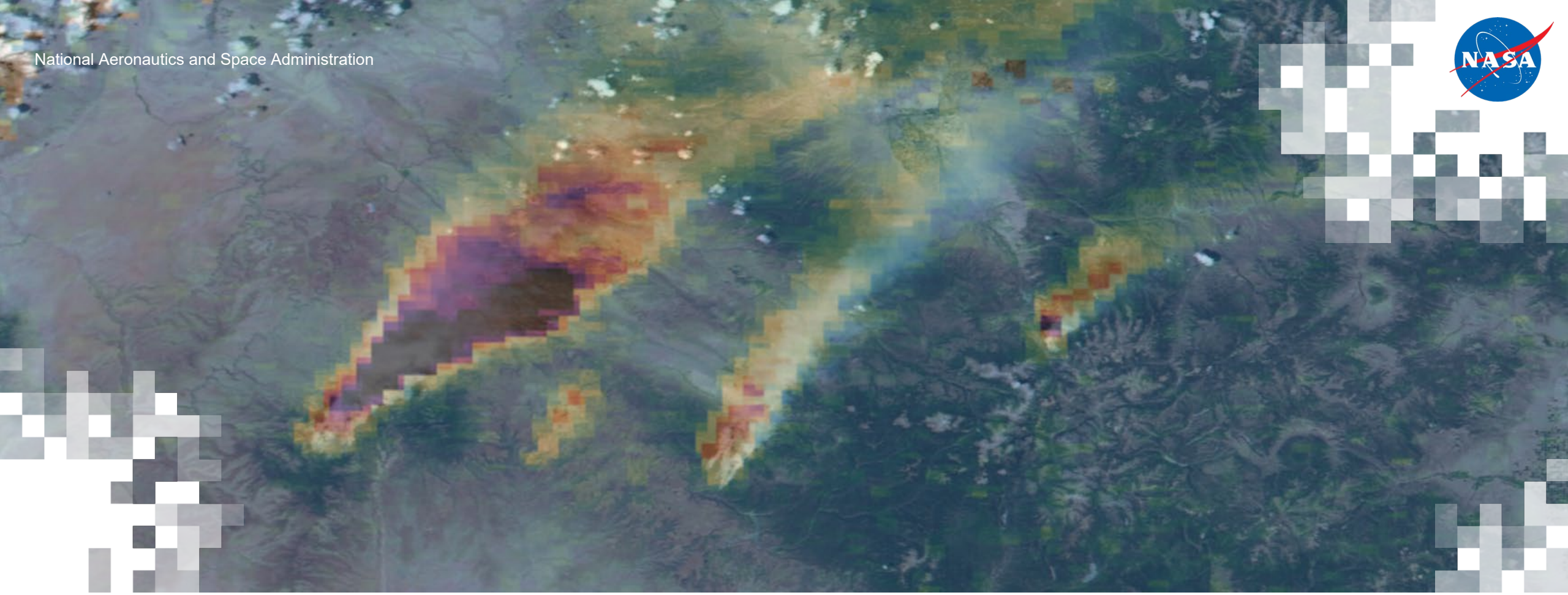
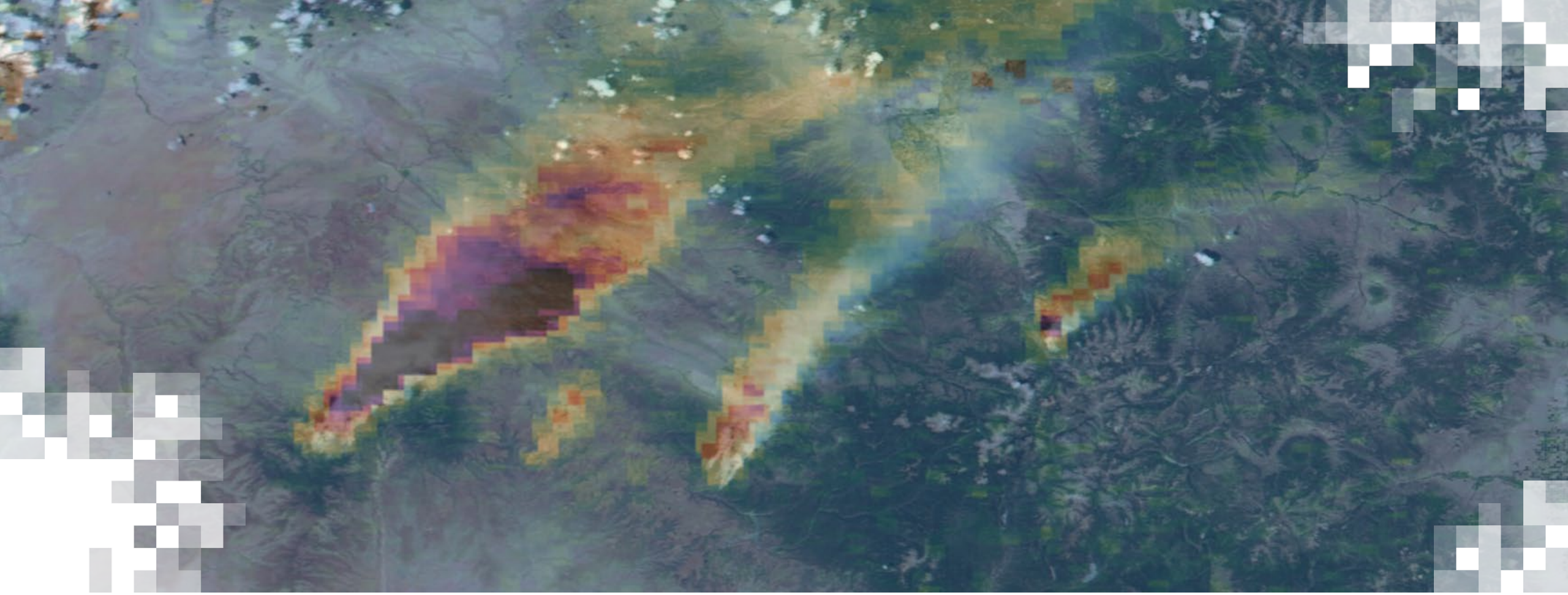
National Aeronautics and Space Administration



Using NASA Worldview for Satellite Data Visualization

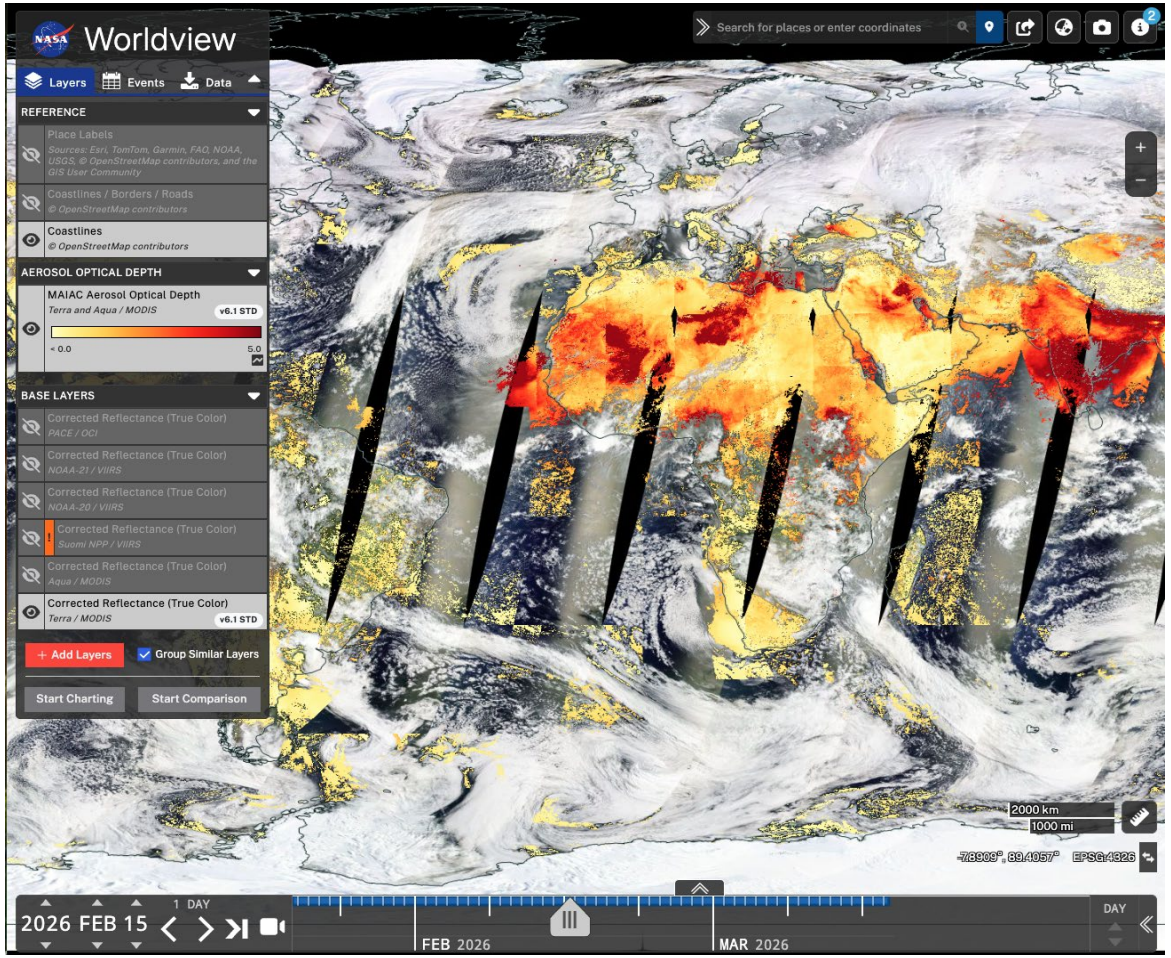
Caterina Mogno (University of Maryland Baltimore County & NASA GSFC)

August 10, 2026



Introduction to Worldview

NASA Worldview

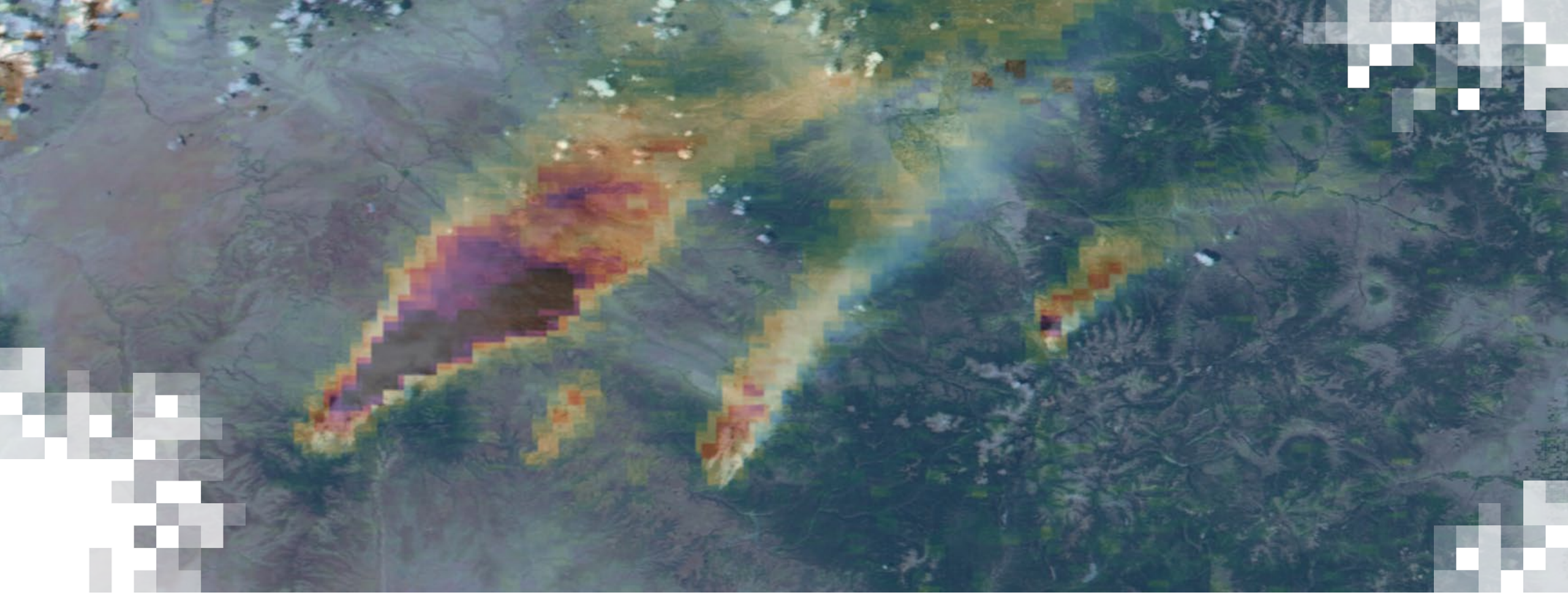


NASA Worldview: an interactive interface for browsing full-resolution, global, daily satellite imagery

- **Over 1,200 global imagery layers, updated within hours.** Full-resolution satellite imagery covering the entire Earth, from 2000 to present.
- **Imagery available within 3–4 hours of satellite observation.** Supporting wildfire, air quality and flood management
- **Explore, animate, compare, and share.** All in your browser, no software needed.

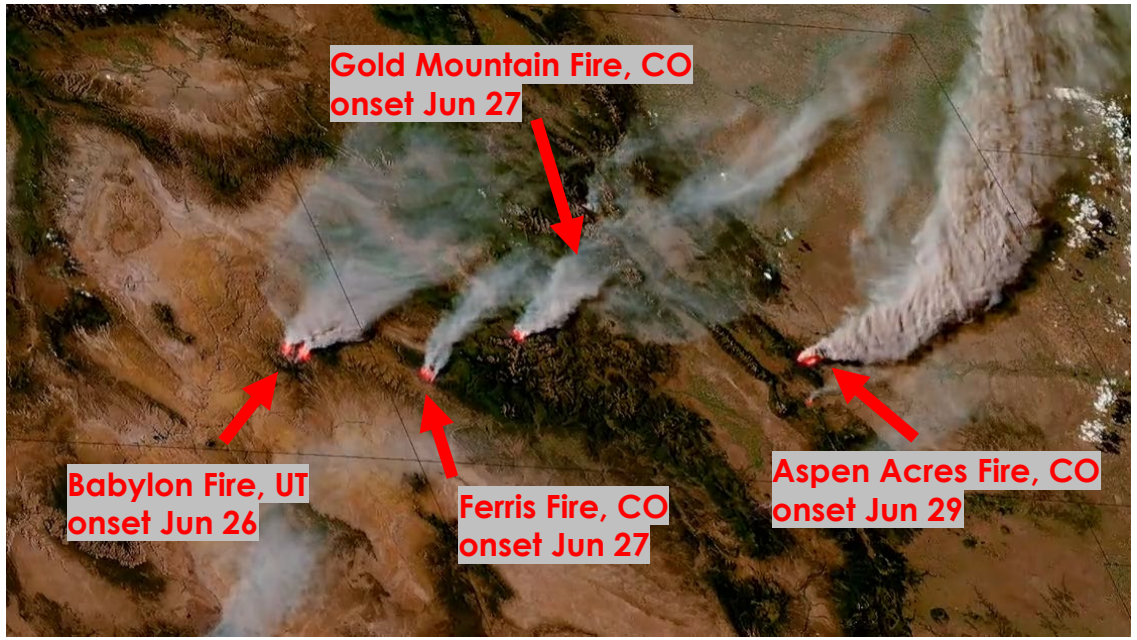
Link to NASA Worldview landing page

Link to Worldview Resources



Case Study: Colorado and Utah June/July 2026 Fires Demo in Worldview

Case Study: Colorado and Utah June/July 2026 Fires



A satellite view of wildfires burning in Colorado and Utah on Jun 29. (CSU/CIRA & NOAA) Source CNN.

