



PM Exceptional Events

2024 Primary Quality Assurance Organization Training

Scott A. Epstein PhD

Program Supervisor, Air Quality Assessment

Planning, Rule Development, and Implementation

South Coast Air Quality Management District

Design value: metric used to compare to standards to determine attainment status

- Design Value methodology depends on standard and pollutant

PM10 (24-hour)

150 $\mu\text{g}/\text{m}^3$

- 4th highest 24-hour average value in 3-year period with daily monitoring
- 1st highest 24-hour average value in 3-year period with 1 in 6 monitoring

PM2.5 (annual)

12 $\mu\text{g}/\text{m}^3$

- Average of quarterly averaged concentrations in 3-year period

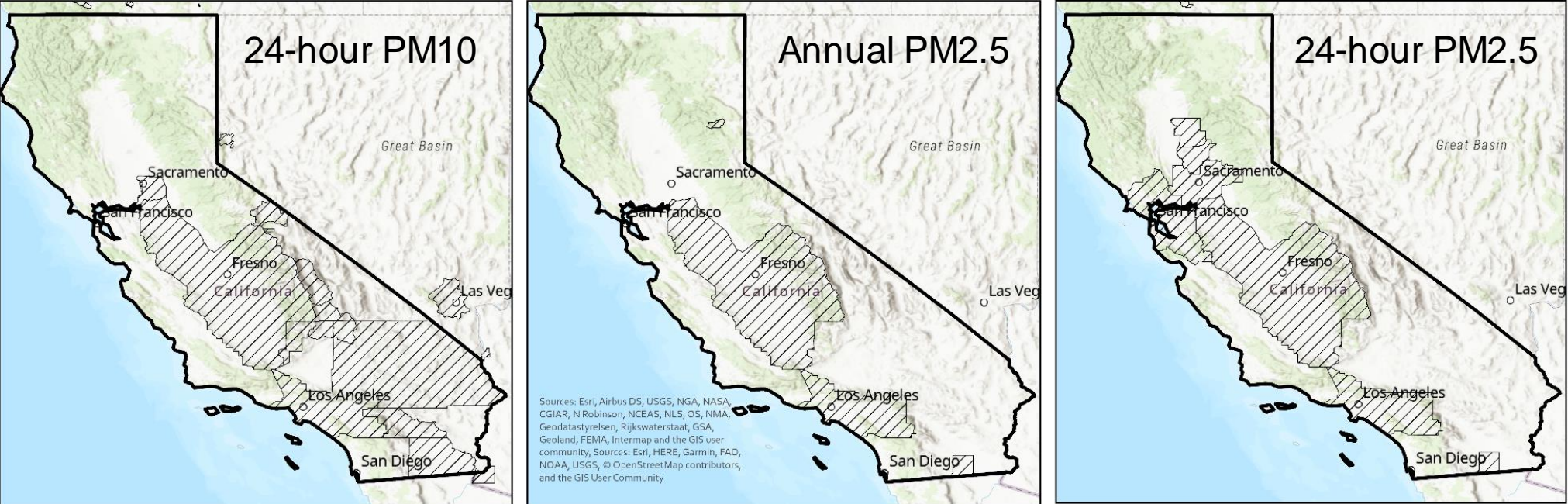
PM2.5 (24-hour)

35 $\mu\text{g}/\text{m}^3$

- 98th percentile value for each year, averaged over 3 years
- 8th highest, 3rd highest, or 2nd highest depending on monitoring frequency

- A single or few measurements can result in non-attainment!

PM Nonattainment and Maintenance Areas



Common Types of PM Exceptional Events (EE)



