



New Tools for Air Quality Forecasting and Communication in the South Coast Air Quality Management District

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The South Coast AQMD

- 17 million residents
- 4 counties
- 3 air basins:
 - South Coast
 - Salton Sea (Riverside County portion)
 - Mojave Desert (Riverside County portion)
- Non-attainment of federal PM2.5, ozone, and PM10
- Air quality forecast also includes additional portions of Mojave Desert Air Basin (entirety of 4 counties)



Presentation Outline

- Hourly Air Quality Forecasting
- Wood Smoke Forecasting
- Gridded Real-Time Air Quality
- South Coast AQMD Mobile Application

Hourly Air Quality Forecasting

- Developed “Cleanest Time of Day*” to communicate the best time to do outdoor activities
- Performance is good for ozone and adequate for PM2.5 (enough to provide useful information)

*Defined as the timespan when the predicted AQI (based on PM2.5 & O3) is lowest and more than 10 AQI points below the daily average

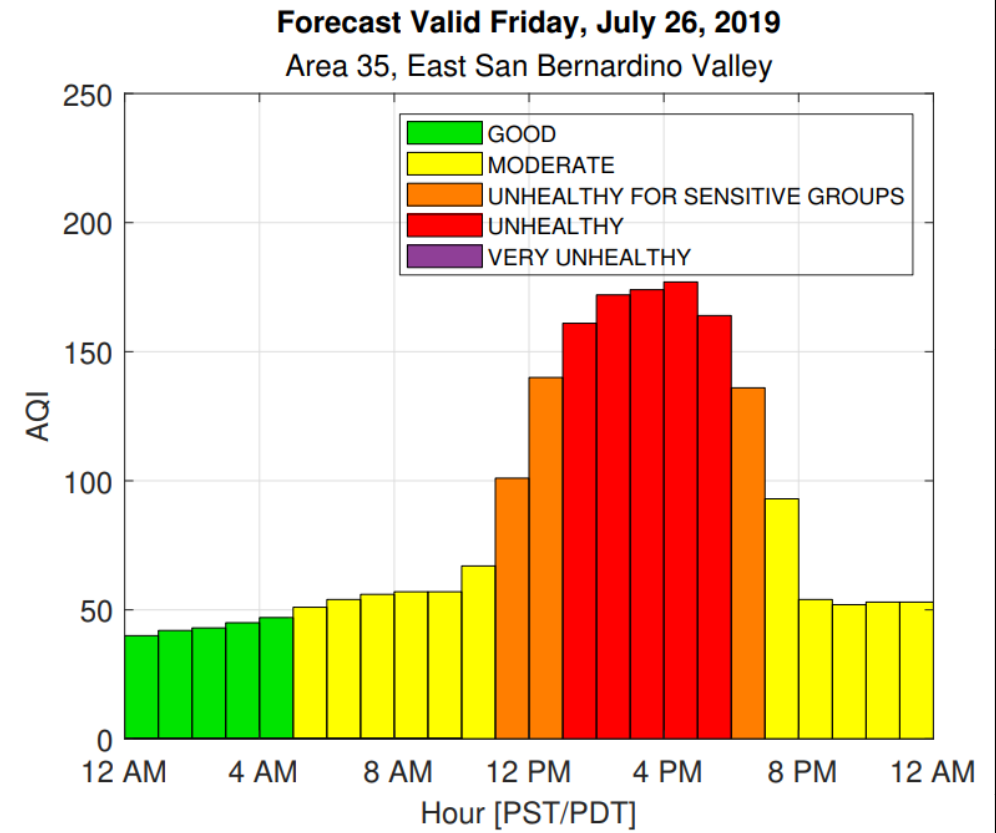


Forecast Valid Friday, July 26, 2019
Issue Date: Thursday, July 25, 2019

| Area | Forecast Area | AQI | AQI Description | Pollutant | Cleanest Time of Day * |
|------|-----------------------------------|-----|--------------------------------|-----------|-----------------------------|
| 1 | Central Los Angeles County | 57 | MODERATE | PM2.5 | Similar all day |
| 2 | Northwest Coastal Los Angeles Co. | 42 | GOOD | PM2.5 | Similar all day |
| 3 | Southwest Los Angeles County Co. | 42 | GOOD | PM2.5 | Similar all day |
| 4 | South Coastal Los Angeles Co. | 42 | GOOD | PM2.5 | Similar all day |
| 5 | Southeast Los Angeles Co. | 42 | GOOD | PM2.5 | Similar all day |
| 6 | West San Fernando Valley | 77 | MODERATE | Ozone | Similar all day |
| 7 | East San Fernando Valley | 71 | MODERATE | Ozone | Similar all day |
| 8 | West San Gabriel Valley | 101 | UNHEALTHY FOR SENSITIVE GROUPS | Ozone | Cleanest from 6 AM to 11 AM |
| 9 | East San Gabriel Valley | 97 | MODERATE | Ozone | Cleanest from 6 PM to 10 PM |
| 10 | Pomona/Walnut Valley | 84 | MODERATE | Ozone | Cleanest from 6 AM to 12 PM |
| 11 | South San Gabriel Valley | 58 | MODERATE | Ozone | Similar all day |
| 12 | South Central Los Angeles Co. | 42 | GOOD | PM2.5 | Similar all day |
| 13 | Santa Clarita Valley | 105 | UNHEALTHY FOR SENSITIVE GROUPS | Ozone | Cleanest from 6 AM to 11 AM |
| 14 | Antelope Valley | 93 | MODERATE | Ozone | Cleanest from 6 AM to 11 AM |
| 15 | San Gabriel Mountains | 43 | GOOD | Ozone | Similar all day |
