imaging Spectroradiometer (MODIS) instrument aboard the Terra and Aqua satellites. These plots also display 24-hr $PM_{2.5}$ concentrations at monitor locations as available on AirNow Tech Navigator, though these may not reflect fully validated AQS values.

NOAA's AerosolWatch: Provides satellite aerosol products and imagery that are crucial for monitoring air quality and atmospheric conditions. The visible imagery on this platform is derived from various satellite sensors, including GEOS-East, GOES-West, and VIIRA (Visible Infrared Imaging Radiometer Suite) on the NOAA-20 and Suomi NPP satellites.[9] The visible imagery helps identify and track aerosols such as smoke, dust, and haze. This data is essential to understand the distribution and movement of aerosols. The platform allows users to view real-time and historical data at every 10-minutes interval, providing valuable insights for researchers and policymakers.

4. AirNow surface level $PM_{2.5}$ AQI

This product was obtained from EPA's AirNow system which has real-time and archived data available.[10] Daily $PM_{2.5}$ Air Quality Index (AQI) values at monitor locations and contours away from monitor locations were obtained for each exceedance day. In contrast to the previous two products that are vertically integrated and do not provide information on surface level smoke, this product provides evidence of surface level $PM_{2.5}$ concentrations to assess the spatial extent of elevated surface level $PM_{2.5}$ concentrations to determine whether there were widespread smoke events that impacted surface level $PM_{2.5}$ concentrations.

5. HRRR-Smoke near-surface smoke

The High-Resolution Rapid Refresh (HRRR-Smoke) model is a continental-scale, hourly-updated assimilation/modeling system operational at National Center for Environmental Prediction (NCEP) by NOAA.[11] HRRR-Smoke is comprised primarily of HRRR, a numerical weather prediction (NWP) model and an analysis/assimilation system used to initialize that model. The near-surface smoke product shows supporting evidence of surface level smoke and uses Visible Infrared Imaging Radiometer Suite (VIIRS) fire radiative power (FRP) to calculate biomass burning emissions, fire size and plume injection height. It also incorporates 3-D transport of smoke and interaction with physical processes including radiation and wet deposition.[12]

6. NAAPS Aerosol Forecast Model

The Navy Aerosol Analysis and Prediction System (NAAPS) is a global forecast model designed to predict the concentrations of sulfate, dust, and smoke aerosols in the troposphere. Developed by the U.S. Naval Research Laboratory (NRL) in Monterey, California, NAAPS integrates meteorological data from the Navy Operational Global Atmospheric Prediction System (NOGAPS) and employs dedicated models for sulfate,

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[8] https://www.airnowtech.org/navigator/index.cfm#
[9] https://www.star.nesdis.noaa.gov/smcd/spb/aq/AerosolWatch/
[10] https://gispub.epa.gov/airnow/index.html?tab=3
[11] National Oceanic & Atmospheric Administration (NOAA) High-Resolution Rapid Refresh (HRRR) - https://rapidrefresh.noaa.gov/hrrr/
[12] https://rapidrefresh.noaa.gov/pdf/Alexander_AMS_NWP_2020.pdf

smoke, and dust emissions.[13] For smoke concentrations, NAAPS provides simulations on a 1°×1° grid at 6-hour intervals, projecting conditions up to 120 hours (5 days) into the future. The model outputs include surface-level smoke concentration predictions, which are typically color-coded for ease of interpretation. These simulations are instrumental in understanding the distribution, transport, and potential impacts of smoke aerosols, making them a crucial resource for air quality monitoring, forecasting, and response.

7. Four-day time evolution of HMS fires and smoke

This product compiles four HMS smoke/fire spatial maps to investigate the evolution of fires and smoke plumes for three (3) days leading up to the exceedance and the exceedance day. When evaluating HYSPLIT back trajectories with a multi-day duration, it is useful to compare the trajectory locations (i.e., estimate of the air parcel's location) with smoke/fire maps from previous days to temporally align the air parcel with active fires and smoke plumes on previous days.

8. Summary table of monitor-day

This table summarizes the evidence presented in this section for each monitor-day, identifies states with fires potentially impacting the monitor, and assesses whether the evidence indicates a clear causal relationship to demonstrate that the exceedance was due to the wildfire Exceptional Event.

9. EPA $PM_{2.5}$ Tiering Tool time series

These plots are screenshots taken directly from the EPA's $PM_{2.5}$ Tiering Tool for Exceptional Events Analysis.[14] The Tiering Tool displays daily $PM_{2.5}$ concentrations, along with tier levels based on the methodology described in the $PM_{2.5}$ Wildland Fire Exceptional Events Tiering Document (EPA, 2024). The guidance states: "You can use the tier level to determine the evidence needed to establish a clear causal relationship in a wildland fire $PM_{2.5}$ exceptional events demonstration." Tiering thresholds are based on the most recent, complete 5-year period (currently 2019-2023) and are site-specific. Tier 2 is based on the lesser value 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 with all "R" flagged and fire-related "I" flagged days excluded.[15] Tier 1 demonstrations are appropriate for 24-hour $PM_{2.5}$ concentrations greater than or equal to 1.5 times the threshold determined above. Tier 2 demonstrations are appropriate for 24-hour $PM_{2.5}$ concentrations greater than or equal to the threshold but less than 1.5 times the threshold. Tier 3 demonstrations are appropriate for 24-hour $PM_{2.5}$ concentrations less than the threshold. In these plots, the exceedance day being evaluated is highlighted with a yellow arrow.[16] Note that the tiering thresholds vary by month, but the Tool only displays a single threshold on the plot that is based on the user selected month. The data for this Tool and the site-level tiering thresholds are refreshed every two weeks and include a date stamp. With each bi-weekly update, any new data submitted to AQS is reflected in the Tool, and the tiering thresholds are recomputed so that if any new "R" flags or fire-related "I"

[13] https://www.nrlmry.navy.mil/aerosol/index_frame.html

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

[15] "flagged data" are data in AQS that have been flagged by the State or local agency as having been impacted by any of the wildfire event types in AQS (e.g., IF, IG, IM, IT, RF, RG, RM, RP, RT). R (Request Exclusion) flag or a fire-related I (Informational) flag.

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

flags were applied since the last data refresh, then those data are excluded in the calculation of the tiering threshold in accordance with the tiering methodology.

10. Seasonal variation of daily $PM_{2.5}$

This next plot is another visualization of daily $PM_{2.5}$ highlighting the exceedance day in a historical context. Specifically, this plot shows the exceedance day compared to historical seasonal $PM_{2.5}$ concentrations by plotting for the 5-year historical period (i.e., 2017-2021, if available) or more recent years if the historical record is shorter (i.e., 2021–2023 for some monitors) as separate time series plots by day of the year. The month-specific tiering thresholds are also displayed on these plots as well as the 99th percentile based on 2017-2021 data, or 2021-2023 data, as applicable.

11. HYSPLIT back trajectories

Another piece of evidence presented for each monitor-day is a HYSPLIT back trajectory plot.[17] For each monitor-day, a set of back trajectories were generated starting at the monitor at three heights: 50 m, 100 m, and 500 m. A total of 24 back trajectories per day, corresponding to each hour, were developed for each height. This results in 72 back trajectories per monitor-day (3 heights x 24 ending hours), each spanning 96 hours. These trajectories are superimposed on the HMS smoke and fire products described above. HYSPLIT was run using the 12 km North American Mesoscale Forecast System (NAM12) and the 0.25° Global Forecasting System (GFS) meteorological dataset, with the isobaric vertical velocity option.

12. HYSPLIT forward trajectories

A set of forward trajectories was produced starting at the locations of fire(s) at three altitudes: 50 m, 100 m, and 500 m. For each day, 24 forward trajectories were generated per altitude, corresponding to each hour of the day. Similar to the back trajectories, the forward trajectories are overlaid on the HMS smoke and fire products described earlier. HYSPLIT was run using the 12 km NAM 12 and 0.25° GFS meteorological datasets.

13. Hourly $PM_{2.5}$ timeseries

Hourly $PM_{2.5}$ data from the Air Quality System (AQS) provides high-resolution measurements of fine particulate matter ($PM_{2.5}$) concentrations at air quality monitoring site. Each hourly value represents the average concentration of $PM_{2.5}$ during a one-hour period. These measurements are recorded using Federal Equivalent Method (FEM) ensuring consistency and accuracy in the reported data. These data are crucial for identifying short-term pollution events and assessing the potential impacts of specific sources, such as wildfires.

[17] https://www.ready.noaa.gov/HYSPLIT.php

2.1.1 May 11-12, 2022

New Mexico experienced a severe wildfire season in 2022 (Figure 2-1), with multiple large fires burning simultaneously across the state. The Hermits Peak/Calf Canyon Fire complex became the largest in state history, scorching over 341,471 acres and causing widespread devastation (Figure 2-2).[18] Other significant fires included the Bear Trap Fire which started on May 1 in Bear Trap Canyon and rapidly grew to 7,552 acres by May 12.[19] The Cerro Pelado Fire in the Jemez Mountains burned 43,887 acres and was only 11% contained by mid-May (Figure 2-3). The Cooks Peak Fire, which began on April 17, had consumed 59,359 acres. These fires, along with others like the Mitchell Fire and Campbell Road Fire, collectively burned hundreds of thousands of acres.

During May 2022, there were multiple fires burning over several regions in Mexico. Although there is not as detailed information about these fires as in the U.S., the Mexican program *Coordinación General de Conservación y Restauración* (CONAFOR), part of the Mexican Commission of Forest Management (Comisión Nacional Forestal) keeps annual and monthly statistics of fires in Mexico. Figure 2-4 shows the total number of fires and area burned over the whole country for year 2022. The figure indicates that there was a total of 6,719 fires that burned 735,206 ha, with the top 5 states with the most incidences of fires usually being different from the top 5 states with the most area burned, reflecting that some of these fires may be more intense and had significant impacts. Durango, Chihuahua and Jalisco were states in the western side of Mexico that had the largest total area burned by fires during 2022. Figure 2-5 shows the weekly number of forest fires and area burned in Mexico during 2022. The figure shows that on May 11-12, 2022 (week 19) fires were very intense during that week as the total area burned was the largest in the entire year (114,310 ha[20]).

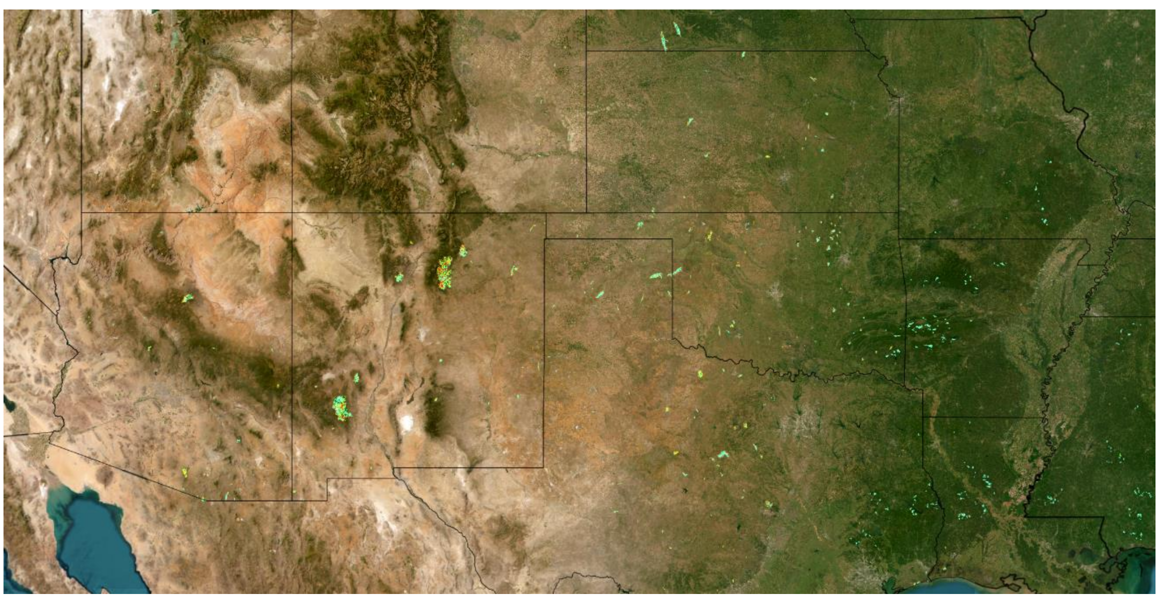


Figure 2-1. Burned severity in New Mexico for 2022. (MTBS Interactive Viewer)

[18] https://wildfiretoday.com/2022/05/12/calf-canyon-hermits-peak-fire-exceeds-a-quarter-million-acres/
[19] https://inciweb.wildfire.gov/incident-information/nmcif-bear-trap-fire
[20] Mexico Fires statistics available at: https://monitor_incendios.cnf.gob.mx/incendios_tarjeta_semanal

Figure 2-2. Calf Canyon, Hermits Peak fire in New Mexico. (https://geraintsmith.com/fire-in-new-mexico-may-11-2022/)

Figure 2-3. The Cerra Pelado Fire. Photo: National Wildfire Coordinating Group. (https://www.axios.com/2022/05/11/wildfire-los-alamos-national-lab-evacuation)

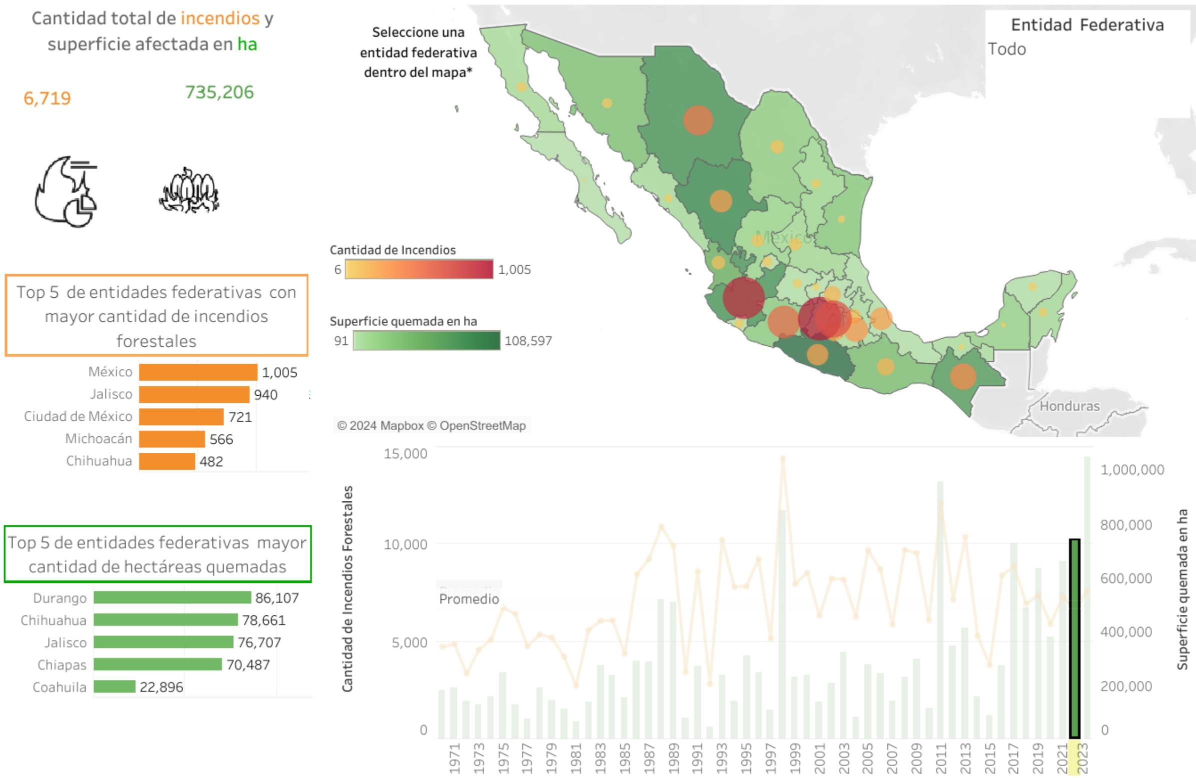


Figure 2-4. Incidence of Forest Fires in Mexico during 2022. Orange indicates number of fires, green shows area burned in hectares. (https://snif.cnf.gob.mx/incendios/#:~:text=%C2%BFPor%20qu%C3%A9%20ocurren%20los%20incendios,bien%20sus%20cigarros%20o%20fogatas.)

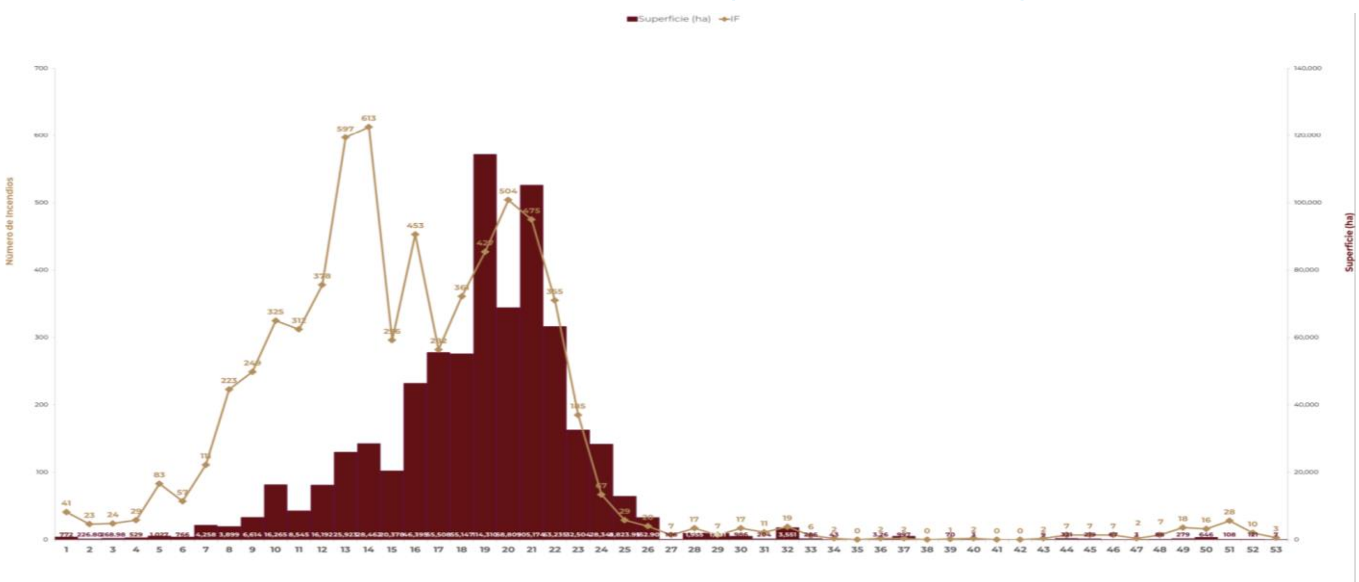
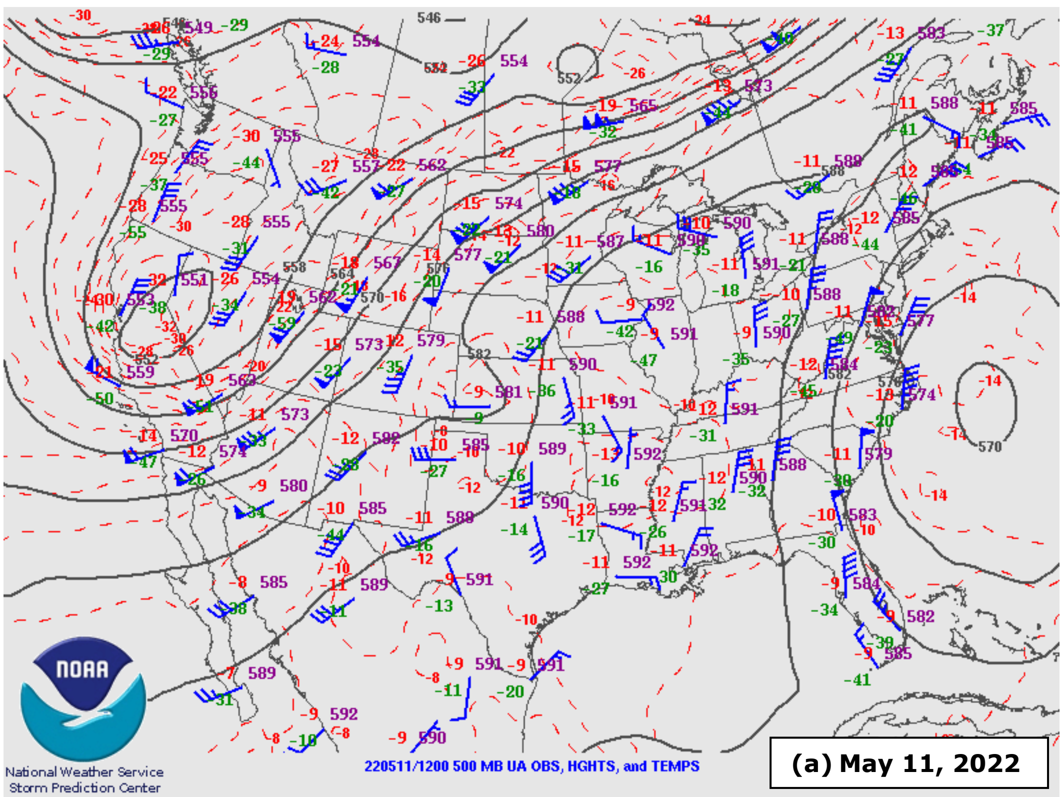


Figure 2-5. Weekly Number of Forest Fires and area burned in Mexico during 2022. (https://www.gob.mx/cms/uploads/attachment/file/821392/Cierre_de_la_Temporada_2022.pdf.)

Figure 2-6a shows a pronounced trough over the western U.S. and a ridge over the southeastern U.S. at 500 mb.[21] The wind barbs indicate predominantly westerly to southwesterly flow across northern Mexico into the southern U.S., including Arkansas. This southwesterly flow facilitates the transport of smoke from large fires in New Mexico and northern Mexico into the U.S. southern states, contingent on lower-level transport. The trough and its associated southwesterly winds enhance smoke transport from fires in New Mexico and Mexico toward Arkansas, while the ridge steers the flow around it, confining pollutants over the central U.S. and directing them eastward toward the eastern U.S. Figure 2-6b illustrates a significant trough over the western U.S. and a prominent ridge over the southeastern U.S., characterized by the northward bulge in geopotential height contours and warmer air aloft. Between the trough and ridge, there is a strong westerly to southwesterly flow across northern Mexico, Texas, and the southern Plains.[22] This flow pattern is likely transporting air masses from the New Mexico fires, into the southern and central U.S. The ridge over the southeastern U.S. indicates subsidence, promoting more stable conditions at the surface. This subsidence acts as a barrier trapping pollutants, including smoke, in the central and eastern U.S.



(a) May 11, 2022

[21]https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2022&STARTMONTH=05&STARTDAY=11&STARTTIME=00&INC=-48

[22]https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2022&STARTMONTH=05&STARTDAY=12&STARTTIME=00&INC=-48

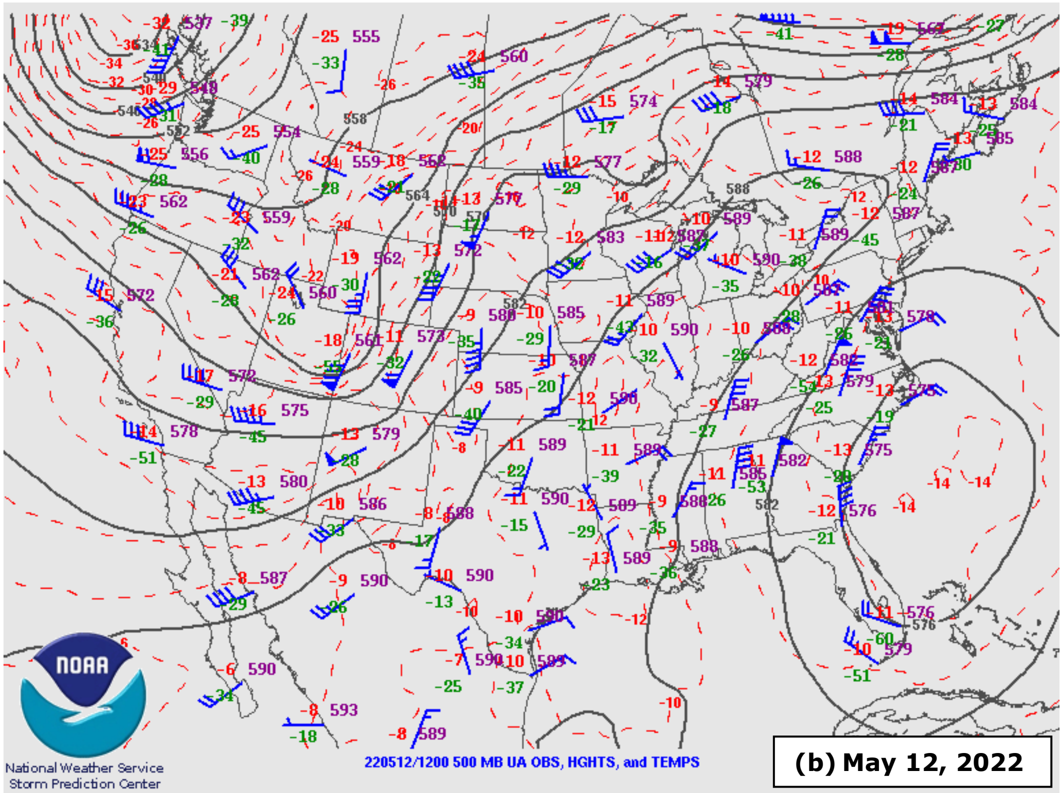


Figure 2-6. 500 mb synoptic analysis map at 12 UTC on (a) May 11 and (b) May 12, 2022.

On May 11, the surface analysis (Figure 2-7a) shows that south to southwesterly winds in Arkansas, align with the broader southerly flow over Texas and the southern Plains. This south-southeasterly flow is the result of a high-pressure system over Mississippi and Louisiana that supports the northward transport of smoke from Mexico into Arkansas. A stationary front is observed across the central U.S. The combined effects of the weak flow near the stationary front and the high-pressure system can lead to stagnation, allowing smoke to accumulate over the eastern U.S. and potentially impacting air quality at the monitor in Arkansas. On May 12 (Figure 2-7b) the surface analysis indicates the presence of a stationary front stretching across the central U.S., extending from the central Plains into the Midwest. This boundary marks a transition zone between differing air masses, potentially influencing localized weather patterns. Several high-pressure systems are evident, including one over the southeastern U.S. and others across the western U.S., which are associated with subsiding air and stable conditions. The clockwise flow around a high-pressure system in the Gulf of Mexico creates southerly winds along the Gulf Coast and into the southern Plains. Near the stationary front, wind speeds are likely weaker, which may contribute to the pooling of pollutants in the region.

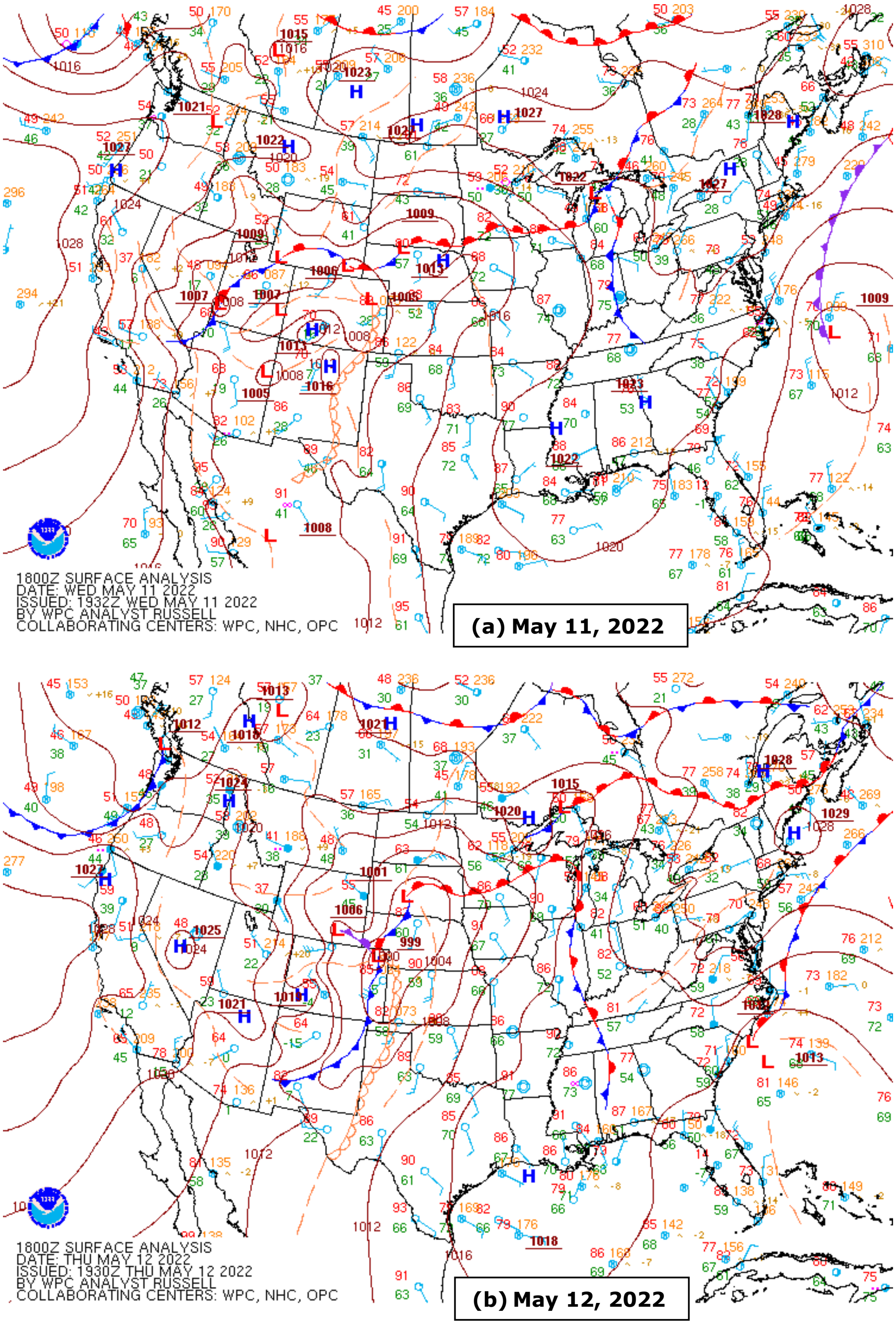


Figure 2-7. Surface synoptic analysis maps at 18 UTC on (a) May 11 and (b) May 12, 2022.

The NOAA HMS product in Figure 2-8 and the satellite visible images in Figure 2-9 show light to medium smoke plumes covering Arkansas, and much of the eastern U.S. Figure 2-10 shows moderate AQI values over Arkansas while the NAAPS surface smoke modeled concentrations in Figure 2-11 show concentrations of 8 to 16 $\mu g/m^3$ impacting Arkansas and the surrounding states (Mississippi, Louisiana, and Missouri). NAAPS modeling captures smoke from fires in Mexico and it links them to the potential impacts observed at monitoring sites in Arkansas. Figure 2-12 shows how the smoke plumes and multiple fires—in New Mexico, Oklahoma, the southeastern U.S., and Mexico—change during the last 3 days prior to the high $PM_{2.5}$ concentration observed in Arkansas.

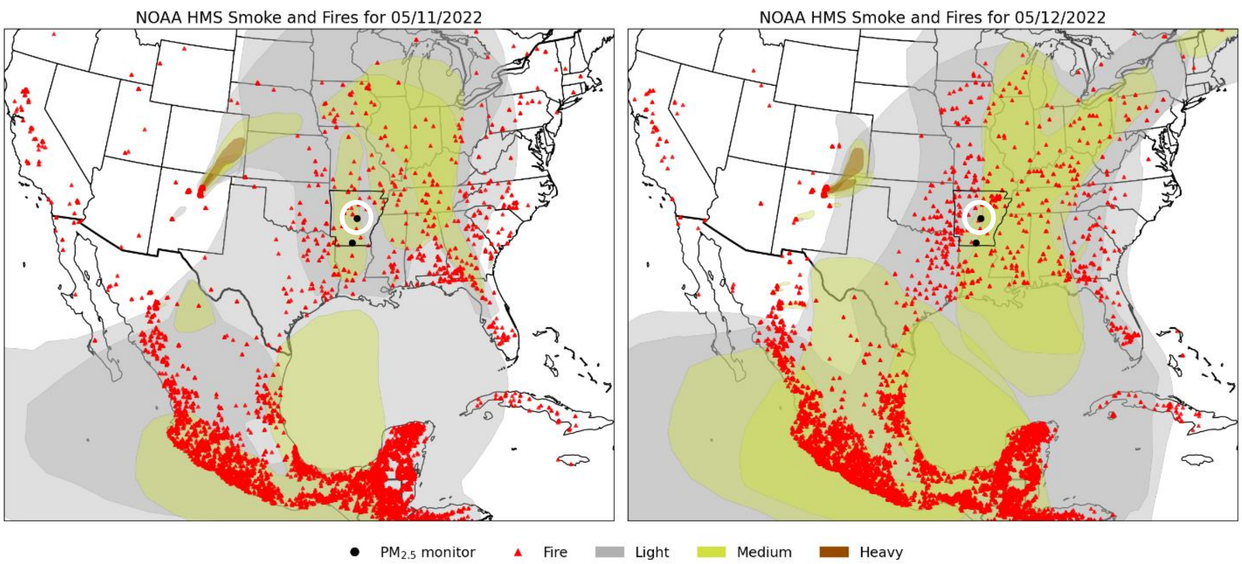
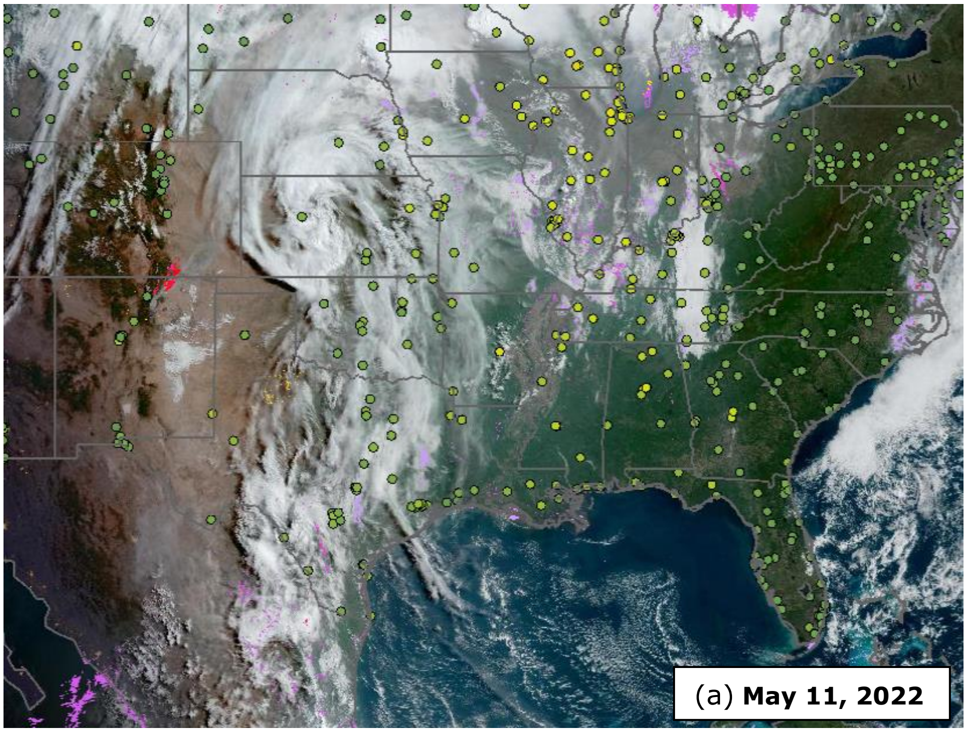


Figure 2-8. NOAA HMS fires and smoke products for May 11 (left) and May 12 (right), 2022.



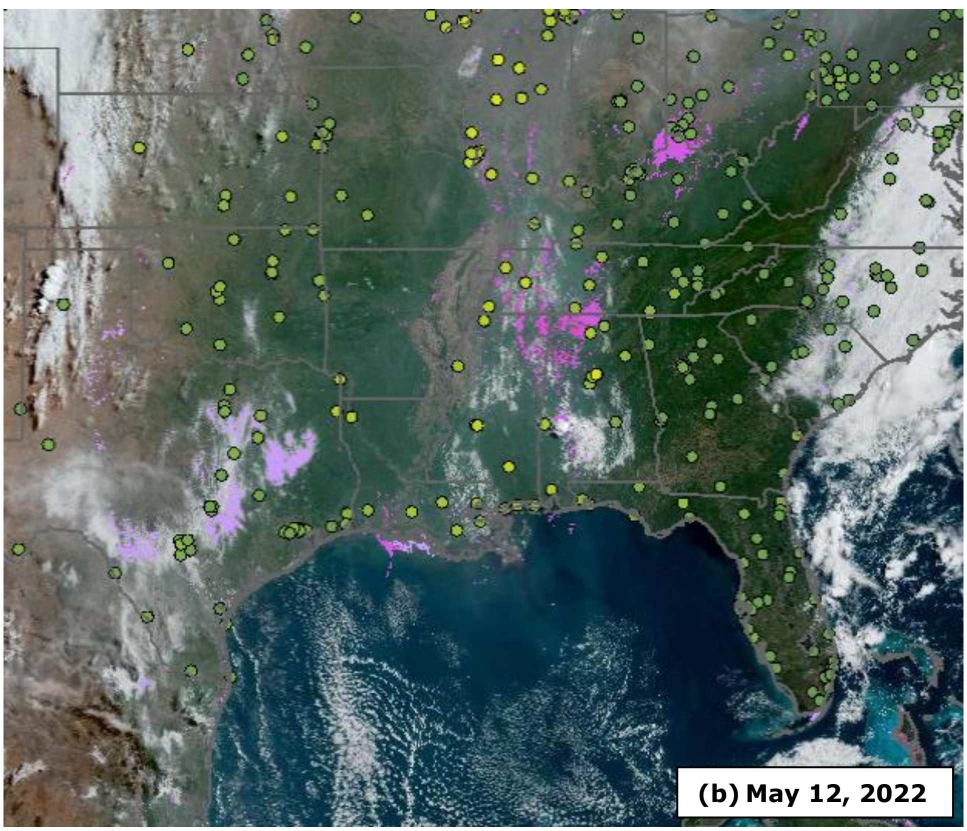


Figure 2-9. NOAA satellite visible imagery on (a) May 11 at 1321 UTC and (b) May 12 at 1331 UTC.

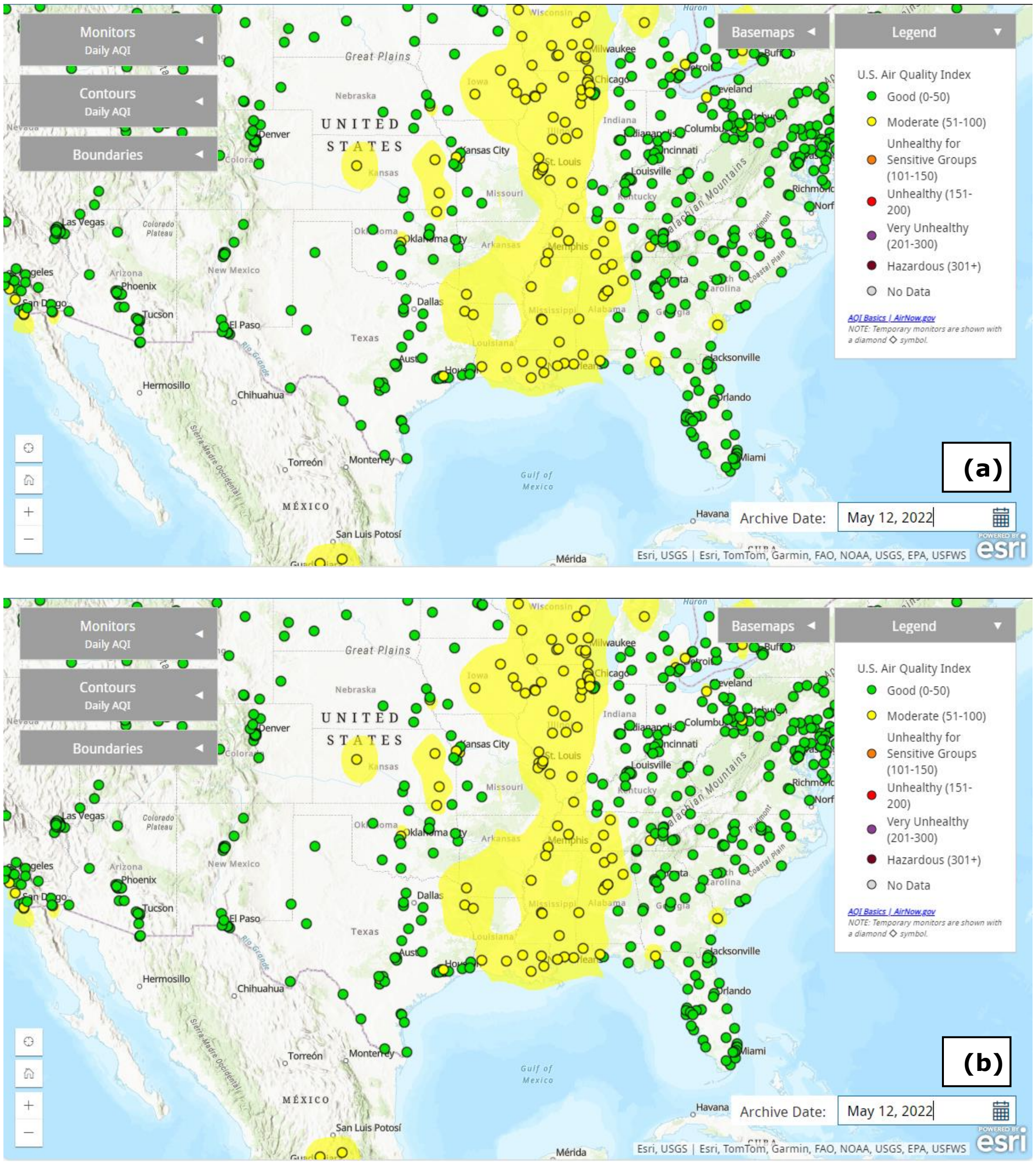


Figure 2-10. AirNow surface level $PM_{2.5}$ concentration contours for (a) May 11 and (b) May 12, 2022.

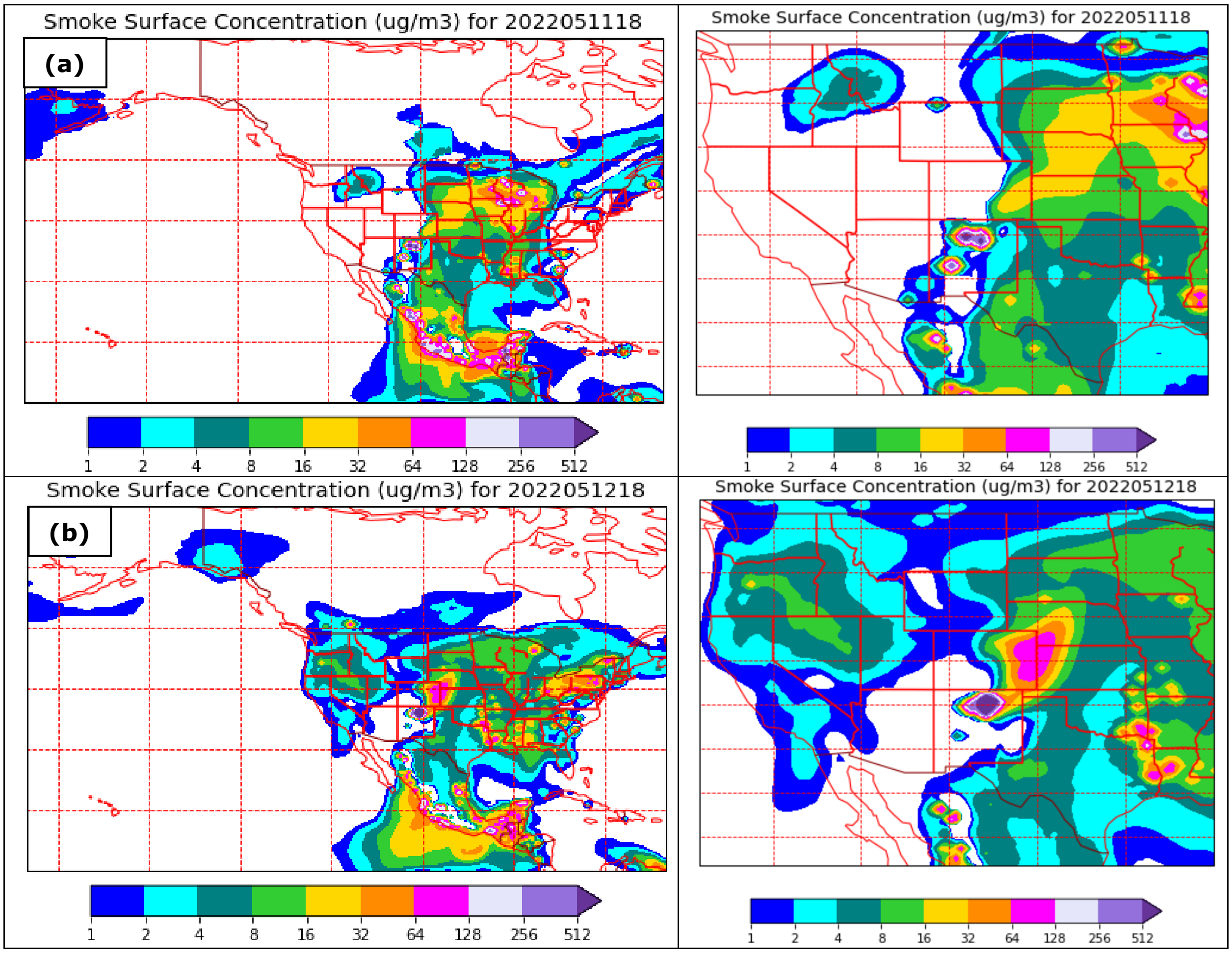


Figure 2-11. NAAPS modeled near-surface smoke concentrations (µg/m³) at 18Z on (a) May 11 and (b) May 12, 2022. North America regional plot on the left and western U.S. plot on the right.

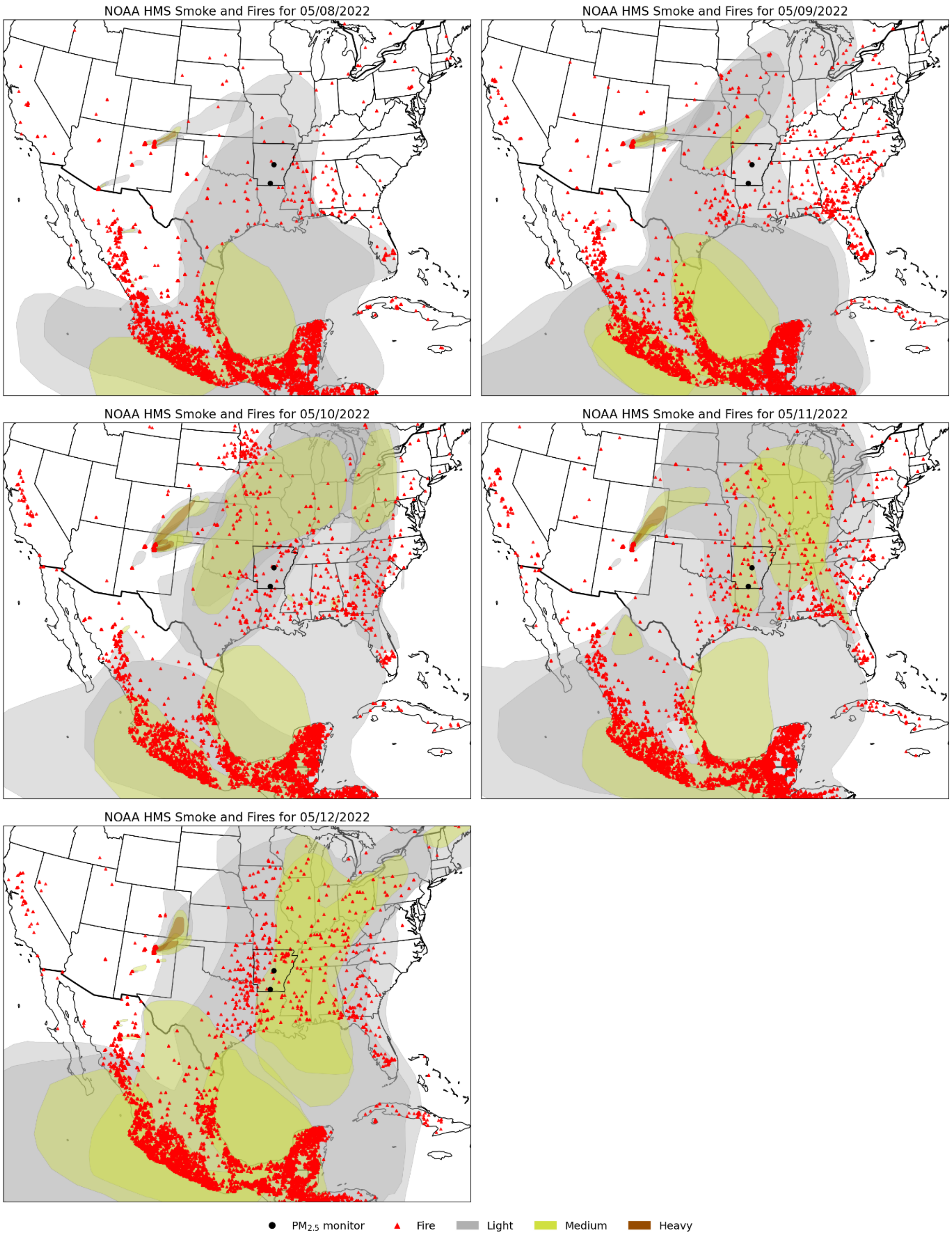


Figure 2-12. Evolution of NOAA HMS fires and smoke for May 8 (top left), May 9 (top right), May 10 (middle left), May 11 (middle right), and May 12 (bottom left).

2.1.1.1 PARR May 11, 2022

Table 2-2 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on May 11, 2022. Figure 2-13 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold. Backward and forward trajectories shown in Figure 2-15 and Figure 2-16 link several active fires burning prior to this day in Mexico with the high observed concentrations at the PARR monitor.

Table 2-2. Exceptional event supporting evidence for PARR on May 11, 2022.

Monitor	PARR (05-119-0007)
Event Date	May 11, 2022
24-hr $PM_{2.5}$ Concentration	16.6 µg/m^3
EPA Tiering Tool Tier 2 Threshold	15.1 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	New Mexico, Oklahoma, Southeastern U.S., and Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: May. Date accessed: 11/20/2024.

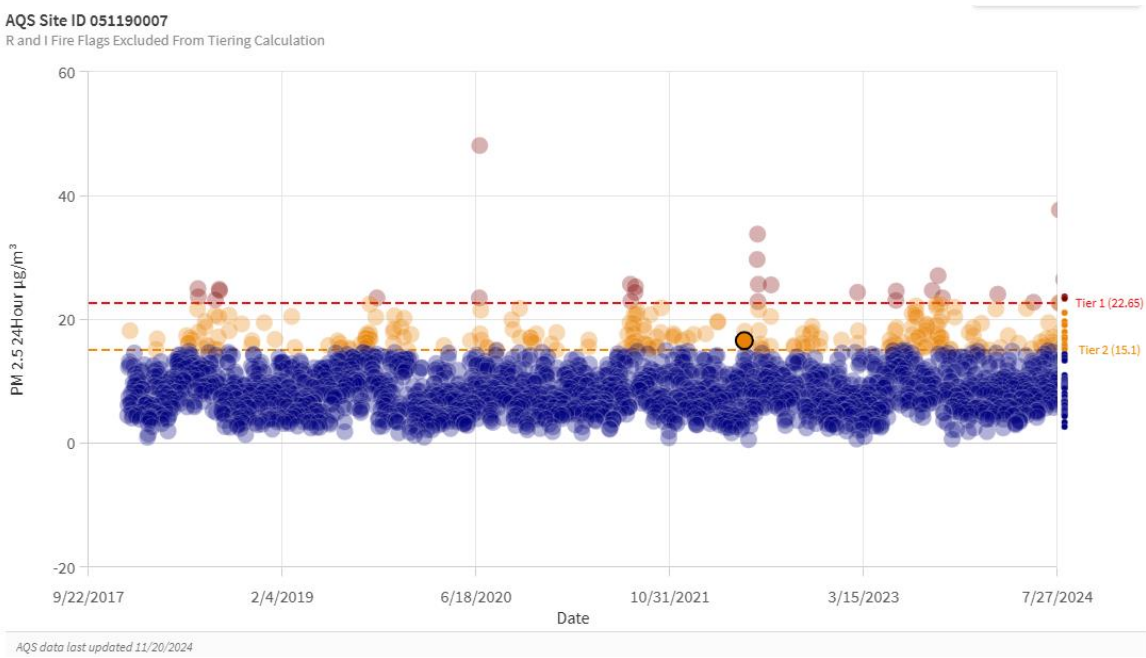


Figure 2-13. EPA $PM_{2.5}$ Tiering Tool for PARR on May 11, 2022.

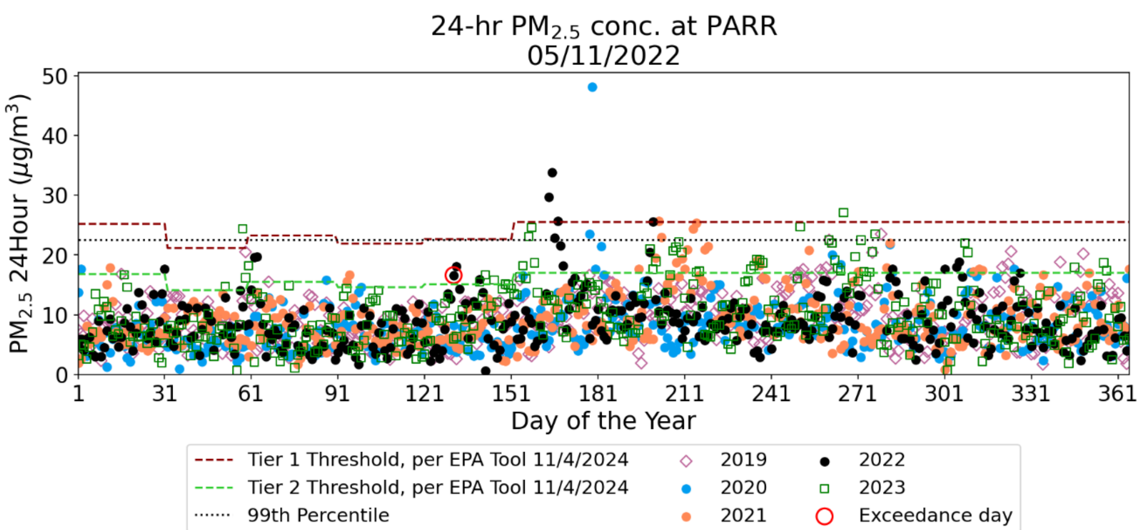


Figure 2-14. Historical 24-hour $PM_{2.5}$ concentration seasonal fluctuations for PARR compared to May 11, 2022.

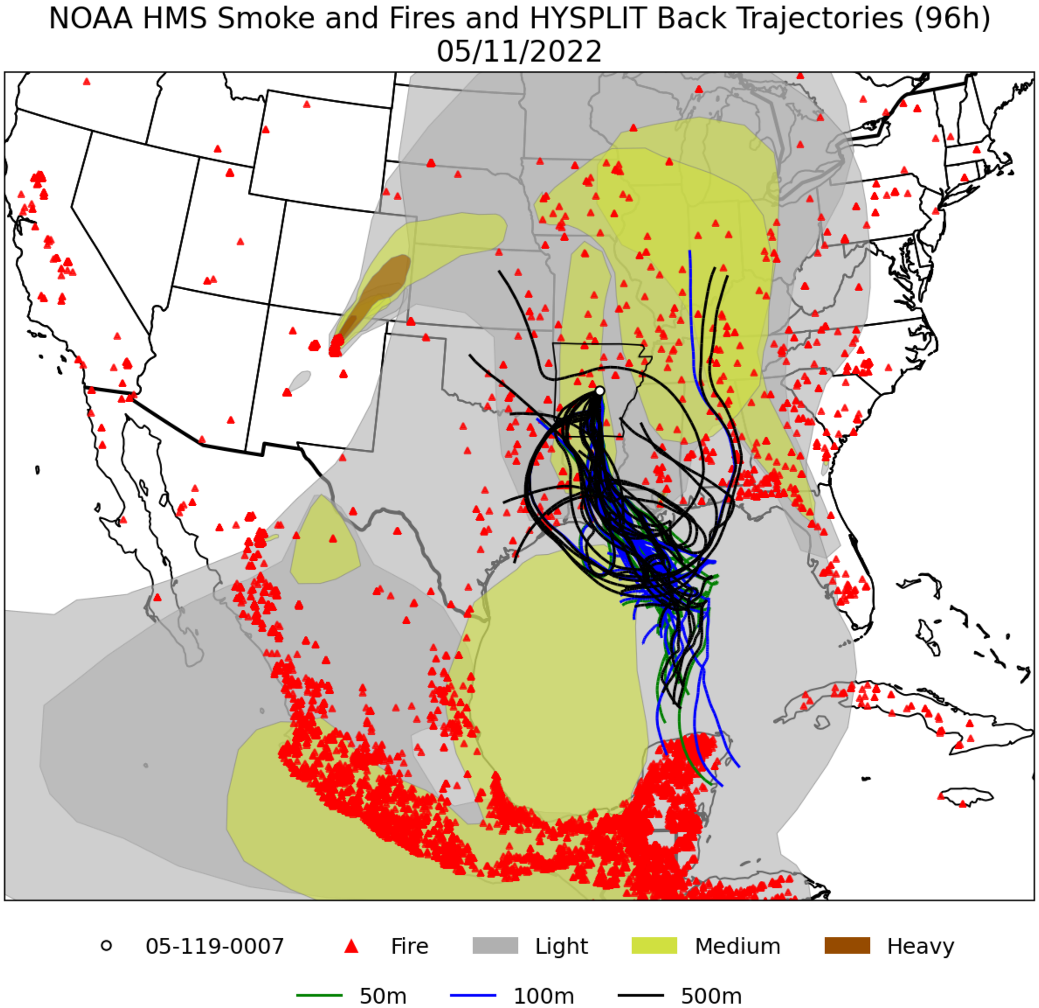


Figure 2-15. HYSPLIT back trajectories for PARR on May 11, 2022.

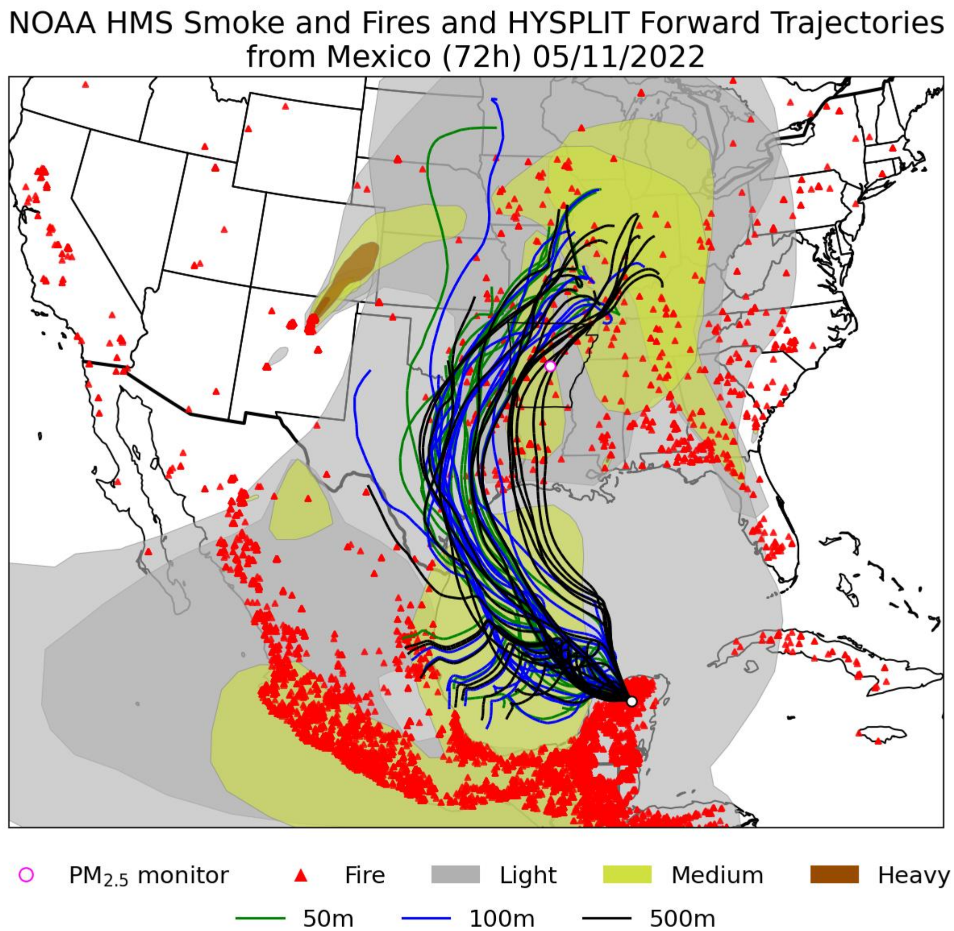


Figure 2-16. HYSPLIT forward trajectories from Mexico at PARR on May 11, 2022.

2.1.1.2 PARR May 12, 2022

Table 2-3 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on May 12, 2022. Figure 2-17 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold. The backward trajectories shown in Figure 2-19 indicate the presence of anticyclonic (clockwise) flow that pulls smoke from surrounding regions, including the Gulf of Mexico, where medium smoke from numerous active fires affect the monitoring site. Forward trajectories shown in Figure 2-20 link the influx of smoke from several active fires in the Mexican states of Campeche and Yucatan, that is then transported north along the Gulf Coast and then into the region surrounding the monitoring site.

Table 2-3. Exceptional event supporting evidence for PARR on May 12, 2022.

Monitor	PARR (05-119-0007)
Event Date	May 12, 2022
24-hr $PM_{2.5}$ Concentration	18.1 $\mu g/m^3$
EPA Tiering Tool Tier 2 Threshold	15.1 $\mu g/m^3$
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	New Mexico, Southeastern U.S., and Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: May. Date accessed: 11/20/2024.

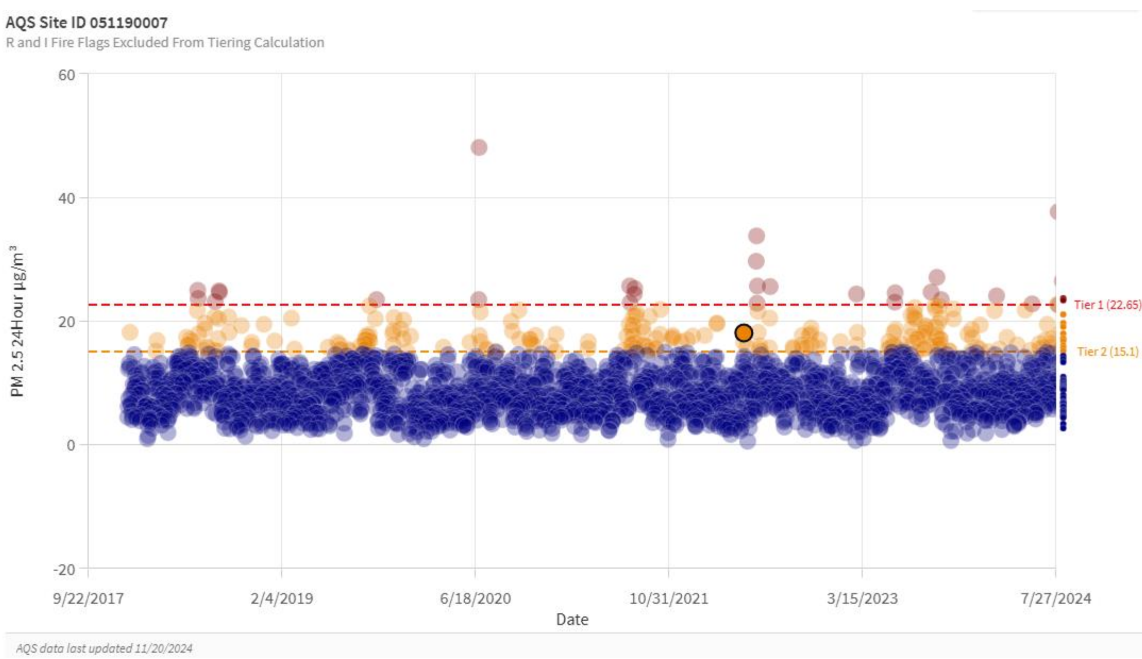


Figure 2-17. EPA PM2.5 Tiering Tool for PARR on May 12, 2022.

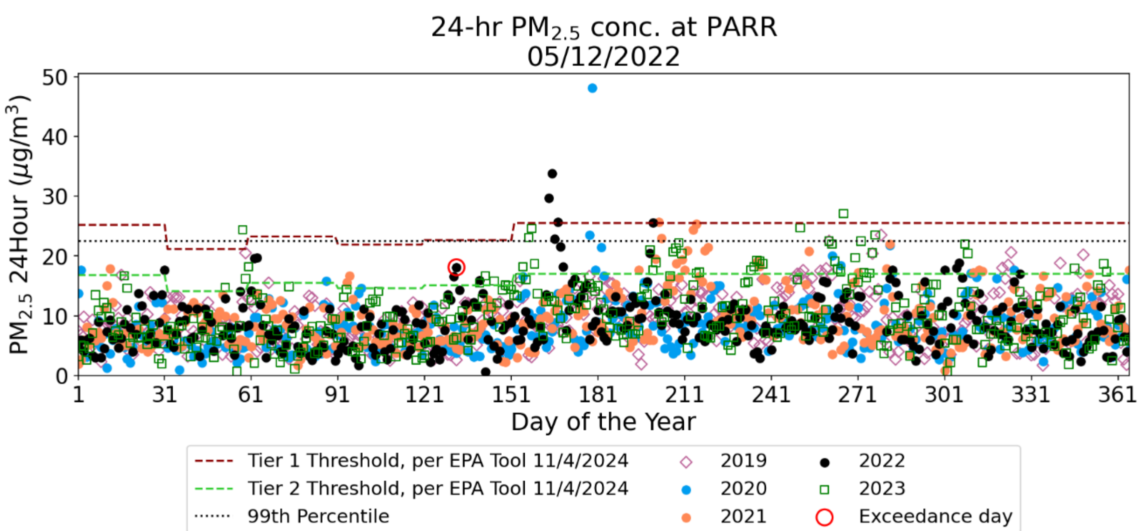


Figure 2-18. Historical 24-hour PM2.5 seasonal fluctuations for PARR compared to May 12, 2022.

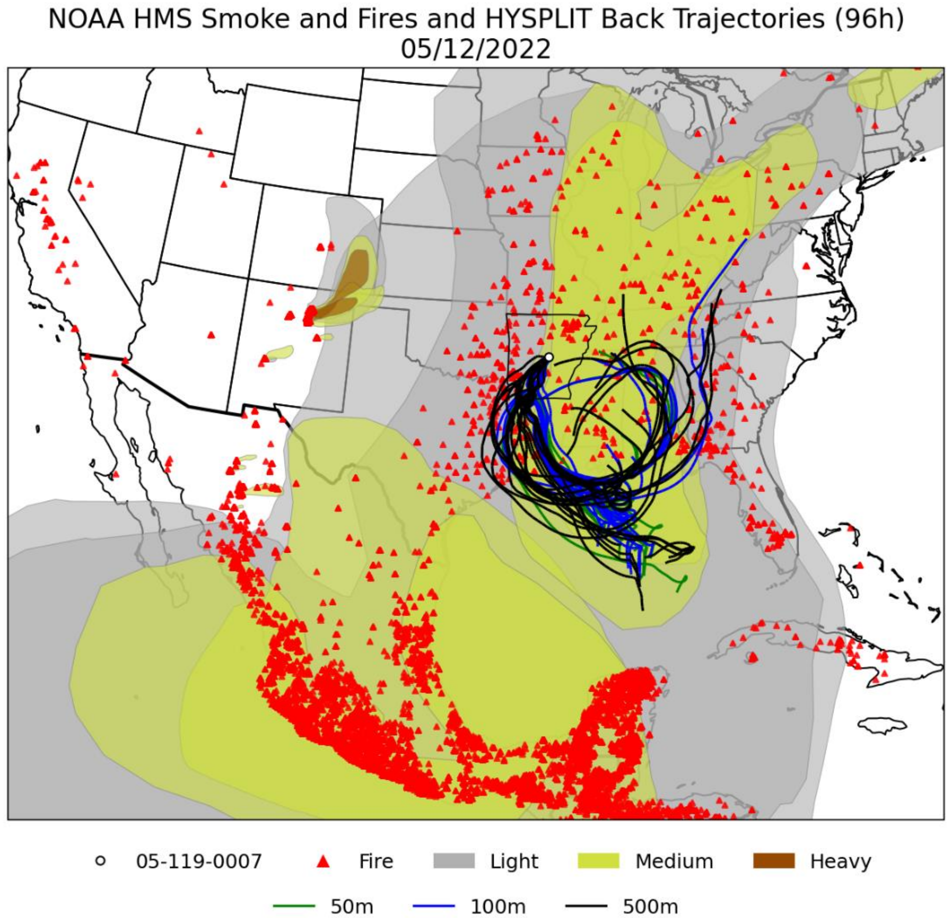


Figure 2-19. HYSPLIT back trajectories for PARR on May 12, 2022.

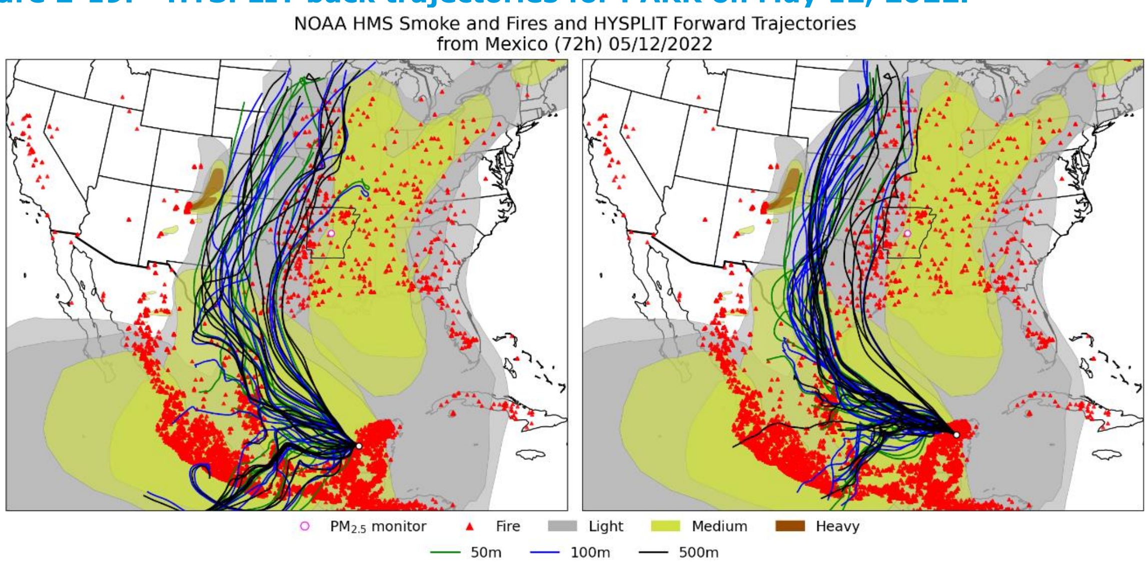


Figure 2-20. HYSPLIT forward trajectories from Mexico for PARR on May 12, 2022.

2.1.2 May 20, 2022

During May 2022, there were multiple fires burning over several regions in Mexico. An annual description of the fire incidences in the country is presented in Section 2.1.1 and summarized in Figure 2-4. Figure 2-5 shows the weekly number of forest fires and area burned in Mexico during 2022. The figure shows that on May 20, 2022 (week 20) fires were very intense during that week as the total area burned was the third largest in the entire year (68,809 ha[23]).

The 500 mb analysis on May 20 shown in Figure 2-21 indicates the presence of a trough over the western U.S.[24] This trough promotes southwesterly flow aloft. Over the southeastern U.S., a ridge is present, as shown by the northward bulge in the contours. This ridge suggests stable air and subsidence in the region. However, on the northwest periphery of the ridge, there is a transition to more dynamic southwesterly flow aloft. Winds generally flow parallel to the height contours, following a west-to-east pattern or curving around troughs and ridges. Stronger winds are associated with tightly packed contours, particularly near the base of the trough and along the ridge's flanks. Over Arkansas, wind barbs indicate southwesterly winds aloft, originating from regions near northern Mexico and New Mexico, where multiple fires are burning prior to this day.

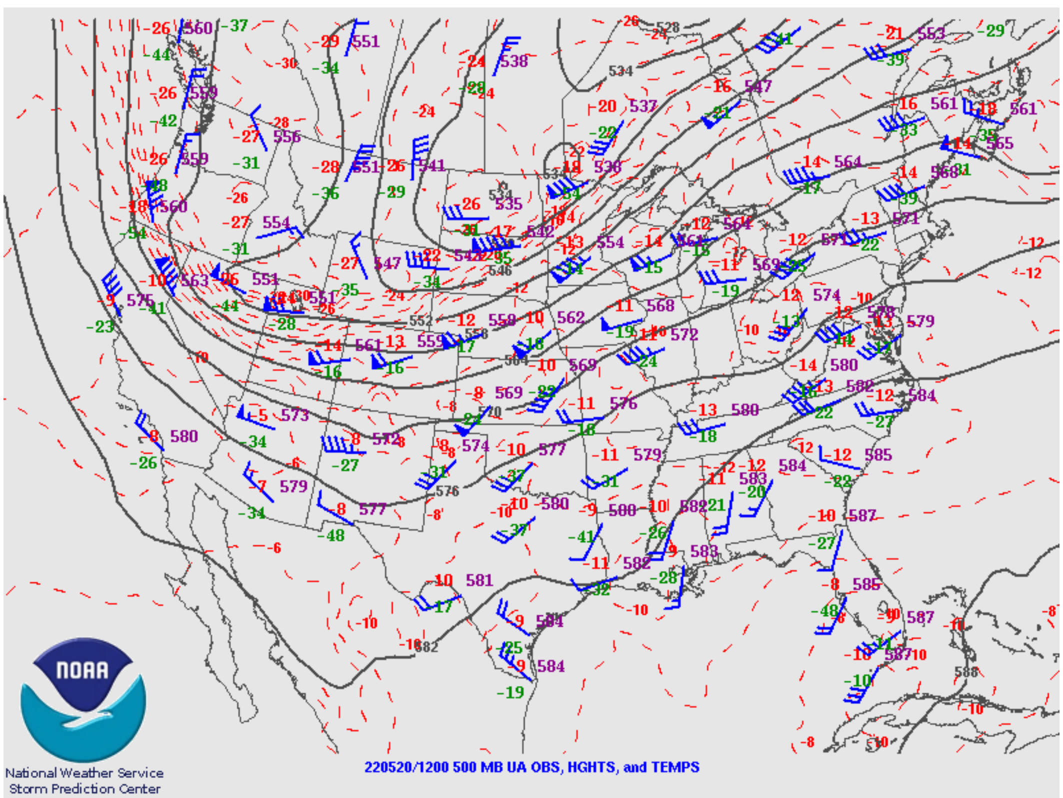


Figure 2-21. 500 mb synoptic analysis map at 12 UTC on May 20, 2022.

[23] Mexico Fires statistics available at: https://monitor_incendios.cnf.gob.mx/incendios_tarjeta_semanal

[24] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2022&STARTMONTH=05&STARTDAY=20&STARTTIME=00&INC=-48

The surface synoptic analysis on May 20 shown in Figure 2-22 indicates the presence of southwesterly surface wind across Texas, Oklahoma, and Arkansas. This wind direction favors the transport of smoke northeastward from New Mexico and Mexico into the central and southern Plains, including Arkansas. The analysis shows a strong low-pressure system centered near the Upper Midwest that is accompanied by a cold front extending southwestward through the central Plains and into the southern Rockies. The cold front creates a cyclonic flow pattern, drawing air masses and smoke northeastward. Ahead of the cold front, southerly and southwesterly winds dominate, further facilitating smoke transport toward Arkansas. Additionally, the stable conditions over the southeastern U.S. acts as a blocking feature, directing the southwesterly winds along its western edge.

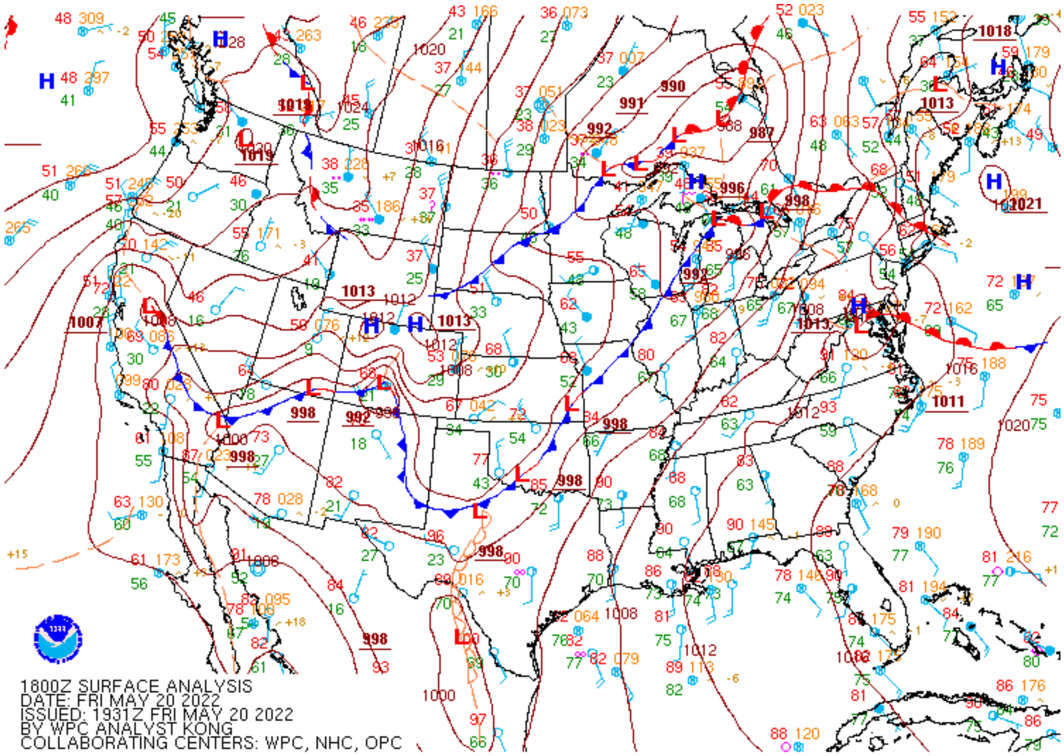


Figure 2-22. Surface synoptic analysis maps at 18 UTC on May 20, 2022.

The NOAA HMS product in Figure 2-23 and the visible satellite image in Figure 2-24 show numerous fires in New Mexico, Oklahoma, and Mexico which produce light to medium smoke plumes. These plumes cover most of Arkansas and the southeast U.S. states. Figure 2-25 shows moderate AQI values over Arkansas, while the NAAPS modeled surface smoke concentrations in Figure 2-26 suggest that smoke was present at surface level over much of Arkansas. Figure 2-27 shows the evolution of the smoke plumes originating primarily from fires in New Mexico and Mexico during May 17 to May 20.

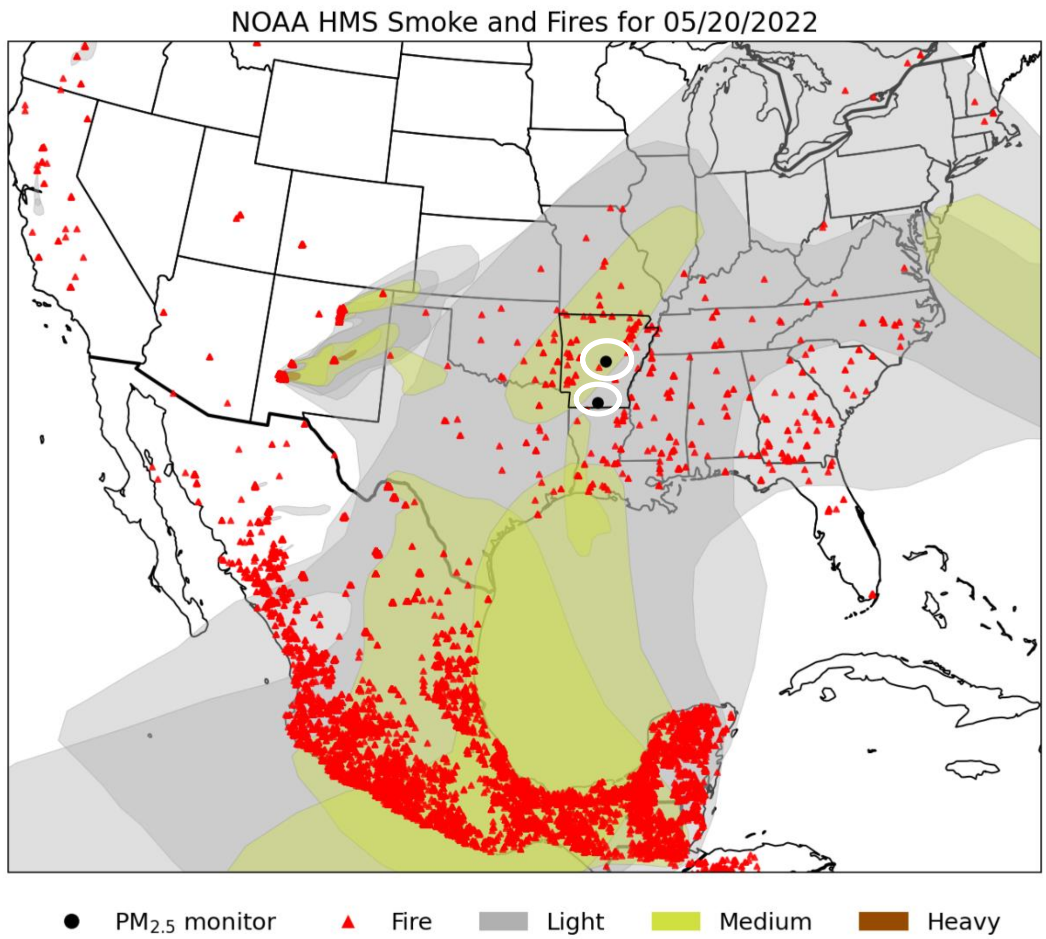


Figure 2-23. NOAA HMS fire and smoke products for May 20, 2022.

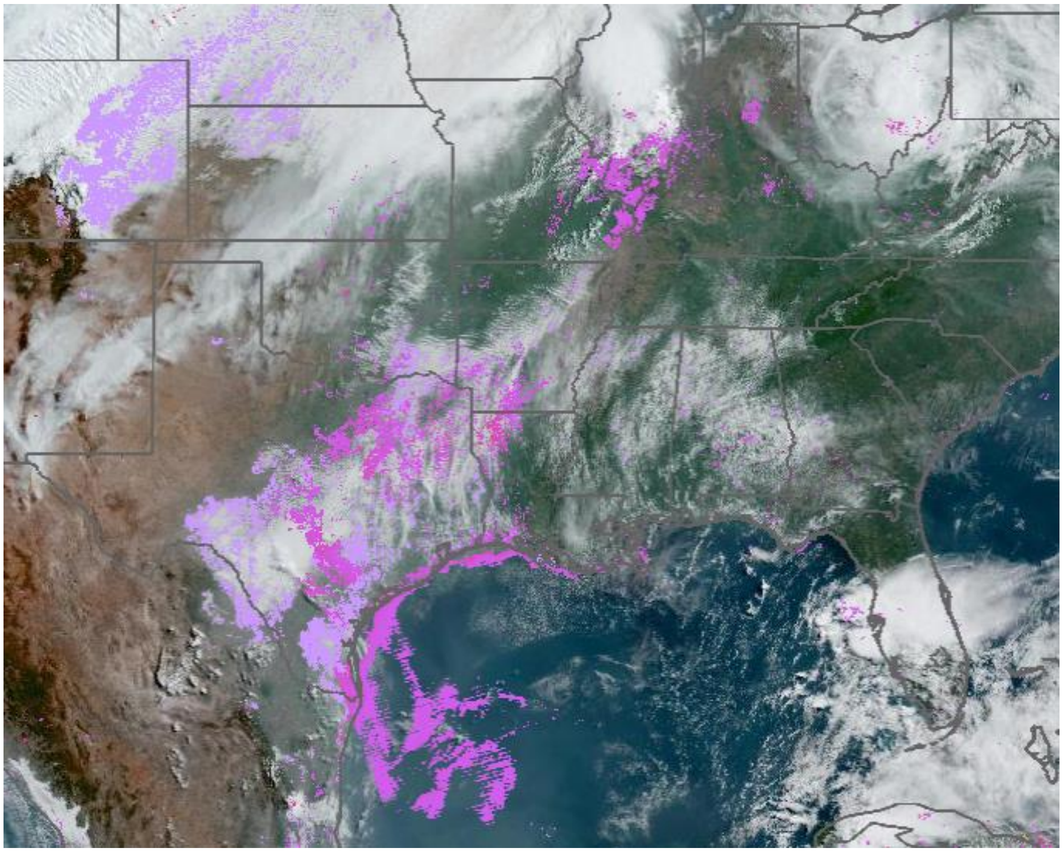


Figure 2-24. NOAA satellite visible imagery on May 20 at 1341 UTC.

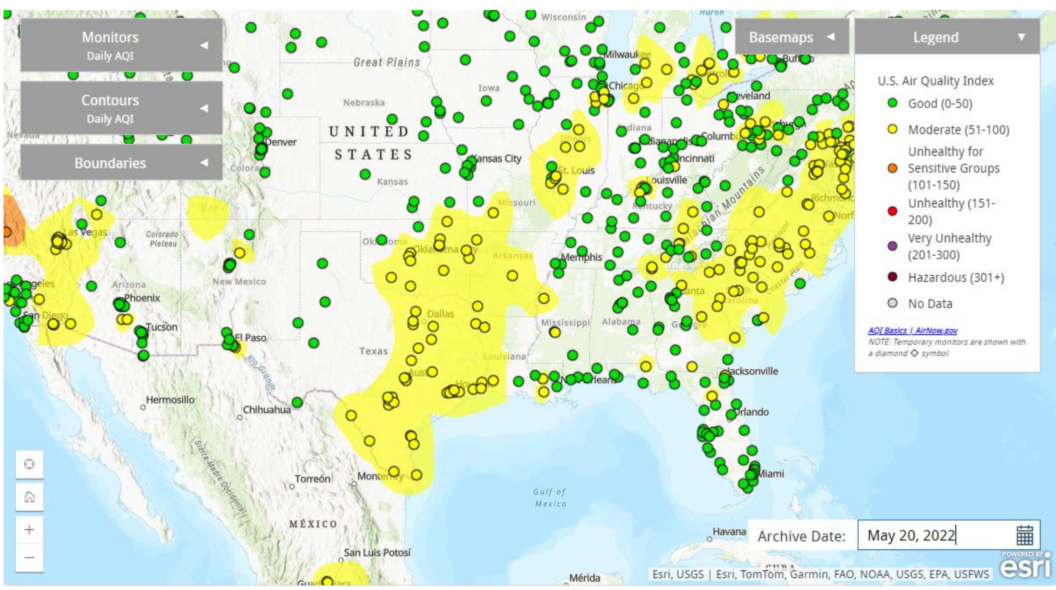


Figure 2-25. AirNow surface level $PM_{2.5}$ concentration contours for May 20, 2022.

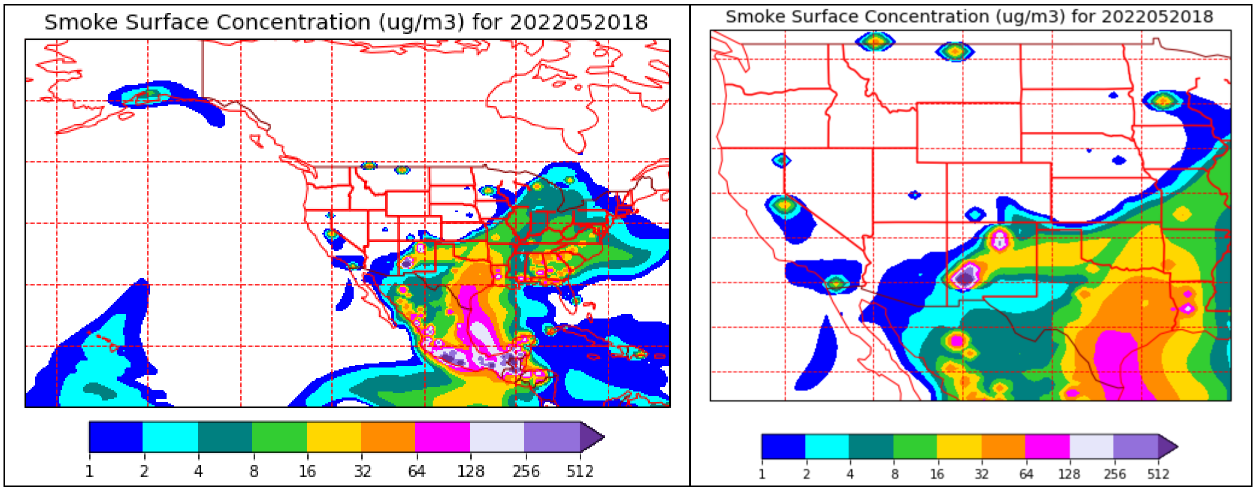


Figure 2-26. NAAPS modeled near-surface smoke concentrations (µg/m^3) at 18Z on May 20, 2022. North America regional plot on the left and western U.S. plot on the right.

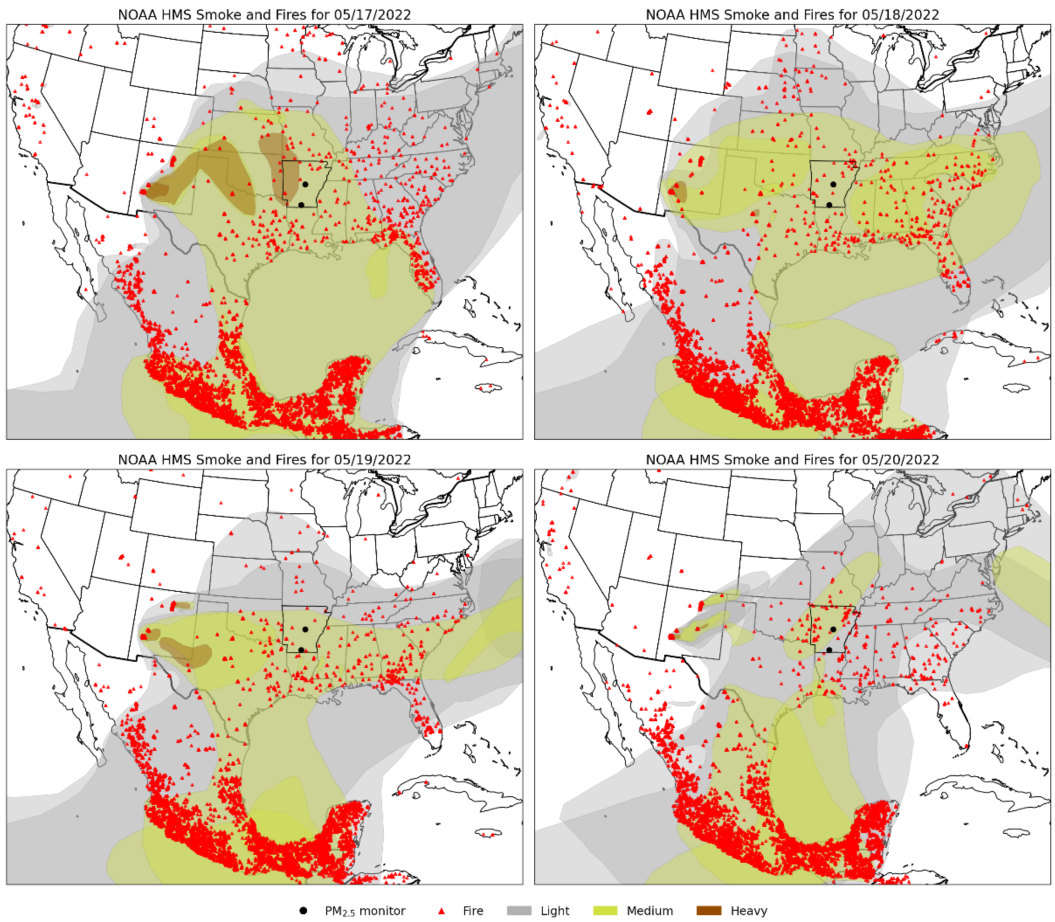


Figure 2-27. Evolution of fires and smoke for May 17 (top left), May 18 (top right), May 19 (bottom left), and May 20 (bottom right).

2.1.2.1 PARR May 20, 2022

Table 2-4 summarizes the evidence supporting the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on May 20, 2022. Figure 2-28 shows that the 24-hour $PM_{2.5}$ concentrations on this day exceeded Tier 2 threshold, indicating elevated pollution levels. Back trajectories shown in Figure 2-30 illustrate anticyclonic (clockwise) flow over the Gulf Coast, which facilitated the transport of smoke from fires in Mexico to the monitoring site. These back trajectories run for 96 hours confirm that the air masses passed over regions with numerous wildfires and areas of medium density smoke. Forward trajectories started in the location of fires in the Yucatan peninsula, Mexico are shown in Figure 2-31 and link the influx of smoke originating from a large fire cluster in the states of Campeche and Yucatan, Mexico. Forward trajectories started near the Hermits Peak and Calf Canyon Fires in New Mexico are shown in Figure 2-32 and link the transport of smoke from these fires in New Mexico affecting the monitoring site. Cyclonic flow associated with the cold front described above draws the smoke from the fire to the east and northeast. Hourly $PM_{2.5}$ concentrations at the site shown in Figure 2-33 show how the increase steadily from 8.7 μg/m^3 at 4 AM CDT to 28.2 μg/m^3 at 4 PM CDT. After reaching this peak, concentrations remained relatively stable, fluctuating between 25.1 μg/m^3 and 29.3 μg/m^3, indicating persistent impacts of transported smoke throughout the day.

Table 2-4. Exceptional event supporting evidence for PARR on May 20, 2022.

Monitor	PARR (05-119-0007)
Event Date	May 20, 2022
24-hr $PM_{2.5}$ Concentration	15.9 μg/m^3
EPA Tiering Tool Tier 2 Threshold	15.1 μg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	New Mexico and Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: May. Date accessed: 11/20/2024.

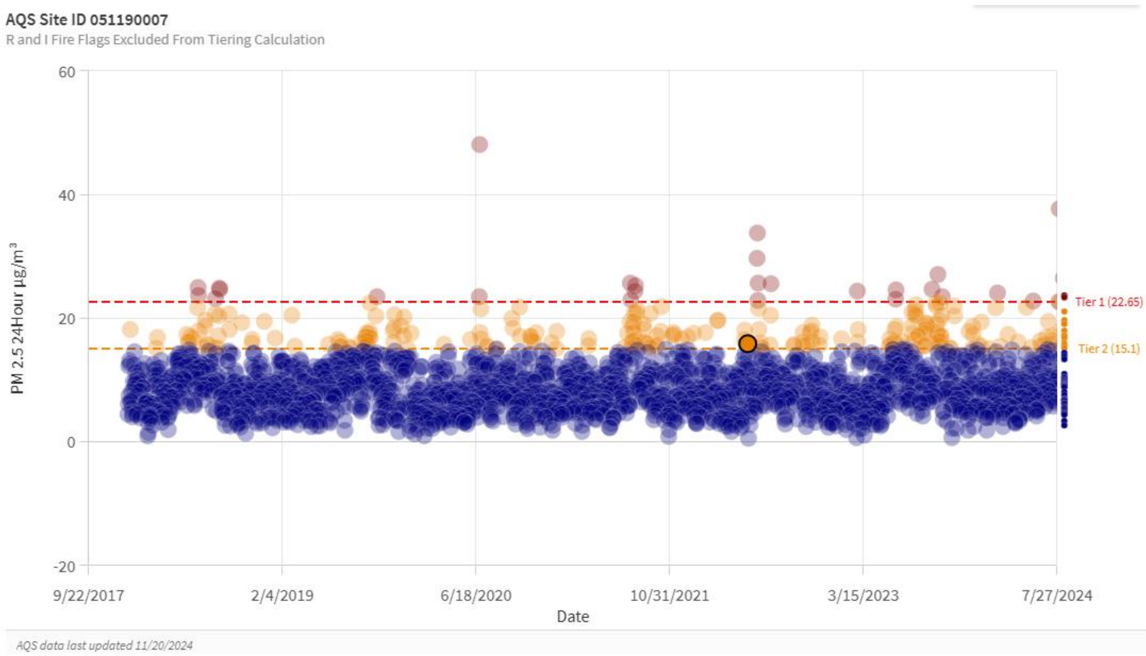


Figure 2-28. EPA $PM_{2.5}$ Tiering Tool PARR on May 20, 2022.

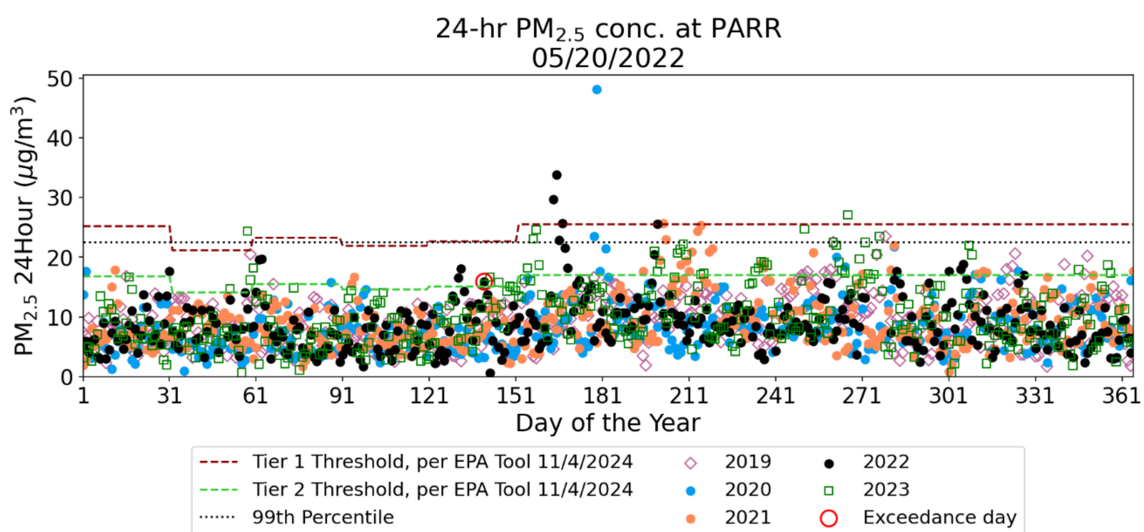


Figure 2-29. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to May 20, 2022.

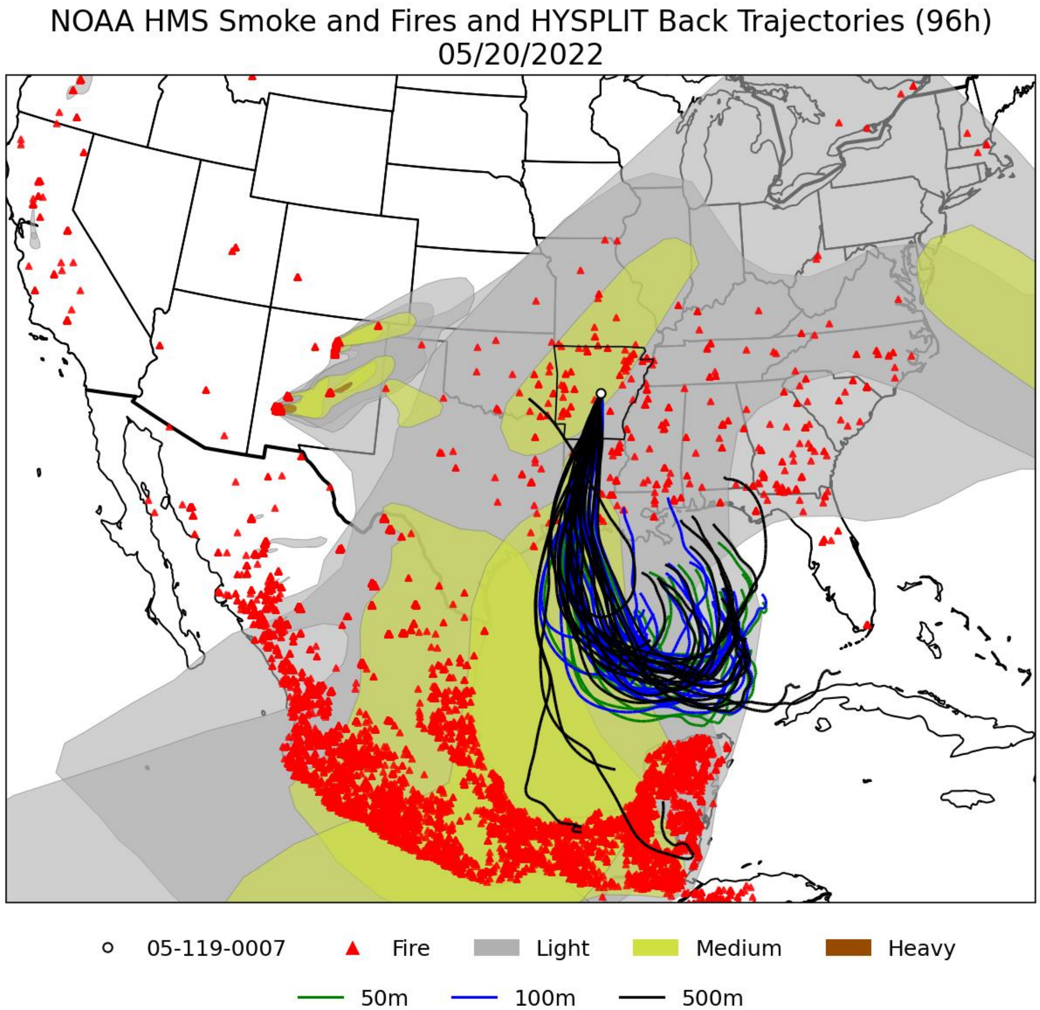


Figure 2-30. HYSPLIT back trajectories for PARR on May 20, 2022.

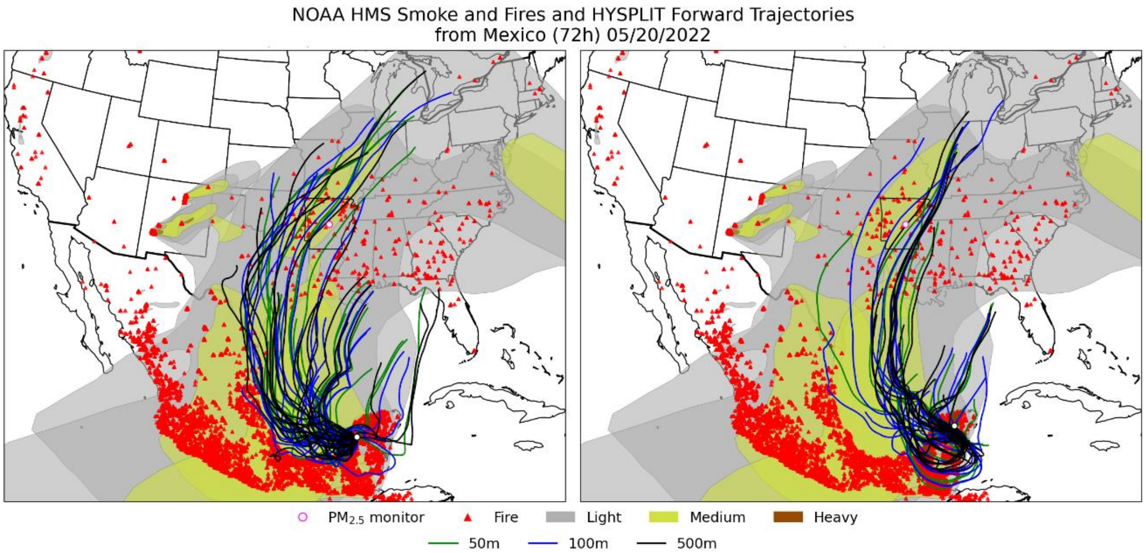


Figure 2-31. HYSPLIT forward trajectories from Mexico for PARR on May 20, 2022.

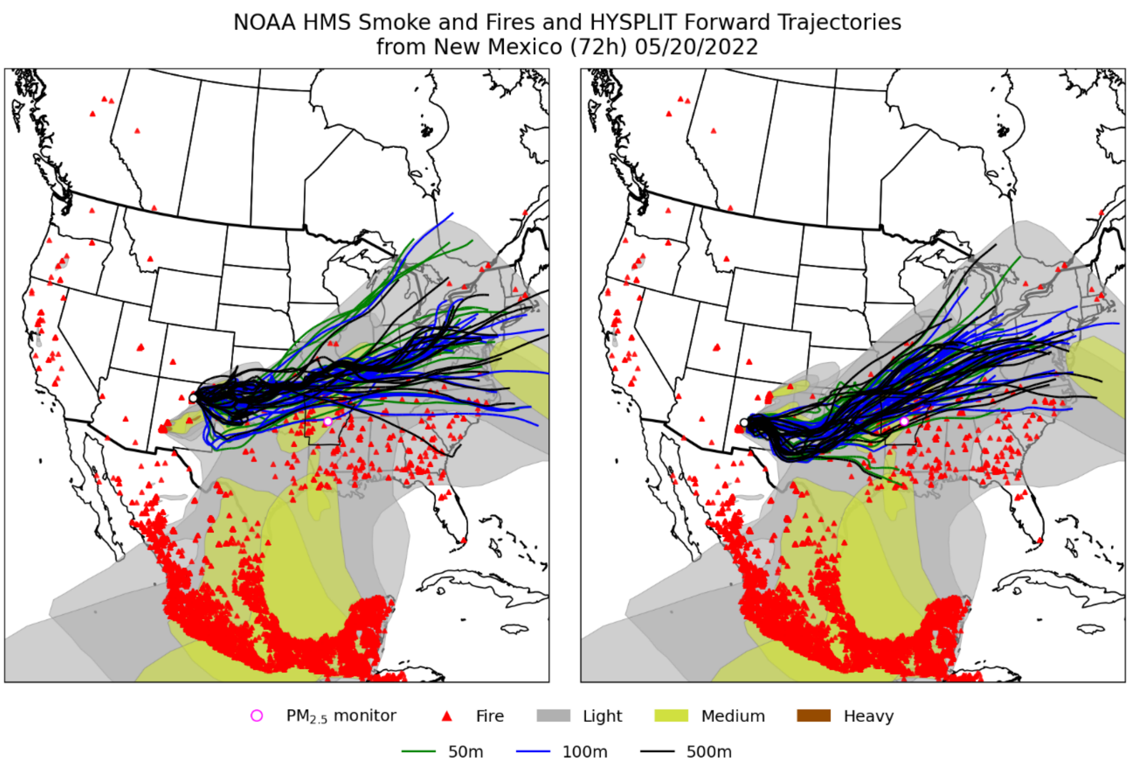


Figure 2-32. HYSPLIT forward trajectories from New Mexico for PARR on May 20, 2022.

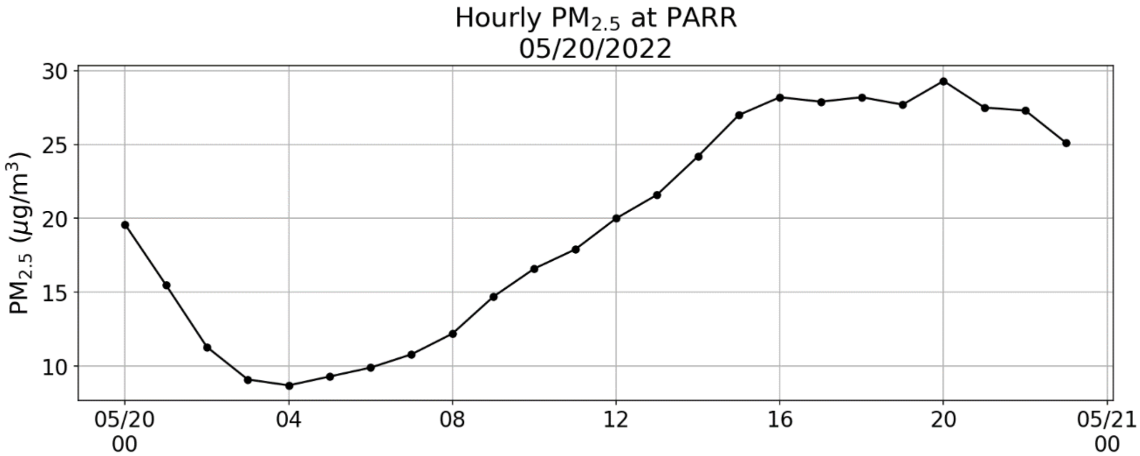


Figure 2-33. Hourly $PM_{2.5}$ concentrations for PARR on May 20, 2022.

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2.1.2.2 El Dorado May 20, 2022

Table 2-5 summarizes the evidence supporting the demonstration of an exceptional event for El Dorado (AQS ID 05-139-0006) on May 20, 2022. Figure 2-34 shows that the 24-hour $PM_{2.5}$ concentrations on this day exceeded the Tier 2 threshold. Back trajectories run for 96 hours are shown in Figure 2-36 and illustrate the anticyclonic (clockwise) flow over the Gulf Coast, which facilitated the transport of smoke from fires in Mexico to the vicinity of the monitoring site. The path of these trajectories confirm that the air masses passed through to both areas with numerous wildfires and with medium density smoke. Forward trajectories in Figure 2-37 show that air masses reach the monitoring site within 72 hours, linking PM concentrations to the smoke from two large fire clusters located in Mexico. This evidence underscores the role of long-range smoke transport in contributing to the elevated $PM_{2.5}$ concentrations observed on this date. Forward trajectories started neat the Hermits Peak/Calf Canyon Fire complex in New Mexico are shown in Figure 2-38 suggesting that smoke from these fires is also transported into the southeastern U.S., where it becomes trapped within the cold front, contributing to the impacts $PM_{2.5}$ concentrations in the region.

Table 2-5. Exceptional event supporting evidence for El Dorado on May 20, 2022.

Monitor	El Dorado (05-139-0006)
Event Date	May 20, 2022
24-hr $PM_{2.5}$ Concentration	17.0 µg/m^3
EPA Tiering Tool Tier 2 Threshold	14.6 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	New Mexico and Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: May. Date accessed: 11/20/2024.

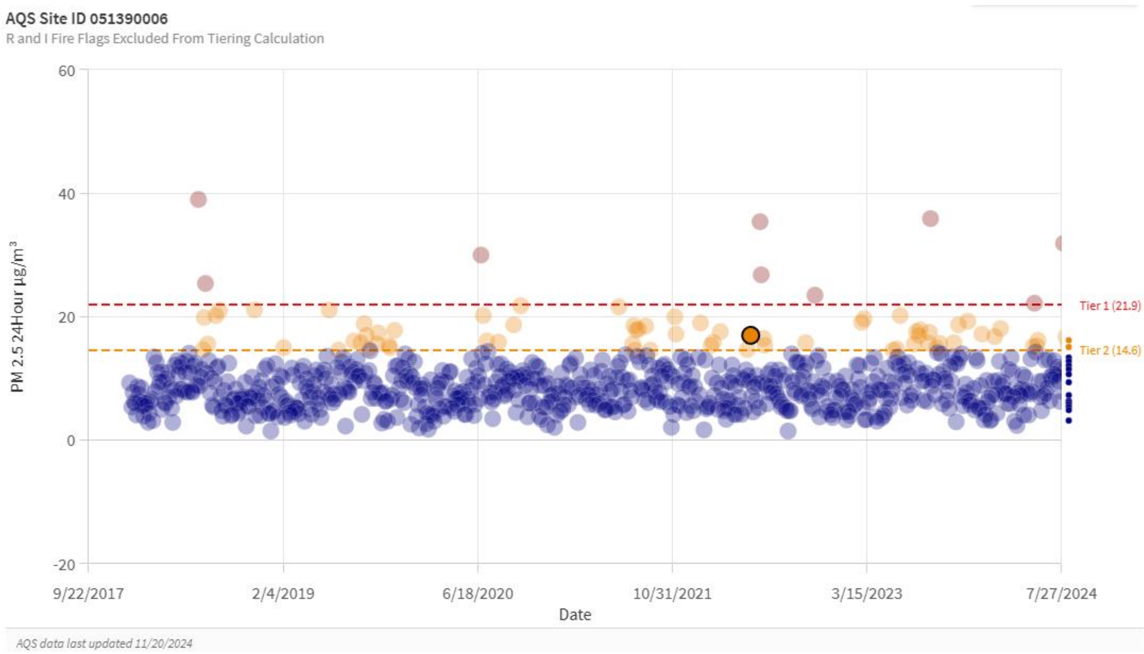

Figure 2-34. EPA $PM_{2.5}$ Tiering Tool El Dorado on May 20, 2022.

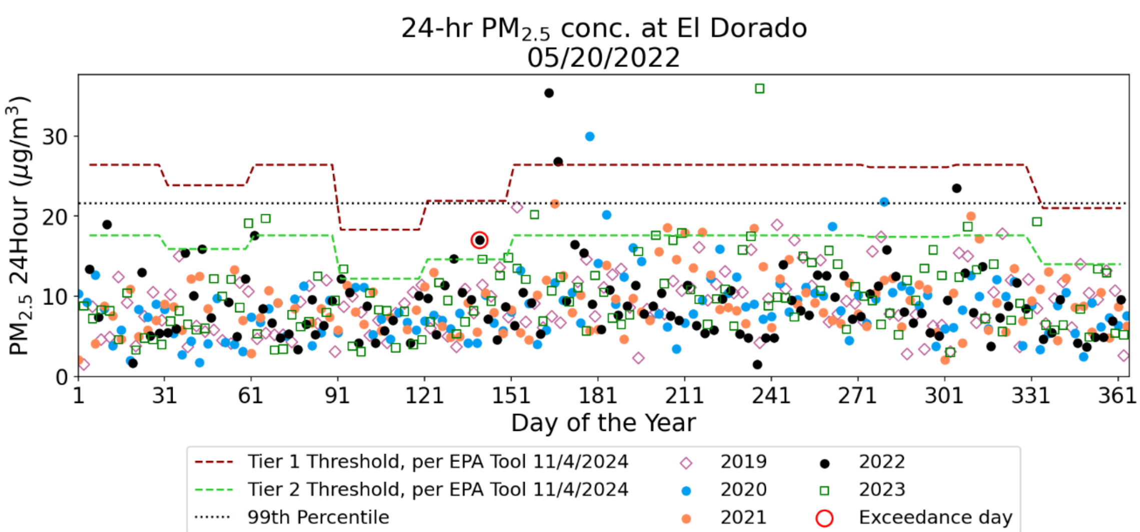

Figure 2-35. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for El Dorado compared to May 20, 2022.

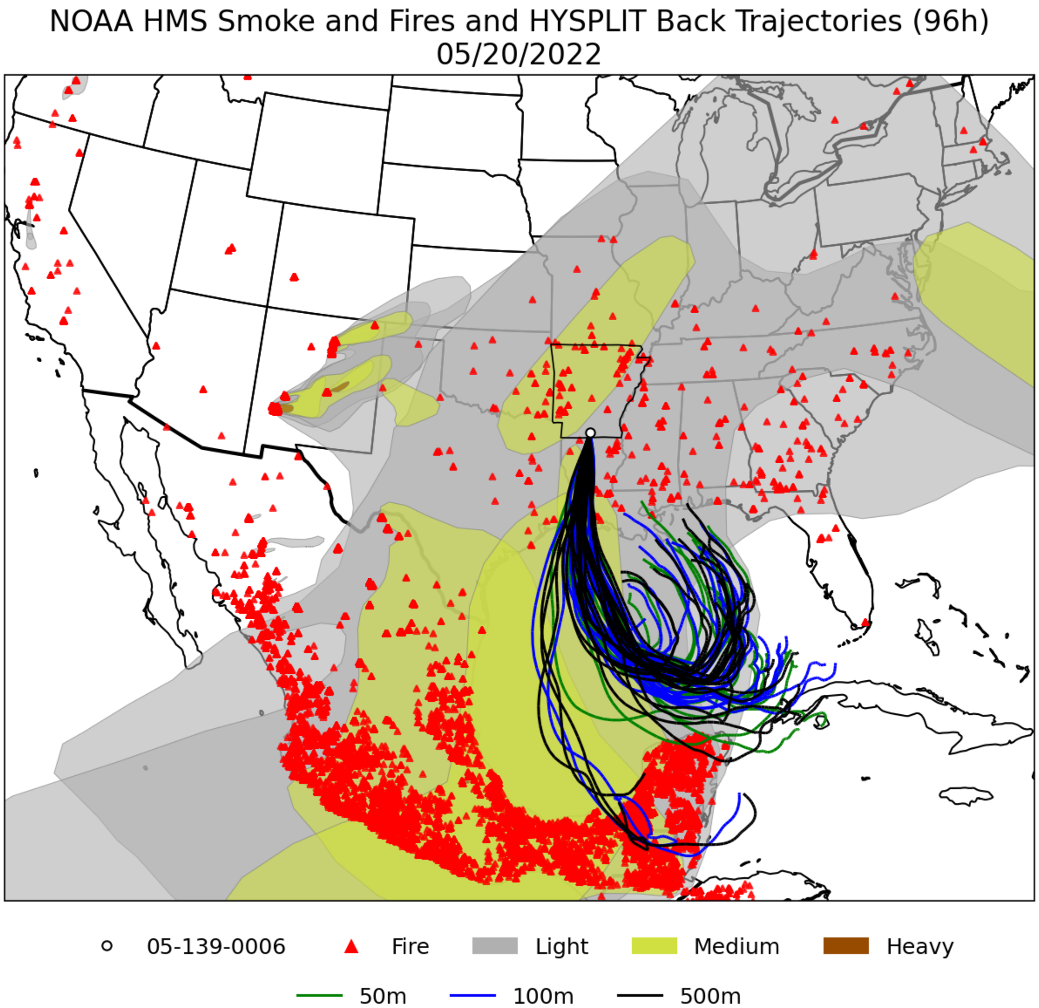

Figure 2-36. HYSPLIT back trajectories for El Dorado on May 20, 2022.

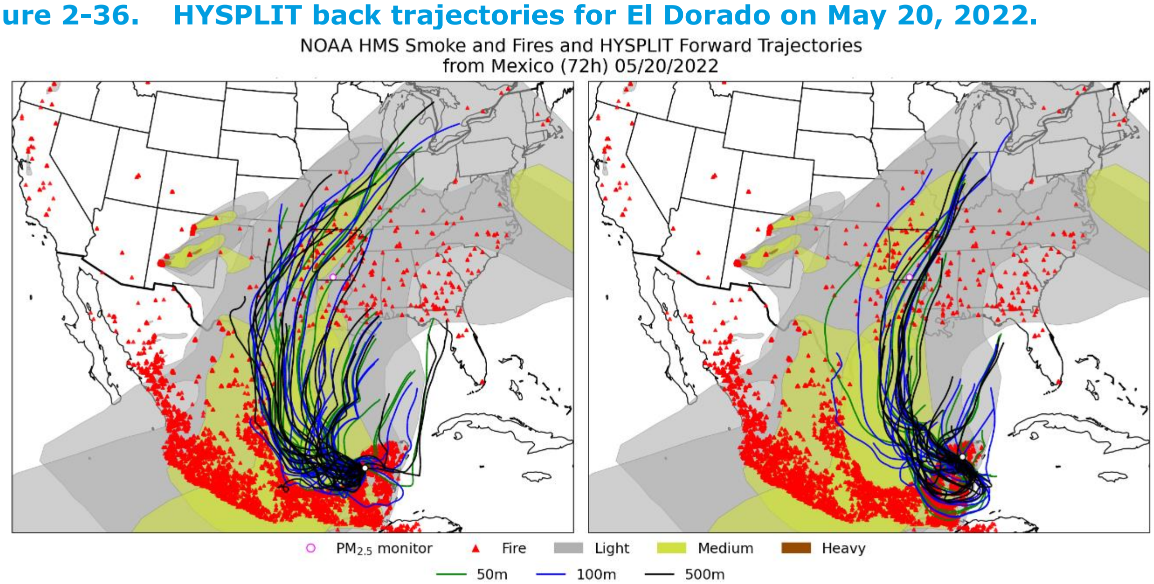

Figure 2-37. HYSPLIT forward trajectories from Mexico for El Dorado on May 20, 2022.

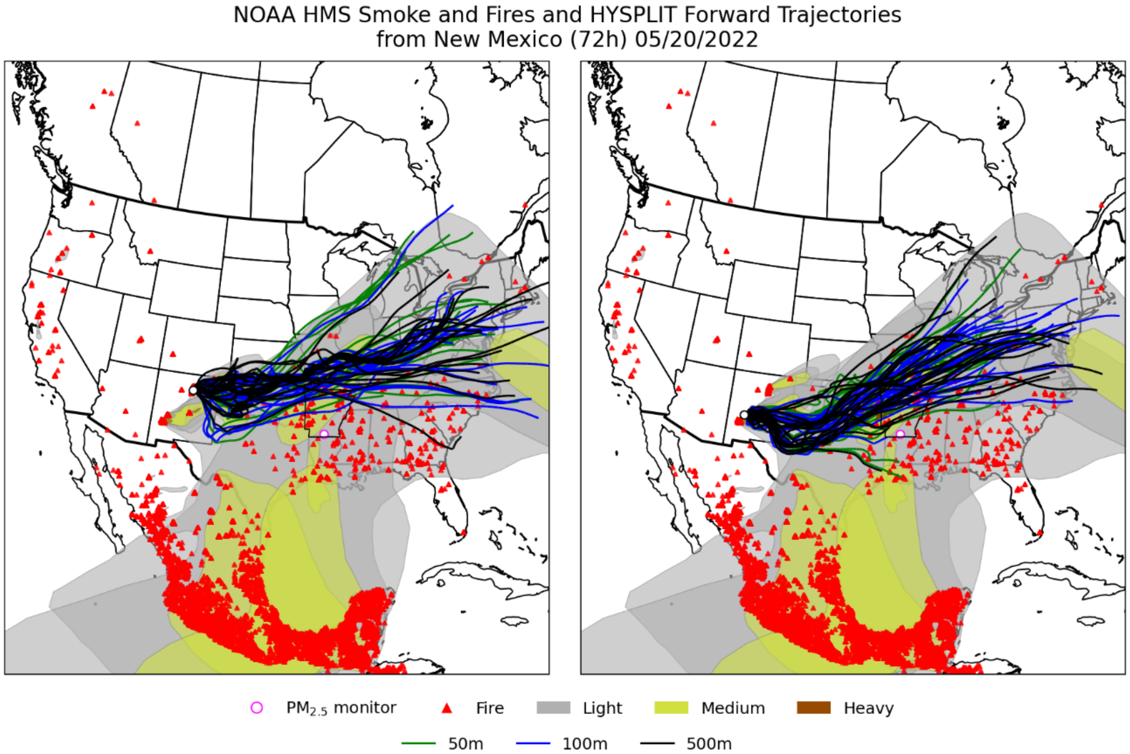

Figure 2-38. HYSPLIT forward trajectories from New Mexico for El Dorado on May 20, 2022.

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2.1.3 June 13-18, 2022

During the summer in 2022, several significant wildfires occurred across Arizona and New Mexico, contributing to a challenging fire season. The Midnight Fire near El Rito, New Mexico, which started on June 10 due to lightning, burned approximately 5,292 acres. The Foster Fire in the Peloncillo Mountains of New Mexico began on May 29, was human-caused, and affected around 7,612 acres. In Arizona, the Haywire Fire, northeast of Doney Park near Flagstaff, ignited on June 12 and consumed about 5,303 acres, while the nearby Pipeline Fire, which also began on June 12, burned approximately 26,437 acres. The Contreras Fire in the Baboquivari Mountain range near Tucson, Arizona, started on June 11 and caused concerns as it reached the Kitt Peak National Observatory, burning 31,286 acres. The Tonto Canyon Fire, which started on June 12 in Tonto National Forest, burned approximately 16,983 acres, contributing to the overall fire impact in the region.

The 500 mb synoptic analysis on June 13, 2022 in Figure 2-39a shows that a positively-tilt trough over the western U.S. promotes southwesterly flow downstream and significantly allows the transport of pollutants from fires in Arizona and New Mexico northeastward toward the central and eastern U.S.[25] Over the eastern U.S., a ridge is located across the midwestern U.S. creating a region of stable air and subsidence in the southeastern states, suppressing vertical mixing and trapping pollutants near the surface. The wind barbs show southwesterly flow over the central and eastern U.S., driven by the interaction between the western trough and southeastern ridge. Near the ridge, winds weaken, as indicated by sparse wind barbs and widely spaced contours. This slower flow allows pollutants to accumulate under the stable air associated with the ridge.

On June 14 (Figure 2-39b), the trough becomes negatively-tilted stretching across the Pacific Northwest and northern Rockies.[26] Strong southwesterly flow persists over the eastern edge of this trough, enhancing upper-level winds over the central U.S. These winds facilitate the transport of smoke northeastward into the Plains. A broad ridge is centered over the eastern half of the U.S., supporting subsidence and stable conditions that inhibit vertical mixing and trap pollutants near the surface. By June 15 (Figure 2-39c), the trough has shifted eastward and is neutrally tilted, extending into the central U.S. A broad ridge dominates the eastern U.S., particularly over the southeast and mid-Atlantic regions.[27] Winds at 500 mb over Arizona and New Mexico remain predominantly southwesterly, transporting smoke northeastward into the central Plains, Midwest, and portions of the eastern U.S and then rotating around the high pressure and redirecting air masses to the north into Arkansas.

On June 16 (Figure 2-39d), the 500 mb map shows a ridge extending northward into the central U.S., while a trough persists across the eastern U.S.[28] Southwesterly flow at 500 mb over the southwest U.S. favors the northeastward transport of smoke from wildfire regions. On June 17 (Figure 2-39e), the 500 mb map reveals a persistent trough over the eastern U.S. and a ridge building across the central Plains and southwest.[29] The flow over Arizona and New Mexico remains generally southwesterly or westerly, aligning with smoke transport

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[25] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2022&STARTMONTH=06&STARTDAY=13&STARTTIME=00&INC=-48

[26] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2022&STARTMONTH=06&STARTDAY=14&STARTTIME=00&INC=-48

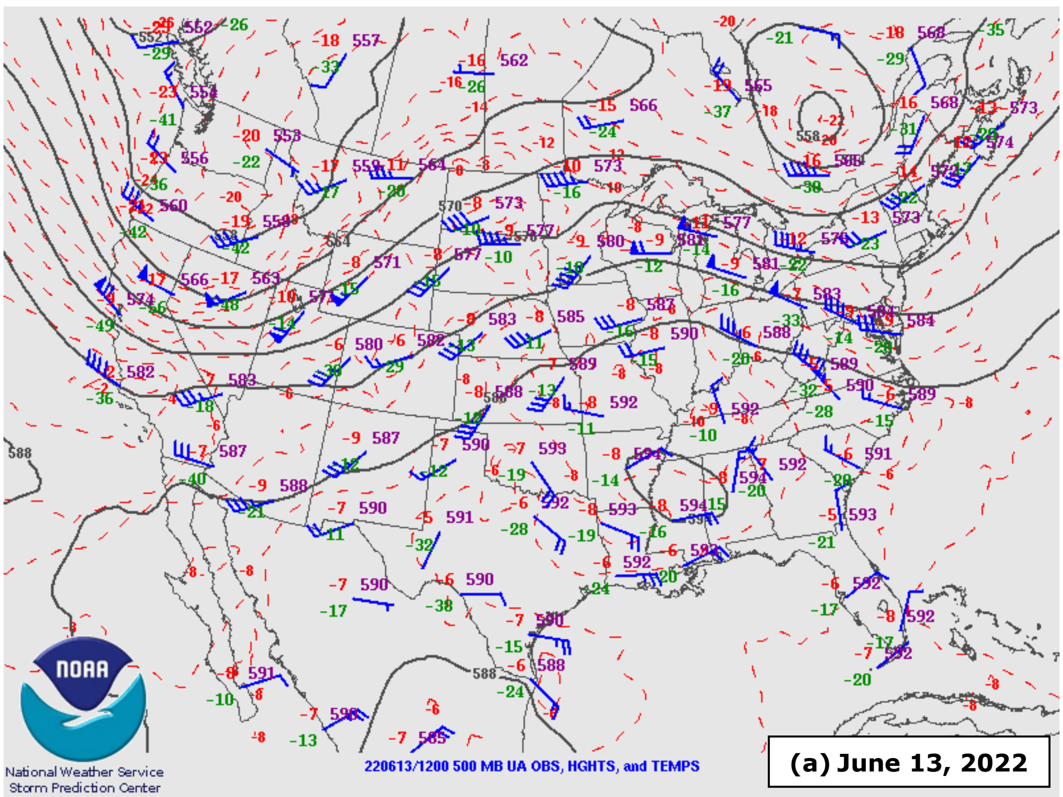
[27] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2022&STARTMONTH=06&STARTDAY=15&STARTTIME=00&INC=-48

[28] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2022&STARTMONTH=06&STARTDAY=16&STARTTIME=00&INC=-48

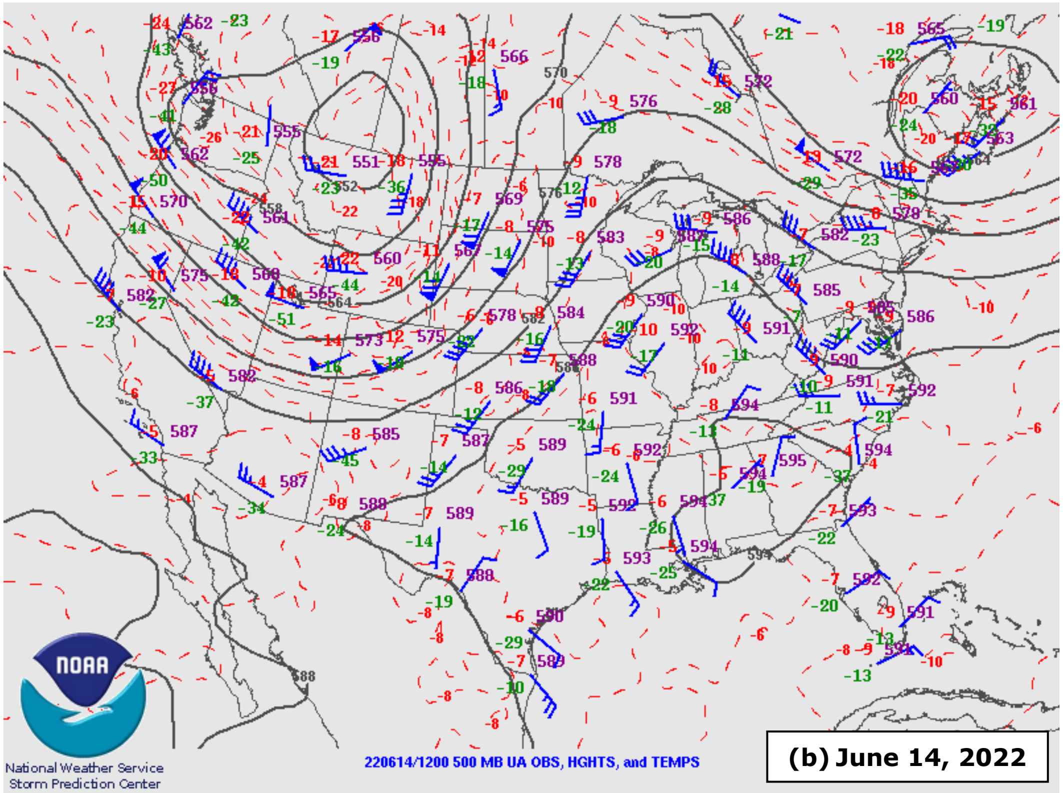
[29] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2022&STARTMONTH=06&STARTDAY=17&STARTTIME=00&INC=-48

out of the fire zones. The upper-level flow carries smoke northeastward into the Midwest and southeastern U.S., as the upper trough downstream acts to draw smoke southward into Arkansas. The coupling of ridging in the west and troughing downstream supports sustained long-range smoke transport into the southeastern U.S.

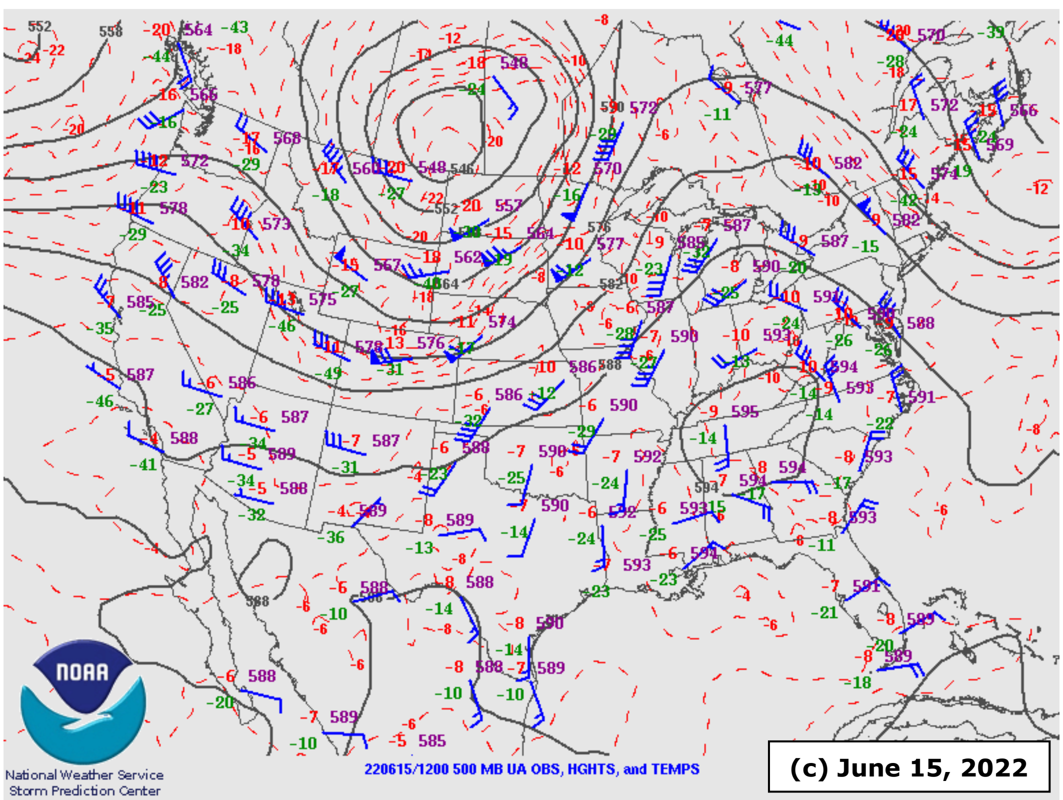
On June 18 (Figure 2-39f), a prominent trough dominates the western U.S., while a ridge persists over the central and Midwest U.S.[30] Strong mid-level winds follow the height contours, concentrating on the east side of the trough and enhancing northerly to northeasterly transport into Arkansas. The strong southwesterly flow on the eastern edge of the trough suggests that smoke from these fires could be lofted up and transported northeastward into the central U.S. (including Texas, Oklahoma, Kansas, and Arkansas). Subsidence under the ridge in the eastern U.S. could cause the smoke to mix downward near the surface.



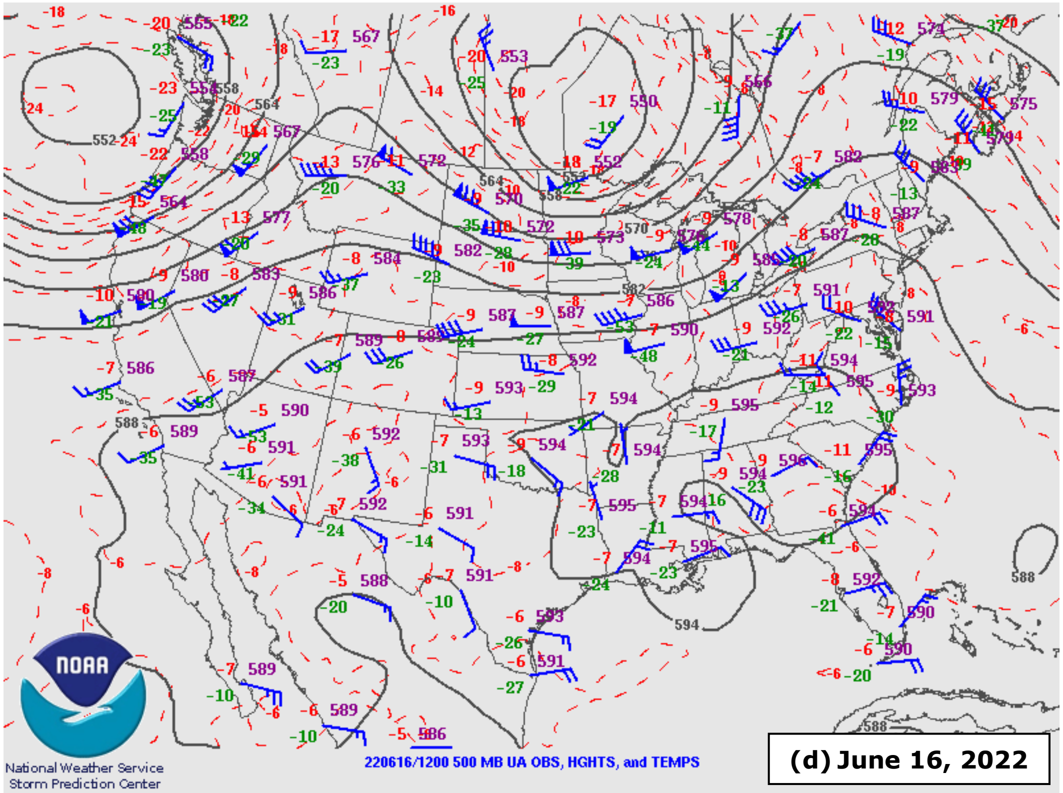
[30] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2022&STARTMONTH=06&STARTDAY=18&STARTTIME=00&INC=-48



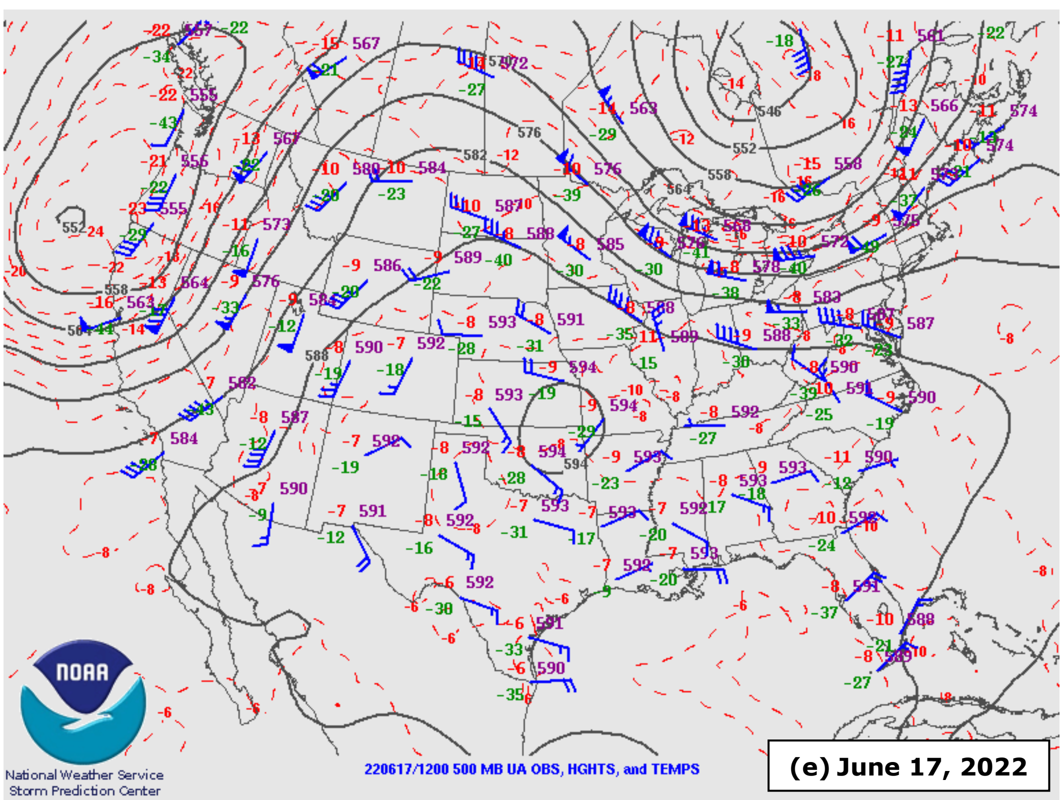
(b) June 14, 2022



(c) June 15, 2022



(d) June 16, 2022



(e) June 17, 2022

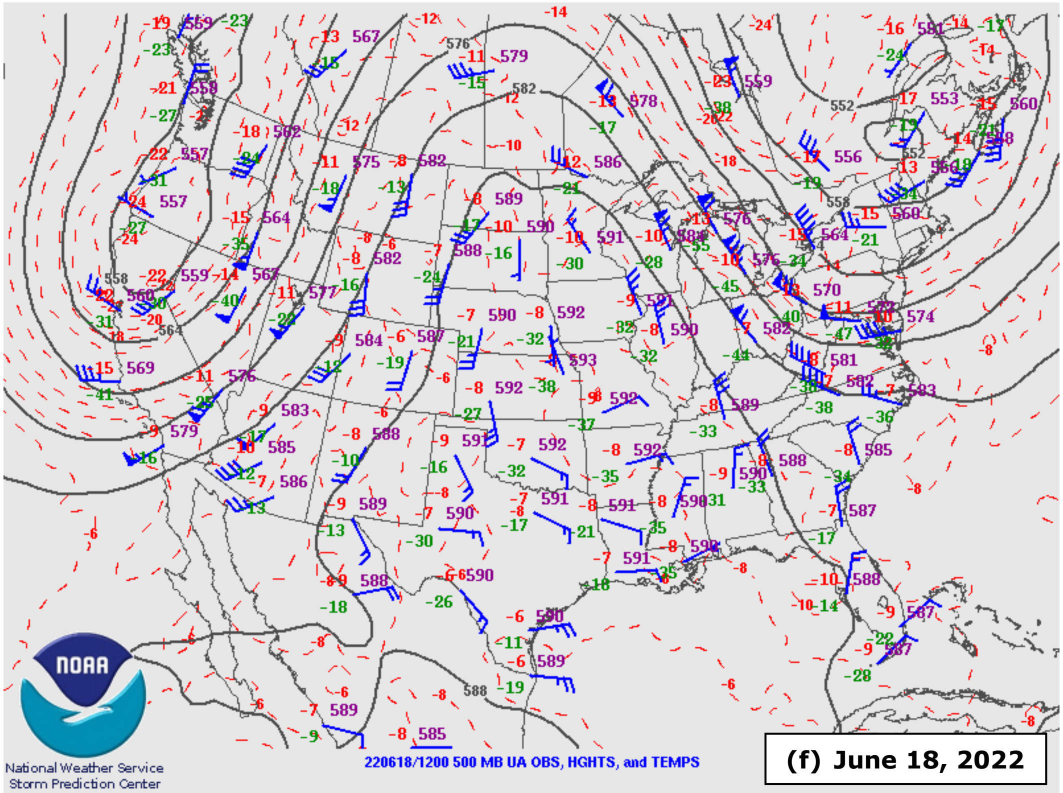


Figure 2-39. 500 mb synoptic analysis map at 12 UTC on (a) June 13, (b) June 14, (c) June 15, (d) June 16, (e) June 17, and (f) June 18, 2022.

The surface analysis for June 13, 2022 (Figure 2-40a) shows a stationary front stretching across the central U.S., from the northern Rockies to the northeast. A cold front extends southwestward from a low-pressure system in the central Plains, likely helping push smoke from fires in Arizona and New Mexico northeastward. A significant low-pressure system is centered over Colorado and Kansas, enhancing surface convergence and upward motion. This low supports the northeastward advection of smoke-laden air along the frontal boundary. A surface high-pressure system moved eastward during the day passing over Arkansas, trapping smoke within its center and dispersing pollutants in a clockwise rotation that impacted the state for most of June 13.

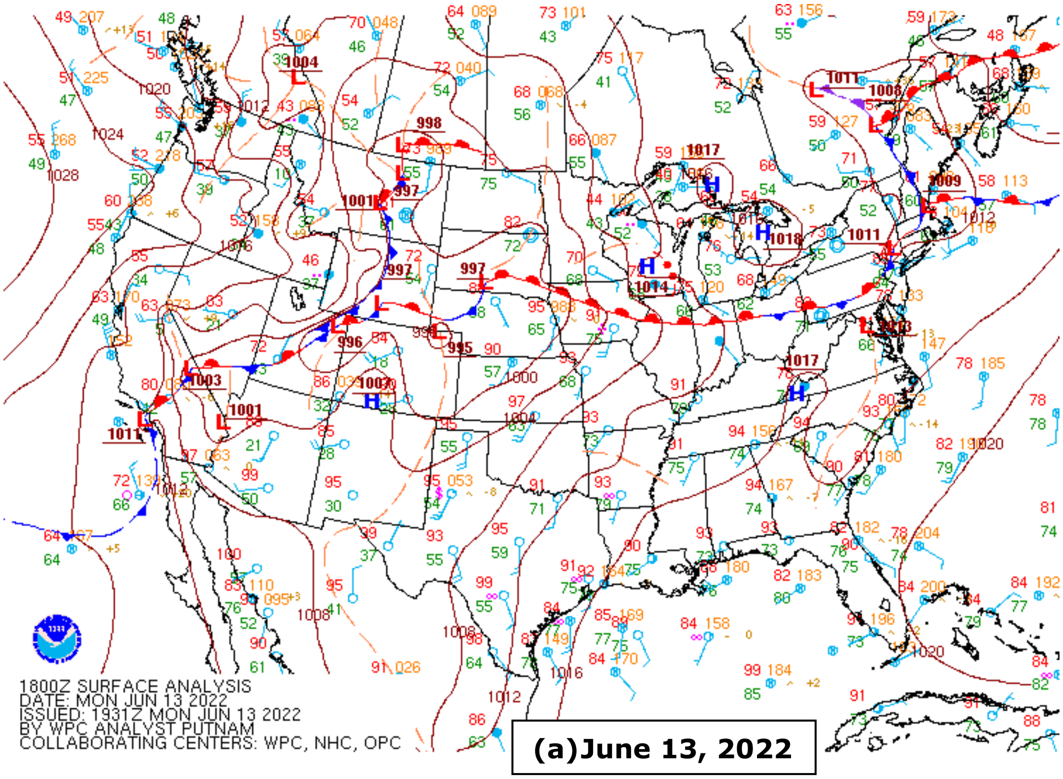
On June 14 (Figure 2-40b), a strong low-pressure center is located over the central Plains, aligned with the upper-level trough at 500 mb. Two surface high-pressure systems remain over the Great Lakes and the southeastern U.S., corresponding to the broad ridge at 500 mb, leading to sinking air and stable weather in the eastern U.S. A stationary front stretched from the northern Plains through the Midwest into the northeast. This boundary lies near the ridge/trough transition zone at the upper levels, inhibiting significant vertical mixing of air masses. The high-pressure system over Tennessee and North Carolina remained stationary during the day, dispersing the trapped smoke from fires in the western U.S. from previous days and continued to recirculate over the region, including Arkansas that was impacted by south to southeasterly winds from this system.

On June 15 (Figure 2-40c), the surface analysis shows a strong low-pressure system over the Canadian Rockies, extending its influence into the central U.S. A trailing cold front stretched southward across the Plains into Texas, enhancing southerly and southwesterly surface winds ahead of the boundary. High pressure dominates the southeastern U.S., maintaining stable conditions. Surface winds near the fire sources help lift smoke into the atmosphere, while upper-level winds disperse it regionally. These dynamics allowed trapped smoke by the high-pressure system over Tennessee and North Carolina to continue the impacts seen over Arkansas during the initial hours of the day but then cleaner air pulled from the south reduced PM concentrations dramatically during the morning and the rest of the day.

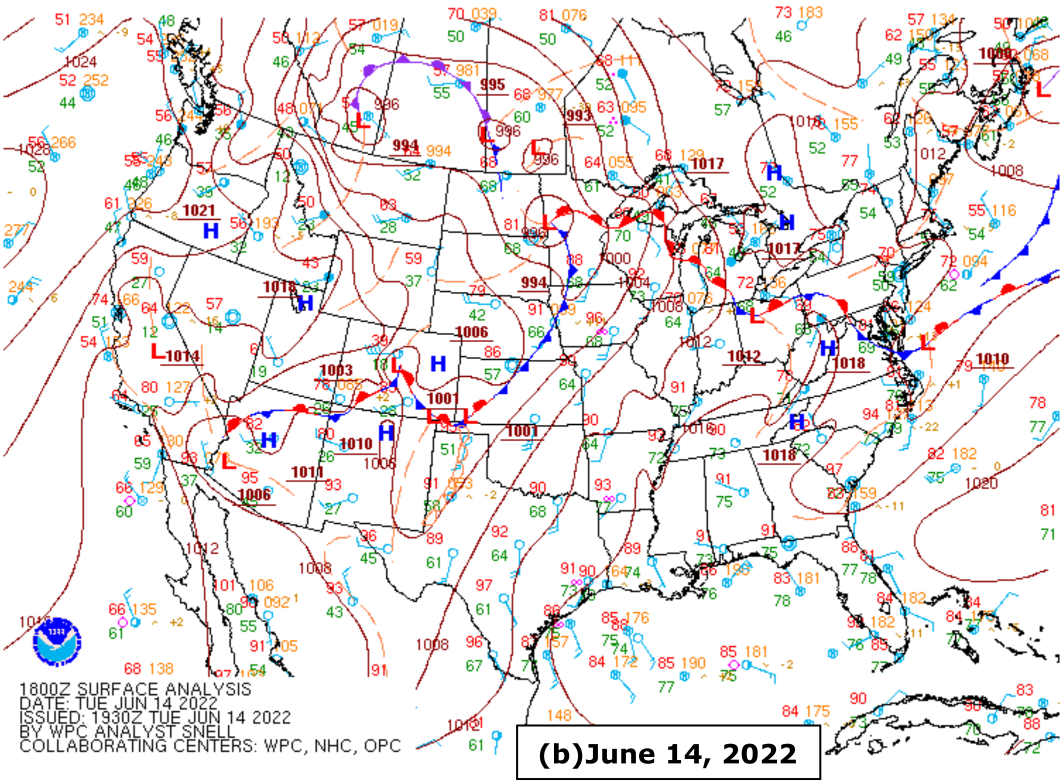
The surface weather pattern for June 16 (Figure 2-40d) reveals a stationary front across the southeastern U.S., with a high pressure in the southeastern U.S. generally favoring southerly flow from the Gulf of Mexico. The pressure gradient between systems is weak suggesting light to moderate wind speeds. This configuration limits air mass mixing and aids smoke transport from the southwest toward the eastern U.S. under the influence of persistent southwesterly flow. The stationary front kept moving southward during the day allowing smoke to impact the northern part of Arkansas late in the day.

On June 17 (Figure 2-40e), the surface analysis shows a prominent cold front stretching across the eastern U.S., extending southwestward into the central and southern Plains. High pressure dominates the upper Midwest and Great lakes regions, while low pressure systems persist in the western U.S., including the southwest. Surface winds over Arizona and New Mexico show air masses move to the north and northeast, along with a warm front that stretched over Nebraska and South Dakota. These air masses are later trapped by the high-pressure system sitting over Iowa and Minnesota and they get dispersed to the south along the cold front that extends from Missouri to Pennsylvania. These create north to northwesterly from into Arkansas that sees the effect of the smoke-laden air masses for most of the day.

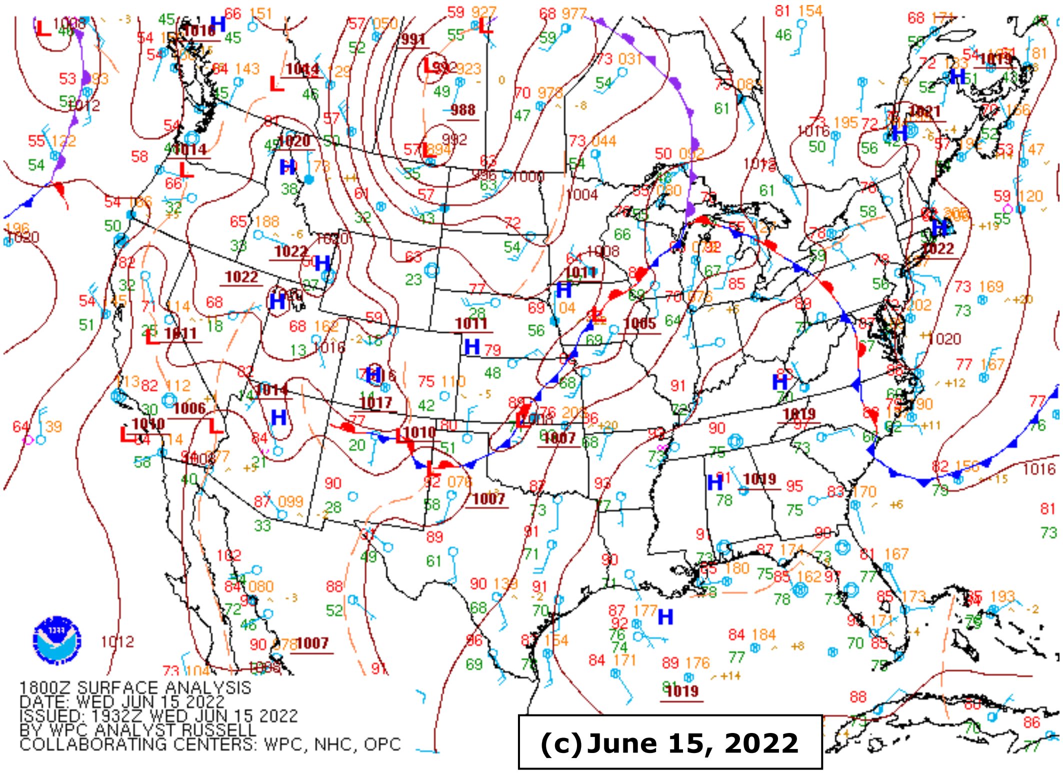
The surface weather pattern for June 18 (Figure 2-40f), shows a strong high-pressure system over the Great Lakes that pulls smoke northwest to the fires burning in the southwestern U.S. The rotation of this system transport smoke over vast region of the U.S., moving air masses south into the northern part of Arkansas, which is affected for most of the day.



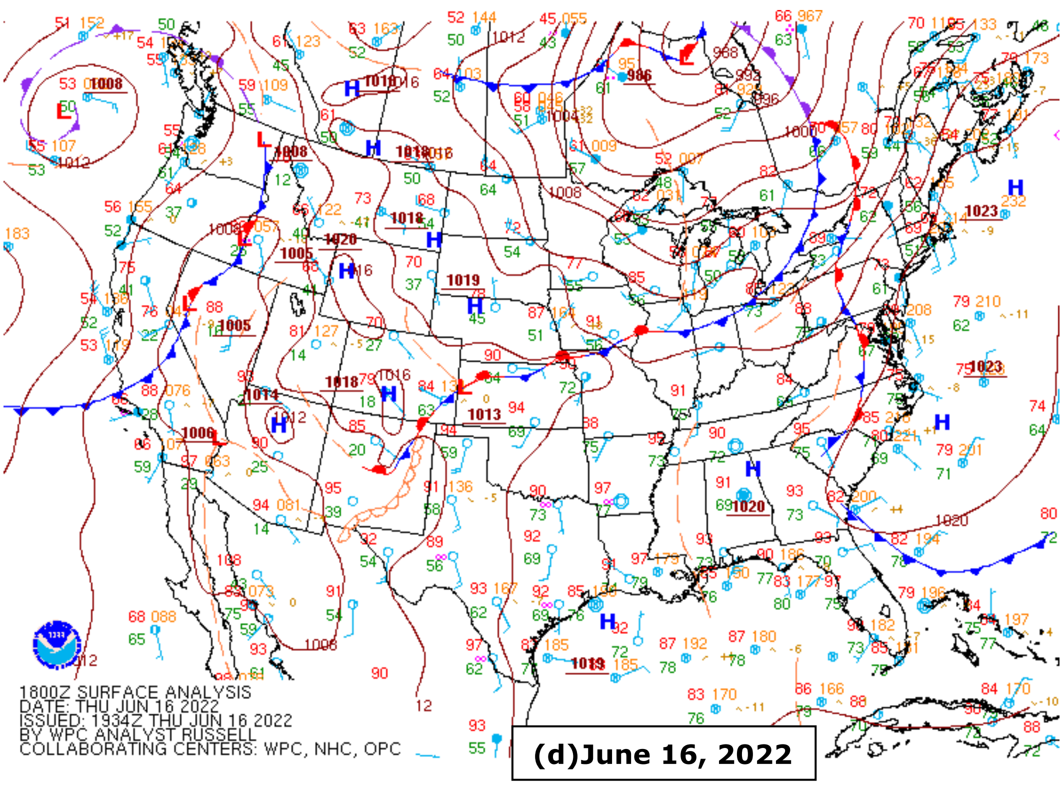
(a)June 13, 2022



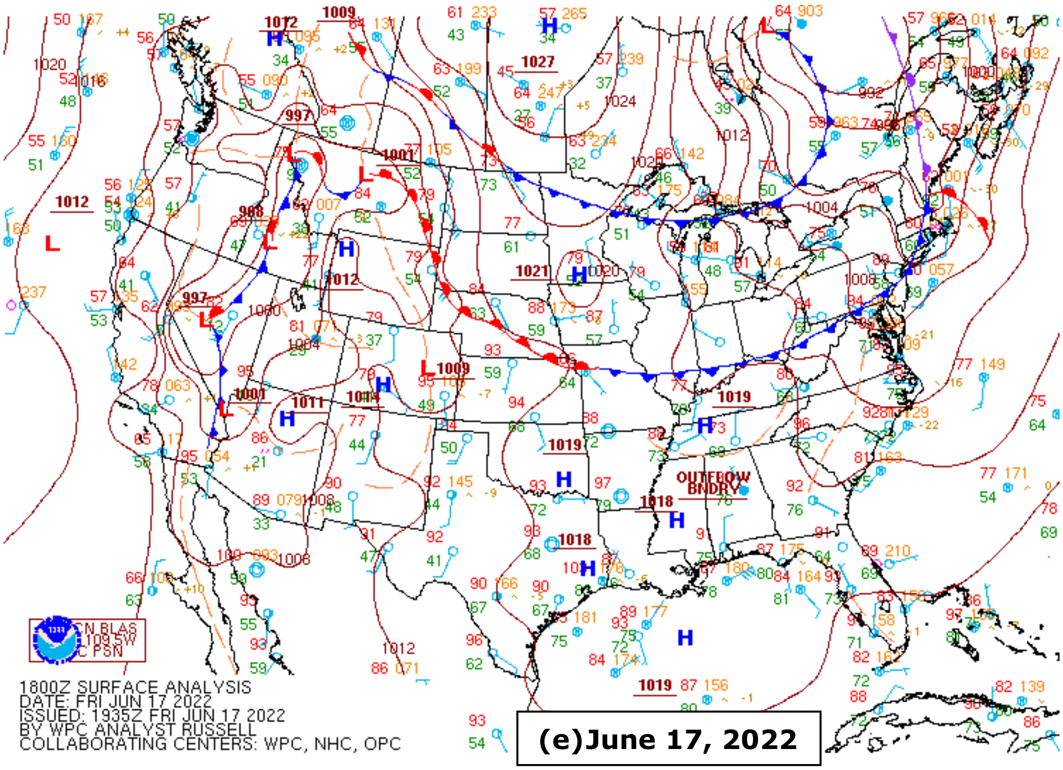
(b)June 14, 2022



(c) June 15, 2022



(d) June 16, 2022



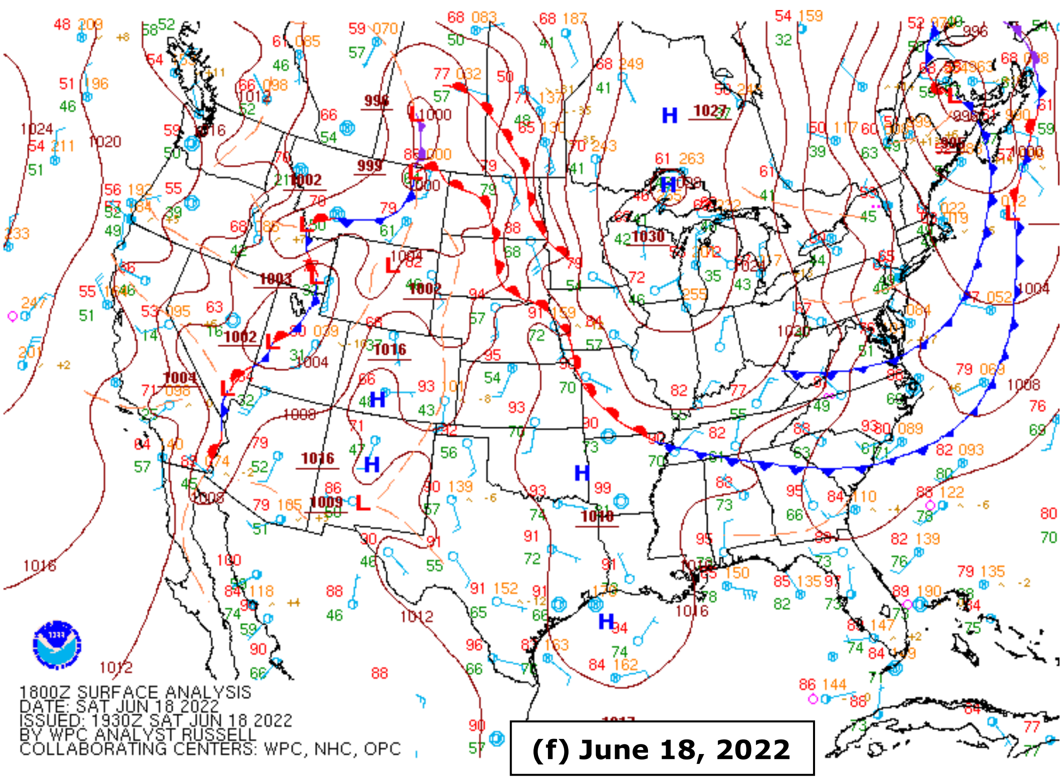


Figure 2-40. Surface synoptic analysis maps at 18 UTC on (a) June 13, (b) June 14, (c) June 15, (d) June 16, (e) June 17, and (f) June 18, 2022.

The NOAA HMS product in Figure 2-41 and the NOAA satellite imagery in Figure 2-42 show light to medium smoke covering Arkansas, much of the central U.S., and the eastern U.S. Moderate AQI values (Figure 2-43) and NAAPS simulated smoke concentrations (, ranging from 4 to 32 μg/m^3 in Arkansas, suggest that this smoke mixed down to the surface, affecting monitors over Arkansas and adjacent states. Figure 2-44 presents the HRRR vertically integrated modeled smoke concentrations during this period and illustrates how the air masses are transported from the fires in the southwestern U.S. and reach Arkansas and the eastern U.S. in a manner consistent with the meteorology described above. Concentrations circulate around a high-pressure system over Tennessee and Nort Carolina which is most noticeable in the period of Jun 13 to 16, 2023. The HMS smoke product in Figure 2-45 and Figure 2-46 also show the evolution of the smoke plumes from multiple fires in Arizona and New Mexico.

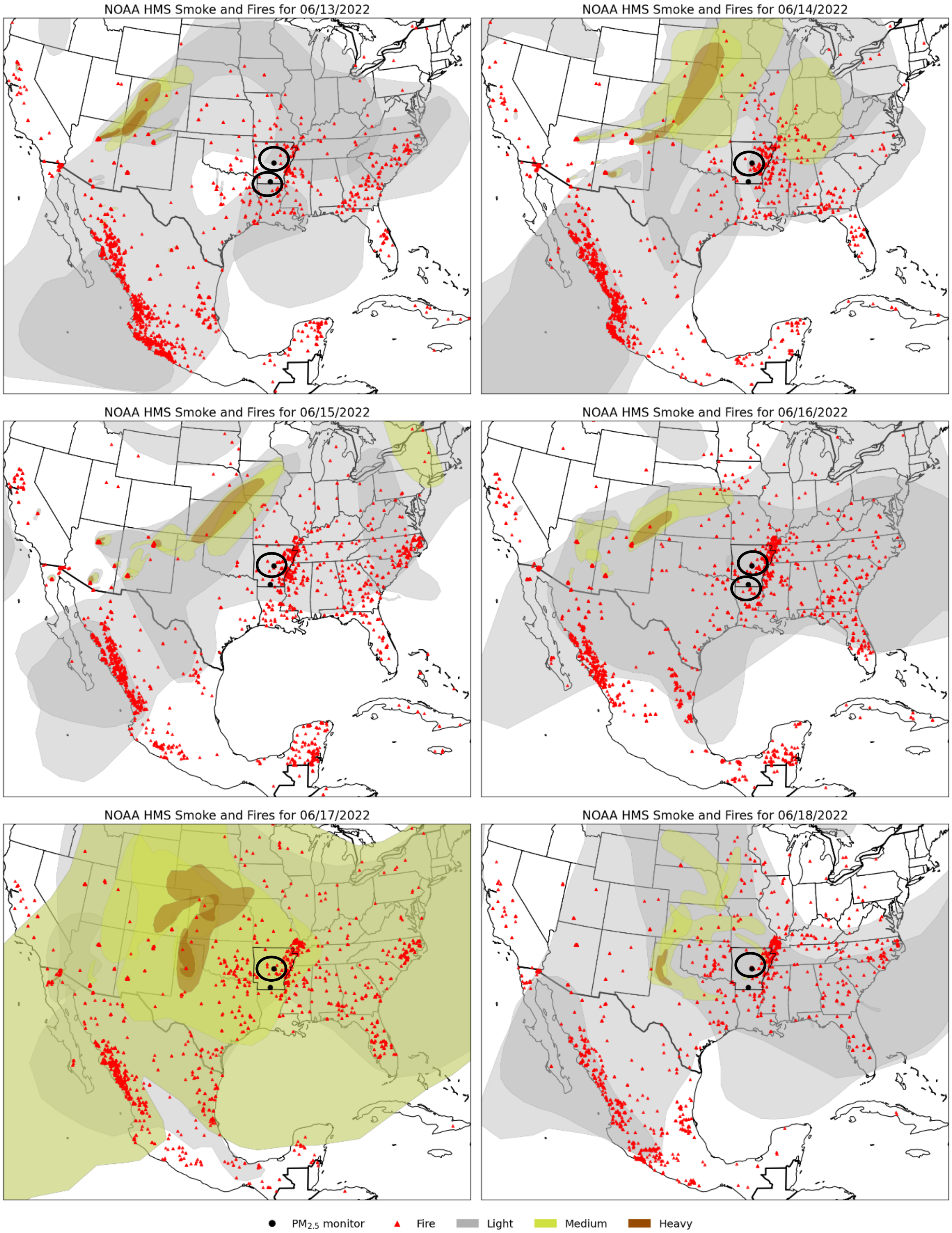
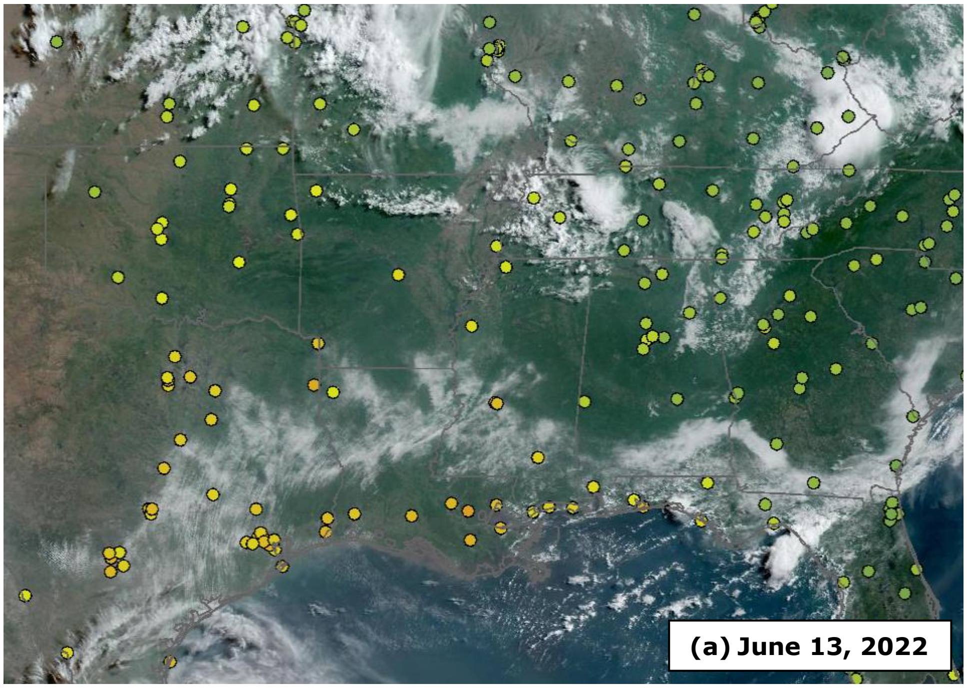
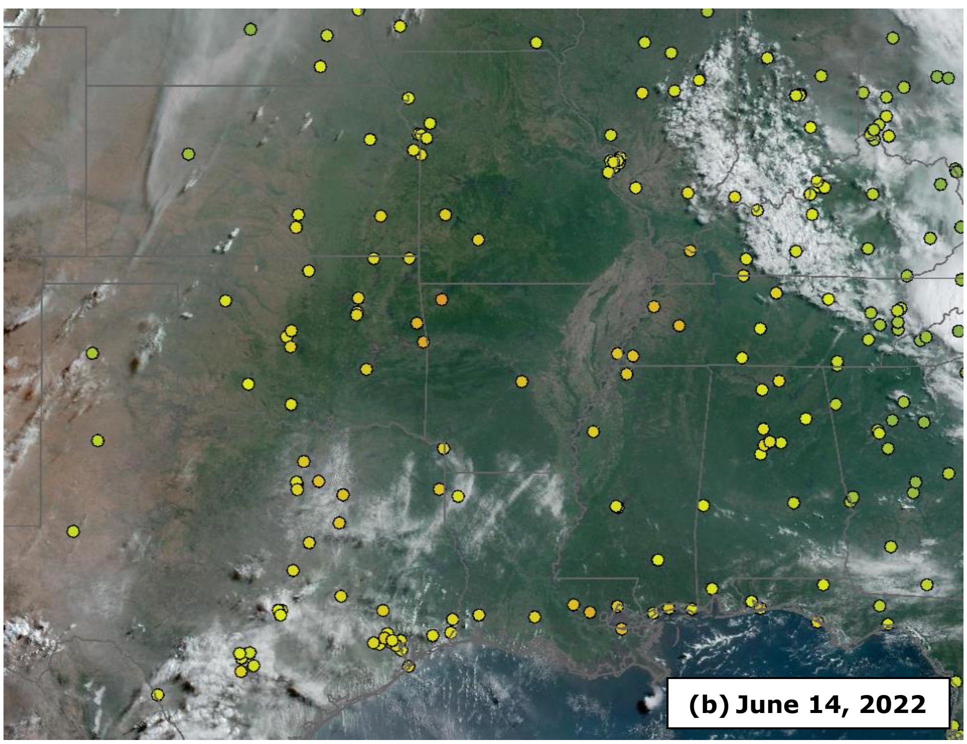
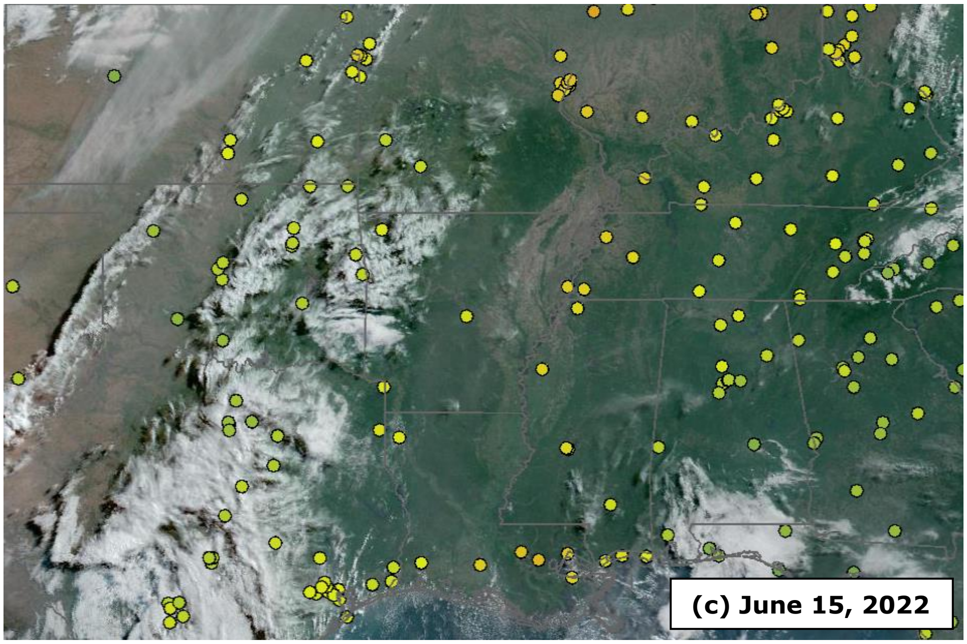
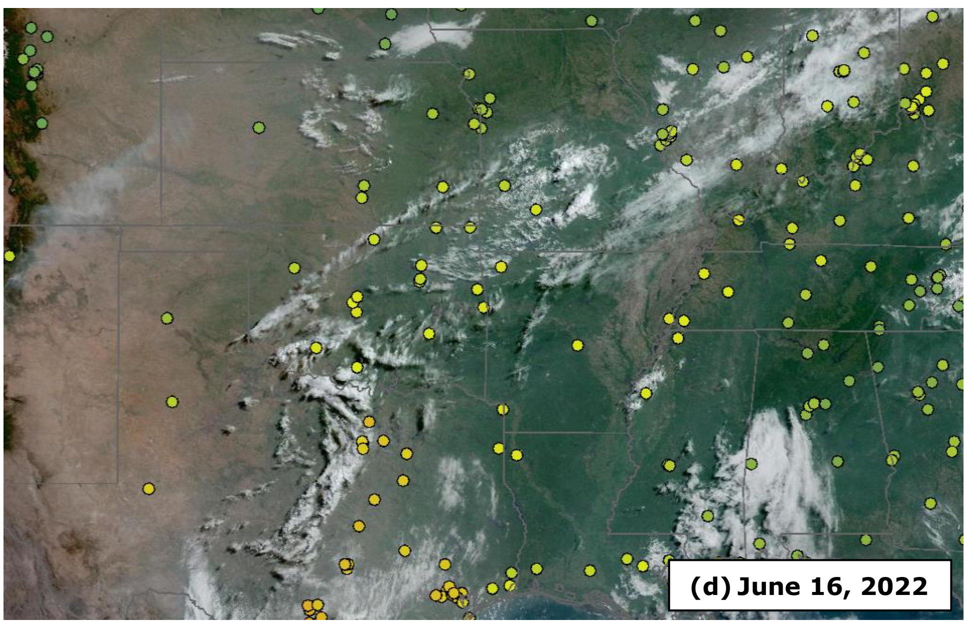


Figure 2-41. NOAA HMS fire and smoke products for June 13 (top left), June 14 (top right), June 15 (middle left), June 16 (middle right), June 17 (bottom left), June 18 (bottom right), 2022.


