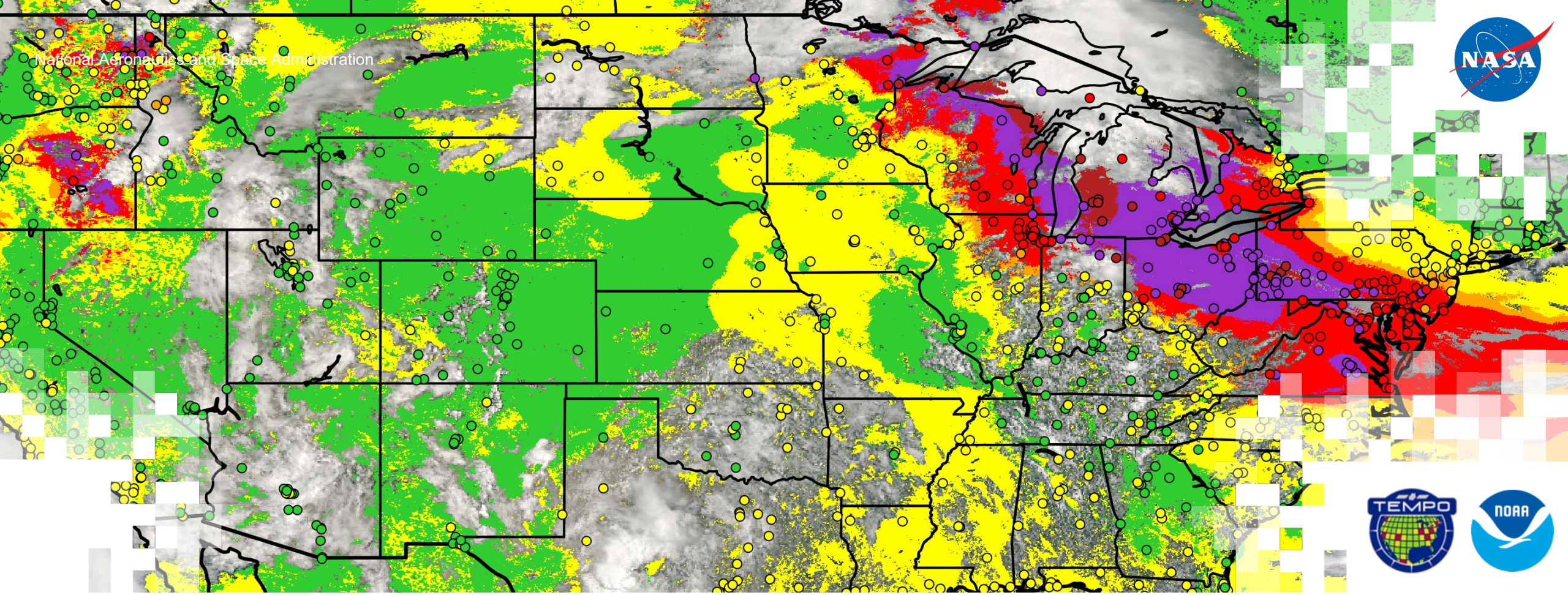


Geostationary Remote Sensing of Aerosols for Air Quality Applications in North America

Part 2: Analyzing TEMPO Aerosol Products Imagery for Smoke and Dust Case Study Events using NOAA's AerosolWatch

Caterina Mogno (UMBC & NASA GSFC), Amy Huff (STC at NOAA/NESDIS)

October 15, 2026

Training Outline

Part 1

NOAA's TEMPO Aerosol Products for Hourly Aerosol Monitoring over North America

October 13, 2026

Part 2

Analyzing TEMPO Aerosol Products Imagery for Smoke and Dust Case Study Events using NOAA's AerosolWatch

October 15, 2026

Homework

Opens Oct 15 – Due Oct 29 – Posted on Training Webpage

A certificate of completion will be awarded to those who attend all live sessions and complete the homework assignment(s) before the given due date.

Part 2 – Trainers

Caterina Mogno

Assistant Research Scientist

University of Maryland Baltimore County & NASA GSFC



Amy Huff

Senior Scientist
STC at NOAA/NESDIS

Aerosols Science Team



Part 2 Objectives

By the end of Part 2, participants will be able to:

3. Use the AerosolWatch website to visualize near real-time and archived hourly TEMPO aerosol product imagery.
4. Interpret TEMPO aerosol imagery on AerosolWatch to analyze smoke and blowing dust events and anticipate their air quality impacts.

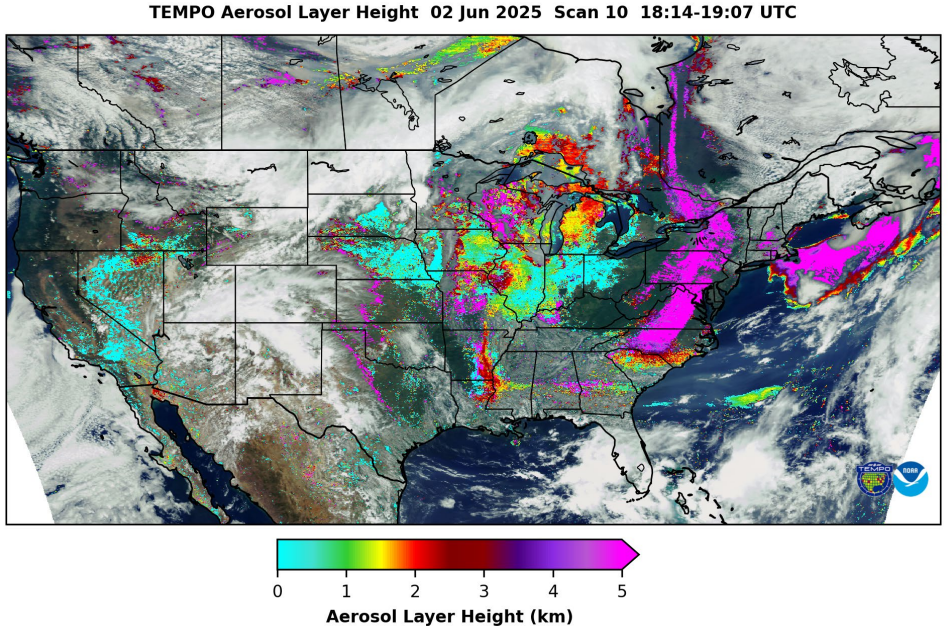
Part 2 Outline

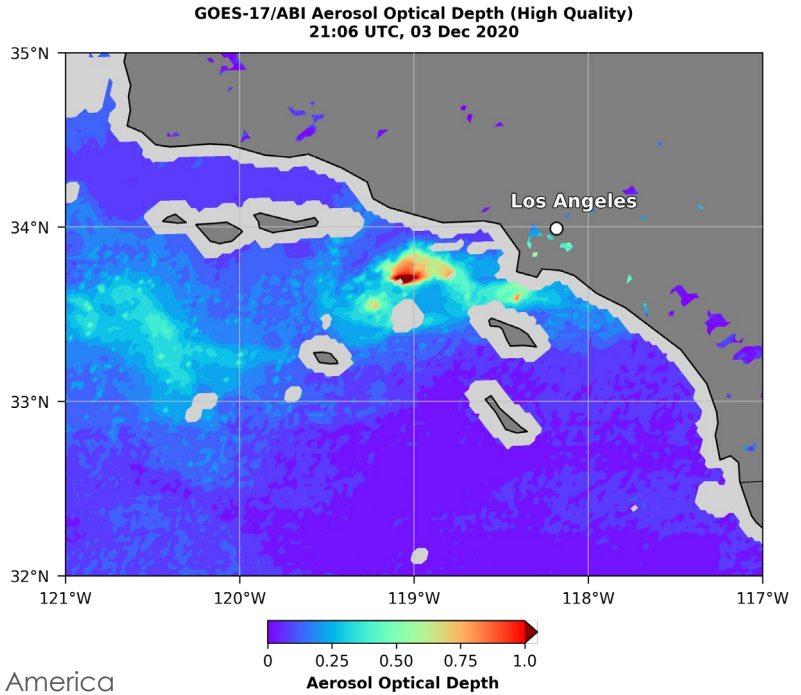
- Overview of the AerosolWatch Website
- Case study 1: smoke event, exercise with AerosolWatch
- Case study 2: dust storm event, exercise with AerosolWatch
- Data Access and Resources
- Summary
- Q&A session

Recap of Part 1

Geostationary air quality monitoring over North America: **TEMPO and the GOES-R ABI**

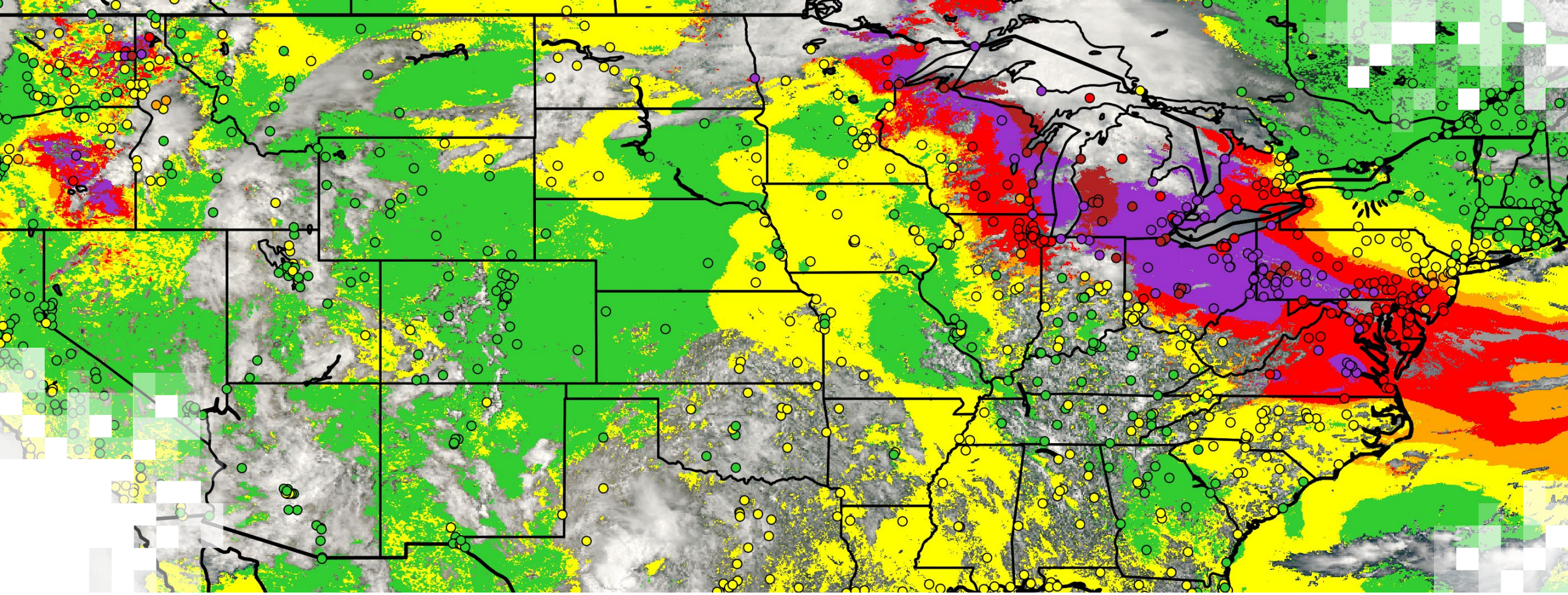
	TEMPO	GOES-R ABI
Bands	UV-Visible hyperspectral	Visible/Infrared
Focus	Trace gases, aerosols	Active fires, aerosols transport
Resolution	Hourly (daytime)	Minute-scale
Aerosol Products	AOD, UV AAI, Smoke/Dust Mask, ALH, surface PM2.5	AOD, Smoke/Dust Mask, Dust RGB
Vertical Info	ALH	-
Latency	~2-3 hr	Near-real-time





How to Ask Questions

- To ensure we see your question, please locate the three dots ... to the bottom right of your training window.
- You will see a Slido/Q&A option. You may also see a standalone Slido tab or app.
- Please place all questions there and we will answer them during the Q&A session.
- We will try to get to all of the questions during the Q&A session after the webinar. The remainder of the questions will be answered in the Q&A document, which will be posted to the training website about a week after the training.



