December 15, 2022

Understanding Air Quality Trends in Richmond-San Pablo, CA

Results from the Richmond Air Monitoring Network

PSE Bringing science to energy policy

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Boris Lukanov, PhD, joined PSE in 2017 to develop analyses on energy transition pathways that maximize health, equity and environmental co-benefits. His work focuses on energy equity and affordability, air quality, energy efficiency, and integrated resource modeling and optimization.

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Karan Shetty is a data analyst at PSE whose work centers around energy equity and affordability, air pollution, and health impacts from fossil fuel power.

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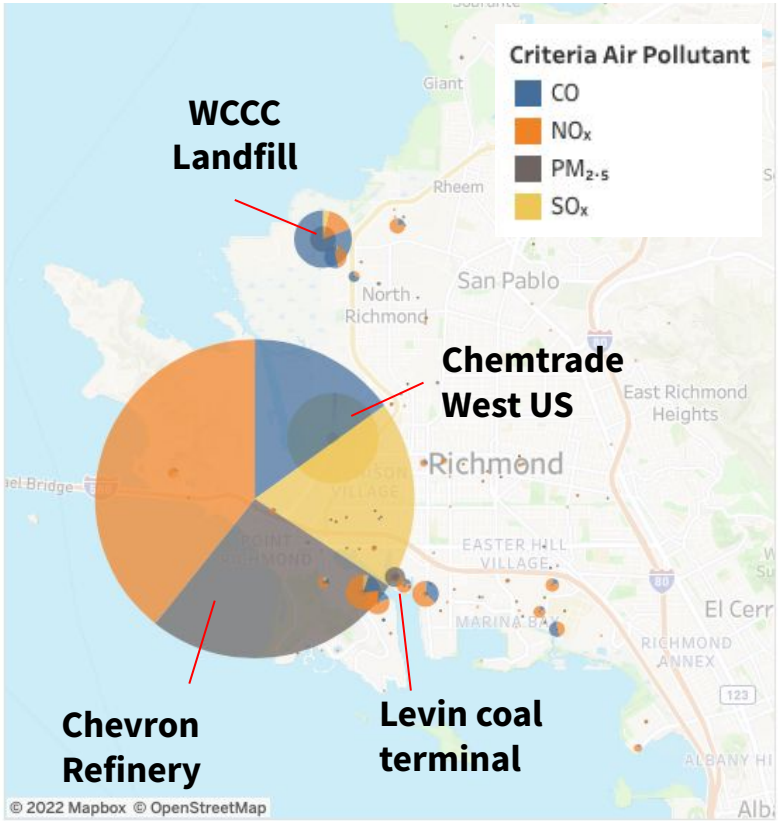
Rebecca Sugrue, a member of UC Berkeley team, joined PSE's Richmond Air Monitoring Network as a collaborator in 2020. Her research focuses on low-cost methods for the monitoring, mitigation, and mobile source characterization of particulate matter pollution in environmental justice communities in California.

