Community-engaged air sensor analysis

Visualizing PM2.5 data from PurpleAir sensors in South/Southeast Los Angeles

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Data interpretation and visualization for air sensor data

Explosion in implementation of low-cost air sensors in past decade
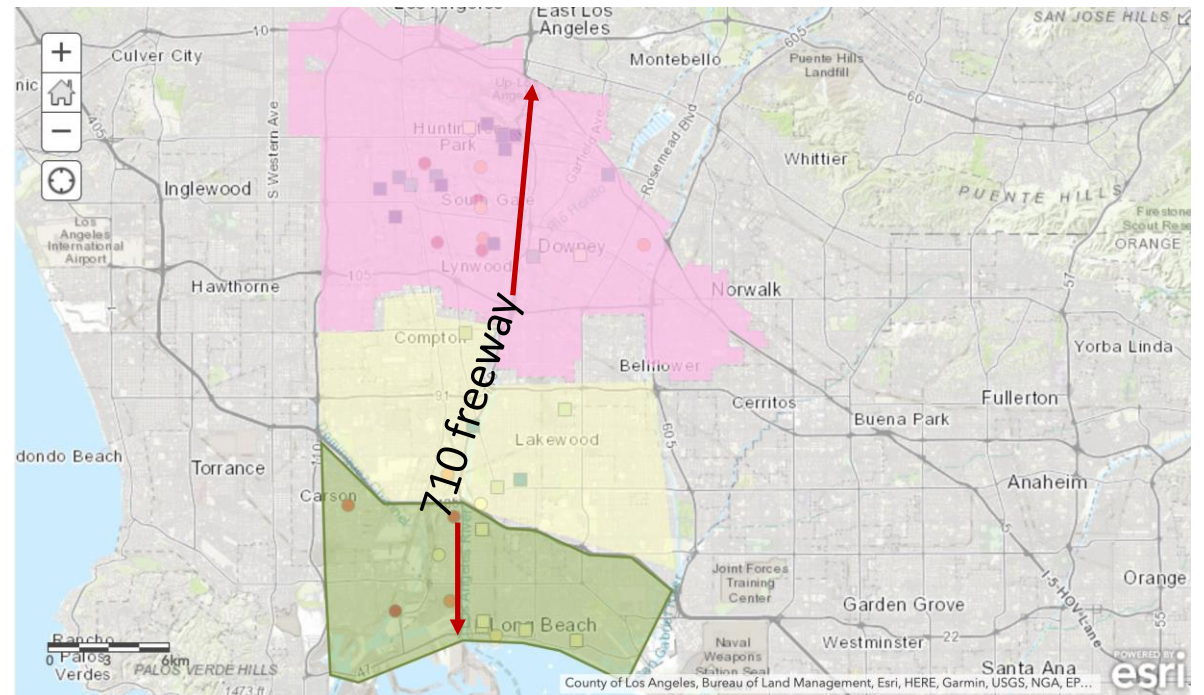
Need for better tools to utilize sensor data

