

**HARC**

UH Energy Electric Vehicle Webinar Series  
October 20, 2020

# **The Air Quality Impacts of COVID-19 on the Houston Region and United States**

**Mustapha Beydoun, Ph.D.**  
Vice President & COO

**Ebrahim Eslami, PhD**  
PD-Research Scientist, Air Quality

# Presentation Outline

- HARC Overview
- Mobility
- Energy Usage
- Air Quality



# About HARC



- The Houston Advanced Research Center (HARC) is an independent research hub helping people thrive and nature flourish
- Founded by George P. Mitchell in 1982
- A 501(c)(3) organization located in The Woodlands
- We provide objective, unbiased, non-advocacy approach to finding meaningful answers to complex questions



**HARC** (härk), *n.*

an independent research  
hub helping people thrive  
and nature flourish.

## Mission

*Providing independent analysis  
on energy, air, and water issues  
to people seeking scientific  
answers.*

*Operating as a research hub  
finding solutions for a  
sustainable future.*

### CLEAN ENERGY



Accelerating  
clean, efficient  
and sustainable  
energy

### WATER MANAGEMENT



Protecting  
water resources  
and ecosystems

### CLIMATE RISK



Understanding,  
mitigating and  
adapting to  
climate change

### AIR QUALITY



Improving air  
quality through  
research



# HARC's Headquarters

- 18,601 SF office building
- Completed in March of 2017
- 88.2 kW rooftop PV solar plant
- Certified **LEED Platinum** and **Energy Star 99/100**
  - Energy use intensity (EUI) 15.4 kBТУs/sqft/yr
  - One of only 10 energy star 99 office buildings in Texas
- In 2020, certified as **Zero Energy** by the International Living Future Institute (ILFI)
  - First and only net zero energy office building in Texas and one less than 50 in the U.S.
  - Net zero energy simply means that more renewable (solar) power was produced on-site than the power consumed by the building over the past 12 months



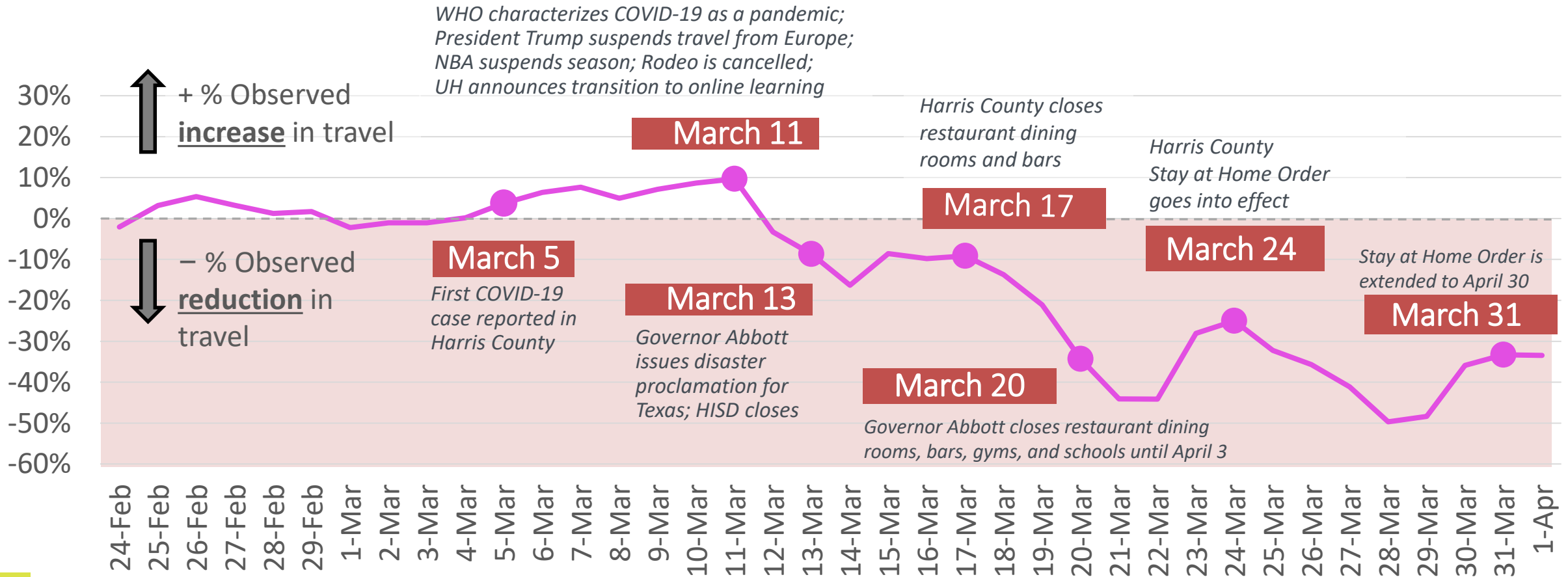
# Mobility





# Local, State and Federal Declarations Impact on Harris County

% change in avg. distance traveled



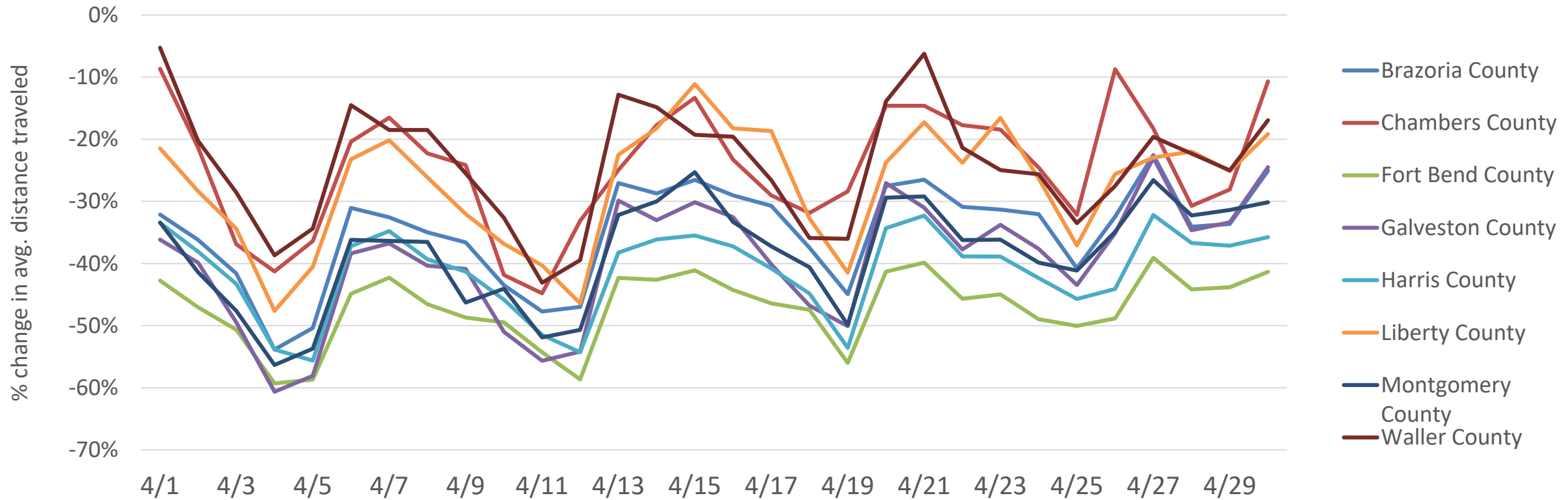
1<sup>st</sup> "Spring Break" period

Regional Stay at Home Orders





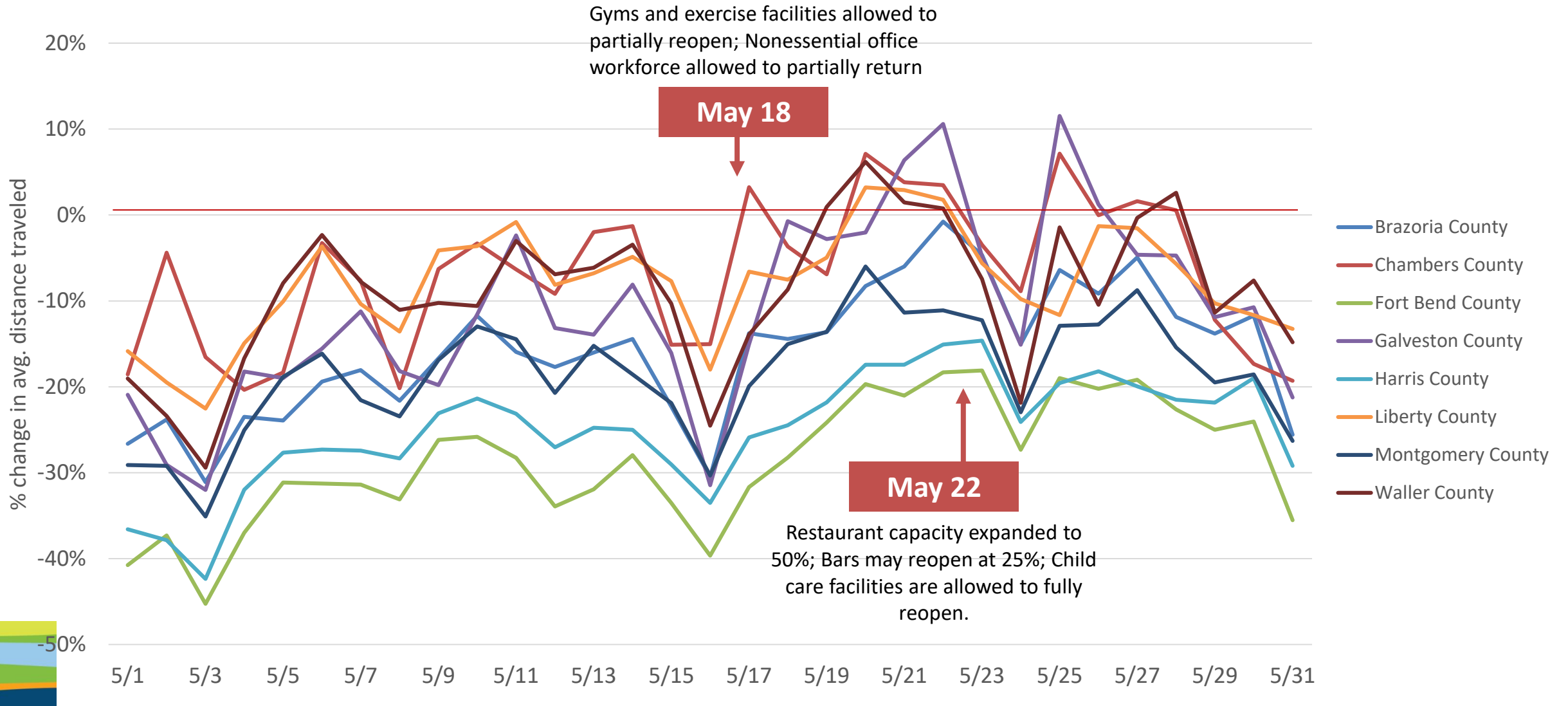
# April Sees Steady Pattern Across Region