Richmond Air Monitoring Network

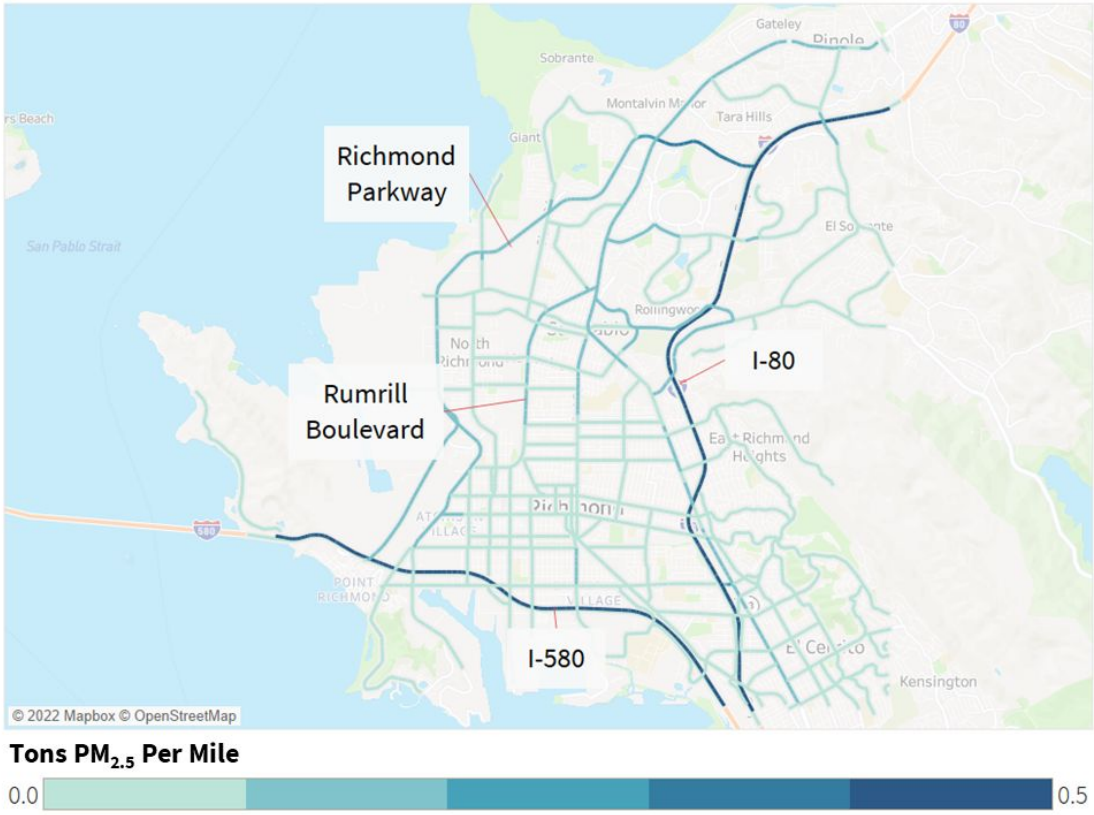
Community Context

Richmond-San Pablo: Pollution sources

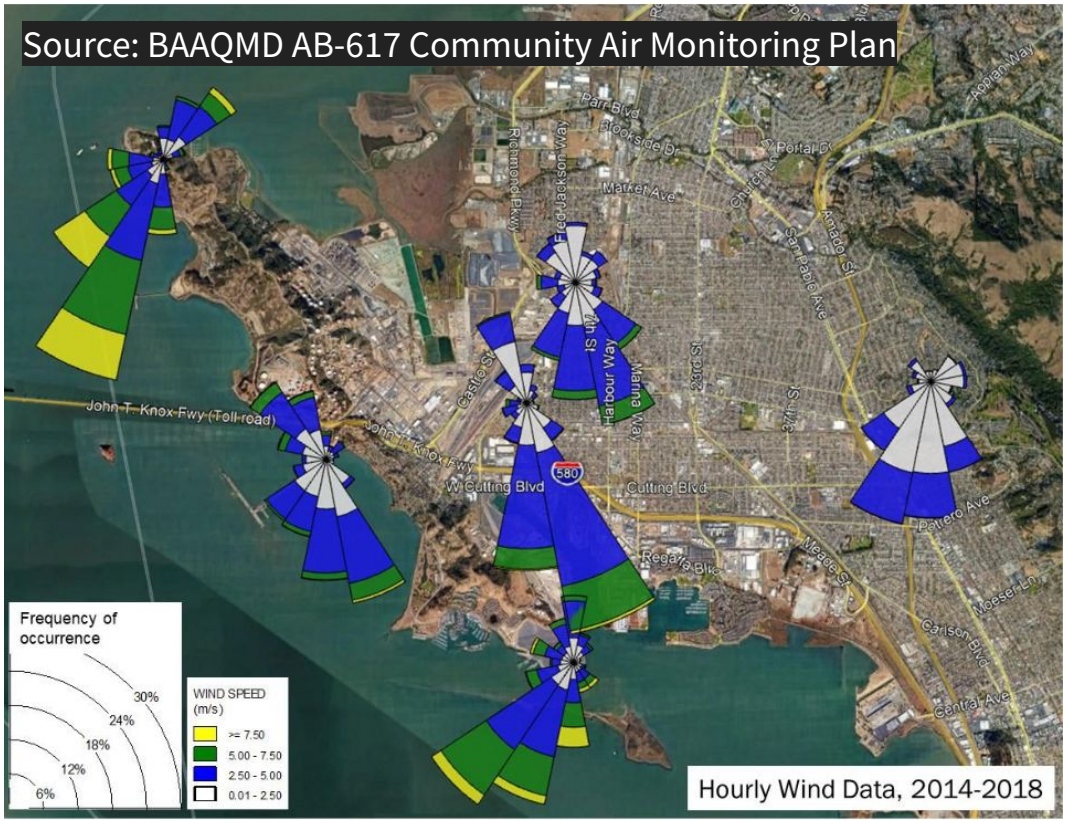
Stationary Sources

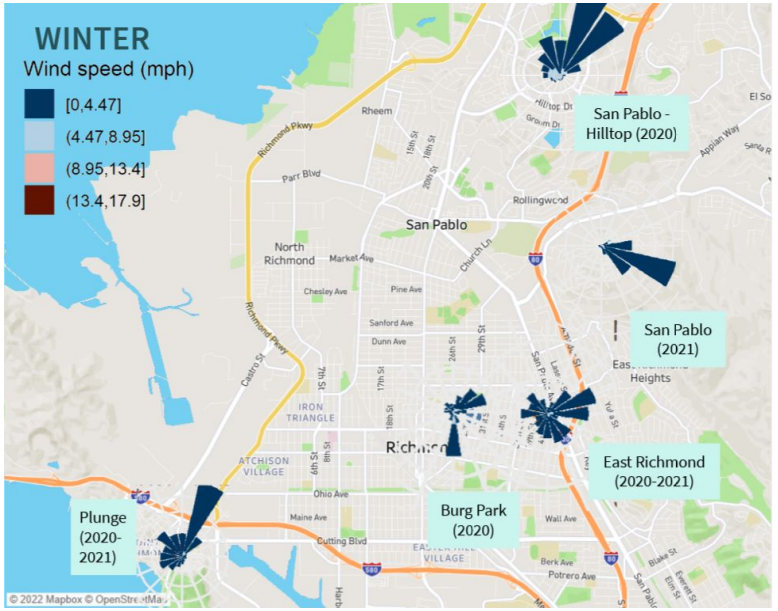


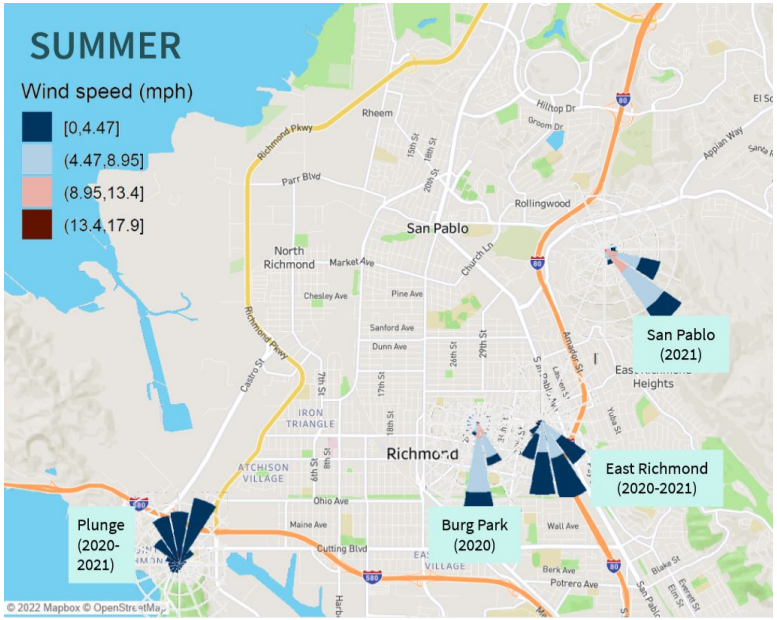
On-Road Mobile Sources



Wind Patterns

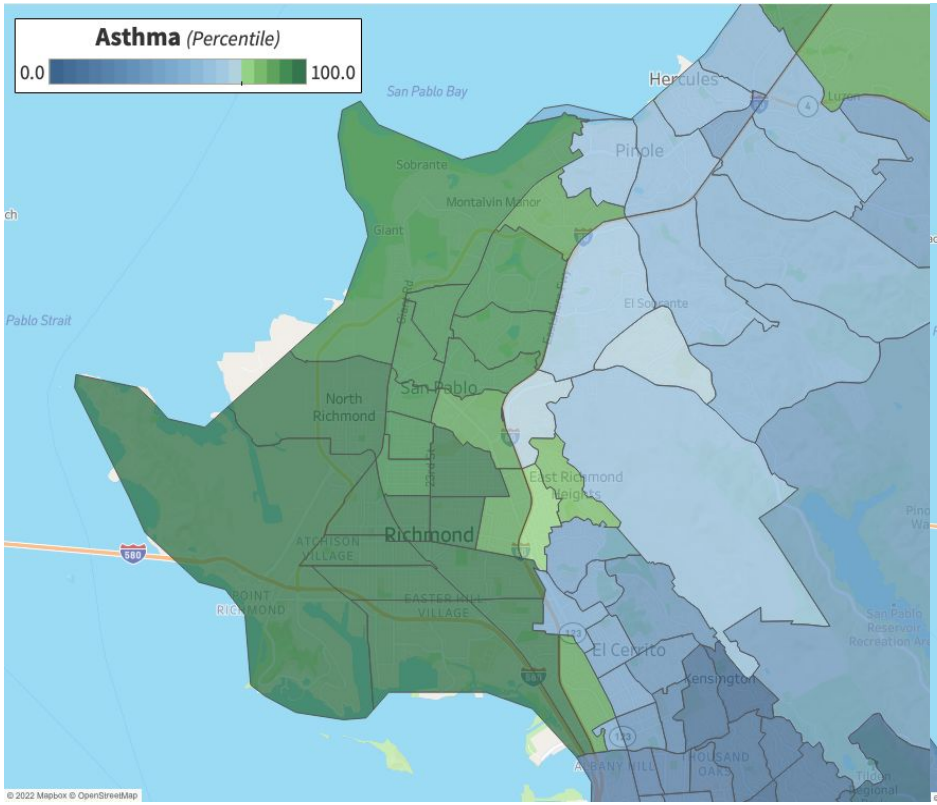




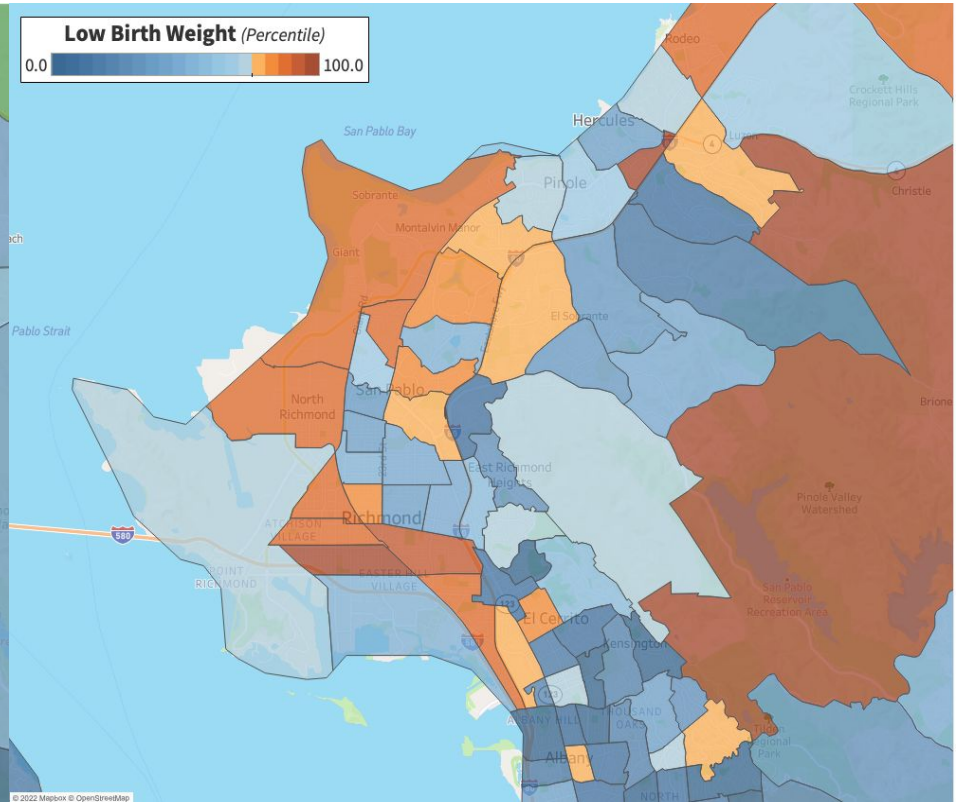