(a) June 13, 2022


(b) June 14, 2022


(c) June 15, 2022


(d) June 16, 2022

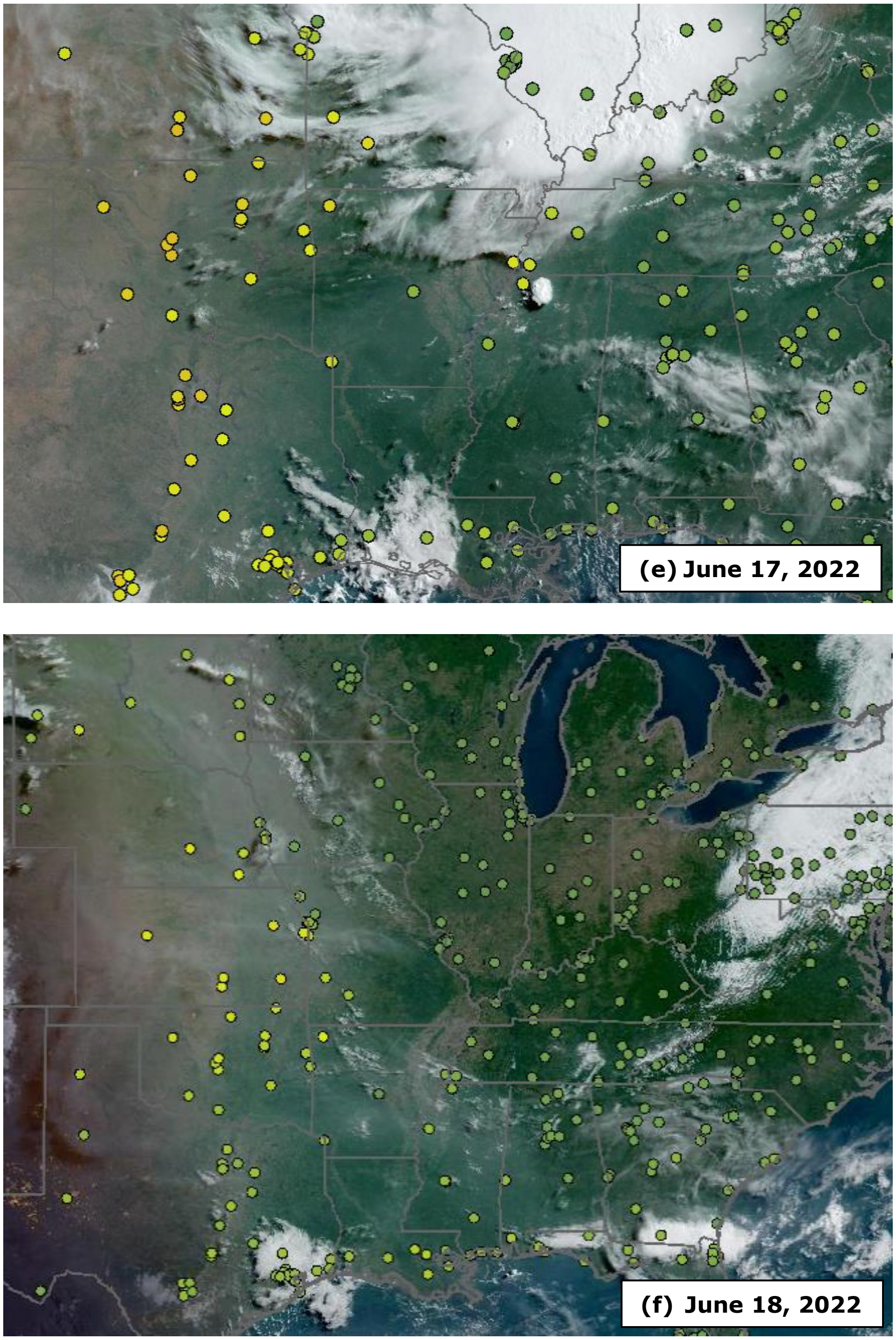
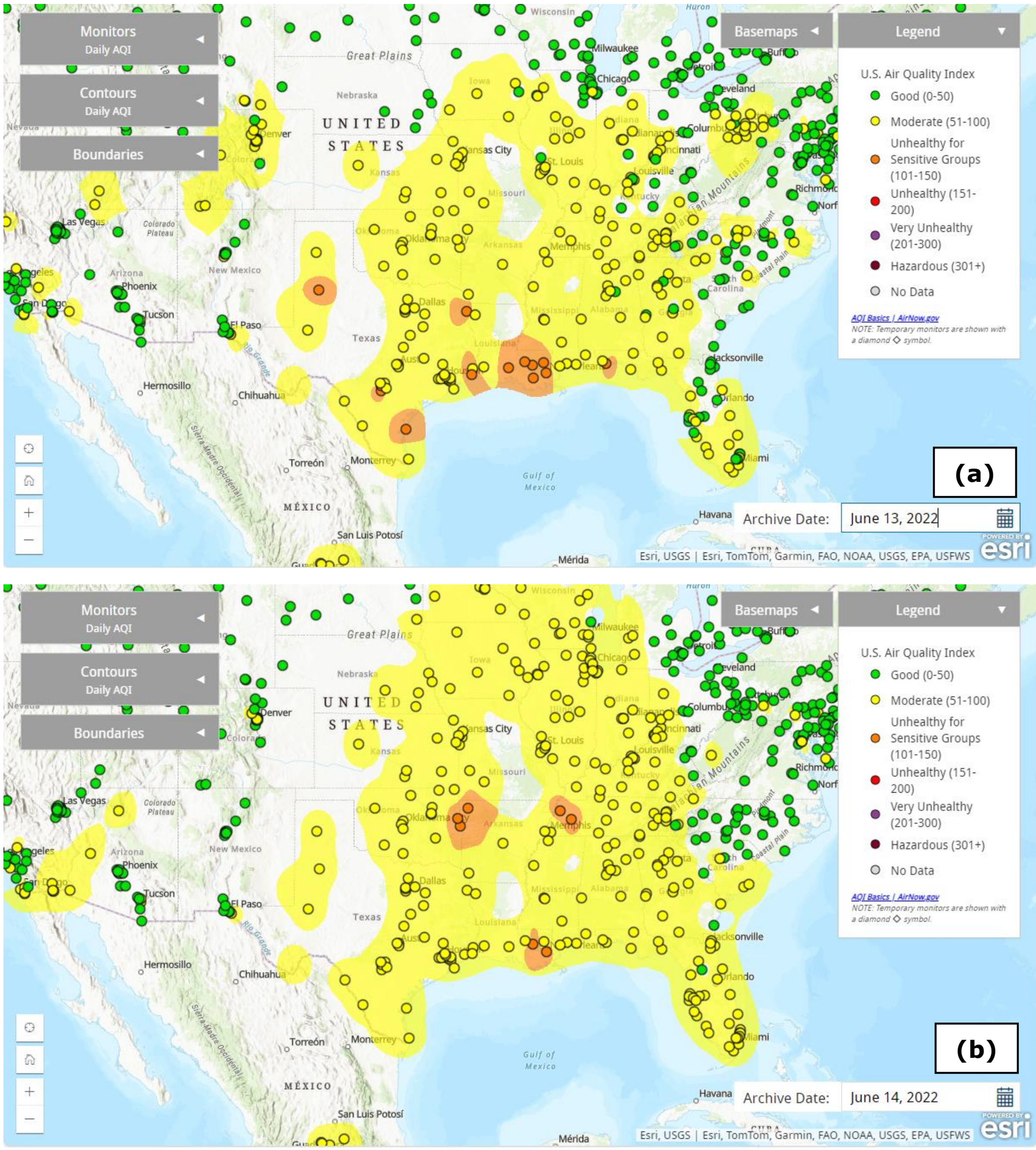
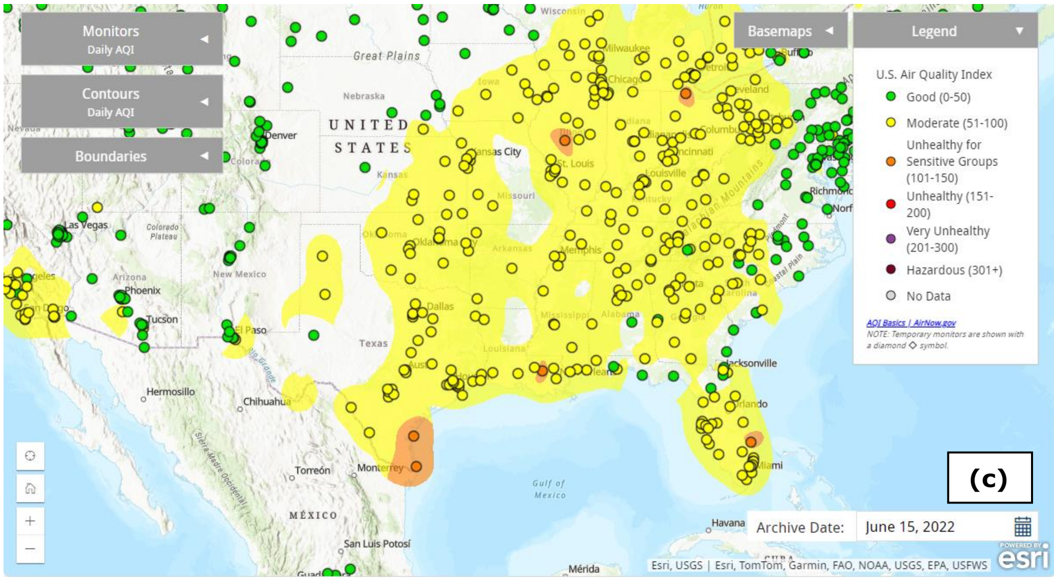
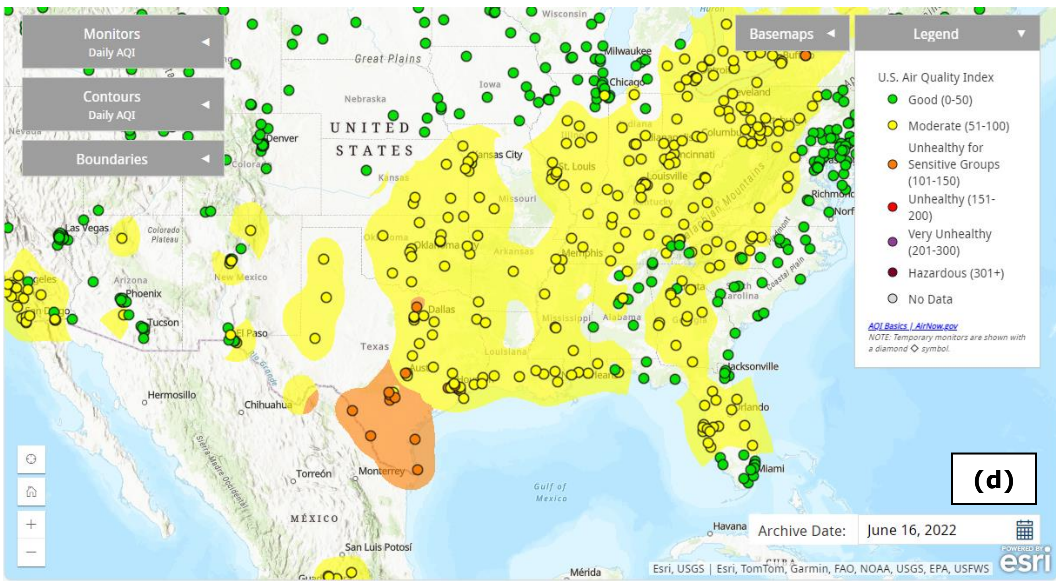


Figure 2-42. NOAA satellite visible imagery on (a) June 13 at 1311 UTC, (b) June 14 at 1311 UTC, (c) June 15 at 1301 UTC, (d) June 16 at 1311 UTC, (e) June 17 at 1301 UTC, and (f) June 18 at 1241 UTC, 2022.


Monitors
Daily AQI
Contours
Daily AQI
Boundaries
Basemaps
Legend
U.S. Air Quality Index
Good (0-50)
Moderate (51-100)
Unhealthy for Sensitive Groups (101-150)
Unhealthy (151-200)
Very Unhealthy (201-300)
Hazardous (301+)
No Data
AQI Basics | AirNow.gov
NOTE: Temporary monitors are shown with a diamond ◇ symbol.
(a)
Archive Date: June 13, 2022
(b)
Archive Date: June 14, 2022
Esri, USGS | Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, USFWS
esri


Monitors
Daily AQI
Contours
Daily AQI
Boundaries
Basemaps
Legend
U.S. Air Quality Index
Good (0-50)
Moderate (51-100)
Unhealthy for Sensitive Groups (101-150)
Unhealthy (151-200)
Very Unhealthy (201-300)
Hazardous (301+)
No Data
AQI Basics | AirNow.gov
NOTE: Temporary monitors are shown with a diamond ◇ symbol.
(c)
Archive Date: June 15, 2022
Esri, USGS | Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, USFWS


Monitors
Daily AQI
Contours
Daily AQI
Boundaries
Basemaps
Legend
U.S. Air Quality Index
Good (0-50)
Moderate (51-100)
Unhealthy for Sensitive Groups (101-150)
Unhealthy (151-200)
Very Unhealthy (201-300)
Hazardous (301+)
No Data
AQI Basics | AirNow.gov
NOTE: Temporary monitors are shown with a diamond ◇ symbol.
(d)
Archive Date: June 16, 2022
Esri, USGS | Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, USFWS

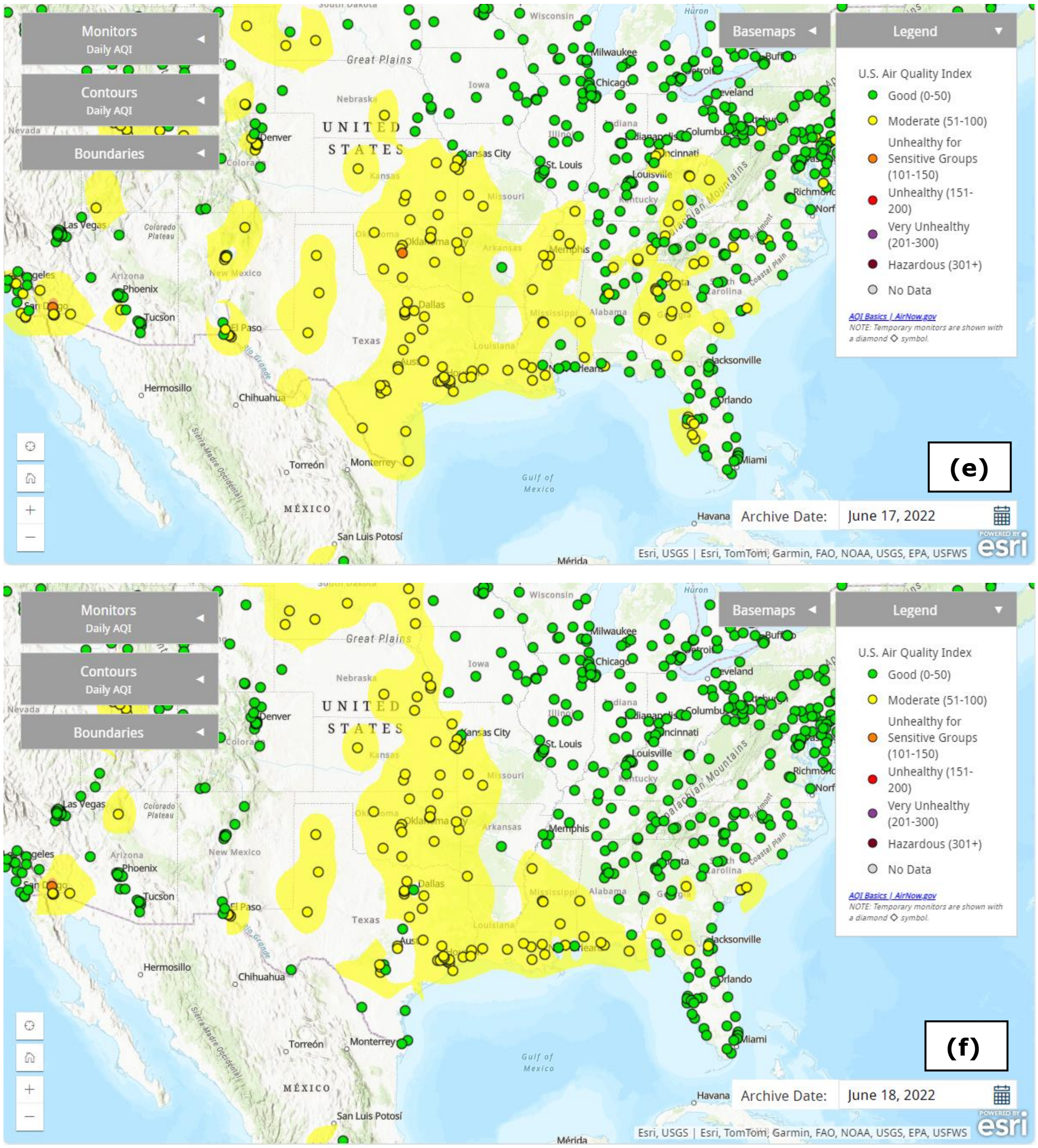


Figure 2-43. AirNow surface level $PM_{2.5}$ concentration contours for (a) June 13, (b) June 14, (c) June 15, (d) June 16, (e) June 17, and (f) June 18, 2022.

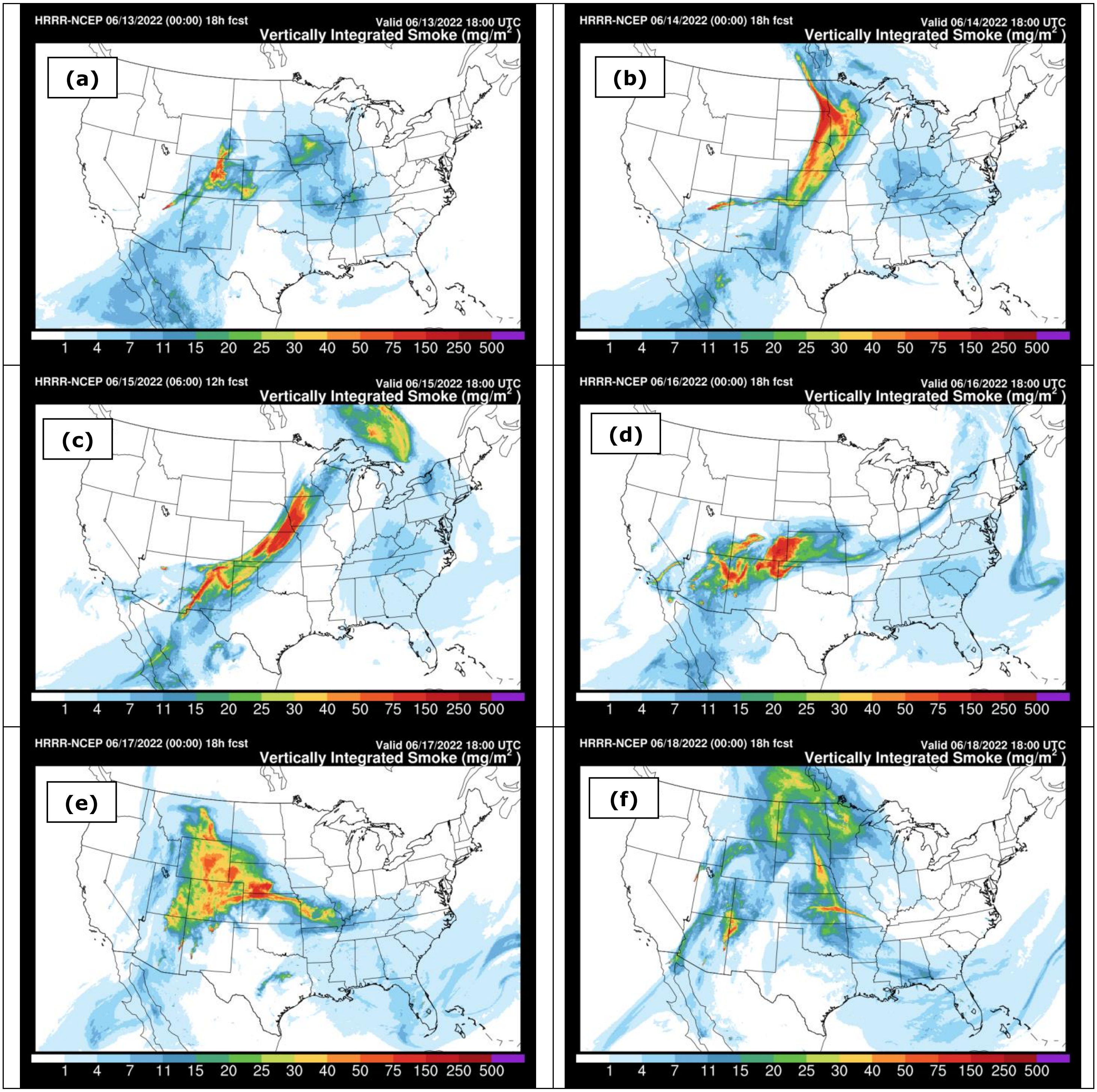


Figure 2-44. HRRR modeled vertically integrated smoke concentrations (μg/m^3) at 18Z on (a) June 13, (b) June 14, (c) June 15, (d) June 16, (e) June 17, and (f) June 18, 2022.

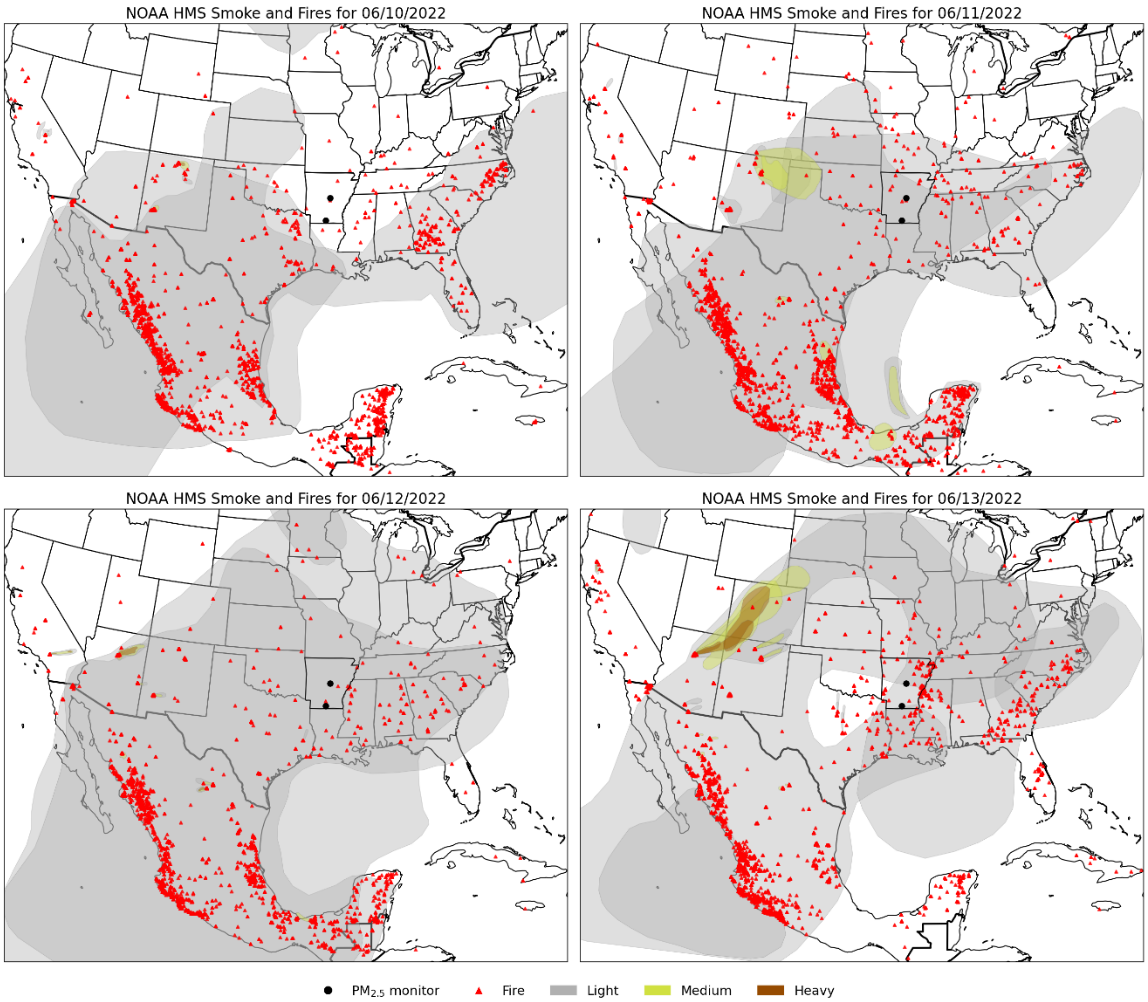


Figure 2-45. Evolution of fires and smoke for June 10 (top left), June 11 (top right), June 12 (bottom left), and June 13 (bottom right).

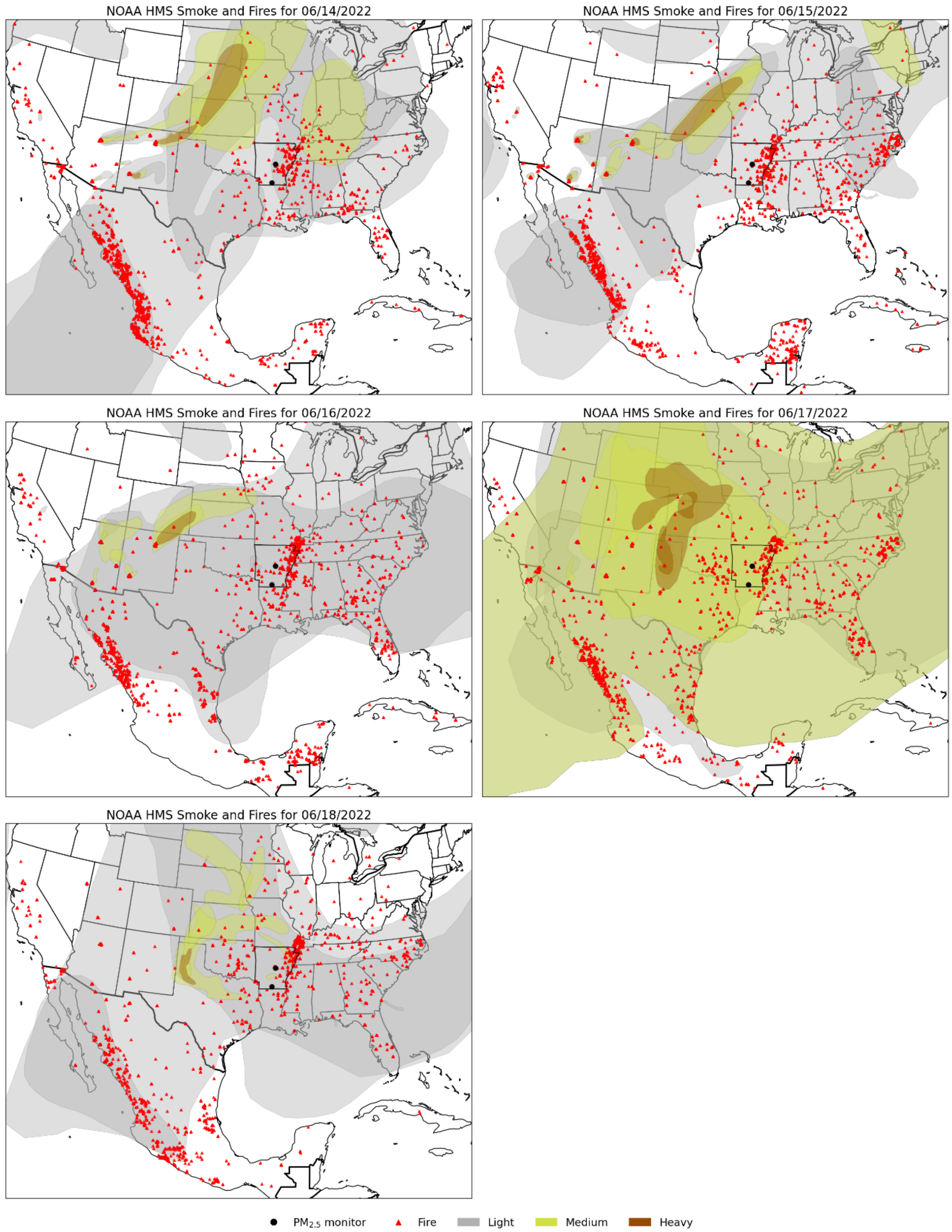


Figure 2-46. Evolution of fires and smoke for June 14 (top left), June 15 (top right), June 16 (middle left), June 17 (middle right), and June 18 (bottom left).

2.1.3.1 PARR June 13, 2022

Table 2-6 summarizes the evidence supporting the exceptional event demonstration for PARR (AQS ID 05-119-0007) on June 13, 2022. Figure 2-47 illustrates that the 24-hour $PM_{2.5}$ concentrations on this day exceed the Tier 1 threshold, while Figure 2-48 shows that it is above the 99th percentile of historical values over the last five years. Forward trajectories in Figure 2-50 show how smoke was transported from fires in Arizona and New Mexico over the eastern U.S. This smoke becomes trapped under the high pressure (Figure 2-39a) system in the southeastern U.S. Figure 2-51 shows that hourly $PM_{2.5}$ concentrations began increasing at 9 AM CDT, rising from 29 µg/m^3 to 39.4 µg/m^3 by 9 PM, due to the subsidence created by the high-pressure system in the southeastern U.S.

Table 2-6. Exceptional event supporting evidence for PARR on June 13, 2022.

Monitor	PARR (05-119-0007)
Event Date	June 13, 2022
24-hr $PM_{2.5}$ Concentration	29.7 µg/m^3
EPA Tiering Tool Tier 1 Threshold	25.5 µg/m^3
Tier 1 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT forward trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Arizona and New Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 1 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: June. Date accessed: 11/20/2024.

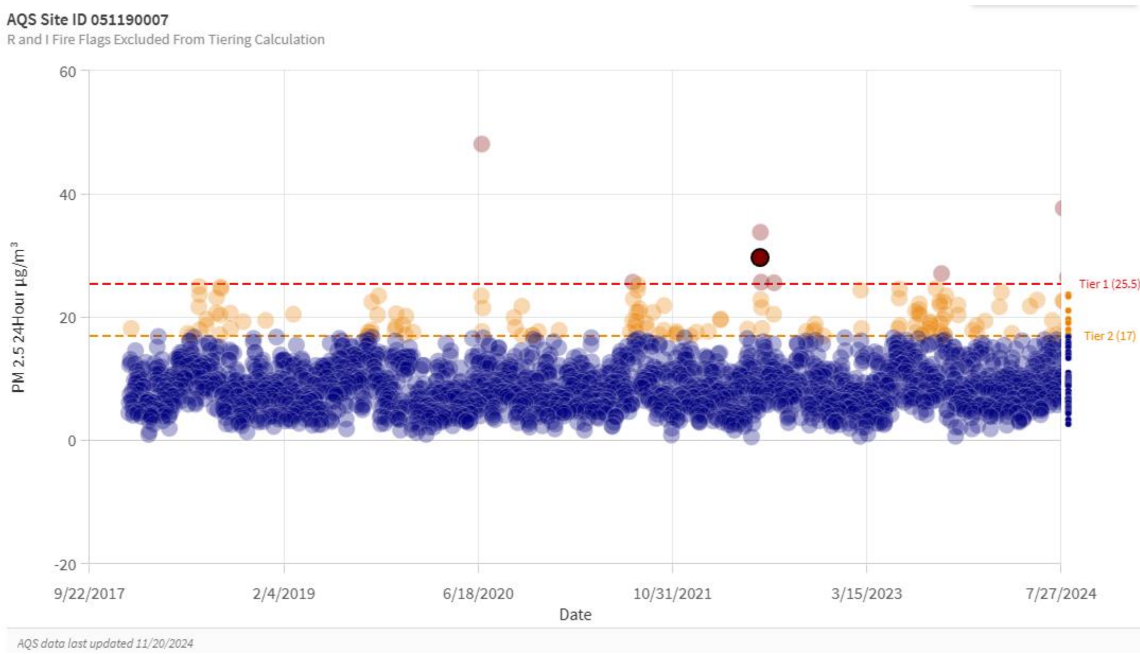


Figure 2-47. EPA $PM_{2.5}$ Tiering Tool PARR on June 13, 2022.

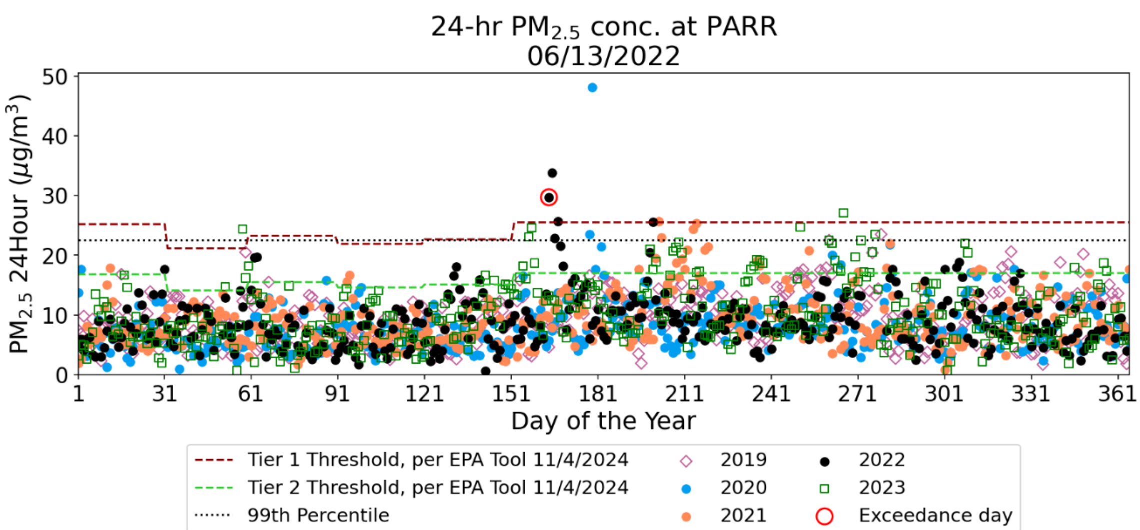


Figure 2-48. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to June 13, 2022.

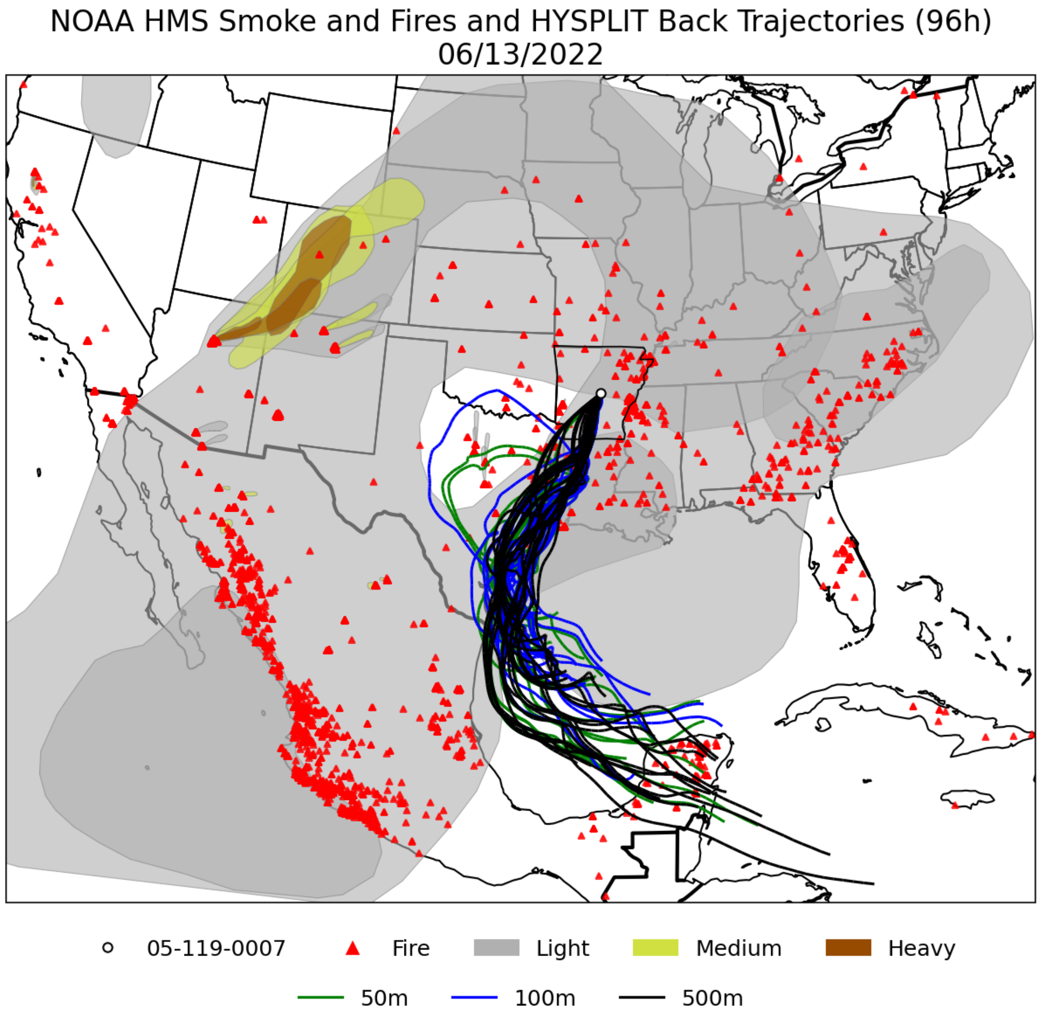


Figure 2-49. HYSPLIT back trajectories for PARR on June 13, 2022.

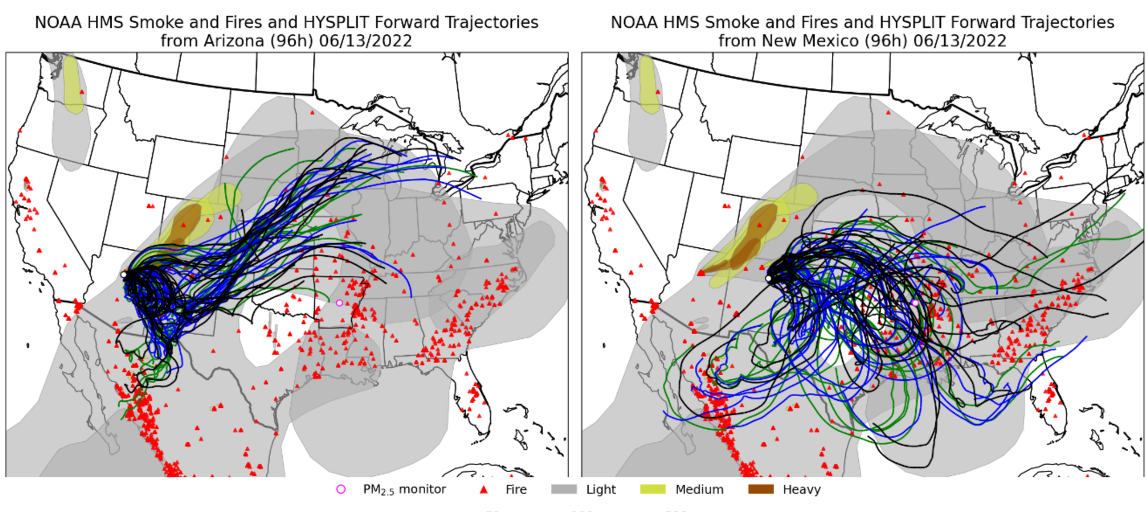


Figure 2-50. HYSPLIT forward trajectories from fires in Arizona (left) and New Mexico (right) on June 13, 2022.

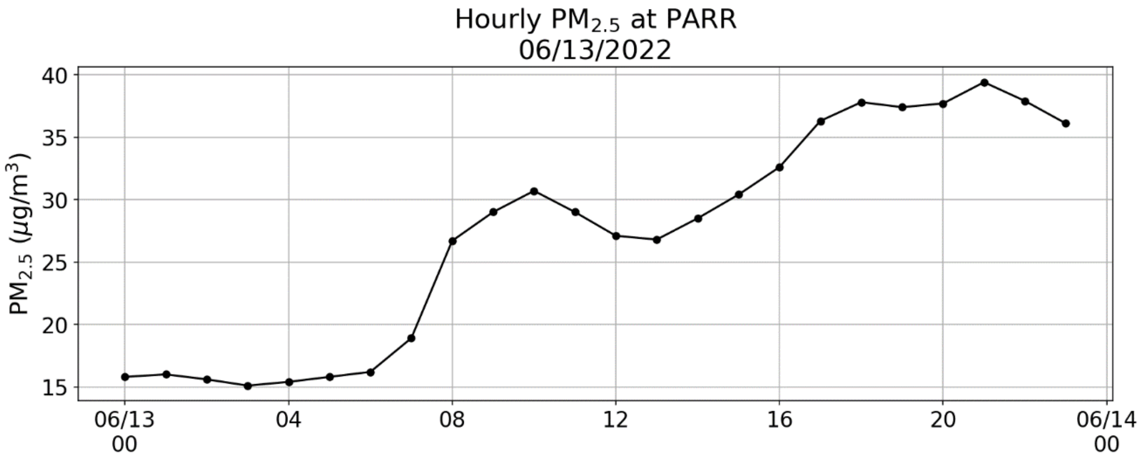


Figure 2-51. Hourly $PM_{2.5}$ concentrations for PARR on June 13, 2022.

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2.1.3.2 El Dorado June 13, 2022

Table 2-7 summarizes the evidence supporting the exceptional event demonstration for El Dorado (AQS ID 05-139-0006) on June 13, 2022. Figure 2-52 shows that the 24-hour $PM_{2.5}$ concentrations on this day exceed the Tier 1 threshold, while Figure 2-53 indicates that concentrations are above the 99th percentile of historical values over the last five years. Forward trajectories in Figure 2-55 show how smoke was transported smoke from fires in Arizona and New Mexico into the eastern U.S., where the smoke becomes trapped under the high-pressure system over the southeastern U.S., impacting the monitoring site.

Table 2-7. Exceptional event supporting evidence for El Dorado on June 13, 2022.

Monitor	El Dorado (05-139-0006)
Event Date	June 13, 2022
24-hr $PM_{2.5}$ Concentration	35.4 $\mu g/m^3$
EPA Tiering Tool Tier 1 Threshold	26.4 $\mu g/m^3$
Tier 1 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT forward trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Arizona and New Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 1 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: June. Date accessed: 11/20/2024.

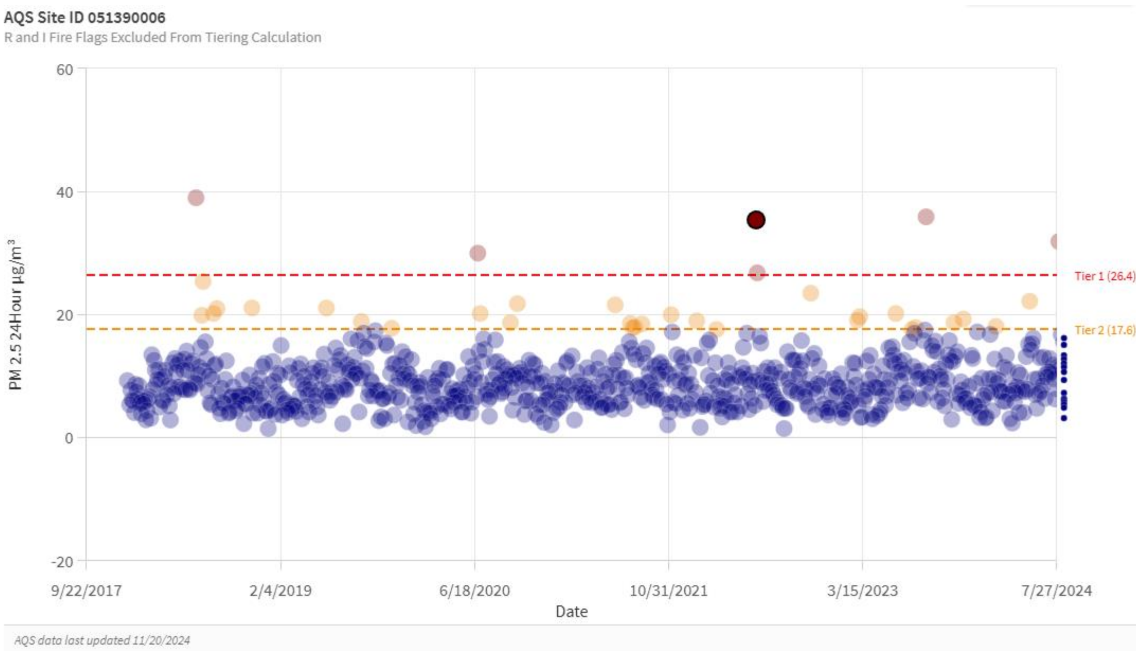

Figure 2-52. EPA $PM_{2.5}$ Tiering Tool El Dorado on June 13, 2022.

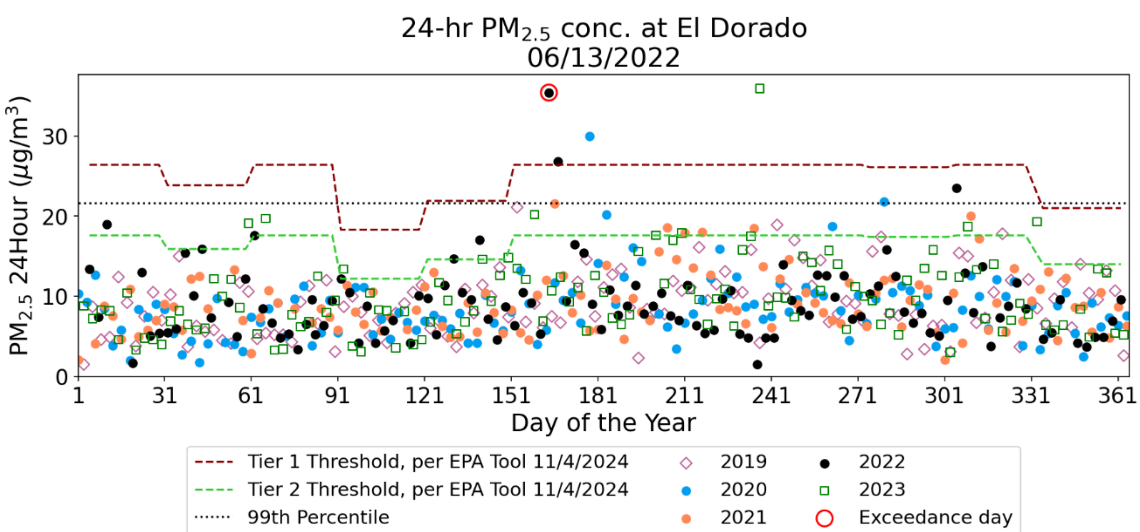

Figure 2-53. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for El Dorado compared to June 13, 2022.

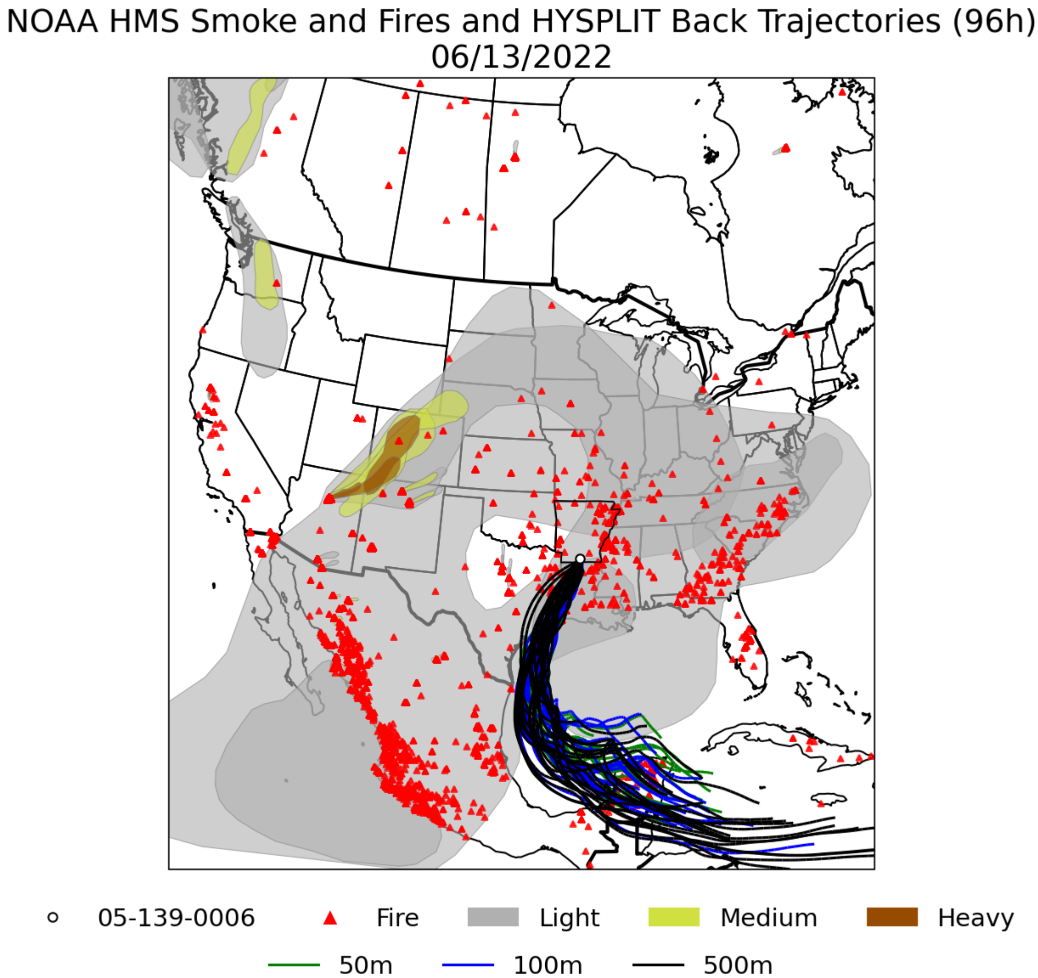

Figure 2-54. HYSPLIT back trajectories for El Dorado on June 13, 2022.

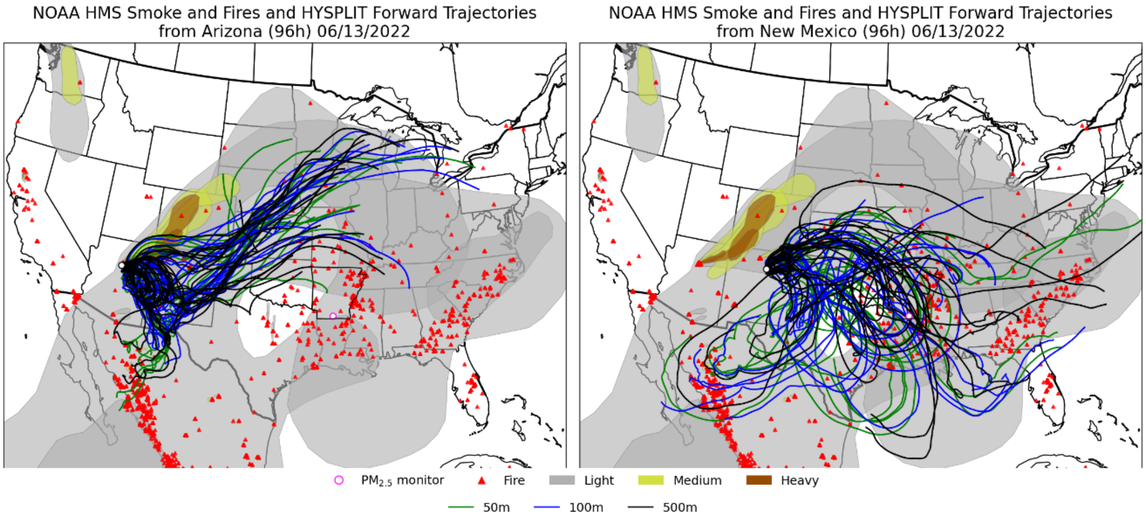

Figure 2-55. HYSPLIT forward trajectories from Arizona (left) and New Mexico (right) fires on June 13, 2022.

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2.1.3.3 PARR June 14, 2022

Table 2-8 summarizes the evidence supporting the exceptional event demonstration for PARR (AQS ID 05-119-0007) on June 14, 2022. Figure 2-56 illustrates that the 24-hour $PM_{2.5}$ concentrations on this day significantly exceeded the Tier 1 threshold. Figure 2-57 highlights levels surpassing the 99th percentile of historical values over the last five years. Forward trajectories in Figure 2-59 show how smoke was transported from fires in Arizona and New Mexico across the eastern U.S., with the smoke becoming trapped under a high pressure system in the southeastern U.S., as shown in Figure 2-39b. Figure 2-60 reveals that hourly $PM_{2.5}$ concentrations started the day at 34.2 μg/m^3 and remained elevated throughout most of Jun 14 due to the subsidence effects associated with the high-pressure system.

Table 2-8. Exceptional event supporting evidence for PARR on June 14, 2022.

Monitor	PARR (05-119-0007)
Event Date	June 14, 2022
24-hr $PM_{2.5}$ Concentration	33.8 μg/m^3
EPA Tiering Tool Tier 1 Threshold	25.5 μg/m^3
Tier 1 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT forward trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Arizona and New Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 1 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: June. Date accessed: 11/20/2024.

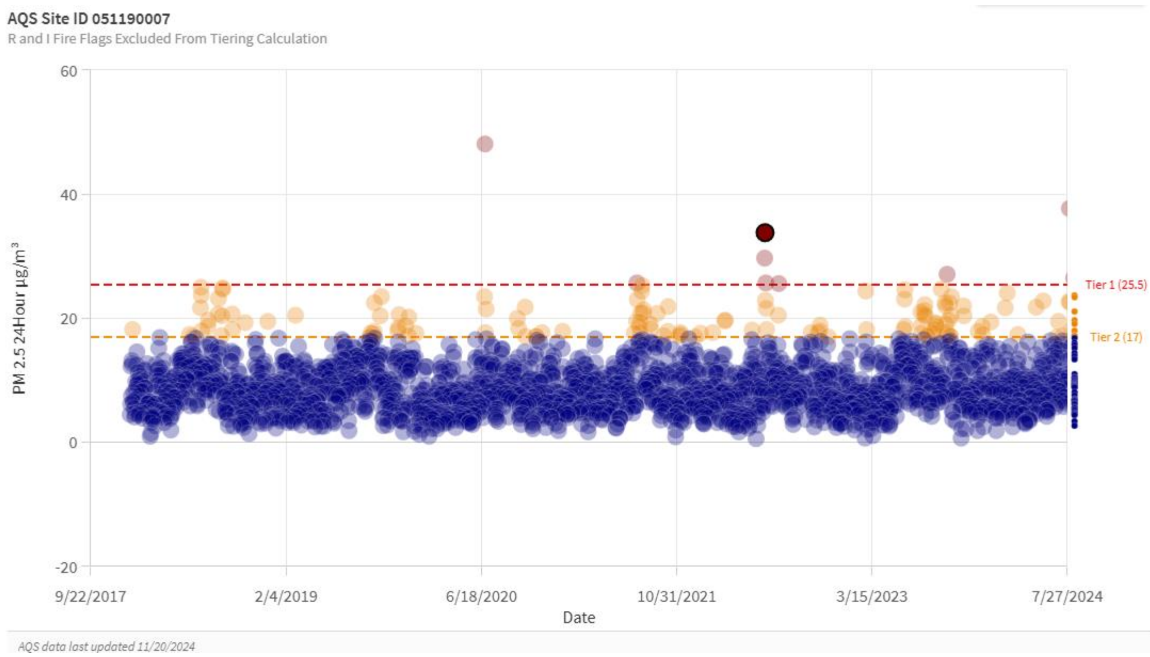

Figure 2-56. EPA $PM_{2.5}$ Tiering Tool PARR on June 14, 2022.

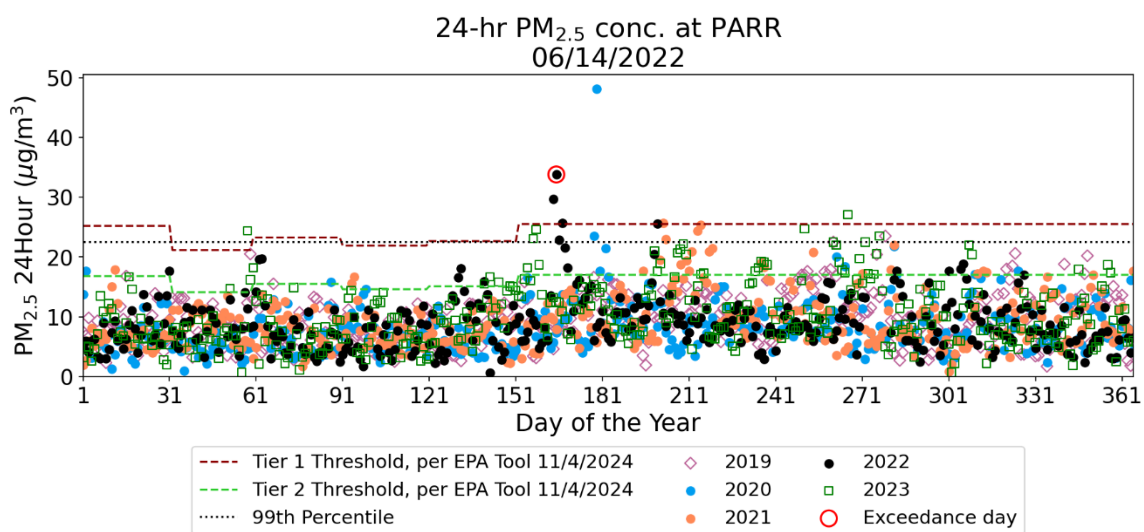

Figure 2-57. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to June 14, 2022.

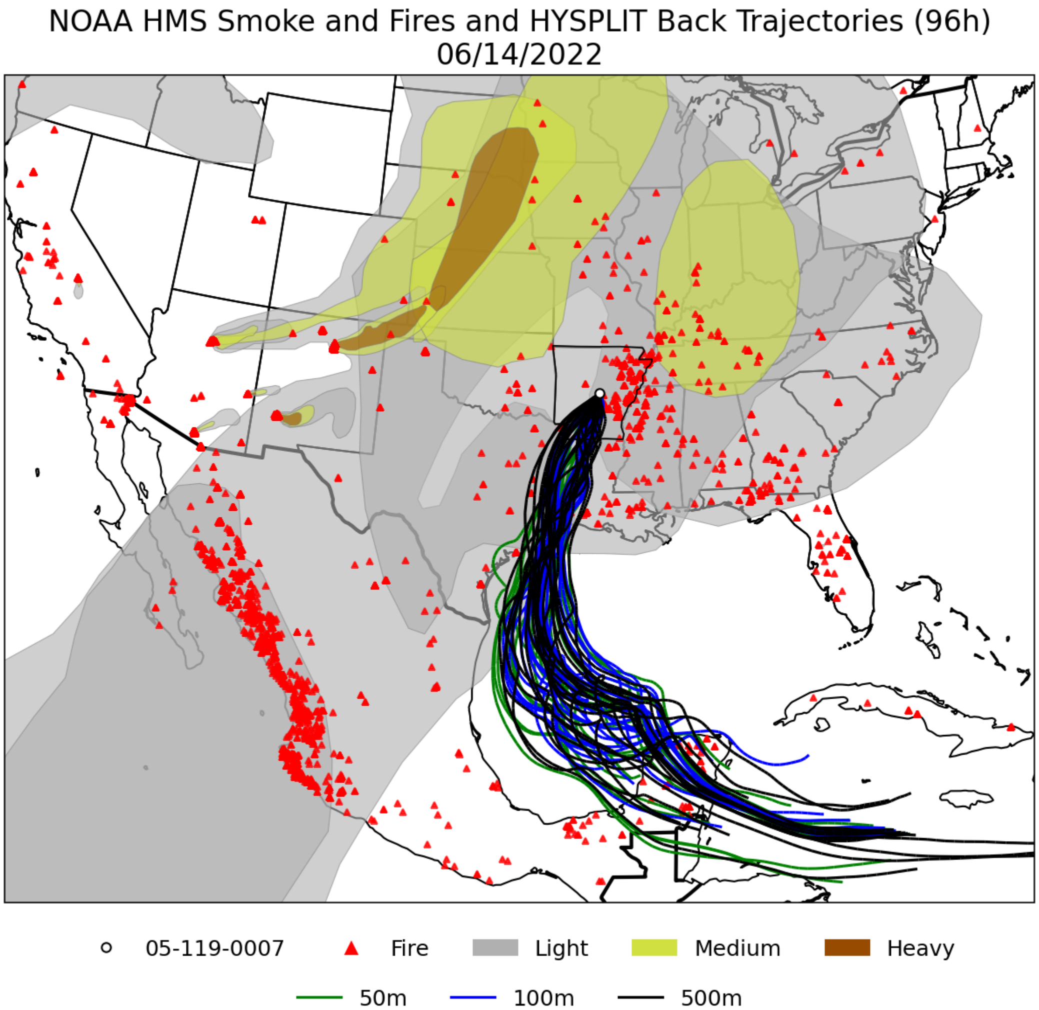

Figure 2-58. HYSPLIT back trajectories for PARR on June 14, 2022.

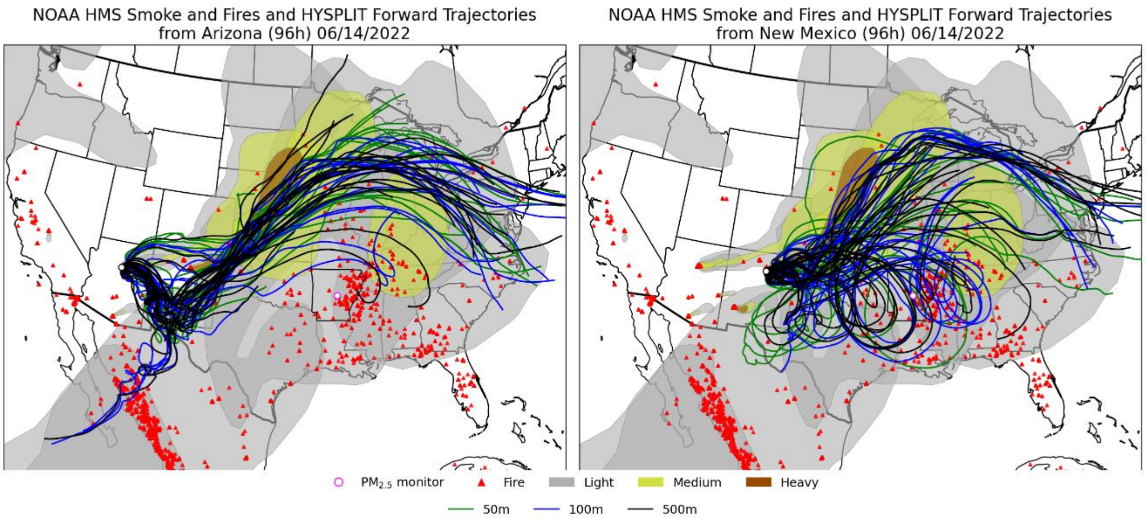

Figure 2-59. HYSPLIT forward trajectories from fires in Arizona (left) and New Mexico (right) on June 14, 2022.

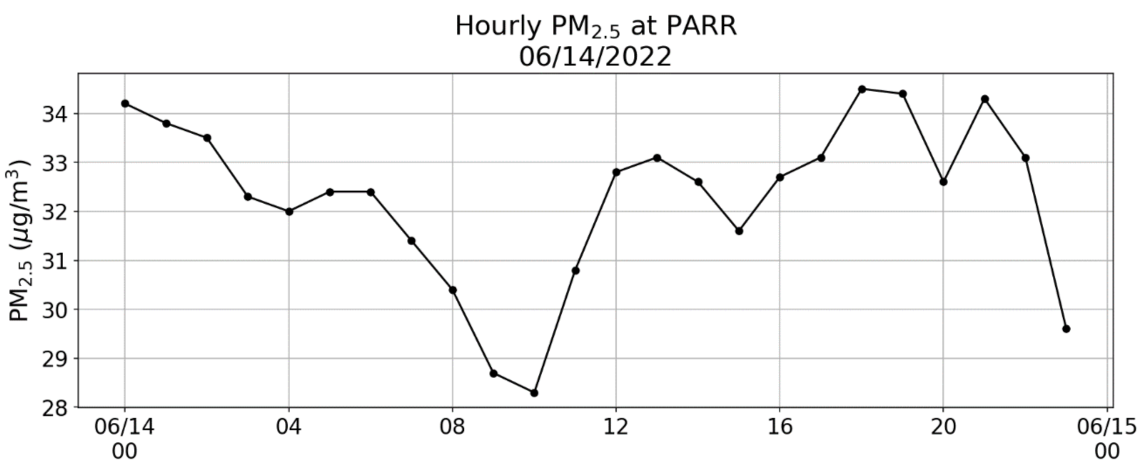

Figure 2-60. Hourly $PM_{2.5}$ concentrations for PARR on June 14, 2022.

2.1.3.4 PARR June 15, 2022

Table 2-9 summarizes the evidence supporting the exceptional event demonstration for PARR (AQS ID 05-119-0007) on June 15, 2022. Figure 2-61 indicates that 24-hour $PM_{2.5}$ concentrations on this day exceeded the Tier 2 threshold and surpassed the 99th percentile of historic values over the last five years. Forward trajectories in Figure 2-64 show how smoke was transported from fires in Arizona and New Mexico moving across the eastern U.S., with the smoke becoming trapped under a high pressure system in the southeastern U.S., as shown in Figure 2-39c. Figure 2-65 shows that hourly $PM_{2.5}$ concentrations started above 28 µg/m^3, dropped to a low of 16.4 µg/m^3, and subsequently increased to 25.9 µg/m^3 by 11 PM CDT.

Table 2-9. Exceptional event supporting evidence for PARR on June 15, 2022.

Monitor	PARR (05-119-0007)
Event Date	June 15, 2022
24-hr $PM_{2.5}$ Concentration	22.9 µg/m^3
EPA Tiering Tool Tier 2 Threshold	25.5 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT forward trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Arizona and New Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: June. Date accessed: 11/20/2024.

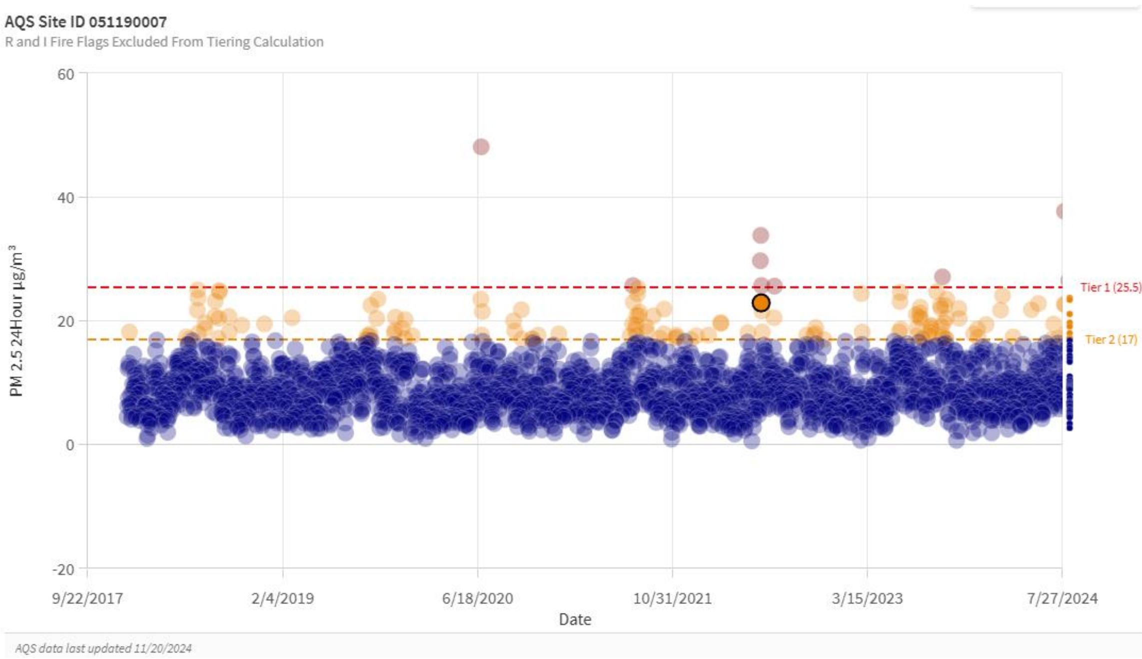

Figure 2-61. EPA $PM_{2.5}$ Tiering Tool for PARR on June 15, 2022.

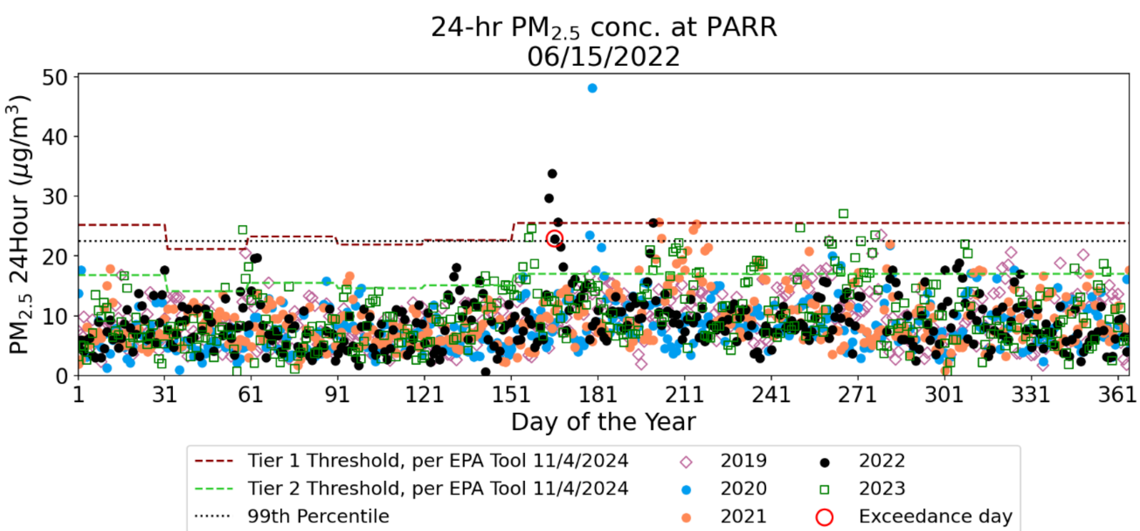

Figure 2-62. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to June 15, 2022.

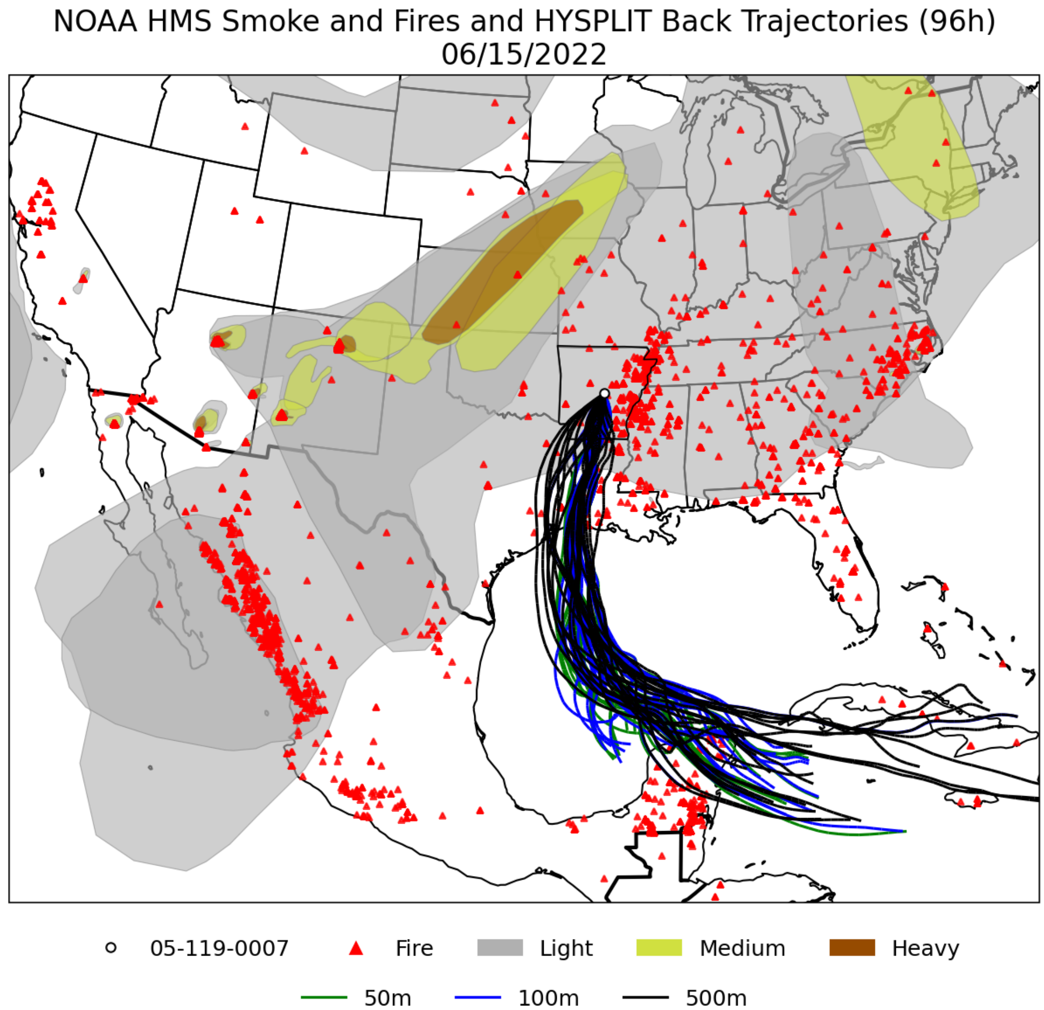

Figure 2-63. HYSPLIT back trajectories for PARR on June 15, 2022.

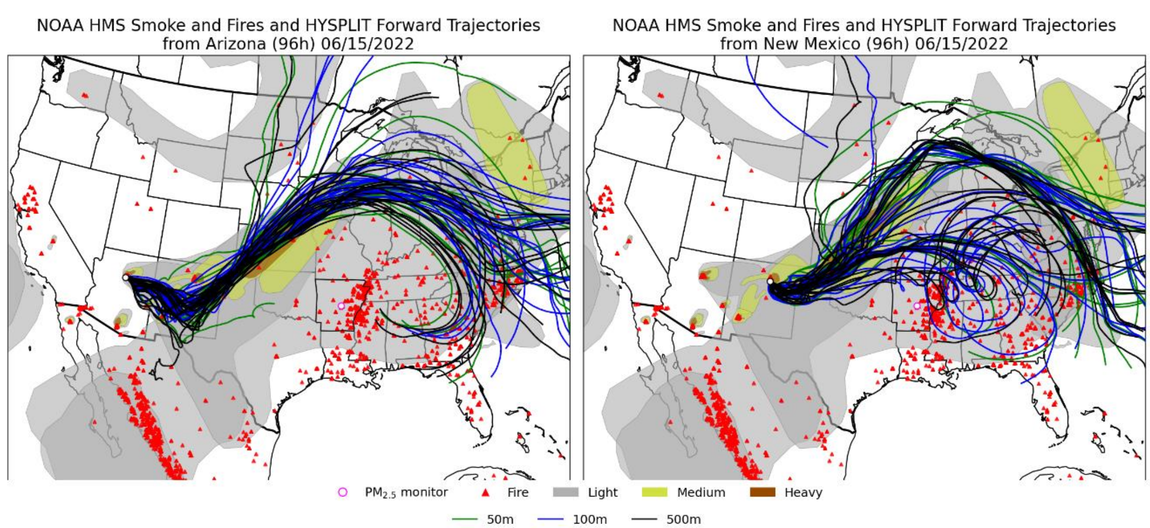

Figure 2-64. HYSPLIT forward trajectories from fires in Arizona (left) and New Mexico (right) on June 15, 2022.

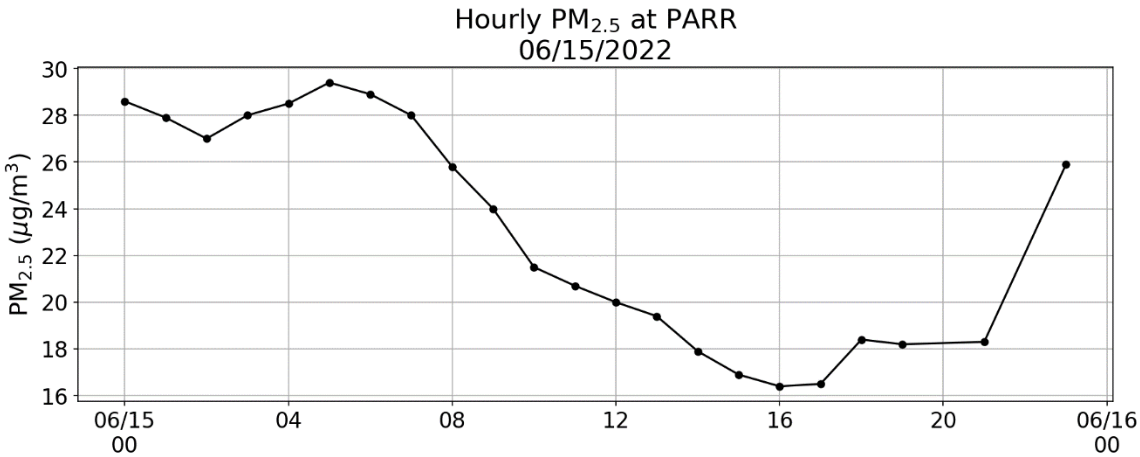

Figure 2-65. Hourly $PM_{2.5}$ concentrations for PARR on June 15, 2022.

2.1.3.5 PARR June 16, 2022

Table 2-10 summarizes the evidence supporting the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on June 16, 2022. Figure 2-66 shows that the observed $PM_{2.5}$ concentrations on this day are above the Tier 1 threshold, while Figure 2-67 indicates that the concentrations were above the 99th percentile of historic values over the last five years. Forward trajectories in Figure 2-69 show how smoke was transported from fires in Arizona and New Mexico, which contributed to the smoke over the eastern U.S. By this day, the high-pressure system in the southeastern U.S, observed in previous days, has shifted to the east and smoke traveled from the fires' location northward and then trapped along the edge of this system, rotating clockwise before finally turning northwest into Arkansas. This dynamic is illustrated in Figure 2-39d and Figure 2-44d. Figure 2-70 reveals that hourly $PM_{2.5}$ concentrations started above 27.5 µg/m^3, decreased to a low of 22.4 µg/m^3, and then increased back to 26.7 µg/m^3 by 10 PM CDT.

Table 2-10. Exceptional event supporting evidence for PARR on June 16, 2022.

Monitor	PARR (05-119-0007)
Event Date	June 16, 2022
24-hr $PM_{2.5}$ Concentration	25.7 µg/m^3
EPA Tiering Tool Tier 1 Threshold	25.5 µg/m^3
Tier 1 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT forward trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Arizona and New Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 1 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: June. Date accessed: 11/20/2024.

Figure 2-66. EPA PM2.5 Tiering Tool for PARR on June 16, 2022.

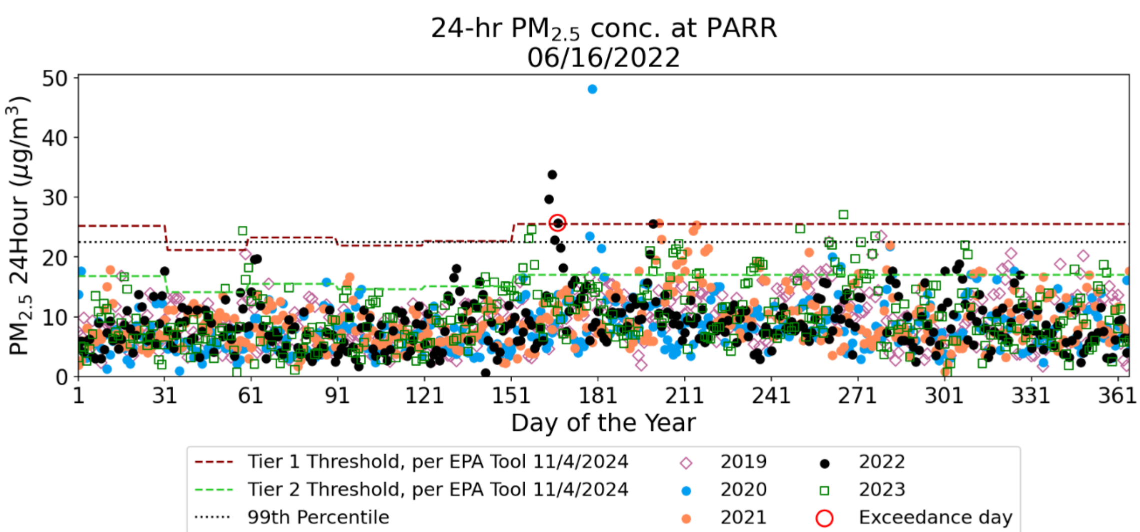

Figure 2-67. Historical 24-hour PM2.5 seasonal fluctuations for PARR compared to June 16, 2022.

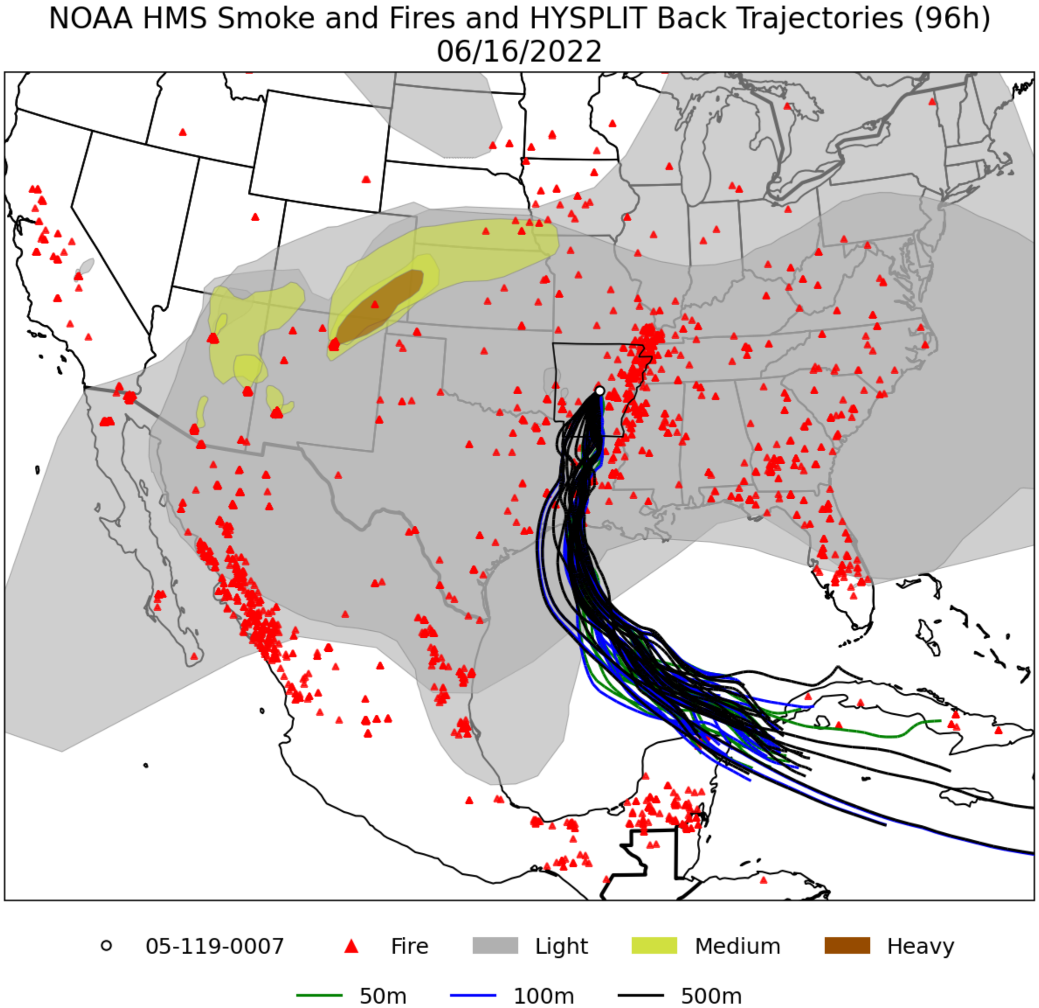

Figure 2-68. HYSPLIT back trajectories for PARR on June 16, 2022.

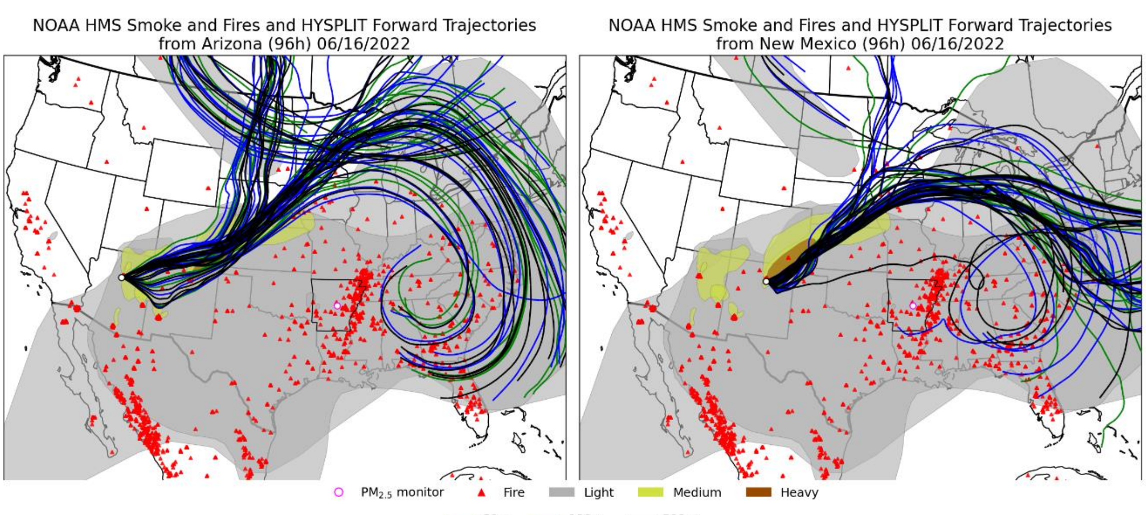

Figure 2-69. HYSPLIT forward trajectories from fires in Arizona (left) and New Mexico (right) on June 16, 2022.

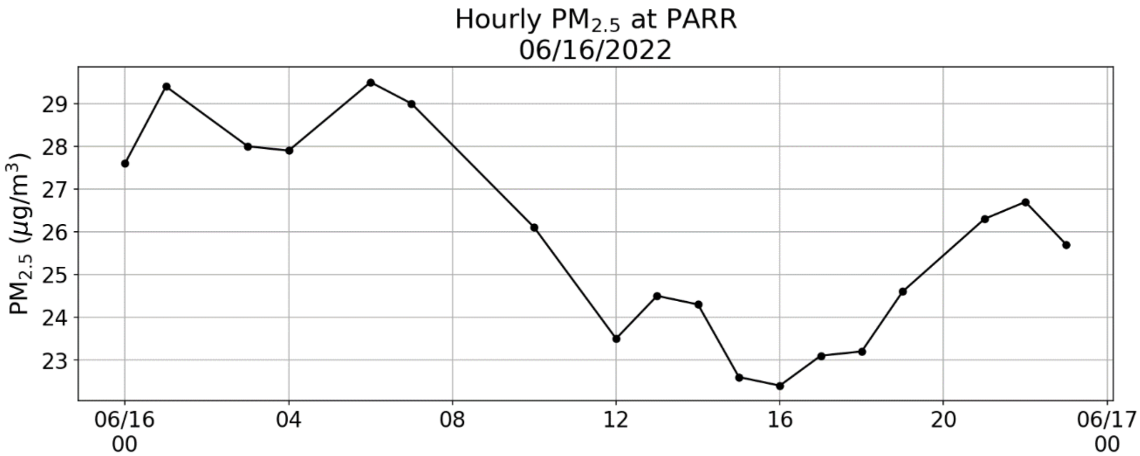

Figure 2-70. Hourly $PM_{2.5}$ concentrations for PARR on June 16, 2022.

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2.1.3.6 El Dorado June 16, 2022

Table 2-11 summarizes the evidence supporting the demonstration of an exceptional event for El Dorado (AQS ID 05-139-0006) on June 16, 2022. Figure 2-71 shows that PM2.5 concentrations on this day exceeded the Tier 1 threshold, while Figure 2-72 indicates that the concentrations were above the 99th percentile of historic values over the last five years. Forward trajectories in Figure 2-74 show how smoke was transported from fires in Arizona and New Mexico, which contributed to the smoke over the eastern U.S. By this day, the high-pressure system in the southeastern U.S, observed in previous days, has shifted to the east and smoke traveled from the fires' location northward and then trapped along the edge of this system, rotating clockwise before finally turning northwest into Arkansas. This dynamic is illustrated in Figure 2-39d and Figure 2-44d.

Table 2-11. Exceptional event supporting evidence for El Dorado on June 16, 2022.

Monitor	El Dorado (05-139-0006)
Event Date	June 16, 2022
24-hr $PM_{2.5}$ Concentration	26.8 µg/m^3
EPA Tiering Tool Tier 1 Threshold	26.4 µg/m^3
Tier 1 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT forward trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Arizona and New Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 1 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: June. Date accessed: 11/20/2024.

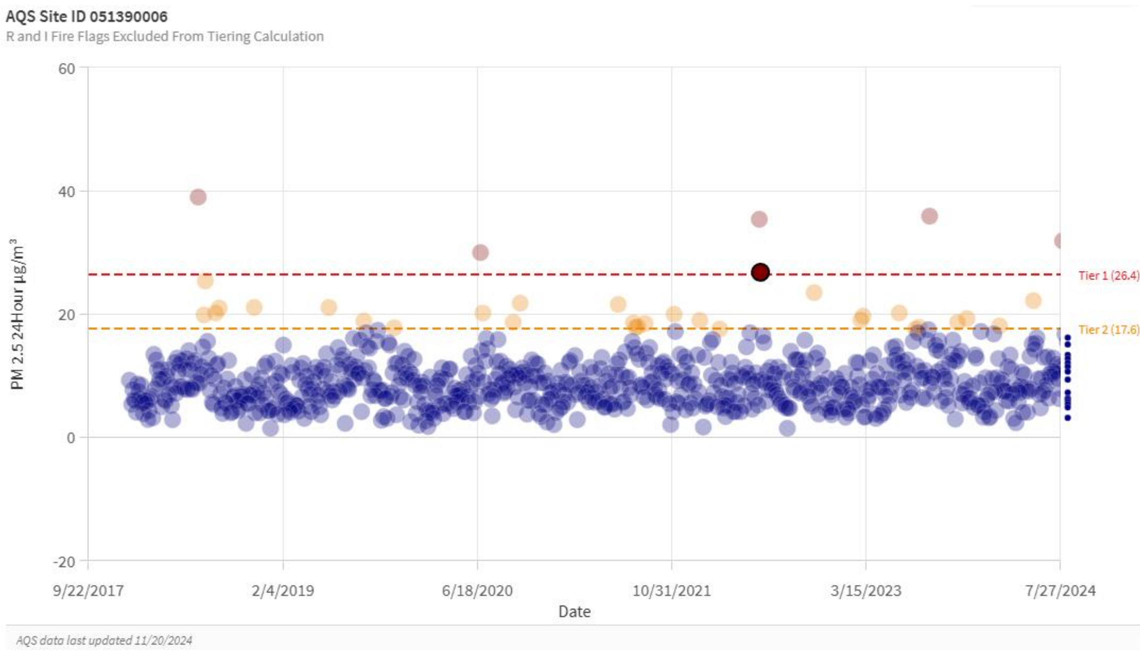


Figure 2-71. EPA PM$_{2.5}$ Tiering Tool El Dorado on June 16, 2022.

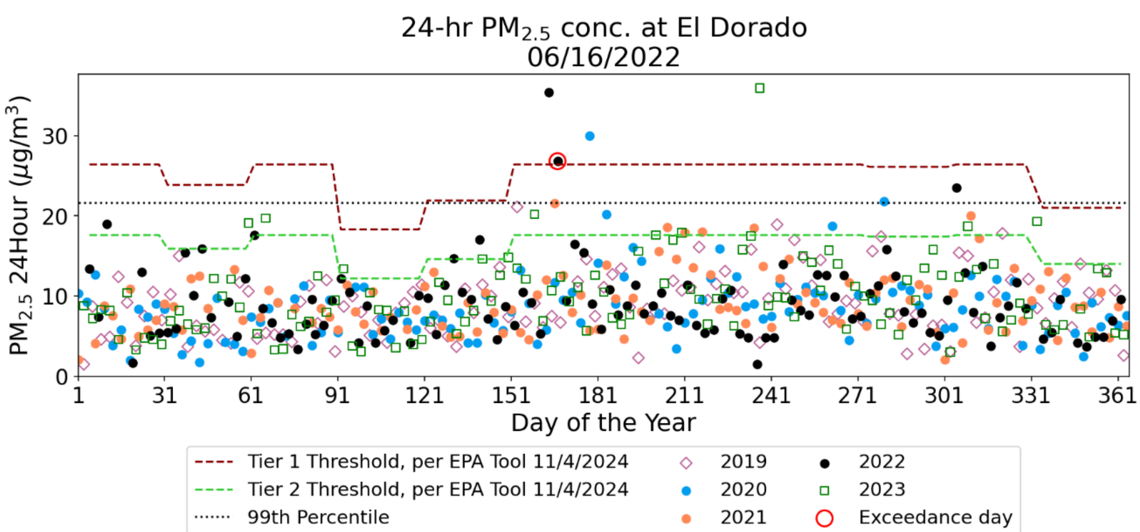


Figure 2-72. Historical 24-hour PM$_{2.5}$ seasonal fluctuations for El Dorado compared to June 16, 2022.

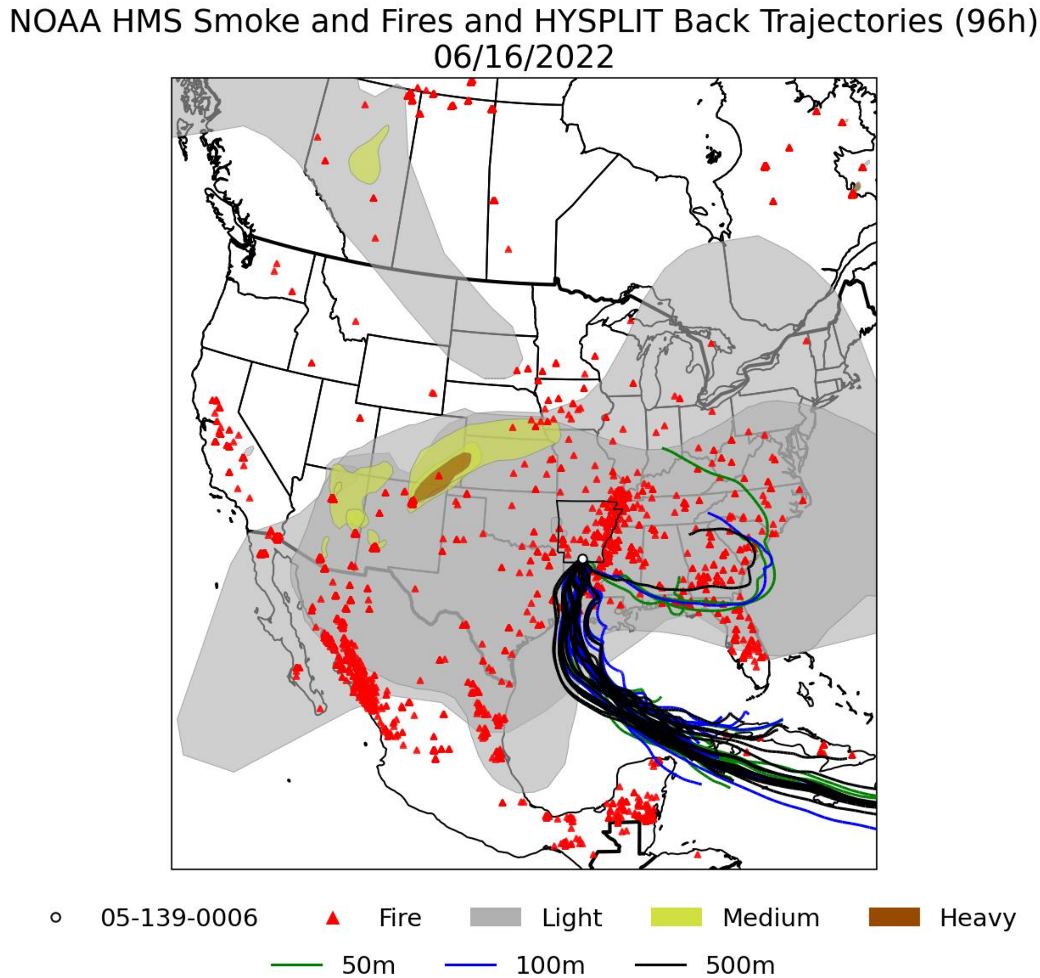


Figure 2-73. HYSPLIT back trajectories for El Dorado on June 16, 2022.

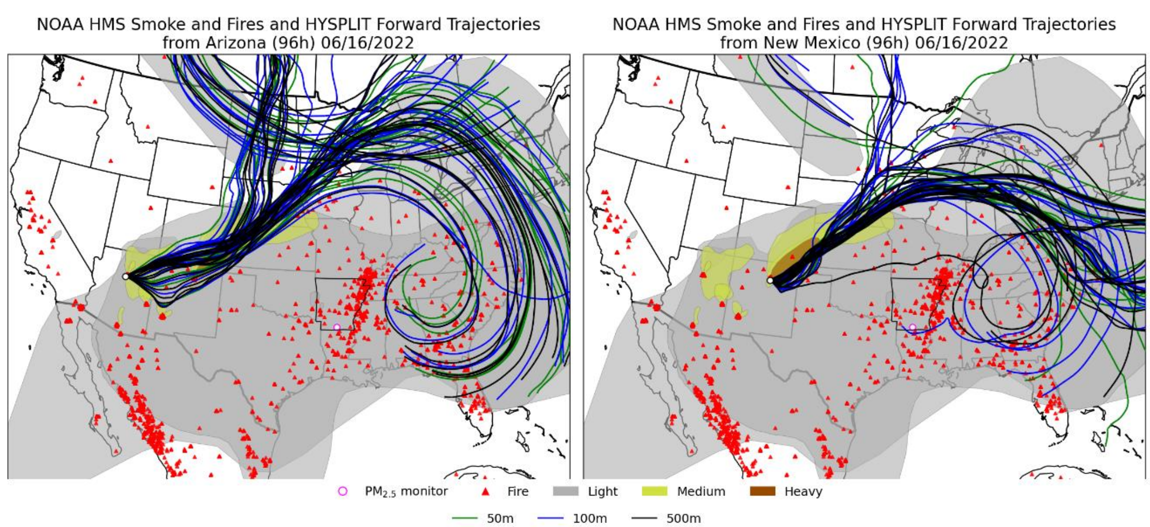


Figure 2-74. HYSPLIT forward trajectories from fires in Arizona (left) and New Mexico (right) on June 16, 2022.

2.1.3.7 PARR June 17, 2022

Table 2-12 summarizes the evidence supporting the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on June 17, 2022. Figure 2-75 indicates that $PM_{2.5}$ concentrations on this day exceeded the Tier 2 threshold, while Figure 2-76 shows that concentrations were near the 99th percentile of historic values over the last five years. Figure 2-77 illustrates that the back trajectories passed through regions with medium levels smoke, and Figure 2-78 shows descending air over the monitoring site. Figure 2-79 reveals that hourly $PM_{2.5}$ concentrations at the start of the day were above 25 µg/m^3, remained above 22 µg/m^3 until noon, and then decreased to 18.0 µg/m^3 by 8 PM CDT.

Table 2-12. Exceptional event supporting evidence for PARR on June 17, 2022.

Monitor	PARR (05-119-0007)
Event Date	June 17, 2022
24-hr $PM_{2.5}$ Concentration	21.6 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke maps and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Arizona and New Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: June. Date accessed: 11/20/2024.

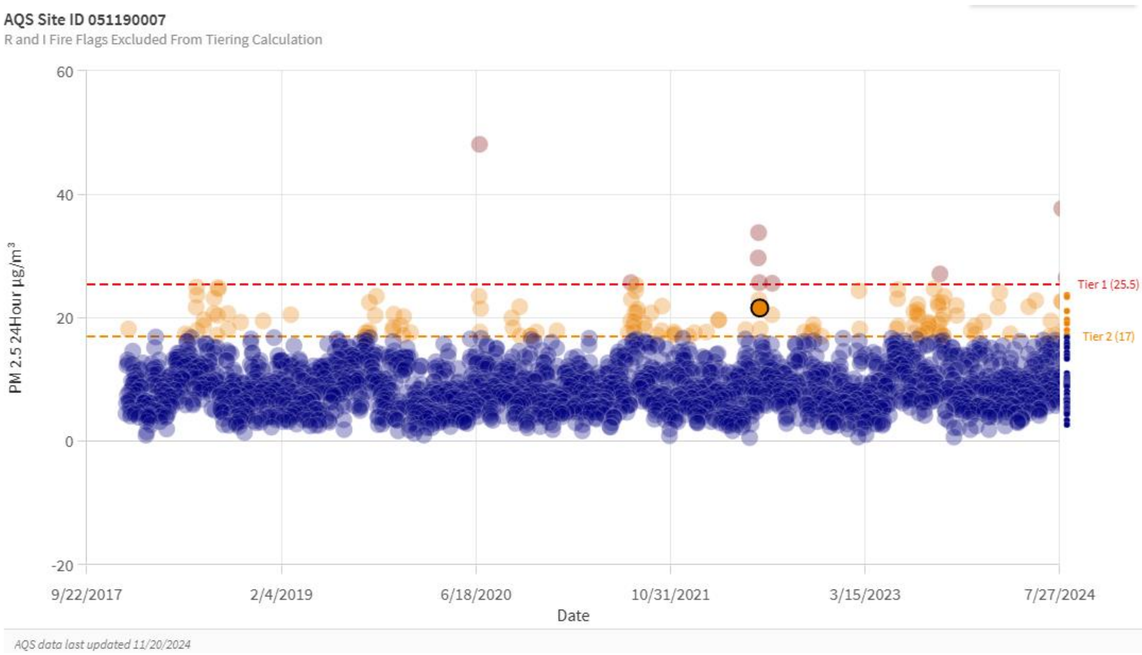


Figure 2-75. EPA $PM_{2.5}$ Tiering Tool for PARR on June 17, 2022.

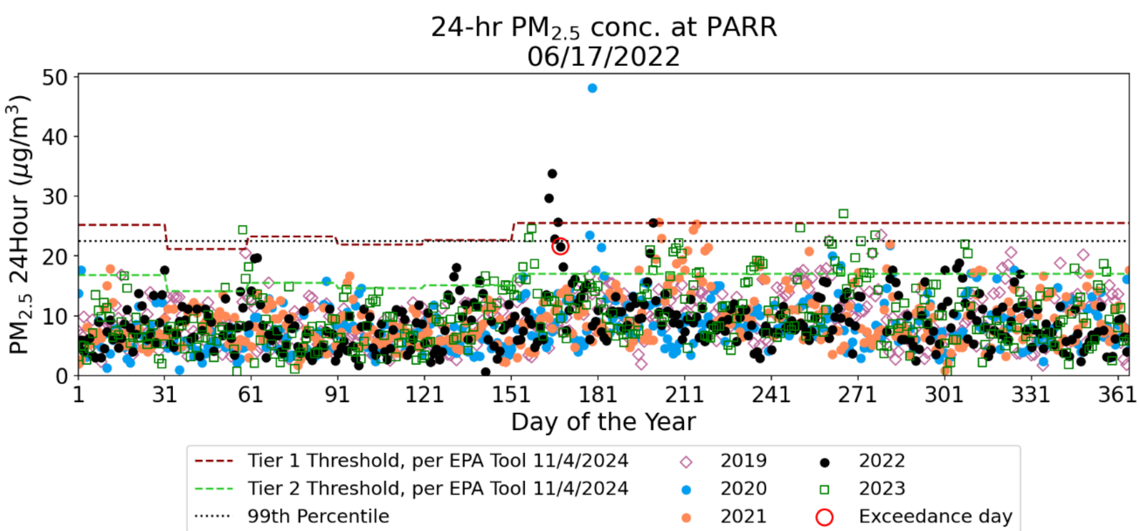


Figure 2-76. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to June 17, 2022.

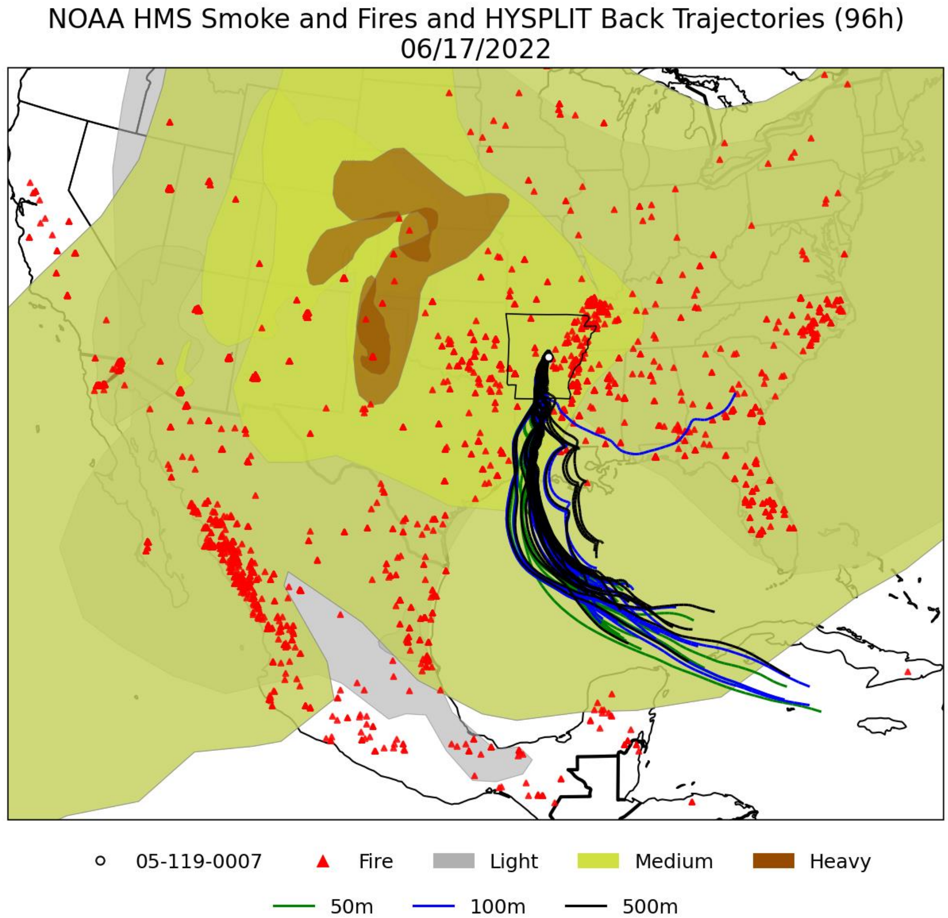
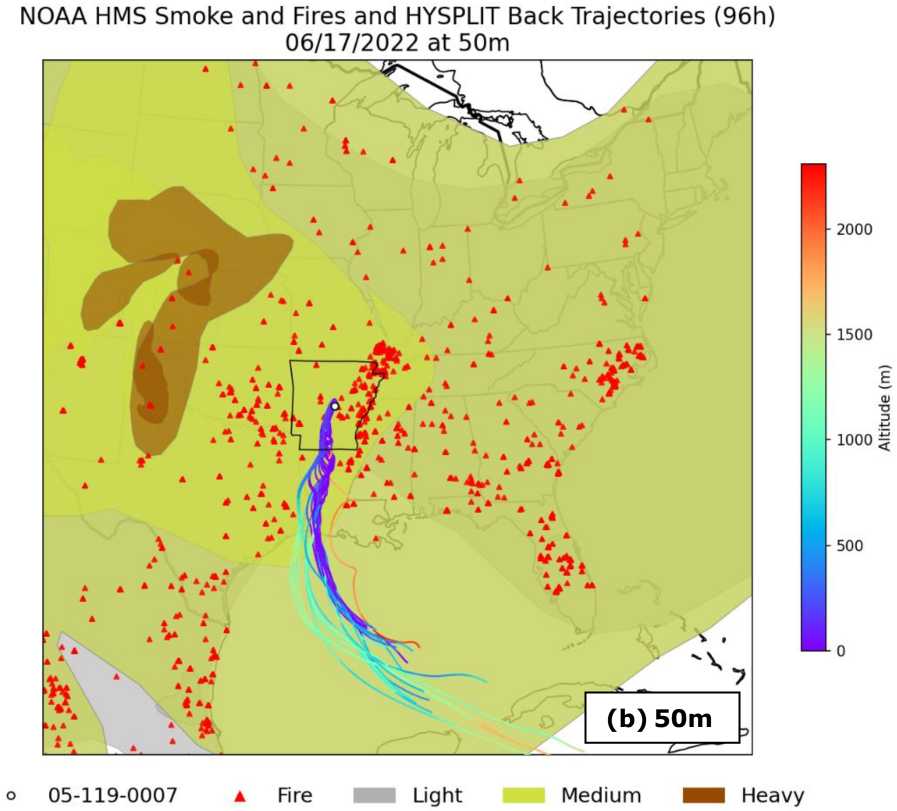
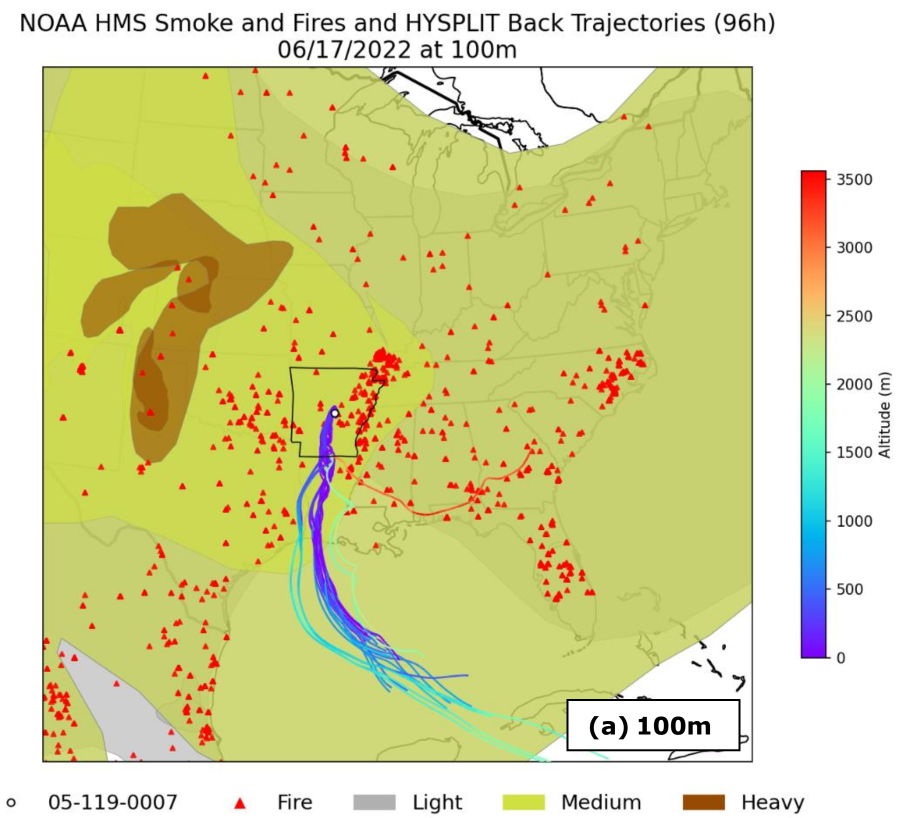


Figure 2-77. HYSPLIT back trajectories for PARR on June 17, 2022.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
06/17/2022 at 50m
Altitude (m)
0
500
1000
1500
2000
(b) 50m
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
06/17/2022 at 100m
Altitude (m)
0
500
1000
1500
2000
2500
3000
3500
(a) 100m
05-119-0007
Fire
Light
Medium
Heavy

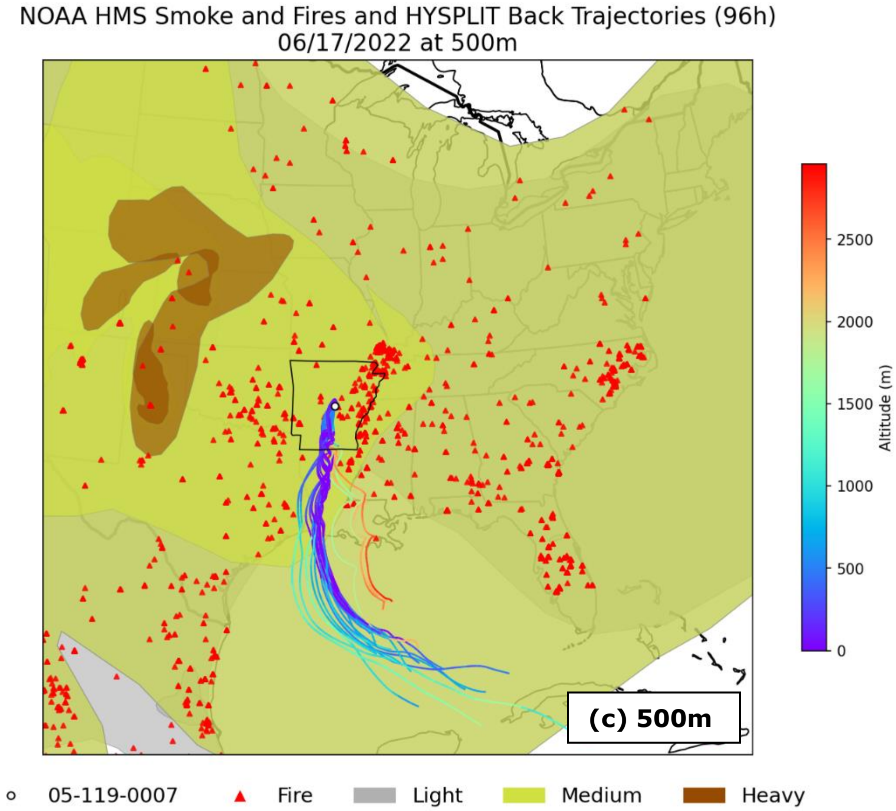


Figure 2-78. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on June 17, 2022.

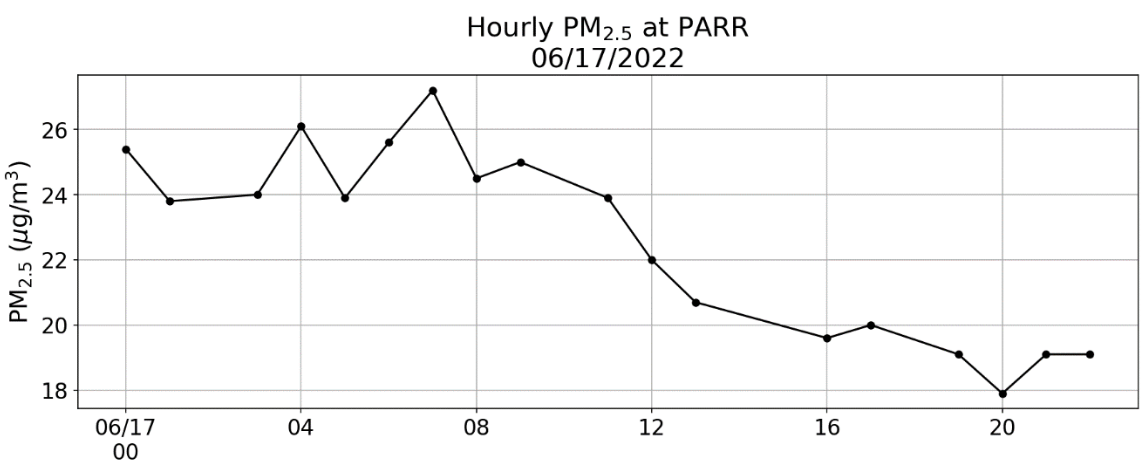


Figure 2-79. Hourly $PM_{2.5}$ concentrations for PARR on June 17, 2022.

2.1.3.8 PARR June 18, 2022

Table 2-13 summarizes the evidence supporting the exceptional event demonstration for PARR (AQS ID 05-119-0007) on June 18, 2022. Figure 2-80 illustrates that 24-hour $PM_{2.5}$ levels on this day exceeded the Tier 2 threshold. Figure 2-82 shows the back trajectories passing through nearby regions with light to medium density smoke and descending over the monitoring site, as depicted in Figure 2-83. Figure 2-84 reveals that hourly $PM_{2.5}$ concentrations began increasing from 18.0 µg/m^3, reaching 26.0 µg/m^3 by 8 AM CDT, remained above 22.0 µg/m^3 until 2 PM CDT, and then decreased to 14.0 µg/m^3 for the remainder of the day.

Table 2-13. Exceptional event supporting evidence for PARR on June 18, 2022.

Monitor	PARR (05-119-0007)
Event Date	June 18, 2022
24-hr $PM_{2.5}$ Concentration	18.2 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Arizona and New Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: June. Date accessed: 11/20/2024.

Figure 2-80. EPA $PM_{2.5}$ Tiering Tool PARR on June 18, 2022.

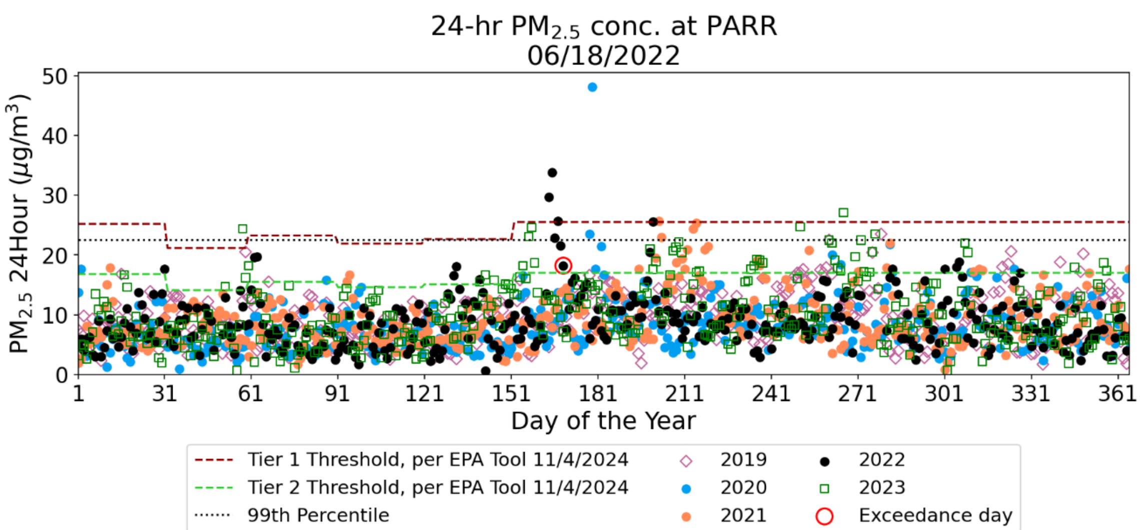


Figure 2-81. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to June 18, 2022.

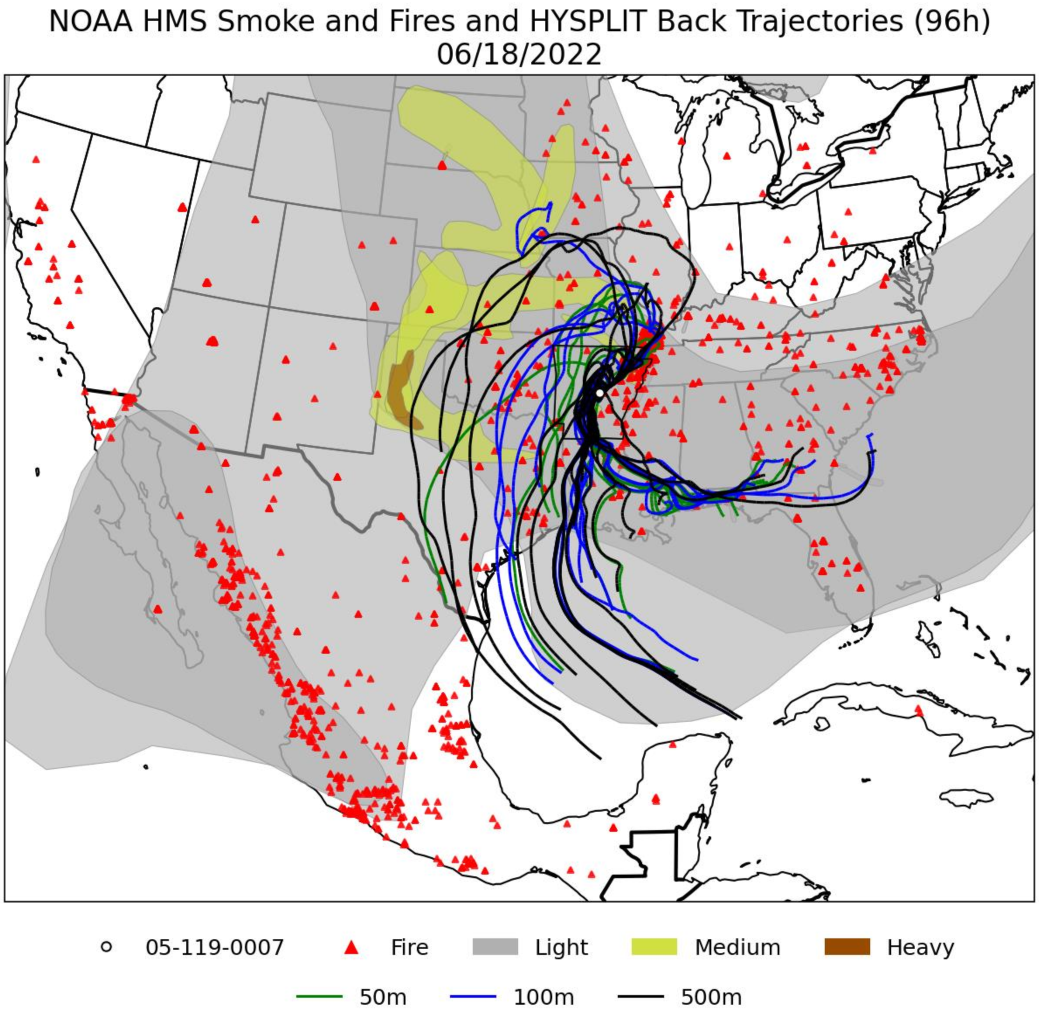
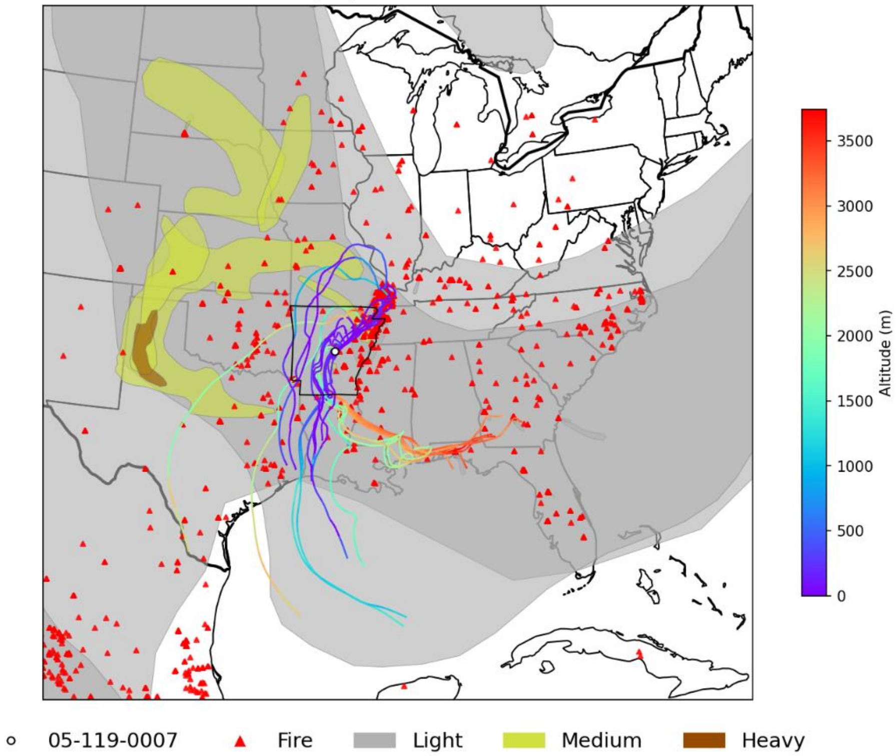
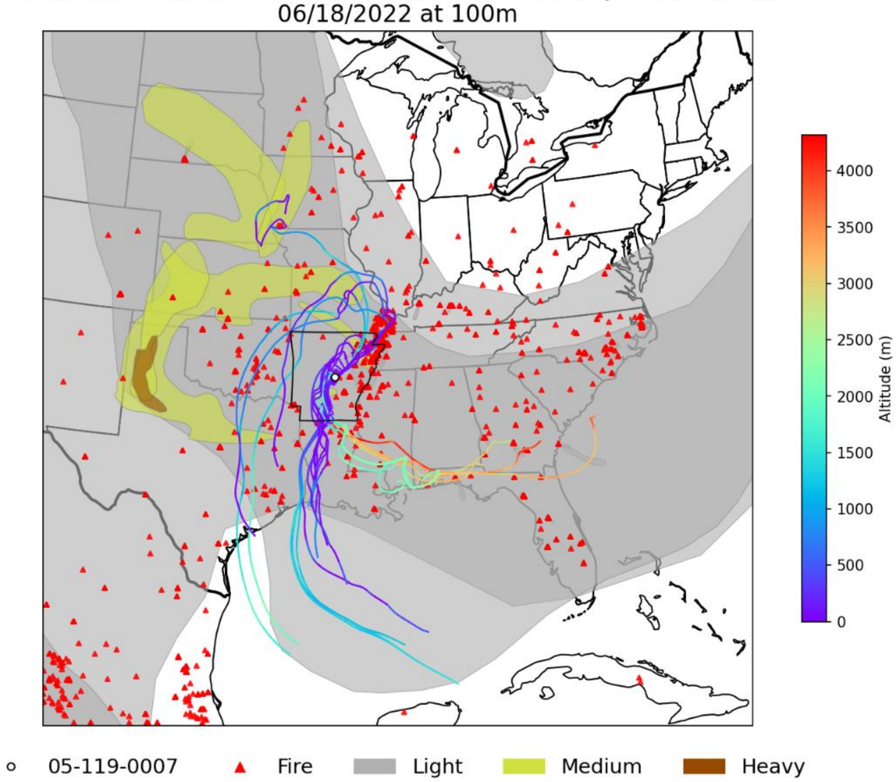


Figure 2-82. HYSPLIT back trajectories for PARR on June 18, 2022.

NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
06/18/2022 at 50m



NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
06/18/2022 at 100m



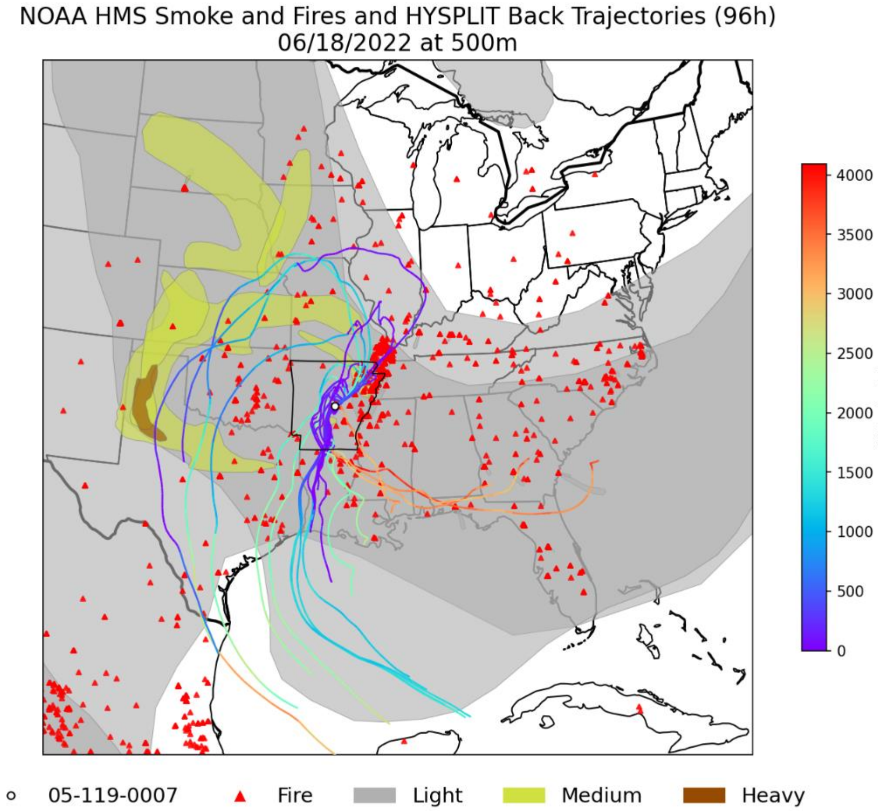


Figure 2-83. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on June 17, 2022.

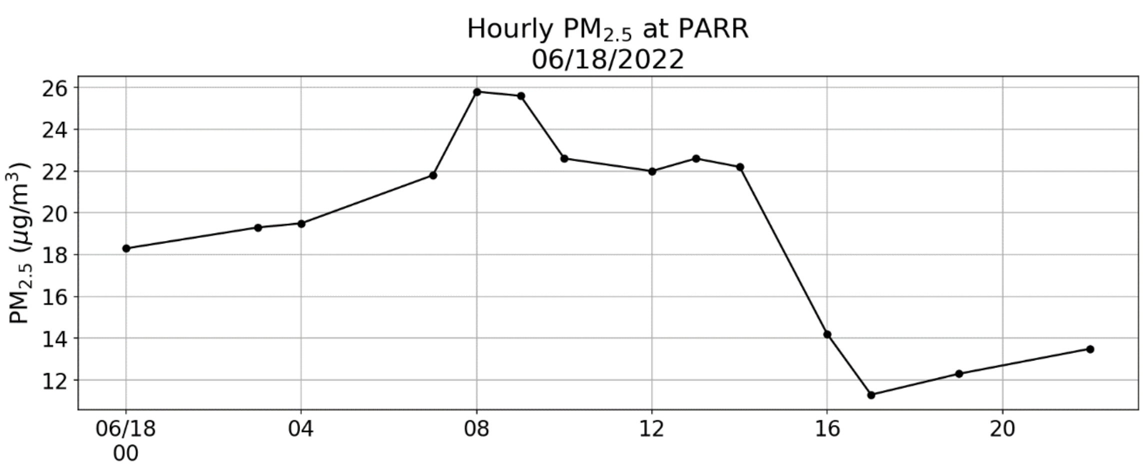
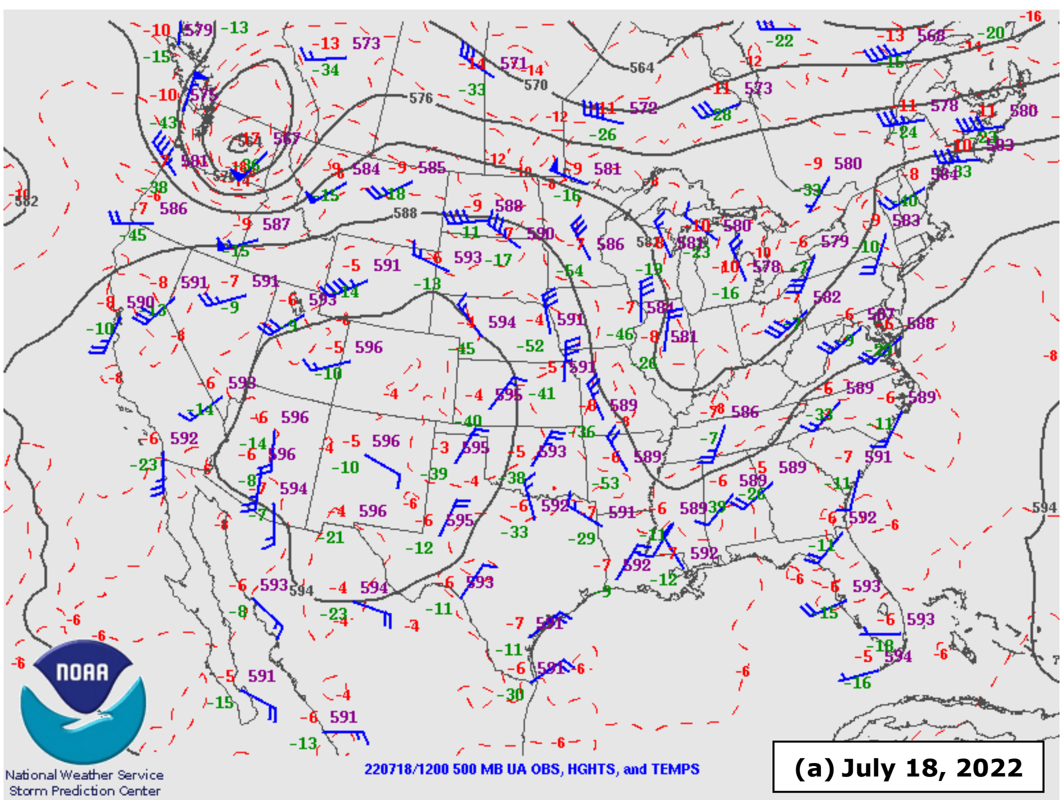


Figure 2-84. Hourly $PM_{2.5}$ concentrations for PARR on June 18, 2022.

2.1.4 July 18-19, 2022

During July 18 to July 19, the Chalk Mountain fire in Texas was the most relevant for the impacts in $PM_{2.5}$ concentrations at monitors in Arkansas. The fire burned 6,755 acres and was 93% contained by August 2, 2022. The 500 mb map on July 18 (Figure 2-85a) shows a pronounced trough over the Pacific Northwest and the northern Rockies, with strong southwesterly to westerly flow on its downstream side. This pattern favors the transport of air masses, including smoke, from the northwestern U.S. toward the central U.S. A large ridge is situated over the central U.S., producing light winds and more stable conditions, which can slow the progression of smoke transport through the central plains and Midwest. Over Texas and the southern U.S., winds are predominantly from the west-northwest, creating a pathway for smoke transport from wildfires in Texas toward the southeastern U.S.

On July 19 (Figure 2-85b), a trough is evident over the Pacific Northwest and southern Canada, centered over southern Alberta. This feature drives cyclonic flow and likely enhances upper-level divergence in the region, supporting lifting and fire activity near the Canadian Rockies and northern U.S. states. A pronounced ridge dominates the central and southern U.S., centered over the Plains, suggesting suppressed vertical motion and stagnant conditions. Winds generally follow a westerly to southwesterly flow around the base of the trough in the northwest and over the northern U.S. Further downstream, the flow becomes more northwest-to-southeast, extending into the Midwest and eastern U.S., influenced by the ridge axis.



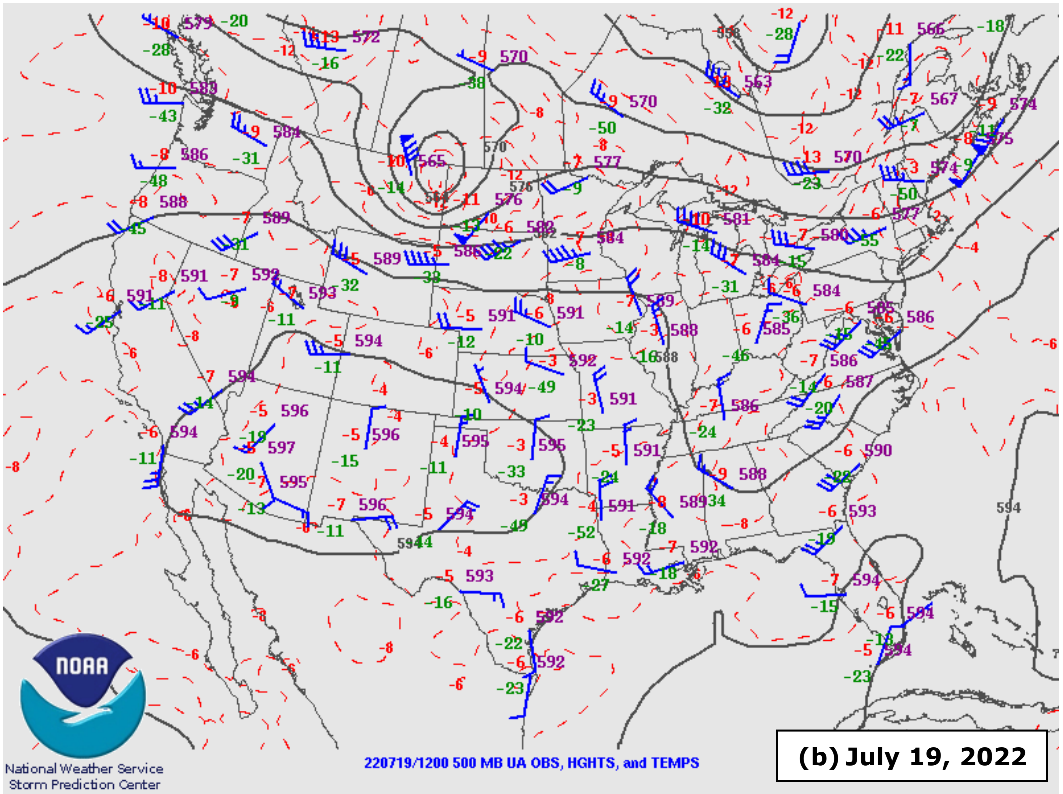


Figure 2-85. 500 mb synoptic analysis map at 12 UTC on (a) July 18 and (b) July 19, 2022.

The surface analysis for July 18 (Figure 2-86a) shows a region of high-pressure over Kansas that creates calm winds and subsidence, which can trap pollutants and smoke near the surface locally. There is a cold front that extends from Texas, Arkansas, Tennessee into the northeast that acts as a barrier, slowing or redirecting smoke transport coming from Texas toward the eastern U.S. The presence of a large ridge of high pressure dominated much of the central U.S, creating stable conditions. The surface analysis for July 19 (Figure 2-86b) shows a complex pattern dominated by high-pressure systems and frontal boundaries across the U.S. A stationary front stretched across the central U.S., starting from Kansas, and extending eastward through Missouri into parts of the Ohio valley. High-pressure systems are centered over the southeastern U.S. and the southwestern U.S., promoting stable conditions and calm winds that can trap pollutants and smoke near the surface. Meanwhile, low-pressure systems and weak troughs over Texas and Oklahoma contribute to localize instability in the southern Plains.

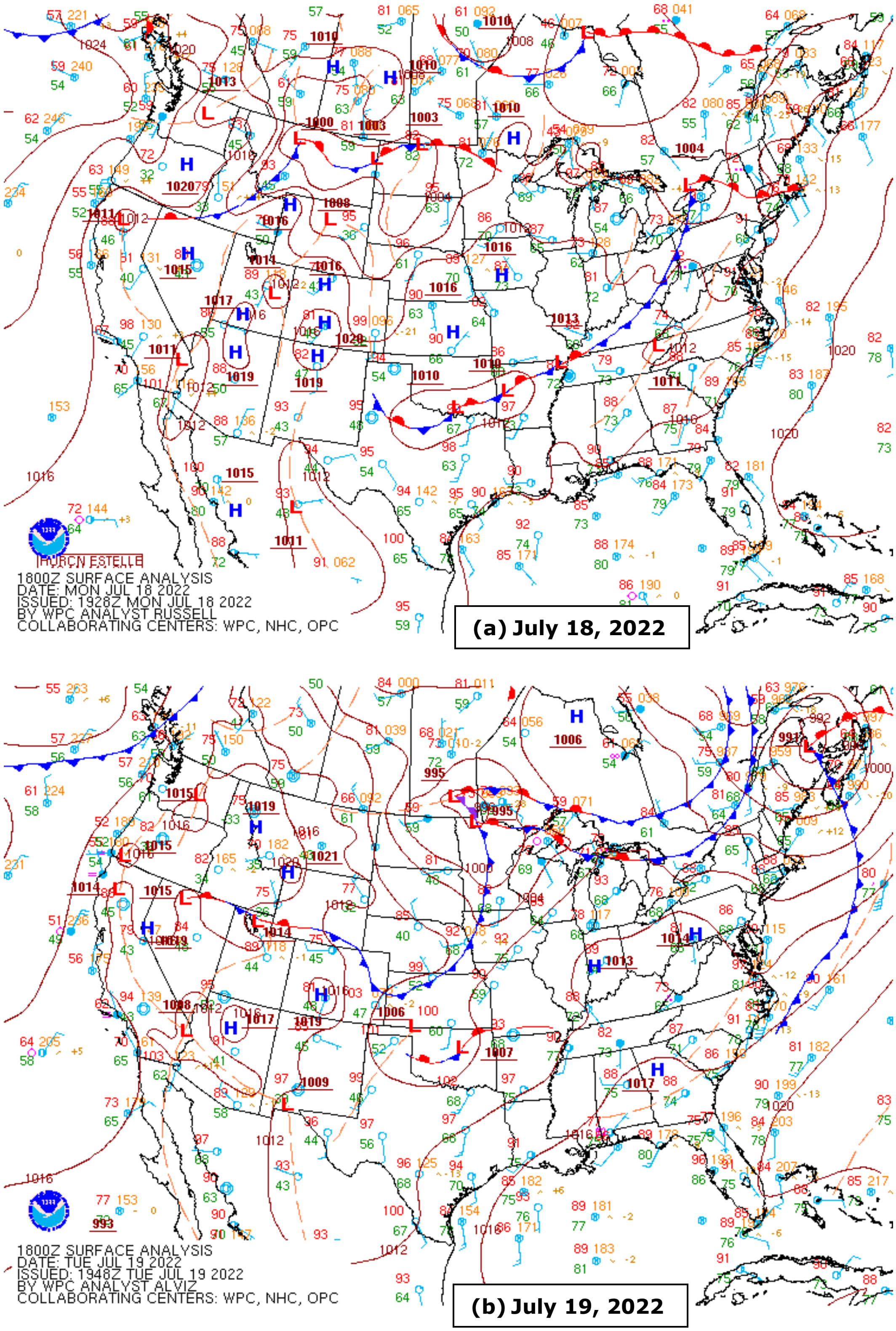


Figure 2-86. Surface synoptic analysis maps at 18 UTC on (a) July 18 and (b) July 19, 2022.

The NOAA HMS product in Figure 2-87 and the NOAA satellite imagery in Figure 2-88 show light-density smoke plumes covering much of the southeastern U.S. Moderate AQI levels (Figure 2-89) and NAAPS simulated smoke concentrations (Figure 2-90), ranging from 1 to 128 μg/m^3 in Arkansas, suggest that this smoke mixed down to surface level, affecting monitors in Arkansas. Figure 2-91 shows the evolution of the smoke plumes originating from multiple fires in Idaho, Texas, and Canada.

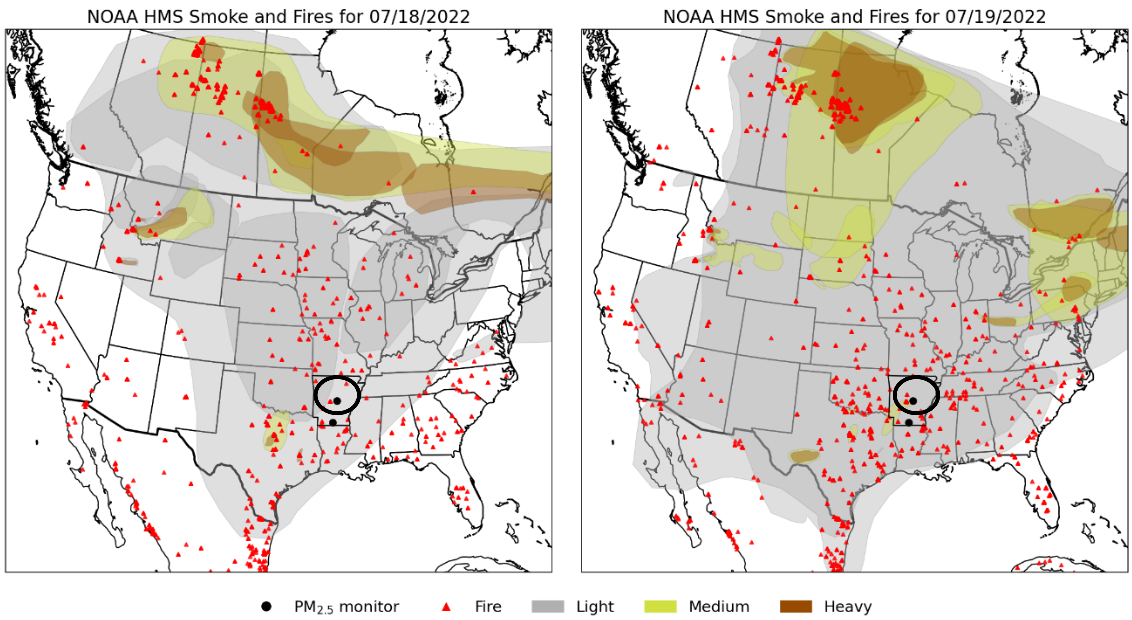


Figure 2-87. NOAA HMS fire and smoke products for July 18 (left) and July 19 (right), 2022.

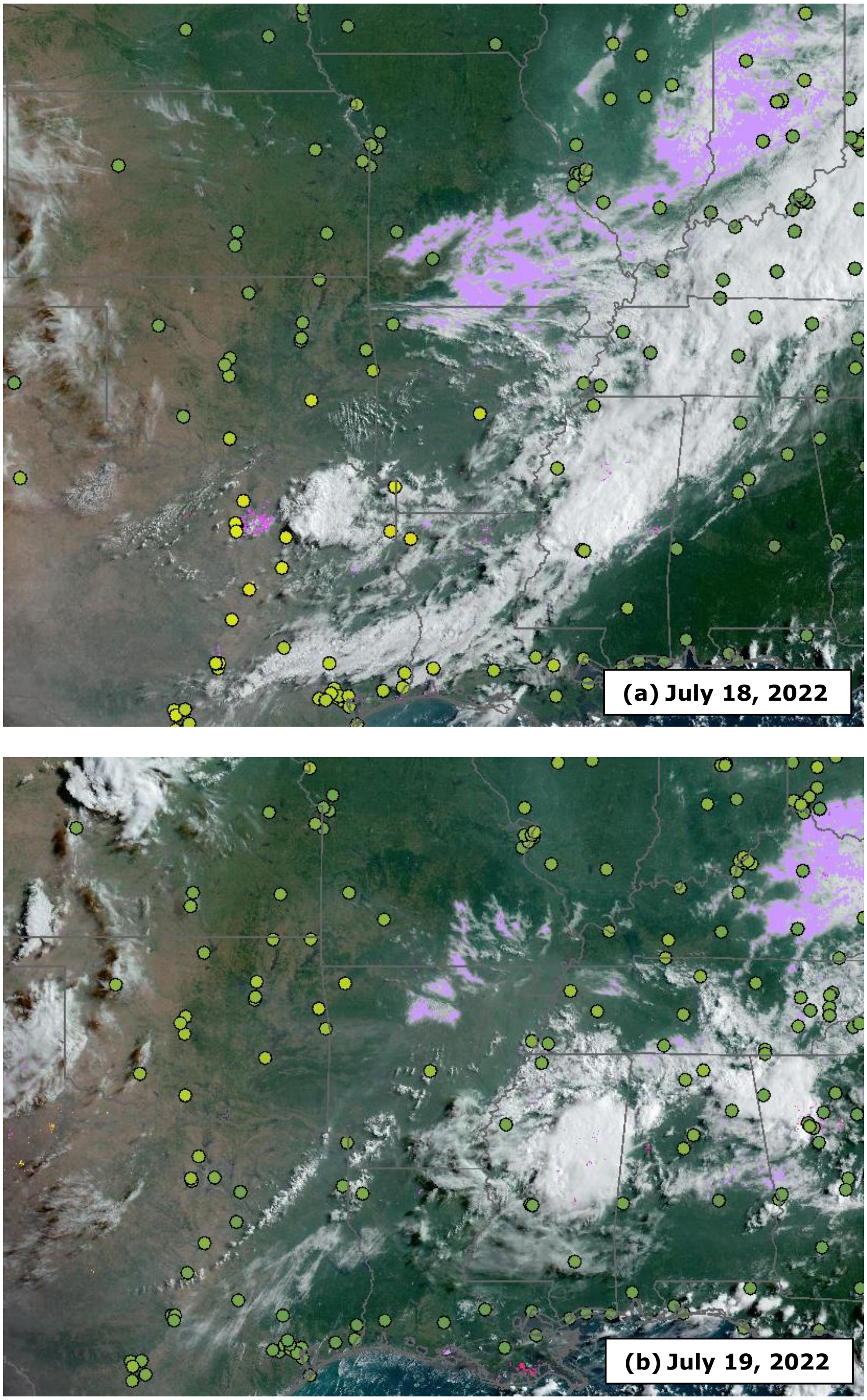


Figure 2-88. NOAA satellite visible imagery on (a) July 18 at 1311 UTC and (b) July 19 at 1301 UTC.

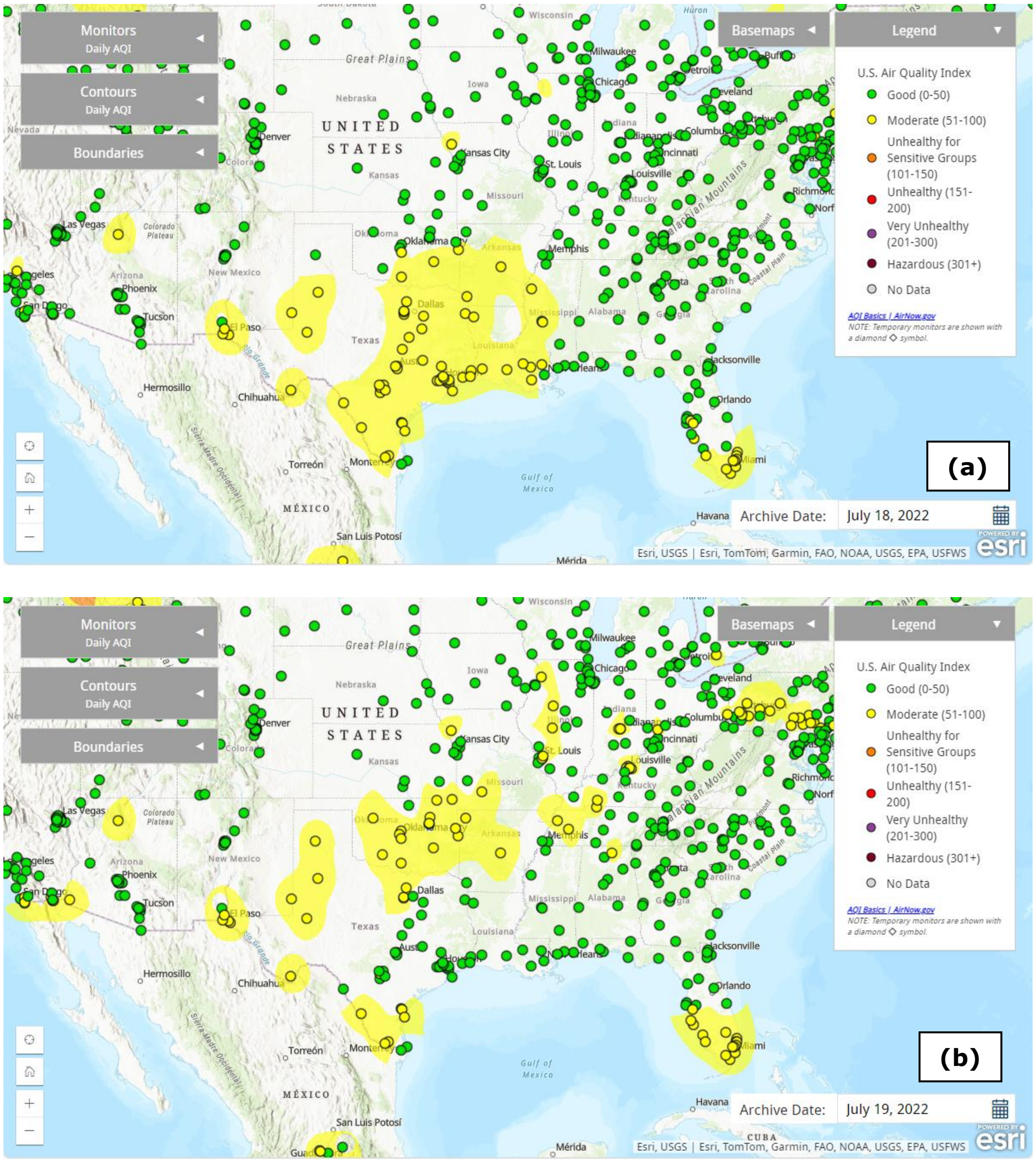


Figure 2-89. AirNow surface level $PM_{2.5}$ concentration contours for (a) July 18 and (b) July 19, 2022.

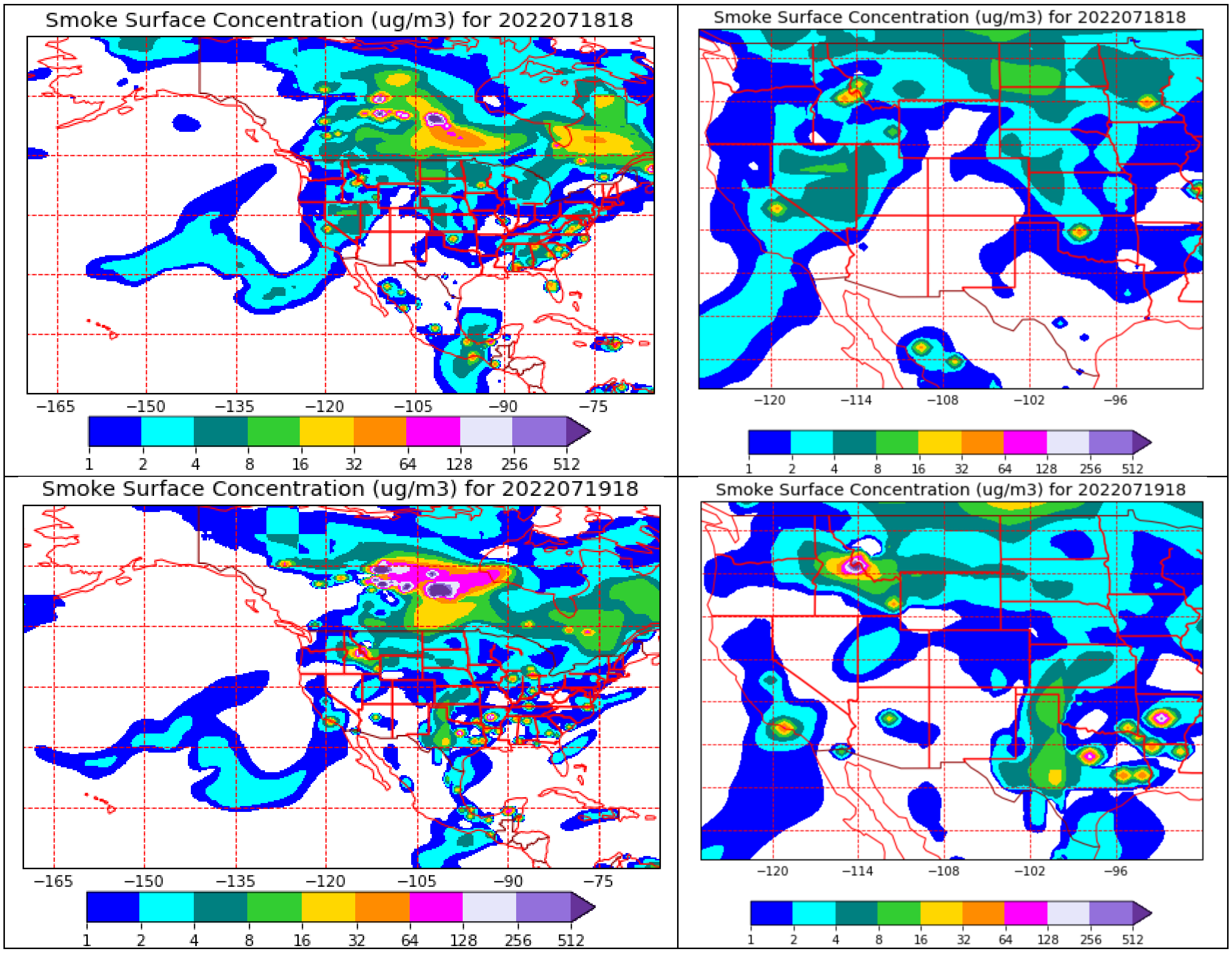


Figure 2-90. NAAPS modeled near-surface smoke concentrations (µg/m^3) at 18Z on (a) July 18 and (b) July 19, 2022. North America regional plot on the left and western U.S. plot on the right.

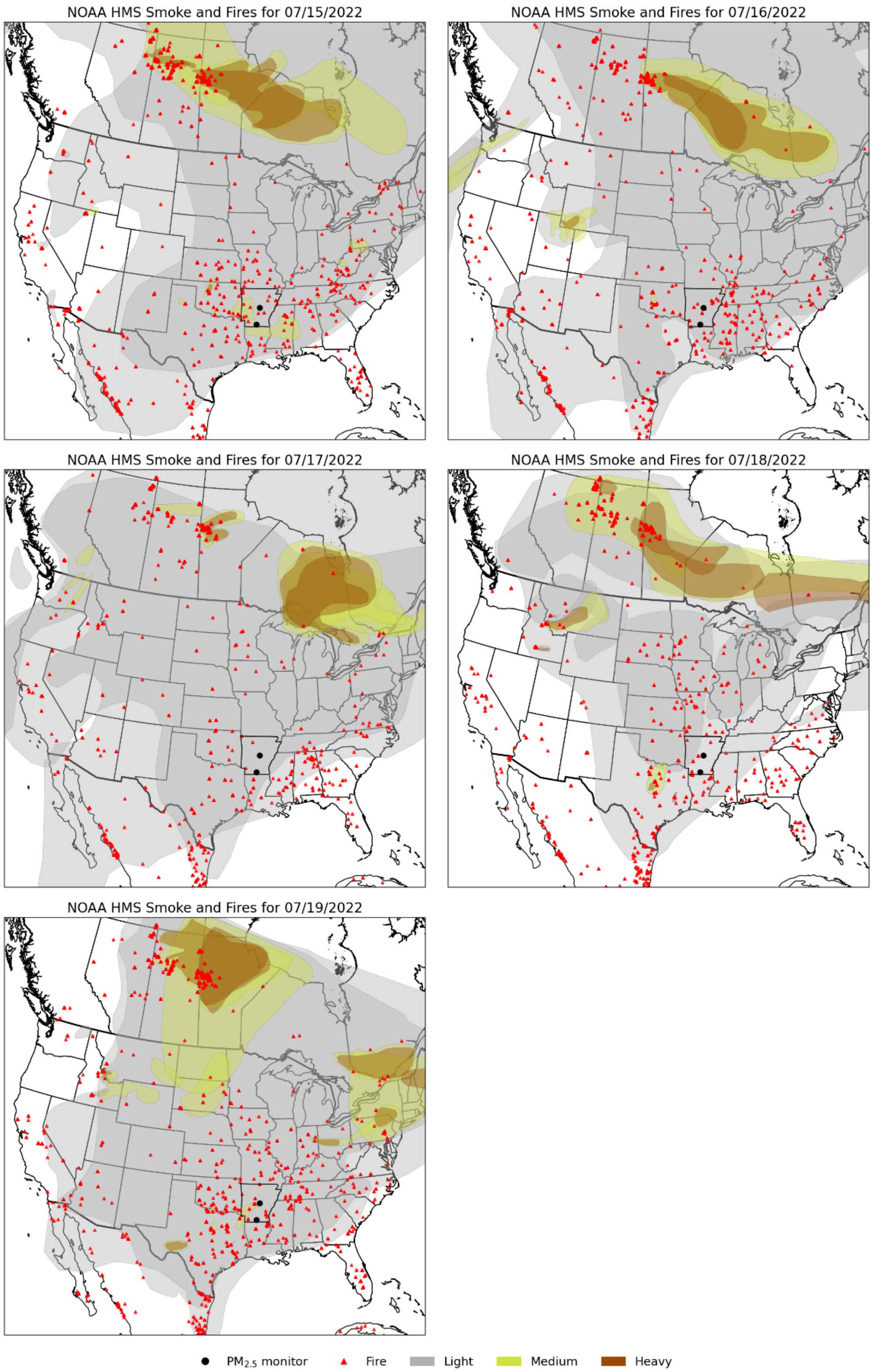


Figure 2-91. Evolution of fires and smoke for July 15 (top left), July 16 (top right), July 17 (middle left), July 18 (middle right), and July 19 (bottom left).

2.1.4.1 PARR July 18, 2022

Table 2-14 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on July 18, 2022. Figure 2-92 shows that observed $PM_{2.5}$ concentrations on this day exceeded the Tier 2 threshold, while Figure 2-93 indicates that the concentration was near the 99th percentile of historic values over the last five years. Figure 2-94 illustrates the path of back trajectories that cross through regions of light to medium density smoke from fires in Texas. Figure 2-95 displays 72-hour forward trajectories from the Chalk Mountain Fire in Texas, showing its influence on the monitoring site in Arkansas. Figure 2-96 depicts hourly $PM_{2.5}$ concentrations steadily increasing from 4.0 µg/m^3 at 2 AM CDT to 28.4 µg/m^3 at noon. After reaching this peak, concentrations remained relatively stable above 25.0 µg/m^3, indicating persistent impacts of transported smoke throughout the day.

Table 2-14. Exceptional event supporting evidence for PARR on July 18, 2022.

Monitor	PARR (05-119-0007)
Event Date	July 18, 2022
24-hr $PM_{2.5}$ Concentration	20.5 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Texas
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: July. Date accessed: 11/20/2024.

Figure 2-92. EPA $PM_{2.5}$ Tiering Tool for PARR July 18, 2022.

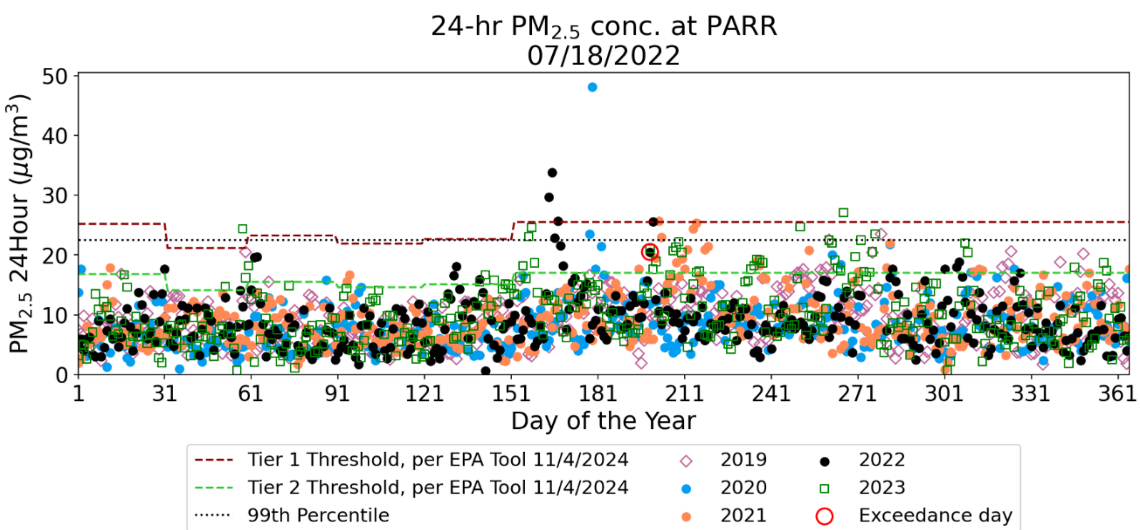


Figure 2-93. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to July 18, 2022.

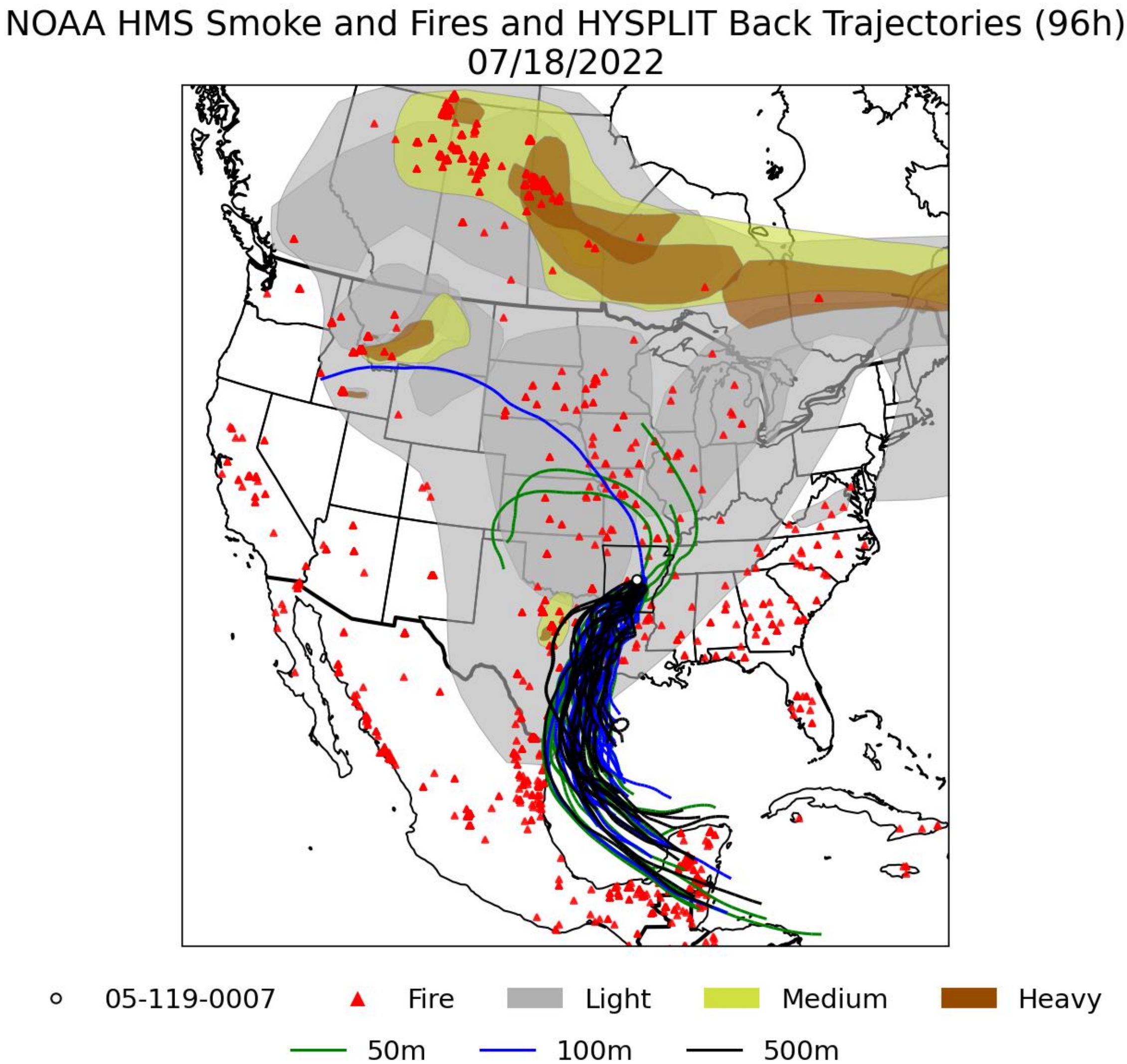


Figure 2-94. HYSPLIT back trajectories for PARR on July 18, 2022.

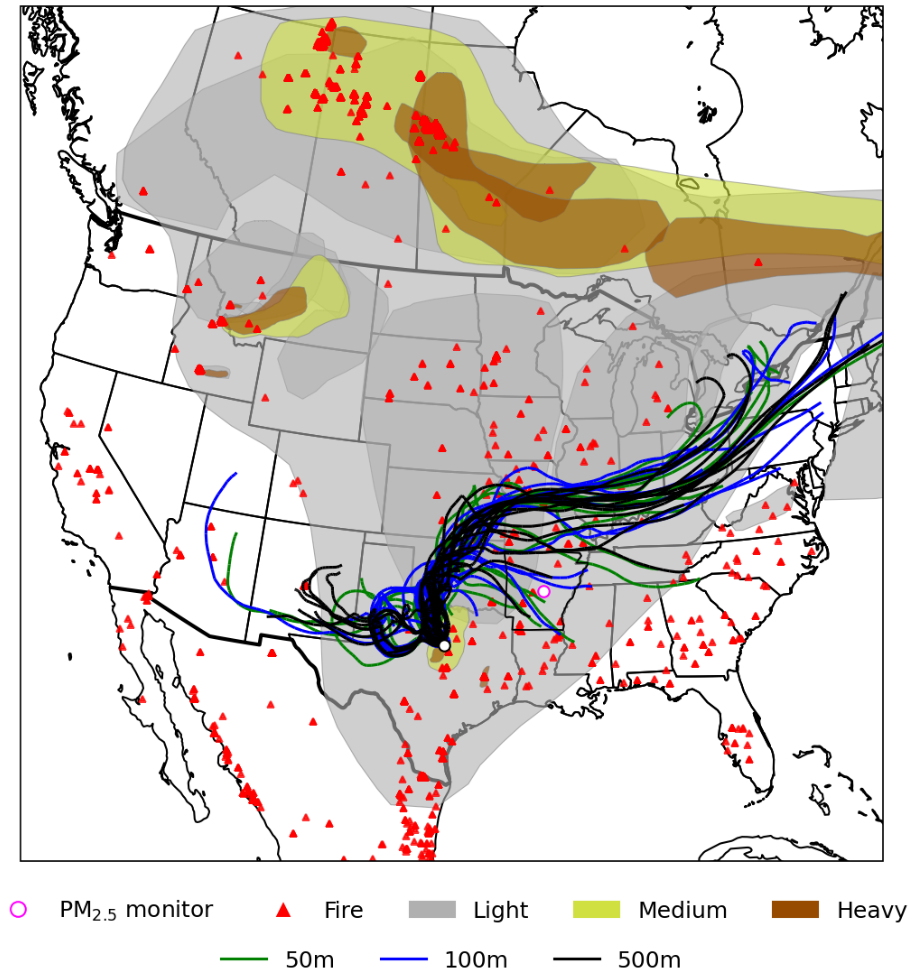


Figure 2-95. HYSPLIT forward trajectories from Texas fire for PARR on July 18, 2022.

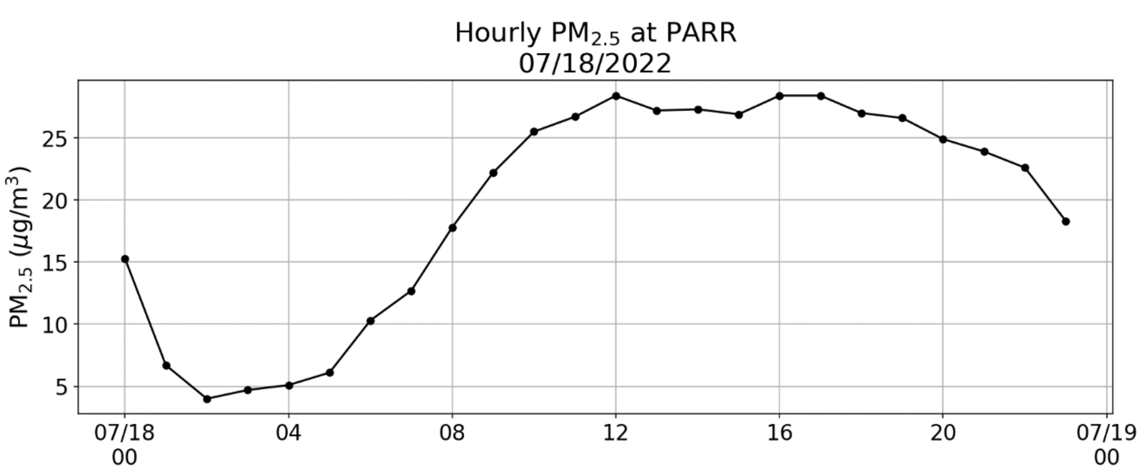


Figure 2-96. Hourly $PM_{2.5}$ concentrations for PARR on July 18, 2022.

2.1.4.2 PARR July 19, 2022

Table 2-15 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on July 19, 2022. Figure 2-97 shows that observed $PM_{2.5}$ concentrations on this day exceeded the Tier 2 threshold, while Figure 2-98 indicates that the value was above the 99th percentile of historic values over the last five years. Figure 2-99 illustrates the path of back trajectories that cross through regions of smoke originating from fires in Texas. Figure 2-100 displays 72-hour forward trajectories from the Chalk Mountain fire in Texas, demonstrating its influence on the monitoring site in Arkansas. Figure 2-101 depicts hourly $PM_{2.5}$ concentrations steadily increasing from 16.0 µg/m^3 at 12 AM CDT to 22.8 µg/m^3 at 4 AM. After reaching this peak, concentrations began decreasing throughout the day, dropping to 2.0 µg/m^3 at 9 PM CDT, indicating a break in stable conditions that resulted in smoke clearing from the monitoring site and surrounding locations.

Table 2-15. Exceptional event supporting evidence for PARR on July 19, 2022.

Monitor	PARR (05-119-0007)
Event Date	July 19, 2022
24-hr $PM_{2.5}$ Concentration	25.6 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Texas
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: July. Date accessed: 11/20/2024.

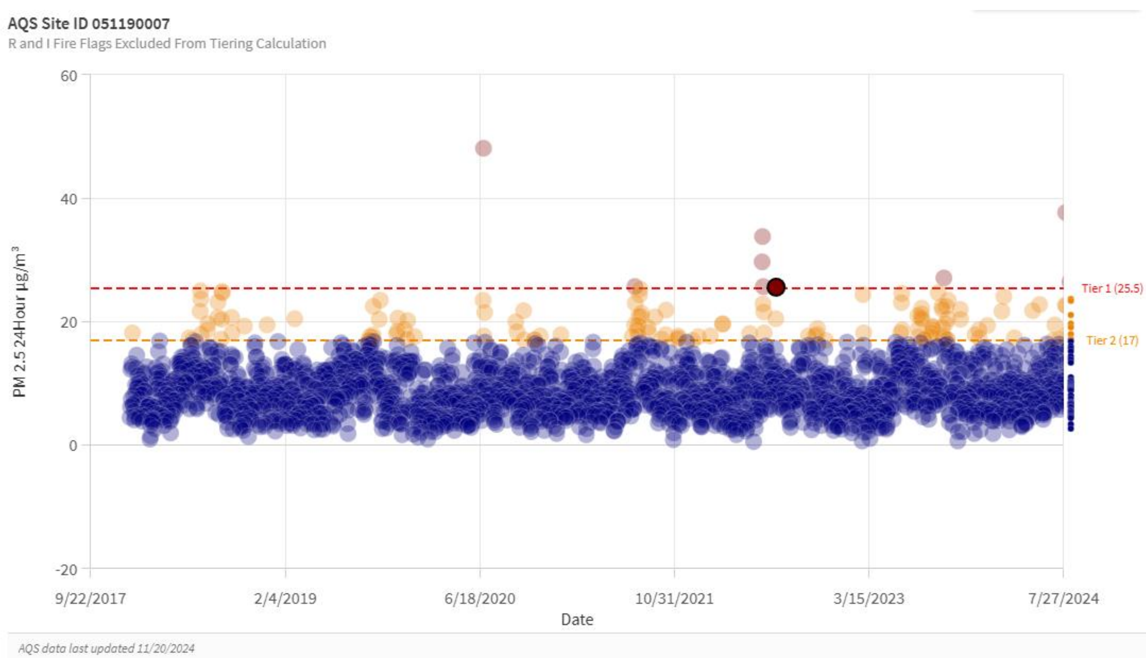


Figure 2-97. EPA $PM_{2.5}$ Tiering Tool PARR on July 19, 2022.