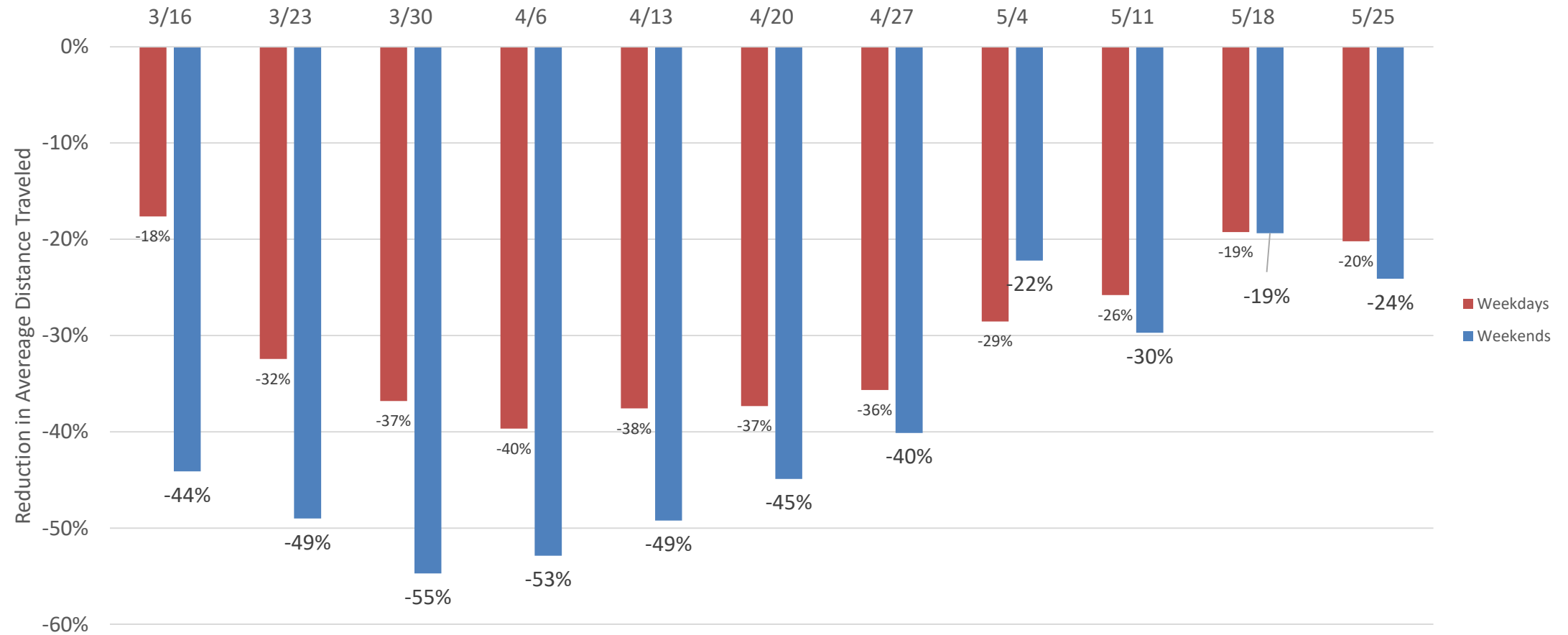
- Relative to “normal” mobility patterns, the trend in reduction of average distance traveled continues throughout the region under the statewide stay at home order (issued March 31).
- The extent that counties reduce mobility is likely related to factors such as the population density and the unique profile of the workforce for that county.



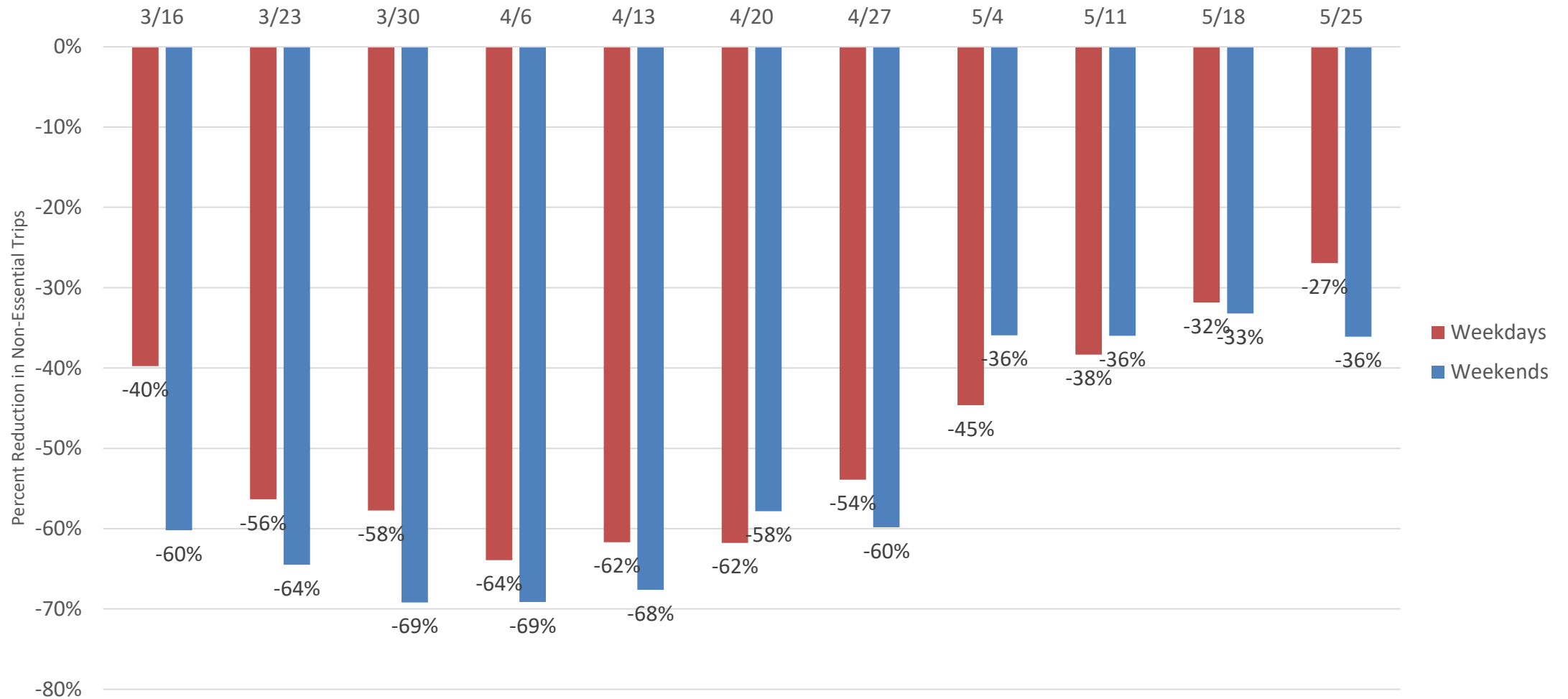
# May Sees Movement to Normal Travel



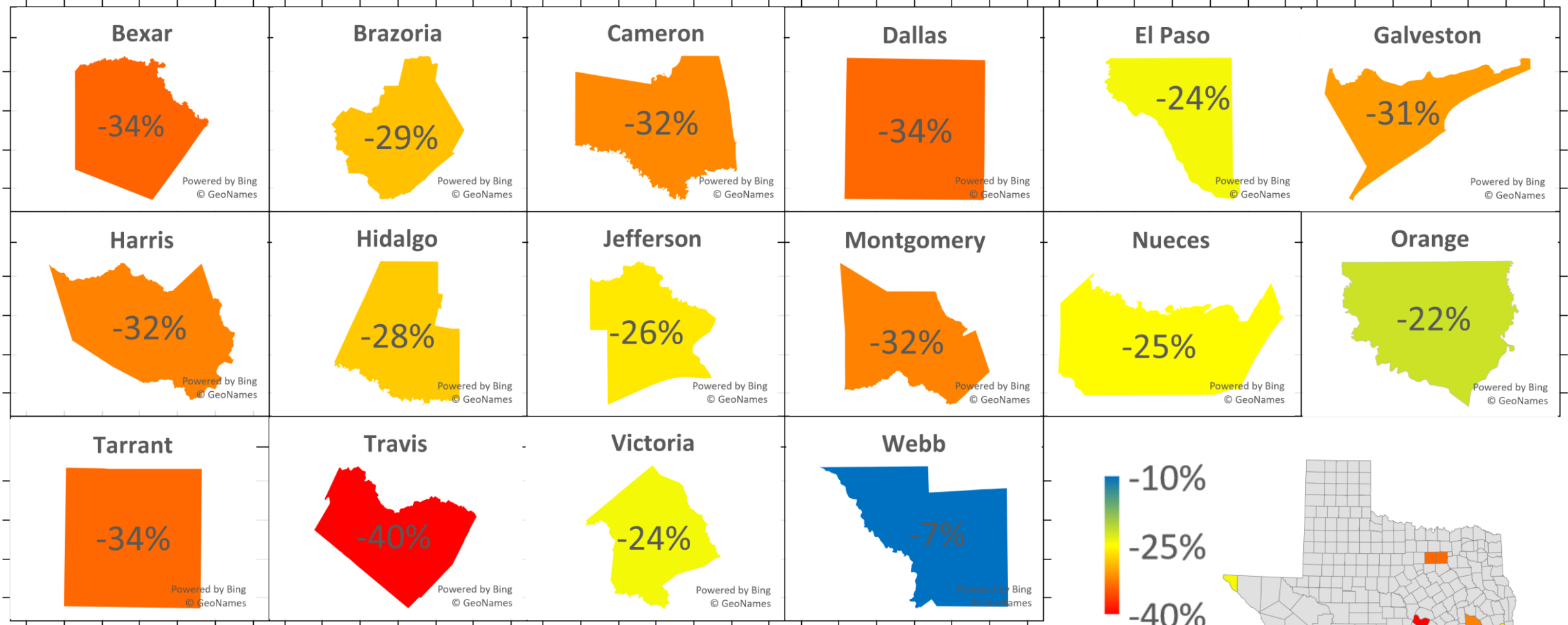
# Weekly Reduction in Average Distance Traveled in Harris County during COVID-19



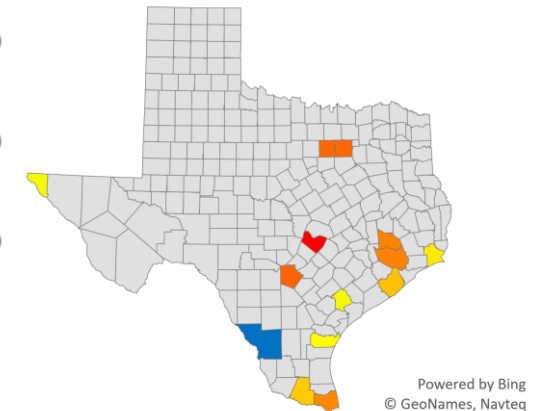
# Weekly Reduction of Nonessential Trips in Harris County



