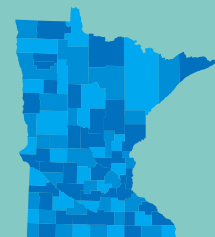


January 2025

Adjustment to 2021 to 2023 Coarse Particulate Matter Background Used in Air Dispersion Modeling to Account for Wildfire Smoke and Windblown Dust



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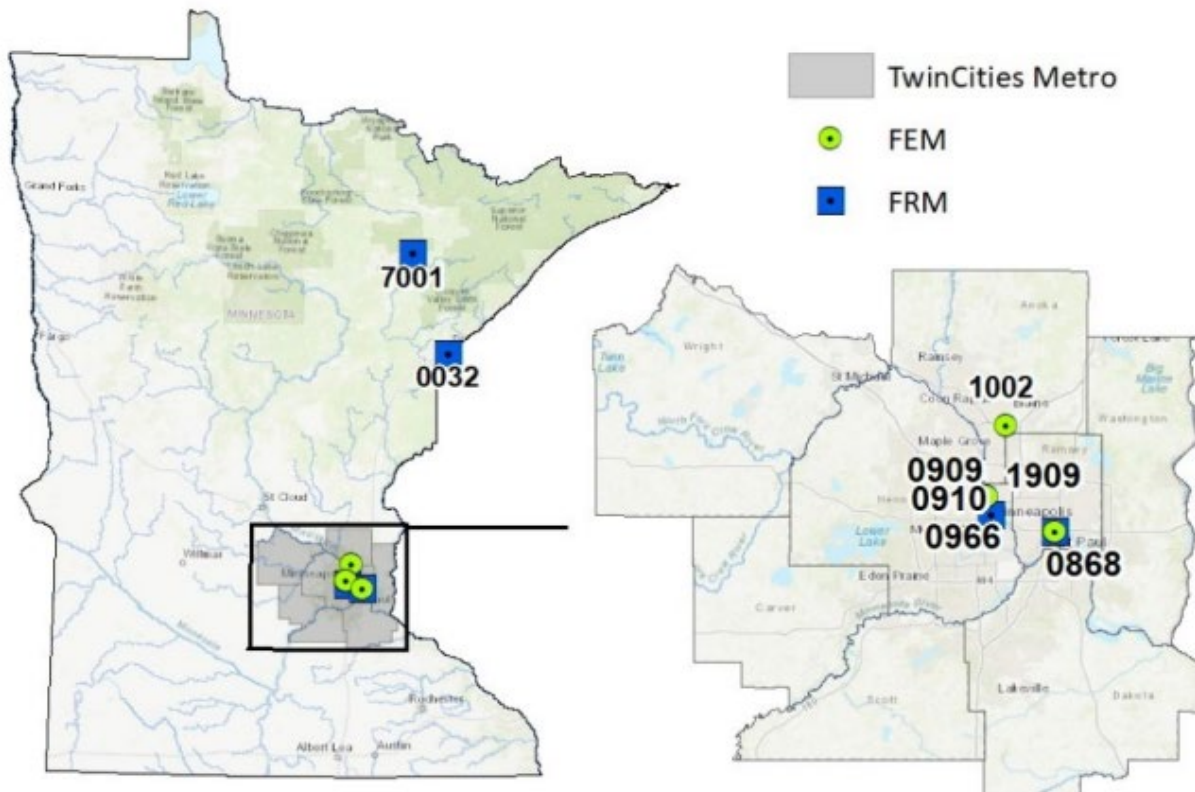
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Overview

Air dispersion modeling for coarse particulate (PM₁₀) requires a background concentration. This value is the first, second, third, or fourth highest monitored value recorded over a 3 year period. This document provides evidence that PM₁₀ background concentrations were impacted by smoke from wildfires and dust events during 2021 to 2023 and provides background concentrations without the influences of smoke or dust.

While the smoke and dust did not change the attainment status at any locations, the smoke and dust impacted the background concentrations of 24-hour PM₁₀ used for air dispersion modeling. In July and August 2021, wildfire smoke from wildfires in Canada and within Minnesota caused large increases to PM₁₀ concentrations on several days. Monitors were also affected by two large windblown dust events during 2021. There were no smoke or dust events large enough to affect PM₁₀ background in 2022. Smoke from fires located in Canada once again impacted Minnesota monitors during the spring and summer of 2023. Windblown dust from unusually strong and widespread wind events impacted Minnesota on March 29-30, 2021, and again on December 15, 2021. Concentrations exceeding 100 µg/m³ were seen during many of the days impacted by smoke and dust.

Figure 1. PM₁₀ monitoring sites in Minnesota.



A monitoring site meets the 24-hour PM₁₀ NAAQS when the level of 150 µg/m³ is not exceeded more than once per year, on average, over three years. To formulate a model background PM₁₀ concentration, the MPCA follows the methodology established in EPA's "PM₁₀ SIP Development Guidance" (EPA-450/2-86-001, June 1987, Table 6-1). Depending on the total number of samples collected over a three-year period, the daily PM₁₀ background concentration is calculated as the 1st, 2nd, 3rd, or 4th highest daily

PM₁₀ concentration measured over three years, using the monitor observation frequency described in Table 1.

Table 1. Monitor value used for PM₁₀ background calculation

Number of observations from the monitor	Monitor value used for modeling background
≤ 347	highest monitor value
348 -695	second highest value
696 -1042	third highest value
1043 -1096	fourth highest value

Model background increased by as much as 30 µg/m³ due to smoke and dust. However, background concentrations at monitors located near sources with significant PM₁₀ emissions may not have changed at all. Table 2 shows the 24-hour PM₁₀ model background concentrations for 2021-2023, including and excluding the impacts of smoke and dust.

Table 2. Summary of 2021-2023 24-hour PM₁₀ model background and effects of removing days influenced by wildfire smoke and dust

Monitor name	AQS	Count of observations	Rank used	PM ₁₀ background including wildfire smoke & dust (µg/m ³)	PM ₁₀ background excluding wildfire smoke & dust (µg/m ³)
Blaine	270031002	1052	4	80	55
Duluth – Oneanta St	271370032	NA	1	94	94
MPLS – Lowrie Ave*	270530909	1075	4	96	83
MPLS – Pacific St*	270530910	1027	3	121	121
MPLS – City of Lakes	270530966	171	1	52	52
MPLS – Bottineau*	270521909	1082	4	87	69
Ramsey Health Center	271230868	1086	4	73	67
Red Rock Road	271230866	172	1	116	116
Virginia	271377001	165	1	414	414

*Source-specific monitors

Meteorological and climatological conditions

Much of the Upper Midwest and south-central Canada were under severe to exceptional drought during the summer of 2021 (Figure 1). By June 30, most of the Upper Midwest and south-central Canada was experiencing drought, with extreme and exceptional drought in much of southern Manitoba and the Dakotas. Precipitation avoided the area for most of the summer, and the area covered by extreme and exceptional drought spread eastward into Minnesota and western Ontario throughout the rest of the summer. The drought set the stage for an active fire season in south-central Canada and northern Minnesota. The extensive drought and dryness in the Central Plains would also lead to more windblown dust events.

Figure 2a. North American Drought Monitor for June 30, 2021.

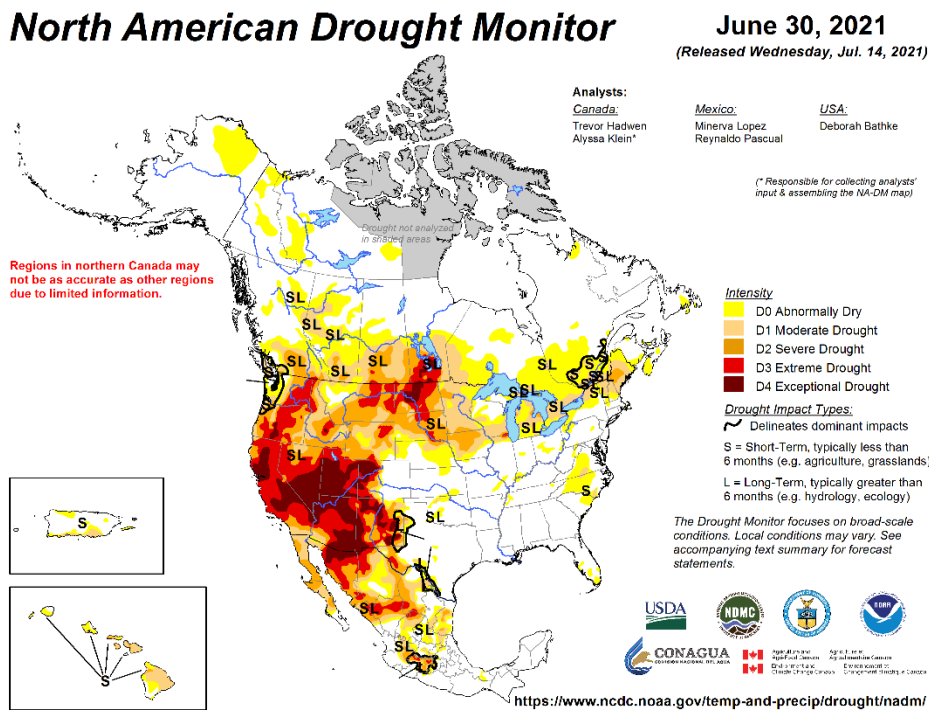


Figure 2b. North American Drought Monitor for July 31, 2021.

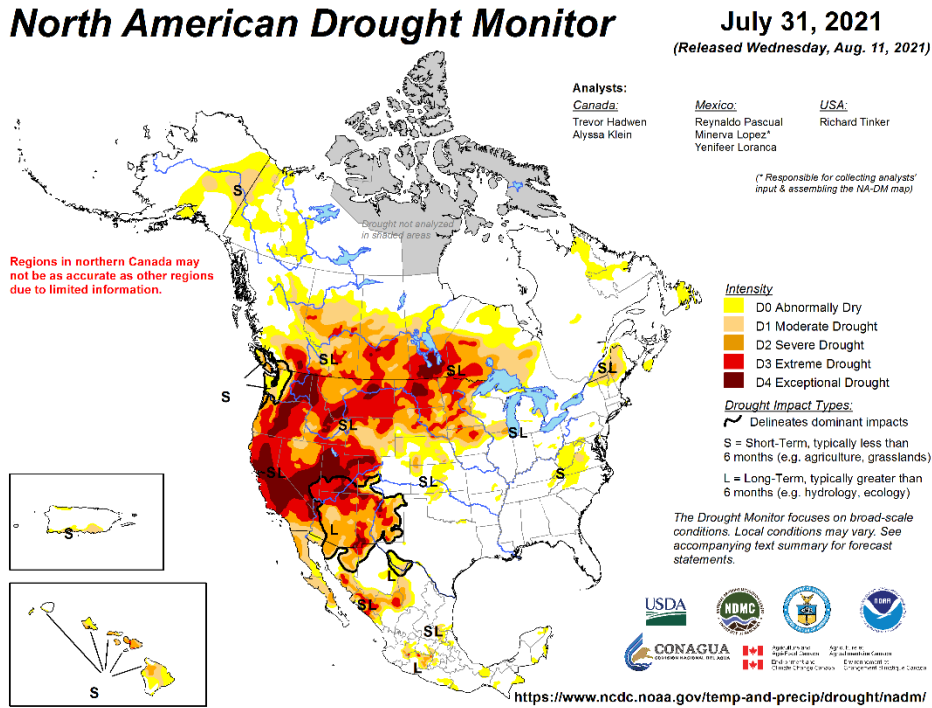
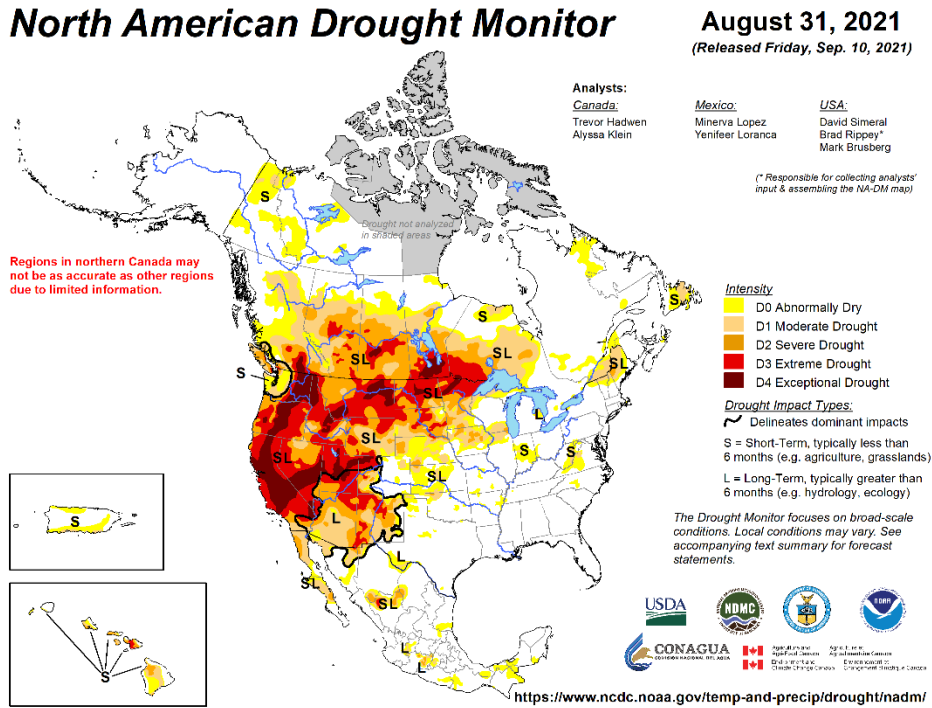


Figure 2c. North American Drought Monitor for August 31, 2021.



There were no events that impacted PM₁₀ background values in 2022.

Throughout the summer of 2023, severe to extreme drought dominated much of Canada (Figure 4a-4f). The dry conditions set the stage for a record fire season in Canada.

Figure 4a: North American Drought Monitor for April 30, 2023.

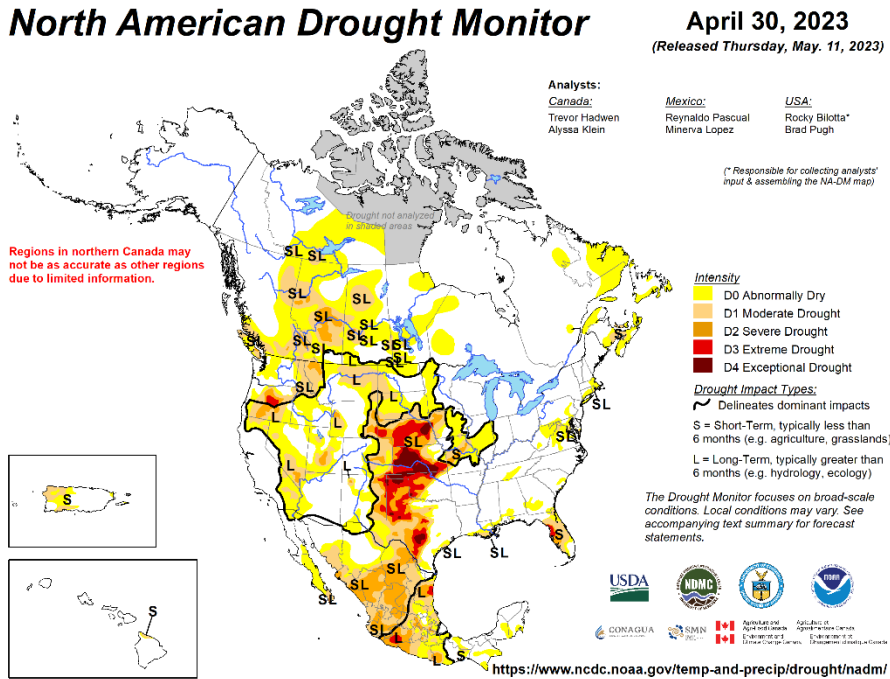


Figure 4b: North American Drought Monitor for May 31, 2023.

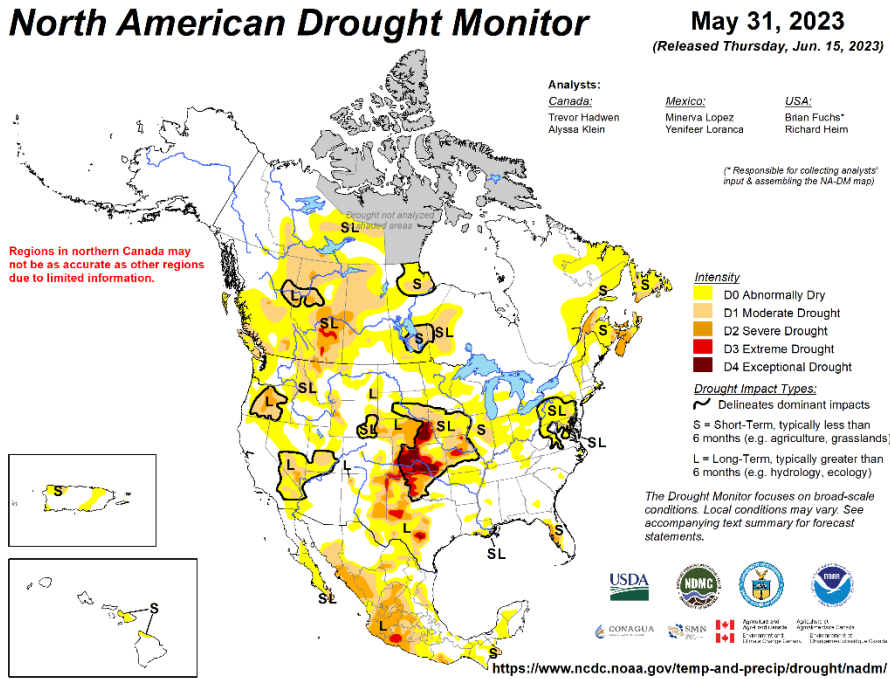


Figure 4c: North American Drought Monitor for June 30, 2023.

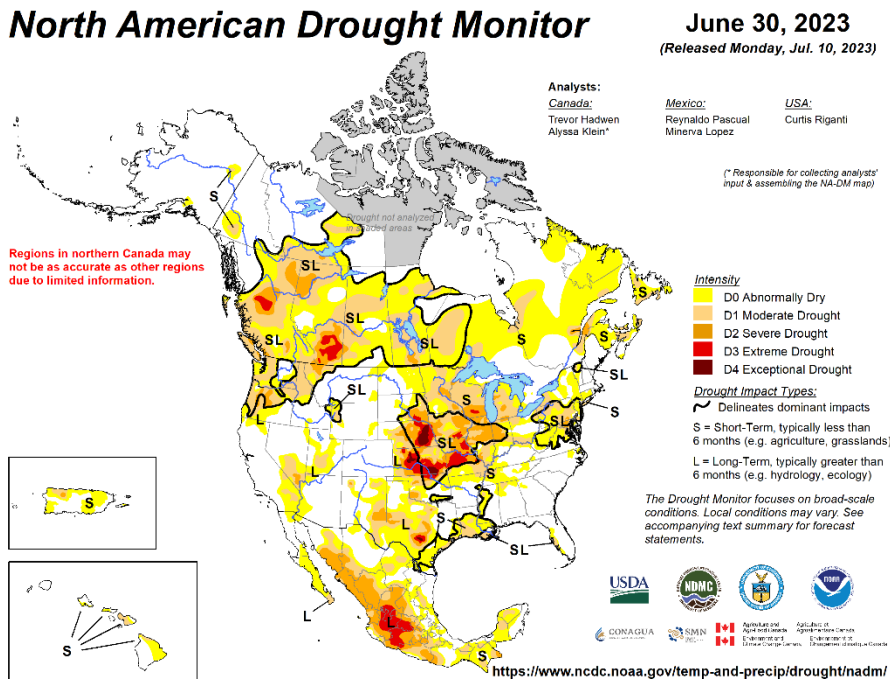


Figure 4d: North American Drought Monitor for July 31, 2023.

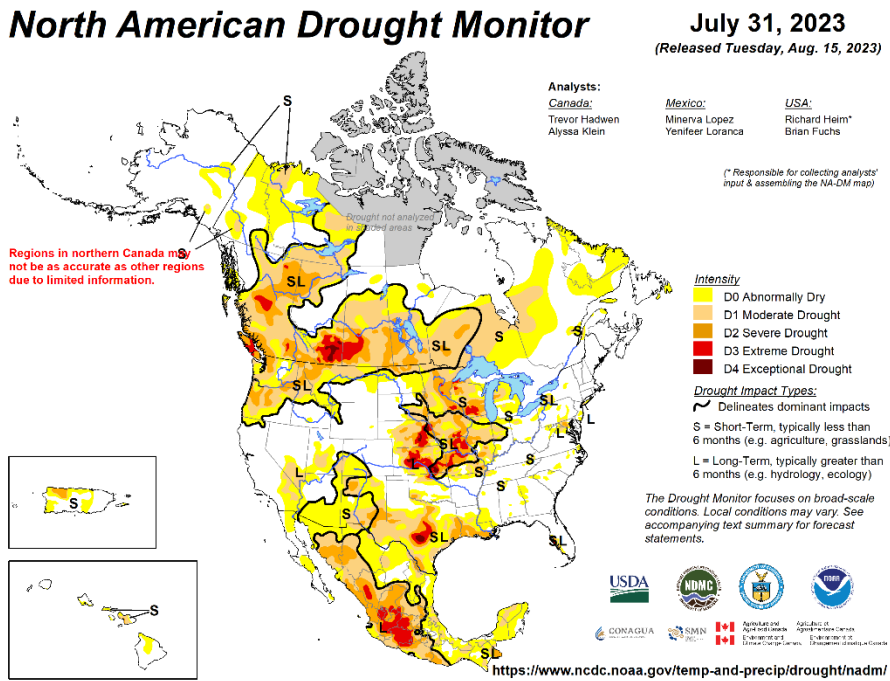


Figure 4e: North American Drought Monitor for August 31, 2023.

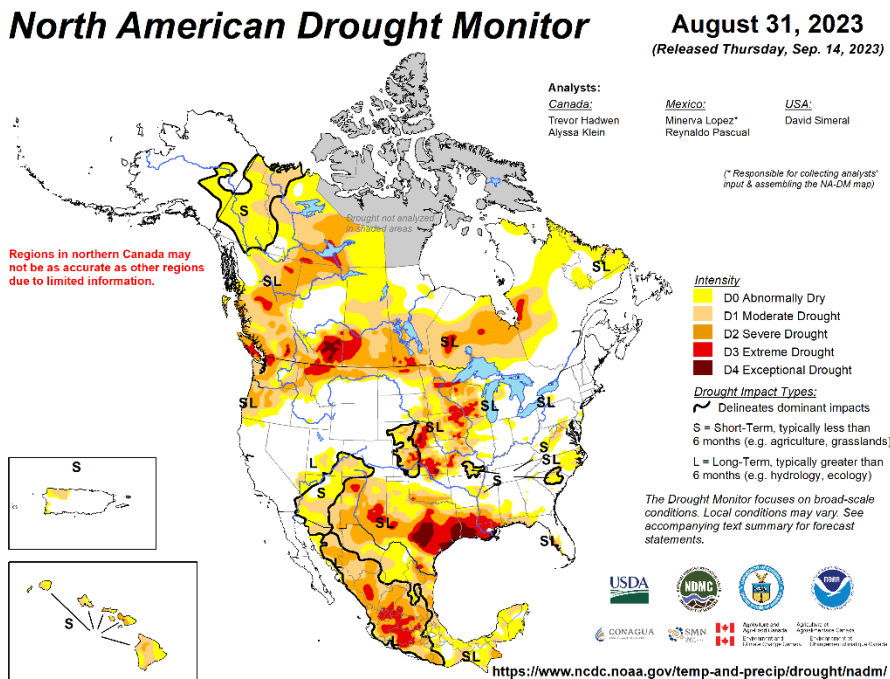
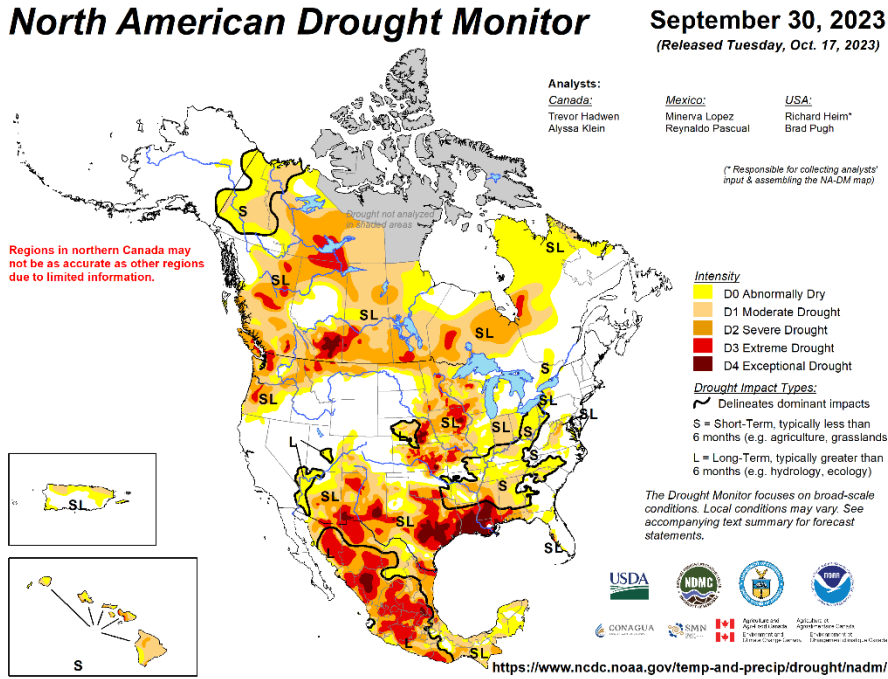


Figure 4f: North American Drought Monitor for September 30, 2023.

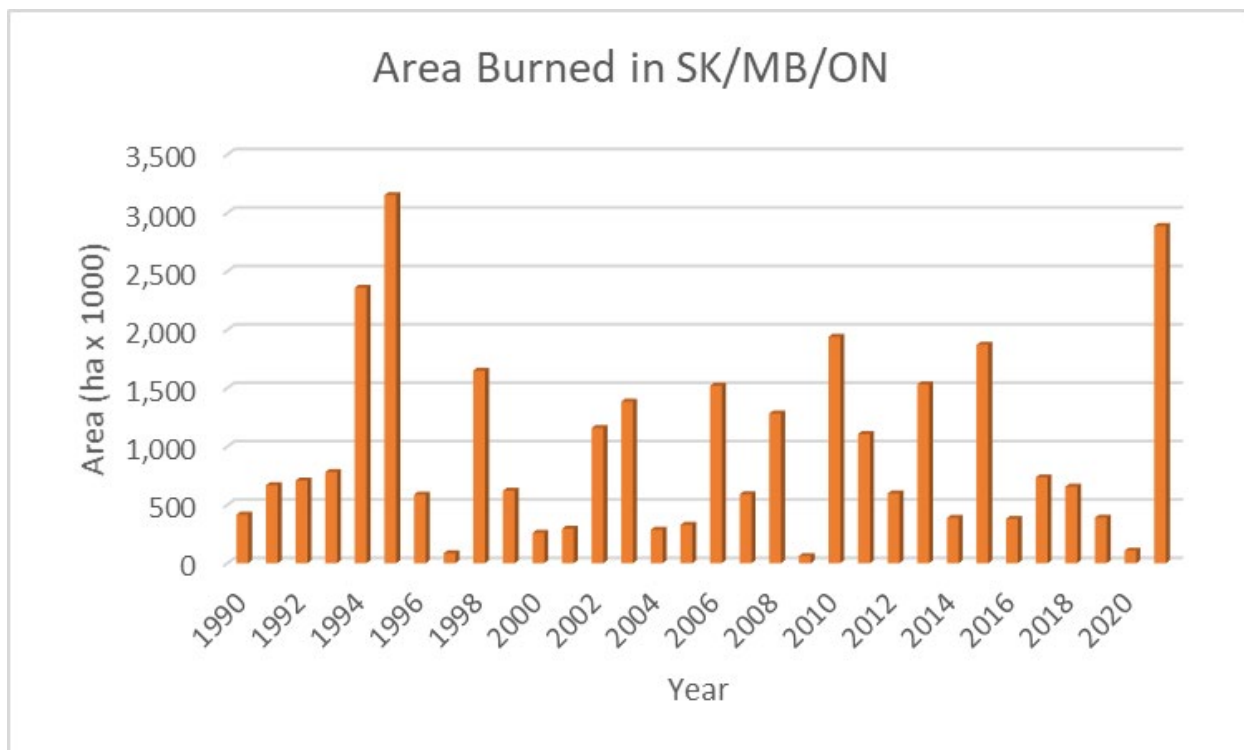


Description of wildfires

Canadian wildfires - 2021

The summer of 2021 was a very active fire season for the provinces of Saskatchewan, Manitoba, and Ontario. Nearly 3 million hectares burned in these provinces, which was the largest area burned since 1995.

Figure 3. Area burned in Saskatchewan, Manitoba, and Ontario provinces from 1990 to 2021.



Canada typically does not name fires as is traditionally done in the United States. These fires burned large areas of Saskatchewan, Manitoba, and Ontario. The maps below show fire locations and fire perimeters from July 1 to August 7.

Figure 4a. Active fires and fire perimeters on July 1, 2021.

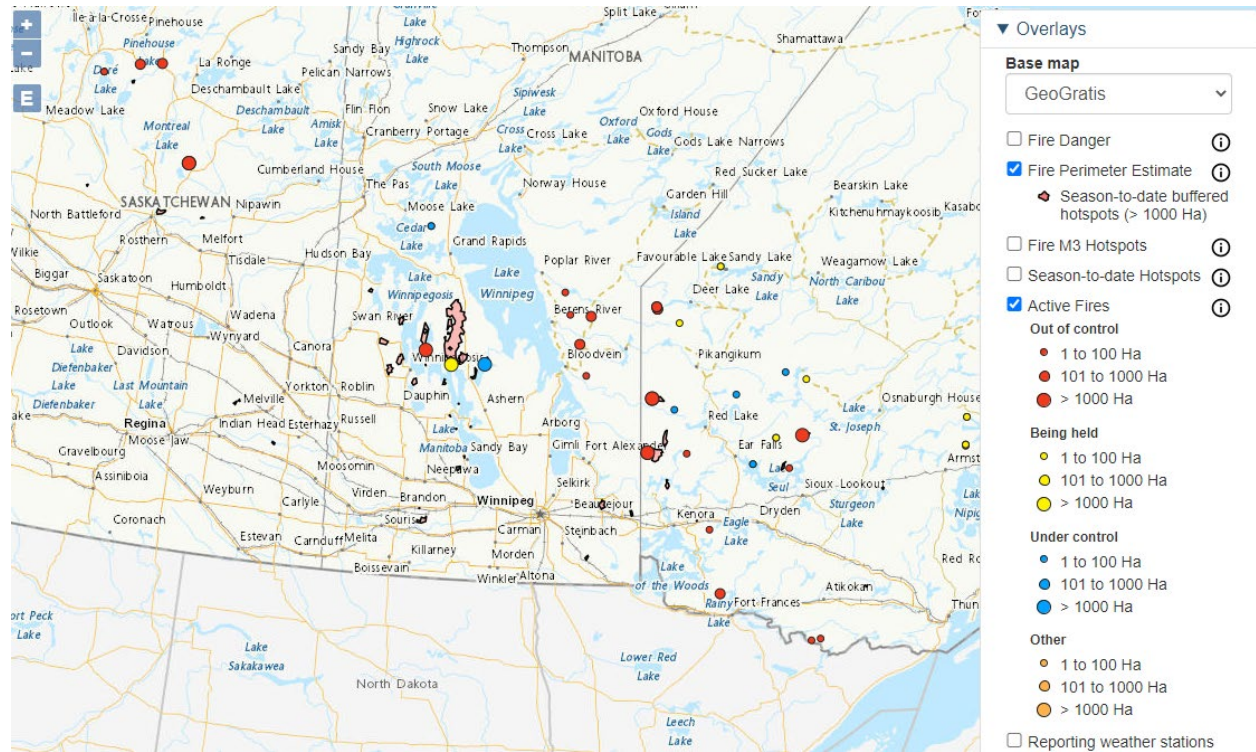


Figure 4b. Active fires and fire perimeters on July 7, 2021.

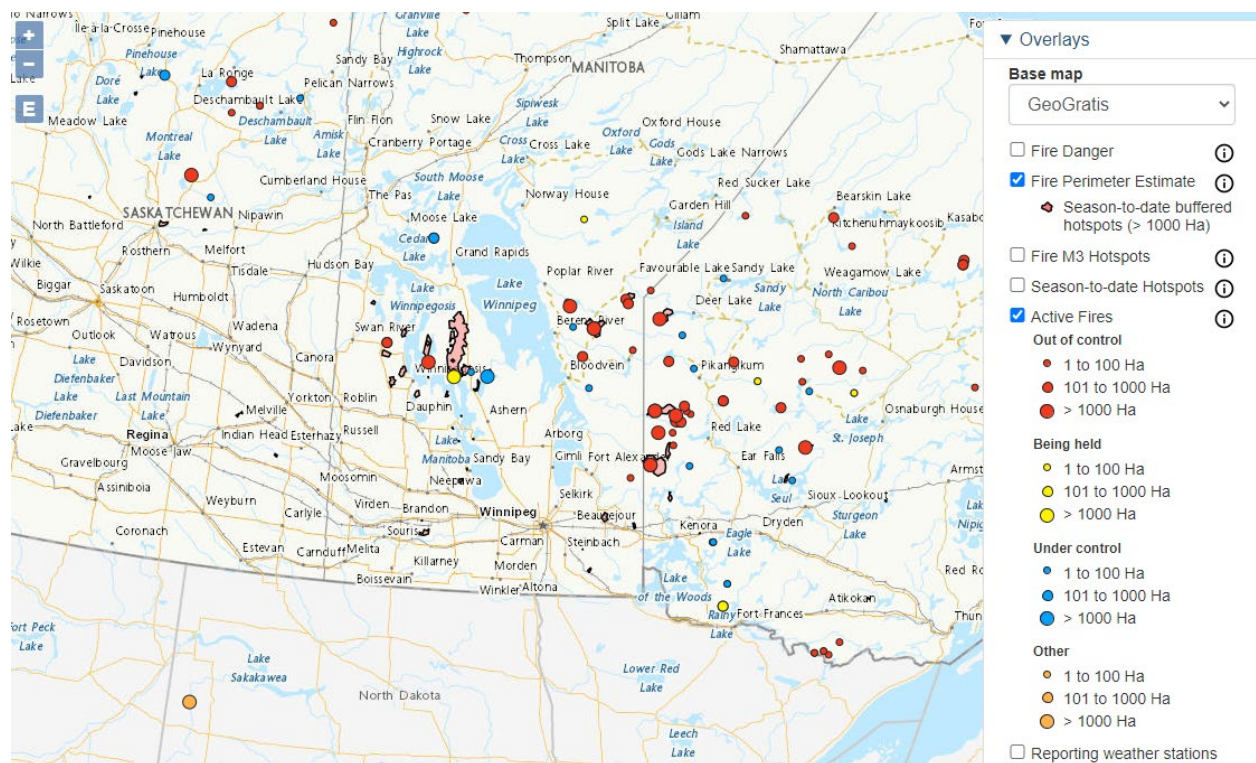


Figure 4c. Active fires and fire perimeters on July 15, 2021.

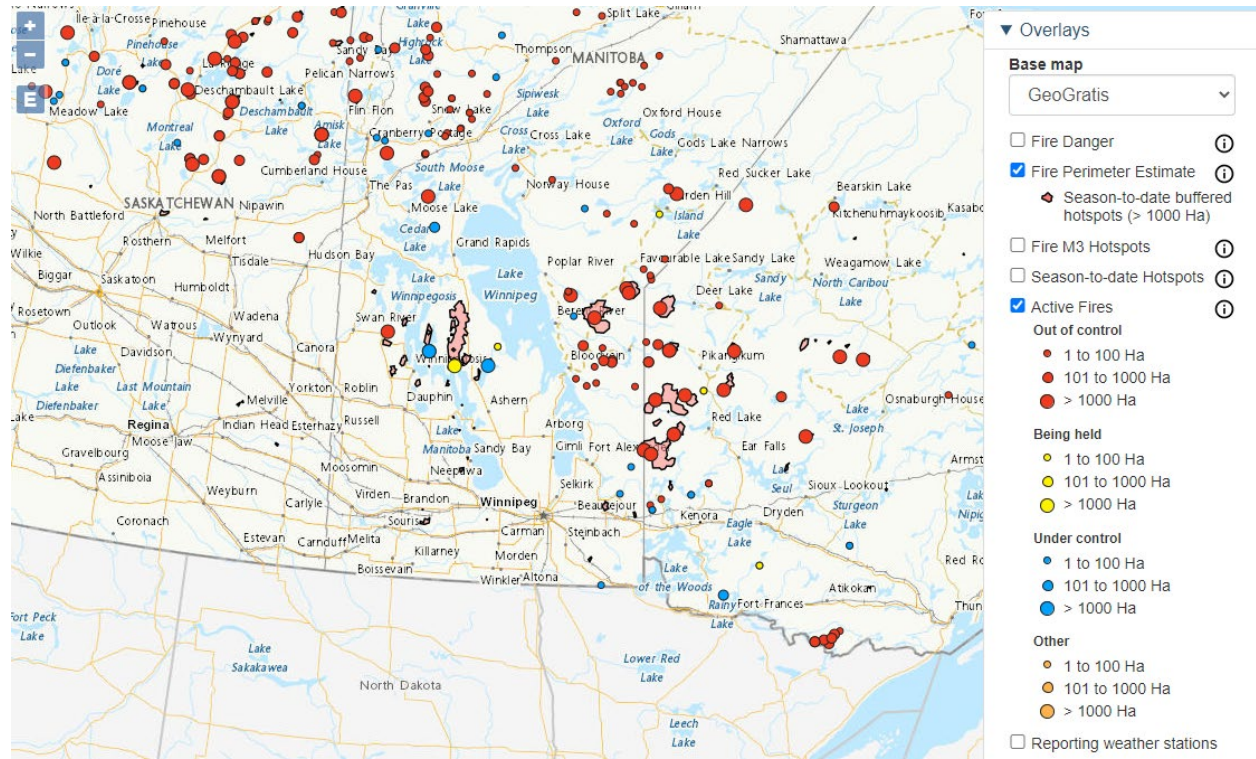


Figure 4d. Active fires and fire perimeters on July 22, 2021.

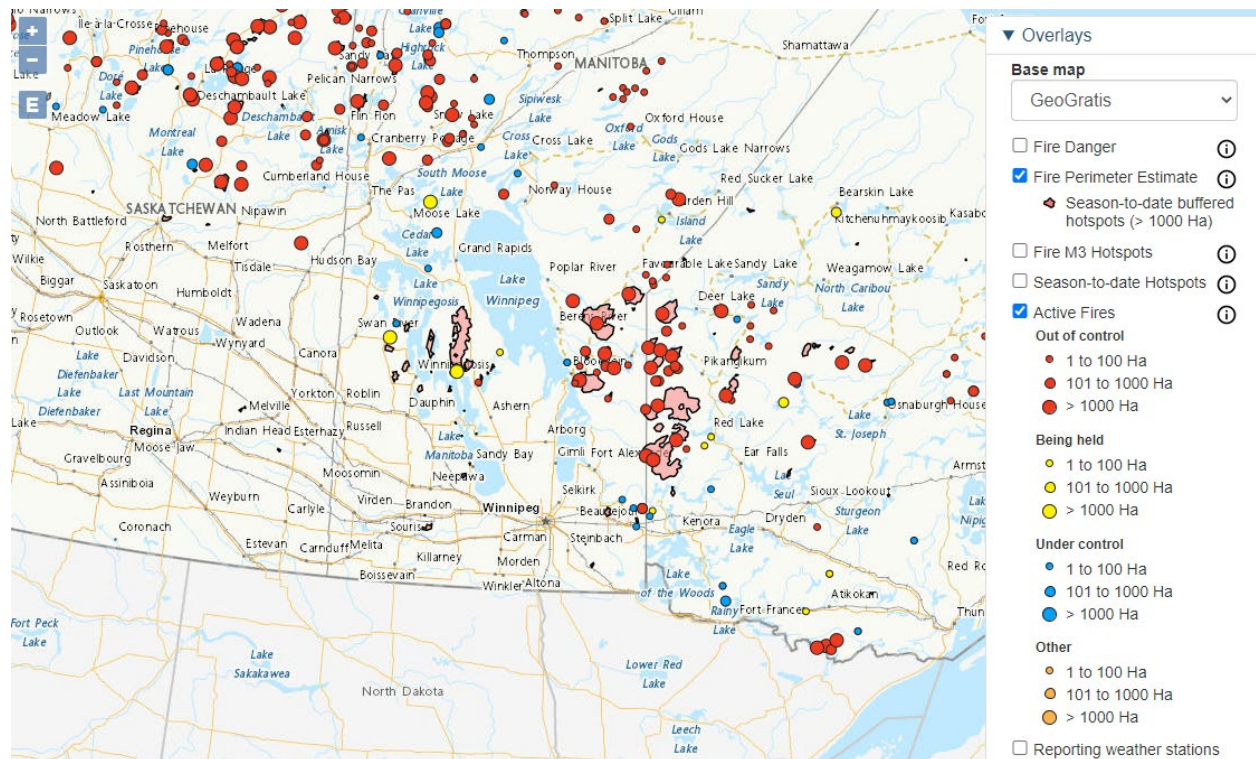


Figure 4e. Active fires and fire perimeters on August 1, 2021.

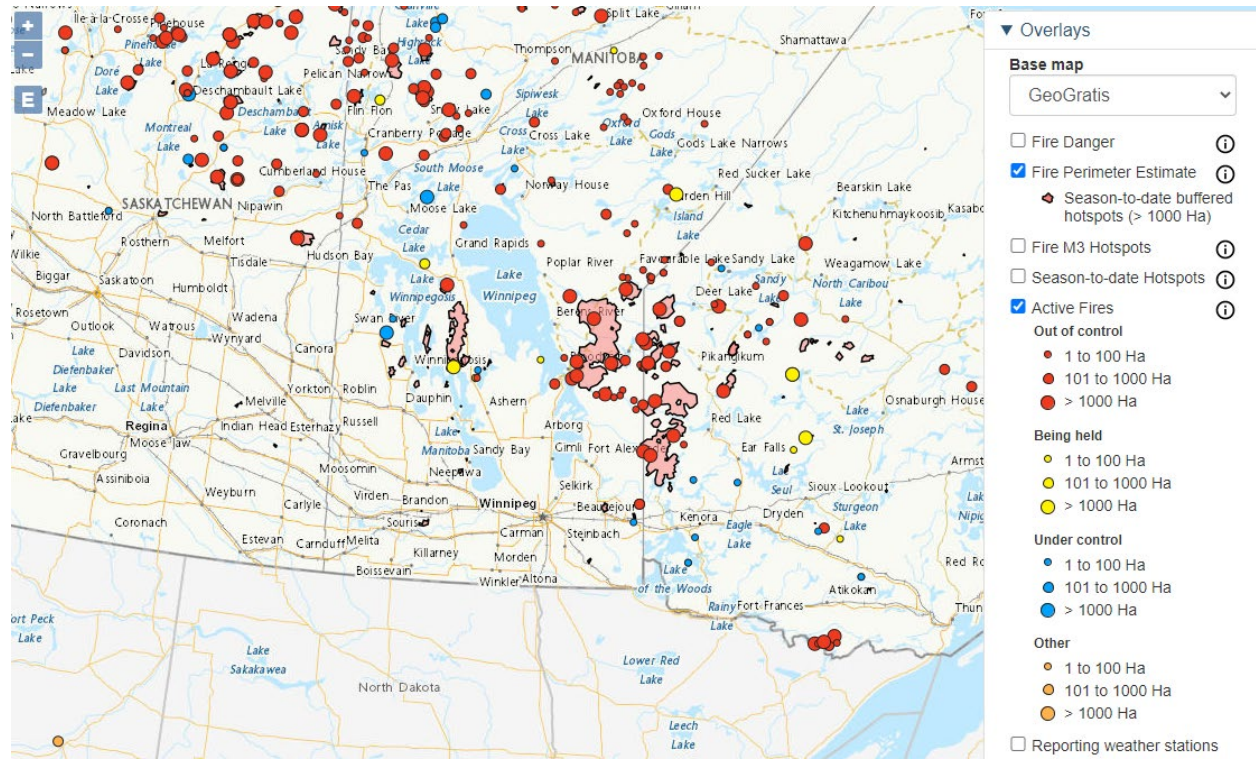
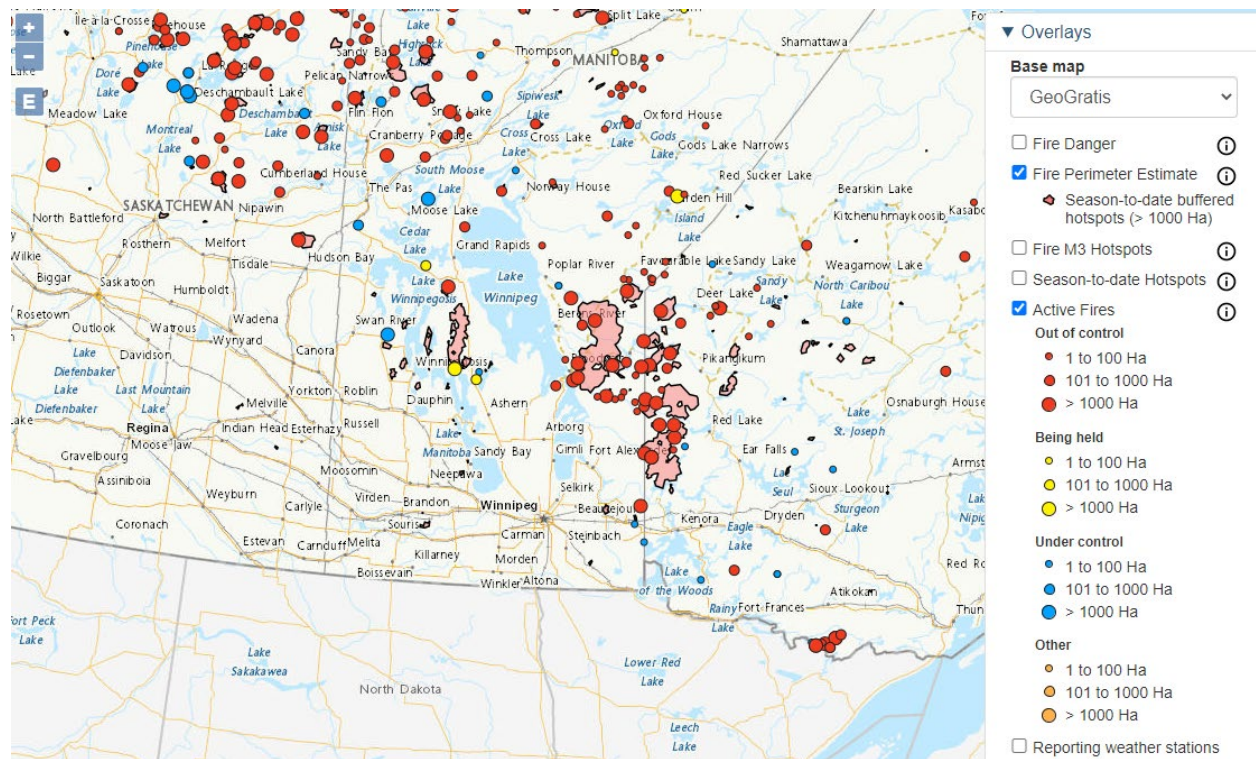


Figure 4f. Active fires and fire perimeters on August 7, 2021.



Northeast Minnesota wildfires - 2021

Several fires erupted in northeast Minnesota during August 2021. The largest was the Greenwood fire, which burned over 26,000 acres between August 15 and September 15. The John Ek fire burned over 1,300 acres between August 14 and September 15. Several wildfires burned over 120,000 acres in/near Quetico Provincial Park, located just north of the Minnesota border between July 6 and September 15.

Figure 5. Large incident map for August 14, 2021, from the National Interagency Fire Center. Number 90 is the Greenwood fire, and number 91 is the John Ek fire. The Quetico fires can be seen in the Canada wildfire maps along the Minnesota border.

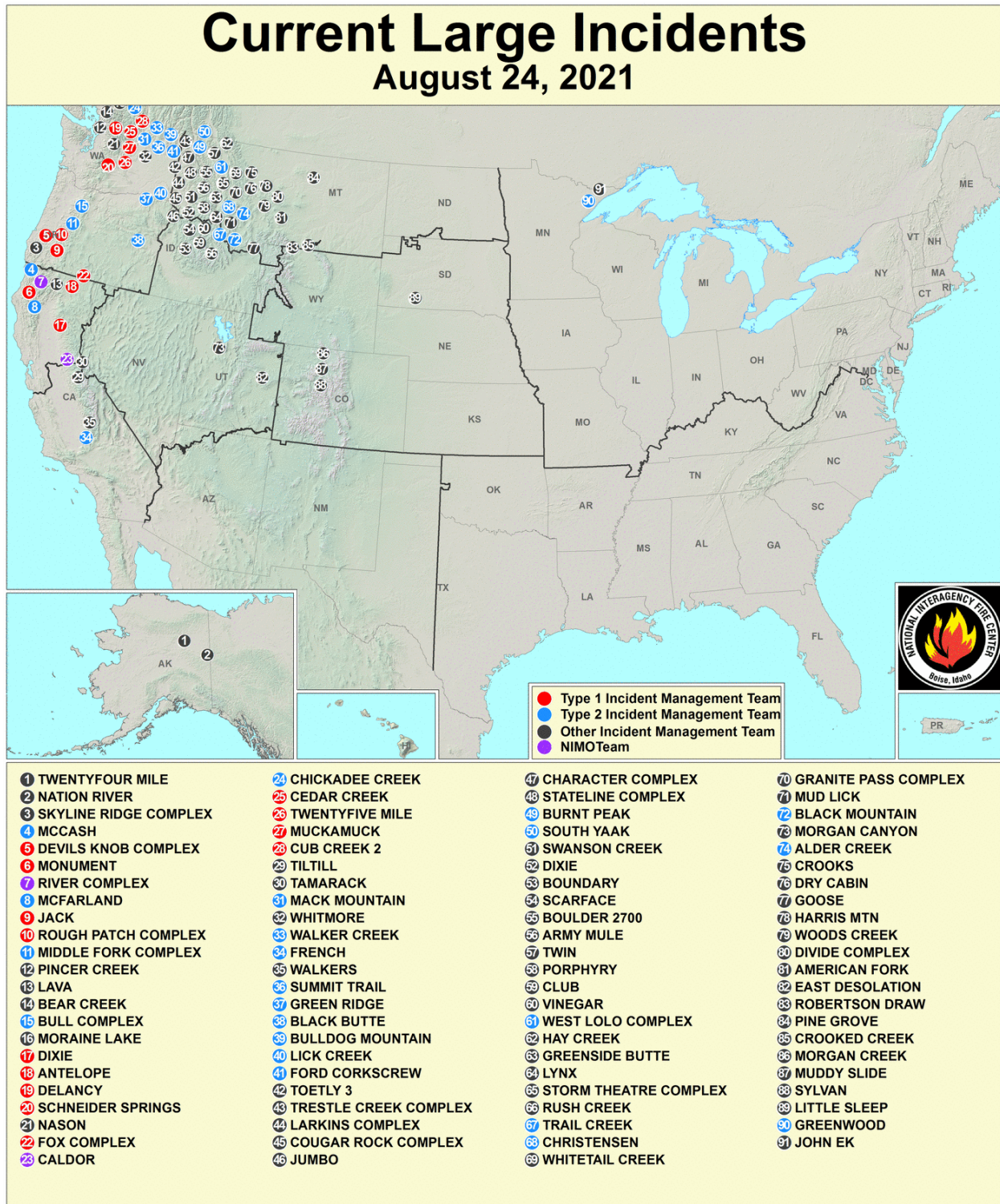


Figure 6. Major fires of Northern Minnesota. Fires from 2021 are depicted in red.

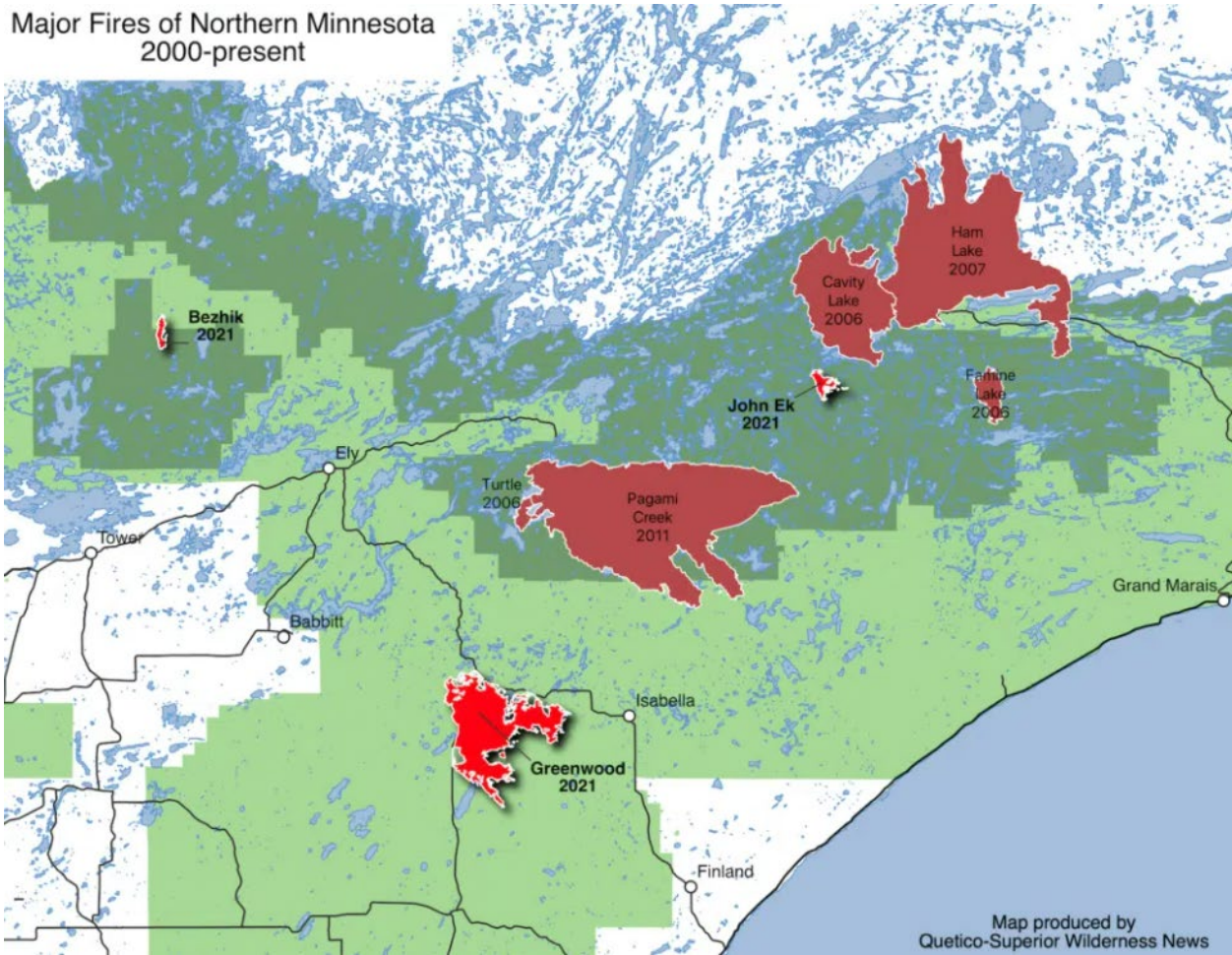
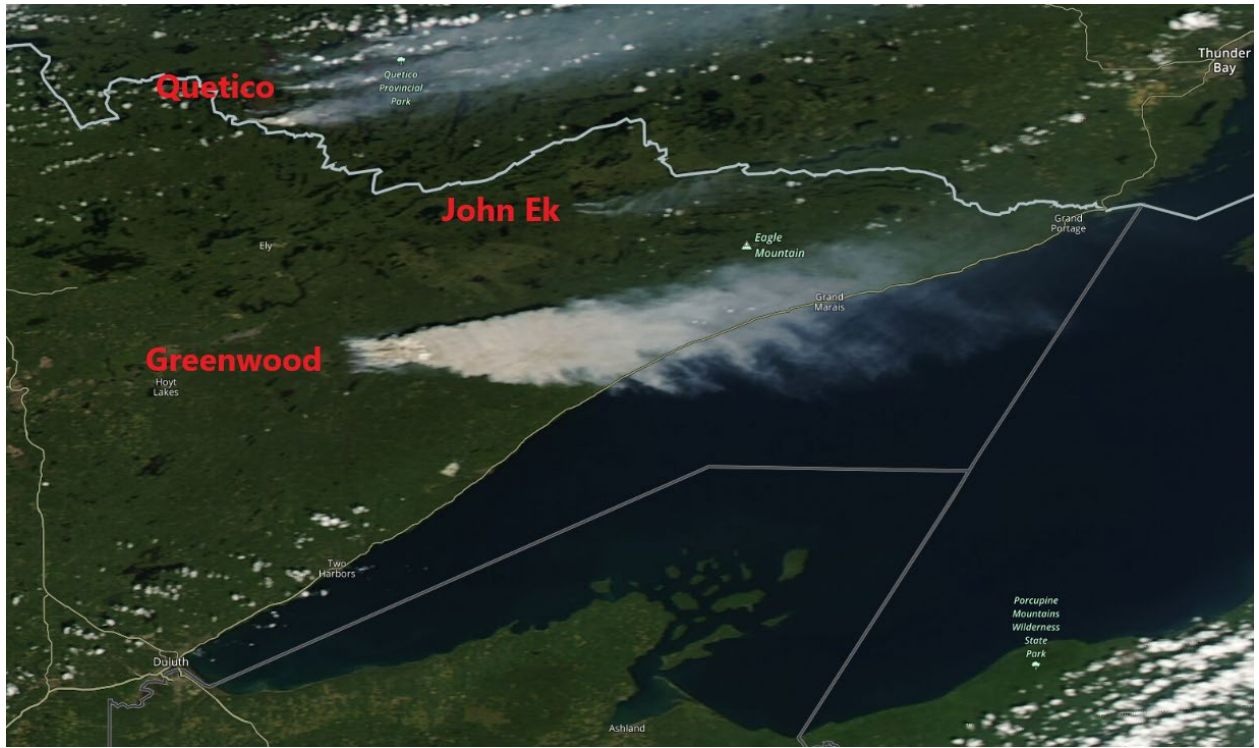


Figure 7. MODIS AQUA visible satellite image from August 24, 2021.



Canada wildfires – Summer 2023

The 2023 wildfire season easily set records for the largest area burned in Canada (Figure 14). High wildfire activity occurred across most of Canada, meaning that for much of the summer any wind with a northerly component transported wildfire smoke into Minnesota. Figure 15 shows the weekly wildfire activity, starting on May 15, 2023.

Figure 14: Number of Fires and Area burned in Canada from 1970 to 2023.