Spatial disparities not covered by federal monitors

Focusing on air pollution in Los Angeles

- Goods movement corridor along the 710 freeway
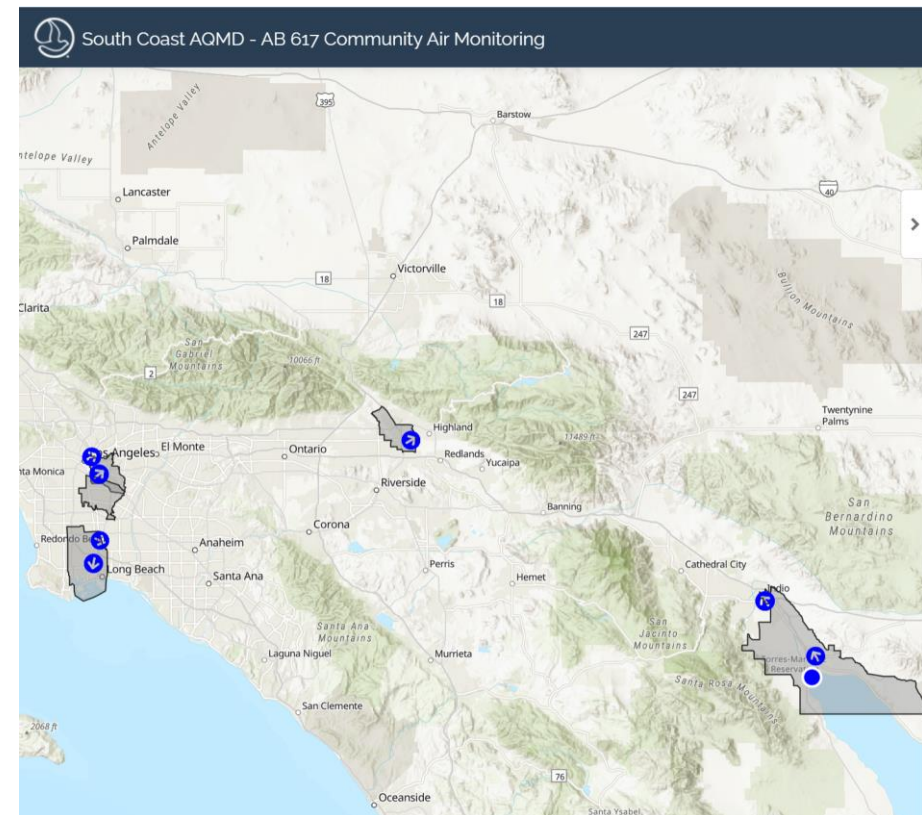- Sources include traffic, ports, trucks

SC-AQMD and AB 617

South LA added to South Coast AQMD's AB 617 program in October 2020

Introduced in 2017 by California Assemblymember Cristina Garcia to address air quality issues and reduce emissions in environmental justice communities

PM2.5 levels in LA much higher than Ambient Air Quality Standard of 12 µg/m³

Image source: http://www.aqmd.gov/nav/about/initiatives/environmental-justice/ab617-134/ab-617-community-air-monitoring

PurpleAir (PA) as a Data Source

Low-cost consumer-friendly sensors that use PMSX003 laser counters to measure particulate matter in real time

Outdoor PA-II sensors read PM2.5 in $\mu g/m^3$
    PM2.5: CF_ATM vs CF_1

Laser counters alternate 5-second readings averaged over 120 seconds

PA sensor readings uploaded to cloud every 120 seconds

Historic data stored in PA's Thingspeak database, which can be accessed through download tool and CSV files

Community Feedback and Input

Community groups that provided feedback on the iterations of this project:
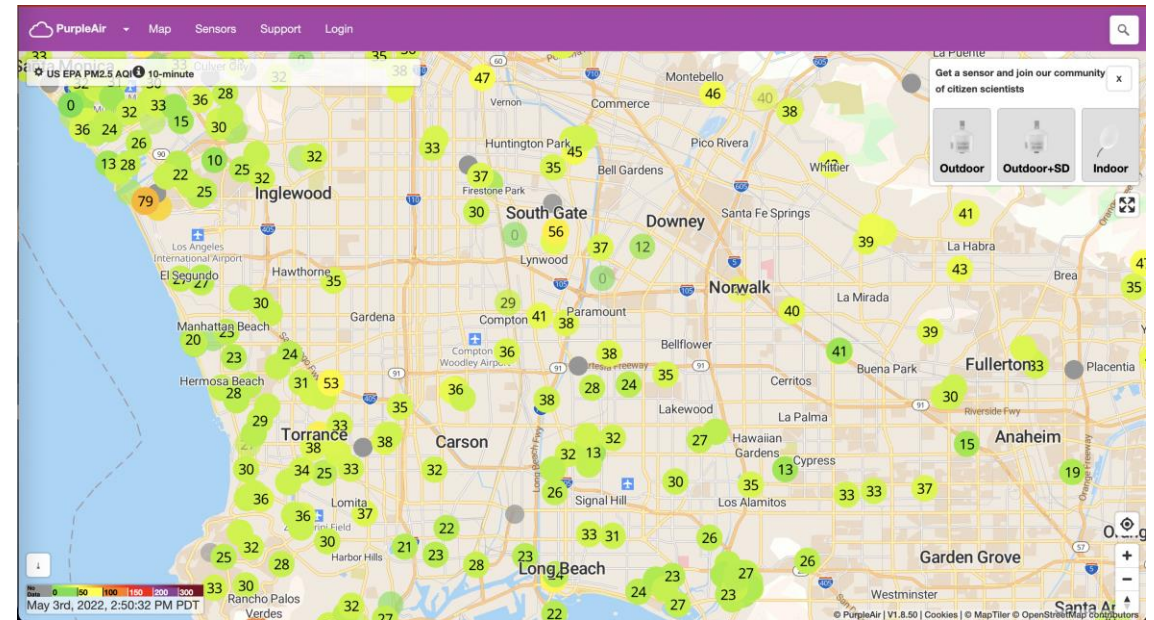
Objective