# COVID-19: Comparison of Average Distance Traveled Across Texas Counties



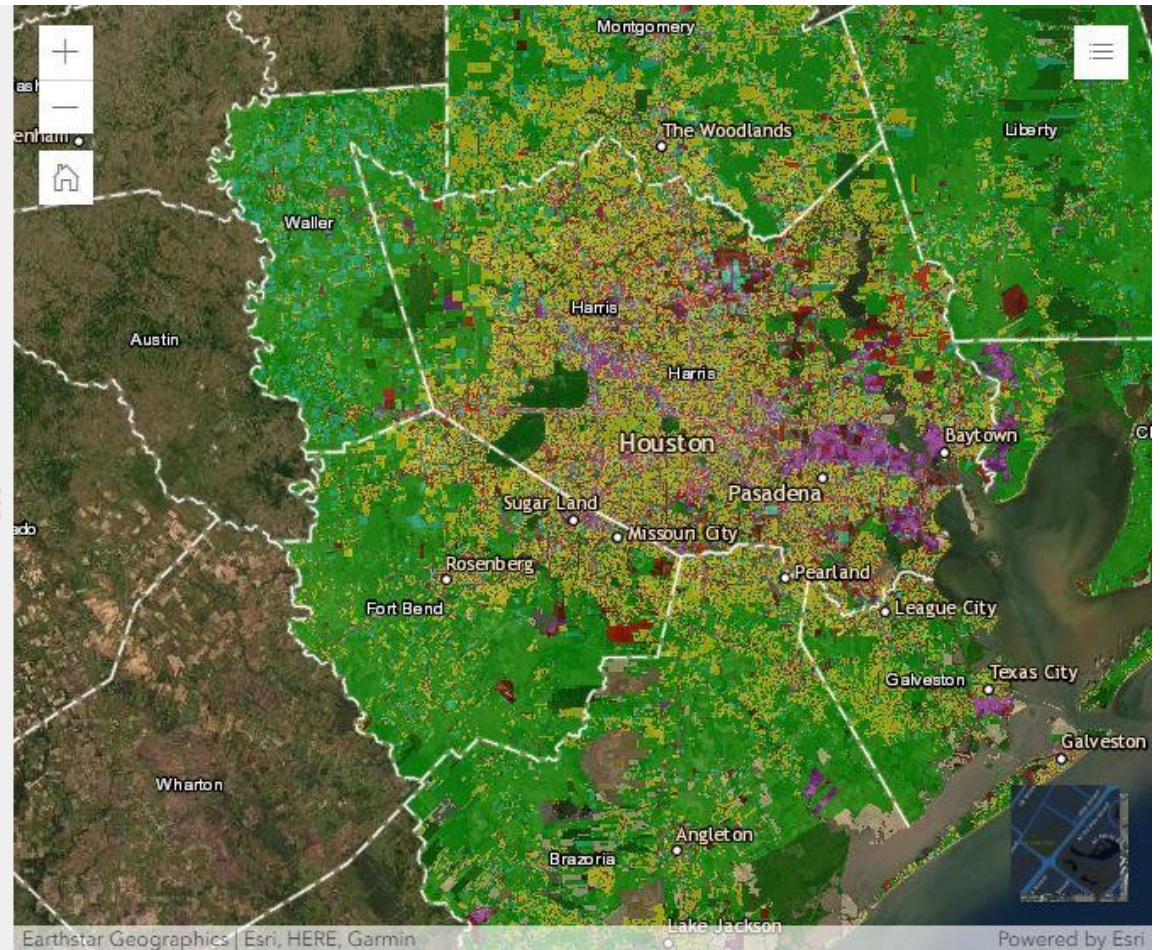
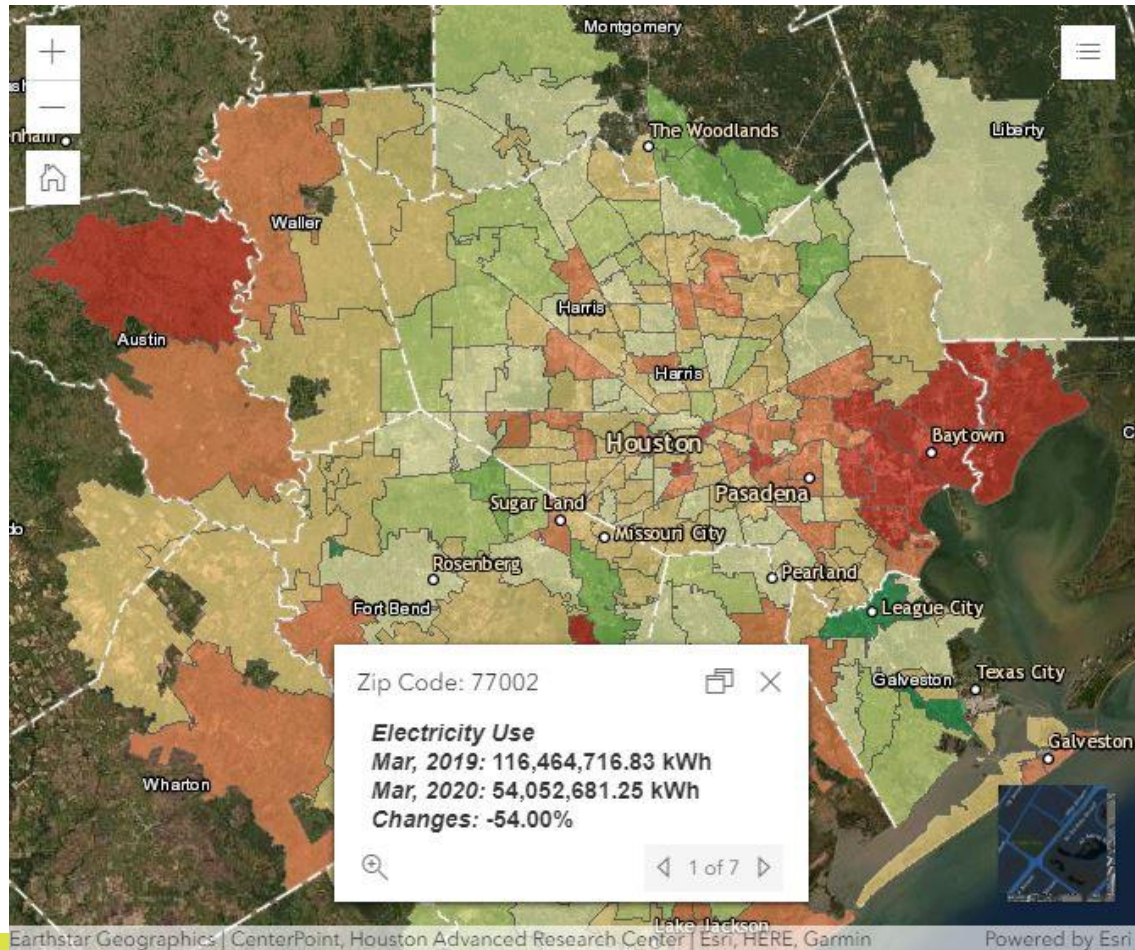
Average Reduction in Daily Average Distance Traveled  
(March 11- April 13, 2020)



# Energy Usage



# Shift in Electric Power Consumption



# Air Quality





# HGB COVID-19 Air Quality Improvements

Ambient air pollution **reductions** during COVID-19 time periods vs. historical (2014-2019) data for the same time period

	March 11-April 13	March 11-April 30	March 11-May 21	March 11-June 11
NOx	46% ↓	18% ↓	15% ↓	14% ↓
BTEX	39% ↓	32% ↓	26% ↓	21% ↓
Total VOC	9% ↓	~3% ↓	Unchanged	Unchanged
Ozone	17% ↓	7% ↓	~1% ↓	<b>9% ↑</b>

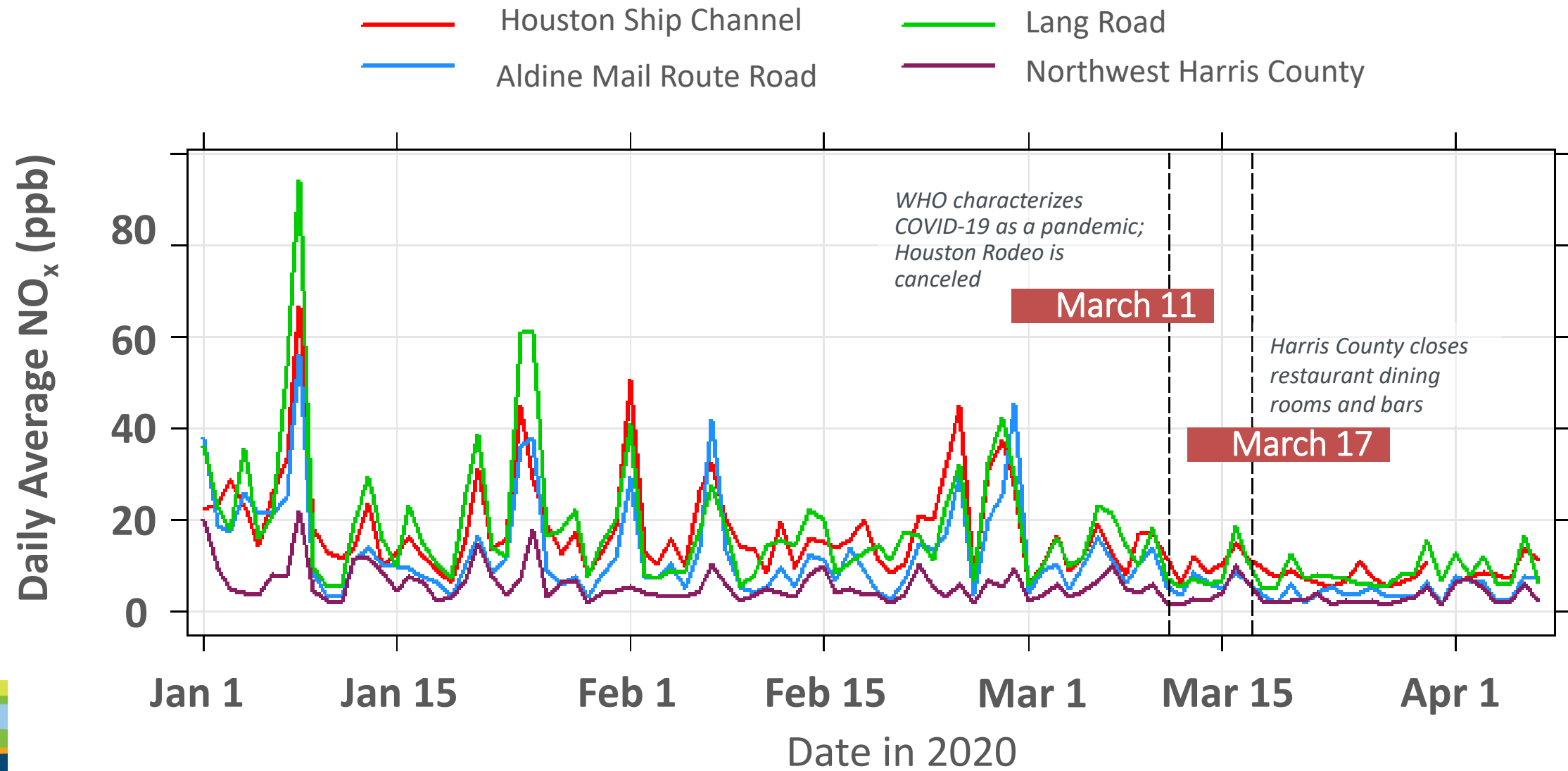


# HGB COVID-19 Weather

- We had ~13% stronger winds during the COVID-19 period
  - 2.93 m/s vs 2.59 m/s
  - May explain pollution transport theory for increased PM values in Houston and in many part of the state
- We had ~10% warmer weather
  - 22.7 Celsius vs 20.6 Celsius
  - Ozone chemistry should be more efficient during the COVID-19
  - Initial impact of COVID-19 on ozone is even higher than the data show

