

**Critical Review of Mobile Emissions from
EPA 2011 NEI: Part Five –
Extended Idling, Fuels, and MOVES Processes**

**Georgia Department of
Natural Resources**

**Virginia Department of
Environmental Quality**

**MARAMA MOVES Workgroup Conference Call
March 20, 2014**

Summary of March 3 joint VA/GA presentation

- **OTAQ's extended idle source category (EXT) only includes hotelling by long haul diesel trucks traveling on interstates**
 - **Other idling types are not included in EXT and may be part of the general drive cycle or may be completely missing from the MOVES model (ex, marine ports, ship/rail yards, oil/gas exploration sites, or regular truck stops)**
 - **Total vehicle operating hours that are idling (EXT) and county percent of total (idleAllocationFactor) were estimated using MOVES default (1999 data? EPA please confirm)**
 - **EPA then allocates total EXT hours in three steps:**
 - **nation --> state using national hotelling demand data**
 - **state --> counties (only on interstates)**
 - **county --> all grid cells in that county (whether or not the cell has an interstate)**
- This committee finds the approach taken to be problematic**
- **The OTAQ approach to estimating extended idling (EXT) was used in EPA 2011 version1.**
 - **In future SMOKE-MOVES modeling, state will have to obtain year-specific national population along with activity of long haul diesel trucks from EPA (states have no way of making this estimate)**
 - **We need better communication and clearer documentation from OTAQ to use MOVES and SMOKE-MOVES tools properly**

Further Review of 2011NEI

- **EXT emission rates and their spatial variation**
- **Vehicle population issues (by county and in total)**
 - **OTAQ EXT methodology versus SMOKE**
 - **Vehicle population in MOVES inputs versus vehicle population in SMOKE inputs**
- **Fuel Month Approach**
- **MOVES Processes (EXT, START, RUNNING)**

EXT Emission Rates

Allocating EXT Emissions in SMOKE-MOVES

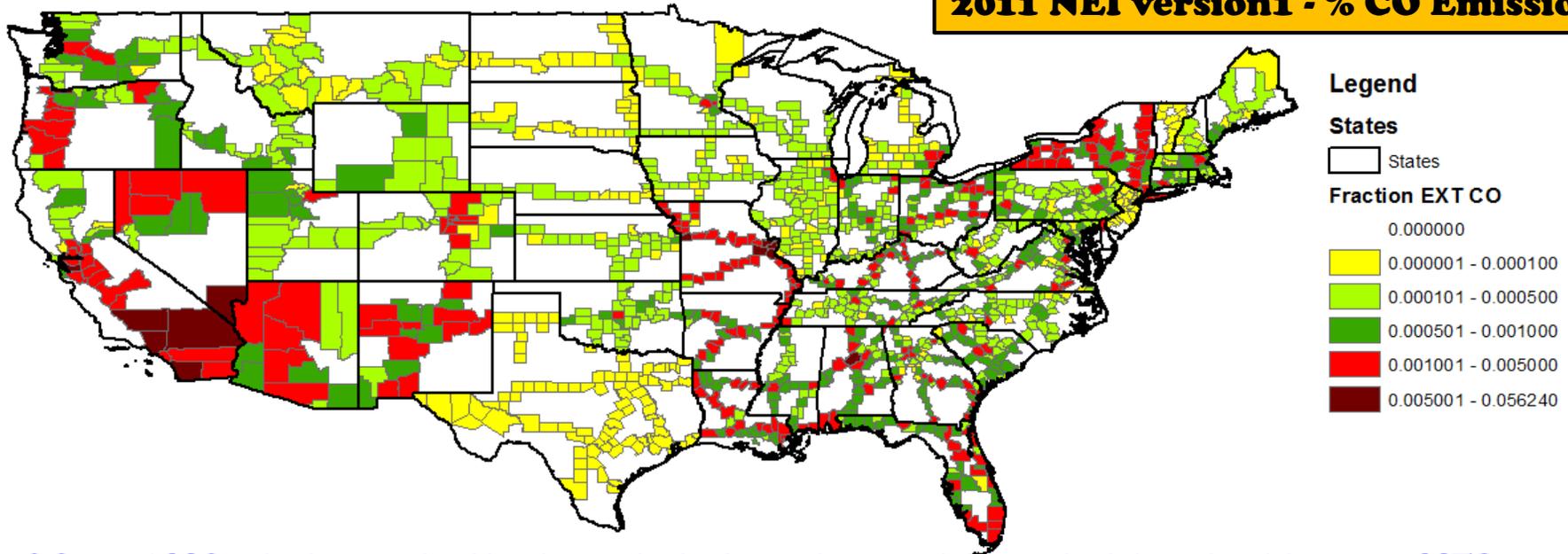
$$\begin{aligned} \blacksquare \text{ EXT Emissions} &= \text{ER}_R(\text{g/vehicle}) * \text{EIAdjust} * \text{VPOP}(\text{county}_i) \\ &= \text{ER}_R(\text{g/vehicle}) * [\text{VPOP}_N / \text{VPOP}(\text{county}_i)] \\ &\quad * \text{idleAllocationFactor} * \text{VPOP}(\text{county}_i) \\ &= \text{ER}_R(\text{g/vehicle}) * \text{VPOP}_N * \text{idleAllocationFactor} \end{aligned}$$

$$\text{ER}_R(\text{g/vehicle}) = \frac{\text{EXT Emissions}}{\text{VPOP}_N * \text{idleAllocationFactor}}$$

Evaluation: calculate averaged emission rates ER_R from EXT emissions, national VPOP (of two SCCs vehicle types) and $\text{idleAllocationFactor}$ in 2011NEI version1

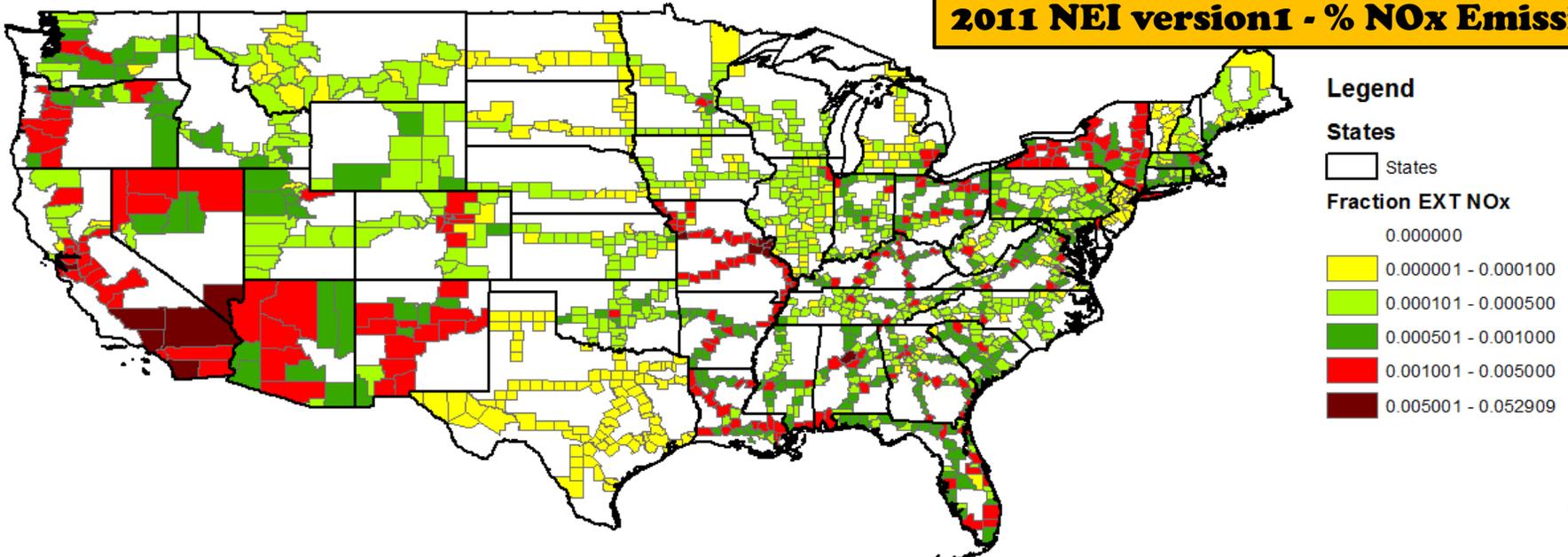
CO is the signature pollutant for EXT or mobile source in general

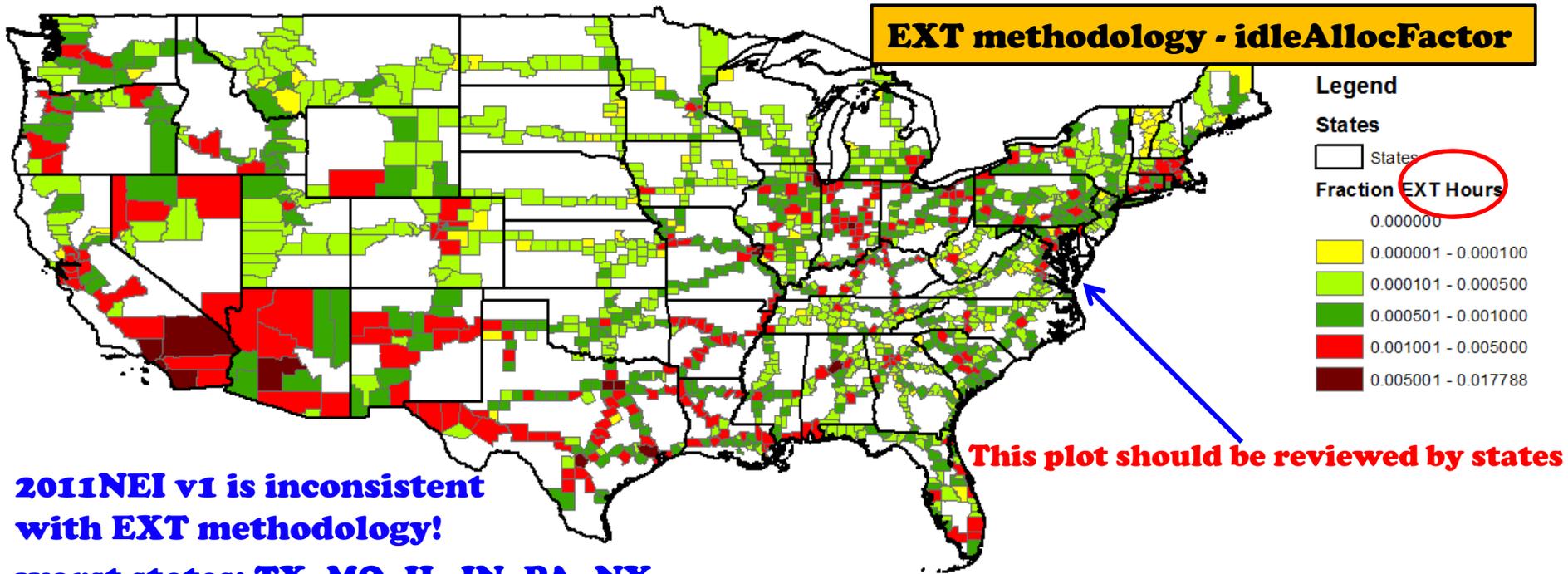
2011 NEI version1 - % CO Emissions



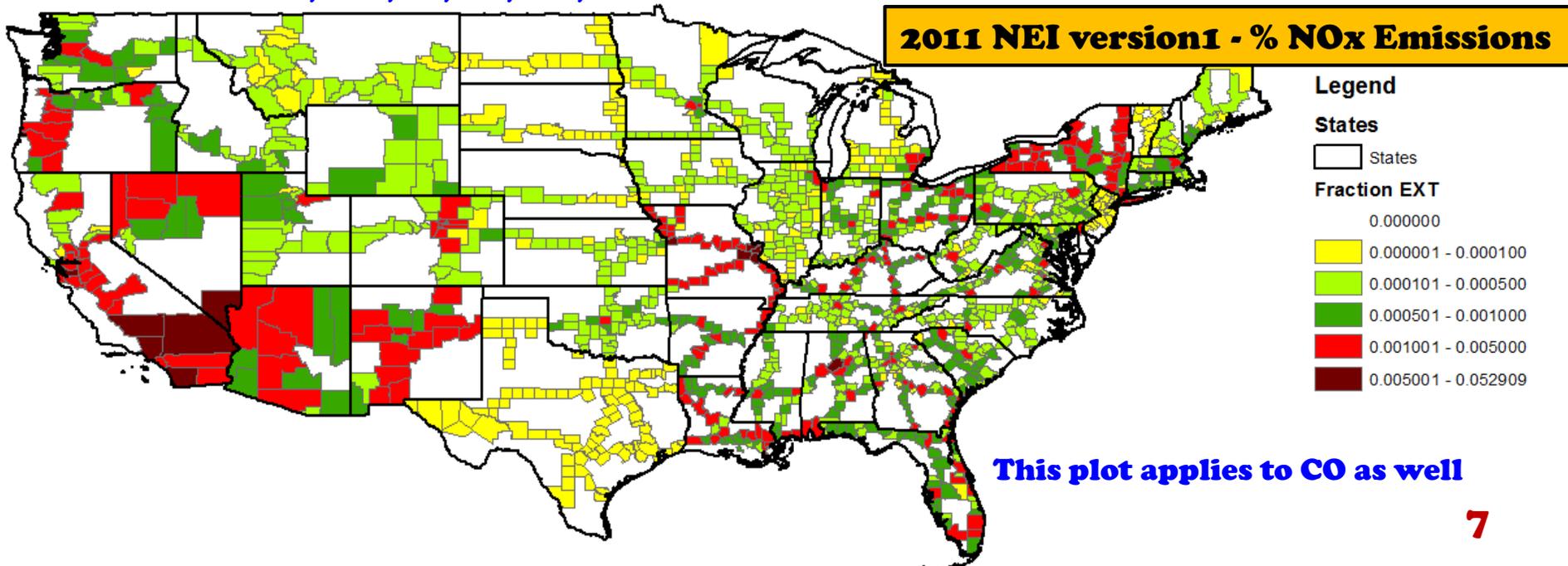
CO and NOx behave similarly - their fractions are nearly identical in 2011NEI

