

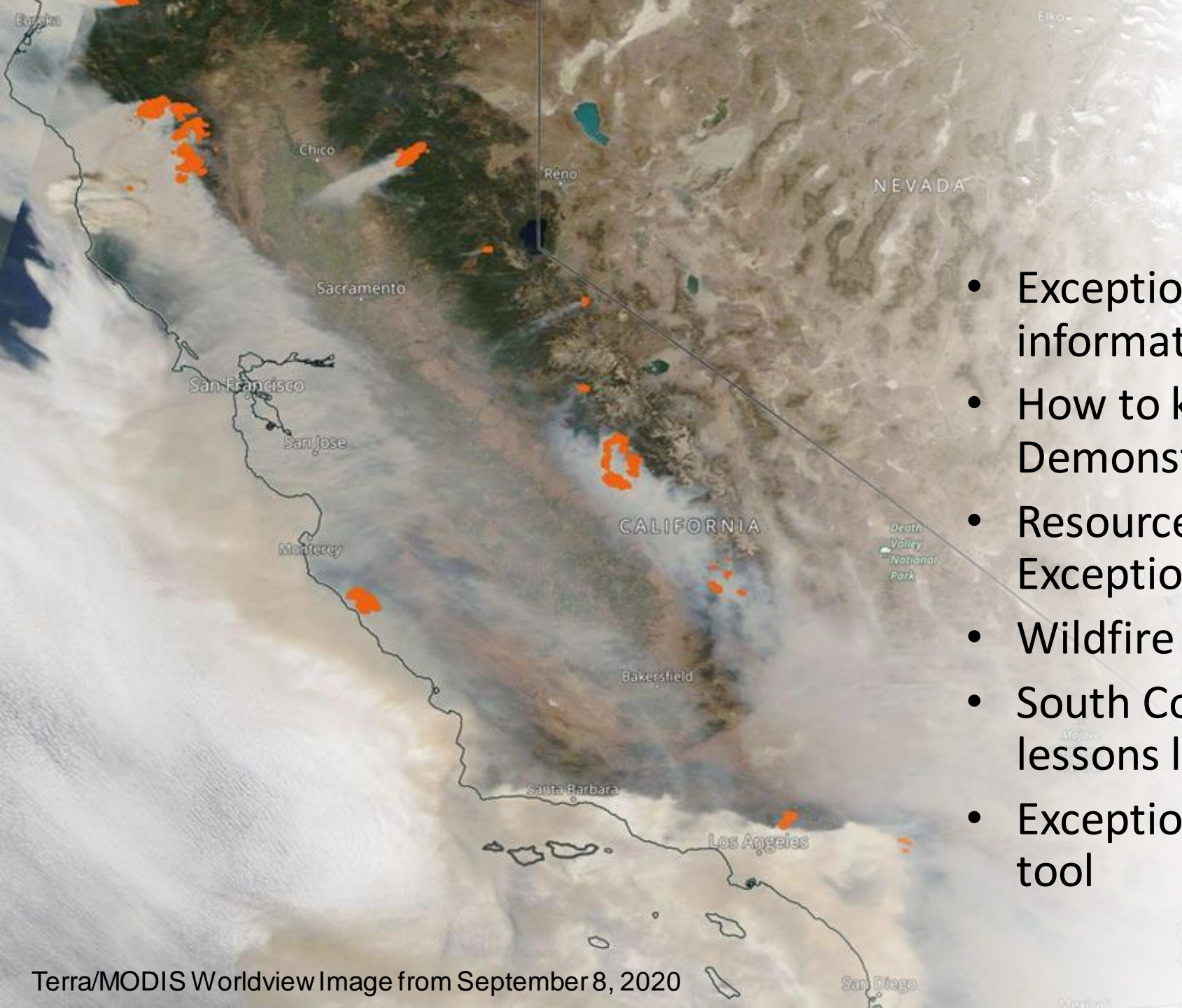


# Exceptional Event Demonstrations: Resource Requirements, Lessons Learned, and an Online Tool

**NACAA Criterial Pollutants Committee August 23, 2023**

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# Outline

- Exceptional Events background information
- How to know if an Exceptional Event Demonstration is needed
- Resources required for an Exceptional Event Demonstration
- Wildfire event analysis examples
- South Coast AQMD perspective and lessons learned
- Exceptional Events Demonstration tool

# 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 concurred exceptional events can be removed when determining attainment of federal standards

# Common Types of Exceptional Events



Windblown Dust  
(PM2.5 & PM10)



Prescribed Fire  
(O3, PM2.5 & PM10)