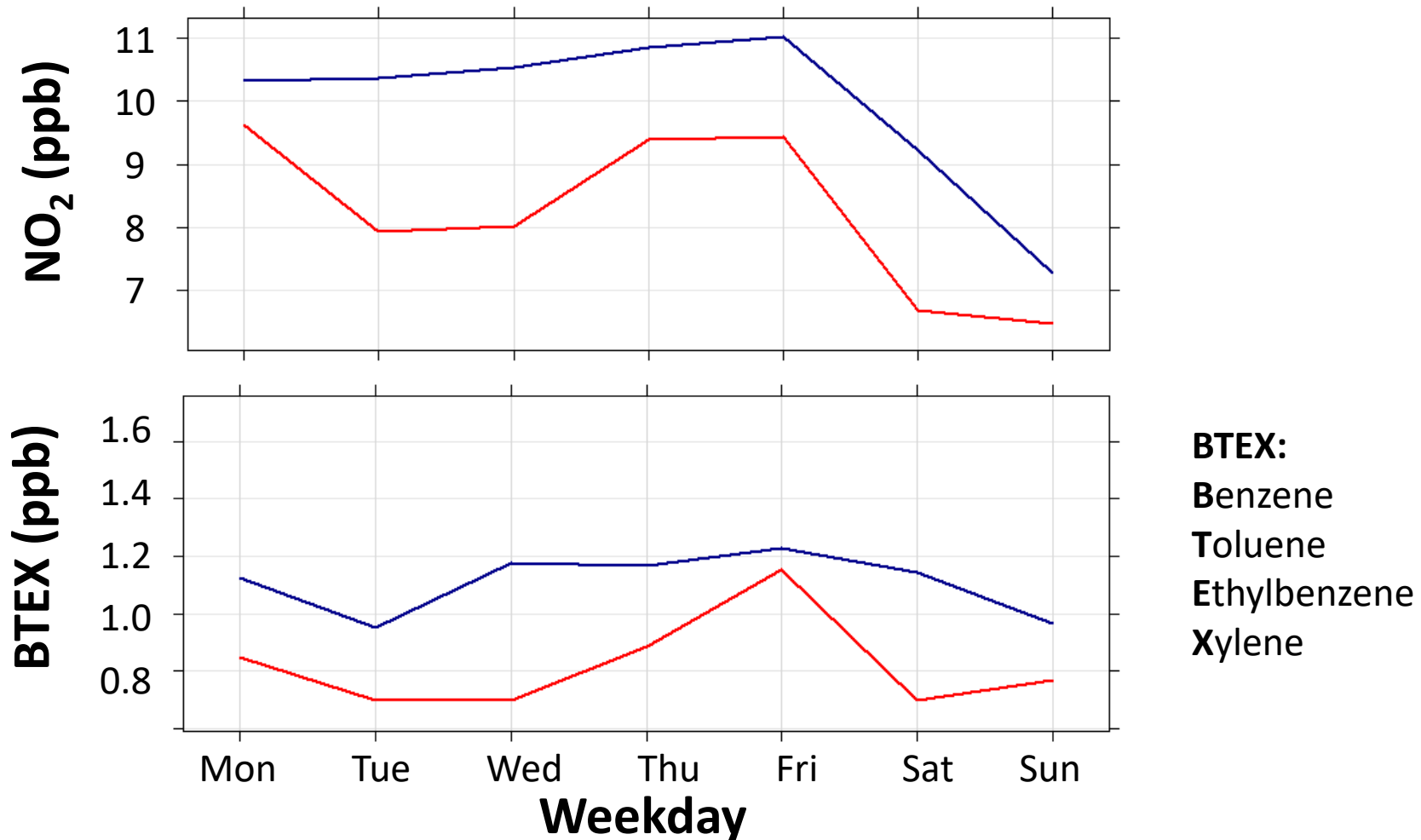


# COVID-19: Average Daily Harris County NO<sub>x</sub> Levels (Jan – Apr, 2020)



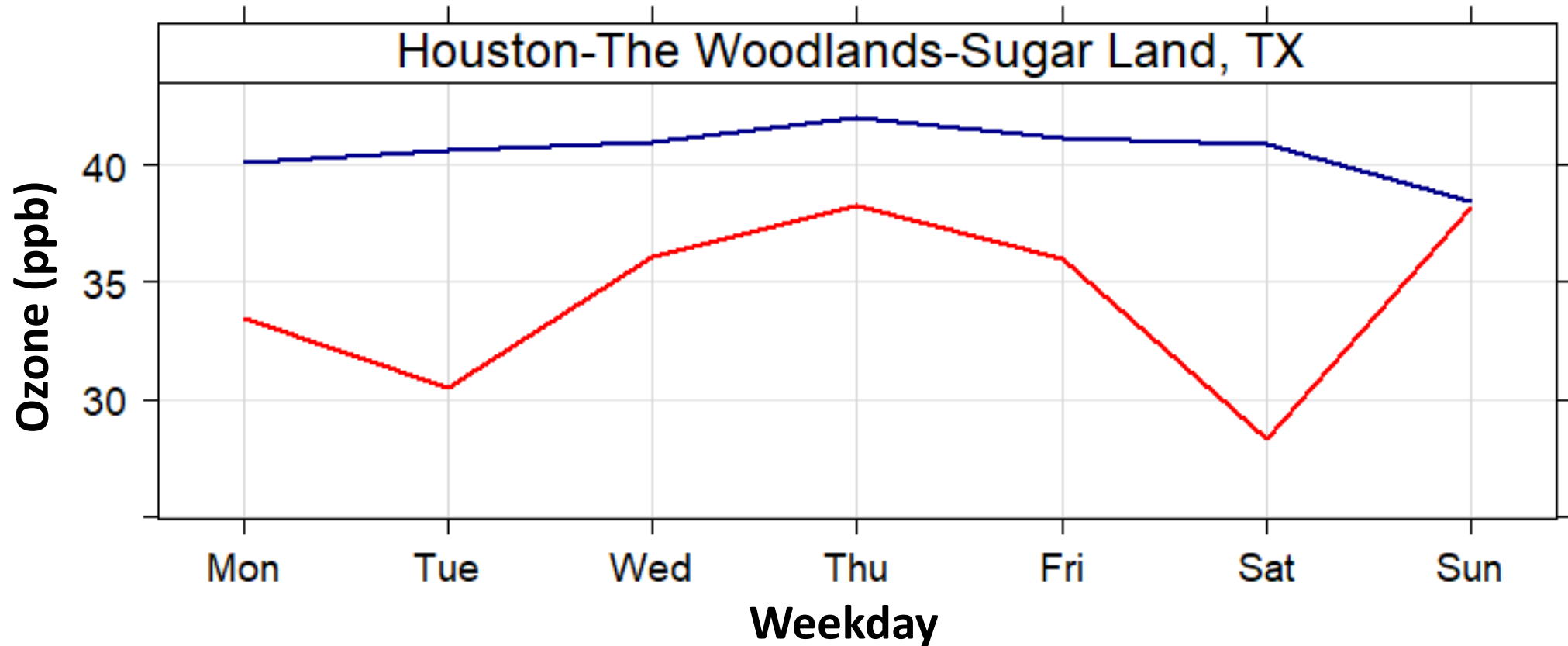
# Houston Air Pollution during COVID-19

 Historical Trend: March 11 to April 13 (2014-2019)  
 During COVID-19: March 11 to April 13, 2020



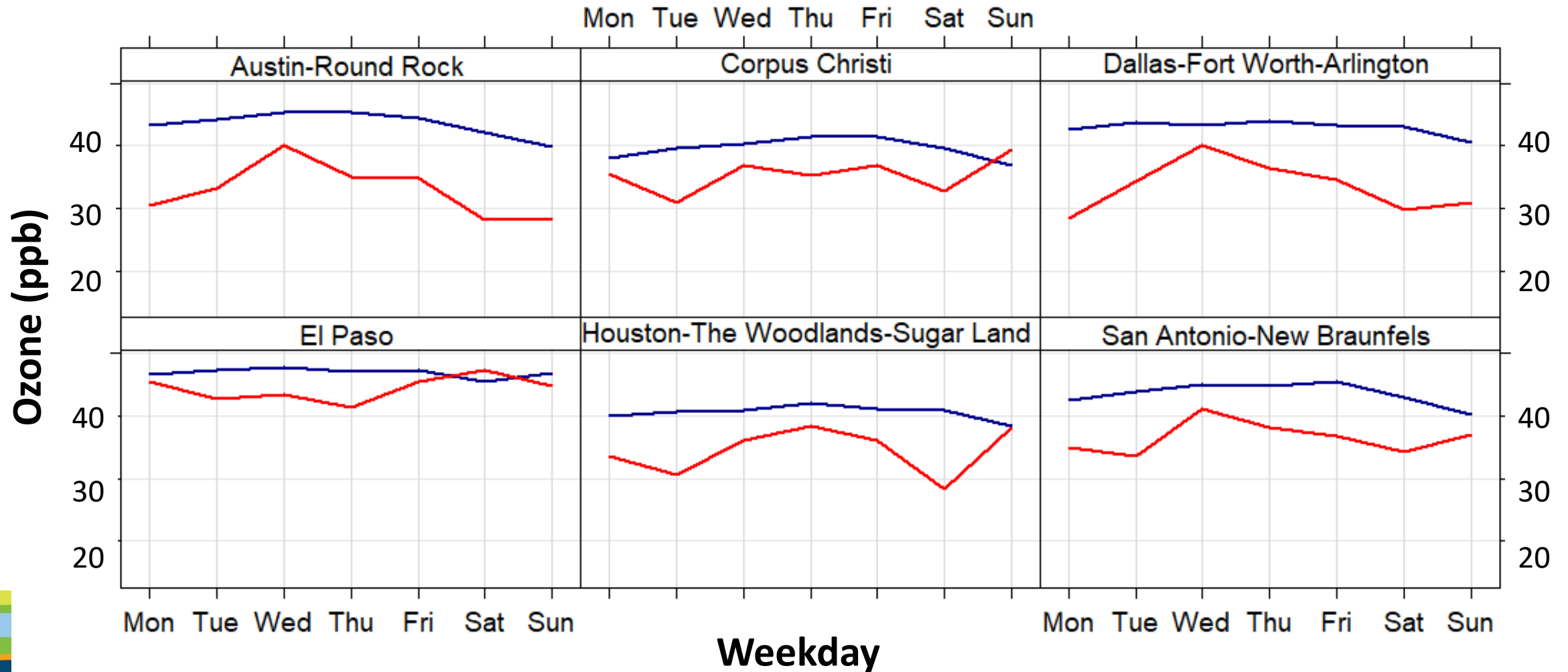
# COVID-19: Harris County Ozone Levels

■ Historical Trend: March 11 to April 13 (2014-2019)  
■ During COVID-19: March 11 to April 13, 2020

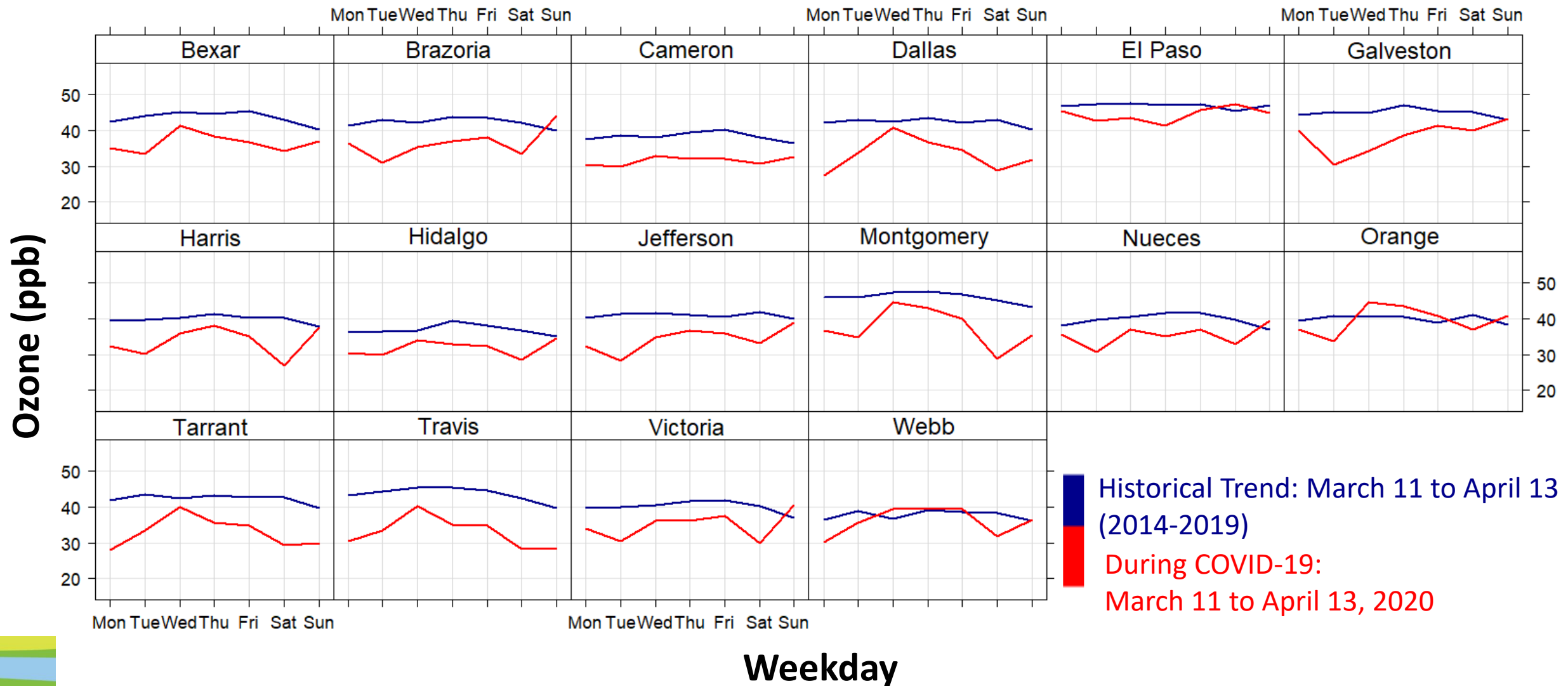


# COVID-19: Comparison of Changing Ozone Levels Across Texas Metros

■ Historical Trend: March 11 to April 13 (2014-2019)  
■ During COVID-19: March 11 to April 13, 2020