2011 NEI version1 - % NOx Emissions

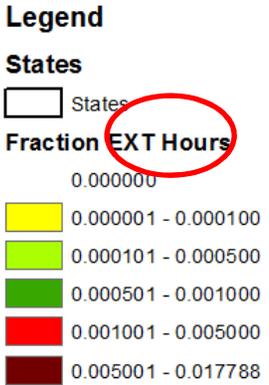
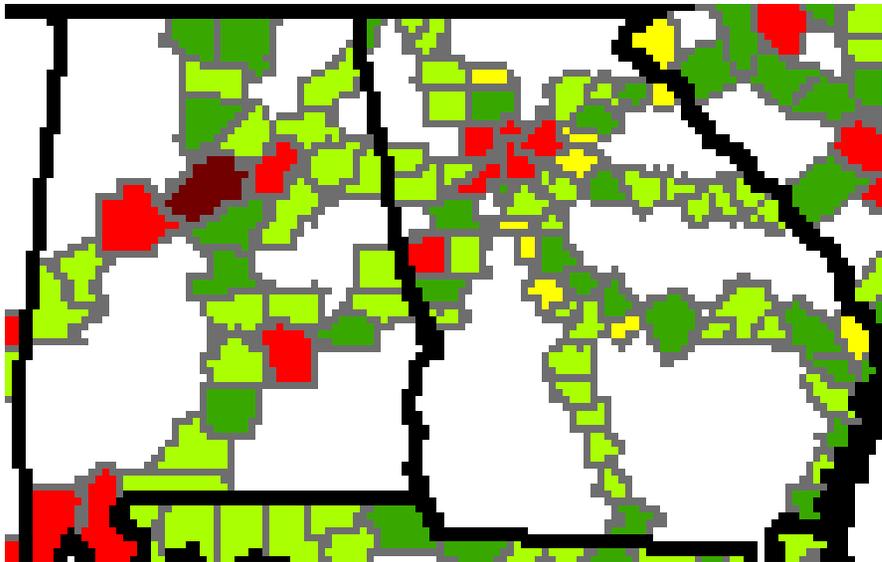




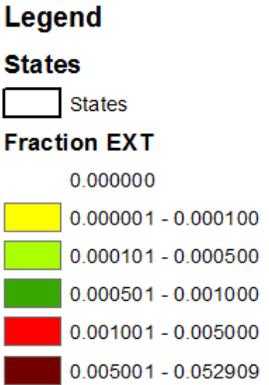
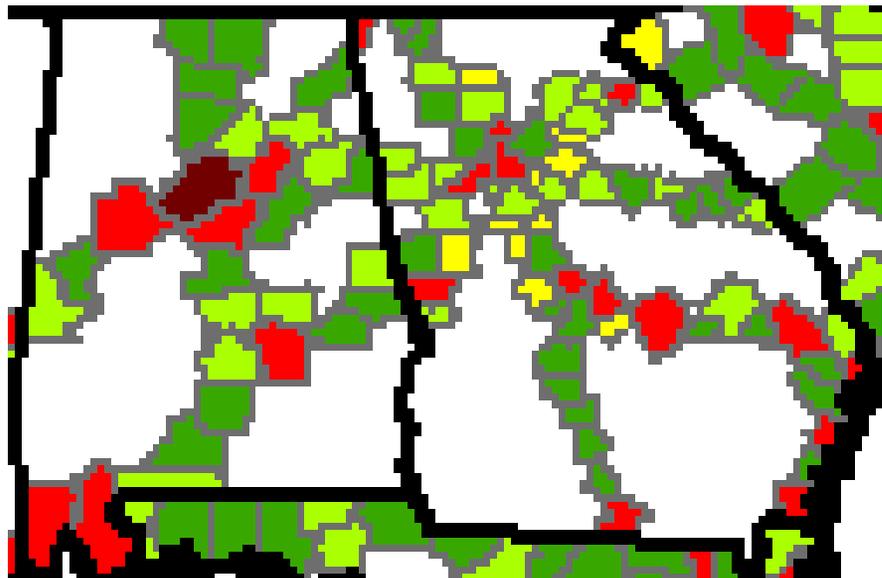
2011NEI v1 is inconsistent with EMT methodology!
worst states: TX, MO, IL, IN, PA, NY



EXT methodology - idleAllocFactor



2011 NEI version1 - % NOx Emissions

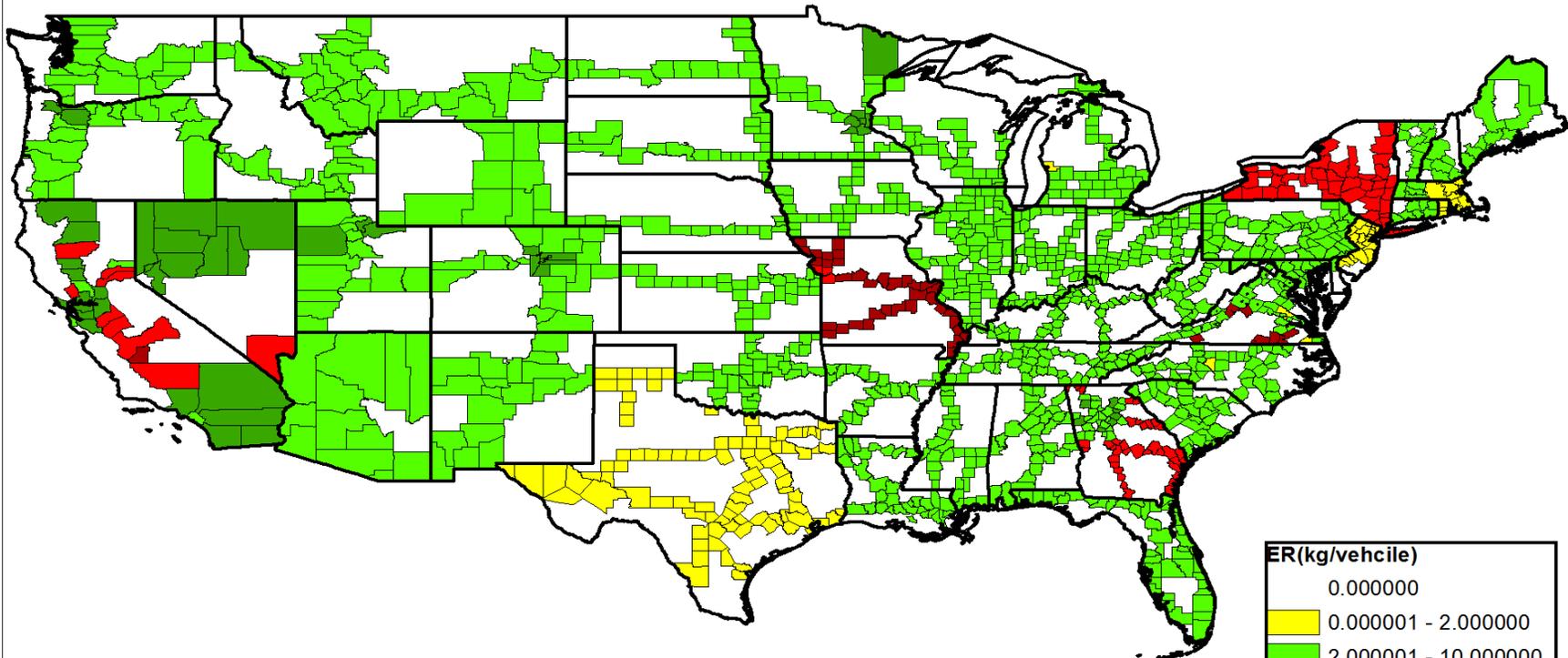


In Georgia, three red counties have turned green and eleven green counties have turned red.

Calculated NO_x Rates (ER_R) for MHDDV

EXT Emissions

$$ER_R(\text{g/vehicle}) = \frac{\text{EXT Emissions}}{VPOP_N * \text{idleAllocationFactor}}$$

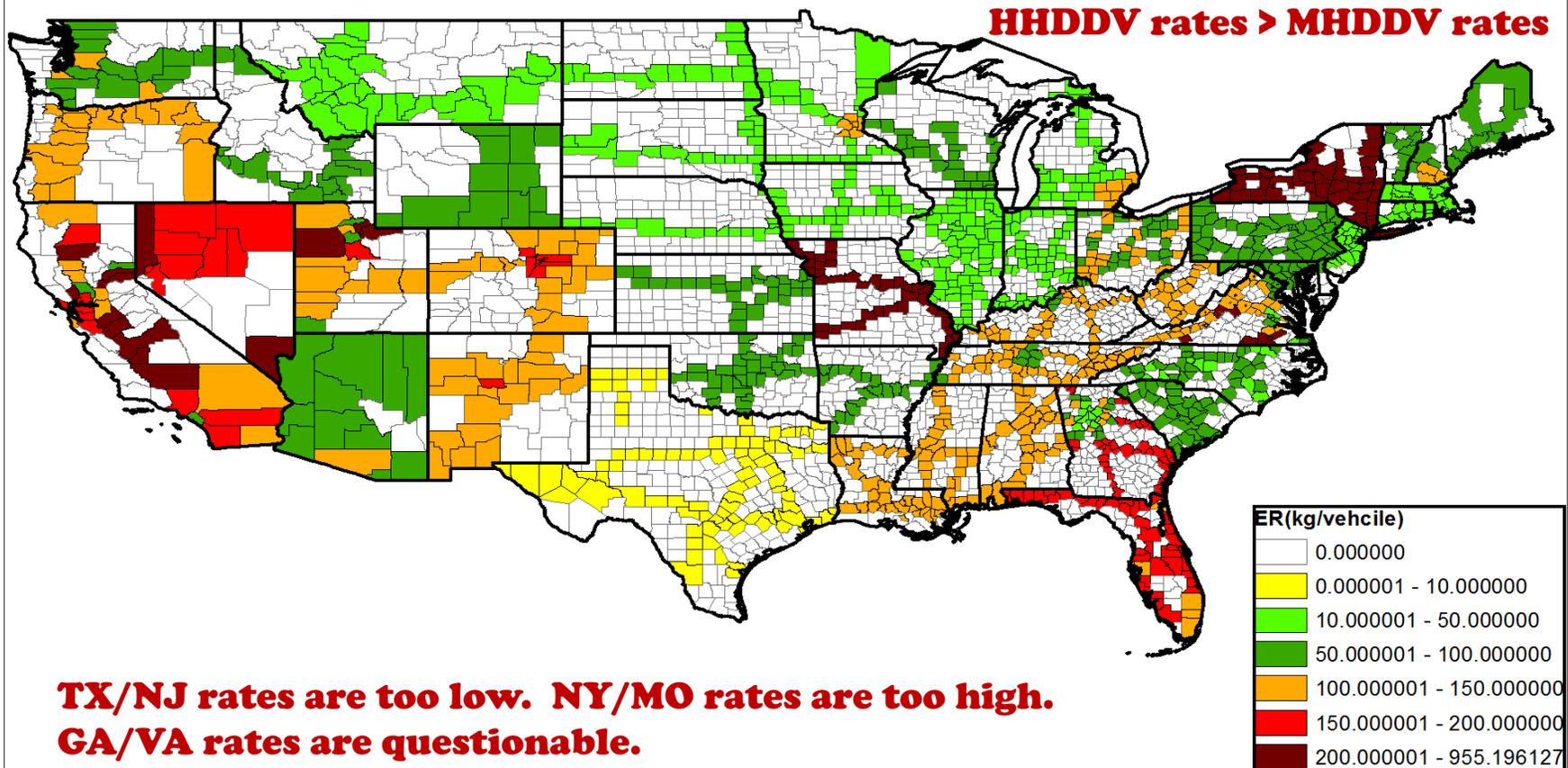


**TX/NJ rates are too low. NY/MO rates are too high.
GA/VA rates are questionable.**

Calculated NO_x Rates (ER_R) for HHDDV

EXT Emissions

$$ER_R(\text{g/vehicle}) = \frac{\text{EXT Emissions}}{VPOP_N * \text{idleAllocationFactor}}$$



