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

NACAA Criterial Pollutants Committee August 23, 2023

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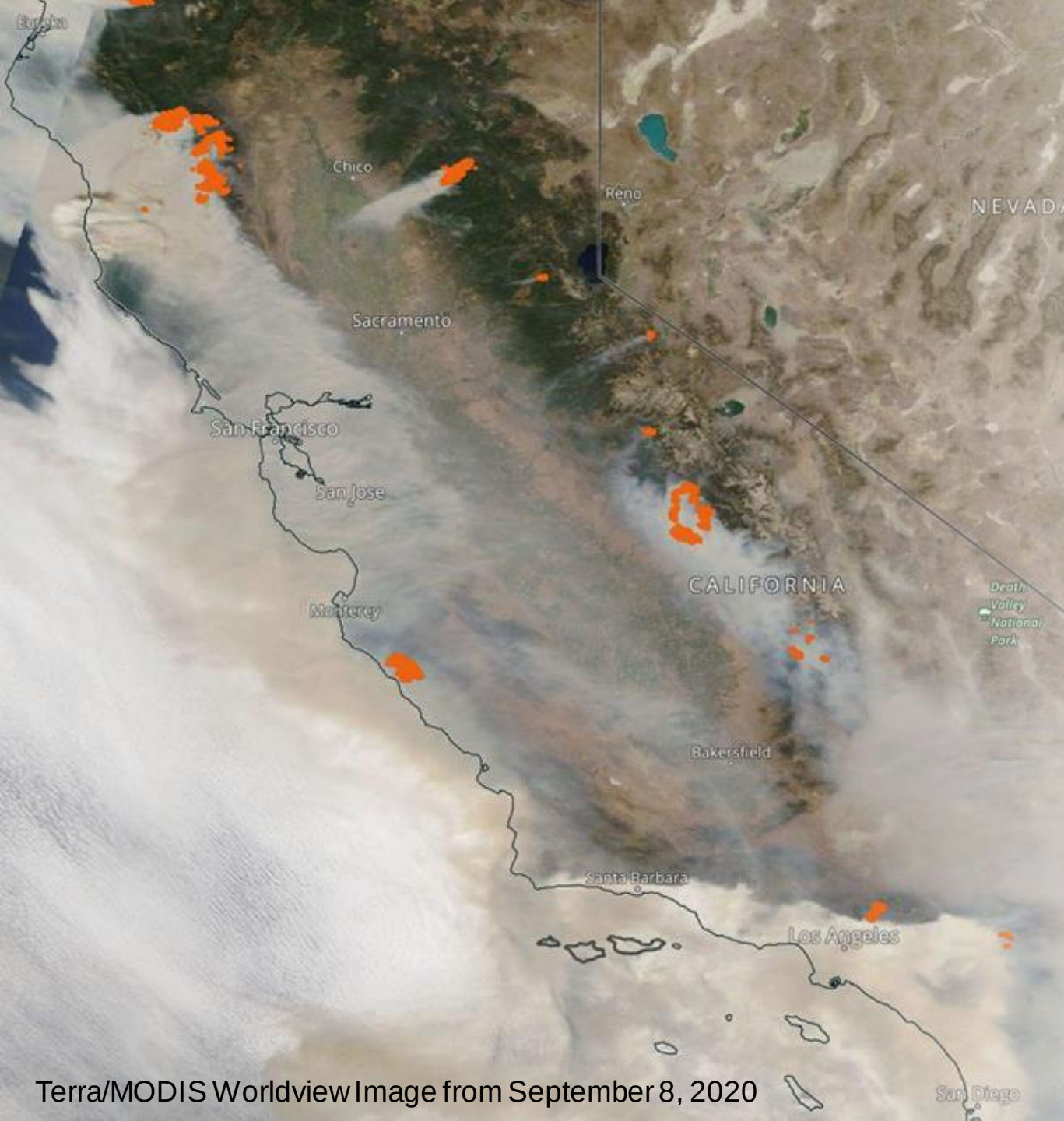


Terra/MODIS Worldview Image from September 8, 2020

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)

