2022 Ozone Plan for Attainment of the 2015 Federal 8-Hour Ozone Standard

Technical Working Group: Emissions Inventory & Modeling Process

July 13, 2021

webcast@valleyair.org

Purpose of Today's Workshop

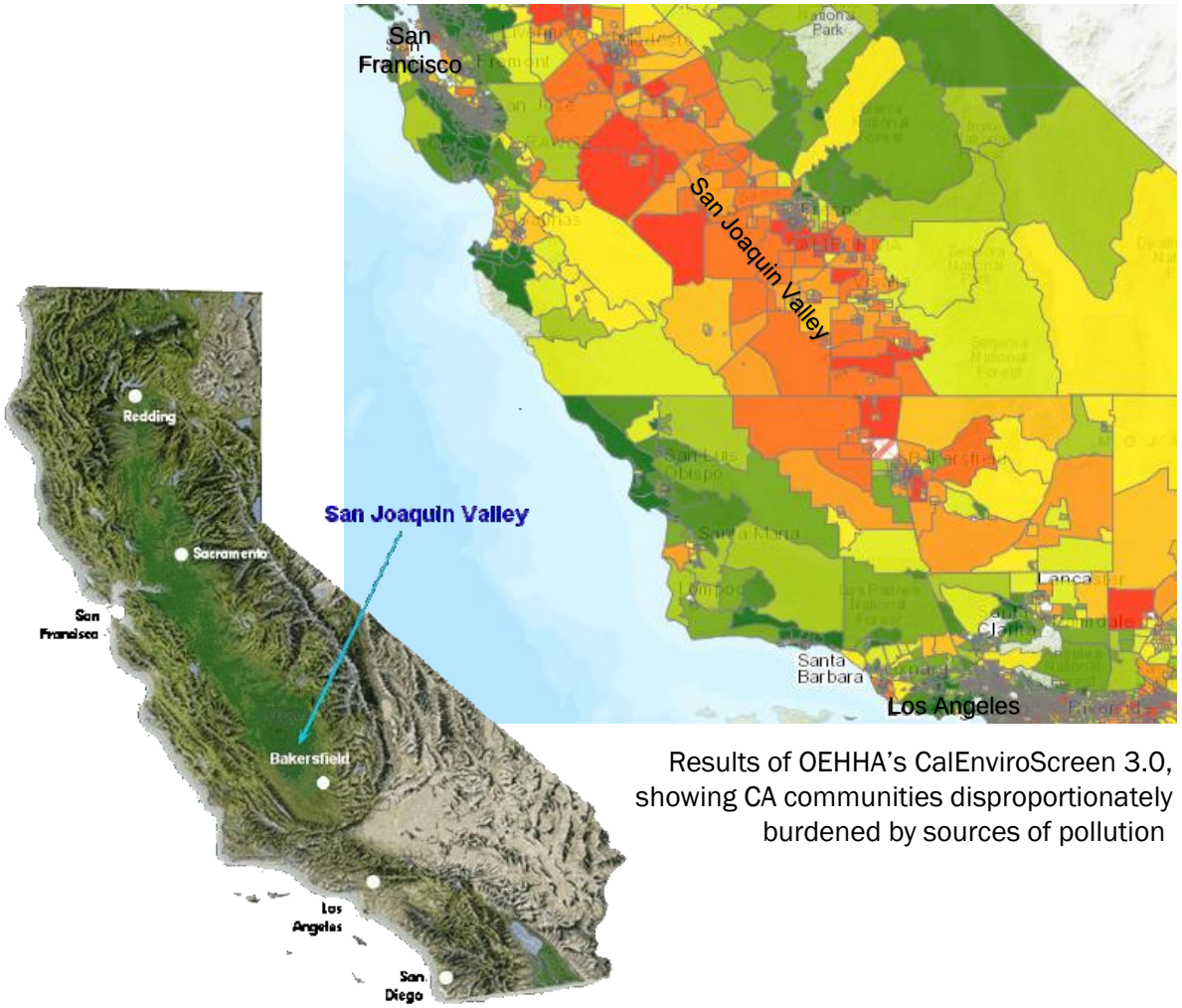
Present information on the development of the upcoming attainment plan to address the 2015 8-hour ozone standard, including

- Ozone formation in the Valley and progress
- Planning process and development timeline
- Emissions inventory
- Modeling process

Receive comments from the public

Valley's Air Quality Challenges

- Valley's challenges in meeting federal air quality standards unmatched due to unique combination of topography and meteorology
- Valley faced with variety of challenges including role as major goods movement corridor, high population growth, pollution transport from other areas and wildfires
- 20 of 30 most disadvantaged California communities located within the San Joaquin Valley