Windblown Dust



Prescribed Fire



Wildfire Smoke



Cultural Events



Volcanic Eruption

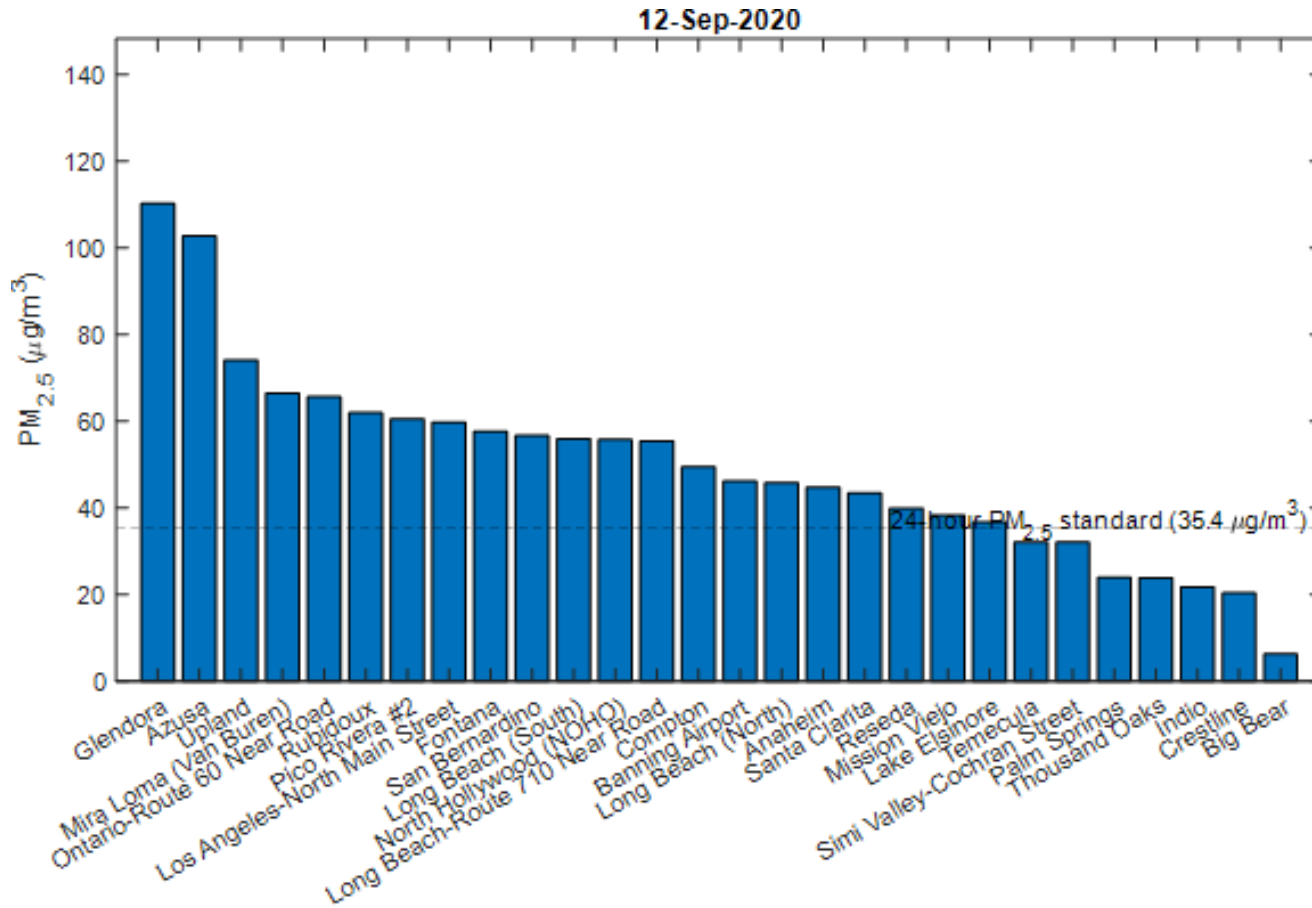
Main Goals of an EE Demonstration

- 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



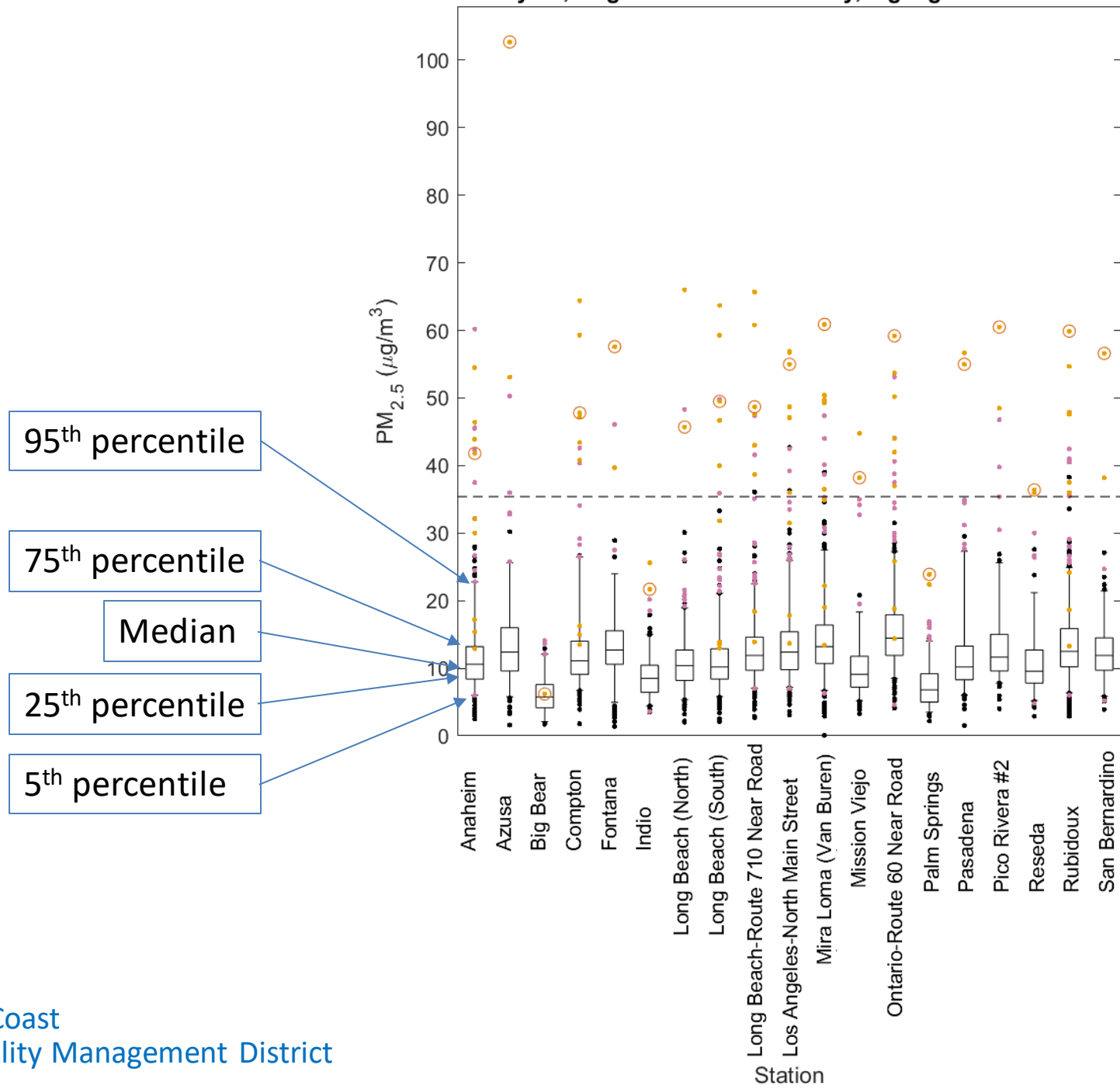
Evaluation of Monitored 24-hour Concentrations



