Recommendation: more regulatory sensors in the ECV.

Abstract:
Many rural regions lack data and monitoring programs for air quality. This puts rural residents at a disadvantage because they can’t rely on the regional air districts to protect them against public health hazards. The rural Eastern Coachella Valley (ECV) doesn’t have a publicly available air quality monitoring program. The region is consistently acknowledged to have poor air quality but detailed real-time data are lacking and many residents experience the negative health effects from poor air quality. This limits the ability of residents to advocate for themselves and to gain the ear of elected officials for mitigation. This paper describes the problem in the ECV, provides background on air quality data and recommends an action. The Alianza Coachella Valley recommends that more regulatory sensors should be placed throughout the Eastern Coachella Valley in conjunction with low-cost sensors that are maintained by the SCAQMD.

1. Problem statement:
The Eastern Coachella Valley is impacted with poor air quality from mobile sources, industrial sources and environmental sources. Some major contributors are the decline of the Salton Sea exposing playa with high erosion potential, agricultural activities and the biomass recycling industry near the community of Mecca. Despite acknowledged poor air quality, there is a lack of real-time data available in the region to residents and policy-makers.

2. Background
The elevation of the Coachella valley extends from 479 feet in Palm Springs, down to -226 feet at the shoreline of the Salton Sea in the community of North Shore. The Air Quality across the Coachella valley varies with blow-sand in the west of the valley, heavy agricultural activity in the eastern valley including controlled burns, goods movement along the highways and industrial activity near the Mecca Industrial complex.

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1 Alianza Coachella Valley. [http://alianzacv.org/](http://alianzacv.org/)
2 Written by Ryan Sinclair PhD and Josi Gaio of Loma Linda University and Gail Wadsworth of the California Institute for Rural Studies.
The Eastern Coachella Valley consistently falls outside the level of safe air quality standards as determined by the United States Environmental Protection Agency. Residents in the East Coachella Valley have complained of poor air quality for a number of years and have requested more monitoring sites. There are a number of reasons for this request, one being the existence of odors that make residents ill and a lack of knowledge regarding these odors.

Focused discussions with community residents within some of these rural communities have addressed the lack of timely and adequate data on air quality. In 2011, students and staff at Saul Martinez Elementary School in Mecca became ill from aerially borne odors. Students and staff were evacuated, the school closed and several were taken to hospital. However, there was no way to pinpoint the source of these odors or the composition. In 2012, the entire South Coast Region was inundated with odors originating at the Salton Sea.

The current Air Quality Monitoring District air monitoring network meets or exceeds U.S. EPA monitoring requirements. However, meeting minimum monitoring requirements is just one factor in determining the value of sites and measurements. There are many potential sources that decrease air quality in the Eastern Coachella Valley including diesel particulates from goods movement, pesticide drift, smoke from burning agricultural residues and at dump sites, windstorms and energy plants. However, without adequate monitoring sites, the emissions from these activities are not recorded and their potential health effects are unknown.

3. Air Quality Questions about the Salton Sea

The Salton Sea is receding with 48,000 acres of playa expected to be exposed by 2028 (1). Community members and advocates are concerned about exposure to windblown contaminants from the increased amount of exposed, easily wind-erodible playa. The wind blows towards the South East (towards the Salton Sea) for most of the year with the exception of the summer months when it can reverse direction and blow from the Salton Sea into the Eastern Coachella Valley.

The popular media has reported that the exposed playa will lead to deteriorated air quality and carry “pesticides such as DDT and heavy metals that have accumulated in the lake for decades” (2). Some local community groups in North Shore have identified nose bleeds and respiratory problems in children as attributable to the Salton Sea and poor air quality (3).

The state agency that is managing the Salton Sea works with the Imperial Irrigation District and the California Air Resources Board (CARB) to collect air quality data from around the lake. The air sensors with publically available data include four regulatory sensors located in the Eastern Coachella Valley (ECV)(4), one regulatory sensor in Palm Springs, three purple air sensors in the ECV, and two IVAN air sensors in the ECV.
Stakeholders, local advocates and community members have questions about the sensors and if those sensors are an appropriate response to the community’s air quality concerns from the Salton Sea and other local emission sources.

This document addresses the following questions raised by the community:

1. What are the primary air quality contaminants of concern in and around the Salton Sea?
2. How is poor air quality currently addressed by agencies through monitoring and reporting?
3. Can the air quality concerns of residents living near the Salton Sea be addressed through "community-placed" low-cost air sensors?