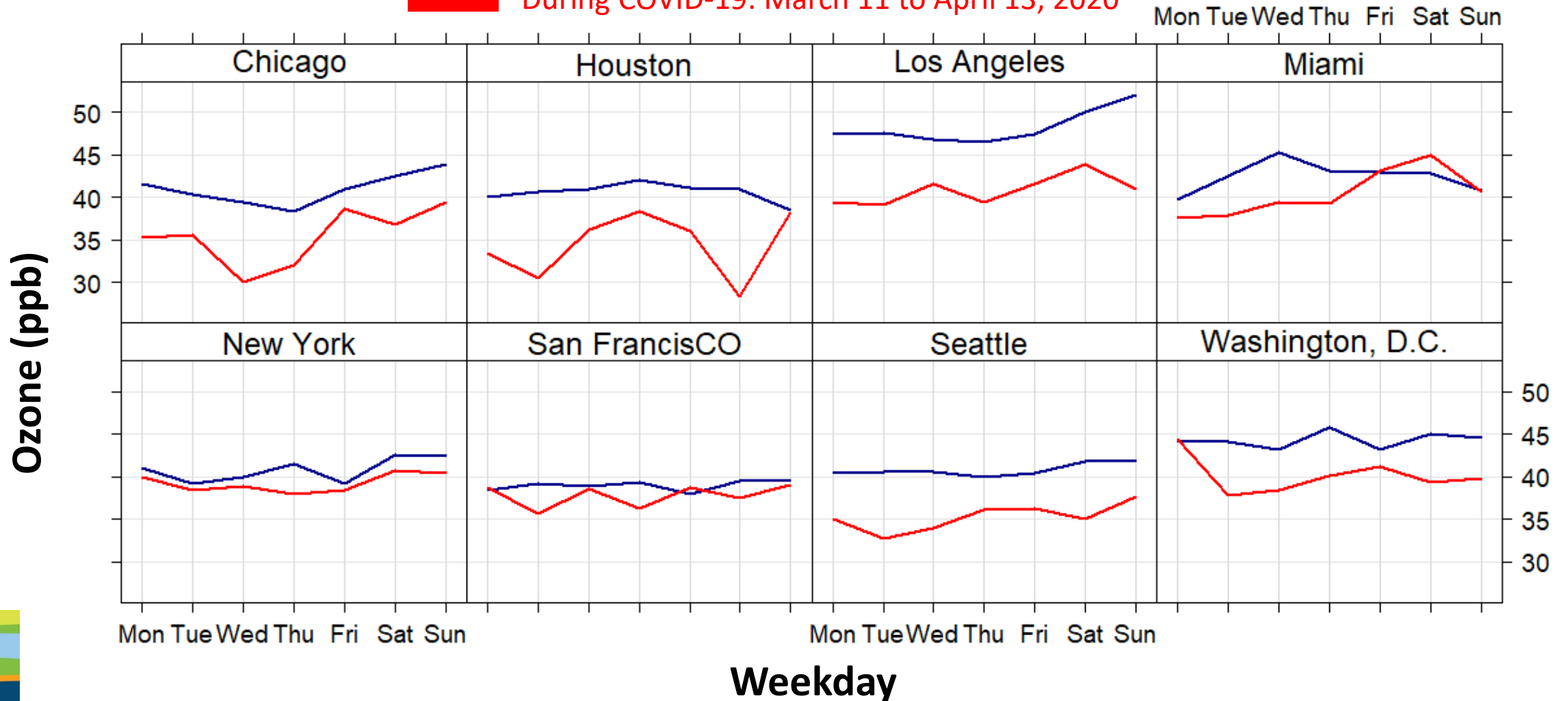


# COVID-19: Comparison of Changing Ozone Levels Across Texas Counties



# COVID-19: Comparison of Changing Ozone Levels Across US Metros

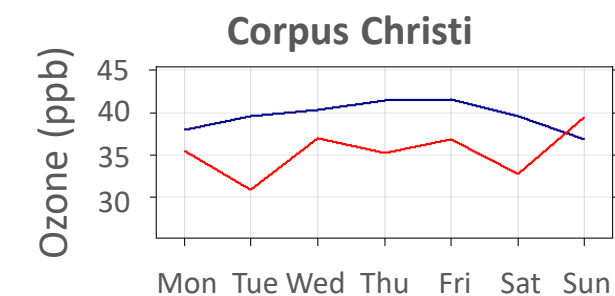
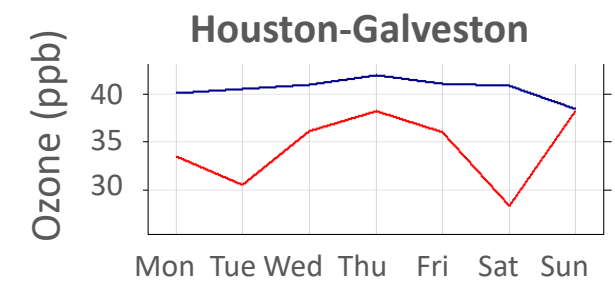
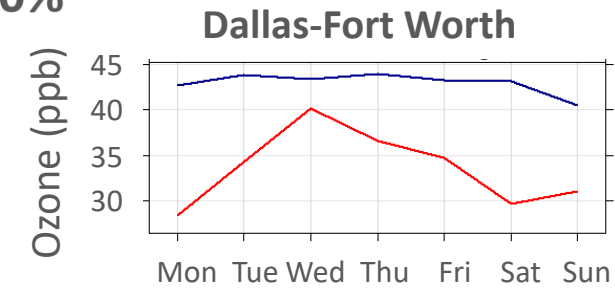
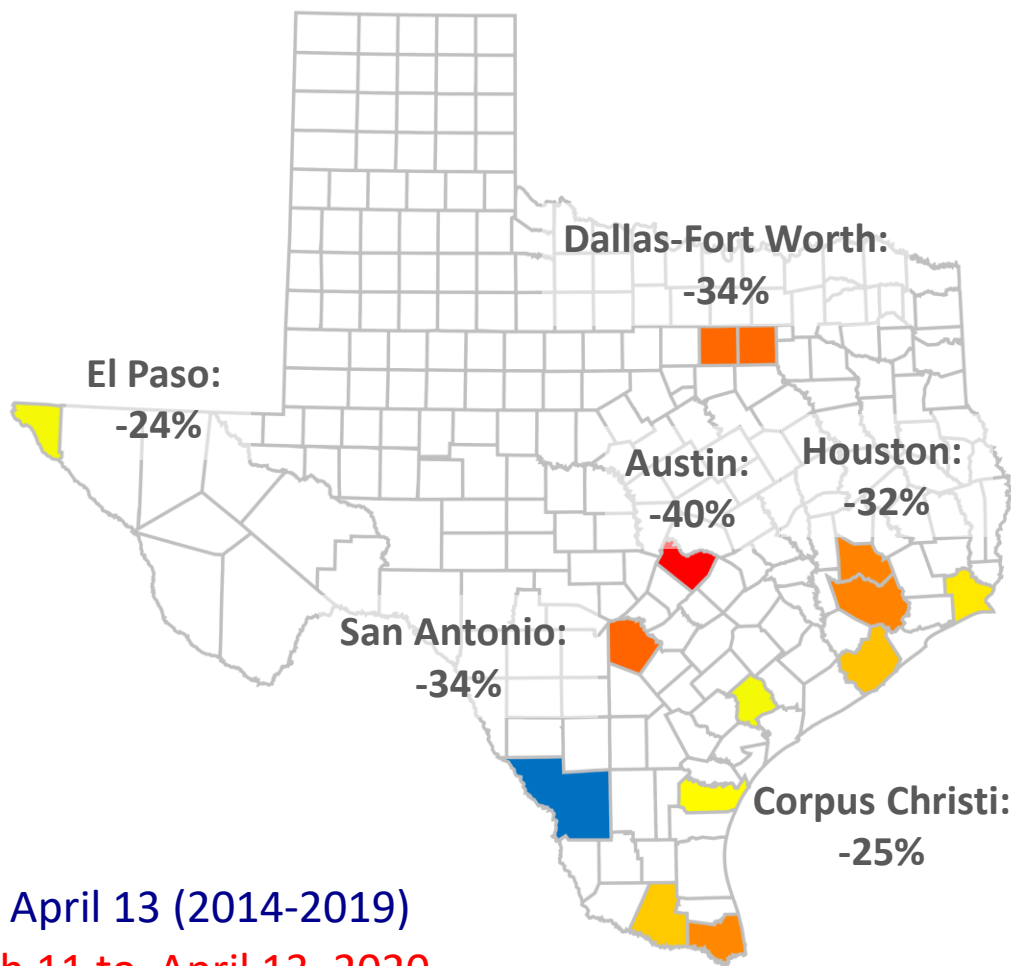
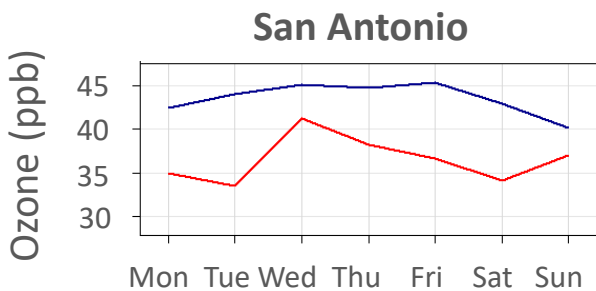
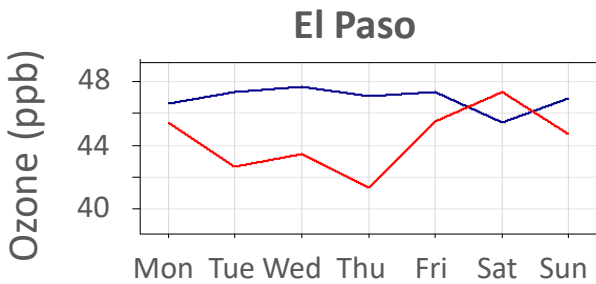
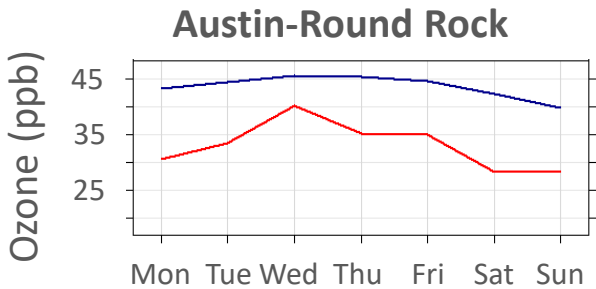
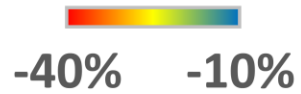
■ Historical: March 11 to April 13 (2014-2019)  
■ During COVID-19: March 11 to April 13, 2020







