Bridging the Gap Between Air Quality Monitoring and Under-Represented Communities

CALIFORNIA AIR RESOURCES BOARD

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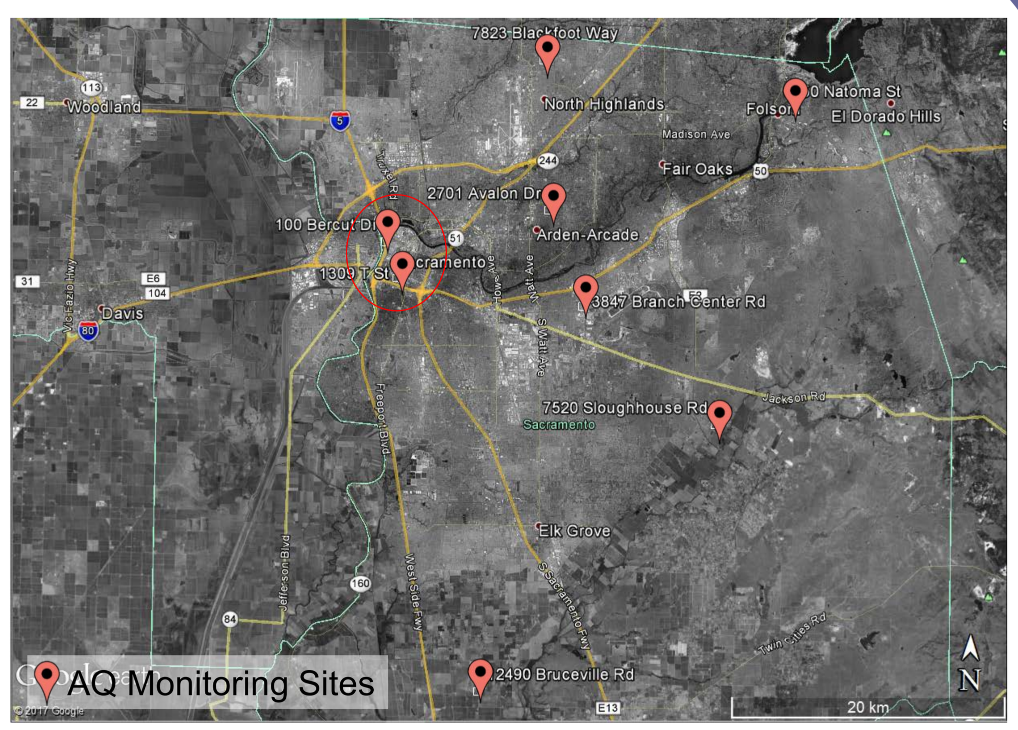
Motivation

1. Assembly Bill 617 (Garcia, 2017) directs CARB to develop a statewide strategy to reduce emissions of toxic air contaminants and criteria pollutants in communities affected by a high cumulative exposure burden.
2. Over 260 monitoring stations exist in California, but are spatially sparse and may not represent the air quality (AQ) in adjacent communities.
3. Recent studies point to discrepancies between regional and local AQ (see references).
4. There is a need to develop air pollution control and mitigation strategies based on AQ data with finer spatial resolution that better characterizes exposure burdens and health risks in local communities.

Existing Monitoring Network



1. CARB and SMAQMD have 8 regional AQ monitoring sites within Sacramento County (some of them in operation since the 80's).
2. Measured air pollutants include O_3, NO, NO_2, NO_x, CO, SO_2, NMHC, $PM_{2.5}$, PM_{10}, PM speciation, and BC.
3. The annual average concentrations at these monitoring sites in 2016 were 27.1±2.8 ppb, 5.7±2.3 ppb, and 7.7±1.0 μg/m³ for O_3, NO_2, and $PM_{2.5}$, respectively. These measurements were made using FEM/FRM.
4. Two monitoring sites are located within disadvantaged communities (highlighted with red circles; top 20% of all CalEnviroScreen scores statewide).
5. Operations of these monitoring sites are resource intensive and the existing network lacks spatial density; may not represent the local AQ in adjacent communities.

