

# Mobile Source Modeling: Strengths, Weaknesses, and Opportunities for Improvement

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# State of Technology



- LADCO works directly with US EPA to build onroad and nonroad emissions inventories for modeling; we pool resources and expertise.
- MOVES is EPA's Java/MYSQL software for calculating onroad (cars/trucks) emissions.
- Needs fleet age/technology, activity, fuel, vehicle population and speed.
- LADCO has worked with Coordinating Research Council (CRC) to improve MOVES inputs like speed, age, and temporal profiles.

# Coordinating Research Council (CRC)

## Auto/Oil industry group

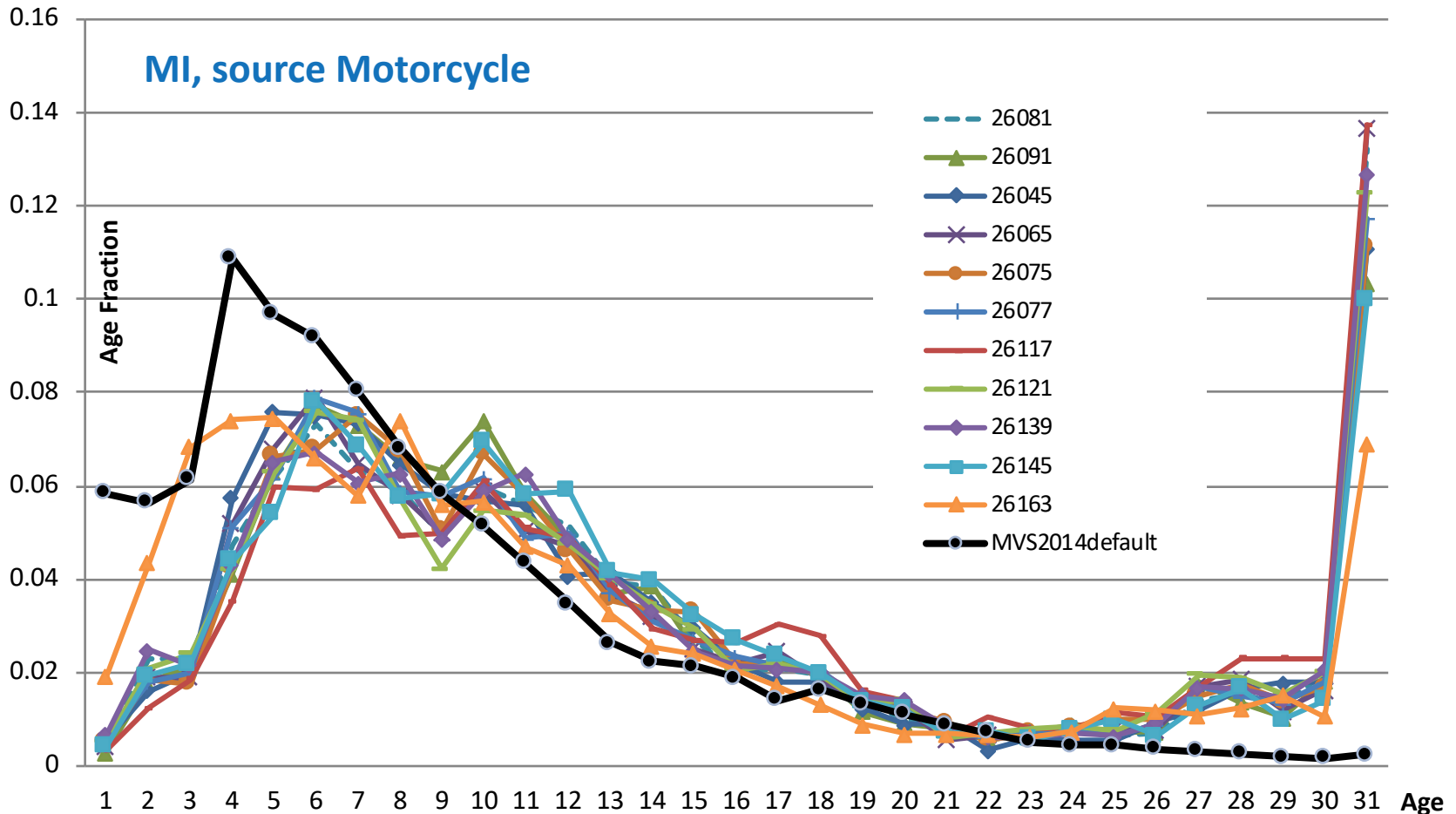


### LADCO led six projects through CRC to evaluate MOVES inputs

- **A-84:** Identified the input variables most likely to impact modeling and inventories: vehicle age, car/truck mix, vehicle count, speed distribution, road type distribution.
- **A-88:** National VIN decode for 2011, get vehicle counts. Use models to get passenger/heavy truck mix
- **A-100:** Use of telemetry data to improve MOVES inputs: speed distribution, temporal
- **A-103:** Improve cloud based computing
- **A-106:** Improved start information from telemetry
- **A-115:** Re-evaluate VIN decode techniques and update age distributions.
- **A-119:** (Pending) project to build modeling to remote sensing tools.

# Age Distribution Example

(from CRC Project A-88)

