Revised Methodology for the Spatial Allocation of VMT and Mobile Source Emissions Data

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Emission Inventory Preparation for Modeling Session

Emission Inventory Conference

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Introduction

- Improvement Necessary for Allocation of Highway Vehicle VMT and Emissions ("Activity")
  - Current Methods Used Population Basis for Many Source Types
  - Tends to Overestimate Activity in Highly Populated Areas or Small Counties
  - Use Existing Data Currently Available for Emissions Modeling

Project Summary

- Base Year 1996 Emissions Inventory
- 36-km Grid Cell Resolution
- Annual Episode for CMAQ Model
- SMOKE Modeling System
- Focus on Atlanta Metro and Maricopa County, Arizona

Study Domain Inputs

1996 VMT and Annual NOx Emissions by Facility Type

	Vehicle Miles Traveled (Millions)		Annual NOx Emissions (Tons)	
Facility Type	**Atlanta Metro**	**Maricopa Co.**	**Atlanta Metro**	**Maricopa Co.**
Rural Interstate	2,430	975	15,675	5,929
Rural Other Principal Arterial	1,741	388	9,778	2,082
Rural Minor Arterial	1,929	306	7,790	1,164
Rural Major Collector	1,781	471	7,299	1,821
Rural Minor Collector	594	77	2,421	294
Rural Local	1,327	278	5,405	1,070
Urban Interstate	11,887	3,038	45,076	10,849
Urban Other Freeways & Expressways	1,659	2,177	6,290	7,774
Urban Other Principal Arterial	6,714	7,118	19,639	19,417
Urban Minor Arterial	7,314	3,863	21,393	10,536
Urban Collector	3,502	2,283	10,243	6,229
Urban Local	6,523	2,243	19,077	6,120
Total	**47,401**	**23,217**	**170,086**	**73,285**

Allocation Methods

- TIGER/Line Only Approach
  - Match Facility Class Based Activity to TIGER/Line Classes
- TIGER Urban/Rural Definition Differed From Inventory Data

Allocation Methods (TIGER/Line)

- Spatial Discontinuity with Classification System
  - Gaps in Highway Network where Roadway Classification Differed
  - Resulted in Uneven Distribution of Highway Vehicle Activity

Allocation Methods

- Population-Based Approach
  - Most Frequently Used Basis
  - Used Interstate Roadway Miles for Interstate Highway Source Categories
  - Population for Remainder
  - Urban/Rural Designation Overlay to Generate Four Gridding Surrogates
    - Urban Interstate, Rural Interstate, Urban Population, Rural Population

Allocation Methods (Population-Based)

Population-Based SCC / Spatial Surrogate Associations

SCC	Description	Spatial Surrogate
Prefix 220 or 223	**Highway Mobile Source**	
xxxxxxx110	Rural Interstate	Rural Interstate
xxxxxxx130	Rural Other Principal Arterial	Rural Population
xxxxxxx150	Rural Minor Arterial	Rural Population
xxxxxxx170	Rural Major Collector	Rural Population
xxxxxxx190	Rural Minor Collector	Rural Population
xxxxxxx210	Rural Local	Rural Population
xxxxxxx230	Urban Interstate	Urban Interstate
xxxxxxx250	Urban Other Freeways & Expressways	Urban Interstate
xxxxxxx270	Urban Other Principal Arterial	Urban Population
xxxxxxx290	Urban Minor Arterial	Urban Population
xxxxxxx310	Urban Collector	Urban Population
xxxxxxx330	Urban Local	Urban Population

Allocation Methods

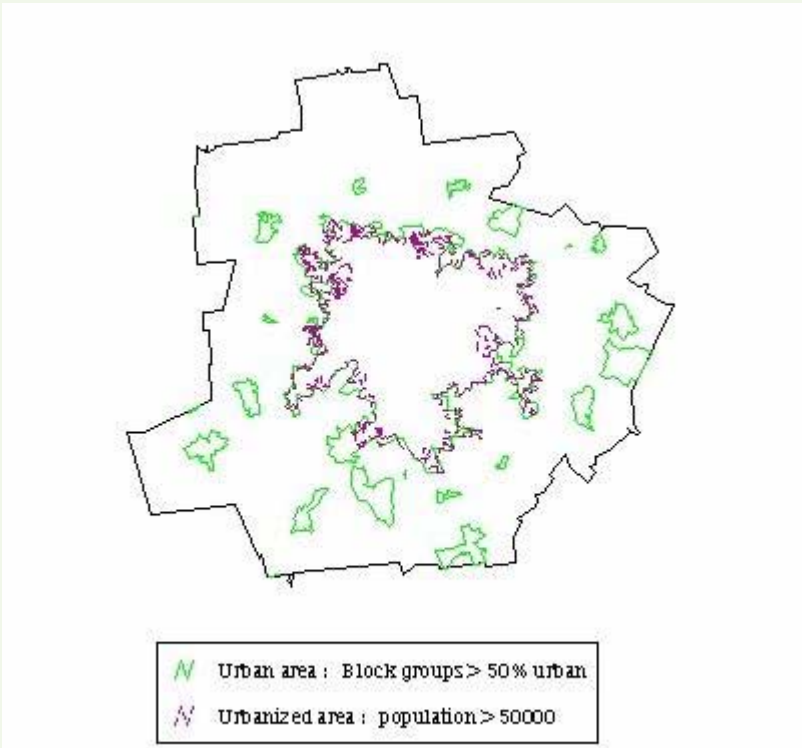
- Mixed Approach
  - Mixed Facility Type and Population Surrogates
  - "Common Sense" Approach for Allocation
    - Example: Heavy Duty Diesel Trucks
    - Usually Occurring in Populated Areas / Sometimes on Highways
      - 25% Roadway / 75% Population
  - Purely Objective & Not Physically Meaningful