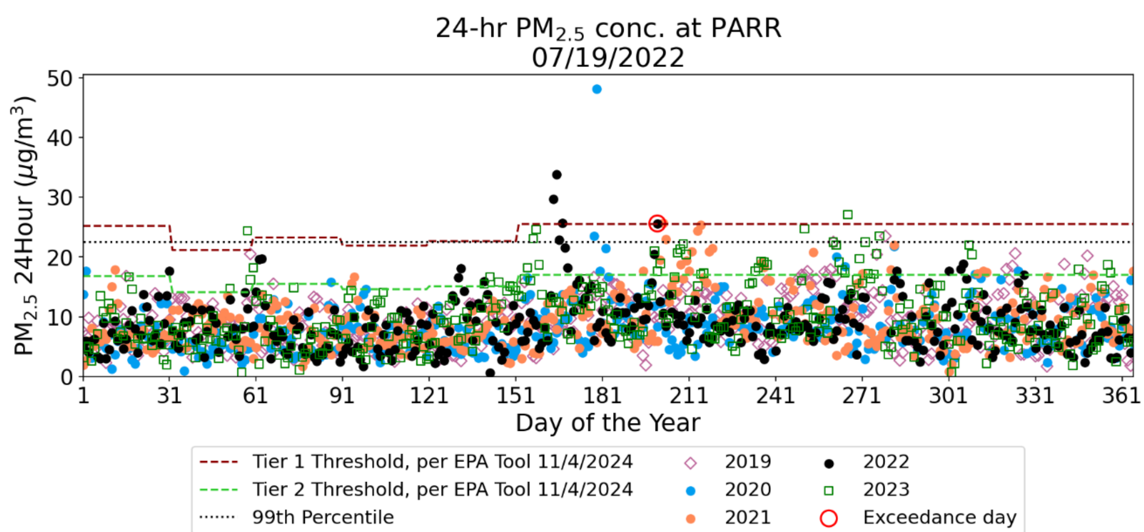


Figure 2-98. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to July 19, 2022.

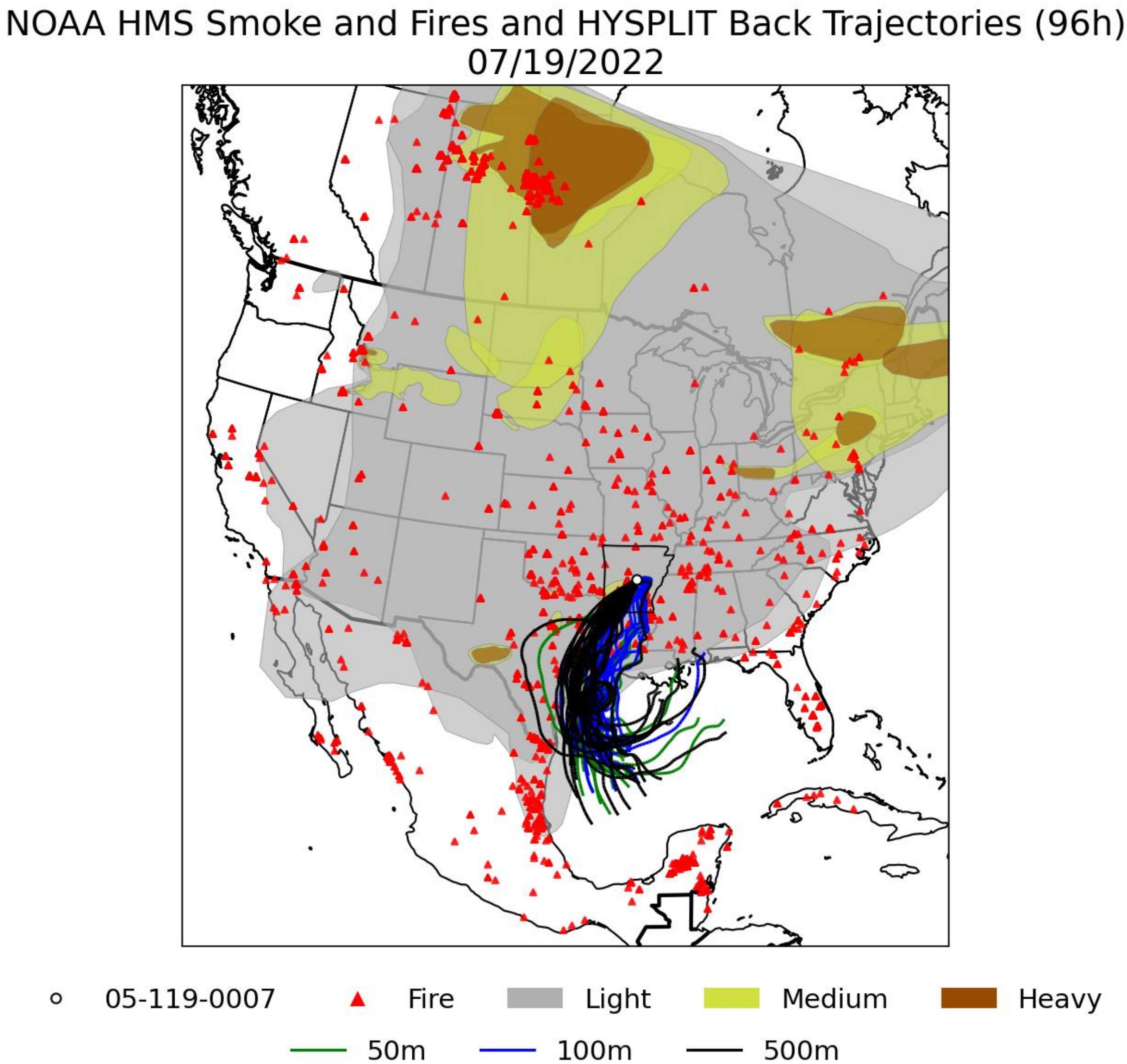


Figure 2-99. HYSPLIT back trajectories for PARR on July 19, 2022.

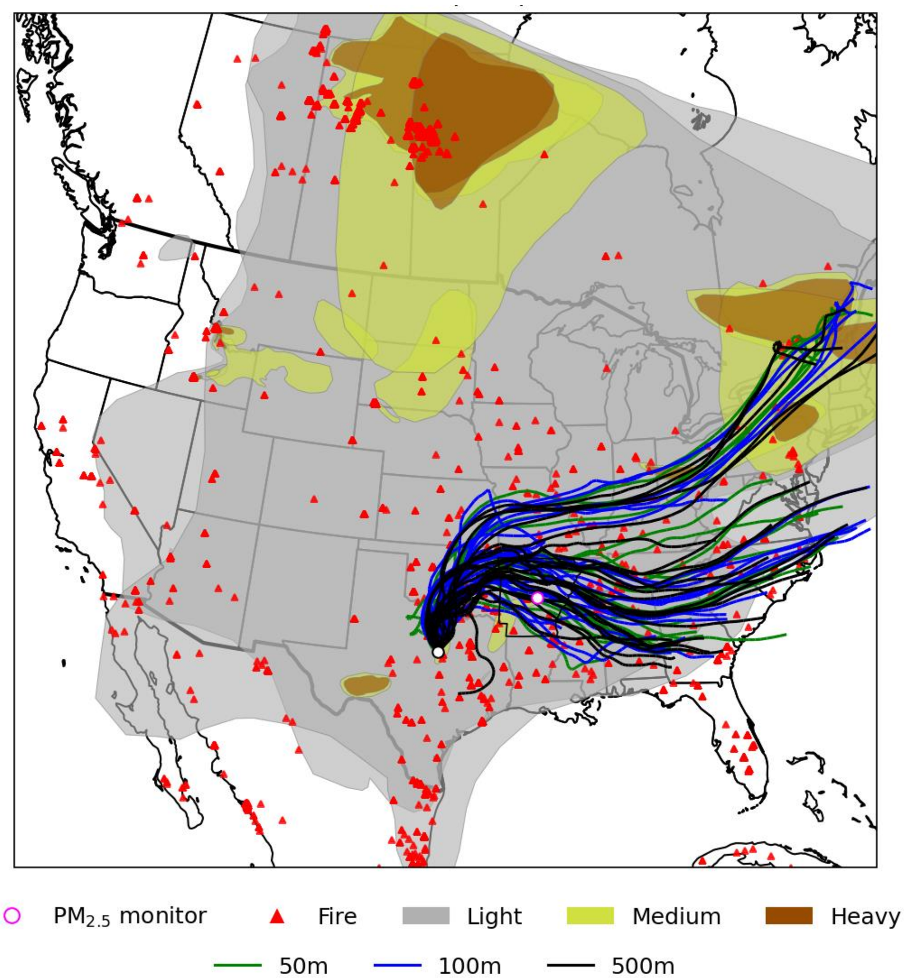


Figure 2-100. HYSPLIT forward trajectories from Texas fire for PARR on July 19, 2022.

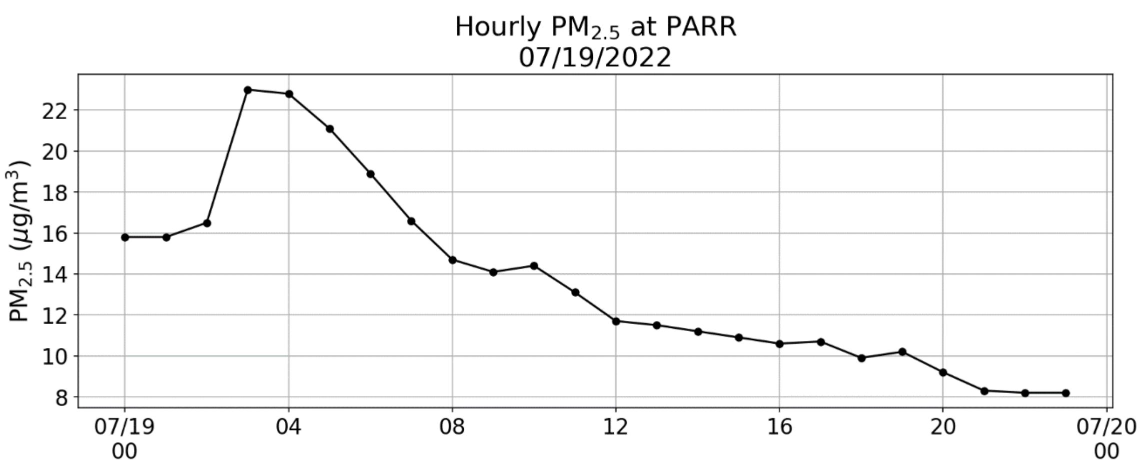


Figure 2-101. Hourly $PM_{2.5}$ concentrations for PARR on July 19, 2022.

2.1.5 February 27-March 1, 2023

During February to May 2023, there were multiple fires burning over several regions in Mexico. Although there is not as detailed information about these fires as in the U.S., the Mexican program *Coordinación General de Conservación y Restauración* (CONAFOR), part of the Mexican Commission of Forest Management (Comisión Nacional Forestal) keeps annual and monthly statistics of fires in Mexico. Figure 2-102 shows the total number of fires and area burned over the whole country for year 2022. The figure indicates that there was a total of 7,611 fires that burned 1,047,493 ha, with the top 5 states with the most incidences of fires usually being different from the top 5 states with the most area burned, reflecting that some of these fires may be more intense and have significant impacts. The year 2023 was historically the largest wildfire season by area burned in Mexico. Jalisco, Chihuahua and Durango were states in the western side of Mexico that had the largest total area burned by fires during 2023. Figure 2-103 shows the weekly number of forest fires and area burned in Mexico during 2022. The figure shows that on February 27 to March 1, 2023 (week 9) fires were not as intense as later in the year (6, 538 ha[31] of total area burned), but the rate at which the number of fires were burning continued to go up.

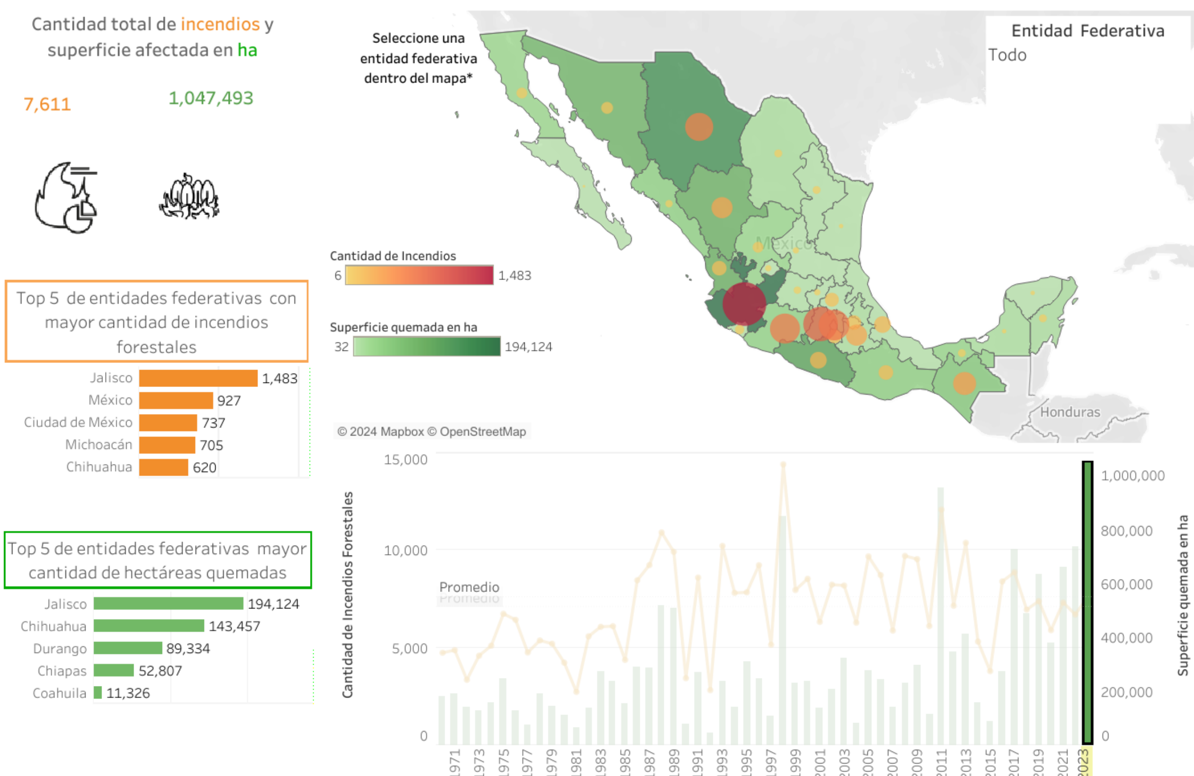


Figure 2-102. Incidence of Forest Fires in Mexico during 2023. Orange indicates number of fires, green shows area burned in hectares. (https://snif.cnf.gob.mx/incendios/#:~:text=%C2%BFPor%20qu%C3%A9%20ocurren%20los%20incendios,bien%20sus%20cigarros%20o%20fogatas.)

[31] Mexico Fires statistics available at: https://monitor_incendios.cnf.gob.mx/incendios_tarjeta_semanal

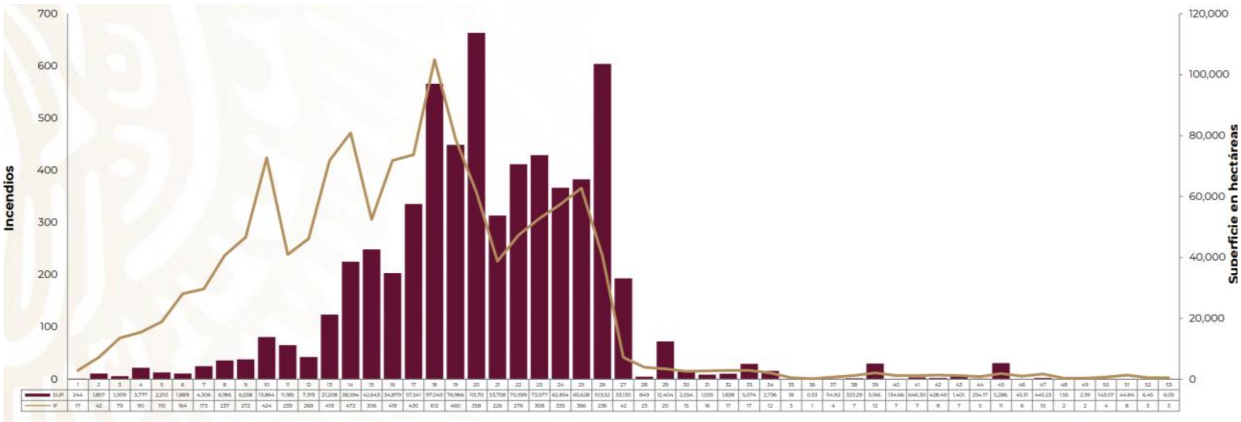


Figure 2-103. Weekly Number of Forest Fires and area burned in Mexico during 2023. (https://www.gob.mx/cms/uploads/attachment/file/879026/Cierre_de_la_Temporada_2023.pdf.)

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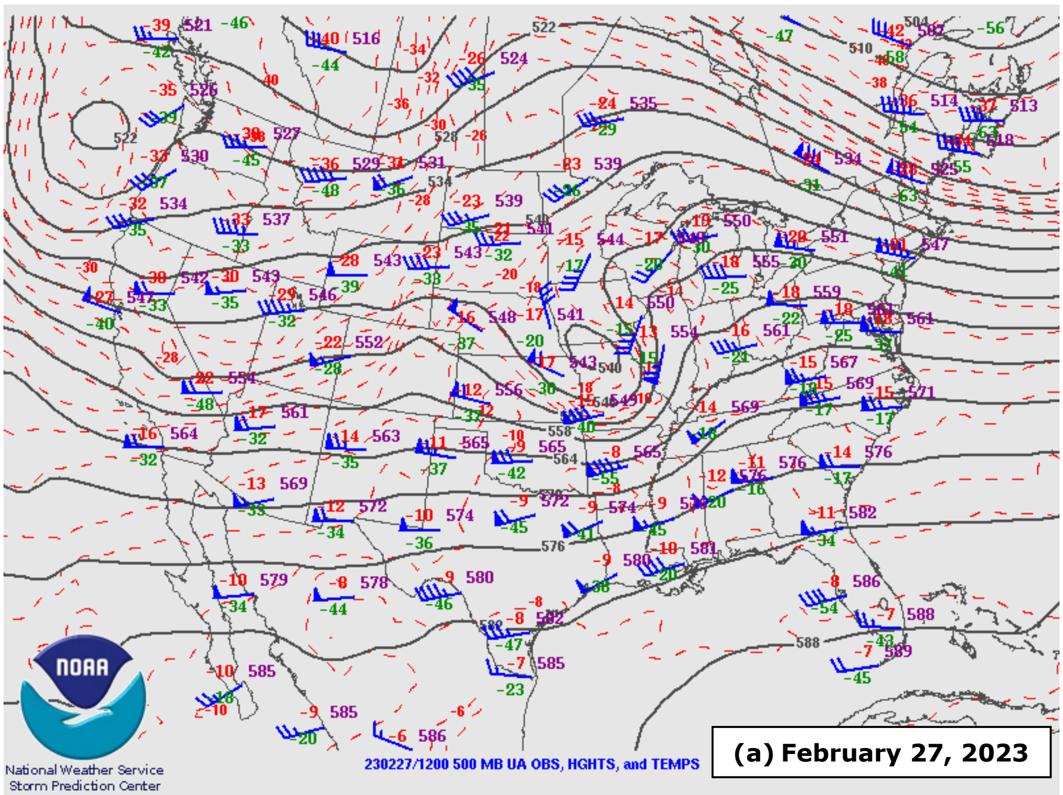
On February 27, the 500mb analysis (Figure 2-104a) shows a trough over the western U.S. with a ridge over the southeastern U.S. This pattern leads to southwesterly flow aloft in Arkansas, which favors transporting air (and smoke) from Mexico toward the central U.S. On February 28 (Figure 2-104b), the pattern evolves slightly, but the trough remains over the western U.S., and the ridge persists in the southeast. A sustained southwesterly flow continues over this day and can keep transporting smoke from Mexico. By March 1 (Figure 2-104c), the trough over the western U.S. deepens, further sustaining the southwesterly flow. This continuous pattern effectively transports smoke from the fires in Mexico increasing the likelihood of this smoke impacting monitors in Arkansas.



(a) February 27, 2023

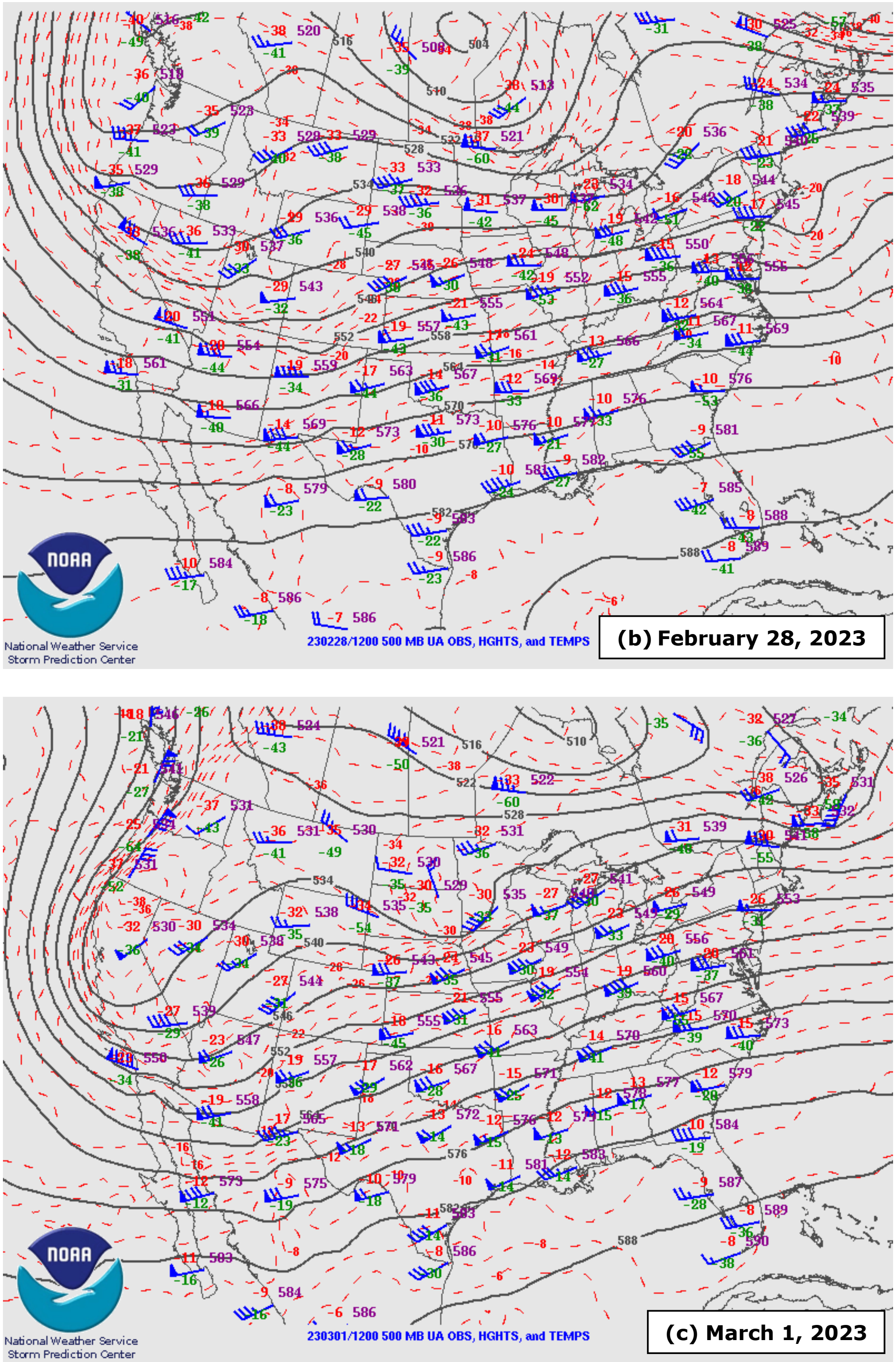
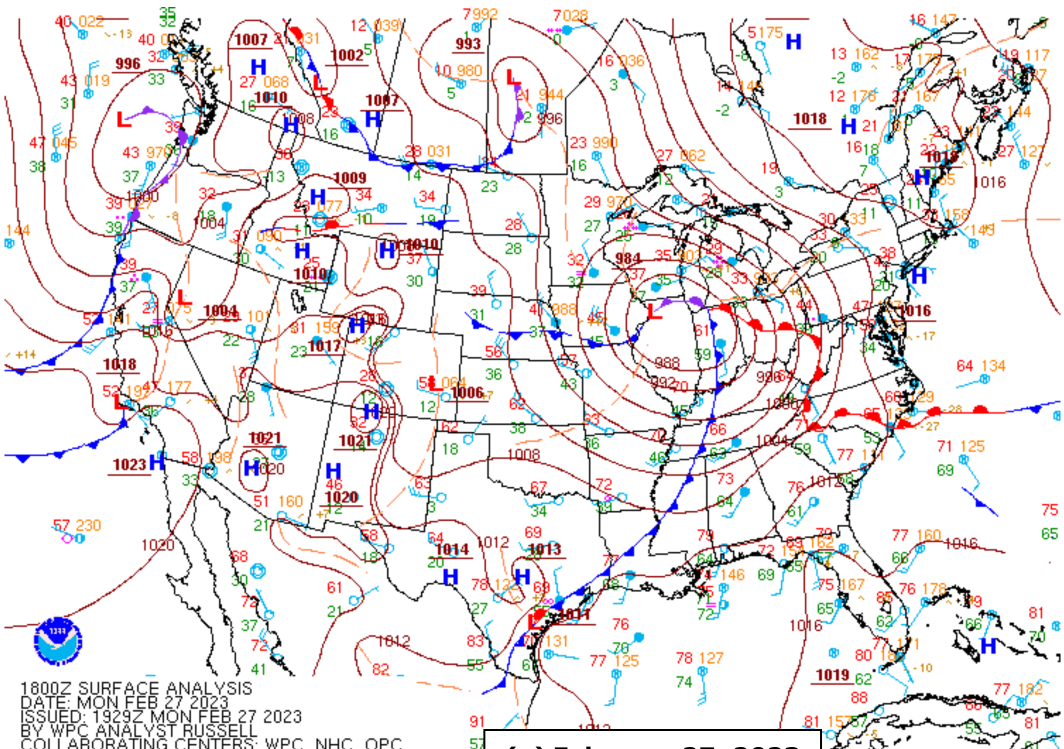


Figure 2-104. 500 mb synoptic analysis map at 12 UTC on (a) February 27, (b) February 28, and (c) March 1, 2023.

The surface analysis on February 27 (Figure 2-105a) shows a high-pressure system over the western U.S. and a low-pressure system in the Midwest, with an associated cold front, that strengthens the southerly flow and favors transport of air (and smoke) from Mexico toward the central U.S., including Arkansas. On February 28 (Figure 2-105b), the surface analysis shows a warm front extending from Arkansas to Kansas pushing air towards the northeast and continues to favor southerly flow. This flow can transport smoke from Mexico. The stronger winds and vertical mixing associated with the front further facilitate this transport. On March 1 (Figure 2-105c), a stationary front developed over Texas, Arkansas, and Illinois with a weak low-pressure system over Arkansas which continue to maintain the southerly flow, supporting the movement of smoke northward from the Gulf of Mexico.



(a) February 27, 2023

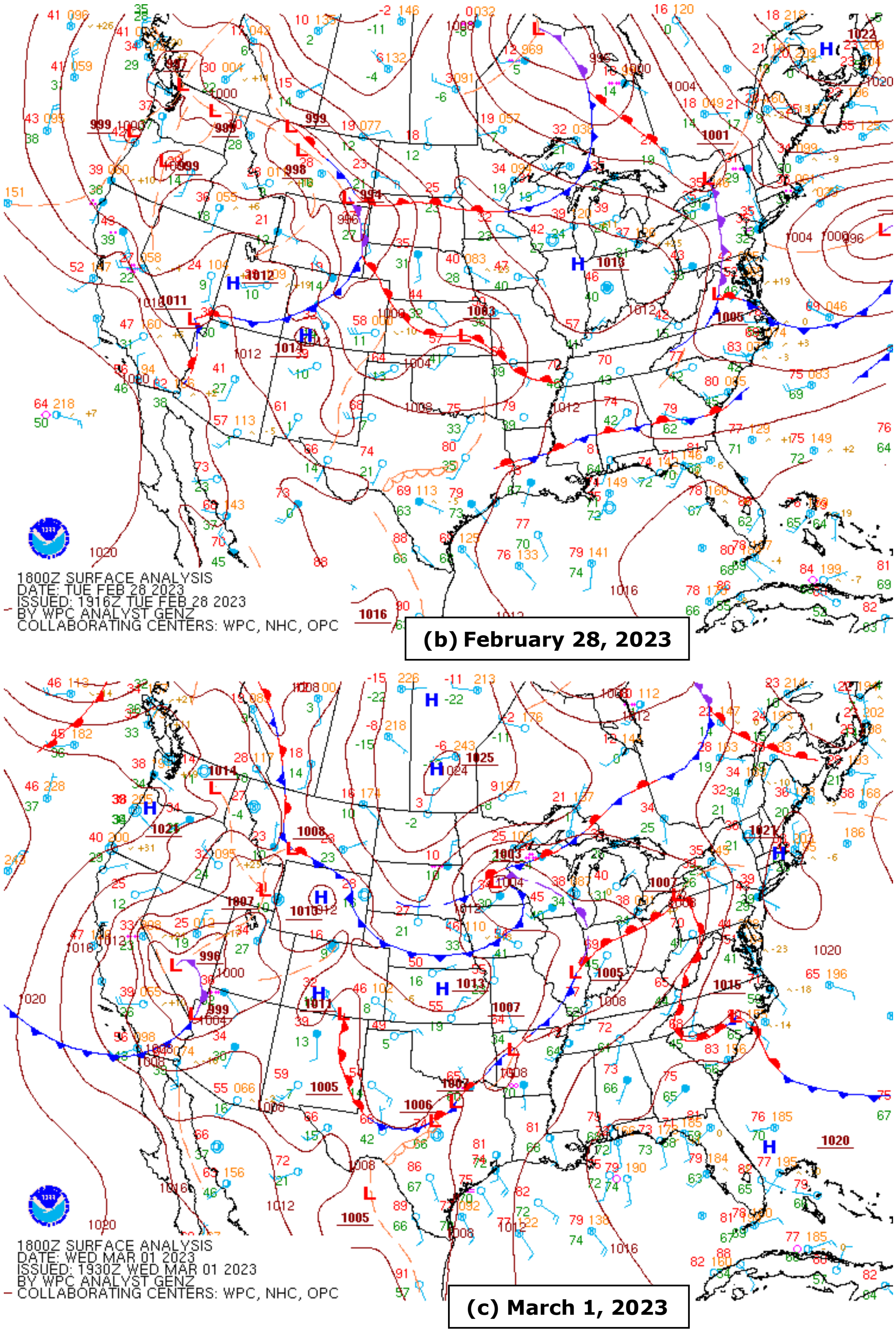


Figure 2-105. Surface synoptic analysis maps (bottom row) at 18 UTC on (a) February 27, (b) February 28, and (c) March 1, 2023.

The NOAA HMS product Figure 2-106 and the visible satellite images Figure 2-107 show light to medium smoke density over the Gulf Coast and Arkansas. Moderate AQI values in Figure 2-108 and NAAPS modeled surface concentrations in Figure 2-109 suggest that smoke from several fires that have been burning in Mexico, Central America and Cuba for several days, mixed down to surface level over parts of the southeastern U.S., including over Arkansas, East Texas, Oklahoma, Louisiana, and Mississippi. Figure 2-110 shows the evolution of the smoke plumes from February 22 – March 1, originating from multiple fires in Mexico.

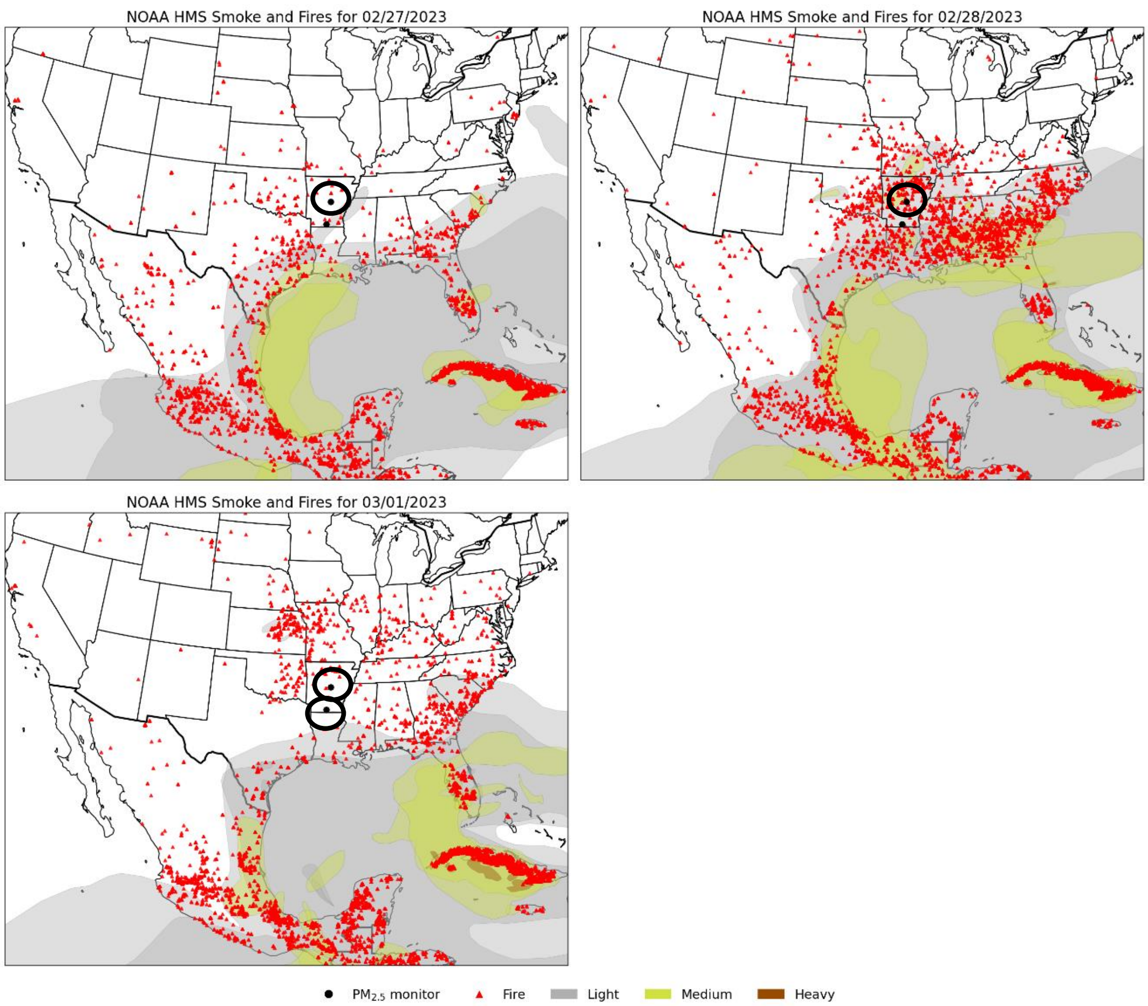
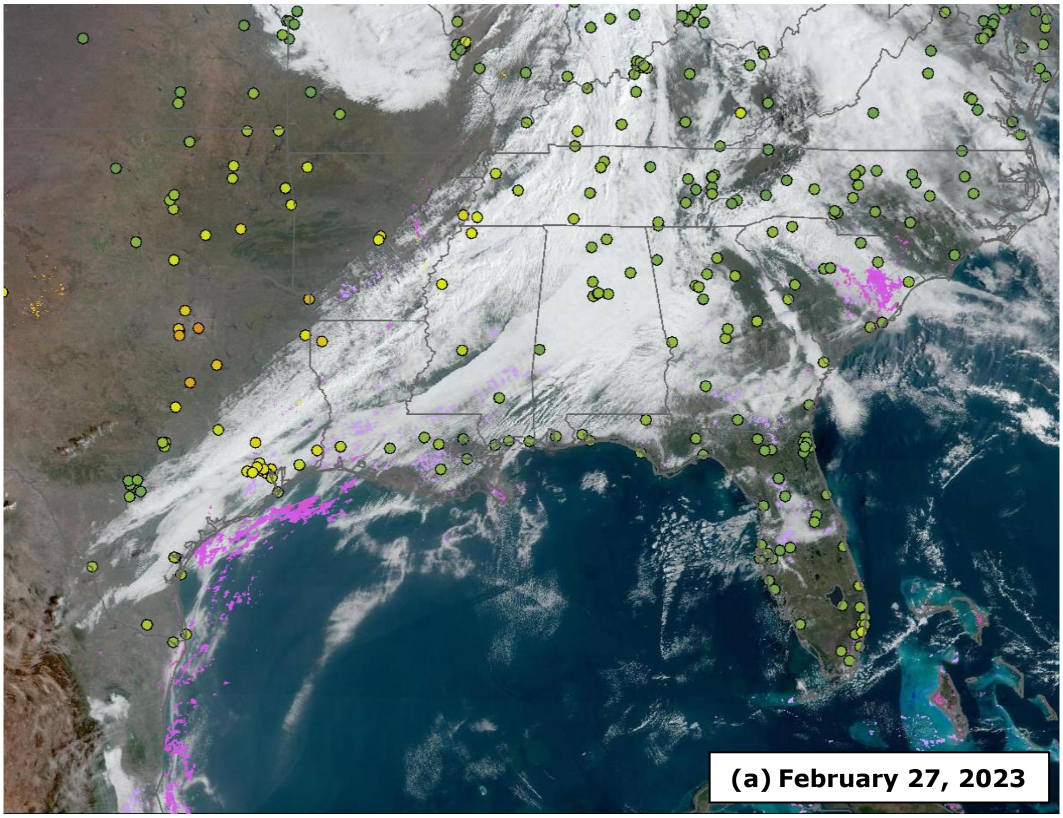
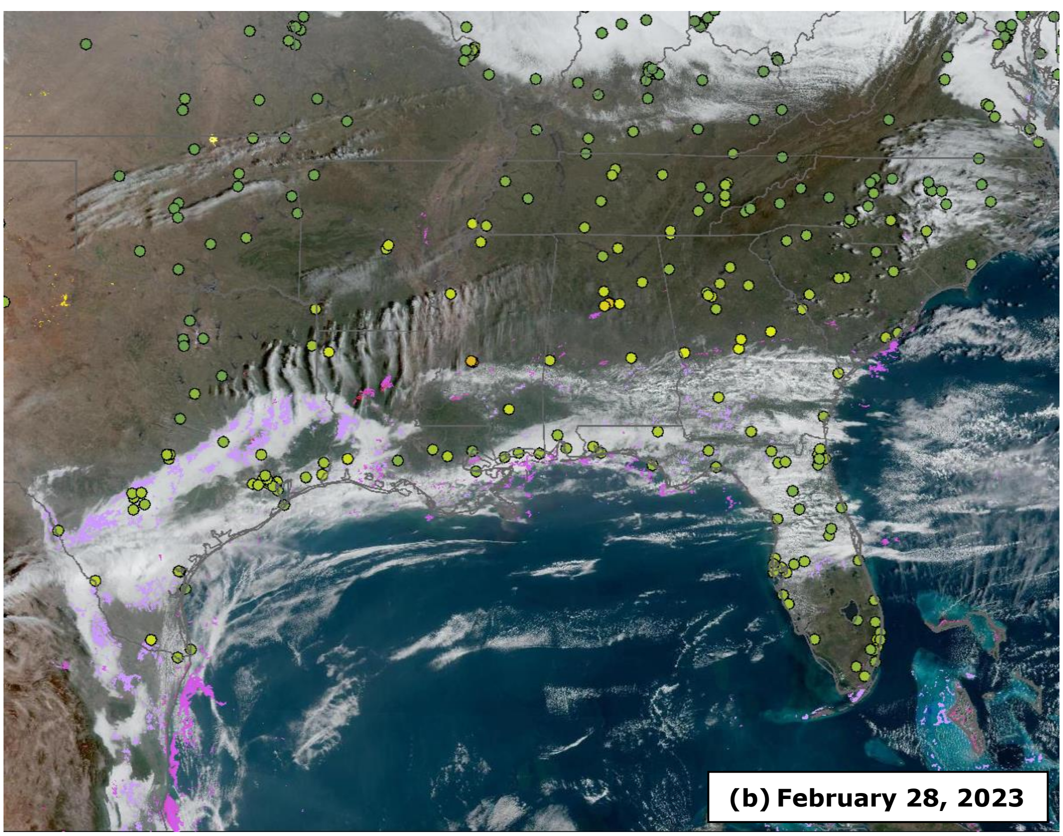


Figure 2-106. NOAA HMS fire and smoke products for February 27 (top left), February 28 (top right), and March 1 (bottom left), 2023.


(a) February 27, 2023


(b) February 28, 2023

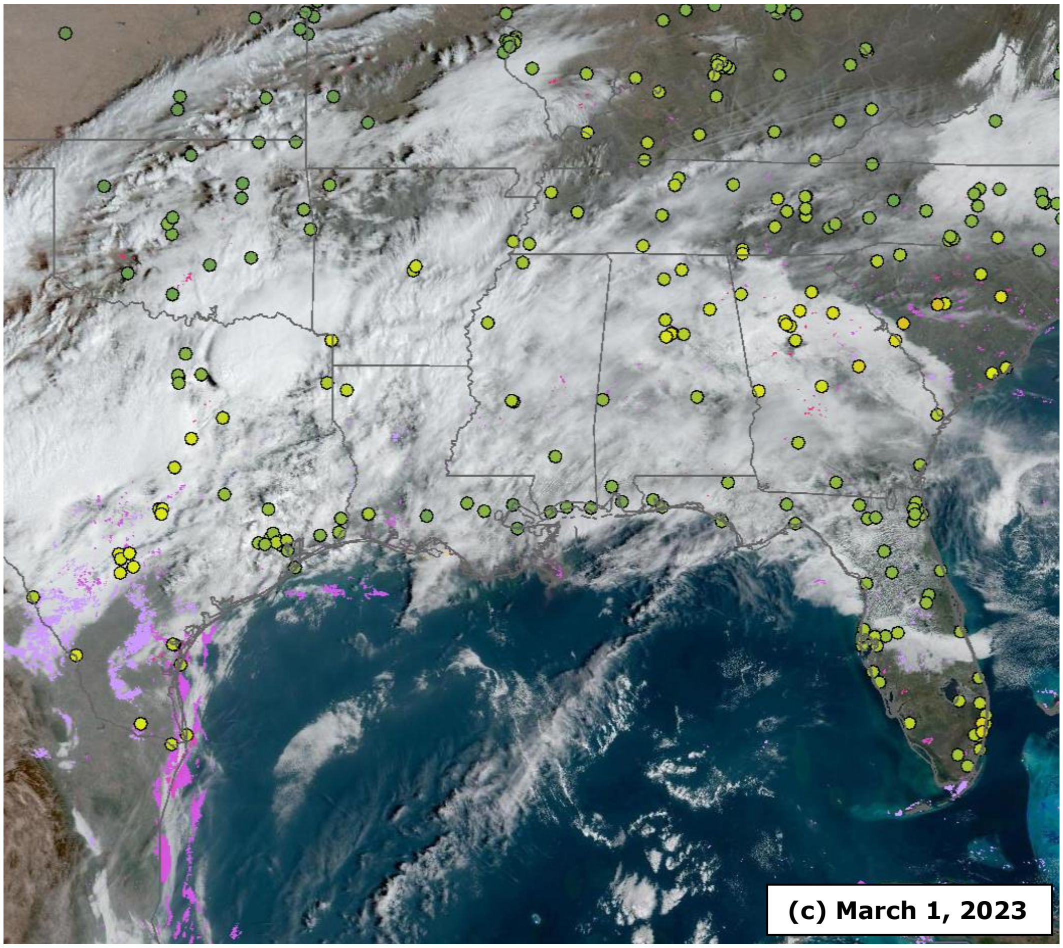
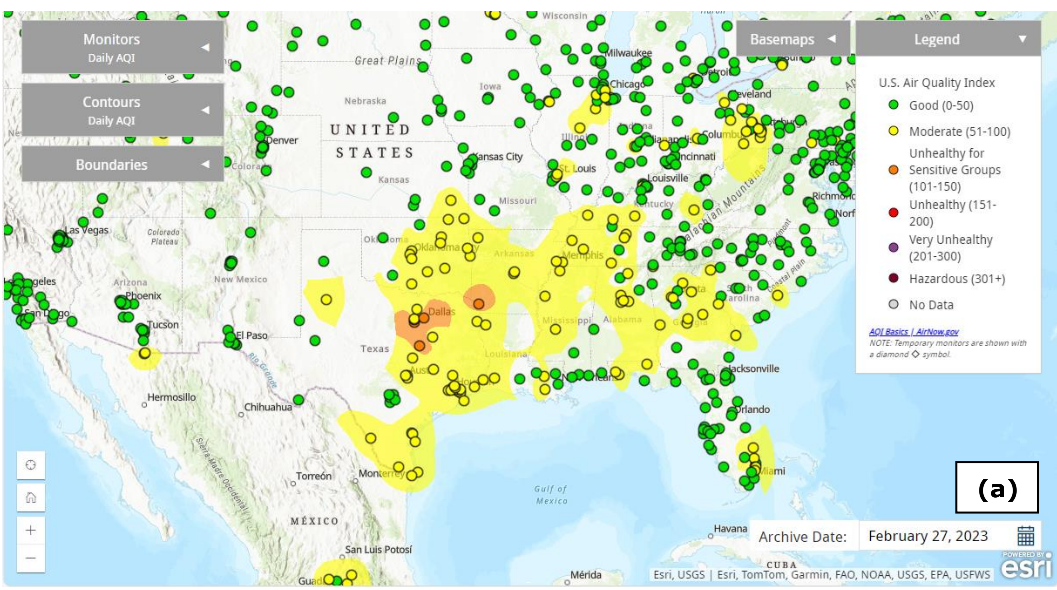
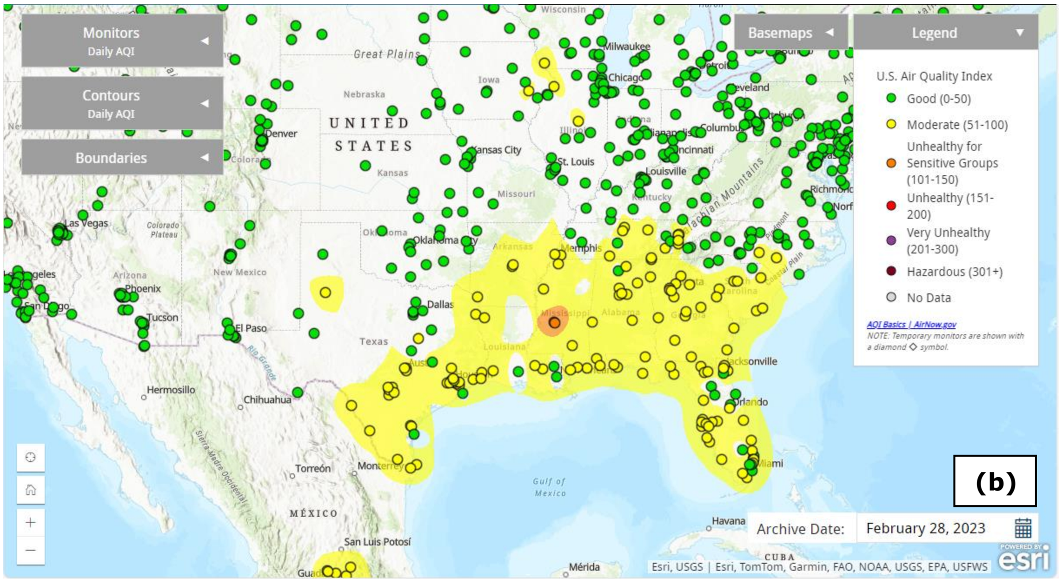


Figure 2-107. NOAA satellite visible imagery on (a) February 27 at 1431 UTC, (b) February 28 at 1451 UTC, and (c) March 1 at 1451 UTC, 2023.





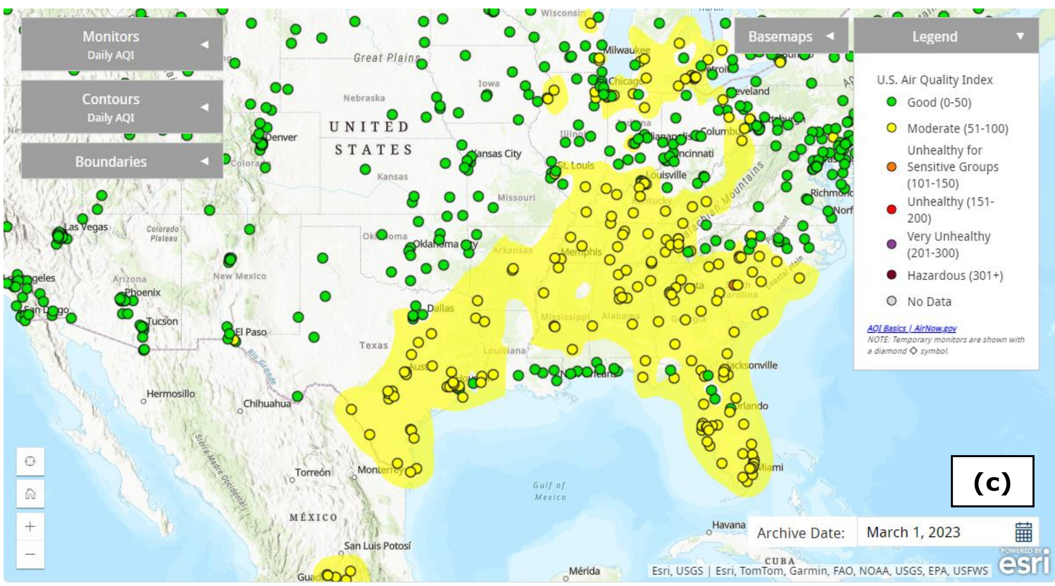


Figure 2-108. AirNow surface level $PM_{2.5}$ concentration contours for (a) February 27, (b) February 28, and (c) March 1, 2023.

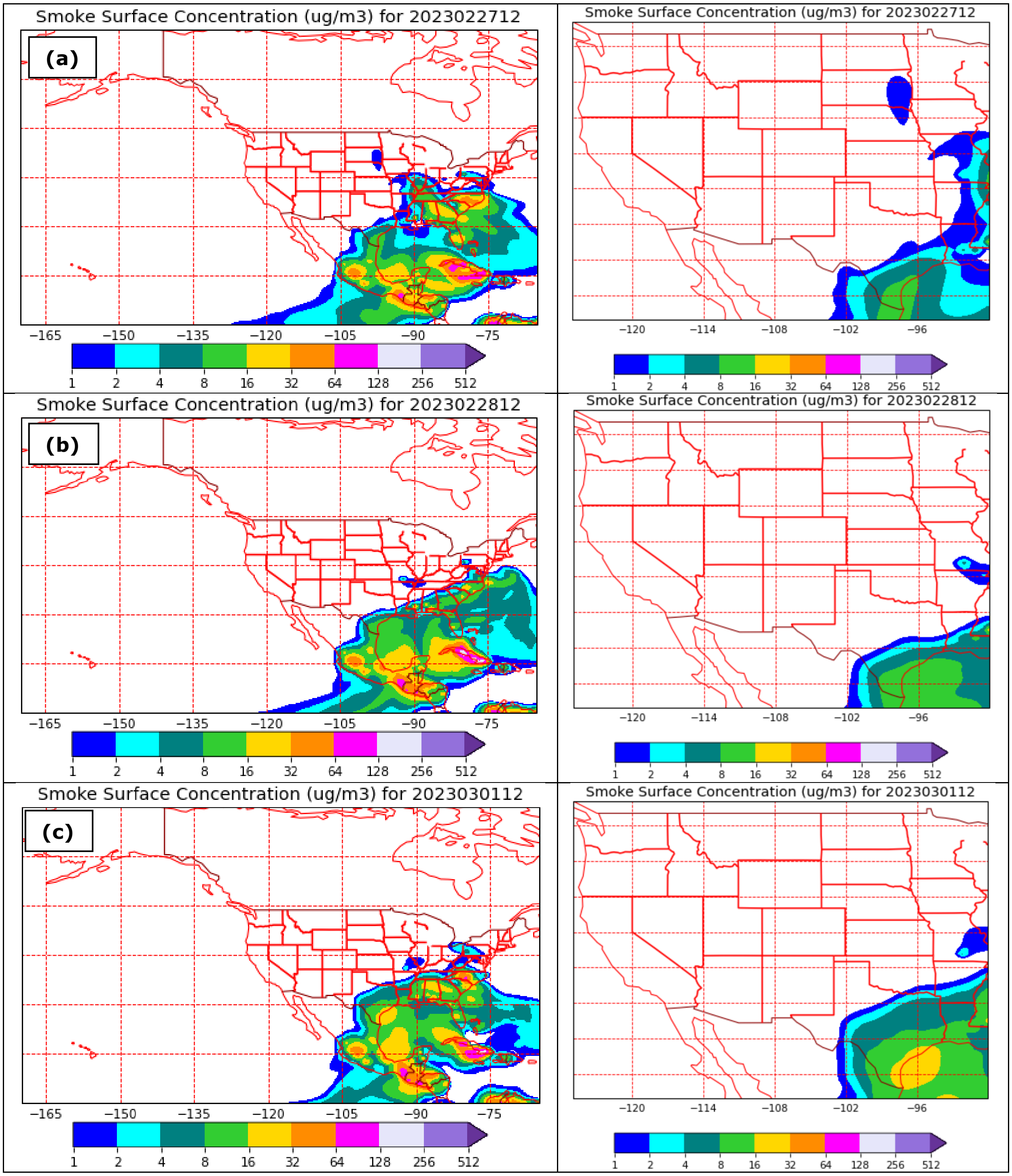


Figure 2-109. NAAPS modeled near-surface smoke concentrations (µg/m^3) at 12Z for (a) February 27, (b) February 28, and (c) March 1, 2023. North America regional plot on the left and western U.S. plot on the right.

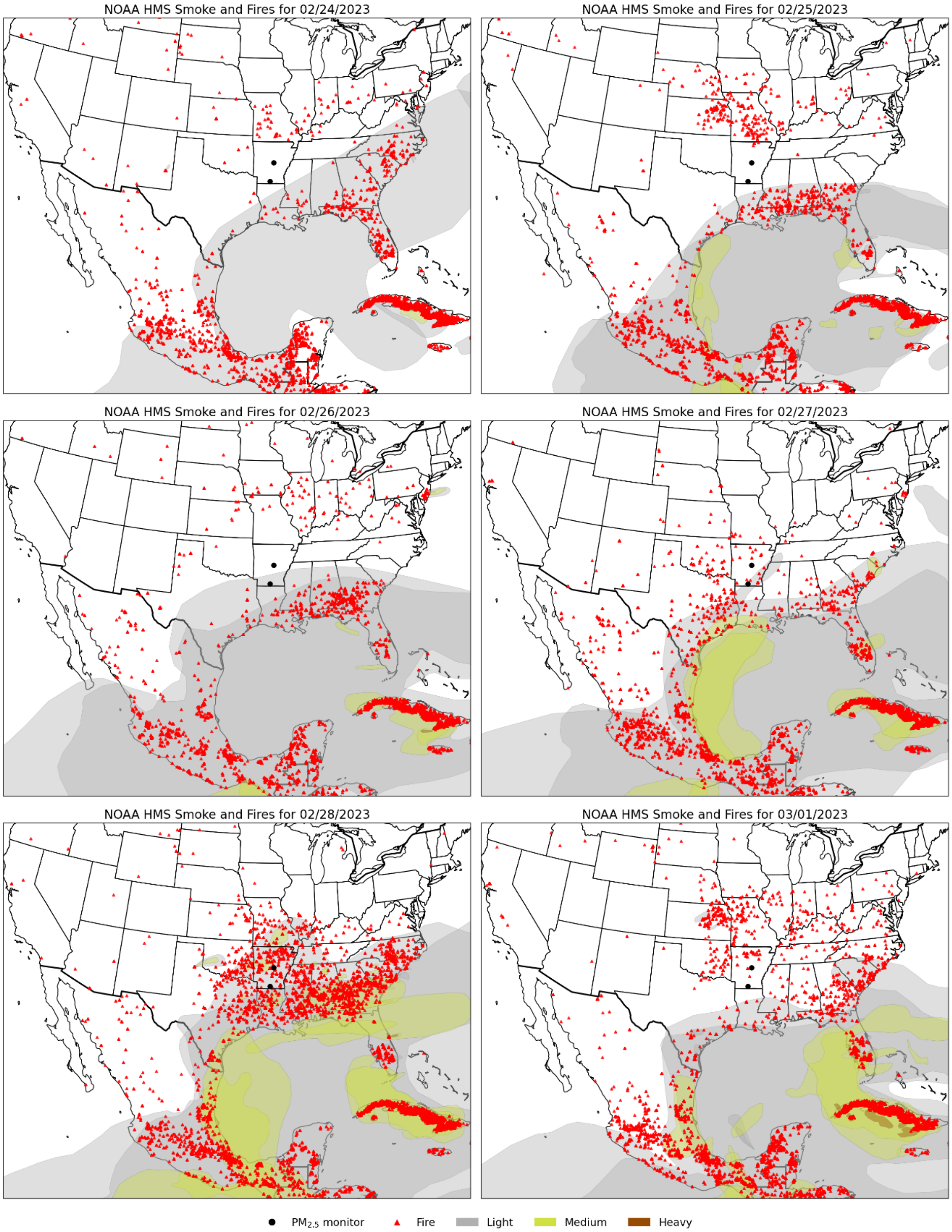


Figure 2-110. Evolution of fires and smoke for February 24 (top left), February 25 (top right), February 26 (middle left), February 27 (middle right), February 28 (bottom left), and March 1(bottom right).

2.1.5.1 PARR February 27, 2023

Table 2-16 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on February 27, 2023. Figure 2-111 shows that observed PM2.5 concentrations on this day are above the Tier 1 threshold, and Figure 2-112 shows it is above the 99^{th} percentile of historical values over the last five years. Back trajectories in Figure 2-113 show that air mases pass through regions with medium density smoke, while forward trajectories in Figure 2-114 link the influx of smoke from a large fire cluster located in the states of Campeche and Yucatan, Mexico with the impacts at the Parr monitor.

Table 2-16. Exceptional event supporting evidence for PARR on February 27, 2023.

Monitor	PARR (05-119-0007)
Event Date	February 27, 2023
24-hr $PM_{2.5}$ Concentration	24.4 μg/m^3
EPA Tiering Tool Tier 1 Threshold	21.15 μg/m^3
Tier 1 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 1 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: February. Date accessed: 11/20/2024.

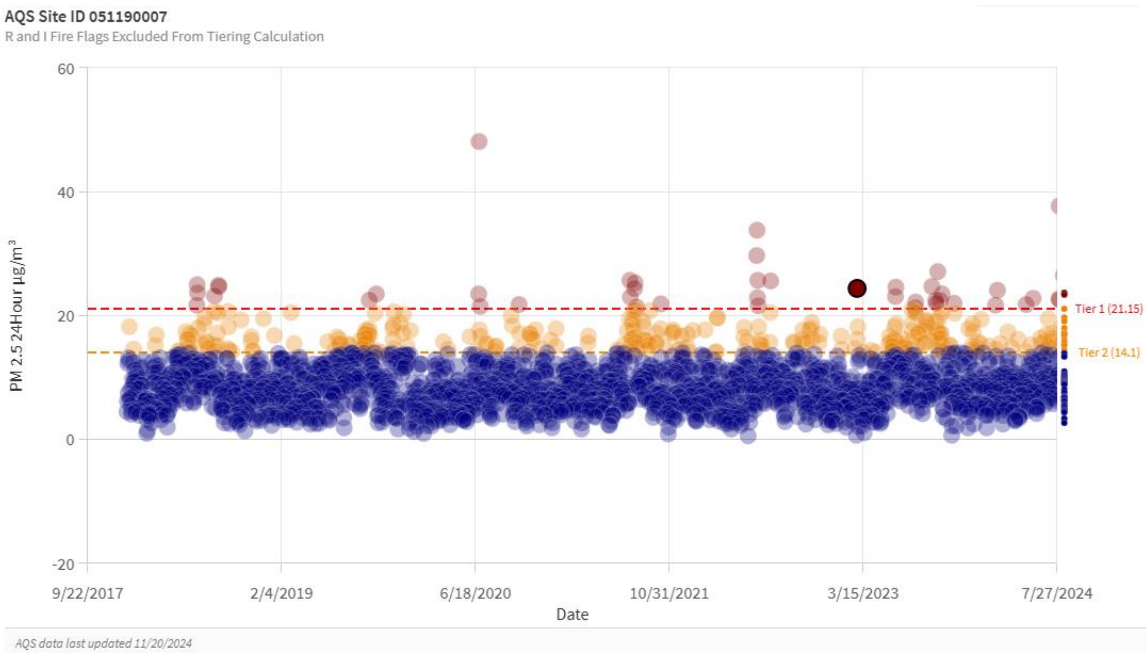


Figure 2-111. EPA PM2.5 Tiering Tool PARR on February 27, 2023.

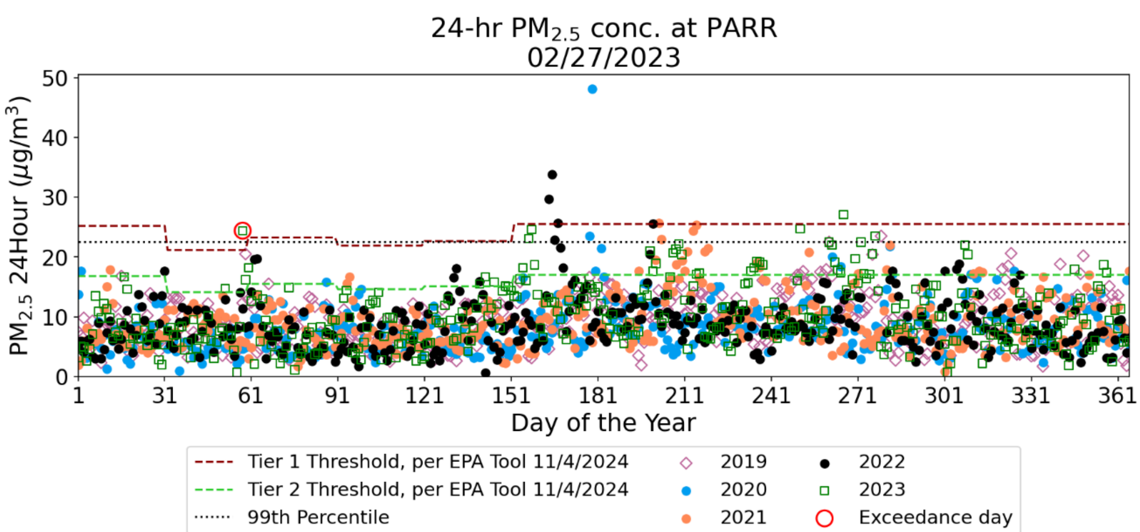


Figure 2-112. Historical 24-hour PM2.5 seasonal fluctuations for Jackson SLAMS compared to February 27, 2023.

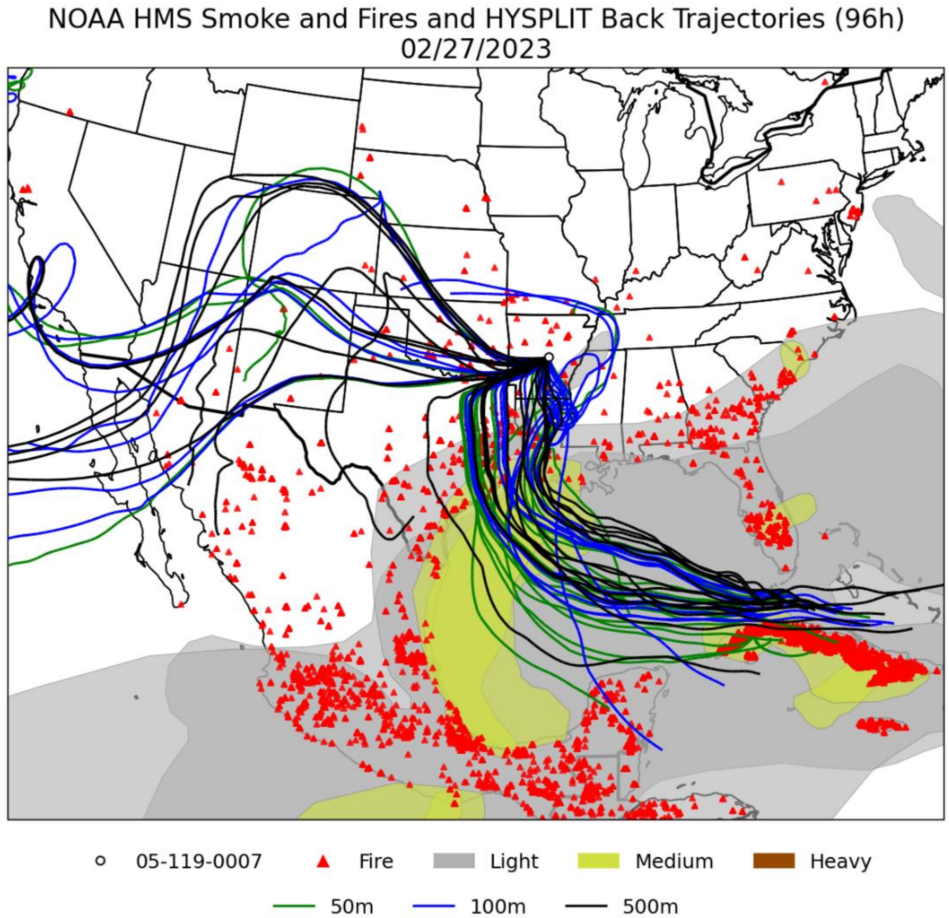


Figure 2-113. HYSPLIT back trajectories for PARR on February 27, 2023.

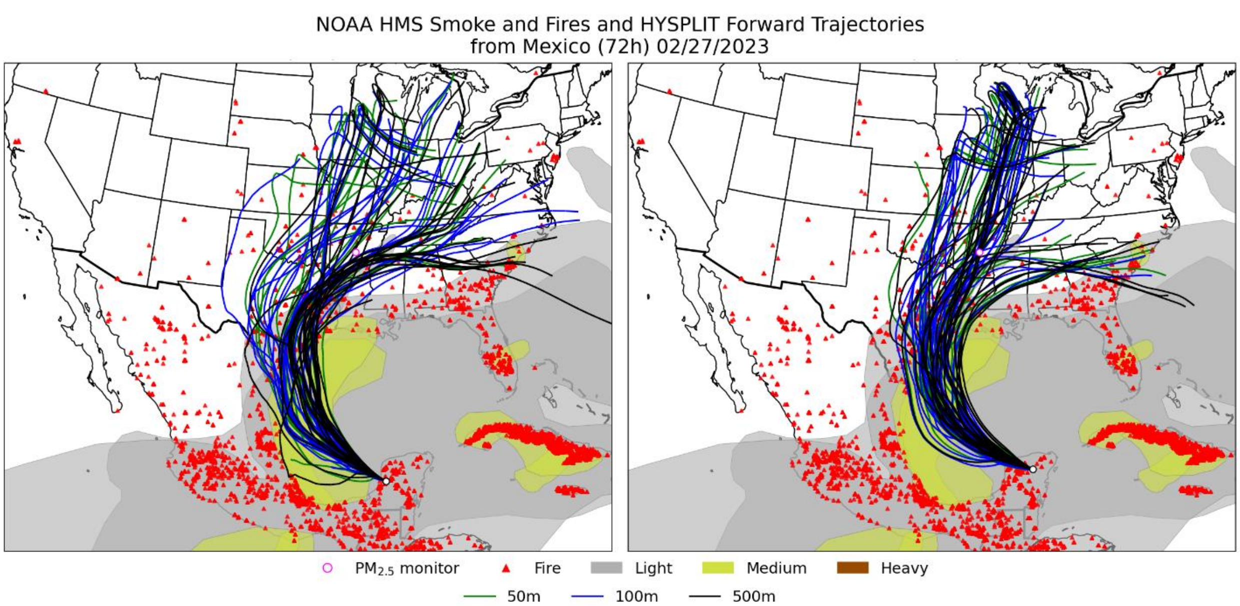


Figure 2-114. HYSPLIT forward trajectories from Mexico for PARR on February 27, 2023.

2.1.5.2 PARR February 28, 2023

Table 2-17 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on February 28, 2023. Figure 2-115 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold. Figure 2-117 shows that the back trajectories pass through regions with medium density smoke over the Gulf of Mexico before arriving at the monitoring site. Forward trajectories in Figure 2-118 link the influx of smoke originating from a fire cluster located in Campeche, Mexico with the impacts at the Parr monitor.

Table 2-17. Exceptional event supporting evidence for PARR on February 28, 2023.

Monitor	PARR (05-119-0007)
Event Date	February 28, 2023
24-hr $PM_{2.5}$ Concentration	16.2 µg/m^3
EPA Tiering Tool Tier 2 Threshold	14.1 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: February. Date accessed: 11/20/2024.

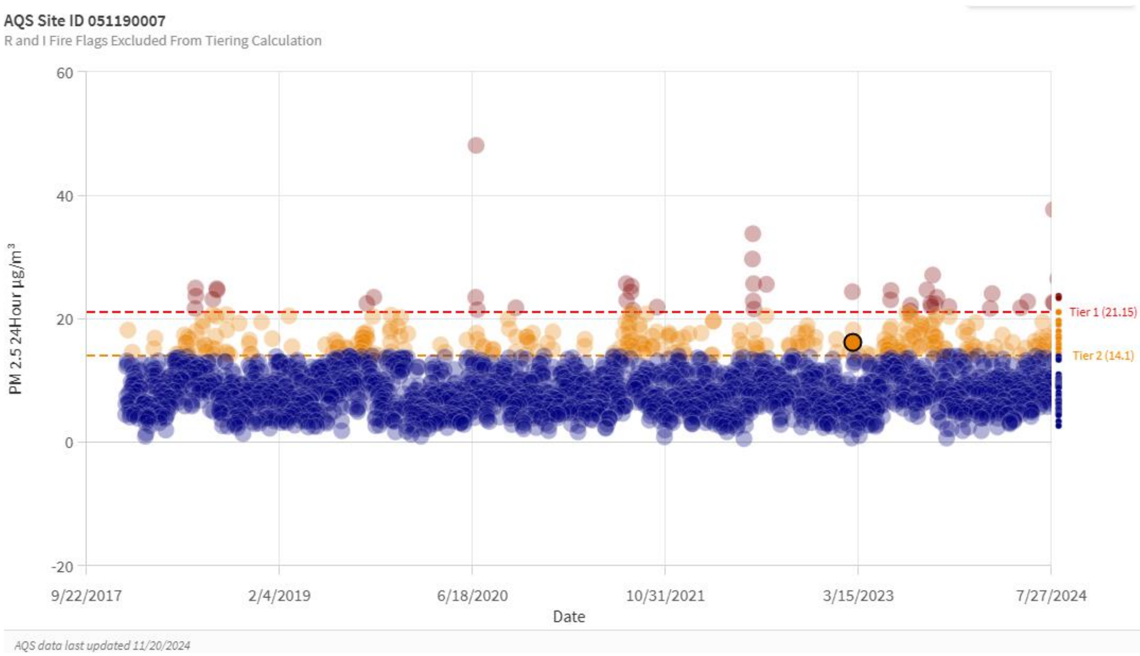


Figure 2-115. EPA $PM_{2.5}$ Tiering Tool PARR on February 28, 2023.

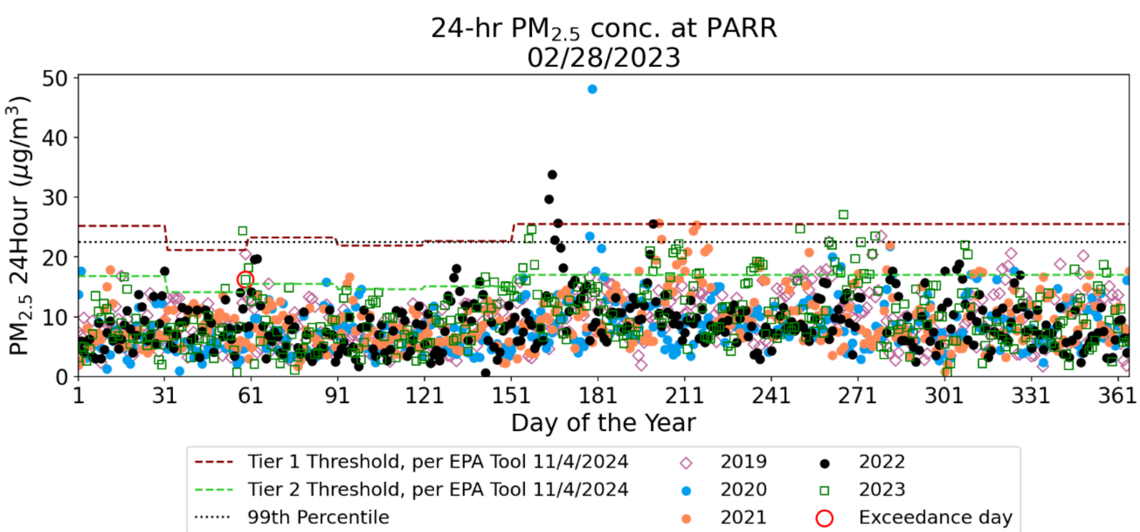


Figure 2-116. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to February 28, 2023.

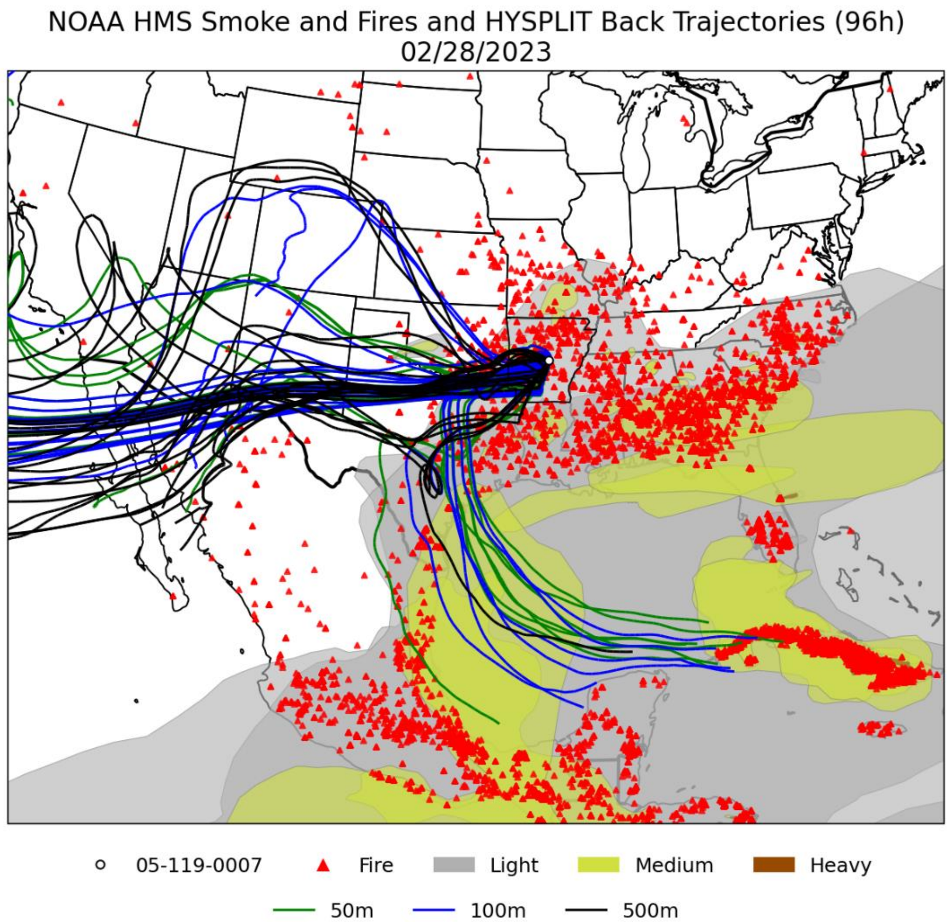


Figure 2-117. HYSPLIT back trajectories for PARR on February 28, 2023.

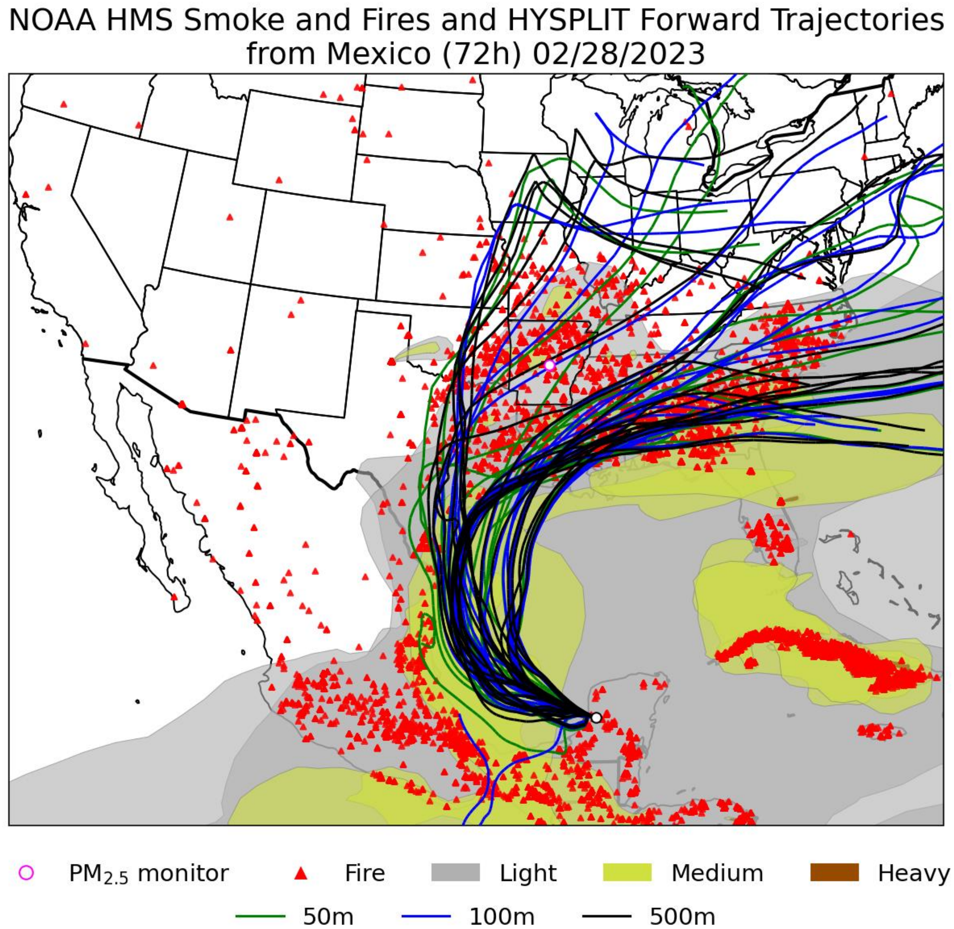


Figure 2-118. HYSPLIT forward trajectories from Mexico for PARR on February 28, 2023.

2.1.5.3 PARR March 1, 2023

Table 2-18 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on March 1, 2023. Figure 2-119 shows that this day is above the Tier 2 threshold. Figure 2-121 shows that back trajectories cross a region of light and medium smoke over the Gulf of Mexico and reach as far back as the Yucatan peninsula in Mexico, where multiple fires were burning. Forward trajectories in Figure 2-122 link the influx of smoke originating from fires located in the states of Tabasco and Chiapas in Mexico with impacts at the Parr monitor.

Table 2-18. Exceptional event supporting evidence for PARR on March 1, 2023.

Monitor	PARR (05-119-0007)
Event Date	March 1, 2023
24-hr PM$_{2.5}$ Concentration	18.2 μg/m^3
EPA Tiering Tool Tier 2 Threshold	15.5 μg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: March. Date accessed: 11/20/2024.

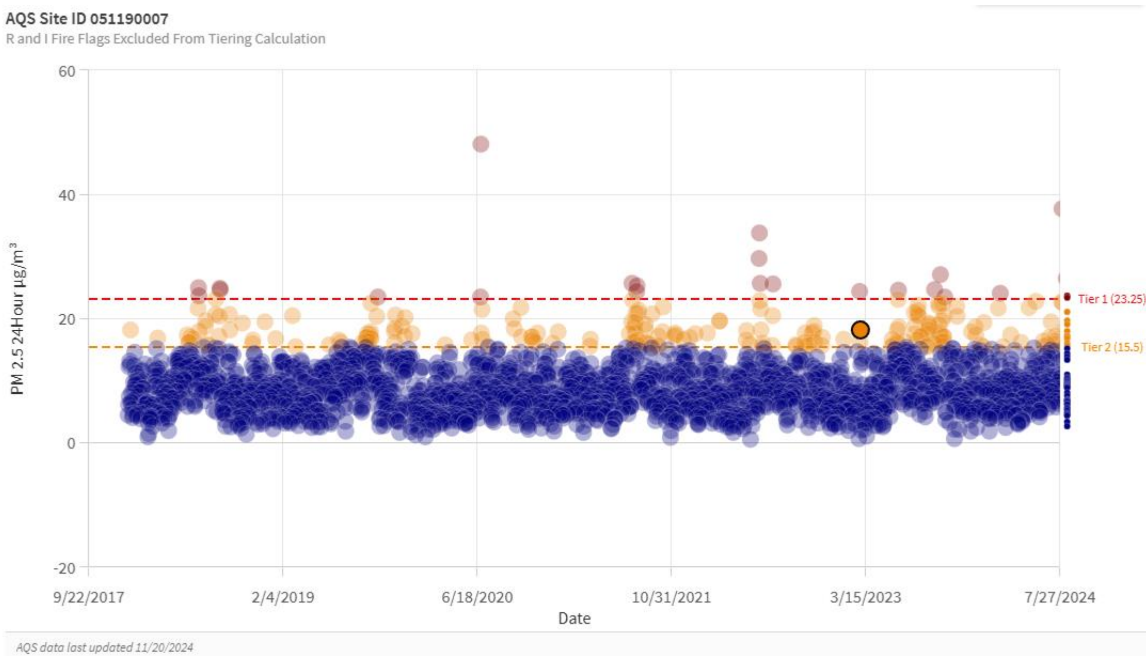


Figure 2-119. EPA PM2.5 Tiering Tool for PARR on March 1, 2023.

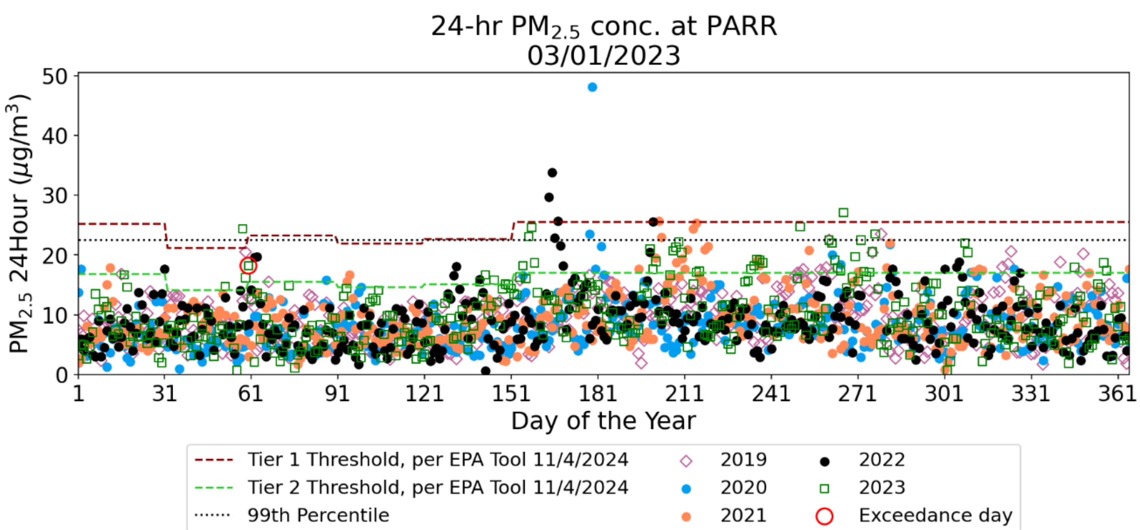


Figure 2-120. Historical 24-hour PM2.5 seasonal fluctuations for PARR compared to March 1, 2023.

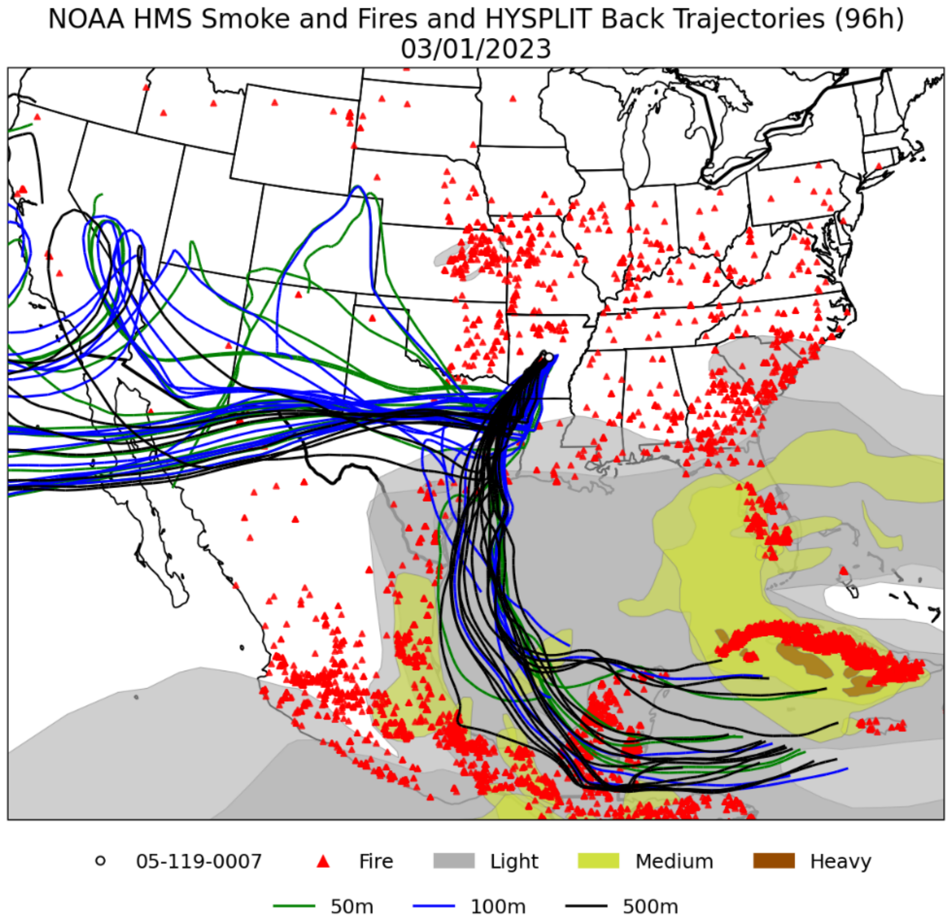


Figure 2-121. HYSPLIT back trajectories for PARR on March 1, 2023.

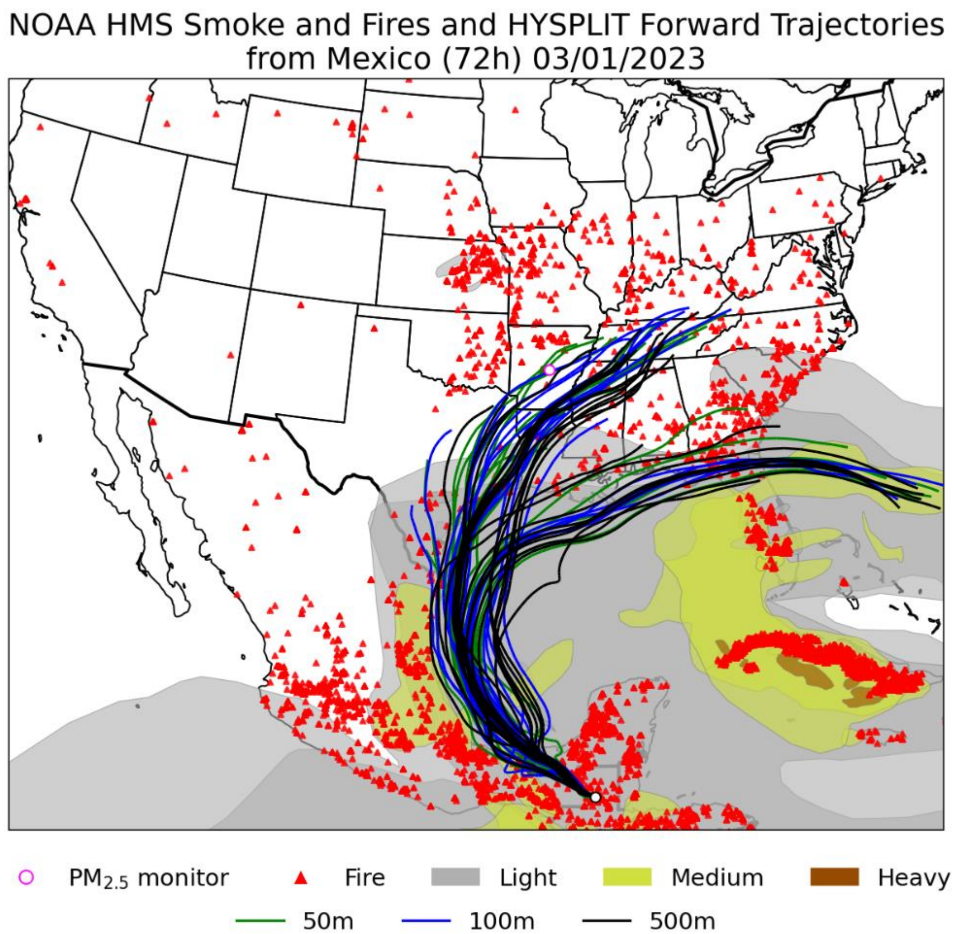


Figure 2-122. HYSPLIT forward trajectories from Mexico for PARR on March 1, 2023.

2.1.5.4 El Dorado March 1, 2023

Table 2-19 summarizes the evidence supporting the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on March 1, 2023. Figure 2-123 shows that this day exceeds the Tier 2 threshold. Figure 2-125 shows that back trajectories cross a region of light and medium smoke over the Gulf of Mexico and reach as far back as the Yucatan peninsula in Mexico, where multiple fires were burning. Forward trajectories in Figure 2-126 link the influx of smoke originating from fires located in the states of Tabasco and Chiapas in Mexico with impacts at El Dorado monitor.

Table 2-19. Exceptional event supporting evidence for El Dorado on March 1, 2023.

Monitor	El Dorado (05-139-0006)
Event Date	March 1, 2023
24-hr $PM_{2.5}$ Concentration	19.1 $\mu g/m^3$
EPA Tiering Tool Tier 2 Threshold	17.6 $\mu g/m^3$
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: March. Date accessed: 11/20/2024.

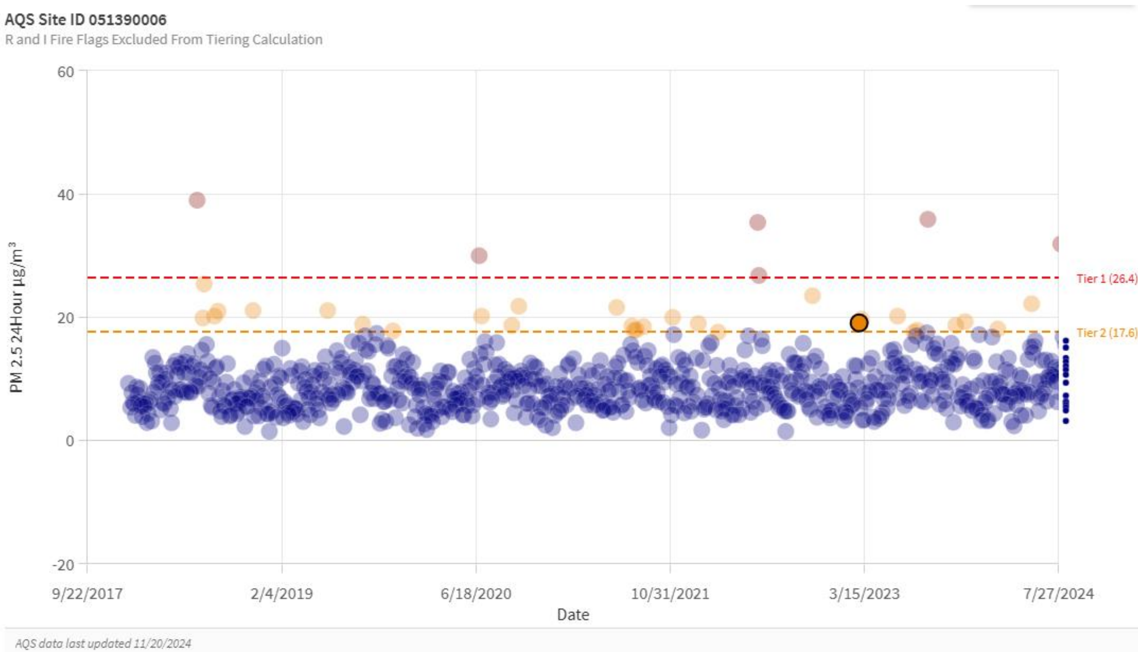


Figure 2-123. EPA PM2.5 Tiering Tool for El Dorada on March 1, 2023.

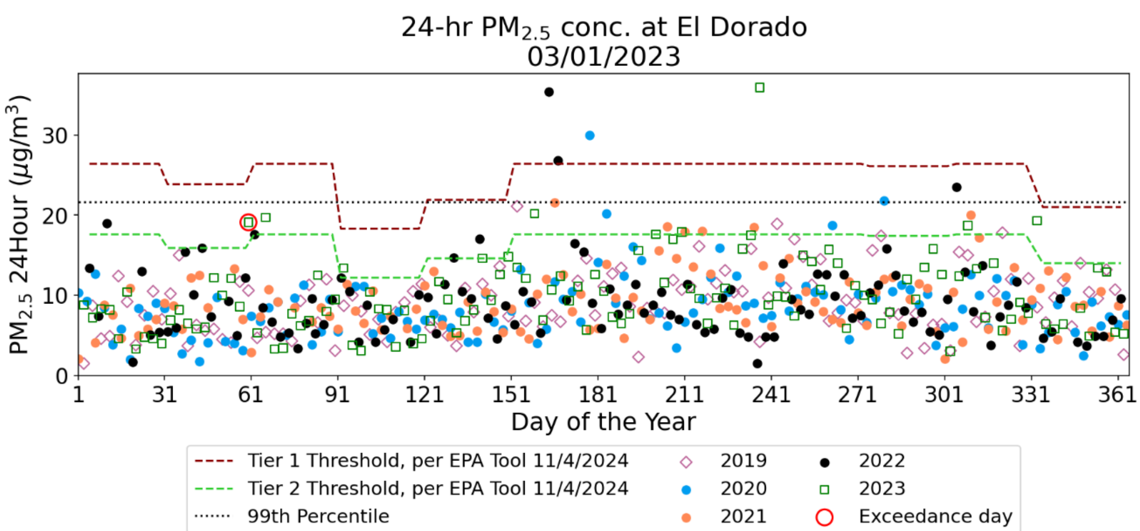


Figure 2-124. Historical 24-hour PM2.5 seasonal fluctuations for El Dorado compared to March 1, 2023.

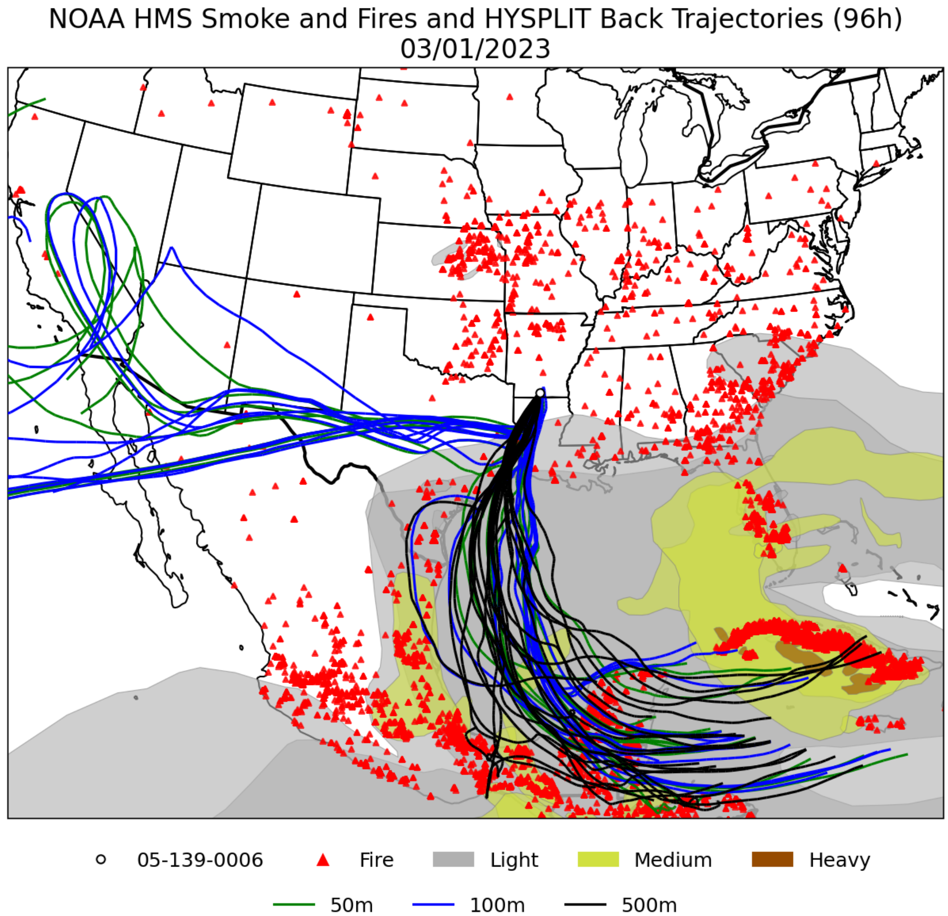


Figure 2-125. HYSPLIT back trajectories for El Dorado on March 1, 2023.

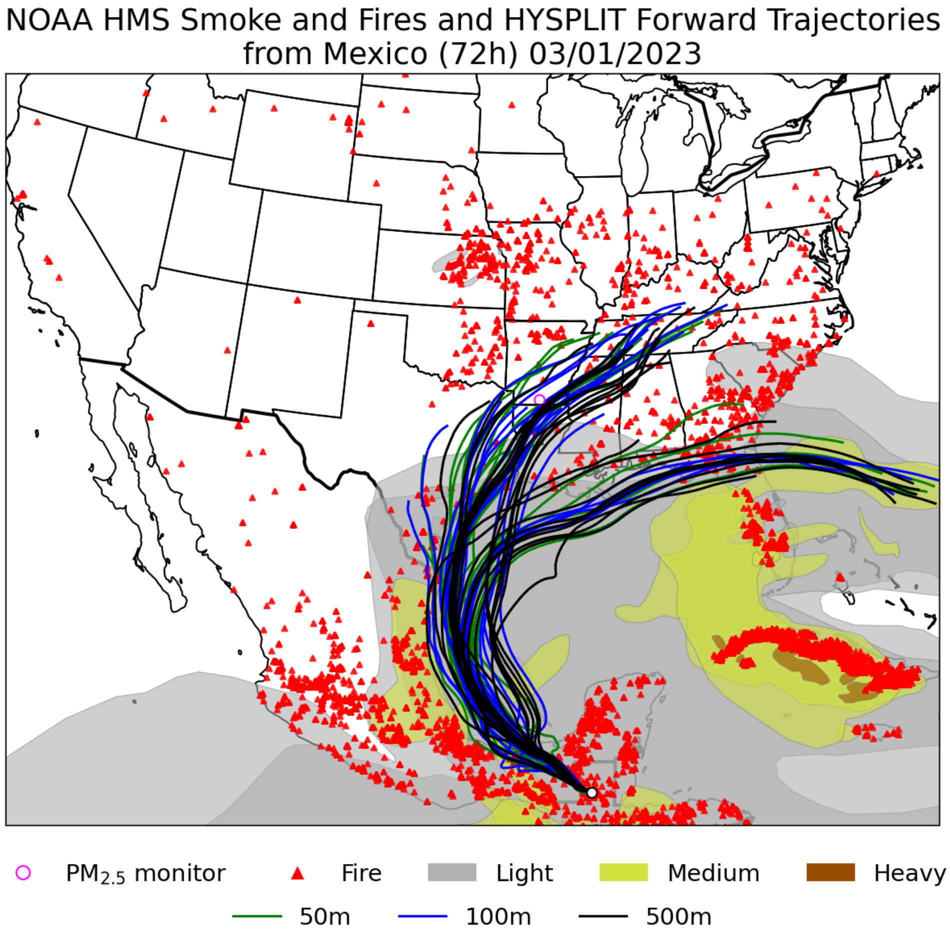


Figure 2-126. HYSPLIT forward trajectories from Mexico for El Dorado on March 1, 2023.

2.1.6 April 3, 2023

During April 2023, there were multiple fires burning over several regions in Mexico. An annual description of the fire incidences in the country is presented in Section 2.1.5 and summarized in Figure 2-102. Figure 2-103 shows the weekly number of forest fires and area burned in Mexico during 2023. The figure shows that on April 3, 2023 (week 14) fires continue to grow every week as the total area burned was 38,594 ha[32] and the number of forest fires incidences was 472, the second largest in the year.

The 500 mb synoptic analysis on April 3 (Figure 2-127) shows the presence of a trough over the western U.S that sustains southwesterly flow over most of the continental U.S. This southwesterly flow allows the efficient transport of smoke into Arkansas from fires located in Mexico.[33] The surface analysis map (Figure 2-128) shows that Arkansas is situated on the eastern edge of a large low pressure system centered in Oklahoma and Texas that produces south to southeasterly flow into Arkansas, helping pull warm air from the Gulf of Mexico and thus transport smoke from fires occurring in Mexico. The tight isobar spacing in this region also indicates the potential for breezy to windy conditions. The presence of a stationary front north of Arkansas passing through Kansas, Missouri, and Illinois prevented the smoke from being transported further north.

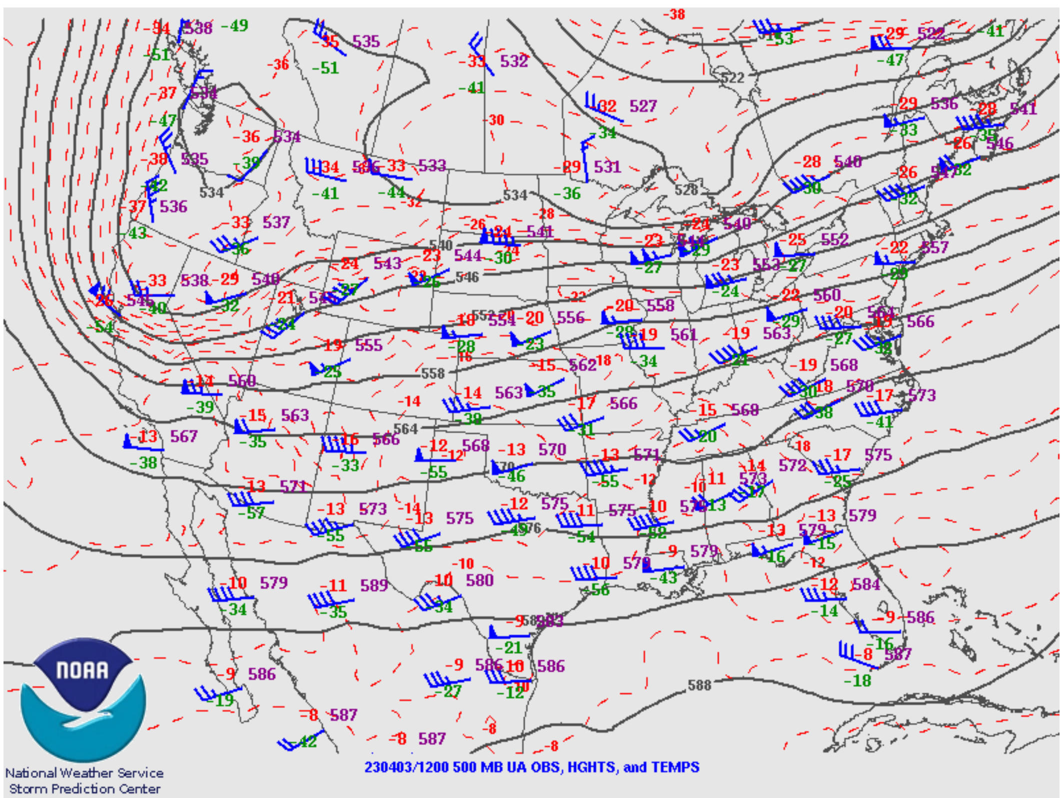


Figure 2-127. 500 mb synoptic analysis map at 12 UTC on April 3, 2023.

[32] Mexico Fires statistics available at: https://monitor_incendios.cnf.gob.mx/incendios_tarjeta_semanal

[33] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=04&STARTDAY=03&STARTTIME=00&INC=-48

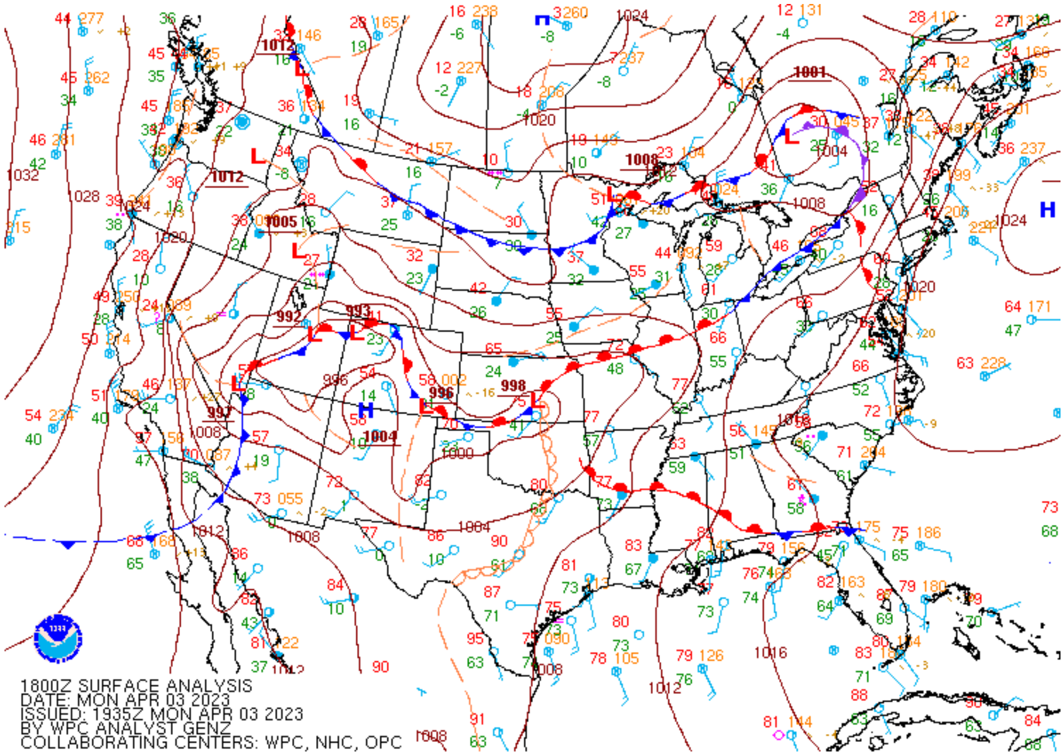


Figure 2-128. Surface synoptic analysis maps at 18 UTC on April 3, 2023.

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The NOAA HMS product in Figure 2-129 shows that light smoke covers Arkansas and some parts of southeast U.S., eastern Texas, and the Gulf Coast during April 3, 2023. Moderate values of the AQI in Arkansas (Figure 2-131) suggest that this smoke mixed down to the surface affecting monitors at Arkansas, Louisiana, and eastern Texas. Figure 2-129 and Figure 2-133 shows the evolution of the smoke plumes from multiple active fires in Mexico during this and prior days. The NAAPS modeling product shows that PM surface concentrations with influence from Mexican fires can range between 2 and 16 $\mu g/m^3$.

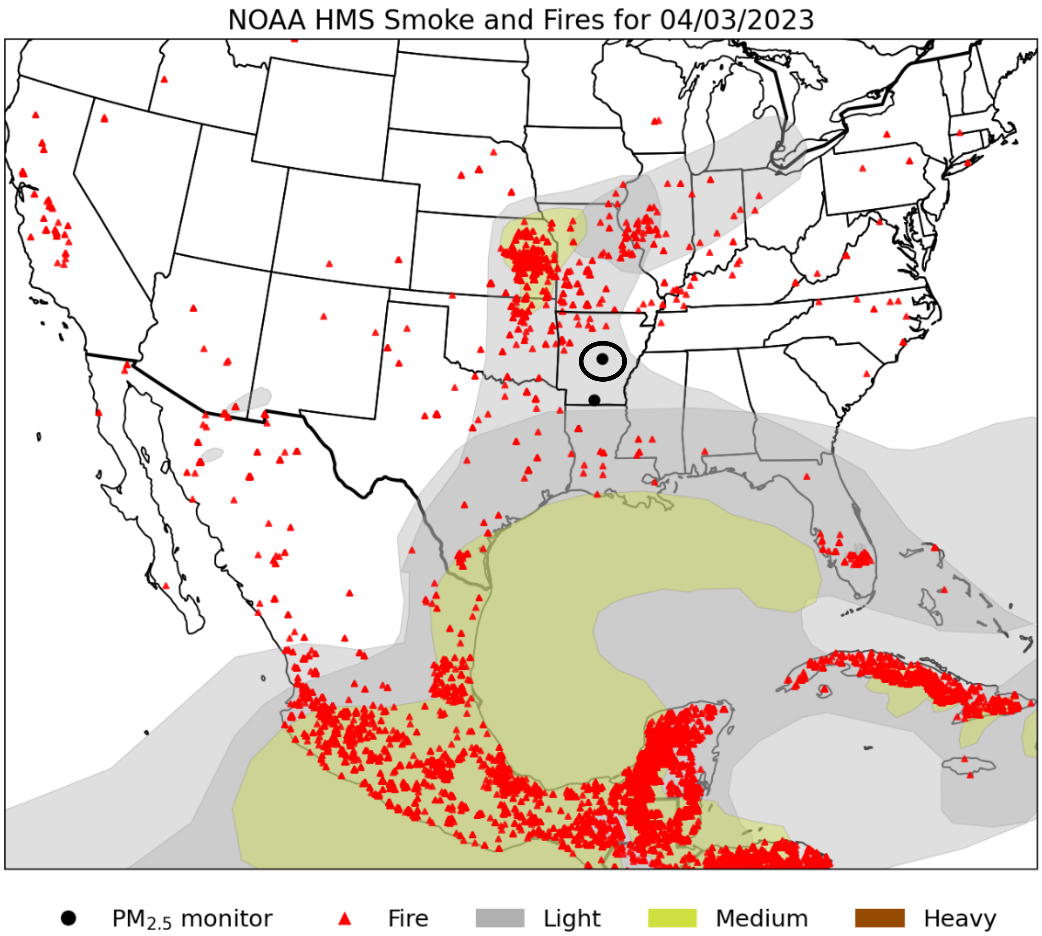


Figure 2-129. NOAA HMS fire and smoke products for April 3, 2023.

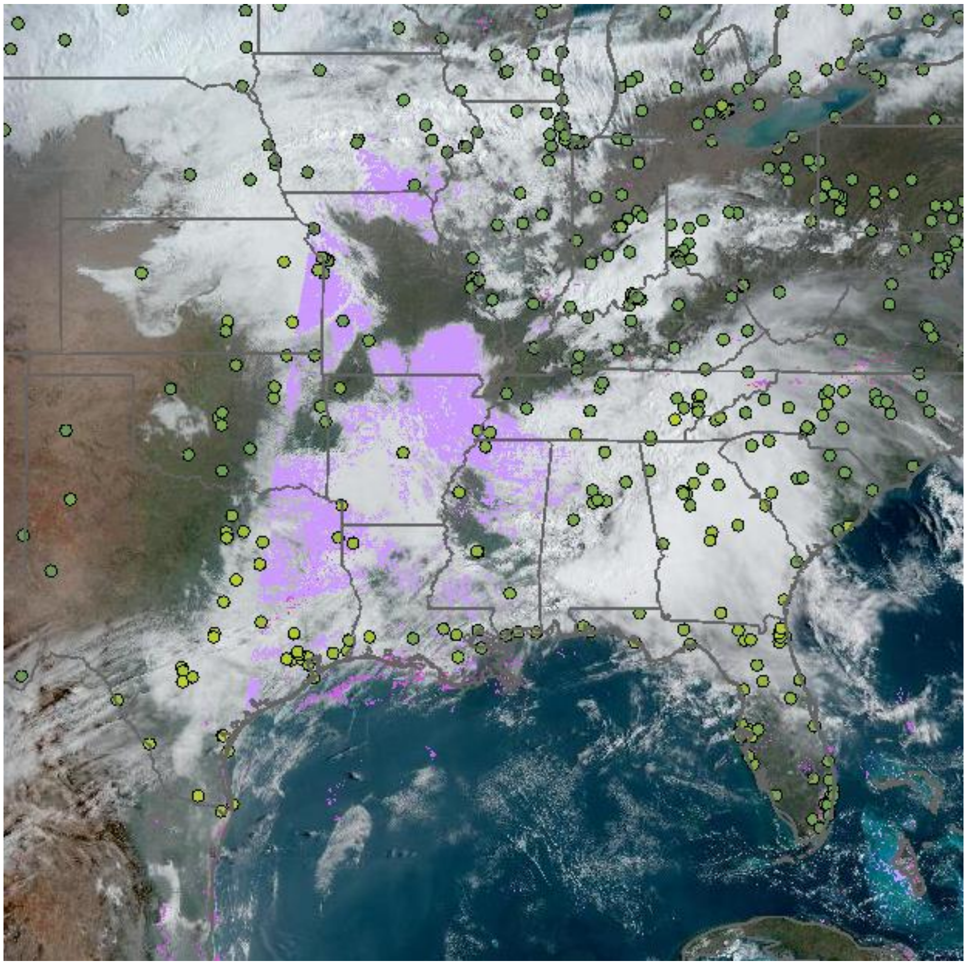


Figure 2-130. NOAA satellite visible imagery on April 3 at 1351 UTC.

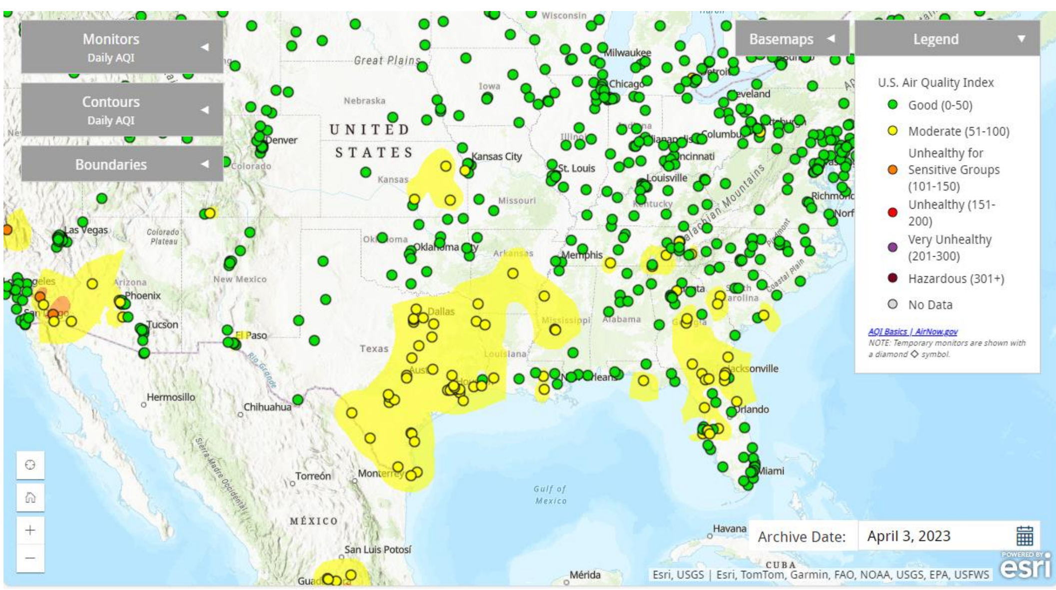


Figure 2-131. AirNow surface level $PM_{2.5}$ concentration contours for April 3, 2023.

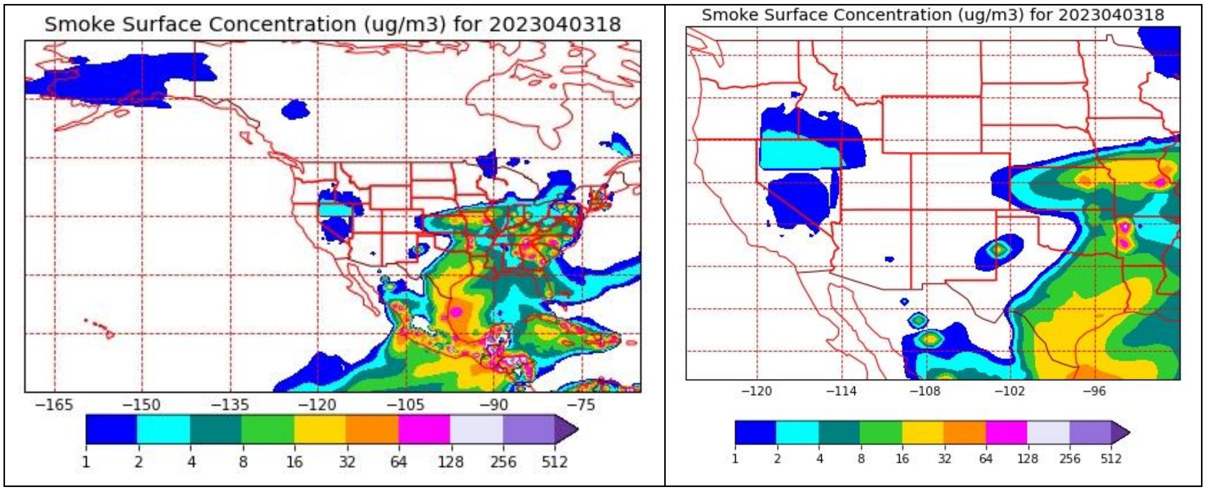


Figure 2-132. NAAPS modeled near-surface smoke concentrations (μg/m^3) at 18Z on April 3, 2023. North America regional plot on the left and western U.S. plot on the right.

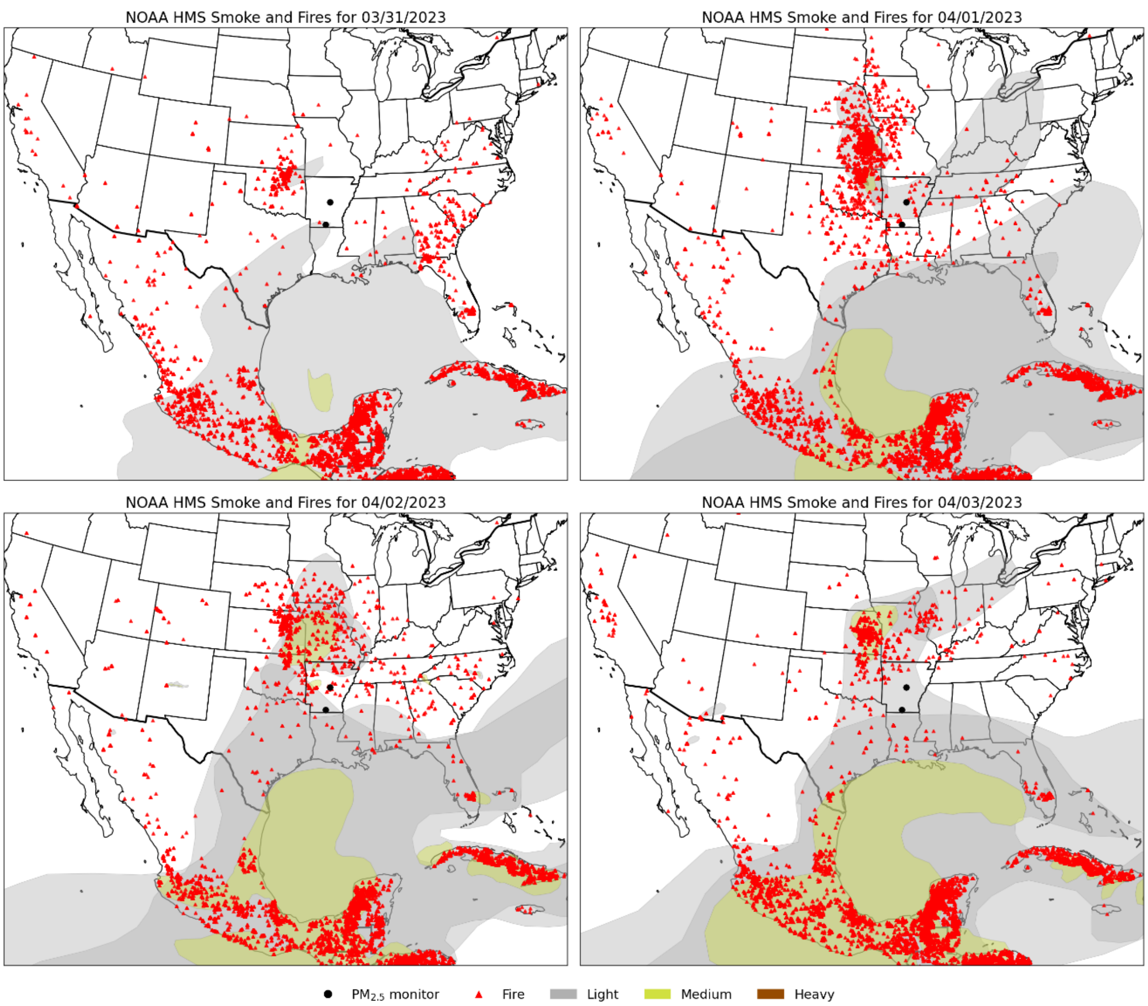


Figure 2-133. Evolution of fires and smoke for March 31 (top left), April 1 (top right), April 2 (bottom left), and April 3 (bottom right).

2.1.6.1 El Dorado April 3, 2023

Table 2-20 summarizes the evidence gathered to support the demonstration of an exceptional event for El Dorado (AQS ID 05-139-0006) on April 3, 2023. Figure 2-134 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold. Backward and forward trajectories shown in Figure 2-136 and Figure 2-137 link several active fires burning prior to this day in the states of Campeche and Yucatan, Mexico with high observed concentrations at El Dorado monitor.

Table 2-20. Exceptional event supporting evidence for El Dorado on April 3, 2023.

Monitor	El Dorado (05-139-0006)
Event Date	April 3, 2023
24-hr $PM_{2.5}$ Concentration	13.4 µg/m^3
EPA Tiering Tool Tier 2 Threshold	12.2 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Mexico
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: April. Date accessed: 11/20/2024.

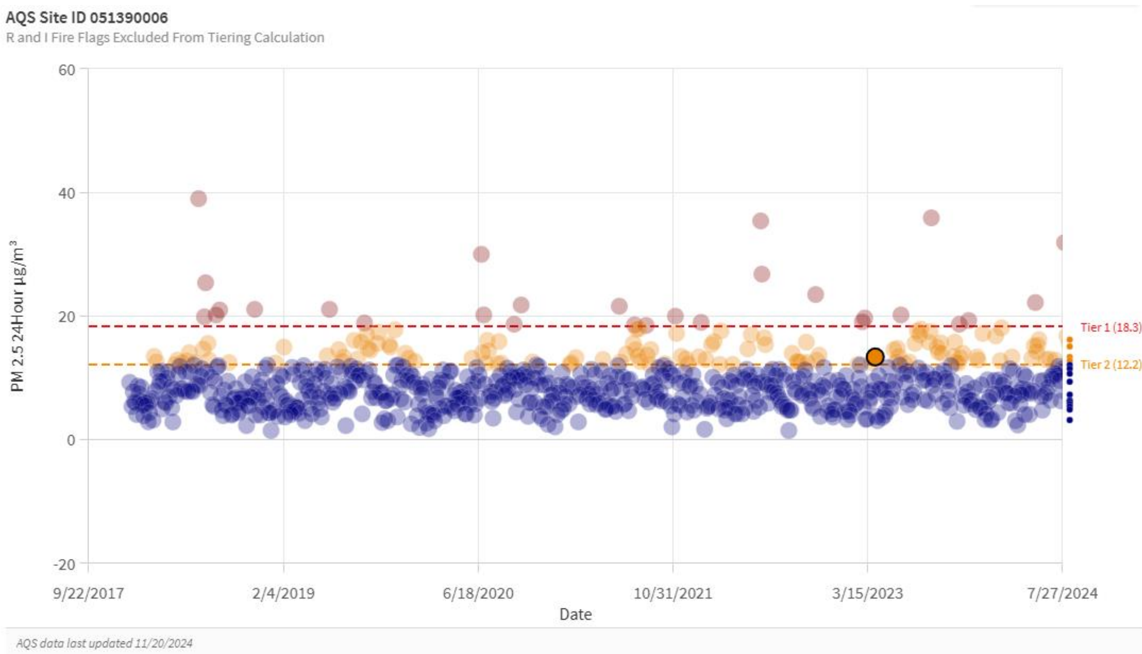


Figure 2-134. EPA PM2.5 Tiering Tool for El Dorado on April 3, 2023.

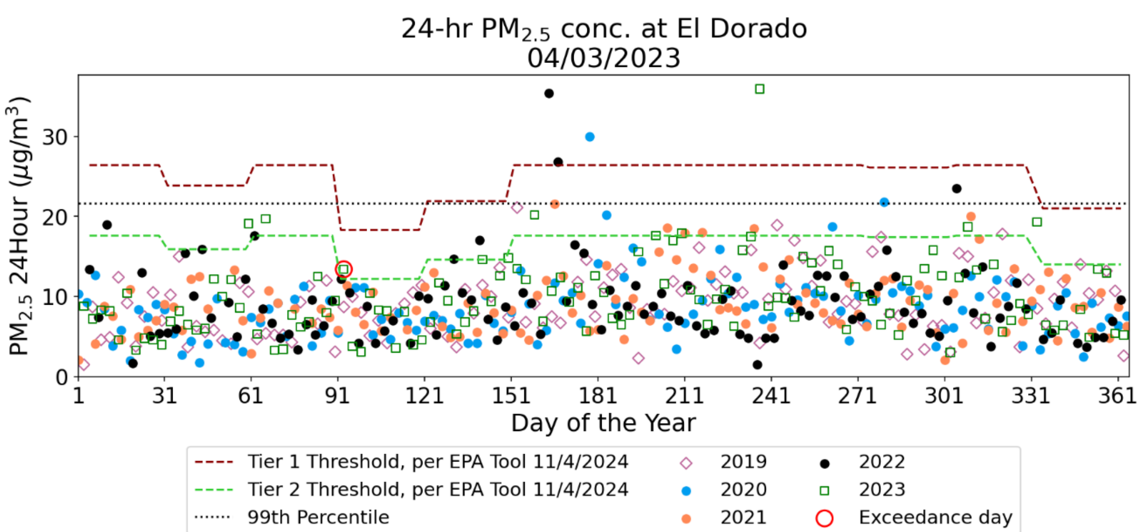


Figure 2-135. Historical 24-hour PM2.5 seasonal fluctuations for El Dorado compared to April 3, 2023.

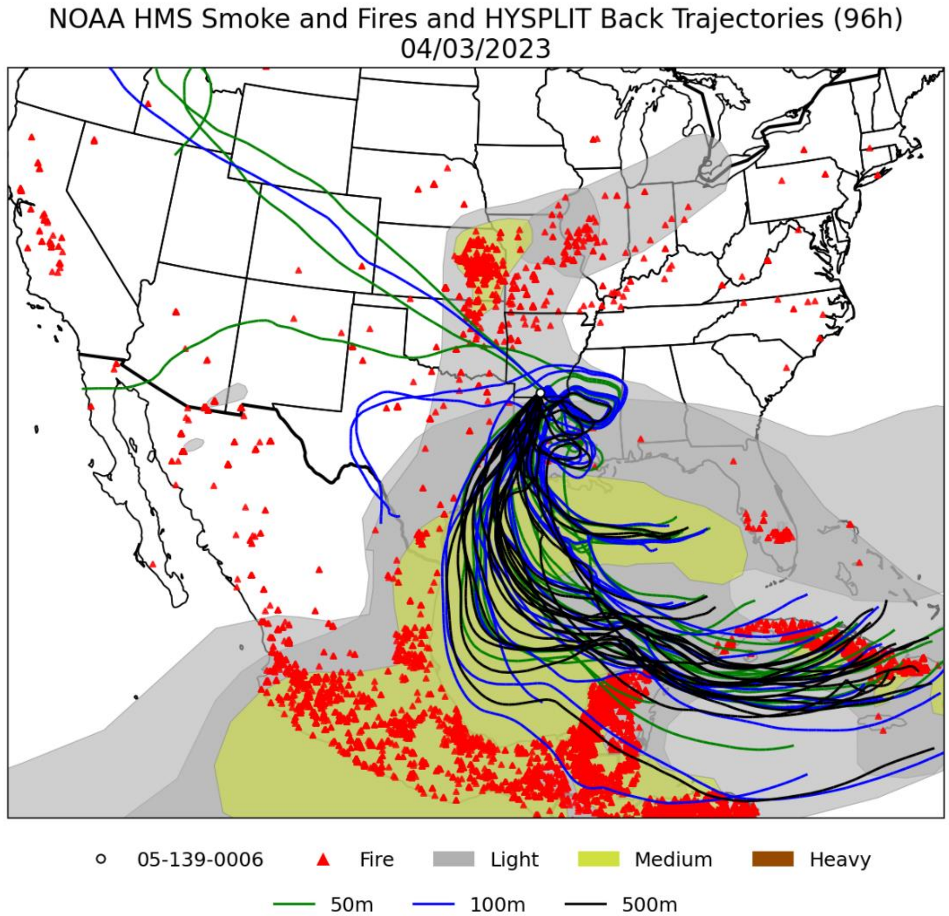


Figure 2-136. HYSPLIT back trajectories for El Dorado on April 3, 2023.

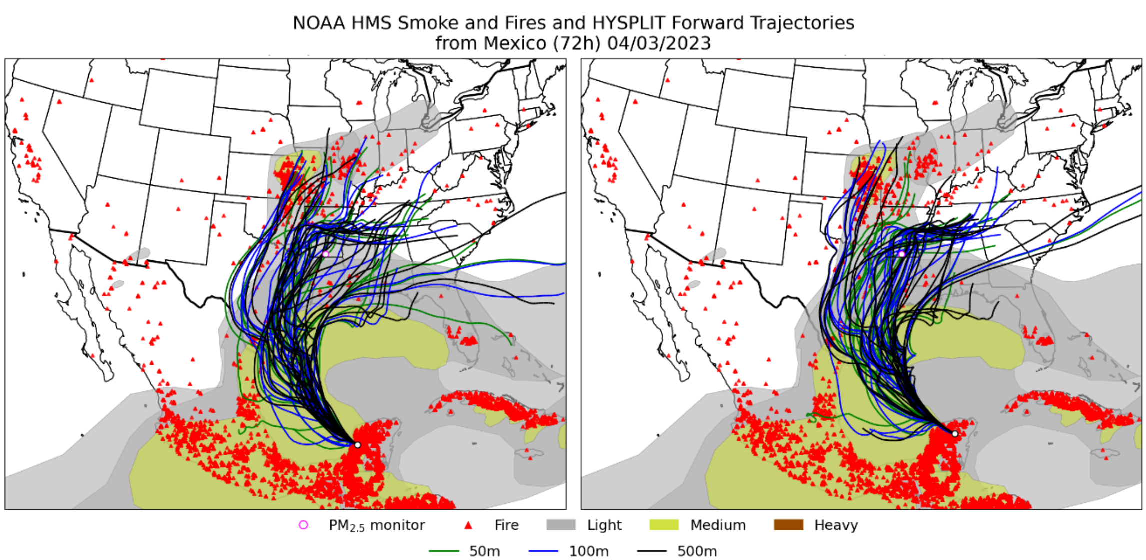
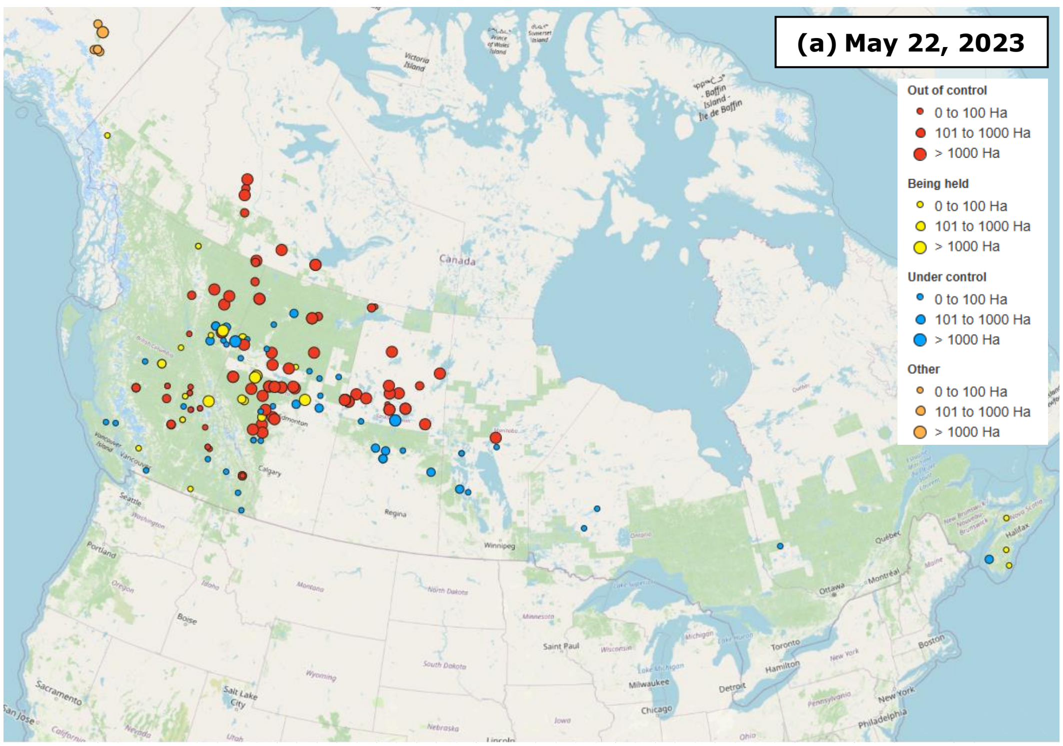


Figure 2-137. HYSPLIT forward trajectories from Mexico for El Dorado on April 3, 2023.

2.1.7 May 22 and May 30, 2023

During the end of May wildfires burning in northwestern Canada (Figure 2-138) produced smoke that affected the air quality at several locations in the U.S. The Long Lake Fire (HWF036) was detected on May 3, 2023, in Alberta, Canada. In mid-May, it had grown significantly, becoming a prominent wildfire during an intense fire season in Canada. By late May, the fire had covered over 150,000 ha (Figure 2-139). Weather conditions, such as high temperatures and low humidity, favored the fire's growth. The Paskwa fire (HWF030) located in Alberta had a burnt area of 80,560 ha by May 29, 2023. An unnamed fire in Alberta had burned 119,916 ha as of May 25, 2023. There were also multiple fires burning in proximity in the Grizzly Complex Fire. The Eagle fire, in Alberta, burned 73,479 ha as of May 26. The O'Chiese Fire (87,108 ha as of May 23) and the Blackstone Fire (5,089 ha as of May 28) occurred near the O'Chiese First Nation and the Blackstone River regions. The Donnie Creek Fire located in northeastern British Columbia had an estimated 157,500 ha burned by May 2023.



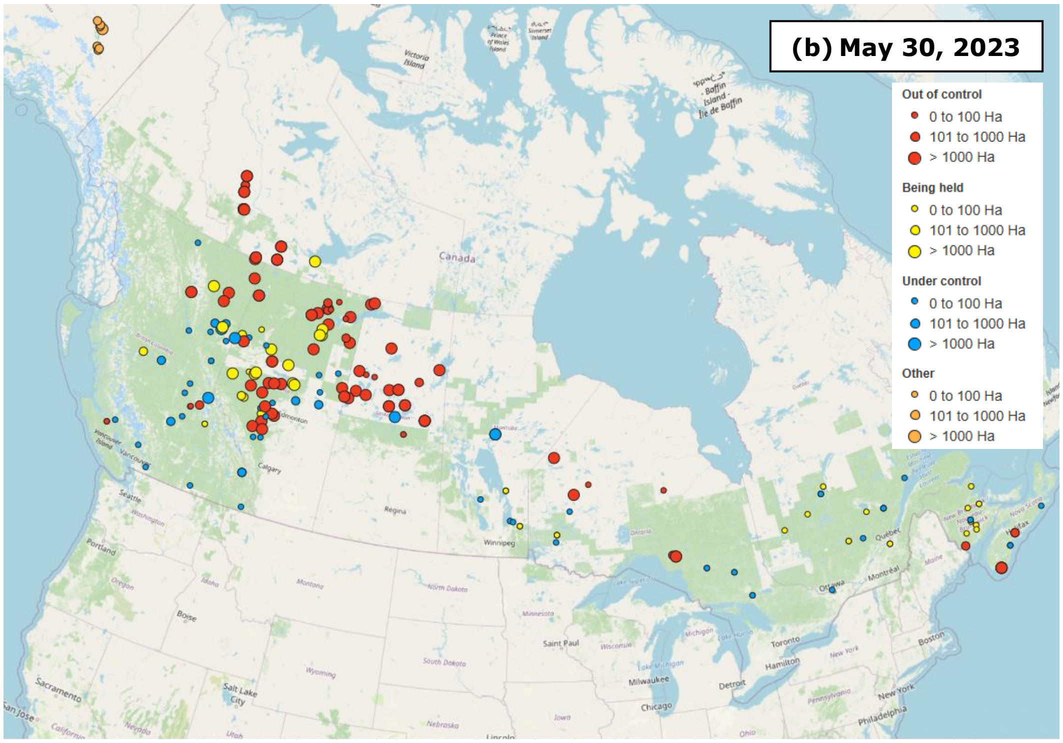
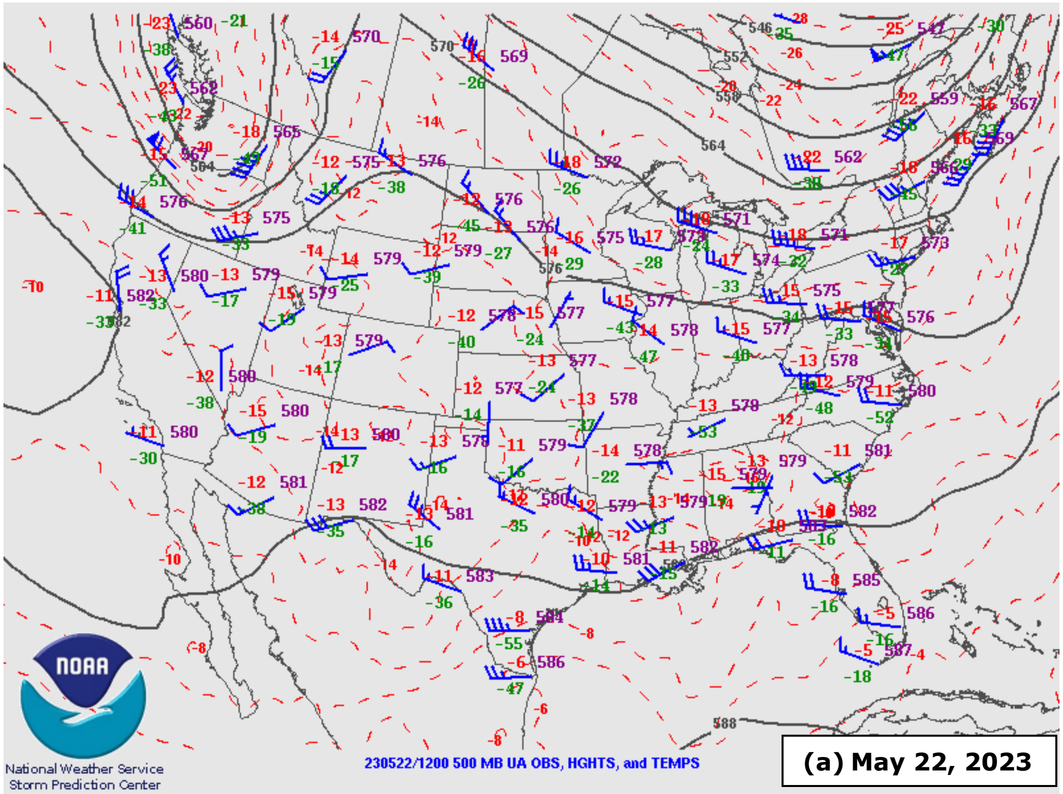


Figure 2-138. Canadian Wildfire Information System map of active fires for (a) May 22 and (b) May 30, 2023. (https://cwfis.cfs.nrcan.gc.ca/interactive-map)

Figure 2-139. The Long Lake Fire in the vicinity of the Town of Rainbow Lake on May 26, 2023. (https://www.youtube.com/watch?v=j7MbpCp6jmo)

The 500 mb synoptic analysis on May 22 (Figure 2-140a) shows the presence of a trough extending across the western U.S. favoring wind to flow from Canada into the central and southeastern U.S. This pattern is conducive to the transport of smoke from northwest Canadian wildfires southward. Stronger winds and height gradients near the trough and ridging over the eastern U.S. likely facilitated the advection of smoke over Arkansas, supported by the upper-level flow moving from northwest to southeast. The weak high-pressure system centered over the southwestern U.S. further contributes to the north-to-south flow over the central U.S., aiding the transport of smoke from Canada. The surface weather map for May 22, 2023, (Figure 2-141a), shows a strong high-pressure system was centered over the eastern U.S., resulting in relatively stable and warm conditions in the region. In contrast, a low-pressure system over parts of the northern and central Plains, accompanied by frontal boundaries, contributed to increased instability. Over the western U.S., a series of troughs and smaller-scale disturbances dominated, aligning with the 500 mb analysis, which showed an active trough in the region. These surface features interacted with mid-level flow, influencing smoke transport from Canadian wildfires into the central U.S., including Arkansas. While the ridge in the east and high-pressure systems acted to block and stabilize air masses, the western features facilitated dynamic uplift and transport pathways.

On May 30 (Figure 2-140b), a prominent trough over the western U.S. indicates instability and cooler air. A persistent ridge over the central U.S. promotes warmer and more stable conditions, while a weak ridge over the eastern U.S. leads to relatively stable weather. Wind flow predominantly follows a west-east pattern across the continental U.S. A cutoff low near the southwestern U.S. disrupts the typical westerly flow, interacting with adjacent high-pressure ridges to further stabilize air masses in both the eastern and southwestern U.S. On May 30 (Figure 2-141b), the surface analysis indicates a high-pressure system dominates the southeastern U.S., promoting stable and warm conditions in that region. Meanwhile, a low-pressure system was positioned over the western U.S., accompanied by a cold front extending across the Rockies. A ridge extending through the central U.S. maintained a relatively stable and warm weather regime. These features contributed to the larger-scale west-to-east flow across the continent, consistent with the upper-level pattern. Over Arkansas is situated in a region of relatively mild atmospheric pressure with no immediate proximity to strong low-pressure systems or sharp frontal boundaries. The state is under the influence of a weak pressure gradient, which generally leads calm to moderate wind conditions.



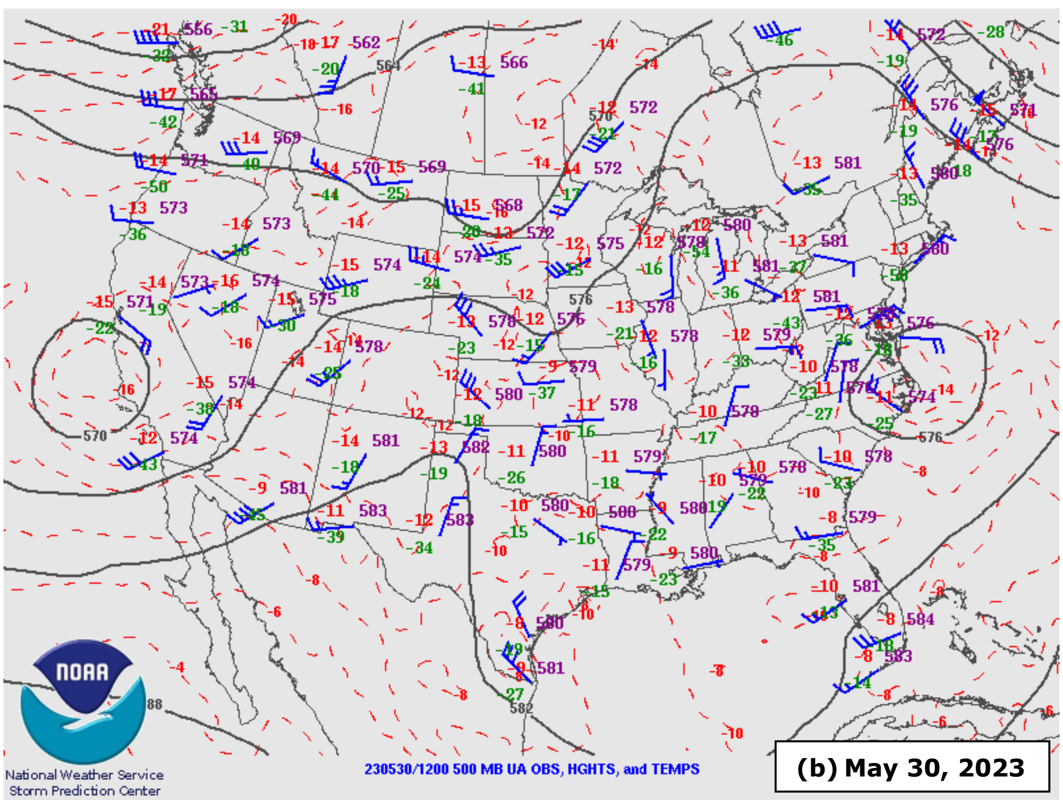


Figure 2-140. 500 mb synoptic analysis map at 12 UTC on (a) May 22 and (b) May 30, 2023.

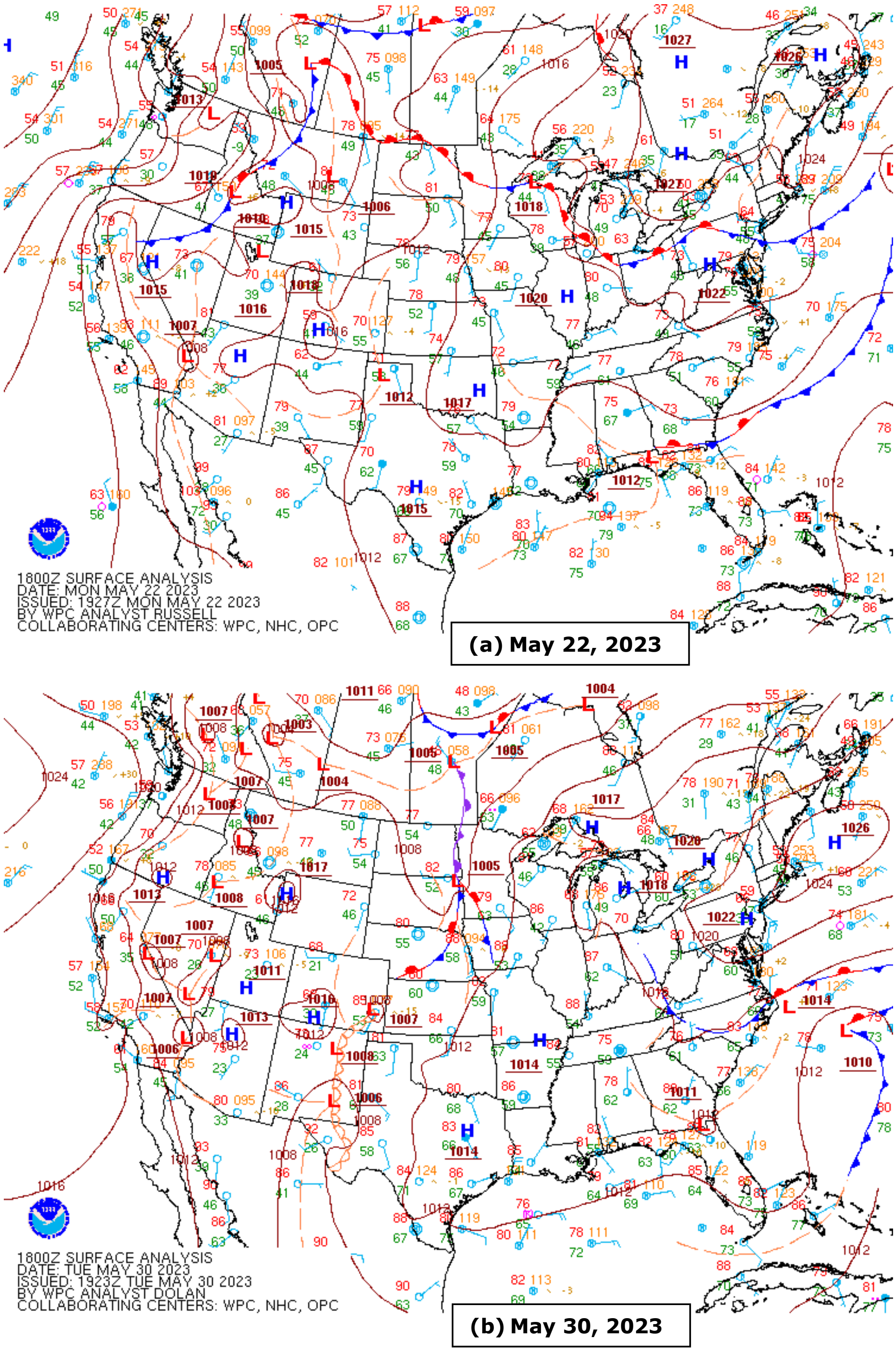


Figure 2-141. Surface synoptic analysis maps (bottom row) at 18 UTC on (a) May 22 and (b) May 30, 2023.

The NOAA HMS product in Figure 2-142 and the NOAA satellite imagery in Figure 2-143 show medium smoke plumes covering Arkansas and heavy smoke plume covering the U.S. Midwest. Moderate values of the AQI (Figure 2-144) and the NAAPS simulated smoke concentrations (Figure 2-145) in the range of 8 to 64 µg/m^3 in Arkansas suggest that this smoke mixed down to the surface affecting monitors over Arkansas and adjacent states (Oklahoma, Texas, Louisiana, and Mississippi). Figure 2-146 and Figure 2-147 show the evolution of the smoke plumes from multiple fires in Saskatchewan and Manitoba provinces in Canada. On May 30, there was remnant smoke lingering over the Midwest and the southeastern U.S.

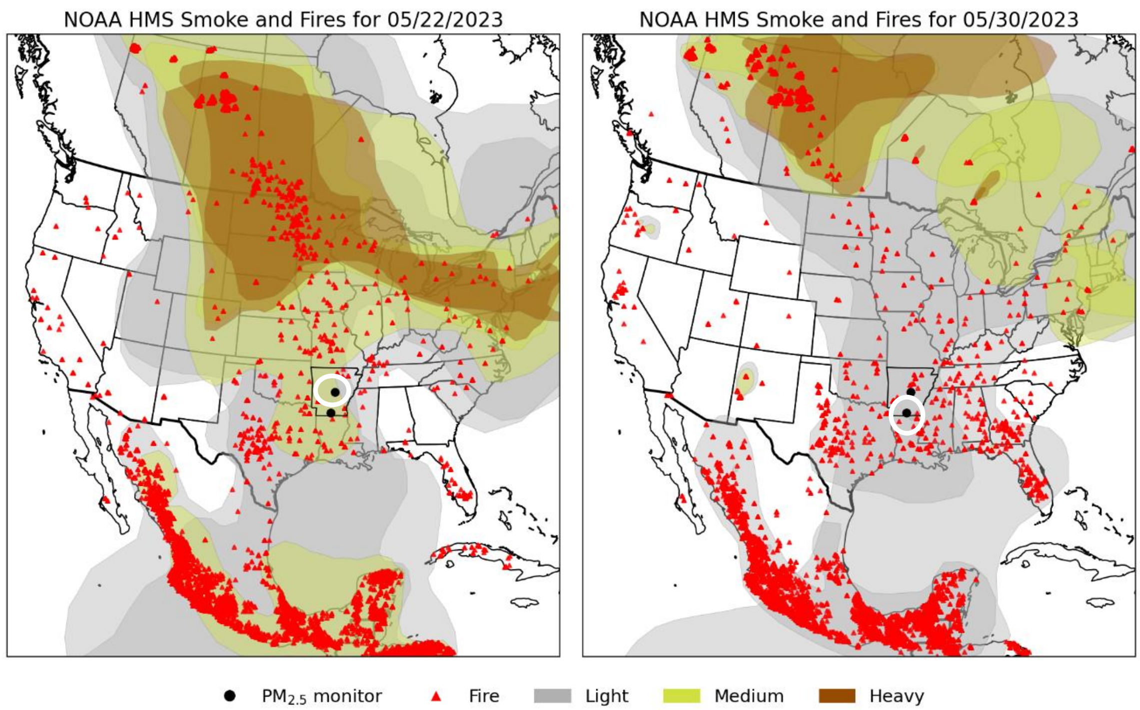
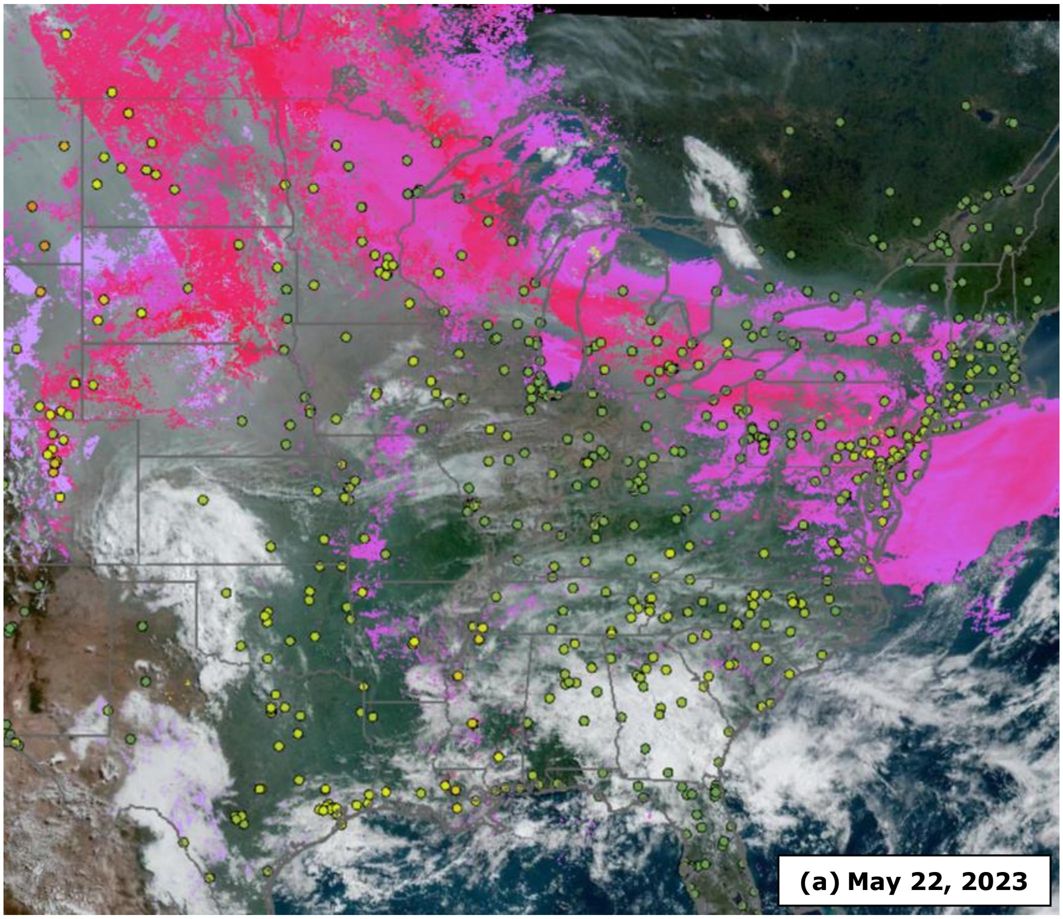


Figure 2-142. NOAA HMS fire and smoke products for May 22 (left) and May 30 (right), 2023.


(a) May 22, 2023

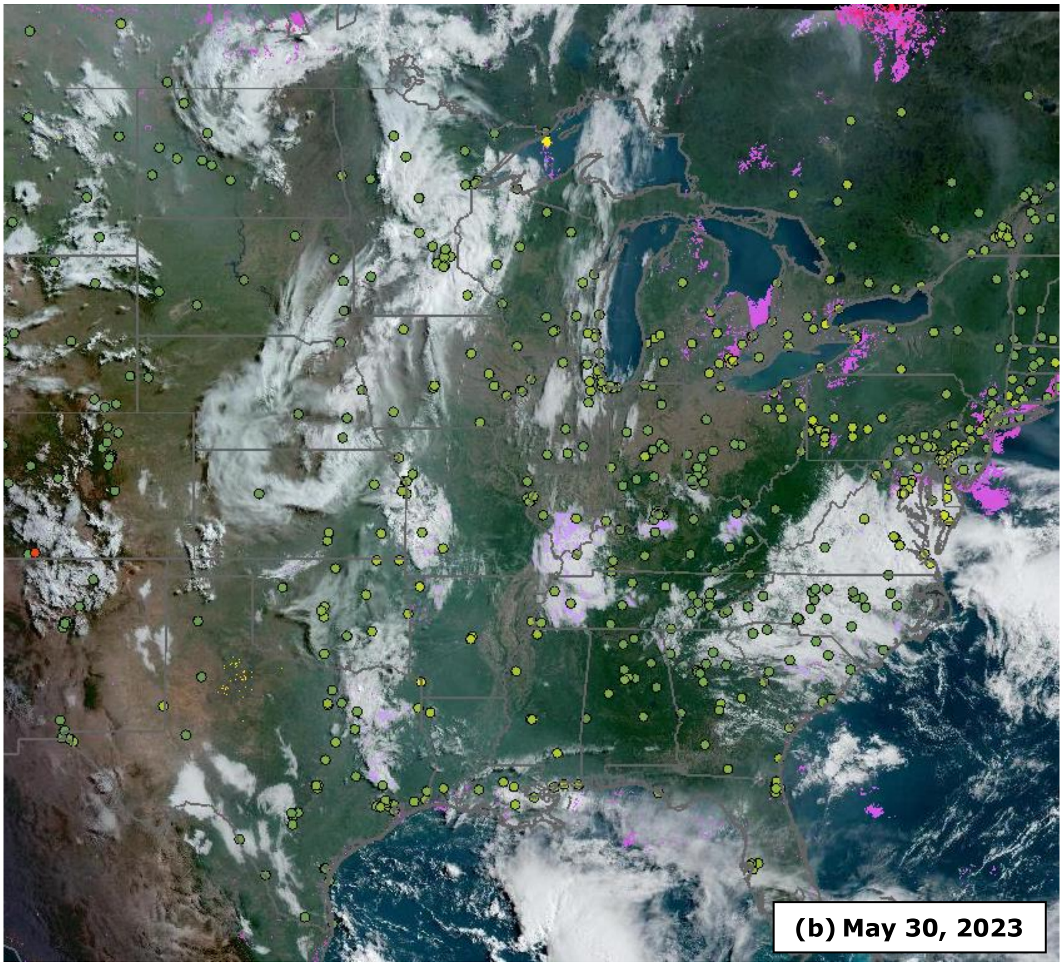


Figure 2-143. NOAA satellite visible imagery on (a) May 22 at 1411 UTC and (b) May 30 at 1311 UTC.

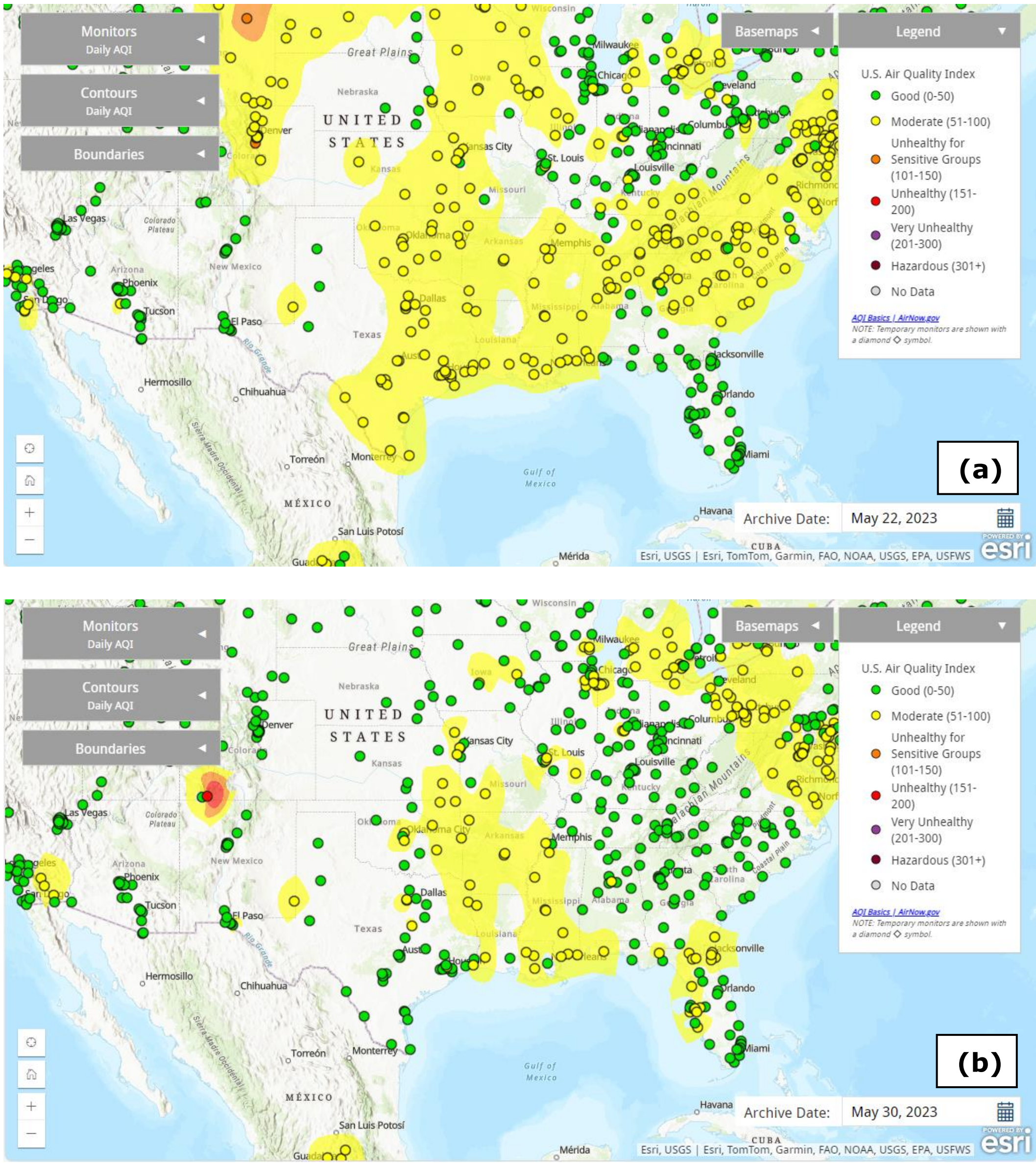


Figure 2-144. AirNow surface level PM$_{2.5}$ concentration contours for (a) May 22 and (b) May 30, 2023.

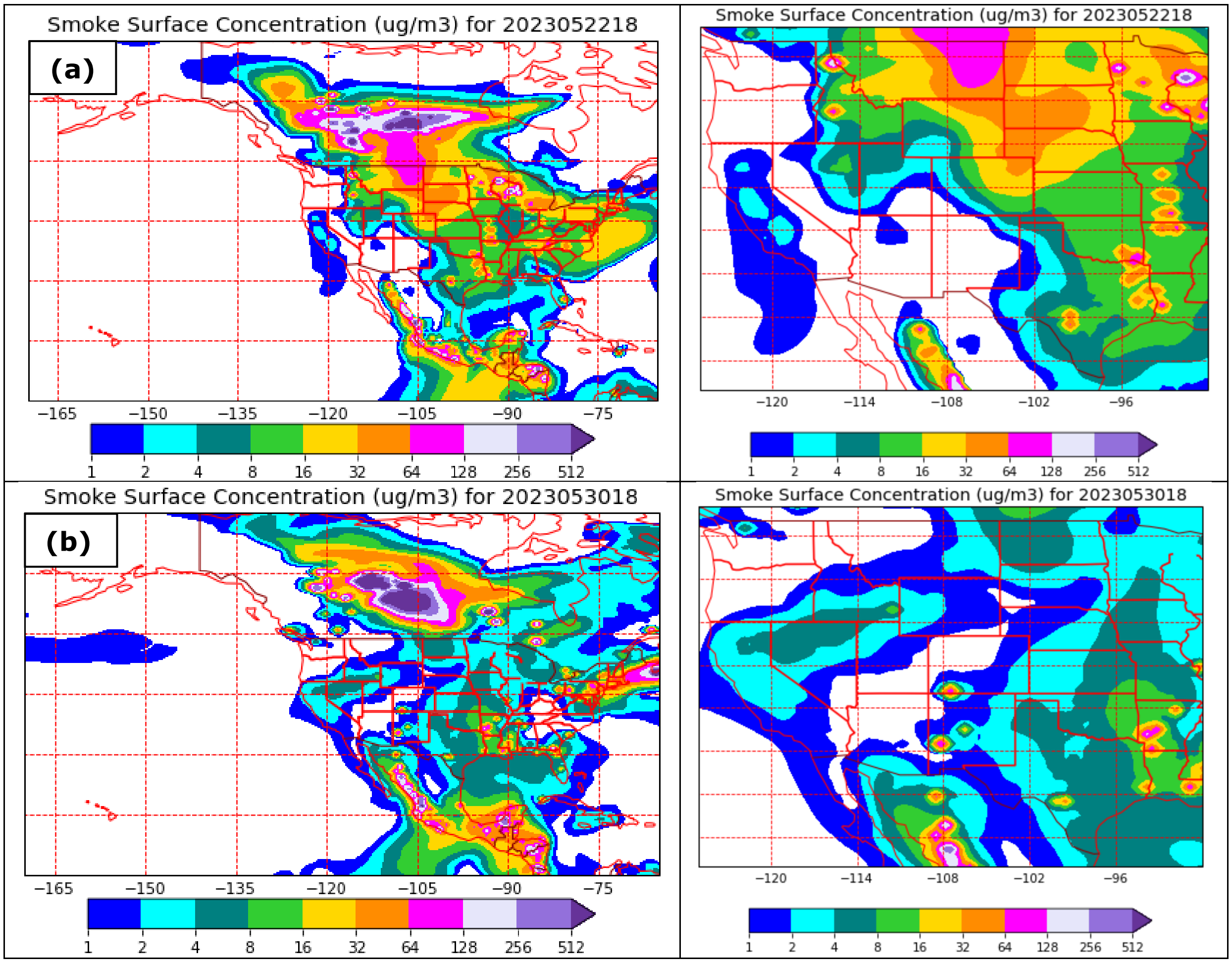


Figure 2-145. NAAPS modeled near-surface smoke concentrations (μg/m^3) at 18Z for (a) May 22 and (b) May 30, 2023. North America regional plot on the left and western U.S. plot on the right.

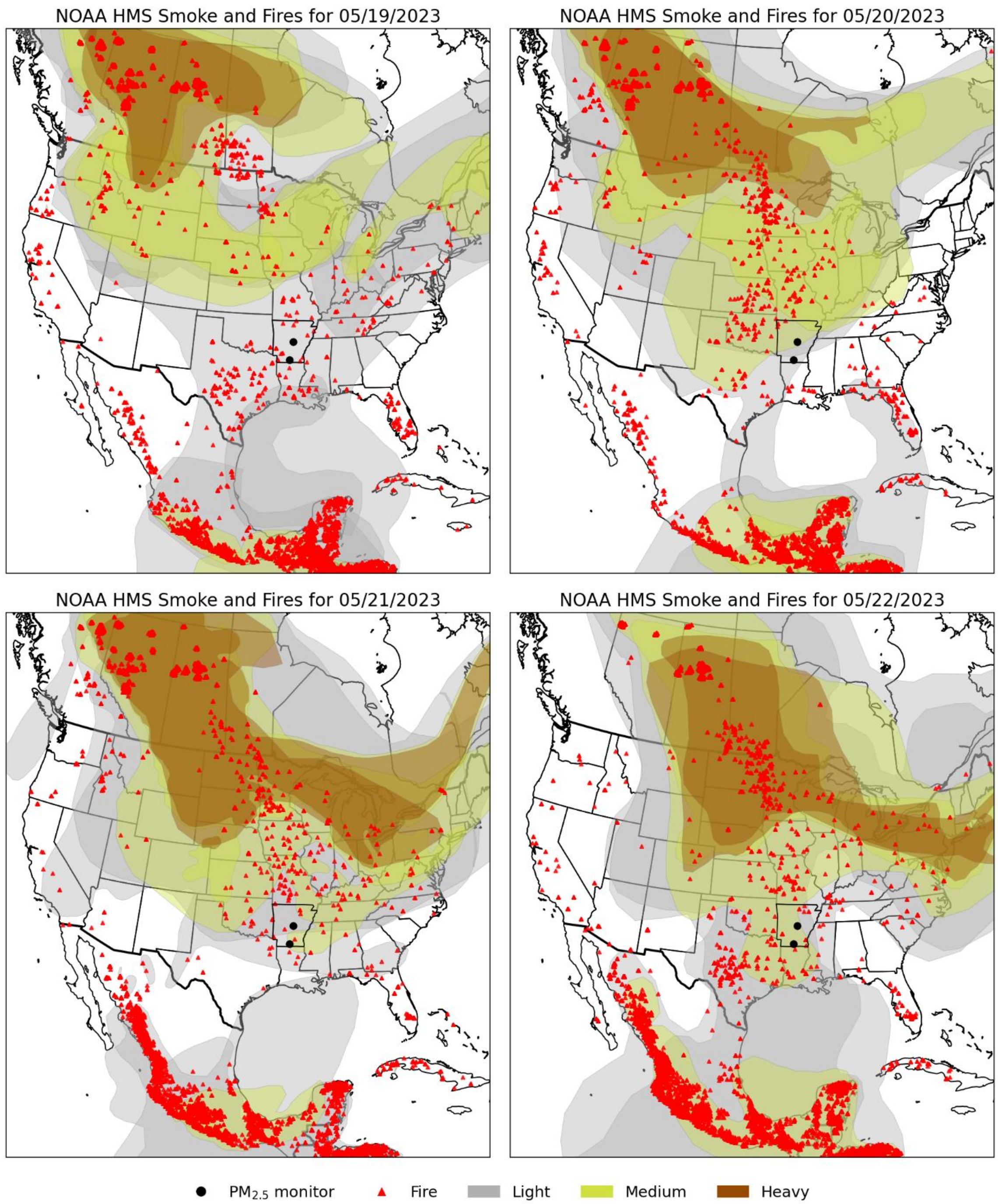


Figure 2-146. Evolution of fires and smoke for May 19 (top left), May 20 (top right), May 21 (bottom left), and May 22 (bottom right).

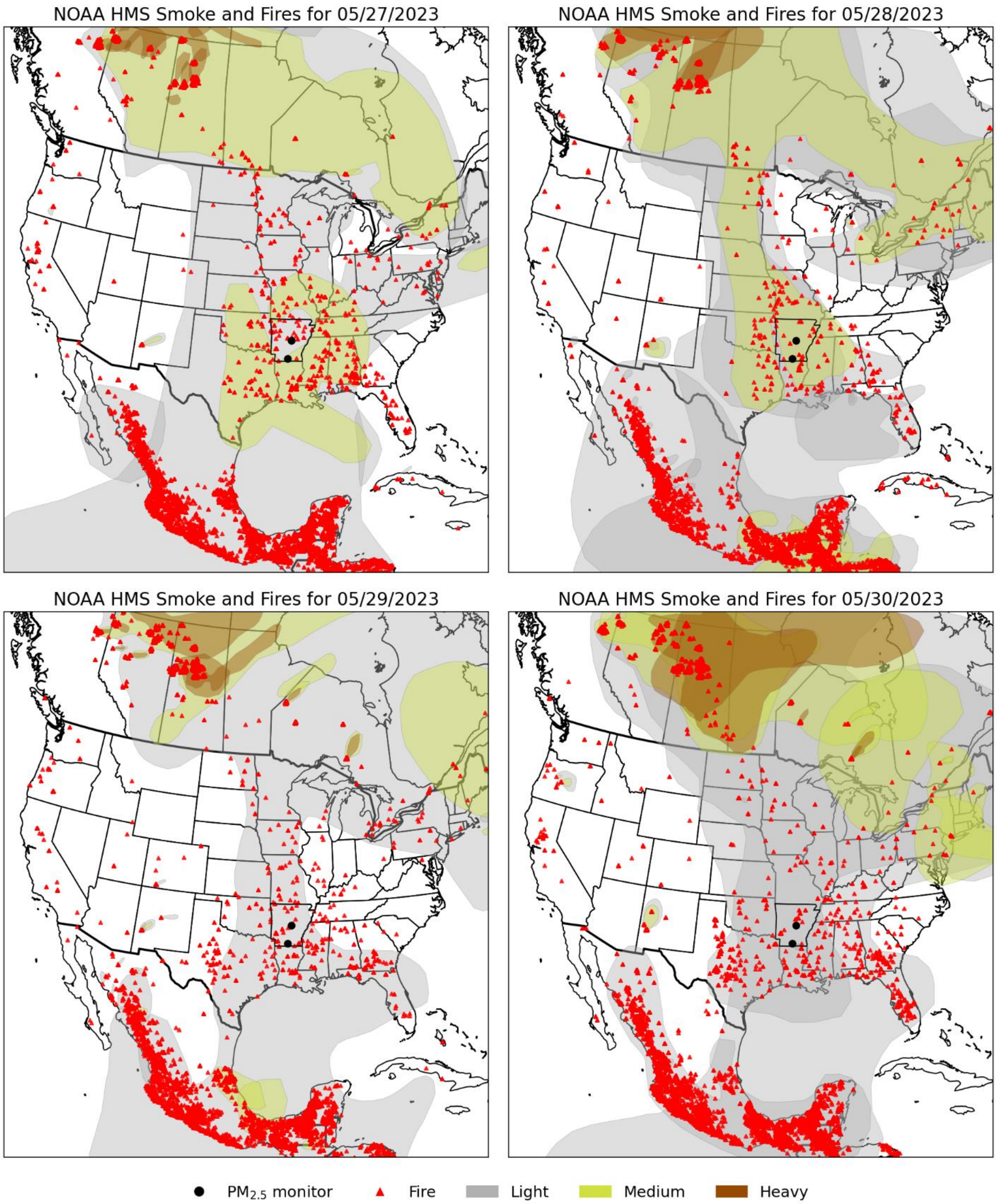


Figure 2-147. Evolution of fires and smoke for May 27 (top left), May 28 (top right), May 29 (bottom left), and May 30 (bottom right).