Stratospheric  
Intrusion (O3)



Wildfire Smoke  
(O3, PM2.5, & PM10)



Cultural Events  
(PM2.5 & PM10)



Volcanic Eruption  
(SO2, PM2.5, & PM10)

# 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 natural or caused by human activity that is unlikely to recur at a particular location
- Demonstrate that the event is not reasonably controllable or preventable

*EE Demonstrations are often lengthy reports that take multiple months to prepare*



# 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 will result in regulatory implications upon their removal\*
- EPA will only review 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

\* Some regulatory determinations, actions, and analyses do not require a full exceptional event demonstration. See [https://www.epa.gov/sites/default/files/2019-04/documents/clarification\\_memo\\_on\\_data\\_modification\\_methods.pdf](https://www.epa.gov/sites/default/files/2019-04/documents/clarification_memo_on_data_modification_methods.pdf) for details

# Determining the Set of Events to Demonstrate May be Challenging

- In periods with several events, must consider the following factors:
  - Which events reduce the design value (DV) to the required level upon their removal?
  - Which set of events are the most clear-cut and consistent with EPA guidance?
  - Events in the most recent year of the DV period may extend the usefulness of the demonstration to subsequent periods
- In some cases, all the data over the 3-year DV period must be used for this determination

The screenshot shows a software interface for determining the set of events to demonstrate. It includes input fields for Species (PM2.5 selected), Start Year (2020), and End Year (2022). There are buttons for Save Inputs, Load Inputs, Run, and Export Table. A section for Exclusion Dates (MM/DD/YYYY) lists stations like ANAH, CELA, CMPT, SLBH, and AZUS with their respective exclusion start and end dates. An 'Add events' dropdown shows '2022 Independence Day' selected. A table at the bottom shows the 24 hr DV and Ann DV for various stations before and after the events.

Stns	24 hr DV Bef	24 hr DV After	Ann DV Bef	Ann DV Aft
AZUS	NaN	NaN	NaN	NaN
CELA	38	32	12.5000	12.0100
RESE	31	27	9.9700	9.6700
CMPT	39	35	13.4100	13.0200
PICO	41	34	13.0400	12.3900
PASA	28	27	10.5900	10.3000
LBCH	NaN	NaN	NaN	NaN
SLBH	NaN	NaN	NaN	NaN
W710	34	31	12.9200	12.6200
ANAH	34	29	11.2200	10.8600
MSVJ	NaN	NaN	NaN	NaN
PCHG	17	17	6.2400	6.2400
MORO	22	22	7.8900	7.8900
INDI	NaN	NaN	NaN	NaN
PLSP	15	15	6.3100	6.3100
RIVR	34	30	12.2700	11.9700
MLVB	35	33	13.5300	13.3000



