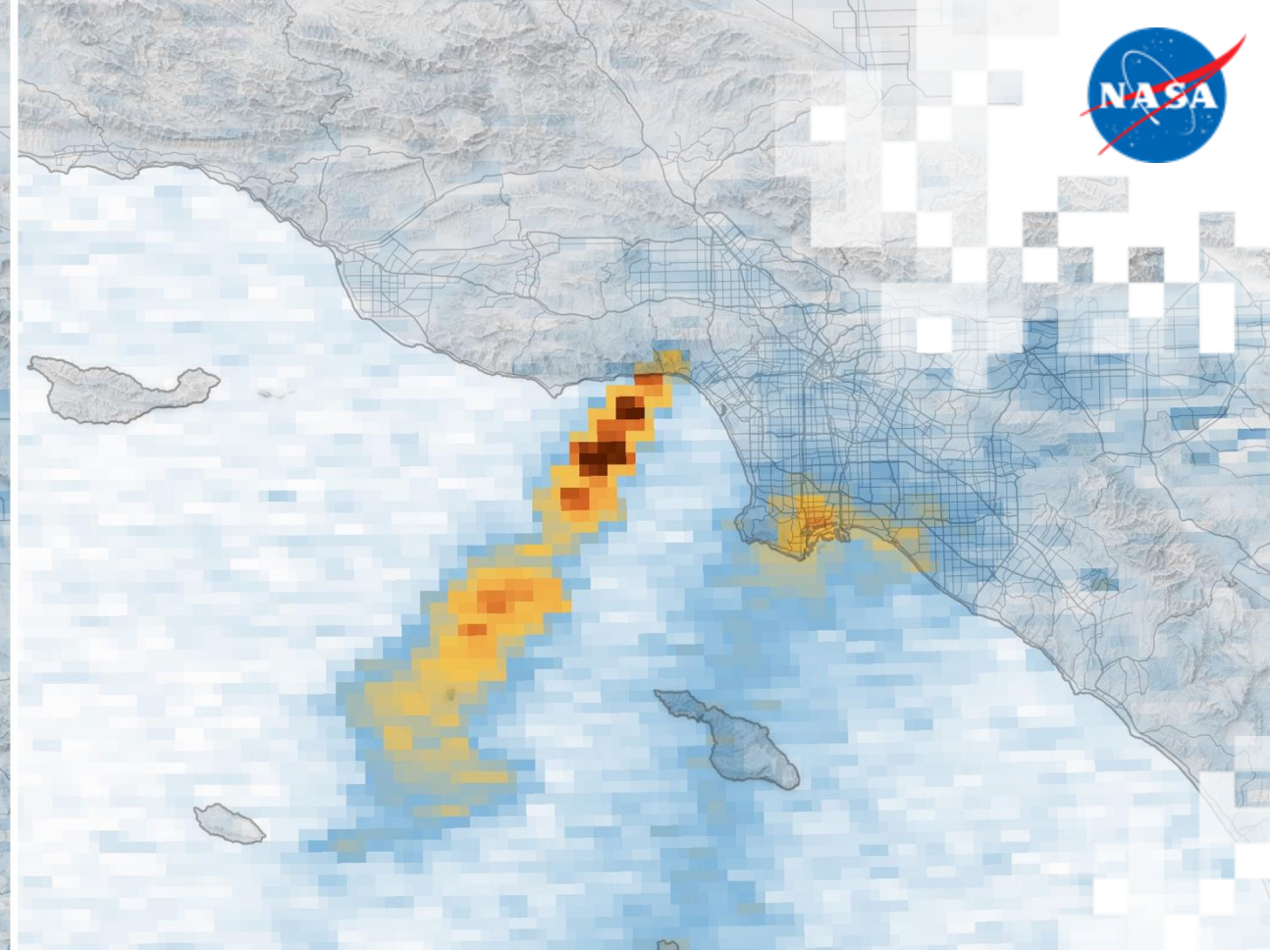
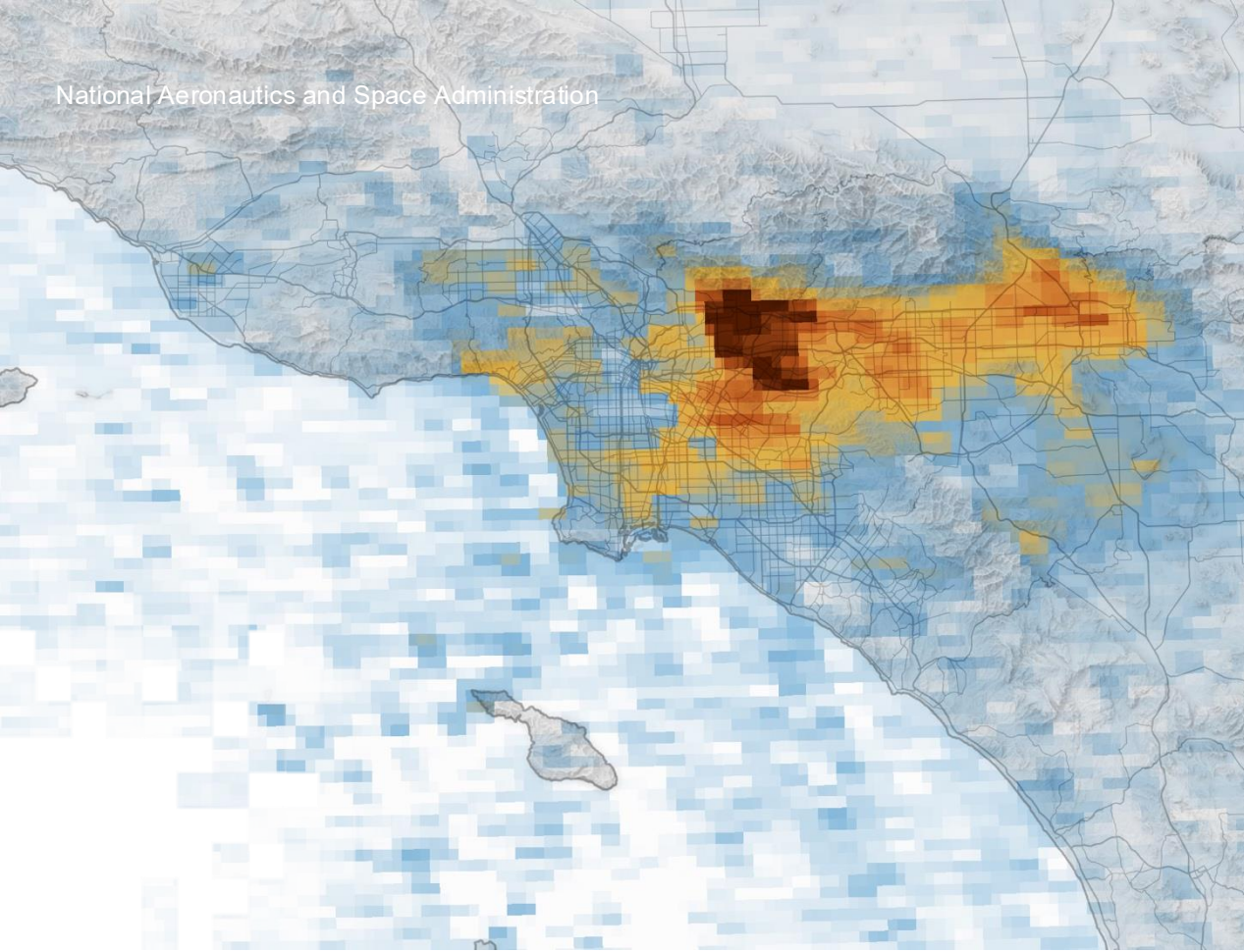


National Aeronautics and Space Administration



Introduction to Geostationary Observations for Air Quality Applications in the Western US

Day 3, Part 2: Exceptional Event Tools and Satellite Observations for Air Quality
Applications in the South Coast AQMD

August 7, 2025



Exceptional Event Tools and Satellite Observations for Air Quality Applications in the South Coast AQMD

Emily Bian, PhD

Melissa Maestas, PhD

Ranil Dhammapala, PhD

Nico Schulte, PhD

Scott A. Epstein, PhD

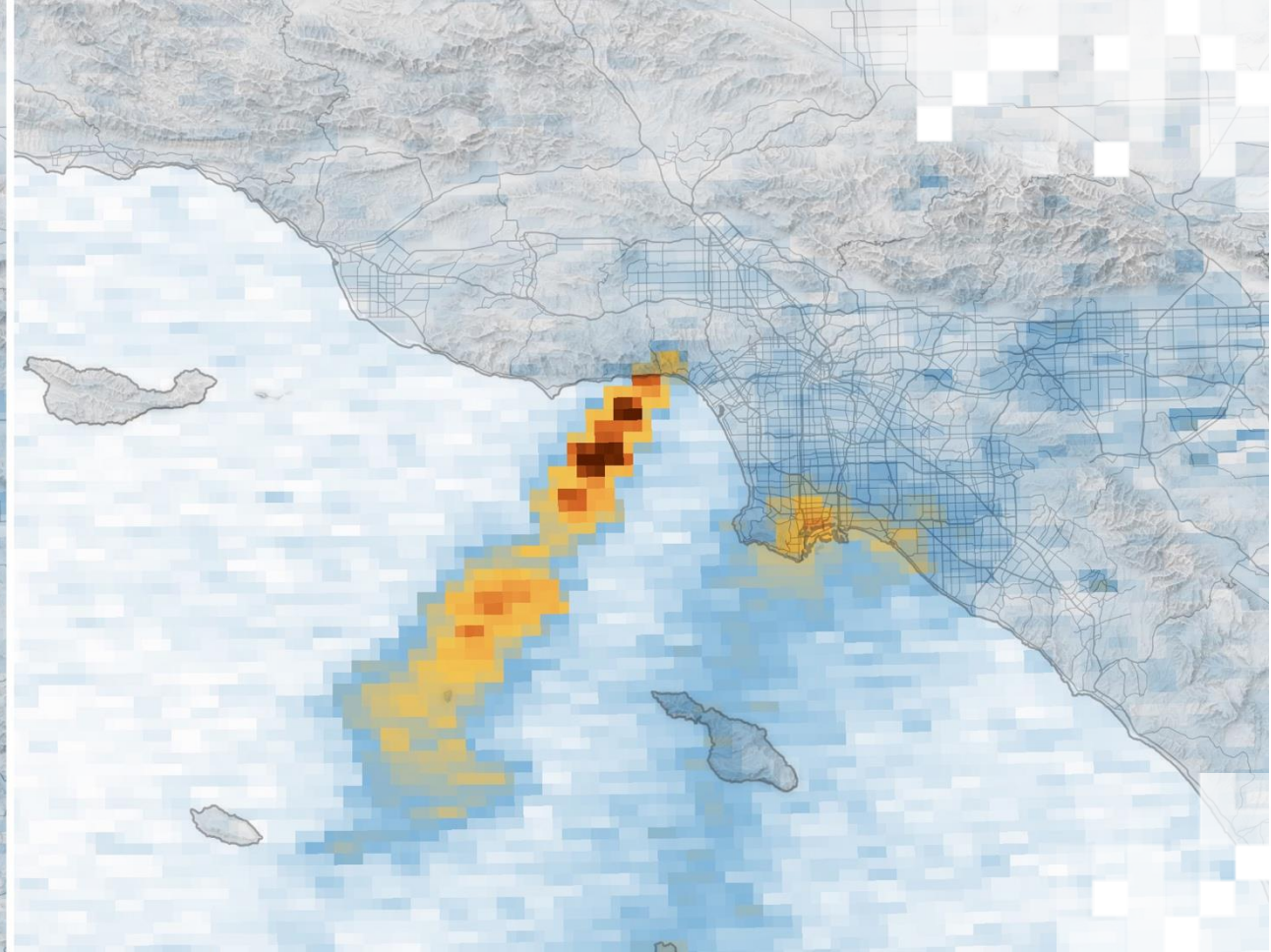
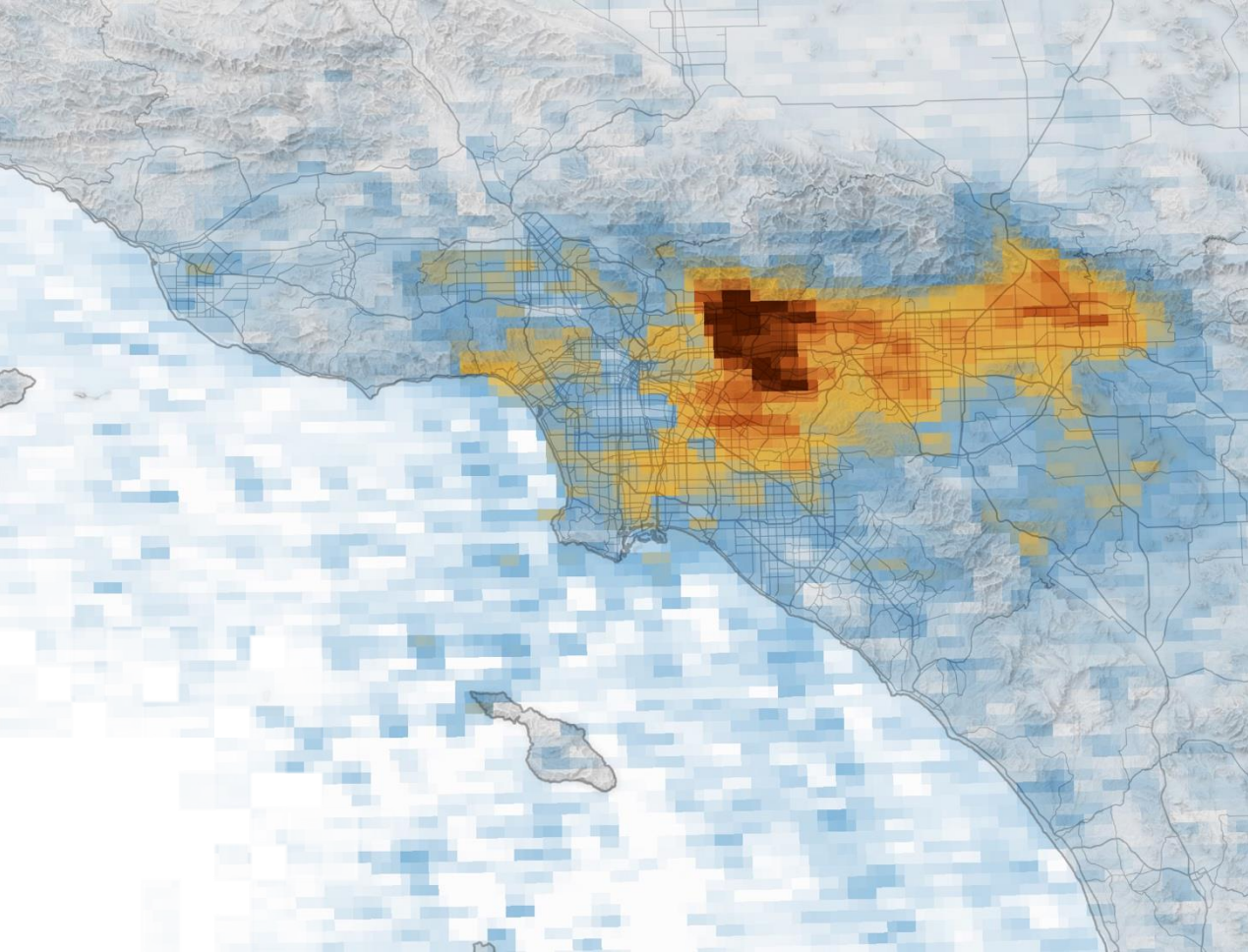
Planning, Rule Development, and Implementation
South Coast Air Quality Management District



Outline

- Exceptional Event (EE) tools to facilitate incorporating satellite data in EE demonstrations
 - Developed by Melissa and Ranil in collaboration with WESTAR/WRAP
- Satellite data analysis over South Coast AQMD region
 - Aerosol Optical Depth (AOD) in the Ozone EE Demo
 - AOD Analysis in the Coachella Valley
 - MAIAC - Nico
 - GOES
- TEMPO Data over South Coast AQMD





Exceptional Event (EE) Tools

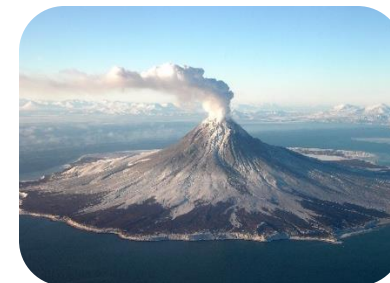
Exceptional Event (EE) Demonstration

- Events that are naturally caused, or events that are the result of human activity and are unlikely to occur again at a particular location may be designated as “exceptional events” if the resulting emissions clearly cause high air pollutant concentrations.
- EE Demonstration
 - Provide a conceptual model of event
 - Demonstrate a clear causal relationship between the event and monitored pollutant levels
 - Show that the event was a human activity that is unlikely to recur at a particular location or a natural event
 - Demonstrate that the event is not reasonably controllable or preventable
 - EE Demonstrations are often lengthy reports that take multiple months to years to prepare

Common Types of PM Exceptional Events (EE)



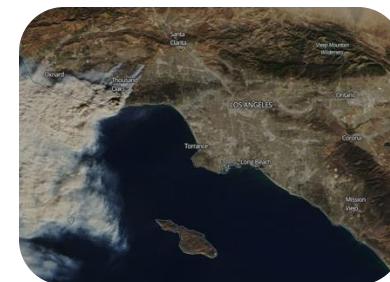
Windblown Dust



Volcanic Eruption



Prescribed Fire



Wildfire Smoke

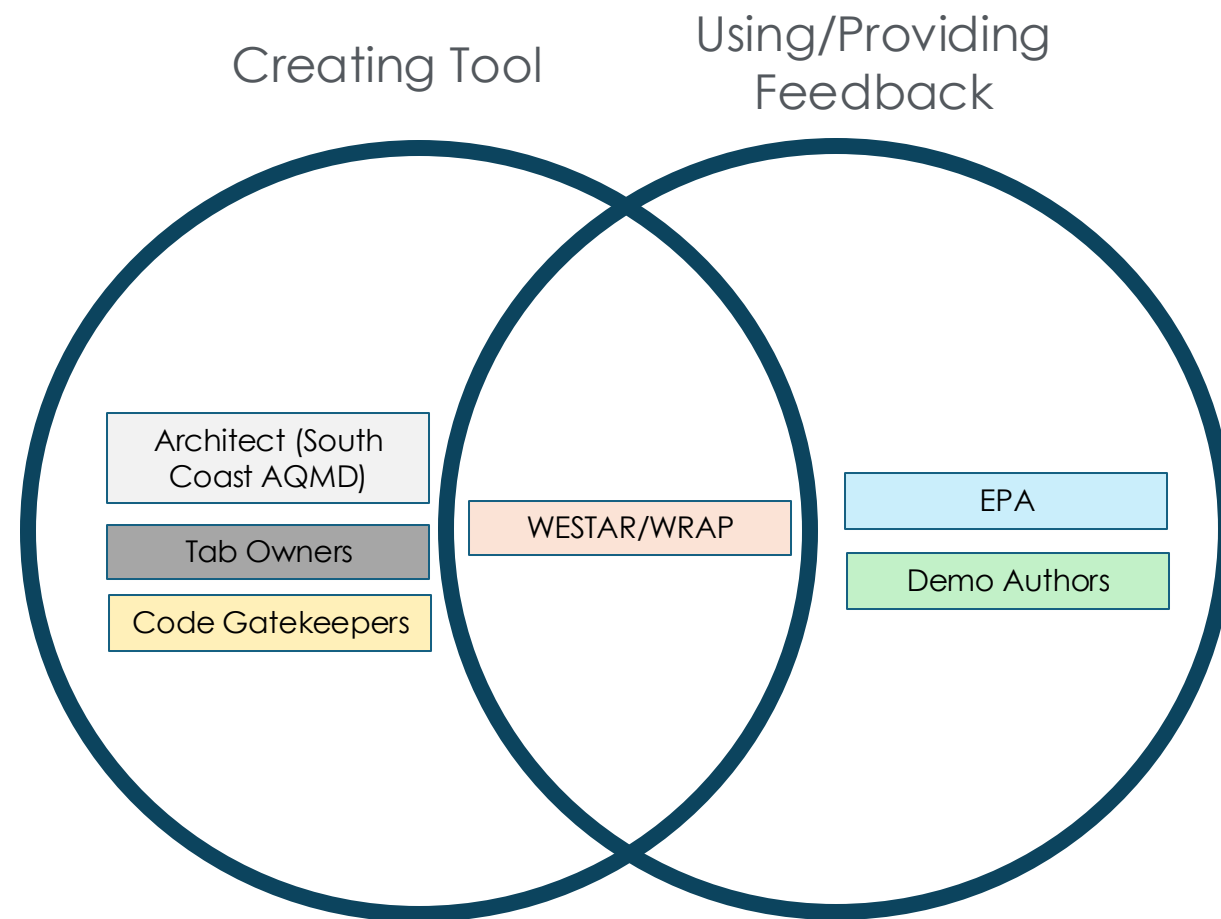


Cultural Events



Exceptional Event Demonstration Tool (EE Demo Tool)

- Username and password will be sent via email
- South Coast AQMD spearheaded collaboration with WESTAR/WRAP and 34 other air agencies starting in July 2022
- Interactive web-based software using R-shiny platform
 - Development can be completely conducted by scientists
- Currently in development, but enough complete to be useful
- Tool will automate much of the EE demonstration process for several types of events (e.g., wildfire and dust)



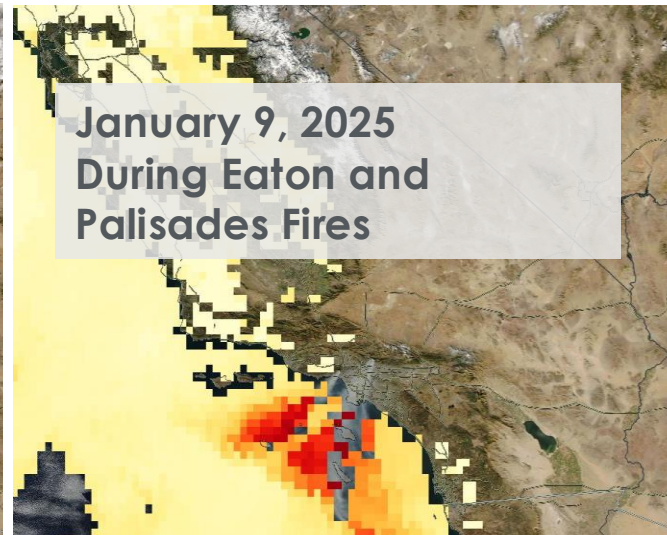
AOD and True Color MODIS Accessed via EE Demo Tool

- User inputs fire information
 - Dates, area of interest, reference (non-event) date
 - EE Demo tool downloads the relevant imagery for every day of fire and inputs it into Word files with template text

1. AOD Report for 2025-01-09

Figure[X] shows the NASA Worldview Aerosol Optical Depth from the aqua MODIS satellite image taken on 2025-01-09 contrasted with a similar view from 2025-01-06 (before the Palisades and Eaton Fires started). The image from 2025-01-09 shows [HIGH?] AOD values throughout [MUCH/ALL??] of the South Coast Air Basin.

