Air Pollution Trends in the Coachella Valley – 2017-2019

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Air Pollution in the Coachella Valley

The Coachella Valley, located in Riverside County, CA, extends 45 miles from the San Gorgonio Pass to the Salton Sea, and is approximately 15 miles wide. The primary pollutants of concern in the Valley are ozone, respirable particulate matter (PM_{10} or particulate matter with diameter of 10 microns or less), and fine particulate matter ($PM_{2.5}$ or particulate matter with diameter of 2.5 microns or less). The Coachella Valley is designated a nonattainment area for both 8-hour ozone and PM_{10} (U.S. EPA, 2021).

Ozone is created by the reaction of volatile organic compounds (VOCs) with oxides of nitrogen (NOx) in the presence of sunlight. Precursors to ozone include pollutants from vehicles, industrial emissions, fossil fuels, and consumer and industrial products. Hot and sunny days promote the formation of ozone.

Exposure to ozone causes airway inflammation and chronic obstructive pulmonary disease (COPD), exacerbates asthma attacks, and is associated with premature mortality. Ozone exposure is related to decreased lung function, increased airway hyperresponsiveness, and enhanced response to allergens (Fry et al., 2012). Ozone exposure is also associated with an increase in hospital admissions and emergency department visits for asthma and respiratory infections, and school-age children are especially vulnerable (U.S. EPA, 2020).

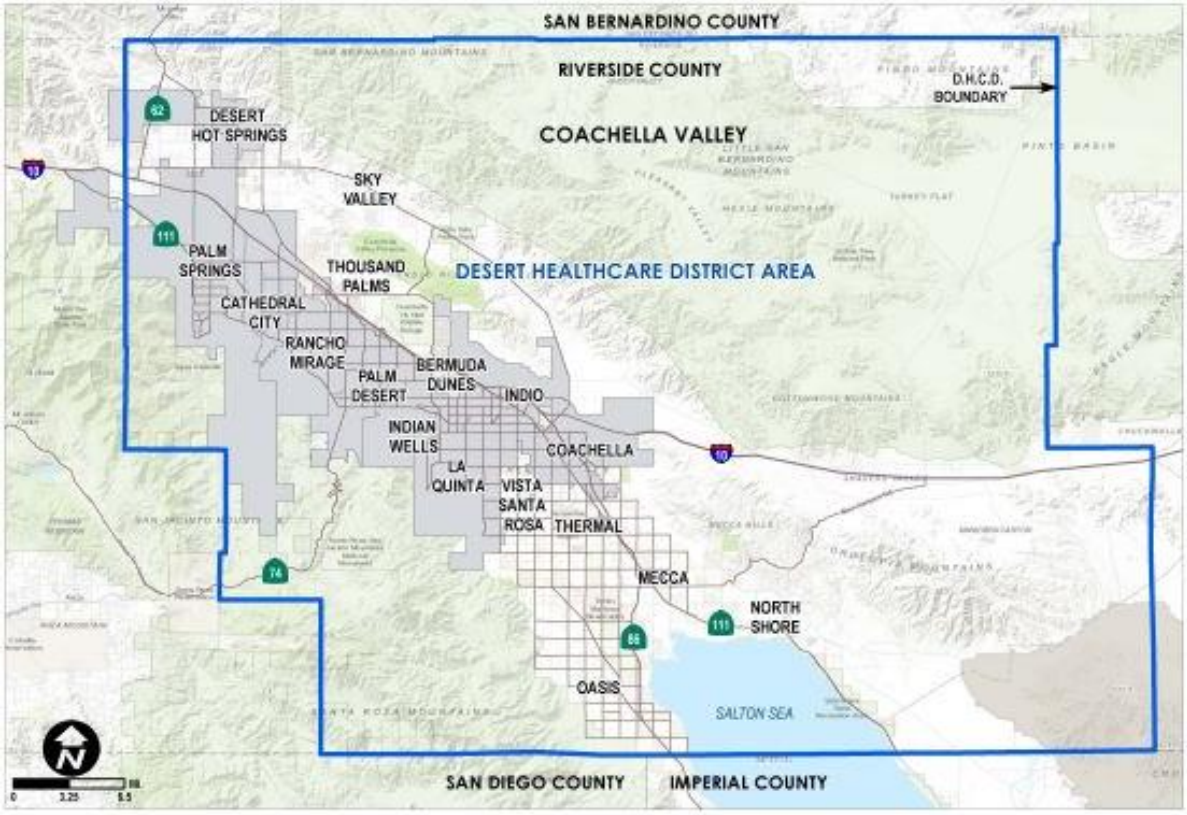
Airborne particulate matter (PM) is a complex mixture of solid particles and aerosols that vary in size, shape, and chemical composition. Sources of PM include both anthopogenic (e.g., vehicle emissions and agriculture) and natural (e.g., dust and pollen) sources, and may be emitted directly from the source or formed in the atmosphere through chemical reactions. Particulate matter is defined by its size, and particulate matter small enough to be inhaled into the lungs is of greatest concern for public health.

