



2. Brake, Tire Wear, and Road Dust Emission Health Risk Study

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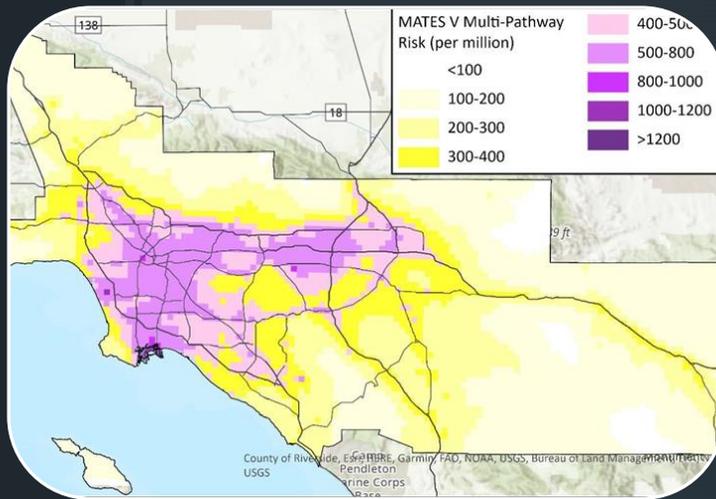
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MATES VI Technical Advisory Committee Mtg. #2

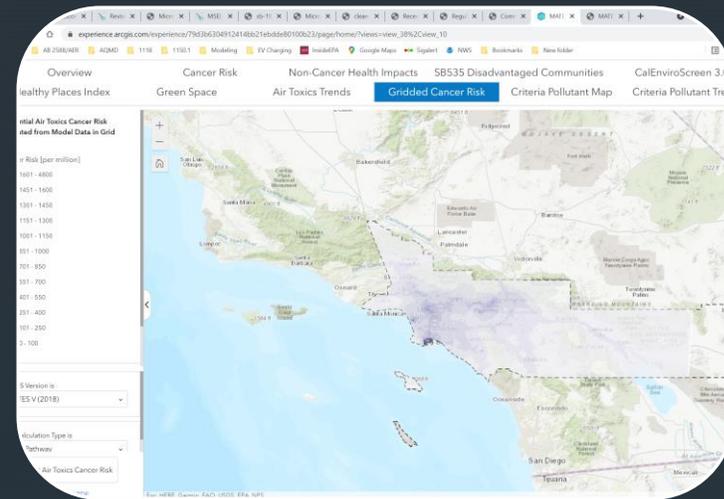
January 16, 2024

MATES VI Goals

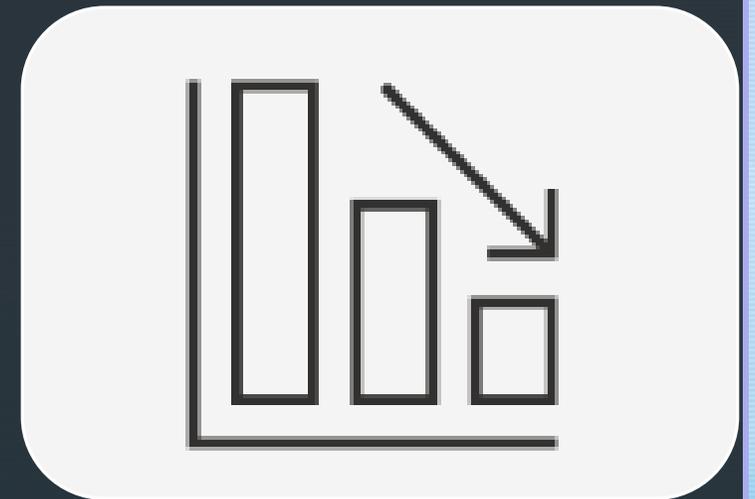
- Provide public information about air toxics and associated health risks throughout the region
- Evaluate progress in reducing air toxics exposure
- Provide direction to future toxics control programs



Health risk assessment for South Coast AQMD region



Interactive data display to visualize risk and concentration

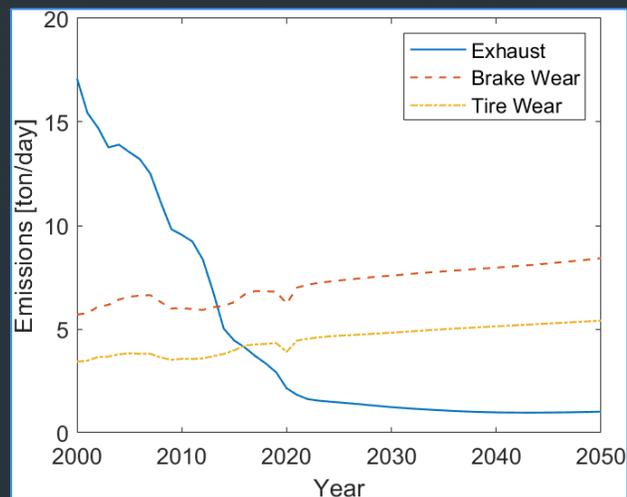


Analyze concentration trends

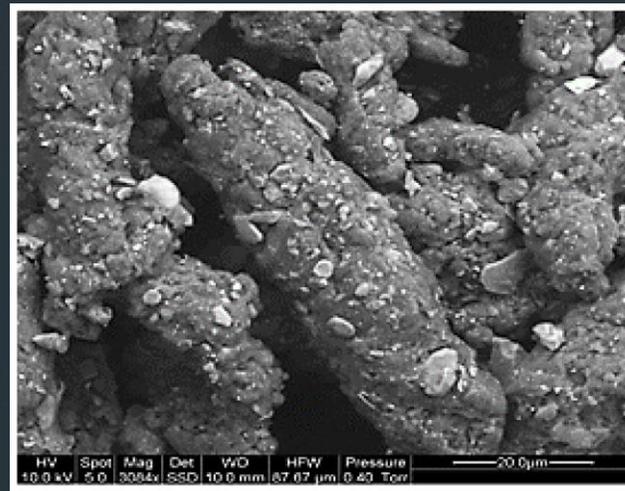
Brake and Tire Emissions Background

- Brake wear particles (BWP) and tire wear particles (as tire and road wear particles, TRWP) are becoming a larger fraction of vehicle-related toxic emissions
- Risk assessments should consider TRWP since tire wear and road wear are often mixed
- Risk assessments should consider total risk due to direct + resuspended BWP and TRWP

PM10 emissions for South Coast AQMD from EMFAC



Tire and road wear particles (TRWP)



From: Panko, J.M., Hitchcock, K.M., Fuller, G.W. and Green, D., 2019. Evaluation of tire wear contribution to PM2.5 in urban environments. *Atmosphere*, 10(2), p.99.

Brake, Tire Wear, and Road Dust Emission Health Risk Study

- South Coast AQMD will contract research study due to limited staff experience with brake and tire wear health risk assessment
- \$850,000 funding available
- South Coast AQMD staff will support sample collection, chemical transport modeling, and data analysis as resources allow
- Contractor will work closely with staff to design methods for exposure assessment and risk calculation
- Seeking feedback from technical advisory group on proposed request for proposals

BWP and TRWP measurements

- CARB 18RD017 measured brake and tire particle concentrations in South Coast AQMD
- Standard errors are too large to use for model evaluation or health risk calculation
- Contractor should develop targets for measurement uncertainties and model performance metrics to reduce uncertainties

From CARB research 18RD017
Using Chemical Mass Balance

Source	Anaheim (I-5 Near Road) [$\mu\text{g m}^{-3}$]	Long Beach (710 Near Road) [$\mu\text{g m}^{-3}$]
Road Dust	17.1±1.44	10.3±1.36
Brake Wear (two CMB profiles)	2.10±1.26 and 1.18±0.61	1.23±1.17 and 1.81±1.39
Tire Wear	2.01±1.10	1.84±1.56

Errors are standard error of the average

Research Objectives

1. Estimate BWP and TRWP concentrations over the South Coast AQMD domain during MATES VI
 - Don't need to separate BWP and TRWP from resuspended BWP and TRWP but should separate these from other road dust
 - Estimates must be useful for temporal trends analysis (we could repeat in in a future study to analyze trends)
2. Estimate health impacts of BWP and TRWP on the South Coast AQMD population during MATES VI
 - Methods should use parts of OEHHA Risk Assessment Procedure when possible (although do not need to rely on OEHHA standard risk factors/RELS)

Study Should Address Risk Assessment Guidelines

OEHHA risk assessment guidelines

Hazard identification

- Identify pollutants or mixtures that can contribute to risk



Exposure assessment

- Estimate concentrations (based on measurements and model, outdoor exposures)



Dose-response assessment

- Develop cancer potency factors, non-cancer RELs



Risk characterization

- Estimate risk from exposures and pathways



Trends analysis

- If a priority in MATES 7, track concentration and risk trends through MATES 7

MATES BWP and TRWP study should use OEHHA guideline where possible

Draft Scope of Work - Tasks

1. Literature review to identify pollutants in BWP and TRWP and screening of those with highest potential cancer and non-cancer chronic health risks
2. Develop method to estimate exposures to BWP and TRWP
 - Contractor should test methods using a pilot study and evaluate method performance
3. Develop method to estimate cancer risk and non-cancer chronic health risks due to exposure to BWP and TRWP
4. Conduct measurement, modeling, and analysis needed for objective 2 and 3, and estimate BWP and TRWP exposure and risk for MATES VI

Task 1: Identify pollutants in BWP and TRWP and screen those with highest potential cancer and non-cancer chronic health risks

- Develop criteria to screen pollutants based on risk
 - to identify pollutants with highest potential risks even if they don't have risk factors identified by OEHHA
- Literature review of pollutant risk factors, exposure pathways, other data (scientific research, manufacturer data, EPA and CARB emissions data, other data)
- Deliverables: List of identified pollutants and their associated risk criteria, exposure pathways, and other health data in progress report

Task 2: Develop method to estimate exposures to BWP and TRWP

- Design measurement, modeling, and analysis method to quantify the outdoor concentration of pollutants in BWP and TRWP
 - must be applicable over entire South Coast AQMD jurisdiction
 - must resolve hot spots and spatial trends (approximately 2 km spatial resolution)
 - Contractor should work with South Coast AQMD staff to determine support that will be provided
- Design and conduct pilot study to evaluate performance of the method
 - evaluation should include estimate of the uncertainty and representativeness of concentrations or other metrics to assess whether the method can be used to achieve objectives 1 and 2
- Deliverables
 - Method design, pilot study design, and results of pilot study and method evaluation in progress report and final report
 - Training and support for South Coast AQMD staff to conduct the staff-supported part of sampling, measurement, modeling, and analysis for the method

Task 3: Develop method to estimate cancer risk and non-cancer chronic health risks due to exposure to BWP and TRWP

- Design an analysis method to quantify cancer and non-cancer chronic health risks
- Deliverables
 - Method design in progress report and final report
 - Training and support for South Coast AQMD staff to conduct the staff-supported part of the required measurement, modeling, and analysis

Task 4: Measurement, modeling, and analysis to estimate exposure and risk in MATES VI

- In coordination with South Coast AQMD staff and MATES VI measurement and modeling phases, conduct measurements, modeling, and analysis necessary to implement methods designed in task 2 and 3 to estimate exposure and risk in MATES VI
- South Coast AQMD staff can support sampling, measurement, modeling, and analysis as resources allow
- South Coast AQMD can provide better support if the methods for task 2 and 3 are developed early in the planning process
- Deliverables: Exposure and health risk estimates in progress report and final report