Auto-generated text – starting point for report author.

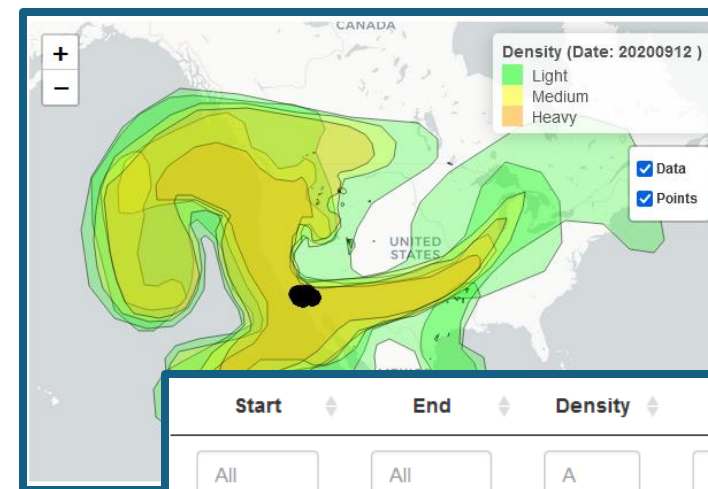


Similar Outputs for True Color Imagery

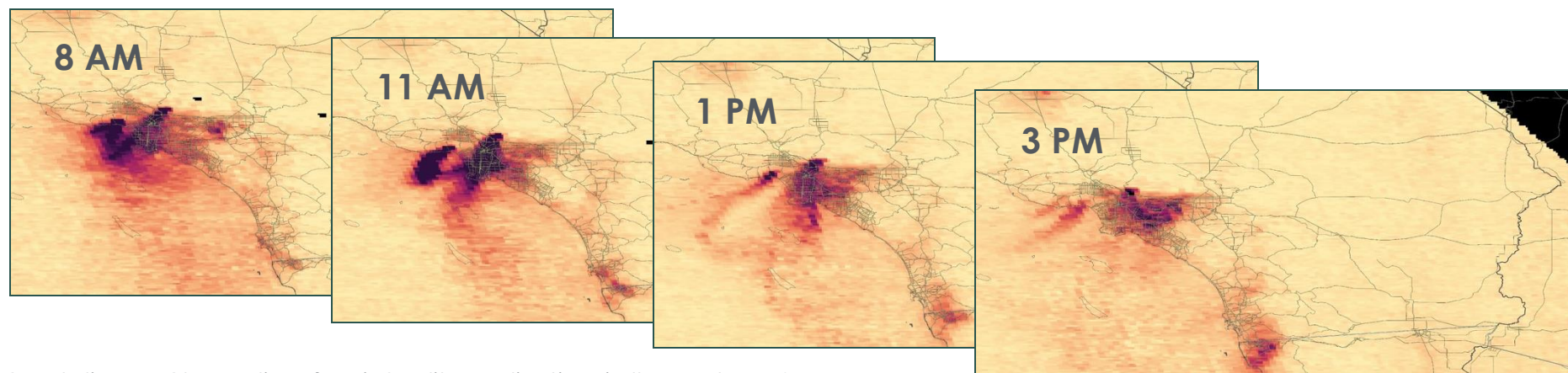


In-Progress Satellite Capabilities for EE Demo Tool

- Hazard Mapping System (HMS)
 - Built into app
 - Courtesy of former staff of OK DEQ
 - Purpose:
 - HMS imagery shows where smoke is located
 - Map HMS imagery and monitor locations
 - Create table of smoke density above each monitor
 - Debugging in progress
- TEMPO NO_x Data
 - Project of University of Utah undergraduate student Toby Armstrong and Associate Professor Heather Holmes

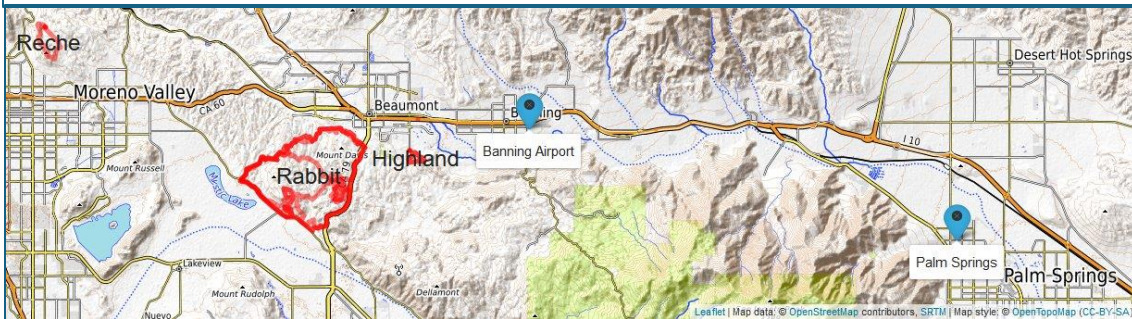


January 9, 2025
Eaton and Palisades
Fires in LA County

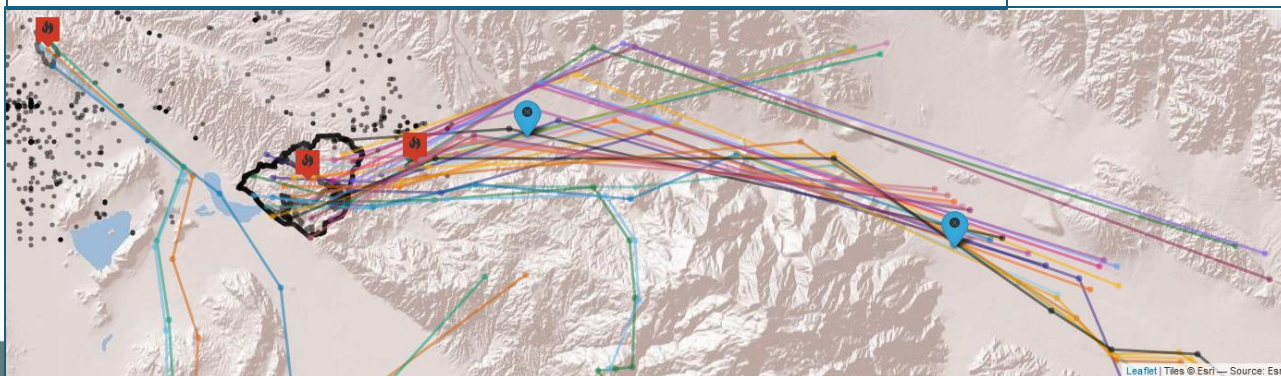


Non-Satellite Capabilities of EE Demo Tool

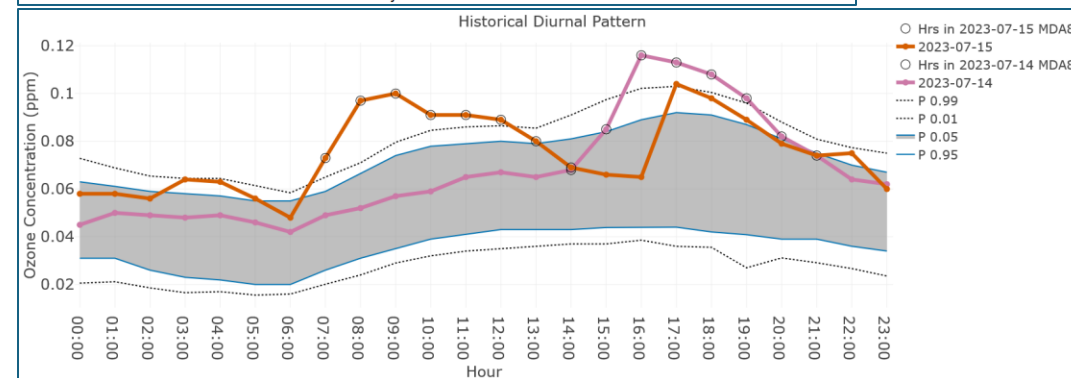
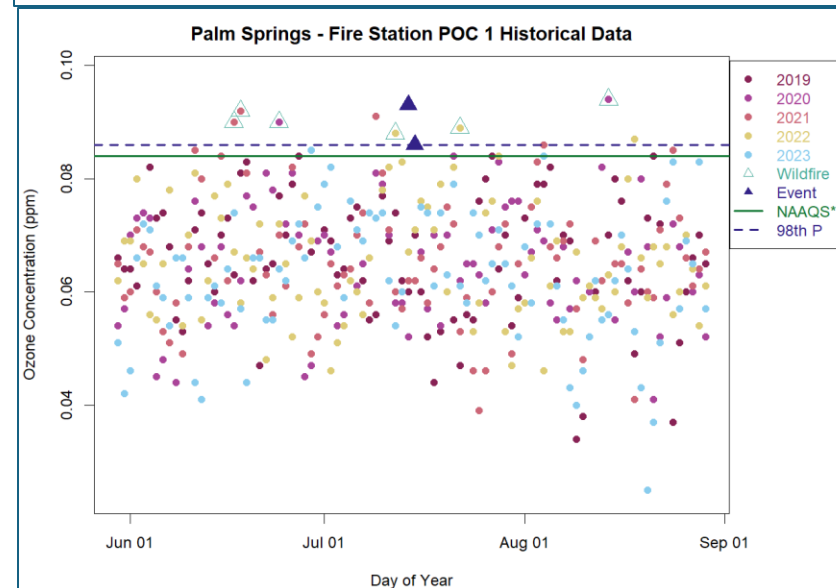
Map of fire and monitor locations. The red polygons are fire perimeters.



Interactive map of HYSPLIT trajectories with fire and monitor locations. (Doesn't run HYSPLIT)



Analyze 3-month window centered on event across 5 years: daily and diurnal. Mark past events.



Why Get Involved in EE Demo Tool



App is useful even before it is complete.



Tabs can be sub-divided if people want to contribute to part of a topic area.



Contributing to the tool development may be the fastest route to completing EE Demos for your agency, especially if multiple EE Demos are needed.



The people who are involved in developing, testing, or using the app are the people who will have a say in what the app can do.



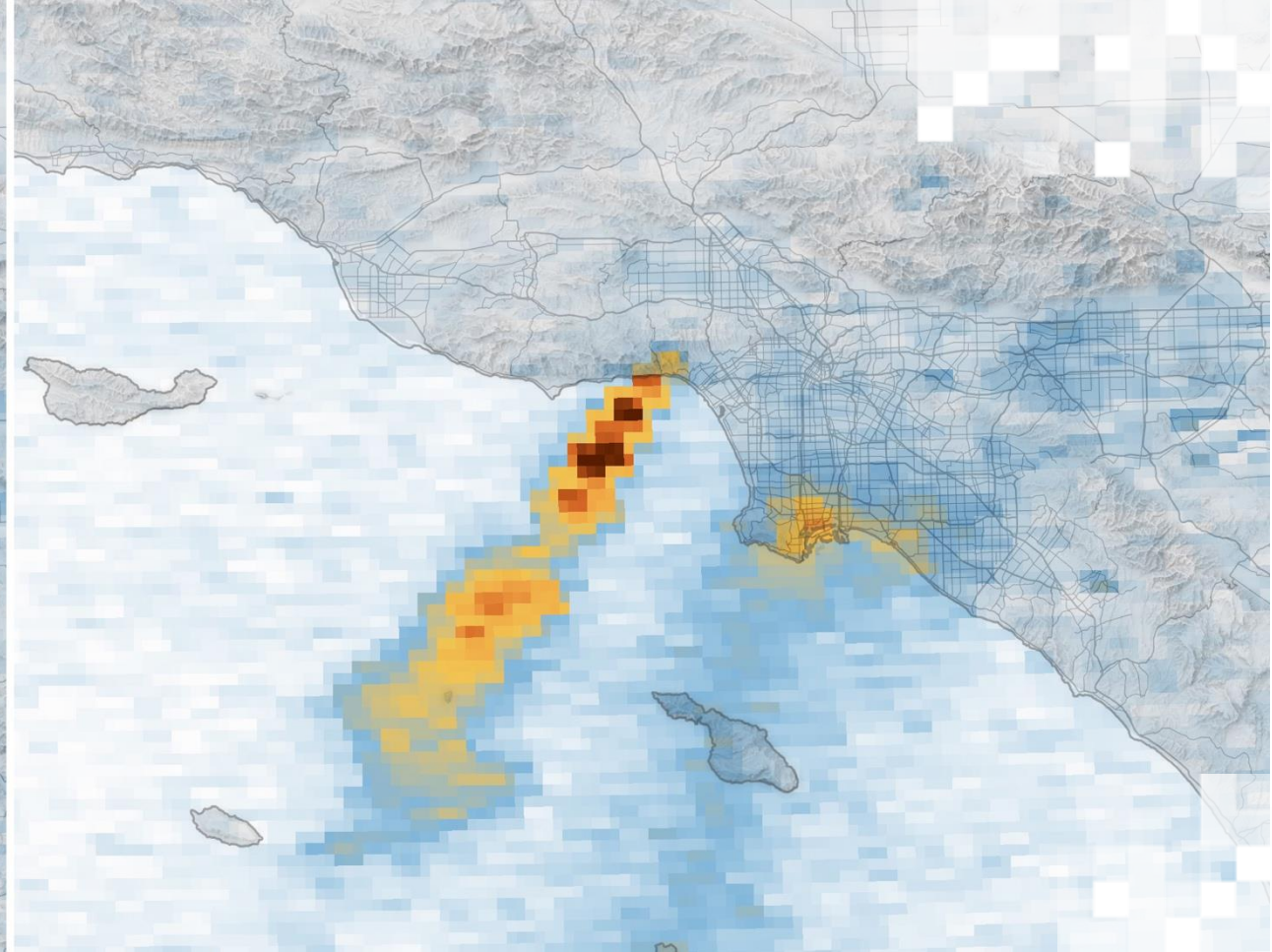
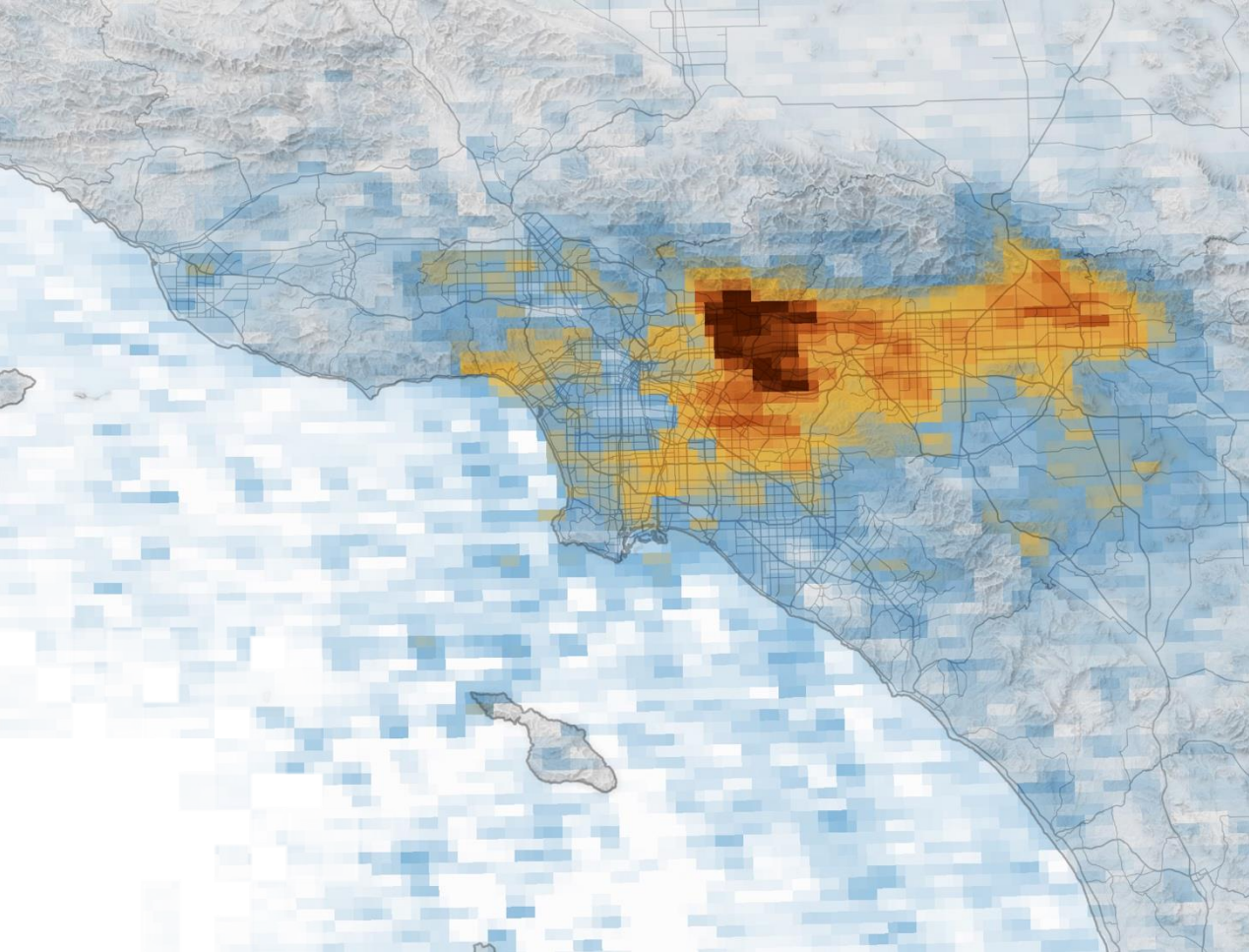
More Training Videos:

- [Exceptional Events Tool Demo Webinar - July 11, 2023](#)
- [April 2025 EE app training recording](#)

WESTAR/WRAP Coordination Hub:

Rhonda Payne, rpayne@westar.org
Jay Baker, jbaker@westar.org





Application of Satellite Data in the Ozone EE Demo

Ozone EE Demo-Concurrence by EPA

[EE Demo Document](#)

Final Rabbit, Reche, and Highland Wildfires Ozone Exceptional Events Demonstration

December 13, 2024

Authors

Melissa Maestas, Ph.D. – Air Quality Specialist
Nico Schulte, Ph.D. – Program Supervisor
Qijing Bian, Ph.D. – Air Quality Specialist

Ranil Dhammapala, Ph.D. – Senior Meteorologist
Scott A. Epstein, Ph.D. – Planning & Rules Manager

[EPA Concurrence Letter](#)



December 10, 2024

Michael Benjamin, Division Chief
Air Quality Planning and Science Division
California Air Resources Board
P.O. Box 2815
Sacramento, California 95812

Dear Michael Benjamin:

The U.S. Environmental Protection Agency (EPA) concurs with the State's request to exclude data showing exceedances of the 1997 8-hour ozone National Ambient Air Quality Standards (NAAQS) on July 14-15, 2023 at the Palm Springs – Fire Station monitoring site in the Riverside County (Coachella Valley), California, nonattainment area, pursuant to the Exceptional Events Rule (EER).

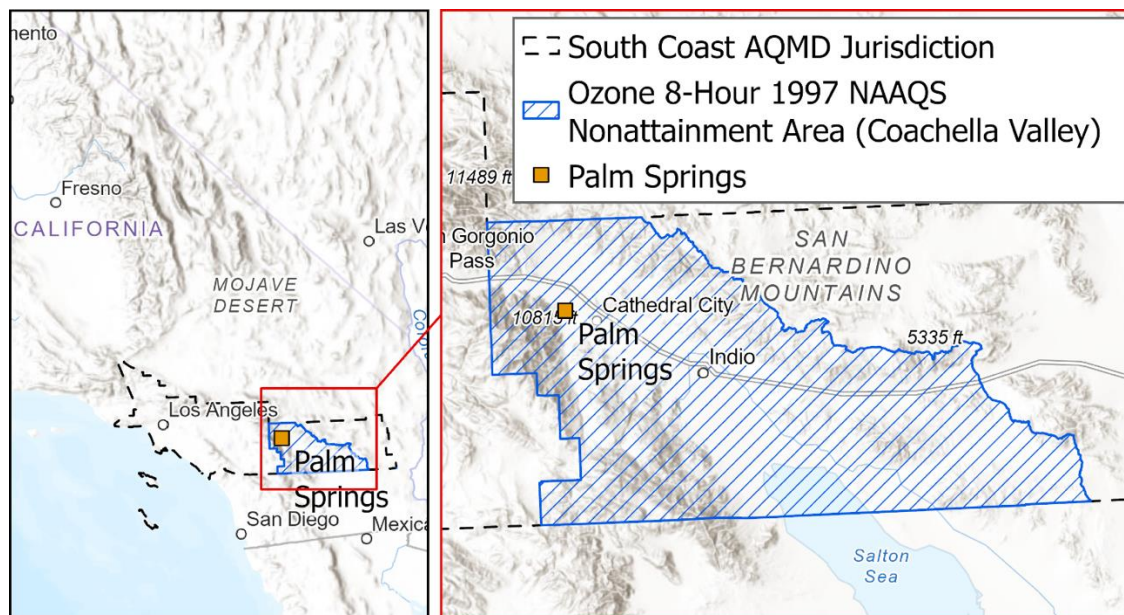
The submittal from California Air Resources Board (CARB) and South Coast Air Quality Management District (South Coast AQMD), dated September 12, 2024 and November 13, 2024, included documentation that the July 14-15, 2023 exceedances were caused by exceptional events due to wildfire emissions.¹ After thoroughly reviewing the information you provided, we agree that the State's submittal meets the demonstration criteria and the schedule and procedural requirements in the EER. The basis for our concurrence is set forth in the enclosed technical support document. EPA staff will enter concurrence flags for these data into the EPA's Air Quality System database.

The EPA's concurrence is a preliminary step in the regulatory process for actions that may rely on these data and does not constitute final Agency action. If the EPA completes a notice-and-comment rulemaking for an action that is influenced by the exclusion of the ozone data specified in this concurrence, the EPA's concurrence letter and accompanying technical support

¹ CARB and South Coast AQMD submitted the *Rabbit, Reche, and Highland Wildfires Ozone Exceptional Events Demonstration* concurrent with the 30-day public comment period. On November 13, 2024, CARB resubmitted the demonstration along with a letter notifying EPA that no public comments were received. There were no changes between the September 14, 2024 and November 13, 2024 demonstrations.



Overview of the Fire Locations and Palm Springs, CA



Location of Palm Springs and boundary of the nonattainment area for the Ozone 8-hour 1997 NAAQS in the Coachella Valley.