Particles with a diameter of 10 or less microns—PM_{10}—are inhalable and can lead to poor health outcomes. Short-term exposures to PM_{10} have been associated with respiratory diseases like asthma and chronic obstructive pulmonary disease (COPD), leading to hospitalizations and emergency department visits (CARB, 2020). Long-term exposure to PM_{10} is associated with premature mortality. High levels of coarse particulate matter may adversely affect heart rate variability in older adults with pre-existing coronary artery disease (Lipsett et al., 2009). The California Environmental Protection Agency conducted a series of studies in the Coachella Valley investigating health effects of PM_{10}, finding that a 10 $\mu g/m^3$ change in daily PM_{10} levels was associated with a 1% increase in mortality (Ostro et al., 1999). A follow-up study found that, more specifically, a 10 $\mu g/m^3$ increase in PM_{10} was associated with a 1.1% increase in cardiovascular mortality (Ostro et al., 2000).

Fine particulate matter, or $PM_{2.5}$, is particulate matter with a diameter of 2.5 microns or less. It can be inhaled deep into the lungs and has been associated with exacerbations of asthma and chronic obstructive pulmonary disease, cardiovascular disease mortality, and lung cancer (Khreis et al., 2017; Atkinson et al., 2014; Brook et al., 2010; Turner et al., 2011).

To assess recent air pollution trends in the Coachella Valley, we analyzed air pollution data from 2017-2019 for ozone and respirable and fine particulate matter, using data from all air monitors within the Desert Healthcare District boundaries (Figure 1).

Figure 1. The Desert Healthcare District Area in the Coachella Valley, CA



Source: Desert Healthcare District

Methods

We accessed data on ozone, PM_{10}, and $PM_{2.5}$ from the U.S. EPA and CARB for 2017-2019. For ozone, we analyzed daily ozone 8-hr averages based on 17 observations per day. There were 99.7% complete days in 2017, 2018, and 2019. For PM_{10} and $PM_{2.5}$, we analyzed daily 24-hr averages based on 1 observation per day. All years had 100% of days with complete observations. Exceptional events that may impact air quality (e.g., wildfire smoke or high winds) were included if present. We computed the number of days exceeding the California Ambient Air Qaulity Standard (CAAQS) for 8-hour average of ozone of 0.070 ppm, the days that exceeded the National Ambient Air Quality Standard (NAAQS) for 24-hour average of $PM_{2.5}$ of 35 $\mu g/m^3$, and the days that exceeded the CAAQS for 24-hour average of PM_{10} of 50 $\mu g/m^3$. The complete list of monitor sites used in this analysis is showin in Table 1.

Table 1. Location of air monitors in the Coachella Valley measuring ozone, $PM_{2.5}$, or PM_{10}

