Item #2

Air Quality Trends in the Basin and Design Values

STMPR meeting on Jan 27, 2021

Sang-Mi Lee, Ph.D.
Program Supervisor

South Coast Air Quality Management District

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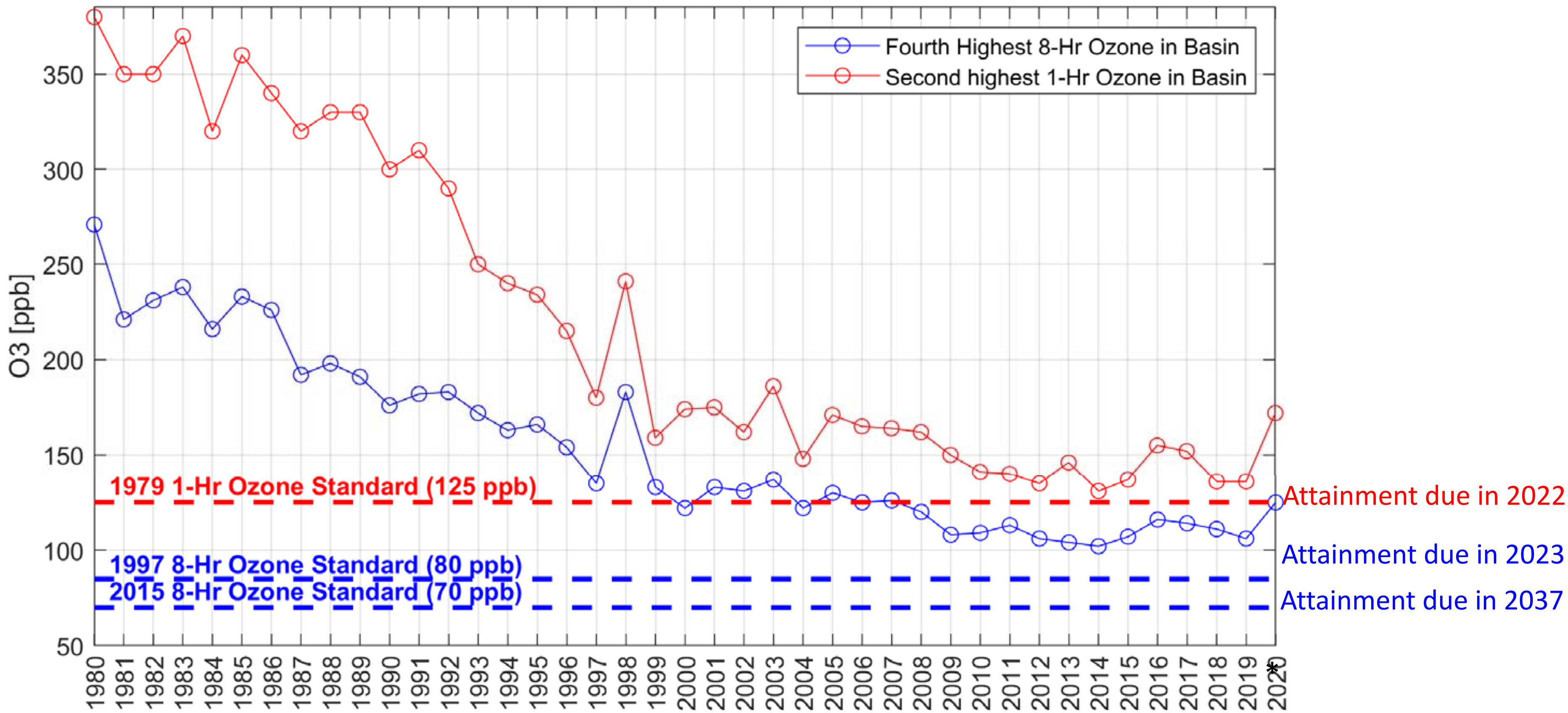
Progress Towards Attaining Ozone Standards in the Basin



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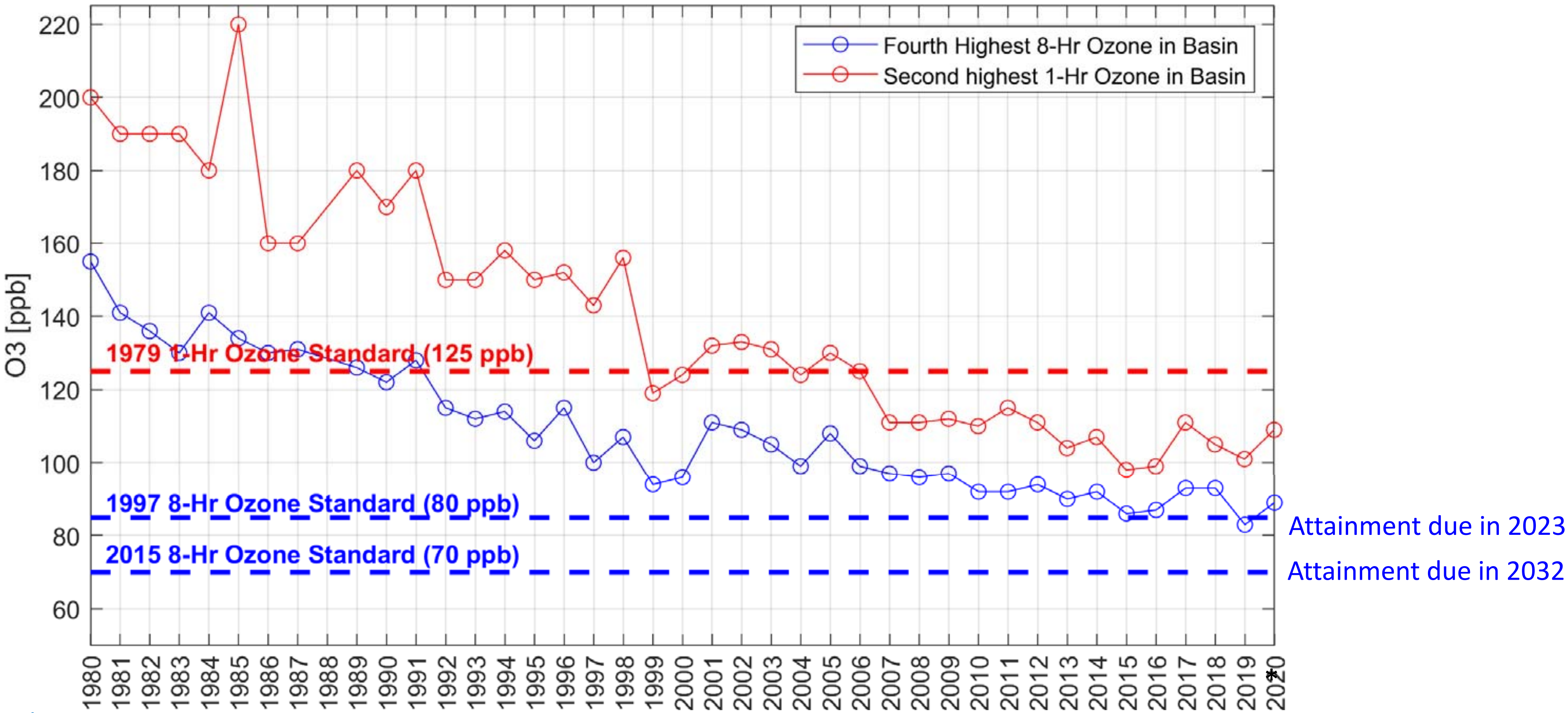
* As of 10/21/2020. Data is preliminary.

Progress Towards Attaining Ozone Standards in the Coachella Valley



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* As of 10/21/2020. Data is preliminary.

8-hour Ozone Design Value Calculation

1. Rank the daily max. 8-hour ozone for each year

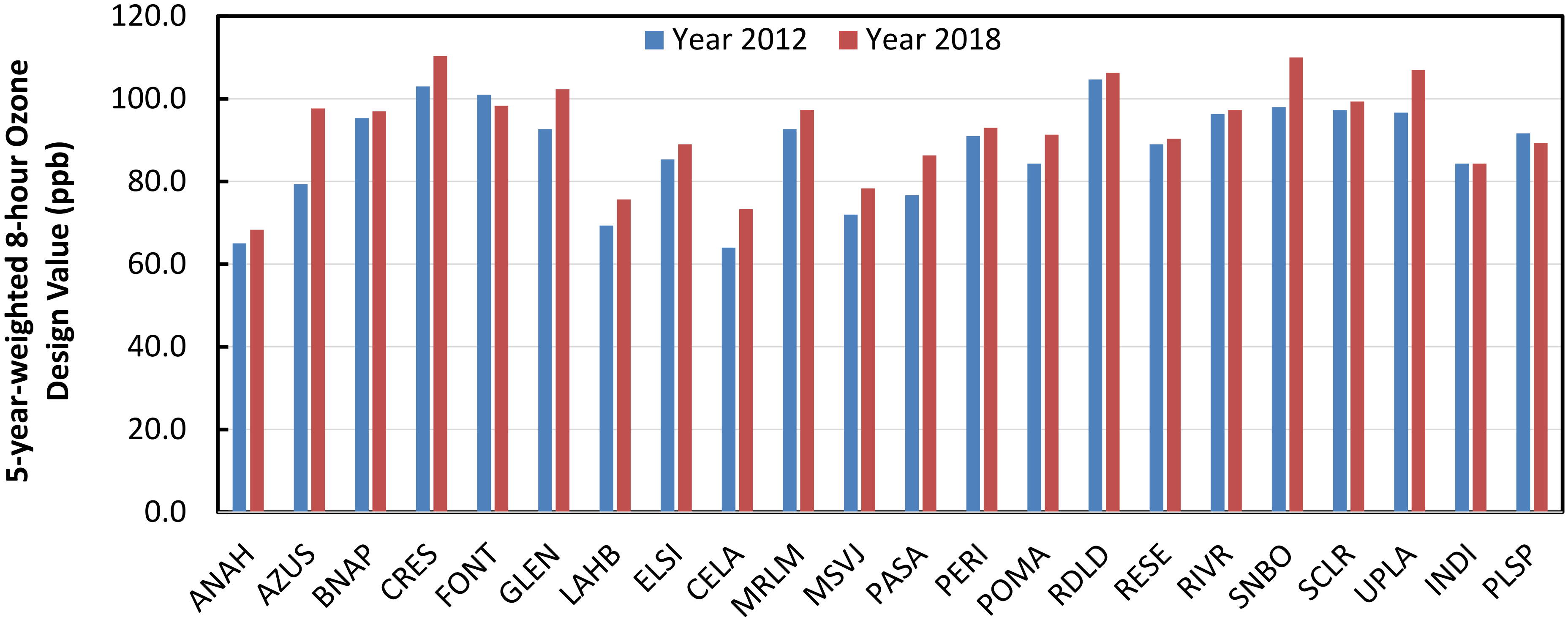
Crestline	2016	2017	2018
First Highest	0.121	0.121	0.125
Second Highest	0.121	0.115	0.107
Third Highest	0.117	0.115	0.106
Fourth Highest	0.116	0.114	0.105

2. Average the 4^{th} highest daily maximum over 3 years:
   2018 Design Value = (0.116 + 0.114 + 0.105)/3 = 0.111

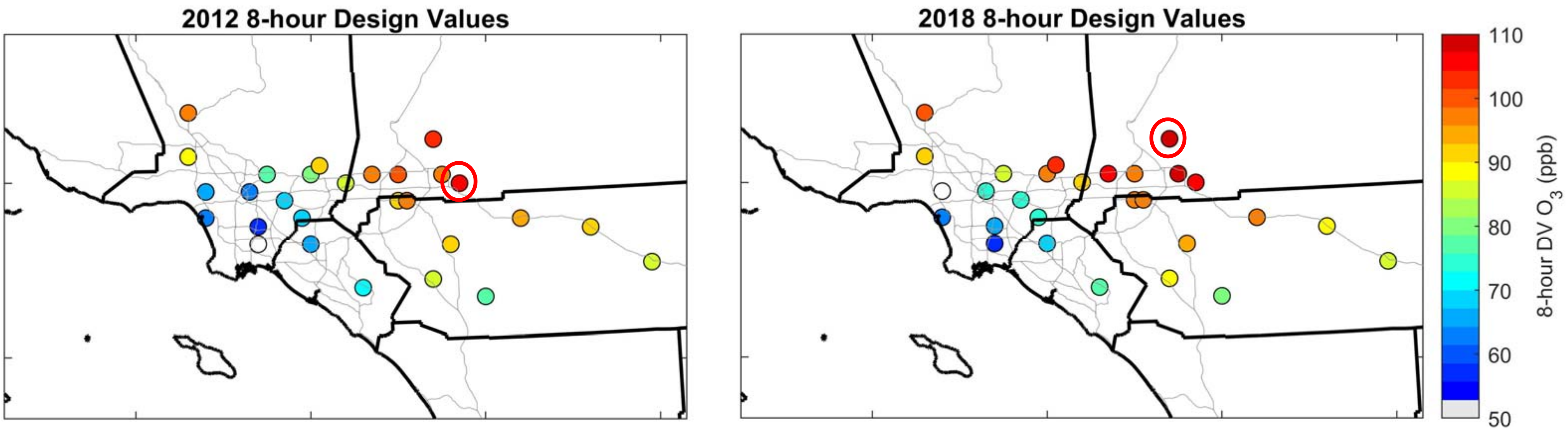
❖ For attainment demonstration, EPA recommends using an average of 3 design value periods (5 year-weighted avg.) as a base year design value

	2015	2016	2017	2018	2019	2020
Period 1	X	X	X			
Period 2		X	X	X		
Period 3			X	X	X	

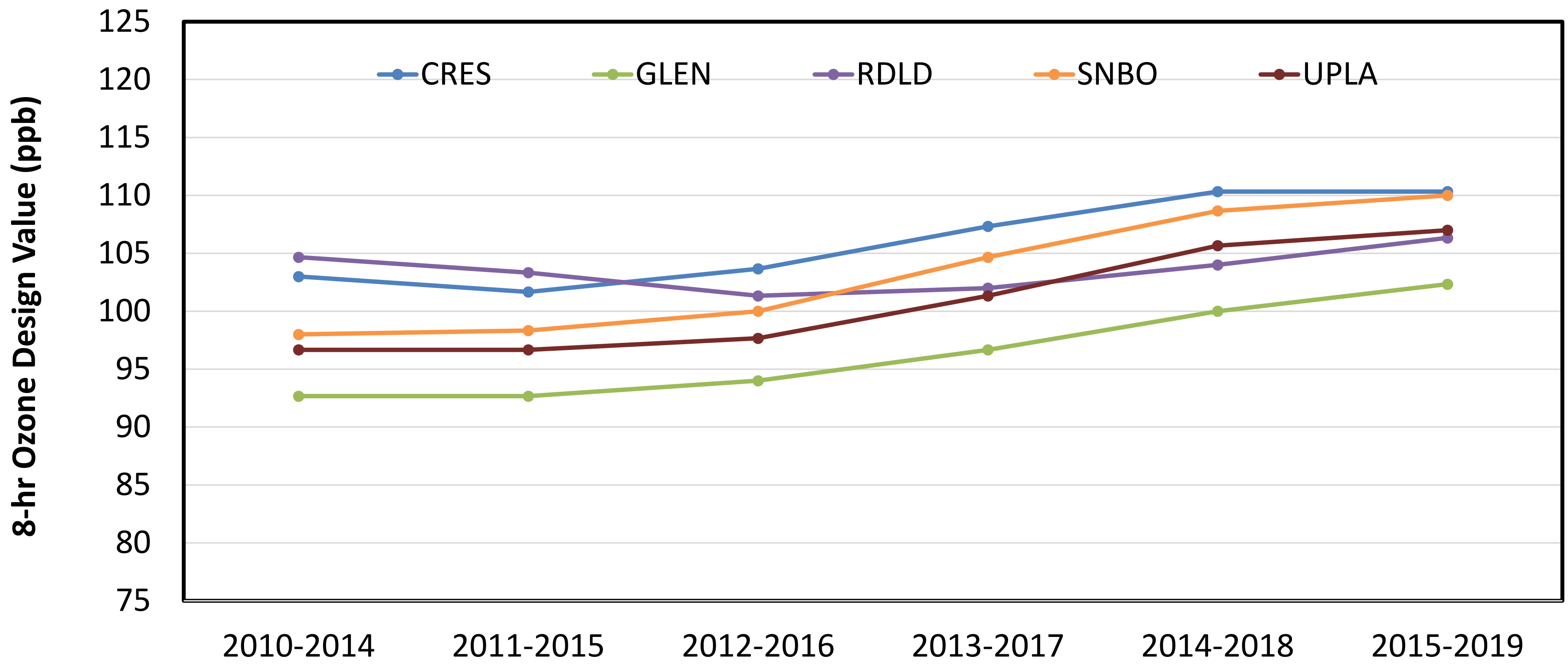
5-year weighted 8-hour Ozone – 2012 vs. 2018 Base Year