Georgia EXT Emission Rates

■ For MHDDV:

- **Fulton County group – 3.7 kg/vehicle**
- **Floyd County group – 6.2 kg/vehicle**
- **Barrow County group – 14.4 kg/vehicle**
- **Chatham County group – 27.2 kg/vehicle**

■ For HHDDV:

- **Fulton County group – 49.1 kg/vehicle**
- **Floyd County group – 74.6 kg/vehicle**
- **Barrow County group – 120.6 kg/vehicle**
- **Chatham County group – 189.8 kg/vehicle**

■ **Georgia representative counties based on fuel RVP, I&M Programs, Stage II, and Age Distribution**

- **None of these differences would account for the large differences in EXT emission rates**
- **VMT/VPOP ratios for individual representative counties vs. aggregation across all counties in the county group?**

Summary on EXT Emission Rates

- **An average emission rate for extended idling was calculated for counties along interstates using extended idling emissions, VPOP, and idleAllocationFactor**
- **The average emission rates for some states are either too low (TX) or too high (MO, NY, parts of GA and VA)**

Vehicle Population

Allocating EXT Emissions in SMOKE-MOVES

$$\begin{aligned}
 \blacksquare \text{ EXT Emissions} &= ER_R (\text{g/vehicle}) * EIAdjust * VPOP(\text{county}_i) \\
 &= ER_R (\text{g/vehicle}) * [VPOP_N / VPOP(\text{county}_i)] \\
 &\quad * idleAllocationFactor * VPOP(\text{county}_i) \\
 &= ER_R (\text{g/vehicle}) * VPOP_N * idleAllocationFactor
 \end{aligned}$$

National total VPOP ($VPOP_N$) is used to calculate emissions

Does ($VPOP_N$) include VPOP from all counties or just VPOP from counties that contain interstates?

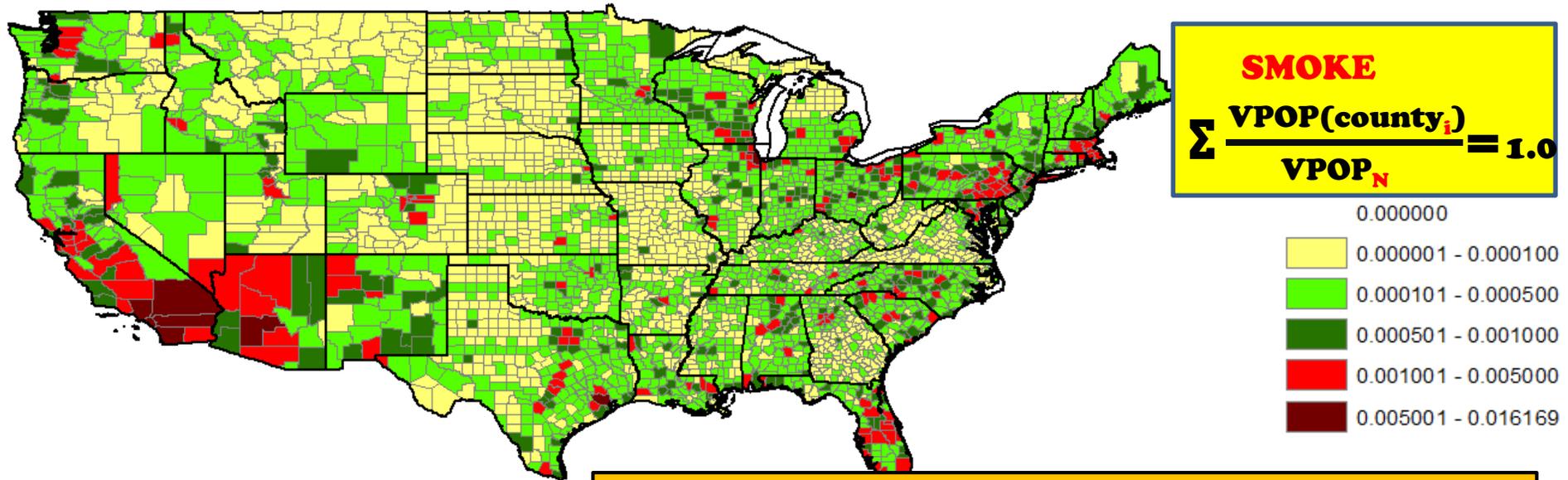
$$EIAdjust = \frac{VPOP_N}{VPOP(\text{county}_i)} * idleAllocationFactor$$

$$\frac{\text{idleAllocationFactor}}{EIAdjust} = \frac{VPOP(\text{county}_i)}{VPOP_N} \quad ???$$

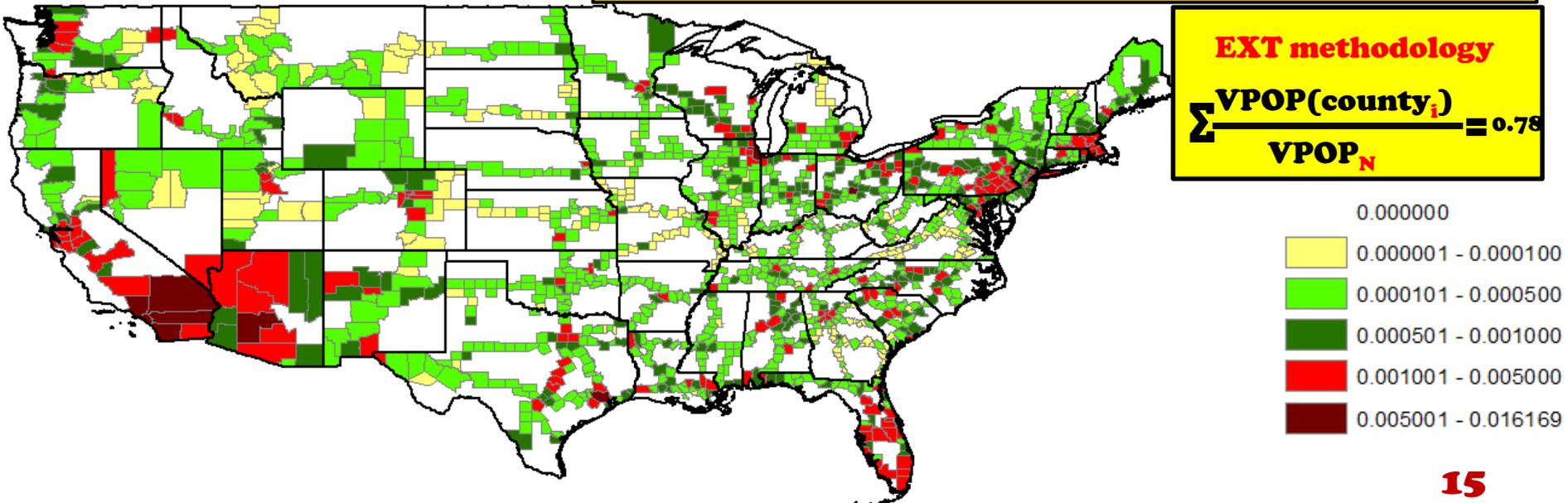
EXT methodology

SMOKE FF10

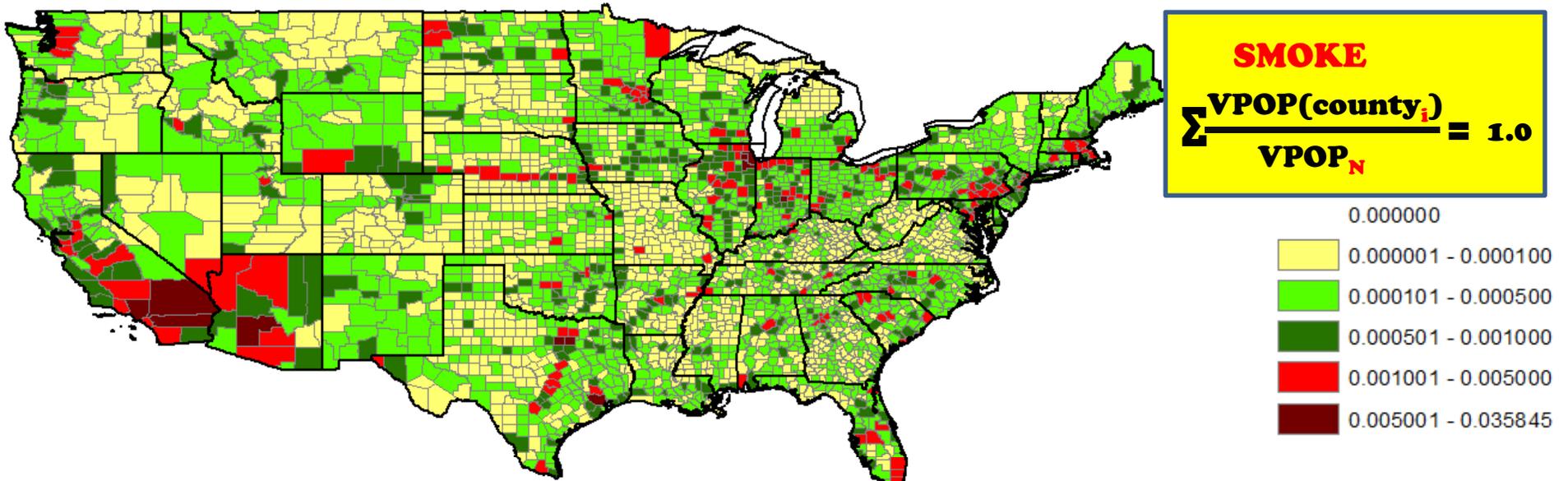
Inconsistent VPOP – fractional MHDDV



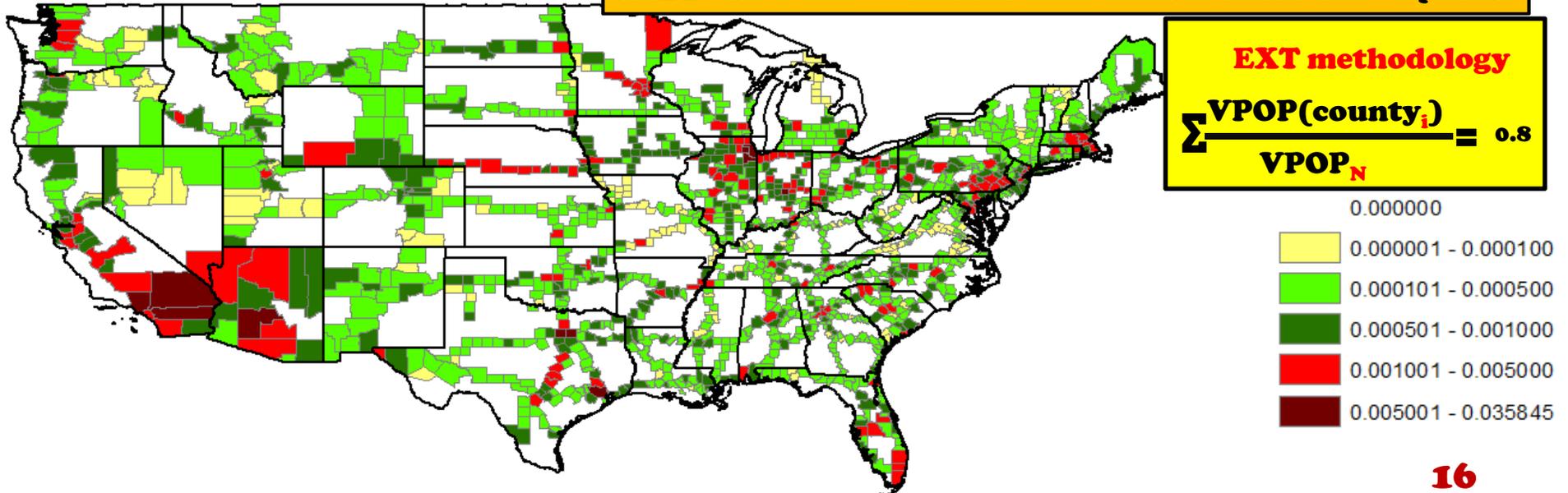
MHDDV in counties with interstates are identical in the two panels!



