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Spatial and Statistical Analysis of Commercial Vehicle Activity in Metropolitan Atlanta

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The next generation of air quality models demands a better understanding of medium- and heavy-duty vehicle activities and the relationship between these activities and emissions. Understanding fleet characteristics and their associated impact, therefore, is critically important. Data collected in a 1996 commercial vehicle trip survey for the Atlanta region are presented and analyzed. A survey data collection effort undertaken in 1996, which included the collection of data related to spatial, temporal, cargo, land use, and vehicle characteristics, is described. The results of a series of statistical analyses are reported and discussed. The results of geographic information systems analyses, which provide a spatial picture of commercial vehicle activity, are presented. The spatial analysis combines vehicle, cargo, and land use characteristics with spatial and temporal data within the study area. The results of this study provide a compelling snapshot of commercial vehicle activity in the Atlanta area.

Transportation professionals widely recognize that the contribution of mobile sources to regional emissions is poorly understood and documented. Although air quality and transportation professionals may recognize intuitively the impact of commercial vehicle activity on the transportation system, the lack of data and research in this area limits the ability to draw meaningful conclusions regarding this impact. Data on both fleet characteristics and vehicle activity for trucks are lacking. The ability to model emissions levels and the contribution of the truck fleet to emissions thus depends on gaining a broader understanding of the nature of truck activity and freight movement in urban areas (*1*). This study was intended to begin to document the characteristics and activities of the commercial vehicle fleet in the Atlanta region in order to broaden understanding of the possible contribution of commercial vehicles to mobile source emissions.

Within the Atlanta 13-county nonattainment area, as defined by the 1990 Clean Air Act Amendments, the contribution of heavy-duty trucks is particularly important to developing estimates of emissions (*2*). The extent to which trucks contribute to mobile source emissions is not well understood and may be underestimated, exacerbating the ability to reduce pollution levels. In addition, it is likely that the need for more detailed information on truck characteristics and fleet activity will be even more critical in modeling emissions as more sophisticated models are developed and tested. The Georgia Institute of Technology (Georgia Tech) currently is conducting research to develop the next generation of air quality emissions models. The methodological direction taken by Georgia Tech requires better information on truck fleet activity at the micro level as one component of total mobile source emissions modeling at the regional level (*3*).

For a recent survey conducted in Atlanta, data were collected on commercial vehicle activity, including heavy-duty trucks. The findings of the survey are reviewed and expanded and the spatial allocation of commercial vehicle activity throughout the 13-county nonattainment area is investigated further. The data collection effort includes the tripmaking of 744 vehicles associated with 152 firms based in the Atlanta region. The fleet characteristics of the 153 firms varied from 1-vehicle companies to firms with 51 vehicles or more. Only firms registered in the Atlanta Regional Commission (ARC) planning area contributed data.

EMISSIONS RESEARCH

The Atlanta region currently does not meet federal air quality standards promulgated by the Environmental Protection Agency under the authority of the Clean Air Act. The 13-county metropolitan Atlanta region falls in the "serious" ozone nonattainment category. The 1996 Transportation Improvement Program (TIP) failed to conform to the air quality plan and therefore was not adopted. As a result, Atlanta presents an excellent case demonstrating the need for better integration of modeling efforts between the transportation community and the emissions modeling community (*4*). A question that must be answered is how different vehicle operating modes and activities affect emissions. Improved understanding of vehicle activity patterns and their spatial allocation can help answer this question. Understanding current activity patterns will help predict vehicle activity by mode and subsequently generate improved emissions estimates (*5*).

COMMERCIAL VEHICLE SURVEY

In the spring of 1996, ARC, the metropolitan planning organization for the Atlanta area, commissioned a survey of commercial vehicles (*6*). Before this survey, conducted by NuStats International, there was no survey information available in the region regarding commercial vehicle activity. Agencies relied on sporadic traffic count data and typically assumed truck percentages or volumes by road class. The purpose of the survey was to begin to fill the existing information gap by collecting data related to vehicle characteristics, spatial and temporal vehicle movements, land use at destination, and cargo hauled. In collecting these data, the ARC would have a database of information from which to derive a trip table that could be used in travel demand modeling (*7*).