Overview of the AerosolWatch Website

NOAA's AerosolWatch Website

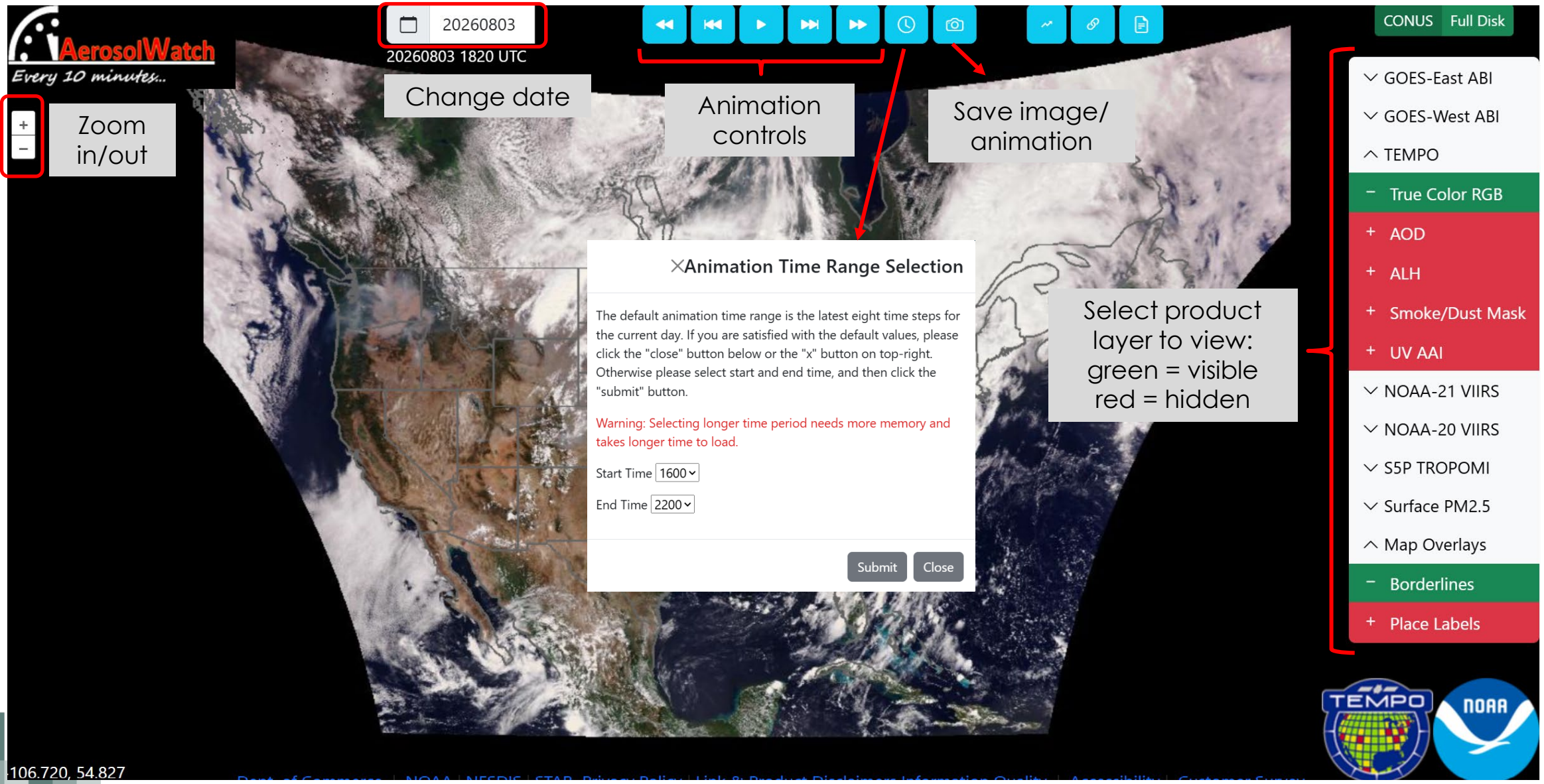
- AerosolWatch website developed by Hai Zhang (STC) & Shobha Kondragunta (NOAA)
- Designed for operational air quality community & emergency responders
- Aerosol & fire product imagery from geostationary & polar-orbiting satellites (see next slide)
- Updated in near real time (NRT)!
  - GOES-East & -West ABI imagery latency ~20 min
  - TEMPO imagery operational latency will be ~2 hours; current research product latency can be longer
- All imagery is archived!
- Complementary products also available to aid aerosol interpretation:
  - GeoColor/True Color RGB and Dust RGB composite imagery
  - AirNow 1-hour & 24-hour average surface $PM_{2.5}$

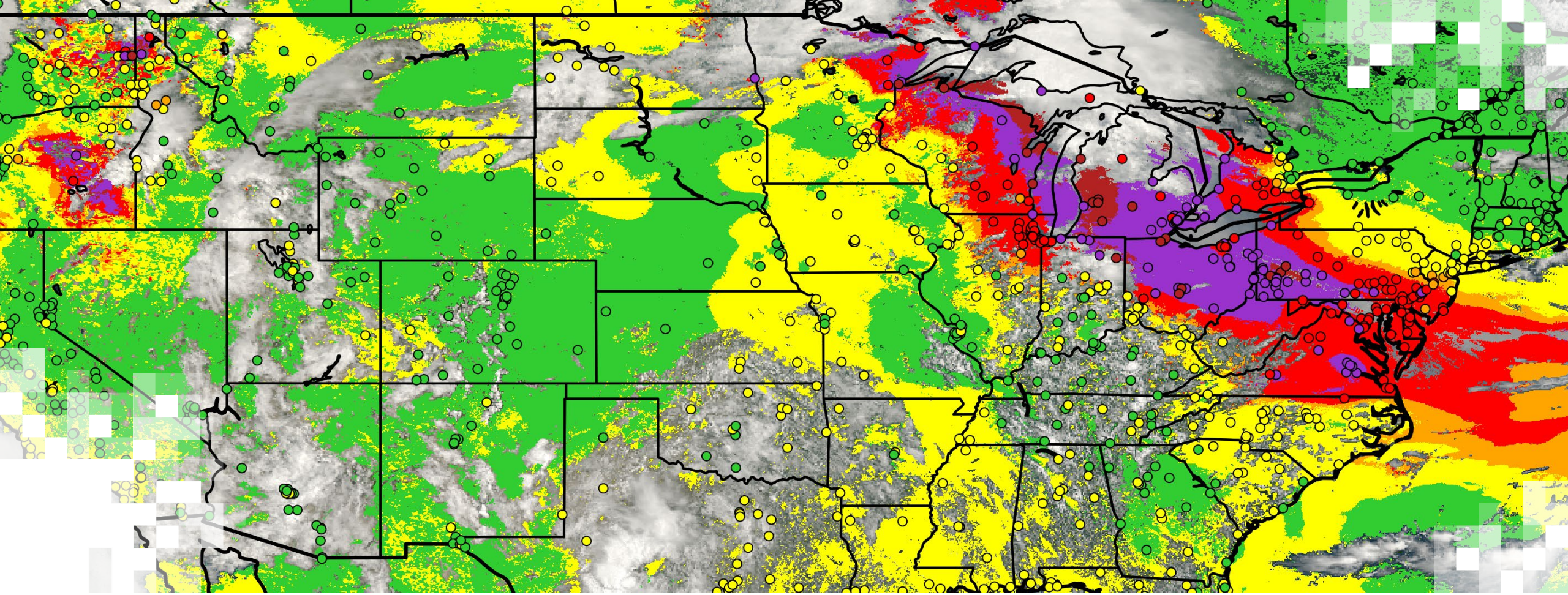


Geostationary (and Polar-Orbiting) Satellite Imagery on AerosolWatch

Satellite	Sensor	Aerosol & Related Product Imagery	Coverage	Archive Starts
GOES-East	ABI	Aerosol Optical Depth (AOD) Aerosol Detection smoke/dust mask (ADP) Fire Radiative Power (FRP) GeoColor Dust RGB	CONUS, Full Disk	January 2018
GOES-West		Aerosol Optical Depth (AOD) Aerosol Detection smoke/dust mask (ADP) GeoColor	Western CONUS	February 2020
SNPP	VIIRS	Aerosol Optical Depth (AOD) Aerosol Detection smoke/dust mask (ADP) Fire Radiative Power (FRP) True Color RGB Dust RGB Fire RGB Daily (24-hour average) estimated surface $PM_{2.5}$	North & Central America (including Alaska)	January 2018
NOAA-20				June 2019
NOAA-21				July 2026
Sentinel 5-P	TROPOMI	Carbon monoxide (CO)		July 2022
IS-40e	TEMPO	Aerosol Optical Depth (AOD) Aerosol Layer Height (ALH) Aerosol Detection smoke/dust mask (ADP) UV Absorbing Aerosol Index (AAI) True Color RGB Hourly (1-hour average) estimated surface $PM_{2.5}$	Southern Canada, CONUS, Mexico, Caribbean	September 2025