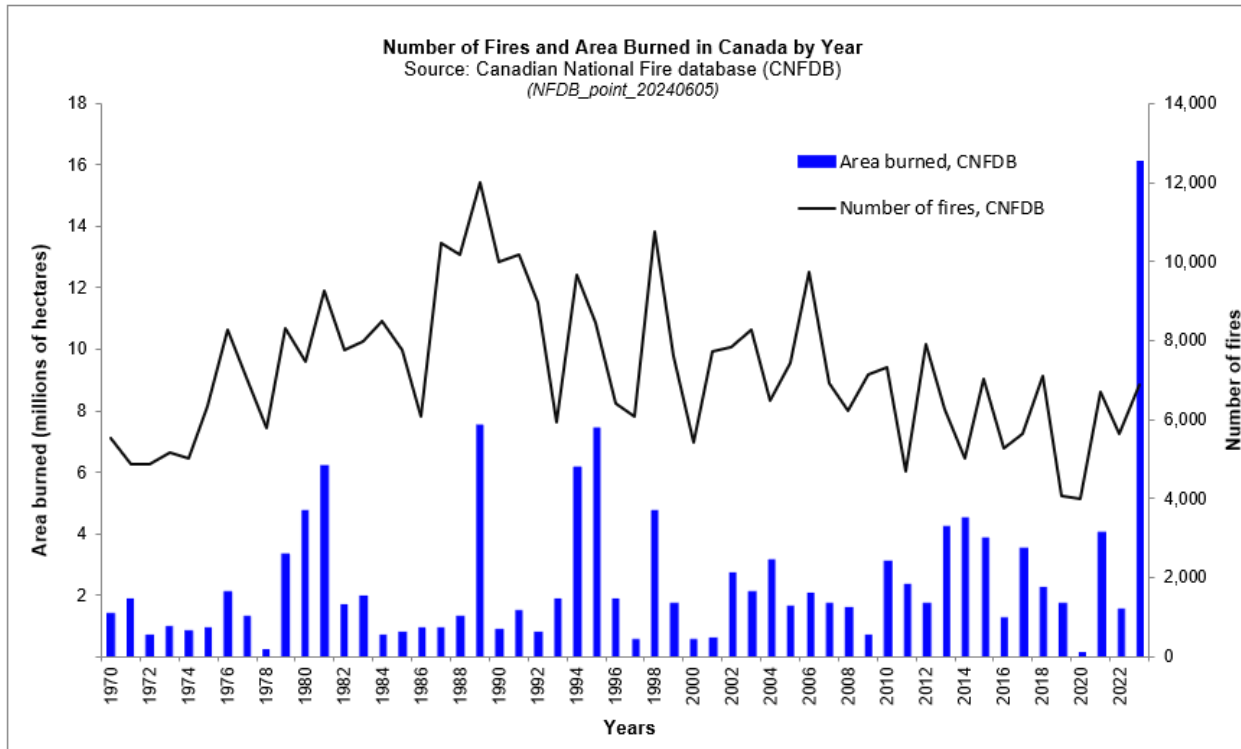


Figure 15a: Active fires and fire perimeters on May 15, 2023.

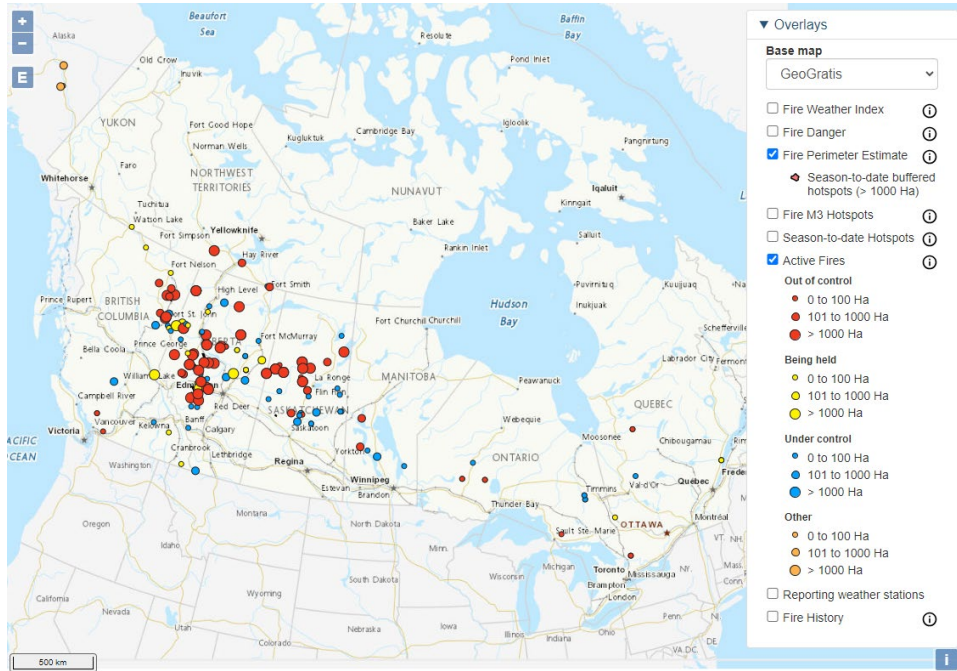


Figure 15b: Active fires and fire perimeters on May 22, 2023.

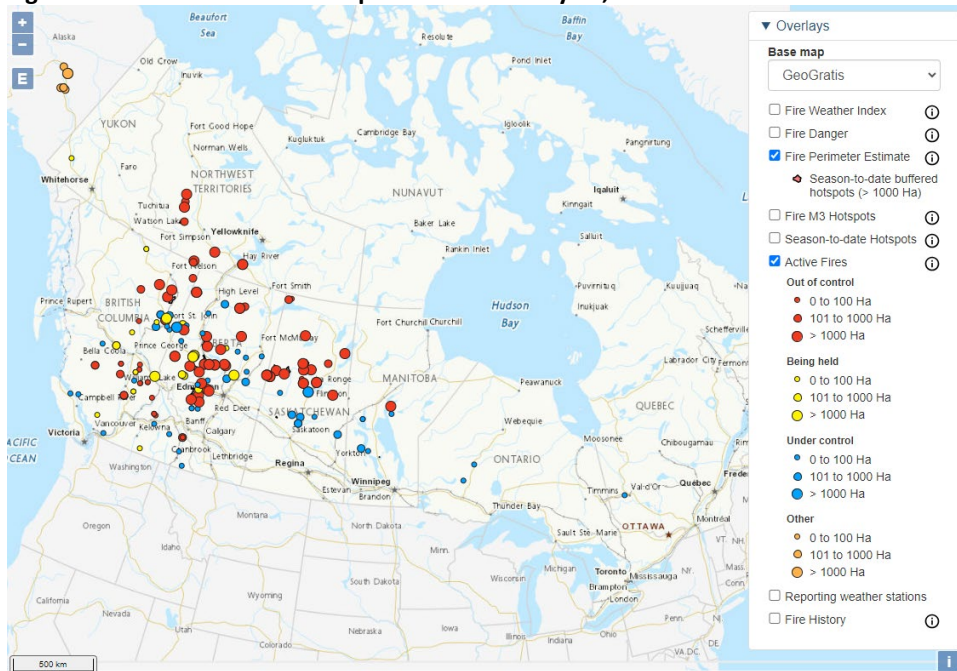


Figure 15c: Active fires and fire perimeters on May 29, 2023.

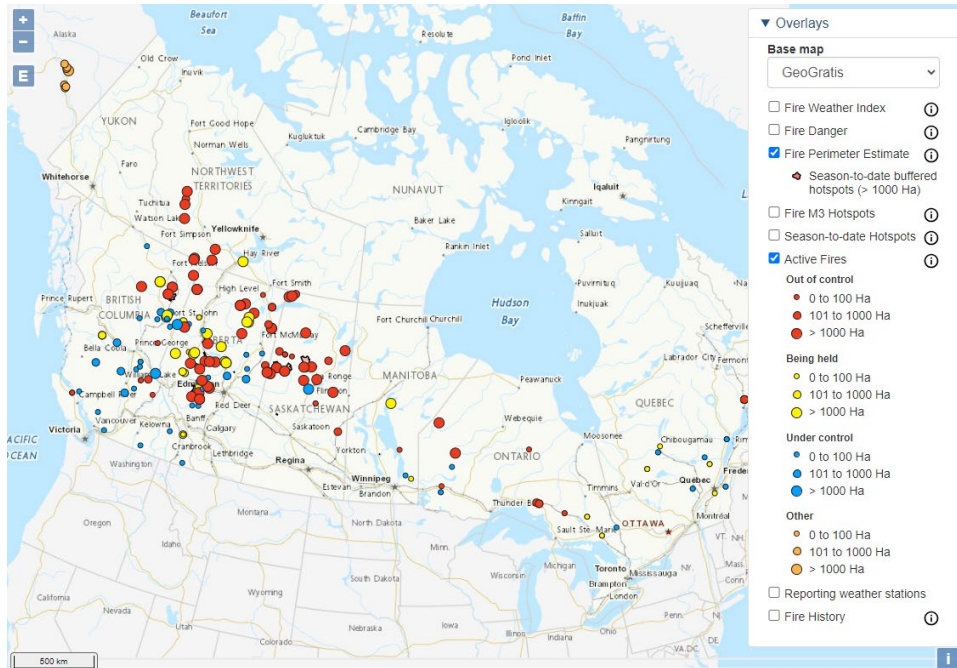


Figure 15d: Active fires and fire perimeters on June 5, 2023.

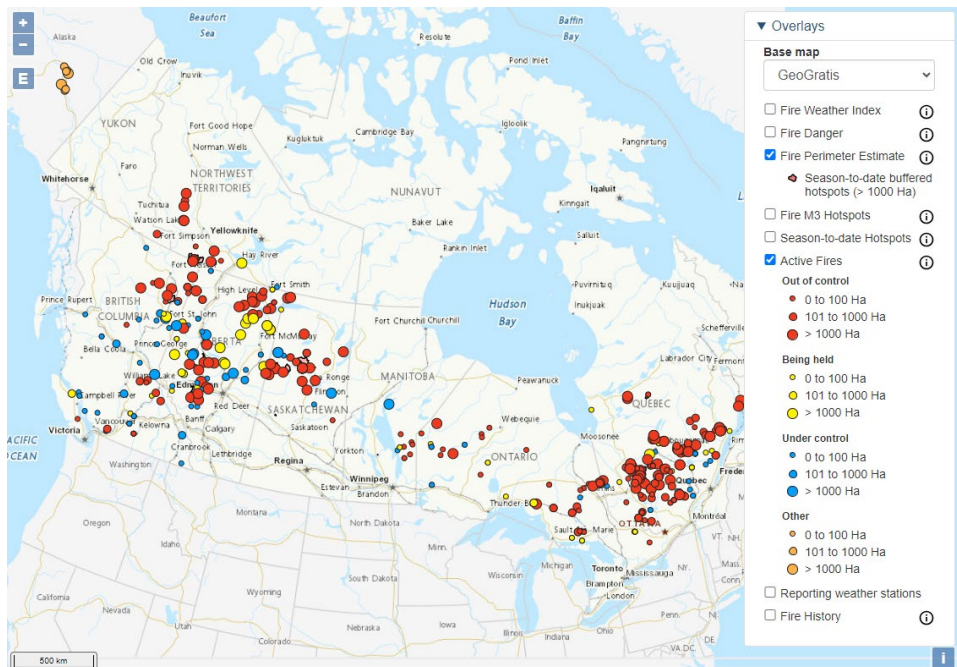


Figure 15e: Active fires and fire perimeters on June 12, 2023.

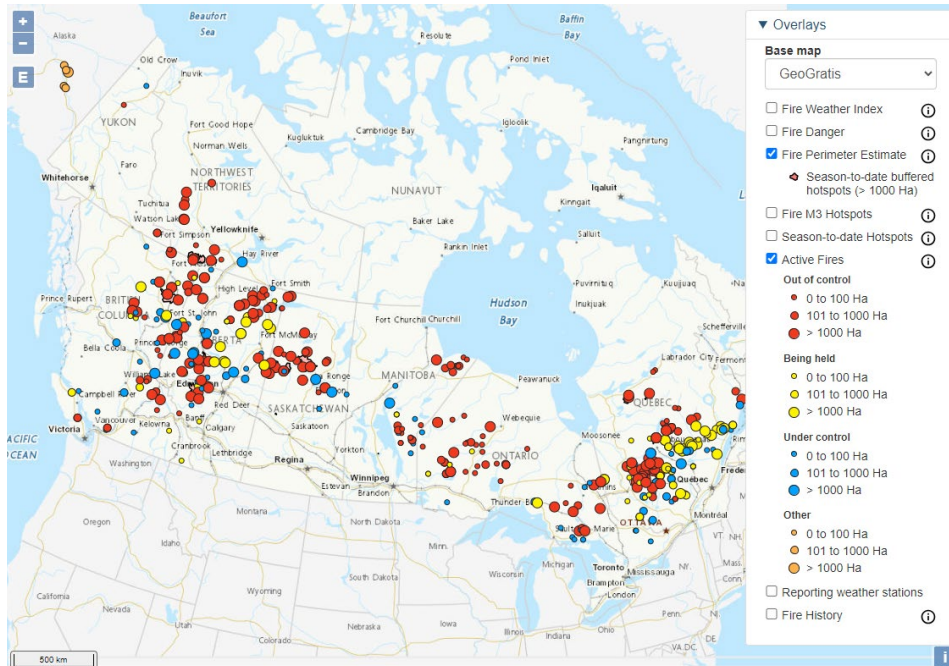


Figure 15f: Active fires and fire perimeters on June 19, 2023.

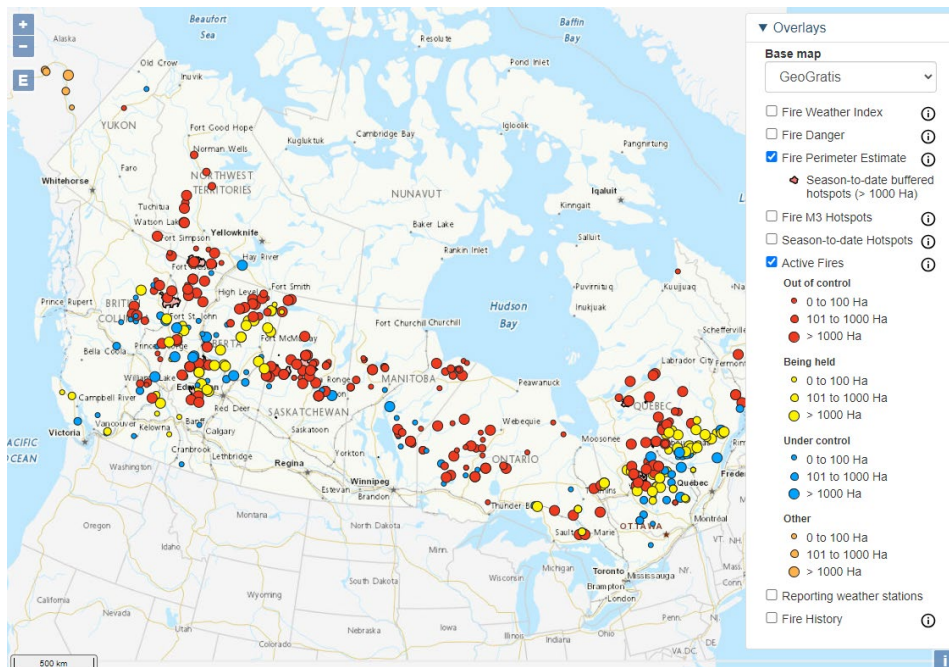


Figure 15g: Active fires and fire perimeters on June 26, 2023.

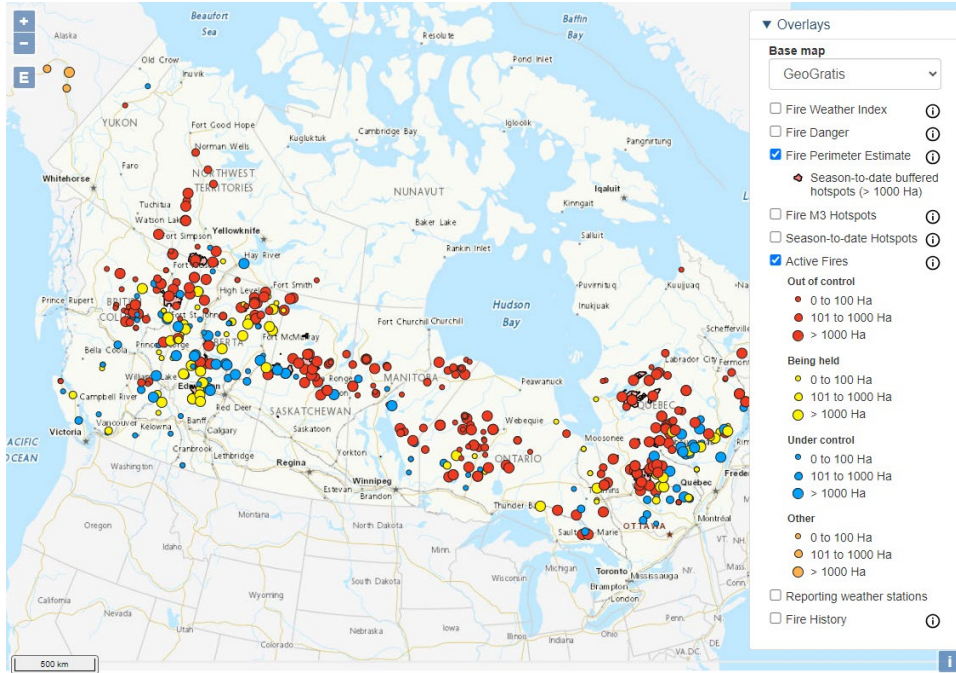


Figure 15h: Active fires and fire perimeters on July 3, 2023.

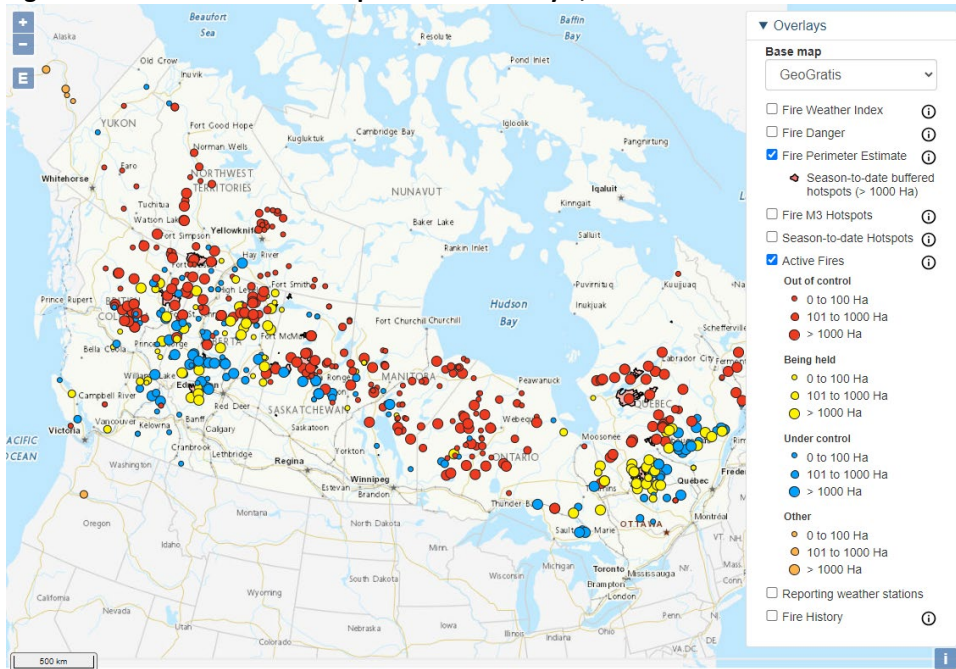


Figure 15i: Active fires and fire perimeters on July 10, 2023.

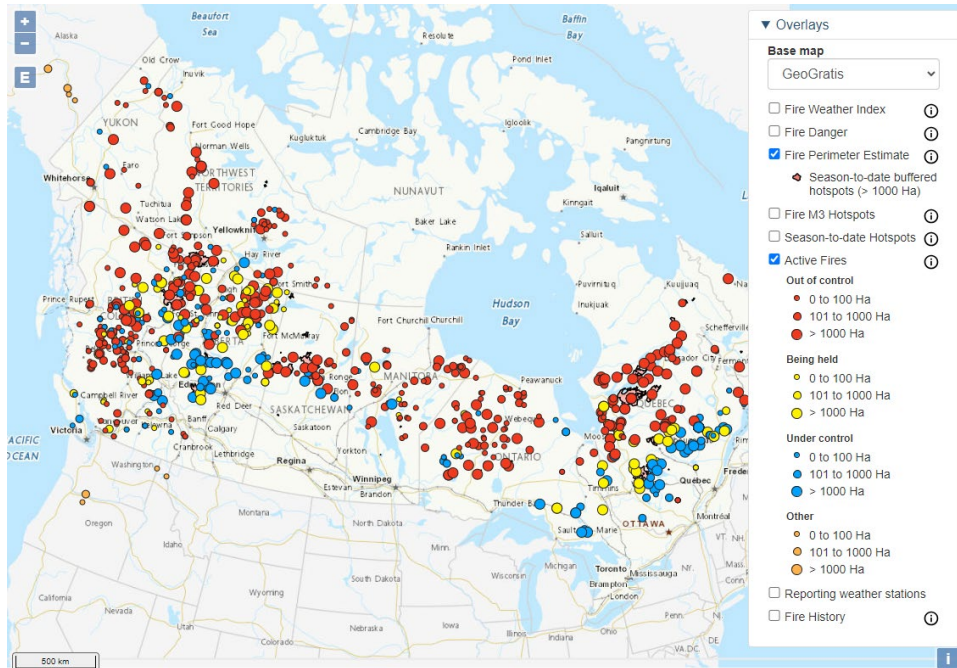


Figure 15j: Active fires and fire perimeters on July 17, 2023.

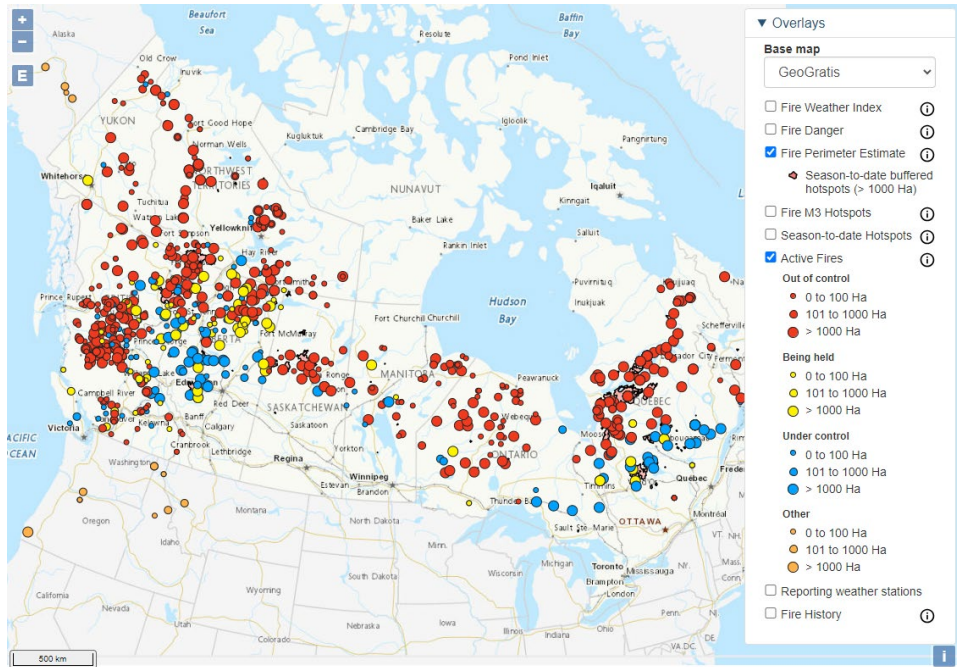


Figure 15k: Active fires and fire perimeters on July 24, 2023.

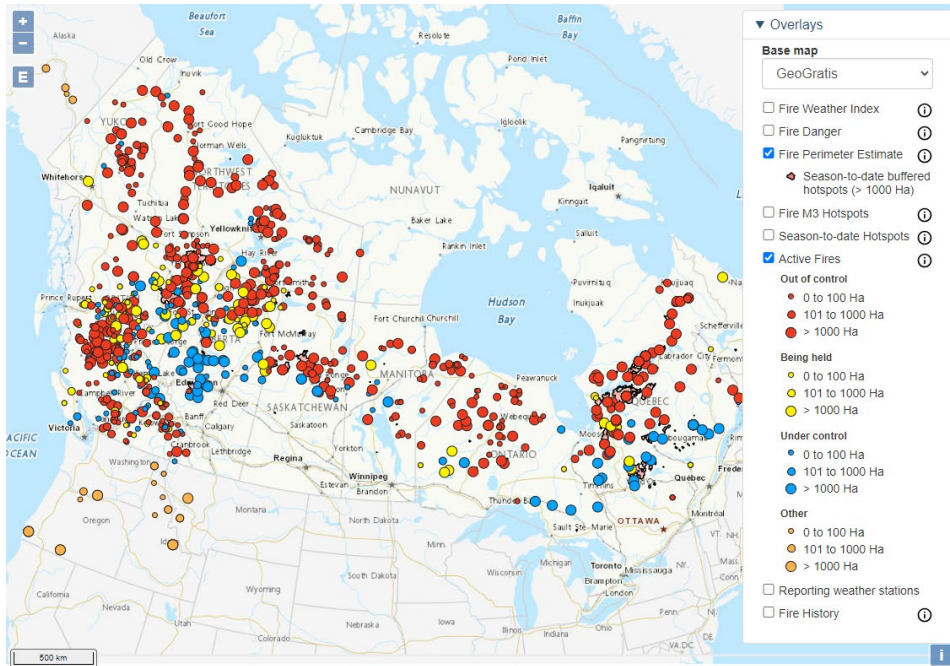


Figure 15l: Active fires and fire perimeters on July 31, 2023.

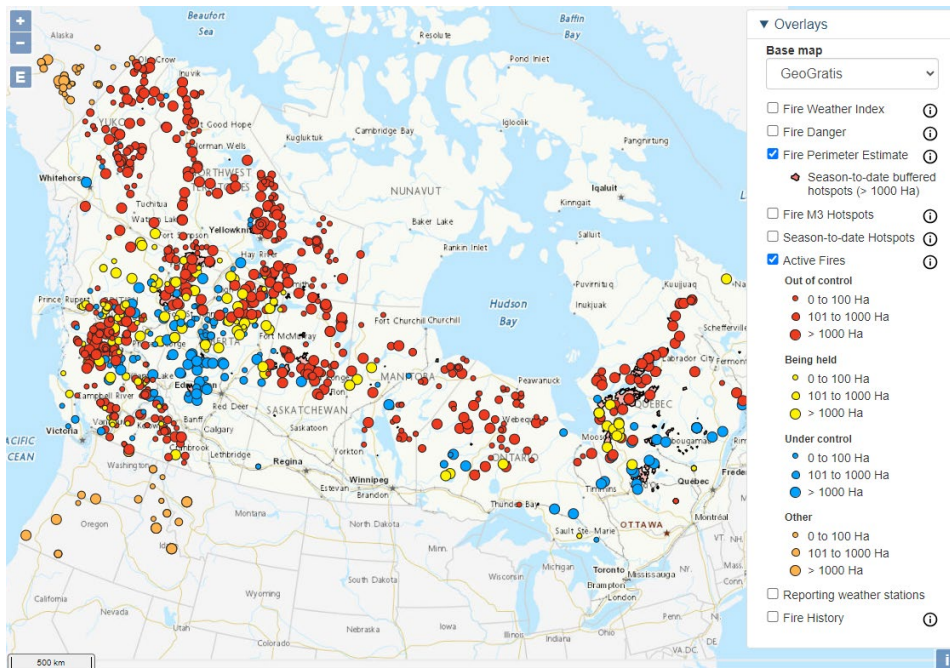


Figure 15m: Active fires and fire perimeters on August 7, 2023.

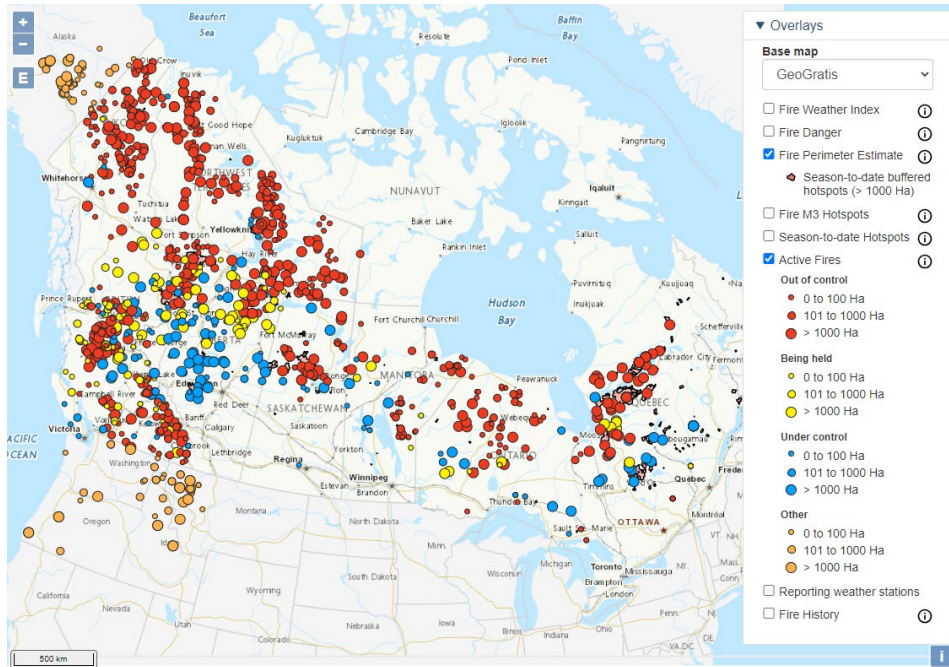


Figure 15n: Active fires and fire perimeters on August 14, 2023.

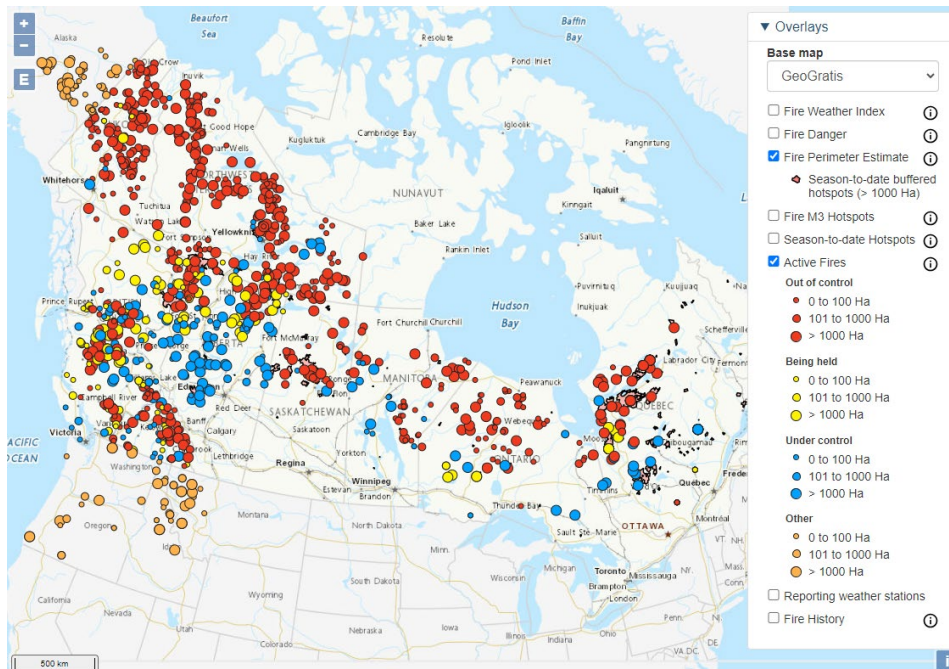


Figure 15o: Active fires and fire perimeters on August 21, 2023.

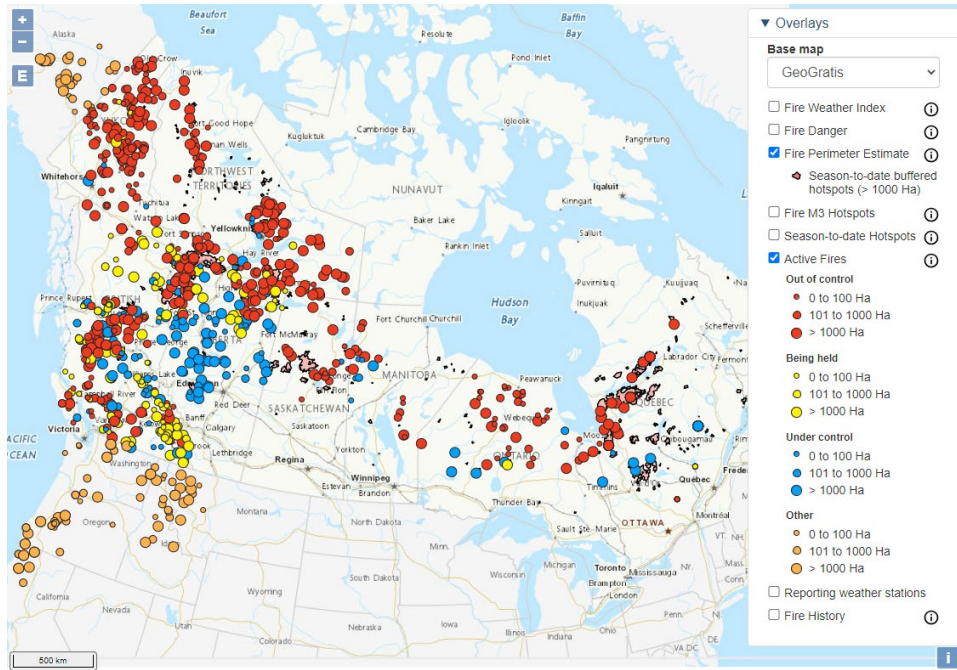


Figure 15p: Active fires and fire perimeters on August 28, 2023.

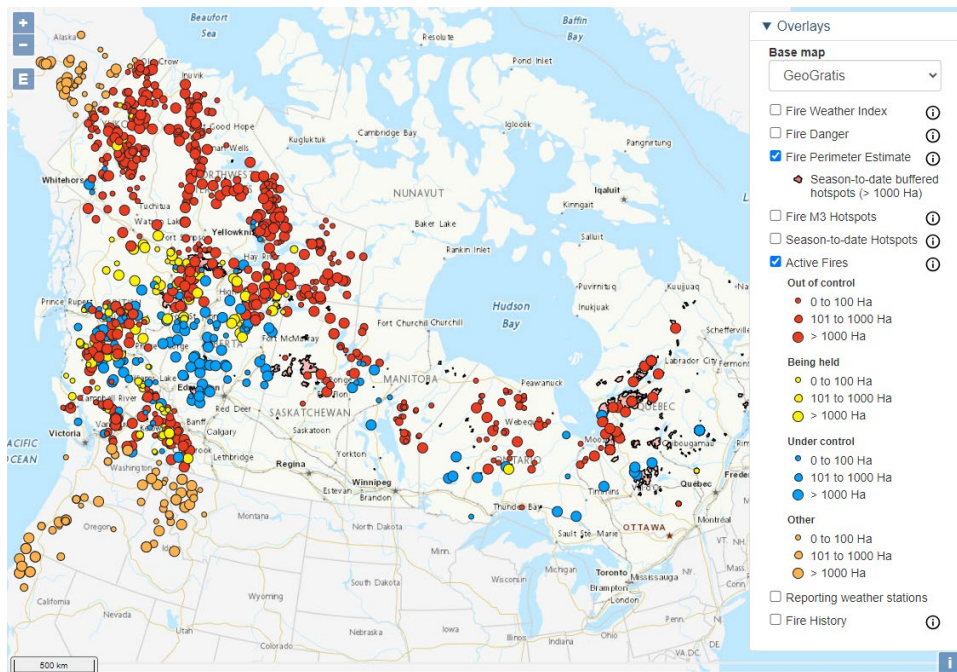


Figure 15q: Active fires and fire perimeters on September 4, 2023.

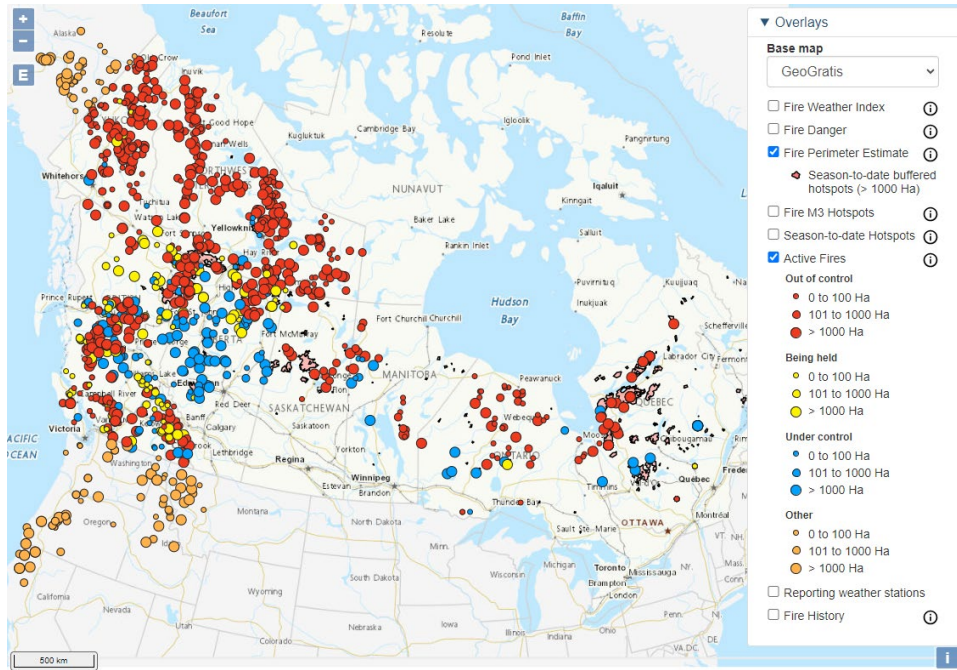


Figure 15r: Active fires and fire perimeters on September 11, 2023.

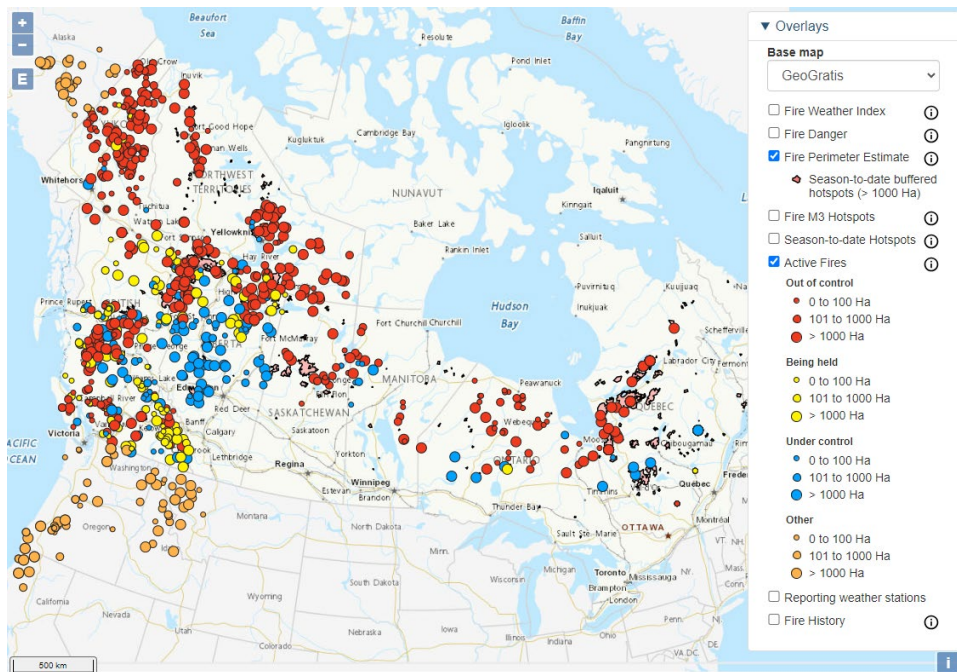
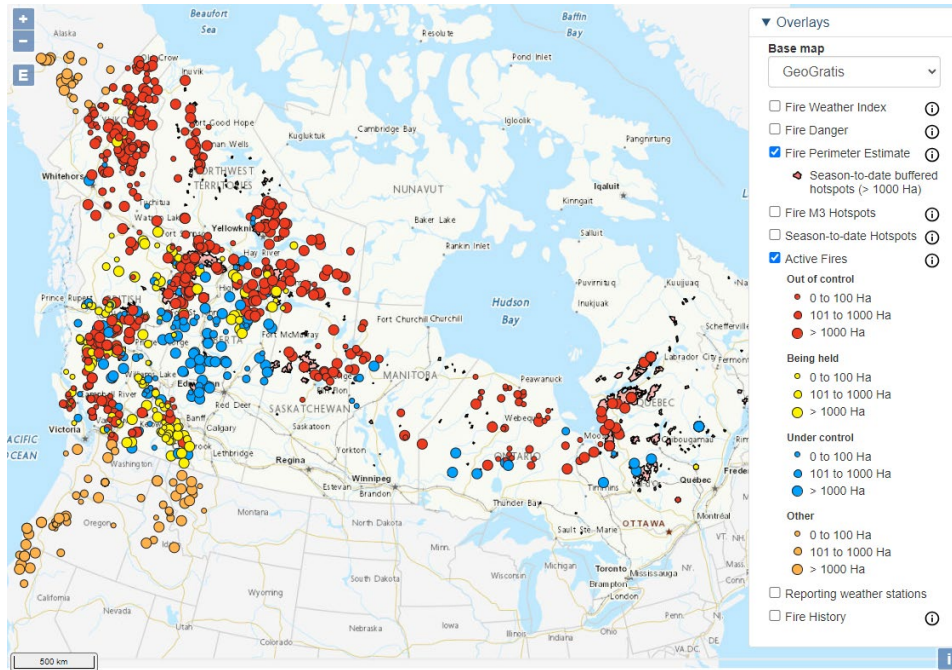


Figure 15: Active fires and fire perimeters on September 18, 2023.



Daily smoke and dust impacts

Throughout Minnesota in 2021, a total of 39 days were impacted by smoke that was high enough to affect PM₁₀ model background. Table 3 provides a list of days and the monitors impacted by smoke during 2021. For 2022 there were no days where smoke or dust significantly impacted PM₁₀ background. For 2023, there were 14 days with high smoke impacts (Table 4). The rest of this section shows daily satellite, fire locations, and monitor data for each day identified in Tables 3 and 4.

Table 3: List of days for 2021 when 24-hour PM₁₀ concentrations were influenced by wildfire smoke and dust.

Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
MPLS - Lowrie Ave	270530909	3/29/2021	101	Windblown dust
MPLS - Pacific St	270530910	3/29/2021	92	Windblown dust
Blaine	270031002	3/30/2021	89	Windblown dust
MPLS - Lowrie Ave	270530909	3/30/2021	109	Windblown dust
MPLS - Pacific St	270530910	3/30/2021	131	Windblown dust
MPLS - Bottineau	270531909	3/30/2021	101	Windblown dust
Ramsey Health Center	271230868	3/30/2021	111	Windblown dust
Blaine	270031002	7/20/2021	51	Wildfire smoke
Ramsey Health Center	271230868	7/20/2021	51	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/20/2021	62	Wildfire smoke

Site	Site AQS	Date (LST)	Daily average ($\mu\text{g}/\text{m}^3$)	Notes
MPLS - Pacific St	270530910	7/20/2021	79	Wildfire smoke
MPLS - Bottineau	270531909	7/20/2021	58	Wildfire smoke
Blaine	270031002	7/21/2021	48	Wildfire smoke
MPLS - City of Lakes	270530966	7/21/2021	49	Wildfire smoke
Ramsey Health Center	271230868	7/21/2021	49	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/21/2021	57	Wildfire smoke
MPLS - Pacific St	270530910	7/21/2021	57	Wildfire smoke
MPLS - Bottineau	270531909	7/21/2021	55	Wildfire smoke
Blaine	270031002	7/22/2021	48	Wildfire smoke
Ramsey Health Center	271230868	7/22/2021	45	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/22/2021	62	Wildfire smoke
MPLS - Pacific St	270530910	7/22/2021	71	Wildfire smoke
MPLS - Bottineau	270531909	7/22/2021	48	Wildfire smoke
Blaine	270031002	7/23/2021	43	Wildfire smoke
Ramsey Health Center	271230868	7/23/2021	43	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/23/2021	64	Wildfire smoke
MPLS - Pacific St	270530910	7/23/2021	78	Wildfire smoke
MPLS - Bottineau	270531909	7/23/2021	49	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/26/2021	44	Wildfire smoke
MPLS - Pacific St	270530910	7/26/2021	51	Wildfire smoke
MPLS - Bottineau	270531909	7/26/2021	36	Wildfire smoke
MPLS - City of Lakes	270530966	7/27/2021	40	Wildfire smoke
Ramsey Health Center	271230868	7/27/2021	42	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/27/2021	50	Wildfire smoke
MPLS - Pacific St	270530910	7/27/2021	54	Wildfire smoke
Blaine	270031002	7/29/2021	82	Wildfire smoke
Ramsey Health Center	271230868	7/29/2021	79	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/29/2021	96	Wildfire smoke
MPLS - Pacific St	270530910	7/29/2021	115	Wildfire smoke
MPLS - Bottineau	270531909	7/29/2021	87	Wildfire smoke
Blaine	270031002	7/30/2021	74	Wildfire smoke
Ramsey Health Center	271230868	7/30/2021	72	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/30/2021	87	Wildfire smoke
MPLS - Pacific St	270530910	7/30/2021	89	Wildfire smoke
Blaine	270031002	7/31/2021	66	Wildfire smoke
Ramsey Health Center	271230868	7/31/2021	70	Wildfire smoke
MPLS - Bottineau	270531909	7/31/2021	84	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/31/2021	72	Wildfire smoke

Site	Site AQS	Date (LST)	Daily average ($\mu\text{g}/\text{m}^3$)	Notes
MPLS - Pacific St	270530910	7/31/2021	80	Wildfire smoke
MPLS - Bottineau	270531909	7/31/2021	69	Wildfire smoke
Virginia	271327001	8/2/2021	42	Wildfire smoke
Blaine	270031002	8/3/2021	45	Wildfire smoke
Ramsey Health Center	271230868	8/3/2021	50	Wildfire smoke
MPLS - Lowrie Ave	270530909	8/3/2021	55	Wildfire smoke
MPLS - Pacific St	270530910	8/3/2021	62	Wildfire smoke
MPLS - Bottineau	270531909	8/3/2021	51	Wildfire smoke
Blaine	270031002	8/4/2021	38	Wildfire smoke
MPLS - Lowrie Ave	270530909	8/4/2021	50	Wildfire smoke
MPLS - Pacific St	270530910	8/4/2021	68	Wildfire smoke
MPLS - Bottineau	270531909	8/4/2021	45	Wildfire smoke
Virginia	271327001	8/26/2021	59	Wildfire smoke
Blaine	270031002	12/15/2021	50	Windblown dust
Ramsey Health Center	271230868	12/15/2021	55	Windblown dust
MPLS - Lowrie Ave	270530909	12/15/2021	77	Windblown dust
MPLS - Pacific St	270530910	12/15/2021	64	Windblown dust
MPLS - Bottineau	270531909	12/15/2021	64	Windblown dust

Table 4: List of days for 2023 when 24-hour PM₁₀ concentrations were influenced by wildfire smoke and dust.

Site	Site AQS	Date (LST)	Daily average ($\mu\text{g}/\text{m}^3$)	Notes
Fargo NW	380171004	5/16/2023	65	Wildfire smoke
Fargo NW	380171004	5/17/2023	89	Wildfire smoke
Fargo NW	380171004	5/18/2023	126	Wildfire smoke
Fargo NW	380171004	5/23/2023	55	Wildfire smoke
St. Paul - Downtown	271230868	5/23/2023	66	Wildfire smoke
MPLS - Bottineau	270531909	6/5/2023	63	Wildfire smoke
Blaine	270031002	6/14/2023	109	Wildfire smoke
Fargo NW	380171004	6/14/2023	115	Wildfire smoke
MPLS - Bottineau	270531909	6/14/2023	114	Wildfire smoke
MPLS - Lowrie Ave	270530909	6/14/2023	131	Wildfire smoke
MPLS - Pacific St	270530910	6/14/2023	121	Wildfire smoke
St. Paul - Downtown	271230868	6/14/2023	118	Wildfire smoke
Blaine	270031002	6/27/2023	81	Wildfire smoke
St. Paul - Downtown	271230868	6/27/2023	52	Wildfire smoke
Blaine	270031002	6/28/2023	72	Wildfire smoke

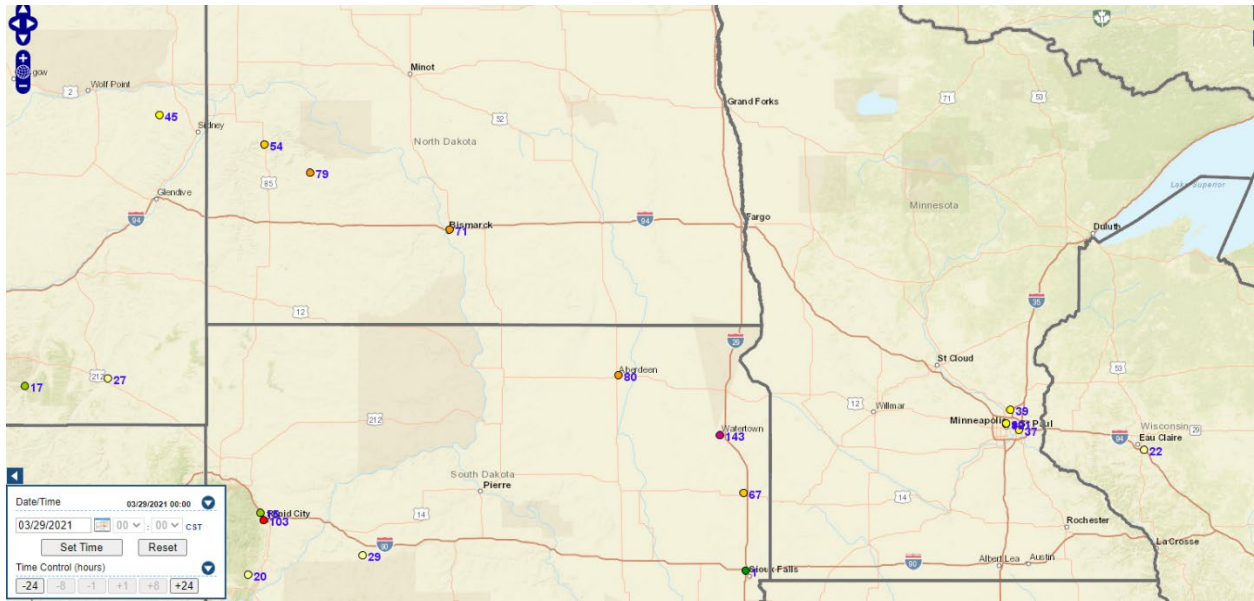
Site	Site AQS	Date (LST)	Daily average ($\mu\text{g}/\text{m}^3$)	Notes
MPLS - Bottineau	270531909	6/28/2023	75	Wildfire smoke
MPLS - Lowrie Ave	270530909	6/28/2023	76	Wildfire smoke
MPLS - Pacific St	270530910	6/28/2023	92	Wildfire smoke
St. Paul - Downtown	271230868	6/28/2023	73	Wildfire smoke
Fargo NW	380171004	8/4/2023	73	Wildfire smoke
Fargo NW	380171004	8/29/2023	80	Wildfire smoke
Fargo NW	380171004	9/5/2023	74	Wildfire smoke
Fargo NW	380171004	9/15/2023	59	Wildfire smoke
Fargo NW	380171004	9/19/2023	67	Wildfire smoke
Fargo NW	380171004	9/20/2023	98	Wildfire smoke

3/29/2021 & 3/30/21 Impacts

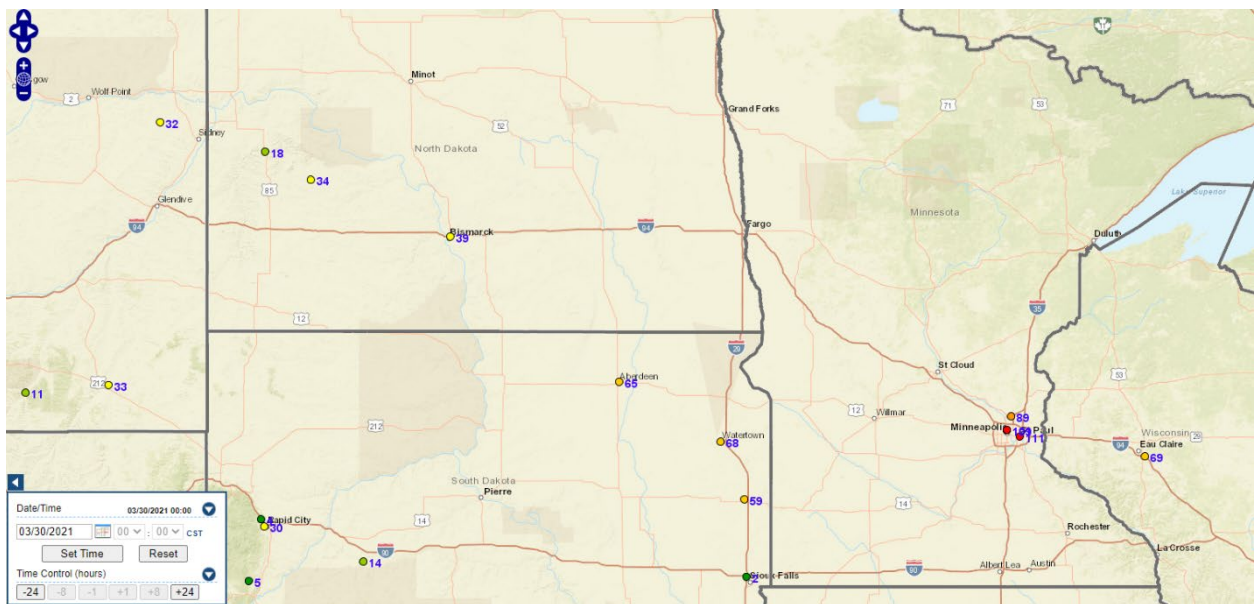
On March 29, 2021, a large-scale wind event occurred in the western Dakotas. A large swath within the Dakotas recorded wind gusts over 40 knots, which is capable of producing significant windblown dust.

Monitored 24-hour PM_{10} concentrations impacted by dust on March 29 and 30, 2021.

Site	Site AQS	Date (LST)	Daily average ($\mu\text{g}/\text{m}^3$)	Notes
MPLS - Lowrie Ave	270530909	3/29/2021	101	Windblown dust
MPLS - Pacific St	270530910	3/29/2021	92	Windblown dust
Blaine	270031002	3/30/2021	89	Windblown dust
MPLS - Lowrie Ave	270530909	3/30/2021	109	Windblown dust
MPLS - Pacific St	270530910	3/30/2021	131	Windblown dust
MPLS - Bottineau	270531909	3/30/2021	101	Windblown dust
Ramsey Health Center	271230868	3/30/2021	111	Windblown dust



24-hour PM₁₀ on March 29, 2021. Note that not all PM₁₀ monitors report to Airnow.



24-hour PM₁₀ on March 30, 2021. Note that not all PM₁₀ monitors report to Airnow.

US National Weather Service Bismarck North Dakota [Follow](#) ⋮
March 30, 2021 · 🌐

This video taken by an emergency manager along the LaMoure-Dickey county line shows reduced visibility due to blowing dirt/dust. This may be a possibility in other areas with bare fields and gusty winds today. Use caution if on the roads!
[See less](#)

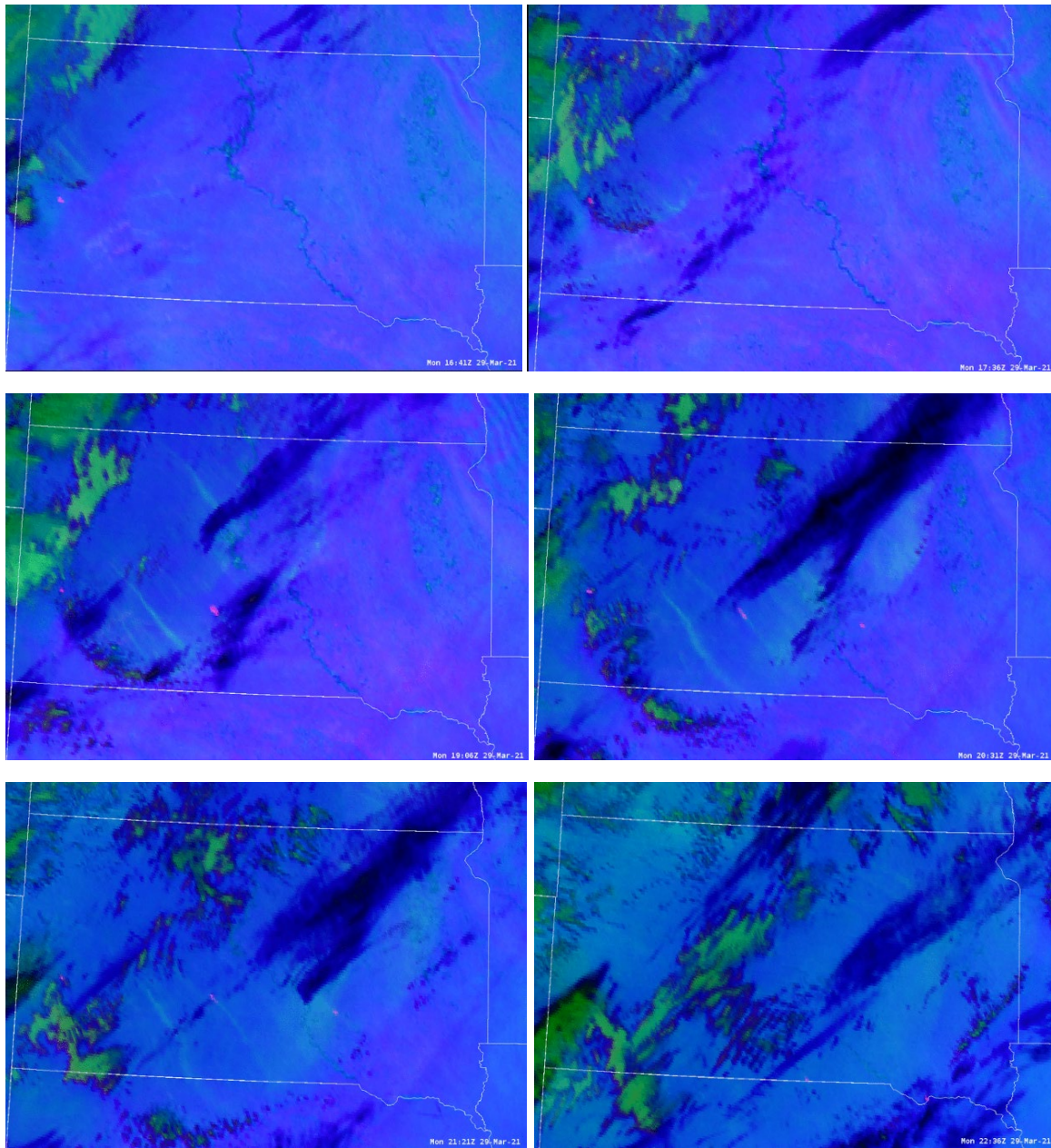
Most relevant ▾

Karen Vasvick
We need rain bad 🙏
1y

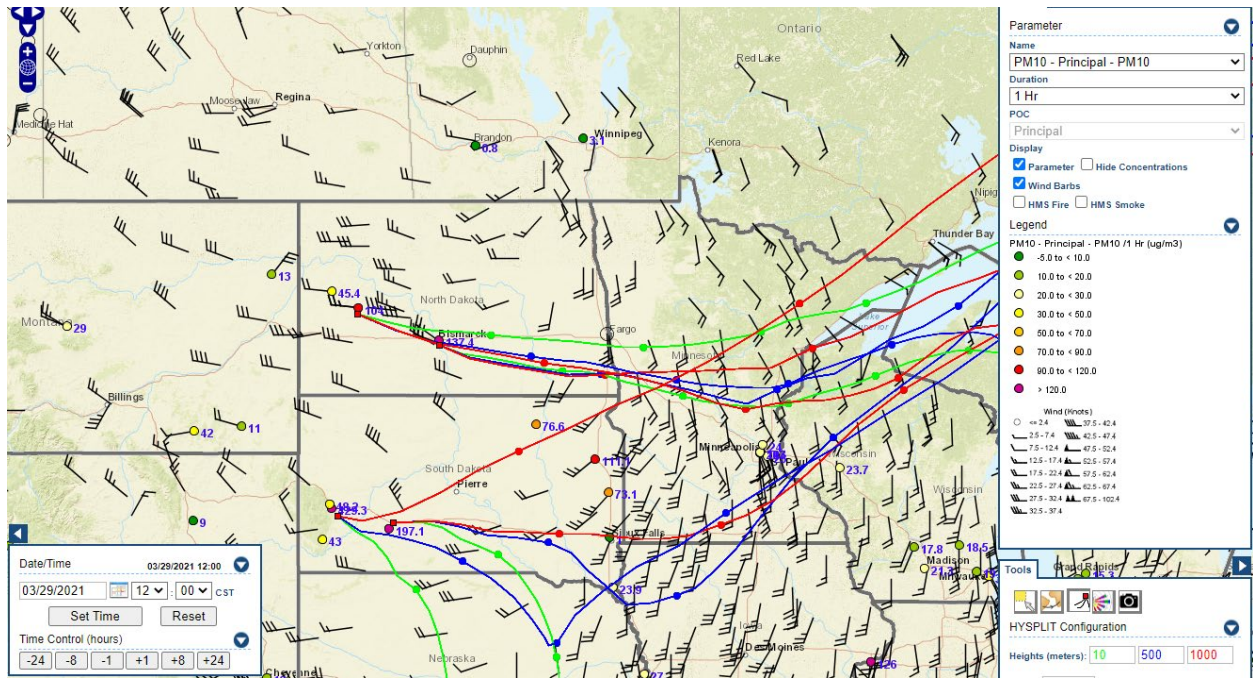
Blowing Dirt March 30 2021 ⋮

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Video of blowing dirt near Bismarck, ND.