Working with community organizations to understand need for PM2.5 air pollution data visualizations

Selecting types of visualizations

Using data on annual scale

Ease of interactions, including web-based app

Methods

Selected sensors in area extending north to south from Long Beach to Huntington Park and Bell Gardens

  East-west boundaries were 110 freeway and SR-19

Data from calendar years 2019, 2020, and 2021

Data completeness threshold at 30% coverage for year and 80% reliability between two channels

Cleaning and analyses done in RStudio with tidyverse, openair, and AirSensor packages

Quality control for PM2.5 done through AirSensor function

Number of PurpleAir sensors with available data increasing by year
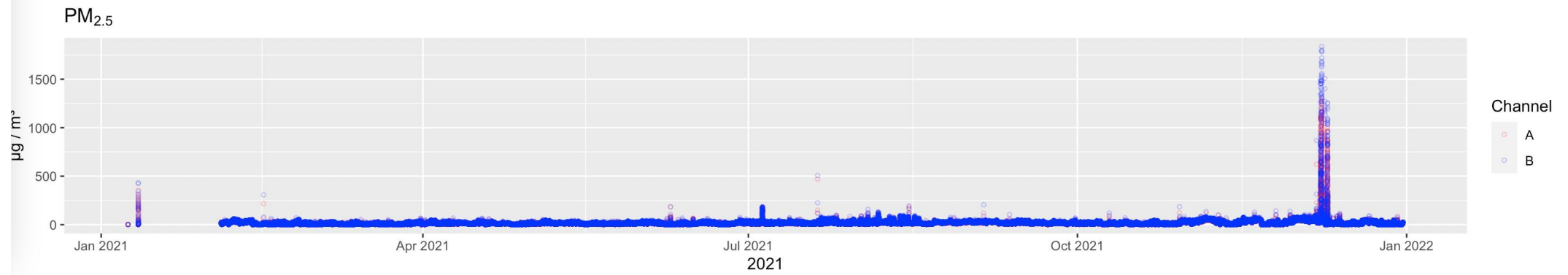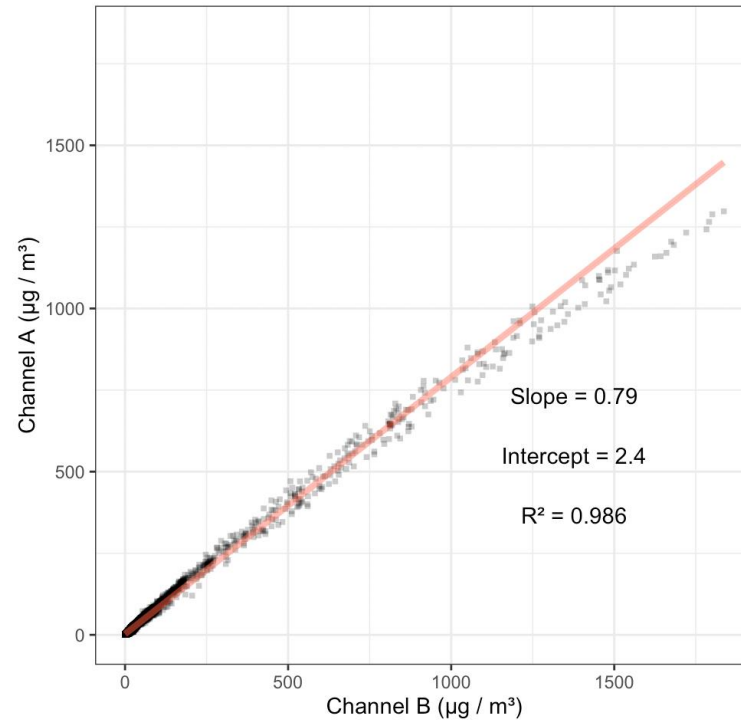
Image source: https://www.rdocumentation.org/packages/AirSensor/versions/1.0.8