Site Name	Address	County	AQS id	Reporting agency	Available measures
Joshua Tree NP - Cottonwood Visitor Center	Joshua Tree National Park	Riverside	060650010	National Park Service	Ozone $PM_{2.5}$
Indio-29 Palms Reservation	84245 Vista Del Norte, Indio, CA	Riverside	060650500	Twenty-Nine Palms Band of Mission Indians	Ozone PM_{10} $PM_{2.5}$
Indio-Jackson Street	46-990 Jackson St., Indio, CA	Riverside	060652002	South Coast Air Quality Management District	Ozone PM_{10} $PM_{2.5}$
Torres Martinez Administration Site	66725 Martinez Road Thermal, CA	Riverside	060651999	Torres-Martinez Cahuilla Indians, California	PM_{10}
Cabazon Resource Recovery Park Station	90-333 Avenue 63	Riverside	060651010	Cabazon Band of Mission Indians	Ozone
Mecca (Saul Martinez)	65705 Johnson St., Mecca, CA	Riverside	060652005	South Coast Air Quality Management District	PM_{10}
Palm Springs-Fire Station	FS-590 Racquet Club Ave., Palm Springs, CA	Riverside	060655001	South Coast Air Quality Management District	Ozone PM_{10} $PM_{2.5}$
Banning Airport	200 S. Hathaway St., Banning, CA	Riverside	060650012	South Coast Air Quality Management District	Ozone PM_{10}
Morongo Air Monitoring Station	12160 Santiago Rd. Banning, CA	Riverside	060651016	Morongo Band of Mission Indians	Ozone $PM_{2.5}$
Salton Sea Park	100-225 State Park Rd., North Shore, CA	Riverside	N/A	Imperial Irrigation District	PM_{10} $PM_{2.5}$

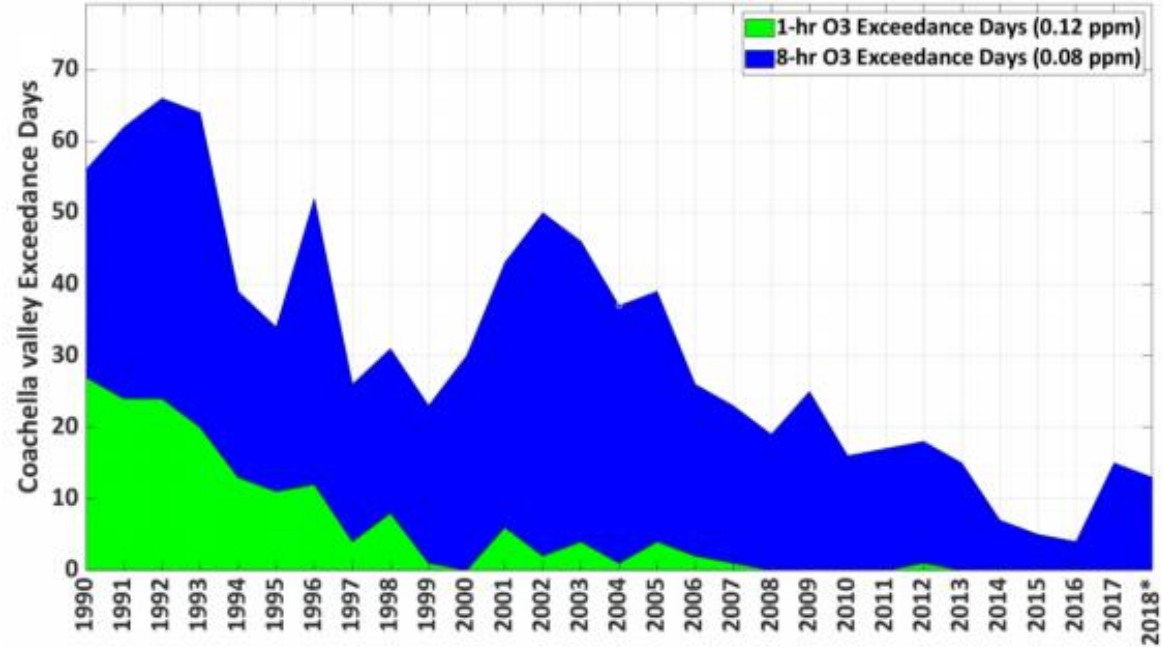
Air Pollution Data – 2017-2019

Ozone

Ozone is transported to the Coachella Valley from the metro areas of the South Coast Air Basin via the San Gorgonio Pass. It is also formed in the Valley from volatile organic compound precursors, such as transportation emissions and consumer products, which again primarily come from the South Coast metro areas, and combine with oxides of nitrogen on sunny days to produce ozone. According to the South Coast Air Quality Management District, local emission sources in the Valley have limited impact on ozone levels (SCAQMD, 2019).

