Vehicle Fleet Age Implemented in 2011NEI

Virginia Department of Environmental Quality

LADCO Modeling Conference Call
March 9, 2015

Outline of Talk

- Effect of Vehicle Fleet Age
- Representative County Practice
- Vehicle Fleet Age in 2011NEIv2
  - CRC data (passenger cars/trucks)
  - Non-CRC data
- Data Issues
- Summary

-- Fleet age distribution is considered one of the most important parameters affecting mobile emissions

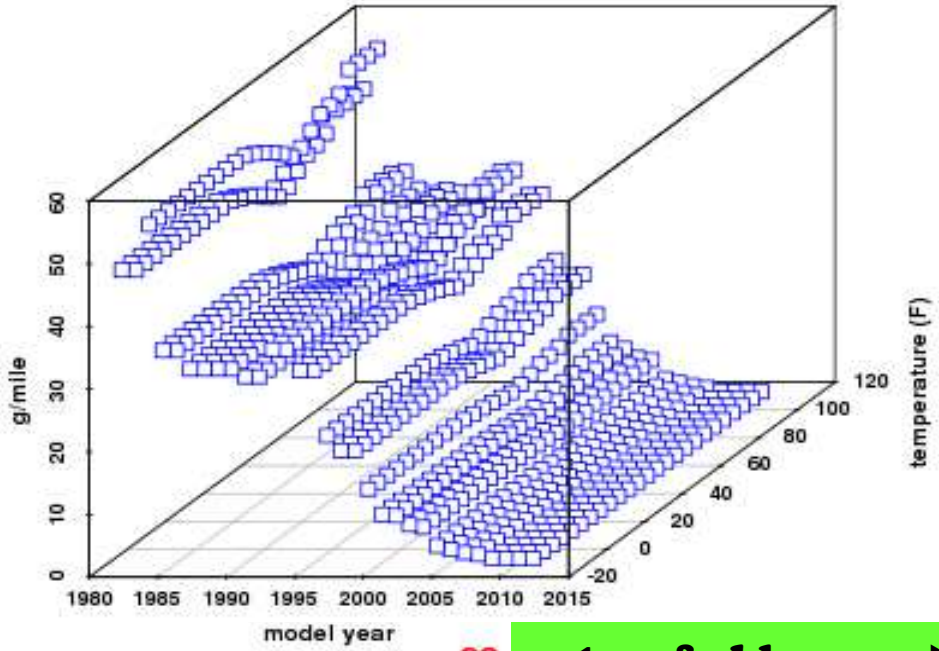
-- There are 13 vehicle types in MOVES

2201210401

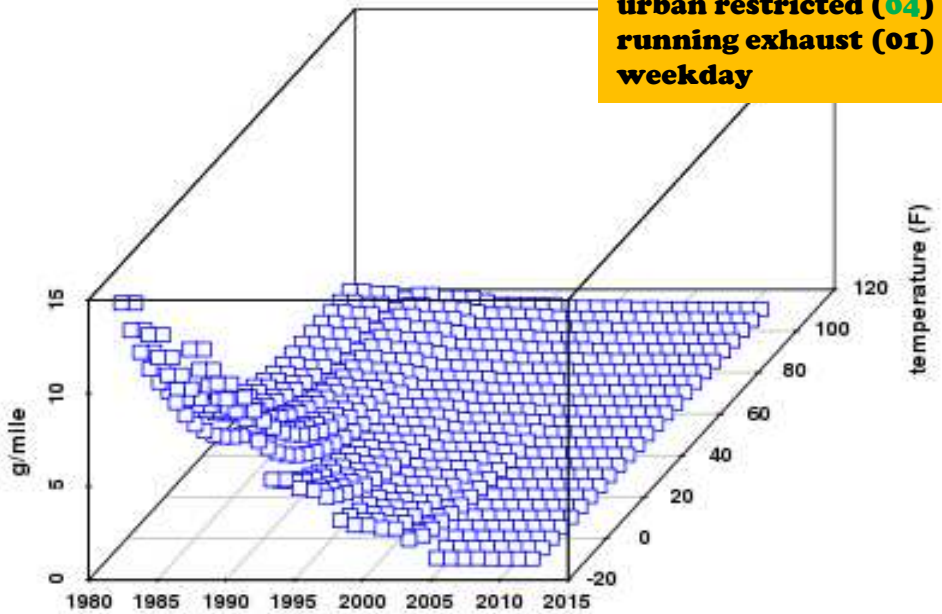
Running Exhaust Rate for Passenger Car (21) at RH=60% (gram/mile)

gasoline (01)
passenger car (21)
urban restricted (04)
running exhaust (01)
weekday

