Scientific, Technical & Modeling Peer Review Advisory Group (STMPR) Meeting

October 11, 2023

Agenda

1. Welcome, Introduction and Approval of Minutes
2. Precursor Demonstration
3. Contribution Thresholds for the PM2.5 Precursor Demonstration
4. Preliminary Control Scenario for the Attainment of the Annual PM2.5 Standard
5. Attainment Demonstration for the Ontario CA-60 Near-Road Site
6. Other Business
7. Public Comment

Need to Develop Revised PM2.5 Plan

- 2016 AQMP included an attainment plan for the annual PM2.5 standard
  - U.S. EPA has not acted on the Plan within the statutory review timeline
- After the 2016 AQMP, near-road monitoring stations were established and accumulated sufficient data to use in attainment demonstration
  - Ontario CA-60 near-road has the highest annual PM2.5 levels in the South Coast Air Basin
- South Coast AQMD is developing a new attainment plan to include the near-road stations and to reflect changes in emissions and demographics since 2012, the base year of the 2016 AQMP
- This PM plan will demonstrate attainment of the 2012 annual PM2.5 standard in 2030 for the South Coast Air Basin

Item 2

Precursor Demonstration

Rui Zhang, Ph.D.

Air Quality Specialist

STMPR Meeting on October 11, 2023

South Coast Air Quality Management District

Background

U.S. EPA requires all precursors of PM2.5 – NOx, SOx, NH3 and VOC – to be evaluated in PM2.5 State Implementation Plan (SIP)

State can demonstrate that a particular precursor does not contribute to PM2.5 levels significantly in the nonattainment area

Successful demonstration waives all SIP planning requirements such as Best Available Control Measure, control measure and contingency measure

Design of Numerical Experiments

Modeling Years

2018 and 2030 reflecting 2022 AQMP/SIP strategy

Precursors

VOC and SOx

Emission Reductions Range

30-70%

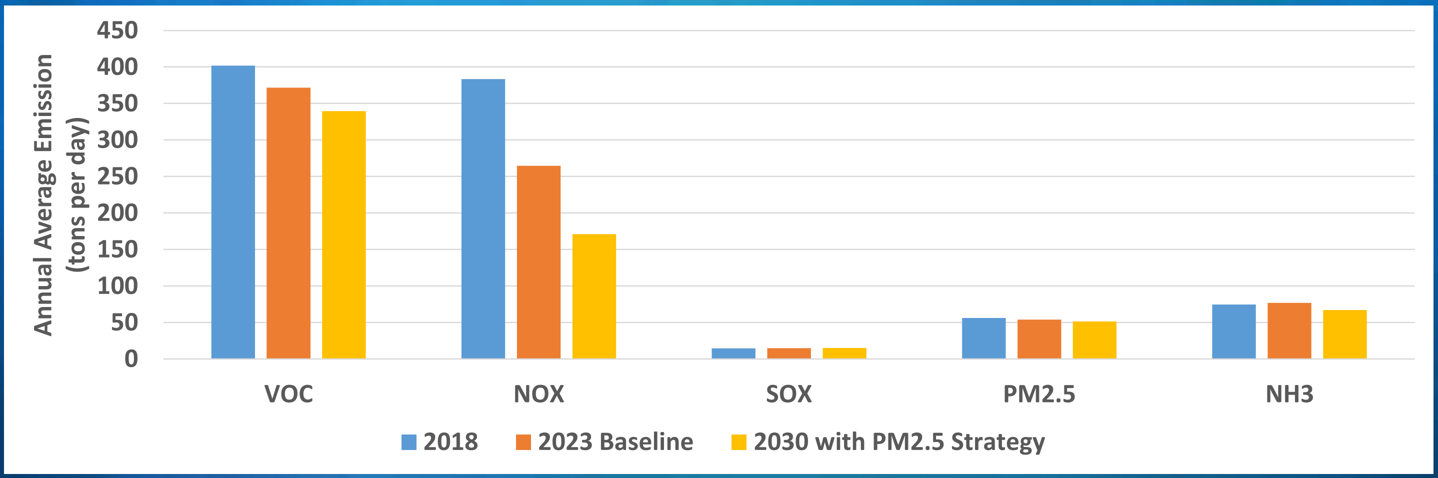
Contribution Threshold

- U.S. EPA guidance - 0.2 $\mu g/m^3$ based on nation-wide data
- South Coast Air Basin specific number – 0.4 $\mu g/m^3$

Stations of Interest

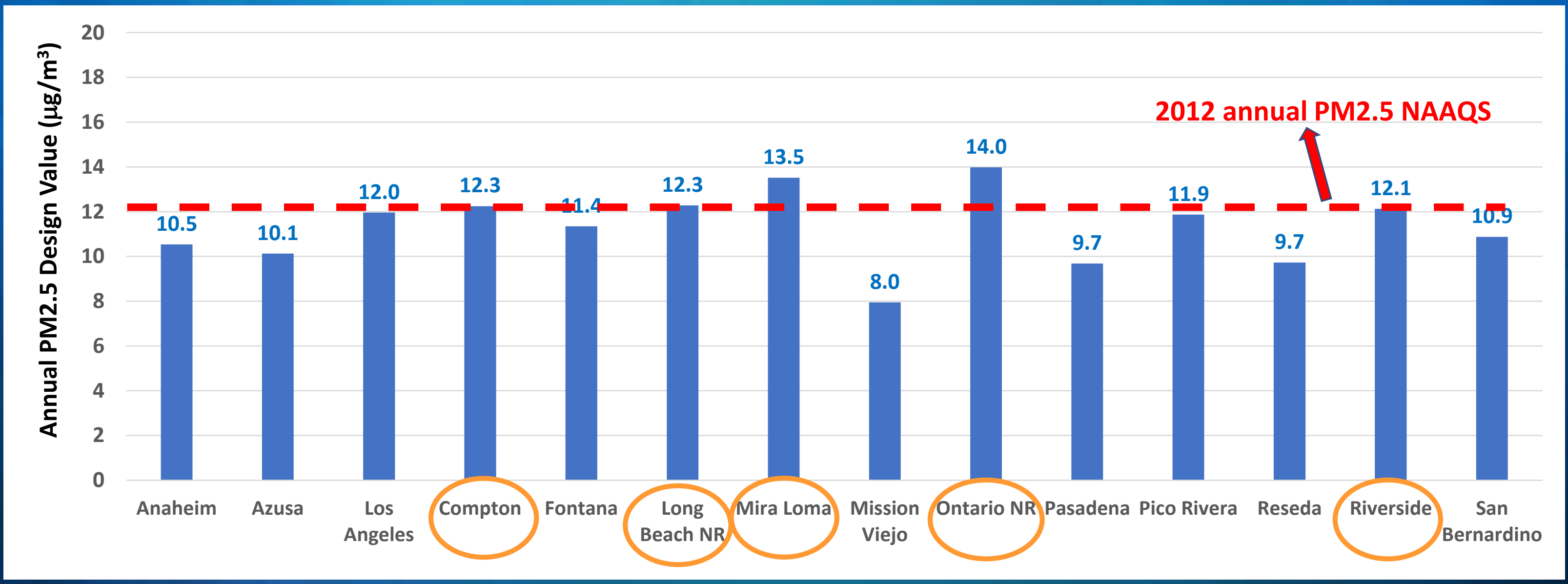
Stations with 2018 annual PM2.5 design value exceeding 12 $\mu g/m^3$

South Coast Air Basin Total Emissions



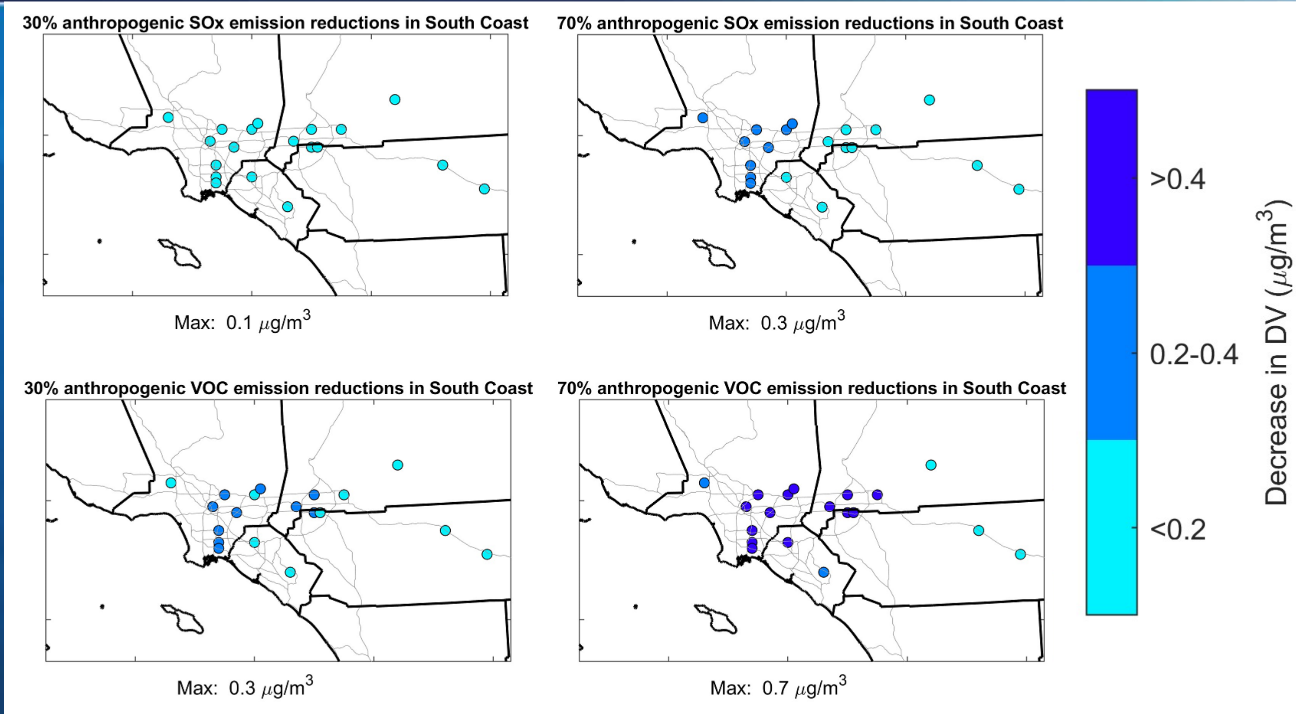
- Current emission levels are closer to 2030 than to 2018, confirming the emissions reduction path to 2030