March 29, 2021, GOES-East Fire-Dust RGB, centered over South Dakota. Order of images is from left to right and top to bottom. First image is at 1641z, and the last image is at 2234z. Dust is depicted in light blue streaks that advance eastward. Images obtained from <https://satelliteliaisonblog.com/2021/03/>.

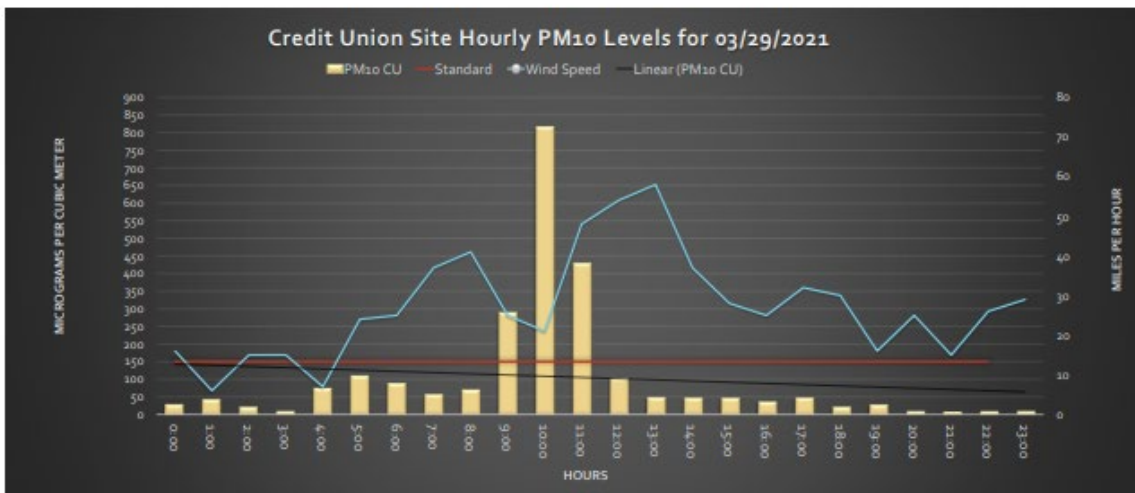


1-hour PM₁₀ concentrations on March 29 at 1200 CST, with forward trajectories originating at the area of higher PM₁₀ concentrations. The higher PM₁₀ coincides with the area of blowing dust.

High Wind Dust Alert - 03/29/2021
 Credit Union Site, Rapid City, South Dakota

Date and Time Issued: March 29, 2021 6:32 AM MDT
 Date Issued for: March 29, 2021 6:32 AM MDT
 Date and Time Cancelled: March 29, 2021 9:00 PM MDT

Date	Hours	PM10 Concentrations (ug/m3)	Wind Speed (MPH)	Wind Direction	Wind Gust (MPH)	Precipitation (Inches)	Weather Conditions	PM10 Standard
03/29/2021	0:00	30.0	16	S	0	0	Fair	150
03/29/2021	1:00	44.2	6	ENE	0	0	Fair	150
03/29/2021	2:00	22.9	15	SSW	0	0	Fair	150
03/29/2021	3:00	10.8	15	W	0	0	Fair	150
03/29/2021	4:00	76.2	7	SSW	0	0	Fair	150
03/29/2021	5:00	111.2	24	WSW	39	0	Fair / Windy	150
03/29/2021	6:00	90.0	25	W	46	0	Fair / Windy	150
03/29/2021	7:00	58.6	37	WSW	71	0	Fair / Windy	150
03/29/2021	8:00	71.6	41	WSW	64	0	Fair / Windy	150
03/29/2021	9:00	290.3	25	WSW	46	0	Fair / Windy	150
03/29/2021	10:00	813.6	21	W	39	0	Fair / Windy	150
03/29/2021	11:00	429.3	48	NNW	68	0	Smoke / Windy	150
03/29/2021	12:00	104.3	54	NW	72	0	Smoke / Windy	150
03/29/2021	13:00	50.0	58	NNW	75	0	Smoke / Windy	150
03/29/2021	14:00	48.7	37	NNW	49	0	Smoke / Windy	150
03/29/2021	15:00	48.3	28	WNW	41	0	Smoke / Windy	150
03/29/2021	16:00	37.7	25	WNW	41	0	Smoke / Windy	150
03/29/2021	17:00	49.0	32	NW	47	0	Smoke / Windy	150
03/29/2021	18:00	22.9	30	NW	48	0	Smoke / Windy	150
03/29/2021	19:00	29.2	16	NW	36	0	Smoke	150
03/29/2021	20:00	10.8	25	NW	41	0	Smoke / Windy	150
03/29/2021	21:00	9.3	15	NW	26	0	Smoke	150
03/29/2021	22:00	10.6	26	NW	38	0	Smoke / Windy	150
03/29/2021	23:00	11.3	29	NW	45	0	Smoke / Windy	150
24-Hour Averages		103.4	27.3					

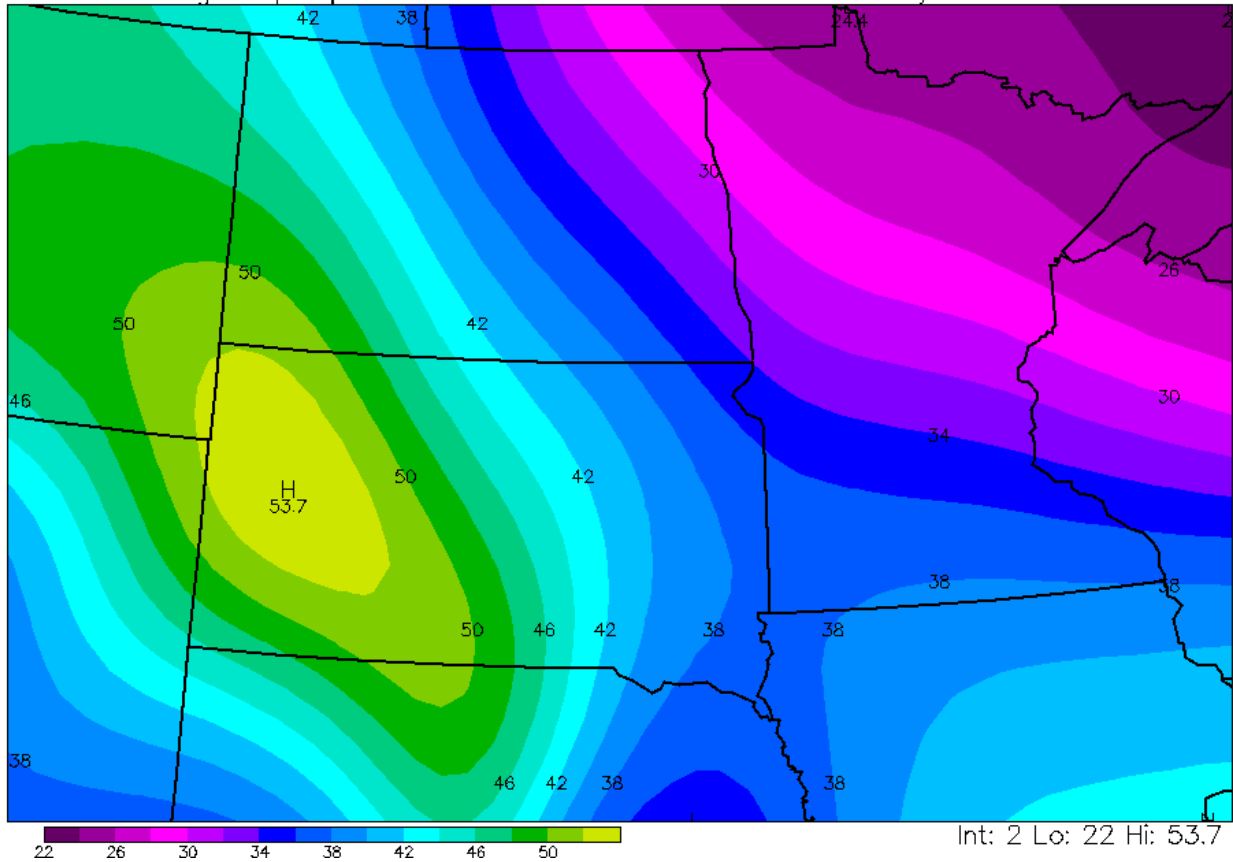


High wind and dust alert issued by South Dakota on 3/29/2021.

Plymouth State Weather Center

Surface Wind gusts [knt]

WXP analysis for 20Z 29 MAR 21



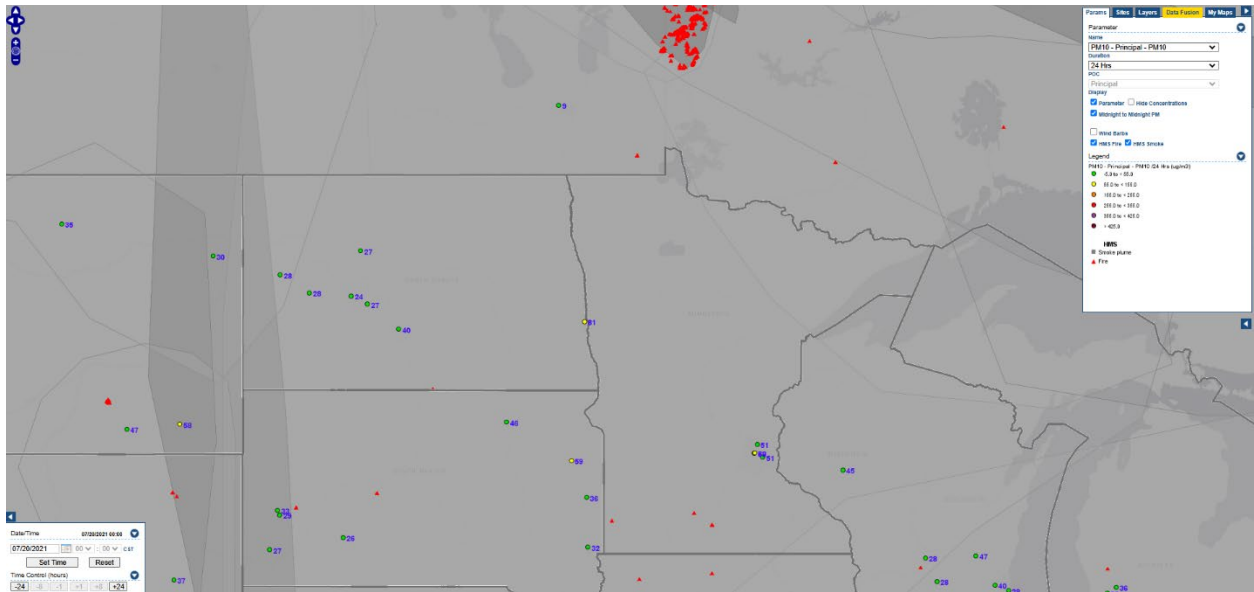
Surface wind gusts on March 29, 2021 at 20z, in knots. Source: <https://vortex.plymouth.edu/>

7/20/2021 Impacts

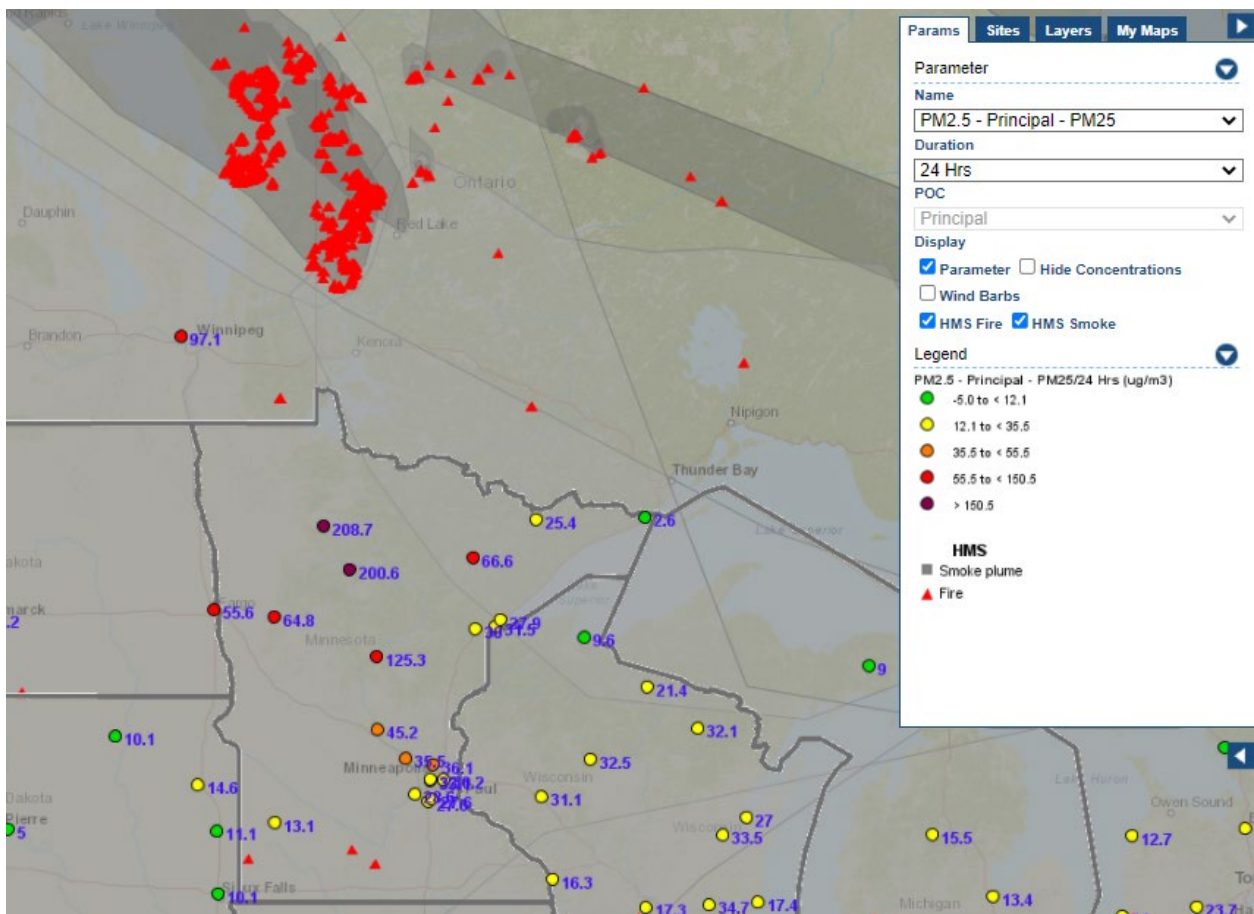
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on July 20, 2021.

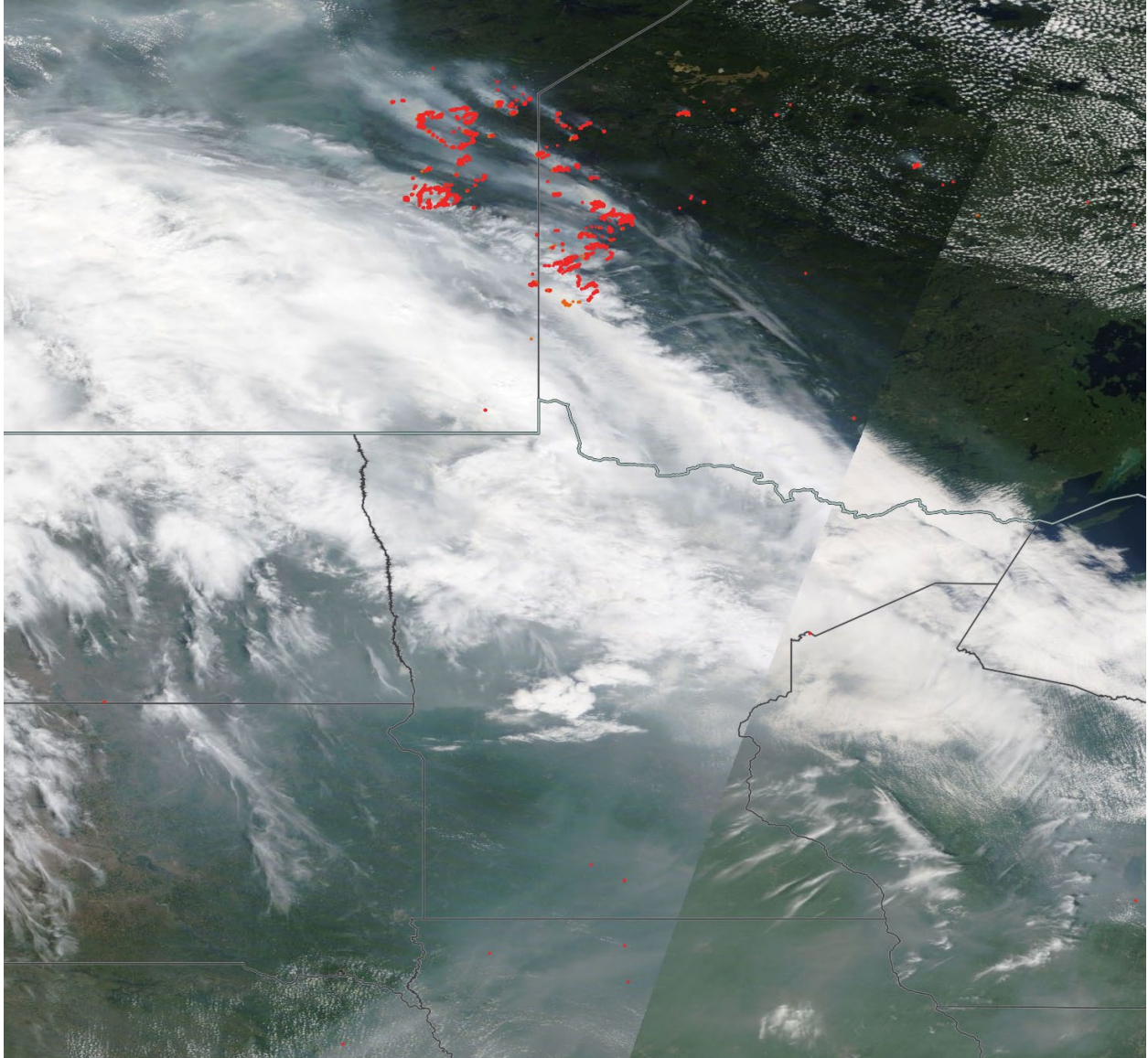
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Blaine	270031002	7/20/2021	51	Wildfire smoke
Ramsey Health Center	271230868	7/20/2021	51	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/20/2021	62	Wildfire smoke
MPLS - Pacific St	270530910	7/20/2021	79	Wildfire smoke
MPLS - Bottineau	270531909	7/20/2021	58	Wildfire smoke



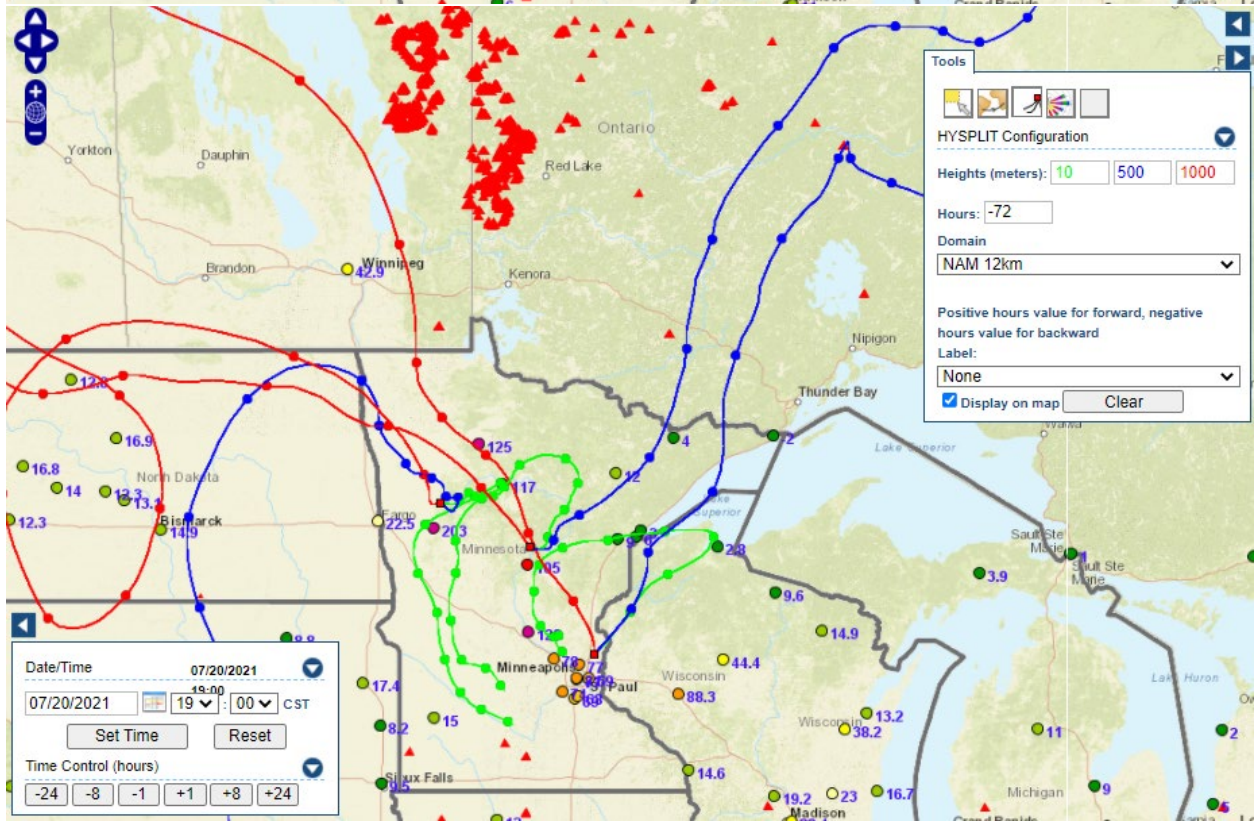
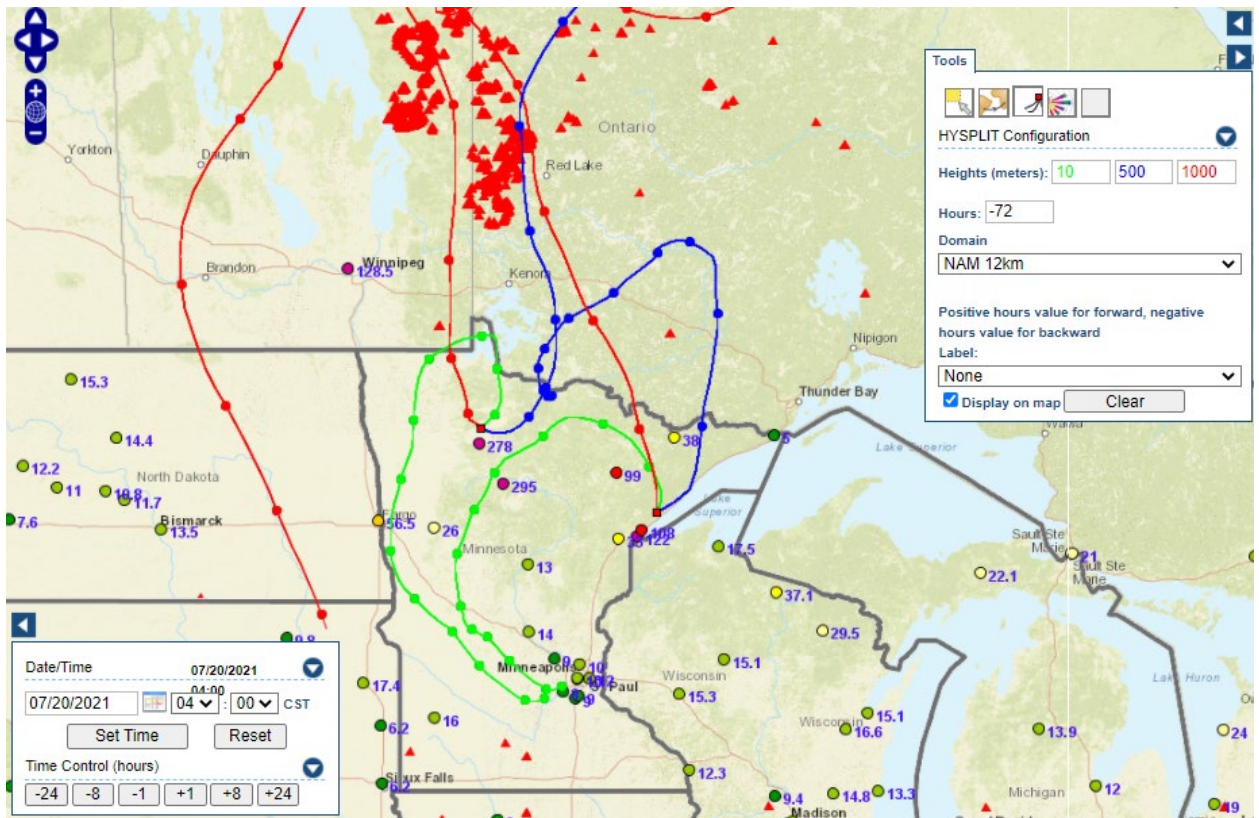
Analyzed smoke, hotspots, and 24-hour PM₁₀ on July 20, 2021



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on July 20, 2021



MODIS visible satellite for July 20, 2021



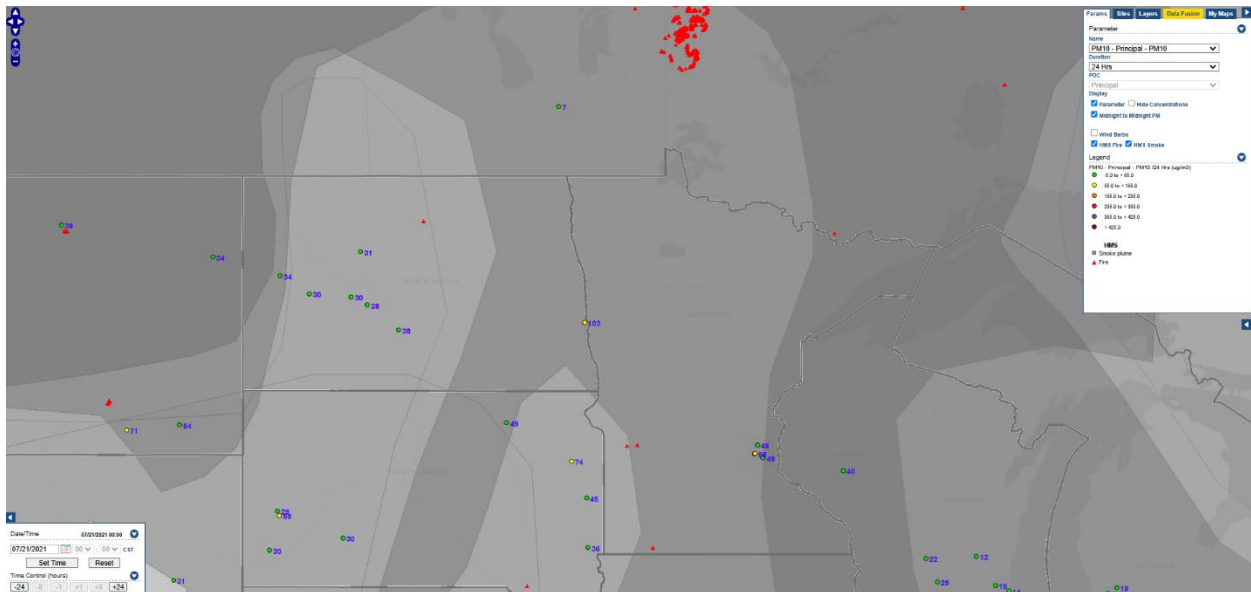
Backward trajectories for July 20, 2021.

7/21/2021 Impacts

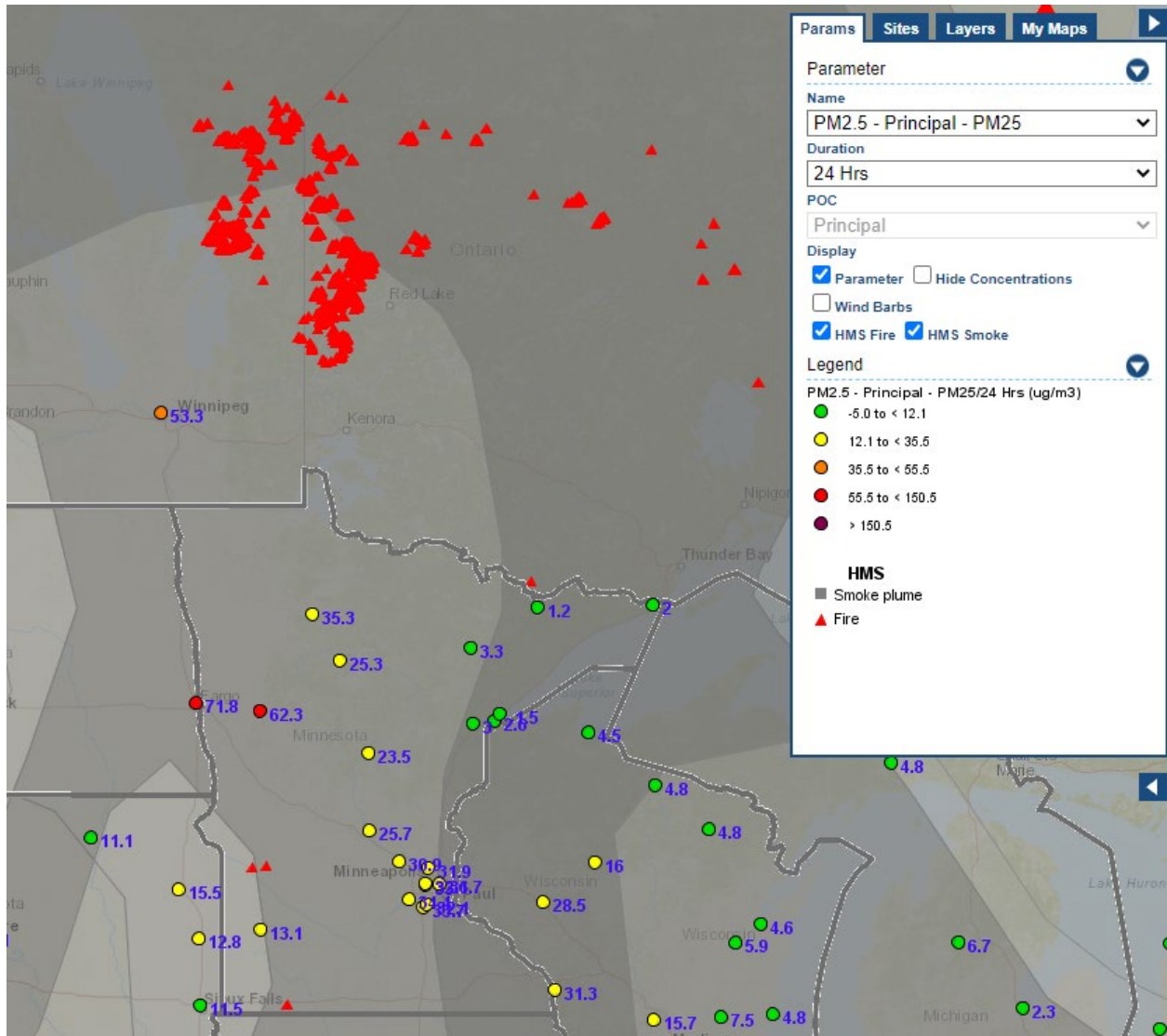
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on July 21, 2021.

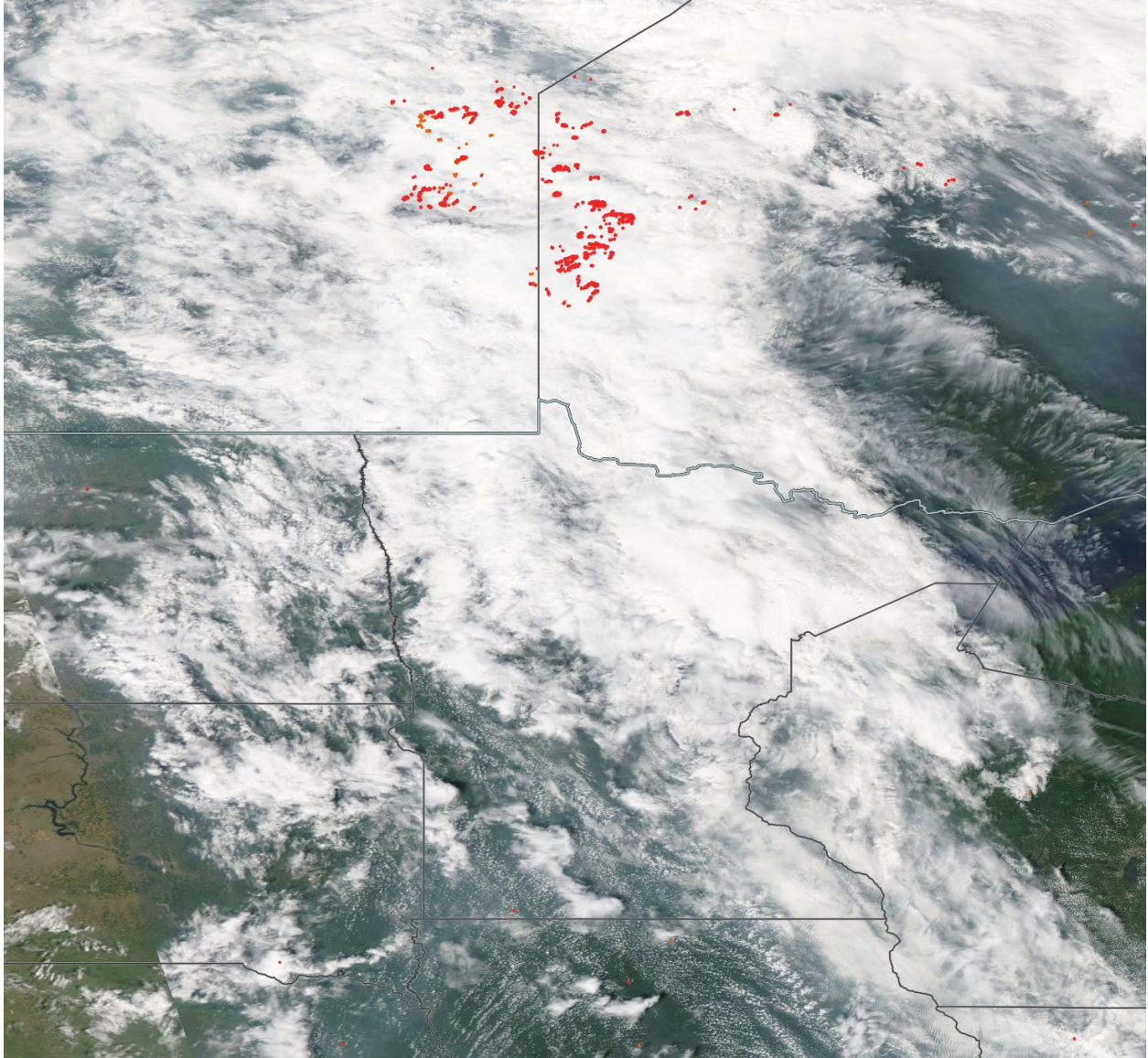
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Blaine	270031002	7/21/2021	48	Wildfire smoke
MPLS - City of Lakes	270530966	7/21/2021	49	Wildfire smoke
Ramsey Health Center	271230868	7/21/2021	49	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/21/2021	57	Wildfire smoke
MPLS - Pacific St	270530910	7/21/2021	57	Wildfire smoke
MPLS - Bottineau	270531909	7/21/2021	55	Wildfire smoke



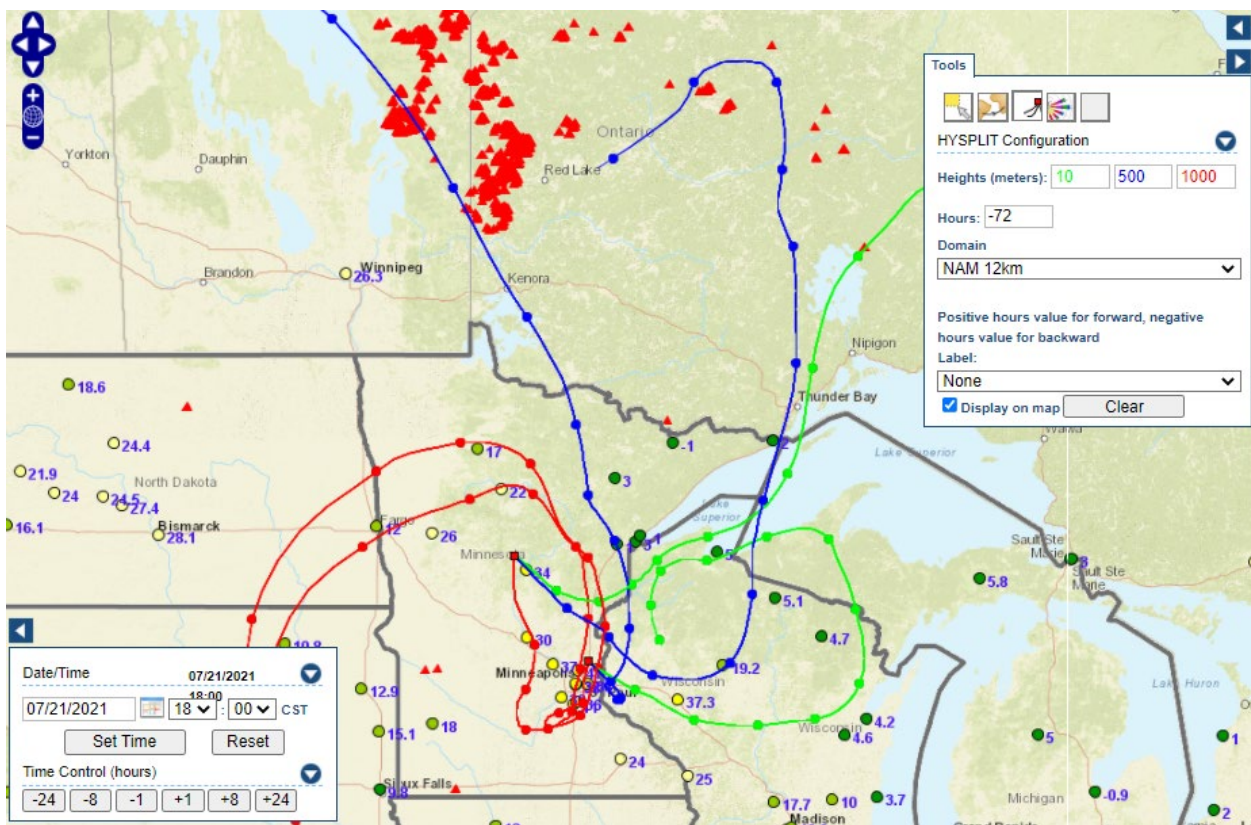
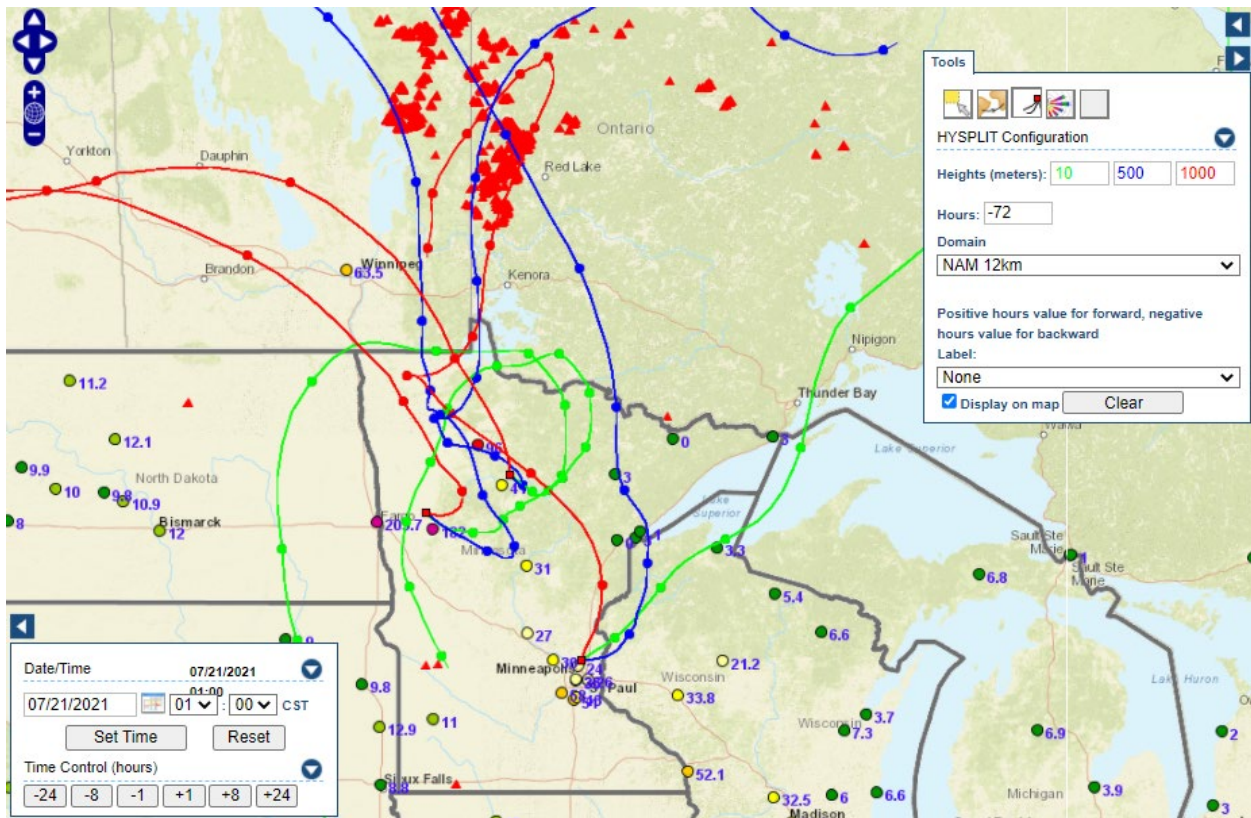
Analyzed smoke, hotspots, and 24-hour PM₁₀ on July 21, 2021



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on July 21, 2021



MODIS visible satellite for July 21, 2021.



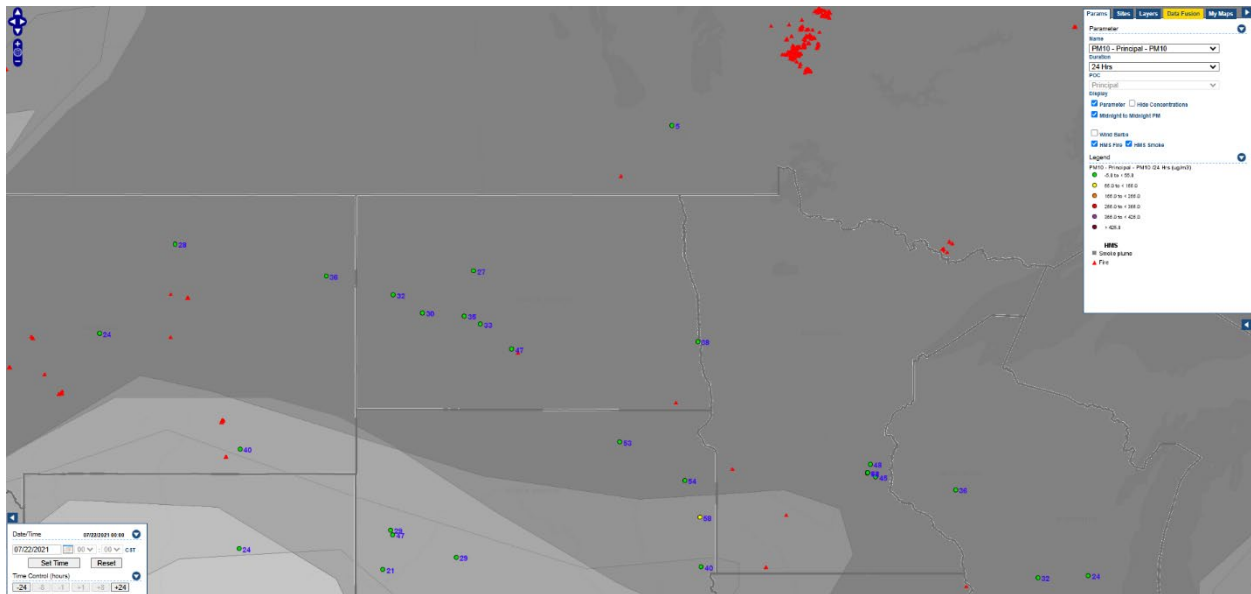
Backward trajectories for July 21, 2021.

7/22/2021 Impacts

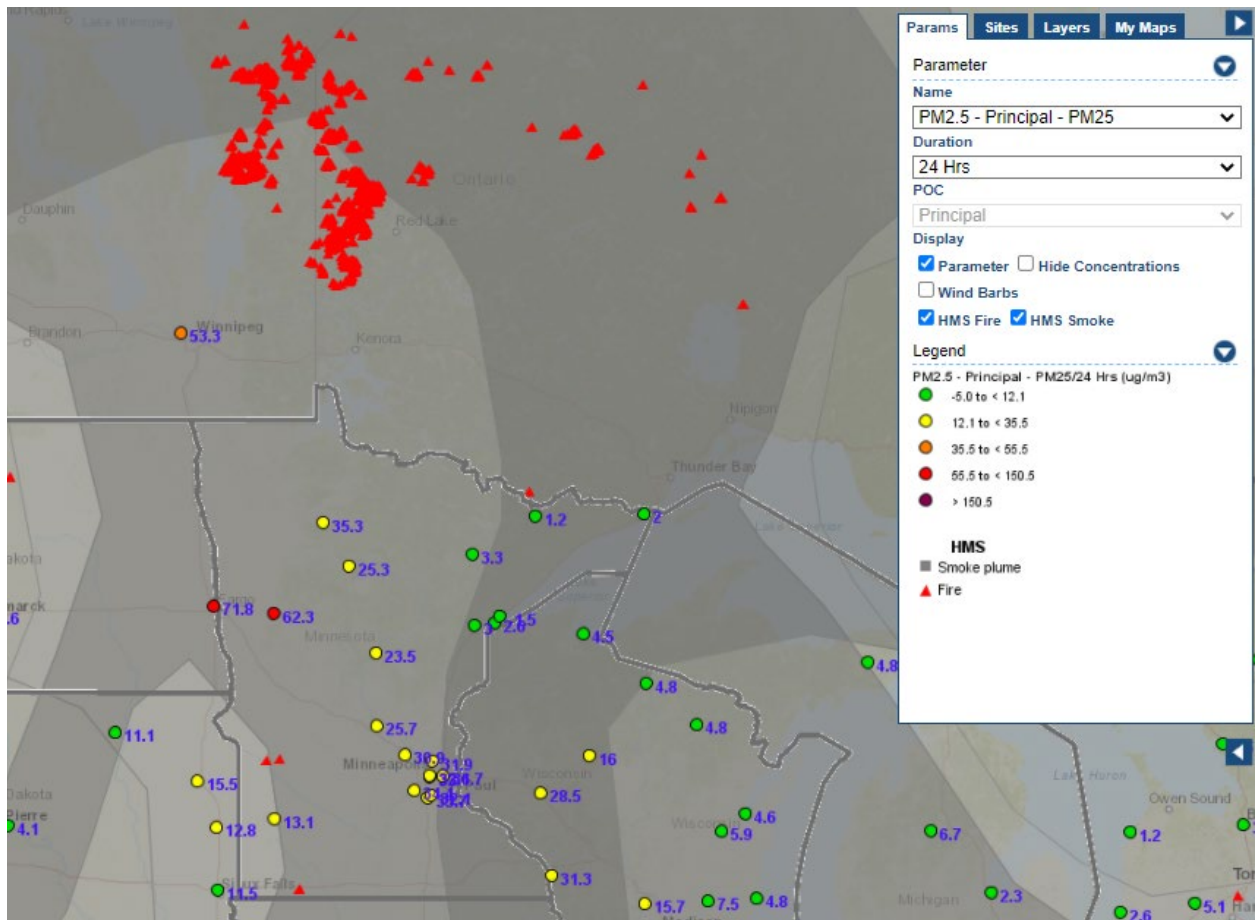
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on July 22, 2021.

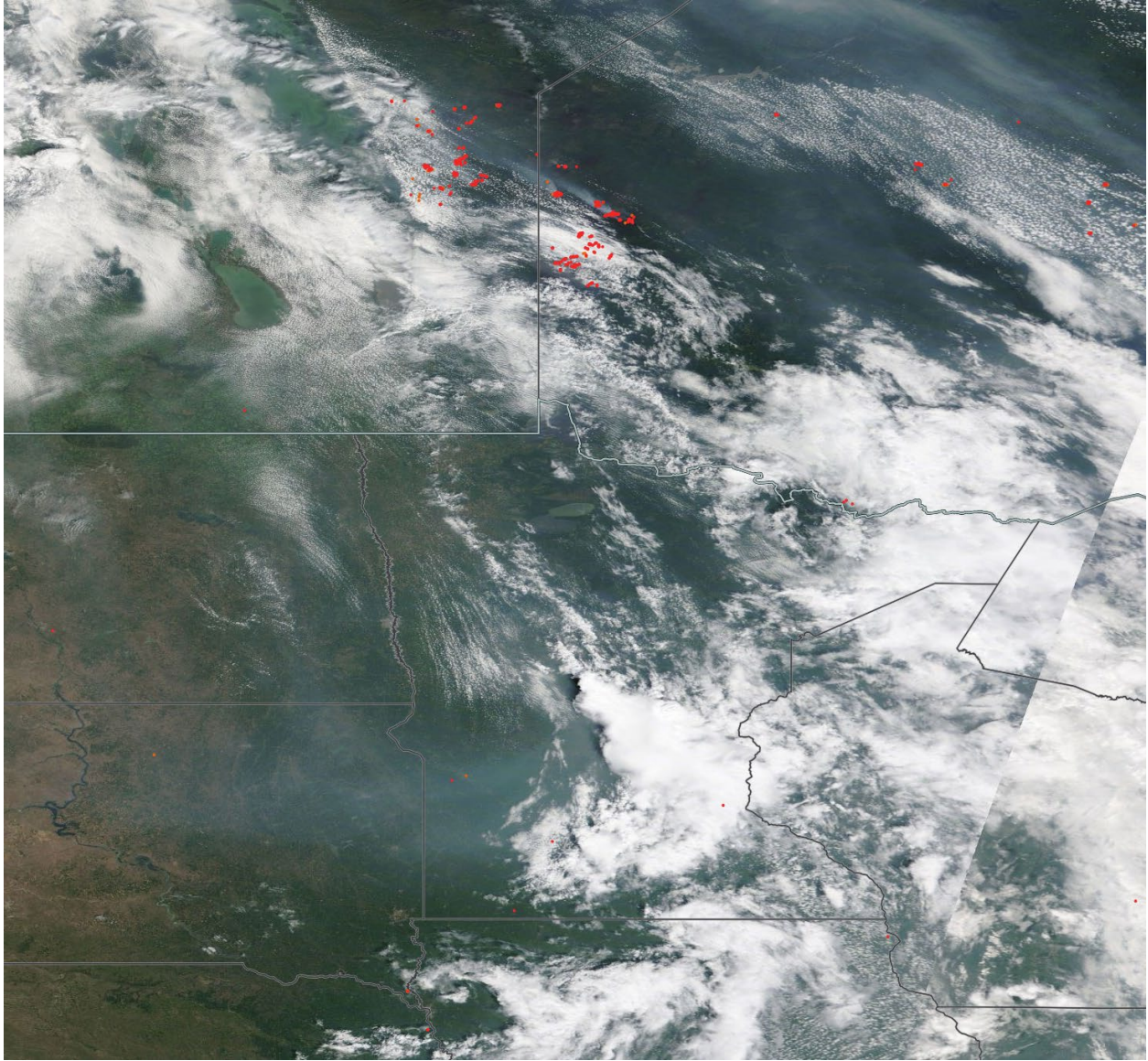
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Blaine	270031002	7/22/2021	48	Wildfire smoke
Ramsey Health Center	271230868	7/22/2021	45	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/22/2021	62	Wildfire smoke
MPLS - Pacific St	270530910	7/22/2021	71	Wildfire smoke
MPLS - Bottineau	270531909	7/22/2021	48	Wildfire smoke



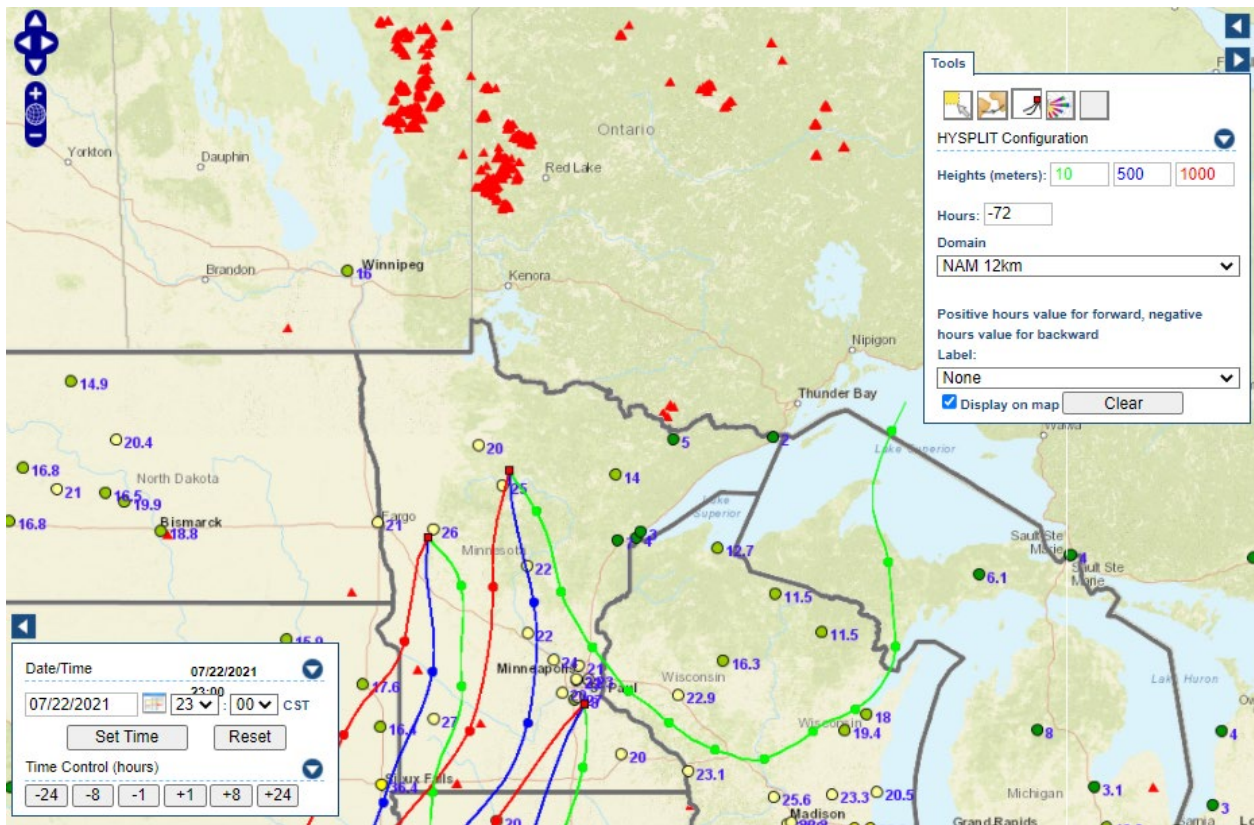
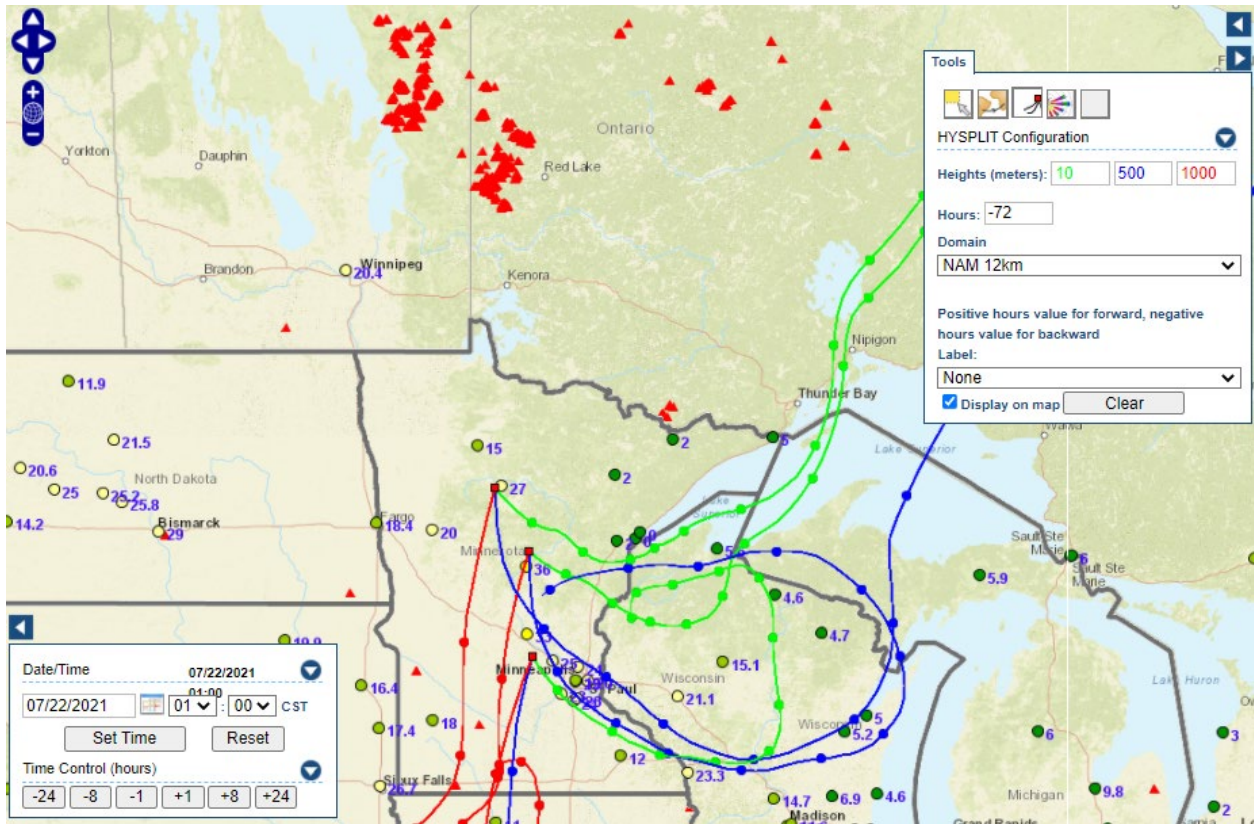
Analyzed smoke, hotspots, and 24-hour PM₁₀ on July 22, 2021



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on July 22, 2021.



MODIS visible satellite for July 22, 2021.



