

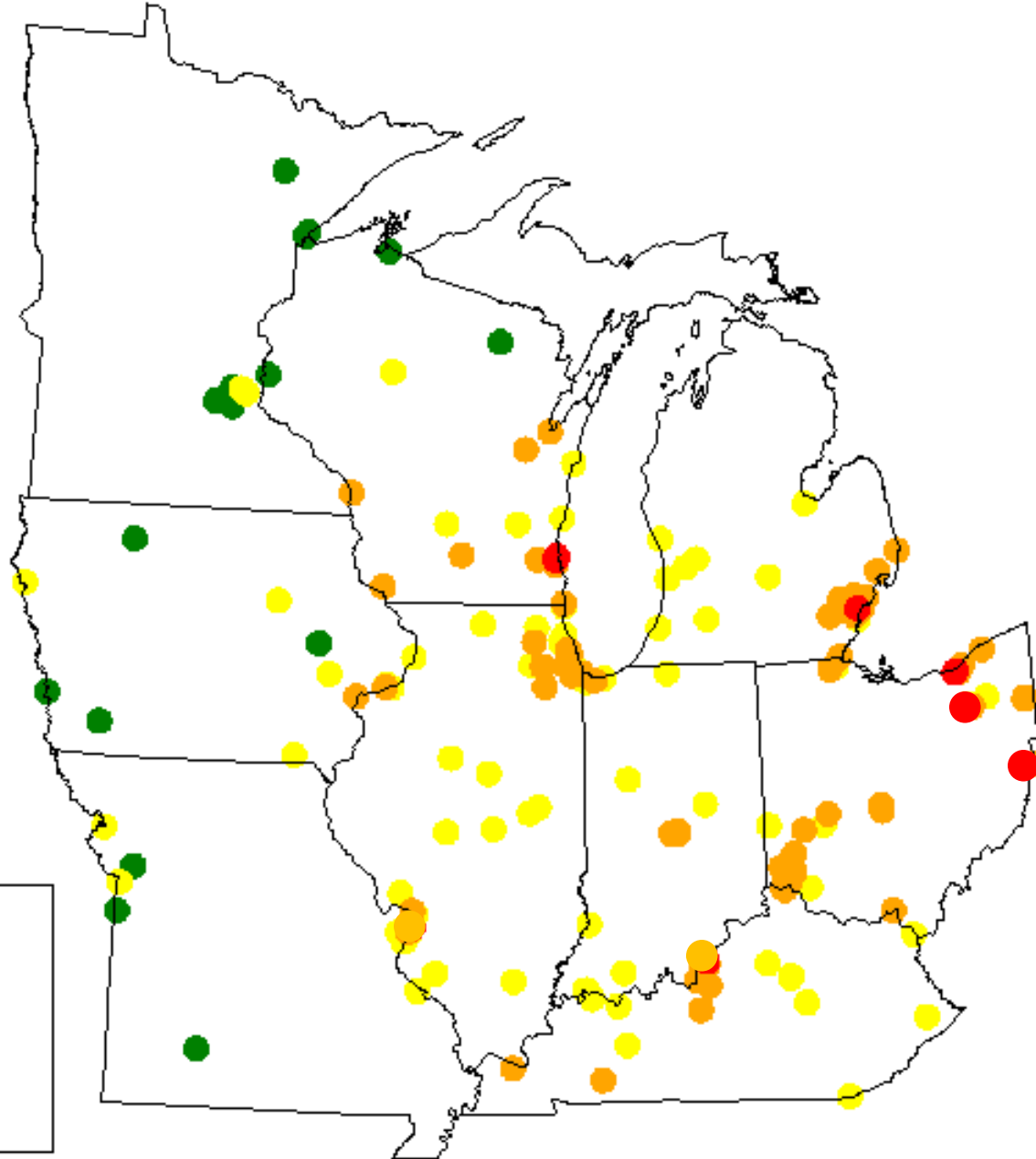
# LADCO's Mobile Source Emissions Sensitivity Study

Midwest Transportation Air Quality Summit  
October 28 2009






# Overview

- Develop mobile source emissions inventory adjustment factors (e.g., MOVES-like)
- Apply adjustment factors and assess effect on air quality modeling
- Provide guidance to states on upcoming PM<sub>2.5</sub> SIP activities