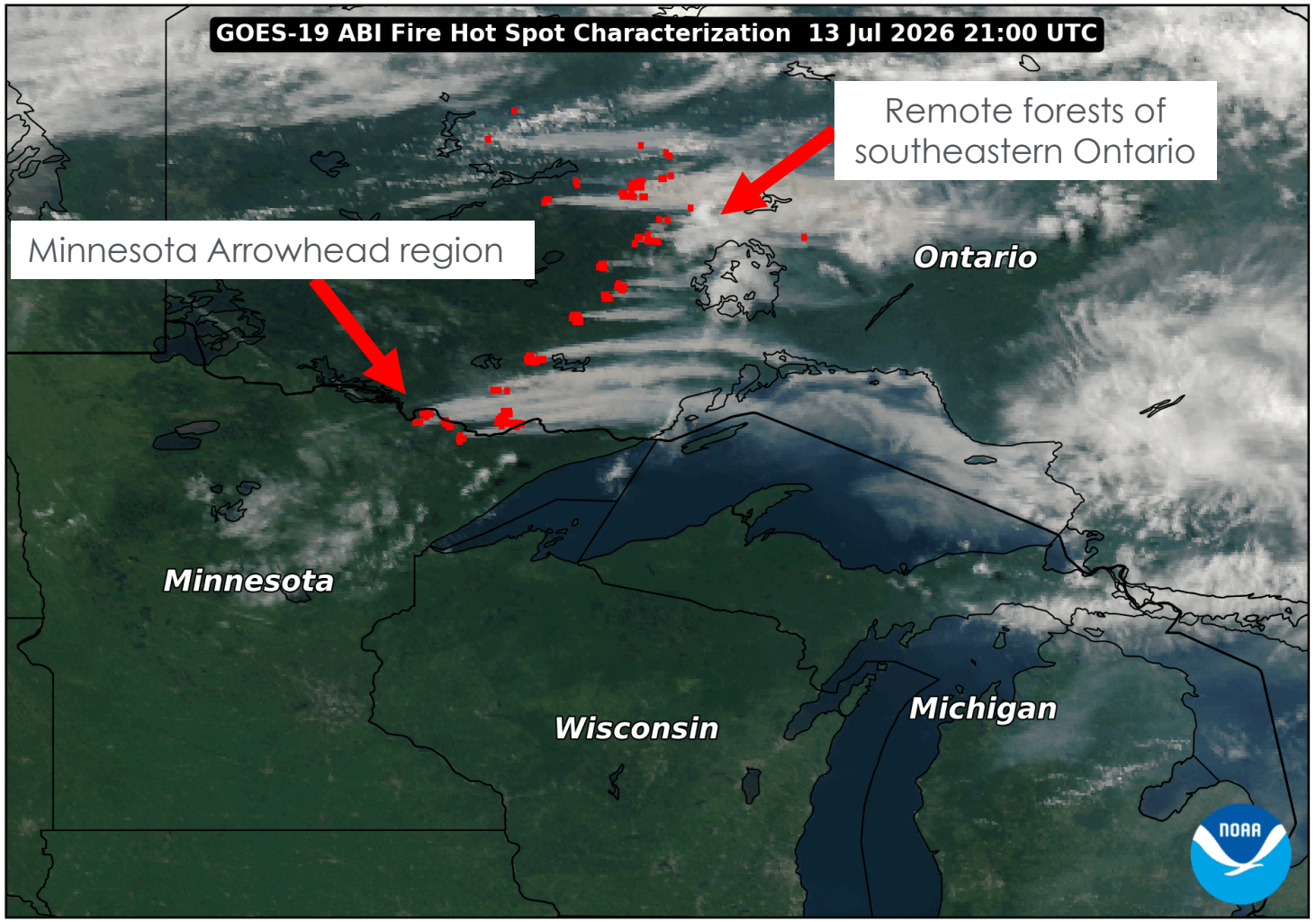
Navigating the AerosolWatch Website





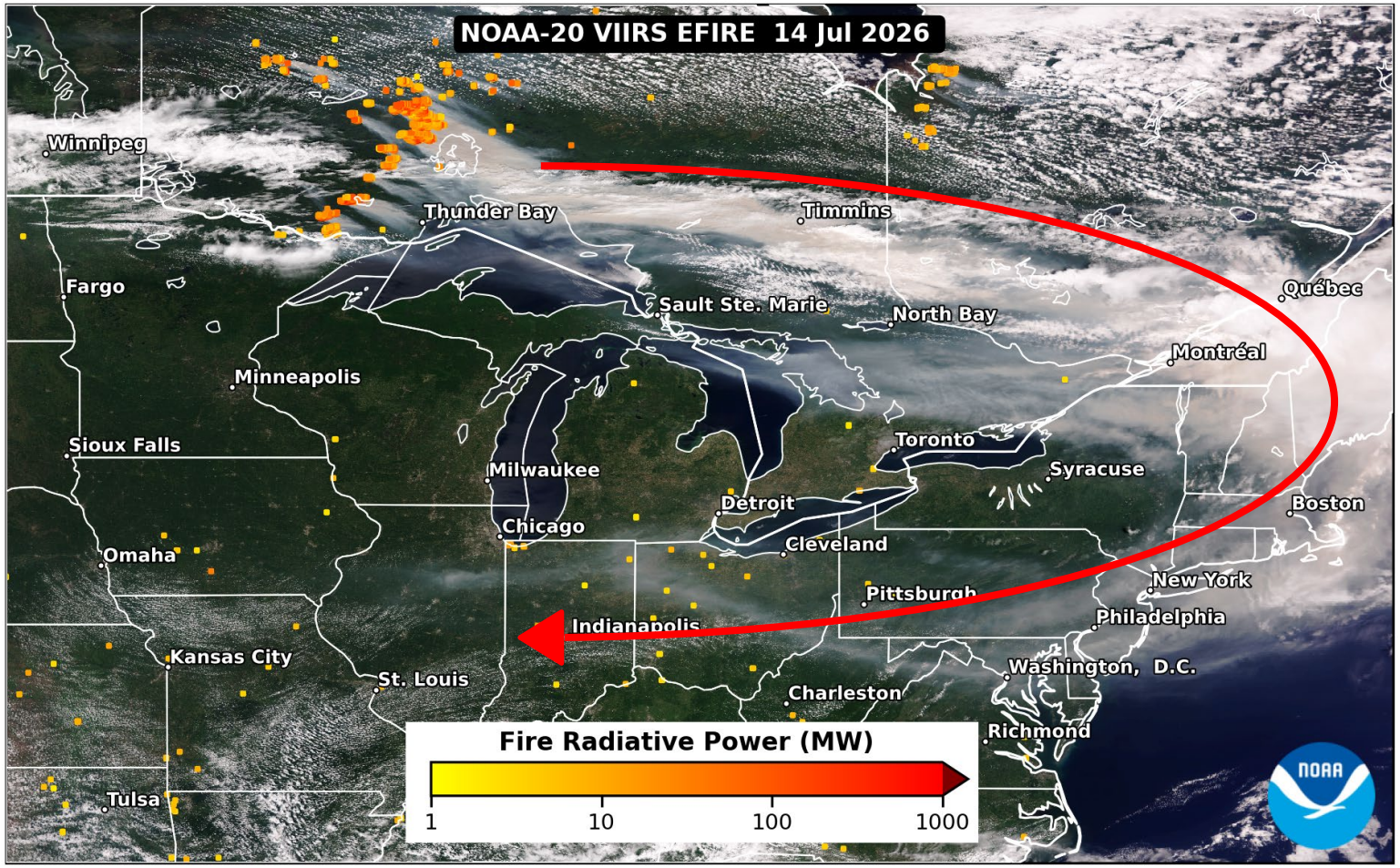
Case 1: Smoke Transport from Wildfires in Ontario, Canada
July 14, 2026

Wildfires Ignited in Ontario & Minnesota on July 13, 2026



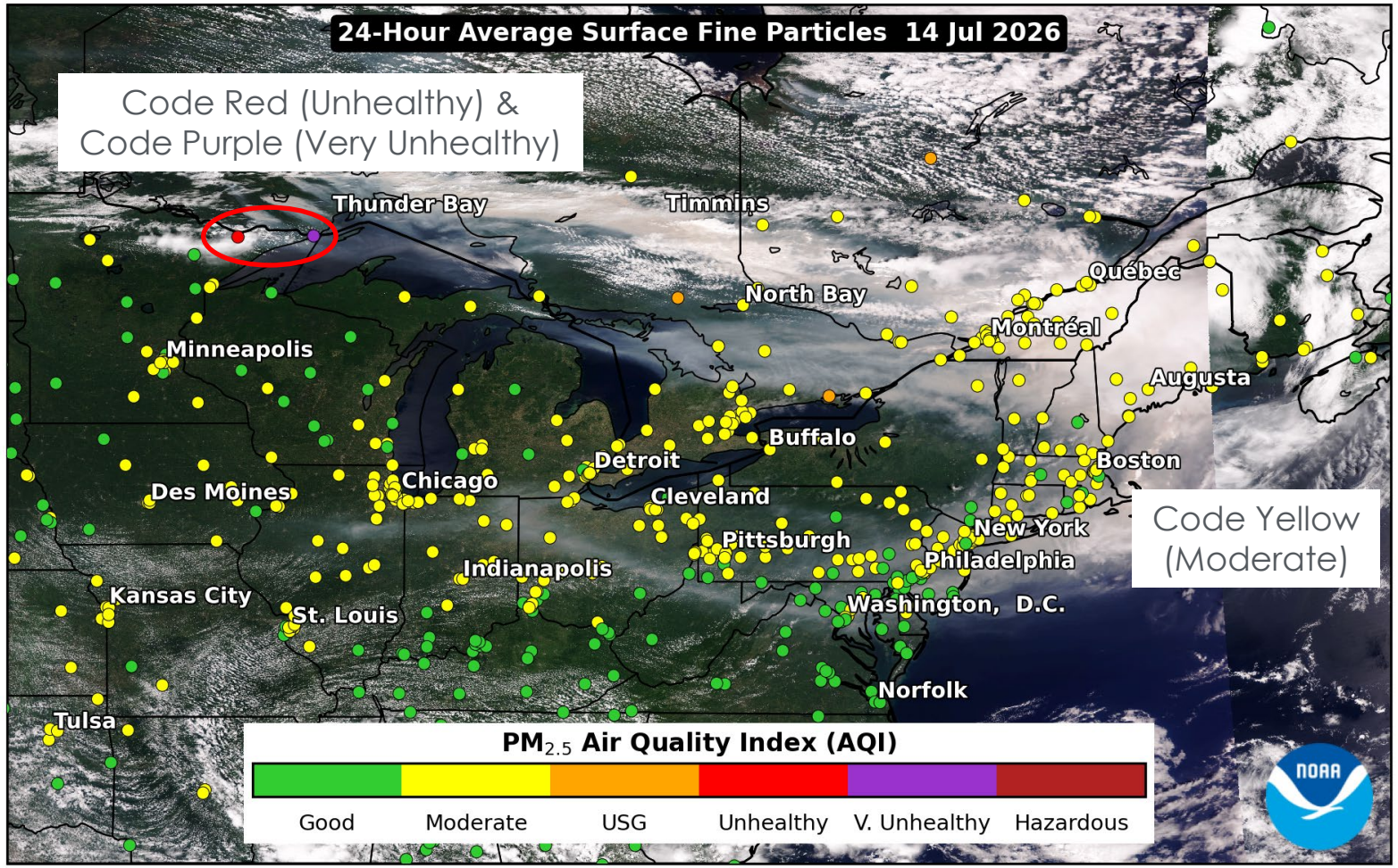
- Numerous wildfires (red dots) ignited in the afternoon of July 13.
- Wildfires underwent **explosive growth**, emitting large plumes of very thick, brown-colored smoke that blew eastward.