Images from NASA Worldview MODIS/Terra Satellite and Wikimedia commons

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

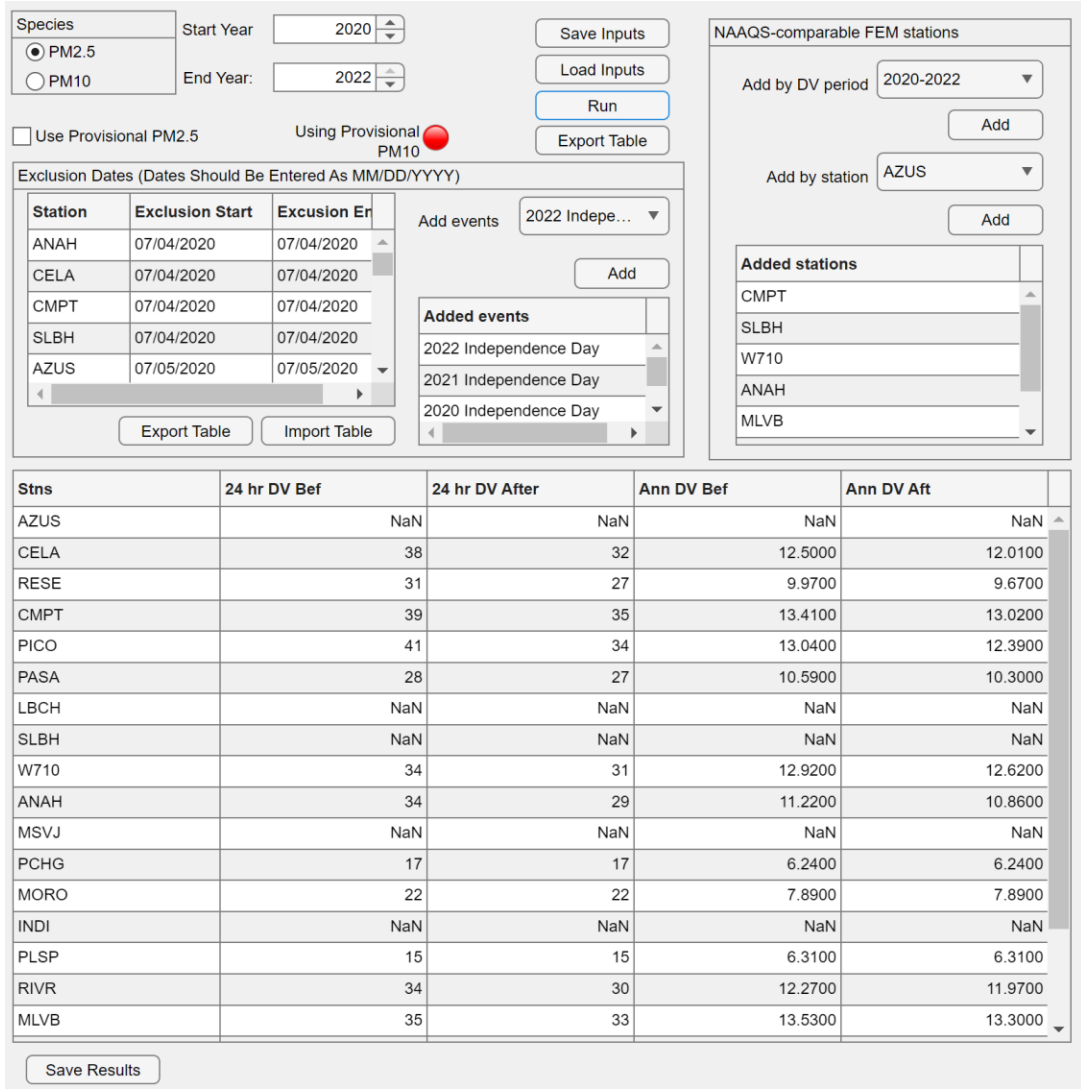
- ***Regulatory significant*** exceptional events are a set of exceptional events that will result in regulatory implications upon their removal*
- EPA will only review demonstrations for **regulatory significant** exceptional events

  - *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 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



Required Resources

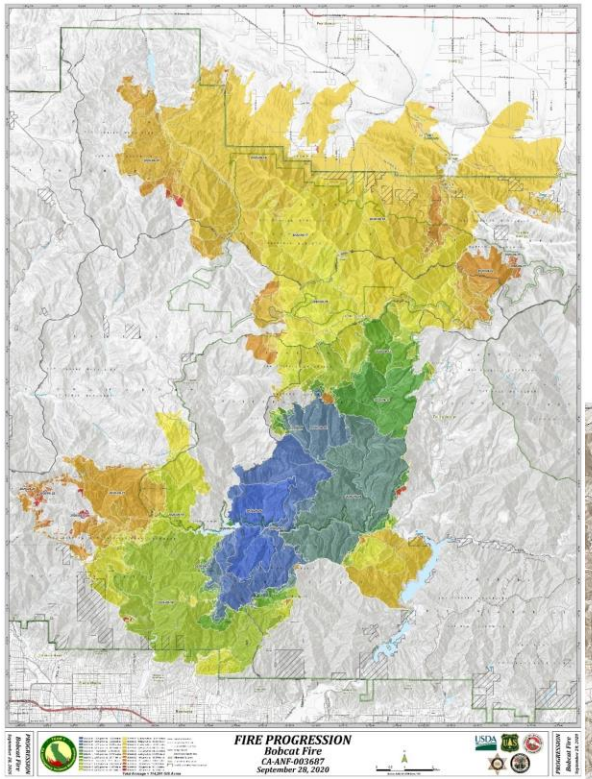
- Staff time:
  - Demonstration of a single event may take several months
- Staff skill sets:
  - Data analysis
  - Coding skills are extremely useful
  - Writing skills
  - Familiarity with EE process/guidelines/requirements. See https://www.epa.gov/air-quality-analysis/treatment-air-quality-data-influenced-exceptional-events-homepage-exceptional