RDocumentation

Search all packages and functions

AirSensor R Package

`Process and display PM2.5 data from PurpleAir`

Background

The AirSensor R package is being developed to help air quality analysts, scientists and interested members of the public more easily work with air quality data from consumer-grade air quality sensors. Initial focus is on PM2.5 measurements from sensors produced by PurpleAir.

The package makes it easier to obtain data, perform analyses and create visualizations. It includes functionality to:

- download and easily work with PM2.5 data from PurpleAir
- visualize raw "engineering-level" data from a PurpleAir sensor
- visualize data quality using built-in analytics and plots
- aggregate raw data onto an hourly axis
- create interactive maps and time series plots
- convert aggregated PurpleAir data into `ws_monitor` objects appropriate for

use with the **PWFSLSmoke** package

Institutional Support

COPY LINK
https://rdocumentation.org/packages/AirSensor/

VERSION
1.0.8

INSTALL
install.packages('AirSensor')

MONTHLY DOWNLOADS
398

VERSION   LICENSE
1.0.8   GPL-3

ISSUES   PULL REQUESTS
17   0

STARS   FORKS
27   6

REPOSITORY
https://github.com/MazamaScience/AirSensor

A / B Channel Comparison -- Los Angeles Memorial Coliseum

Channel Linear Regression

Slope = 0.79

Intercept = 2.4

R² = 0.986

Channel A (µg / m³)

Channel B (µg / m³)