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Survey Limitations

In conducting this survey, several trip types were not captured in the sample, limiting the applicability and generalizability of the survey results. For example, the sample did not include trips made within the study area by vehicles registered outside the area. Therefore, companies registered in surrounding counties or states would not be included in the sample even if they had trips with origins or destinations inside the area. Second, the sample did not include external trips—trips that pass through the survey area but that have origins and destinations outside the region. This omission is important because the Atlanta area is a major truck route along the East Coast and an important pass-through point between Florida and other states. Last, the sample did not include trips with either an origin or destination outside the study area, even if a sample firm makes the trip. This last category of trip made up 7.1 percent of all sample trips.

The survey results also may be biased because completed trip logs were received from only 15 percent (152) of the firms contacted. This self selection may skew the results away from an accurate representation of the population of commercial vehicles operating in the Atlanta region. For these reasons, caution is advised in applying the results of this survey to the region and to areas outside the region.

Survey Results

The survey sample was drawn from a 1993 list of firms registered in the ARC planning area. The counties in which these firms operate or are registered include Cherokee, Clayton, Cobb, DeKalb, Douglas, Fayette, Fulton, Gwinnett, Henry, and Rockdale. Because the place of registration and the actual business site differed in some instances, firms in Forsyth and Coweta were captured in the sample (Figure 1). Of the 1,008 firms contacted, 629 firms were eligible to participate in the survey. Approximately 55 percent (347) of all eligible firms agreed to participate in the study and 45 percent (282) refused. Of the 347 firms recruited, 152 provided completed trip logs, yielding a survey completion rate of 43 percent. The overall response rate for the survey was 19 percent, based on those firms eligible to participate.

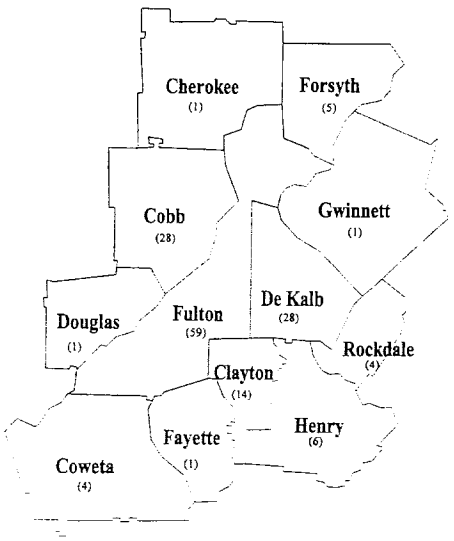

FIGURE 1 Locations of participating firms.

TABLE 1 Distribution of Firms by County (6)

County	Frequency	Percent
Cherokee	1	0.6
Clayton	14	9.1
Cobb	28	18.3
Coweta	4	2.6
DeKalb	28	18.4
Douglas	1	0.6
Fayette	1	0.6
Forsyth	5	3.3
Fulton	59	38.7
Gwinnett	1	1.3
Henry	6	3.9
Rockdale	4	2.6
Total:	152	100.0

Base: All firms

Table 1 summarizes the distribution of participating firms within the study area. Three counties—Fulton, DeKalb, and Cobb—contain approximately 55 percent of all firms in the sample. These three counties are located most centrally within the study area and include the largest portions of major thoroughfares within the region.

Participating firms were provided with vehicle trip logs to be completed for all trips made on an assigned day. A total of 4,136 trips was recorded for 744 vehicles in four vehicle classifications. Autos comprised 5 percent of the total sample fleet, light-duty trucks comprised 58.6 percent of the fleet, medium-duty trucks comprised 4.6 percent of the total, and heavy-duty trucks comprised 29.6 percent. Approximately 2.2 percent of the total vehicle sample was of an unknown category (Table 2).

The NuStats report included an analysis of vehicle age and vehicle class; however, the data were analyzed again for this report by using a more disaggregate vehicle age structure. As summarized in Table 3, nearly 50 percent of the sample vehicles were 0 to 3 years old in 1996. An additional 28 percent were 4 to 7 years old in 1996 and 14 percent were 8 to 11 years old. Only 9 percent of the sample vehicles were 12 or more years old. These data indicate a very young vehicle fleet operating in the sample area. This result has implications for emissions modeling because newer vehicles are less likely to be high emitters than are older vehicles.