# PM<sub>2.5</sub> Design Value: Daily Standard

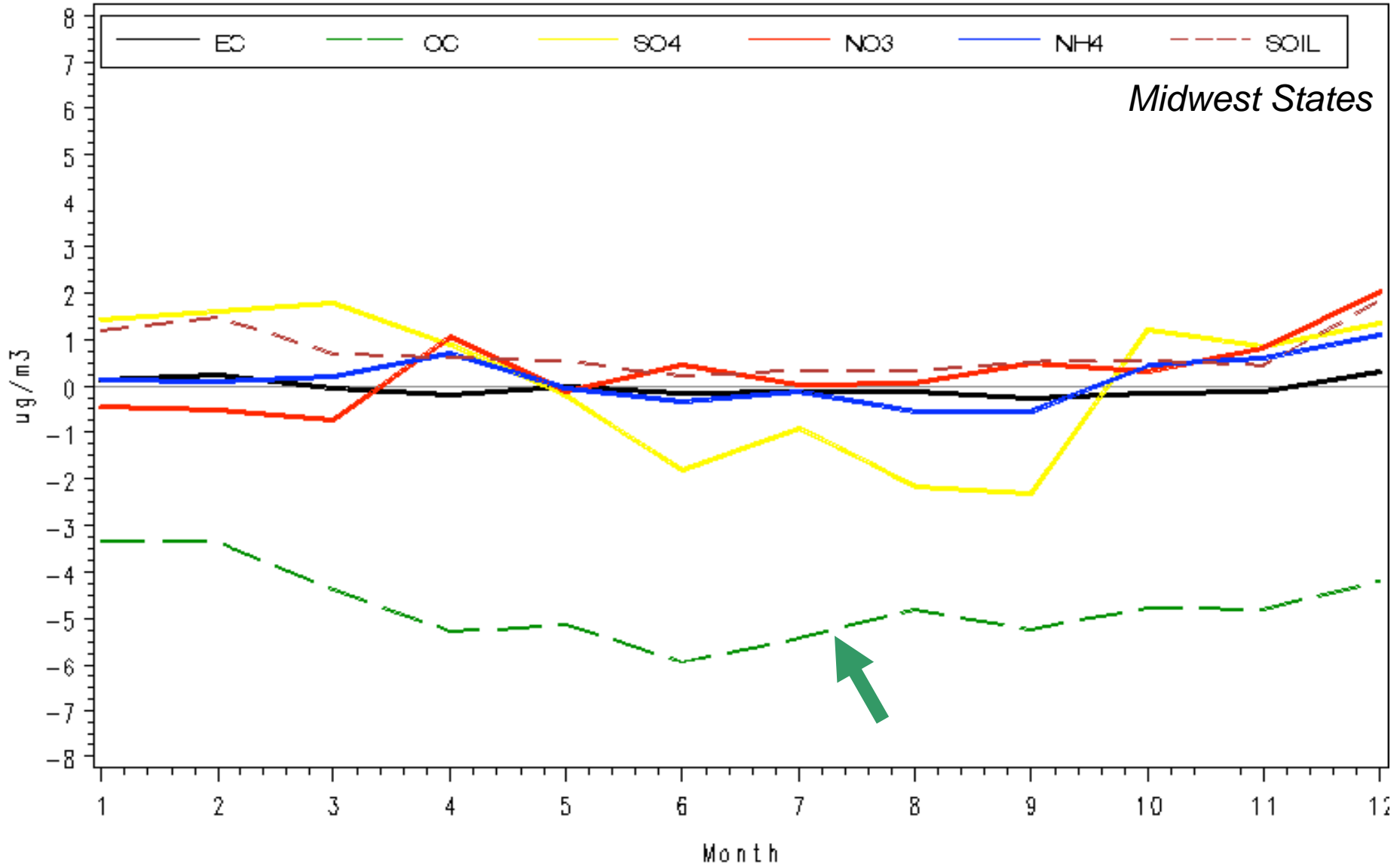


## Color:

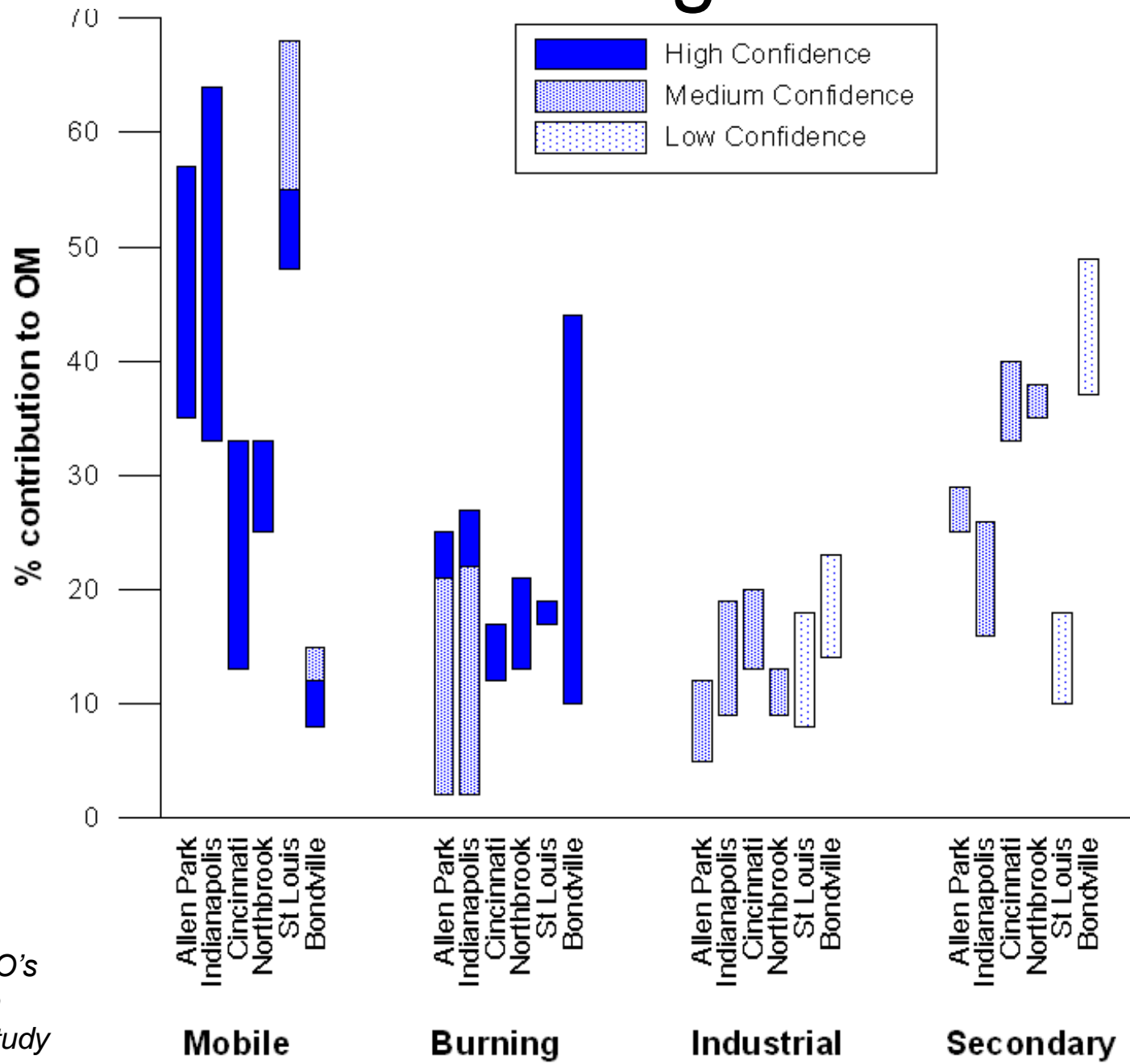
-  > 40 ug/m<sup>3</sup>
-  36-40 ug/m<sup>3</sup>
-  31-35 ug/m<sup>3</sup>
-  25 to 30 ug/m<sup>3</sup>
-  <= 25 ug/m<sup>3</sup>