Stations of Interest for the Precursor Demo

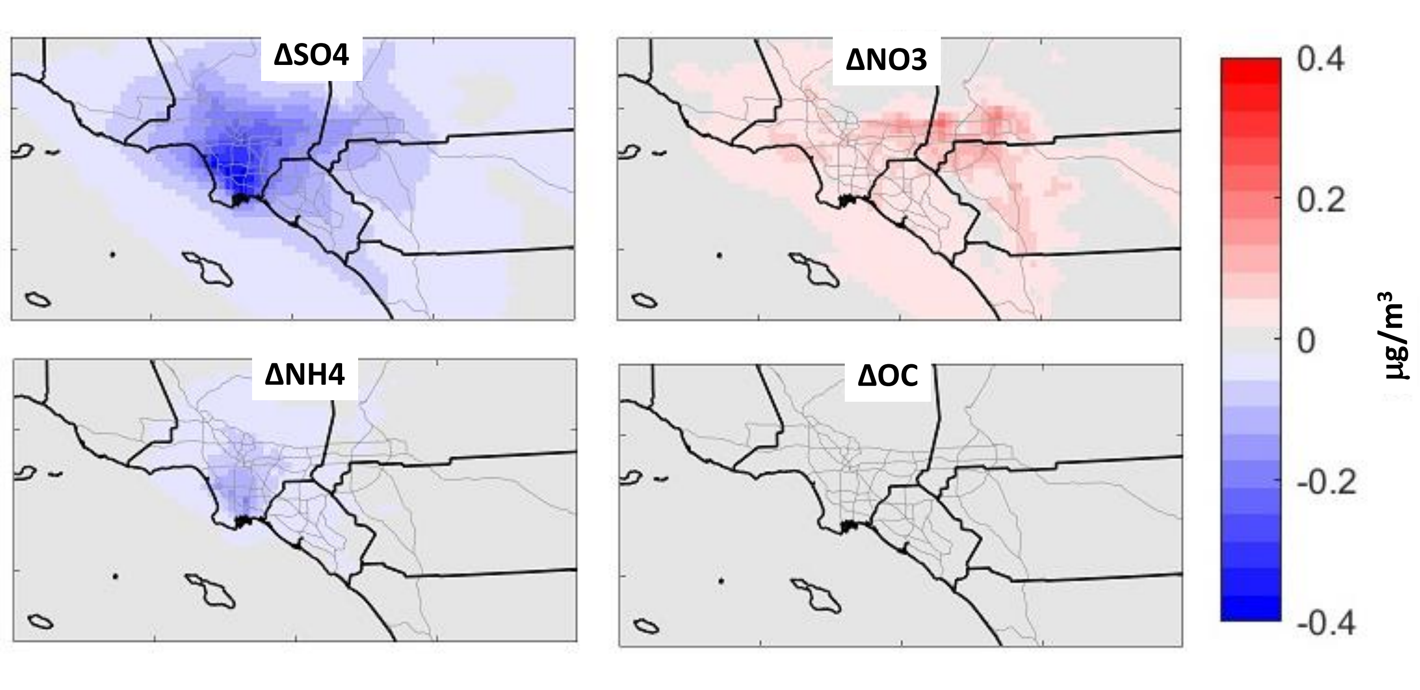


Precursor demonstration focuses on the 5 Stations that exceed the 2012 annual PM2.5 NAAQS
Design site is Ontario Near-Road with a base year design value of 14.0 µg/m^3

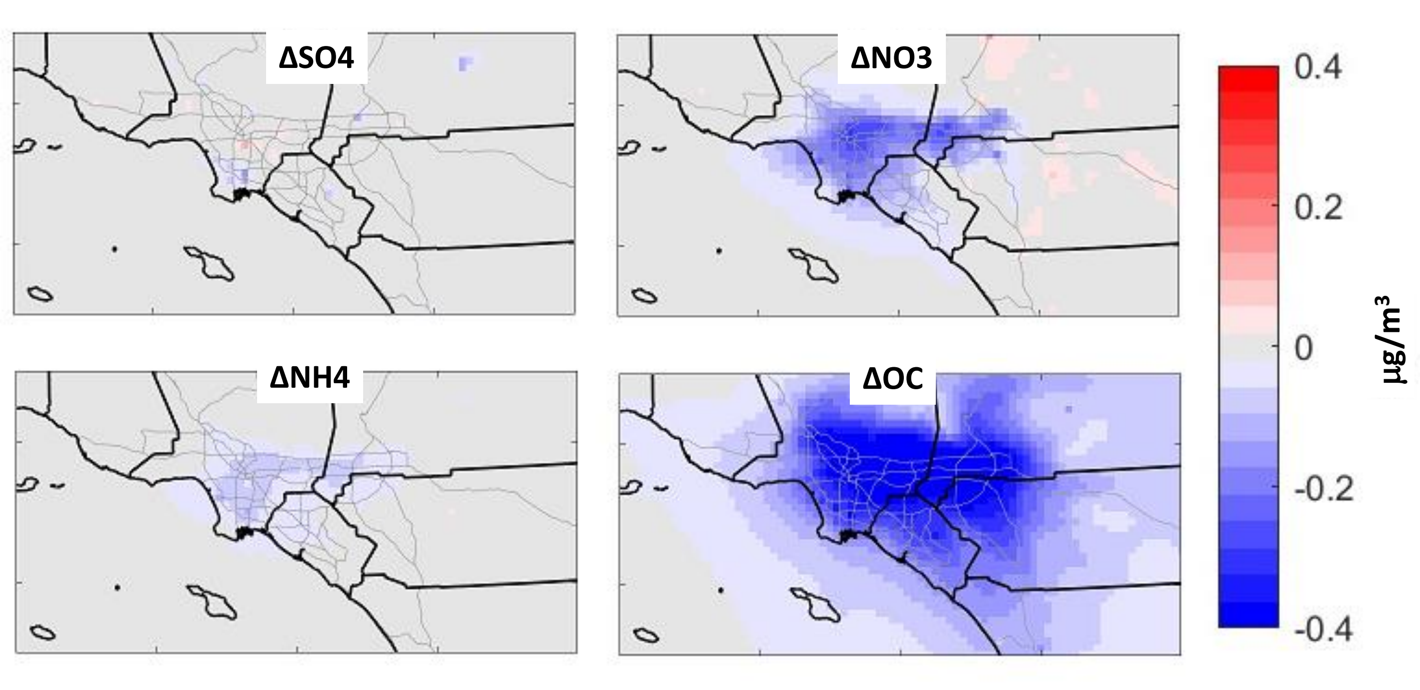
Decreases in Design Value in Response to Precursor Reductions for 2018



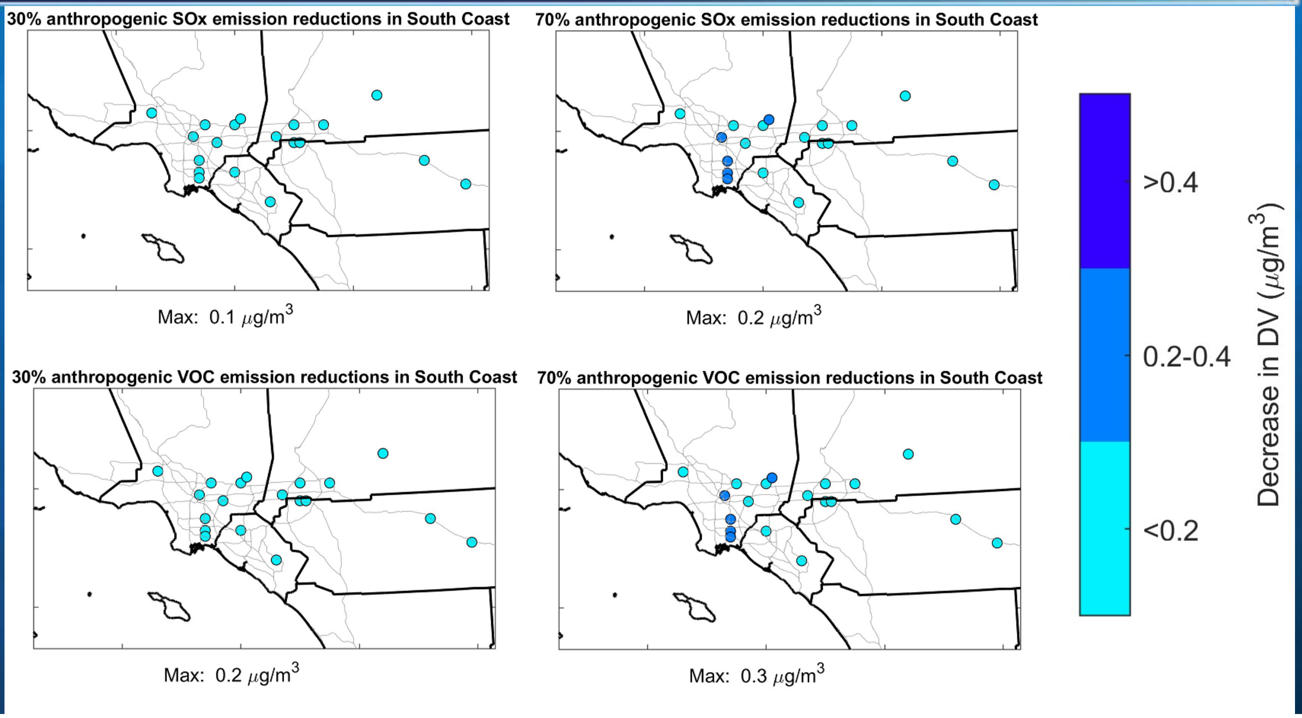
Changes in PM2.5 Species under 70% SOx Emission Reduction for 2018



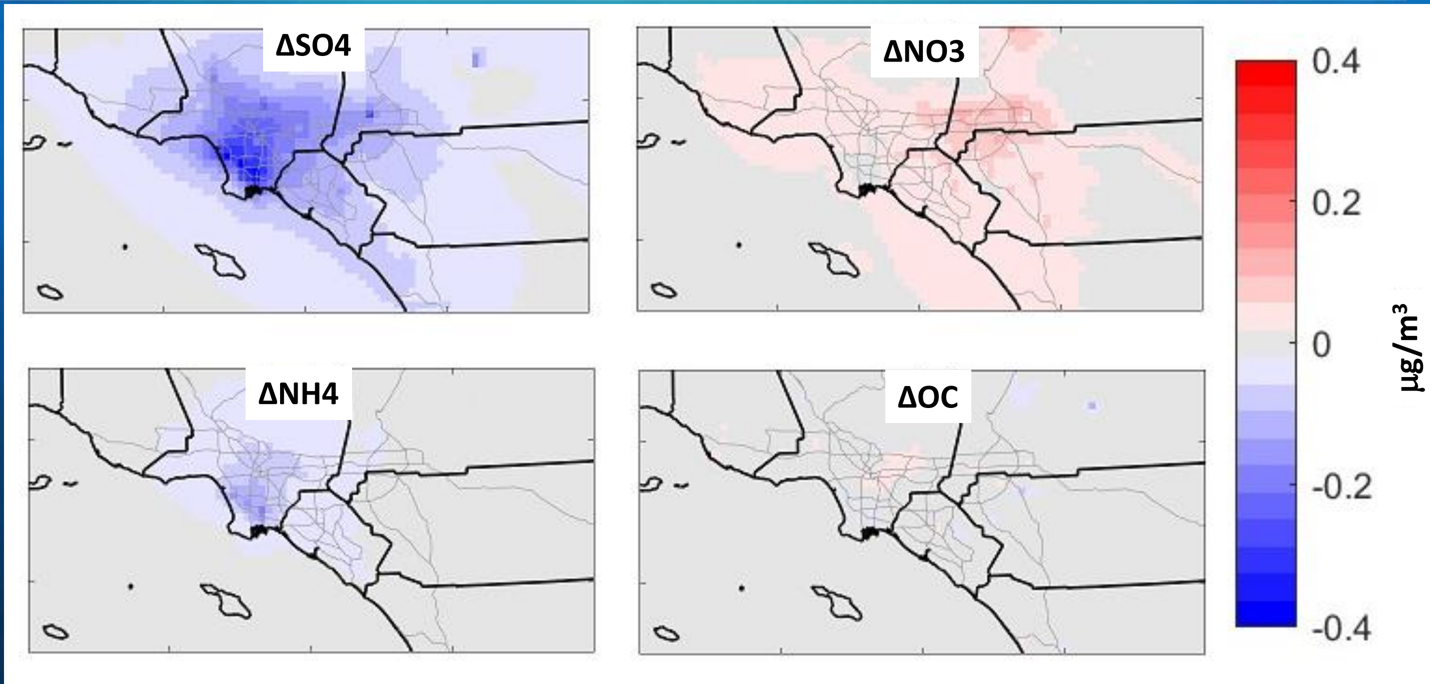
Changes in PM2.5 Species under 70% VOC Emission Reduction for 2018