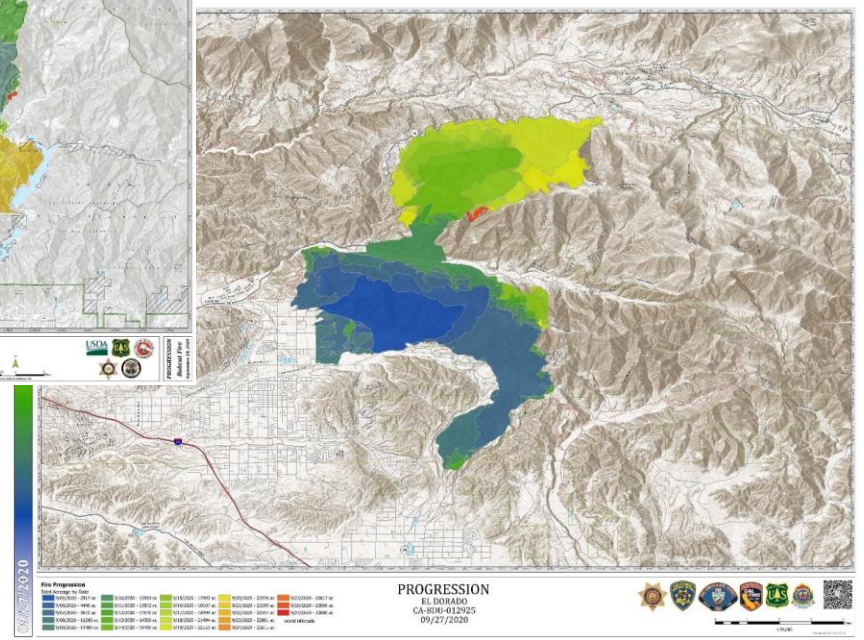
Wildfire PM2.5 Analysis Examples

Bobcat Fire Burn Boundary

El Dorado Fire Burn Boundary

South Coast Air Basin





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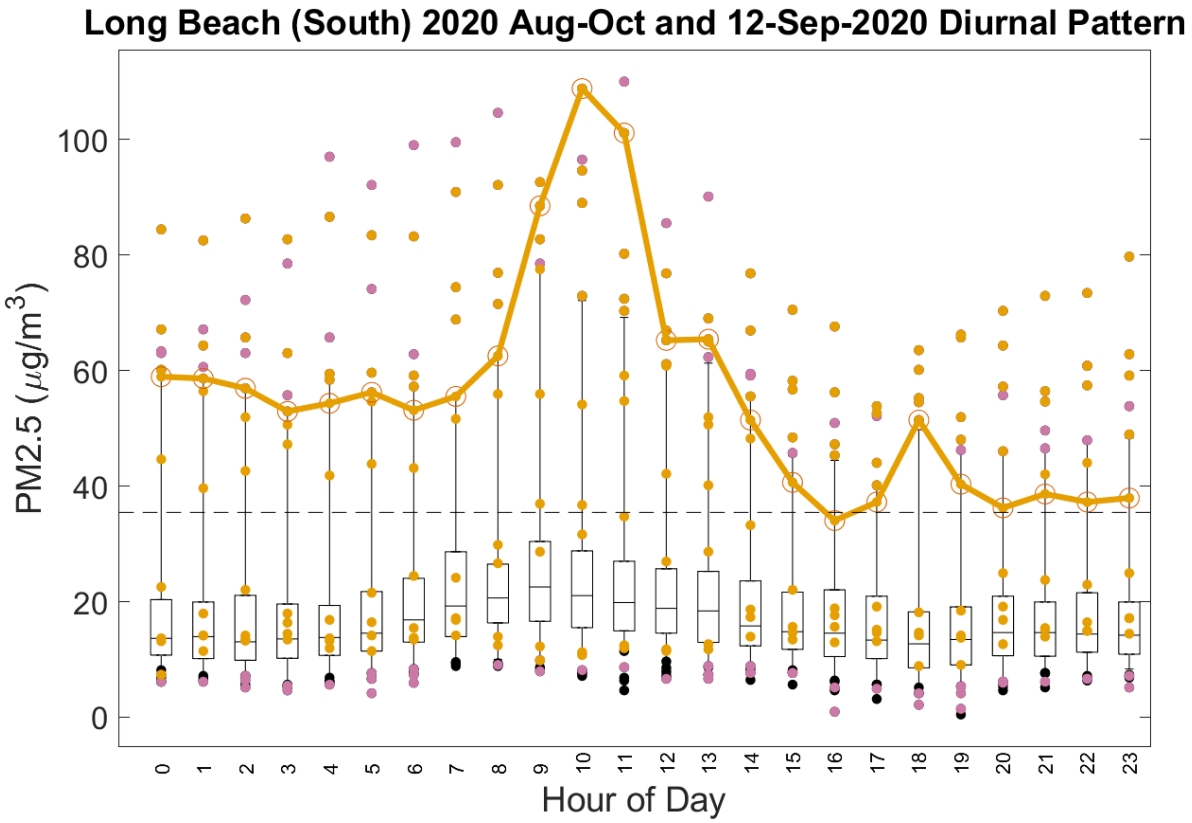
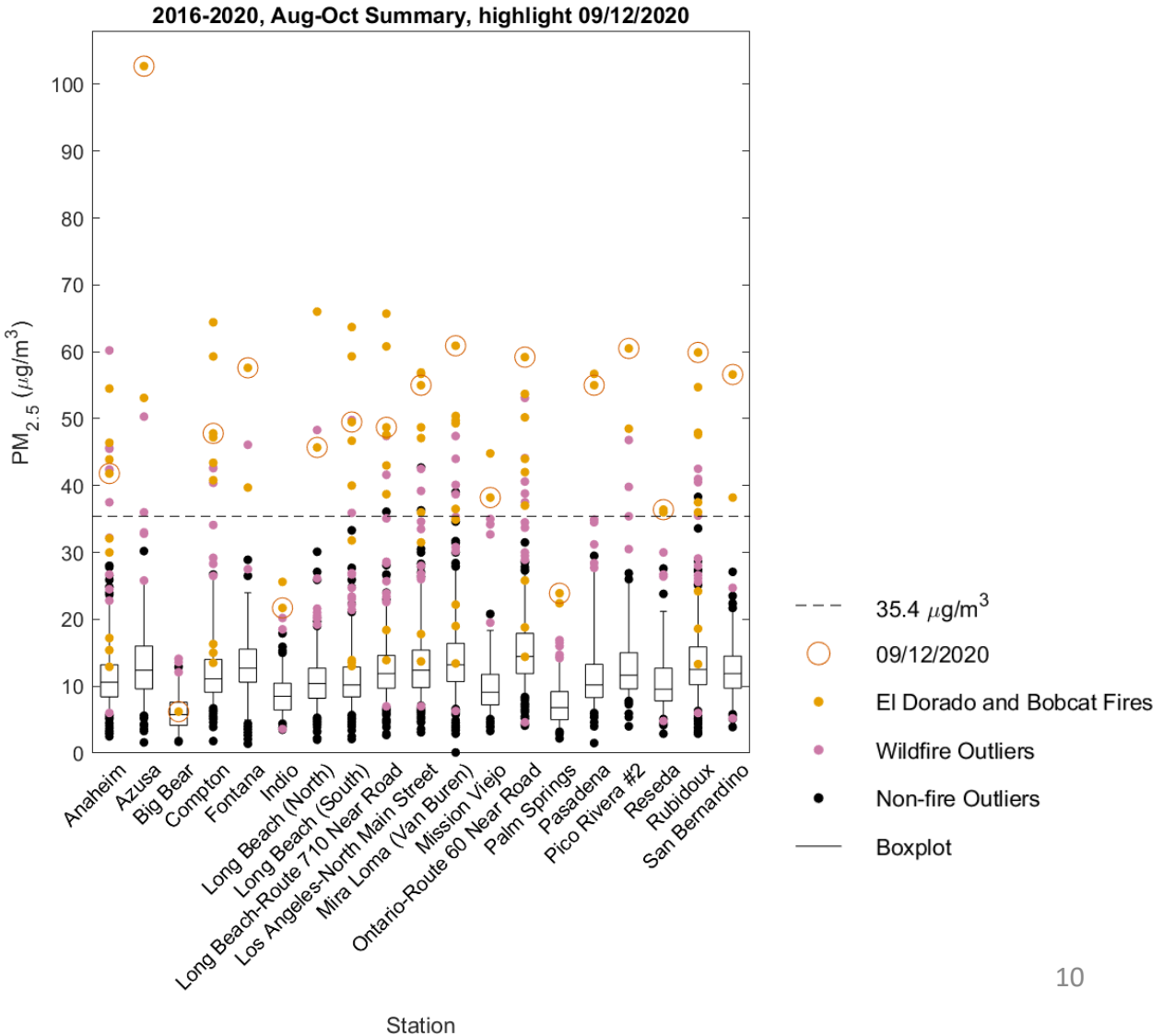
Wildfire PM2.5 Analysis Examples