Scoring Criteria

Criteria	Points
Understanding of Requirement – applicant provides their knowledge of the subject and a clear outline of proposed methods	20
Technical/Management Approach – Meets technical requirements, applicability for South Coast AQMD, compatible with MATES VI methods, spatial resolution, ability to quantify highest-risk compounds	20
Contractor Qualifications	20
Previous experience on similar projects	30
Cost	10

Additional points can be awarded based on South Coast AQMD procurement policy (For example, small business points)

Tentative Timeline

Task	Due Date
Tentative RFP release/Notice inviting proposals	Friday, February 2
Proposals Due to South Coast AQMD	Thursday, May 2
Evaluate Proposals	May 2 - May 24
Governing board to approve selected contractor	Friday, August 2
Anticipated contract execution date	Friday, August 16
MATES VI measurement phase begins	Early 2025
Task 1 and 2 due (exposure method design)	February 2025
Task 3 due (risk method design)	May 2025
Task 4 due (exposure and risk estimates)	August 2027
Final report due, BWP and TRWP study end	February 2028

Discussion Topics

- Are the objectives and tasks appropriate for a first study of BWP and TRWP in MATES?
- The research tasks and South Coast AQMD measurements focus on roadway emitted BWP/TRWP - should other sources such as airports be studied?
- Is the scope of work reasonable with the allocated funding and timeline?
- Any other tasks that we should specify for the study?
- Is there enough time allocated to develop proposals (Feb 2 – May 2)?
- Enough time to conduct tasks 1 and 2 before start of MATES measurement phase (August 16 – early 2025)?
- Other TAG feedback



3: MATES VI Source Apportionment Study

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MATES VI Technical
Advisory Committee Mtg. #2

January 16, 2024

Source Apportionment

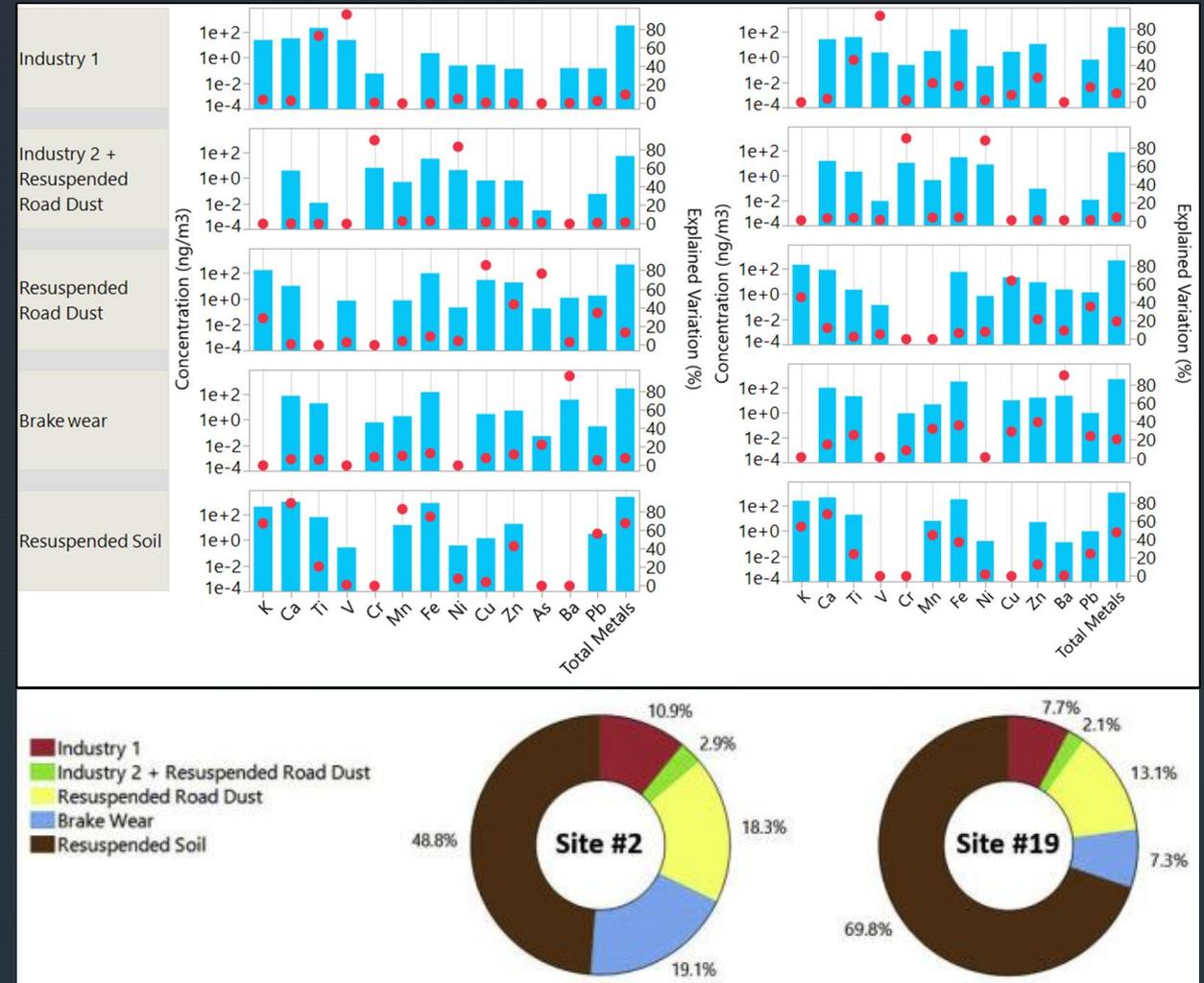
- Source apportionment is a mathematical procedure for identifying and quantifying the sources of ambient air pollutants
- It is based on concentration measurements of a suite of compounds and the knowledge of source profiles or fingerprints
- Positive Matrix Factorization (PMF), a multi-variate analysis tool, is one of the most commonly used models for source apportionment
- MATES VI is the first of MATES campaigns that will include source apportionment

Source Apportionment Studies Conducted by South Coast AQMD

Particulate Elements and Metals Trends and Source Apportionment Study in Paramount, CA

Atmospheric Environment X 7:100089, published August 2020

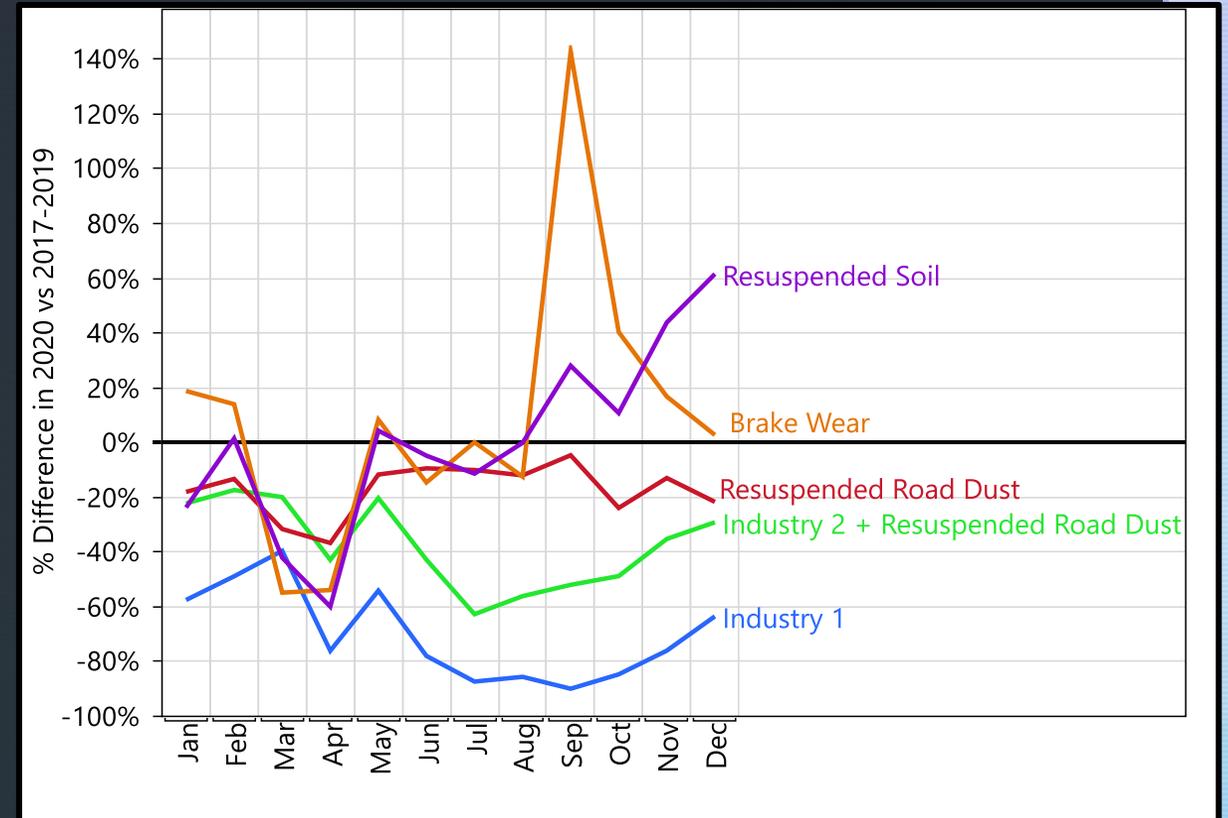
- An air toxic metals emission investigation led to deployment of high time resolution metals monitors at two sites to complement the time-integrated sample collection efforts
- Levels of metals showed strong intra-community spatial and temporal variations
- A PMF model was used to identify and quantify major sources of metals
- Five major sources of distinct profiles and temporal trends were identified



Long-Term Trends in Composition and Sources of Metals in Paramount: A Focus on COVID-19 Lockdown Period

Under Review

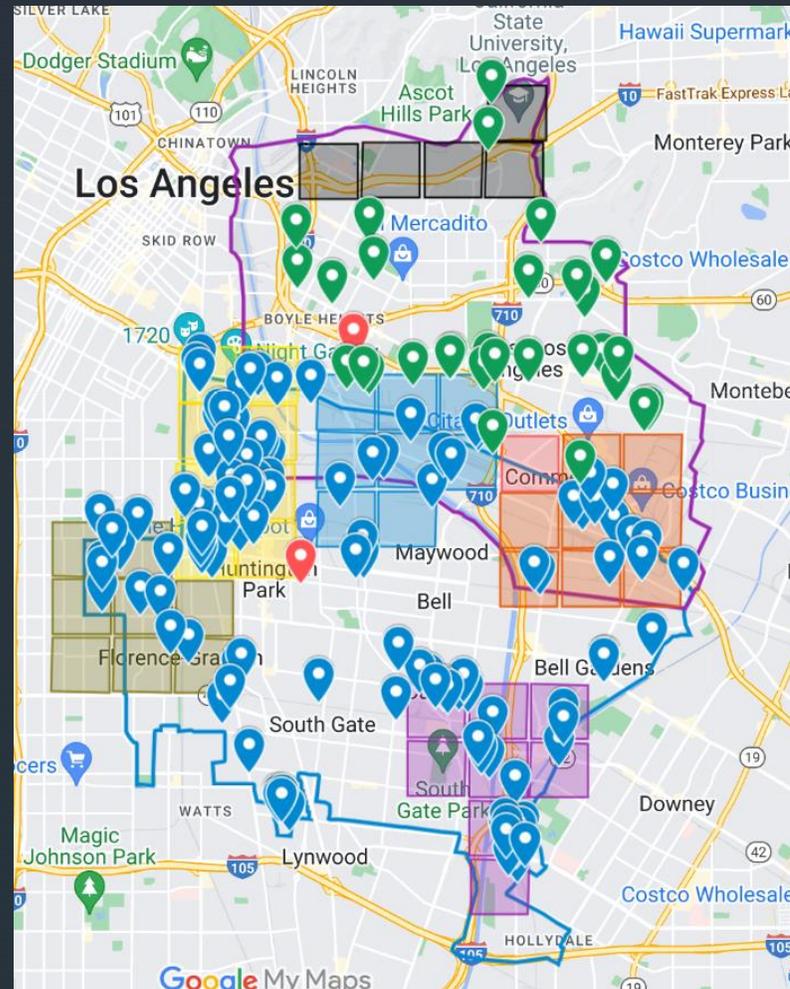
- Continuation of the previous work with a focus on trends before and after COVID-19 lockdown period
- Levels of metals showed significant decreases at the beginning of the COVID-19 stay-at-home period
- Contributions of industrial-related metals (i.e., Ni, Cr, Ti, and V) remained substantially low through end of 2020
- The reduction in industrial-related metals took place amidst ongoing decline over the past couple of years (associated with regulatory action and lower demand by aerospace industry)



