

An Analysis of 2011 NEI Mobile Source Inventory Generated by MOVES and SMOKE-MOVES

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Background

- **September 2013 -- 2011NEI version1 released by OAQPS**
- **July 2014 -- MOVES2014 released by OTAQ**
- **October 2014 -- Updated MOVES2014 released by OTAQ**
- **October 2014 -- 2011NEI version2 released by OAQPS**

MOVES Workgroup

- **Reviewed both V1 & V2 mobile source inventory**
- **Collaboration with EPA helped improve V2 results**
- **Additional improvements are possible**

Outline of Talk

- **Analysis of 2011NEI version2**
- **Additional areas for future improvement**

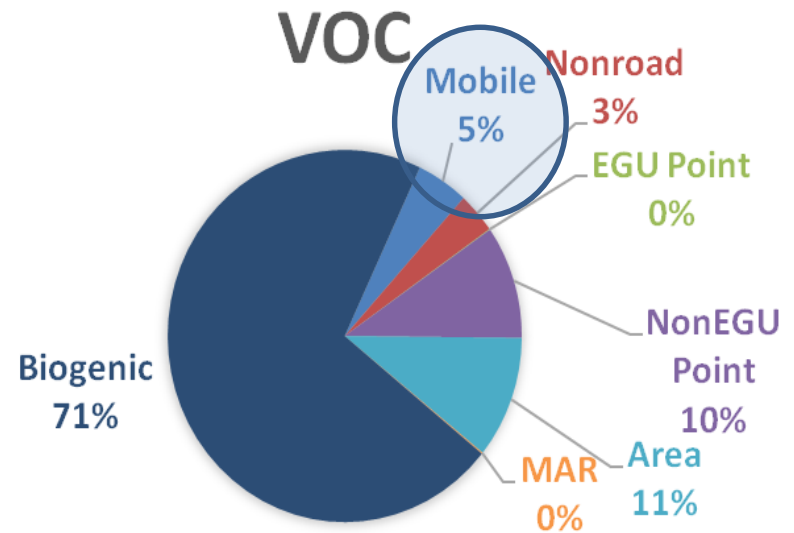
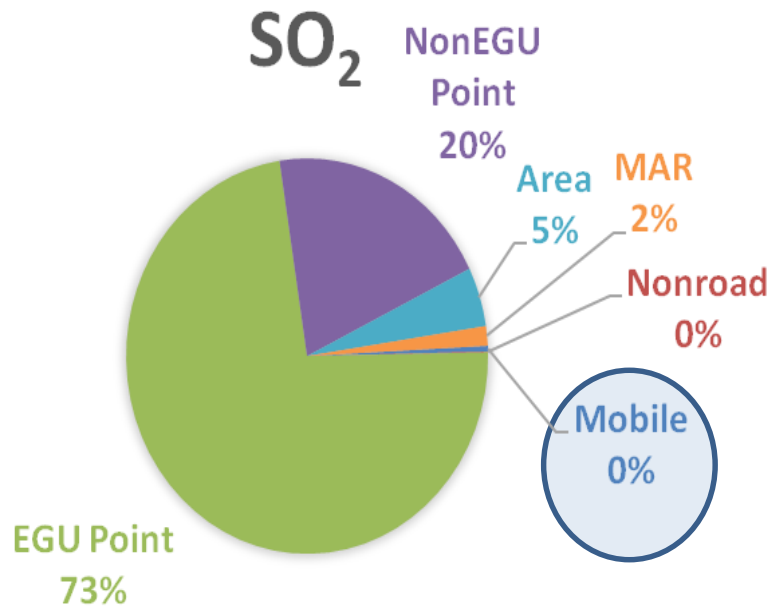
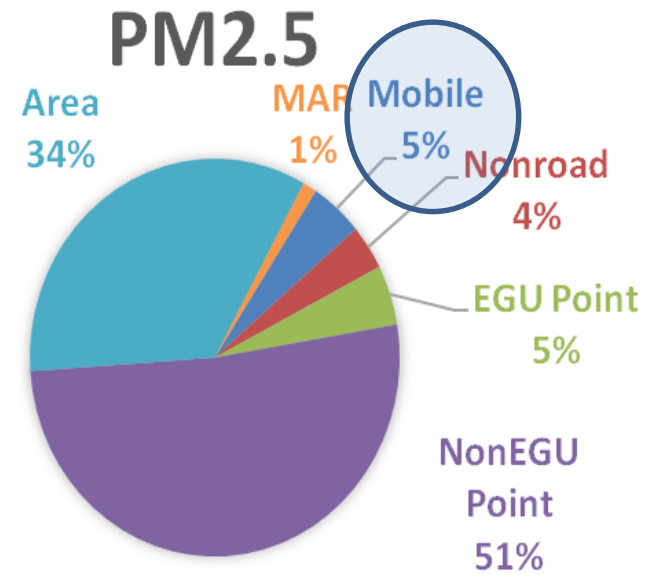
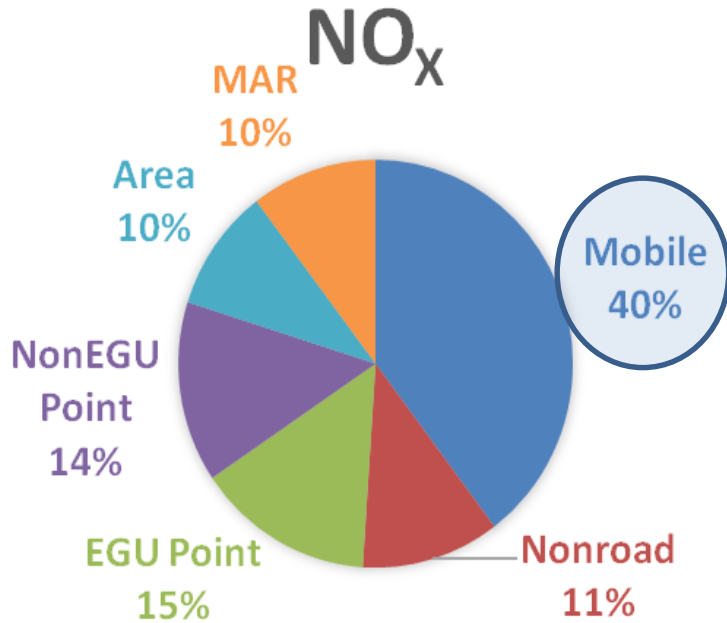
Key Results

- **Analysis focused on NO_x emission – mobile sector predominates**
- **County comparisons highlight similarities and differences for further review**
- **Six key vehicle types emit most of the NO_x**
- **Vehicle age distribution matters**
- **Ongoing collaboration among states and EPA is critical**