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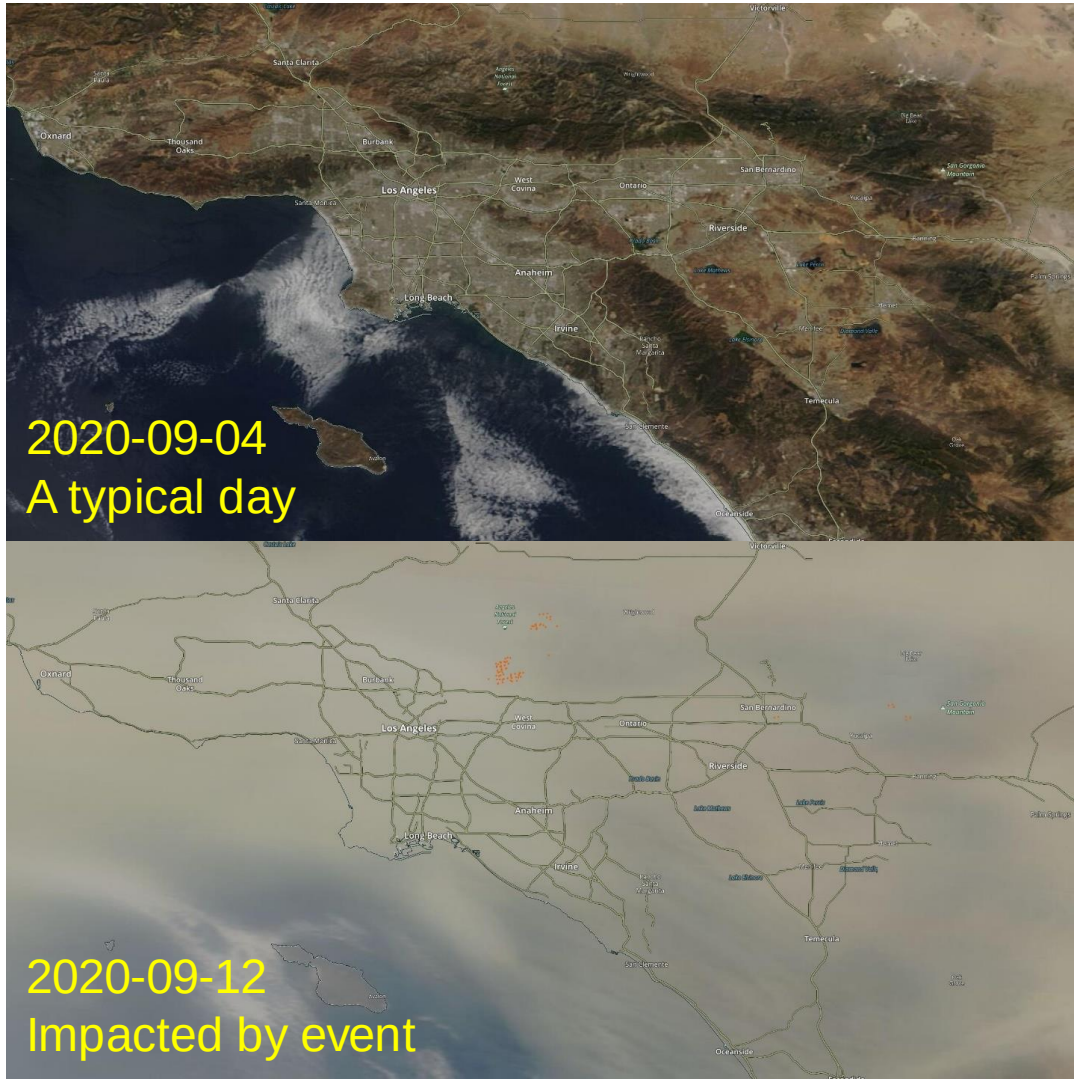
Wildfire PM2.5 Analysis Examples