# PM<sub>2.5</sub> Model Performance

## Monthly Average Mean Bias



# Sources of Organic Carbon



# Potential Adjustments to MOBILE6

## 1. LDGV and LDGT PM adjustment

- Mass adjustment
- Temperature adjustment

## 2. HDDV HC and PM adjustment

- Speed adjustment

## 3. LDGV and LDGT HC adjustment

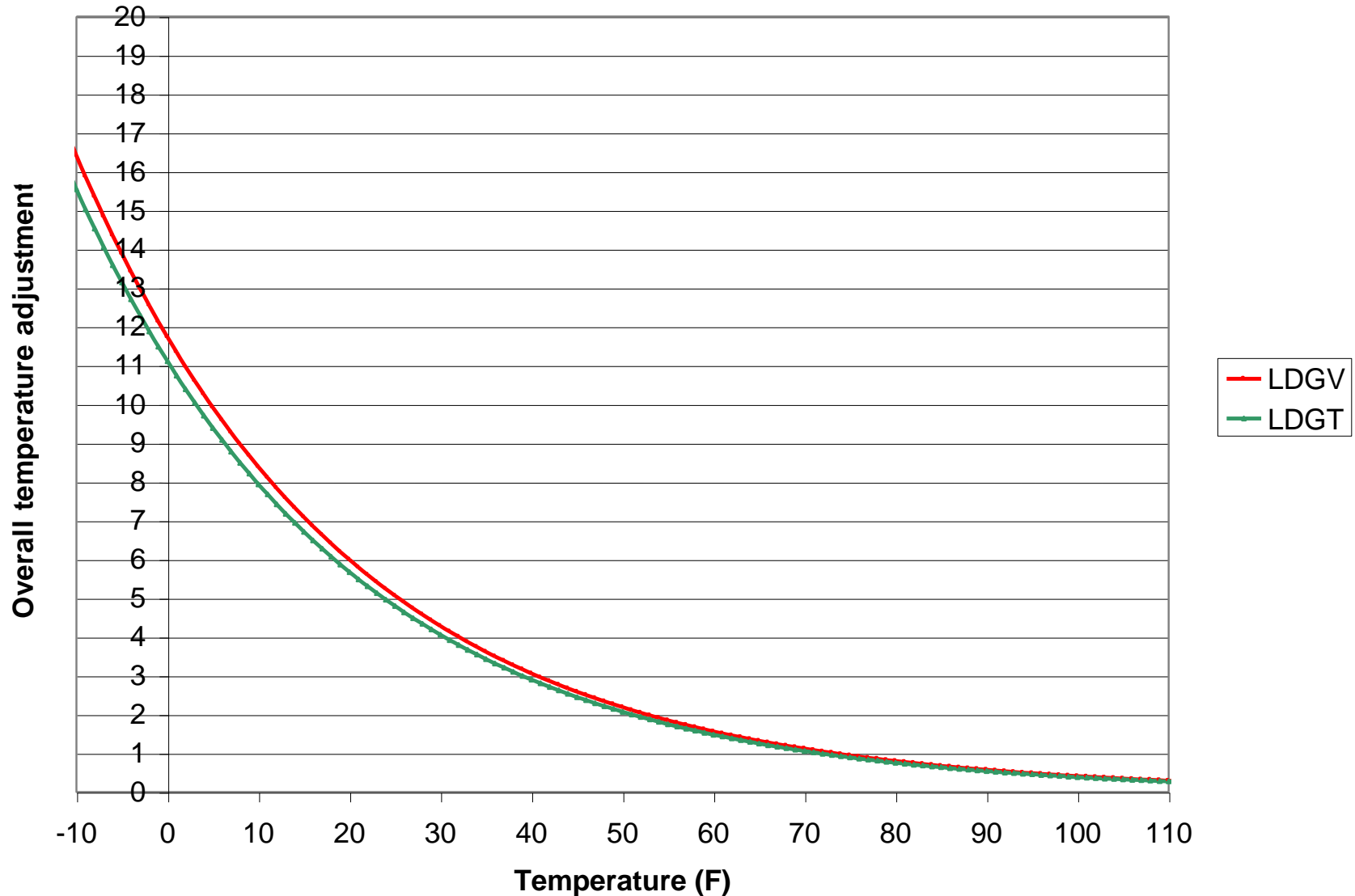
- Inclusion of semi-volatile hydrocarbons

## 4. LDGV HC, CO, NOx adjustment

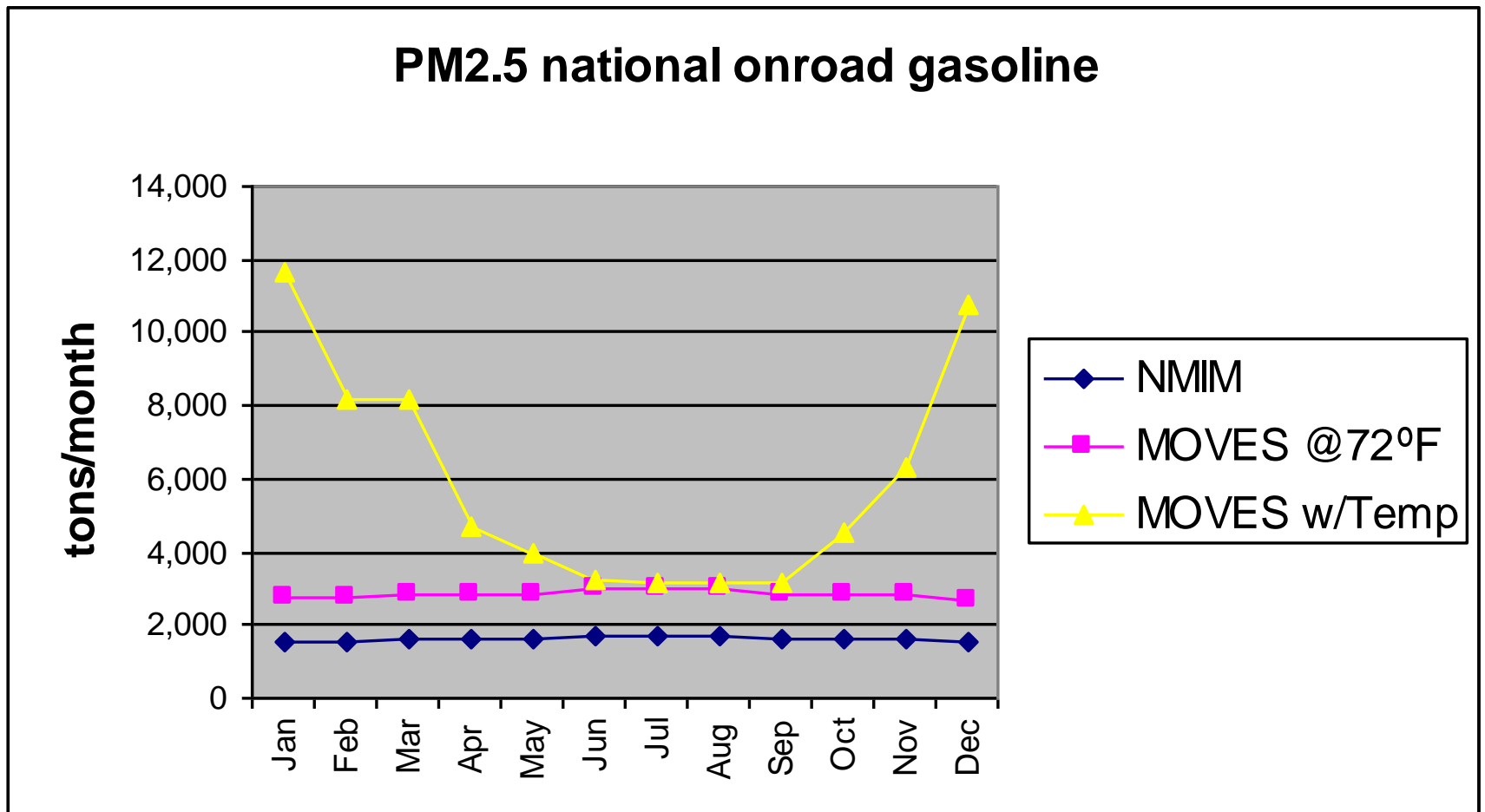
- Consideration of high emitting vehicles