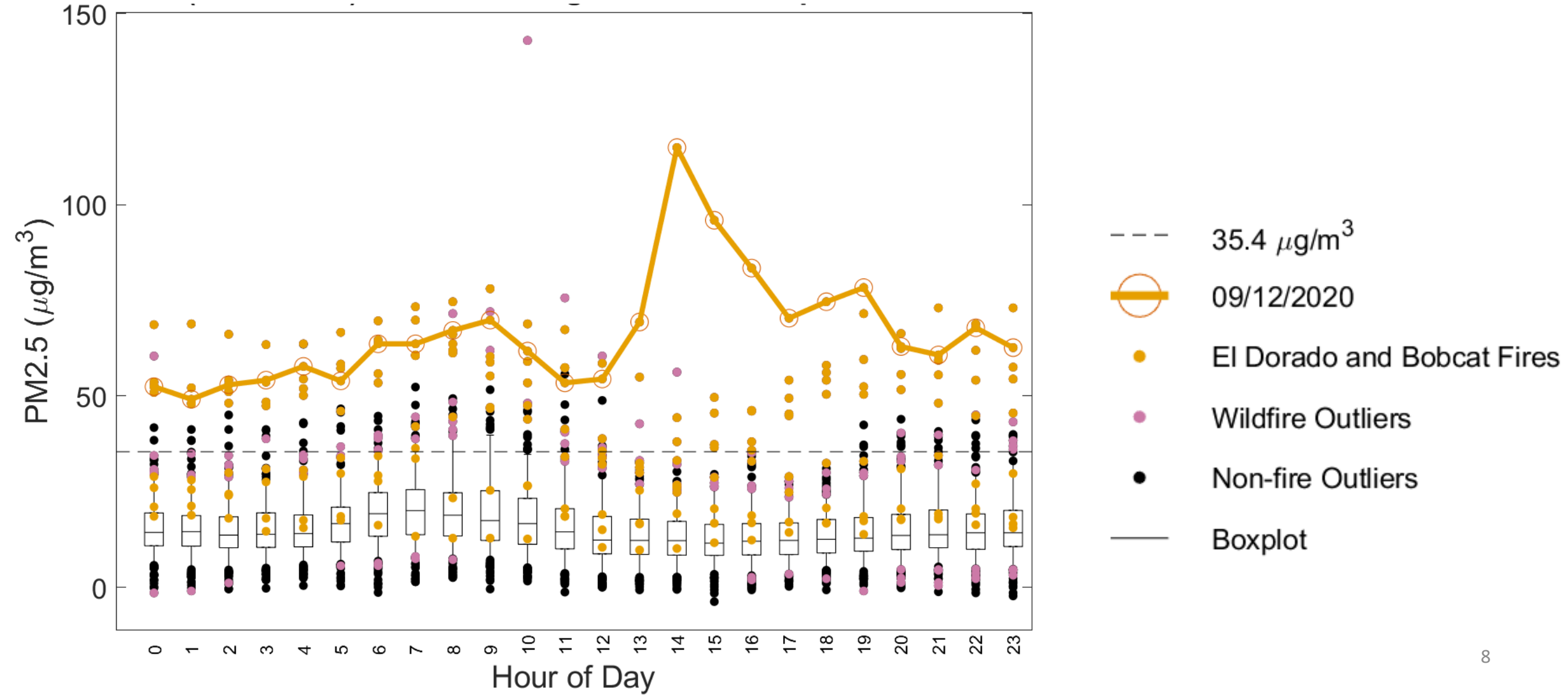
Site Name	ID
Anaheim	1
Azusa	2
Banning Airport	3
Big Bear	4
Compton	5
Crestline	6
Fontana	7
Glendora	8
Lake Elsinore	9
Long Beach-Route 710 Near Road	10
Long Beach (North)	11
Long Beach (South)	12
Los Angeles-North Main Street	13
Mira Loma (Van Buren)	14
Mission Viejo	15
North Hollywood (NOHO)	16
Ontario-Route 60 Near Road	17
Pasadena	18
Pico Rivera #2	19
Reseda	20
Rubidoux	21
San Bernardino	22
Santa Clarita	23
Temecula	24
Upland	25