The Aspen Acres Fire near Beulah, Colorado, on Jun 29. (Jerilee Bennett/The Gazette/AP)) Source CNN.

- Multiple wildfires ignited across Utah and Colorado in late June, with dangerous fire weather (extreme heat, low humidity, dry vegetation, and strong winds) driving rapid fire growth.
- Evacuation orders were issued in multiple counties, and air quality advisories remained in effect through most of July.

Demo Overview

[Link to Worldview case study with layers]

Step	Topic
1	True Color: Setting the scene
2	Fire Detection: Fires and Thermal Anomalies (FRP)
3	Aerosol in the plume: AOD from DT/DB vs MAIAC
4	Hourly smoke tracking: TEMPO UVAI
5	Hourly smoke tracking: TEMPO trace gases
6	Summary

Satellite Overpass Times for UT/CO

Satellite	Approx. Local Time July 2026 (MDT, UTC−6)
Terra	~10:00 -11:00 AM
Aqua	~3:30 -16:30 PM
NOAA-21	~1:00–2:00 PM
S-NPP	~25 min after NOAA-21
NOAA-20	~25 min after S-NPP
TEMPO	daylight time, every ~1h

Products Used in this Case Study

Product	Layer Name in Worldview
True Color (default layers)	Corrected Reflectance (True Color) Terra/MODIS, Aqua/MODIS, NOAA-20/VIIRS, NOAA-21/VIIRS, Suomi NPP/VIIRS, PACE/OCI
AOD	MODIS Terra Merged DT/DB Aerosol Optical Depth (Land and Ocean)
AOD	MODIS Aqua Merged DT/DB Aerosol Optical Depth (Land and Ocean)
AOD	MODIS Terra/Aqua MAIAC Aerosol Optical Depth
TEMPO UVAI (L2)	TEMPO Ozone (L2, UV Aerosol Index, Subdaily)
TEMPO UVAI (L3)	TEMPO Ozone (L3, UV Aerosol Index, Subdaily)
TEMPO NO_2 (L3)	TEMPO Nitrogen Dioxide (L3, Vertical Column Troposphere, Subdaily)
TEMPO HCHO (L3)	TEMPO Formaldehyde (L3, Vertical Column, Subdaily)
TEMPO O_3 (L3)	TEMPO Ozone (L3, Tropospheric Column Amount O3, Subdaily)
TROPOMI NO_2 (L2)	TROPOMI/Sentinel-5P Nitrogen Dioxide (L2, Tropospheric Column)

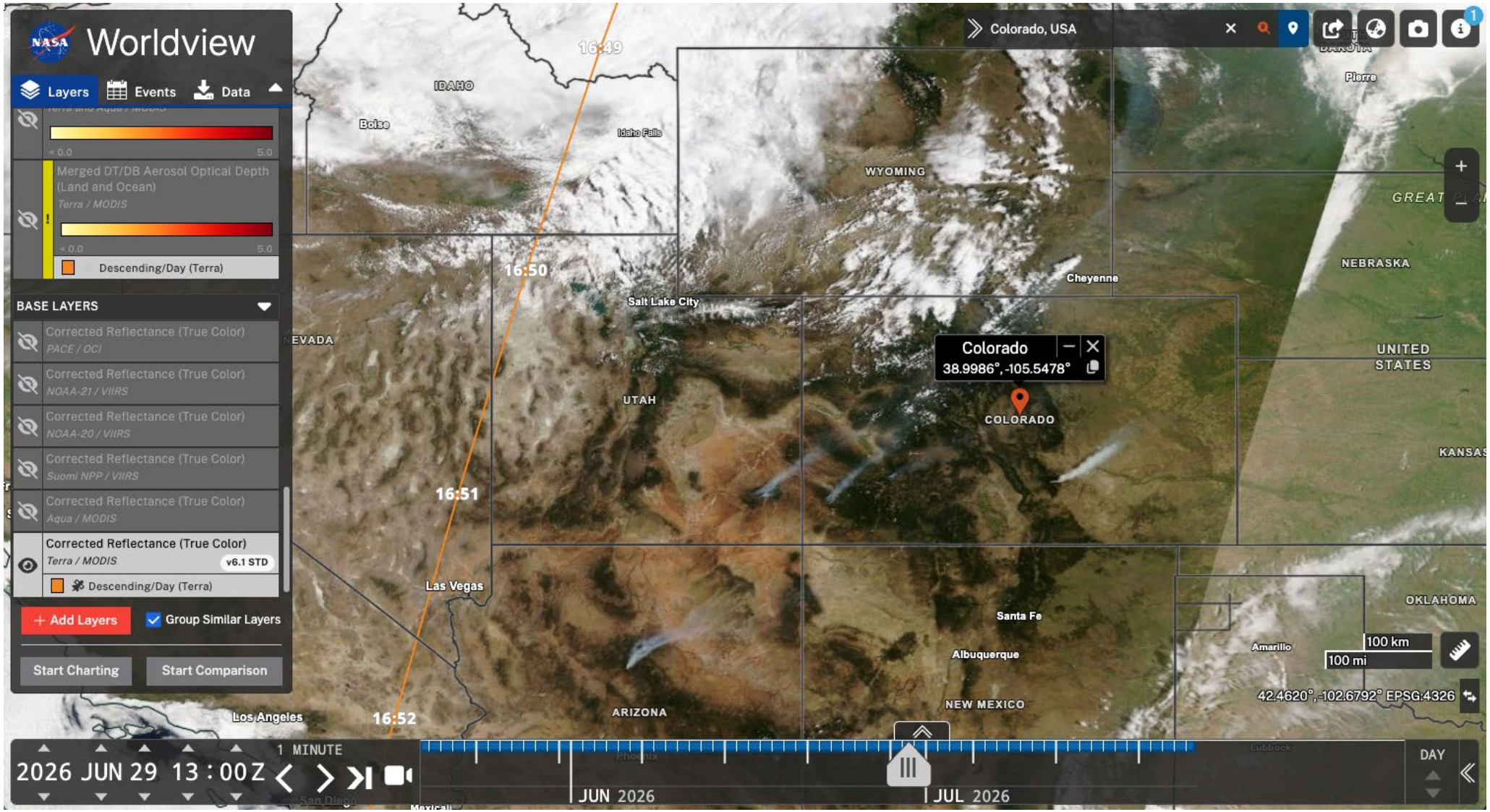
Step 1 – True Color: Setting the Scene

Actions

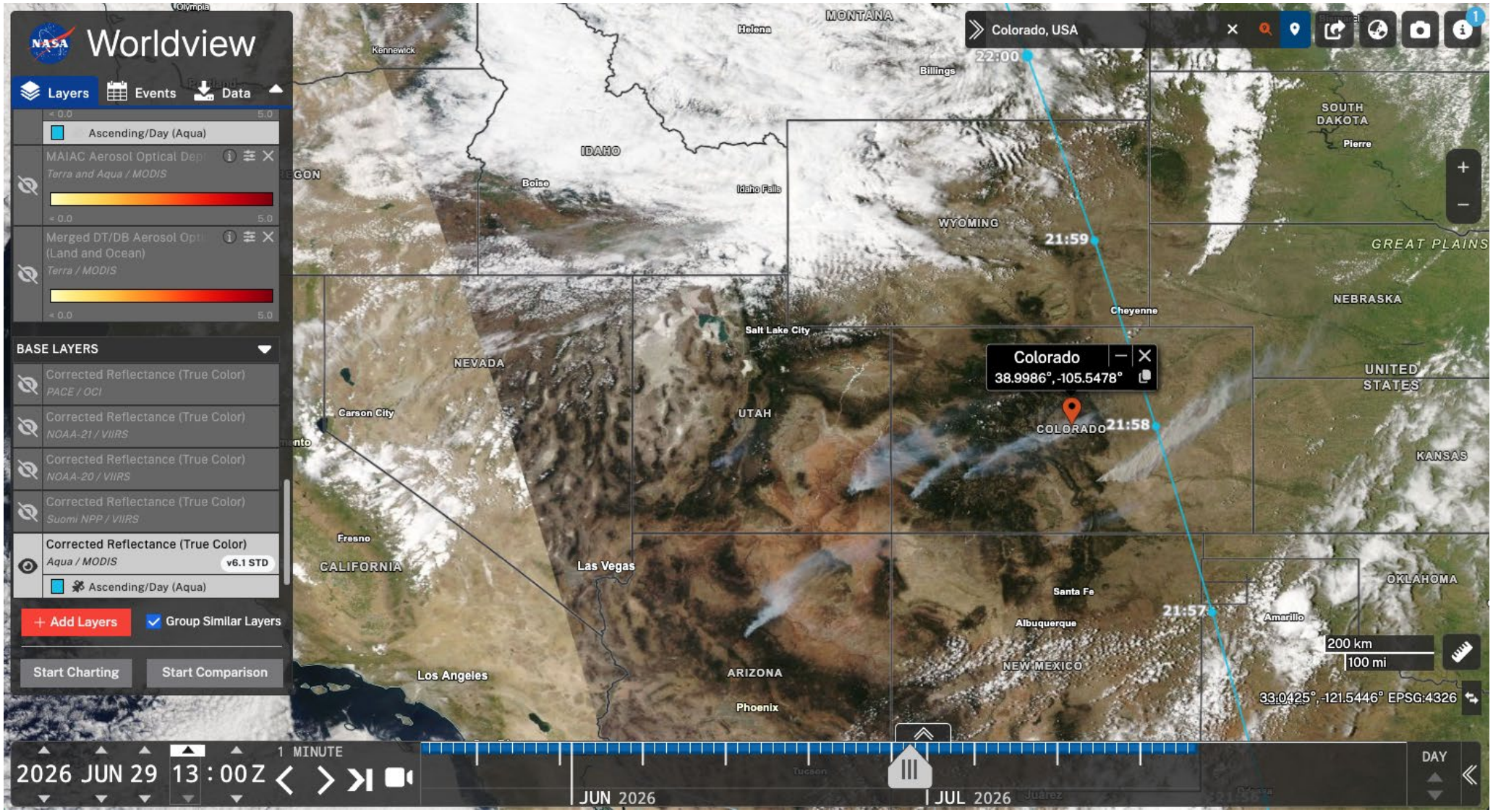
1. Search/locate Colorado using the Worldview search bar.
2. Select Jun 29 13Z (7am MDT) 2026 in the time bar (lower left).
3. Turn on Reference Labels and Coastlines/Borders layers.
4. Toggle MODIS Terra True Color layer. Click ‘View Options’ on MODIS Terra and check the box for ‘Associated Layer’ ‘Orbit Track’ to view overpass time for MODIS Terra.
5. Repeat for MODIS Aqua, VIIRS NOAA-21, VIIRS Suomi NPP and VIIRS NOAA-20 to view and compare overpass times.
6. Remove the Orbit Track layers.
7. Finally Select MODIS Aqua as main True Color layer for this example and toggle off all the other ones.

Note: NOAA-21/VIIRS covers the Utah/Colorado scene with 2 consecutive overpasses, while all the others cover with one overpass.

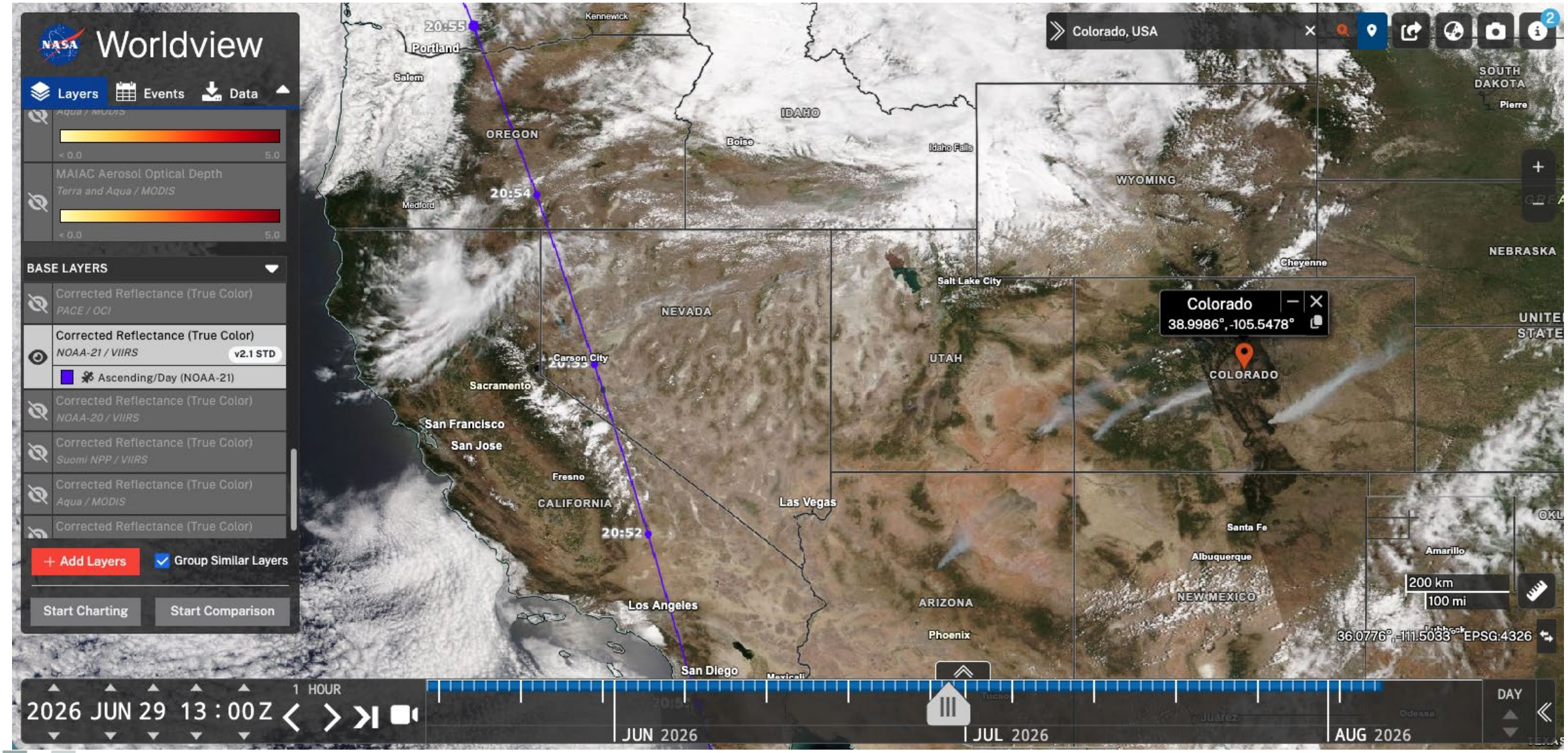
Step 1 – Product: MODIS/Terra True Color