| 16 | North Orange County | 46 | GOOD | Ozone | Similar all day |
| 17 | Central Orange County | 44 | GOOD | Ozone | Similar all day |
| 18 | North Coastal Orange County | 37 | GOOD | Ozone | Similar all day |
| 19 | Saddleback Valley | 48 | GOOD | Ozone | Similar all day |
| 20 | Central Coastal Orange County | 42 | GOOD | PM2.5 | Similar all day |
| 21 | Capistrano Valley | 44 | GOOD | Ozone | Similar all day |
| 22 | Corona/Norco Area | 108 | UNHEALTHY FOR SENSITIVE GROUPS | Ozone | Cleanest from 6 PM to 10 PM |
| 23 | Metropolitan Riverside County | 133 | UNHEALTHY FOR SENSITIVE GROUPS | Ozone | Cleanest from 6 AM to 12 PM |
| 24 | Perris Valley | 115 | UNHEALTHY FOR SENSITIVE GROUPS | Ozone | Cleanest from 6 AM to 11 AM |
| 25 | Lake Elsinore Area | 61 | MODERATE | Ozone | Similar all day |
| 26 | Temecula Valley | 51 | MODERATE | Ozone | Similar all day |
| 27 | Anza Area | 61 | MODERATE | Ozone | Similar all day |
| 28 | Hemet/San Jacinto Valley | 108 | UNHEALTHY FOR SENSITIVE GROUPS | Ozone | Cleanest from 6 AM to 12 PM |
| 29 | Banning/San Gorgonio Pass | 136 | UNHEALTHY FOR SENSITIVE GROUPS | Ozone | Cleanest from 6 AM to 11 AM |
| 30 | Coachella Valley | 87 | MODERATE | Ozone | Similar all day |
| 31 | East Riverside County | 87 | MODERATE | Ozone | Similar all day |
| 32 | Northwest San Bernardino Valley | 129 | UNHEALTHY FOR SENSITIVE GROUPS | Ozone | Cleanest from 6 AM to 12 PM |
| 33 | Southwest San Bernardino Valley | 100 | MODERATE | Ozone | Cleanest from 6 PM to 10 PM |
| 34 | Central San Bernardino Valley | 147 | UNHEALTHY FOR SENSITIVE GROUPS | Ozone | Cleanest from 6 AM to 12 PM |
| 35 | East San Bernardino Valley | 166 | UNHEALTHY | Ozone | Cleanest from 6 AM to 11 AM |
| 36 | West San Bernardino Mountains | 112 | UNHEALTHY FOR SENSITIVE GROUPS | Ozone | Cleanest from 6 AM to 12 PM |
| 37 | Central San Bernardino Mountains | 159 | UNHEALTHY | Ozone | Cleanest from 6 AM to 12 PM |
| 38 | East San Bernardino Mountains | 143 | UNHEALTHY FOR SENSITIVE GROUPS | Ozone | Cleanest from 6 AM to 12 PM |
| 39 | Phelan | 105 | UNHEALTHY FOR SENSITIVE GROUPS | Ozone | Cleanest from 6 AM to 12 PM |
| 40 | Hesperia | 133 | UNHEALTHY FOR SENSITIVE GROUPS | Ozone | Cleanest from 6 AM to 12 PM |
| 41 | Trona | 61 | MODERATE | Ozone | Similar all day |
| 42 | Victorville | 105 | UNHEALTHY FOR SENSITIVE GROUPS | Ozone | Cleanest from 6 AM to 12 PM |
| 43 | Yucca Valley | 87 | MODERATE | Ozone | Similar all day |
| 44 | Barstow | 80 | MODERATE | Ozone | Similar all day |
| 45 | Twentynine Palms | 101 | UNHEALTHY FOR SENSITIVE GROUPS | Ozone | Similar all day |

