



# **2022 AQMP Reasonably Available Control Measures (RACM) Demonstration Methodology for Stationary Sources**

**AQMP Advisory Group Meeting  
Agenda Item #2  
August 27, 2021**

*Cleaning The Air That We Breathe...*



# Key SIP Elements and Due Dates for Severe and Extreme Nonattainment Areas

	8/3/2020	8/3/2021	8/3/2022	8/3/2028
Severe and Extreme Areas	Baseline Year Emissions Inventory	Nonattainment New Source Review (NSR)	Attainment Demonstration	Section 185 Fee Program (Failure to Attain)
	Emissions Statement		Reasonably Available Control Measures	
	Reasonably Available Control Technology Demonstration		Reasonable Further Progress	
	Vehicle Miles Traveled Offset		Conformity	
Extreme Area Only		Clean Fuels for Boilers	Contingency Measures	
			Enhanced Inspection and Maintenance Program	



# RACM and RACT for Nonattainment Areas

## Reasonably Available Control Measures (RACM)

- ❑ Applies to stationary and mobile sources
  - RACM analysis for mobile sources conducted by California Air Resources Board and Southern California Association of Governments
- ❑ All reasonable measures (including RACT) to meet Reasonable Further Progress requirements and to demonstrate attainment as expeditiously as possible

## Reasonably Available Control Technology (RACT)

- ❑ Applies to major stationary sources and sources subject to U.S. EPA's Control Techniques Guidelines and Alternative Control Techniques (CTG/ACT)
- ❑ Lowest emission limitation that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility
- ❑ Adopted in June 2020 for 2015 ozone standard



# RACM Overview

- **Purpose**

- Demonstrate that an air agency has adopted all available measures, including those being implemented in other areas, considering:
  - Control measures that have been implemented at the federal, state (California and other states), and local air district levels

- **Measures must be adopted if:**

- Technologically and economically feasible; and
- Will advance the attainment date, at a minimum, by one year, or are necessary for Reasonable Further Progress





# 2022 AQMP RACM Demonstration Seven-Step Analysis for Stationary Sources

1. Updated RACT/Prior RACM
2. EPA's Technical Support Documents
3. Control Measures Beyond RACM in 2016 AQMP
4. Other Districts' Control Measures
5. EPA's Menu of Control Measures
6. EPA's Guidance Documents
7. Control Measures Workshop and Working Group



# Seven-Step Analysis Overview

## Step 1 Updated RACT/ Prior RACM

- Evaluate stringency of South Coast AQMD rules against other air agencies' rules
- Review rules adopted from March 2020 to September 2021\*
- Cover CTG/ACT sources and stationary sources of VOC and NOx

## Step 2 EPA's Technical Support Documents

- EPA issues technical documents for evaluation of rules submitted to the SIP
- Evaluate EPA's technical documents to identify potential feasible measures

\* 2020 RACT Demonstration covered rules from March 2014 to February 2020.



# Seven-Step Analysis Overview (cont'd)

## Step 3 Control Measures Beyond RACM in 2016 AQMP

- Identify control measures evaluated but rejected in 2016 AQMP
- Re-evaluate the feasibility of those control measures

## Step 4 Other Districts' Control Measures

- Identify control measures in adopted air quality plans for other ozone nonattainment areas (Serious or above) from January 2016 to September 2021
- Evaluate if any of these control measures are applicable and feasible for South Coast AQMD



# Seven-Step Analysis Overview (cont'd)

## Step 5 EPA's Menu of Control Measures

- EPA's Menu of Control measures provides information on existing emissions reduction measures, and their control efficiency and cost effectiveness
- Evaluate most recent EPA's Menu of Control Measures to identify feasible measures

## Step 6 EPA's Guidance Documents

- EPA issues Guidance Documents for control strategies on reducing emissions from various sources
- Evaluate most recent EPA's Guidance Documents to identify feasible measures

## Step 7 Control Measures Workshop and Working Group

- South Coast AQMD will host a Control Measures Workshop to present proposed control measures and gather input on new control strategies
- Evaluate suggestions and ideas from Control Measure Workshop and Working Group for Residential and Commercial Buildings

# Next Steps



Research and collect related documents



Conduct a seven-step RACM analysis



Present draft results to AQMP Advisory Group

# Updates on Emissions Inventory and Air Quality Modeling

AQMP Advisory Group Meeting

Agenda Item # 3

August 27, 2021



# 2022 AQMP Emissions Inventory – Base Year (2018)

## Point sources

- Reported emissions from AER

## Area sources

- Natural Gas combustion categories – residential, commercial and industrial sectors
- LPG combustion categories
- Composting categories
- Fugitive VOC emissions from tanker ships
- Paved and unpaved road dust
- Architectural coatings and sealants from reported sales data under R1111 and R1168
- Consumer products



# 2022 AQMP Emissions Inventory – Base Year (2018, Cont'd)

## On-Road mobile sources:

- Travel activity data from 2020 Regional Transportation Plan
- Vehicular emission rates from EMFAC2017 with adjustments for CARB's regulations adopted since the release of EMFAC2017

## Off-Road mobile sources (major updates):

- Aircraft
- Locomotives
- Small Off-Road Engines
- Navy emissions from ship, aircraft and ground operation



# 2022 AQMP Emissions Inventory – Future Years

## Growth Scalars

- 2020 RTP/SCS growth forecast - Population, employment, housing, industrial output, etc
- Natural Gas consumption projection from Southern California Gas company
- Federal Aviation Agency's growth forecast for some airports

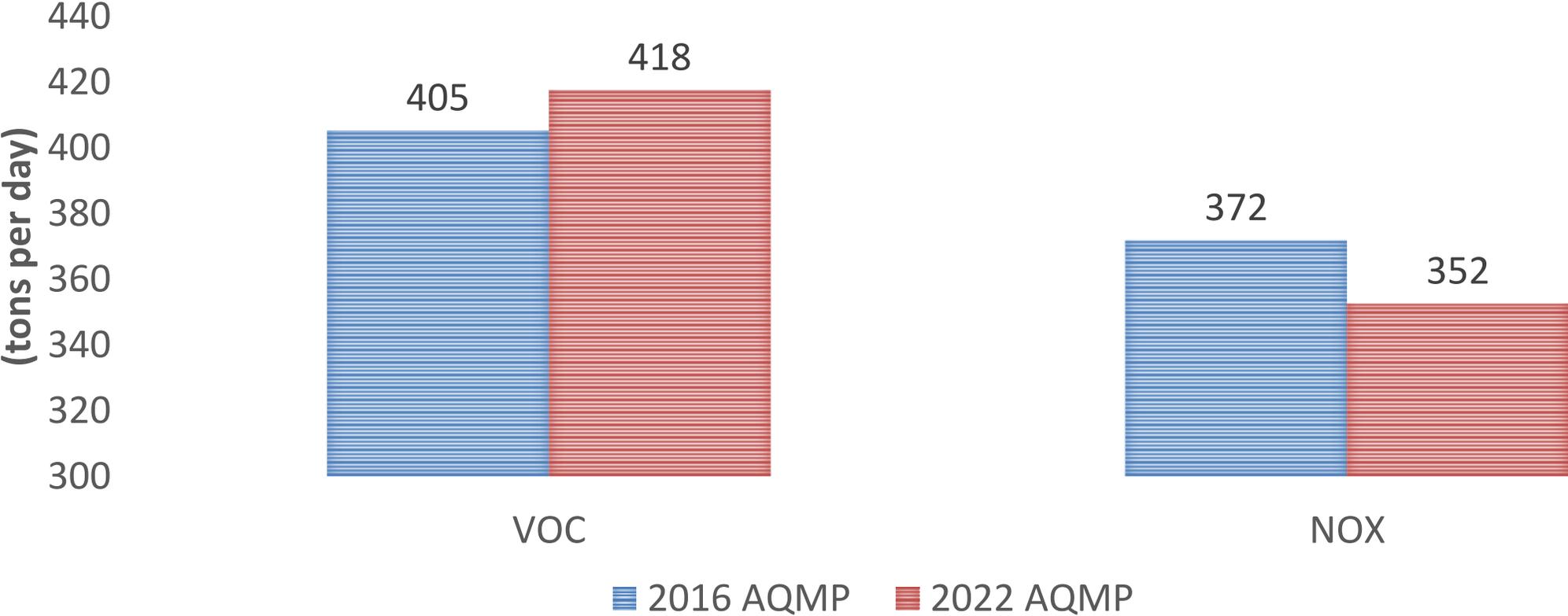
## Regulation Scalars

- South Coast AQMD, CARB and EPA/NHTSA rules and regulations adopted since the release of the 2016 AQMP