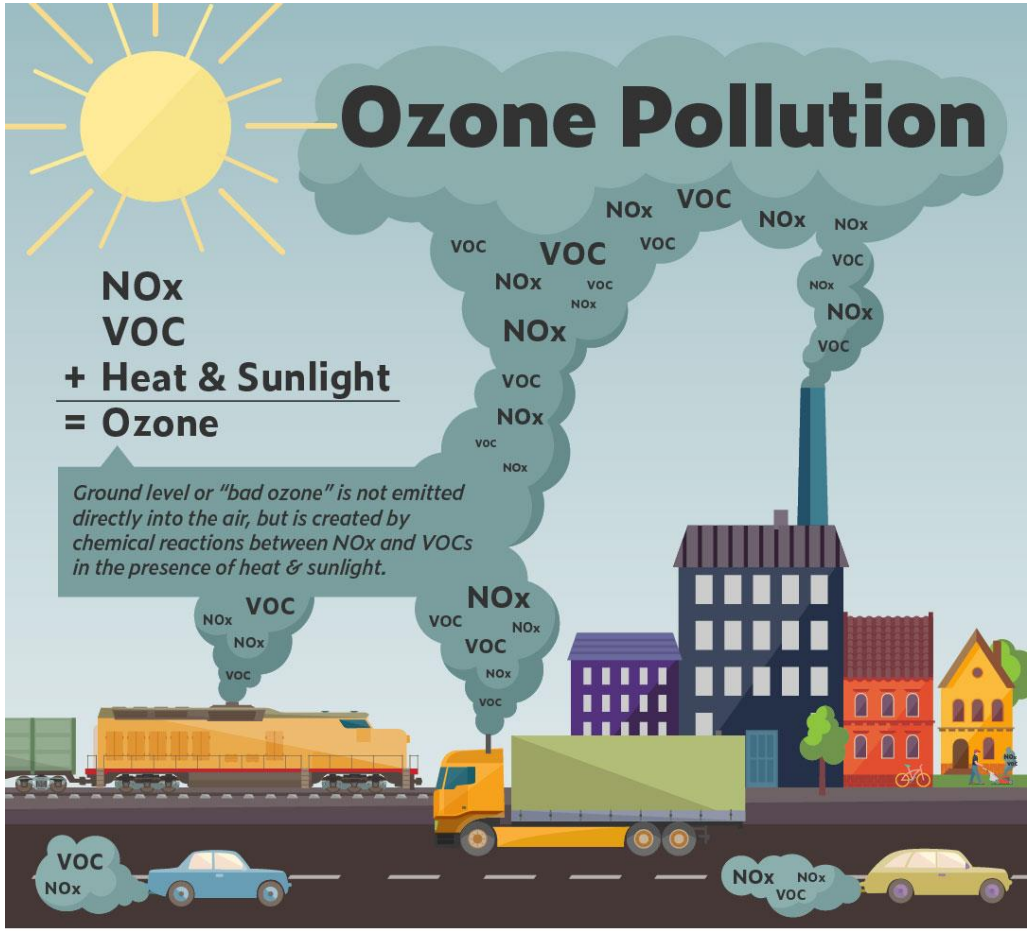


Results of OEHHA's CalEnviroScreen 3.0, showing CA communities disproportionately burdened by sources of pollution

Source: OEHHA, San Joaquin Valley Geology

Ozone Formation

- Ozone is formed through reaction of NOx and VOCs in presence of heat/sunlight
  - NOx: combustion primarily from mobile sources
  - VOCs: biogenic, consumer, stationary, mobile sources
- Valley experiences high ozone in the summer, with peaks in the afternoon

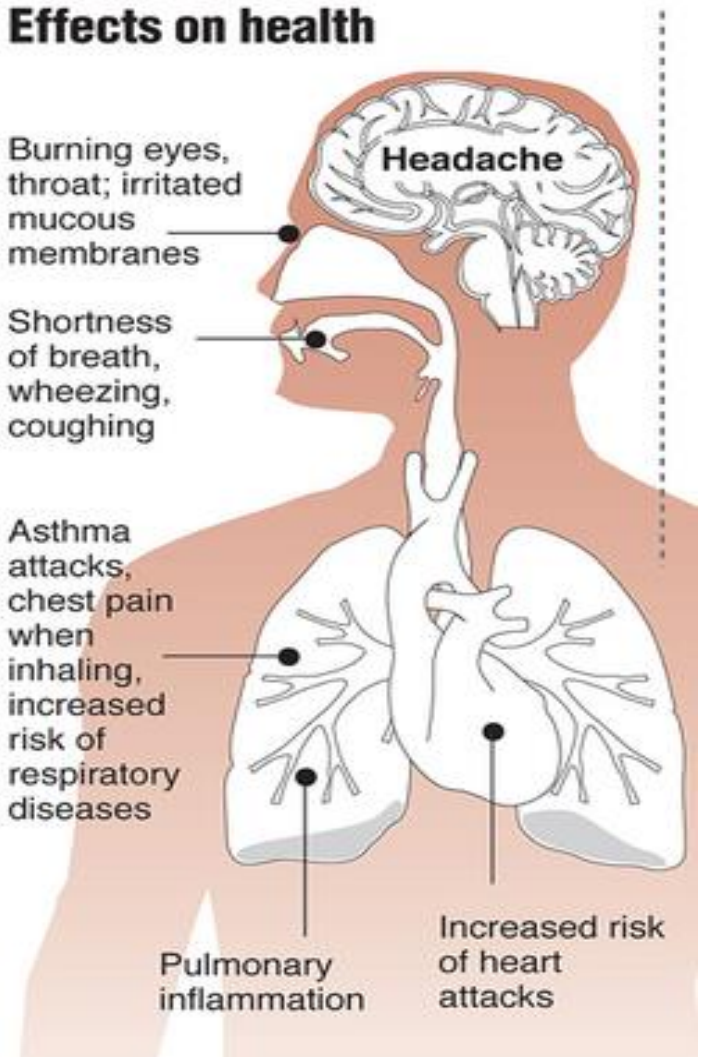


Industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapors and chemical solvents are major sources of oxides of nitrogen (NOx) and volatile organic compounds (VOC).

San Joaquin Valley AIR POLLUTION CONTROL DISTRICT

Ozone Impacts on Public Health

- Ozone most significantly impacts people with asthma, children, older adults, and outdoor workers
- Exposure to ozone causes coughing, throat irritation, pain, burning, or discomfort in the chest, chest tightness or shortness of breath
  - Ozone impacts lung function and aggravates existing respiratory conditions, such as asthma and COPD
  - Leads to increased medication use, emergency visits and hospital admissions



Source: US EPA

Ongoing Valley Clean Air Efforts

- District Governing Board has adopted numerous attainment plans and air quality control strategies to address federal standards
  - Adopted nearly 650 stringent rules and regulations
  - Stationary source emissions reduced by over 90%
- CARB has adopted numerous mobile source emissions control regulations and strategies
- District/CARB combined efforts represent nation's toughest emissions control program
- Strong incentive programs (over $3.5 billion in public/private investment), reducing 190,000 tons of emissions
- Through significant clean air investments, Valley continues to make major improvements with respect to air quality

Valley Efforts to Improve Ozone Air Quality

- District Governing Board has shown commitment in reducing ozone concentrations through approving multiple ozone plans
  - *2013 Ozone Plan:* Valley now meets the 1-hour ozone standard
  - *2007 Ozone Plan:* Valley on track to meeting 2023 deadline
  - *2016 Ozone Plan:* Valley on track to meeting 2031 deadline

- NOx reductions achieved through implementation of PM2.5 attainment strategy, as detailed in District's *2018 PM2.5 Plan*, further contributing to reduced ozone formation throughout Valley

- San Joaquin Valley first and only region in nation classified as "Extreme" nonattainment to reach attainment (1-hour ozone)