Example Issues Examined/Analyzed by the Workgroup

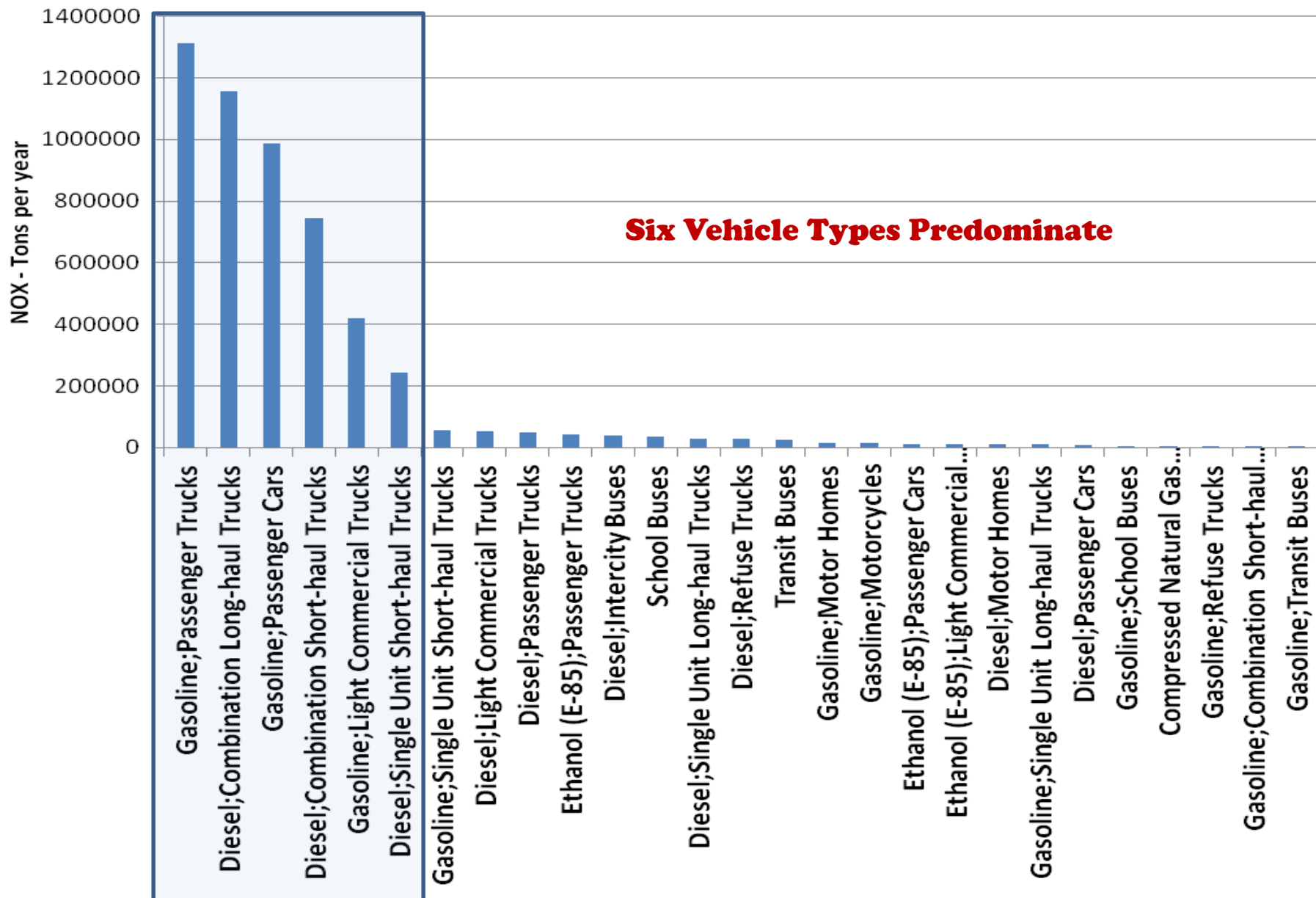
- **Data exploration & comparison of 2011NEI versions 1 and 2**
- **Representative County Scheme**
 - **Data analysis to understand the impact on emissions**
 - **Resulted in national revision of representative county scheme, both in version 1 and version 2**
- **Hourly meteorology versus monthly averaged meteorology**
- **Extended Idling – VPOP-based EXT to Idle hour based EXT**
- **Activity Flip – passenger cars/trucks reversed between two NEI versions (ongoing)**
- **Please visit our poster for many more examples of our analysis**

2011 NEI V2 Emissions Breakdown



2011 Mobile NOX by Vehicle Type (TPY)

NEI2011 - Version 2 - CONUS Summary

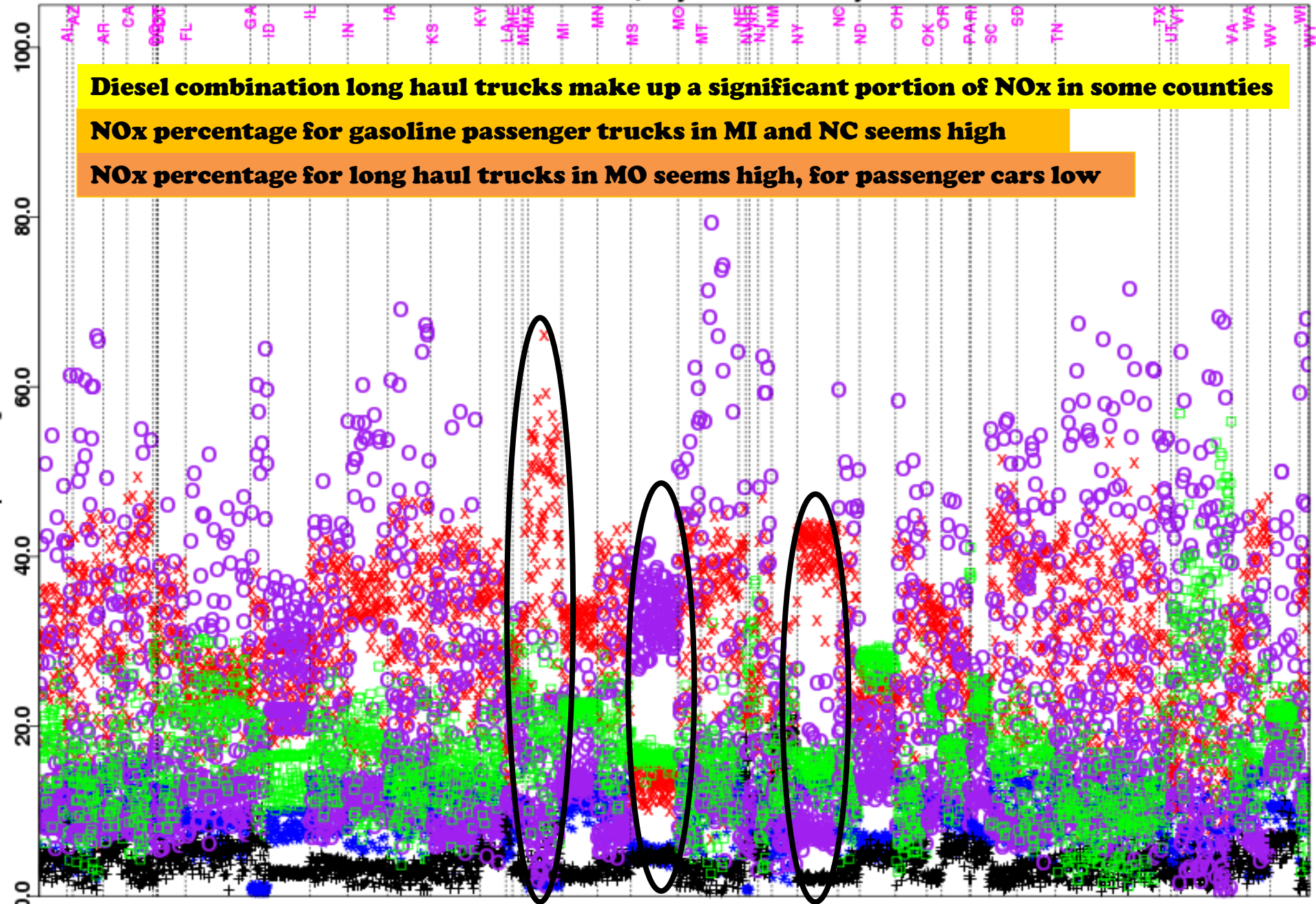


NOx Percent Makeup by SCC6 and by State

Diesel combination long haul trucks make up a significant portion of NOx in some counties