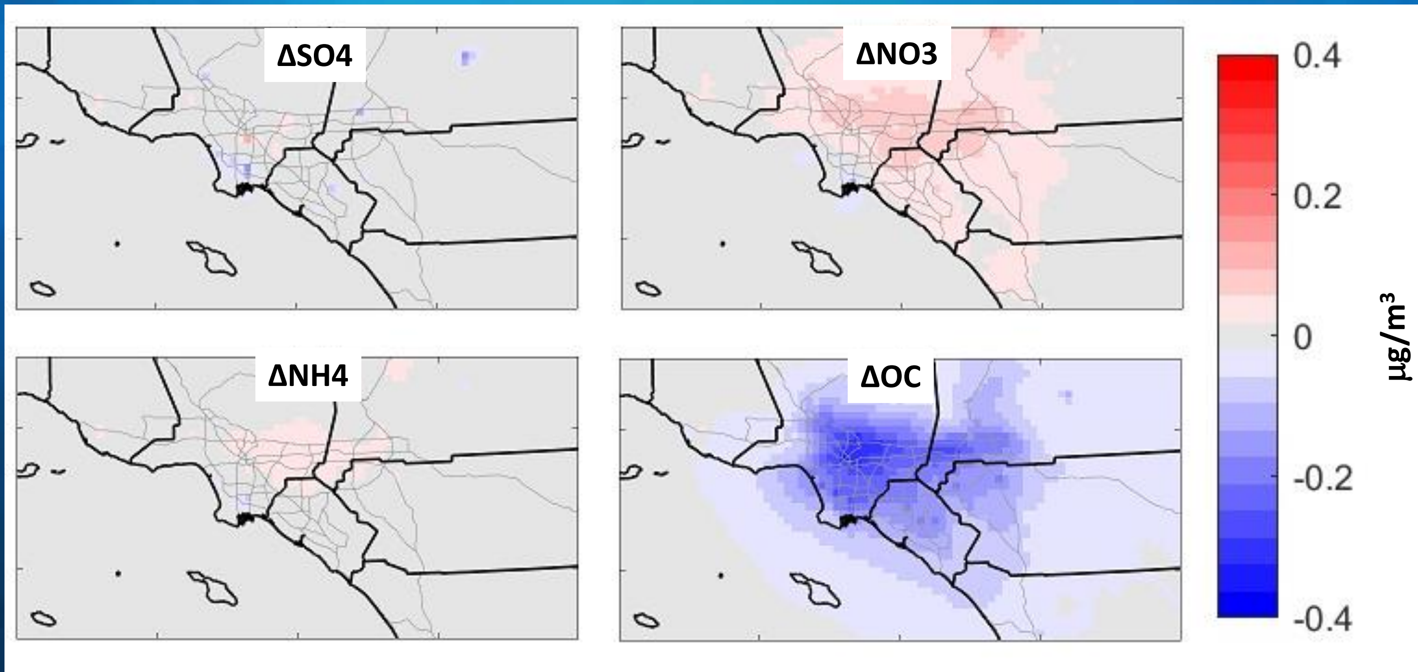
Decreases in Design Value in Response to Precursor Reductions for 2030



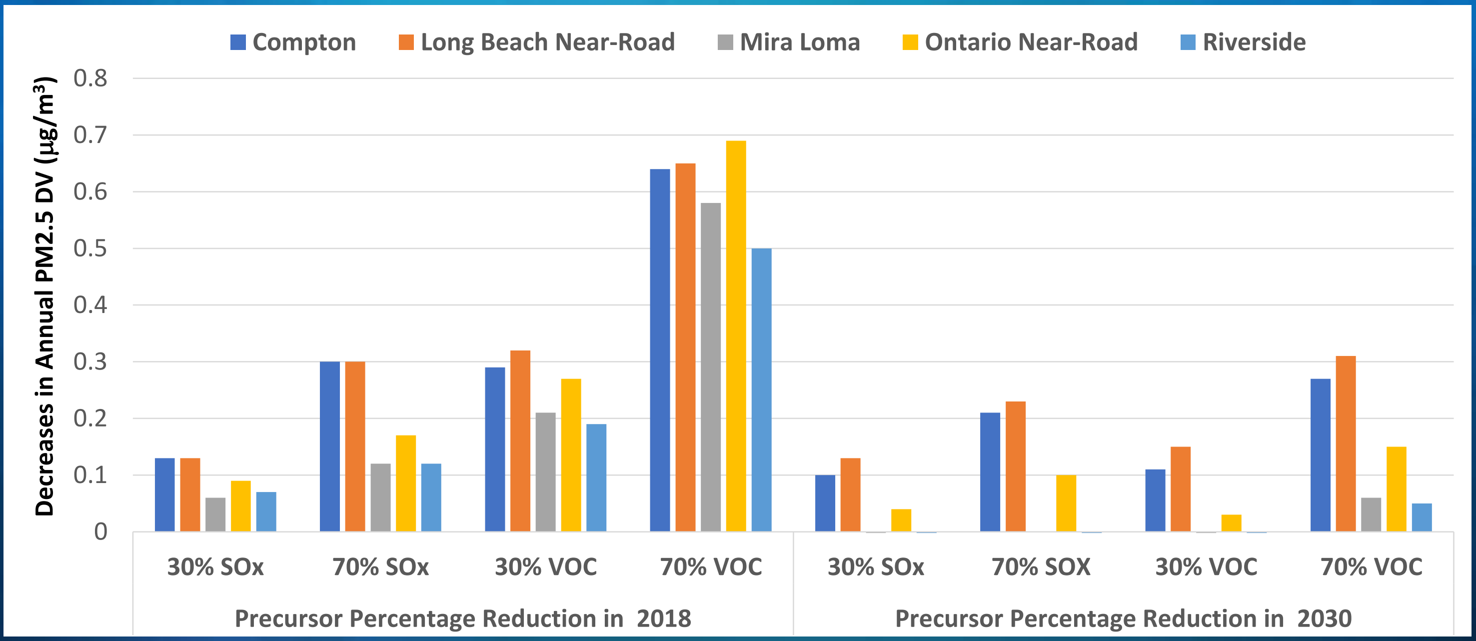
Changes in PM2.5 Species under the 70% SOx Emission Reduction Scenario



Changes in PM2.5 Species under the 70% VOC Emission Reduction Scenario



Summary of Annual PM2.5 Design Value Decreases



Summary of Precursor Demonstration

- The sensitivity of annual PM2.5 to SOx and VOC emissions is analyzed following U.S. EPA's precursor demonstration guidance
- Precursor demonstration focuses on stations that have a base year annual PM2.5 DV above 12 $\mu g/m^3$
- Precursor emission reductions analyzed in this demonstration range between 30% and 70%
- Emissions projected for 2030 are closer to current conditions than emissions in 2018, and thus, 2030 should have stronger weight in determining the significance of precursors
- The modeling results indicate VOC and SOx are not significant contributors to annual PM2.5

Item 3

Contribution Thresholds for PM2.5 Precursor Demonstration

Emily Bian, Ph.D.
Air Quality Specialist

STMPR Meeting on October 11, 2023
South Coast Air Quality Management District

Introduction

- What is a contribution threshold?
  - Generally: a measure of variability in air quality levels
    - Specifically: A metric that captures the change of ambient air quality at a location caused by local meteorological variation and/or day-to-day changes in emissions
  - Contribution thresholds are used to help determine whether a precursor pollutant significantly contributes to PM2.5
  - Contribution threshold is not the same as significance threshold
- Contribution thresholds defined in the U.S. EPA's guidance* are:
  - **the annual PM2.5 NAAQS (12 µg/m^3) : 0.2 µg/m^3**
  - 24-hour PM2.5 NAAQS (35 µg/m^3): 1.5 µg/m^3
  - Ozone 8-hour (70 ppb): 1.0 ppb

*PM2.5 Precursor Demonstration Guidance, U.S. Environmental Protection Agency, May 2019

U.S. EPA Guidance Method

- U.S. EPA's contribution thresholds calculated using nationwide observations
- Threshold is sensitive to the time window of observations
  - The suggested threshold of 0.2 μg/m³ is based on the period 2012-2016

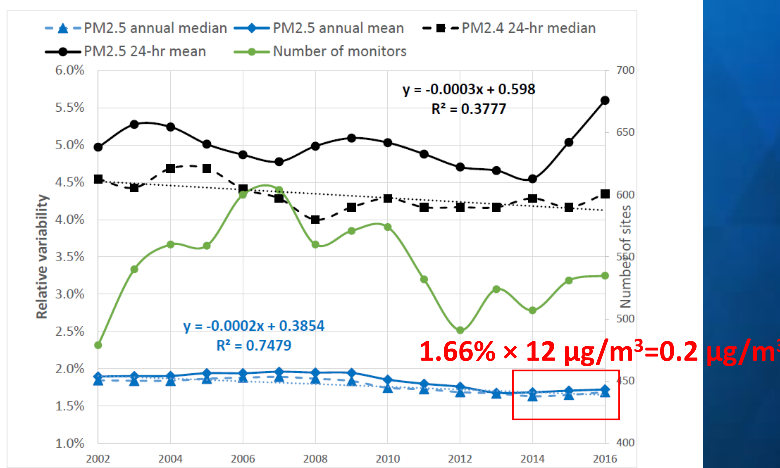
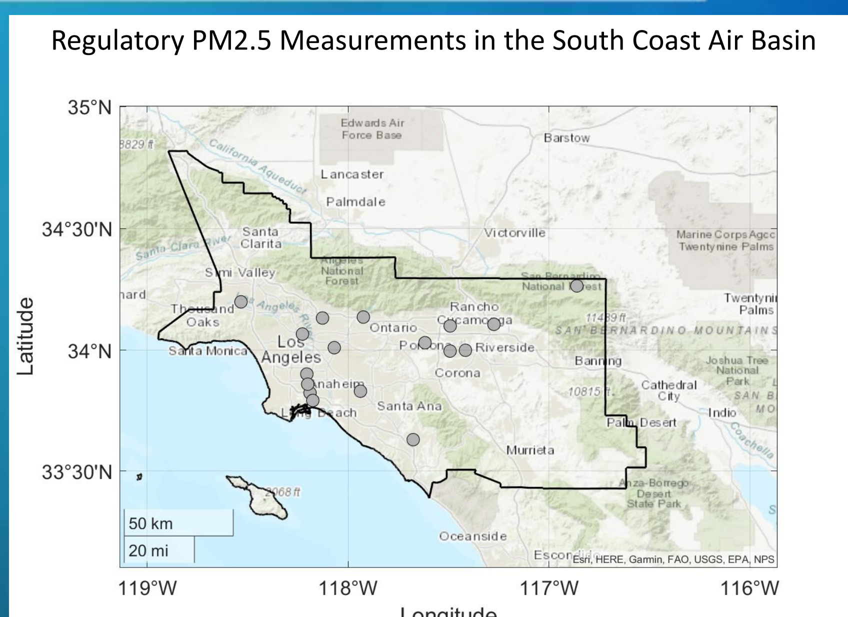


Figure 15 - Median and mean variability in the network determined from the bootstrap analysis (50% CI) for the 15 DV periods from 2002-2016 for $PM_{2.5}$ (each DV period represents 3 years of data and the data is plotted on the ending year: *i.e.*, the 2016 DV period is from 2014-2016 and plotted at 2016).