https://hpwren.ucsd.edu/



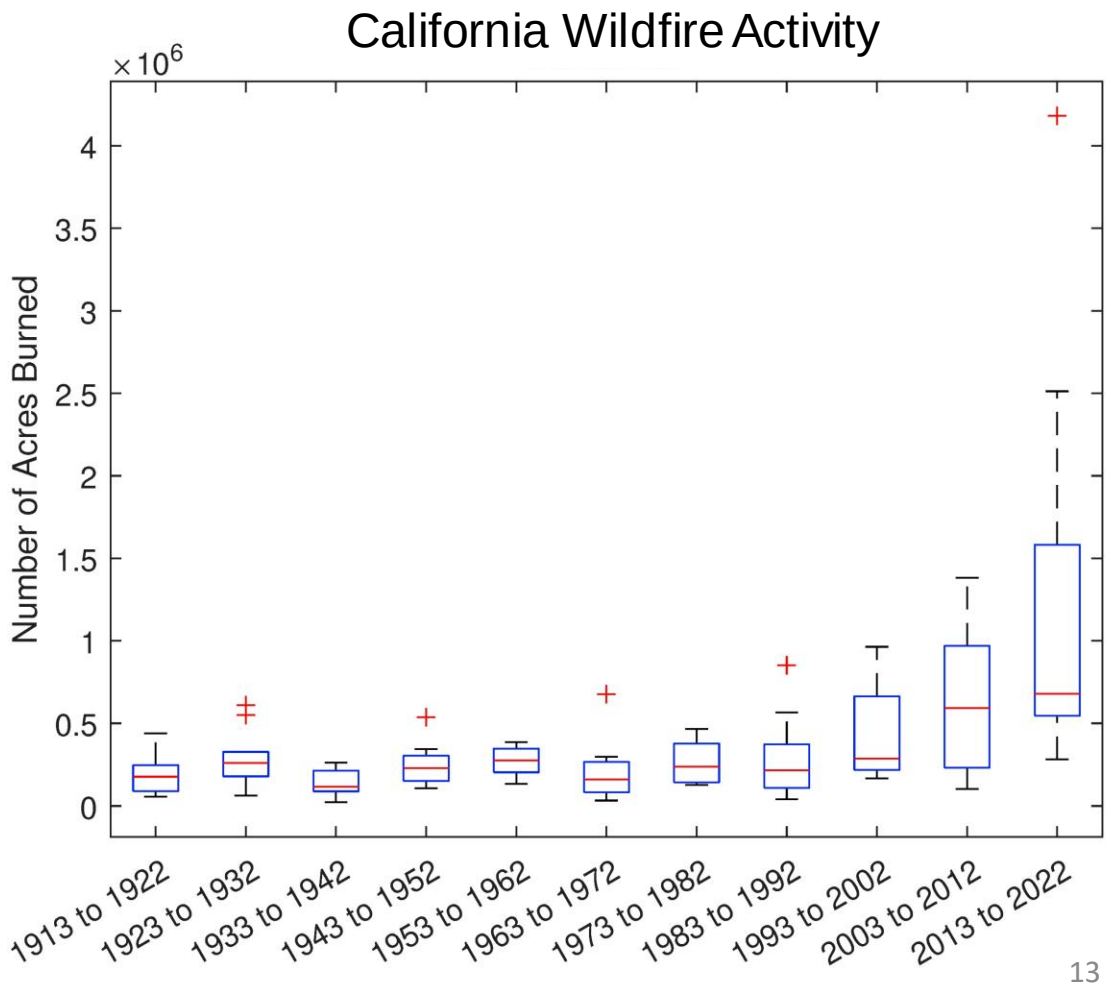
NASA Worldview

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

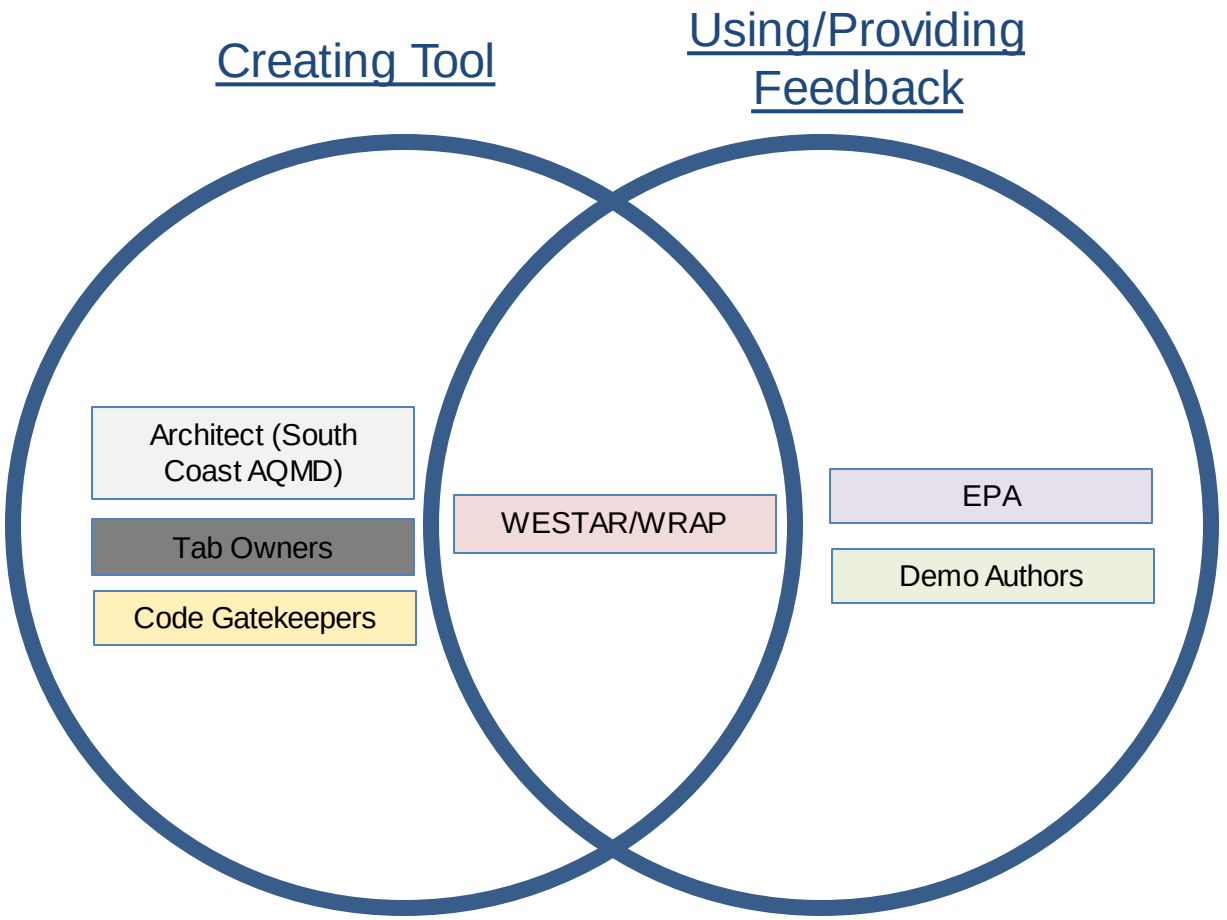
South Coast AQMD Perspective and Lessons Learned