# Required Resources

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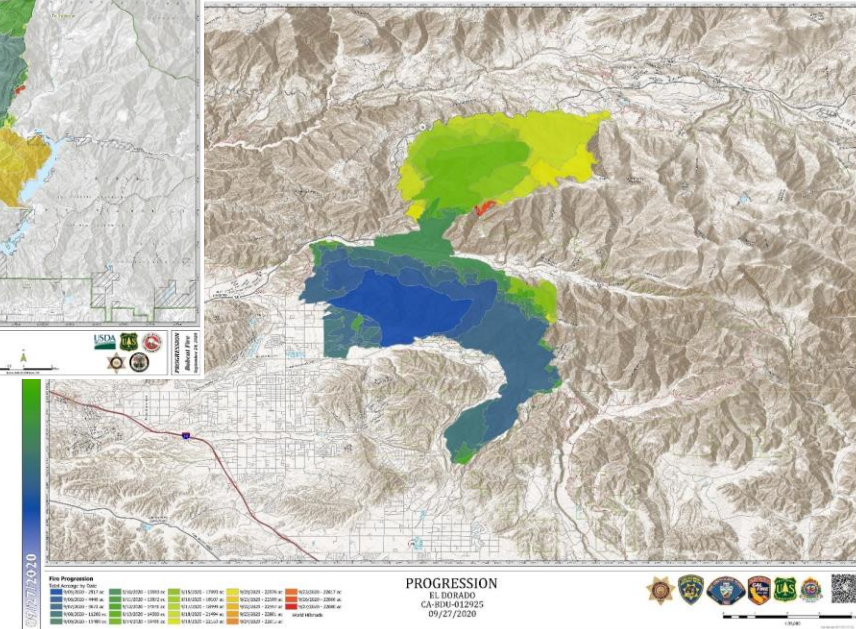
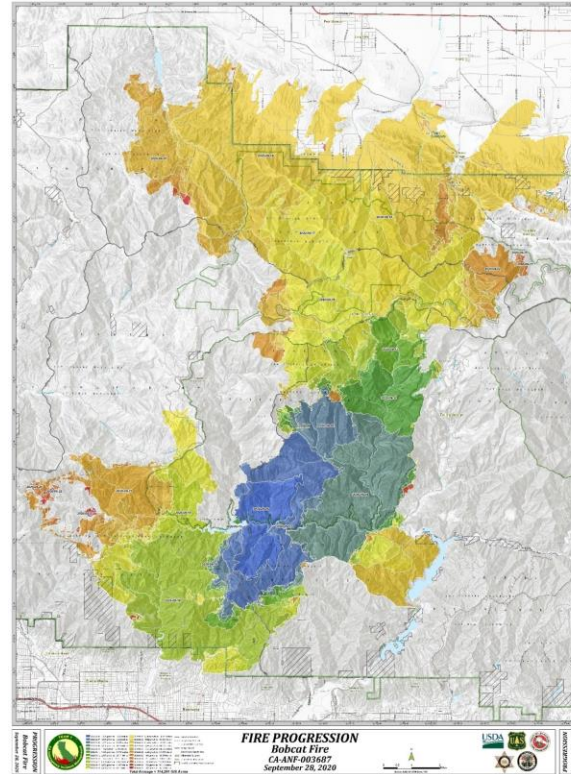
- Staff time:
  - Demonstration of a single event may take several months
- Staff skill sets:
  - Data analysis
  - Coding skills are extremely useful
  - Writing skills
  - Familiarity with EE process/guidelines/requirements. See <https://www.epa.gov/air-quality-analysis/treatment-air-quality-data-influenced-exceptional-events-homepage-exceptional>



# Wildfire PM2.5 Analysis Examples

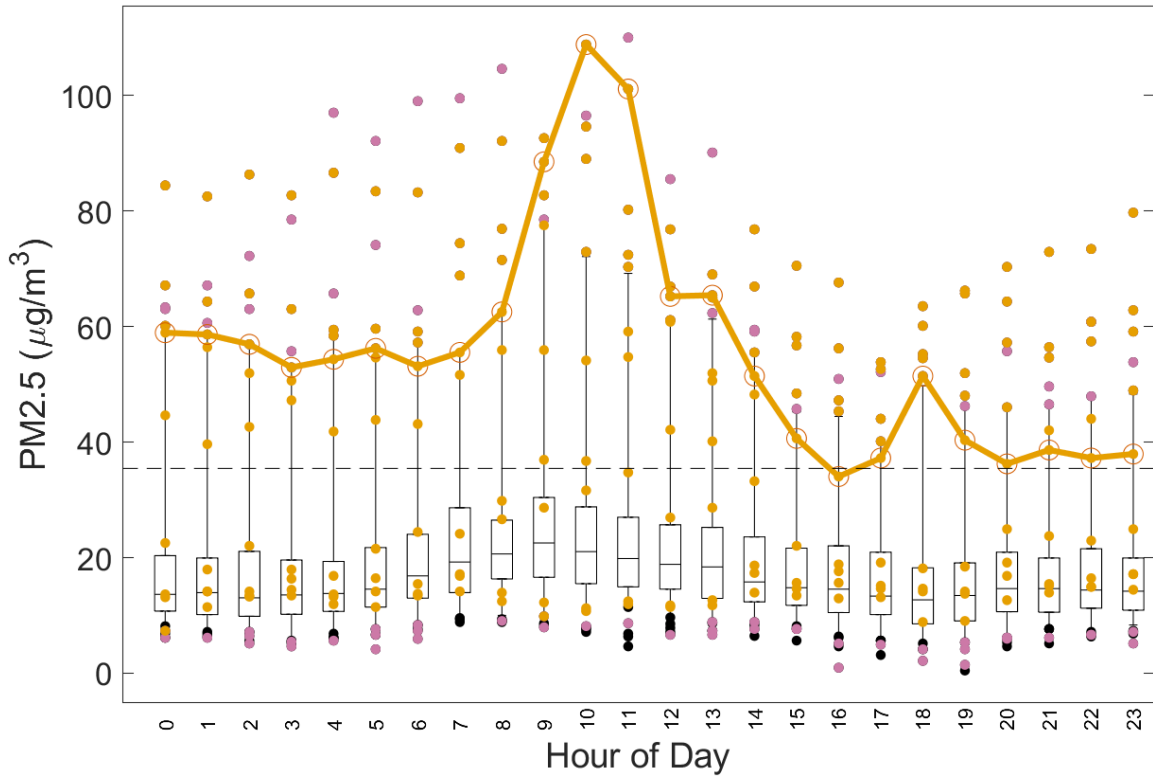


- Bobcat Fire Burn Boundary
- El Dorado Fire Burn Boundary
- South Coast Air Basin