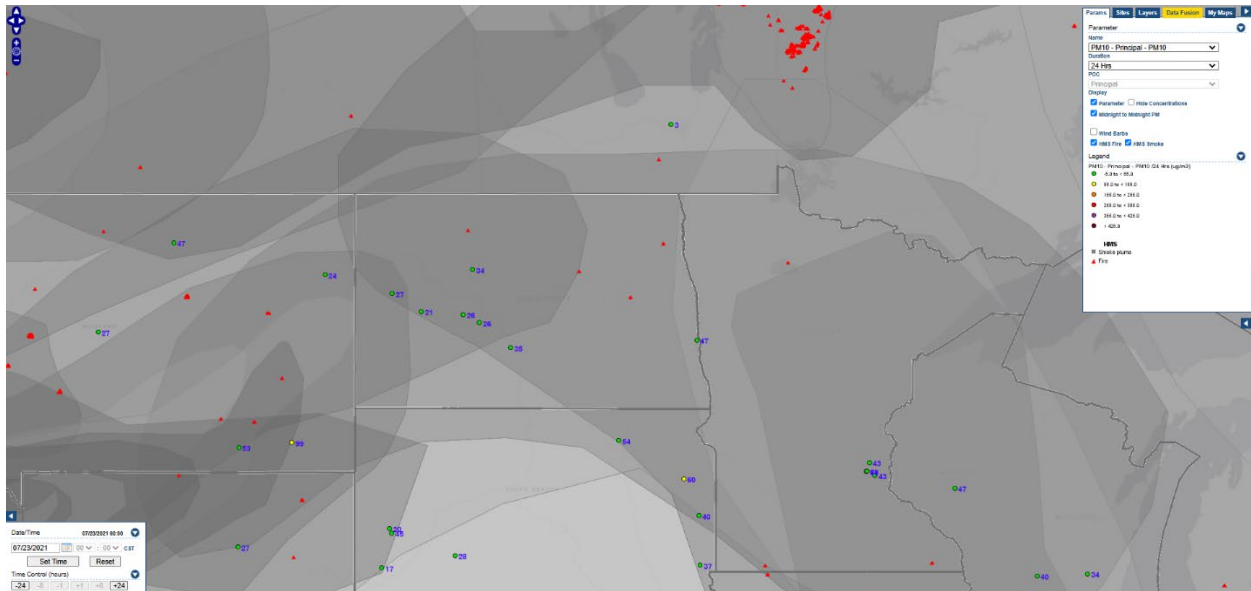
Backward trajectories for July 22, 2021.

7/23/2021 Impacts

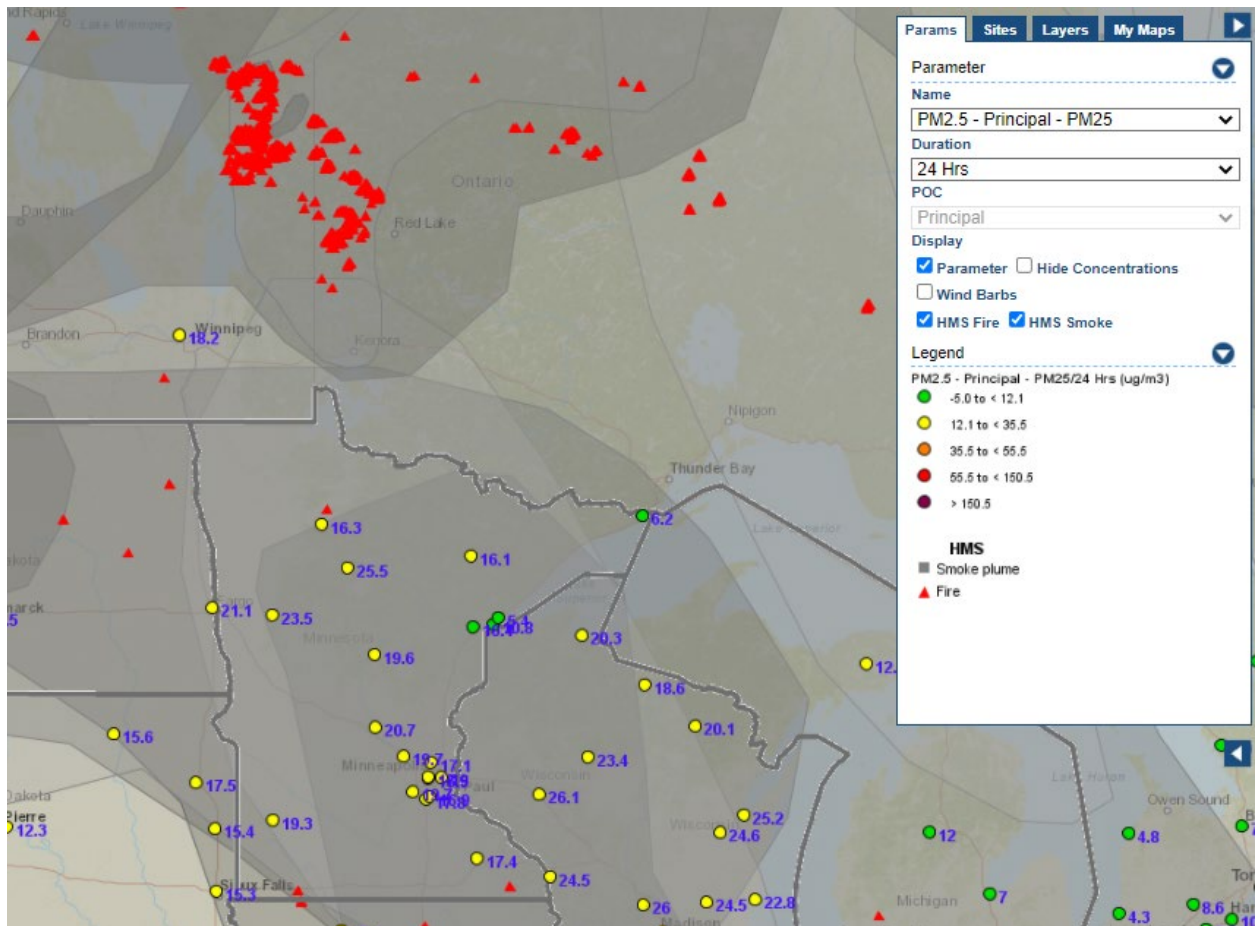
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on July 23, 2021.

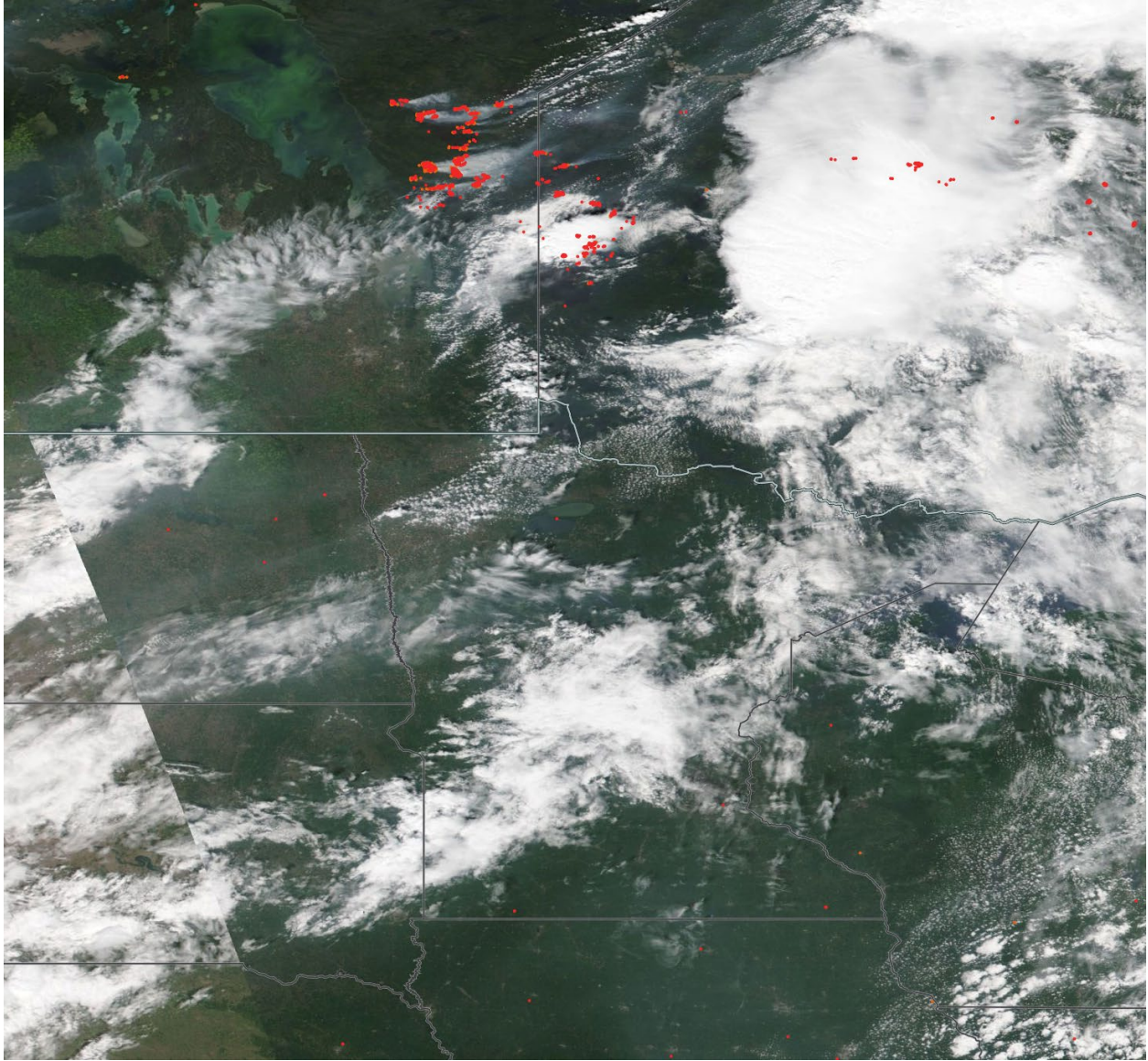
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Blaine	270031002	7/23/2021	43	Wildfire smoke
Ramsey Health Center	271230868	7/23/2021	43	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/23/2021	64	Wildfire smoke
MPLS - Pacific St	270530910	7/23/2021	78	Wildfire smoke
MPLS - Bottineau	270531909	7/23/2021	49	Wildfire smoke



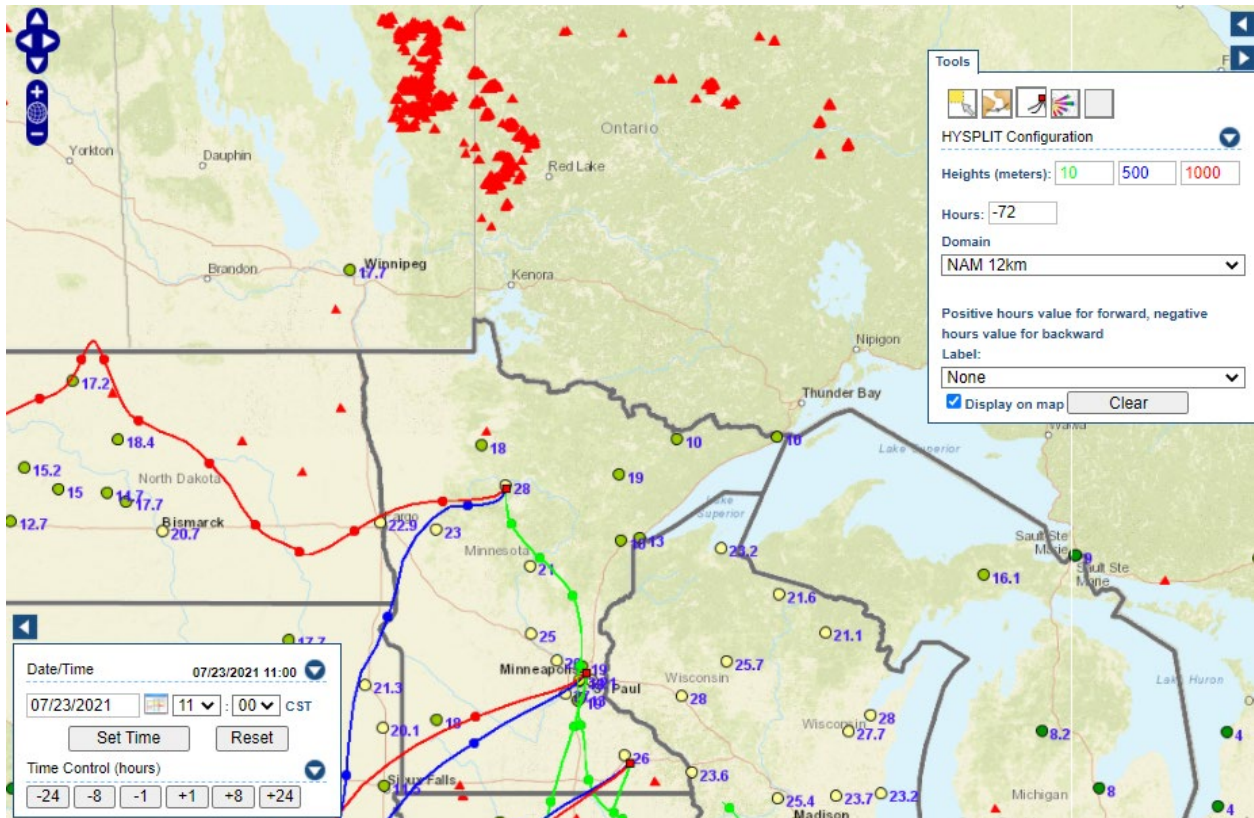
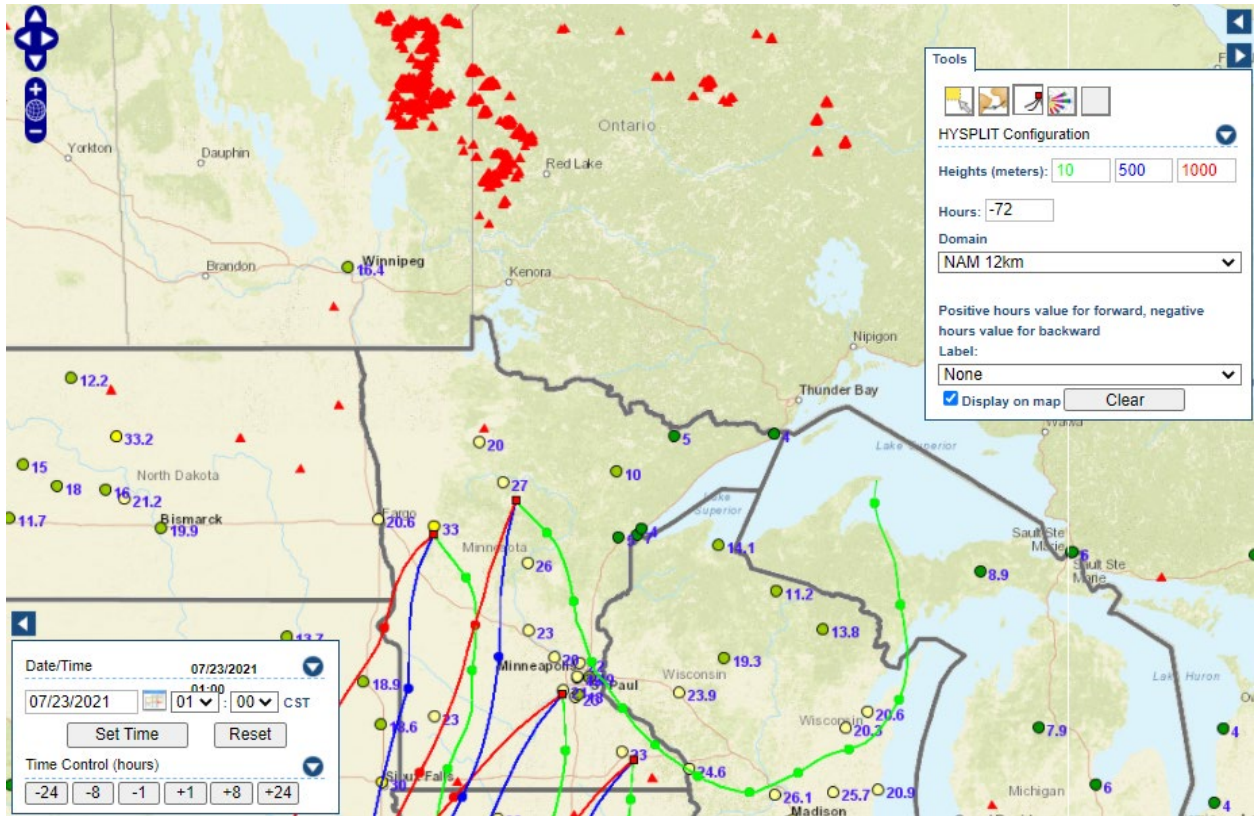
Analyzed smoke, hotspots, and 24-hour PM₁₀ on July 23, 2021



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on July 23, 2021.



MODIS visible satellite for July 23, 2021.



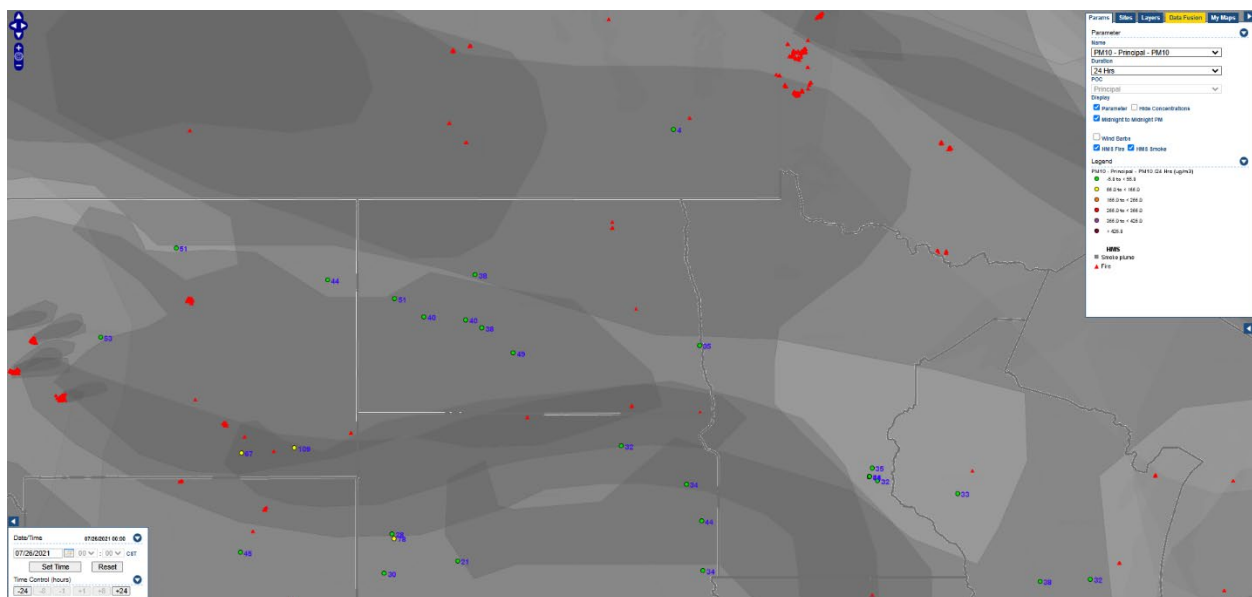
Backward trajectories for July 23, 2021.

7/26/2021 Impacts

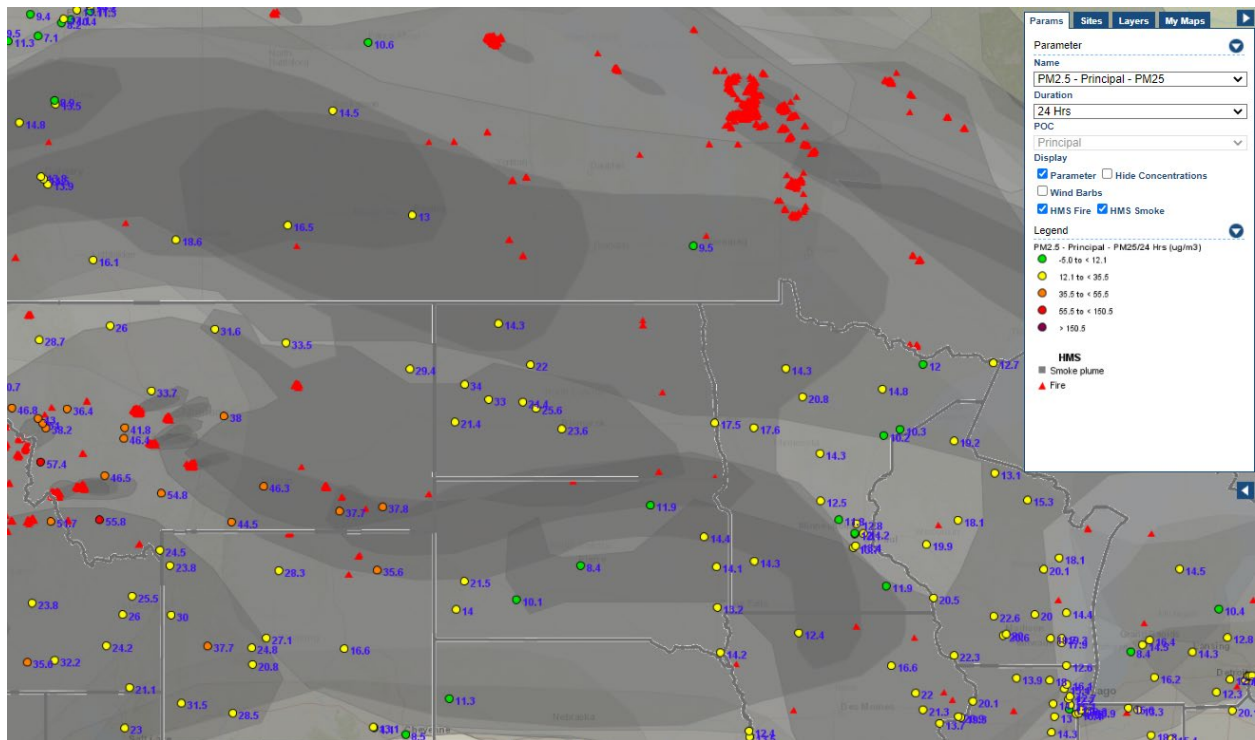
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on July 26, 2021.

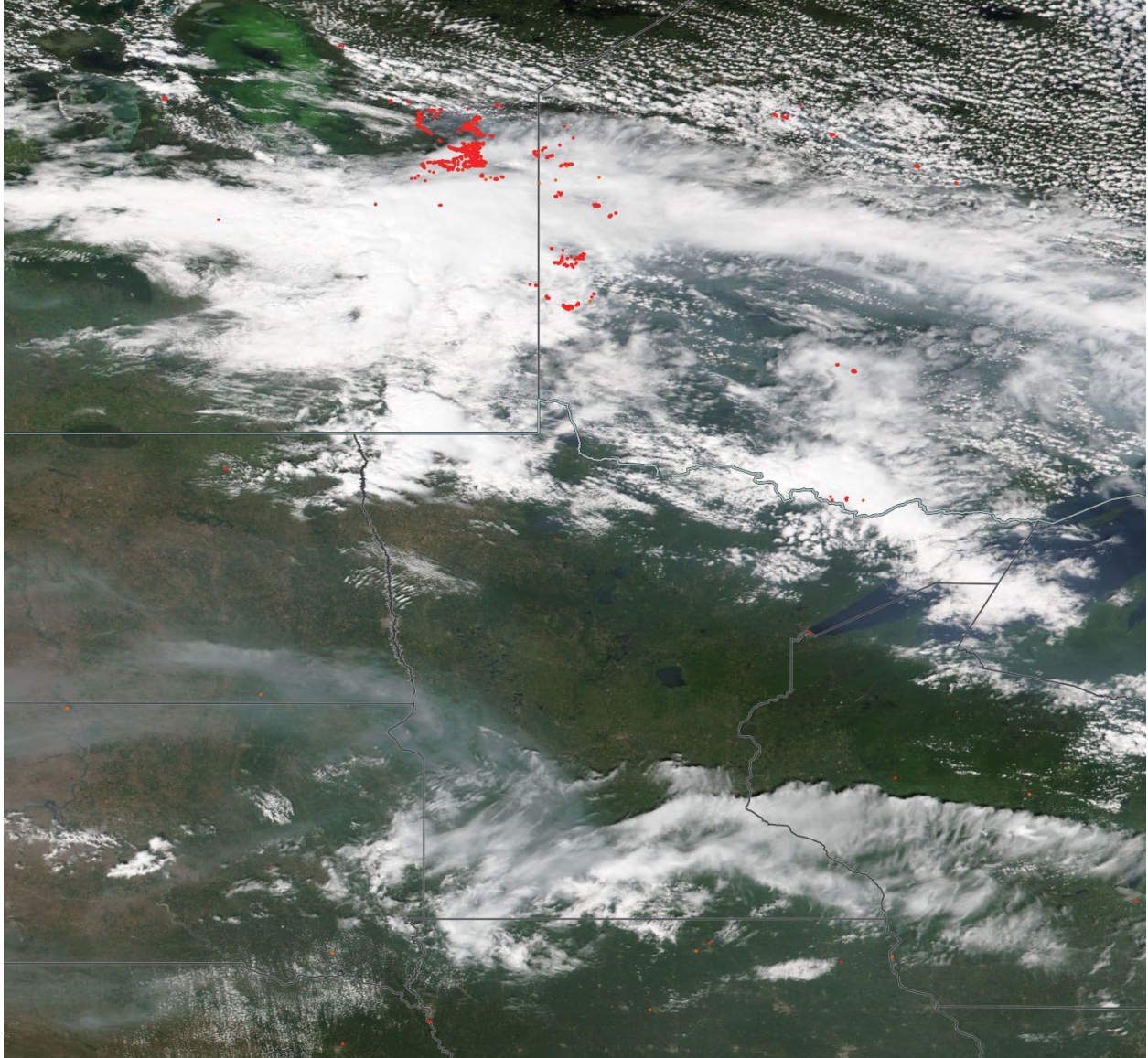
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
MPLS - Lowrie Ave	270530909	7/26/2021	44	Wildfire smoke
MPLS - Pacific St	270530910	7/26/2021	51	Wildfire smoke
MPLS - Bottineau	270531909	7/26/2021	36	Wildfire smoke



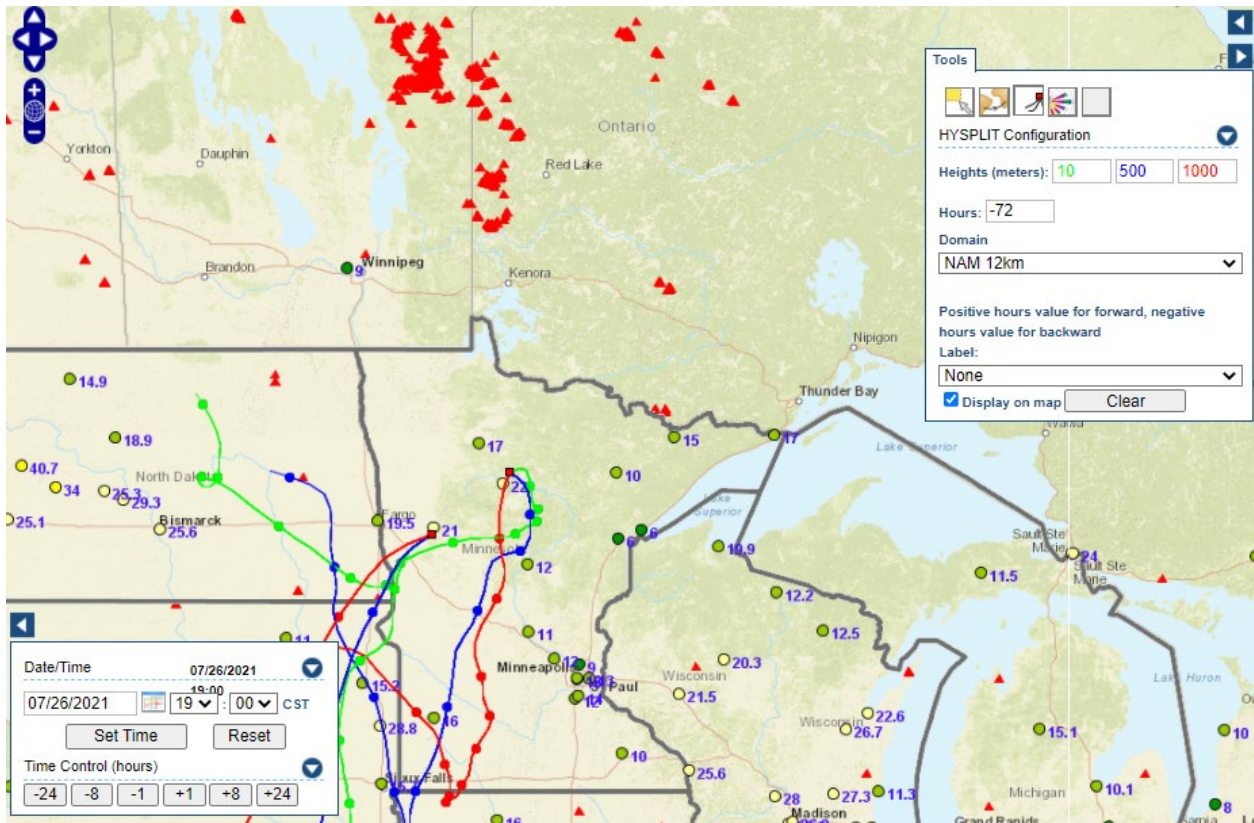
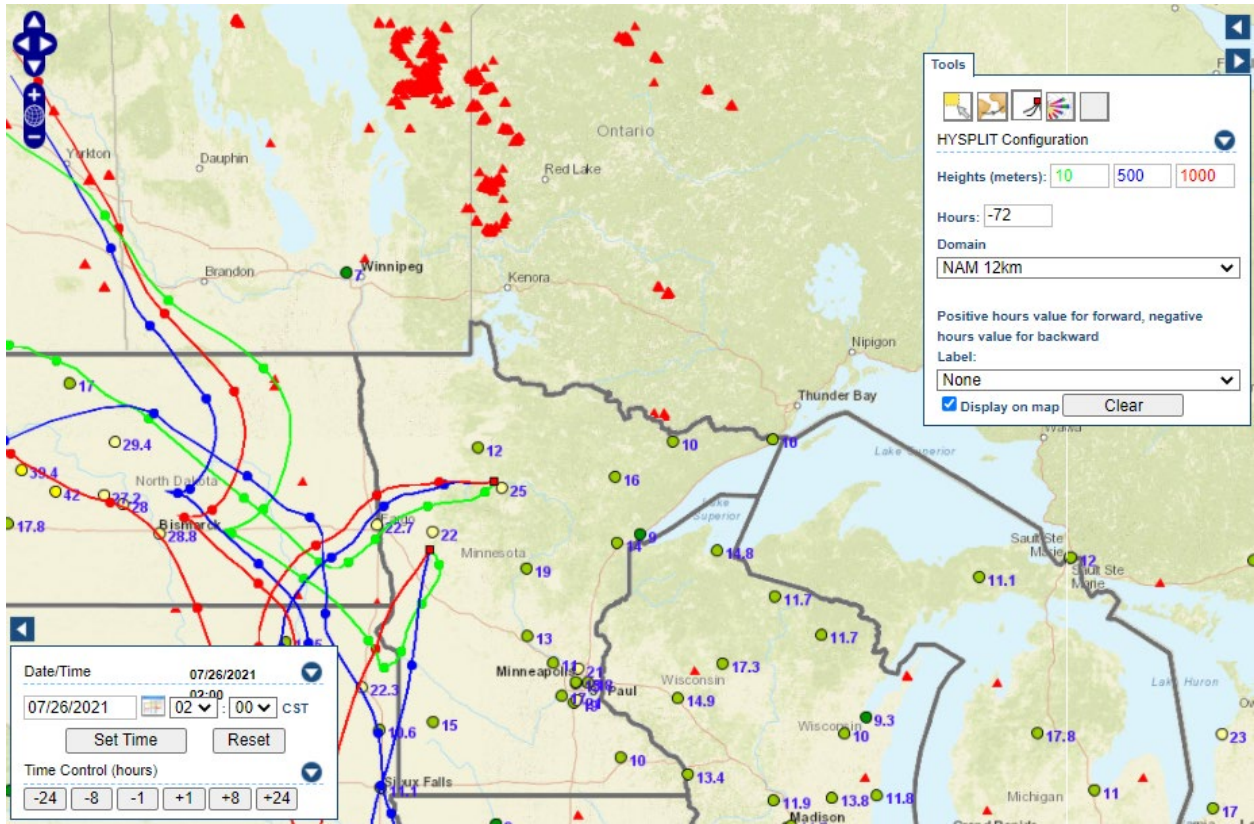
Analyzed smoke, hotspots, and 24-hour PM₁₀ on July 26, 2021



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on July 26, 2021.



MODIS visible satellite for July 26, 2021.



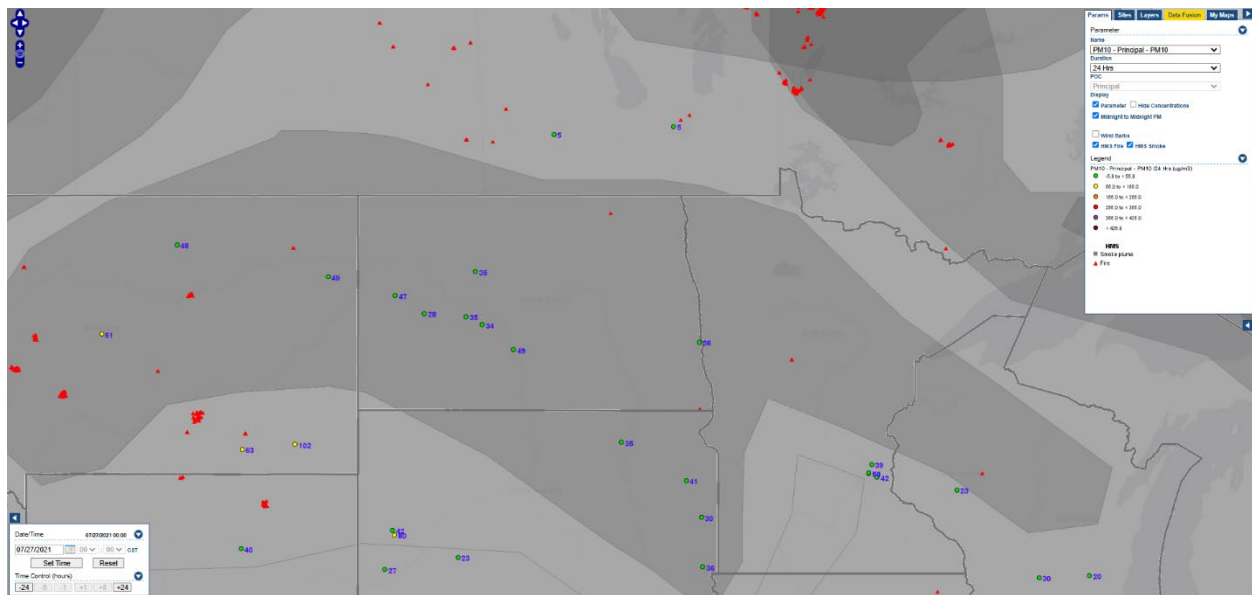
Backward trajectories for July 26, 2021.

7/27/2021 Impacts

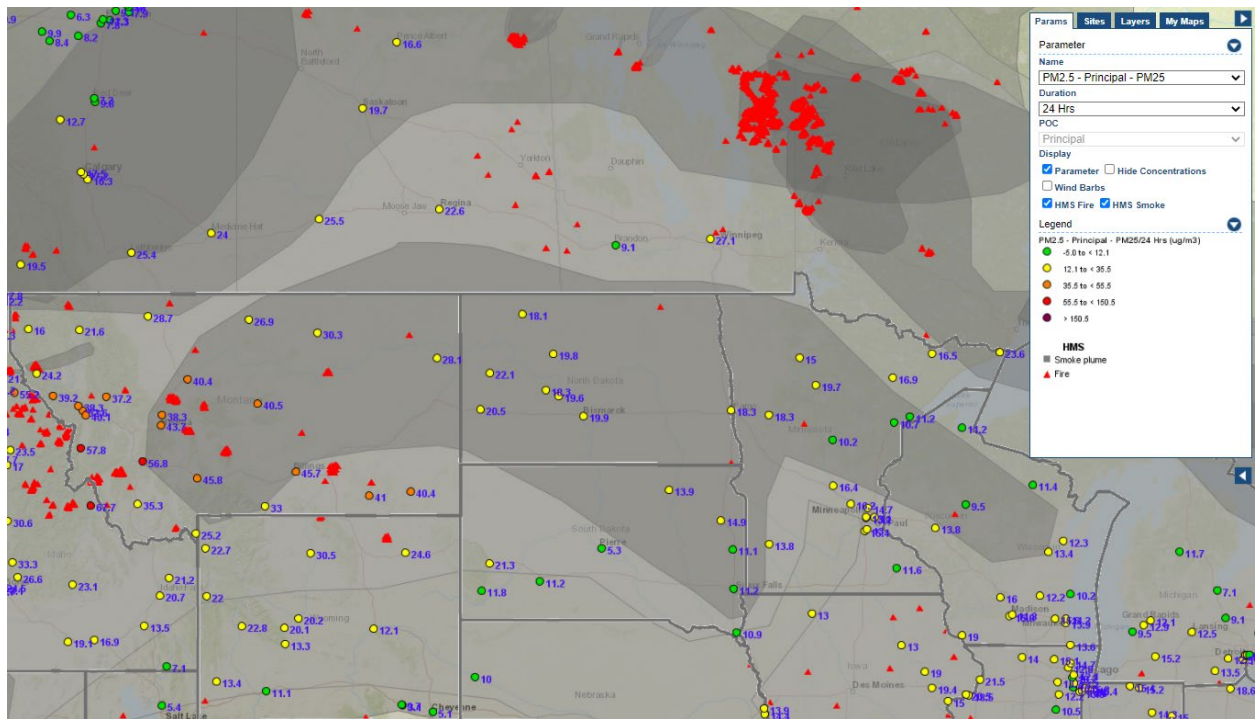
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on July 27, 2021.

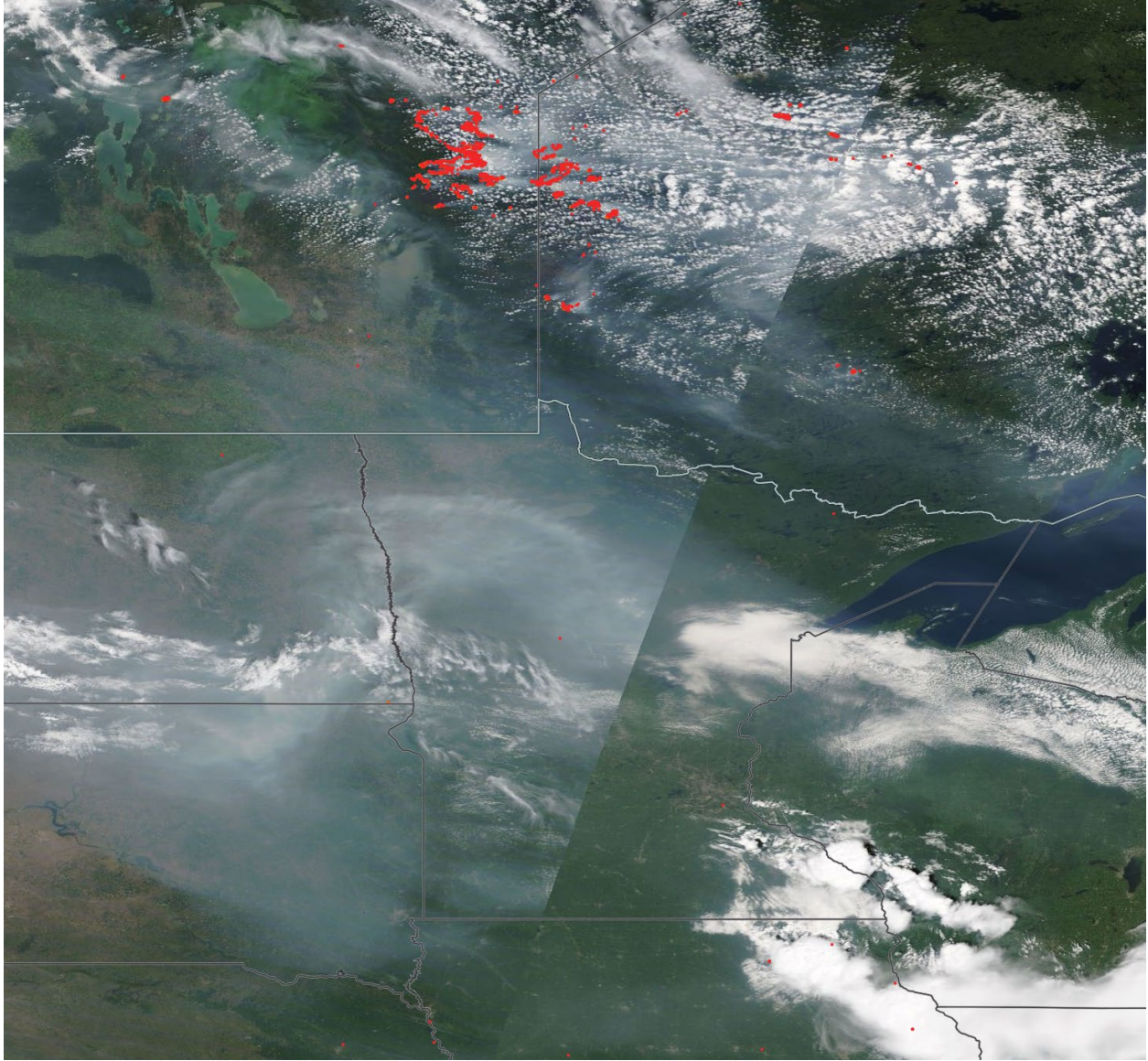
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
MPLS - City of Lakes	270530966	7/27/2021	40	Wildfire smoke
Ramsey Health Center	271230868	7/27/2021	42	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/27/2021	50	Wildfire smoke
MPLS - Pacific St	270530910	7/27/2021	54	Wildfire smoke



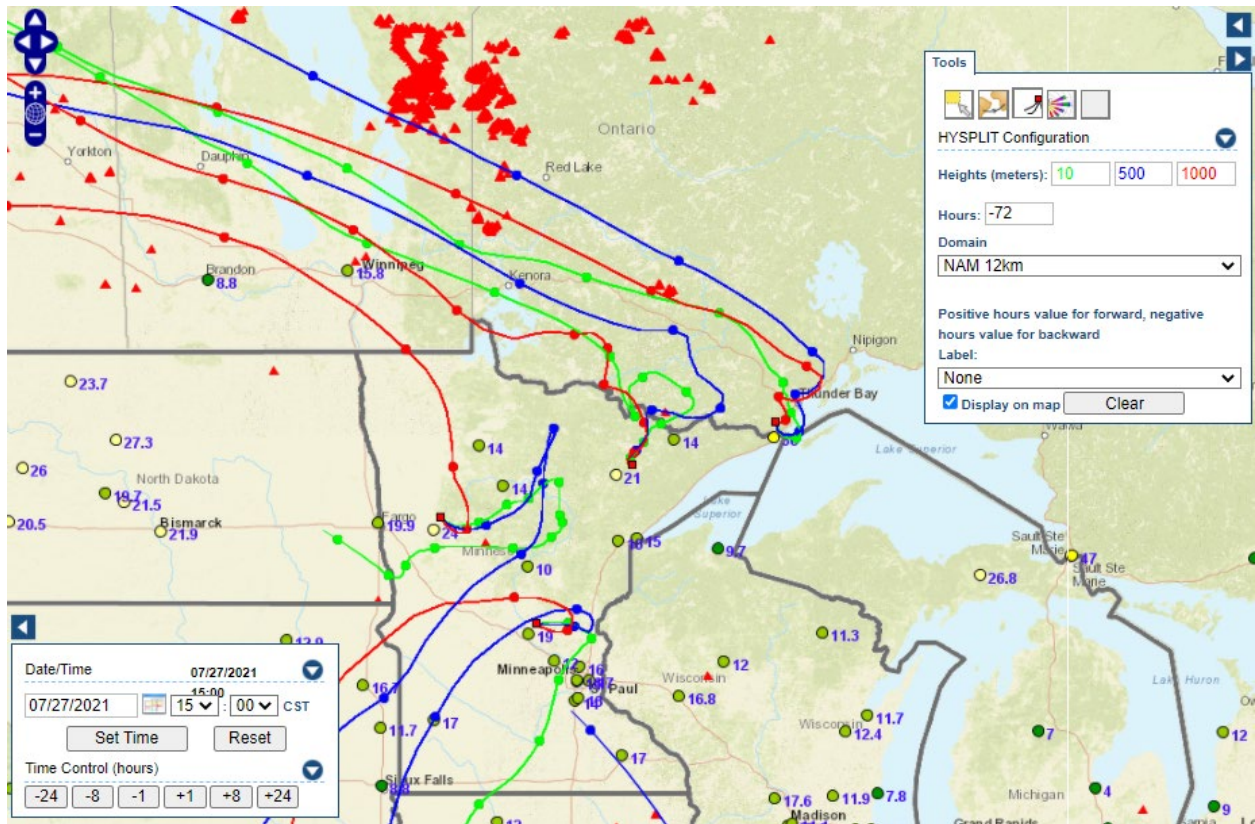
Analyzed smoke, hotspots, and 24-hour PM₁₀ on July 27, 2021



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on July 27, 2021.



MODIS visible satellite for July 27, 2021.



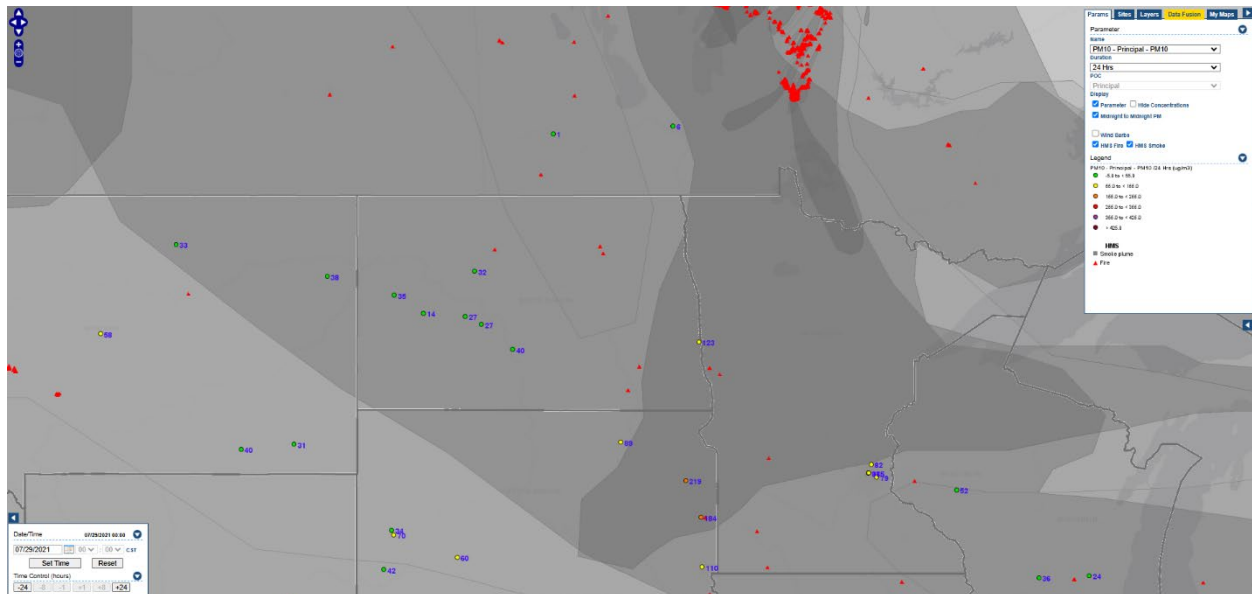
Backward trajectories for July 27, 2021.

7/29/2021 Impacts

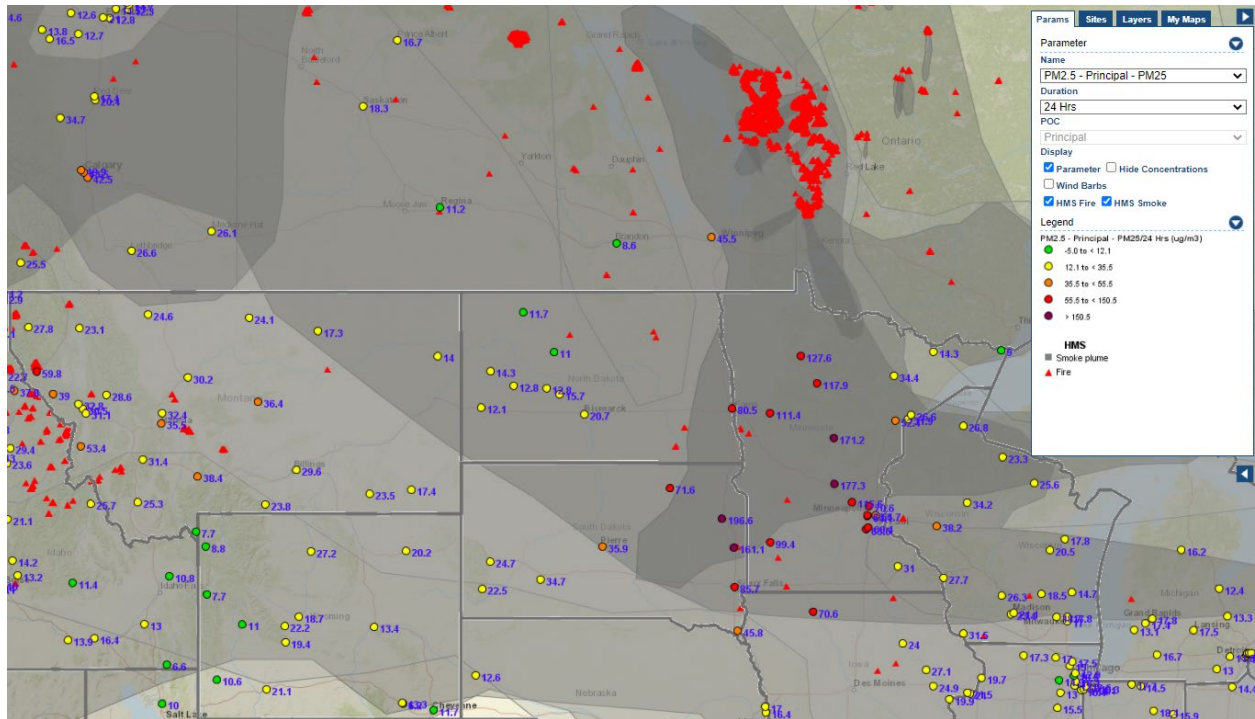
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on July 29, 2021.

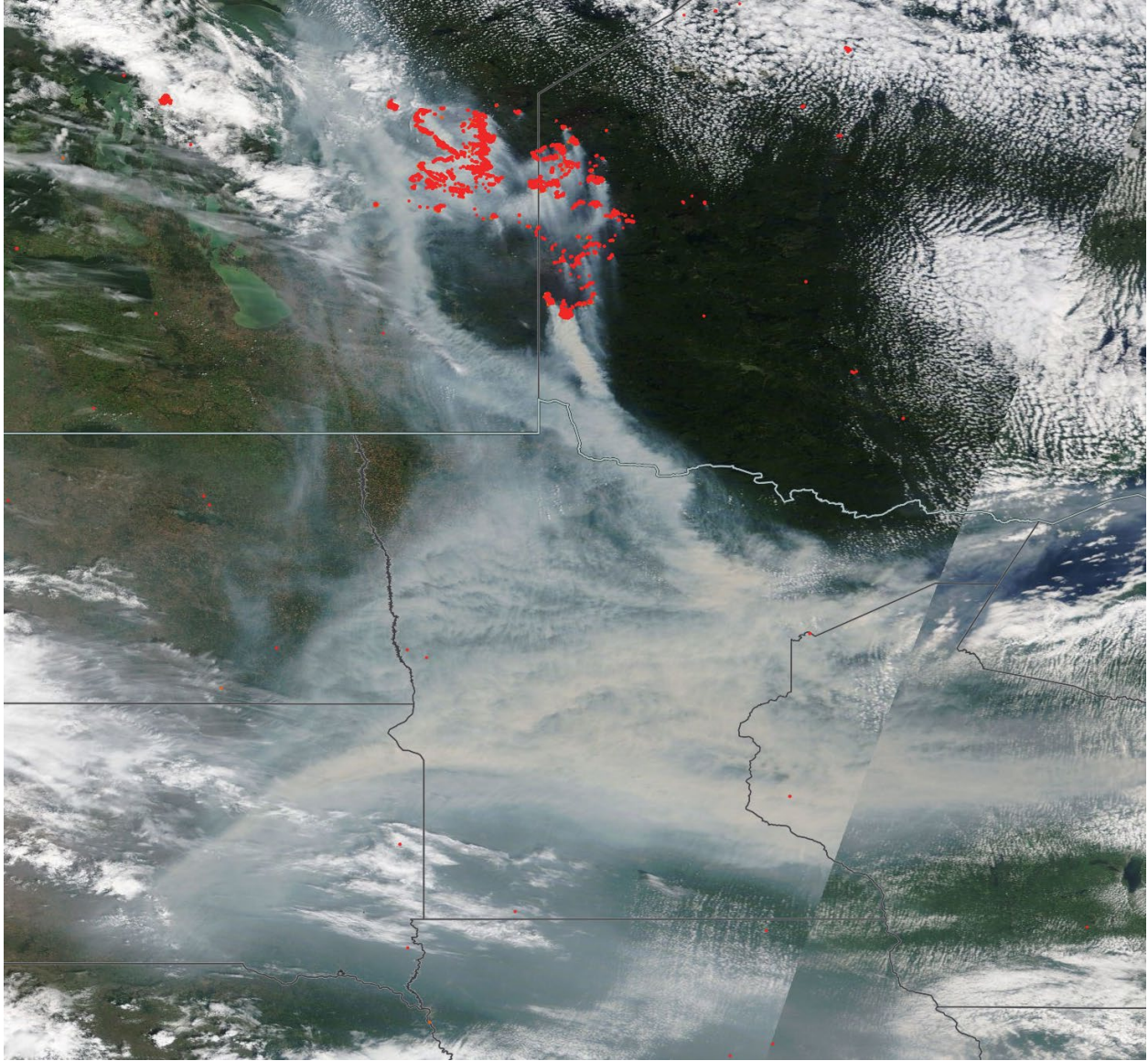
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Blaine	270031002	7/29/2021	82	Wildfire smoke
Ramsey Health Center	271230868	7/29/2021	79	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/29/2021	96	Wildfire smoke
MPLS - Pacific St	270530910	7/29/2021	115	Wildfire smoke
MPLS - Bottineau	270531909	7/29/2021	87	Wildfire smoke



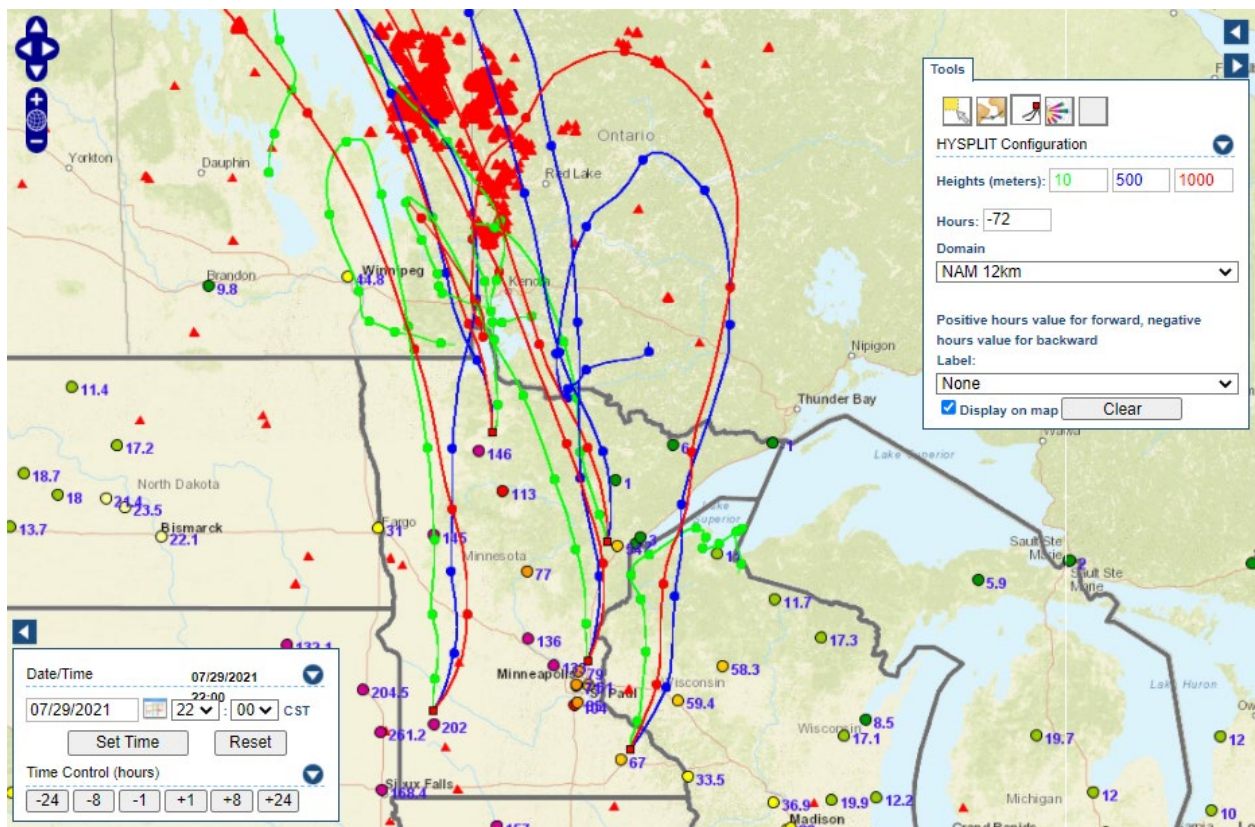
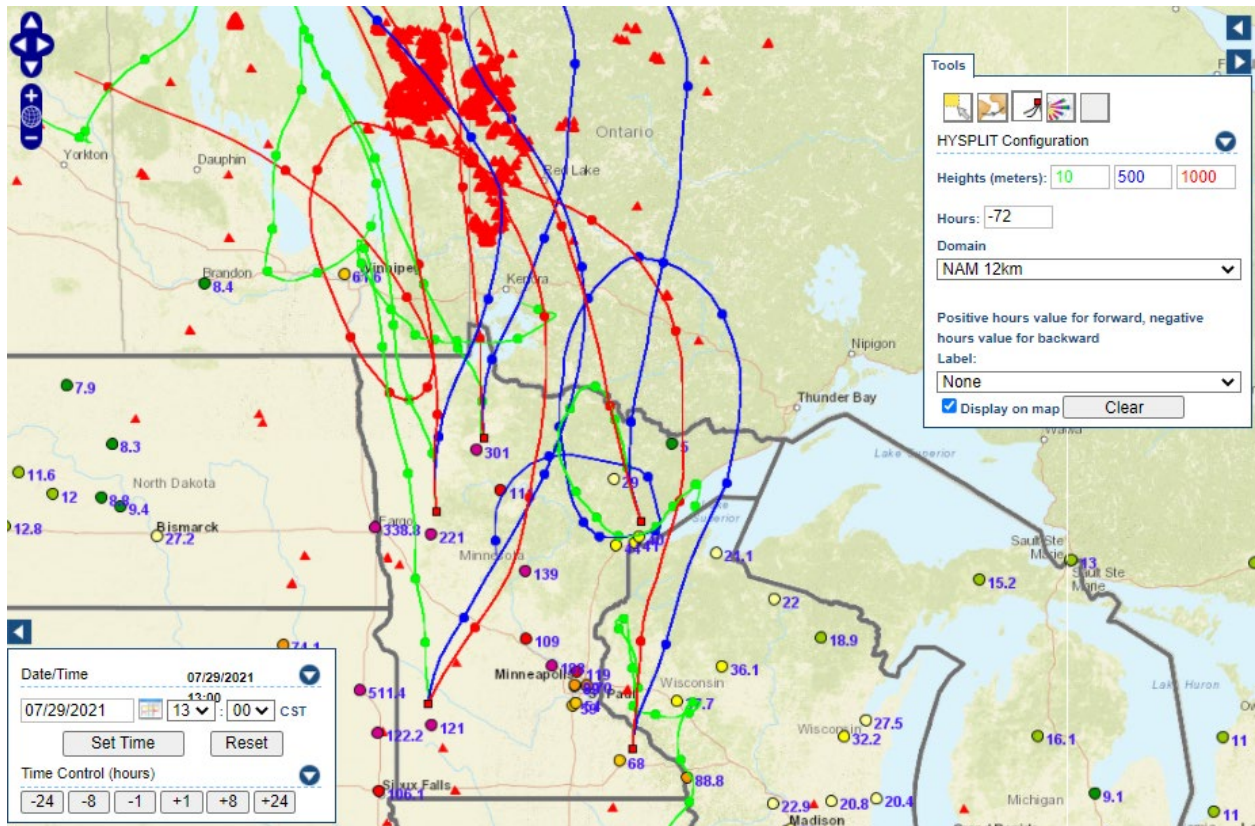
Analyzed smoke, hotspots, and 24-hour PM₁₀ on July 29, 2021



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on July 29, 2021.