- Prevailing winds come from the south and the southwest of Richmond.
- These winds can blow air pollutants north across Richmond.

Health Outcomes Related to Air Quality

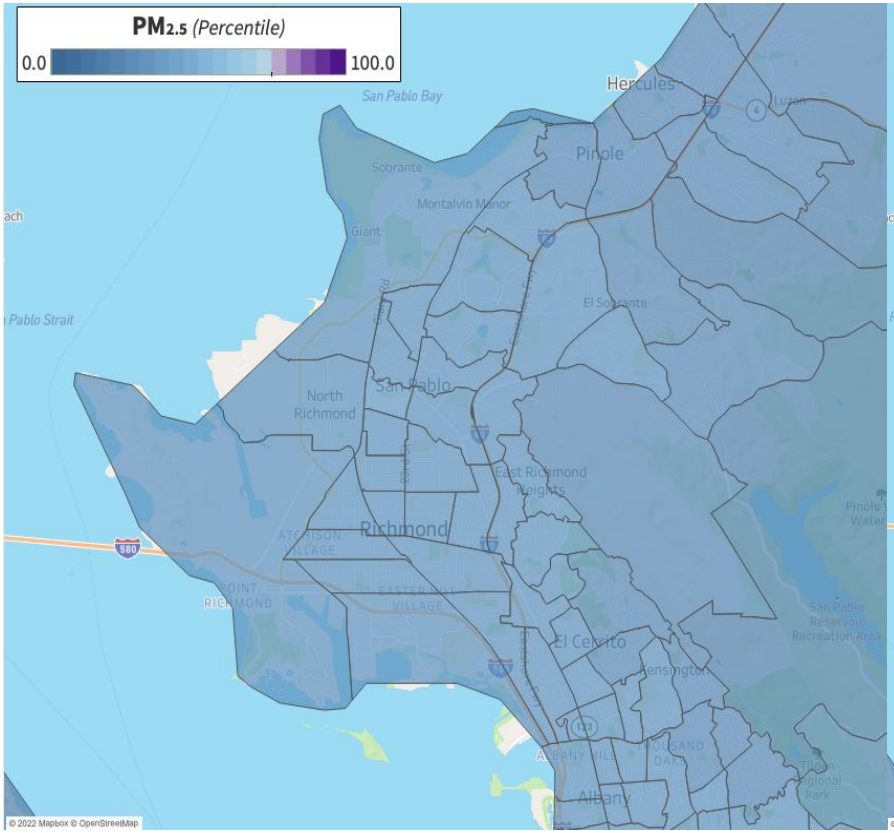


Census tracts with the highest asthma rates in the state (top 25%) are colored in green.

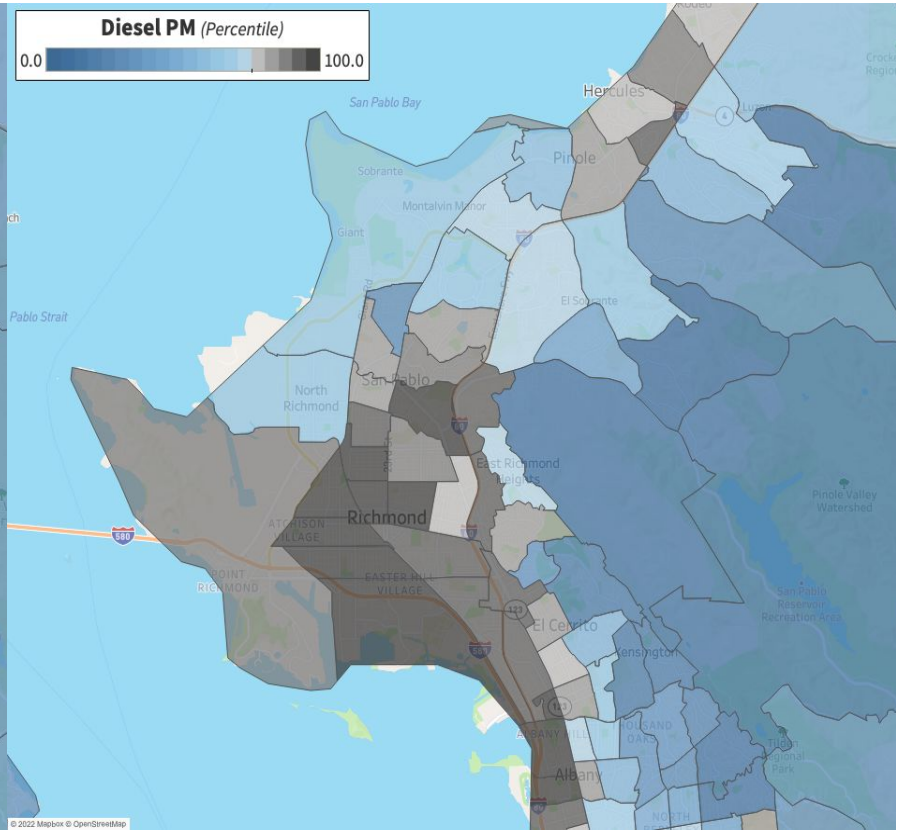


Census tracts among the top 25% in California for low birth weight are colored in orange-brown.