Need to Address South Coast Specific Threshold

- PM2.5 levels in the South Coast Air Basin are highly variable across stations
- Calculate the contribution threshold using observations from the South Coast Air Basin monitors only
- Use the observations from the same period used to calculate base year design value: 2016-2019



Methodology

Year 1				Year 2				Year 3			
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Annual Mean				Annual Mean				Annual Mean			
Mean = Design Value (DV)											

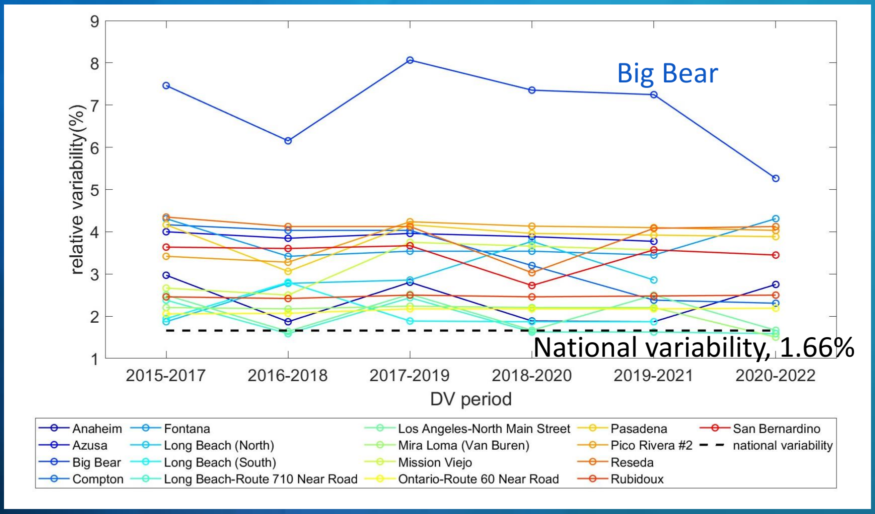
bootstrap resampling each quarter for 20,000 times →

DV_1
DV_2
…
$DV_{20,000}$

rank order → 50% Confidence interval (CI) → Relative variability (%) = 50% CI / actual DV

repeat for all 17 sites → Contribution threshold (µg/m³) = median (relative variability of all the sites) × 12.0

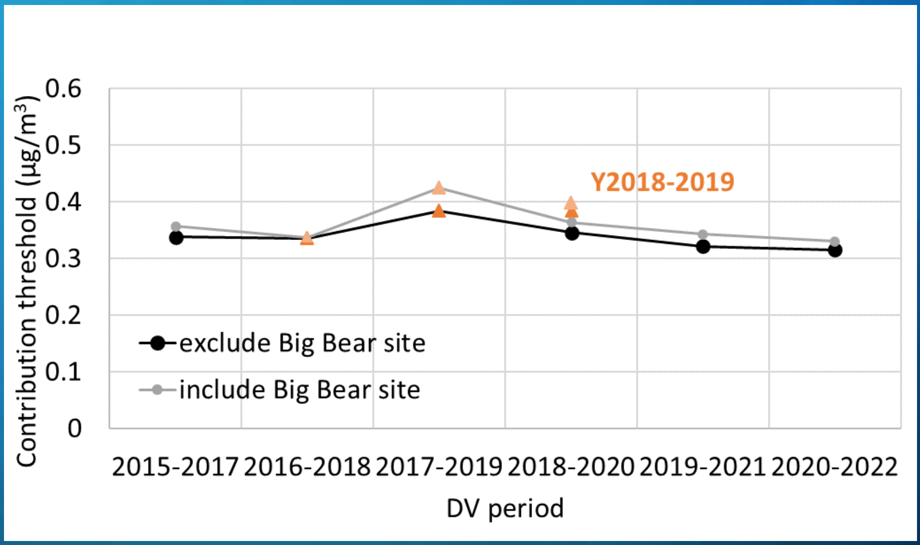
Results – Relative Variability (%) by Site



- Relative variability is a strong function of sampling schedule (e.g., 1-in-6-day schedule at Big Bear)
- The range of relative variability in the South Coast Air Basin is larger than the national variability (1.66%)

Contribution Threshold for South Coast Air Basin

- The contribution thresholds are higher than the national value of 0.2 µg/m³
- PM2.5 2018 base year design values use measurements from 2016-2019
- Contribution threshold for the same period is **0.4** µg/m³



Summary

- South Coast Air Basin has high PM2.5 levels and significant improvements over a short period of time, which suggests that national contribution thresholds may not adequately capture the variability in the Basin.
- The contribution threshold was determined using the same time-period for the base year design value in the annual PM2.5 plan
- The South Coast-specific contribution threshold stands at 0.4 µg/m³, a value considerably higher than the EPA's nationwide standard of 0.2 µg/m³

Item 4

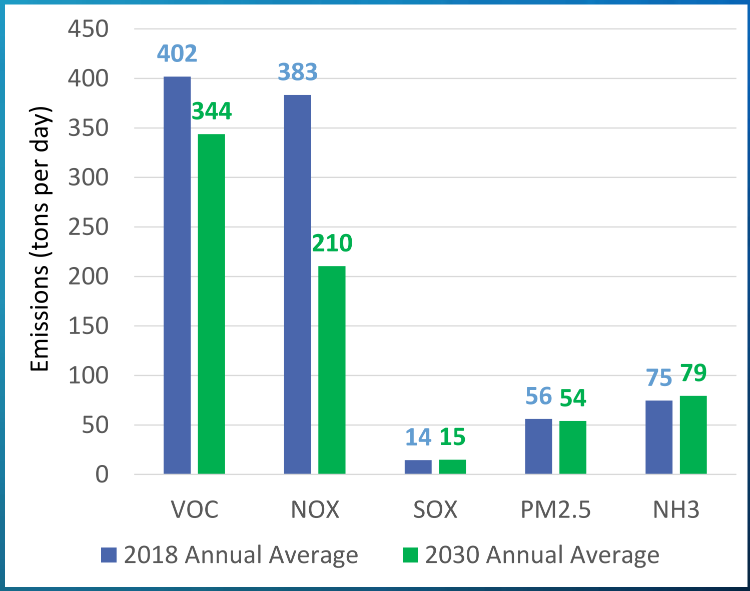
Preliminary Control Scenario for the Attainment of the Annual PM2.5 Standard

Marc Carreras-Sospedra, Ph.D.
Program Supervisor

STMPR Meeting on October 11, 2023
South Coast Air Quality Management District

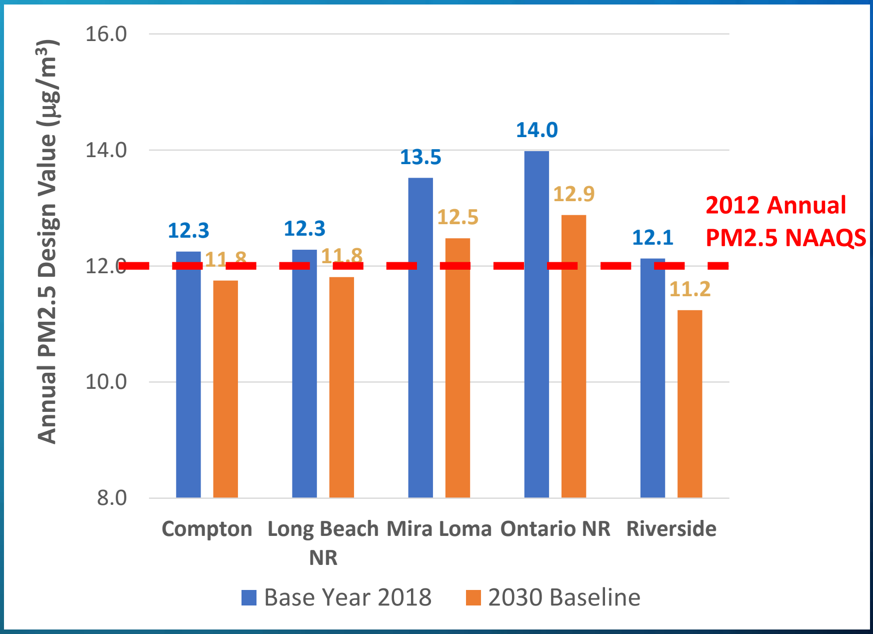
2030 Baseline (Business-As-Usual) Emissions

- NOx and VOC emissions are expected to decline due to ongoing implementation of adopted rules and regulations
- Increases in NH3 emissions due to NH3 slip in diesel trucks and growth in population



Projected RRF-Calculated PM2.5 DV for 2030 Baseline

- In base year 2018, 5 monitors do not meet the annual PM2.5 standard
- Design values for 2030 are projected using relative response factors (RRF)
- Mira Loma and Ontario CA-60 near-road are projected to exceed the annual PM2.5 standard in 2030 under baseline conditions



Proposed PM2.5 Strategy

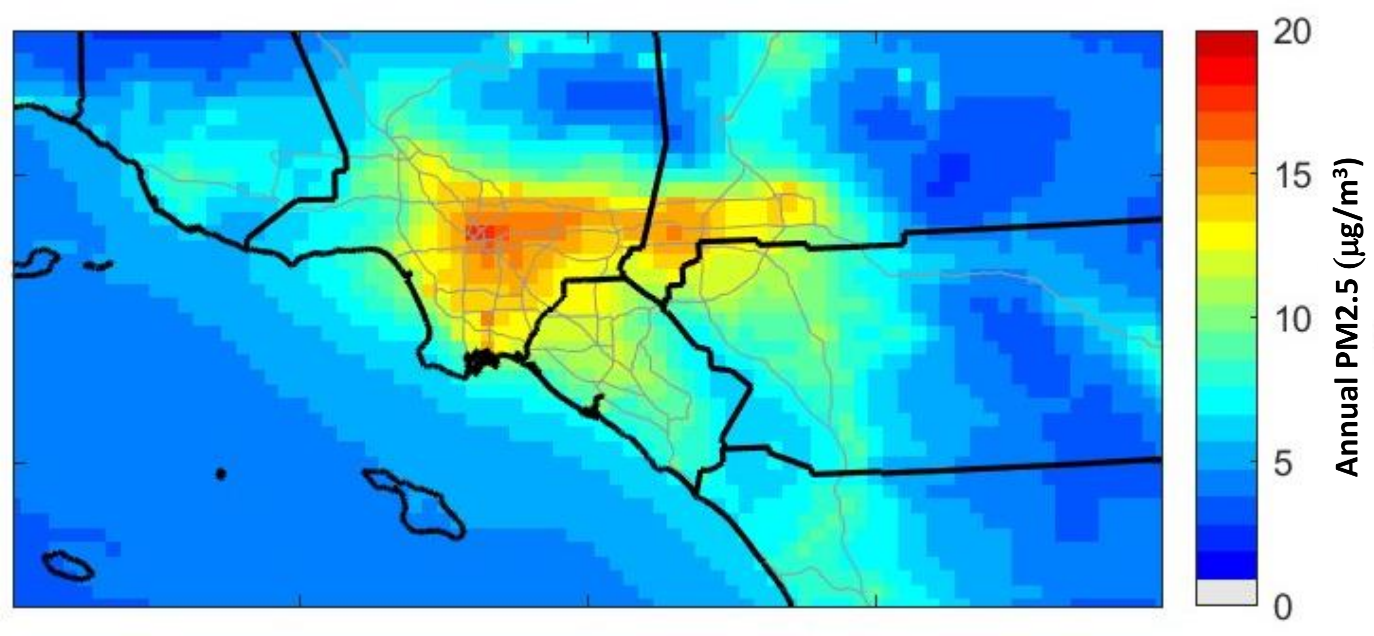
- Baseline Reductions
  - Baseline emissions continue to decrease due to ongoing implementation of adopted regulations
  - South Coast AQMD regulations adopted by October 2020 and Rule 1109.1
  - CARB's regulations adopted by December 2021 such as Truck and Bus regulations and HD I/M and Small Off-Road Equipment
- Measures from the 2022 AQMP/SIP that can be implemented by 2030, such as
  - Zero emission building measures
  - Advanced Clean Fleet
  - Clean Trucks Plan
  - Locomotive regulations
- PM co-benefits from adopted NOx regulations
  - NOx RECLIAM shave and Rule 1109.1
- Limited PM2.5 and NH3 measures