MODIS visible satellite for July 29, 2021.



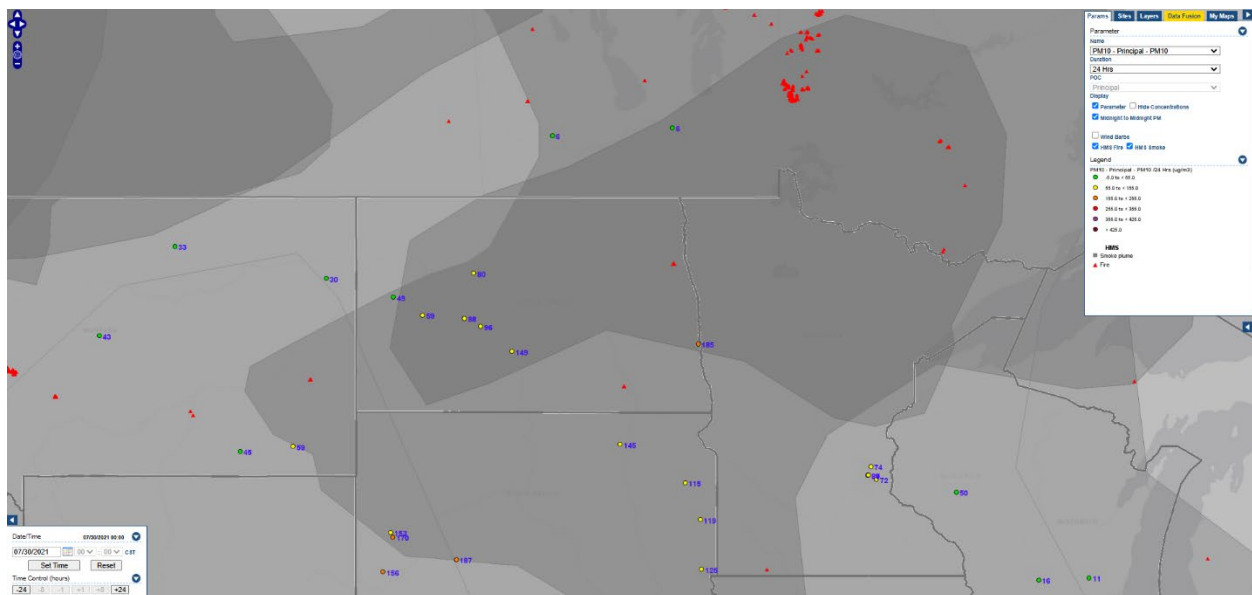
Backward trajectories for July 29, 2021.

7/30/2021 Impacts

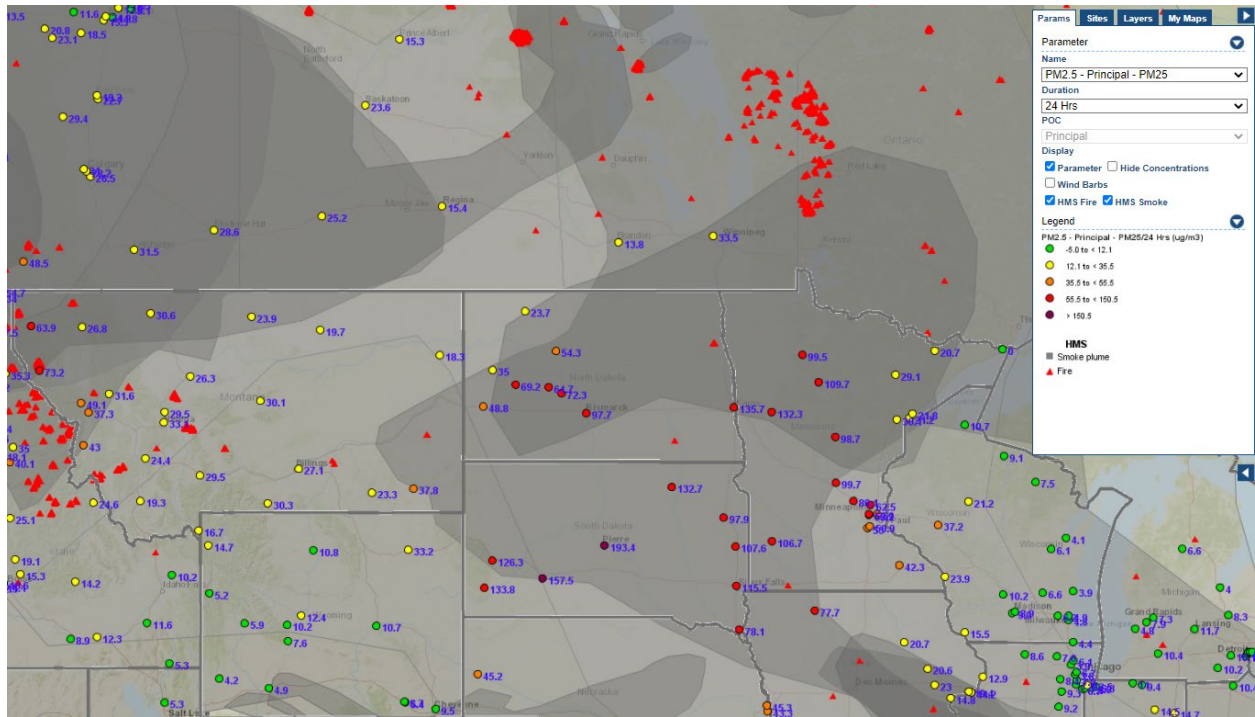
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on July 30, 2021.

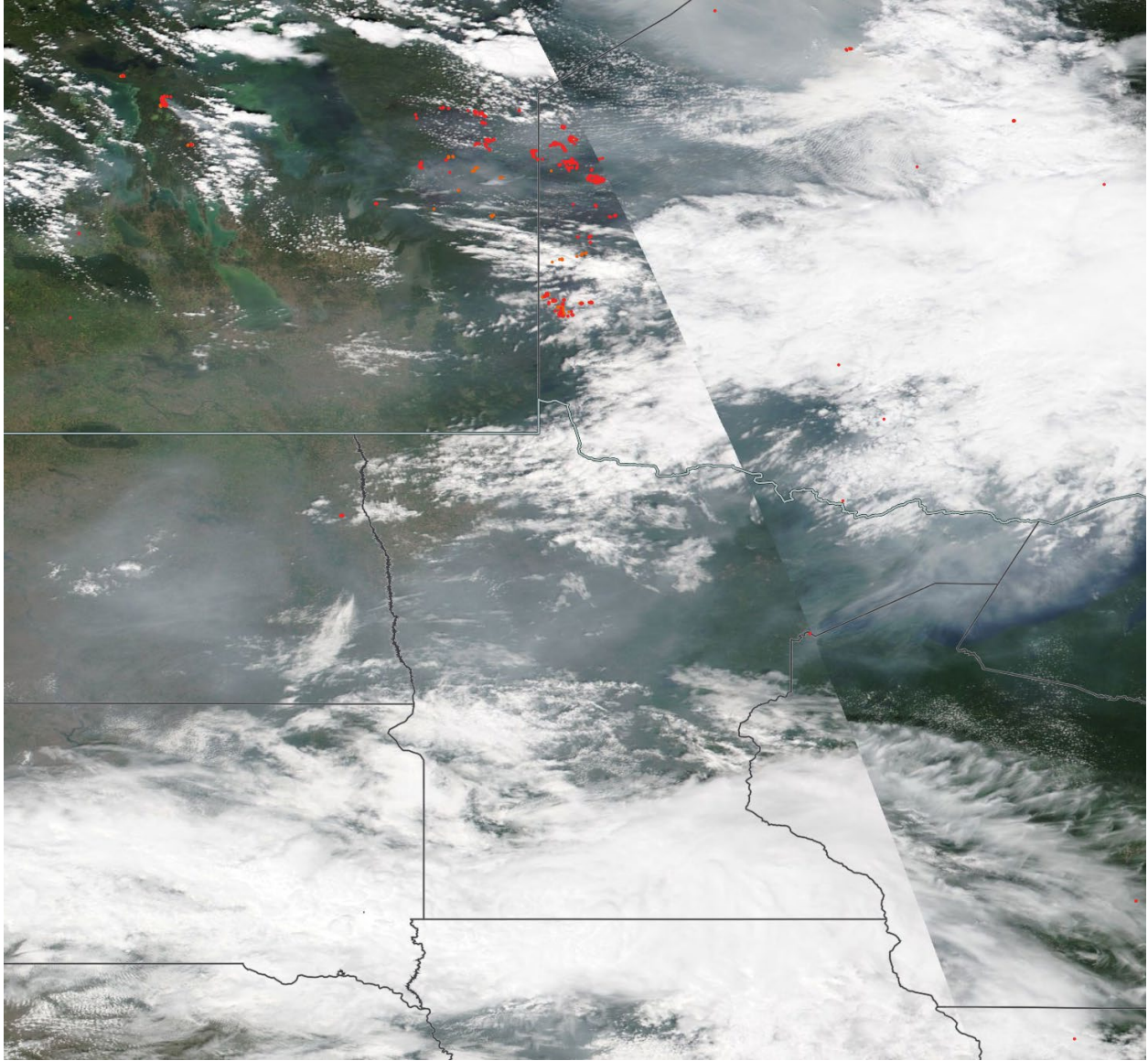
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Blaine	270031002	7/30/2021	74	Wildfire smoke
Ramsey Health Center	271230868	7/30/2021	72	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/30/2021	87	Wildfire smoke
MPLS - Pacific St	270530910	7/30/2021	89	Wildfire smoke



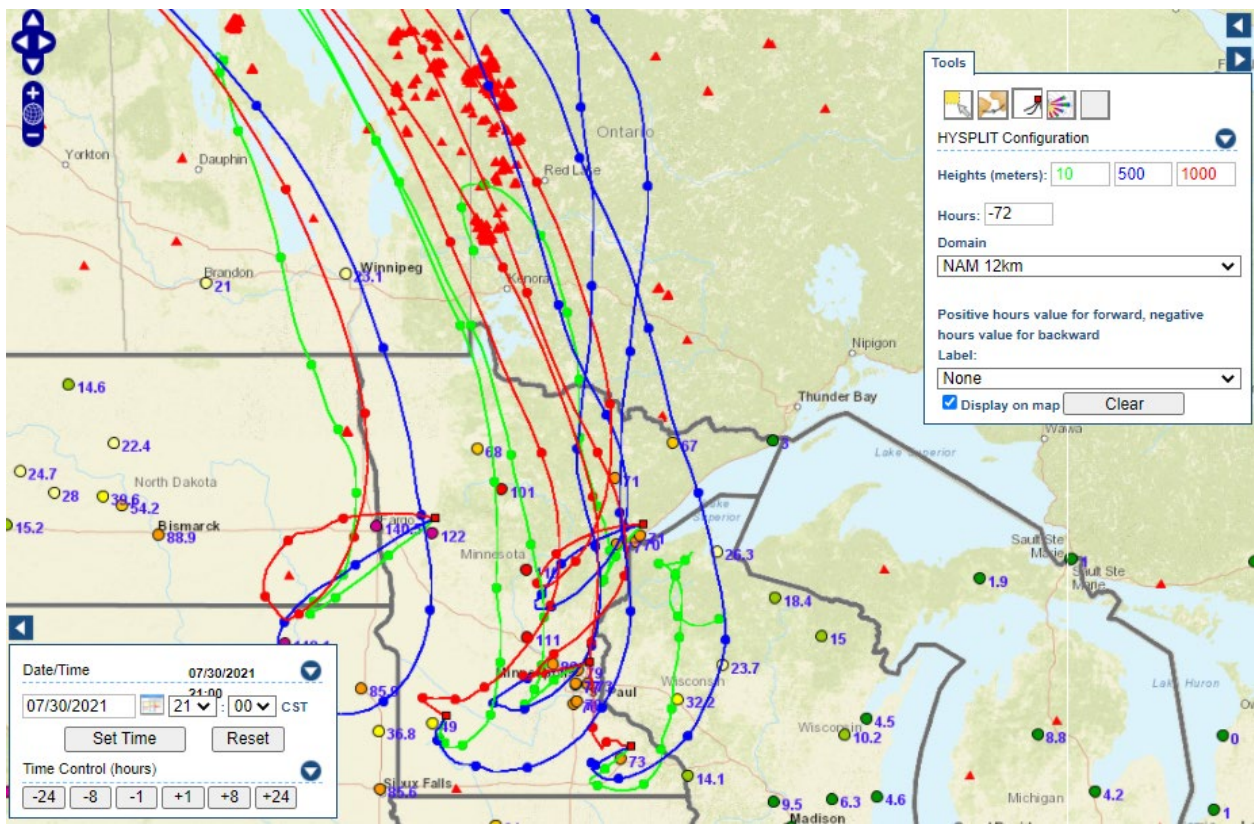
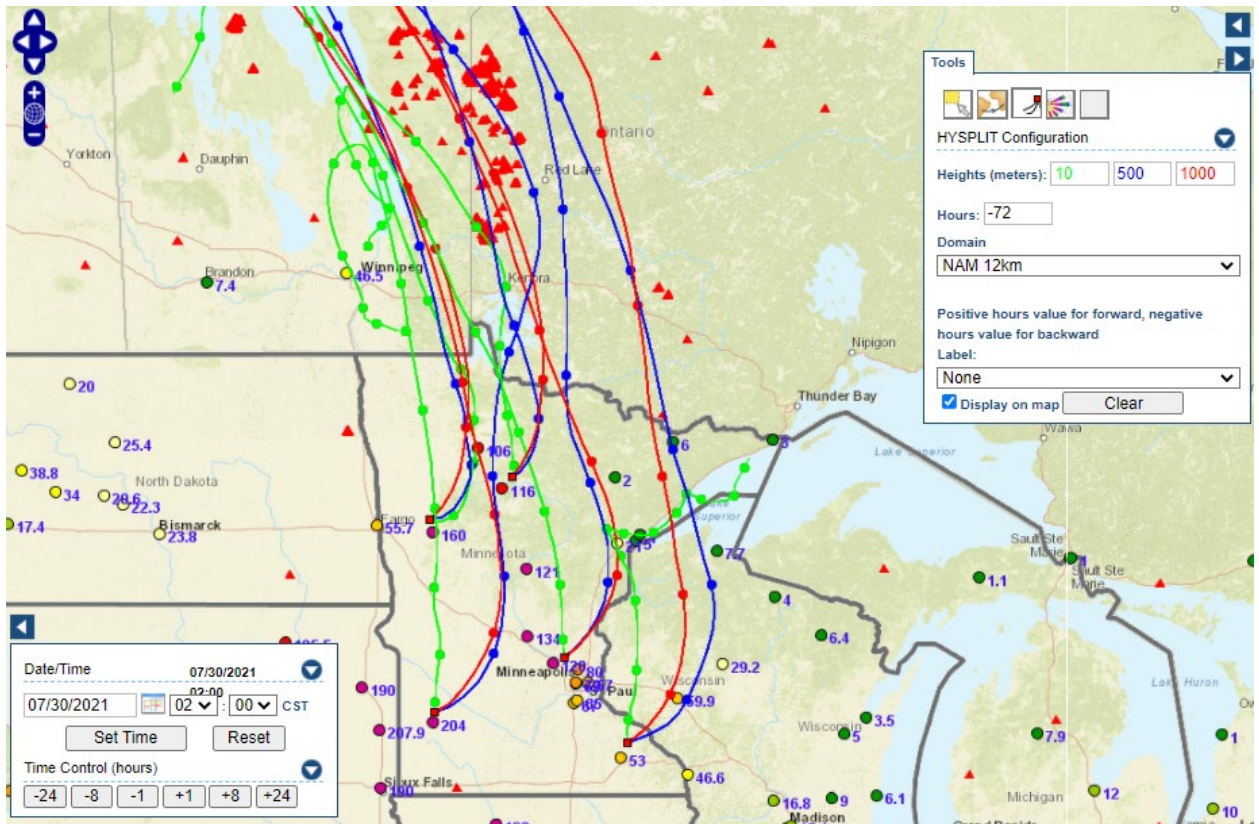
Analyzed smoke, hotspots, and 24-hour PM₁₀ on July 30, 2021



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on July 30, 2021.



MODIS visible satellite for July 30, 2021.



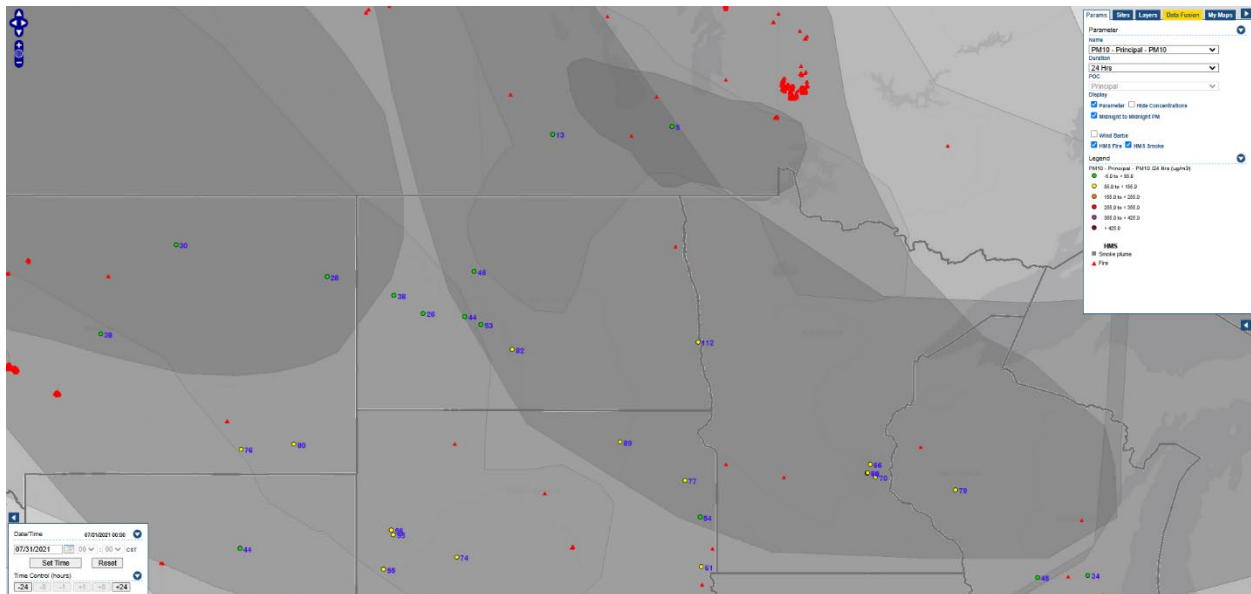
Backward trajectories for July 30, 2021.

7/31/2021 Impacts

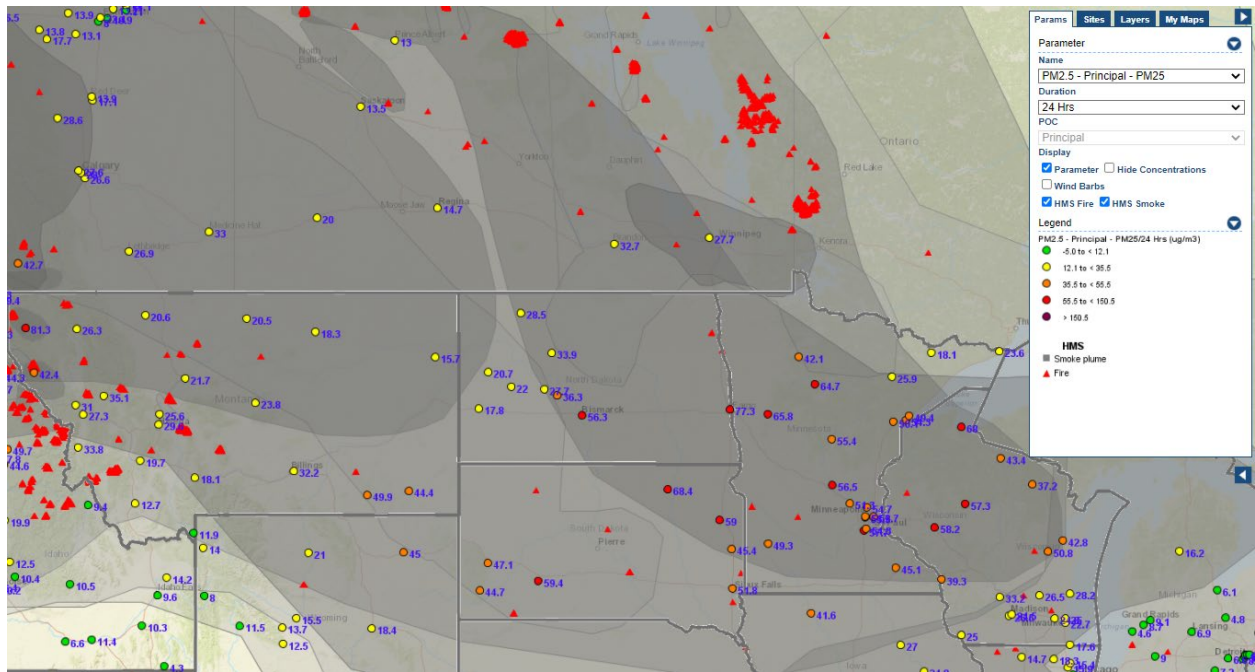
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on July 31, 2021.

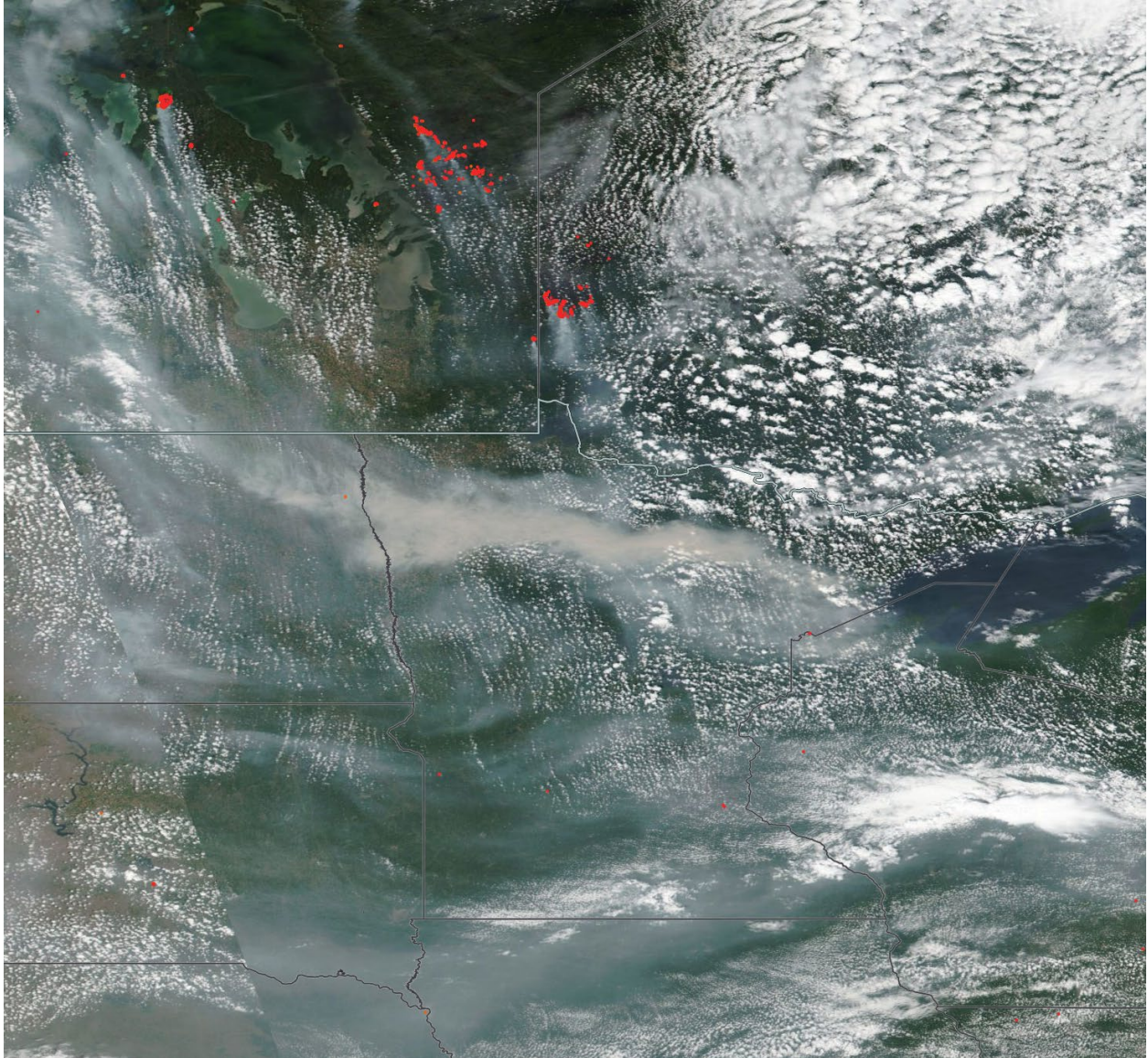
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Blaine	270031002	7/31/2021	66	Wildfire smoke
Ramsey Health Center	271230868	7/31/2021	70	Wildfire smoke
MPLS - Bottineau	270531909	7/31/2021	84	Wildfire smoke
MPLS - Lowrie Ave	270530909	7/31/2021	72	Wildfire smoke
MPLS - Pacific St	270530910	7/31/2021	80	Wildfire smoke
MPLS - Bottineau	270531909	7/31/2021	69	Wildfire smoke



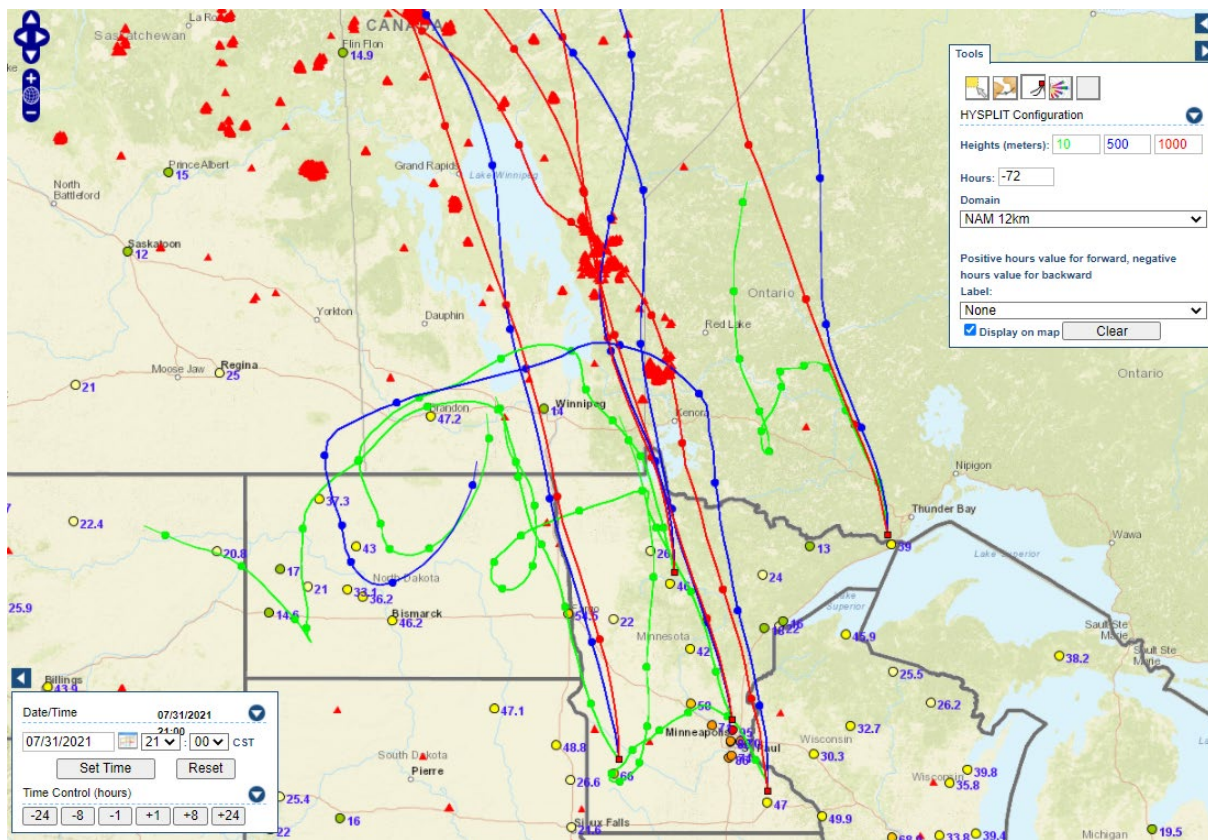
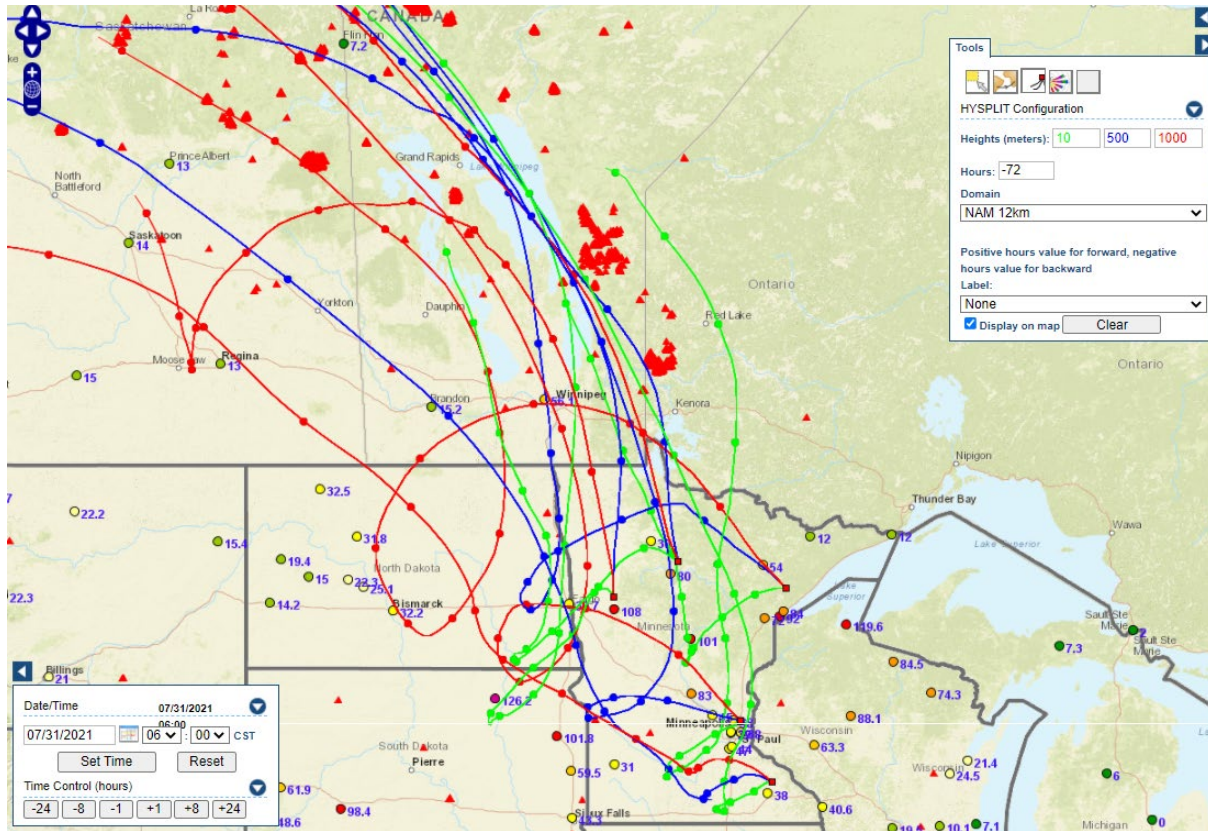
Analyzed smoke, hotspots, and 24-hour PM₁₀ on July 31, 2021



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on July 31, 2021.



MODIS visible satellite for July 31, 2021.



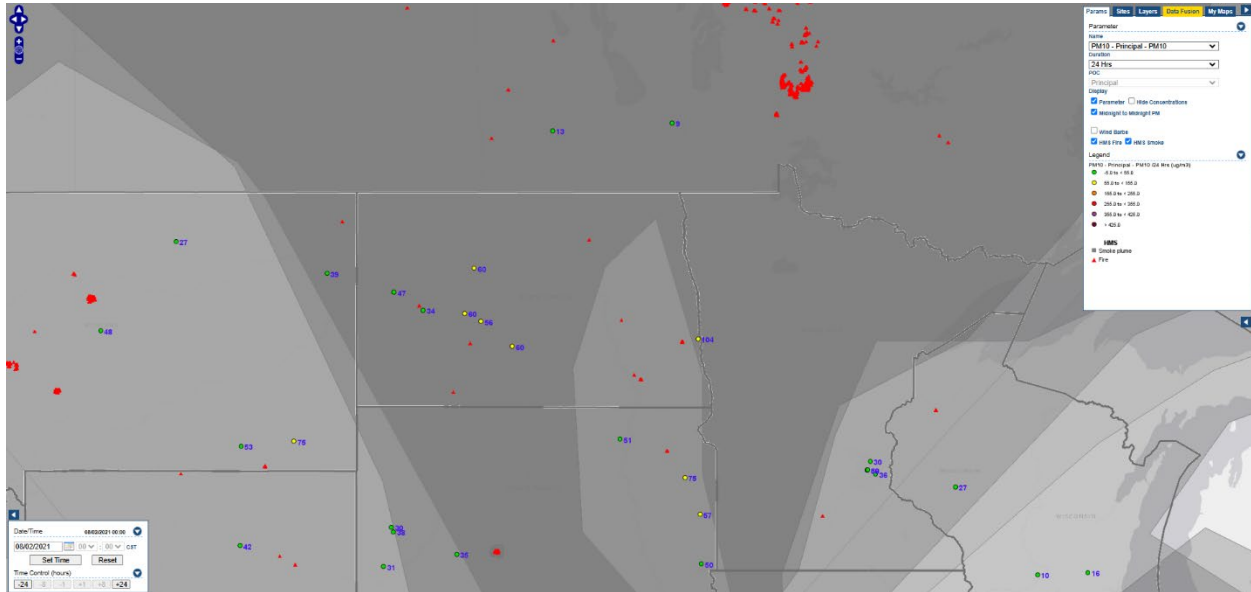
Backward trajectories for July 31, 2021.

8/2/2021 Impacts

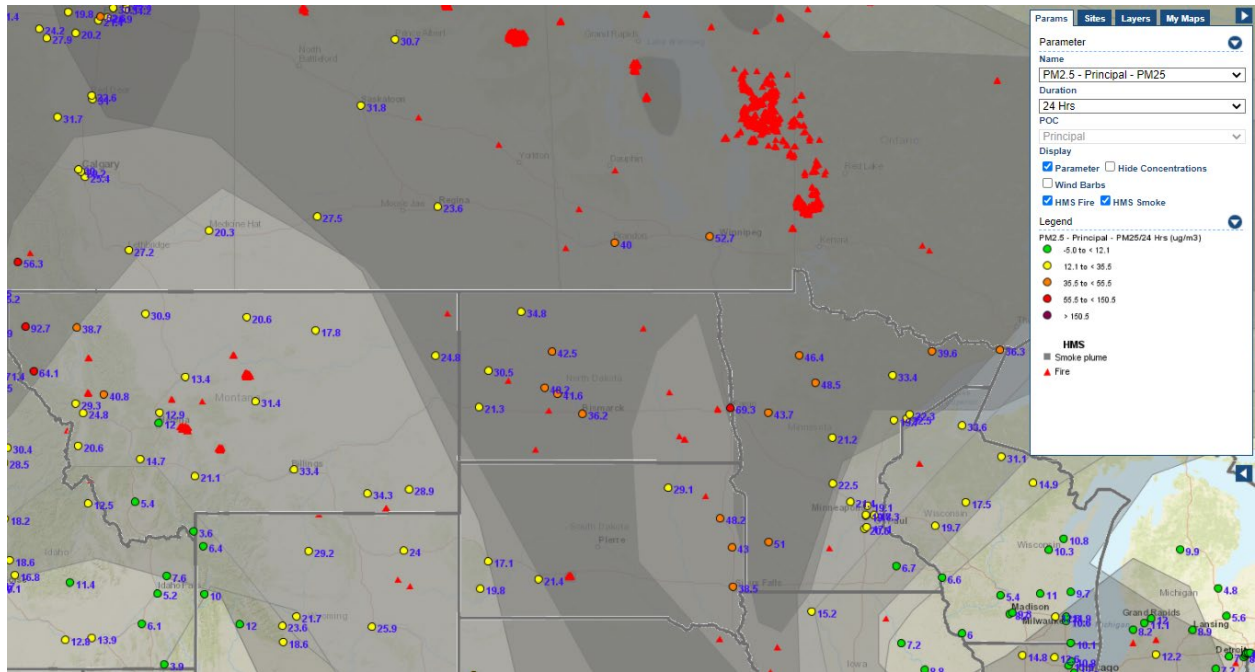
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on August 2, 2021.

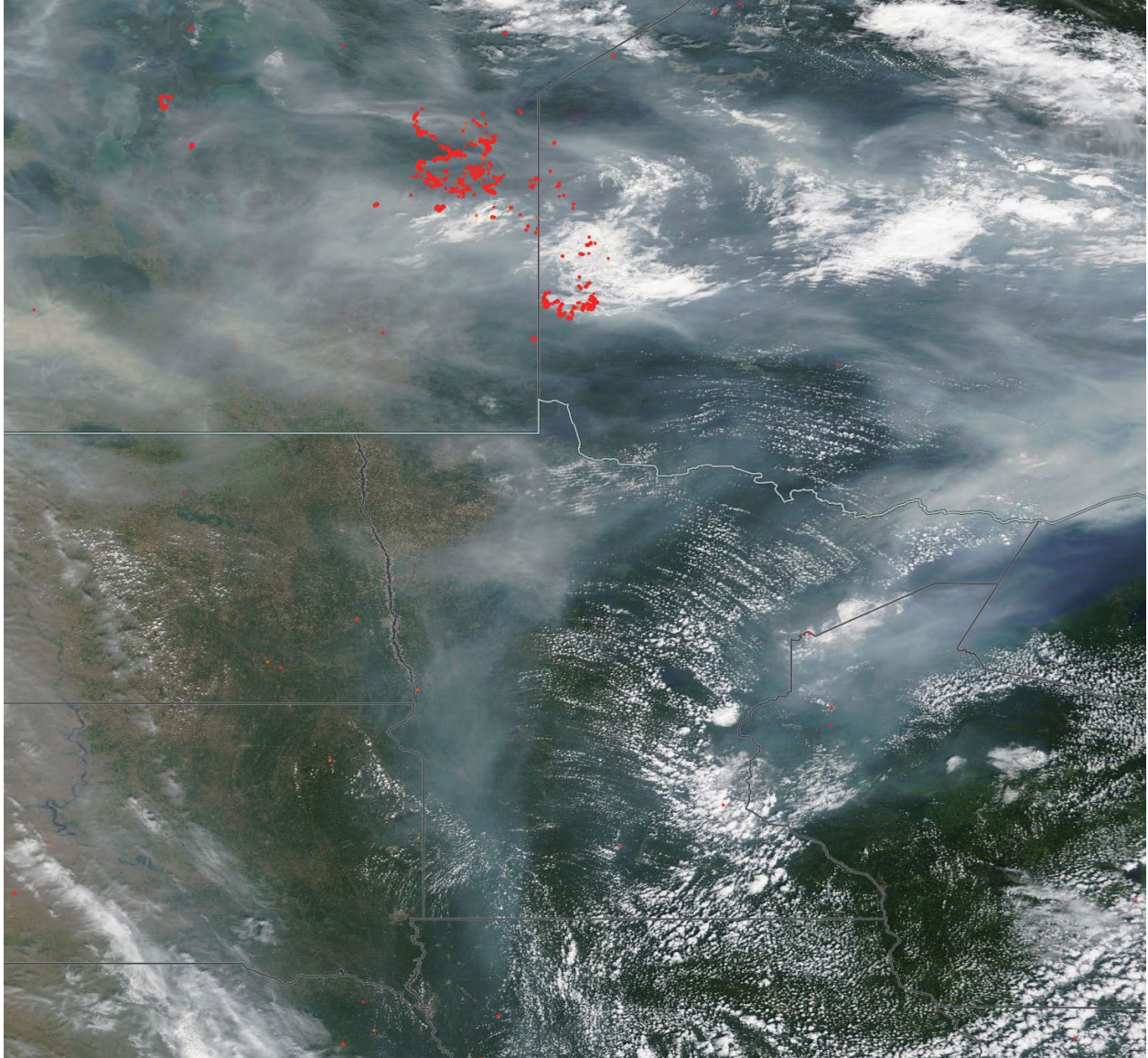
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Virginia	271327001	8/2/2021	42	Wildfire smoke



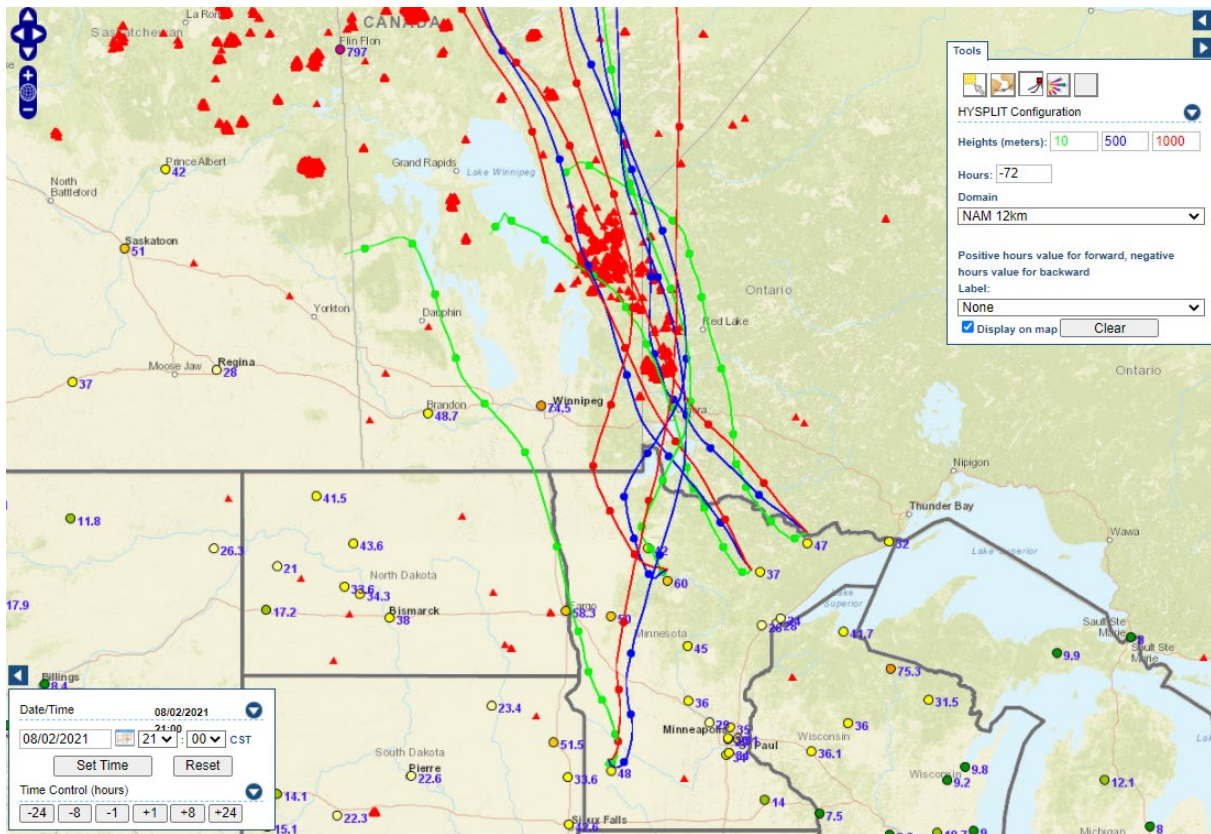
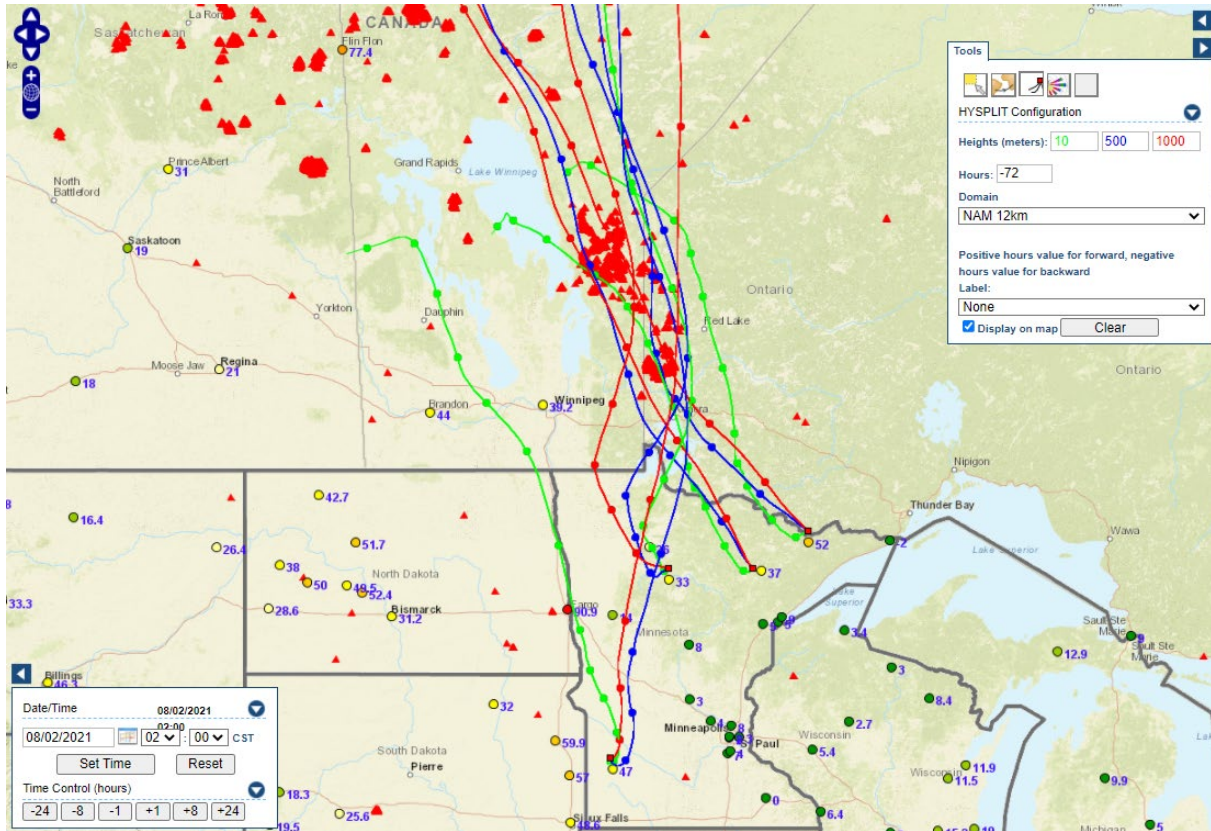
Analyzed smoke, hotspots, and 24-hour PM₁₀ on August 2, 2021



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on August 2, 2021.



MODIS visible satellite for August 2, 2021.



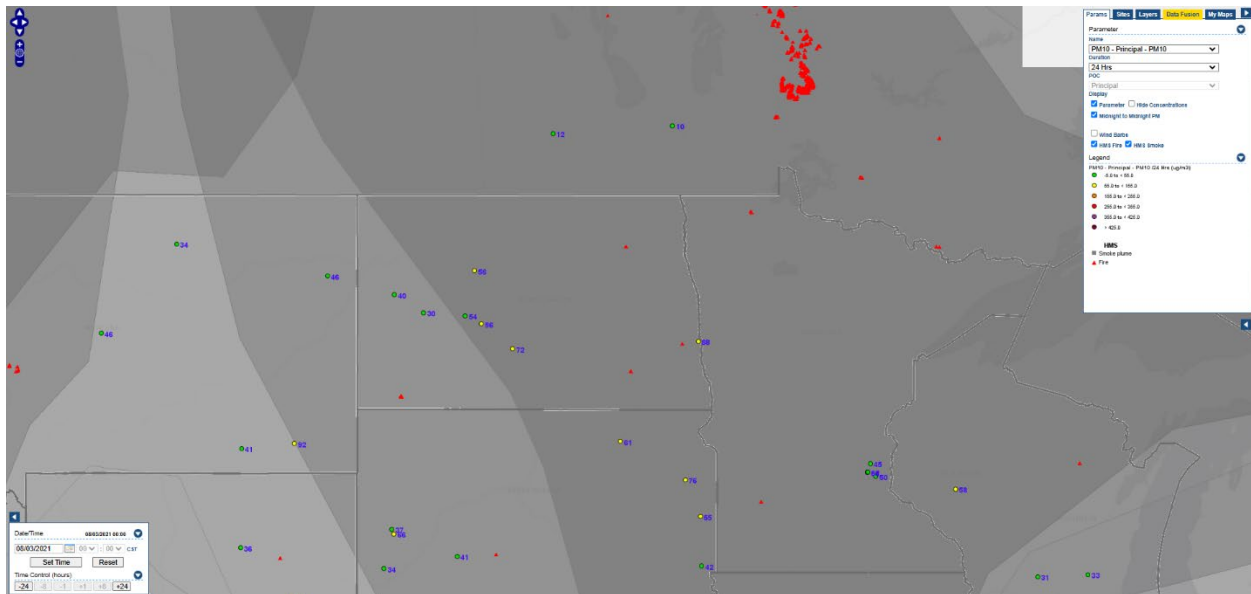
Backward trajectories for August 2, 2021.

8/3/2021 Impacts

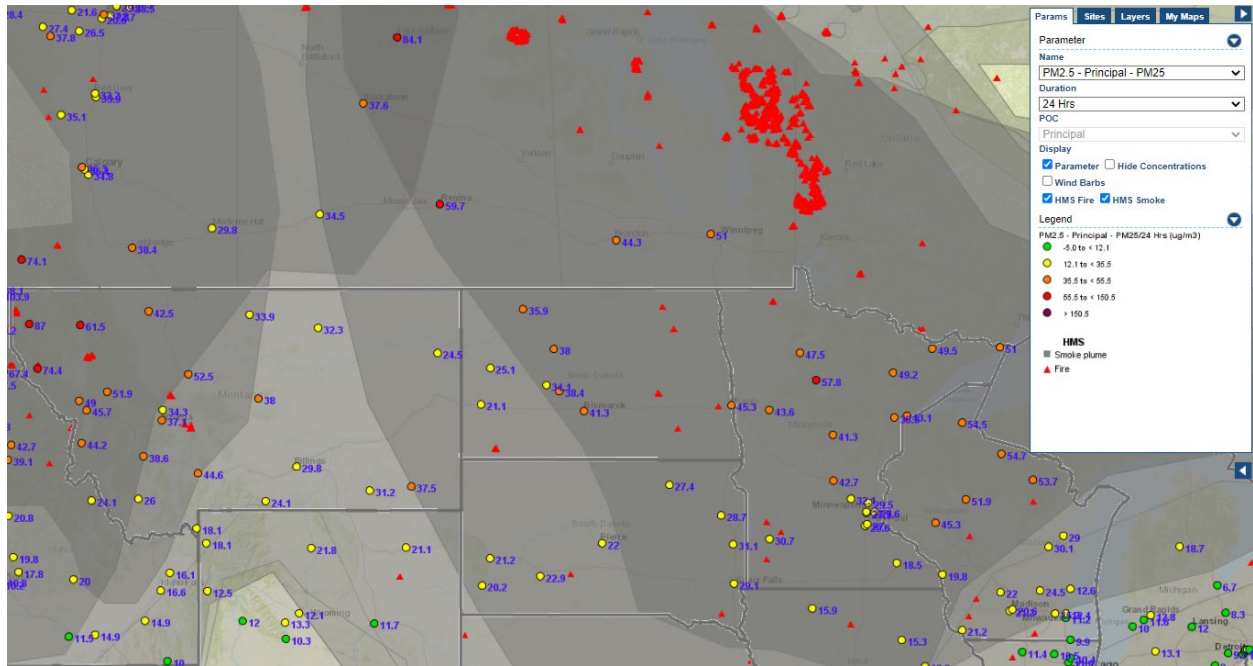
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on August 3, 2021.

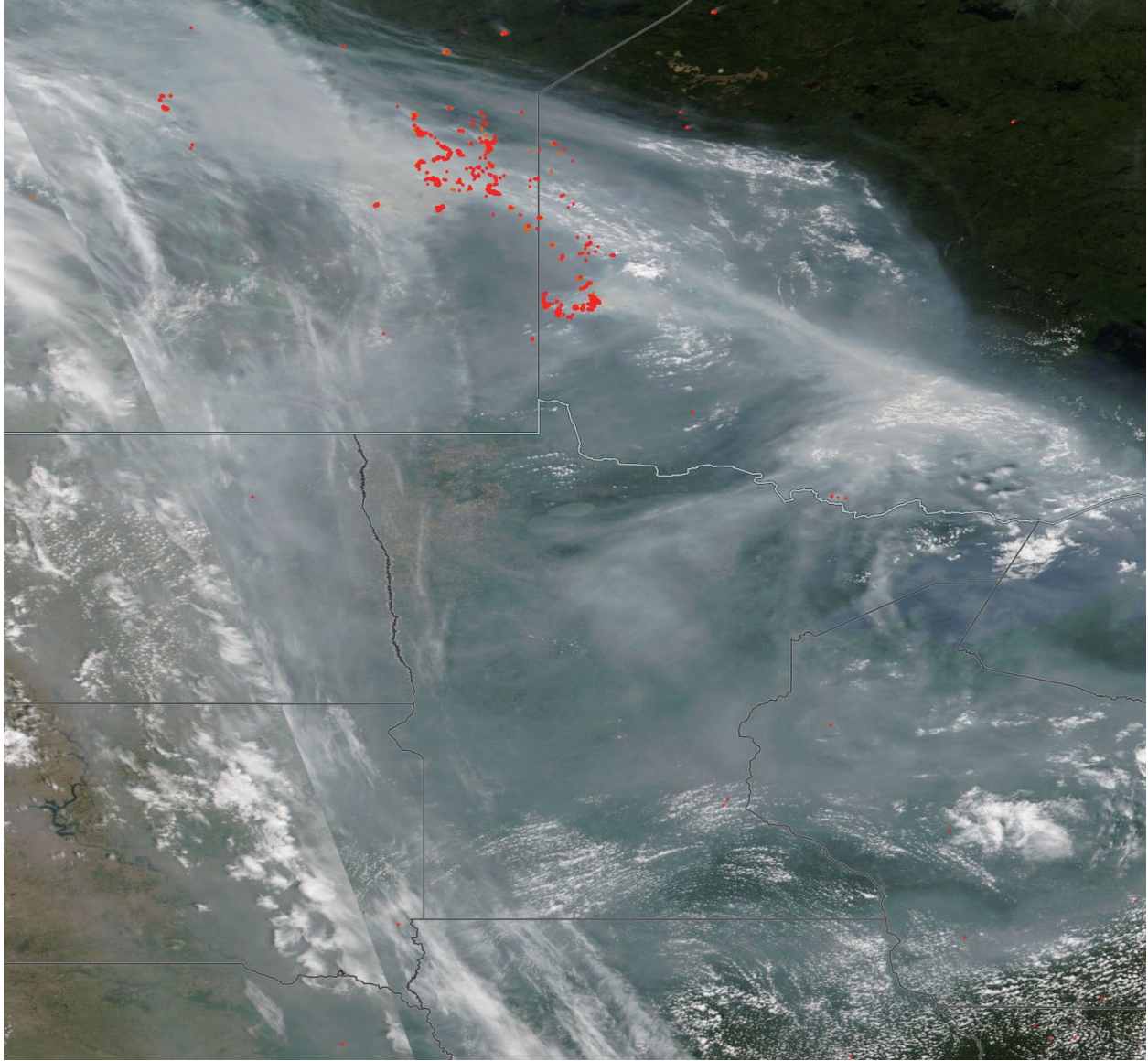
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Blaine	270031002	8/3/2021	45	Wildfire smoke
Ramsey Health Center	271230868	8/3/2021	50	Wildfire smoke
MPLS - Lowrie Ave	270530909	8/3/2021	55	Wildfire smoke
MPLS - Pacific St	270530910	8/3/2021	62	Wildfire smoke
MPLS - Bottineau	270531909	8/3/2021	51	Wildfire smoke



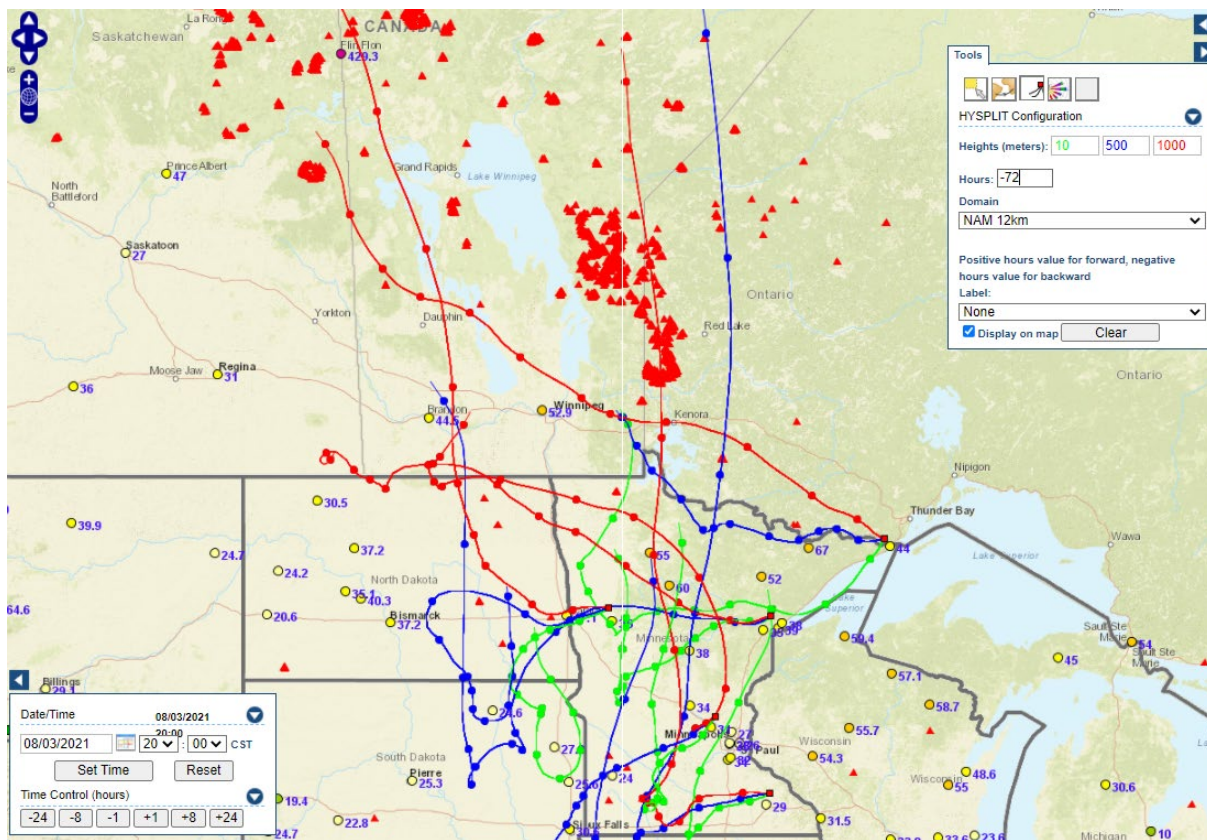
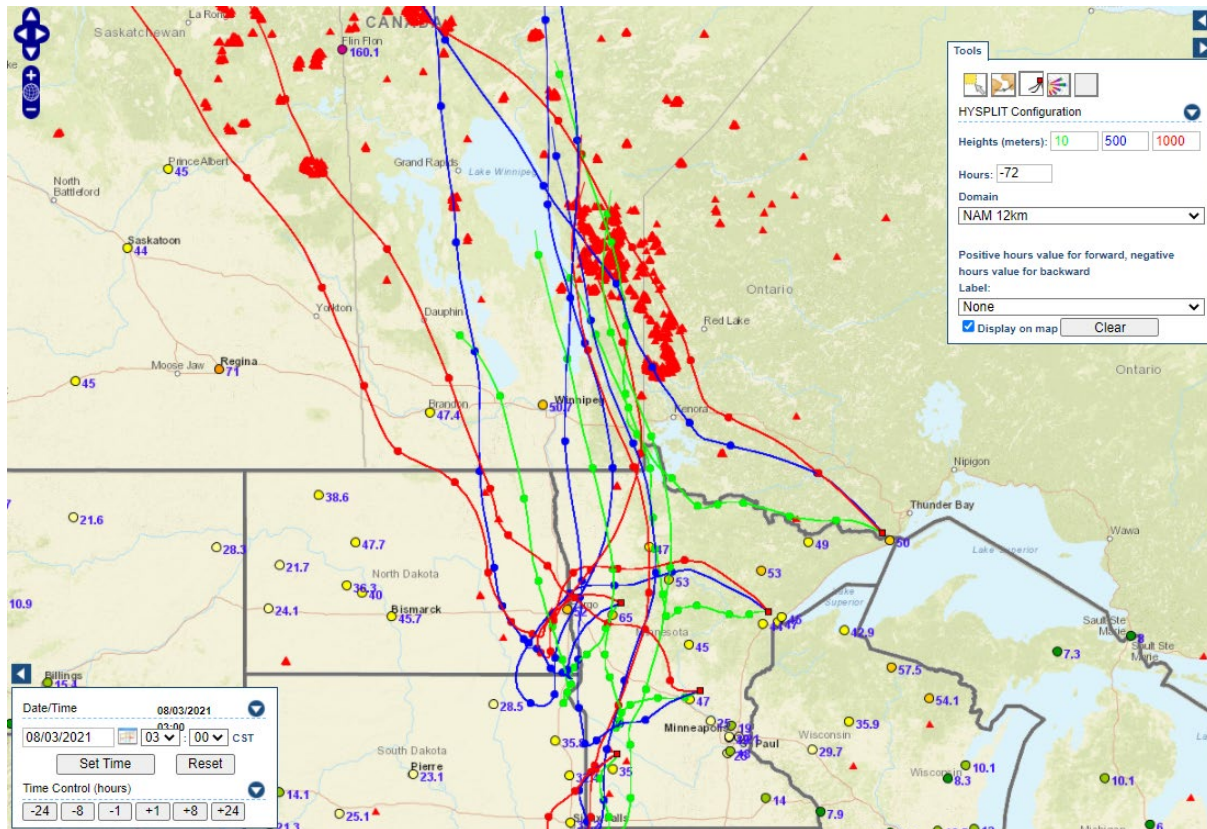
Analyzed smoke, hotspots, and 24-hour PM₁₀ on August 3, 2021



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on August 3, 2021.



