**Can You Identify the “Exceptional Air Pollution Events” Caused by Wildfires?**

*Project Sponsored by the South Coast Air Quality Management District*

**Background Information**

The South Coast Air Quality Management District (South Coast AQMD) is the regional governmental agency responsible for regulating air pollution in major portions of Los Angeles, Riverside, San Bernardino Counties, and the entirety of Orange County. While there has been significant progress in reducing air pollution in the region over the past several decades, the South Coast AQMD still suffers from the worst air quality in the country. A comprehensive regime of regulations and incentive programs are in place and continue to be developed to attain federal air quality standards and improve public health.

Some air quality events are not reasonably controllable or preventable and can be excluded from calculations to determine if a region meets federal air quality standards subject to approval by U.S. EPA. These events are defined as Exceptional Events; the criteria to demonstrate that a specific event is an Exceptional Event is documented in the 2016 U.S. EPA Exceptional Event Rule[[1]](#footnote-2). While these events may be removed from regulatory calculations, they still have public health impacts, and therefore, South Coast AQMD has a comprehensive program to help residents reduce their exposure to poor air quality. However, the exceptional event framework, established in the Clean Air Act, allows regulatory air agencies to focus on improving air quality by reducing sources that are within their control. There is a high burden of proof required to establish that a specific event meets the “exceptional event” criteria that is based on three main premises:

1. The emissions from the event(s) caused the monitored exceedance(s)
2. The event is not reasonably controllable or preventable
3. The event is either:
   * Natural; or
   * Caused by human activity but is unlikely to recur at that same location

Wildfires are a significant source of fine particulate matter (PM2.5) and meet criteria 2 and 3 above. However, establishing that the emissions from a particular wildfire or a group of wildfires caused the monitored exceedance may require a considerable amount of analysis. In addition, to truly assess the progress in reducing PM2.5 through regulatory and incentive-based programs, one must remove the influence of wildfire smoke impacted days.

**Problem Statement**

Evaluate all historical PM2.5 24-hour average measurements (1999 to present) in the South Coast Air Quality Management District Jurisdiction that exceed the 24-hour µg/m3 24-hour PM2.5 standard[[2]](#footnote-3) and determine whether the presence of wildfire smoke caused the exceedance for each measurement. Use the criteria established in the Clear Causal section of the US EPA “Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations[[3]](#footnote-4)”. Note that this guidance is written to address wildfire-influenced ozone events, but much of it can also be applied to PM2.5 exceedances. While this project does not aim to prepare data for a full exceptional event demonstration, project participants can use many of the data analysis methodologies recommended in the guidance. Each data point should be classified into one of the following three categories:

1. Wildfire smoke did not cause the monitored exceedance
2. Wildfire smoke may have caused the monitored exceedance
3. Wildfire smoke caused the monitored exceedance

The basis for each determination should be clearly stated with the proper references included.

**Deliverables**

1. Group Presentation
2. Project report
3. List of data points in the above three categories; Code or tools that you used to generate the results

**SCAQMD has provided observation data and a list of resources that may be helpful.**

**Data provided by SCAQMD (uploaded to BlackBoard)**

* ExceedancesWithHMSsmokeOverhead.csv: this is a list of all the 24-hour average PM2.5 measurements from PM2.5 monitors that exceed the 24-hour standard (35.4 ug/m^3) and had a smoke plume overhead on the day they were measured. There were over 14,000 exceedances between 1999 and the present, so SCAQMD narrowed them down by using the HMS smoke data ([https://www.ospo.noaa.gov/Products/land/hms.html](https://urldefense.com/v3/__https:/www.ospo.noaa.gov/Products/land/hms.html__;!!LIr3w8kk_Xxm!oQlvELfTPBGLg7Jt_o0-mdltX0M0JKaP7hNtP9i2zRh6sHWwQRslE33KoyrUgqLHptfsTGb6HAO4ZHtscasDQi5ooG14$), available from 2007 to present) to identify the exceedances with smoke overhead. HMS Smoke polygons are made manually by trained analysts each day using various satellites. They are unable to determine if the smoke is overhead or at the surface, so it is a very crude way of identifying smoke impacted days. data window to include. There are 1381 total exceedances with smoke overhead from 2007 to 2022. If you think that this is too many to evaluate for the students, you can focus just on the regulatory monitors (Parameter Code=88101), which results in 675 total exceedances.
* Daily\_88101\_YEAR.csv: These are the regulatory 24-hour average PM2.5 measurements from the EPA AQS. They include both gravimetric measurements (24-hour integrated samples on a filter that are weighed in a lab) and continuous methods (hourly measurements that are averaged to get a 24-hour average).
* Daily\_88502\_YEAR.csv: These are the non-regulatory 24-hour average PM2.5 measurements from the EPA AQS. These should all be from continuous instruments
* Hourly\_88101\_YEAR.csv: These are the regulatory hourly PM2.5 measurements. These can be used to understand the hourly profile of the exceedance. Note that there are no gravimetric hourly measurements.
* Hourly\_88502\_YEAR.csv: These are the non-regulatory hourly PM2.5 measurements.
* Hourly\_42101\_YEAR.csv: These are the hourly regulatory CO measurements.
* Daily\_42101\_YEAR.csv: These are the daily regulatory CO measurements.