Emission Reductions by Category

Measures	NOx Emissions Reductions (tons per day)	Direct PM2.5 Emissions Reductions (tons per day)
South Coast AQMD Stationary*	1.76	0.04
South Coast AQMD Mobile	7.19	0.39
CARB Stationary	2.58	0.41
CARB Mobile	27.76	1.02
RECLAIM PM2.5 Reductions	--	0.86
Total	39.29	2.62

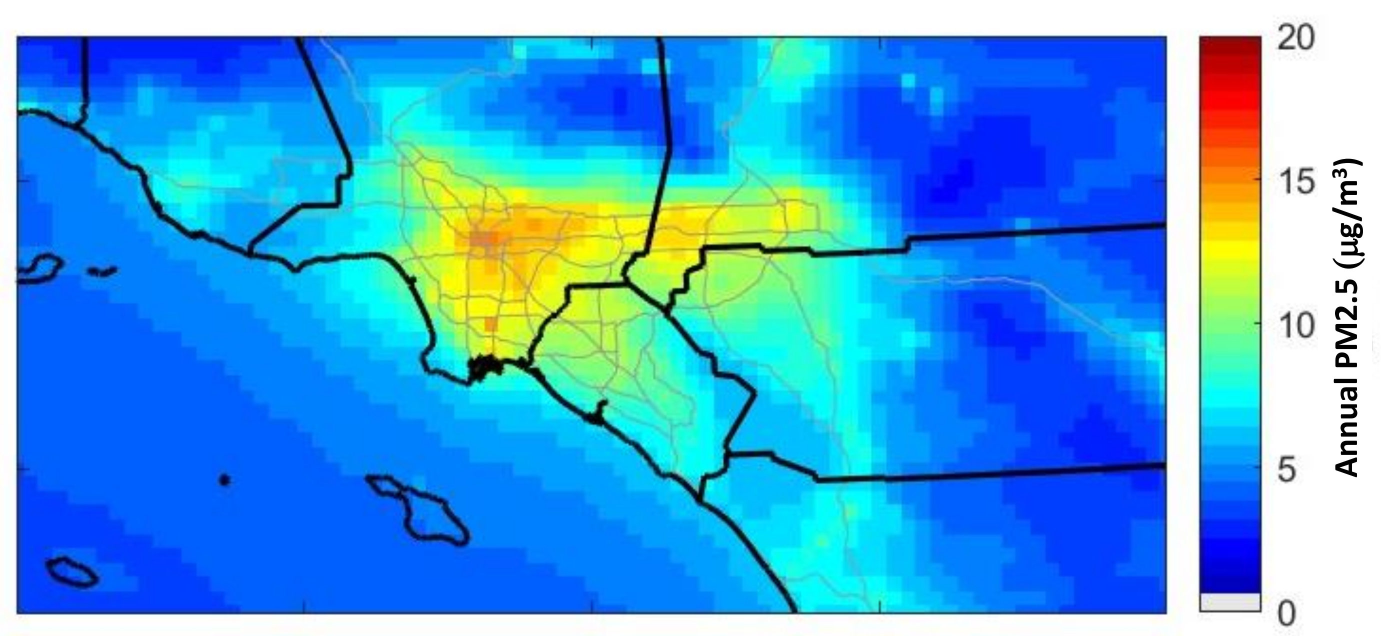
*South Coast AQMD's residential and commercial space and water heating measures are not included due to the overlap with CARB's stationary source measure

CMAQ Predicted PM2.5 Levels for 2018



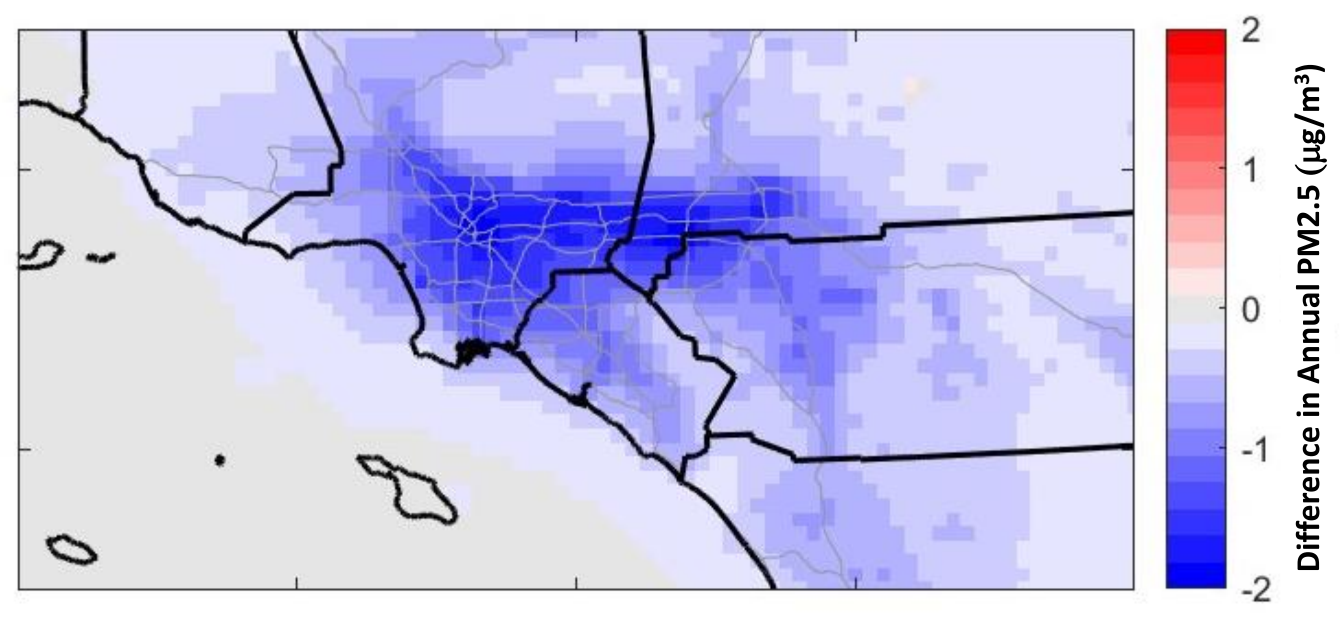
(Not RRF adjusted)

CMAQ Predicted PM2.5 Levels for the 2030 Attainment Scenario



(Not RRF adjusted)

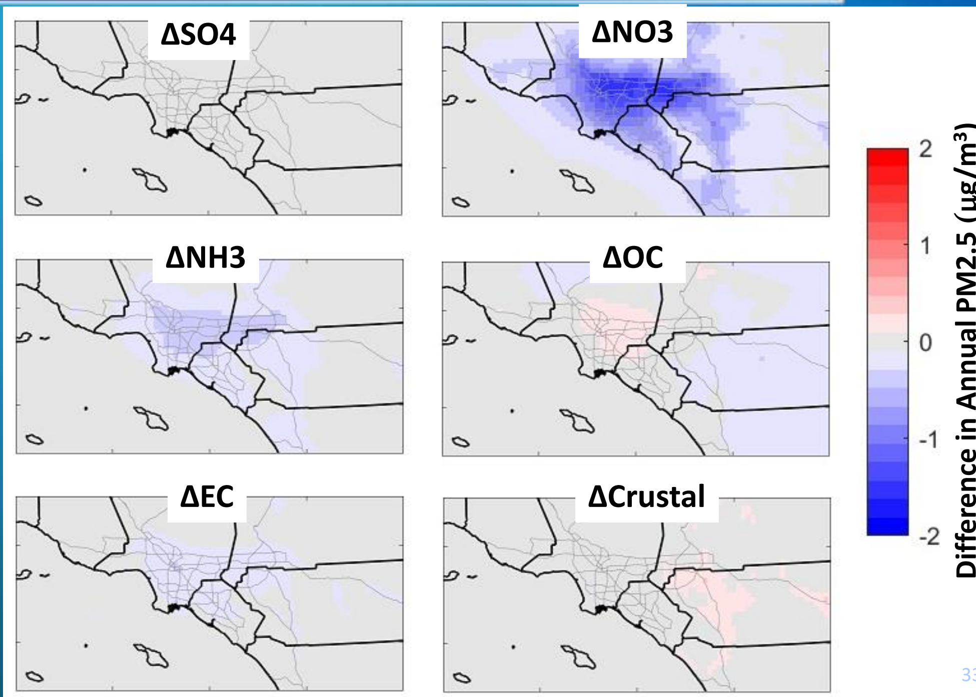
Changes in PM2.5 from 2018 Base Year to the 2030 Attainment Scenario



Modeling results show an overall decrease in annual PM2.5 throughout the Basin

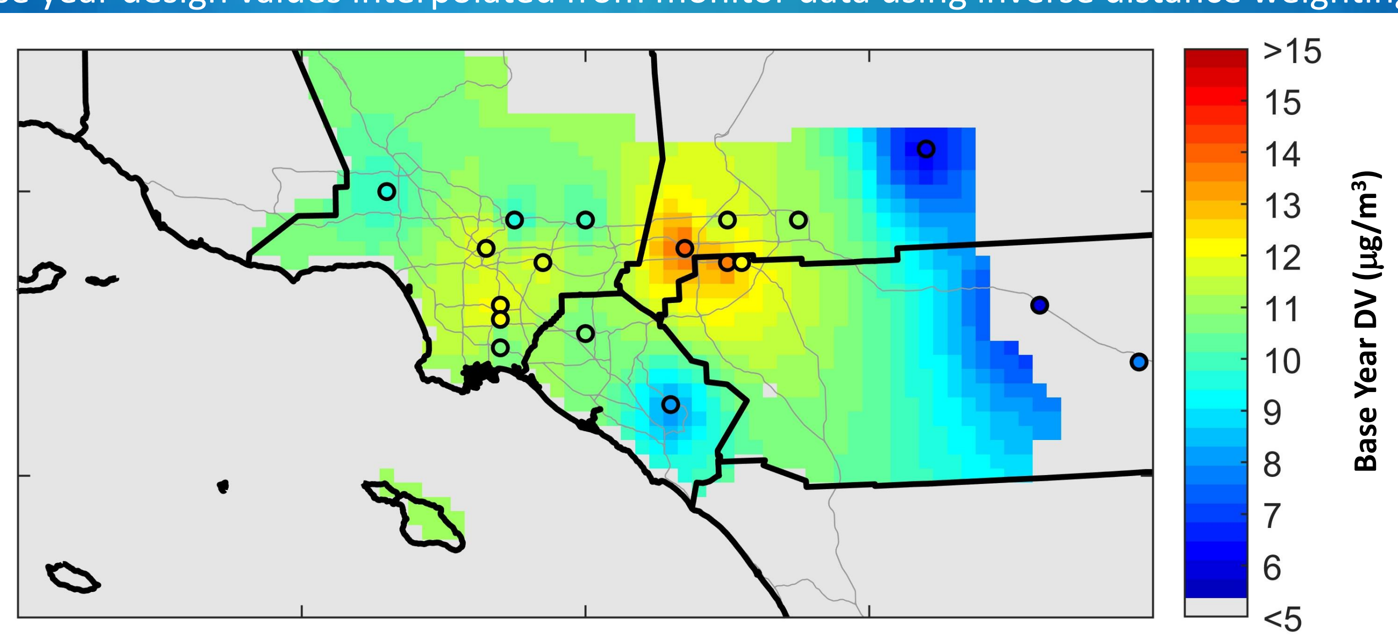
Changes between 2018 and 2030 Attainment