2.1.7.1 PARR May 22, 2023

Table 2-21 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on May 22, 2023. Figure 2-148 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold. Back trajectories shown in Figure 2-150 illustrate that air masses transported from regions closer to the U.S-Canadian border, pass through areas of heavy smoke density from the Canadian wildfires and reach Parr after 96 hours. Figure 2-151 shows forward trajectories started from regions where two large wildfires (> 3000 acres) have been identified. The trajectories show two main pathways of transport that lead to the spreading of the heavy smoke across the U.S. and they clearly link the impacts in PM observed at the Parr monitor in Arkansas.

Table 2-21. Exceptional event supporting evidence for PARR on May 22, 2023.

Monitor	PARR (05-119-0007)
Event Date	May 22, 2023
24-hr $PM_{2.5}$ Concentration	16.7 µg/m^3
EPA Tiering Tool Tier 2 Threshold	15.1 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: May. Date accessed: 11/20/2024.

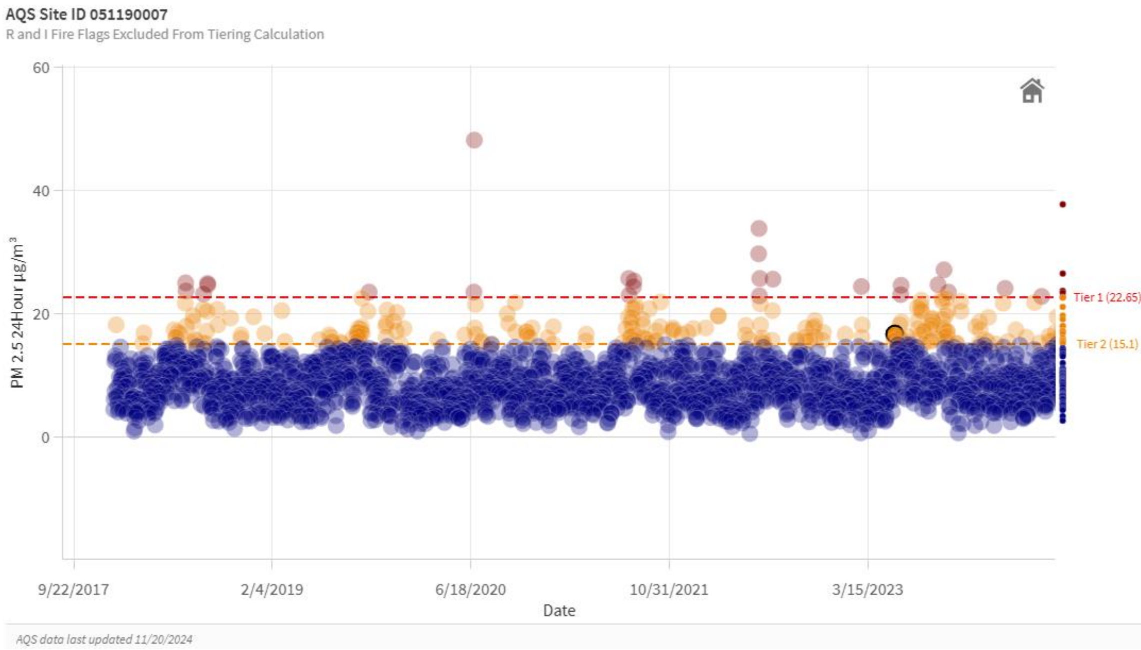


Figure 2-148. EPA $PM_{2.5}$ Tiering Tool for PARR on May 22, 2023.

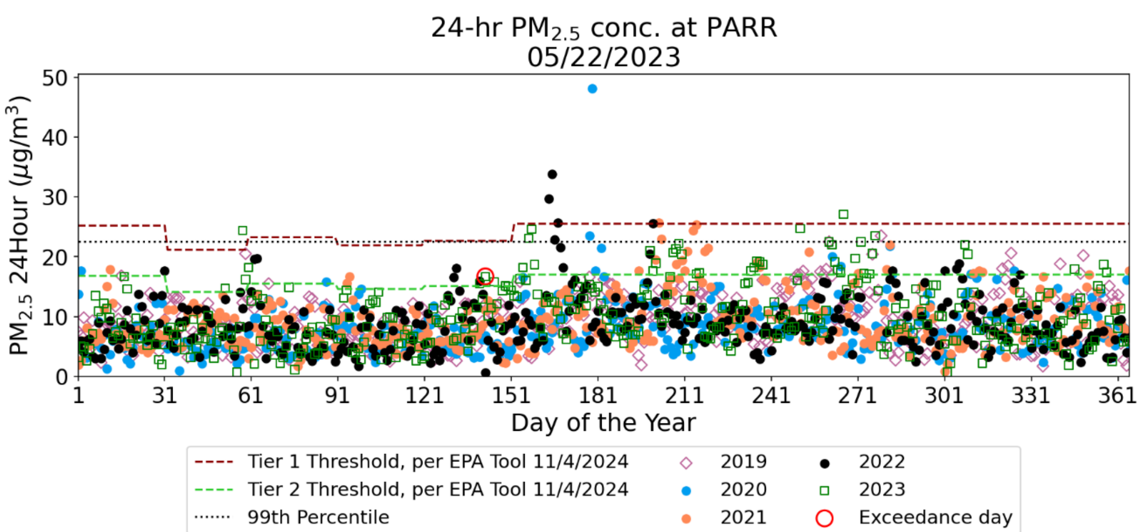


Figure 2-149. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to May 22, 2023.

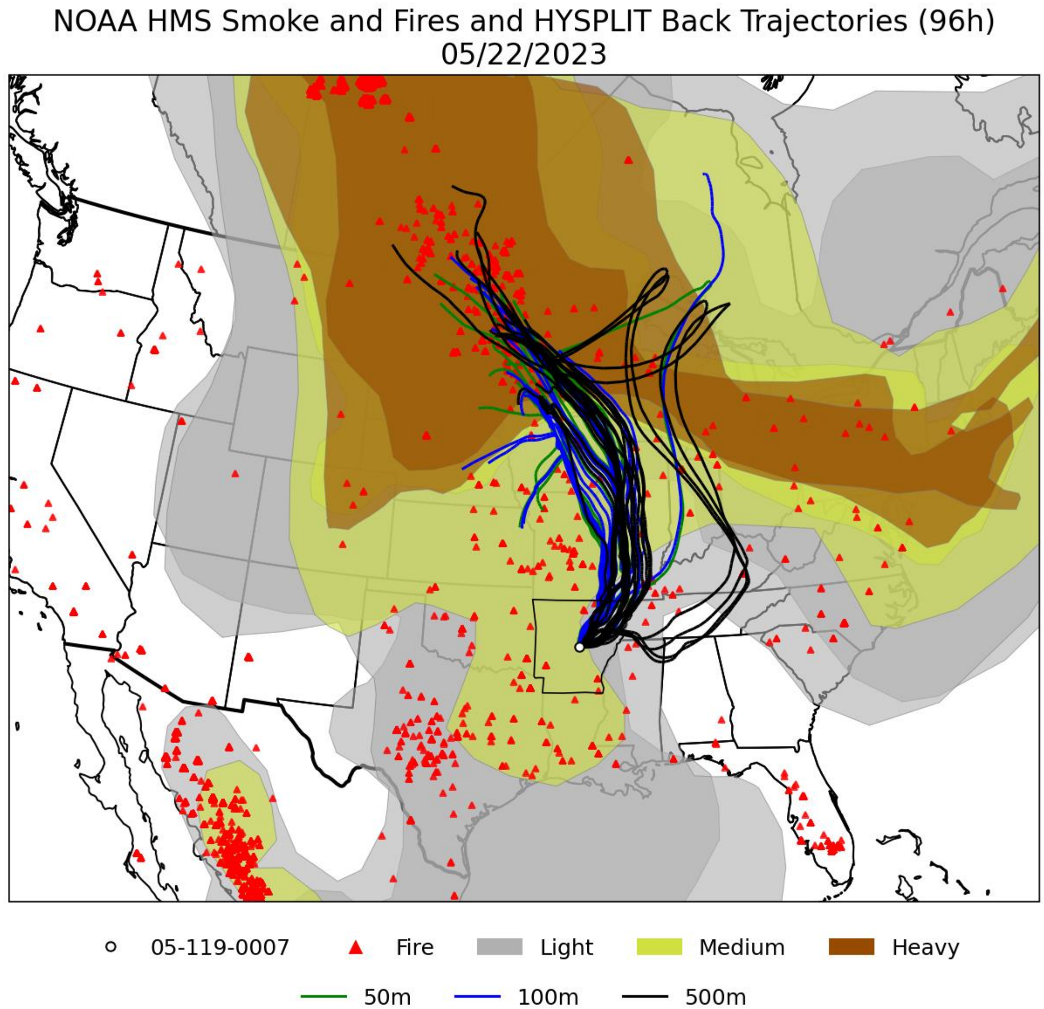


Figure 2-150. HYSPLIT back trajectories for PARR on May 22, 2023.

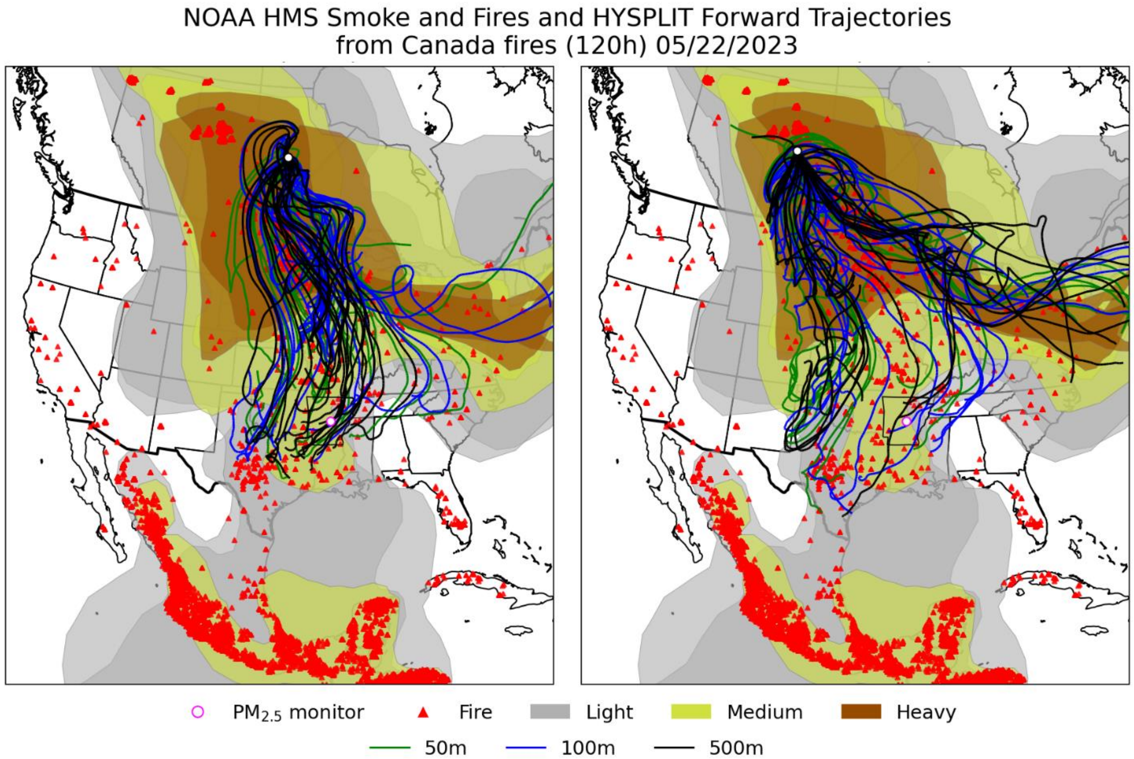


Figure 2-151. HYSPLIT forward trajectories from Canada for PARR on May 22, 2023.

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2.1.7.2 El Dorado May 30, 2023

Table 2-22 summarizes the evidence gathered to support the demonstration of an exceptional event for El Dorado (AQS ID 05-139-0006) on May 30, 2023. Figure 2-152 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold. Figure 2-154 shows the 96-hour back trajectories originating from nearby regions illustrating how they pass through areas with light density smoke accumulated from the stagnant conditions in previous days from Canadian fires and that impact El Dorado monitor on this day.

Table 2-22. Exceptional event supporting evidence for El Dorado on May 30, 2023.

Monitor	El Dorado (05-139-0006)
Event Date	May 30, 2023
24-hr $PM_{2.5}$ Concentration	14.8 µg/m^3
EPA Tiering Tool Tier 2 Threshold	14.6 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: May. Date accessed: 11/20/2024.

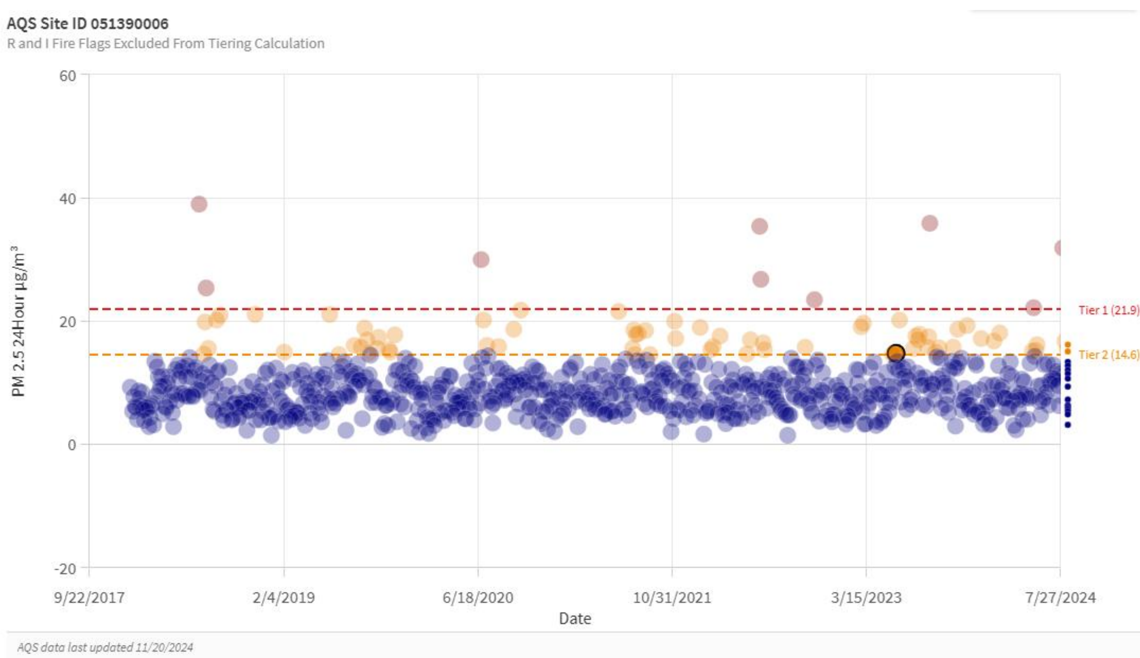


Figure 2-152. EPA $PM_{2.5}$ Tiering Tool for El Dorado on May 30, 2023.

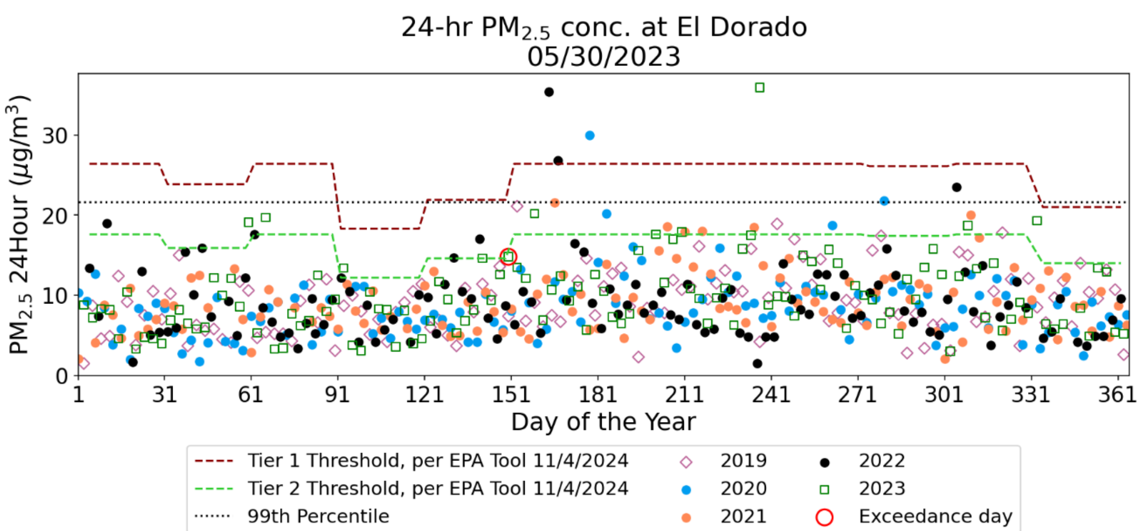


Figure 2-153. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for El Dorado compared to May 30, 2023.

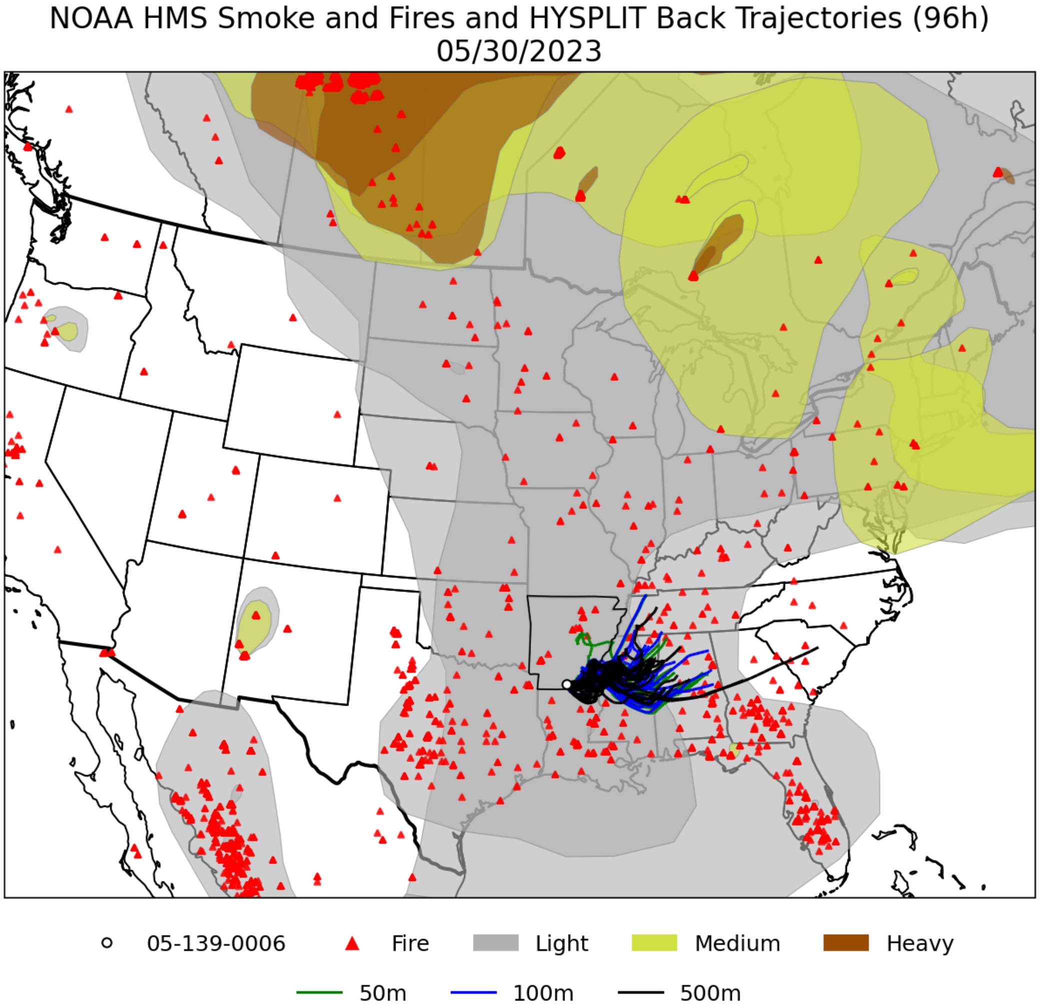
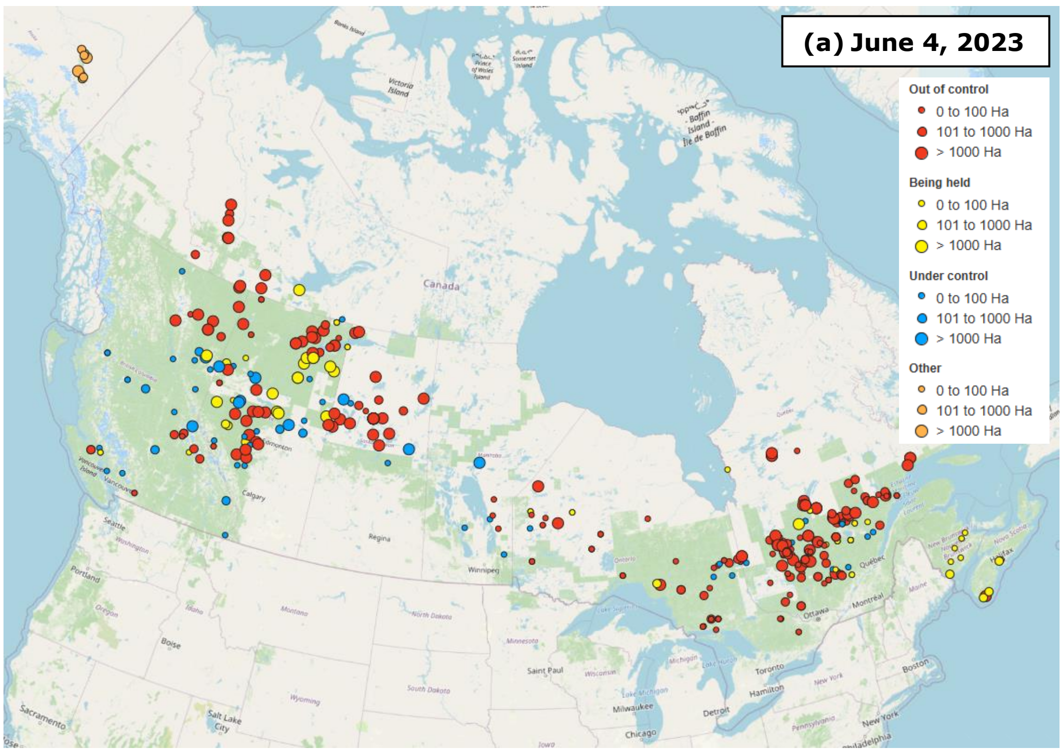
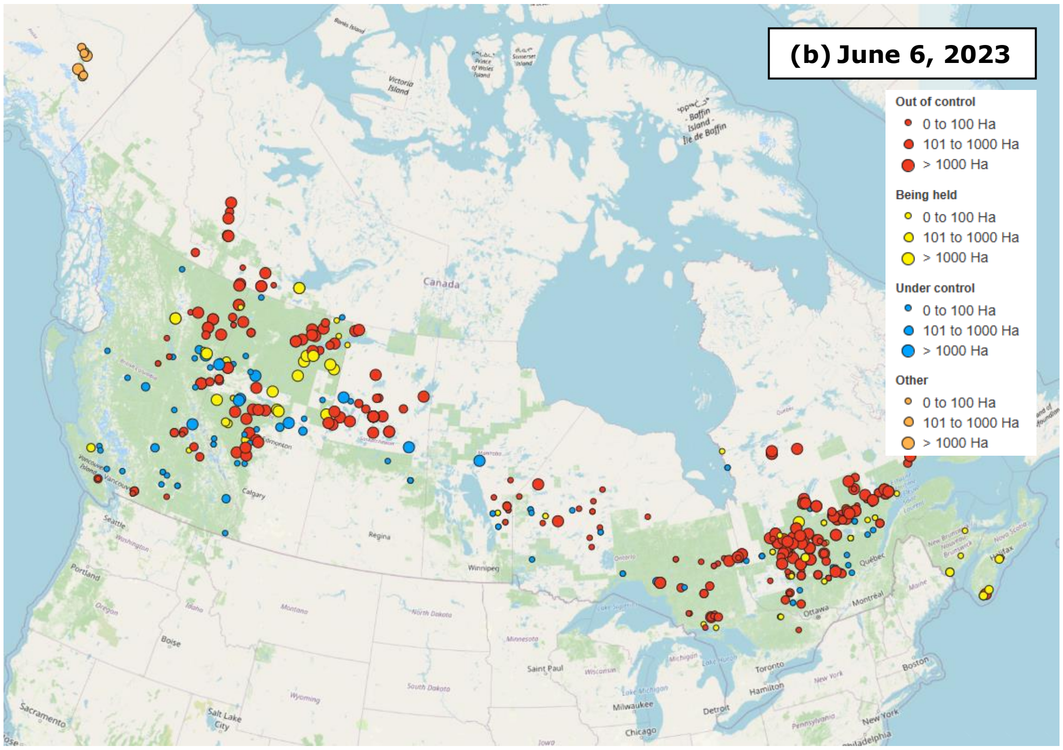


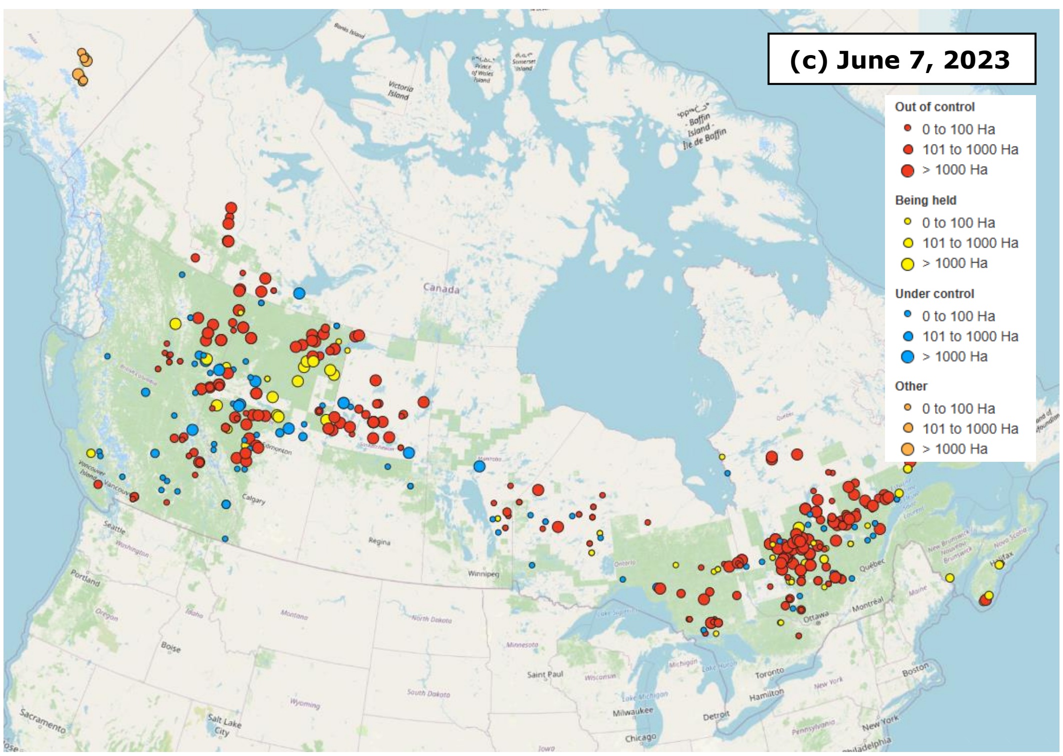
Figure 2-154. HYSPLIT back trajectories for El Dorado on May 30, 2023.

2.1.8 June 4, and June 6-8, 2023

Wildfires in Quebec, Canada, burned approximately 5.1 million hectares (about 12.6 million acres) between June 1 and June 8, 2023 (Figure 2-155) generating significant smoke (illustrated in Figure 2-156 and Figure 2-157). Starting on June 3, heavy smoke began to move into the U.S., impacting Arkansas from June 4 onward. On June 5, weather conditions initially allowed the 24-hour $PM_{2.5}$ concentrations to narrowly avoid an exceedance. However, by June 6, wind flow from the fires brought smoke into the eastern U.S. in a consistent manner. A large smoke plume that moved into Arkansas between June 4 and June 9 was not caused by a single fire, but brough by multiple waves of smoke that impacted air quality monitors in Arkansas, leading to 24-hour $PM_{2.5}$ exceedances above the Tier 2 threshold. Therefore, in this section we describe the impacts that affect monitors in Arkansas under the fact that fires were burning in Canada from June 2 to June 8 without specifically linking a particular one given the number and size of these wildfires.




(b) June 6, 2023
Out of control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Being held
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Under control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Other
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha


(c) June 7, 2023
Out of control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Being held
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Under control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Other
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha

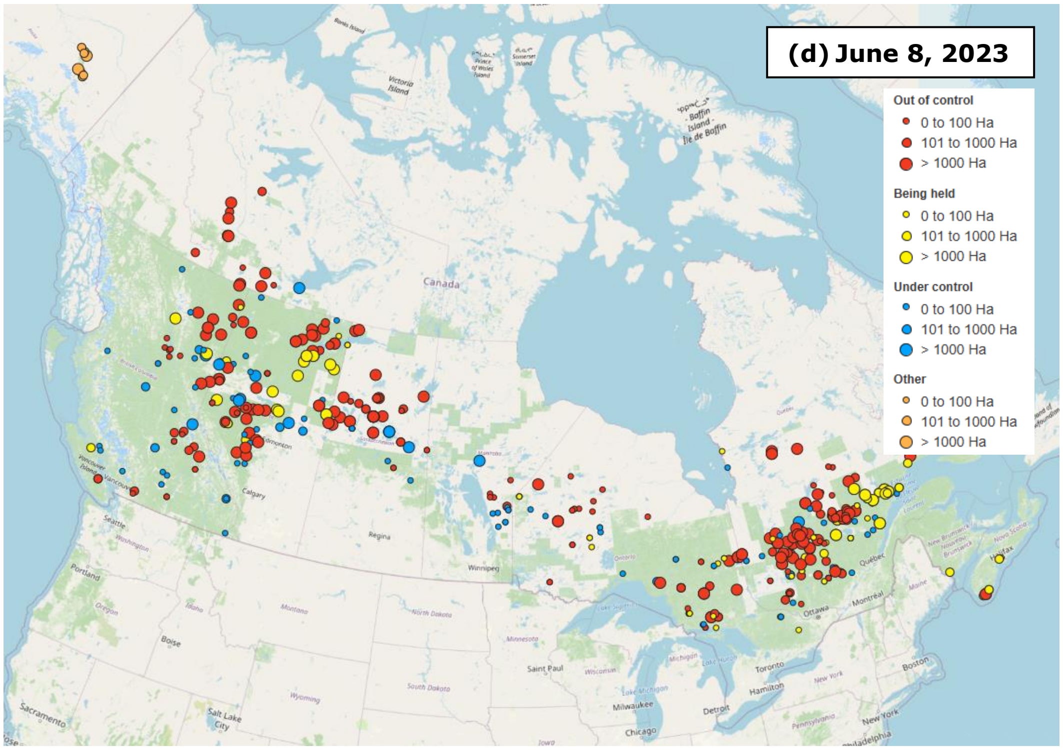
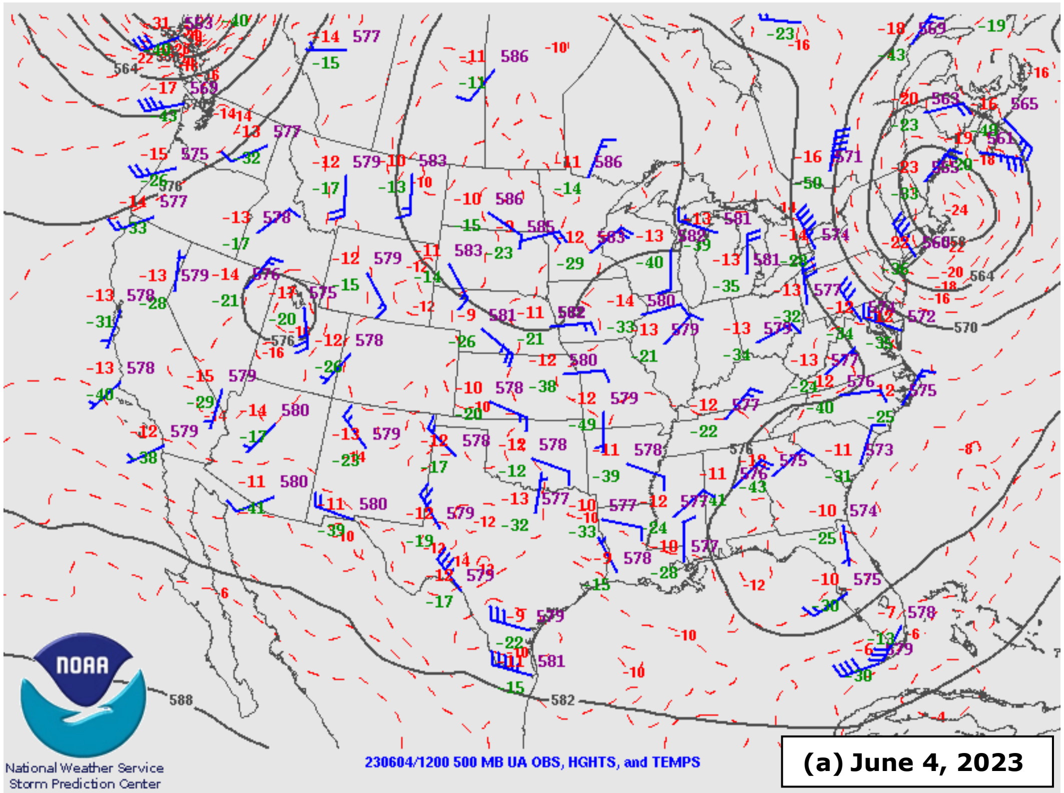


Figure 2-155. Canadian Wildfire Information System map of active fires for (a) June 4, (b) June 6, (c) June 7, and (d) June 8. (https://cwfis.cfs.nrcan.gc.ca/interactive-map)

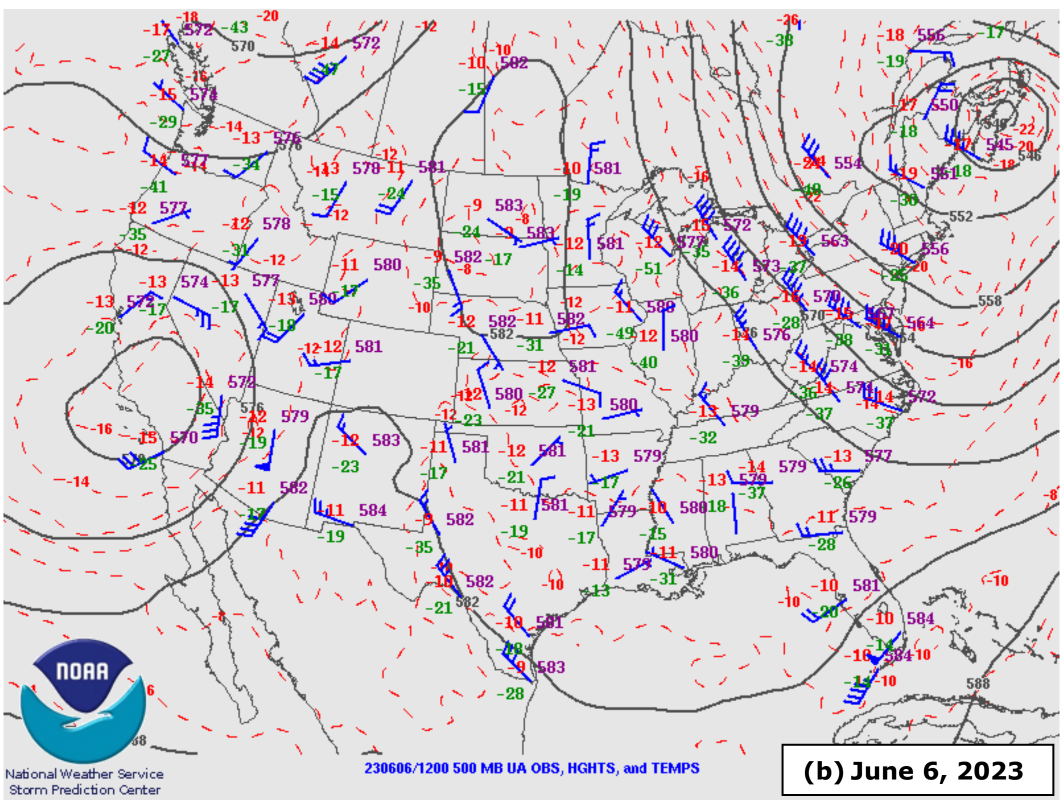
Figure 2-156. A wildfire raging west of Chibougamau, in northern Quebec, is shown on June 4, 2023. (Audrey Marcoux/The Canadian Press) (https://www.cbc.ca/news/climate/quebec-climate-change-wildfires-research-1.6943502)

Figure 2-157. Thick smoke fills the sky as wildfires approach the municipality of Normetal, in Quebec's Abitibi-Quest region, June 7, 2023. (https://montreal.ctvnews.ca/more-evacuations-in-quebec-as-record-breaking-fires-continue-to-burn-1.6431211)

In early June 2023, a significant weather phenomenon unfolded across North America, characterized by a persistent omega-block pattern. A strong high-pressure ridge dominated the central U.S., creating stable atmospheric conditions that influenced wind patterns and air quality. Concurrently, a low-pressure system developed over Maine and the Canadian Maritime which played a crucial role in transporting smoke from wildfires in Canada southward into the continental U.S., particularly affecting the air quality in southern states like Arkansas. The high-pressure ridge established over the central U.S. acted as a barrier, redirecting airflow and trapping pollutants within its vicinity. This was intensified by a deepening low-pressure system over the northeastern U.S. around June 6 to 7 (Figure 2-158), which generated persistent northerly winds in Arkansas. As this low-pressure area intensified, it enhanced the southward flow of large and dense smoke plumes from fires in Quebec and northwest Canada. By June 8, the low-pressure system over the northeastern U.S. weakened but continued to transport smoke into the region leading to high $PM_{2.5}$ concentrations, although these were lower compared to those observed in June 6 and June 7.



(a) June 4, 2023



(b) June 6, 2023

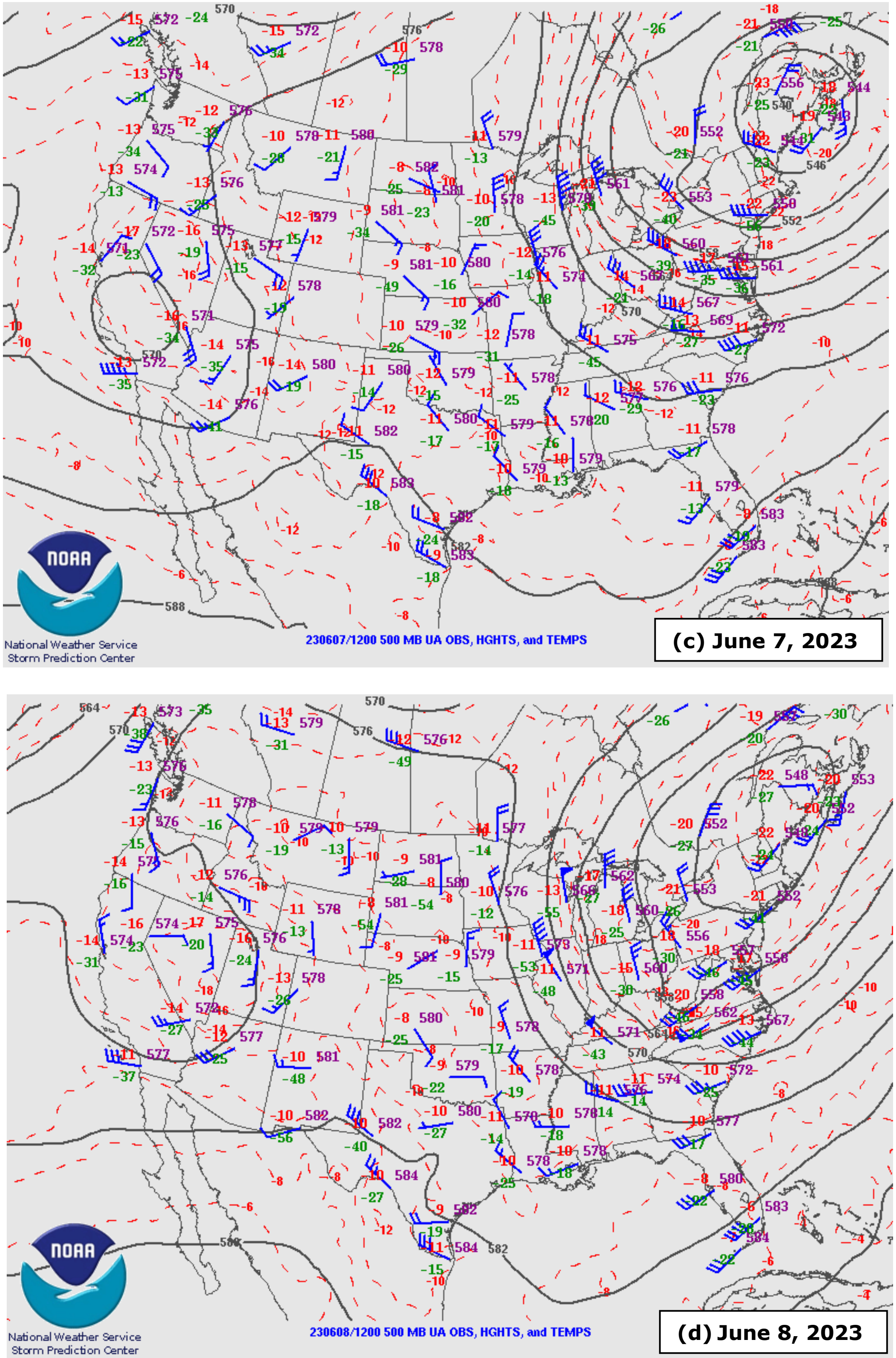
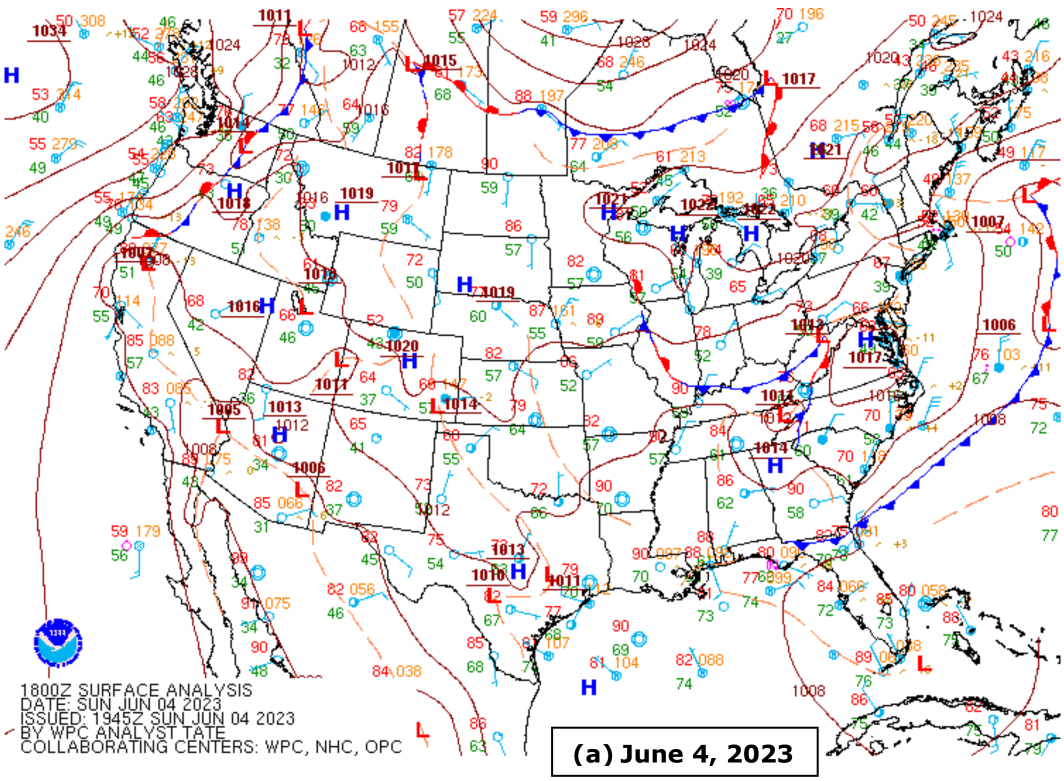
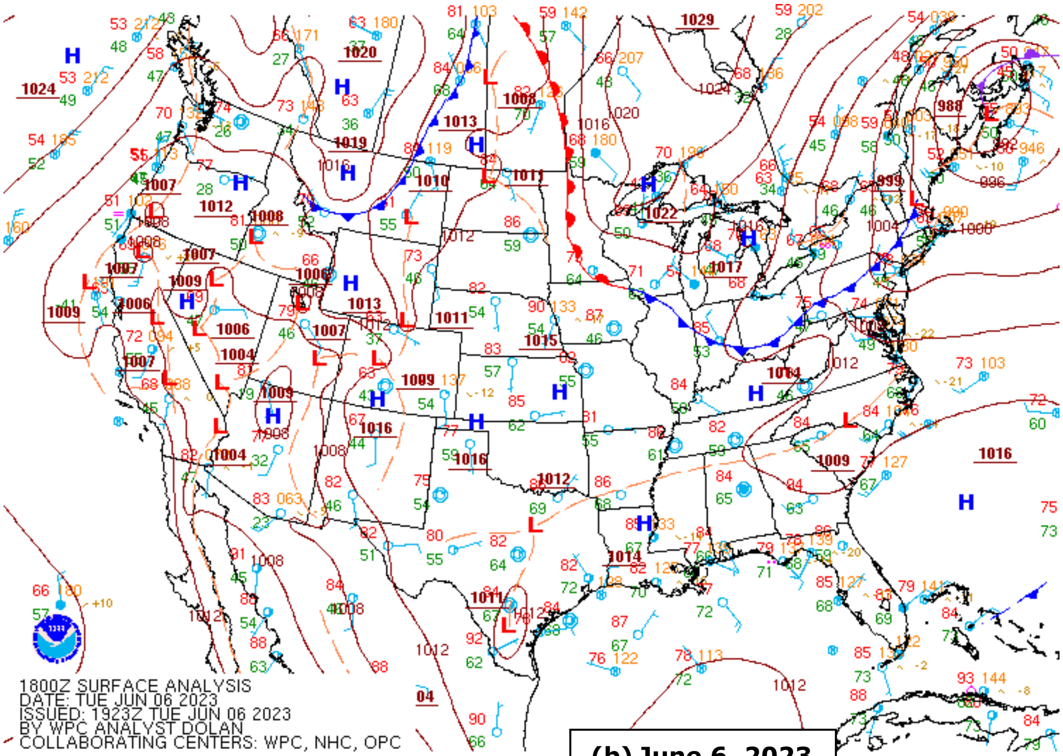


Figure 2-158. 500 mb synoptic analysis map at 12 UTC on (a) June 4, (b) June 6, (c) June 7, and (d) June 8, 2023.

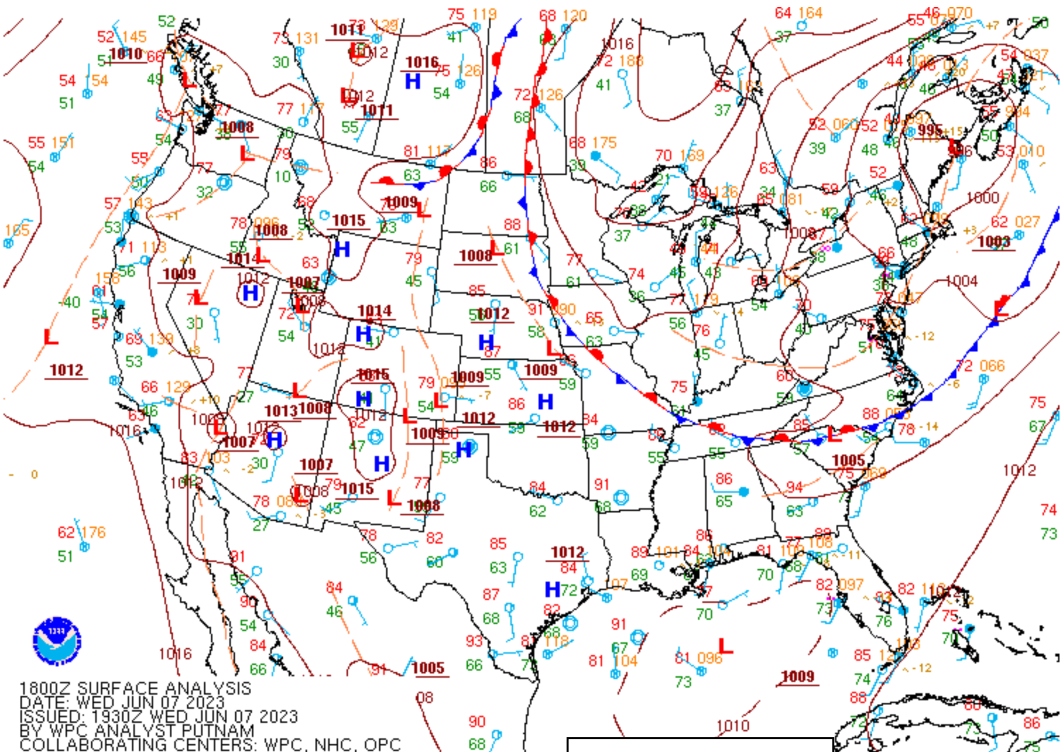
On June 4, 2023 (Figure 2-159), the surface analysis indicated the presence of a cold front moving through the northeastern U.S. This cold front was associated with a low-pressure system that had developed in that region. As the cold front advanced, it brought cooler air and increased wind speeds, enhancing atmospheric mixing. The movement of this cold front, combined with the low-pressure system, facilitated the transport of northerly winds from Canada southward into the continental U.S., impacting air quality in southern states. Between June 6 and June 8 (Figure 2-159), another stationary front moved south and southwestward. A significant smoke gradient existed across this front, explaining the movement of smoke as a wall. The presence of a high pressure over the central U.S. led to the smoke descending to the surface, ultimately resulting in moderate air quality over Arkansas.



(a) June 4, 2023



(b) June 6, 2023



(c) June 7, 2023

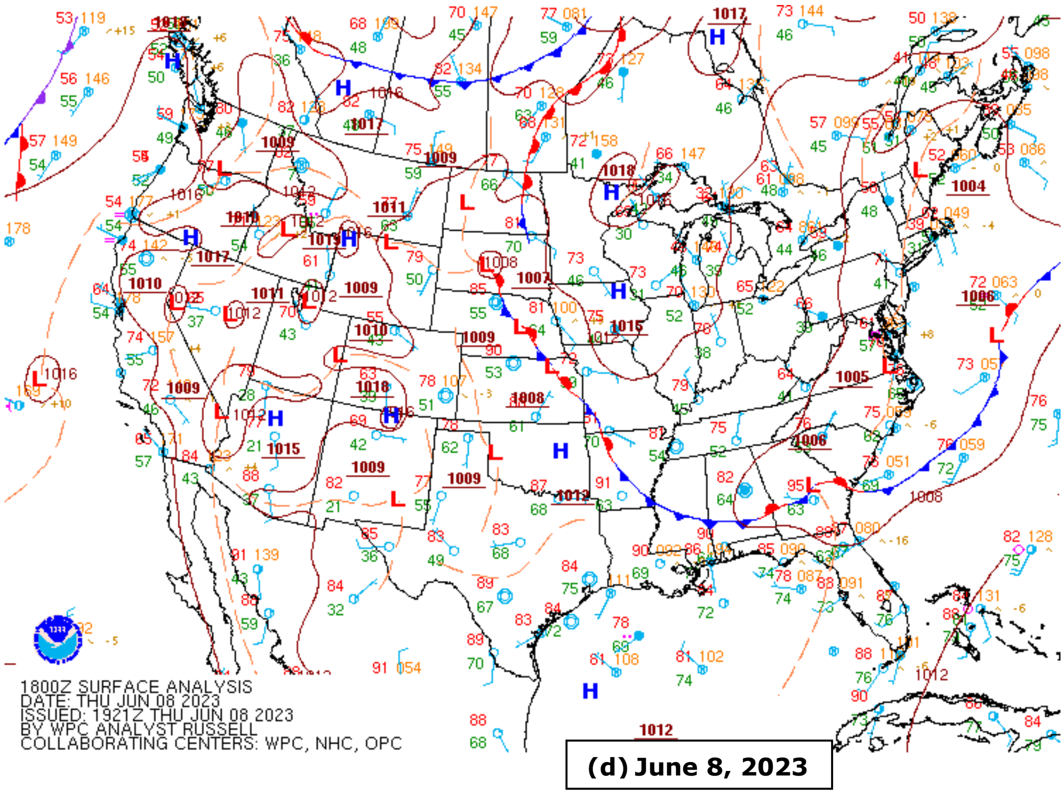


Figure 2-159. Surface synoptic analysis maps (bottom row) at 18 UTC on (a) June 4, (b) June 6, (c) June 7, and (d) June 8.

The NOAA HMS product in Figure 2-160 and visible satellite images in Figure 2-161 show heavy smoke covering parts of the Midwest and northeast U.S., with light to medium smoke in the central and southeast U.S. on June 4, 2023. From June 6 to 8, light to heavy smoke plumes covered regions east of 103° West longitude. Moderate values of the AQI (Figure 2-162) and the HRRR surface simulated model (Figure 2-163) suggest that wildfire smoke mixed down to the surface affecting monitors over Arkansas, the southeastern, and northeastern U.S. Figure 2-164 and Figure 2-165 illustrate a more complete evolution of the smoke plumes from June 1 to June 8 that originate from multiple fires in the British Columbia, Alberta, and Quebec provinces in Canada.

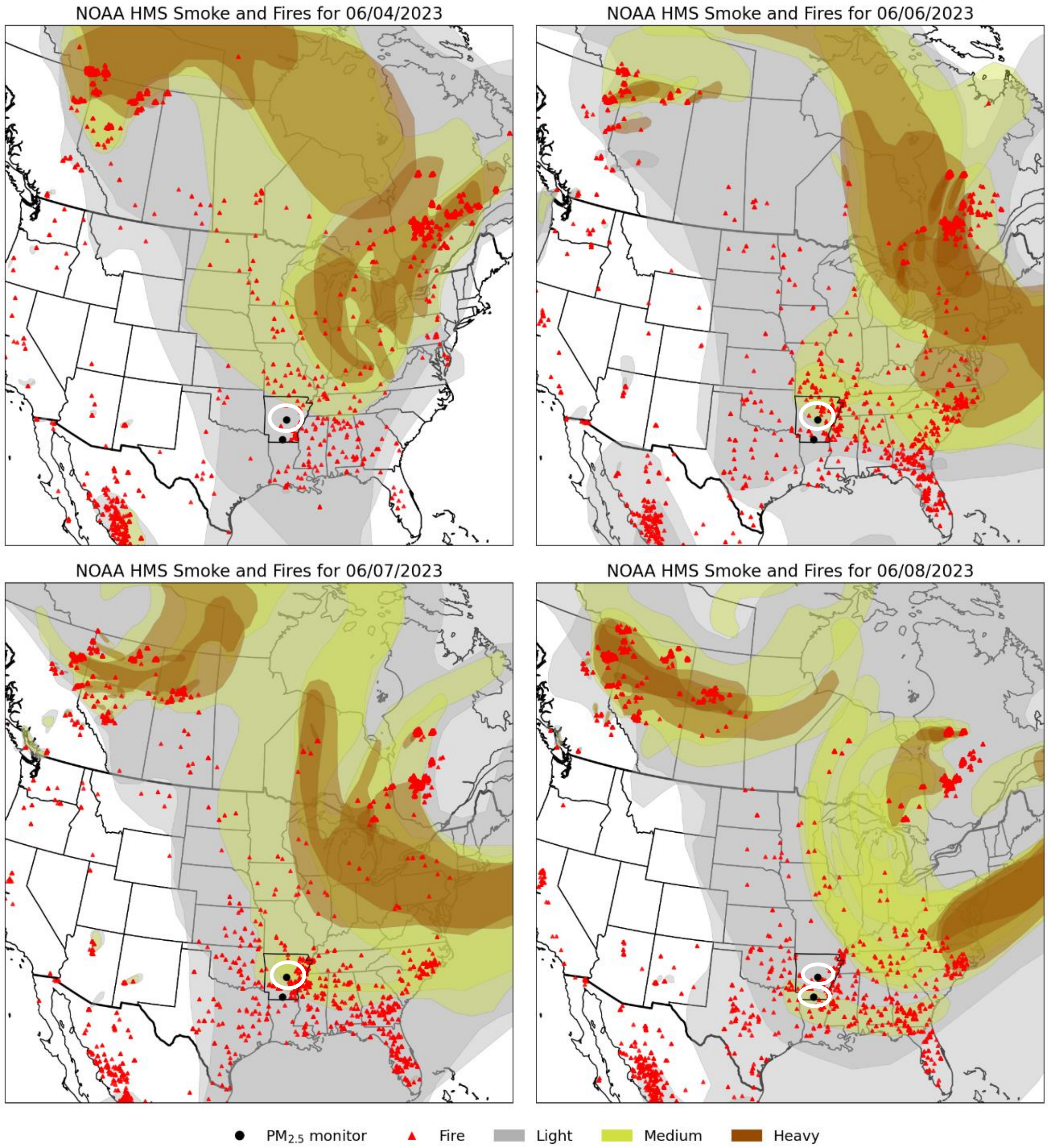
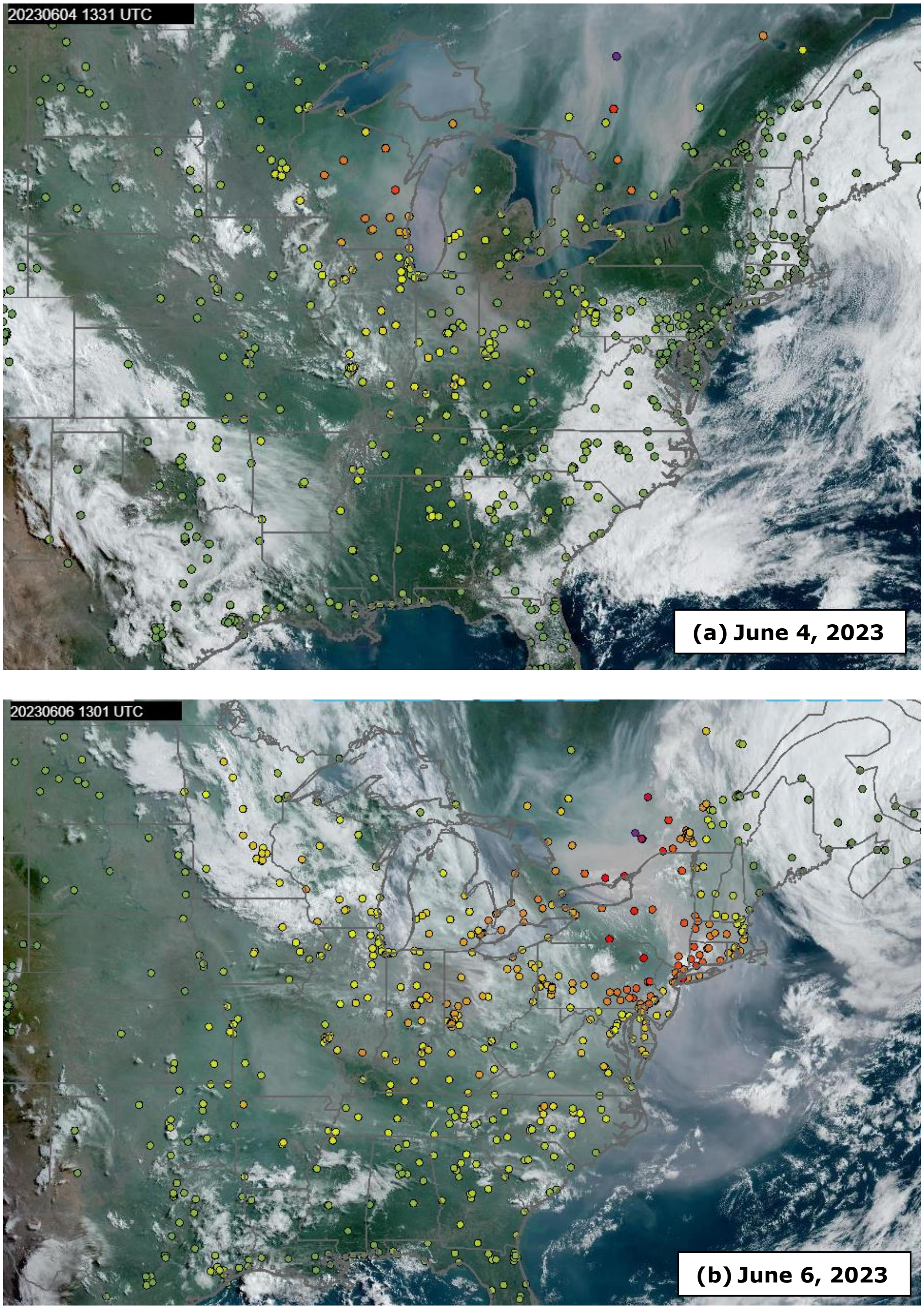
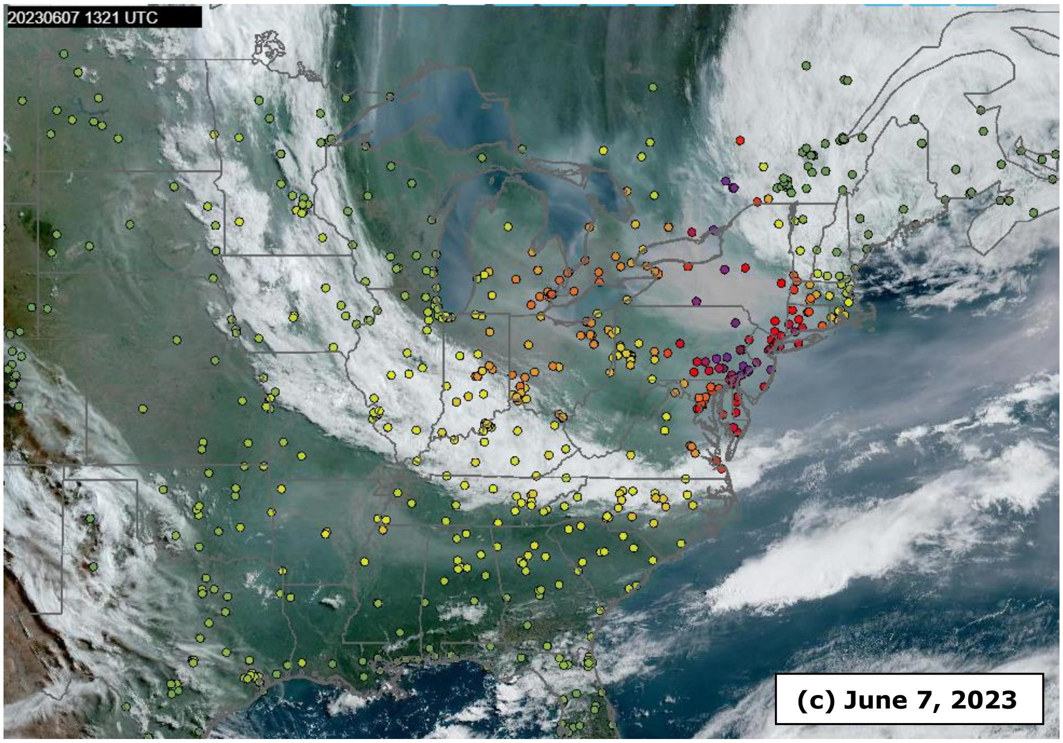


Figure 2-160. NOAA HMS fire and smoke products for June 4 (top left), June 6 (top right), June 7 (bottom left), and June 8 (bottom right), 2023.


20230604 1331 UTC
(a) June 4, 2023
20230606 1301 UTC
(b) June 6, 2023



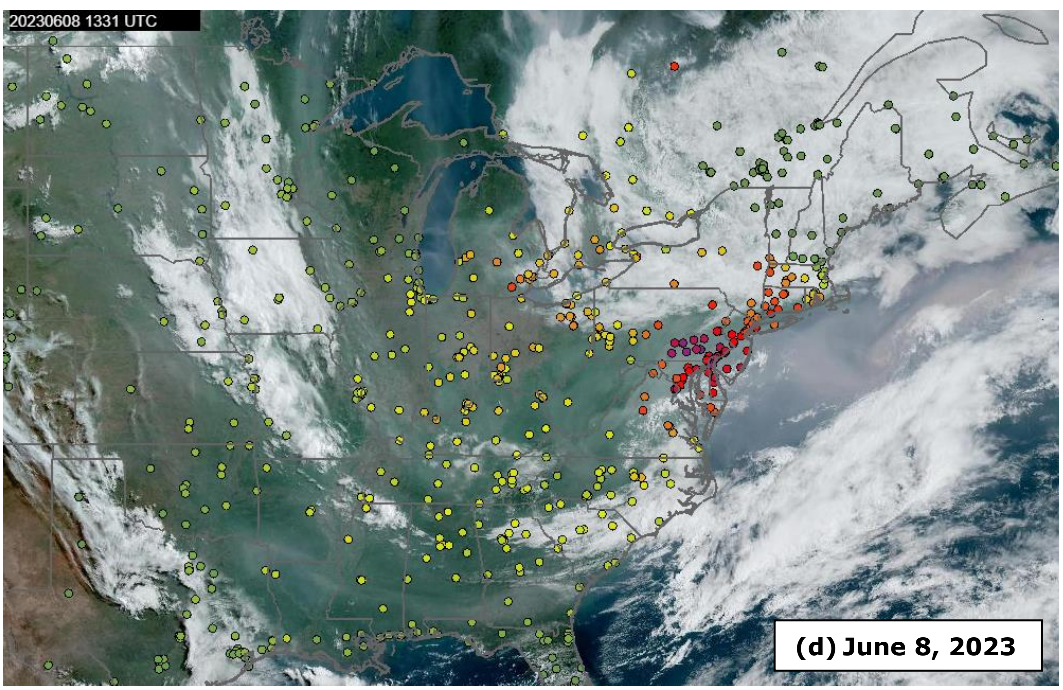
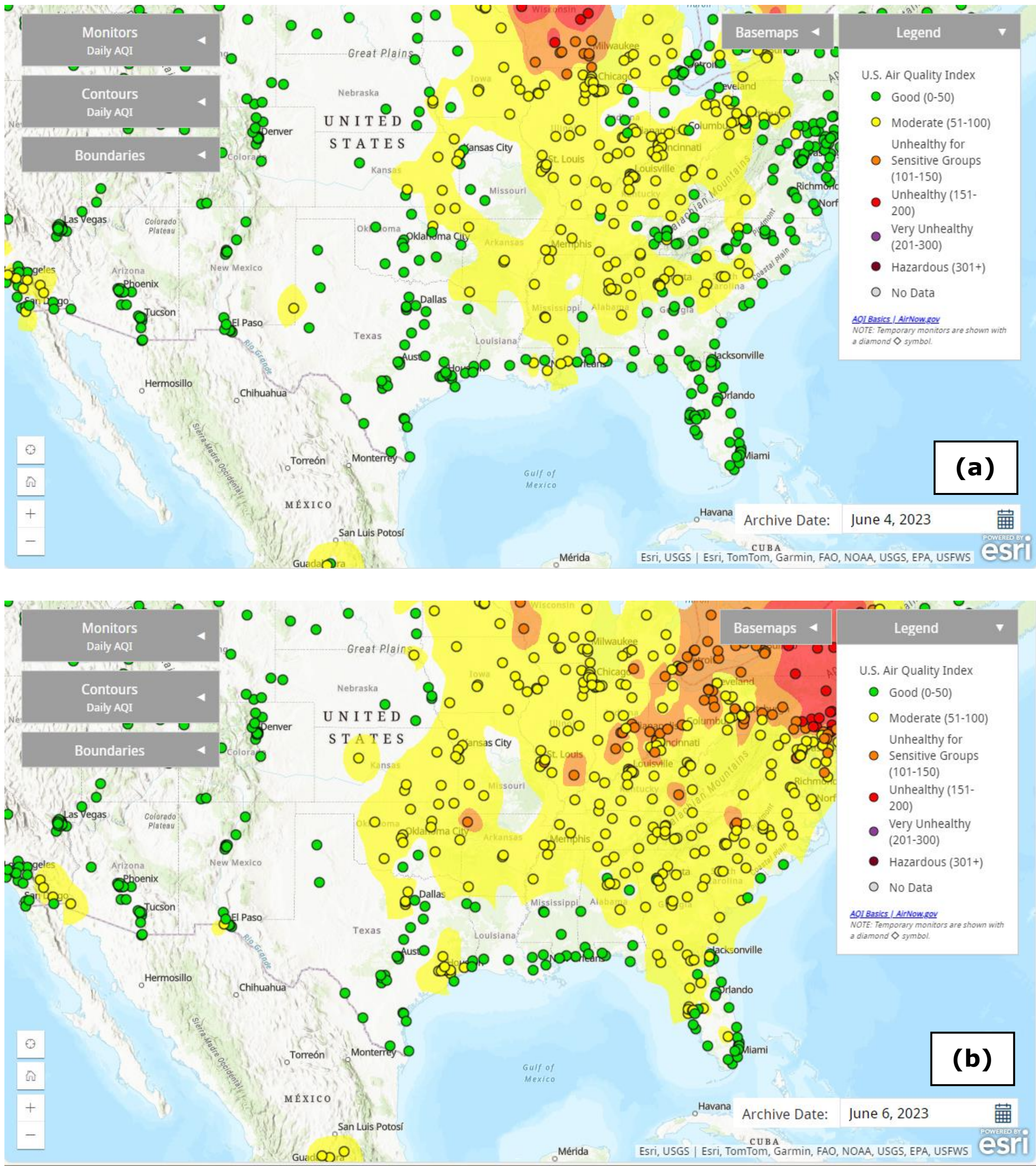


Figure 2-161. NOAA satellite visible imagery on (a) June 4 at 1331 UTC, (b) June 6 at 1301 UTC, (c) June 7 at 1321 UTC, and (d) June 8 at 1331 UTC, 2023.


Monitors
Daily AQI
Contours
Daily AQI
Boundaries
Basemaps
Legend
U.S. Air Quality Index
Good (0-50)
Moderate (51-100)
Unhealthy for Sensitive Groups (101-150)
Unhealthy (151-200)
Very Unhealthy (201-300)
Hazardous (301+)
No Data
AQI Basics | AirNow.gov
NOTE: Temporary monitors are shown with a diamond ◇ symbol.
UNITED STATES
MÉXICO
Gulf of Mexico
(a)
Archive Date: June 4, 2023
(b)
Archive Date: June 6, 2023
Esri, USGS | Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, USFWS

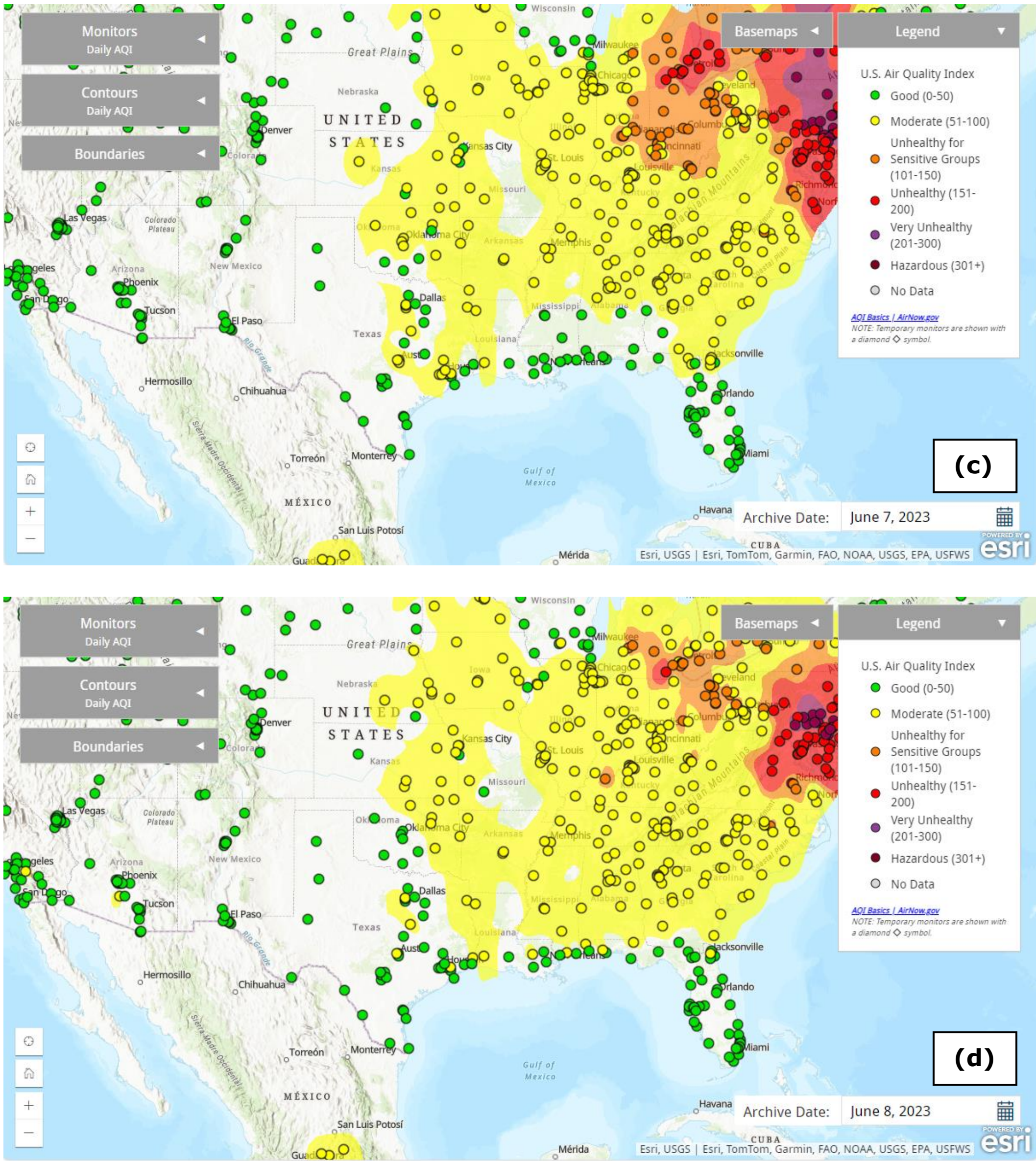
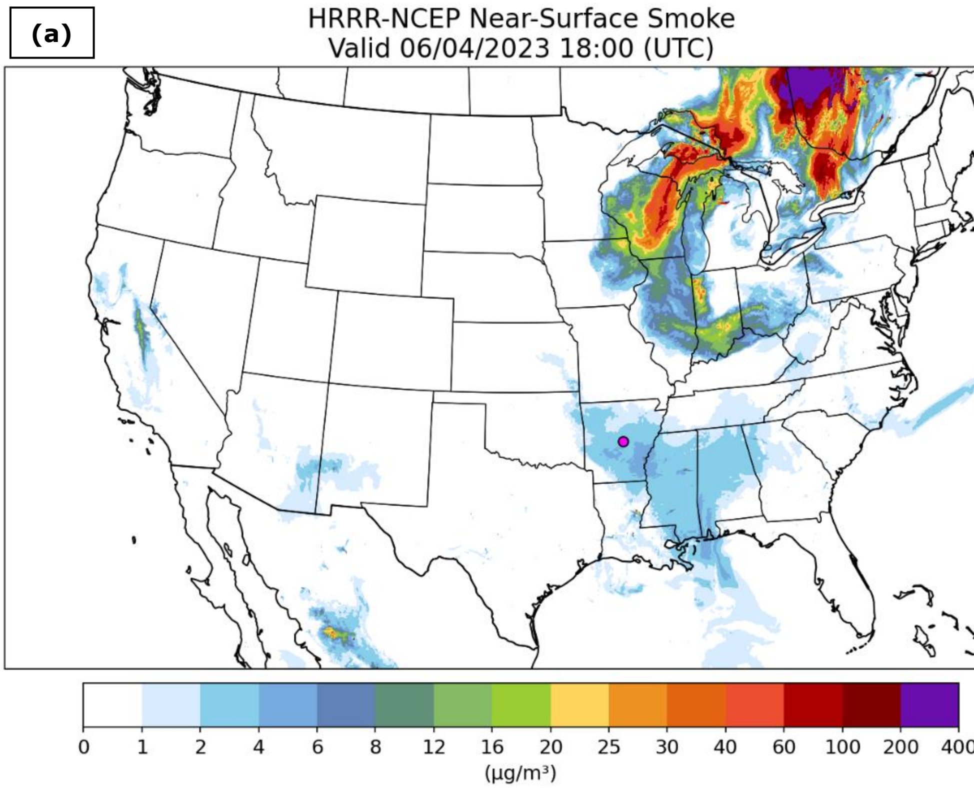
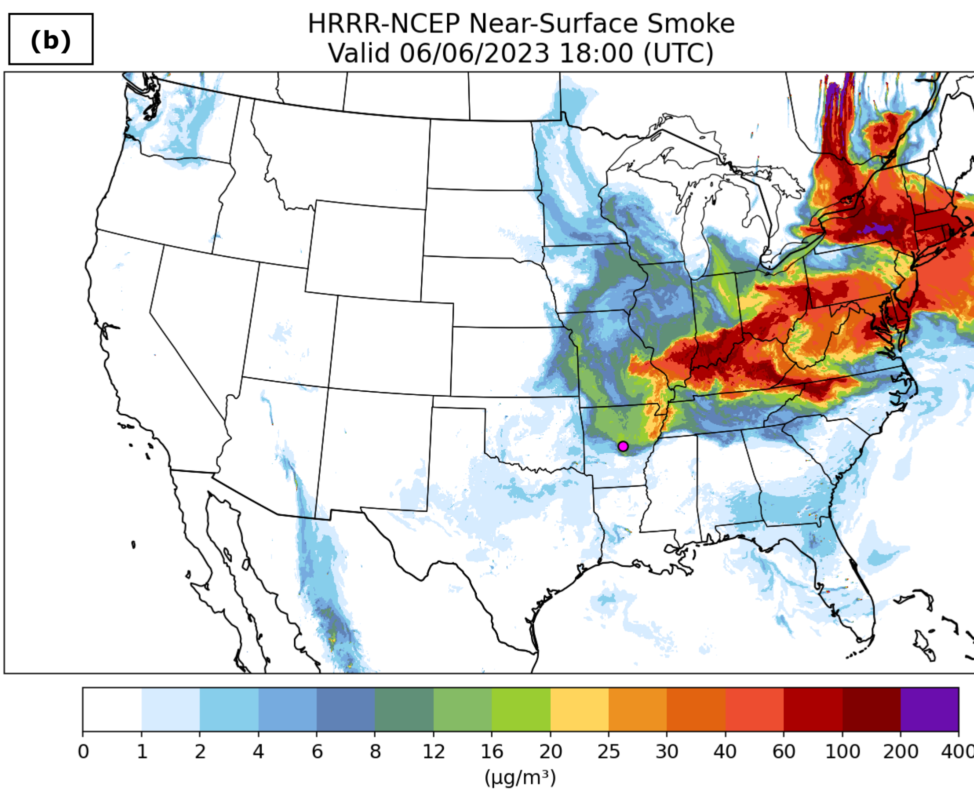


Figure 2-162. AirNow surface level $PM_{2.5}$ concentration contours (a) June 4, (b) June 6, (c) June 7, and (d) June 8, 2023.


(a)
HRRR-NCEP Near-Surface Smoke
Valid 06/04/2023 18:00 (UTC)
0 1 2 4 6 8 12 16 20 25 30 40 60 100 200 400
(μg/m³)


(b)
HRRR-NCEP Near-Surface Smoke
Valid 06/06/2023 18:00 (UTC)
0 1 2 4 6 8 12 16 20 25 30 40 60 100 200 400
(μg/m³)

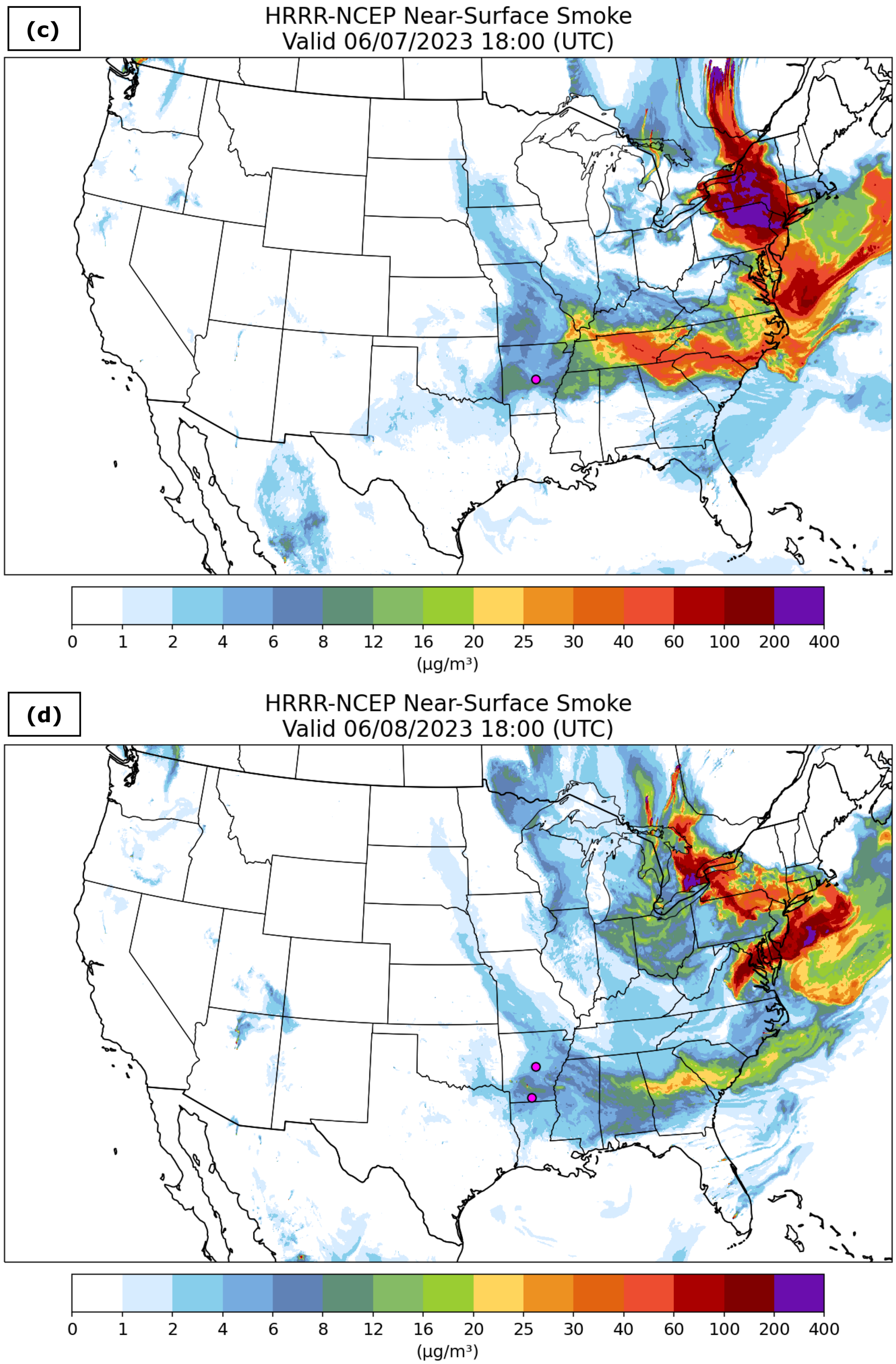


Figure 2-163. HRRR-Smoke modeled near-surface smoke concentrations (µg/m³) at 1 PM CDT on (a) June 4, (b) June 6, (c) June 7, and (d) June 8, 2023.

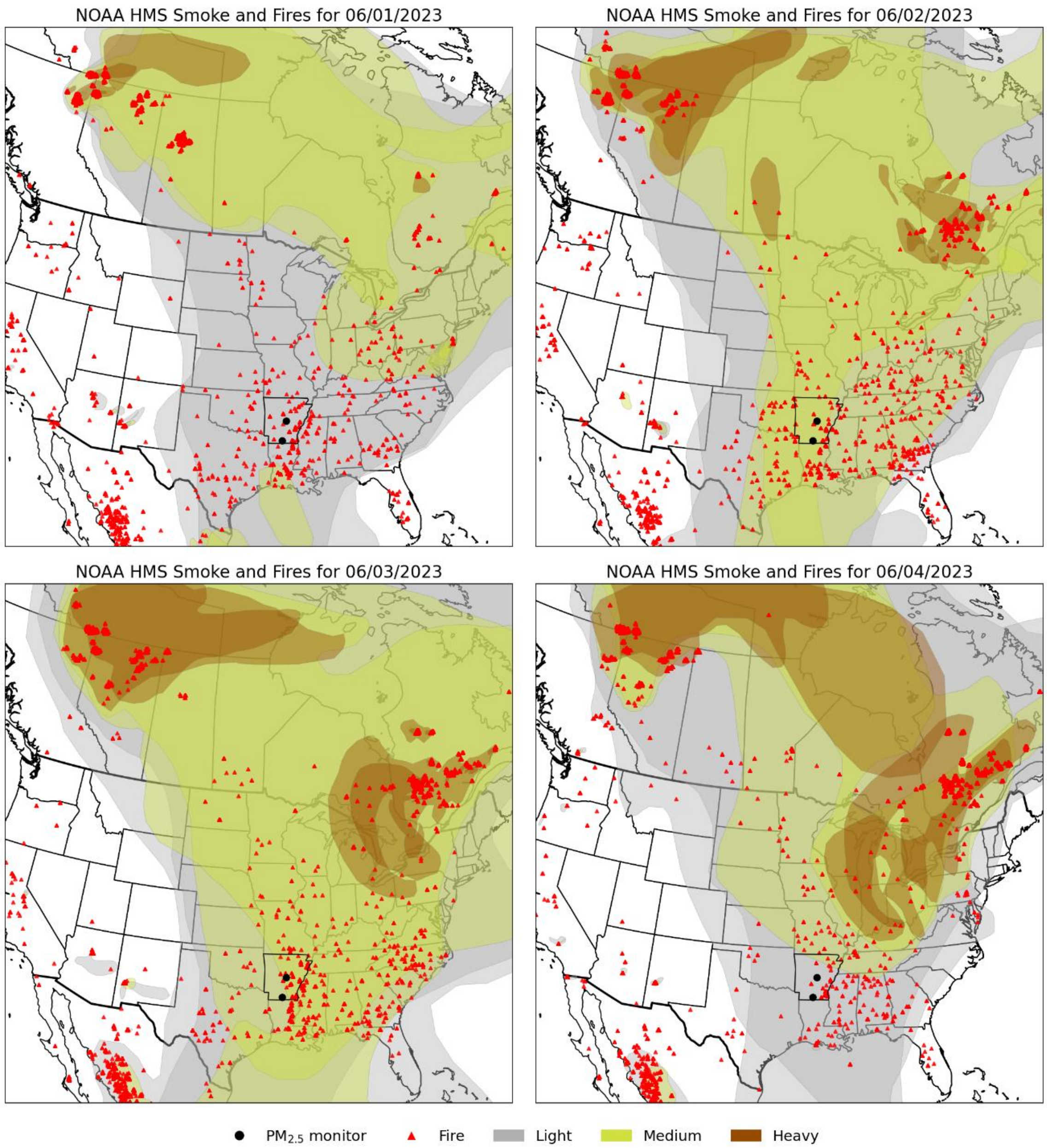


Figure 2-164. Evolution of fires and smoke for (a) June 1 (top left), June 2 (top right), June 3 (bottom left), and June 4 (bottom right).

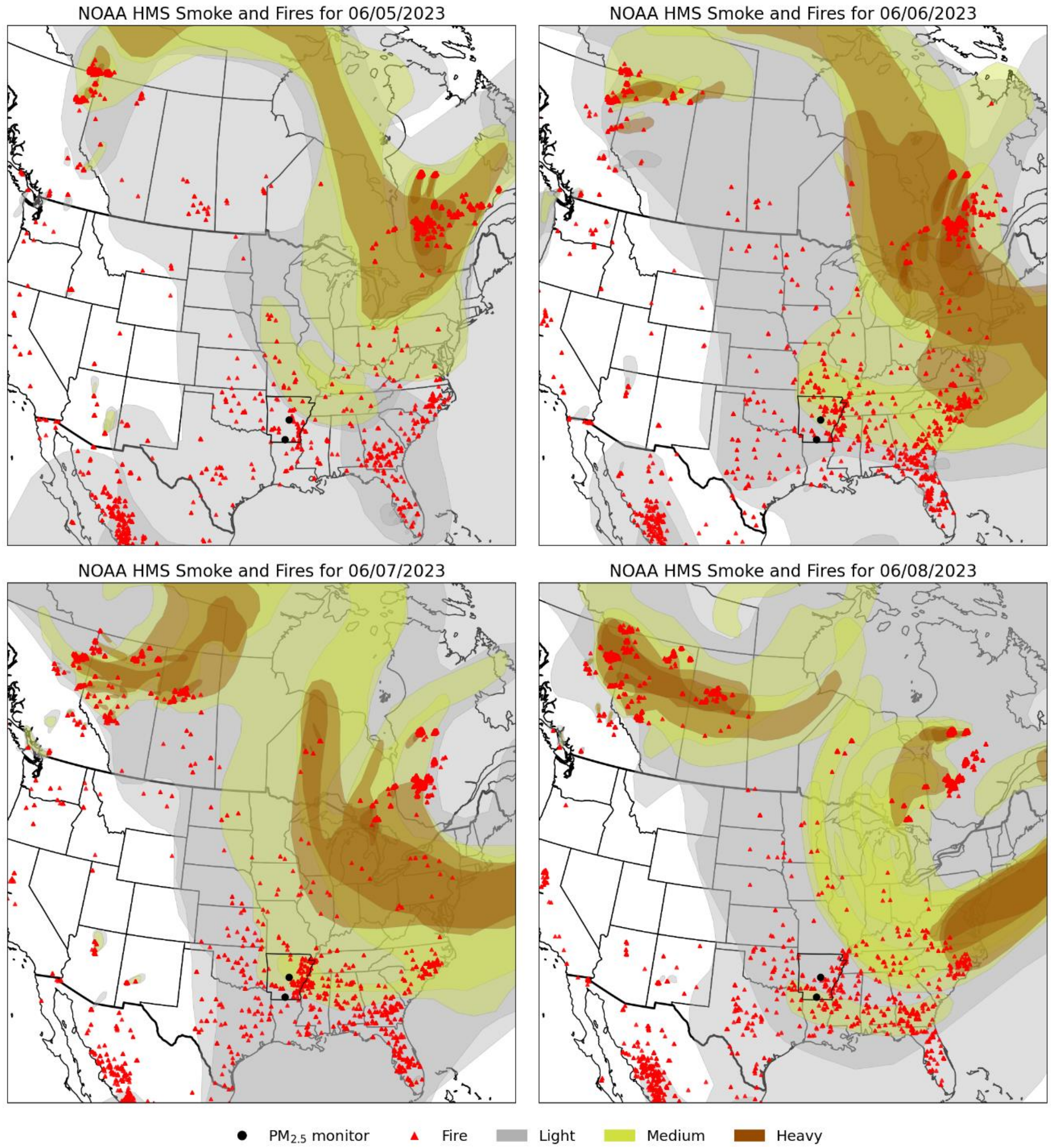


Figure 2-165. Evolution of fires and smoke for (a) June 5 (top left), June 6 (top right), June 7 (bottom left), and June 8 (bottom right).

2.1.8.1 PARR June 4, 2023

Table 2-23 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on June 4, 2023. Figure 2-166 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold. Back trajectories shown in Figure 2-168 illustrate that air masses are transported through regions with heavy smoke from numerous wildfires in the Quebec province in Canada. The hourly $PM_{2.5}$ concentrations (Figure 2-169) started to increase on June 4, 2023, in anticipation of an approaching surface cold front, indicating the vertical downward mixing of smoke.

Table 2-23. Exceptional event supporting evidence for PARR on June 4, 2023.

Monitor	PARR (05-119-0007)
Event Date	June 4, 2023
24-hr $PM_{2.5}$ Concentration	18.2 $\mu g/m^3$
EPA Tiering Tool Tier 2 Threshold	17.0 $\mu g/m^3$
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: June. Date accessed: 11/20/2024.

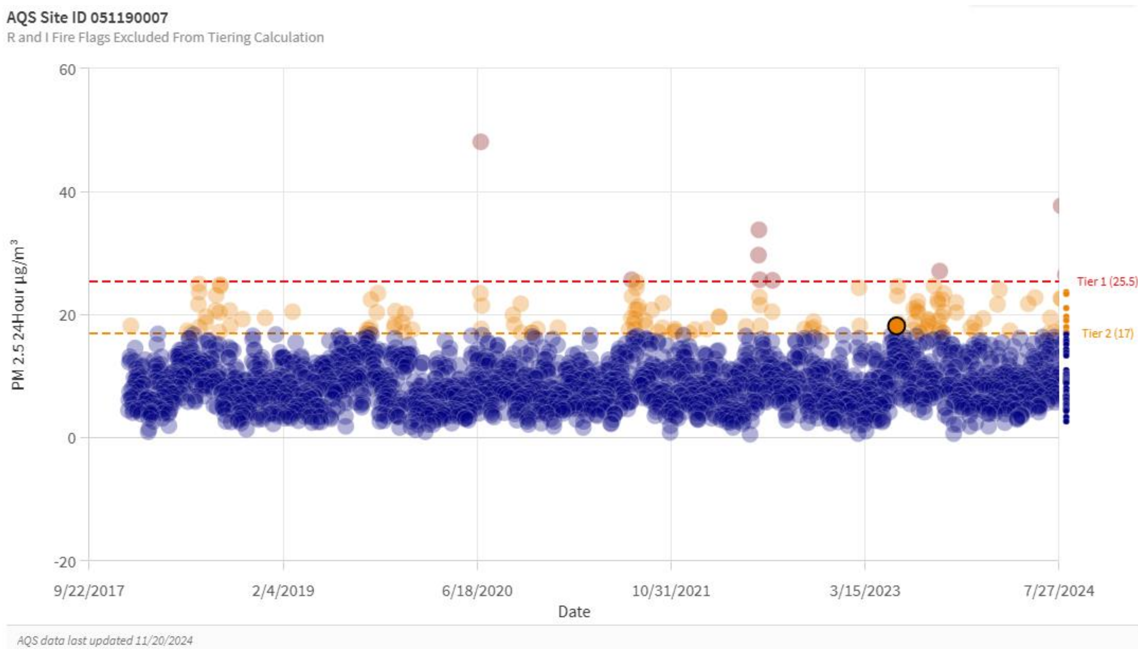


Figure 2-166. EPA $PM_{2.5}$ Tiering Tool for PARR on June 4, 2023.

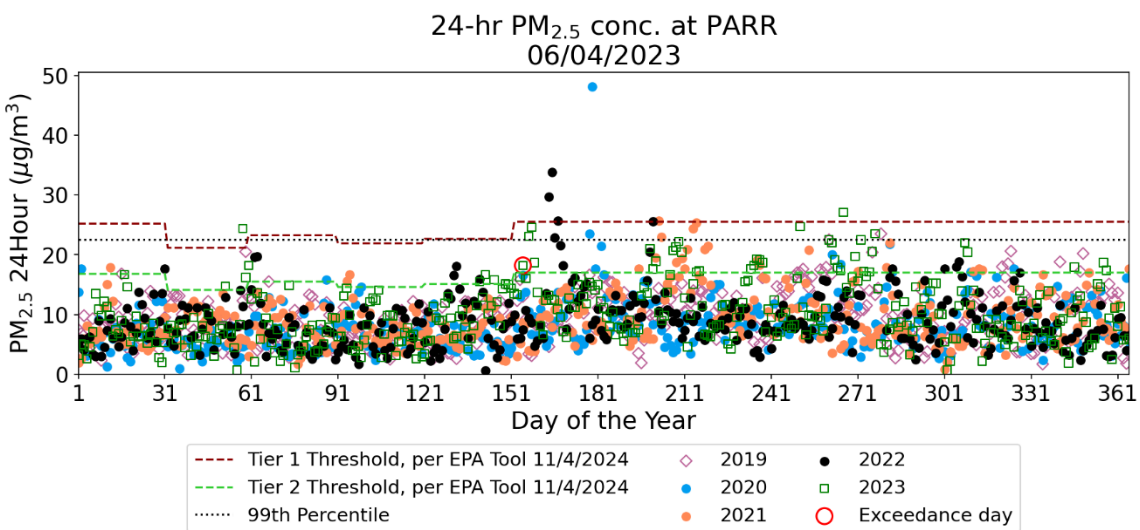


Figure 2-167. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to June 4, 2023.

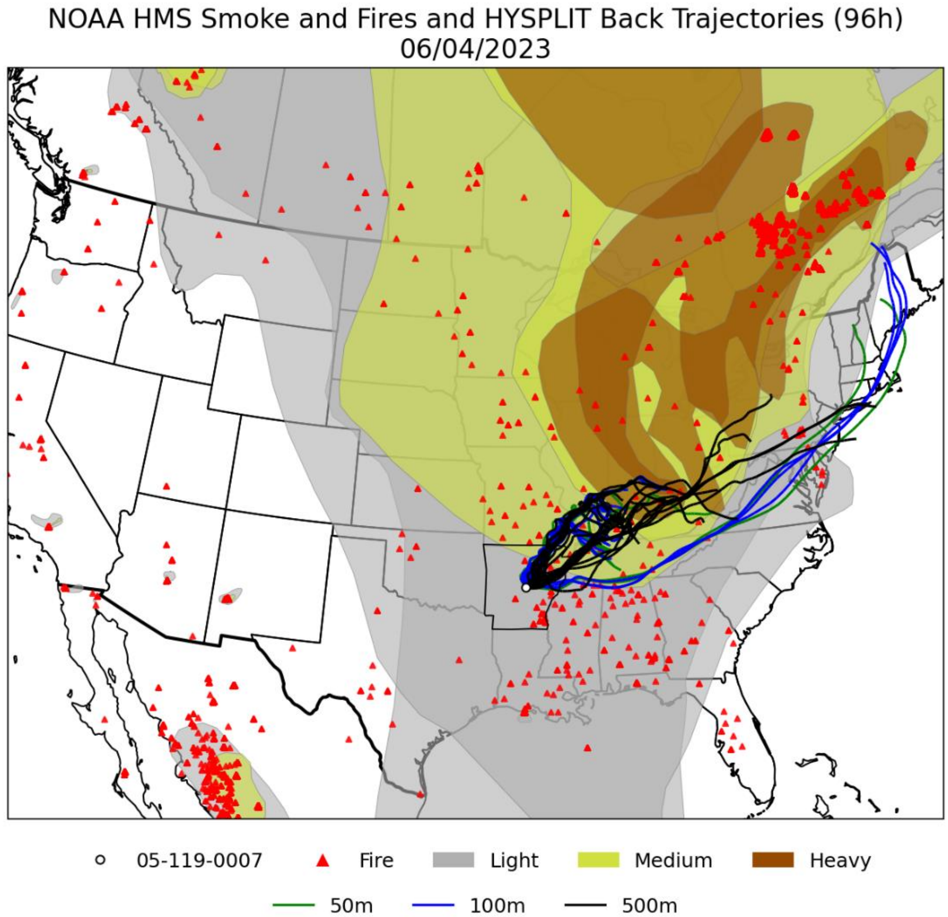


Figure 2-168. HYSPLIT back trajectories for PARR on June 4, 2023.

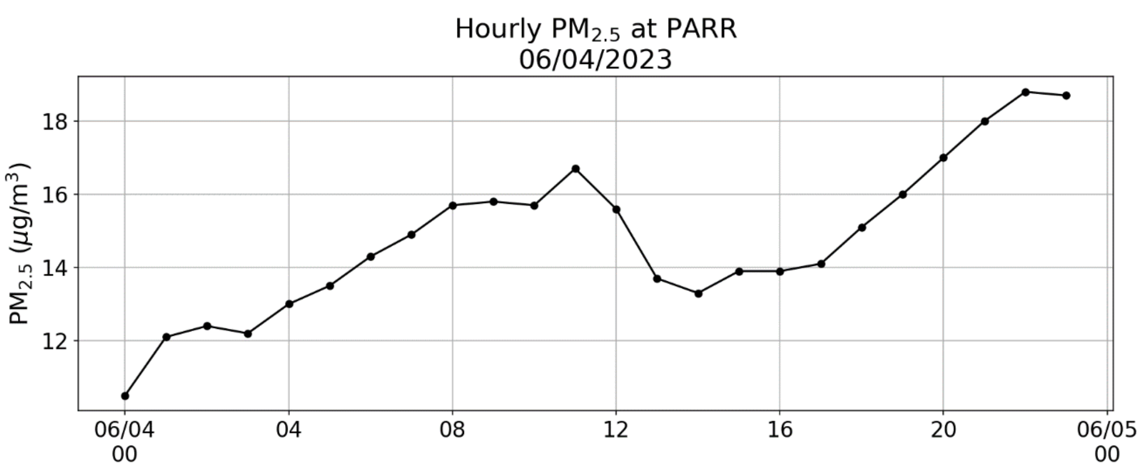


Figure 2-169. Hourly $PM_{2.5}$ concentrations for PARR on June 4, 2023.

2.1.8.2 PARR June 6, 2023

Table 2-24 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on June 6, 2023. Figure 2-170 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold, while Figure 2-112 shows it is above the historic 99th percentile. Figure 2-172 shows that back trajectories can reach Quebec, Canada, where numerous wildfires were burning. Figure 2-173 shows that hourly $PM_{2.5}$ concentrations continuously increased from 20.5 µg/m^3 at 2 AM CDT to 31.3 µg/m^3 at 1 PM CDT, remaining fairly constant thereafter around 28 µg/m^3. These high concentrations are associated with a low-pressure system passing over Arkansas and the presence of a high-pressure system southeast of Arkansas (Figure 2-159b); the interaction between these systems facilitated the transport of smoke into the region from Canadian wildfires.

Table 2-24. Exceptional event supporting evidence for PARR on June 6, 2023.

Monitor	PARR (05-119-0007)
Event Date	June 6, 2023
24-hr $PM_{2.5}$ Concentration	23.1 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: June. Date accessed: 11/20/2024.

Figure 2-170. EPA $PM_{2.5}$ Tiering Tool for PARR on June 6, 2023.

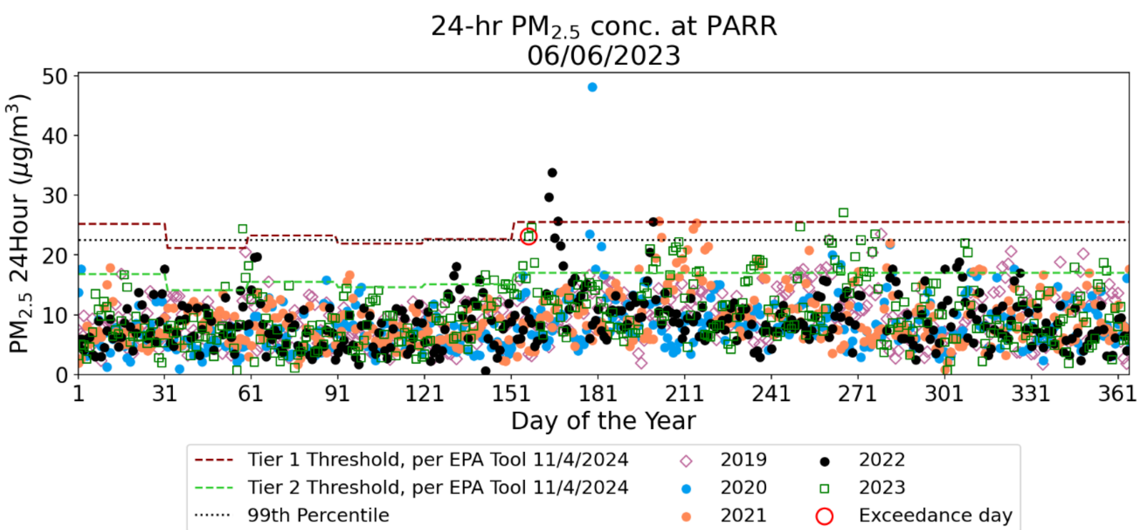


Figure 2-171. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to June 6, 2023.

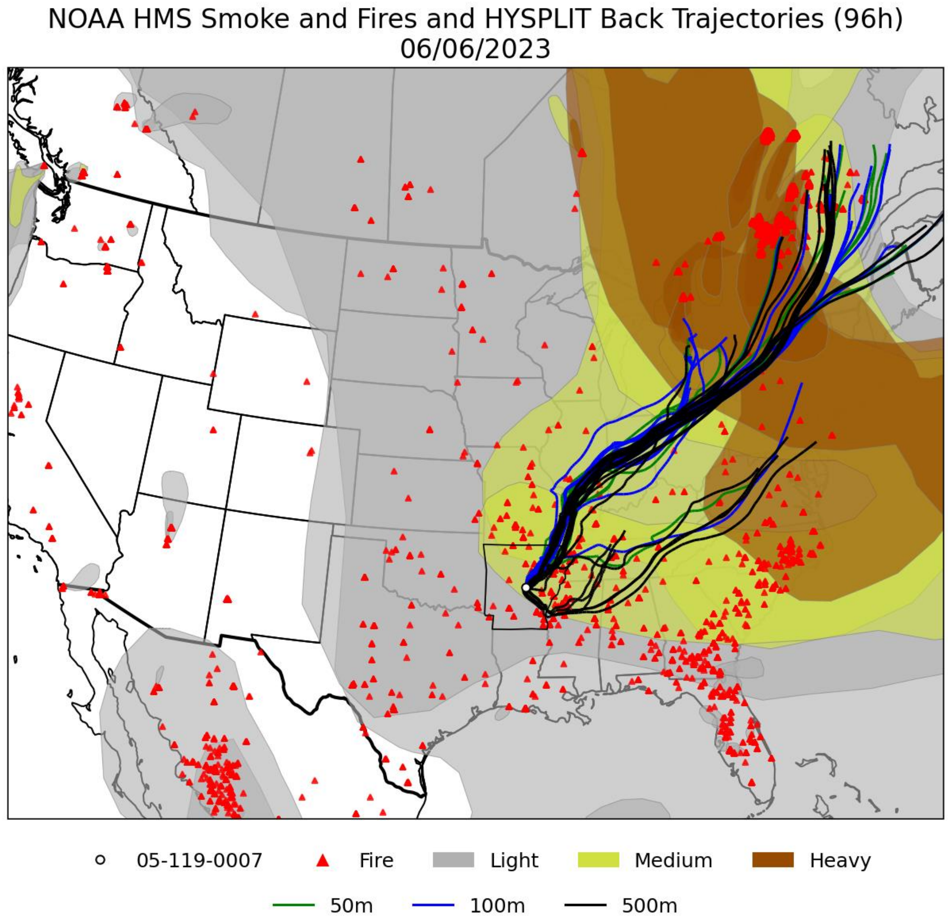


Figure 2-172. HYSPLIT back trajectories for PARR on June 6, 2023.

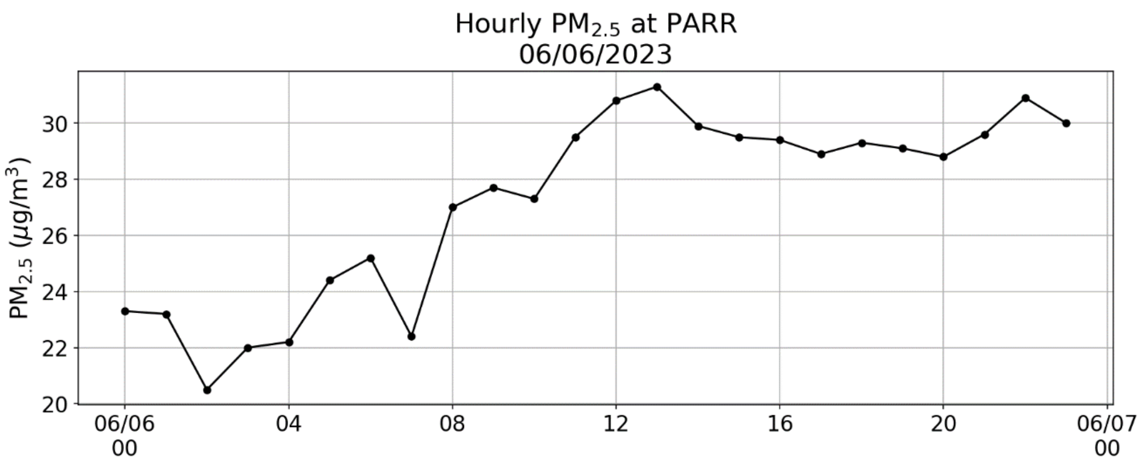


Figure 2-173. Hourly $PM_{2.5}$ concentrations for PARR on June 6, 2023.

2.1.8.3 PARR June 7, 2023

Table 2-25 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on June 7, 2023. Figure 2-174 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold and Figure 2-175 shows this day is above the historic 99th percentile over the last five years. Figure 2-176 shows that back trajectories can reach Quebec, Canada, where numerous wildfires were burning. Figure 2-177 provides visual evidence that surface observations of $PM_{2.5}$ from smoke created hazy sky conditions in Little Rock Arkansas.

Table 2-25. Exceptional event supporting evidence for PARR on June 7, 2023.

Monitor	PARR (05-119-0007)
Event Date	June 7, 2023
24-hr $PM_{2.5}$ Concentration	24.6 µg/m^3
EPA Tiering Tool Tier 21 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: June. Date accessed: 11/20/2024.

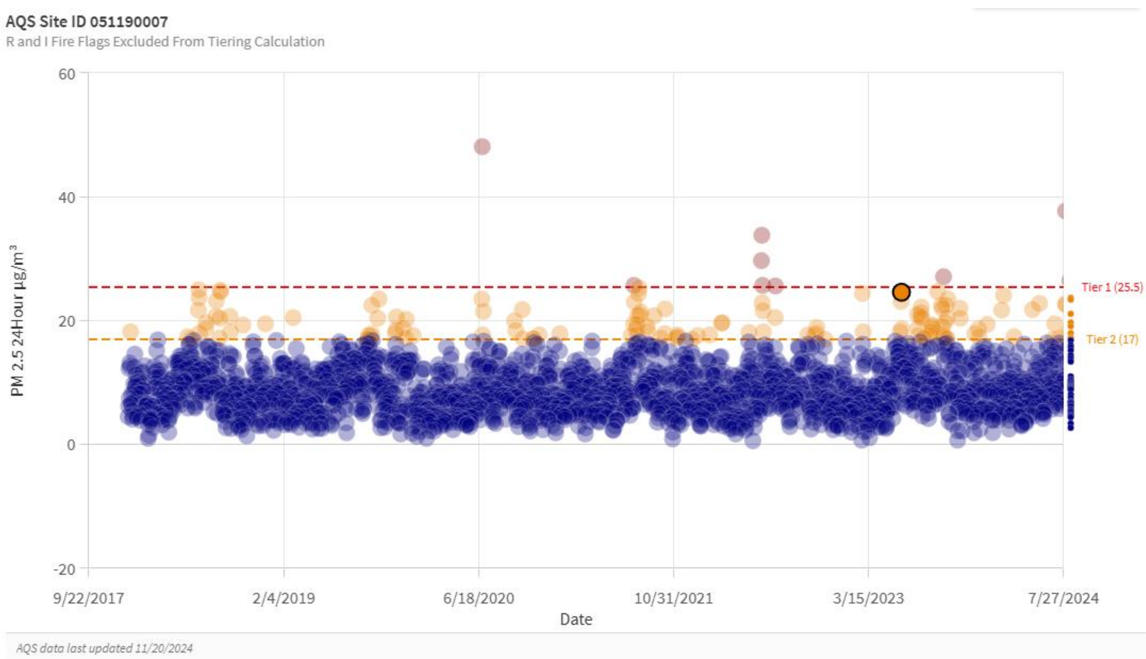


Figure 2-174. EPA $PM_{2.5}$ Tiering Tool for PARR on June 7, 2023.

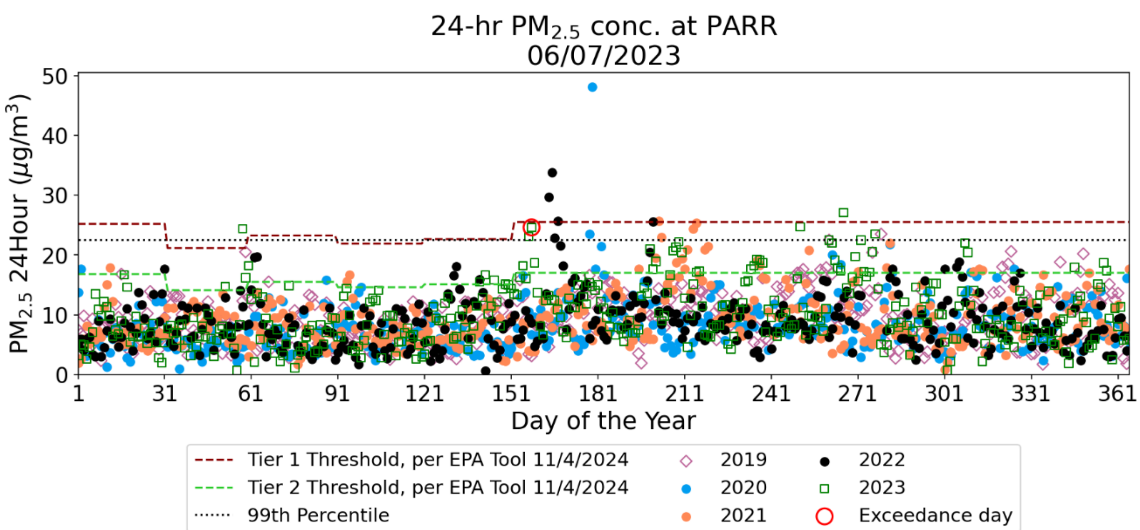


Figure 2-175. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to June 7, 2023.

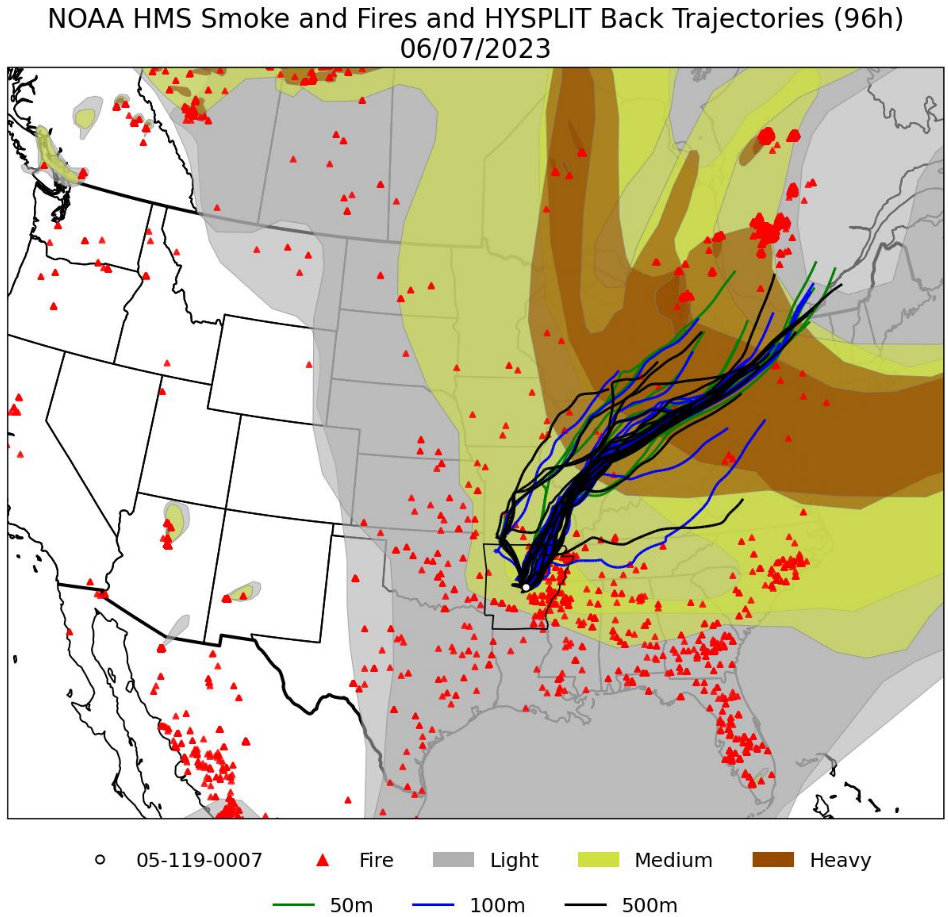


Figure 2-176. HYSPLIT back trajectories for PARR on June 7, 2023.

Figure 2-177. Hazy skies in Little Rock on June 7, 2023. (https://www.fox16.com/weather/weather-headlines/arkansas-storm-team-blog-how-long-will-canadian-wildfire-smoke-stay-in-arkansas/?nxsparam=7)

2.1.8.4 PARR June 8, 2023

Table 2-3 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on June 8, 2023. Figure 2-178 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold. Figure 2-180 shows that 96-hour back trajectories passed over regions with medium-density smoke and then descended over the monitoring site. Figure 2-181 shows that hourly $PM_{2.5}$ concentrations remain between 25 to 35 μg/m^3 for most of the day. This is associated with a cold front (Figure 2-159d) that passed through Arkansas and brought smoke from wildfires in Quebec, Canada, leading to the vertical mixing of smoke to the surface.

Table 2-26. Exceptional event supporting evidence for PARR on June 8, 2023.

Monitor	PARR (05-119-0007)
Event Date	June 8, 2023
24-hr $PM_{2.5}$ Concentration	18.7 μg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 μg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: June. Date accessed: 11/20/2024.

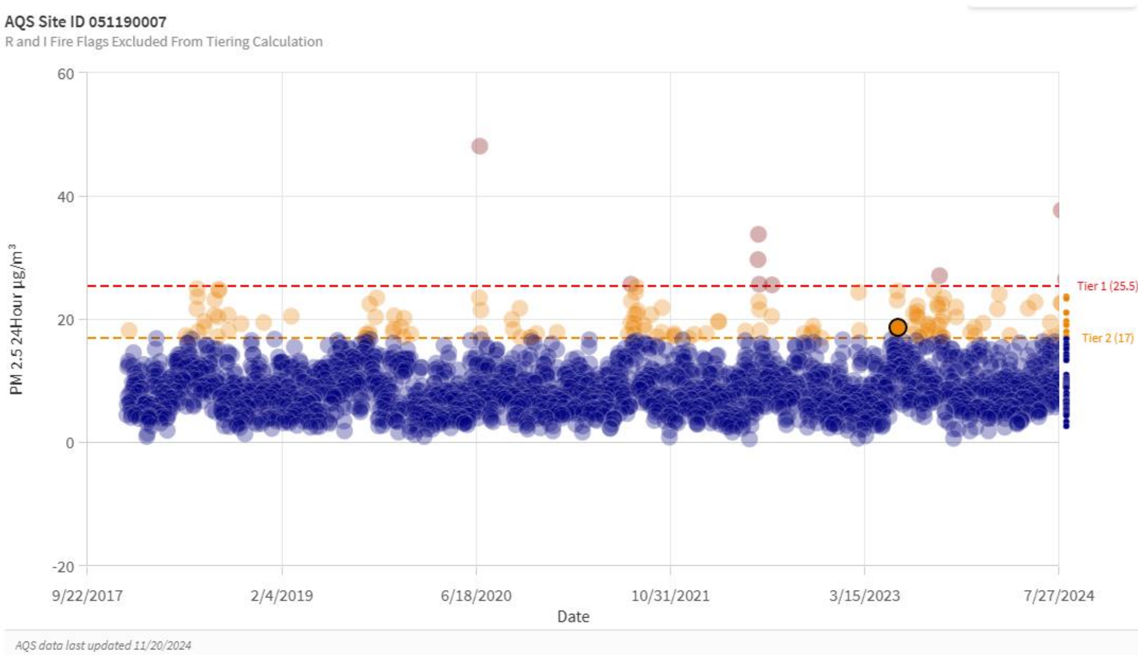


Figure 2-178. EPA PM2.5 Tiering Tool for PARR on June 8, 2023.

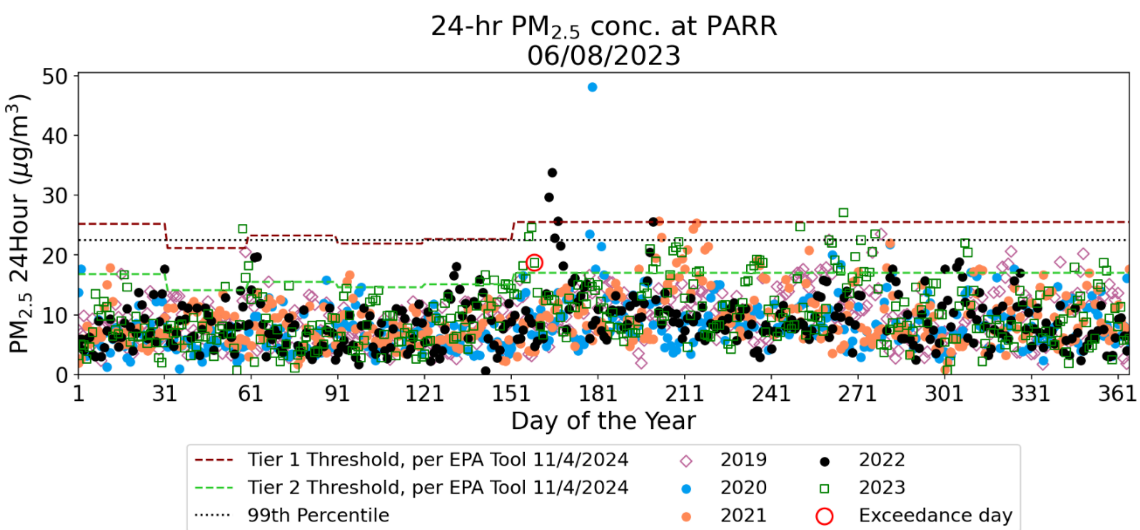


Figure 2-179. Historical 24-hour PM2.5 seasonal fluctuations for PARR compared to June 8, 2023.

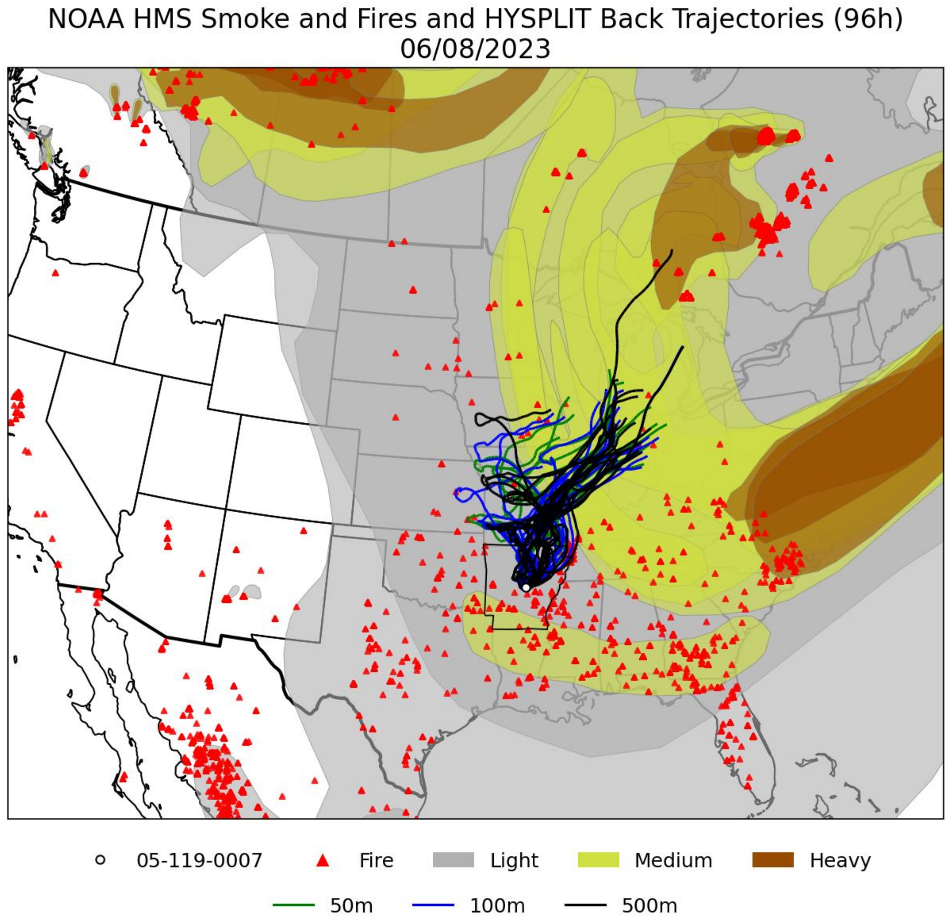


Figure 2-180. HYSPLIT back trajectories for PARR on June 8, 2023.

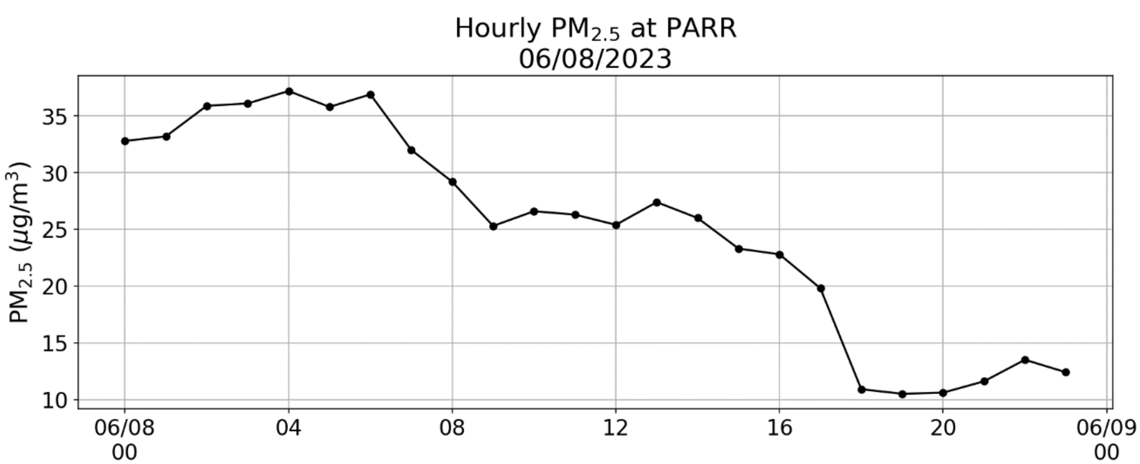


Figure 2-181. Hourly $PM_{2.5}$ concentrations for PARR on June 8, 2023.

2.1.8.5 El Dorado June 8, 2023

Table 2-27 summarizes the evidence gathered to support the demonstration of an exceptional event for El Dorado (AQS ID 05-139-0006) on June 8, 2023. Figure 2-182 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold and Figure 2-183 shows this day is close to the historic 99th percentile over the last five years. Figure 2-184 shows that the 96-hour back trajectories pass over regions with medium-density smoke and then descend over the monitoring site.

Table 2-27. Exceptional event supporting evidence for El Dorado on June 8, 2023.

Monitor	El Dorado (05-139-0006)
Event Date	June 8, 2023
24-hr $PM_{2.5}$ Concentration	20.2 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.6 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: June. Date accessed: 11/20/2024.

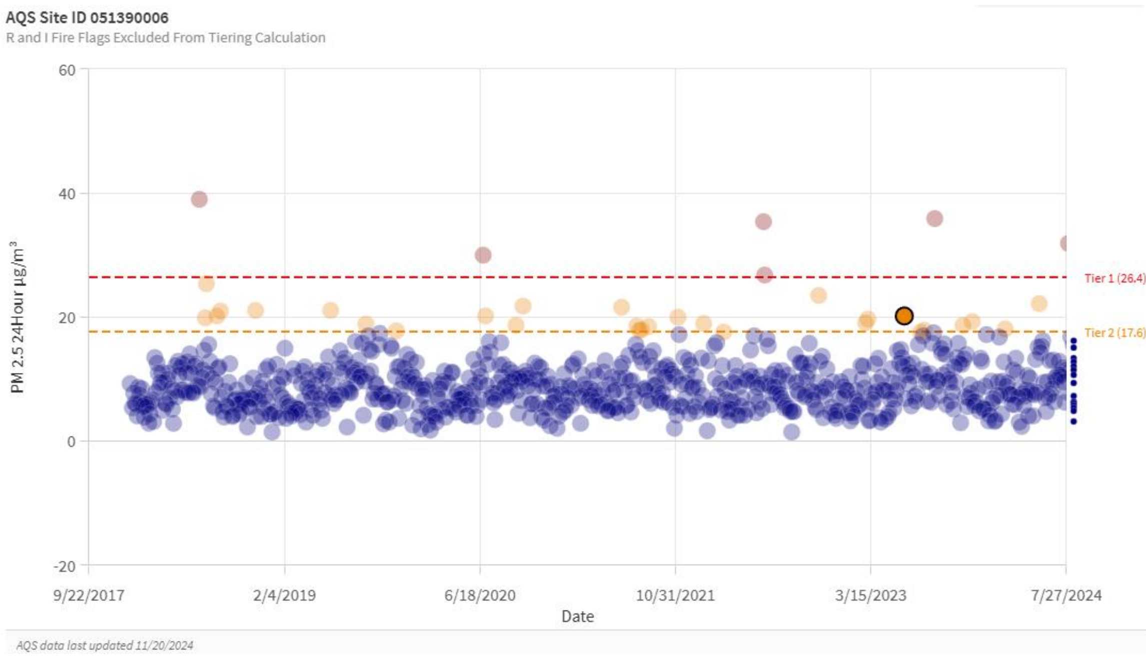


Figure 2-182. EPA $PM_{2.5}$ Tiering Tool for El Dorado on June 8, 2023.

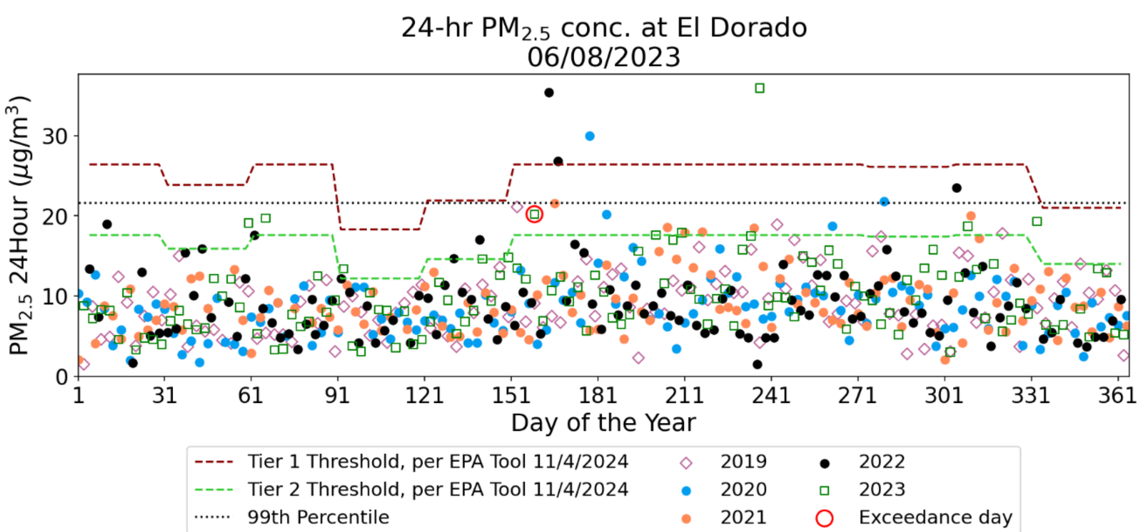


Figure 2-183. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for El Dorado compared to June 8, 2023.

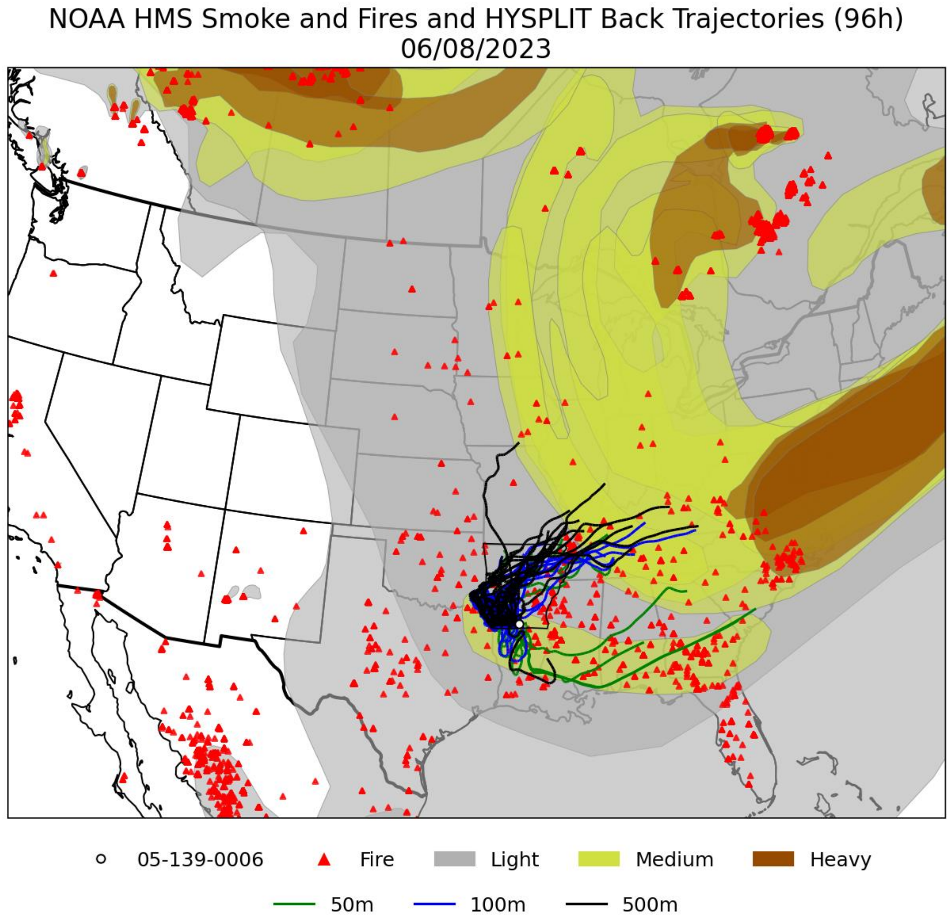
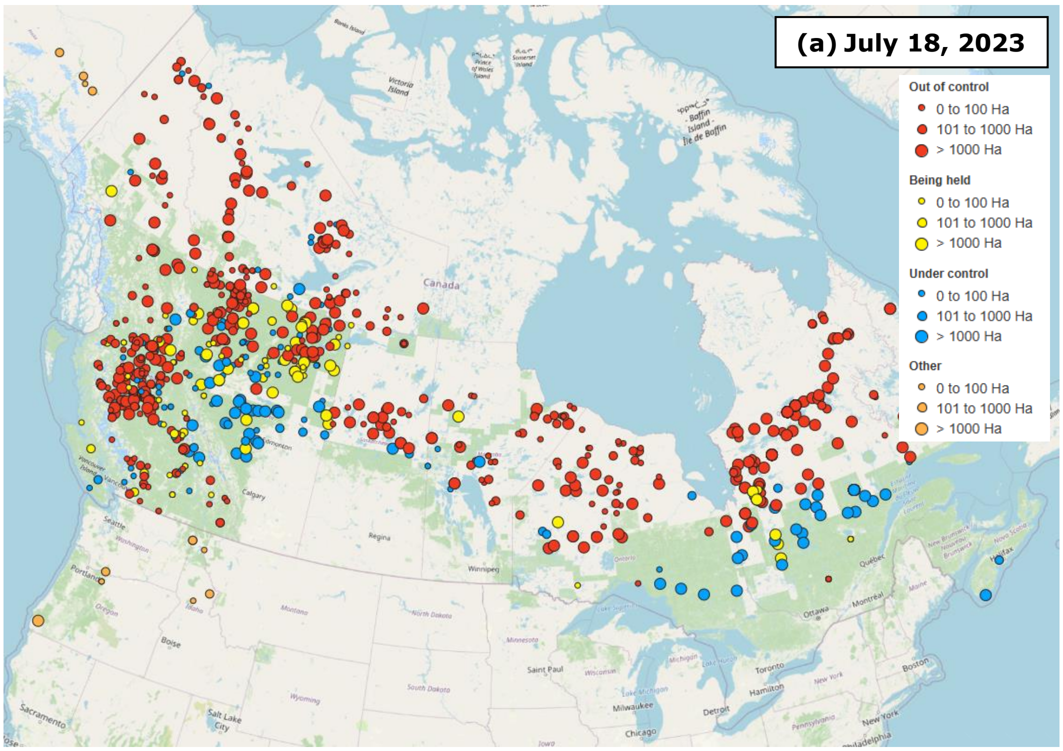


Figure 2-184. HYSPLIT back trajectories for El Dorado on June 8, 2023.

2.1.9 July 18 and 20, 2023

During mid-July 2023, an anomalous upper-level high pressure system over Canada contributed to record warm and dry conditions across Quebec. Unseasonably high temperatures often reached into the 90° F, alongside persistent dry weather that created ideal conditions for wildfire increase in size and number. Thunderstorms that moved through the region ignited numerous new fires due to lightning strikes. By mid-July (Figure 2-185), the Quebec Province had seen over 700 wildfires started since the first week of June.[34] This marked one of the most devastating wildfire seasons on record, with the area burned surpassing totals from the previous two decades combined.



[34] https://theconversation.com/quebecs-summer-2023-wildfires-were-the-most-devastating-in-50-years-is-the-worst-yet-to-come-216933

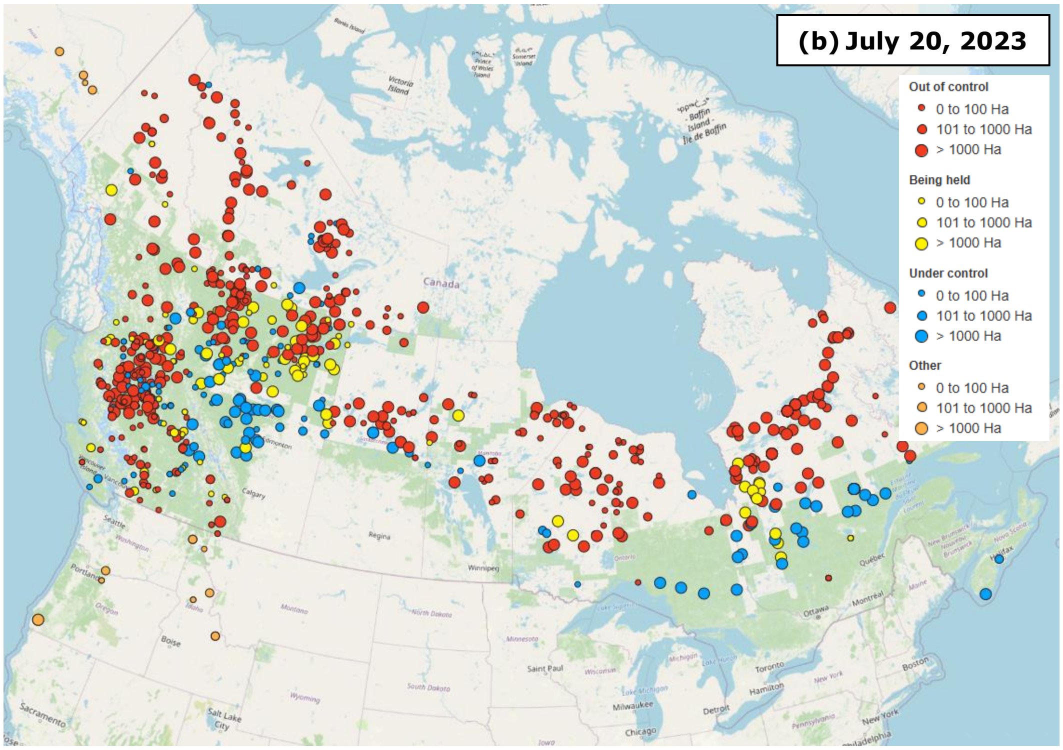
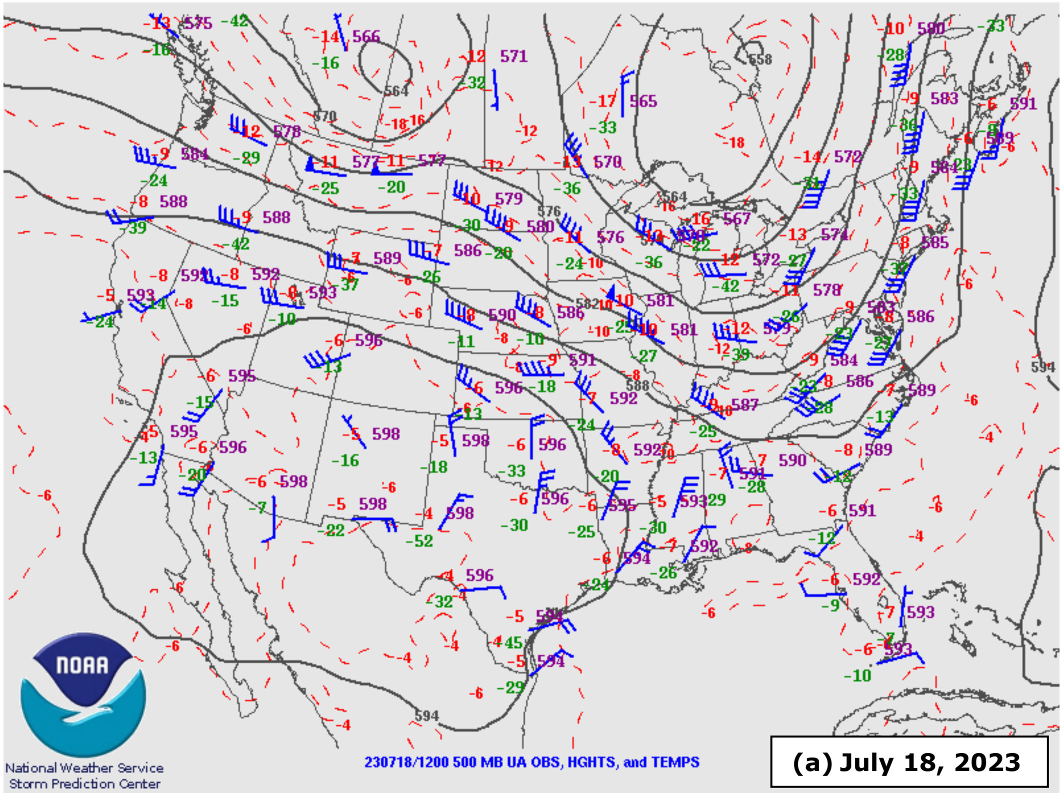


Figure 2-185. Canadian Wildfire Information System map of active fires for (a) July 18 and (b) July 20. (https://cwfis.cfs.nrcan.gc.ca/interactive-map)

The 500 mbar analysis on July 18, 2023 (Figure 2-186a) indicated the presence of a low pressure system over the northwest and central Canada and a high pressure system over the southwestern U. S. The atmospheric pattern resulted in decreased westerlies and blocked jet stream that concurrently led to increased air mass stagnation and smoke transport in the downwind regions of the upper atmosphere on July 17th and July 18th.[35] The low-pressure weakend and moved to the east by July 20, 2023 (Figure 2-186b). The northwesterly winds along the trough's southern flank led to transport of smoke from fires in Canada into the northern and central U.S. The flow around the ridge in the southwestern U.S. would trap pollutants and prevent dispersion, enhancing localized air quality issues.[36]

[35] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=07&STARTDAY=18&STARTTIME=00&INC=-48
[36] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=07&STARTDAY=20&STARTTIME=00&INC=-48



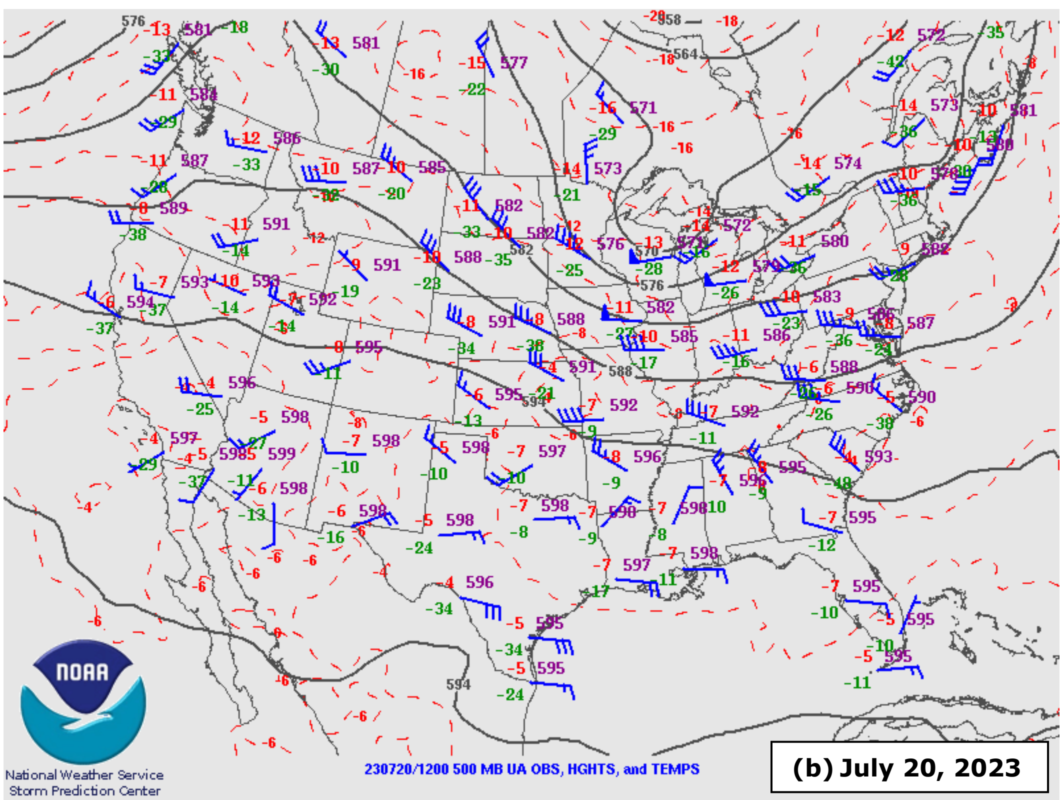
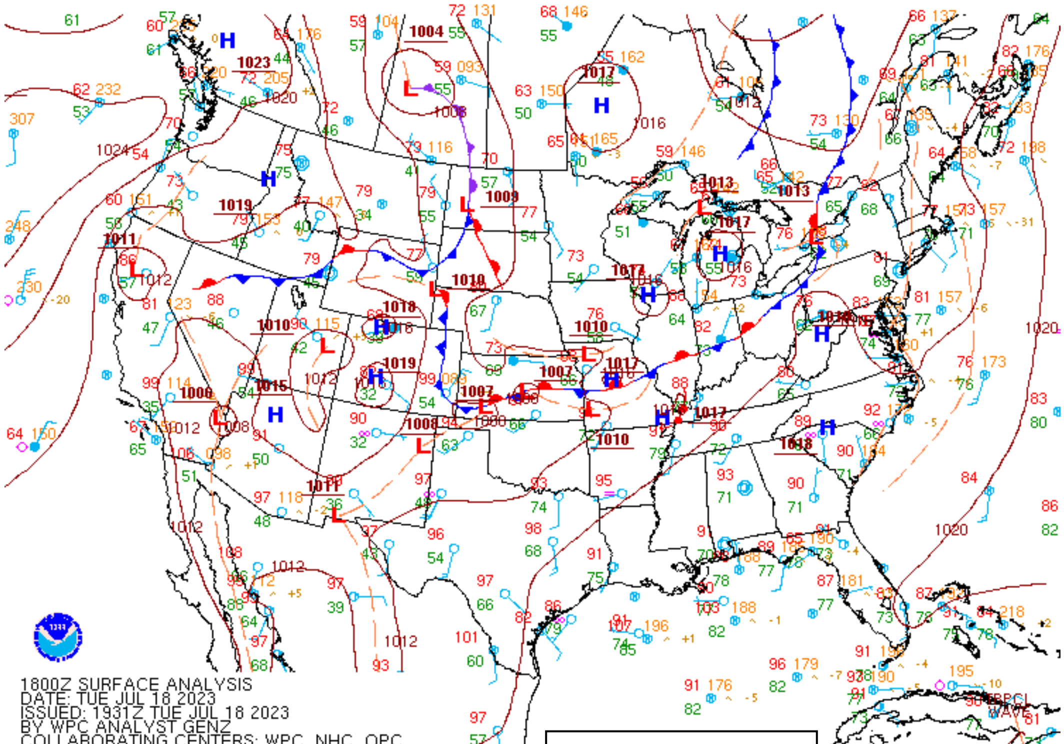


Figure 2-186. 500 mb synoptic analysis map at 12 UTC on (a) July 18 and (b) July 20, 2023.

The surface analysis on July 18, 2023 (Figure 2-187a) shows a stationary front extended across the southern U.S., passing through Kansas, Missouri and into the Midwest. This frontal system marked the convergence of contrasting air masses but remained largely stationary, creating a zone of stagnation. Near Arkansas, the stationary front acted as a barrier to vertical air movement, effectively trapping pollutants near the surface. The surface pressure analysis showed a high pressure positioned northeast of Arkansas, driving easterly to southeasterly winds across the state. These light winds, combined with the weak air mixing typically associated with stationary fronts, further contributed to air mass stagnation and smoke accumulation. By July 20, 2023 (Figure 2-187b), a cold front advanced into the central and eastern U.S., while a high-pressure system dominated the western Plains. The approaching cold front steered smoke southward from the upper Midwest into Arkansas. Behind the front, northerly surface winds helped disperse pollutants to some extent, decreasing the air quality impacts in Arkansas and surrounding regions.



(a) July 18, 2023

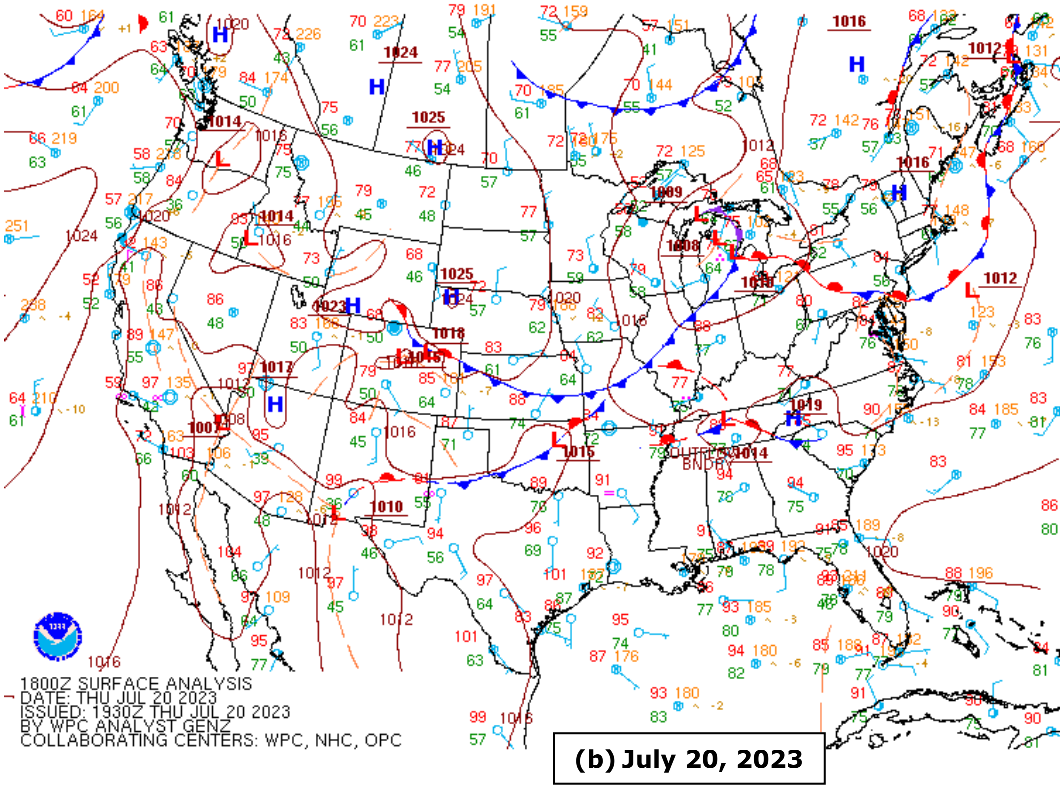


Figure 2-187. Surface synoptic analysis maps (bottom row) at 18 UTC on (a) July 18 and (d) July 20.

The NOAA HMS product in Figure 2-188 and visible satellite images in Figure 2-189 during July 18 and 20, 2023 show light smoke covering most of the U.S., with medium to heavy smoke affecting areas in the Midwest, eastern, and southeastern U.S. Moderate values of the AQI in Arkansas Figure 2-190 and NAAPS modeled surface concentrations in Figure 2-191 indicate that this smoke mixed down to surface affecting Arkansas and other areas in the southeastern U.S. Figure 2-192 illustrates the evolution of the smoke plumes that clearly originate from multiple fires in northwest Canada during several days in the period July 15 to July 20, 2023.

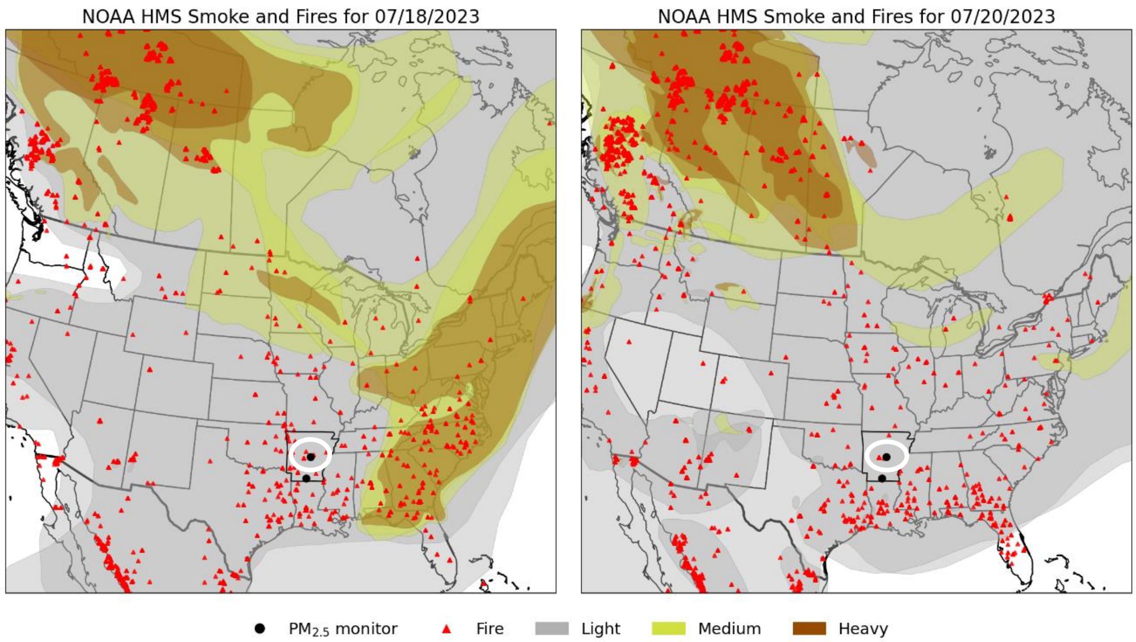
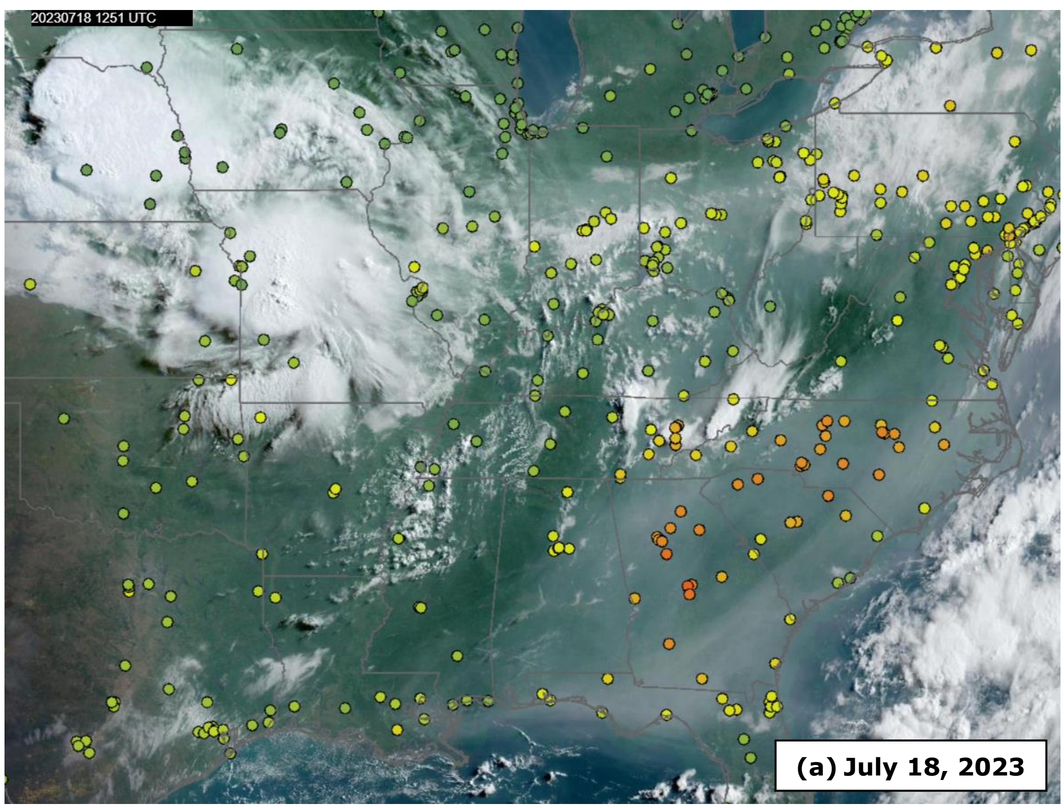


Figure 2-188. NOAA HMS fire and smoke products for July 18 (left) and July 20 (right), 2023.



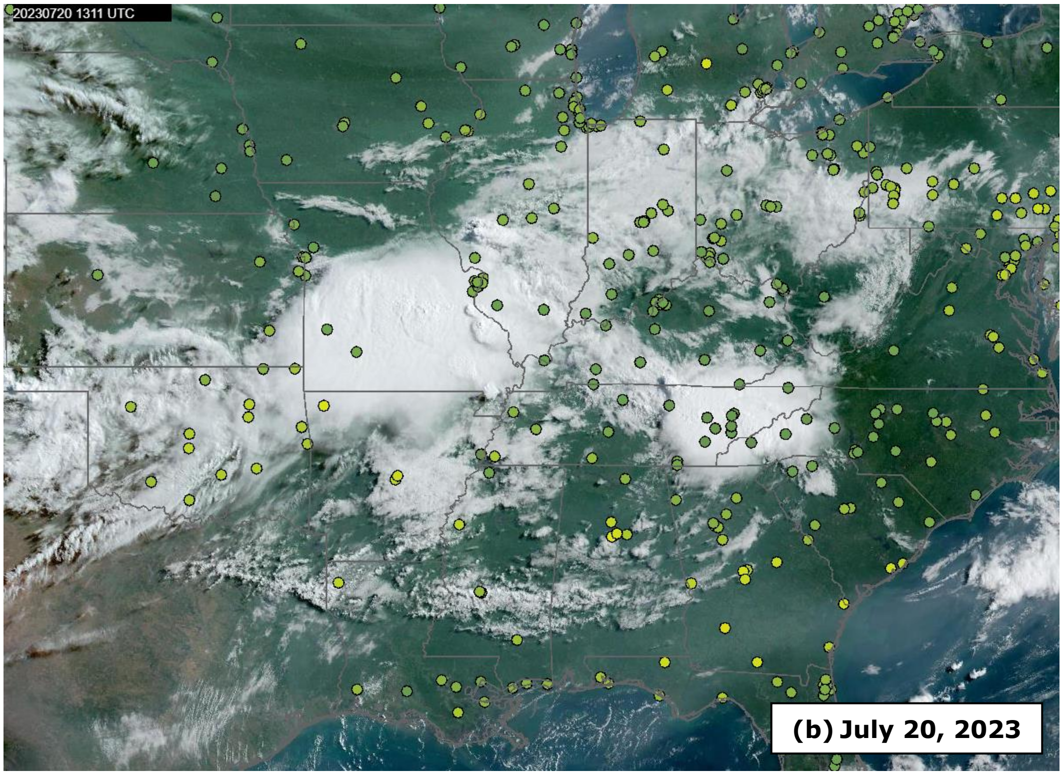


Figure 2-189. NOAA satellite visible imagery on (a) July 18 at 1251 UTC and (b) July 20 at 1311 UTC, 2023.

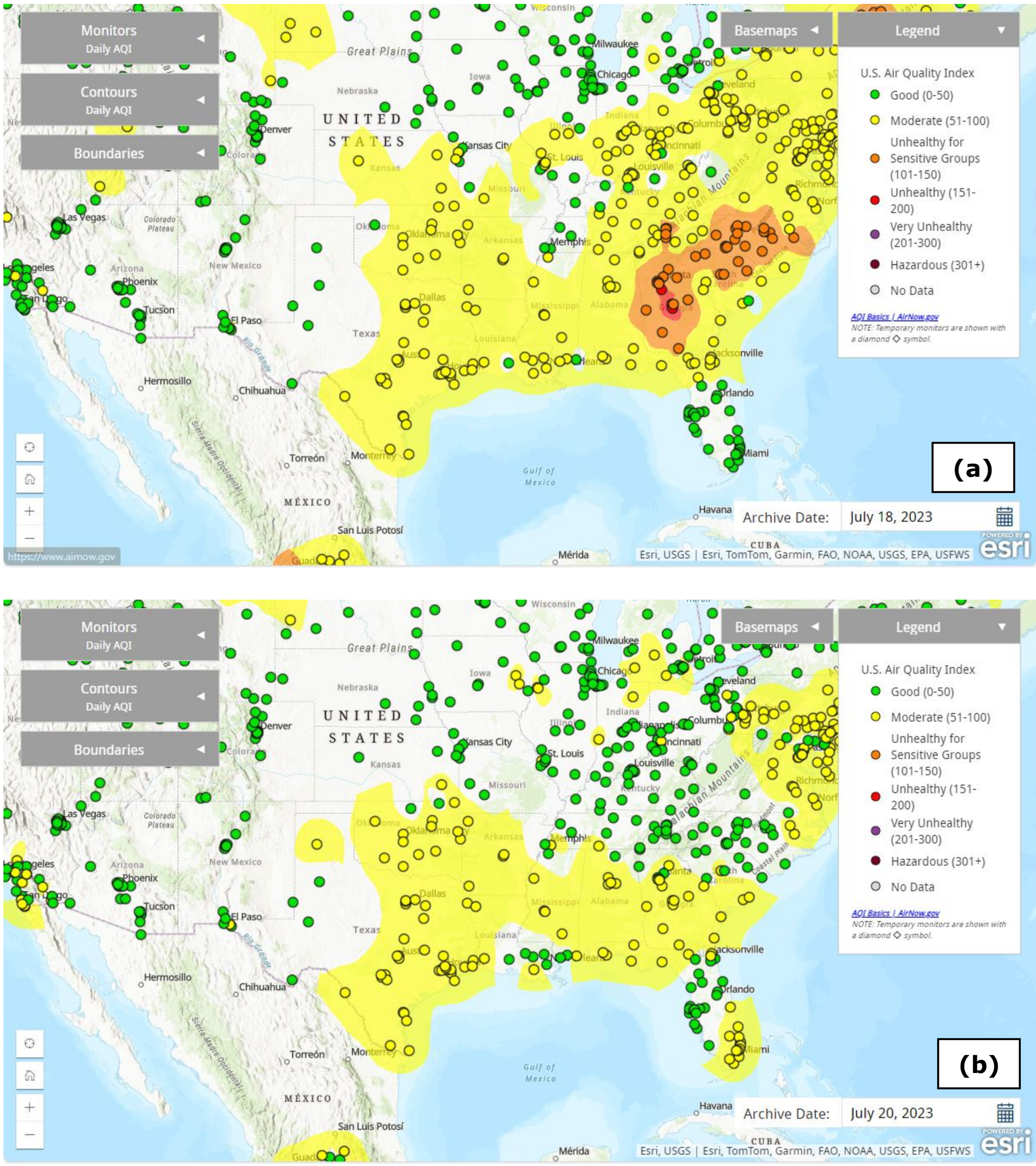
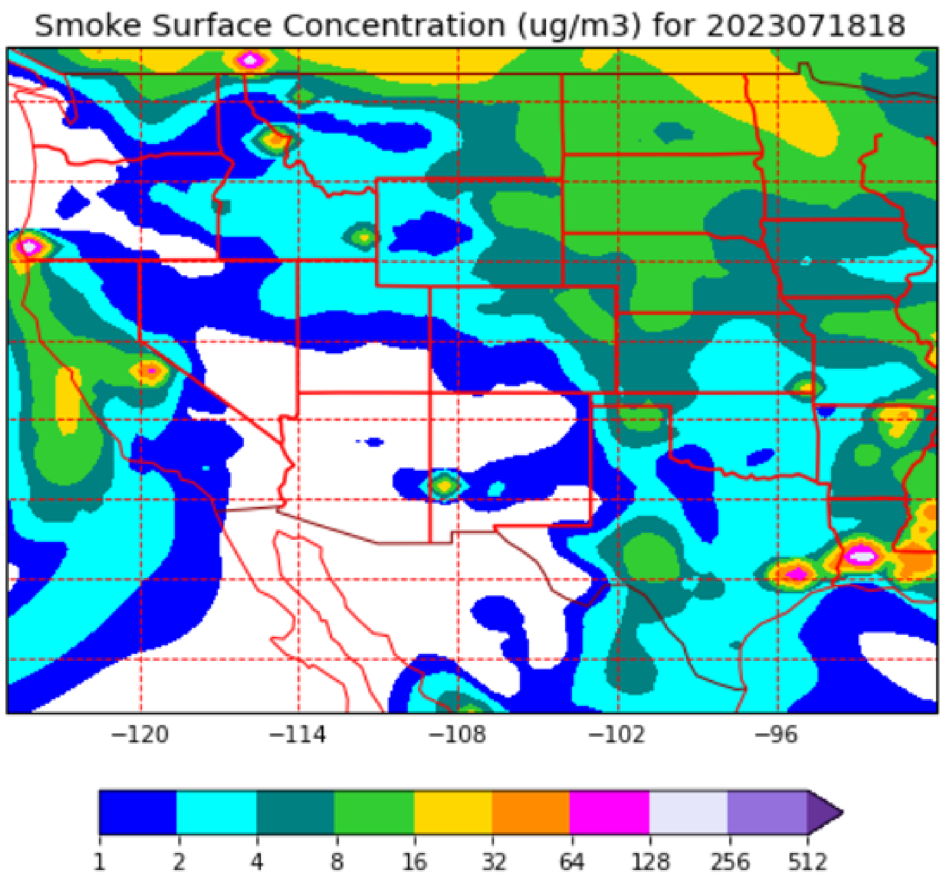


Figure 2-190. AirNow surface level $PM_{2.5}$ concentration contours for (a) July 18 and (b) July 20, 2023.


Smoke Surface Concentration (ug/m3) for 2023071818
−120
−114
−108
−102
−96
1
2
4
8
16
32
64
128
256
512

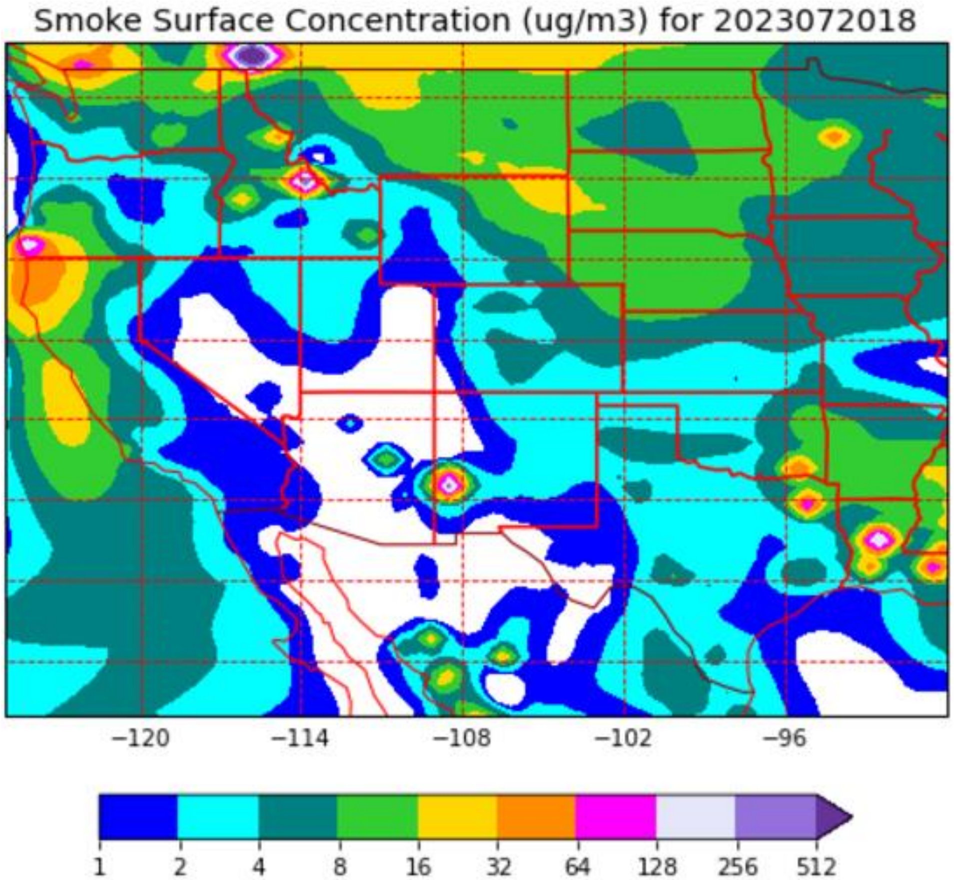


Figure 2-191. NAAPS modeled near-surface smoke concentrations (µg/m³) on (a) July 18 at 5 PM CDT and (b) July 20 at 8 PM CDT, 2023.

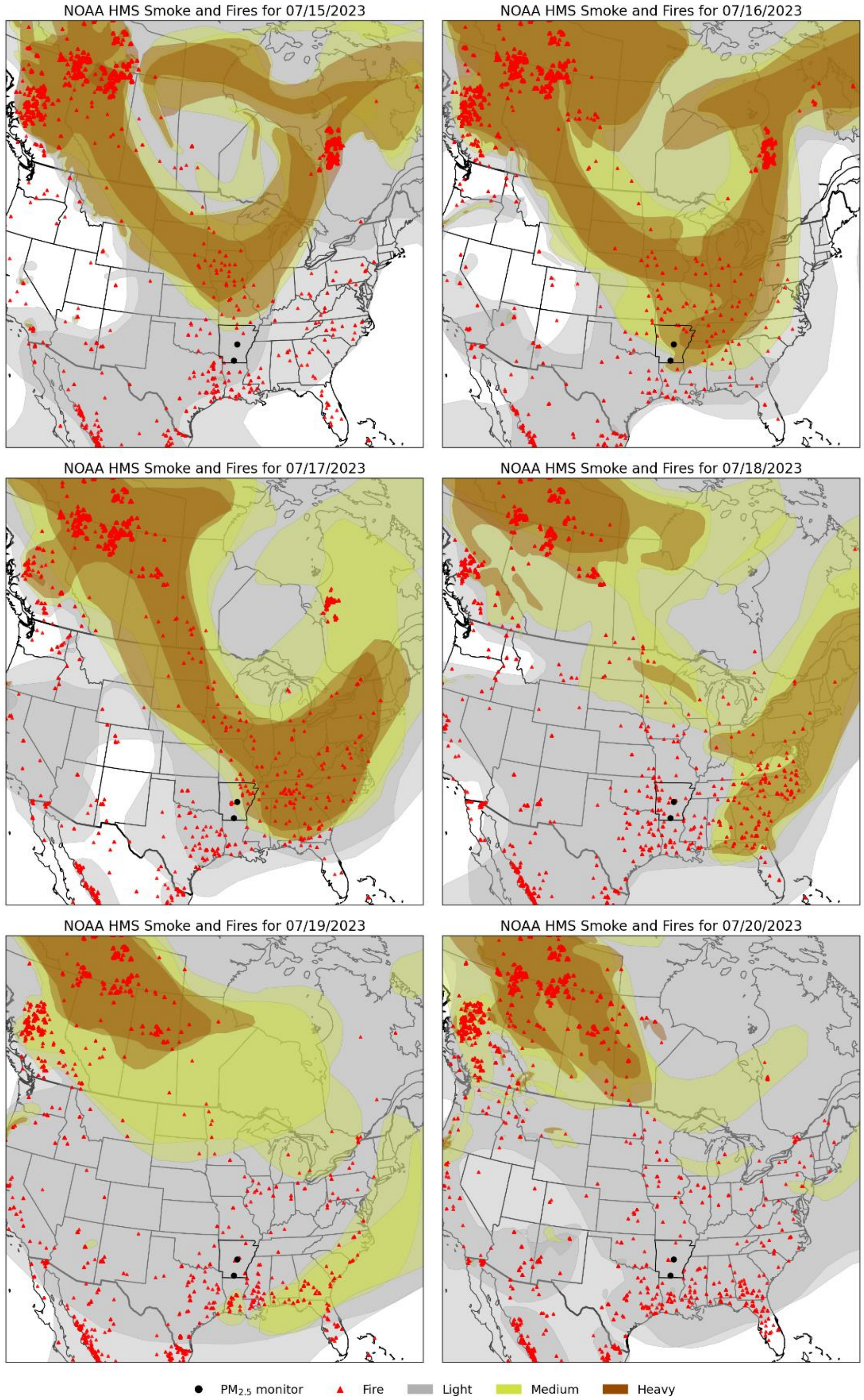


Figure 2-192. Evolution of fires and smoke for July 15 (top left), July 16 (top right), July 17 (middle left), and July 18 (middle right), July 19 (bottom left), and July 20 (bottom right).

2.1.9.1 PARR July 18, 2023

Table 2-28 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on July 18, 2023. Figure 2-193 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold and Figure 2-194 shows that this day is close to the historic 99th percentile over the last five years. Back trajectories started over the monitor at different heights and run for 96 hours (Figure 2-195) show that air masses cross regions of light smoke, while Figure 2-196 displays the trajectories traveling over lower altitude regions with light density smoke from fires in Canada. The movement of the air parcels also shows the sinking of air over the monitoring site. The hourly $PM_{2.5}$ concentrations started to increase (Figure 2-197) from the previous day (7/17/2023 at 8:00 CDT; 6.2 $\mu g/m^3$) in anticipation of an approaching surface cold front, clearly indicating the vertical downward mixing of smoke.

Table 2-28. Exceptional event supporting evidence for PARR on July 18, 2023.