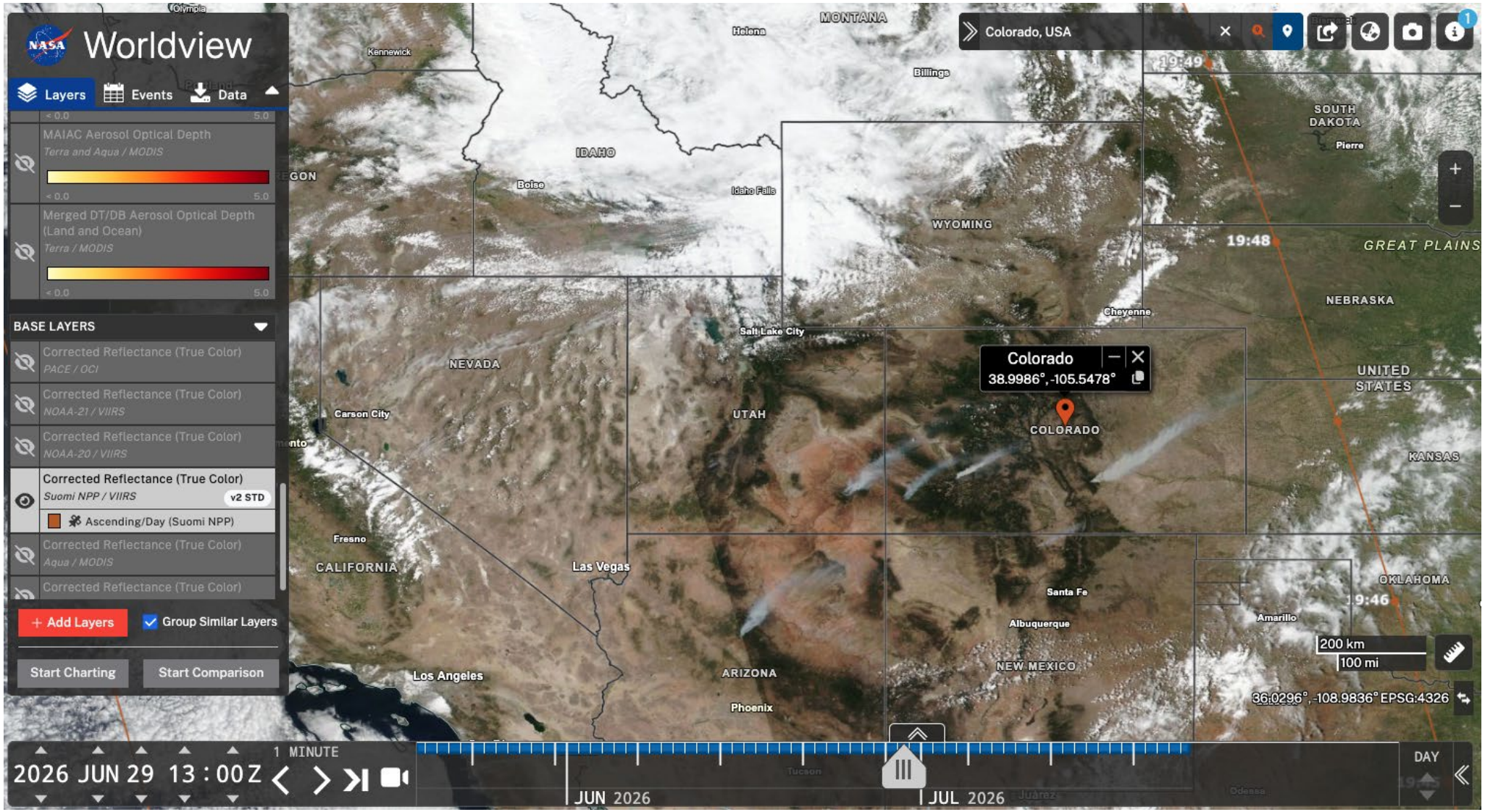
Step 1 – Product: MODIS/Aqua True Color



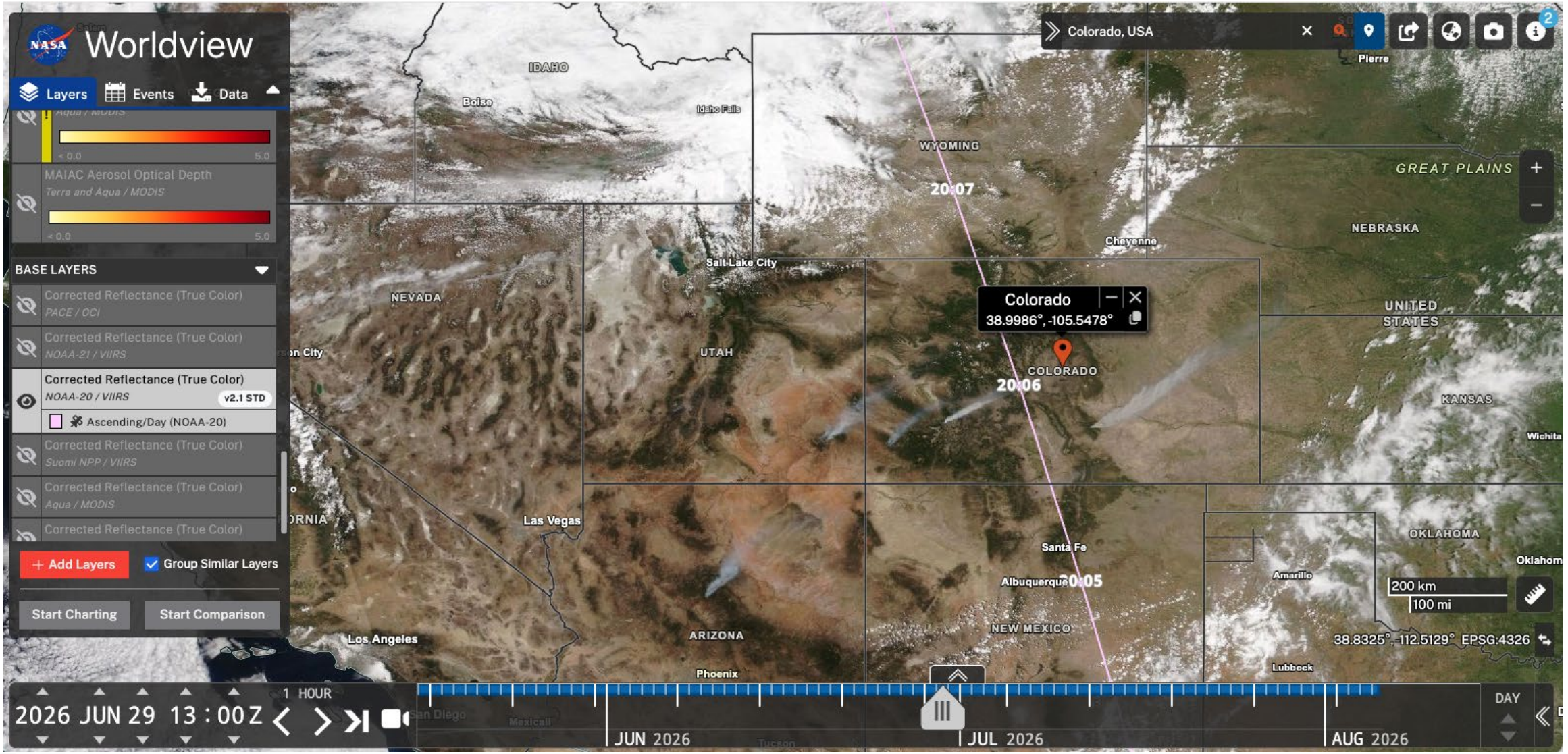
Step 1 – Product: NOAA-21/VIIRS True Color



Step 1 – Product: S-NPP/VIIRS True Color



Step 1 – Product: NOAA-20/VIIRS True Color



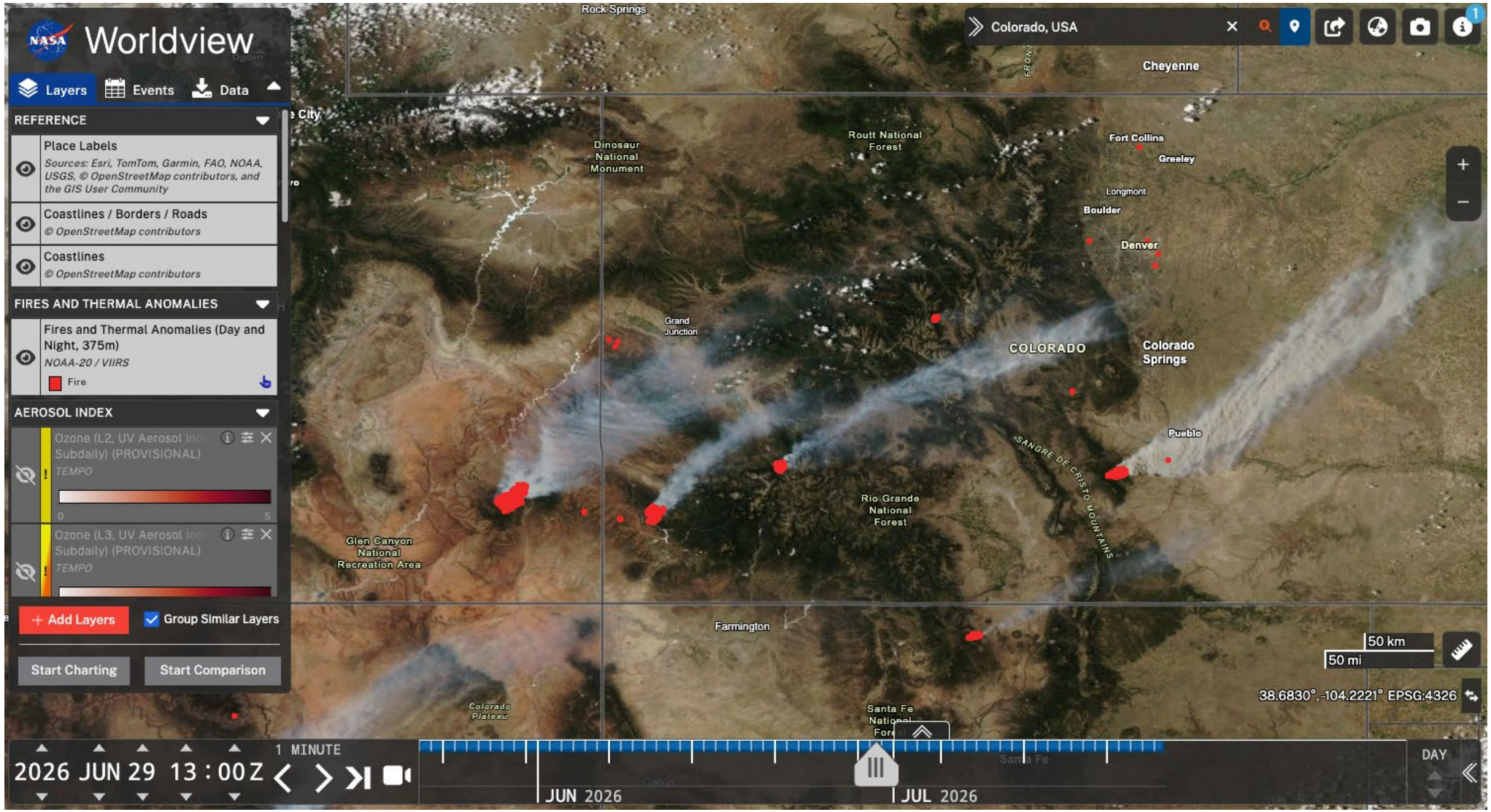
Step 2 – Fire Detection: Fires and Thermal Anomalies (FRP)

Actions

1. Keep MODIS Aqua true color as base layer.
2. Toggle on VIIRS NOAA-20 Fires and Thermal Anomalies (Day and Night, 375m) to see active fires. Highlight fire detection clusters, at the base of the smoke plume.

Note: sometimes thermal anomaly detections appear as an oblong shape aligned along the smoke plume. This may indicate that the algorithm is detecting the hot plume itself rather than the ground fire. Typically, fire thermal anomalies at the surface are more spread out, following the evolving shape of the fire. However, in fast wind-driven fire spread, the ground detection can also appear more oblong-shaped.

Step 2 – Product: VIIRS/NOAA-20 Fires and Thermal Anomalies



Step 3 – AOD: Aerosols in the Plume

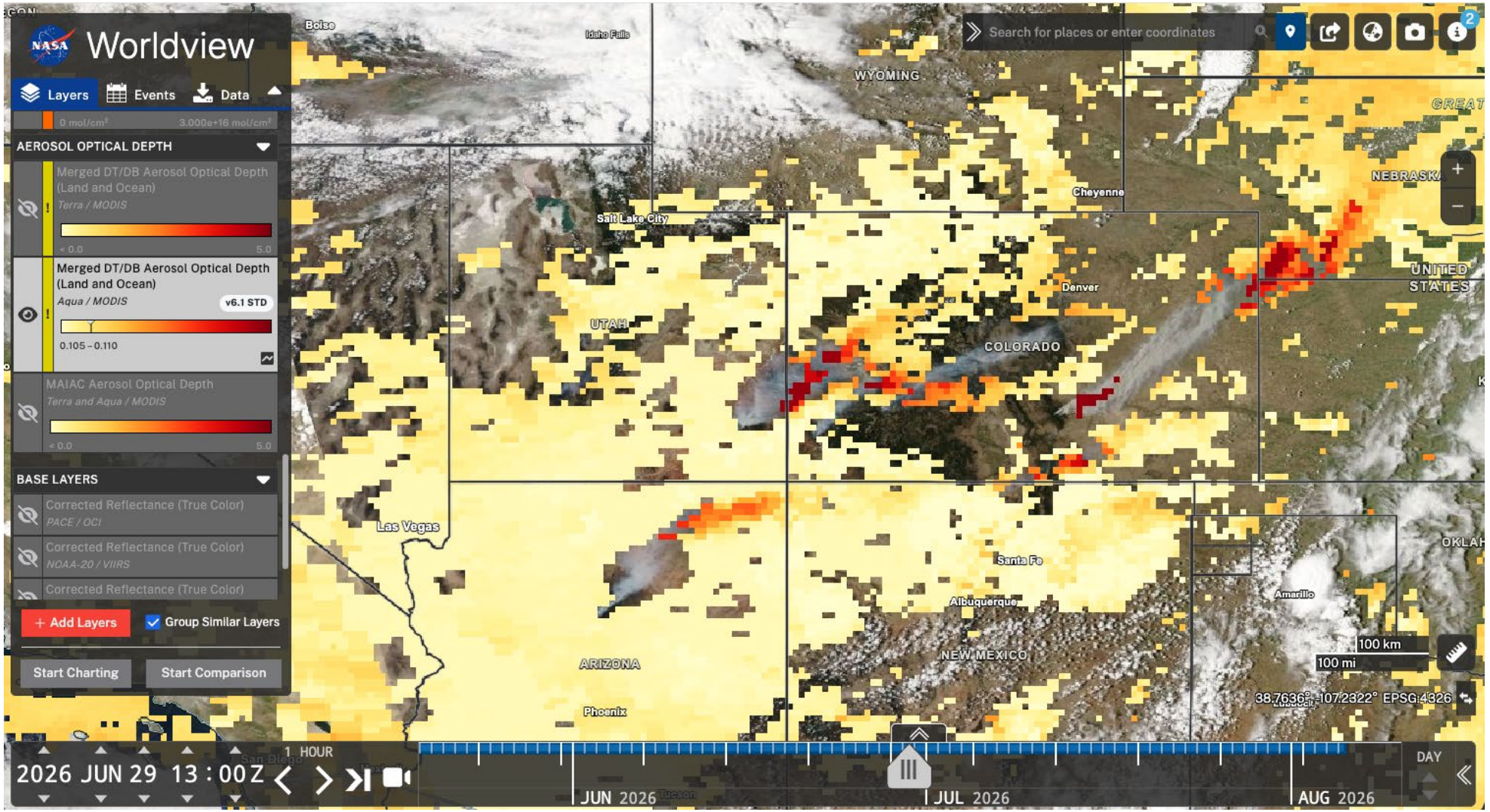
Actions

1. Keep MODIS Aqua true color as base layer. Toggle Fire and Thermal Anomalies Layer off.
2. Toggle MODIS/Aqua Merged DT/DB Aerosol Optical Depth to view aerosol detection (PM overpass time)
3. Toggle MODIS/Terra Merged DT/DB Aerosol Optical Depth to view aerosol detection (AM overpass time)
4. Toggle to MODIS/Terra and Aqua MAIAC Aerosol Optical Depth for direct comparison.