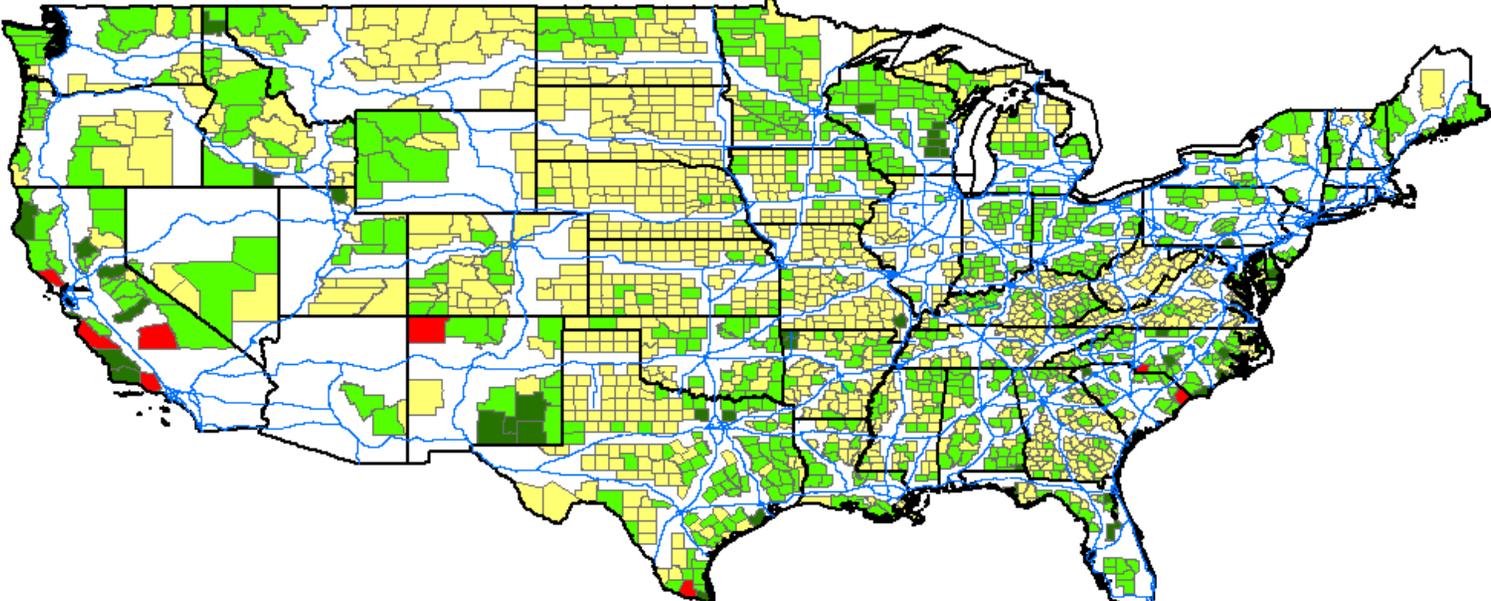
Inconsistent VPOP – fractional HHDDV



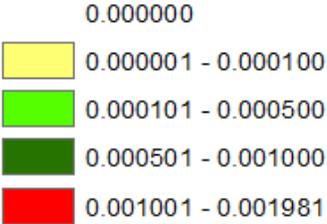
HHDDV in counties with interstates are identical in the two panels!



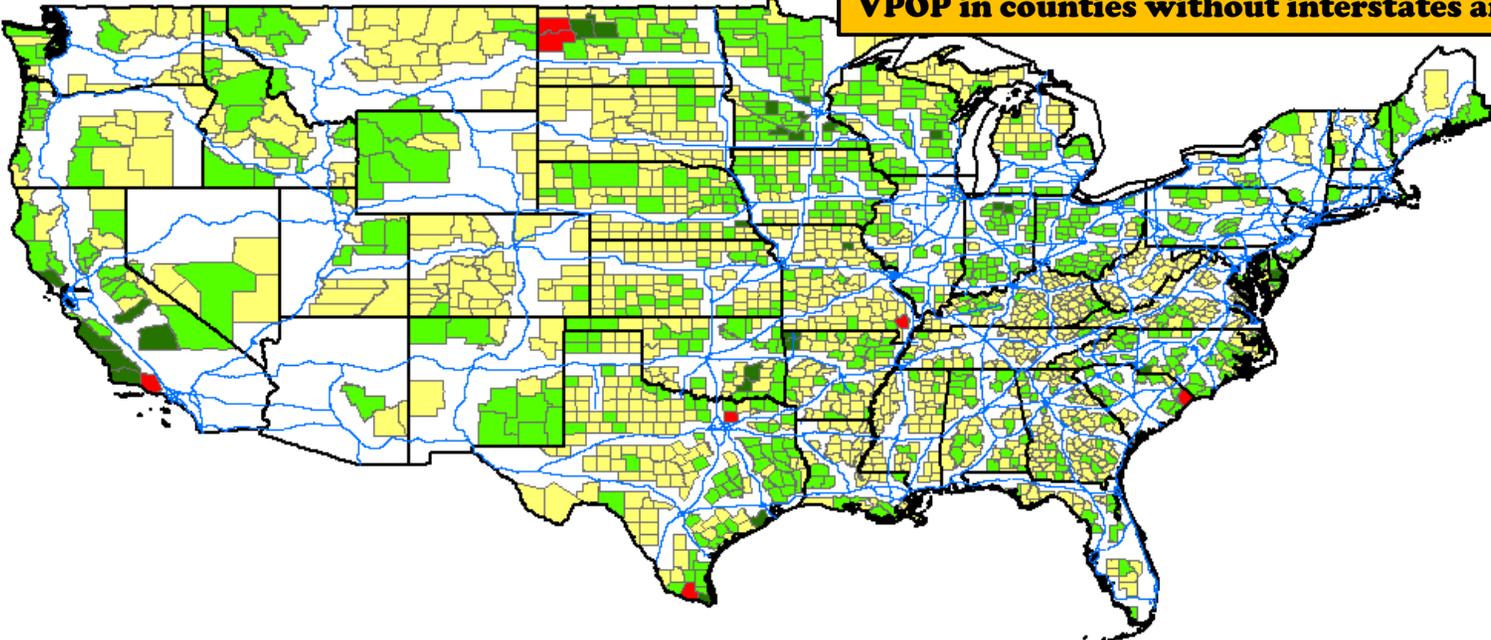
Inconsistent VPOP – VPOP “Loss”



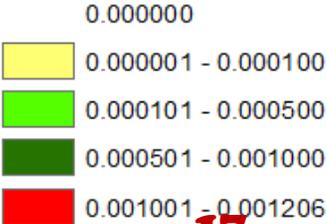
MHDDV
22% of vehicles
not on the
interstates are
unaccounted for



VPOP in counties without interstates are unaccounted for!



HHDDV
20% of vehicles
not on the
interstates are
unaccounted for



Which Vehicle Type is it for EXT?

- **National total VPOP is used to calculate EXT emissions**
- **EXT methodology specifies combination long haul diesel truck (sourcetypeid=62) to be the vehicle type for EXT**
- **SMOKE-MOVES calculates EXT from both MHDDV (2230073390) and HHDDV (2230074390)**

VPOP (62) = VPOP (MHDDV) + VPOP (HHDDV)??

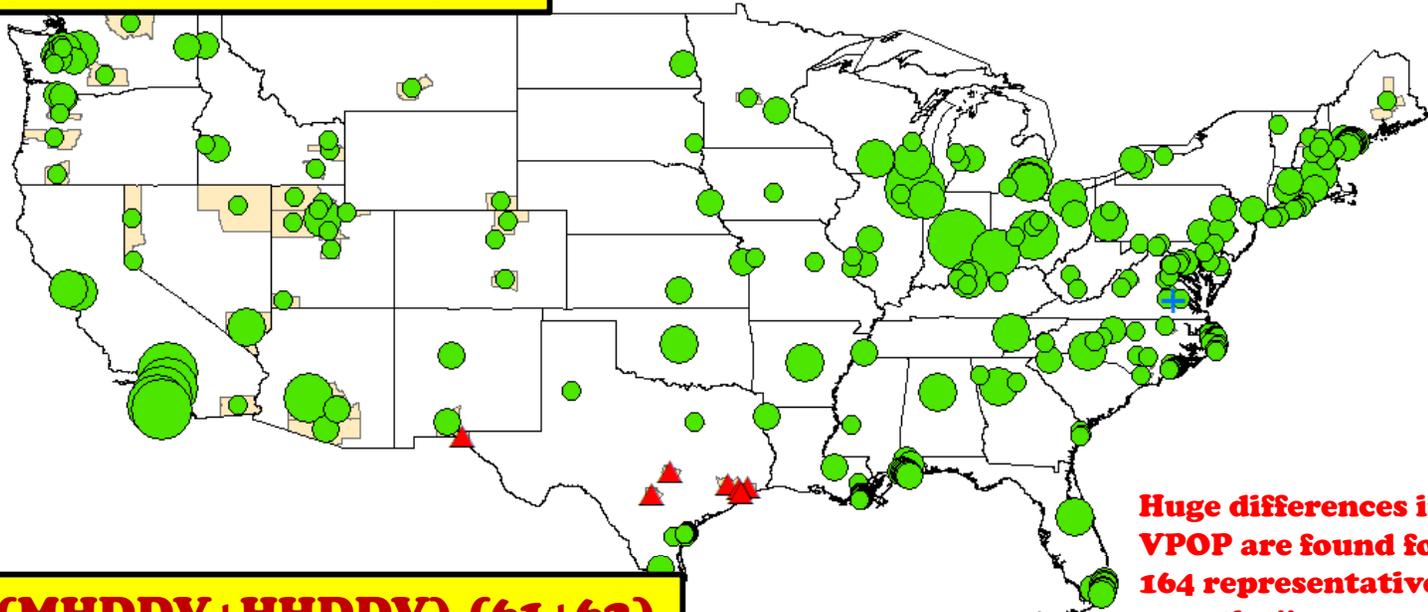
Evaluation: compare VPOP of MOVES CDBs with VPOP of SMOKE FF10 in EPA 2011NEI version1

VPOP of 164 representative counties in 2011NEI version1 were examined because, according to EPA, only those CDBs were “updated” (the remaining CDBs were not updated, causing differences ranging from -100% to +2900%)

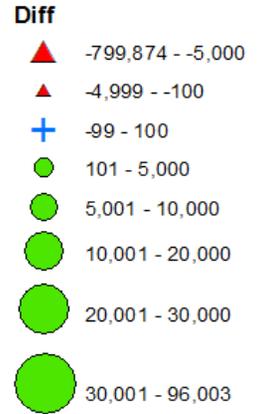
Inconsistent VPOP

Note: these are not VPOP_N!