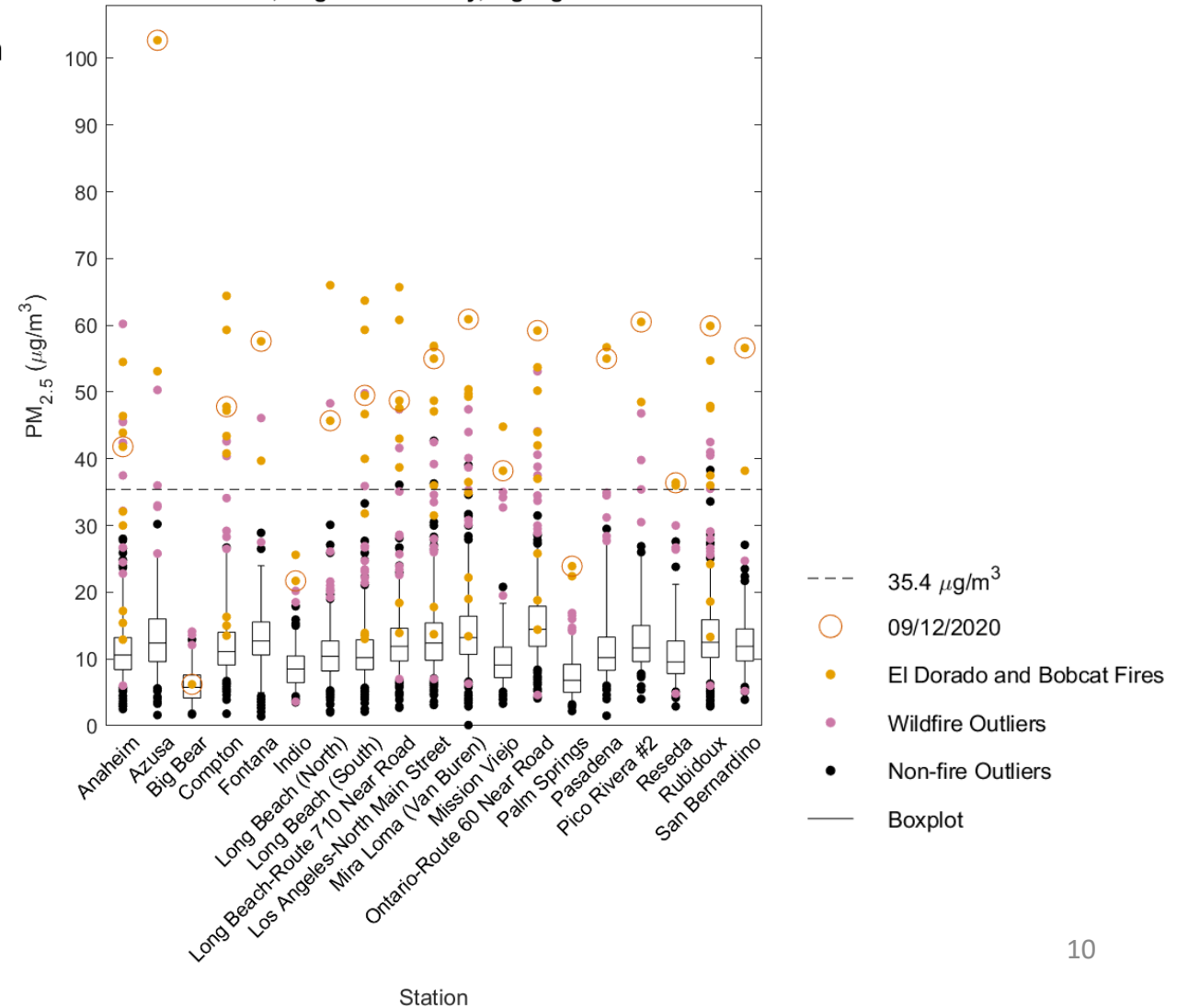


# Wildfire PM2.5 Analysis Examples

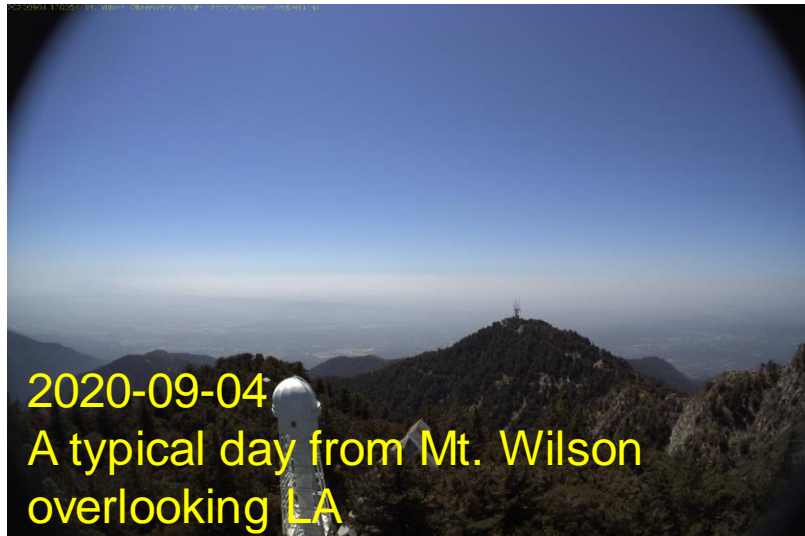