} MOVES-like

# 1. PM Temperature Adjustment

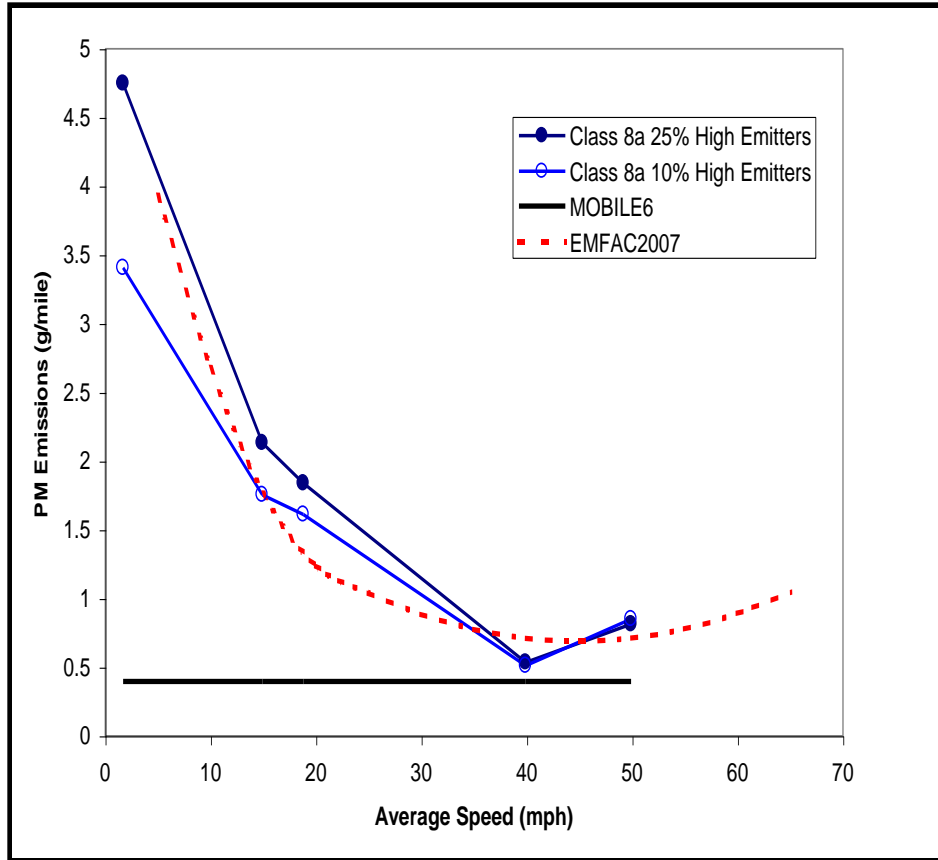


# MOVES v. MOBILE6 (NMIM)

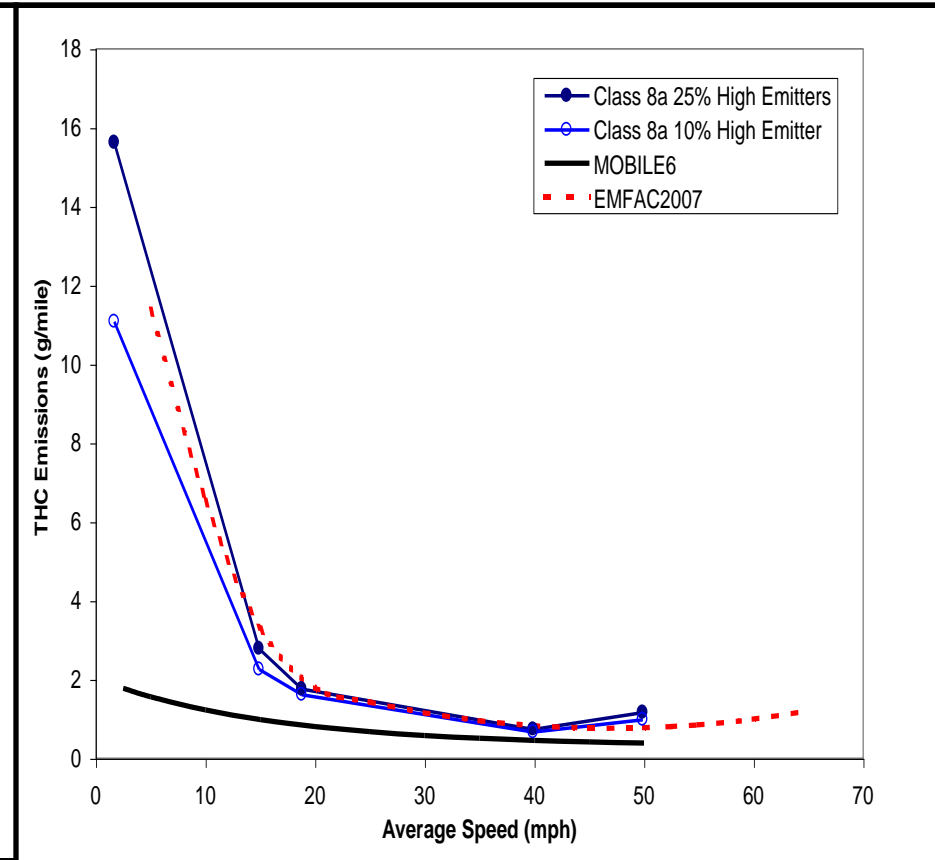


# 2. HDDV Emissions v. Speed

*PM Emissions*



*HC Emissions*



# 3. Semi-Volatile Organic Carbon (SVOC) Emissions

Vehicle ID	S2-1	S5-1	S5-4	S6-1	S6-2	S6-3	W2-1	W2-2	W6-1	Total / Average	Uncertainty	Without S5-4
Vehicle Model Year	1989	1968	1978	1989	1989	1985	1989	1987	1988			
C5Bz-C6Bz (SVOC) (mg)	34.1	5.0	37.1	55.3	40.9	26.0	25.4	2.2	7.4	233		196
Alkanes (SVOC) (mg)	0.2	0.4	0.3	1.3	0.5	0.3	2.2	0.3	1.3	7		7
PAH (SVOC) (mg)	55.9	6.3	140.4	90.4	24.9	21.8	52.9	5.8	19.3	418		277
Third of UCM (SVOC) (mg)	8.4	0.0	13.0	5.7	0.0	0.2	7.2	1.2	8.4	44		31
SVOC	98.7	11.8	190.9	152.8	66.4	48.2	87.8	9.4	36.4	702		511
THC (mg)	1,100	4,632	15,447	1,967	2,148	1,150	3,414	633	1,059	31,550		
Carbonyls (as formaldehyde)	13.7	66.2	49.4	53.7	9.5	24.3	628.0	7.6	254.2	1,107		1,057
VOC (mg) (speciated)	581	3,406	656	2,100	2,369	1,119	4,034	392	1,382	16,040		15,384
TOG (mg) (THC + carbonyl)	1,114	4,698	15,496	2,021	2,158	1,174	4,042	641	1,313	32,657		17,160
OC (mg)	59.1	9.0	101.6	35.6	9.1	3.7	25.7	4.8	32.1	281		
TC (mg)	63.6	19.0	179.2	36.2	45.7	8.5	48.5	8.4	52.5	462		