Air Pollution Indicators

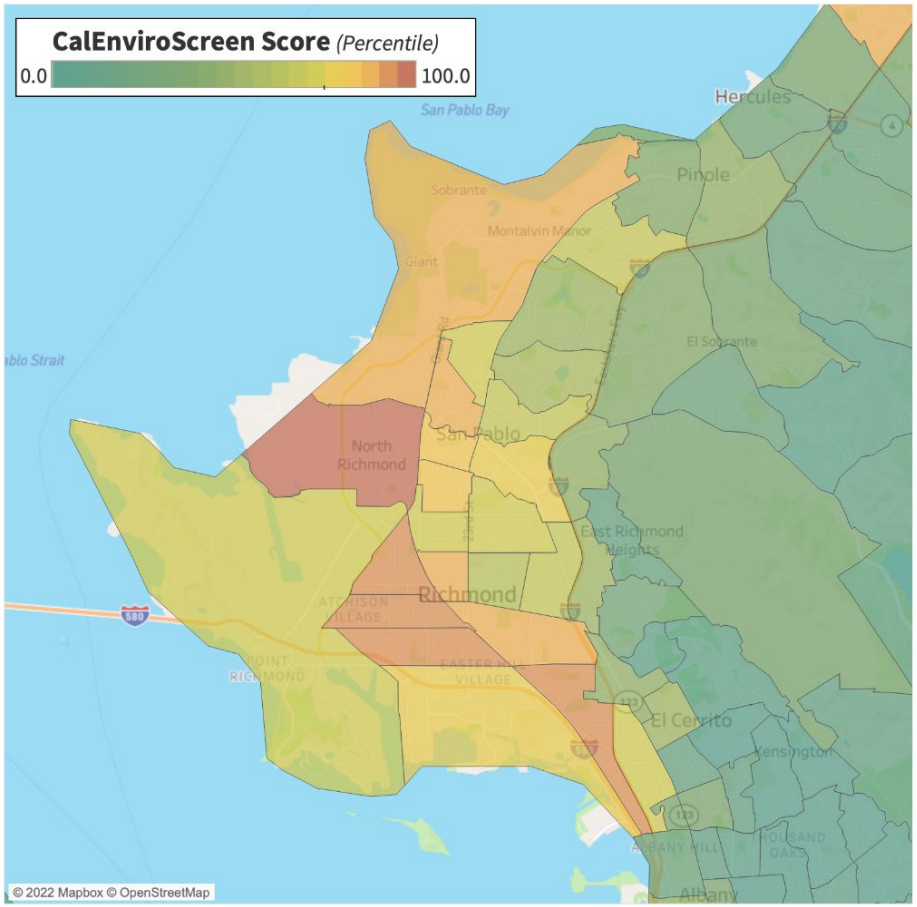


Census tracts colored in purple reflect modeled $PM_{2.5}$ concentrations that are in the top 25% of census tracts in California.

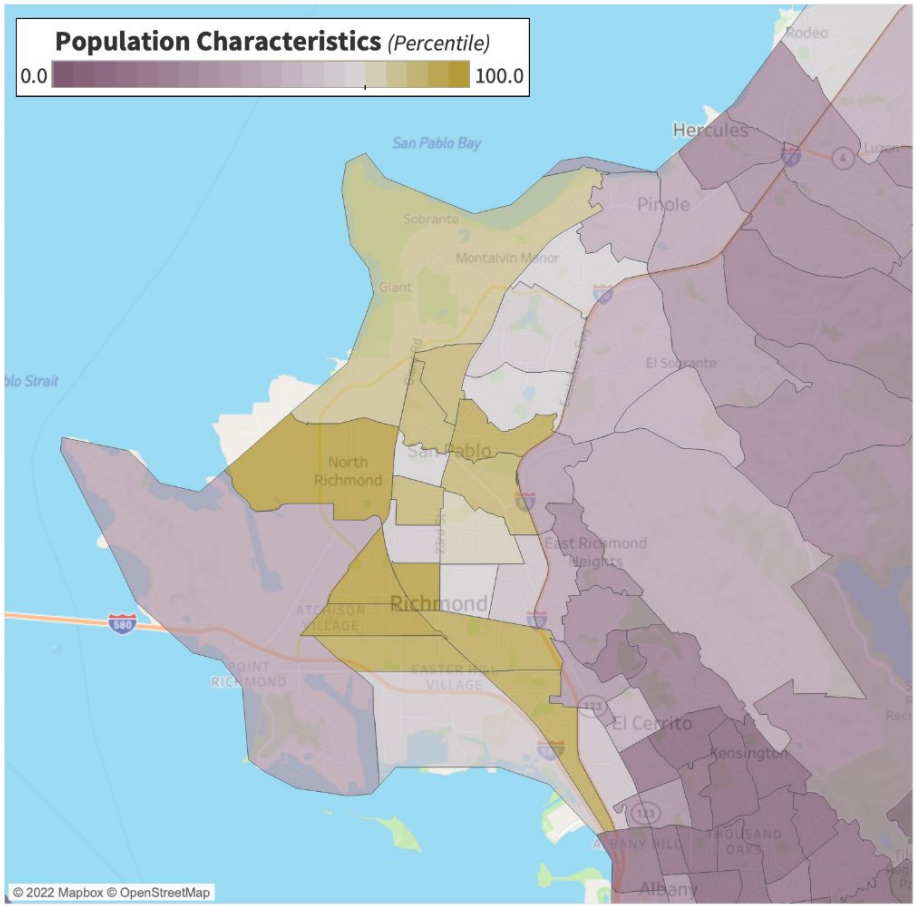


Census tracts colored in dark grey reflect higher modeled diesel PM emissions (top 25%) relative to other census tracts in California.