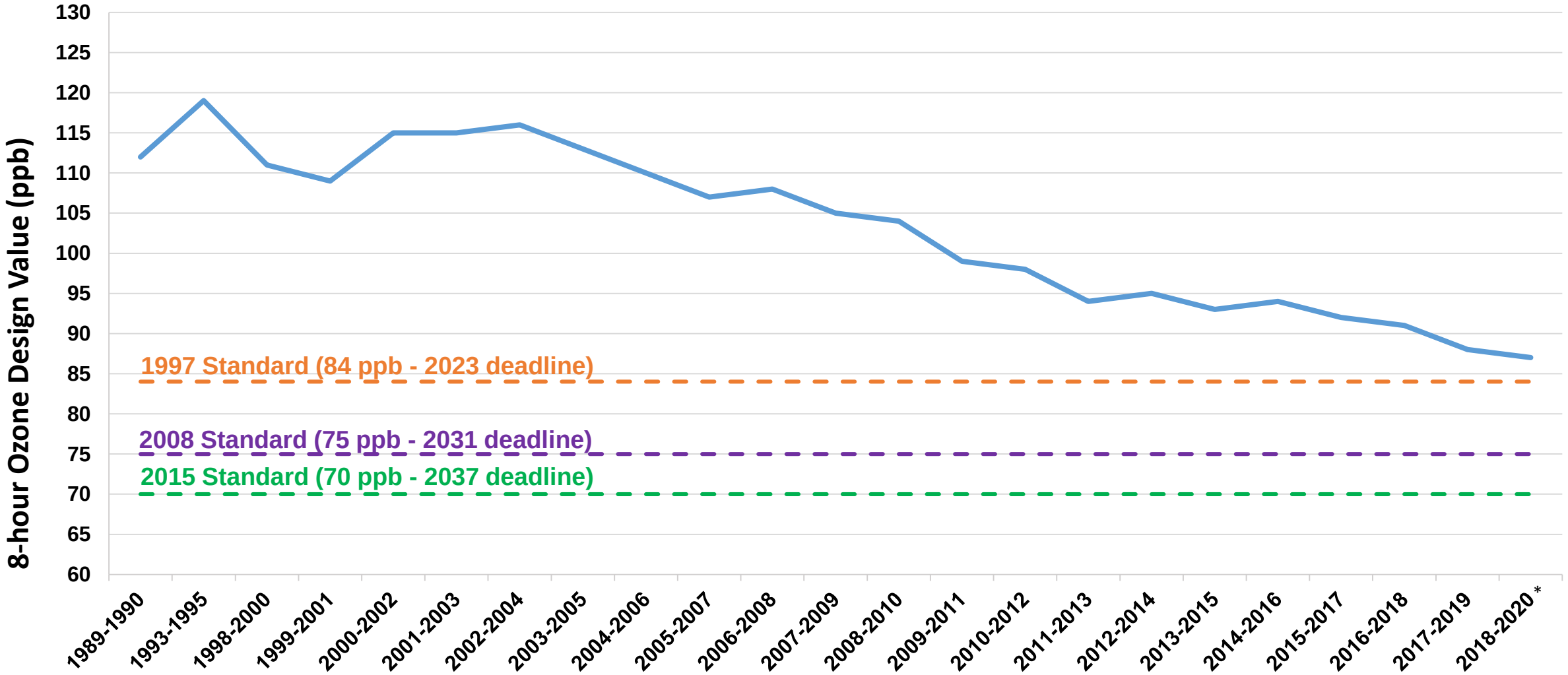
Progress Towards Valley Attainment of Ozone Standards

- Valley-wide significant reduction in days exceeding the federal ozone standards*:
  - Over 90% reduction in days over 84 ppb
  - Over 70% reduction in days over 75 ppb
  - Over 35% reduction in days over 70 ppb
- Over 90% reduction in population exposure to peak ozone values
- In 2020, Valley experienced lowest federal 8-hour ozone design value on record*
  - Demonstrates 91% progress towards meeting 84 ppb standard (2023 deadline)