5-year weighted 8-hour Ozone DV



5-year weighted 8-hour Ozone Design Value Trends – SCAB



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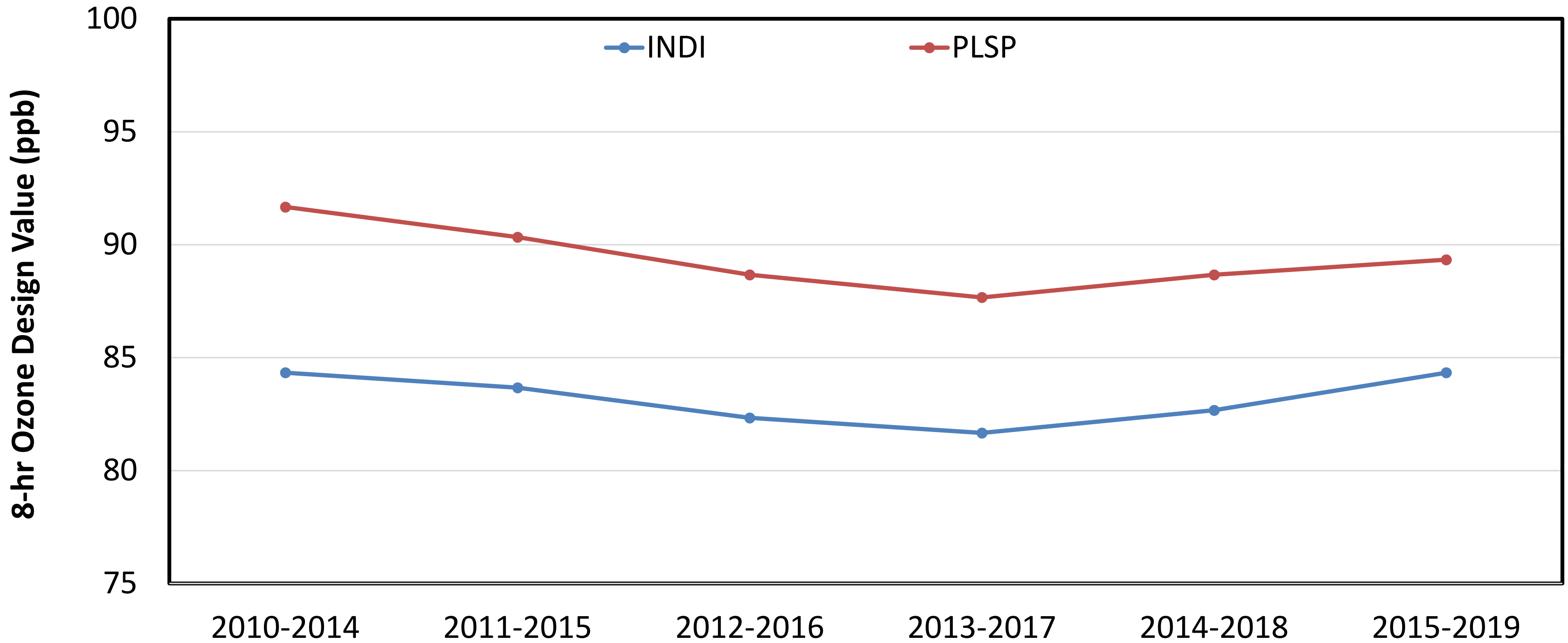
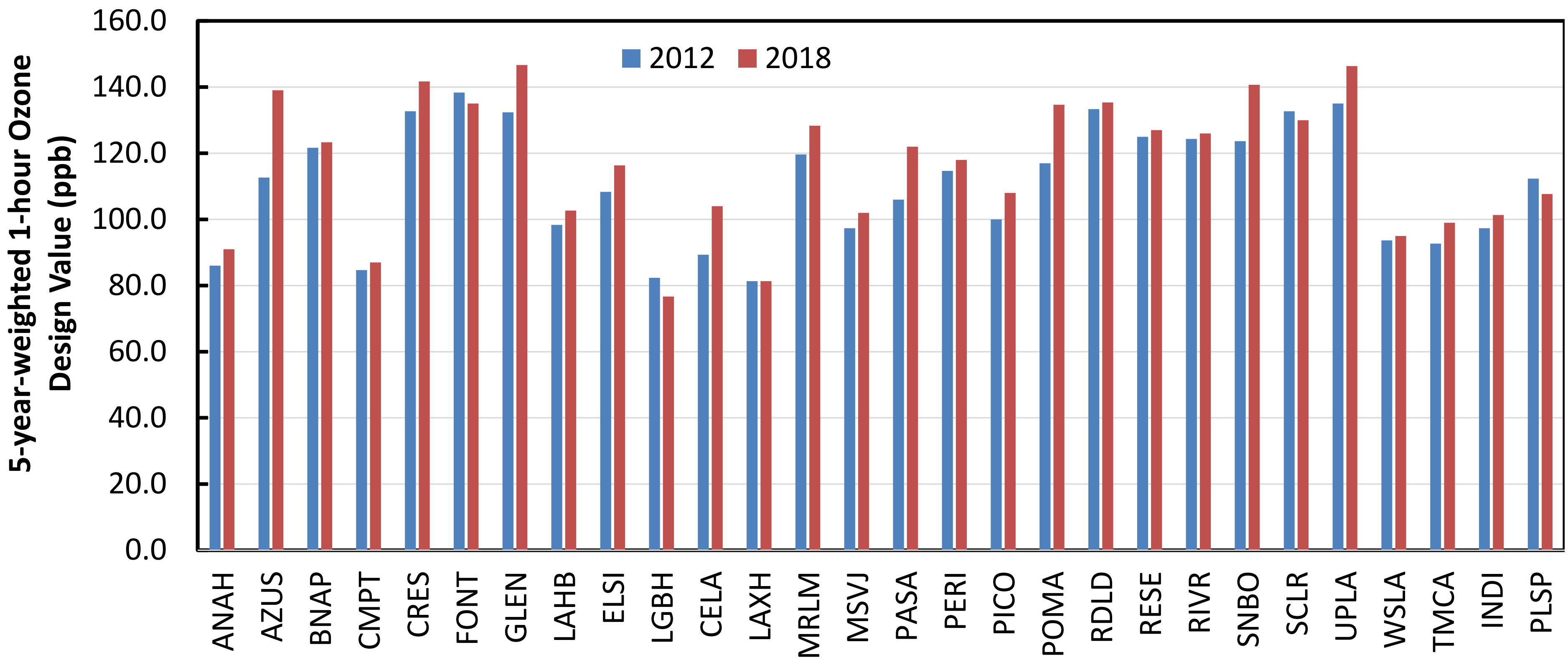
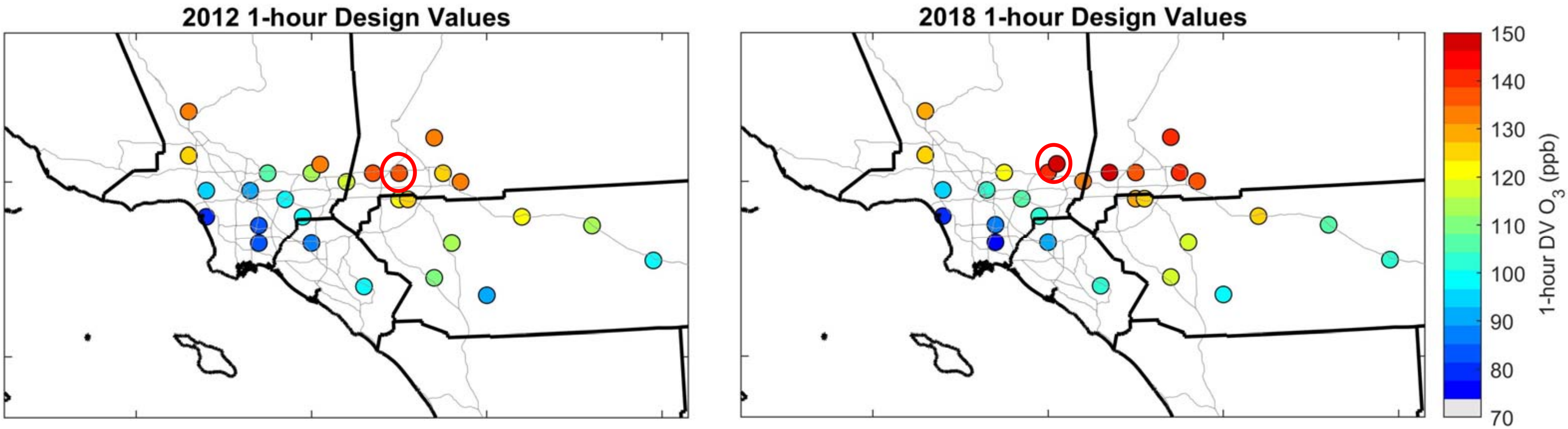
5-year weighted 8-hour Ozone Design Value Trends – CV



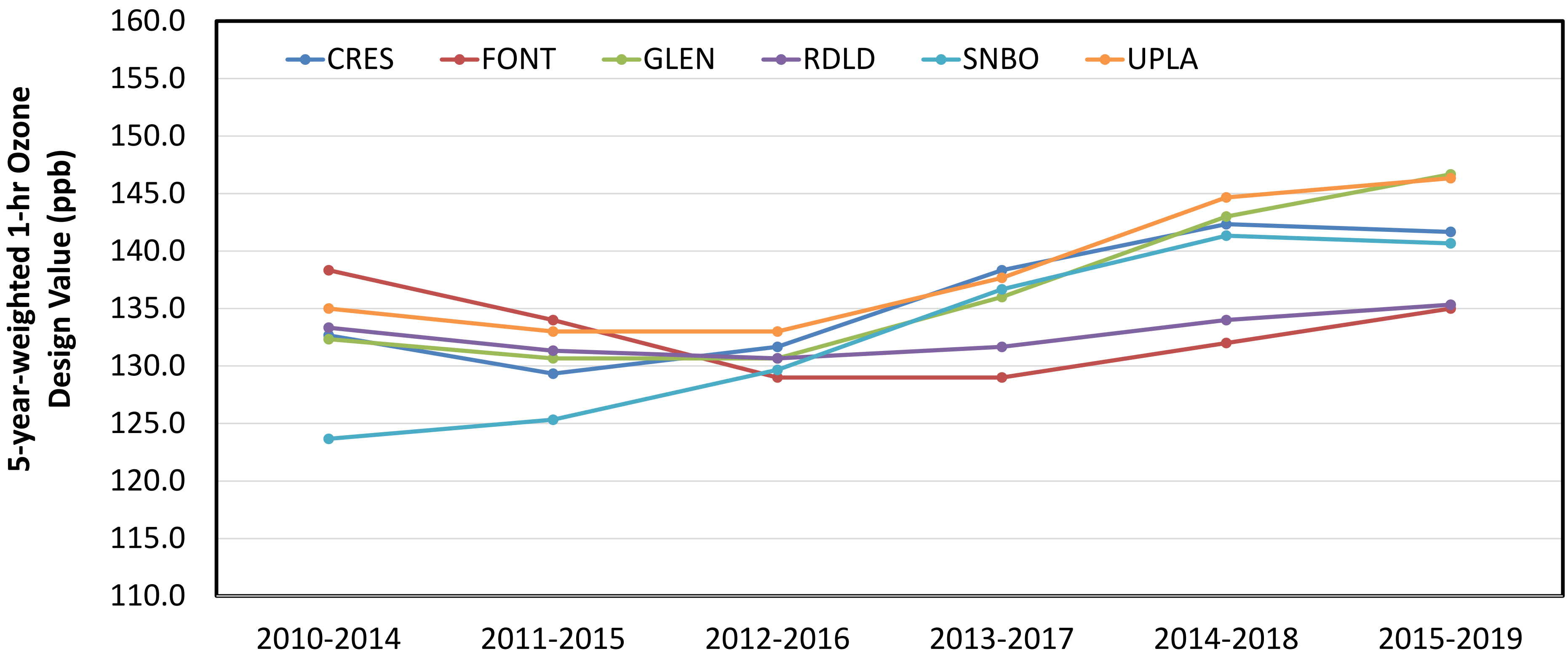
5-year weighted 1-hour Ozone : 2012 vs. 2018 Base Year



5-year weighted 1-hour Ozone DV



5-year weighted 1-hour Ozone Design Value Trends – SCAB



Summary

- 5-year weighted 8-hour ozone DV for 2022 AQMP is higher than the DV in 2016 AQMP by 5.6 ppb
- 1-hour ozone shows similar pattern as 8-hour ozone DV: 5-year weighted 1-hour ozone DV increased by 8.3 ppb
- The design site for 8-hour ozone has changed from Redlands to Crestline
- The location of the design site for 1-hour ozone has changed from Fontana to Glendora
- Coachella Valley 8-hour DV in 2022 AQMP is lower than in 2016 AQMP by 2.3 ppb

Item #3

Estimating Biogenic Emissions in the South Coast Air Basin

STMPR Advisory Group Meeting
January 27, 2021

Eric Praske, Ph.D.
Air Quality Specialist

South Coast Air Quality Management District

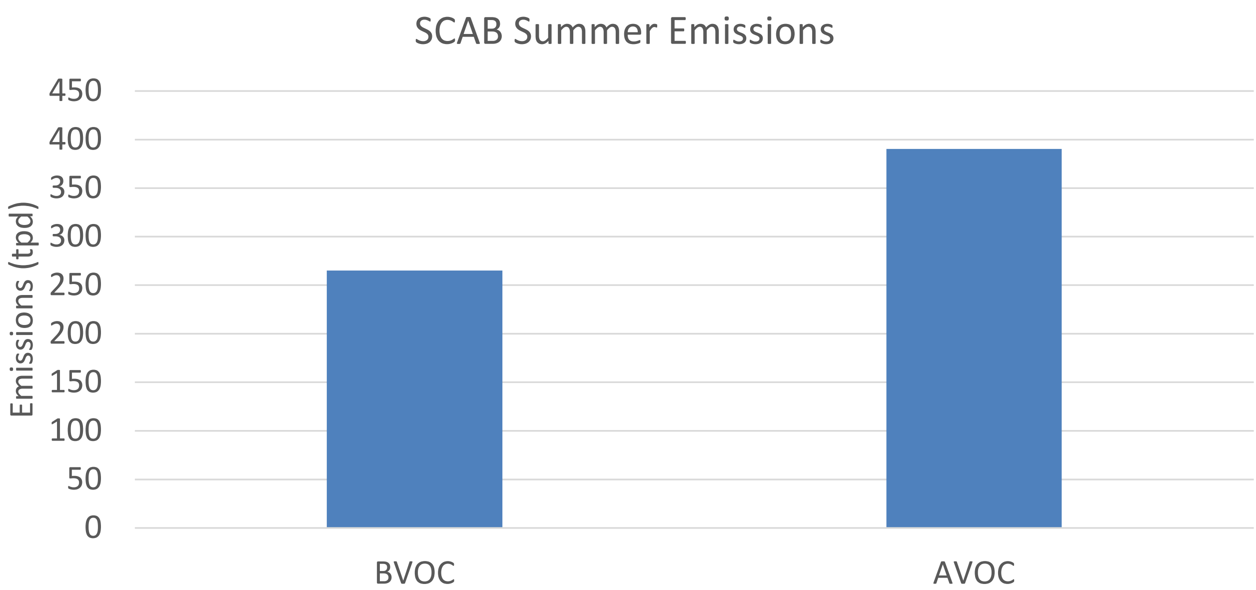
Background

- Model of Emissions of Gases and Aerosols from Nature (MEGAN)[1] was used to develop the biogenic inventory
- While MEGAN estimates emissions for > 30 SAPRC07 species, isoprene (ISOP) and terpenes (TERP) account for majority of VOC emissions

[1] Guenther et al., Geosci. Model Dev., 2012.

Biogenic vs. Anthropogenic Emissions

- 2018 Anthropogenic VOC (AVOC) vs. Biogenic VOC (BVOC)[1]



[1] BVOC emissions quantified using MEGAN3.1

Updating BVOC Emissions

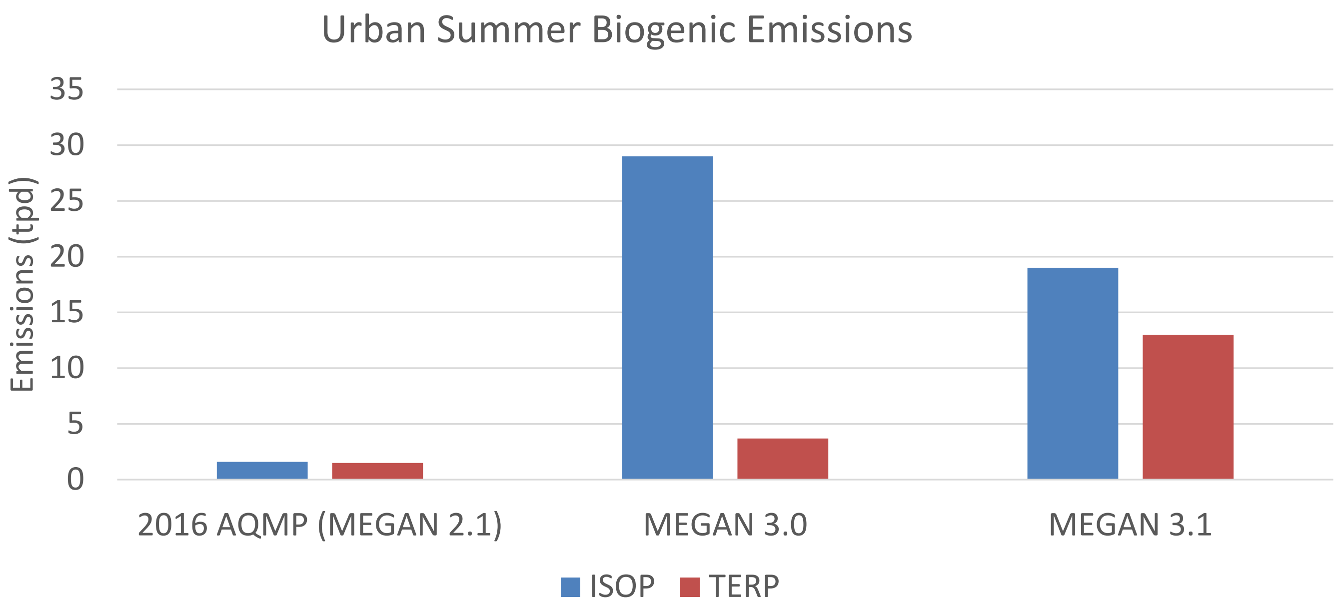
- Latest Available version of MEGAN
- Improving LAI using remote sensing products
- Improving Tree species and their Emission Factors

MEGAN Version Differences

- MEGAN2.1 was employed in the 2016 AQMP
- MEGAN3.0
  - Significant update which introduced leaf area and emission factors in urban areas
- MEGAN3.1
  - Berkeley Dalhousie Soil NO Processor
  - Updated emission factors

Biogenic Summer Emissions Comparison

- Biogenic emissions differ widely depending on model version



Improving LAI using Remote Sensing Products

- MEGAN 3.1 uses 2008 Leaf Area Index (LAI) for North America, with average values assigned for urban areas
  - Dataset based on MODIS retrieval algorithm v5 (1 km)
- **Objective**: Replace default LAI with latest available, high resolution satellite imagery targeting urban vegetation

MEGAN Emissions Calculation

- Additional inputs must be considered when updating LAIv
  - Landscape Weighted EF depends on growth forms
  - Growth forms (i.e., tree, shrub, crops, and herbs) must be scaled to maintain consistency with Green Vegetation Fraction (GVF)