Ozone levels have been decreasing over the last several decades in the Coachella Valley, and the number of days exceeding the 8-hour standard have decreased over time (Figure 2). However, in the last few years, the number of days exceeding the 8-hour standard have increased. The U.S. Environmental Protection Agency, at the request of the California Air Resources Board and the South Coast Air Quality Management District (SCAQMD) recently downgraded the Coachella Valley's ozone pollution classification from "severe" to "extreme." District air officials have pointed to meteorological conditions, in particular record-breaking heat and stagnant air masses, as causes for recent increases in ozone levels.

Figure 2. Trends in Ozone exceedance days, Coachella Valley, 1990-2018



Source: South Coast Air Quality Management District

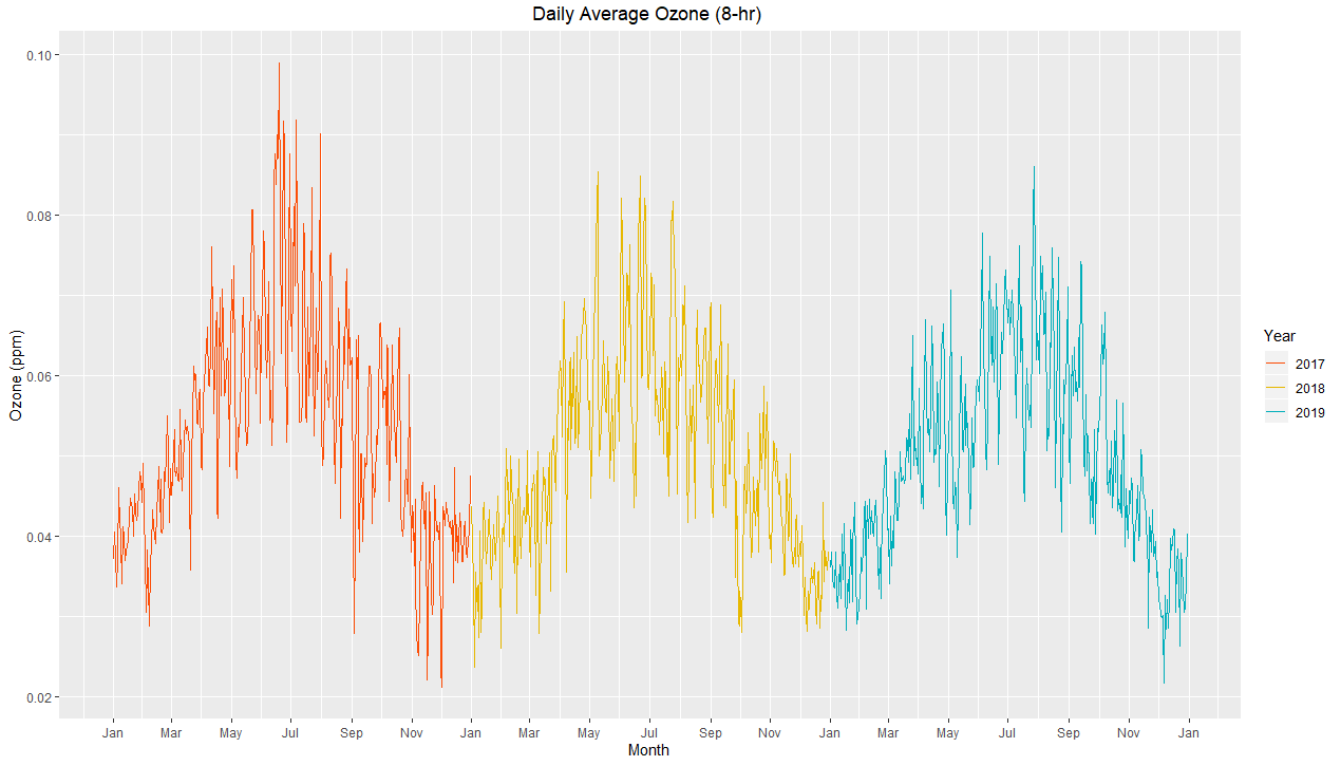
Table 2 shows data for the annual daily 8-hour average concentrations (ppm) of ozone, calculated using data from the monitor with the highest average reading each day (7 monitoring stations each provide a daily average based on 17 observations per day). 2017 had the most days (36) exceeding the CAAQS/NAAQS of 0.070 ppm (8-hour average), with the number of days decreasing in subsequent years. Figure 3 shows the seasonal distribution of ozone using the daily 8-hour average concentration (ppm); ozone levels peak each year during the summer. The Coachella Valley is a nonattainment area for the NAAQS for 8-hour ozone.