MODIS visible satellite for August 3, 2021.



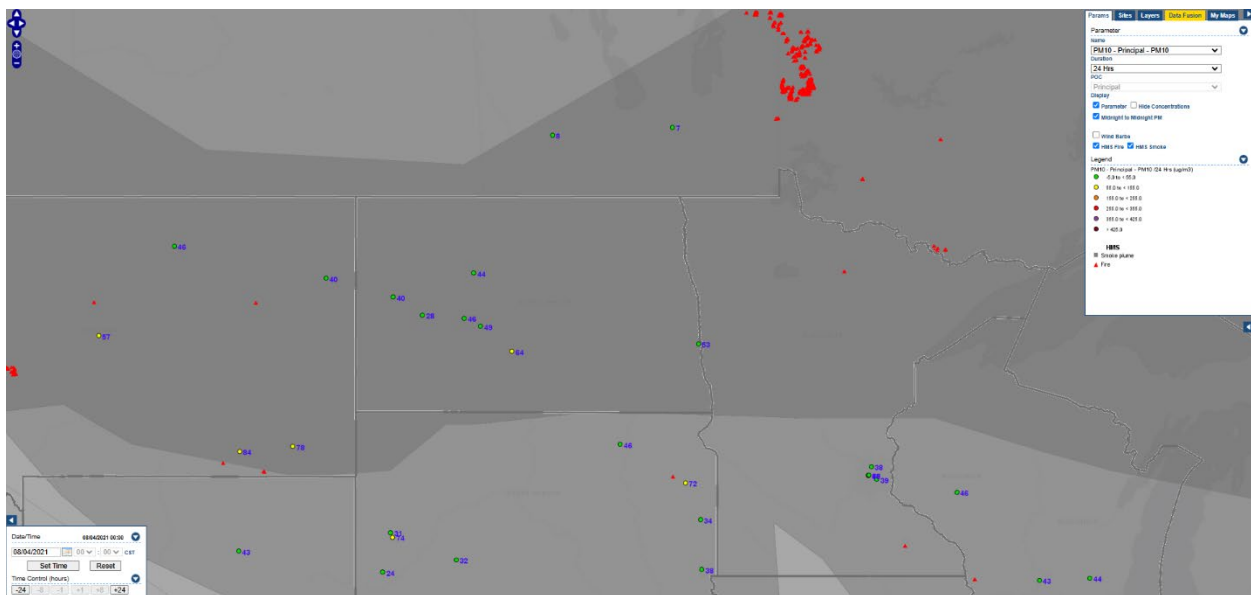
Backward trajectories for August 3, 2021.

8/4/2021 Impacts

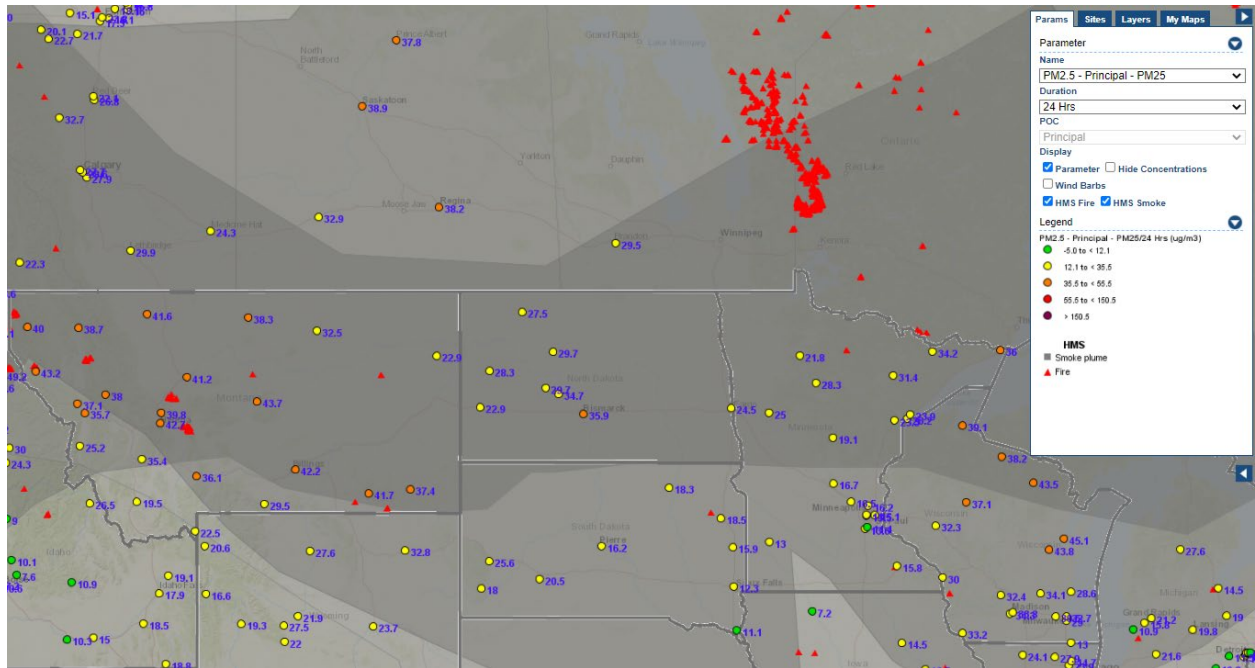
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on August 4, 2021.

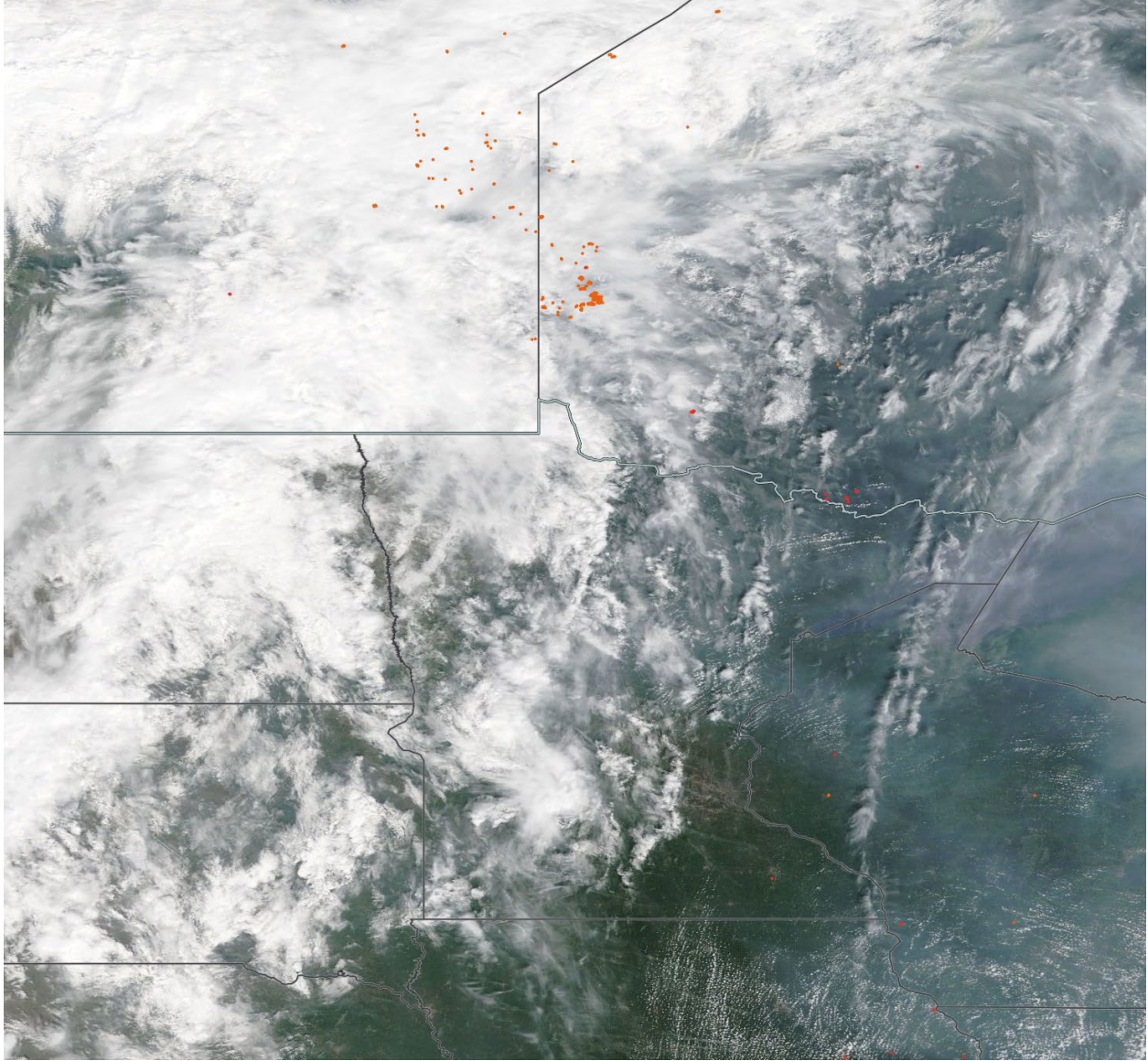
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Blaine	270031002	8/4/2021	38	Wildfire smoke
MPLS - Lowrie Ave	270530909	8/4/2021	50	Wildfire smoke
MPLS - Pacific St	270530910	8/4/2021	68	Wildfire smoke
MPLS - Bottineau	270531909	8/4/2021	45	Wildfire smoke



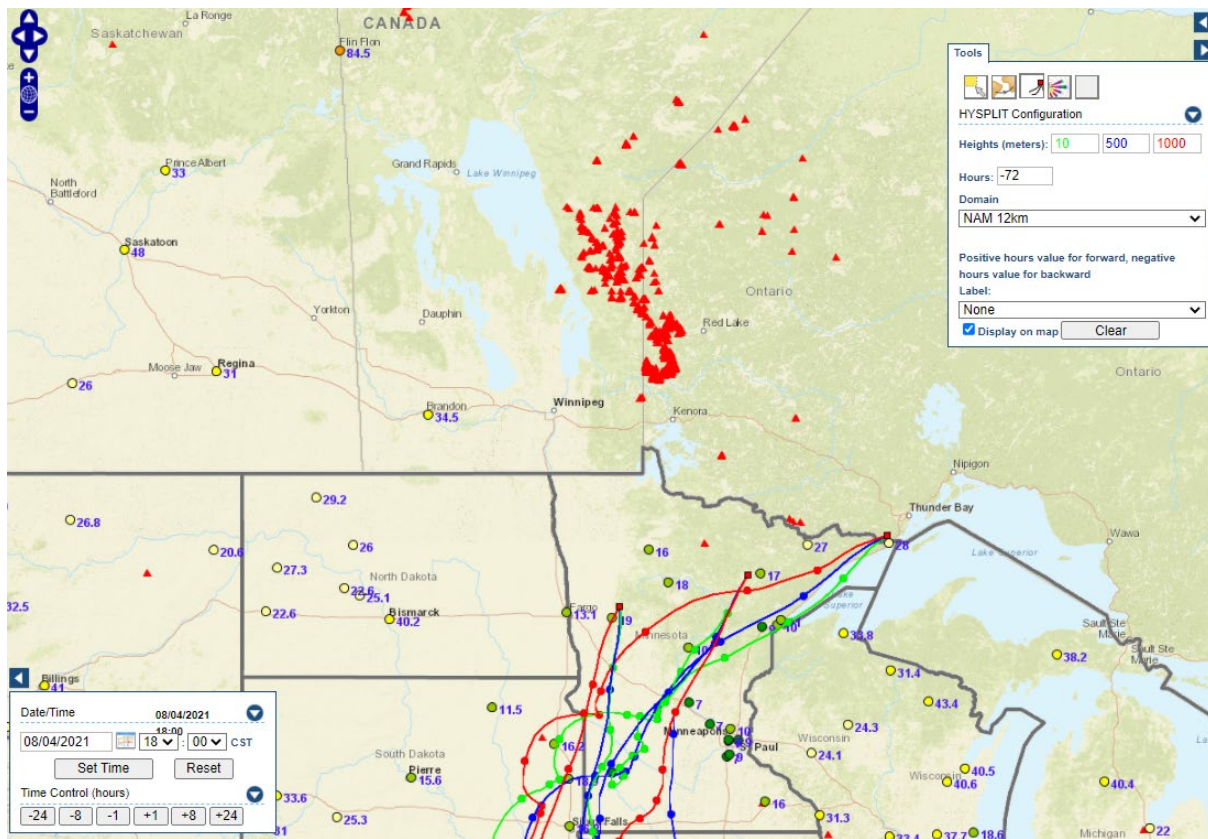
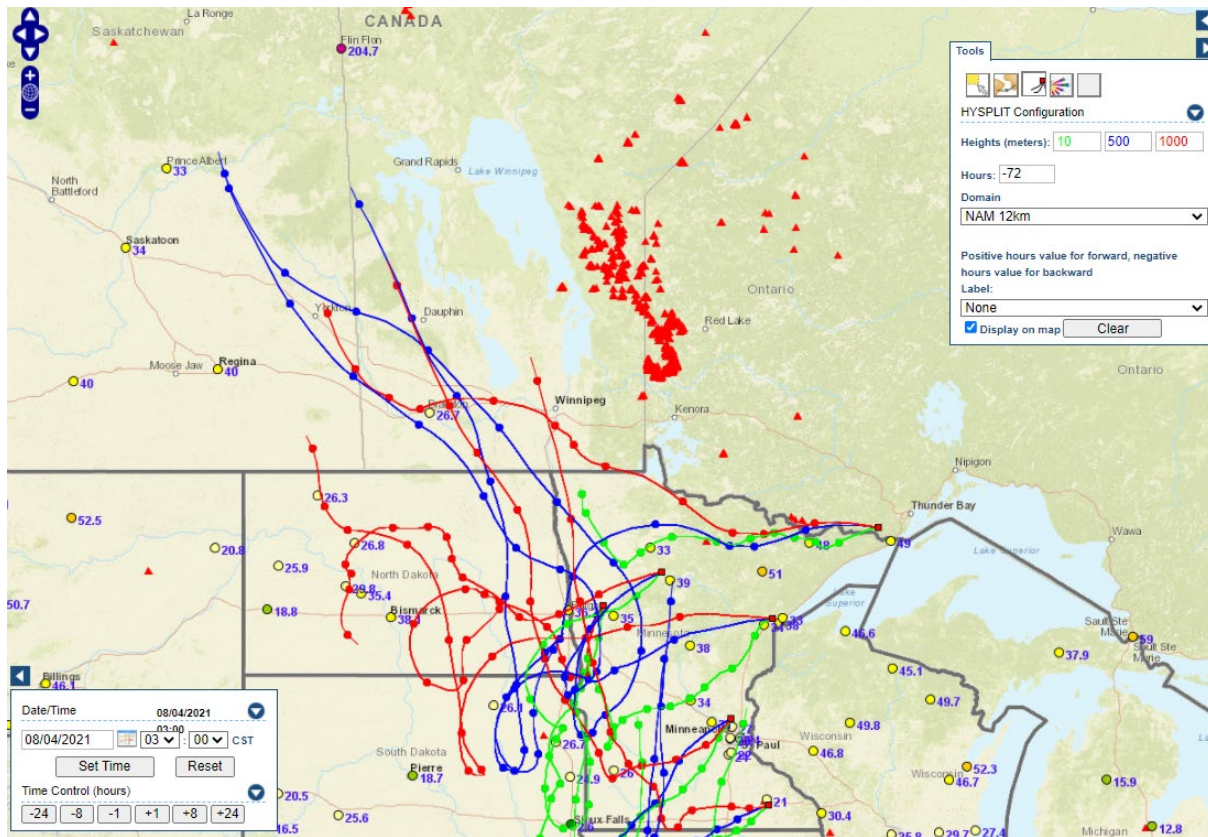
Analyzed smoke, hotspots, and 24-hour PM₁₀ on August 4, 2021



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on August 4, 2021.



MODIS visible satellite for August 4, 2021.



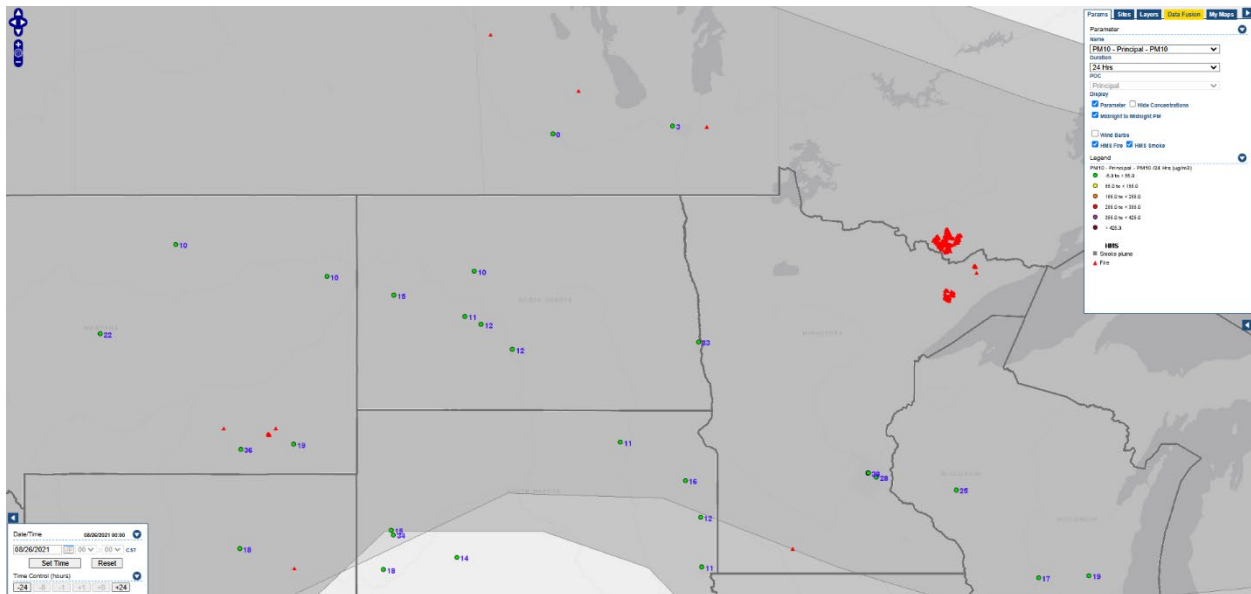
Backward trajectories for August 4, 2021.

8/26/2021 Impacts

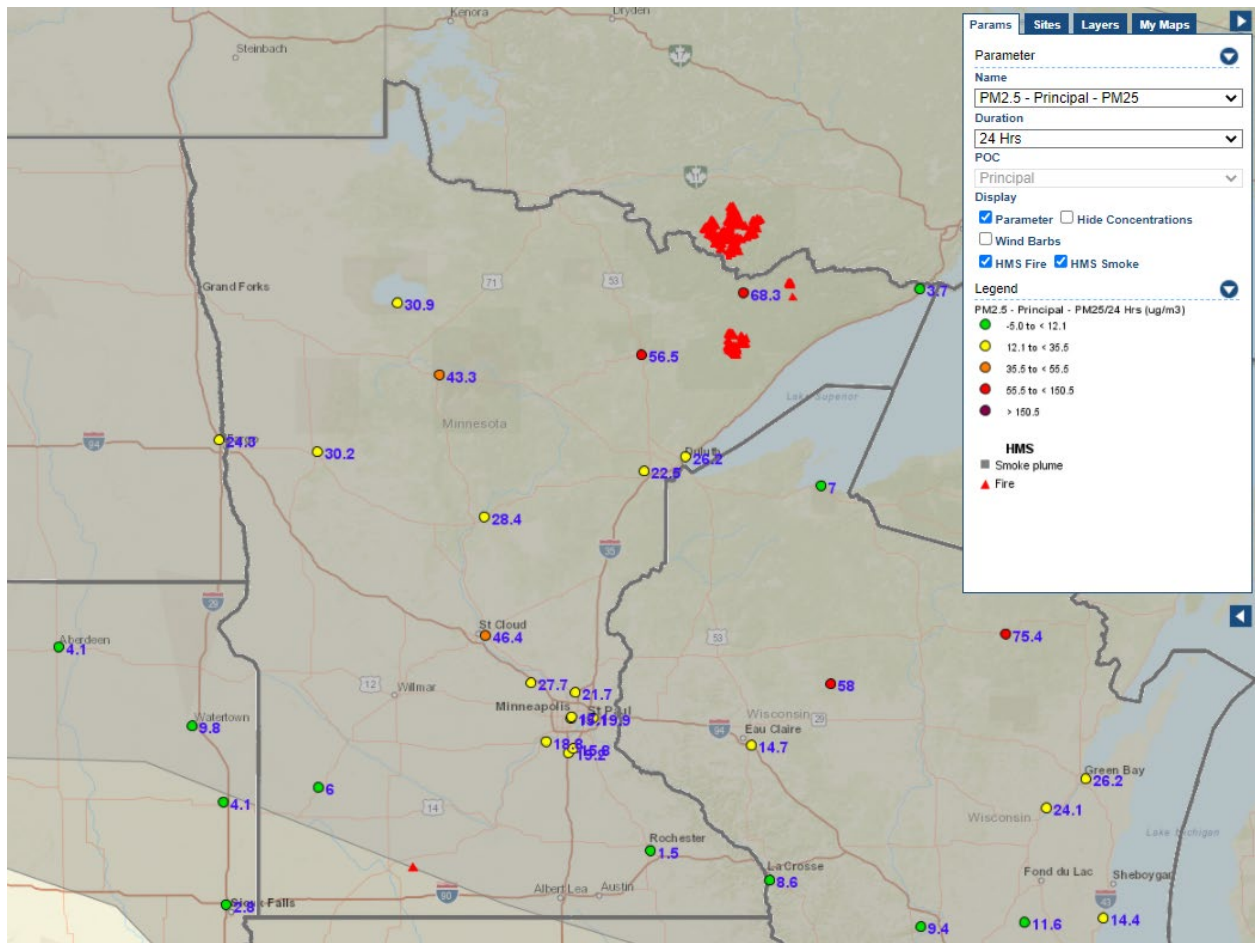
High PM₁₀ was recorded at the Virginia PM₁₀ monitor, which is a 1 in 6 day monitor. PM₁₀ at Virginia is only measured daily. A continuous PM_{2.5} monitor is collocated at Virginia, which measured very high PM_{2.5} on 8/26/2021.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on August 26, 2021.

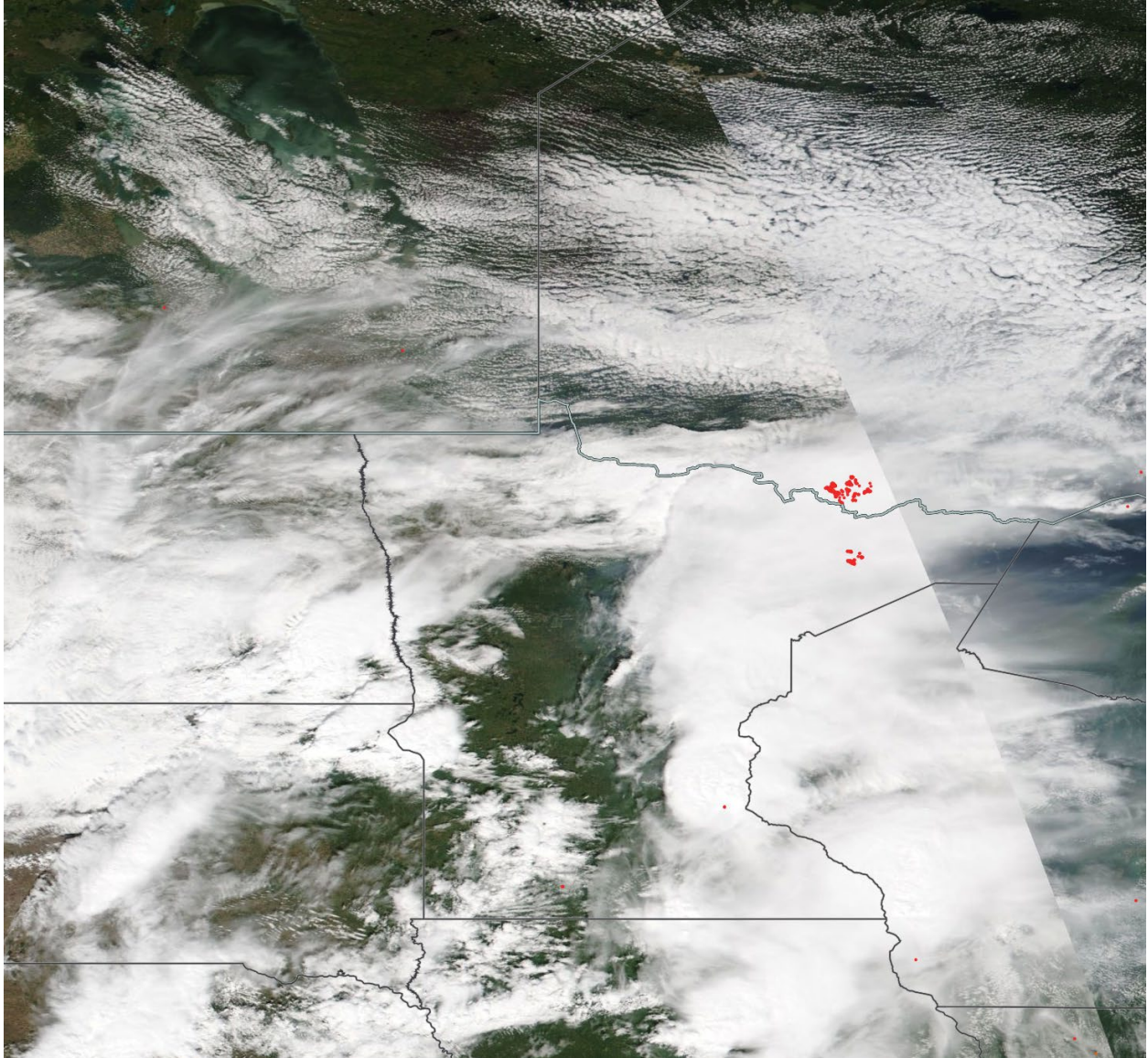
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Virginia	271377001	8/26/2021	59	Northeast MN fires



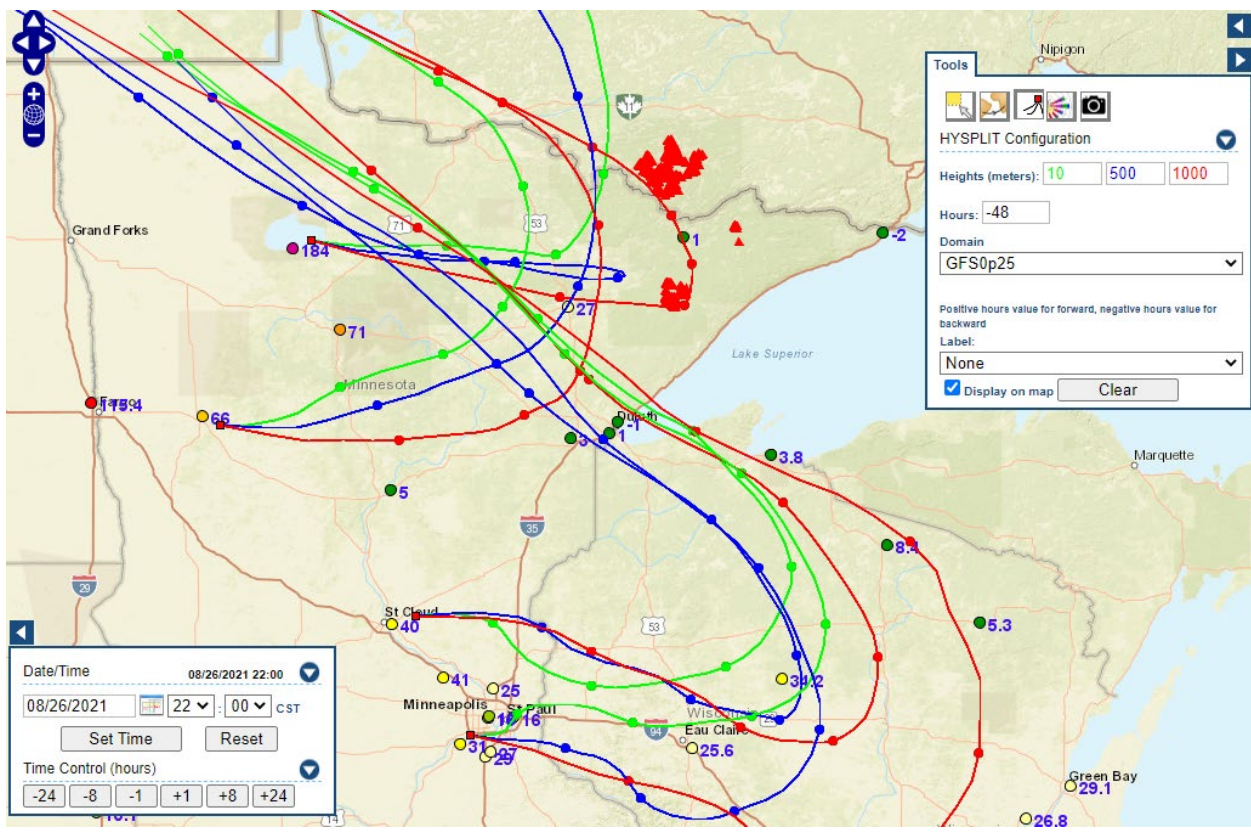
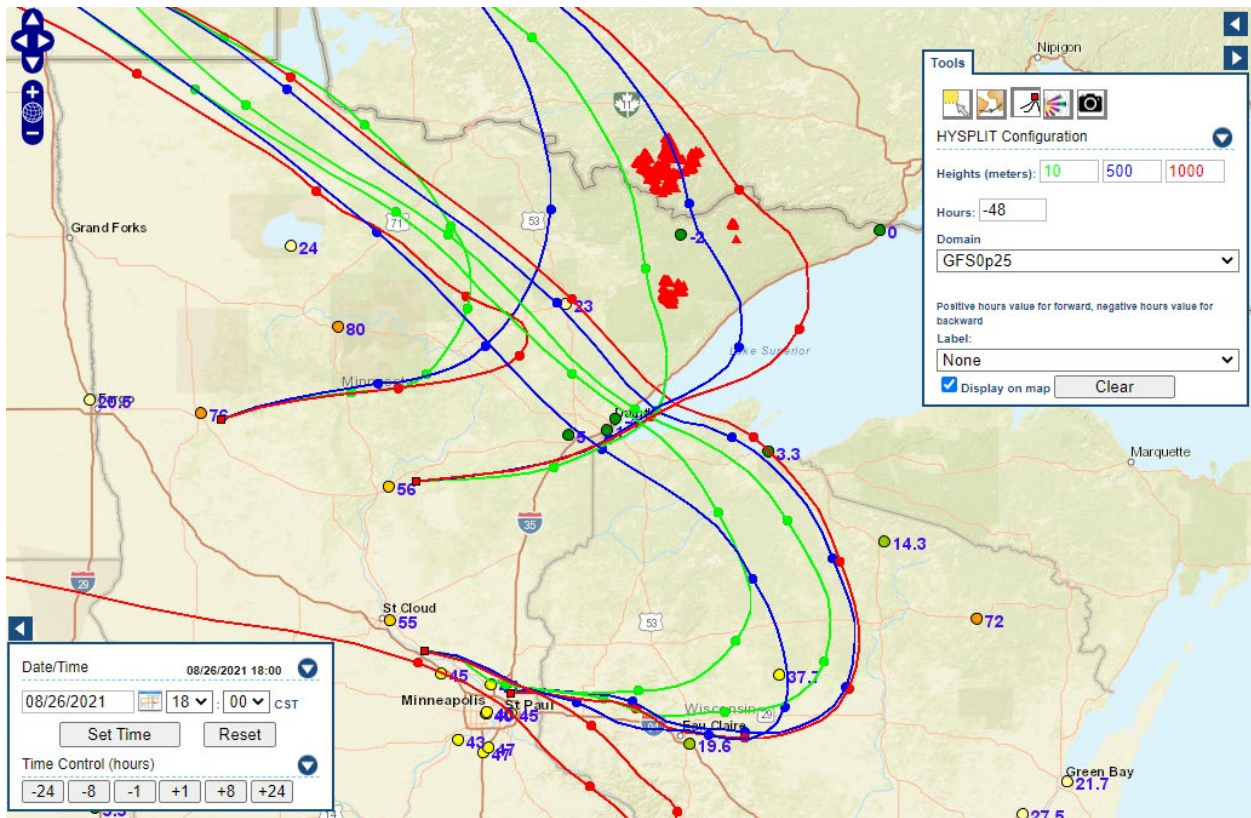
Analyzed smoke, hotspots, and 24-hour PM₁₀ on August 26, 2021



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on August 26, 2021.



MODIS visible satellite for August 26, 2021.



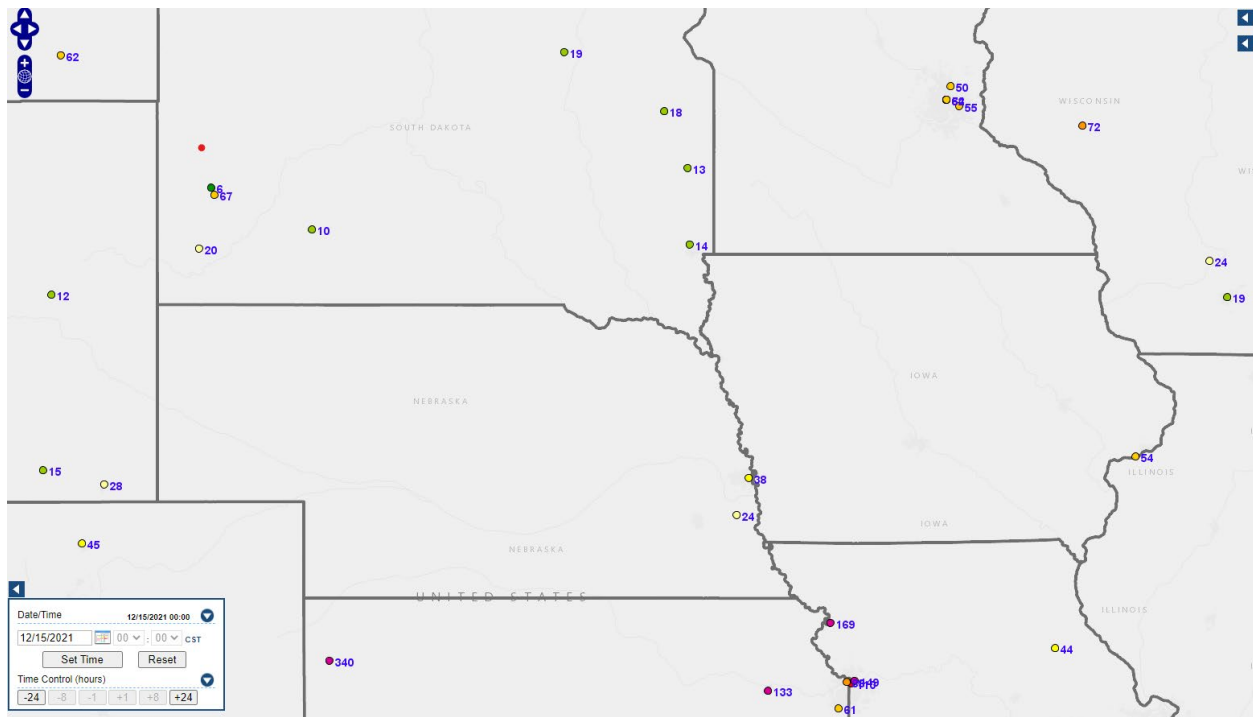
Backward trajectories for August 26, 2021.

12/15/2021 Impacts

A severe windstorm kicked up significant windblown dust in the Great Plains.

Monitored 24-hour PM₁₀ concentrations impacted by dust on December 15, 2021.

Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Blaine	270031002	12/15/2021	50	Windblown dust
Ramsey Health Center	271230868	12/15/2021	55	Windblown dust
MPLS - Lowrie Ave	270530909	12/15/2021	77	Windblown dust
MPLS - Pacific St	270530910	12/15/2021	64	Windblown dust
MPLS - Bottineau	270531909	12/15/2021	64	Windblown dust



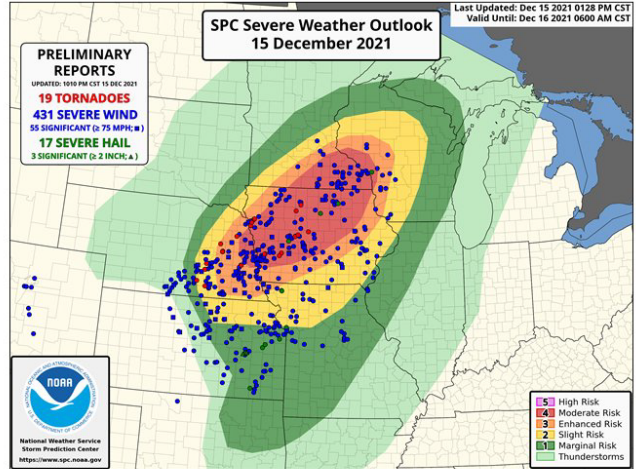
24-hour PM₁₀ on December 15, 2021.



Most Significant (75+ mph) Wind Gusts in a Day since at least 2004*

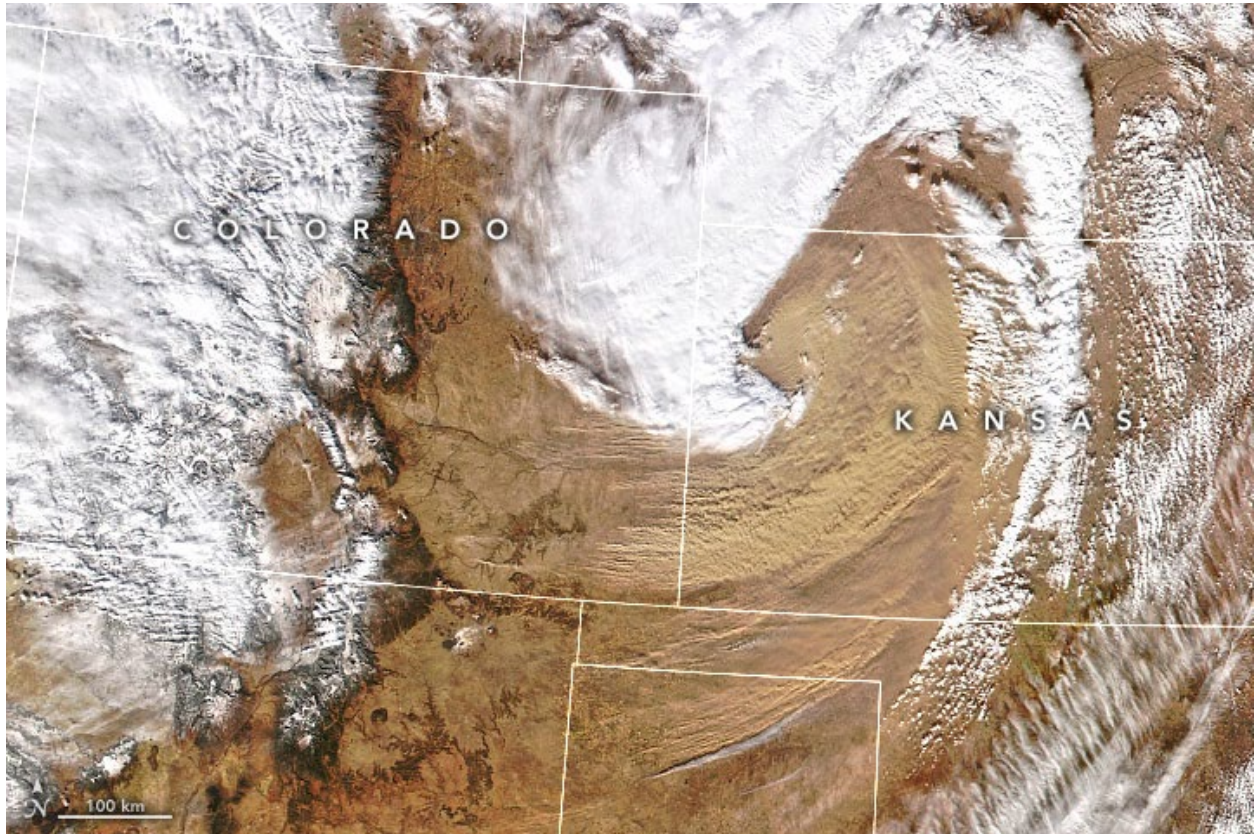


Top 8 Days by Number of Significant Wind Gusts	
Date	# of 75+ mph wind gusts
12/15/2021	55+
8/10/2020	53
6/6/2020	44
6/29/2012	37
6/14/2014	30
6/30/14 & 6/16/17 & 6/10/21	23



*Data from 2004 to present. Data is preliminary and subject to change before final storm data publication.

Severe weather reports on December 15, 2021.



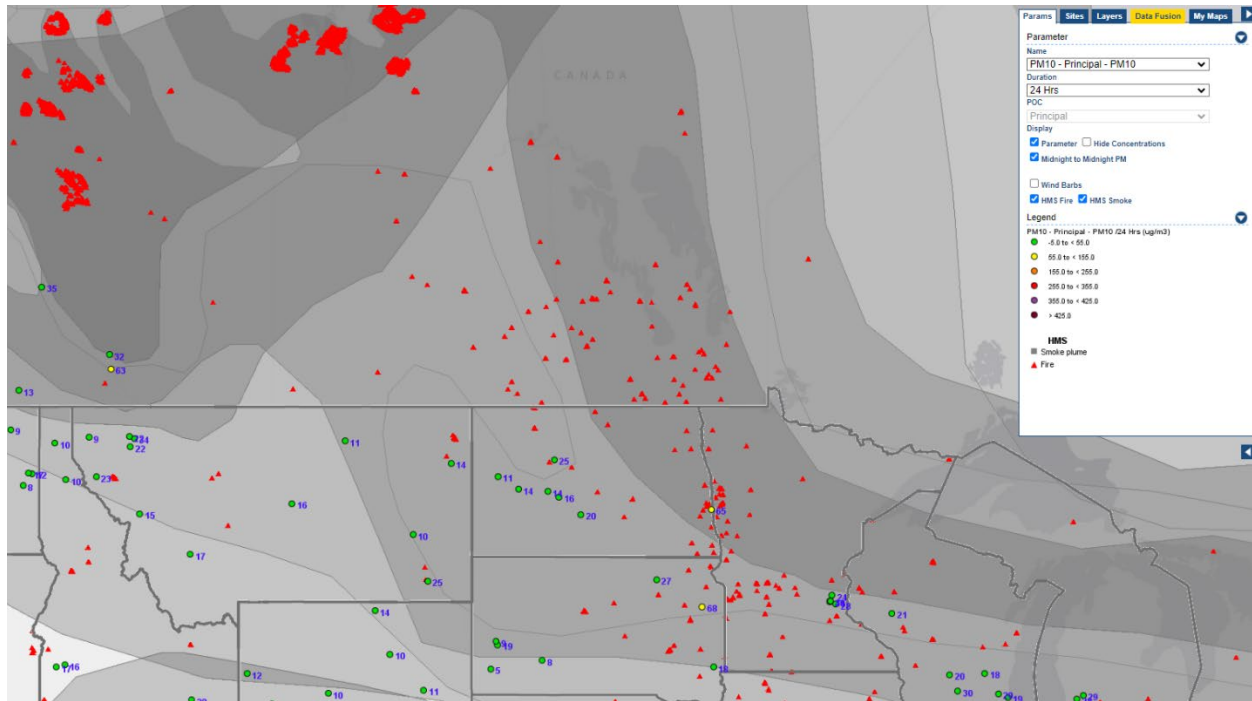
MODIS imagery showing a major dust storm occurring in western Kansas on December 15, 2021.

5/16/2023 Impacts

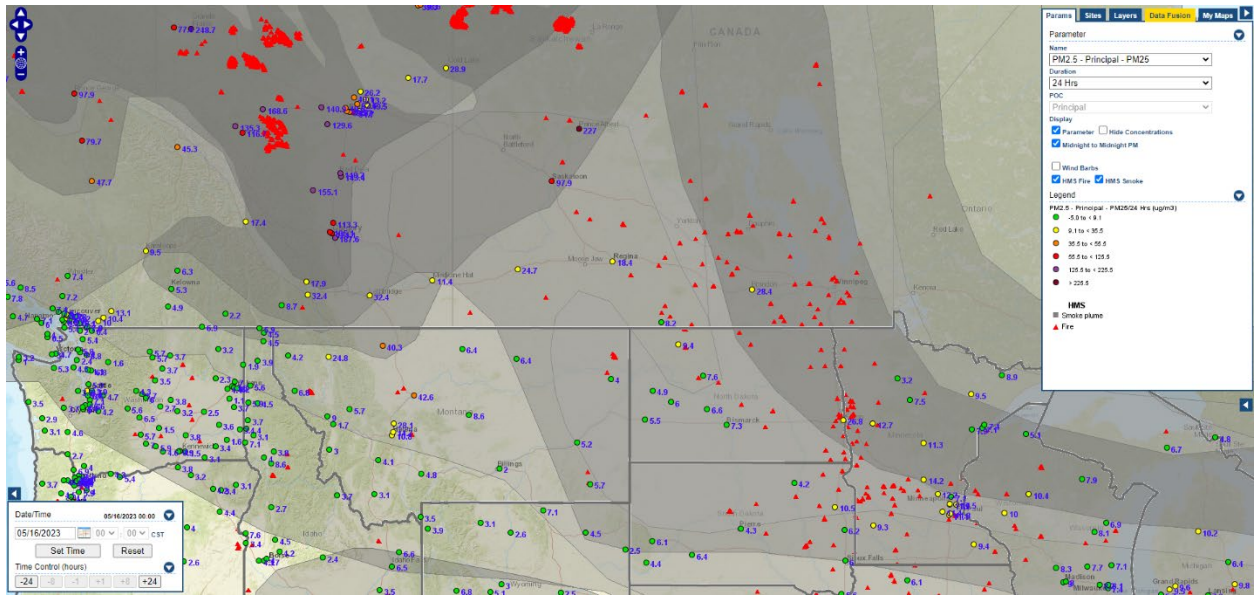
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on May 16, 2023.

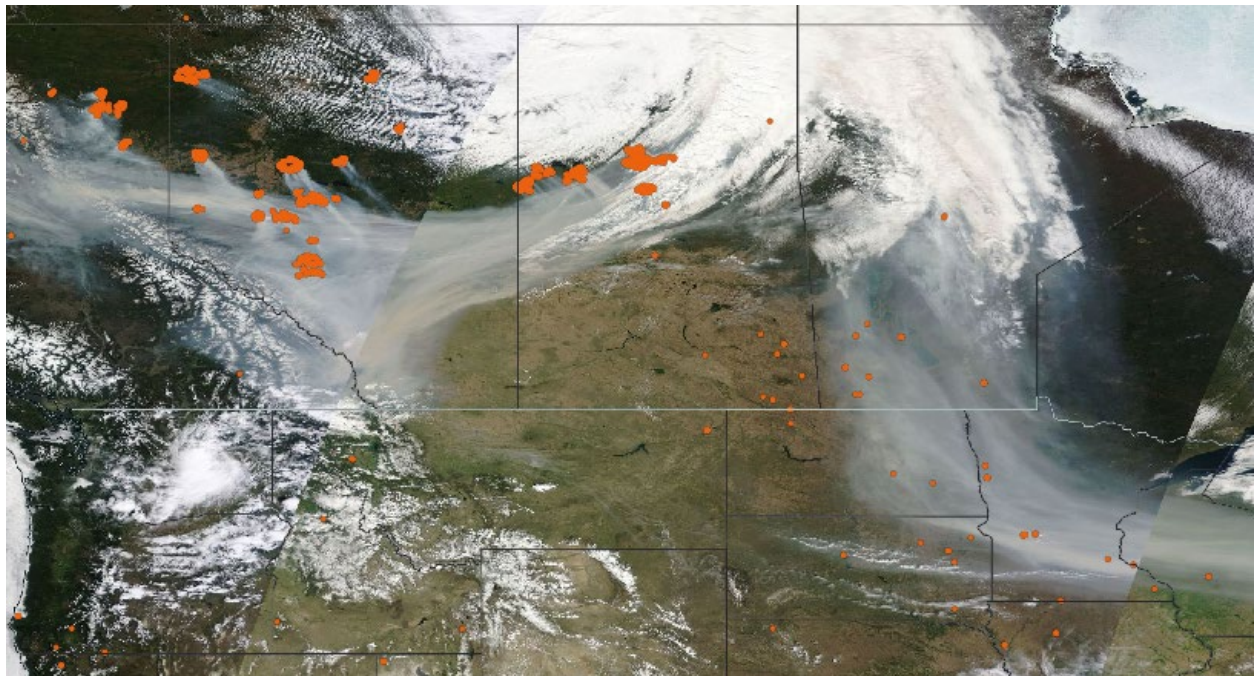
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Fargo NW	380171004	5/16/2023	65	Wildfire smoke



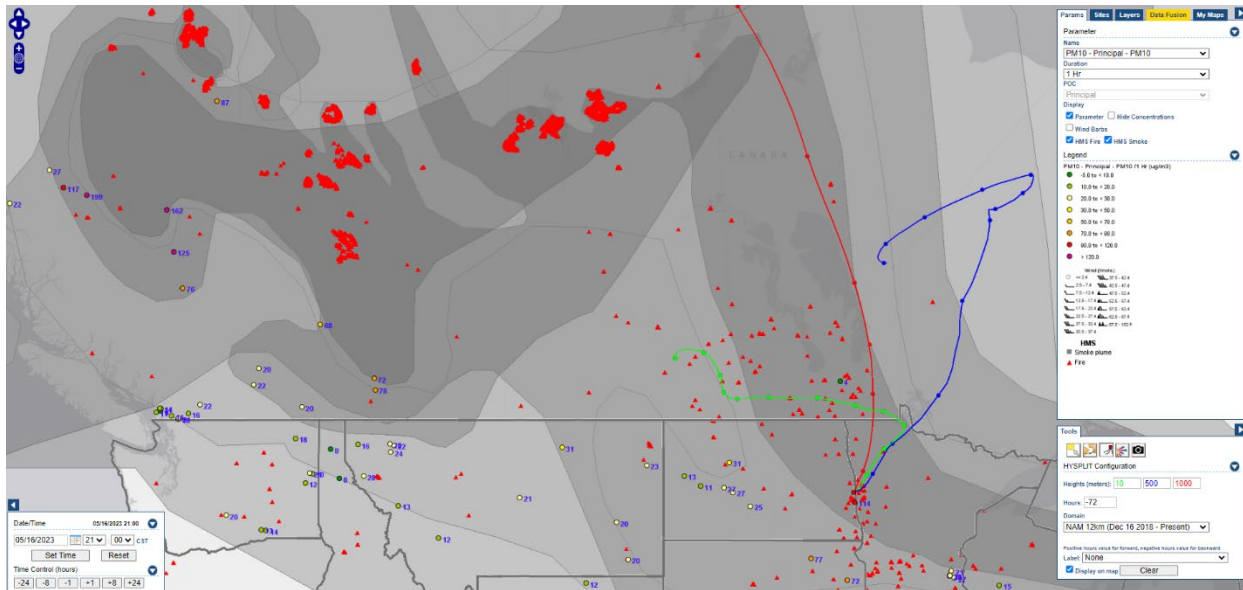
Analyzed smoke, hotspots, and 24-hour PM₁₀ on May 16, 2023.



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on May 16, 2023.



MODIS visible satellite for May 16, 2023.



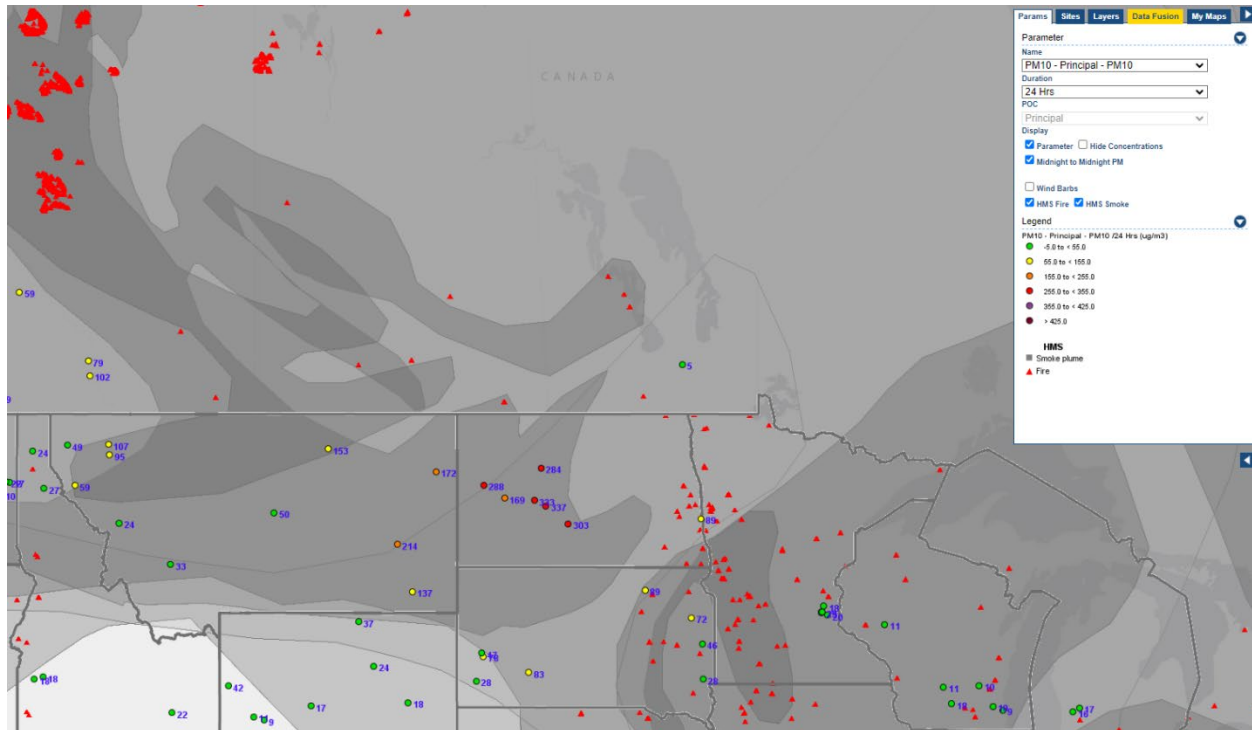
Backward trajectories for May 16, 2023.

5/17/2023 Impacts

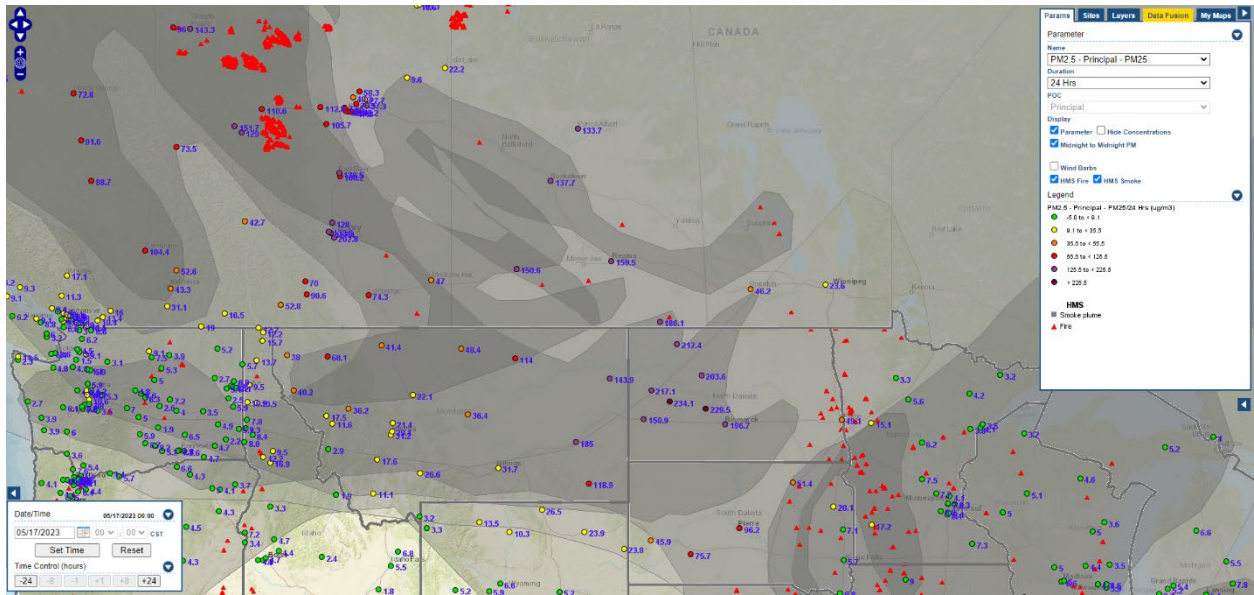
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on May 17, 2023.