Wildfire Smoke Transported East & South on July 14, 2026



- A "heat dome" over the CONUS drove wildfire smoke in a clockwise loop: eastward over Ontario/Québec, south over New England, then west across the Mid-Atlantic-Midwest.

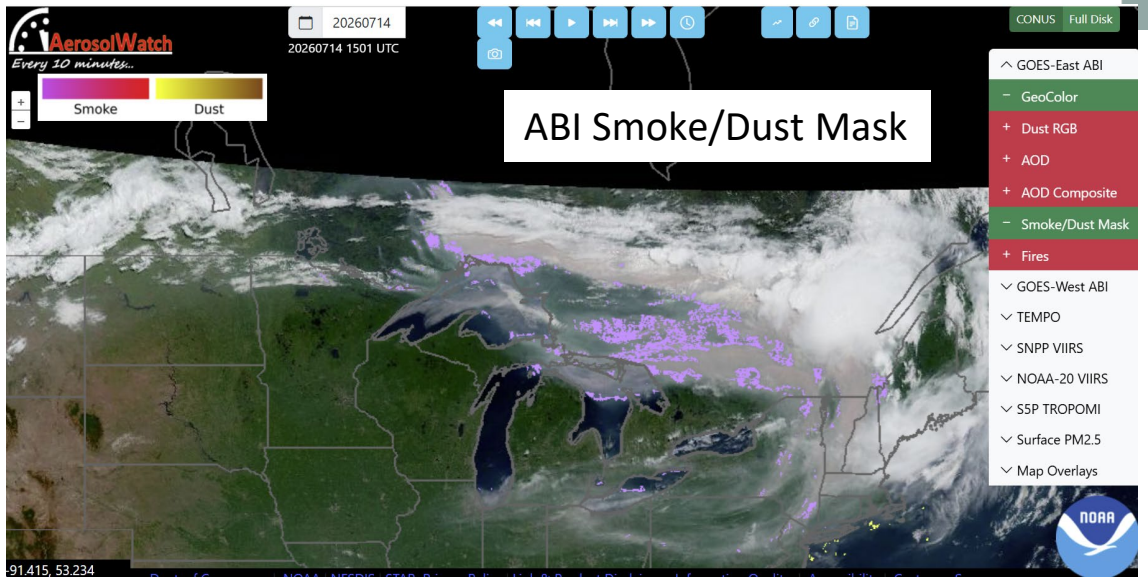
$PM_{2.5}$ Air Quality Impacts of Wildfire Smoke on July 14, 2026

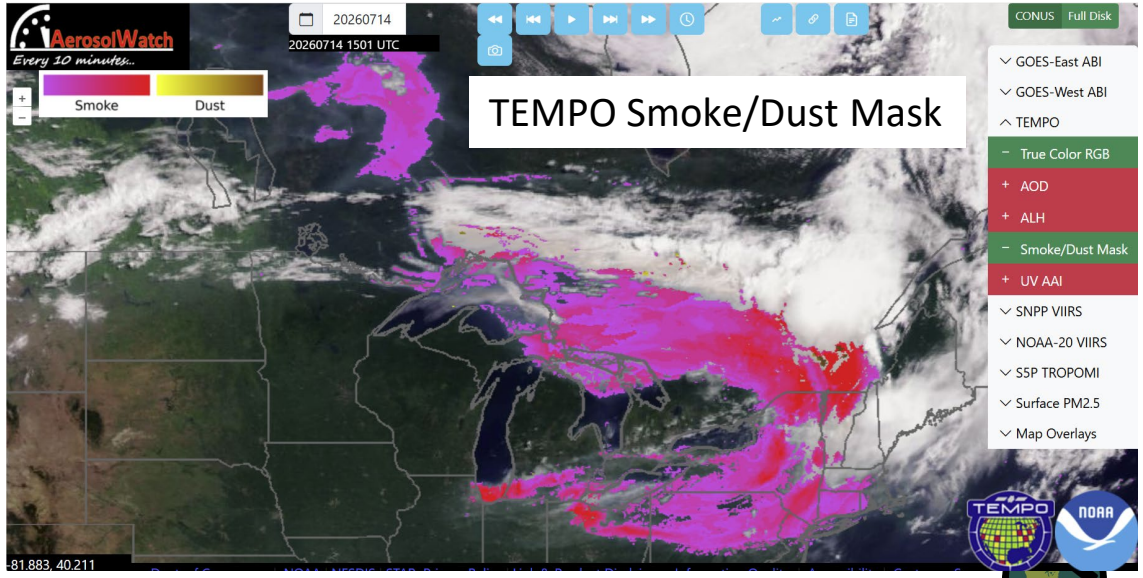


- **Smoke in the vicinity of the fires:** near surface-level all day → daily NAAQS $PM_{2.5}$ exceedances
- **Smoke downwind:** aloft in the morning, mixed to the surface in the afternoon

TEMPO & ABI - Case Study 1 Learning Prompt

- ABI smoke/dust mask product has limited retrievals of smoke over land, especially thinner smoke downwind from fires.
- TEMPO's UV observations enhance aerosol detection:
  - Much greater geographic extent of smoke plumes
  - Smoke on top of clouds
  - Information on relative intensity of smoke (thin vs. thick smoke)





TEMPO & ABI Aerosol Imagery on AerosolWatch for Case Study 1

1. Open the AerosolWatch website
2. Change the date to July 14, 2026 using the Calendar menu at the top center-left of the page
3. Select the animation range for geostationary imagery:
   - Start Time: 1331 UTC
   - End Time: 1531 UTC
4. Under "Map Overlays", select the "Borderlines" (state/international borderlines)
5. Under "GOES-East ABI", deselect "GeoColor" (default when the website opens)
6. Under "TEMPO", select "True Color RGB"
7. Zoom into the region of the smoke
8. Click the small blue square button with the white arrow at the center top of the page to start the animation
9. One at a time, select the remaining products under "TEMPO"
10. Under "Surface PM2.5", select "Hourly Satellite PM2.5" and "Hourly AirNow PM2.5"
11. Under "GOES-East ABI", select "GeoColor" and then one at a time, select "AOD" and "Smoke/Dust Mask"

Case Study 1 Summary

Smoke Mask

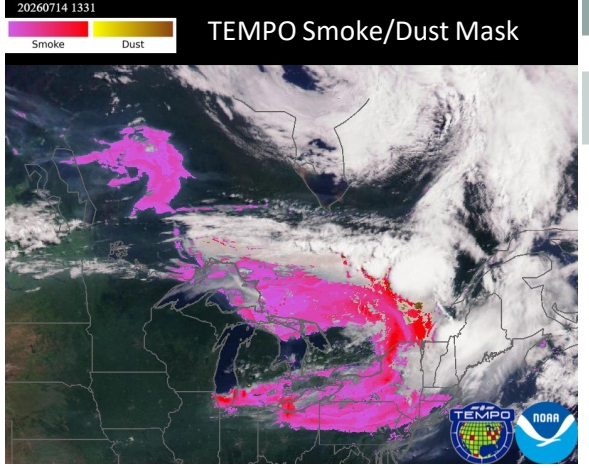
- TEMPO: full plume extent, including over clouds
- ABI: misses thinner downwind smoke
- Why: TEMPO UV AAI retrieves smoke over clouds & thin smoke

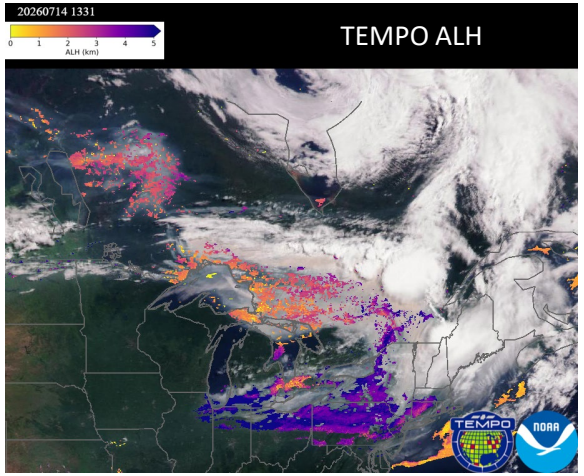
Aerosol Layer Height

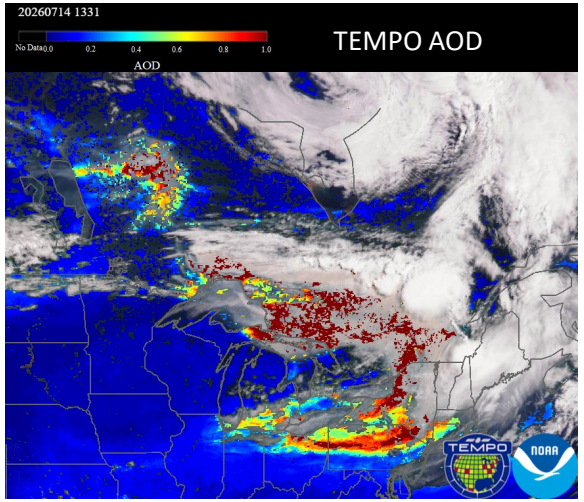
- Ontario/Québec: boundary layer
- Downwind (New England, Mid-Atlantic, Midwest): aloft, not reaching surface
- Reflected in TEMPO PM2.5, verified by AirNow