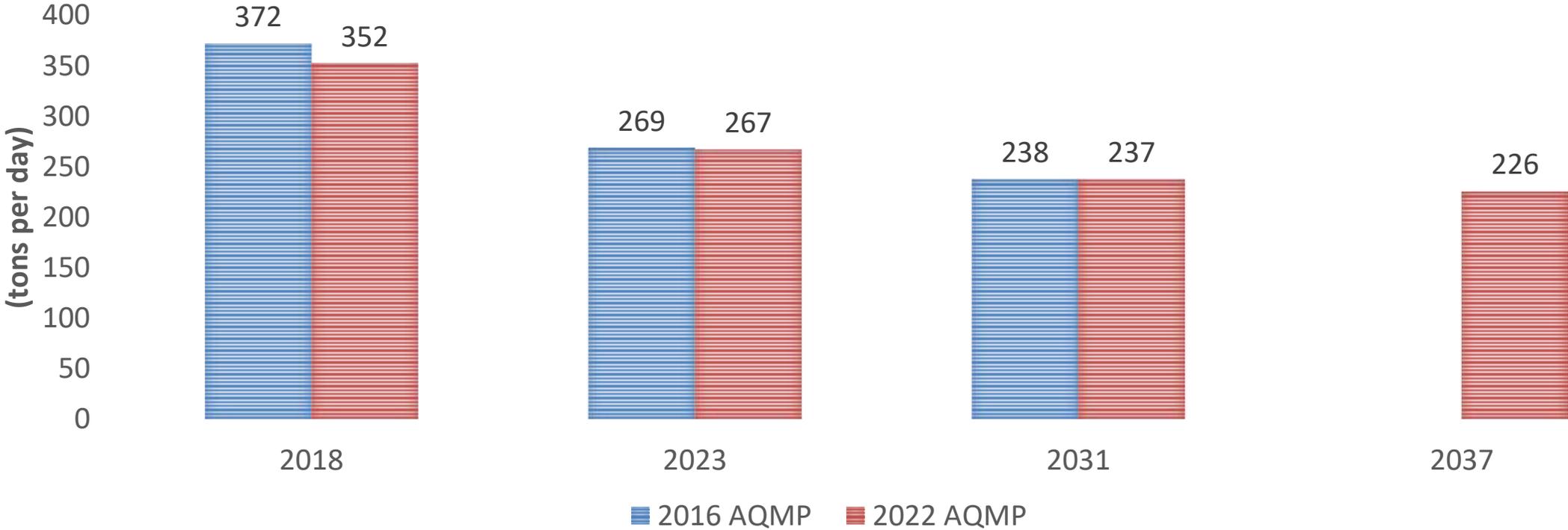
# Base Year: 2016 AQMP vs 2022 AQMP

## 2018 PRELIMINARY BASIN TOTAL EMISSIONS



# Future Years NOx emissions: 2016 AQMP vs 2022 AQMP

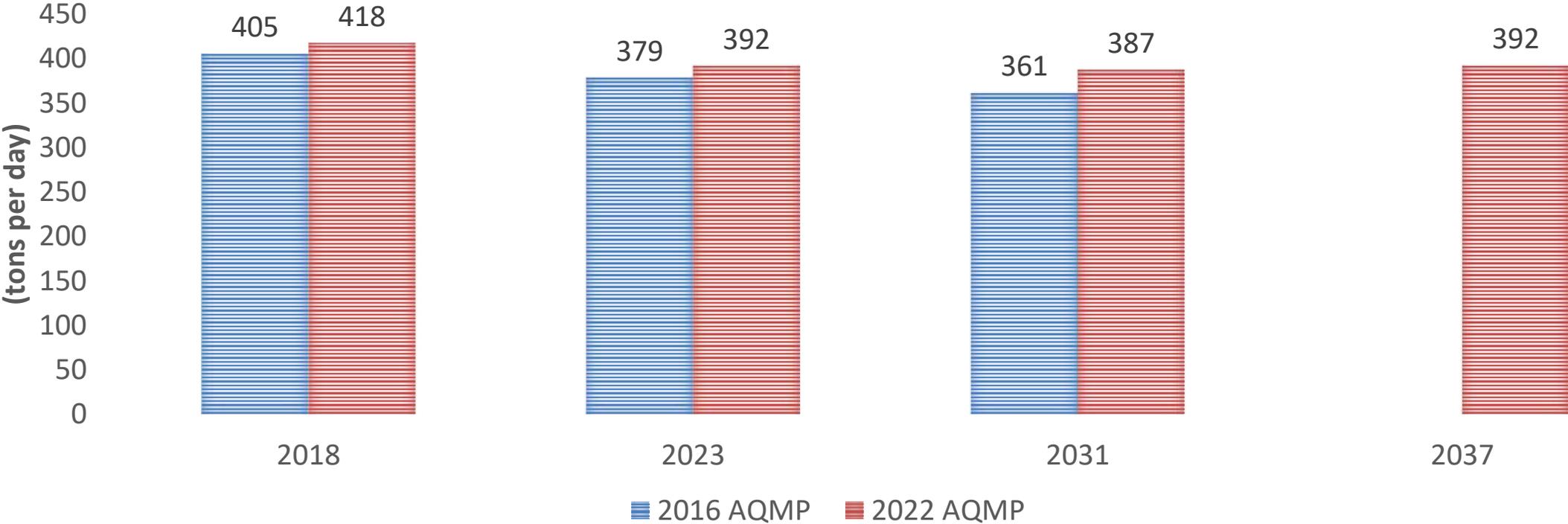
PRELIMINARY BASIN TOTAL NOX EMISSIONS



Since May 18, 2021, Navy ships, aircraft, Natural Gas combustion categories were updated.

# Future Years VOC emissions: 2016 AQMP vs 2022 AQMP

PRELIMINARY BASIN TOTAL VOC EMISSIONS

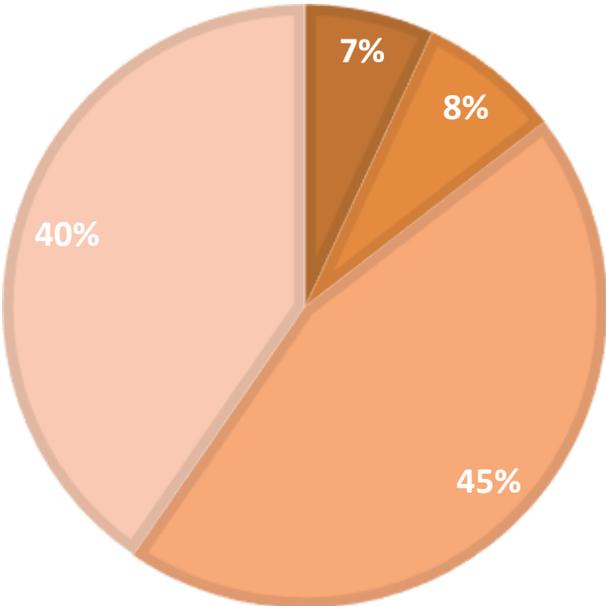


Since May 18, 2021, Navy ships, aircraft, Natural Gas combustion categories were updated.

# Distribution of Preliminary NOx emissions in 2018 vs 2037

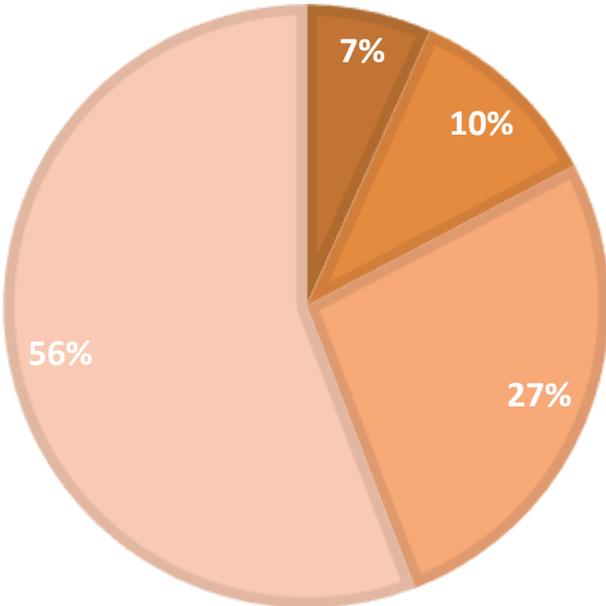
2022 AQMP - 2018 NOX

■ Points ■ Area ■ On-Road ■ Off-Road



2022 AQMP - 2037 NOX

■ Points ■ Area ■ On-Road ■ Off-Road



# Emissions Inventory – Next Steps

- Potential NO<sub>x</sub> reductions from Proposed Amended Rule 1109.1 (Emissions of Oxides of Nitrogen for Petroleum Refineries and Related Operations) – November 2021
- Updates on select off-road mobile categories – Summer 2021
  - Ocean Going Vessels (OGV), Cargo Handling Equipment (CHE) and construction equipment



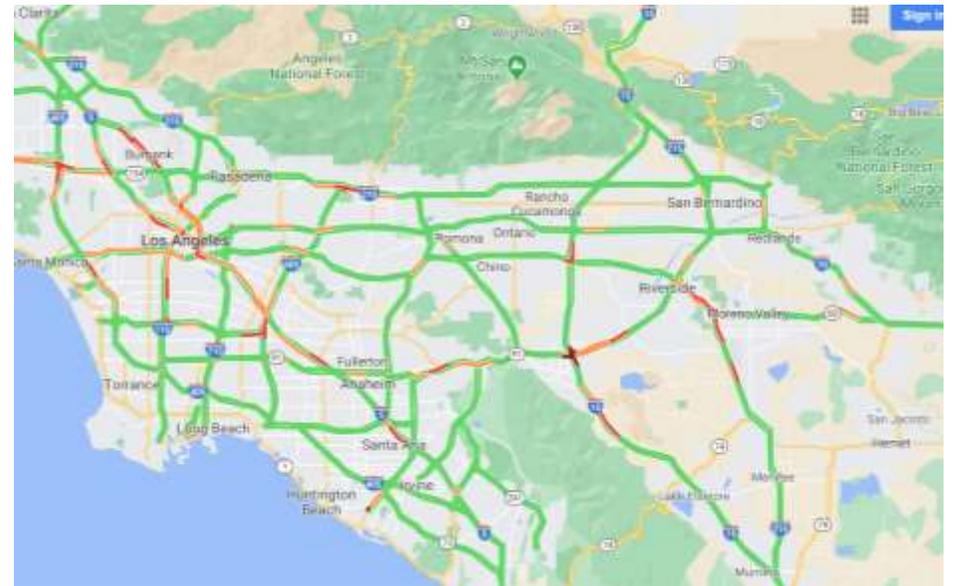
# Updates on Staff Air Quality Modeling Activities