- Decrease of total PM2.5 mass is driven by ammonium nitrate decrease
- Nitrate and EC concentration decrease following the emissions trend
- OC increases slightly due to NOx-nitrate disbenefits
- Crustal components increase in future year due to increase in direct emissions (mostly road dust)



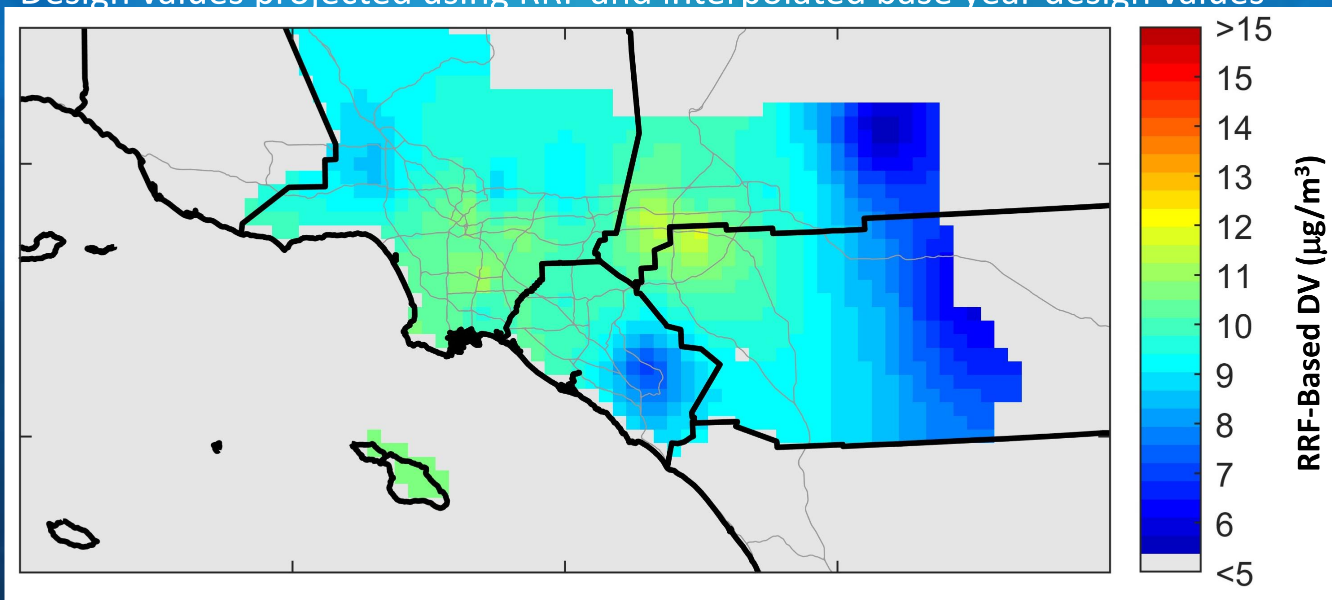
2018 Annual PM2.5 Design Values

Base year design values interpolated from monitor data using inverse distance weighting



RRF-adjusted Annual PM2.5 DVs under the 2030 Attainment Scenario

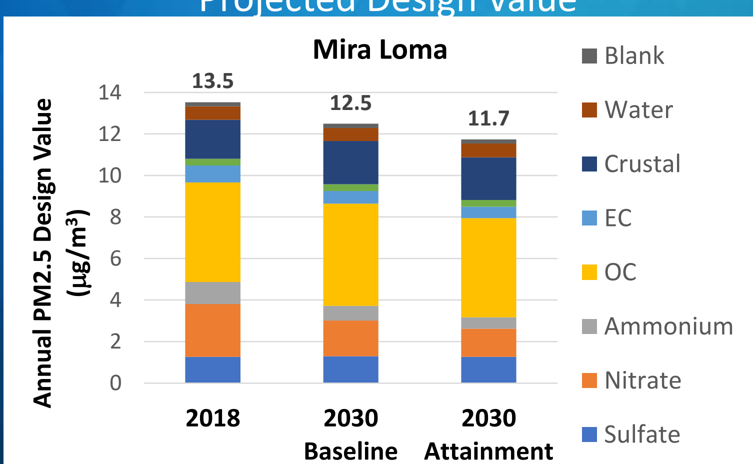
Design values projected using RRF and interpolated base year design values*



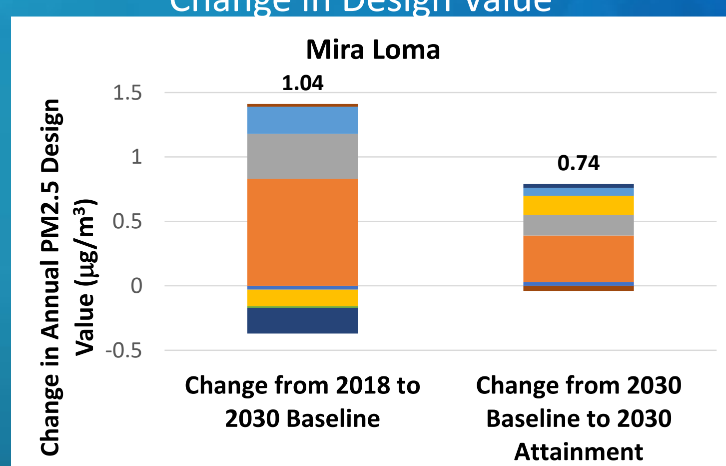
(*Min = 5.61 $\mu g/m^3$ Max = 11.66 $\mu g/m^3$ at South Coast Air Basin modeling grids)

Projected Future Annual PM2.5 Design Values

Projected Design Value



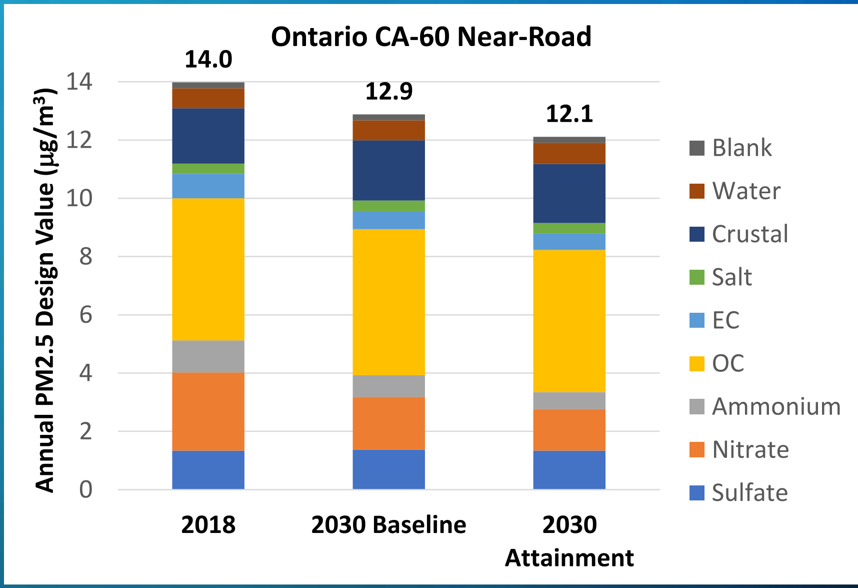
Change in Design Value



- Design values decrease due to decrease in ammonium nitrate and EC
- Mira Loma is projected to meet the standard

Projected DV at Near-Road Monitor

- DV trend at the Ontario CA-60 near-road site is comparable to Mira Loma
- DV at Ontario CA-60 near-road is projected to be higher than 12.0 $\mu g/m^3$
- Primary PM2.5 components related to on-road sources are not declining as fast as emissions suggest
- Additional modeling is needed to better resolve the steep gradients in primary PM2.5 around the near-road monitor



Summary

- CMAQ simulations were performed for base year 2018 and future attainment year 2030
- The proposed PM2.5 strategy to attain the annual PM2.5 standard includes
  - Baseline Reductions
  - Selected Strategy from the 2022 AQMP/SIP
  - PM co-benefits from adopted NOx regulations, and
  - Limited PM2.5 and NH3 measures
- The proposed PM2.5 strategy is expected to lead all stations except for the Ontario CA-60 near-road site to attainment
- Alternative attainment demonstration for the Ontario CA-60 near-road is proposed in the following presentation

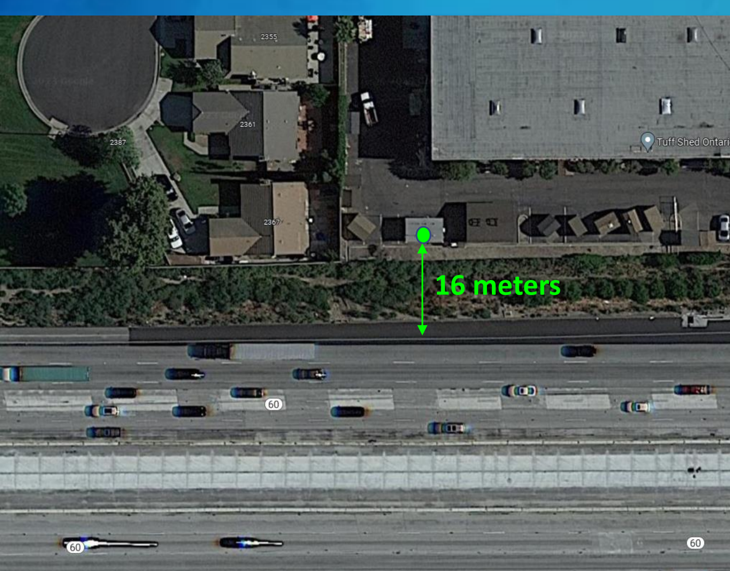
Item 5

Attainment Demonstration for the Ontario CA-60 Near-Road Site

Sang-Mi Lee, Ph.D.
Planning and Rules Manager

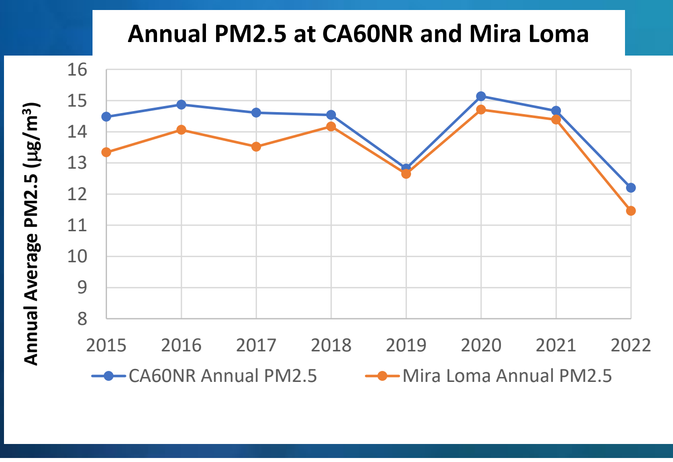
STMPR Meeting on October 11, 2023
South Coast Air Quality Management District