California State Parks, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, USFWS, County of Riverside, California State Parks, Esri, TomTom, Garmin, FAO, NOAA, USGS, Bureau of Land Management, EPA, NPS, USFWS, Esri, USGS



Map of fire and monitor locations. The red polygons are fire perimeters.



Ozone EE Demo – Regulatory Significance

- **Exceedances Recorded:** On July 14 and 15, 2023, Palm Springs recorded ozone levels exceeding the 1997 8-hour ozone standard of 0.084 ppm.
- **Exclusion of One of the Two Days:**
 - Then 4th highest ozone value in 2023 becomes 0.084 ppm—just below the standard.
 - This qualifies the area for a one-year attainment deadline extension.
- **Exclusion of Both Days:**
 - Then **area's 3-year design value meets the 1997 standard.**
 - Certain planning obligations, including the need to submit attainment demonstrations, may be suspended.

4th highest of the maximum daily 8-hour average ozone			Design Value	Meets NAAQS ?
2022	2023	2024		
0.084	0.085	0.087	0.09	No

4th highest of the maximum daily 8-hour average ozone			Design Value	Meets NAAQS ?
2022	2023	2024		
0.084	0.083	0.087	0.08	Yes

Table 4: Top 2023 MDA8 Ozone Concentrations at Palm Springs.

Rank	Rank after event exclusion	Date	Concentration (ppm)	Part of Rabbit, Reche, Highland Wildfires Event
1	-	2023-07-14	0.093	Yes
2	-	2023-07-15	0.086	Yes
3	1	2023-04-28	0.086	No
4	2	2023-06-29	0.085	No
5	3	2023-08-04	0.084	No
6	4	2024-08-24	0.083	No
7	5	2024-08-28	0.083	No



Ozone EE Demo – Satellite Data Analysis

A Screenshot of the EE Demo Document Index

17.	HMS Report for July 14, 2023.....	121
18.	Satellite Report for July 14, 2023.....	122
19.	AOD Report for July 14, 2023.....	123
20.	HMS Report for July 15, 2023.....	124
21.	Satellite Report for July 15, 2023.....	125
22.	AOD Report for July 15, 2023.....	126

- Satellite data analysis support the hypothesis that smoke impacted Palm Springs on 07/14/23 and 07/15/23.
- HMS polygons with light density do overlap with the Palm Springs Station, indicating a potential impact of smoke in that area.

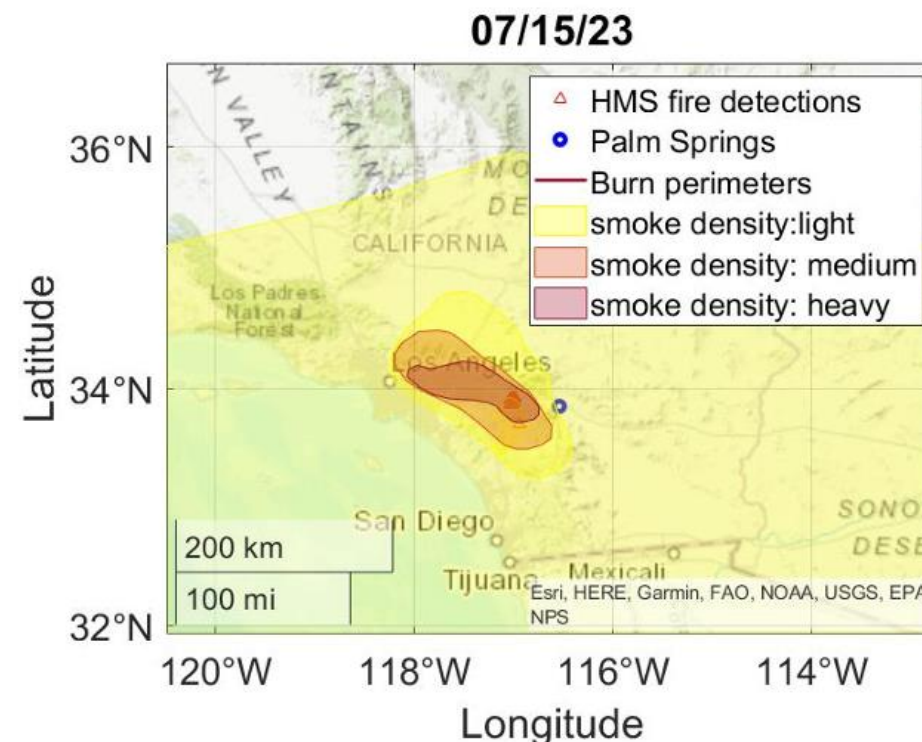


Figure 120: HMS smoke polygons for light, medium and heavy density and HMS fire pixels (red triangles) during the periods of 02:00 AM – 08:00 AM, 01:00 PM – 04:30 PM, and 01:00 PM – 05:00 PM Local Standard time⁶, respectively, which are 01:00 AM – 07:00 AM, 12:00 PM – 03:30 PM, and 12:00 PM – 04:00 PM PST on July 15, 2023. The dark red polygons represent the burn perimeters for the dates of 07/14/23 and 07/15/23, reported by the Interagency Fire Center. Blue circle indicates the location of the Palm Springs AQS station.



Ozone EE Demo – Satellite Data Analysis

- The MAIAC instrument on the Aqua satellite and the HYSPLIT analysis indicate that air parcels arriving at the Palm Springs monitoring station around 1:30 PM LST (Aqua overpass time) predominantly originated from the southeast of the monitor, bringing residual smoke that lingered in the Coachella Valley from July 15, 2023 back towards the monitor.

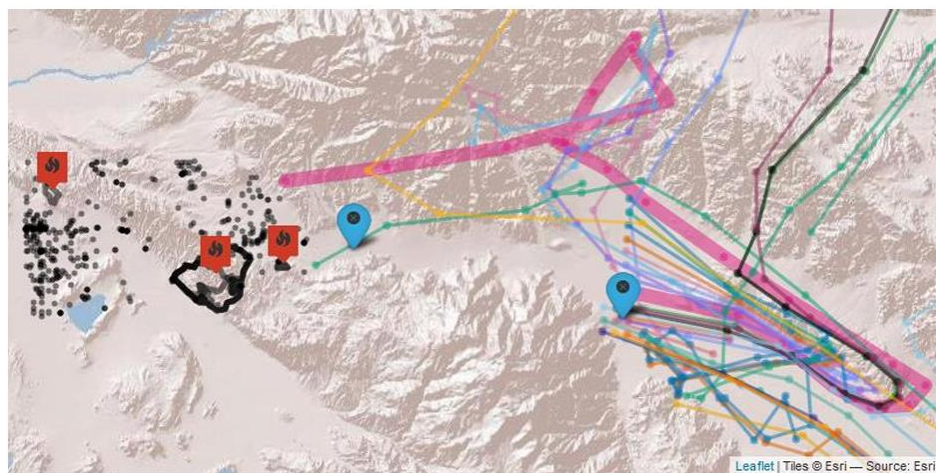


Figure 115: Back HYSPLIT trajectories launched at 13:00 PST on July 15, 2023 with Trajectory #3 highlighted.

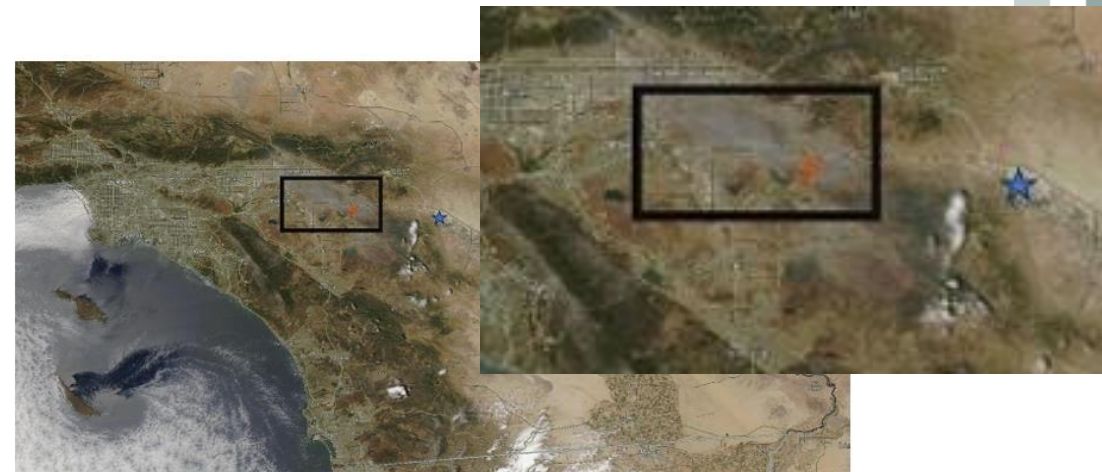


Figure 121: NASA Worldview visible satellite image for July 15, 2023.

Note: The black rectangle encompasses the burn areas for the Reche, Rabbit, and Highland Fires. The orange dots in the black rectangle indicate Fires and Thermal Anomalies related to the Rabbit Fire. The blue star indicates the approximate location of the Palm Springs monitor.

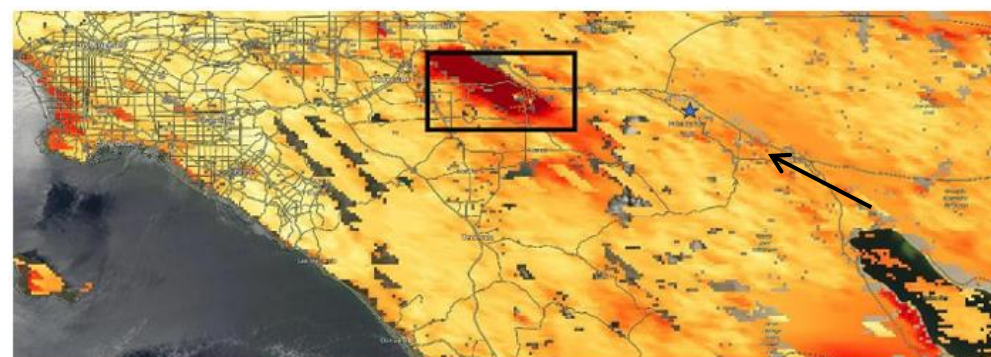
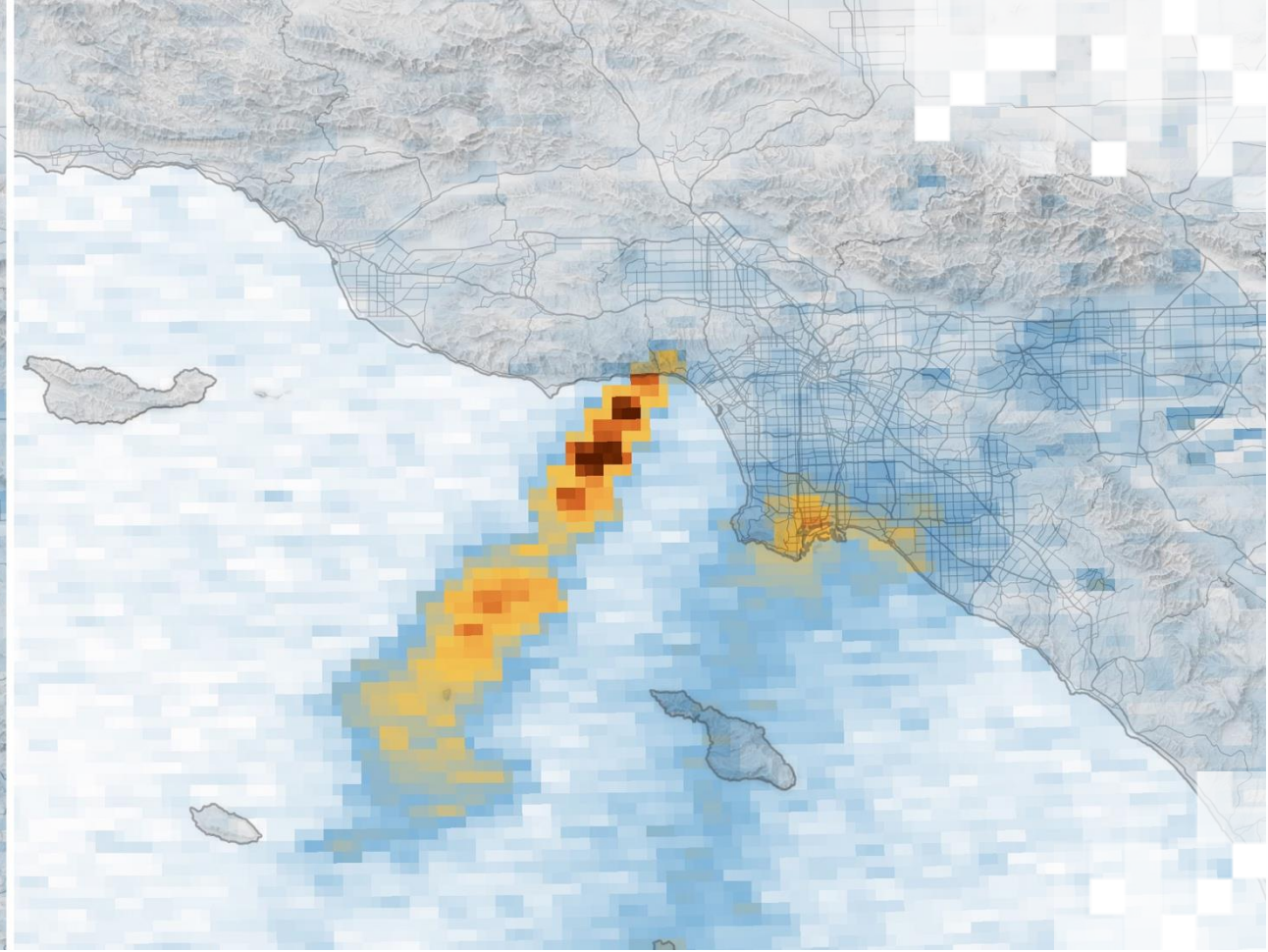
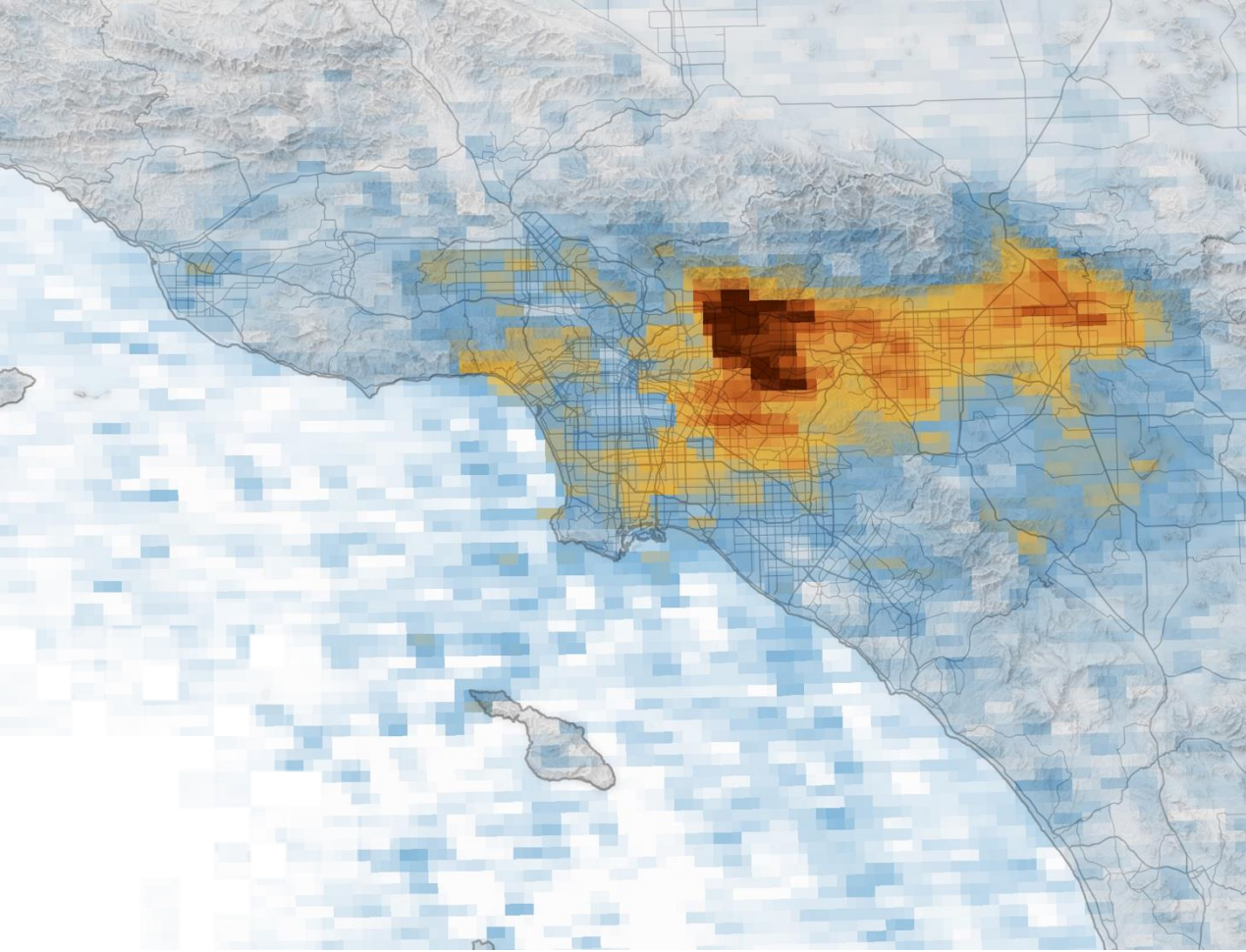


Figure 122: NASA Worldview MAIAC Aerosol Optical Depth image for July 15, 2023.

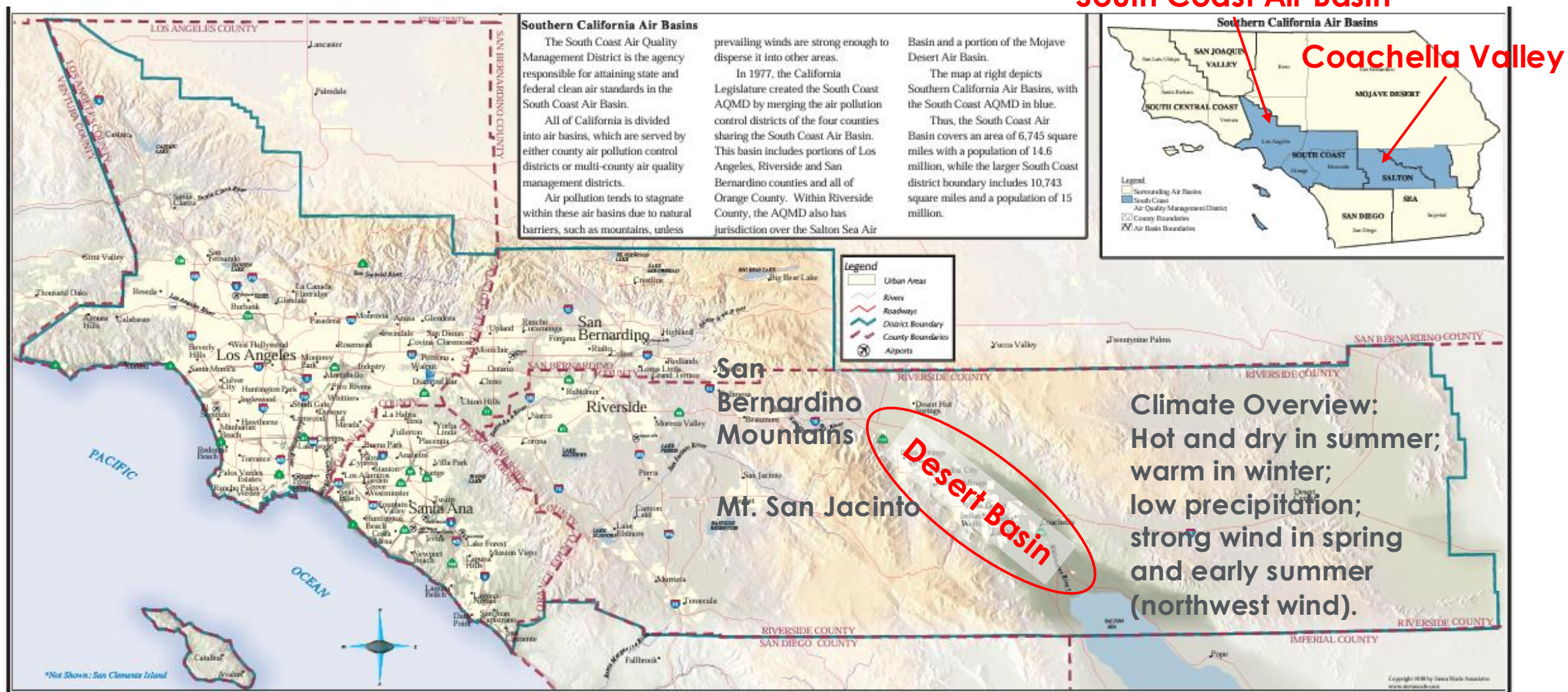
Note: The black rectangle encompasses the burn areas for the Reche, Rabbit, and Highland Fires. The orange dots in the black rectangle indicate Fires and Thermal Anomalies related to the Rabbit Fire. The blue star indicates the approximate location of the Palm Springs monitor.





AOD Analysis in the Coachella Valley

Background on Recent Dust In Coachella Valley – Location



Background on Recent Dust in Coachella Valley

- Tropical Storm Hilary brought 3-4 inches of rain and subsequent mudflows on August 20-21, 2023.
- Received reports from the community of increased levels of dust after tropical storm.
- Is it indicated in satellite data? If so, where and when?
- Analyzing aerosol optical depth (AOD) to help answer questions for which surface measurements provide limited data:
 - Dust may have increased in locations far from regional monitors – satellite data's great spatial coverage addresses this limitation.
 - Complaints about dust in Coachella Valley focus on visibility degradation rather than health impacts – AOD may capture a signal related to visibility.