(MHDDV+HHDDV)-62

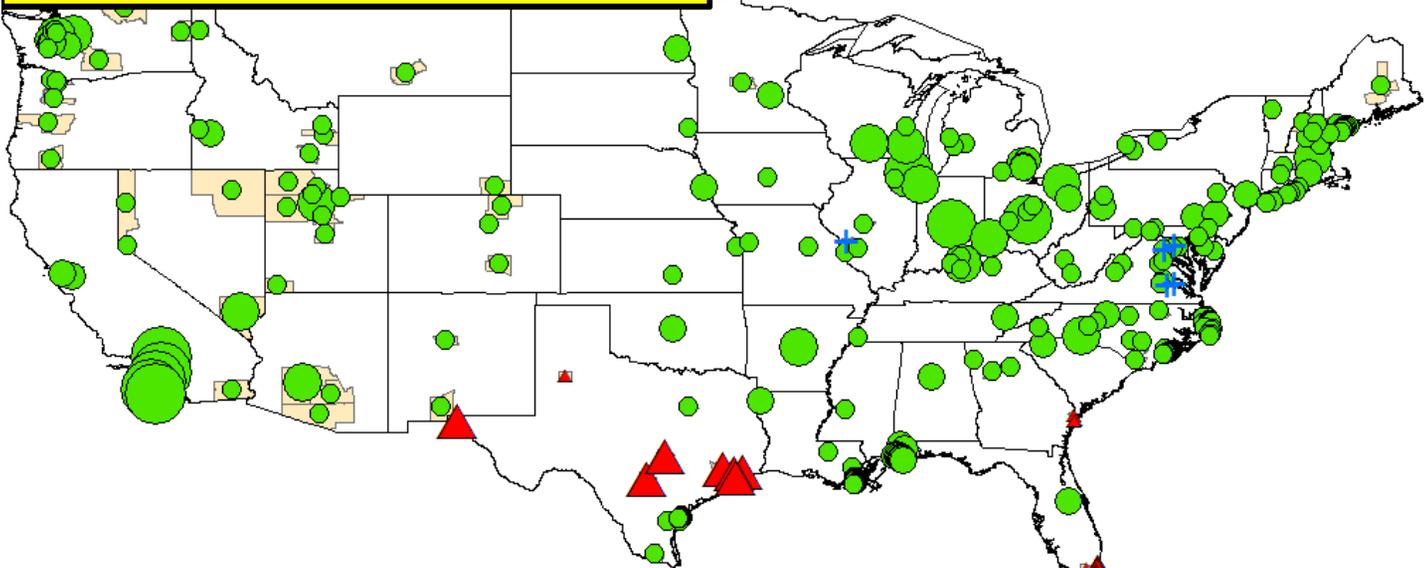


Difference b/w SMOKE and MOVES CDBs

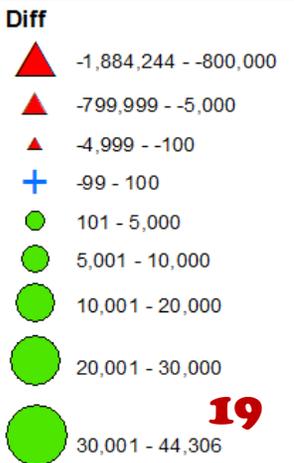


Huge differences in VPOP are found for 164 representative counties!!

(MHDDV+HHDDV)-(61+62)



Difference b/w SMOKE and MOVES CDBs



Extremely high VPOP (> 3/4 millions) are in TX CDBs

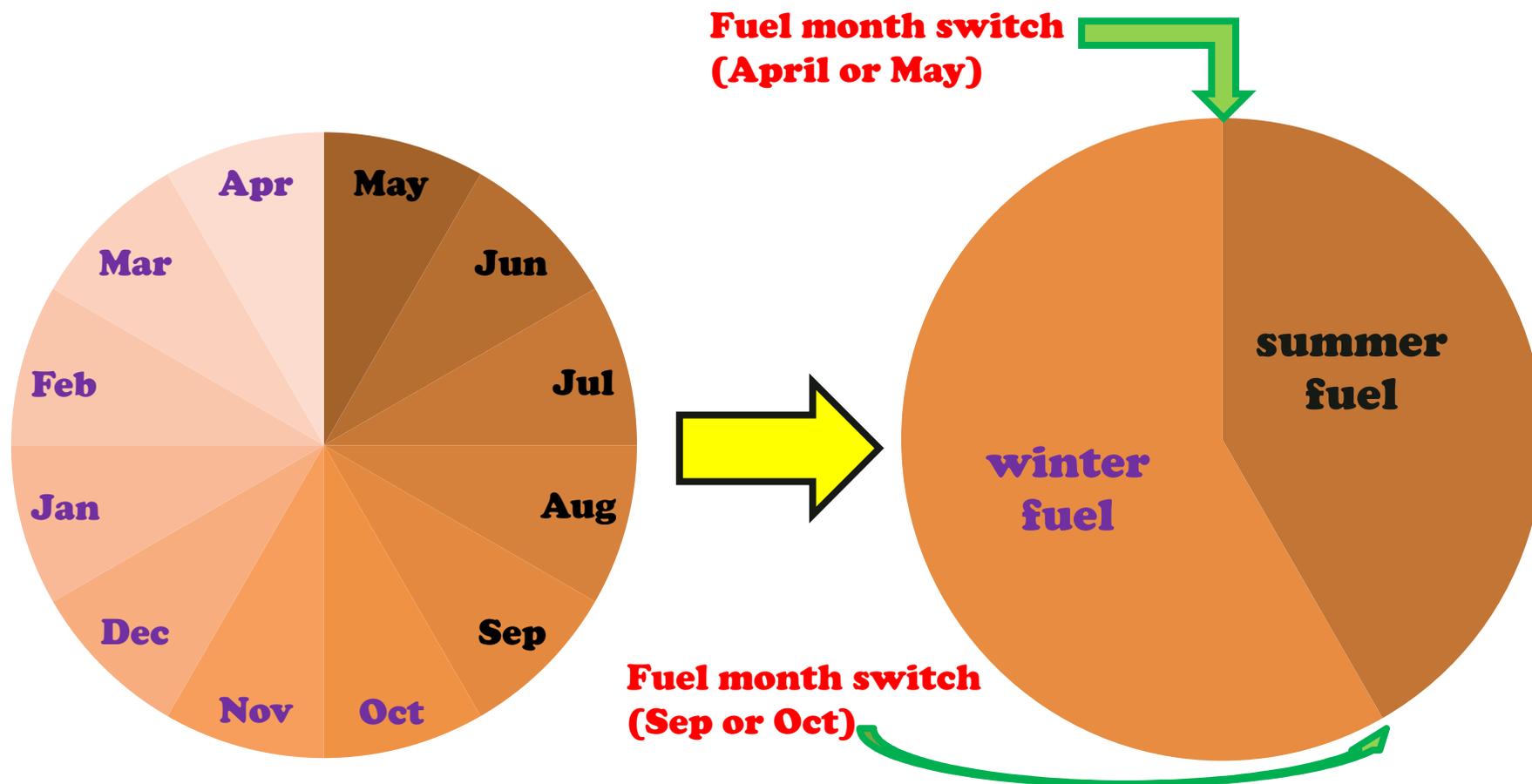
Summary on National VPOP

- **Total numbers of vehicle type for EXT are different between MOVES CDBs and SMOKE**
- **Adding vehicle type 61 (combination short haul diesel trucks) to vehicle type 62 (combination long haul diesel trucks) reduces differences but does not close the gap**
- **Which vehicle types, 62 or MHDDV+HHDDV, are responsible for EXT?**
- **EXT depends on national total VPOP. It's imperative that VPOP_N be counted accurately**

It's critical that these issues be corrected in MOVES2014

Fuel Month Concept

Two Fuel-month Approach



- Twelve-month fuels get lumped into SMOKE-MOVES in two groups: summer and winter fuels;
- May to September is assumed for summer fuels, and October to April for winter fuels;
- Resolution of two fuel months may be too coarse. Research is needed in this area.

Reid Vapor Pressure (RVP)

$$\text{RVP}_{\text{avg}} = \sum \text{RVP}(\text{fuelid}) * \text{market share}(\text{fuelid})$$

-- by county and by fuel month

$$\sum \text{market share}(\text{fuelid}) = 1.0$$

Evaluation: calculate averaged RVP from fuel databases of 2011NEI version1 posted by EPA

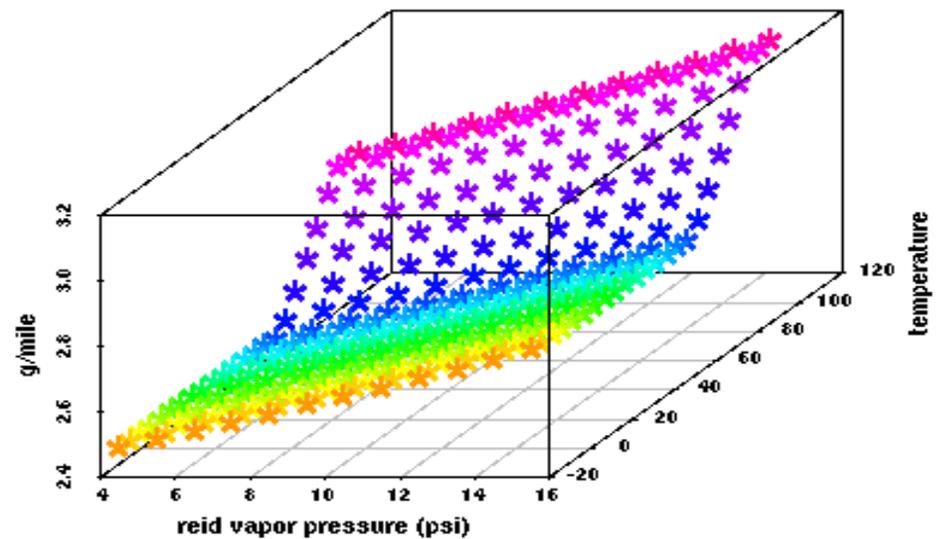
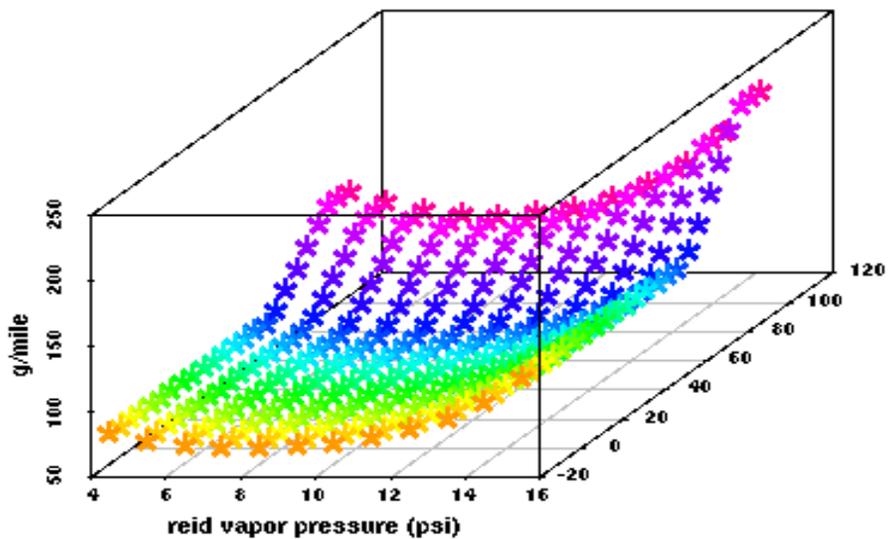
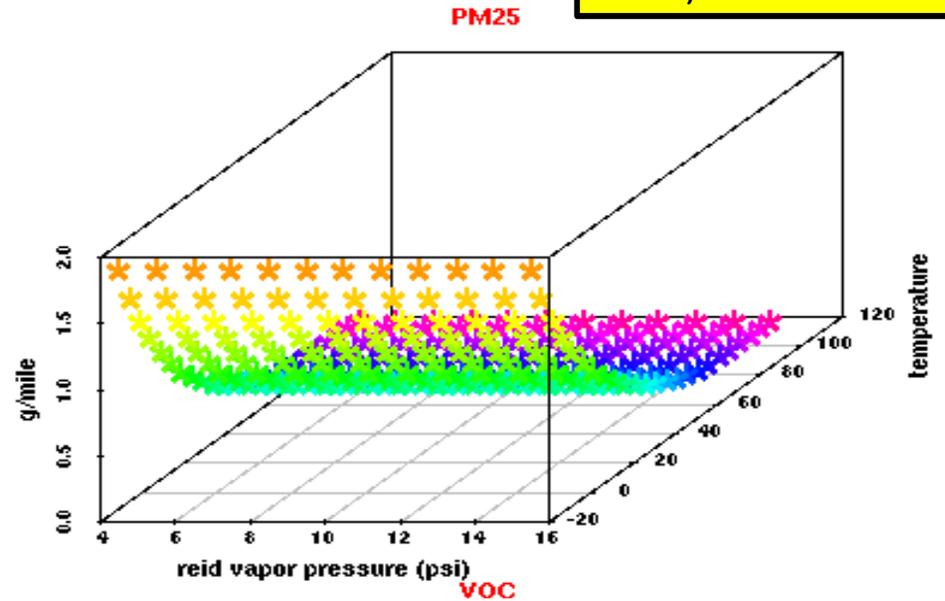
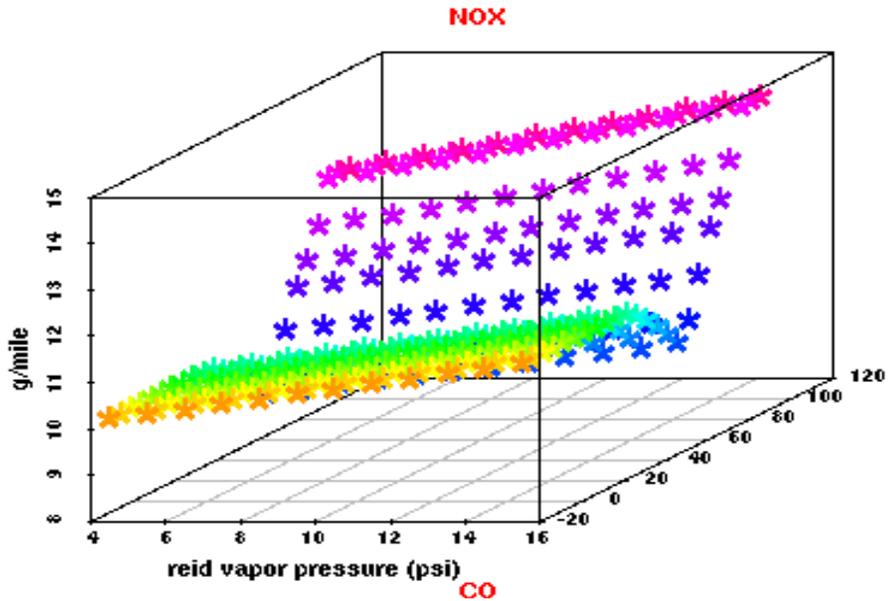
Note: EPA override and replaced state-submitted fuel data with national fuel data in 2011NEI version1