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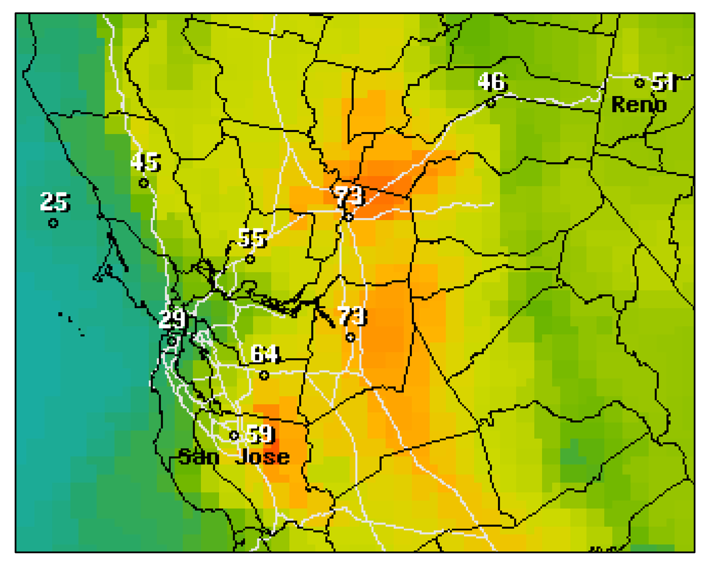
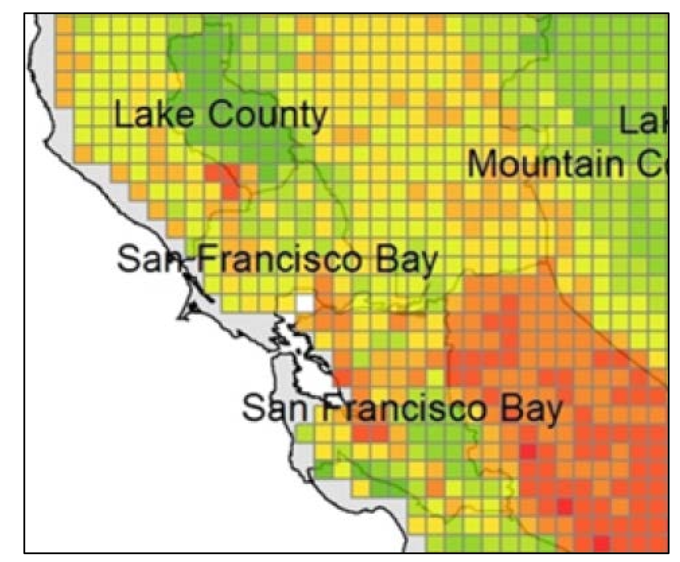
Tiered Approaches to Identify Under-Represented Communities