Cumulative Burdens and Vulnerabilities

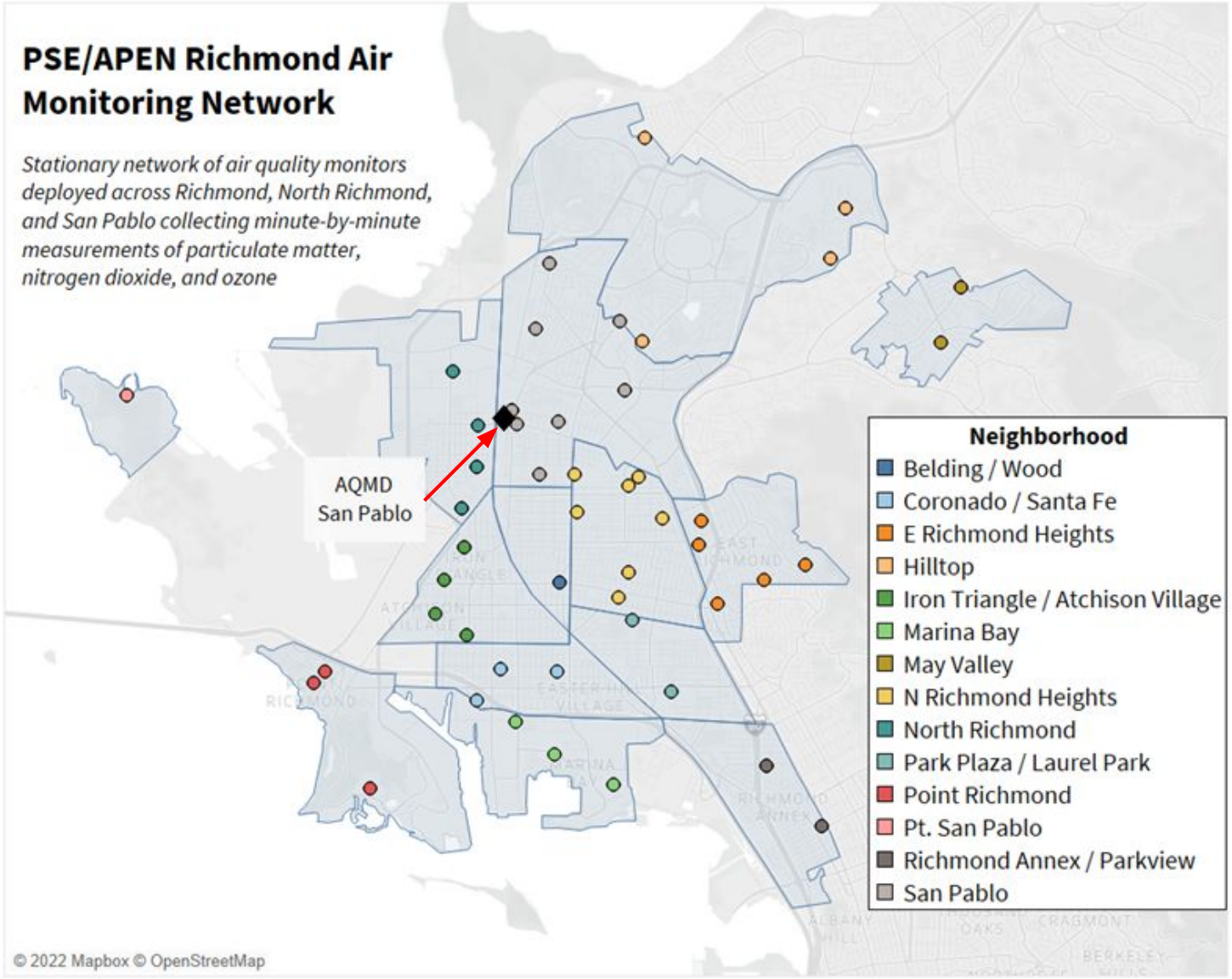


Census tracts with CES Scores within the top 25 percent (orange-red) are designated as disadvantaged communities in CA



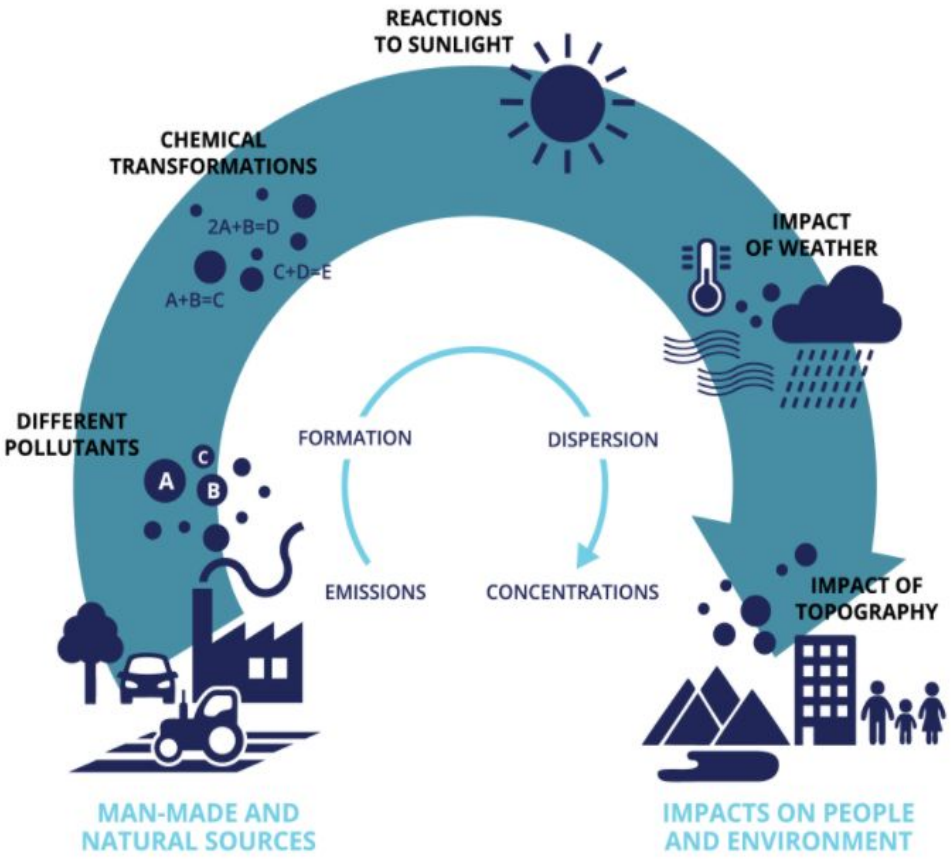
Represents physiological traits, health status, and community characteristics that can result in increased vulnerability to pollution.

The Richmond Air Monitoring Network (RAMN)



Pollutants Measured and Their Health Impacts

- Fine particulate matter **($PM_{2.5}$)**, nitrogen dioxide **(NO_2)**, ozone **(O_3)**, black carbon **(BC)** are among many air pollutants in the region.
- These pollutants can cause respiratory, cardiovascular, and neurological diseases, especially in children, the elderly, and vulnerable populations.



Source: EEA, 2015, Air Quality in Europe, 2015 Report

The Richmond Air Monitoring Network

Project Goals

- Collect air quality data for multiple air pollutants ($PM_{2.5}$, O_3, BC, NO_2)
- Deploy a dense network of monitors in areas that lack data representation
- Real-time data visualization
- Community engagement
- Policy engagement

Key Findings

Key Finding #1 – Air Pollution Sources

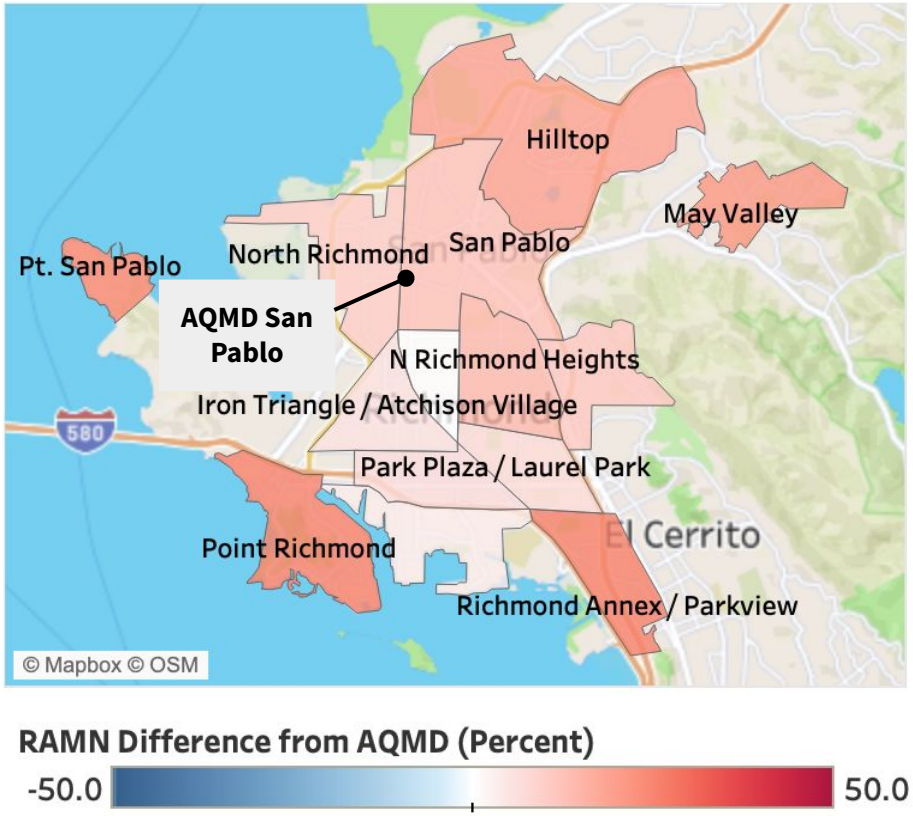
Traffic is an important source of $PM_{2.5}$, NO_x, and BC in the Richmond-San Pablo region.

