California Building Resilience Against Climate Effects (CalBRACE) Project

**Short Title:** Ozone Air Pollution  
**Full Title:** Three-year ozone concentration exceedance

**CalBRACE Domain:** Environmental Exposures

**Healthy Community Framework:** Quality and sustainability of environment

**What is our aspirational goal:** Clean air, soil and water, and environments free of excessive noise

**Why is this important to health?**

Higher temperatures increase ground-level ozone and other secondary air pollutants created from chemical reactions with pollutants directly emitted from power plants, motor vehicles, and other sources, creating smog and air pollution.\(^1\) With the projected increasing temperatures, demand for electric power generation will increase and may contribute further to poor air quality. The health impacts of air pollution are likely to be modified by climate change, due mainly to the exposure of populations to increased levels of air pollutants and the enhanced pollutant emission and production rates in a warmer climate.\(^2\) Climate change is projected to increase cardiovascular and respiratory morbidity and mortality associated with ground-level ozone.\(^3\) Most California residents are currently exposed to levels at or above the current State ozone standard during some parts of the year.\(^4\) Studies have shown that exposure to ozone is associated with decreased lung function, respiratory symptoms, hospitalizations for cardiopulmonary causes, emergency room visits for asthma, and premature death.\(^1\) At higher daily concentrations, ozone increases asthma attacks, hospital admissions, daily mortality, and days of restricted activity and school absences.\(^1,4\) In California, the Air Resources Board estimated that 630 deaths, 4,200 hospital admissions, and 4.7 million lost school days could be prevented each year if California met its current statewide standard of 0.070 ppm for ozone (8-hour average).\(^1\) Populations at increased risk include people with chronic diseases (e.g., respiratory diseases), agricultural and outdoor workers, and those who are active outdoors.\(^1,2,4\) Besides harming human health, ground level ozone can harm crops and potentially alter food quality and costs. Ozone can cause significant damage to a wide range of materials found in the built environment, which can shorten material life span and increase maintenance costs.

**Summary of Evidence for Climate and Health**

Laboratory studies in which human subjects were exposed to measured concentrations of ozone for brief periods demonstrate that ozone can reduce lung function, increase respiratory symptoms, increase airway hyper-reactivity, and increase airway inflammation. Numerous community-based epidemiologic studies have shown that exposure to ozone is also associated with decreased lung function, respiratory symptoms, hospitalizations for cardiopulmonary causes, emergency room visits for asthma, and premature death. At higher daily concentrations, ozone increases asthma attacks, hospital admissions, daily mortality, and days of restricted activity and school absences. Children may be more affected by ozone than the general population due to effects on the developing lung and to relatively higher exposure than adults.\(^1,2,4\)
Key References:


What is the indicator?

Detailed Definition

- Indicator = Amount of the daily maximum 8-hour ozone concentration that exceeds the 8-hour California standard (0.070 ppm), averaged over three years (2009 to 2011)
- Stratification: 8 race/ethnicity strata (African American, American Indian/Native Alaskan, Asian, Latino, Multiple, Native Hawaiian and Other Pacific Islander, White, Total).
- Interpretation: Climate resilient communities will have lower ozone levels

Data Description and Methodology

- Air Monitoring Network, California Air Resources Board (CARB) ([http://www.arb.ca.gov/aqmis2/aqmis2.php](http://www.arb.ca.gov/aqmis2/aqmis2.php))
  - Years available: 3-year average of 2009-2011
  - Geographies available: census tracts, place (derived), county subdivision (derived), county (derived), region (derived), state (derived)
  - Years available: 2010
  - Geographies available: census block

California Air Resources Board, local air pollution control districts, tribes and federal land managers maintain a wide network of air monitoring stations in California. For each day in the 2009-2011 time period, the 8-hour ozone concentrations over the federal standard of 0.07 ppm were estimated at the geographic center of the census tract using a geostatistical kriging method that incorporates monitoring data from nearby monitors (within 50 km). The estimated daily concentrations over the standard were averaged to obtain a single value for each census tract. Population weighted PM$_{2.5}$ concentration averages by race/ethnicity were calculated for census tracts, cities/towns, counties, regions, and the state, from census tract air quality estimates merged with census block population data. Regions in the CalBRACE project are based on county aggregations in the [Adaptation Planning Guide Understanding Regional Characteristics](https://www.adaptationplanningguide.org/). Decile rankings for places and census tracts as well as relative risk were calculated.
Limitations

Geographic coverage was not complete because of the limited number and geographic extent of monitoring stations. The uncertainty of the interpolated values increases with distance from the nearest monitor. Values at census tracts with centers more than 50 km from the nearest monitor were not estimated. Even within populated areas, monitoring stations are often located in areas that cannot detect highly localized areas of pollution that significant numbers or sensitive subgroups (daycare centers, schools, hospitals, etc.) in the population may encounter. Data were not available to present standard errors.

Acknowledgement and Disclaimer

This publication was supported by Cooperative Agreement 5UEE1EH001052 from the Centers for Disease Control and Prevention. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention.
Examples of Maps, Figures, and Tables:

Figure 1. Daily Maximum Ozone Concentrations Exceeding California Standard by Race/Ethnicity, Sacramento County, CA 2009-2011

AIAN, American Indian/Alaska Native; AfricanAm, African American; NHOPI, Native Hawaiian/Other Pacific Islander

Source: Air Monitoring Network, CARB, 2009 - 2011
Table 2. Ozone Exceedance* above state standard weighted by population, San Diego County, California, 2009-2011

<table>
<thead>
<tr>
<th>Location</th>
<th>Concentration (ppm)</th>
<th>Total Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Diego County</td>
<td>0.01</td>
<td>3,095,313</td>
</tr>
<tr>
<td>California</td>
<td>0.11</td>
<td>37,253,956</td>
</tr>
</tbody>
</table>

*Ozone exceedance in this analysis is defined as the amount of the daily maximum 8-hour ozone concentration that exceeded the 8-hour California standard (0.070 ppm), averaged over 2009-2011.

Source: Data obtained from California Air Resources Board (CARB), 2009-2011. Analysis done by Office of Environmental Health Hazard Assessment (OEHHA) California Communities Environmental Health Screening Tool (CalEnviroScreen 2.0) and further analysis done by UC Davis and CDPH. County-level estimates for race/ethnicity groups were obtained using residential data from U.S. Census 2010.
Figure 2. Ozone exceedance* above state standard in units of parts per million (ppm), by census tracts, San Diego County, California, 2009-2011

*Ozone exceedance in this analysis is defined as the amount of the daily maximum 8-hour ozone concentration that exceeded the 8-hour California standard (0.070 ppm), averaged over 2009-2011. Estimates are not available for census tracts with centers more than 50 km (or 31.1 miles) from the nearest air quality monitoring station.

Source: Data compiled from CAAQMS 2009-2011. Analyses done by CDPH, AEC, U.S. Census 2010 and further analysis done by UC Davis and CDPH using U.S. Census Bureau 2010 data.

Only tracts with population greater than 1,000 were labeled.