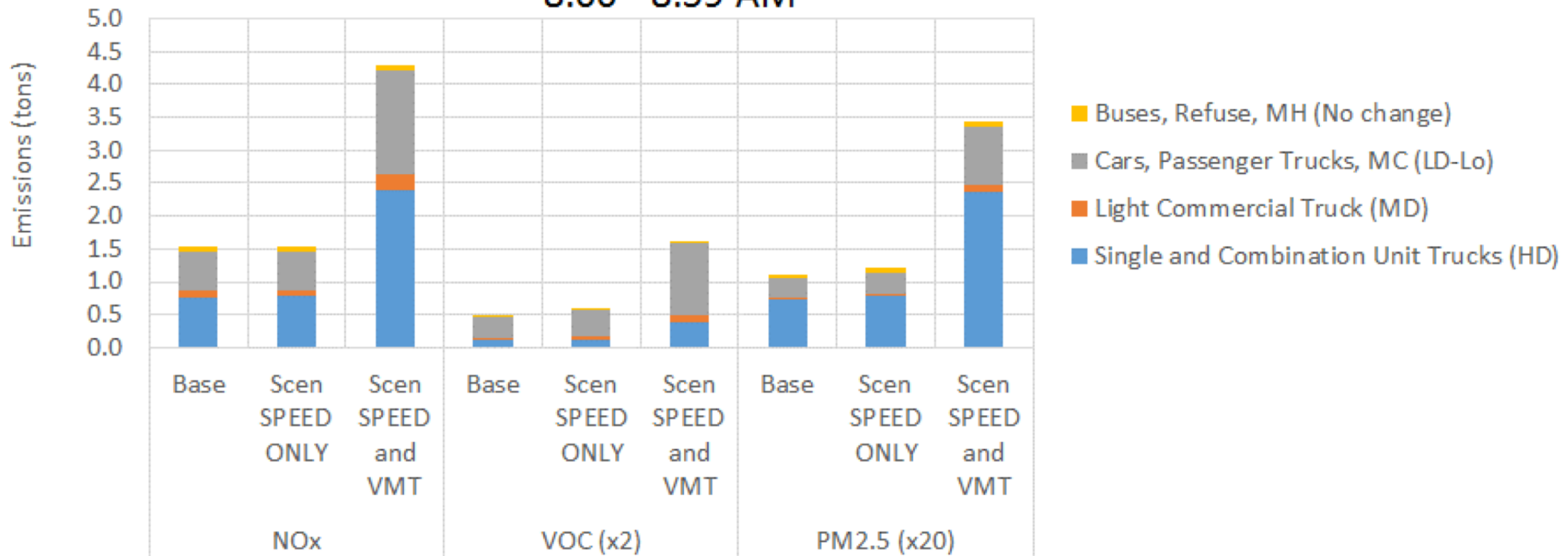




# Chicago Telemetry Data



Urban Restricted Access  
8:00 - 8:59 AM

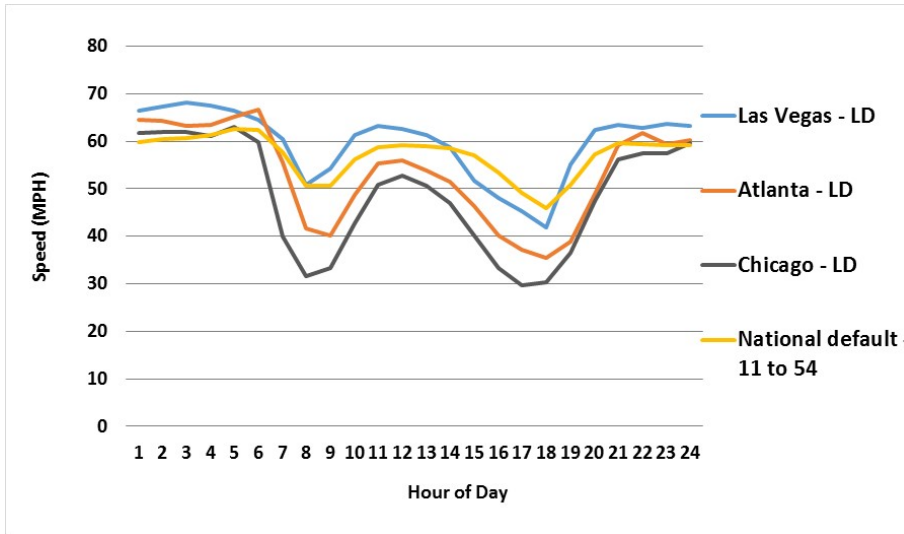


# Telemetry Data Improvement

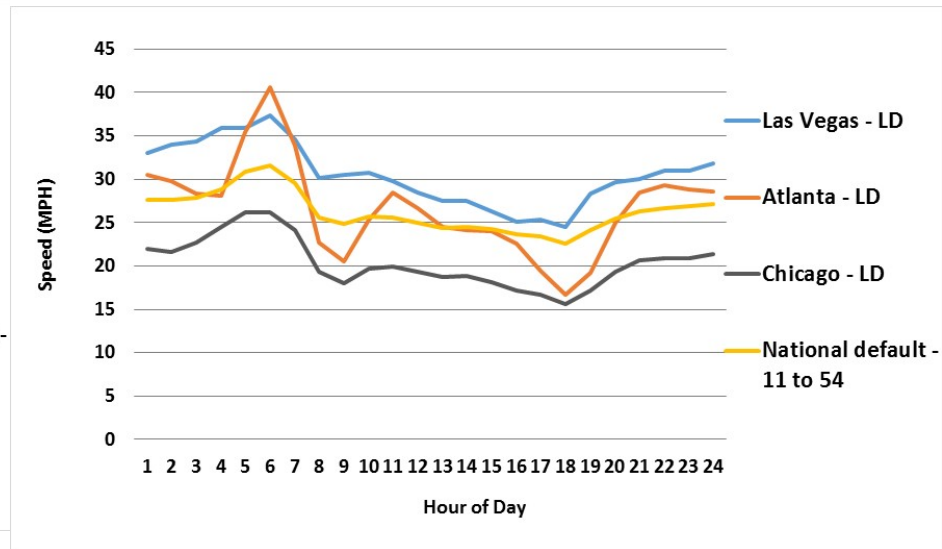
## Weekday, LD Passenger Vehicles



Urban Restricted Roads



Urban Unrestricted Roads

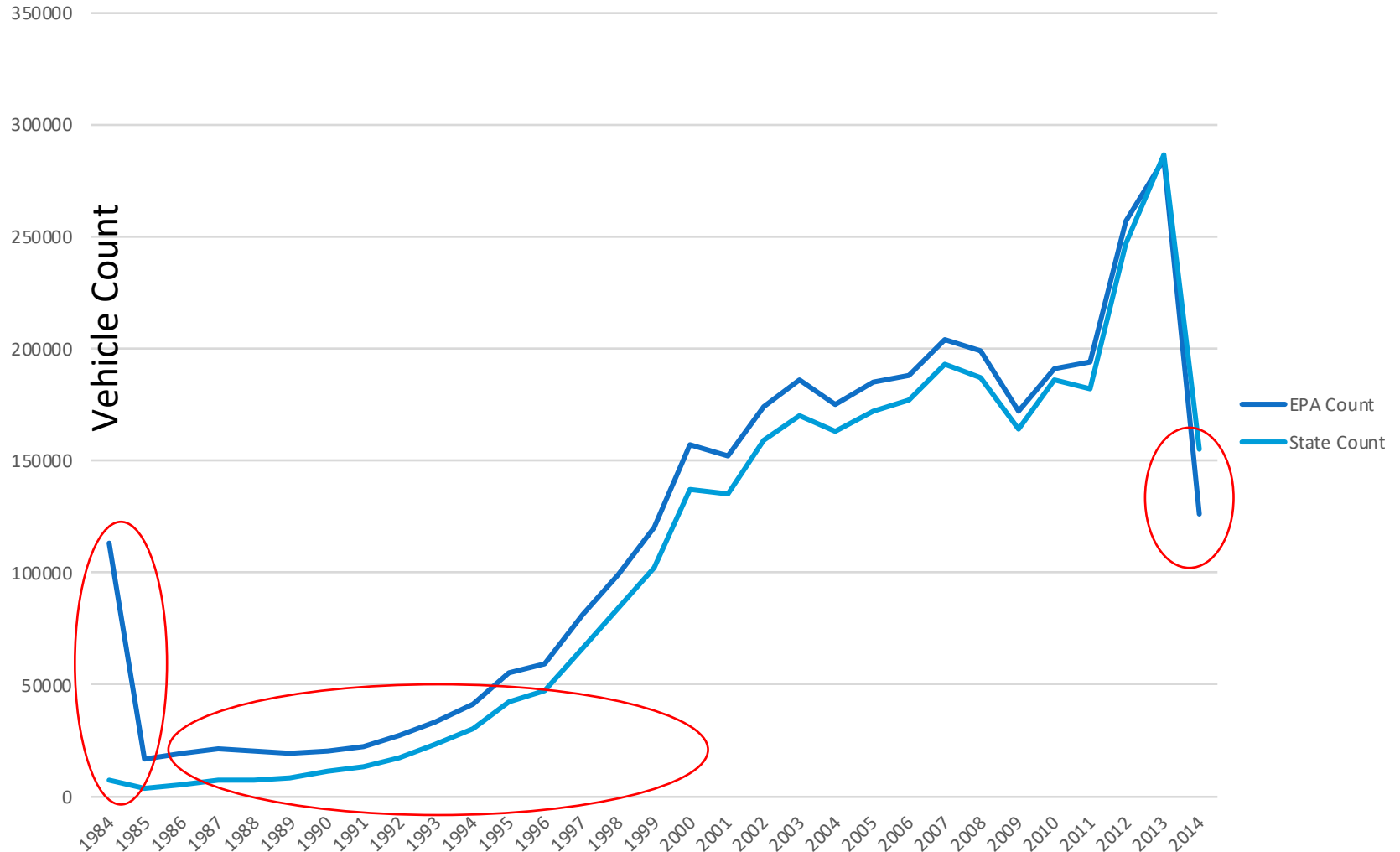


# 2014 Vehicle Count by Age

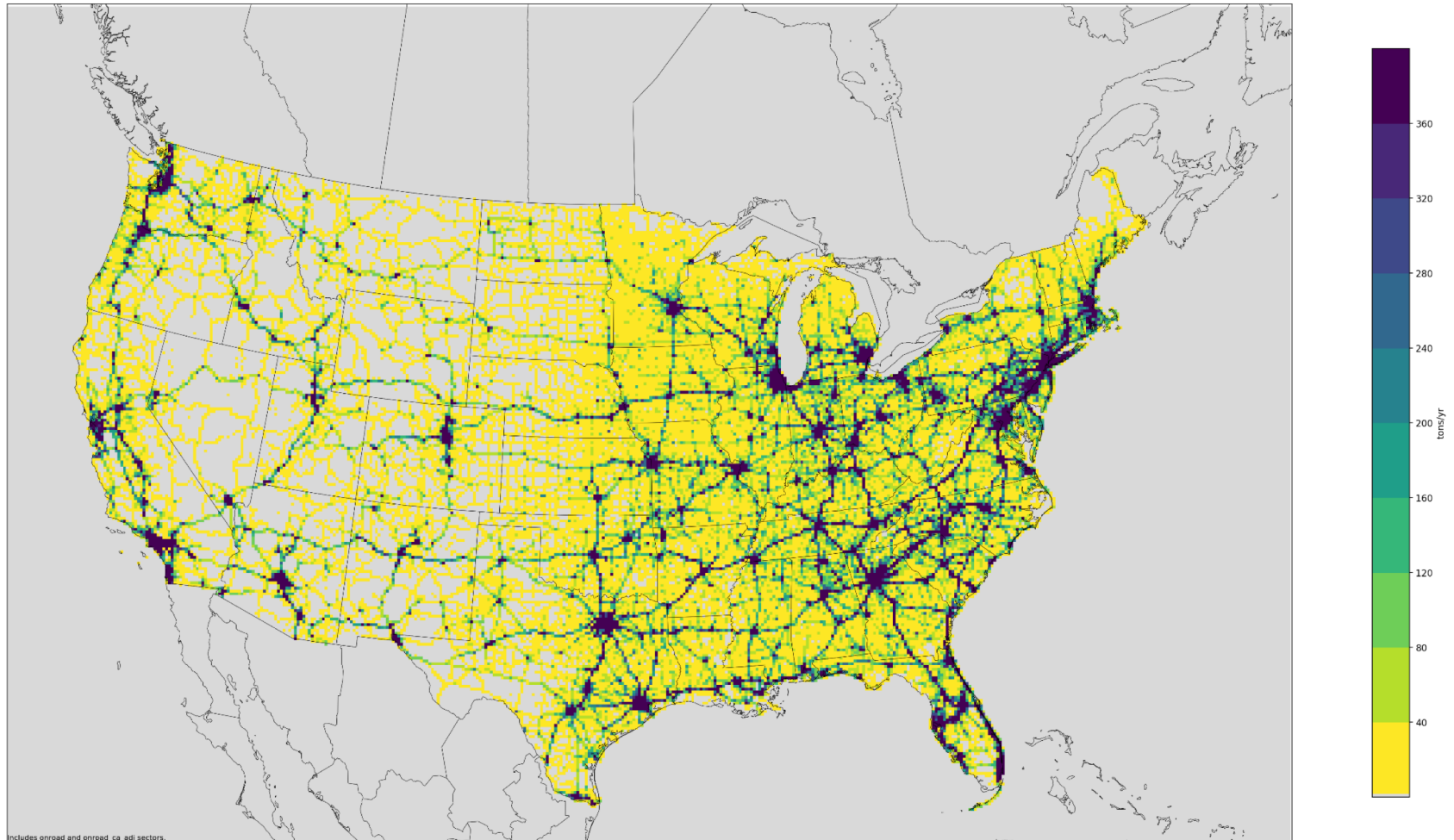
## Passenger Cars



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2016ff onroad annual : NOX



# Onroad Mobile Data Strengths



- We continue work with states and cities to improve transportation data. This includes reflecting the differences between states and cities.
- Changes to these inputs do have a measureable effect on emissions.
- Awareness that even if inputs are good, will model produce realistic emissions.
  - Use satellite and remote sensing data to verify inventories and models
  - Compare ground based measurements and Inventories

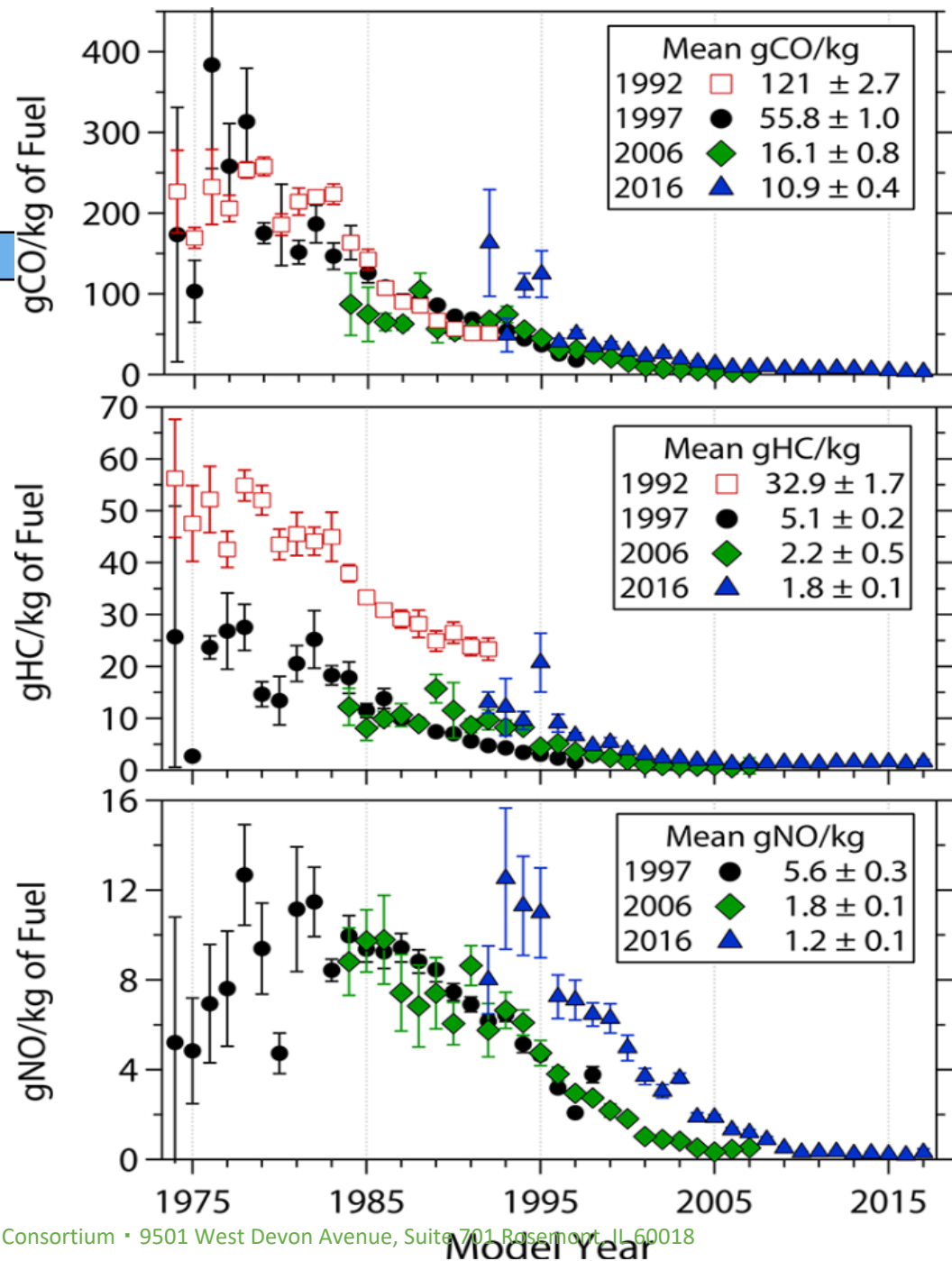
# Data Weaknesses



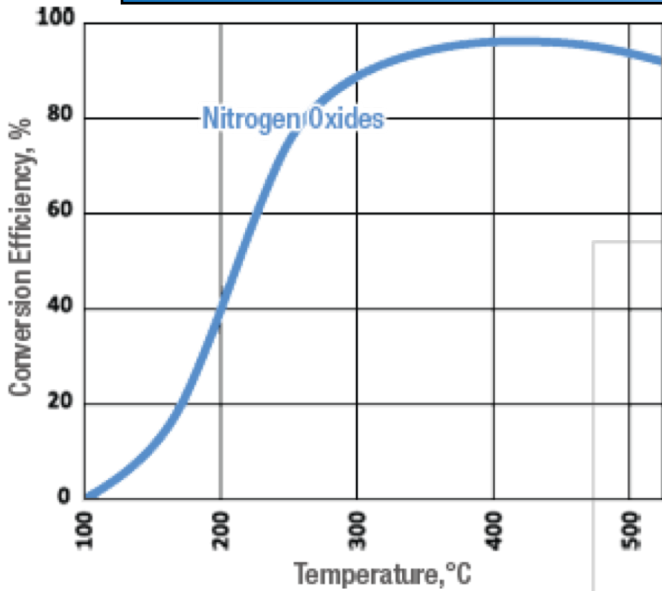
- Cars are becoming so clean that outliers define the category
- How does MOVES compare to real world data?
- MOVES is only as good as the drive cycles that it is based off. If drivers deviate from the predictable then we may see significant impact.



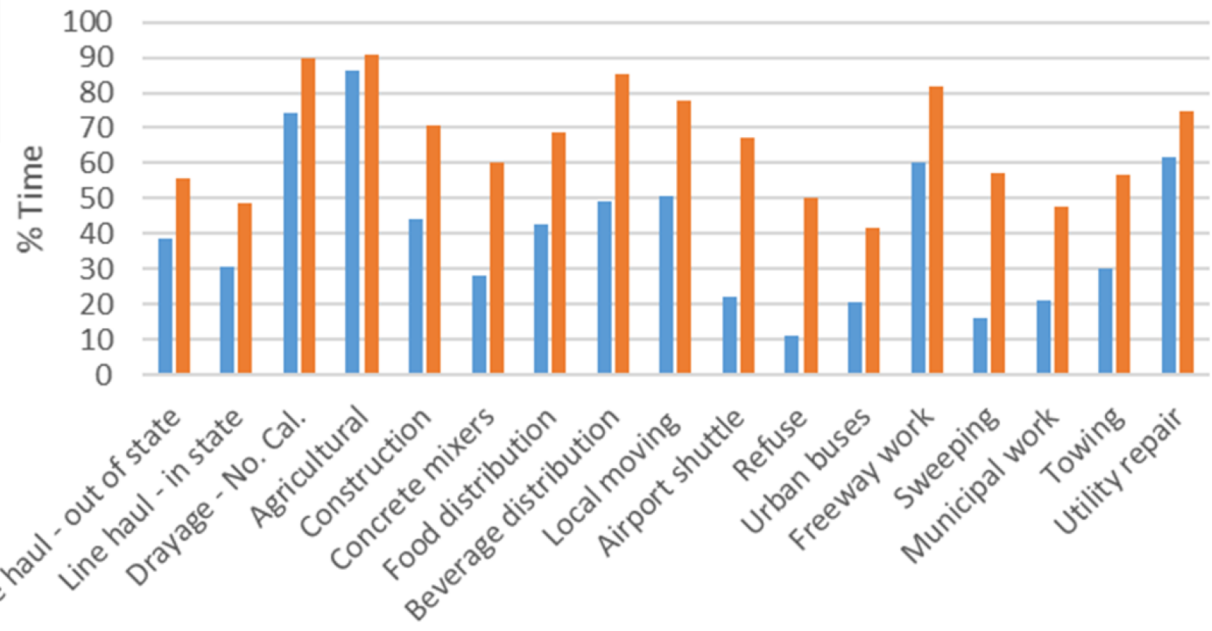
# Historic and current emissions rates from in-use measurements



# Heavy Duty Off Cycle Idling



Fraction with SCR Temperature Lower Than ■ 200 °C ■ 250 °C



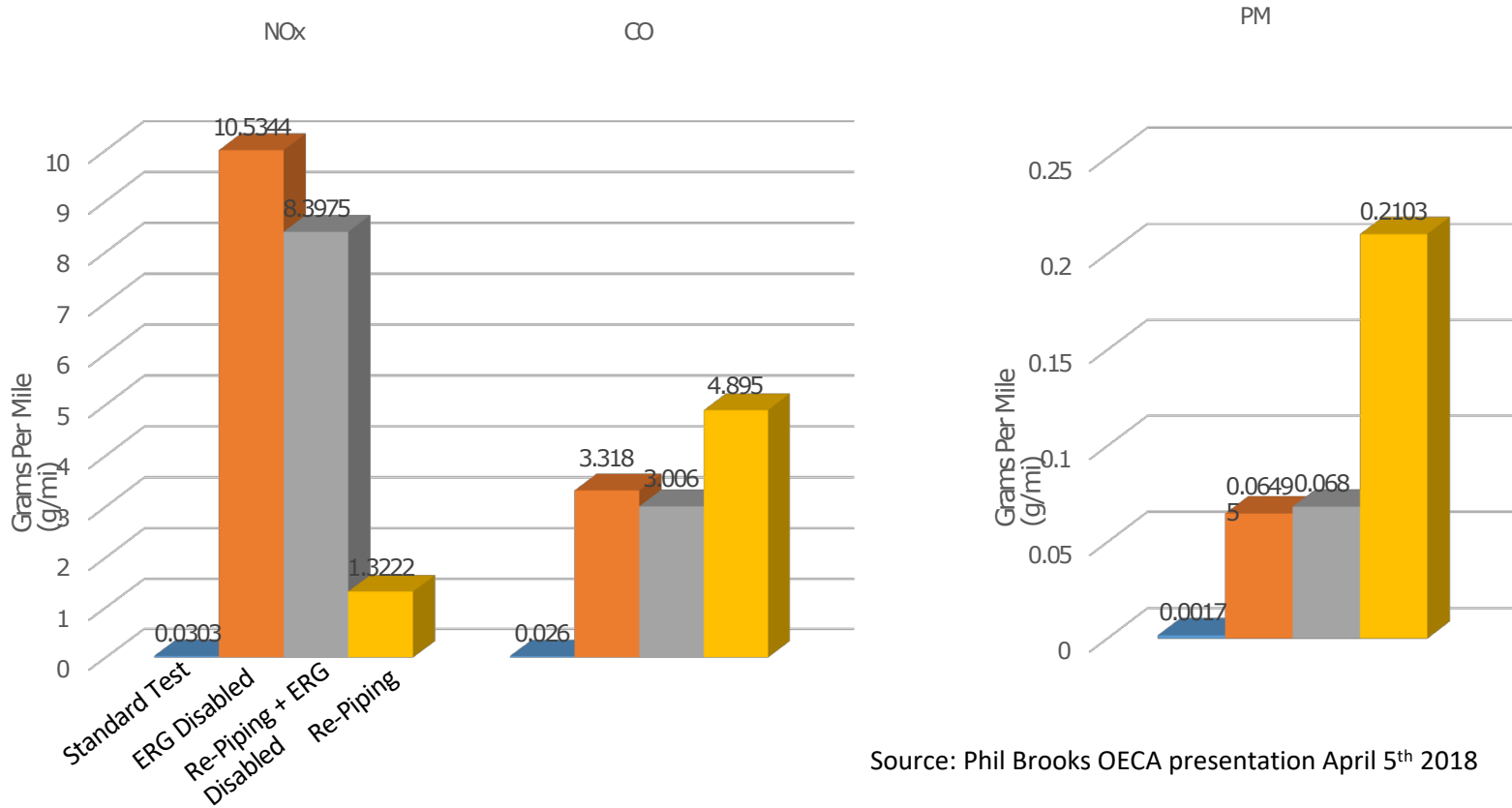
# Heavy Duty Defeat Device



- Aftermarket Defeat Device – “any part or component... where a principal effect...is to bypass, defeat, or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle...”

# EPA Tuner Emissions Tests

## Stock Calibration Equipment vs. Emissions Equipment wo/ Tuners



Source: Phil Brooks OECA presentation April 5<sup>th</sup> 2018

# Nonroad Mobile Sources



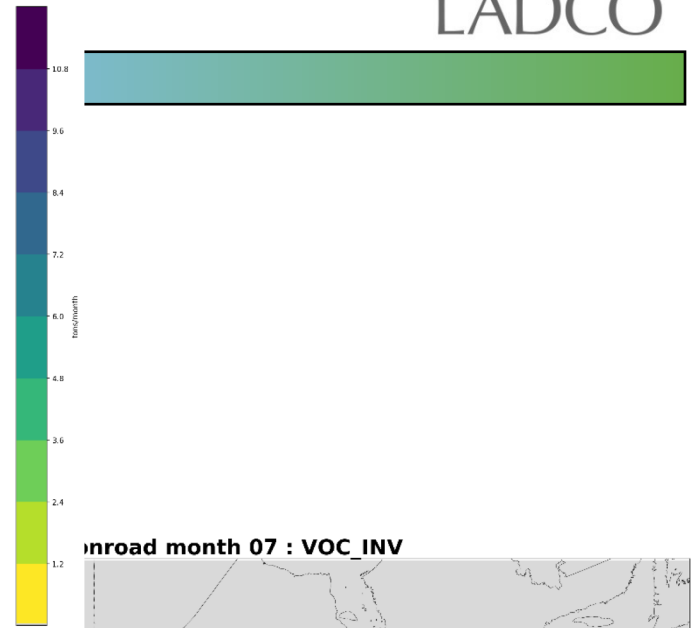
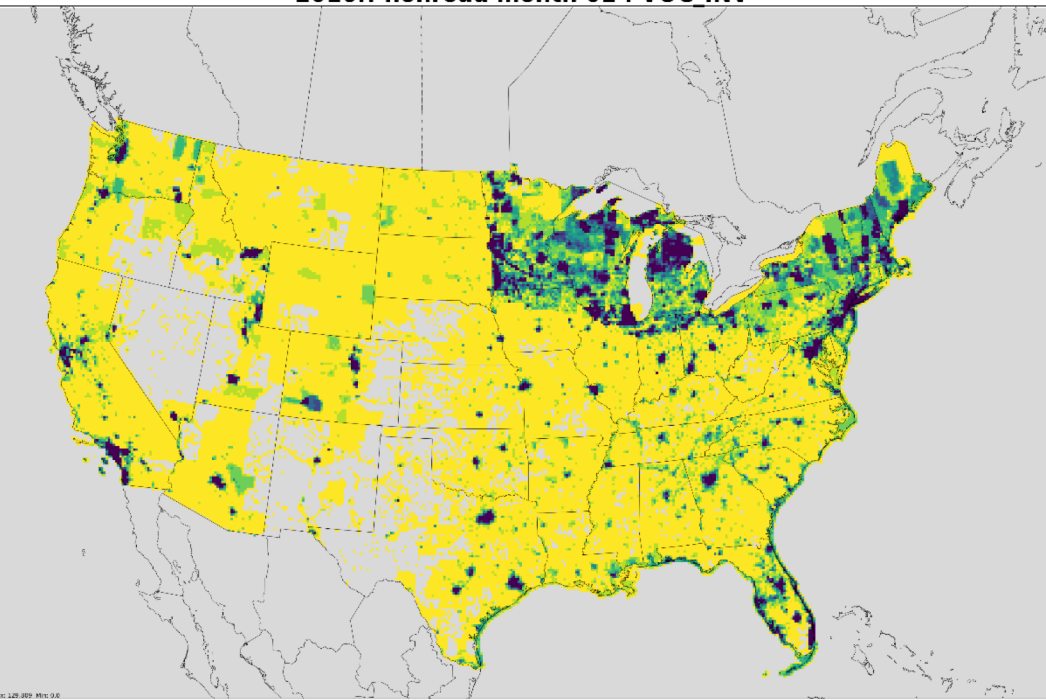
- EPA recently added nonroad source calculation into MOVES. The model creates emissions estimates for engines that do not operate on highways.
- Difficult to inventory because of diversity of sources, across many industries, low individual emissions, large composite emissions.
  - Recreational vehicles, all-terrain vehicles and off-road motorcycles;
  - Logging equipment, chain saws;
  - Agricultural equipment, tractors, combines;
  - Construction equipment, graders and back hoes;
  - Industrial equipment, forklifts and sweepers;
  - Residential and commercial lawn and garden equipment, tillers, leaf and snow blowers
  - Recreational and commercial marine vessels, power boats and oil tankers
  - Railway equipment, train and switching engines
  - Aircraft, Baggage handling equipment, jets and prop planes.