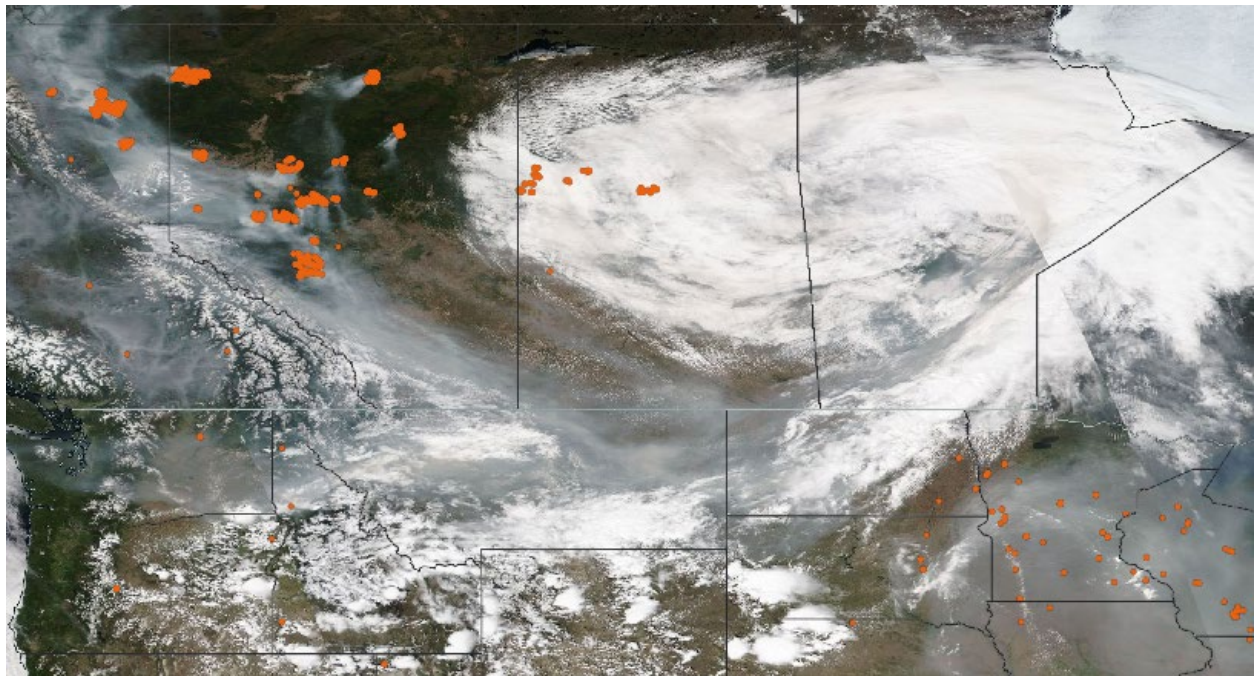
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Fargo NW	380171004	5/17/2023	89	Wildfire smoke



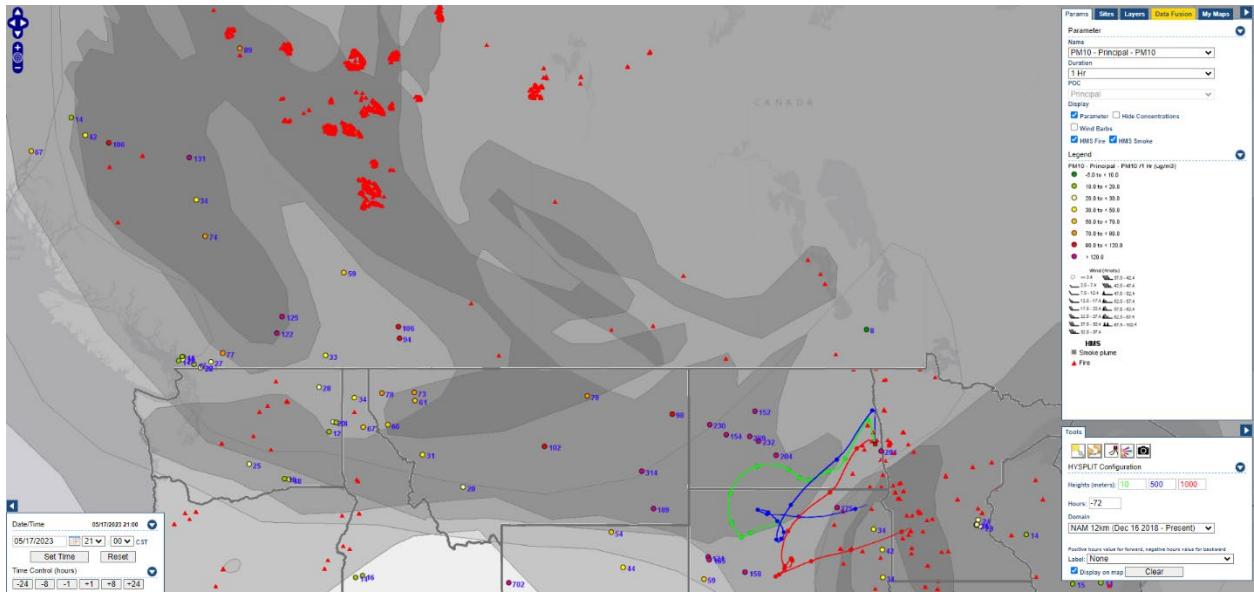
Analyzed smoke, hotspots, and 24-hour PM₁₀ on May 17, 2023.



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on May 17, 2023.



MODIS visible satellite for May 17, 2023.



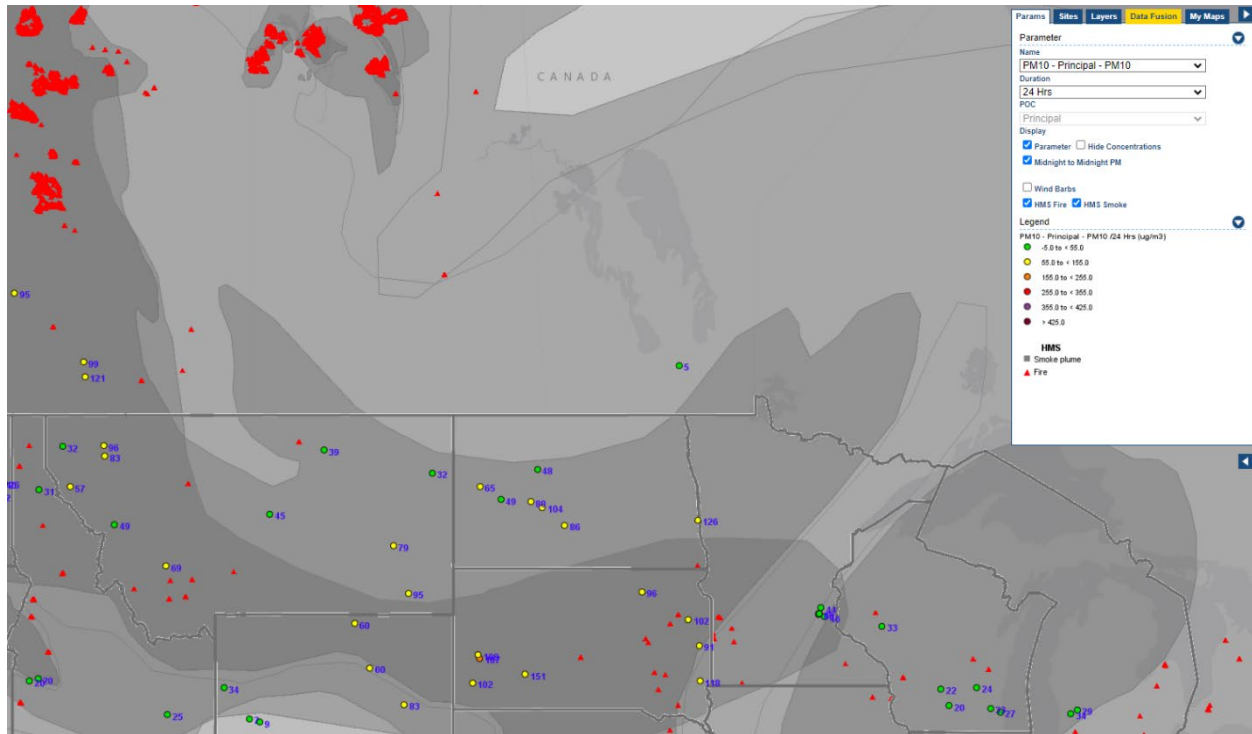
Backward trajectories for May 17, 2023.

5/18/2023 Impacts

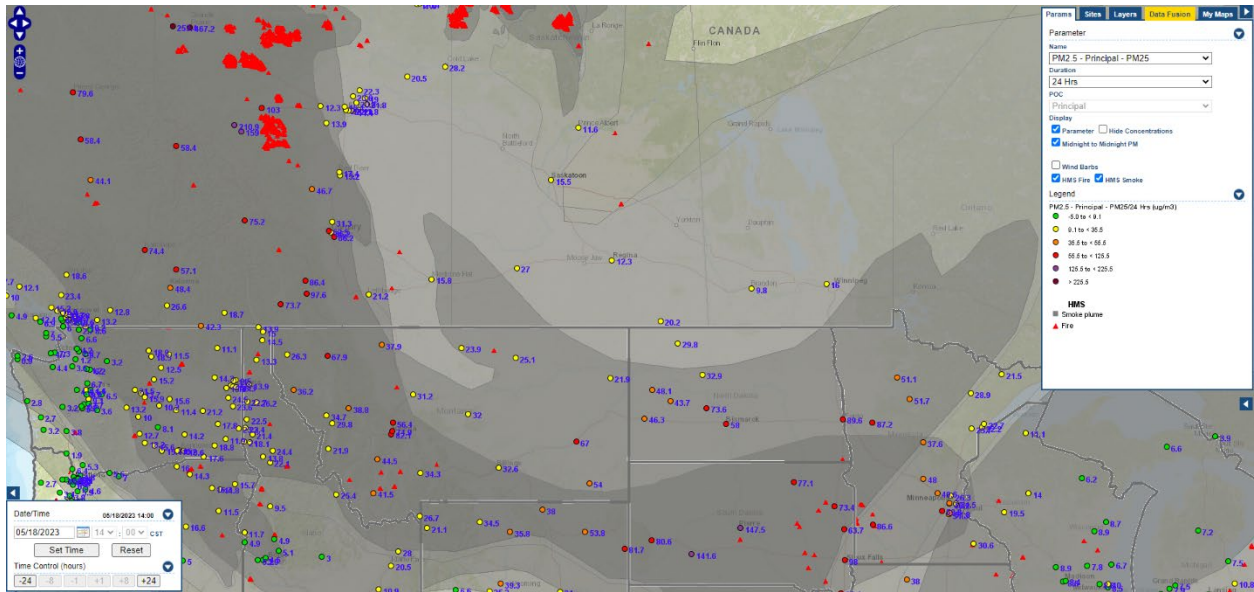
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on May 18, 2023.

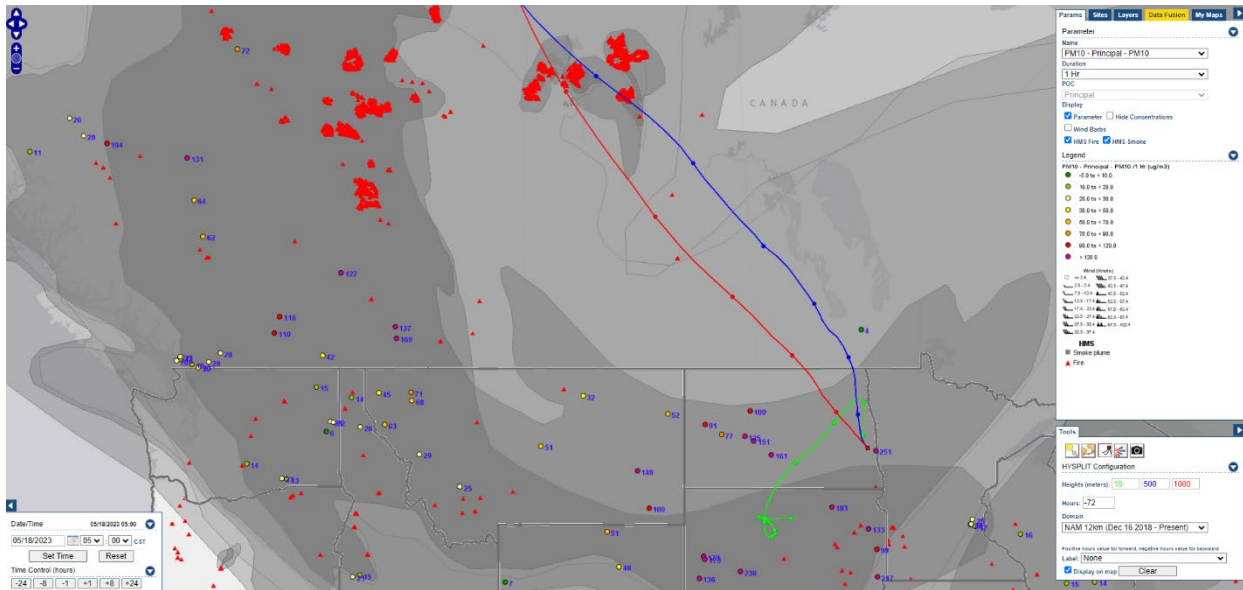
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Fargo NW	380171004	5/18/2023	126	Wildfire smoke



Analyzed smoke, hotspots, and 24-hour PM₁₀ on May 18, 2023.



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on



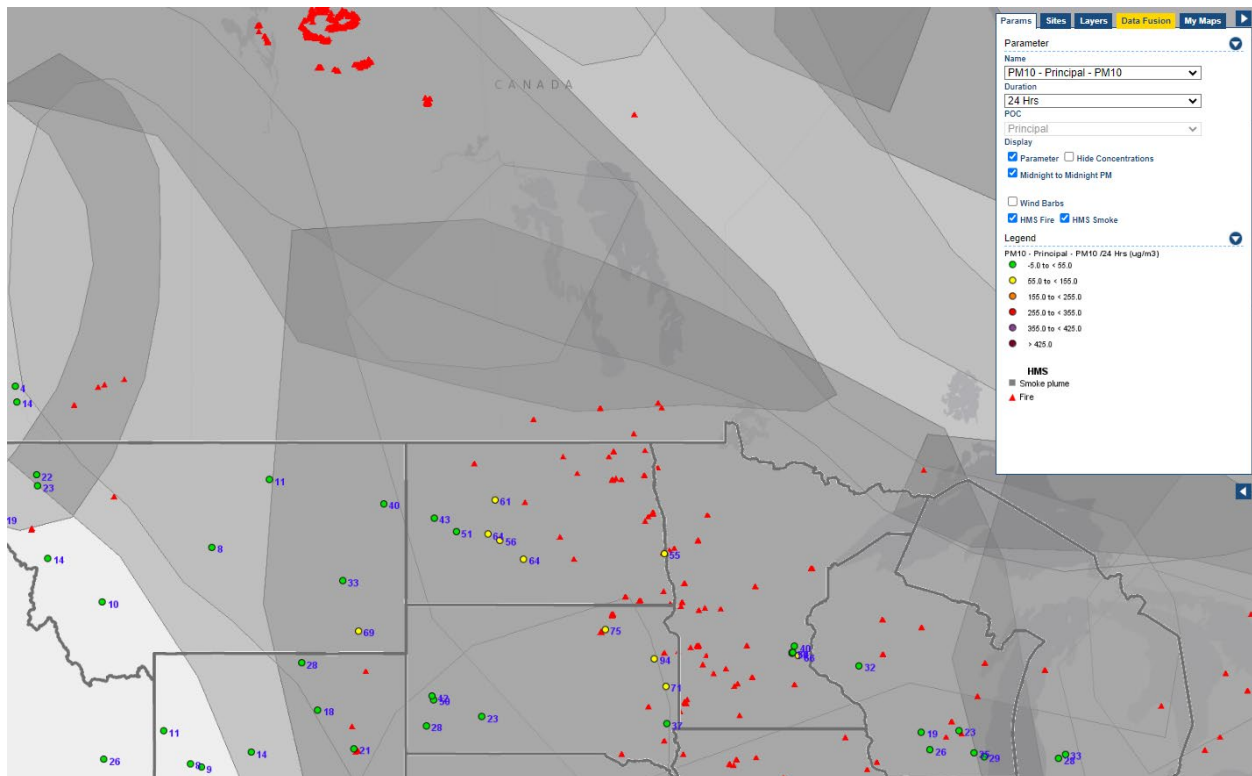
Backward trajectories for May 18, 2023.

5/23/2023 Impacts

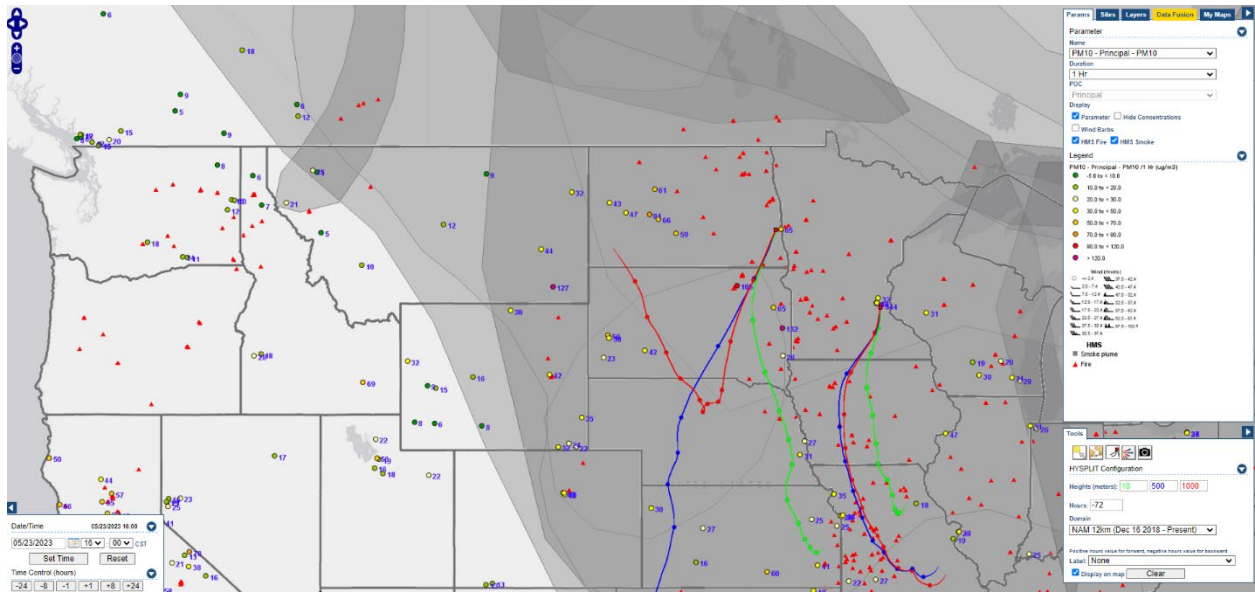
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on May 23, 2023.

Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Fargo NW	380171004	5/23/2023	55	Wildfire smoke
St. Paul - Downtown	271230868	5/23/2023	66	Wildfire smoke



Analyzed smoke, hotspots, and 24-hour PM₁₀ on May 23, 2023.



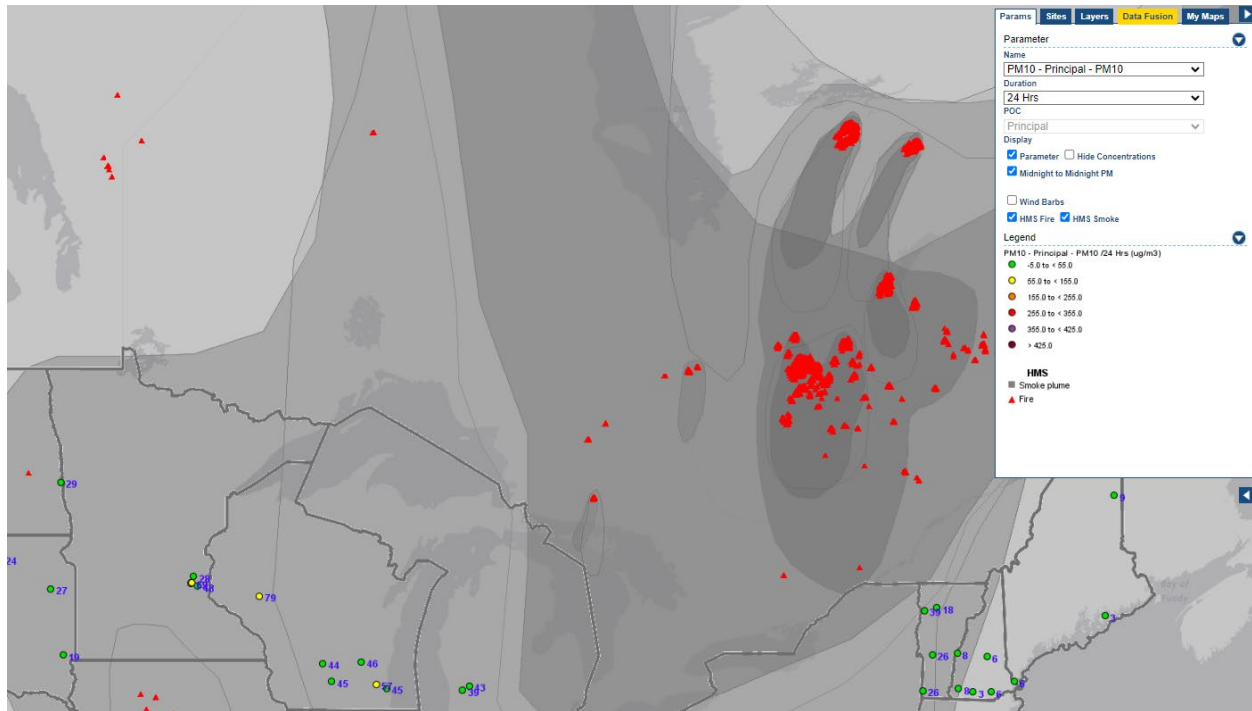
Backward trajectories for May 23, 2023.

6/5/2023 Impacts

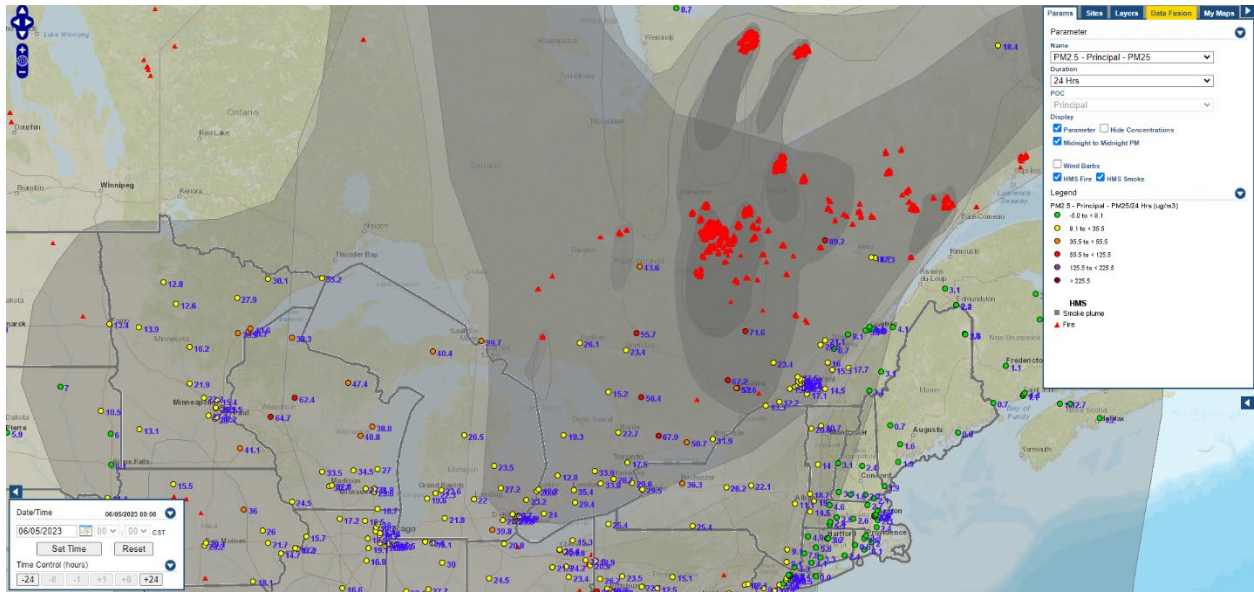
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on June 5, 2023.

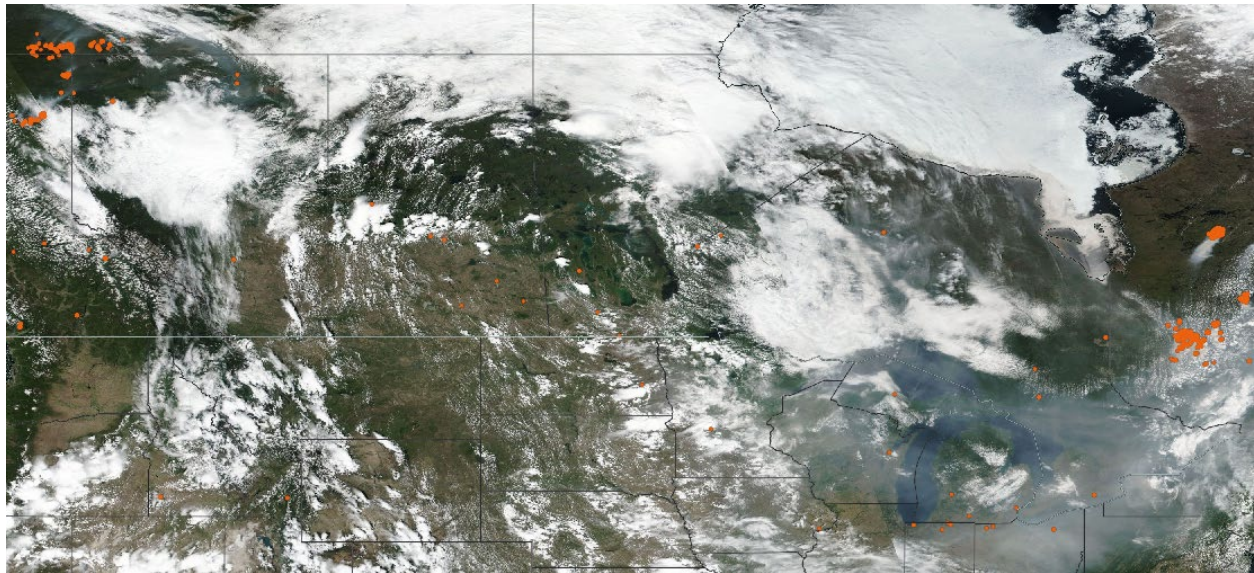
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
MPLS - Bottineau	270531909	6/5/2023	63	Wildfire smoke



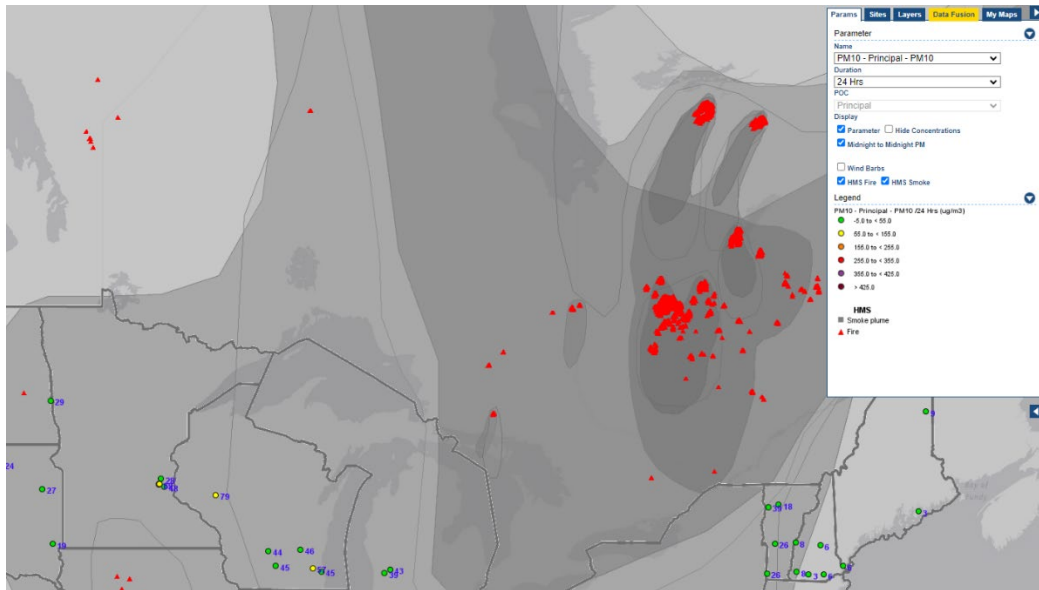
Analyzed smoke, hotspots, and 24-hour PM₁₀ on June 5, 2023.



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on June 5, 2023.



MODIS visible satellite for June 5, 2023.



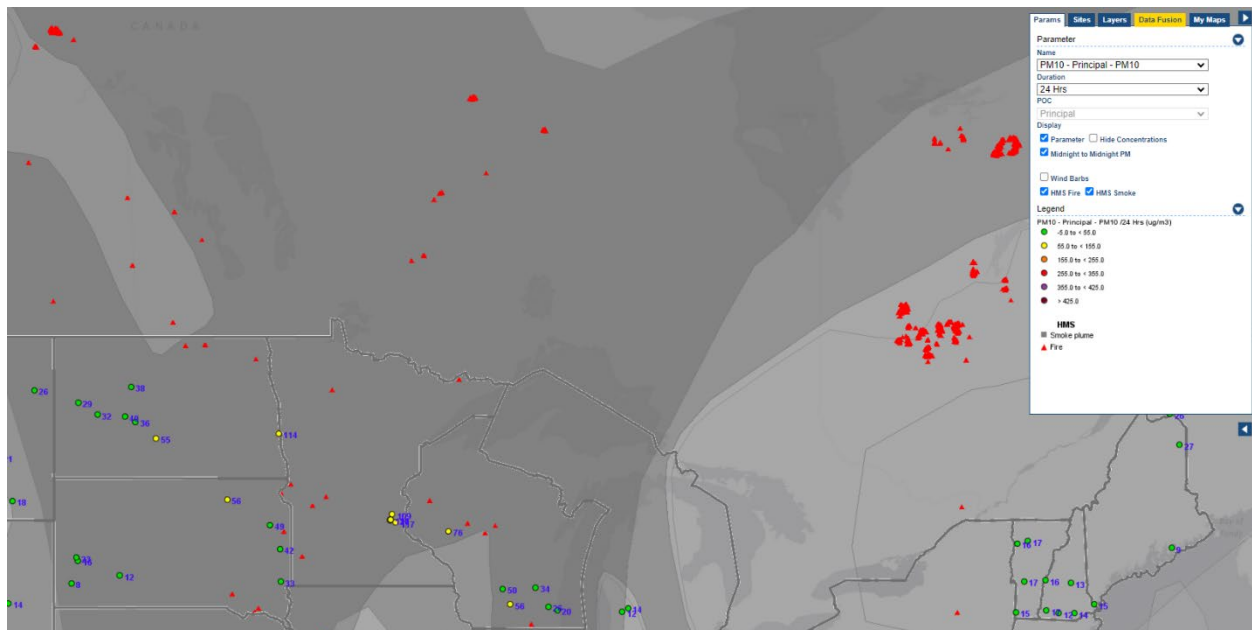
Backward trajectories for June 5, 2023.

6/14/2023 Impacts

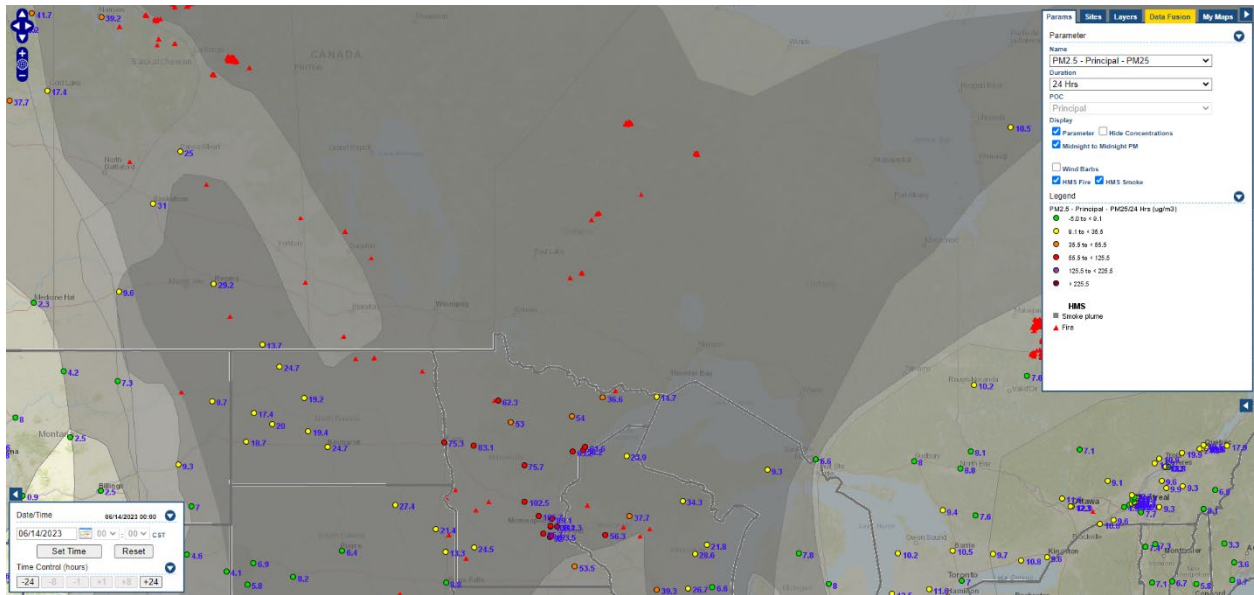
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on June 14, 2023.

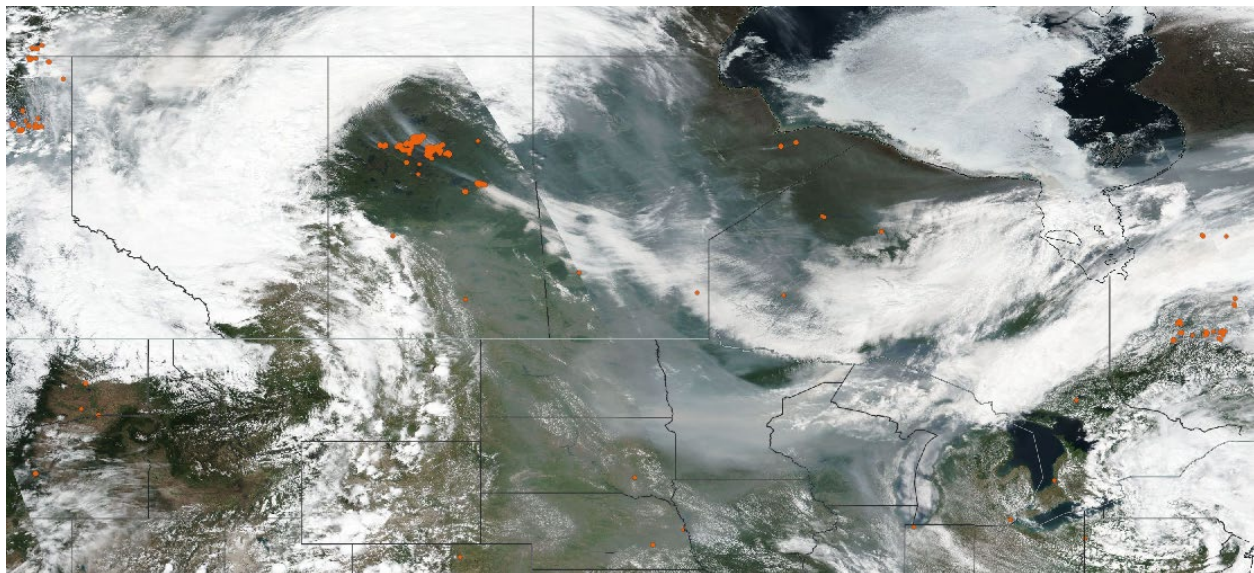
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Blaine	270031002	6/14/2023	109	Wildfire smoke
Fargo NW	380171004	6/14/2023	115	Wildfire smoke
MPLS - Bottineau	270531909	6/14/2023	114	Wildfire smoke
MPLS - Lowrie Ave	270530909	6/14/2023	131	Wildfire smoke
MPLS - Pacific St	270530910	6/14/2023	121	Wildfire smoke
St. Paul - Downtown	271230868	6/14/2023	118	Wildfire smoke



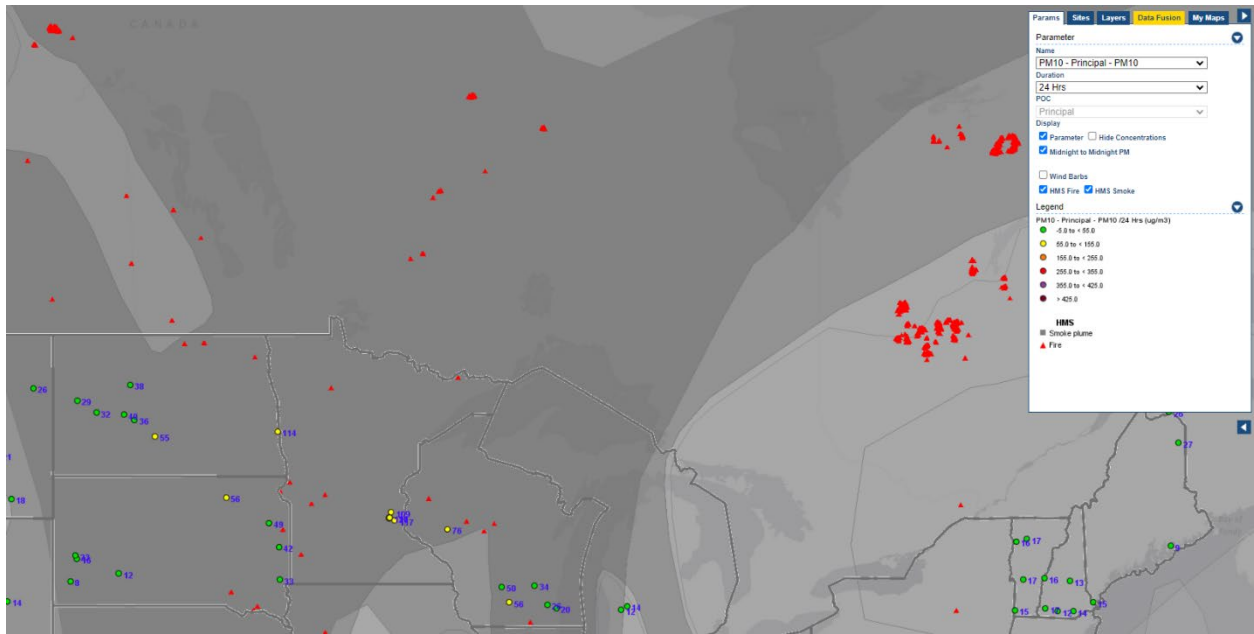
Analyzed smoke, hotspots, and 24-hour PM₁₀ on June 14, 2023.



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on June 14, 2023.



MODIS visible satellite for June 14, 2023.



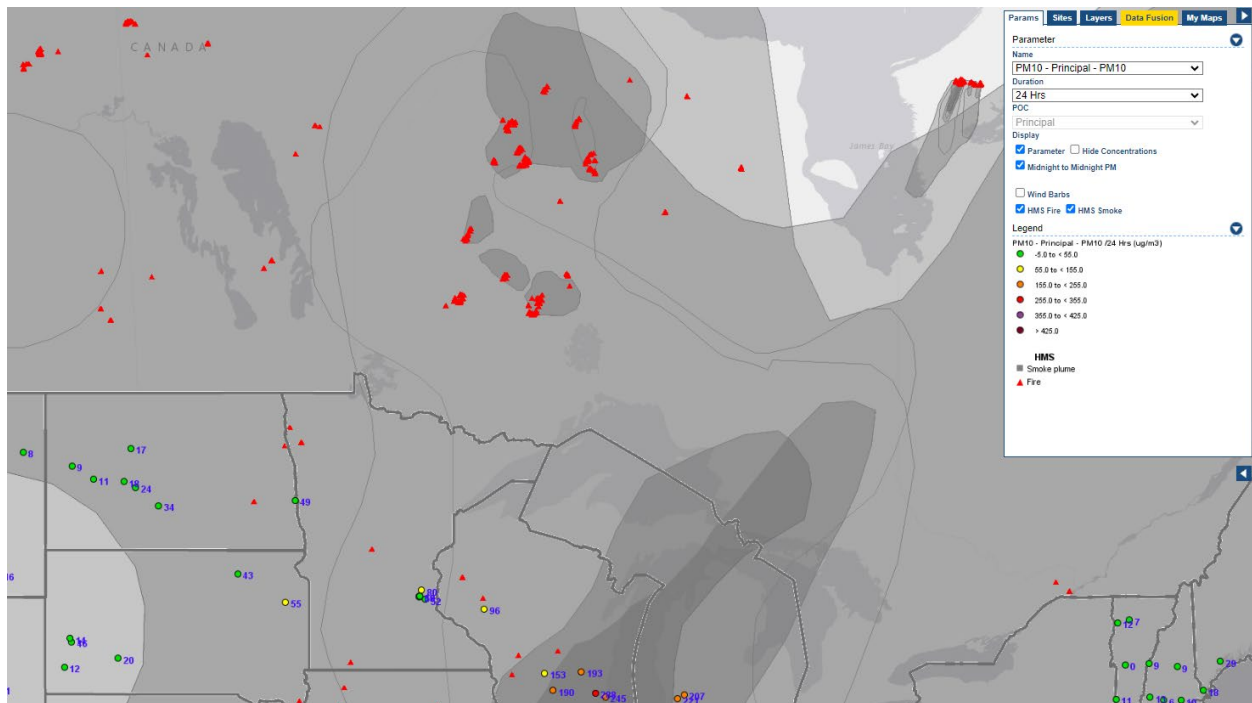
Backward trajectories for June 14, 2023.

6/27/2023 Impacts

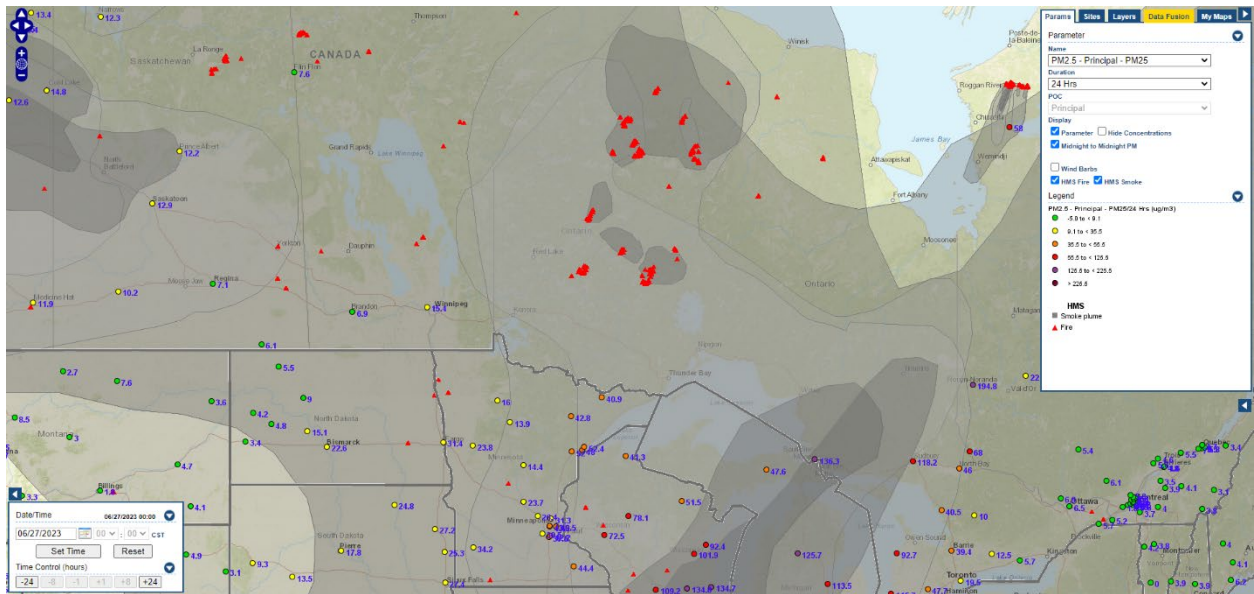
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on June 27, 2023.

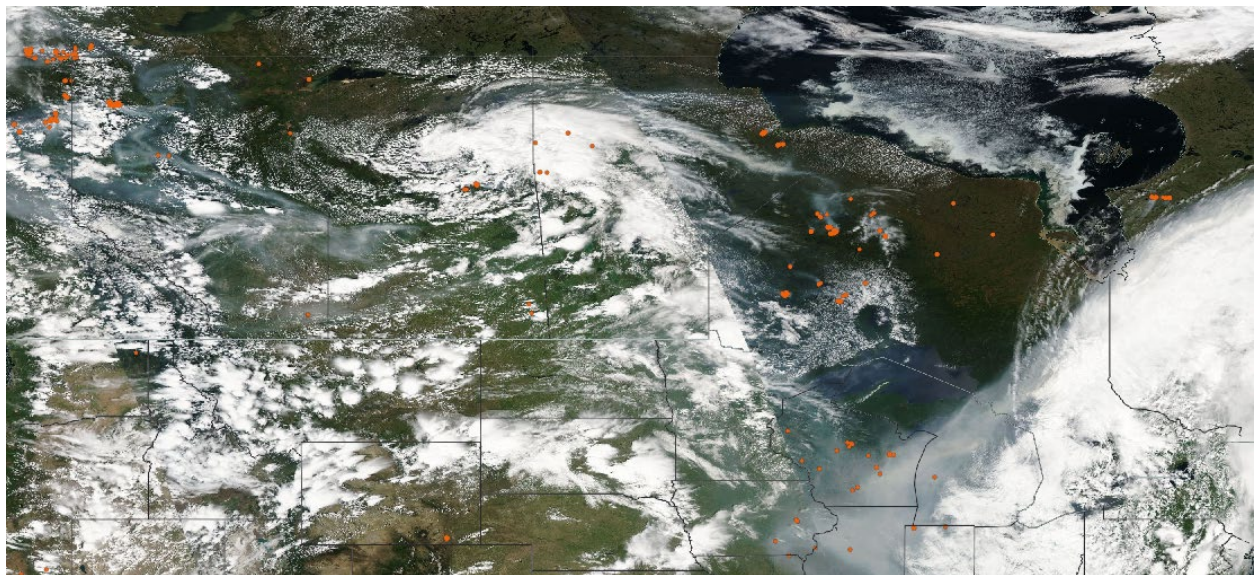
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Blaine	270031002	6/27/2023	81	Wildfire smoke
St. Paul - Downtown	271230868	6/27/2023	52	Wildfire smoke



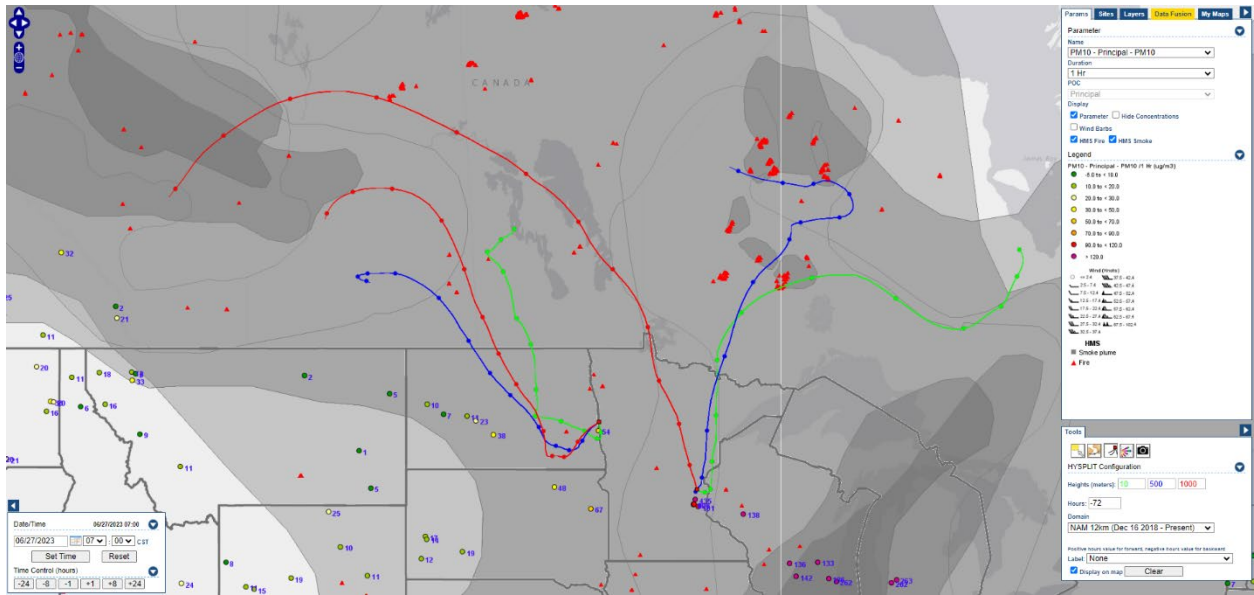
Analyzed smoke, hotspots, and 24-hour PM₁₀ on June 27, 2023.



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on June 27, 2023.



MODIS visible satellite for June 27, 2023.



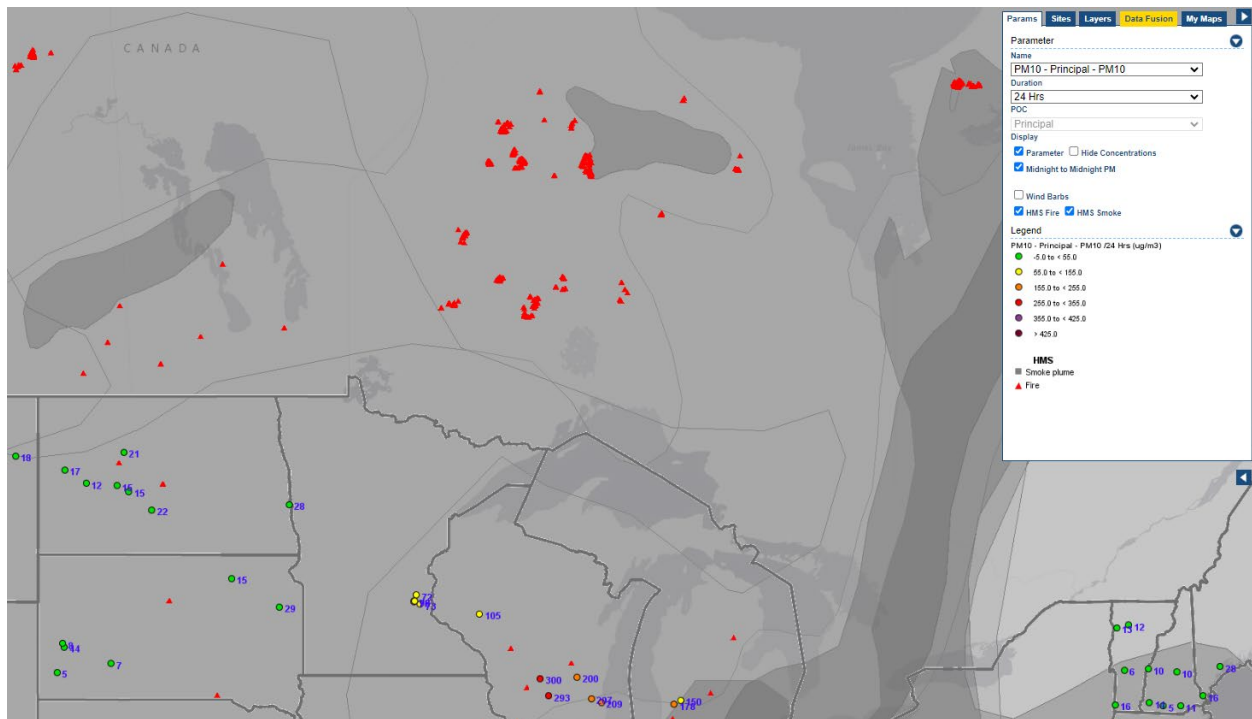
Backward trajectories for June 27, 2023.

6/28/2023 Impacts

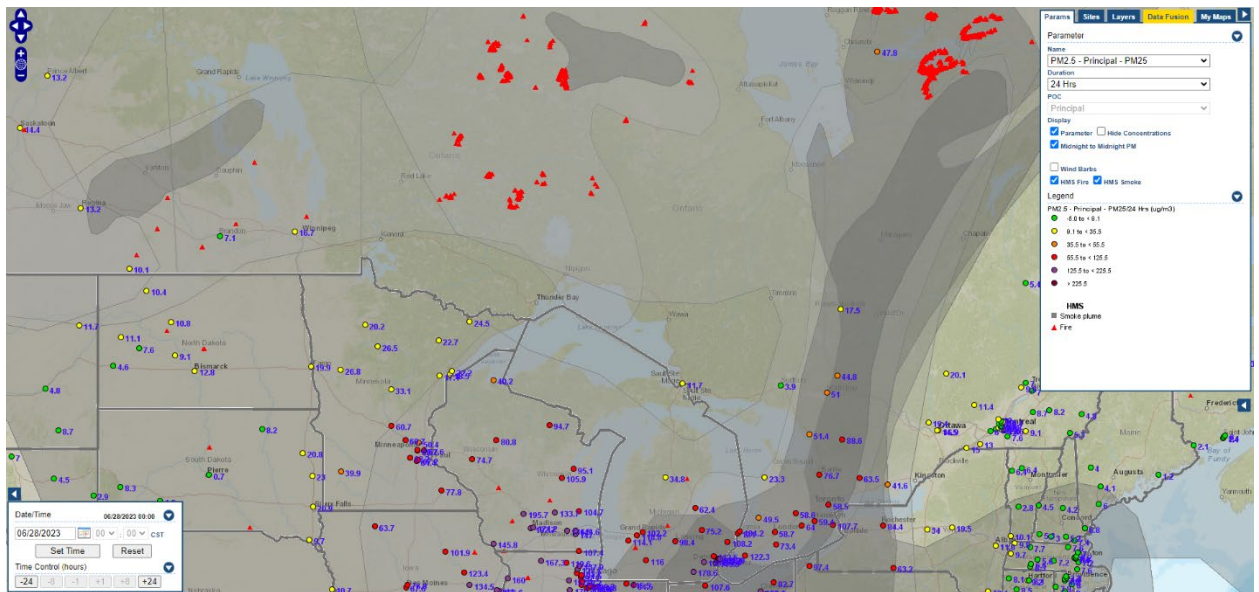
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on June 28, 2023.

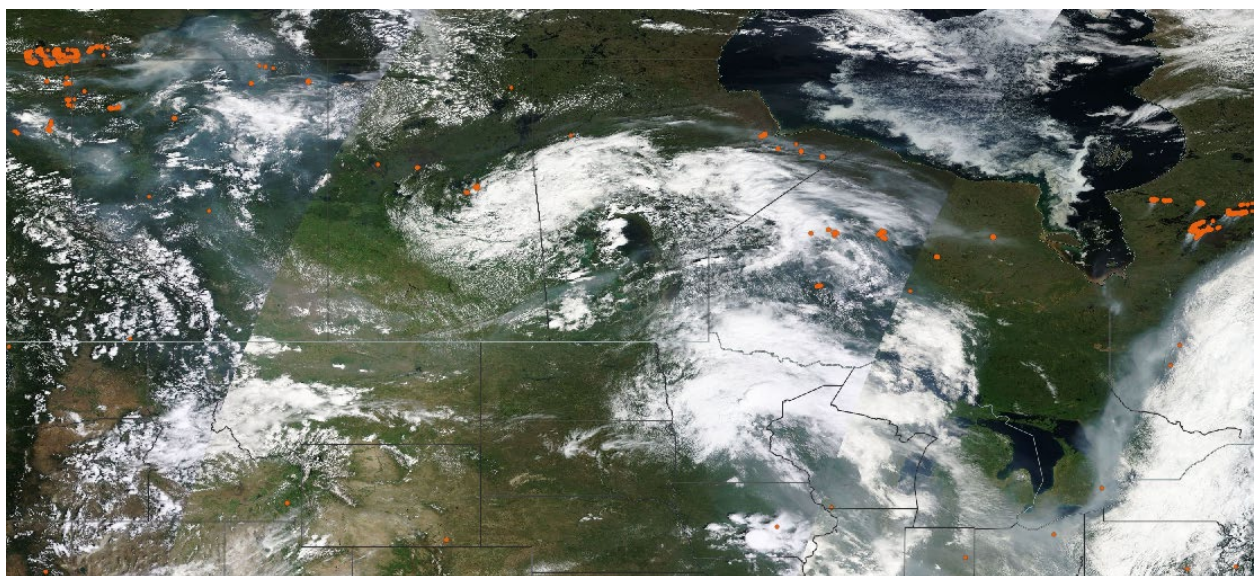
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Blaine	270031002	6/28/2023	72	Wildfire smoke
MPLS - Bottineau	270531909	6/28/2023	75	Wildfire smoke
MPLS - Lowrie Ave	270530909	6/28/2023	76	Wildfire smoke
MPLS - Pacific St	270530910	6/28/2023	92	Wildfire smoke
St. Paul - Downtown	271230868	6/28/2023	73	Wildfire smoke
Blaine	270031002	6/28/2023	72	Wildfire smoke



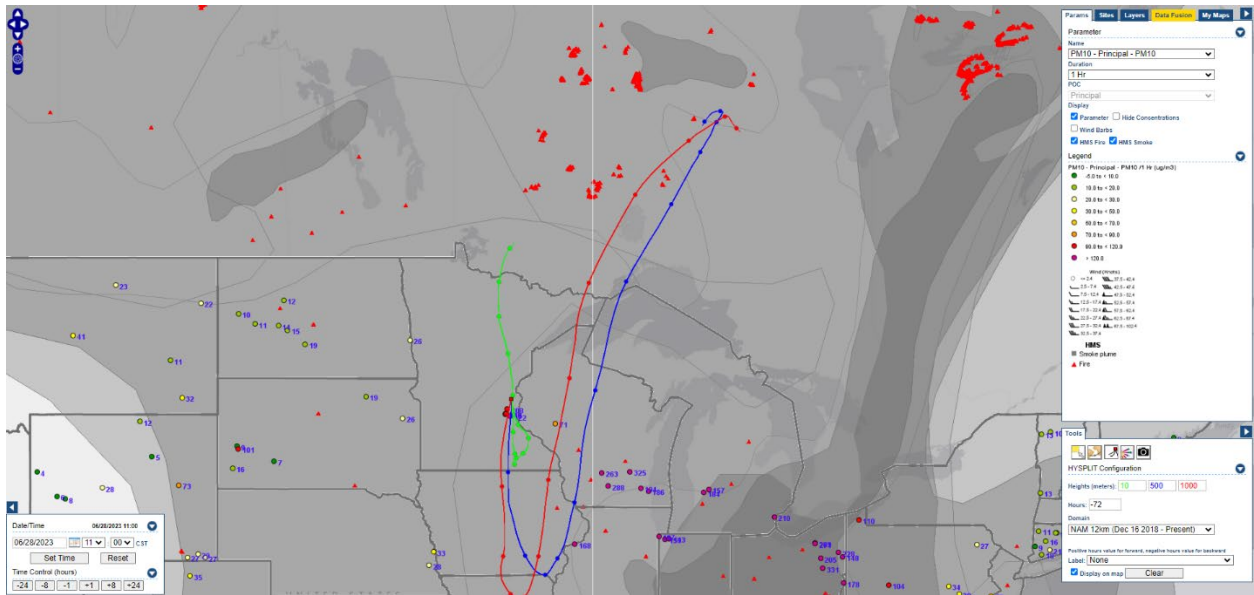
Analyzed smoke, hotspots, and 24-hour PM₁₀ on June 28, 2023.