NOX

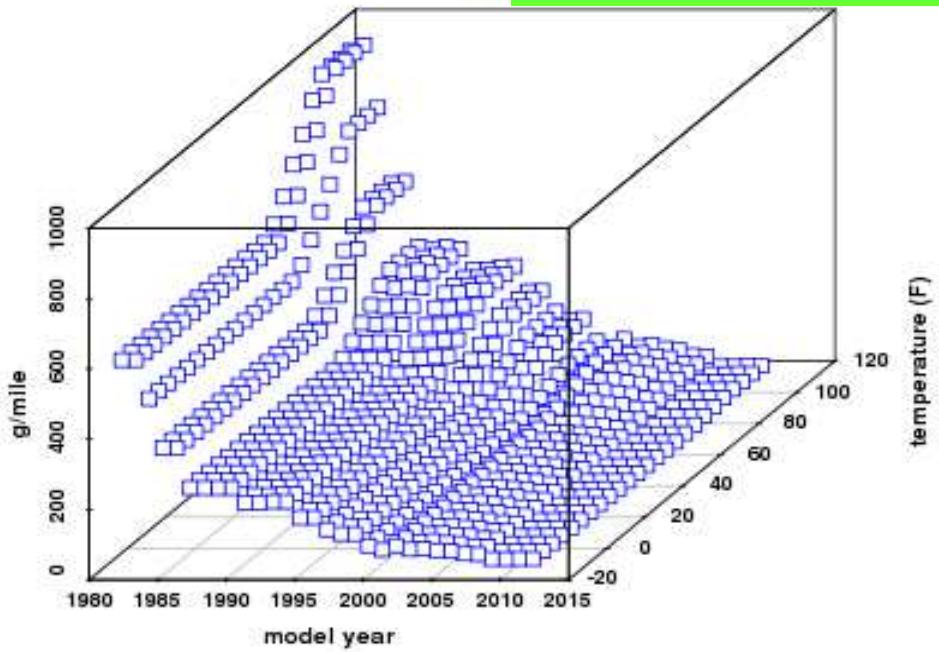


PM25

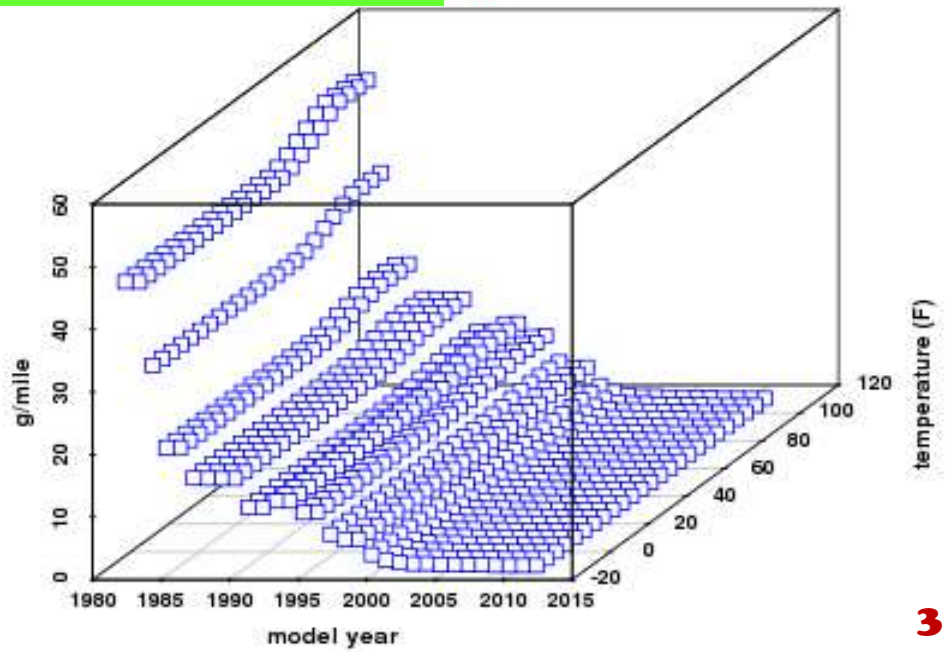


rates of older cars > rates of newer cars

CO



VOC



Representative County

How can this be implemented in practice??

- **Original** county grouping criteria:

  (a) control programs (CALEV, NLEV, I/M, stageII);

  (b) fleet age distribution;

  (c) fuel parameters

  (state-supplied data overridden by EPA);

local, state-specific data

- **Proposed** county grouping criteria (May 27 2014 joint GA-VA presentation):

  (a) control programs;

  (b) fleet age distribution;

  (c) fuel parameters;

  (d) ramp fraction;

  (e) VMT/VPOP ratio (by vehicle type);

  (if no activity aggregation)

  (f) Extended Idling

Reconsider with new CRC data

new suggestion for grouping

additional criterion

Representative County

Simple Analogy

Representative County		Range of Actual Values	Example Modeled Value
County Blue		1 - 5	5
County Yellow		6 - 10	7
County Red		11 - 15	14

-- Number 5 used to model County Blue cannot fully cover actual number range from 1 to 5 (likewise for Counties Yellow and Red), causing incorrect representation.

-- Options: (1) phase out current representative county approach using data from a single representative county and aggregate actual values to correctly represent the entire county group or (2) use inventory mode.

CRC Data in 2011NEIv2

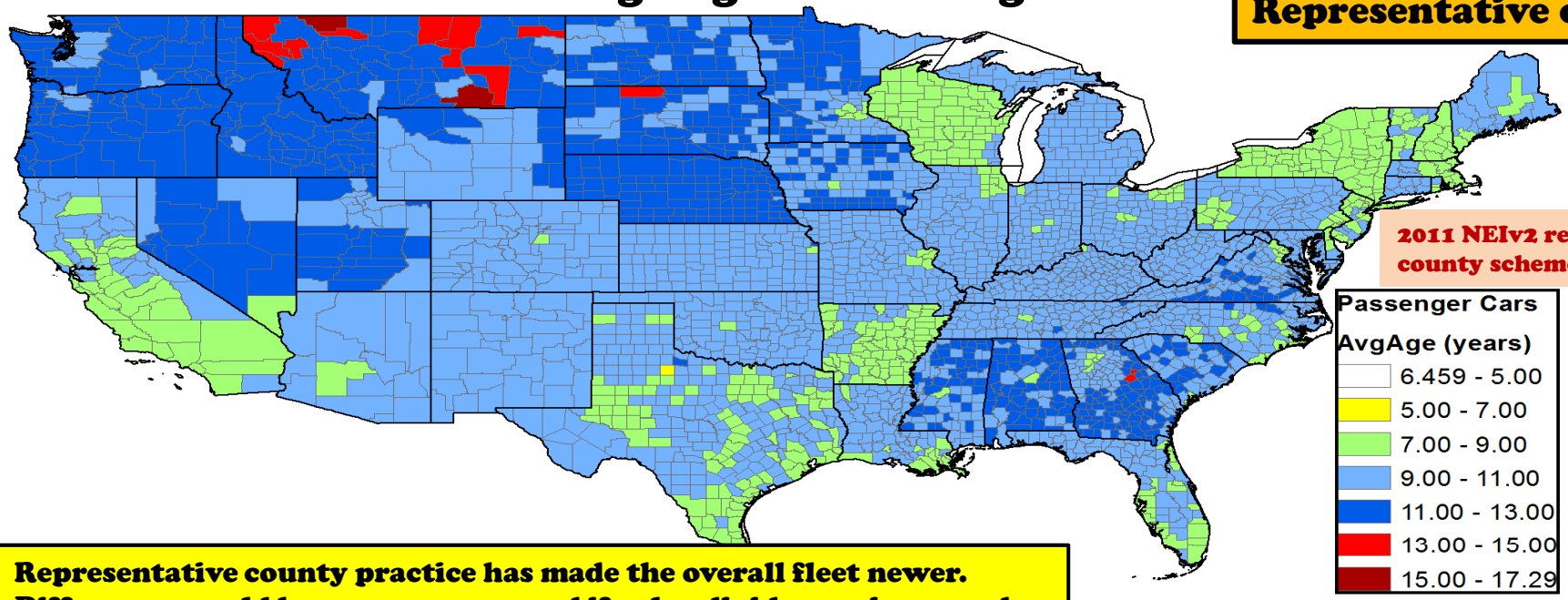
- **CRC project goal was to improve the default inputs used by USEPA in MOVES modeling**
- **Selected critical inputs to improve:**
  - Passenger car & truck age distribution
  - Passenger car & truck population
  - Combination long-haul VMT
  - Heavy-duty extended idling
- **For age and population, IHS data for passenger cars (21) and passenger trucks (31, 32) were obtained for 2011**
- **CRC data (21, 31, 32) has been incorporated into 2011NEIv2 via external MySQL CDBs (but not in MOVES database)**
- **Evaluation: average age for a source vehicle type:**