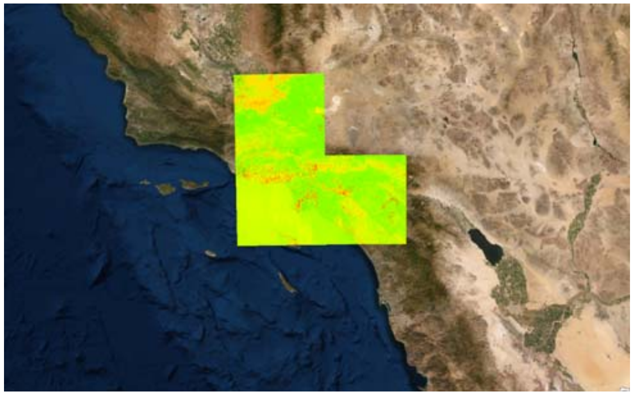
$$\text{Emission} = \text{Emission Activity} \times \boxed{\text{Landscape Weighted EF}} \times \boxed{\text{LAIv}}$$

GVF LAI

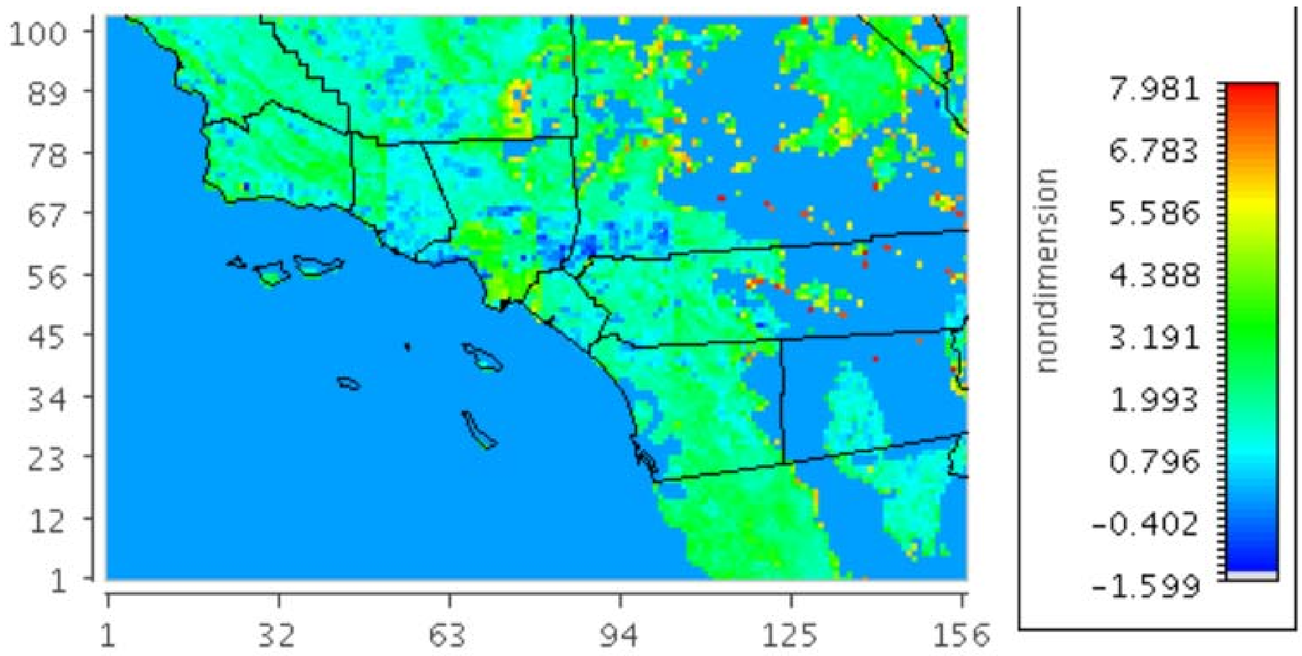
$$\text{LAIv} = \frac{\text{LAI}}{\text{GVF}}$$

Remote Sensing Products

- LAI
  - Sentinel (10 m) – purchased product
    - Significant SCAB coverage, but little beyond
  - MODIS (1 km) retrieval algorithm v6
    - Does not include urban areas
- GVF
  - NOAA VIIRS (1 km)
    - USGS MGVF used in MEGAN was discontinued in 2012



June LAIv Comparison {Updated} – {Base}



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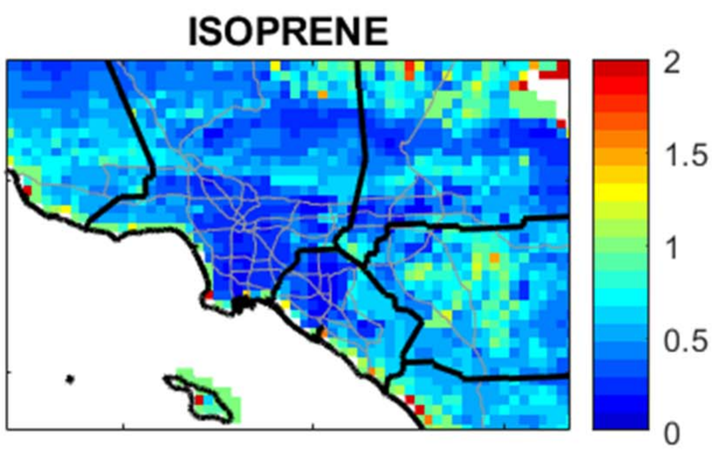
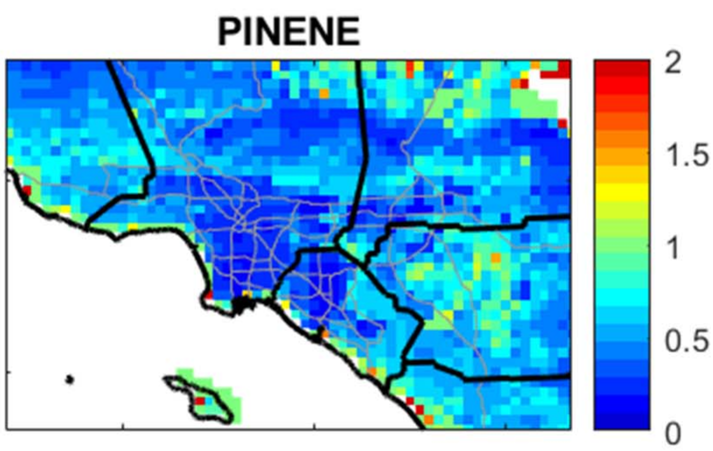
Landscape Weighted EF Ratio

- Emission factor ratios expressed as: $\frac{\text{Updated}}{\text{Base}}$





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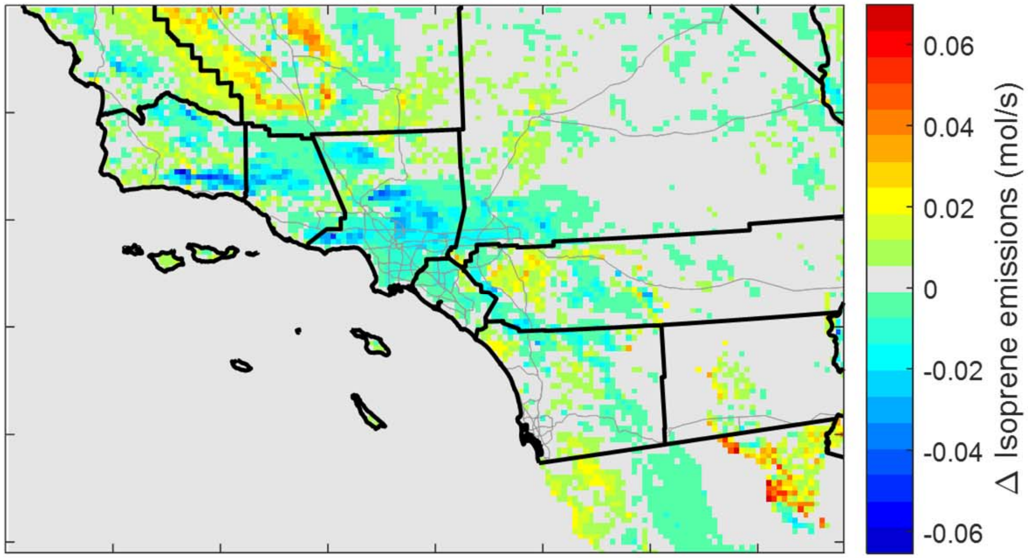
Isoprene Emissions Difference {Updated} – {Base}

- Annual average isoprene emission difference at 2200 UTC



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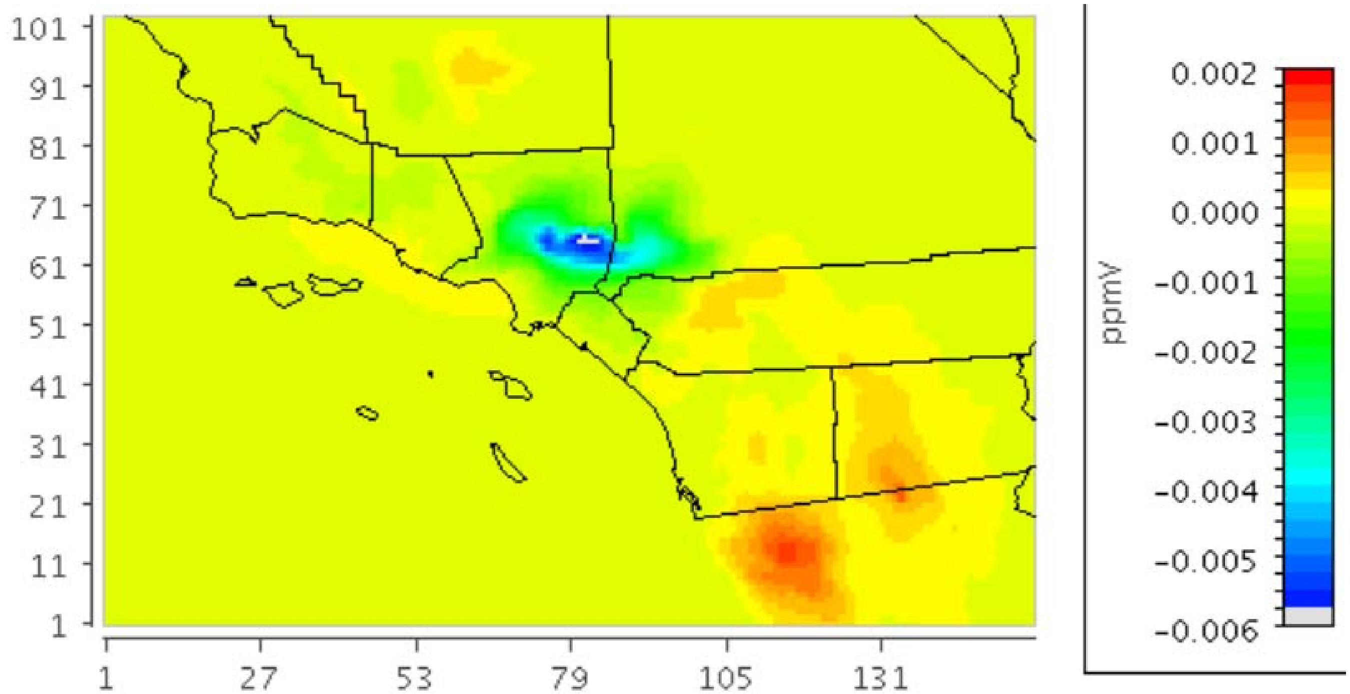
Emissions Summary

- While domain-wide BVOC emissions increase, significant decreases observed in SCAB and urban areas

Summer Average Emission Rates				
	Base		Updated	
	ISOP (tpd)	TERP (tpd)	ISOP (tpd)	TERP (tpd)
Urban	19	13	7.9	9.0
SCAB	110	53	84	50
Domain	500	250	530	370

Preliminary Summer Average Ozone Difference at 2200 UTC {Updated} – {Base}



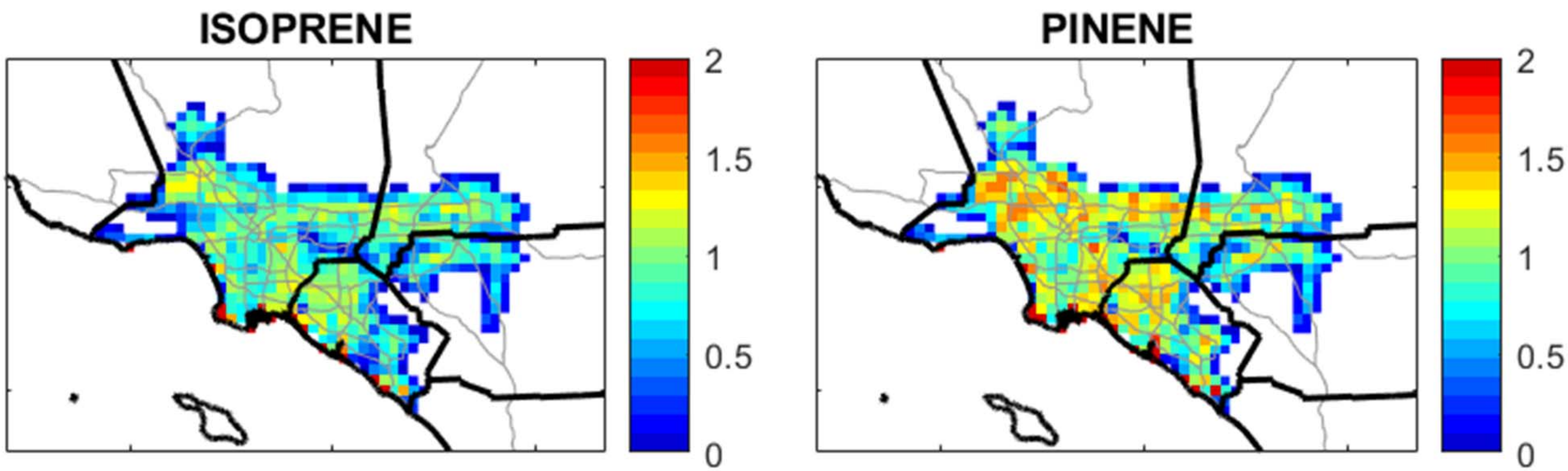
Improving Tree species and their Emission Factors

- Collaboration with UC Irvine utilizing urban tree inventory
- Tree species composition was estimated for 140 cities within Basin
- 45 tree species account for 80% of all trees
- Compared to 1982 inventory,[1] substantial decrease in native species (e.g. oaks, pines, elm)
- About half of tree species do not emit isoprene
- > 50% of tree species lack reliable BVOC measurements

[1] Miller, P. R., and Winer, A. M. Composition and dominance in Los Angeles Basin urban vegetation, Urban Ecology, 1984.

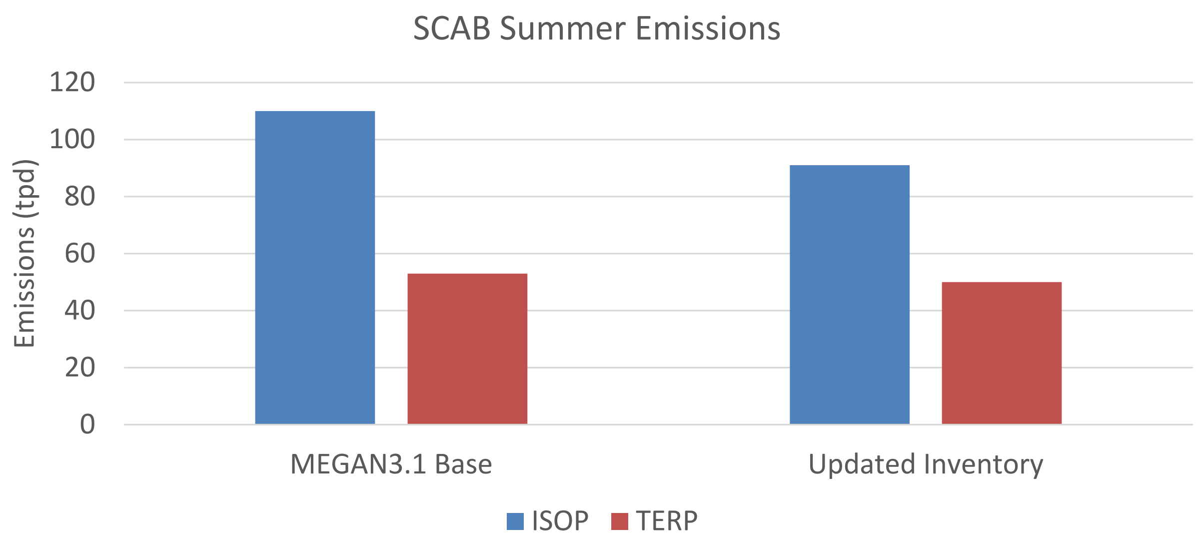
Emission Factor Ratio

- Emission factor ratios expressed as: $\frac{\text{Updated}}{\text{Base}}$

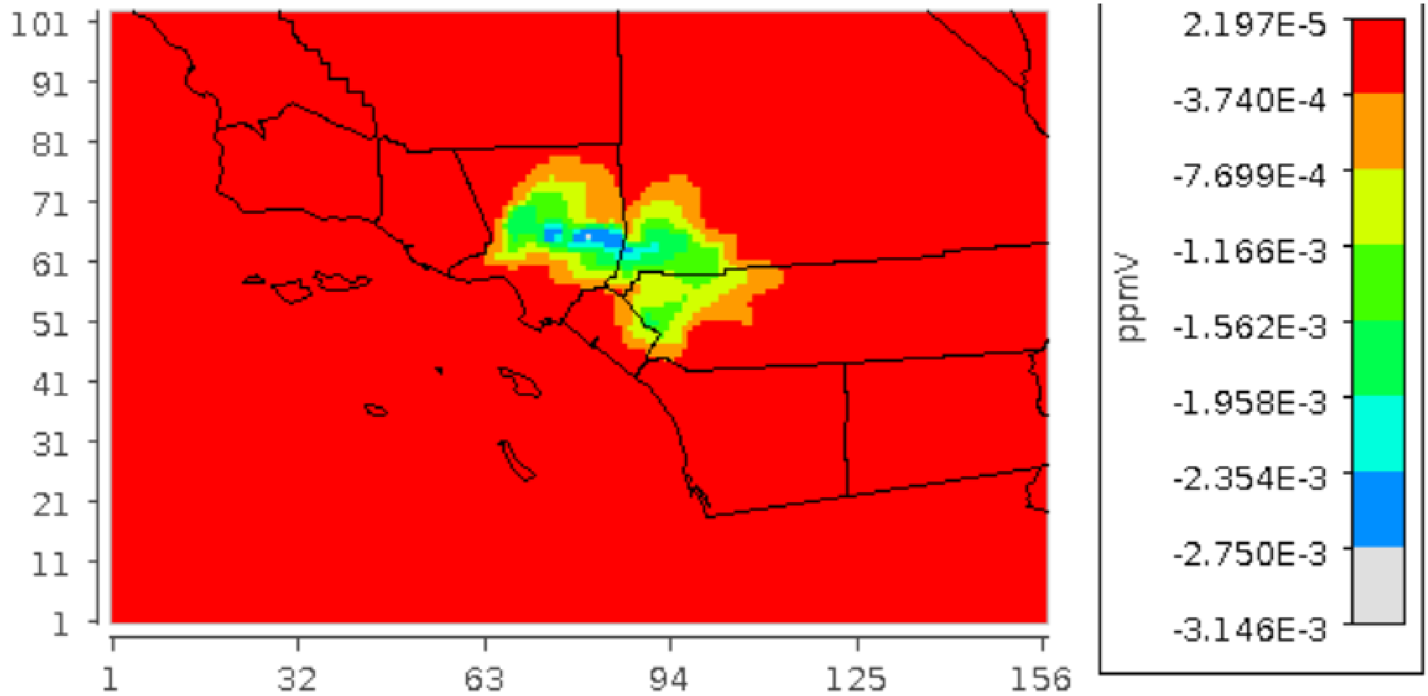


Emissions Comparison

- Isoprene emissions decrease, while terpenes are similar



Preliminary Summer Average Ozone Difference at 2200 UTC {Updated} – {Base}



Areas of Further Improvement

- Growth forms
  - Default distribution poorly characterizes urban areas
  - Few trees in SCAB, mostly bare soil or grass
  - High resolution imagery can be used to quantify individual trees
- Emission factors
  - Majority of tree species have poorly constrained emission factors
  - Enclosure experiments would benefit to validate and improve EFs