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on June 28, 2023.



MODIS visible satellite for June 28, 2023.



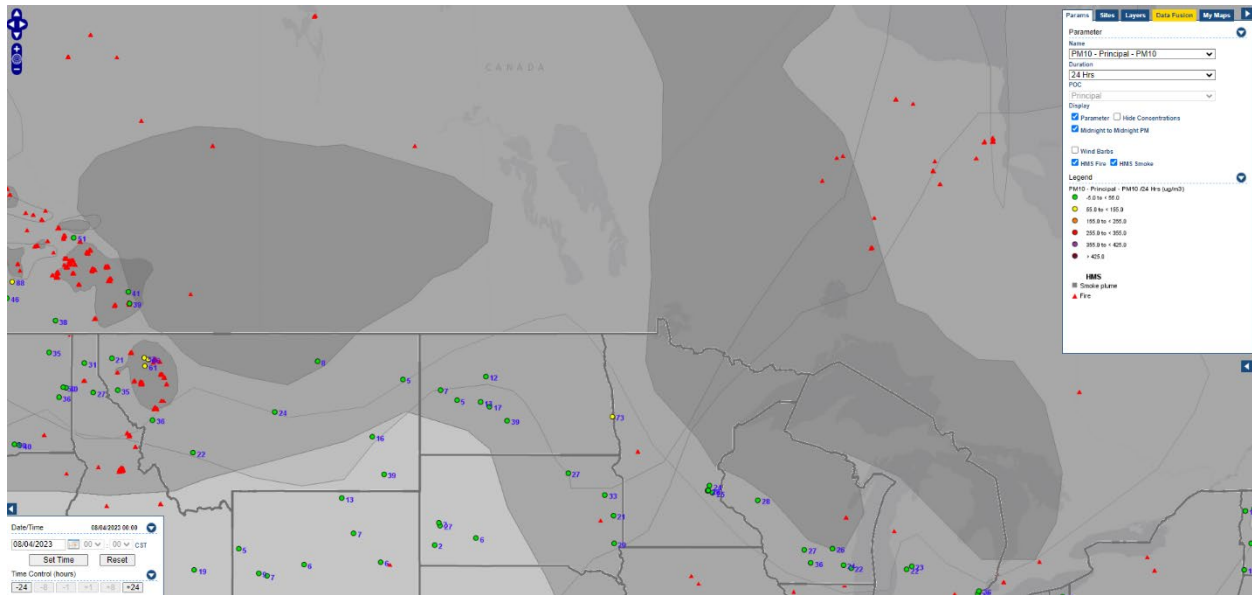
Backward trajectories for June 28, 2023.

8/4/2023 Impacts

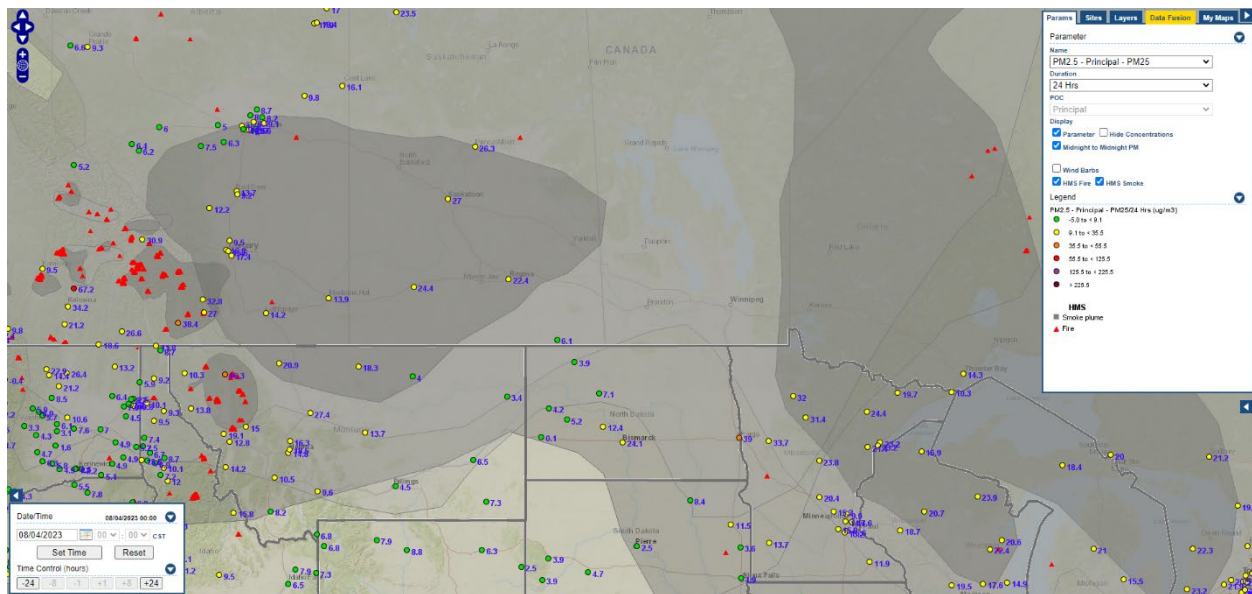
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on August 4, 2023.

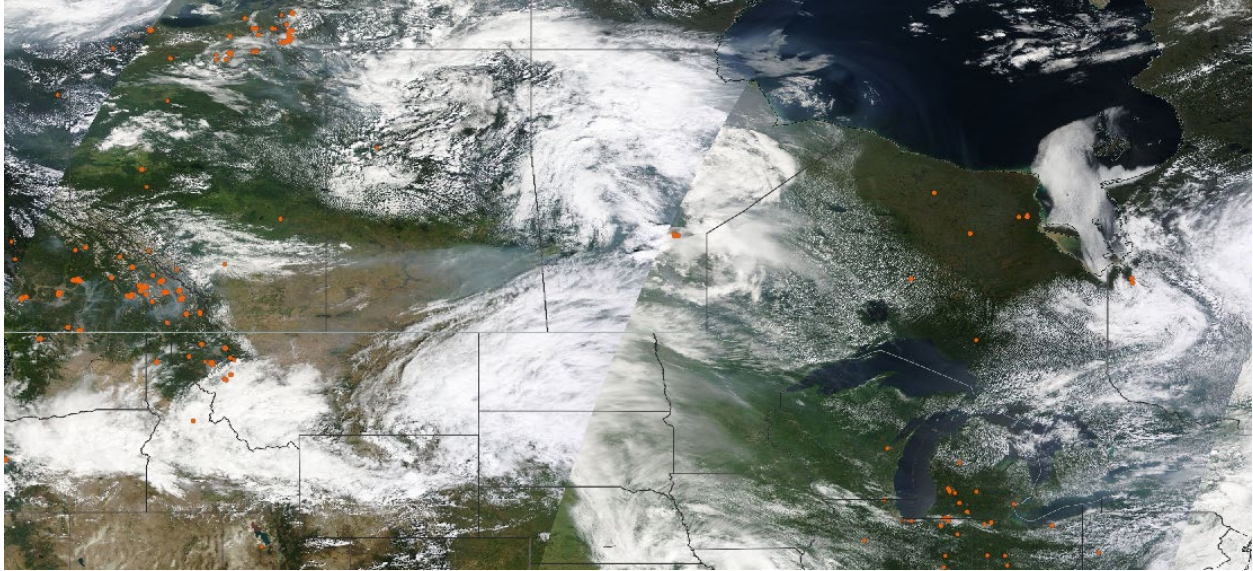
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Fargo NW	380171004	8/4/2023	73	Wildfire smoke



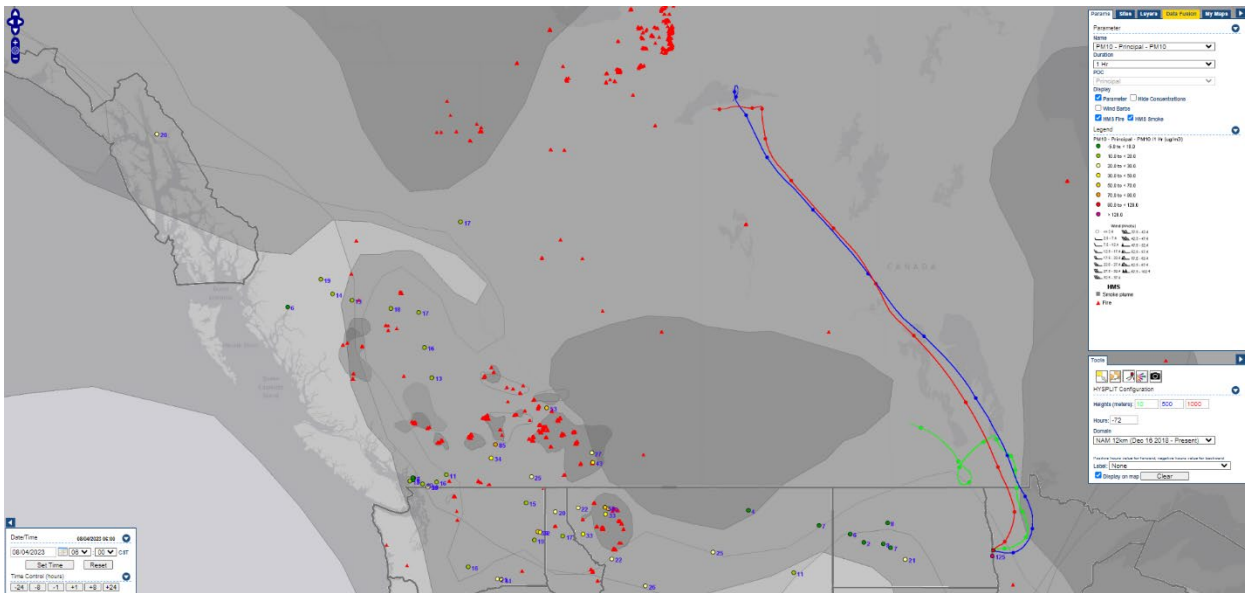
Analyzed smoke, hotspots, and 24-hour PM₁₀ on August 4, 2023.



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on August 4, 2023.



MODIS visible satellite for August 4, 2023.



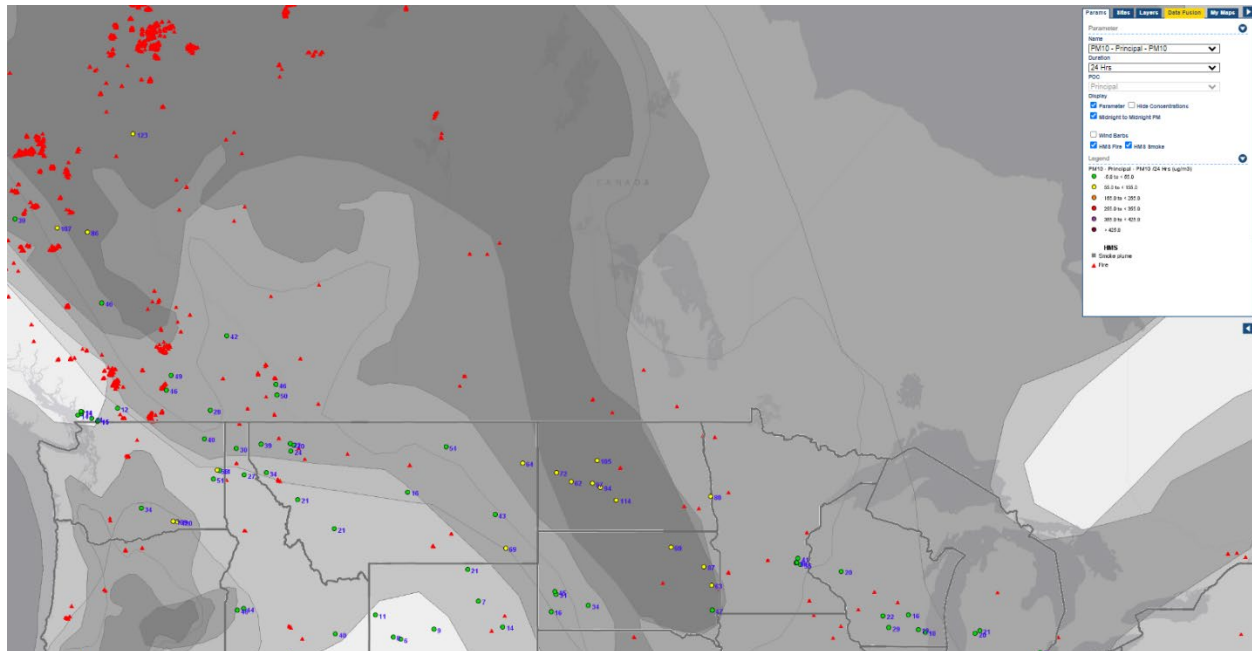
Backward trajectories for August 4, 2023.

8/29/2023 Impacts

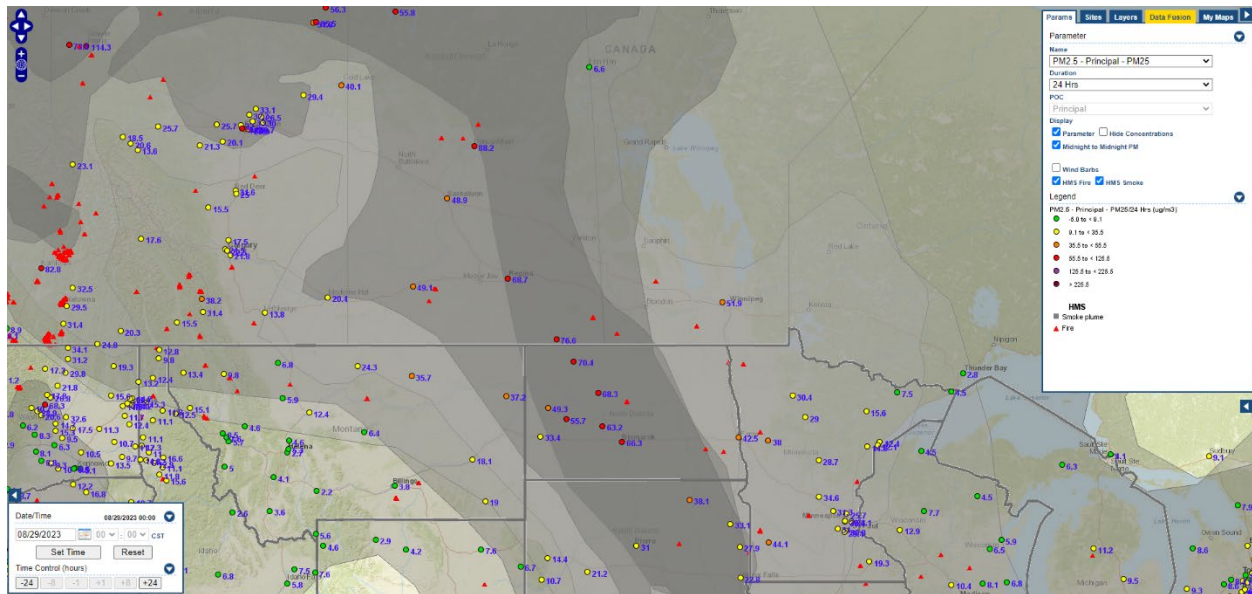
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on August 29, 2023.

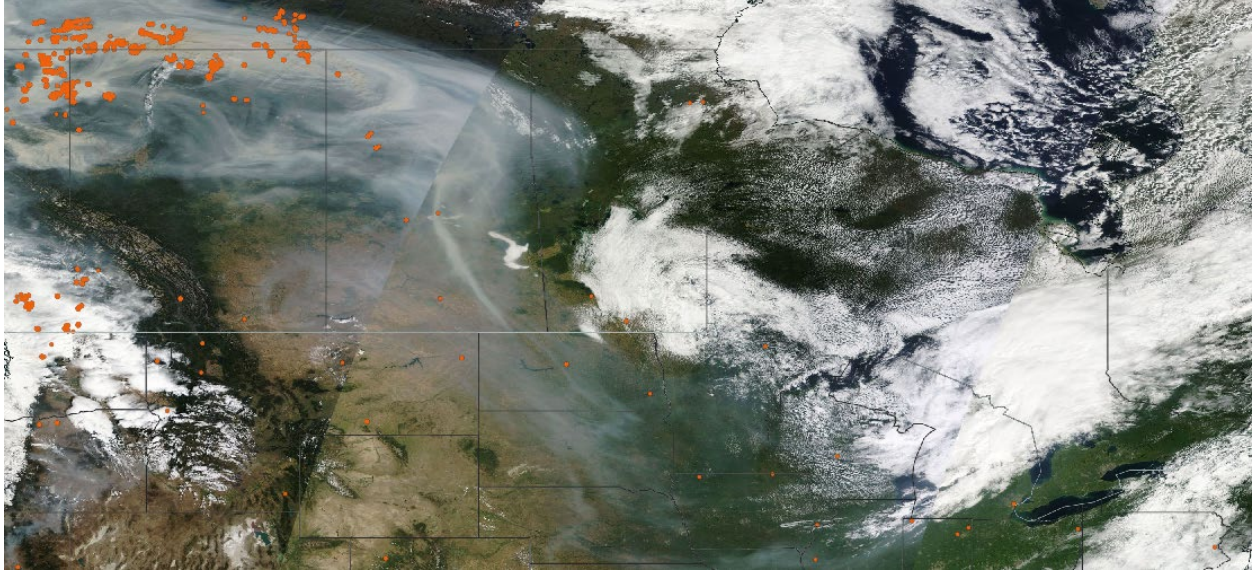
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Fargo NW	380171004	8/29/2023	80	Wildfire smoke



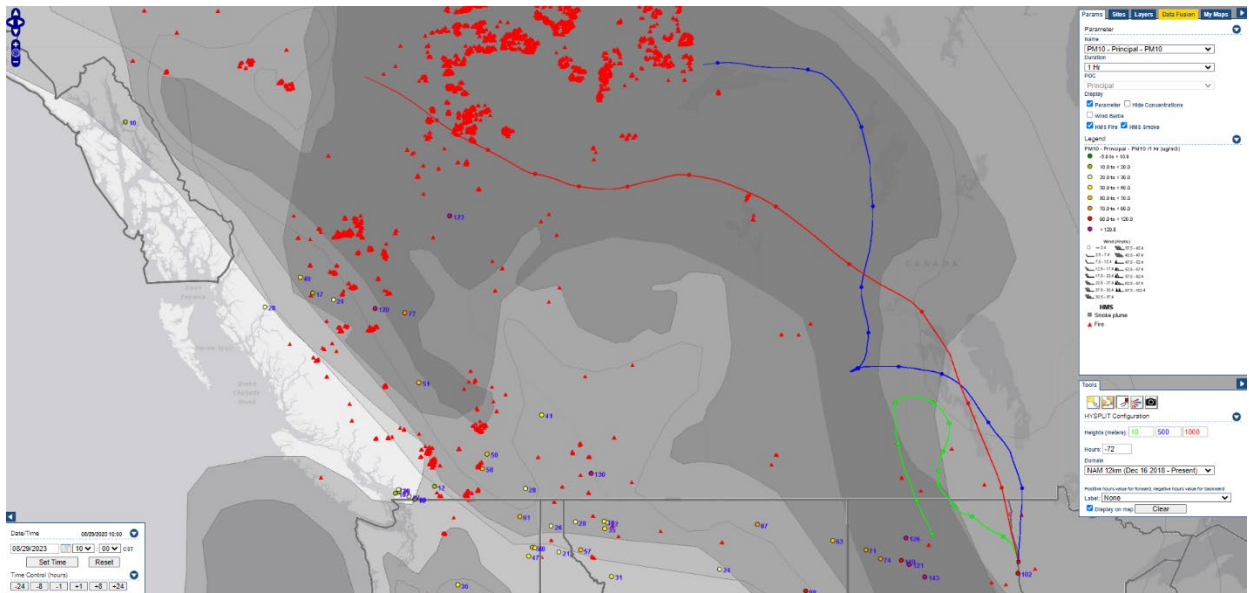
Analyzed smoke, hotspots, and 24-hour PM₁₀ on August 29, 2023.



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on August 29, 2023.



MODIS visible satellite for August 29, 2023.



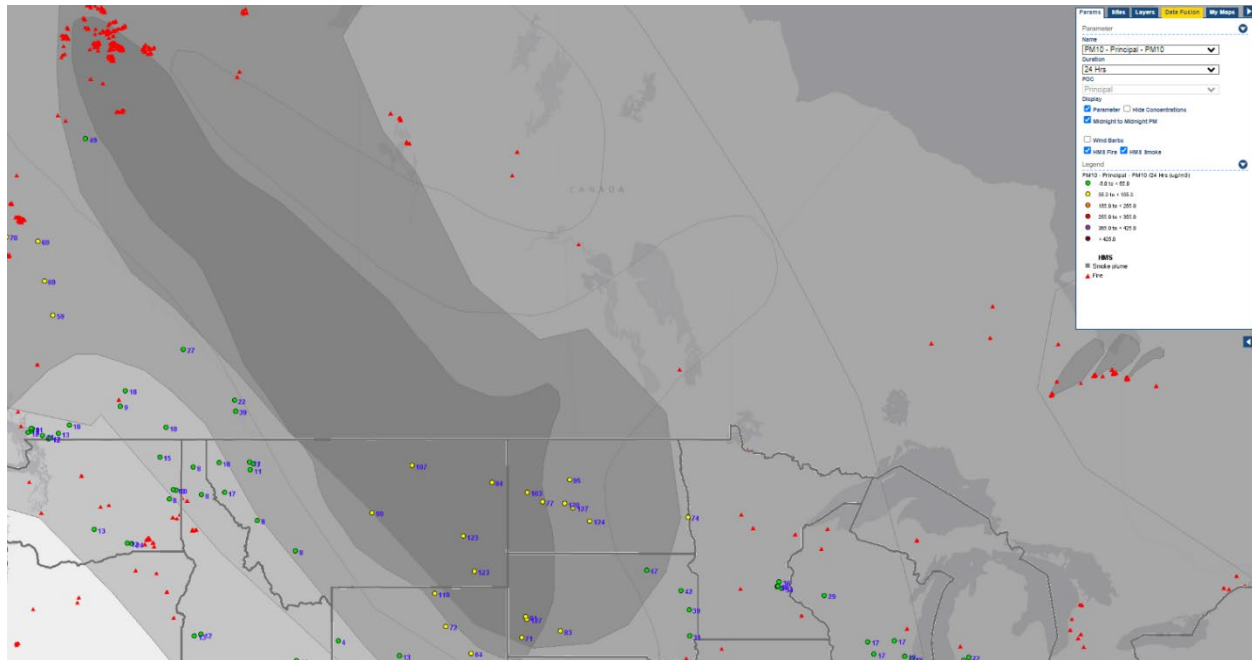
Backward trajectories for August 29, 2023.

9/5/2023 Impacts

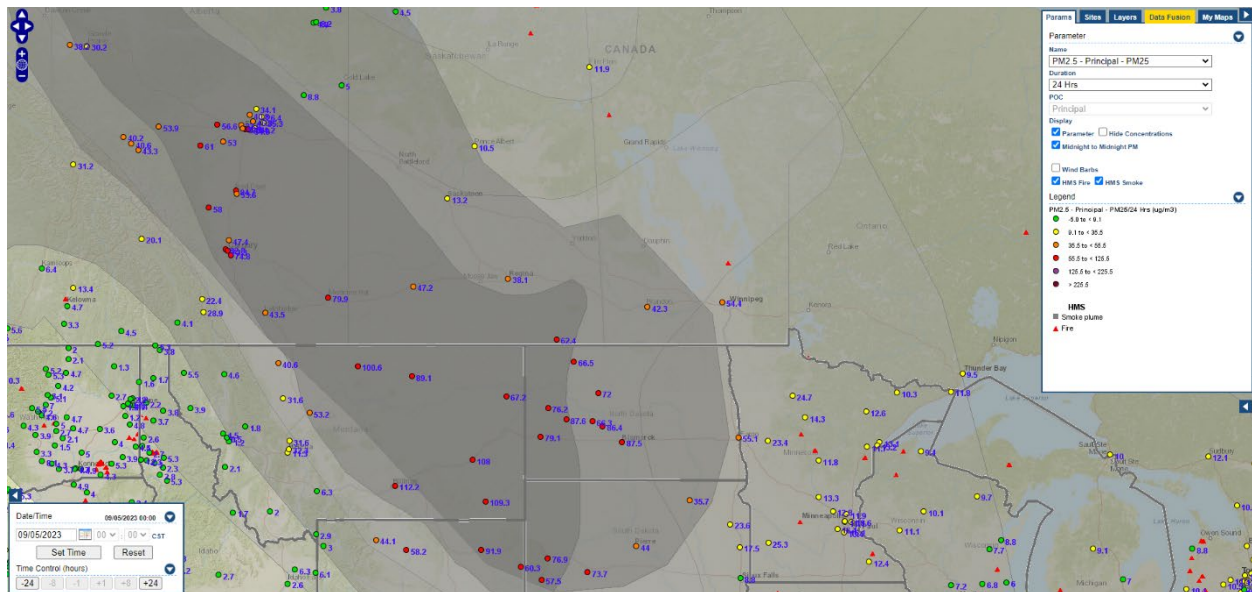
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on September 5, 2023.

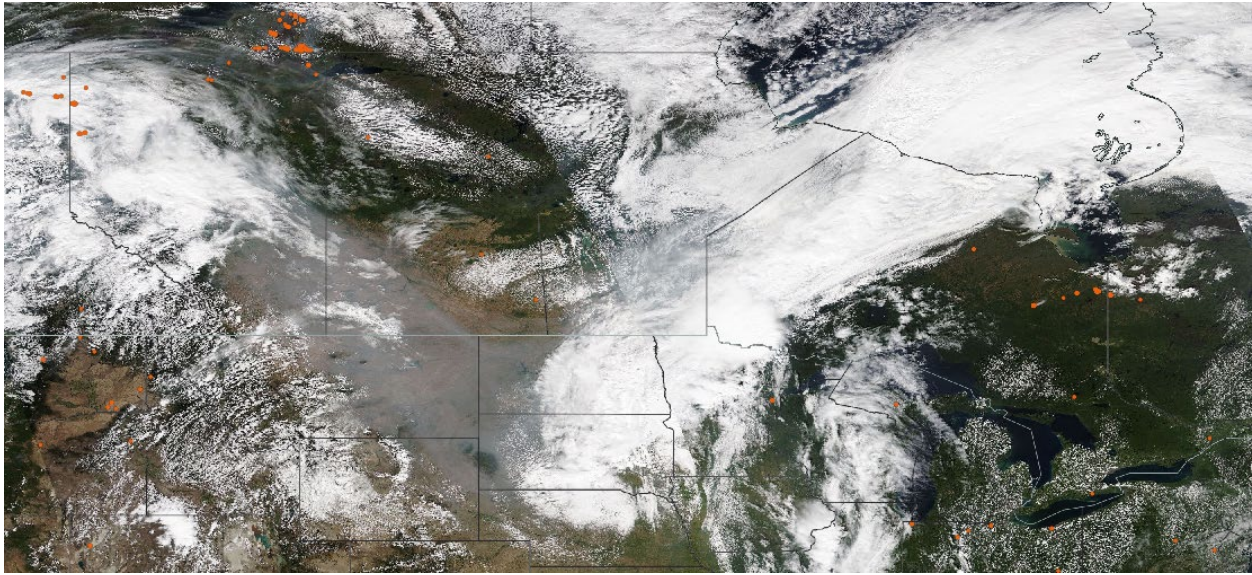
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Fargo NW	380171004	9/5/2023	74	Wildfire smoke



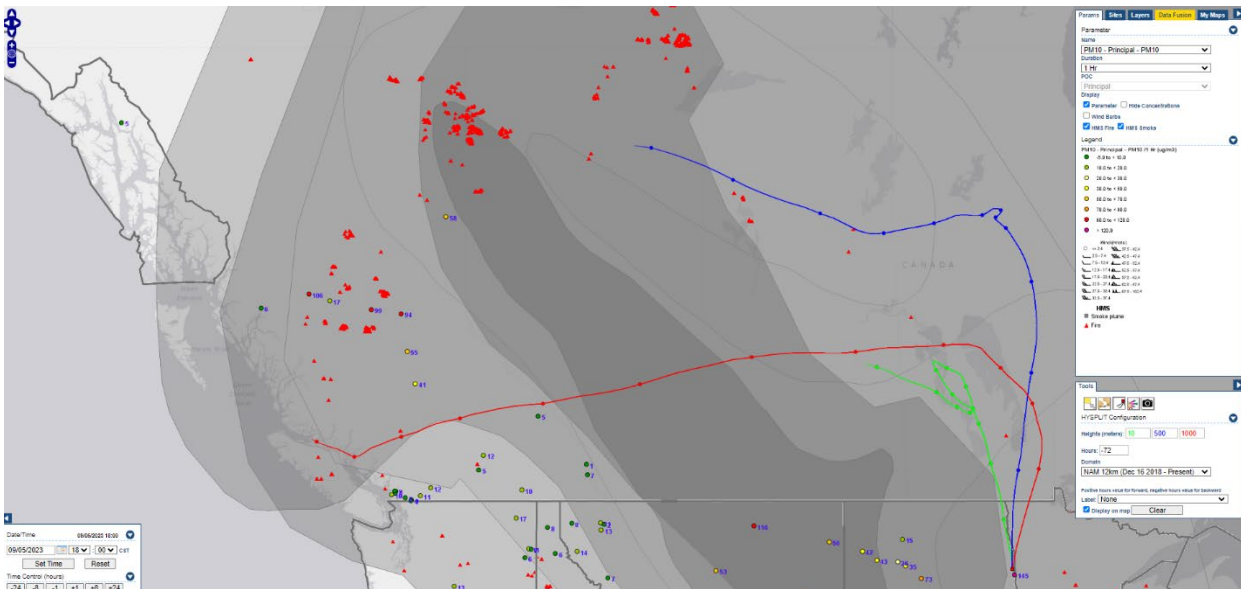
Analyzed smoke, hotspots, and 24-hour PM₁₀ on September 5, 2023.



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on September 5, 2023.



MODIS visible satellite for September 5, 2023.



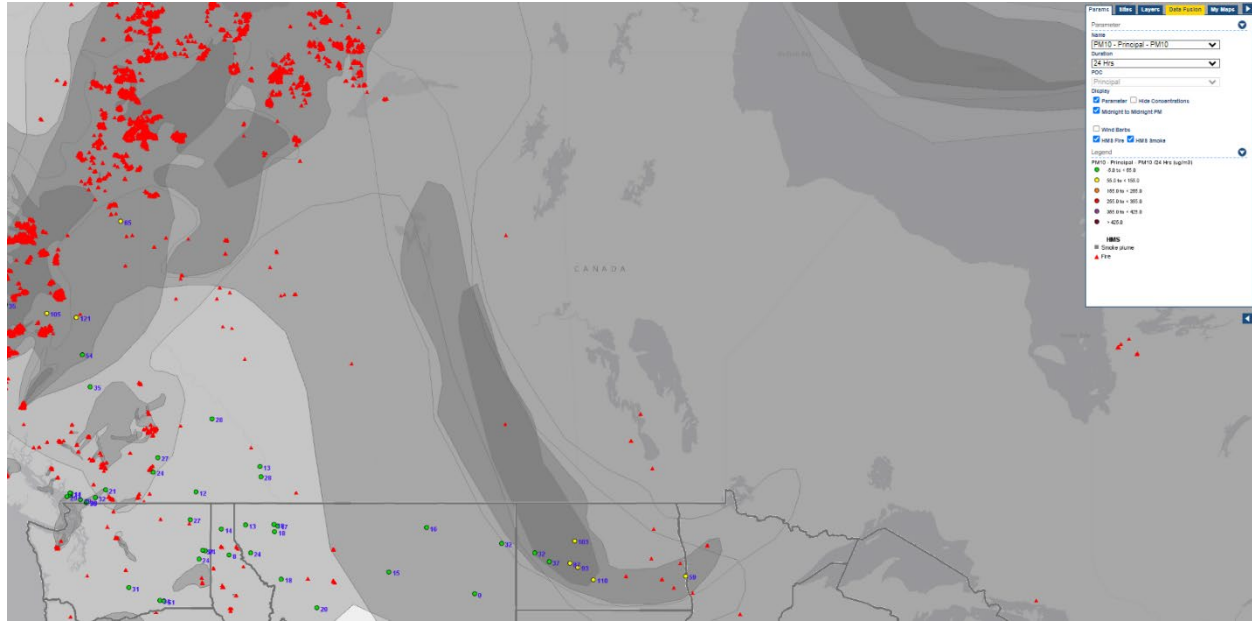
Backward trajectories for September 5, 2023.

9/15/2023 Impacts

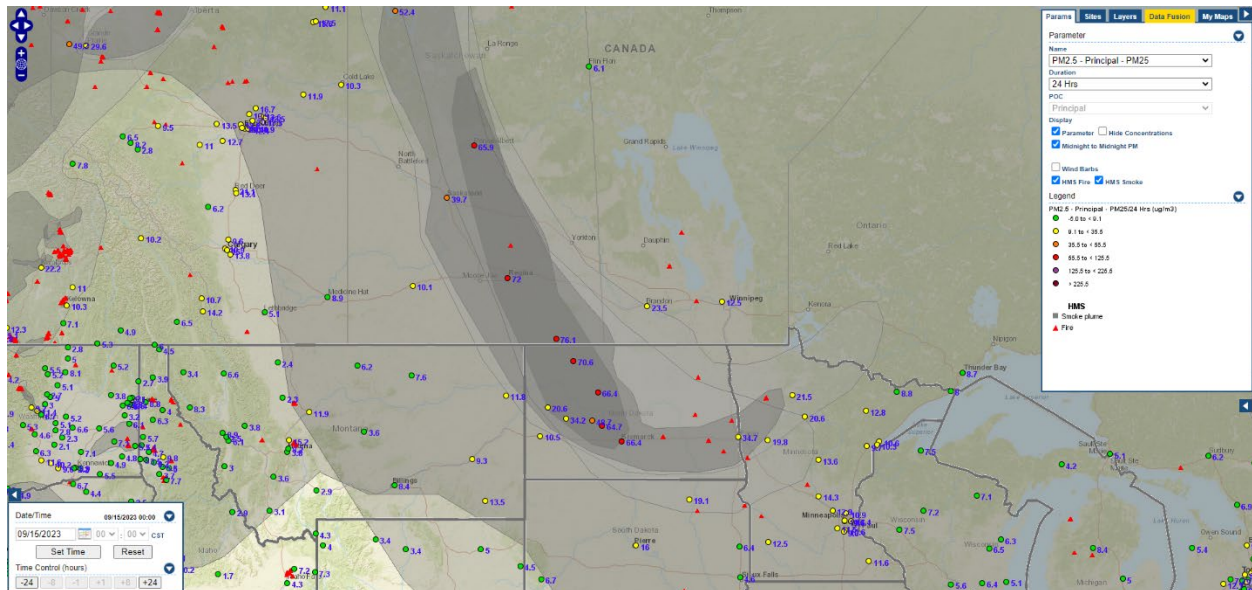
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on September 15, 2023.

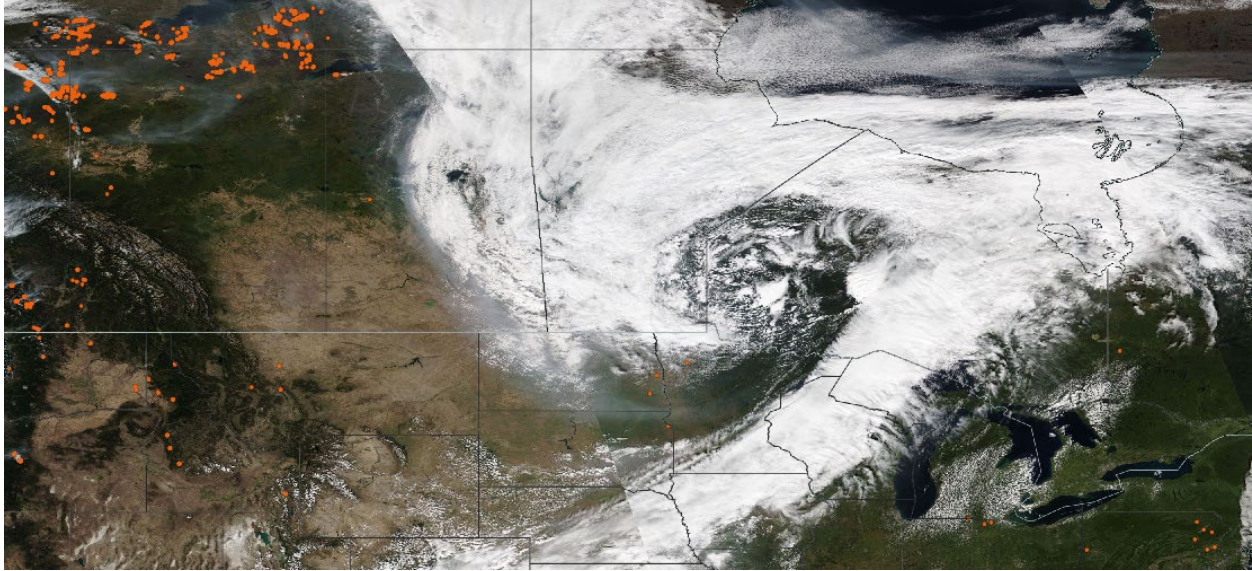
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Fargo NW	380171004	9/15/2023	59	Wildfire smoke



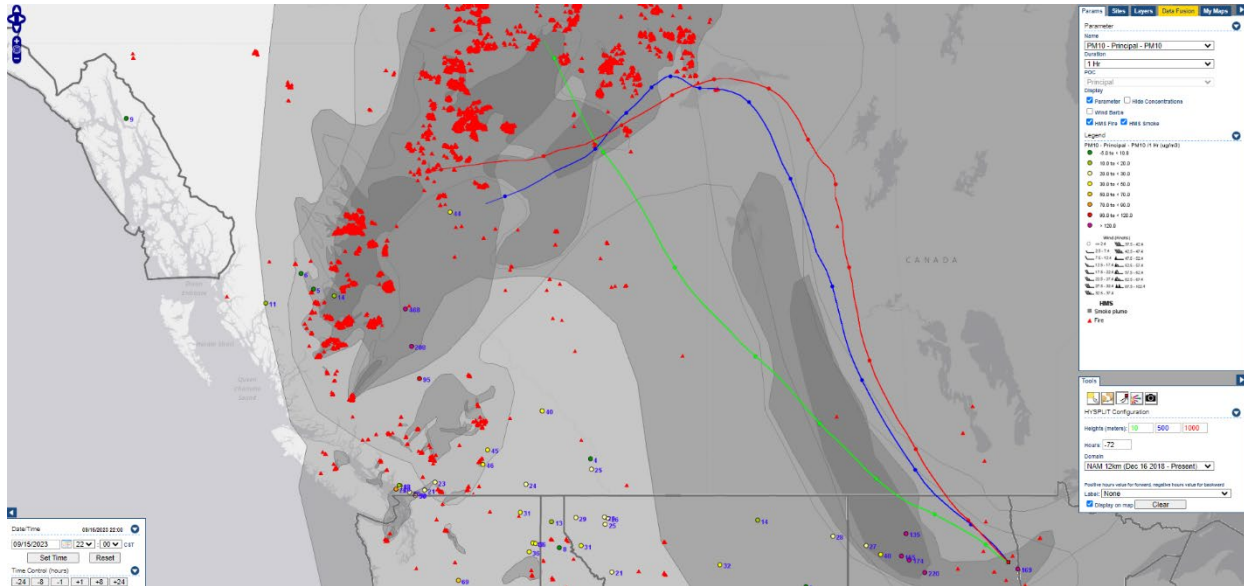
Analyzed smoke, hotspots, and 24-hour PM₁₀ on September 15, 2023.



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on September 15, 2023.



MODIS visible satellite for September 15, 2023.



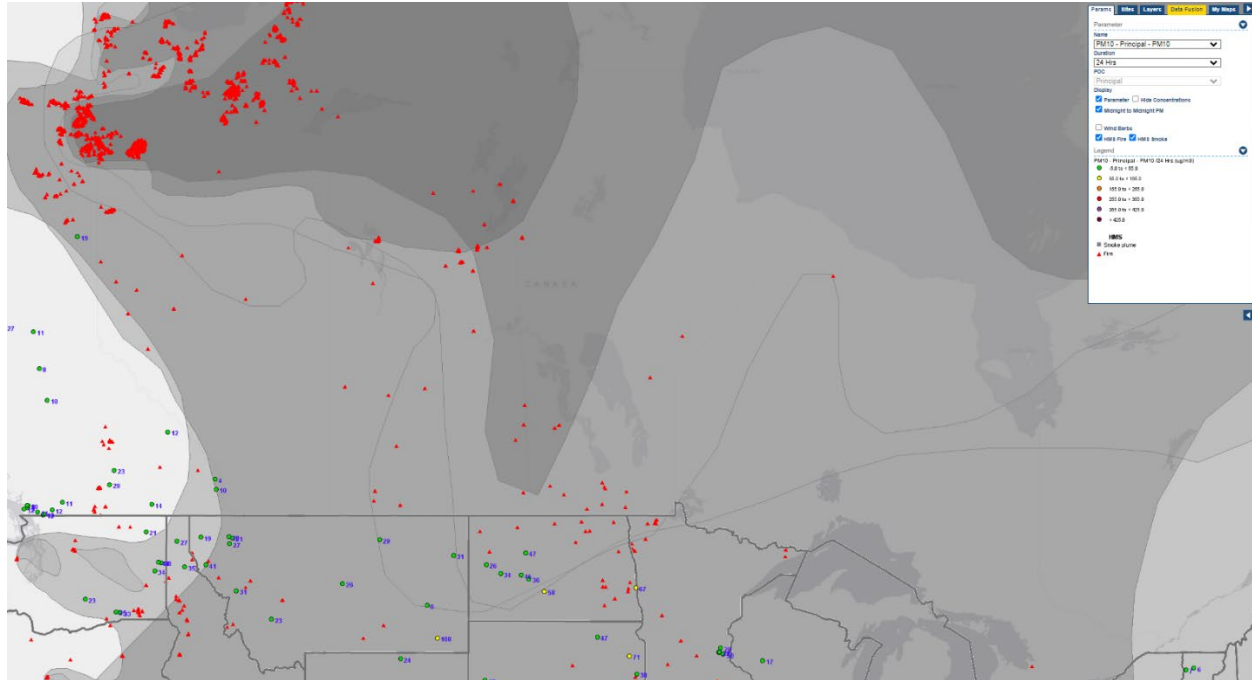
Backward trajectories for September 15, 2023.

9/19/2023 Impacts

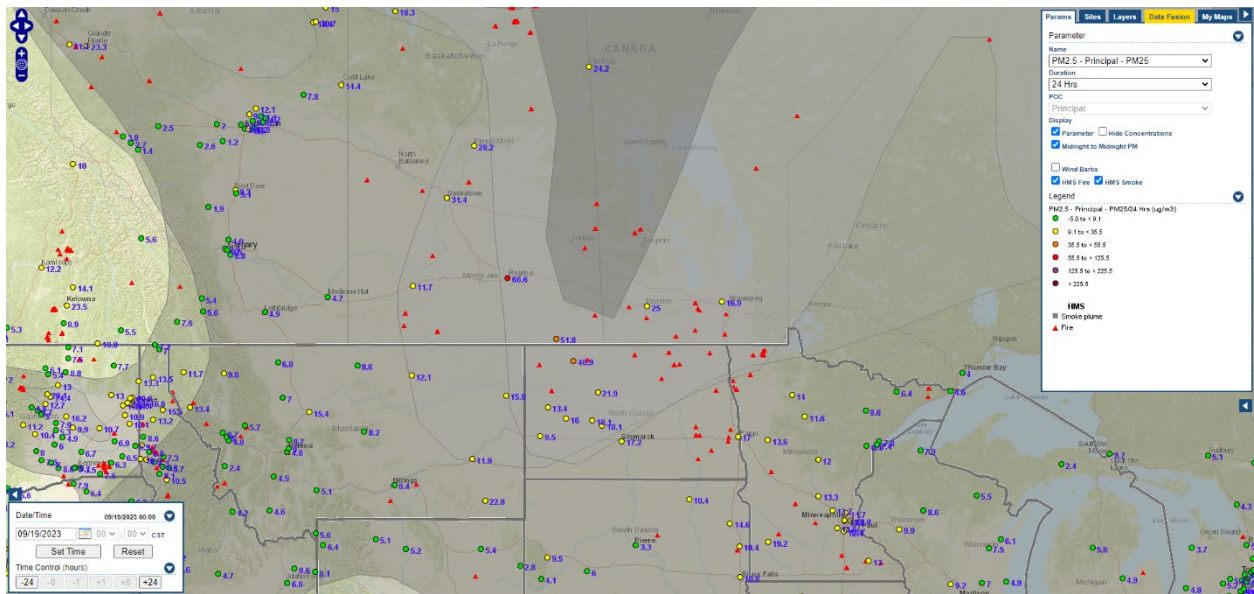
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on September 19, 2023.

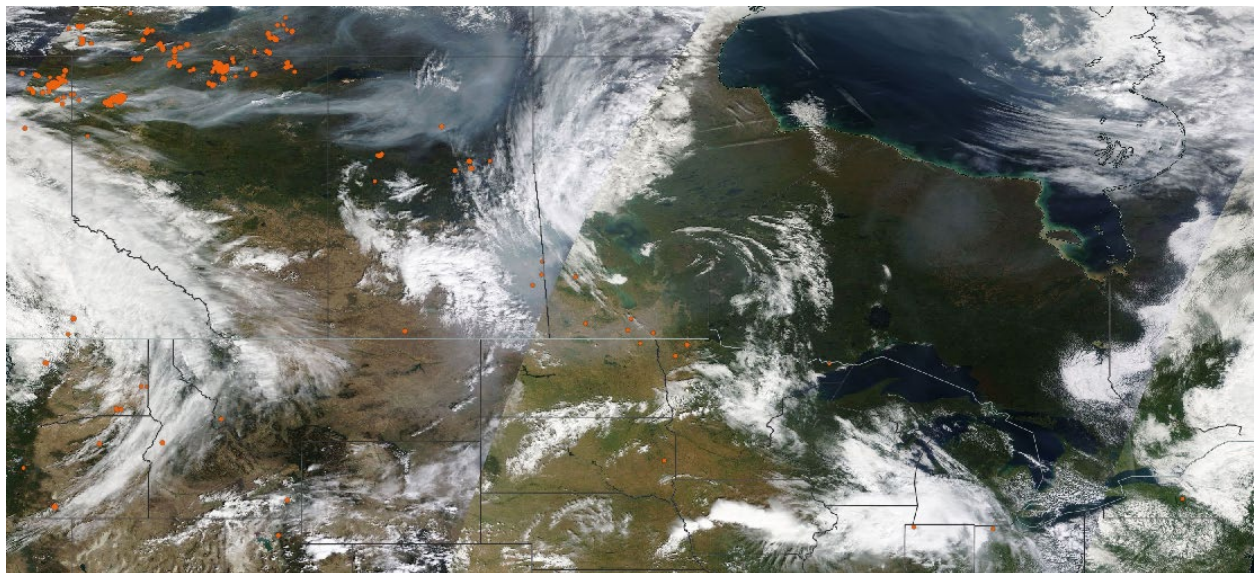
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Fargo NW	380171004	9/19/2023	67	Wildfire smoke



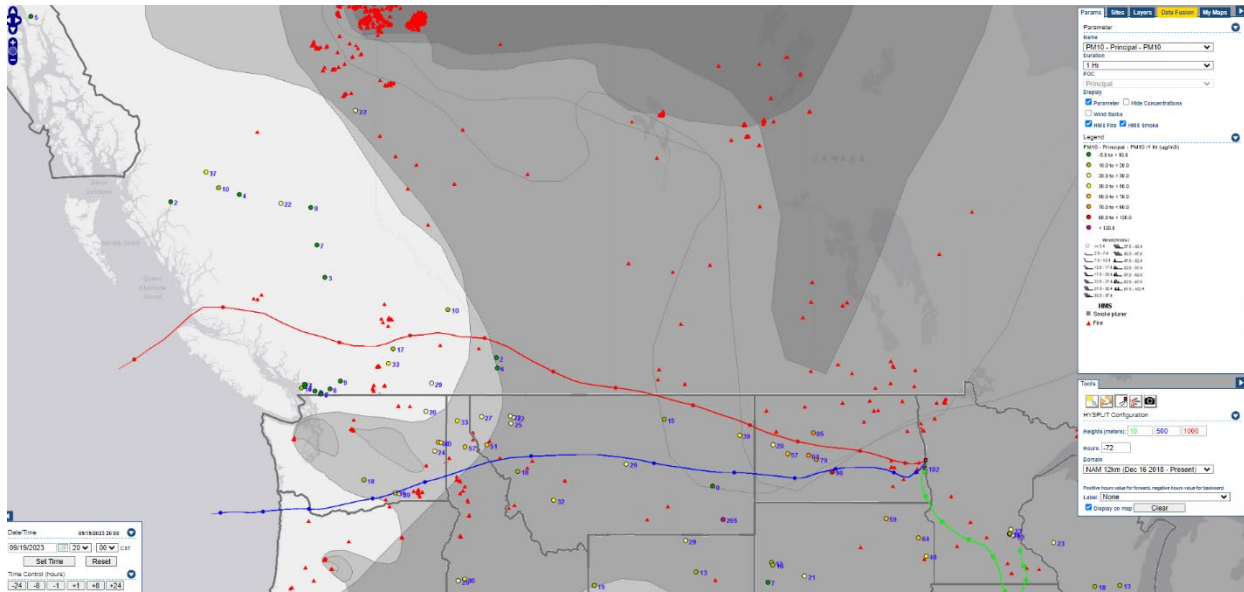
Analyzed smoke, hotspots, and 24-hour PM₁₀ on September 19, 2023.



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on September 19, 2023.



MODIS visible satellite for September 19, 2023.



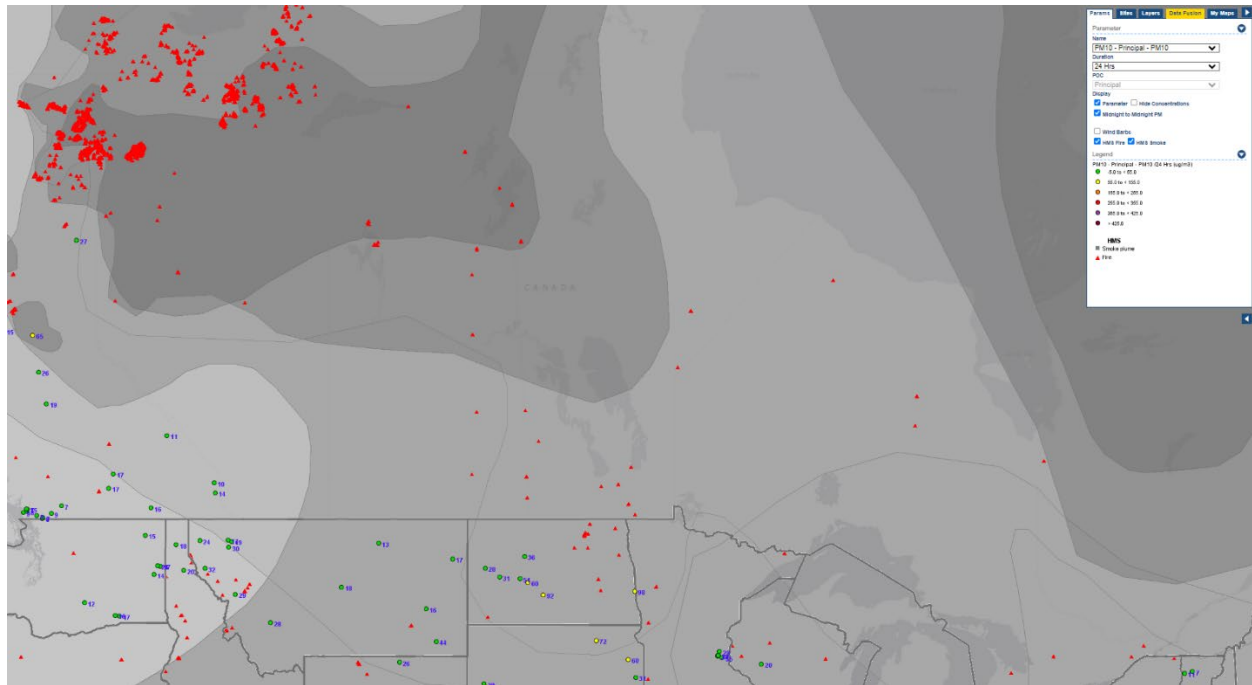
Backward trajectories for September 19, 2023.

9/20/2023 Impacts

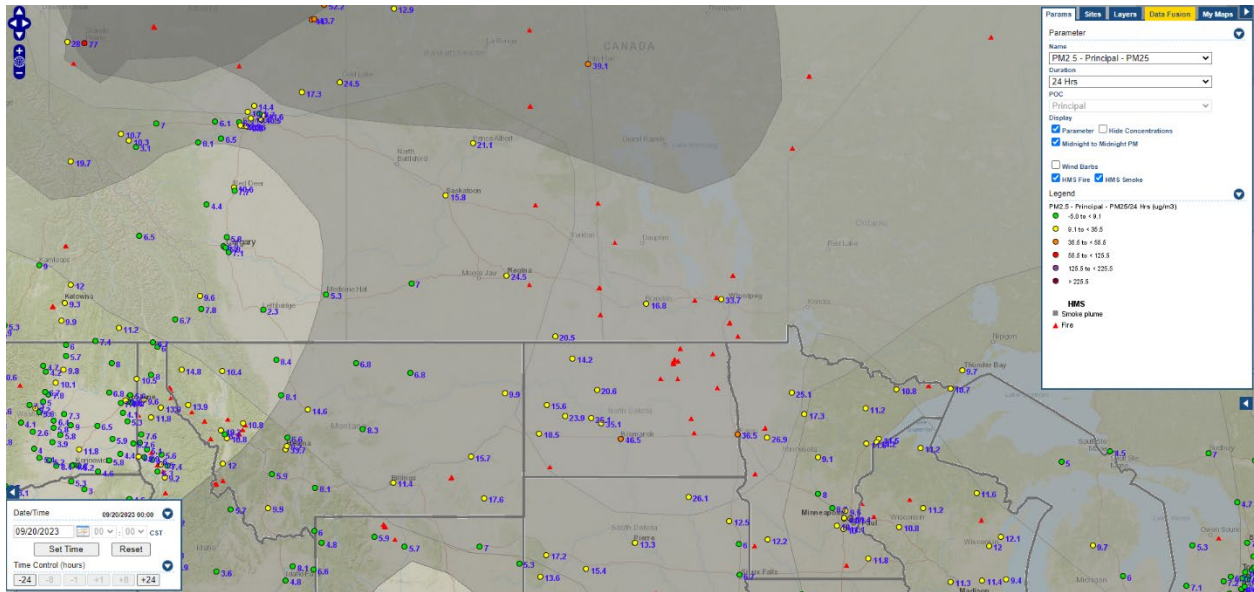
Heavy smoke impacts from wildfires over Canada.

Monitored 24-hour PM₁₀ concentrations impacted by smoke on September 20, 2023.

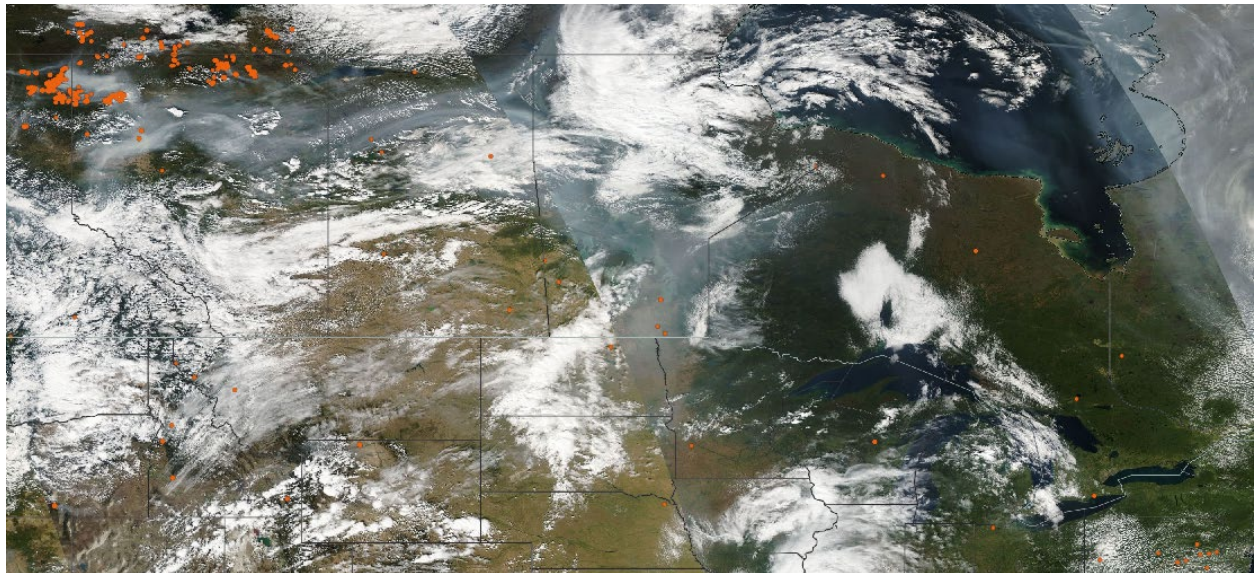
Site	Site AQS	Date (LST)	Daily average (µg/m ³)	Notes
Fargo NW	380171004	9/20/2023	98	Wildfire smoke



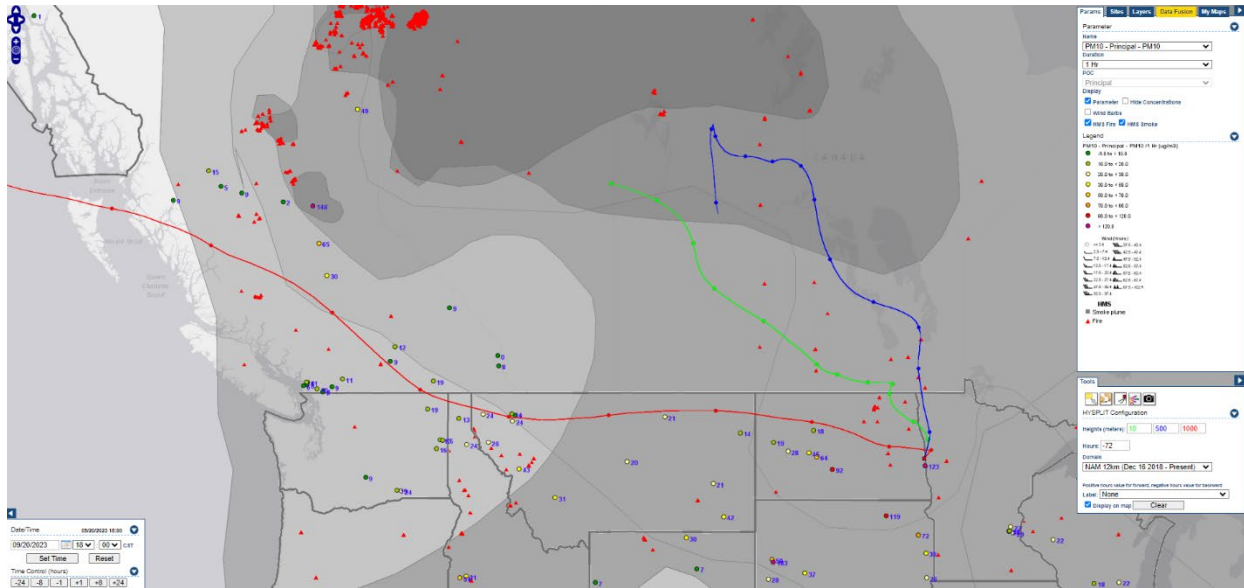
Analyzed smoke, hotspots, and 24-hour PM₁₀ on September 20, 2023.



Analyzed smoke, hotspots, and 24-hour PM_{2.5} on September 20, 2023.



MODIS visible satellite for September 20, 2023.



Backward trajectories for September 20, 2023.