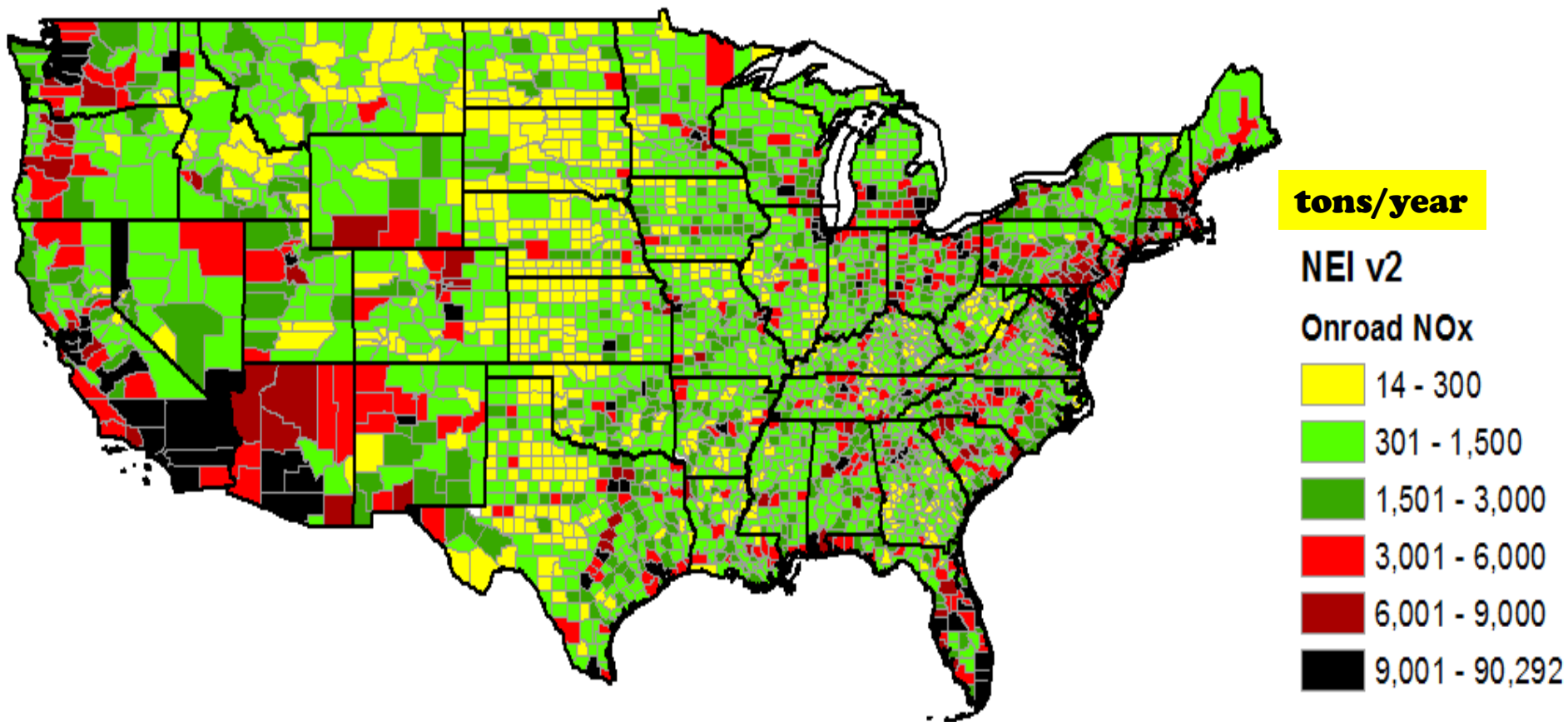
NOx percentage for gasoline passenger trucks in MI and NC seems high

NOx percentage for long haul trucks in MO seems high, for passenger cars low



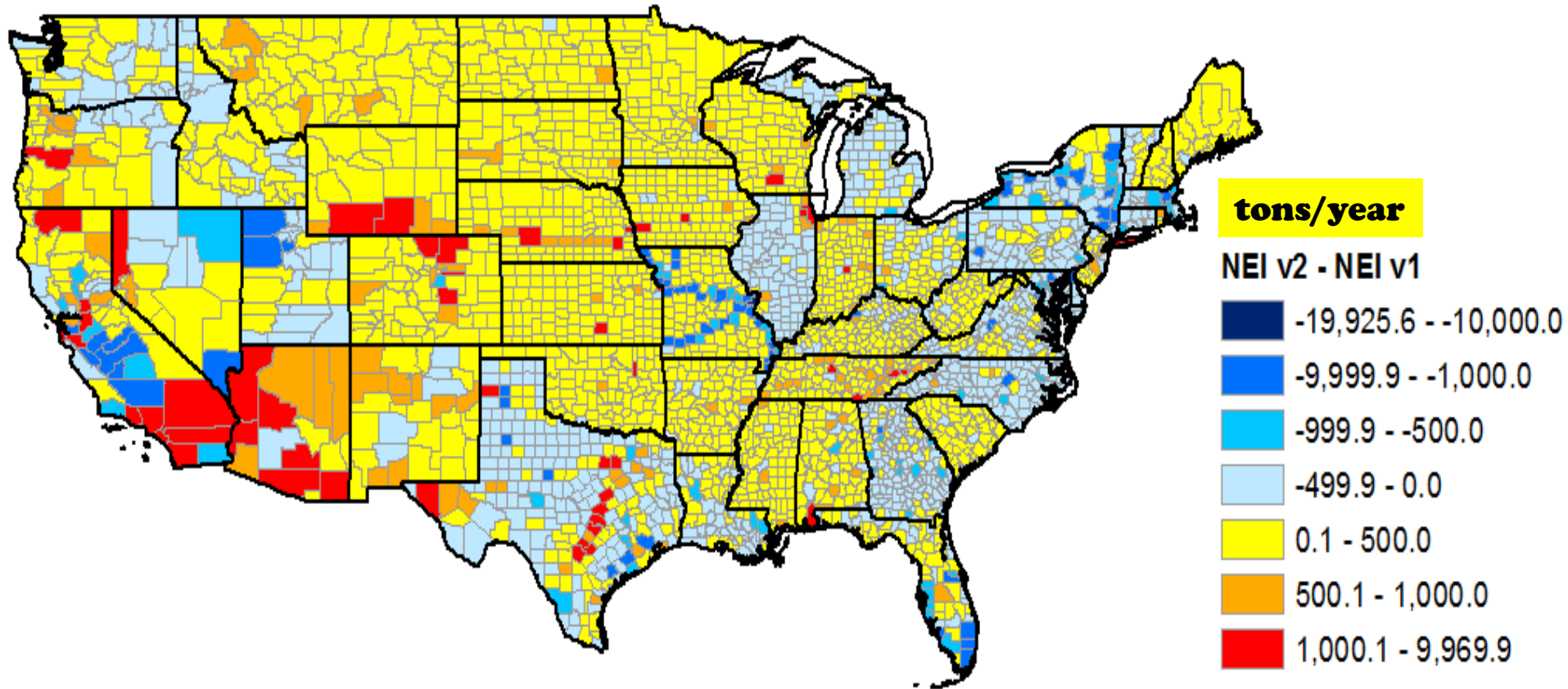
Legend:
 ■ 220121-Passenger Cars X 220131-Passenger Trucks ★ 220132-Light Commercial Trucks + 220252-Single Short-Haul ○ 220262-Combo Long-Haul
 gasoline gasoline gasoline diesel diesel

2011 NEI V2 Total Mobile NOx



NO_x Differences

2011 NEI V2 - 2011 NEI V1



V2 NO_x is lower for many southeastern and northeastern states
State participation has improved inventory quality

Changes in 2011NEIv2 from 2011NEIv1

	2011NEI version1	2011NEI version2
MOVES version	MOVES2010b	MOVES2014 (in-between July and October releases)
SCC Scheme	Old SCCs (144)	New SCCs correcting non-conservation issue with VPOP/VMT activities
Extended idling	VPOP-based, rural interstate only	Idling hour based, does not restricted to rural interstate
MOVES inputs	Unknown defaults for 21/31/32	IHS CRC data for 21/31/32
HPMS VMT type	Separate 20/30	20/30 combined to 25
Rep County	164	284