$$\text{Average Age} = \sum_{i=0}^{i=30} \text{fraction_}i * \text{age_}i$$

Effect of Representative County

Average Age for Passenger Cars

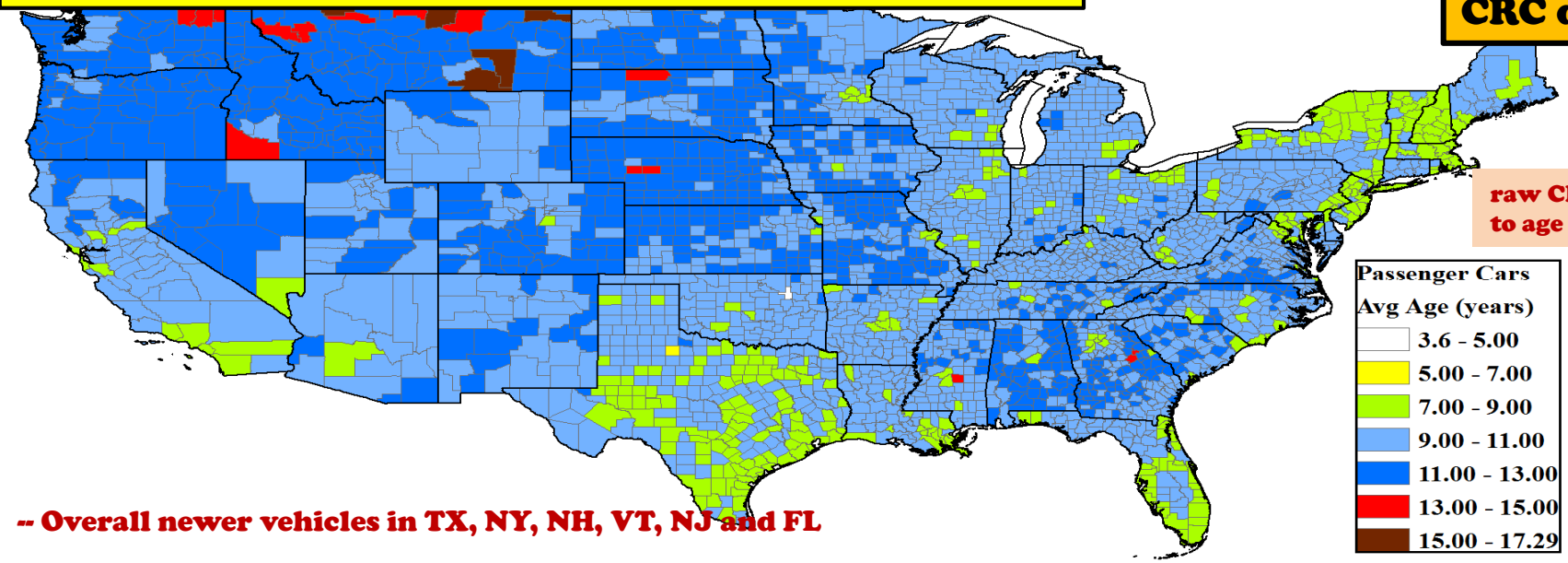
Representative county



2011 NEIv2 representative county scheme applied

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

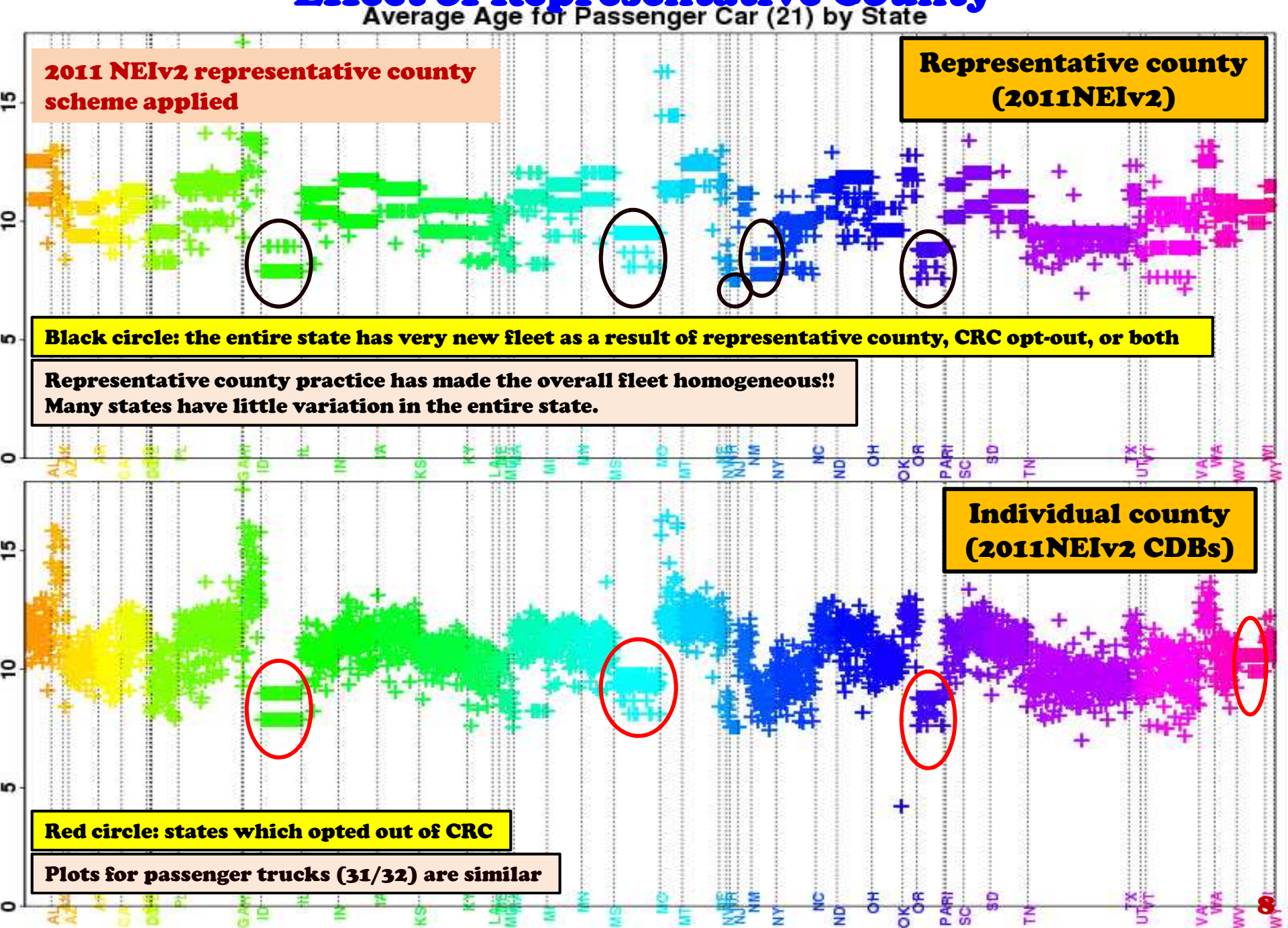
CRC data



raw CRC data prior to age 30 correction

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

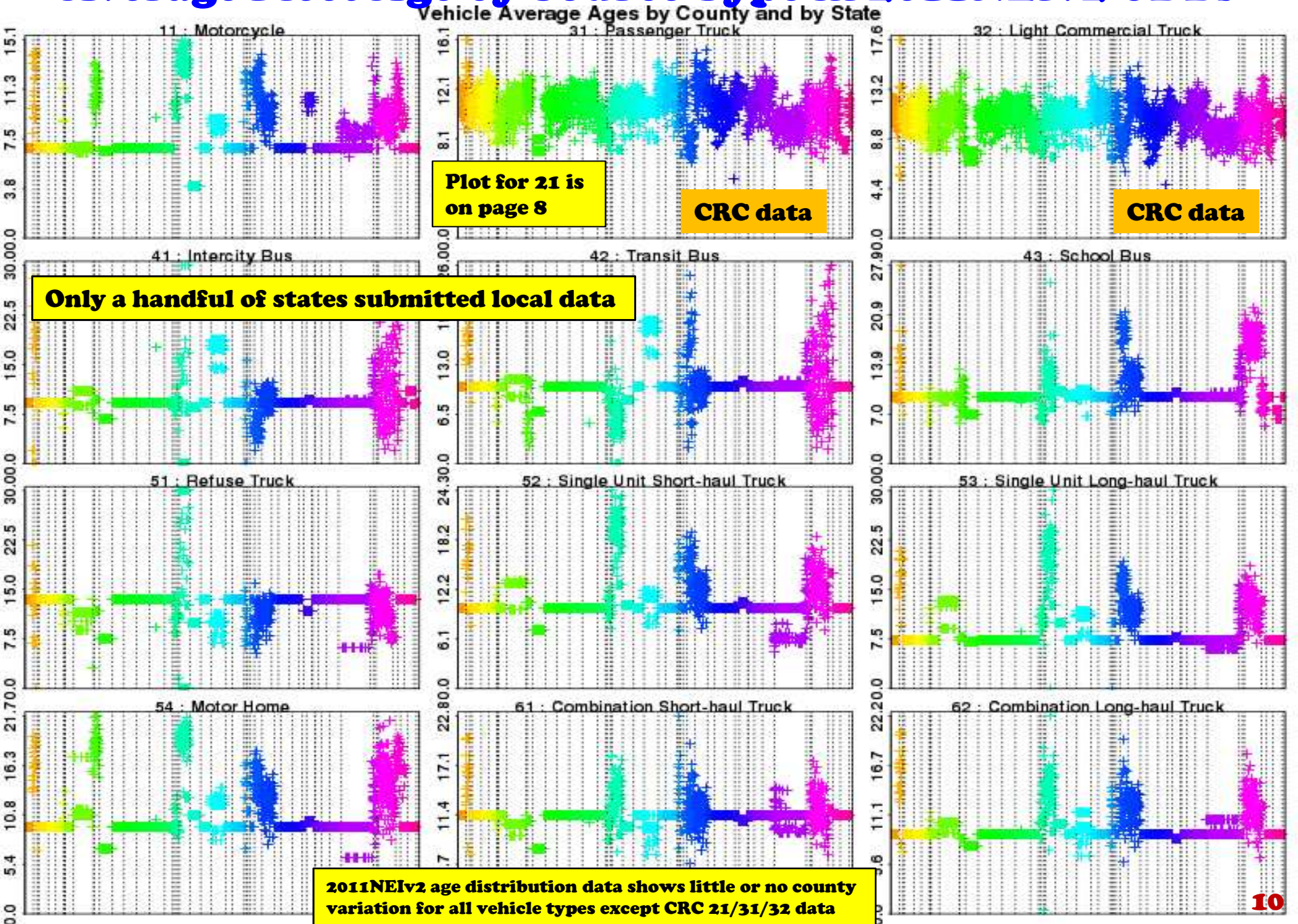
Effect of Representative County

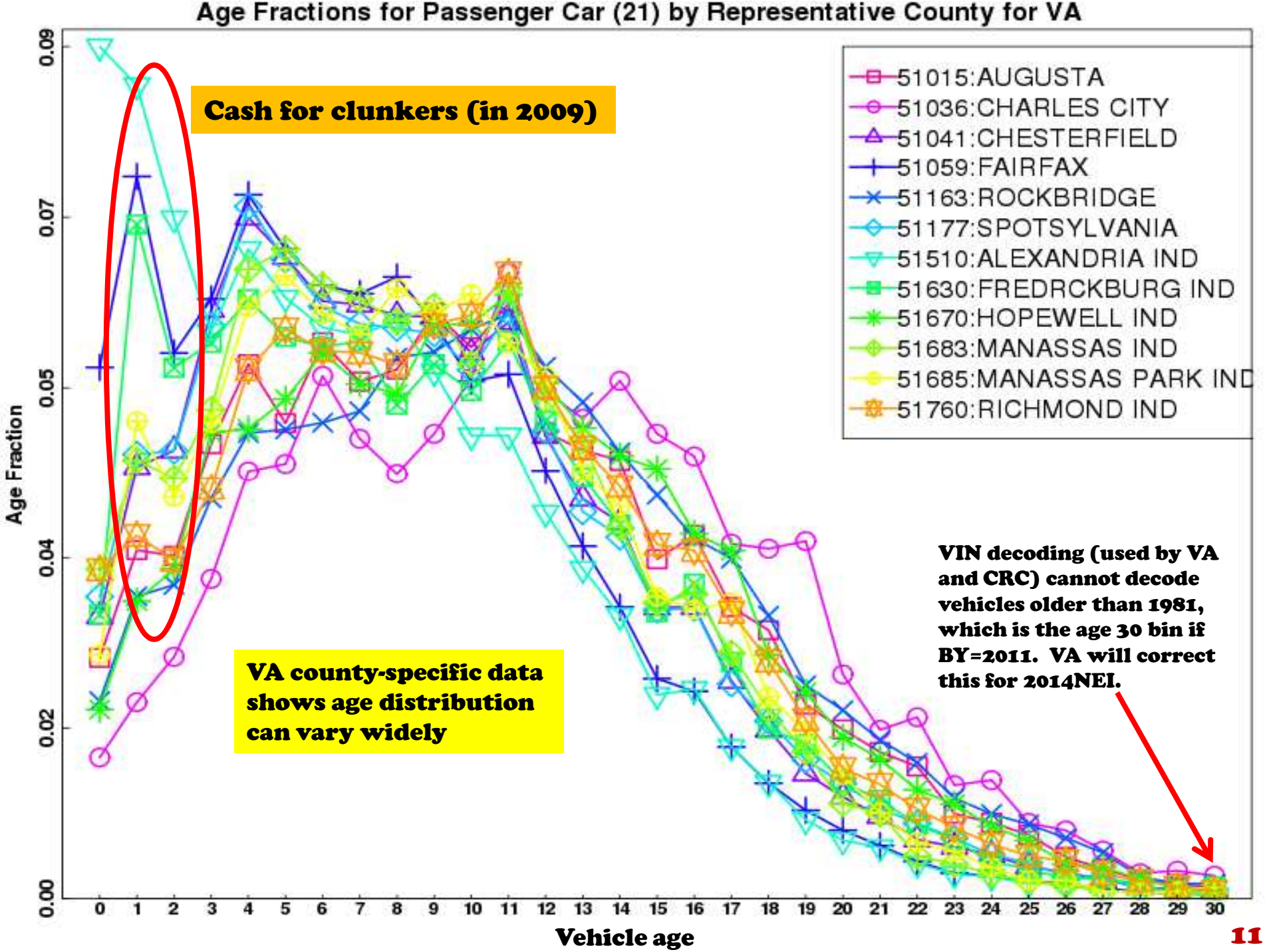


Summary on Representative County

- Representative county is generally selected as county in a group with the highest VMT (which is usually more urbanized), making overall fleet newer (lower emissions)
- The approach also makes the entire fleet more homogeneous. Many states have very little variation in average fleet age for the entire state
- The overall fleet in some states is very new, as a result of either representative county scheme, CRC opt-out, or both (IL, MO, NJ, NY, PA)
- Representative county scheme should consider a total of six criteria. How can this approach be realistically implemented in practice?