Of all drivers reporting a fuel type for their vehicle, 36.3 percent reported gasoline and 20.1 percent reported diesel. Nearly 44 percent of drivers responded that they did not know what fuel type their vehicle used (Table 4). Cross tabulations of vehicle type with fuel type did not yield meaningful results because of the high percentage of unknown fuel type. Similarly, cross tabulations involving fuel type and other variables were not attempted because any tabulations using fuel type would yield potentially inaccurate results.

TABLE 2 Vehicle Type (6)

Vehicle Type	Frequency	Percent
Auto	38	5.0
Light-duty Trucks (<14,000 lbs.)	436	58.6
Medium-duty Trucks (14,001 lbs. to 18,000 lbs.)	34	4.6
Heavy-duty Trucks (greater than 18,000 lbs.)	220	29.6
Type unknown	16	2.2
Total:	744	100.0

Base: All vehicles (unweighted)

TABLE 3 Vehicle Type by Age (*6*)

	Vehicle Type				
Vehicle Age	Auto	Light-duty Truck	Medium-duty Truck	Heavy-duty Truck	Total
0 – 3 years	57.1%	42.3%	29.0%	64.3%	49.1%
4 – 7 years	34.2%	32.0%	41.4%	16.0%	27.6%
8 – 11 years	6.5%	15.9%	9.7%	13.4%	14.4%
12 – 15 years	0.0%	4.5%	18.3%	4.7%	5.0%
Over 15 years	2.2%	5.3%	1.6%	1.6%	3.9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Base: All vehicles (unweighted)

TABLE 4 Vehicle Fuel (*6*)

Vehicle Fuel Type	Frequency	Percent
Gas	250	36.3
Diesel	139	20.1
Fuel Type Unknown	301	43.6
Total:	690	100.0

Base: All vehicles reporting fuel (unweighted)

As summarized in Table 5, light-duty trucks made nearly three-fourths of all trips. Heavy-duty trucks made roughly 17 percent of trips and medium-duty trucks made approximately 7 percent of all trips. An estimated 2.6 percent of total trips were made by autos; however, the sample was not framed around the inclusion of autos—only major shippers were targeted, so this number is not likely to be representative of Atlanta goods movement overall.

According to the results reported by NuStats, weighted means for daily truck trips for the Atlanta area survey compared closely with similar data collected in three other areas of the country. The mean for the NuStats survey is 6.88 compared with 8.27 for San Antonio, 7.7 for Phoenix, and 7.4 for the Winston-Salem area (Table 6).

Table 7 is a cross tabulation of vehicle type to land use at the trip destination. When these data are combined, a heavy dependence on light-duty trucks becomes apparent within the industrial, residential, retail, and home base categories. Overall, light-duty trucks comprise 74.4 percent of all trips to these land uses. Heavy-duty trucks constitute the next-highest percentage at 20.2 percent. In addition, the same land use categories comprise nearly 85 percent of all land use types at the destination. Office/government, educational, and medical comprise the remaining 15 percent. It must be noted, however, that this analysis does not include the land use type unknown category. By omitting this category, 16.1 percent of the sample trips are not represented in the analysis.

A comparison of trip length to vehicle type indicates that the percentage of trips made by the different vehicle types is comparable across vehicle types for trip lengths of less than 16 km. The percentage within the auto, light-duty, medium-duty, and heavy-duty categories ranges from 19.1 percent to 21.4 percent. Percentages are not clustered as tightly for the remaining mileage categories; however, the differences are not dramatic until the 81 to 160 km category and the greater than 160 km category. Within these categories, automobiles are used far less than heavy-duty trucks. The high percentage of short trips (less than 16 km) for all vehicle types has serious implications for emissions levels because of the likelihood that these vehicles are operating under cold start conditions (Table 8).

As noted in Table 9, the majority of trips (51.3 percent) occurred in vehicles that were 0 to 3 years old in 1996. This is particularly true for trips longer than 160 km. As the vehicle's age increases, the use of that vehicle decreases for all trip lengths. This has implications for emissions modeling because vehicle age is associated with emissions—newer vehicles typically emit less pollution than older vehicles, assuming adequate maintenance.