- The Workgroup has examined all of these subject areas**
- These changes may all have contributed to NO_x increases for many counties in 2011NEI version2 from 2011NEI version1**

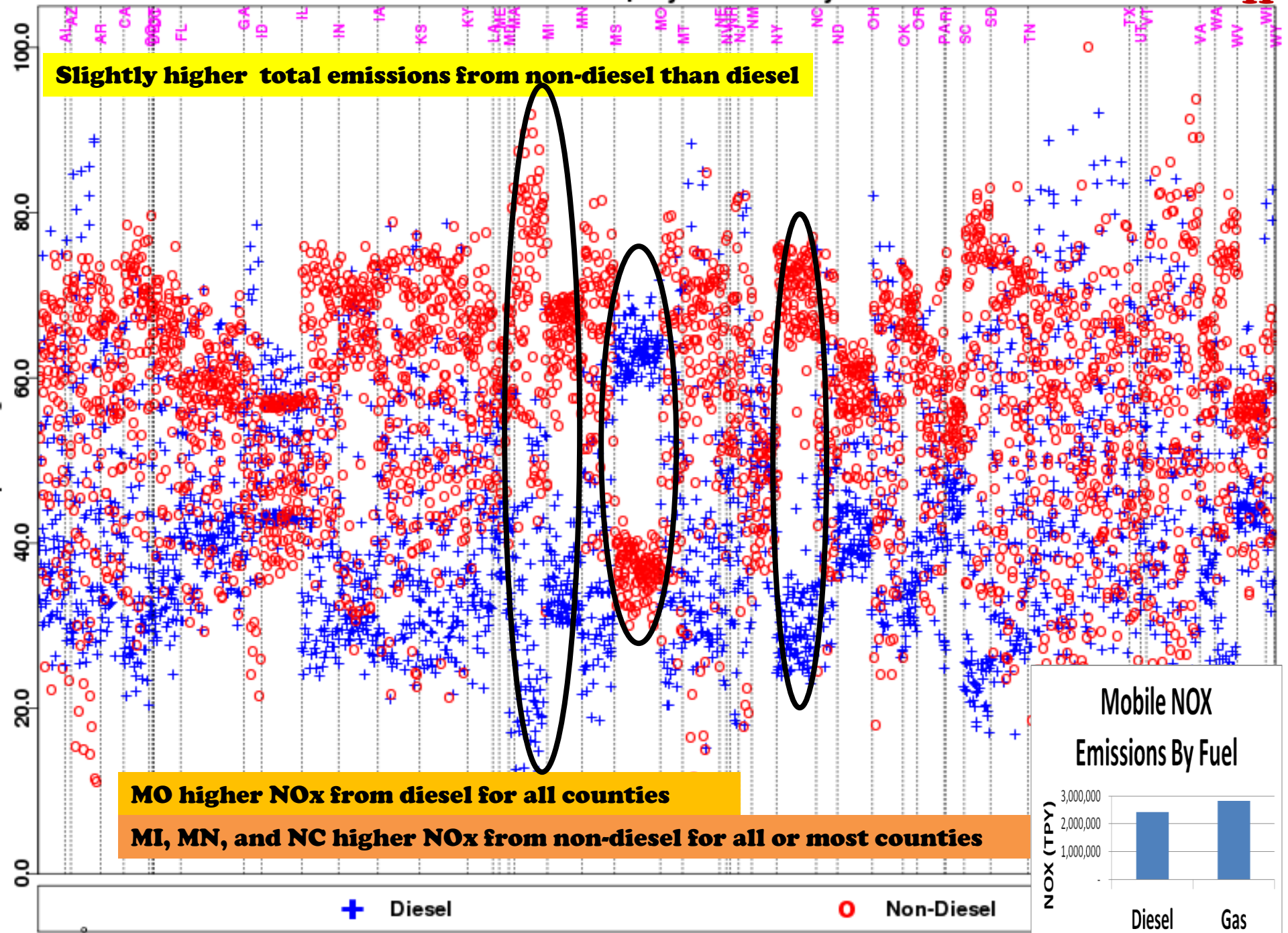
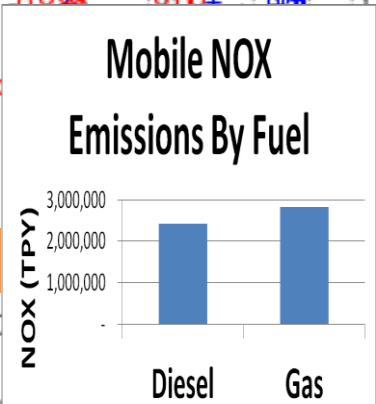
NOx Percent Makeup by Fuel and by State

Slightly higher total emissions from non-diesel than diesel

MO higher NOx from diesel for all counties

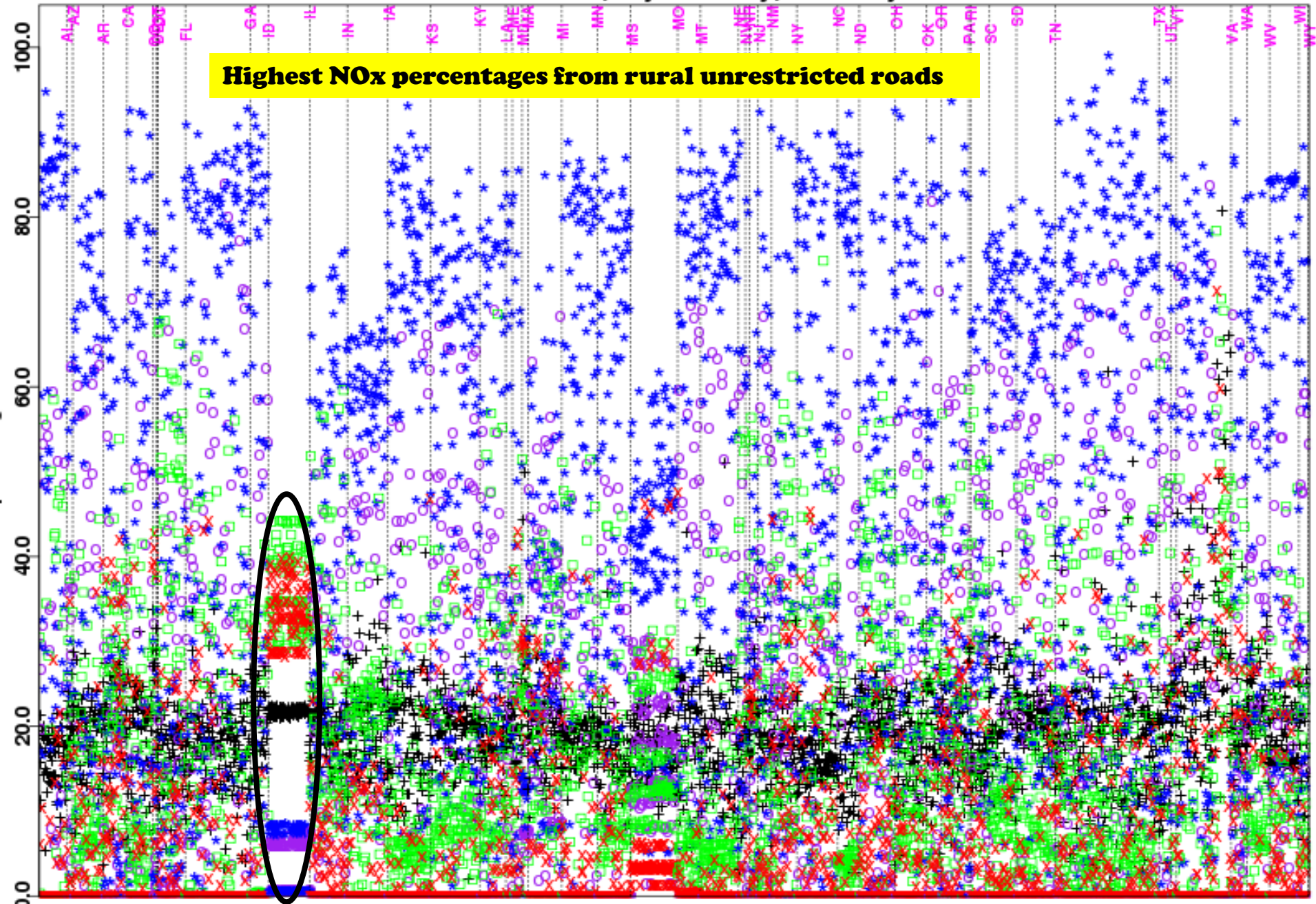
MI, MN, and NC higher NOx from non-diesel for all or most counties