Hourly Air Quality Forecasting

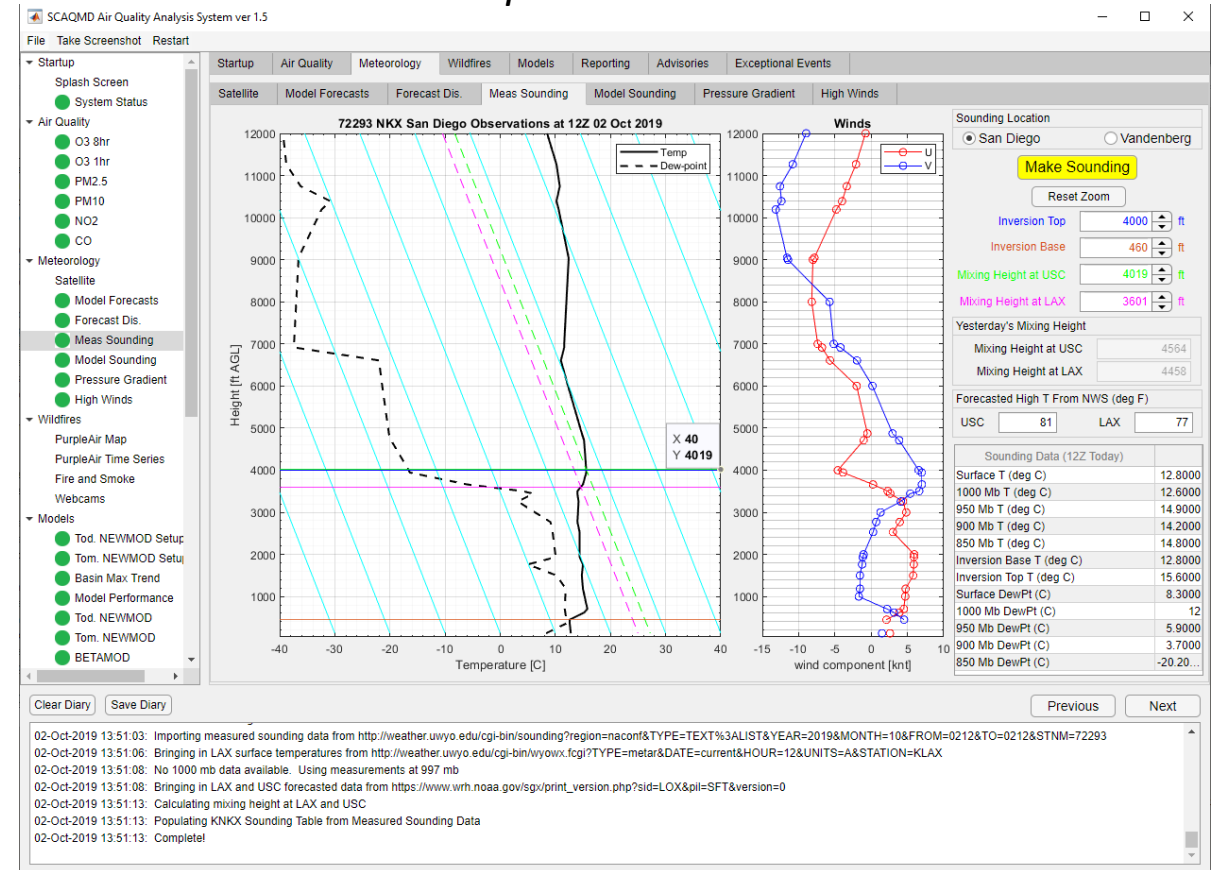
- Hourly AQI time series plots generated for 45 forecasting areas
- Profile shape from NOAA's NAQFC predictions and scaled by final ensemble-derived 24-hr values
- Ability to modify hourly predictions for events not captured by model (i.e. fireworks & holiday wood burning)