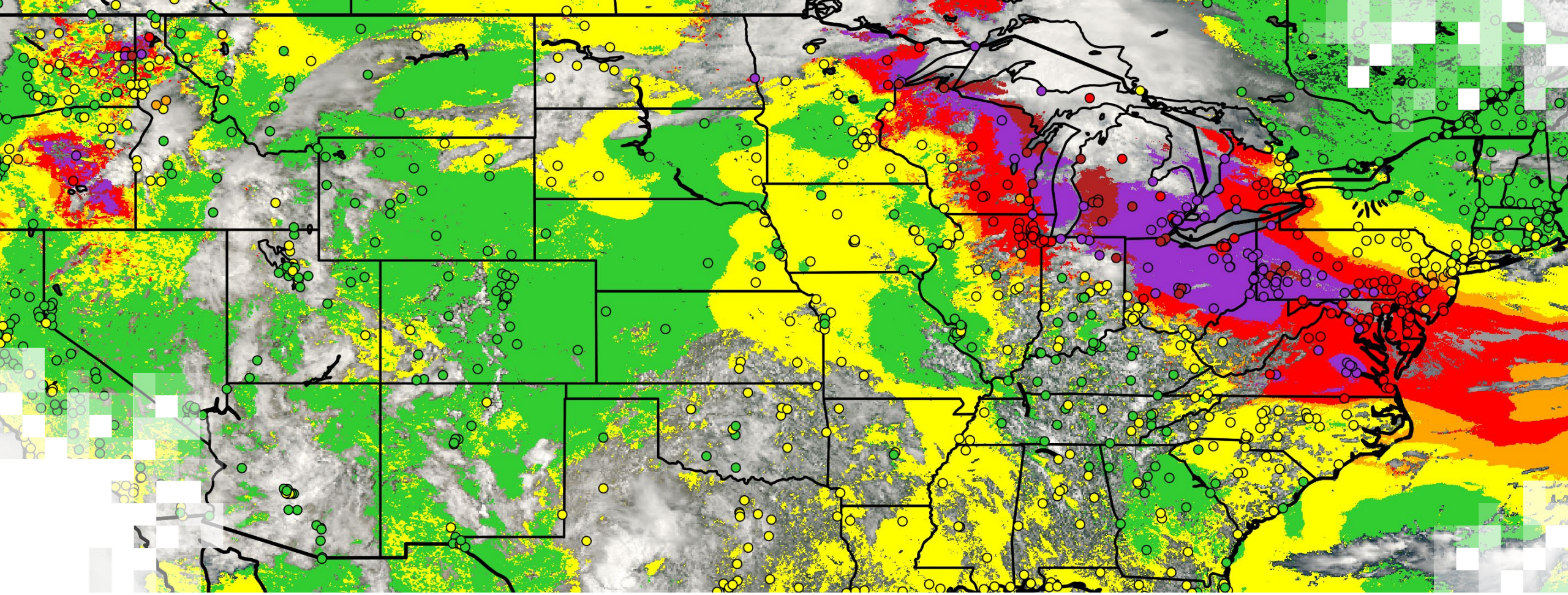
AOD

- Both TEMPO & ABI: gaps for thickest smoke (misclassification by upstream ABI Cloud Mask product)
- ABI composite AOD: 3-hr average smooths gaps



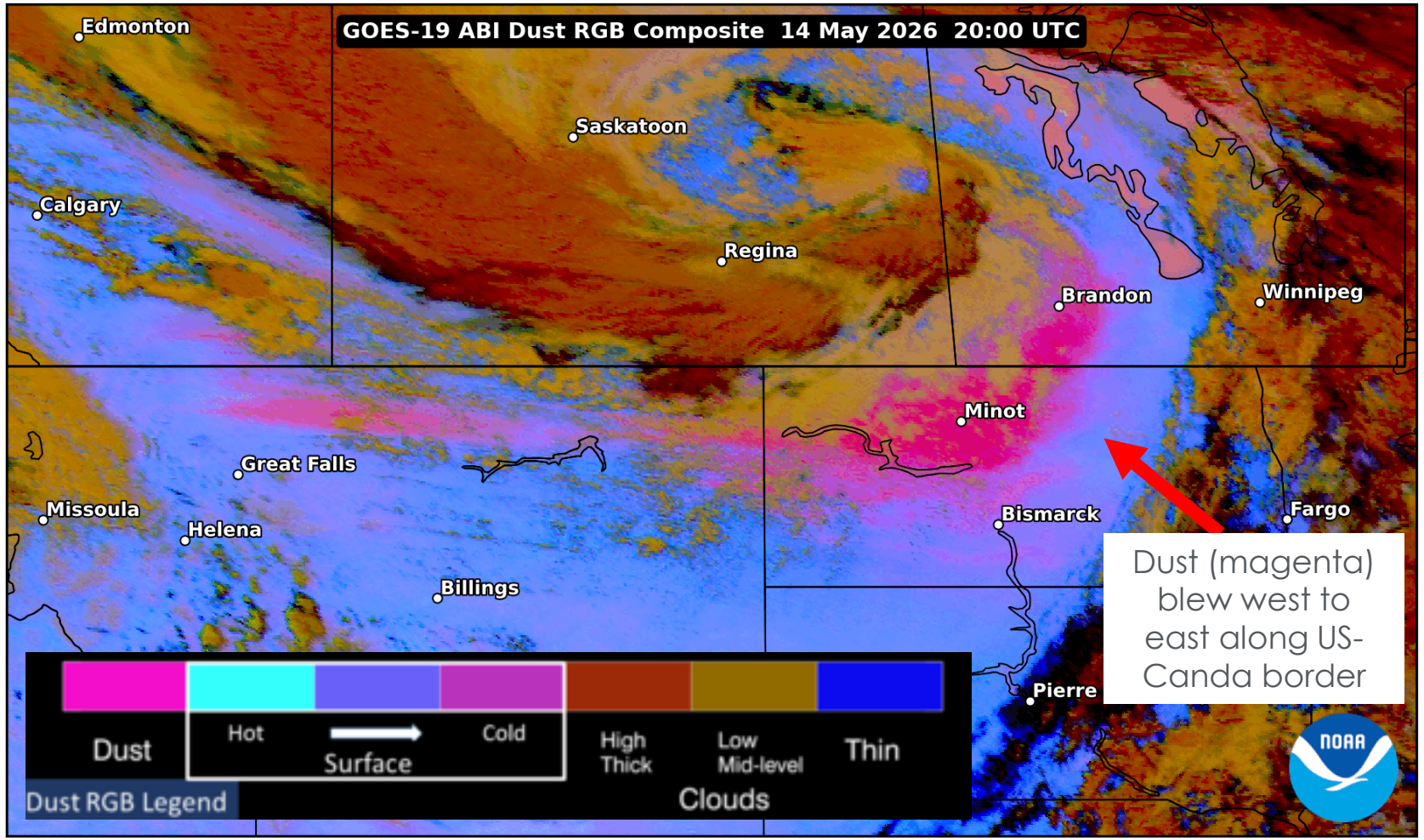






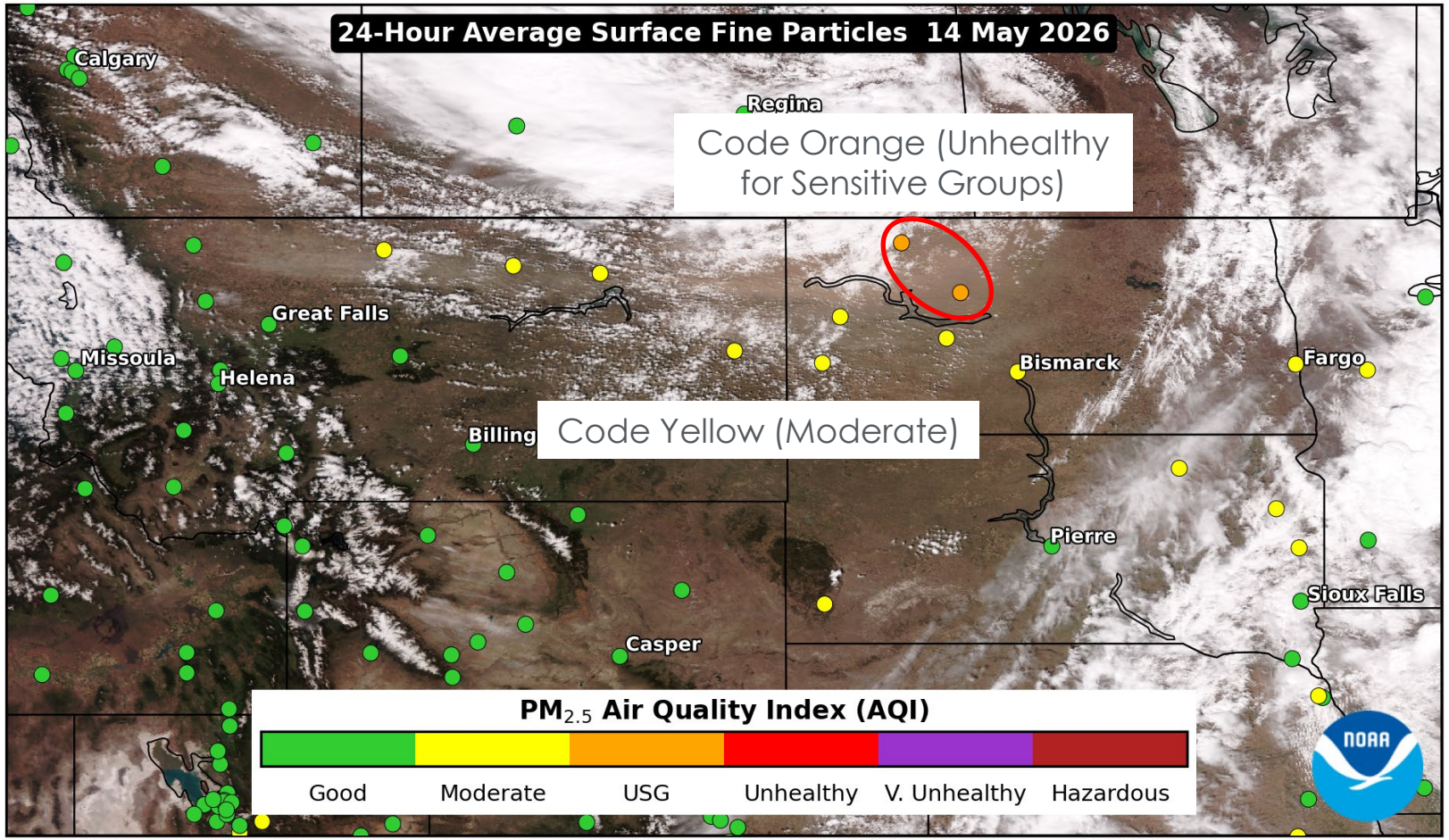
Case 2: Blowing Dust across the Northern Plains
May 14, 2026

Dust Storm on May 14, 2026



- Large, long-lived dust storm occurred on May 14, 2026
- Caused by strong winds associated with a low pressure system centered over southern Saskatchewan, Canada