PM₂.₅

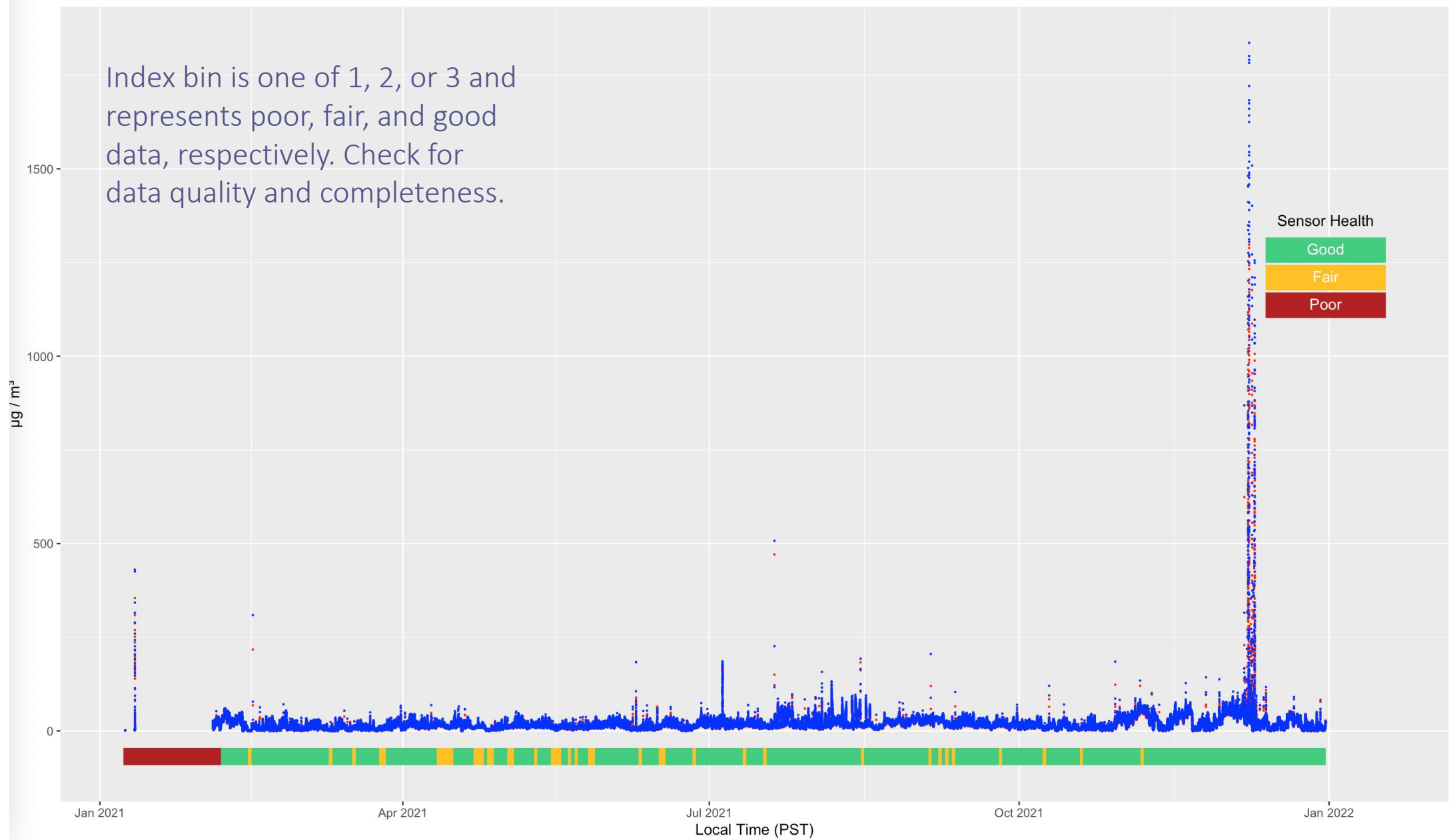µg / m³

Channel
A
B

Jan 2021   Apr 2021   Jul 2021   Oct 2021   Jan 2022

2021

Channel A and Channel B reliability check
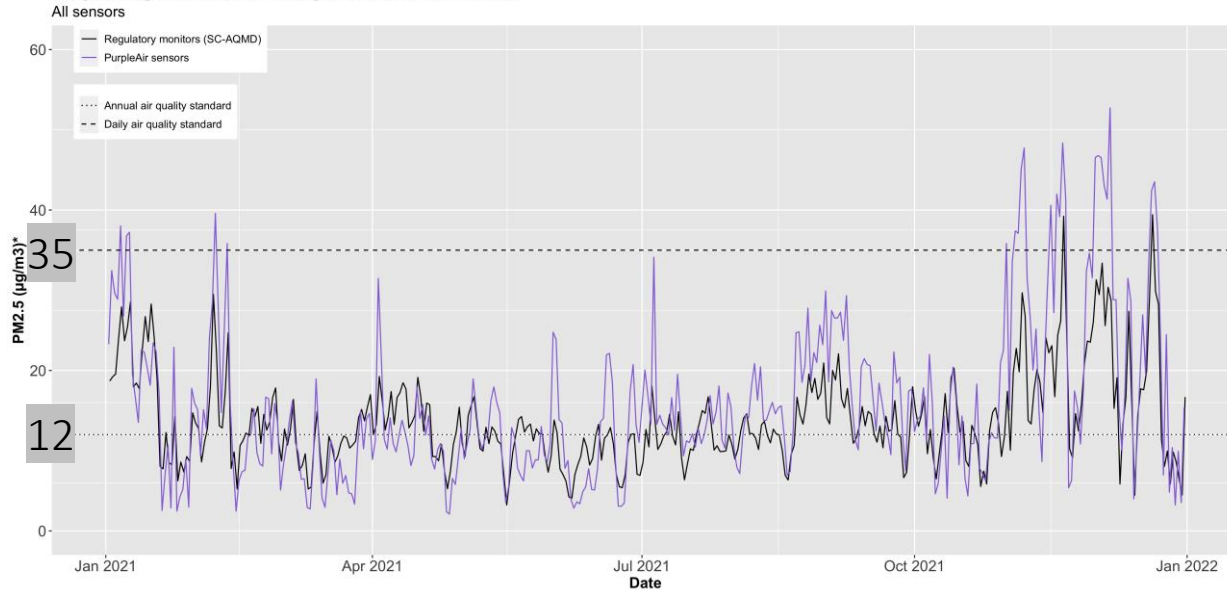Checking for at least 80% reliability, or R-squared value greater than 0.8