Hourly Air Quality Forecasting (In-House Forecasting System)


- Unified workflow to issue forecast and air quality advisories
- Software developed in Air Quality Assessment Group using MATLAB App Designer
- Automates tedious/manual tasks and allows forecasters to focus only on tasks requiring human decision-making
- 45 panel workflow

Example Screenshot



Wood Smoke Forecasting

- Rule 445 prohibits residential wood burning on “No Burn” days (Nov 1st to end of Feb.)
- Burning prohibited when 24-hr PM_{2.5} is forecast to exceed 30 µg/m³
- Traditional statistical and chemical transport models have difficulties predicting wood smoke PM_{2.5} because emissions don’t follow regular patterns



**CHECK
BEFORE
YOU
BURN**

Due to high air pollution levels, today is a **No Burn Day** for wood-burning fireplaces.



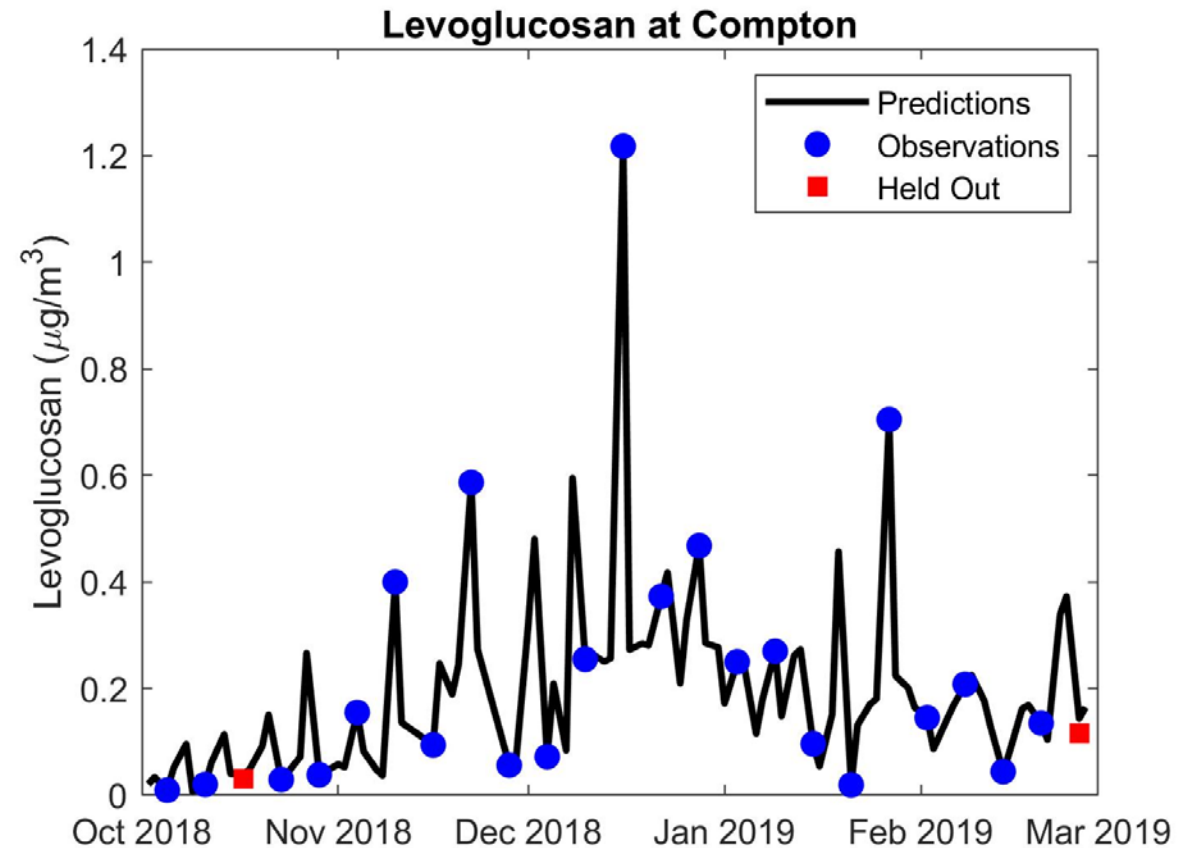
Protect your family's health.
Help keep our air clean.