- Heavy duty diesel trucks **contribute a disproportionately high** amount of particulate matter, NO_x, and BC emissions, despite being a minority of on-road vehicles.
- $PM_{2.5}$ and NO_2 were elevated **during commute hours, near freeways (I-80, I-580)**, and during times associated with **industrial truck activity**.

Key Finding #2 – Spatial Trends in Air Pollution

Average $PM_{2.5}$ levels were varied throughout Richmond-San Pablo.

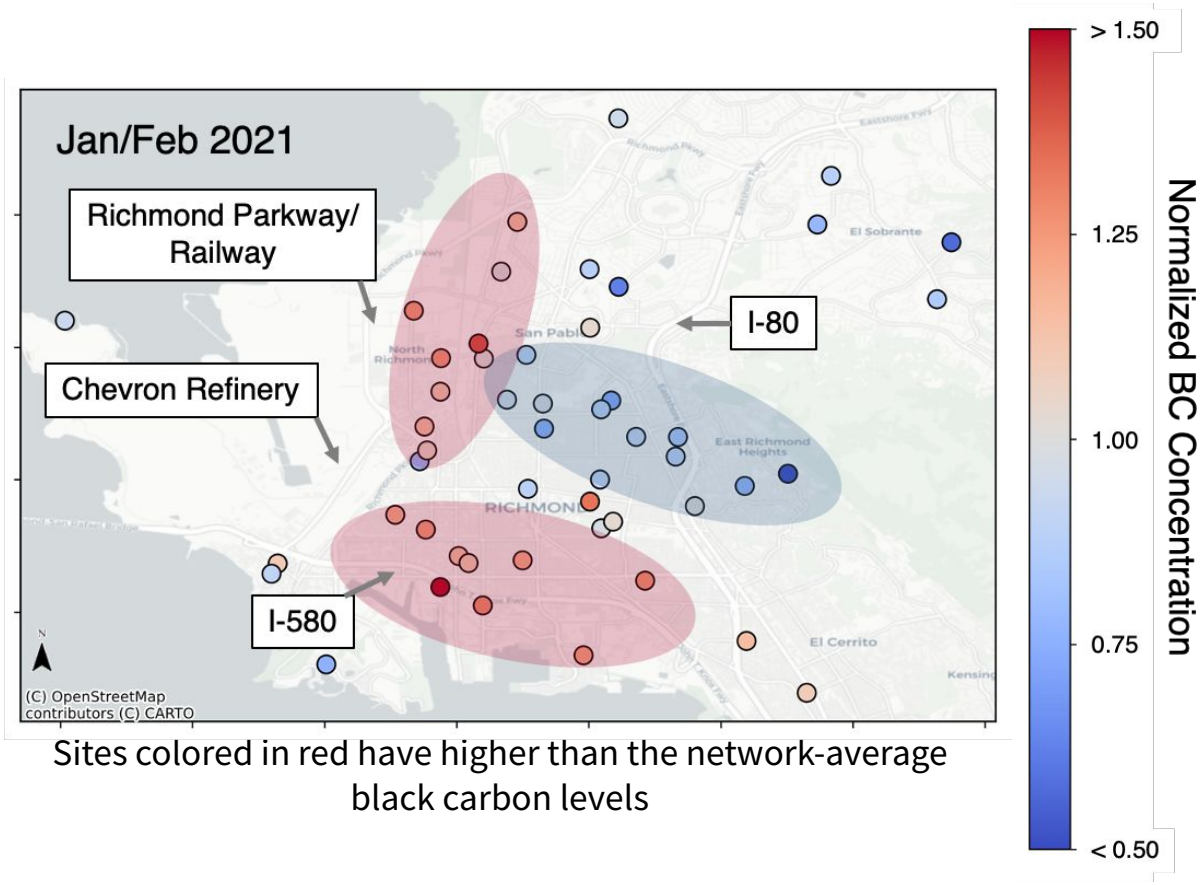
- Average $PM_{2.5}$ levels were highest in southern and northern neighborhoods.
- $PM_{2.5}$ levels were particularly high in the summer/fall months due to wildfire smoke, but also in the winter months as well.



Key Finding #3 – Spatial Trends in Air Pollution

BC (soot) measurements better indicate local pollution sources.

- BC, a type of $PM_{2.5}$, is a key pollutant from diesel engines and incomplete fuel combustion.
- Sites that experienced higher BC tended to be within 500 meters of I-580 and the Richmond Parkway.
- These sites were also closest to industrial areas, and the major rail line.

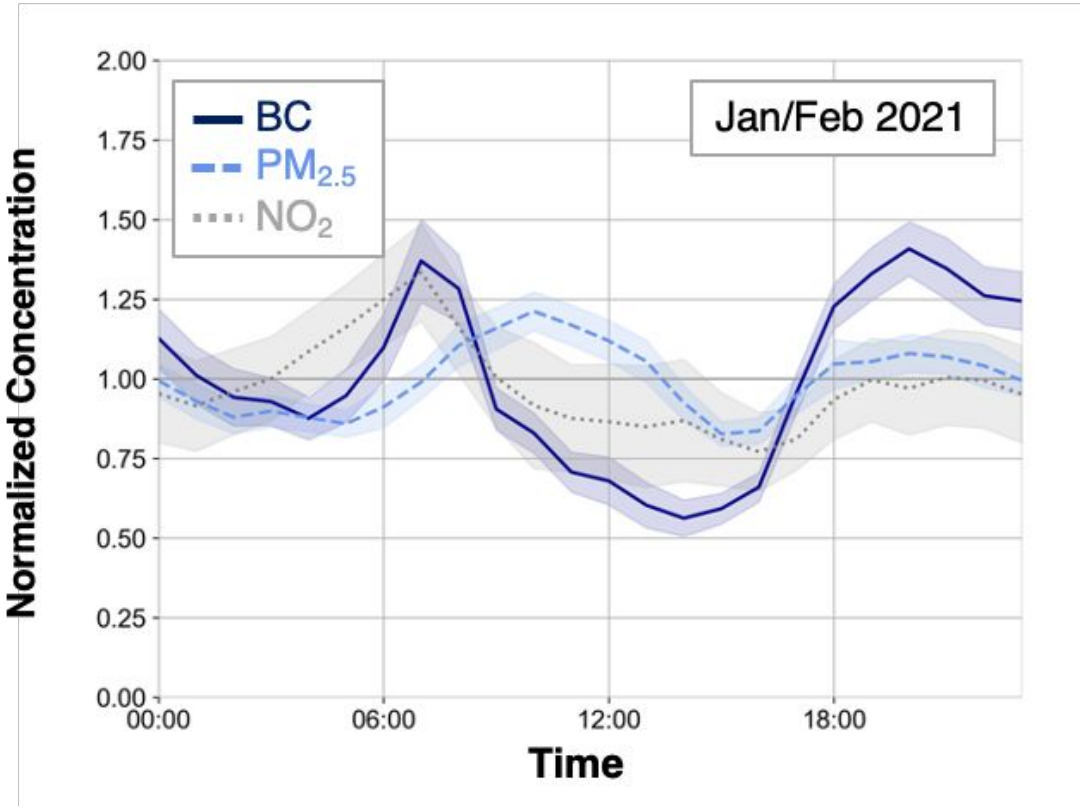


Sites colored in red have higher than the network-average black carbon levels

Key Finding #4 –Temporal Trends in Air Pollution

The combination of $PM_{2.5}$, NO_2, and BC measurements can be powerful in identifying local pollution sources.