Long Beach (South) 2020 Aug-Oct and 12-Sep-2020 Diurnal Pattern



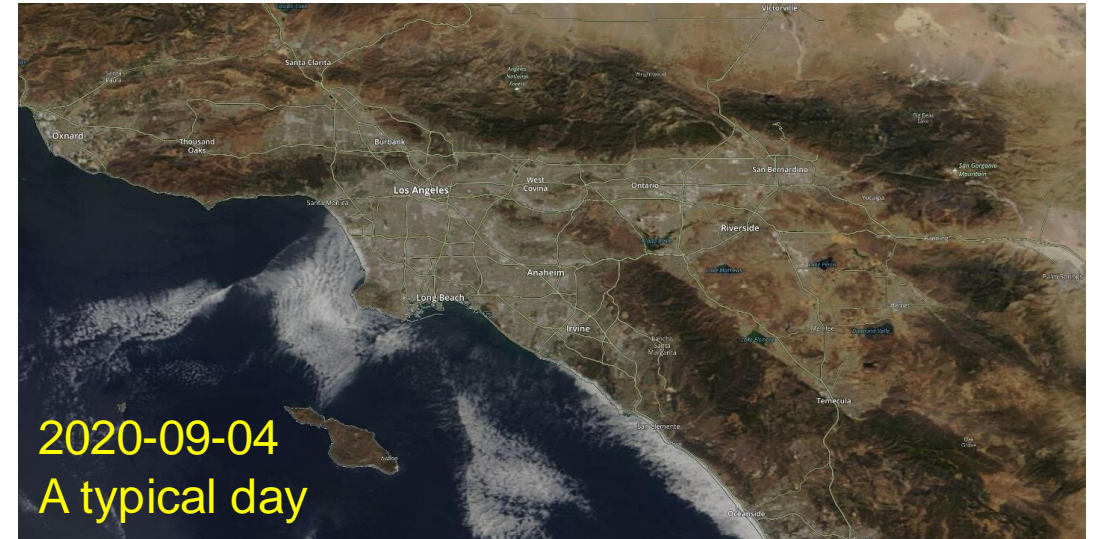
2016-2020, Aug-Oct Summary, highlight 09/12/2020