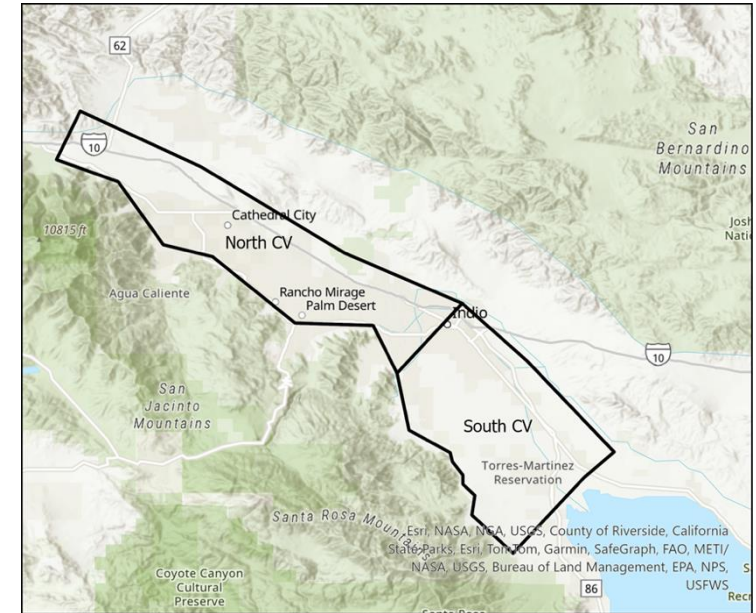
*Satellite Imagery from Sentinel 2A & 2B/MSI at 30 m Resolution



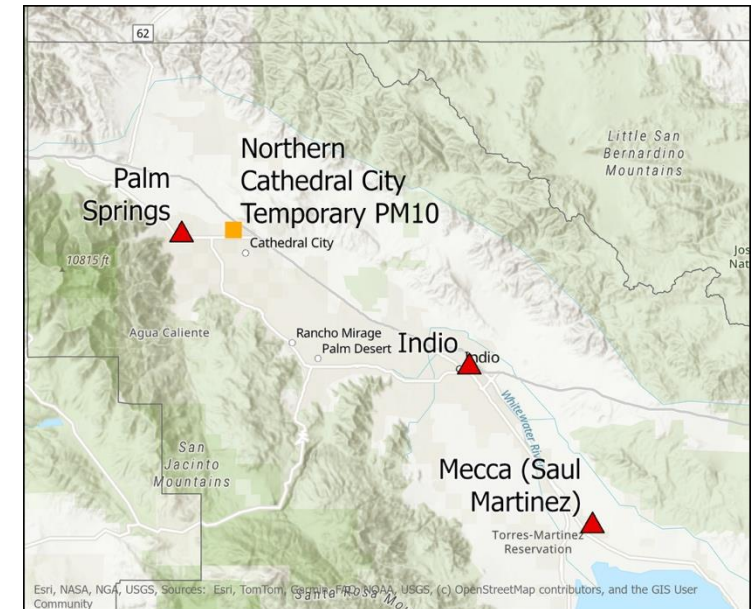
AOD Data Analysis

- AOD Data:
 - Geostationary Operational Environmental Satellite (GOES) – Every 10 Minutes in the Daytime (1300-0200 UTC)
 - Multi-Angle Implementation of Atmospheric Correction (MAIAC) AOD on Terra/Aqua Satellite (Two Scans Each Day)
- Evaluated Data Quality using Ground-Based AERONET AOD
- Analysis:
 - Map of Monthly Average AOD
 - Trend of Monthly Average AOD in North CV and South CV from 2019 to 2024
 - Comparison of AOD with Surface Measurements (PM10 and PM2.5)

Buffer Regions



Monitoring Locations in Coachella Valley



Data Processing – MAIAC

- Download AOD Data using NASA Earthdata Search and API Download
 - [MODIS Sinusoidal Tiles Calculation \(index of file, h and f\)](#) or check from EARTHDATA
 - Used MODIS MAIAC AOD 470 nm band
 - Data available at: [MODIS/Terra+Aqua Land Aerosol Optical Depth Daily L2G Global 1km SIN Grid V061](#)
 - Time Period: January 2017 – May 2024
- Data Processing:
 - Data Structure: .hdf file
 - Remove data based on QC flags
 - Average AOD by month for time series and map analysis
 - Plot monthly averaged AOD with comparison to previous years
 - Plot contour maps of monthly averaged AOD

Lat/lon calculation or get from Panoply

<https://landweb.modaps.eosdis.nasa.gov/filecalc>

Name	Long Name	Type
▼ MCD19A2N.A2025183.h08v05....	MCD19A2N.A2025183.h08v05.061.202..	Local File
ArchiveMetadata.0	ArchiveMetadata.0	—
CoreMetadata.0	CoreMetadata.0	—
▼ grid1km	grid1km	—
_HDFEOS_CRS	HDFEOS CRS	—
▼ Data_Fields	Data_Fields	—
AngstromExp_470...	Angstrom Exponent 470-780	2D
AOD_QA	AOD QA	2D
AOD_Uncertainty	AOD uncertainty at 0.47 micron, range...	2D
Column_WV	Column Water Vapor (in cm liquid water)	2D
FineModeFraction	Fine mode fraction for Ocean	2D
Injection_Height	Smoke Injection Height over local surfa...	2D
Optical_Depth_047	AOD at 0.47 micron	2D
Optical_Depth_055	AOD at 0.55 micron	2D
Projection	Projection	—
XDm	x coordinate	1D
YDm	y coordinate	1D



Remove Data Based on QA Flags

- Filtered data to only include high quality measurements
- Filter criteria from [MODIS Multi-Angle Implementation of Atmospheric Correct \(MAIAC\) Data User's Guide](#) includes:
 - Cloud Mask = 1 (clear)
 - and Land = 0 (land)
 - and QA = 0 (best quality)
 - and AOD QA integer not equal 0

5.4 AOD QA definition for MCD19A2 (16-bit unsigned integer)

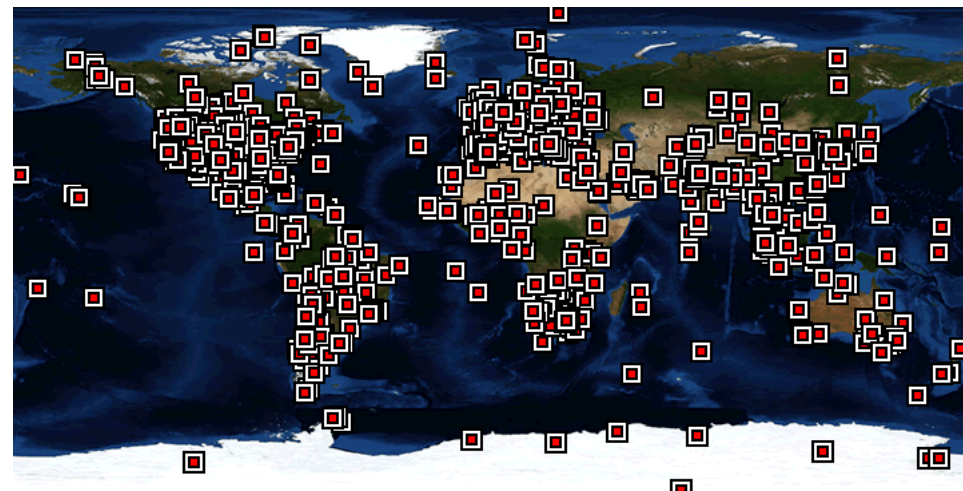
Bits	Definition
0-2	Cloud Mask 000 --- Undefined 001 --- Clear 010 --- Possibly Cloudy (detected by AOD filter) 011 --- Cloudy (detected by cloud mask algorithm) 101 --- Cloud Shadow 110 --- Hot spot of fire 111 --- Water Sediments
3-4	Land Water Snow/Ice Mask 00 --- Land 01 --- Water 10 --- Snow 11 --- Ice
5-7	Adjacency Mask 000 --- Normal condition/Clear 001 --- Adjacent to clouds 010 --- Surrounded by more than 4 cloudy pixels 011 --- Adjacent to a single cloudy pixel 100 --- Adjacent to snow 101 --- Snow was previously detected in this pixel
8-11	QA for AOD 0000 --- Best quality 0001 --- Water Sediments are detected (water) 0011 --- There is 1 neighbor cloud 0100 --- There is >1 neighbor clouds 0101 --- No retrieval (cloudy, or whatever) 0110 --- No retrievals near detected or previously detected snow 0111 --- Climatology AOD: altitude above 3.5km (water) and 4.2km (land) 1000 --- No retrieval due to sun glint (water) 1001 --- Retrieved AOD is very low (<0.05) due to glint (water) 1010 --- AOD within +/-2km from the coastline is replaced by nearby AOD 1011 --- Land, research quality: AOD retrieved but CM is possibly cloudy
12	Glint Mask 0 --- No glint 1 --- Glint (glint angle < 40°)
13-14	Aerosol Model 00 --- Background model (regional) 01 --- Smoke model (regional) 10 --- Dust model
15	Reserved



Data Validation: Available AERONET Sites in Southern CA

- The AERONET (AERosol ROBotic NETwork) program is a federation of ground-based remote sensing aerosol networks established by [NASA](#) and [LOA-PHOTONS \(CNRS\)](#) and is greatly expanded by [collaborators](#) from national agencies, institutes, universities, individual scientists, and partners.
- Sun photometer measurements of the direct (collimated) solar radiation provide information to calculate the columnar aerosol optical depth (AOD).
- Three Levels of Data: Level 1.0 (unscreened), Level 1.5 (cloud-screened), and Level 2.0 (cloud-screened and quality-assured)

Overview of AERONET Network

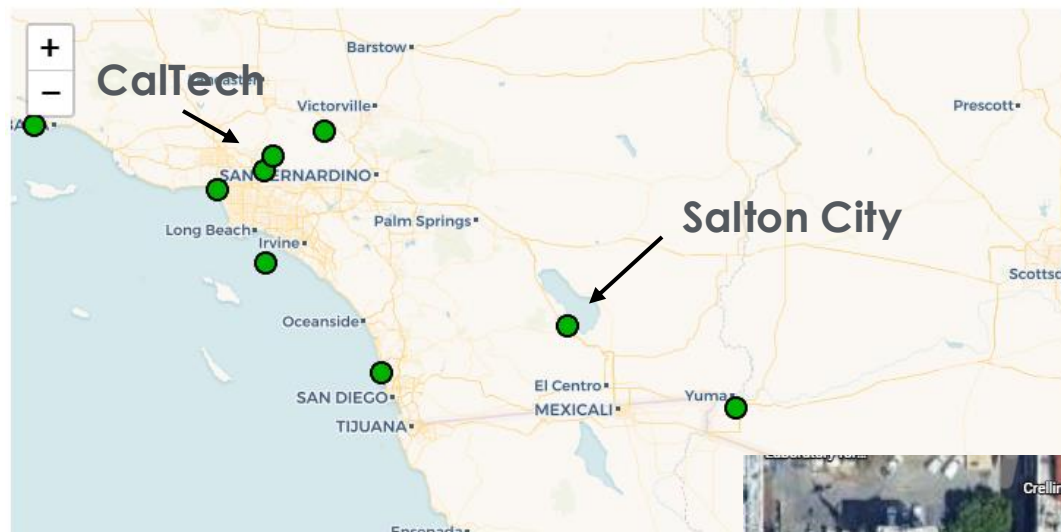


Sun Photometer



Data Validation: Available AERONET Sites in Southern CA

CalTech Site in South Coast Air Basin



CalTech Site, in the
CalTech Campus
Urban Site



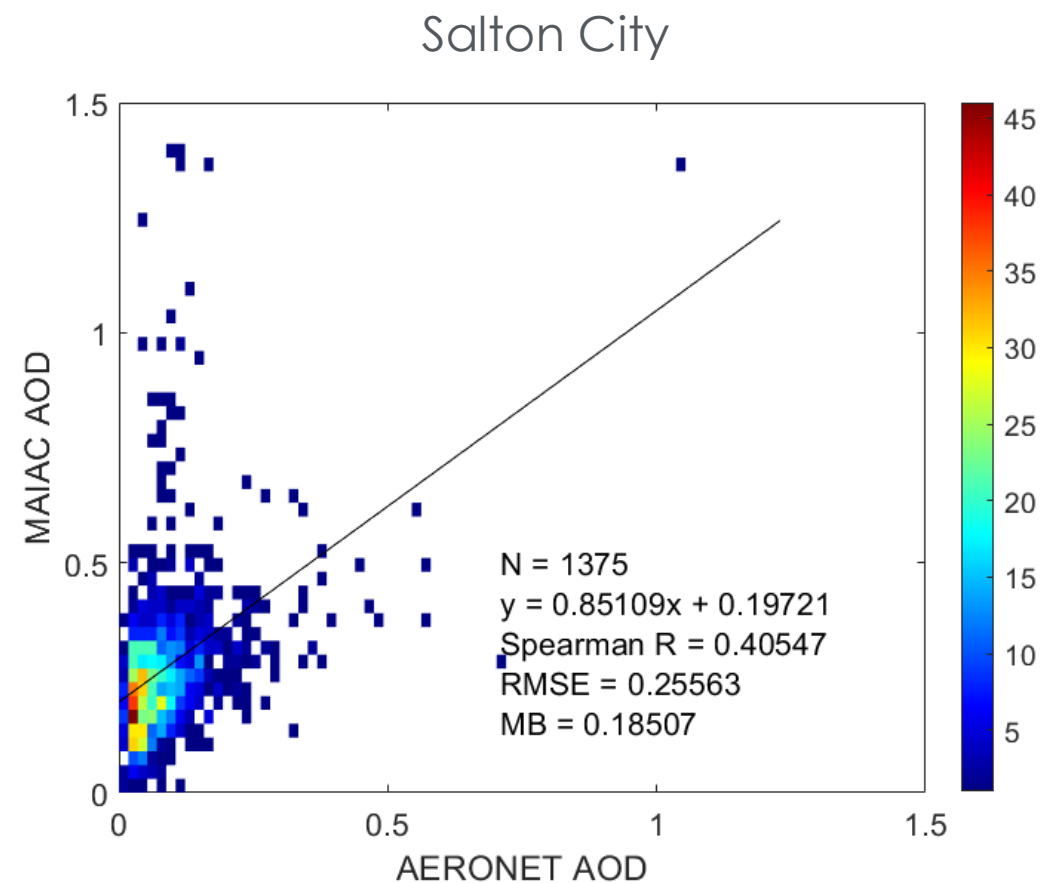
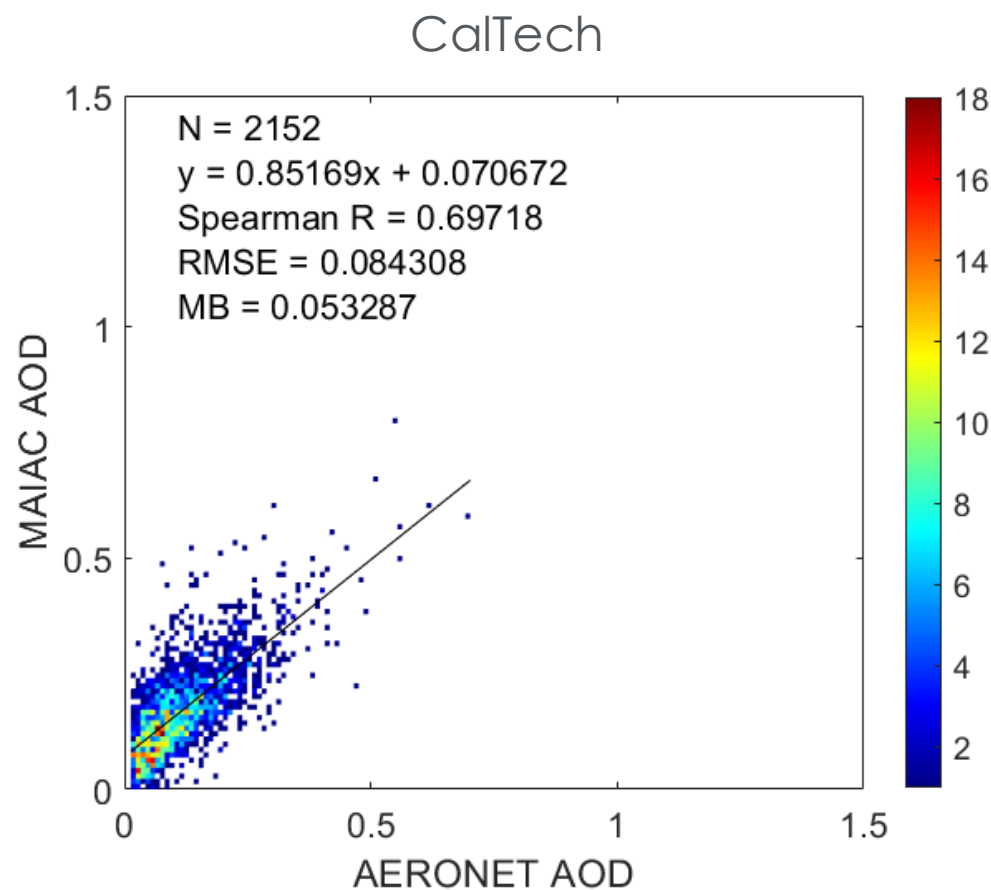
Salton City Site, South of CV

The main aerosol type is mineral, although aerosols from nearby agricultural activity may also be present.

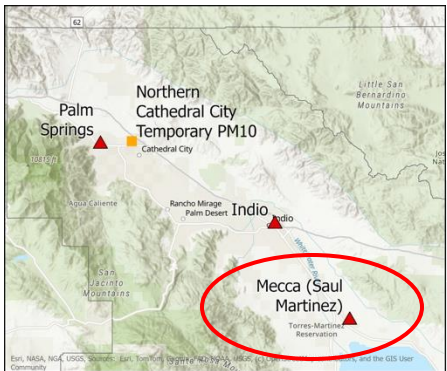


Data Validation: MAIAC AOD vs. AERONET AOD

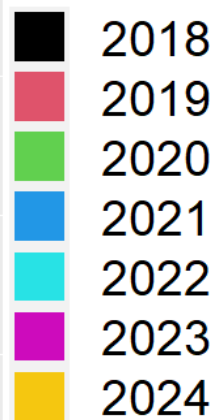
- AERONET AOD (level 1.5 with cloud cleared) were hourly averaged and align with MAIAC AOD.
- CalTech site has better performance compared with Salton City.



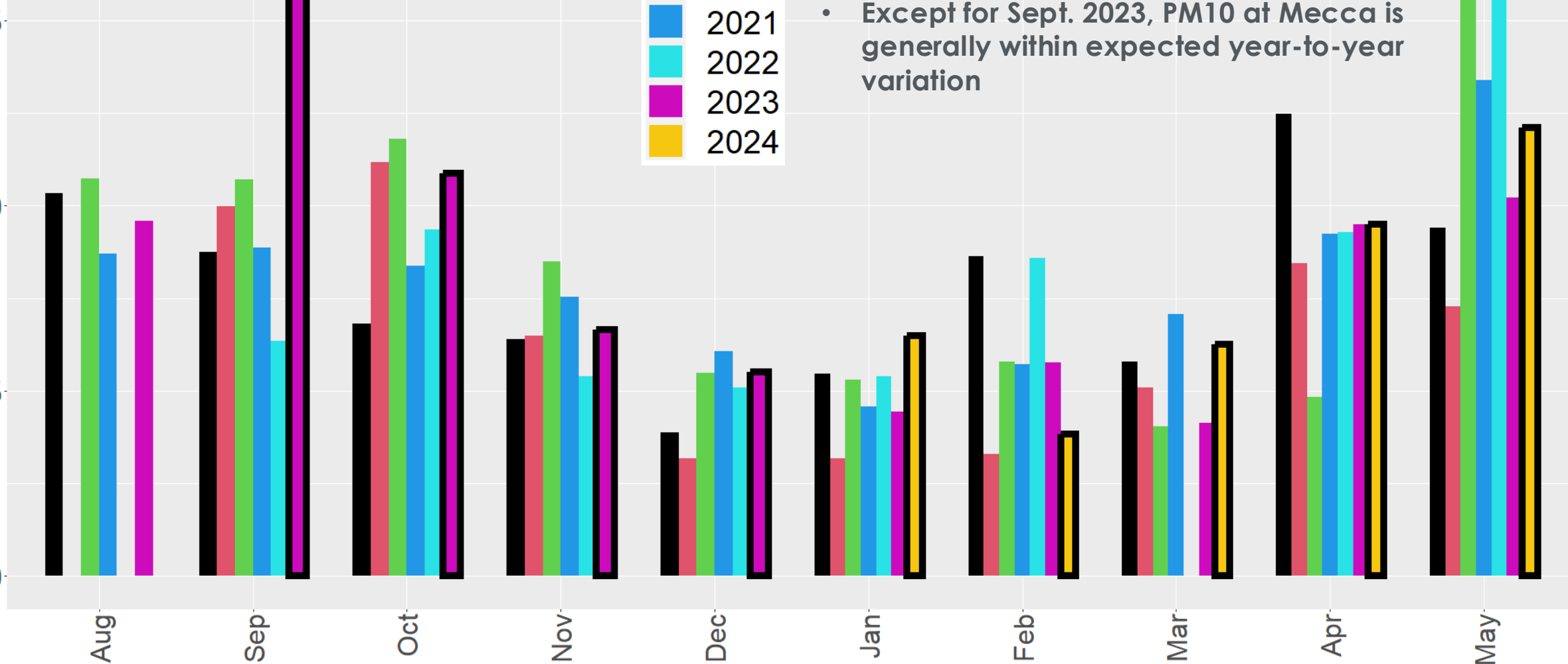
Average Surface PM₁₀ Mass by Month at Mecca



Monthly avg PM₁₀, µg/m³

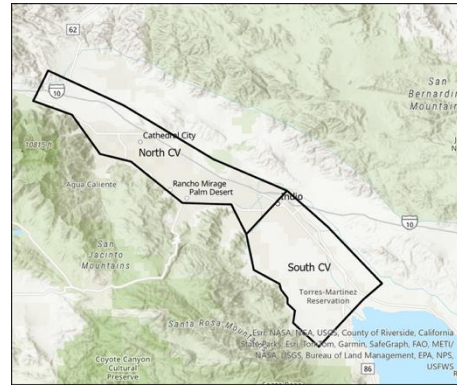


- Wide annual variation in average PM10 over the past several years, even when controlling for the month of year
- Except for Sept. 2023, PM10 at Mecca is generally within expected year-to-year variation