Summary and Conclusions

- MEGAN3.1 LAIv and growth form inputs were updated using the latest available, high resolution satellite products
  - Preliminary CMAQ results show high sensitivity to BVOCs. Further evaluation is on-going
- MEGAN3.1 ecotypes were updated using municipal tree inventories
  - Majority of tree species do not emit isoprene or have poorly constrained emission factors
- SCAB BVOC emissions likely artificially low following updates
  - Improvements to the growth forms and quantification of emissions factors would likely yield more accurate estimates

Item #4

Ozone Sensitivity to Meteorological Factors and Emission Changes – a case study with the COVID-19 Shelter-in-Place period

STMPR meeting on Jan 27, 2021

Sang-Mi Lee, Ph.D.
Program Supervisor

South Coast Air Quality Management District

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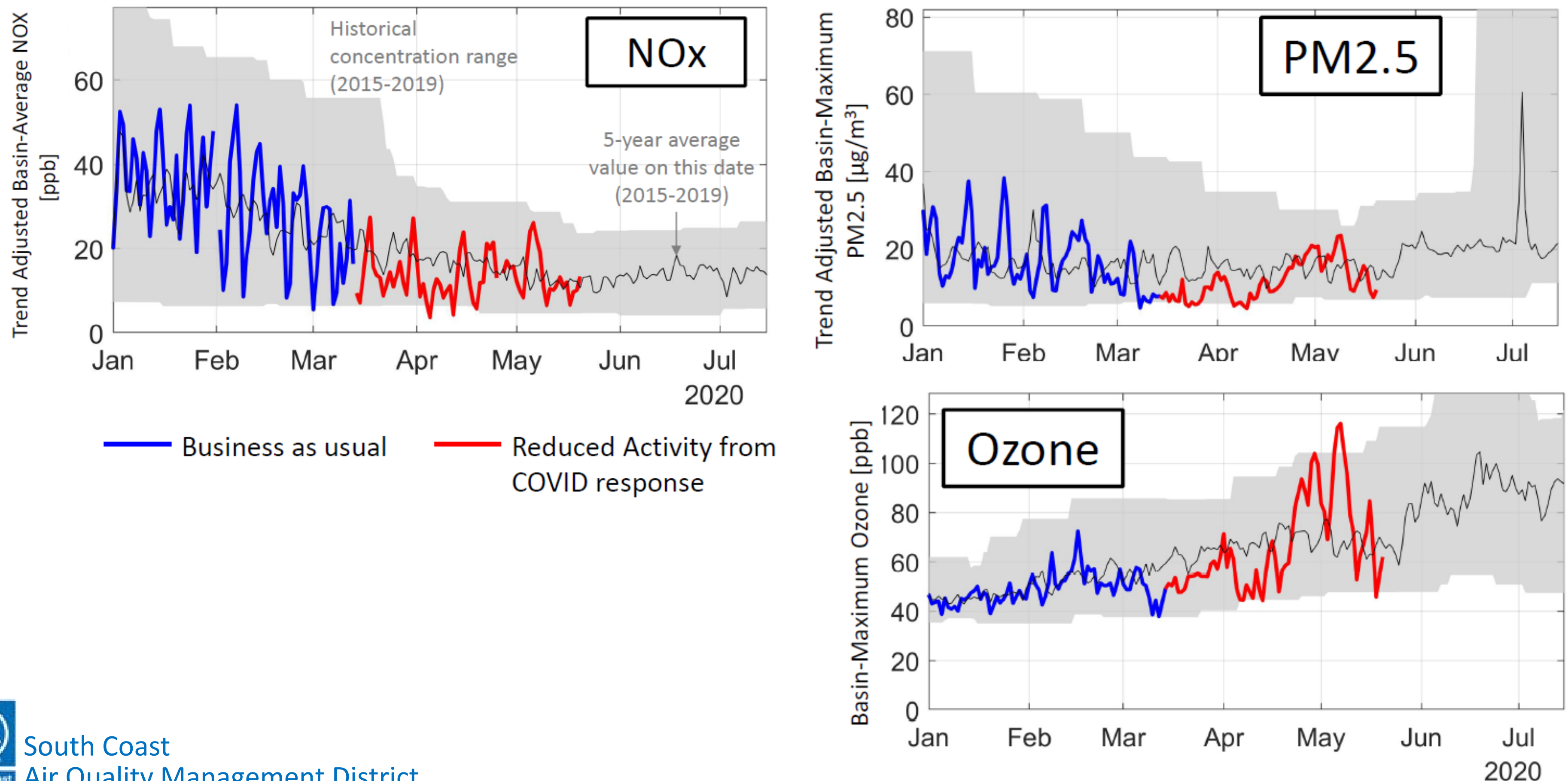
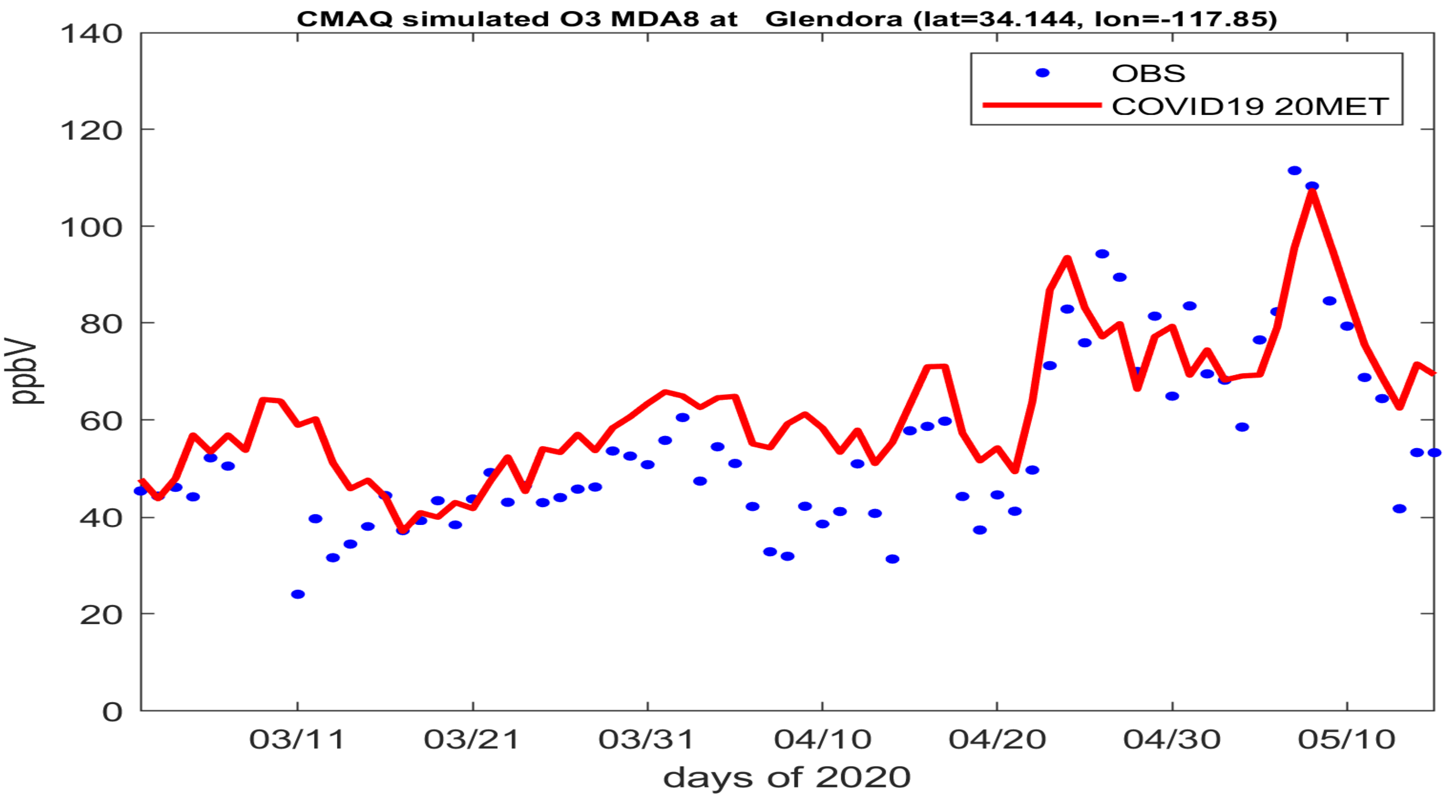
Air Quality During COVID-19 Study Period



Experiment Design

- Study Period: Mar 15 – May 15, 2020
- CMAQ-WRF-SMOKE-MEGAN platform
- Anthropogenic Emissions:
  – Point, area and Off-Road mobile sources: projection from the 2016 AQMP
  – On-Road mobiles – 2016 AQMP activity data with EMFAC2017

Predicted vs Observed 8-hour Ozone in 2020



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Sensitivity Experiments

Meteorological Impact

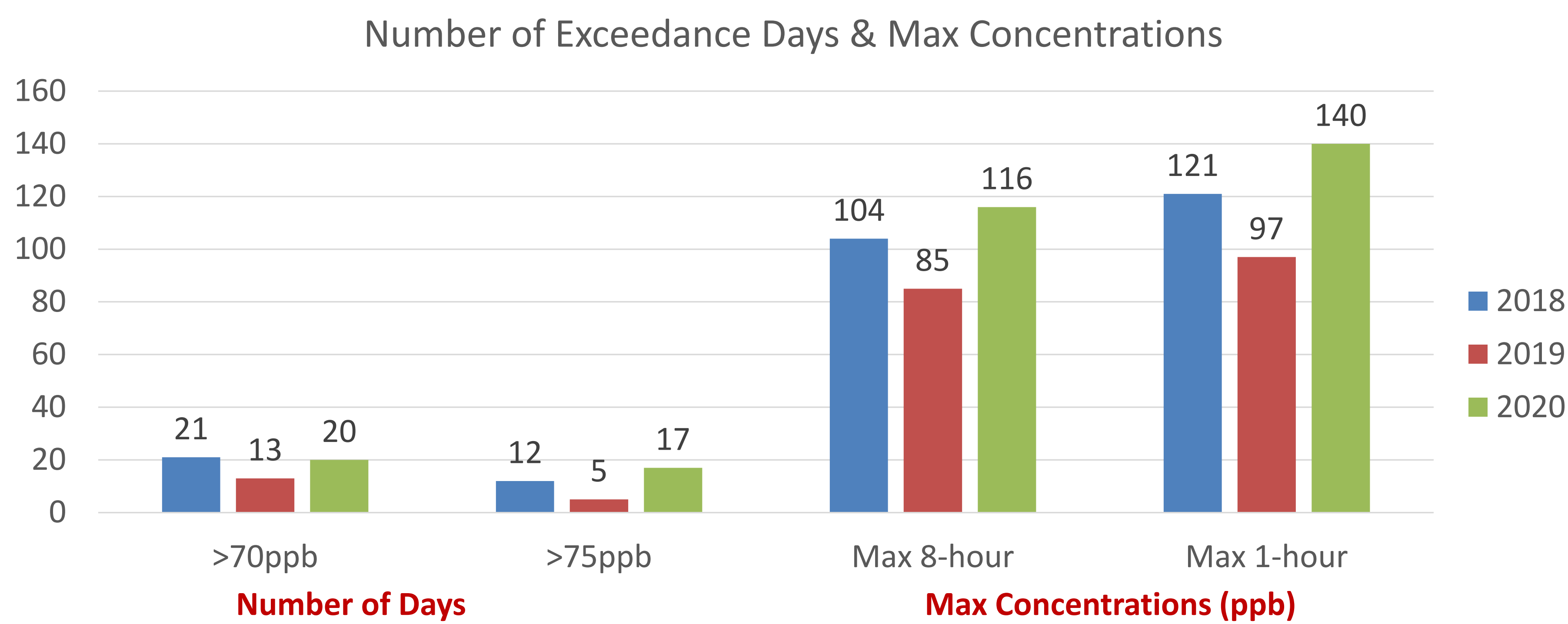
- 2018, 2019 and 2020

Biogenic Emissions

Changes in Anthropogenic Emissions

Meteorological Impact

Ozone Measurements in 2018 - 2020



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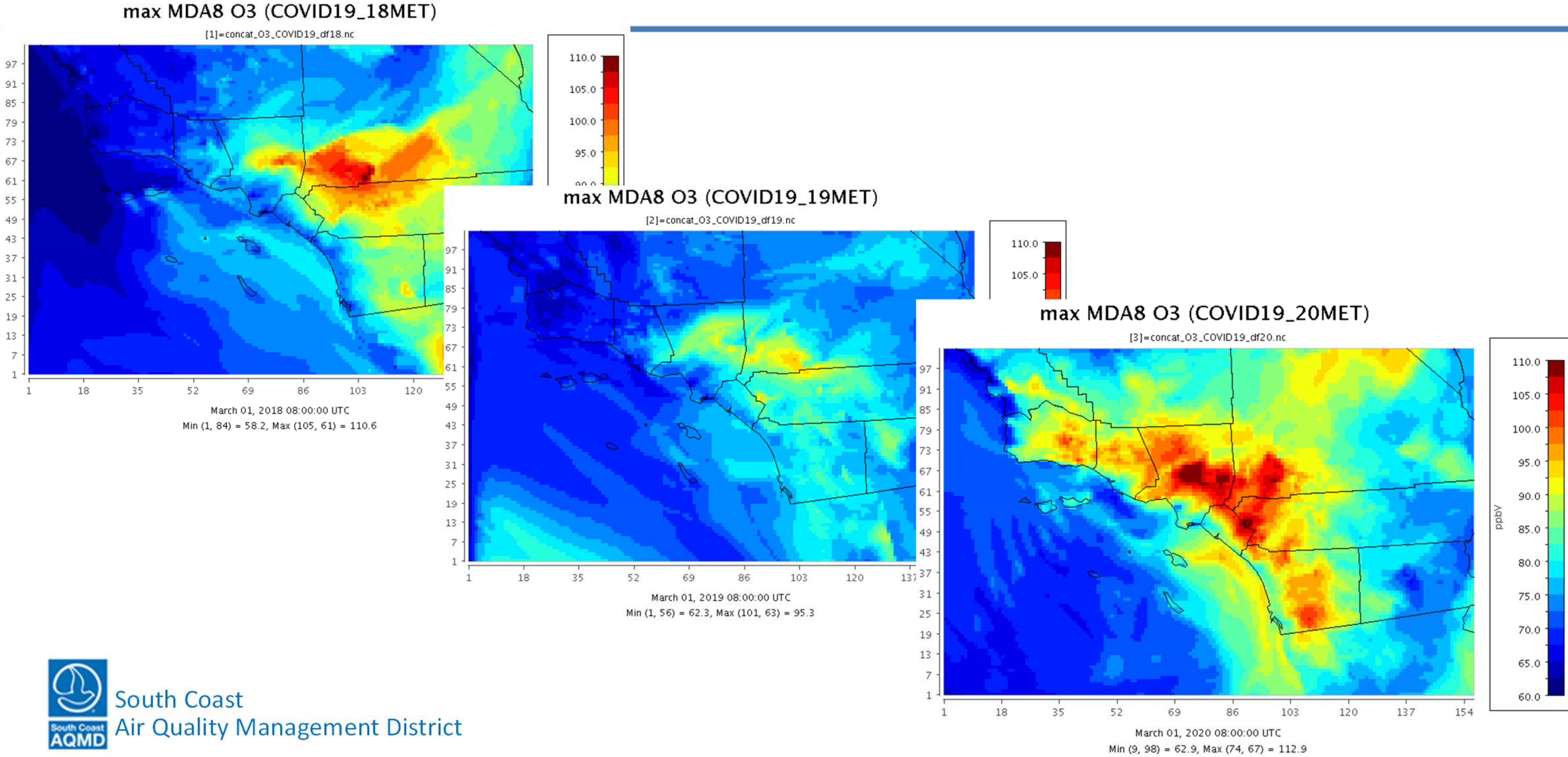
MDA8 averaged over the simulation period