Source: Craig Kohlruss Photography

*excluding 2020 wildfire impacts

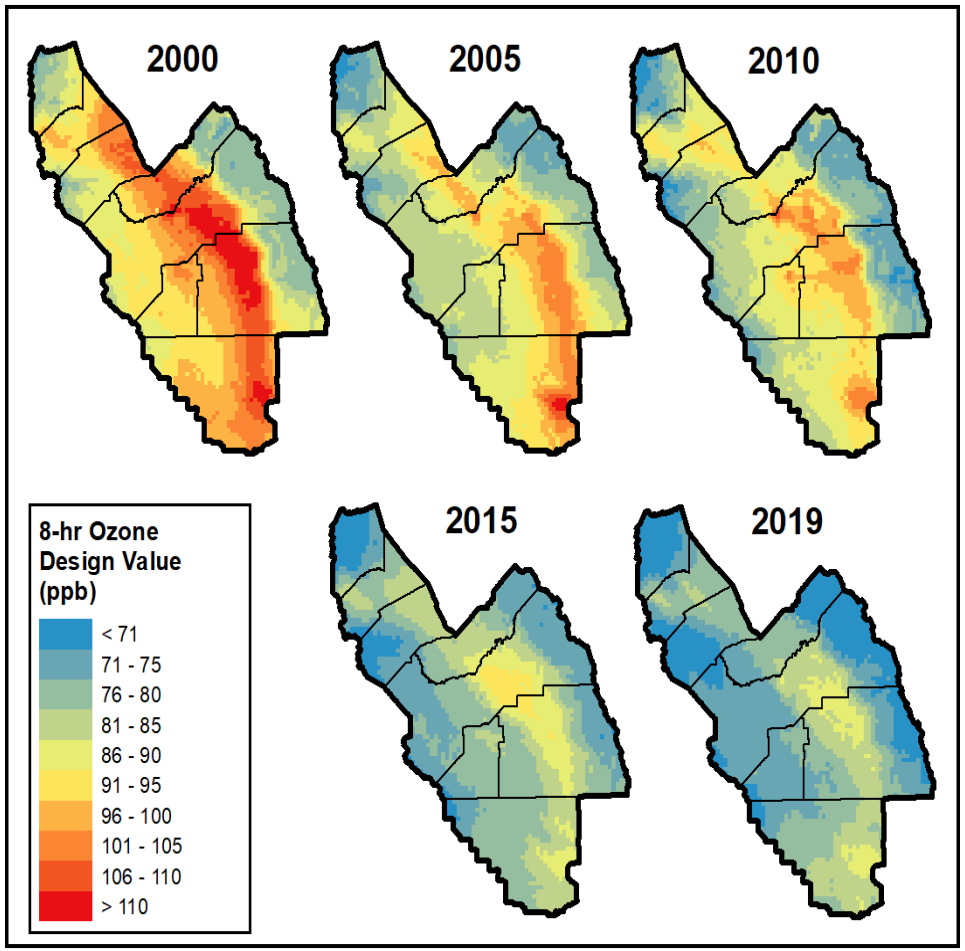
Valley 8-hour Ozone Design Value Trend



*Year 2020 excludes data impacted by wildfire emissions

New Plan Required for 2015 Ozone Standard

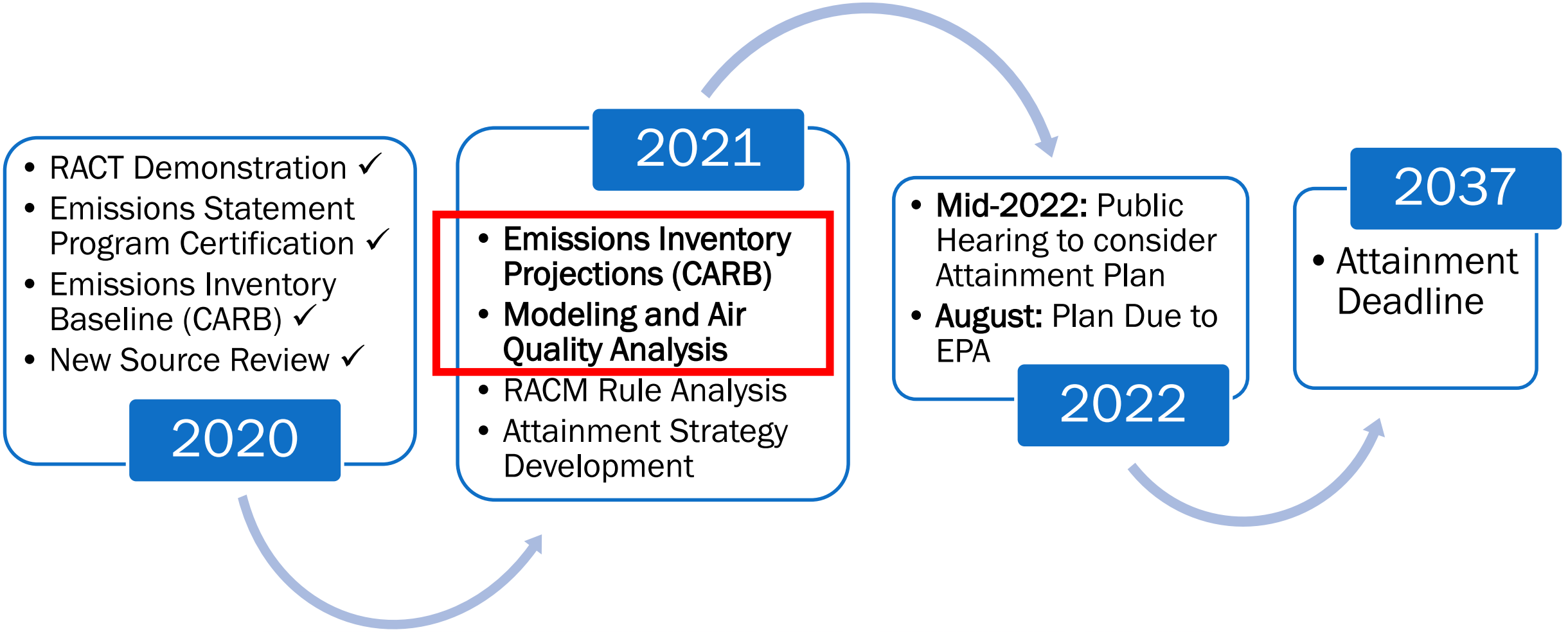
- NAAQS reevaluated every 5 years by CASAC (Clean Air Scientific Advisory Committee) based on latest health science
  - 8-hour ozone standards: 1997, 2008, 2015
- October 2015 – EPA lowered 8-hr standard from 75 ppb to 70 ppb
- In 2018, EPA designated Valley as "Extreme" nonattainment
- District required to adopt new Ozone Plan by 2022 with attainment deadline of 2037 *(2022 Ozone Plan)*



2022 Ozone Plan

- Despite significant progress, substantial further reductions in NOx emissions needed to attain new 2015 federal 8-hour ozone standard
- Over 85% of remaining NOx emissions in Valley come from mobile sources under state and federal jurisdiction
  - Important that continued efforts to reduce emissions from passenger vehicles, heavy duty trucks, locomotives, and other mobile sources be pursued
- *2022 Ozone Plan* will build on existing air quality strategies, and comprehensive NOx emissions reduction strategies in existing adopted ozone and PM2.5 plans will greatly contribute to meeting new ozone standard

Planning Requirements for *2022 Ozone Plan*



Agency Roles

Federal

US EPA

Regulates stationary, area, and mobile sources including interstate transportation

Trains | Ships | Planes

State

CARB

Regulates mobile and area sources of air pollution

Cars | Trucks | Buses

Local

Local Air Districts

Regulates stationary and area sources of air pollution

Factories | Refineries | Residential woodstoves

Source: CARB

SJV Ozone Workshop

Emissions Inventory

Tiffanie Be
Andrew King
Criteria Pollutant Inventory Section

Presentation Outline

- Overview
  - Emission Inventory
  - Type of Sources
  - Pollutants
- 2015 70 ppb 8-Hour Ozone Standard
  - Background
  - Base Year
  - Forecasting
- Inventory Updates

Overview

Emission Inventory

- A comprehensive estimate of air pollutant emissions, by source, for a specific geographic area during a given time period

Uses for Emission Inventories

- Identify pollutants of concern and their sources
- Determine amount, distribution, trends
- Input to air quality modeling
- Identify and track control strategies
- Input to health risk assessment

Types of Emissions Sources

- Point sources
  - Ex. Industrial facilities
- Area-wide sources
  - Ex. Consumer products
- Mobile sources
  - Ex. Passenger vehicles, Ships, locomotives, agricultural equipment
- Natural sources
  - Ex. Wildfires, biogenic emissions

Point Sources

- Facility operators report activity, emissions data, temporal data, and other facility information to local air district

- Various estimation methodologies available
  - Continuous emission monitors
  - Source testing
  - Fuel consumption
  - Published emission factors (U.S. EPA AP-42)
  - Material balance
  - Engineering judgment

Areawide Sources

- CARB and/or local air districts develop estimation methodologies

- Data sources:
  - County-level activity data from surveys, industry reports, census reports, other government agencies
  - Emission factors from U.S. EPA (AP-42) or special studies

On-Road Mobile Sources

- CARB has developed motor vehicle emissions models since 1970s. EMFAC2017 is the most recent on-road model approved by US EPA

- Data sources:
  - DMV vehicle registration data
  - Emission factors by vehicle class, technology and model year based on latest available emission test data
  - Travel activity (vehicle-miles, or VMT) from local transportation planning agencies