# Nonroad January/July VOC

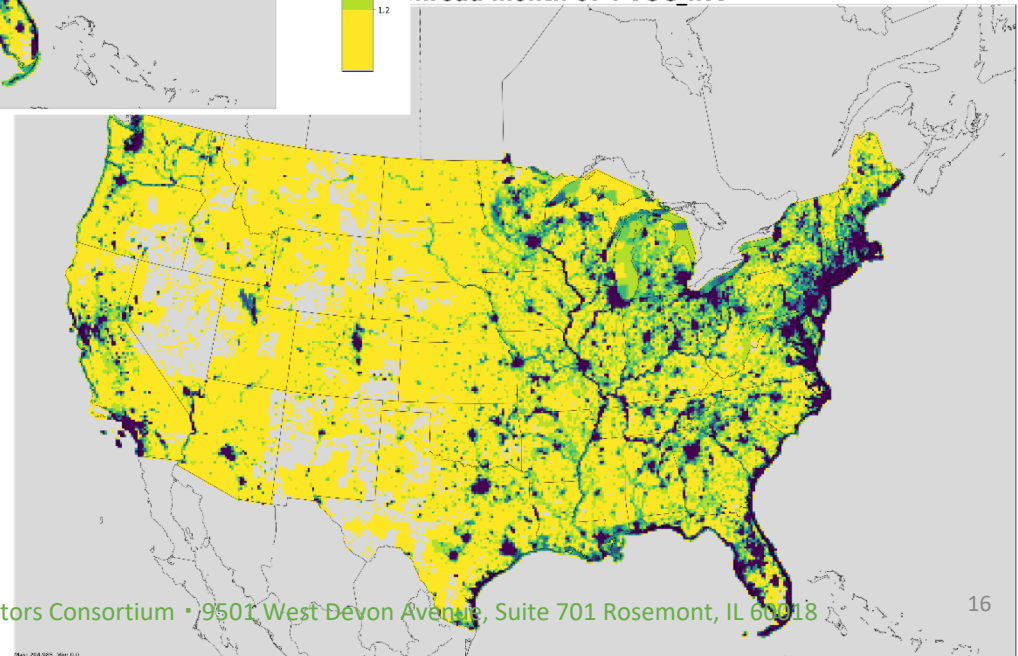


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2016ff nonroad month 01 : VOC\_INV



nonroad month 07 : VOC\_INV



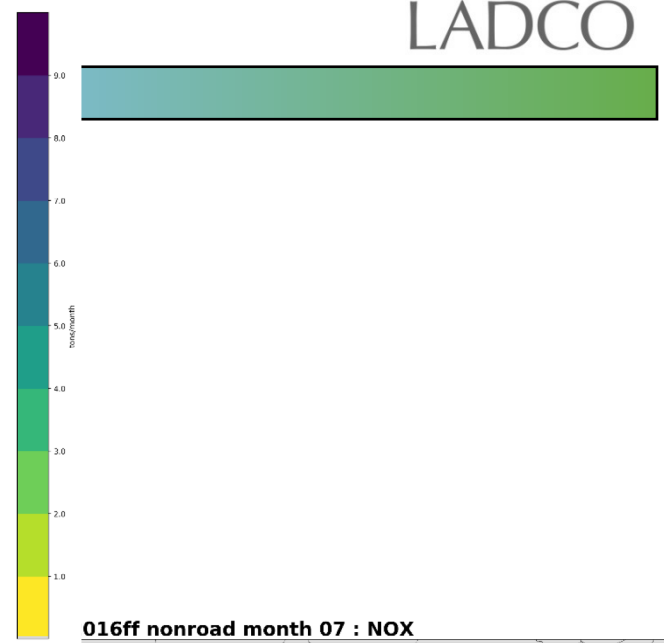
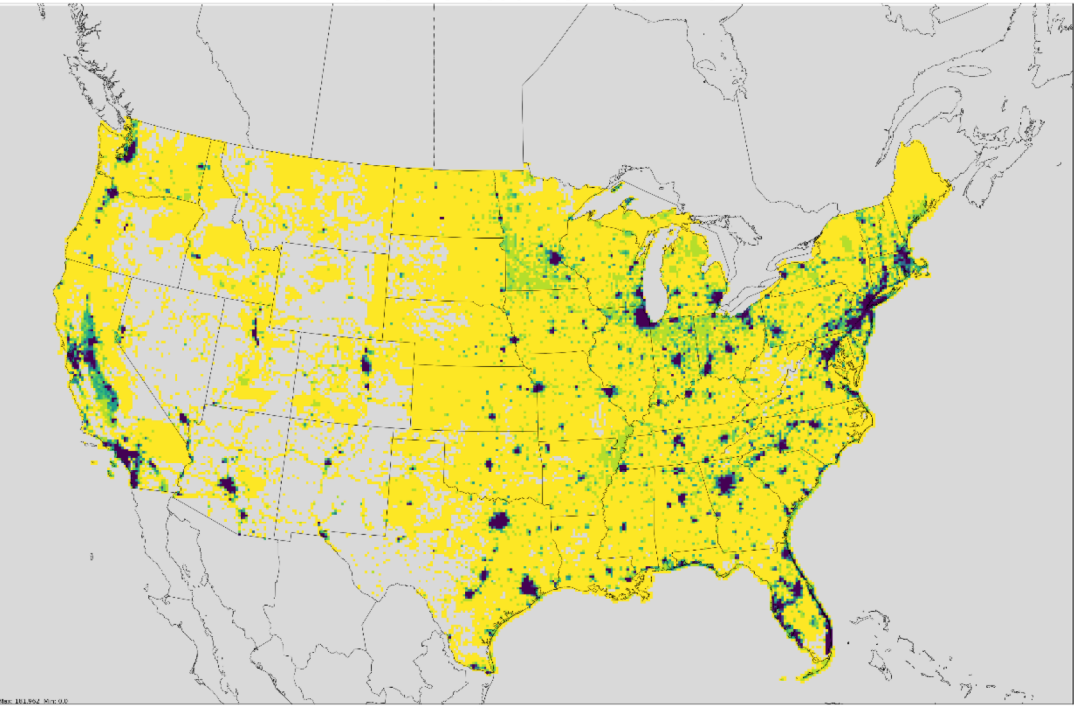