Tier 1: Air Quality Modeling and Satellite Data

NOAA AQ Model for 1 Hr Avg. O_3



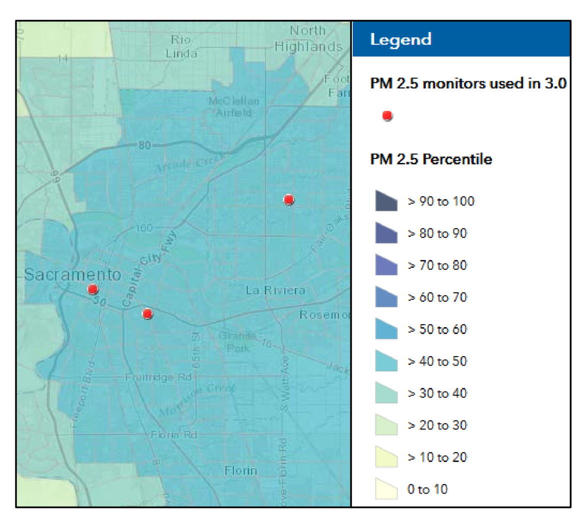
MODIS Satellite-derived $PM_{2.5}$



1. AQ modeling and satellite data can generally identify the location of criteria pollutant hot-spots.
2. AQ modeling relies on air monitoring data and emission inventory information, and produces spatial maps with 4 x 4 km grid cells for the development of State Implementation Plans (SIPs). Other AQ models (dispersion/transport and chemistry) are also used in many applications to understand local and regional AQ.
3. Satellite (MODIS) data are obtained daily in cloud-free conditions and used to estimate $PM_{2.5}$ in statistical models. Product is an annual aggregated dataset in 10 x 10 km grid cells.

Tier 2: Monitoring and Inventory Data

AQ Monitoring Data



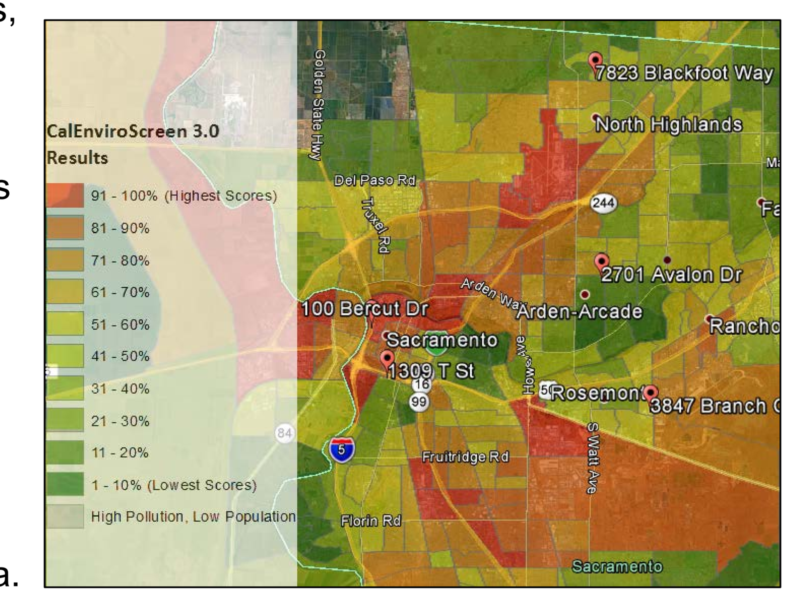
CEIDARS Point Source

1. Existing air quality monitoring network produces real-world AQ measurements that can be used in AQ modeling efforts.
2. Inventory data, such as CEIDARS, can be used to identify potential areas of high air pollution exposure.

Tier 3: Statistical Data

OEHHA CalEnviroScreen 3.0

1. CalEnviroScreen scores are based on various parameters/indicators including exposure, environmental factors, sensitive population, socioeconomic factors, health statistics, etc.
2. CalEnviroScreen can be used to pair various information at air pollution "hot-spots" identified by satellites, AQ modeling, and AQ monitoring at census tract level, and further compared with emission inventories and other existing data.