# Wildfire PM2.5 Analysis Examples



<https://hpwren.ucsd.edu/>



NASA Worldview

# Wildfire PM2.5 Analysis Examples

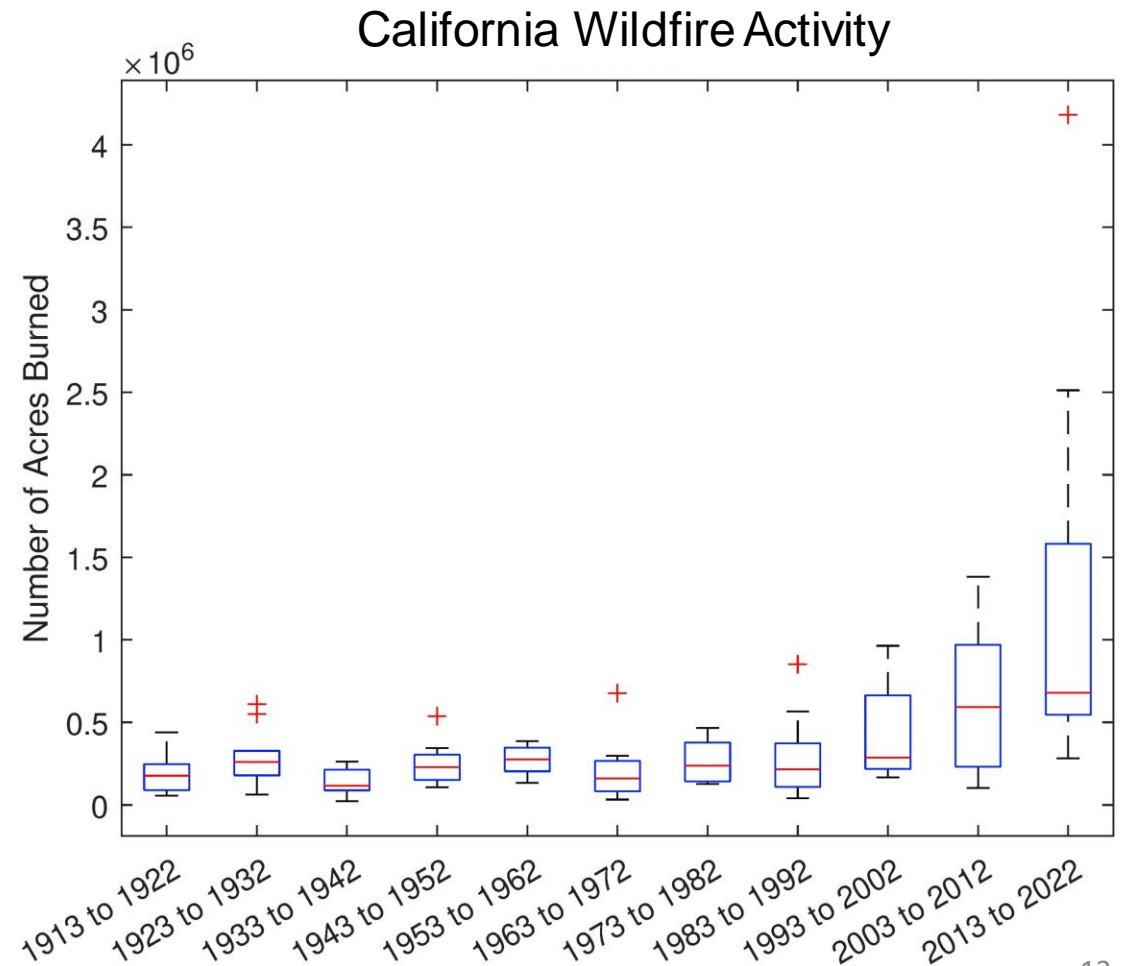
- Gathering news stories demonstrating smoke impacts at the ground
  - Time consuming task
  - More difficult as more time elapses between the event and preparing the EE Demo

The screenshot shows a web browser displaying a news article from The Orange County Register. The article title is "Smoke advisory extended across Southern California". The main image is a photograph of a city skyline (Los Angeles) obscured by a thick layer of orange-brown smoke. Below the image is a caption: "A view of downtown Los Angeles and Dodger Stadium looking south from Elysian Fields through the smoke from the Bobcat and the El Dorado fires with poor air quality in Los Angeles on Friday, September 11, 2020. (Photo by Keith Birmingham, Pasadena Star-News/ SCNG)". The article is by SEAN EMERY, published on September 12, 2020. The page also features a "TRENDING" section, a "SUBSCRIBE" button, and a "HEALTHY LIVING SPOTLIGHT" section with a photo of a chef.