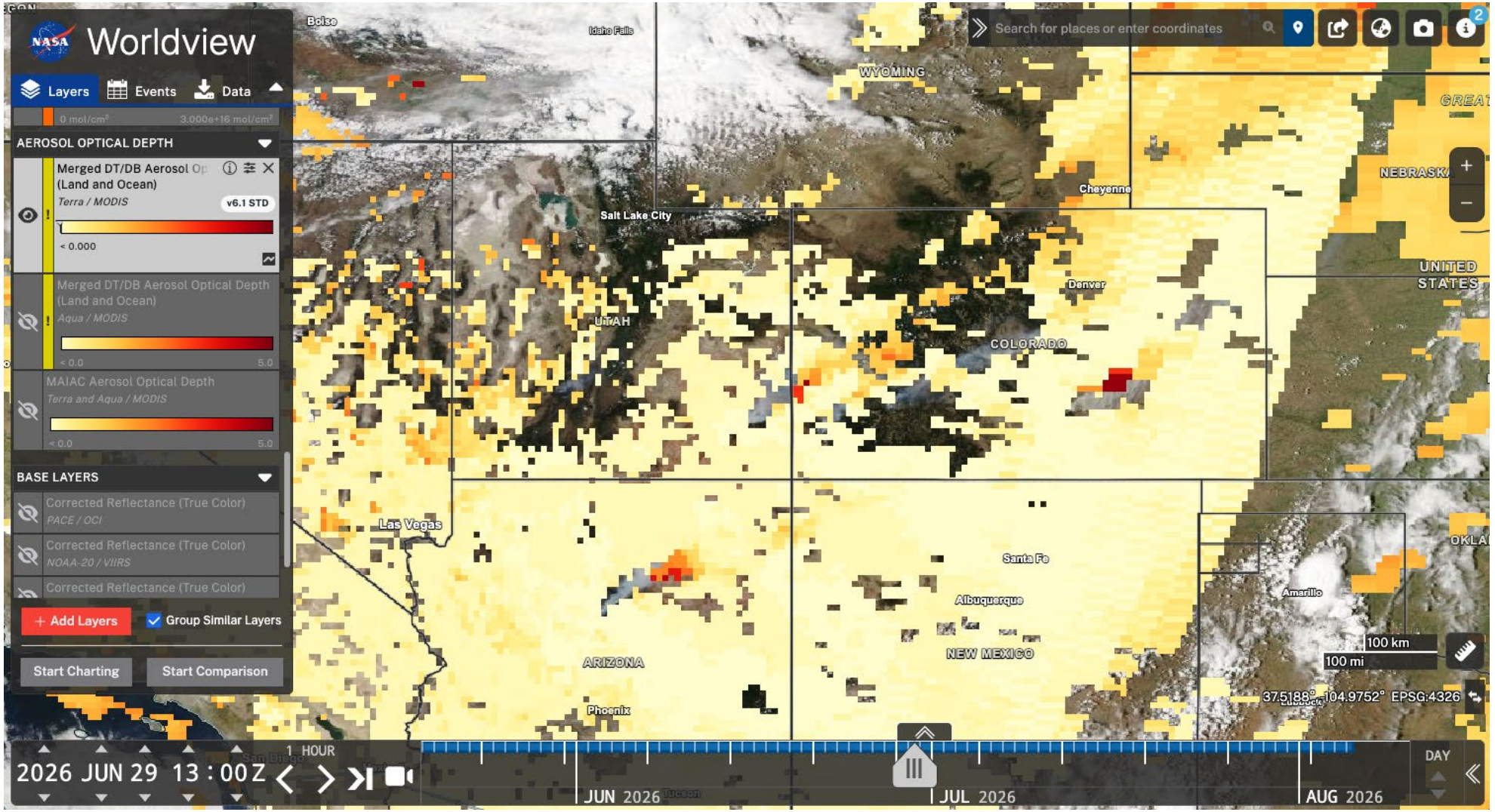
Notes:

- Gaps in DT/DB and MAIAC products occur where thick smoke is misclassified as cloud and retrievals are withheld.
- MAIAC achieves more coverage than DT/DB, which usually makes it preferred for detecting AOD from fire smoke.
- Also note the higher resolution of MAIAC AOD retrieval compared to DT/DB.

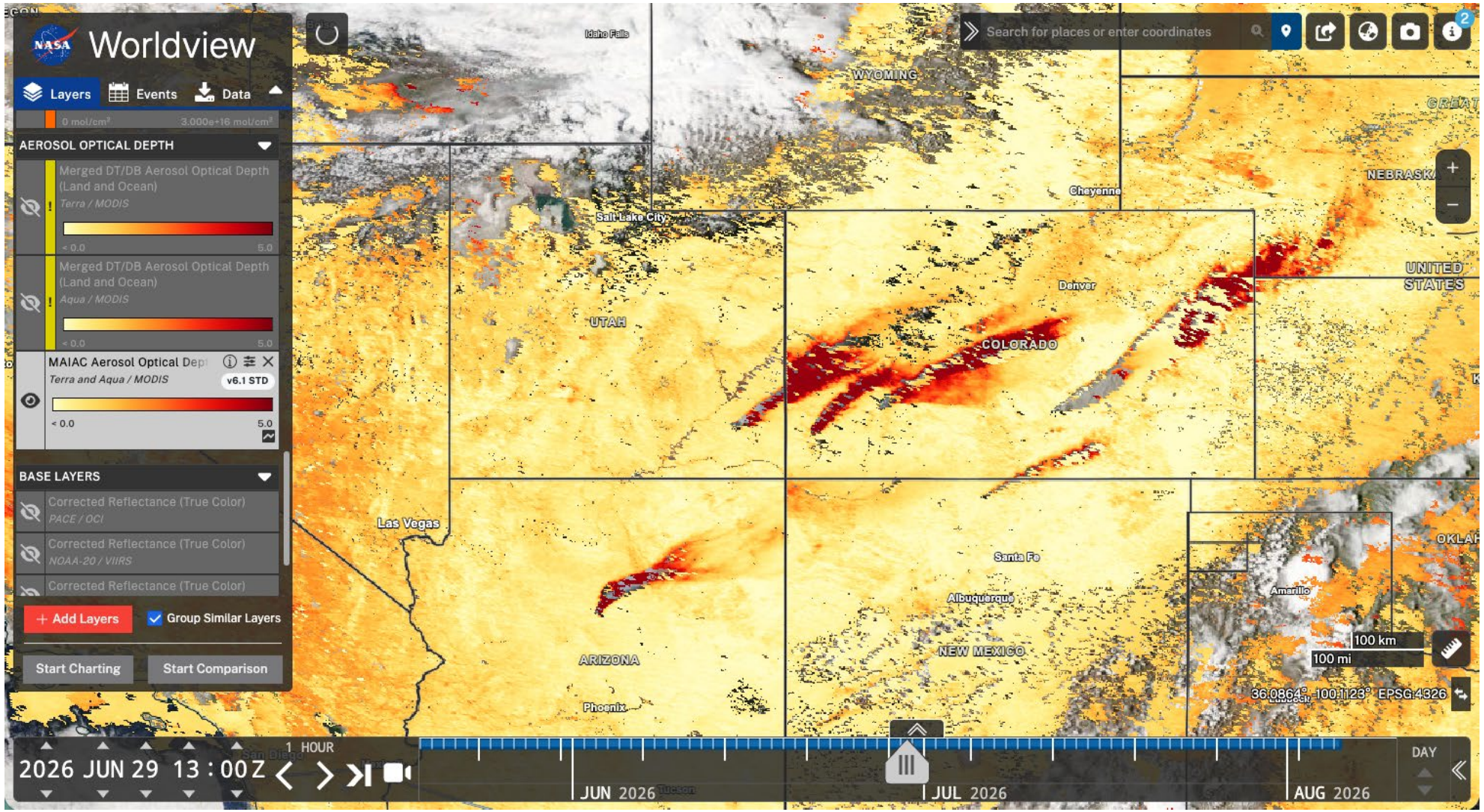
Step 3 – Product: MODIS/Aqua Merged DT/DB Aerosol Optical Depth (Land and Ocean)



Step 3 – Product: MODIS/Terra Merged DT/DB Aerosol Optical Depth (Land and Ocean)



Step 3 – Product: MODIS Terra & Aqua_MAIAC Aerosol Optical Depth



Step 4 – TEMPO: Hourly Smoke Tracking (UVAI)

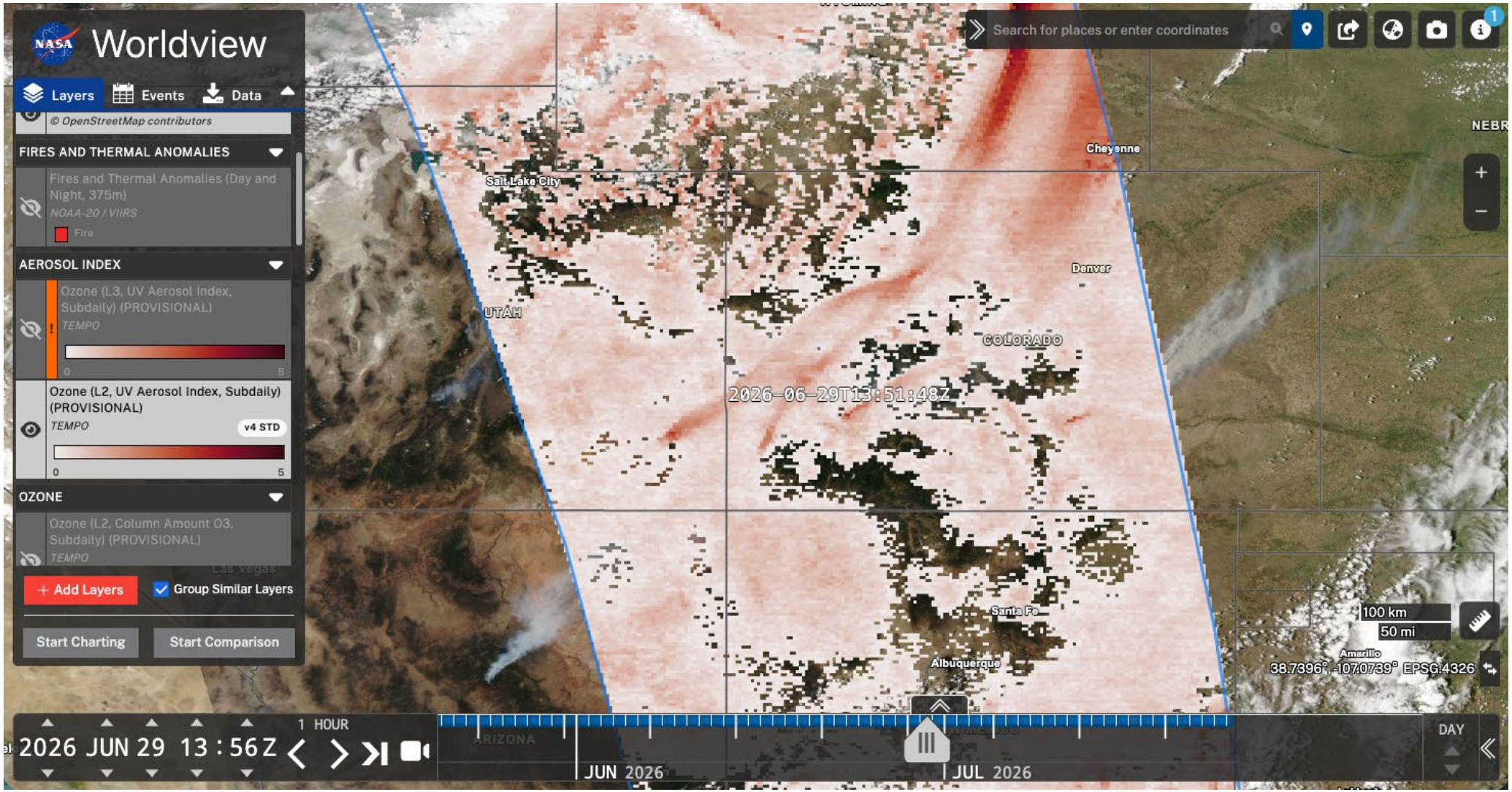
Actions

1. Keep MODIS Aqua true color as base layer, Jun 29, 13Z (7am MDT). Toggle off AOD layers.
2. Toggle on TEMPO L2 Ozone-UV Aerosol Index layer (listed under Ozone layers); set granule count to 1 in settings; note overpass timestamp (around 13:51Z over UT/CO fires) and set time to 13.56Z.
3. Zoom out to full US and step through custom 8-minute intervals (Custom interval Selector in the bottom left of the Time bar) to see hourly granule coverage across the US within 1 hour; zoom back to Utah/Colorado.
4. Keep L2 TEMPO Ozone-UV Aerosol Index layer on and set granule count 2; Toggle TEMPO L3 Ozone-UV Aerosol Index layer on top of the L2; step forward at 1h increments to from 13:56Z to 22:55Z to show plume evolution over time.