# COVID-19: Changes in Mobility and Ozone Concentrations Across Texas

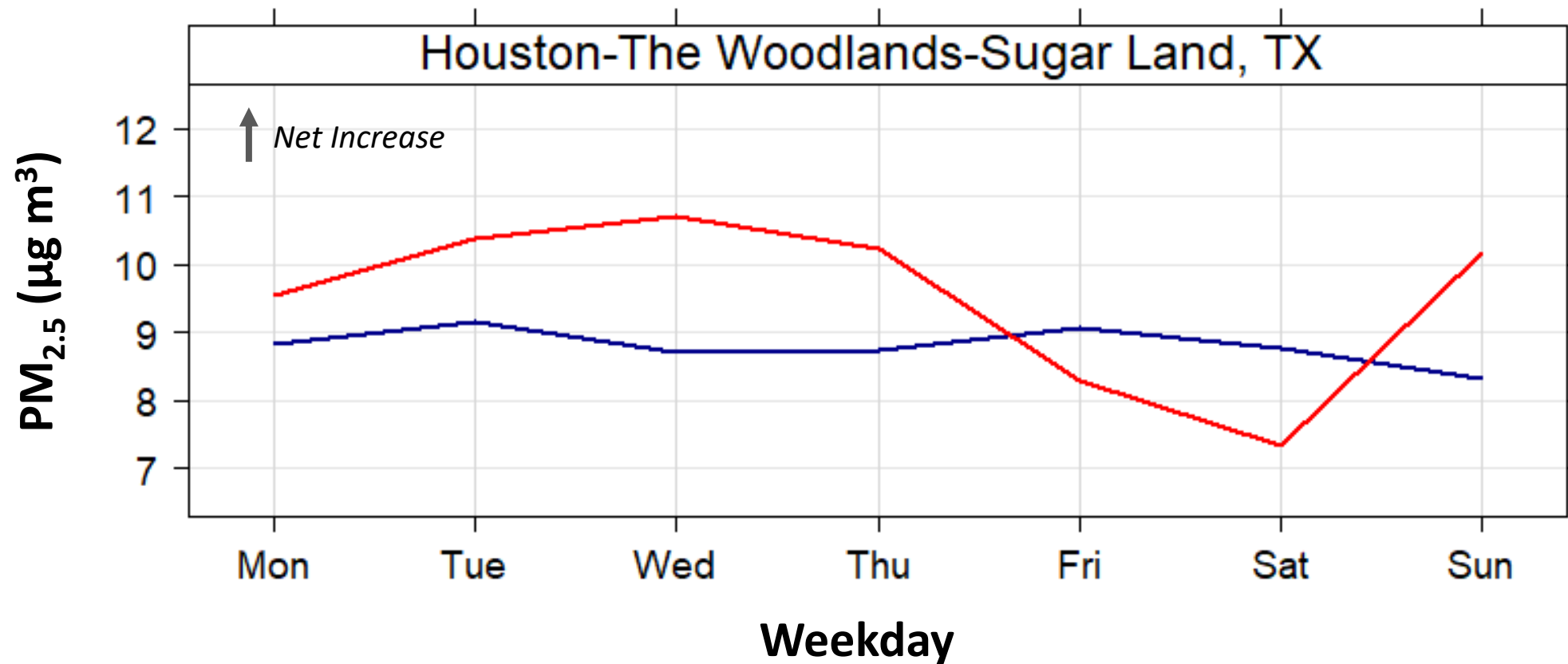
**Reduction in Daily Avg. Distance Traveled**  
 March 11 to April 13, 2020



 Historical: March 11 to April 13 (2014-2019)  
 During COVID-19: March 11 to April 13, 2020

# COVID-19: Harris County PM<sub>2.5</sub> Levels

Historical Trend: March 11 to April 13 (2014-2019)  
During COVID-19: March 11 to April 13, 2020

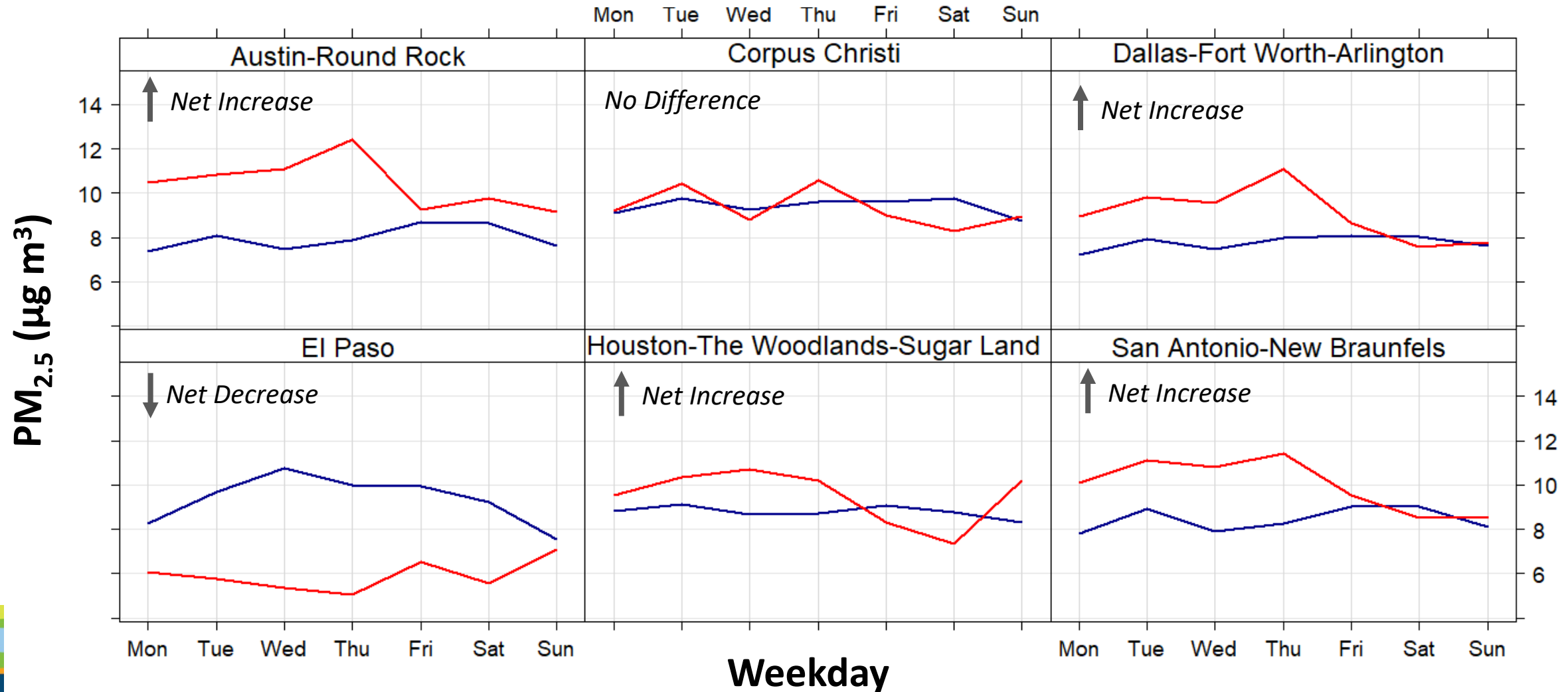


# COVID-19: Comparison of Changing PM<sub>2.5</sub> Levels Across Texas Metro Areas



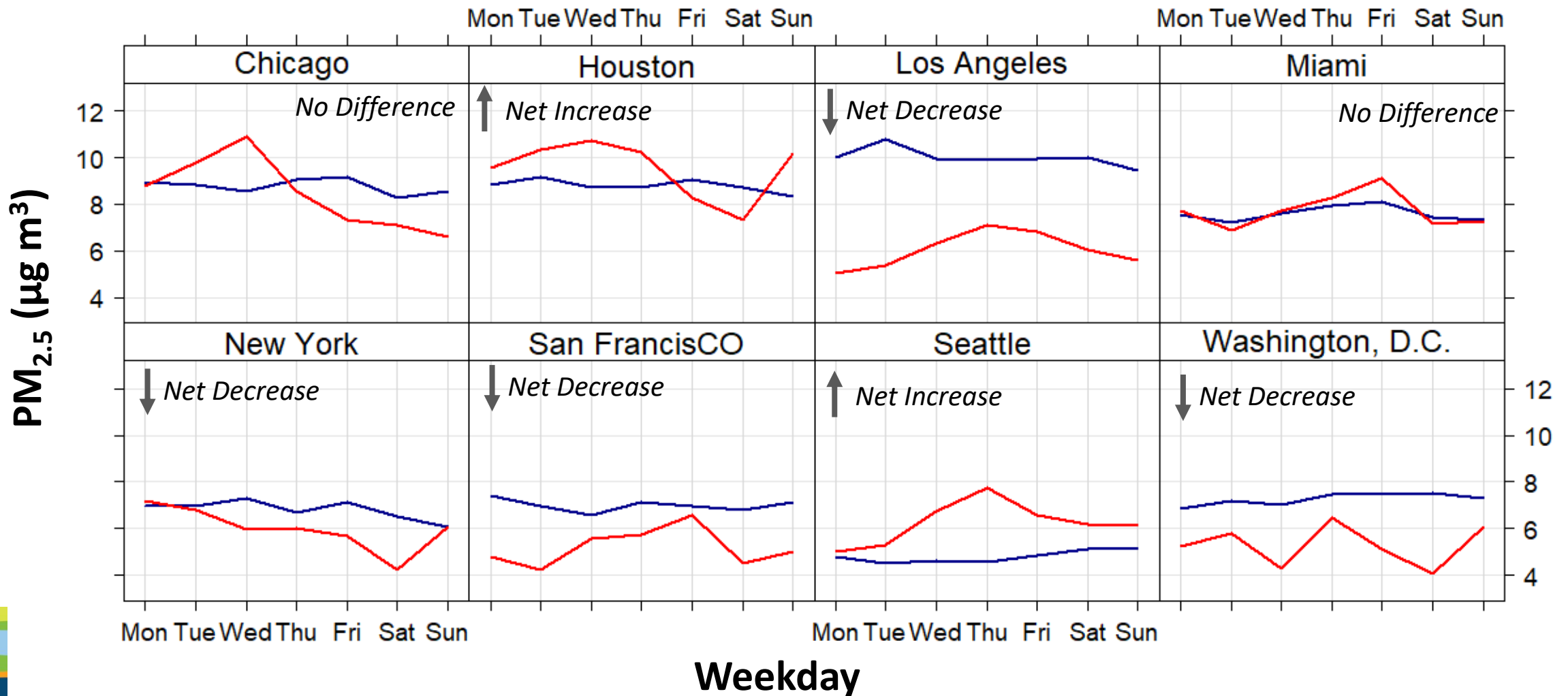
Historical Trend: March 11 to April 13 (2014-2019)