**How does MOVES handle multiple fuel IDs?
What is marketshareCV for?**

Effect of Reid Vapor Pressure (RVP) on EXR - Albemarle

EXR Emission Rate for 2201001110 (gram/mile)

LDGV, Rural Interstate



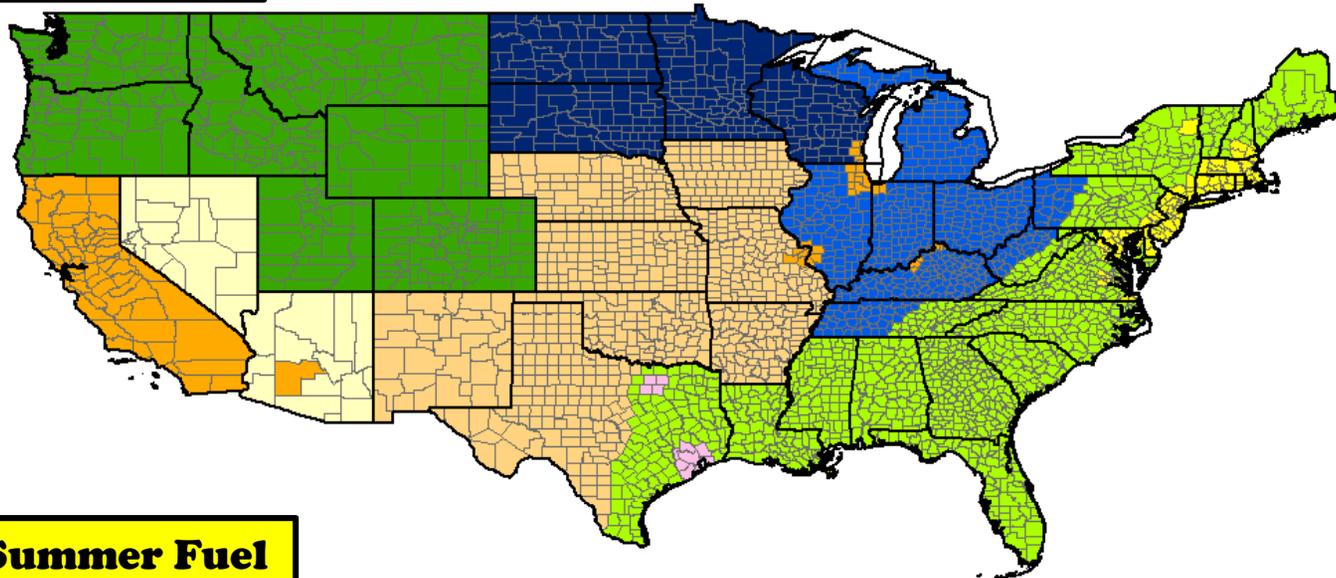
T(°F) * -10 * -5 * 0 * 5 * 10 * 15 * 20 * 25 * 30 * 35 * 40 * 45 * 50 * 55 * 60 * 65 * 70 * 75 * 80 * 85 * 90 * 95 * 100 * 105

-- Fuels with higher Reid Vapor Pressure release higher emissions. All criteria pollutants except PM2.5 are affected by RVP. **24**
 -- NOx rates are higher at higher temperature, whereas PM2.5 rates are higher at lower temperature.

RVP in 2011 NEI version 1

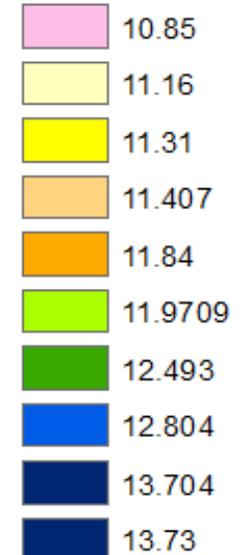
winter RVP > summer RVP

Winter Fuel

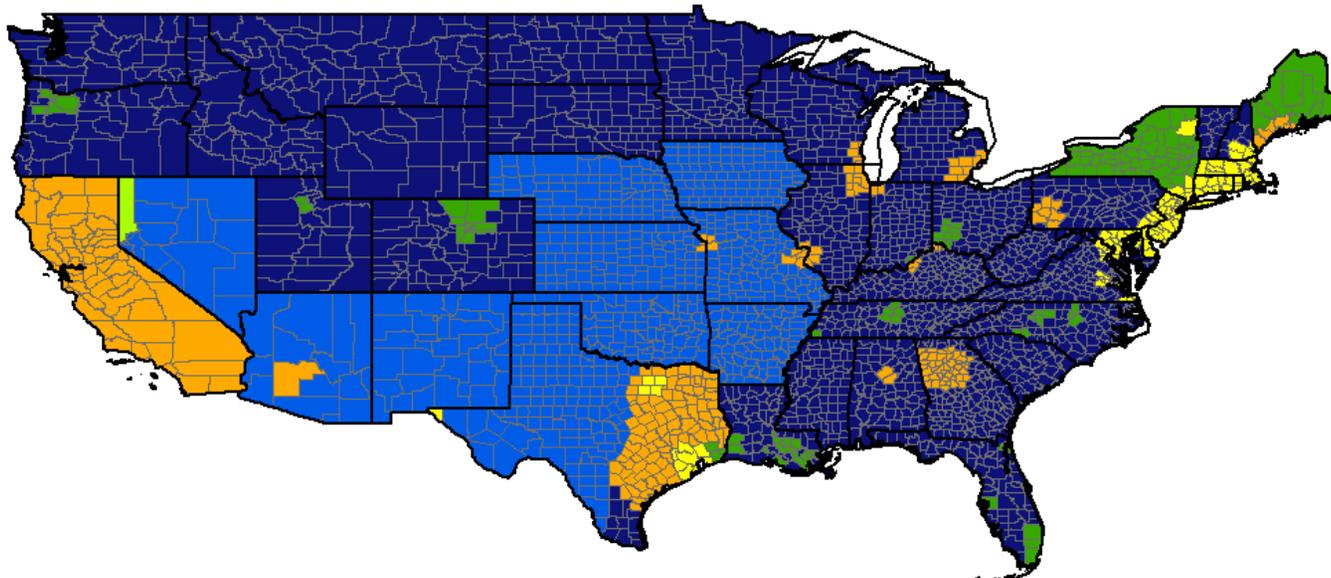


RVP (psi)

RVP FuelMonth1

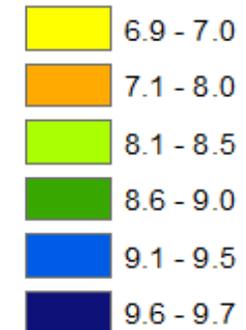


Summer Fuel



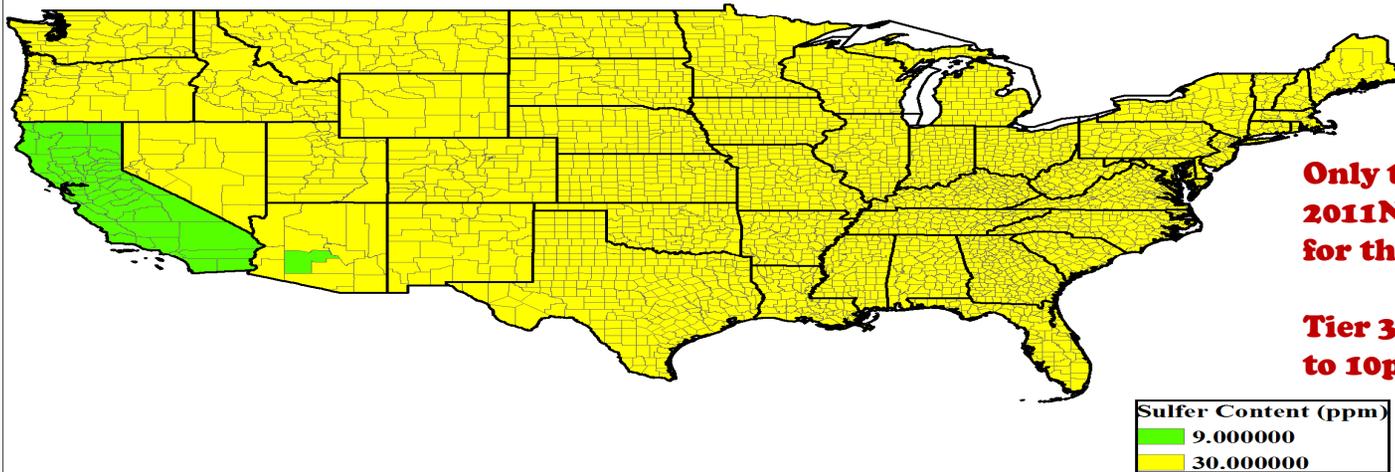
RVP (psi)

RVP FuelMonth7



Sulfur Content in 2011NEI version1

Winter Fuel

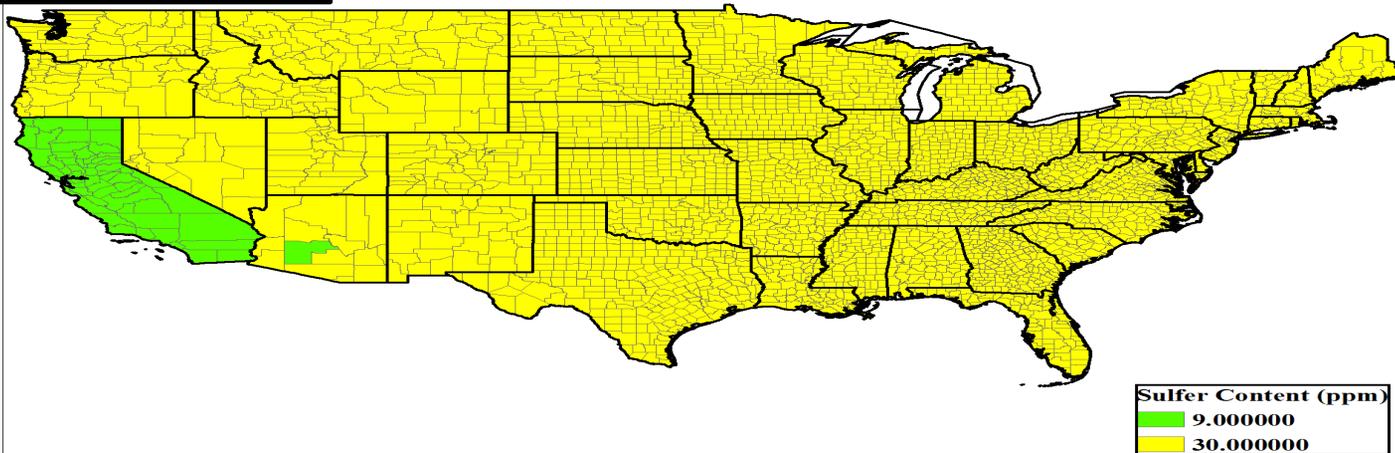


Only two sulfur levels are found in 2011NEI: 9ppm in CA and 30ppm for the rest of the US