5-year, August-October Summary, highlight 09/12/2020



Evaluation of Diurnal Data



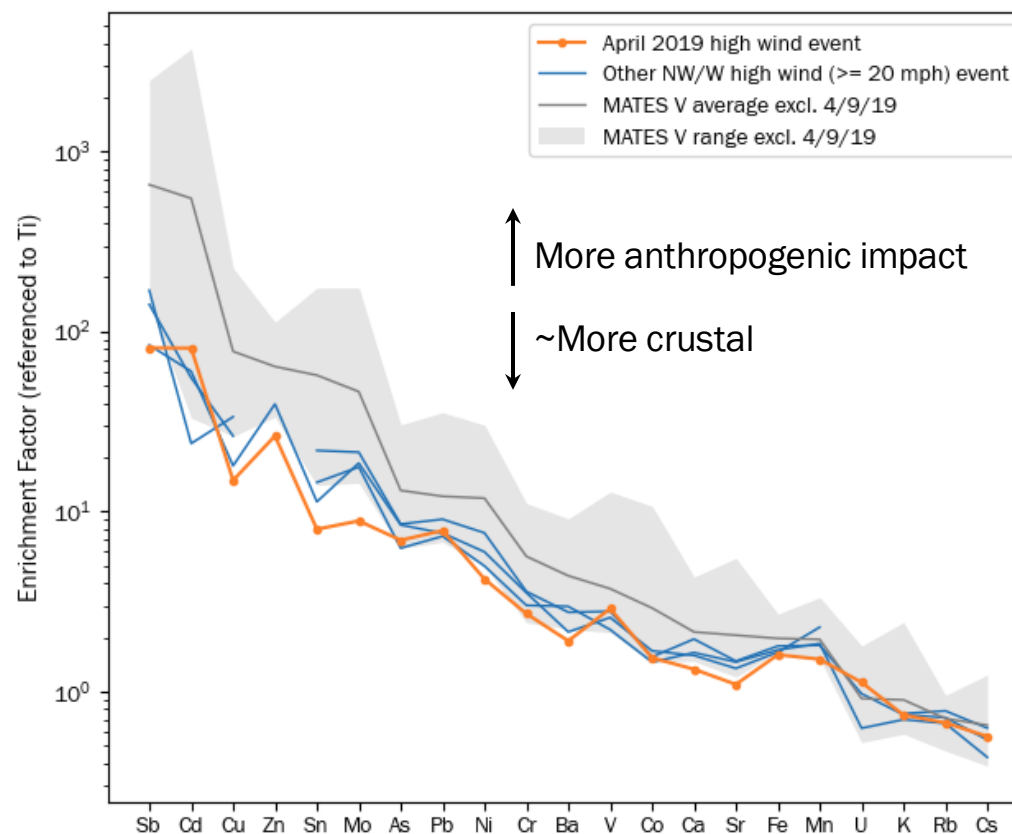
Using Metal Data to Assess PM10 Sources During a High Wind Event



May 2019 Satellite Imagery

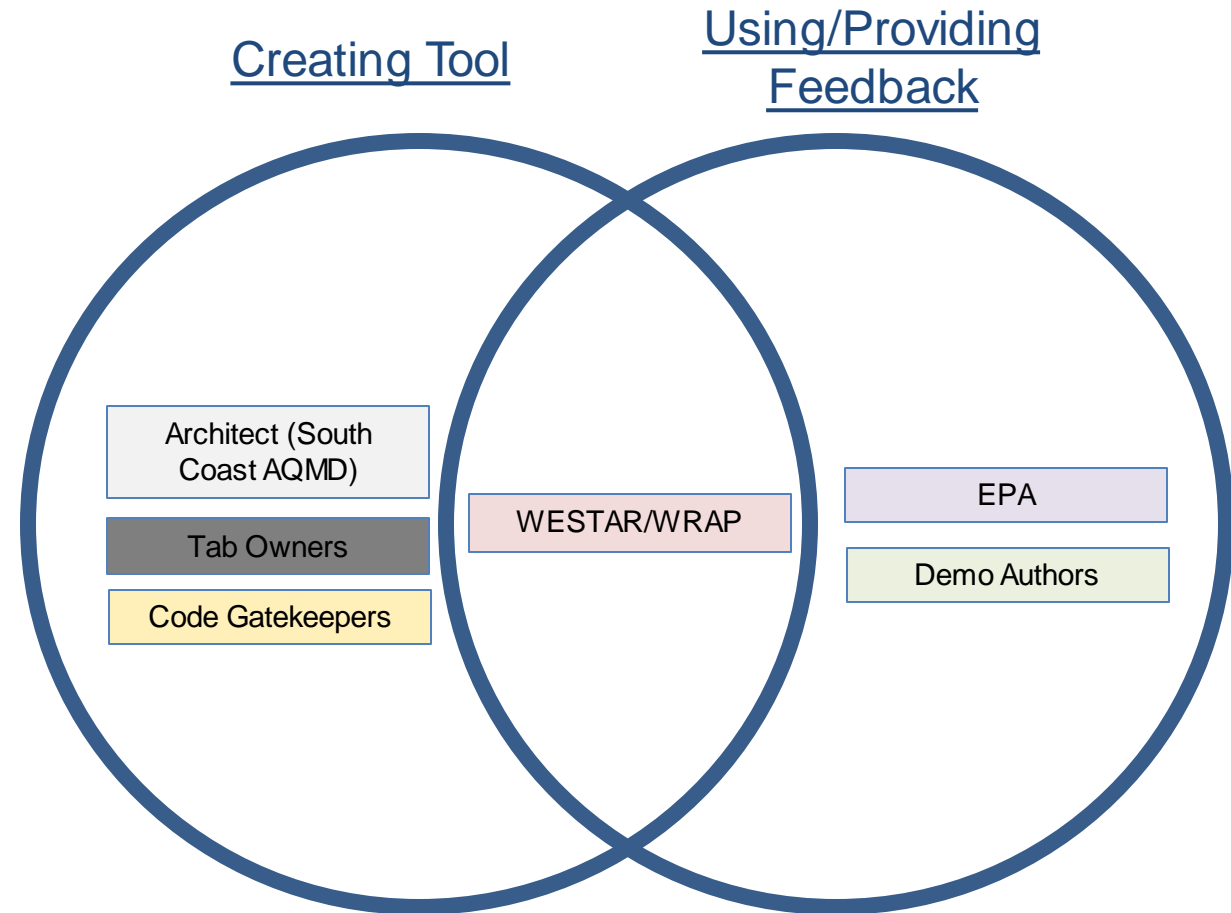
— Railroad track
 — 10 m — 50 m HYSPLIT back trajectory

$$\text{Enrichment factor for metal } M = \frac{(M/Ti)_{\text{sample}}}{(M/Ti)_{\text{crust}}}$$