4. Contaminants

There are four air quality contaminants that are monitored by a network of regulatory sensors near the Salton Sea at Torres-Martinez, and in North Shore, Mecca, Indio and Palm Springs. Those contaminants are **PM10, PM 2.5, H2S and Ozone**. There are others that are not monitored, such as selenium, which can pose risks. A summary of these measurements and the real-time air quality indicator for the entire valley is on the South Coast Air Quality Management District (SCAQMD) website (5). While the real time air quality indicator is updated every hour for the entire Coachella Valley, air quality is not separated for the east or west portions of the valley. The raw sensor data to generate this information is available to the public on the California Air Resources Board (CARB) Air Quality Information System (AQMIS) with a delay ranging from a few days to 2 months (6) for data screening and quality control. The H2S sensor data is the only SCAQMD public data with a real-time data summary available on a website designed to inform the public about the Salton Sea (7) from two sensors.
a. PM10

The PM10 Air quality problem has put the Coachella Valley out of federal and state compliance since 1990 (8–10). The PM10 is the larger type of particle that is generated by erosion and fragmentation of the desert soils “that may be further pulverized by motor vehicles on roadways and re-suspended in the air” and then blown in the valley’s heavy winds (9). The federal standard for PM10 is not to exceed 150 µg/m$^3$ over a 24 hour period more than once per year over three years. The state standard for PM10 is not to exceed 50 µg/m$^3$ more than once per year over three years (6).

The source of PM10 non-compliance in most of the Coachella Valley is from blow-sand and construction activities caught in the general southeastern wind and reported on four of the five regulatory sensors of the valley (Table 1 and Figure 1). The agricultural source of PM10 occurs in the agricultural zone south of Indio and would not have contributed to PM10 reports because the prevailing winds blow southeast for most of the year (Figure 2). The exception to this is for the months of July and August when the winds reverse direction and wind blows into the Eastern Coachella Valley from the Salton Sea (Figure 3).
The five regulatory sensors placed in the Coachella Valley are designed to measure PM10 with high precision. The data for 2018 were evaluated for this white paper to
determine the correlation between the Indio TEOM sensor\(^3\) and the Saul Martinez TEOM in two air sensors that are 12.8 miles away from each other. The correlation between these two regulatory sensors is high considering the distance between the sensors.

This analysis also evaluates the utility of two low cost PurpleAir sensors\(^4\) ability to estimate the PM10 that is measured by nearby regulatory sensors. This is a field-scale analysis that evaluates low-cost sensors within a mile of a regulatory sensor. This is different than two sensors co-located at the AQ-SPEC field evaluations (11). The two regulatory sensors that are compared to the two PurpleAir sensors are located at two different sites in Indio and Mecca.

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\(^4\) PurpleAir: Air Quality Monitoring [https://www.purpleair.com/](https://www.purpleair.com/)
**Figure 5** Graphs showing comparison data from regulatory and Purple Air Monitors for PM2.5

The Indio TEOM sensor is located 4050 feet away from a PurpleAir sensor and the Mecca sensor is located 1750 feet away from another comparable PurpleAir sensor. The graphs above in

<table>
<thead>
<tr>
<th>REGULATORY SENSOR COMPARISON</th>
<th>PURPLEAIR SENSOR COMPARISON</th>
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<tbody>
<tr>
<td><img src="image" alt="Graph showing comparison of regulatory and PurpleAir sensors for PM2.5" /></td>
<td><img src="image" alt="Graph showing comparison of regulatory and PurpleAir sensors for PM2.5" /></td>
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Figure 4 show that there was no correlation in the PM10 data streams from the PurpleAir sensors when compared to the nearby regulatory sensors or when compared to other nearby PM10 PurpleAir sensors.

This was true for data comparisons in Mecca and in the city of Coachella. The low cost PurpleAir sensors do not reliably estimate the PM10 values. This discrepancy is due to the PurpleAir sensors not having a field calibration and a unique type of light scattering error that exists for large particles in a laser sensor designed for smaller particle counting (12). The South Coast Air Quality Management District AQ SPEC is currently evaluating two new low cost sensor platforms that field calibrate laser sensors to a mobile air quality platform. These newer low-cost sensors could be alternatives to the PurpleAir PM10 calibration challenges (12).

**Table 1** Regulatory Sensors located in the Coachella Valley as of April 1, 2019. The sensor text with active hyperlinks can be downloaded from the AQMIS.