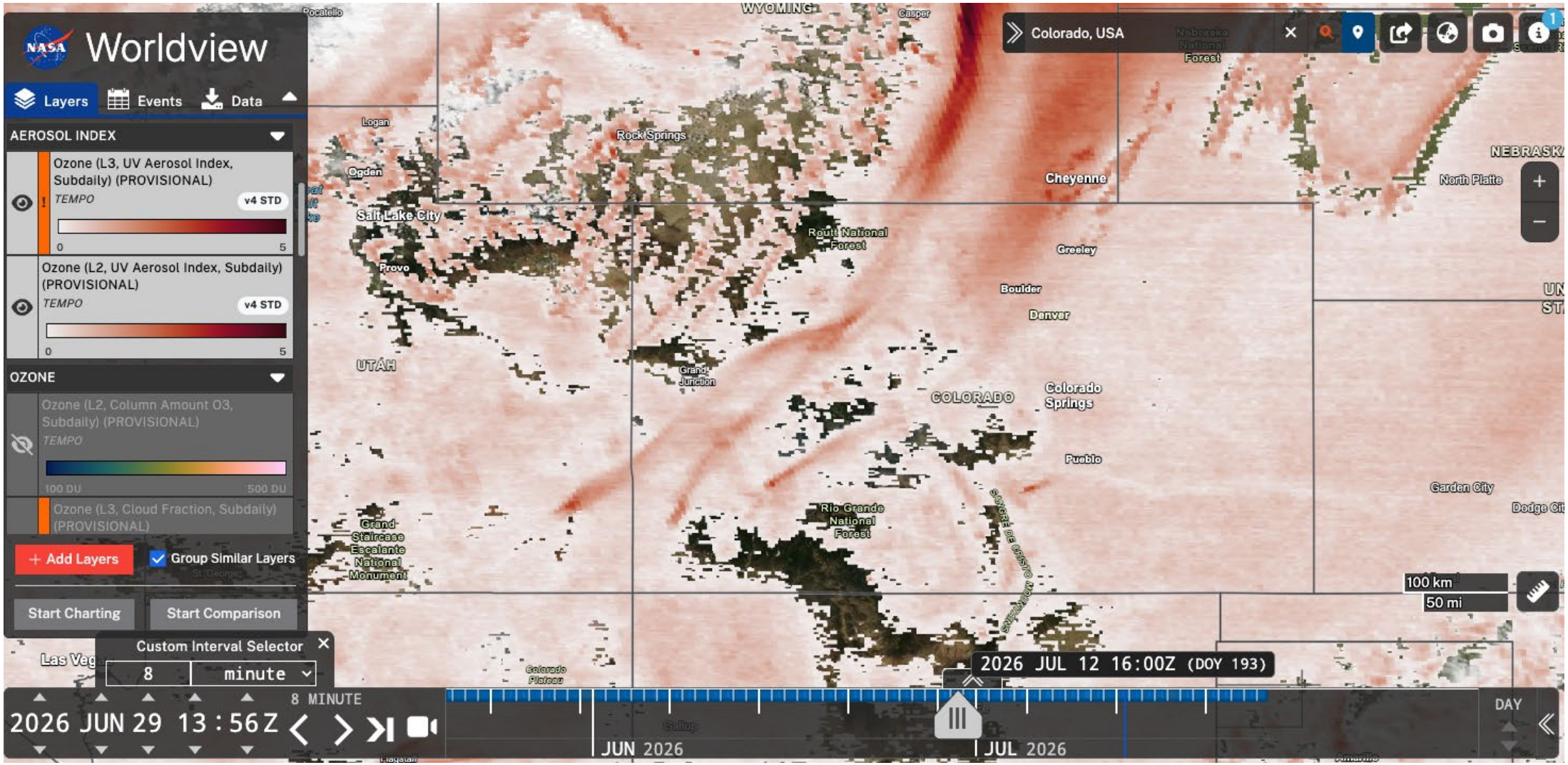
Note:

There are UVAI gaps in the dense plume in the L3 data. This has been mistakenly taken out during the processing from L2 to L3 data. Usually, UVAI is well retrieved in cloud and even in dense smoke. If you look at just L2 UVAI data for the same scene, the UVAI is retrieved throughout the plume, with no gaps (hence why we suggest keeping L2 below L3 in Worldview).

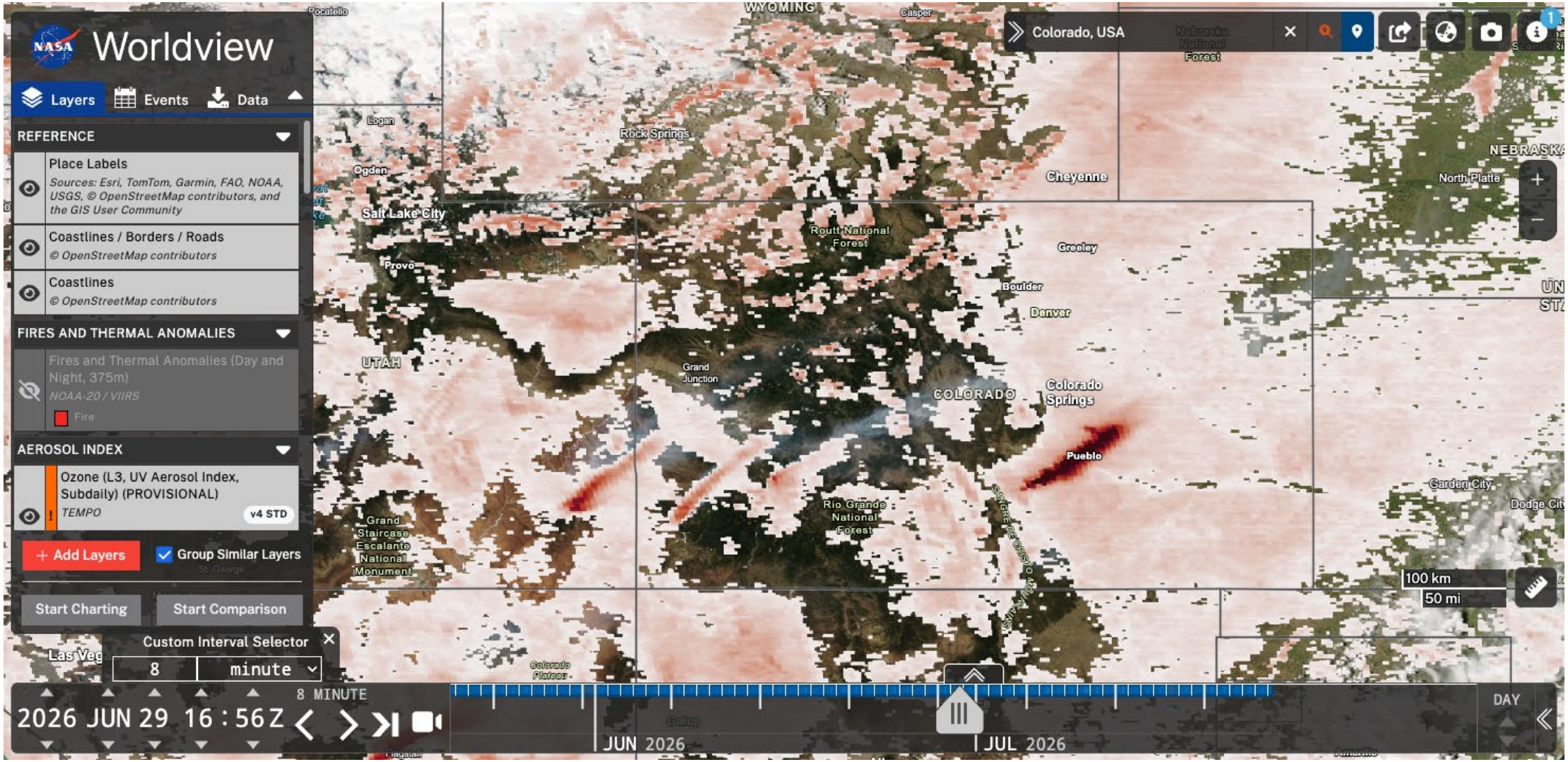
Step 4 – Product: TEMPO Ozone (L2, UV Aerosol Index, Subdaily)- 13:55Z (7:56am MDT) 1 Granule



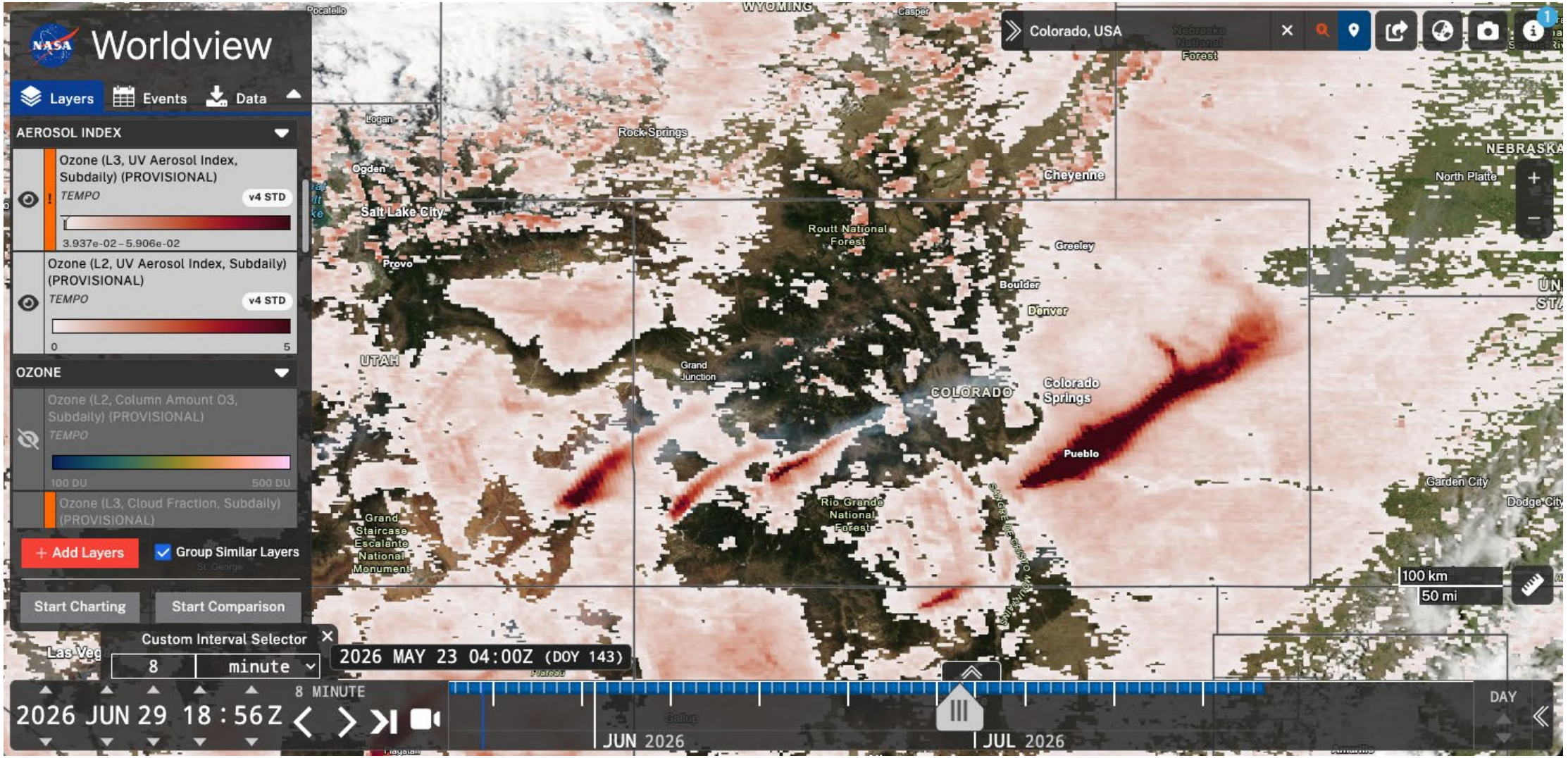
Step 4 – Product: TEMPO Ozone (L3 over L2, UV Aerosol Index, Subdaily)- 13:56Z (7:56am MDT)



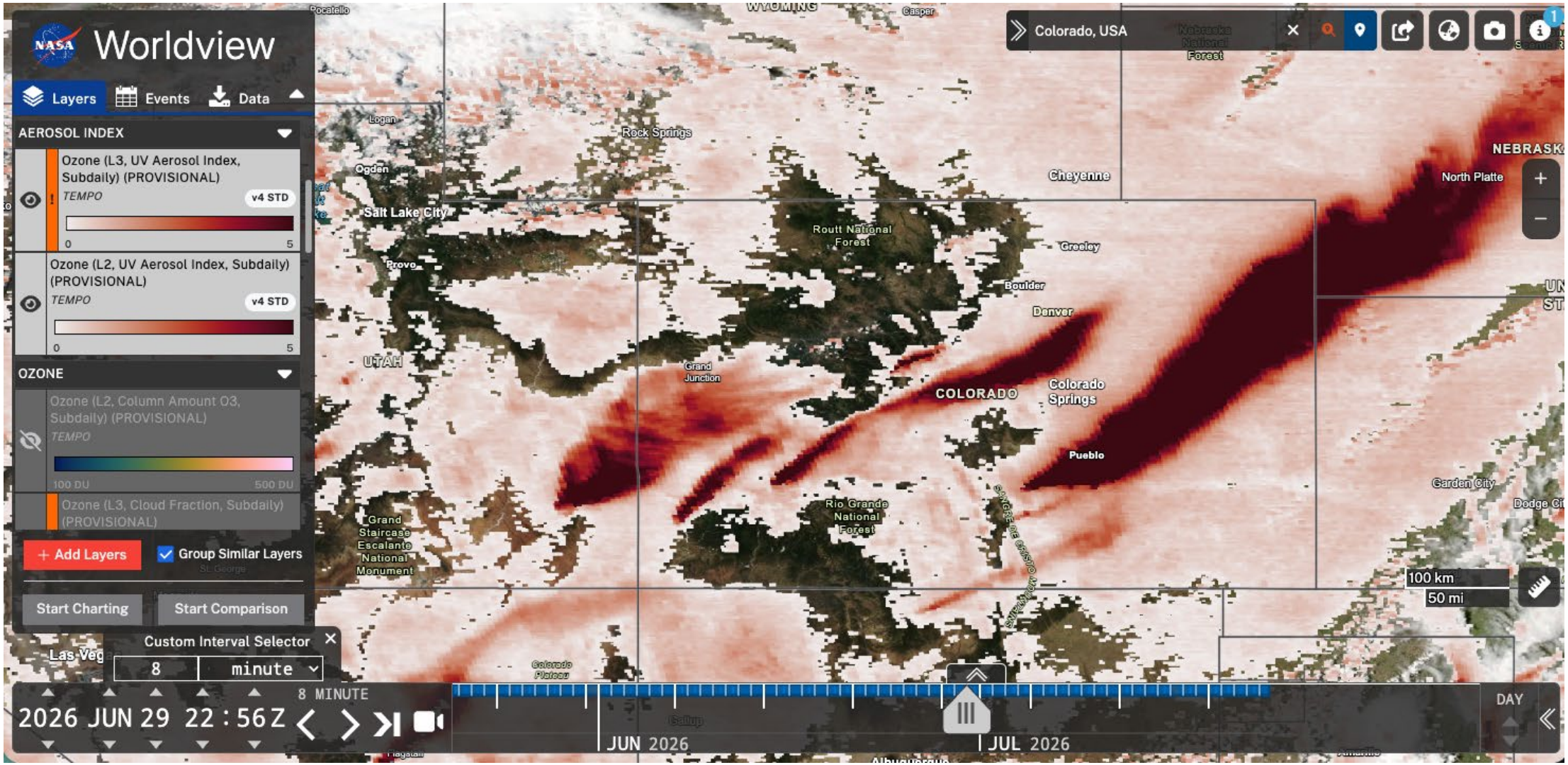
Step 4 – Product: TEMPO Ozone (L3 over L2, UV Aerosol Index, Subdaily)- 16:56Z (10:56am MDT)