The cross tabulation in Table 10 provides insight into the relationship between types of cargo and land use at the destination. Significantly, 31.6 percent of all trips were made when vehicles were empty. Approximately half (48.5 percent) of these empty vehicles returned to the home base after completing deliveries. More efficient scheduling and resource management leading to a reduction in empty-vehicle trips may have strong implications for reducing mobile source emissions levels in urban areas.

This study primarily focused on cargo types that are the most significant, based on category totals. These categories include cargo shipments of farm products, food or kindred products, apparel or finished textile products, wood or allied products, chemical or allied products, primary and fabricated metal products, machinery, equipment or supplies, and empty delivery vehicles. The remaining cargo types were placed into the miscellaneous category.

TABLE 5 Trips by Vehicle Type (*6*)

Vehicle Type	Frequency	Percent
Auto	29,308	2.6
Light-duty Truck	825,098	72.4
Medium-duty Truck	82,659	7.3
Heavy-duty Truck	191,837	16.8
Type Unknown	10,641	0.9
Total:	1,139,543	100.0

Base: All trips (weighted)

TABLE 6 Comparison of Weighted Daily Truck Trips (*6*)

City	Mean
Atlanta	6.88
San Antonio, Texas	8.27
Phoenix, Arizona	7.70
Winston-Salem/Highpoint/Greensboro, North Carolina	7.40

Excludes vehicles with no trips on travel day
Based on data collected from:
San Antonio-Bexar County Travel Study: Workplace and Truck Survey (San Antonio-Bexar County MPO, 1991)
Development of an Urban Truck Travel Model for the Phoenix Metropolitan Area (Arizona Department of Transportation, 1992)
Piedmont Triad Area Commercial Vehicle Survey (North Carolina Department of Transportation – Statewide Planning, 1995)

TABLE 7 Vehicle Type by Land Use (*6*)

	Vehicle Type				
Land Use	Auto	Light-duty Truck	Medium-duty Truck	Heavy-duty Truck	Total
Educational	0.1	3.0	0.0	0.3	3.4
Industrial	0.4	14.7	0.5	4.5	20.1
Medical	0.3	0.4	0.0	0.1	0.8
Office/Government	0.7	10.0	0.2	2.0	12.9
Residential	0.6	15.9	0.6	3.0	20.1
Retail	0.3	14.7	0.2	6.2	21.4
Home Base	0.7	15.7	0.8	4.1	21.3
Total	3.1	74.4	2.3	20.2	100.0

Base: All trips reporting both trips purpose and vehicle class (weighted)

TABLE 8 Trip Length by Vehicle Type

	Vehicle Type				
Trip Length	Auto	Light-duty Truck	Medium-duty Truck	Heavy-duty Truck	Total
Less than 1.6 km	19.1%	19.9%	21.4%	21.0%	20.3%
1.6 to 16 km	52.5%	45.5%	42.7%	46.2%	46.0%
17 to 32 km	17.3%	17.7%	19.1%	12.7%	16.2%
33 to 48 km	2.5%	8.6%	3.8%	5.3%	7.1%
49 to 64 km	4.9%	3.8%	5.3%	3.6%	3.8%
65 to 80 km	1.2%	1.7%	3.1%	2.2%	1.9%
81 to 160 km	0.6%	1.9%	3.1%	3.0%	2.2%
More than 160 km	1.9%	0.9%	1.5%	6.0%	2.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Base: All vehicles reporting a trip with length greater than 0 km

TABLE 9 Trip Length by Age

	Vehicle Age					
Trip Length	0 – 3 years	4 – 7 years	8 – 11 years	12 – 15 years	Over 15 years	Total
Less than 1.6 km	49.1%	26.7%	15.2%	4.7%	4.3%	100.0%
1.6 to 16 km	52.0%	27.3%	12.8%	3.7%	4.2%	100.0%
17 to 32 km	46.6%	31.2%	14.0%	4.8%	3.4%	100.0%
33 to 48 km	48.8%	28.9%	10.0%	10.0%	2.3%	100.0%
49 to 64 km	57.5%	22.5%	16.7%	1.7%	1.6%	100.0%
65 to 80 km	62.9%	24.2%	9.7%	1.6%	1.6%	100.0%
81 to 160 km	52.1%	35.2%	8.5%	2.8%	1.4%	100.0%
More than 160 km	75.3%	19.8%	3.7%	0.0%	1.2%	100.0%
Total	51.3%	27.7%	13.0%	4.3%	3.7%	100.0%