Off-Road Mobile Sources

- CARB develops category-specific off-road models (trains, ocean-going vessels, commercial harborcraft, recreational boats, off-road equipment)

- Each model reflects the unique characteristics (equipment types, activity, emission factors, economics) of the source category

Pollutants

- Criteria Pollutants
  - Total organic gases (TOG)
  - Reactive organic gases (ROG)
  - Volatile organic gases (VOC)
  - Oxides of nitrogen (NOx)
  - Oxides of sulfur (SOx)
  - Particulate matter (Total PM, PM10, and PM2.5)
  - Carbon monoxide (CO)
  - Ammonia (NH3)
  - Lead (Pb)

2015 70 ppb 8-Hour Ozone Standard

Background

- Federal Clean Air Act (CAA) establishes planning requirements for areas that exceed the health-based National Ambient Air Quality Standards (NAAQS)

- 2015 70 ppb 8-Hour Ozone Standard
  - 0.075 to 0.070 parts per million
  - 19 areas in CA classified as marginal, serious, severe, or extreme
  - US EPA designated San Joaquin Valley is as “extreme” on August 3, 2018

Base Year Requirements

- U.S. EPA's Ozone Implementation Rule establishes that the base year inventory should be preferably consistent with the triennial reporting schedule required under the Air Emissions Reporting Requirements (AERR) rule

- CARB selected **2017 as the baseline inventory year**, which is consistent with triennial reporting

Base Year Inventory Requirements

- The base year inventory includes the total amount of actual ROG and NOx emissions from all anthropogenic sources in the non-attainment area

- Since ozone concentrations tend to be highest during the summer months, the emissions used in the base year inventory is based on the 2017 summer season (May – October)

Forecasted Inventory

- In addition to a base year inventory, U.S. EPA regulations also require future year inventory projections for specific years
- Projection of a base year inventory that reflects expected growth or decline in emissions
- Uses growth surrogates based on forecasted trends such as fuel consumption, economic conditions, or population growth
- Reflects effects of existing emission controls and other emission reduction programs

Forecasted Inventory (cont.)

- All emission forecasts are conducted by CARB
- Point and areawide sources are forecasted from base-year inventory using the California Emission Projections and Analysis Model (CEPAM)
- Mobile source emissions are forecasted by EMFAC and off-road models

Inventory Updates

Inventory Updates - Mobile

Category	Updates
On-road	• 2019 Transportation Improvement Program • Advanced Clean Trucks regulation and Omnibus (Low NOx) • Safer Affordable Fuel-Efficient (SAFE) rule
Off-road	• Recreational vehicles • Pleasure craft • Gas cans • Small off-road engines • Portable equipment registration program • Commercial harbor craft • Transportation refrigeration diesel units • Locomotives • Ocean-going vessel “at-berth” regulation (in progress)

Inventory Updates – Stationary/Area Base year (2017)

Category	Updates
Facility Point Sources	• Annual District Update
Pesticides	• Department of Pesticides Regulation data (2015 – 2018)
Agricultural Burning	• Methodology Updates from District
Industrial Natural Gas Combustion	• Methodology Updates from District

Inventory Updates – Stationary/Area Growth (2018 onward)

Updates	Categories
Industry-specific economic forecast Incorporates COVID-19 recession	• Degreasing solvents, coatings and thinners*, adhesives and sealants • Manufacturing processes* • Personal care products
Population forecast	• Waste disposal, laundering • Consumer products* • Architectural coatings • Structural pesticides • Structural and auto fires
California Energy Commission; Energy Information Administration forecasts	• Electric utilities • Natural gas combustion • Cogeneration

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*Update affects certain subgroups within this category

Inventory Updates – Stationary/Area Control (2018 onward)

Updates	Category
District rule amendments	• Flares • Boilers, process heaters, steam generators

More Information

- **CARB's Emission Inventory Activities**
  https://ww2.arb.ca.gov/criteria-pollutant-emission-inventory-data (data reflected here will be updated Fall 2021)

- **Tiffanie Be** (EI/CEIDARS) or **Andrew King** (Forecasting/CEPAM)
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Ozone SIP Modeling In The San Joaquin Valley: 70 ppb 8-hr Ozone Standard

Air Quality Planning & Science Division
California Air Resources Board

San Joaquin Valley Ozone SIP workshop 7/13/2021

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Outline

- Modeling overview
- Gridded emission processing
- Model attainment demonstration for ozone SIP
- Updates to the ozone standard
- Next steps

Modeling Overview

3-D Air Quality Model

- Mathematical representation of our best knowledge about physical and chemical atmospheric processes
- Chemical mechanism describes the chemical reactions that lead to ozone formation
- Simulate the atmosphere by dividing it into millions of individual grid cells

Emissions

- Models require hourly emissions for each grid cell for various chemical compounds
- California's EI is one of the most complete and robust in the world

Meteorology

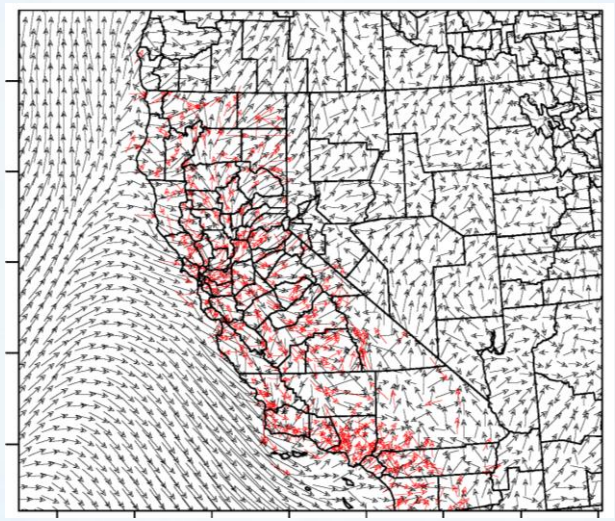
- Generated using a 3-D numerical meteorological model
- Very time-consuming iterative process