Tier 3 rule will reduce sulfur level to 10ppm, in line with CA

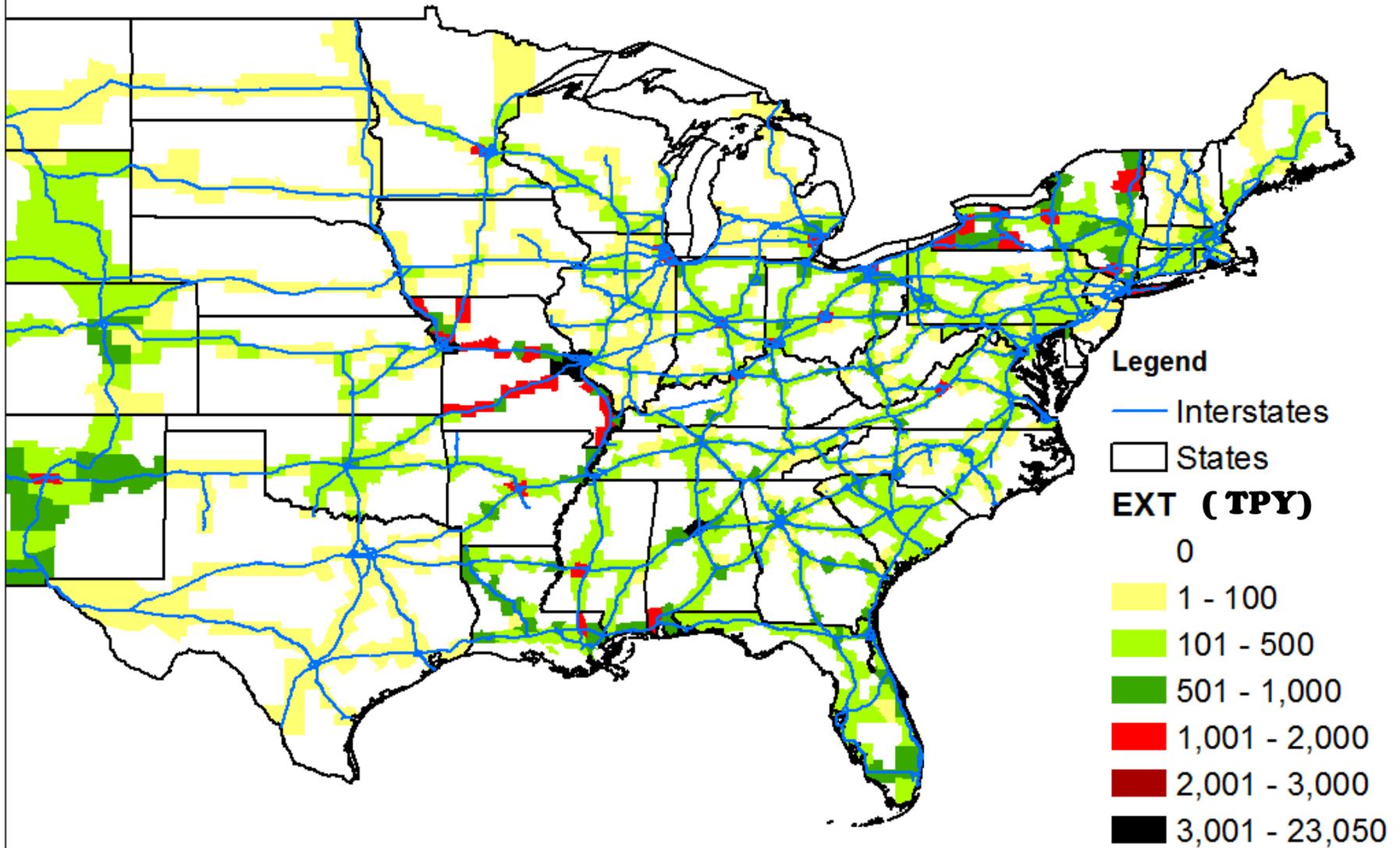
winter sulfur = summer sulfur

Summer Fuel

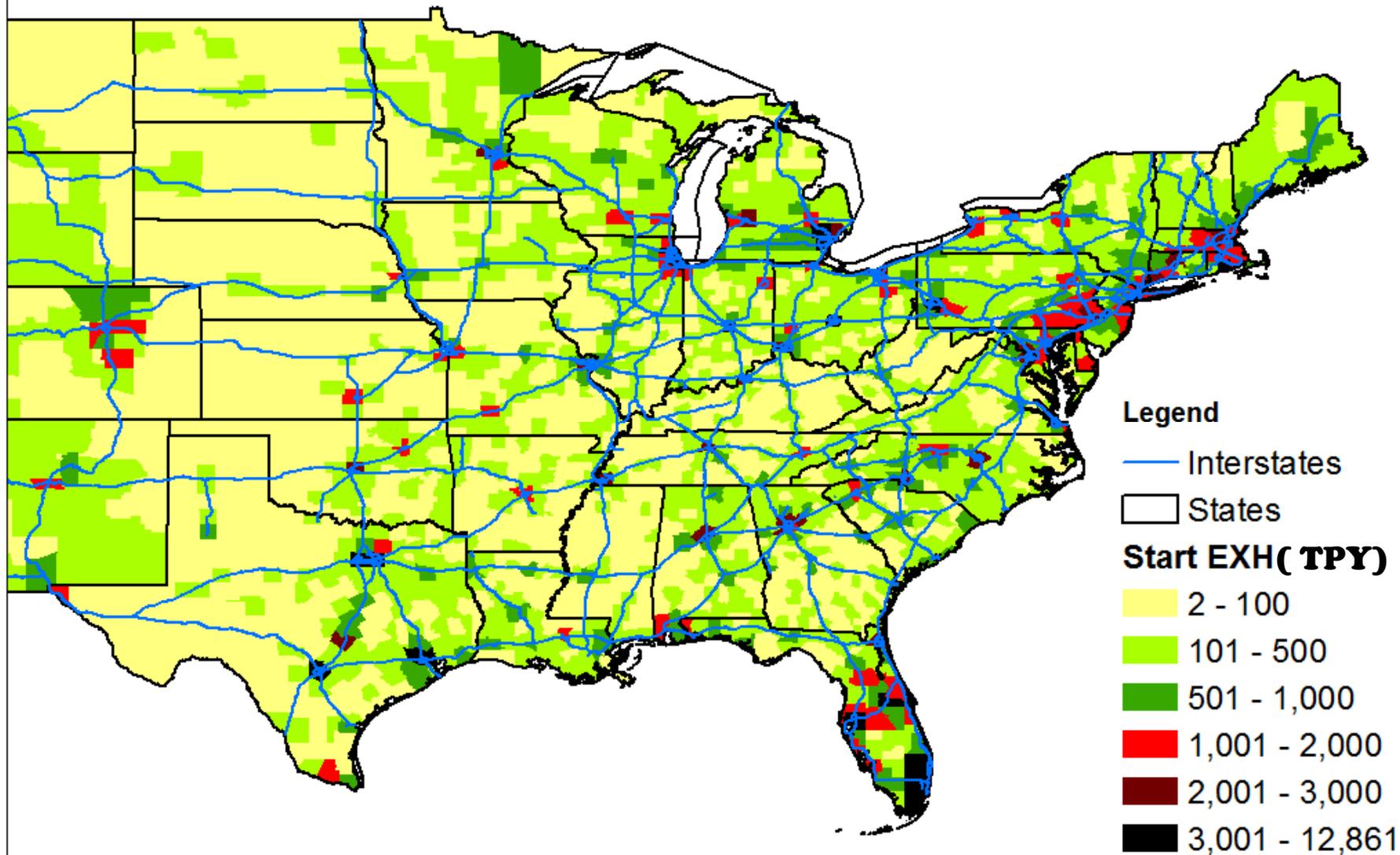


NO_x Emissions for MOVES Processes

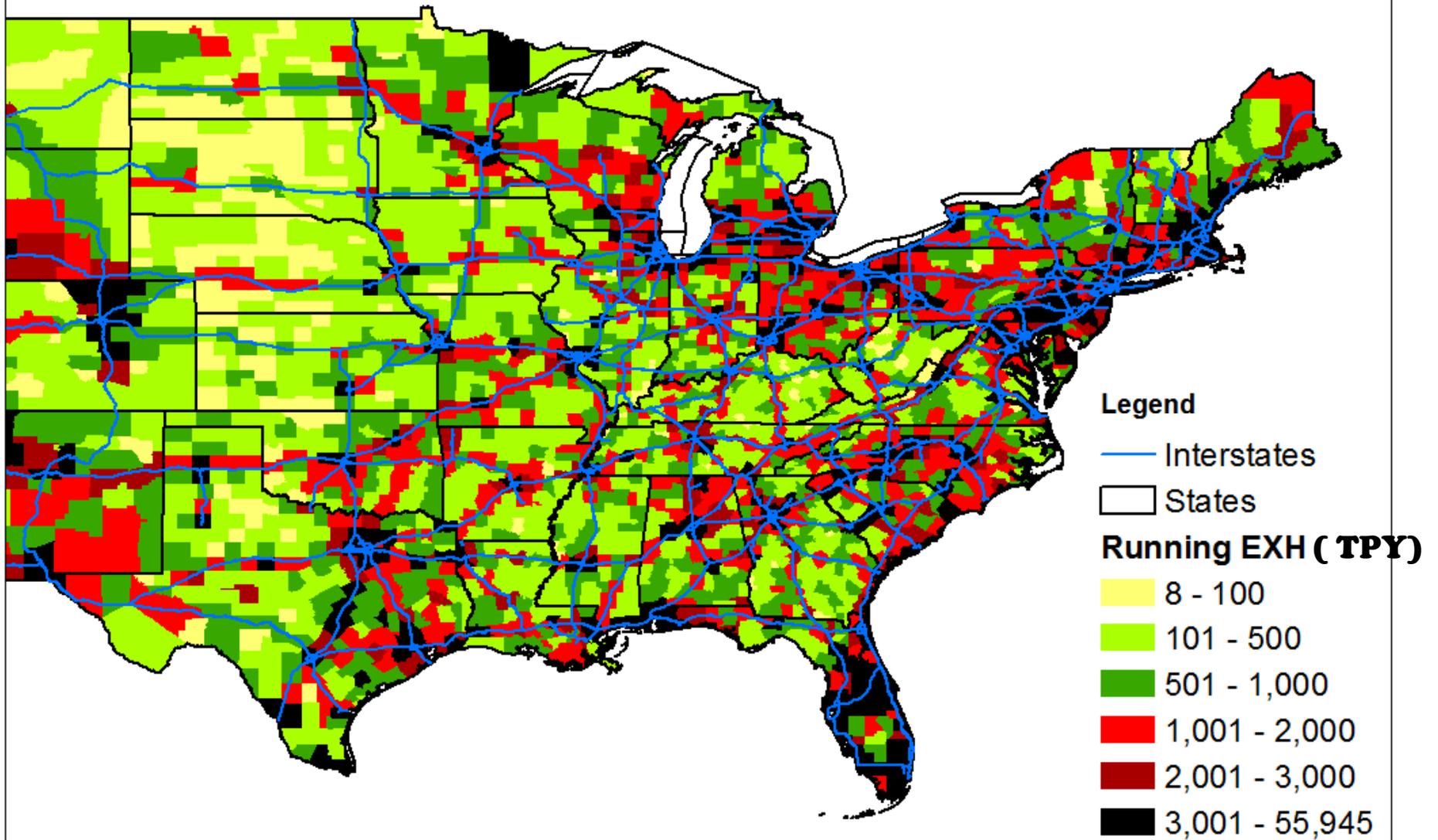
NOx Extended Idling in 2011 NEI V1



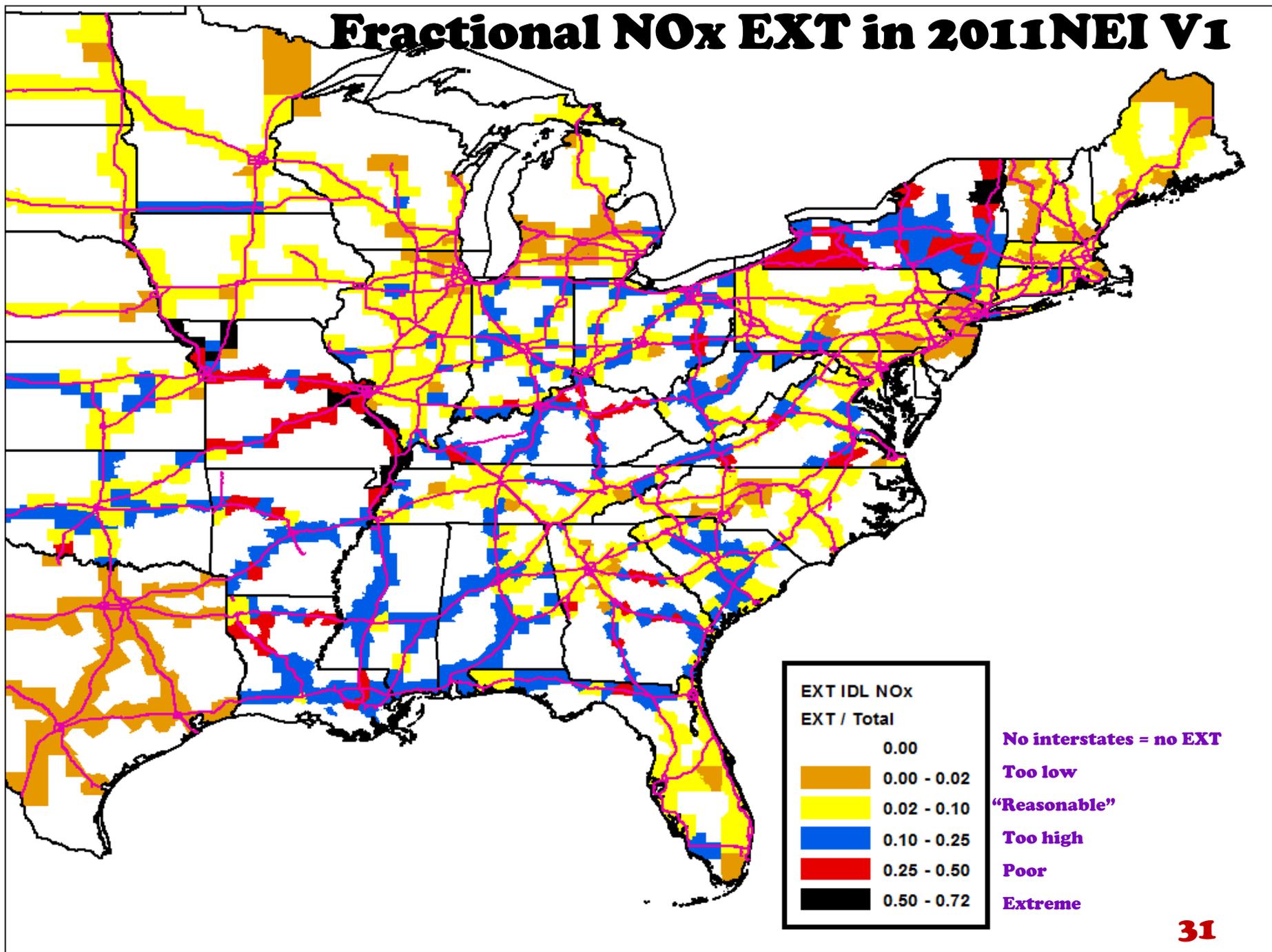
NOx Start Exhaust in 2011 NEI V1



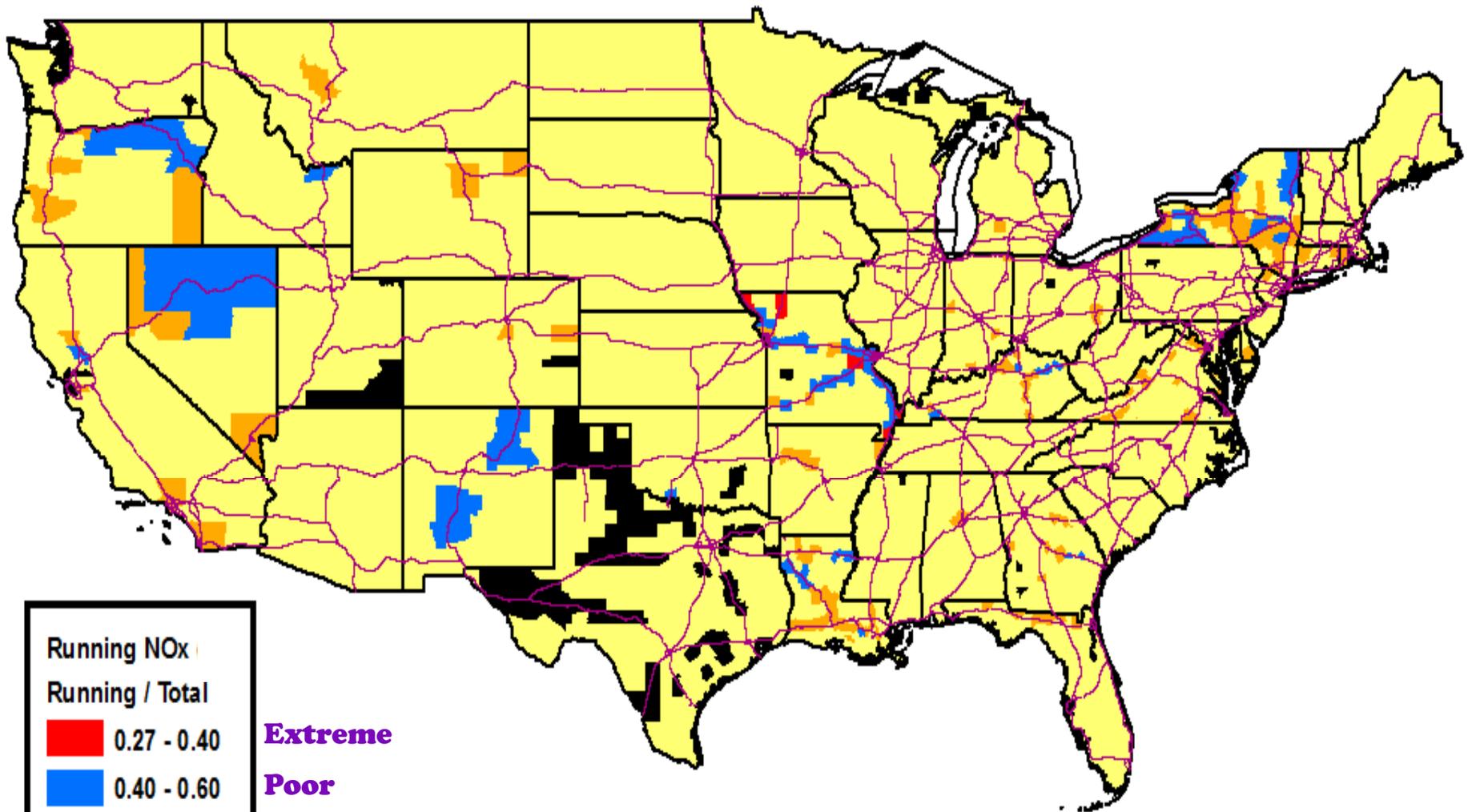
NOx Running Exhaust in 2011 NEI V1



Fractional NO_x EXT in 2011 NEI V1



Fractional NO_x Running Exhaust in 2011 NEI V1



Running NO _x	
Running / Total	
	0.27 - 0.40
	0.40 - 0.60
	0.60 - 0.70
	0.70 - 0.92
	0.92 - 0.96

Extreme

Poor

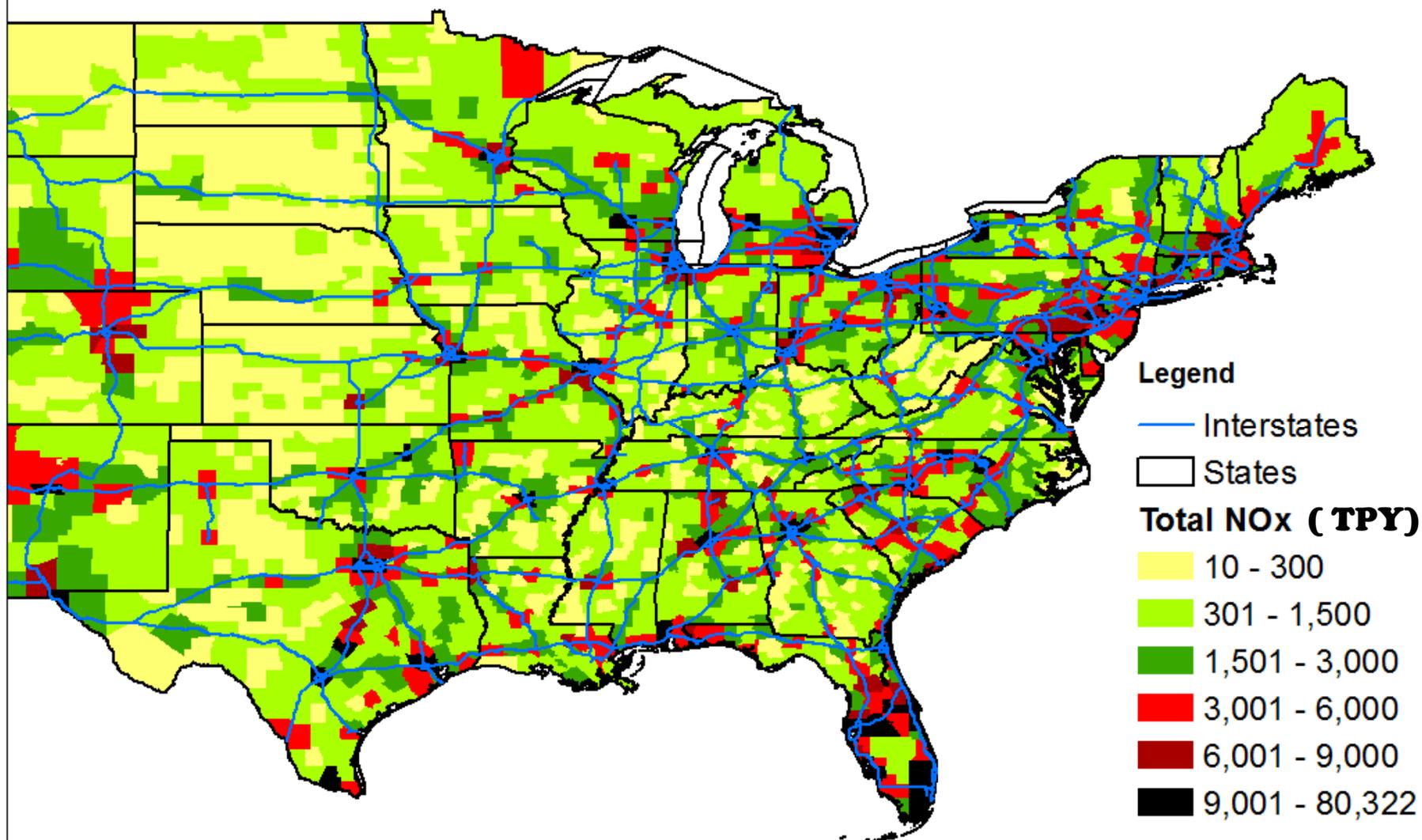
Fair (a little low)

"Reasonable" (close to INV MOVES)

Too high

Many states have unusually **low** percentage for running exhaust (<50%) along interstates.

Total NOx in 2011 NEI V1



Summary on Emission Processes

- **SMOKE-MOVES has changed spatial pattern of EXT**
- **EXT > 25% of total NO_x along interstates in some states**
- **Running exhaust (EXH) < 50% of total NO_x along interstates in some states**
- **Breakdown of EXT and EXH reversed in many counties**

Conclusion

- **Additional inconsistencies with EXT in 2011NEI V1 identified**
- **An overall review and analysis involving the two models (MOVES and SMOKE-MOVES) is urgently needed to resolve inconsistency**
- **Correct & QA of EXT emissions required for 2011NEIV2**
- **An evaluation is needed of whether other idling types that are not included in EXT methodology are part of the general drive cycle or are missing from the MOVES model (ex, marine ports, ship/rail yards, oil/gas exploration sites, or regular truck stops).**