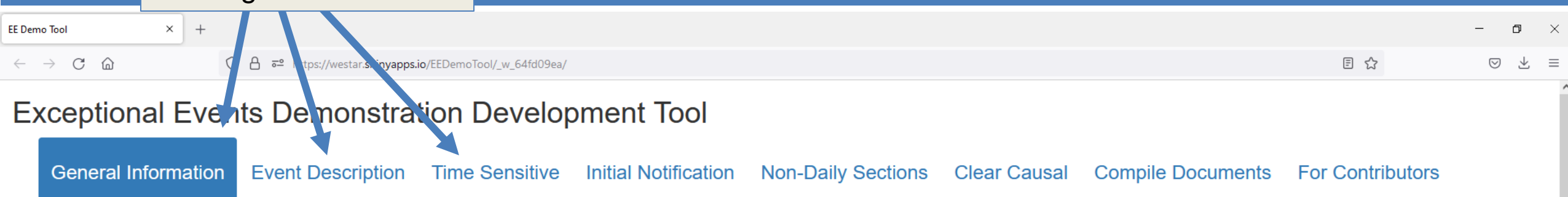
Exceptional Event Demonstration Tool

- South Coast AQMD spearheaded a collaboration with WESTAR/WRAP and 20 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



General Layout

Tabs to walk through creating EE Demo



The screenshot shows a web browser window titled "EE Demo Tool" with the URL https://westar.sinyapps.io/EEDemoTool/_w_64fd09ea/. The main heading is "Exceptional Events Demonstration Development Tool". Below the heading is a navigation menu with the following tabs: "General Information", "Event Description", "Time Sensitive", "Initial Notification", "Non-Daily Sections", "Clear Causal", "Compile Documents", and "For Contributors". A blue box highlights the "General Information" tab, and three blue arrows point from the text box above to the "Event Description", "Time Sensitive", and "Initial Notification" tabs.

Purpose of Tool:

The purpose of this app is to quasi-automate some of the tasks involved in preparing an Exceptional Events (EE) Demonstration for submission to the EPA. **Use of this app in no way guarantees EPA concurrence for any EE demo submitted to the EPA. EE demos created using this app are subject to the same review process as EE demos that do not use this app.** This interactive app lays the ground work for automating much of the technical data collection required in Exceptional Event Demonstrations. This online tool is a collaborative project among air quality regulatory agencies. It is, and will continue to be, a work in progress. If you are interested in contributing to this project, please contact [Rhonda Payne at WESTAR](#) or [Jay Baker at WESTAR](#). Please also see the 'For Contributors' tabs. Both R coders and non-coders are welcome to contribute.

General Instructions:

To start an EE demo, fill out the information on the 'Event Description' tab. Save the resulting Event Description file (EventDescriptionValues.csv) to a folder on your local computer that is dedicated to this EE Demo. This local folder will be referred to as the project folder. Which tabs appear or disappear depends on the Event Type and Report Type selected on the Event Description tab. Note that all tabs controlled by Event Type are visible if 'Multi Type' is selected, but data cannot be downloaded or plotted on the Event Description page with this selection.

Once the Event Description page is done, most of the other tabs can be used in any order. Be sure to download files created on each tab and save them to the project folder. No data is stored within the app from one session to another, so the files must be saved to the local project folder for future use. In general, most tabs will create 1) a small csv file referred to as the 'Meta file' used for tracking file names for the main report, 2) a zip file containing one Word document for each day of the Event or just one Word document for non-daily tabs, 3) another Meta file for the appendix, and 4) another zip file containing Word document(s) for the appendix. The Word documents will generally end in _Draft.

IMPORTANT: Before you make edits to the _Draft Word files, it is important to change _Draft in the file name to _Edited. This way, your edits won't be over-written if you happen to re-run the tab that created the Word file. If both _Draft and _Edited versions of the same Word file are uploaded on the Compile Documents tab, the _Edited version will be used for compiling and the _Draft version will be ignored.

Tabs create many small Word files

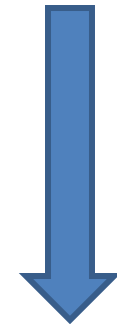
Word files are merged to create report



Input Data that is carried throughout tool

Agency Name (full) My Agency's Name (full)	Agency Name (short) My Agency's Name (short)	Name of Area, e.g., 'South Coast Air Basin' or 'Coachella Valley' My Basin's Name	Name of Event, e.g. 'Bobcat Fire' This Fire Name
Select Event Type PM2.5 Wildfire	Standard of Interest (See EPA NAAQS table) PM2.5 24-hour (2006)	Select Report Type ⓘ Contiguous dates	Append this text to filenames for easy ID <input type="text"/>
Select Event START Date: 2023-07-30	Select Event ENDING date (max time span 1 month): 2023-08-03	Select Reference Date (for comparison) 2023-07-29	Select preferred timezone ⓘ US/Pacific
Use Preliminary (AirNow) or Finalized (AQS; ~6 month time lag) Concentration Data? <input checked="" type="radio"/> AirNow Data <input type="radio"/> AQS Data			

Event information filled in on "Event Description" tab



Event information is carried to the other tabs for creating Word files

Exceptional Events Demonstration Development Tool

General Information Event Description Time Sensitive Initial Notification Non-Daily Sections Clear Causal

Historical Transport Effect

HYSPLIT Meteorology Satellite HMS AOD

Step 3: Output Word File (inside zip file)

Create Word file for this tab, put it in a zip file, and download it:

[Generate Word Report for each day \(zipped\)](#)



Satellite Tab

Step 2: Determine Area of Satellite Image

Date for Satellite Preview

2020-09-12

The step 3 export button will loop through the days of the event, as defined by the Event Description Tab. The date provided here will be used to preview the image below to determine the extent. You can change the date here and it will not impact the days that are downloaded to Word

Imagery Type:

- Aqua (afternoon)
 Terra (morning)

Pre-Defined Satellite Area

California (southern)

Modify Bounding Box Area (if desired)

Please select the closest pre-defined area and then make small adjustments below.