<b>SVOC / VOC</b>	<b>17.0%</b>	<b>0.3%</b>	<b>29.1%</b>	<b>7.3%</b>	<b>2.8%</b>	<b>4.3%</b>	<b>2.2%</b>	<b>2.4%</b>	<b>2.6%</b>	<b>4.4%</b>	<b>+/- 5.9%</b>	<b>3.3%</b>
<b>SVOC / TOG</b>	<b>8.9%</b>	<b>0.3%</b>	<b>1.2%</b>	<b>7.6%</b>	<b>3.1%</b>	<b>4.1%</b>	<b>2.2%</b>	<b>1.5%</b>	<b>2.8%</b>	<b>2.2%</b>	<b>+/- 1.8%</b>	<b>3.0%</b>
SVOC/OC	153%	130%	175%	413%	732%	1,285%	313%	172%	87%	250%	+/- 243%	
SVOC/TC	142%	62%	99%	406%	145%	567%	166%	99%	53%	152%	+/- 108%	

*Samples taken during Kansas City study  
(Note: only 9 of about 50 samples were analyzed!!!)*

# 4. High Emitter Analysis for Detroit and Atlanta

- Results from ENVIRON study funded by EPRI
- Used RSD data for:
  - Atlanta: Continuous Atlanta Fleet Evaluation (CAFÉ), Release 18.
  - Detroit: ESP and McClintock: *2007 High Emitter Remote Sensing Project*

Area	Running Exhaust Emission Factor Adjustments			
	LDGV	LDGT	LDGT1	LDGT2
<b>HC</b>				
Detroit – SEMCOG (CY 2007)	+32%	-8%	-	-
Atlanta - CAFE (CY 2006)	+26%	-	+24%	+21%
<b>CO</b>				
Detroit SEMCOG (CY 2007)	-61%	-46%	-	-
Atlanta – CAFE (CY 2006)	-46%	-	-36%	-35%
<b>NO<sub>x</sub></b>				
Detroit SEMCOG (CY 2007)	-22%	-54%	-	-
Atlanta – CAFE (CY 2006)	+68%	-	+88%	+83%