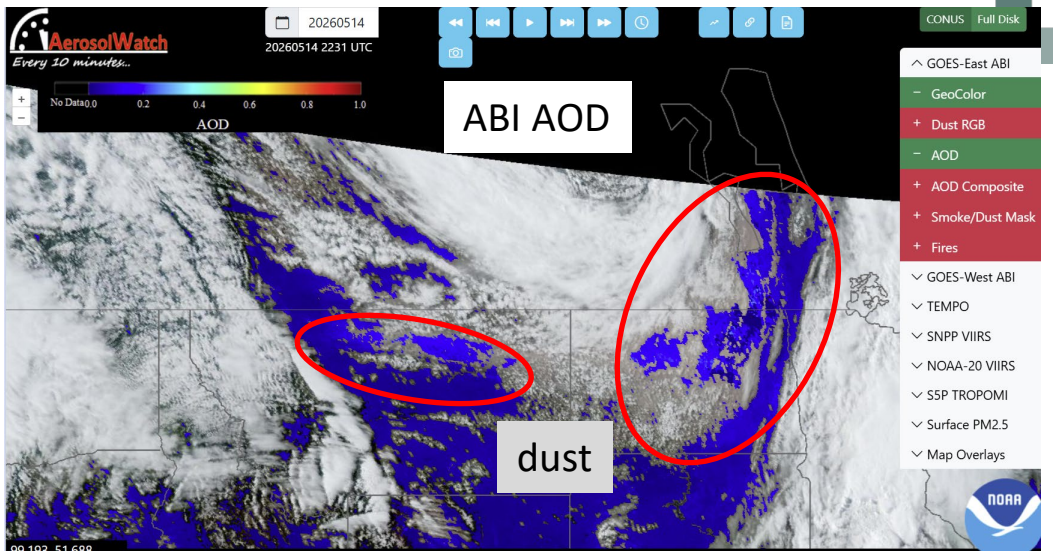
$PM_{2.5}$ Air Quality Impacts of Blowing Dust on May 14, 2026

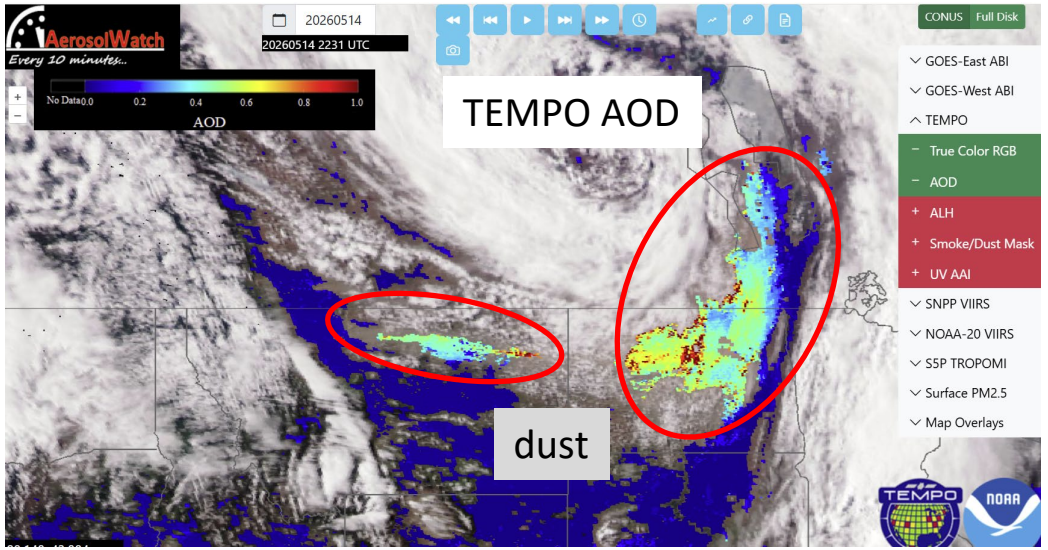


- Daily NAAQS exceedances in northwestern North Dakota
- Elsewhere, dust degraded air quality for several hours, but not enough to exceed the NAAQS

TEMPO & ABI - Case Study 2 Learning Prompt

- ABI AOD tends to under-estimate dust retrievals over land
- TEMPO's UV observations enhance AOD retrievals of dust:
  - TEMPO AOD algorithm uses the TEMPO smoke/dust mask to select the correct aerosol model
  - TEMPO smoke/dust mask is enhanced by TEMPO's UV observations
- Much greater geographic coverage of dust and accurate (higher) AOD values for dust with TEMPO AOD





TEMPO & ABI Aerosol Imagery on AerosolWatch for Case Study 2

- Open the AerosolWatch website
- Change the date to May 14, 2026 using the Calendar menu at the top center-left of the page
- Select the animation range for geostationary imagery:
  - Start Time: 1931 UTC
  - End Time: 2231 UTC
- Under "Map Overlays", select "Borderlines" (state/international borderlines)
- Deselect all layers (anything in the menu shaded green)
- Under "TEMPO", select "True Color RGB"
- Zoom into the region of the dust
- Click the small blue square button with the white arrow at the center top of the page to start the animation
- One at a time, select the remaining products under "TEMPO"
- Under "Surface PM2.5", select "Hourly Satellite PM2.5" and "Hourly AirNow PM2.5"
- Under "GOES-East ABI", select "GeoColor" and then one at a time, select "AOD" and "Smoke/Dust Mask"; then deselect "GeoColor" and select "Dust RGB"

Case Study 2 Summary

Dust Mask

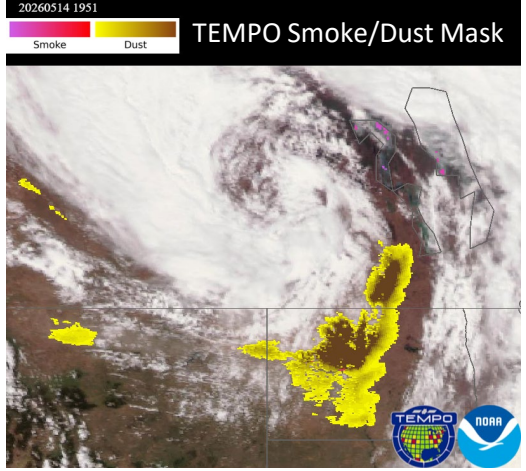
- TEMPO: full plume extent, including trailing edges (Montana/Alberta)
- ABI: cuts off near US-Canada border (high VZA)
- ABI Dust RGB: useful post-sunset & as decision aid

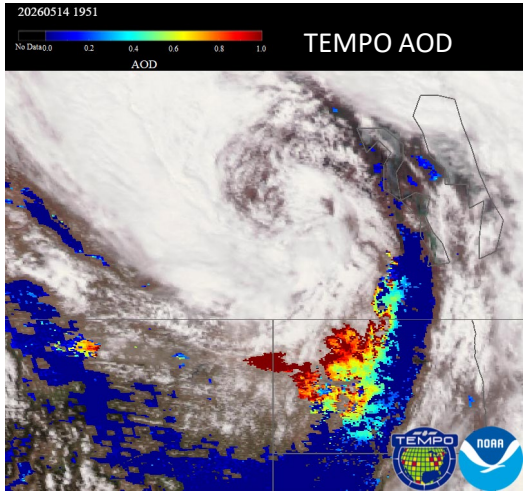
Aerosol Layer Height

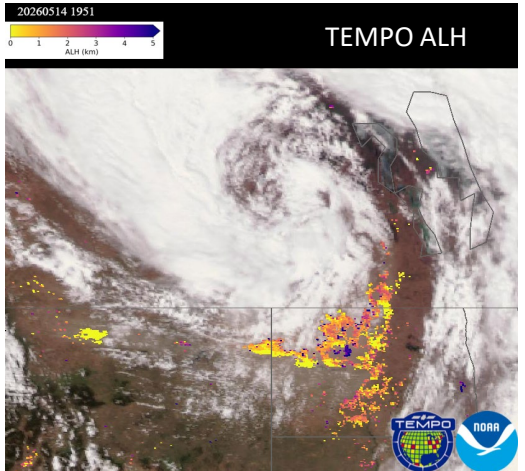
- Leading edge of storm lofted aloft by afternoon (~21 UTC)
- Reflected in TEMPO PM2.5, fills gaps where no AirNow monitors (e.g., N. Dakota)

AOD

- TEMPO retrieves dust more accurately than ABI over land
- Why: TEMPO dust mask product informs correct aerosol model selection



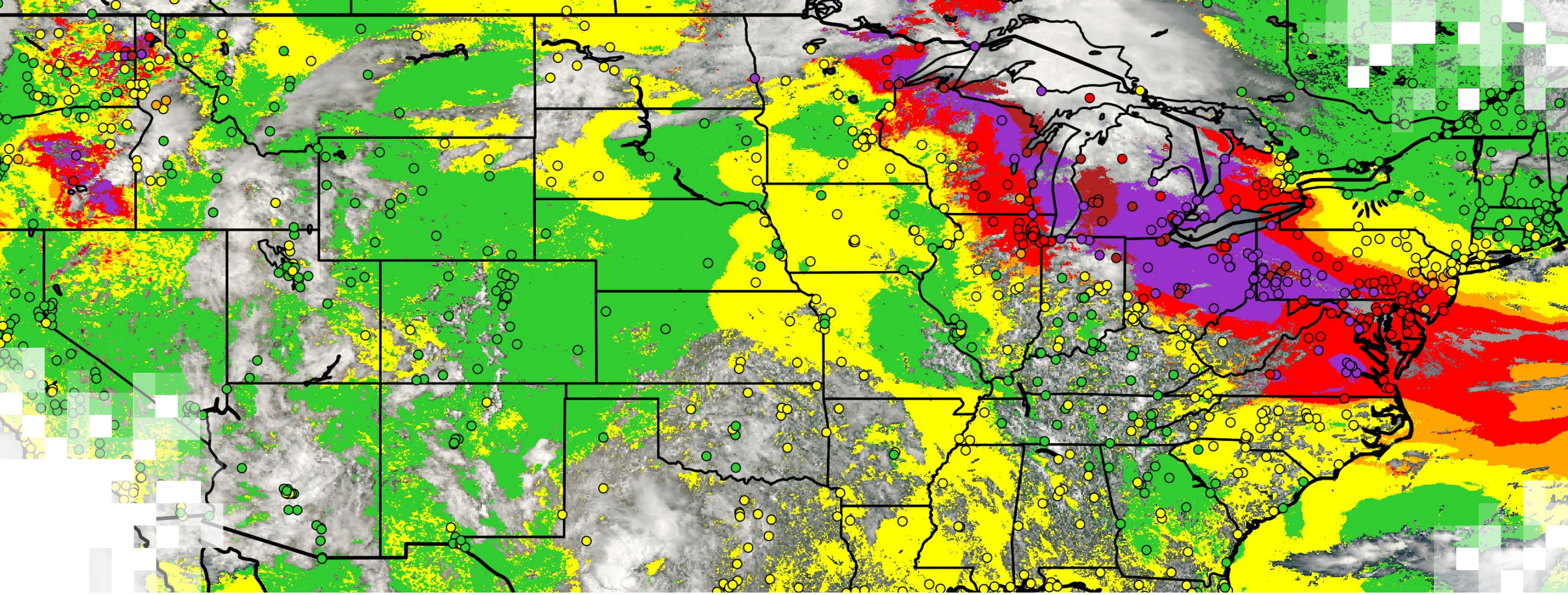




TEMPO Imagery on AerosolWatch – Things to Remember

- Select ~2-3 hours of ABI/TEMPO imagery to animate, otherwise the site will slow down
- TEMPO Granules or entire Scans are sometimes missing, esp. during Special Operations
- Current latency of TEMPO aerosol products is **much longer** than it will be when products become operational in ~April 2027
- NOAA's Aerosol Science Team is reprocessing the TEMPO aerosol products beginning on September 17, 2025
  - Corresponds to the most recent version of the TEMPO L1b files, used as input to the aerosol product algorithms
  - Reprocessing anticipated to be complete by mid-October 2026
- **All TEMPO imagery on AerosolWatch will be regenerated using the reprocessed data files, expected by November 2026**
  - Will remove anomalies seen in current versions of images on AerosolWatch, especially prior to June 2026