Table 2. Days exceeding the CAAQS/NAAQS 0.070 ppm ozone (8-hour) standard, Coachella Valley, 2017 - 2019

Year	Number of days	Annual Ozone (8-hr) (ppm)							Exceedance days
		Mean	Standard deviation	Min	Q1	Median	Q3	Max	
2017	364	0.053	0.014	0.021	0.043	0.052	0.062	0.099	36
2018	364	0.050	0.013	0.024	0.041	0.049	0.059	0.085	25
2019	364	0.050	0.012	0.022	0.041	0.048	0.059	0.086	20
2017-2019	**1092**	**0.051**	**0.013**	**0.021**	**0.041**	**0.050**	**0.060**	**0.099**	**81**

Source: U.S. Environmental Protection Agency

Figure 3. Seasonal distributions of ozone using the daily 8-hour average concentration (ppm), Coachella Valley, 2017-2019



Source: U.S. Environmental Protection Agency

Fine particulate matter – PM2.5

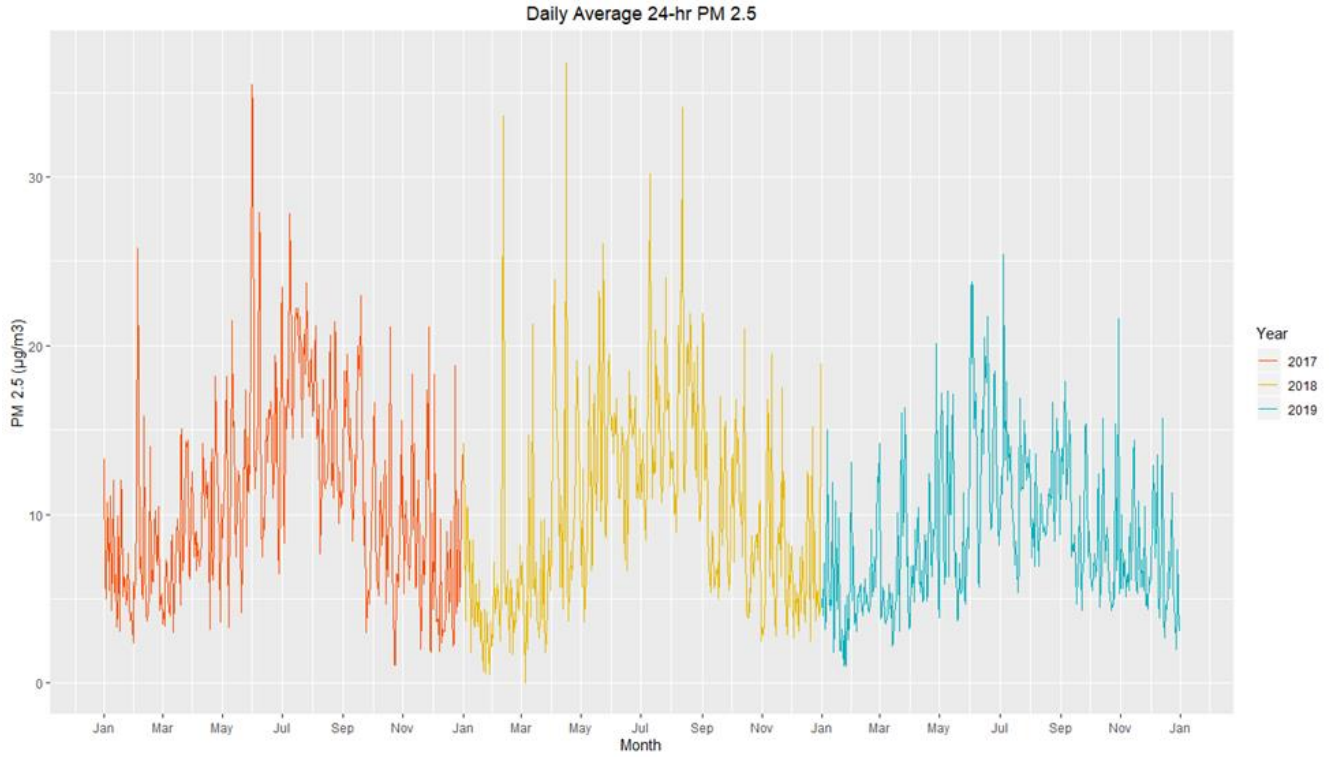
Table 3 shows data for the annual $PM_{2.5}$ 24-hour average concentration (µg/m^3), 2017-2019, based on the highest daily observation from all monitors. There were only 2 exceedances over the NAAQS during this time period. Figure 4 shows the seasonal distributions of $PM_{2.5}$. In general, $PM_{2.5}$ peaks during the summer months, with several exceptional peaks during other times in the year.