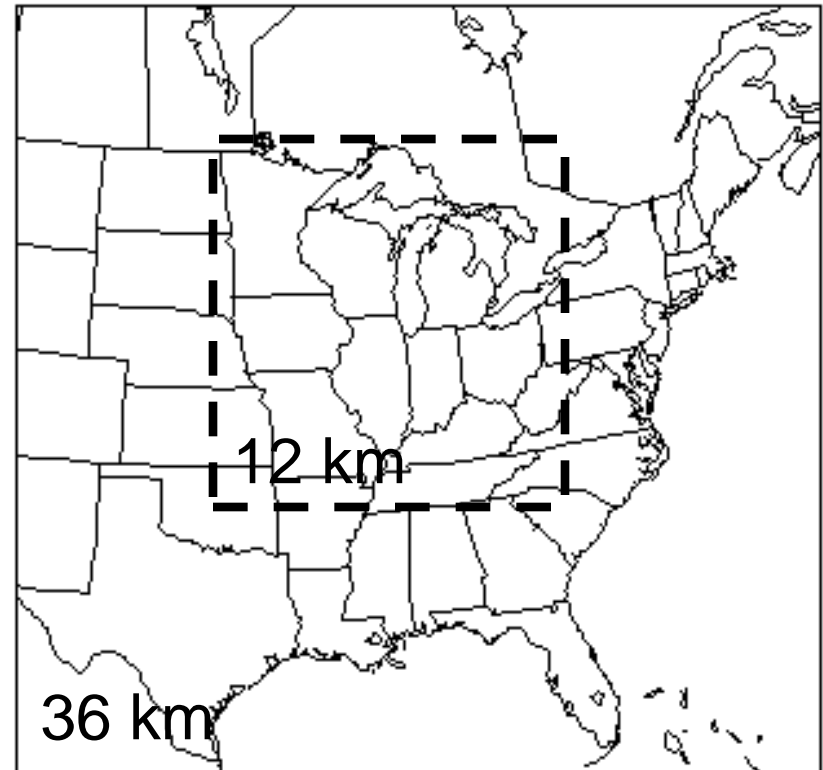
# Air Quality Modeling: Overview

Model: CAMx

Base Year: 2005

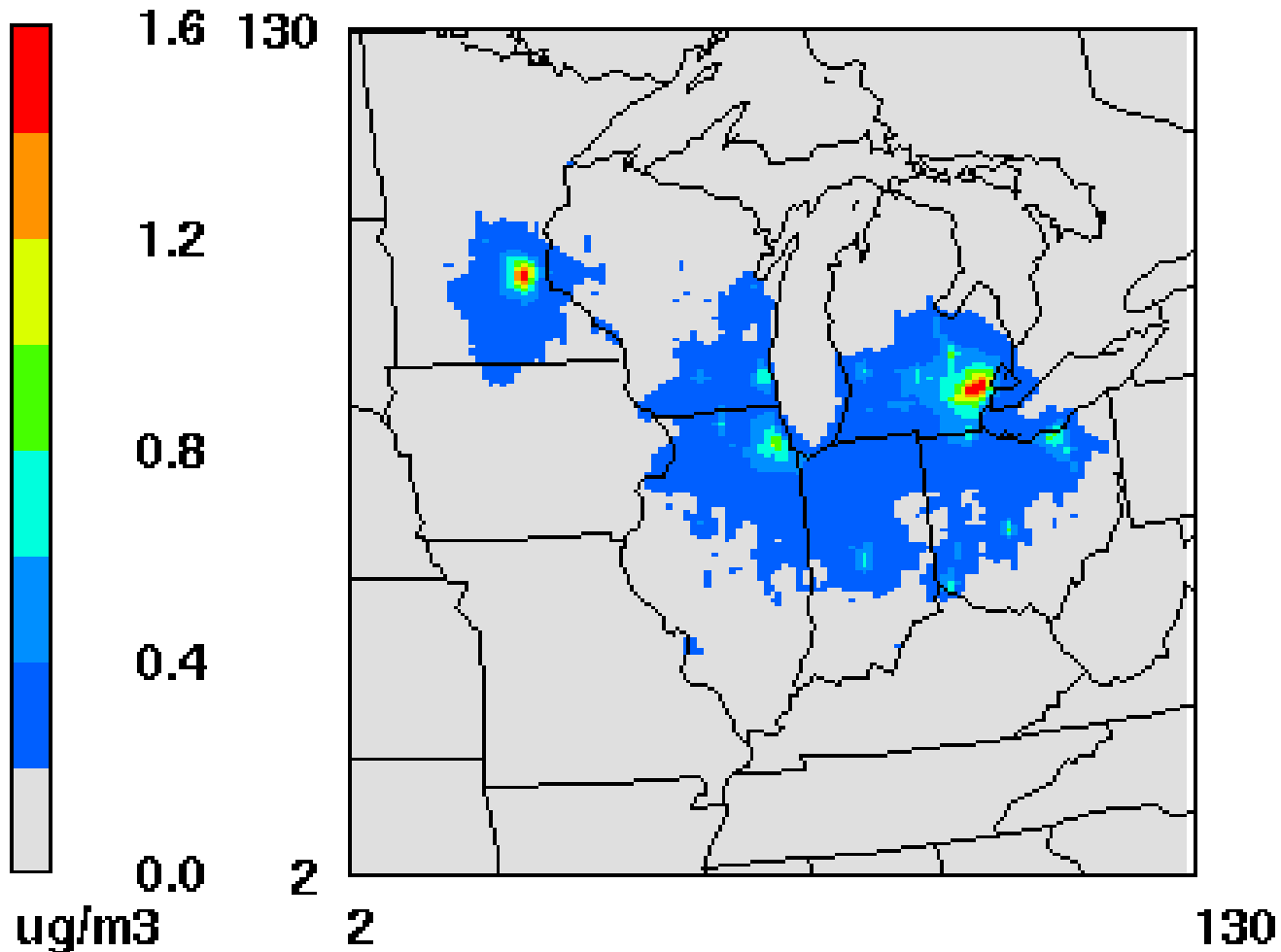
Scenarios:

- \* Base (Mobile 6.2)
- \* Base w/ Adj. 1-2
- \* Base w/ Adj. 1-3
- \* Base w. Adj. 1-4 (*not done*)