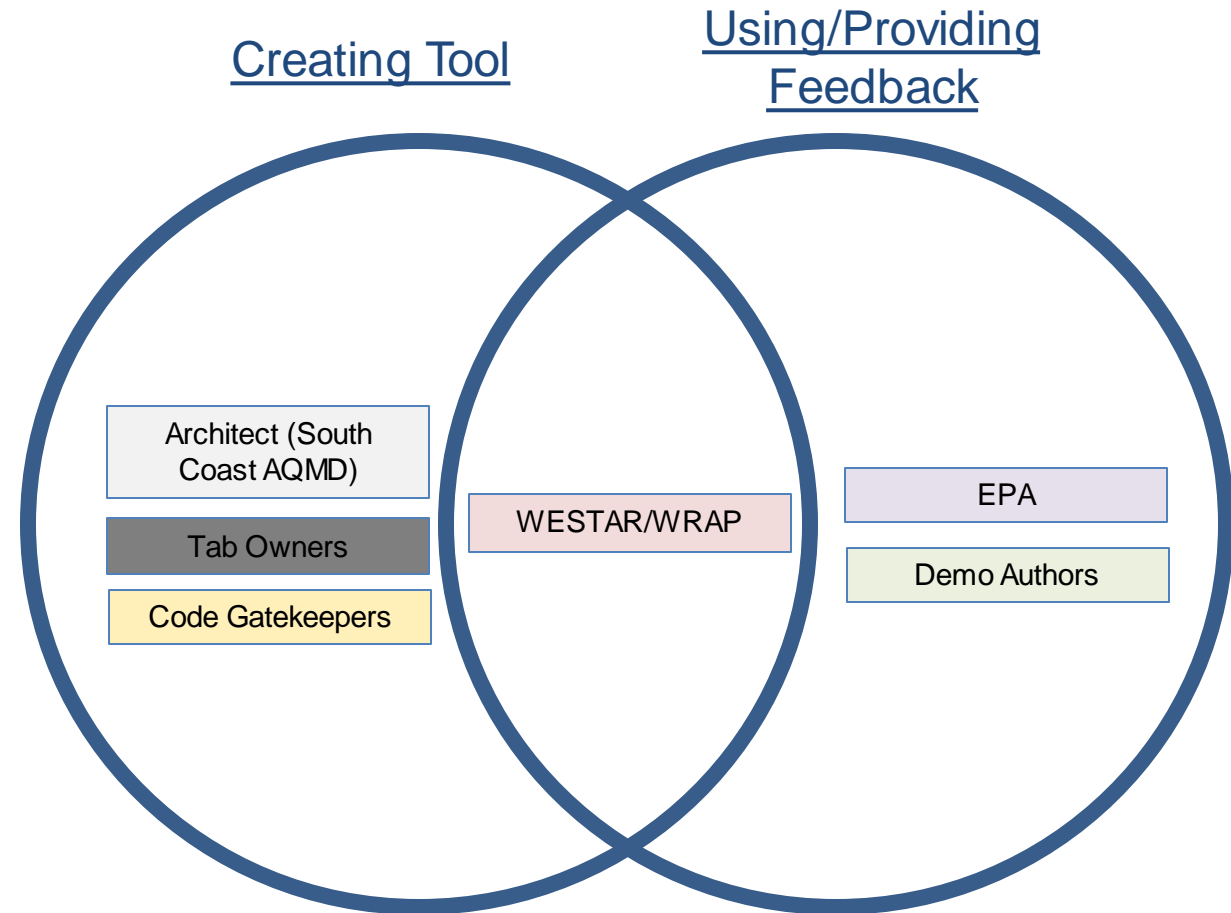
# South Coast AQMD Perspective and Lessons Learned

- Potential for increased frequency of EE Demos due to increasing wildfire activity and reductions in annual PM2.5 NAAQS
- Need to generate EE Demos quickly to reduce delays in EPA actions
- Without the right tools, staff time requirements may be prohibitive
- Opportunity to collaborate among agencies



# Exceptional Event Demonstration Tool

- South Coast AQMD spearheaded a collaboration with WESTAR/WRAP and 17 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



# Exceptional Event Demonstration Tool

Tabs to walk through creating EE Demo

EE Demo Tool

https://westar.sinyapps.io/EEDemoTool/\_w\_64fd09ea/

## Exceptional Events Demonstration Development Tool

General Information Event Description Time Sensitive Initial Notification Non-Daily Sections Clear Causal Compile Documents For Contributors