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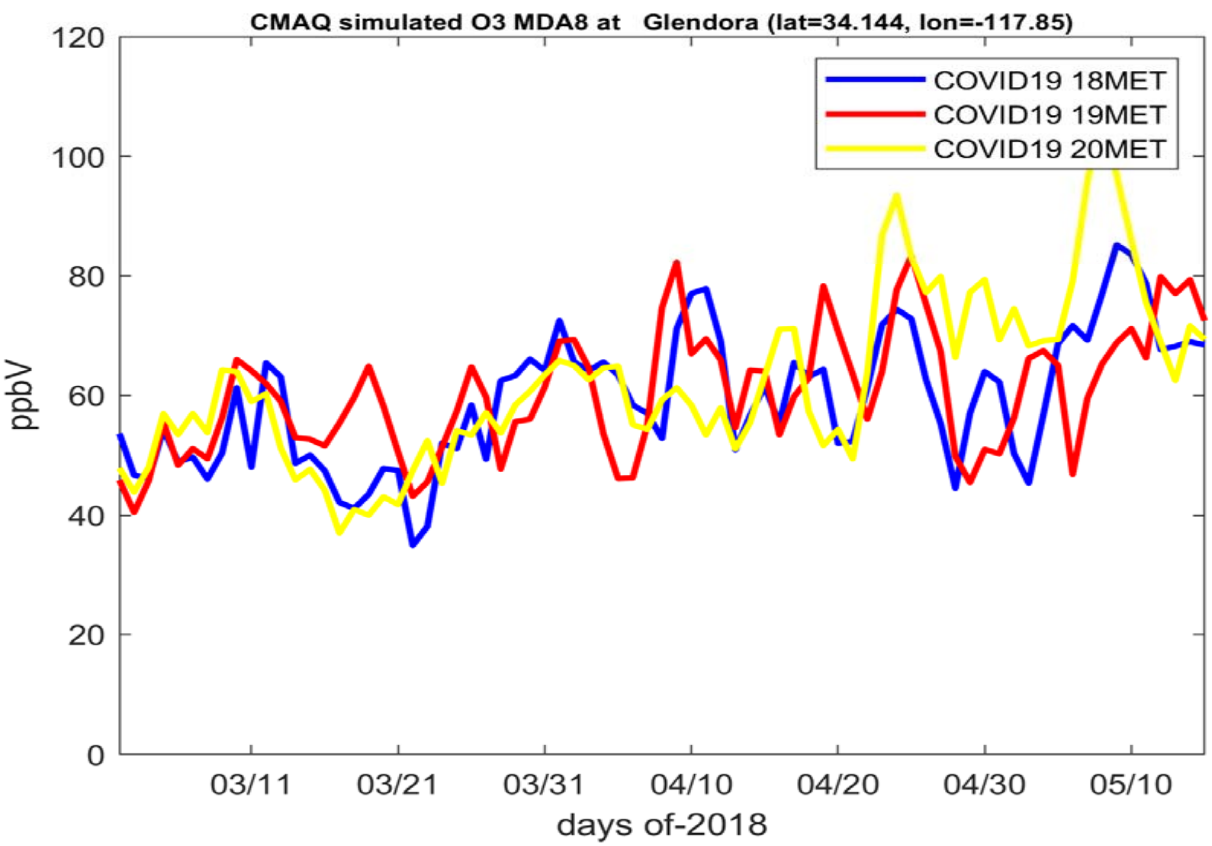
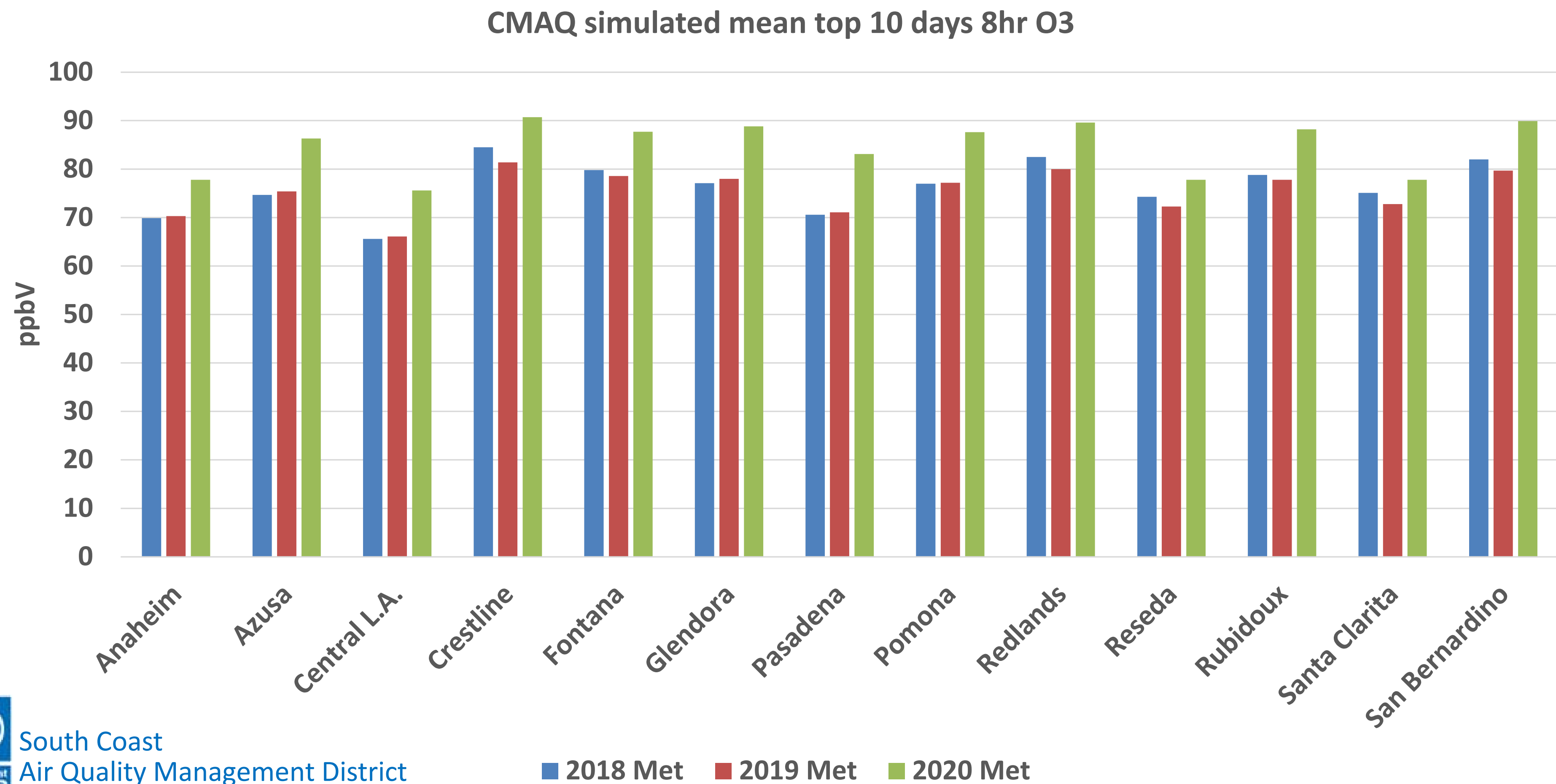
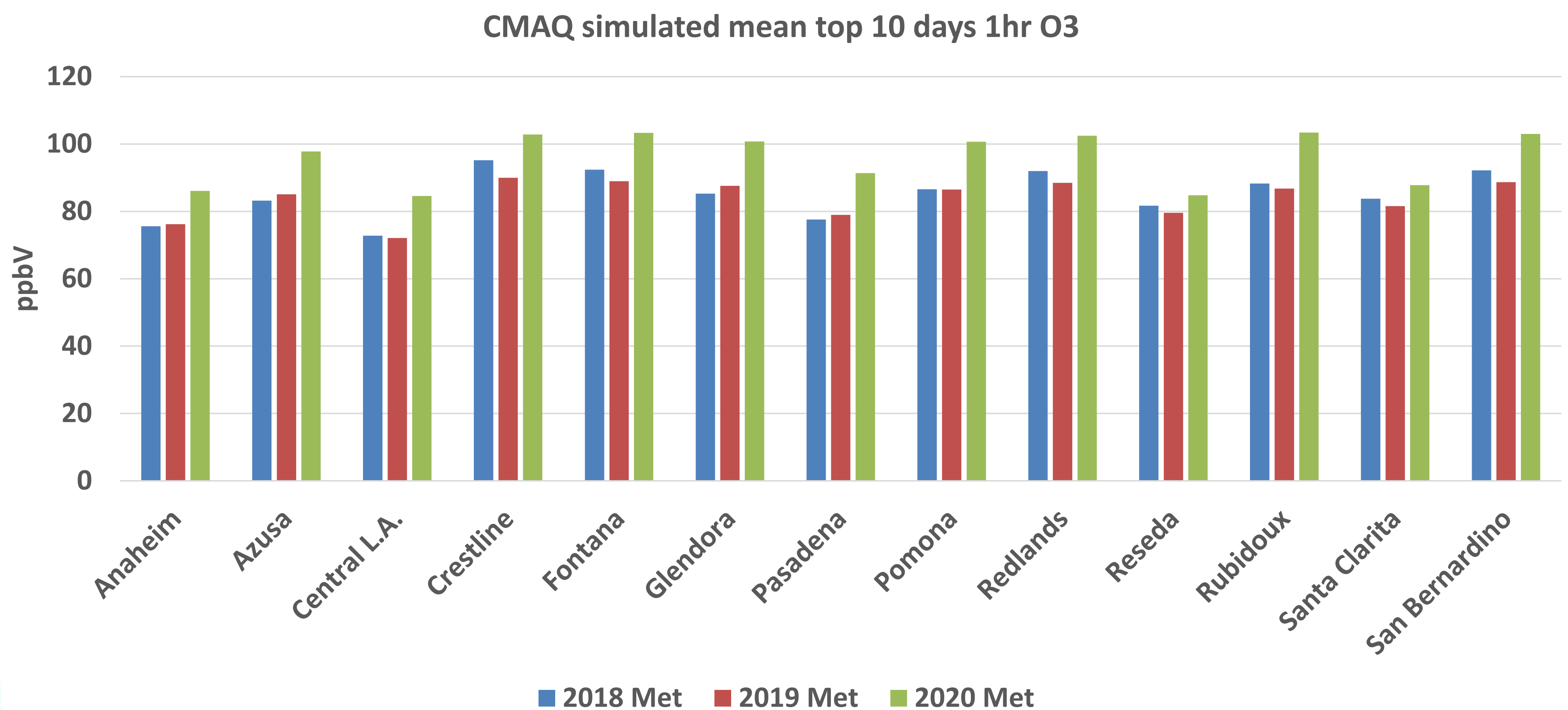
CMAQ Simulations – MDA8



CMAQ Simulations – Top 10 days MDA8



CMAQ Simulations – Top 10 days MD1



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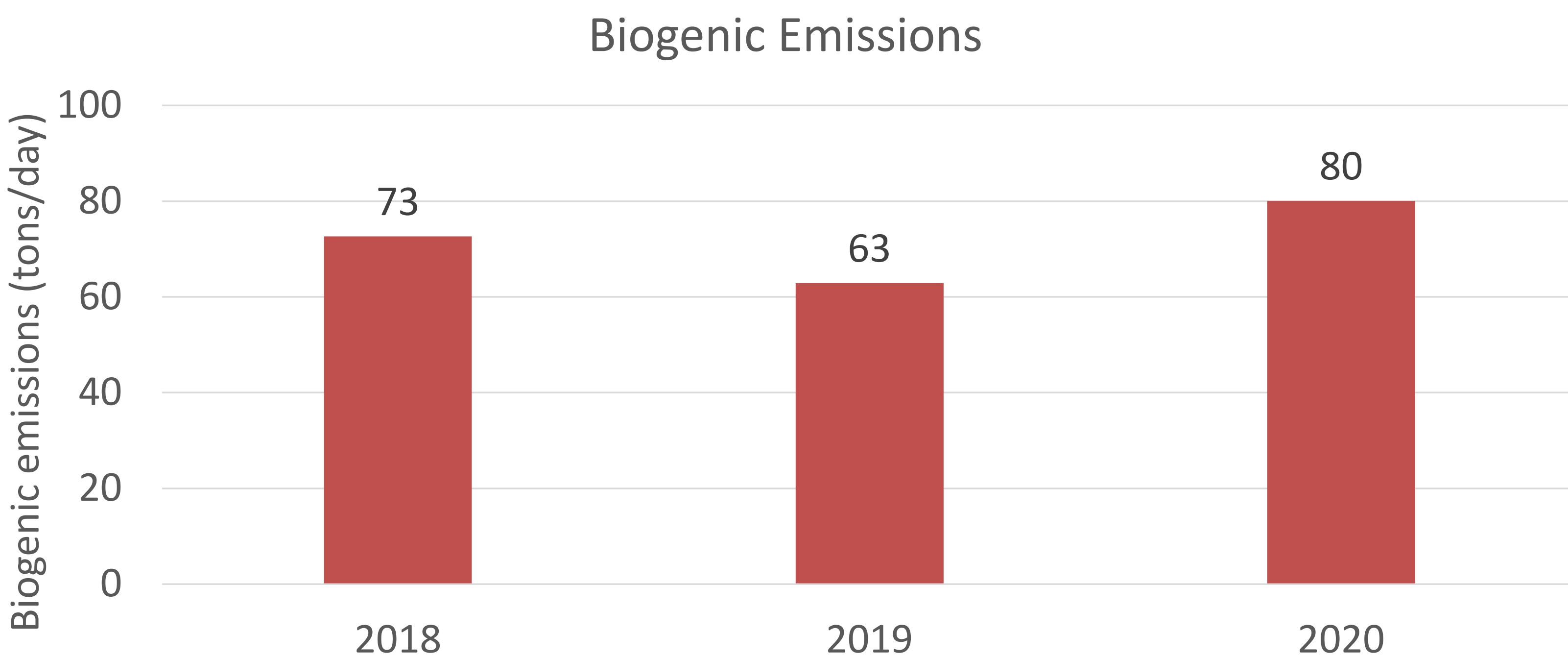
Biogenic Emissions

Biogenic emissions



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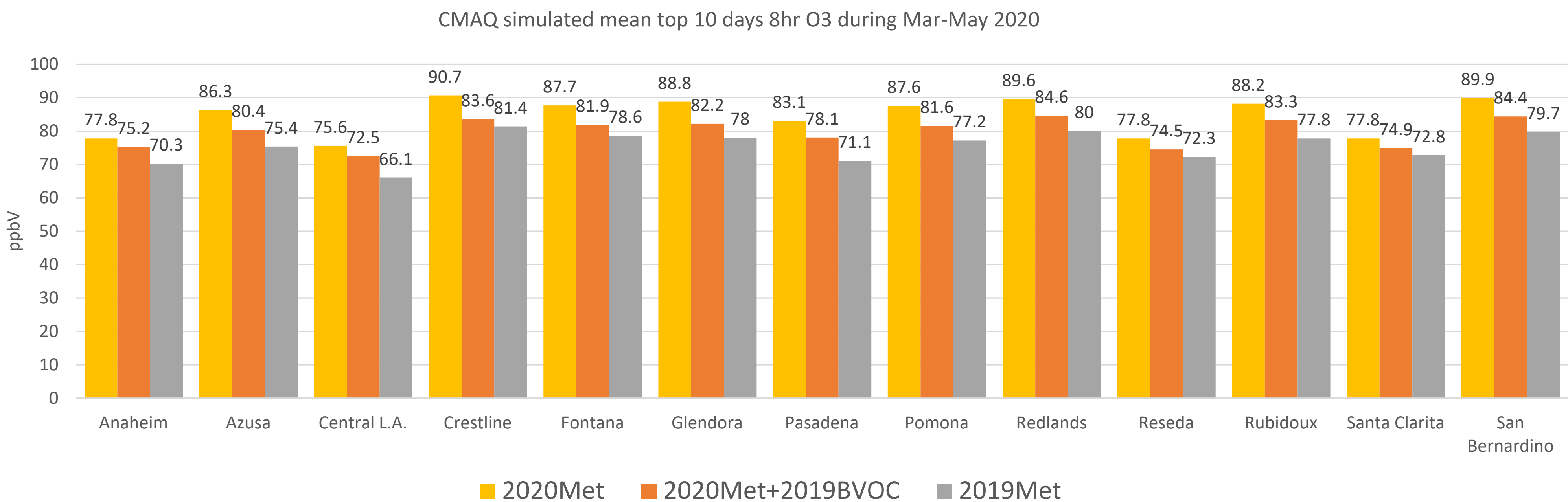
Impact of Biogenic Emissions



Changes in Anthropogenic Emissions

Data to Estimate Emission Changes

On-Road mobile

- CalTrans Performance Measurement System(PeMS), which includes traffic detectors, weigh-in-motion stations and other incident reports on freeways
- Other sources such as streetlight and Geotab considered

Off-Road mobile

- Aircraft: FAA Operations Network (OPSNET) data
- Ocean Going Vessels: in-house analysis based on IHS-seaweb data

RECLAIM facilities

- Based on Continuous Emissions Monitoring System (CEMS)

Changes in Economic Activities during the initial COVID-19 shelter-in-pace period

Cargo at Ports of LA & Long Beach[1]

↓~11%

Flights at Major Airports in Jurisdiction[2]

↓~61%

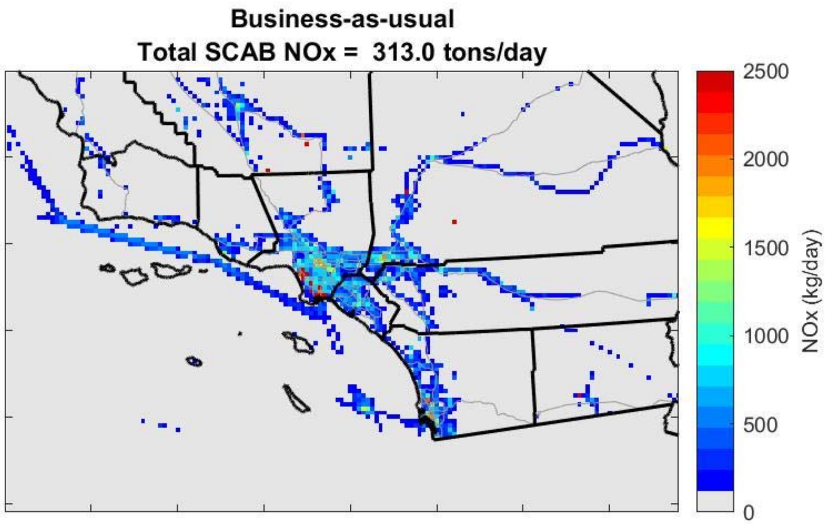
Vehicle Activity on Freeways in Jurisdiction

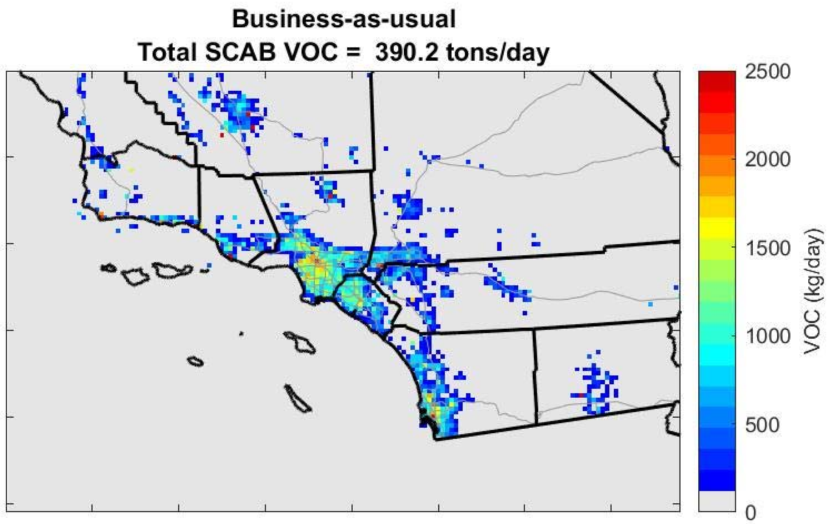
↓~25-43% Cars

↓~12-26% Trucks

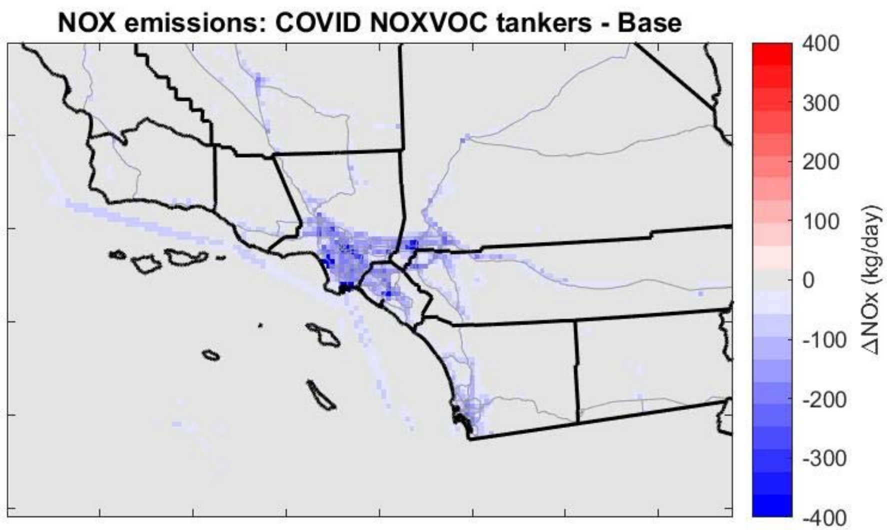
1) Approximate change in TEUs (Twenty foot equivalent units) comparing April 2020 to April 2019
2) Approximate change in aircraft operations at LAX, LGB, SNA, BUR, PSP, ONT from April 2020 to April 2019 from FAA Operations Network (OPSNET)
3) Approximate change in car and truck flow from pre-COVID orders (Feb 1 – Mar 7) to post-COVID orders (Apr 9 to May 7) calculated from CalTrans PeMS data.