<table>
<thead>
<tr>
<th>Sensor Site Name</th>
<th>Available sensors.</th>
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<tbody>
<tr>
<td>Torres–Martinez 33601</td>
<td>H₂S, TEOMPM₂.₅, Outdoor Temperature, Relative Humidity, Wind Direction-Scalar, Wind Speed-Scalar, Barometric Pressure</td>
</tr>
<tr>
<td>Salton Sea Park 33602</td>
<td>TEOMPM₁₀, TEOMPM₂.₅, Outdoor Temperature, Relative Humidity, Wind Direction-Scalar, Wind Speed-Scalar, Barometric Pressure</td>
</tr>
<tr>
<td>Indio-Jackson Street 33157</td>
<td>O₃, Hi-Vol PM₁₀, TEOMPM₁₀, PM₂.₅, Outdoor Temperature, Relative Humidity, Wind Direction-Resultant, Wind Speed-Resultant, Wind Speed-Scalar, Barometric Pressure</td>
</tr>
<tr>
<td>Mecca-Saul Martinez 33033</td>
<td>H₂S, TEOMPM₁₀, Outdoor Temperature, Relative Humidity</td>
</tr>
<tr>
<td>Palm Springs-Fire Station 33137</td>
<td>O₃, CO, NO₂, Total NMHC, Hi-Vol PM₁₀, TEOMPM₁₀, PM₂.₅, Outdoor Temperature, Relative Humidity, Wind Direction-Sc...</td>
</tr>
</tbody>
</table>
b. PM2.5
The Eastern Coachella Valley TEOM sensors for PM10 are often co-located with regulatory sensors for PM2.5. Public data is available for only PM2.5 sensors at two of the five Coachella Valley regulatory sensor locations (Table 1). PM2.5 is a smaller particulate size than PM10. PM2.5 is a useful indicator of automobile combustion, forest fires and gases emitted from industries. CARB studies found that the Salton Sea playa will not emit the PM2.5 air particle fraction (13). The federal standard should not exceed a mean of 12 μg/m³ averaged over 3 years or a 24-hour occurrence above 35μg/m³. The state standard should not exceed a mean of 12 μg/m³ averaged over 1 year (6).

The Figure 5 above shows that regulatory sensors located in Mecca and Coachella give similar readings and trends for PM2.5. The PurpleAir sensors did not show a similar trend for two nearby sensors with the Mecca sensor showing results consistently above the state standard. These low-cost sensors succeed in showing spikes when there is poor air quality, but they don’t stay in calibration. The PurpleAir readings will get higher as the sensor ages without calibration. The baseline data for the Mecca sensor (Figure 5) is far above the Thermal sensor and needs calibration. There are new generations of low-cost sensors that are designed to adapt to this problem.

c. H₂S
The Hydrogen Sulfide release from the Salton Sea is a unique environmental phenomenon that is only partially understood and known to occur on the north side of the lake during the summer months (14). Hydrogen Sulfide is not an Ambient Air Quality Standard routinely measured by the USEPA or the SCAQMD, but it is the best indicator for monitoring the odor associated with the natural cycling that occurs during the summer.

The SCAQMD’s website, [www.saltonsegador.org](http://www.saltonsegador.org), is setup for the public to review hourly data from two sensors located close to the Salton Sea (7). The H₂S spikes in air quality happen in the summer, which is also the time that the wind often changes direction and blows from the Salton Sea into the eastern Coachella Valley (Figure 2).
The guideline for H2S is that it should not exceed 30 µg/m³. The Figure 6 shows that during the summer months, the H2S often exceeds this value.

d. Ozone
One component of poor air quality is ground level ozone (O₃). Ozone is a component of smog produced when nitrogen oxides (NOx) combine with volatile organic compounds (VOCs) and "cook" in the summer heat (5). Emissions from industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapors, and chemical solvents are some of the major sources of NOx and VOCs. Ozone at ground level is a pollutant that affects lung health. Coachella Valley ozone levels consistently exceed federal ozone standards that require an 8 hour average to be below 0.08ppm. This region is classified as “serious” ozone non-attainment area but little of the ozone is from local emissions. While there is some generated in the Coachella Valley, a large proportion of the valley’s ozone drifts in from the coastal and central Los Angeles County areas of the South Coast Air Basin.

Ozone is a hazard in the Eastern Coachella Valley during the late afternoon hours. This is because Ozone takes time to form and then be carried east to the ECV in the winds through the Banning pass and Palm Springs. The sensor in Indio shows that ozone is highest from 5-6pm depending on the season and wind direction. The Indio and Palm Springs sensor locations are the only places where Ozone is measured in the Coachella Valley.

e. Selenium
Selenium is a possible air quality contaminant that is carried on windblown dust from the Salton Sea. There is research data available on the occurrence of Selenium transported
with particulate data but no empirical data from AQ sensors. Selenium is a health hazard that should be monitored and available as daily sensor data. A study from UC Riverside scientists evaluated the contaminants of the Salton Sea and found that the playa zones of the Salton Sea contain high concentrations of selenium that have the potential to become airborne and adhere to the PM10 particles blowing from the playa. UC Riverside scientists found that concentration of PM10 selenium varies by season (17).