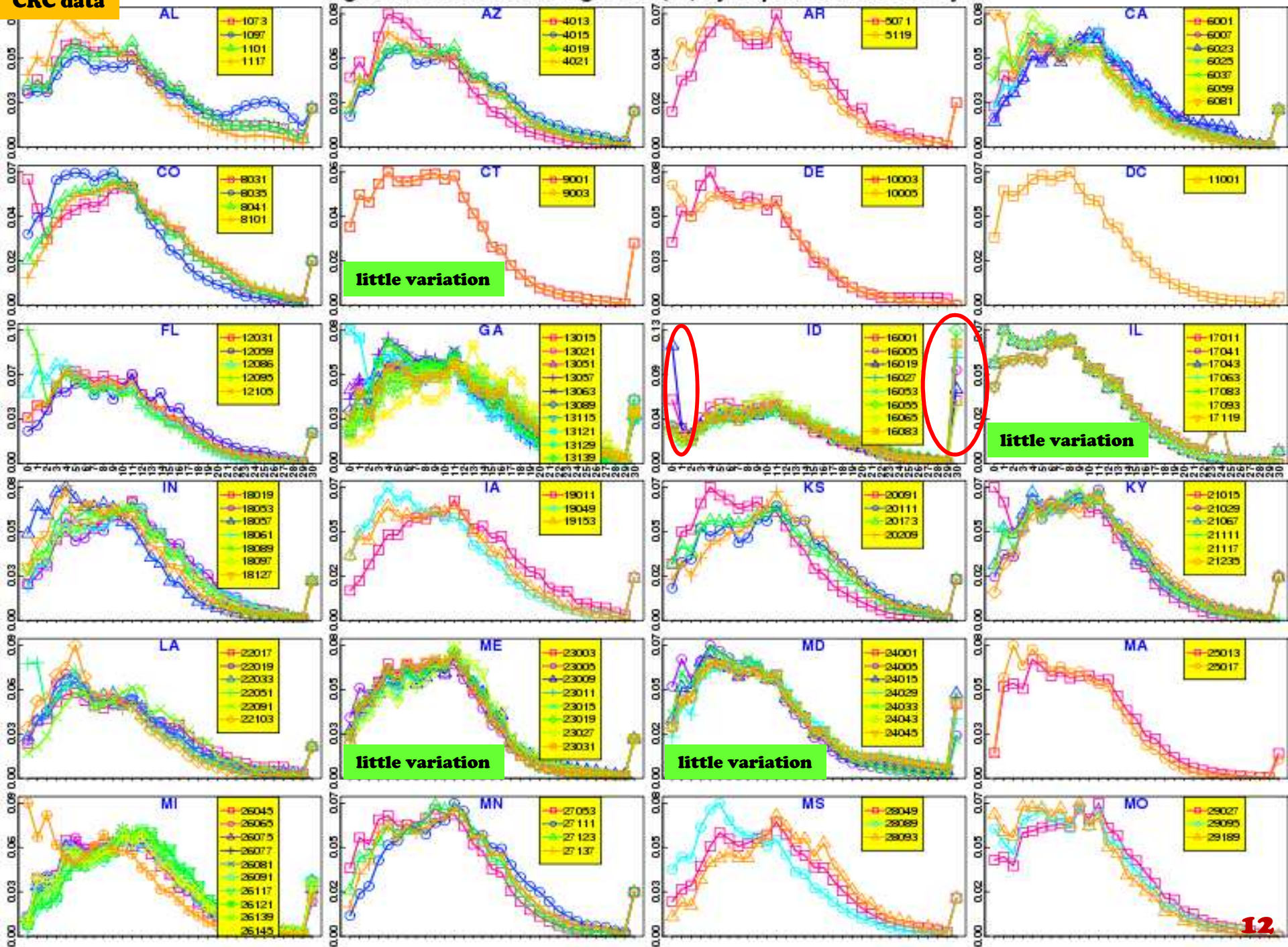
Average Fleet Age by Source Type in 2011NEIv2 CDBs




Age Fractions for Passenger Car (21) by Representative County for VA
Age Fraction
Vehicle age
0.00
0.02
0.04
0.05
0.07
0.09
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
51015:AUGUSTA
51036:CHARLES CITY
51041:CHESTERFIELD
51059:FAIRFAX
51163:ROCKBRIDGE
51177:SPOTSYLVANIA
51510:ALEXANDRIA IND
51630:FREDRCKBURG IND
51670:HOPEWELL IND
51683:MANASSAS IND
51685:MANASSAS PARK IND
51760:RICHMOND IND
Cash for clunkers (in 2009)
VA county-specific data shows age distribution can vary widely
VIN decoding (used by VA and CRC) cannot decode vehicles older than 1981, which is the age 30 bin if BY=2011. VA will correct this for 2014NEI.

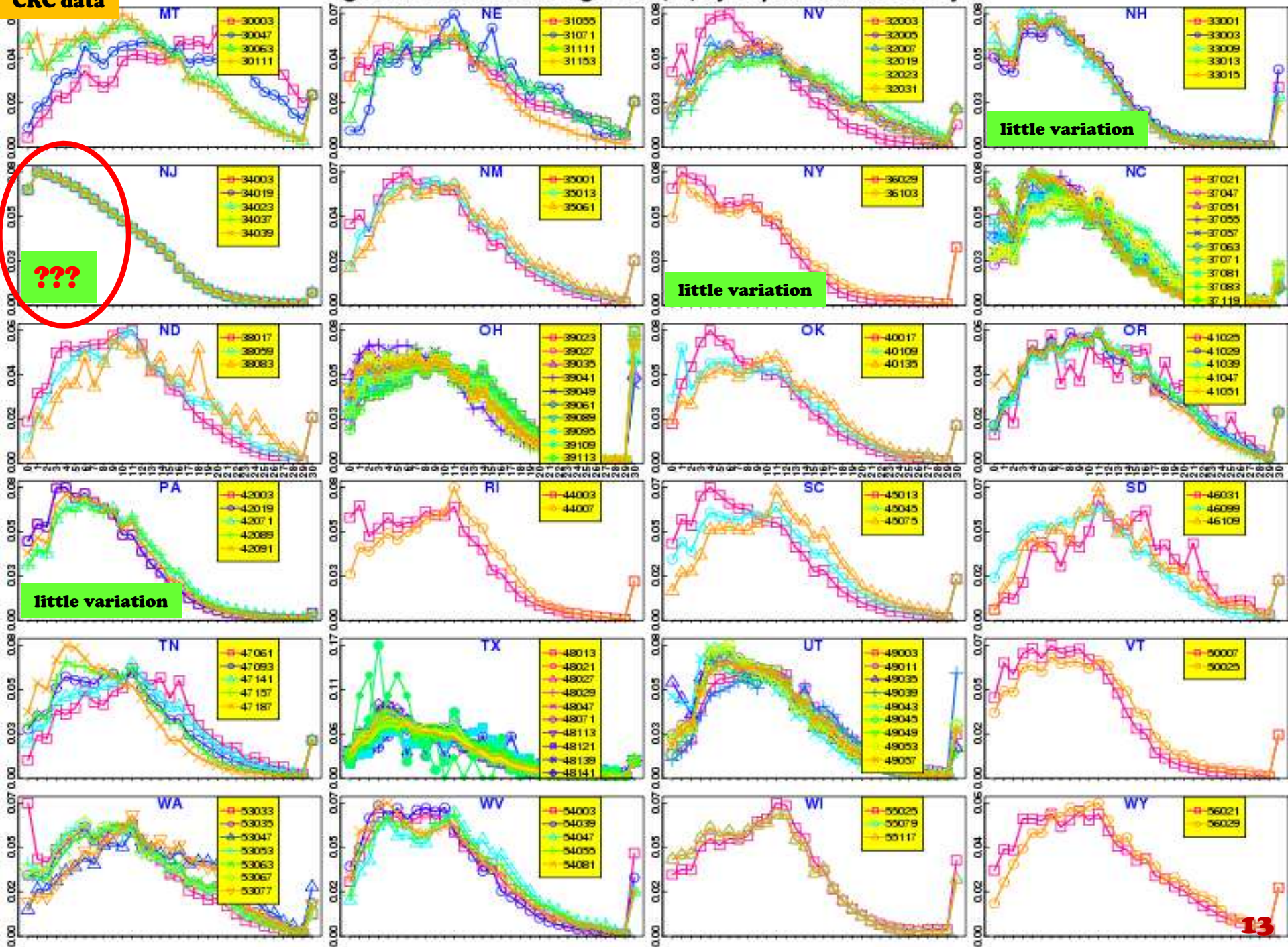
CRC data

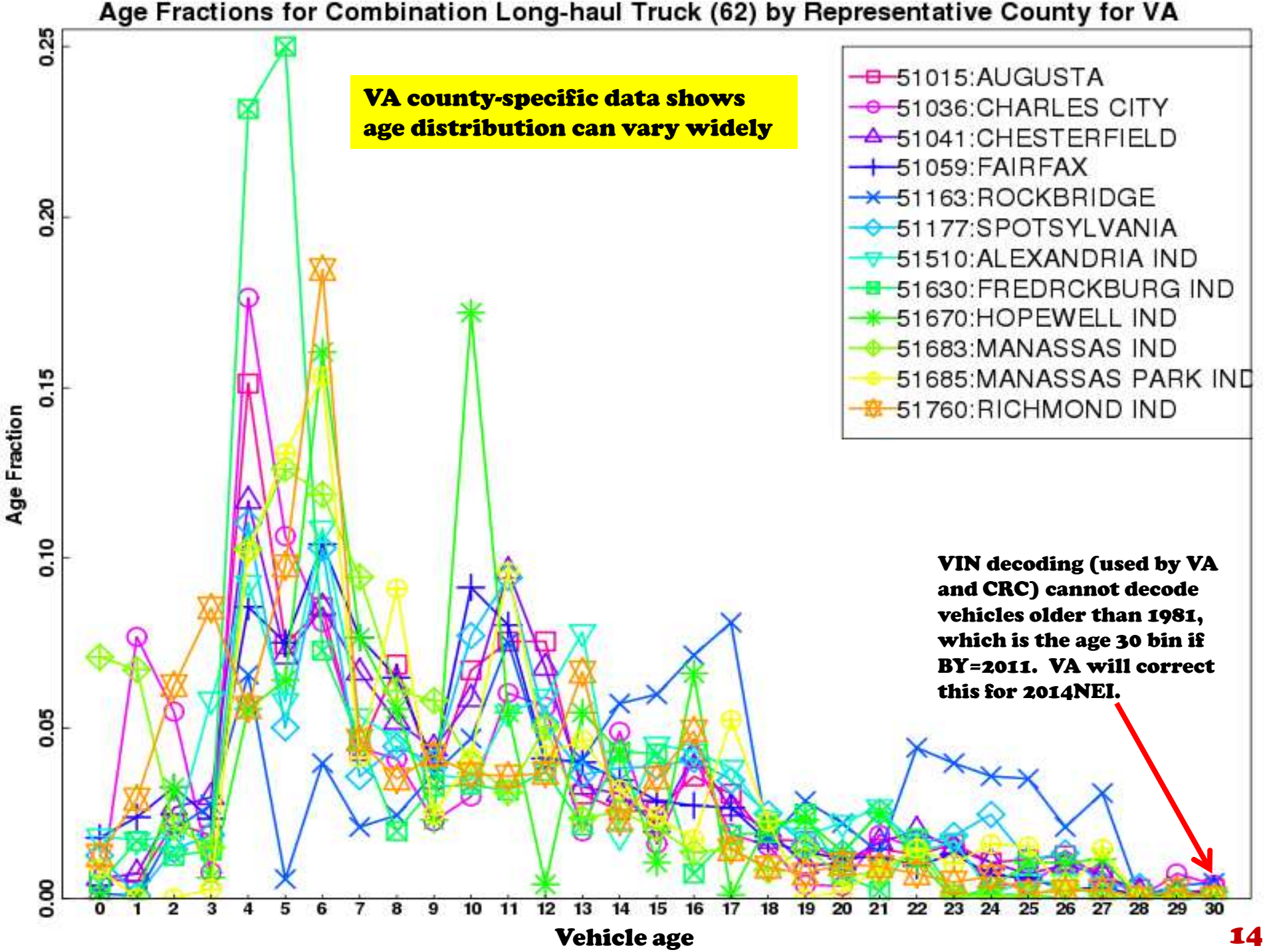
Age Fractions for Passenger Car (21) by Representative County



CRC data

Age Fractions for Passenger Car (21) by Representative County




Age Fractions for Combination Long-haul Truck (62) by Representative County for VA
VA county-specific data shows age distribution can vary widely
51015:AUGUSTA
51036:CHARLES CITY
51041:CHESTERFIELD
51059:FAIRFAX
51163:ROCKBRIDGE
51177:SPOTSYLVANIA
51510:ALEXANDRIA IND
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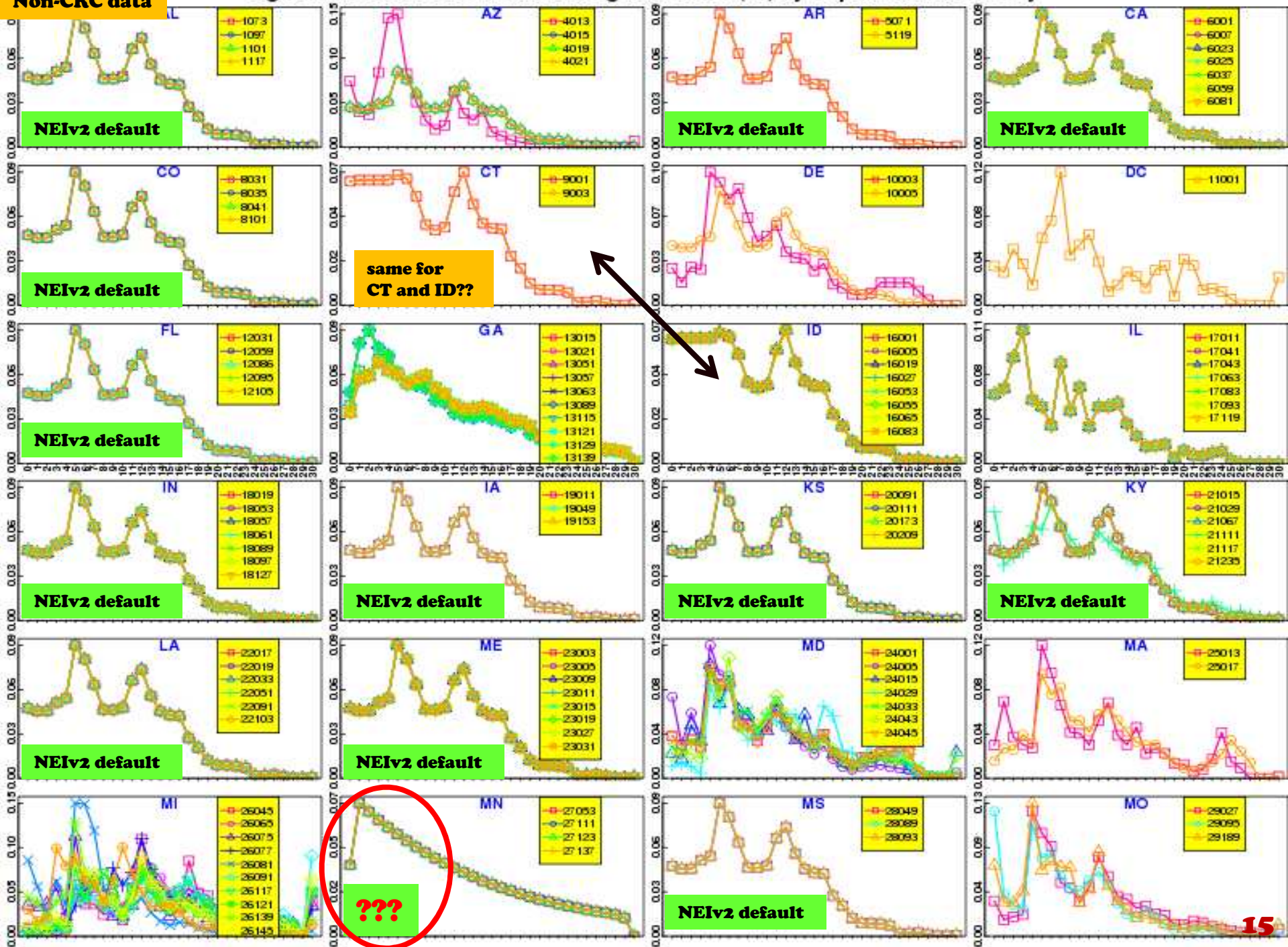
51685:MANASSAS PARK IND
51760:RICHMOND IND
VIN decoding (used by VA and CRC) cannot decode vehicles older than 1981, which is the age 30 bin if BY=2011. VA will correct this for 2014NEI.
Age Fraction
0.00
0.05
0.10
0.15
0.20
0.25
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Vehicle age

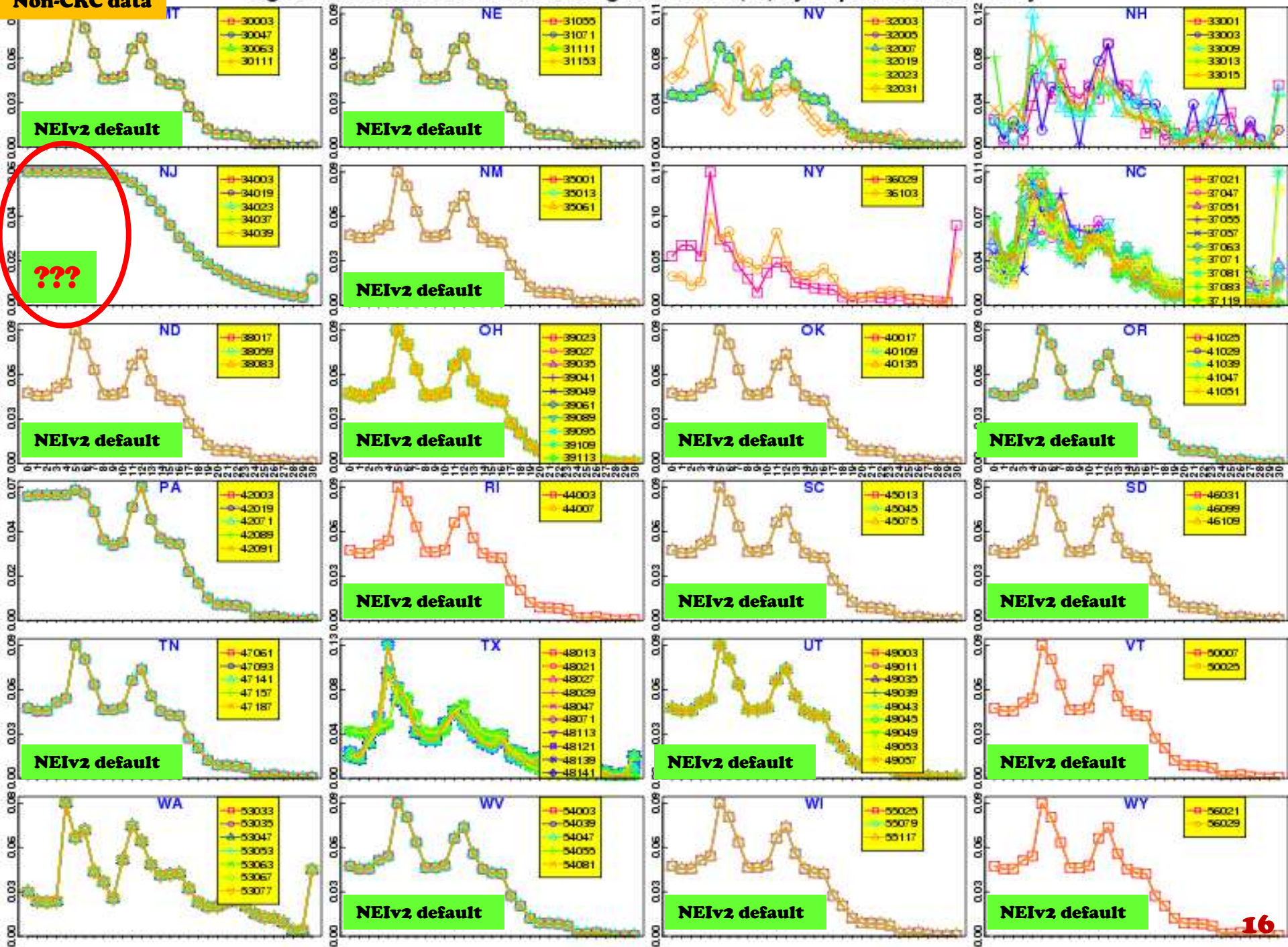
Non-CRC data

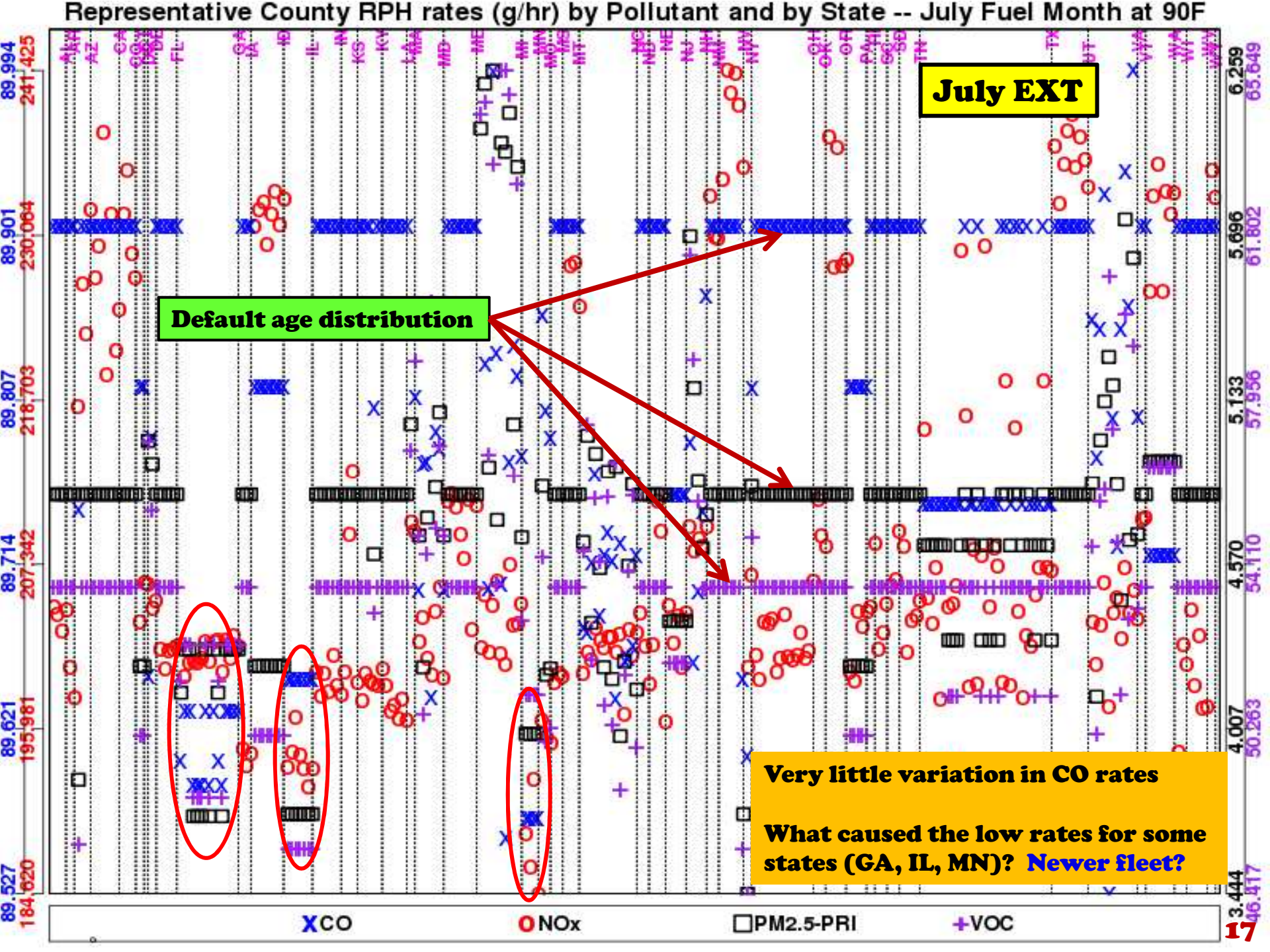
Age Fractions for Combination Long-haul Truck (62) by Representative County



Non-CRC data

Age Fractions for Combination Long-haul Truck (62) by Representative County




Representative County RPH rates (g/hr) by Pollutant and by State -- July Fuel Month at 90F
July EXT
Default age distribution
Very little variation in CO rates
What caused the low rates for some states (GA, IL, MN)? Newer fleet?
CO
NOx
PM2.5-PRI
VOC
89.994
241,425
89.901
230,064
89.807
218,703
89.714
207,342
89.621
195,981
89.527
184,620
6.259
65.649
5.696
61.802
5.133
57.956
4.570
54.110
4.007
50.263
3.444
46.417

Data Issues with Fleet Age in 2011NEIv2
Overall Summary

	Category	Effect on Mobile Emissions	Example States
(1)	MOVES defaults for all counties and for all types (except CRC 21/31/32)	Unknown, depends on default	Too many to list
(2)	No variation with representative county	Homogeneous emissions for the entire state	CT, IL, MN, NJ
(3)	Fewer representative counties	Emissions underestimated	IL, NY, PA
(4)	Smooth age distribution	Overall newer fleet, emissions underestimated	MN, NJ
(5)	No correction for age 30	Newer fleet, emissions underestimated	PA, VA
(6)	Over-corrected age 30 (CRC data only)	Older fleet, emissions overestimated	MI, NH, NC, WA
(7)	Large peaks for particular model years	Effects vary	GA, TX, ...

Roughly in order of significance

-- See next page for a detailed overall summary table by state
-- Default (in the table) = 2011NEIv2 default

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	Default (except 1)				Default (except 1)	Default (except 1)	Default (except 1)	Default (except 1)	Default (except 1)	Default (except 1)	Default (except 1)	Default (except 1)	Default (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	Default (except 1)				Default (except 1)	Default (except 1 - High)	Default (except 1)	Default (except 1)	Default (except 1)	Default (except 1)	Default (except 1)	Default (except 1)	Default (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	Default (except 2)				Default (except 1)	Default (except 1)	Default (except 1)	Default (except 1)	Default (except 1)	Default (except 1)	Default (except 1)	Default (except 1)	Default (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
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	Default (except 2)				Default	Default	Default	Default	Default	Default	Default (except 2)	Default	Default
WY	Default				Default	Default	Default	Default	Default	Default	Default	Default	Default

CRC data

Summary on Fleet Age Data in 2011NEIv2

- Most states show no data variation for the entire state for all vehicle source types (except CRC data for vehicle types 21/31/32)
- Some states opted out of using CRC data, but the data replaced are homogeneous with no variation in the entire state
- Methods adopted by states are inconsistent, creating "biased" mobile source inventory (age distribution very smooth or very new vehicle fleet)
- Widespread use of defaults for source types other than 21/31/32
- Representative county approach in SMOKE-MOVES magnifies the issues

Overall Summary

- Several data issues are found in mobile source inventory for 2011NEI version2
- Nearly two thirds (2/3) of US did not supply county-specific data and relied on model defaults
- Methods adopted by states and EPA are inconsistent
- Issues are magnified by representative county scheme used in SMOKE-MOVES
- Due to representative county scheme and widespread use of defaults, the mobile source inventory in 2011NEI has very coarse resolution
- Development of quality mobile source inventory is a critical component in air quality modeling
- Strongly recommend addressing mobile source inventory issues prior to the final transport modeling analyses