The Georgia Institute of Technology

The Impact of Vehicle Fleet Characteristics on Emissions Outputs from MOBILE6

David Kall, Vishal Pandey, Jennifer Indech Nelson, and Randall Guensler (Georgia Institute of Technology)

Overview

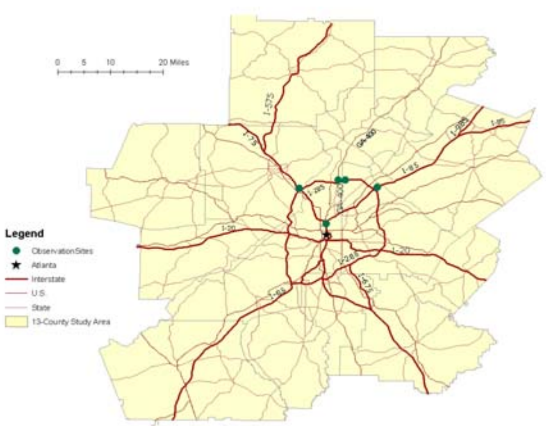
This paper examines the sensitivity of MOBILE6 emission rates to onroad fleet characteristics. Georgia Tech researchers collected license plate data during the peak morning commute at five locations in the Atlanta metropolitan area to obtain fleet characteristic data. The researchers then compared MOBILE6 emission rates for the observed fleet to emission rates using the national/regional default fleet.

Background

In MOBILE6, registration distributions (for the previous 25 model years), coupled with mileage accumulation rates for each model year, yield onroad subfleet distributions per vehicle class. Atlanta typically has an older vehicle fleet than the national average, leading to higher onroad emission rate predictions. In microscale analysis, accurate local subfleet characteristics are important.

License Plate Data Collection

- **Five sites, five days at each site**
- **One hour of data collection every day during the morning peak period (7am-9am)**
- **Binoculars and tape recorders to collect license plate data from highway overpasses**
- **Observed all lanes (except HOV lane)**
- **Ignored trucks and out-of-state vehicles**
- **Registration database double-blind matching**
- **Data are illustrative of northern Atlanta freeway morning peak commute fleet**

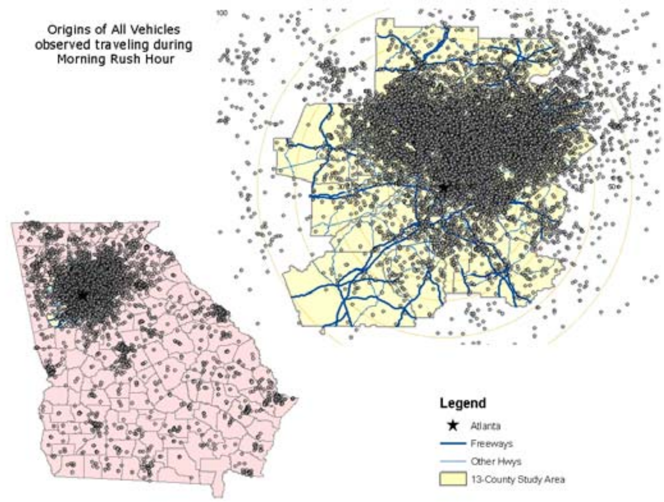


License Plate (LP) Observation

- **38,580 License plates recorded at five observation sites**
- **34,950 (90.6%) unique tags, due to multiple sightings**
- **25,956 (74.3%) matched to unique addresses**

Freeway	Passenger Cars (LDV)	Light Duty Trucks (LDT)	Total
Connector (I-75/I-85)	3,528	2,158	5,686
GA 400	3,350	2,397	5,747
I-285	2,475	1,946	4,421
I-75	2,831	2,316	5,147
I-85	2,427	1,947	4,374
Grand Total	14,611	10,764	25,375

Location of Registration Addresses for Observed Vehicles

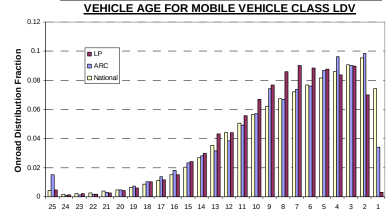


Emissions Analyses

Step 1: Define Subfleet Composition:

- **License Plate (LP) Data:**
  - **Fractions taken directly from observation**
- **Atlanta Regional Commission (ARC)**
  - **National mileage accumulation rates x**
  - **Normalized ARC registration distribution**

VARIATION OF ONROAD DISTRIBUTION FRACTIONS WITH VEHICLE AGE FOR MOBILE VEHICLE CLASS LDV

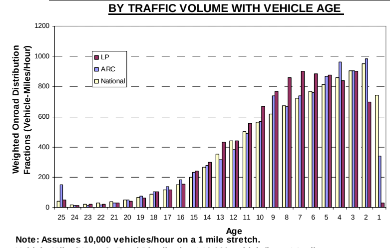


For License Plate Data: Onroad Distribution Fraction = Normalized (Number of Vehicles Observed)
For ARC and National: Onroad Distribution Fraction = Normalized (REGDIST*Daily Miles)

Step 2: Set to Vehicle-Miles/Hour

- **Multiply onroad distribution x 10,000 vehicles/hour x 1 mile of travel**

VARIATION OF ONROAD DISTRIBUTION FRACTIONS WEIGHTED BY TRAFFIC VOLUME WITH VEHICLE AGE



Note: Assumes 10,000 vehicles/hour on a 1 mile stretch.
Vehicle-Miles/Hour=OnRoad Distribution * 10,000 vehicle/hour * 1 mile