Boundary Conditions

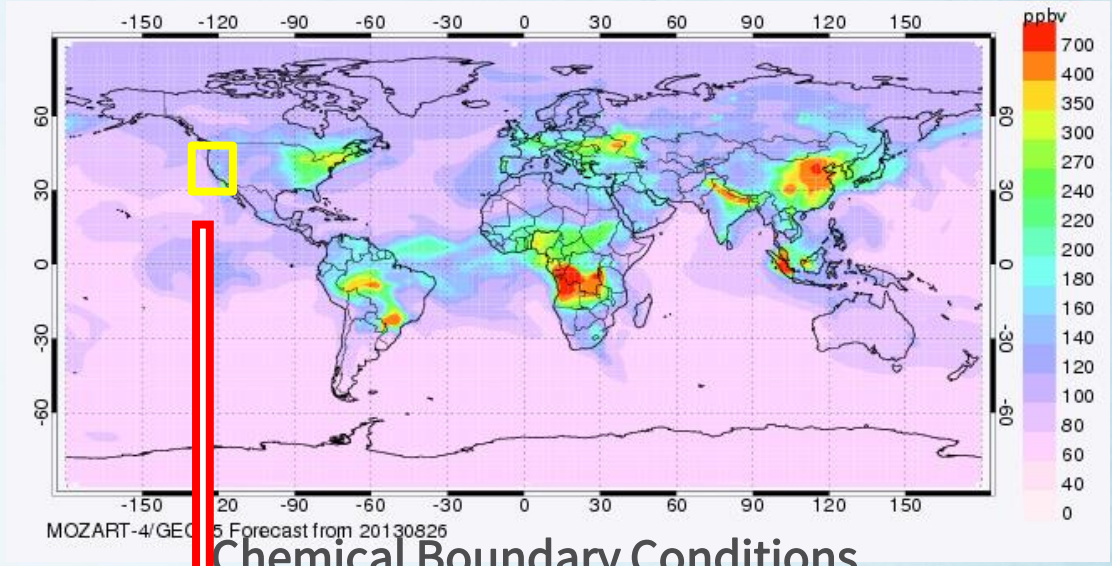
- Derived from global air quality models to provide background concentrations along the model domain boundaries
- Capture the transport of external emissions that could affect modeling region

Modeling platform:

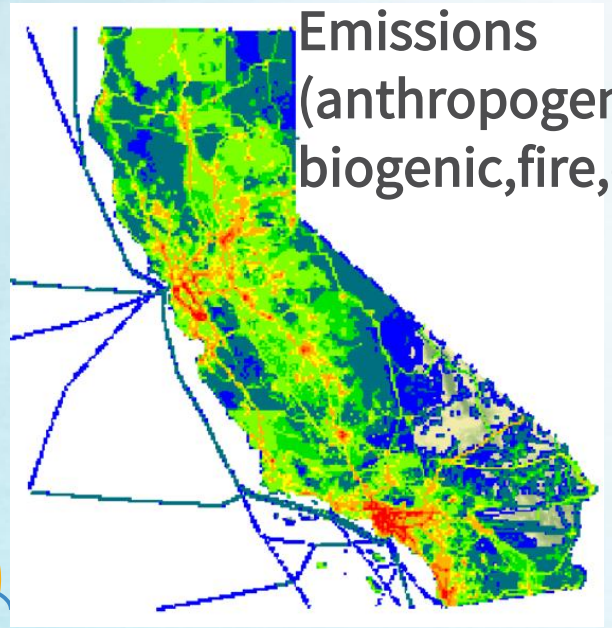
Meteorology (WRF)



Global Chemistry Model



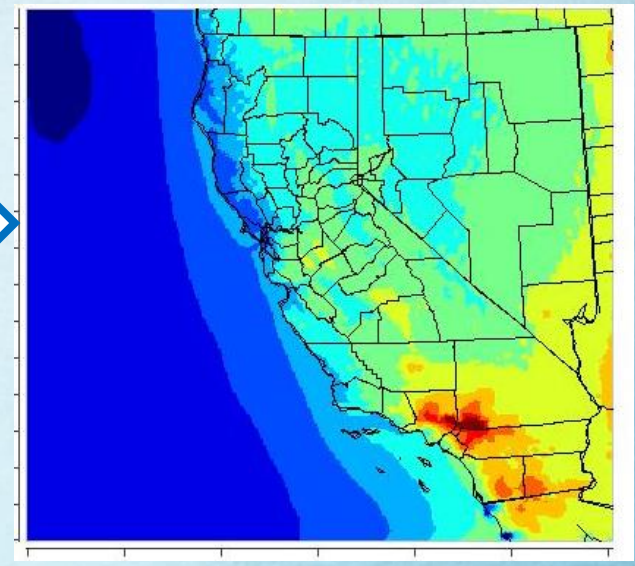
Chemical Boundary Conditions



Emissions (anthropogenic, biogenic,fire,etc.)

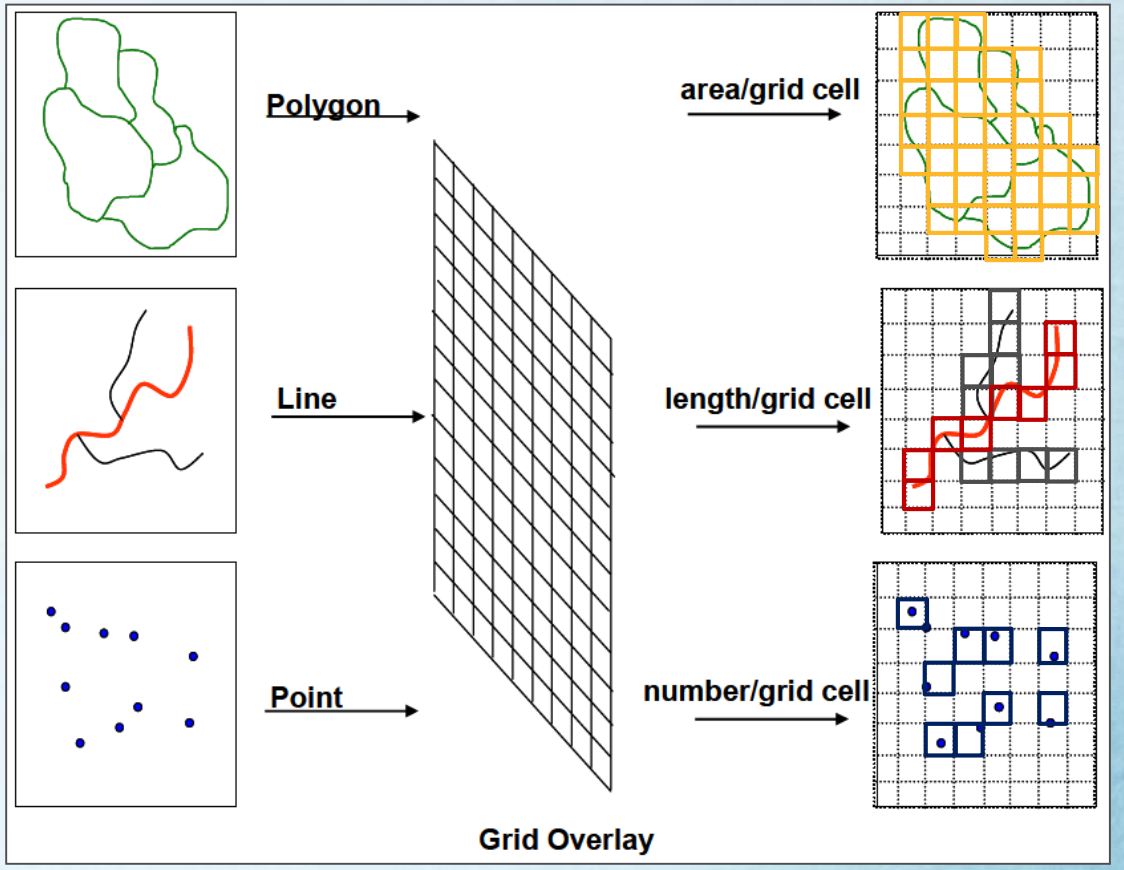
Air Quality Model (CMAQ)