Daily state of health metric plots

Checking for quality of data readings per day

Daily averages of PM2.5, January 2021 to December 2021
All sensors

PM2.5 daily averages in 2021, all sensors

Percent of days in 2021 that average PM2.5 was above 12ug/m3

Sensor regions

Northern Southeast LA

Wilmington/Long Beach

Southern Southeast LA
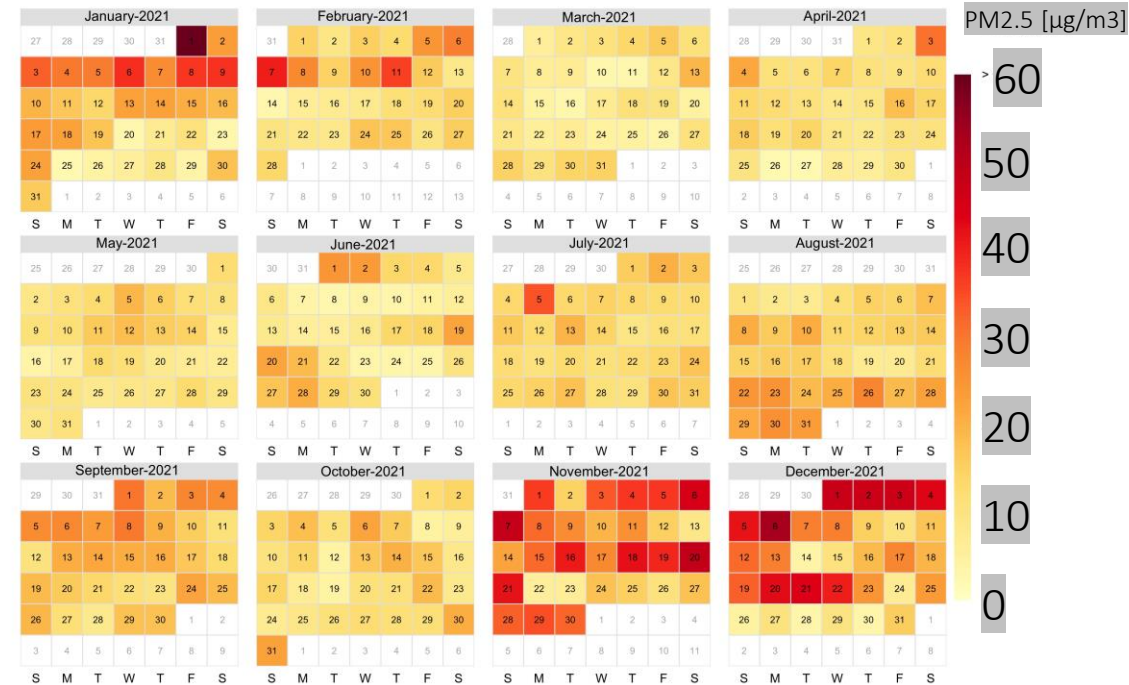
Clockwise:

Time variation with reference AQMD monitor

Calendar heat map

Percentage of time throughout year that PM2.5 levels were above daily (35 µg/m3) or annual (12 µg/m3) EPA standard

How to visualize data for community use

Increasing web-based interactions

R packages 'Shiny' and 'ShinyDashboard'

Create an interactive tool for community groups to easily look through and interpret visualizations

Image source: https://envhealthcenters.usc.edu/pm-2-5-shiny

Future Directions

Further development of Shiny platform to update data internally

Further analyses/visualizations of PM2.5 data

Continuing to meet with community organizations to help achieve their goals

References and Thank You!

http://www.aqmd.gov/nav/about/initiatives/environmental-justice/ab617-134/ab-617-community-air-monitoring
https://envhealthcenters.usc.edu/resources/community-air-monitoring
https://envhealthcenters.usc.edu/pacoima-beautiful-purpleair-data-tool
https://www2.purpleair.com/community/faq
https://mazamascience.github.io/AirSensor/articles/articles/pat_introduction.html
https://mazamascience.github.io/AirSensor/articles/articles/pas_introduction.html

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