Monitor	PARR (05-119-0007)
Event Date	July 18, 2023
24-hr $PM_{2.5}$ Concentration	21.0 $\mu g/m^3$
EPA Tiering Tool Tier 2 Threshold	17.0 $\mu g/m^3$
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: July. Date accessed: 11/20/2024.

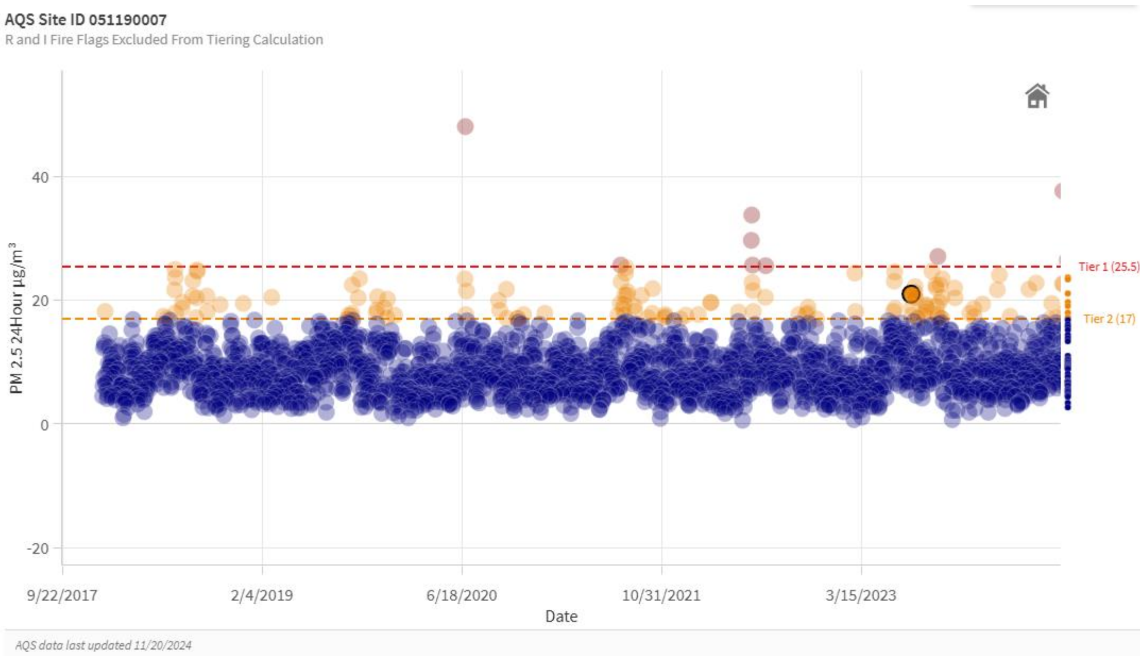


Figure 2-193. EPA $PM_{2.5}$ Tiering Tool for PARR on July 18, 2023.

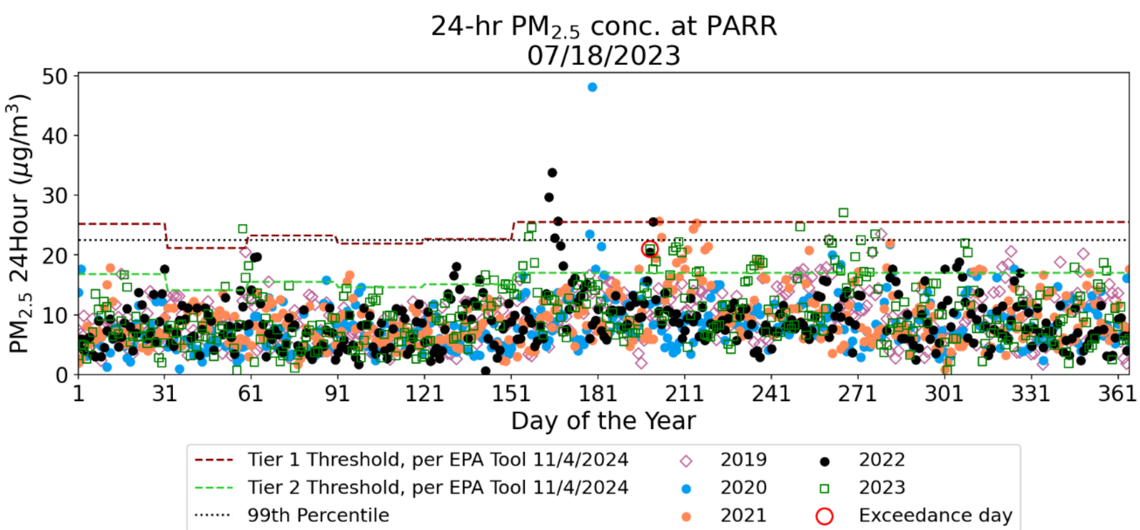


Figure 2-194. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to July 18, 2023.

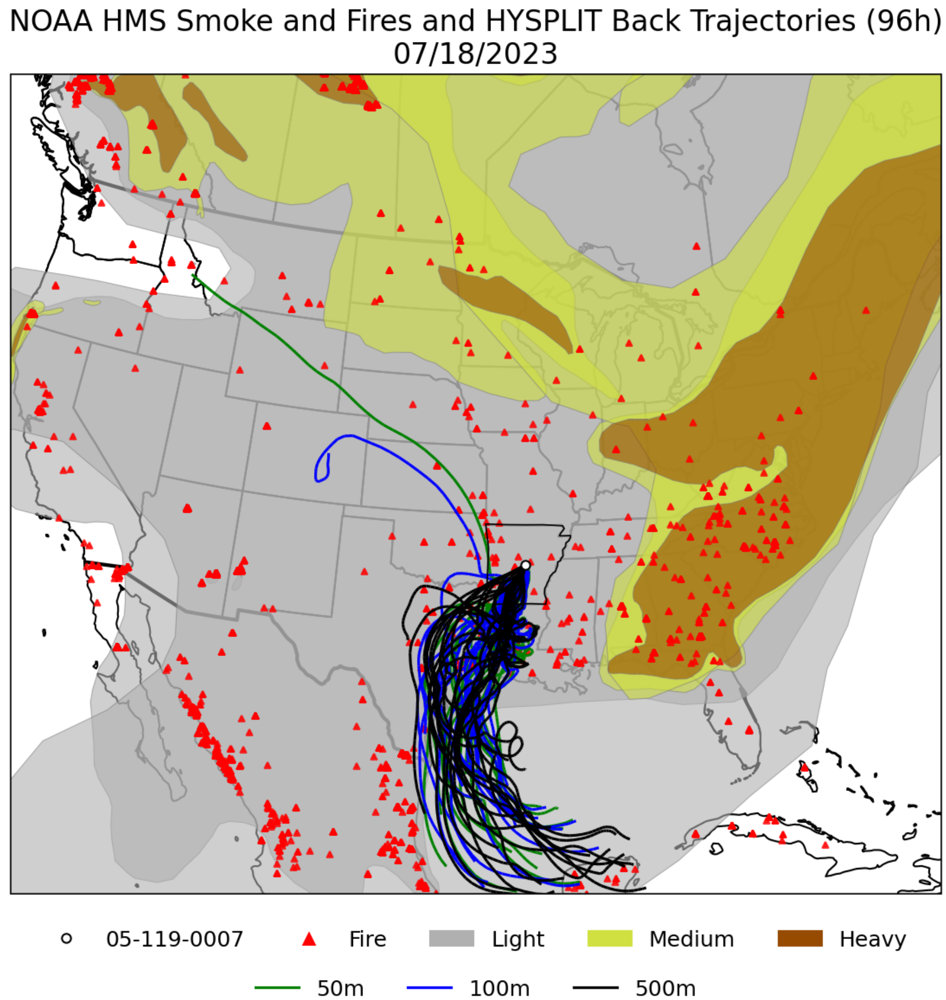
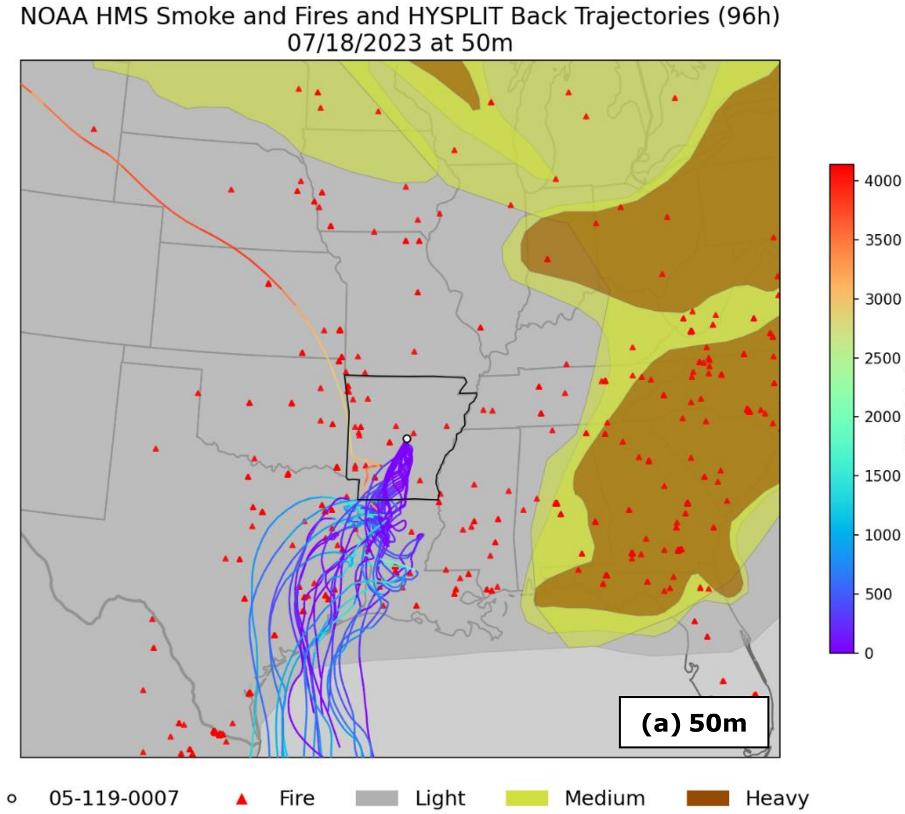
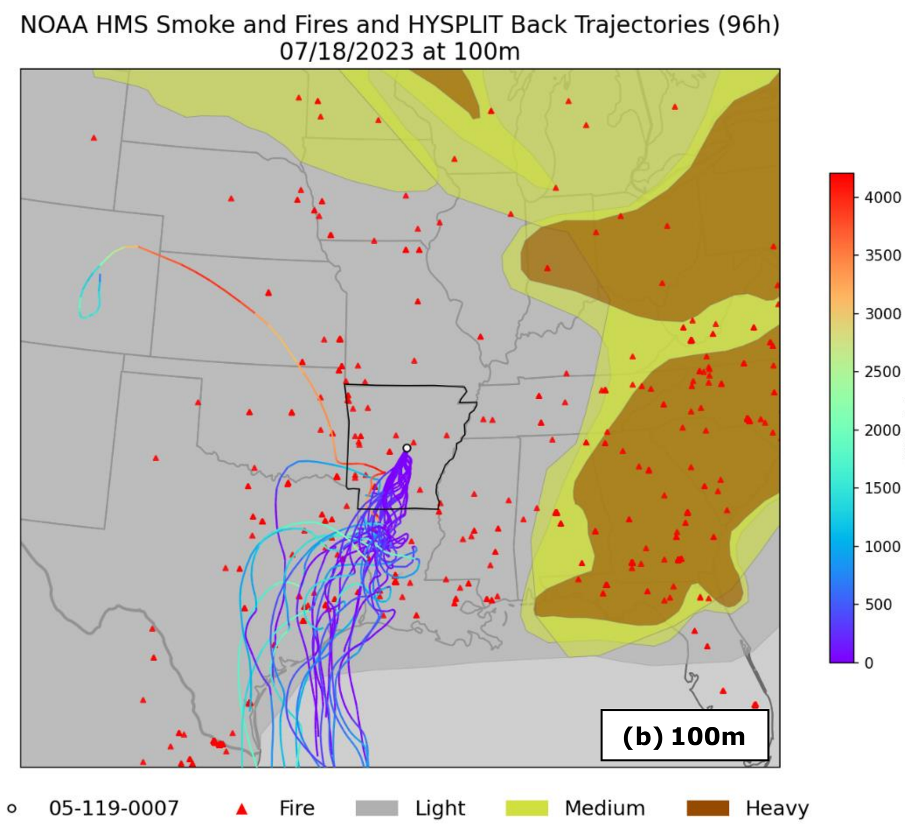


Figure 2-195. HYSPLIT back trajectories for PARR on July 18, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
07/18/2023 at 50m
(a) 50m
Altitude (m)
4000
3500
3000
2500
2000
1500
1000
500
0
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
07/18/2023 at 100m
(b) 100m
Altitude (m)
4000
3500
3000
2500
2000
1500
1000
500
0
05-119-0007
Fire
Light
Medium
Heavy

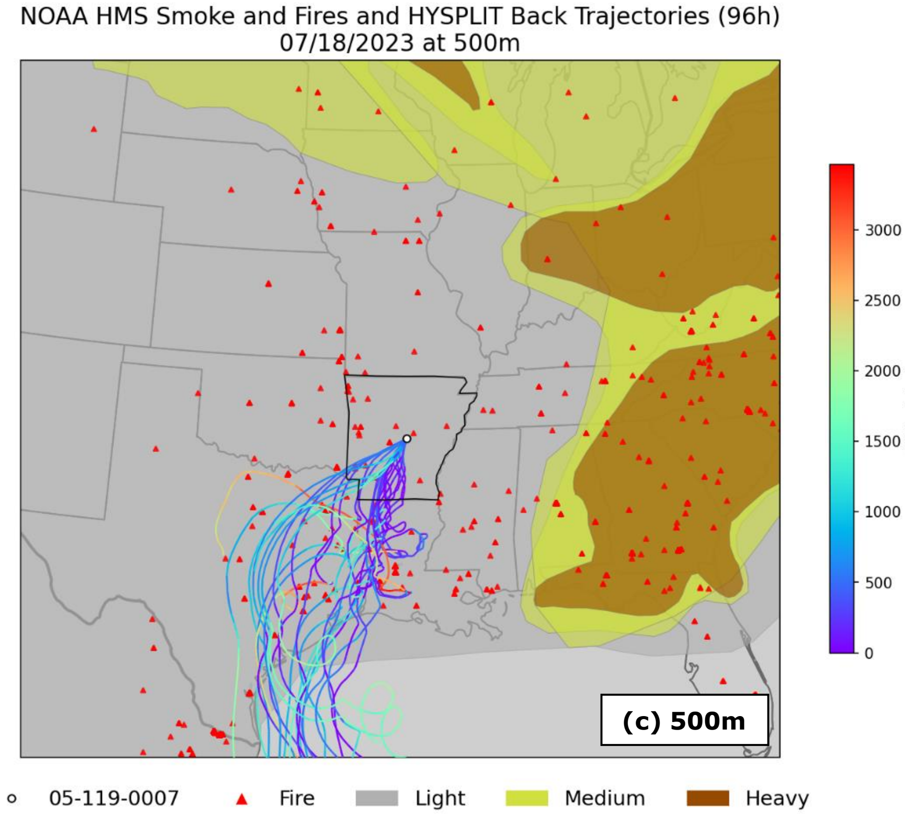


Figure 2-196. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on July 18, 2023.

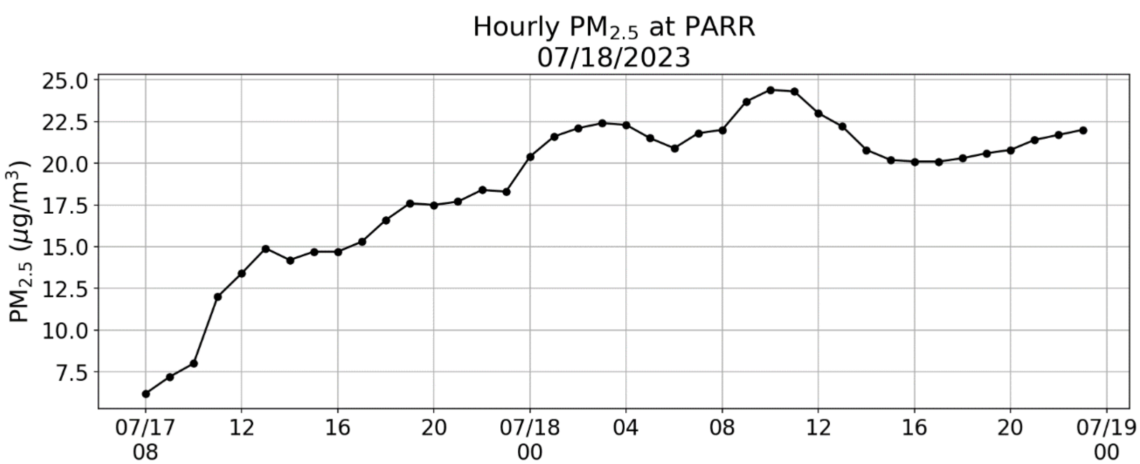


Figure 2-197. Hourly $PM_{2.5}$ concentrations for PARR on July 18, 2023.

2.1.9.2 PARR July 20, 2023

Table 2-29 summarizes the evidence supporting the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on July 20, 2023. Figure 2-198 indicates that the 24-hour $PM_{2.5}$ concentrations on this day exceeds the Tier 2 threshold. Figure 2-200 shows that the back trajectories can go as far south as Mexico; however, a more detailed look at Figure 2-201 illustrates the back trajectories pass over lower altitude regions carrying light density smoke from fires in Canada during the last 48 hours before reaching the monitoring site at 50 m and 100 m. The 500 m trajectories (Figure 2-201c) depict sinking air over the monitoring site, further suggesting downward transport of air parcels. The hourly $PM_{2.5}$ concentrations started to increase on 7/19/2023 at 18:00 CDT (15.8 $\mu g/m^3$; Figure 2-202). However, as the surface cold front moved southeastward and with no high-pressure system present in northeast Arkansas, the resulting flow of cooler, drier air helped disperse the pollutants. This flushing effect reduced $PM_{2.5}$ concentrations to levels below those observed on 7/18/2023.

Table 2-29. Exceptional event supporting evidence for PARR on July 20, 2023.

Monitor	PARR (05-119-0007)
Event Date	July 20, 2023
24-hr $PM_{2.5}$ Concentration	18.9 $\mu g/m^3$
EPA Tiering Tool Tier 2 Threshold	17.0 $\mu g/m^3$
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: July. Date accessed: 11/20/2024.

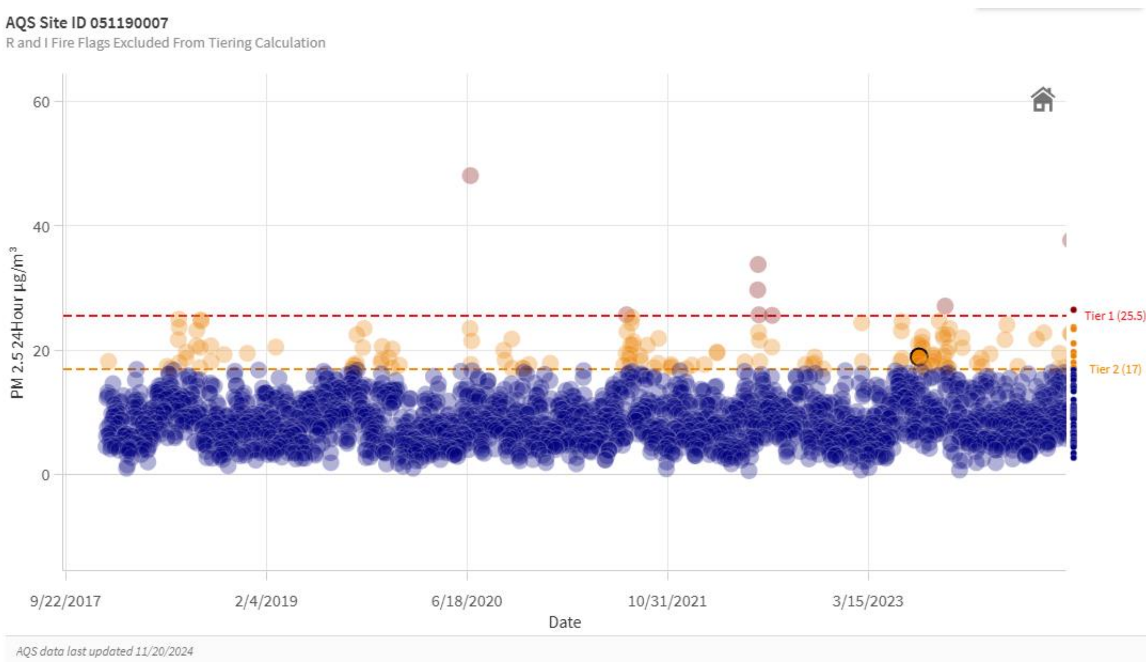


Figure 2-198. EPA PM2.5 Tiering Tool for PARR on July 20, 2023.

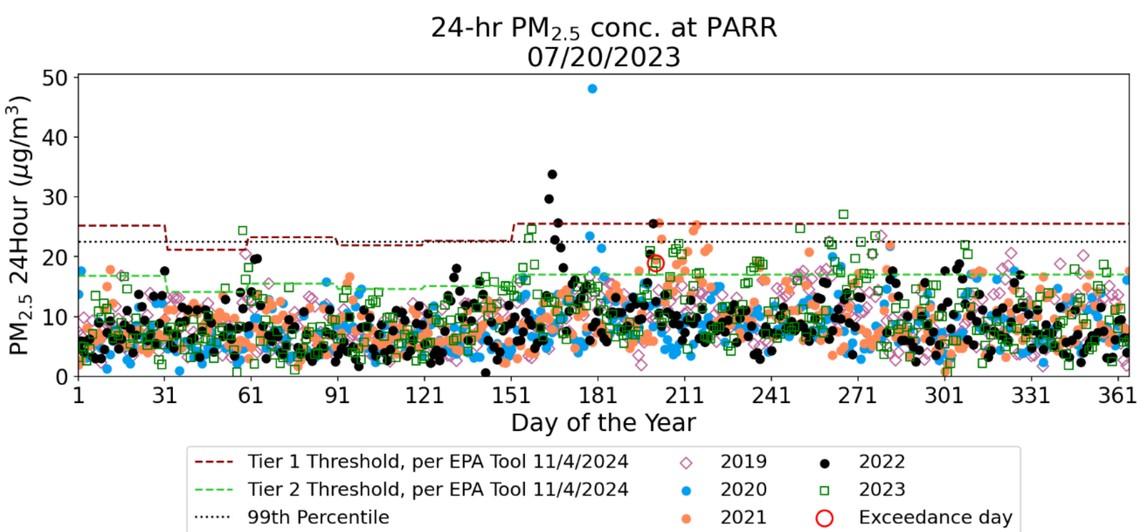


Figure 2-199. Historical 24-hour PM2.5 seasonal fluctuations for PARR compared to July 20, 2023.

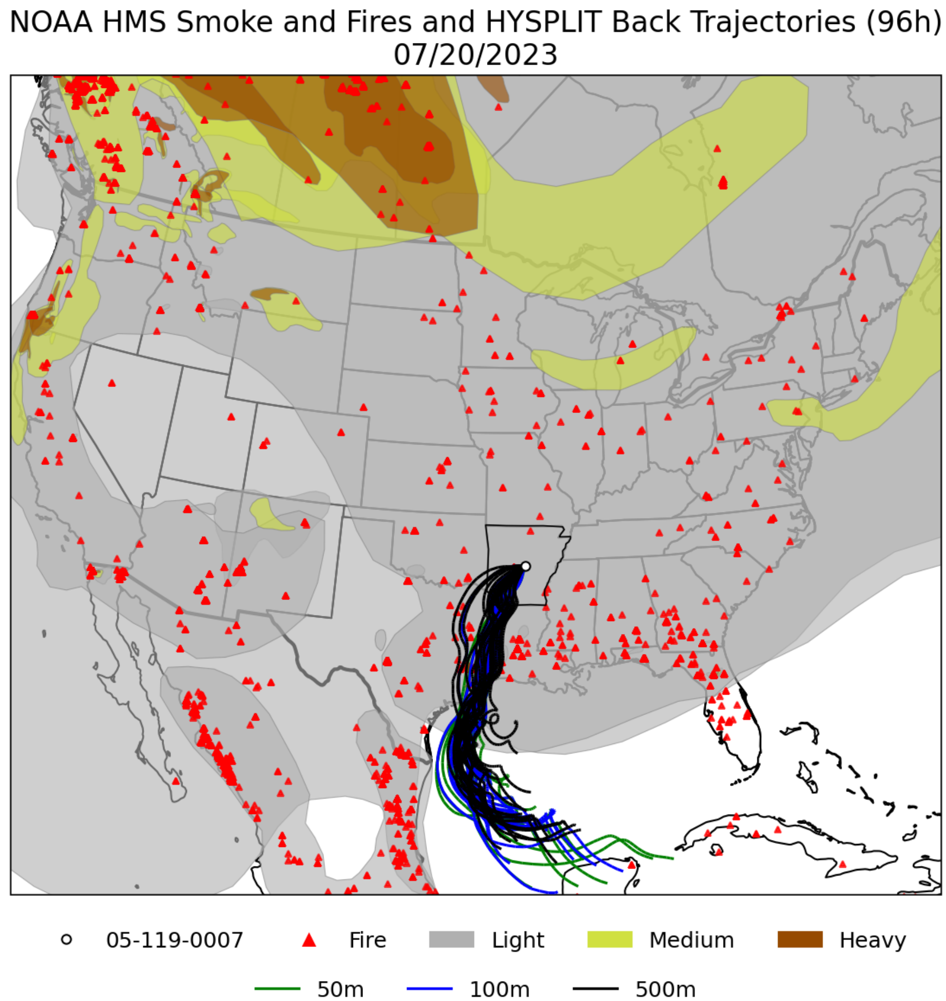
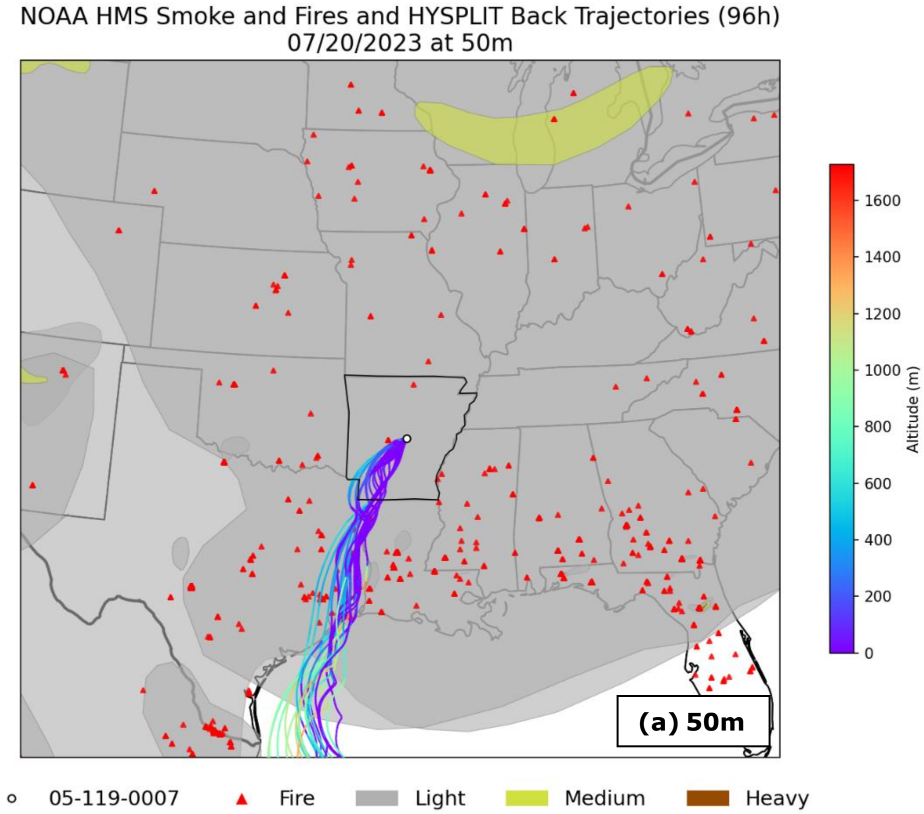
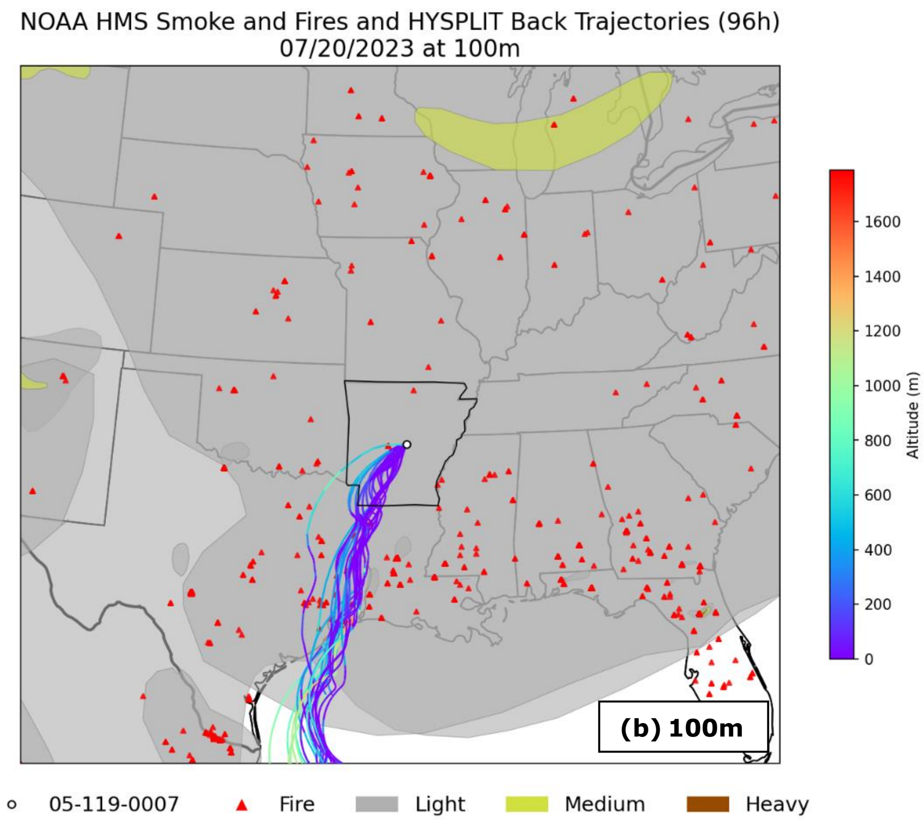


Figure 2-200. HYSPLIT back trajectories for PARR on July 20, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
07/20/2023 at 50m
(a) 50m
Altitude (m)
0
200
400
600
800
1000
1200
1400
1600
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
07/20/2023 at 100m
(b) 100m
Altitude (m)
0
200
400
600
800
1000
1200
1400
1600
05-119-0007
Fire
Light
Medium
Heavy

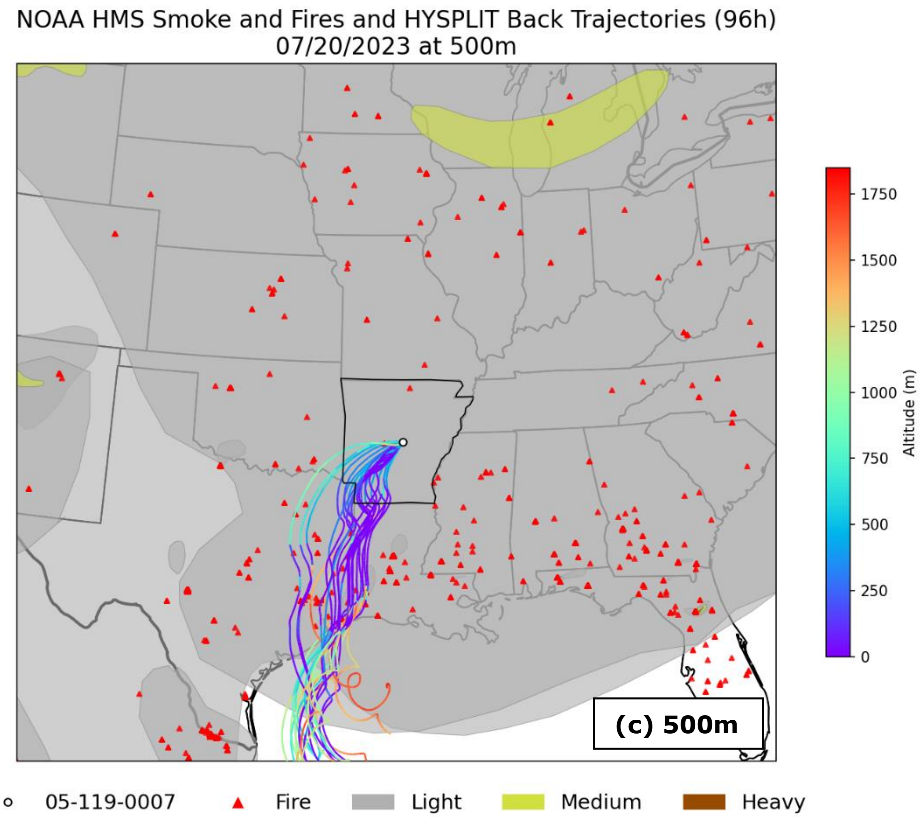


Figure 2-201. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on July 20, 2023.

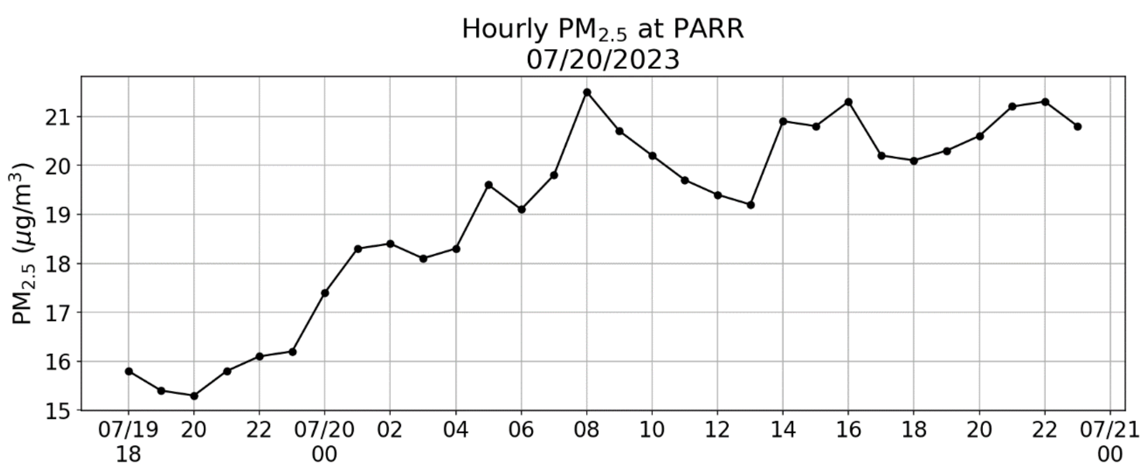


Figure 2-202. Hourly $PM_{2.5}$ concentrations for PARR on July 20, 2023.

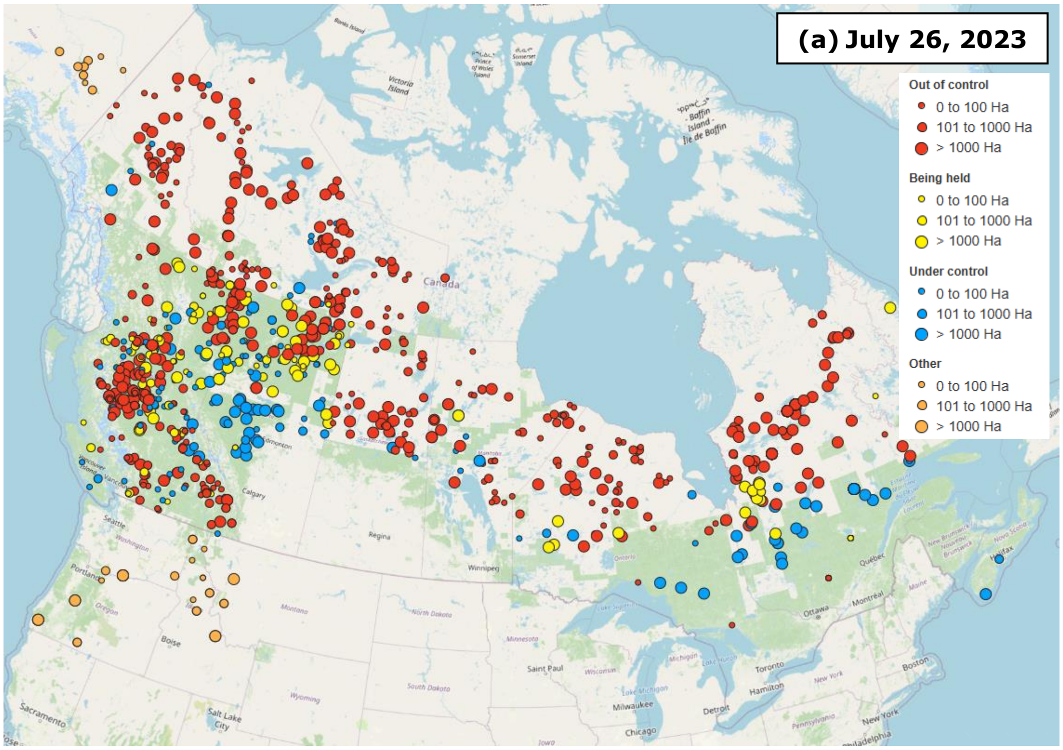
2.1.10 July 26-29, 2023

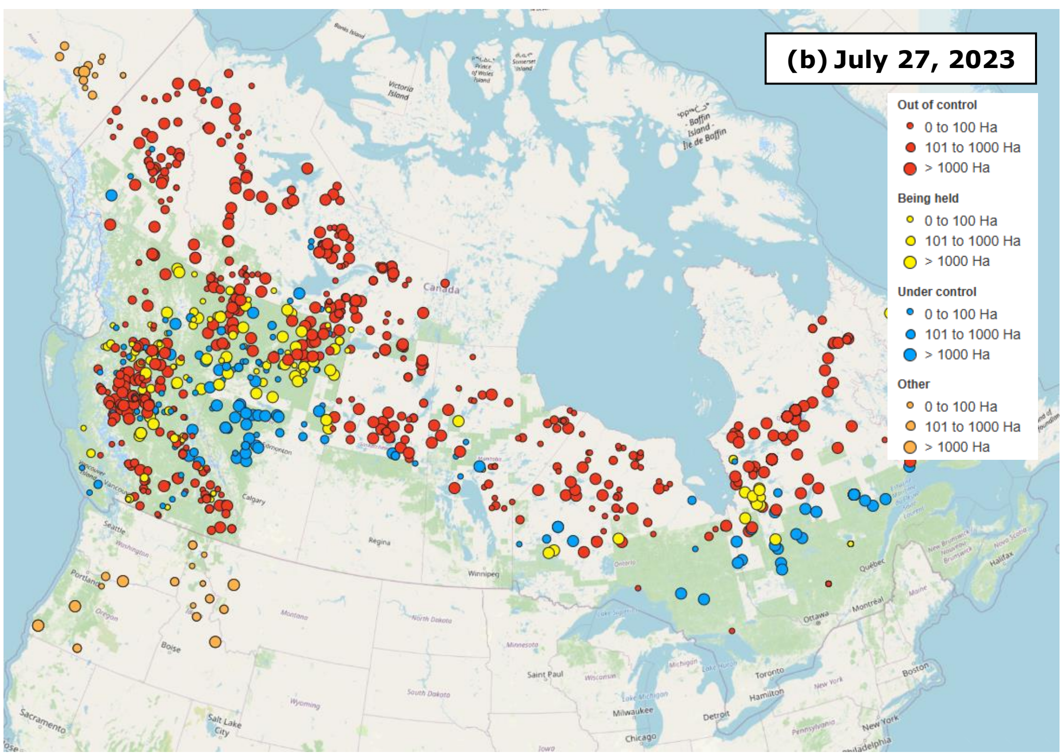
During July 26 to July 29, 2023, a sever heatwave gripped parts of Canada, bringing temperatures of 100.2˚F to the community of Norman Wells, in the Northwest Territories (NWT) on July 9, the hottest temperature ever measured north of 65˚N latitude in the Western Hemisphere. It was just short of the record of 100.4˚F set on Jun 2020 at Verkhoyansk, Russia, a village at a similar latitude. The fires were fueled by a combination of unusual heat, dry lightning, and severe drought conditions The second-largest fire in Canada, raged throughout much of June and July near Fort Nelson, at the intersection of the British Columbia, the Northwest Territories, and Alberta. In July 2023, British Columbia, Canada experienced an unprecedented wildfire season. By mid-July over 1.39 million hectares (3.4 million acres) of land had already burned, surpassing previous records. The fires during July were particularly aggressive, with many producing pyrocumulonimbus clouds, indicating extreme fire behavior. By July 13, nearly 600 out-of-control fires were burning across Canada, with about half in British Columbia or Alberta.

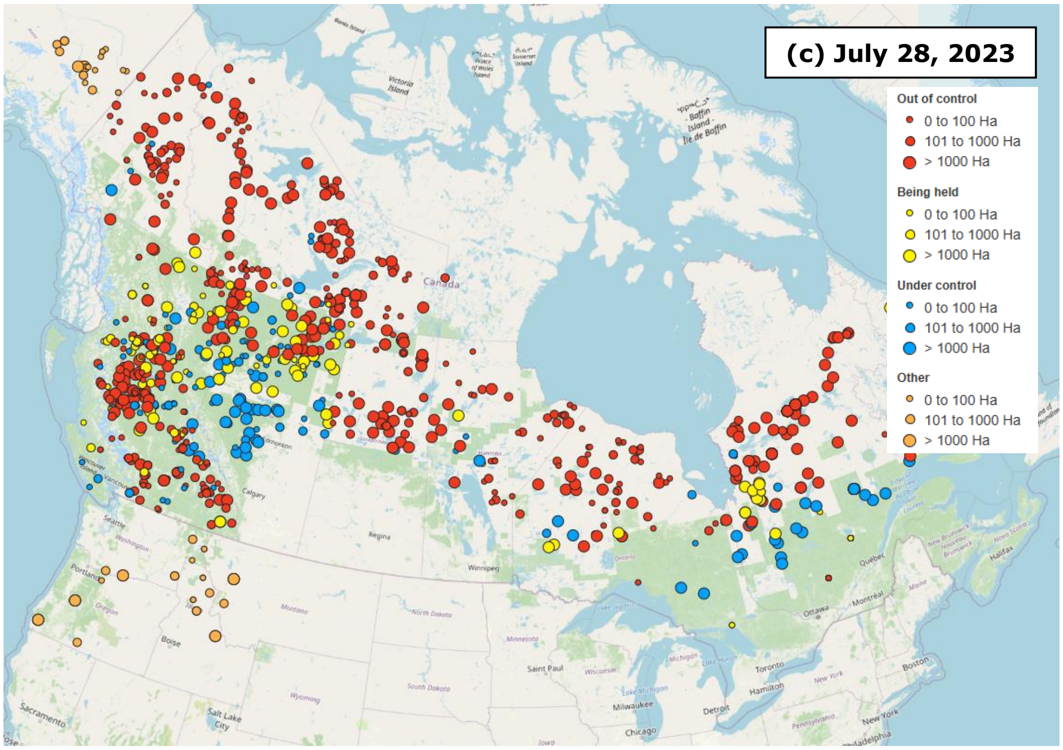
Additionally, the Behchokǫ̀ fire in the Northwest Territories was a significant event during this period. The fire, which started in early July, grew rapidly due to the extreme heat and dry conditions. By July 22, satellite images showed the fire near Behchokǫ̀ and Highway 3, with the burn area expanding to more than 63,000 hectares.[37] An aerial shot from July 21 (Figure 2-203) highlighted the fire's proximity to Highway 3 between Yellowknife and Behchokǫ̀. By July 26, the fire had grown significantly, leading to the closure of Highway 3 and posing a serious threat to the community. Figure 2-204 shows the location and approximate size of wildfire burning in Canada during July 26 to 29.

Figure 2-203. An aerial shot taken on July 21, 2023, of fire ZF015 near Highway 3 between Yellowknife and Behchokǫ̀. (https://www.cbc.ca/news/canada/north/nwt-fire-update-july-22-1.6915259)

[37] https://www.cbc.ca/news/canada/north/behchoko-evacuation-wildfire-1.6916369


(a) July 26, 2023
Out of control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Being held
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Under control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Other
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha


(b) July 27, 2023
Out of control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Being held
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Under control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Other
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha



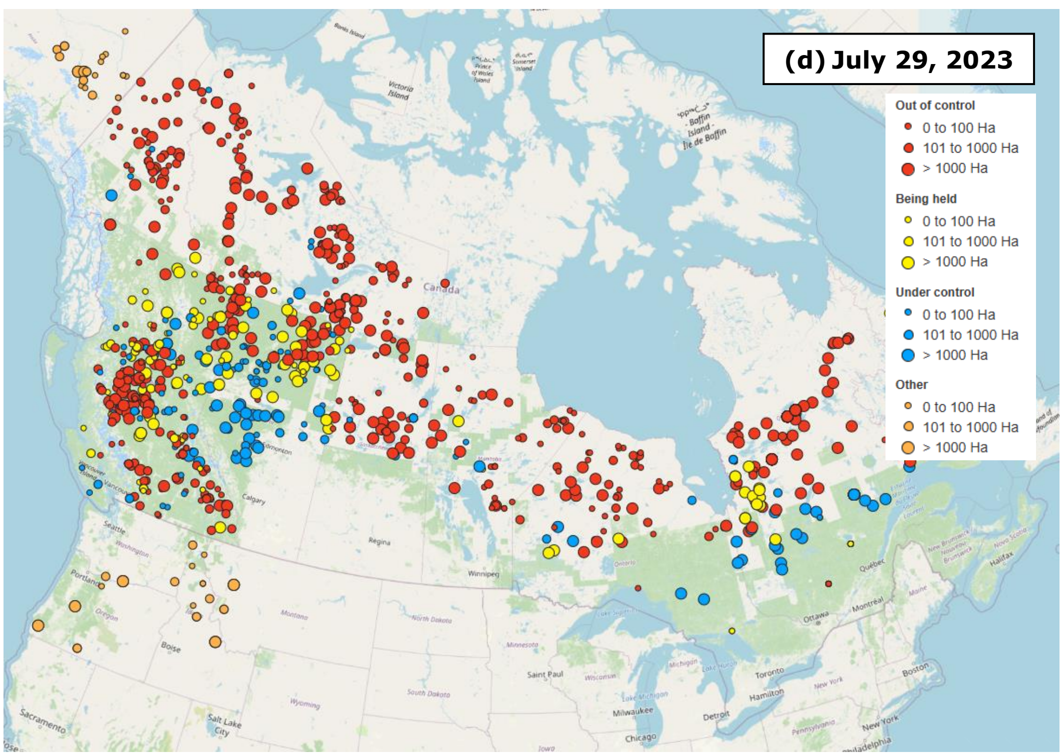


Figure 2-204. Canadian Wildfire Information System map of active fires for (a) July 26, (b) July 27, (c) July 28, and (d) July 29. (https://cwfis.cfs.nrcan.gc.ca/interactive-map)

On July 26, 2023 (Figure 2-205a), the 500 mb analysis shows a prominent ridge over western North America, impacting the Northwest territories. This ridge created hot, stable, and dry conditions favorable for the rapid spread of wildfires. A downstream trough across central and eastern North America influenced atmospheric circulation patterns.[38] By July 27 (Figure 2-205b), the ridge persisted but shifted slightly eastward, continuing to dominate the Northwest territories, keeping conditions hot and dry.[39] On July 28 (Figure 2-205c), the ridge started to weaken as a trough moved into the Pacific Northwest, but it still suppressed precipitation and maintained stable atmospheric conditions that favored wildfires growth.[40] By July 29 (Figure 2-205d), the ridge diminished further, and the trough across the Pacific Northwest strengthened. This shift altered wind flow patterns, enhancing the transport of wildfire smoke southward into the central and eastern U.S., including Arkansas.[41] The clockwise flow around the ridge directed smoke toward the central U.S., while the downstream trough over the Midwest (Figure 2-205a and Figure 2-205b) helped pull smoke into the eastern U.S., including Arkansas. The 500 mb synoptic maps also show a robust high-pressure system over the southwestern U.S., acting as a blocking feature and limiting the eastward progression of troughs. This high-pressure system facilitated the southward and southeastward transport of wildfire smoke into the U.S., impacting air quality in Arkansas.

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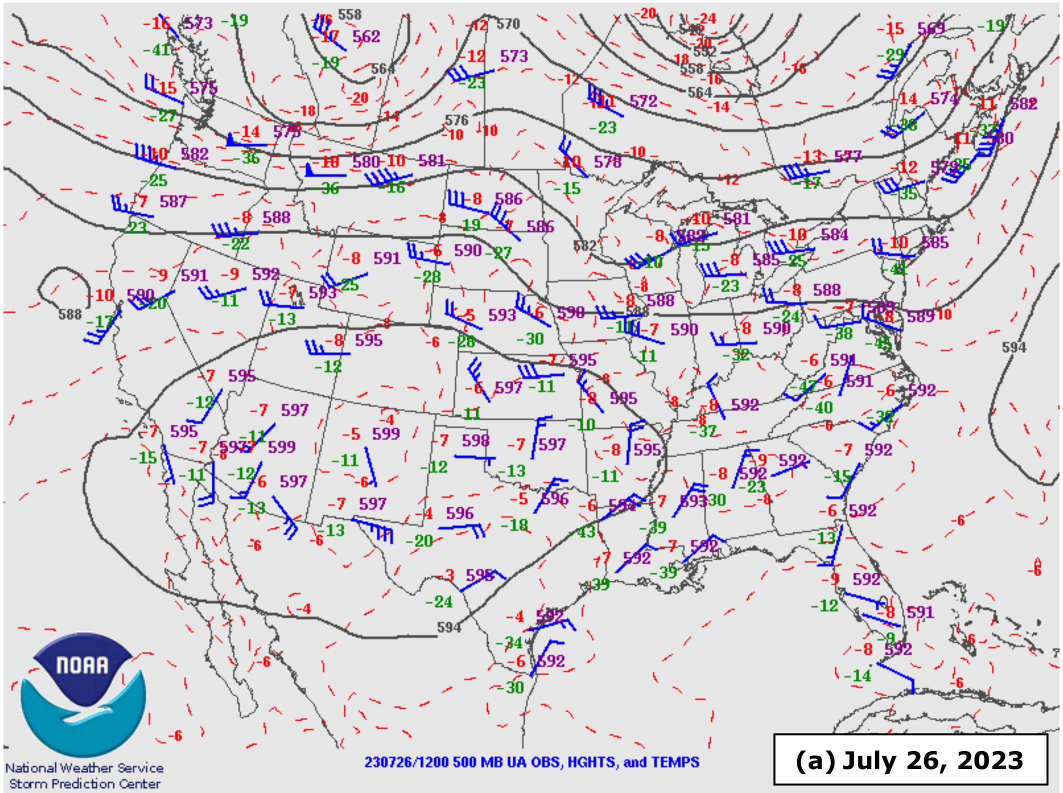
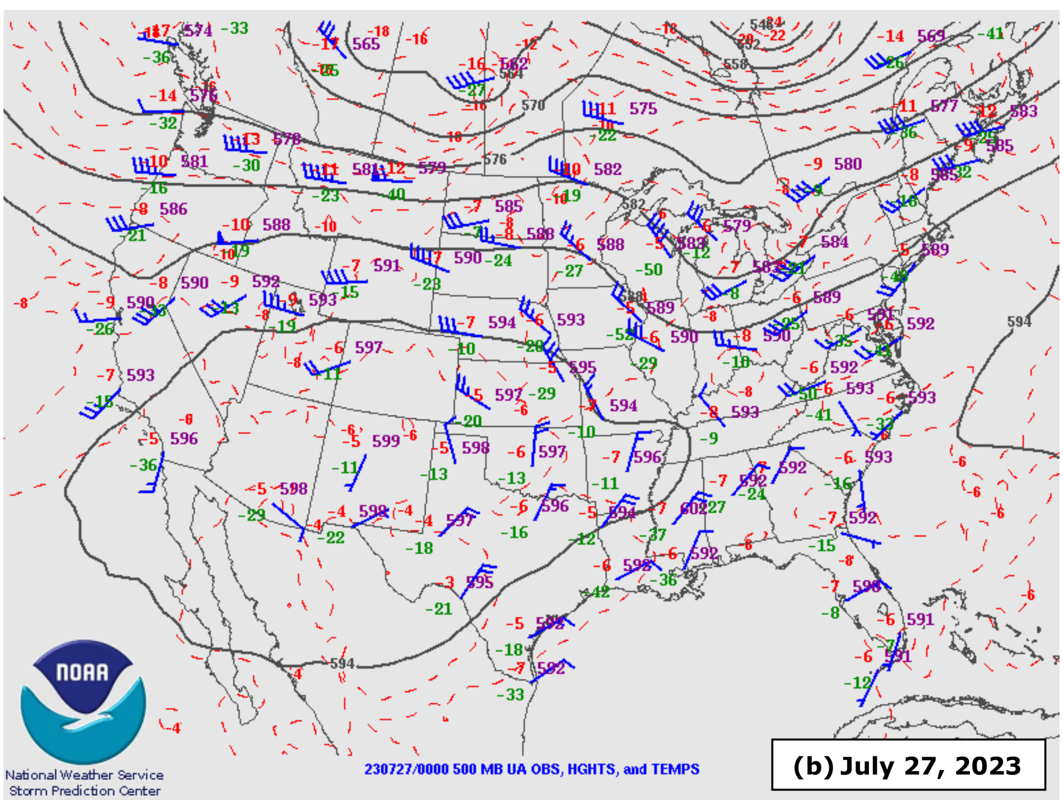
[38] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=07&STARTDAY=26&STARTTIME=00&INC=-48

[39] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=07&STARTDAY=27&STARTTIME=00&INC=-48

[40] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=07&STARTDAY=28&STARTTIME=00&INC=-48

[41] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=07&STARTDAY=29&STARTTIME=00&INC=-48


NOAA
National Weather Service
Storm Prediction Center
230726/1200 500 MB UA OBS, HGHTS, and TEMPS
(a) July 26, 2023


NOAA
National Weather Service
Storm Prediction Center
230727/0000 500 MB UA OBS, HGHTS, and TEMPS
(b) July 27, 2023

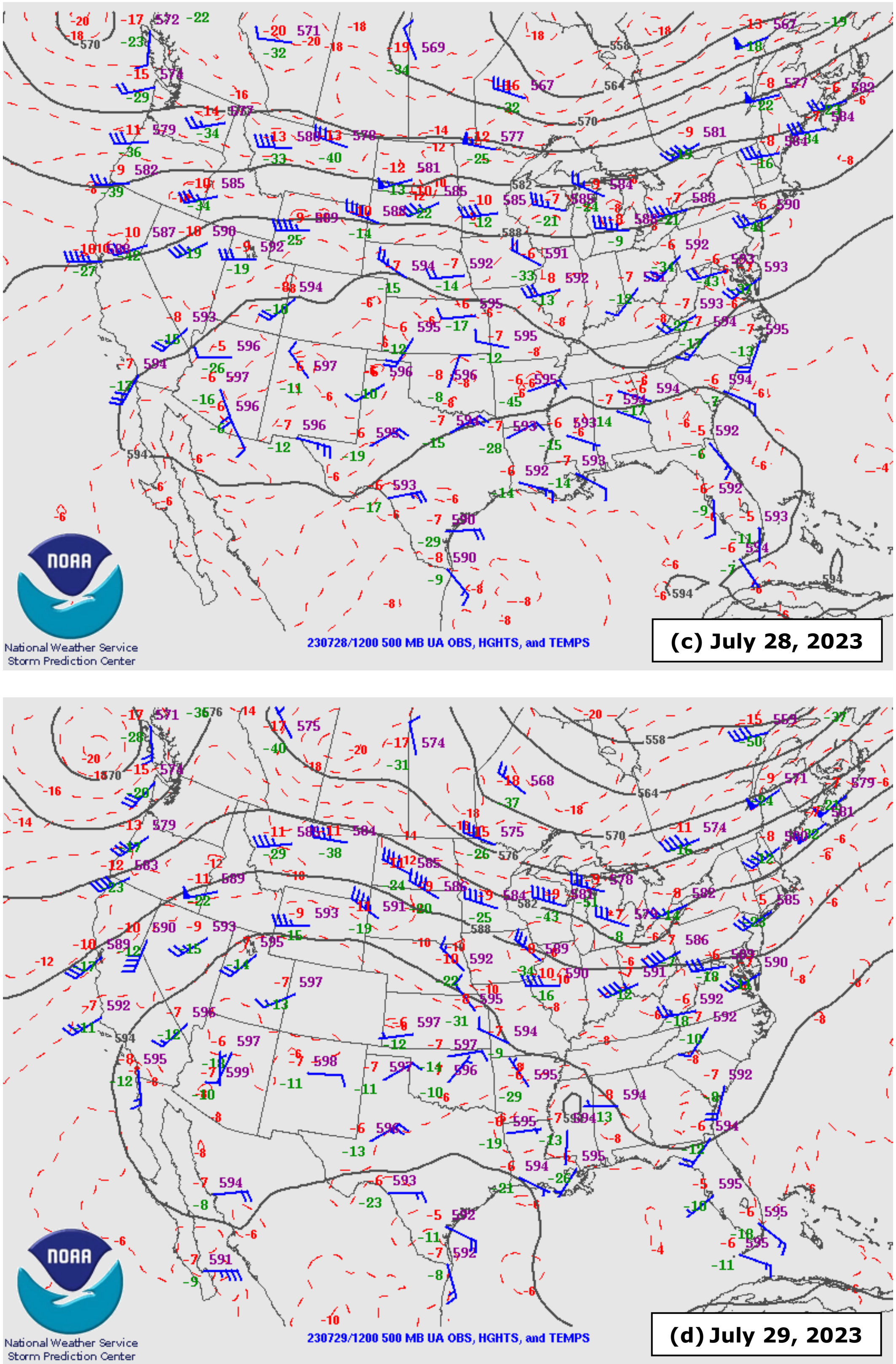
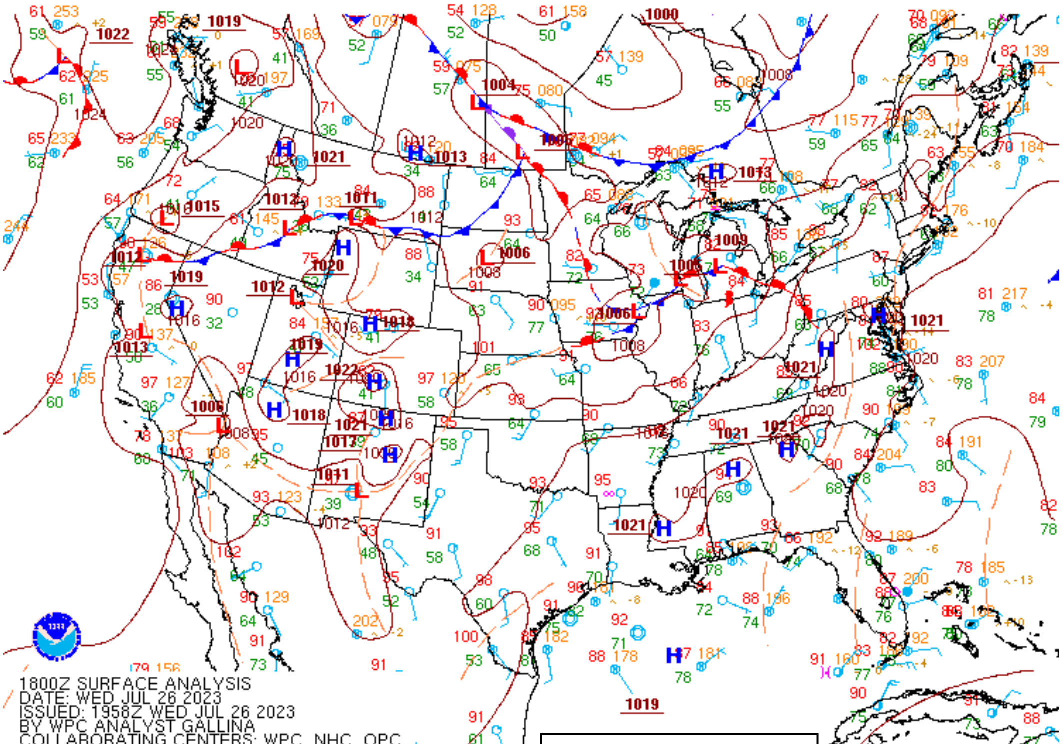
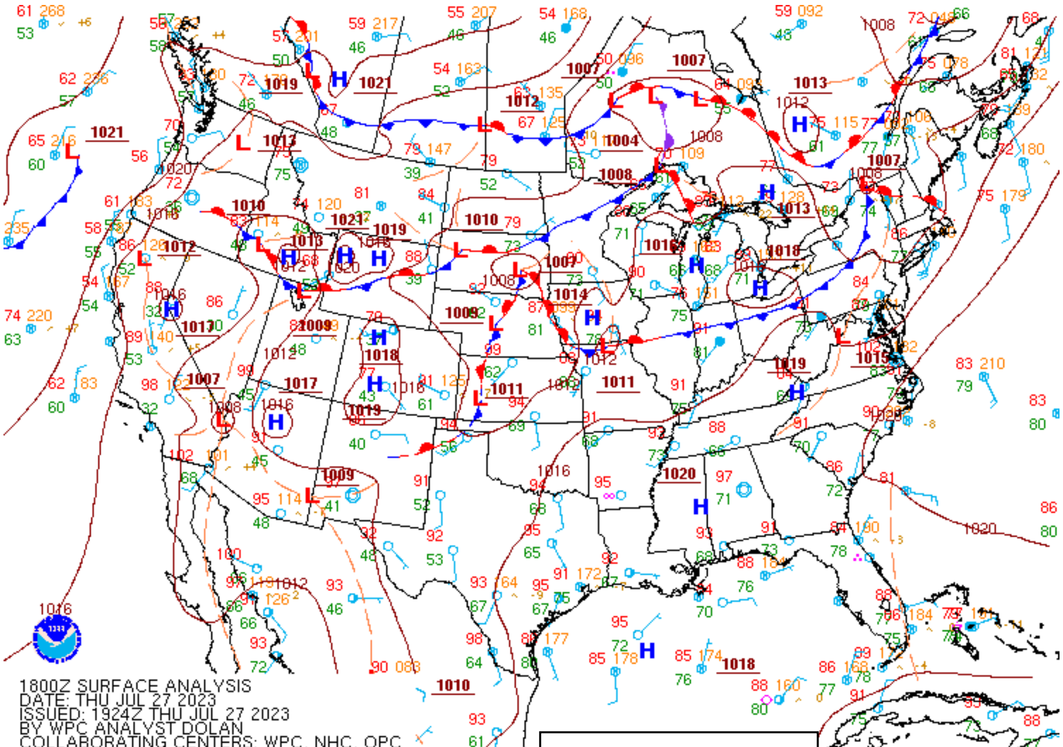


Figure 2-205. 500 mb synoptic analysis map at 12 UTC on (a) July 26, (b) July 27 (00 UTC, as the 12 UTC map was unavailable), (c) July 28, and (d) July 29, 2023.

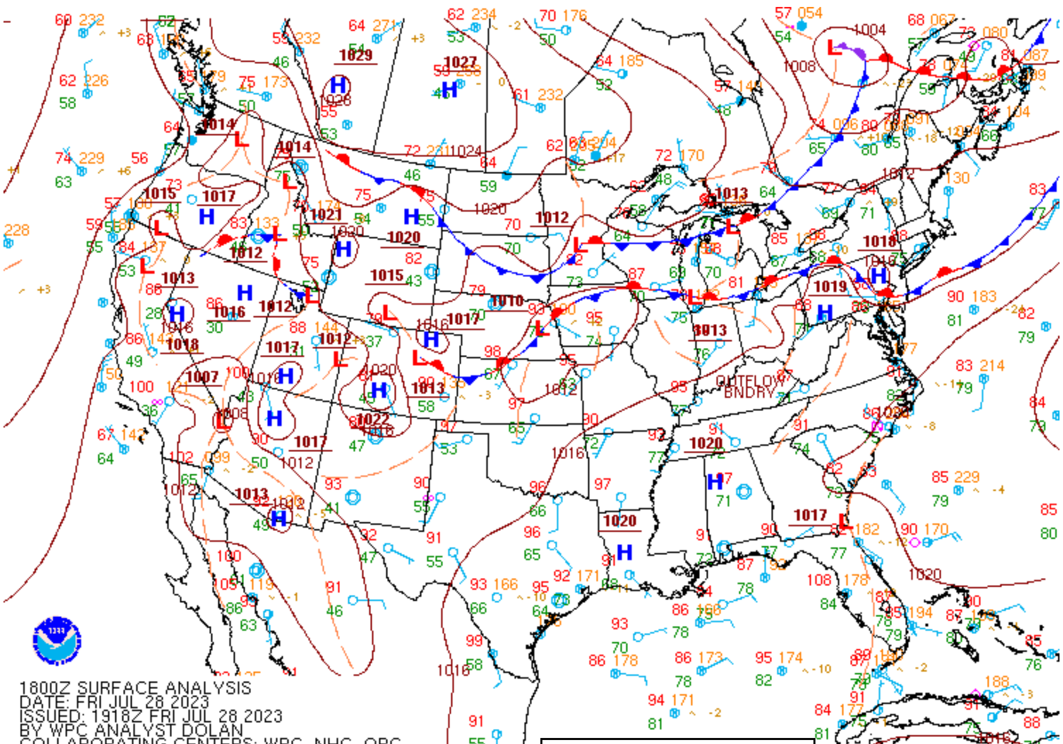
On July 26, 2023 (Figure 2-206a), the surface analysis shows a high-pressure system over the southwestern U.S. and a low-pressure system near the Great Lakes, consistent with the 500 mb analysis. The southwestern high acted as a blocking feature, limiting the eastward weather systems, enhancing atmospheric stability, and facilitating the southward transport of wildfire smoke into the central U.S. On July 27, 2023 (Figure 2-206b), the high-pressure system over the Midwest influenced the airflow, directing it from the south or southeast toward the eastern U.S. This contributed to stable and dry conditions in the Midwest and eastern U.S., making these regions more susceptible to the ongoing transport of wildfire smoke from Canada. By July 28, 2023 (Figure 2-206c), a cold front over the Great Lakes played a key role in dispersing smoke further into the eastern U.S., while the high-pressure system over the southwestern U.S. persisted, maintaining its blocking influence. On July 29, 2023 (Figure 2-206d), this cold front stretched continues moving south, with the west portion becoming a stationary front near the Pacific Northwest into norther Montana. Meanwhile, the high-pressure system over the southern U.S. continued to dominate, influencing airflow patterns, and helping funnel wildfire smoke southward into the central and eastern U.S. The cold front's progression southward also contributed to transporting smoke from the Northwest territories toward Arkansas.



(a) July 26, 2023



(b) July 27, 2023



(c) July 28, 2023

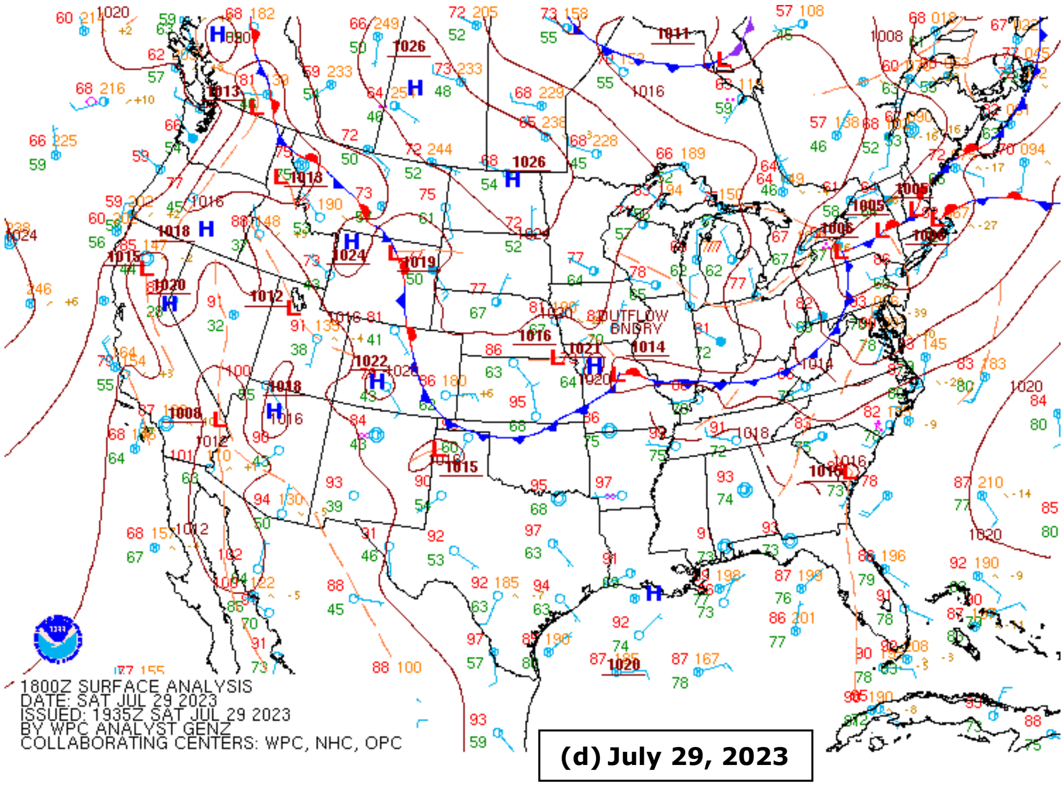


Figure 2-206. Surface synoptic analysis maps (bottom row) at 18 UTC on (a) July 26, (b) July 27, (c) July 28, and (d) July 29, 2023.

The NOAA HMS smoke product in Figure 2-207 and the visible satellite images in Figure 2-208 show light to medium density smoke covering almost the entire continental U.S., with heavy smoke concentrated over northwest Canada during July 26 to July 29, 2023. Moderate AQI values in Arkansas (Figure 2-209) and HRRR smoke modeled surface concentrations (Figure 2-210) suggest this smoke mixed down to surface level, impacting PM monitors at Arkansas and most of the eastern and southeastern U.S. Figure 2-211 and Figure 2-207 show the evolution of the smoke plumes originating from multiple fires in British Columbia, Alberta, Saskatchewan, and the Northwest Territories, Canada, during July 26 to 29, 2023.

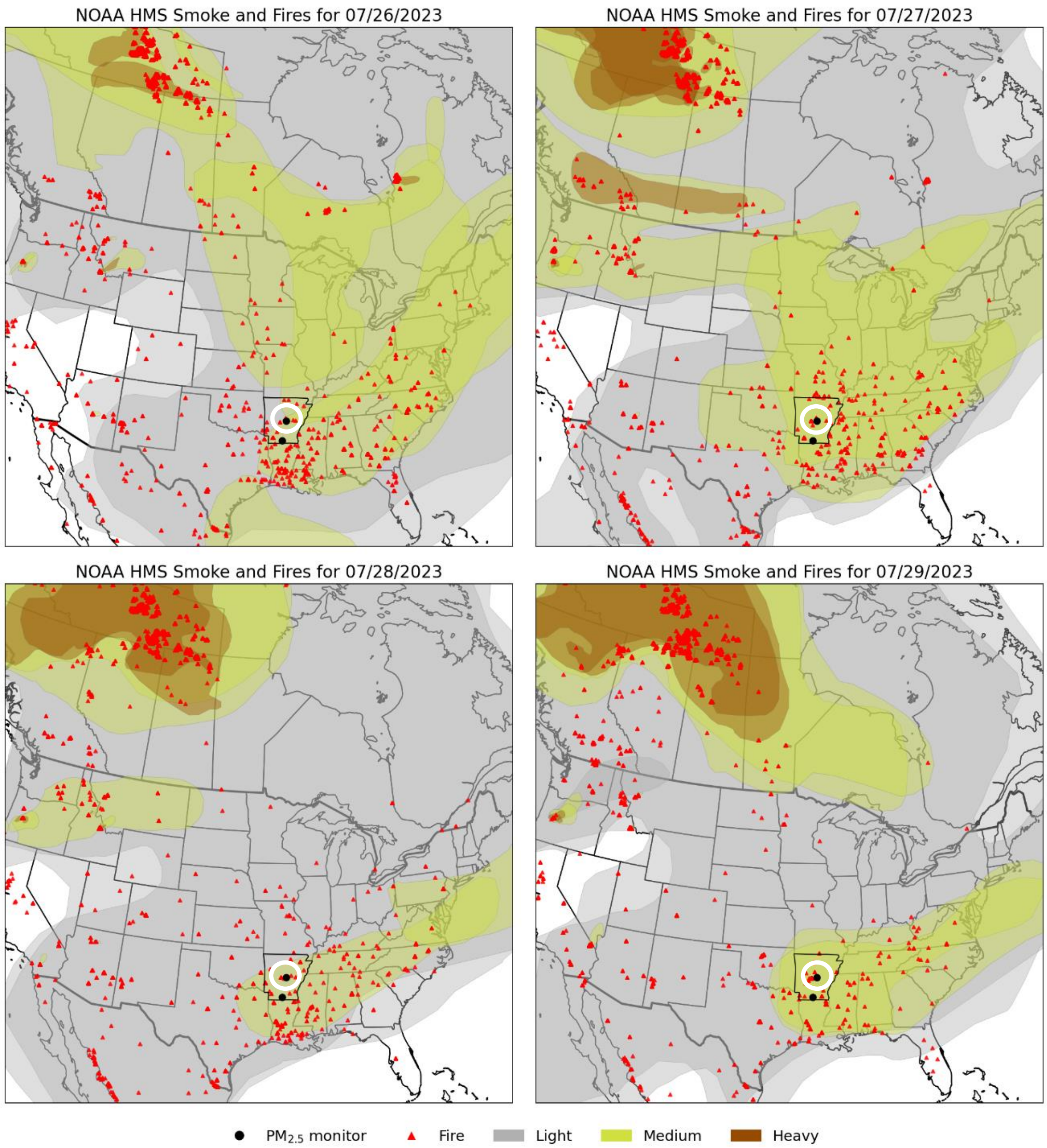
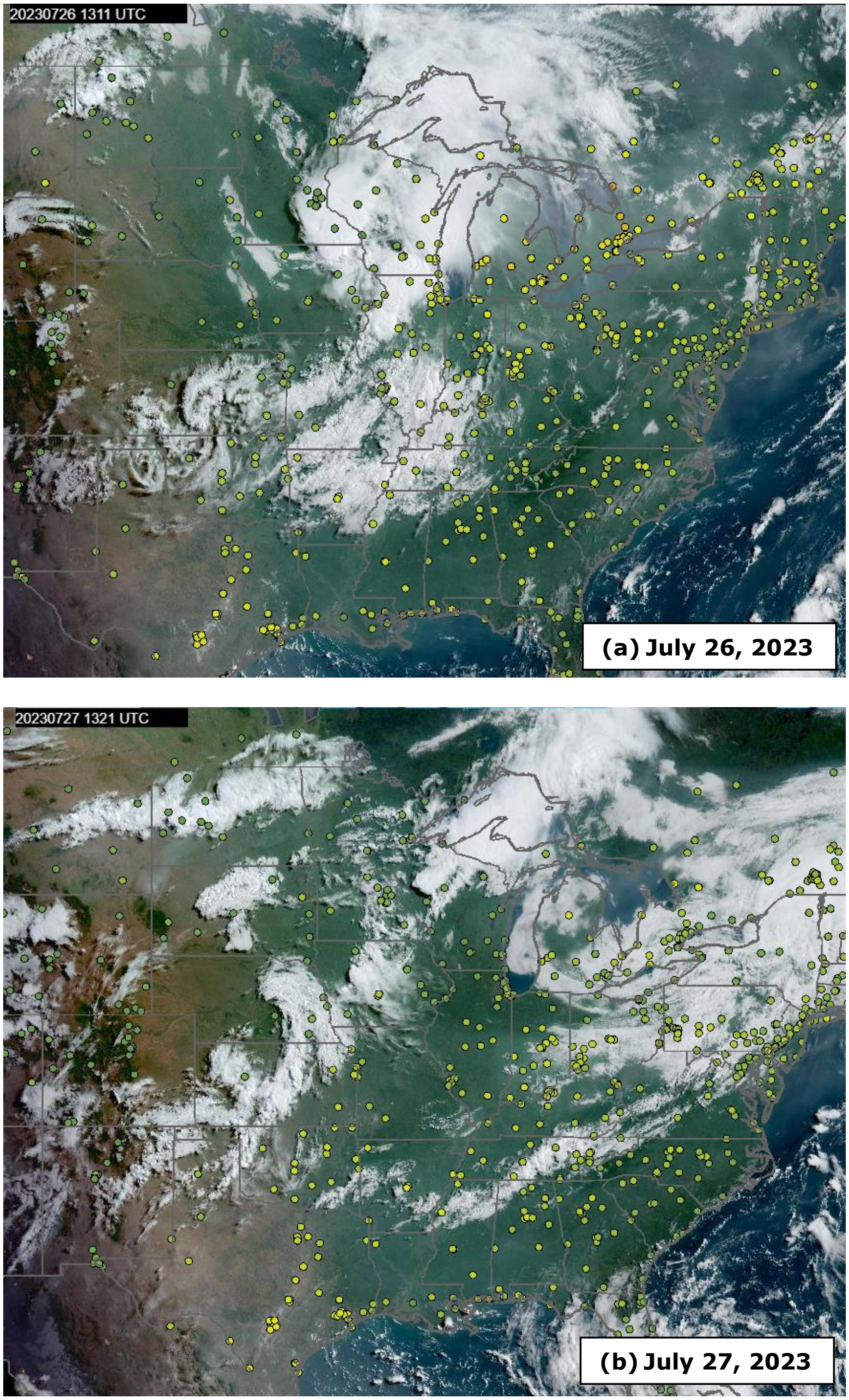


Figure 2-207. NOAA HMS fire and smoke products for July 26 (top left), July 27 (top right), July 27 (bottom left), and July 28 (bottom right).


20230726 1311 UTC
(a) July 26, 2023
20230727 1321 UTC
(b) July 27, 2023

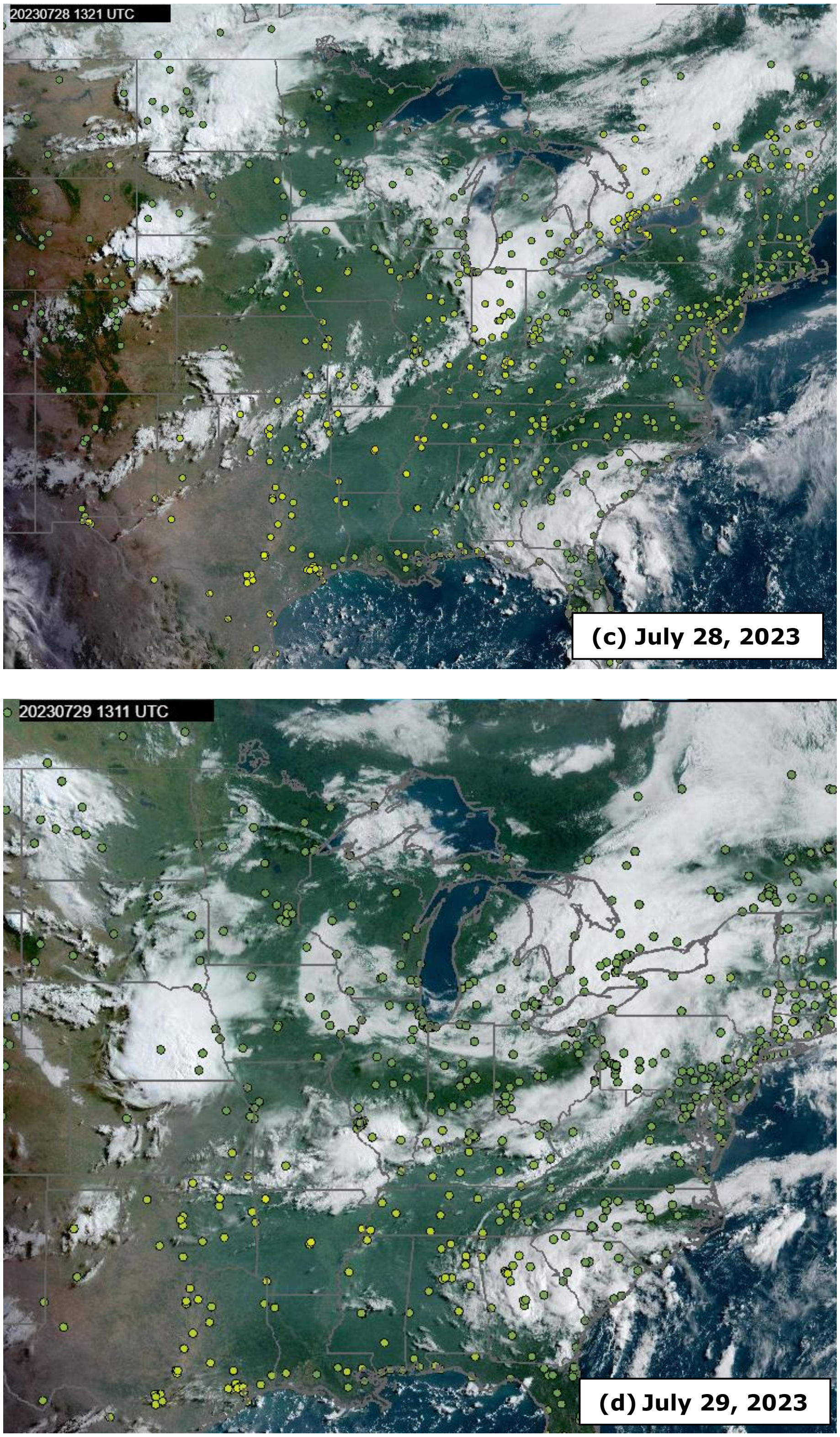
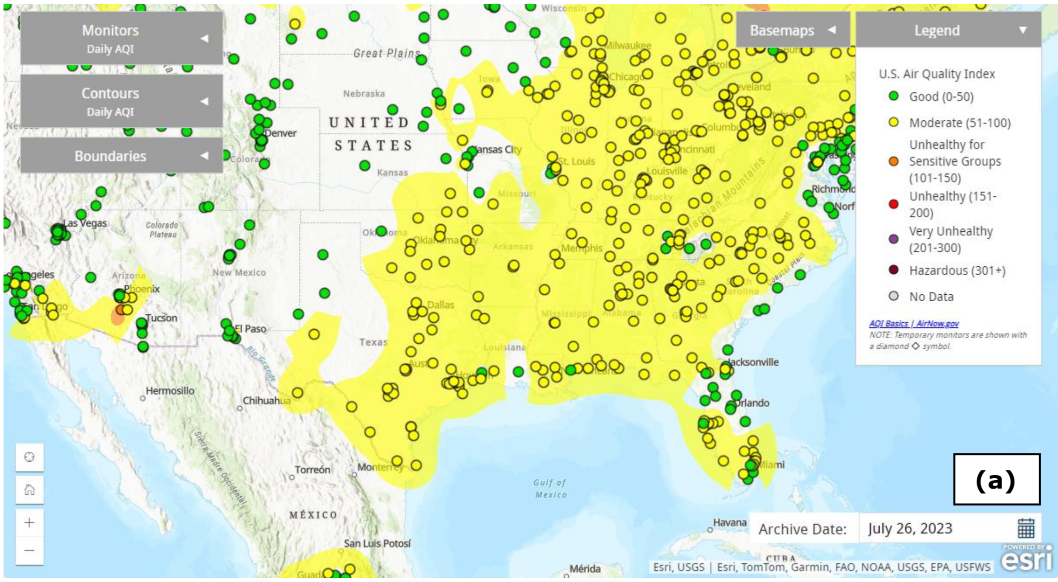
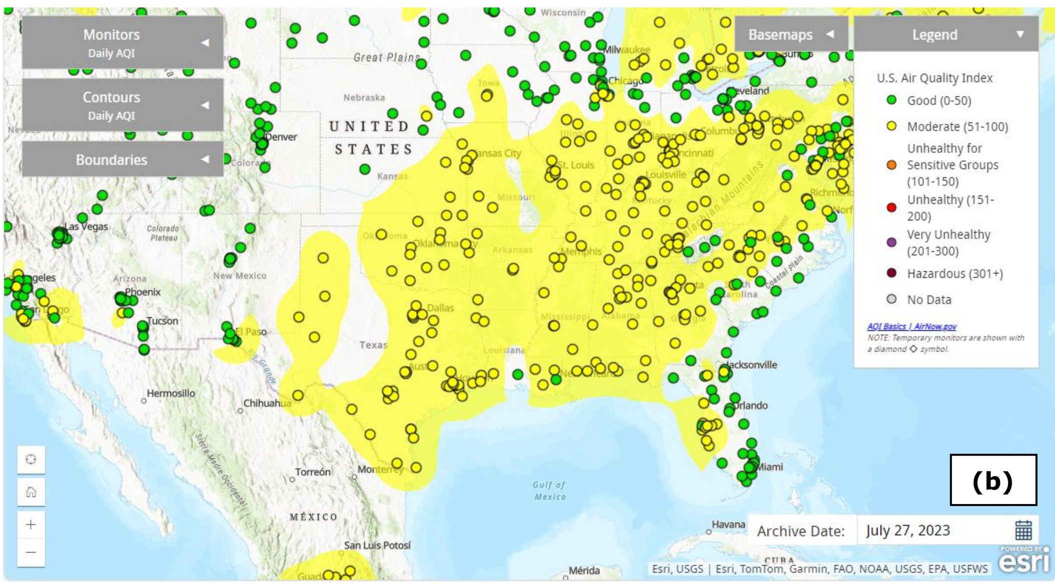


Figure 2-208. NOAA satellite visible imagery on (a) July 26 at 1311 UTC, (b) July 27 at 1321 UTC, (c) July 28 at 1321 UTC, and July 29 at 1311 UTC, 2023.



Monitors
Daily AQI
Contours
Daily AQI
Boundaries
Basemaps
Legend
U.S. Air Quality Index
Good (0-50)
Moderate (51-100)
Unhealthy for Sensitive Groups (101-150)
Unhealthy (151-200)
Very Unhealthy (201-300)
Hazardous (301+)
No Data
AQI Basics | AirNow.gov
NOTE: Temporary monitors are shown with a diamond ◇ symbol.
(a)
Archive Date:
July 26, 2023
Esri, USGS | Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, USFWS



Monitors
Daily AQI
Contours
Daily AQI
Boundaries
Basemaps
Legend
U.S. Air Quality Index
Good (0-50)
Moderate (51-100)
Unhealthy for Sensitive Groups (101-150)
Unhealthy (151-200)
Very Unhealthy (201-300)
Hazardous (301+)
No Data
AQI Basics | AirNow.gov
NOTE: Temporary monitors are shown with a diamond ◇ symbol.
(b)
Archive Date:
July 27, 2023
Esri, USGS | Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, USFWS

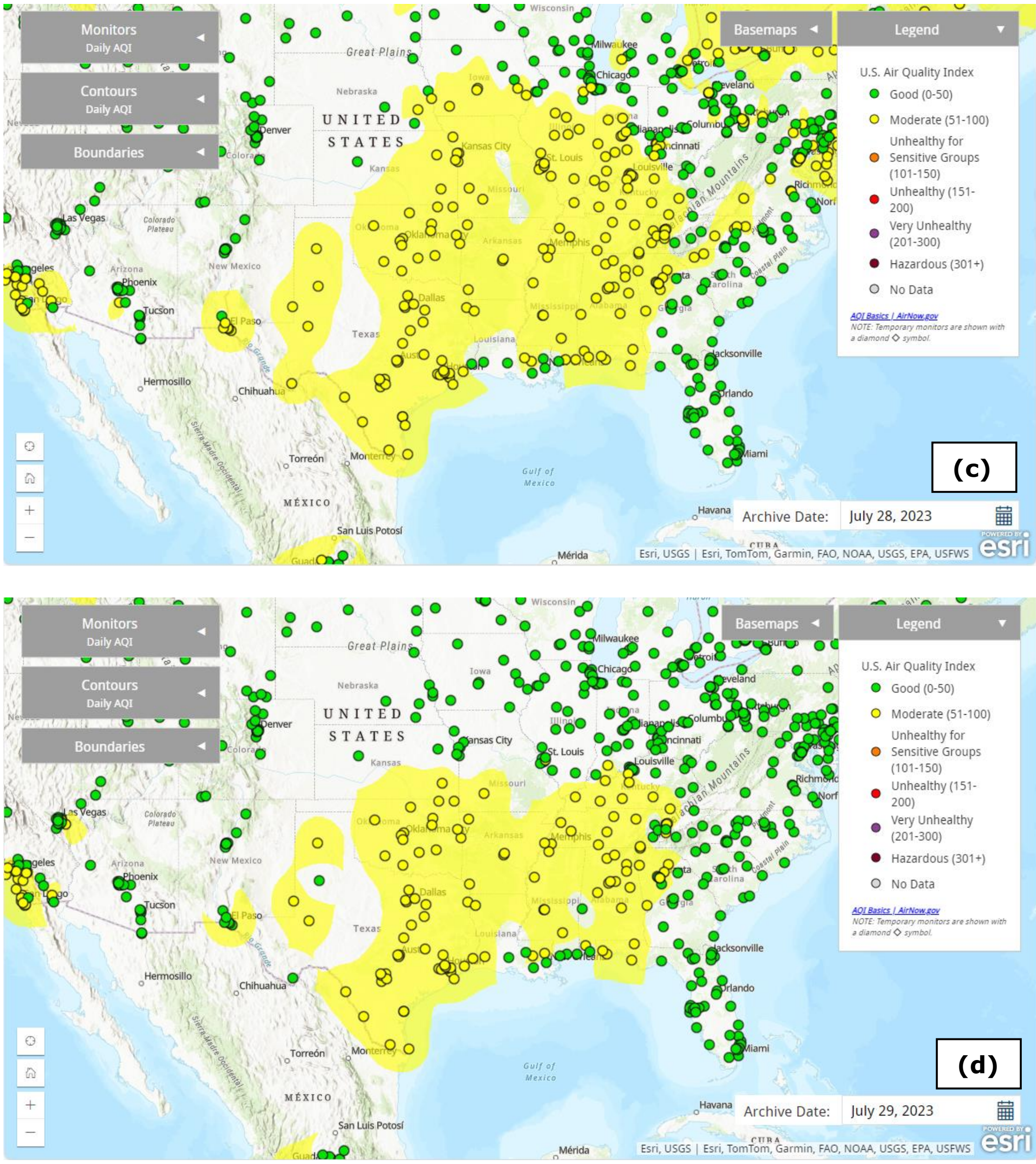
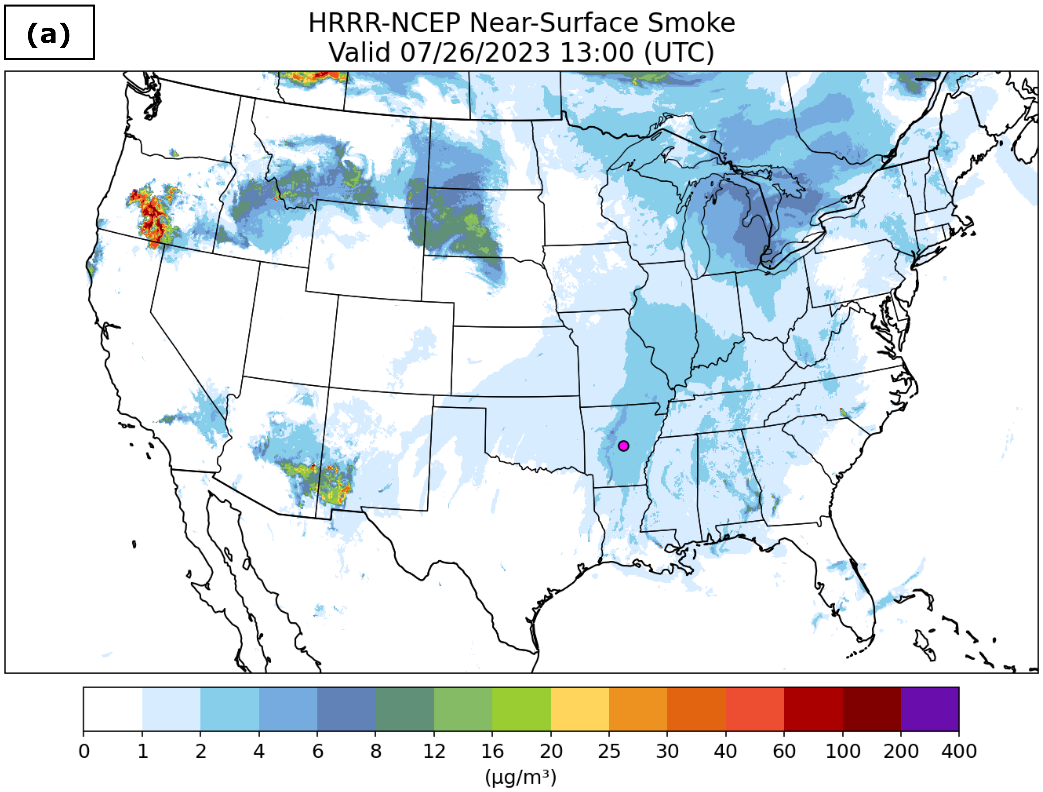
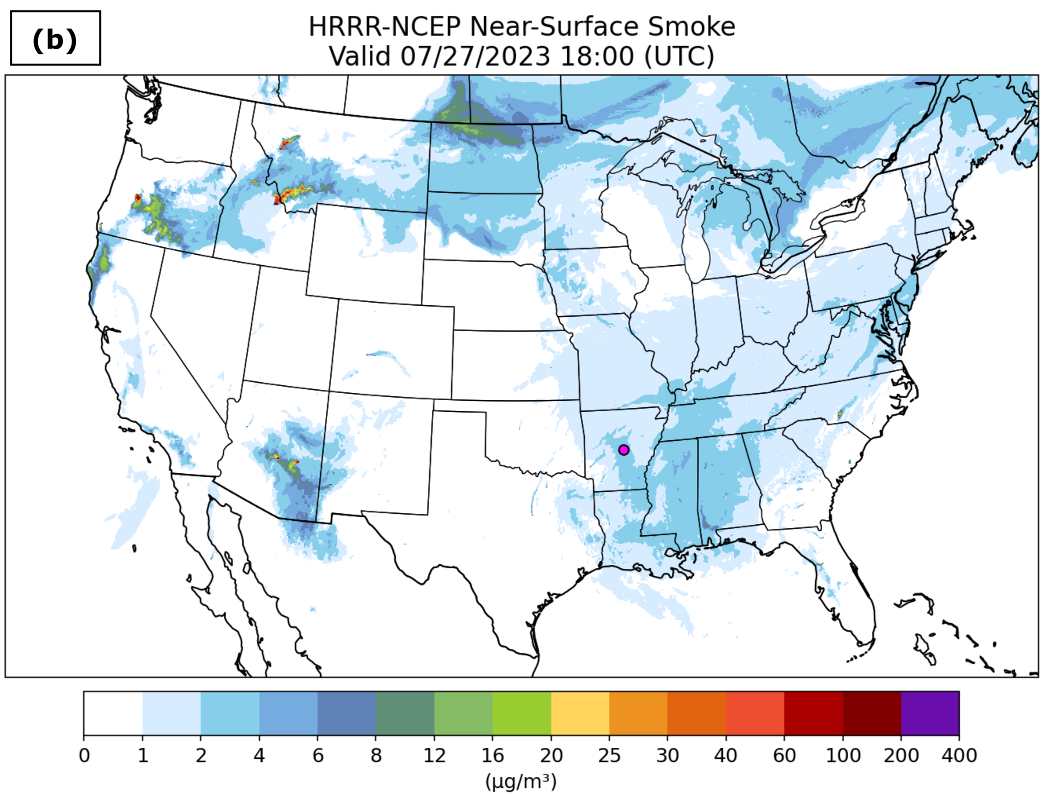


Figure 2-209. AirNow surface level $PM_{2.5}$ concentration contours for (a) July 26, (b) July 27, (c) July 28, and (d) July 29, 2023.


(a)
HRRR-NCEP Near-Surface Smoke
Valid 07/26/2023 13:00 (UTC)
0
1
2
4
6
8
12
16
20
25
30
40
60
100
200
400
(μg/m³)


(b)
HRRR-NCEP Near-Surface Smoke
Valid 07/27/2023 18:00 (UTC)
0
1
2
4
6
8
12
16
20
25
30
40
60
100
200
400
(μg/m³)

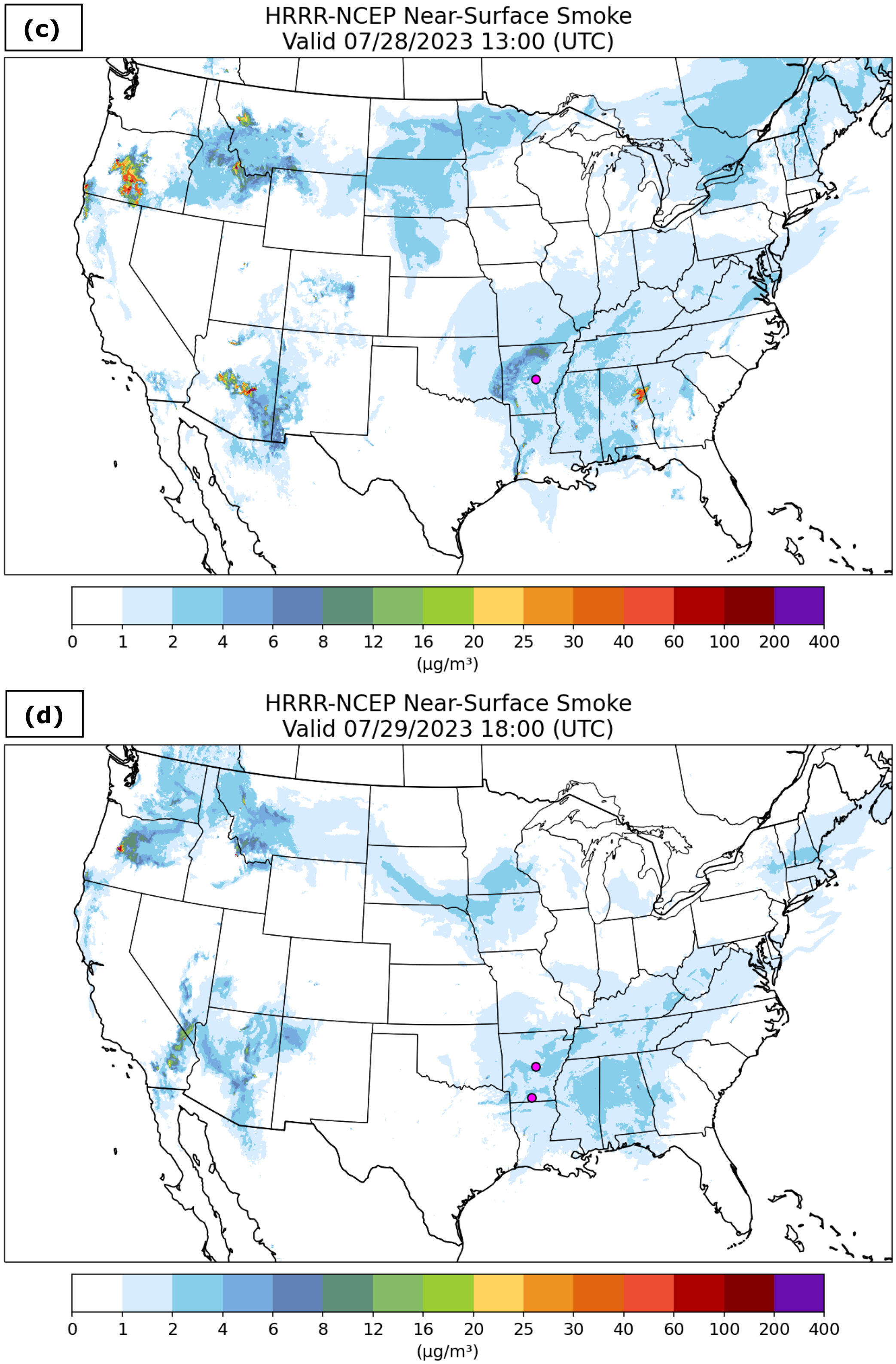


Figure 2-210. HRRR-Smoke modeled near-surface smoke concentrations (μg/m^3) on (a) July 26 at 8 AM CDT, (b) July 27 at 1 PM CDT, (c) July 28 at 8 AM CDT, and (d) July 29 at 1 PM CDT, 2023.

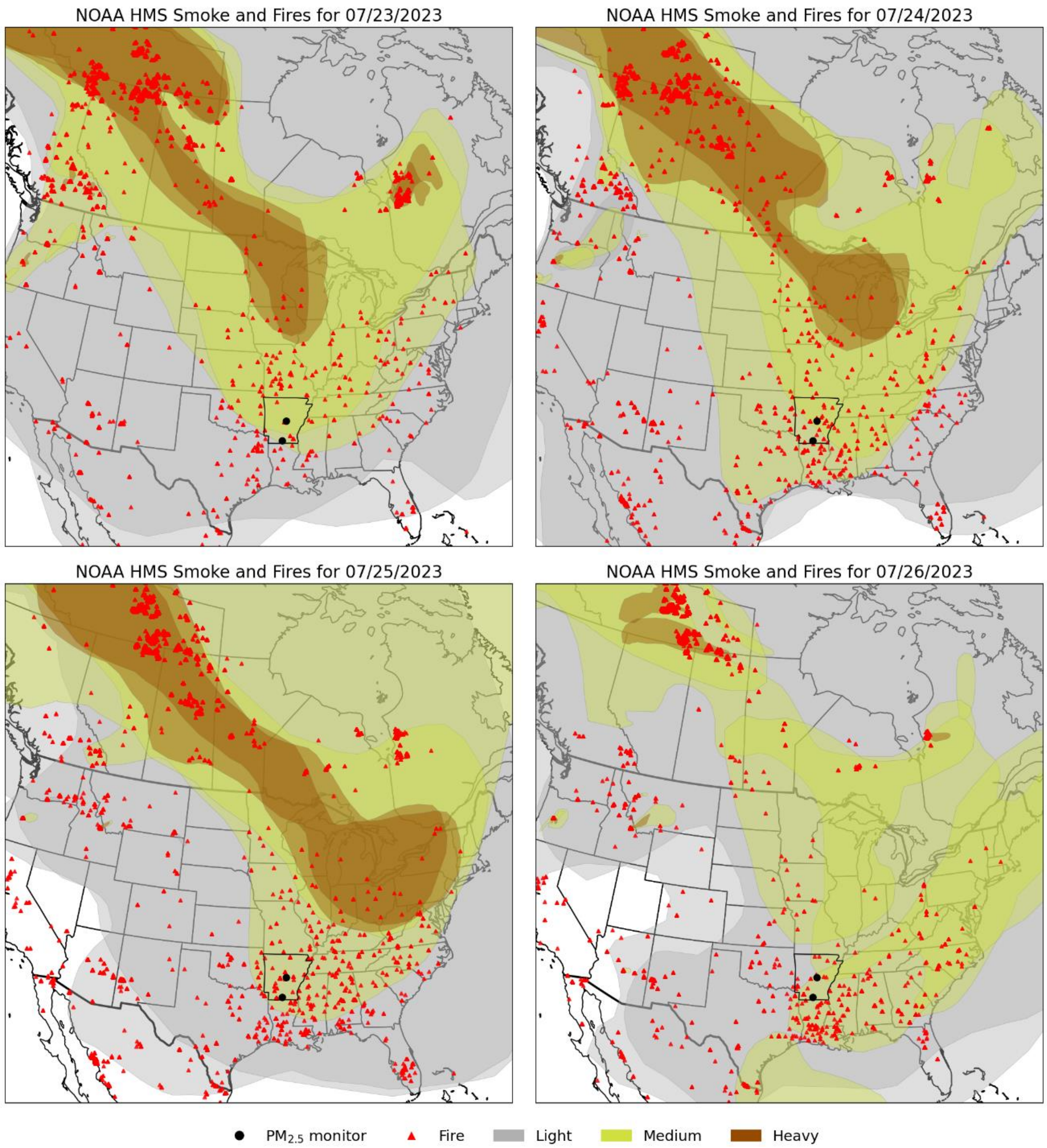


Figure 2-211. Evolution of fires and smoke for July 23 (top left), July 24 (top right), July 25 (bottom left), and July 26 (bottom right).

2.1.10.1 PARR July 26, 2023

Table 2-30 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on July 26, 2023. Figure 2-212 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold, and Figure 2-213 indicates that it is close to the historic 99th percentile over the last five years. Figure 2-214 illustrates that 96-hour back trajectories traversed regions with medium density smoke that was transported from fires in northwest Canada. For instance, the ZF015 fire had burned more than 100,000 hectares (247,105 acres) by July 26.[42] Figure 2-215 shows that air masses move from higher altitudes and descend over the monitoring site because of the presence of a high-pressure system over Arkansas. Figure 2-216 shows that $PM_{2.5}$ concentrations started to increase the previous day on July 25, 2023, at 16:00 (CDT). This rise was driven by the combined effects of a high-pressure system over the southwestern U.S. and a low-pressure system near the Great Lakes, which facilitated the southward transport of smoke-laden air into Arkansas and inhibited its dispersion, leading to elevated $PM_{2.5}$ levels in the morning that persisted until noon on July 26, 2023.

Table 2-30. Exceptional event supporting evidence for PARR on July 26, 2023.

Monitor	PARR (05-119-0007)
Event Date	July 26, 2023
24-hr $PM_{2.5}$ Concentration	20.7 $\mu g/m^3$
EPA Tiering Tool Tier 2 Threshold	17.0 $\mu g/m^3$
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: July. Date accessed: 11/20/2024.

[42] https://cabinradio.ca/137503/news/yellowknife/behchoko-fire-wednesday/

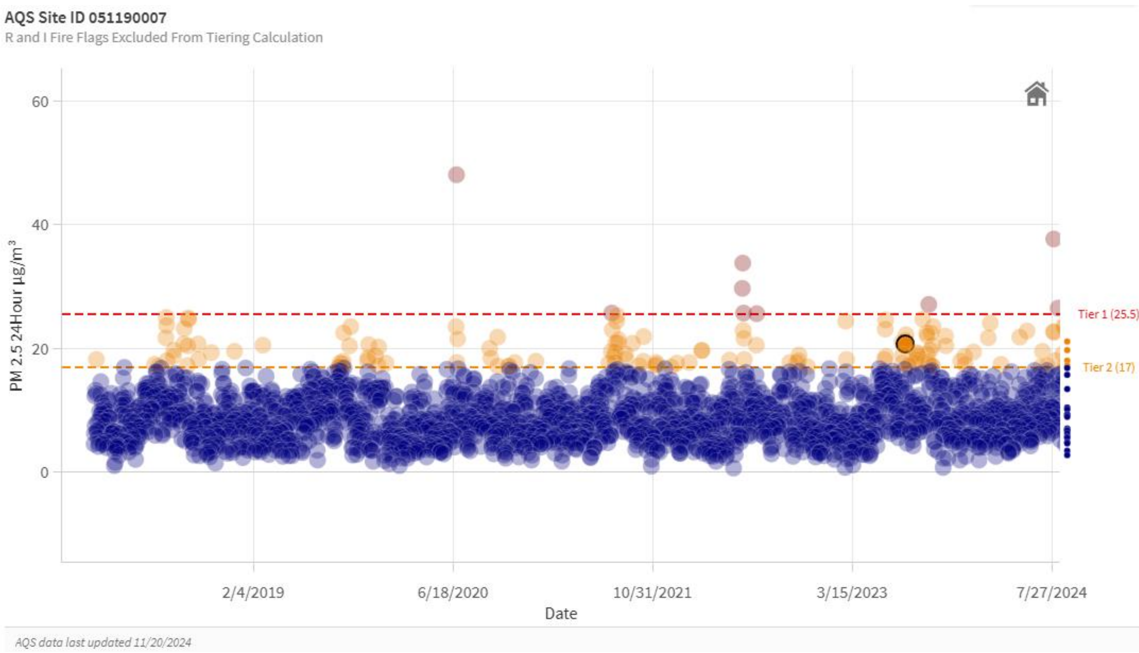


Figure 2-212. EPA $PM_{2.5}$ Tiering Tool for PARR on July 26, 2023.

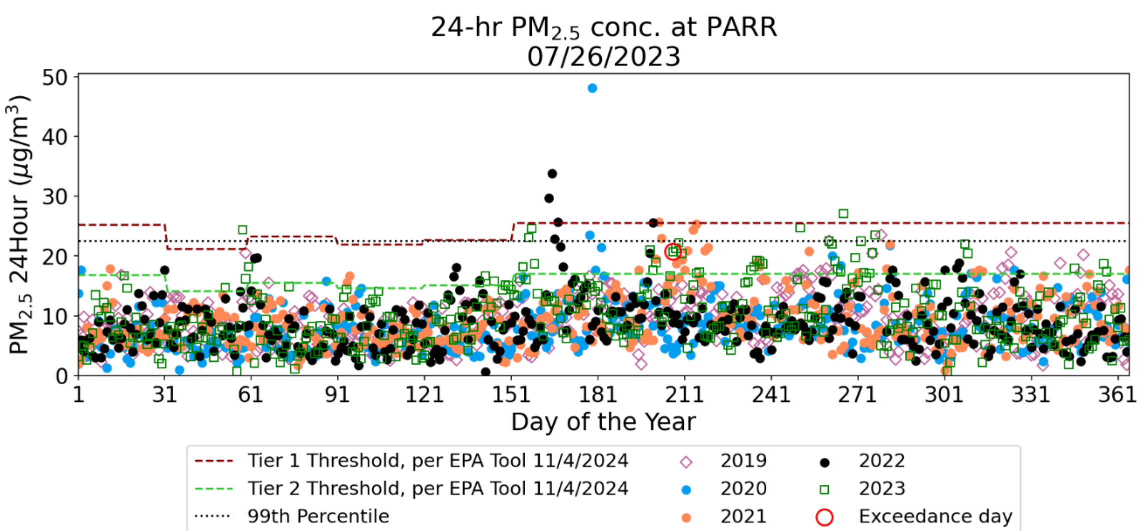


Figure 2-213. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to July 26, 2023.

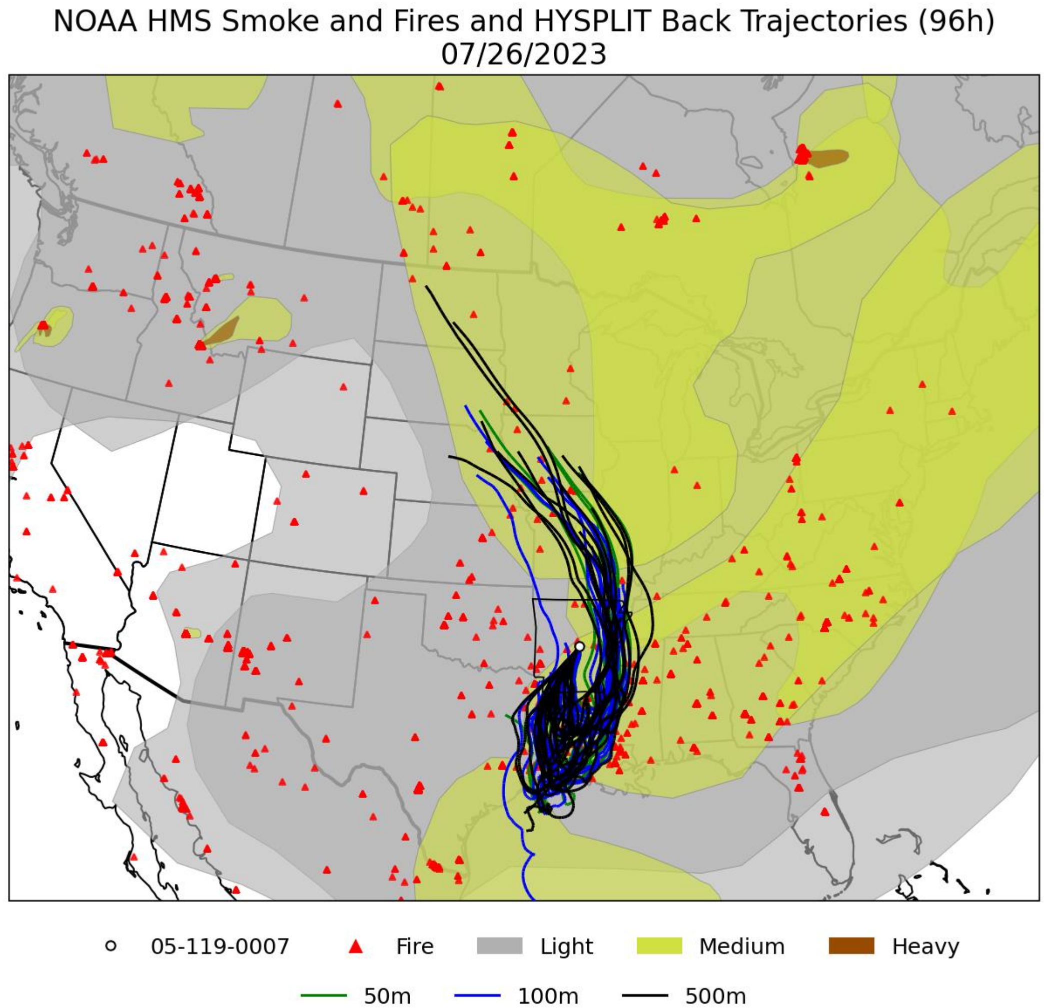
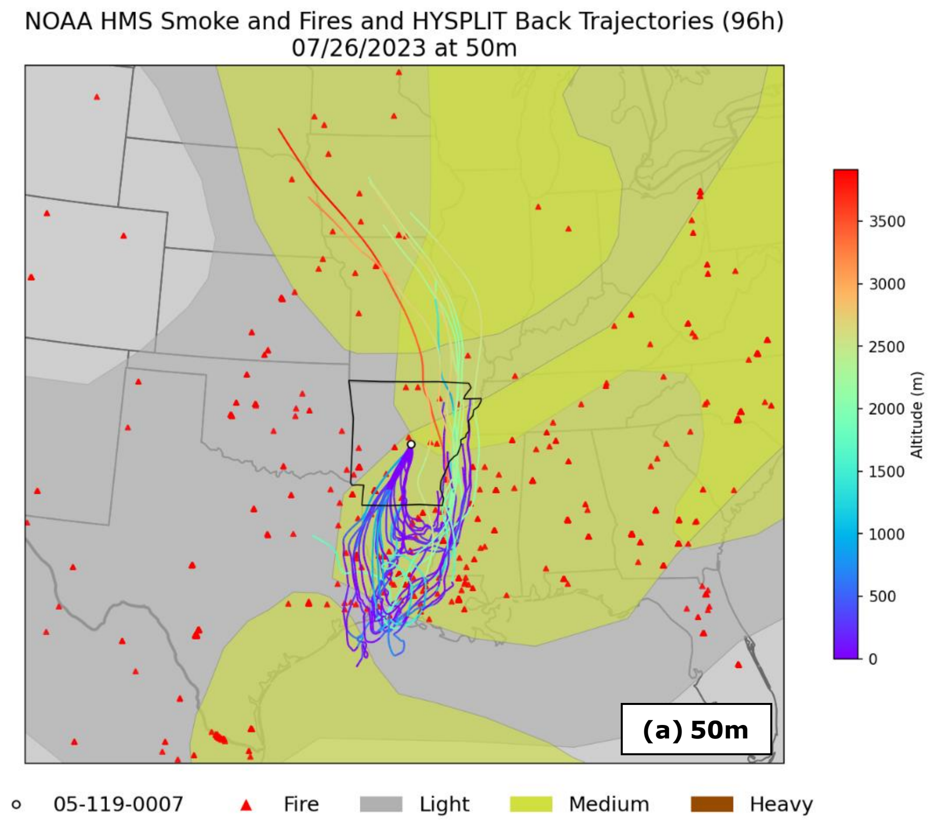
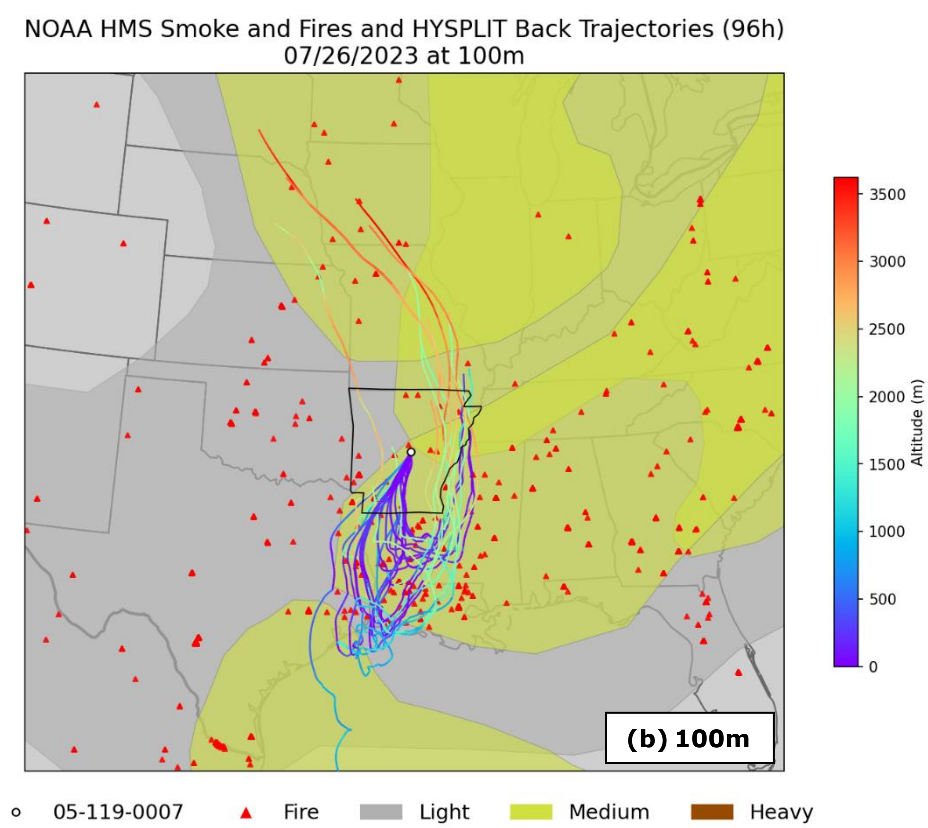


Figure 2-214. HYSPLIT back trajectories for PARR on July 26, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
07/26/2023 at 50m
(a) 50m
Altitude (m)
0
500
1000
1500
2000
2500
3000
3500
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
07/26/2023 at 100m
(b) 100m
Altitude (m)
0
500
1000
1500
2000
2500
3000
3500
05-119-0007
Fire
Light
Medium
Heavy

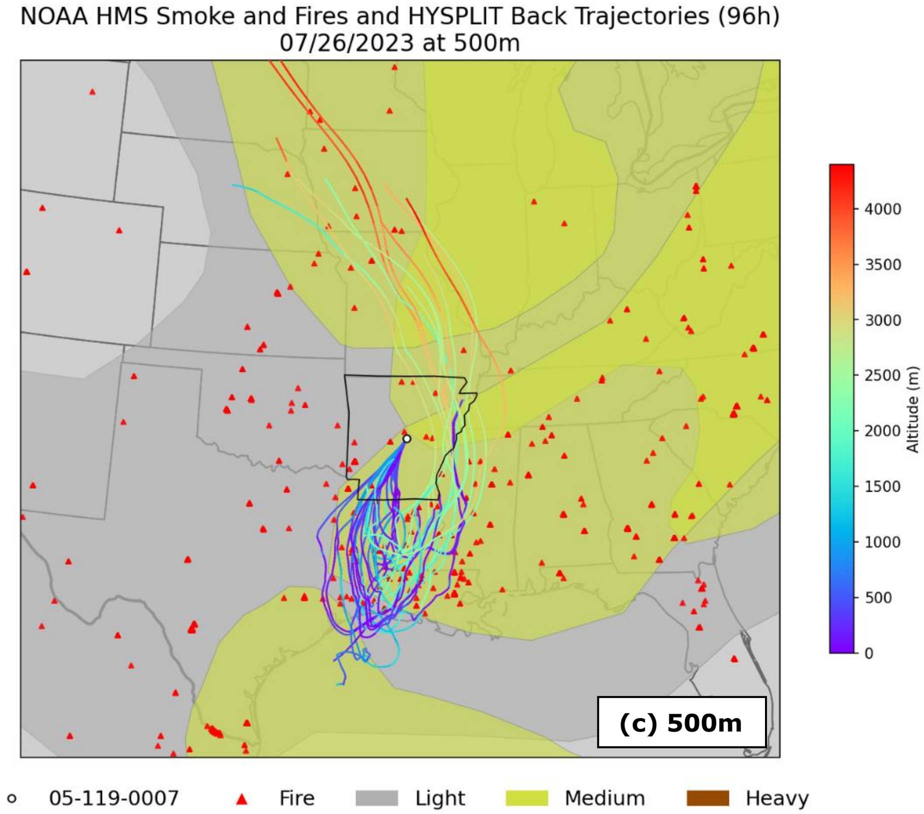


Figure 2-215. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on July 26, 2023.

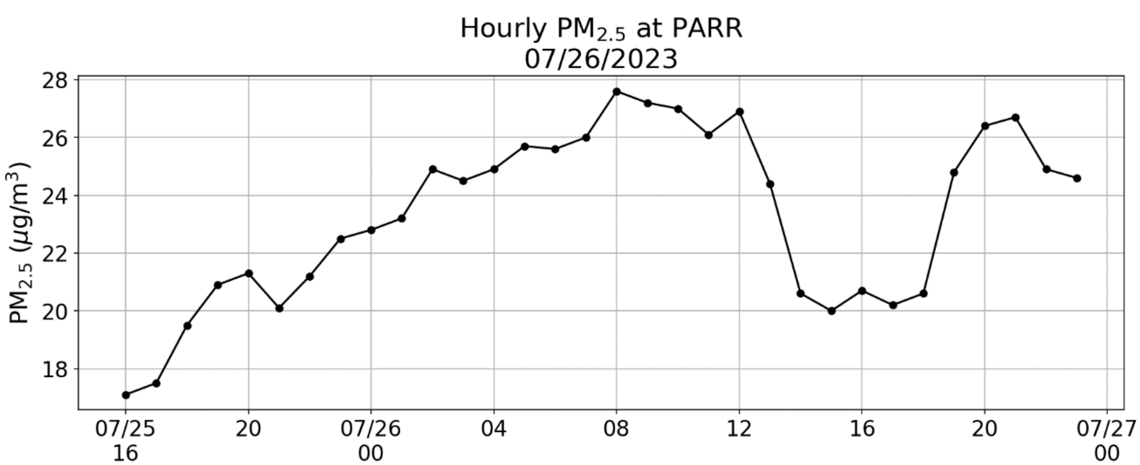


Figure 2-216. Hourly $PM_{2.5}$ concentrations for PARR on July 26, 2023.

2.1.10.2 PARR July 27, 2023

Table 2-31 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on July 27, 2023. Figure 2-217 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold, and Figure 2-218 indicates that it is close to the historic 99th percentile over the last five years. Figure 2-219 illustrates anticyclonic (clockwise) flow bringing air masses from regions with medium density smoke transported from numerous wildfires in the northwest Canada. Figure 2-220 shows that the air mass travelled through regions with medium density smoke at higher altitudes before descending over the monitoring site. Figure 2-221 shows the increase in hourly $PM_{2.5}$ concentrations throughout the day on July 27, 2023. This increase was driven by the 500 mb ridge and its downstream trough, which facilitated the long-range transport of wildfire smoke into the central and eastern U.S. Additionally, the surface high-pressure system reinforced this transport while stabilizing the atmosphere, leading to the trapping of smoke near the surface and elevated $PM_{2.5}$ levels, especially in the last hours of this day.

Table 2-31. Exceptional event supporting evidence for PARR on July 27, 2023.

Monitor	PARR (05-119-0007)
Event Date	July 27, 2023
24-hr $PM_{2.5}$ Concentration	21.3 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: July. Date accessed: 11/20/2024.

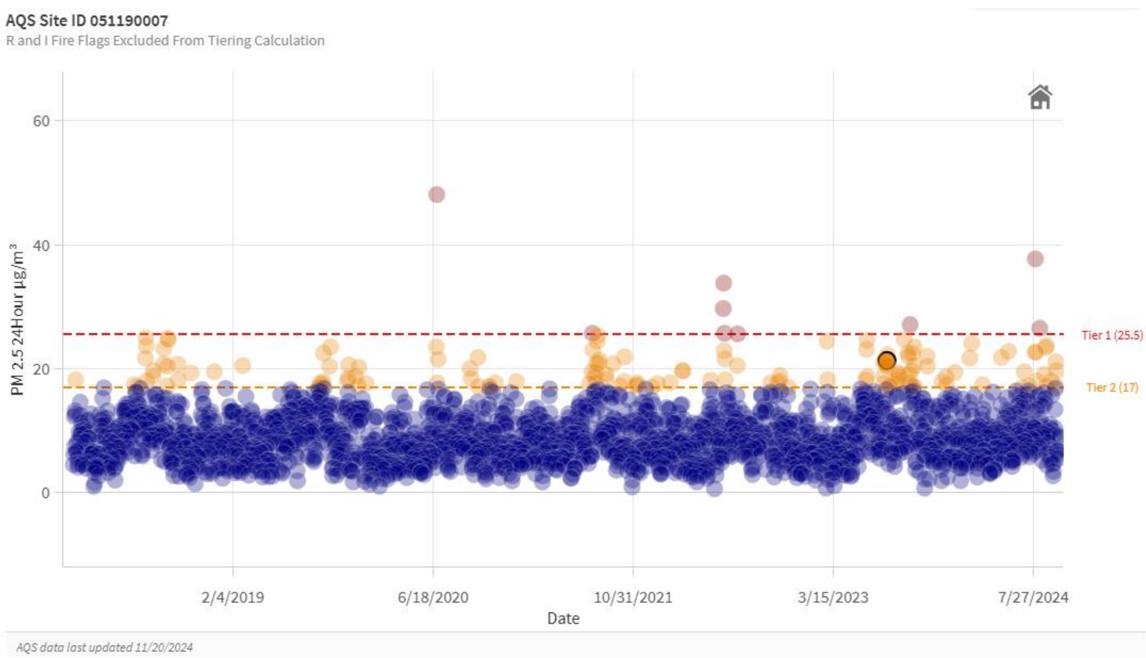


Figure 2-217. EPA $PM_{2.5}$ Tiering Tool for PARR on July 27, 2023.

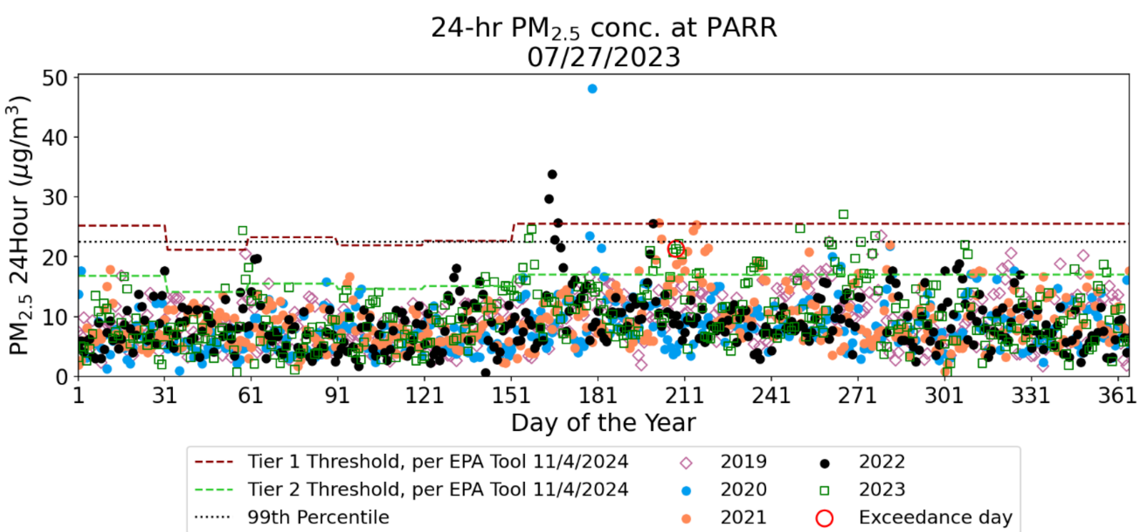


Figure 2-218. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to July 27, 2023.

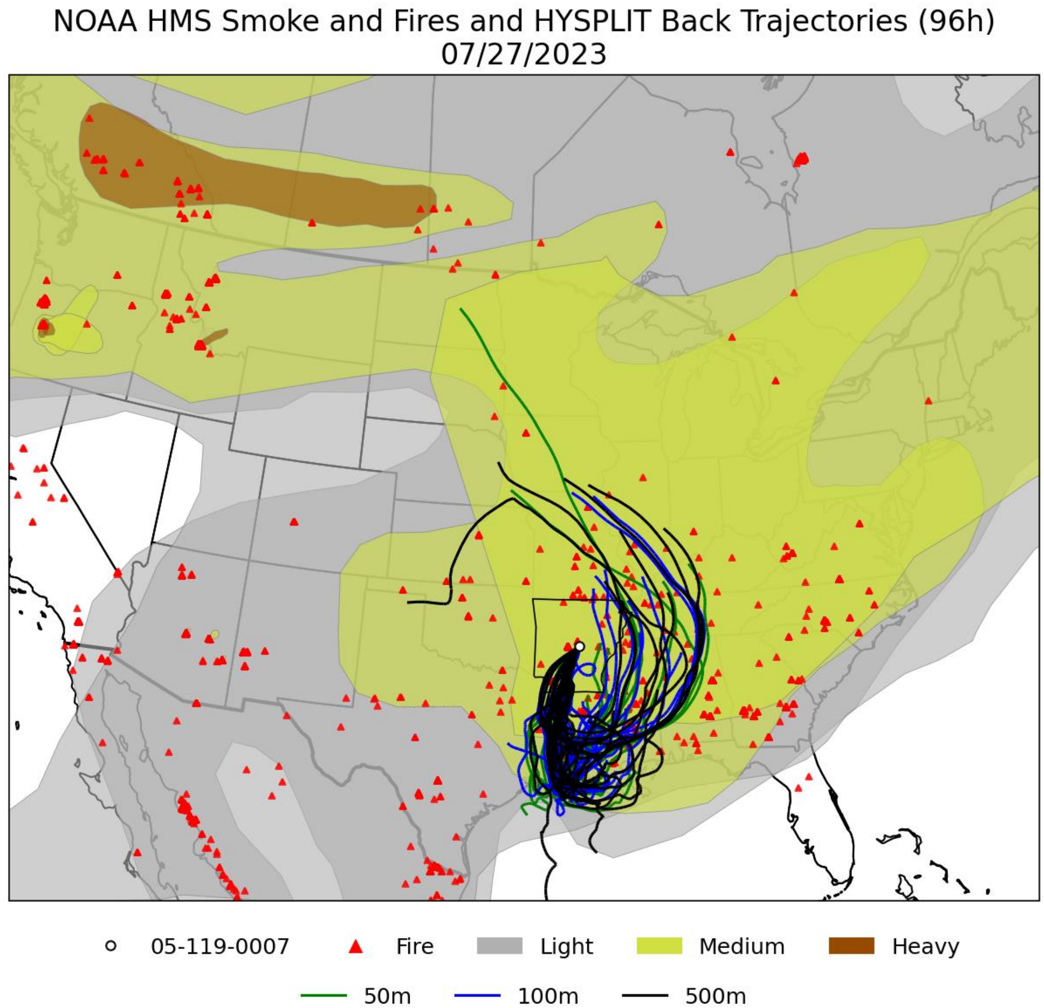
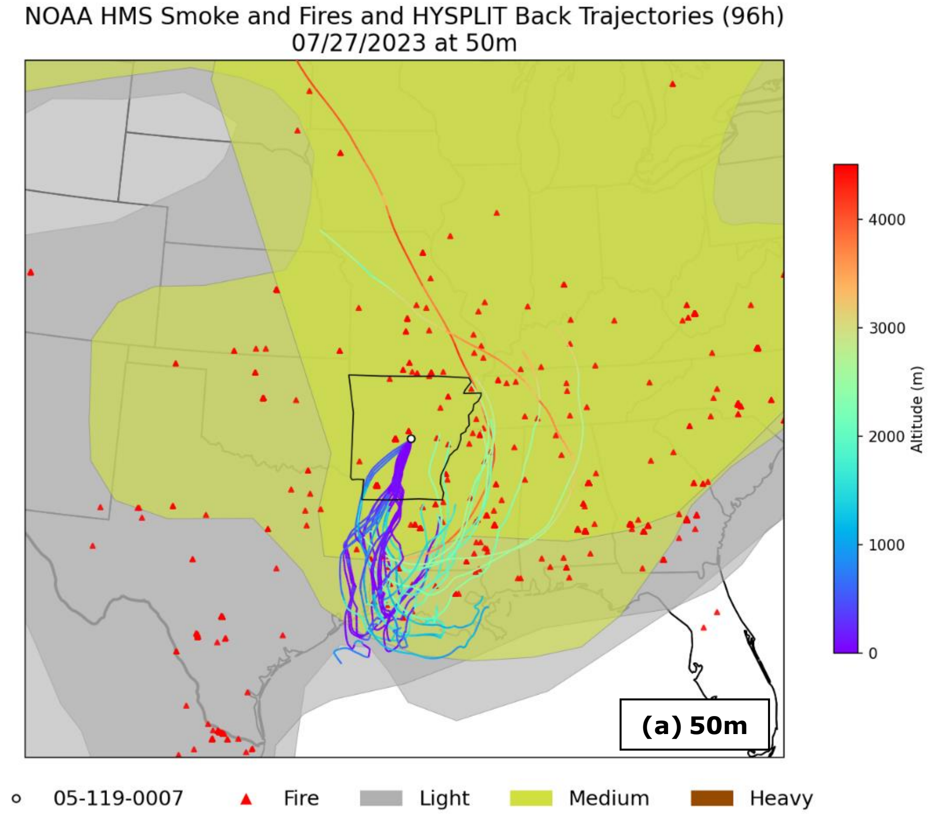
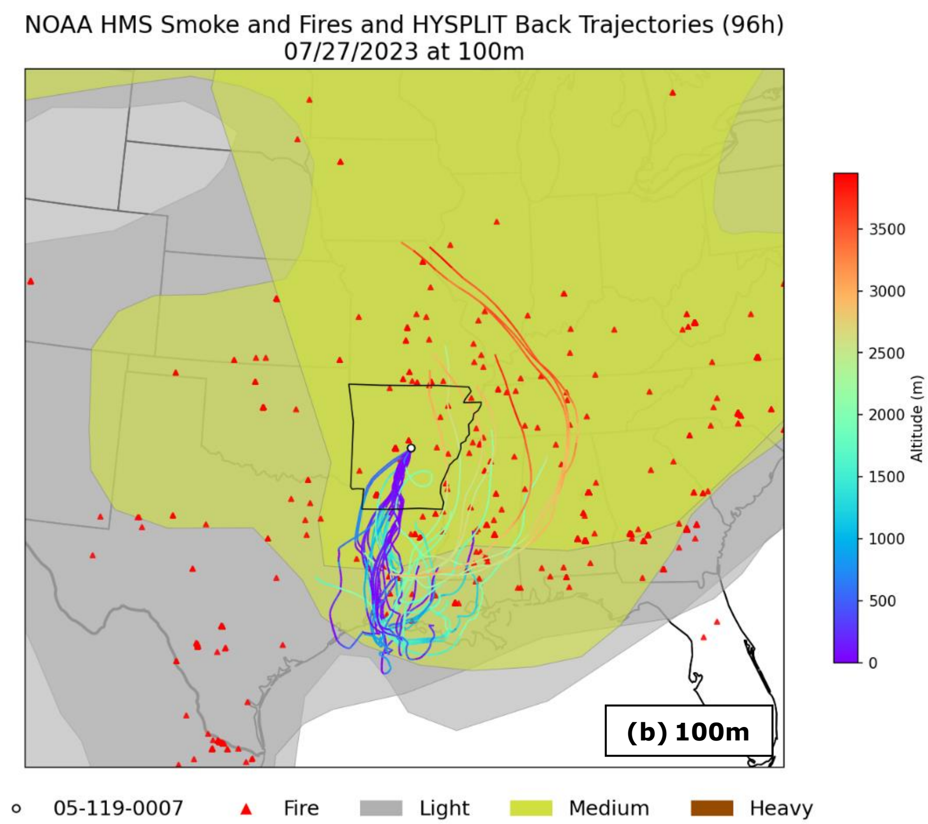


Figure 2-219. HYSPLIT back trajectories for PARR on July 27, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
07/27/2023 at 50m
(a) 50m
Altitude (m)
4000
3000
2000
1000
0
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
07/27/2023 at 100m
(b) 100m
Altitude (m)
3500
3000
2500
2000
1500
1000
500
0
05-119-0007
Fire
Light
Medium
Heavy

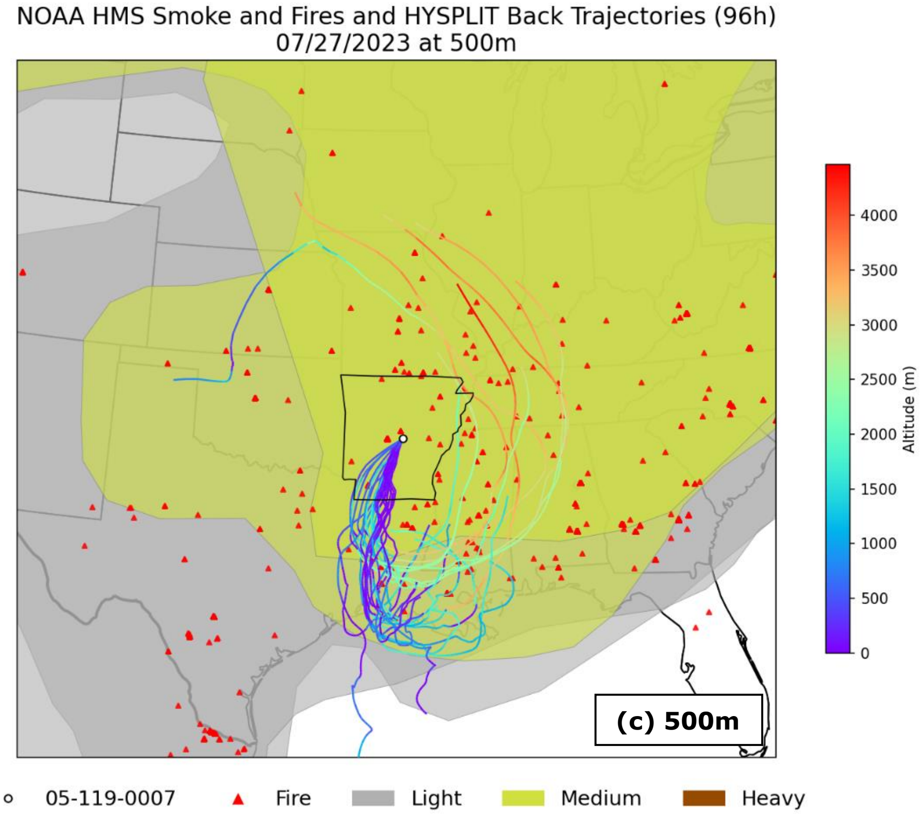


Figure 2-220. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on July 27, 2023.

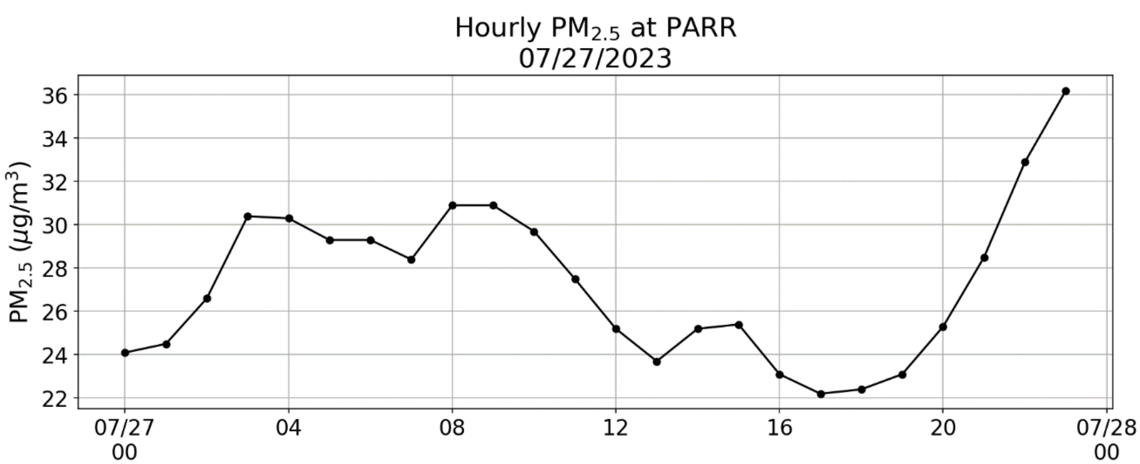


Figure 2-221. Hourly PM2.5 concentrations for PARR on July 27, 2023.

2.1.10.3 PARR July 28, 2023

Table 2-32 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on July 28, 2023. Figure 2-222 indicates that this day is clearly above the Tier 2 threshold, while Figure 2-223 places it at the historic 99th percentile over the last five years. Back trajectories shown in Figure 2-224 depict anticyclonic (clockwise) flow, with air masses moving through regions containing residual medium density smoke from numerous large wildfires that continue to burn in northwest Canada. Figure 2-225 illustrates that the air mass passed through areas with medium density smoke at higher altitudes before descending to the monitoring site. Hourly time series in Figure 2-226 showed continued high $PM_{2.5}$ levels. The ridge's weakening allowed for the trough over the Pacific Northwest to influence flow patterns, facilitating the continued transport of wildfire smoke into the central U.S. Surface high pressure conditions maintained atmospheric stability, trapping smoke near the surface, and contributing to elevated $PM_{2.5}$ levels.

Table 2-32. Exceptional event supporting evidence for PARR on July 28, 2023.

Monitor	PARR (05-119-0007)
Event Date	July 28, 2023
24-hr $PM_{2.5}$ Concentration	22.2 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: July. Date accessed: 11/20/2024.

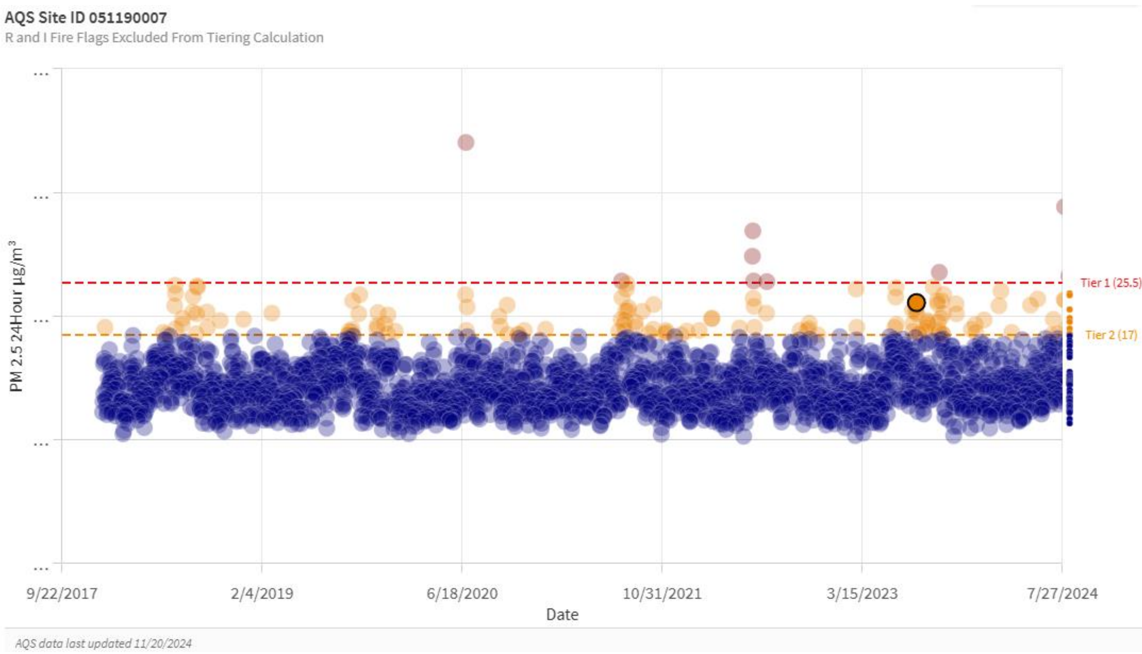


Figure 2-222. EPA $PM_{2.5}$ Tiering Tool for PARR on July 28, 2023.

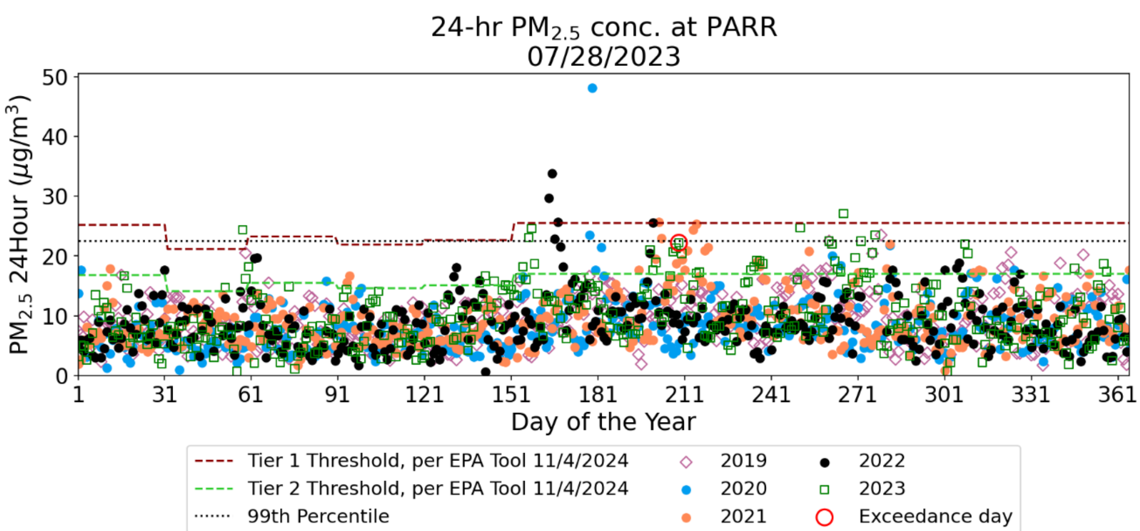


Figure 2-223. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to July 28, 2023.

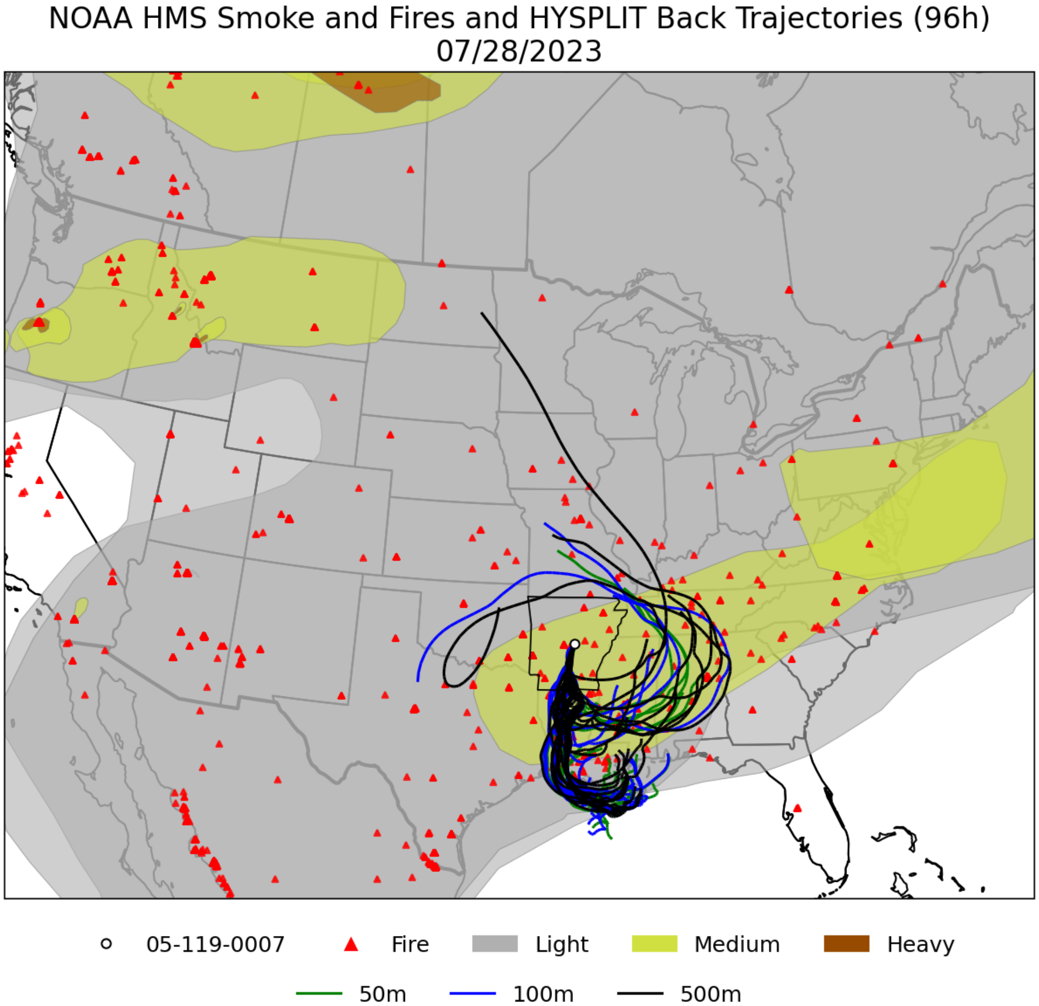
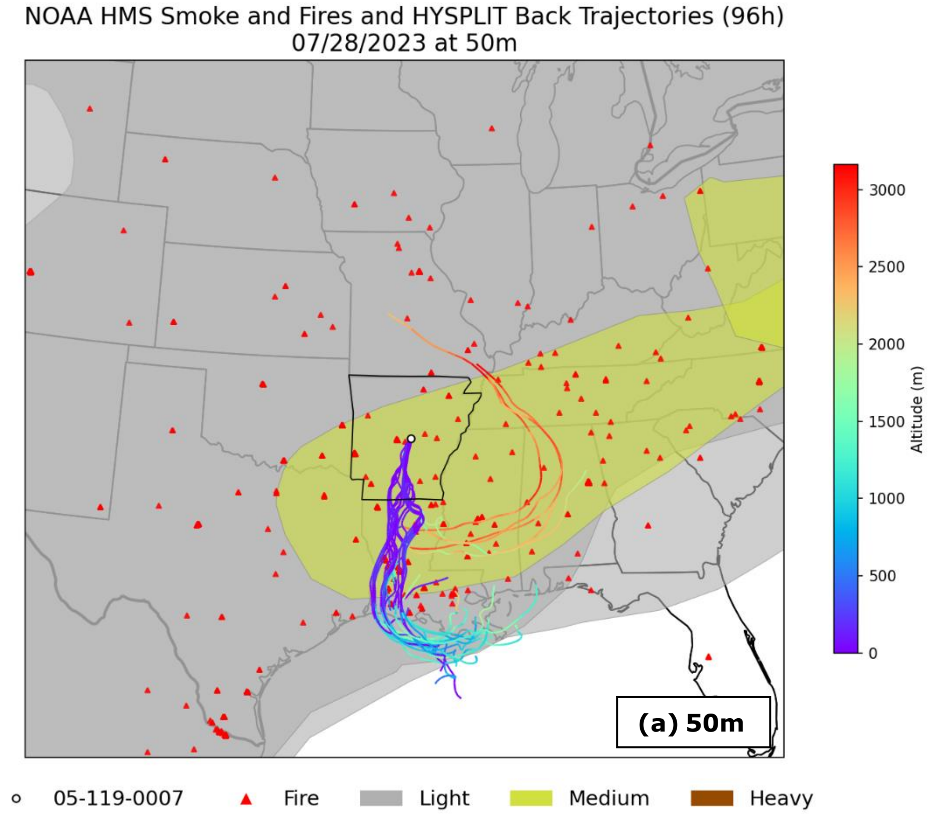
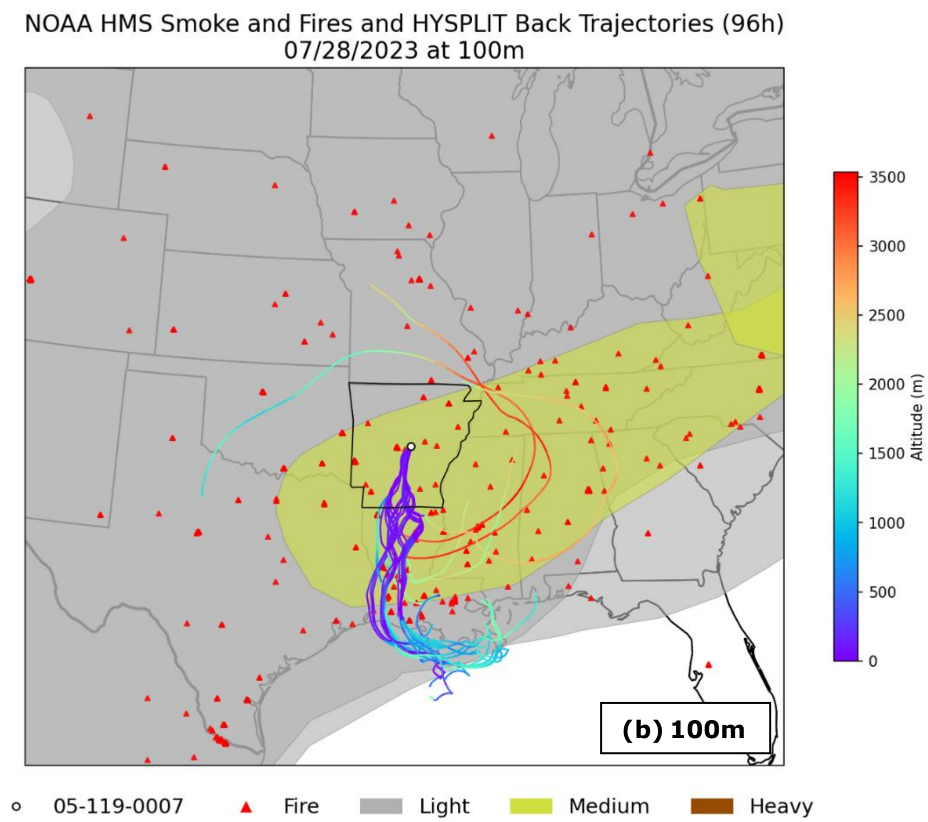


Figure 2-224. HYSPLIT back trajectories for PARR on July 28, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
07/28/2023 at 50m
(a) 50m
Altitude (m)
3000
2500
2000
1500
1000
500
0
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
07/28/2023 at 100m
(b) 100m
Altitude (m)
3500
3000
2500
2000
1500
1000
500
0
05-119-0007
Fire
Light
Medium
Heavy

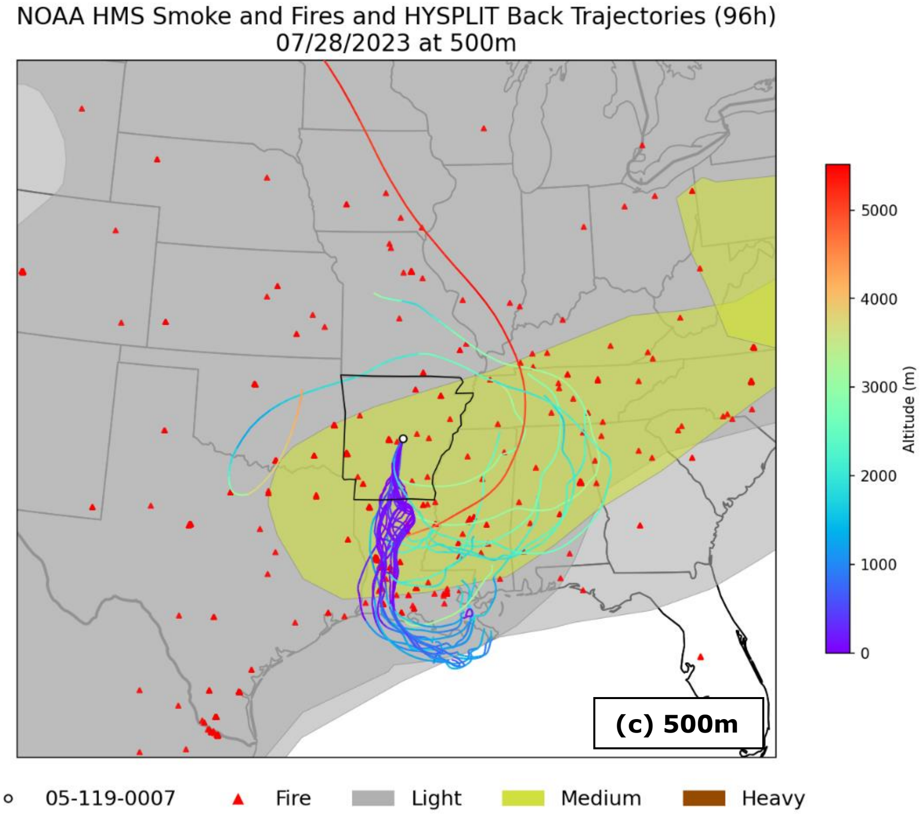


Figure 2-225. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on July 28, 2023.

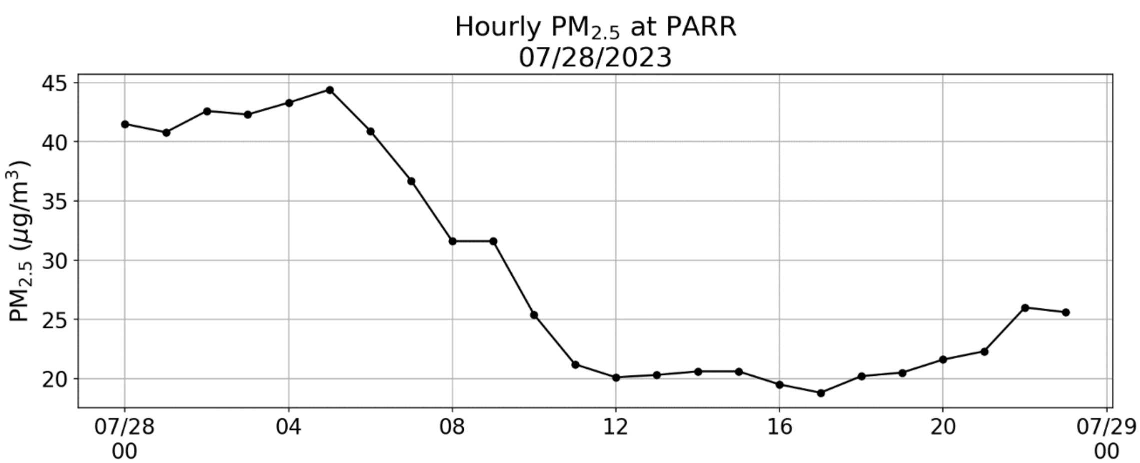


Figure 2-226. Hourly $PM_{2.5}$ concentrations for PARR on July 28, 2023.

2.1.10.4 PARR July 29, 2023

Table 2-33 compiles the evidence supporting the demonstration of an exceptional event for El Dorado (AQS ID 05-119-0007) on July 29, 2023. Figure 2-227 shows that this day exceeds the Tier 2 threshold. Back trajectories in Figure 2-229 depict anticyclonic (clockwise) flow, with air masses transporting residual medium density smoke from numerous large wildfires in northwest Canada. The high-pressure over Arkansas (Figure 2-205 and Figure 2-206) prevented the dispersion of smoke-filled air in the region. Figure 2-230 illustrates the movement of air masses at higher altitudes, passing through regions with medium density smoke before descending over the monitoring site. The strengthening of the Pacific Northwest trough led to the southward and southeastward transport of smoke into the central and eastern U.S. Combined with the surface high pressure conditions and a cold front funneling smoke into the region, this resulted in high $PM_{2.5}$ concentrations for the day (Figure 2-231).

Table 2-33. Exceptional event supporting evidence for PARR on July 29, 2023.

Monitor	PARR (05-119-0007)
Event Date	July 29, 2023
24-hr $PM_{2.5}$ Concentration	20.4 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: July. Date accessed: 11/20/2024.

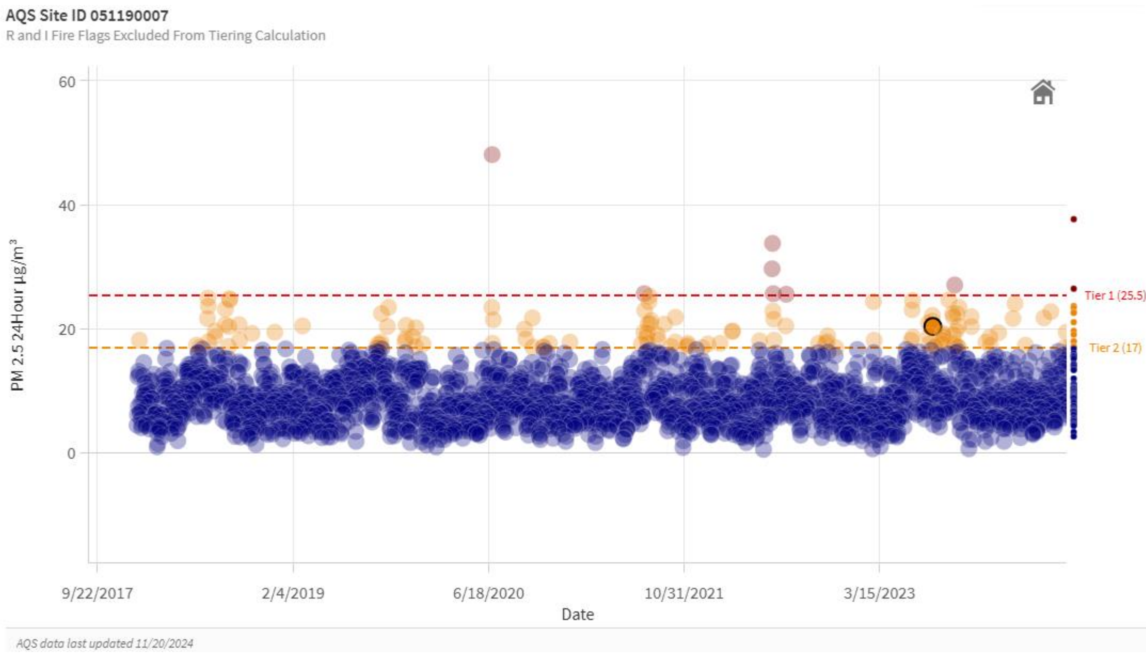


Figure 2-227. EPA PM2.5 Tiering Tool for PARR on July 29, 2023.

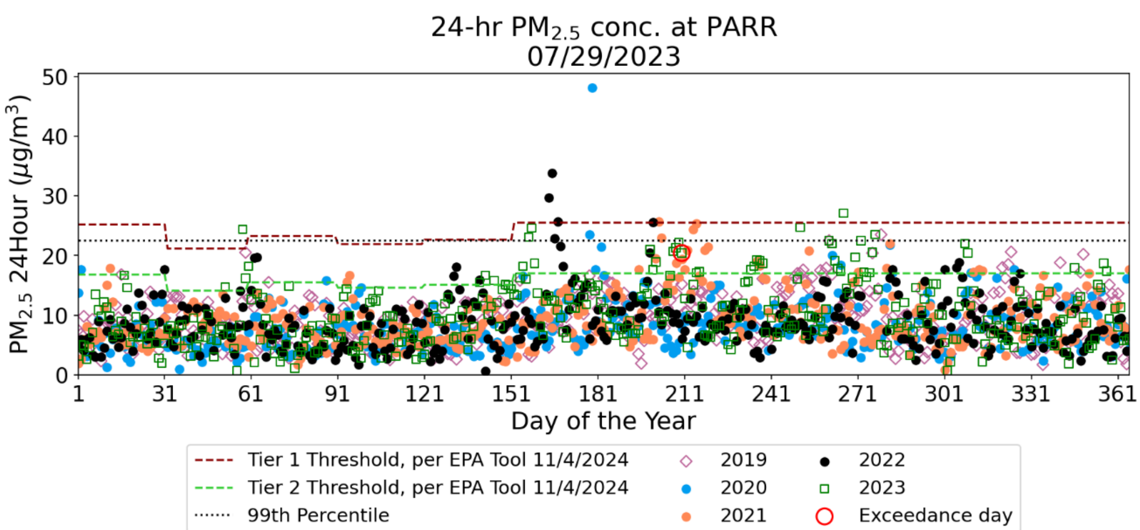


Figure 2-228. Historical 24-hour PM2.5 seasonal fluctuations for PARR compared to July 29, 2023.

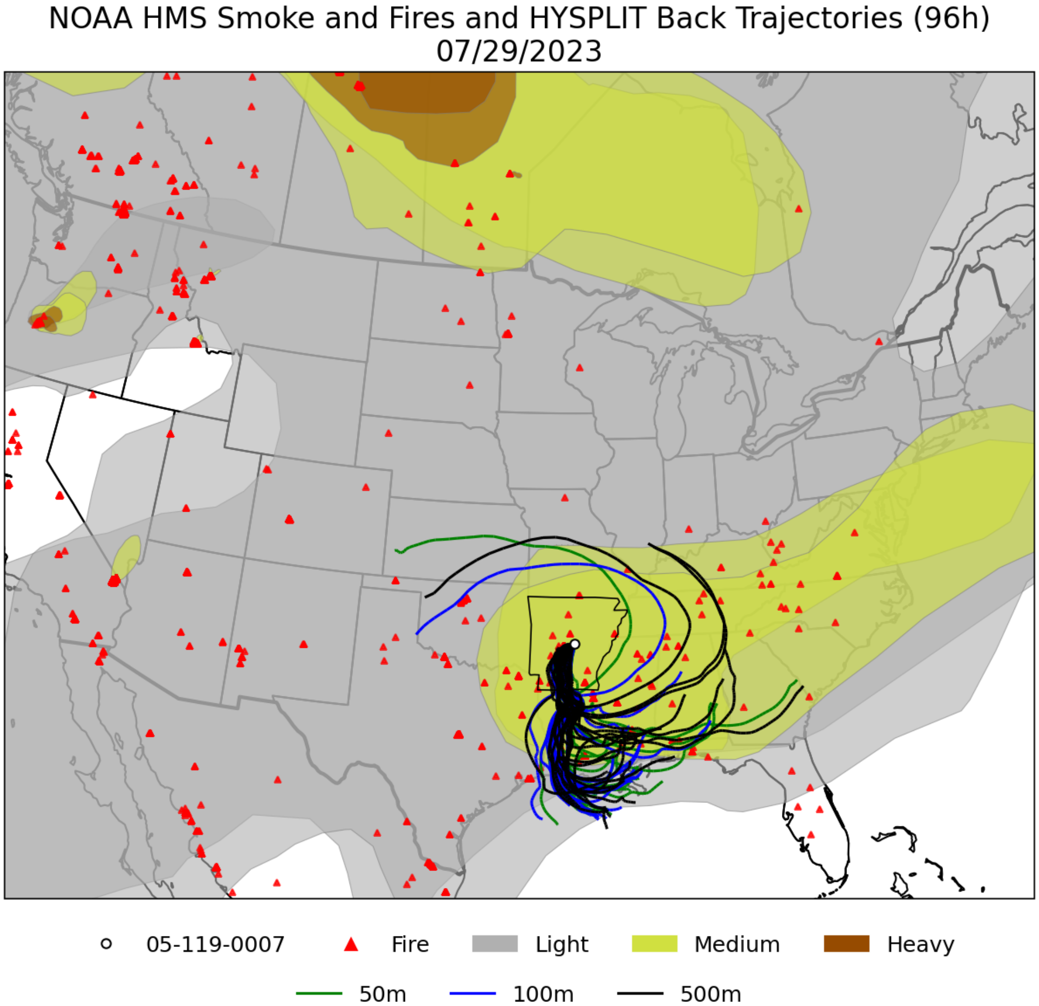
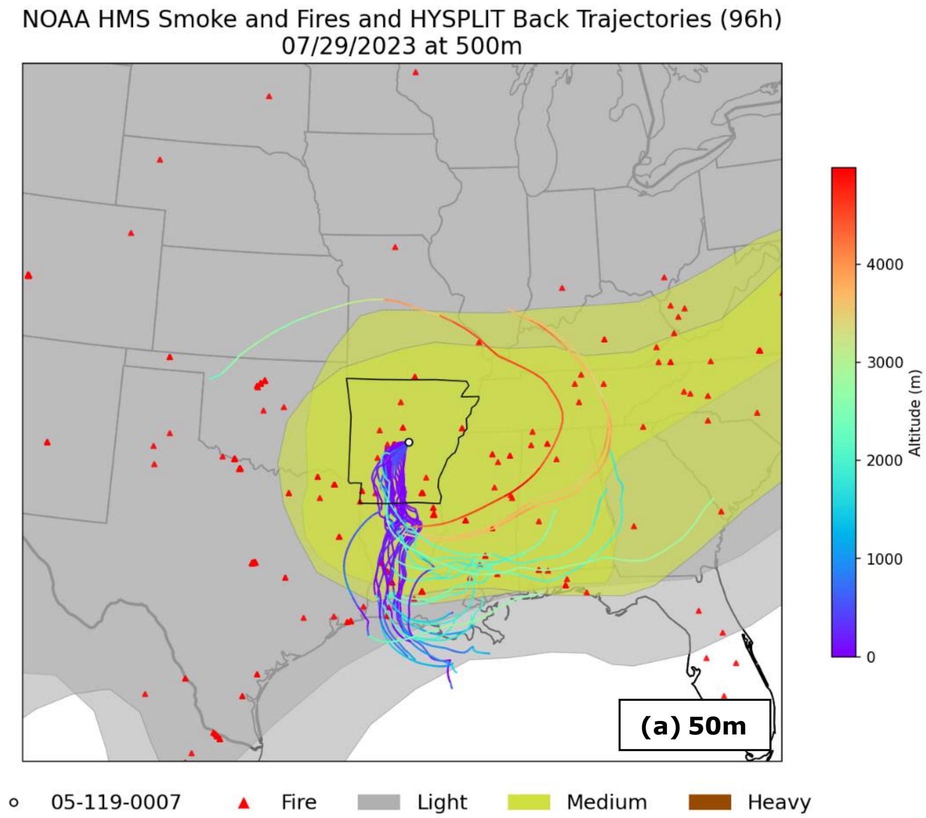
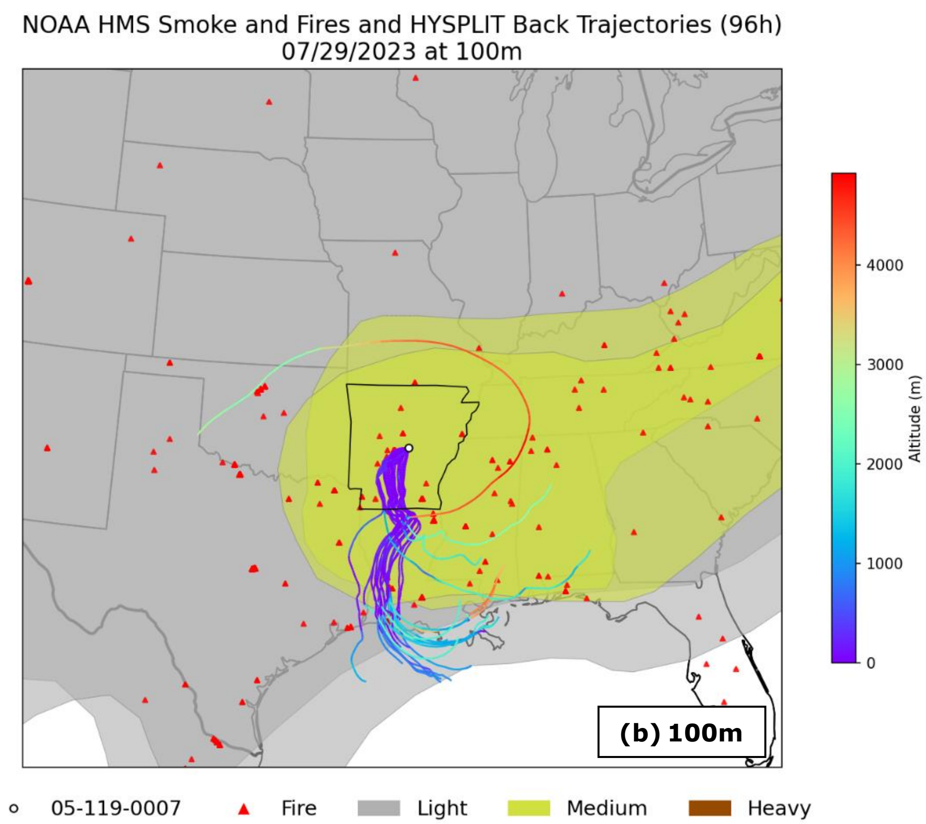


Figure 2-229. HYSPLIT back trajectories for PARR on July 29, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
07/29/2023 at 500m
(a) 50m
Altitude (m)
4000
3000
2000
1000
0
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
07/29/2023 at 100m
(b) 100m
Altitude (m)
4000
3000
2000
1000
0
05-119-0007
Fire
Light
Medium
Heavy

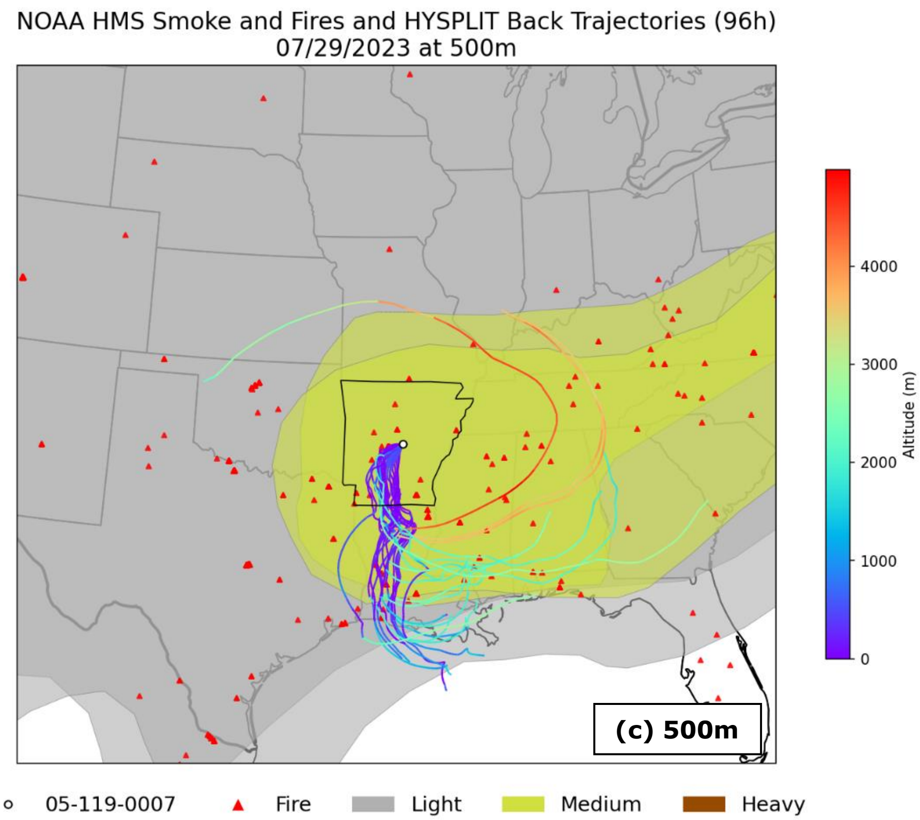


Figure 2-230. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on July 29, 2023.