Revised Method

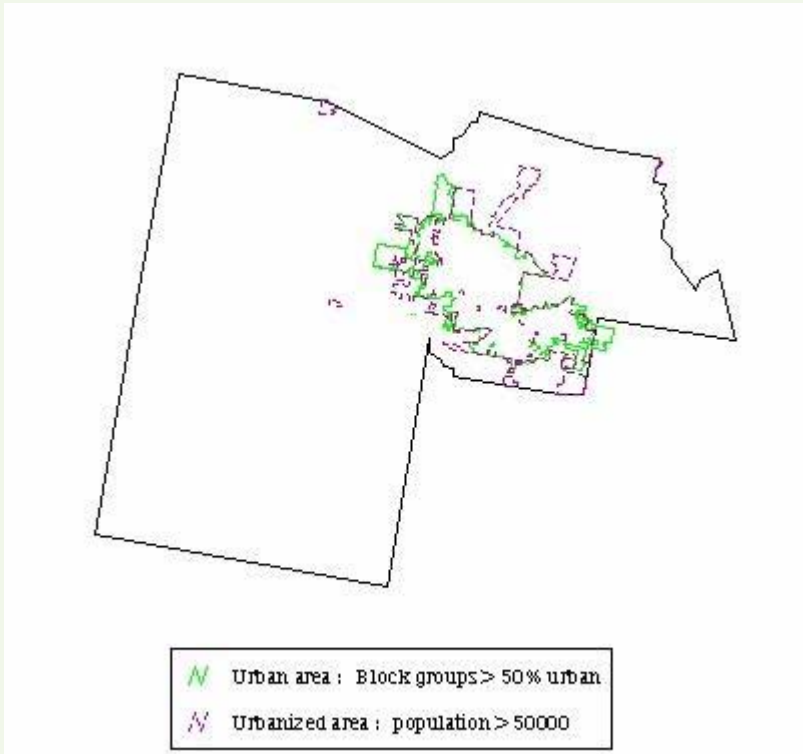
- Reclassify TIGER Census Feature Class Codes (CFCC) Into Three Groups
  - Primary, Secondary, Local Roads
- Generate Urban Area Coverages
  - Import 1990 Census Block Data
  - Subtract Rural from Total Population
  - Dissolved Boundaries To Create New Areas
  - Used Polygons With >50% Urban Population

Urban Boundary Development

Atlanta Metro



Maricopa County

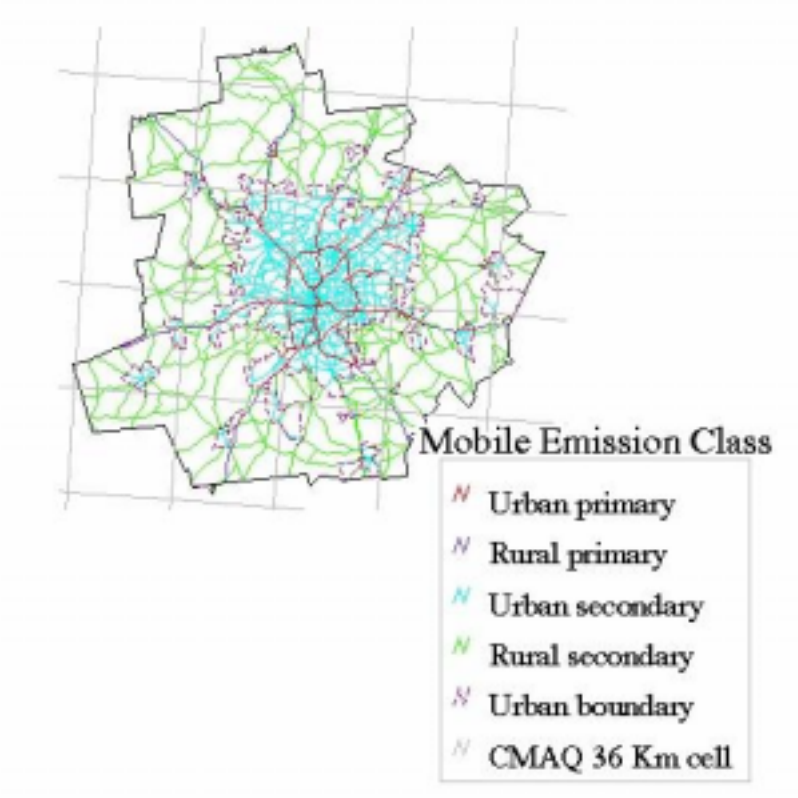


Revised Method (2)