During COVID-19: March 11 to April 13, 2020

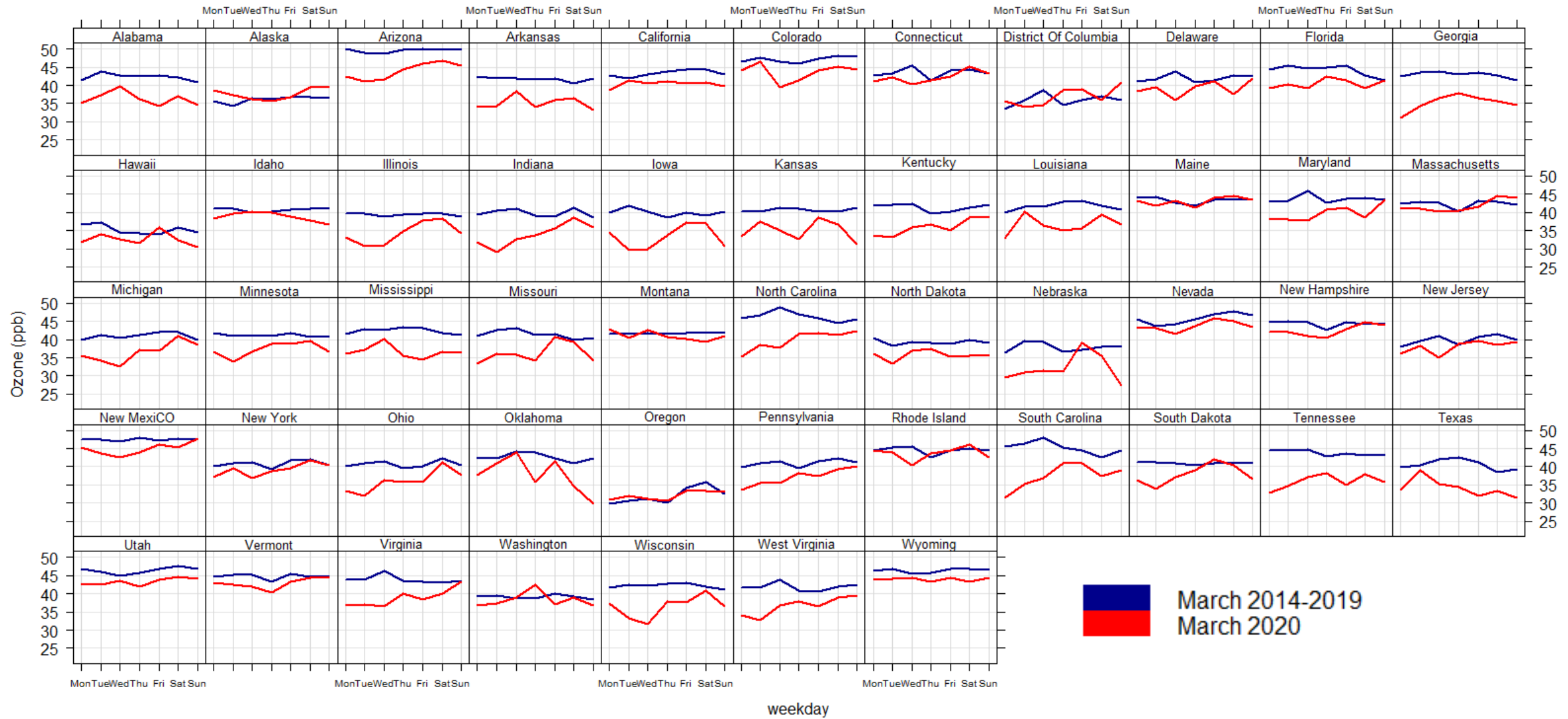


# COVID-19: Comparison of Changing PM<sub>2.5</sub> Levels Across US Metro Areas

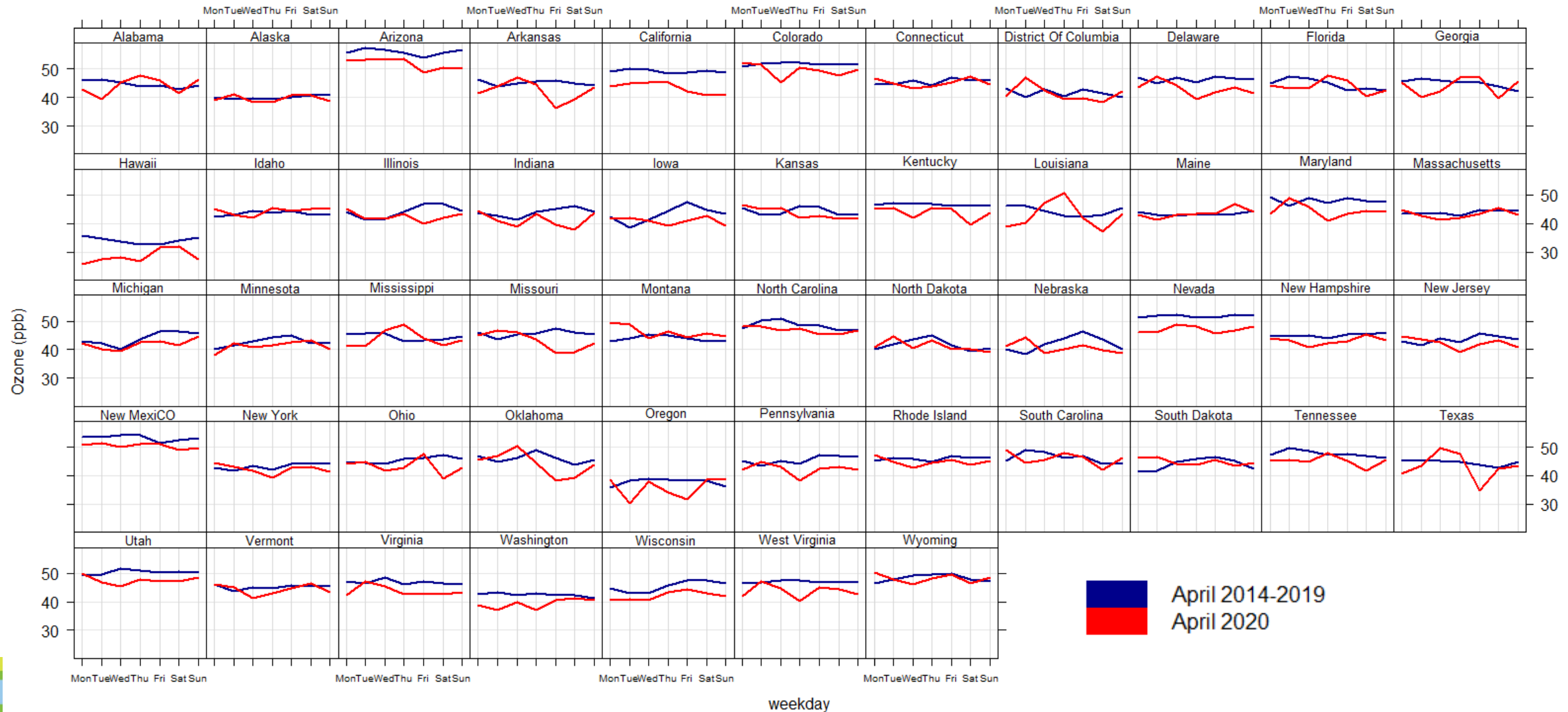
■ Historical Trend: March 11 to April 13 (2014-2019)  
■ During COVID-19: March 11 to April 13, 2020



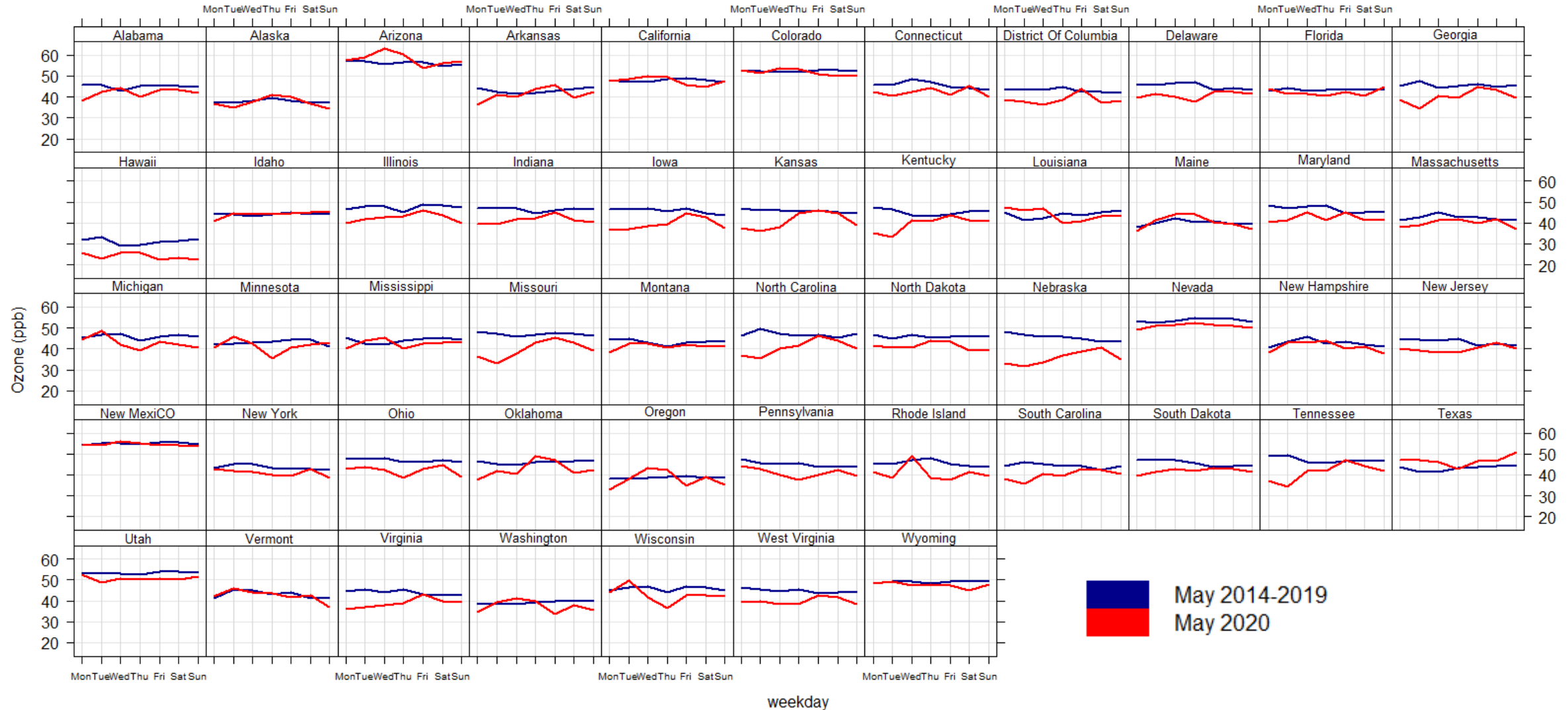
# National Ozone Data by Weekday - March



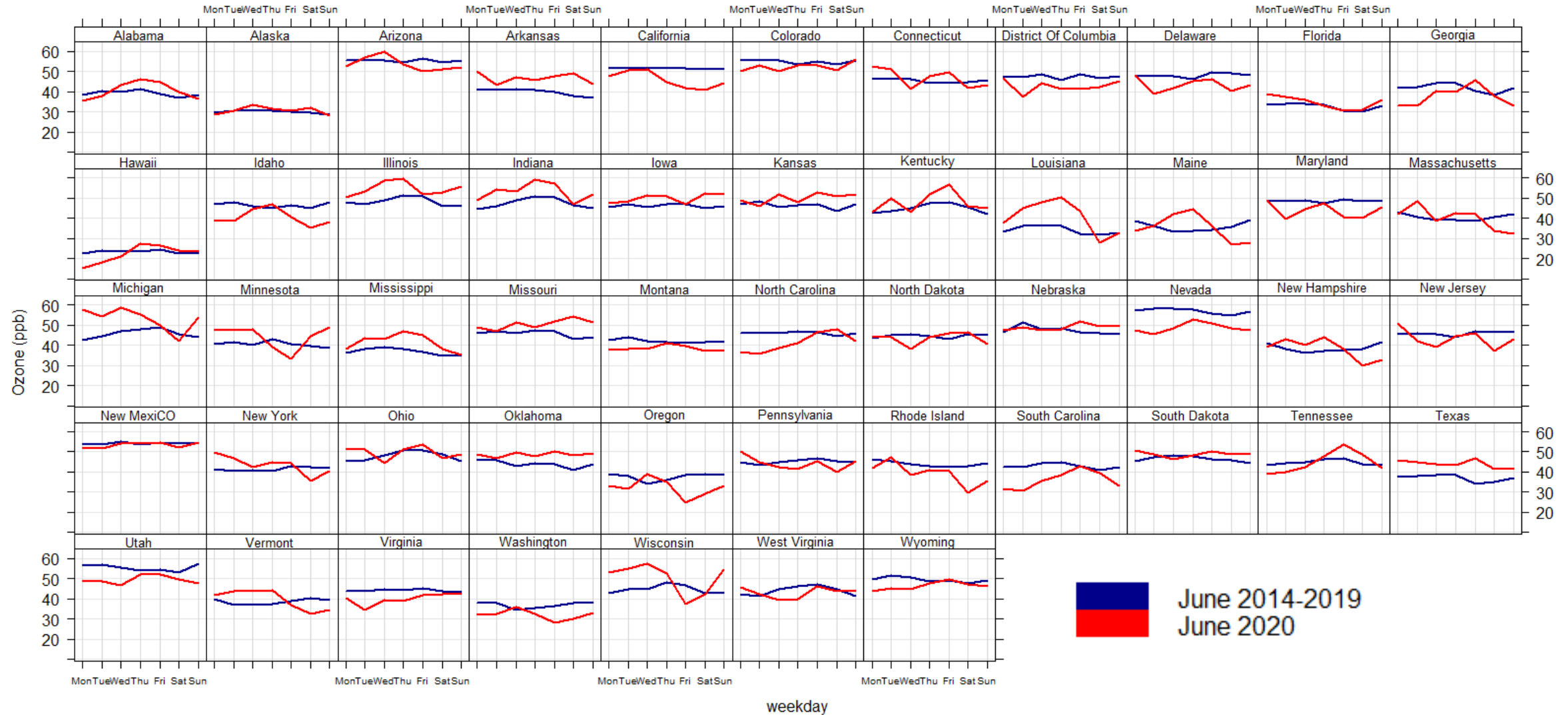
# National Ozone Data by Weekday - April



# National Ozone Data by Weekday - May



# National Ozone Data by Weekday - June

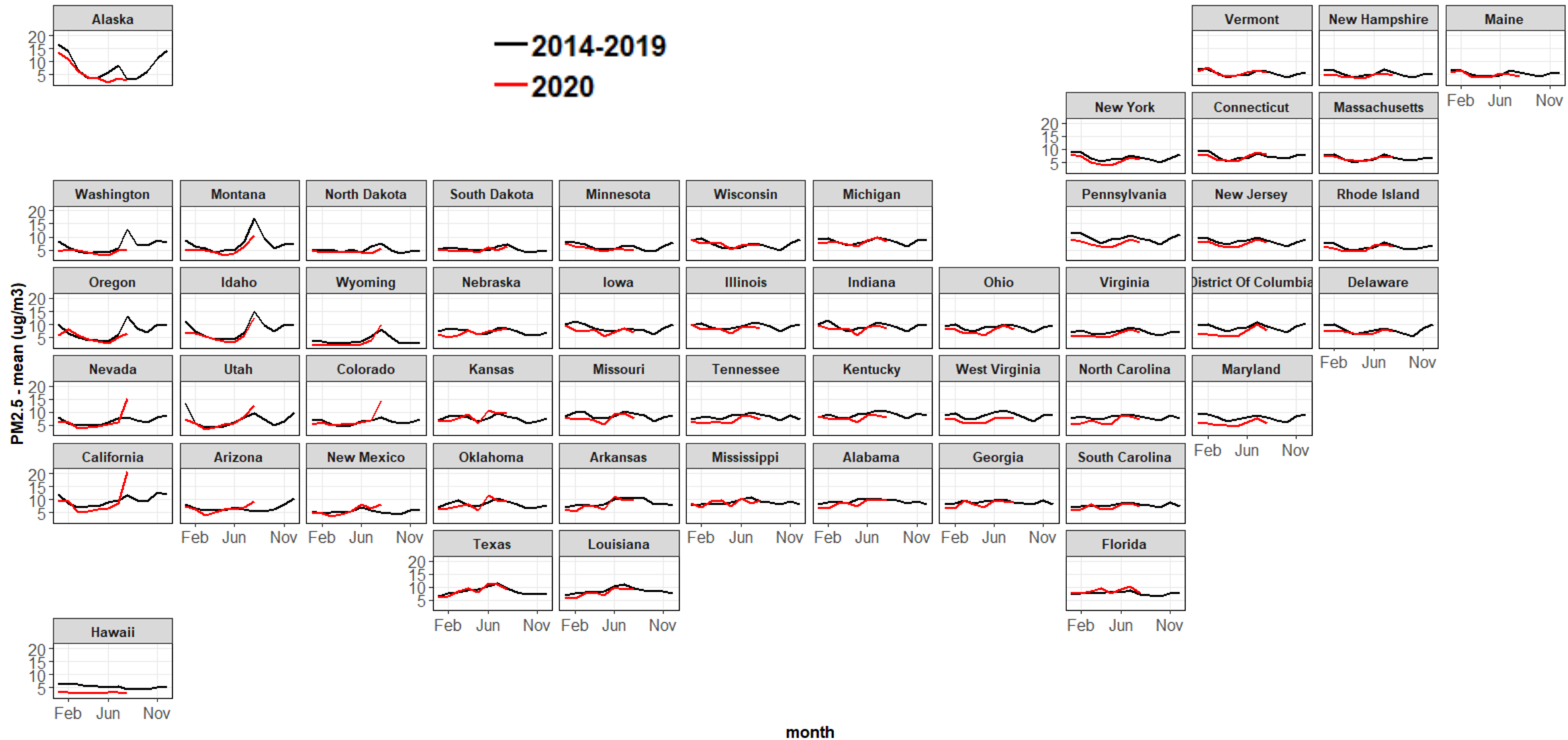






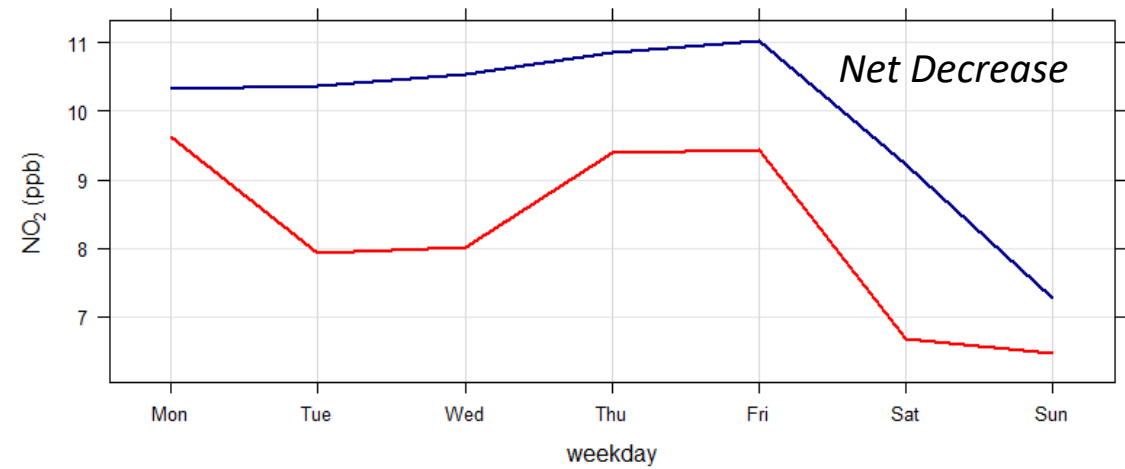
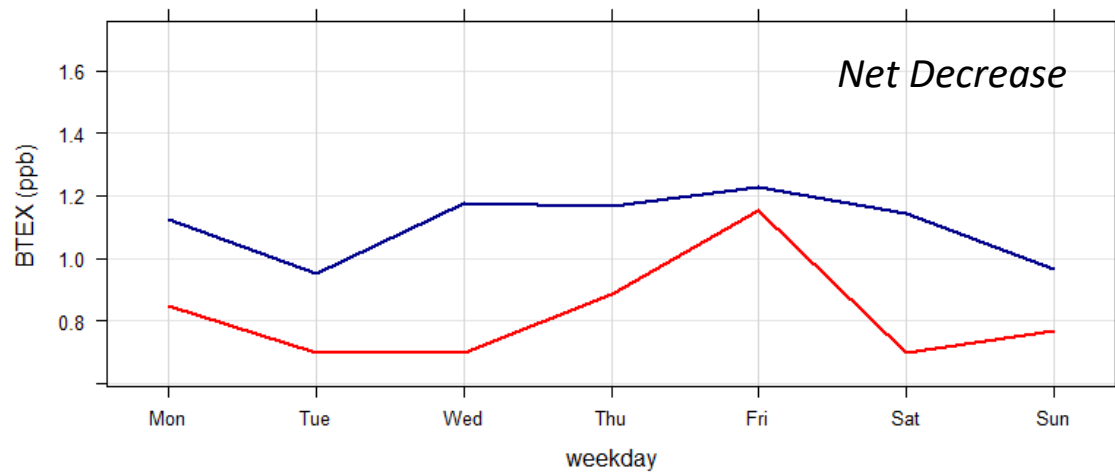
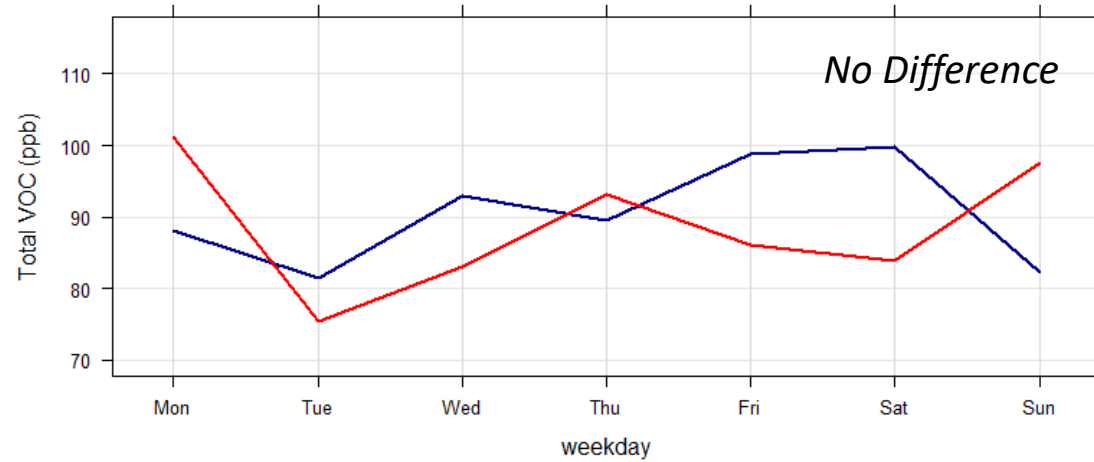


# PM2.5 Annual Comparison by Month



# Houston Air Pollution during COVID-19

2014-2019  
2020



# Houston Air Pollution during COVID-19

- Air pollution change in different COVID-19 time periods compared to the same historical time period (2014-2019):

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BTEX	39% ↓	32% ↓	26% ↓	21% ↓
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HARC



***Mustapha Beydoun***

[mbeydoun@HARCresearch.org](mailto:mbeydoun@HARCresearch.org)

(281) 364-6046

***Ebrahim Eslami***

[eeslami@HARCresearch.org](mailto:eeslami@HARCresearch.org)

(281) 364-6049

[HARCresearch.org](http://HARCresearch.org)