- 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



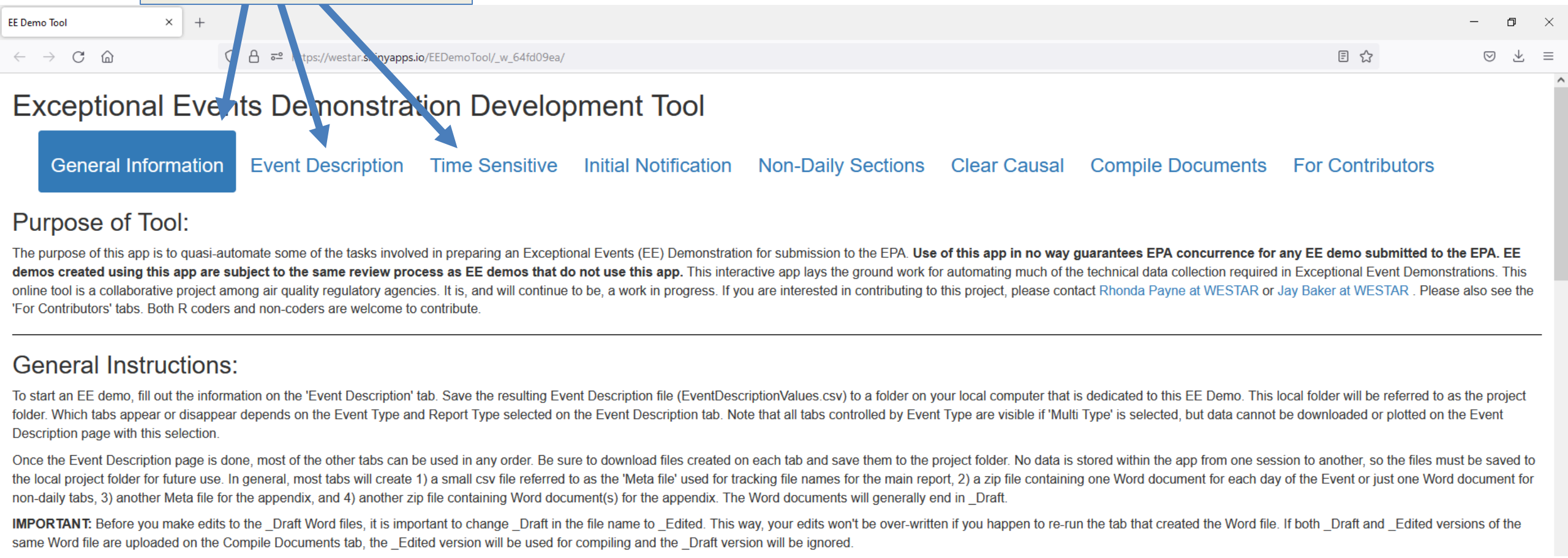
Exceptional Event Demonstration Tool

- 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



Tabs create many small Word files → Word files are merged to create report

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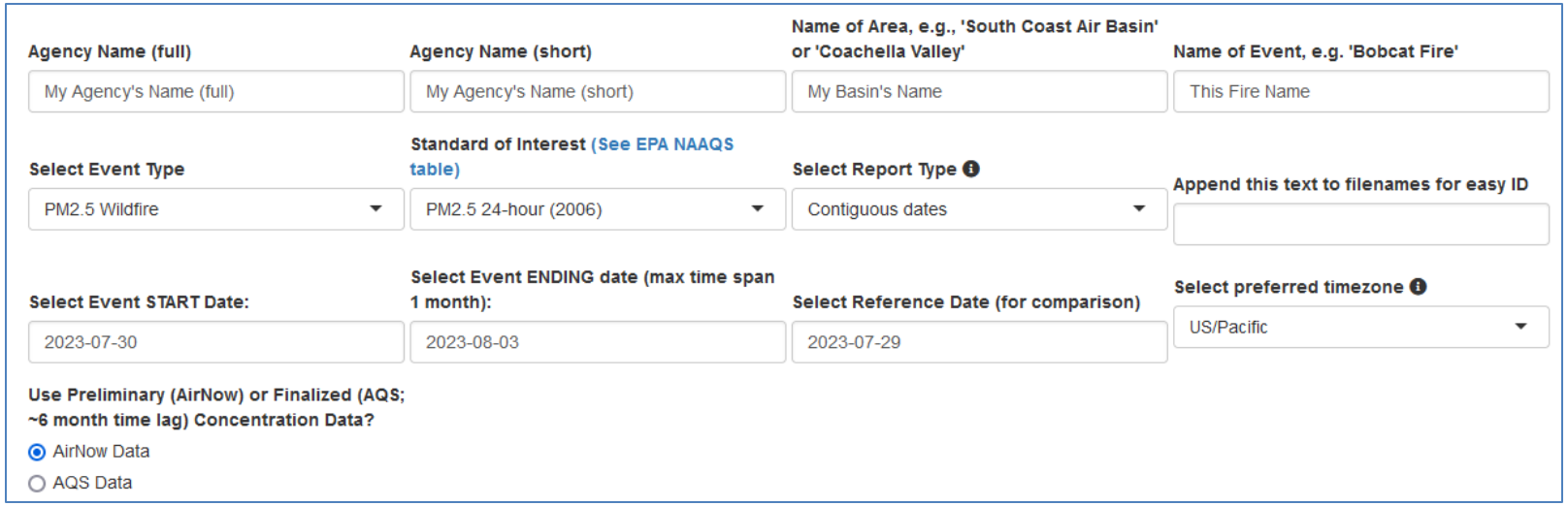
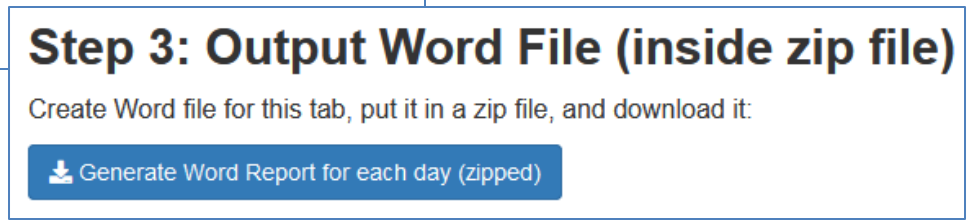
Exceptional Event Demonstration Tool



Event information filled in on “Event Description” tab

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



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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	Longitude of SW Corner of Image