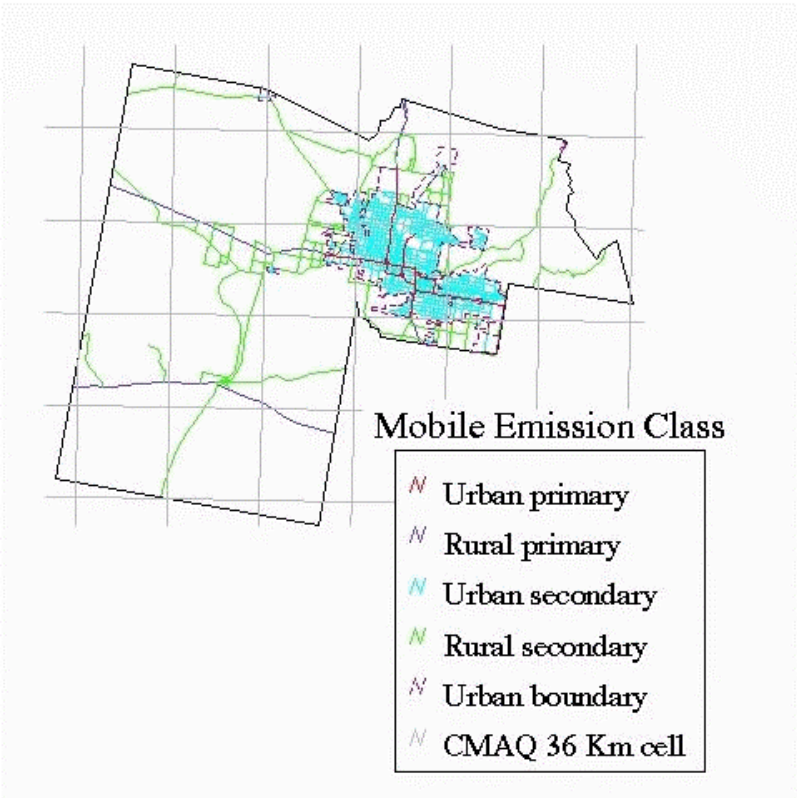
- Major Road Surrogate Development
  - Overlay Major Roads and Newly Defined Urban Area Coverages
  - Results in Four New Major Road Classes
    - Urban Primary, Rural Primary, Urban Secondary, Rural Secondary
  - Further Defined with 36-km National Grid
    - Statistics Generated for Grid Cell to County Contribution

Major Road Surrogates

Atlanta Metro



Maricopa County



Revised Method (3)

- Local Road Surrogate Development
  - Overlay Population and Newly Defined Urban Area Coverages
  - Results in Two New Local Road Surrogates
    - Urban Population, Rural Population
  - Further Defined with 36-km National Grid
    - Statistics Generated for Grid Cell to County Contribution

Revised Method (4)

Revised Method SCC / Spatial Surrogate Associations

SCC	Description	Spatial Surrogate
Prefix 220 or 223	**Highway Mobile Source**	
xxxxxxx110	Rural Interstate	Rural Primary Roads
xxxxxxx130	Rural Other Principal Arterial	Rural Primary Roads
xxxxxxx150	Rural Minor Arterial	Rural Primary Roads
xxxxxxx170	Rural Major Collector	Rural Secondary Roads
xxxxxxx190	Rural Minor Collector	Rural Secondary Roads
xxxxxxx210	Rural Local	Rural Population
xxxxxxx230	Urban Interstate	Urban Primary Roads
xxxxxxx250	Urban Other Freeways & Expressways	Urban Primary Roads
xxxxxxx270	Urban Other Principal Arterial	Urban Primary Roads
xxxxxxx290	Urban Minor Arterial	Urban Primary Roads
xxxxxxx310	Urban Collector	Urban Secondary Roads
xxxxxxx330	Urban Local	Urban Population

Initial Results

- Both VMT and Emissions Are Better Distributed Among Spatial Surrogate Classes
- Population-Based Activity Decreases as More Attributed to Road Types
- Consistent Allocation of Urban and Rural Activity

Annual VMT Distribution

Population-Based VMT (Millions)