Base: All trips reporting a trip with length greater than 0 km

TABLE 10 Cargo by Land Use at Trip Destination

Cargo	Land Use at Destination							
	Educational	Industrial	Medical	Office/ Govt.	Residential	Retail	Home Base	Total
Farm products	3.4%	0.6%	2.3%	0.0%	0.4%	2.3%	1.1%	1.0%
Crude petroleum, natural gas, gasoline	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
Food or kindred products	13.8%	3.7%	0.0%	5.1%	0.2%	10.6%	1.9%	3.7%
Apparel of finished textile products	0.0%	12.2%	2.3%	0.3%	0.4%	4.1%	1.8%	3.5%
Wood or allied products	3.4%	3.2%	9.3%	3.2%	1.6%	4.6%	1.9%	2.7%
Furniture or fixtures	0.0%	1.4%	0.0%	0.3%	3.9%	1.1%	1.1%	1.7%
Printed matter	1.8%	3.5%	7.0%	22.6%	2.1%	2.9%	0.6%	3.9%
Chemical or allied products	5.3%	7.3%	2.3%	1.6%	15.4%	4.9%	4.3%	7.2%
Rubber or misc. plastic products	0.0%	3.7%	0.0%	0.5%	0.0%	0.5%	0.5%	0.9%
Clay, concrete, glass or stone products	0.0%	1.6%	4.7%	17.0%	2.2%	0.6%	2.1%	3.2%
Primary and fabricated metal products	6.9%	8.6%	16.3%	2.2%	4.7%	4.0%	4.4%	5.1%
Machinery, equipment or supplies	10.3%	8.8%	9.3%	3.0%	6.7%	3.3%	4.0%	5.4%
Transportation equipment	0.0%	4.0%	0.0%	0.3%	1.4%	9.7%	2.0%	3.3%
Instruments, photographic/optical goods, watches/clocks	0.0%	1.7%	25.6%	0.8%	0.1%	3.3%	0.4%	1.3%
Misc. products of manufacturing	1.7%	0.7%	0.0%	1.3%	0.0%	0.5%	0.2%	0.4%
Waste or scrap materials	0.0%	1.3%	0.0%	0.0%	0.6%	0.2%	0.2%	0.4%
Misc. freight shipments	3.4%	3.2%	0.0%	2.2%	0.2%	1.2%	0.9%	1.3%
Containers, carriers or devices	3.4%	1.0%	2.3%	0.3%	0.2%	0.0%	0.3%	0.4%
Miscellaneous	10.4%	16.4%	2.3%	14.2%	28.6%	27.5%	23.6%	22.9%
Empty	36.2%	16.7%	16.3%	25.1%	31.3%	18.7%	48.6%	31.6%
Total	100.0%	100.0%	100. 0%	100.0%	100.0%	100.0%	100.0%	100.0%

Base: All vehicles reporting a trip with length greater than 0 km

Table 11 includes data on trip length for different vehicle types across different cargo categories. Across all cargo categories, automobiles and medium-duty trucks constitute 81 percent of trips under 18 km that are made when vehicles are empty. Empty vehicles traveling less than 18 km make the largest number of trips. This is true across all vehicle and cargo categories. In comparison with other vehicle types, heavy-duty trucks generally carry a greater proportion of cargo for trips over 81 km.