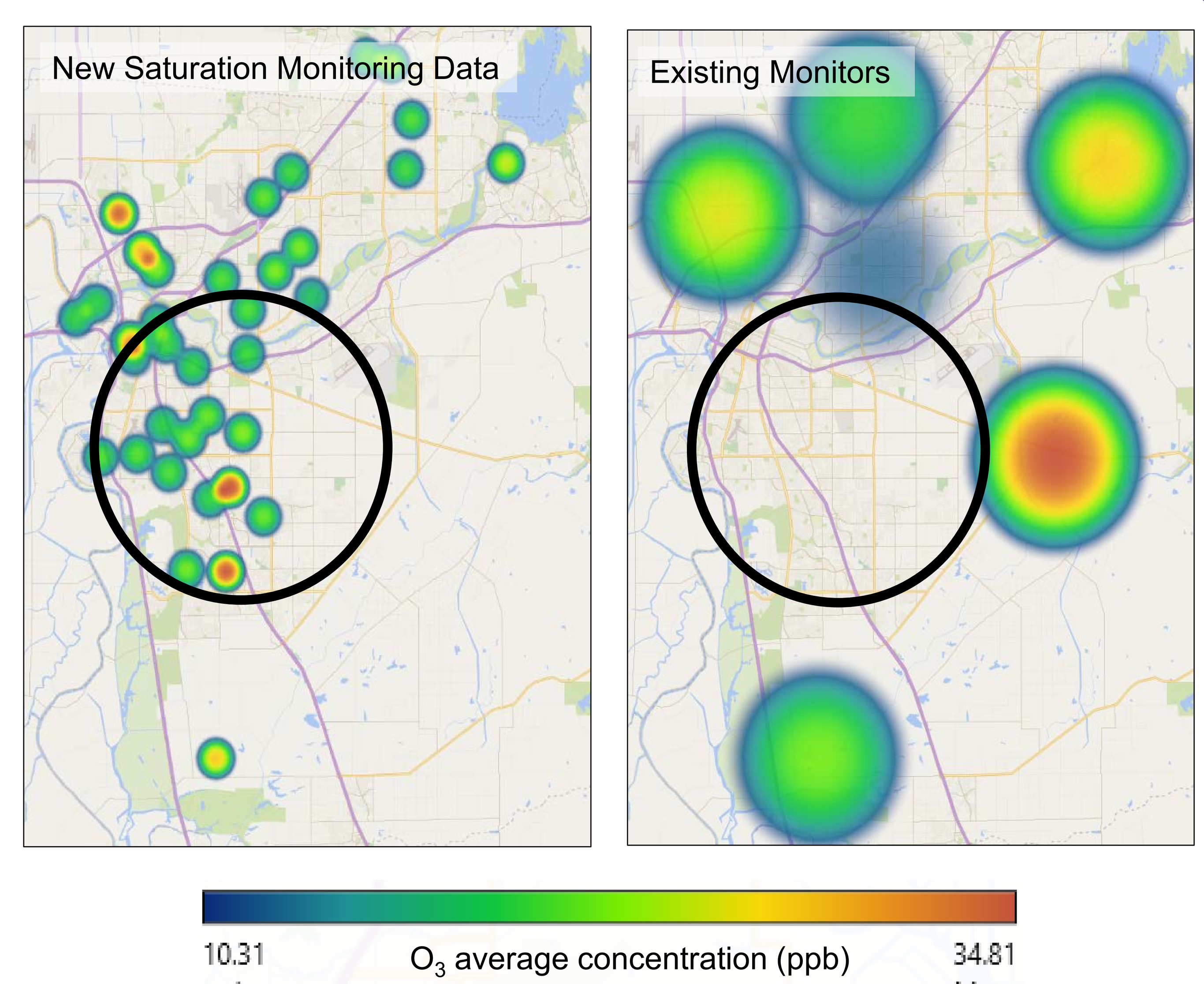
Pilot Study – Utilization of Saturation Air Monitoring in Sacramento, CA