Hourly 3D concentrations of primary and secondary air pollutants



Emissions: Spatial allocation

- County level emissions are allocated into each grid cell using spatial surrogates, which distribute the emissions using information such as population (polygon), roadway networks (line) or specific location information (point).
- For example, emissions from consumer products should be highly correlated spatially with population. Using population data, county-level emissions from these sources can be reasonably distributed geographically within the counties.



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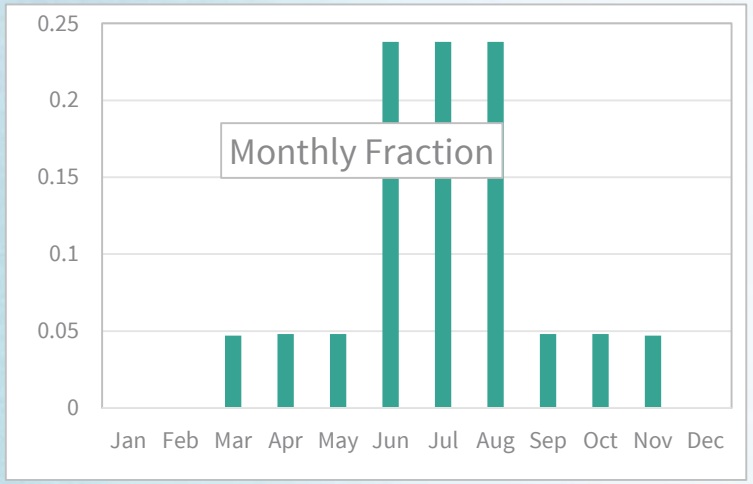
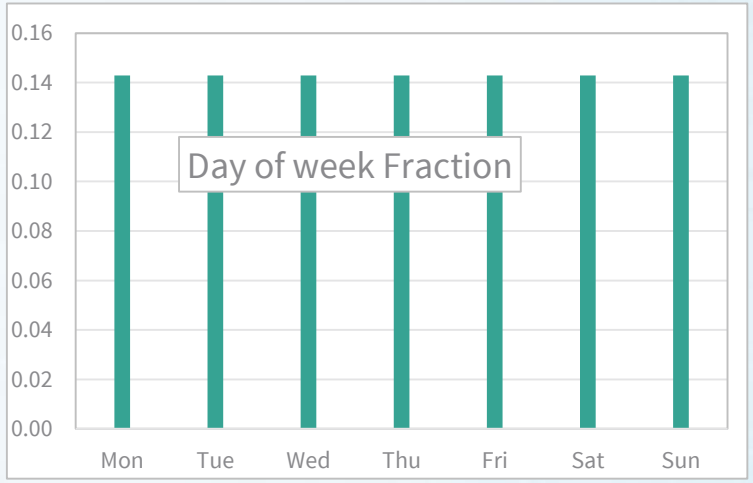
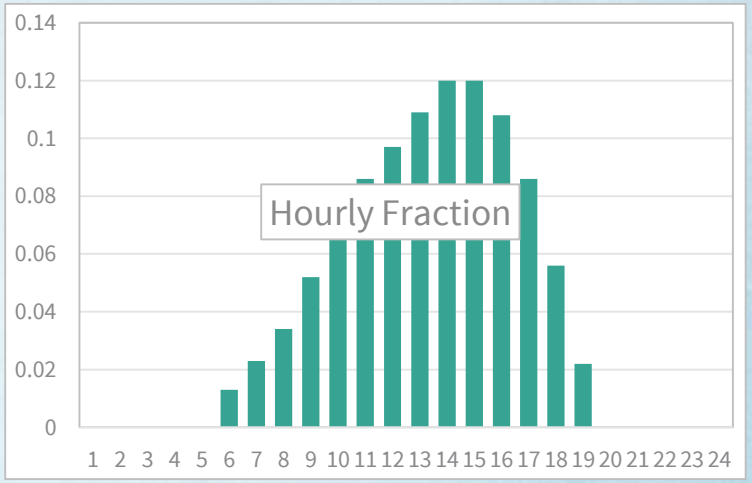
Emissions: Temporal allocation and Speciation

Annual emissions (Ton per year) are allocated hourly via three sets of temporal profiles (monthly, day of week, hourly)







*Soil ammonia profile example
(The fractions will be different for other sources and other chemical species)

Speciation profiles are applied to total NOx, VOCs and PM2.5 emissions to get the emissions for individual chemical species in the model (NO, NO2, Benzene, Toluene, Sulfate, Nitrate, etc.)