#CheckBeforeYouBurn
AirAlerts.org



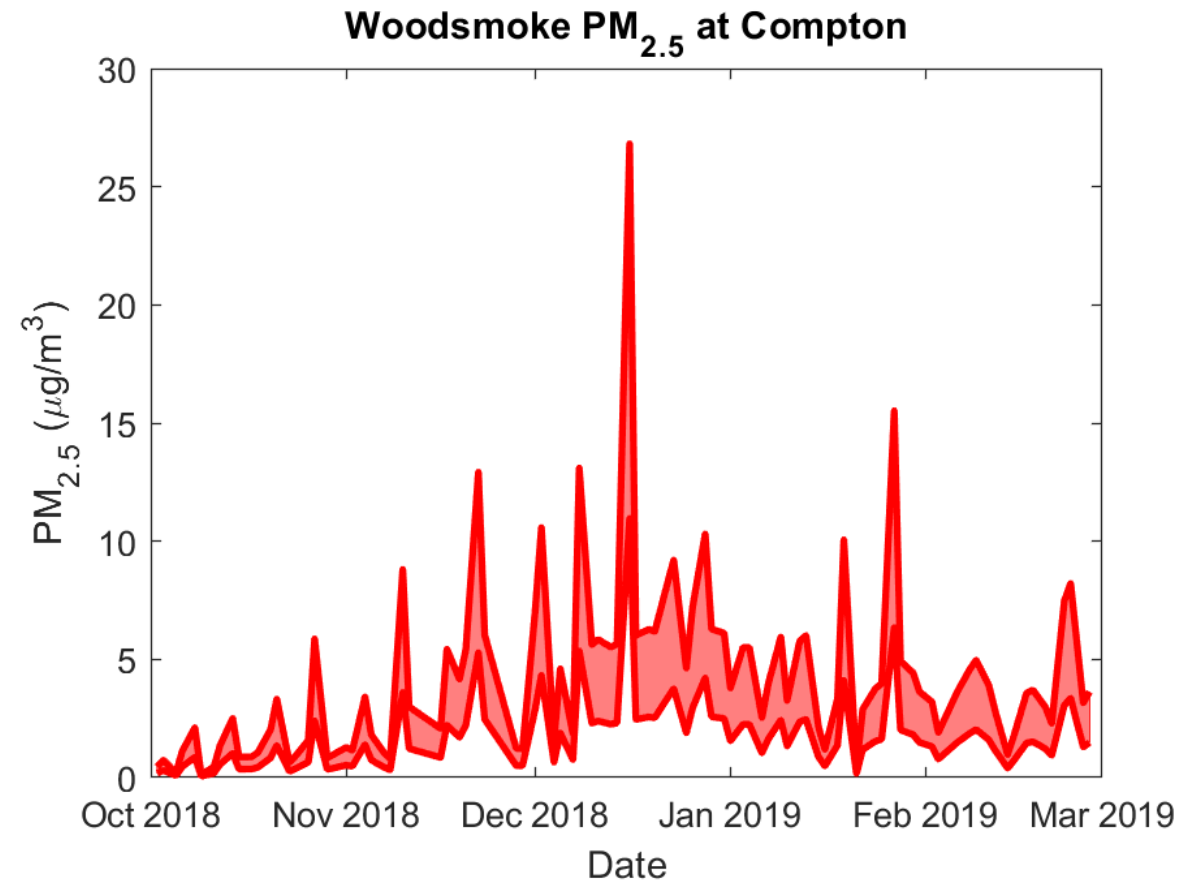
Wood Smoke Forecasting

- Used levoglucosan as a wood smoke tracer
- 918 measurements across 10 sites used to train machine learning model
- Conversion of levoglucosan to wood smoke PM2.5 is main source of uncertainty
- Wood smoke PM2.5 predictions will be used to improve forecast accuracy during burning season and target outreach efforts