Enter Latitude and Longitude of the SW Corner of the block (default value is based on pre-defined area above)

Latitude of SW Corner of Image

32.1731

Longitude of SW Corner of Image

-122.8771

Enter Latitude and Longitude of the NE Corner of the block (default value is based on pre-defined area above)

Latitude of NE Corner of Image

38.3366

Longitude of NE Corner of Image

-113.9677

Width and Height of image. If you change the lat/longs you will likely want to tweak these. The rough equation is 1km per pixel but there is an adjustment for the curve of the earth.

Width of Image (in pixels)

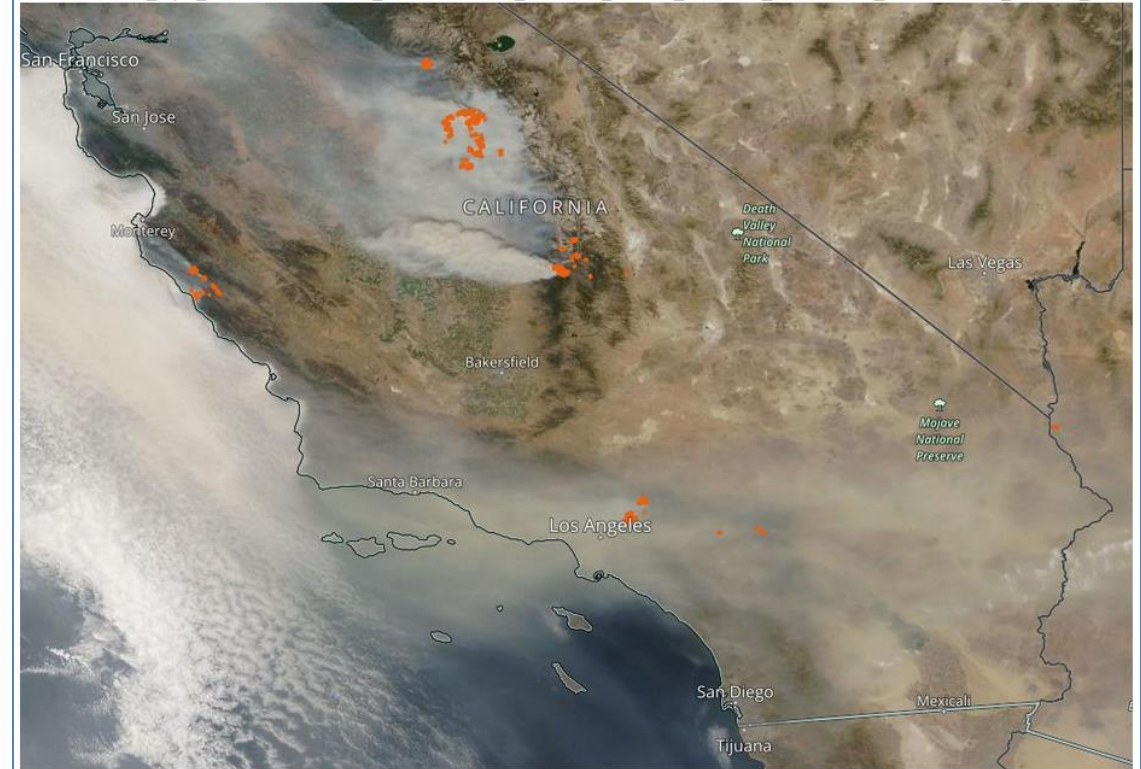
1014

Height of Image (in pixels)

701

Preview image before moving to step 3. You can view other days by changing the Preview Date above. Note: The days that will download in Step 3 are determined by the Start and End Date in the Event Description tab.

URL: https://wvs.earthdata.nasa.gov/api/v1/snapshot?REQUEST=GetSnapshot&TIME=2020-09-12T00:00:00Z&BBOX=32.1731,-122.8771,38.3366,LAYERS=MODIS_Aqua_CorrectedReflectance_TrueColor,MODIS_Combined_Thermal_Anomalies_All,Coastlines_15m,Reference_Features_15m,R



Step 3: Output Word File (inside zip file)

Create Word file for this tab, put it in a zip file, and download it:

[Generate Word Report for each day \(zipped\)](#)

Create Draft Reports

Draft Bobcat and El Dorado Fires 2020-09-07 to 2020-09-16 Exceptional Event Demonstration (Title Page)

South Coast Air Quality Management District (South Coast AQMD)

South Coast Air Basin

2020-09-07 to 2020-09-16

PM2.5 Wildfire exceptional events demonstration for the PM2.5 24-hour (2006) National Ambient Air Quality Standard (NAAQS)

Authors List: [Fill in]

Introduction

The Bobcat and El Dorado Fires occurred during 2020-09-07 through 2020-09-16 (10 days) in the South Coast Air Basin within the jurisdiction of the South Coast Air Quality Management District (South Coast AQMD). The analyses use 2020-09-04 as a non-event reference day for comparison. This analysis uses AQS Data data. This document is part of a PM2.5 Wildfire exceptional events demonstration for the PM2.5 24-hour (2006) National Ambient Air Quality Standard (NAAQS). [Insert Analysis]

Example sub-section

Sub-section text goes here

Area Description for South Coast Air Basin

The South Coast Air Basin area is located in ... The region covers [X] square miles and has a population of approximately [Y] people. [Insert description of geography of area, e.g., mountains, bodies of water, etc.]

[Insert map of South Coast Air Basin with terrain, county lines, etc.]