Upcoming Source Apportionment Studies

Multi-metals Mobile Monitoring Study as part of a U.S. EPA grant and the AB 617 program

- Measurements taken place in East and Southeast Los Angeles
- Comprehensive mobile monitoring surveys
- Stationary monitoring at air monitoring stations and near facilities
- Measured PM mass and number, elements and metals, black carbon



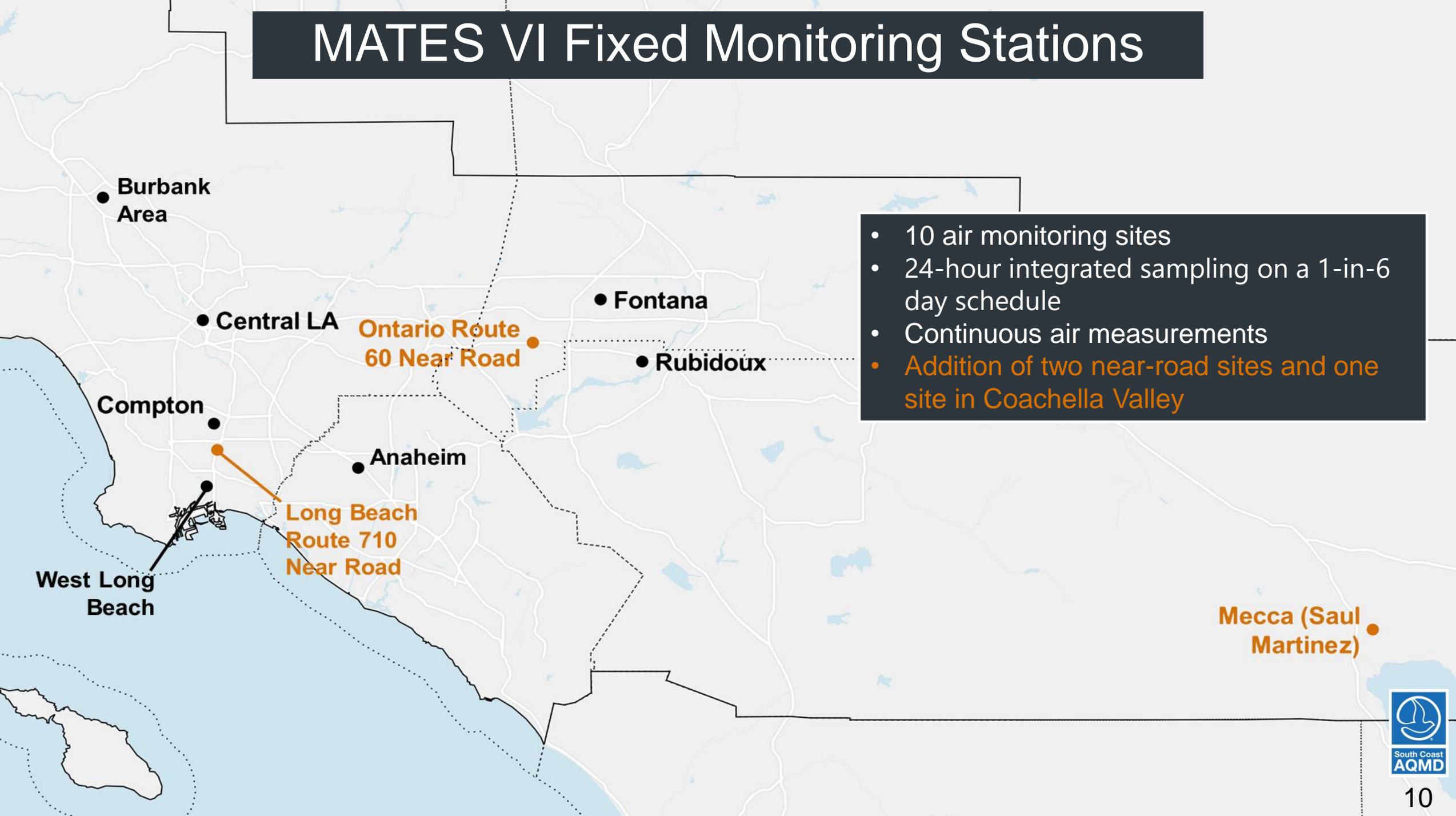
Dust Characterization Study as part of the AB 617 program

- Over one year of PM10 & TSP monitoring in Mecca, Coachella Valley (Jan 2022 through May 2023)
- Time-integrated (1-in-6 days) and continuous
- Measured PM mass, metals, ions, carbonaceous content, morphology



MATES VI Source Apportionment Study

MATES VI Fixed Monitoring Stations



Time-integrated Samples

1-in-6 days

Particulate Matter

- **PM2.5 speciation (6 sites)**
 - Mass, metals, EC-OC, ions
- **PM10 speciation (10 sites)**
 - Mass, metals, EC-OC, ions, levoglucosan
- **TSP speciation (2 sites)**
 - Metals, Cr⁶⁺

Gaseous (10 sites)

- Volatile organic compounds
- Carbonyls

Semi-volatiles (4 sites)

- Polycyclic Aromatic Hydrocarbons

High Time Resolution Measurements

Particulate Matter

- Particle mass
 - PM2.5 (9 sites)
 - PM10 (5 sites)
- Particle number (10 sites)
- Elements and metals (5 sites)
- Black carbon (10 sites)
- Total carbon (2 sites)
 - Estimated particle-bound OC

Gaseous

- Ammonia (3 sites)
- Ethylene Oxide (TBD)

Potential Source Apportionment Scenarios

- A. Run PMF separately on time-integrated datasets (e.g., PM_{2.5}, PM₁₀, gaseous (VOCs and carbonyls), and PAHs) and use continuous data in interpretation of different factors
- B. Run PMF on combined, time-integrated datasets (e.g., PM with gaseous) and use continuous data in interpretation of different factors
- C. Use multi-linear engine to include continuous data (e.g., metals, BC) and time-integrated data only available at limited number of sites in the source apportionment

Questions for Discussion

- Given the available data and the proposed scenarios, what would be the most effective approach to perform a comprehensive source apportionment study?
- What are the potential challenges and/or data gaps?

4. Ethylene Oxide (EtO) Literature Review, Health Risks and Monitoring Capabilities

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MATES VI Technical
Advisory Committee
Mtg. #2

January 16, 2024



Background

- Ethylene Oxide (EtO) is a flammable, colorless gas
 - Used in manufacturing plastics, detergents, antifreeze etc.
 - Direct use as a medical equipment sterilizing agent
 - Eye and respiratory irritant
- EPA revised EtO cancer potency upward by x37.5 in 2016
 - Typical background levels are < 1ppb
 - Challenge to develop analyzers and analytical methods with low MDLs
- Measurements close to EtO manufacturing facilities nationwide have shown > 5 ppb, quickly dropping off to background levels with distance
- MATES VI will focus on ambient (not source-oriented) monitoring data

Regulating EtO – South Coast AQMD

South Coast AQMD regulates EtO emission sources including sterilization facilities

- Fenceline monitoring, enforcement actions (<https://www.aqmd.gov/home/eto>)
- Rule 1405 (amended Dec 1, 2023) – requires controls and limits fugitive emissions for sterilization facilities (<https://www.aqmd.gov/docs/default-source/rule-book/reg-xiv/rule-1405.pdf>)
- AB 2588 Air Toxics Hotspots program – must submit emissions reduction plans, if determined to be high risk (<https://www.aqmd.gov/home/rules-compliance/compliance/toxic-hot-spots-ab-2588>)

Regulating EtO – U.S. EPA

EPA has several rules and regulations

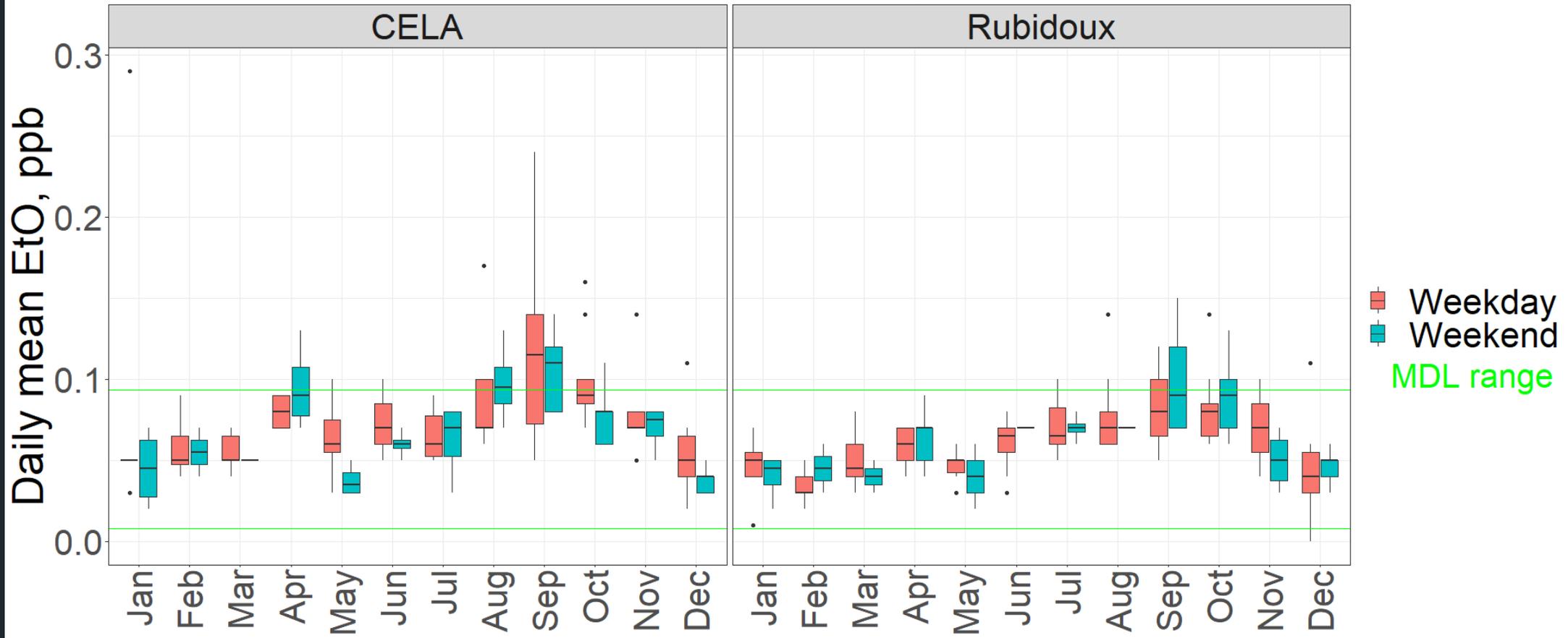
- Miscellaneous Organic Chemical Manufacturing (<https://www.epa.gov/stationary-sources-air-pollution/miscellaneous-organic-chemical-manufacturing-national-emission>)
- Commercial Sterilizers (<https://www.epa.gov/hazardous-air-pollutants-ethylene-oxide/proposal-reduce-ethylene-oxide-emissions-commercial>)
- Hazardous Organic National Emission Standards for Hazardous Air Pollutants (<https://www.epa.gov/hazardous-air-pollutants-ethylene-oxide/proposal-strengthen-standards-synthetic-organic-chemical>)
- EtO use as a pesticide (<https://www.epa.gov/ingredients-used-pesticide-products/regulation-ethylene-oxide-eto-under-federal-insecticide>)