Wood Smoke Forecasting

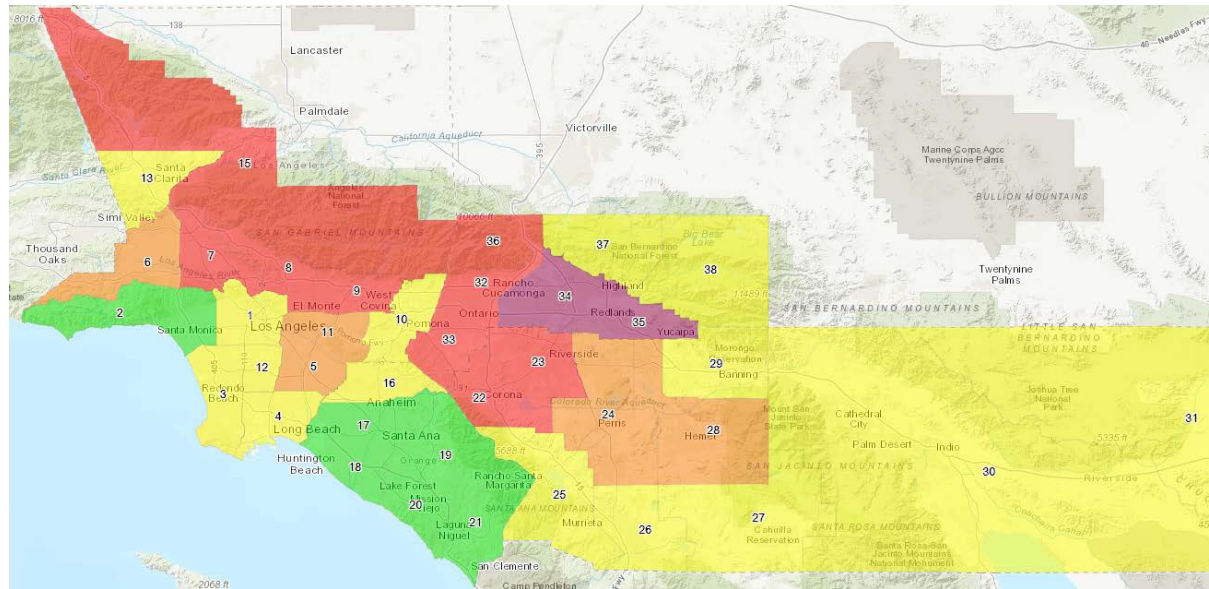
- Used levoglucosan as a wood smoke tracer
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Gridded Real-Time Air Quality

Current Methods of Displaying Real-Time Air Quality Data

South Coast AQMD “Proxy Method”



www.aqmd.gov/aqdata

AirNow Inverse Distance Weighted Interpolation



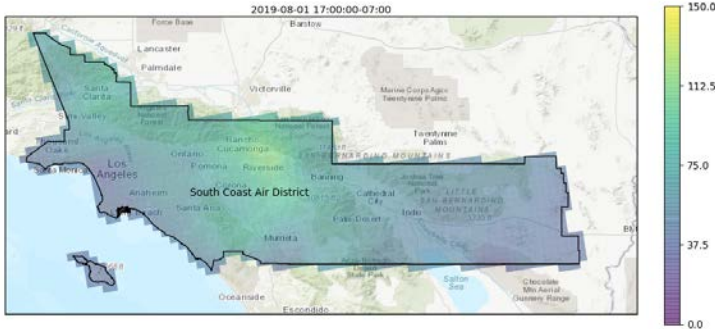
www.airnow.gov

Limitations identified:

- *Location of monitor that is driving an area’s current AQI is unclear*
- *Distance-weighted interpolation doesn’t take into account complex terrain*