## 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

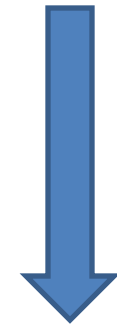
Word files are merged to create report



# Exceptional Event Demonstration Tool

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





# Exceptional Event Demonstration Tool

## 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)

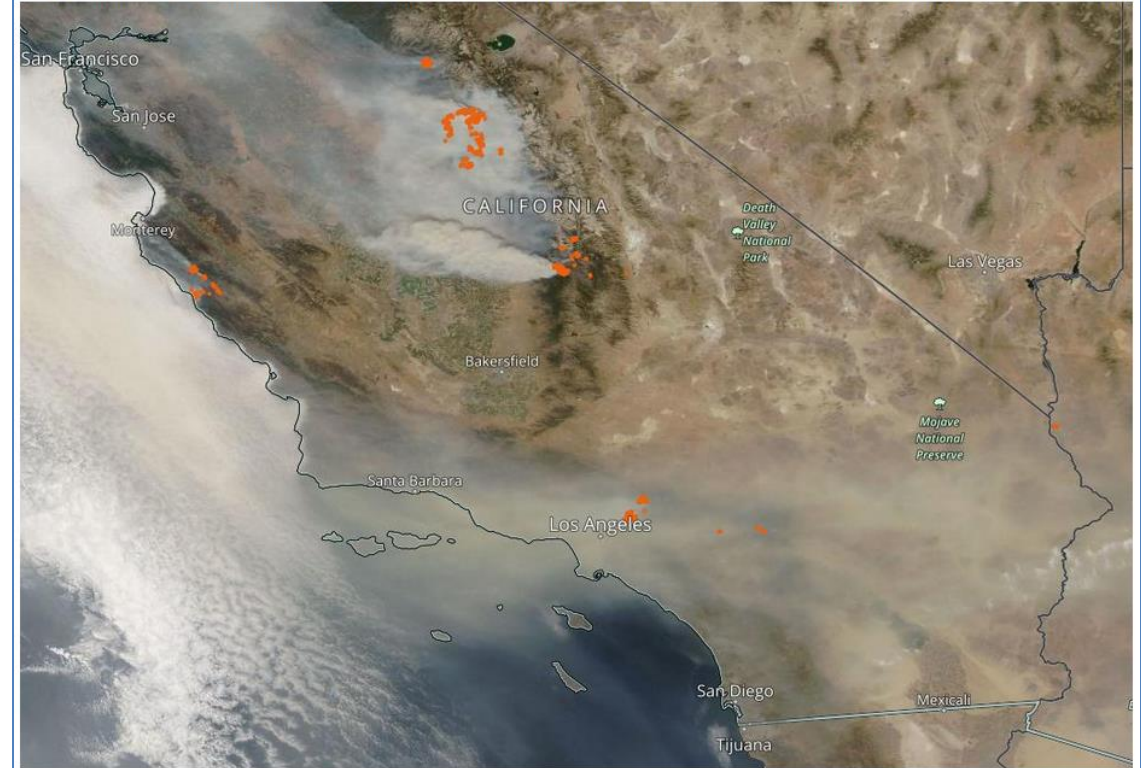
1014

#### 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](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 \(zipped\)](#)

# Exceptional Event Demonstration Tool

## Satellite Report for 2020-09-12

Figure [X] shows a NASA Worldview satellite image of the South Coast Air Basin taken on 2020-09-12 contrasted with a similar view from 2020-09-04 ([BEFORE/AFTER] the Bobcat and El Dorado Fires). The Worldview image from 2020-09-12 shows [WRITE DESCRIPTION OF SMOKE IN IMAGE, E.G., WIDESPREAD SMOKE]. The image also shows [WRITE DESCRIPTION, E.G., A FEW, MANY] thermal anomalies (orange dots) in the areas of the Bobcat and El Dorado Fires, indicating that the Bobcat and El Dorado Fires were [WAS/WERE] [WRITE DESCRIPTION, E.G., ACTIVE ON 2020-09-12?].

1<sup>st</sup> page of output satellite file for 2020-09-12

Word file is filled in with information provided

2<sup>nd</sup> page of output satellite file for 2020-09-12



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://wvs.earthdata.nasa.gov/api/v1/snapshot?REQUEST=GetSnapshot&TIME=2020->

# Why and How to Get Involved

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



Coders and Non-Coders Welcome  
WESTAR/WRAP Coordination Hub:

Rhonda Payne [rpayne@westar.org](mailto:rpayne@westar.org)

Jay Baker [jbaker@westar.org](mailto:jbaker@westar.org)

# Conclusions

- The exceptional event demonstration process is burdensome, especially for multiple events
- Extensive amount of staff time, scientific knowledge, and strong analysis skills are required
- The exceptional event demonstration tool spearheaded by South Coast AQMD and coordinated by WESTAR/WRAP can help



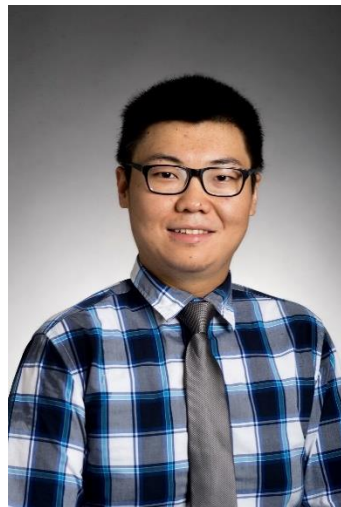
# South Coast AQMD Air Quality Assessment Group



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## Thank You!

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