EtO Ambient Monitoring

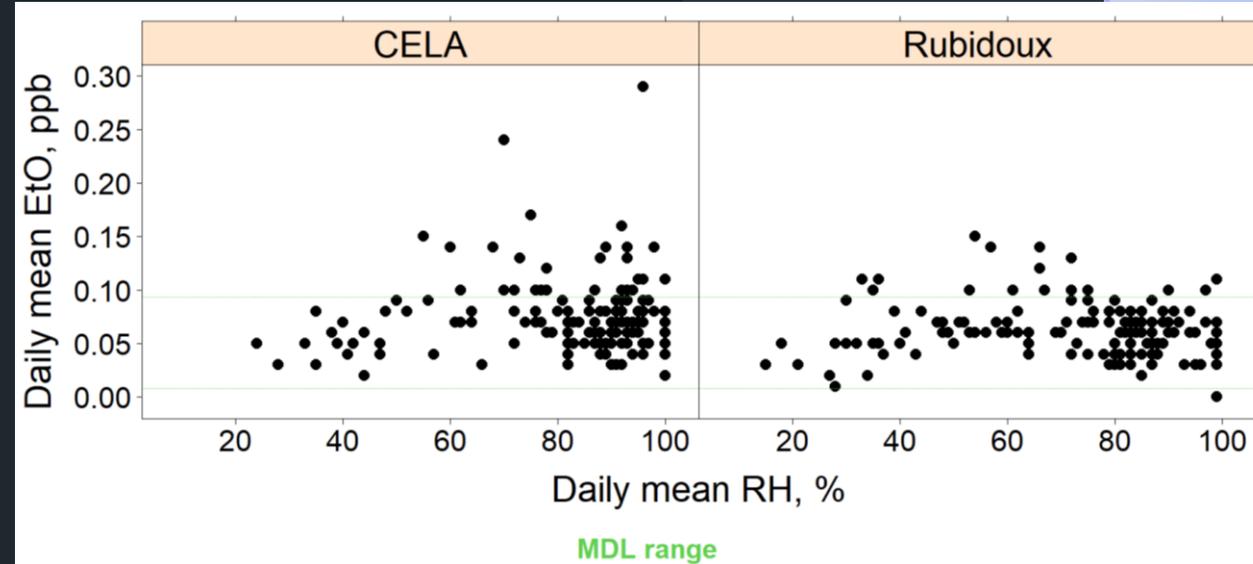
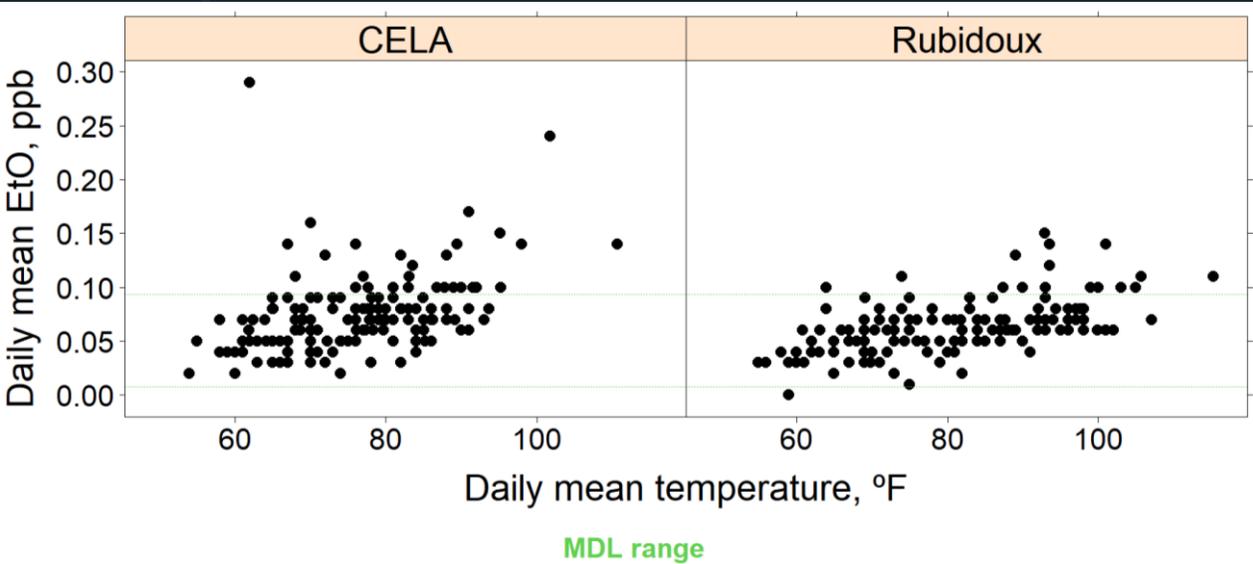
- South Coast AQMD has conducted routine one-in-six day measurements of EtO in Central Los Angeles (CELA) and Rubidoux, since June 2020.
- Only data through December 2022 are finalized.
- South Coast AQMD laboratory switched to a different analytical method (TO-15A) in April 2021
- This lowered the Method Detection Limit (MDL) from around 0.09 ppb to 0.008 ppb.

Seasonal/Day-of-Week Dependence

South Coast AQMD EtO monitoring, June 2020- Dec 2022



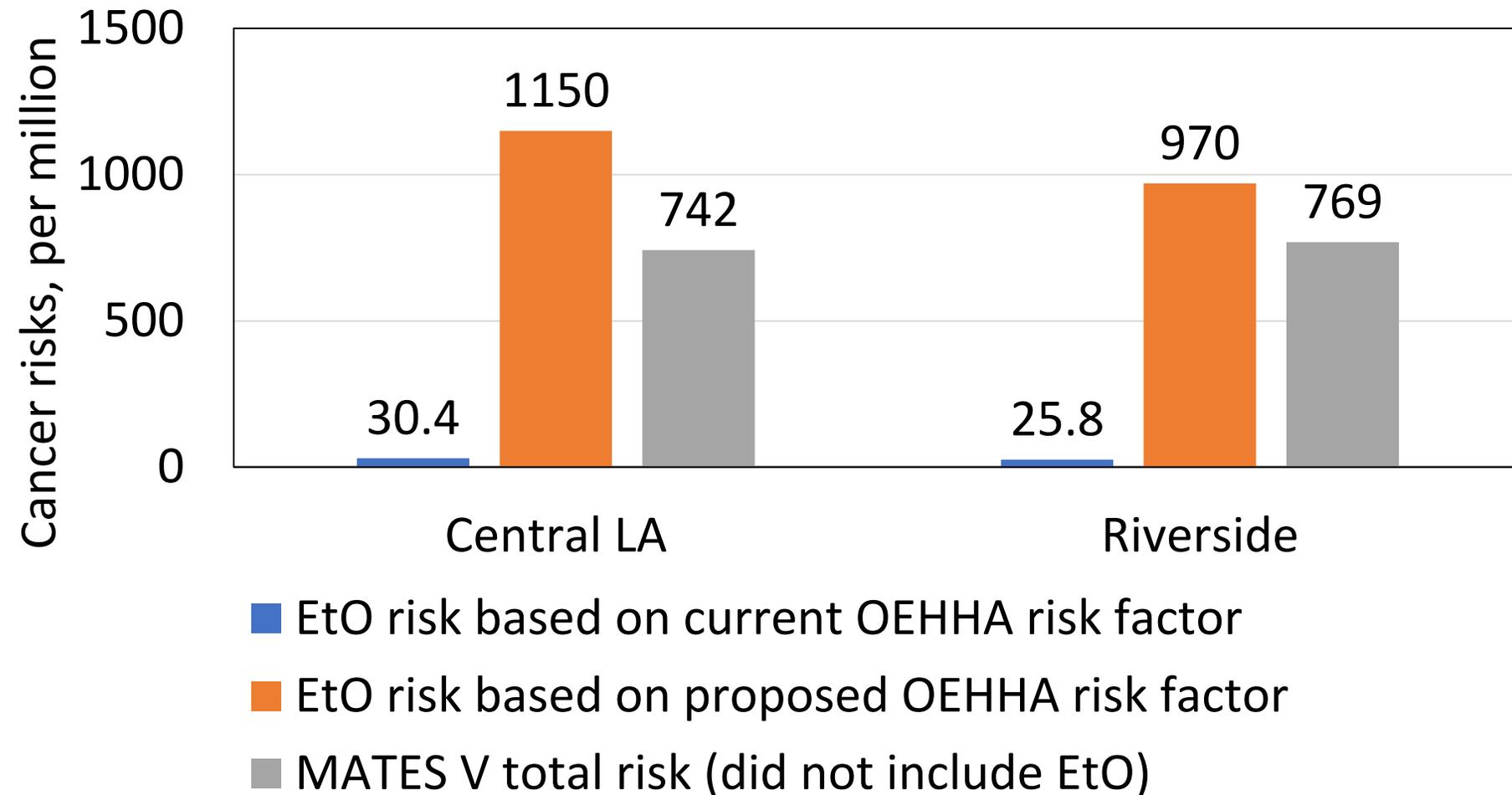
EtO Dependence on Meteorology



- EtO concentrations appear insensitive to RH, but increase with temperature (higher emissions in the summer months? Secondary formation?)