- Modeling performance was evaluated extensively using various measurement data
  - Presentation at Scientific, Technical & Modeling Peer Review advisory group meeting on Aug 19. 2021
- Ozone and PM2.5 modeling
  - Ozone: 2022 AQMP for the 70 ppb attainment demonstration
  - PM2.5: 2006 24-hour PM2.5 maintenance demonstration



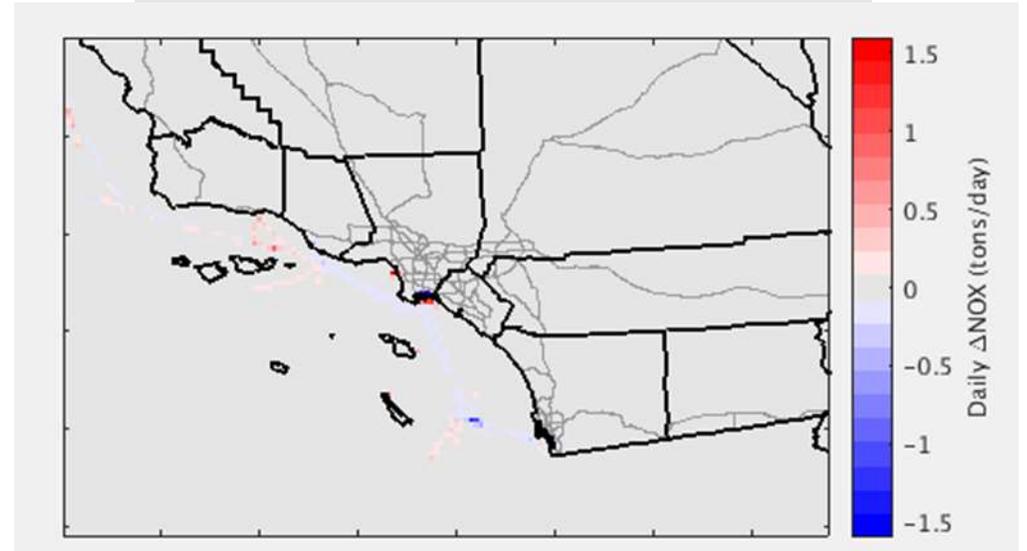
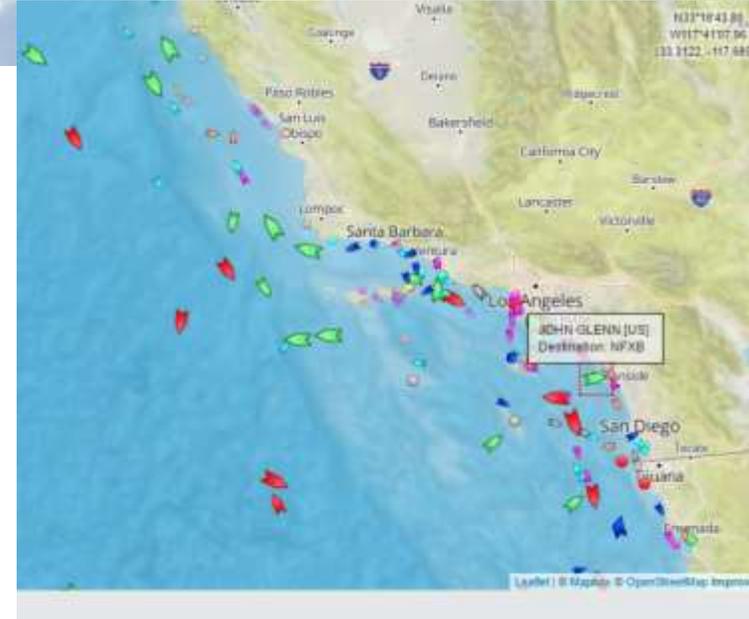
# Improvement in On-Road Emissions Allocation

- Based on real-time sensor data
- Light and Medium duty vehicles
  - California Department of Transportation Performance Measurement System (Caltrans PeMS)
  - > 9000 traffic monitoring stations
- Heavy duty vehicles
  - Single loop sensors to detect Heavy Duty traffic



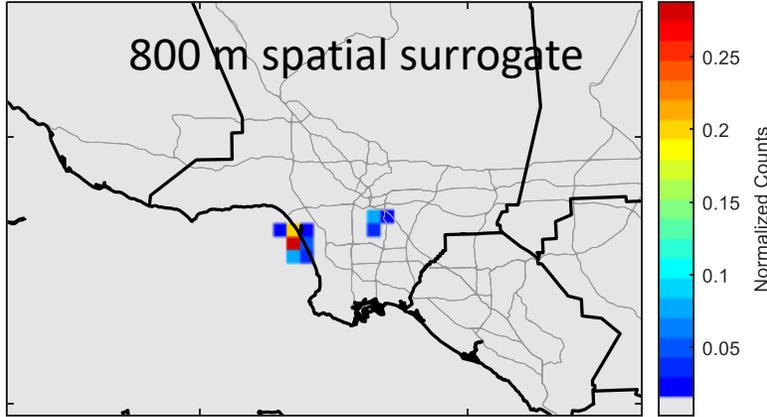
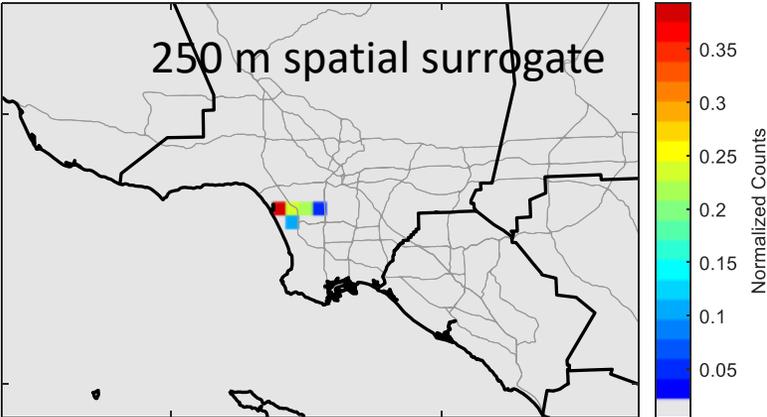
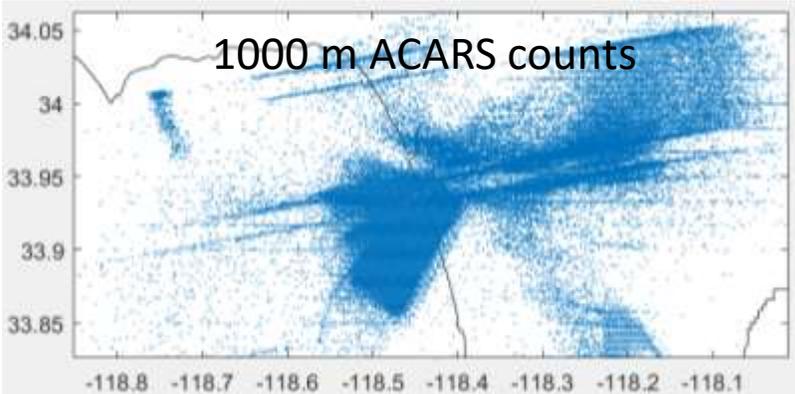
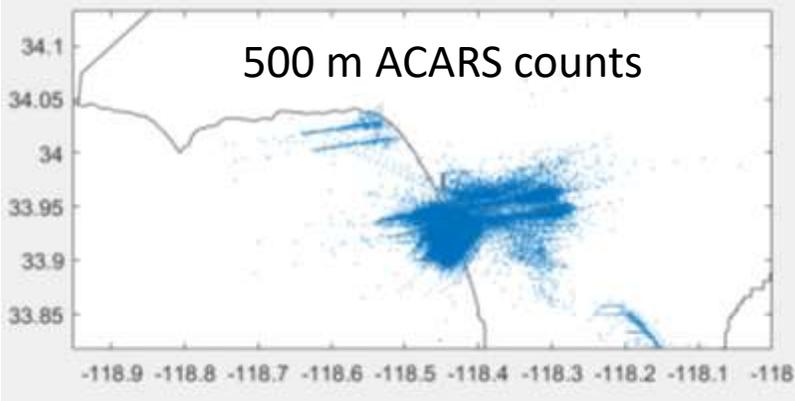
# Improvement in Vessel Emissions Allocation

- The Automatic identification system (AIS) is an automatic tracking system used for collision avoidance on ships and by vessel traffic services (VTS).
- Provides vessel type, size, position, course, and speed.