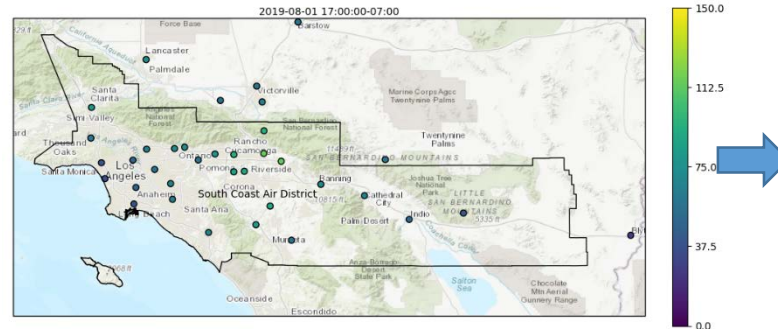
Gridded Real-Time Air Quality

Modeled Hourly Concentrations



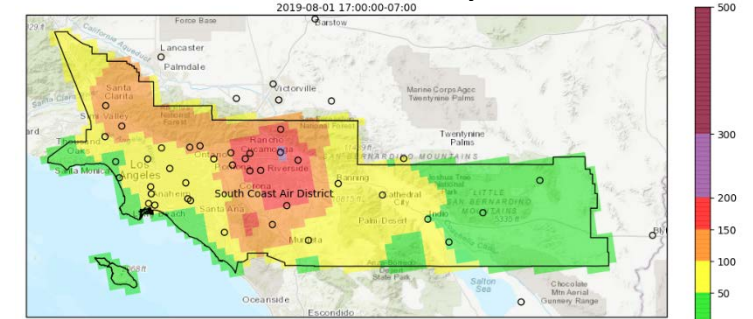
Models drive the estimated concentration far from monitors

Measured Hourly Concentrations



Monitor data drives the estimated concentration near monitors

Gridded Air Quality Index



Final AQI is the maximum AQI of all pollutants

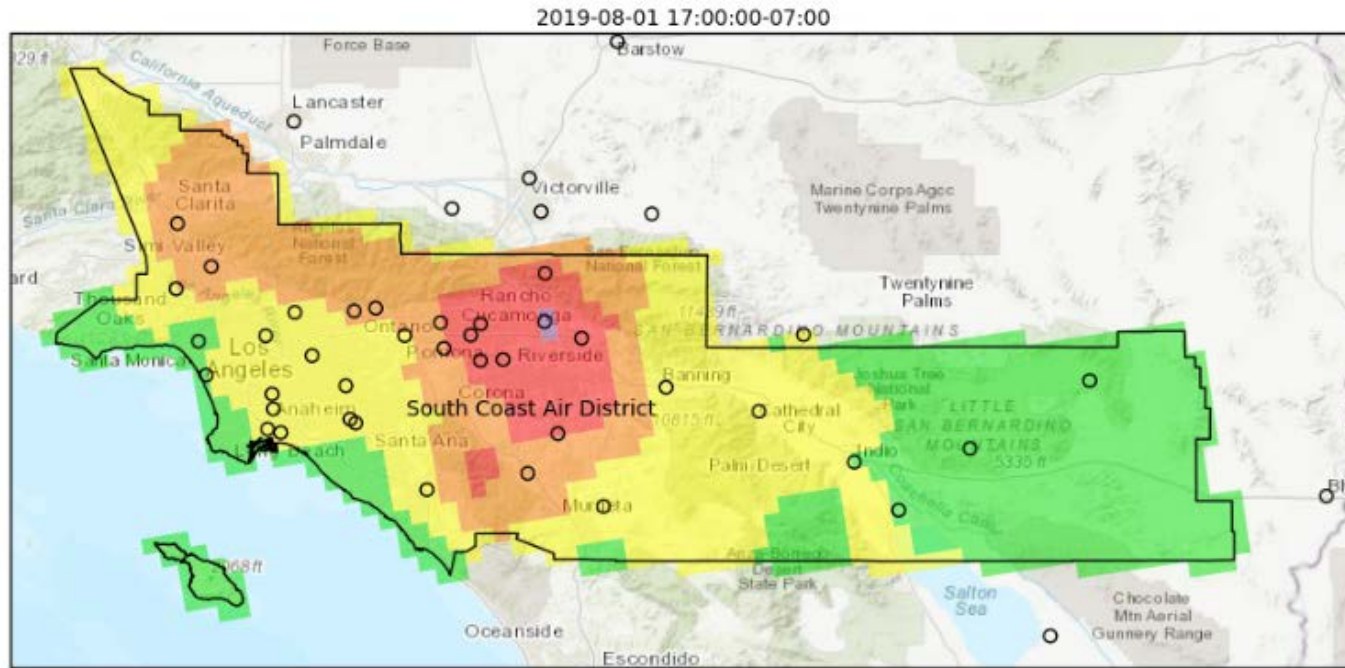
For PM2.5 and Ozone:

- Difference between NOAA's NAQFC model prediction and measured concentrations interpolated and added to modeled values

For PM10, NO2, and CO:

- Natural neighbor interpolation used to estimate values in between monitors
- Coarse PM is interpolated and added to PM2.5 values to estimate PM10

Gridded Real-Time Air Quality



Significant Improvement in Accuracy Between Monitors

| Root Mean Square Error | AQMD Proxy | AirNow IDW | Gridded Real-Time |
|--|------------|------------|-------------------|
| PM _{2.5} [$\mu\text{g m}^{-3}$] | 7.5 | 7.1 | 5.5 |
| O ₃ [ppb] | 18.8 | 18.5 | 7.5 |
| PM ₁₀ [$\mu\text{g m}^{-3}$] | 21.4 | 24.2 | 17.0 |
| CO [ppm] | 0.18 | 0.23 | 0.18 |
| NO ₂ [ppb] | 8.9 | 8.5 | 7.9 |

At every grid cell, users can click to see concentrations of all species and whether they are measured or estimated.

South Coast AQMD Mobile Application

- Developed from the ground up for both iOS and Android devices
- Real-time and forecasted air quality for multiple cities in the South Coast Air Basin
- Integrated current temperature and animated weather background
- Interactive air quality map
- Alternative fuel stations map with driving directions



South Coast AQMD Mobile Application

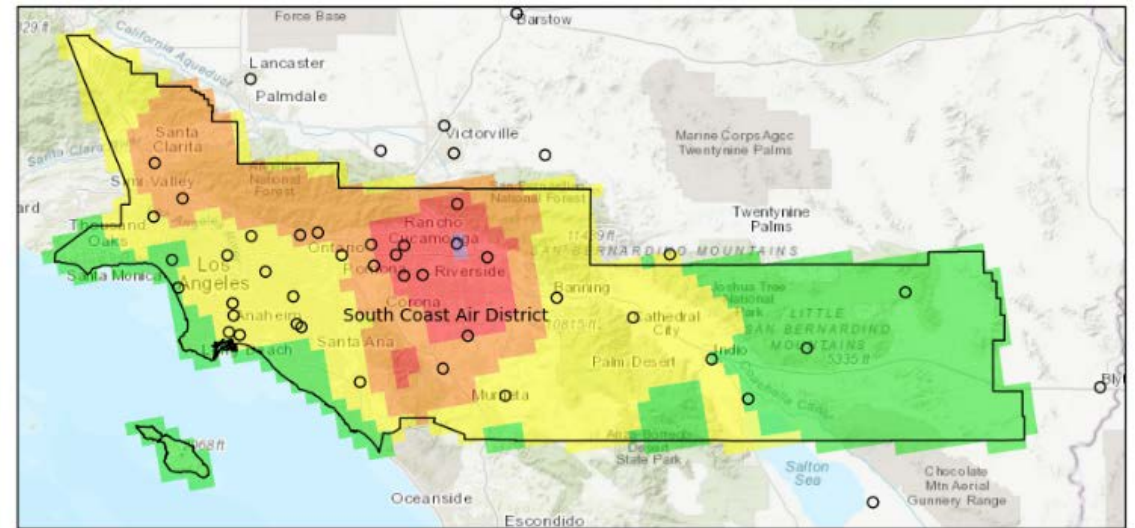
Upcoming Improvements

- Improved interface for real-time alternative fuel stations status
- Additional info on alternative fuel stations (electric plug types, H2 fuel status, etc.)
- Advance push notifications based upon geolocation for major disasters and air quality warnings
- Hour by hour air quality forecast for each city
- Interface to submit air quality complains directly from the app



Summary

- “Cleanest Time of Day” and hourly AQI forecasts provide additional information to help minimize exposure to poor air quality
- Wood smoke forecasting will improve predictions of ‘No Burn’ days and help target outreach
- Gridded real-time AQI maps are more accurate and provide a higher level of transparency than traditional methods of displaying AQI



Acknowledgements

South Coast AQMD Air Quality Assessment Group



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