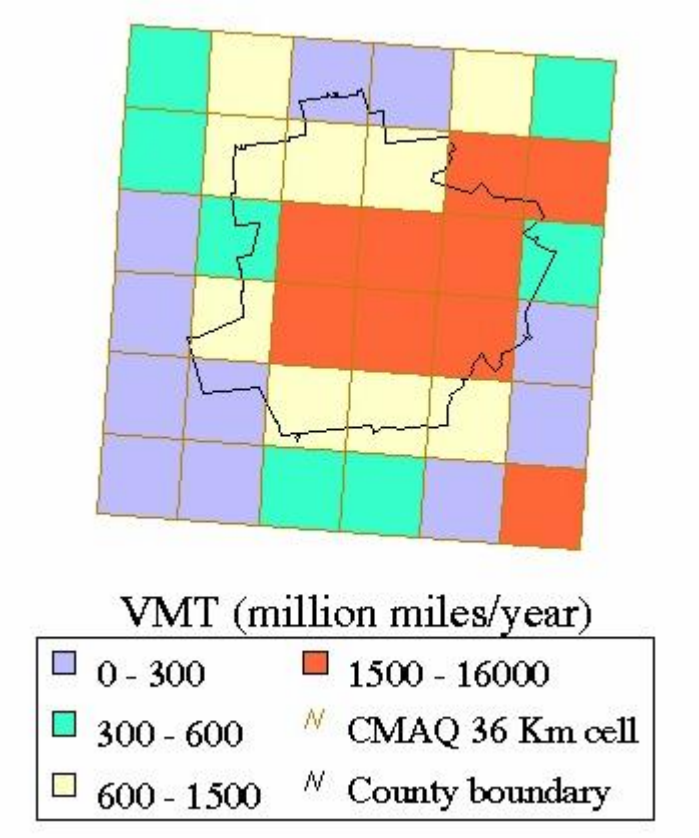
	Interstate		Other		
Study Domain	**Rural**	**Urban**	**Rural**	**Urban**	**Total**
Atlanta Metro	2,430	13,546	7,372	24,054	47,402
Maricopa Co.	975	5,214	1,520	15,507	23,216

Revised Method VMT (Millions)

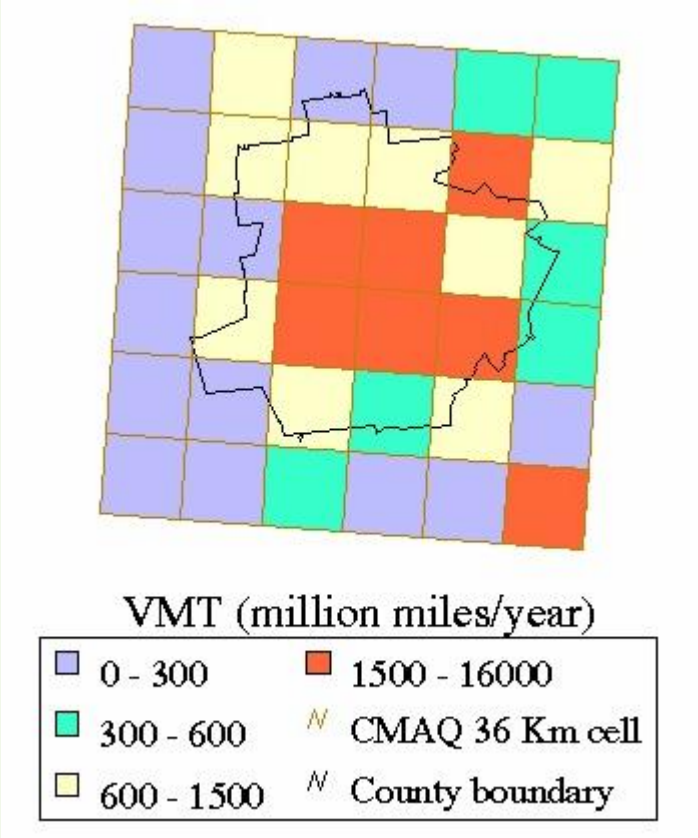
	Primary		Secondary		Local		
Study Domain	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Total**
Atlanta Metro	6,101	27,575	2,375	3,502	1,327	6,523	47,403
Maricopa Co.	1,669	16,195	548	2,283	278	2,243	23,216

Annual VMT Distribution (Atlanta)