An earlier study found several other agricultural runoff salts, pesticides and metals in the upper 30cm of playa sediment (18). Of those runoff-associated chemicals, the UC Riverside scientists found that selenium concentrations in the air represent a major public health concern. The California Air Resources Board has worked to monitor Selenium around the Salton Sea. There is no active monitoring of Selenium available to the public.

5. Major findings presented in this white paper:
The SCAQMD and the CARB should prioritize more regulatory sensors and the public’s access to those regulatory sensors. There are some regulatory sensors in the Coachella Valley, but most are reporting data that is not specific to the ECV. Most of the data in the Coachella valley is summarized into the SCAQMD’s Air Quality index to give a single value to the entire Coachella Valley. The AQI is an insufficient indicator of air quality because the East and West portions of the valley experience different air quality conditions.

Along with the above general recommendations, our research for this white paper has found:

- Most air quality regulatory sensor data is not available in real-time for residents of the Eastern Coachella Valley.
  - H2S is the exception.
- The regulatory sensor data for PM10 and PM2.5 is of high quality.
- The PM10 and PM2.5 measurements from low-cost sensors (PurpleAir) does not correlate with nearby regulatory sensors or other nearby PurpleAir sensors.
- The low-cost sensors could produce high quality data, but will drift out of calibration when they are not maintained.
- The H2S spikes from the Salton Sea happen in the summer months in the deepest part of the lake which is in the north. This is also the only time when the wind blows from the lake to the ECV.
- Wind, temperature, humidity, ozone, PM10, H2S and PM2.5 are the only routine environmental monitoring that is summarized into a single AQI for the entire Coachella Valley.
- Ozone is only measured in two locations and reaches hazardous levels in the late afternoon.
- Selenium is recognized as a potential Public Health Hazard but is not monitored.
6. Recommendations

a. Regulatory Sensors
The Alianza Coachella Valley recommends that more regulatory sensors should be placed throughout the Eastern Coachella Valley.

These should:

- Produce data streams that are publically available with real-time data similar to the two H2S monitors located in Mecca and at the Salton Sea.
- Be routinely maintained by the SCAQMD or other approved organizations.
- Include sensors that are specific to detect environmental air quality hazards from the Salton Sea, the industrial pollutants from the Mecca industrial complex, and the particulate pollution from the regional agricultural activity, unique to the ECV.
- Include additional parameters that are specific to the ECV’s unique air quality basin. This includes monitoring potential of wind and Salton Sea emissions of Selenium, VOCs and H2S.

b. Low-cost sensors
To further address the issue of low-cost sensors, the Alianza recognizes the potential for these sensors to document and detect precise occurrences of air quality concerns that may occur only in specific locations of the ECV. An example of this is the PurpleAir sensor that is inexpensive and could alert the public to hazardous air quality that may occur only in specific location. The Alianza would like to have these networks available, but also recognize that low cost sensors can drift out of calibration after several months of use. The low cost sensor measurement of PM10 is also susceptible to humidity and wind. As a result, the readings from low cost sensors could be artificially high and may misinform residents. Low cost sensors should be routinely maintained and sited by SCAQMD in partnership with trained community scientists approved by the SCAQMD. The SCAQMD is positioned well to tackle this problem of “sensor drift”. The district houses the AQ-SPEC, the only low-cost sensor testing center in the United States. Scientists from this center have been working with several manufacturers to evaluate the “sensor drift” and PM10 false positive issues. Those scientists should advise the Alianza on improved monitoring with low-cost sensors in the ECV.

The following are recommended:

- The low cost sensors should be maintained by an SCAQMD housed program that maintains the sensors to give accurate readings of PM2.5 and PM10 that are networked together for automated regional calibrations and routine field calibrations.
- Selenium should be continually monitored as a component of PM10 emissions. Daily sample frequencies of selenium should increase when the prevailing wind blows Northwest in the summer.
More low-cost air monitoring stations should be located in proximity to possible air pollution emitting sites in the Eastern Coachella Valley. These low-cost sensors should house a suite of parameters that include VOCs, H₂S, PM10, PM2.5 and the necessary climatic measurements.
References:


