



# Incorporating Satellite Data Into TCEQ Programs

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Air Modeling and Data Analysis

**AOS Applications  
Seminar Series**

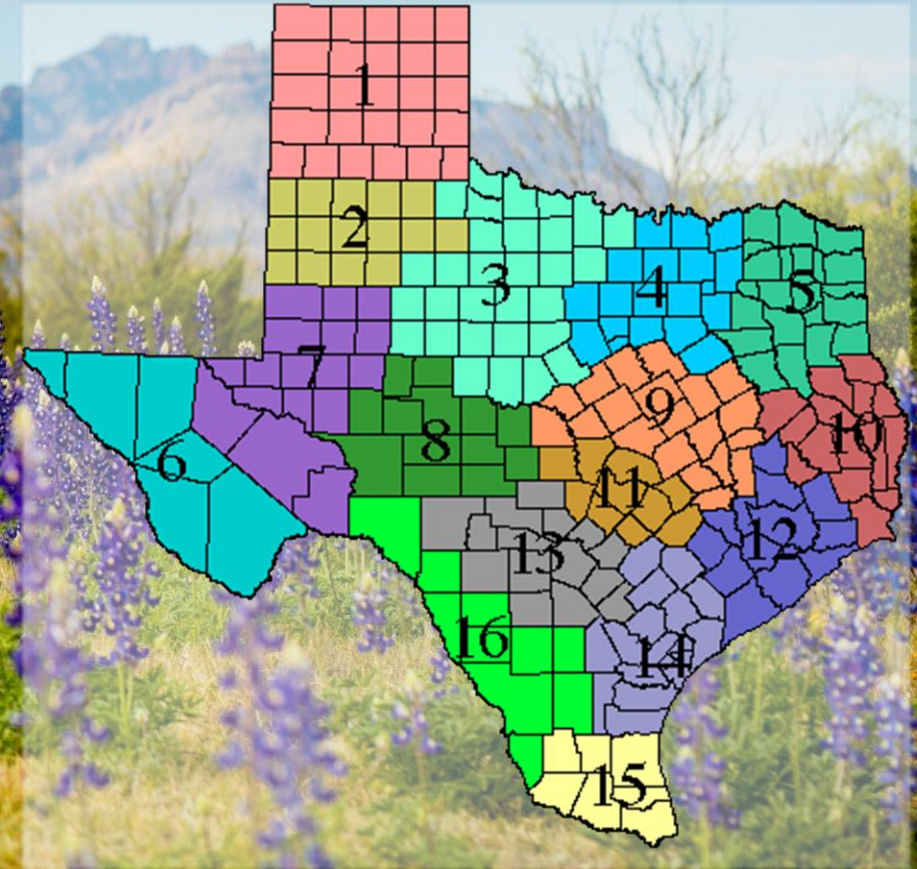
September 15, 2022

# Outline

- TCEQ Background
- Relevant Air Quality Programs
- Recent Major Field Study: TRACER-AQ
- Future Challenges

# Texas Commission on Environmental Quality

- ~2,800 employees
- 16 regions
- 254 counties
- ~29 million residents



Protecting Texas by Reducing and Preventing Pollution

# What's Special About Texas?

## • Geography:

- Second largest state
- Lush piney woods to desert mountains, subtropical beaches to windswept high plains

## • Demography:

- Second-most populous state; four of eleven largest cities in the U.S.
- Top two fastest growing metro areas (Fort Worth, Austin)<sup>1</sup>

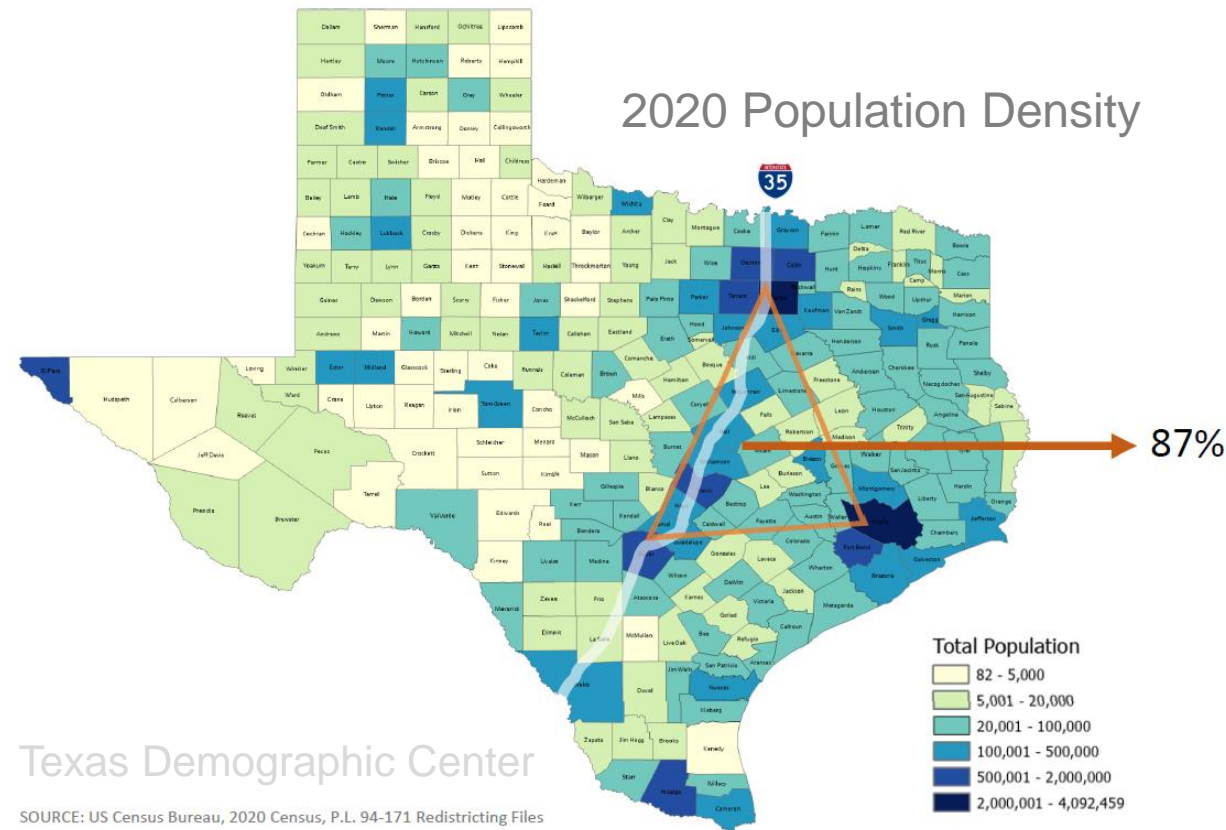
## • Economy:

- Ninth largest economy in the world<sup>2</sup>
- Significant oil and gas production
- Nation's leading exporter (in dollars)<sup>3</sup>

<sup>1</sup>Brookings Institution

<sup>2</sup>Bureau of Economic Analysis

<sup>3</sup>U.S. Department of Commerce



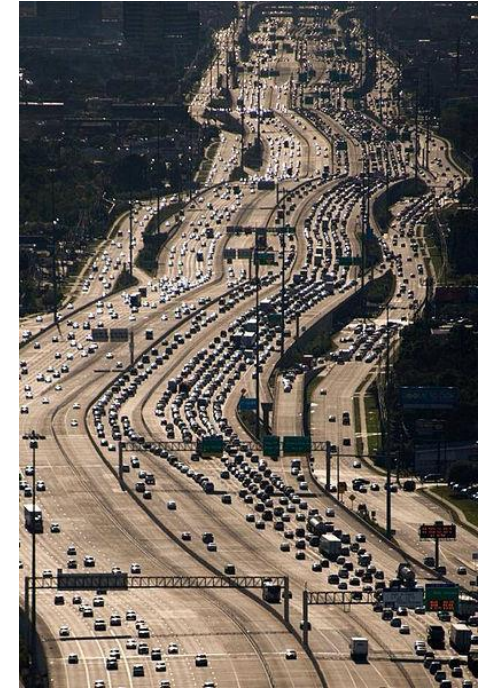
# What's Special About Texas?

- Emission sources:

- Oil and gas exploration & production
- Petroleum refining and petrochemical production
- Biogenic isoprene and terpenes from oak and pine forests
- Mobile sources
- Large urban areas

- Meteorology:

- Precipitation increases from 8 to 60 inches/year from West to East Texas.
- It's **all hot** in the summer.

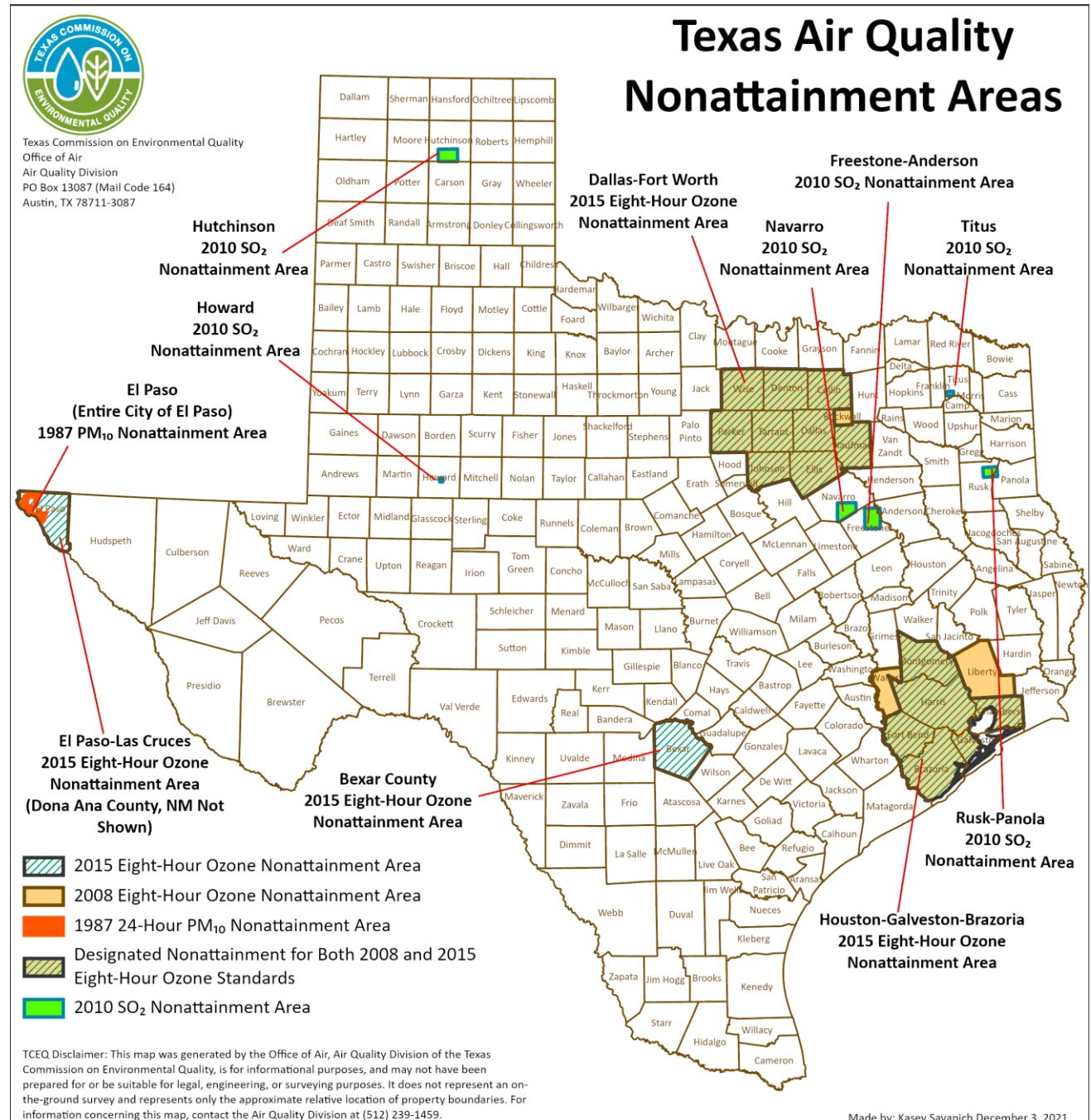


# Air Quality Challenges

- Health-based standards for six criteria air pollutants:

- Ground-Level Ozone ( $O_3$ )
- Particulate Matter (PM)
- Nitrogen Dioxide ( $NO_2$ )
- Sulfur Dioxide ( $SO_2$ )
- Carbon Monoxide (CO)
- Lead (Pb)

- Hazardous Air Pollutants



# How Do We (typically) Measure Air Quality?

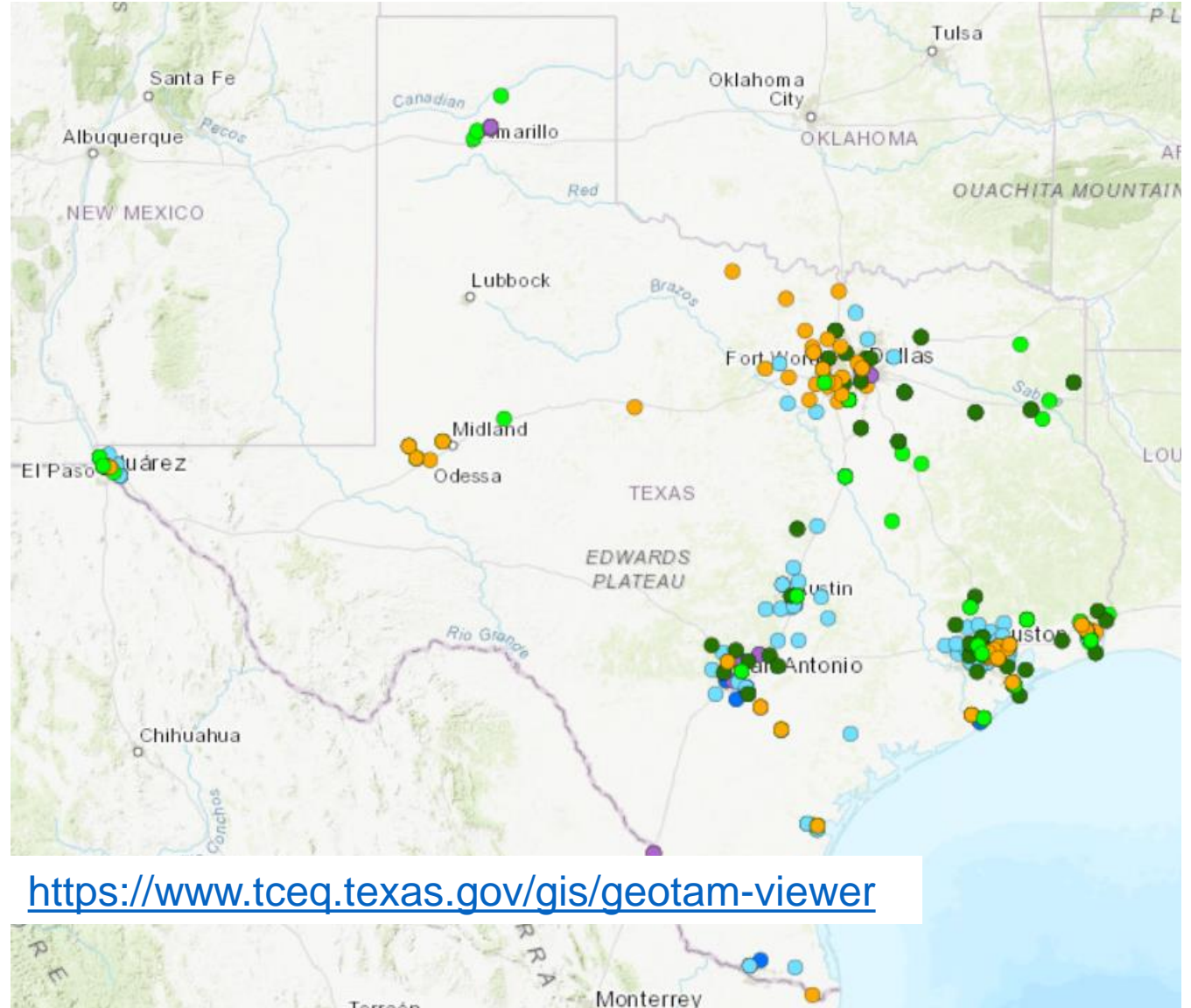


## Air Quality Data Resources

EPA: <https://www.airnow.gov/>

TCEQ:

<https://www.tceq.texas.gov/agency/data/air-quality-data.html>



<https://www.tceq.texas.gov/gis/geotam-viewer>

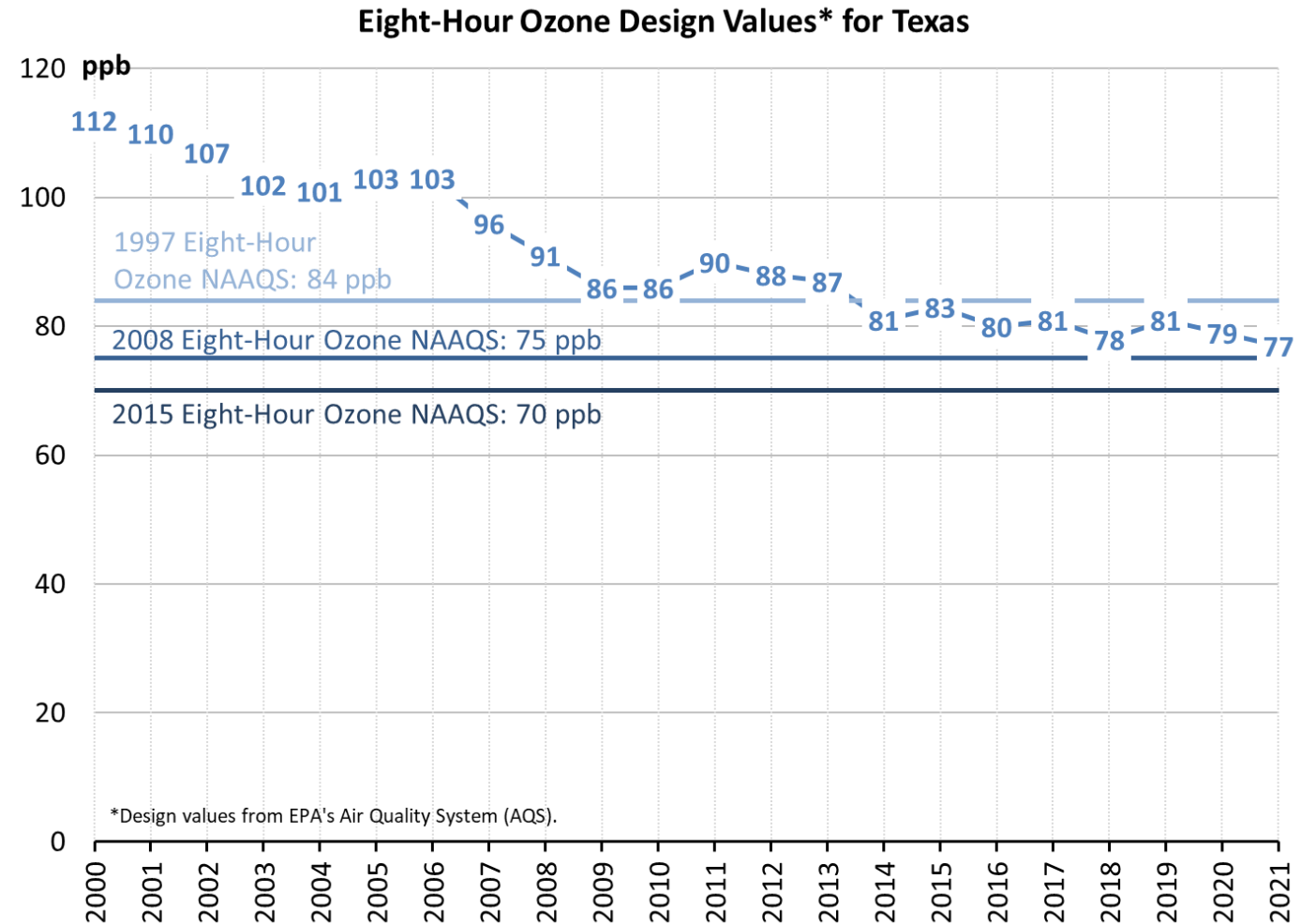
# Relevant Air Quality Activities

- Comparisons to health-based standards
- Exceptional events and elevated concentration days
- Photochemical modeling
- Forecasting
- Transport (interstate and international)
- Regional haze

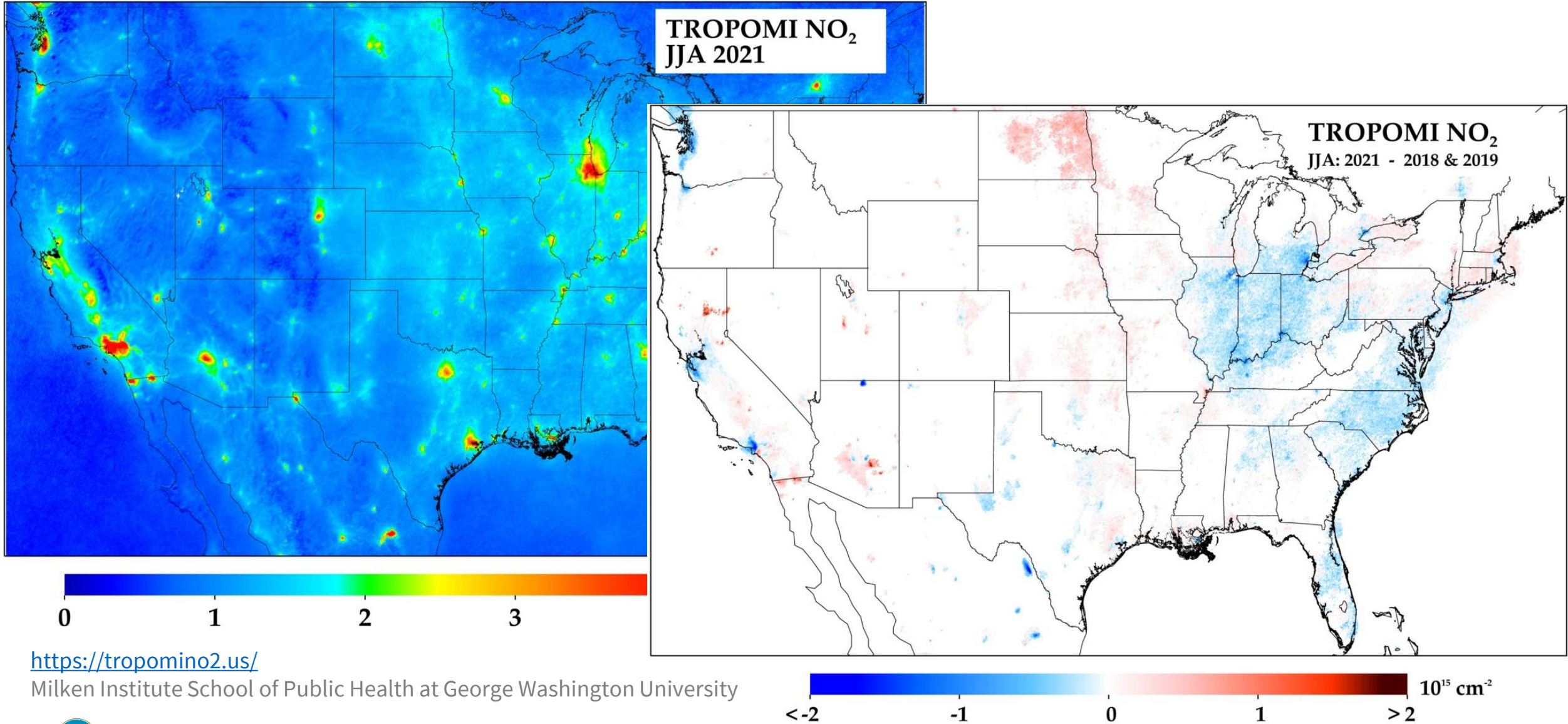


# Data Analyses: Comparisons to Health-Based Standards

- Determine compliance with the health-based standards.
  - Required to use federal reference method surface monitors.
- Analyze trends.
  - Where and when are high levels most likely?
  - Are there seasonal/diurnal patterns?



# Data Analyses: Satellite Data to Support Surface Trends

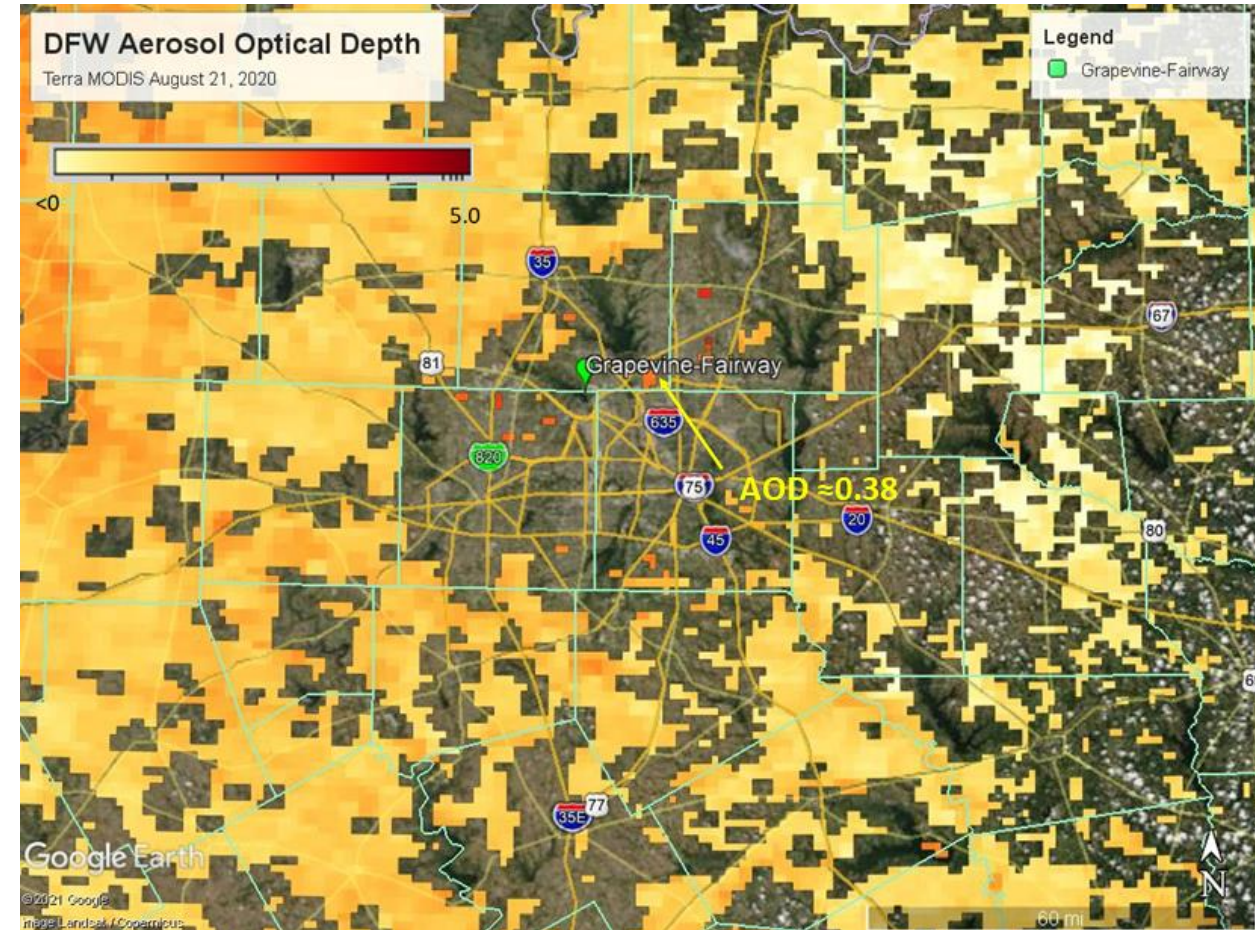
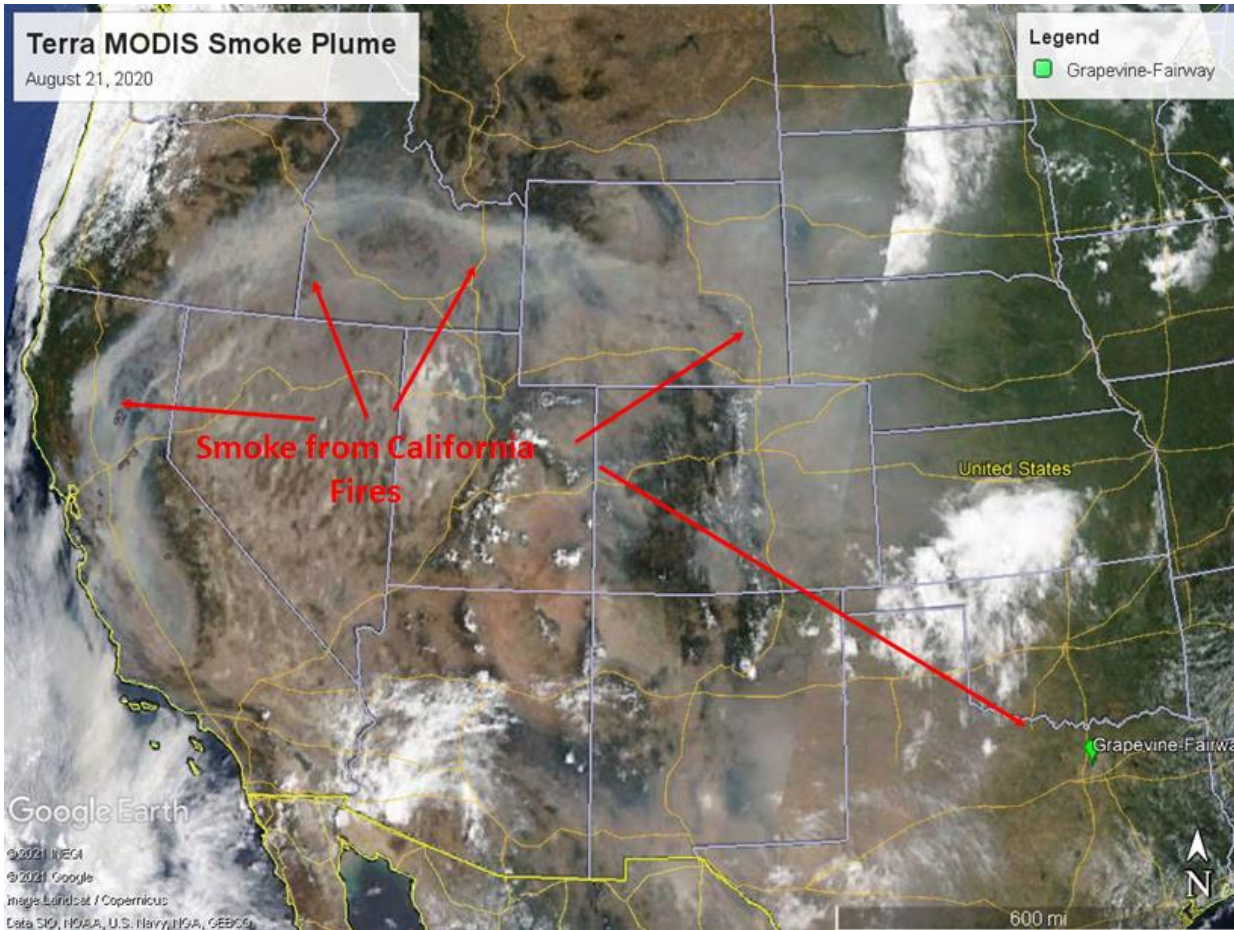


<https://tropomino2.us/>

Milken Institute School of Public Health at George Washington University

# Data Analyses: Exceptional Events and Elevated Days

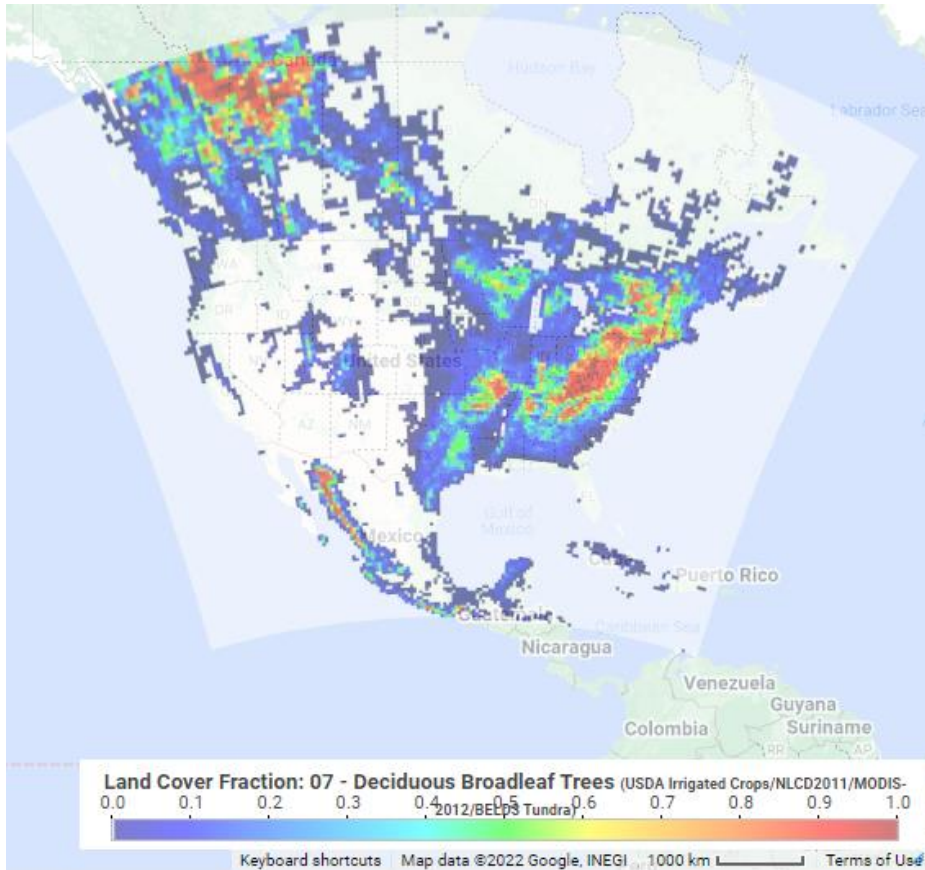
- Evaluate days/events with elevated concentrations.
  - Was it a local and/or transported event? Were the weather and emissions like past events?



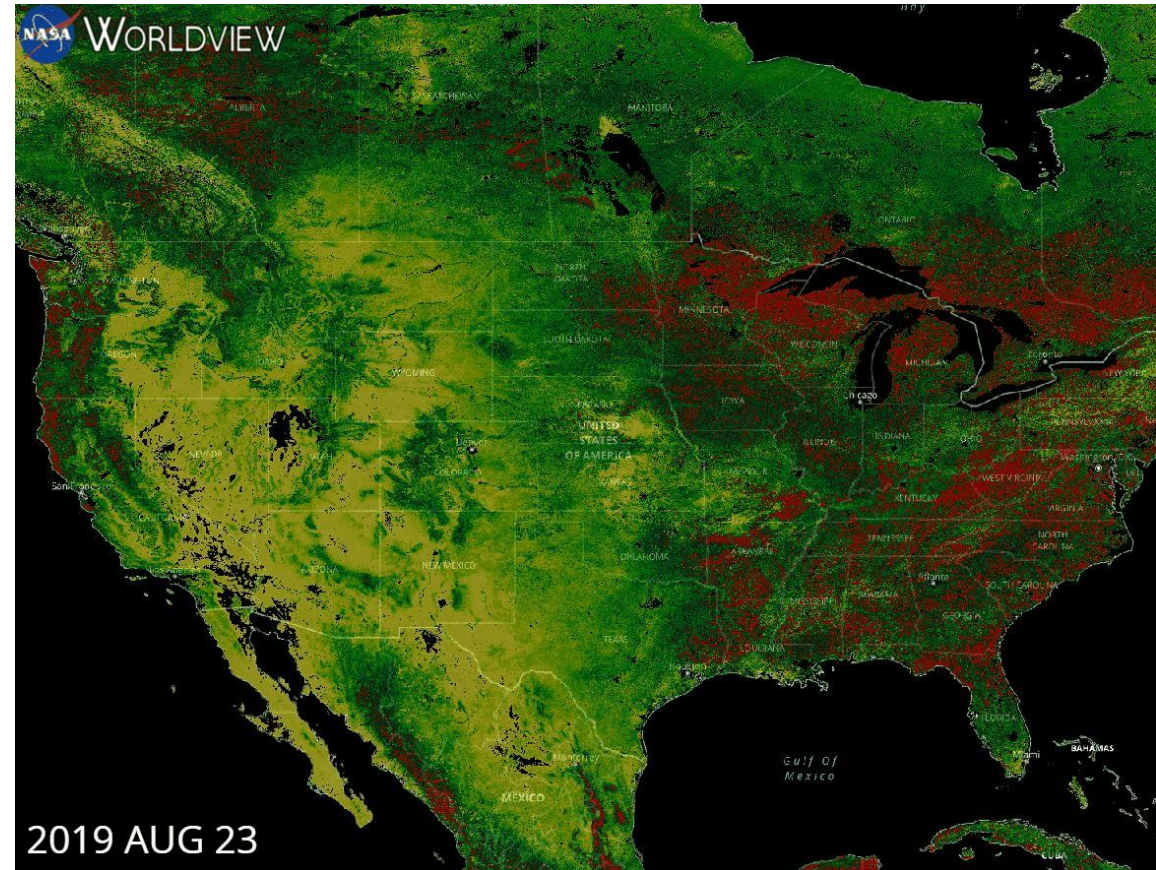
# Photochemical Modeling

- Satellite data is necessary for input development and useful for model performance evaluation.

Landcover

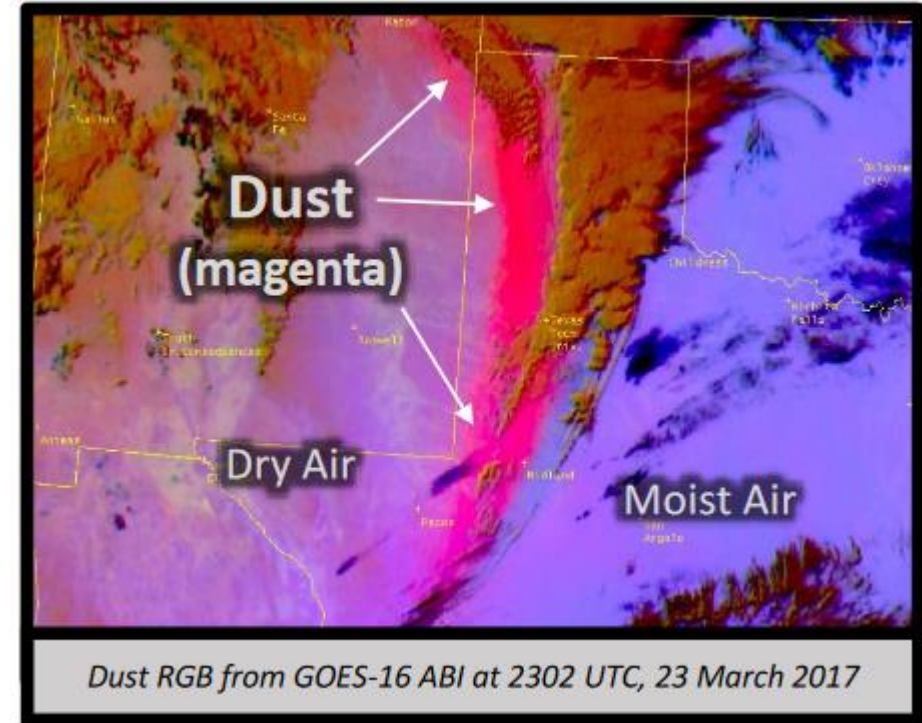
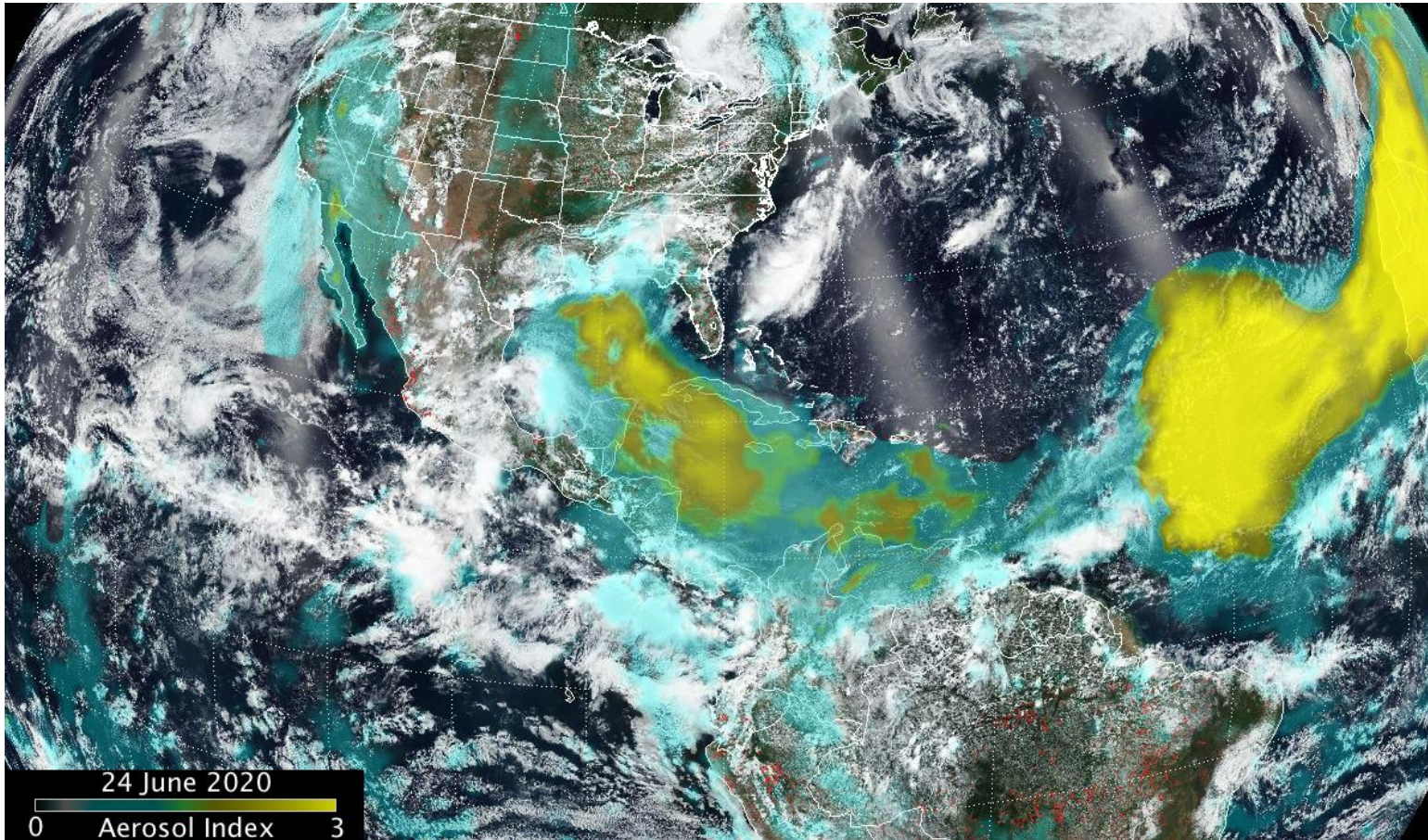


Leaf Area Index



# Air Quality Forecasting

- Daily forecasts (Ozone, PM<sub>2.5</sub>, and PM<sub>10</sub>) for urban areas of the state.

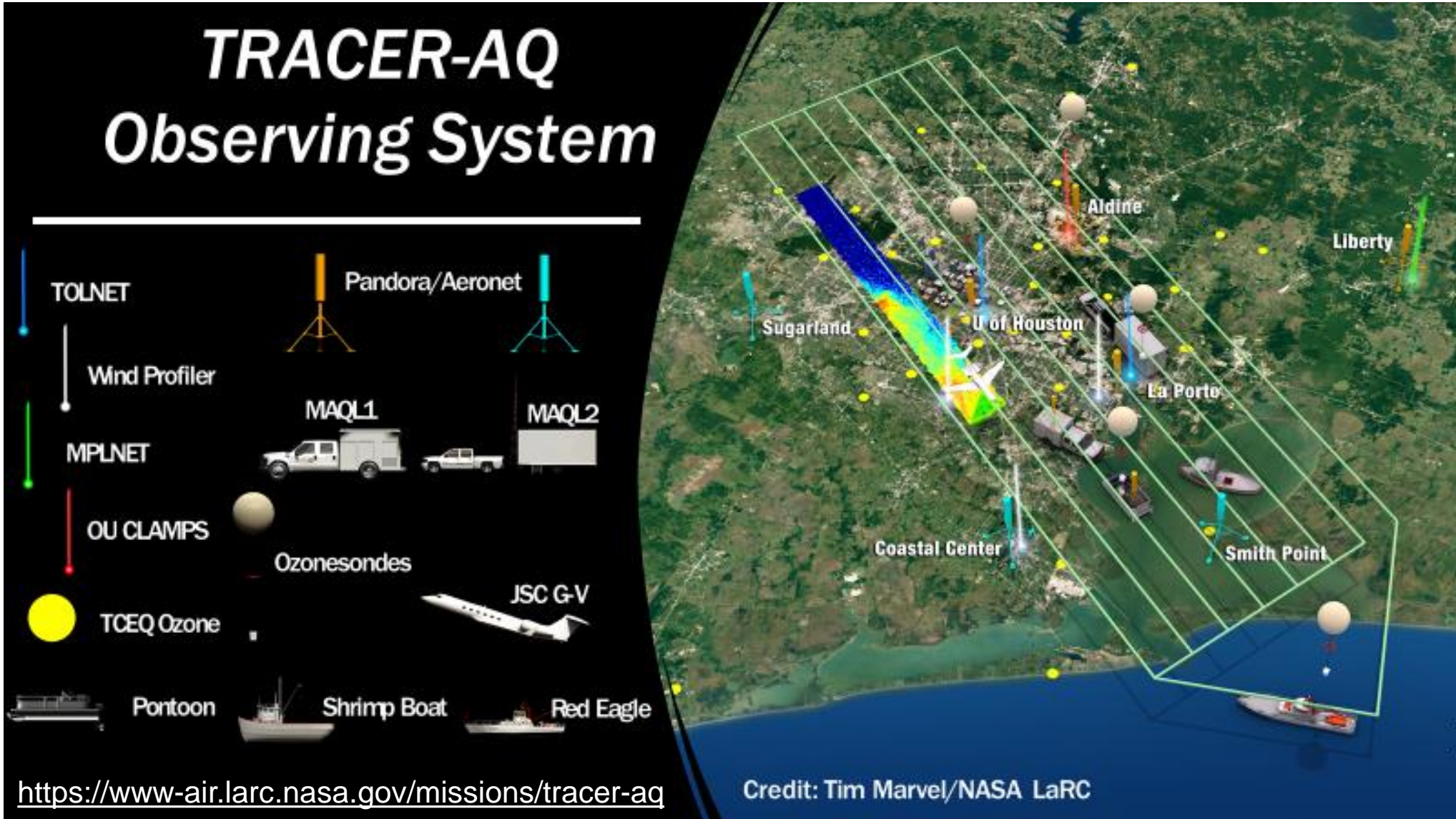


# Air Quality Research in Texas: Example Projects

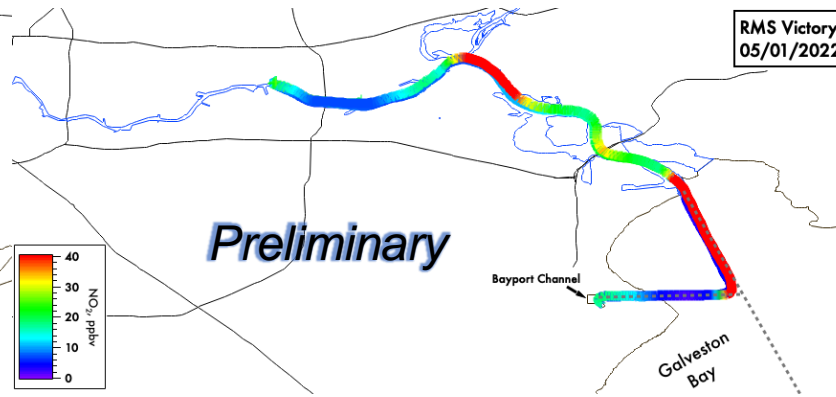
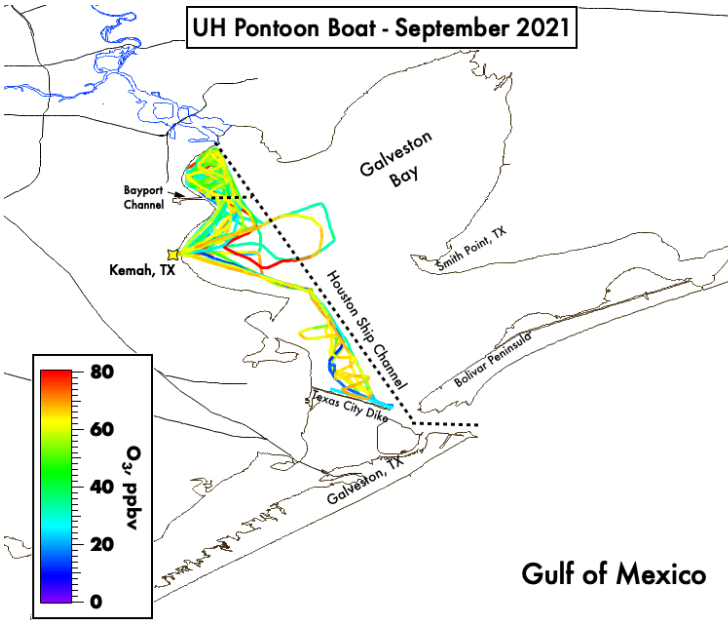
- Air Quality Research Program (AQRP)
  - Evaluating emission inventories using satellite data and a photochemical model.
  - <http://aqrp.ceer.utexas.edu/>
- TCEQ funded applied research
  - Tracking smoke plumes from GOES and TROPOMI satellite data.
  - <https://www.tceq.texas.gov/airquality/airmod/project/>
- NASA Health and Air Quality Applied Sciences Team (HAQAST) participation
  - Incorporating satellite data into air quality plans.
  - <https://haqast.org/>



# 2021 TRacking Aerosol Convection ExpeRiment – Air Quality

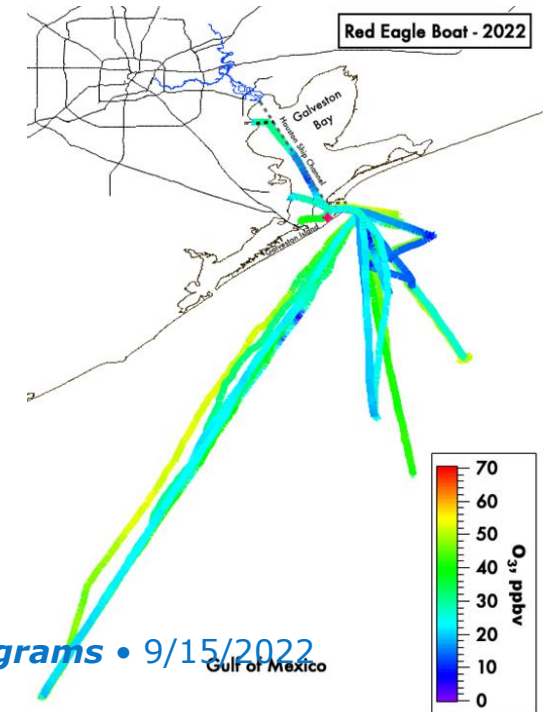


# How Does the Coastal Environment Influence Ozone Formation?



Preliminary

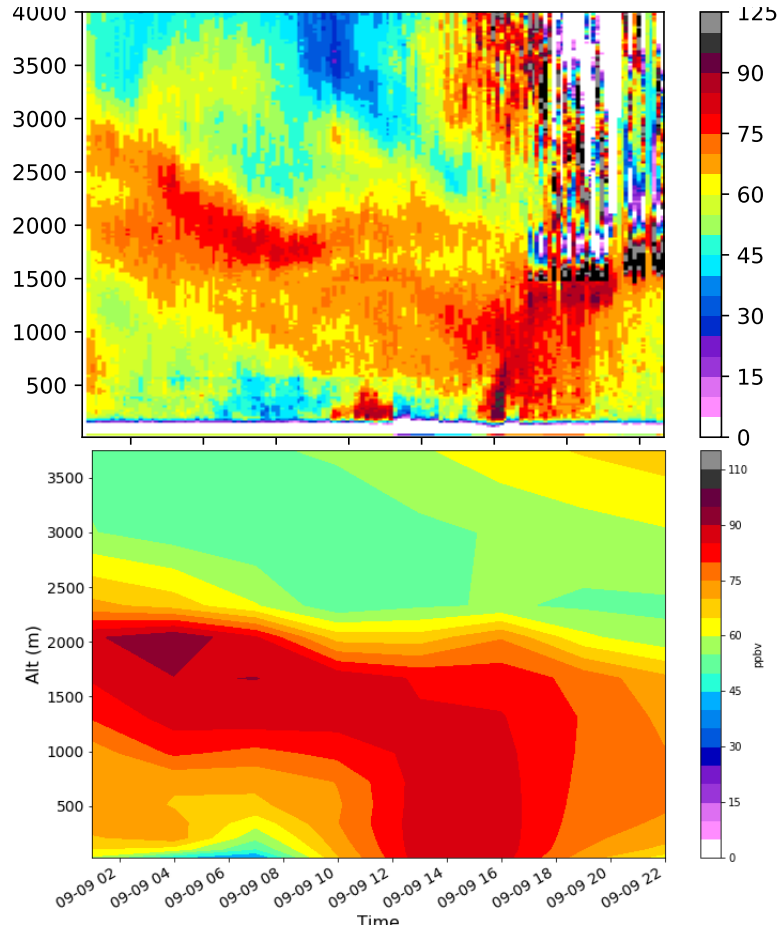
University of Houston





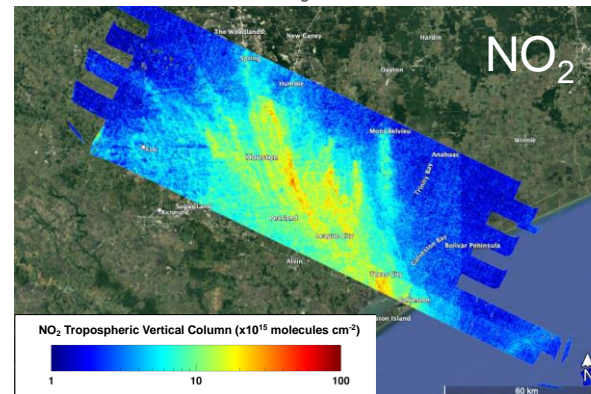
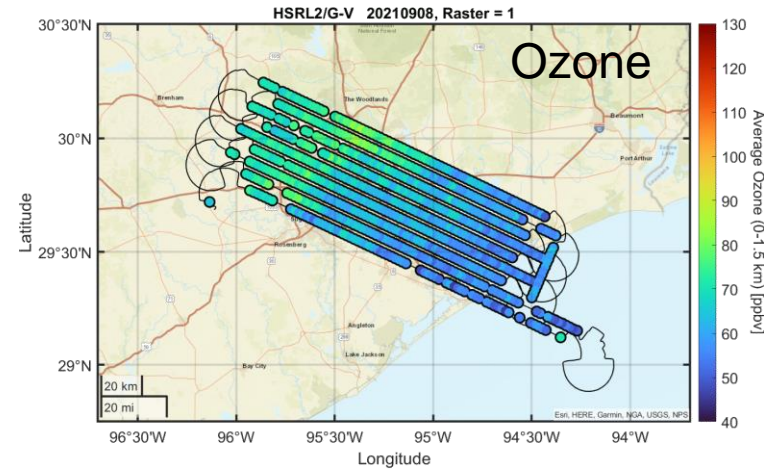
# How Do Pollutants Vary Spatially, Vertically, and Temporally?

## Ozone lidar (2021)

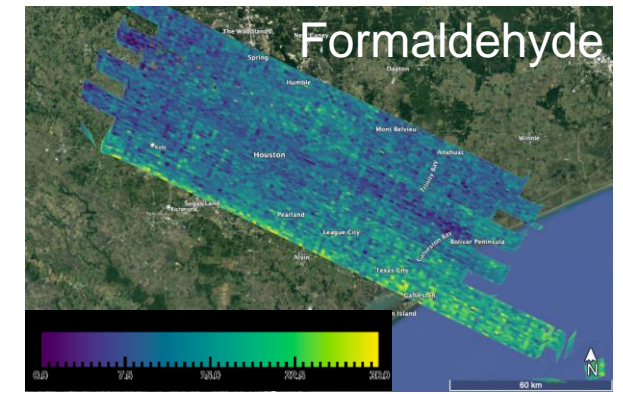
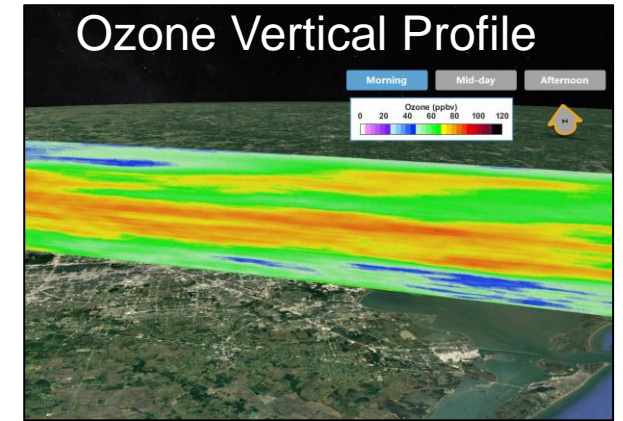


Dr. John Sullivan, NASA

## Aircraft remote sensing (2021)



NO<sub>2</sub> = Nitrogen Dioxide



Dr. Laura Judd, NASA

# Future Challenges

- Lower PM<sub>2.5</sub> standard?
- Additional nonattainment areas?

# Satellite Data Needs

- Vertical gradient
- Speciation and composition
- Ozone production sensitivity (NO<sub>x</sub>/VOC)

# Contact

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