# Improvement in Aircraft Emissions Allocation

- Improve aircraft emission allocation using Aircraft Communications, Addressing and Reporting System (ACARS) data



# Air Quality Modeling – Next Steps

- Continue improving modeling performance and reduce uncertainties
  - Spatial and temporal allocation of mobile source emissions
  - Meteorological impact
  - Emissions emanating outside U.S. and background ozone
- Developing preliminary carrying capacity estimation – Fall 2021
  - A carrying capacity is the maximum level of emissions which would enable the attainment and maintenance of an ambient air quality standard for a pollutant



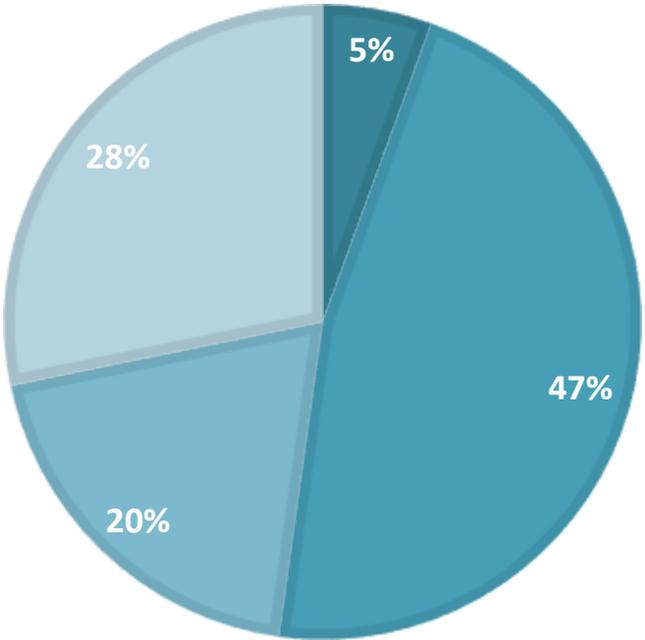
# EXTRA SLIDES



# Distribution of VOC emissions in 2018 vs 2037

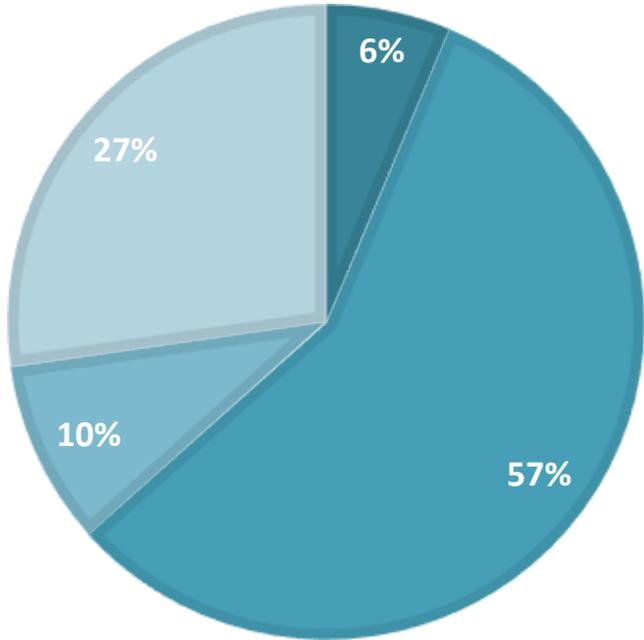
2022 AQMP - 2018 VOC

■ Points ■ Area ■ On-Road ■ Off-Road



2022 AQMP - 2037 VOC

■ Points ■ Area ■ On-Road ■ Off-Road



# **Meteorological Impact on High Ozone Episodes in South Coast Air Basin**

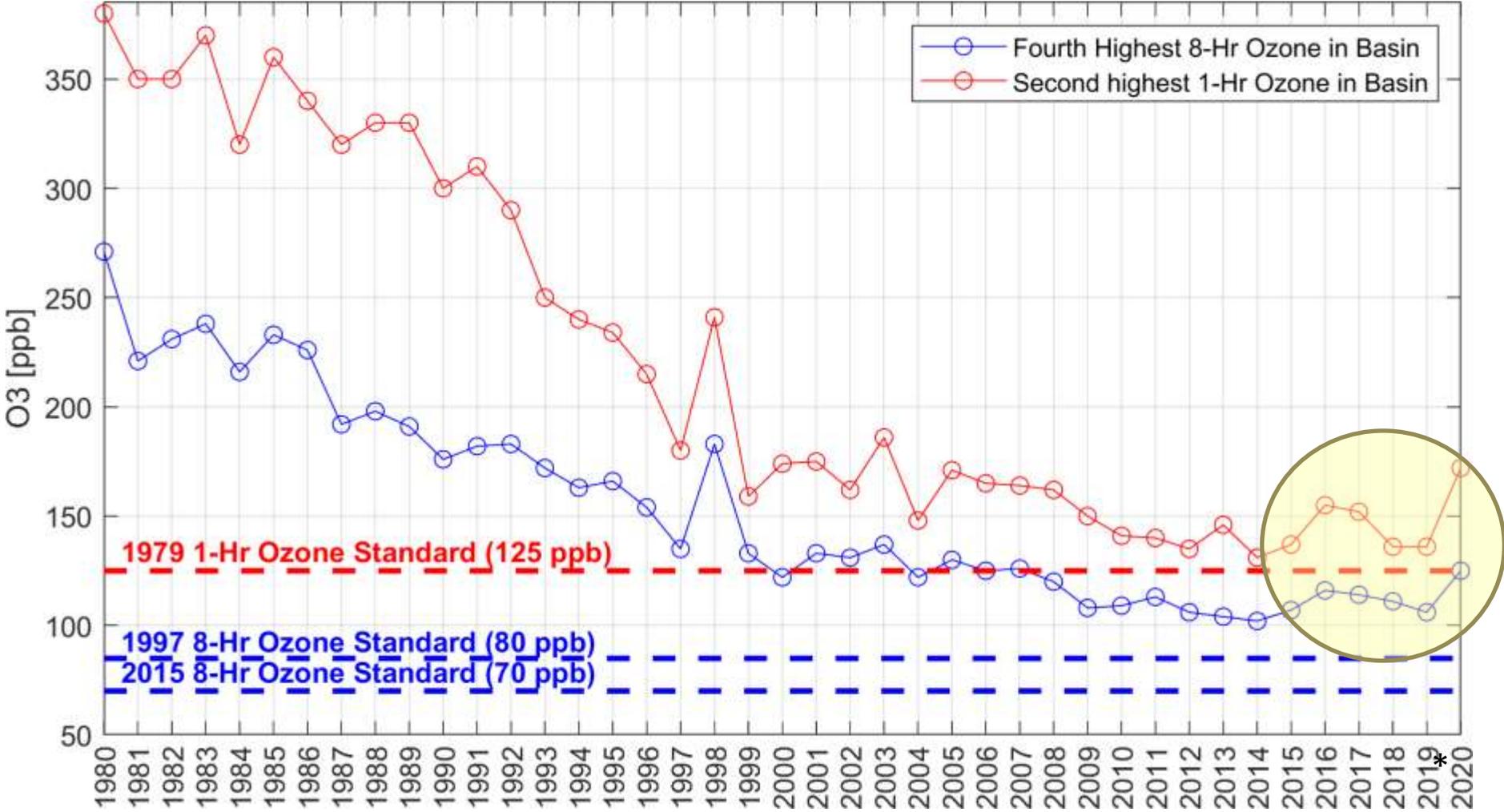
AQMP Advisory Group Meeting

Agenda Item # 4

August 27, 2021



# Ozone Design Values



# Approaches

## Contract with Outside Experts

- **University of California Riverside**
- Professor Cesunica Ivey at UC Riverside\*
- Professor Armistead (Ted) Russell at Georgia Tech
- Dr. Charles Blanchard EnvAir

## In-House Research

- Regional air quality modeling
- AQMP Emissions Inventory development

(\*currently UC Berkeley)



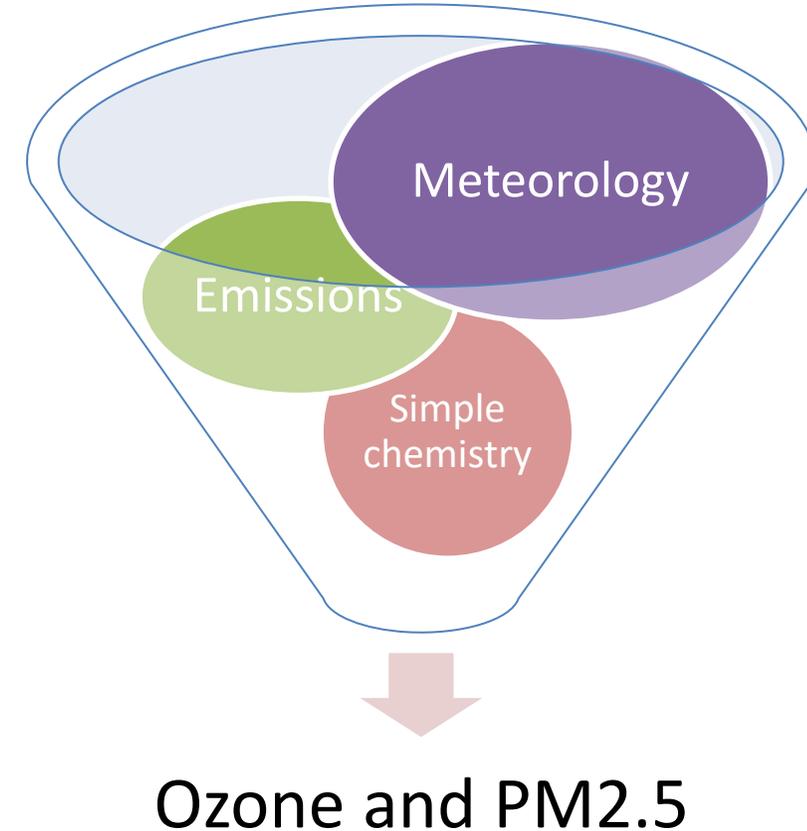
Contract with UC Riverside

# Meteorological Factors and Trends Contributing to Air Quality in South Coast Air Basin

# More extreme weather during 2015 – 2018

- Meteorological data measured during 1990-2018
- Warmer Surface Temperature
  - Used Barstow daily max temperature to link with synoptic meteorology
- Warmer upper air temperature
  - 850 mb temperature measured at Miramar Marine Corps air station near San Diego
- Stronger high pressure
  - Higher 500 mb height measured at Miramar
- Ocean Temperature: El Niño (ENSO)