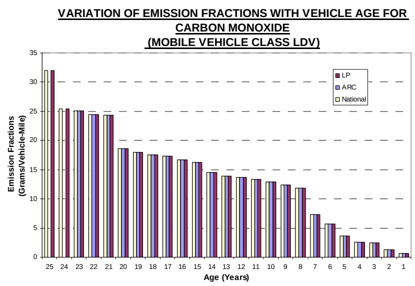
The Impact of Vehicle Fleet Characteristics on Emissions Outputs from MOBILE6

David Kall, Vishal Pandey, Jennifer Indech-Nelson, and Randall Guensler (Georgia Institute of Technology)

The Georgia Institute of Technology

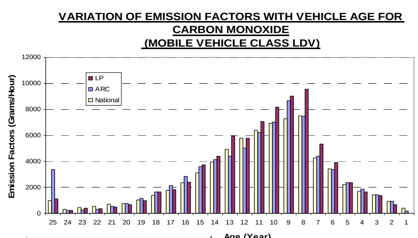
Step 3: Determine Grams/Vehicle-Mile

- Standard MOBILE6 database outputs using vehicle class and vehicle age for ARC inputs



Step 4: Calculate Grams/Hour

- For each Vehicle Class and MY, multiply Vehicle-Miles/Hour by Grams/Vehicle-Mile



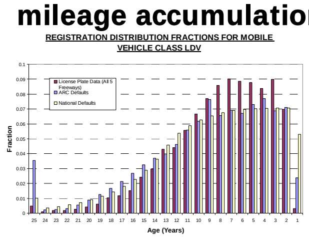
$$\frac{\text{Grams}}{\text{Hour}} = \frac{\text{Vehicle-Miles}}{\text{Hour}} * \frac{\text{Grams}}{\text{Vehicle-Mile}}$$

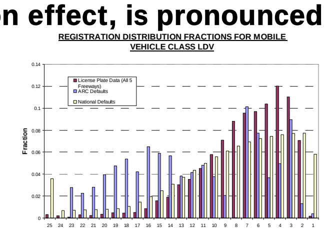
Step 5: Calculate Total Emissions

- Sum all 25 model years for each vehicle class

Registration vs. Observation Alone

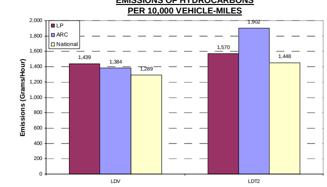
- LDT difference (ARC vs. EPA), taken before mileage accumulation effect, is pronounced

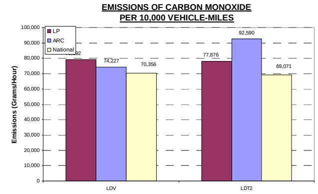


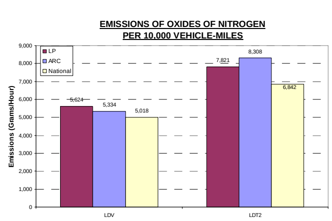


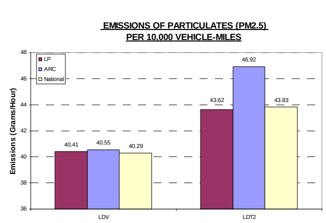
Emissions Results

Comparison of LP, ARC, and National

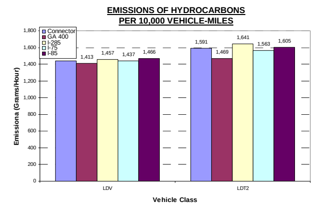


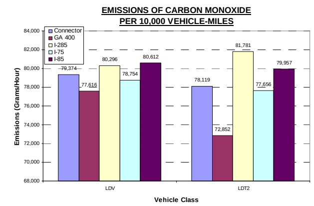


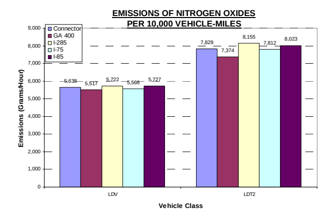


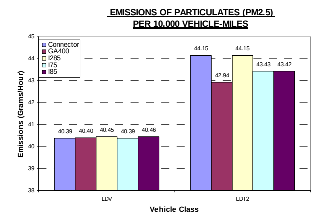


Comparison Across Five Freeways









Conclusions

- Problem with registration distribution fractions used by ARC for light-duty trucks (LDT2), lead to high emissions estimates
- As expected, the older vehicle fleet in Atlanta leads to higher emissions estimates than the national average
- For LDVs, using observed onroad distributions produces higher emissions estimates than calculations used by the ARC
- For LDTs, calculation using ARC produces higher emissions estimates than using observed onroad distributions
- Highest emissions rates are found on I-285, which is traveled by older vehicles
- Lowest emission rates from GA 400, which is traveled by newer vehicles and fewer LDTs

Suggested Future Research

- Examine whether use of commutershed registration data and mileage accumulation, rather than national/regional defaults, improves subfleet composition accuracy
- Develop subfleet characterization tools for use with travel demand models to enhance regional air quality analysis
- Collect additional data in Southern Atlanta
- Compare registration composition and mileage accumulation across census block groups to assess relative emissions impacts (potential environmental justice issue)
- Evaluate potential impacts of using observed subfleet compositions in microscale air quality impact assessments