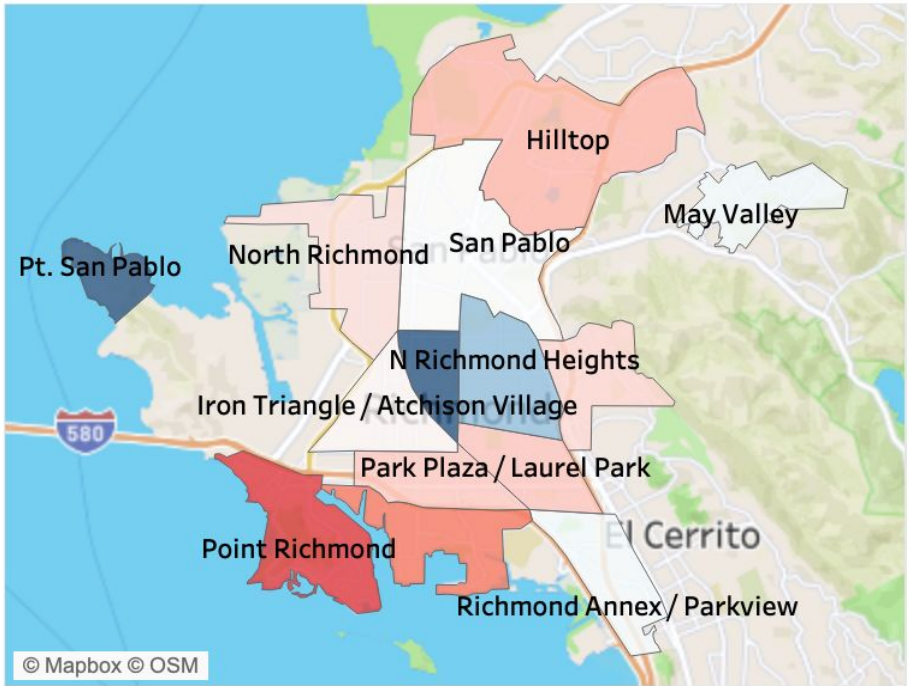
- The diurnal patterns of pollution are governed by a combination of meteorology, local emissions and activity patterns, and atmospheric formation.
- The wintertime early morning peak in BC and NO_2 concentrations coincides with on-road heavy-duty diesel truck activity, while their evening peaks differ.



Key Finding #5 – Spatial Trends Continued

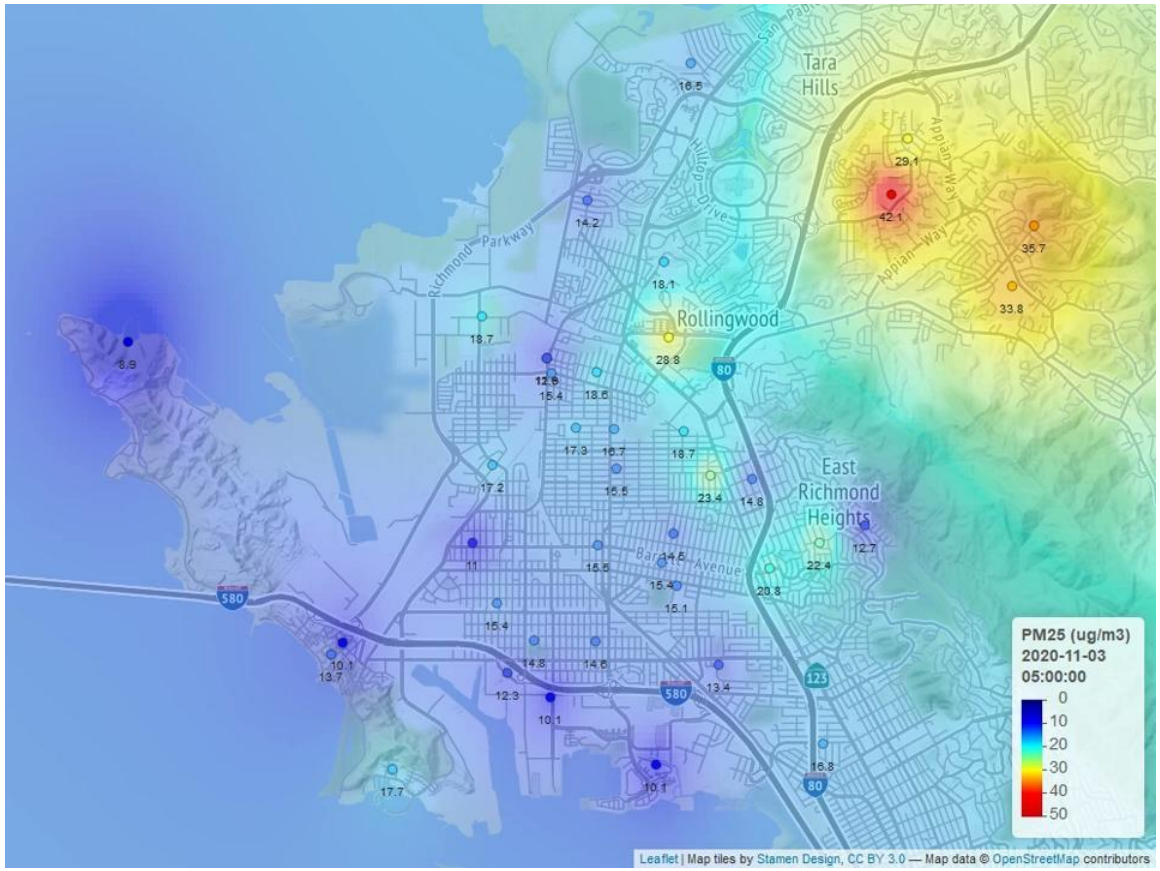
Average NO_2 levels were highest near major freeways and expressways.

- NO_2 is associated primarily with emissions from car and truck tailpipes.
- Average NO_2 levels were highest in Point Richmond and Marina Bay, and in neighborhoods adjacent to I-80 and I-580.