Table 3. Days exceeding the NAAQS of 35 µg/m^3 $PM_{2.5}$ (24-hour), Coachella Valley, 2017 - 2019

Year	Number of days	Annual $PM_{2.5}$ (24-hr) (µg/m^3)							Exceedance days
		Mean	Standard deviation	Min	Q1	Median	Q3	Max	
2017	365	10.9	5.8	1.1	6.3	10.2	14.5	35.5	1
2018	365	10.1	6.0	0.0	5.5	8.9	14.2	36.8	1
2019	365	8.8	4.5	1.0	5.3	7.7	11.5	25.4	0
2017-2019	**1095**	**10.0**	**5.5**	**0.0**	**5.6**	**8.9**	**13.4**	**36.8**	**2**

Source: U.S. Environmental Protection Agency and California Air Resources Board

Figure 4. Seasonal distributions of $PM_{2.5}$, Coachella Valley, 2017-2019



Source: U.S. Environmental Protection Agency and California Air Resources Board

Fine particulate matter – PM10

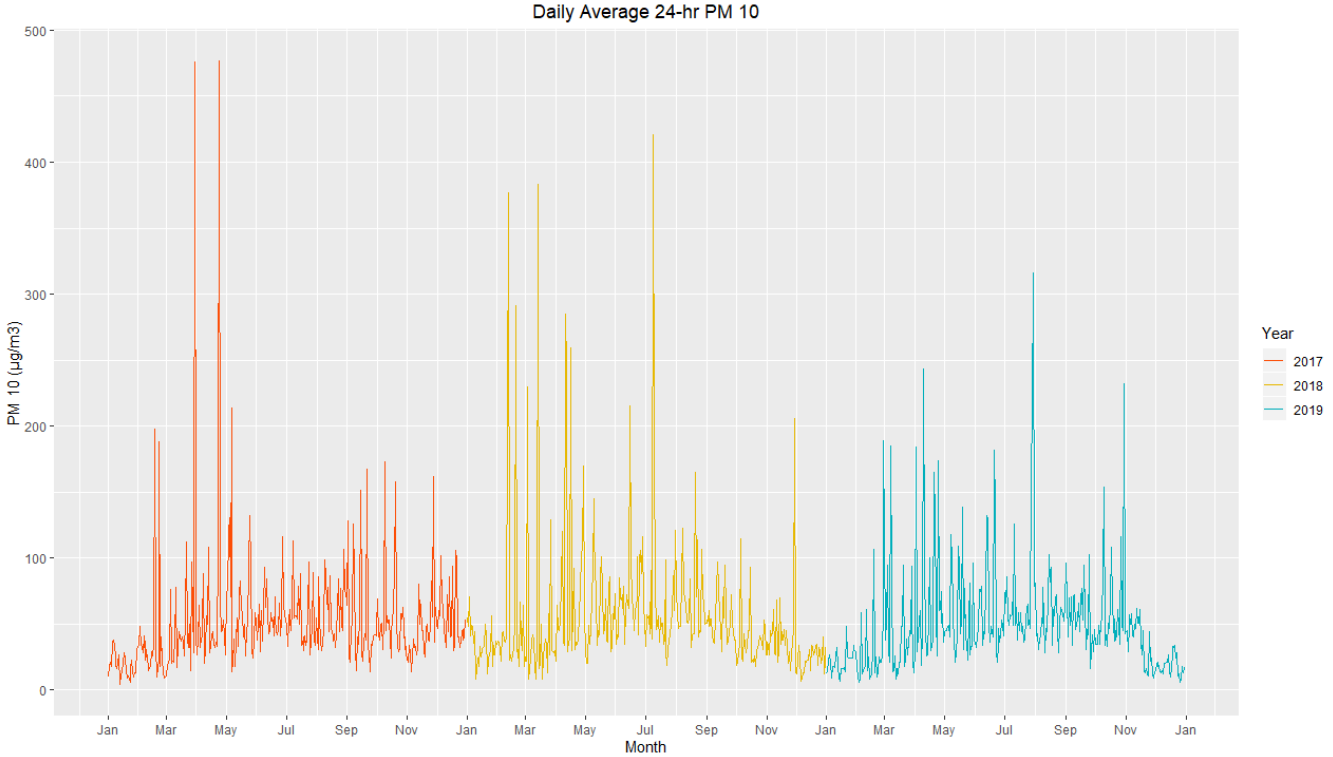
Table 4 shows data for the PM_{10} 24-hour average concentrations (µg/m^3), 2017-2019, based on the highest daily observation from all monitors. Monitored levels of PM_{10} exceed the CAAQS of 50 µg/m^3 (24-hour average) approximately one-third of each year. Figure 5 shows the seasonal distributions of PM_{10}. PM_{10} generally starts peaking during the spring and extends into the summer.