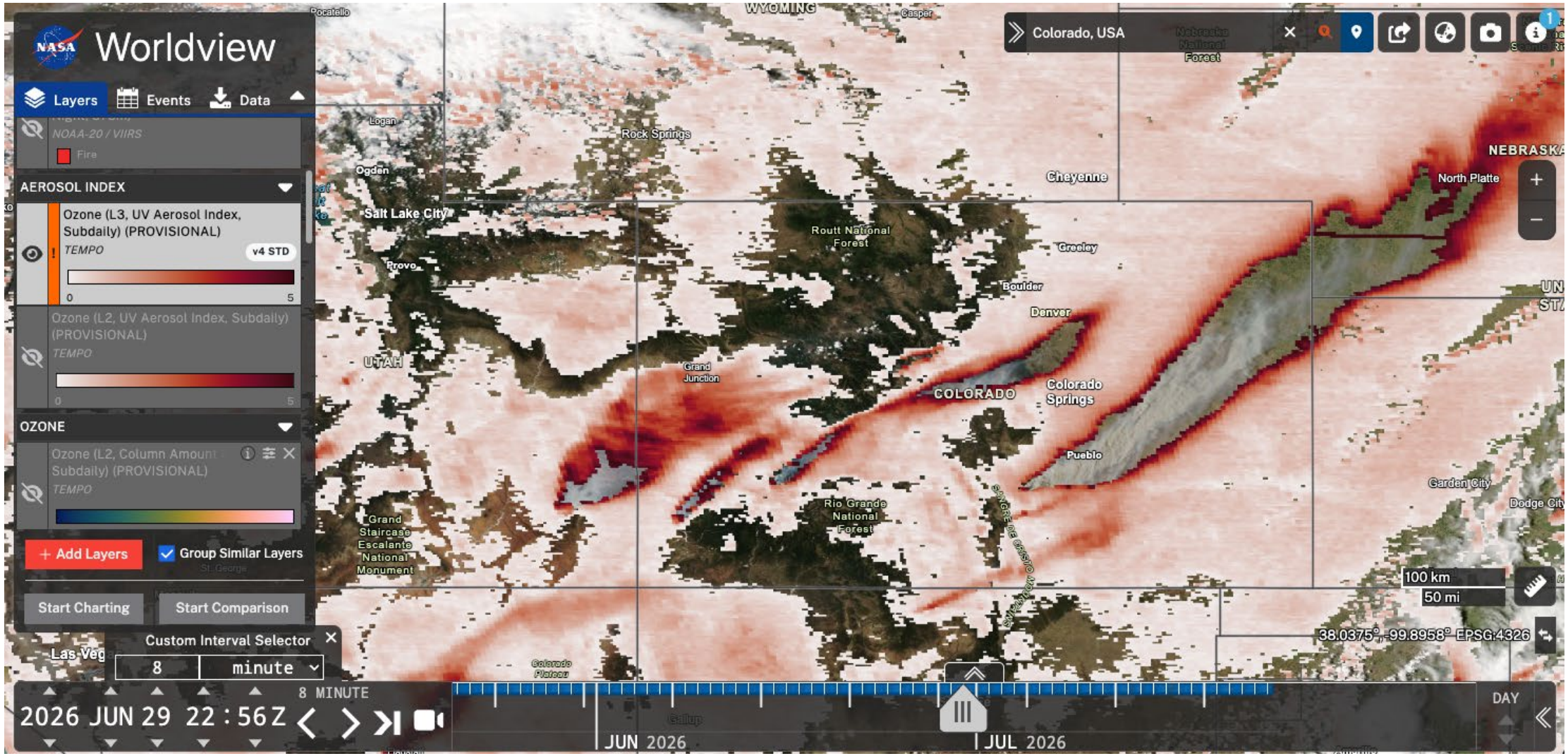
Step 4 – Product: TEMPO Ozone (L3 over L2, UV Aerosol Index, Subdaily)- 18:56Z (12:56pm MDT)



Step 4 – Product: TEMPO Ozone (L3 over L2, UV Aerosol Index, Subdaily)- 22:56Z (4:56pm MDT)



Step 4 – Product: TEMPO Ozone (L3, UV Aerosol Index, Subdaily)- 22:56Z (4:56pm MDT)*



*Note missing data in the center of the plume for L3. This has been mistakenly taken out during the processing from L2 to L3 data.

Step 5 – TEMPO: Hourly Smoke Tracking (Trace Gases)

Actions

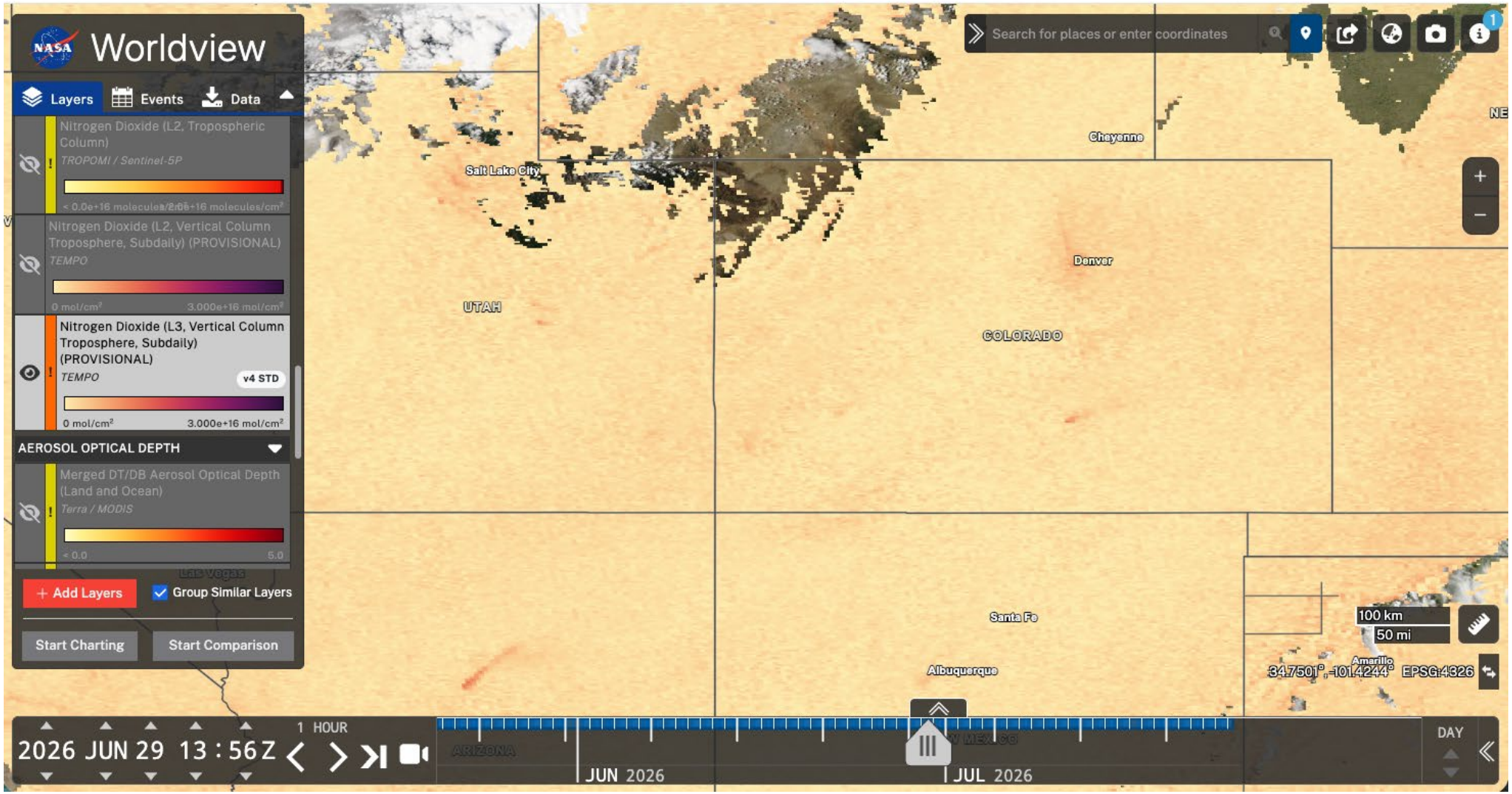
1. Keep MODIS Aqua true color as base layer, Jun 29, 13Z (7am MDT). Toggle off UVAI layers.
2. Toggle TEMPO NO_2 L3 Troposphere on; step forward at 1h increments to 21Z to show NO_2 plume evolution over time.
3. With the animation tool, create an animation of the UVAI Jun 29, 13:56Z to Jun 29 22:56Z (7:56am MDT-16:56pm MDT); 2 frames per second, 1h increment; loop through it and save.
4. Toggle on TROPOMI L2 NO_2 for comparison with TEMPO NO_2. Check overpass time of TROPOMI over UT/CO (~19:51Z). Select TEMPO L3 closest to ~19:51Z overpass for a near-simultaneous comparison. Use Comparison Mode to compare TEMPO and TROPOMI NO_2 side by side
5. Switch to TEMPO HCHO L3; repeat time progression as for NO_2.
6. Switch to TEMPO O_3 L3 on for Jun 29, 22:56Z (4.56pm MDT); Toggle on the Fire and Thermal Anomaly Layer as reference for fires; go into View Options and squash Ozone values palette to ~40–70 DU and use Rainbow 4 color palette to better see differences in values in Ozone. Ozone from fires is particularly visible downwind of the Aspen Acres Fire.

Step 5 – TEMPO: Hourly Smoke Tracking (Trace Gases)

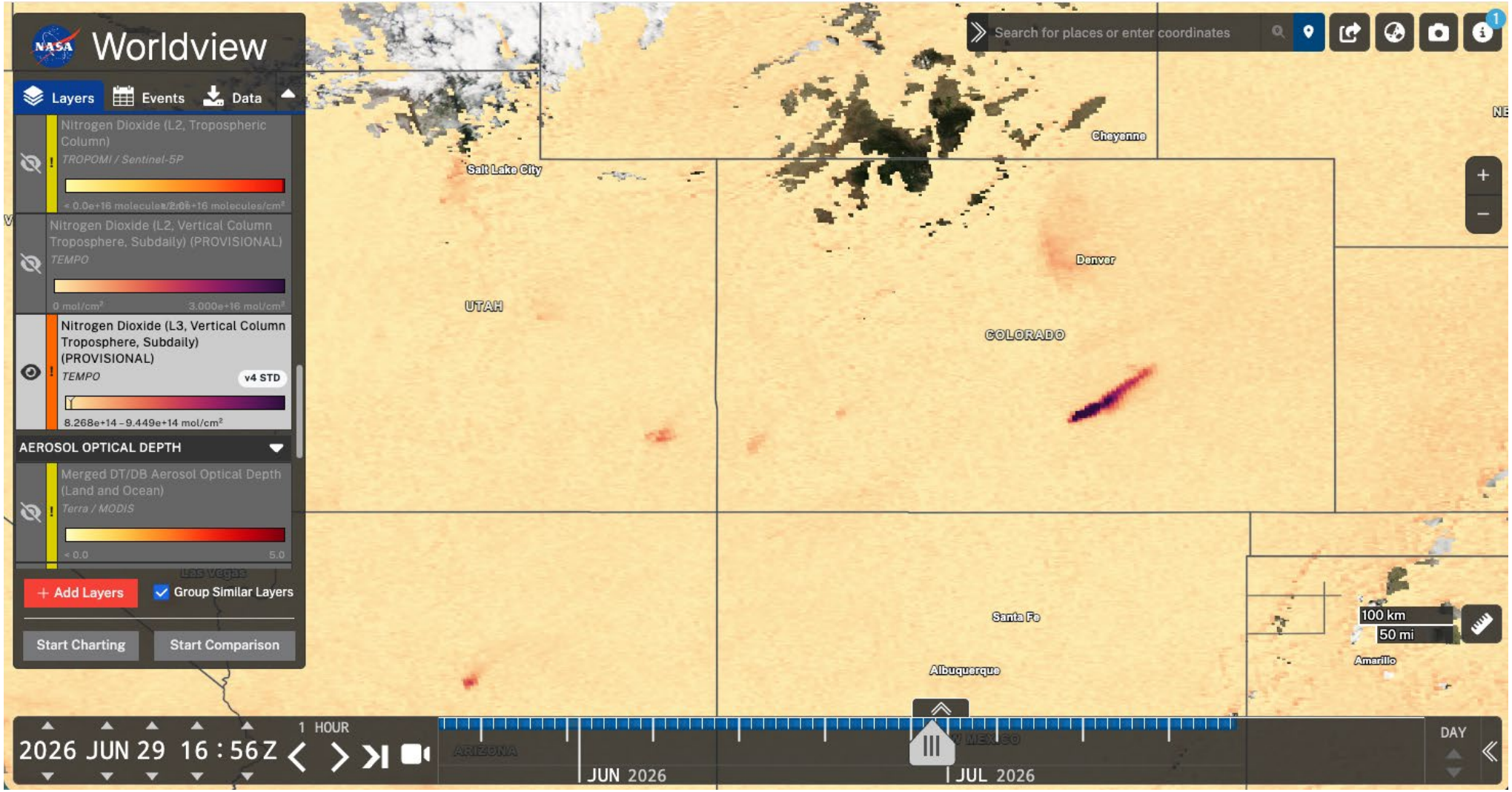
Notes

- TEMPO NO_2 is able to better capture fire signal than TROPOMI and with increased definition, in addition to hourly data compared to 1 day overpass for TROPOMI.
- HCHO shows noisier signal compared to NO_2.
- Note that L3 Ozone product is express in Dobson Unit (DU).
- While Ozone enhancements in dense smoke plumes can reflect genuine wildfire photochemistry, ozone retrieval in dense plumes is more uncertain, so observed enhancements should be interpreted cautiously and ideally validated against independent ground-based measurements.