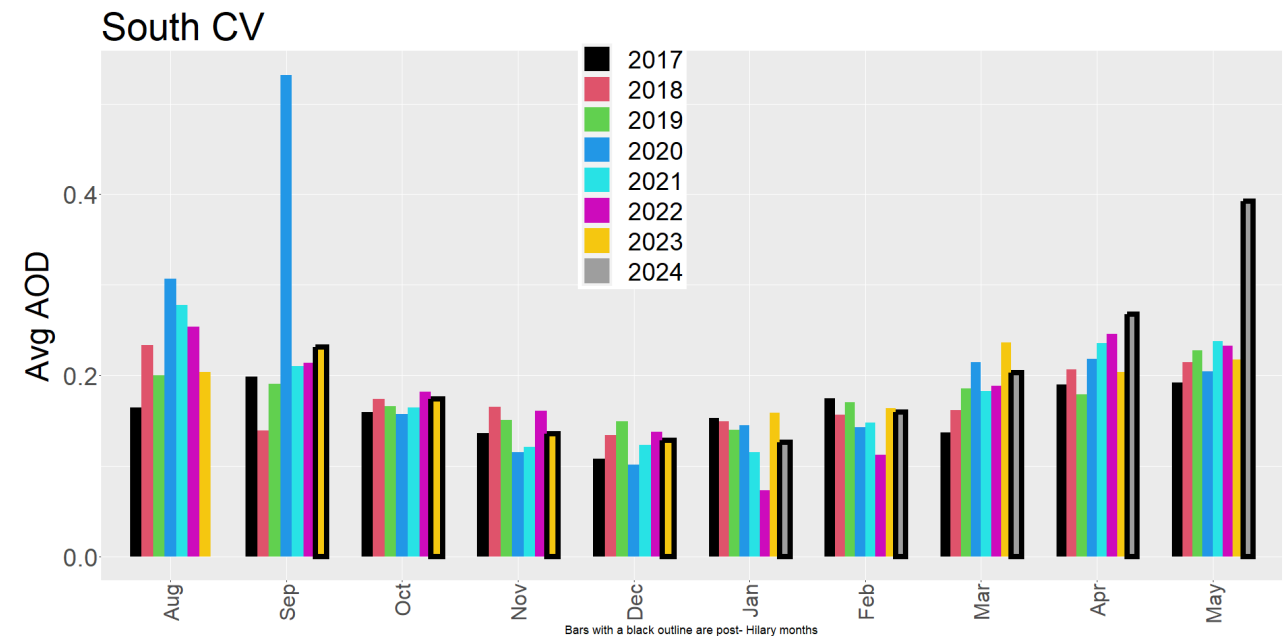
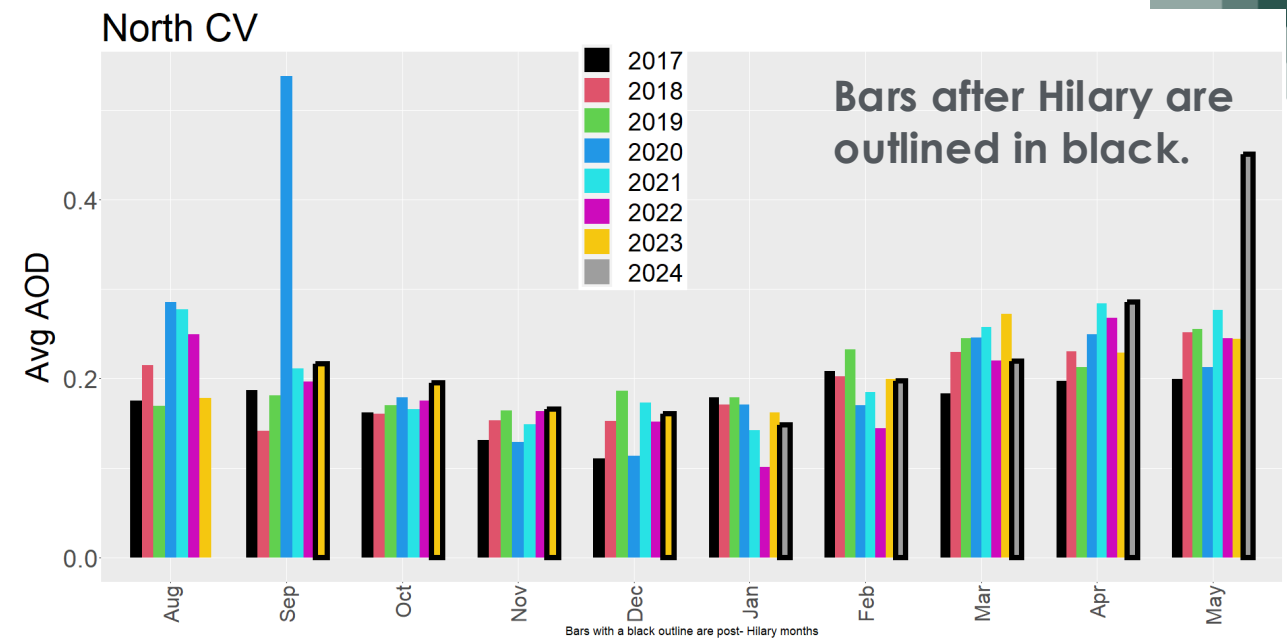


Bars with a black outline are post- Hilary months

Monthly Variation of AOD

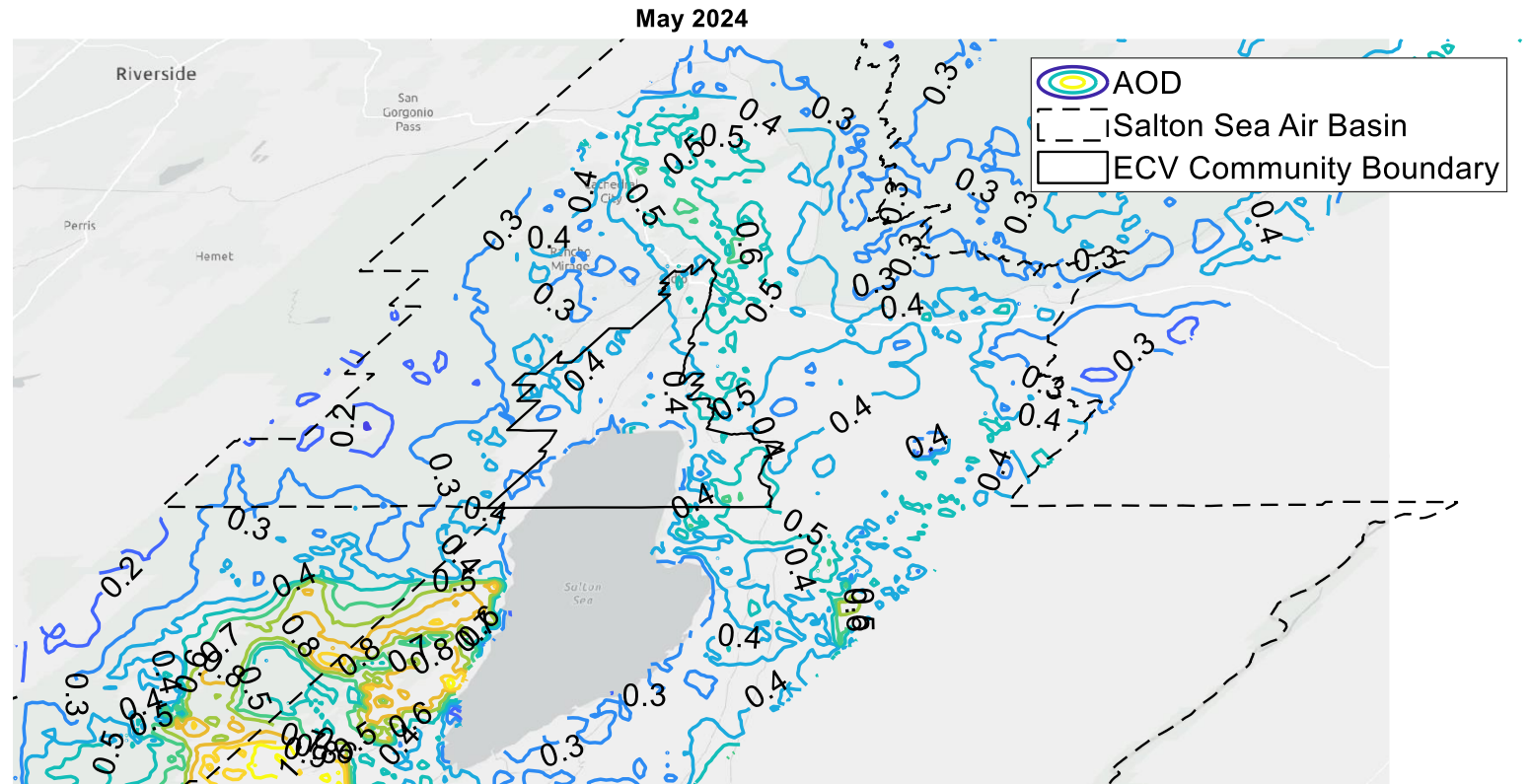


- Monthly averaged AOD shows seasonal variation that follows typical PM10 seasonal variation
- 2023 and 2024 may have similar AOD to previous years, except May 2024 was much higher
- North and South CV have similar AOD variation
- Sep 2020 likely higher AOD due to smoke from widespread fire activity throughout the West



Monthly Averaged AOD Map in May 2024

- Maps show contours of monthly averaged AOD
- May 2024:
 - Increased AOD throughout most of Coachella Valley
 - Especially high AOD in Anza Borrego State Park area



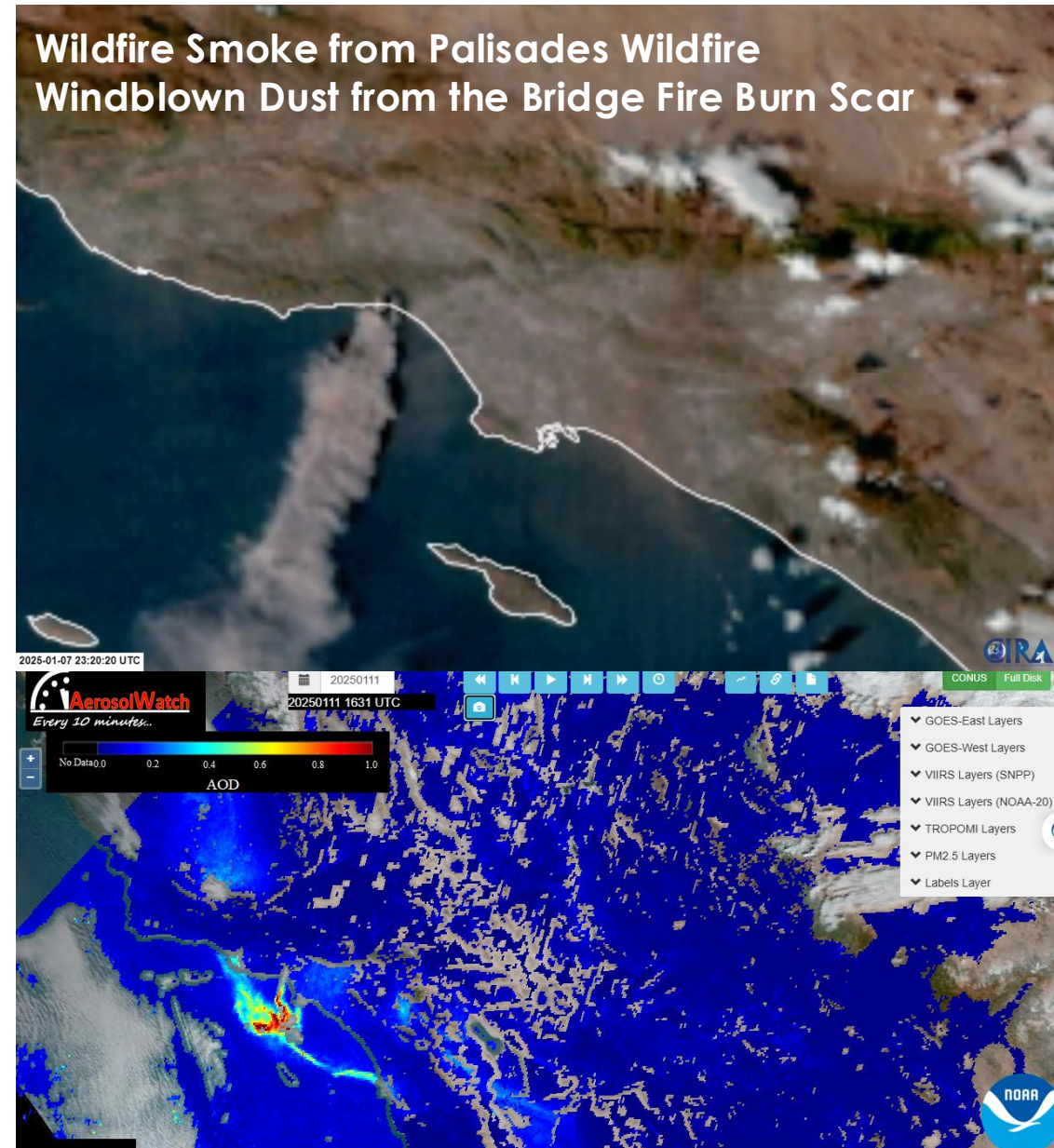
Summary and Limitations of MAIAC

- There is evidence that AOD increased above typical levels seen in past years throughout Coachella Valley in May 2024.
- There is evidence that AOD increased to unusually high levels in Anza Borrego State Park in May 2024.
- Limitations:
 - AOD is determined from at most two measurements (Aqua and Terra satellite passes) per day around noon, so it doesn't capture the full diurnal variation.
 - AOD is sensitive to a column of air and is not the same as surface PM10 or TSP.
 - The MODIS AOD may be most sensitive to fine PM, but community concerns may be more related to visibility which could be associated with TSP.
 - MODIS AOD is noisy, so we need to use longer time periods to determine changes/trends.
 - MODIS AOD doesn't capture the evening and overnight hours when winds (and dust) tend to peak.



Data Access: Geostationary Operational Environmental Satellites (GOES) Data

- Advanced Baseline Imager (ABI) Imagery:
 - [CIRA Slider](#)
 - Can be downloaded for future use
 - [GOES Image Viewer](#)
 - [Aerosol Watch](#)
 - Near Real-Time AOD and Archived AOD
 - Daily AOD-Estimate PM2.5
- Data Download (.nc file)
 - [AWS S3 Storage](#)
 - [NOAA CLASS](#)



Data Access: GOES Data Structure

- GOES fixed grid projection y-coordinate (5424*1) and x-coordinate (5424*1)
- AOD, DQF, AE1, AE2, AE_DQF (5424*5424)
- GOES Imager Projection (Latitude and Longitude)
 - [Python Code for Lat/Lon Calculation](#)
 - [ABI Fixed Grid Lat/Lon in .nc Files](#)

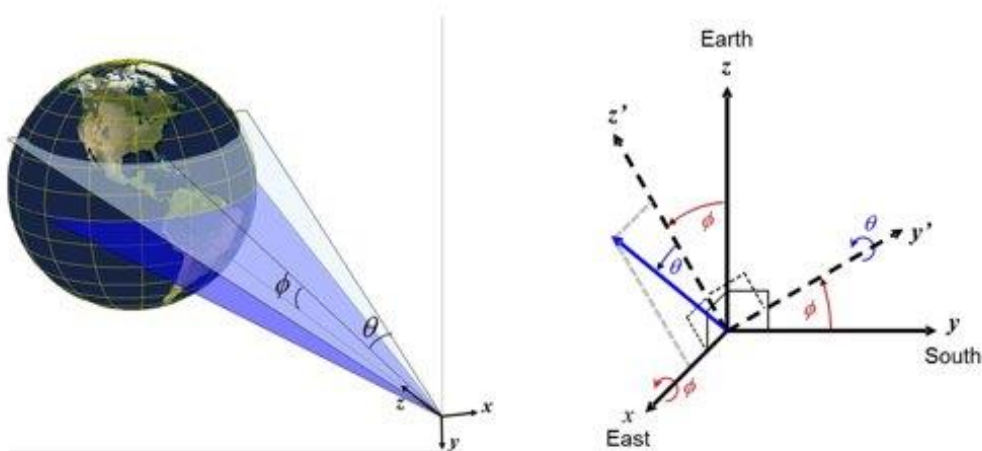


Figure 3-15. Fixed Grid Frame (Elevation-Azimuth Coordinate System)

Data Structure of Lat/Lon Files

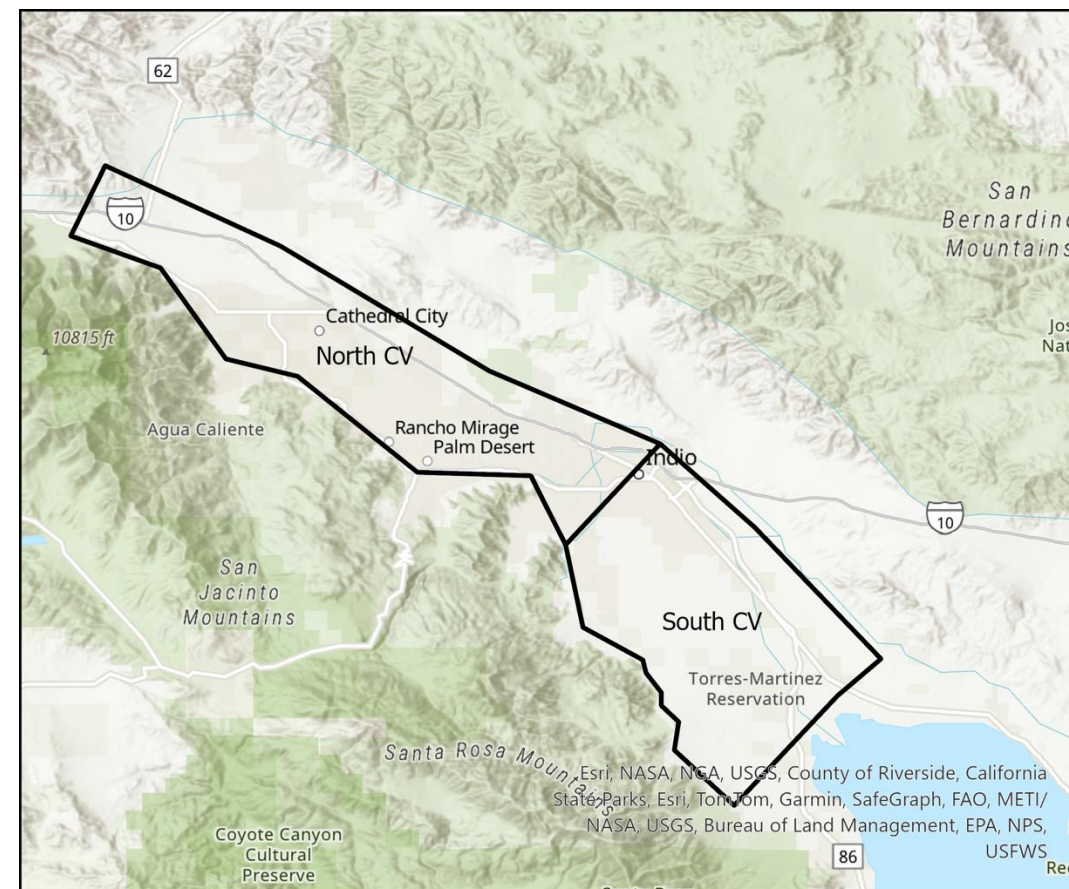
```
>> ncdisp('goes19_abi_full_disk_lat_lon.nc')
Source:
    D:\training\ARSET_TEMPO_Aug2025\goes19_abi_full_disk_lat_lon\goes19_abi_full_
Format:
    netcdf4
Global Attributes:
    title   = 'ABI fixed grid latitude and longitude for GOES-19 ABI Full Disk se
    comment = 'Converted from GOES Imager Projection'
    created = 'File created 07 Apr 2025 by Amy Huff (amy.huff@noaa.gov)'
Dimensions:
    rows      = 5424
    columns   = 5424
Variables:
    latitude
        Size:          5424x5424
        Dimensions:    columns,rows
        Datatype:      single
        Attributes:
            _FillValue = -999.99
            long_name  = 'Latitude for GOES-19 ABI Full Disk sector'
            units       = 'degrees_north'
            valid_range = [-90 90]
            comment     = 'Converted from GOES Imager Projection'

    longitude
        Size:          5424x5424
        Dimensions:    columns,rows
        Datatype:      single
        Attributes:
            _FillValue = -999.99
            long_name  = 'Longitude for GOES-19 ABI Full Disk sector'
            units       = 'degrees_east'
```



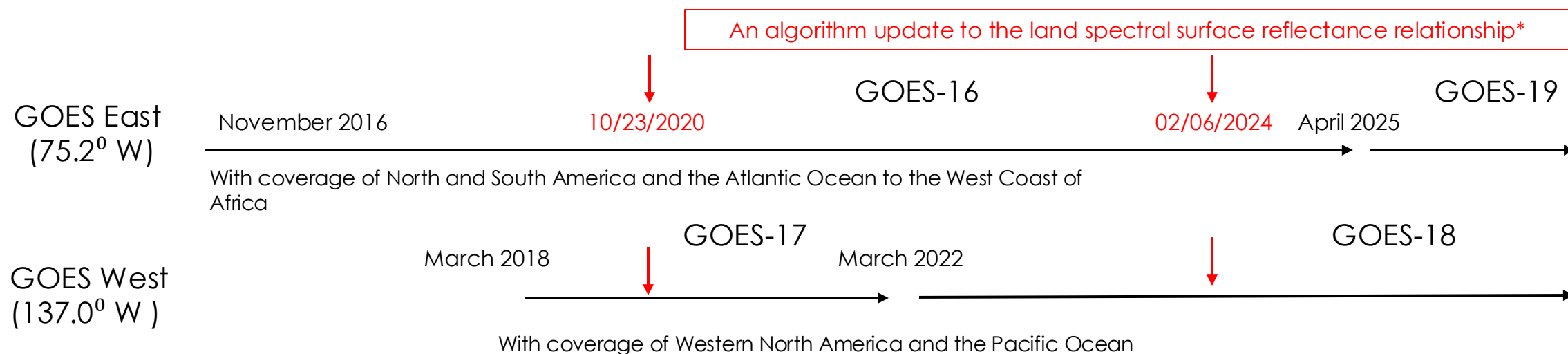
Data Preprocessing for our Study

- Timestamp: 1300-0200 UTC every day (every 10 min)
- Get the data with high (DQF code of 0) and medium (DQF code of 1) retrieval quality
 - DQF: 'ABI L2+ Aerosol Optical Depth at 550 nm data quality flags
 - flag_values = [0 1 2 3]
 - flag_meanings = high_quality_retrieval_qf, medium_quality_retrieval_qf, low_quality_retrieval_qf, no_retrieval_qf
- Classify into two regions: North CV and South CV, same with MAIAC AOD
- Wavelength of GOES AOD: 550 nm



Data Validation: Useful GOES Information

Beginners Guide to GOES-R Series Data



GOES-17 ABI Cooling System Issue

- Inadequate cooling of the infrared channels leads to partial loss of imagery during some of the overnight hours before and after the vernal and autumnal equinoxes.
- As aerosol retrieval is performed at daytime using shortwave channels (ABI bands 1-6), the direct impact on the retrieved AOD value is insignificant; however, the indirect impact through using the upstream retrieval products derived with affected Infrared channels (e.g., ABI cloud mask) need to be addressed.