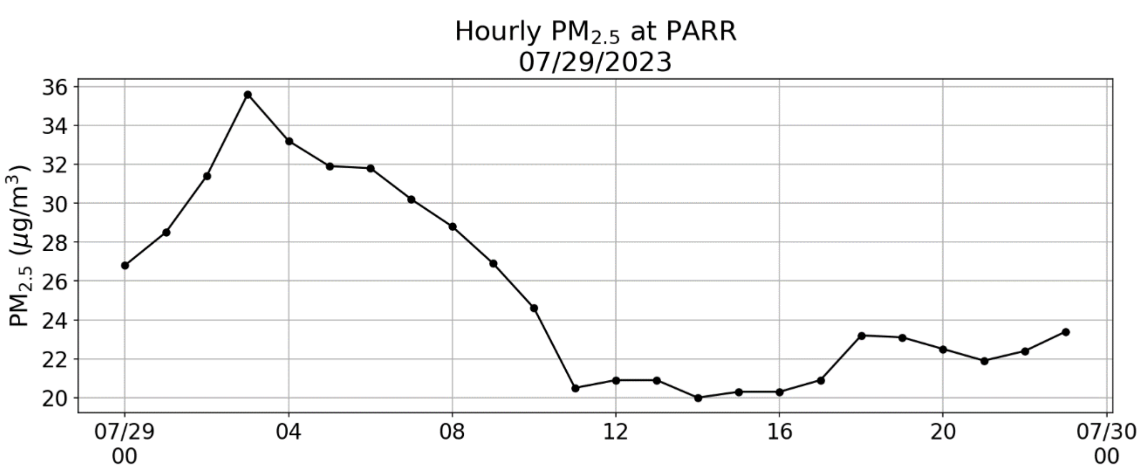


Figure 2-231. Hourly PM2.5 concentrations for PARR on July 29, 2023.

2.1.10.5 El Dorado July 29, 2023

Table 2-34 presents the evidence supporting the demonstration of an exceptional event for El Dorado (AQS ID 05-139-0006) on July 29, 2023. Figure 2-232 shows that this day exceeds the Tier 2 threshold. Figure 2-234 depicts an anticyclonic flow, with air masses carrying residual medium density smoke that originated from several large wildfires in northwest Canada. The high-pressure system over Arkansas (Figure 2-205 and Figure 2-206) has inhibited the dispersion of smoke-laden air from the area. Like PARR, Figure 2-235 demonstrates the descent of air masses from higher altitudes, passing through regions with medium density smoke before reaching the monitoring site.

Table 2-34. Exceptional event supporting evidence for El Dorado on July 29, 2023.

Monitor	El Dorado (05-139-0006)
Event Date	July 29, 2023
24-hr $PM_{2.5}$ Concentration	17.9 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.6 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: July. Date accessed: 11/20/2024.

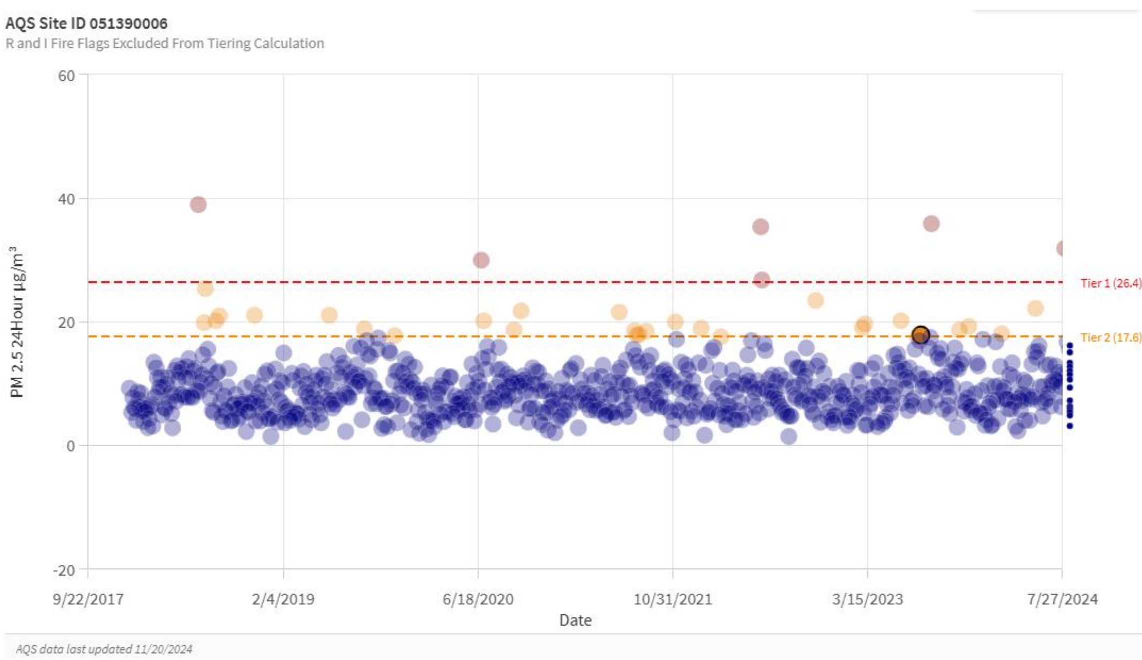


Figure 2-232. EPA PM2.5 Tiering Tool for El Dorado on July 29, 2023.

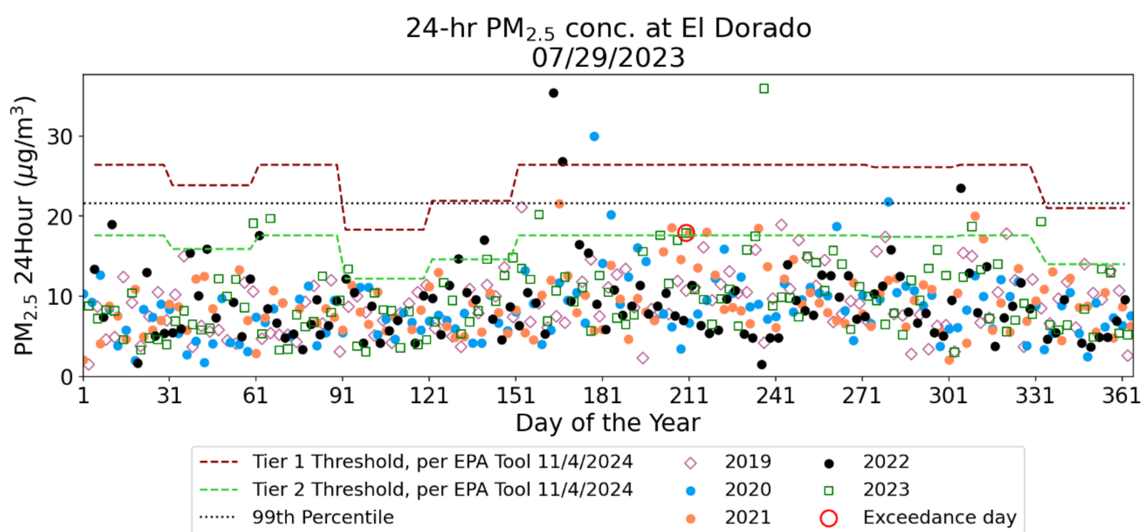


Figure 2-233. Historical 24-hour PM2.5 seasonal fluctuations for El Dorado compared to July 29, 2023.

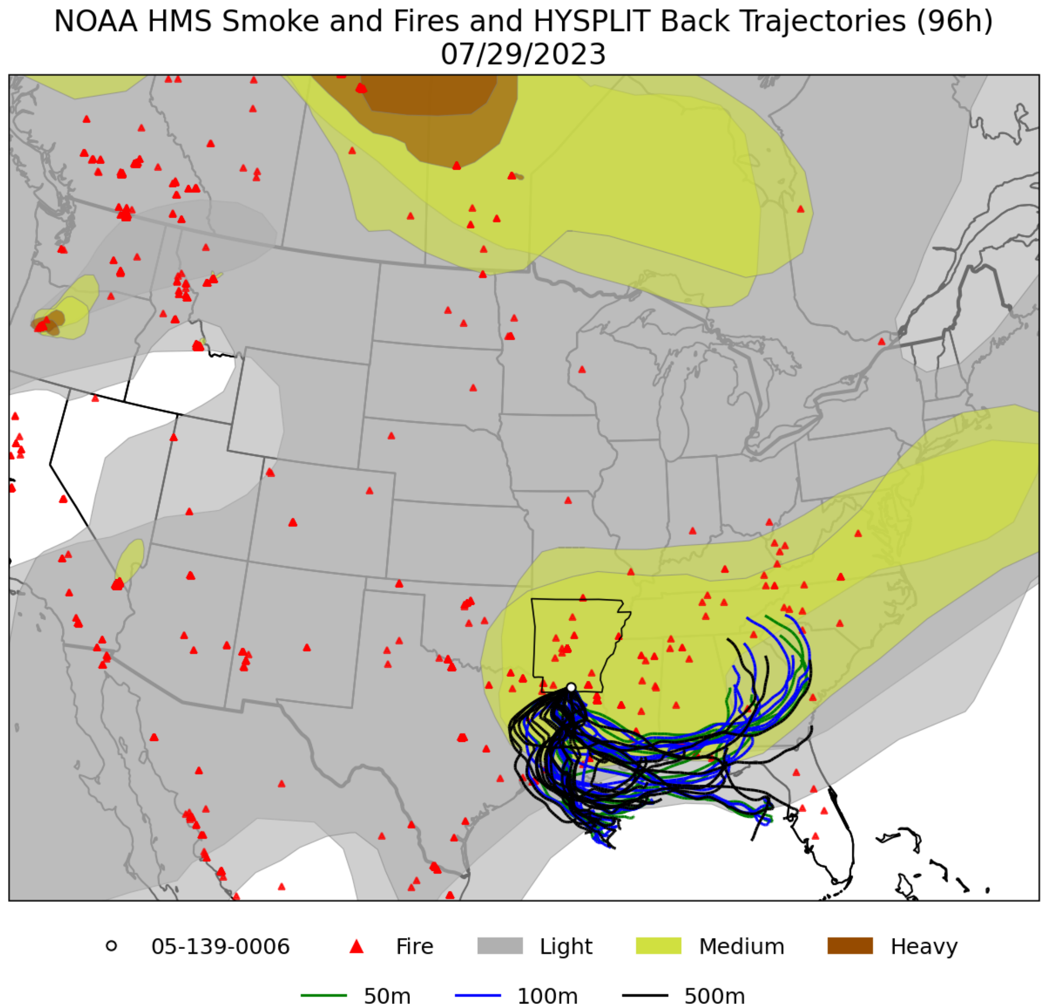
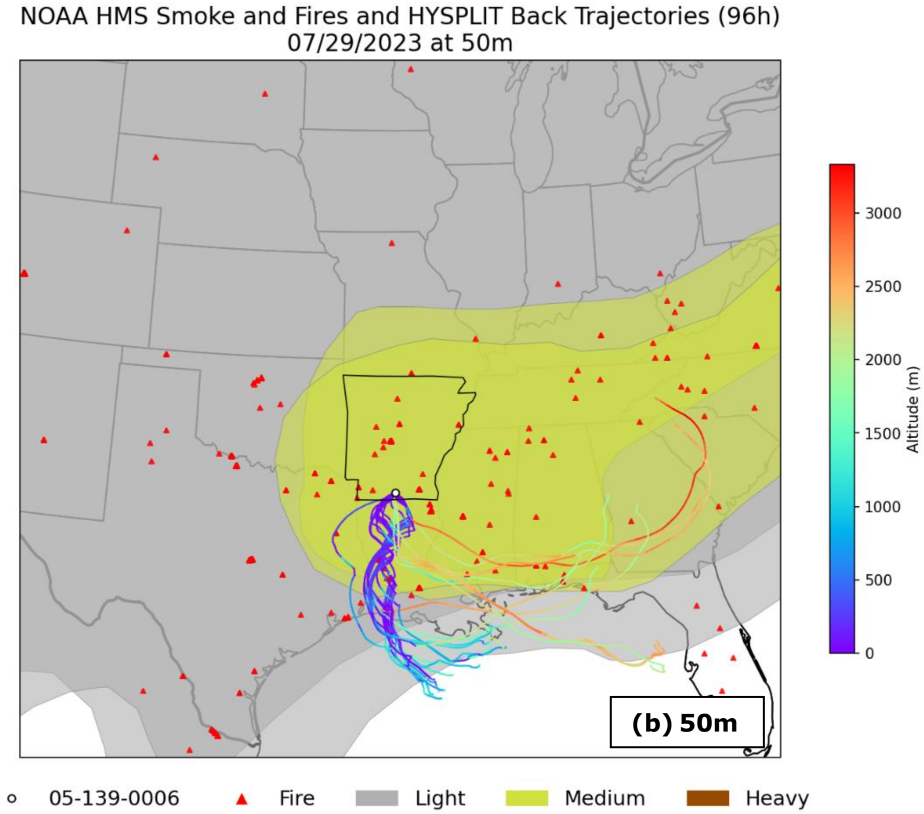
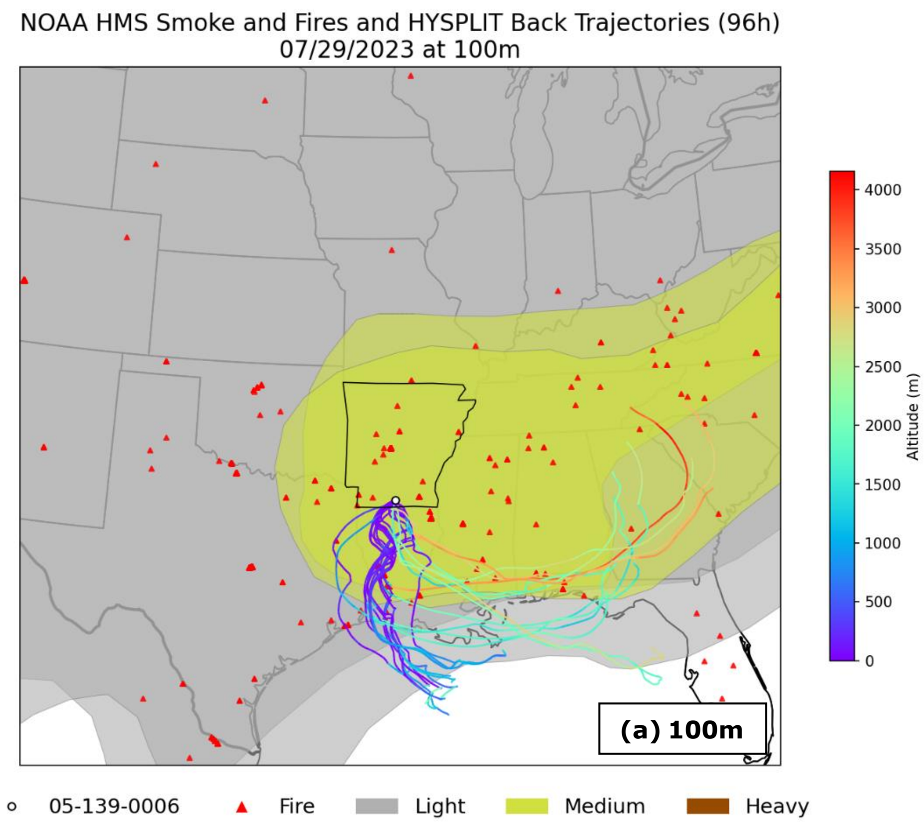


Figure 2-234. HYSPLIT back trajectories for El Dorado on July 29, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
07/29/2023 at 50m
(b) 50m
Altitude (m)
3000
2500
2000
1500
1000
500
0
05-139-0006
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
07/29/2023 at 100m
(a) 100m
Altitude (m)
4000
3500
3000
2500
2000
1500
1000
500
0
05-139-0006
Fire
Light
Medium
Heavy

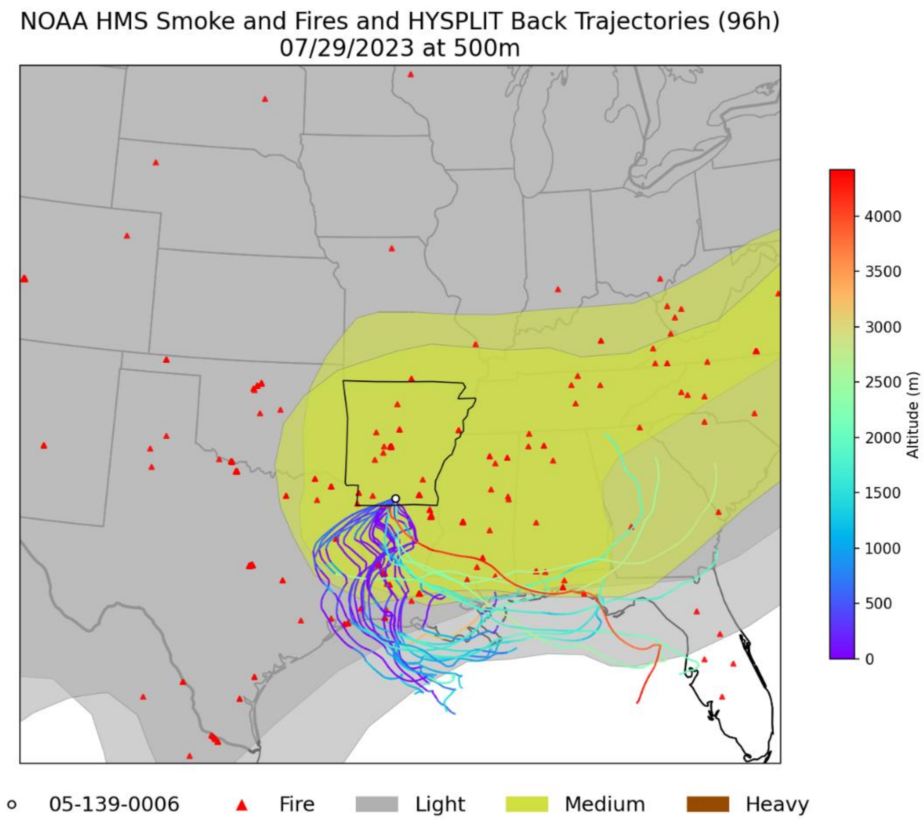
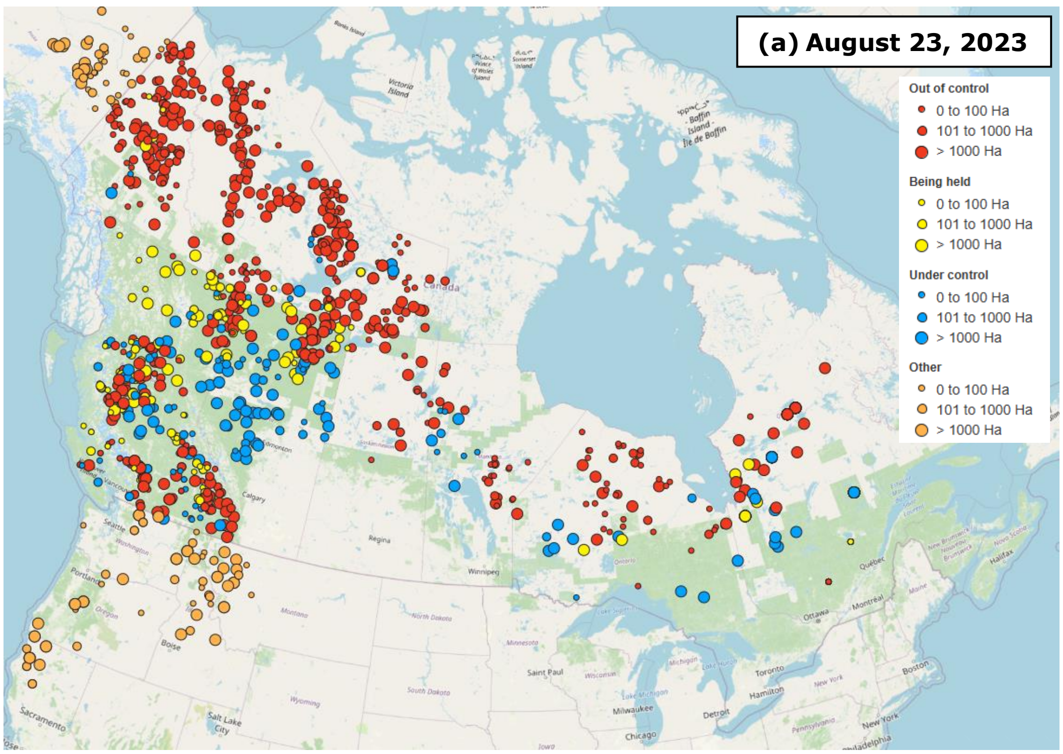
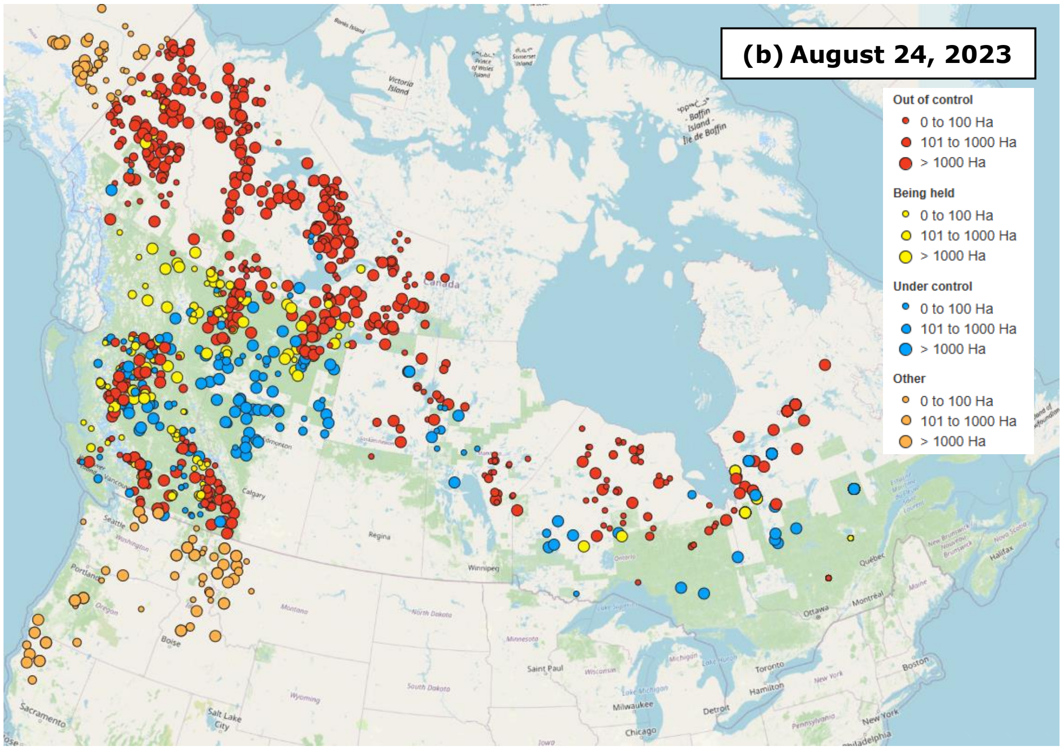


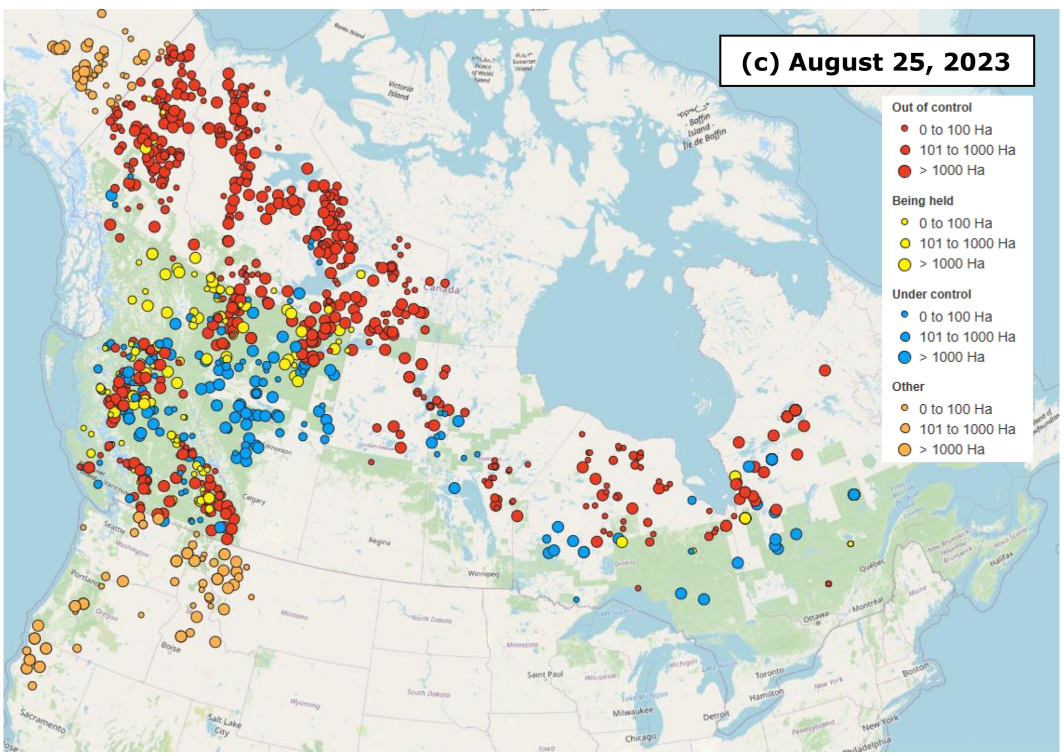
Figure 2-235. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for El Dorado on July 29, 2023.

2.1.11 August 23-26, 2023

During August 2023, significant wildfires burned in British Columbia, Alberta, and the Northwest Territories in Canada (Figure 2-236). Several fires were particularly intense during this period like the Wood Buffalo Complex in Alberta and the Kakisa Fire in the Northwest Territories, along with numerous other blazes in British Columbia, like the Bush Creek East fire and the Kookipi Creek fire (Figure 2-237). These fires were driven by extreme heat, dry conditions, and high winds. In addition to the Canadian fires, Arkansas was also affected by the Tiger Island Fire in Beauregard Parish, Louisiana, which started on August 22, 2023, and spread rapidly due also to high temperatures, dry conditions, and strong winds. This fire burned more than 30,000 acres and contributed to smoke that affected air quality in Arkansas and nearby regions.




(b) August 24, 2023
Out of control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Being held
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Under control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Other
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha


(c) August 25, 2023
Out of control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Being held
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Under control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Other
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha

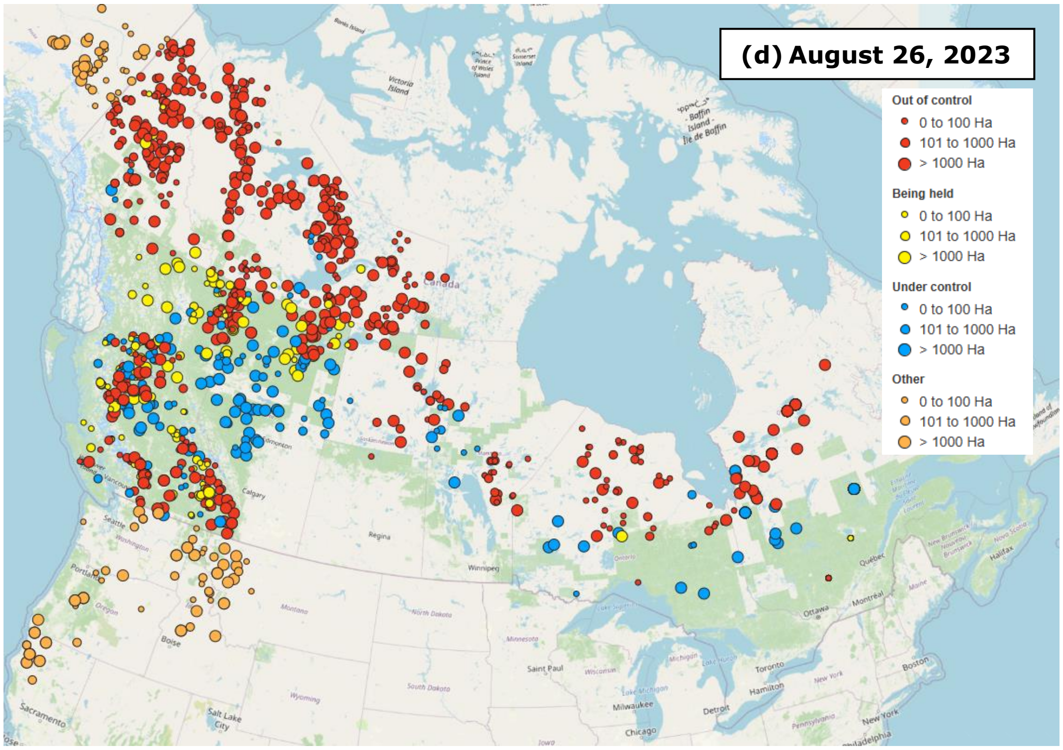


Figure 2-236. Canadian Wildfire Information System map of active fires for (a) August 23, (b) August 24, (c) August 25, and (d) August 26. (https://cwfis.cfs.nrcan.gc.ca/interactive-map)

Figure 2-237. Kookipi Creek wildfire. (@BCGovFireInfo)

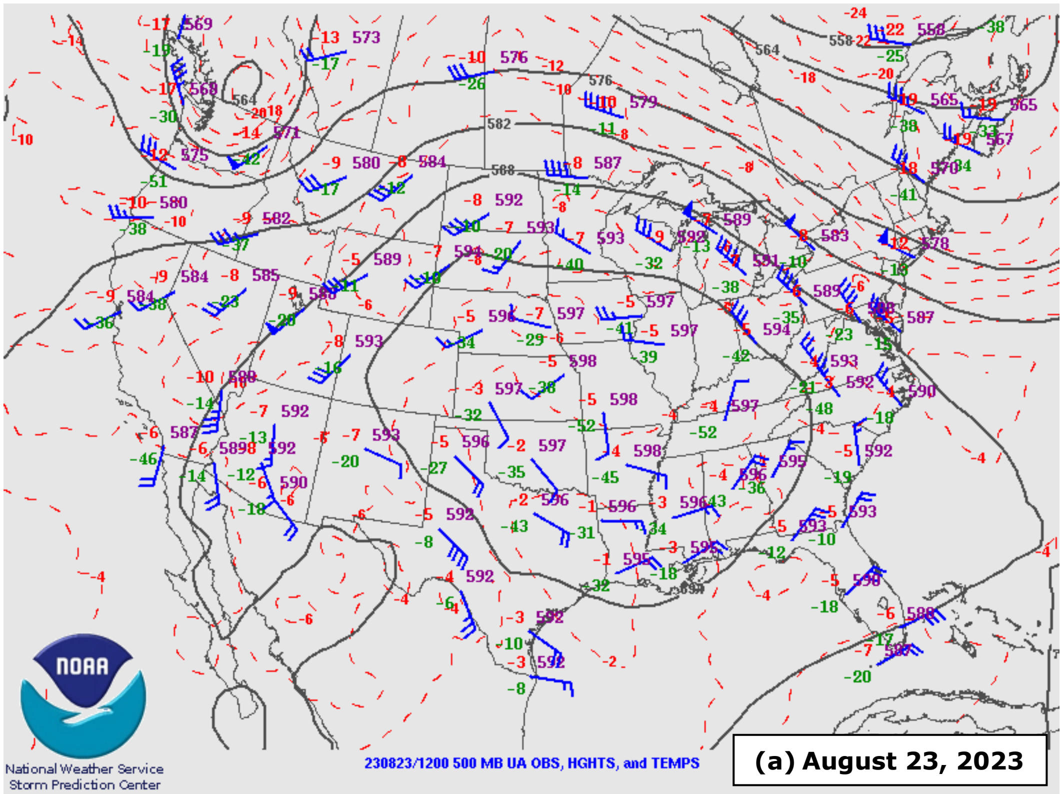
The 500 mb synoptic analysis on August 23, 2023 (Figure 2-238a) shows that the combination of a deep trough in northwest Canada and a strong ridge over the central U.S. created a transport corridor along the upper-level flow.[43] Upper-level winds facilitated the rapid movement of smoke from fires in northwestern Canada. By August 24 (Figure 2-238b), the trough in northwest Canada weakened and moved eastward, reducing the funneling effect for smoke transport. The ridge over the central U.S. still supported some smoke transport, but with less intensity.[44] By August 25 (Figure 2-238c), the trough's further eastward movement continued to weaken its influence on smoke transport. The ridge over the central U.S. also weakened, reducing its role in transporting smoke. The high-pressure area over Texas recirculated remnant smoke over the southeastern U.S., affecting air quality in Arkansas.[45] On August 26 (Figure 2-238d), the high-pressure over

[43] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=08&STARTDAY=23&STARTTIME=00&INC=-48

[44] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=08&STARTDAY=24&STARTTIME=00&INC=-48

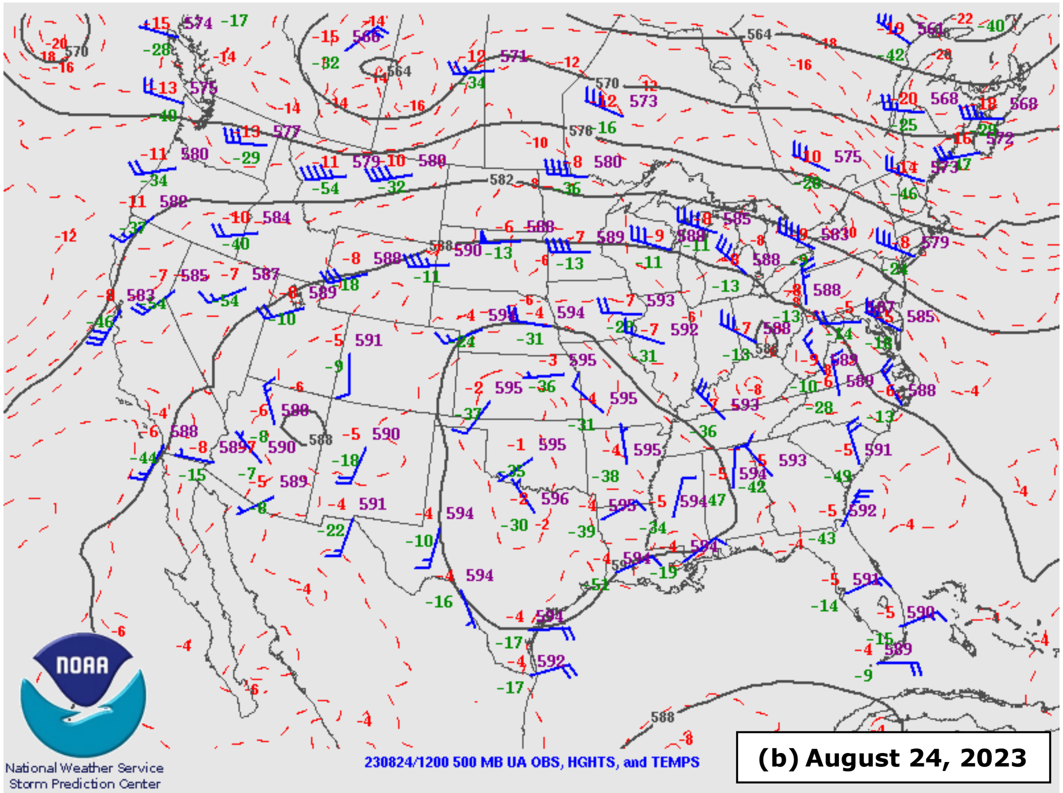
[45] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=08&STARTDAY=25&STARTTIME=00&INC=-48

Oklahoma acted as a barrier, limiting the southward movement of smoke.[46] The stable conditions with the high could trap smoke near the surface, potentially worsening air quality locally.

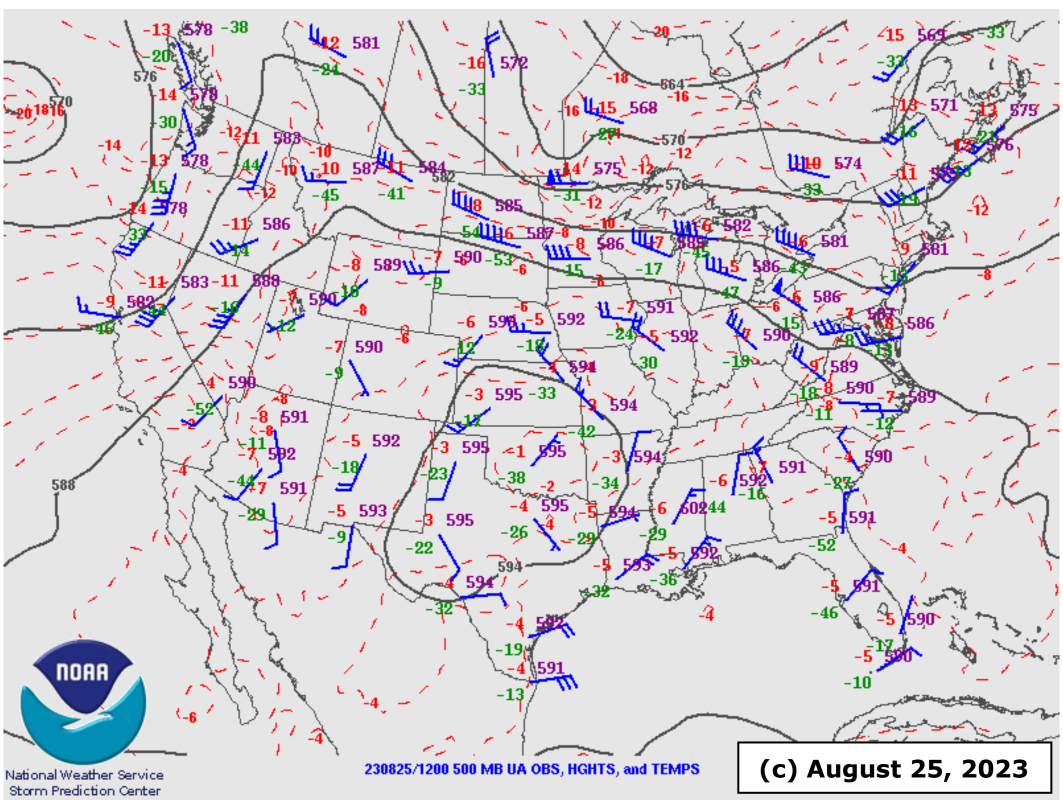


(a) August 23, 2023

[46]https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=08&STARTDAY=26&STARTTIME=00&INC=-48



(b) August 24, 2023



(c) August 25, 2023

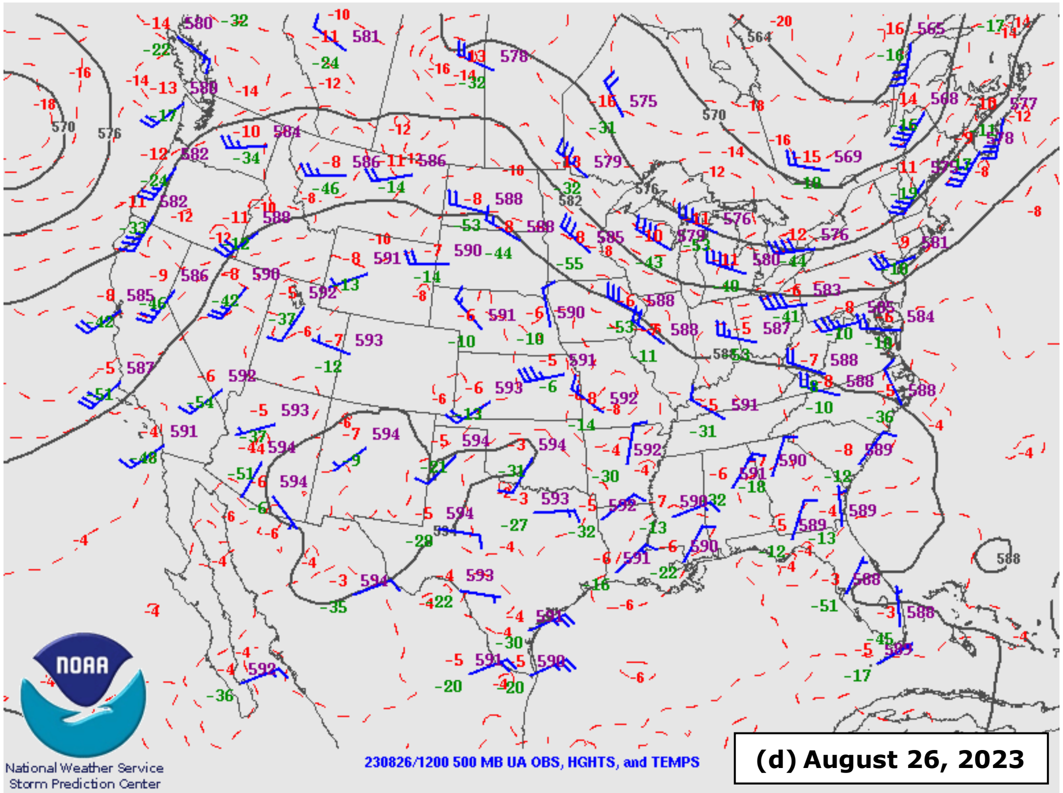
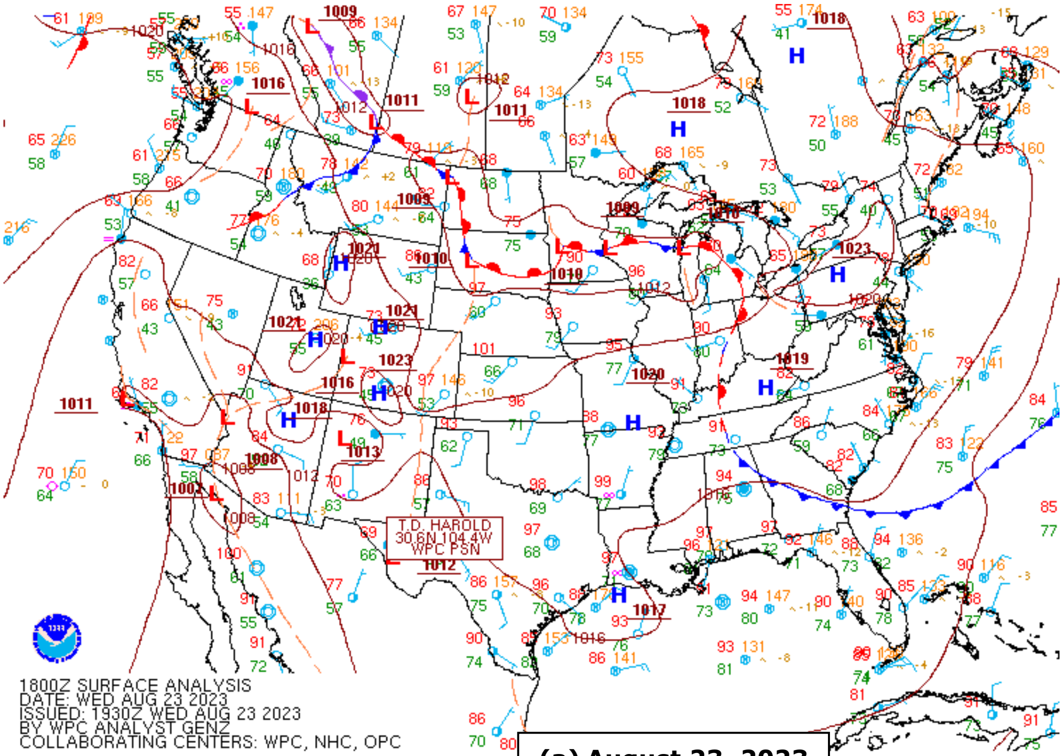
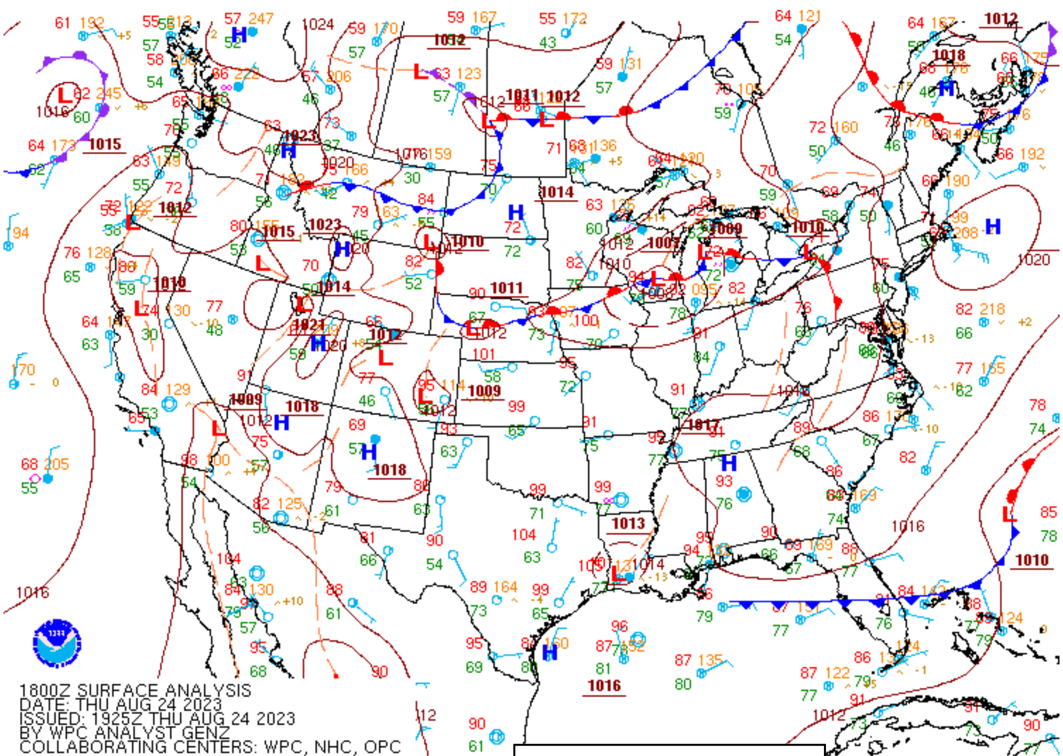


Figure 2-238. 500 mb synoptic analysis map at 12 UTC on (a) August 23, (b) August 24, (c) August 25, and (d) August 26, 2023.

Surface analysis on August 23, 2023 (Figure 2-239a) shows a high-pressure system centered over the eastern U.S. (spanning the Ohio Valley and the Appalachia mountains) that funneled smoke southward into Arkansas along the western edge of the high pressure. A stationary front extending from the Midwest to the Plains led to weak surface-level mixing, allowing smoke to remain trapped and concentrated in the lower atmosphere. On August 24 (Figure 2-239b), the high-pressure moved southeastward and was centered over Alabama. On August 25 (Figure 2-239c), the high-pressure system with its center over the southeastern U.S., influenced the recirculation of remnant smoke over parts of the southeastern U.S. On August 26 (Figure 2-239d), the combination of the cold front, high-pressure system behind it, and low-pressure system ahead of it likely led to improved air quality by clearing out smoke in the region.



(a) August 23, 2023



(b) August 24, 2023

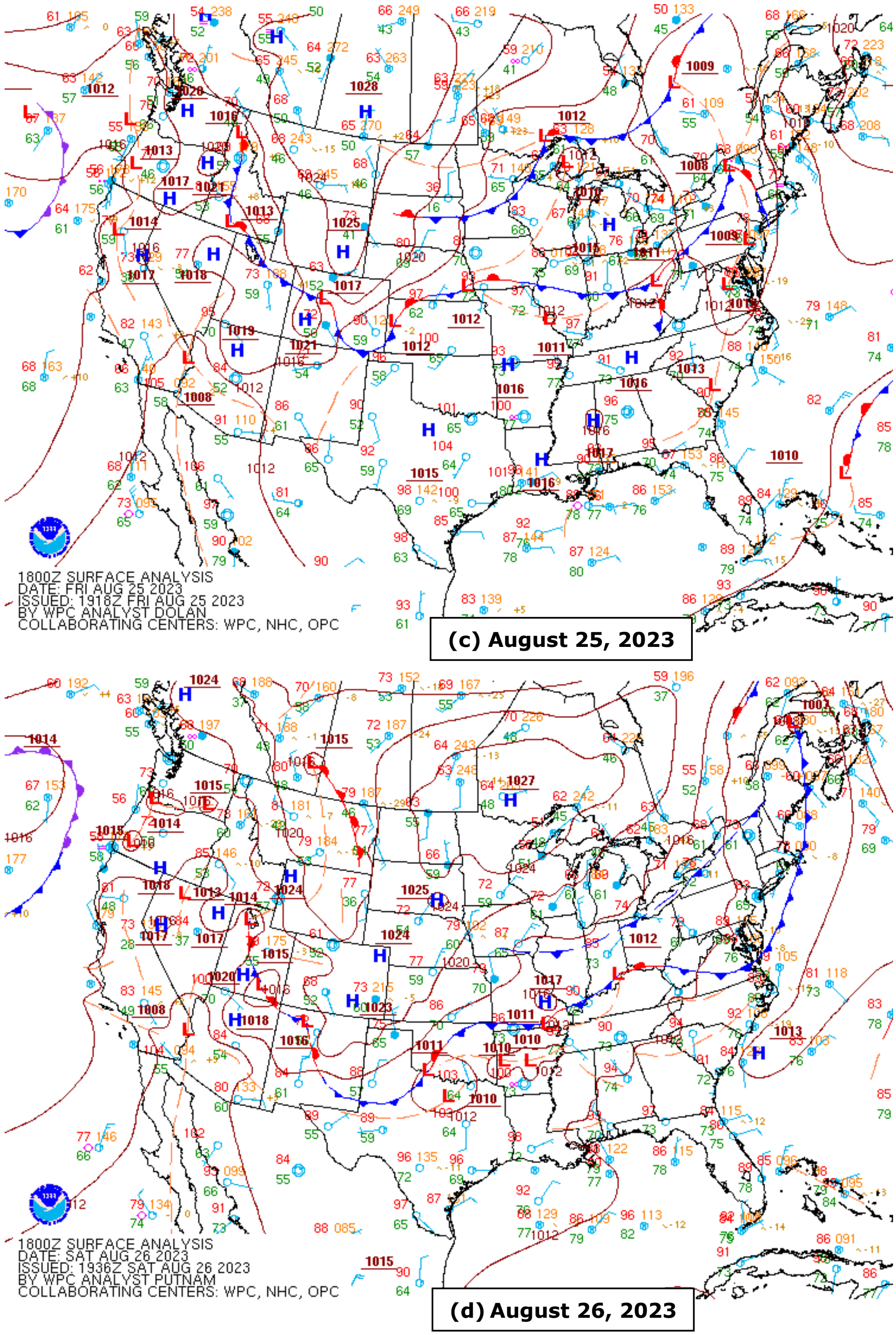


Figure 2-239. Surface synoptic analysis maps (bottom row) at 18 UTC on (a) August 23, (b) August 24, (c) August 25, and (d) August 26, 2023.

The NOAA HMS product in Figure 2-240 and visible satellite images in Figure 2-241 show light to medium smoke over most of the U.S., while heavy smoke plumes cover northwest Canada during August 23 to 26, 2023. Moderate AQI values are observed for all days in the period in Arkansas (Figure 2-242). , while the HRRR modeled surface smoke (Figure 2-243) suggest that this smoke mixed down to surface level, including Arkansas and the southeastern U.S. Smoke contributions could range between 2 to 8 $\mu g/m^3$, but all days modeled have at least some impacts from wildfires. Figure 2-240 and Figure 2-244 illustrate the evolution of the smoke plumes from multiple fires in northern California, Oregon, and British Columbia and Alberta, Canada from August 20 until August 26, 2023.

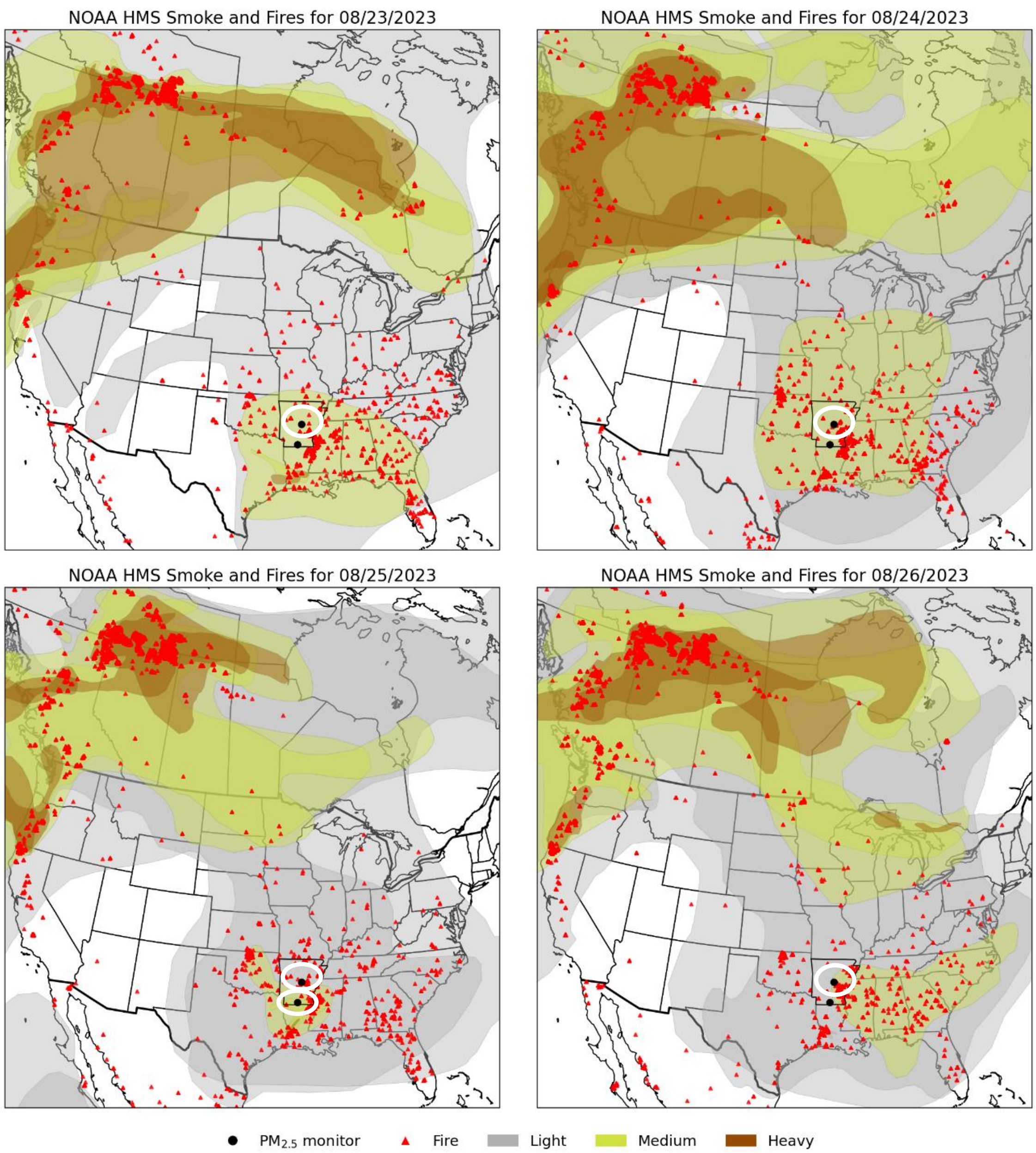
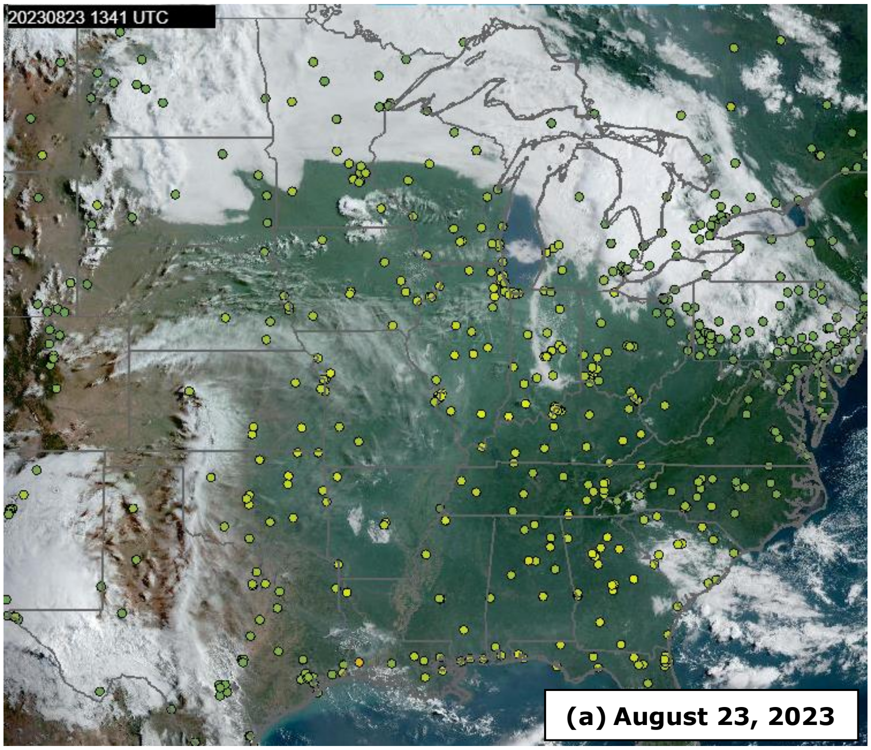
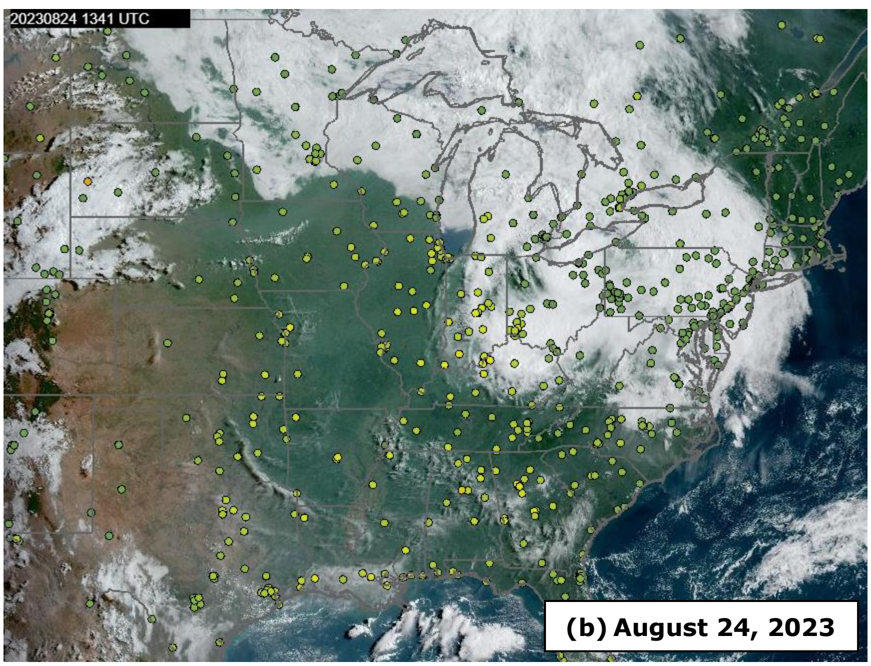
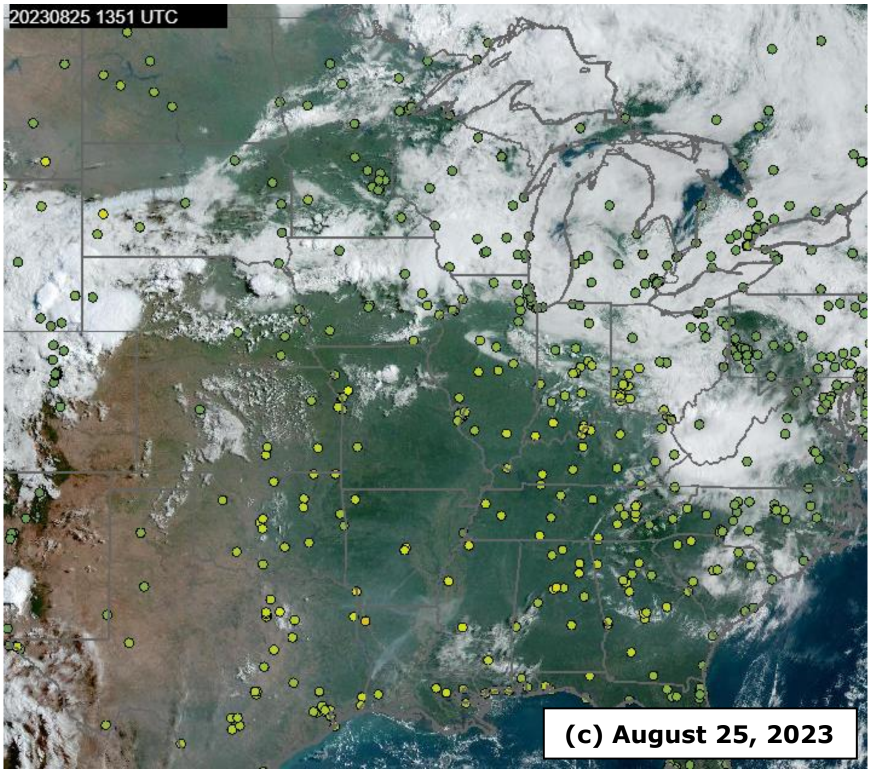


Figure 2-240. NOAA HMS fire and smoke products for August 23 (top left), August 24 (top right), August 25 (bottom left), and August 26 (bottom right).


20230823 1341 UTC
(a) August 23, 2023


20230824 1341 UTC
(b) August 24, 2023



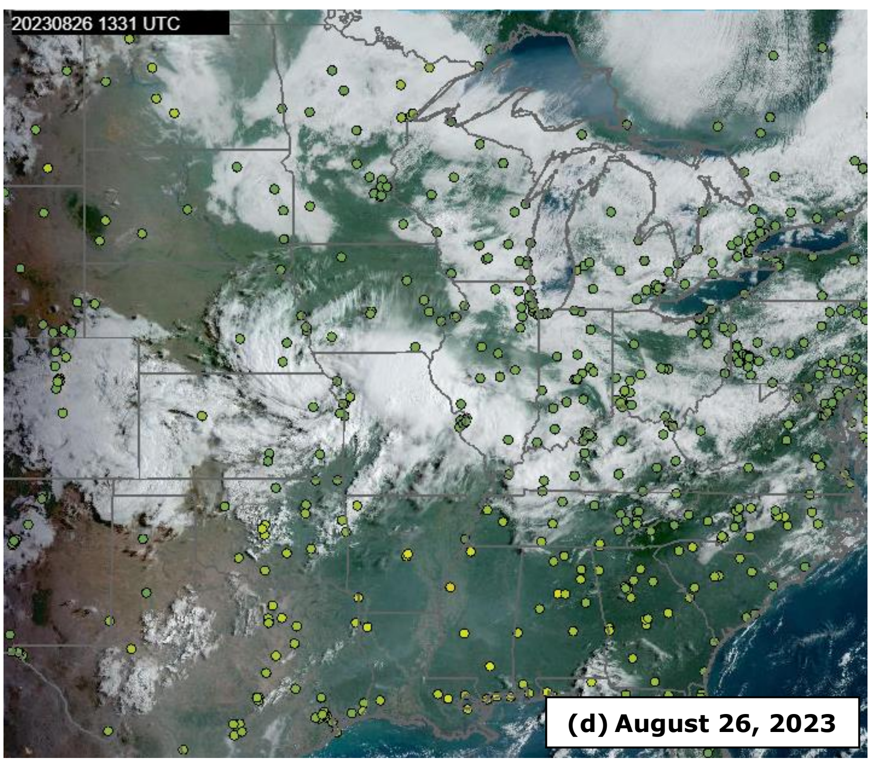
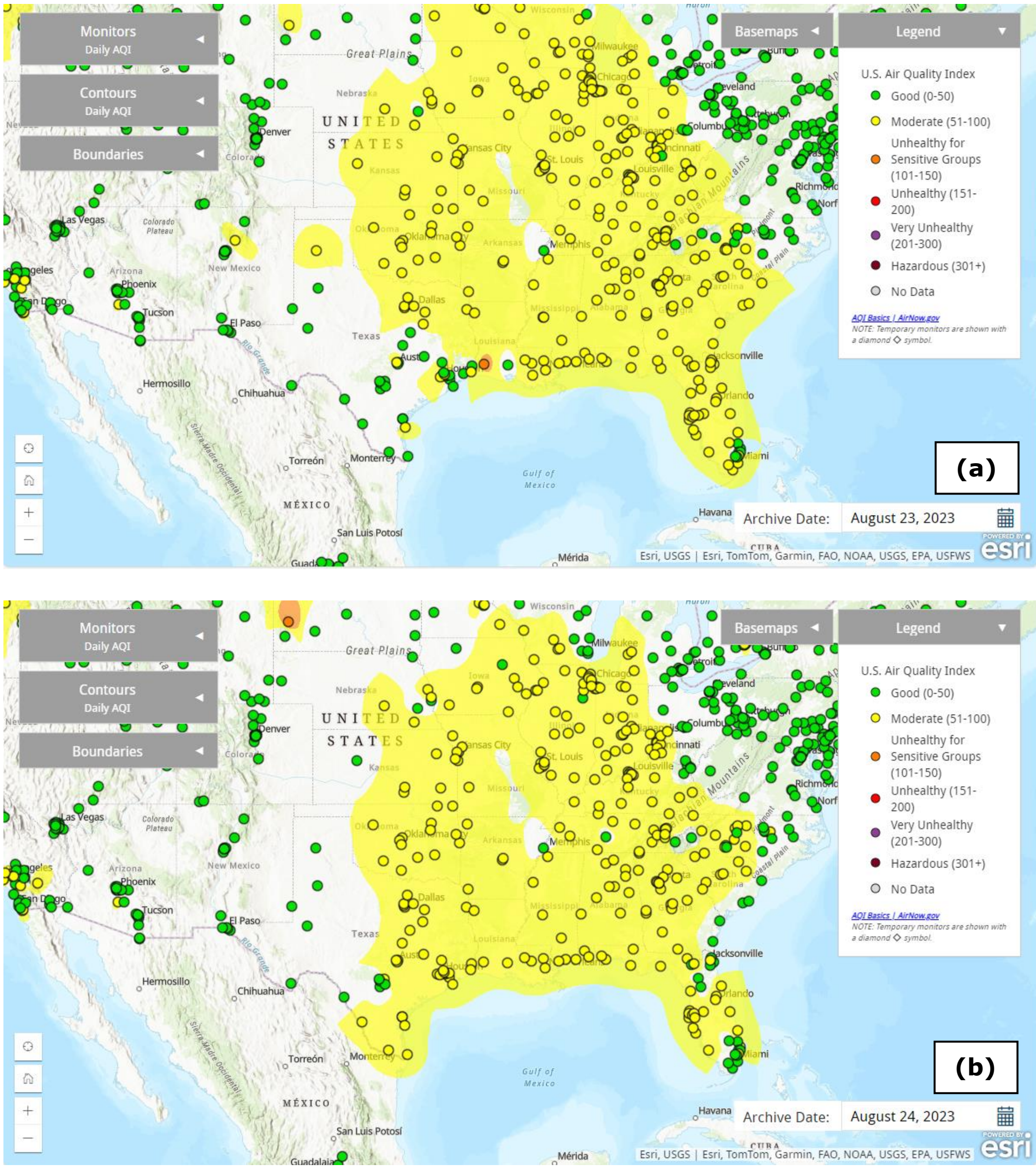


Figure 2-241. NOAA satellite visible imagery for (a) August 23 at 1341 UTC, (b) August 24 at 1341 UTC, (c) August 25 at 1351 UTC, and (d) August 26 at 1341 UTC, 2023.


Monitors
Daily AQI
Contours
Daily AQI
Boundaries
Basemaps
Legend
U.S. Air Quality Index
Good (0-50)
Moderate (51-100)
Unhealthy for Sensitive Groups (101-150)
Unhealthy (151-200)
Very Unhealthy (201-300)
Hazardous (301+)
No Data
AQI Basics | AirNow.gov
NOTE: Temporary monitors are shown with a diamond ◇ symbol.
(a)
Archive Date: August 23, 2023
Esri, USGS | Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, USFWS
(b)
Archive Date: August 24, 2023

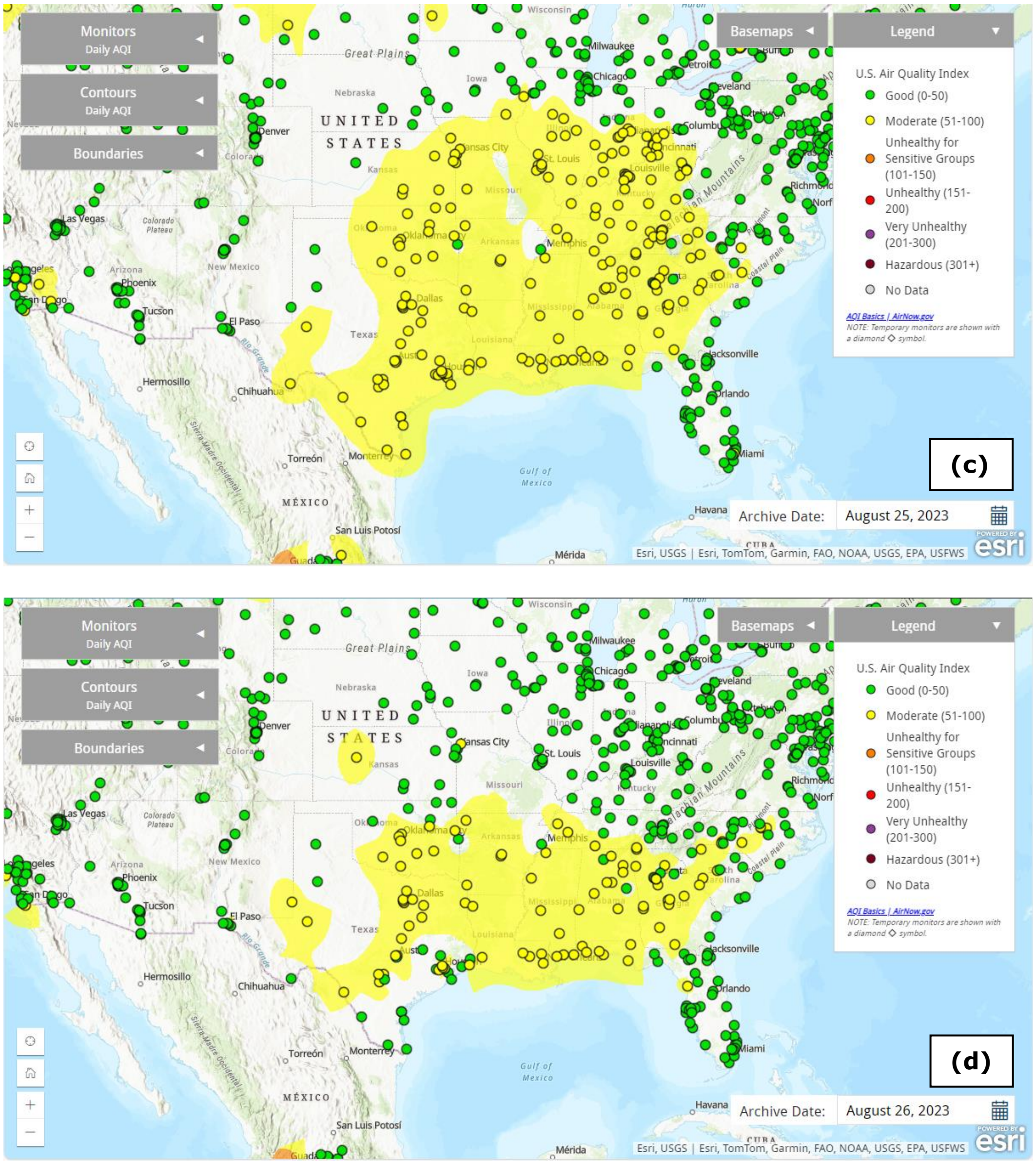
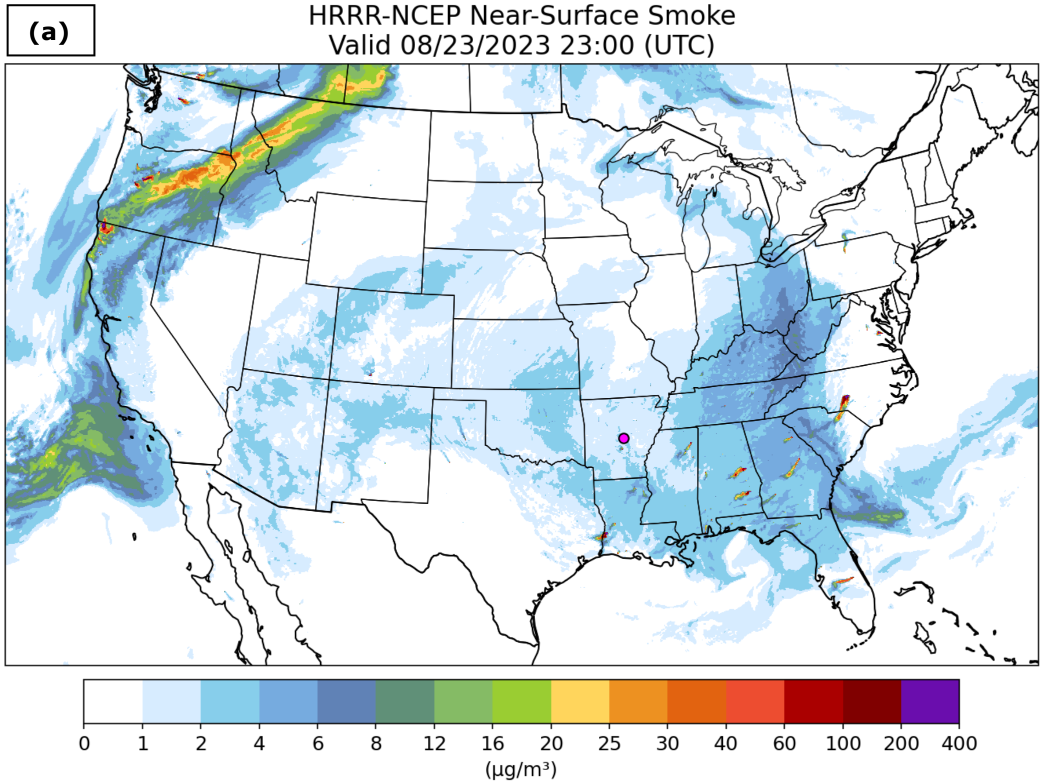
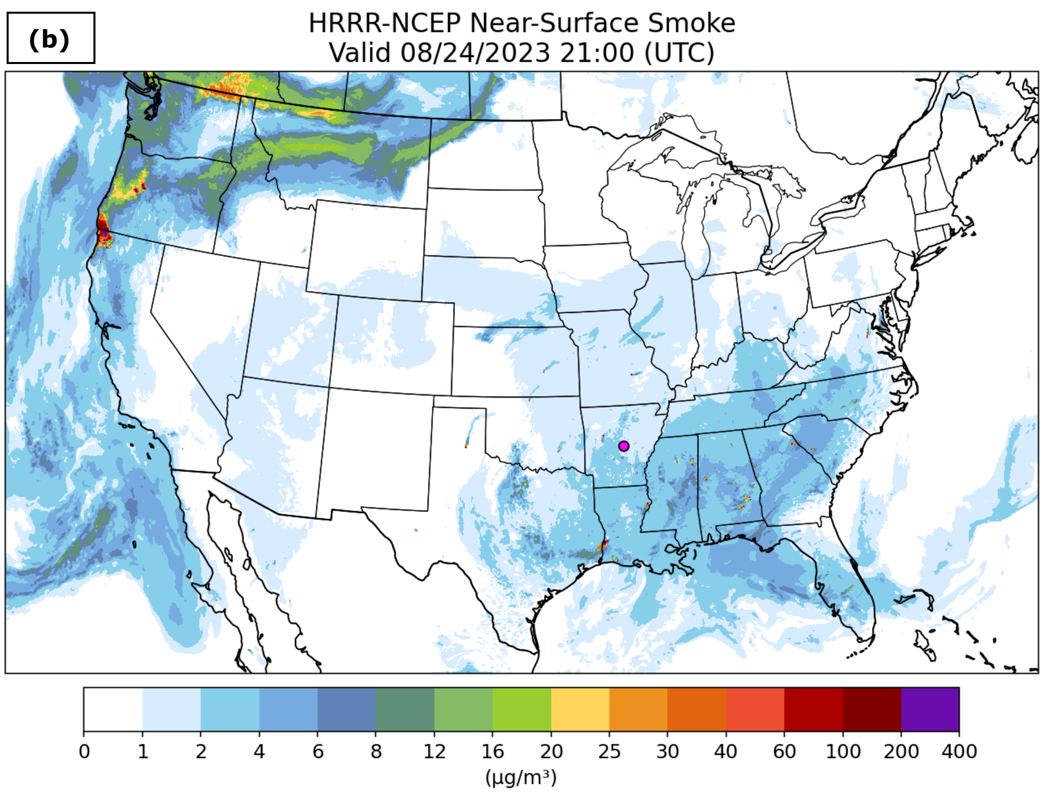


Figure 2-242. AirNow surface level PM$_{2.5}$ concentration contours for (a) August 23, (b) August 24, (c) August 25, and (d) August 26, 2023.


(a)
HRRR-NCEP Near-Surface Smoke
Valid 08/23/2023 23:00 (UTC)
0 1 2 4 6 8 12 16 20 25 30 40 60 100 200 400
(µg/m³)


(b)
HRRR-NCEP Near-Surface Smoke
Valid 08/24/2023 21:00 (UTC)
0 1 2 4 6 8 12 16 20 25 30 40 60 100 200 400
(µg/m³)

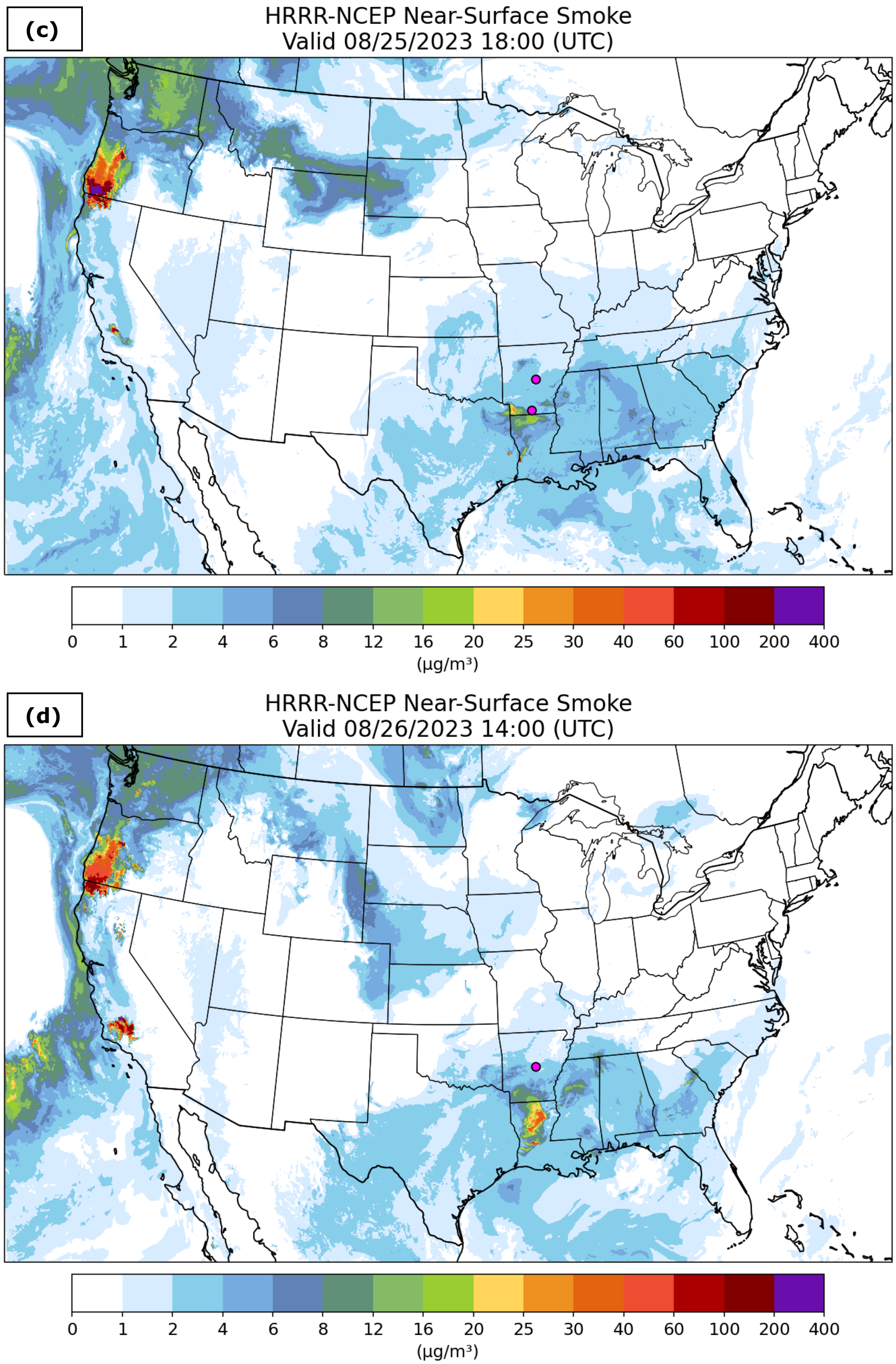


Figure 2-243. HRRR-Smoke modeled near-surface smoke concentrations (μg/m^3) for (a) August 23 at 6 PM CDT, (b) August 24 at 4 PM CDT, (c) August 25 at 1 PM CDT, and (d) August 26 at 9 AM CDT, 2023.

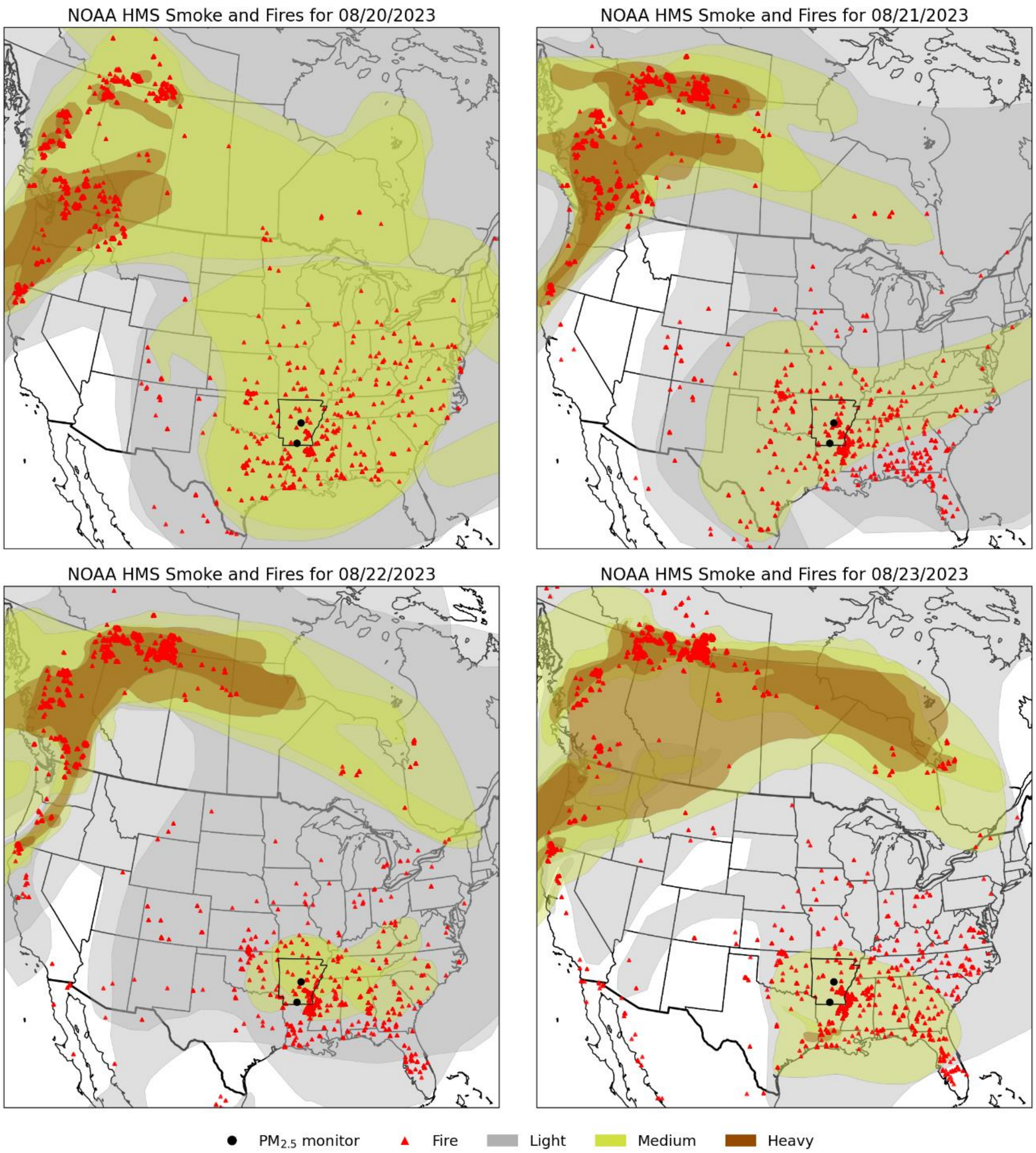


Figure 2-244. Evolution of fires and smoke for August 20 (top left), August 21 (top right), August 22 (bottom left), and August 23 (bottom right).

2.1.11.1 PARR August 23, 2023

Table 2-35 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on August 23, 2023. Figure 2-245 shows that this day exceeds the Tier 2 threshold, but Figure 2-246 shows the value does not exceed the 99th historic percentile over the last five years. Back trajectories in Figure 2-247 illustrate anticyclonic (clockwise) flow and thus air parcels travel through regions with light and medium smoke and descending over the monitoring site (Figure 2-248).

Table 2-35. Exceptional event supporting evidence for PARR on August 23, 2023.

Monitor	PARR (05-119-0007)
Event Date	August 23, 2023
24-hr $PM_{2.5}$ Concentration	18.2 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada and Louisiana
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: August. Date accessed: 11/20/2024.

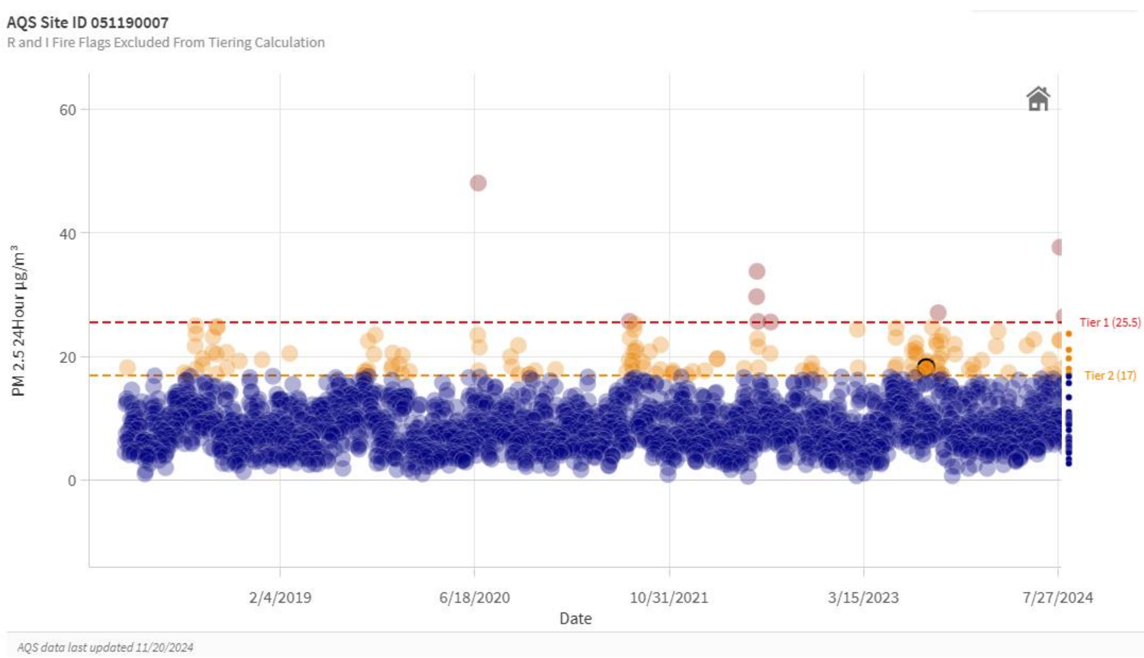


Figure 2-245. EPA $PM_{2.5}$ Tiering Tool for PARR on August 23, 2023.

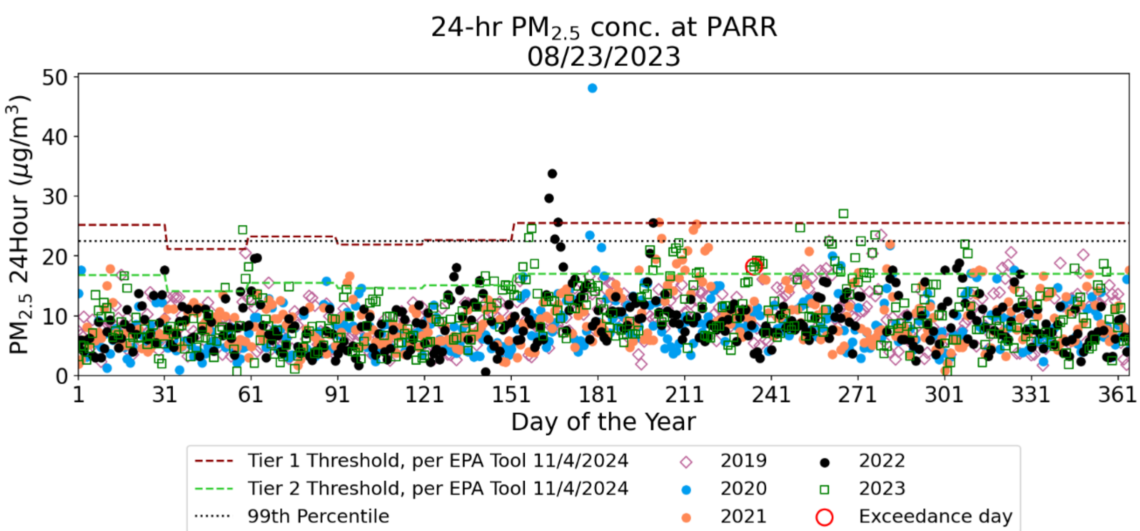


Figure 2-246. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to August 23, 2023.

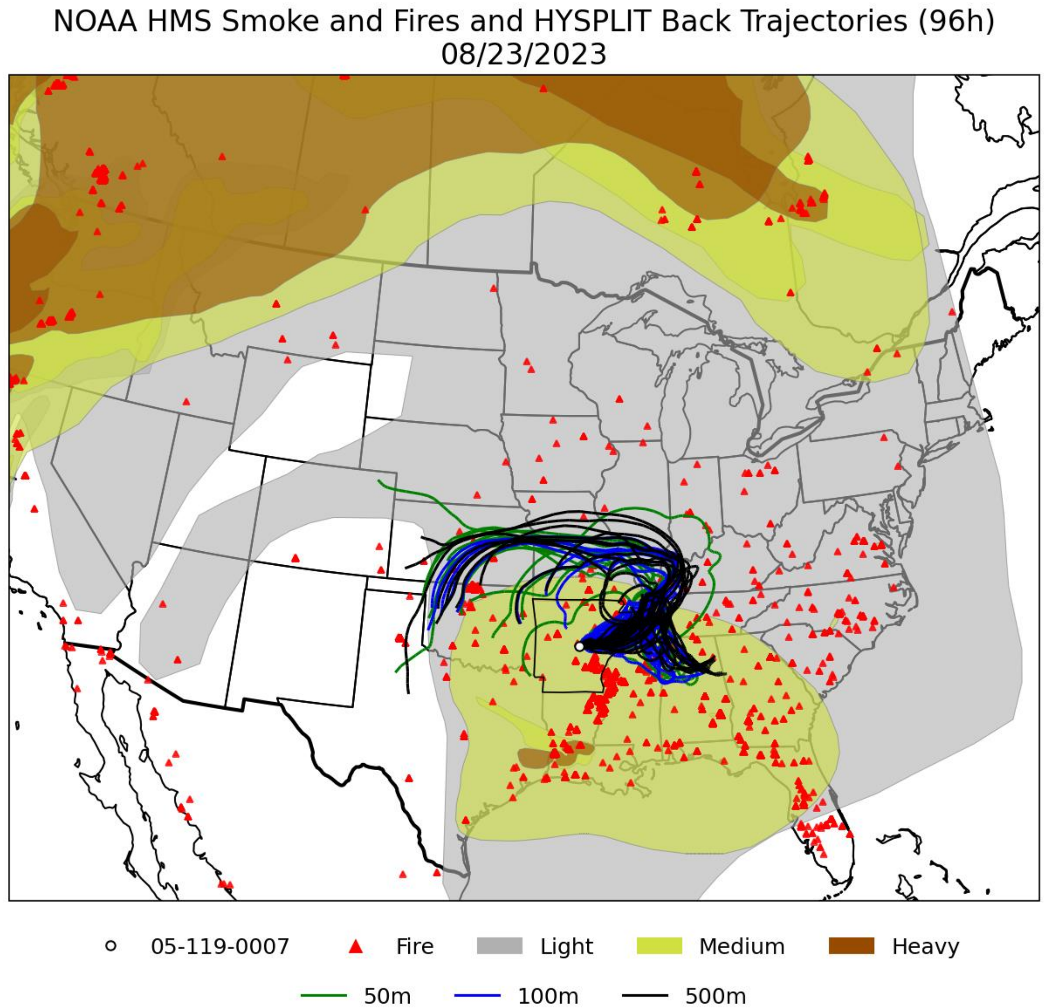
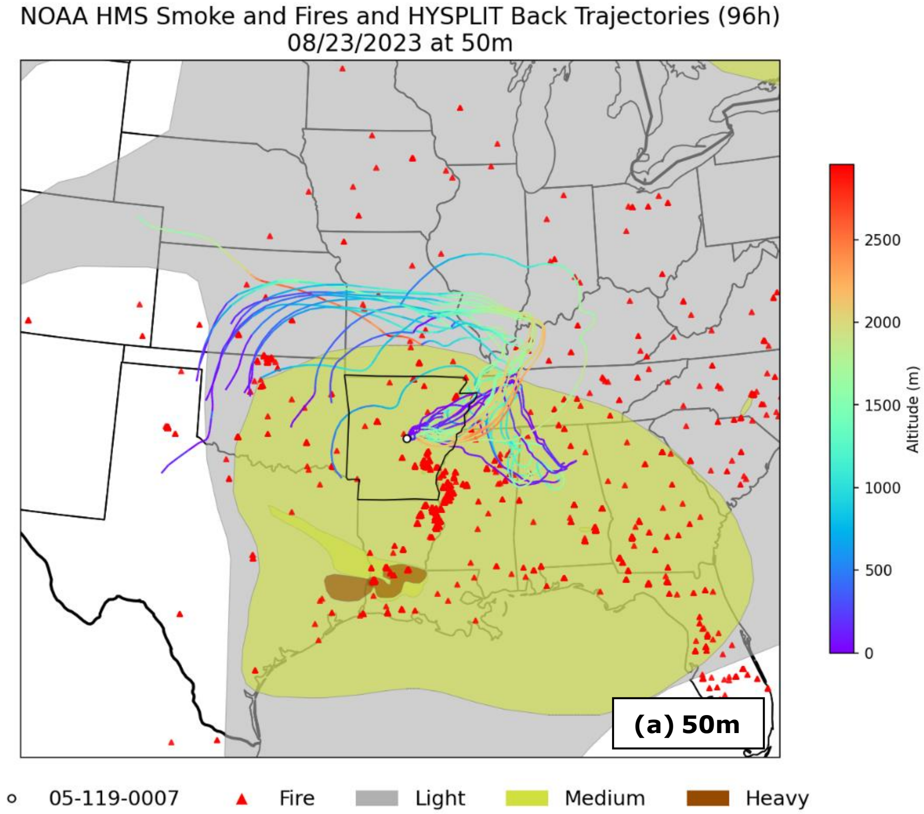
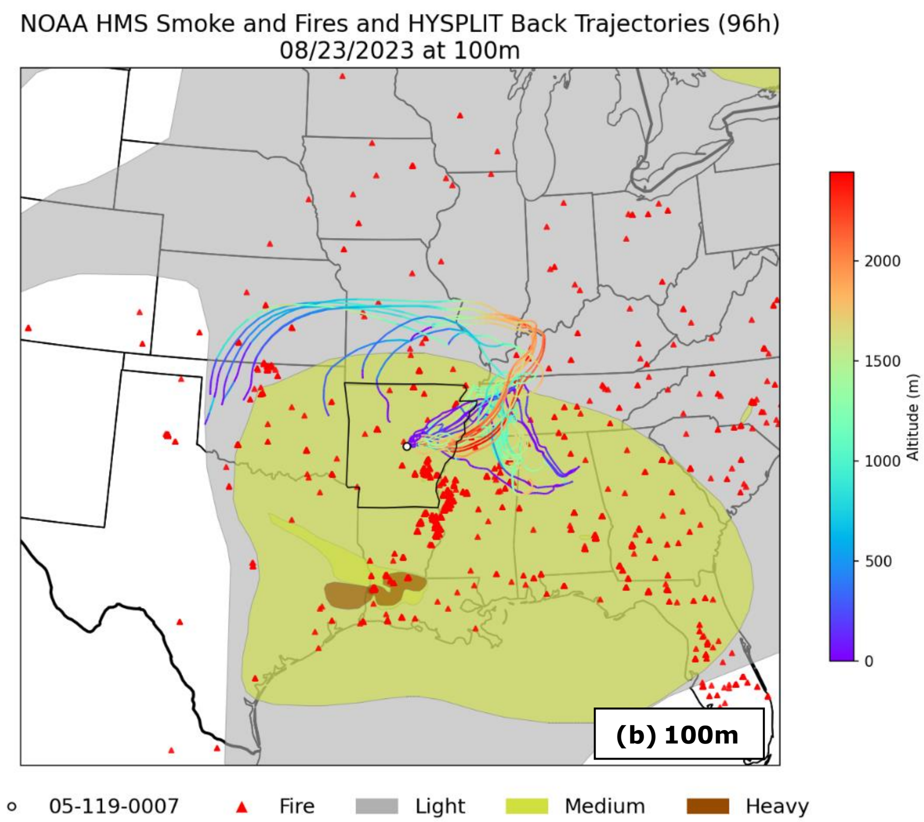


Figure 2-247. HYSPLIT back trajectories for PARR on August 23, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
08/23/2023 at 50m
(a) 50m
Altitude (m)
0
500
1000
1500
2000
2500
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
08/23/2023 at 100m
(b) 100m
Altitude (m)
0
500
1000
1500
2000
05-119-0007
Fire
Light
Medium
Heavy

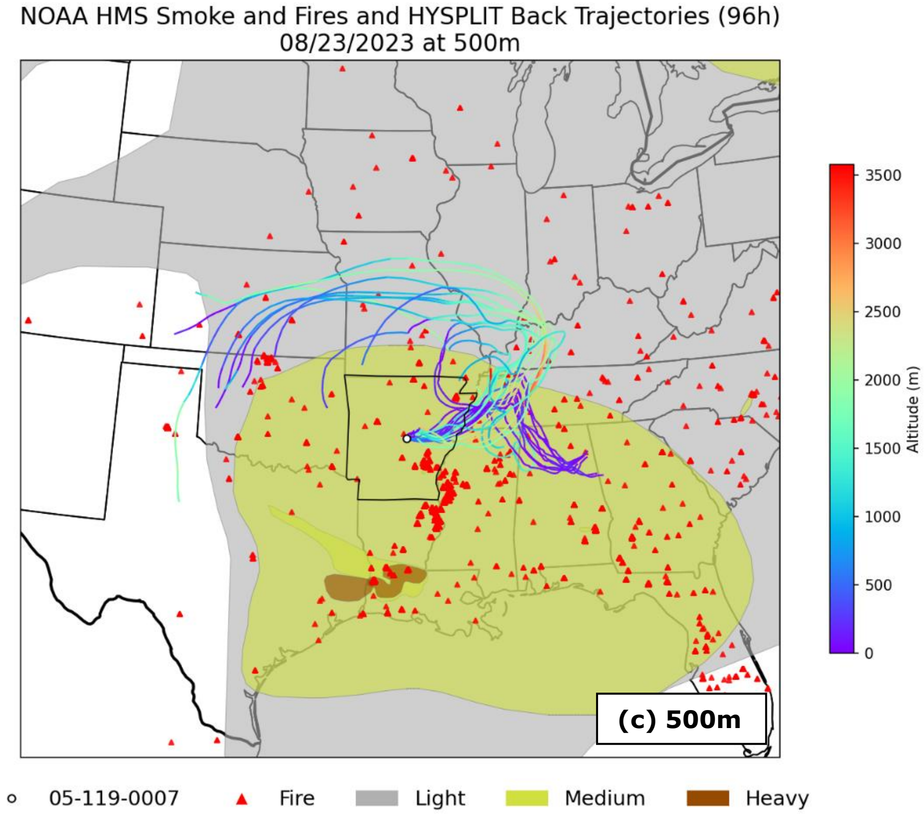


Figure 2-248. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on August 23, 2023.

2.1.11.2 PARR August 24, 2023

Table 2-36 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on August 24, 2023. Figure 2-249 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold, but under the 99th percentile historic values over the last five years (Figure 2-250). Back trajectories in Figure 2-251 show anticyclonic (clockwise) flow that forces air parcels to travel through regions with light and medium smoke as they descend over the monitoring site.

Table 2-36. Exceptional event supporting evidence for PARR on August 24, 2023.

Monitor	PARR (05-119-0007)
Event Date	August 24, 2023
24-hr $PM_{2.5}$ Concentration	19.3 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada and Louisiana
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: August. Date accessed: 11/20/2024.

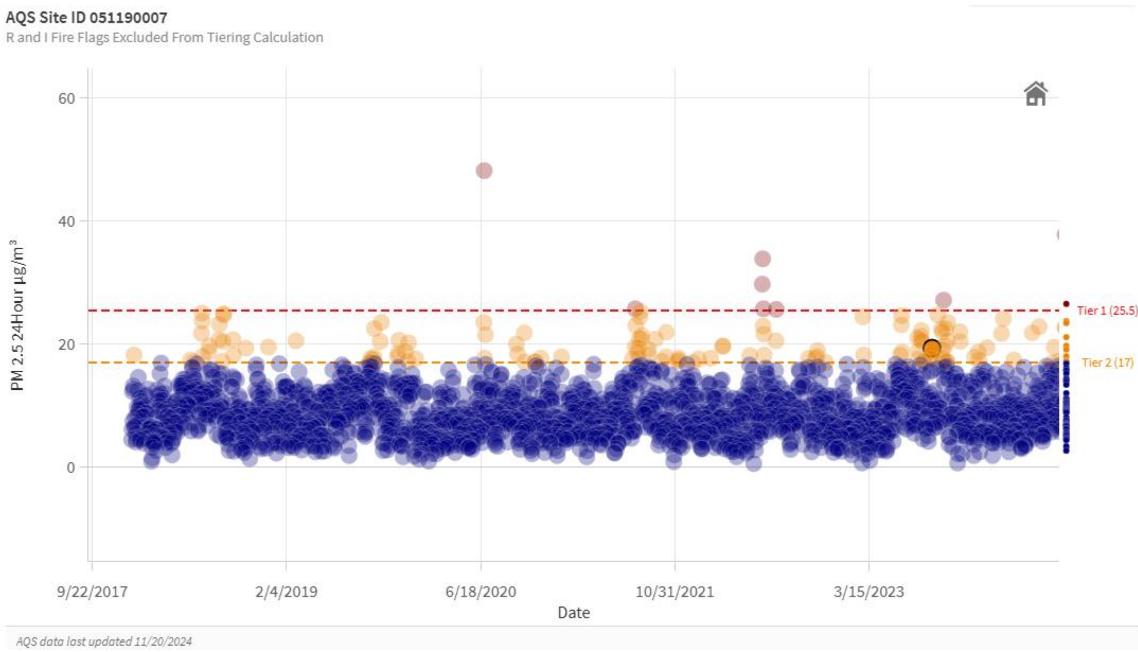


Figure 2-249. EPA $PM_{2.5}$ Tiering Tool for PARR on August 24, 2023.

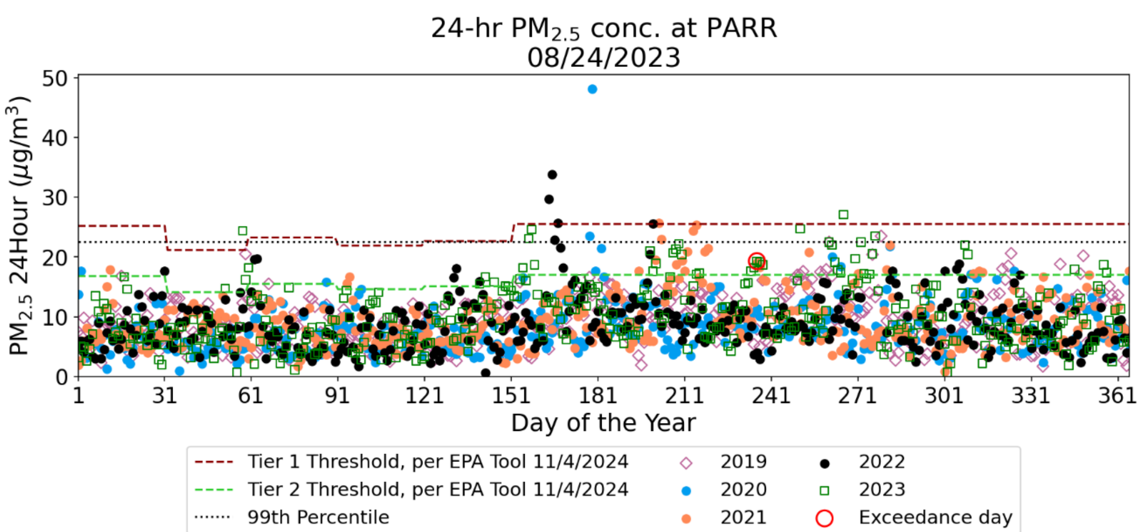


Figure 2-250. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to August 24, 2023.

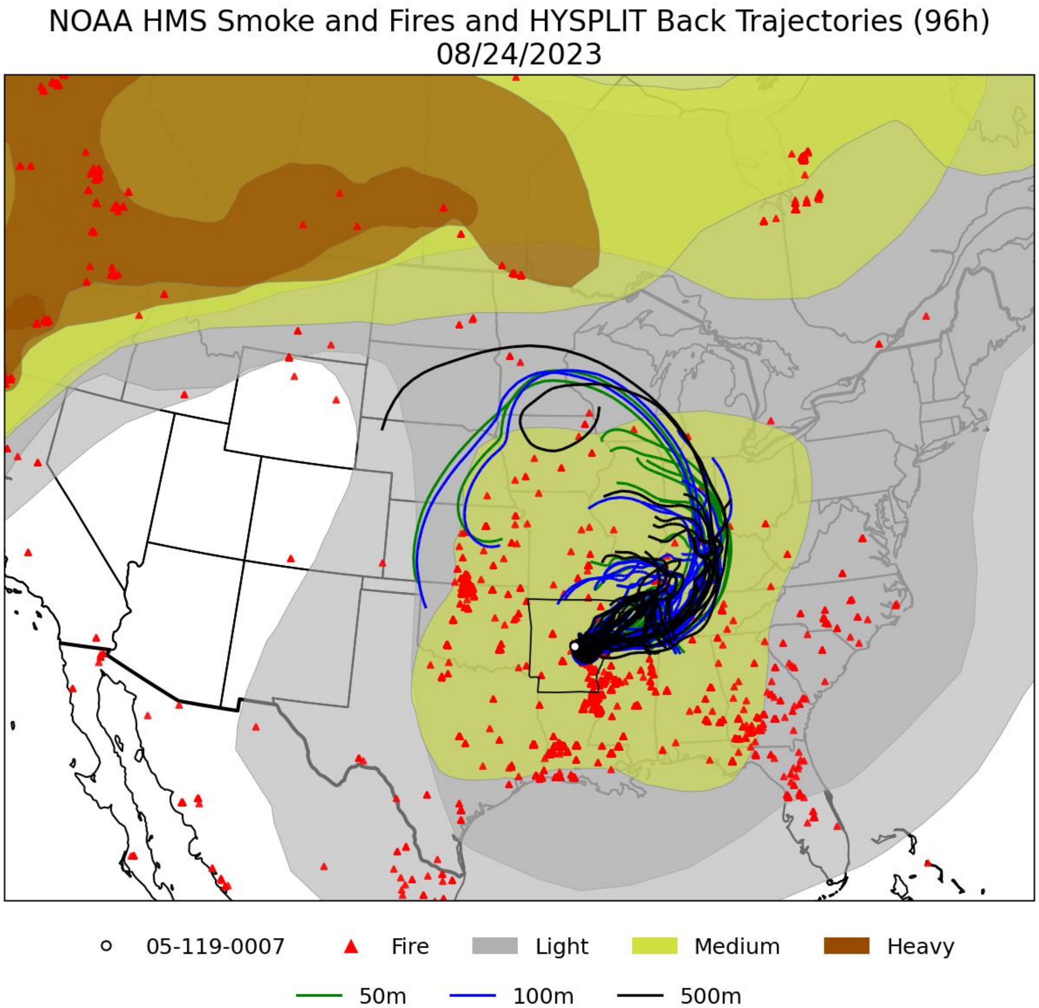


Figure 2-251. HYSPLIT back trajectories for PARR on August 24, 2023.

2.1.11.3 PARR August 25, 2023

Table 2-37 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on August 25, 2023. Figure 2-252 shows that this day exceeds the Tier 2 threshold. Back trajectories in Figure 2-254 illustrate anticyclonic (clockwise) flow that forces air parcels to travel through regions with light and medium smoke as they descend over the monitoring site (Figure 2-255). Figure 2-256 shows that $PM_{2.5}$ concentrations began increasing on August 25, 2023. This rise was driven by the combined effects of a high-pressure system over the southeastern U.S., which facilitated the transport of smoke-laden air from higher altitudes into Arkansas, leading to elevated $PM_{2.5}$ levels.

Table 2-37. Exceptional event supporting evidence for PARR on August 25, 2023.

Monitor	PARR (05-119-0007)
Event Date	August 25, 2023
24-hr $PM_{2.5}$ Concentration	19.1 $\mu g/m^3$
EPA Tiering Tool Tier 2 Threshold	17.0 $\mu g/m^3$
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada and Louisiana
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: August. Date accessed: 11/20/2024.

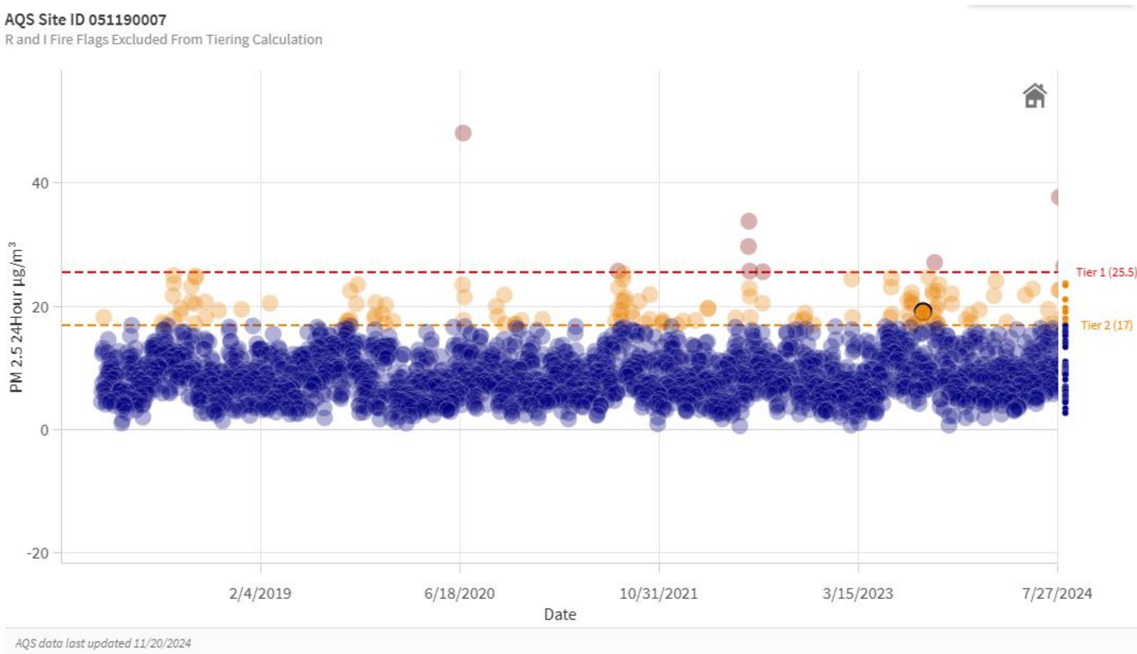


Figure 2-252. EPA PM2.5 Tiering Tool for PARR on August 25, 2023.

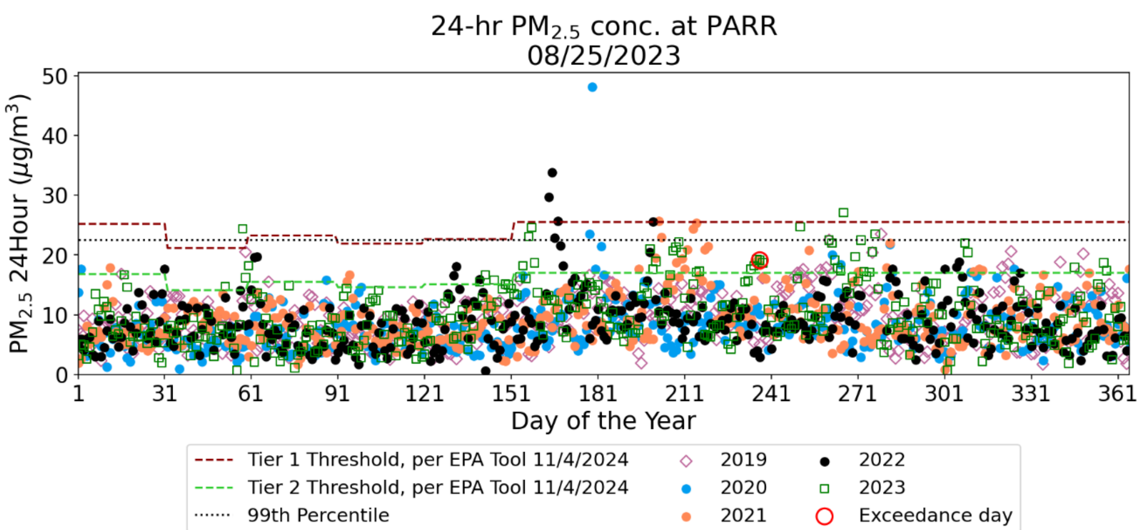


Figure 2-253. Historical 24-hour PM2.5 seasonal fluctuations for PARR compared to August 25, 2023.

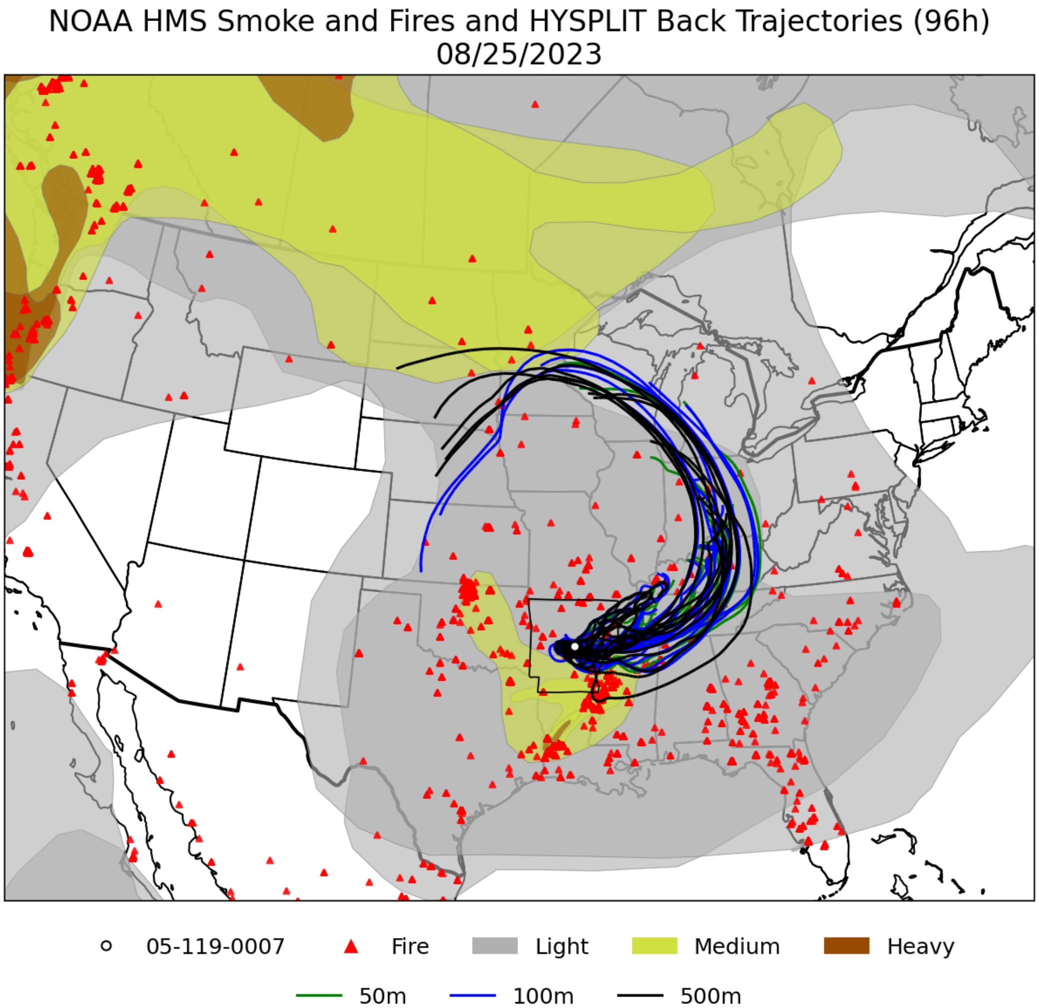
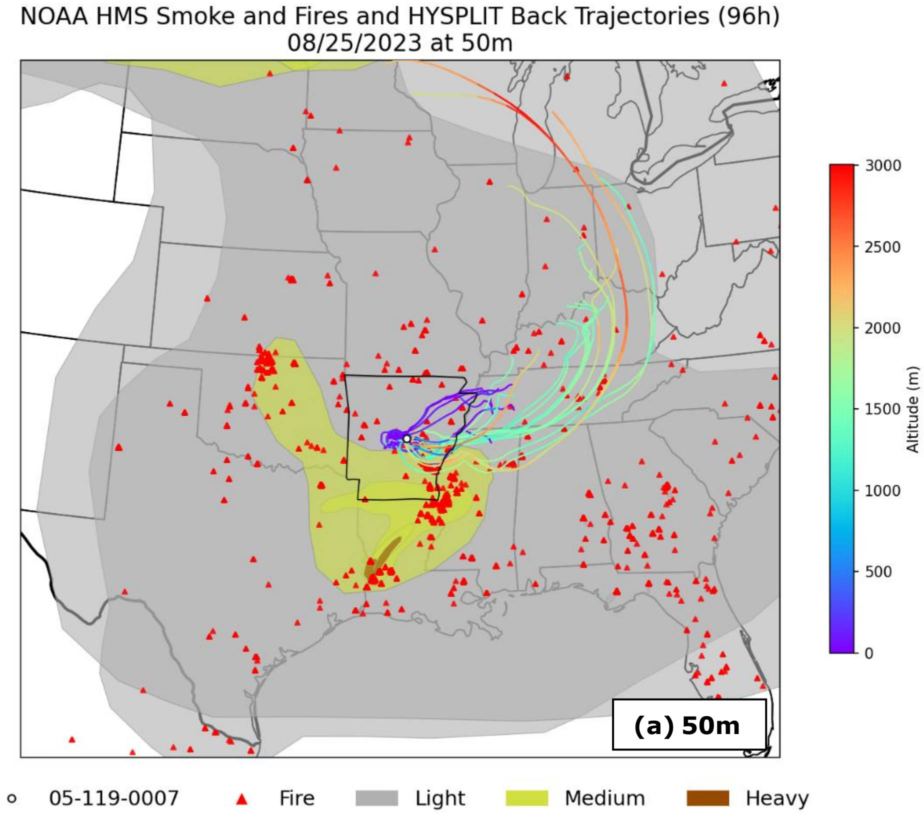
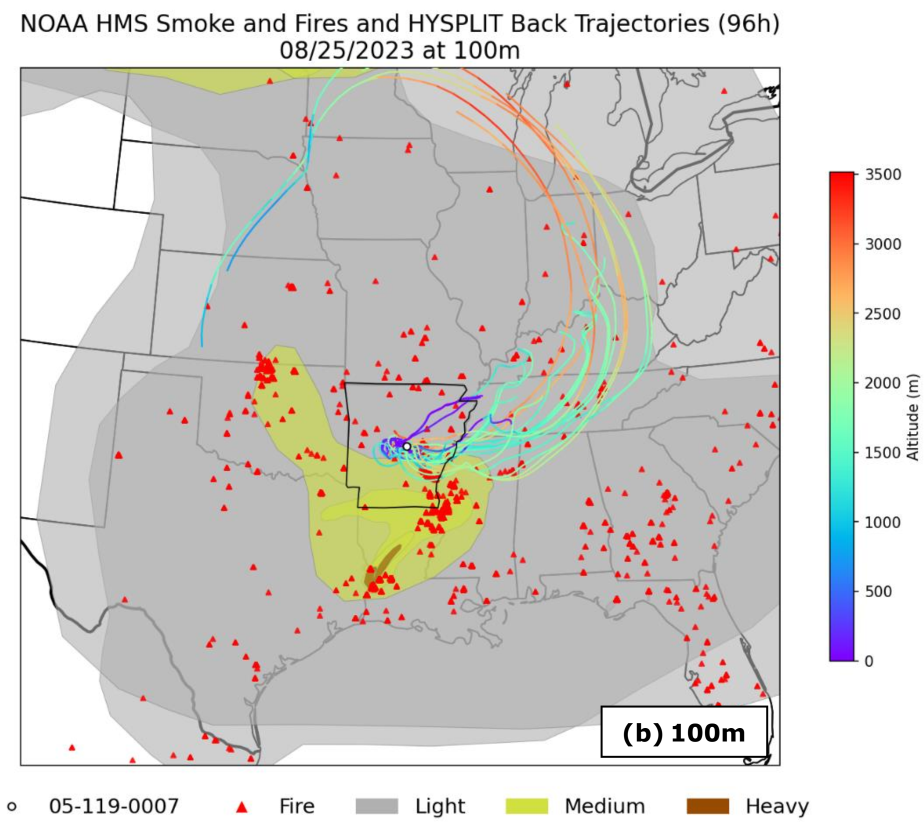


Figure 2-254. HYSPLIT back trajectories for PARR on August 25, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
08/25/2023 at 50m
(a) 50m
3000
2500
2000
1500
1000
500
0
Altitude (m)
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
08/25/2023 at 100m
(b) 100m
3500
3000
2500
2000
1500
1000
500
0
Altitude (m)
05-119-0007
Fire
Light
Medium
Heavy

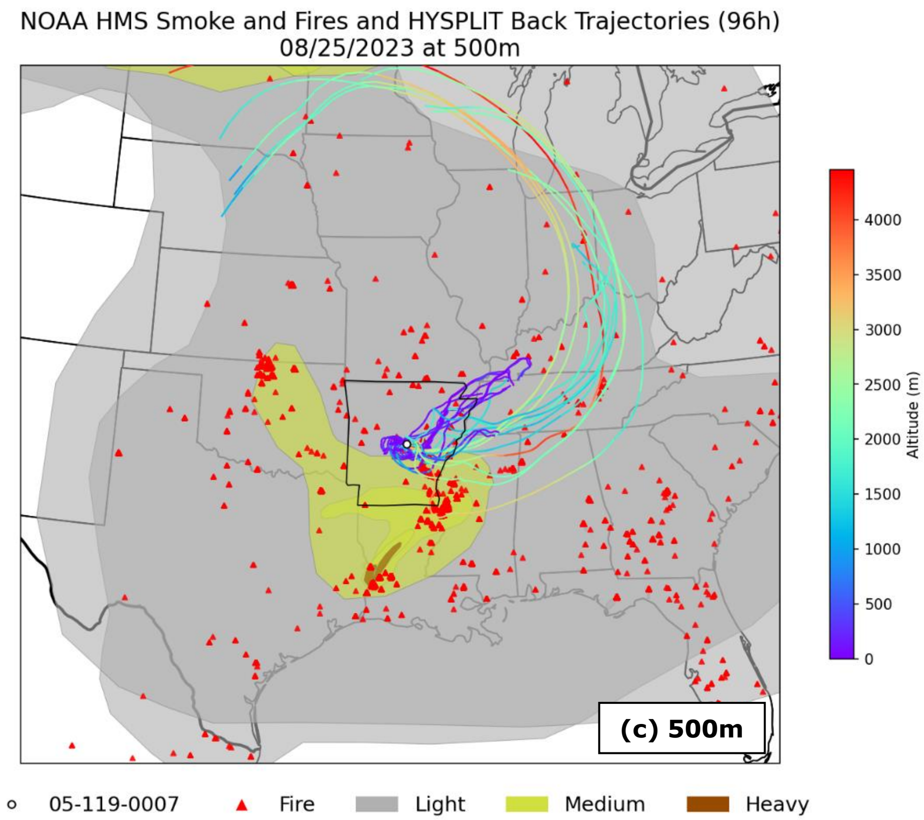


Figure 2-255. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on August 25, 2023.

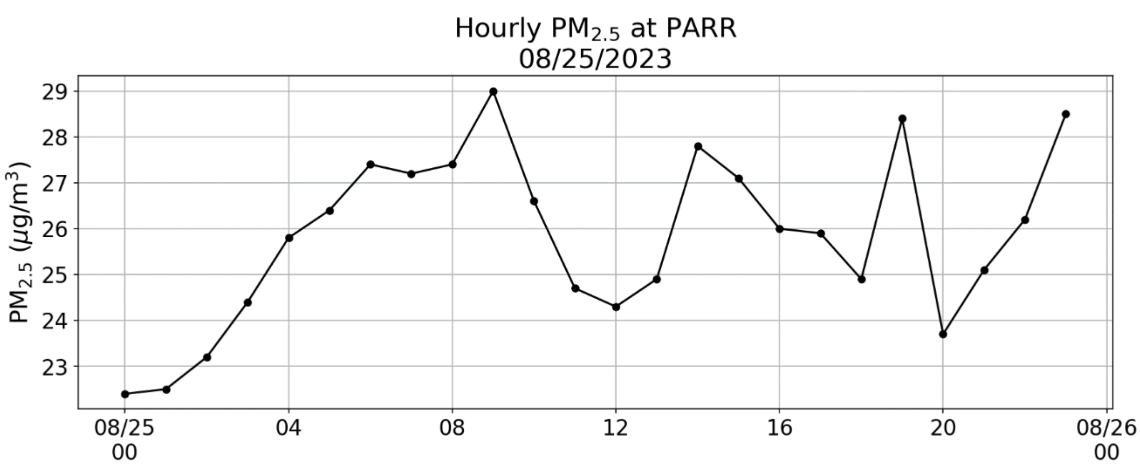


Figure 2-256. Hourly $PM_{2.5}$ concentrations for PARR on August 25, 2023.

2.1.11.4 El Dorado August 25, 2023

Table 2-38 summarizes the evidence gathered to support the demonstration of an exceptional event for El Dorado (AQS ID 05-139-0006) on August 25, 2023. Figure 2-257 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 1 threshold, and Figure 2-258 shows that it is above the 99th percentile of historical 24-hour concentrations over the last five years. Figure 2-259 shows that back trajectories pass over regions with light and medium smoke from fires in northwest Canada before reaching the monitoring site. Also, as trajectories get close to the monitor, they pass through smoke from the Tiger Island Fire in Beauregard Parish, Louisiana, located approximately 250 miles away from this site (Figure 2-260).

Table 2-38. Exceptional event supporting evidence for El Dorado on August 25, 2023.

Monitor	El Dorado (05-139-0006)
Event Date	August 25, 2023
24-hr $PM_{2.5}$ Concentration	35.9 µg/m^3
EPA Tiering Tool Tier 1 Threshold	26.4 µg/m^3
Tier 1 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada and Louisiana
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 1 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: August. Date accessed: 11/20/2024.

Figure 2-257. EPA $PM_{2.5}$ Tiering Tool for El Dorado on August 25, 2023.

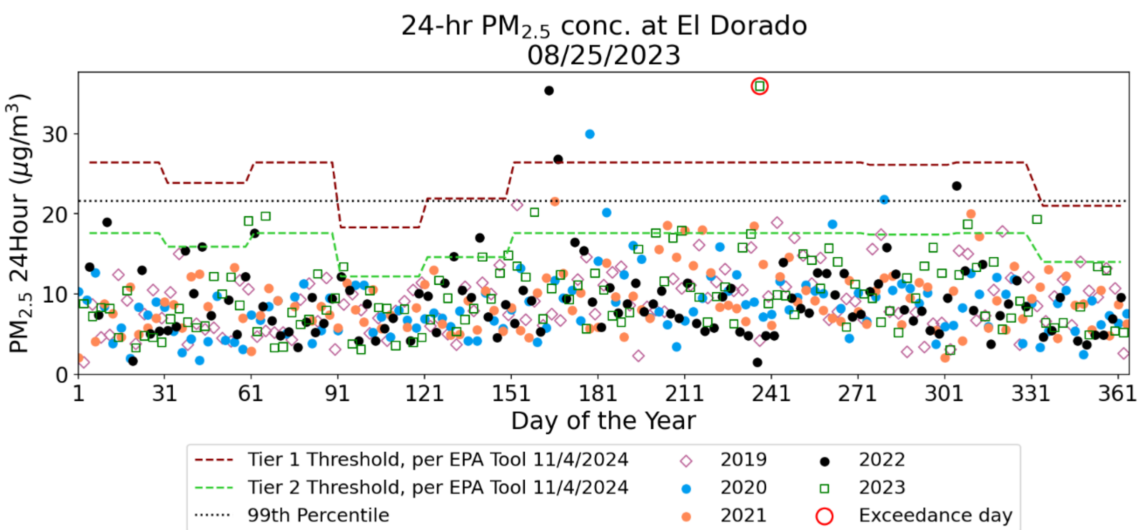


Figure 2-258. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for El Dorado compared to August 25, 2023.

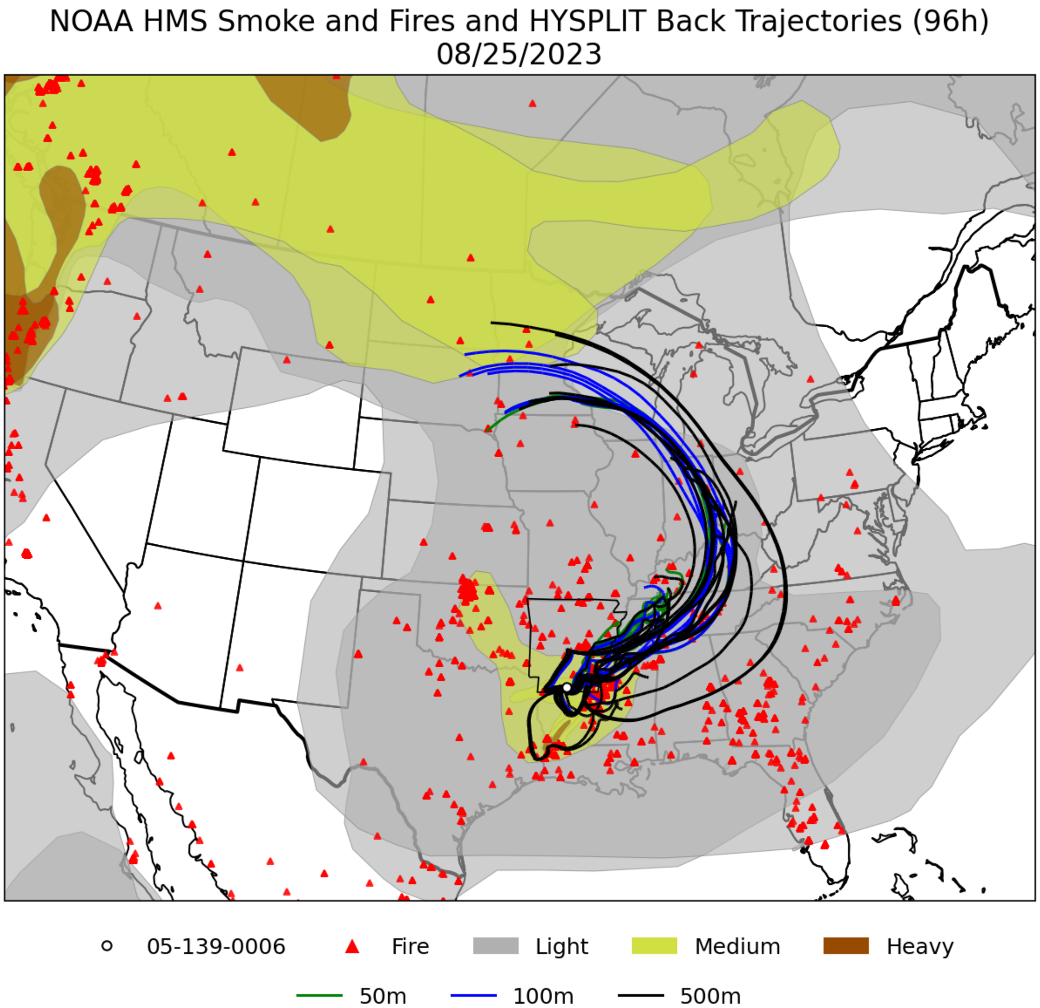
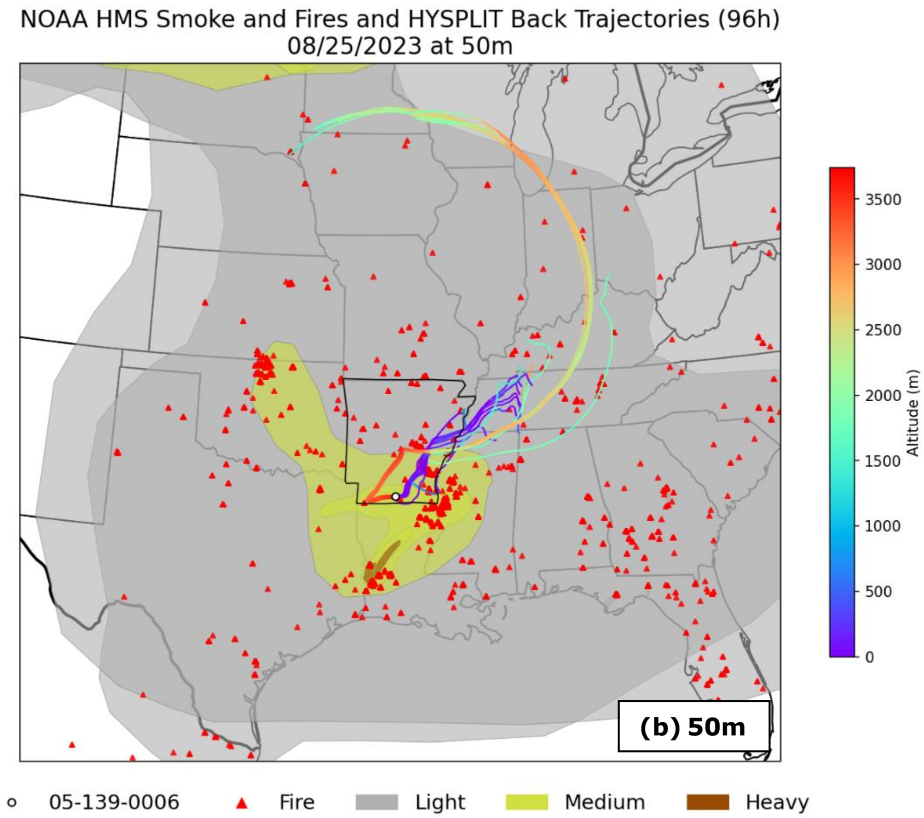
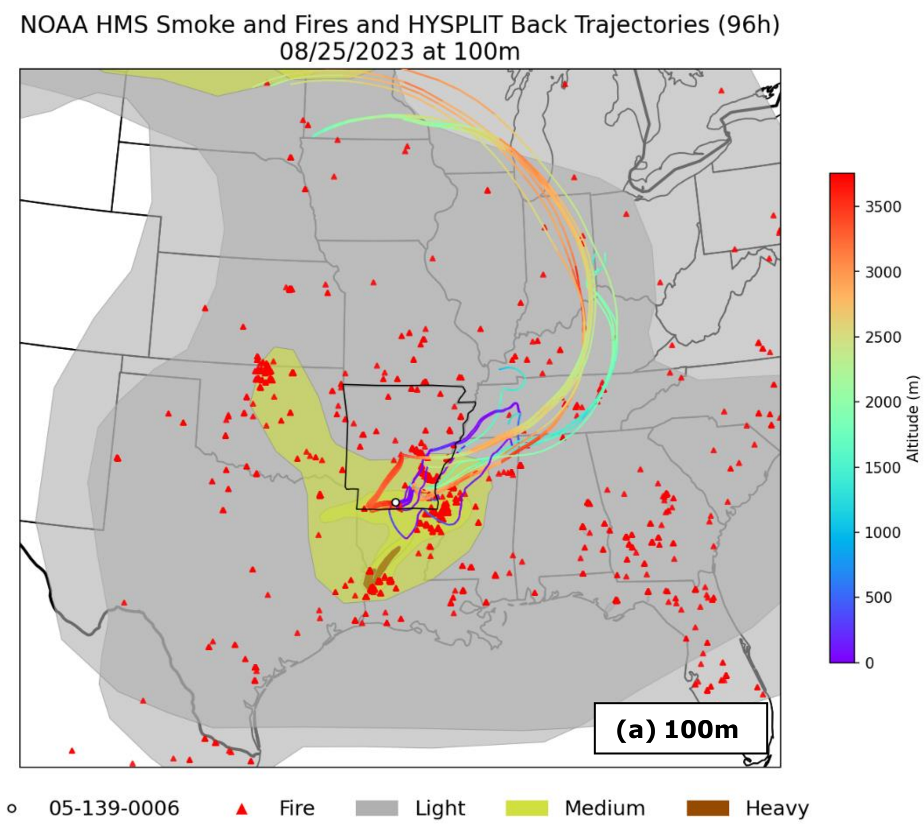


Figure 2-259. HYSPLIT back trajectories for El Dorado on August 25, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
08/25/2023 at 50m
(b) 50m
Altitude (m)
0
500
1000
1500
2000
2500
3000
3500
05-139-0006
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
08/25/2023 at 100m
(a) 100m
Altitude (m)
0
500
1000
1500
2000
2500
3000
3500
05-139-0006
Fire
Light
Medium
Heavy

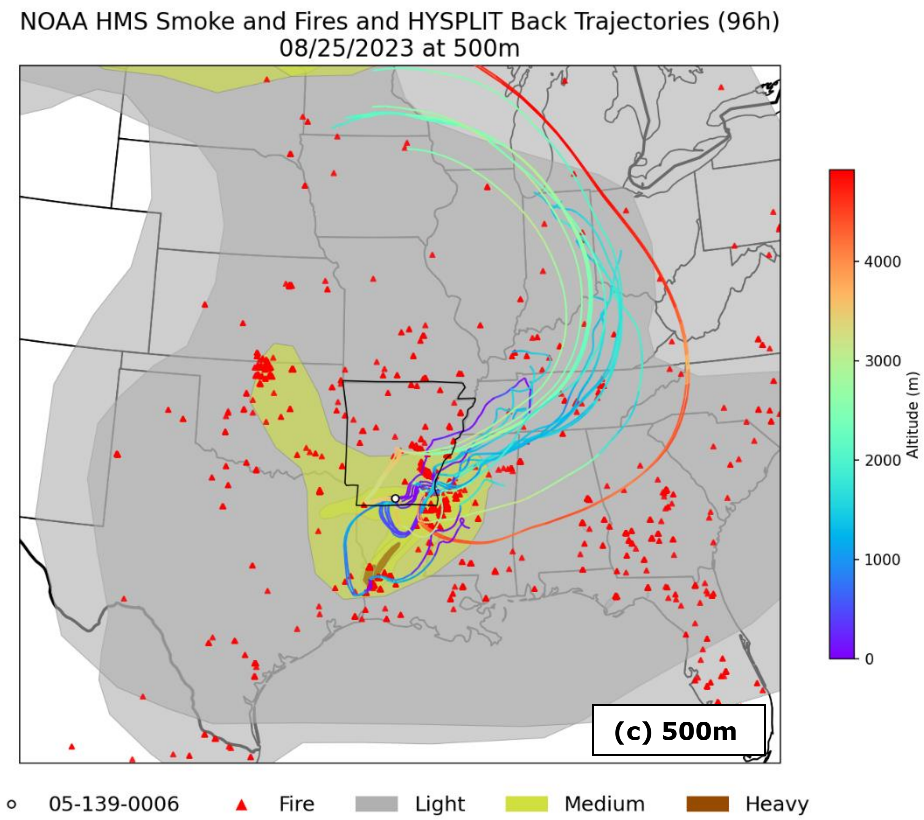


Figure 2-260. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for El Dorado on August 25, 2023.

2.1.11.5 PARR August 26, 2023

Table 2-39 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on August 26, 2023. Figure 2-261 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold. Figure 2-263 indicates that the anticyclonic flow persisted on this day, and the back trajectories passed through regions with remnant light and medium smoke from wildfires in Canada before descending over the monitoring site (Figure 2-264). Figure 2-265 illustrates the hourly variation in $PM_{2.5}$, which increased throughout the morning, but then decreased as a cold front approached, clearing the smoke from the region.

Table 2-39. Exceptional event supporting evidence for PARR on August 26, 2023.

Monitor	PARR (05-119-0007)
Event Date	August 26, 2023
24-hr $PM_{2.5}$ Concentration	18.7 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: August. Date accessed: 11/20/2024.

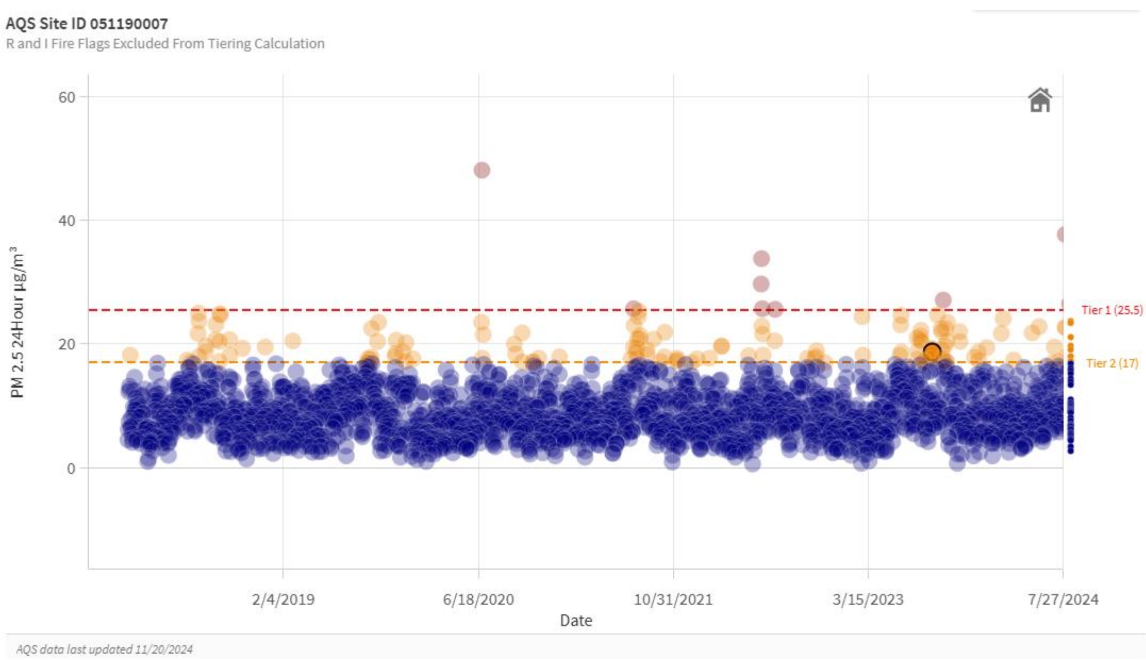


Figure 2-261. EPA PM2.5 Tiering Tool for PARR on August 26, 2023.

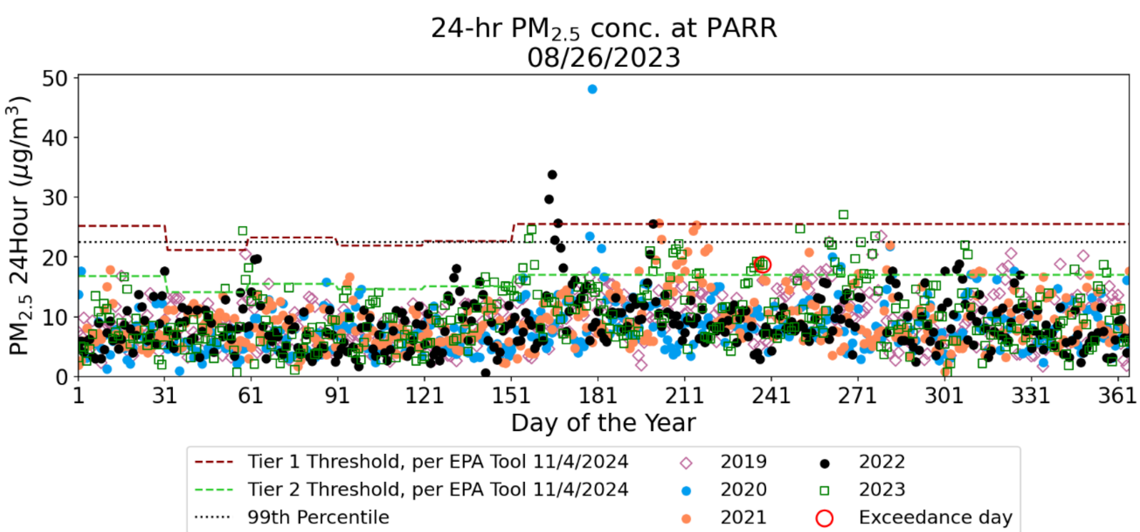


Figure 2-262. Historical 24-hour PM2.5 seasonal fluctuations for PARR compared to August 26, 2023.

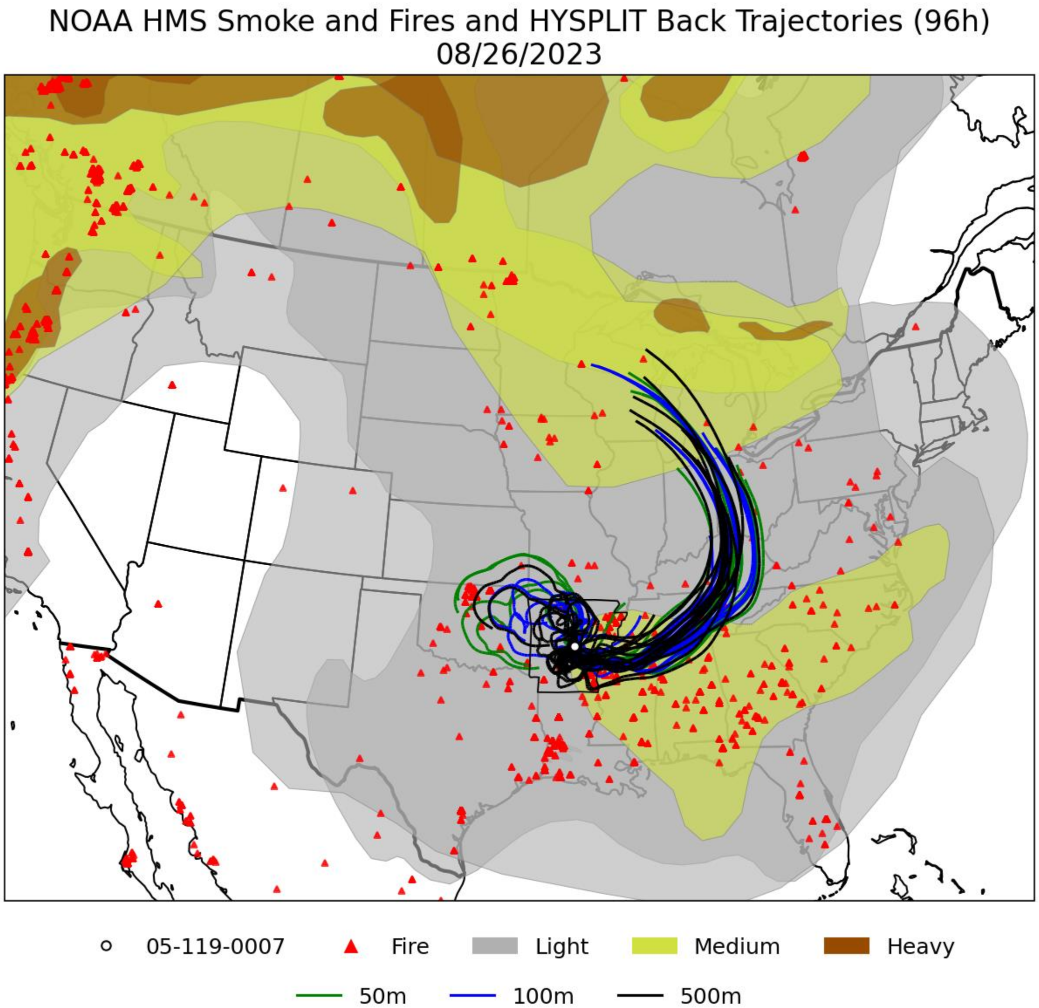
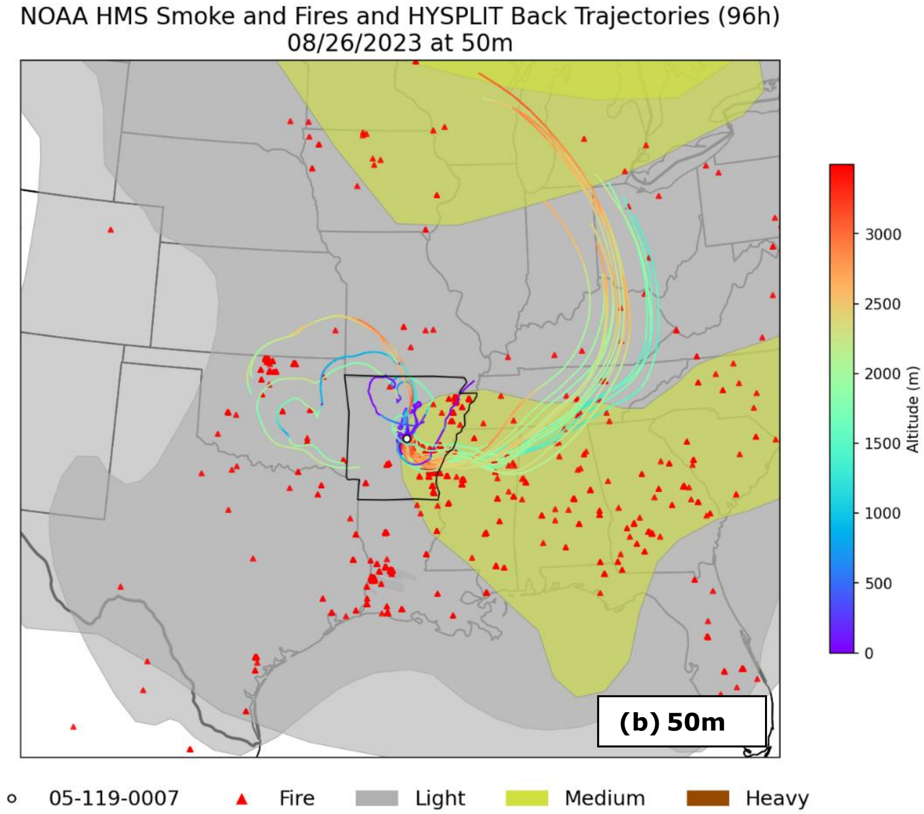
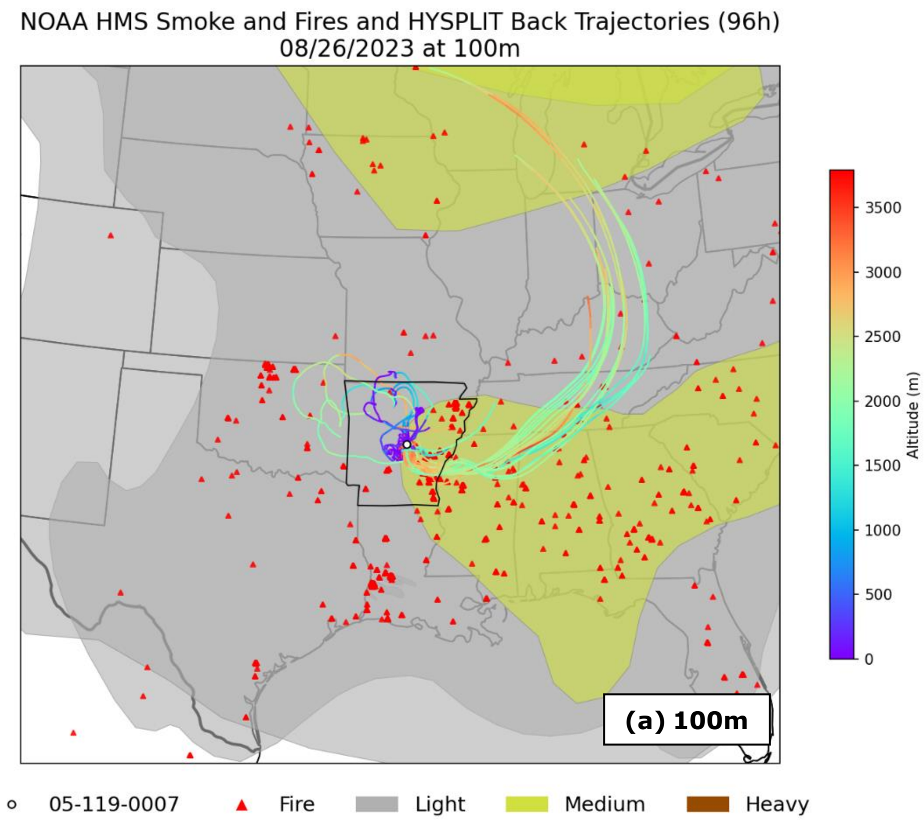


Figure 2-263. HYSPLIT back trajectories for PARR on August 26, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
08/26/2023 at 50m
(b) 50m
Altitude (m)
0
500
1000
1500
2000
2500
3000
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
08/26/2023 at 100m
(a) 100m
Altitude (m)
0
500
1000
1500
2000
2500
3000
3500
05-119-0007
Fire
Light
Medium
Heavy

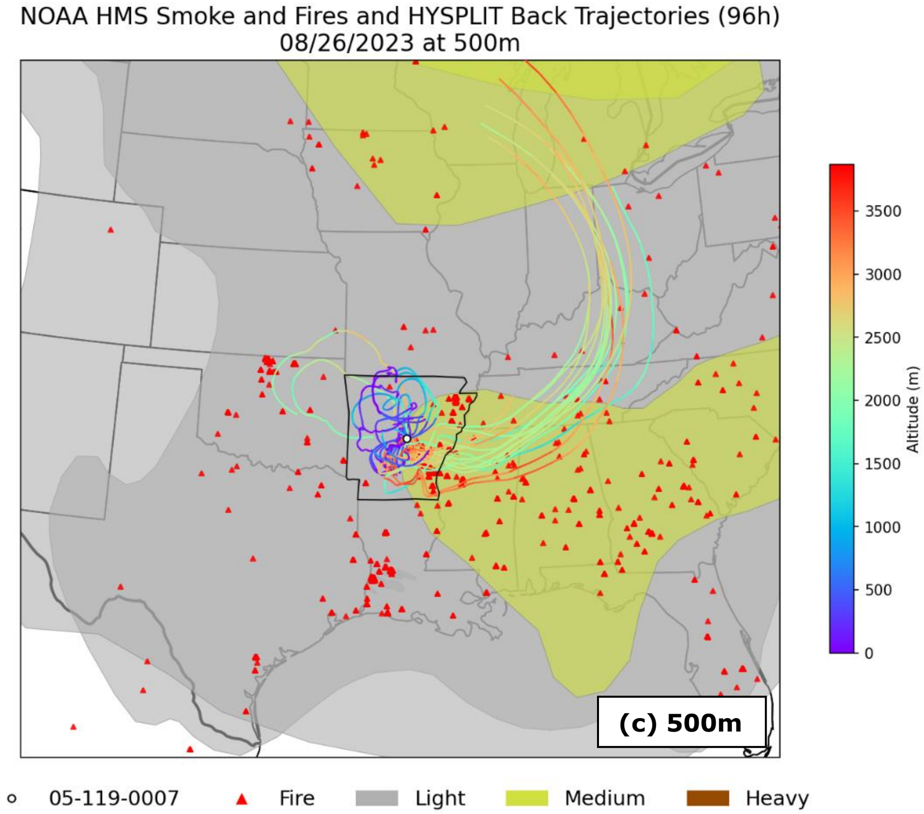


Figure 2-264. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on August 26, 2023.

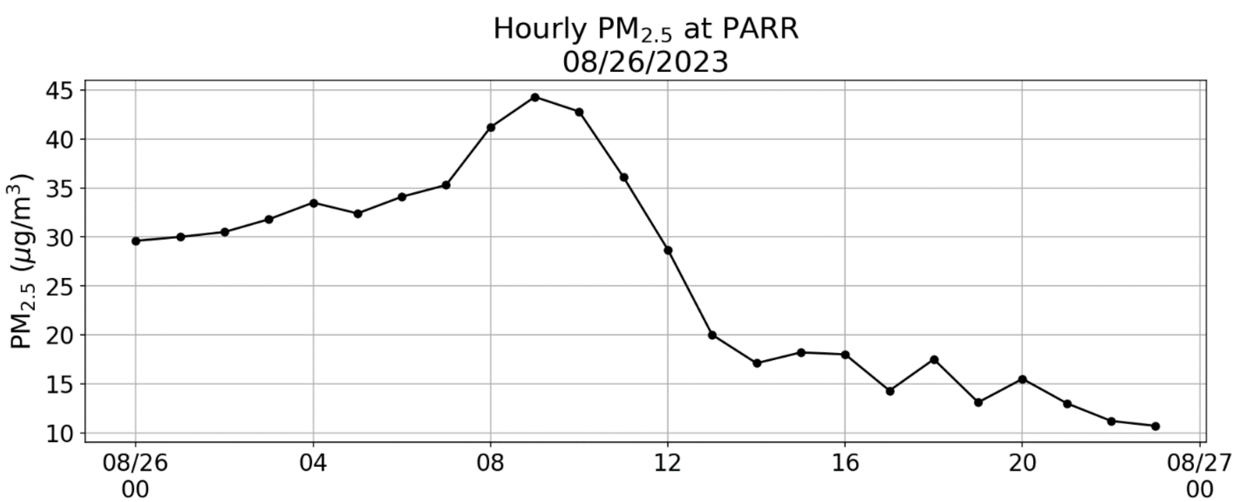


Figure 2-265. Hourly $PM_{2.5}$ concentrations for PARR on August 26, 2023.

2.1.12 September 8, 2023

During August, prior to September 8, 2023, several wildfires were burning in British Columbia, Alberta, and the Northwest Territories in Canada during August 2023 (described in Section 2.1.11) and they continued to be active into September. The active fires on September 8 are shown in Figure 2-266. The Wood Buffalo Complex fire in Alberta, which had been a significant concern in August, was still active in early September. In Wood Buffalo National Park, there were multiple active fires being monitored and managed. These fires experienced a reduction in intensity with the advent of cooler weather in late September.

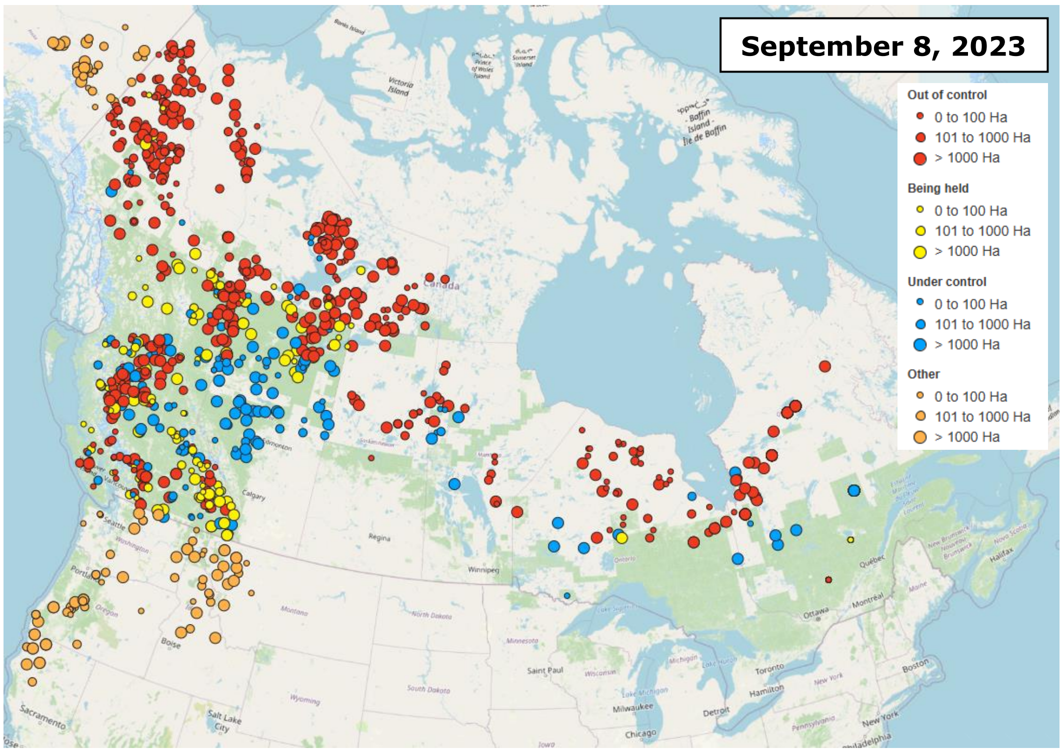


Figure 2-266. Canadian Wildfire Information System map of active fires for September 8. (https://cwfis.cfs.nrcan.gc.ca/interactive-map)

On September 8, 2023, the 500 mb analysis (Figure 2-267) shows a dynamic weather pattern with a ridge over the western U.S., and a trough over the eastern U.S., accompanied by strong westerly winds that can transport smoke from northwest Canada into the central U.S. The ridge over the western U.S. helps to funnel smoke southward along its eastern edge.[47]

[47] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=09&STARTDAY=08&STARTTIME=00&INC=-48

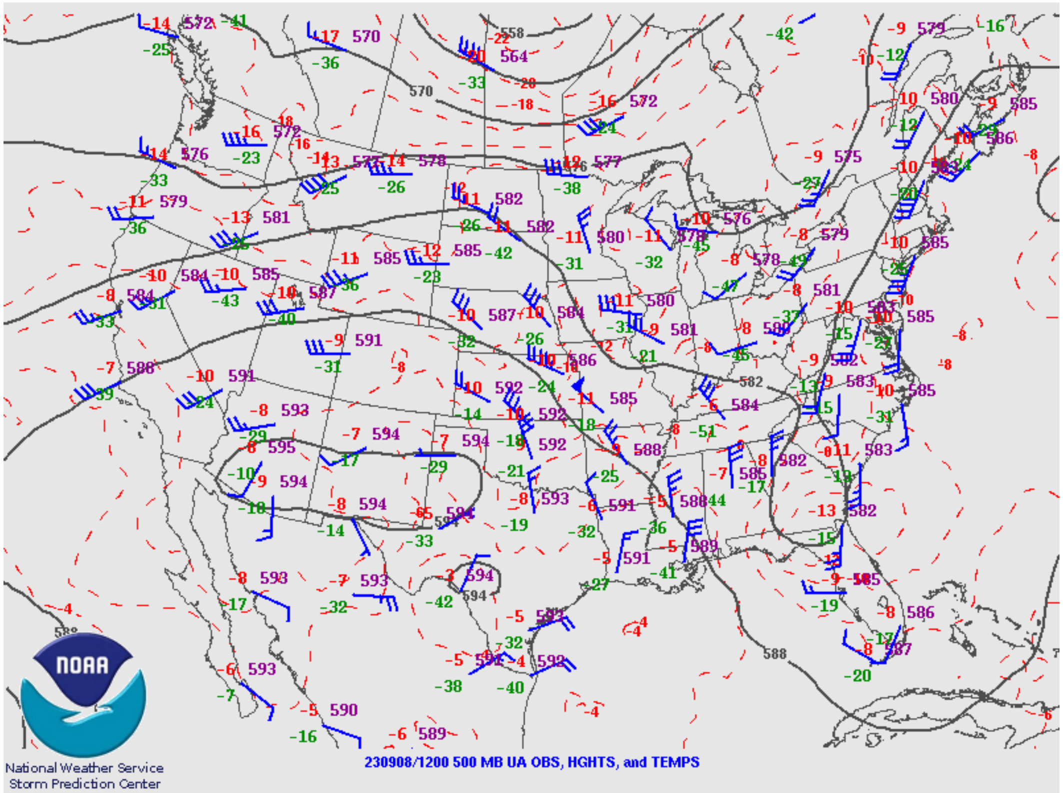


Figure 2-267. 500 mb synoptic analysis map at 12 UTC on September 8, 2023.

Figure 2-268 shows the surface analysis on September 8, 2023, at 18 UT. High-pressure systems over both Nebraska and the southeastern U.S. along with an advancing cold front extending through the central Plains create a pathway from smoke to move southward into Arkansas. The high-pressure system's clockwise circulation can funnel smoke along its western periphery. A stationary front is present across the northern plains, indicating a boundary between different air masses with little movement.

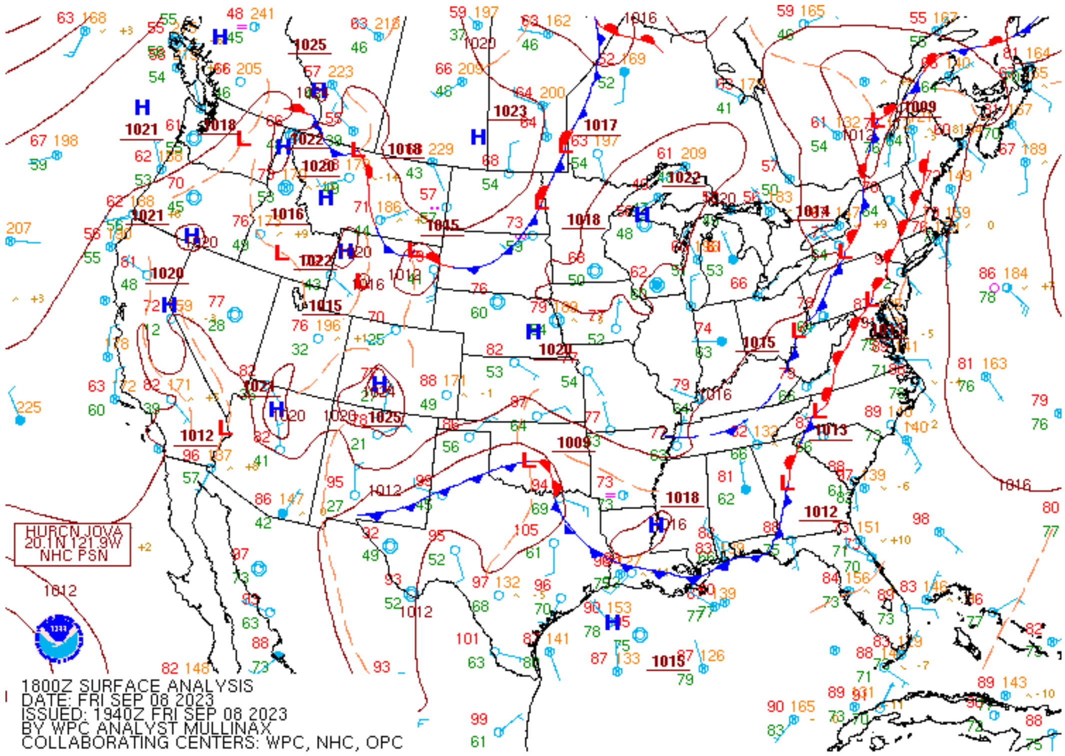


Figure 2-268. Surface synoptic analysis maps (bottom row) at 18 UTC on September 8, 2023.

The NOAA HMS product in Figure 2-269 and the visible satellite image in Figure 2-270 show medium to heavy density smoke from Canadian fires that covers the central U.S. and clearly impacts Arkansas. Moderate AQI values in Figure 2-271 and the HRRR surface modeled concentrations in Figure 2-272 suggest that this smoke mixed down to surface level including parts of Arkansas, Mississippi, Oklahoma, Kansas, and Nebraska. The modeling indicates impacts from smoke that range between 6 and 2 $\mu g/m^3$. Figure 2-273 shows the evolution of the smoke plumes from multiple fires in British Columbia, Alberta, and Saskatchewan, Canada.

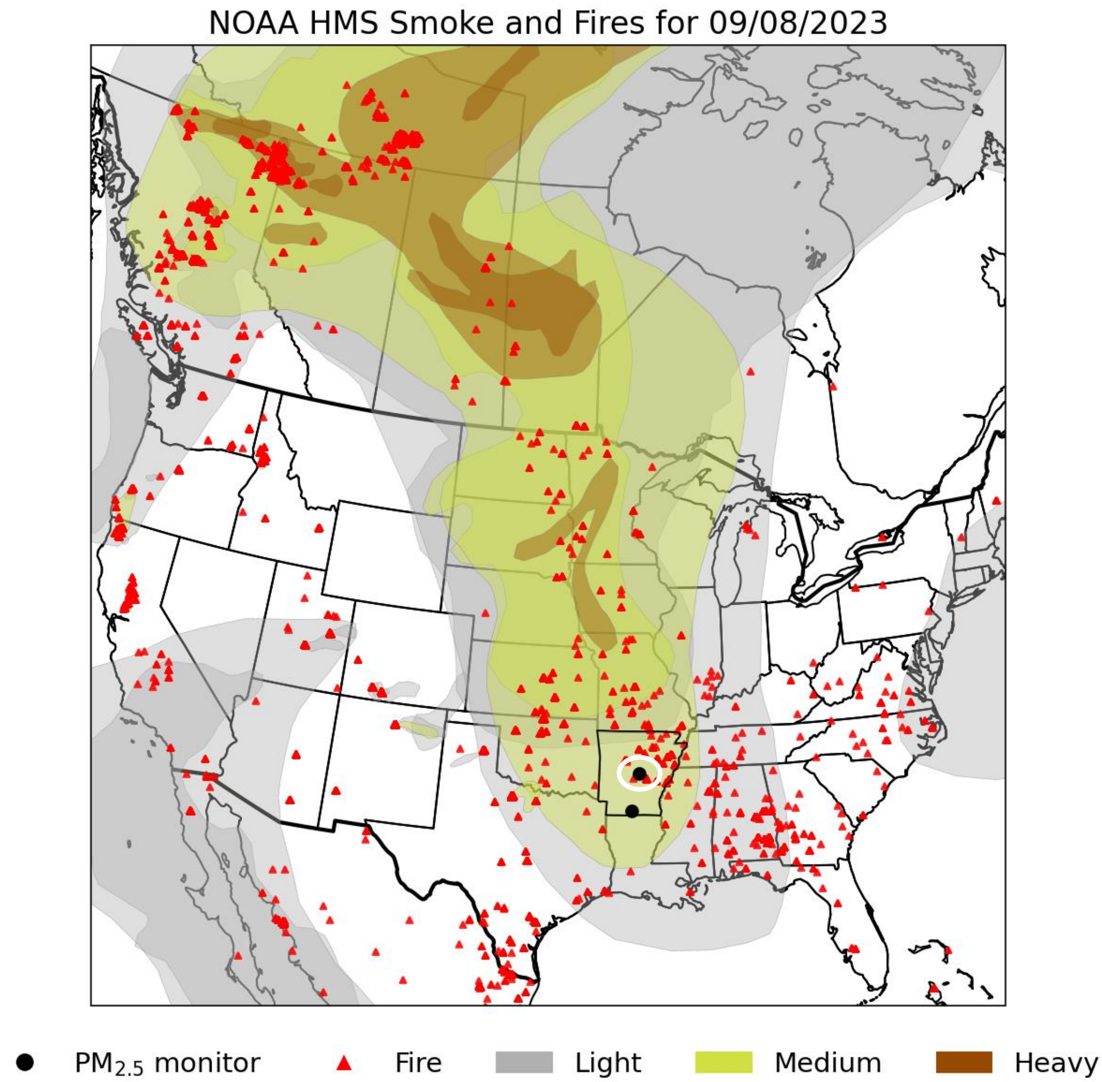


Figure 2-269. NOAA HMS fire and smoke products for September 8, 2023.

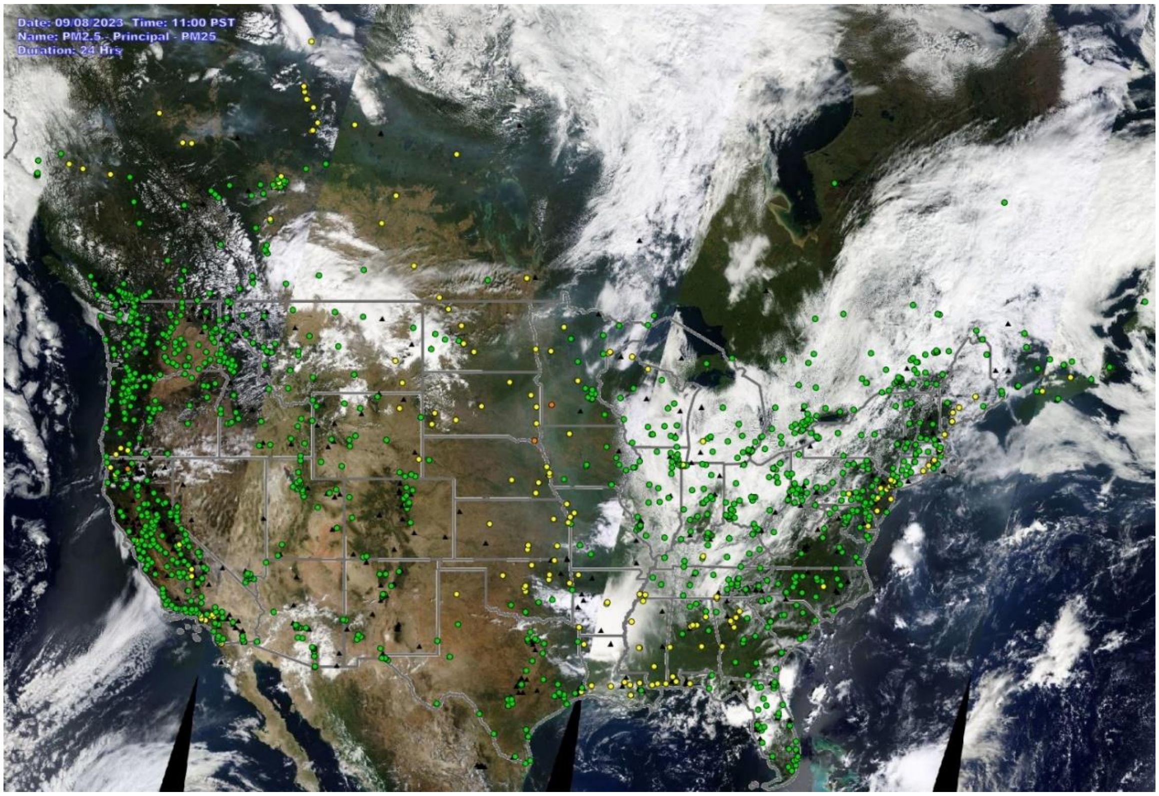


Figure 2-270. MODIS satellite visible imagery for September 8, 2023.