Population-Based

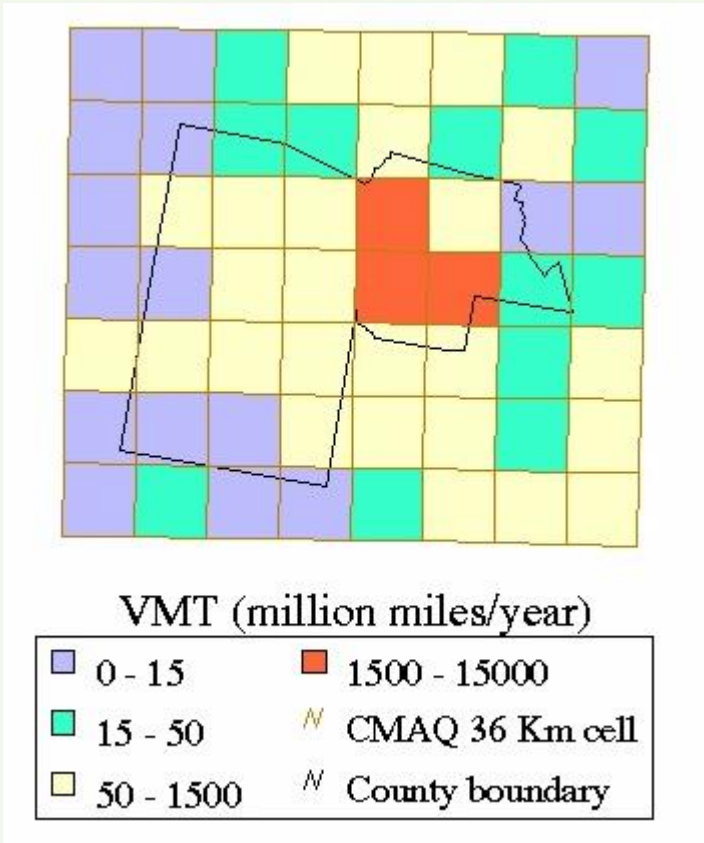


Revised Method



Annual VMT Distribution (Maricopa Co.)

Population-Based



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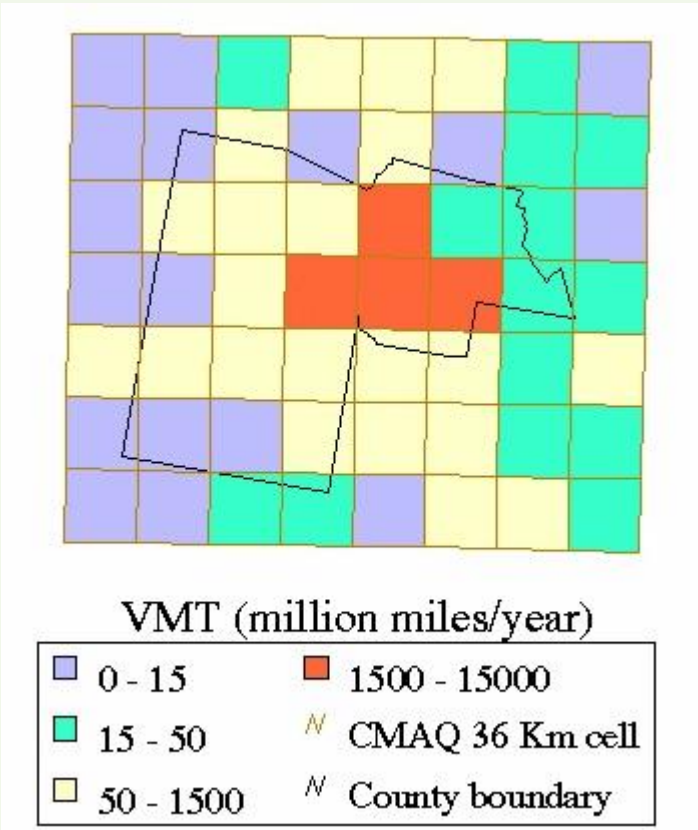
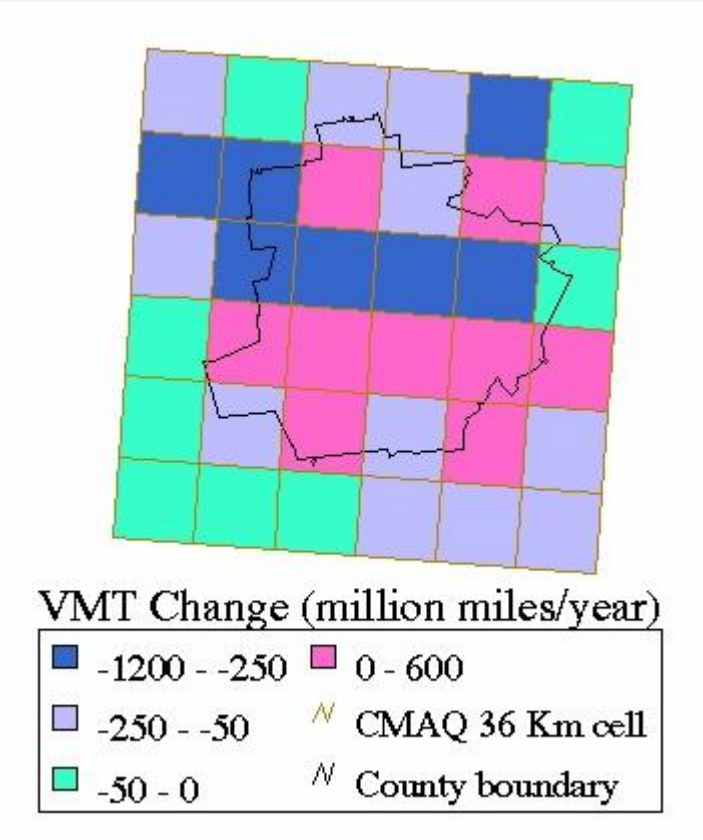
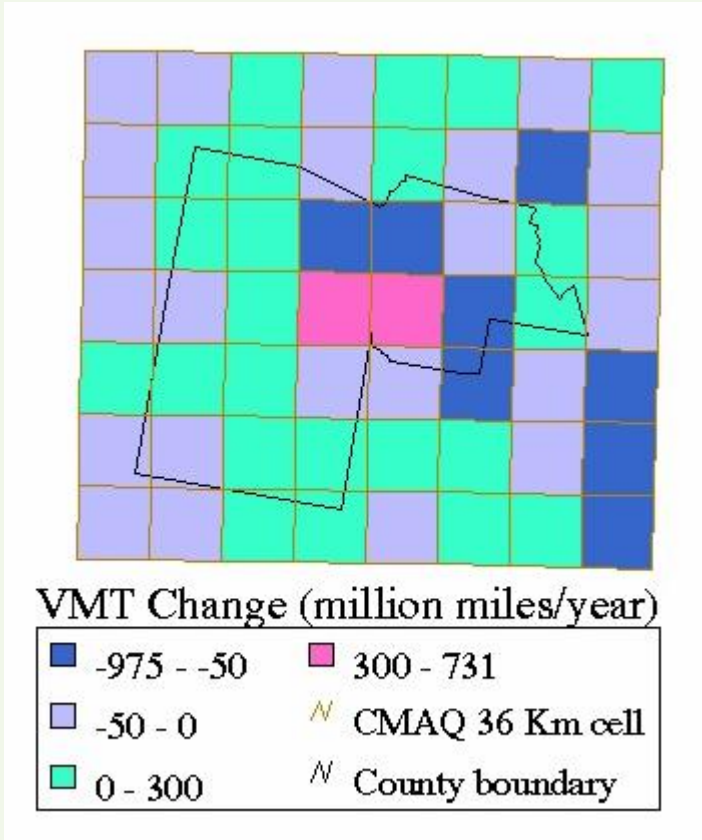