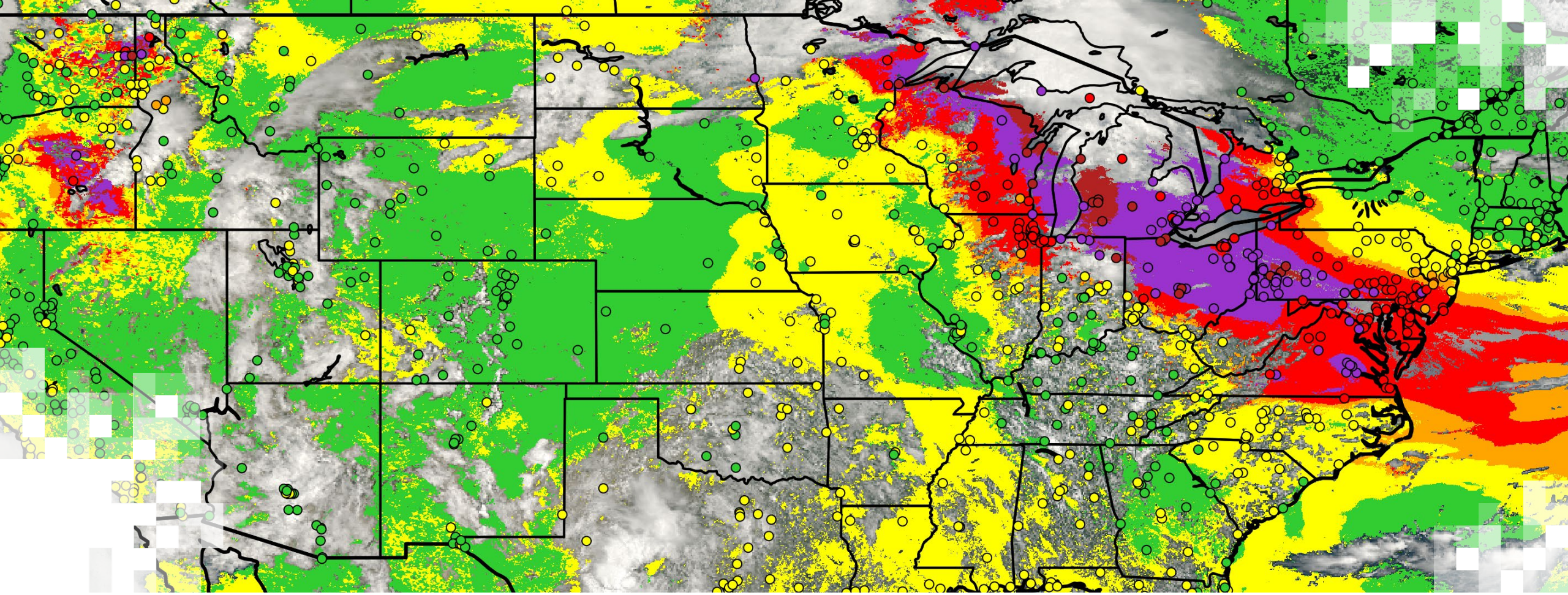


Geostationary Remote Sensing of Aerosols for Air Quality Applications in North America

Part 2 Summary

Summary

- AerosolWatch provides near-real-time & archived hourly TEMPO imagery for visualizing aerosol events.
- TEMPO enhances ABI's aerosol detection: smoke detection over clouds/thin plumes, more accurate dust AOD retrievals, and smoke/dust detection beyond ABI's viewing-angle limits.
- TEMPO ALH and estimated PM2.5 reveal aerosol vertical structure and surface impacts.
- Together TEMPO and ABI aerosol synergistic products enable analysis of smoke/dust events and anticipation of air quality impacts.



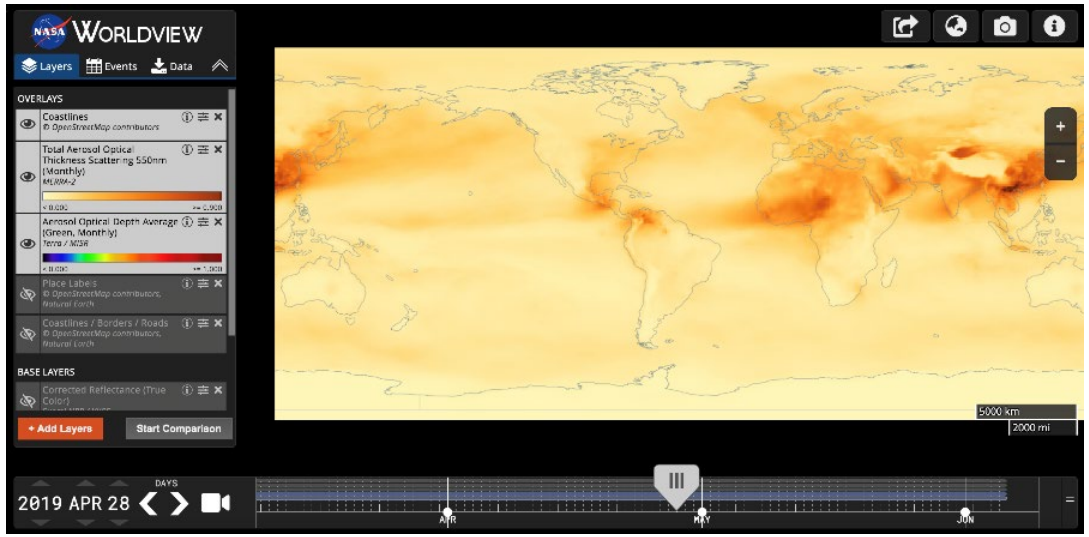
Data Access and Resources

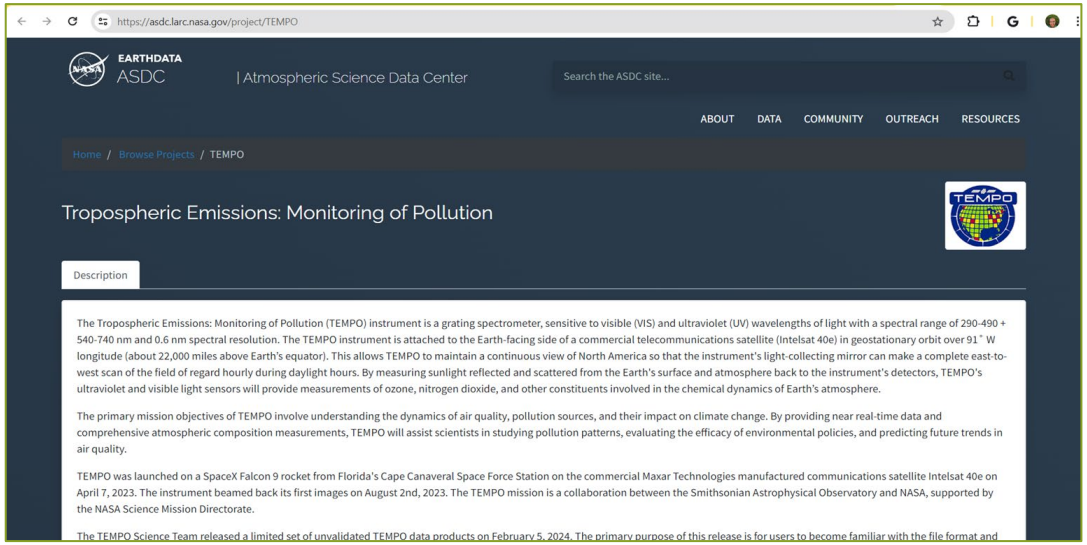
ABI and TEMPO Data Access

- **ABI : NOAA Open Data Dissemination (NODD)**
  - ABI data files via the NODD on Amazon Web Services (AWS)
    - GOES-19
    - GOES-18
  - ABI data files via the NODD on Google Cloud Storage (GCS)
    - GOES-19
    - GOES-18
- **TEMPO:**
- Algorithms are being transitioned to operations; products expected by **Spring 2027**
  - Operational data files will be generated by NOAA & distributed by **NASA Earthdata**
  - Anticipated latency of ~2 hours for operational files
- **User's Guides** are available for each aerosol product