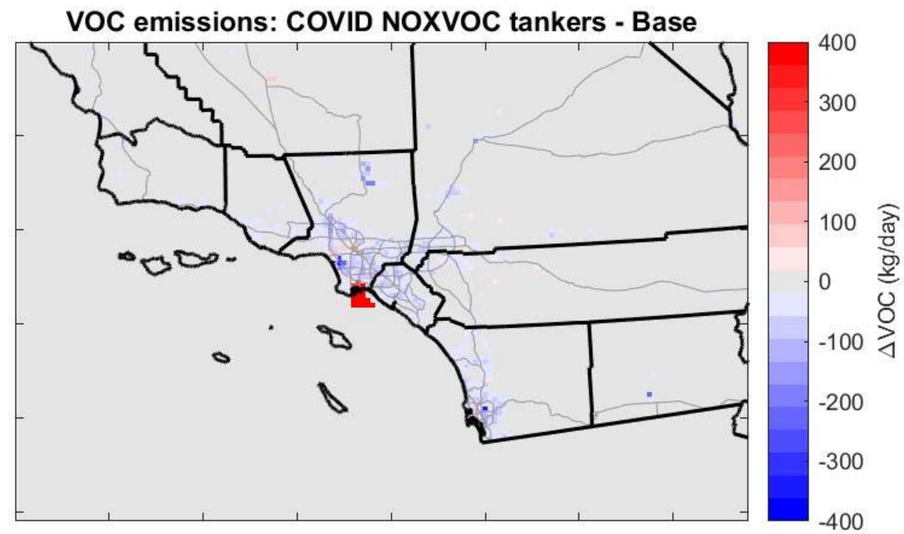
NOx and VOC emissions of Business-As-Usual Scenario





Emission Changes due to COVID-19





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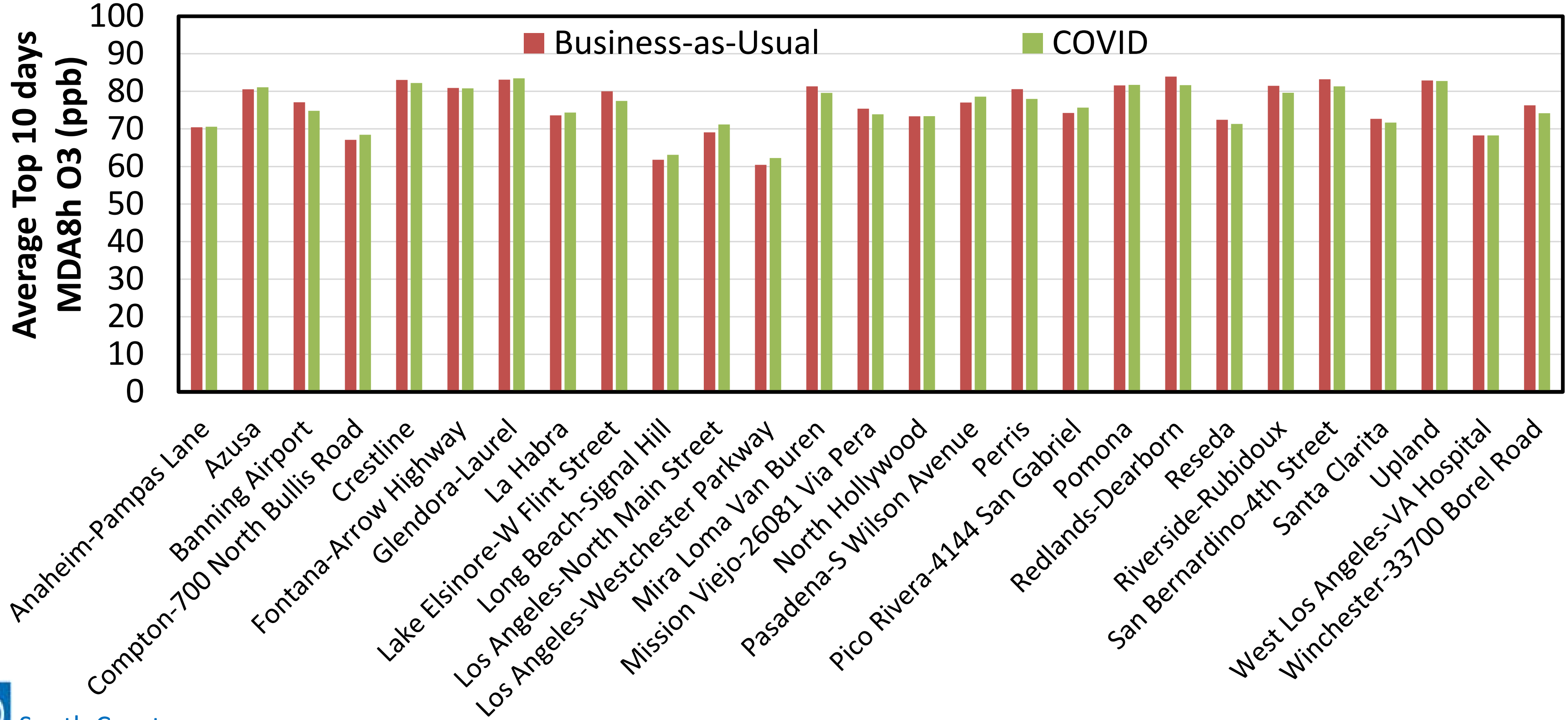
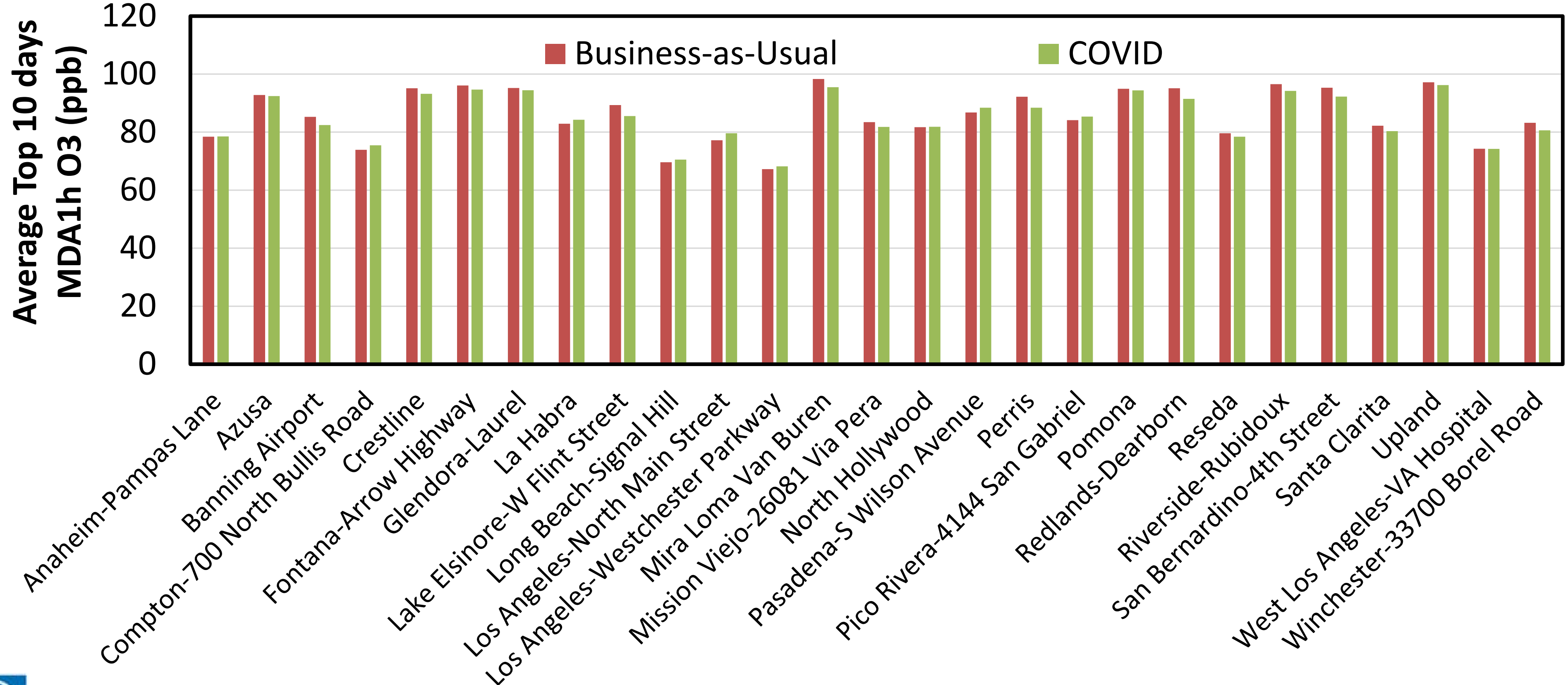
Emission Changes

	Emissions in Modeling Domain (tons/day)		Emissions in SCAB (tons/day)	
	NOX	**VOC**	**NOX**	**VOC**
Business As Usual	723.2	798.3	313.0	390.2
COVID	599.0	768.4	240.0	372.8

Top 10 days – MDA8



Top 10 Days – MD 1h



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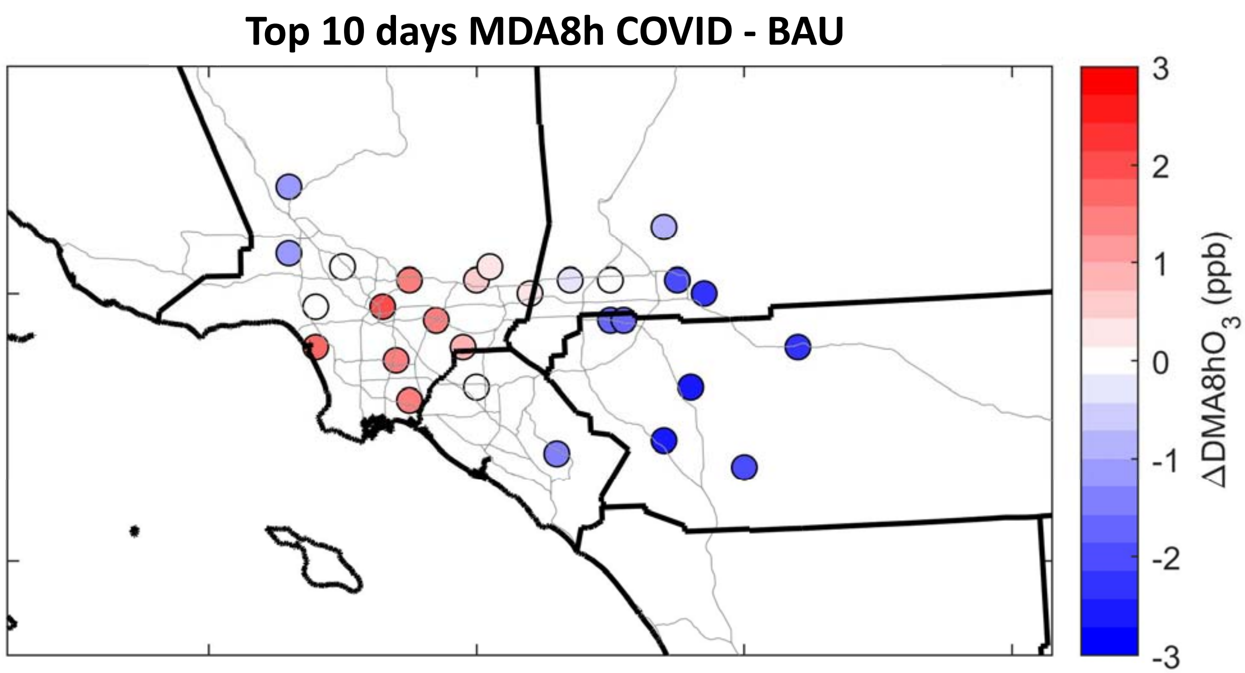
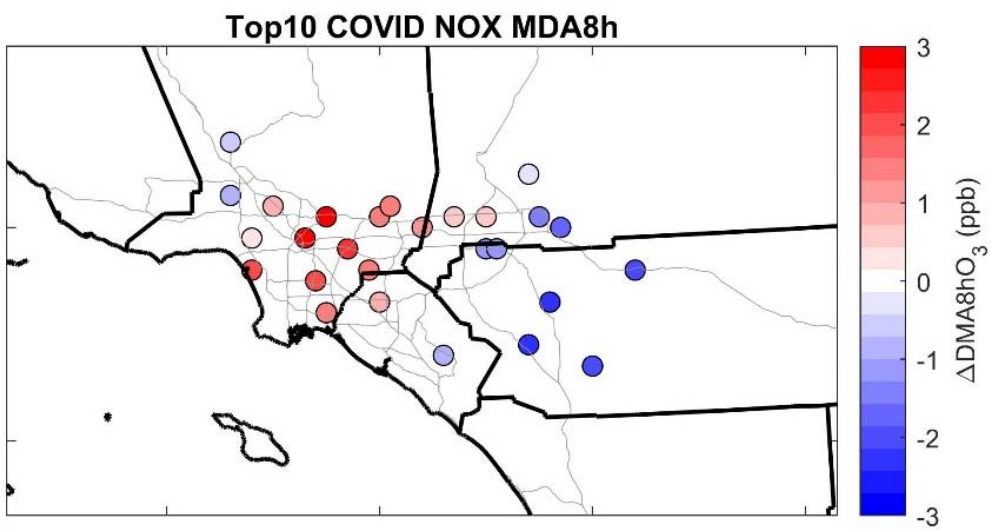
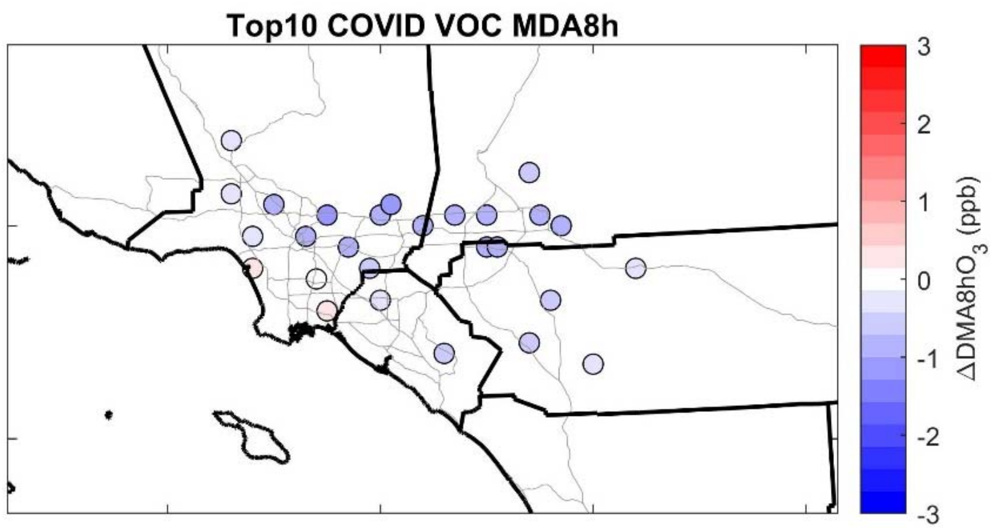
Spatial Variability of MDA8 Responses