Tier 4: Saturation Air Monitoring

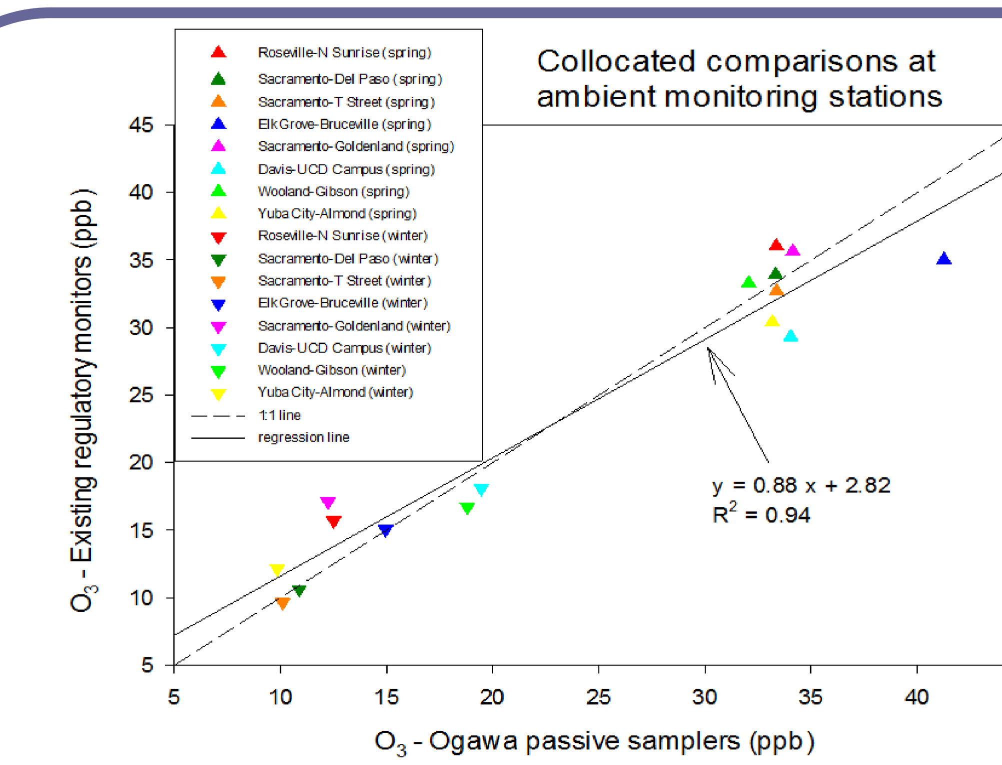
1. Measurements were made in spring and winter of 2016 using passive samplers (PS-100, Ogawa USA) at 72 different locations throughout local communities in Yolo and Sacramento County. PS-100s were deployed to quantify two-week average concentrations of O_3 and NO_2 at each sampling site. Below are the resulting data:
   - Annual: 22±5 ppb O_3 and 6±1 ppb NO_2
   - Spring: 32±4 ppb O_3 and 3±1 ppb NO_2
   - Winter: 11±4 ppb O_3 and 9±2 ppb NO_2
2. Comparison between the saturation air monitoring data and the regulatory monitoring data identifies an under-represented community located near Highway 99, where O_3 concentrations are approximately 170% of the median concentrations.

Study Challenges:

1. QAQC of low-cost AQ sensor: performance/calibration/maintenance
2. Consistency in operating AQ sensors
3. Consistency in sampling strategies at each community
4. Data analysis/interpretation/sharing
5. Cost effective deployment of saturation monitors



Quality Assessment of Pilot Study Data



New network data are consistent with the existing monitoring data at collocated sites within 2% with RSQ > 0.90.

Future Needs

To better represent air pollution exposure in various communities, there are needs for:

1. Higher-resolution satellite estimates
2. Spatially disaggregated emission inventories
3. Additional air monitoring data to improve modeling results
4. Utilization of advanced monitoring technologies at the community-scale with a unified visualization tool to inform the public and to develop air pollution mitigation strategies
5. Strong communication and collaboration with local air districts (e.g., public policy guidance like "Planning Healthy Places" created under SB 375)
6. Community outreach (engagement, education, and empowerment)
7. Incorporation of low-cost air sensors and additional monitoring strategies to better represent disadvantaged communities

Summary

Saturation air monitoring and targeted action plans can help improve AQ in local communities. Statistical analyses are required to develop a comprehensive monitoring strategy to improve the representation of various communities and to understand air pollution exposure.

References

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