+ Diesel **o** Non-Diesel



NOx Percent Makeup by Road Type and by State

Highest NOx percentages from rural unrestricted roads



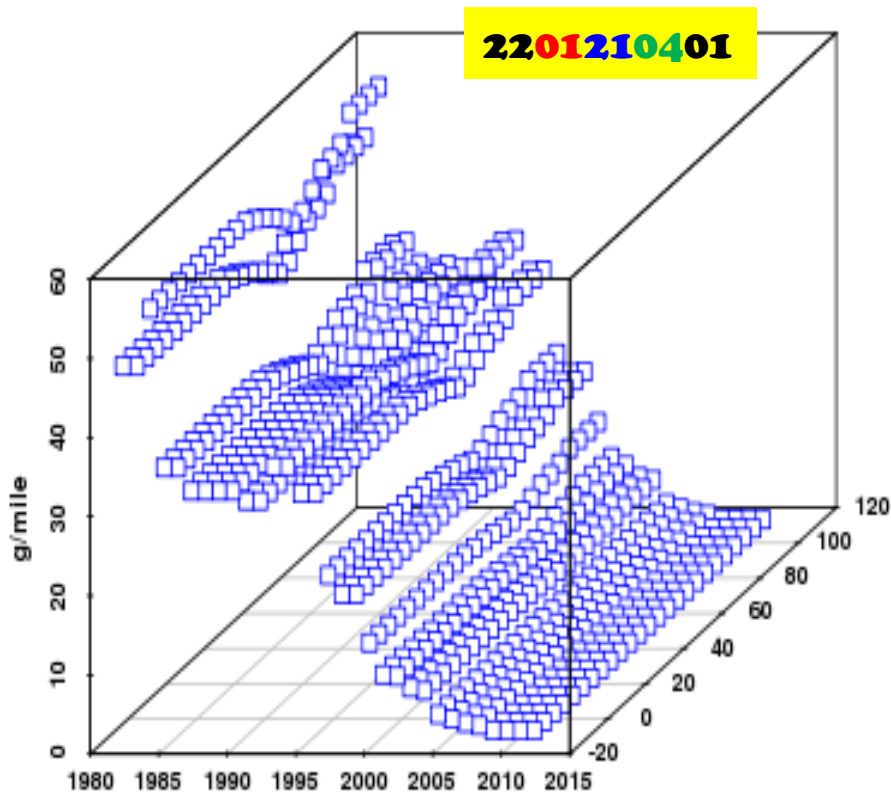
★ Rural UnRestricted ○ Rural Restricted □ Urban UnRestricted × Urban Restricted + Off-Network

Results of V2 Analysis

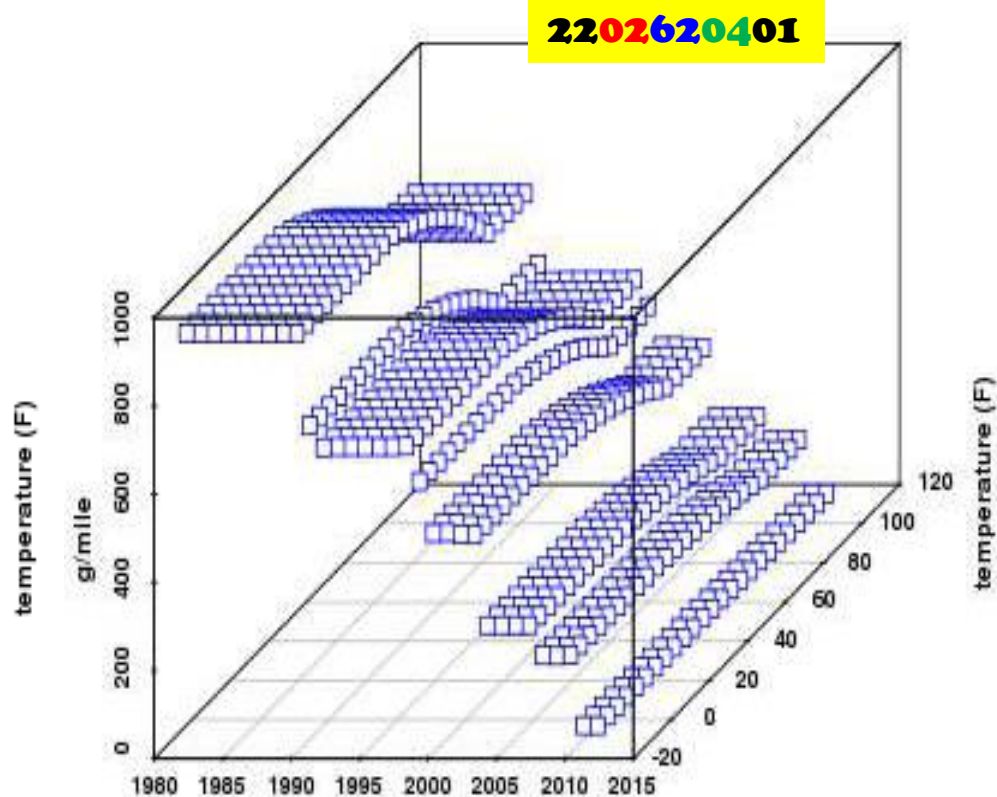
- **NO_x is the most important pollutant from mobile sources**
- **Six vehicle types predominate for NO_x:**
 - **Gasoline passenger truck (31)**
 - **Diesel combination long-haul truck (62)**
 - **Gasoline passenger car (21)**
 - **Diesel combination short-haul truck (61)**
 - **Gasoline light commercial truck (32)**
 - **Diesel single unit short-haul truck (52)**
- **V2 reflects better input data, and emissions decline in Eastern United States**
- **Differences vary by county and state and highlight a need for QA of input data**

Effect of Vehicle Age versus Ambient Temperature

NO_x, urban restricted (04), running exhaust (01), weekday, RH = 60%



Gasoline (01) Passenger Cars (21)



Diesel (02) Combination Long-haul Truck (62)

- **Temperature has small impact on NO_x emission rates from newer vehicles**
- **Vehicle age has a significant impact on NO_x emission rates**
- **Rate data generated by rate mode with hypothetical fleets of 1/31 (=0.03225) age fraction**
- **Cautions:**

Other roadway types, processes & humidity regimes have not been investigated.
Are the emission factors in MOVES based on observations or measurements?