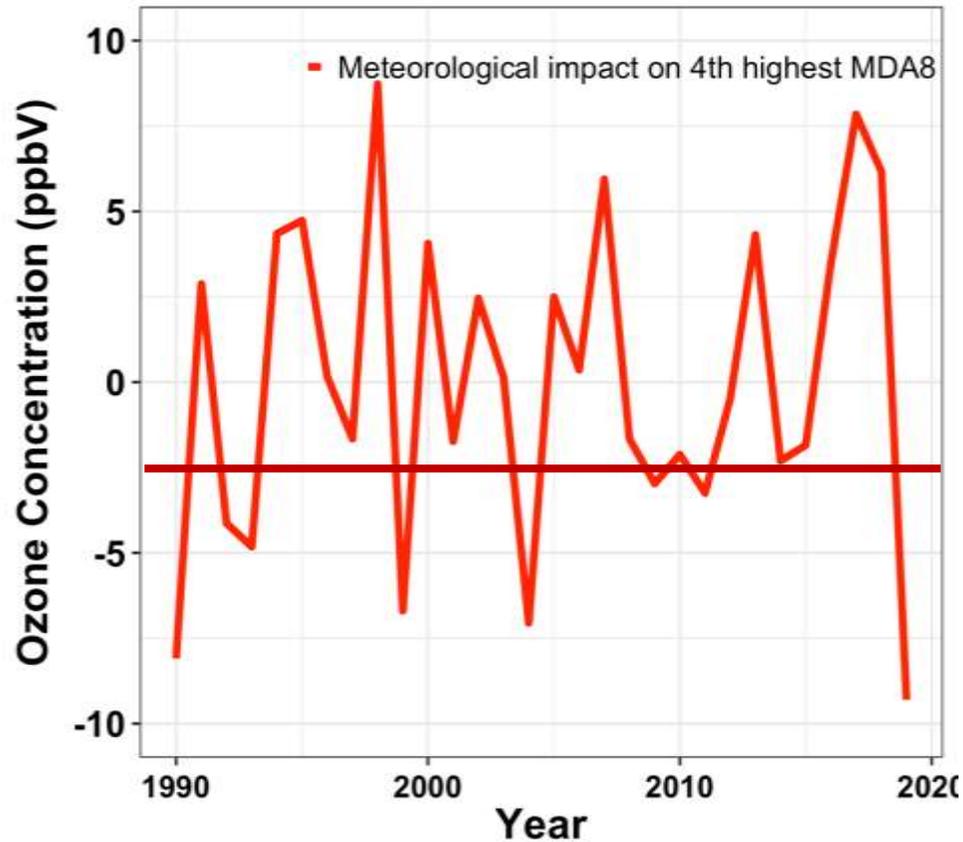
- Generalized Additive Modeling (GAM)
- A statistical approach using historic measurements of meteorology and air quality and simple chemistry
- Distinguish the impacts of meteorology vs. emissions



# Historical Impacts: 4<sup>th</sup> Highest Ozone

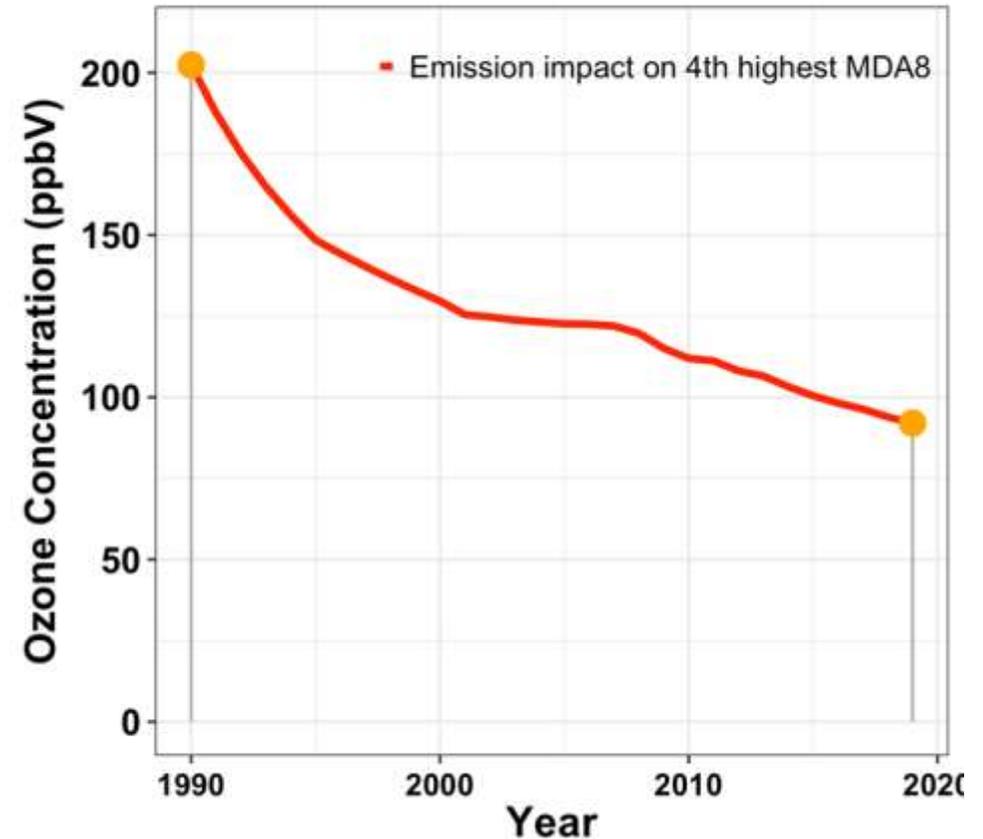
## Meteorological

Meteorological Impact on 4th Highest MDA8 Ozone from 1990 to 2019



## Emissions

Emission Impact on 4th Highest MDA8 Ozone from 1990 to 2019

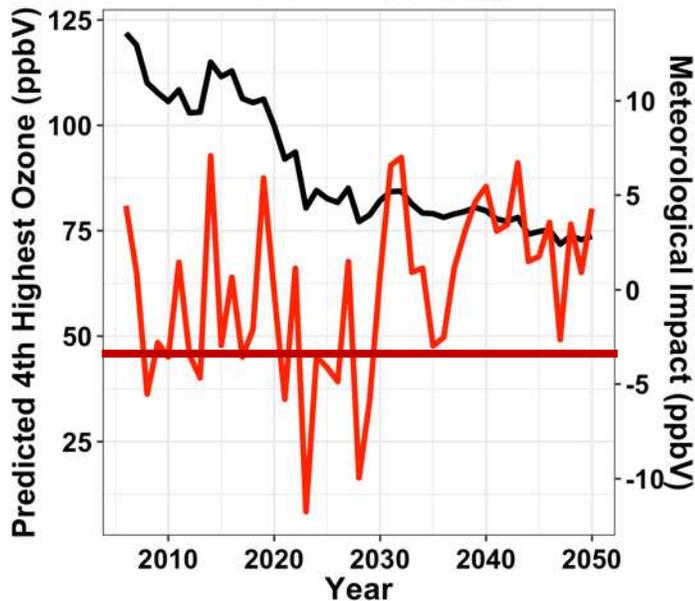


\*MDA8 – Maximum Daily 8-hour ozone Average

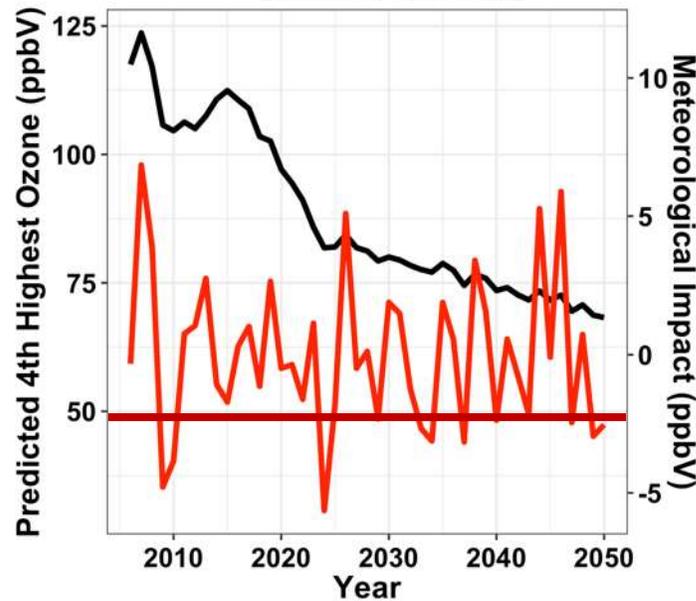
# Future Impacts: 4<sup>th</sup> Highest Ozone