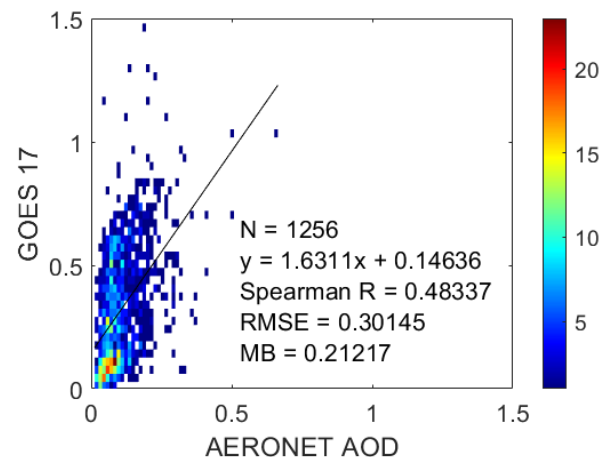
Personal communication with Dr. Laszlo's group. There are also problematic data during 18 UTC on 5/22/2024 to 18 UTC on 6/4/2024 due to operational system upgrade



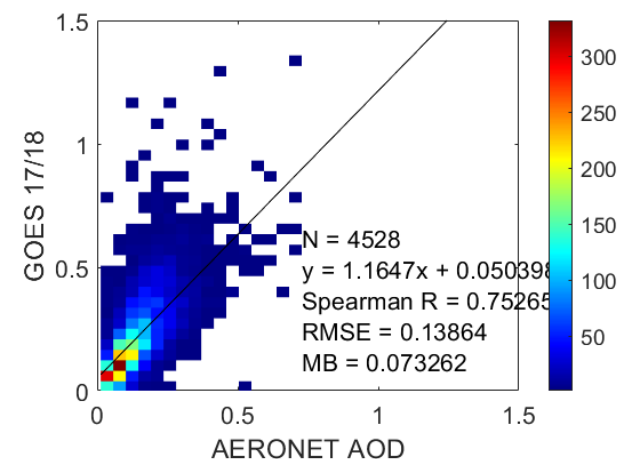
Data Validation: Hourly GOES West vs. AERONET AOD

- Overestimate AOD before 2021 at CalTech site
- AOD estimate improved after first algorithm update
- No significant difference was found after replacement of G17 with G18 at CalTech site

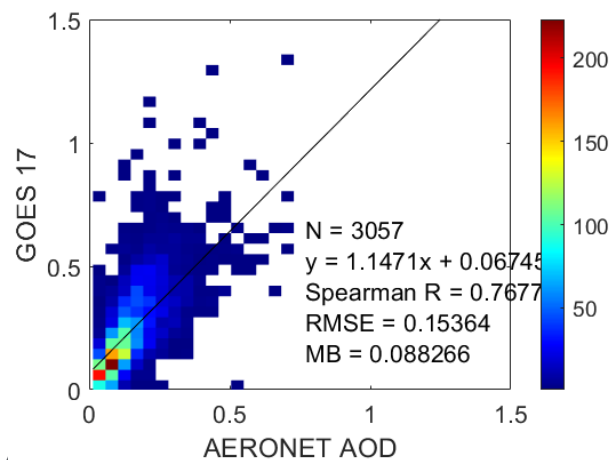
GOES-17 vs. CalTech AOD
(Y2020)



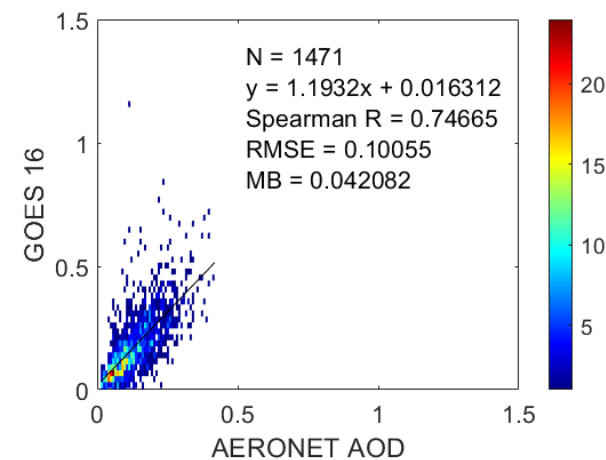
GOES-17/18 vs. CalTech AOD
(Y2021-2024)



GOES-17 vs. CalTech AOD
(Y2021- Y2022)



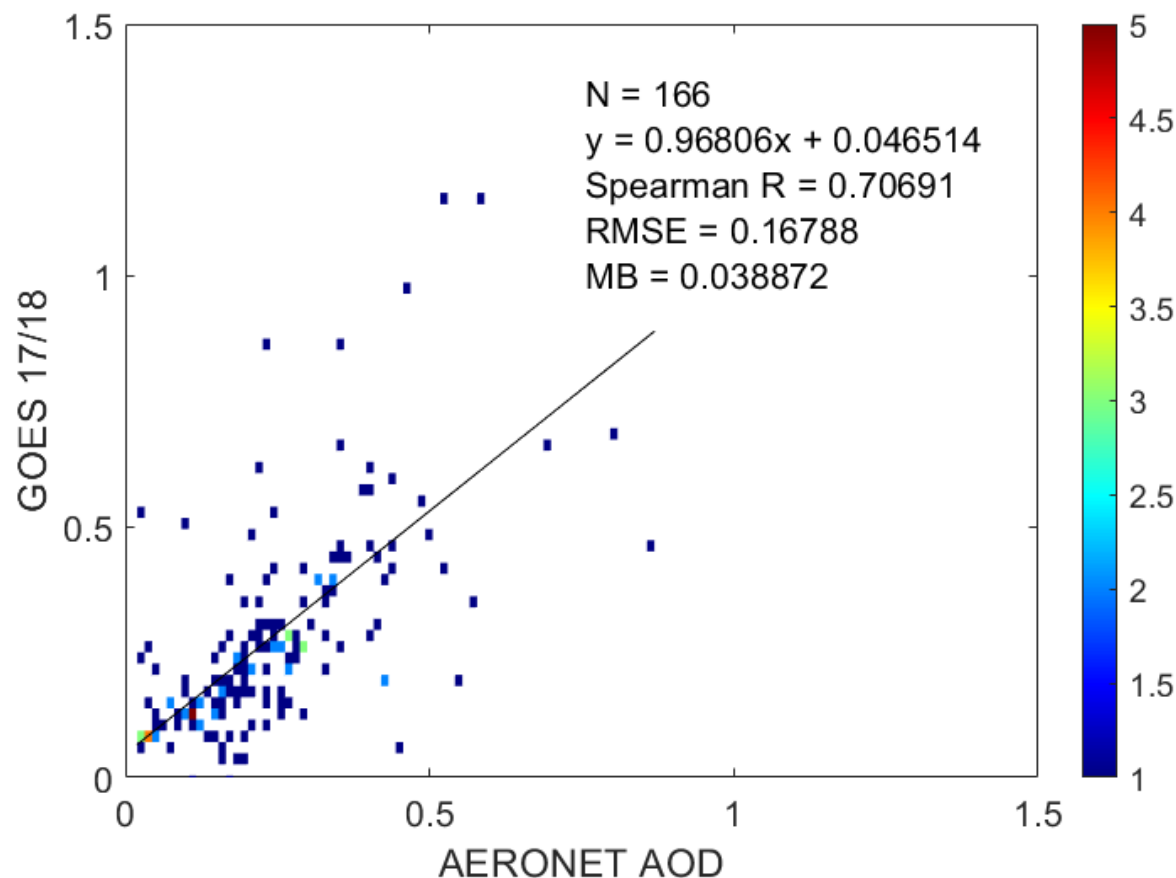
GOES-18 vs. CalTech AOD
(Y2023- Y2024)



Data Validation: Hourly GOES West vs. AERONET AOD

- Few good quality data are available at Salton City, though GOES West AOD shows fairly good correlation with AERONET AOD.

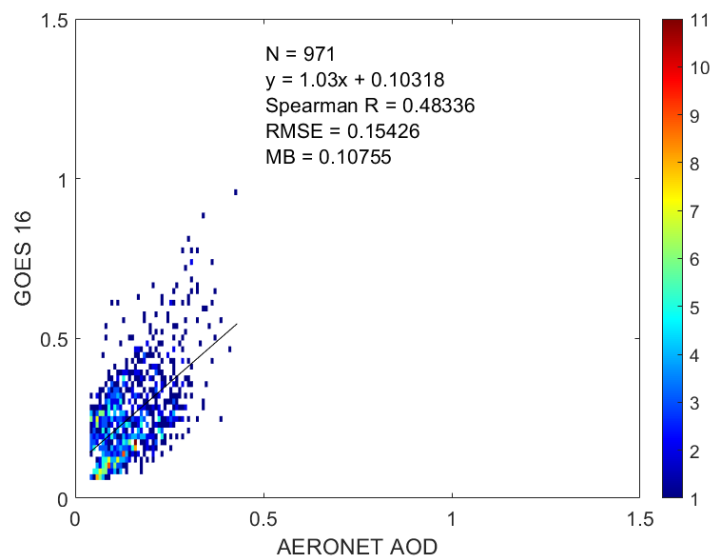
GOES West
vs.
Salton City



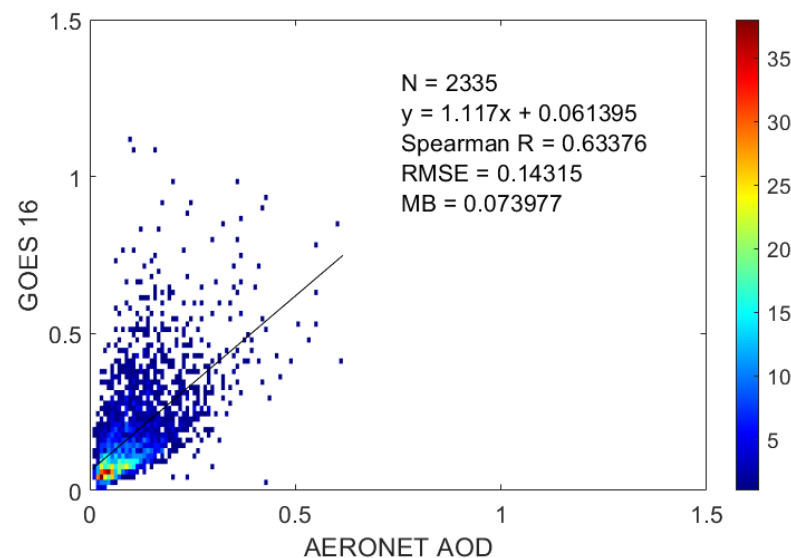
Data Validation: Hourly GOES East vs. AERONET AOD

- No good quality data of GOES East before 2024 at CalTech site
- Fairly good estimate of AOD in the CalTech and Salton City, but may tend to overestimate AOD at Salton City

GOES East vs. CalTech AOD (Y2024)



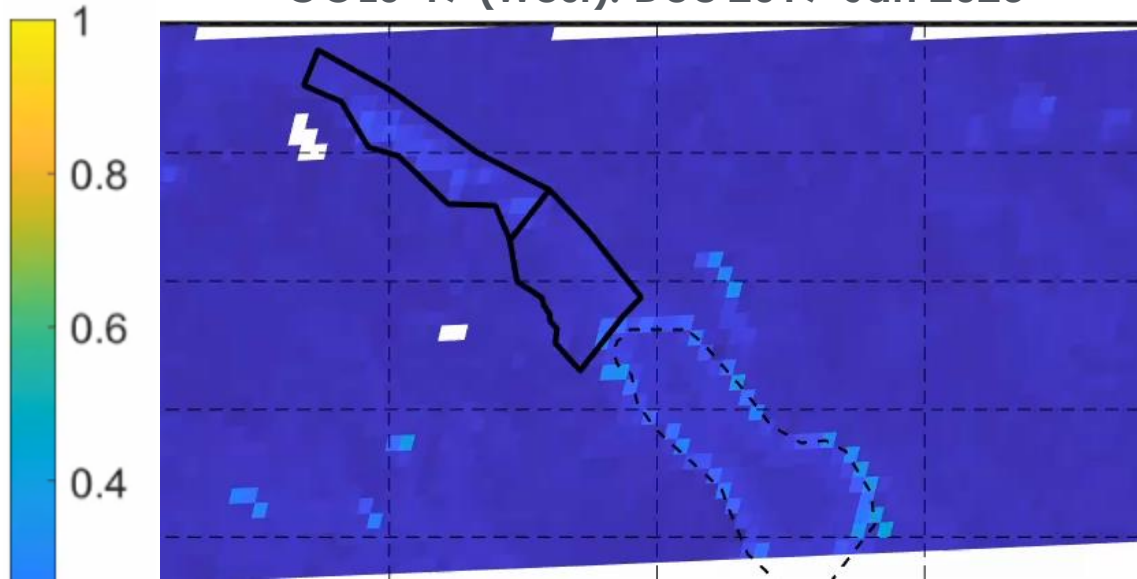
GOES East vs. Salton City AOD



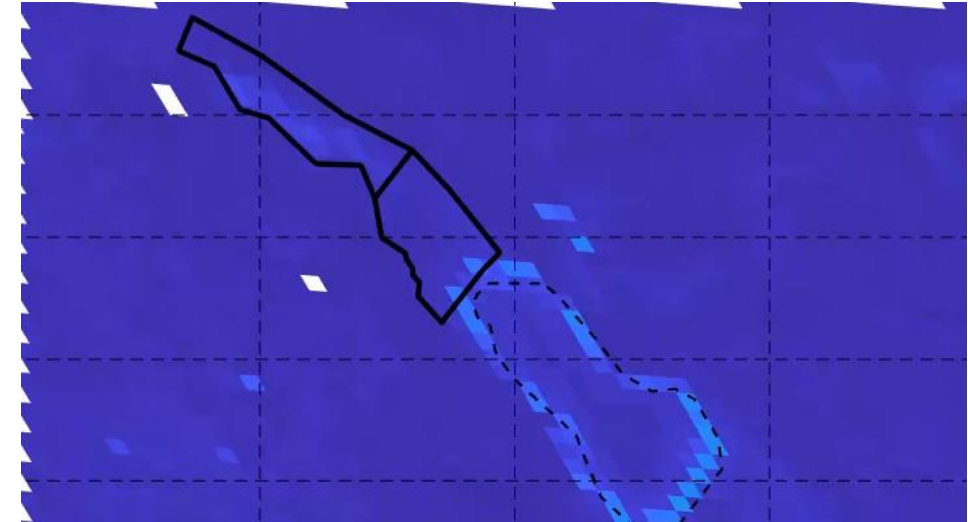
Monthly GOES AOD (550nm) Animation

201912

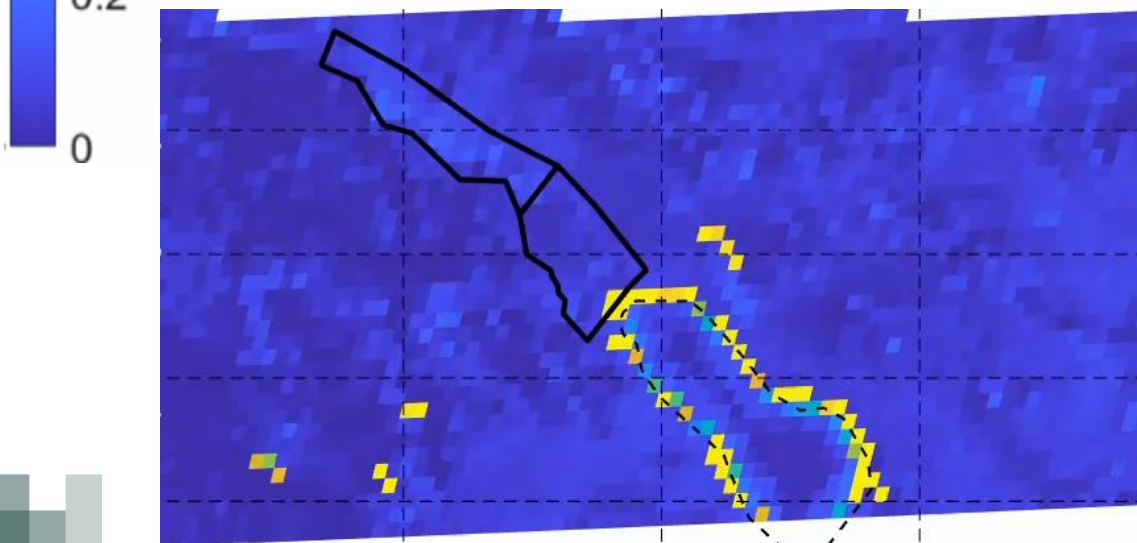
GOES-17 (West): Dec 2019-Jan 2023



GOES East: Dec 2019-June 2024



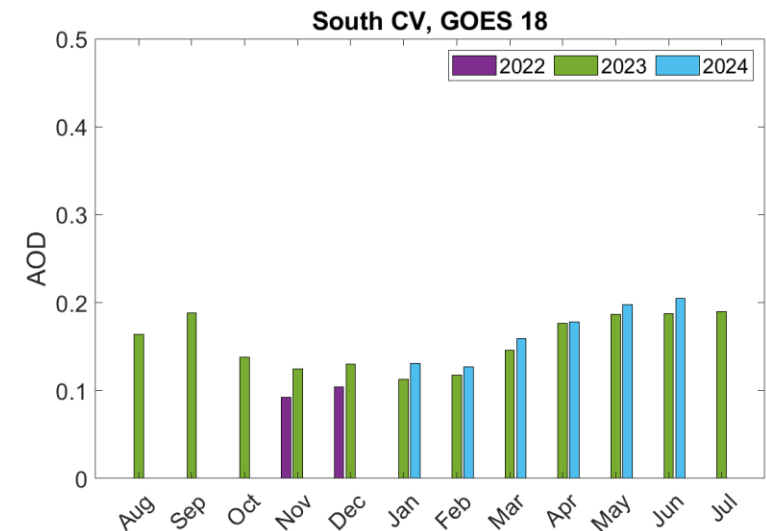
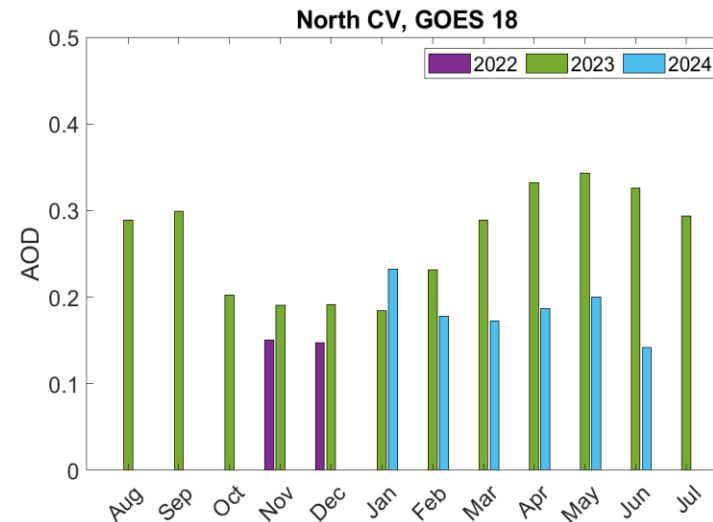
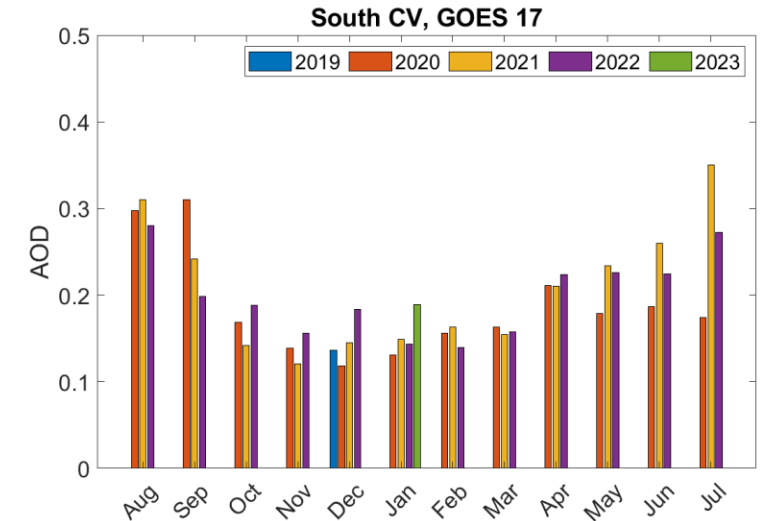
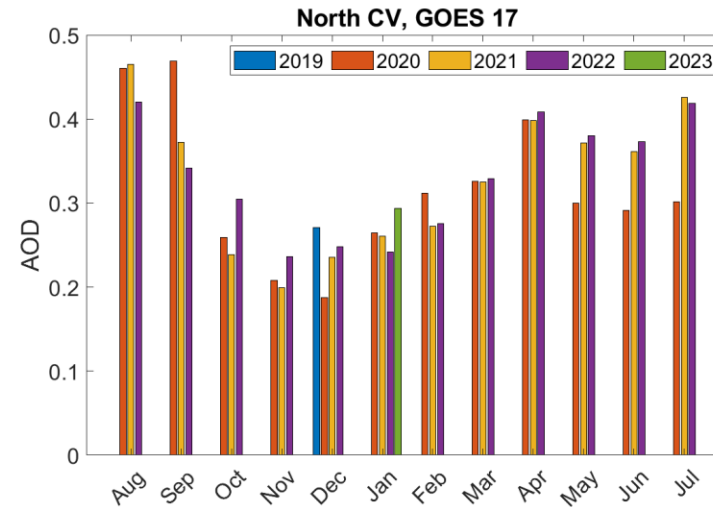
GOES-18 (West): Nov 2022-Jun 2024



- AOD at North CV > AOD at South CV
- Similar pattern between GOES West and GOES East
- High levels in Anza Borrego State Park in May 2024 like MAIAC