Annual VMT Distribution (Differences)

Atlanta Metro



Maricopa County



Annual NOx Distribution

Population-Based NOx (Tons)

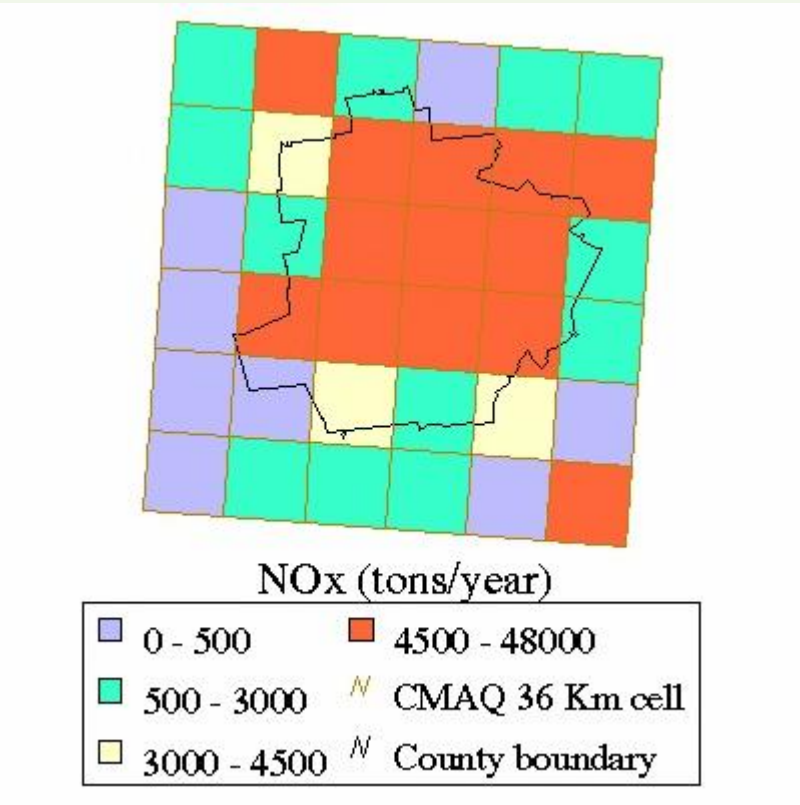
	Interstate		Other		
Study Domain	**Rural**	**Urban**	**Rural**	**Urban**	**Total**
Atlanta Metro	15,675	51,366	32,692	70,351	170,084
Maricopa Co.	5,929	18,622	6,432	42,301	73,284

Revised Method NOx (Tons)