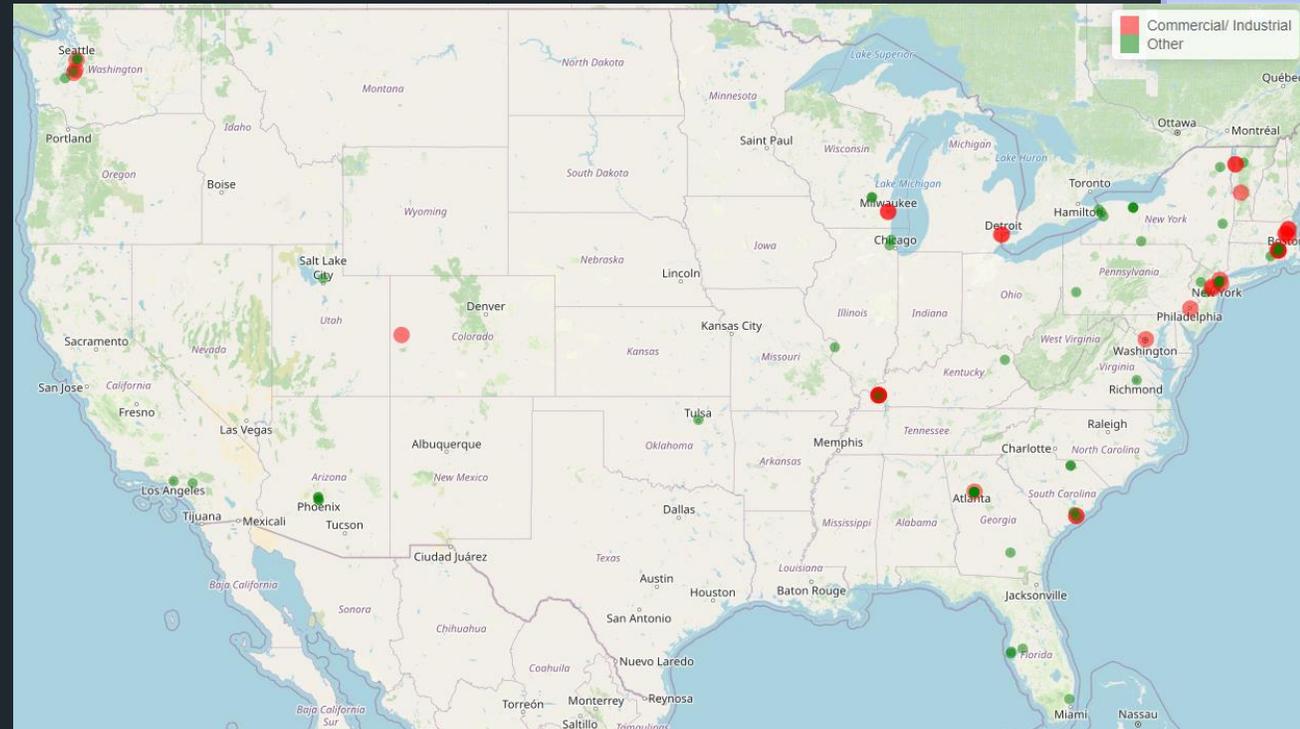
Putting Southern California EtO Cancer Risks in Perspective

- OEHHA adoption of new EtO risk factors still pending
- Based on 2020- 2022 average levels, EtO will dominate cancer risk with proposed risk factor

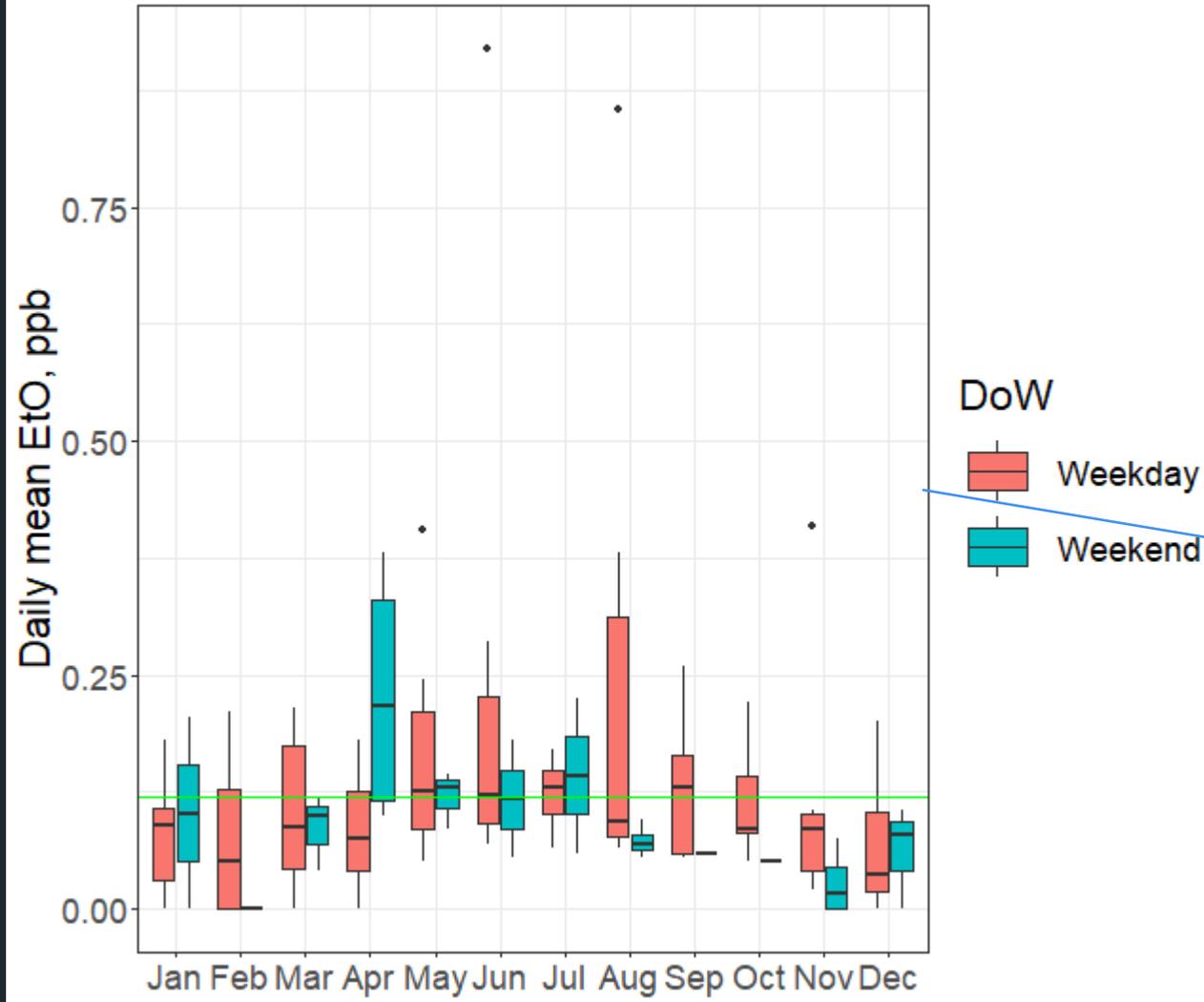


EtO Monitoring at NATTS Sites Around the Country

- Not many NATTS sites measuring EtO in the Western US
- Not clear if/when agencies switched from stainless steel to silica-coated canisters, or changed from method TO-15 to TO-15A
- MDLs default to 0.12 ppb unless reported to AQS AMP503
- See next 3 slides for comparisons