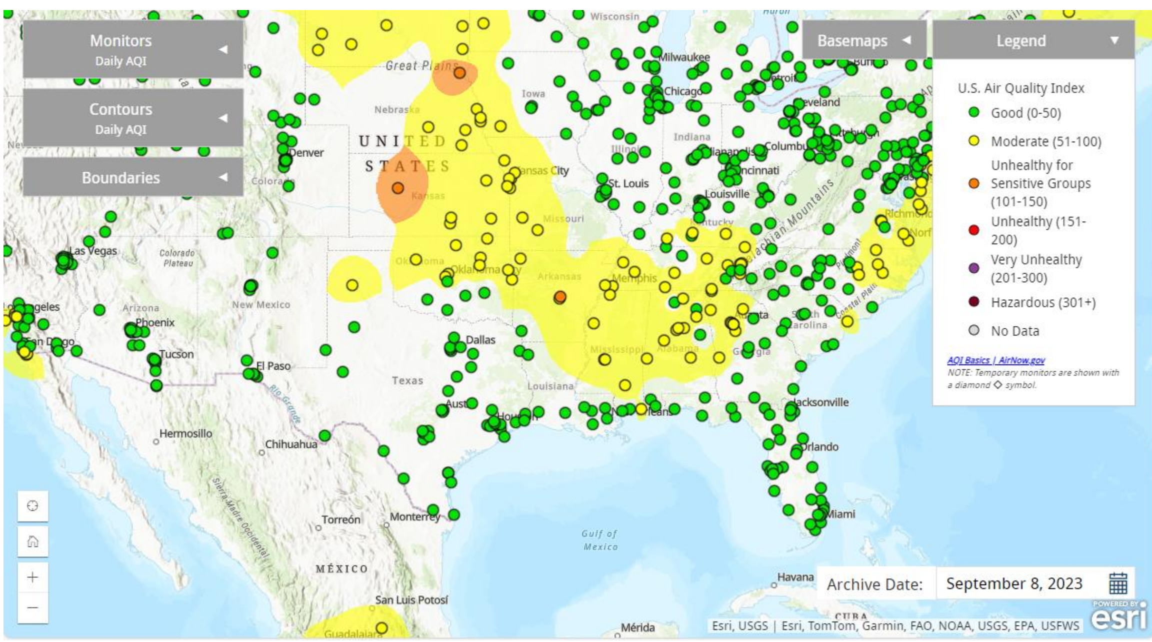


Figure 2-271. AirNow surface level $PM_{2.5}$ concentration contours for September 8, 2023.

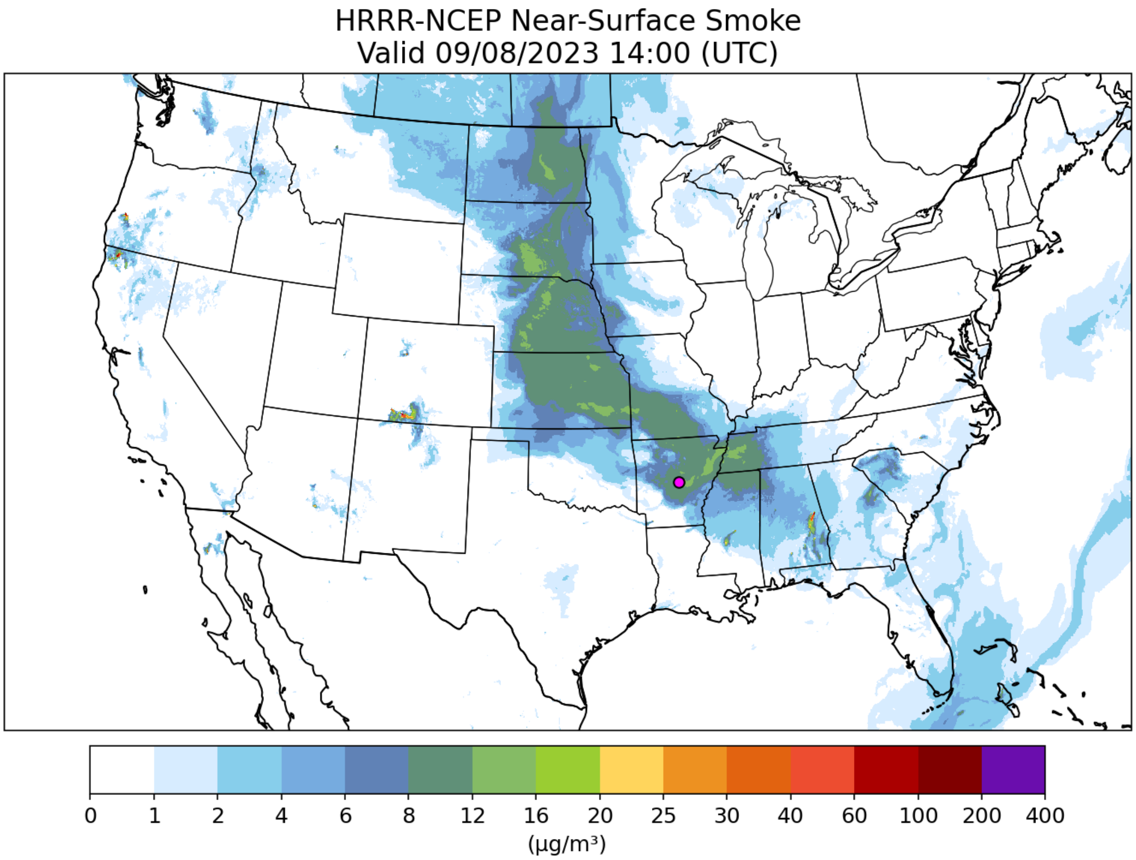


Figure 2-272. HRRR-Smoke modeled near-surface smoke concentrations (µg/m^3) at 9 AM CDT on September 8, 2023.

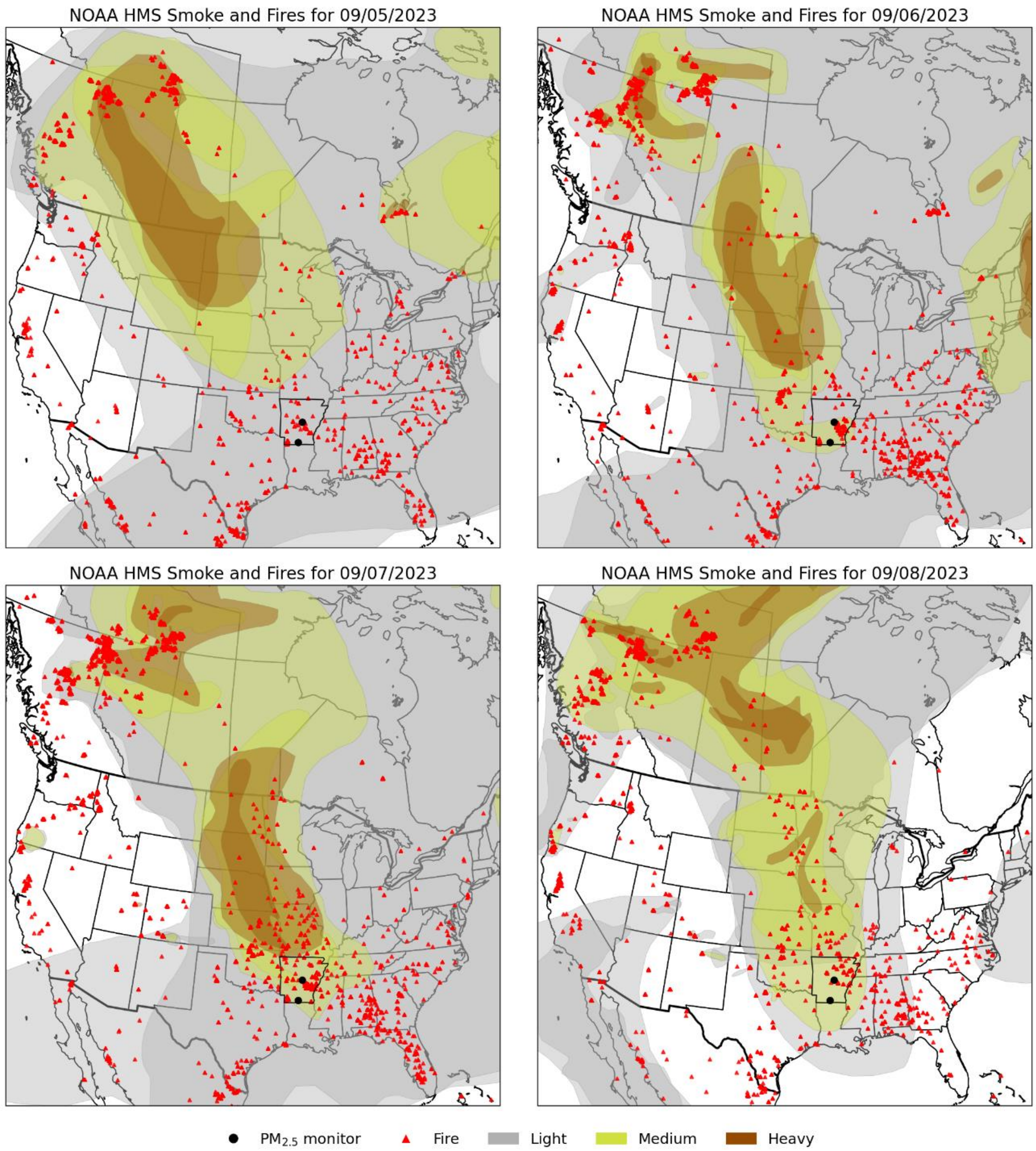


Figure 2-273. Evolution of fires and smoke for September 5 (top left), September 6 (top right), September 7 (bottom left), and September 8 (bottom right).

2.1.12.1 PARR September 8, 2023

Table 2-40 summarizes the evidence gathered to support the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on September 8, 2023. Figure 2-274 shows that observed $PM_{2.5}$ concentrations on this day are above the Tier 2 threshold, and Figure 2-275 shows this day is above the 99th historic percentile over the last five years. Figure 2-276 shows that 96-hour back trajectories cross through regions of medium to heavy density smoke transported from northwest Canada and that the trajectories can reach the Canadian provinces where these fires were burning. The presence of high-pressure system at the surface level (Figure 2-268) indicates that some of the trajectories passed over regions with smoke and descend over the monitoring site and is shown in the detailed trajectories showing the altitude (Figure 2-277). Figure 2-278 shows that $PM_{2.5}$ concentrations increases from 15 µg/m^3 on September 7 to 38.8 µg/m^3 on September 8 at 9 CDT. This increase was driven by the weather pattern in Figure 2-267 and Figure 2-268 that facilitated the transport of smoke-laden air from northwest Canada into Arkansas, leading to elevated $PM_{2.5}$ levels.

Table 2-40. Exceptional event supporting evidence for PARR on September 8, 2023.

Monitor	PARR (05-119-0007)
Event Date	September 8, 2023
24-hr $PM_{2.5}$ Concentration	24.7 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: September. Date accessed: 11/20/2024.

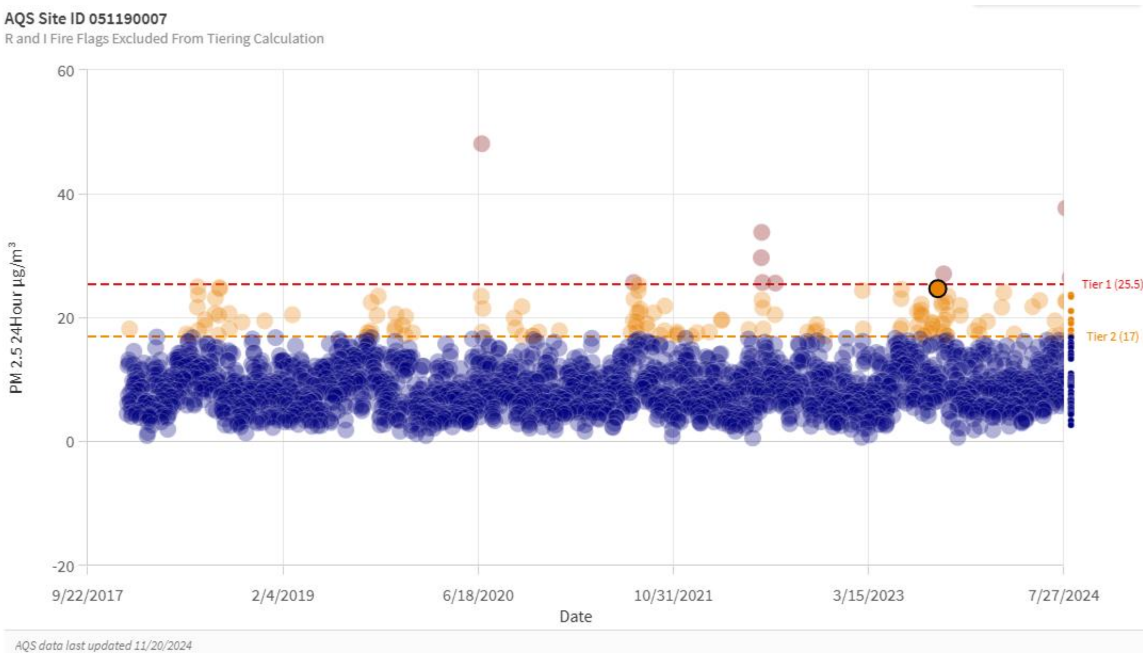


Figure 2-274. EPA PM2.5 Tiering Tool for PARR on September 8, 2023.

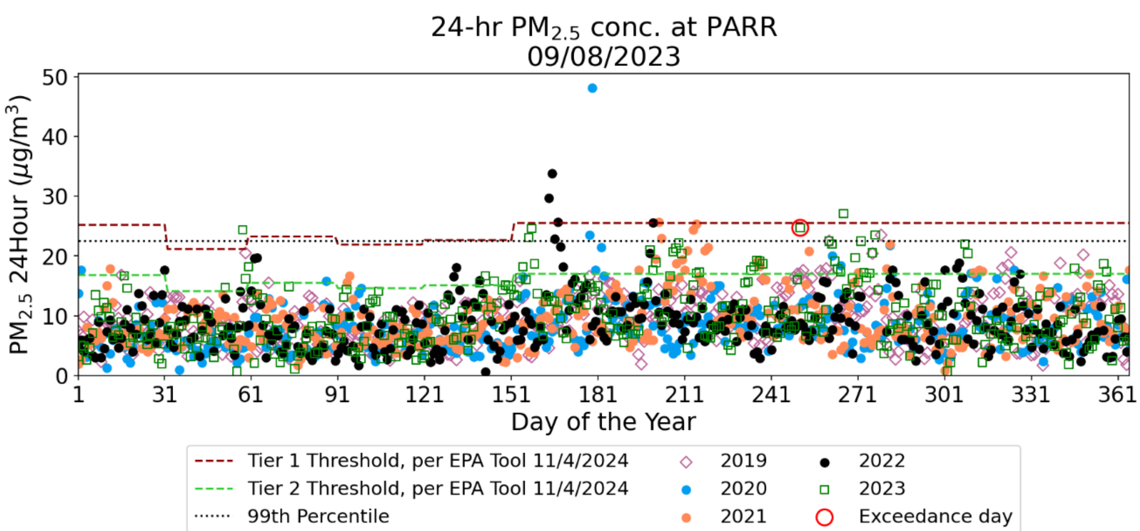


Figure 2-275. Historical 24-hour PM2.5 seasonal fluctuations for PARR compared to September 8, 2023.

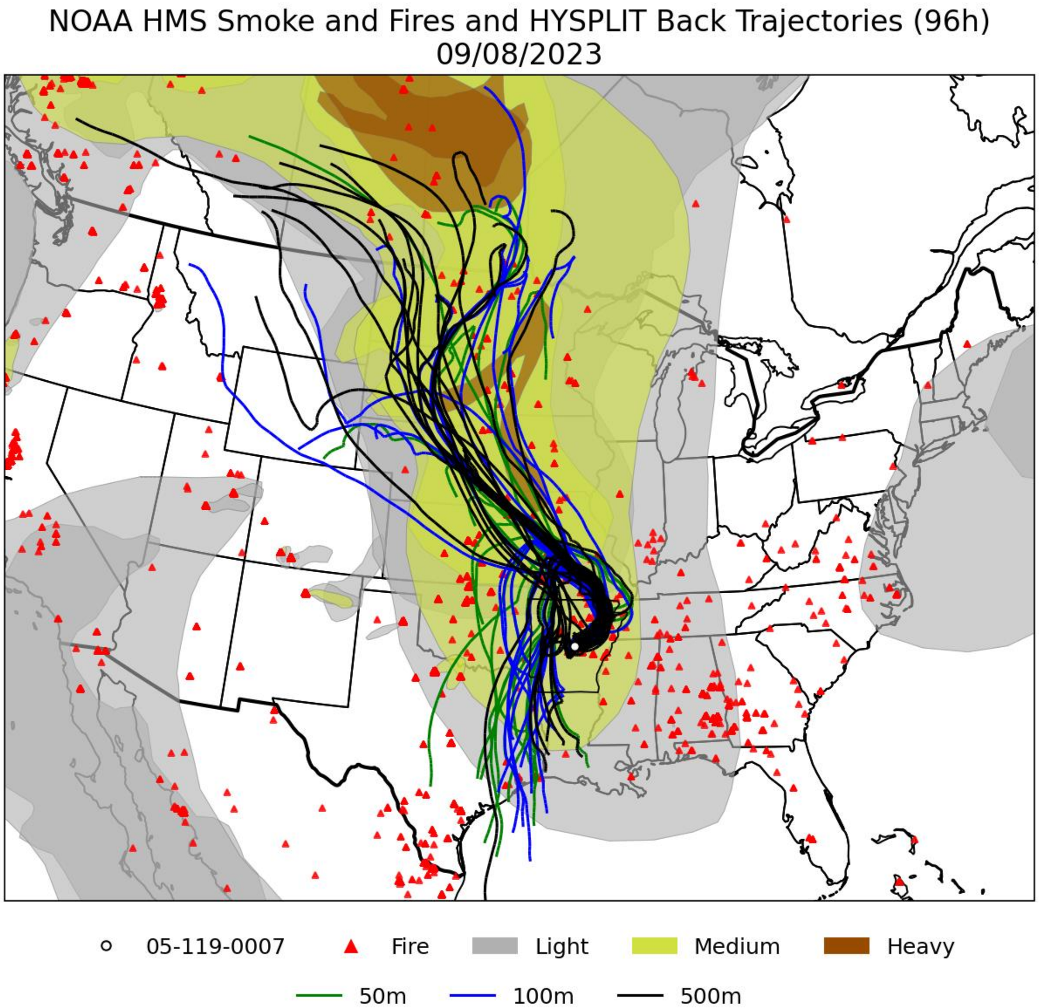
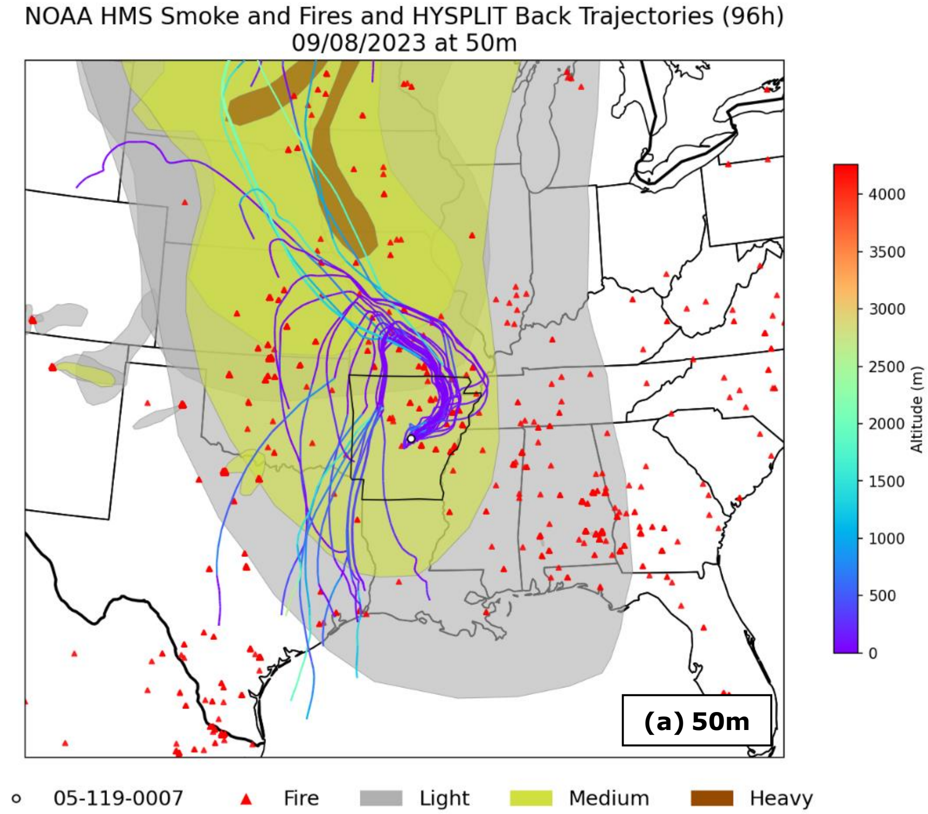
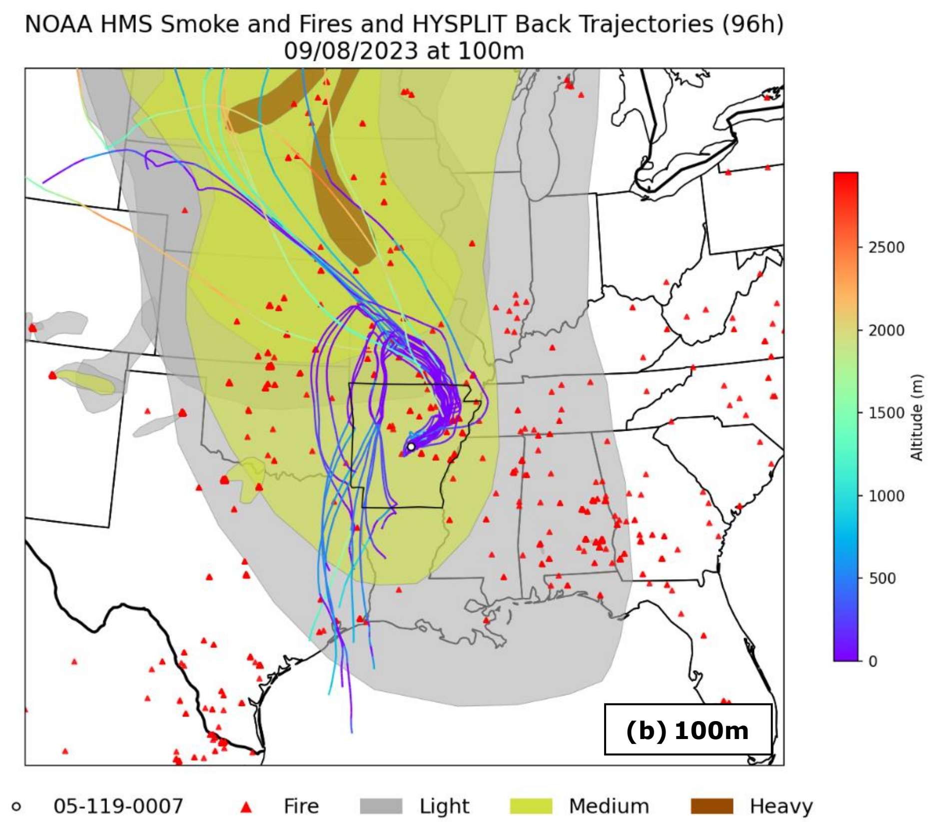


Figure 2-276. HYSPLIT back trajectories for PARR on September 8, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
09/08/2023 at 50m
(a) 50m
Altitude (m)
4000
3500
3000
2500
2000
1500
1000
500
0
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
09/08/2023 at 100m
(b) 100m
Altitude (m)
2500
2000
1500
1000
500
0
05-119-0007
Fire
Light
Medium
Heavy

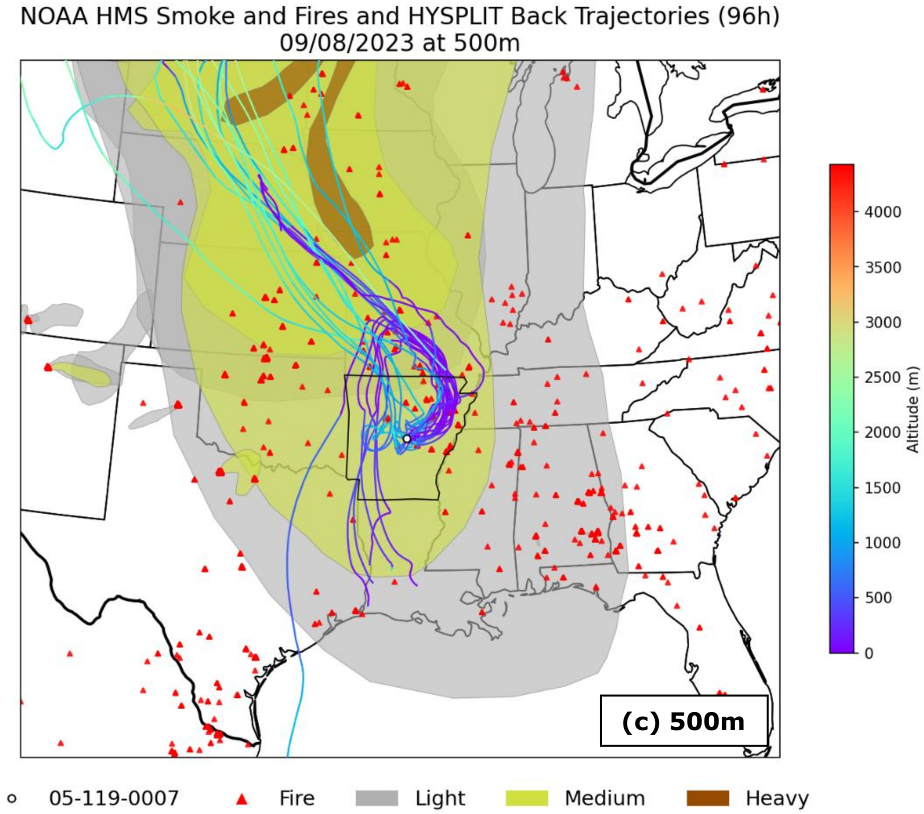


Figure 2-277. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on September 8, 2023.

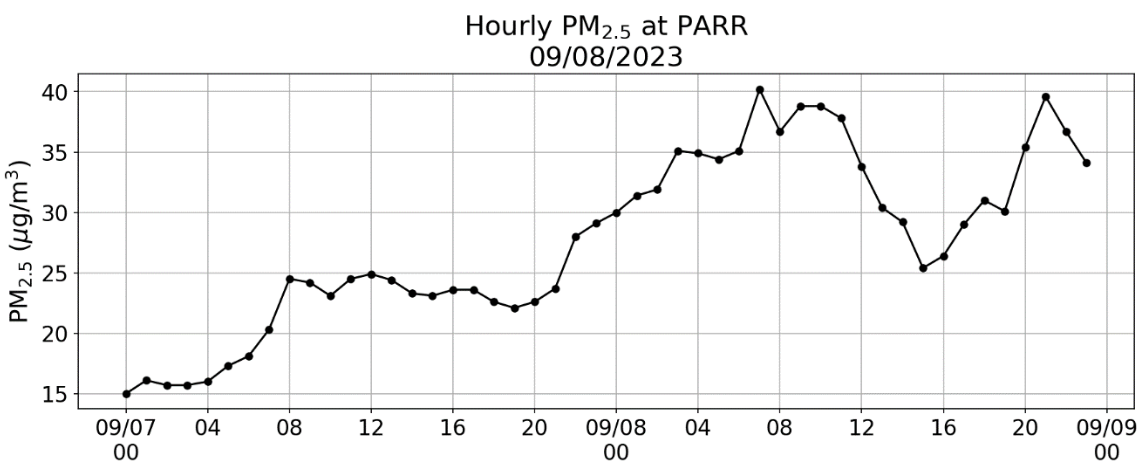
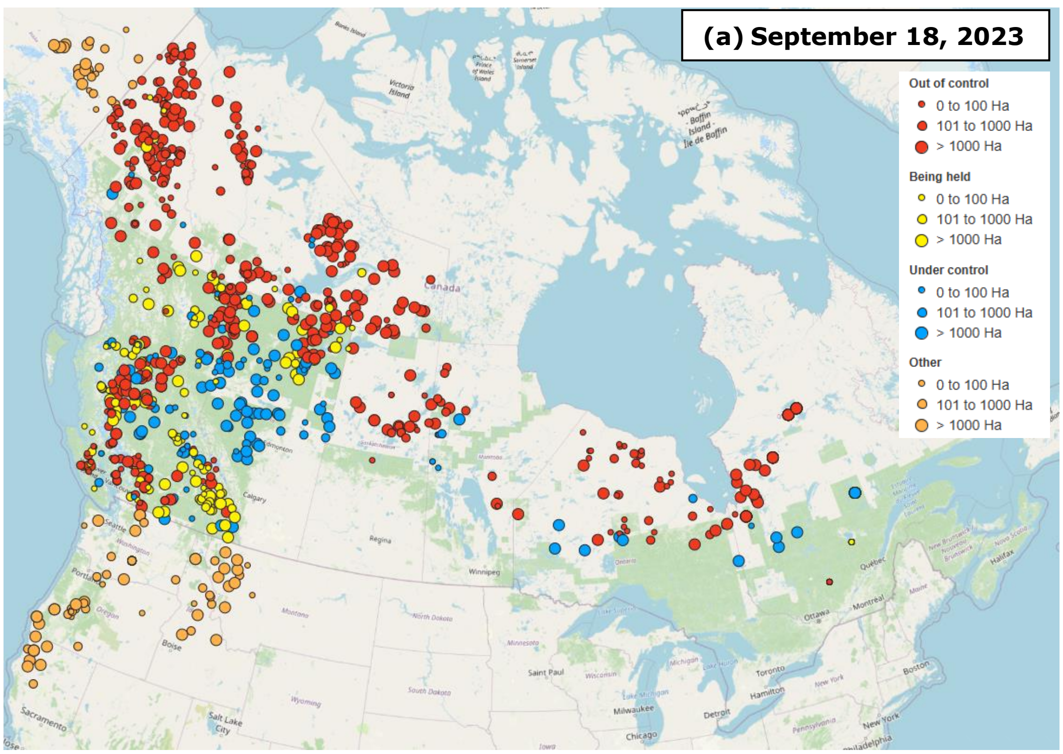
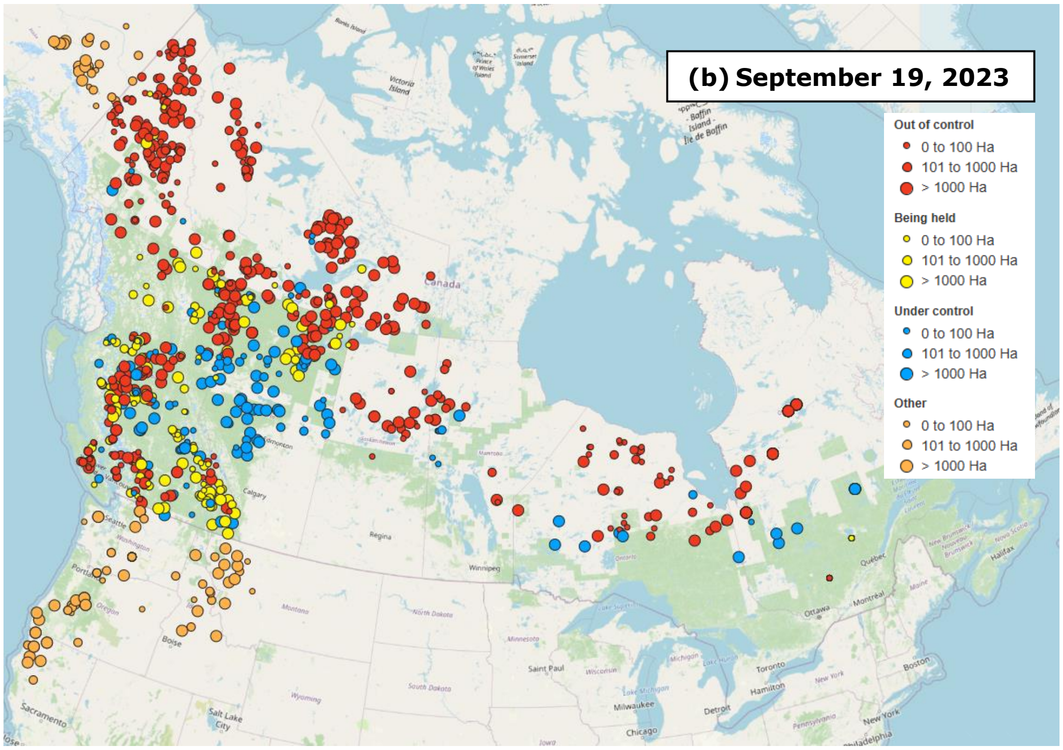


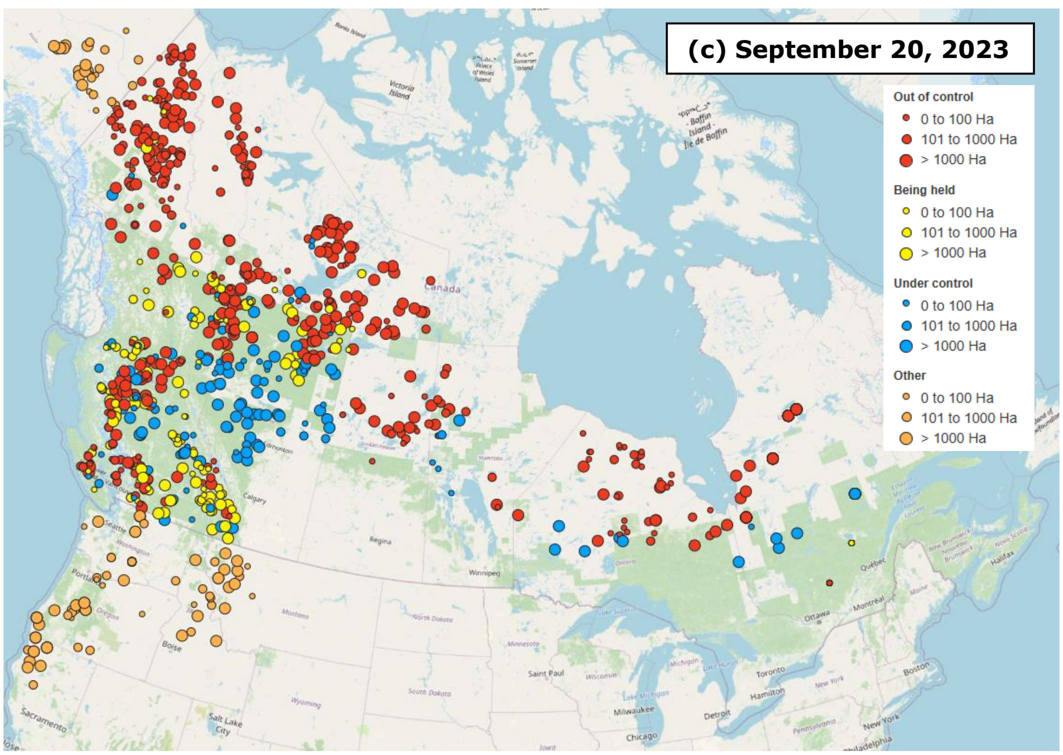
Figure 2-278. Hourly $PM_{2.5}$ concentrations for PARR on September 8, 2023.

2.1.13 September 18-21, 2023

The fire near Fort Nelson, which burned for much of June and July 2023, and became the largest fire of the year in late September, initially charred an area of 802,575 ha by mid-August. This fire, located at the intersection of British Columbia, the Northwest Territories, and Alberta, was rekindled in late September due to strong winds, pushing its growth even further. There were three other large fires that charred parts of the Northwest Territories, Alberta, and Saskatchewan. The Shaw fire was one of the largest fires in the Saskatchewan province and had burned 651,842 ha by September 19, 2023. On September 15, 2023, of 447 active fires, nearly half were out of control, and by September 27, the number of fires had increased to 798, with 382 of them out of control (Figure 2-279). The intense burning from these fires on September 15 and 22 in British Columbia and Alberta produced pyrocumulonimbus clouds, which sent smoke high into the atmosphere. Fast-moving upper-level winds (Figure 2-280) then spread this smoke widely across regions, significantly affecting air quality.




(b) September 19, 2023
Out of control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Being held
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Under control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Other
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha


(c) September 20, 2023
Out of control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Being held
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Under control
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha
Other
0 to 100 Ha
101 to 1000 Ha
> 1000 Ha

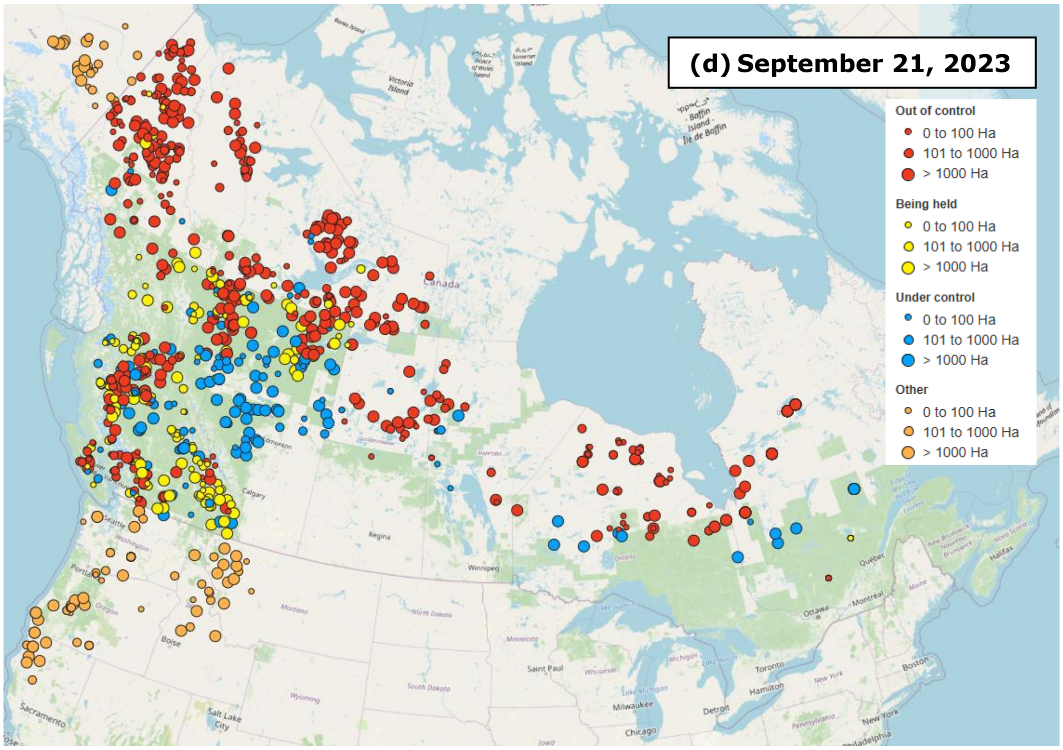


Figure 2-279. Canadian Wildfire Information System map of active fires for (a) September 18, (b) September 19, (c) September 20, and (d) September 21. (https://cwfis.cfs.nrcan.gc.ca/interactive-map)

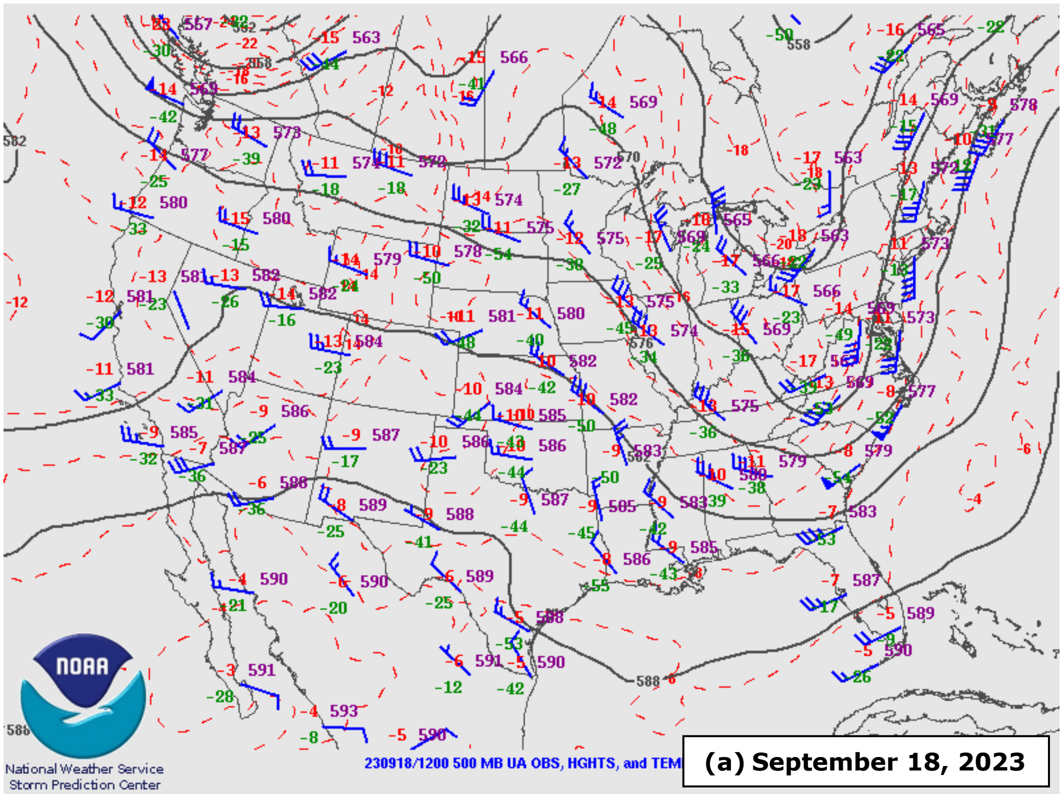
On September 18 (Figure 2-280a), a ridge over the western U.S. and a trough over the eastern U.S., facilitated strong westerly winds at 500 mb that helped the transport of smoke from northwest Canada into the central U.S. The ridge funneled smoke southward along its eastern side, while the trough drew it further south and east.[48] On September 19 (Figure 2-280b), a prominent trough over the western part of North America facilitated the movement of air from northwest Canada. The winds at the 500 mb, oriented northwest to southeast, aided the transport of smoke from the wildfire regions in Canada toward the central and eastern parts of the U.S..[49] On September 20 (Figure 2-280c), the trough over the western part of North America promoted the southward movement of smoke from Canada. This flow pattern also carried smoke from northern California eastward.[50] A high-pressure system over the southeastern U.S. acted as a barrier, redirecting the smoke flow around its periphery. On September 21 (Figure 2-280d), a significant trough over the western part of North America facilitated the southward movement of air from northwest

[48] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=09&STARTDAY=18&STARTTIME=00&INC=-48

[49] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=09&STARTDAY=19&STARTTIME=00&INC=-48

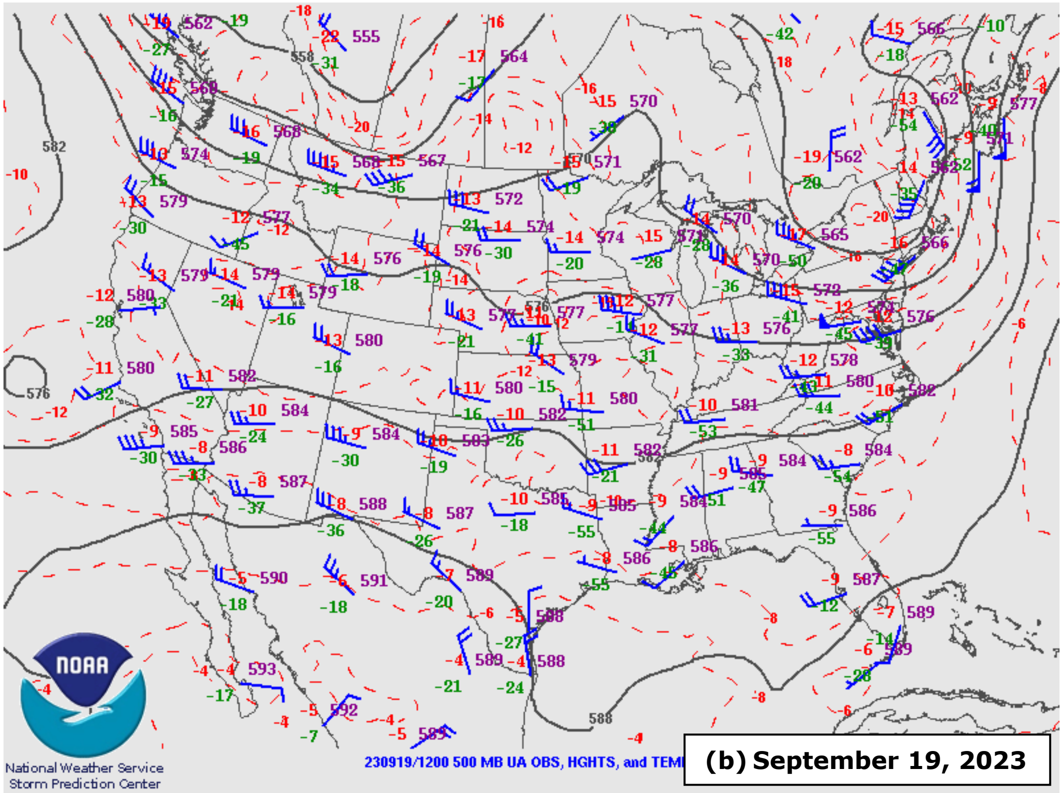
[50] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=09&STARTDAY=20&STARTTIME=00&INC=-48

Canada and northern California toward the central and southeastern U.S.[51] The ridge over Kansas led to subsidence of a smoke-filled air mass over Arkansas.

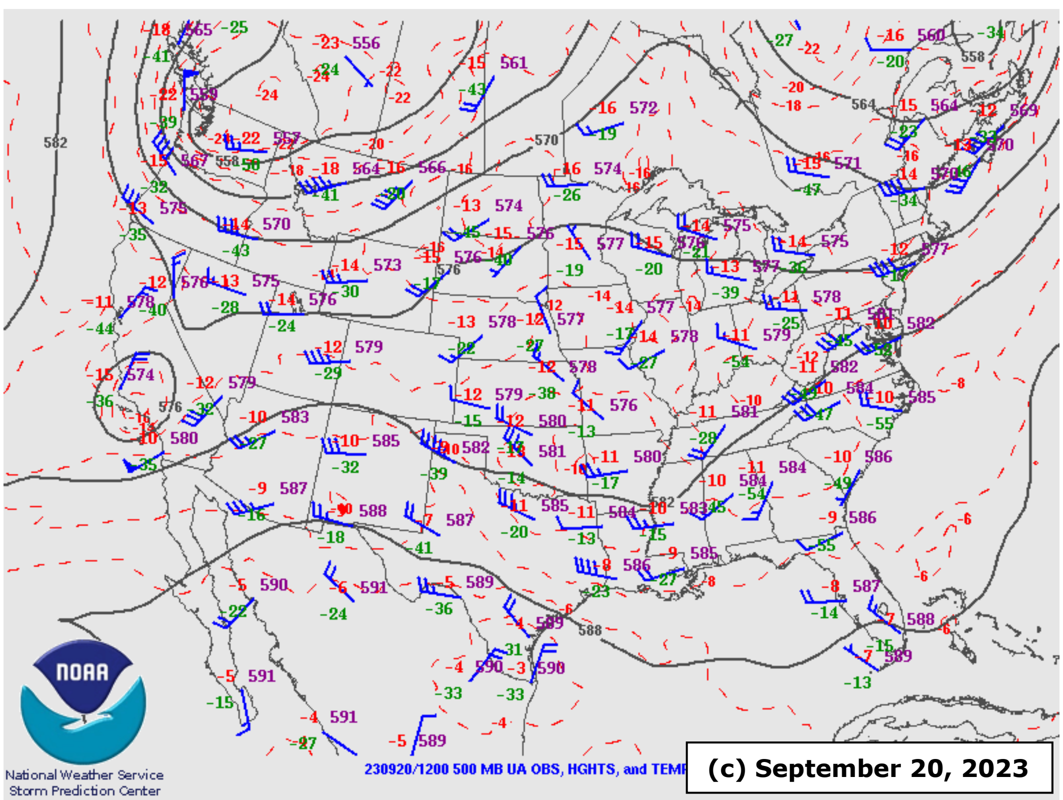


(a) September 18, 2023

[51] https://www.spc.noaa.gov/exper/ma_archive/action5.php?BASICPARAM=500mb.gif&STARTYEAR=2023&STARTMONTH=09&STARTDAY=21&STARTTIME=00&INC=-48



(b) September 19, 2023



(c) September 20, 2023

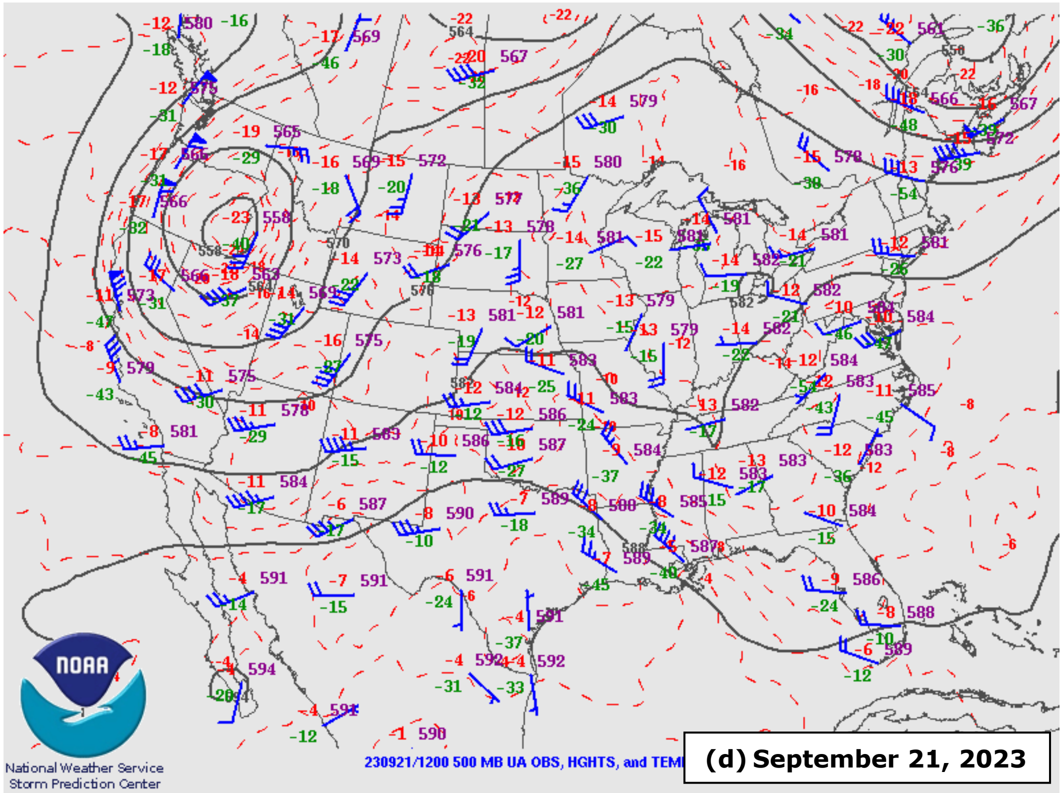
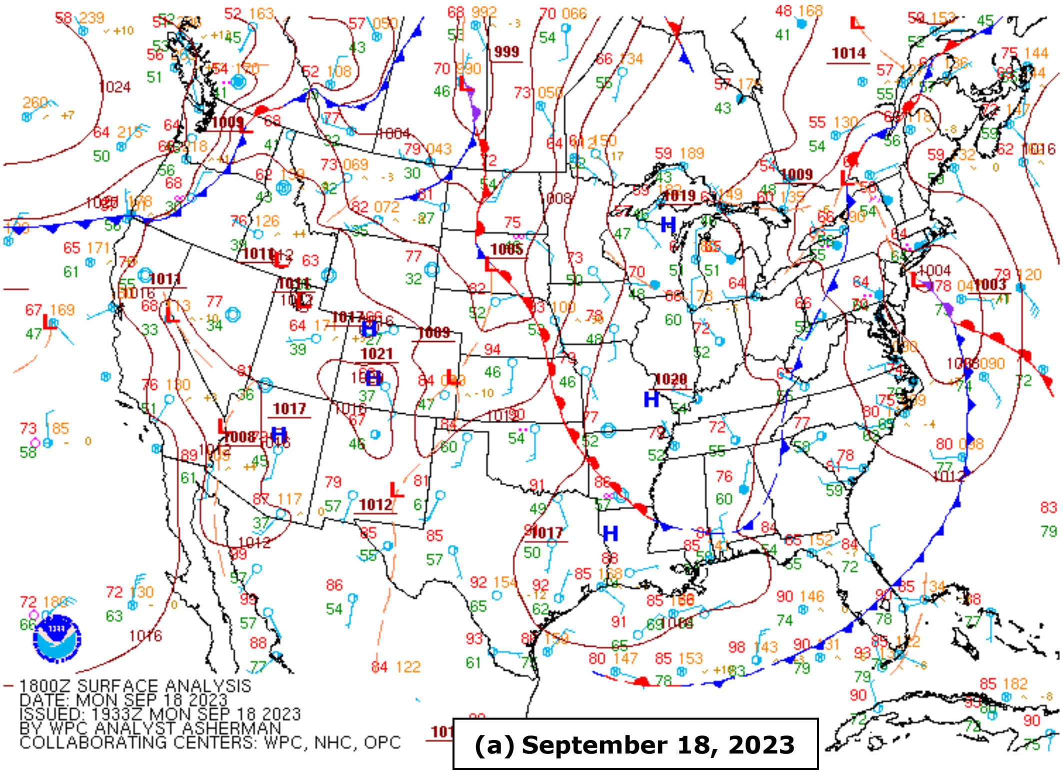
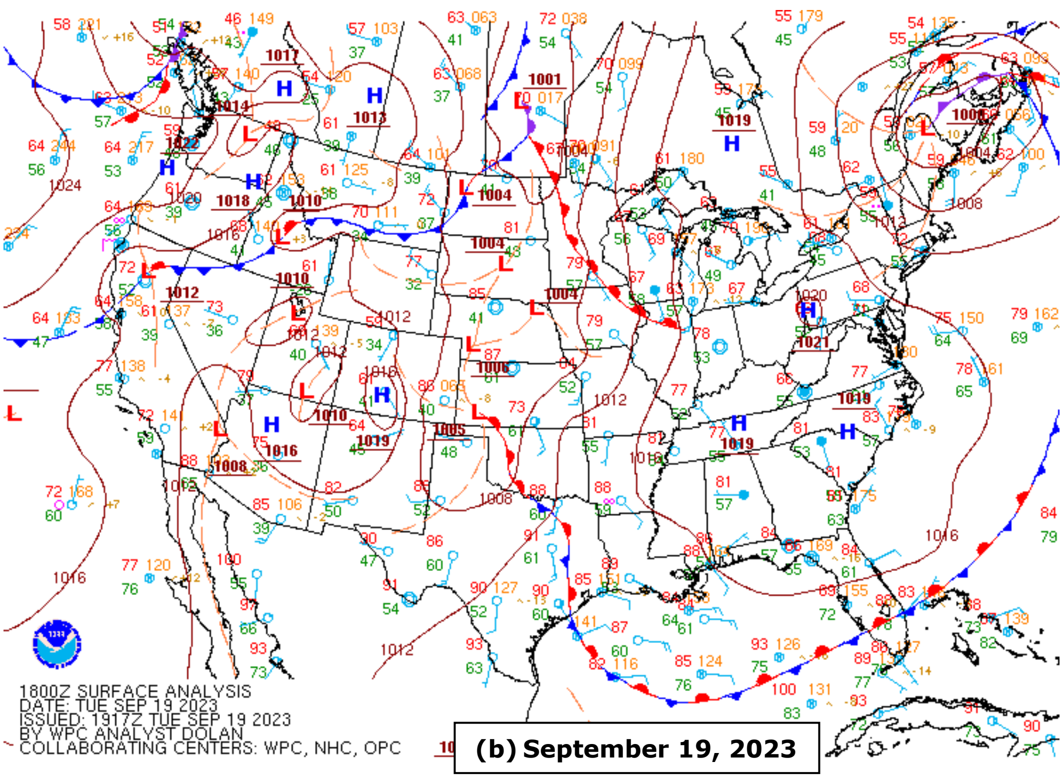


Figure 2-280. 500 mb synoptic analysis map at 12 UTC on (a) September 18, (b) September 19, (c) September 20, and (d) September 21, 2023.

The surface analysis on September 18 (Figure 2-281a), shows a high-pressure system over the southeastern U.S. and a warm front through the central Plains, creating a pathway for smoke to move southward into Arkansas (reflected on the wind barbs). The clockwise circulation of the high-pressure system funneled smoke along its western edge. On September 19 (Figure 2-281b), a high-pressures system over the Pacific Northwest and a low-pressure system further east, over the northern plains, drove surface winds from the northwest to the southeast. The presence of cold fronts moving southeastward further enhanced the transport of smoke by creating a pathway for air masses to move. On September 20 (Figure 2-281c), the high-pressure system over the southeastern U.S. redirected the smoke flow, preventing it from moving directly east. Instead, the system guided the smoke around its periphery. On September 21 (Figure 2-281d), a high-pressure system over the southwestern U.S. facilitated the southeastward transport of smoke toward regions like Arkansas.



(a) September 18, 2023



(b) September 19, 2023

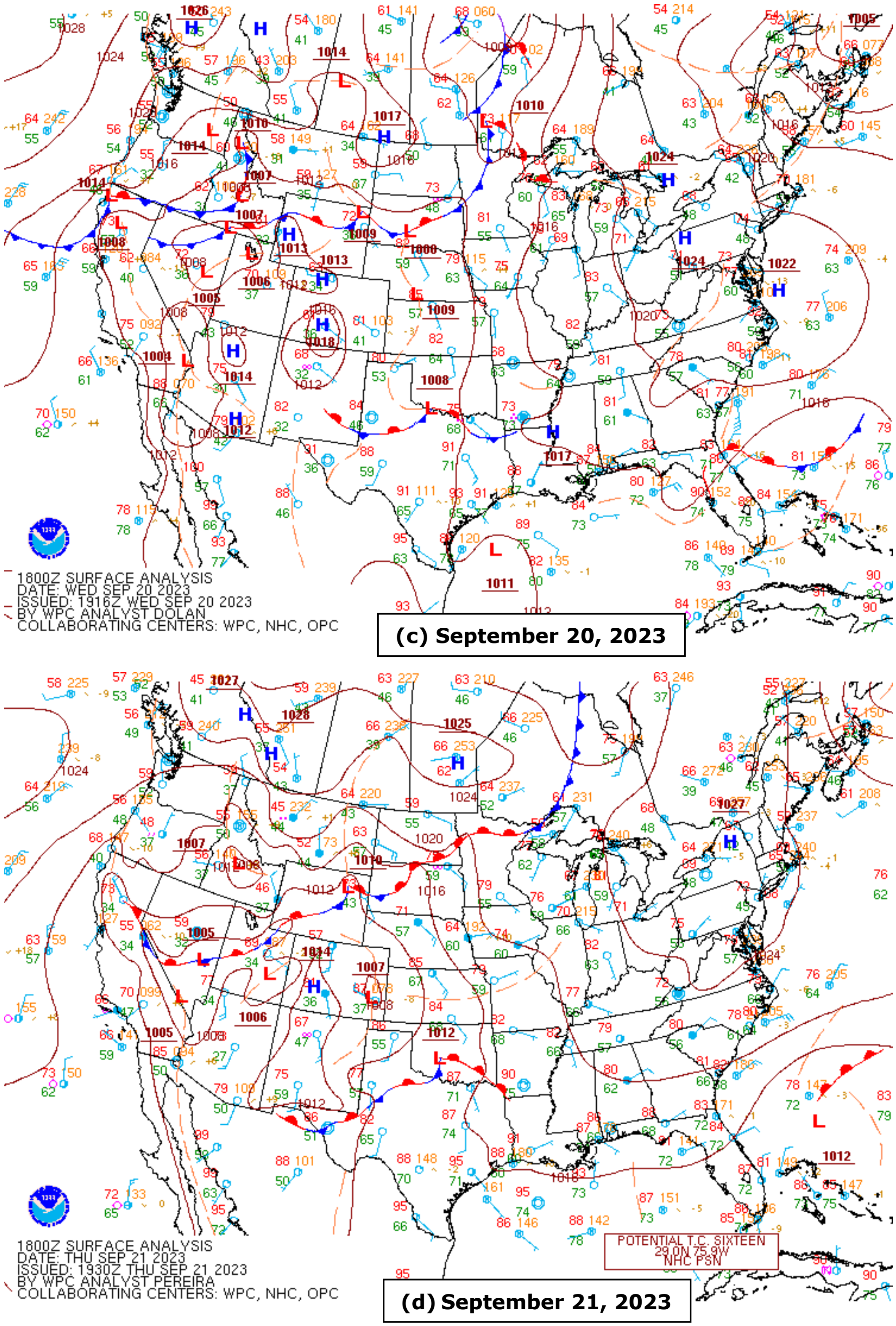


Figure 2-281. Surface synoptic analysis maps at 18 UTC on (a) September 18, (b) September 19, (c) September 20, and (d) September 21, 2023.

The NOAA HMS product in Figure 2-282 and the visible satellite images in Figure 2-283 show the presence of light to medium-density smoke covering much of the central Plains and southeastern U.S. the AQI index in Figure 2-284 shows consist moderate values in Arkansas during the period of September 18 to 21, 2023, while the HRRR modeled smoke surface concentrations in Figure 2-285 indicate that this smoke mixed down to surface level, impacting monitors over Arkansas and parts of the southeastern U.S. Modeled smoke impacts in Arkansas generally range between 2 and 4 $\mu g/m^3$. Figure 2-286 and Figure 2-287 illustrate the evolution of smoke plumes from September 15-23, 2023, originating from multiple fires in northwest Canada and northern California.

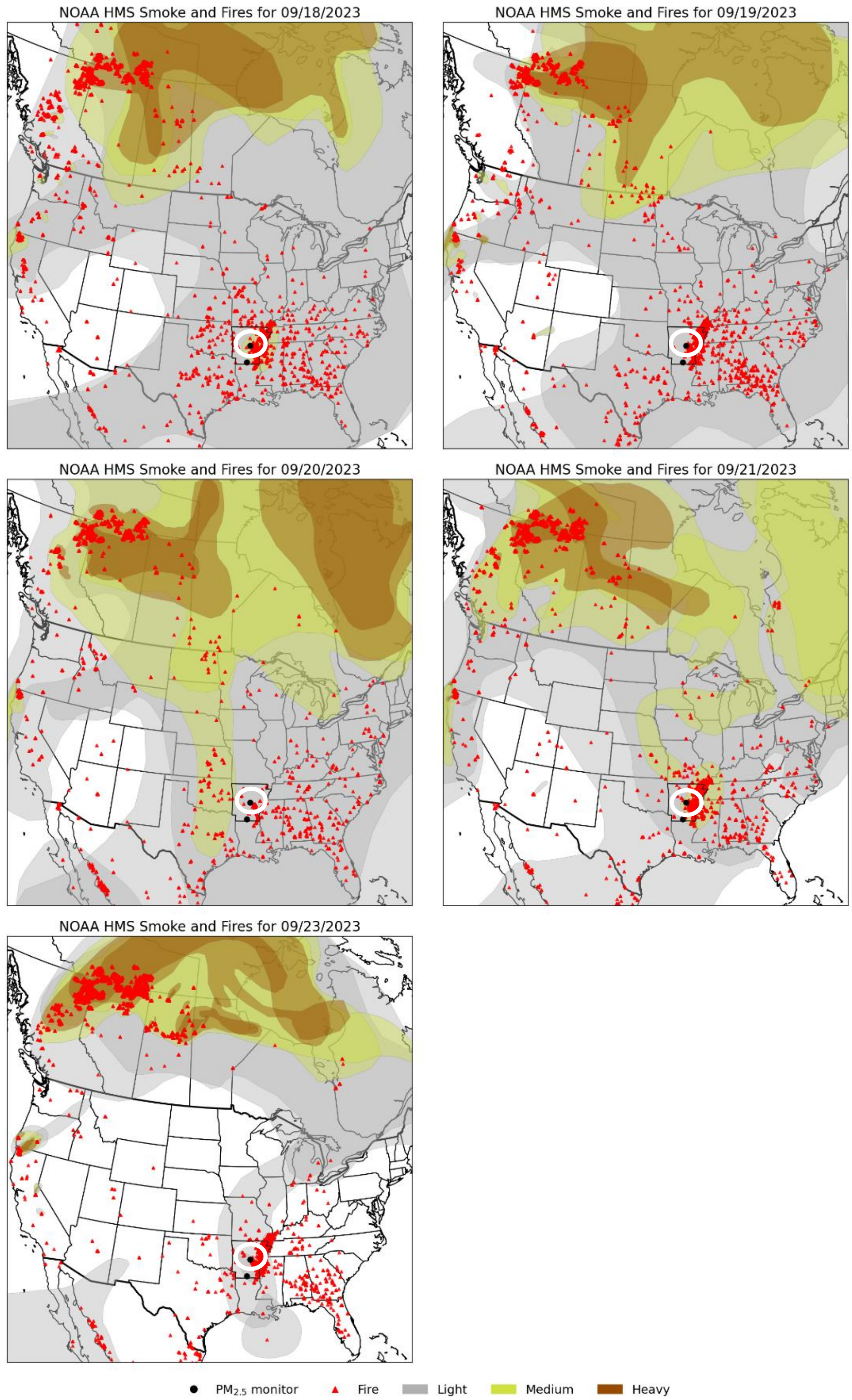
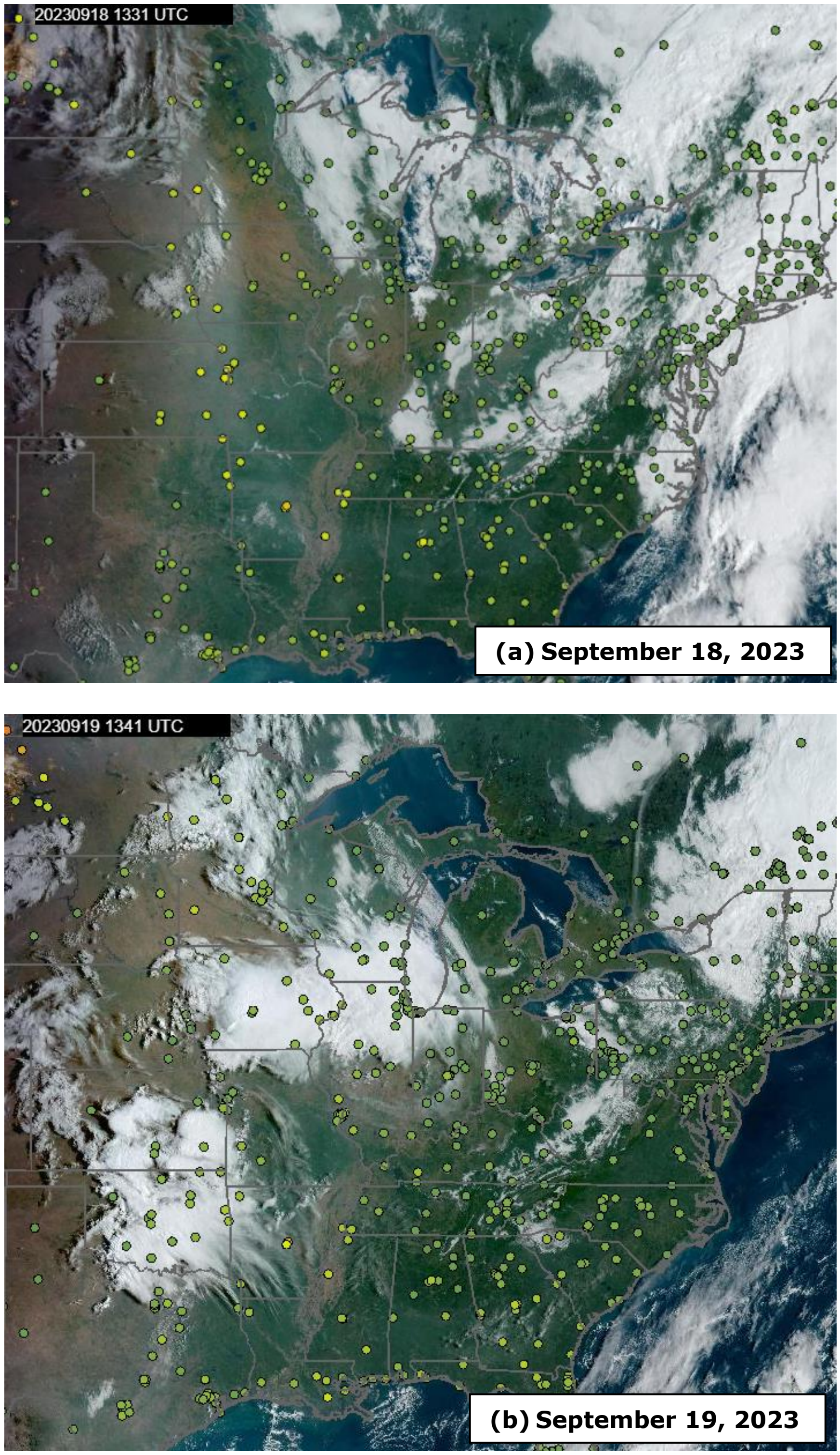


Figure 2-282. NOAA HMS fire and smoke products for September 18 (top left), September 19 (top right), September 20 (middle left), September 21 (middle right), and September 23 (bottom left).


20230918 1331 UTC
(a) September 18, 2023
20230919 1341 UTC
(b) September 19, 2023

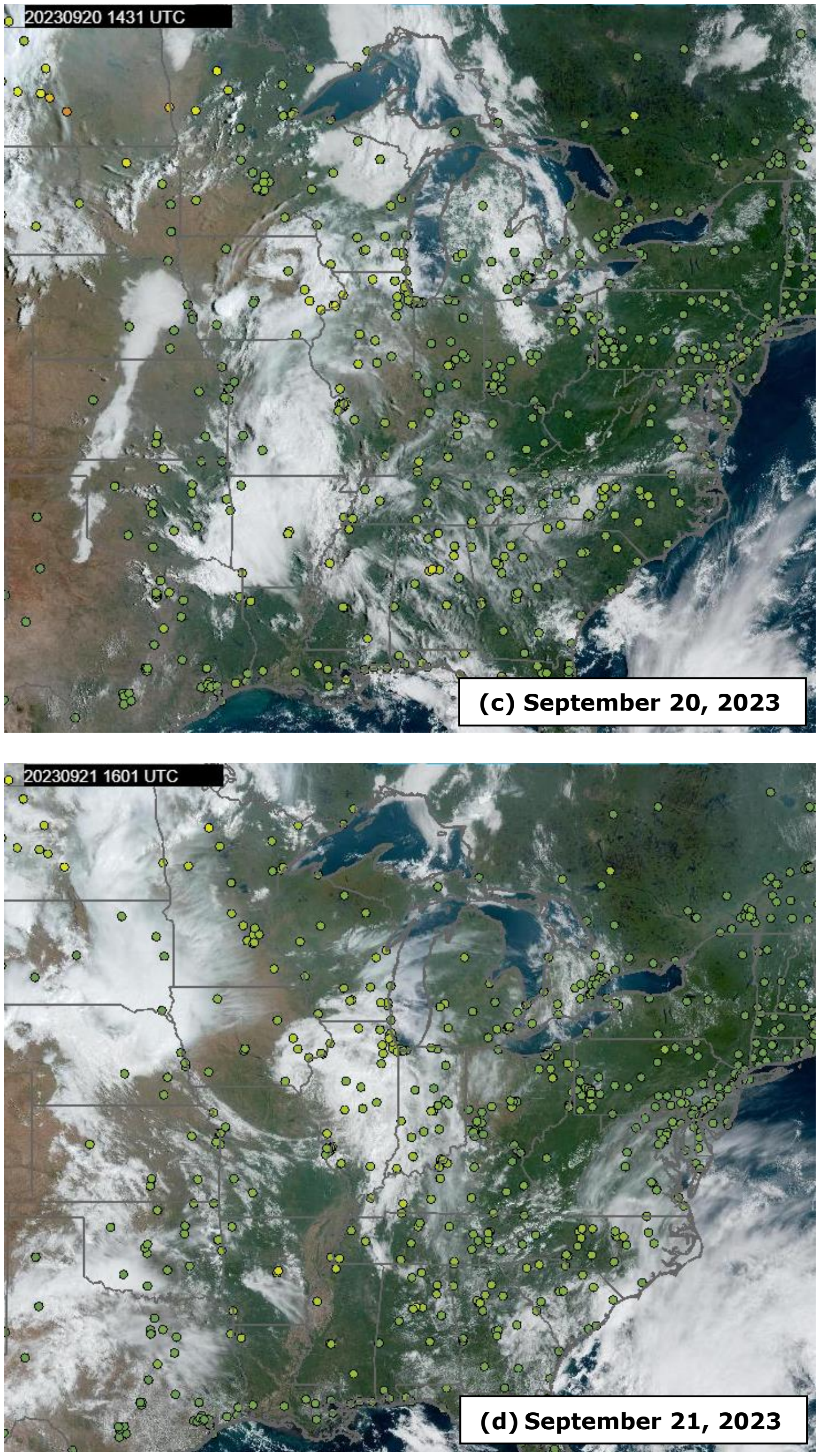
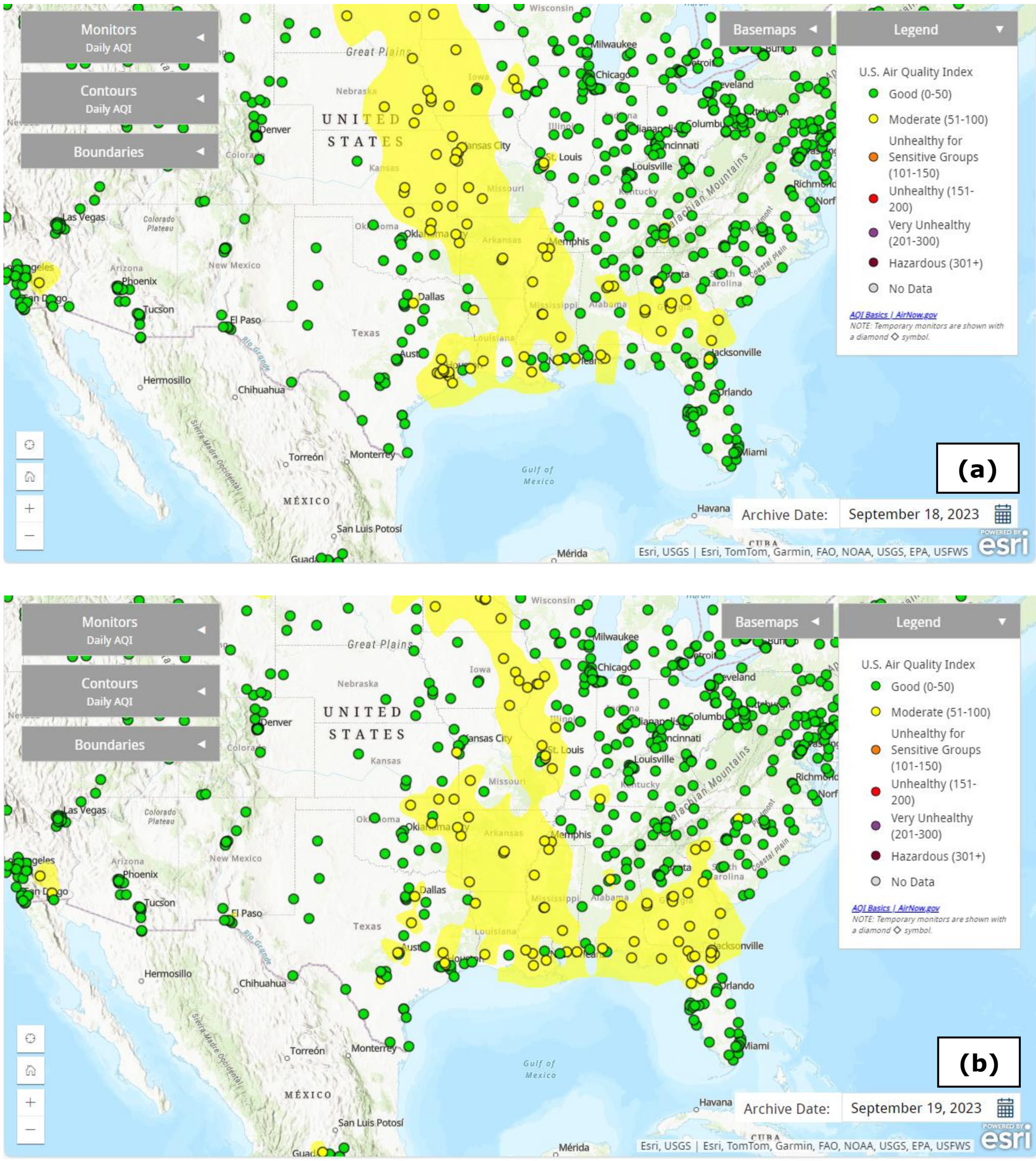


Figure 2-283. NOAA satellite visible imagery for (a) September 18 at 1331 UTC, (b) September 19 at 1341 UTC, (c) September 20 at 1431 UTC, and (d) September 21 at 1601 UTC, 2023.


Monitors
Daily AQI
Contours
Daily AQI
Boundaries
Basemaps
Legend
U.S. Air Quality Index
Good (0-50)
Moderate (51-100)
Unhealthy for Sensitive Groups (101-150)
Unhealthy (151-200)
Very Unhealthy (201-300)
Hazardous (301+)
No Data
AQI Basics | AirNow.gov
NOTE: Temporary monitors are shown with a diamond ◇ symbol.
(a)
Archive Date:
September 18, 2023
(b)
Archive Date:
September 19, 2023
Esri, USGS | Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, USFWS

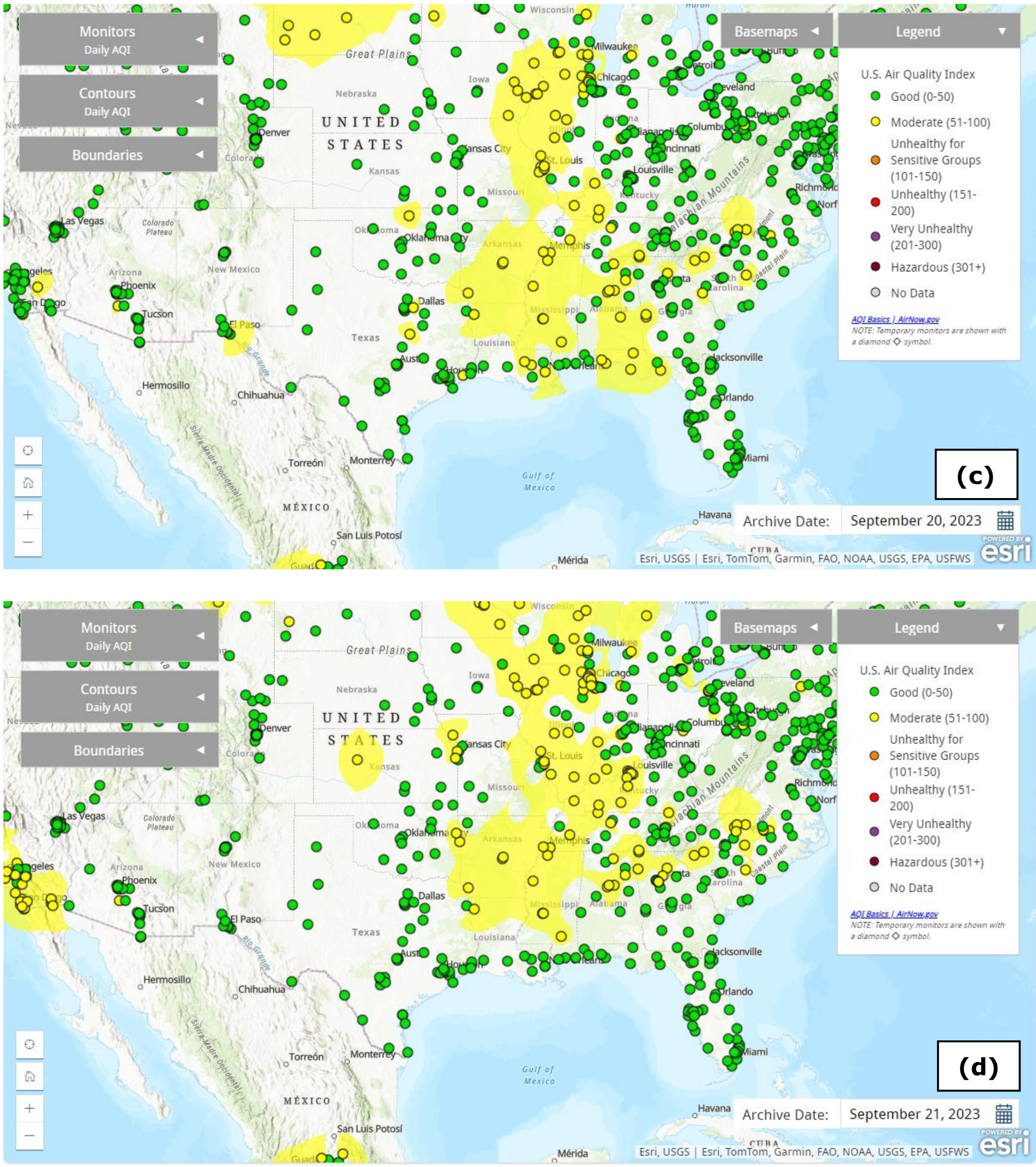
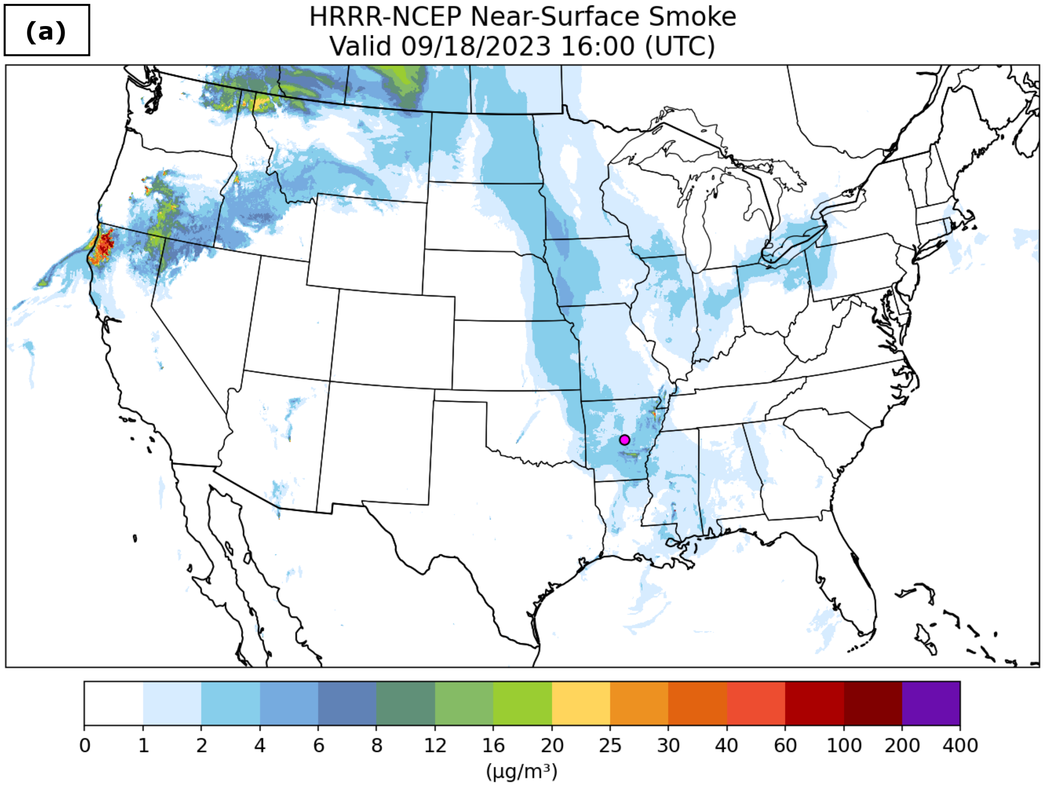
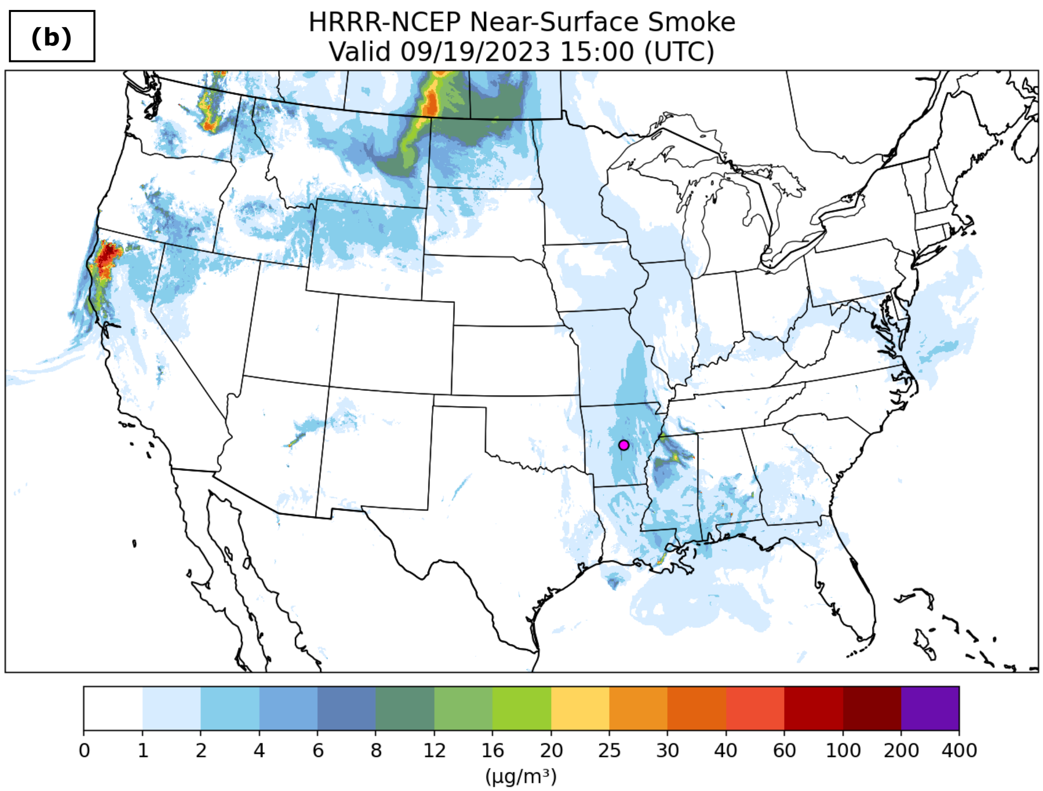
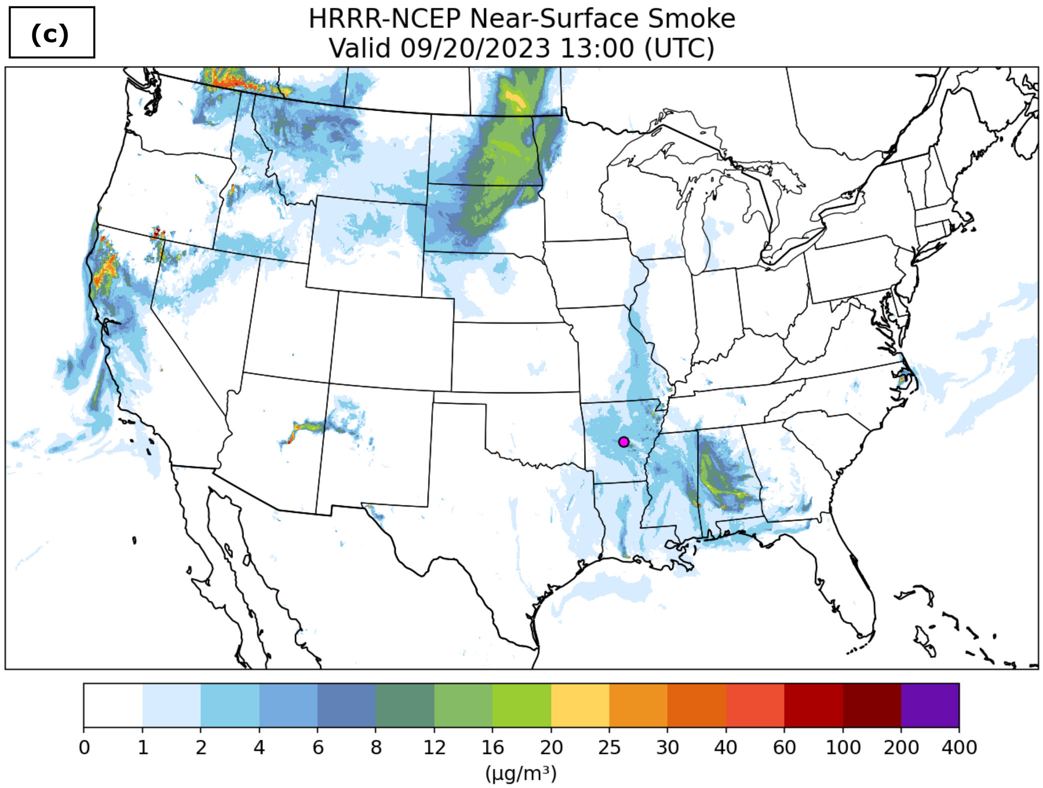
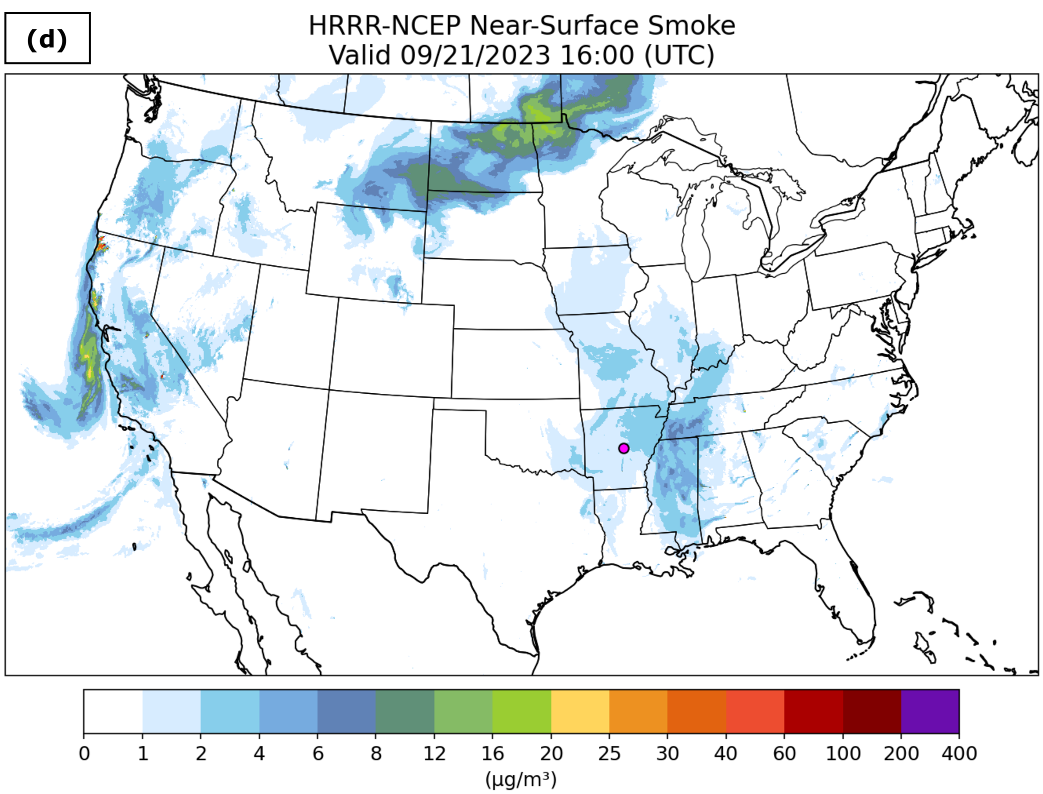


Figure 2-284. AirNow surface level $PM_{2.5}$ concentration contours for (a) September 18, (b) September 19, (c) September 20, (d) and September 21, 2023.


(a)
HRRR-NCEP Near-Surface Smoke
Valid 09/18/2023 16:00 (UTC)
0 1 2 4 6 8 12 16 20 25 30 40 60 100 200 400
(µg/m³)


(b)
HRRR-NCEP Near-Surface Smoke
Valid 09/19/2023 15:00 (UTC)
0 1 2 4 6 8 12 16 20 25 30 40 60 100 200 400
(µg/m³)


(c)
HRRR-NCEP Near-Surface Smoke
Valid 09/20/2023 13:00 (UTC)
0 1 2 4 6 8 12 16 20 25 30 40 60 100 200 400
(µg/m³)


(d)
HRRR-NCEP Near-Surface Smoke
Valid 09/21/2023 16:00 (UTC)
0 1 2 4 6 8 12 16 20 25 30 40 60 100 200 400
(µg/m³)

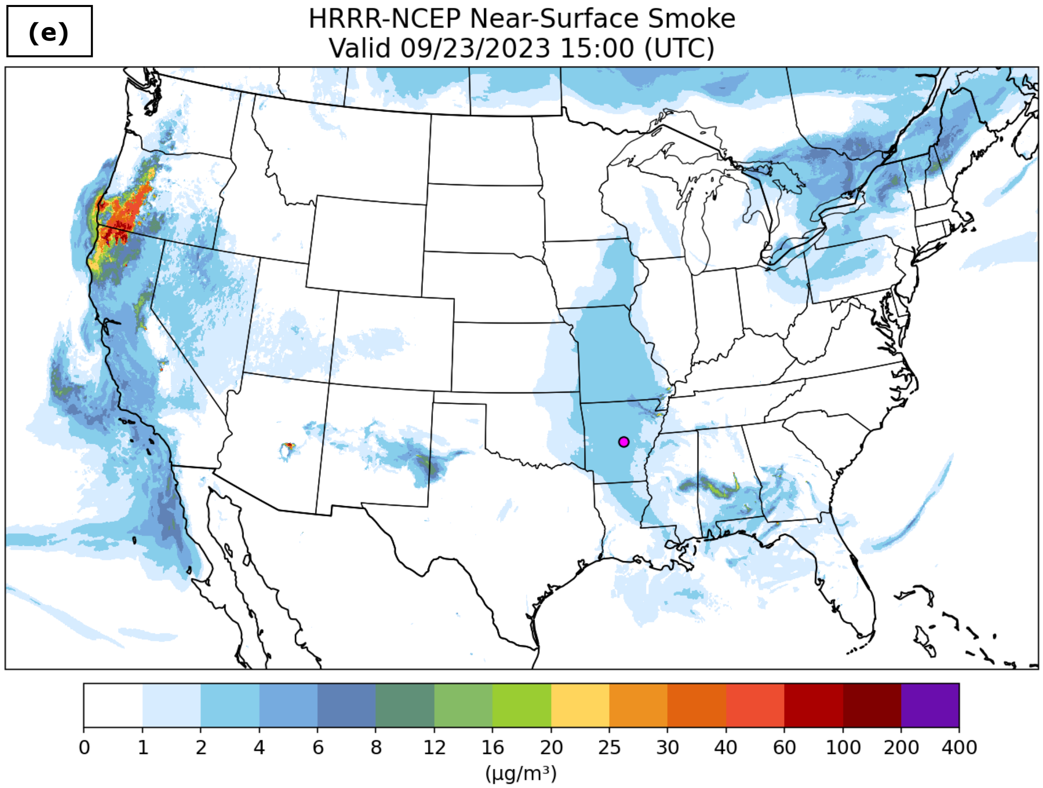


Figure 2-285. HRRR-Smoke modeled near-surface smoke concentrations (µg/m^3) for (a) September 18 at 11 AM CDT, (b) September 19 at 10 AM CDT, (c) September 20 at 8 AM CDT, (d) September 21 at 11 AM CDT, and (e) September 23 at 10 AM CDT, 2023.

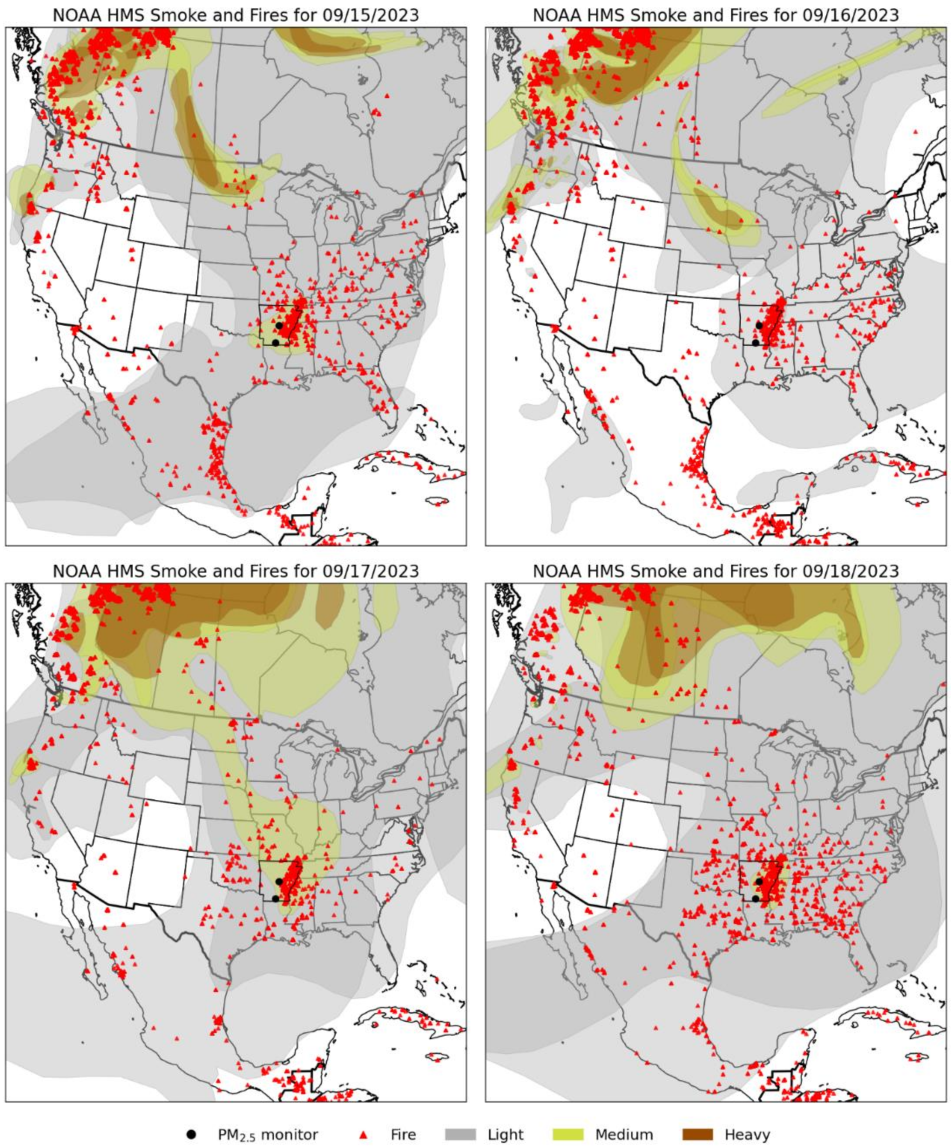


Figure 2-286. Evolution of fires and smoke for September 15 (top left), September 14 (top right), September 17 (bottom left), and September 18 (bottom right).

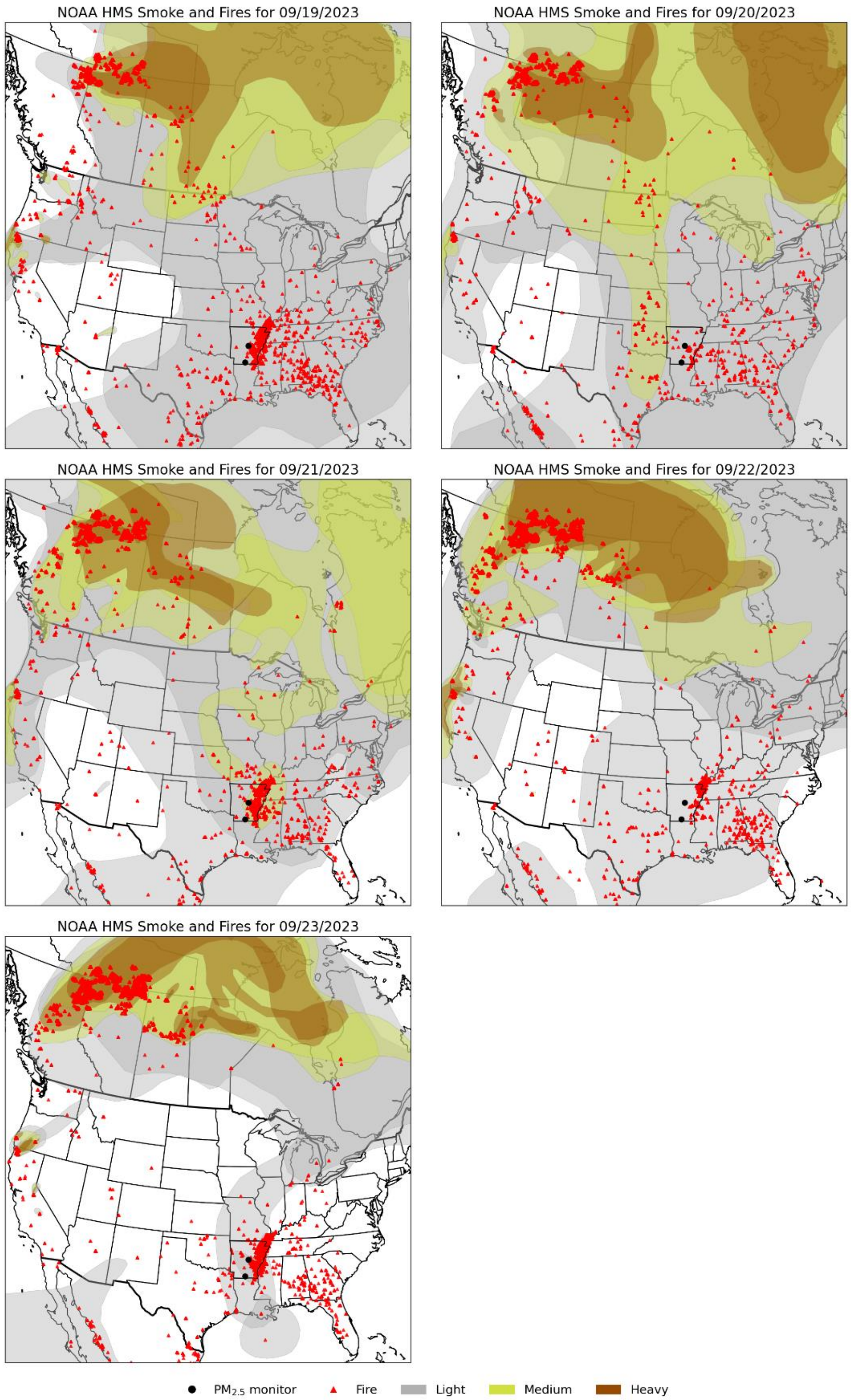


Figure 2-287. Evolution of fires and smoke for September 19 (top left), September 20 (top right), September 21 (middle left), September 22 (middle right), and September 23 (bottom left).

2.1.13.1 PARR September 18, 2023

Table 2-41 summarizes the evidence supporting the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on September 18, 2023. Figure 2-288 indicates that the 24-hour $PM_{2.5}$ concentrations on this day is clearly above the Tier 2 threshold, while Figure 2-289 shows it is at the 99th percentile historical values over the last five years. Figure 2-290 and Figure 2-291 show 96-hour back trajectories passing through regions with light to heavy-density smoke from wildfires in northwest Canada and northern California and then descend over the monitoring site. Figure 2-292 shows that $PM_{2.5}$ concentrations started to increase from 10 µg/m^3 on September 17 at 8 hours CDT to 35 µg/m^3 on September 18 and continued to increase to 48.4 µg/m^3 by 21 hours CDT. This rise was driven by the combined effects of ridge at 500 mb (Figure 2-280a) over the western U.S. and the presence of a stationary front over the central plains (Figure 2-281a), which facilitated the transport of smoke-laden air into Arkansas, leading to elevated $PM_{2.5}$ concentrations.

Table 2-41. Exceptional event supporting evidence for PARR on September 18, 2023.

Monitor	PARR (05-119-0007)
Event Date	September 18, 2023
24-hr $PM_{2.5}$ Concentration	22.5 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada and northern California
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: September. Date accessed: 11/20/2024.

Figure 2-288. EPA $PM_{2.5}$ Tiering Tool for PARR on September 18, 2023.

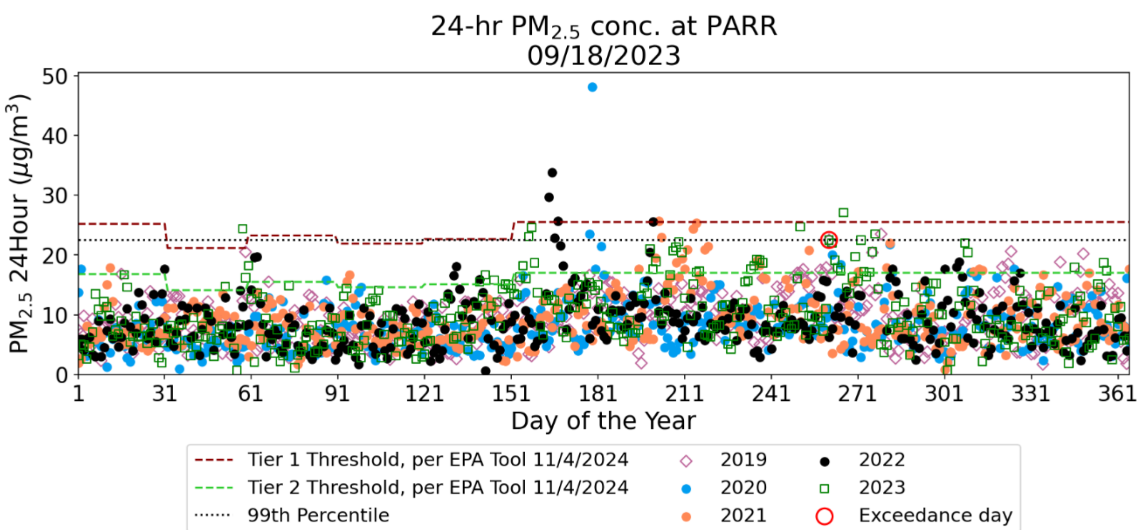


Figure 2-289. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to September 18, 2023.

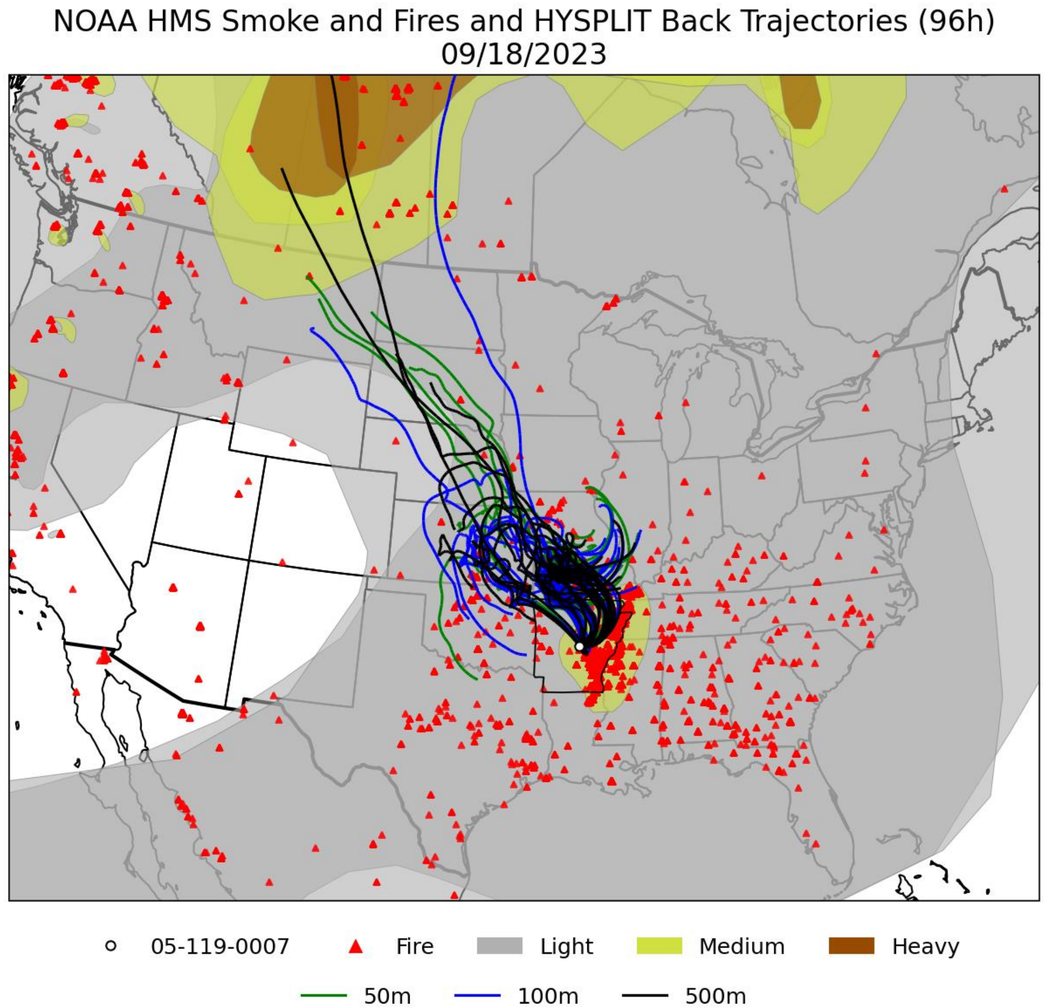
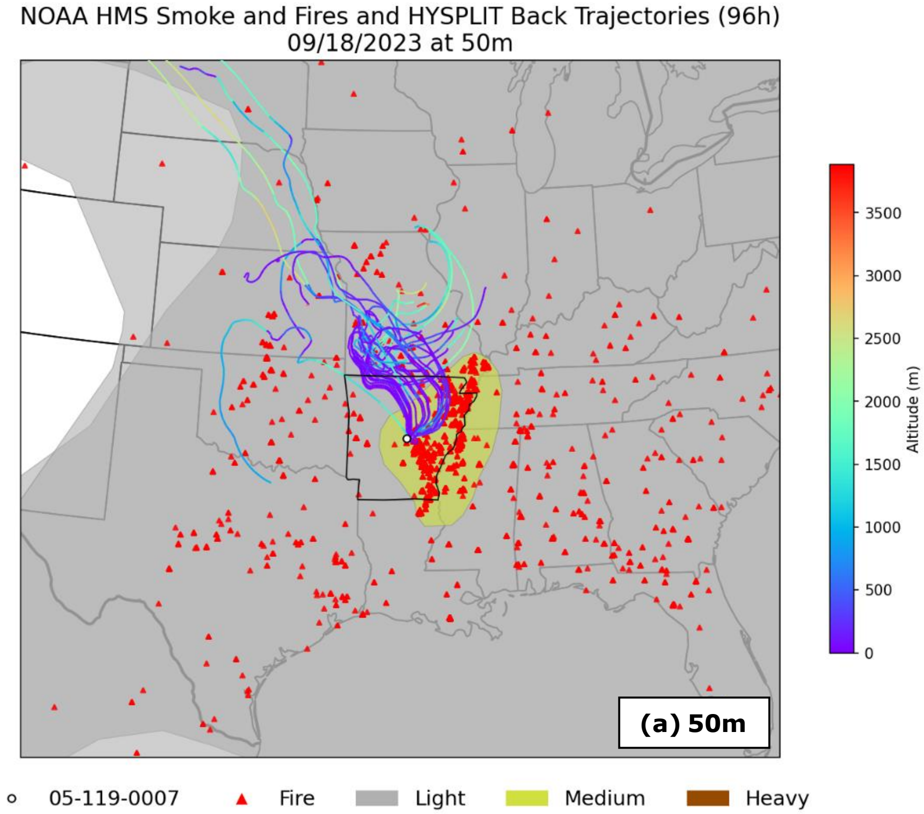
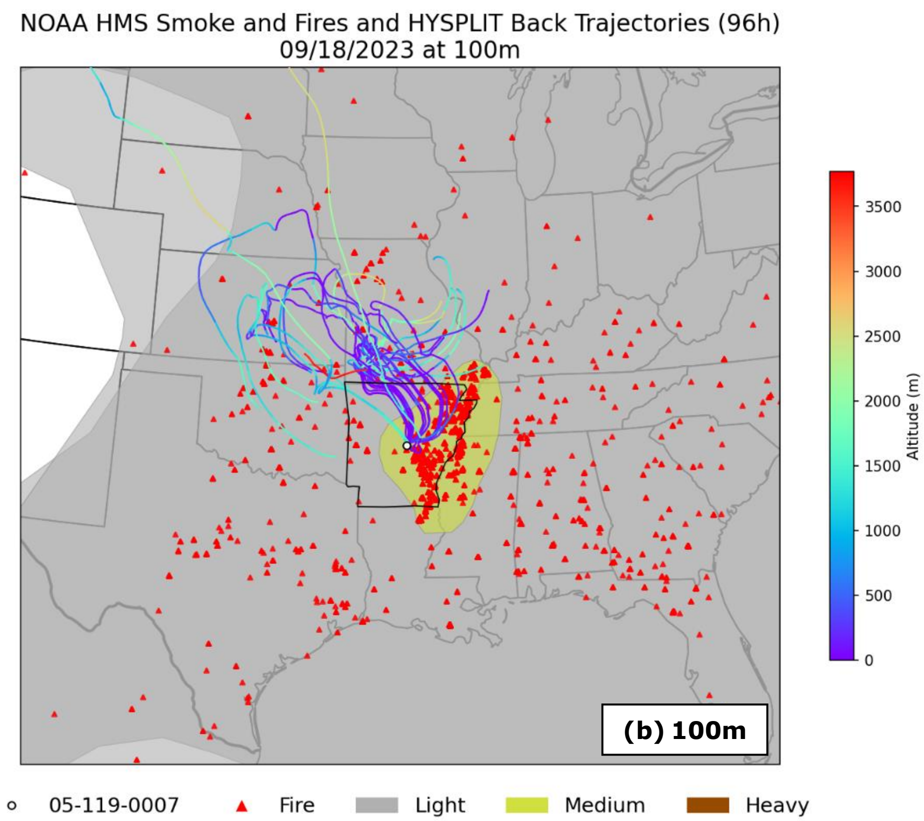


Figure 2-290. HYSPLIT back trajectories for PARR on September 18, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
09/18/2023 at 50m
Altitude (m)
0
500
1000
1500
2000
2500
3000
3500
(a) 50m
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
09/18/2023 at 100m
Altitude (m)
0
500
1000
1500
2000
2500
3000
3500
(b) 100m
05-119-0007
Fire
Light
Medium
Heavy

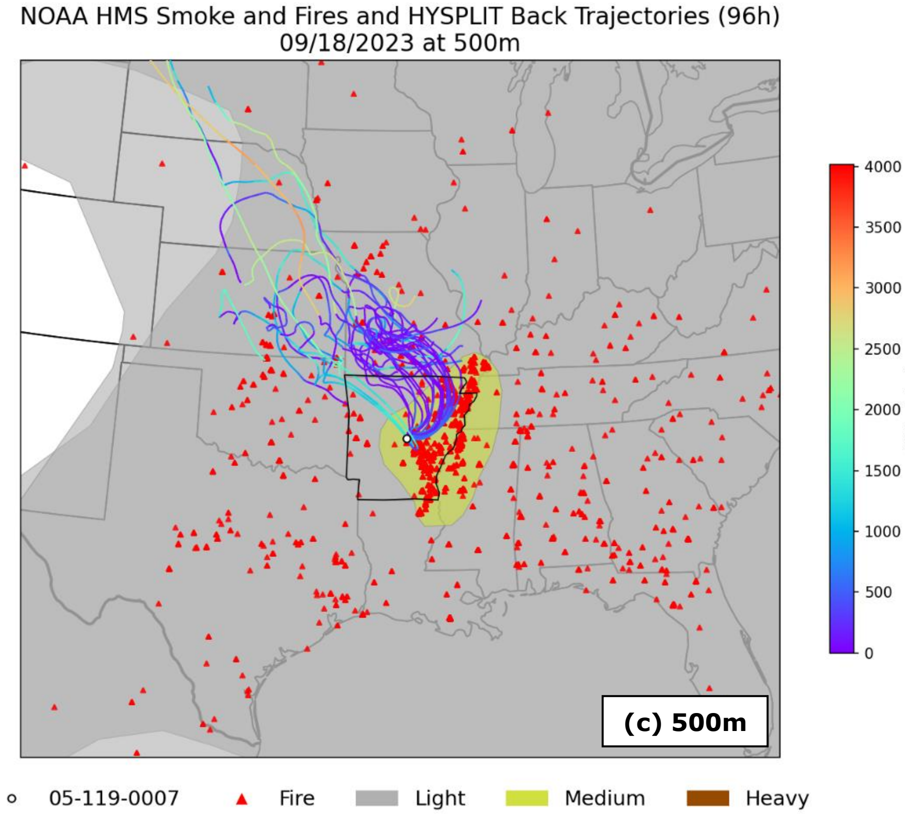


Figure 2-291. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on September 18, 2023.

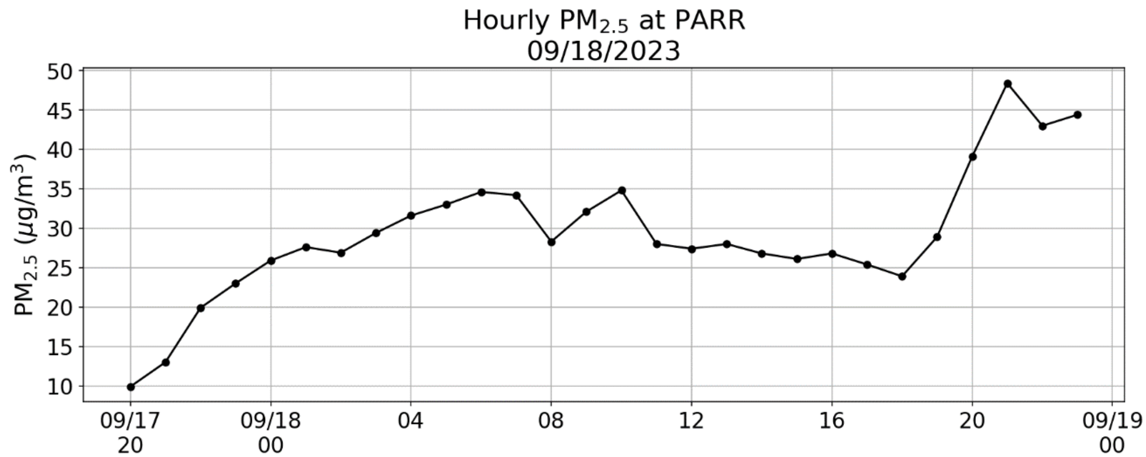


Figure 2-292. Hourly PM2.5 concentrations for PARR on September 18, 2023.

2.1.13.2 PARR September 19, 2023

Table 2-42 summarizes the evidence supporting the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on September 19, 2023. Figure 2-293 shows that this day exceeds the Tier 2 threshold, while Figure 2-294 indicates it is near the 99th percentile of historical values over the last five years. Figure 2-295 shows that several 96-hour back trajectories, started at 100 m and 500 m above the monitoring site, travel to regions in Canada and in their path, they cross areas with heavy-density smoke. The 500 mb trough over northwest North America (Figure 2-280b) drove the smoke eastward, and the movement of the cold front southeastward (Figure 2-281b) enhanced the southward transport of smoke impacting the site in Arkansas. Most of the trajectories descended over the site (Figure 2-296). Time series of hourly $PM_{2.5}$ concentrations on September 19 (Figure 2-297) started the day with high values of approximately 40-45 µg/m^3, and then dropped to around 20 µg/m^3 for several hours (12-18 hours CDT) before increasing again to 35 µg/m^3 at night.

Table 2-42. Exceptional event supporting evidence for PARR on September 19, 2023.

Monitor	PARR (05-119-0007)
Event Date	September 19, 2023
24-hr $PM_{2.5}$ Concentration	22.0 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada and northern California
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: September. Date accessed: 11/20/2024.

Figure 2-293. EPA PM2.5 Tiering Tool for PARR on September 19, 2023.

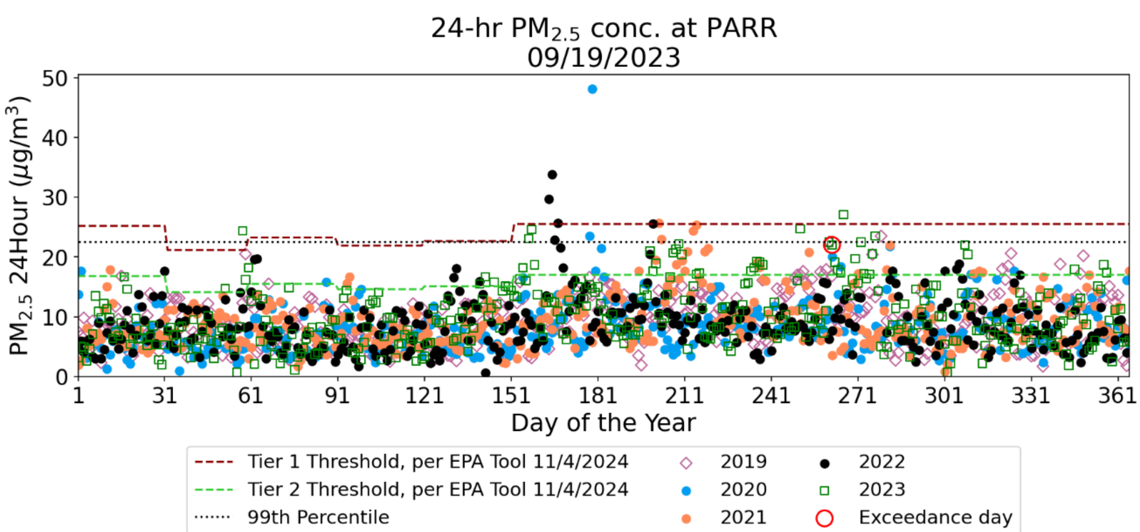


Figure 2-294. Historical 24-hour PM2.5 seasonal fluctuations for PARR compared to September 19, 2023.

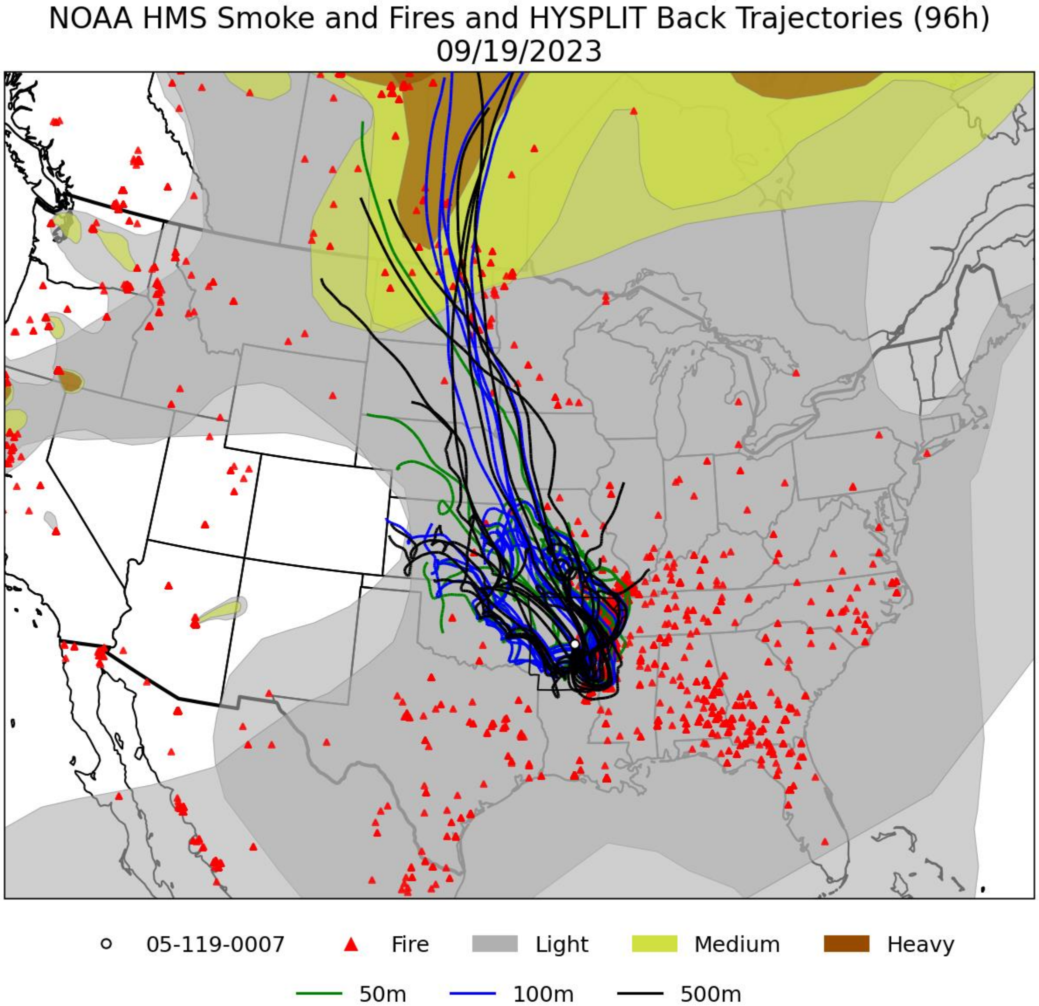
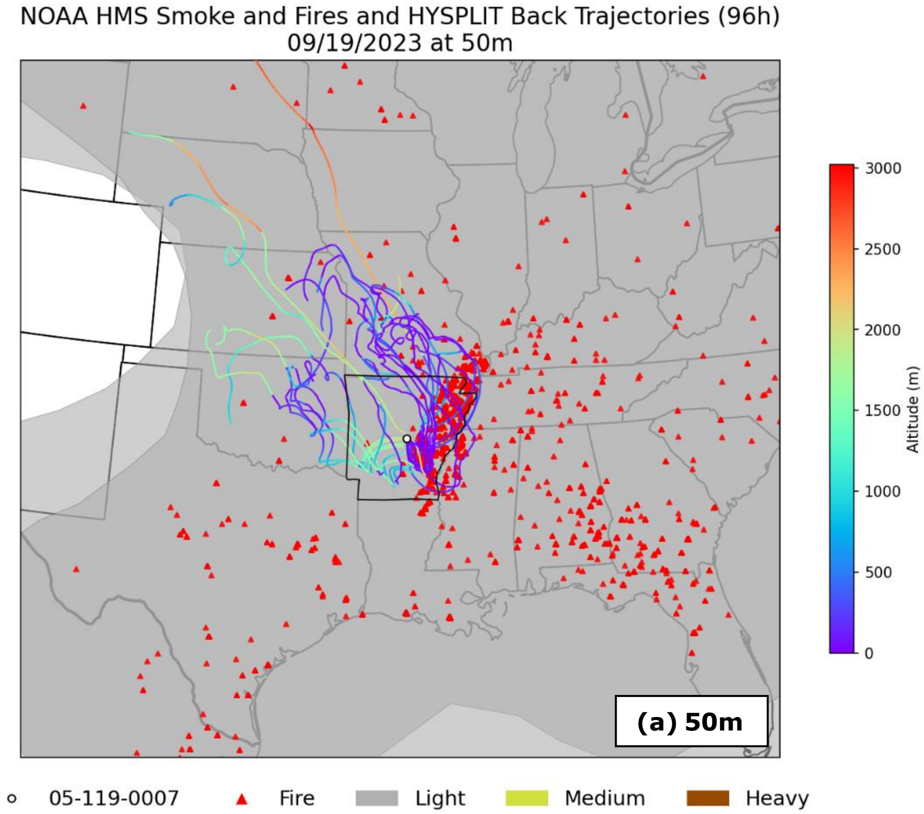
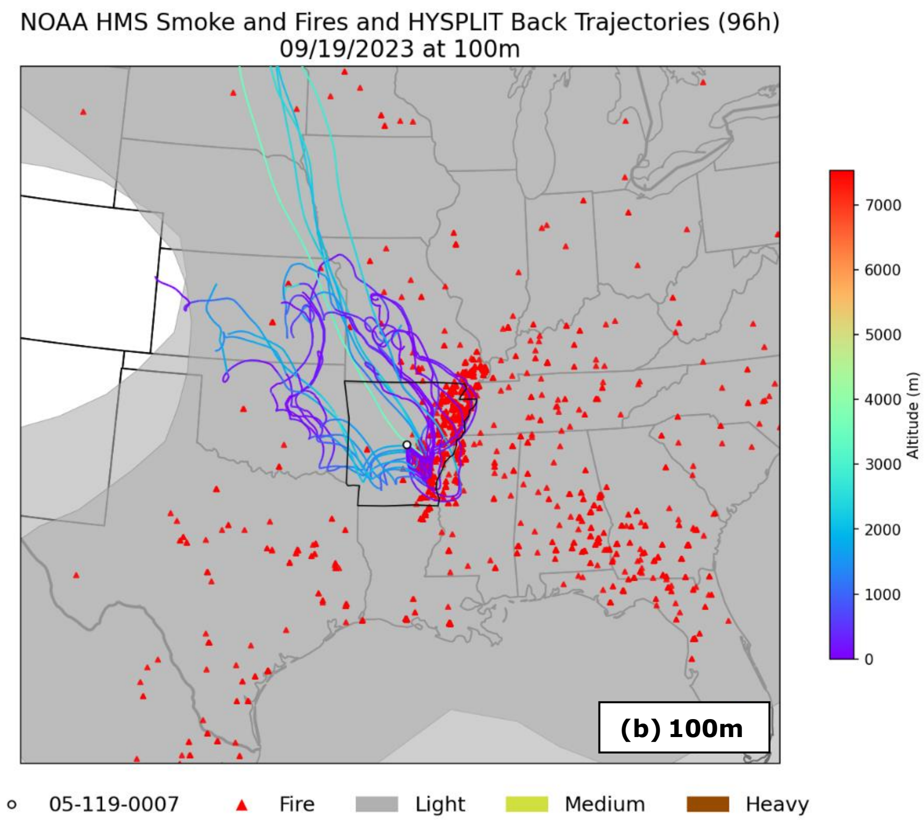


Figure 2-295. HYSPLIT back trajectories for PARR on September 19, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
09/19/2023 at 50m
3000
2500
2000
1500
1000
500
0
Altitude (m)
(a) 50m
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
09/19/2023 at 100m
7000
6000
5000
4000
3000
2000
1000
0
Altitude (m)
(b) 100m
05-119-0007
Fire
Light
Medium
Heavy

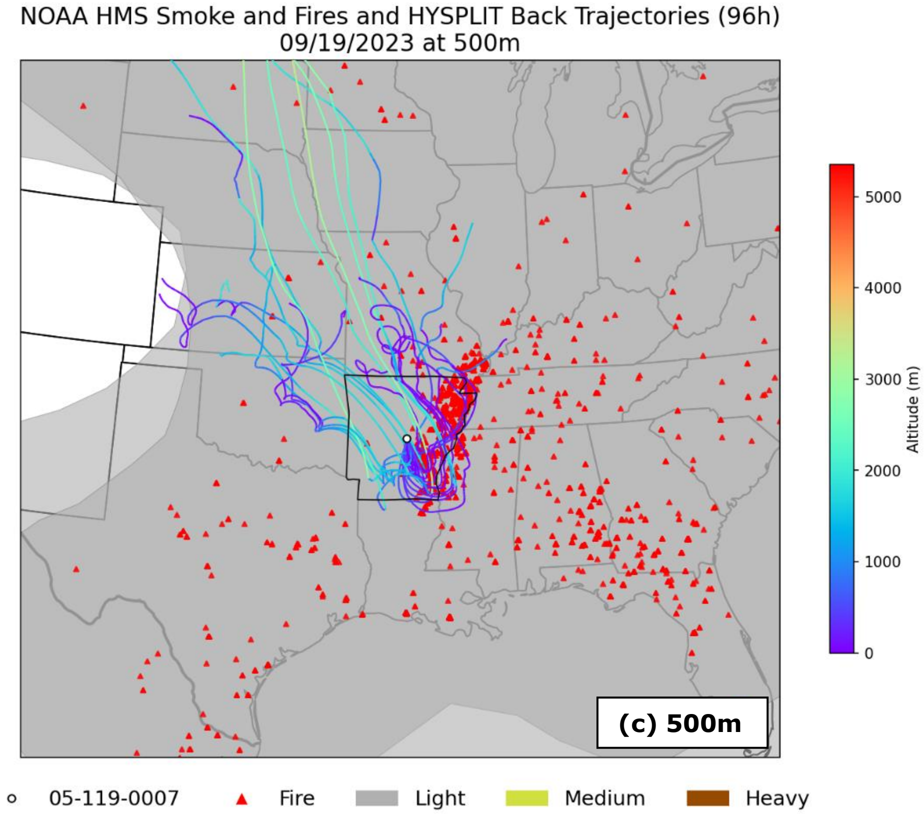


Figure 2-296. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on September 19, 2023.

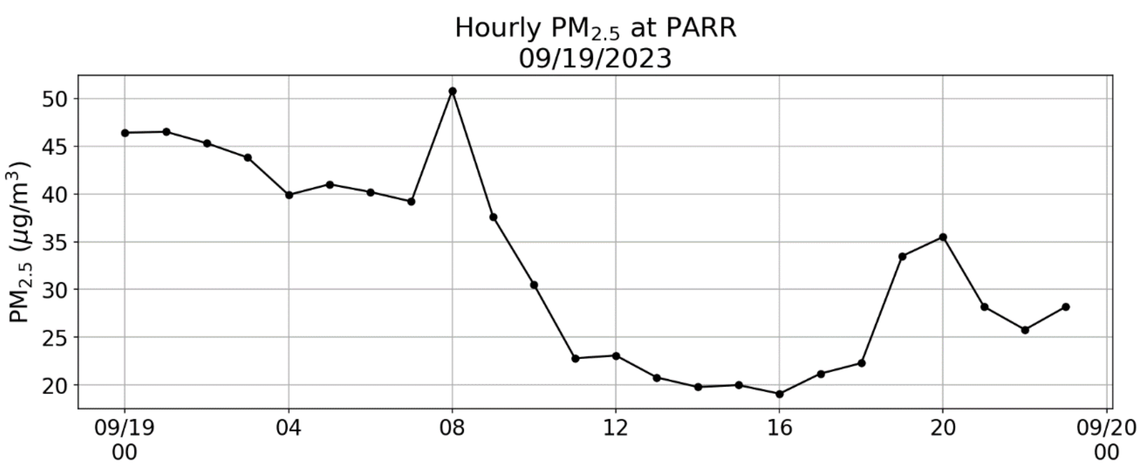


Figure 2-297. Hourly $PM_{2.5}$ concentrations for PARR on September 19, 2023.

2.1.13.3 PARR September 20, 2023

Table 2-43 summarizes the evidence supporting the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on September 20, 2023. Figure 2-298 shows that this day exceeds the Tier 2 threshold. Figure 2-300 indicates that the 96-hour back trajectories pass through regions with medium-density smoke and then descend over the monitoring site (Figure 2-301). The high-pressure system at 500 mb (Figure 2-280c) and the surface analysis (Figure 2-281c) over the southeastern U.S. are consistent with the direct transport of smoke from wildfires in northwest Canada and northern California into Arkansas, impacting the monitoring site. Hourly $PM_{2.5}$ concentrations (Figure 2-302) remained almost constant at very low values, between 20-25 µg/m^3, before rapidly increasing to 50 µg/m^3 at 22 hours CDT.

Table 2-43. Exceptional event supporting evidence for PARR on September 20, 2023.

Monitor	PARR (05-119-0007)
Event Date	September 20, 2023
24-hr $PM_{2.5}$ Concentration	19.1 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada and northern California
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: September. Date accessed: 11/20/2024.

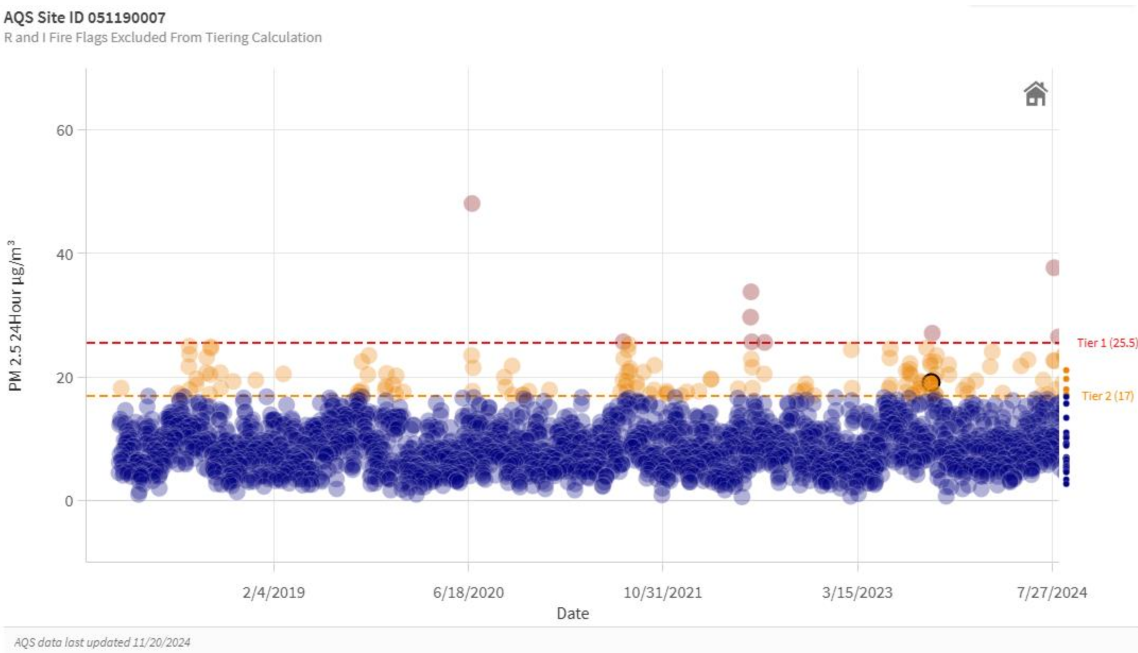


Figure 2-298. EPA $PM_{2.5}$ Tiering Tool for PARR on September 20, 2023.

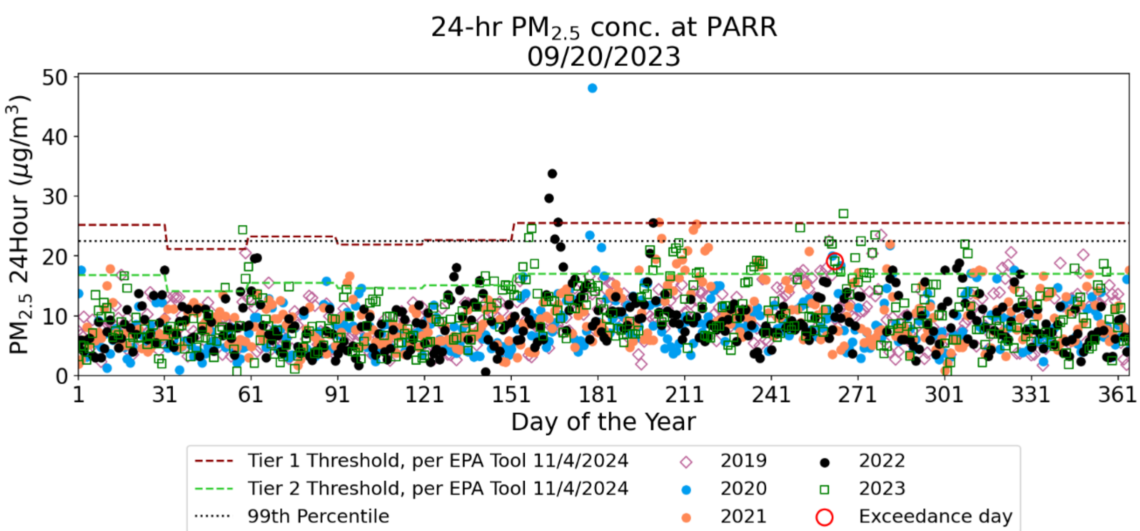


Figure 2-299. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to September 20, 2023.

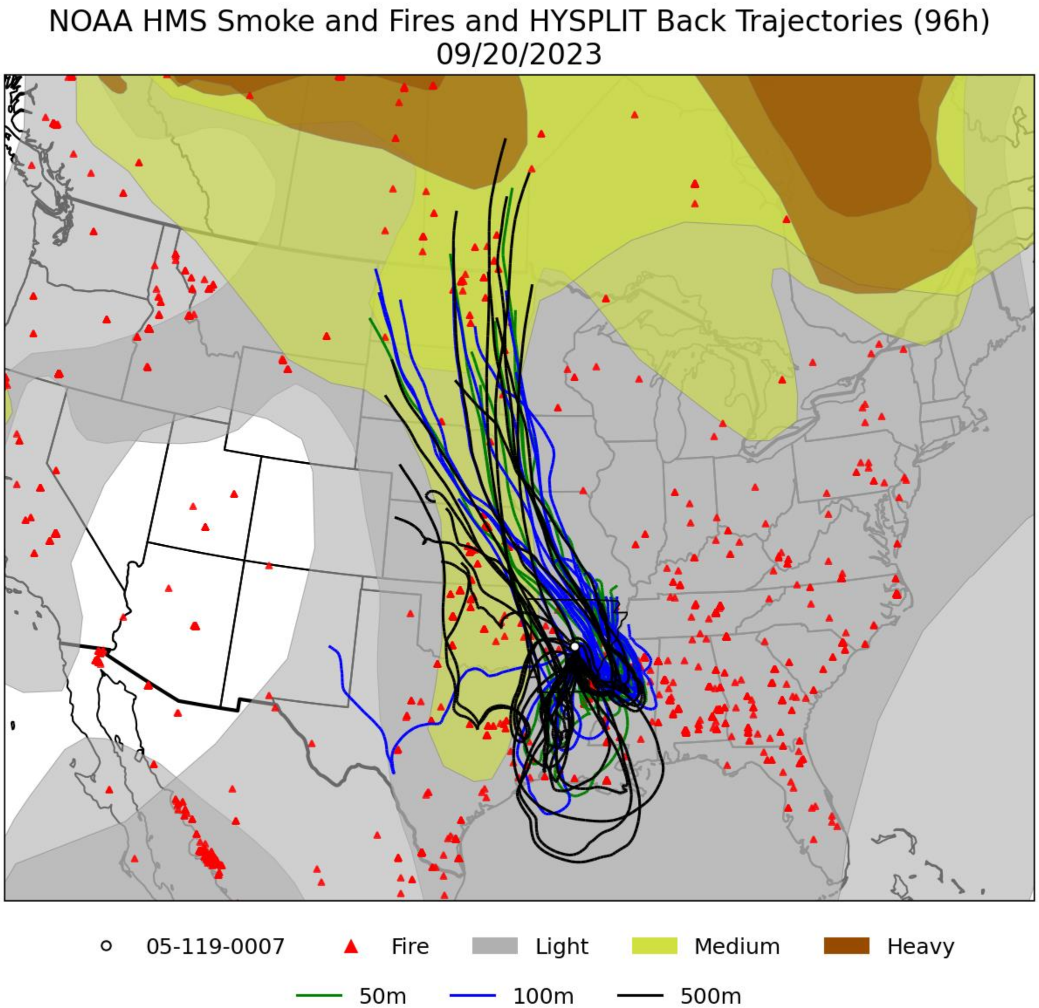
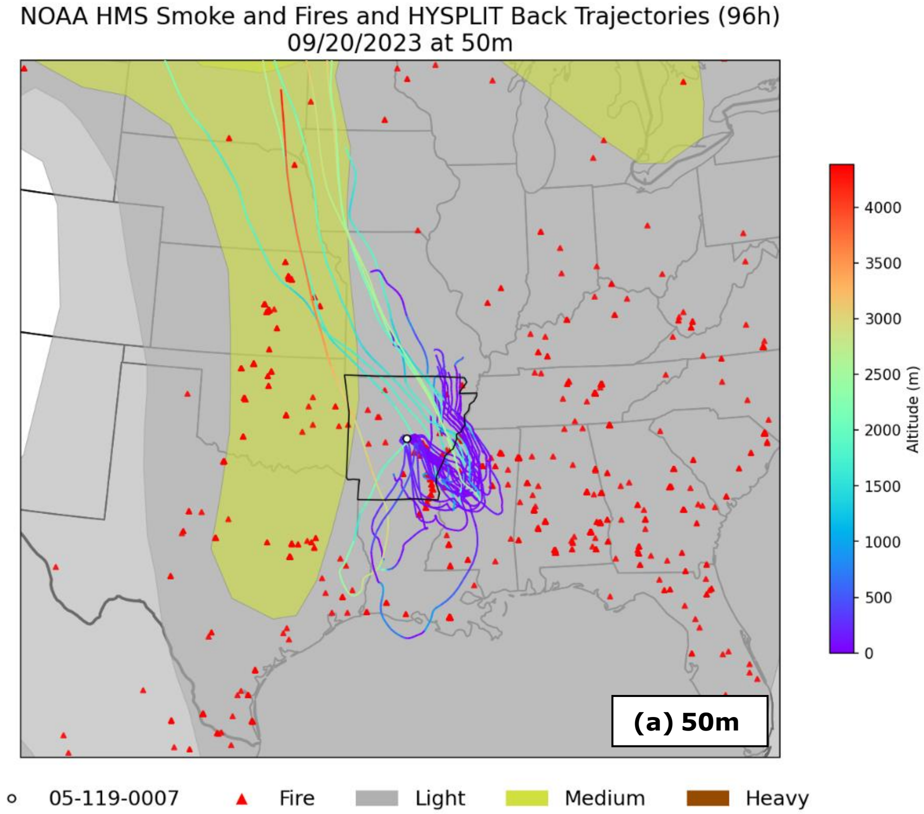
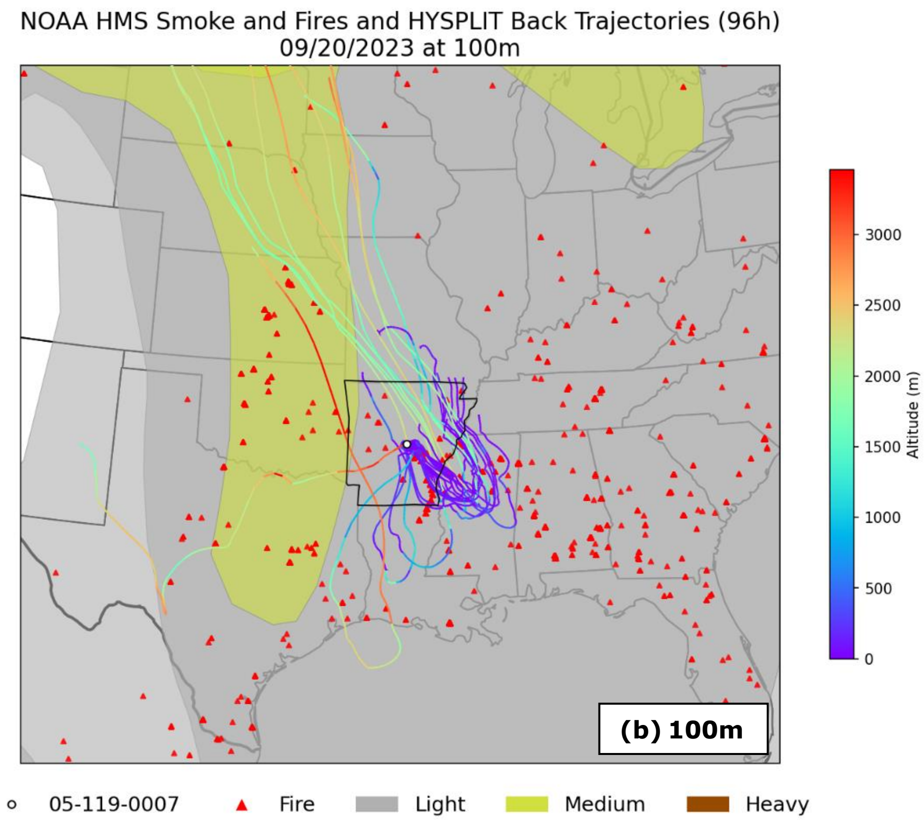


Figure 2-300. HYSPLIT back trajectories for PARR on September 20, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
09/20/2023 at 50m
(a) 50m
Altitude (m)
0
500
1000
1500
2000
2500
3000
3500
4000
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
09/20/2023 at 100m
(b) 100m
Altitude (m)
0
500
1000
1500
2000
2500
3000
05-119-0007
Fire
Light
Medium
Heavy

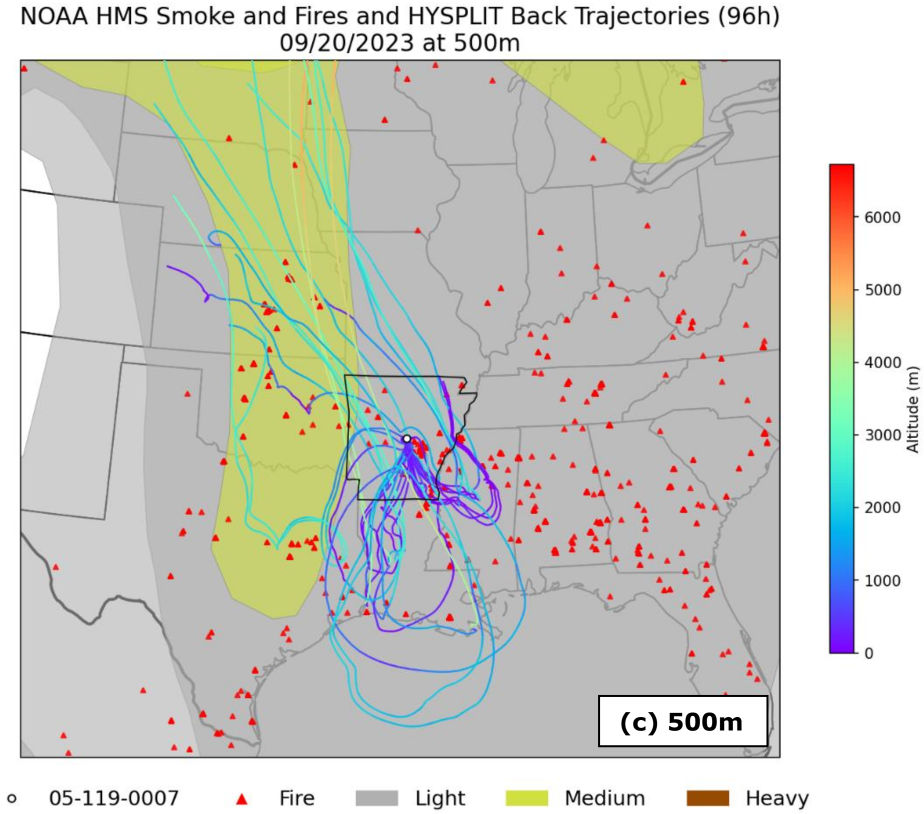


Figure 2-301. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on September 20, 2023.

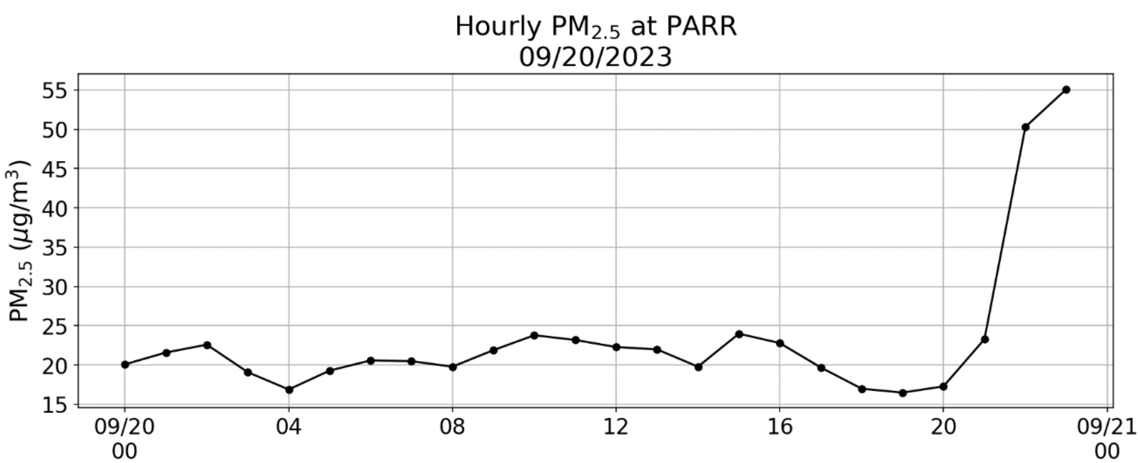


Figure 2-302. Hourly $PM_{2.5}$ concentrations for PARR on September 20, 2023.

2.1.13.4 PARR September 21, 2023

Table 2-44 summarizes the evidence supporting the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on September 21, 2023. Figure 2-303 shows that this day exceeds the Tier 2 threshold. Figure 2-305 indicates the presence of anticyclonic (clockwise) flow, as back trajectories pass over regions with medium-density smoke transported from wildfires in northwest Canada and northern California before they circulate around Mississippi, Louisiana and Texas and descend over the monitoring site (Figure 2-306). The synoptic scale features on this day (Figure 2-280d) were conducive to transporting smoke from wildfires in Canada and northern California into the eastern U.S., facilitated by the presence of ridge and low-pressure systems (Figure 2-281d) that directed smoke into Arkansas. Figure 2-307 shows that the hourly $PM_{2.5}$ concentrations had an initial high value of 50 µg/m^3 at the start of the day that decreased to approximately 15-25 µg/m^3 by early morning, but that increased after 20 hours CDT, reaching 42.2 µg/m^3 by midnight.

Table 2-44. Exceptional event supporting evidence for PARR on September 21, 2023.

Monitor	PARR (05-119-0007)
Event Date	September 21, 2023
24-hr $PM_{2.5}$ Concentration	17.8 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: September. Date accessed: 11/20/2024.

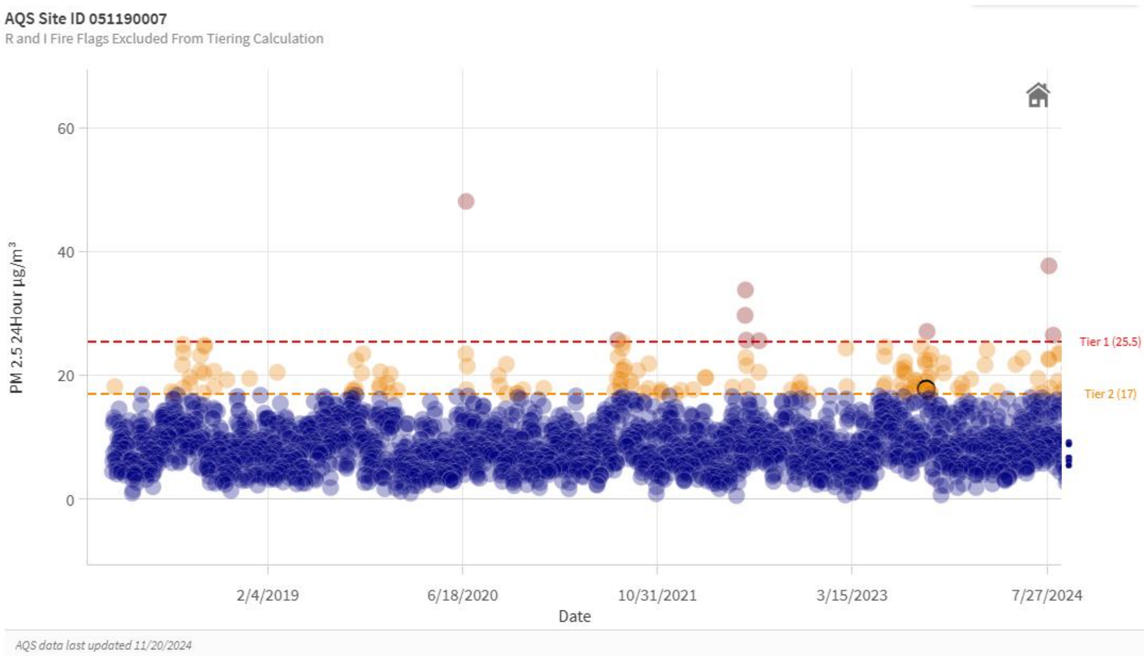


Figure 2-303. EPA PM2.5 Tiering Tool for PARR on September 21, 2023.

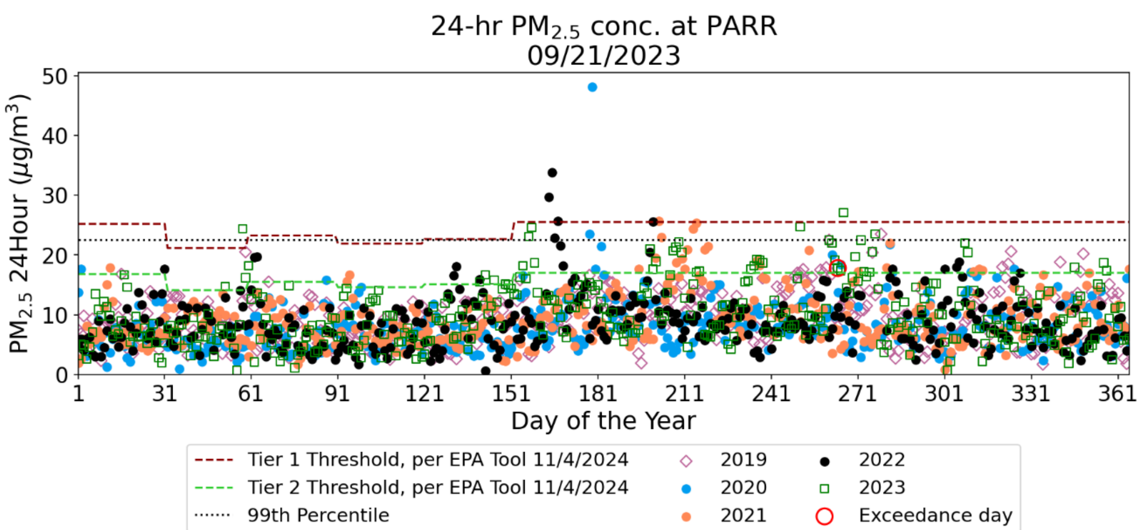


Figure 2-304. Historical 24-hour PM2.5 seasonal fluctuations for PARR compared to September 21, 2023.

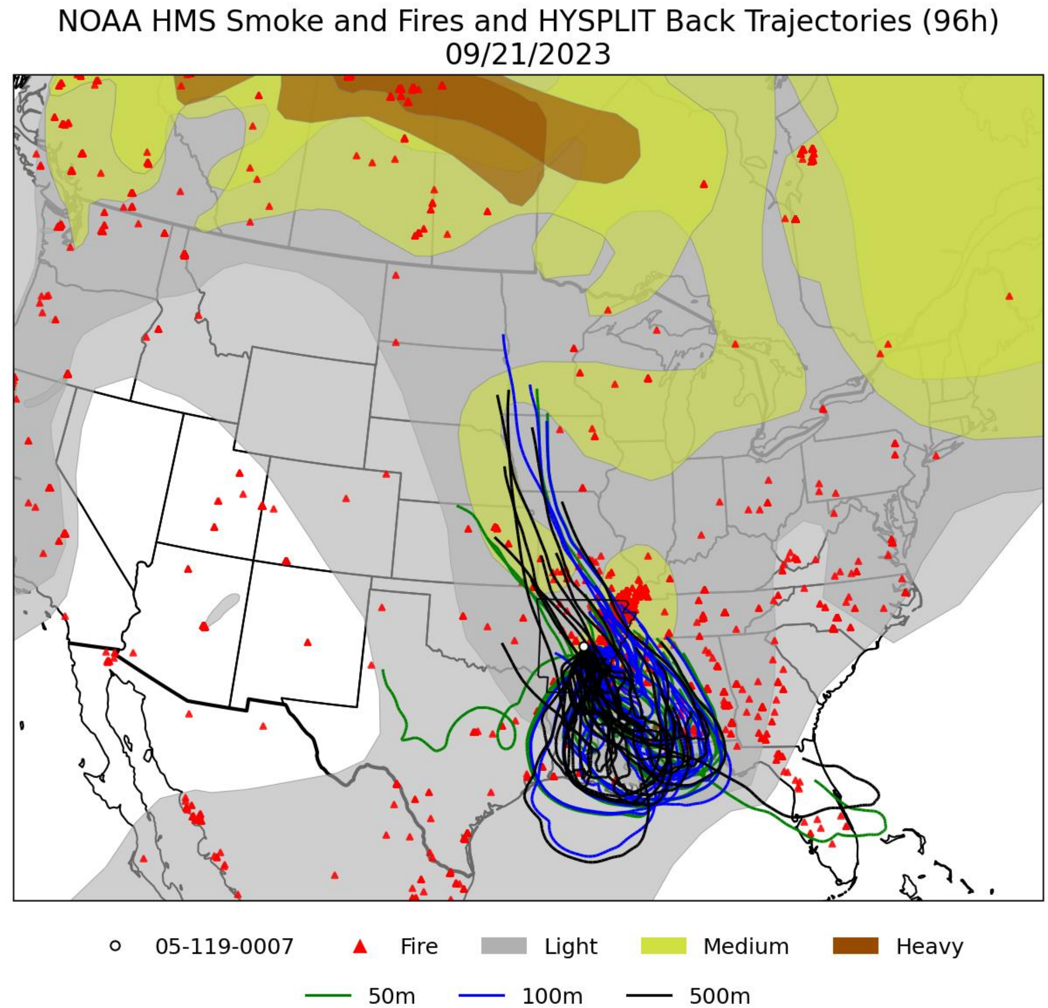
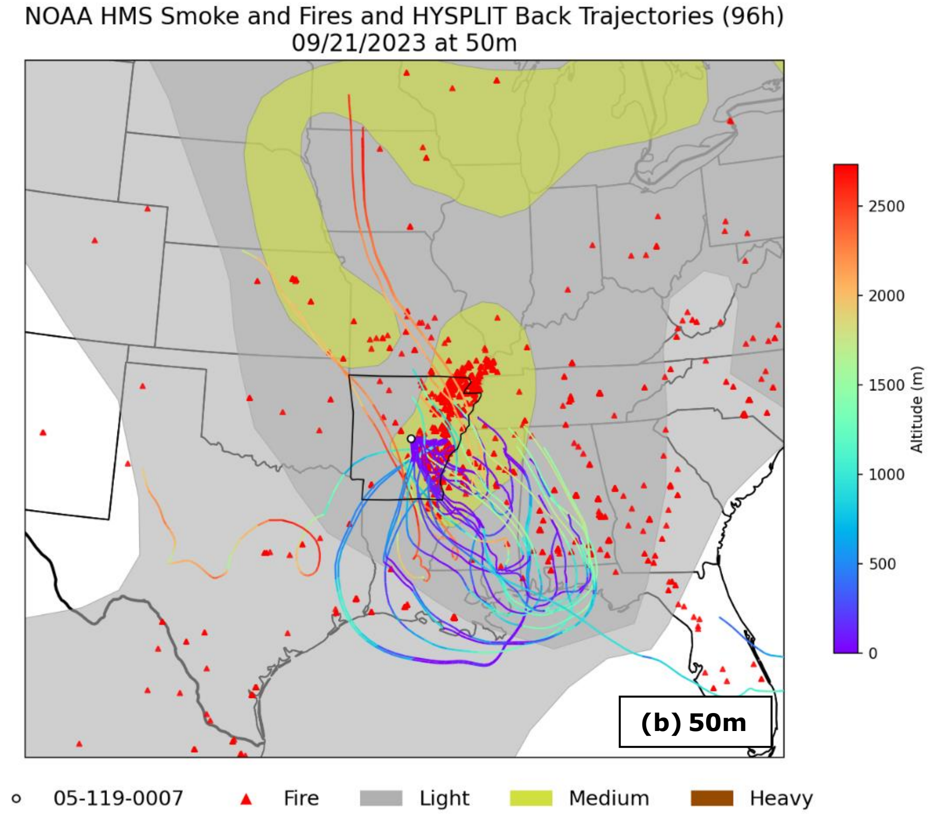
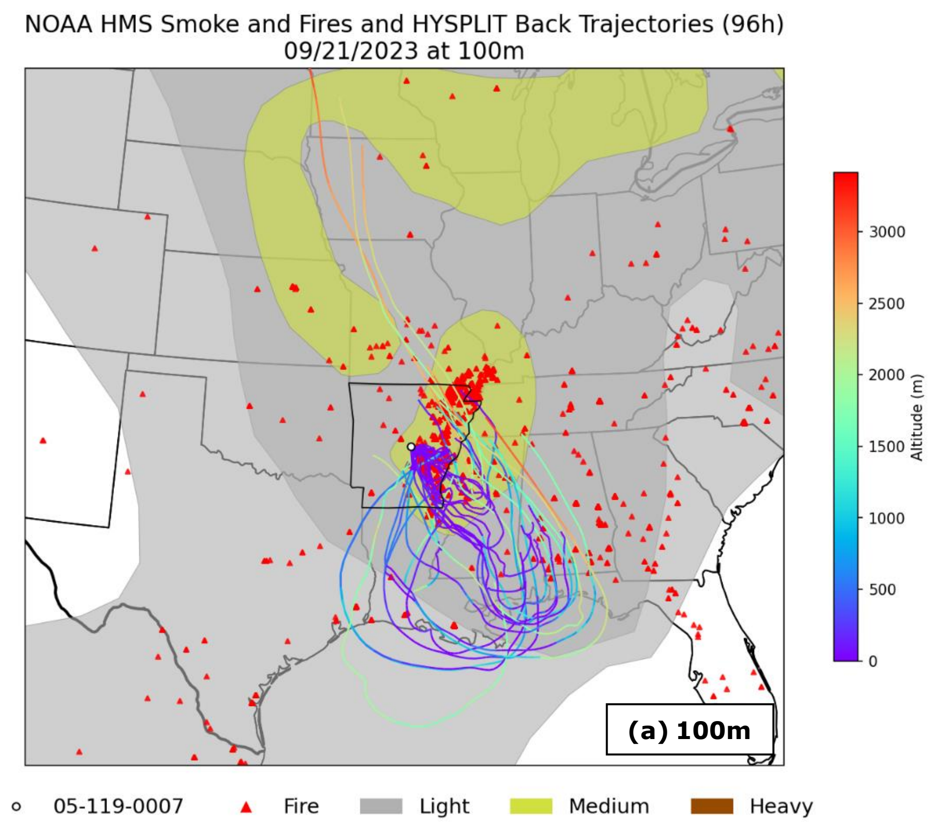


Figure 2-305. HYSPLIT back trajectories for PARR on September 21, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
09/21/2023 at 50m
(b) 50m
Altitude (m)
2500
2000
1500
1000
500
0
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
09/21/2023 at 100m
(a) 100m
Altitude (m)
3000
2500
2000
1500
1000
500
0
05-119-0007
Fire
Light
Medium
Heavy

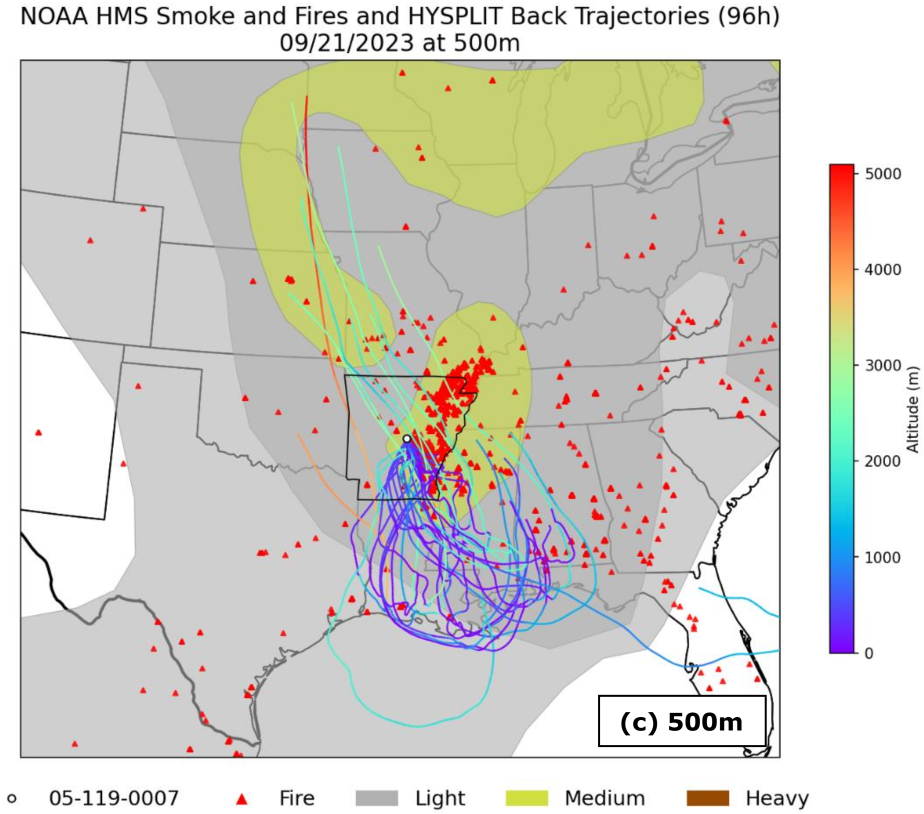


Figure 2-306. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on September 21, 2023.

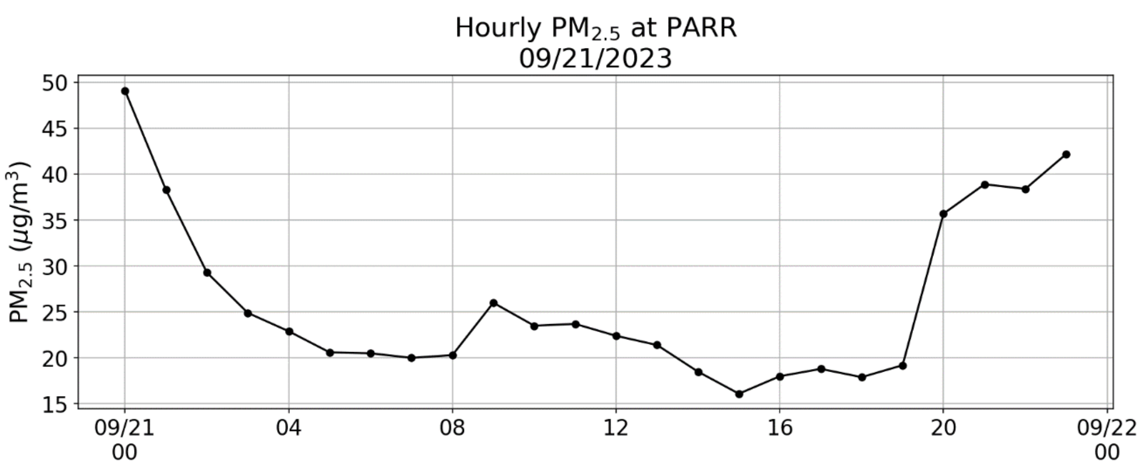
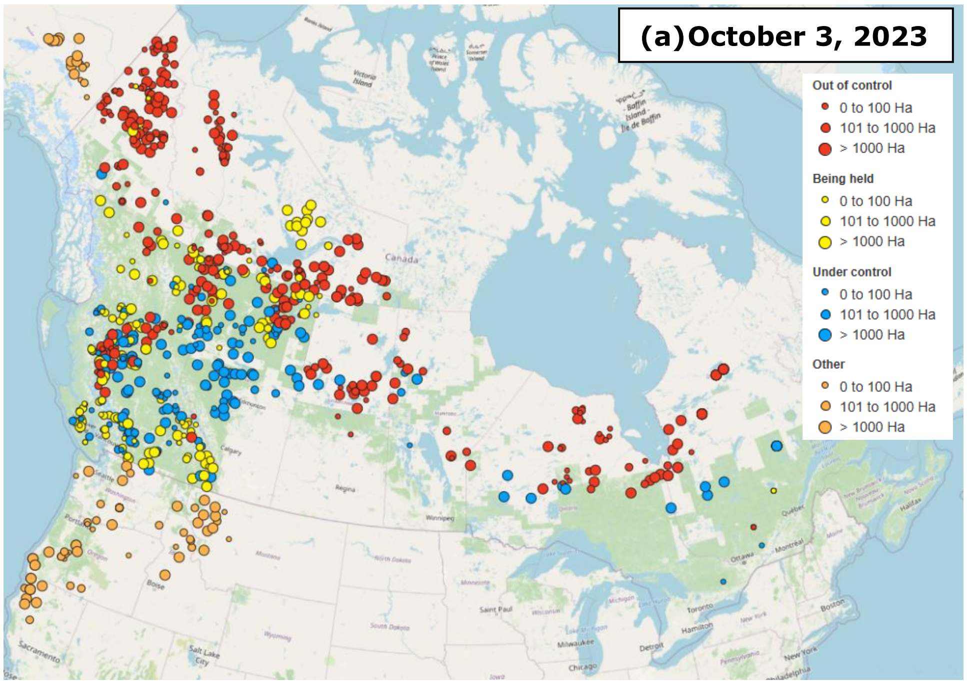


Figure 2-307. Hourly $PM_{2.5}$ concentrations for PARR on September 21, 2023.

2.1.14 October 3-4, 2023

Wildfires in Canada—described in section 2.1.13—that were burning in late September 2023, continued to be very active at the start of October and continued to impact the air quality in several areas in the U.S. Figure 2-308 shows the active fires in Canada for each day during October 3 to 4, 2023. As cooler temperatures due to fall were felt in the region, the number of fires decreased when compared to the period of September 18-21, 2023.