[Description of typical seasonal climate of area. Include descriptions of micro-climates within region (e.g., coastal vs mountain, etc.). Include typical seasonality of storms, wind events, wildfires, etc.]

[Insert map of area and surrounding air agency jurisdictions]

Example sub-section

Sub-section text goes here

Wildfire Description for Bobcat and El Dorado Fires

During 2020-09-07 through 2020-09-16 [edit time if fires burned longer], Bobcat and El Dorado Fires [was/were] burning [in and near] the South Coast Air Basin. Smoke from these fires ... As a result of the wildfire smoke, daily [PM2.5/PM10] concentrations measured at [X] stations exceeded the PM2.5 24-hour (2006) during 2020-09-07 through 2020-09-16. The location[s] of the Bobcat and El Dorado Fires [are/is] shown below in Figure [X]. The fires are summarized in Table [X].

[Insert map showing locations of fires in/near jurisdiction]

[Insert table summarizing fire(s): name, dates burning (may be longer than exceptional event), total acres burned, location (cities and lat/lon), # fatalities, # injuries, # structures destroyed, # structures damaged]

[from EPA Guidance, section 2: "Maps and tables of the wildfire event information including location, size, and extent. The maps should also include the location of the monitor(s) where data exclusion is requested. This map and table should clearly identify the wildfire(s) believed by the air agency to have caused the exceedance, not just a list of wildfires occurring within the jurisdiction of the submitting air agency." ... "A brief explanation and identification of the cause and point of origin for the event wildfire(s) (to the extent known)."]

Description of Fire #1

The [Name Fire] started in [location] at approximately [time] on [date] near [geographic reference point, e.g., nearby city]. The [Name Fire] resulted in [description of impacts of fire, stats from table above, evacuations, etc.]

[insert map of area of Fire #1 and any cities/locations mentioned in the narrative. Mark the fire ignition location.]

Describe day-by-day progression of fire, e.g., # acres burned each day, containment percentage.

[insert map of day-by-day fire progression created by inter-agency fire response group, these can sometimes be found on the maps tab on the incivew.wildfire.gov page for the specific fire]

[insert table showing daily fire growth for this fire example columns: date, acreage, containment, 1-day fire growth, references]

Cause of Fire #1

The [Name Fire] was caused by [...] in ... near ... at [time] on [date], see [reference appendix with screenshots of newspaper articles describing cause, etc.]. The [Name Fire] [meets?] the U.S. E.P.A. definition of a wildfire on wildland, see [Reference section of report for Human activity that is unlikely to recur or natural event].

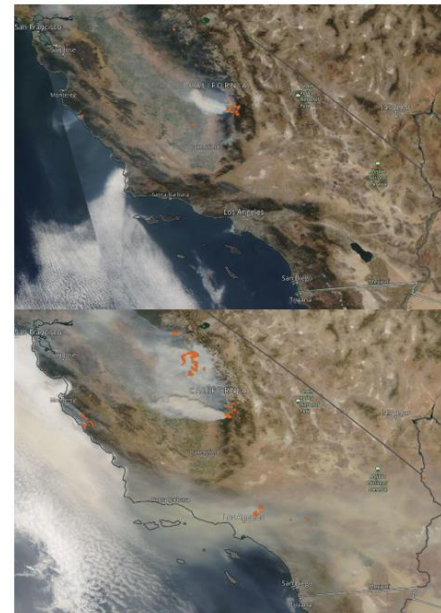


Figure [X] Worldview Satellite Image of the South Coast Air Basin for 2020-09-04 (top) and 2020-09-12 (bottom). The orange dots are thermal anomalies. Images can be viewed online: <https://www.earthdata.nasa.gov/api/v1/snapshot?REQUEST=GetSnapshot&TIME=2020->

References

- Allaire, JJ, Yihui Xie, Jonathan McPherson, Javier Luraschi, Kevin Ushey, Aron Atkins, Hadley Wickham, Joe Cheng, Winston Chang, and Richard Iannone. 2022. *Rmarkdown: Dynamic Documents for r*. <https://CRAN.R-project.org/package=rmarkdown>.
- Appelhans, Tim, Florian Detsch, Christoph Reudenbach, and Stefan Woellauer. 2022. *Mapview: Interactive Viewing of Spatial Data in r*. <https://github.com/r-spatial/mapview>.
- Bache, Stefan Milton, and Hadley Wickham. 2022. *Magrittr: A Forward-Pipe Operator for r*. <https://CRAN.R-project.org/package=magrittr>.
- Bailey, Eric. 2022. *shinyBS: Twitter Bootstrap Components for Shiny*. <https://ebailey78.github.io/shinyBS>.
- Bengtsson, Henrik. 2022. *Rutils: Various Programming Utilities*. <https://CRAN.R-project.org/package=Rutils>.
- Bivand, Roger S., Edzer Pebesma, and Virgilio Gomez-Rubio. 2013. *Applied Spatial Data Analysis with R, Second Edition*. Springer, NY. <https://asdar-book.org/>.
- Borchers, Hans W. 2022. *Pracma: Practical Numerical Math Functions*. <https://CRAN.R-project.org/package=pracma>.
- Cambon, Jesse, Diego Hernangómez, Christopher Belanger, and Daniel Possenriede. 2021. *Tidygeocoder: Geocoding Made Easy*. <https://CRAN.R-project.org/package=tidygeocoder>.
- Carslaw, David C., and Karl Ropkins. 2012. "Openair — an r Package for Air Quality Data Analysis." *Environmental Modelling & Software* 27–28 (0): 52–61. <https://doi.org/10.1016/j.envsoft.2011.09.008>.
- Carslaw, David, and Karl Ropkins. 2022. *Openair: Tools for the Analysis of Air Pollution Data*. <https://davidcarslaw.github.io/openair/>.
- Chang, Winston. 2022. *Webshot: Take Screenshots of Web Pages*. <https://CRAN.R-project.org/package=webshot>.
- Chang, Winston, Joe Cheng, JJ Allaire, Carson Sievert, Barret Schloerke, Yihui Xie, Jeff Allen, Jonathan McPherson, Alan Dipert, and Barbara Borges. 2021. *Shiny: Web Application Framework for r*. <https://shiny.rstudio.com/>.
- Cheng, Joe, Bhaskar Karambelkar, and Yihui Xie. 2023. *Leaflet: Create Interactive Web Maps with the JavaScript Leaflet Library*. <https://rstudio.github.io/leaflet/>.
- Cheng, Joe, Carson Sievert, Barret Schloerke, Winston Chang, Yihui Xie, and Jeff Allen. 2021. *Htmltools: Tools for HTML*. <https://github.com/rstudio/htmltools>.
- Cooley, David. 2022a. *Geojsonsf: GeoJSON to Simple Feature Converter*. <https://github.com/SymbolixAU/geojsonsf>.