TEMPO Data Distribution: Tools and Services

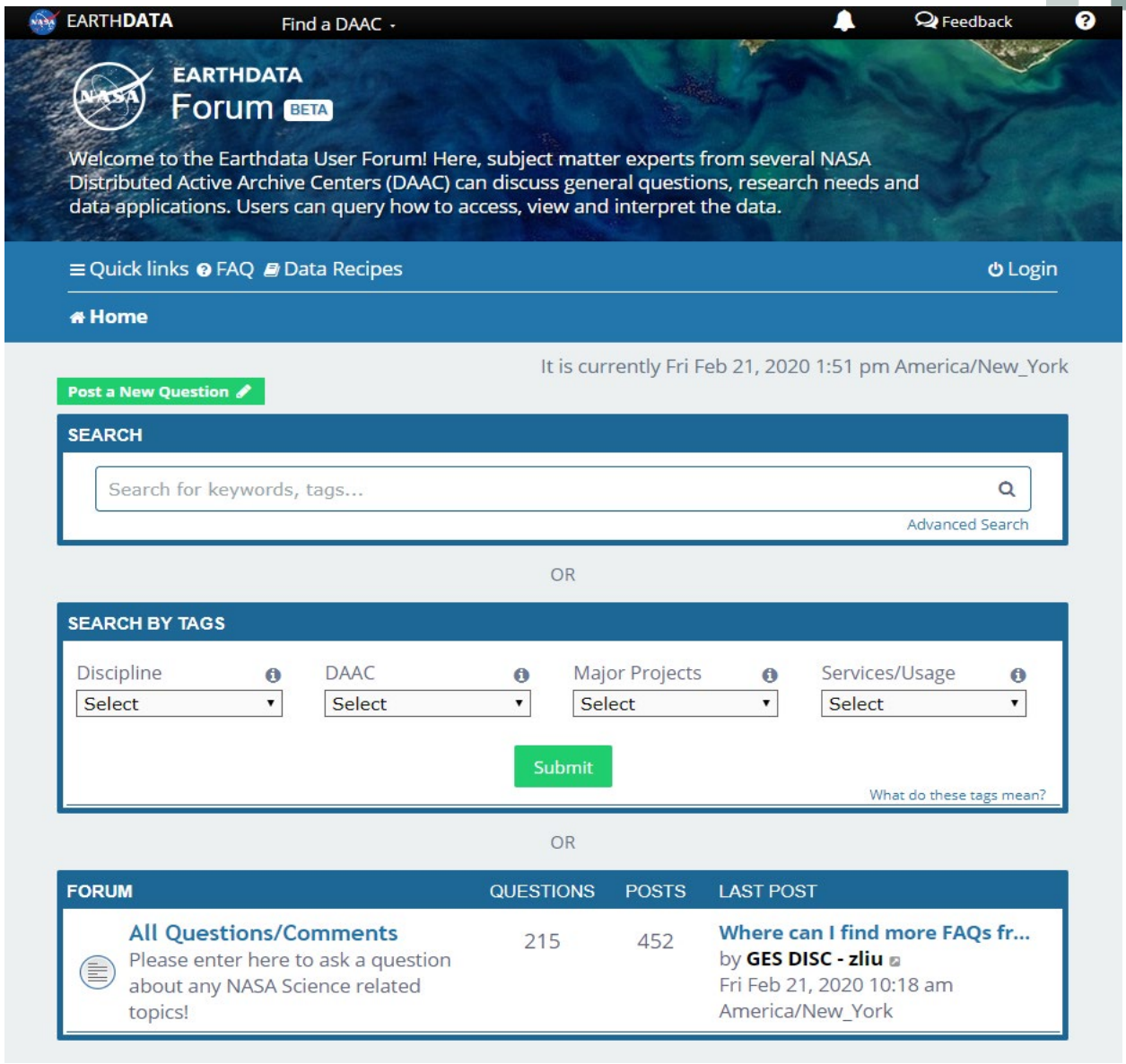
- Earthdata TEMPO Page
- Earthdata Search
- Worldview
- Harmony
- Earthdata GIS
- OPeNDAP
- Google Earth Engine
- Jupyter Notebooks
- Earthdata Forum



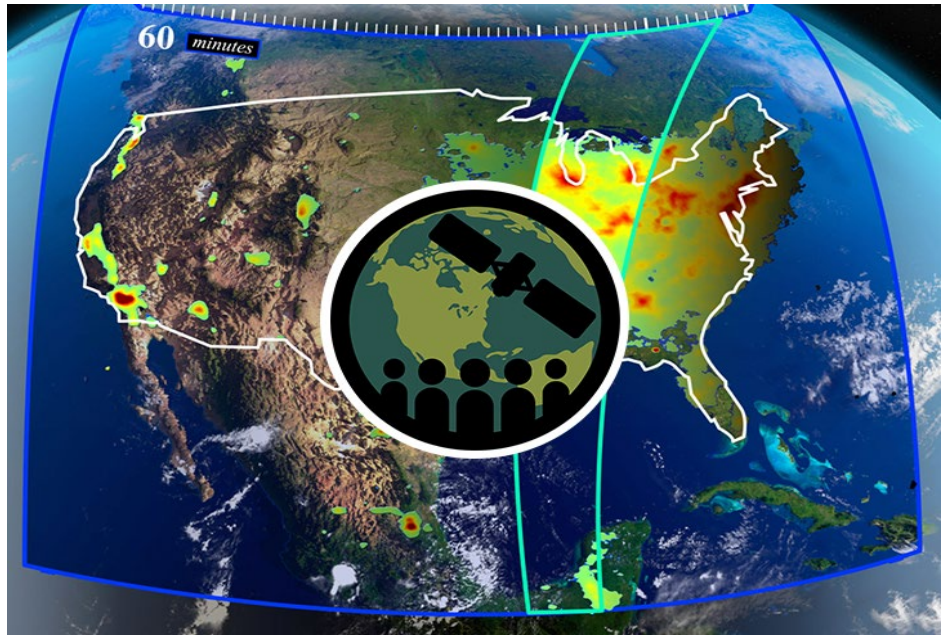


Earthdata Forum

- **Science Data Users** can seamlessly search for information across NASA Distributed Active Archive Centers (DAAC)
- **Scientists & Data Providers** can effectively assist their user community in more accurately using their products.
- **DAACs & Subject Matter Experts (SMEs)** can quickly link users to existing resources.
- **DAAC User Services** can swiftly provide inquirers with an authoritative source related to DAAC data products & services.
- **Tag** posts with "ASDC" or "TEMPO"



Complementary Training: Geostationary Remote Sensing of Trace Gases for Air Quality Applications in North America



Online, Intermediate

Instructors



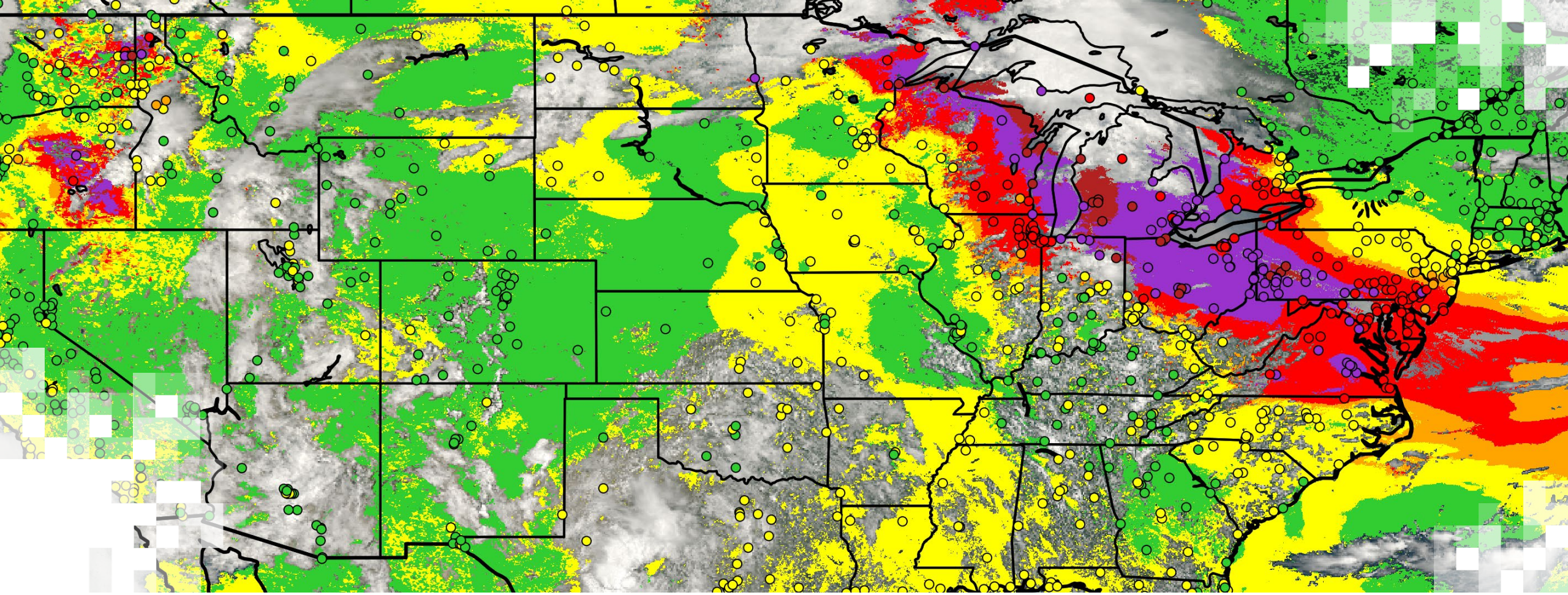
Kristina Pistone
NASA ARC/BAERI
ARSET Instructor



Aaron Naeger
NASA MSFC/TEMPO
ARSET Instructor

This training provides an overview of TEMPO capabilities and available trace gas data products and illustrates how TEMPO trace gas data can be visualized using NASA Worldview online.

Training Webpage



Geostationary Remote Sensing of Aerosols for Air Quality Applications in North America

Training Summary

Training Summary

- **The GEO Constellation over North America:** TEMPO and ABI form a synergistic view. ABI tracks aerosol transport at high frequency, TEMPO reveals diurnal atmospheric composition.
- **New & Enhanced Aerosol Products - a 3D View:** TEMPO enables new hourly products (UV AAI, ALH) and enhances ABI's products (AOD, Smoke/Dust Mask, PM2.5), giving a first 3D view of aerosols (column, height, surface) from geostationary orbit
- **Aerosol Data Visualization through AerosolWatch:** NOAA's hub for visualizing & saving near-real-time and archived TEMPO imagery over North America
- **Applications to Air Quality Events:** Smoke and dust case studies show how synergistic TEMPO/ABI imagery helps analyze events and anticipate air quality impacts.

Homework and Certificates

- **Homework:**
  - One homework assignment
  - Opens on Oct 15 2026
  - Access from the training webpage
  - Answers must be submitted via Google Forms
  - **Due by Oct 29, 2026**

- **Certificate of Completion:**
  - Attend all two live webinars (attendance is recorded automatically)
  - Complete the homework assignment by the deadline
  - You will receive a certificate via email approximately two months after completion of the course.

Share Your Thoughts!

Within a day or two, we will send you an invitation to complete a short online survey.* **Your feedback helps us improve the ARSET program.**

- Participation is optional, and all responses are confidential.
- **Survey data are crucial to helping us understand how to better meet your needs. We want to help you use Earth observation data more effectively.**
- We read every survey comment – so please share your thoughts!

*The survey will come from noreply@alchemer.com. This is not spam.

Contact Information

Trainers:

- Caterina Mogno
  - caterina.mogno@nasa.gov
- Amy Huff
  - amy.huff@noaa.gov

- ARSET Website
- ARSET YouTube

For questions, comments, or to share how you have applied our trainings to your work or studies, email nasa.arset@gmail.com.

Join our mailing list to stay up-to-date on our latest trainings. Visit our contact page to subscribe.

Acknowledgements

Aaron Naeger
MSFC / TEMPO



Carl Malings
GSFC / MSU



Kristina Pistone
ARC / BAERI



Melanie Follette-Cook
GSFC



Kevin Fuell
MSFC / UAH



Sarah Cutshall
GSFC / ADNET



Selwyn Hudson-Odoi
GSFC / UMBC




APPLIED REMOTE SENSING TRAINING PROGRAM
TRAIN - EMPOWER - ADVANCE

Thank You!