**Resources that may be helpful**

* South Coast Jurisdiction Map <http://www.aqmd.gov/docs/default-source/default-document-library/map-of-jurisdiction.pdf>
* Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations <https://www.epa.gov/air-quality-analysis/treatment-air-quality-data-influenced-exceptional-events-homepage-exceptional>
* InciWeb <https://inciweb.wildfire.gov/>
* WorldView Fires and Thermal Anomalies <https://go.nasa.gov/3ktWkHp>
* RAVG <https://burnseverity.cr.usgs.gov/ravg/> (can get shape files and other data for fires)
* Wildland Fire Emissions Inventory System (Michigan Tech Research Institute) <https://wfeis.mtri.org/home>
* North American Wildland Fuels Database (Michigan Tech Research Institute, U.S. Forest Service, University of Washington) <https://fuels.mtri.org/>
* Interagency Wildland Fire Air Quality Response Program <https://www.wildlandfiresmoke.net/>
* CA Public Utilities Commission SED Staff Wildfire Investigations, Wildfire Incident Reports and Staff Investigations Reports <https://www.cpuc.ca.gov/industries-and-topics/wildfires/wildfires-staff-investigations>
* Los Angeles County Fire Department Major Incident Archive <https://fire.lacounty.gov/incident-archive-2/>
* Daily Weather Maps: <https://www.wpc.ncep.noaa.gov/dailywxmap/>
* Weather Research & Forecasting Model (WRF): <https://www.mmm.ucar.edu/models/wrf>
* NASA Worldview: <https://worldview.earthdata.nasa.gov/>
* Hazard Mapping System (HMS): <https://www.ospo.noaa.gov/Products/land/hms.html>
* NASA Worldview with Aerosol Optical Depth selected (example link, needs dates changed) <https://worldview.earthdata.nasa.gov/?v=-129.23409484120796,27.480819498698487,-106.55706543280581,40.190070135449695&l=Reference_Labels_15m,Reference_Features_15m,Coastlines_15m,MODIS_Combined_Value_Added_AOD(hidden),MODIS_Combined_MAIAC_L2G_AerosolOpticalDepth,MODIS_Combined_Thermal_Anomalies_Night(hidden),MODIS_Combined_Thermal_Anomalies_Day(hidden),MODIS_Combined_Thermal_Anomalies_All(hidden),VIIRS_NOAA20_CorrectedReflectance_TrueColor(hidden),VIIRS_SNPP_CorrectedReflectance_TrueColor(hidden),MODIS_Aqua_CorrectedReflectance_TrueColor(hidden),MODIS_Terra_CorrectedReflectance_TrueColor&lg=true&t=2020-09-04-T21%3A15%3A23Z>
* The HPWREN project at the University of California, San Diego and the National Science Foundation; High Performance Wireless Research & Education Network (Webcams) <http://hpwren.ucsd.edu> Note: this group likes to be notified (in addition to being cited) when their resources are used. The bottom of the webpage has a contact form.
* HYSPLIT trajectory model: <https://www.ready.noaa.gov/HYSPLIT.php>
* National Weather Service Hazards and Data Viewer: <https://www.wrh.noaa.gov/map/>
* Iowa State University, Iowa Environmental Mesonet (Archive of National Weather Service Products such as forecast discussions) <https://mesonet.agron.iastate.edu/wx/afos/list.phtml?> For the Product ID: AFD = Area Forecast Discussion; FWS = spot forecasts; STQ = spot forecast requests; LSR = Local Storm Reports; ZFP = Zone Forecast Products; NPW = watches, warnings, and advisories issued or urgent weather messages; PNS = Public Information Statements (includes summaries of top locations for rainfall, winds or storm damage)
* NWS Chat (shows reports of high wind, flooding, etc. NWS receives from Dept. transportation, etc.) Note that times are UTC.: <https://nwschat.weather.gov/lsr> .

1. <https://www.epa.gov/air-quality-analysis/treatment-air-quality-data-influenced-exceptional-events-homepage-exceptional> [↑](#footnote-ref-2)
2. https://www.epa.gov/criteria-air-pollutants/naaqs-table [↑](#footnote-ref-3)
3. <https://www.epa.gov/sites/default/files/2018-10/documents/exceptional_events_guidance_9-16-16_final.pdf> [↑](#footnote-ref-4)