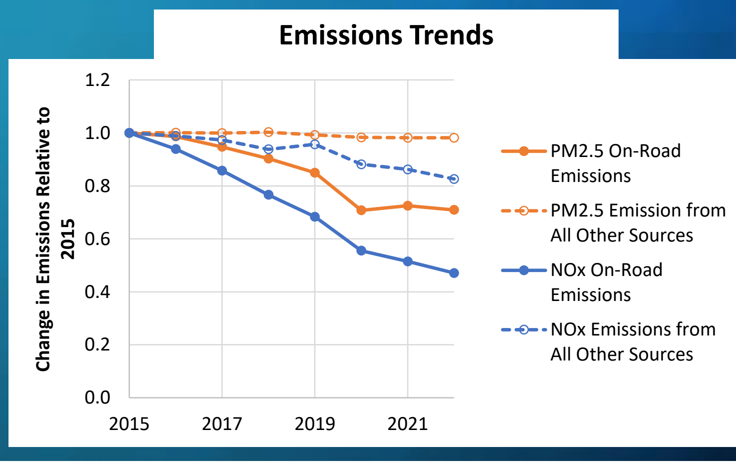
Ontario CA-60 Near-Road (CA60NR) Monitor



Background

- Ontario CA-60 near-road (CA60NR) became the design site since data became available
- CA60NR is 12 km from the Mira Loma, which was the design site before the Near-Road site
- Annual PM2.5 between CA60NR and Mira Loma is decreasing over time
- On-road PM2.5 emissions have declined faster than overall PM2.5 emissions in the basin



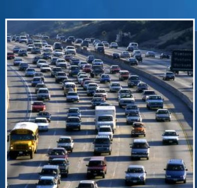


SIP Attainment Demonstration Approach

The SIP modeling traditional approach uses a regional chemical transport model such as CMAQ

- Air Quality Management Plans (AQMPs) use 4 km grid resolution

Regional modeling is appropriate to capture neighborhood and regional phenomena



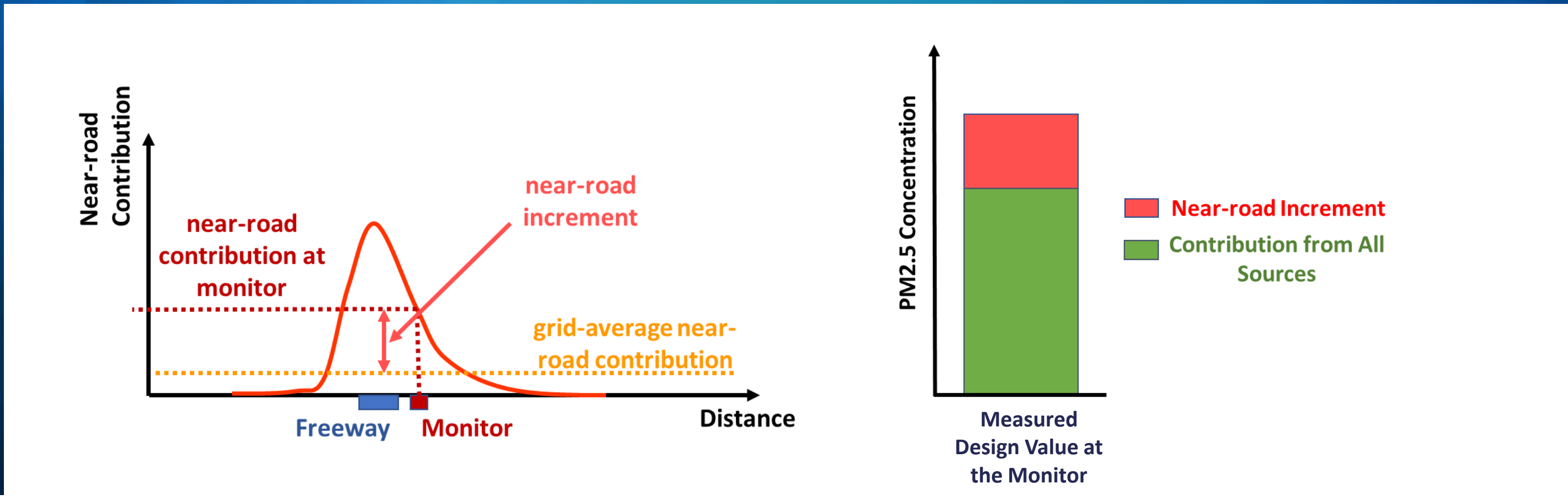
A near-road monitor is largely affected by nearby road sources and is not representative of a wider area like a modeling grid cell

EPA Suggested Approaches for Near-Road monitor

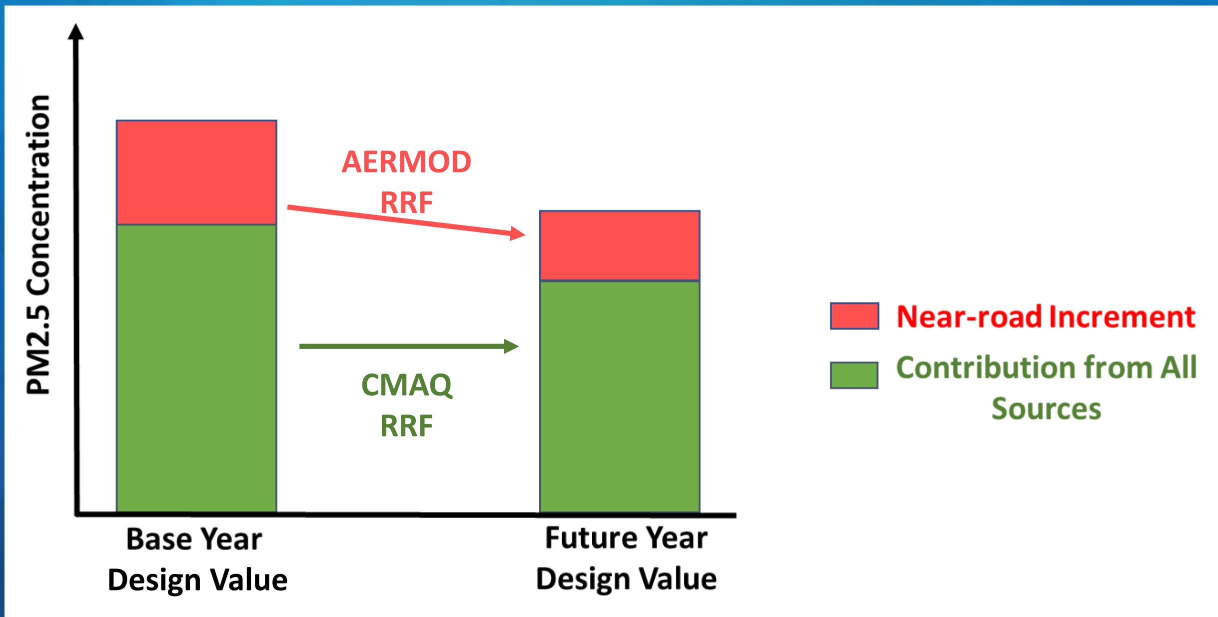
- Traditional approach using regional modeling
- Regional modeling with increased model resolution (e.g., 1km)
- Combine results from regional modeling and local-scale dispersion modeling, such as CMAQ + AERMOD
- Estimate the increment in PM2.5 due to near-road impacts with respect to regional monitors and PM2.5 reductions from on-road mobile sources as weight of evidence

Identifying On-Road Increment

- CMAQ is not designed to model the steep gradients in primary PM2.5 concentrations near the freeway
- AERMOD used to model the “near-road increment”

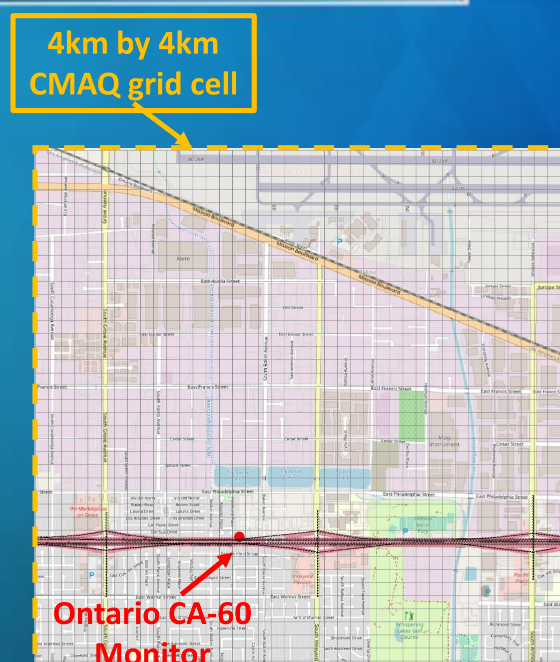


RRF-Based Design Value using Hybrid Approach



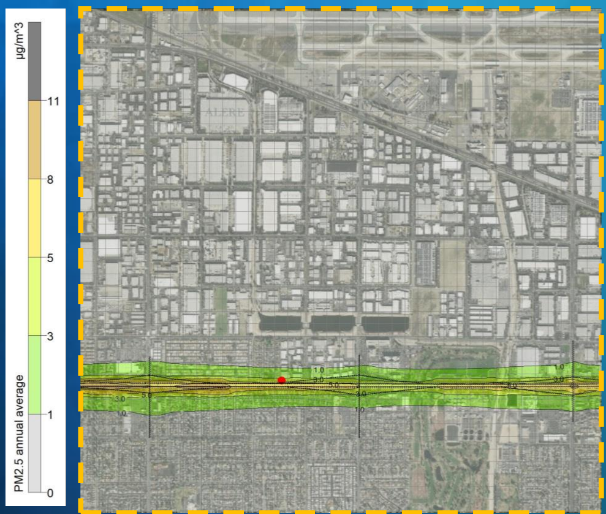
AERMOD Modeling Set-Up

- Meteorological input:
  - Hourly meteorology from WRF4.4.2 for 2018
  - Processed through MMIF
- Receptor grid:
  - Receptor spacing: 100 meter
  - Receptor domain: 4 km-by-4km grid, identical to a CMAQ grid contains the CA60NR
- Sources (10 source categories):
  - 5 vehicle categories: light & medium duty, light-heavy duty, medium-heavy duty, heavy-heavy duty and buses
  - 2 emission processes: vehicle emissions (exhaust + tire & brake wear) and road dust