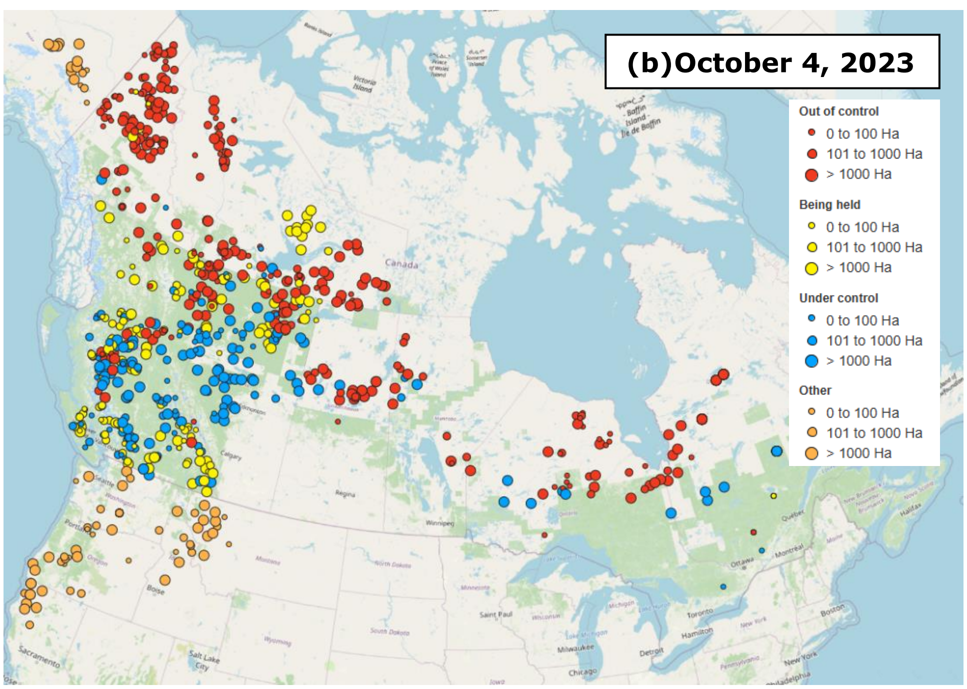
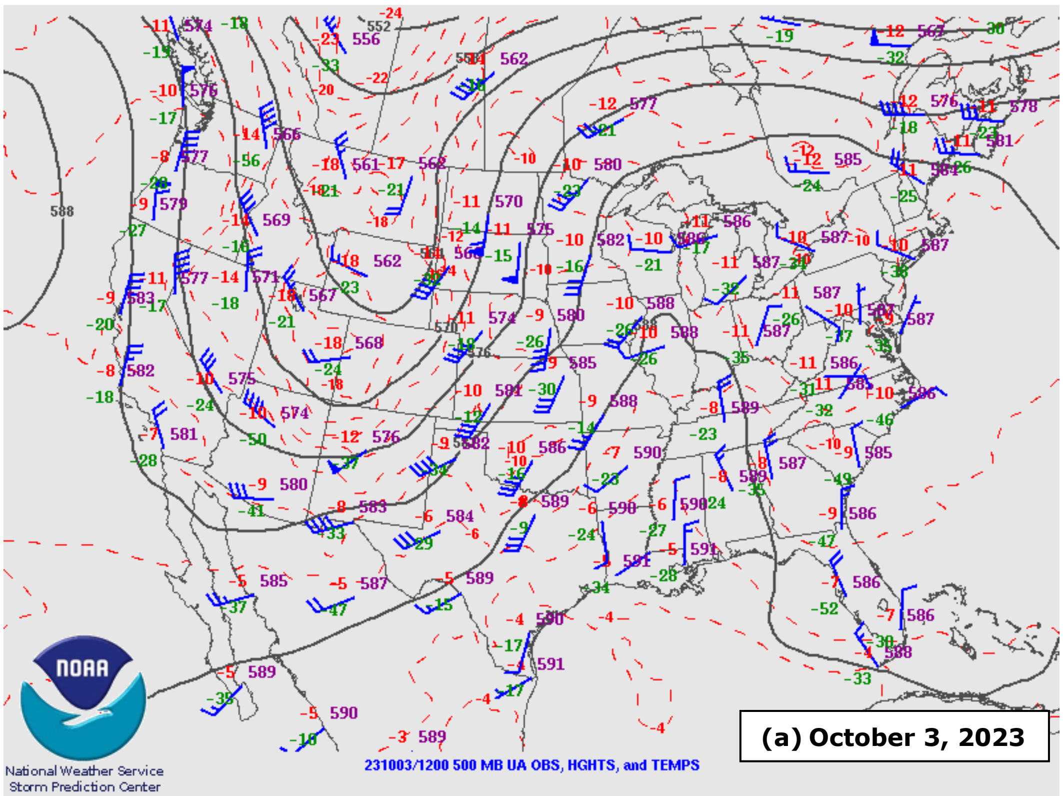


Figure 2-308. Canadian Wildfire Information System map of active fires for (a) October 3 and (b) October 4. (https://cwfis.cfs.nrcan.gc.ca/interactive-map)

On October 3, the 500 mb analysis (Figure 2-309a) shows a strong omega block pattern in the upper atmosphere, influencing the transport of smoke from northwest Canada. This brought smoke into the western U.S., south from the fires and the turning north before if affected Arkansas with southwesterly flow. The high-pressure system over the southeastern U.S. caused subsidence on the eastern side of the omega block. The jet stream also played a role carrying smoke from Canadian wildfires into the southeastern U.S. On October 4 (Figure 2-309b), the omega block pattern persisted, with a strong ridge over the central U.S. This pattern enhanced the transport of smoke, keeping it trapped in the lower atmosphere.



(a) October 3, 2023

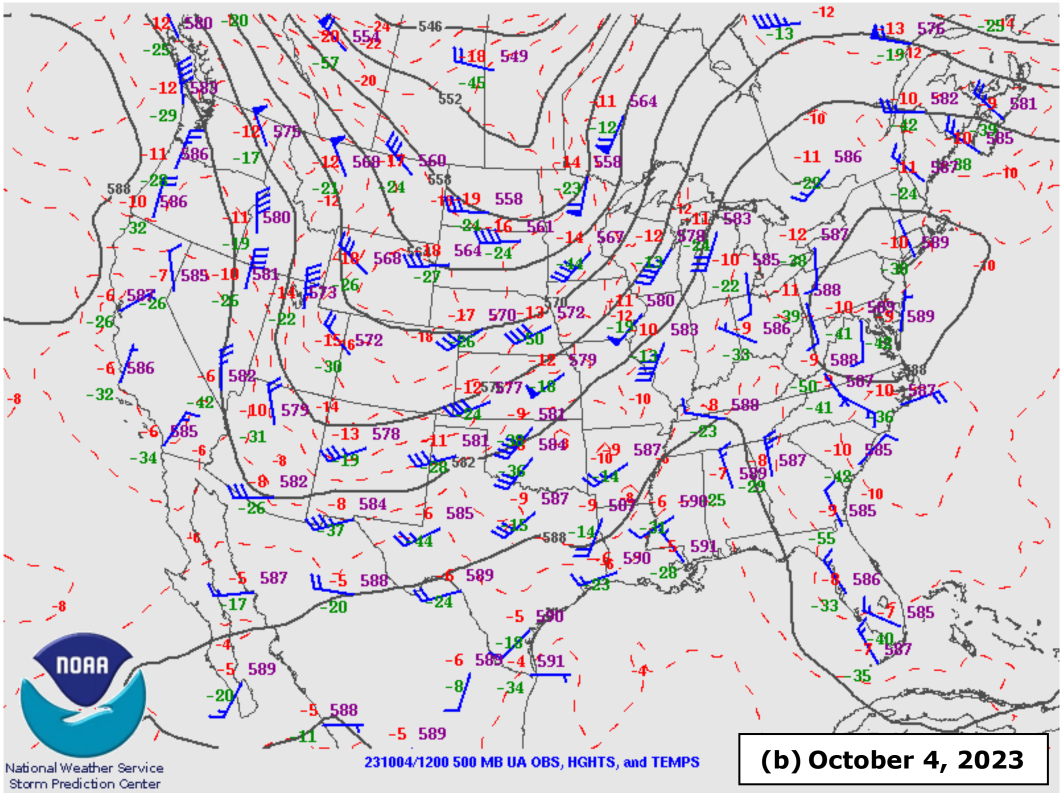


Figure 2-309. 500 mb synoptic analysis map at 12 UTC on (a) October 3 and (b) October 4, 2023.

The surface analysis on October 3 (Figure 2-310a) shows a high-pressure system over the southeastern U.S., which helps steer smoke from Canadian wildfires southeastward into Arkansas due to its clockwise circulation. The cold front passing through the central Plains enhances this transport by also creating southwesterly pre-frontal winds that act as a conduit for the smoke. Additionally, the interaction between the high-pressure system and the cold front promotes subsidence, which can trap smoke closer to the ground. The surface analysis map for October 4 (Figure 2-310b) shows a distinct high-pressure system centered over the southeastern U.S., which promotes stable atmospheric conditions. This high-pressure system extends its influence over much of the eastern and central U.S., steering air masses clockwise around it, leading to sinking air that traps pollutants, including transported wildfire smoke. The cold front in the Central Plains continues to move to the east and enhances the mixing of air masses and can act as a channel for smoke transport, directing it southeastward. These surface patterns work in combination with the upper-level winds to transport smoke from Canada into regions like Arkansas, significantly affecting air quality.

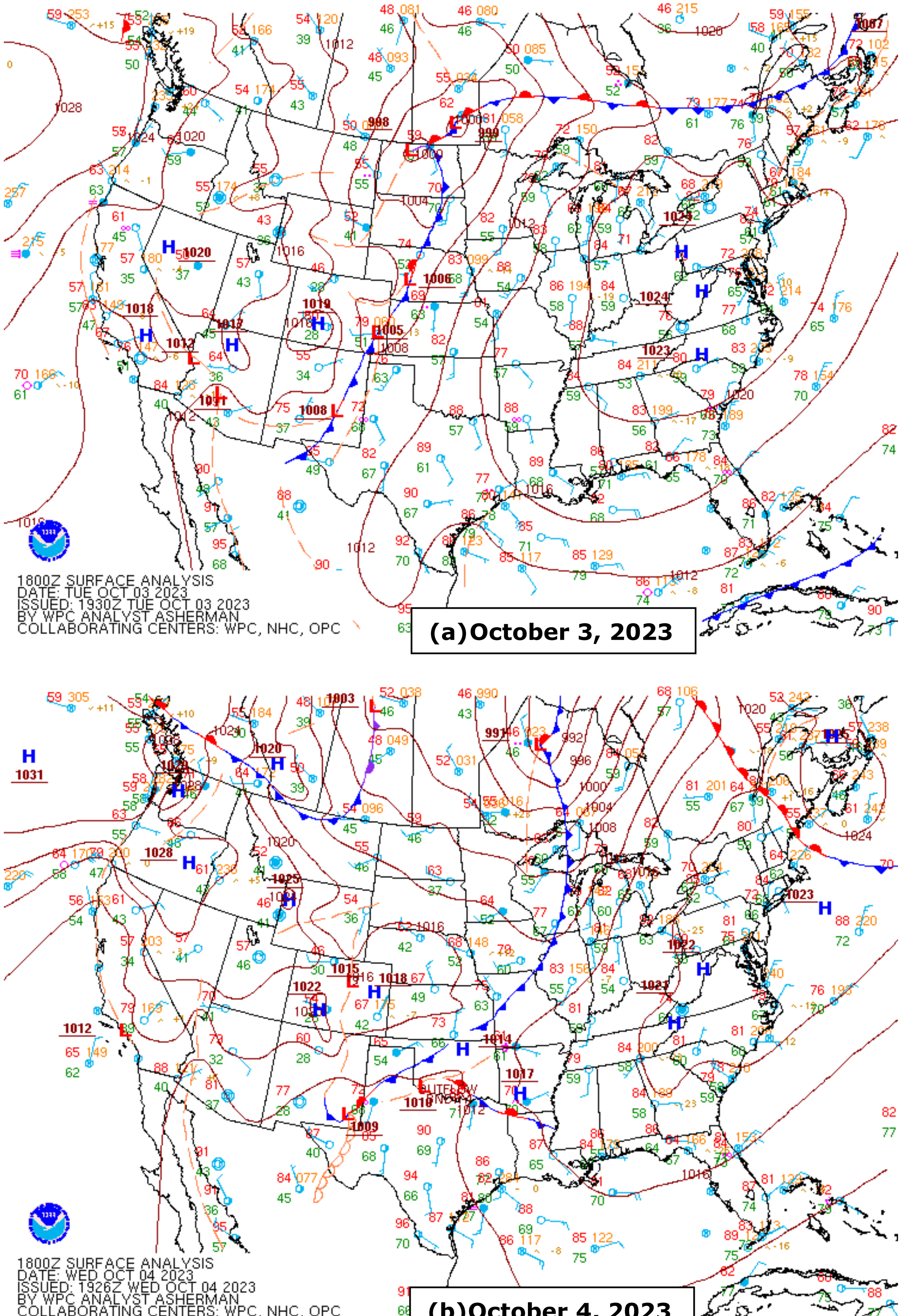


Figure 2-310. Surface synoptic analysis maps at 18 UTC on (a) October 3 and (b) October 4, 2023.

The NOAA HMS product in Figure 2-311 and the satellite visible images in Figure 2-312 show heavy smoke plumes covering parts of Arkansas and southeastern U.S. Moderate AQI values in Arkansas (Figure 2-313) and the HRRR surface modeled smoke in Figure 2-314 suggest that this smoke mixed down to surface level impacting Arkansas, Mississippi, Louisiana, Alabama, Georgia, Florida, and the southeast coast. Additionally, Figure 2-315 shows the NAAPS surface modeled concentrations which is consistent with the results of HRRR even when this product has a coarser spatial resolution. Figure 2-316 shows the evolution of the smoke plumes from September 30 to October 4, 2023, from multiple fires in Canada.

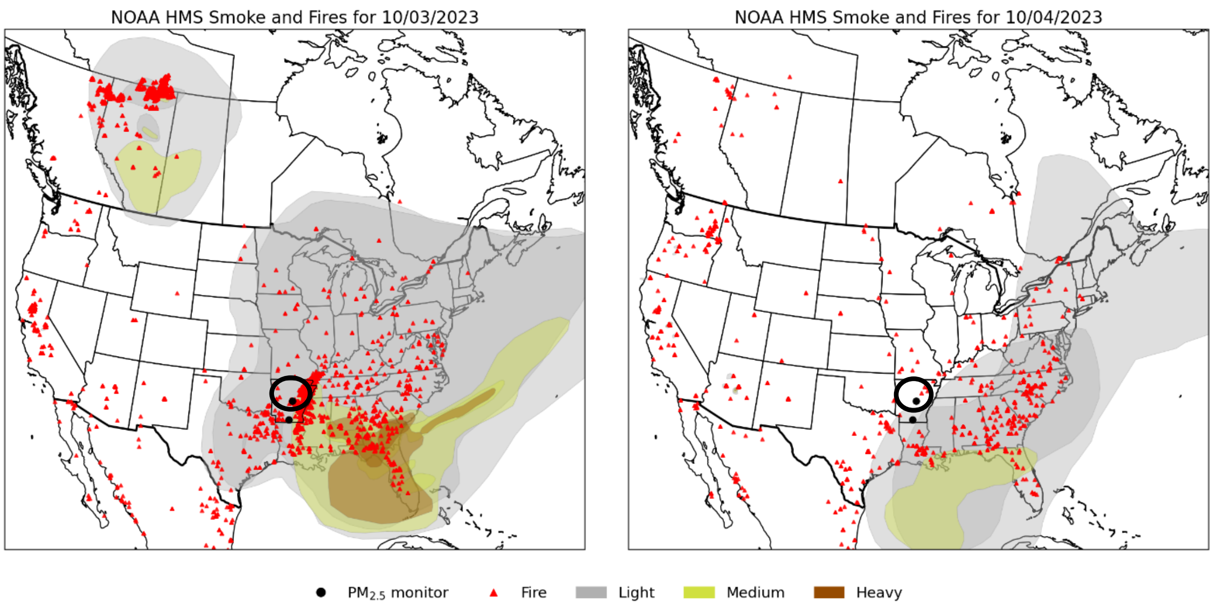
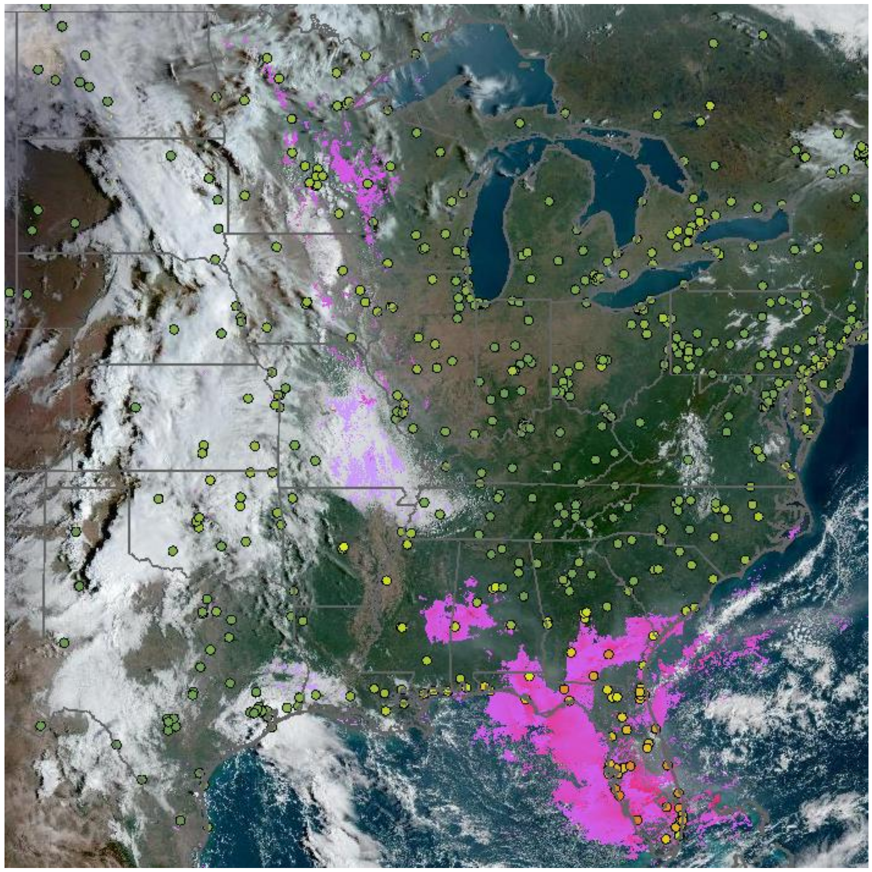


Figure 2-311. NOAA HMS fire and smoke products for October 3 (left) and October 4 (right), 2023.



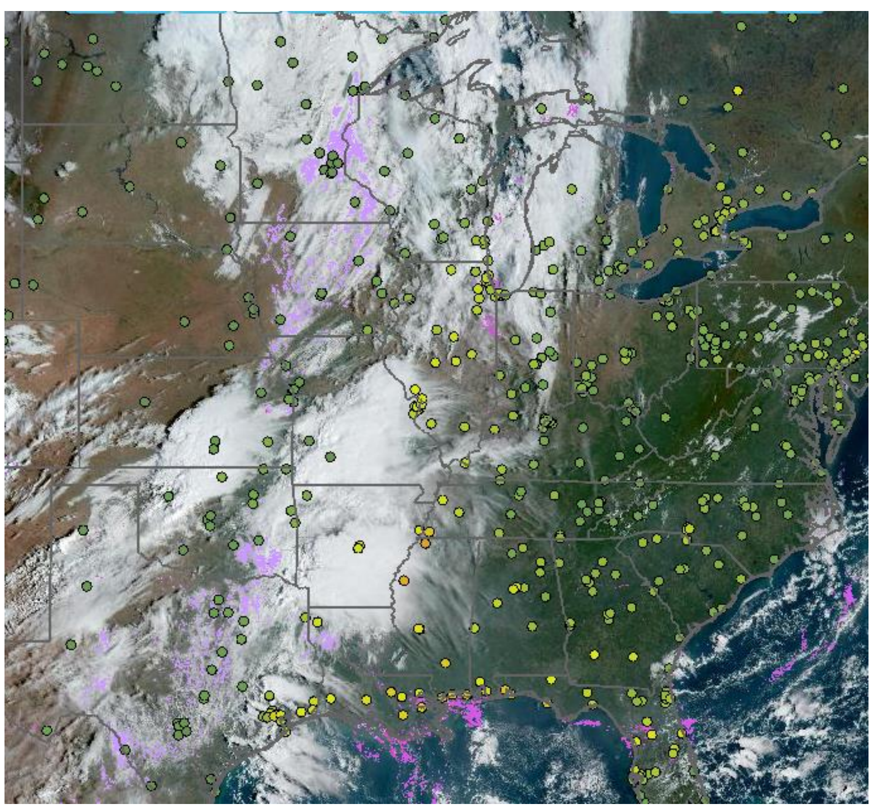


Figure 2-312. NOAA satellite visible imagery for (a) October 3 at 1401 UTC and (b) October 4 at 1421 UTC, 2023.

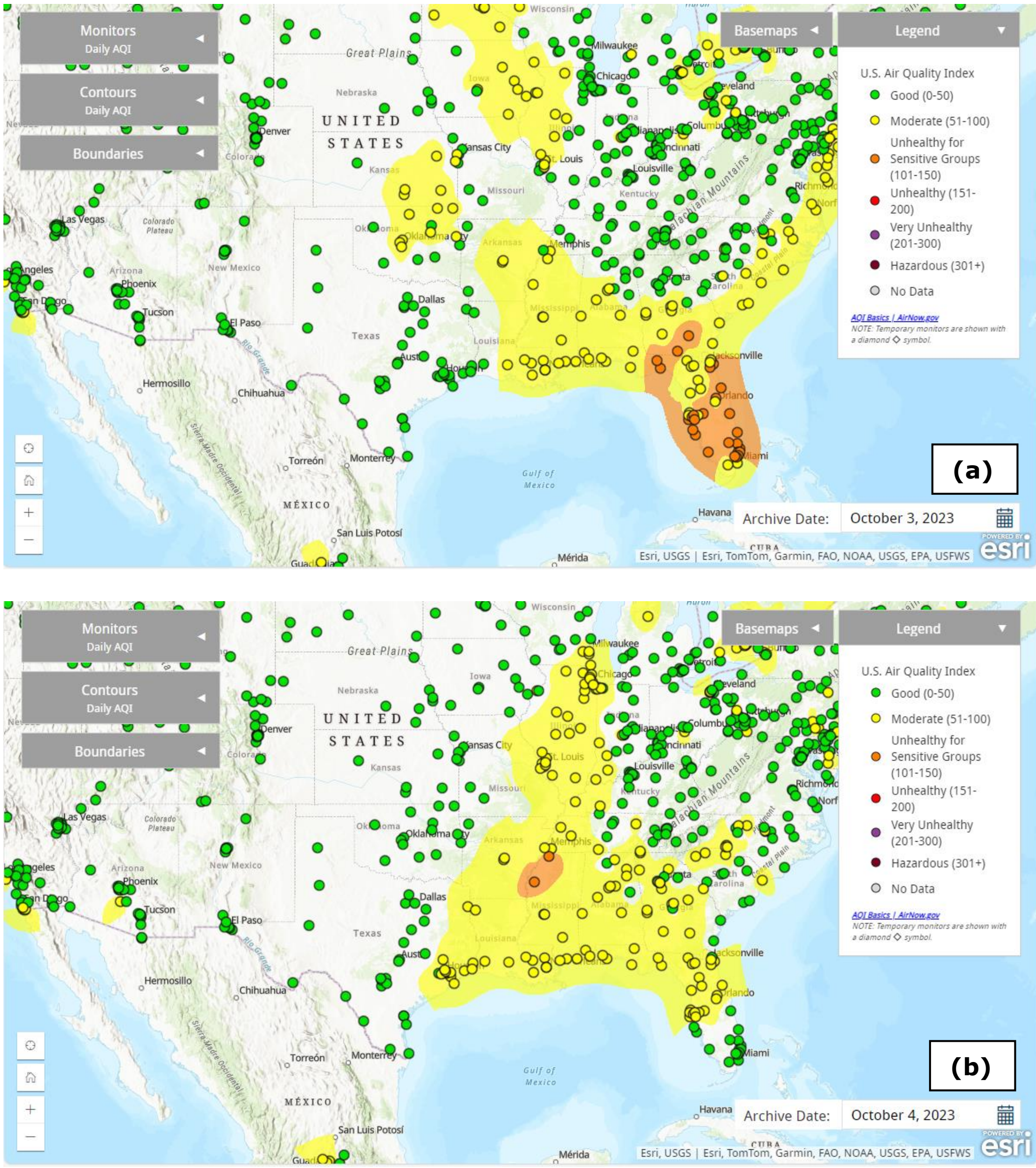


Figure 2-313. AirNow surface level $PM_{2.5}$ concentration contours for (a) October 3 and (b) October 4, 2023.

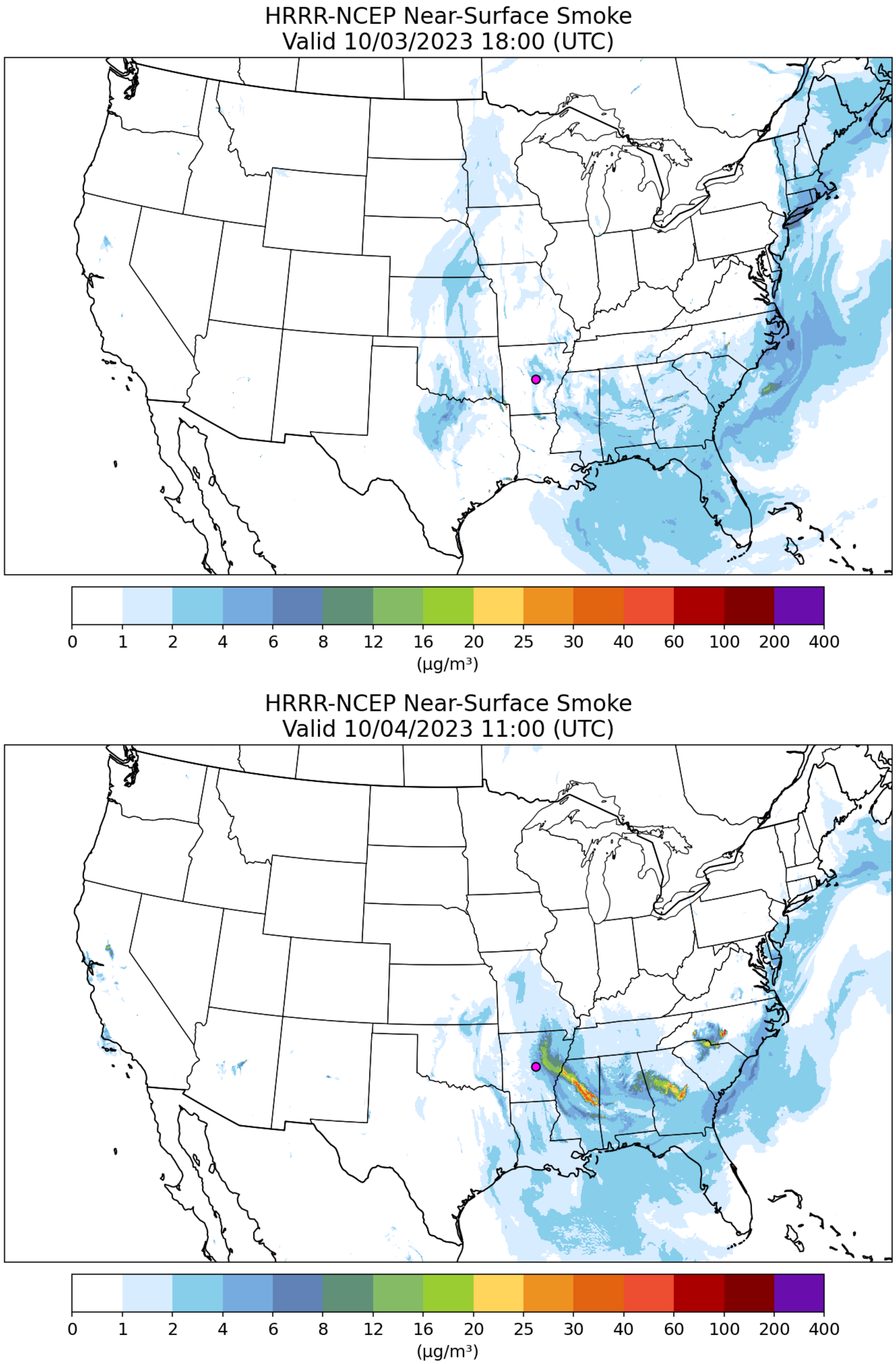


Figure 2-314. HRRR-Smoke modeled near-surface smoke concentrations (µg/m^3) for (a) October 3 at 1 PM CDT and (b) October 4 at 6 AM CDT, 2023.

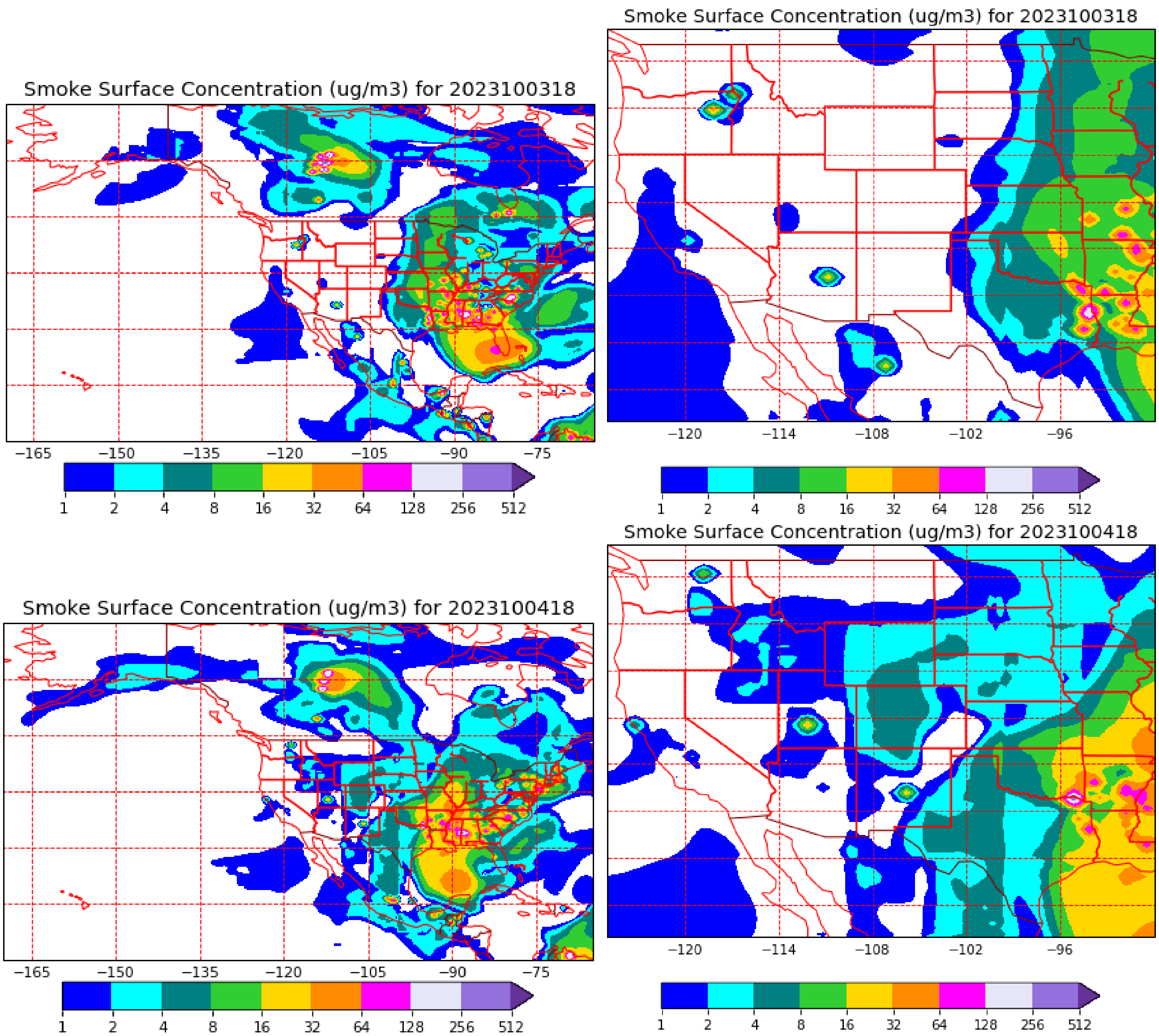


Figure 2-315. NAAPS modeled near-surface smoke concentrations (μg/m^3) at 18Z for (a) October 3 and (b) October 4, 2023. North America regional plot on the left and western U.S. plot on the right.

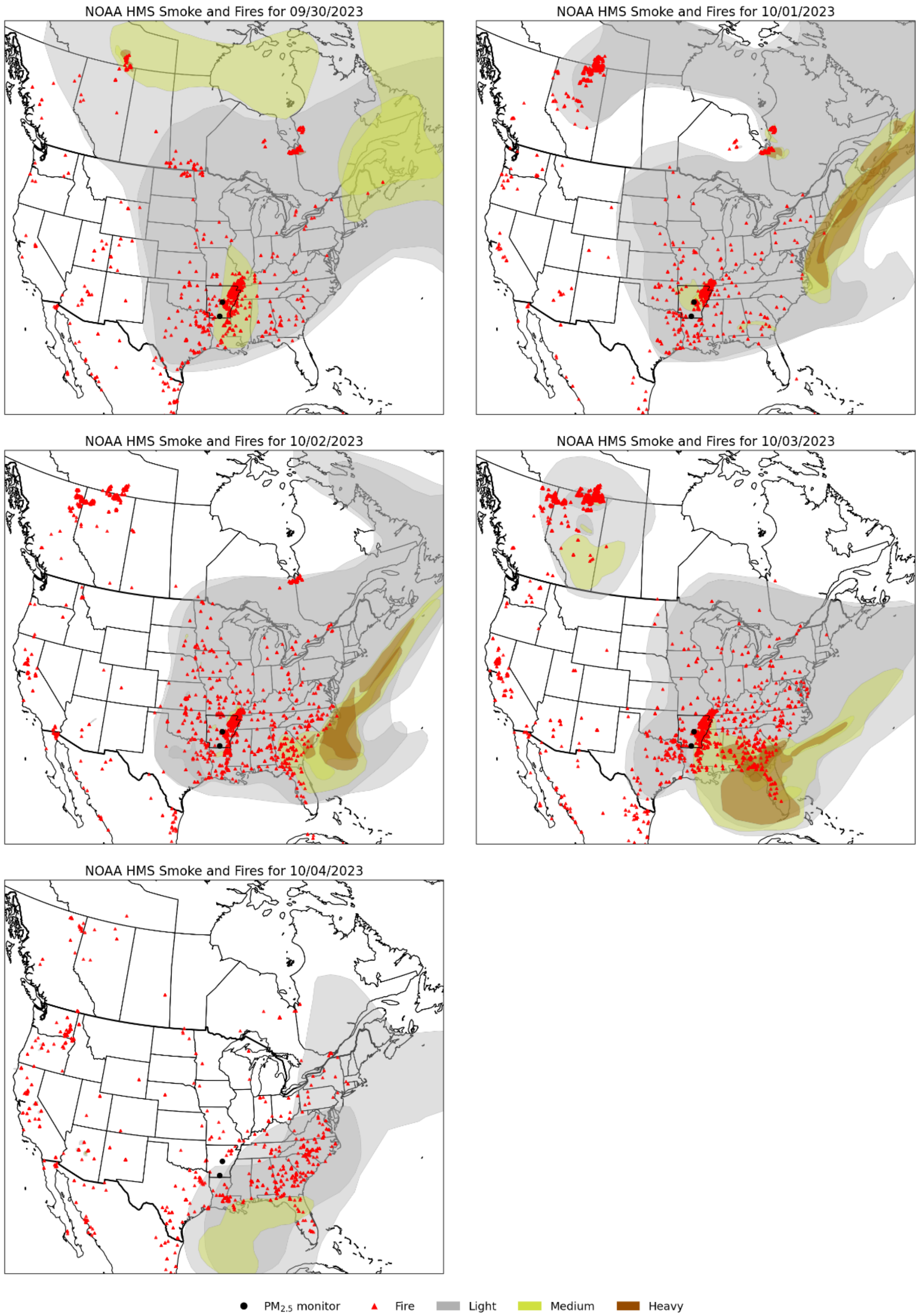


Figure 2-316. Evolution of fires and smoke for September 30 (top left), October 1 (top right), October 2 (middle left), October 3 (middle right), and October 4 (bottom left).

2.1.14.1 PARR October 3, 2023

Table 2-45 summarizes the evidence supporting the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on October 3, 2023. Figure 2-317 shows that 24-hour $PM_{2.5}$ concentrations on this day were significantly above the Tier 2 threshold, while Figure 2-318 indicates values close to the 99th percentile of historical values over the last five years. Figure 2-319 shows back trajectories passing through regions with light to medium density smoke transported into the U.S. from the wildfires in Canada by an omega block of high pressure (Figure 2-309a). This smoke then descended over the monitoring site (Figure 2-320). Figure 2-321 shows the hourly variation in $PM_{2.5}$ concentrations, which remained in the range of 20-30 μg/m³ until 8 AM, started increasing at 2 PM, and reached 45 μg/m³ by 9 PM.

Table 2-45. Exceptional event supporting evidence for PARR on October 3, 2023.

Monitor	PARR (05-119-0007)
Event Date	October 3, 2023
24-hr $PM_{2.5}$ Concentration	20.5 μg/m³
EPA Tiering Tool Tier 2 Threshold	17.0 μg/m³
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: October. Date accessed: 11/20/2024.

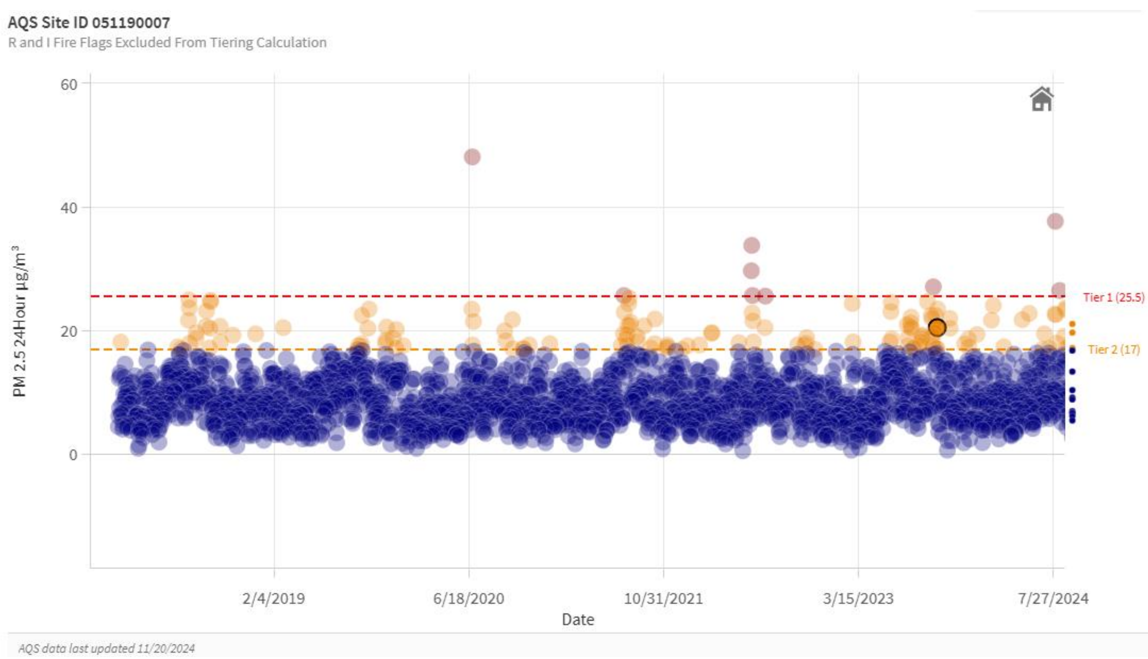


Figure 2-317. EPA PM2.5 Tiering Tool for PARR on October 3, 2023.

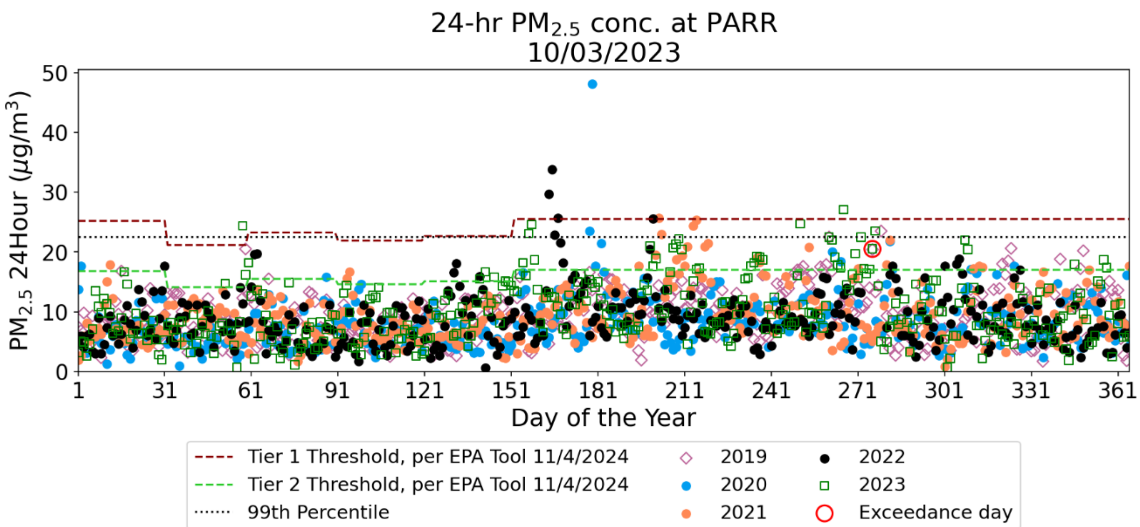


Figure 2-318. Historical 24-hour PM2.5 seasonal fluctuations for PARR compared to October 3, 2023.

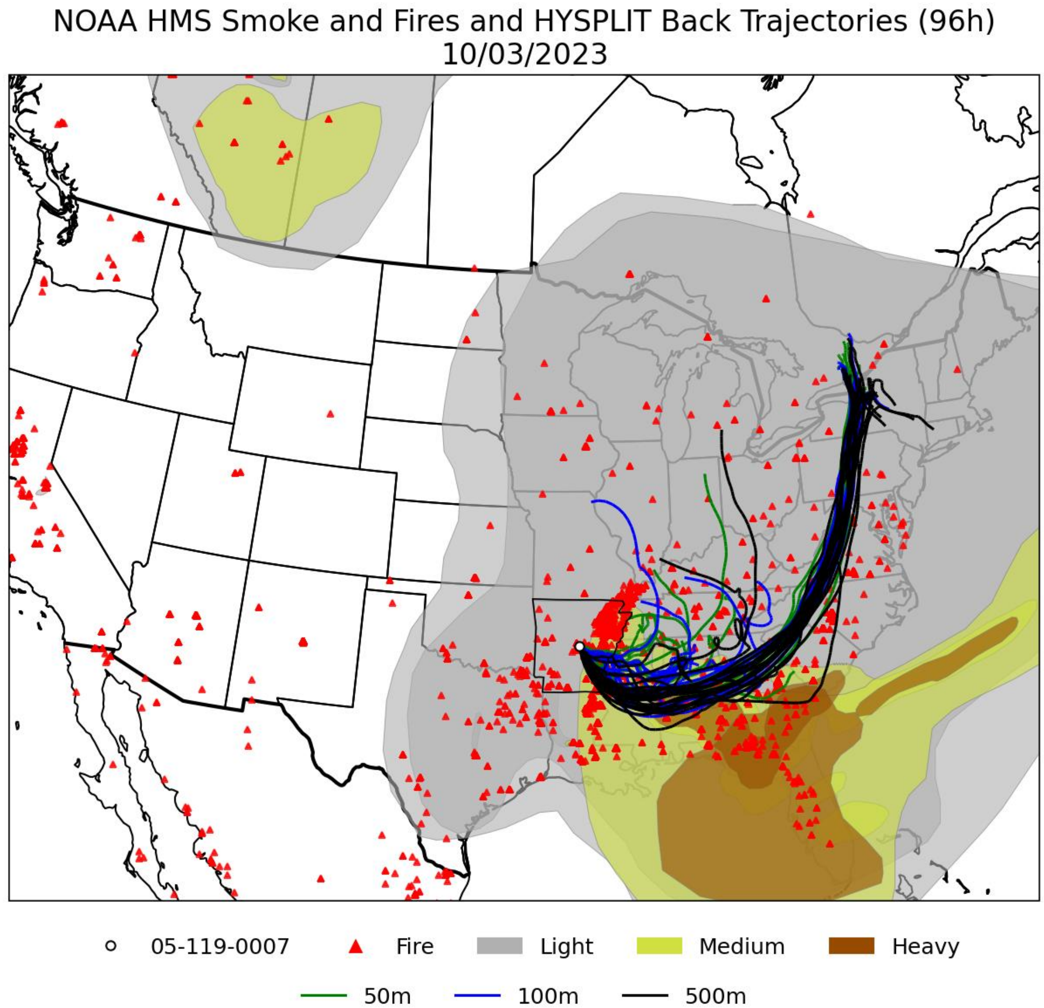
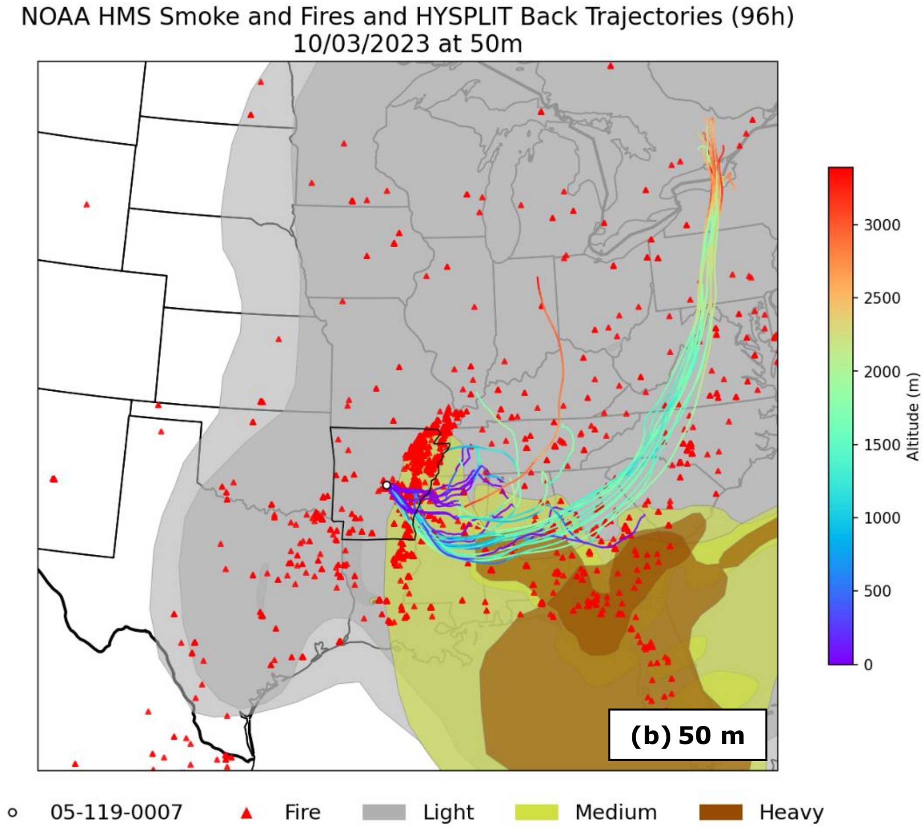
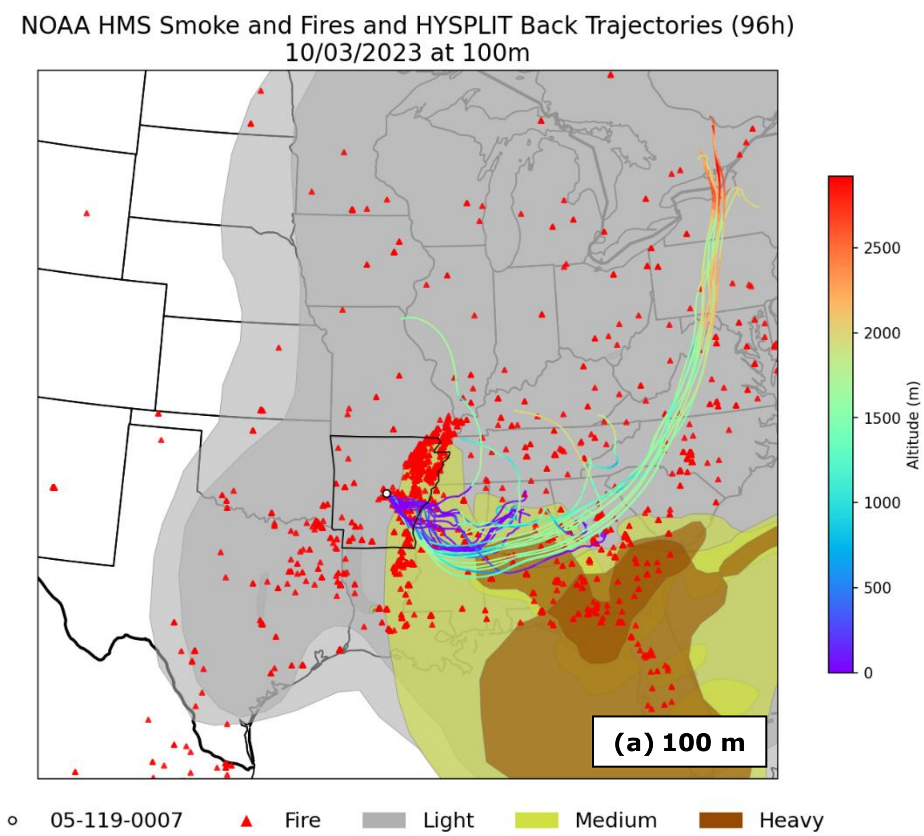


Figure 2-319. HYSPLIT back trajectories for PARR on October 3, 2023.


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
10/03/2023 at 50m
(b) 50 m
Altitude (m)
0
500
1000
1500
2000
2500
3000
05-119-0007
Fire
Light
Medium
Heavy


NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
10/03/2023 at 100m
(a) 100 m
Altitude (m)
0
500
1000
1500
2000
2500
05-119-0007
Fire
Light
Medium
Heavy

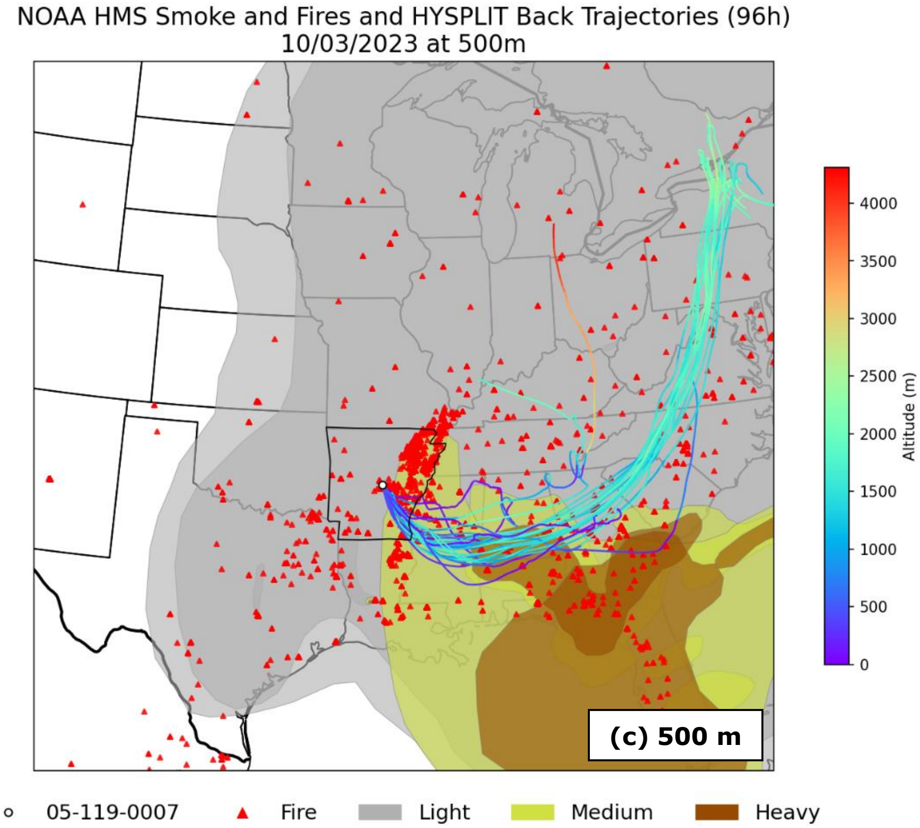


Figure 2-320. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on October 3, 2023.

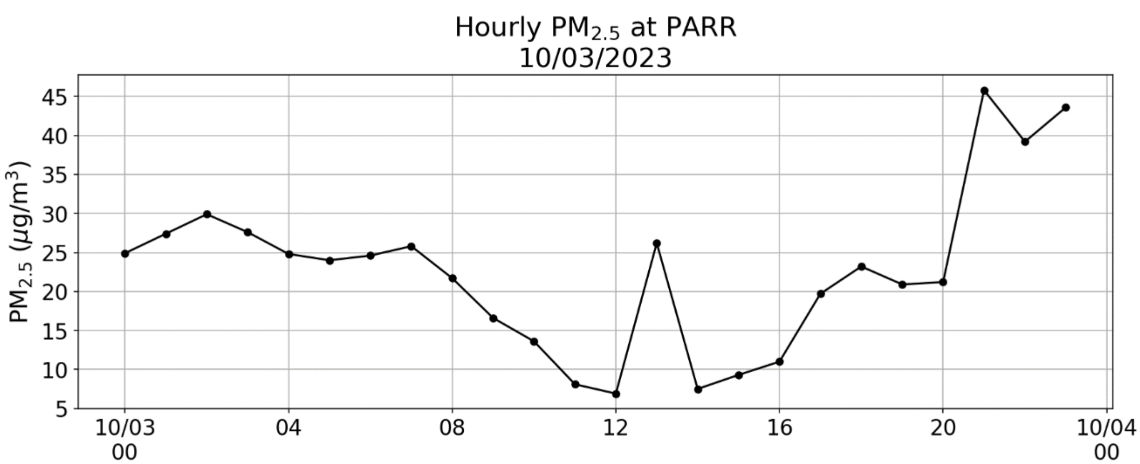


Figure 2-321. Hourly $PM_{2.5}$ concentrations for PARR on October 3, 2023.

2.1.14.2 PARR October 4, 2023

Table 2-46 summarizes the evidence supporting the demonstration of an exceptional event for PARR (AQS ID 05-119-0007) on October 4, 2023. Figure 2-322 shows that 24-hour $PM_{2.5}$ concentrations on this day were significantly above the Tier 2 threshold, while Figure 2-323 indicates levels above the 99th percentile of historical values over the last five years. Figure 2-324 illustrates back trajectories passing through regions with remnant light smoke from Canadian fires, transported into the U.S. by the omega block over the central U.S. Figure 2-325 shows the back trajectories moving through smoke at higher altitudes before descending over the monitoring site. Figure 2-326 depicts the hourly variation in $PM_{2.5}$ concentrations, which started with high values of 40-50 µg/m^3 from the previous day and decreased by 10 AM, remaining in the range of 15-25 µg/m^3 for the rest of the day.

Table 2-46. Exceptional event supporting evidence for PARR on October 4, 2023.

Monitor	PARR (05-119-0007)
Event Date	October 4, 2023
24-hr $PM_{2.5}$ Concentration	23.5 µg/m^3
EPA Tiering Tool Tier 2 Threshold	17.0 µg/m^3
Tier 2 Monitor/Day?	Yes
Does satellite evidence show smoke covering monitor on event day?	Yes
Do smoke map and HYSPLIT back trajectories suggest transport from regions with fires and smoke prior to the event day?	Yes
Smoke/fire regions	Canada
Is there evidence that smoke reaches surface level regionwide?	Yes
Criteria for Wildfire Smoke Exceptional Event Tier 2 Analysis satisfied?	Yes

Excluded Flag Specification for Tier Threshold Calculation: R and I Fire Flags Excluded, Month of EE: October. Date accessed: 11/20/2024.

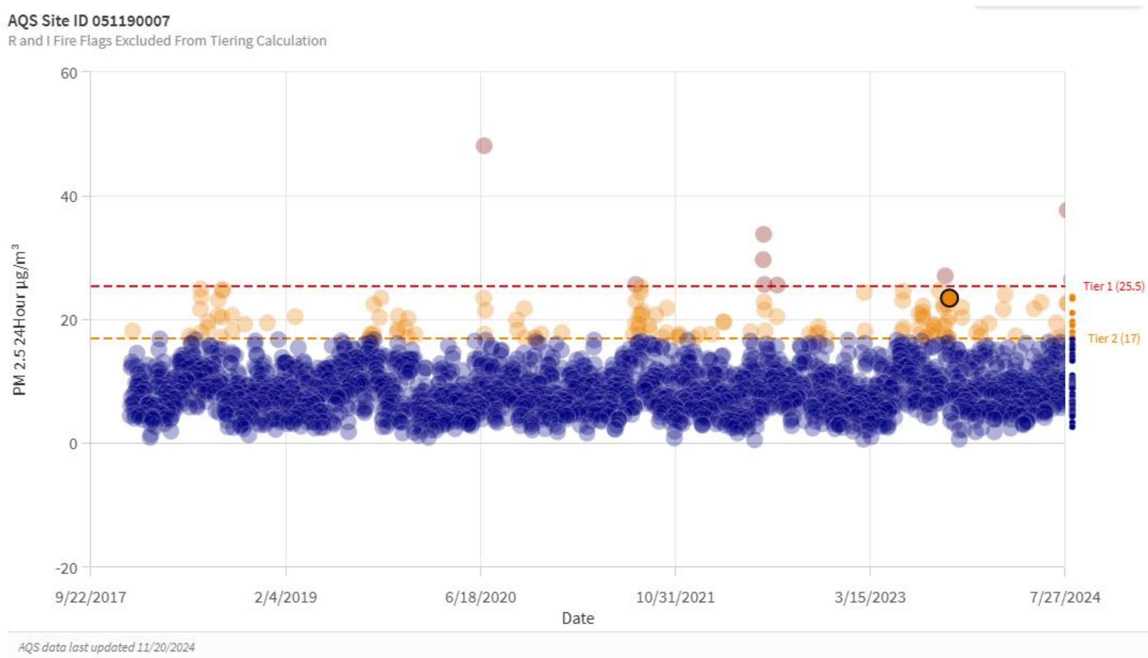


Figure 2-322. EPA $PM_{2.5}$ Tiering Tool for PARR on October 4, 2023.

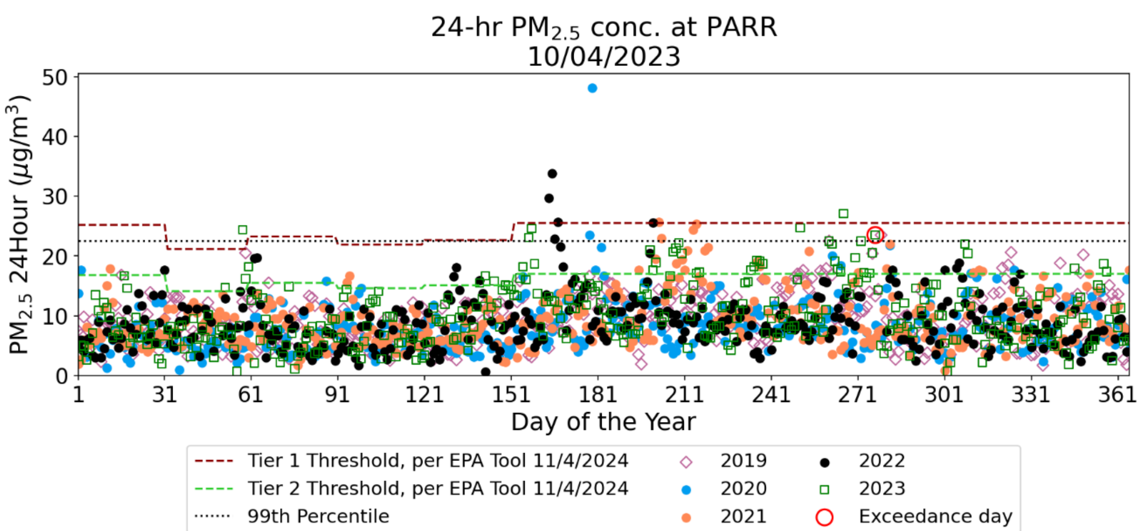


Figure 2-323. Historical 24-hour $PM_{2.5}$ seasonal fluctuations for PARR compared to October 4, 2023.

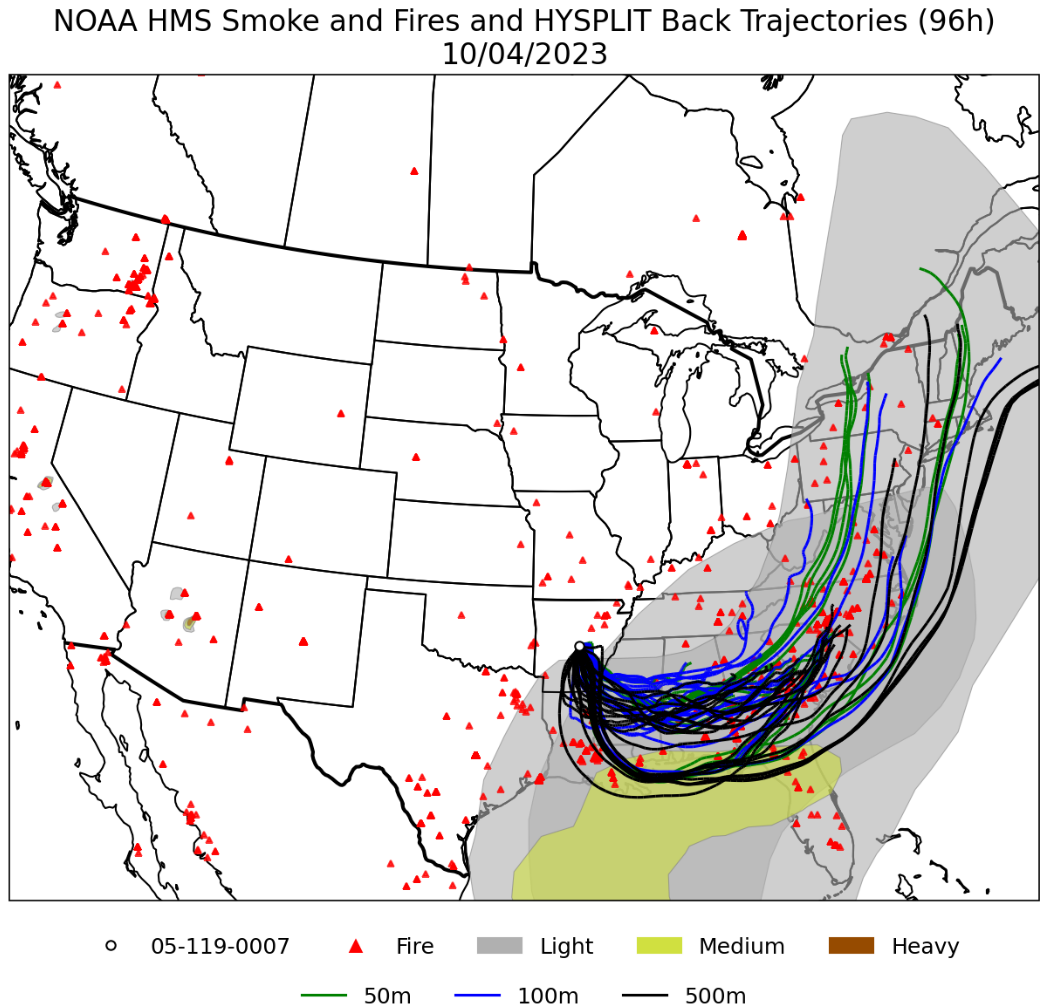
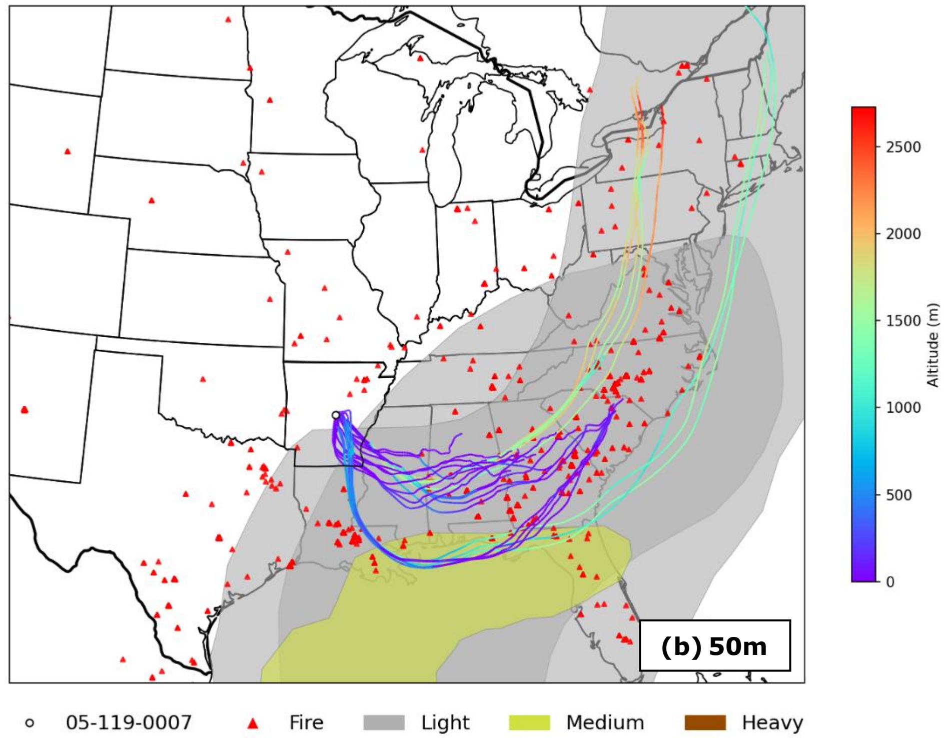
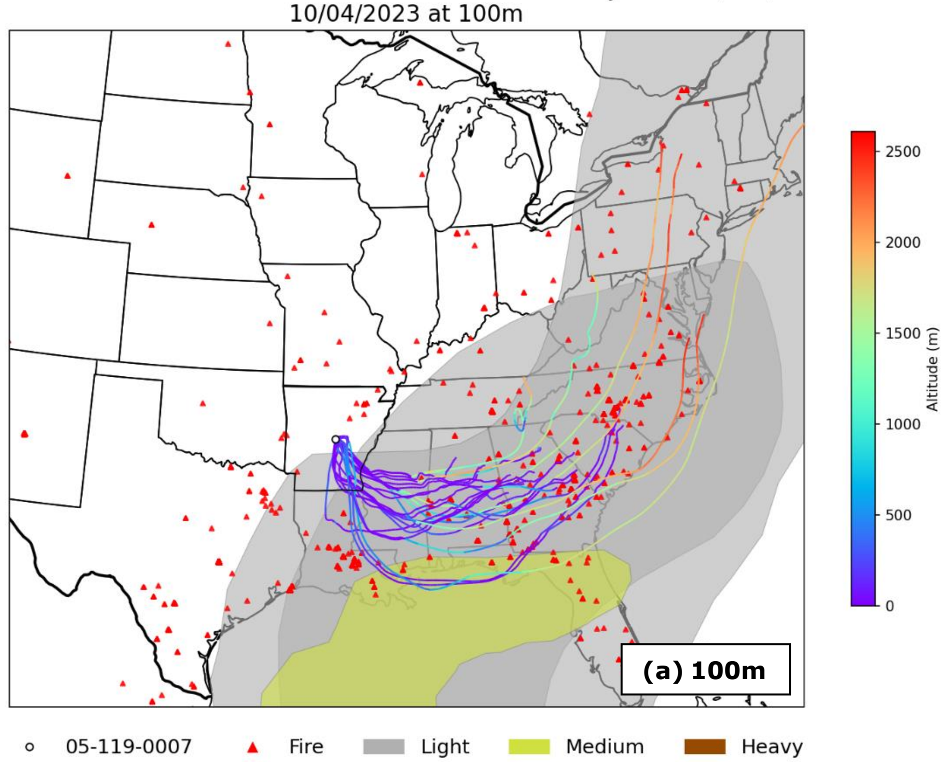


Figure 2-324. HYSPLIT back trajectories for PARR on October 4, 2023.

NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
10/04/2023 at 50m



NOAA HMS Smoke and Fires and HYSPLIT Back Trajectories (96h)
10/04/2023 at 100m



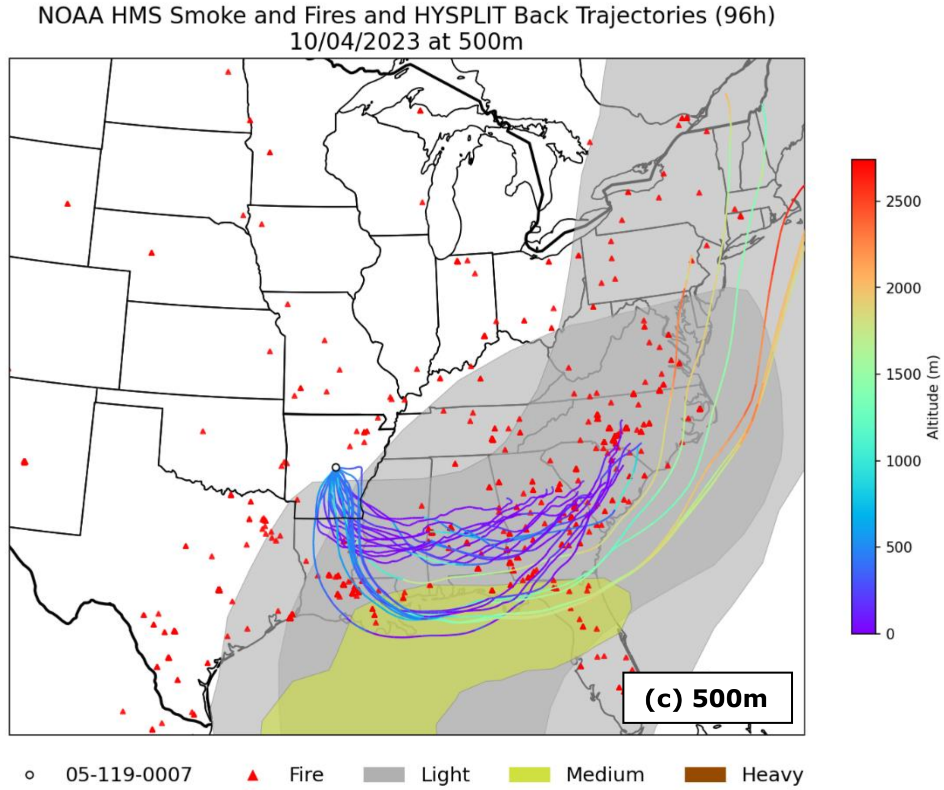


Figure 2-325. HYSPLIT back trajectories with altitude at (a) 50m, (b) 100m, and (c) 500 m for PARR on October 3, 2023.

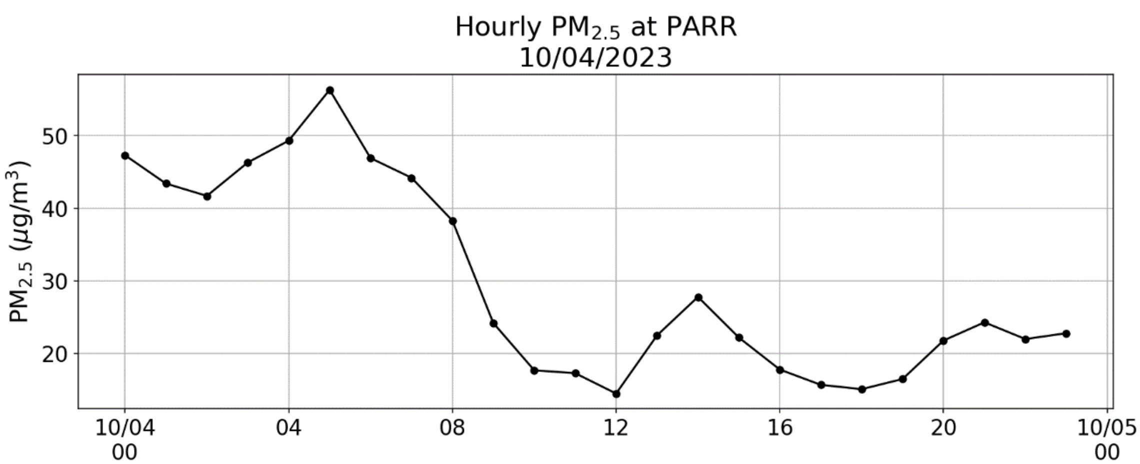


Figure 2-326. Hourly $PM_{2.5}$ concentrations for PARR on October 3, 2023.

3.0 Not Reasonably Controllable or Preventable

The next element to address in the demonstration is "not reasonably controllable or preventable" according to 40 CFR Part 50.14(c)(3)(iv)(D). Control and prevention are the two (2) prongs that must be demonstrated according to 40 CFR Part 50.14(b)(8)(i). This section demonstrates that the exceedances of the $PM_{2.5}$ NAAQS listed in Table 1-1 were caused by multiple wildfires in wildlands in Canada, the U.S. and Mexico and therefore meets the criteria of being not reasonably controllable and not reasonably preventable.

3.1 Source Areas Contributing to the Event

During 2022 and 2023, numerous fires were burning across several regions in Mexico, Canada and the U.S. $PM_{2.5}$ exceedances in Arkansas emerged from wildfires in New Mexico, Arizona, Quebec, Alberta Northwest Territories and other Provinces in Canada as discussed in Section 1.2 and reported in Appendix A. 40 CFR Part 50.14(b)(4) explains that wildfires occurring predominantly on wildland will meet the requirements of the not reasonably controllable or preventable criterion. Wildfires in Mexico are "not reasonably controllable or preventable" as detailed in Appendix C.

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4.0 Natural Event or Human Event not likely to Recur

In 40 CFR Part 50.14(c)(3)(iv)(E), a demonstration must reveal "that the event was a human activity that is unlikely to recur at a particular location or was a natural event." The Exceptional Events Rule indicates that if an agency has adequately demonstrated that the source is a natural event or, if not natural, is a human activity unlikely to recur at the same location and that there is a *clear causal relationship* between the identified source(s) and the affected monitor, then the human activity unlikely to recur/natural event criterion is also satisfied.

The wildfires burning during dates detailed in the Day-Specific Analysis (Section 2.1) and that affected Arkansas' air quality, qualify as Natural Events. Under 40 CFR Part 50.1(k) a natural event "means an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions." Furthermore, 40 CFR Part 50.1(n) defines that "Wildfire is any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." See Appendix A for a list of wildfires that affected monitors at Arkansas. Wildfires in Mexico qualify as "natural events or human events not likely to recur" as detailed in Appendix C.

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5.0 Documentation and Mitigation

5.1 Regulatory Documentation Procedures

This demonstration follows the procedures outlined in the Exceptional Events Rule.[52] This includes adhering to 40 CFR Part 50.14(c)(3)(v)(A) to document that the DEQ followed the public comment process and that the comment period was open for a minimum of 30 days. This document will be made available for a thirty (30) day public comment period. The public and all interested parties will be invited to comment on this document.

In terms of Initial Notifications, DEQ notified EPA Region 6 of its intent to request exclusion of one or more measured exceedances of an applicable national ambient air quality standard as being due to an exceptional event by creating an initial event description and flagging the associated data that have been submitted to the AQS database and by engaging in the Initial Notification of Potential Exceptional Event process as shown in Appendix D.

5.2 Arkansas DEQ Methods of Public Notification

In terms of mitigations, according to 40 CFR Part 50.14(c)(1)(i) and 40 CFR Part 51.930(a)(1), states must notify the public promptly whenever an event occurs or is reasonably anticipated to occur which may result in the exceedance of an applicable air quality standard. This section provides information on public notification conducted by the DEQ for the period of exceedances during the 2022 and 2023 wildfire season.

5.2.1 DEQ Website

Prominent on DEQ's website homepage, color-coded AQI wheels provides a quick-look graphic to easily inform the public about the current day's AQI.

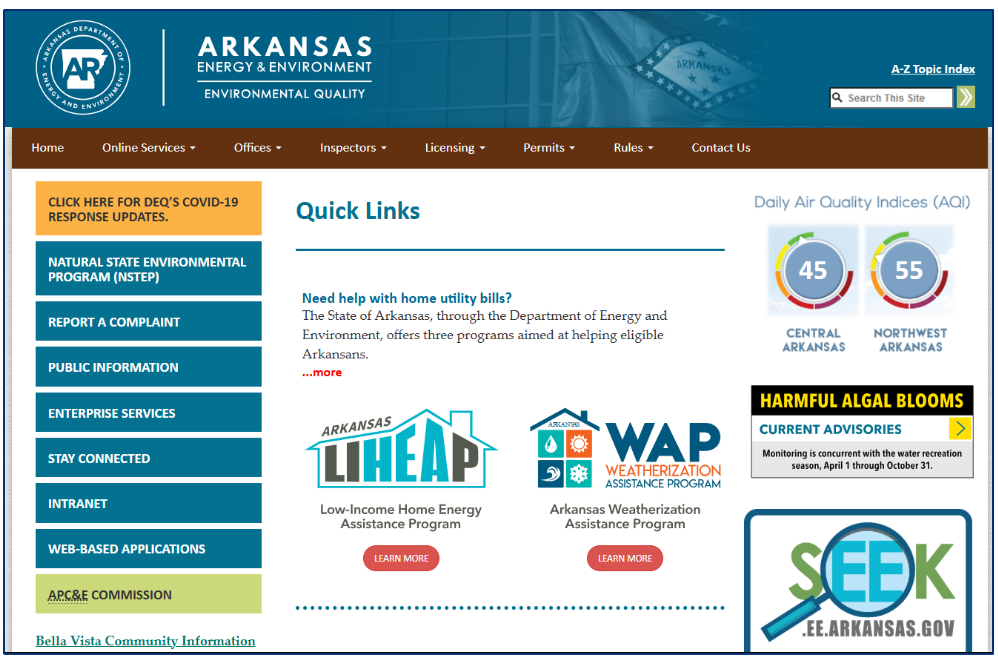

Figure 5-1. DEQ's website homepage.

52 https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-50/section-50.14

The AQI wheels on the landing page direct users to more detailed information, should the public be interested in more than an AQI quick glance. A user can select more detailed information for the Little Rock metropolitan area or for the Springdale metropolitan area.

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Laboratory and Monitoring Services

Air Chemistry Laboratory

- Air Quality Index for Little Rock
- Air Quality Index for Springdale
- Ozone Monitors... Today's Readings
- PM Monitors... Today's Readings

AQI - Little Rock Metropolitan Area

DEQ takes continuous readings at various locations throughout Arkansas. The pollutants that are monitored include five major atmospheric pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulates (PM_{10} and $PM_{2.5}$). The index is based upon the highest contributing pollutant. For example, if ozone is highest, then the value for ozone determines the index. The numbers that are retrieved from the readings are then converted to the Air Quality Index (AQI), which allows pollutant levels to be compared to their health standards and to be assigned a rating of good, moderate, or unhealthy.

AQI - Little Rock Metropolitan Area

Most Recent Observed Maximum Value
(24 Hour Period Beginning at 6:00 am CST 01/01/2025)

Critical Pollutant	AQI	Air Quality	Condition
Fine Particulate	61	Moderate	Yellow
(Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.)			

Details of Most Recent Observed Maximum Value

Pollutant	Concentration	AQI	Air Quality	Condition
Ozone	0.030	28	Good	Green
Fine Particulate	14.4	61	Moderate	Yellow
(Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.)				

Forecast for Today
(24 Hour Period Beginning at 6:00 am CST 01/02/2025)

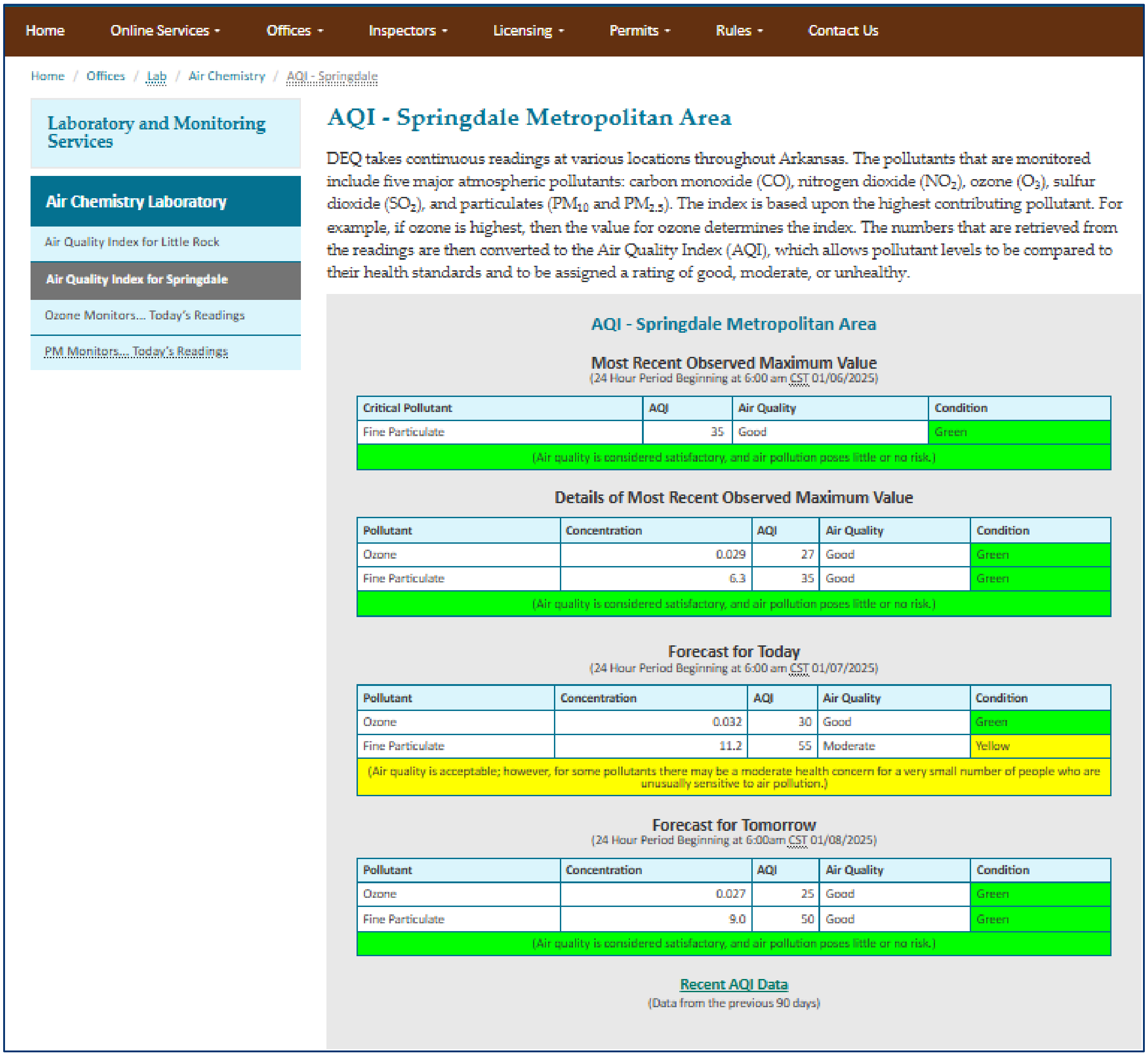
Pollutant	Concentration	AQI	Air Quality	Condition
Ozone	0.027	25	Good	Green
Fine Particulate	13.9	60	Moderate	Yellow
(Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.)				

Forecast for Tomorrow
(24 Hour Period Beginning at 6:00am CST 01/03/2025)

Pollutant	Concentration	AQI	Air Quality	Condition
Ozone	0.032	30	Good	Green
Fine Particulate	9.0	50	Good	Green
(Air quality is considered satisfactory, and air pollution poses little or no risk.)				

Recent AQI Data
(Data from the previous 90 days)

Figure 5-2. DEQ's website Little Rock Metropolitan Area AQI details



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Laboratory and Monitoring Services

Air Chemistry Laboratory

Air Quality Index for Little Rock

Air Quality Index for Springdale

Ozone Monitors... Today's Readings

PM Monitors... Today's Readings

AQI - Springdale Metropolitan Area

DEQ takes continuous readings at various locations throughout Arkansas. The pollutants that are monitored include five major atmospheric pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulates (PM_{10} and $PM_{2.5}$). The index is based upon the highest contributing pollutant. For example, if ozone is highest, then the value for ozone determines the index. The numbers that are retrieved from the readings are then converted to the Air Quality Index (AQI), which allows pollutant levels to be compared to their health standards and to be assigned a rating of good, moderate, or unhealthy.

AQI - Springdale Metropolitan Area

Most Recent Observed Maximum Value
(24 Hour Period Beginning at 6:00 am CST 01/06/2025)

Critical Pollutant	AQI	Air Quality	Condition
Fine Particulate	35	Good	Green
(Air quality is considered satisfactory, and air pollution poses little or no risk.)			

Details of Most Recent Observed Maximum Value

Pollutant	Concentration	AQI	Air Quality	Condition
Ozone	0.029	27	Good	Green
Fine Particulate	6.3	35	Good	Green
(Air quality is considered satisfactory, and air pollution poses little or no risk.)				

Forecast for Today
(24 Hour Period Beginning at 6:00 am CST 01/07/2025)

Pollutant	Concentration	AQI	Air Quality	Condition
Ozone	0.032	30	Good	Green
Fine Particulate	11.2	55	Moderate	Yellow
(Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.)				

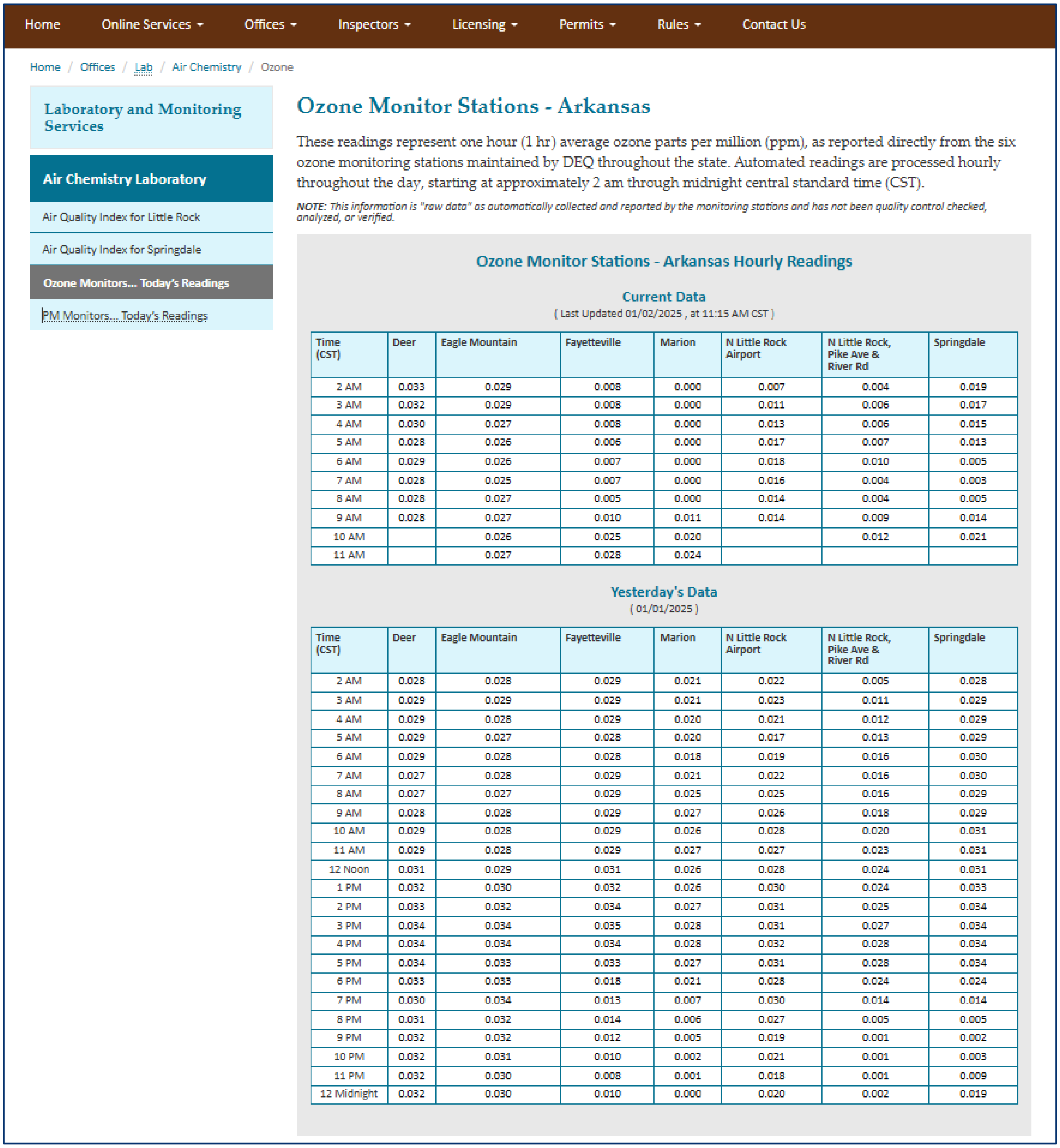
Forecast for Tomorrow
(24 Hour Period Beginning at 6:00am CST 01/08/2025)

Pollutant	Concentration	AQI	Air Quality	Condition
Ozone	0.027	25	Good	Green
Fine Particulate	9.0	50	Good	Green
(Air quality is considered satisfactory, and air pollution poses little or no risk.)				

Recent AQI Data
(Data from the previous 90 days)

Figure 5-3. DEQ's website Springdale Metropolitan Area AQI details

DEQ provides near real-time continuous ambient air quality monitoring information on its public-facing website. Data for the monitoring stations that continuously record $PM_{2.5}$ concentrations is presented in the form of a rolling 24-hour average (the latest hourly average and the previous 23 hourly averages). The rolling 24-hour averages are color-coded according to the breakpoint concentrations in 40 CFR Part 58 Appendix G so that the public can promptly view the concentration and associated color to assist in making a health-based decision.



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Laboratory and Monitoring Services

Air Chemistry Laboratory

Air Quality Index for Little Rock

Air Quality Index for Springdale

Ozone Monitors... Today's Readings

PM Monitors... Today's Readings

Ozone Monitor Stations - Arkansas

These readings represent one hour (1 hr) average ozone parts per million (ppm), as reported directly from the six ozone monitoring stations maintained by DEQ throughout the state. Automated readings are processed hourly throughout the day, starting at approximately 2 am through midnight central standard time (CST).

NOTE: This information is "raw data" as automatically collected and reported by the monitoring stations and has not been quality control checked, analyzed, or verified.

Ozone Monitor Stations - Arkansas Hourly Readings

Current Data

(Last Updated 01/02/2025 , at 11:15 AM CST)

Time (CST)	Deer	Eagle Mountain	Fayetteville	Marion	N Little Rock Airport	N Little Rock, Pike Ave & River Rd	Springdale
2 AM	0.033	0.029	0.008	0.000	0.007	0.004	0.019
3 AM	0.032	0.029	0.008	0.000	0.011	0.006	0.017
4 AM	0.030	0.027	0.008	0.000	0.013	0.006	0.015
5 AM	0.028	0.026	0.006	0.000	0.017	0.007	0.013
6 AM	0.029	0.026	0.007	0.000	0.018	0.010	0.005
7 AM	0.028	0.025	0.007	0.000	0.016	0.004	0.003
8 AM	0.028	0.027	0.005	0.000	0.014	0.004	0.005
9 AM	0.028	0.027	0.010	0.011	0.014	0.009	0.014
10 AM		0.026	0.025	0.020		0.012	0.021
11 AM		0.027	0.028	0.024			

Yesterday's Data

(01/01/2025)

Time (CST)	Deer	Eagle Mountain	Fayetteville	Marion	N Little Rock Airport	N Little Rock, Pike Ave & River Rd	Springdale
2 AM	0.028	0.028	0.029	0.021	0.022	0.005	0.028
3 AM	0.029	0.029	0.029	0.021	0.023	0.011	0.029
4 AM	0.029	0.028	0.029	0.020	0.021	0.012	0.029
5 AM	0.029	0.027	0.028	0.020	0.017	0.013	0.029
6 AM	0.029	0.028	0.028	0.018	0.019	0.016	0.030
7 AM	0.027	0.028	0.029	0.021	0.022	0.016	0.030
8 AM	0.027	0.027	0.029	0.025	0.025	0.016	0.029
9 AM	0.028	0.028	0.029	0.027	0.026	0.018	0.029
10 AM	0.029	0.028	0.029	0.026	0.028	0.020	0.031
11 AM	0.029	0.028	0.029	0.027	0.027	0.023	0.031
12 Noon	0.031	0.029	0.031	0.026	0.028	0.024	0.031
1 PM	0.032	0.030	0.032	0.026	0.030	0.024	0.033
2 PM	0.033	0.032	0.034	0.027	0.031	0.025	0.034
3 PM	0.034	0.034	0.035	0.028	0.031	0.027	0.034
4 PM	0.034	0.034	0.034	0.028	0.032	0.028	0.034
5 PM	0.034	0.033	0.033	0.027	0.031	0.028	0.034
6 PM	0.033	0.033	0.018	0.021	0.028	0.024	0.024
7 PM	0.030	0.034	0.013	0.007	0.030	0.014	0.014
8 PM	0.031	0.032	0.014	0.006	0.027	0.005	0.005
9 PM	0.032	0.032	0.012	0.005	0.019	0.001	0.002
10 PM	0.032	0.031	0.010	0.002	0.021	0.001	0.003
11 PM	0.032	0.030	0.008	0.001	0.018	0.001	0.009
12 Midnight	0.032	0.030	0.010	0.000	0.020	0.002	0.019

Figure 5-4. Near real-time continuous hourly monitor data.

Additionally, DEQ hosts topical webpages to inform the public about Ozone Action Days. This page includes more detailed information about the AQI and its purpose, voluntary preventative actions individuals can take to reduce air pollution, and links to EPA's AirNow website and other informative resources.

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FAQs

Office of Air Quality

Policy & Planning

Energy and Environment Innovation Plan

State Air Quality Plans

Go RED!

Monitoring Site Map

Ozone

Cars and Air Pollution

Commuter Calculator

SLEIS

Volkswagen Settlement

Efficiency and Streamlining Effort

DEQ Comments

Planning Archive

Related Links & Documents

Ozone Information

Cars and Air Pollution
(What do cars contribute to Air Pollution?)

Commuter Calculator
(Commuting Alternatives - Calculate what you can save)

EPA - AIR Now Website
(The U.S. EPA has developed the AIRNow website to provide the public with easy access to national air quality information. It is a joint partnership between EPA and State and local air quality agencies. The website offers daily air quality forecasts, real-time air quality for over 165 cities across the U.S. and links to more detailed State and local air quality websites.)

Ozone Action Days

Air quality is variable and dependent upon a number of factors including sunlight, temperature, wind speed and direction. Like the weather, it can change from day to day or even hour to hour. The U.S. Environmental Protection Agency (EPA) and others are working to make local air quality information as available to the public as weather information. Ozone Action Days is our local central Arkansas program coordinated through Metroplan and the Central Arkansas Clean Cities Coalition in cooperation with the Arkansas Department of Health (ADH), Arkansas Division of Environmental Quality (DEQ), and the Arkansas Highway and Transportation Department (AHTD). Counties included in the program are Pulaski, Faulkner, Lonoke and Saline.

More about Ozone Action Days

There are now two basic types of Ozone Action Days:

1. An **Ozone Action *Advisory*** will be declared when the AQI forecast is **code orange**, indicating that prolonged outdoor exertion is **UNHEALTHY FOR SENSITIVE GROUPS** (i.e., children and persons with asthma or other breathing problems).
2. An **Ozone Action *Alert*** will be declared when the AQI forecast is **code red**, indicating that prolonged outdoor exertion is **UNHEALTHY FOR EVERYONE**.

In addition, **UNUSUALLY SENSITIVE PEOPLE** should routinely check the AQI as reported in newspapers and on the radio, television, and the Internet and consider limiting prolonged outdoor exertion when the AQI is **code yellow**.

A website dedicated to Ozone Action Days information has been set up by Metroplan. DEQ advises Metroplan on ozone-related issues and provides support.

DEQ's Laboratory and Monitoring Services staff calculates the local Air Quality Index (AQI), not to be confused with the Ozone Forecast. It is a scale used to report actual levels of ozone and the other four major atmospheric pollutants of concern. The higher the AQI value the greater the health concern.

- Today's AQI (Little Rock) (Posted by 10 a.m. Daily)
- Today's AQI (Springdale) (Posted by 10 a.m. Daily)

Figure 5-5. DEQ Ozone Action Days webpage.

5.2.2 EPA's AirNow Website

DEQ also submits monitor data to EPA's AirNow website that provides an Air Quality Index (AQI) to the public using easily interpreted graphics. On one webpage, the AQI index translates actual air quality concentrations to an easy-to-read graphic.

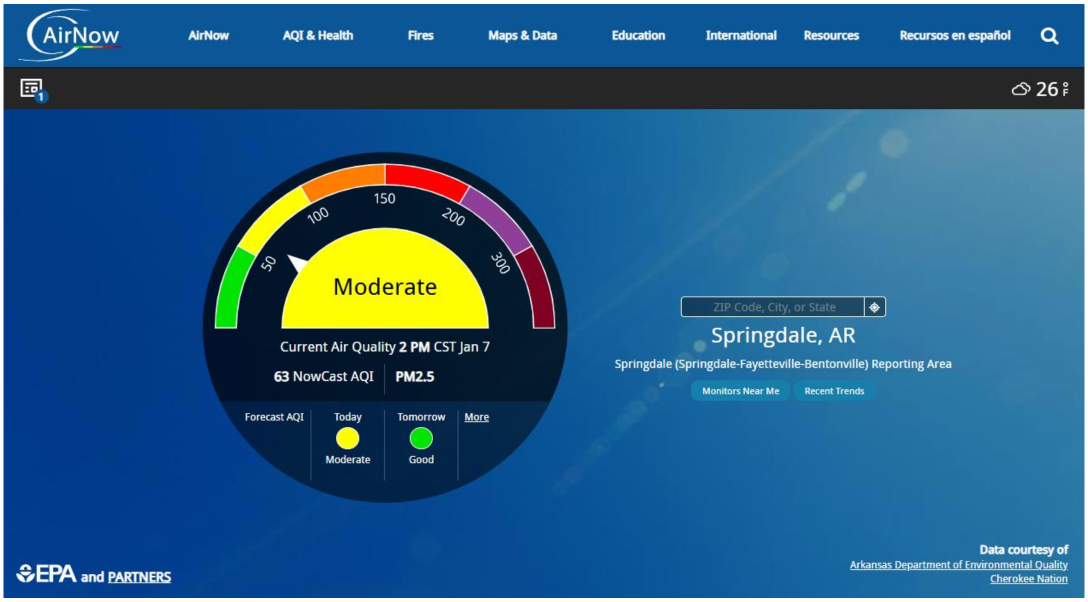

Figure 5-6. EPA's AirNow Website Homepage.

On another AirNow webpage, the AQI index translates monitored concentrations to the color-coded AQI and displays it on an interactive map that allows the public to focus on a specific area in Arkansas or view AQIs as broadly as the continental United States.

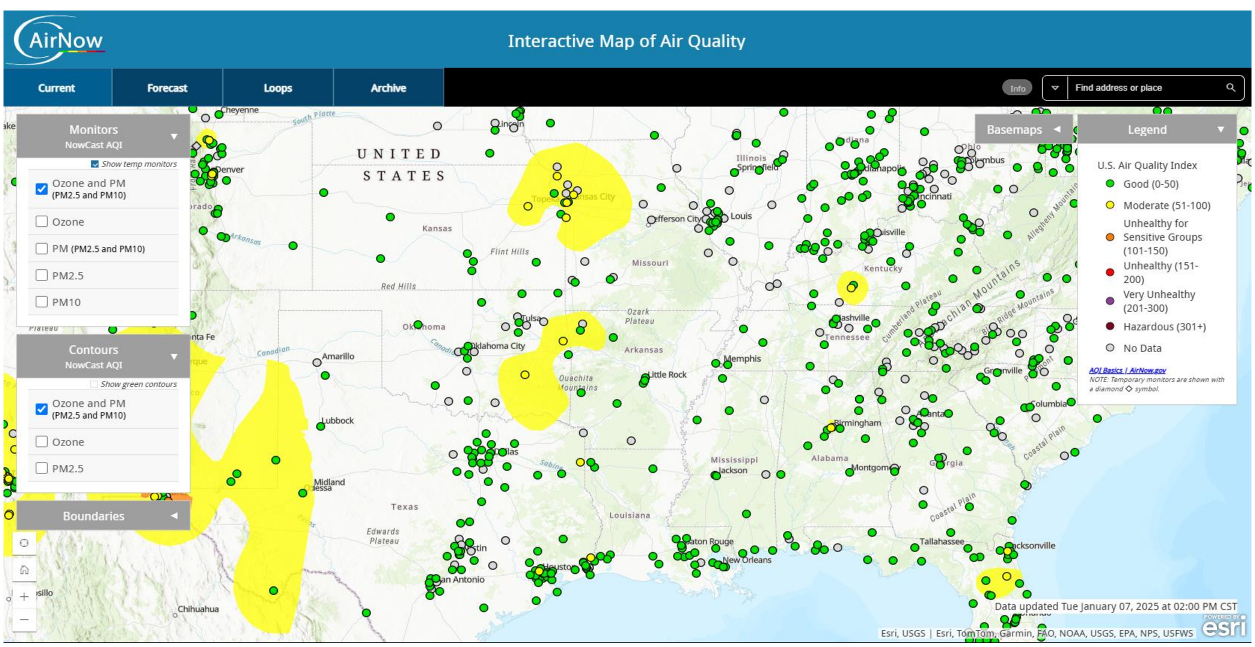

Figure 5-7. EPA's AirNow Website Interactive Map.

AirNow also has a fire and smoke-specific interactive map that shows observed air quality conditions based on fine scale particulate (PM2.5) concentrations, as well as fire locations from incidents and satellite detections, and smoke plumes detected by satellites.

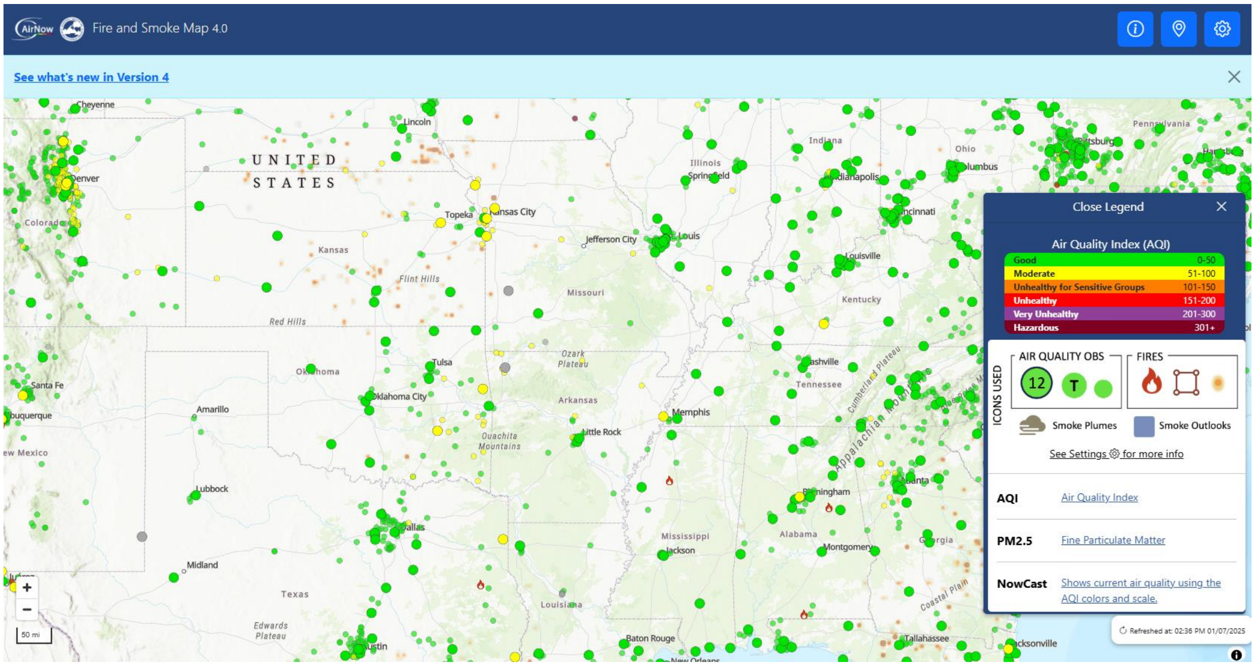

Figure 5-8. EPA's AirNow Website fire and smoke-specific interactive map.

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5.2.3 Arkansas DEQ Social Media Utilization

DEQ provides daily social media posts on Facebook and X (formerly Twitter) informing the public of Arkansas' air quality index for ozone and particulate matter, and DEQ staff forecast air quality for the Central Arkansas and Northwest Arkansas regions. Regional and state-wide updates and advisories or alerts on specific events impacting air quality are also shared via social media.

DEQ makes an extra effort to elevate public awareness on days when the air quality index rises above "yellow" for any pollutant by releasing additional eye-catching posts information through social media and news releases. At times, Office of Air Quality staff have been invited to speak during local news segments to explain the AQI and related advisories and alerts that E&E broadcasts, and to talk about voluntary actions that can be taken to reduce air pollution.

Figure 5-9. DEQ Facebook Social media Post regarding Saharan Dust.

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Figure 5-10. DEQ Facebook Social Media Post regarding an August 1, 2024 Code Orange Advisory.

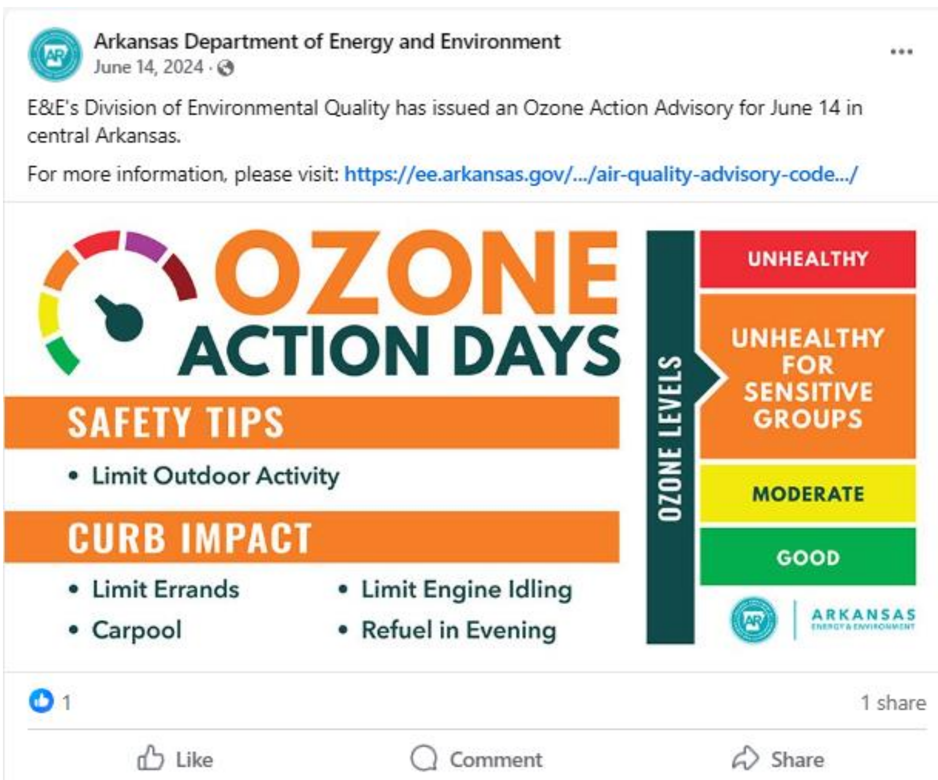

Figure 5-11. DEQ Facebook Social Media Post regarding a June 14, 2024 Code Orange Advisory providing Tips.

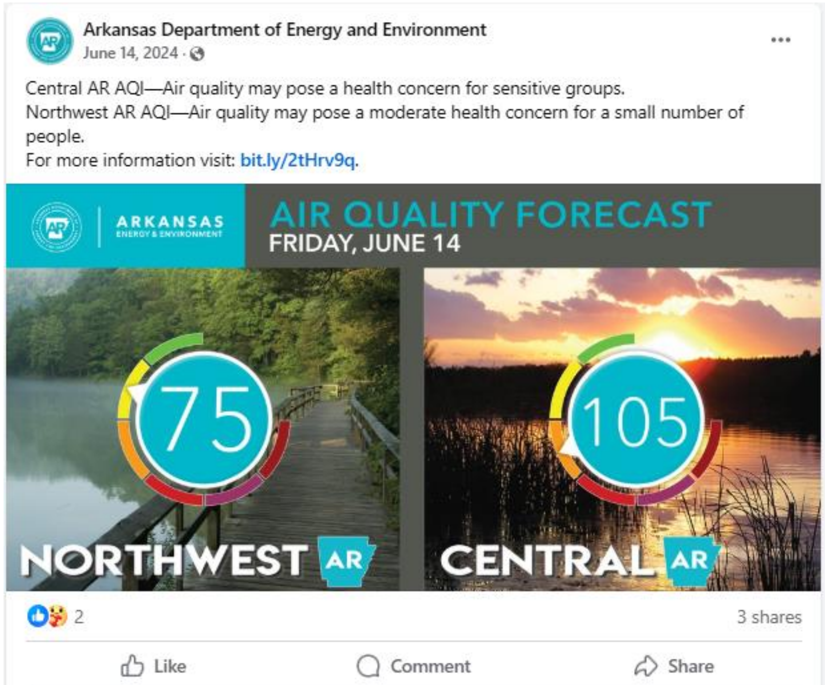

Figure 5-12. DEQ Facebook Social Media Post regarding a June 14, 2024 Code Orange Advisory providing AQIs.

Figures 5-13 and 5-14 show screen captures of DEQ social media posts between September 18 and September 21, 2024, during an exceptional event period discussed in this document. During this three-day period, Central Arkansas air quality was being influenced by smoke.

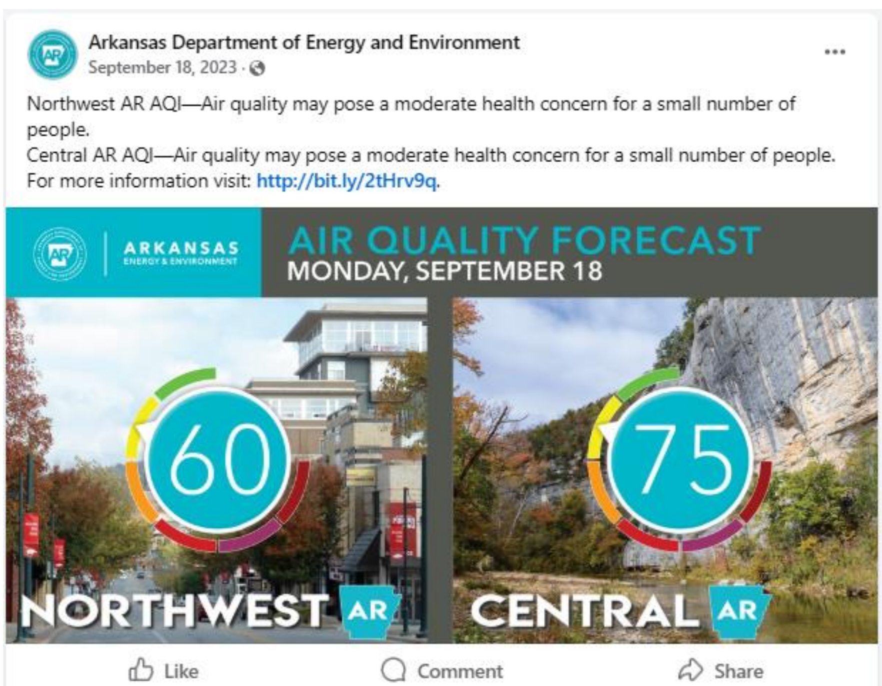

Figure 5-13. DEQ Facebook Social Media Post regarding a September 18, 2024 "Yellow" AQI.

Figure 5-14. DEQ Facebook Social Media Post regarding a September 19, 2024 "Yellow" AQI.

Figure 5-15. DEQ X Social Media Post regarding an October 18, 2024 Code Orange Advisory.

5.2.4 Other Cooperators re-posting of E&E's Advisories

Figure 5-16. U.S. National Weather Service X Social Media Post regarding a June 13, 2024 Code Orange Advisory.

Figure 5-17. U.S. National Weather Service X Social Media Post regarding a June 14, 2024 Code Orange Advisory.

Metroplan is the designated Metropolitan Planning Organization (MPO) for central Arkansas. Metroplan now has members in Pulaski, Faulkner, Saline, Lonoke and Grant Counties. MetroPlan is a long-time partner of DEQ to help disiminate air quality-related public announcements.

Figure 5-18. MetroPlan Facebook Social Media Post regarding an October 18, 2024 Code Orange Advisory.

Figure 5-19. NBC-affiliated TV News Facebook Social Media Post regarding an October 18, 2024 Code Orange Advisory.

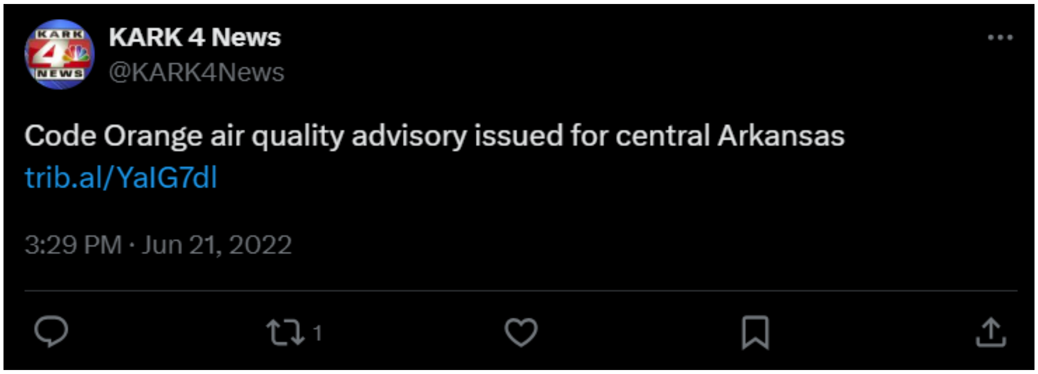

Figure 5-20. NBC-affiliated TV News Channel X Social Media Post regarding a June 21, 2024 Code Orange Advisory.

Figure 5-21. CBS-affiliated TV News Channel X Social Media Post regarding an August 26, 2024 Code Orange Advisory.

5.2.5 Other E&E Publicly-available Products

DEQ also works to inform the public about best practices in smoke management for agricultural fire and prescribed forestry burns to help reduce impacts of smoke on air quality. In October 2022, the Arkansas Department of Agriculture (ADA) and DEQ announced the launch of the Arkansas FireSMART mobile application. This app offers row crop producers and forest landowners a simple, easy way to check conditions and report prescribed burns. With the app, producers can select the area they plan to burn on a map and the application will generate real-time weather data, letting producers know if current conditions align with the state's Voluntary Smoke Management Guidelines. Under Voluntary Smoke Management Guidelines, producers and landowners report prescribed burns to the ADA's Dispatch Center. The FireSMART app also streamlines this process, making the app a one-stop shop for reporting and information.

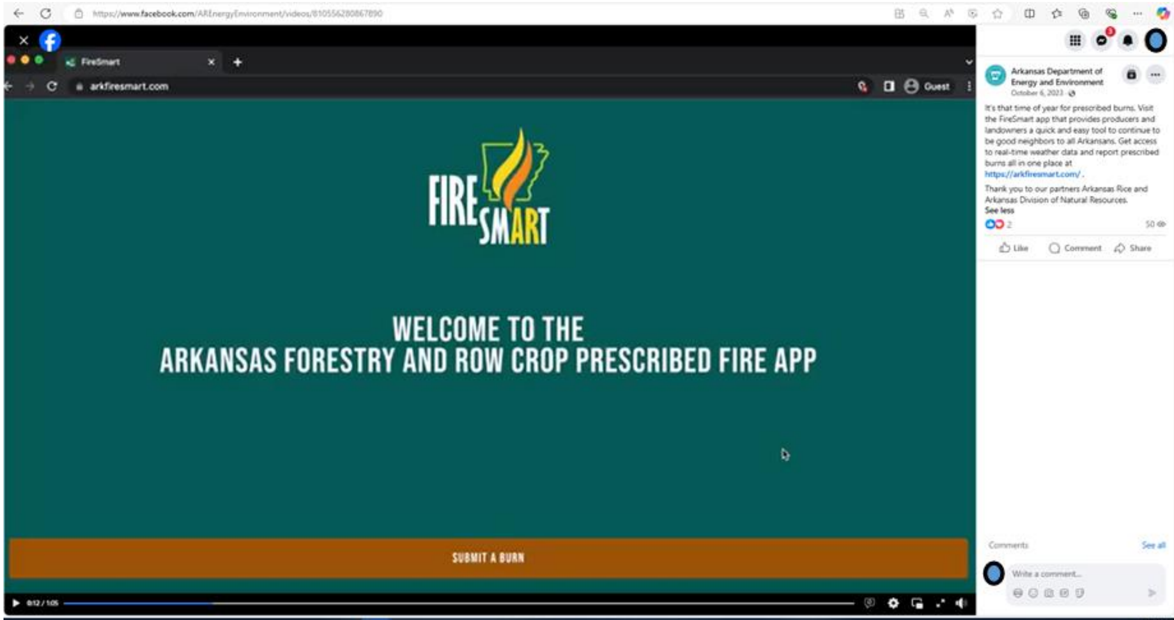

Figure 5-22. FireSMART Prescribed Fire Smoke Management App.

In the interest of promoting voluntary pollution reduction through public awareness, DEQ also develops and distributes informative flyers to be shared by partners with other state agencies, local governments, and citizen groups.

Figure 5-23. DEQ Example Public Awareness Flyer.

6.0 Summary

Wildfires during the spring of 2022 and 2023 were prevalent in Mexico. Fires in Arizona and New Mexico were important during the summer of 2022, while the immense fire season in Canada during the spring and summer of 2023, all created smoke that led to elevated $PM_{2.5}$ concentrations at the DEQ's ambient air monitoring stations, and corresponding exceedances of the tiering thresholds for $PM_{2.5}$.

On behalf of the DEQ, Ramboll has prepared a thorough demonstration addressing all required components of a request to exclude these data from regulatory decisions under the Exceptional Events Rule in 40 CFR Part 50.14. This demonstration followed the procedures outlined in the Exceptional Events Rule, including the Initial Notification process (Appendix D) and will be made available for a thirty (30) day public comment period, per Exceptional Events Rule requirements outlined in Section 5.1. The public and all interested parties will be invited to comment on this document that will be available on the DEQ's website (https://www.adeq.state.ar.us/air/planning/sip/2024pm25.aspx). Comments will be due by the deadline in the public notice.

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7.0 References

EPA, 1999. Guideline on Data Handling Conventions for the PM NAAQS. https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/19990401_oaqps_epa-454_r-99-009_guideline_data_handling_pm_naaqs.pdf. April.

EPA, 2006a. 40 CFR Part 50. https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-50?toc=1. October.

EPA, 2006b. 40 CFR Part 58 Appendix G. https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-58#Appendix-G-to-Part-58. October.

EPA, 2016. Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations. https://www.epa.gov/system/files/documents/2023-12/guidance-on-the-preparation-of-ee-wf-ozone.pdf. September.

EPA, 2024. PM$_{2.5}$ Wildland Fire Exceptional Events Tiering Document. https://www.epa.gov/system/files/documents/2024-04/final-pm-fire-tiering-4-30-24.pdf. April.

APPENDIX A

Wildfires Affecting Arkansas During the Exceedance Period

Table A-1. Mexican Wildfires (> 1000 ha) Affecting Arkansas during Spring 2022.

State	Municipio	Latitude	Longitude	Total Size (Hectares)
Tamaulipas	Gómez farías	23.018	-99.2826	9627
Nuevo león	Santiago	25.295	-100.19	8142
Durango	Mezquital	22.475	-104.637	6788
Sonora	Álamos	26.949	-109.001	5435
Guerrero	Ajuchitlán del progreso	17.966	-100.69	4105
Campeche	Hopelchén	19.098	-89.1712	4000
Guerrero	Coyuca de catalán	18.105	-101.137	3200
Tamaulipas	Güémez	23.910	-99.3377	3100
Oaxaca	San miguel chimalapa	16.600	-94.4725	2769
Chiapas	La concordia	15.951	-92.699	2545
Guerrero	Chilpancingo de los bravo	17.457	-99.7554	2447
Nayarit	La yesca	21.415	-104.273	2349
Durango	Ocampo	26.688	-105.729	2262
San luis potosí	Ciudad del maíz	22.338	-99.3794	2094
San luis potosí	Charcas	23.351	-101.098	2062
Guerrero	General heliodoro castillo	17.898	-100.013	2025
Jalisco	Cuautitlán de garcía barragán	19.380	-104.192	1919
Michoacán	Tancítaro	19.249	-102.205	1822
Chiapas	Cintalapa	16.660	-93.9189	1788
Quintana roo	Bacalar	18.994	-89.1056	1716
Michoacán	Uruapan	19.319	-102.009	1630
Oaxaca	San miguel chimalapa	16.669	-94.5381	1601
Oaxaca	Santiago juxtlahuaca	17.169	-98.1196	1592
Oaxaca	Santiago ixtayutla	16.521	-97.7292	1588
Tabasco	Jalpa de méndez	18.296	-93.0531	1585
Chiapas	La concordia	15.946	-92.6415	1509

State	Municipio	Latitude	Longitude	Total Size (Hectares)
Jalisco	Atoyac	19.996	-103.321	1459
Sonora	Opodepe	30.014	-110.87	1431
Nayarit	Del nayar	22.457	-104.628	1241
Chiapas	Villa corzo	16.094	-93.2366	1230
Chiapas	Cintalapa	16.569	-93.7165	1219
Guerrero	Tlacoachistlahuaca	17.035	-98.1846	1199
Jalisco	Mascota	20.406	-104.731	1124
Chiapas	Villa comaltitlán	15.045	-92.7164	1103
Nuevo león	Montemorelos	25.010	-99.9321	1080
Guerrero	Coyuca de catalán	17.949	-100.805	1078
Sinaloa	San ignacio	24.233	-106.086	1010
Guerrero	Coyuca de catalán	17.907	-101.065	1005
Durango	Mezquital	22.566	-104.605	966

Table A-2 U.S. Wildfires Affecting Arkansas during the 2022 Wildfire Exceptional Event Period.

Wildfire Name	State	Latitude	Longitude	Total Size (Hectares)	Start Date	Containment Date
Hermits Peak	New Mexico	35.759	-105.503	138189	4/6/2022	8/21/2022
Black Fire	New Mexico	33.245	-107.927	131577	5/13/2022	7/27/2022
Contreras Fire	Arizona	31.907	-111.602	12661	6/11/2022	N/A
Pipeline Fire	Arizona	35.361	-111.564	10699	6/12/2022	N/A
Tonto Canyon Fire	Arizona	31.373	-111.144	6873	6/12/2022	N/A
Dempsey Fire	Texas	32.801	-98.2508	4685	6/23/2022	7/4/2022
Foster Fire	New Mexico	31.531	-108.986	3080	5/29/2022	N/A
Chalk Mountain	Texas	32.188	-97.8683	2615	7/18/2022	N/A
Haywire Fire	Arizona	35.372	-111.429	2146	6/13/2022	N/A
Midnight Fire	New Mexico	36.435	-106.204	2142	6/10/2022	N/A
Koonce Fire	Texas	33.966	-98.7942	1517	7/6/2022	N/A
Deer Creek Fire	New Mexico	31.611	-108.997	432	6/9/2022	N/A

Table A-3. Mexican Wildfires (> 700 ha) Affecting Arkansas during Spring 2023.

State	Municipio	Latitude	Longitude	Total Size (Hectares)
Sonora	Suaqui grande	28.389	-110.054	5248
Guerrero	Coyuca de catalán	18.104	-101.156	4804
Guerrero	San miguel totolapan	17.979	-100.260	4535
Oaxaca	San juan mixtepec - dto. 08	17.435	-97.838	4389
Durango	San dimas	24.183	-105.919	3096
Oaxaca	San juan mixtepec - dto. 08	17.403	-97.814	2820
Guerrero	Ajuchitlán del progreso	17.867	-100.640	2733
Chihuahua	Buenaventura	29.919	-107.016	2670
Guerrero	Coyuca de catalán	17.979	-100.782	2382
Sonora	Cajeme	27.782	-109.753	2332
Nayarit	Ixtlán del río	20.911	-104.327	2009
Jalisco	Talpa de allende	20.321	-105.100	1783
Nayarit	Amatlán de cañas	20.851	-104.397	1587
Michoacán	Huetamo	18.708	-100.851	1454
Jalisco	San martín hidalgo	20.537	-103.769	1421
Sonora	Mazatán	29.017	-110.235	1368
Jalisco	Tequila	21.186	-103.983	1367
Tamaulipas	Nuevo morelos	22.541	-99.162	1359
Jalisco	Cabo corrientes	20.302	-105.187	1328
Nayarit	Ixtlán del río	20.965	-104.307	1276
Sonora	Opodepe	30.044	-111.069	1274
Jalisco	Cabo corrientes	20.283	-105.177	1208
Jalisco	Bolaños	21.924	-104.050	1205
Guerrero	Eduardo neri	17.888	-99.662	1200
Jalisco	Talpa de allende	20.325	-105.170	1179

State	Municipio	Latitude	Longitude	Total Size (Hectares)
Guerrero	Ajuchitlán del progreso	17.908	-100.619	1172
Oaxaca	Santiago ixtayutla	16.565	-97.712	1172
Campeche	Escárcega	18.799	-90.110	1094
Guerrero	Marquelia	16.700	-98.751	1063
Oaxaca	San juan mixtepec - dto. 08	17.422	-97.842	1054
Oaxaca	San juan tamazola	17.140	-97.125	939
Guerrero	Copalillo	18.106	-98.896	939
Nayarit	Del nayar	22.146	-104.436	936
México	Temamatla	19.163	-98.902	876
Guanajuato	Guanajuato	20.882	-101.144	791
Jalisco	Tala	20.737	-103.761	765
Oaxaca	San juan tamazola	17.086	-97.256	745
Guerrero	Coyuca de catalán	18.005	-100.775	730
Michoacán	Ario	19.044	-101.740	728

Table A-4. . Canadian Wildfires (> 11,000 ha) Affecting Arkansas during May to October 2023.

Wildfire Code	Province	Latitude	Longitude	Total Size (Hectares)	Start Date
218	Quebec	53.051	-75.326	1080520	5/27/2023
SS022-23	Northwest Territories	60.291	-111.851	641421	7/5/2023
G80280	British Columbia	57.619	-122.012	619072	5/13/2023
23LX-SMITH	Saskatchewan	55.985	-106.587	543976	5/11/2023
FS001-23	Northwest Territories	60.051	-120.976	541766	5/13/2023
SS067-23	Northwest Territories	60.019	-118.326	430000	8/4/2023
483	Quebec	54.057	-74.638	425872	6/14/2023
2023WB7	Park Canada	59.675	-112.425	348511	5/29/2023
23LA-MCCRAE	Saskatchewan	56.068	-105.852	339372	5/11/2023
G90288	British Columbia	59.964	-120.987	290073	5/13/2023
608	Quebec	50.838	-78.407	280488	7/5/2023
344	Quebec	49.122	-76.787	277702	6/1/2023
G92498	British Columbia	58.579	-120.937	275055	8/5/2023
SS052-23	Northwest Territories	60.767	-116.8	252253	8/2/2023
HWF-058-2023	Alberta	58.167	-118.42	234061	6/5/2023
ZF015-23	Northwest Territories	62.938	-115.105	215280	6/28/2023
357	Quebec	52.896	-73.406	212432	6/1/2023
602	Quebec	52.777	-78.32	208681	7/5/2023
HWF-036-2023	Alberta	58.491	-119.403	203022	5/3/2023

Wildfire Code	Province	Latitude	Longitude	Total Size (Hectares)	Start Date
EWF-031-2023	Alberta	53.145	-115.687	201913	5/4/2023
23LX-SHAW	Saskatchewan	55.558	-108.38	191000	5/4/2023
SS027-23	Northwest Territories	61.281	-111.385	176000	7/5/2023
G90628	British Columbia	58.502	-120.412	173353	6/5/2023
G60666	British Columbia	55.947	-124.545	166857	6/8/2023
601	Quebec	53.043	-77.14	155279	7/7/2023
SWF-068-2023	Alberta	55.878	-116.408	143039	5/5/2023
334	Quebec	50.453	-74.131	140435	6/2/2023
485	Quebec	53.384	-76.113	133572	6/14/2023
ZF013-23	Northwest Territories	64.24	-113.592	132001	7/1/2023
MWF-043-2023	Alberta	59.762	-111.149	130805	6/30/2023
SWF-063-2023	Alberta	54.958	-115.681	123670	5/4/2023
2023WB11	Park Canada	59.217	-113.423	118948	5/30/2023
587	Quebec	53.059	-77.969	113713	7/5/2023
2023WB18	Park Canada	59.762	-113.908	109244	7/2/2023
MWF-025-2023	Alberta	58.867	-111.146	105251	5/28/2023
314	Quebec	49.556	-76.764	101700	6/1/2023
EV004-23	Northwest Territories	67.117	-132.314	100000	7/2/2023
ZF033-23	Northwest Territories	65.317	-116.25	99628	6/30/2023
469	Quebec	54.003	-72.172	96803	6/10/2023

Wildfire Code	Province	Latitude	Longitude	Total Size (Hectares)	Start Date
HWF-030-2023	Alberta	58.468	-114.484	96582	5/2/2023
FS010-23	Northwest Territories	61.008	-119.992	90508	6/12/2023
274	Quebec	49.508	-75.288	87689	6/1/2023
RWF-034-2023	Alberta	52.815	-115.45	87492	5/4/2023
504	Quebec	54.412	-76.011	87032	6/22/2023
23LX-VEDETTE	Saskatchewan	56.328	-106.763	85148	5/11/2023
2023WB14	Park Canada	58.96	-113.29	83116	5/31/2023
ZF019-23	Northwest Territories	63.2	-114.533	82000	6/30/2023
2023WB25	Park Canada	59.508	-114.258	77293	7/17/2023
SS016-23	Northwest Territories	61.419	-110.4	75643	6/29/2023
G91313	British Columbia	58.672	-121.643	74686	7/8/2023
ZF085-23	Northwest Territories	62.186	-113.387	73109	8/2/2023
547	Quebec	55.993	-68.983	71599	7/3/2023
222	Quebec	49.06	-76.128	71466	6/1/2023
G92940	British Columbia	59.284	-121.89	71003	8/25/2023
23LX-LSZ001	Saskatchewan	55.283	-110.001	69996	5/13/2023
467	Quebec	50.729	-76.262	68622	6/11/2023
WWF-023-2023	Alberta	54.389	-116.372	66437	5/5/2023
23LA-WISTIGO	Saskatchewan	55.257	-106.375	64309	5/11/2023

Wildfire Code	Province	Latitude	Longitude	Total Size (Hectares)	Start Date
2023WB2	Park Canada	59.395	-112.452	64149	5/28/2023
SS004-23	Northwest Territories	60.954	-119.188	64000	5/12/2023
SLK_FIRE_033	Ontario	50.558	-90.108	62378	6/11/2023
ZF018-23	Northwest Territories	63.067	-112.033	62083	7/1/2023
R91162	British Columbia	59.642	-129.594	60064	7/7/2023
MWF-023-2023	Alberta	57.976	-113.215	59444	5/28/2023
606	Quebec	51.233	-78.173	58400	7/5/2023
ZF011-23	Northwest Territories	62.865	-113.718	57414	6/29/2023
HWF-112-2023	Alberta	59.225	-114.404	57412	7/5/2023
2023NA1	Park Canada	61.833	-123.936	57130	5/16/2023
379	Quebec	50.167	-73.473	55623	6/2/2023
23LA-KENNY	Saskatchewan	55.036	-104.087	55345	6/6/2023
VQ009-23	Northwest Territories	64.815	-125.137	55173	7/3/2023
GWF-027-2023	Alberta	54.52	-117.357	54988	5/13/2023
590	Quebec	51.971	-77.933	54061	7/5/2023
575	Quebec	51.307	-77.331	52014	7/5/2023
GWF-018-2023	Alberta	56.282	-119.162	49328	5/5/2023
NIP_FIRE_009	Ontario	53.04	-88.379	48555	6/5/2023
G51279	British Columbia	54.422	-123.649	48396	7/8/2023

Wildfire Code	Province	Latitude	Longitude	Total Size (Hectares)	Start Date
488	Quebec	50.233	-78.394	48247	6/18/2023
K52125	British Columbia	49.173	-120.061	46504	7/22/2023
K21633	British Columbia	51.004	-119.825	45613	7/13/2023
HWF-109-2023	Alberta	59.453	-114.159	45061	7/5/2023
G41307	British Columbia	53.591	-124.152	44642	7/8/2023
SWF-060-2023	Alberta	55.956	-115.056	43981	5/4/2023
SS069-23	Northwest Territories	60.02	-112.674	43000	8/9/2023
23LX-BOLDING	Saskatchewan	57.877	-107.046	42844	5/20/2023
G90273	British Columbia	58.062	-121.912	42839	5/12/2023
HWF-079-2023	Alberta	59.86	-115.804	42579	6/25/2023
534	Quebec	50.821	-76.118	42361	6/19/2023
NIP_FIRE_013	Ontario	50.843	-87.354	40834	6/11/2023
VA1381	British Columbia	53.043	-126.331	40580	7/9/2023
SWF-064-2023	Alberta	54.896	-116.1	40060	5/4/2023
VQ018-23	Northwest Territories	66.92	-129.473	38550	7/14/2023
SLK_FIRE_031	Ontario	50.973	-89.126	38033	6/11/2023
G90709	British Columbia	59.827	-123.552	37794	6/10/2023
COC_FIRE_007	Ontario	48.984	-79.674	37742	6/2/2023

Wildfire Code	Province	Latitude	Longitude	Total Size (Hectares)	Start Date
480	Quebec	51.68	-73.259	36539	6/10/2023
ZF041-23	Northwest Territories	64.769	-119.529	36070	7/23/2023
EV014-23	Northwest Territories	68.521	-133.101	35583	7/26/2023
2023OT003	Yukon	59.6354	-129.416	35318	7/14/2023
VQ020-23	Northwest Territories	67.325	-130.093	35000	7/17/2023
G41502	British Columbia	53.568	-125.245	34854	7/10/2023
G91739	British Columbia	59.42	-123.656	33426	7/16/2023
SWF-081-2023	Alberta	56.991	-113.459	33138	5/14/2023
G91534	British Columbia	59.427	-121.031	32257	7/11/2023
492	Quebec	51.187	-74.081	32137	6/13/2023
VQ006-23	Northwest Territories	64.909	-125.219	32101	6/30/2023
588	Quebec	53.348	-76.906	32074	7/5/2023
ZF012-23	Northwest Territories	63.012	-114.424	31139	7/1/2023
HWF-072-2023	Alberta	57.693	-116.02	30123	6/24/2023
470	Quebec	51.161	-66.196	29918	6/11/2023
376	Quebec	48.904	-75.825	29790	6/2/2023
23LX-PAWR02	Saskatchewan	55.291	-109.988	29790	5/13/2023
468	Quebec	53.952	-72.403	29661	6/10/2023
G80291	British Columbia	56.511	-121.222	29506	5/13/2023
MWF-024-2023	Alberta	57.712	-110.647	28454	5/28/2023

Wildfire Code	Province	Latitude	Longitude	Total Size (Hectares)	Start Date
479	Quebec	52.523	-70.401	27743	6/12/2023
473	Quebec	50.574	-75.011	27602	6/10/2023
237	Quebec	48.609	-76.636	27497	6/1/2023
PWF-093-2023	Alberta	57.982	-119.973	27174	7/9/2023
2023OC017	Yukon	68.08	-138.435	26479	7/30/2023
2023OC026	Yukon	67.776	-139.067	26367	7/30/2023
498	Quebec	54.529	-77.744	26230	6/22/2023
FS023-23	Northwest Territories	64.008	-121.356	26000	7/10/2023
G70645	British Columbia	55.154	-120.67	25095	6/6/2023
ZF066-23	Northwest Territories	64.733	-115.987	25063	7/30/2023
VQ030-23	Northwest Territories	67.78	-129.702	25000	7/29/2023
2023XY018	Yukon	61.861	-134.512	25000	7/7/2023
2023WB1	Park Canada	58.637	-114.002	24947	5/16/2023
369	Quebec	49.169	-75.67	24917	6/1/2023
23BN-SHAD	Saskatchewan	56.441	-107.966	24854	5/29/2023
R11282	British Columbia	53.519	-125.853	24811	7/8/2023
G60325	British Columbia	57.353	-124.844	24705	5/15/2023
368	Quebec	50.483	-74.278	24152	6/2/2023
03-010-2023	Other	43.629	-65.583	23379	5/27/2023
292	Quebec	49.211	-76.344	23280	6/1/2023
558	Quebec	55.056	-69.448	23152	7/2/2023
2023MA007	Yukon	63.03	-133.854	23115	7/18/2023

Wildfire Code	Province	Latitude	Longitude	Total Size (Hectares)	Start Date
NO029	Other	56.5225	-99.6622	23014	6/12/2023
ZF080-23	Northwest Territories	64.454	-115.203	22807	8/1/2023
535	Quebec	50.295	-78.176	22667	6/21/2023
G90981	British Columbia	59.14	-127.65	22394	6/29/2023
G60853	British Columbia	55.24	-123.67	22373	6/24/2023
ZF072-23	Northwest Territories	63.625	-115.998	22286	7/30/2023
WE027	Other	53.4722	-99.5917	22055	6/29/2023
ZF040-23	Northwest Territories	65.669	-115.622	22000	7/22/2023
COC_FIRE_038	Ontario	50.719	-79.848	21880	7/5/2023
ZF038-23	Northwest Territories	64.551	-119.934	21573	7/22/2023
371	Quebec	49.151	-75.168	21468	6/2/2023
VQ003-23	Northwest Territories	65.475	-126.708	21099	6/15/2023
G90292	British Columbia	58.052	-123.325	21056	5/13/2023
SS056-23	Northwest Territories	60.245	-108.112	21000	7/28/2023
K21384	British Columbia	52.146	-119.962	20745	7/9/2023
624	Quebec	52.958	-76.729	20560	7/10/2023
450	Quebec	50.652	-73.106	20476	6/2/2023
SLK_FIRE_007	Ontario	51.764	-91.85	20427	5/26/2023
312	Quebec	49.031	-76.507	20392	6/1/2023
2023WB12	Park Canada	58.117	-112.644	20280	5/31/2023

Wildfire Code	Province	Latitude	Longitude	Total Size (Hectares)	Start Date
ZF052-23	Northwest Territories	65.919	-116.942	20280	7/28/2023
NO025	Other	56.4772	-92.2878	20000	6/11/2023
550	Quebec	56.9	-67.041	19888	7/3/2023
ZF020-23	Northwest Territories	63.817	-115.683	19736	6/30/2023
EWF-035-2023	Alberta	53.837	-115.783	19672	5/5/2023
172	Quebec	50.617	-66.008	19578	5/28/2023
373	Quebec	48.843	-75.103	19525	6/1/2023
NO032	Other	56.2092	-90.6069	19500	6/12/2023
501	Quebec	54.491	-77.33	19483	6/22/2023
VQ002-23	Northwest Territories	64.35	-122.732	19412	6/3/2023
23LA-SHARP	Saskatchewan	55.424	-105.122	19251	5/19/2023
RED_FIRE_028	Ontario	50.716	-92.213	19177	6/10/2023
G80875	British Columbia	57.279	-120.912	19137	6/24/2023
23SR-RIACH	Saskatchewan	59.741	-109.309	18906	5/19/2023
GWF-019-2023	Alberta	54.736	-119.033	18884	5/5/2023
2023WB19	Park Canada	58.163	-113.442	18781	7/3/2023
ZF025-23	Northwest Territories	63.321	-113.592	18529	7/4/2023
23LA-WAPA	Saskatchewan	54.73	-104.651	18423	6/10/2023
23LX-ELLERAAS	Saskatchewan	56.83	-106.595	18342	5/30/2023
SLK_FIRE_023	Ontario	53.763	-90.701	18200	6/8/2023

Wildfire Code	Province	Latitude	Longitude	Total Size (Hectares)	Start Date
EV016-23	Northwest Territories	68.086	-132.359	18000	7/27/2023
VQ007-23	Northwest Territories	64.158	-125.646	18000	6/30/2023
VQ010-23	Northwest Territories	64.381	-125.962	18000	7/5/2023
PWF-125-2023	Alberta	56.859	-119.659	17714	7/24/2023
V11337	British Columbia	49.982	-121.64	17406	7/9/2023
G50872	British Columbia	55.301	-124.841	17334	6/24/2023
689	Quebec	50.571	-79.305	17326	9/20/2023
SLK_FIRE_047	Ontario	53.122	-90.366	17104	6/21/2023
C52978	British Columbia	51.581	-125.082	16842	8/27/2023
SWF-057-2023	Alberta	55.034	-115.148	16728	5/4/2023
23SR-CHAOther	Saskatchewan	59.653	-105.285	16566	7/22/2023
297	Quebec	48.181	-76.909	16435	6/1/2023
23SR-SEGUIN	Saskatchewan	59.73	-105.237	16368	7/22/2023
2023OC016	Yukon	67.96	-138.611	16116	7/30/2023
2023MA038	Yukon	65.685	-135.04	16090	8/5/2023
378	Quebec	50.559	-66.028	16060	5/31/2023
2023OC024	Yukon	66.253	-139.038	16003	8/3/2023
526	Quebec	54.414	-72.619	15956	6/23/2023
NO037	Other	57.0006	-100.587	15779	6/18/2023
ZF086-23	Northwest Territories	63.491	-113.508	15347	8/2/2023
453	Quebec	50.717	-72.555	15313	6/5/2023

Wildfire Code	Province	Latitude	Longitude	Total Size (Hectares)	Start Date
MWF-039-2023	Alberta	57.422	-113.401	15200	6/29/2023
RWF-032-2023	Alberta	52.905	-115.696	15000	5/4/2023
MWF-021-2023	Alberta	57.694	-113.296	14760	5/28/2023
FS002-23	Northwest Territories	61.825	-123.87	14550	5/19/2023
261	Quebec	49.506	-69.657	14486	6/1/2023
R90877	British Columbia	57.48	-127.652	14460	6/24/2023
HWF-104-2023	Alberta	59.955	-116.247	14250	7/3/2023
462	Quebec	50.679	-72.836	14226	6/5/2023
353	Quebec	49.856	-70.019	14179	6/1/2023
NO038	Other	57.0575	-100.511	14019	6/18/2023
FS022-23	Northwest Territories	61.03	-121.346	14000	7/20/2023
K52767	British Columbia	49.908	-119.633	13970	8/16/2023
2023WB23	Park Canada	60.457	-113.851	13934	7/4/2023
2023WB24	Park Canada	59.551	-115.511	13736	7/11/2023
HWF-083-2023	Alberta	57.799	-114.775	13700	6/30/2023
2023MA011	Yukon	64.029	-135.85	13688	7/20/2023
508	Quebec	54.682	-74.856	13478	6/22/2023
WE018	Other	55.4372	-101.673	13381	6/16/2023
EA073	Other	52.7689	-96.4156	13359	7/5/2023
RWF-027-2023	Alberta	52.821	-115.908	13100	5/4/2023
2023OC018	Yukon	66.027	-135.596	13020	7/30/2023

Wildfire Code	Province	Latitude	Longitude	Total Size (Hectares)	Start Date
HWF-087-2023	Alberta	58.158	-114.183	12508	6/30/2023
2023DA014	Yukon	65.949	-137.311	12500	7/27/2023
2023DA015	Yukon	65.914	-137.36	12500	7/27/2023
FS003-23	Northwest Territories	62.554	-124.644	12453	5/17/2023
ZF073-23	Northwest Territories	63.793	-115.979	12339	7/31/2023
G60861	British Columbia	55.367	-124.443	12275	6/24/2023
R11387	British Columbia	53.75	-126.174	12142	7/9/2023
G90956	British Columbia	59.525	-126.651	12107	6/28/2023
EWF-040-2023	Alberta	53.936	-117.776	12073	5/6/2023
HWF-159-2023	Alberta	59.685	-119.684	12060	9/19/2023
VQ034-23	Northwest Territories	65.935	-129.898	12000	7/29/2023
FS025-23	Northwest Territories	63.501	-121.386	12000	8/5/2023
VQ012-23	Northwest Territories	65.676	-129.443	12000	7/10/2023
597	Quebec	51.743	-78.43	11966	7/7/2023
RED_FIRE_005	Ontario	53.469	-93.218	11748	5/25/2023
23SR-HAMIL	Saskatchewan	58.284	-104.215	11741	7/26/2023
593	Quebec	51.473	-77.368	11564	7/6/2023
23SR-DORRELL	Saskatchewan	59.984	-106.805	11456	7/13/2023
ZF083-23	Northwest Territories	64.417	-118.906	11412	8/2/2023

Wildfire Code	Province	Latitude	Longitude	Total Size (Hectares)	Start Date
NO043	Other	55.8589	-94.3678	11392	6/19/2023
K22024	British Columbia	50.448	-120.401	11382	7/21/2023
268	Quebec	48.513	-76.048	11358	6/1/2023
603	Quebec	51.962	-76.85	11319	7/5/2023
K71535	British Columbia	50.681	-122.386	11284	7/11/2023
ZF046-23	Northwest Territories	63.922	-113.854	11211	7/24/2023
NO066	Other	56.2333	-101.628	11017	7/1/2023
618	Quebec	56.973	-67.361	11007	7/8/2023
VQ027-23	Northwest Territories	65.678	-127.606	11000	7/28/2023
VQ032-23	Northwest Territories	66.174	-130.413	11000	7/27/2023
VQ033-23	Northwest Territories	66.038	-130.074	11000	7/29/2023
2023DA029	Yukon	63.837	-137.811	10979	7/30/2023

APPENDIX B

2021-2023 $PM_{2.5}$ Design Values

AQS Site ID	Local Site Name	2021	2022	2023	3-Year Average Design Value (µg/m^3)
		Annual (µg/m^3)	Annual (µg/m^3)	Annual (µg/m^3)	Annual (µg/m^3)
05-119-0007	PARR	9.24	8.81	9.98	9.3
05-139-0006	El Dorado	9.09	9.12	9.83	9.3

APPENDIX C

Documentation of Mexico Fires not Reasonably Controllable or Preventable

Documenting the source of fires in Mexico is difficult as there is less information available compared to the U.S. or even Canada. Below we present results from the Mexican government.

Documentation of the Source of Fires in Mexico by the Mexican Government

Fire plays a significant role in the dynamics of several ecosystems. Fires can be part of a natural process that contributes to the health of ecosystems, but when out of control they can cause severe damage in a brief time. Mexico often experiences fires due to a combination of natural and human factors. Over the last decade, changes to precipitation intensity, increased temperatures, and other factors due to climate change have affected the frequency and extent of forest fires in Mexico.

The Mexican institution in charge of the development of policies and practices that preserve Mexico's forests in a sustainable manner is the Comisión Nacional Forestal (CONAFOR) and was created by executive order on April 4, 2001[1]. One of CONAFOR's responsibilities is the development and maintenance of a database of fires statistics to establish fire management practices and to facilitate collaboration among other Mexican agencies on this issue. Figure A-1—taken from CONAFOR's fire management main page[2]—shows the incidence of forest fires in Mexico from 1970 to 2023. The information in orange shows the total number of fires, while the green indicates the total area burned in hectares (ha[3]). The time series at the bottom right shows that the area burned remains approximately constant from 1970 to 2015 at around 190,000 ha per year, with three major exceptions in 1988-1989 (500,000 ha), 1998 (849, 632 ha) and 2011 (956,405 ha). Since 2015 there has been a substantial increase in burned area with 2023 having a historic maximum of 1,047,493 ha. At the same time, the number of fires since 2015 has not increased and has fluctuated between 6,000 and 9,000 fires per year. This seems to imply that recent fires are now more intense and capable to burn larger areas, possibly a result of climate change leading to persistent drought conditions in Mexico.

Fires in Mexico are not only confined to states along the Gulf Coast and can occur over the entire country including in Central Mexico. State of Mexico, Jalisco, Michoacan, Chihuahua and Mexico City are the top five entities with the most fire incidences from 2021 to 2023[4]. Under the right meteorological conditions, the smoke from these fires along with those on the Yucatan Peninsula and Gulf of Mexico coastal areas (e.g., Veracruz) can be transported north and affect the air quality in the U.S. , especially those located in the southern U.S.

There are two main fire seasons identified in Mexico: the first from January to June occurs in central, north, northeast, south and southeast Mexico; the second, from May to September, in the northwest[5]. Both occur when the country experiences the dry or drought season. This is shown in Figure A-2 that presents a heat map of the average fire incidences per month with data from 2015 to 2023 for all the Mexican States. Higher incidences are colored in red and orange shades. During the climatological dry season, high temperatures and low precipitation increase the probability to experience severe fires due to a combination of natural and human factors.

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[1] Comisión Nacional Forestal (CONAFOR). Mission Statement. Accessed August 2024 at: https://www.gob.mx/conafor/que-hacemos

[2] Comisión Nacional Forestal (CONAFOR). Fire Management Statistics and Maps. Accessed August 2024 at: https://snif.cnf.gob.mx/incendios/

[3] A hectare is 100 m x 100 m and is approximately 2.5 acres.

[4] Comisión Nacional Forestal (CONAFOR). Fire Management Program CONAFOR Annual Summaries from 2019 to 2023 and partial 2024.Accessed August 2024 at: https://www.gob.mx/conafor/documentos/reporte-semanal-de-incendios

[5] Secretaria de Medio Ambiente y Recursos Naturales (SEMARNAT). Fire Seasons in Mexico. Accessed August 2024 at: https://www.gob.mx/semarnat/es/articulos/temporadas-de-incendios-forestales-en-mexico?idiom=es#:~:text=En%20M%C3%A9xico%20se%20tienen%20identificadas,segu%C3%ADa)%20en%20el%20territorio%20nacional.

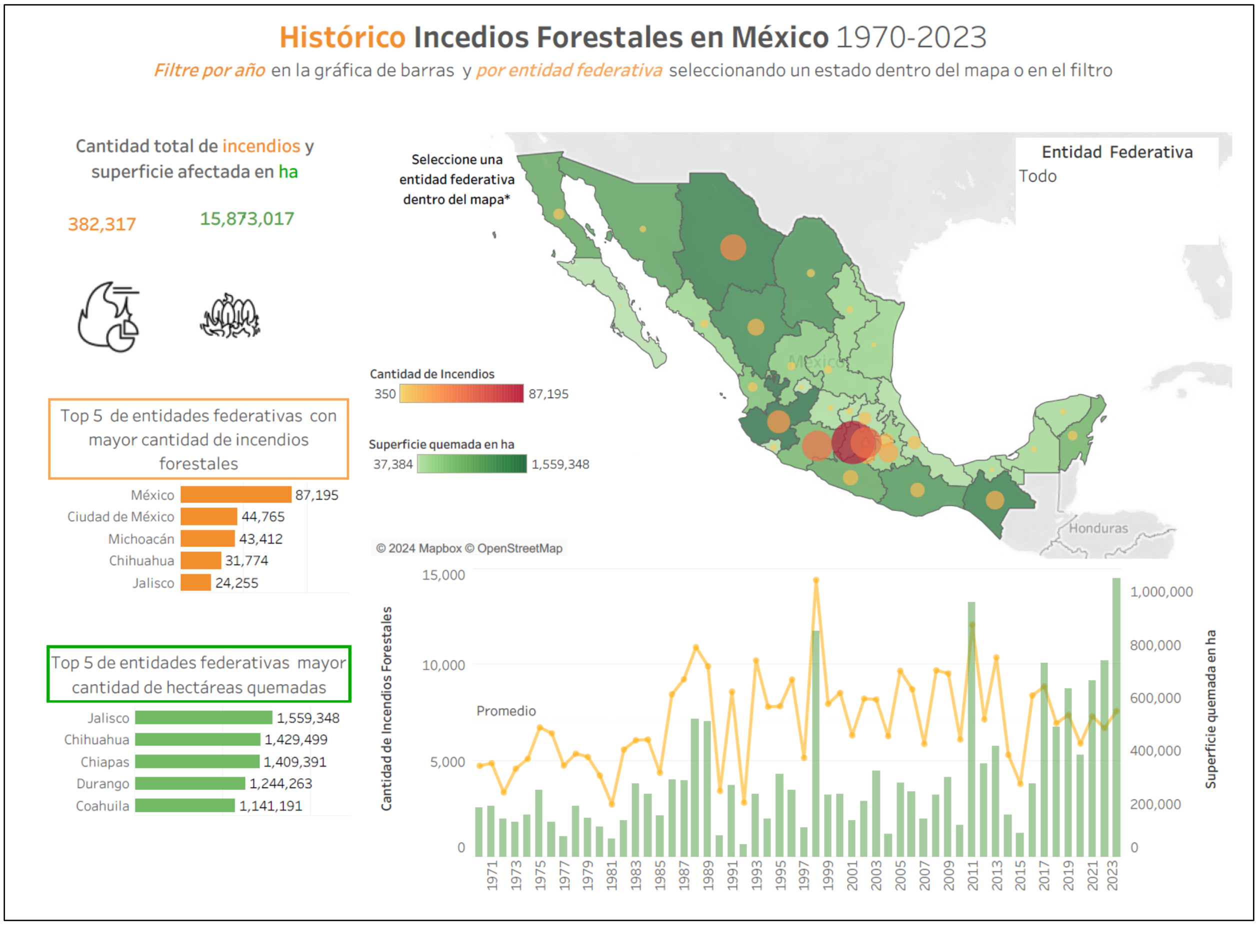

Figure A-1. Incidence of Forest Fires in Mexico from 1970 to 2023[2]. In the time series at the bottom of the figure orange indicates number of fires, green shows area burned in hectares.

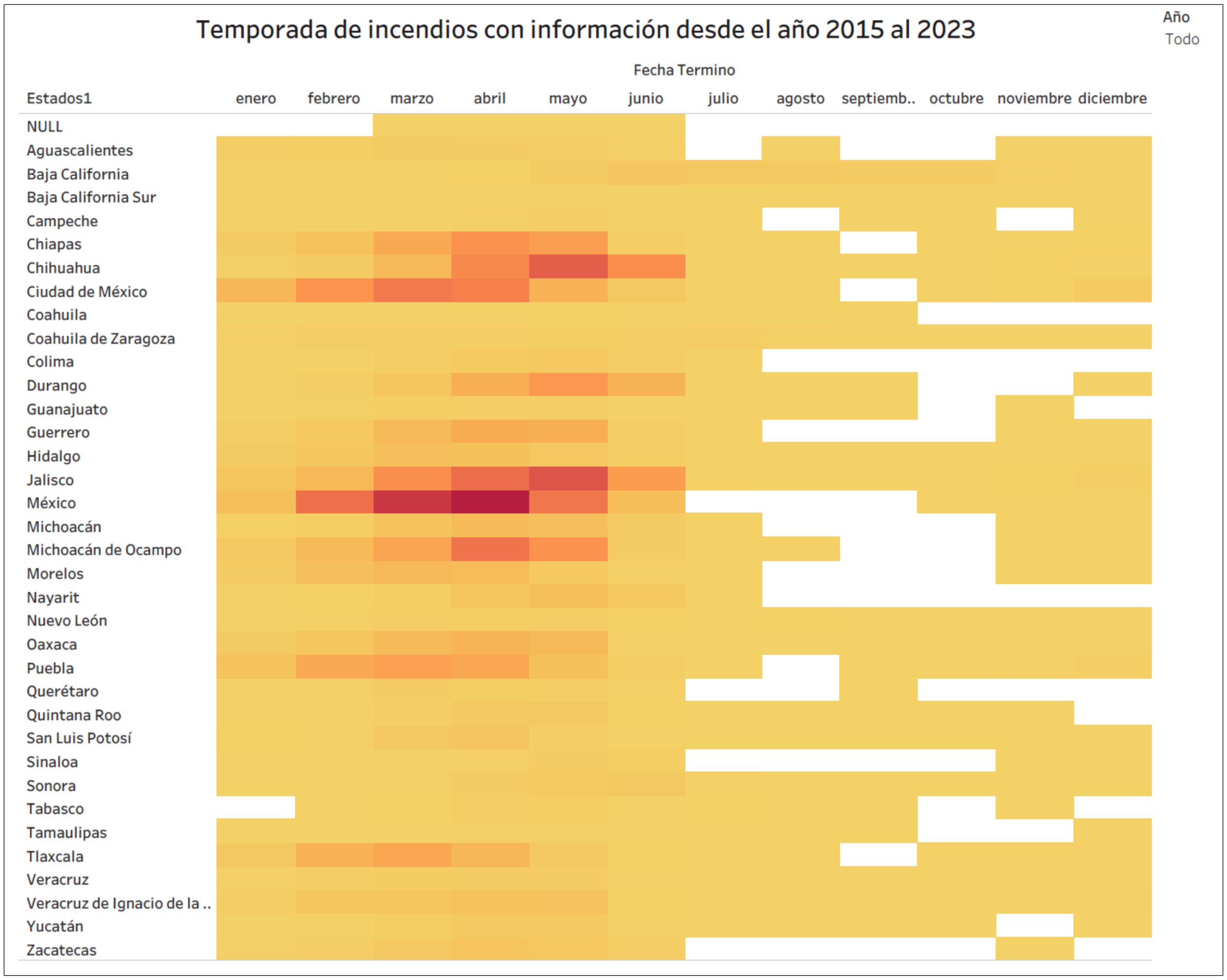

Figure A-2. Heat map with the monthly average fire incidence from 2015 to 2023 for each state in Mexico. Red and orange color indicate higher number of fires.

According to CONAFOR, most wildfires in Mexico are started by human activity. During 1998-2019 anthropogenic causes were responsible for 98% of the fires with only 2% due to natural causes. Figure A-3 shows the probable causes of fires in Mexico from 2019 to 2023 and partial data for 2024 (Jan to Aug). For each year, all causes add to 100%. These are the main factors in the figure that contribute to occurrence of fires:

- Unknown: Includes accidental ignitions and fires started with no specific or unknown causes.
- Intentional: Includes efforts to clear land for development or other land use changes, vandalism and fires started by disputes over land.
- Agricultural: Includes fires started by traditional slash-and-burn farming methods (roza y quema). Farmers clear small plots of land by cutting down vegetation and burning it to prepare for the planting of crops. Sometimes these fires can get out of control and spread to larger areas.
- Livestock: Similar to agricultural fires, but the land is cleared to support livestock activities.

- Other Anthropogenic causes: Includes fires caused by improper disposal of cigarette butts, campfires left unattended, or burning debris during windy conditions that can spread flames to unintended areas. It also includes, fires started by hunters, fireworks at festivities, cleaning land for other economic reasons or to open and clean roads from debris. It also includes prescribed fires.
- Natural: Includes fires started mostly by lightning during storms, but also volcanic activity in central Mexico (Popocatépetl, Volcán de Colima).

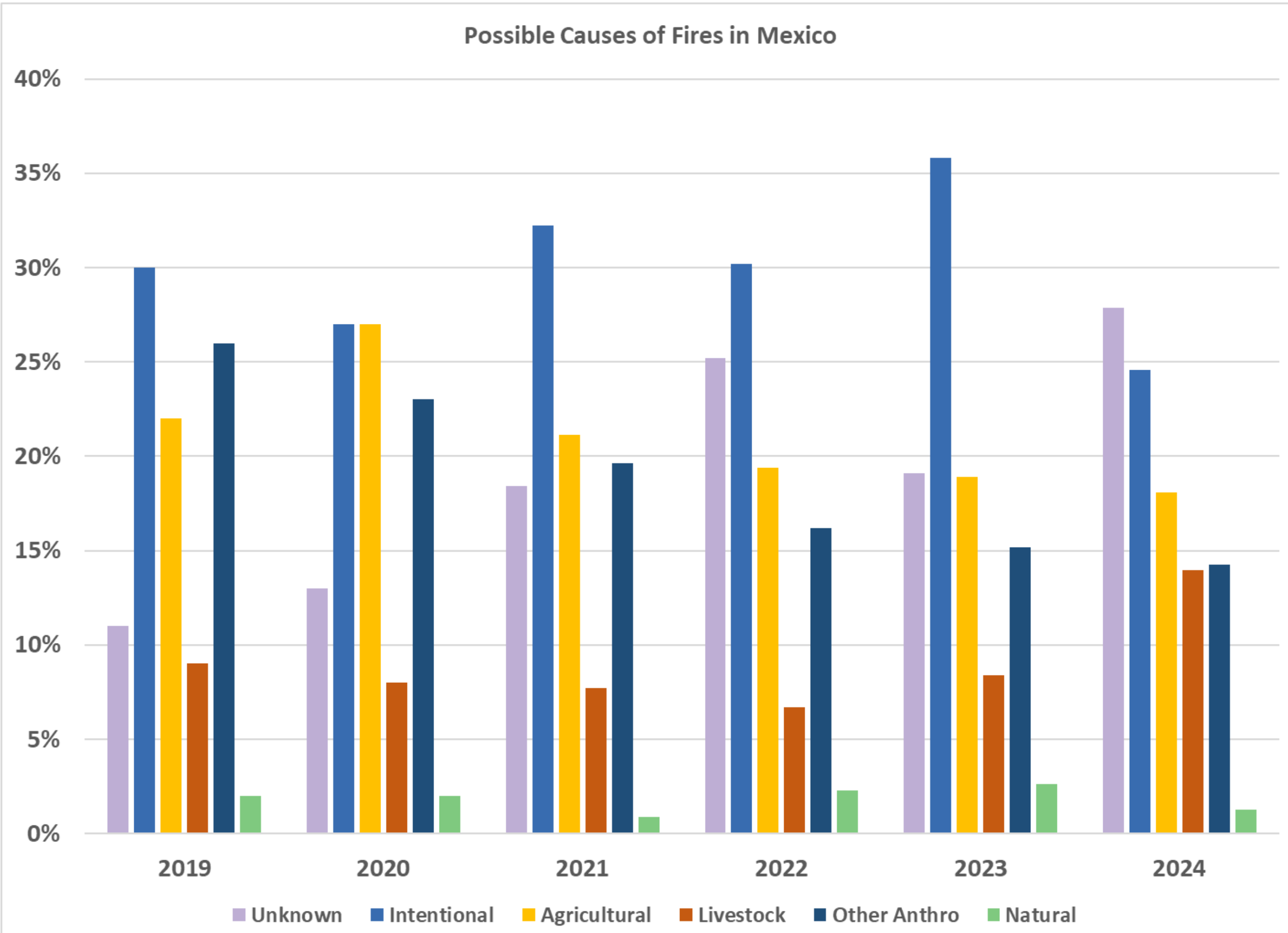

Figure A-3. Possible causes of fires in Mexico from 2019 to 2024. Partial data for 2024 (January to August).

Figure A-3 shows that both agricultural and livestock activities account for about 30% of the fires each year in Mexico. This means that almost 70% of the fires experienced every year are caused by human activity but they are not "reasonably controllable or preventable" and are "unlikely to recur at a particular location" that is they conform with the definition of Exceptional Event based on Section 319(b)(1)(A) of the Clean Air Act. The combination of these factors contributes to the risk and occurrence of fires in Mexico sometimes resulting in significant environmental and economic impacts. Efforts to address these fires often involve improving agricultural practices, promoting sustainable land management, and enhancing fire prevention and suppression capabilities.

Forest fires caused by unintended agricultural burning put the lives of producers at risk, damage ecosystems and degrade soils, which translates into erosion and lower crop yields. According to the UN[6], many farmers consider agricultural burning to be the most efficient and cost-effective way to clear, fertilize and prepare land for new planting. The problem is that these burnings often get out of hand leading to wildfires and are the largest source of black carbon in the world, a threat to both human and environmental health. The Mexican Government has set goals with the intent to reduce the recurring burning of agricultural land by 40 percent by 2024[7]. The Secretaría de Agricultura y Desarrollo Rural (SADER) is the Mexican Ministry of Agriculture and Rural Development and launched the program "Mi Parcela no se quema" (my plot does not burn) in 2020[8] to promote the use of sustainable alternatives that reduce agricultural burning, such as waste management practices. This program involves other federal agencies like CONAFOR and state and local governments. The program organizes workshops for farmers with information to improve farming practices like reducing and composting organic matter into farmland without the need of burning. The number of workshops was initially small with only five provided in the entire country in 2020 but has increased substantially since to 493 workshops in 2023[9]. As a direct result of these efforts the program has reduced the areas that used to be subjected to agricultural fires by 47,200 ha between 2021 and 2023[9]. Figure B-3 indicates the success of these programs as the percentage of fires caused by agricultural activities alone has been decreasing since 2020 (the program's inception) to 2024.

Thus, according to the Mexico government, historically a vast majority of the fires in Mexico are not burns for agriculture or livestock and with the emphasis in reducing agricultural burns in more recent (2020+) years the amount of agriculture burning is being reduced. Climate change and drought contribute to fires in Mexico that get out of control as evident by a similar number of fires in recent years but burning larger areas as occurs with wildfires.

Further Evidence of Most Fires in Mexico not Reoccurring Agricultural Fires

Below we provide supporting information that most of the fires in Mexico are not agricultural burning so are not regularly reoccurring.

Global Forest Watch Indicates Frequent Forest Fires on The Yucatan Peninsula and Eastern Mexico

Forest fires in Mexico are mainly caused by human activities either on purpose (e.g., to clear land for development) or accidently. In either event, such forest fires will not recur as once the forest is burned at a specific location the biomass is consumed. Global Forest Watch[10] is a website that documents deforestation due to forest fires across the planet, including Mexico. Figure A-4 from the Global Forest Watch website shows areas in Mexico with tree loss due to forest fires in pink with the east coast states adjacent to the Gulf of Mexico (e.g., Yucatán, Veracruz, and Tabasco) having some of the highest rate of forest fires. Figures A-5 and A-6 show an average yearly tree loss of approximately 17,000 ha (~42,000 acres) in the state of Veracruz and 14,000 ha (~35,000 acres) in Yucatán respectively.

[6] https://www.unep.org/es/noticias-y-reportajes/reportajes/el-impacto-de-las-quemas-agricolas-un-problema-de-calidad-del-aire

[7] Mexico Business. SADER to Reduce Recurring Burning of Agricultural Land. Accessed August 2024 at: https://mexicobusiness.news/agribusiness/news/sader-reduce-recurring-burning-agricultural-land

[8] Secretaria de Agricultura y Desarrollo Rural (SADER). Mi Parcela No Se Quema. Accessed August 2024 at: https://www.gob.mx/agricultura/acciones-y-programas/miparcelanosequema

[9] Statistics on the implementation of the Mi Parcela No se Quema program. Accessed August 2024 at: https://www.datos.gob.mx/busca/dataset/campana-mi-parcela-no-se-quema/resource/9b505ab0-b6bf-444f-bd73-33779f99a010

[10] https://www.globalforestwatch.org/

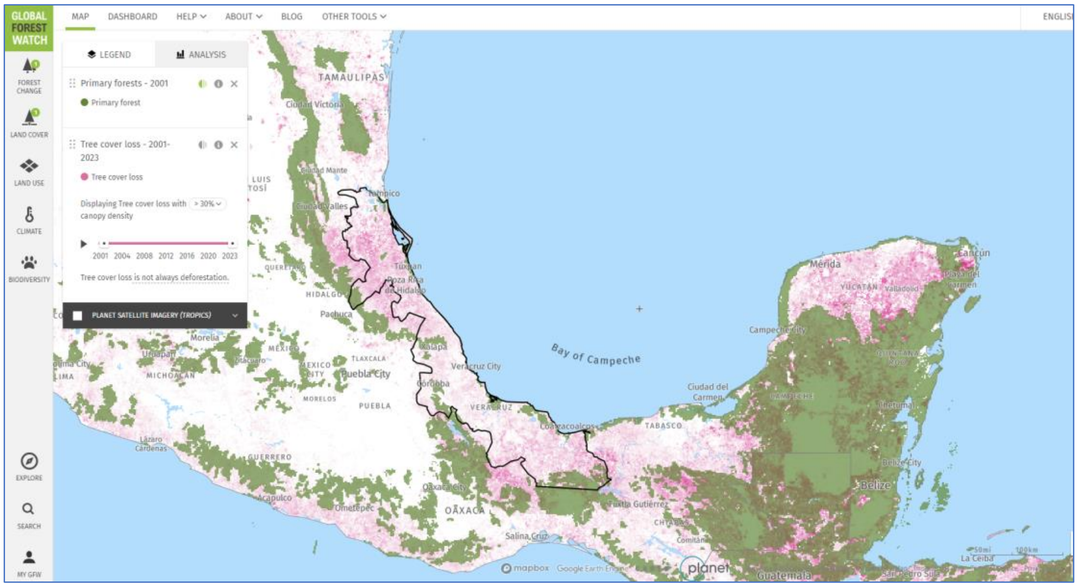

Figure A-4. Locations of tree cover loss in southeastern Mexico (pink areas) that is primarily caused by Forest Fires.

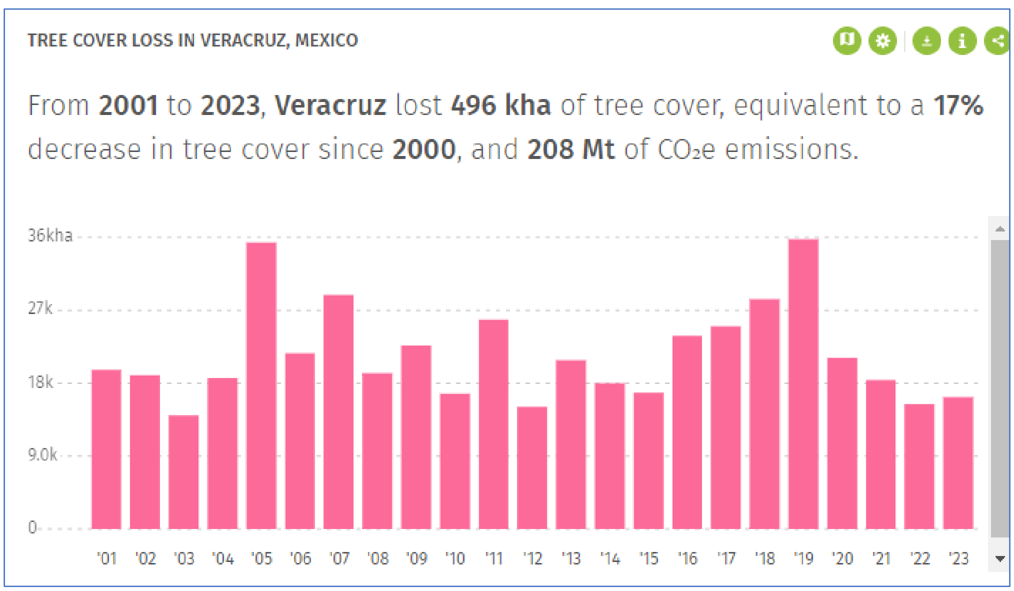

Figure A-5. 2001-2023 annual tree cover loss in the state of Veracruz, Mexico.

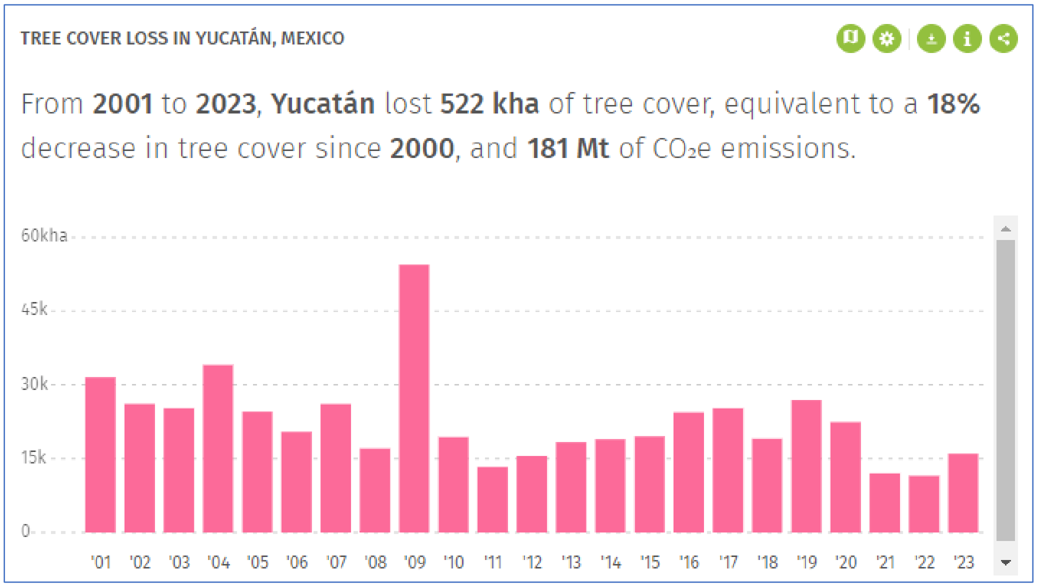

Figure A-6. 2001-2023 annual tree cover loss in the state of Yucatán, Mexico.

Example Articles on the Causes of Fires on the Yucatan Peninsula

There are numerous articles documenting fires in Mexico and the Yucatan Peninsula that are not agricultural burning so are no reoccurring, a few examples are:

- The El Financiero website includes articles about currently active fires in Mexico.[11] El Financiero estimates that from January to March 2024 Agricultural burning in Mexico led to 34.7% of the forest fires in the country.
- A March 29, 2024, article in Yucatan Magazine entitled Fires Rage Out of Control In And Around Merida[12] notes the extreme heat of early 2024 has caused many more fires than usual that include:
  - Fires starting from glass bottles on the side of the road that act as magnifying glasses when hit by the sun.
  - Fires at several warehouses along Merida's Periferico attributed to faulty wiring.
  - Fires started by fireworks at a wedding.
  - Agricultural fires that get out of control due to winds carrying sparks into nearby dry areas.
- A May 16, 2024 article in the Yucatan Times reported that a forest fire consumed 250 hectares of jungle in Cancún.[13]
- A July 2022 article about Modernización Sustentable de la Agricultura Tradicional (MasAgro) program, states that MasAgro has implemented practices that had reduced the area subjected to slash and burn in Mexico by 200 000 ha. The article states about how agricultural fire is not a sustainable practice and lists several alternatives that have reduced agricultural burning in Mexico in more recent years.[14]

11 https://www.elfinanciero.com.mx/nacional/2024/03/26/mexico-en-llamas-hay-95-incendios-activos-en-el-pais-informa-conafor/
12 https://yucatanmagazine.com/fires-rage-out-of-control-in-and-around-merida/
13 https://www.theyucatantimes.com/2024/05/forest-fire-consumes-250-hectares-of-jungle-in-cancun/
14 https://www.gob.mx/agricultura/articulos/el-fuego-ya-no-es-una-alternativa

APPENDIX D

Initial Notification Documentation

Arkansas Division of Environmental Quality (DEQ) Log of Initial Notification of Potential Exceptional Events, 2022-2023 PM2.5

11/5/2024	DEQ completed flagging of possible Exceptional Events for PM 2.5 in AQS (early notification)
11/20/2024	DEQ opened discussions of possible Exceptional Events for PM2.5 during Arkansas DEQ/EPA Air Planning Call with Region 6 staff
11/20/2024	EPA followed up by email with contact info and templates for EE notification
12/23/2024	DEQ finalized analyses of Exceptional Events for PM2.5, removing two previously-flagged events from the early notification list
1/8/2025	DEQ transmitted to EPA Region 6 by email the Exceptional Events Initial Notification Letter with attachment, Appendix A: PM2.5 Exceptional Events Flagged for 2022-2023
1/17/2025	DEQ gained access to CDX to submit the Exceptional Events Initial Notification Letter with attachment, Appendix A: PM2.5 Exceptional Events Flagged for 2022-2023 (tech issues delayed setup)
1/19/2025	DEQ published public notice in newspaper of statewide circulation and made draft Exceptional Events demonstrations and supporting documentation available on website for public review and comment (30 days) https://www.adeq.state.ar.us/air/planning/sip/2024pm25.aspx