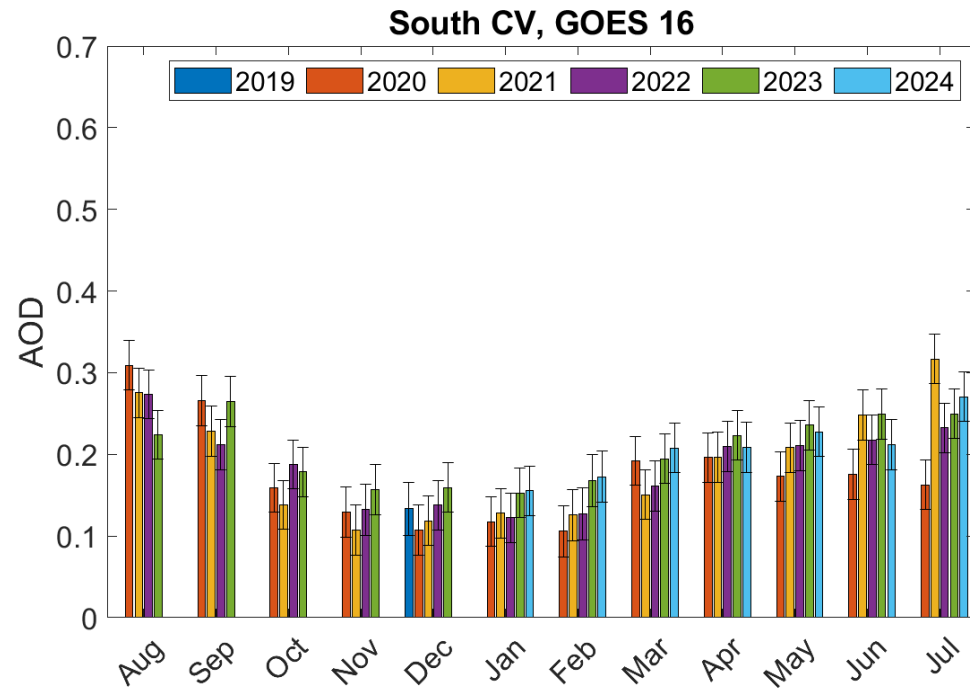
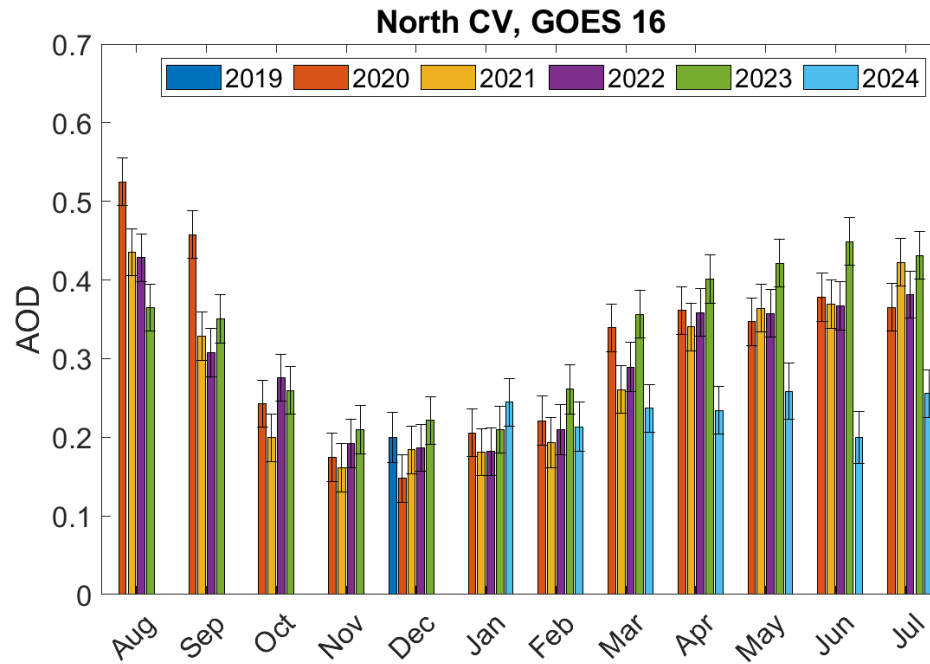
Monthly Variation of GOES West AOD at Coachella Valley

- Same monthly pattern as MAIAC AOD
- $AOD(G18) < AOD(G17)$
- $AOD(North) > AOD(South)$
- AOD from Feb-Jun 2024 in North CV is lower than in 2023 due to algorithm update (02/06/2024)



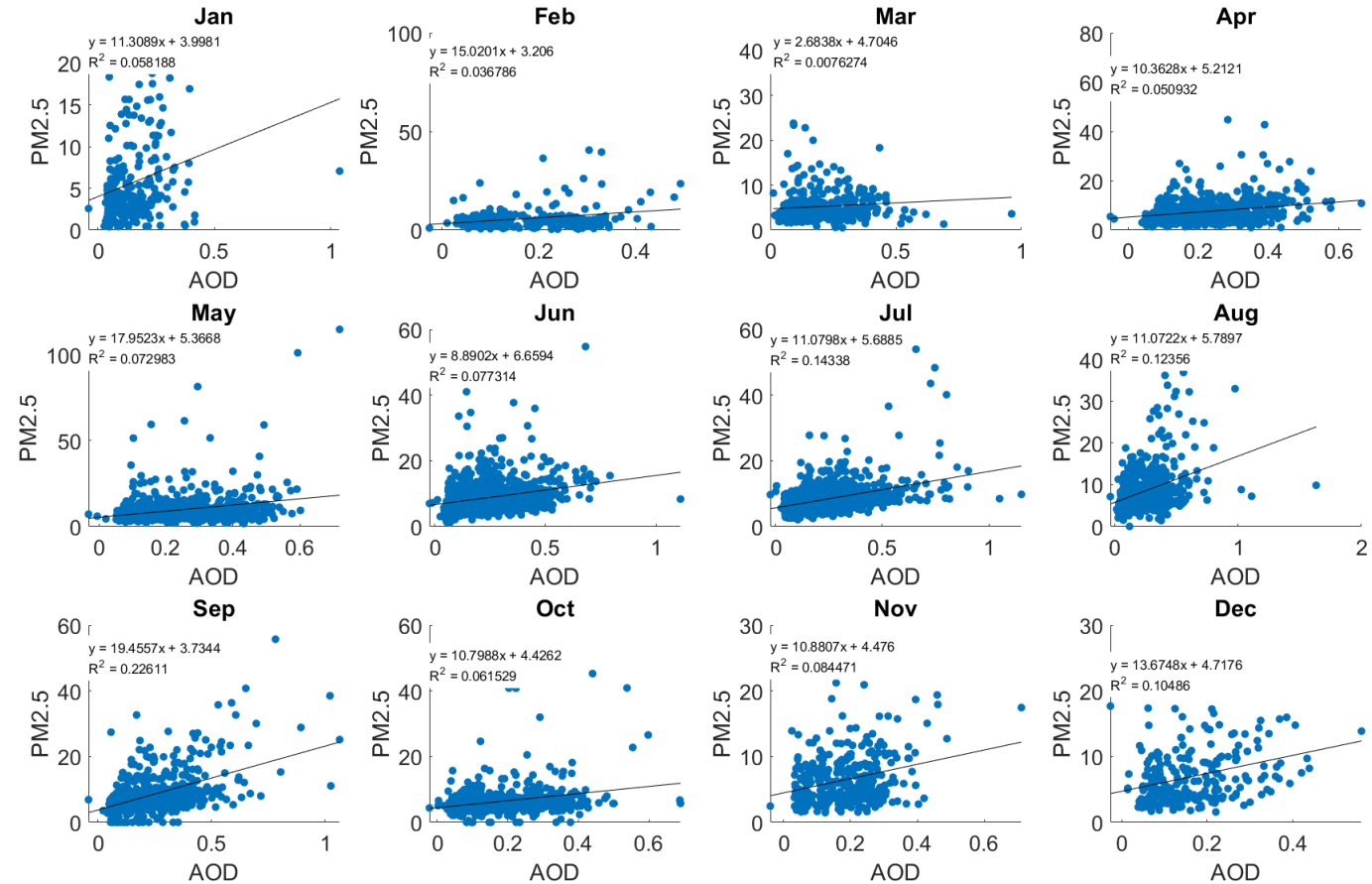
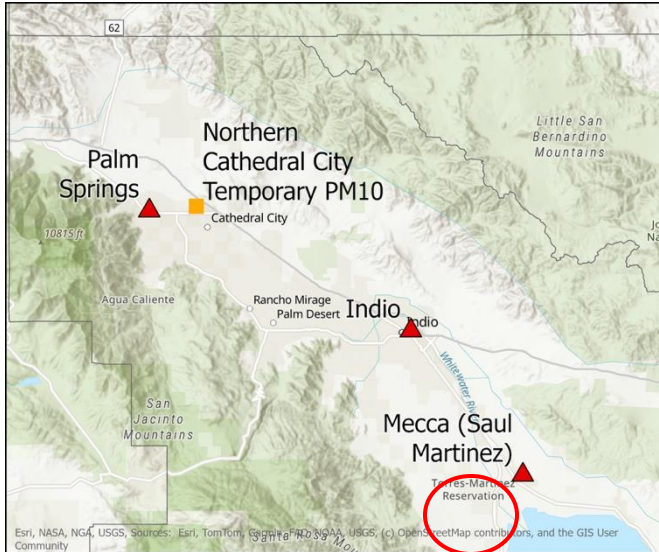
Monthly Variation of GOES East AOD

- Similar monthly variation
- Different AOD magnitude after algorithm update (02/06/2024)
- AOD over North CV > AOD over South CV



PM2.5 vs. GOES AOD at Mecca

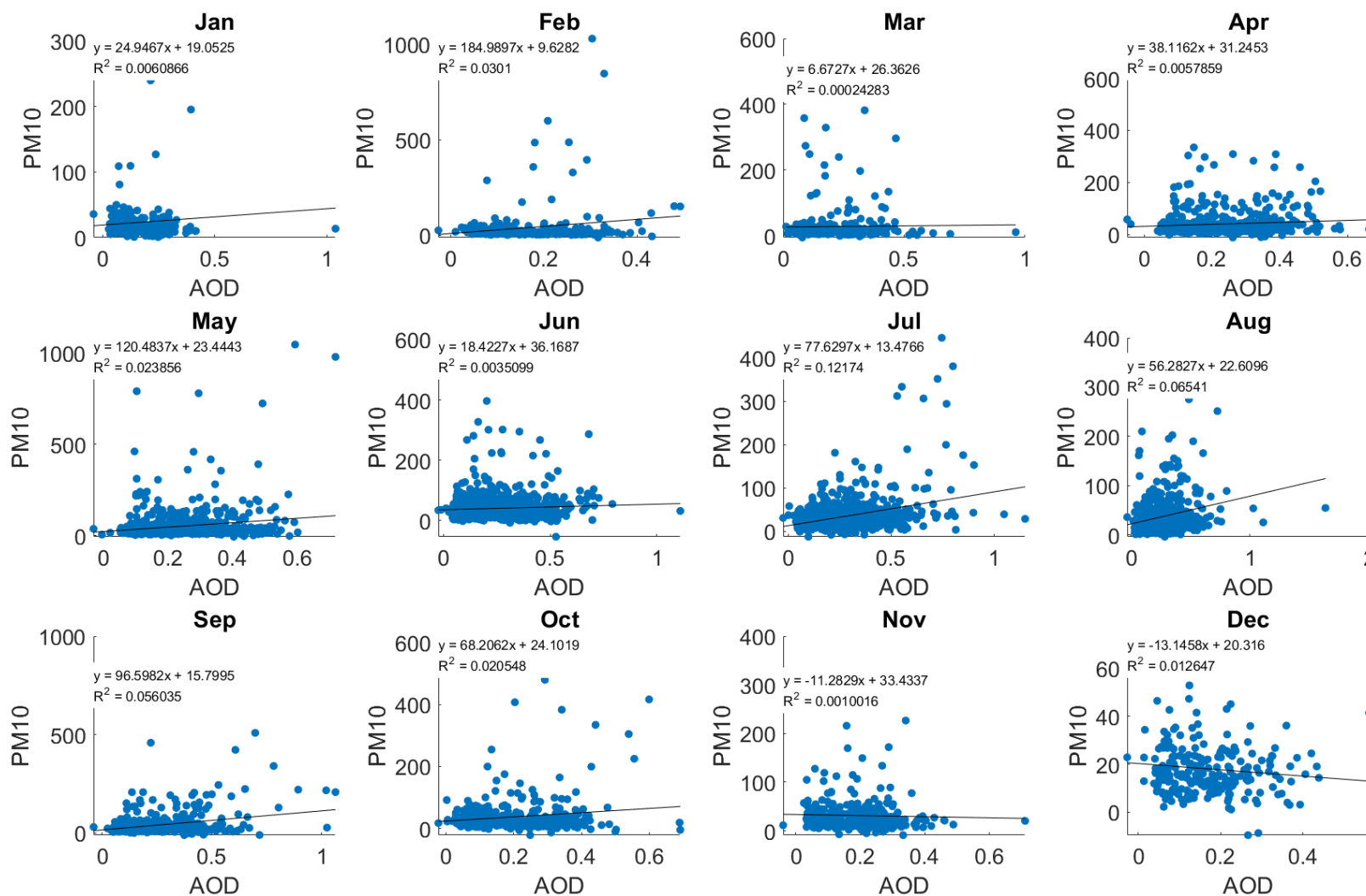
PM Monitoring Locations in Coachella Valley



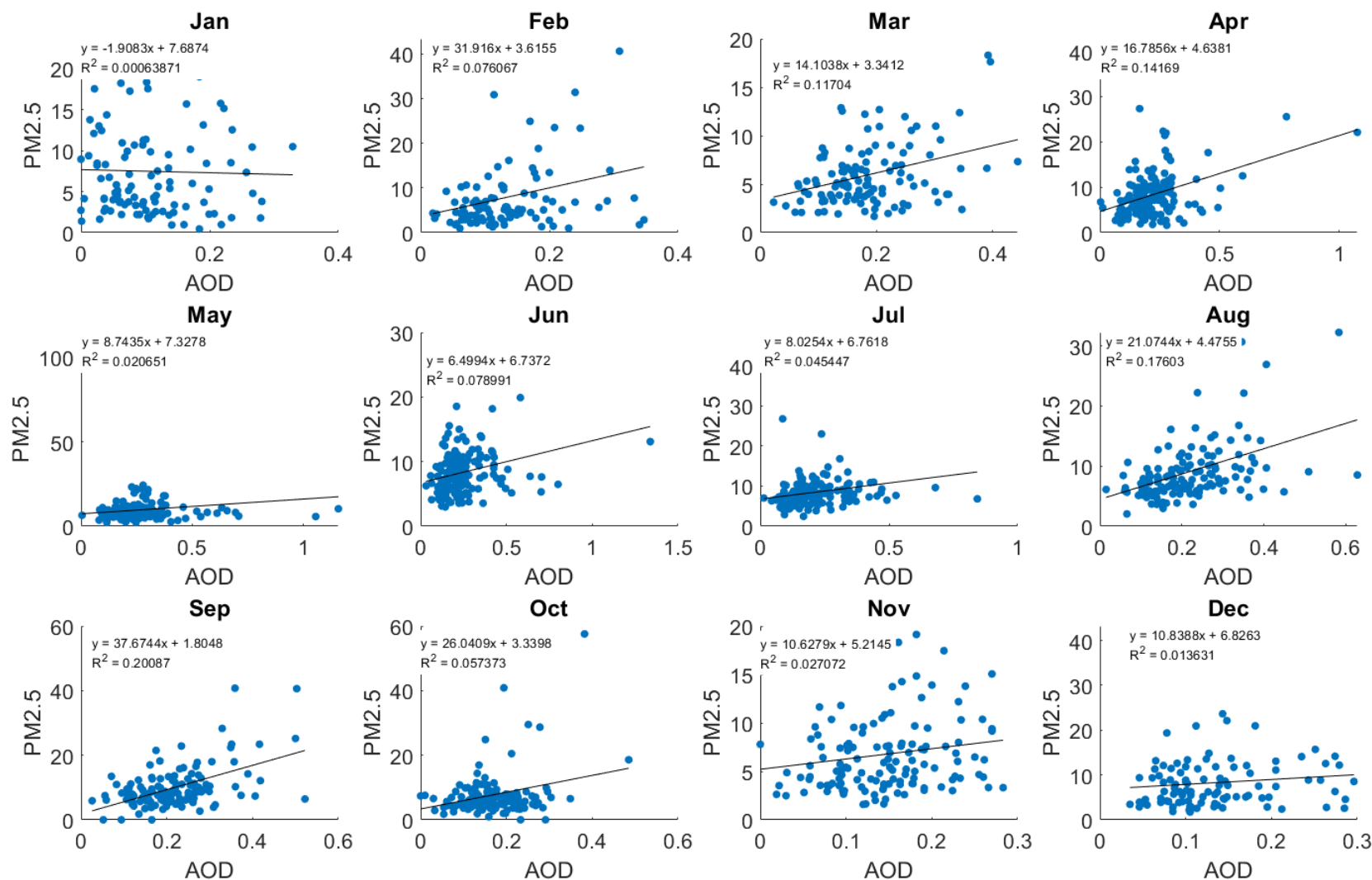
No direct relationship is observed between PM2.5 and GOES AOD at Mecca.