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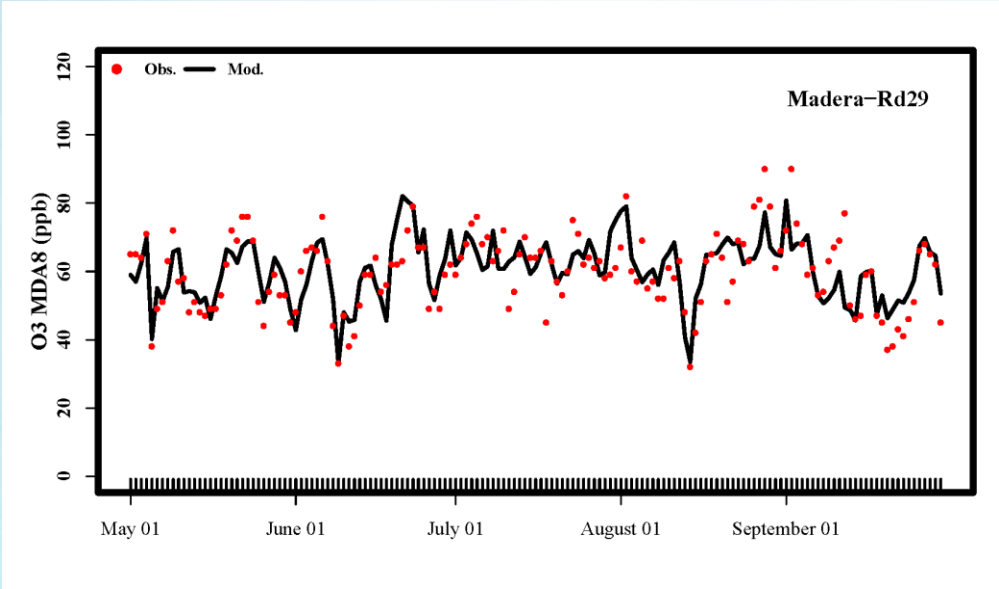
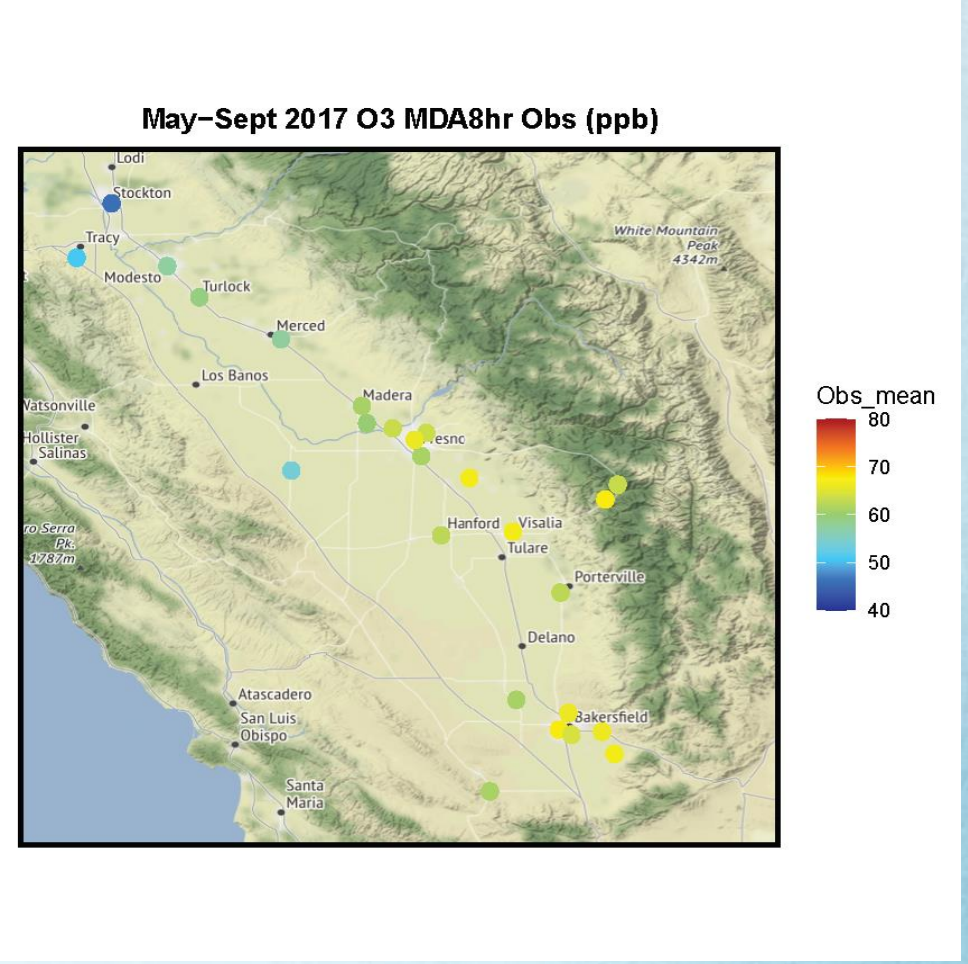
Modeling Overview: performance evaluation

- Model performance is critical for ground-truthing the modeling (does the model reasonably reproduce the observed meteorological parameters and air quality?)





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Model Attainment Demonstration

- Baseline ozone design value (DV) represents current peak ozone levels from observation and is used to assess attainment of the ozone standard
- Projecting the average DV to the future requires three model simulations:
  1. **Base year** simulation (2018): used to assess model performance
  2. **Reference year** simulation (2018): used to project future DV
     - Same as base year simulation except no wildfire emissions
  3. **Future year** simulation (2037): used to project future DV
     - Same as reference year, except anthropogenic emissions are for the future year (e.g., same meteorology and calendar)

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Model Attainment Demonstration

Projecting the baseline DVs to the future is done by first calculating the relative change in ozone between the modeled future and reference years for each monitor location. These ratios, called "relative response factors" or RRFs, are calculated based on the ratio of modeled future year ozone to the corresponding modeled reference year ozone.

$$RRF = \frac{Average\ MDA8\ Ozone_{future}}{Average\ MDA8\ Ozone_{reference}}$$

Future Year Design Value: $\mathbf{DV_F = DV_B \times RRF}$

observation base

model base

DV_F = Future Year Design Value
DV_B = Baseline Design Value

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Updates to the 8-hr ozone standard

Year	Specie	Averaging Time	Standard
2008	Ozone	8 hr	75 ppb
2015	Ozone	8 hr	70 ppb

Next Steps

- Work with the District on finalizing baseline ozone design values
- Continue preliminary modeling with emission inventory 2019 v1.02
  - Updated emission inventory (2019 v1.03) will be available in late summer/early fall

2022 *Ozone Plan* Development Schedule

Tentative Date	Upcoming Topics	
April 2021	**Public Workshop:** General background of Plan requirements and development process	✓
July 2021	**Technical Working Group Public Meeting:** Emissions inventory and modeling	✓
3rd/4th Q 2021	**Technical Working Group Public Meeting(s):** Stationary Source measures, Mobile Source measures	
4th Q 2021	**Technical Working Group Public Meeting(s):** Updates on strategy development; modeling analysis; RACM demonstration	
1st Q 2022	**Technical Working Group Public Meeting:** Share draft plan strategy and final modeling results	
1st Q 2022	**Publish** initial chapters and appendices of Plan for public review	
1st Q 2022	**Public Workshop:** Review of proposed attainment plan	
May 2022	**Publish** proposed plan for 30-day public review/comment	
June 2022	**Public Hearing:** for Governing Board to consider adoption of proposed plan	

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Comments/Questions

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