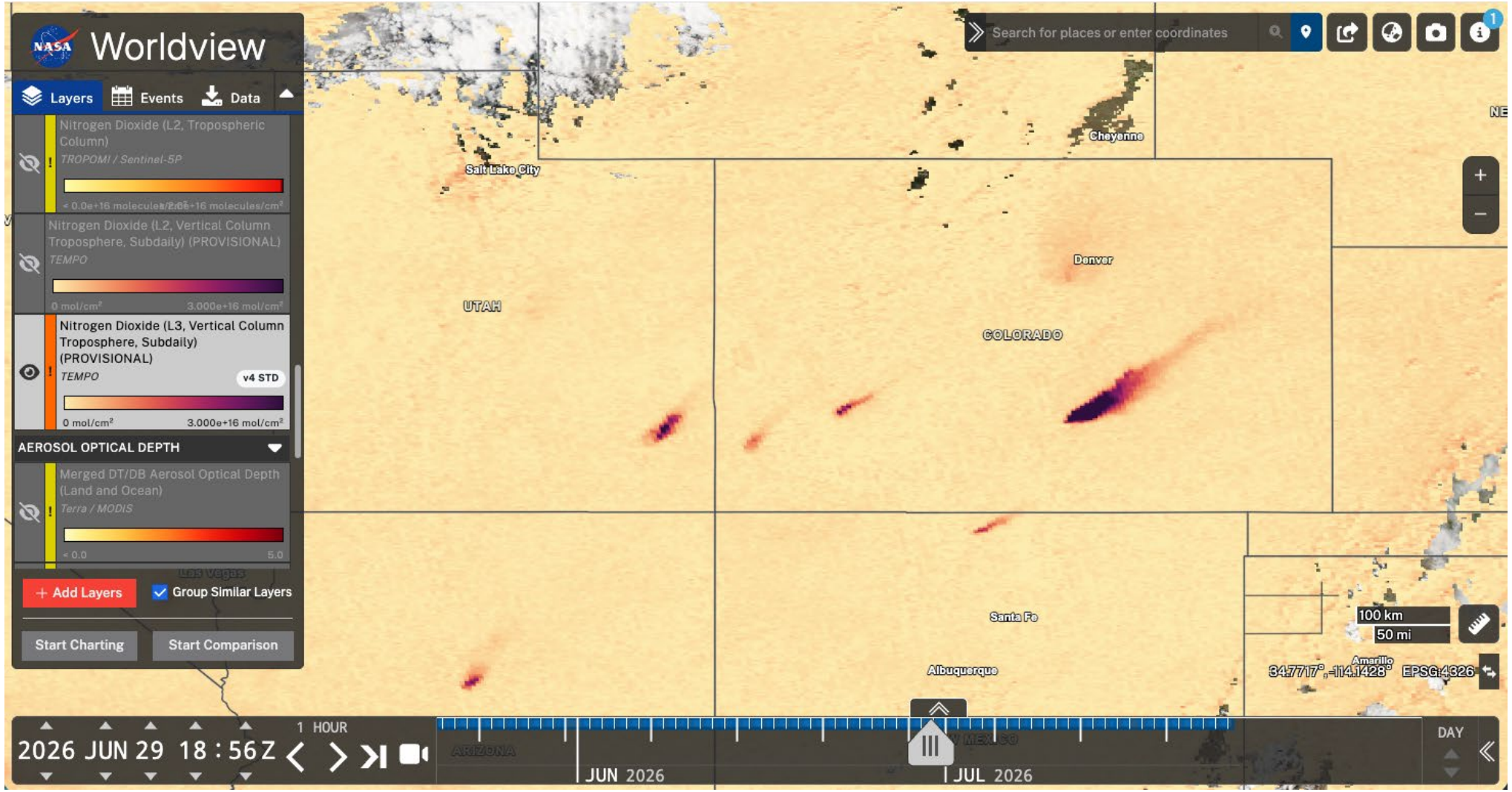
Step 5 – Product: TEMPO Nitrogen Dioxide (L3, Vertical Column Troposphere, Subdaily) -13:56Z (7:56am MDT)



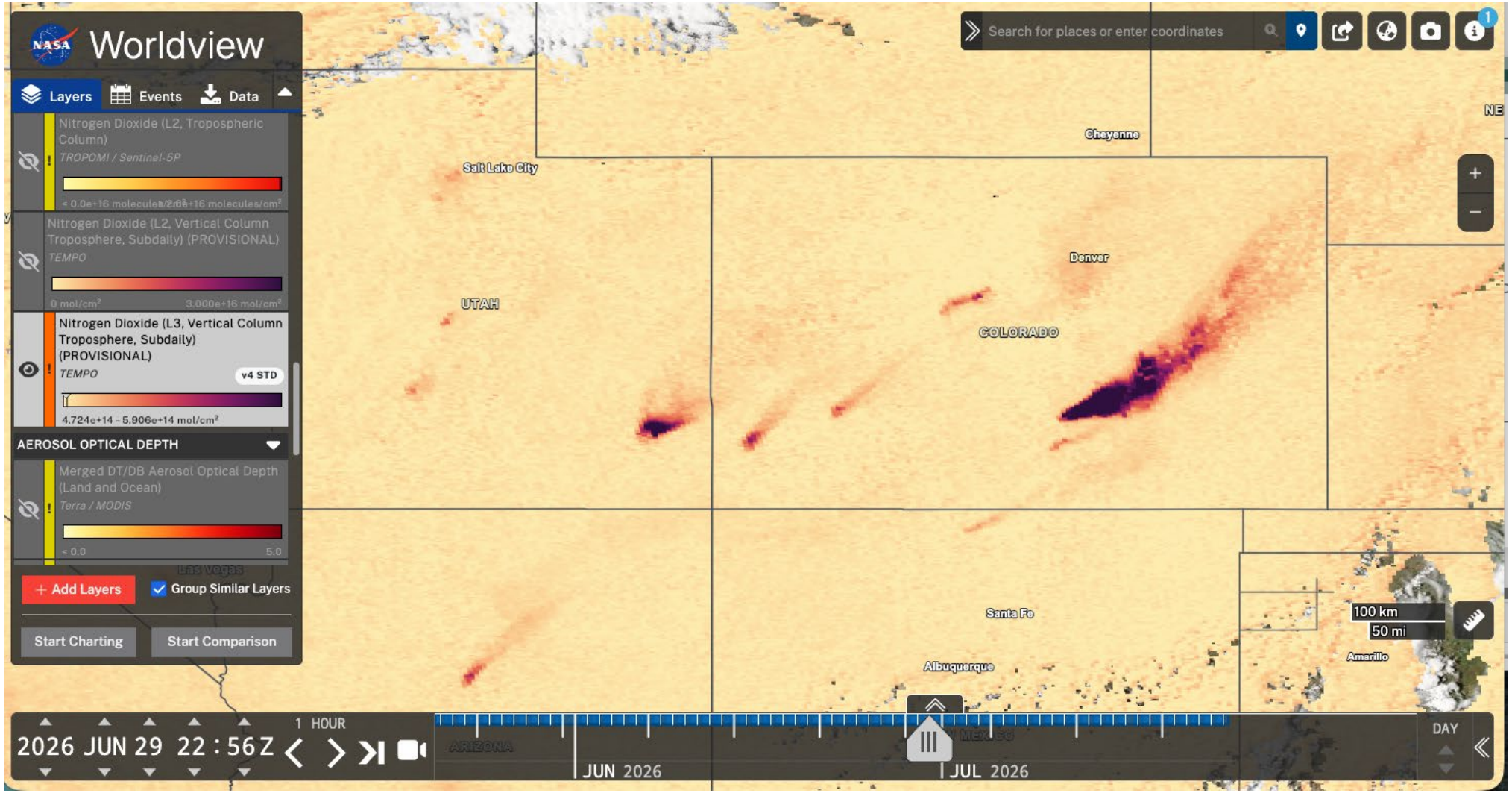
Step 5 – Product: TEMPO Nitrogen Dioxide (L3, Vertical Column Troposphere, Subdaily) -16:56Z (10:56am MDT)



Step 5 – Product: TEMPO Nitrogen Dioxide (L3, Vertical Column Troposphere, Subdaily) -18:56Z (12:56pm MDT)



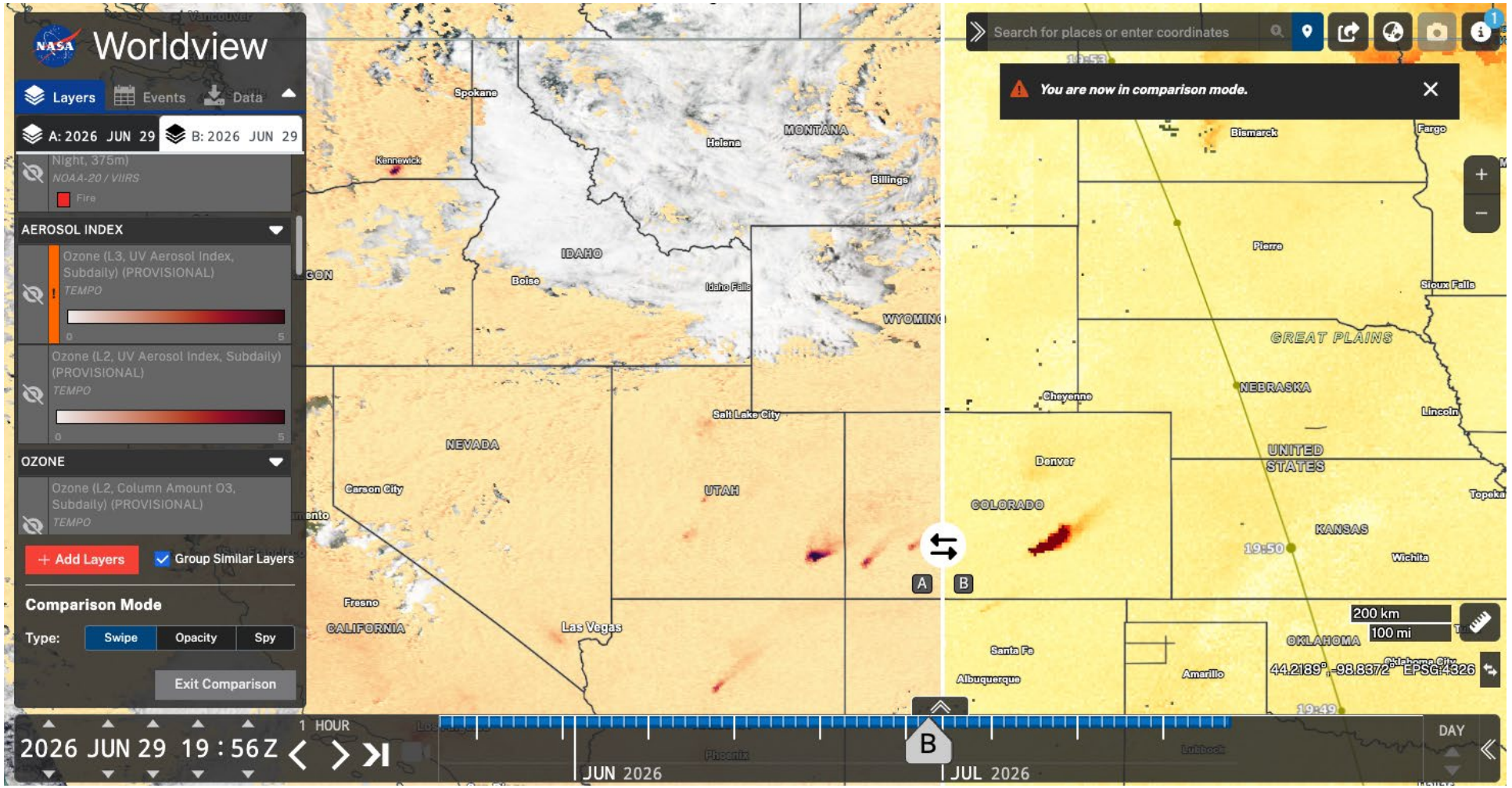
Step 5 – Product: TEMPO Nitrogen Dioxide (L3, Vertical Column Troposphere, Subdaily) -22:56Z (4:56pm MDT)



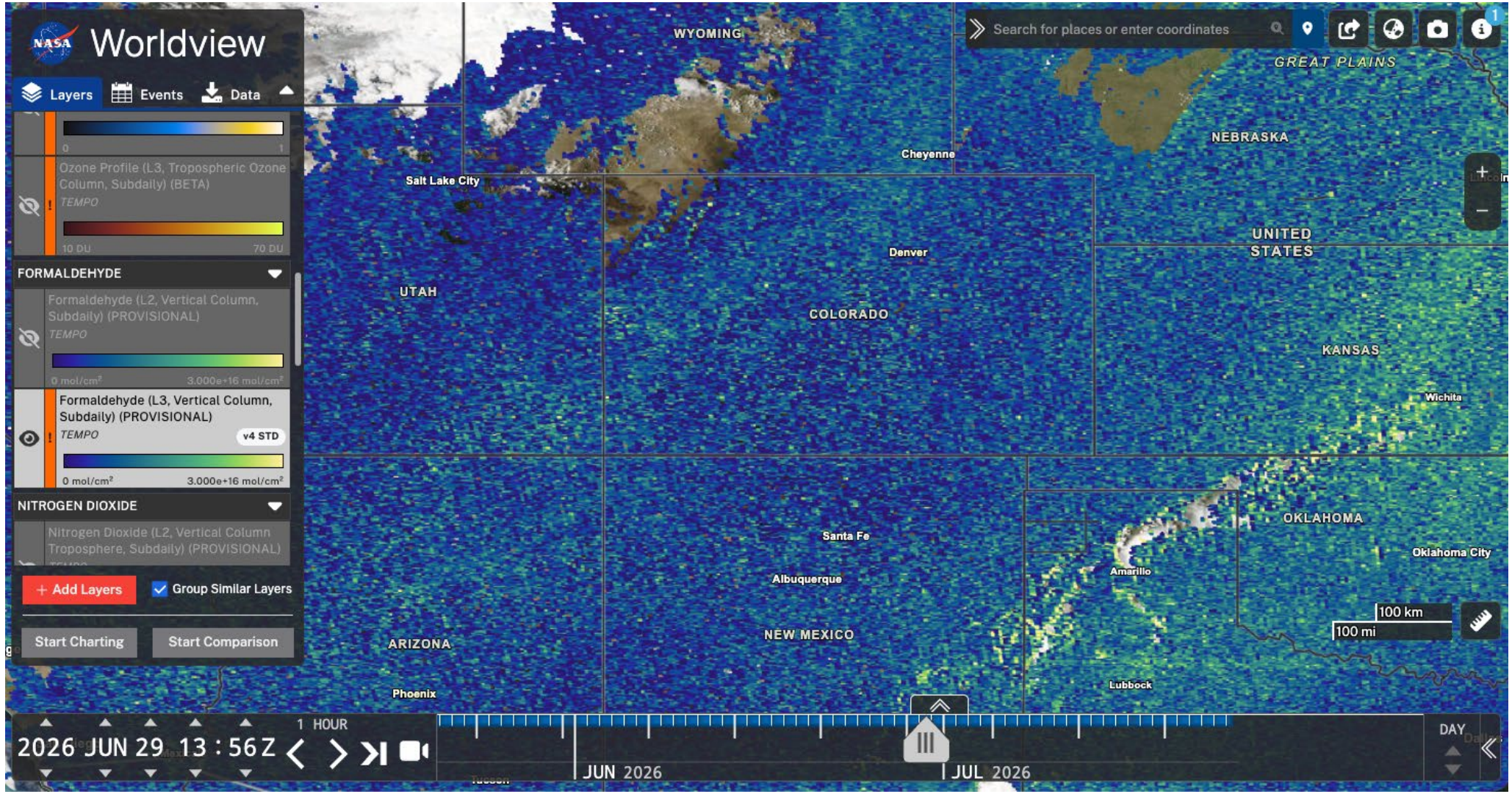
Step 5 – Tropospheric NO_2: TROPOMI vs. TEMPO

PANEL A: TEMPO Nitrogen Dioxide (L3, Vertical Column Troposphere, Subdaily)