32.1731	-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	Longitude of NE Corner of Image
38.3366	-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)	Height of Image (in pixels)
1014	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,
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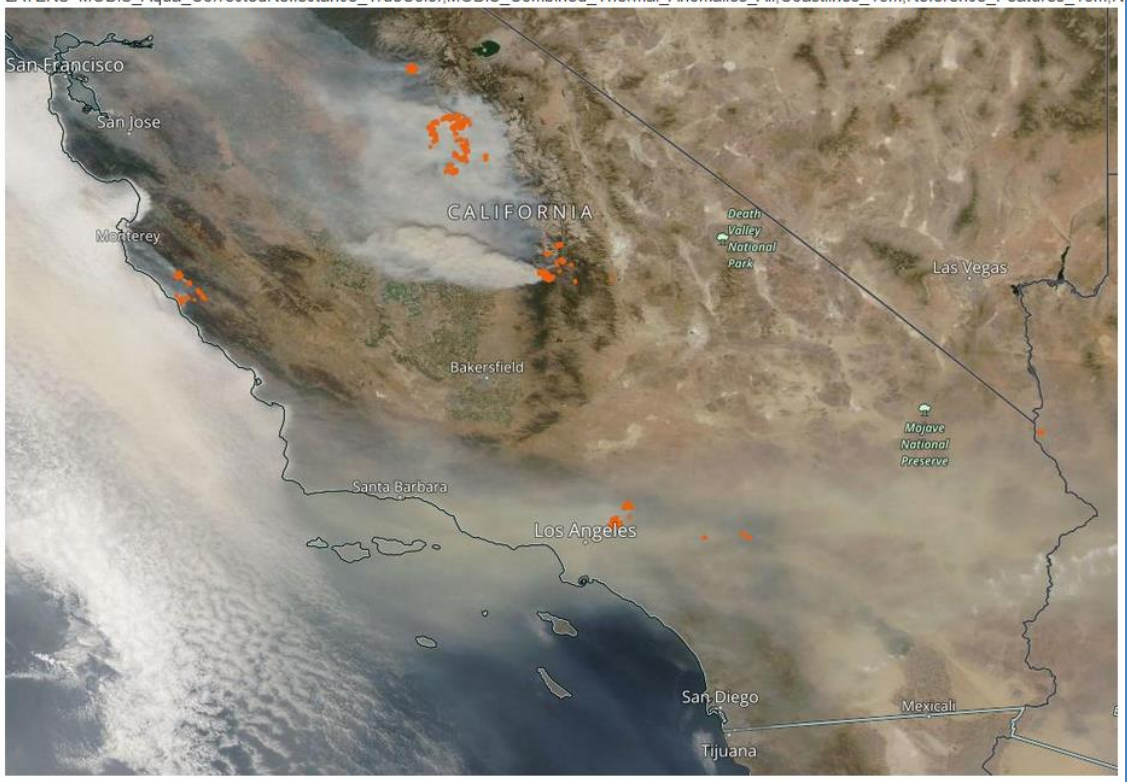

Step 3: Output Word File (inside zip file)

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

Generate Word Report for each day (zipped)

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Gather satellite images, make figures and tables that the tool will put into Word files

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?].