## Meteorological

Meteorological Impact on 4th Highest MDA8 Ozone and Predicted 4th Highest MDA8 Ozone from 2006 to 2050 (RCP4.5 Meteorology)

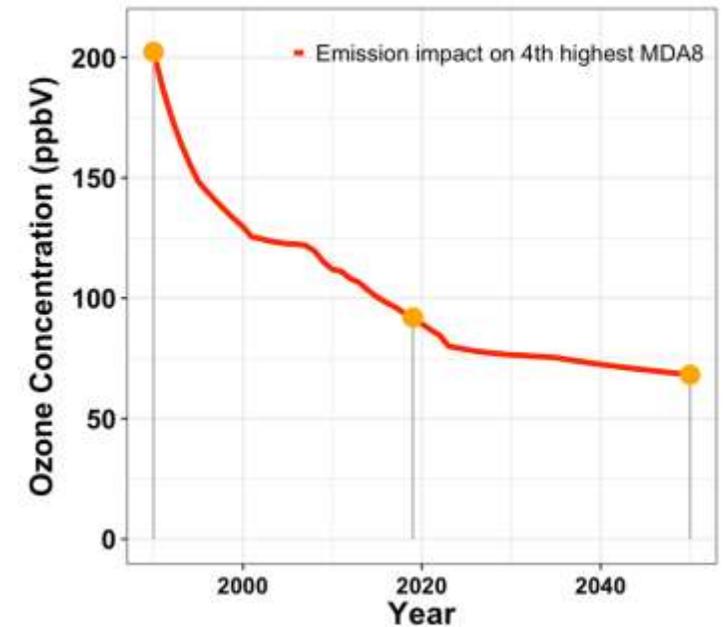


Meteorological Impact on 4th Highest MDA8 Ozone and Predicted 4th Highest MDA8 Ozone from 2006 to 2050 (RCP8.5 Meteorology)



## Emissions (Base Case)

Emission Impact on 4th Highest MDA8 Ozone from 1990 to 2050

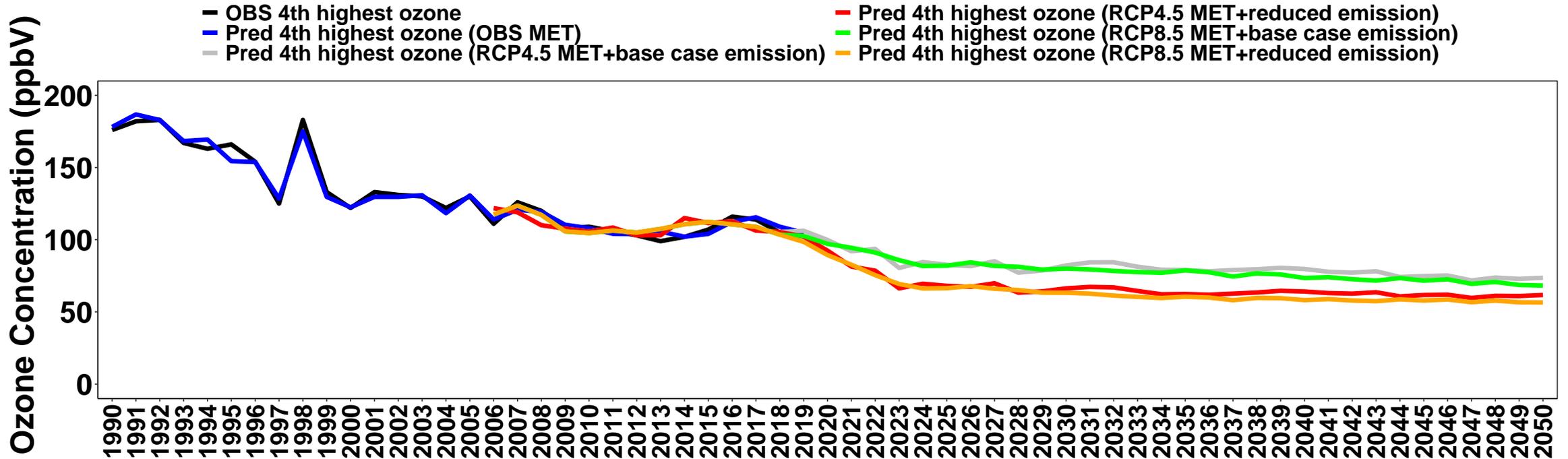


- Future meteorology was simulated with Community Earth System Modeling using IPCC's Representative Concentration Pathway 8.5 scenario
- IPCC represents Intergovernmental Panel on Climate Change

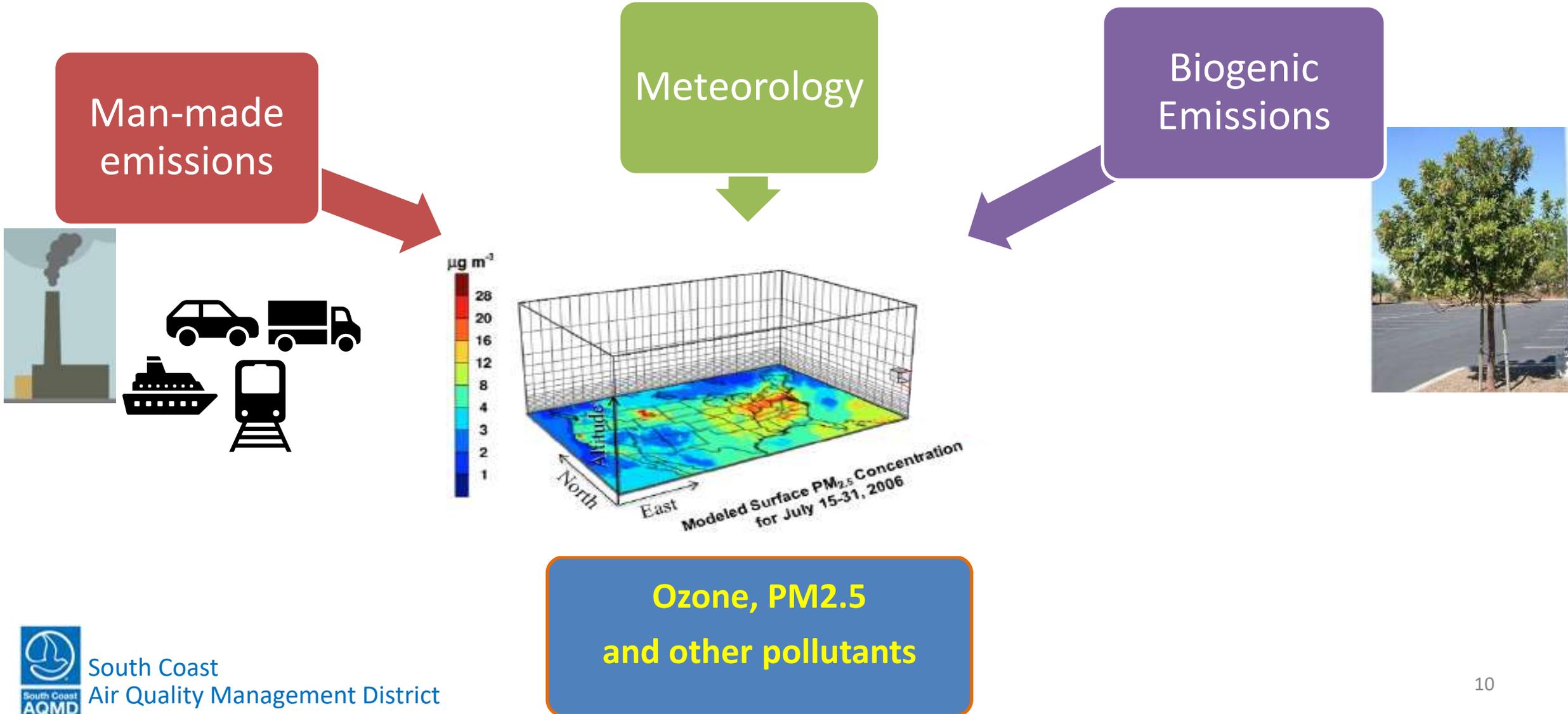
# Future Impacts: 4<sup>th</sup> Highest Ozone