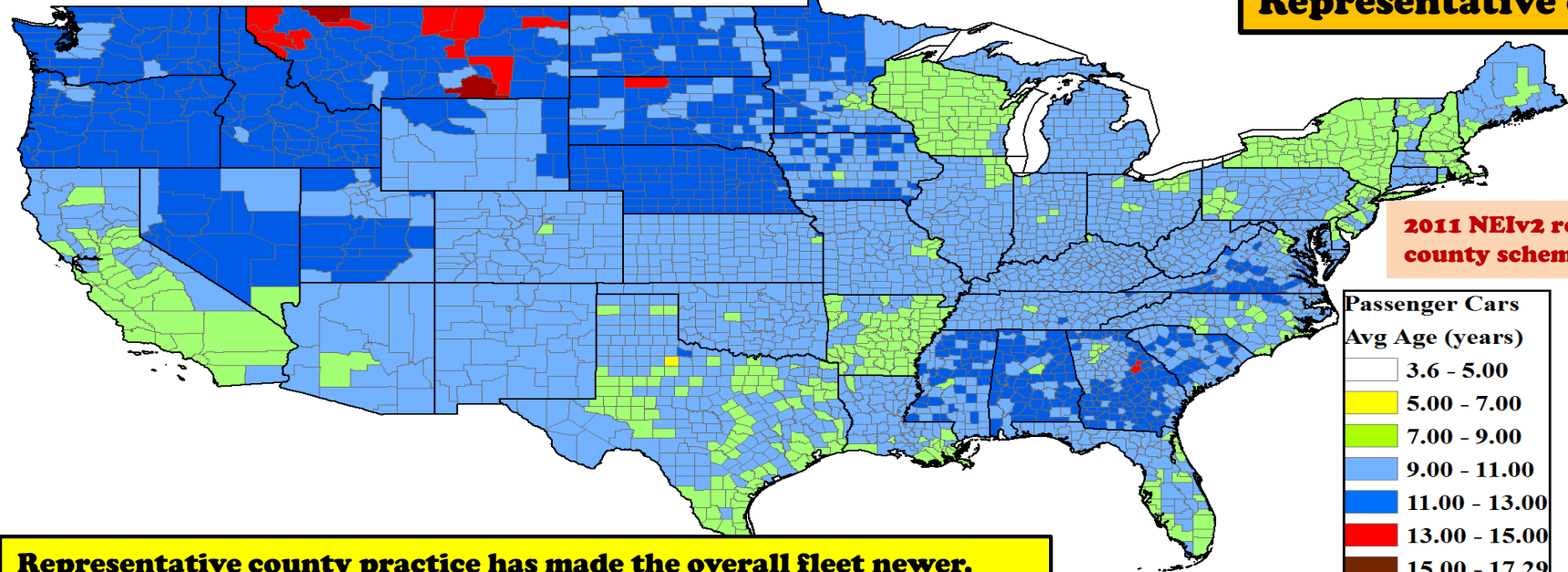
Representative County

- **County grouping criteria:**
 - (a) control programs (CALEV, NLEV, I/M, stageII)**
 - (b) fleet age distribution**
 - (c) fuel parameters**
 - (state-supplied fuel data overridden by EPA)**
- **Parameters from a single county used to represent the group – not averaged/aggregation**
- **Average vehicle age for single representative county is used for all vehicles in all counties**

Effect of Representative County

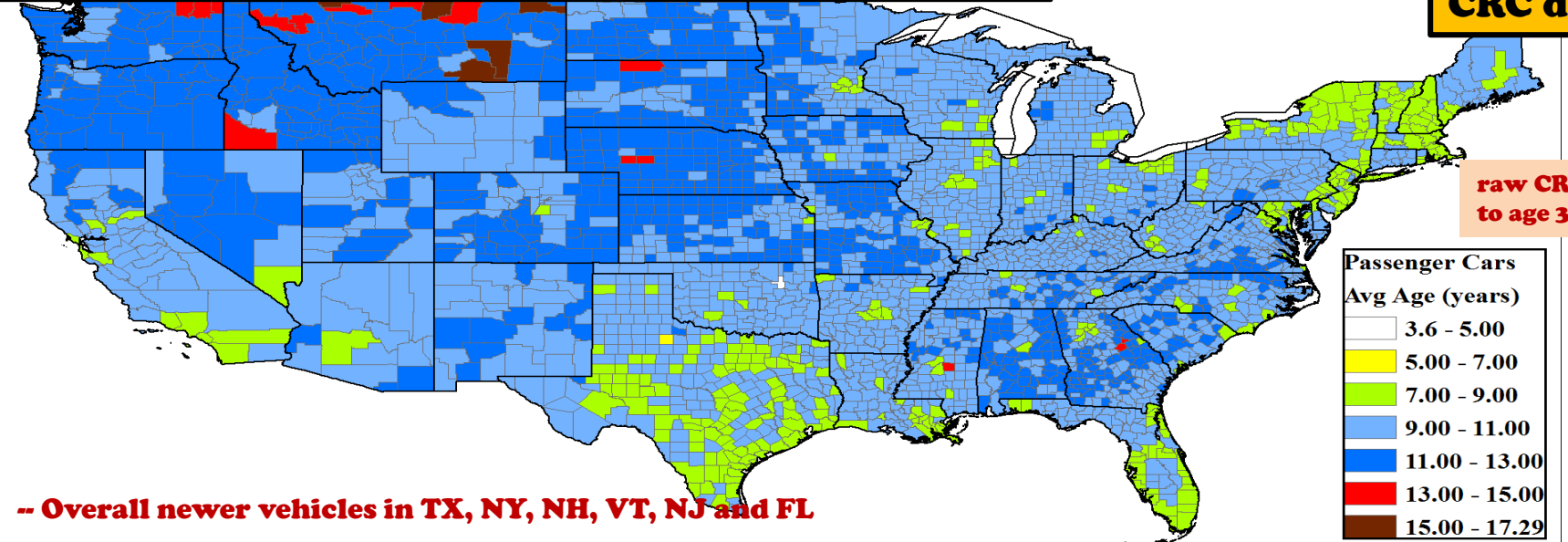
Average Age for Passenger Cars

Representative county



Representative county practice has made the overall fleet newer. Difference would be more pronounced if color divides are increased.

CRC data



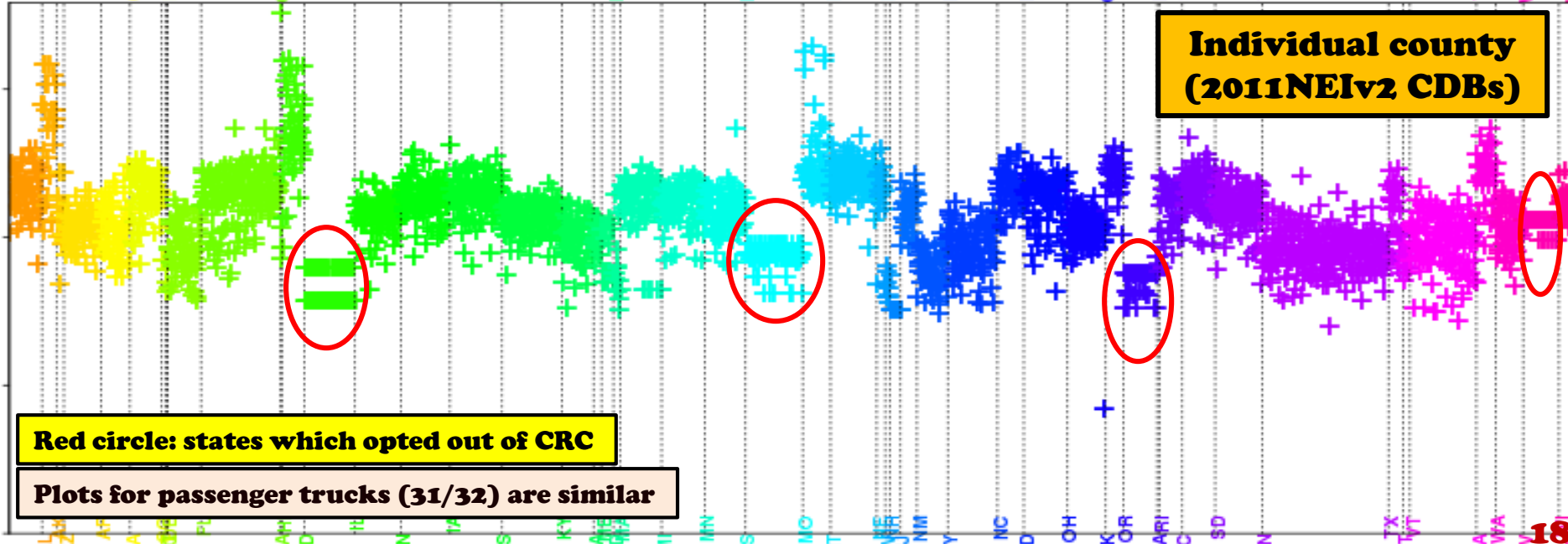
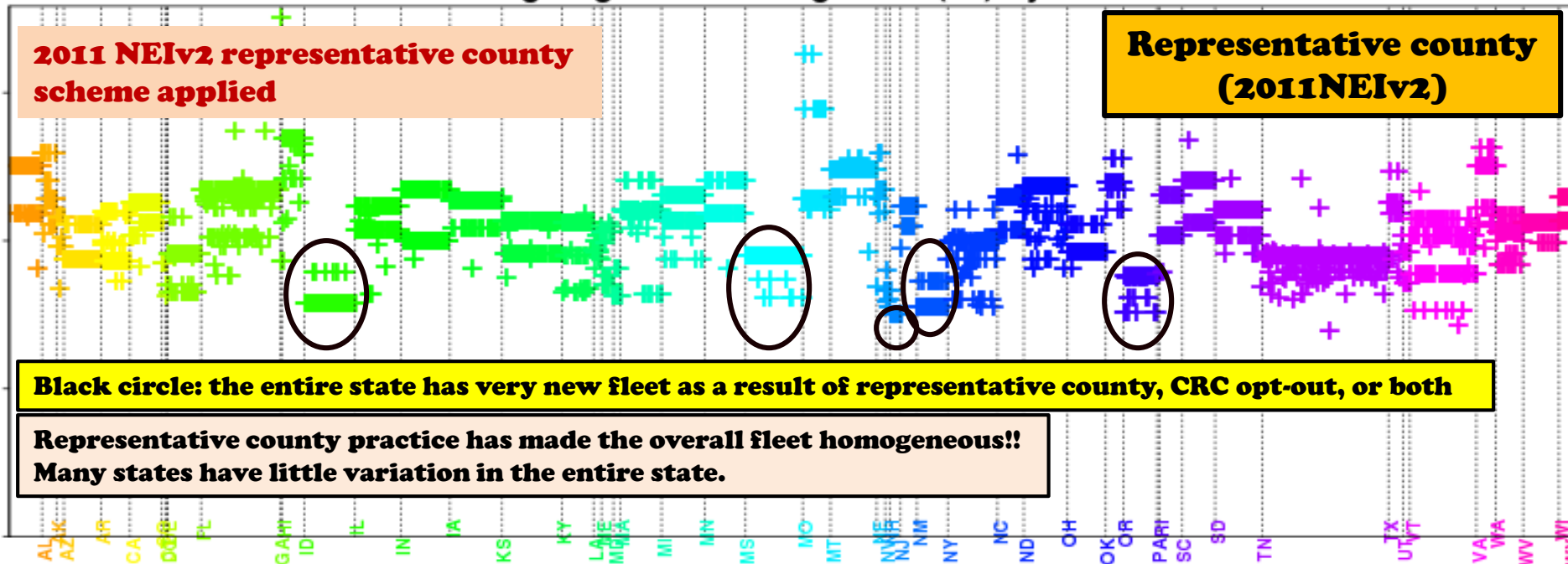
-- Overall newer vehicles in TX, NY, NH, VT, NJ and FL

Default Data

- **Many states rely on default data**
 - **State resources are limited**
- **CRC project resulted in upgrading of default data for three categories:**
 - **Passenger car (21)**
 - **Passenger truck (31)**
 - **Light commercial truck (32)**
- **Documentation by USEPA of the source and nature of default data is needed**

Effect of Representative County

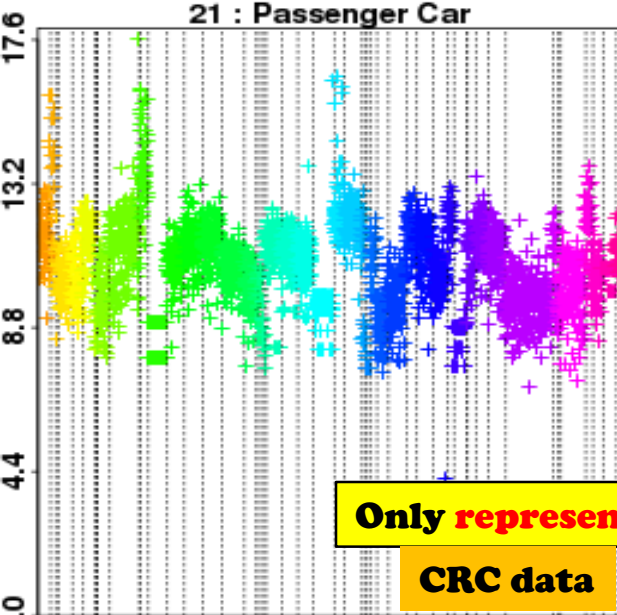
Average Age for Passenger Car (21) by State



Average Fleet Age for Six Major Source Type in 2011NEIv2 CDBs

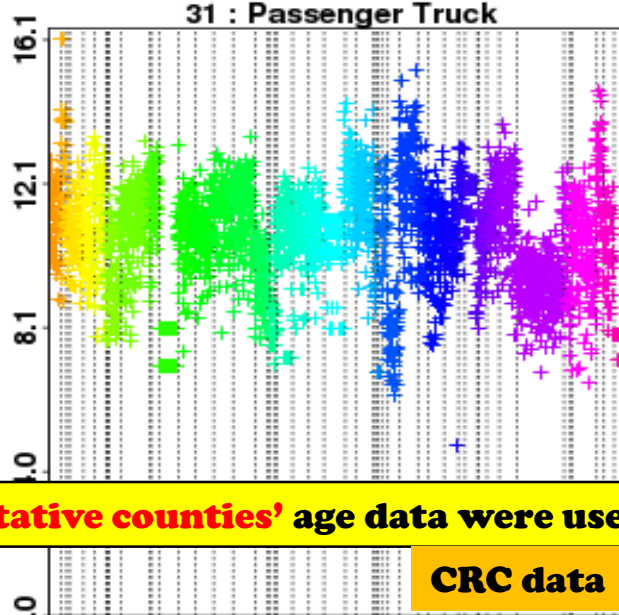
Vehicle Average Ages by County and by State for Six Major Vehicle Types