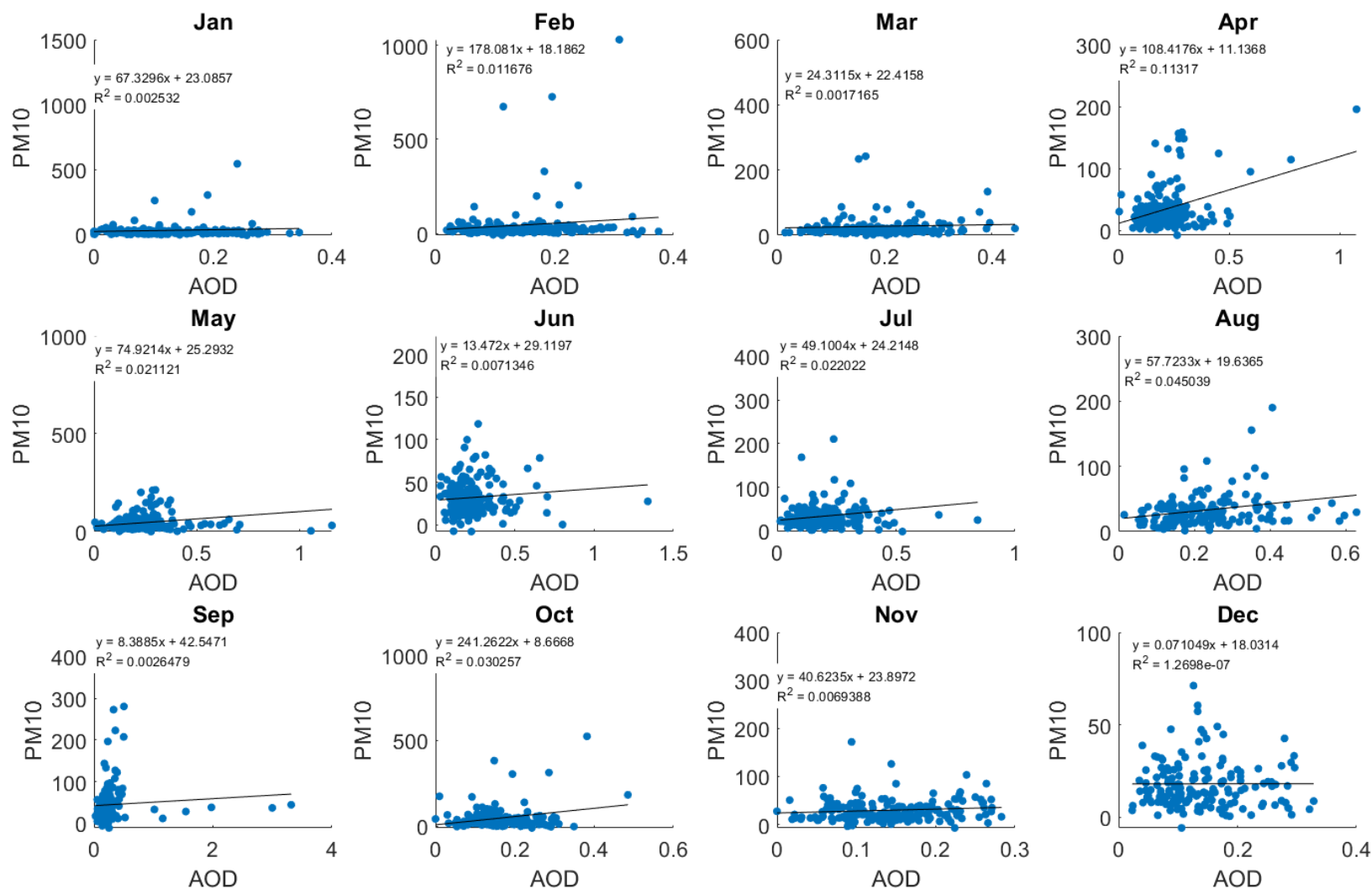
PM10 vs. GOES AOD at Mecca



PM2.5 vs. MAIAC AOD at Mecca



PM10 vs. MAIAC AOD at Mecca



Summary

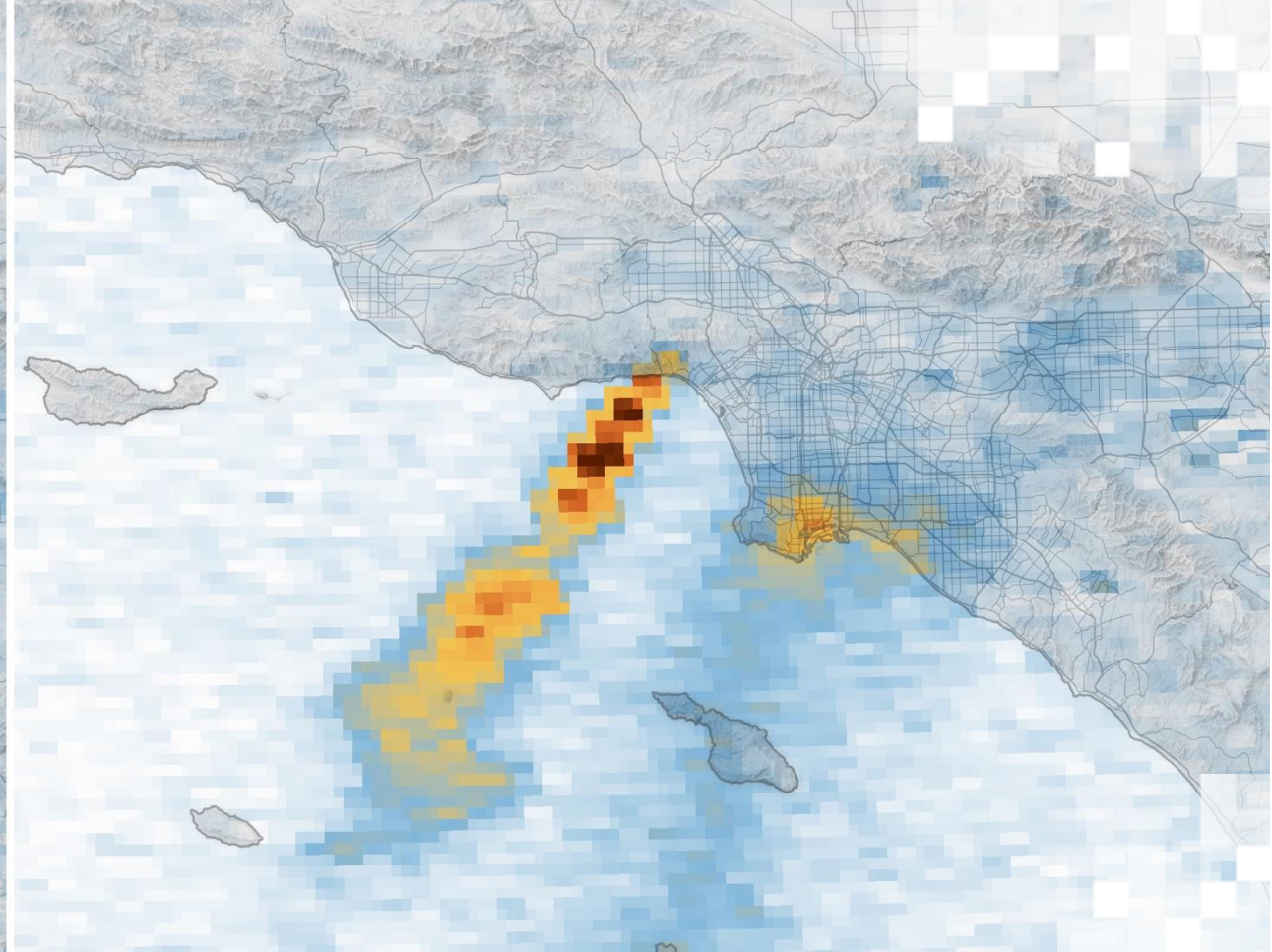
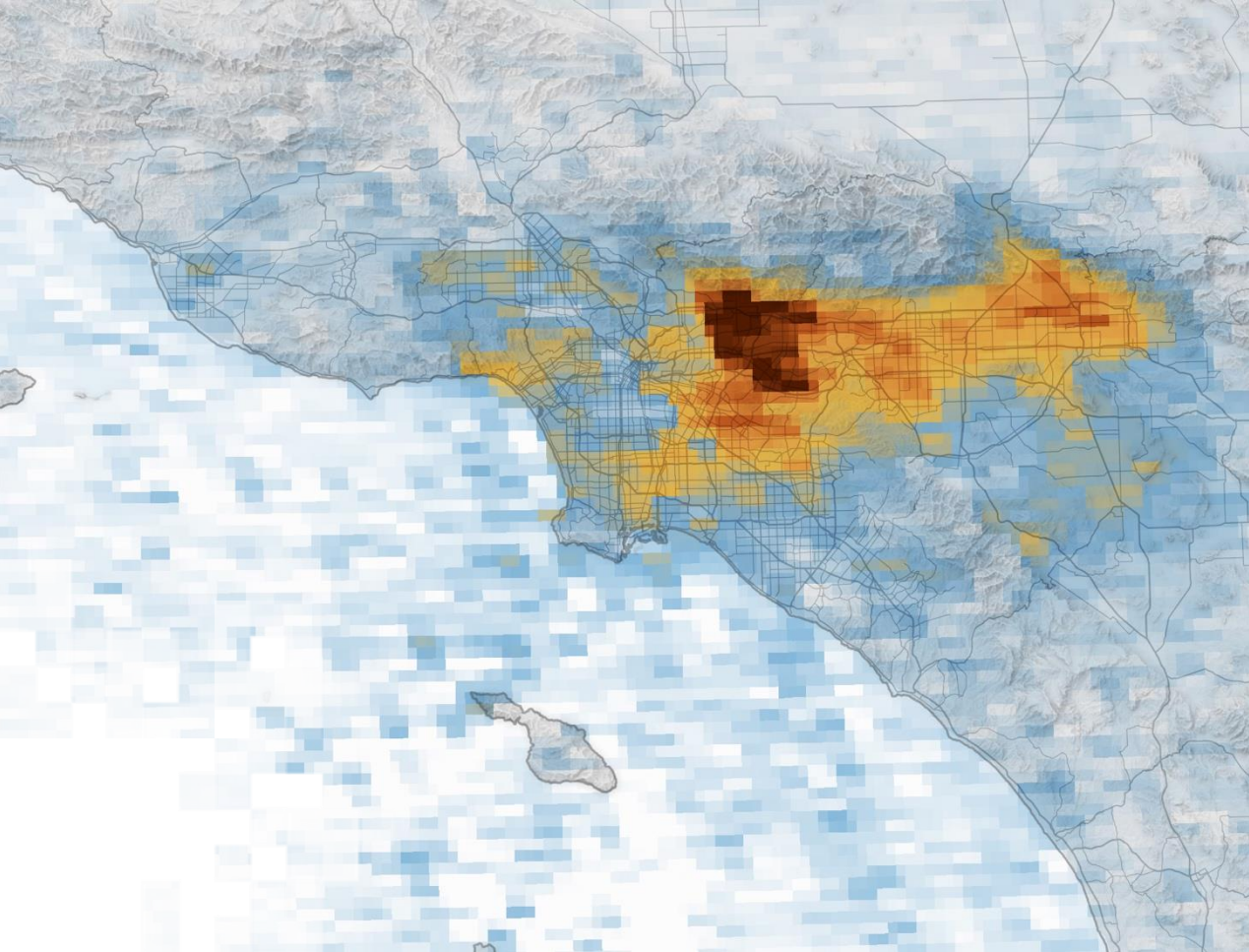
- **CalTech Site in South Coast Air Basin:**
 - GOES West did better job than GOES East
 - Performance improved after 2024 for GOES-16, especially for data points with QC of 0
 - Performance improved after 2021 for GOES-17
 - No significant change when GOES West switched from GOES-17 to GOES-18
- **Salton City Site in Coachella Valley:**
 - Compared with AERONET AOD, GOES-16 had moderate performance while GOES West lost a lot of data points with good quality.
 - Trends:
 - Similar monthly trend with MAIAC AOD: high in summertime while low in wintertime
 - AOD at North CV is higher than South CV; however, inconsistent with MAIAC
 - No conclusive annual trend is observed due to algorithm change of land surface
- AOD shows no correlation with surface PM either in South Coast Air Basin or Coachella Valley.



Takeaways

- Changes in retrieval algorithms can affect analysis of long-term trends
- Influence of bright surface reflectance on our analysis
- Challenging to directly relate satellite-retrieved AOD to surface-level PM₁₀
- Could not identify impacts of tropical storm Hilary on AOD from GOES or MAIAC
- Simple Python code for downloading and plotting GOES AOD on [GitHub](#)





TEMPO Data in South Coast AQMD

Motivation

- **South Coast AQMD Real-time AQI Map:** Data fusion of National Air Quality Forecast Capability model and real time regulatory monitors and sensor data (PurpleAir and Clarity)
- Evaluate the TEMPO data over the South Coast AQMD region to see incorporation will improve accuracy of real-time AQI map
- Provide the real-time gridded AQI

Schulte, N., Li, X., Ghosh, J.K., Fine, P.M., Epstein, S.A. **Responsive High-Resolution Air Quality Index Mapping Using Model, Regulatory Monitor, and Sensor Data in Real-Time**, 2020, *Environmental Research Letters*, **15** 1040a7

Real-Time AQI Map

San Bernardino

AQI: 207

AQI Category: Very Unhealthy

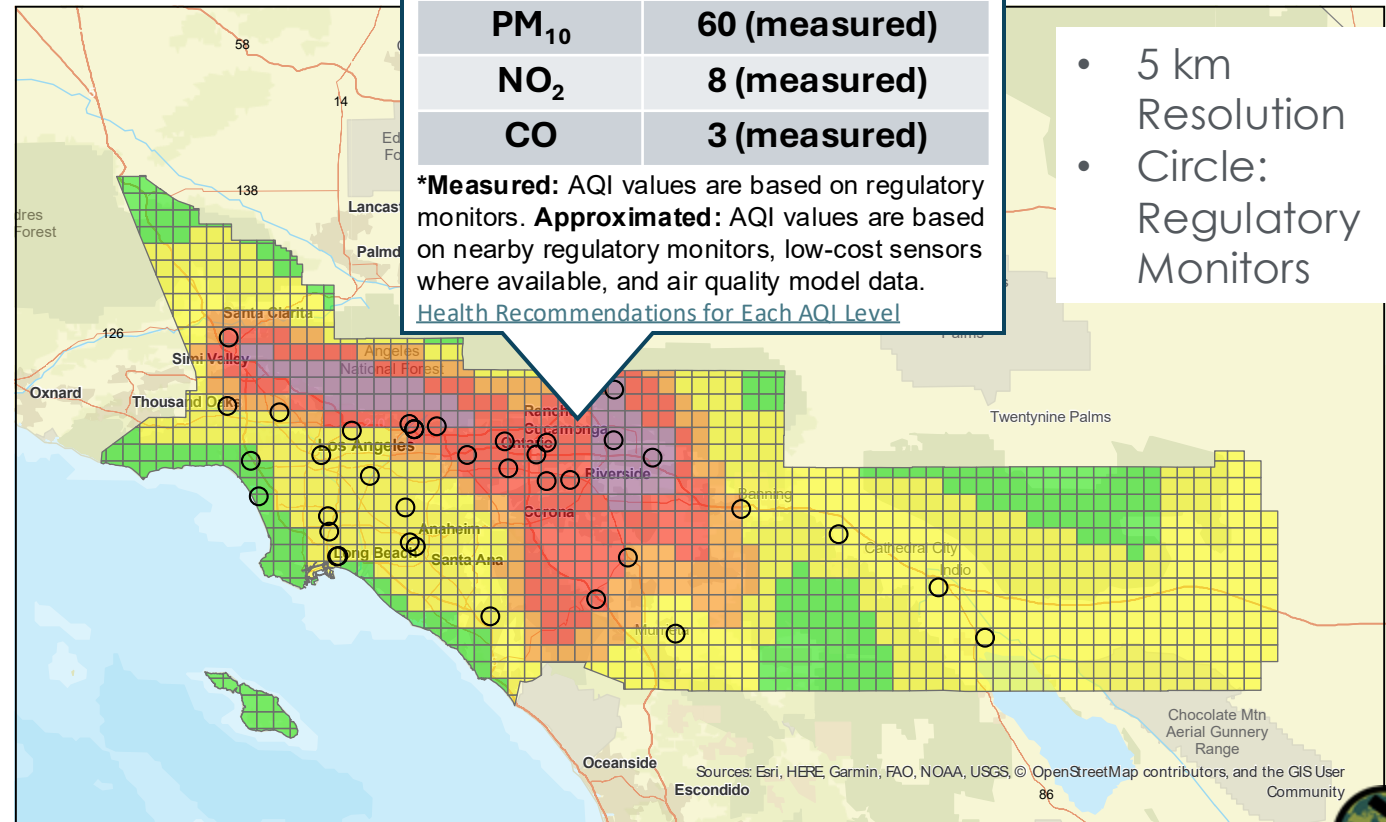
Dominant Pollutant: Ozone | Updated: 4 PM

Pollutant	AQI
PM _{2.5}	70 (approximated)
O ₃	207 (measured)
PM ₁₀	60 (measured)
NO ₂	8 (measured)
CO	3 (measured)

***Measured:** AQI values are based on regulatory monitors. **Approximated:** AQI values are based on nearby regulatory monitors, low-cost sensors where available, and air quality model data.

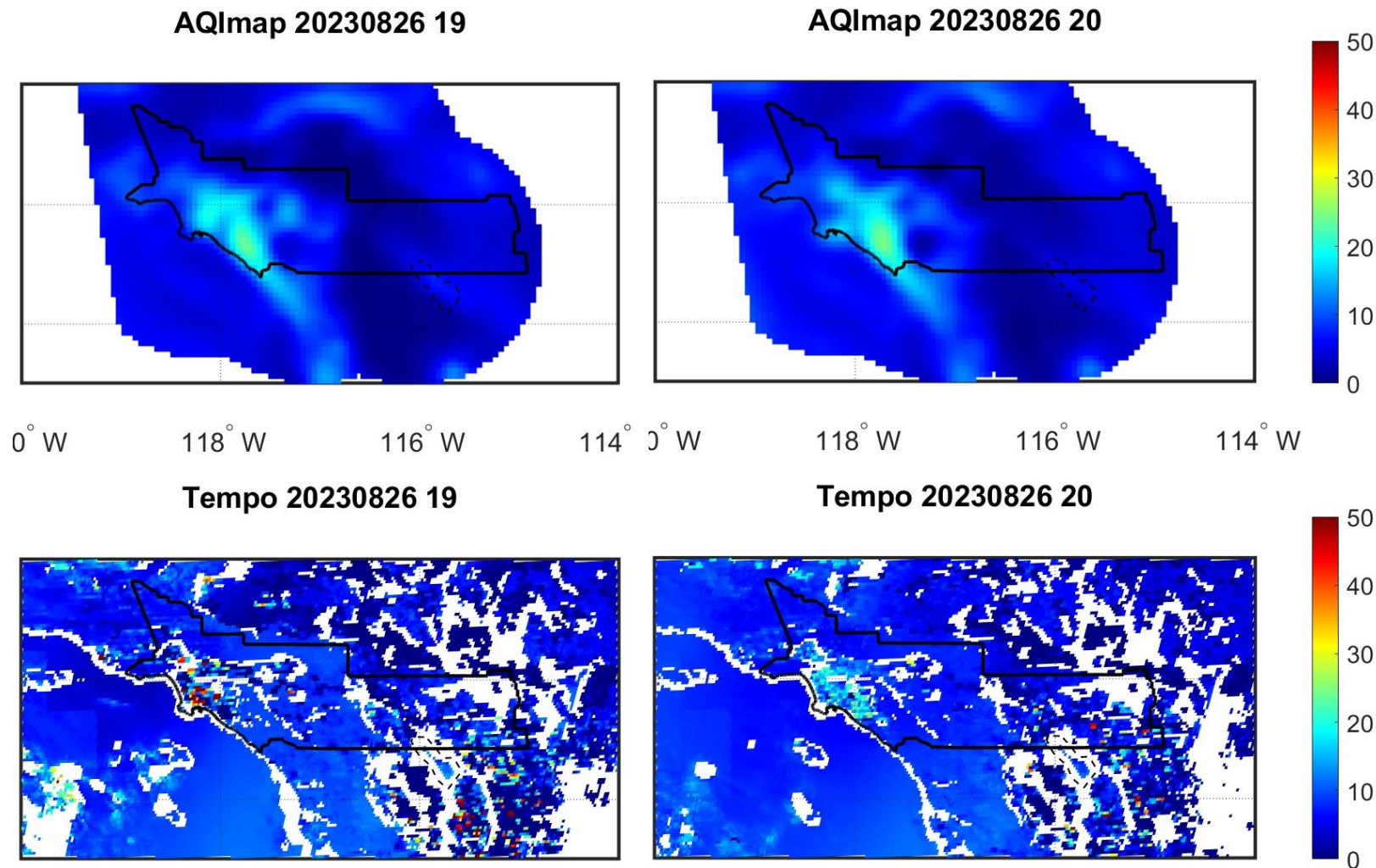
[Health Recommendations for Each AQI Level](#)

- 5 km Resolution
- Circle: Regulatory Monitors



PM2.5 from South Coast AQMD AQI Map vs. TEMPO PM2.5

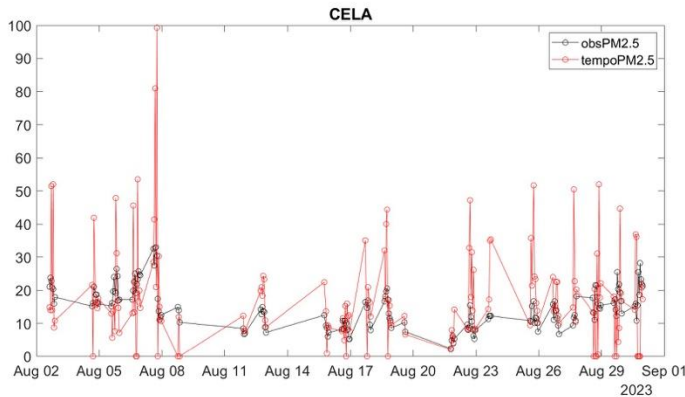
- Overall PM2.5 levels look similar
- Uncertain if PM2.5 spikes (red spots) from Tempo PM2.5 are real
- Slightly different spatial patterns between South Coast AQMD AQI Map and TEMPO PM2.5



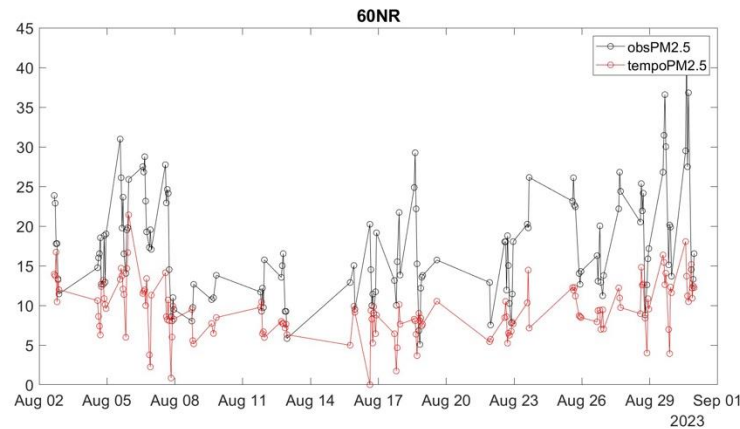
TEMPO PM2.5 vs. PM2.5 Monitors

- TEMPO PM2.5 captured the magnitude of PM2.5 observation for most of the monitors.
 - Underestimate near-road site
 - Overestimate at the high-altitude site

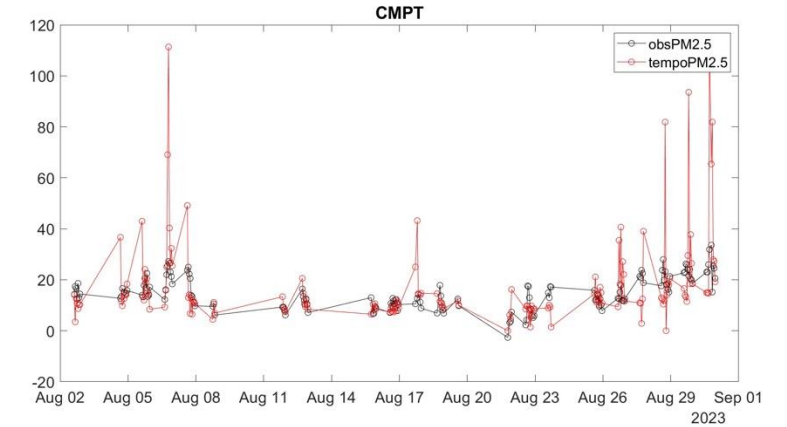
Urban Site (Central LA)



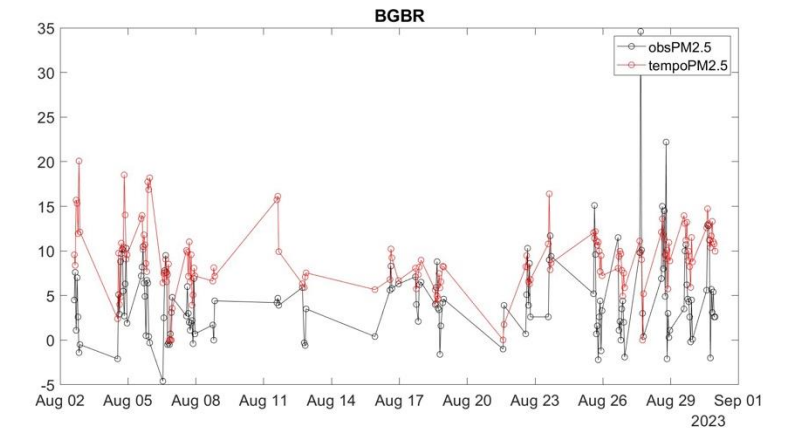
Near Road Site



Urban Site (Compton)



High-Altitude Site



South Coast AQMD Air Quality Assessment Group



Manager
Scott Epstein, PhD



Supervisor
Nico Schulte, PhD



**Air Quality
Specialist**
**Melissa
Maestas, PhD**



Senior Meteorologist
**Ranil Dhammapala,
PhD**



**Air Quality
Specialist**
**Qijing
(Emily) Bian, PhD**



**Air Quality
Specialist**
**Masoud Shorshani,
PhD**



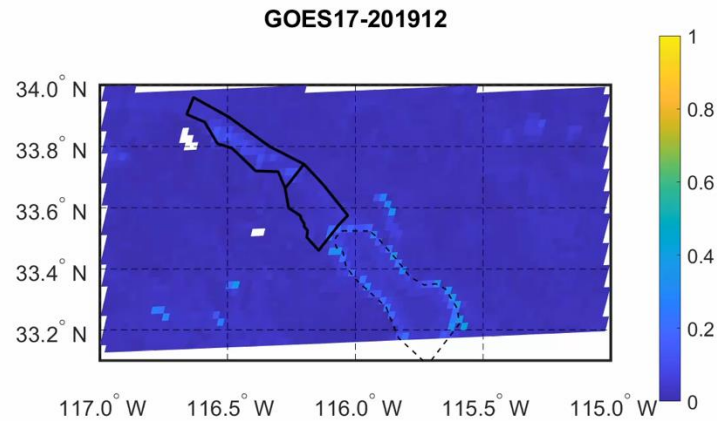


Thank You!
E-mail: qbian@aqmd.gov

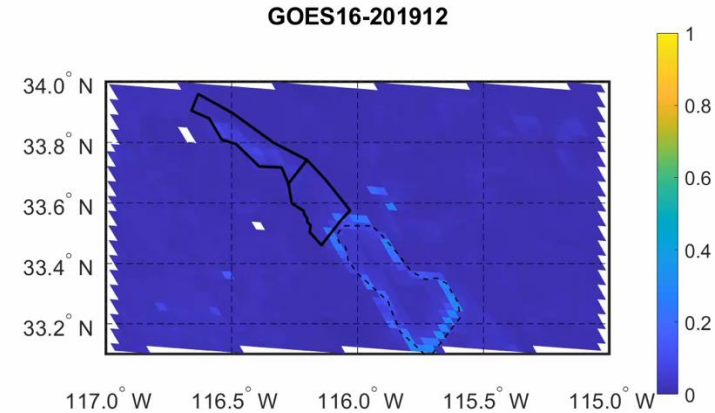


Monthly GOES AOD (550nm) Animation

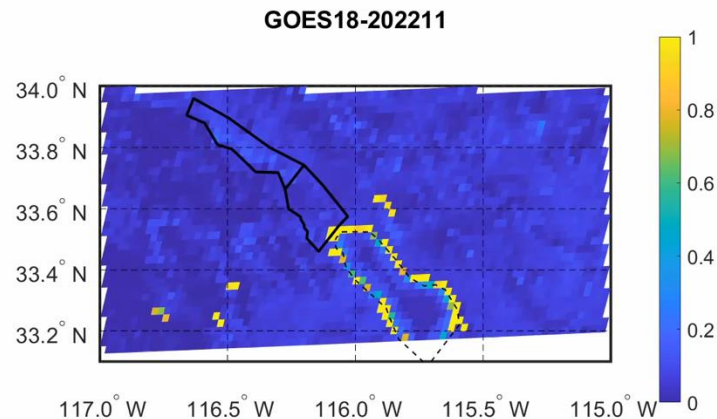
GOES-17 (West) : Dec 2019-Jan 2023



GOES East: Dec 2019-June 2024



GOES-18 (West): Nov 2022-Jun 2024



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