Responses to NOx and VOC reductions

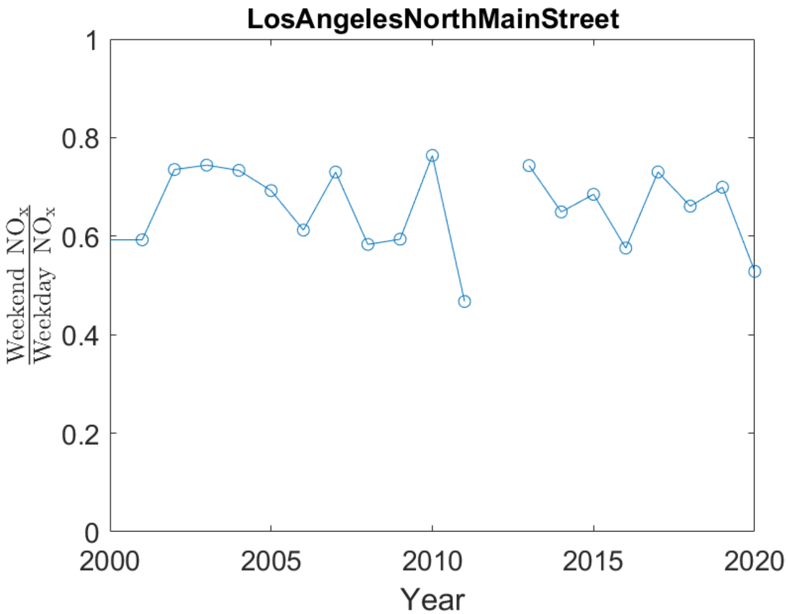


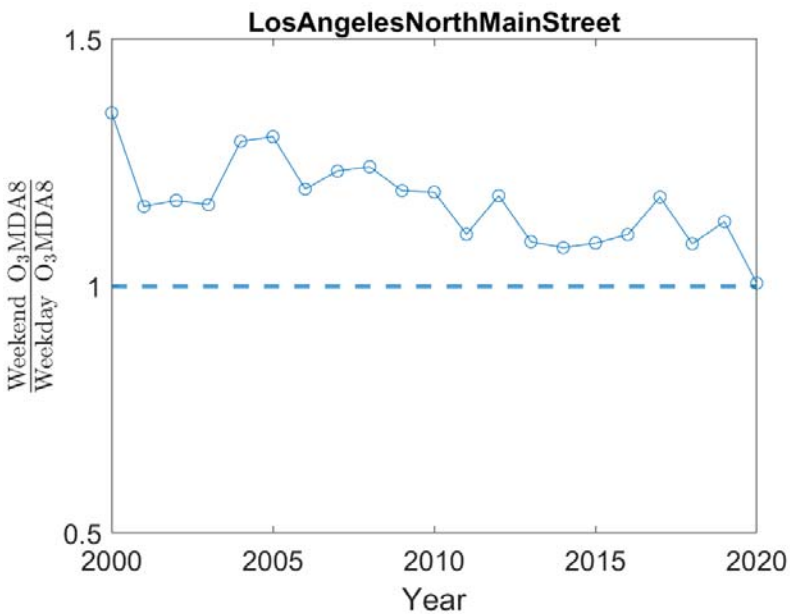


Ozone Chemistry
(Isopleths & Weekend effect)

Weekend Effect – Central Los Angeles

- NOx decrease during weekend causes higher ozone (NOx disbenefit)





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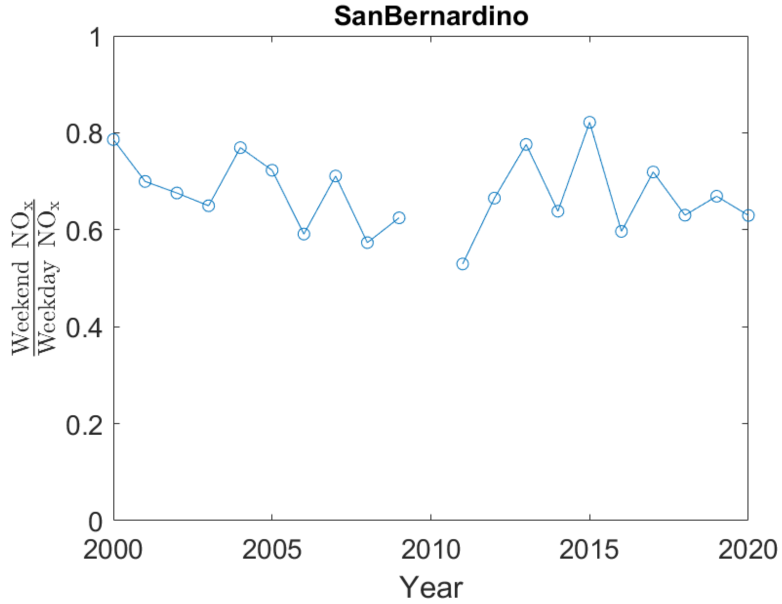
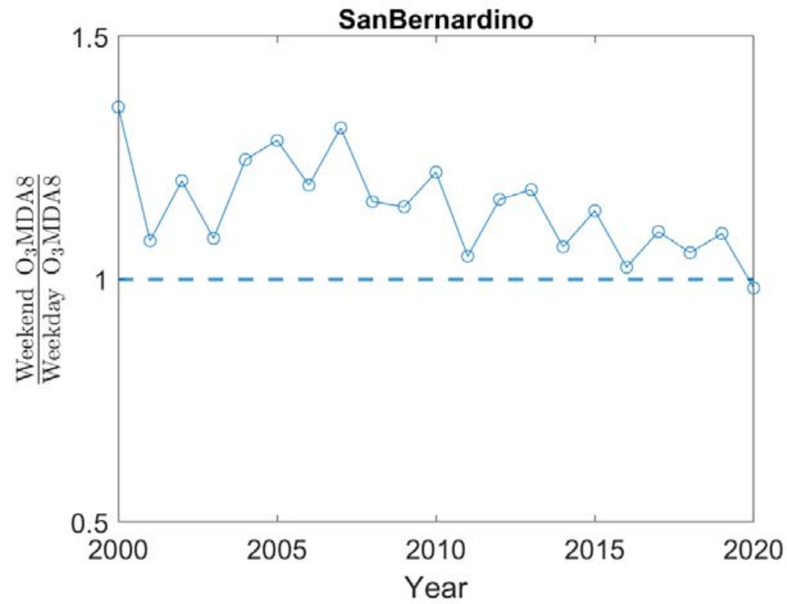
Weekend Effect – Inland Receptors

- NOx disbenefit diminishes with time

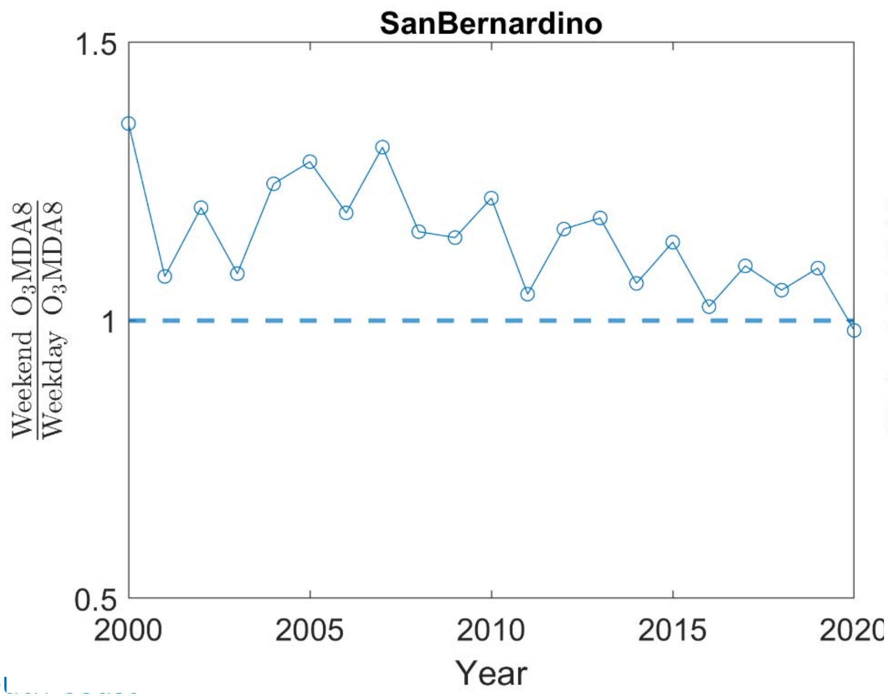




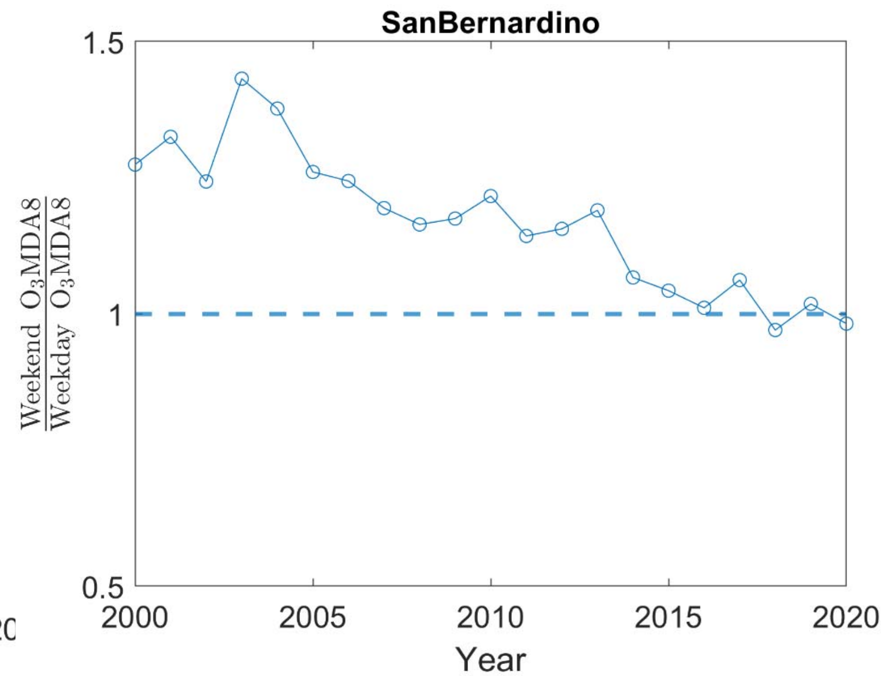
Seasonality of NOx disbenefit

- NOx disbenefit is stronger in spring

March-May



June-September



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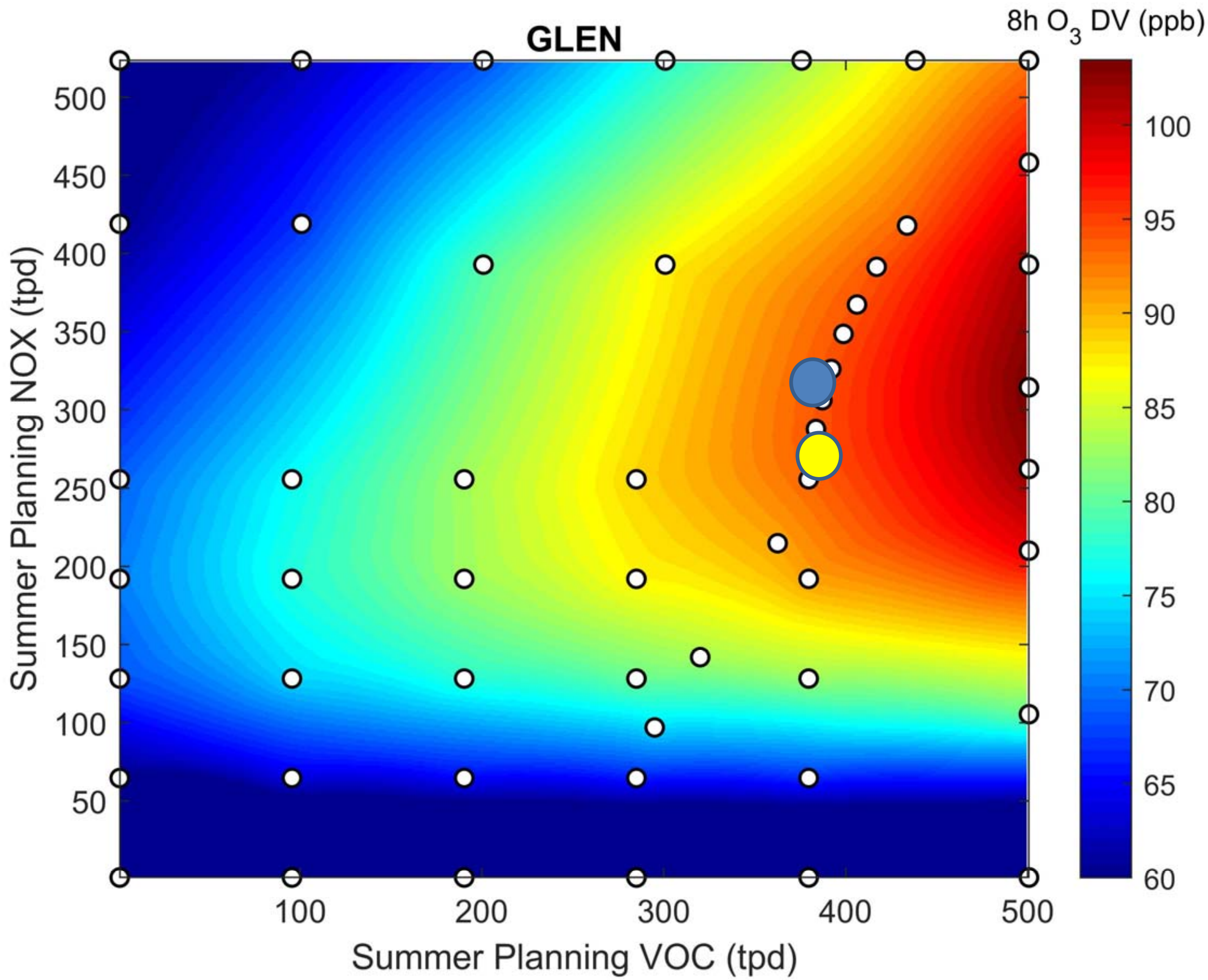
8-hour Ozone

Isopleths from 2016 AQMP modeling platform



Summary

- A set of sensitivity tests was performed to understand chemistry and dynamics of high ozone episodes during Mar 15- May 15, 2020.
- Numerical modeling results indicate that meteorology combined with the biogenic emissions in response to the meteorology have much larger impact on ozone than the changes in anthropogenic emissions
- Emission source areas in LA county are still VOC-limited and downwind inland receptor areas are transitioning to NOx-limited regime.
- The weekend effect is stronger during spring, which resulted in the higher ozone episodes during the study period

Item #5

Net Emissions Analysis Tool (NEAT)

STMPR meeting on Jan 27, 2021

Marc Carreras Sospedra, Ph.D.
Air Quality Specialist

South Coast Air Quality Management District

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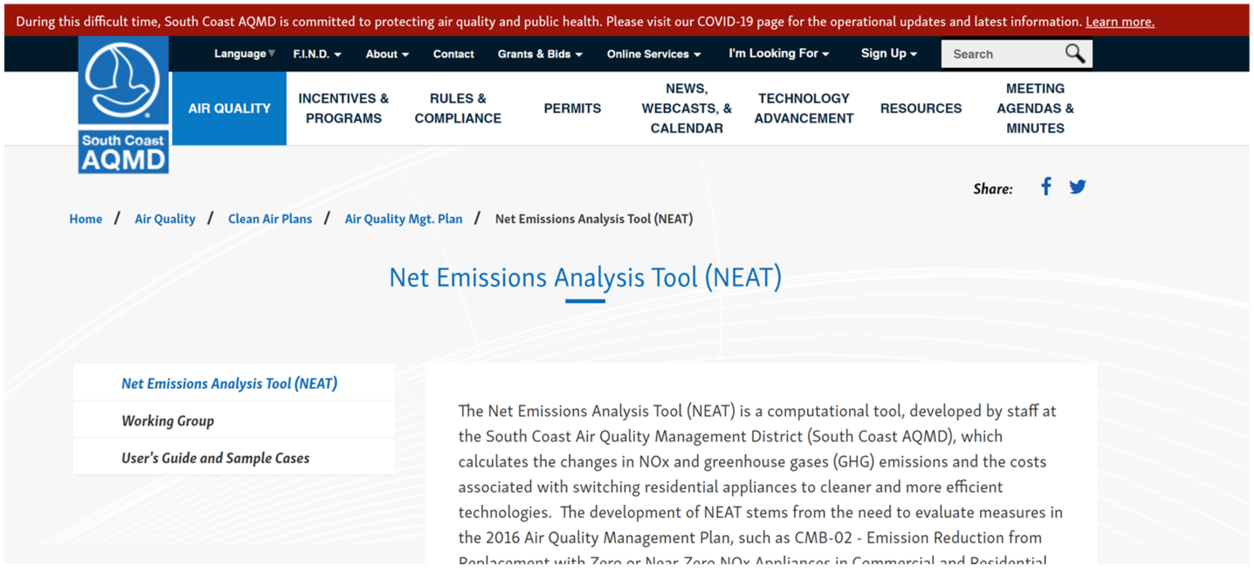
Net Emissions Analysis Tool (NEAT)