21 : Passenger Car



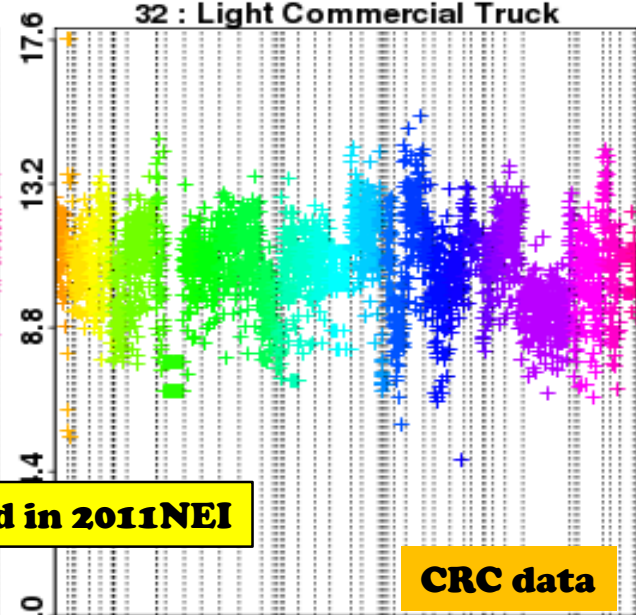
CRC data

31 : Passenger Truck



CRC data

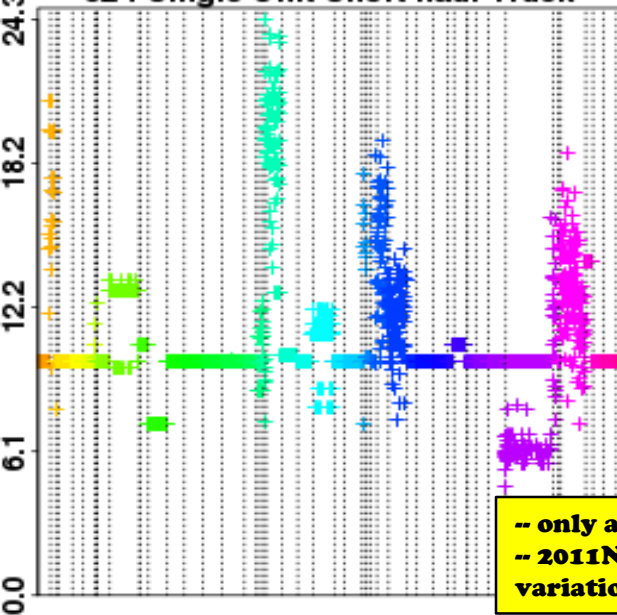
32 : Light Commercial Truck



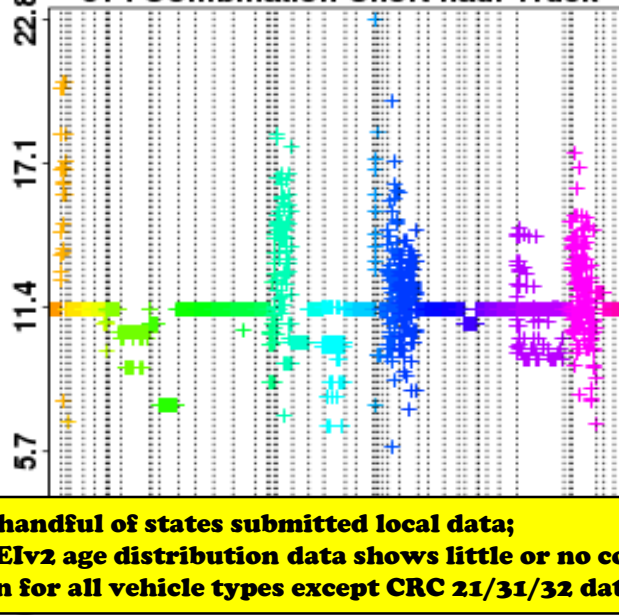
CRC data

Only representative counties' age data were used in 2011NEI

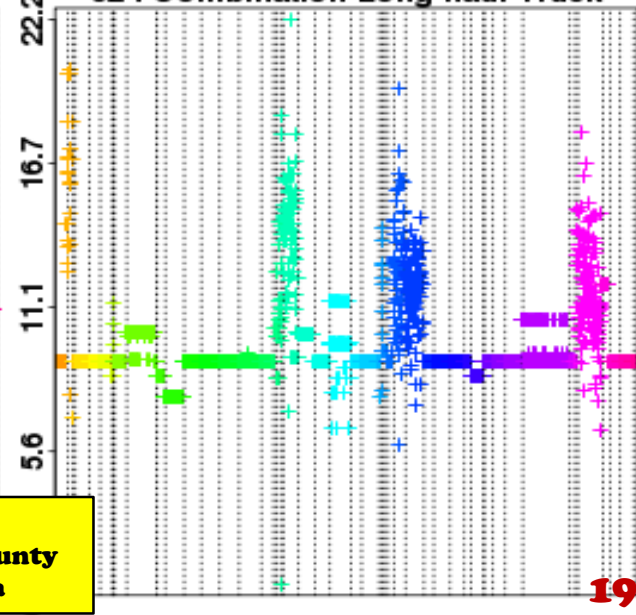
52 : Single Unit Short-haul Truck



61 : Combination Short-haul Truck



62 : Combination Long-haul Truck



- only a handful of states submitted local data;
- 2011NEIv2 age distribution data shows little or no county variation for all vehicle types except CRC 21/31/32 data

Representative County Age Distribution Comments

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State	11	21	31	32	41	42	43	51	52	53	54	61	62
AL	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
AR	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
AZ	(except 1)				(except 1)	(except 1)	(except 1)	(except 1)	(except 1)	(except 1)	(except 1)	(except 1)	(except 1)
CA	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
CO	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
CT	No variation				No variation	No variation	No variation	No variation	No variation	No variation	No variation	No variation	No variation
DC													
DE													
FL	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
GA	Year 11 spike				Little variation	High spikes	Little variation	Little variation	Little variation	Year 30 spike	Year 30 spike	Little variation	Little variation
IA	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
ID					High spikes	High Spikes		High spike	No variation	No variation	Year 30 spike	No variation	No variation
IL	No variation				No variation	No variation	No variation	No variation	No variation	No variation	No variation	No variation	No variation
IN	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
KS	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
KY	(except 1)				(except 1)	(except 1 - High)	(except 1)	(except 1)	(except 1)	(except 1)	(except 1)	(except 1)	(except 1)
LA	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
MA	No variation												
MD													
ME	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
MI					High spikes	High spikes		Year 30 spike	Year 30 spike	Year 30 spike	Year 30 spike		
MN	Year 11 spike				No variation	No variation	No variation	No variation	No variation	No variation	No variation	No variation	No variation
MO													
MS	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
MT	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
NC													
ND	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
NE	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
NH					High spikes					Year 0 spike			
NJ	No variation				No variation	No variation	No variation	No variation	No variation	No variation	No variation	No variation	No variation
NM	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
NV	(except 2)				(except 1)	(except 1)	(except 1)	(except 1)	(except 1)	(except 1)	(except 1)	(except 1)	(except 1)
NY					High spike	Year 30 spike	Year 30 spike						
OH	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
OK	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
OR	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
PA					No variation	No variation	No variation	No variation	No variation	No variation	No variation	No variation	No variation
RI	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
SC	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
SD	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
TN	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
TX					Little variation	Little variation	Little variation	Little variation	Little variation	Little variation	Little variation	Little variation	Little variation
UT												Default	Default
VA					High spike	High spikes	High spike						
VT	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default
WA					High spike	High spike	High spike		No variation	No variation	Year 30 spike	No variation	No variation
WI	Default					Default		Default	Default	Default	Default	Default	Default
WV	(except 2)				Default	Default	Default	Default	Default	Default	(except 2)	Default	Default
WY	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default

CRC data

Recommendations

- **Input data focus based on most important pollutant & vehicle source type**
 - **Focus on getting local input data on vehicle ages**
 - **Focus on getting local input data for the 6 major vehicle types that emit most of the NO_x**
- **Average parameters across county groups rather than using the specific parameters from a single county in the group**
- **Confirm the lack of variability across temperatures is grounded in dynamometer tests**
- **Provide documentation of default data for evaluation by states**

Acknowledgements

- **Virginia DEQ:**
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- **Advanced Research Computing at Virginia Tech:**
Brian Marshall

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