1st page of output satellite file for 2020-09-12

Word file is filled in with information provided

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-

2nd page of output satellite file for 2020-09-12

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

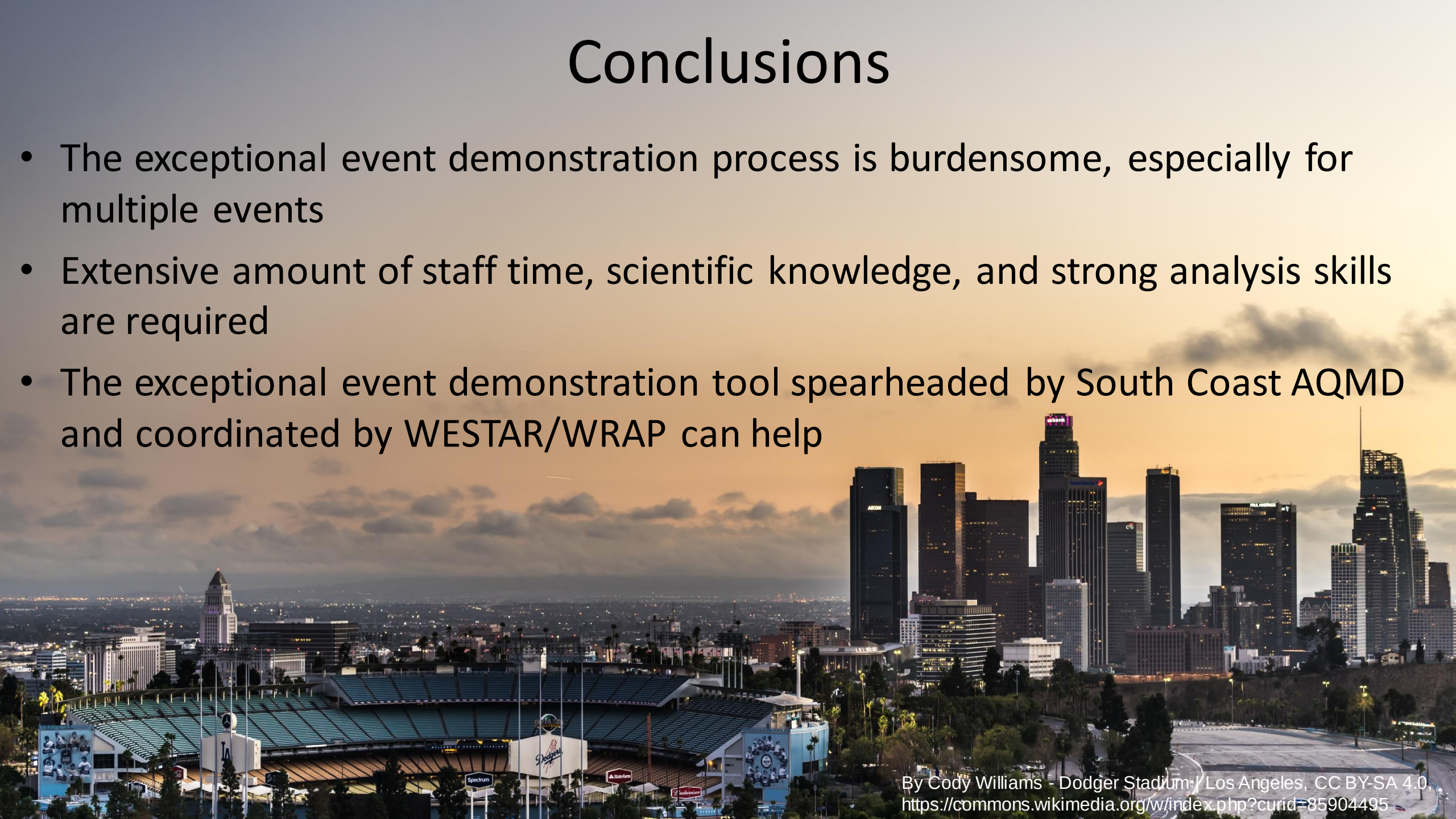
- Contributing to the tool development may be the fastest route to completing EE Demos for your agency especially if multiple EE Demos are needed

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
Jay Baker 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



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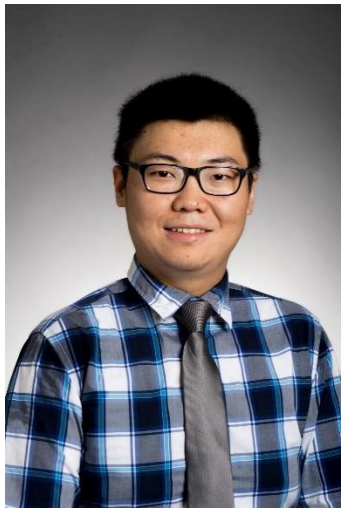

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Thank You!

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