# Nonroad January/July NOX

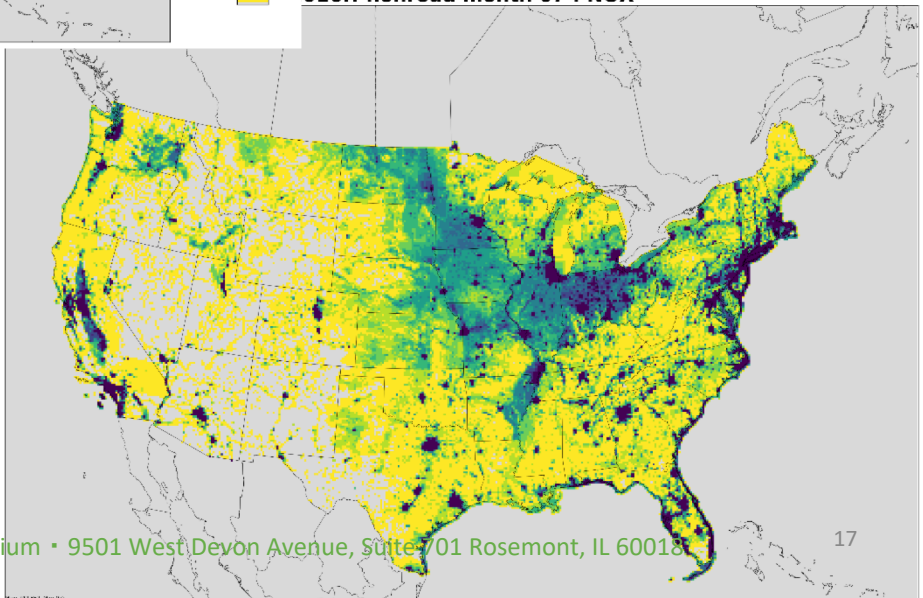


LADCO

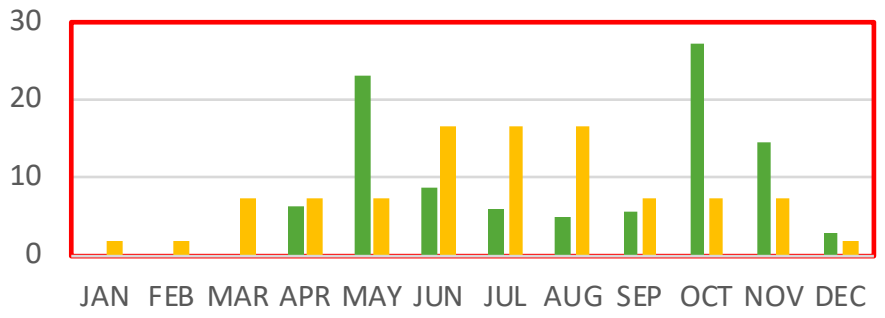
2016ff nonroad month 01 : NOX



016ff nonroad month 07 : NOX

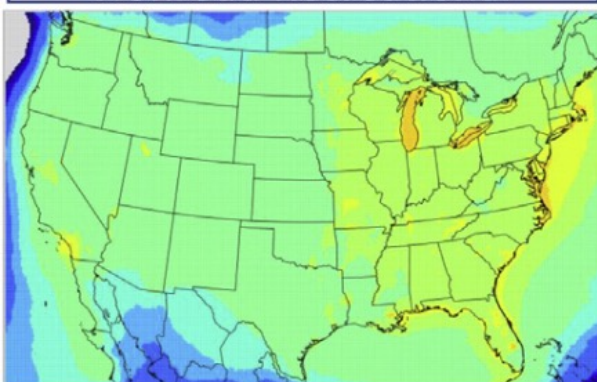


## Agriculture Monthly Profile

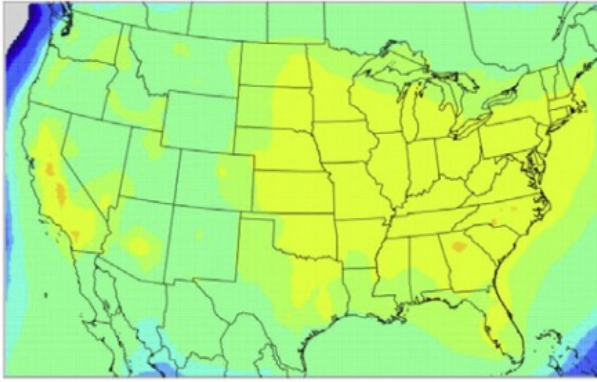


■ LADCO ■ EPA Default

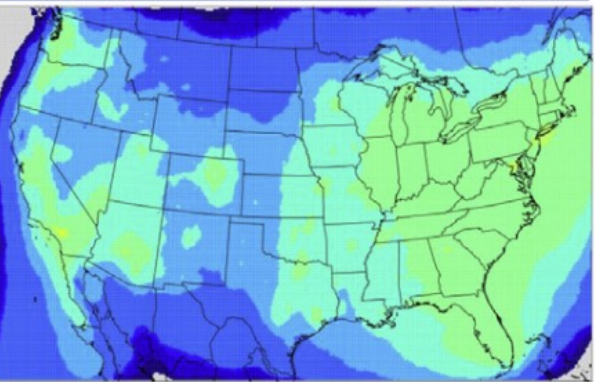
Nonroad Recreational



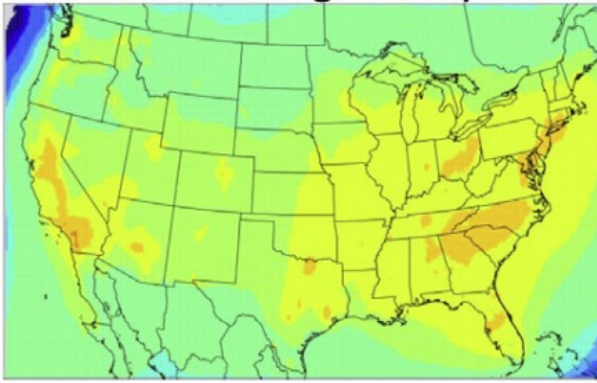
Nonroad Diesel



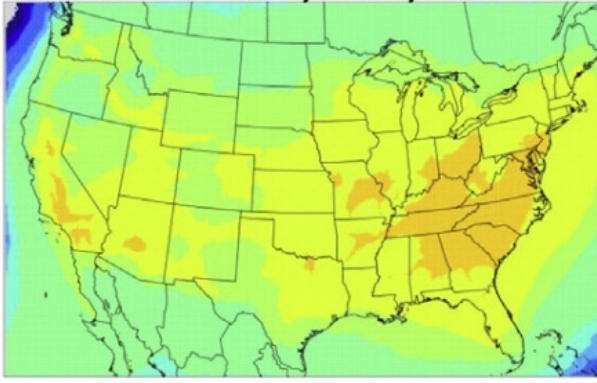
Lawn & Garden Commercial



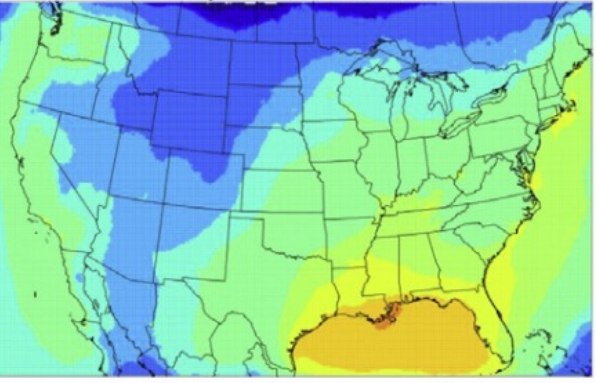
Onroad Light-Duty



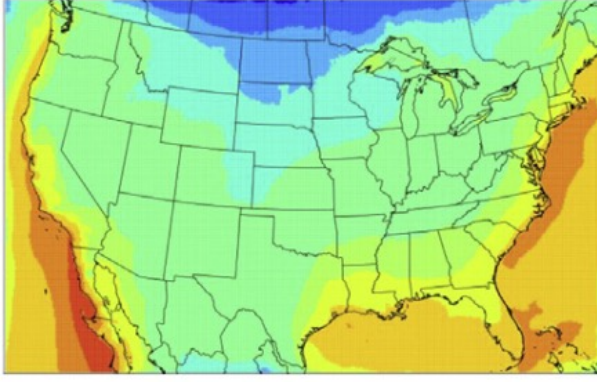
Onroad Heavy-Duty Diesel



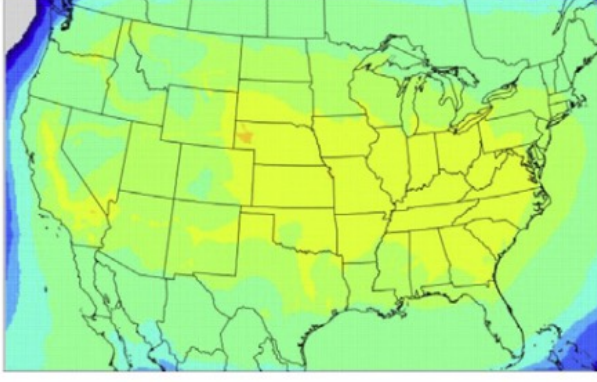
C1/C2 Marine



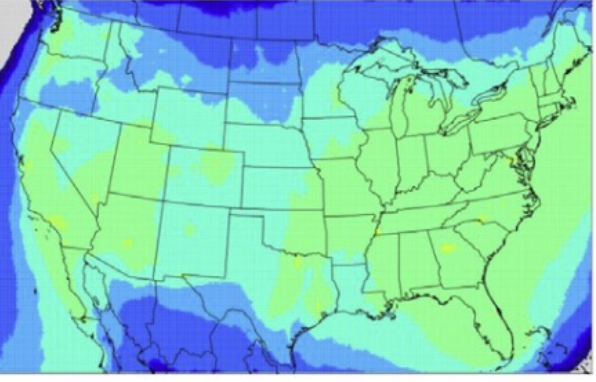
C3 Marine



Rail



Aircraft Landing & Take-off



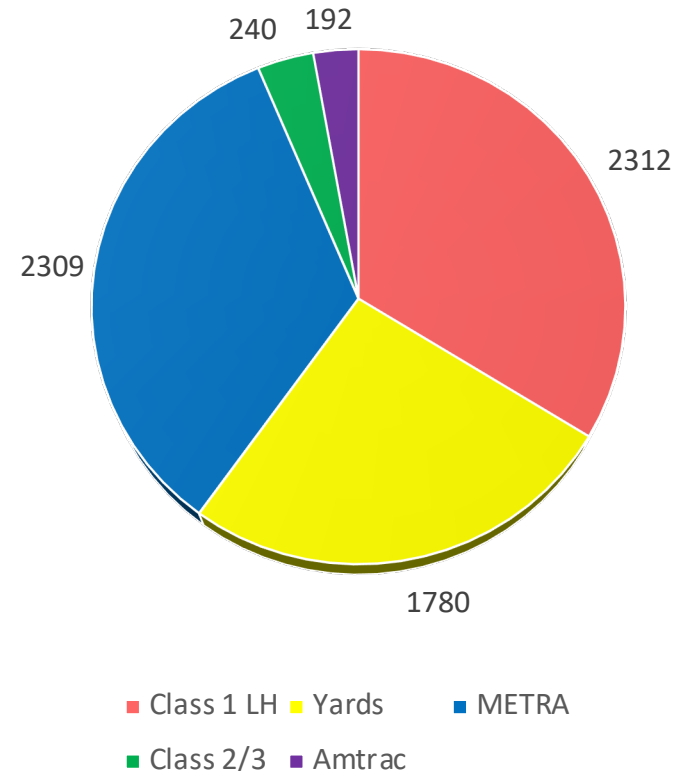


# LADCO Improvements to Rail



- LADCO and IL,MI have put significant effort into rail inventories.
- Included passenger(Amtrak) and commuter(METRA) into inventories into national inventory for the first time ever.
- Use proprietary rail administration database of link level activity and we identified yards as points.
- METRA change is the most significant recent change. Metra's fleet is older, 10% of fleet will upgrade by 2023.

Cook County IL,  
NOX Tons/Year



# What Can We Do About Vehicle Emissions?



- VW Settlement
- Diesel Emissions Reduction Act (DERA)
- Heavy Duty Diesel Devices/Programming
- Heavy Duty Diesel Device Idling
- Work with EPA on national standards
- LADCO needs to characterize reductions in SIP

# Questions and Contact



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