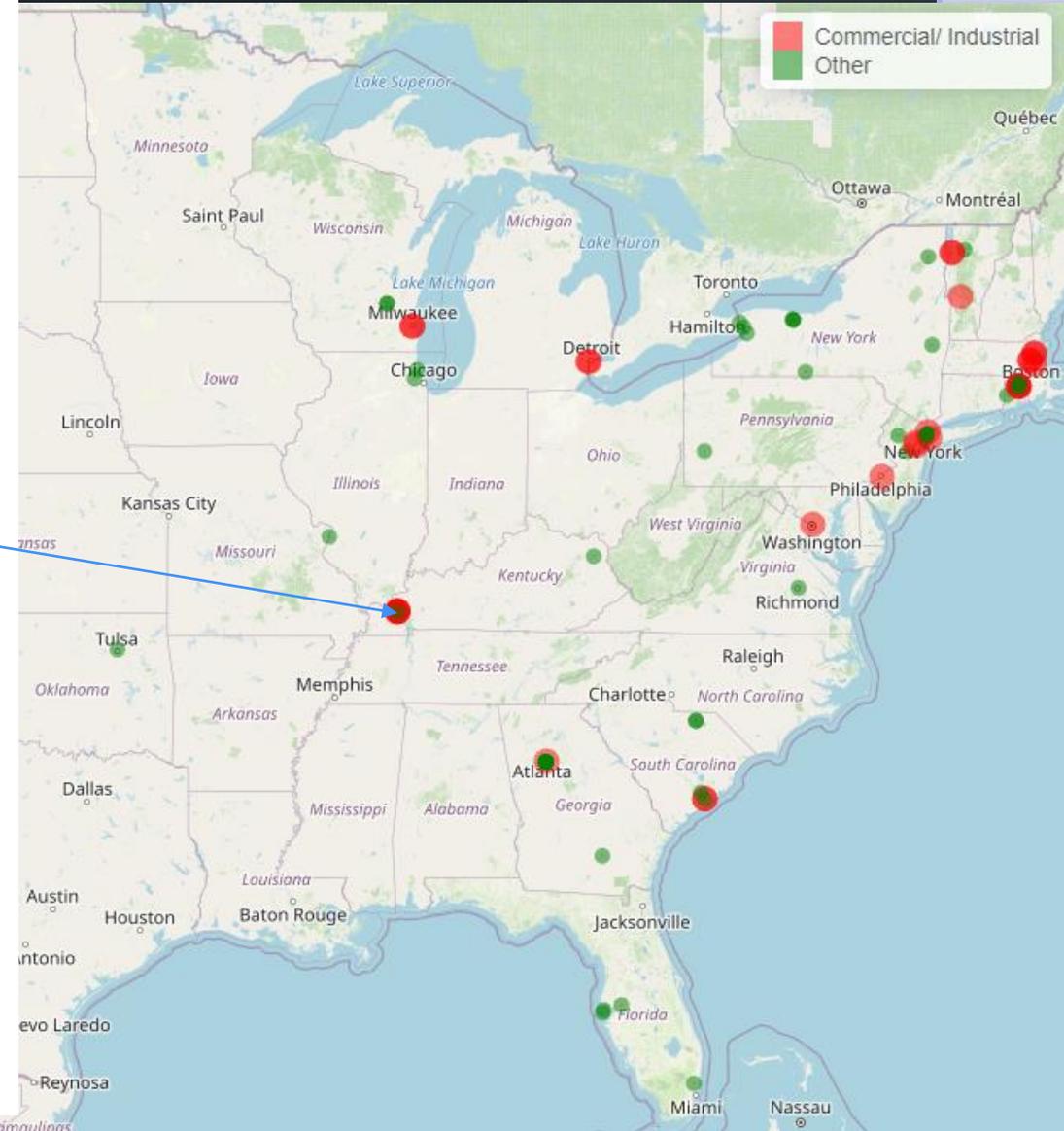


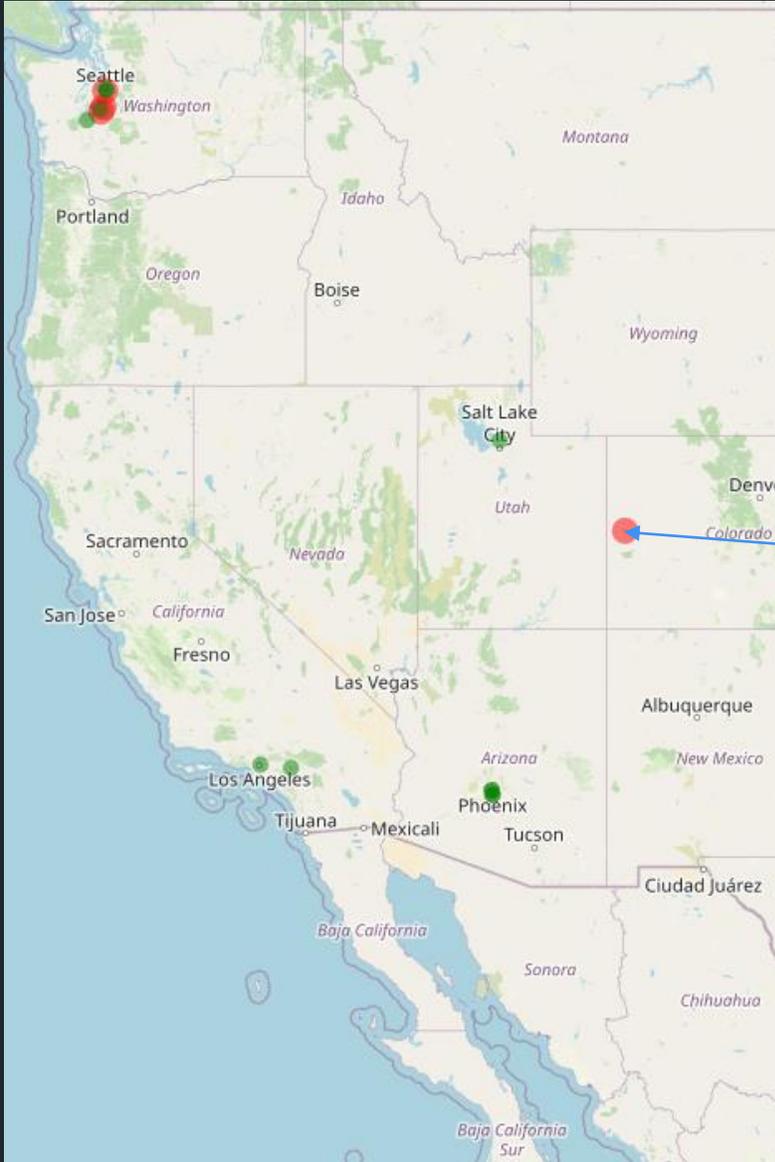
EtO at Calvert City Elementary Oct 24 2020- Jun 23 2023



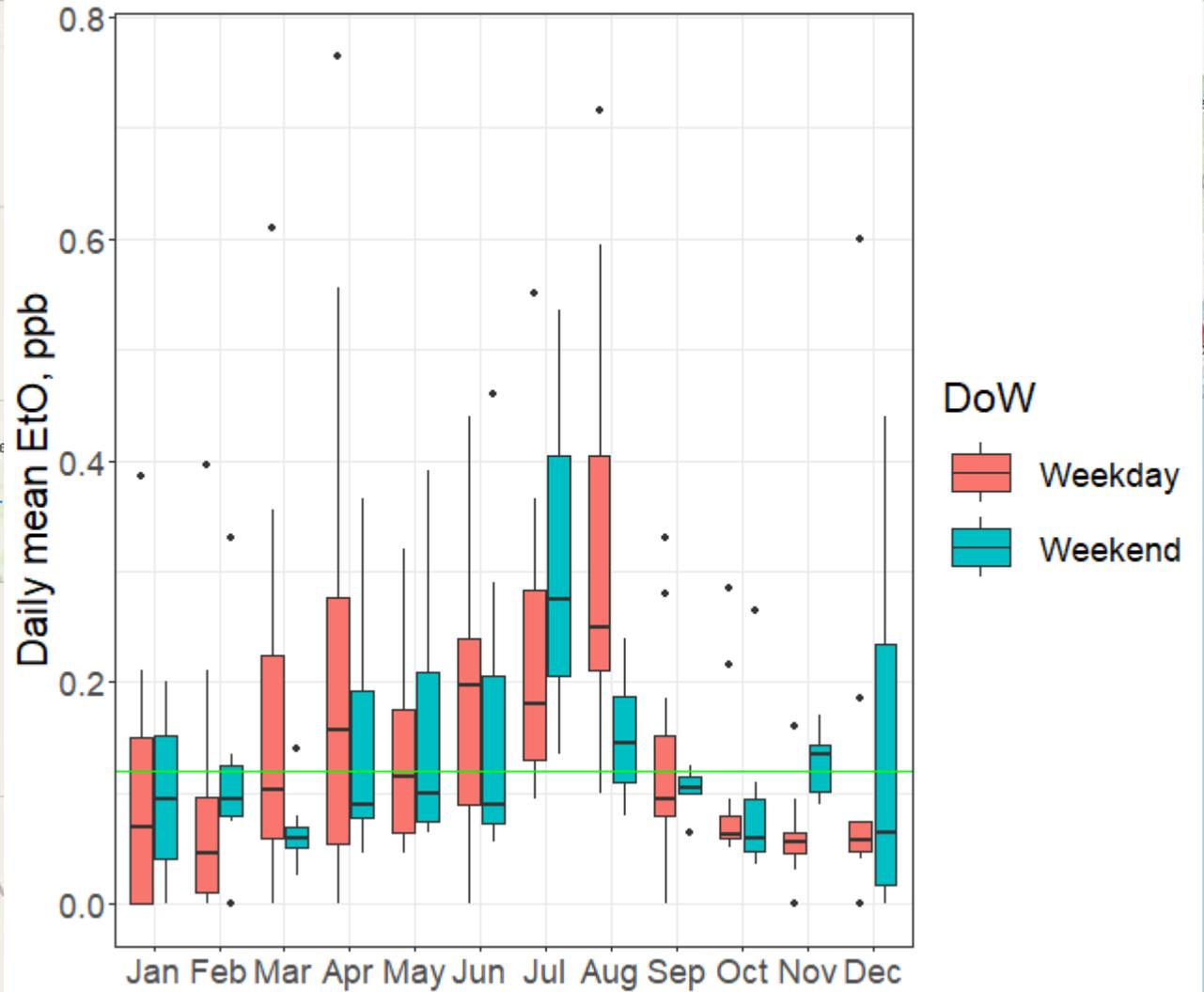
MDL range reported

DoW
Weekday
Weekend



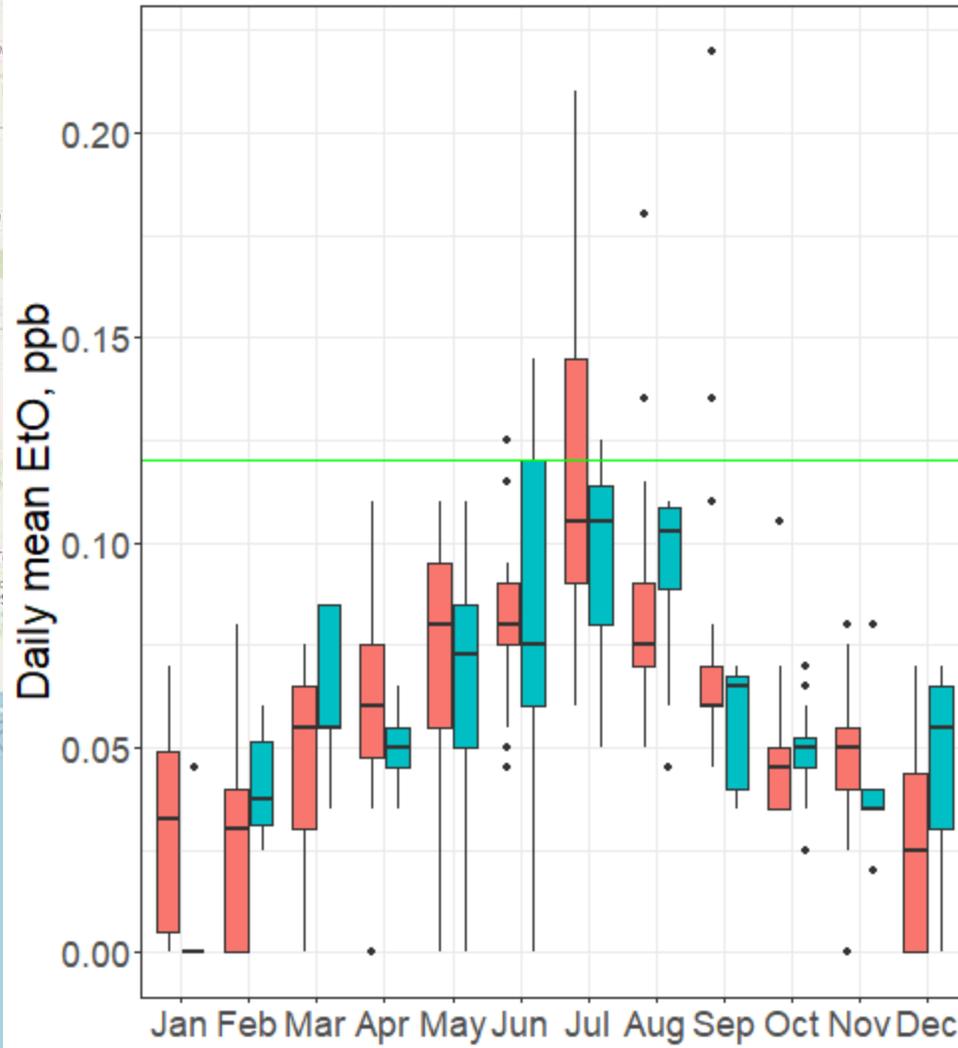


EtO at GRAND JUNCTION - PITKIN Jan 15 2019- Jun 29 2023



MDL range reported

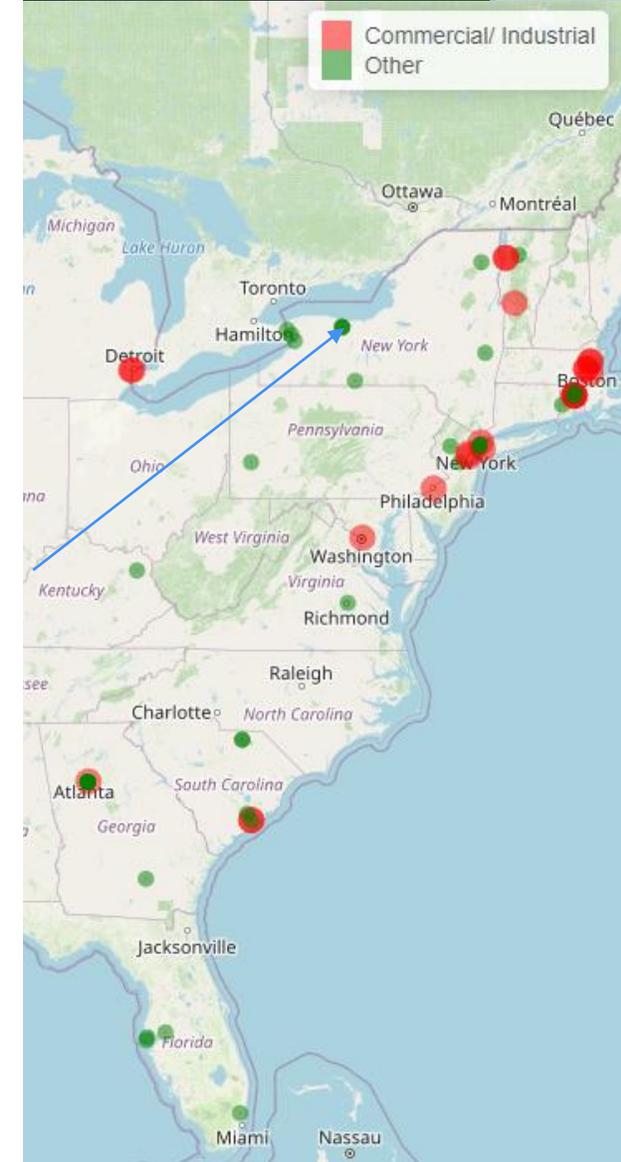
EtO at ROCHESTER 2 Jul 02 2019- Jun 29 2023