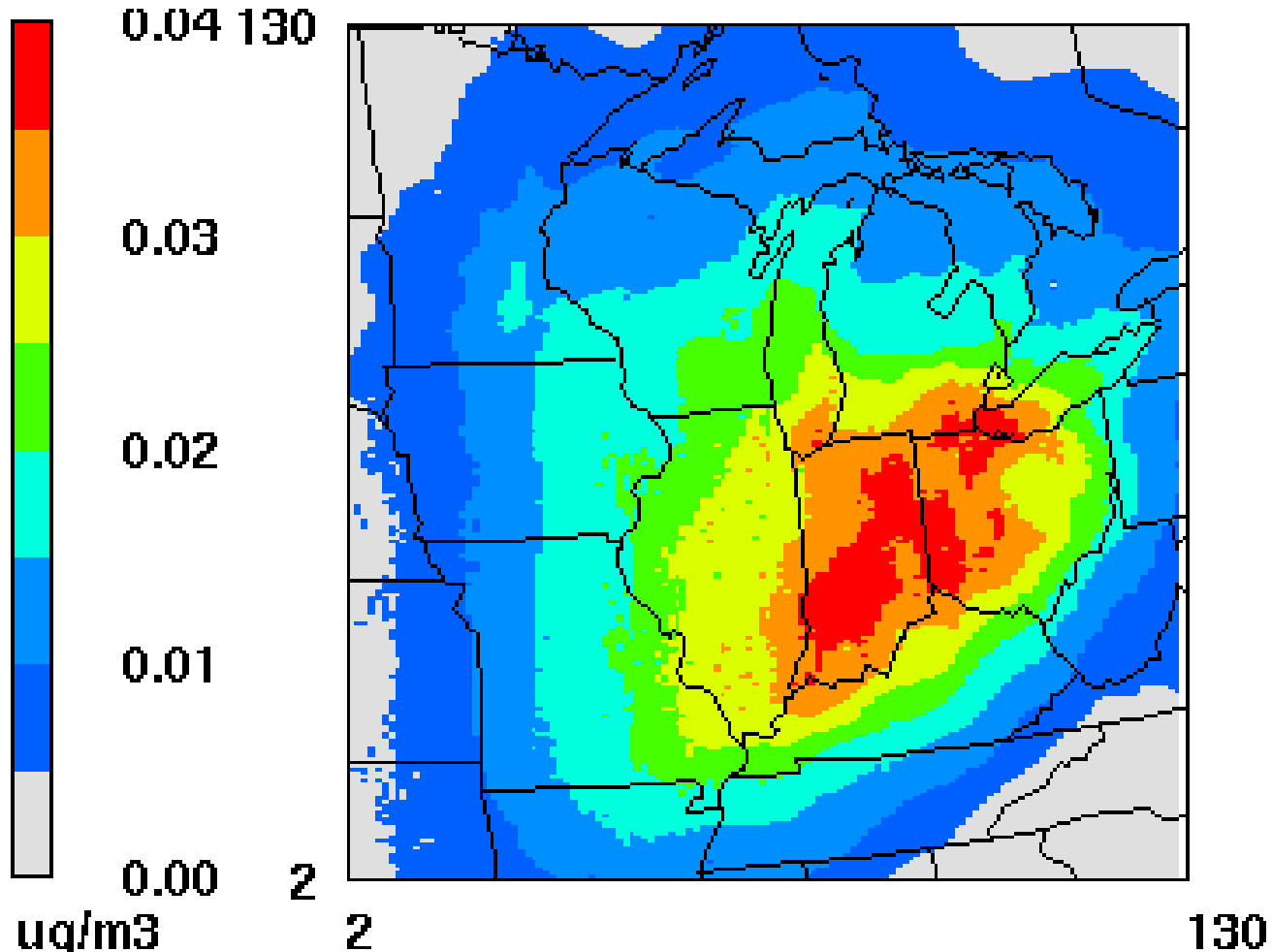
# Results: Adj. 1-2

Absolute change in 2005 base case JANUARY  
average  $PM_{2.5}$  concentrations (Adj. 1-2 v. Base)



# Results: Adj. 3

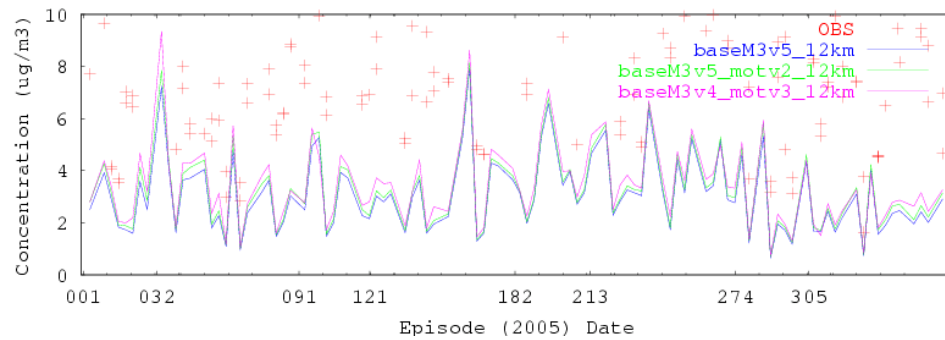
Absolute change in 2005 base case JULY  
average PM<sub>2.5</sub> concentrations (Adj. 1-3 v. Adj. 1-2)



# Results: Adj. 1-3

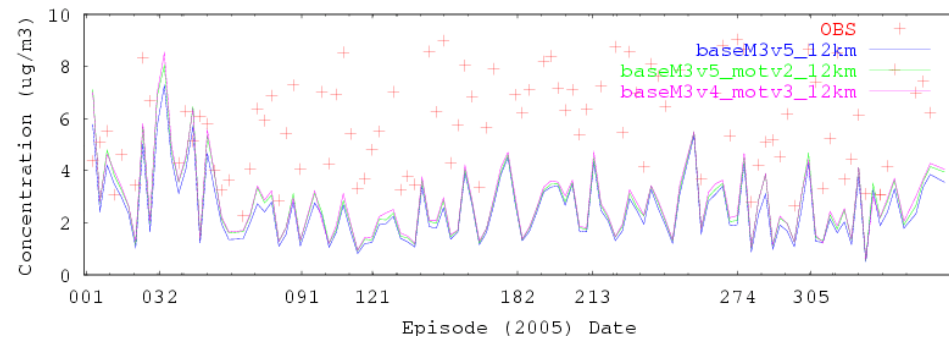
## Cleveland

baseM3v5\_12km - 390350060 - OC (ug/m3) camx [LADCO]



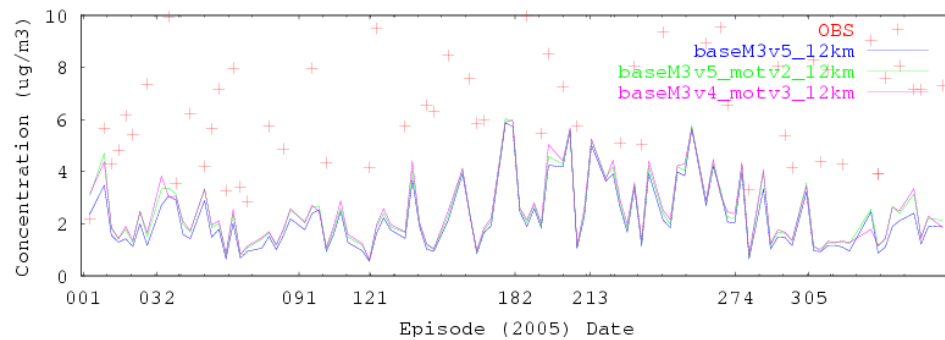
## Detroit

baseM3v5\_12km - 261630001 - OC (ug/m3) camx [LADCO]