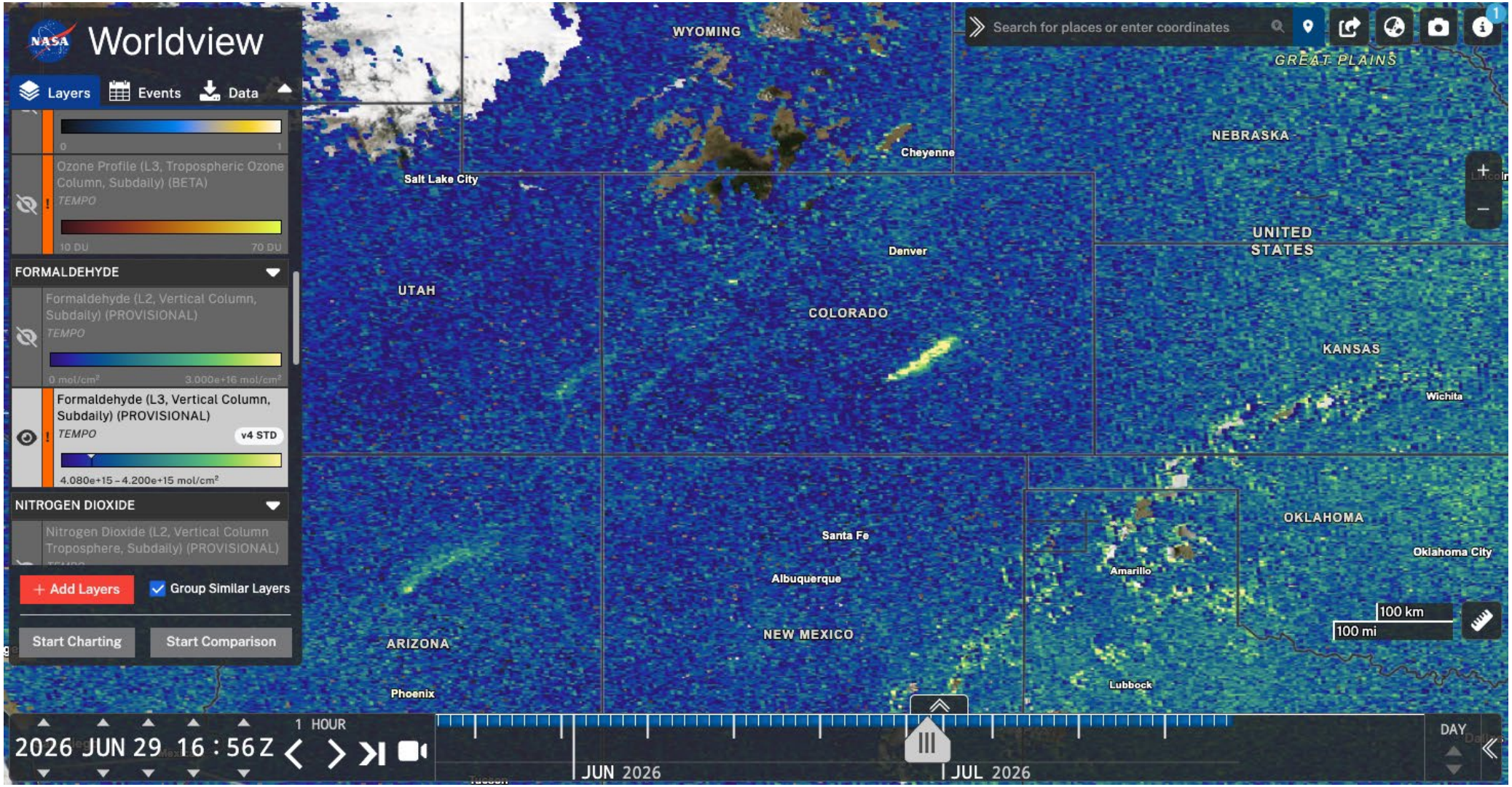
PANEL B: TROPOMI Nitrogen Dioxide (L2 Tropospheric Column); -19:56Z (1:56pm MDT)



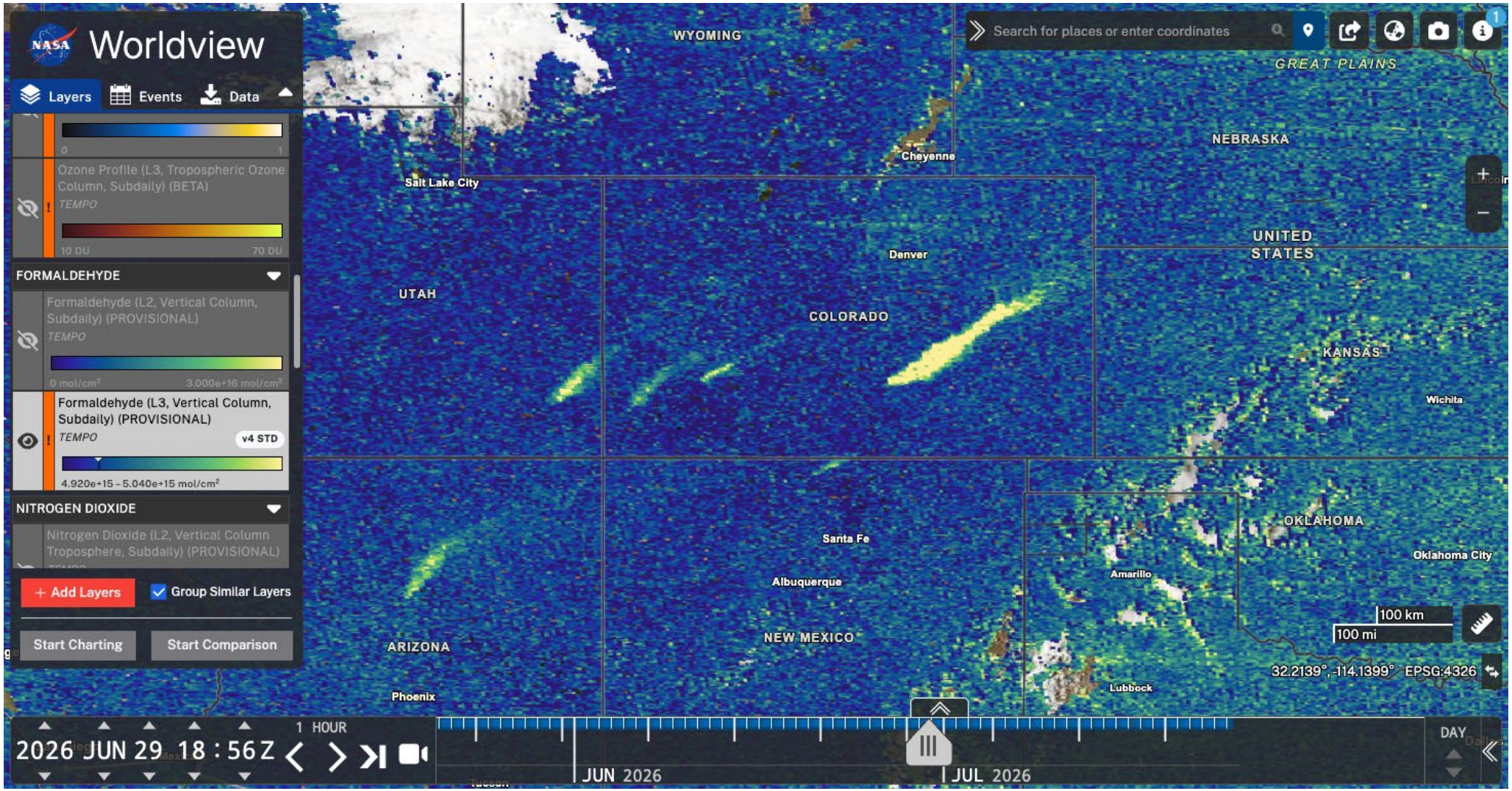
Step 5 – Product: TEMPO Formaldehyde (L3, Vertical Column, Subdaily) 13:56Z (7:56am MDT)



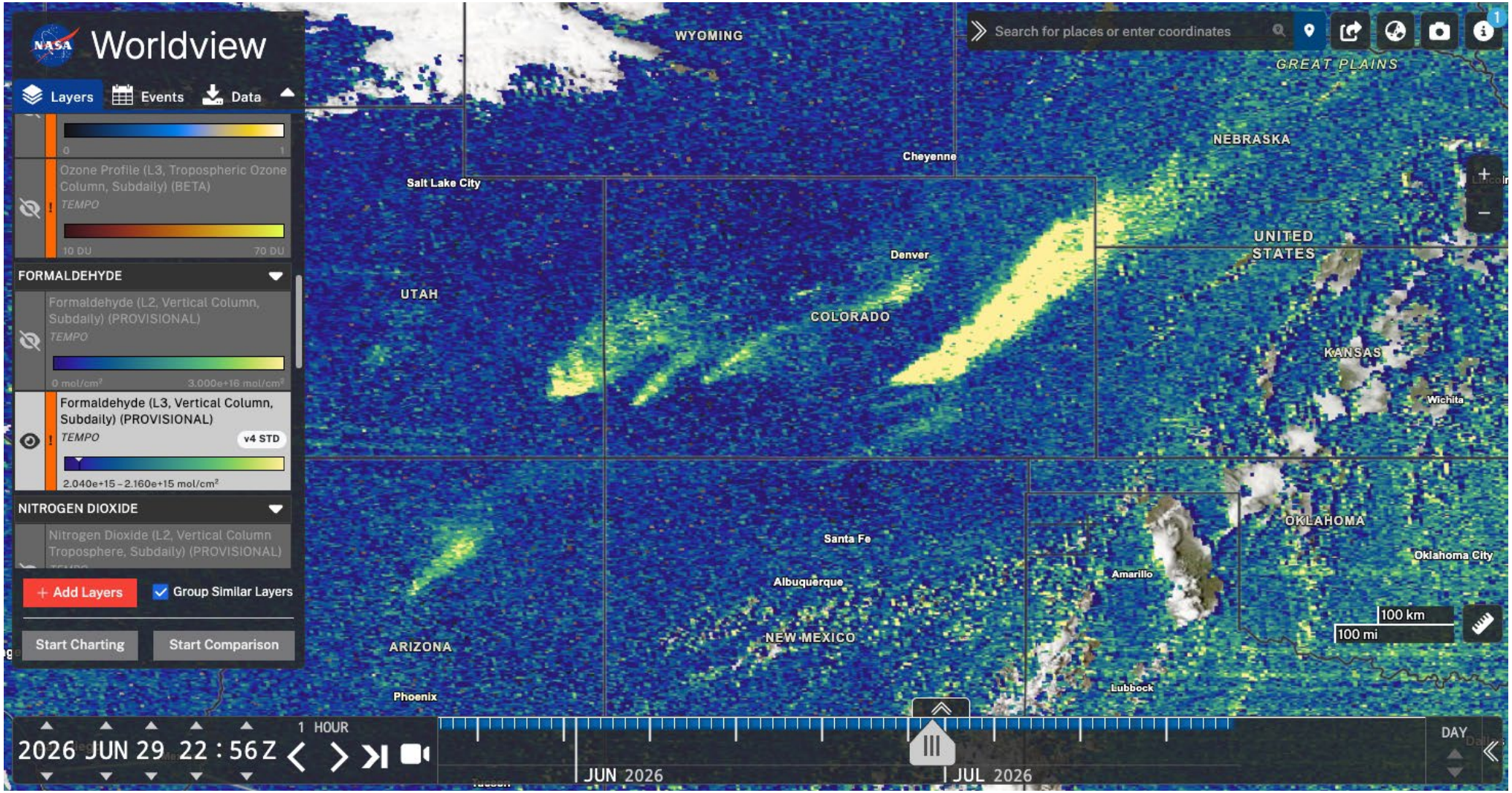
Step 5 – Product: TEMPO Formaldehyde (L3, Vertical Column, Subdaily) 16:56Z (10:56am MDT)



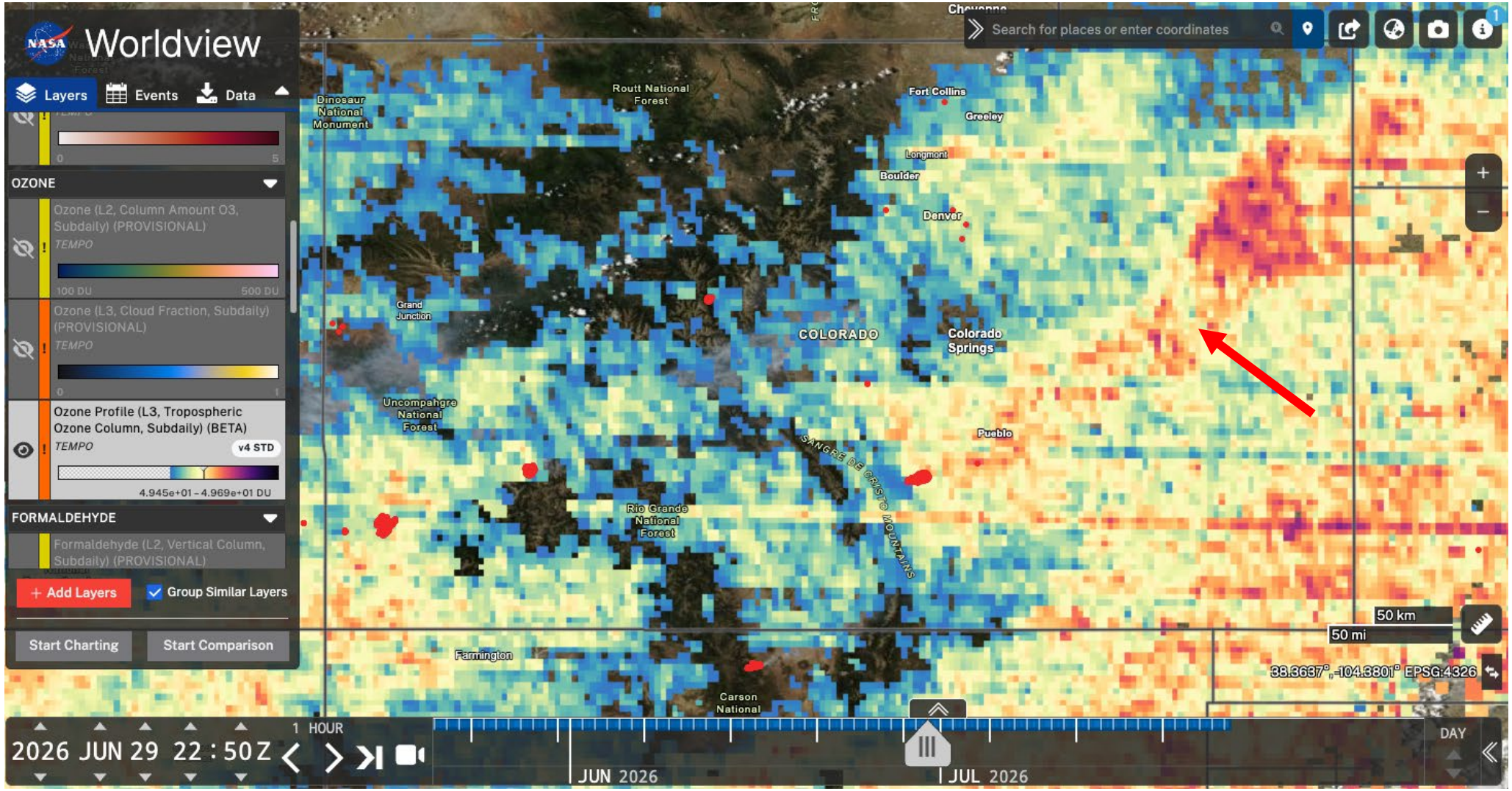
Step 5 – Product: TEMPO Formaldehyde (L3, Vertical Column, Subdaily) 18:56Z (12:56pm MDT)



Step 5 – Product: TEMPO Formaldehyde (L3, Vertical Column, Subdaily) 22:56Z (4:56pm MDT)



Step 5 – Product: TEMPO Ozone profile (L3, Tropospheric Ozone Column, Subdaily) 22:50Z (4:50pm MDT)



Summary

- Utah and Colorado fires of June/July 2026 are detectable across multiple NASA satellite products within hours of ignition.
- True color and fire detection layers together confirm fire location and plume extent.
- MODIS and MAIAC AOD track daily smoke column loading, though thick smoke can be misclassified as cloud, causing retrieval gaps. TEMPO UVAI provides a robust way for tracking the aerosol plume where AOD is not retrieved.
- TEMPO provides hourly aerosol and trace gas observation – UVAI, NO_2, HCHO, and Ozone - enabling tracking of pollutants from the wildfires during daytime.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