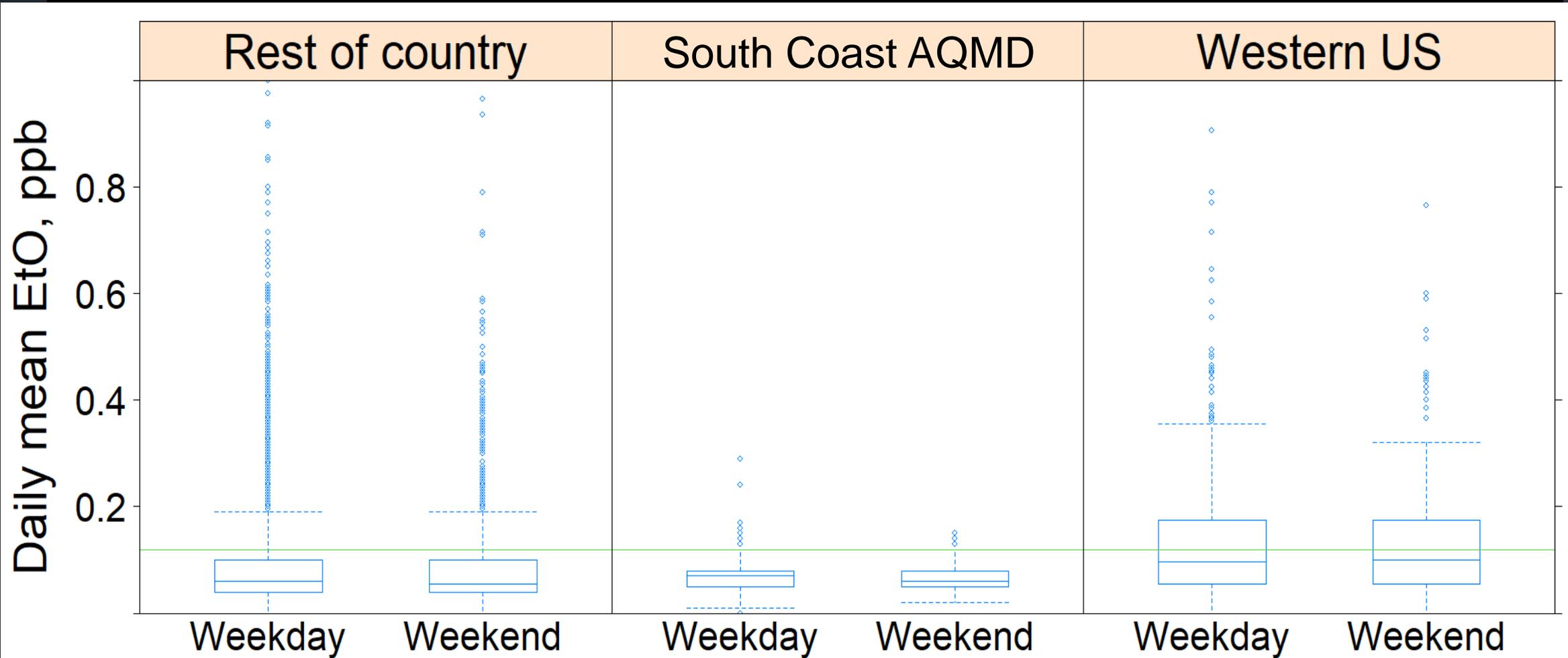
MDL range reported



DoW
Weekday
Weekend



EtO Measurements at Non-Industrial/Commercial Sites (Jan 2019-Dec 2022)



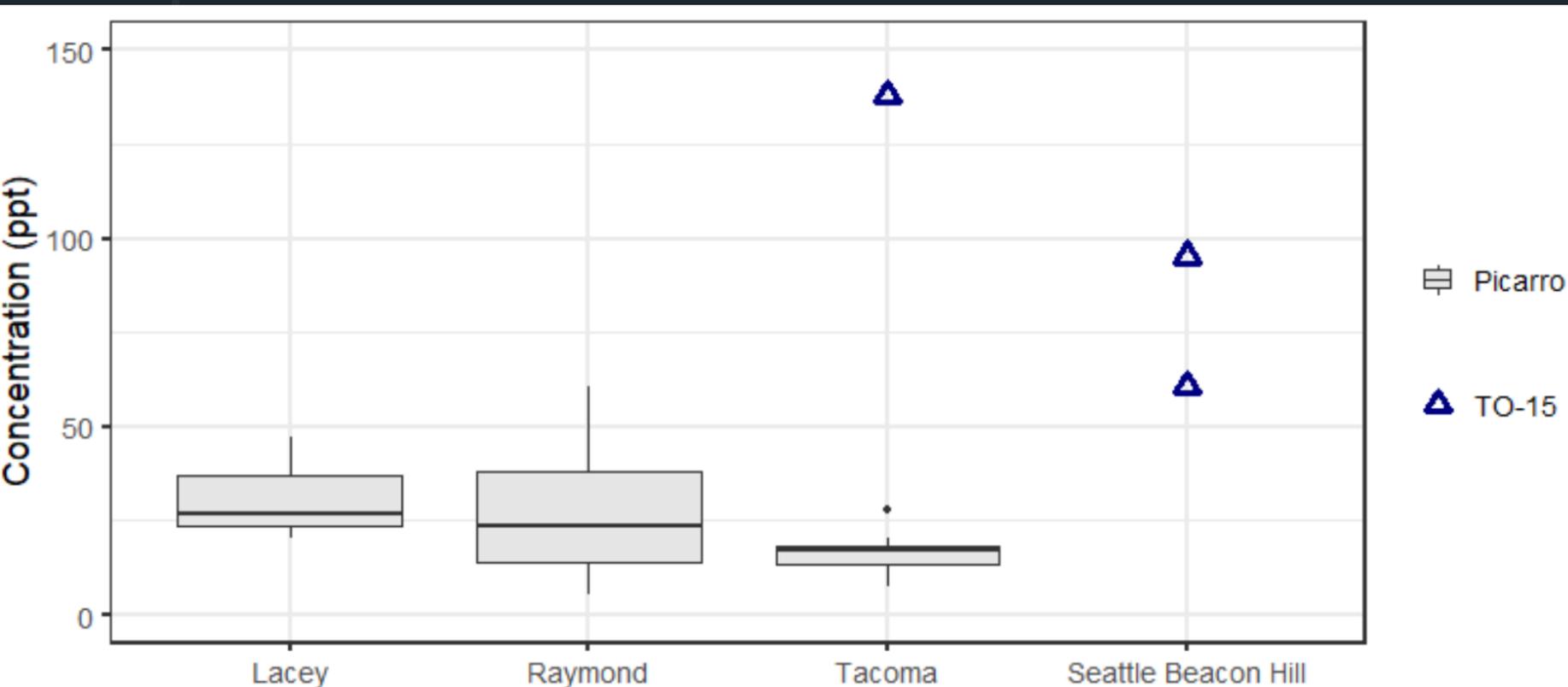
Max Federal MDL for all sites = 0.12 ppb

Ethylene oxide special studies

Summary of Select Community Monitoring Campaigns

Western Washington State

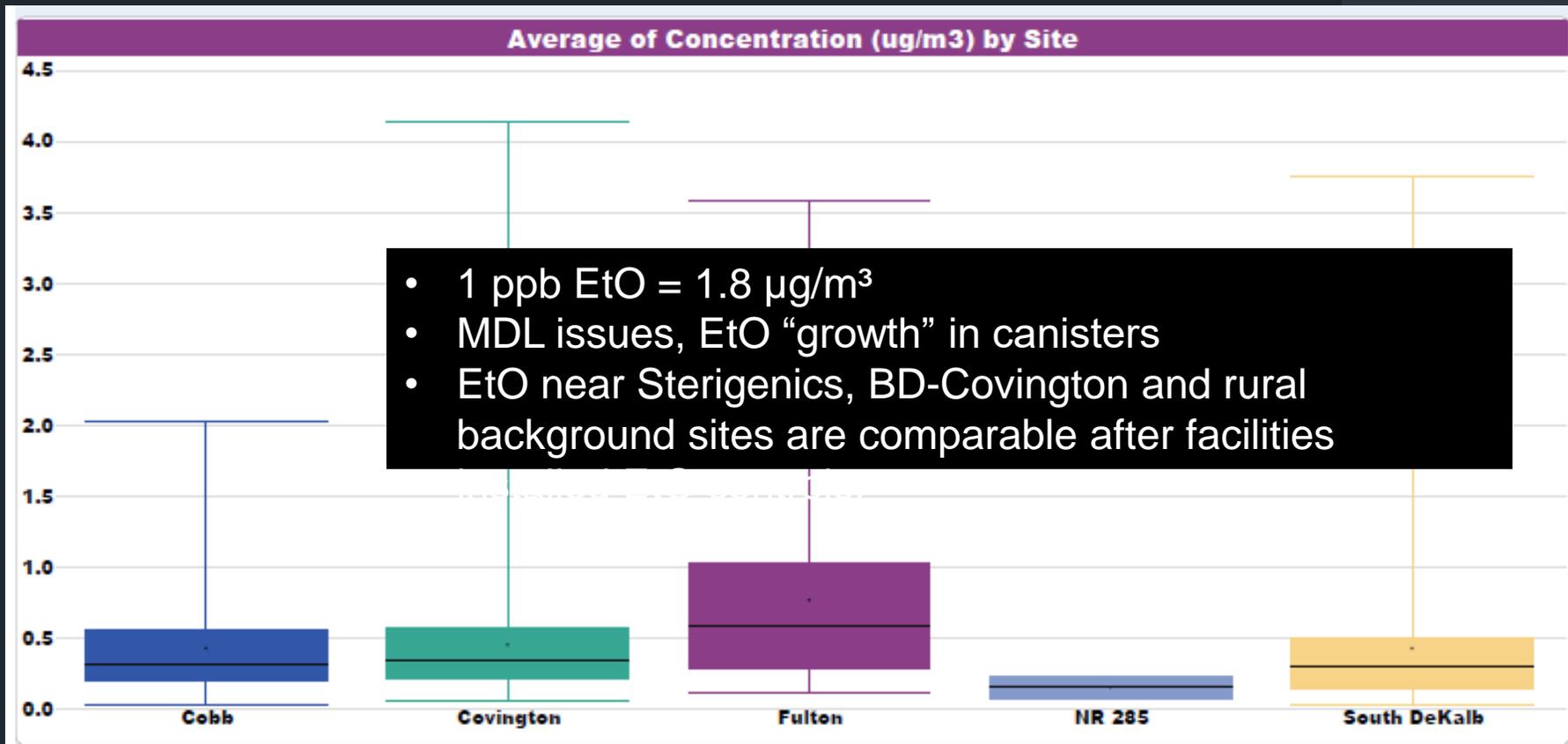
- Led a Picarro CRDS (continuous EtO analyzer) monitoring campaign for 2 weeks
- <https://apps.ecology.wa.gov/publications/documents/2202020.pdf>