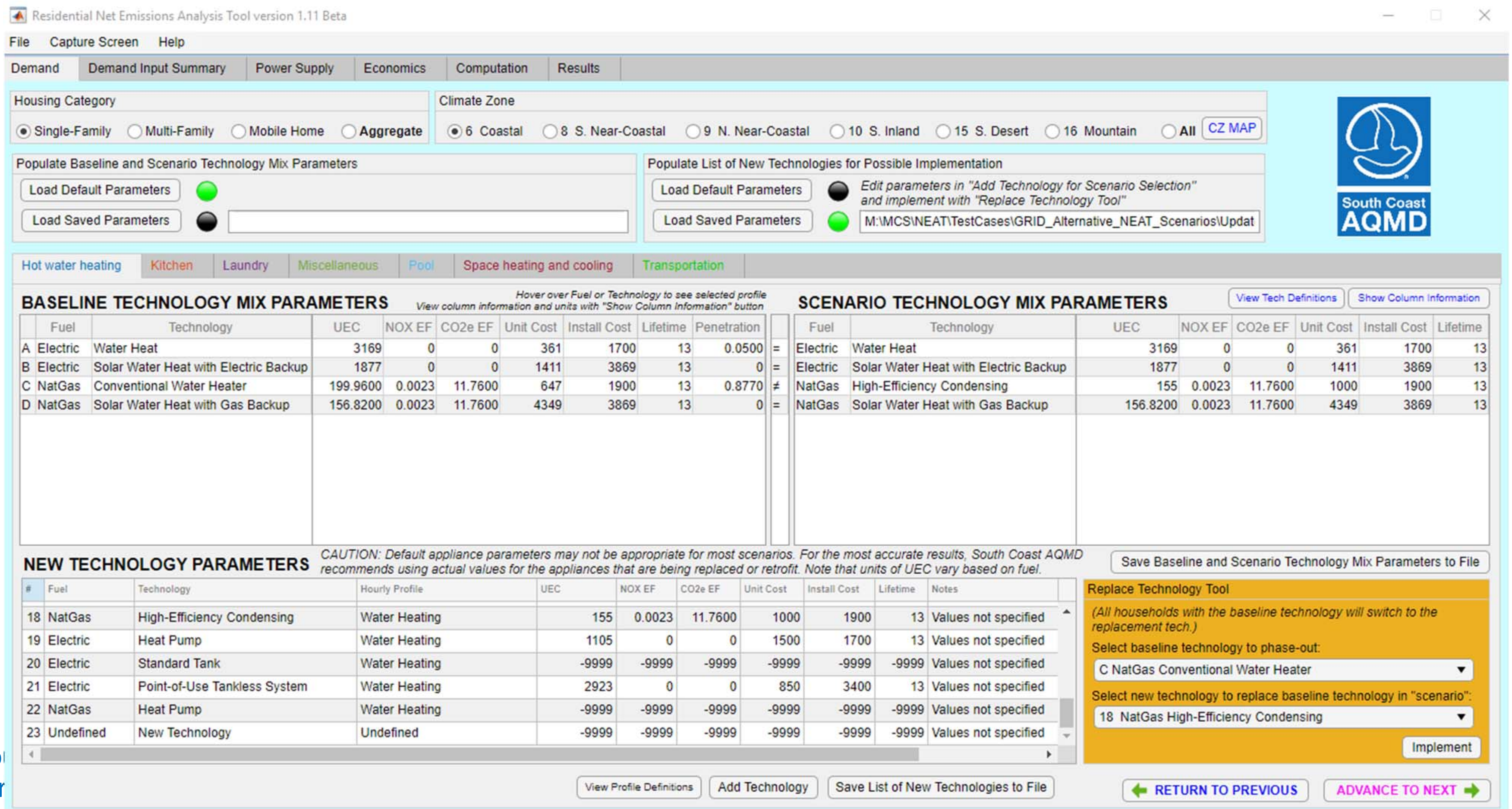
- Analytical software tool that will help policy-makers determine the most cost-effective strategies for NOx and GHG emission reductions from the residential sector
- Calculates changes in emissions and utility costs associated with a retrofit of existing appliances

Developmental History

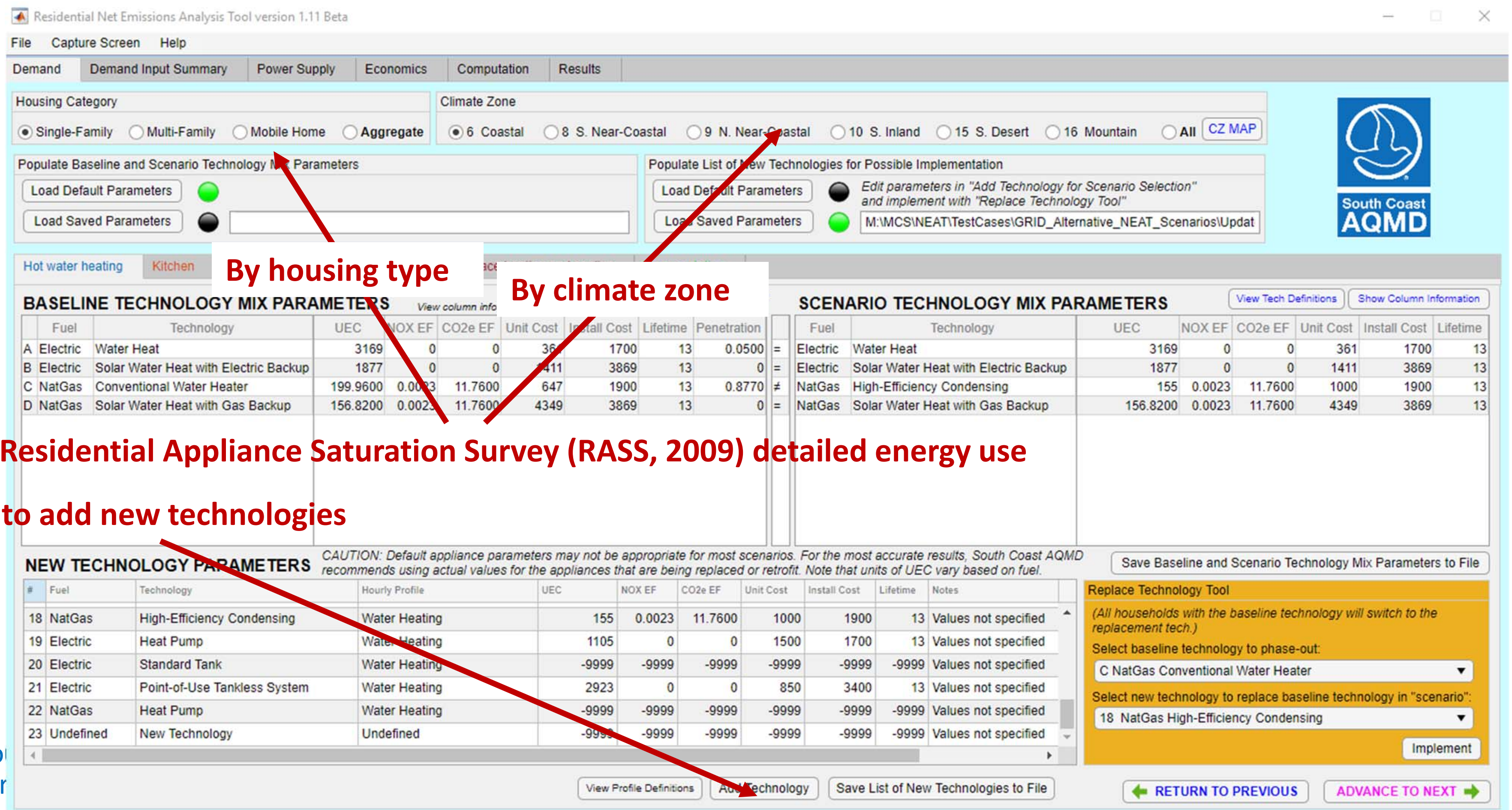
- First working group meeting: August 30, 2017
- 6 working group meetings through Jan 2019
- 10+ comment letters
- URL: aqmd.gov/NEAT



Net Emissions Analysis Tool (NEAT) Inputs



Net Emissions Analysis Tool (NEAT) Inputs



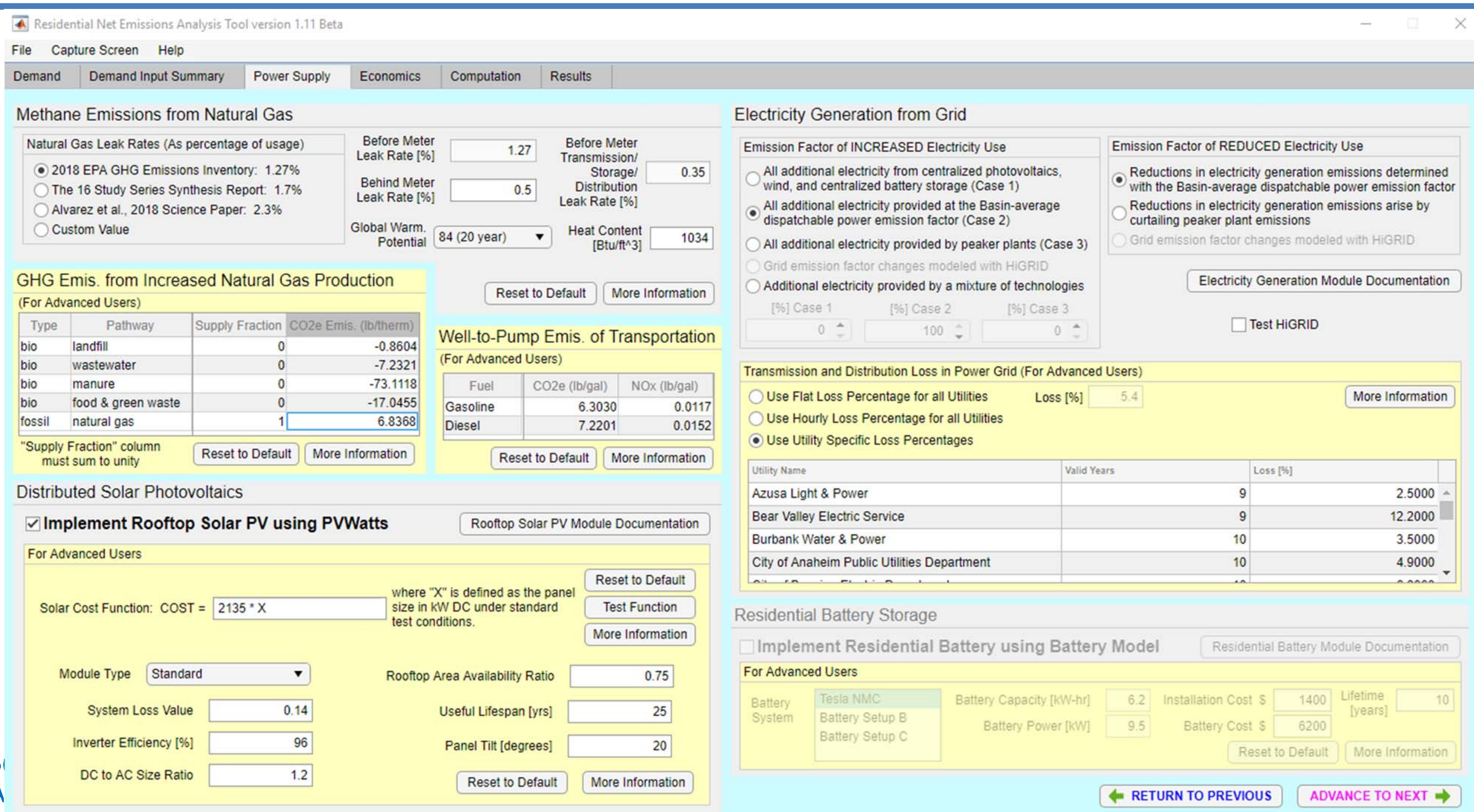
By housing type

By climate zone

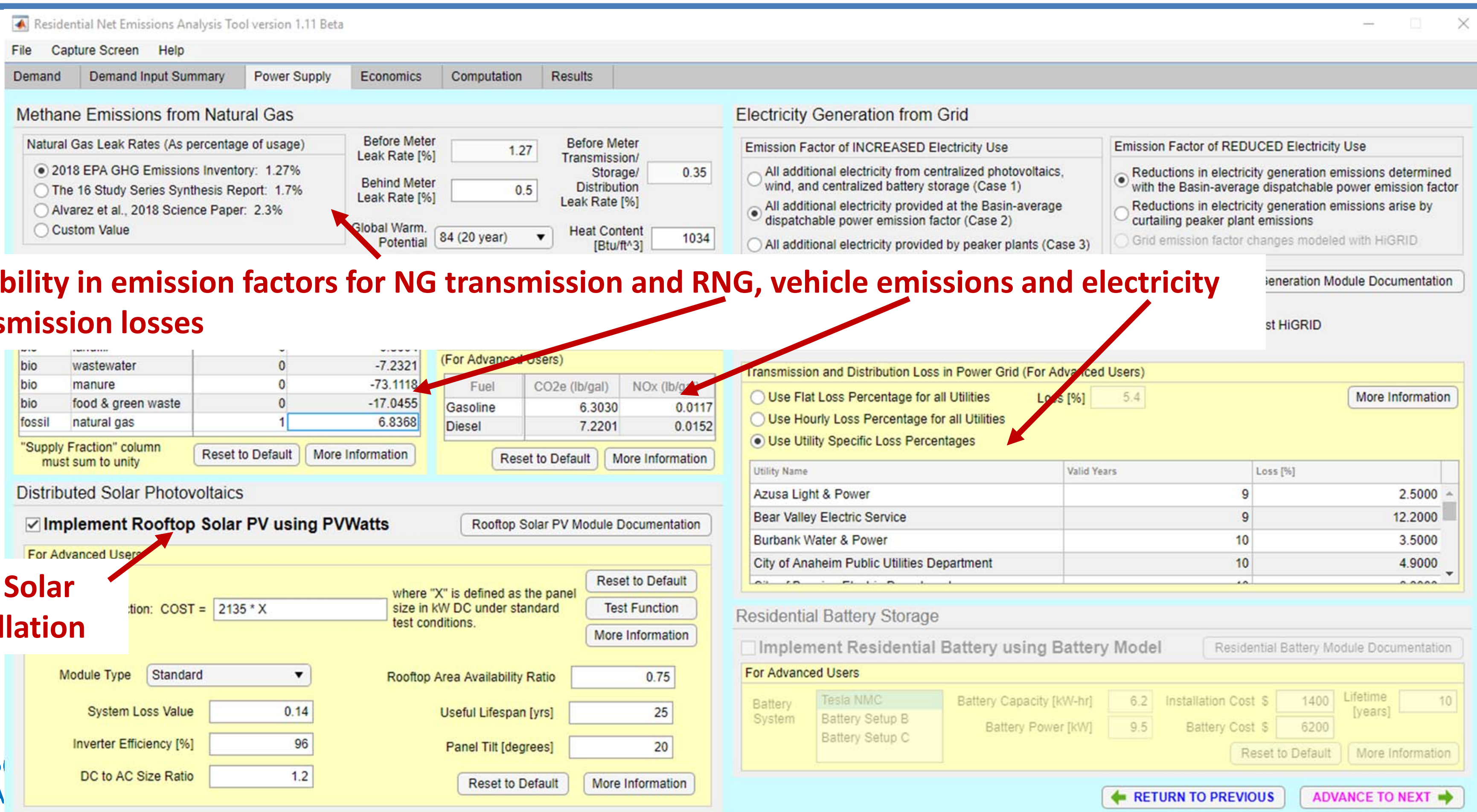
Uses Residential Appliance Saturation Survey (RASS, 2009) detailed energy use

Ability to add new technologies

Net Emissions Analysis Tool (NEAT) Inputs



Net Emissions Analysis Tool (NEAT) Inputs

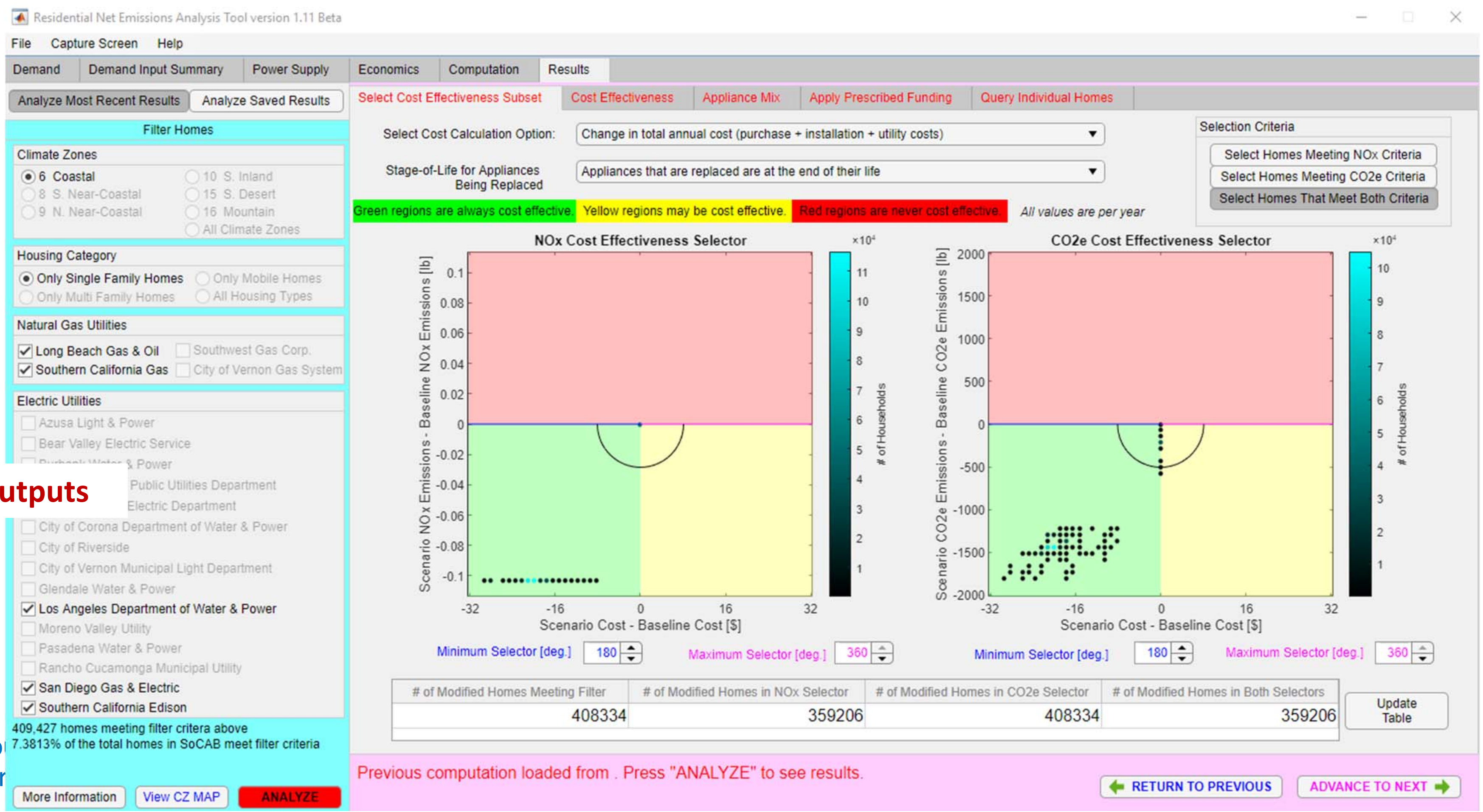


Flexibility in emission factors for NG transmission and RNG, vehicle emissions and electricity transmission losses

Rooftop Solar PV Installation

Net Emissions Analysis Tool (NEAT) Outputs

Visual Outputs



South Coast AQMD

Current Status of NEAT

- Released to Working Group members in December 2019 for beta-testing
- Stakeholders provided comments and identified potential bugs
  - Minor bug fixes have been incorporated as recently as Dec 2020
  - Major comments are related to the vintage of underlying data:
    - Appliance data from RASS 2009 and information on purchase and installation costs
    - Vehicle well-to-tank and tank-to-wheel emissions (EMFAC and GREET versions)
- Contract with UC Irvine finalized to provide an additional module (HiGRID) to model grid emissions with integration of high penetration of renewable electricity generation
  - This module will be incorporated in a future version
- Data and final reports from RASS 2019 is currently under review
  - Data will be reviewed and incorporated when available