Disclaimer: The text shown is not for a real EE demo. It is example output from the tool.



South Coast
Air Quality Management District

Conclusions

- Attainment of National Ambient Air Quality Standards is important to protect public health and avoid economic implications of nonattainment
- Accurate monitoring data is needed to determine attainment and support exceptional event demonstrations
- Comprehensive operator notes, operator observations (pictures & videos), and preliminary data can be extremely useful
- The exceptional events demonstration tool will streamline analysis and document submission



South Coast AQMD Air Quality Assessment Group



Program Supervisor
Scott Epstein, PhD



Senior Meteorologist
Ranil Dhammapala,
PhD



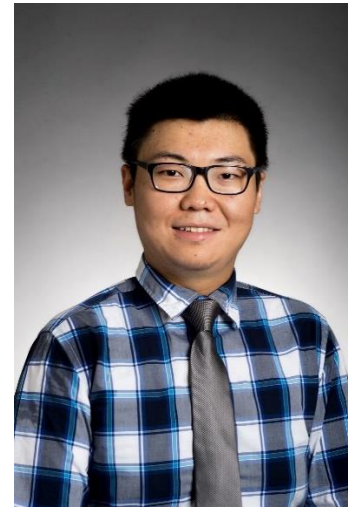
Air Quality Specialist
Nico Schulte , PhD



Air Quality Specialist
Melissa Maestas,
PhD



Air Quality Specialist
Qijing (Emily) Bian,
PhD



QA Supervisor
Xiang Li , PhD
(Previously Air
Quality Specialist in
AQA Group)

Thank You!

sepstein@aqmd.gov



Consequences of Non-Attainment

- Air agencies in non-attainment areas must develop plans by specific deadlines specifying emission reduction control measures to meet the NAAQS
- Failure to implement control measures or develop a plan will result in a Federal Implementation Plan and Sanctions, such as
 - Reduction in emissions for new or modified major facilities undergoing New Source Review (NSR)
 - Withholding of federal highway funding

National Ambient Air Quality Standards (NAAQS)

Criteria Pollutant	Averaging Time
Ground Level Ozone	(1979) 1-Hour (0.12 ppm)
	(2015) 8-Hour (0.070 ppm)
PM2.5	(2006) 24-Hour (35 µg/m ³)
	(2012) Annual (12.0 µg/m ³)
PM10	(1987) 24-hour (150 µg/m ³)
Lead	(2008) 3-Months Rolling (0.15 µg/m ³)
Carbon Monoxide	(1971) 1-Hour (35 ppm)
	(1971) 8-Hour (9 ppm)
Nitrogen Dioxide	(2010) 1-Hour (100 ppb)
	(1971) Annual (0.053 ppm)
Sulfur Dioxide	(2010) 1-Hour (75 ppb)
	(1971) 24-Hour (0.14 ppm)
	(1971) Annual (0.03 ppm)

- EPA establishes air quality standards to protect public health and the environment for 6 criteria pollutants
- Pollutants have multiple standards (current & past or different averaging times)

Definition of Exceptional Events

- An exceptional event meets all these criteria:
 - The emissions from the event(s) caused the monitored exceedance(s)
 - The event is not reasonably controllable or preventable
 - The event is either:
 - Natural; or
 - Caused by human activity but is unlikely to recur at that same location

Measurements caused by exceptional events can be removed when determining attainment of federal standards

How do we Determine Which Exceptional Event(s) to Demonstrate ?

Stations	2018-2020 24-hr PM2.5 Preliminary Design Values		
	All dates	RS EE excluded	All EE excluded
AZUS	35	35	26
CELA	37	32	31
RESE	29	29	26
CMPT	35	35	33
PICO	37	34	31
PASA	31	31	29
LBCH	33	33	27
SLBH	32	32	28
W710	35	35	31
ANAH	33	33	28
MSVJ	23	23	23
INDI	17	17	17
PLSP	15	15	15
RIVR	34	34	30
MLVB	36	35	35
ONNR	36	34	33
FONT	35	35	30
BGBR	22	22	22
SNBO	28	28	27

- **Regulatory significant** exceptional events are a set of exceptional events that by removing them, the standard will be attained.
- We will only draft demonstrations for **regulatory significant** exceptional events
 - All Exceptional Events (EE) include Independence Day, Bobcat & El Dorado Fires, Silverado and Blue Ridge Fires, Long-range transport of wildfire smoke from Central and Northern California
 - Regulatory significant Exceptional Events (RS EE) include Bobcat & El Dorado Fires for only CELA, PICO, MLVB and ONNR stations