- Rural to urban variation very small
- Suspect ubiquitous sources/ regional background (unsure of specifics)

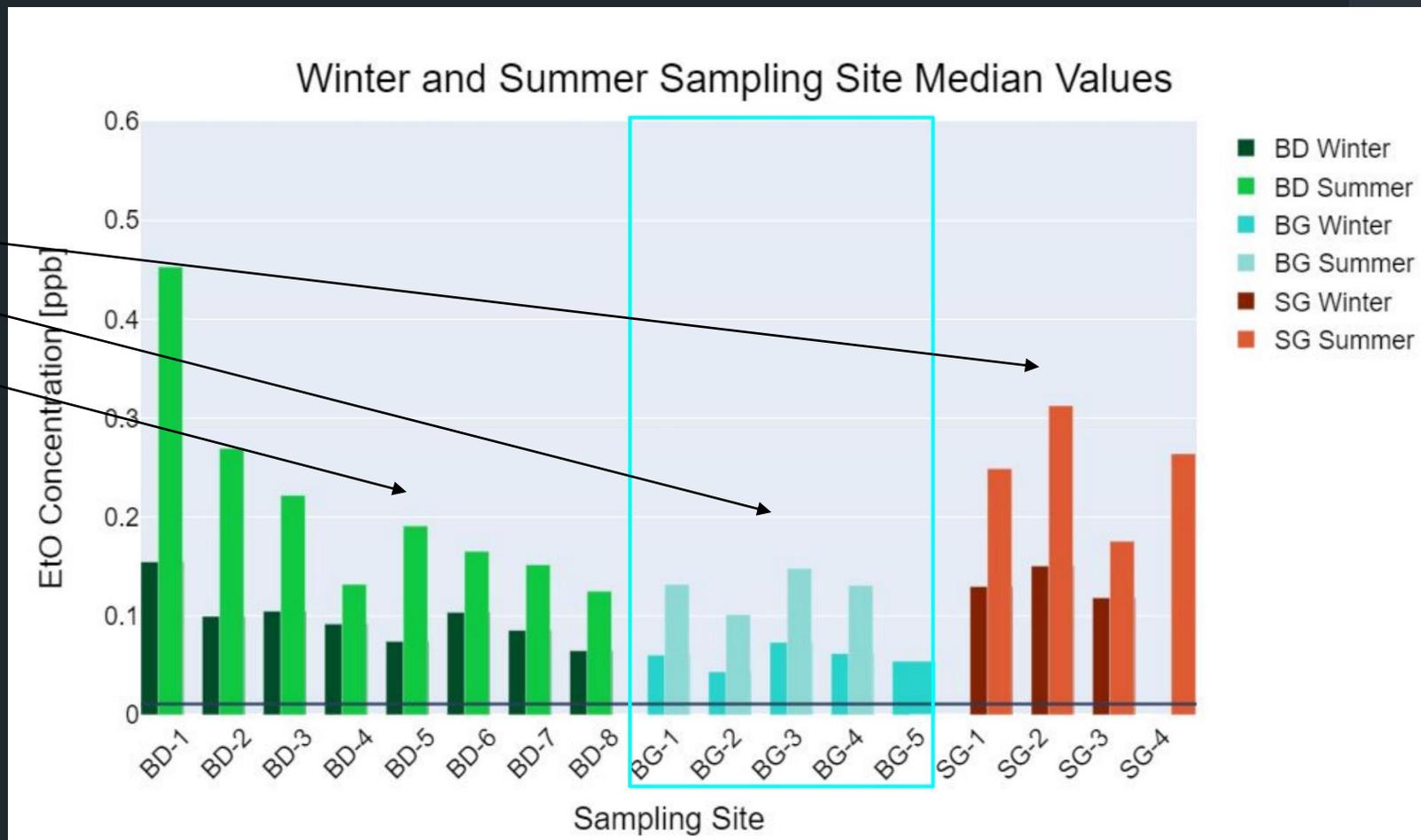
Georgia Community EtO Data

(1.5 years of measurements , 1:6 passive sampling with stainless steel canisters, TO-15 sampling)
<https://epd.georgia.gov/document/document/ethylene-oxide-monitoring-report-appendices51222pdf/download>



Salt Lake City

- (1:3 day passive sampling for 8 weeks each in summer & winter of 2021. 17 sites)
<https://deq.utah.gov/air-quality/ethylene-oxide-study>

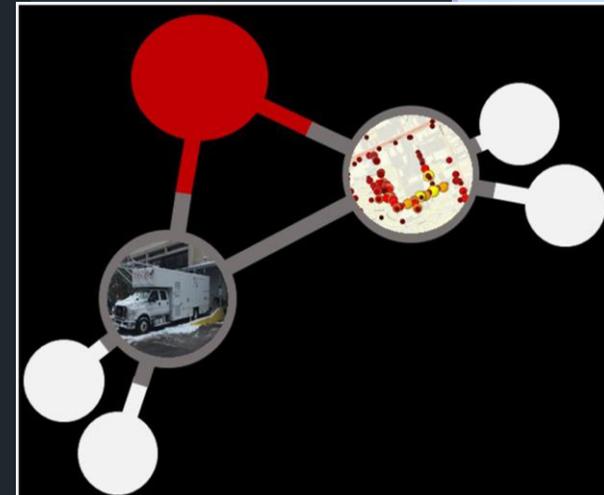


Sterigenics
Background
BD Medical

Summer ~3x
winter levels
even at
background
sites

Ongoing EtO Studies

- EPA near-road study in Morrisville, NC over winter and summer using Picarro, TILDAS & VOC canisters (Presentation by Ali Gitipour at AWMA Air Quality Measurement Methods and Technology Conference, November 2023)
 - No diurnal trends observed over winter portion of the study
 - No trends in EtO measurements observed that are suggestive of an increase in EtO related to heavy traffic or vehicles
- Galarneau et al (2023) used a TILDAS to measured EtO in Toronto (<https://doi.org/10.1016/j.atmosenv.2023.119828>)
 - Wintertime concentrations indistinguishable from background
 - Cold starts showed no EtO enhancement
- CARB/South Coast joint effort to determine EtO emissions from motor vehicles under regulatory duty cycles
 - Method development is ongoing

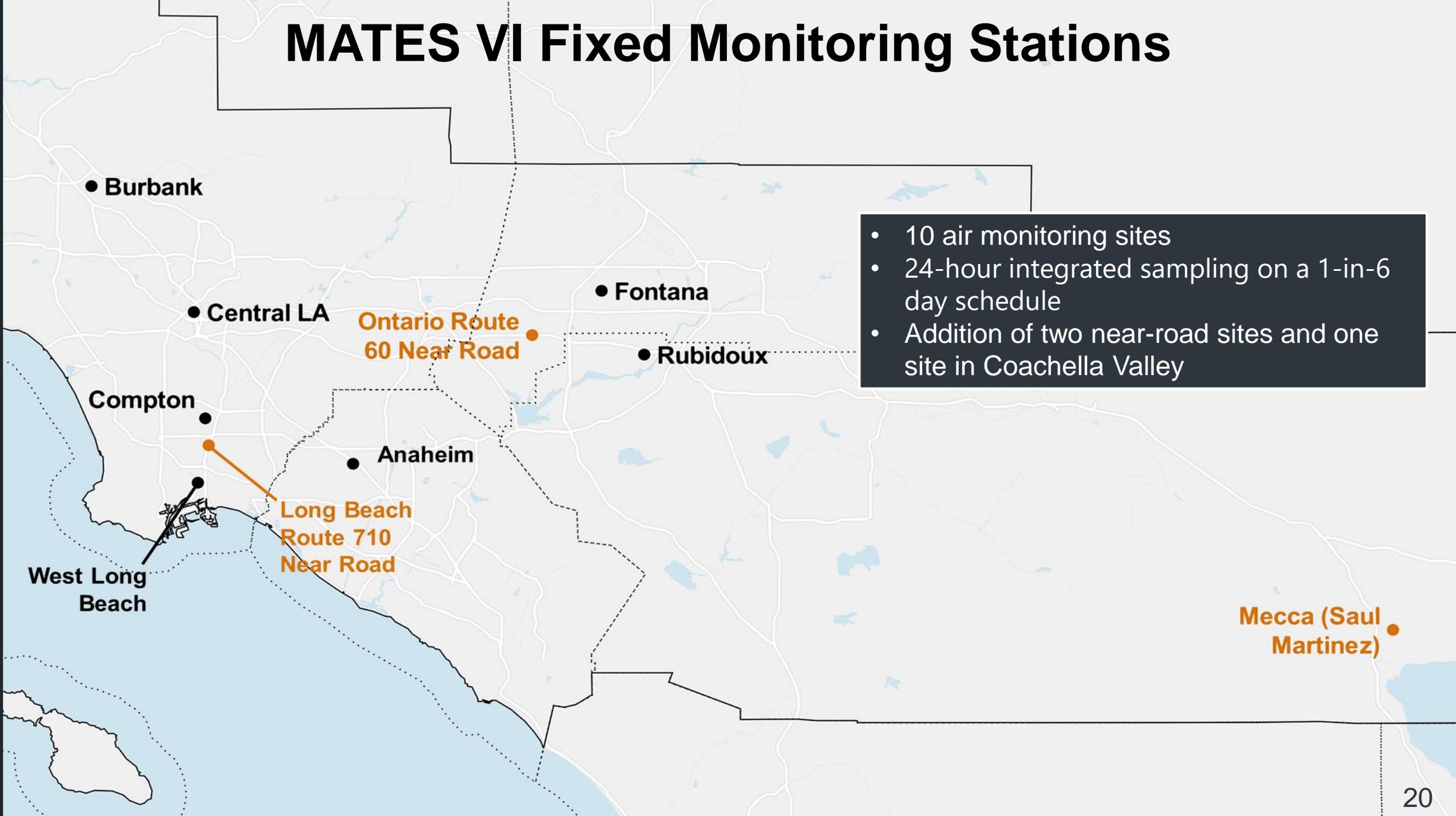


Summary and Next Steps

- In general, EtO is:
 - Higher in summer (some sites high in spring) even at rural sites
 - No consistent weekday- weekend or diurnal pattern
 - Background seems to be > 11(7) ppt [100-in-a-million cancers using proposed risk factors with EPA (OEHHA) procedures]
 - South Coast AQMD jurisdiction MAY have lower levels than other areas

EtO monitoring plan for MATES VI

MATES VI Fixed Monitoring Stations



- 10 air monitoring sites
- 24-hour integrated sampling on a 1-in-6 day schedule
- Addition of two near-road sites and one site in Coachella Valley

Analytical Resources and Ideas

- Four Aerodyne Research Ethylene Oxide Analyzers (TILDAS)
 - Up to one second resolution with 75ppt MDL
 - Lower detection limit at longer integration times (e.g. 20ppt at 100 seconds)
 - Application can be stationary or mobile
- Deployment Ideas
 - Stationary
 - Near Road
 - Areas with high residential wood burning or potential wildfire impacts
 - Basin Upwind vs Basin Downwind
 - Mobile
 - Short-term campaigns around sites that show higher time-integrated levels to help identify new/unknown sources
 - Investigate areas research has shown may be contributing to background



Questions for discussion

- What are the main EtO sources, what contributes to background?
- How best to design sampling study given the known and unknown emissions and trends
- What pitfalls should we watch for?