## Reduced Emissions (2016 AQMP Strategy) vs. Base Case

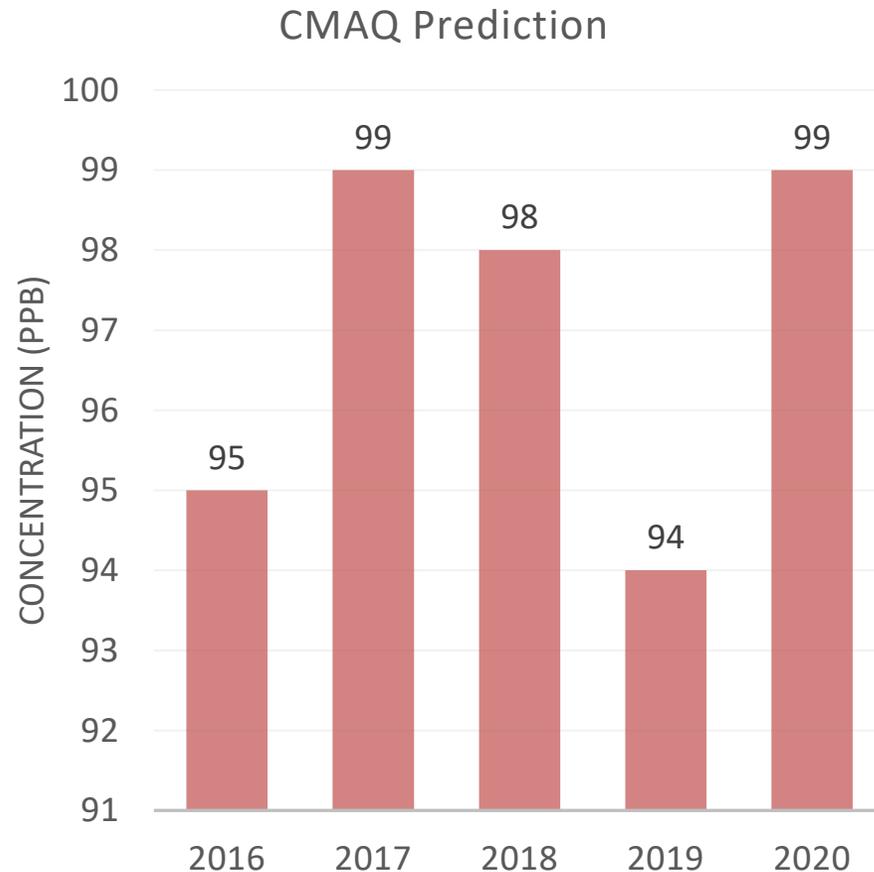
Observed and Predicted 4th Highest Ozone Concentration at Crestline site from 1990 to 2050



# Regional Photochemical Modeling Approach



# Year-to-Year Changes in Meteorology

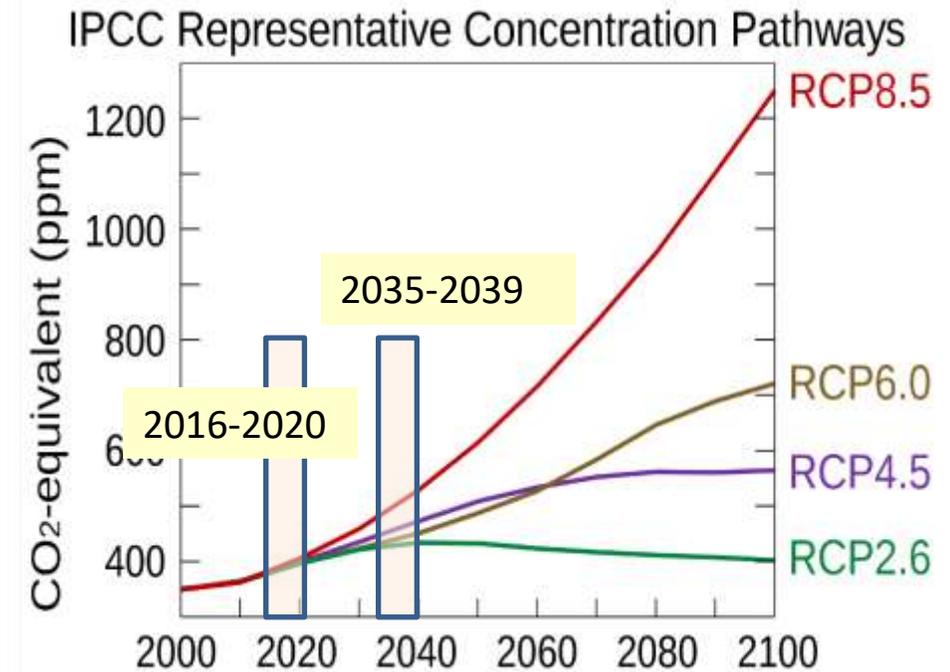


- No change in man-made emissions
- Regional modeling results indicate that top 10 day average ozone level fluctuates by 5ppb or larger due to meteorology in recent years
- The impact on design value is expected to be larger

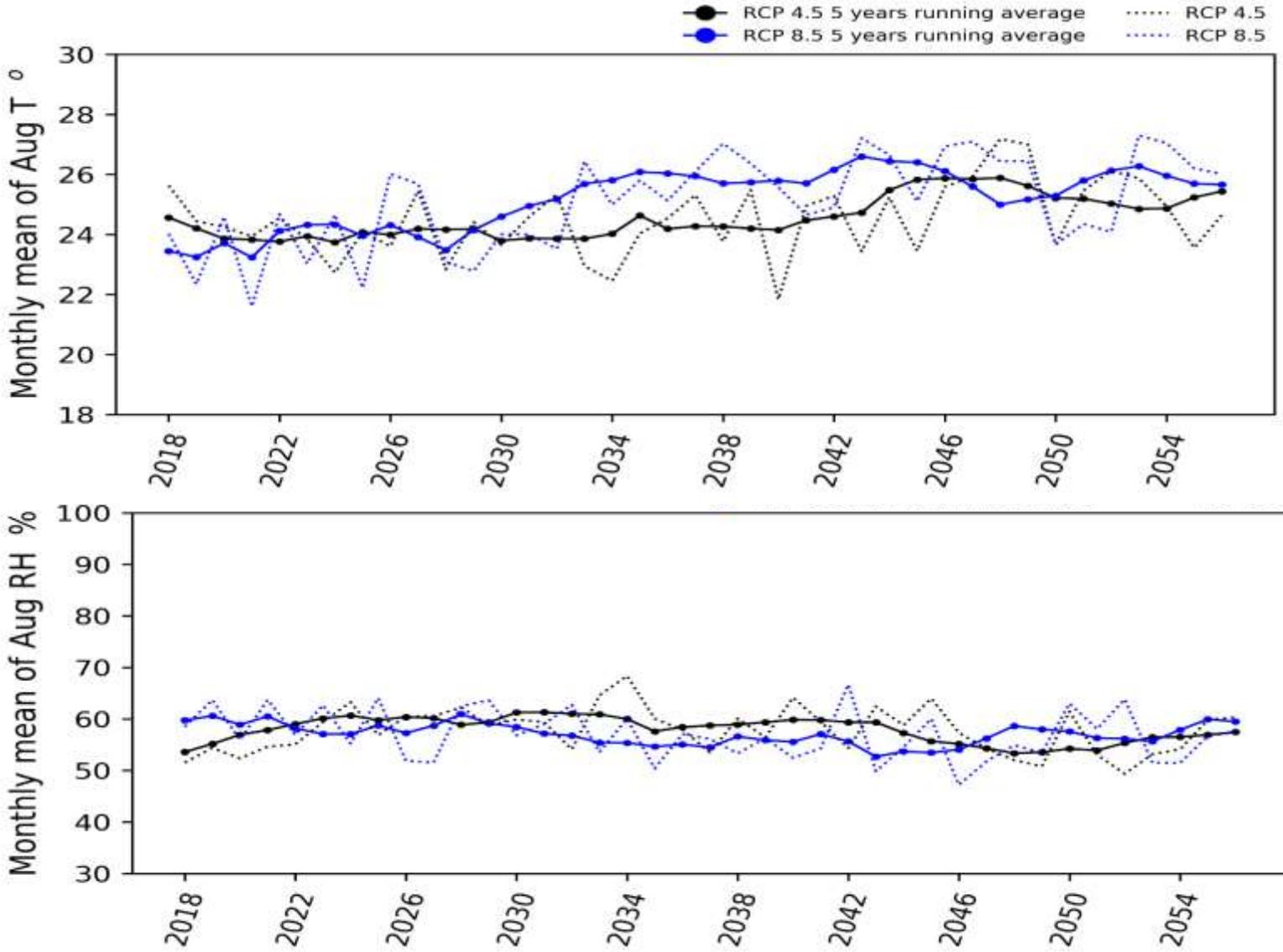


# Representative Concentration Pathway (RCP) and CESM

- National Center for Atmospheric Research (NCAR) Community Earth System Model (CESM)
- Global Bias-Corrected CMIP5 Output (NCAR Research Data Archive ds316.1)
- Four pathways from the IPCC fifth Assessment Report (AR5) labelled after possible radiative forcing ( $\text{W/m}^2$ ) in the year 2100: RCP2.6, RCP4.5, RCP6, and RCP8.5.
- Bias corrected, the European Centre for Medium Range Weather Forecasts (ECMWF) Interim Reanalysis for 1981 - 2005