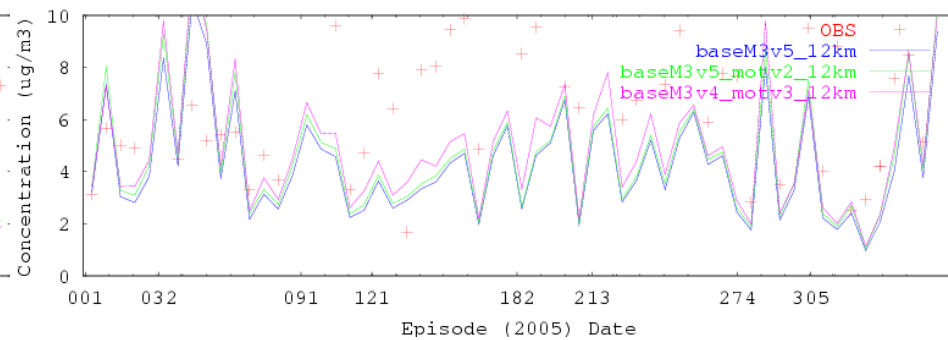
## Indianapolis

baseM3v5\_12km - 180970078 - OC (ug/m3) camx [LADCO]



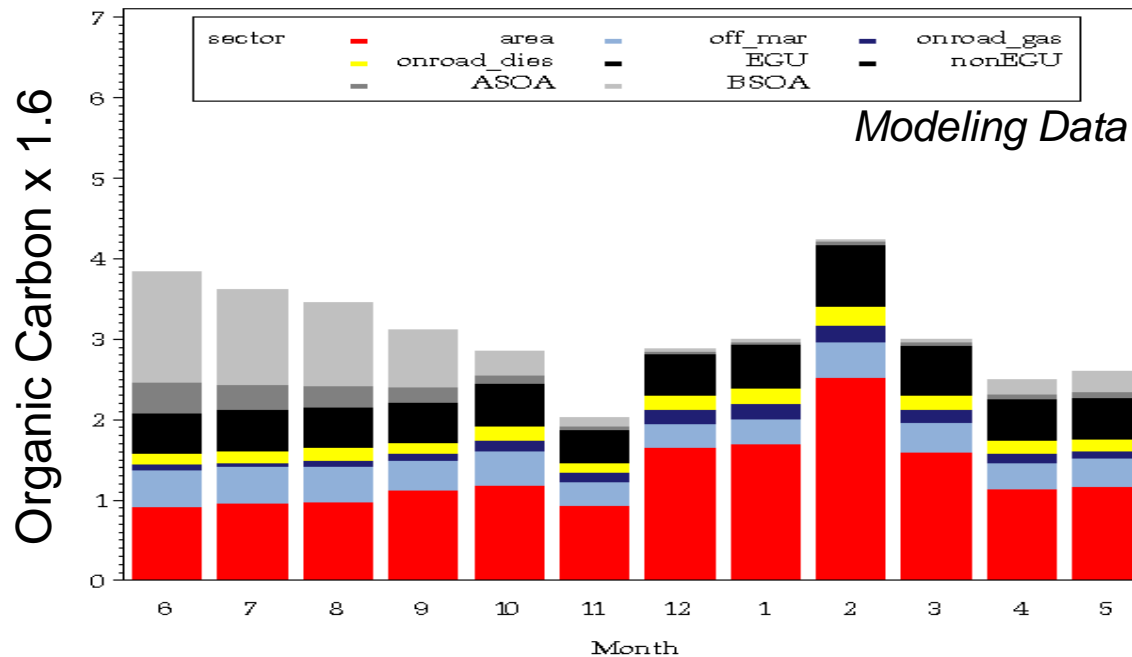
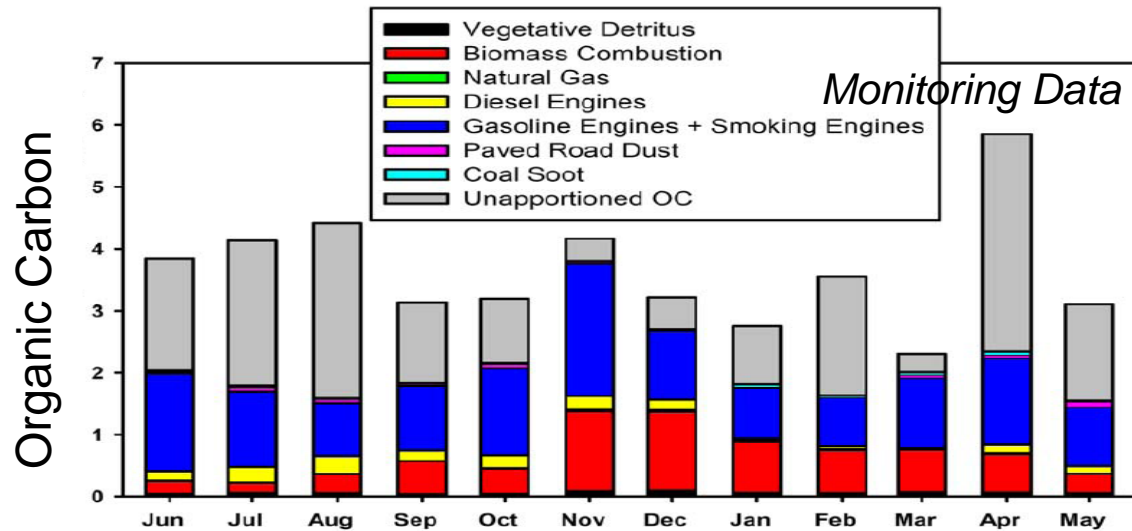
## Chicago

baseM3v5\_12km - 170310057 - OC (ug/m3) camx [LADCO]



Blue = Base (MOBILE6), Green = Adj.1-2, Purple = Adj. 1-3

# Source Apportionment Results



# Conclusions

- Emissions inventory adjustments had little effect on modeled PM<sub>2.5</sub> (organic carbon) concentrations
  - SIP inventories expected to rely on MOVES
  - PM model performance still problematic
- Source apportionment analyses suggest that important sources of organic carbon include...
  - Biogenic emissions
  - Biomass combustion
  - “Mobile” sources
  - Local point sources (in industrialized areas)
- Given inventory and modeling shortcomings, States may need to consider other information (e.g., monitoring data) to support SIP development