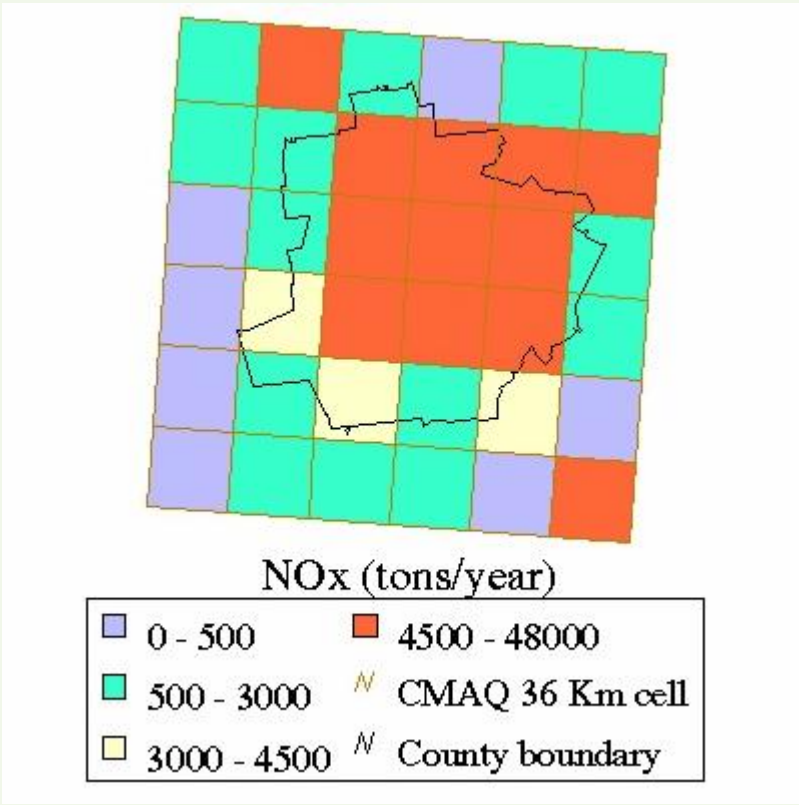
	Primary		Secondary		Local		
Study Domain	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Total**
Atlanta Metro	33,243	92,397	9,720	10,243	5,405	19,077	170,085
Maricopa Co.	9,176	48,575	2,116	6,229	1,070	6,120	73,286

Annual NOx Distribution (Atlanta)

Population-Based

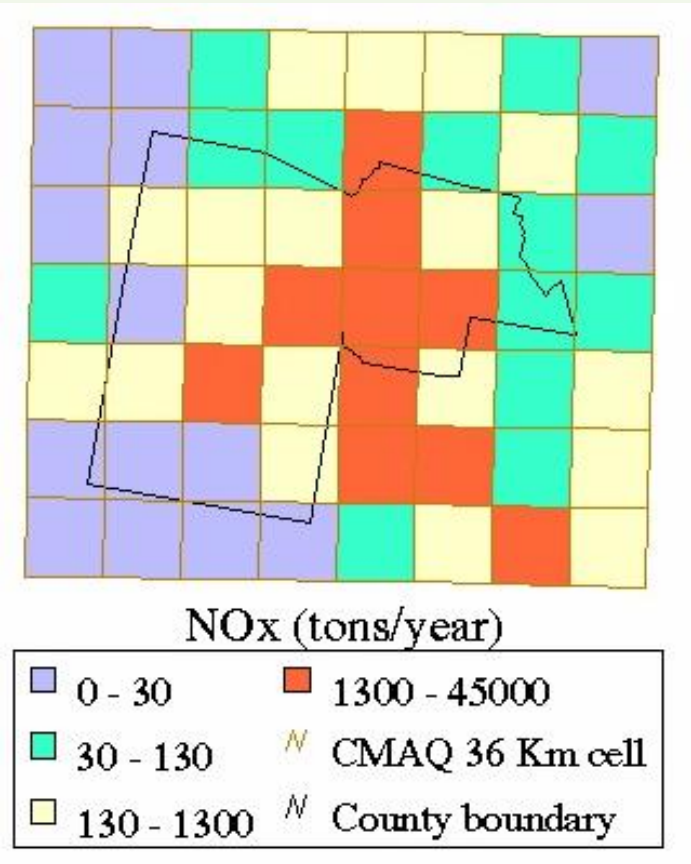


Revised Method



Annual NOx Distribution (Maricopa Co.)