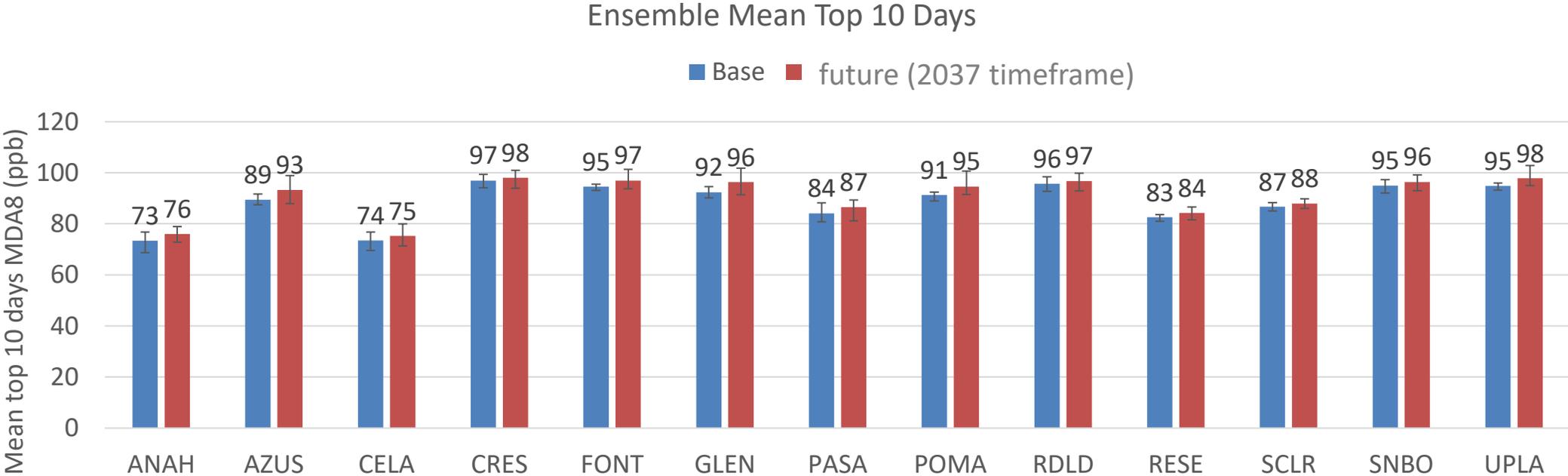


# Average Temperature and Relative Humidity of August in South Coast Air Basin



# Ensemble Mean Top 10 Day MDA8

- Increases up to 4% at many sites with greater impact in the urban and foothill locations
- No changes in man-made emissions



- Future meteorology data are scenarios reflecting prescribed GHG increase paths and inherently uncertain.
- Emissions are forecast/backcast from 2016 AQMP/CEPAM or earlier inventory
- There are no observations for low NO<sub>x</sub>/VOC conditions, so the low NO<sub>x</sub> modeling is more uncertain
- There are large degrees of uncertainties in climate prediction including vegetation responses to GHG, land use changes, hydrological cycle, wildfires, etc
- Modeling approaches including GAM, emissions inventory and CMAQ contain various uncertainties including spline fits in the GAM, spatial and temporal allocation, chemical speciation, and numerical scheme.

# Summary

- Real world ozone levels decreased substantially due to decreasing emissions over the past several decades.
- 2015 – 2018 weather was more extreme than previous years, which likely caused the high ozone and PM2.5 levels observed in the South Coast Air Basin
- Natural variability in meteorology affects high ozone levels in the South Coast Air Basin, but it is challenging to precisely quantify the impact due to large uncertainties in emissions and volatile precursor levels in a large, heterogeneous urban air shed
- High ozone concentrations from year 2020 to year 2050 show a marginally decreasing trend with the baseline emissions
- Reduced emissions scenarios are predicted to show attainment of federal air quality standards despite climate change
- The 5-year averaging window and 19-year time period used in the CMAQ modeling may be too small to capture a climate signal



# 2022 AQMP Approach

- Coordinating with EPA and CARB staff
- EPA guidance for attainment demonstration does not recommend to air agencies explicitly account for long-term climate change in attainment demonstrations for time spans of less than 20 years.
- Key Factors considered in Weight of Evidence discussion
  - Meteorological impact on base and future ozone levels
  - Long range transport and background ozone using satellite data and global chemical transport modeling is steady or marginally decreasing
  - Biogenic emissions
  - Other uncertainty discussions





# Updates on 2022 AQMP Working Group Meetings

AQMP Advisory Group Meeting  
Agenda Item #5  
August 27, 2021



# 2022 AQMP Working Group - Residential and Commercial Buildings



- **Four working group meetings in Dec 2020, Feb, May, and June 2021:**
  - Emission inventory for sources in residential and commercial buildings**
  - 2016 AQMP control measures (CMB-02 and CMB-04) and existing area source rules**
  - South Coast AQMD funded technology demonstration projects and programs**
  - Federal, state, and other local agency programs**
  - Four organizations presented various aspects of building decarbonization**
  - General approaches for 2022 AQMP residential and commercial building control measures**



# General approaches Presented at the June 17, 2021 Working Group Meeting



- Staff proposed to separate CMB-02 and CMB-04 to create individual control measures by commercial and residential sources and by equipment type
  - ❑ Dedicating a control measure for each of individual category allows for a
    - More robust analysis for each equipment category
    - Recognizes status of technology and implementation approaches that are unique to each equipment category
- Staff also proposed regulatory and incentive-based approaches for each individual category

## CMB-02

CMB-02A  
Residential Space Heating

CMB-02B  
Commercial Space Heating

CMB-02C  
Residential Water Heaters

CMB-02D  
Large Water Heaters

CMB-02E  
Laundry Dryers and Other Appliances

## CMB-04

CMB-04A  
Residential Cooking Devices

CMB-04B  
Commercial Cooking Devices

# Next Steps



- **Next steps**
  - Enhance implementation approaches**
  - Update emission inventory and estimated emission reductions**
  - Continue preliminary write up of a residential/commercial building control measures for 2022 AQMP and provide to Working Group for input**



- Third working group meeting held on June 3
- Topics Covered:
  - Measures for Reducing Emissions from On-Road Heavy-Duty Vehicles (CARB)
  - Warehouse Indirect Source Rule Overview (AQMD)



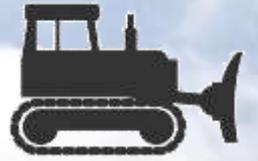
# HD Trucks – Potential Control Strategies



- **CARB proposed HD vehicle measures**
  - ❑ **Advanced Clean Fleets/Zero Emission Drayage**
  - ❑ **Heavy-Duty Vehicle Inspection and Maintenance Program**
- **Federal Cleaner Trucks Initiative**
- **Ports Clean Truck Program**
- **Facility-Based Mobile Source Control Measures (e.g., ports)**
- **Interagency coordination on infrastructure planning and development**
- **Potential incentive measures**



# 2022 AQMP Working Group - Construction and Industrial Equipment



- **Third working group meeting held on June 15**
- **Topic covered:**

## **Development of Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation (CARB)**

- Operational backstop on old equipment**
- Extension of adding vehicles provision**
- Simplify the low-use exemption**
- Other potential changes**





# Construction and Industrial Equipment – Potential Control Strategies



- **In-Use Off-Road Diesel Fleet Regulation**
- **New Tier 5 engine standards**
- **ZE forklift requirements**
- **Targeted Zero-Emission Off-Road Equipment Production**
- **Green Fleet Recognition Program**
- **Expanding Clean Off-Road Equipment Incentive Voucher Project (CORE)**
- **Green construction policies**



# 2022 AQMP Working Group - Ocean-Going Vessels



- **Third working group meeting held on June 2**
- **Topics Covered:**
  - PRIMER – A Multi-Regional Clean Vessel Incentive Framework (AQMD)**
  - Industry Perspectives (PMSA)**
- **Fourth working group meeting on August 24 covering:**
  - Draft Update on OGV Emissions Inventory (CARB)**
  - Water-in-Fuel Retrofit Demonstration Project (AQMD)**





# Ocean-Going Vessels – Potential Control Strategies (1)



- **Possible initiatives/programs for EPA’s consideration**
  - EPA/IMO Tier 4 marine engine standards
  - Optional engine standards based on verified retrofit control technologies
  - Potential limits in ECAs for older vessels and Tier II+ requirements
- **Potential CARB regulatory/incentive measures**
  - At-Berth – additional vessel types & anchorage emissions
  - Transit and maneuvering operations
  - Cleaner vessel calls requirement
  - Enhanced Vessel Speed Reduction (VSR)
  - Incentive measures for alt fuel, cleaner engines



# Ocean-Going Vessels – Potential Control Strategies (2)



- **Ports Clean Air Action Plan measures**
  - Enhance VSR Program
  - Variable rates on ships; higher fees for Tier 0 and Tier I
  - Incentive programs for cleaner vessels
- **Possible South Coast AQMD programs and actions**
  - Pacific Rim Initiative for Maritime Emission Reductions (PRIMER)
  - Ports MOU/ISR
  - Develop & demonstrate retrofit technologies
  - Petition to EPA for additional requirements
  - Legislative efforts



# 2022 AQMP Working Group - Aircraft



- **Two working group meetings held on June 8 and August 18**
- **Topics Covered**
  - Aircraft Forecast and Fleet Mix (FAA)**
  - A4A Input on Draft Emissions Inventory and Emissions Reduction Strategies Discussed to Date**
  - Update on aircraft emission standards (U.S. EPA)**
  - Revised draft aircraft emissions inventory (AQMD)**
  - Aircraft emissions impact on high ozone episodes (AQMD)**



# Aircraft – Potential Control Strategies



- **New aircraft engine and APU standards (EPA/ICAO)**
- **Operational improvements (de-rated take-off, reduced engine taxing, reduced APU usage, zero emission APU)**
- **Incentives for flying cleanest aircraft**
- **Promote and support zero emission aviation**



# Next Steps

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- **Next series of Mobile Source Working Group meetings in September/October**
- **Additional Working Group meetings to cover:**
  - **Charging/fueling infrastructure needs**
  - **Other mobile source categories (locomotives, cargo handling equipment, TRUs, etc.)**
  - **Incentive measures and potential funding strategies**
- **Control Measures Workshop in October**