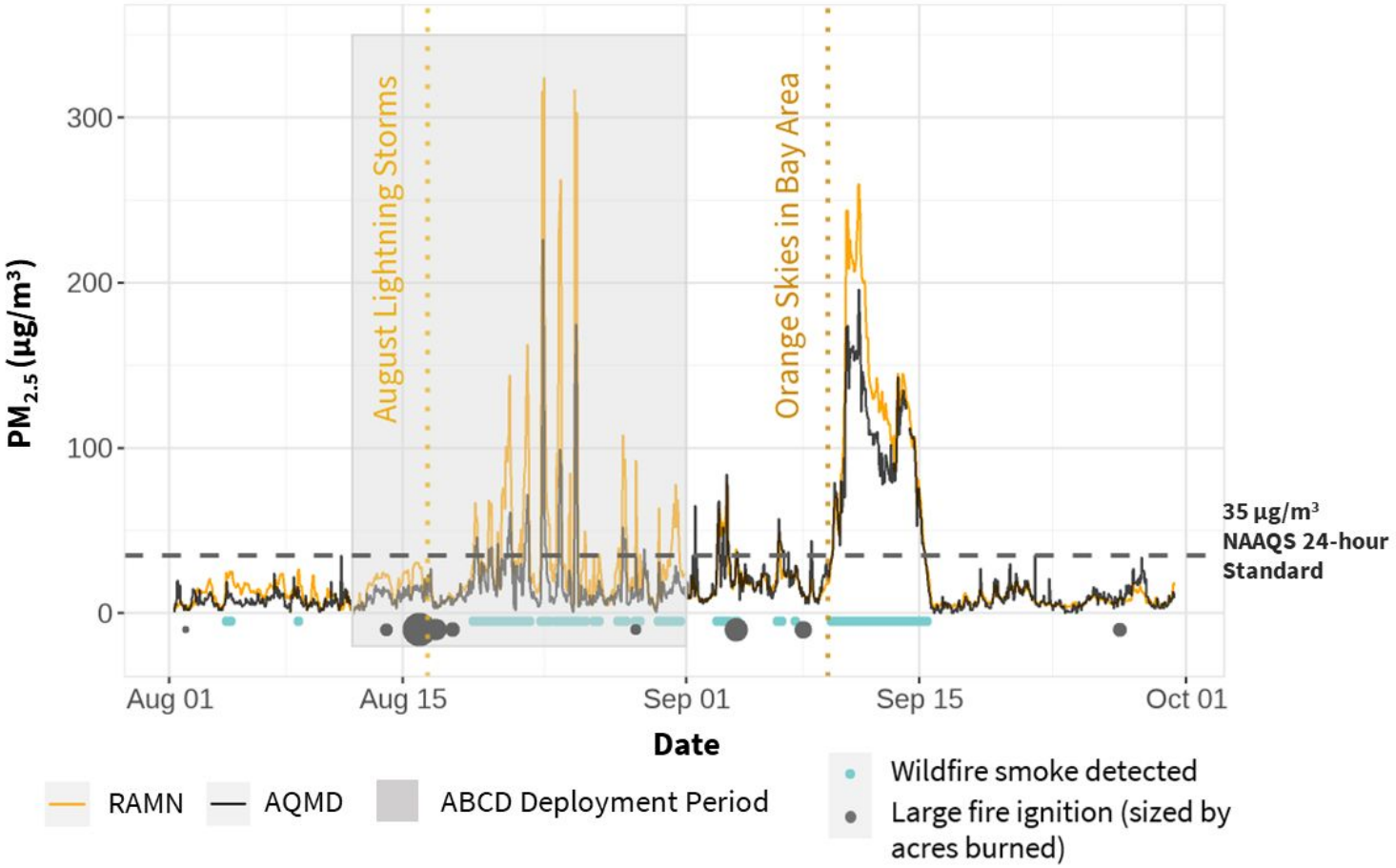
Key Finding #6 –Plumes

Dense sensor networks are able to detect fast-moving plumes and identify acute exposure events.



Key Finding #7 –Wildfires

Wildfires caused acute $PM_{2.5}$ exposure events.



Key Finding #8 – Public Health Context

Average $PM_{2.5}$ concentrations over the study period exceeded health-based standards.

- Average $PM_{2.5}$ levels for the full study period were 12.6 micrograms per cubic meter (inclusive of wildfire events), slightly exceeding the federal standard of 12 micrograms per cubic meter.
- The $PM_{2.5}$ average for 2021 was 10.1 micrograms per cubic meter, **double the WHO annual standard of 5 micrograms per cubic meter.**
- NO_2 and O_3 measurements were lower than federal standards, but adverse health impacts are still possible.

Mitigation Strategies and Recommendations

Mitigation Strategies and Recommendations

Heavy-duty truck electrification, public transit, and other traffic emissions reductions should be prioritized.

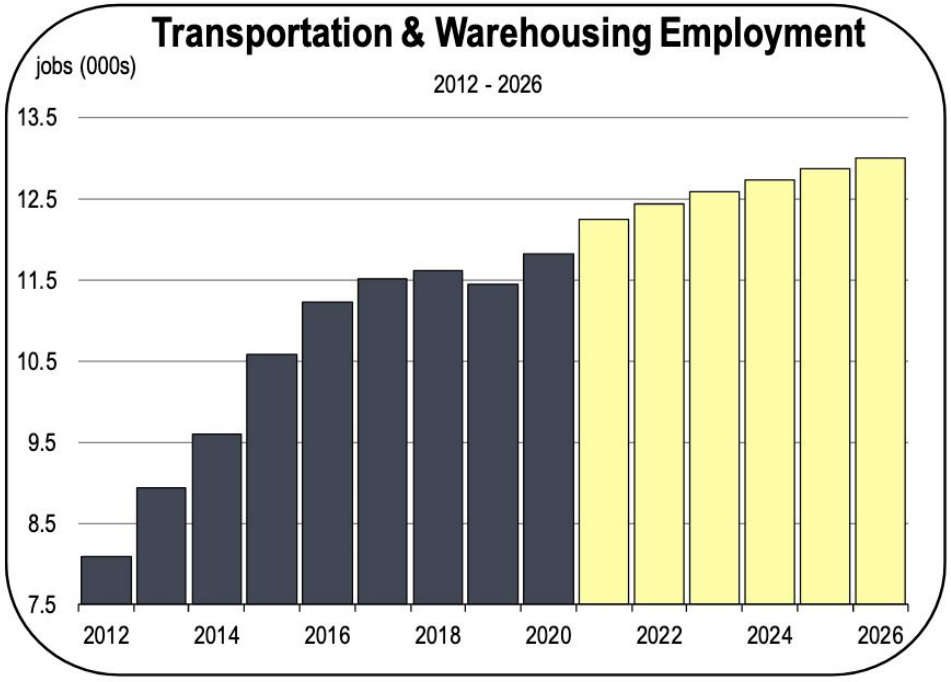
- Provide incentives for businesses to electrify truck fleets.
- Move up the timeline for 100% zero-emission medium and heavy-duty trucks sales.
- Reroute trucks away from areas experiencing high cumulative environmental burdens.
- Prioritize investments in local and regional electrified public transit to reduce overall vehicles miles travelled
- Tree planting and other urban greening efforts along traffic corridors may help protect sensitive groups from vehicular air pollution.

Mitigation Strategies and Recommendations

Restrict industrial development that brings heavy traffic and industrial air pollution into urban areas and EJ communities.

- The Department of Transportation projects growth for many industries in Contra Costa County that rely on heavy trucks, like warehousing – particularly in the Western and Northern Richmond shorelines.

- Zoning and land use policies can limit warehouse development and industrial projects that bring large trucks and other traffic to environmentally-burdened communities.



Source: Department of Transportation, 2021, Contra Costa County Economic Forecast.

Mitigation Strategies and Recommendations

Increase community access to data on other health-damaging air pollutants not captured by RAMN.

- Many additional health-damaging air pollutants are emitted that are more difficult to measure with low-cost sensors, including air toxics
- BAAQMD and Chevron have been measuring some of these air pollutants, including some emitted by key stationary sources (Chevron refinery, West Contra Costa County Landfill, etc.)
- These pollutants may correlate more with health outcomes than the pollutants measured by RAMN, and historical data should be made publicly available.
- Regular reports should be provided on the progress on implementation of rule 11-18, which focuses on reducing health risks from facilities that have high air toxics emissions.

Mitigation Strategies and Recommendations

Meaningful community engagement and participation in the development of the community emissions reduction plan.

- Direct community engagement is vital for understanding concerns, identifying local emission sources/hotspots, and developing successful mitigation strategies.
- Local community leaders from Richmond, North Richmond, and San Pablo have been working with the Air District to develop a Community Emission Reduction Plan (CERP).
- Community participation is critical to the development of the CERP to ensure a community-driven plan that reflects the community's values, needs and concerns.

Acknowledgements

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