Population-Based



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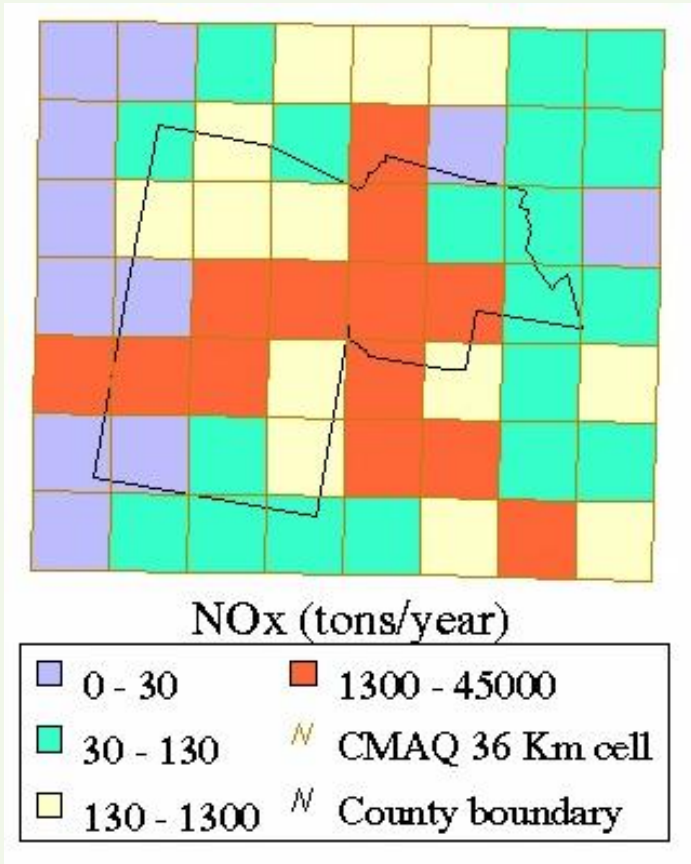
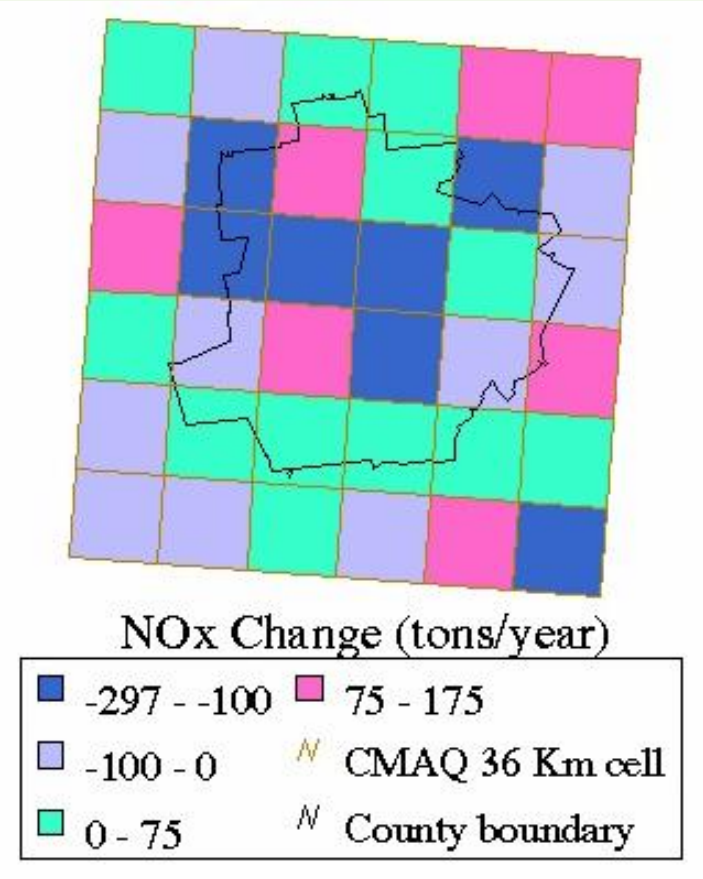
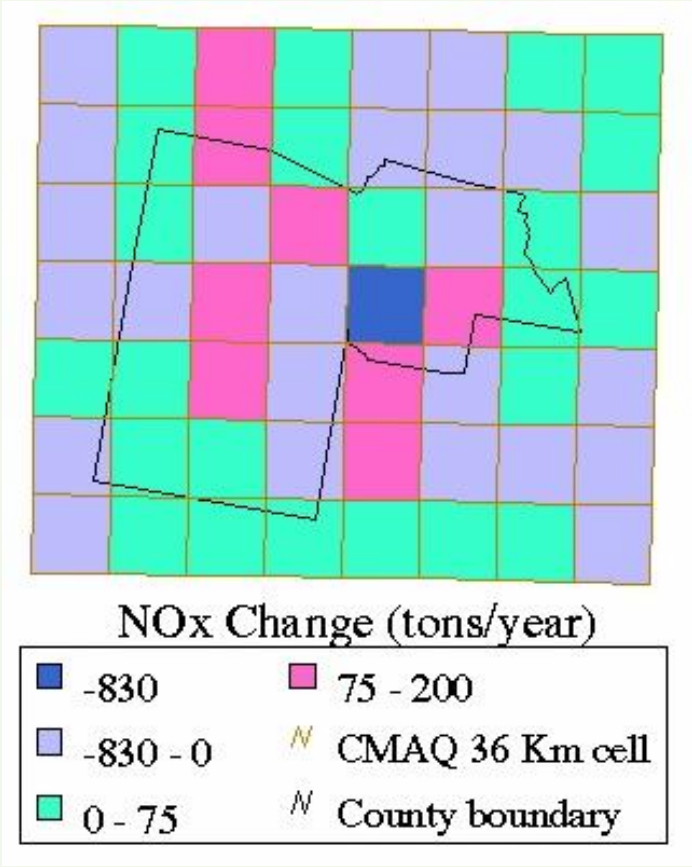


Annual NOx Distribution (Differences)

Atlanta Metro



Maricopa County



Conclusions

- Sensitivity Runs Indicate Better Allocation of Highway Vehicle VMT and Emissions Using Revised Spatial Factors
- New Allocation Better Approximates Actual Road Networks
- Revised Data Enhances Modeling Results
  - Better Utilizing TIGER/Line Data
  - Better Representing Small Grid Distribution