AERMOD Results and Post-Processing

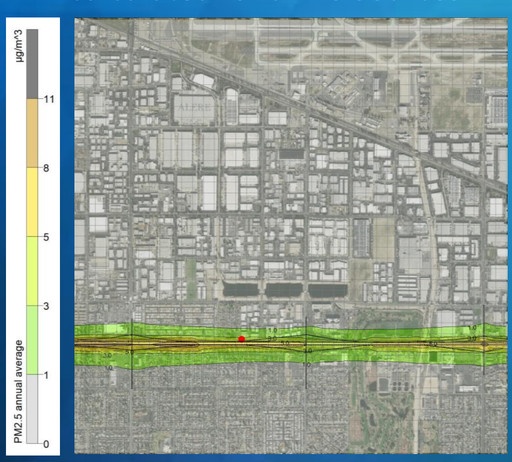
Total PM2.5 Annual Average Calculated for all 10 Sources



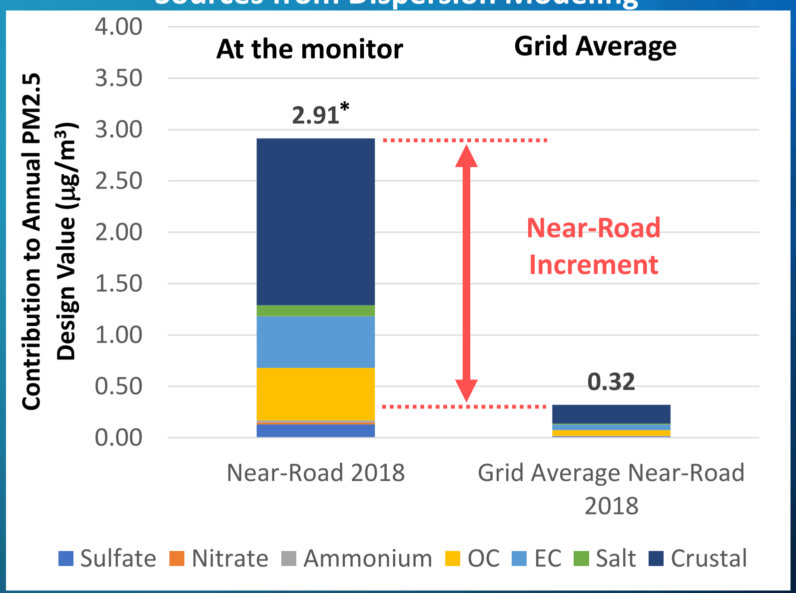
- AERMOD is run for all 10 separated sources at annual average emissions rate
- Hourly output concentrations of PM2.5 are adjusted for hourly temporal variation
- Speciation profiles are applied to the 10 sources to determine speciated PM2.5 concentrations
- Future PM2.5 concentrations estimated with the scaling factor for PM2.5 emissions

Overall AERMOD Results for 2018

Total PM2.5 Annual Average Calculated for all 10 Sources



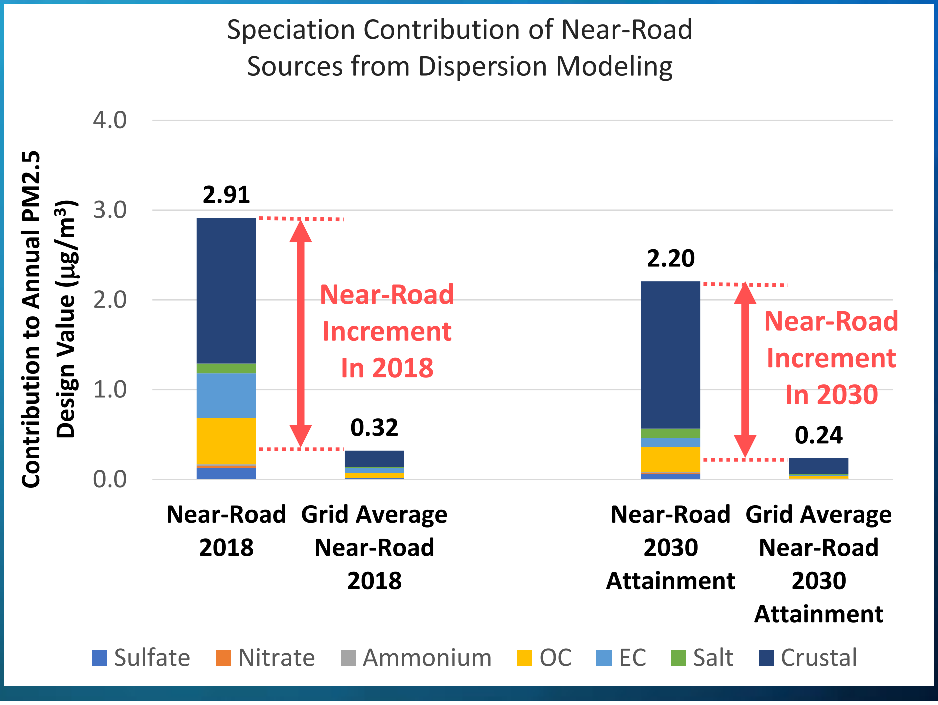
Speciation Contribution of Near-Road Sources from Dispersion Modeling



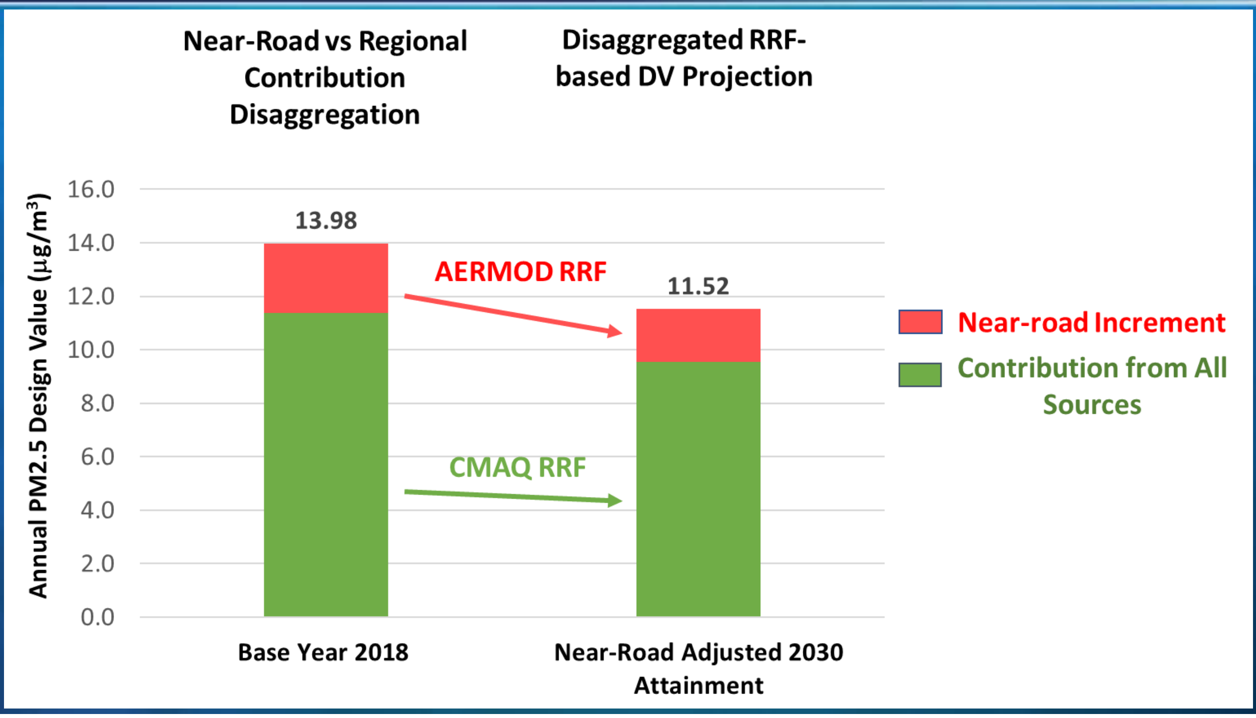
*Concentration of crustal capped at the measured levels

Overall AERMOD Results for 2030

- Future concentrations scaled proportionally to changes in emissions in the AERMOD domain
- Emissions in 2018:
  - Vehicle Emissions: 39.31 lbs/day
  - Paved Road Dust: 25.73 lbs/day
- Emissions in 2030:
  - Vehicle Emissions: 20.11 lbs/day
  - Paved Road Dust: 27.29 lbs/day

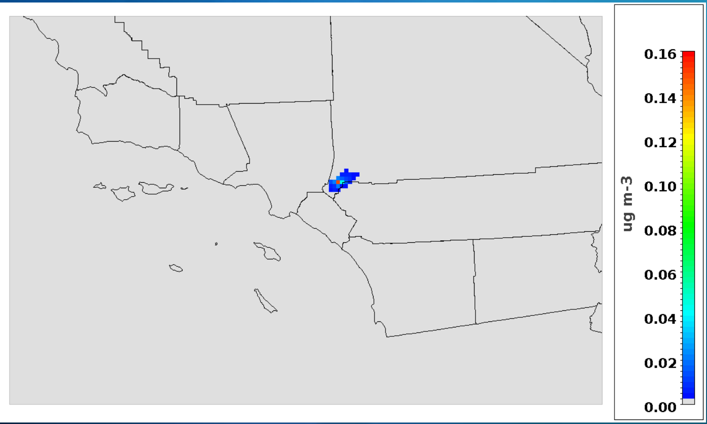


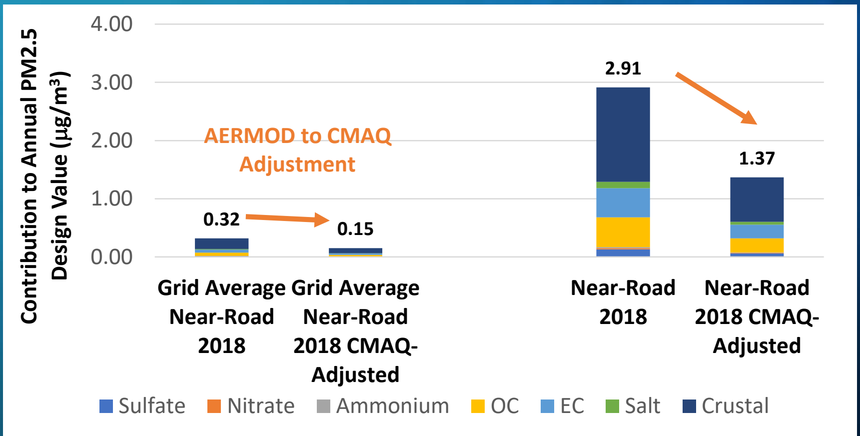
Disaggregation of Near-Road Contribution



Alternative Engineering Adjustment

- CMAQ simulation to estimate the impact from the freeway segment and compare with AERMOD
  - CMAQ modeling: 0.15 μg/m^3
  - AERMOD modeling: 0.32 μg/m^3
- CMAQ to AERMOD ratio of 0.15/0.32 adjusts the CA60NR design value to be 11.81 μg/m^3





Summary

- A hybrid modeling approach using chemical transport and dispersion models is more appropriate for near-road environments
- A CMAQ and AERMOD combined method was employed to demonstrate attainment of Ontario CA-60 Near-Road
- The increment of PM2.5 concentration due to freeway traffic was simulated with AERMOD, while the impact of all sources at grid level was simulated with CMAQ
- The hybrid approach indicates that Ontario CA- 60 Near-Road will meet the 12 μg/m^3 standard in 2030 with the proposed PM2.5 strategy

Additional Information

All meeting materials are available at:
www.aqmd.gov/stmpr

For further questions and inquires, please contact:

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