Table 4. Days exceeding the CAAQS of 50 µg/m^3 PM_{10} (24-hour), Coachella Valley, 2017 - 2019

Year	Number of days	Annual PM_{10} (24-hr) (µg/m^3)							Exceedance days
		Mean	Standard deviation	Min	Q1	Median	Q3	Max	
2017	365	50.8	44.0	4.0	31.0	41.0	57.0	477.0	125
2018	365	53.9	50.0	7.0	29.7	41.0	60.0	421.0	128
2019	365	48.6	38.8	6.0	24.0	42.0	58.0	316.0	122
2017-2019	**1095**	**51.1**	**44.5**	**4.0**	**28.0**	**41.0**	**58.0**	**477.0**	**375**

Source: U.S. Environmental Protection Agency and California Air Resources Board

Figure 5. Seasonal distributions of PM_{10}, Coachella Valley, 2017-2019



Source: U.S. Environmental Protection Agency and California Air Resources Board

Conclusion

The results of this analysis show that ozone and PM_{10} are the pollutants of most concern for residents living in the Desert Healthcare District. The South Coast Air Quality Management District has classified the Coachella Valley's ozone pollution as "extreme." Ozone levels peak in the summer, and while the number of days exceeding the CA 0.070 ppm ozone standard has decreased, the most recent data shows that the area still exceeds standards about 20 days per year.

Respirable particulate matter (PM_{10}) pollution is arguably of larger concern than ozone, as monitored levels of PM_{10} exceed the CA 24-hour standard of 50 $\mu g/m^3$ approximately one-third of each year. Information on the source of this PM_{10} is currently being collected as part of our source ascertainment activities funded under this contract.

There are several limitations to this analysis. We were only able to analyze data from existing monitoring stations. To fully understand the potential of air pollution to impact health, a more accurate assessment of exposure would include other factors, such as daily commute patterns or individual exposure risks (e.g., occupation) or respiratory levels (e.g., during exercise). In addition, there are vulnerable populations in the Valley which do not have an existing monitoring station near where they live, work, and recreate. New low-cost monitoring stations are being implemented in the Coachella Valley through the IVAN monitoring system; these monitors will begin to accumulate data that can be analyzed in the near future (https://www.ivan-coachella.org/air/map). Policy recommendations for reducing ozone and particulate matter sources and exposures will be covered in a future report.

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