Tables 12 through 14 summarize vehicle activity by time of day. With the exception of the nonfreeway category, trips are evenly distributed by time of day over the freeway system. Table 14 depicts the morning-evening split for trips by vehicle type. Trips are evenly

TABLE 11 Trip Length for Vehicle Type by Cargo

Vehicle Type		Farm Products	Food or Kindred Products	Apparel or Finished Textile Products	Wood or Allied Products	Chemical or Allied Products	Primary and Fabricated Metal Products	Machinery, Equipment, or Supplies	Miscellaneous	Empty
Auto	Under 18 km	100%	0%	0%	80%	100%	50%	38%	67%	81%
	18 to 48 km	0%	0%	0%	20%	0%	0%	38%	24%	14%
	48 to 81 km	0%	0%	0%	0%	0%	50%	24%	5%	4%
	Over 81 km	0%	0%	0%	0%	0%	0%	0%	4%	1%
	Total	100%	0%	0%	100%	100%	100%	100%	100%	100%
Light-duty Truck	Under 18 km	60%	74%	87%	39%	83%	60%	60%	58%	66%
	18 to 48 km	40%	22%	11%	49%	14%	30%	27%	33%	25%
	48 to 81 km	0%	2%	2%	7%	2%	4%	9%	6%	7%
	Over 81 km	0%	2%	0%	5%	1%	6%	4%	3%	2%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%
Medium-duty Truck	Under 18 km	0%	42%	71%	67%	100%	0%	67%	58%	81%
	18 to 48 km	0%	50%	29%	0%	0%	100%	11%	23%	14%
	48 to 81 km	0%	8%	0%	33%	0%	0%	0%	12%	5%
	Over 81 km	0%	0%	0%	0%	0%	0%	22%	7%	0%
	Total	0%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy-duty Truck	Under 18 km	52%	76%	33%	43%	62%	58%	54%	71%	65%
	18 to 48 km	22%	10%	25%	26%	33%	26%	25%	15%	22%
	48 to 81 km	11%	4%	25%	17%	2%	11%	17%	4%	6%
	Over 81 km	15%	10%	17%	14%	3%	5%	4%	10%	7%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

TABLE 12 Route by Time of Day

	Grouped Arrival Time			
	8:00 A.M. to Noon	Noon to 4:00 P.M.	4:00 P.M. to 8:00 A.M.	Total
I-75	7%	5%	6%	6%
I-85	5%	4%	4%	4%
I-20	8%	3%	5%	4%
I-285	3%	4%	3%	4%
Other	77%	84%	82%	82%
Total	100%	100%	100%	100%

Base: All vehicles reporting a trip with length greater than 0 km

TABLE 13 Time of Day by Route

	Route					
	I-75	I-85	I-20	I-285	Other	Total
8:00 A.M. to Noon	45%	45%	57%	37%	38%	40%
Noon to 4:00 P.M.	35%	37%	26%	46%	43%	41%
4:00 P.M. to 8:00 A.M.	20%	18%	17%	17%	19%	19%
Total	100%	100%	100%	100%	100%	100%

Base: All vehicles reporting a trip with length greater than 0 km

split between the morning and afternoon within each vehicle type, except for automobile trips, which are split 60 percent in the morning and 40 percent in the evening. Of great interest for planning and emissions modeling purposes are the data contained in Table 15. This table shows that approximately 80 percent of all trips take place between 8:00 a.m. and 4:00 p.m. Little commercial vehicle activity occurs during the morning and evening peak periods when commuters are using the roadway system. This result likely reflects the local nature of the survey results—longhaul (external) trips were not captured in the sample, therefore the results reflect local commercial delivery schedules that are dependent on the hours of operation at the delivery and home base ends.

GEOGRAPHIC INFORMATION SYSTEM SPATIAL ANALYSIS

The geographic information system (GIS) analyses are based on 3,134 trips for which there was sufficient information to geocode the trip origin and destination. This total represents 76 percent of the 4,136 trips reported in the survey. These analyses are important because they contain vehicle, cargo, and land use characteristics with spatial and temporal data within the study area. When combined, these data offer a unique look at commercial vehicle activity that previously was not available for the region.

Figure 2 combines trips with the route taken for each vehicle type. As the figure shows, the preponderance of trips are made on routes other than the freeway system. The percentages are 84 percent for autos, 83.3 percent for light-duty trucks, 86.5 percent for medium-duty trucks, and 74.3 percent for heavy-duty trucks. The relatively short length of trips reported by survey participants may provide a partial explanation for this result. Short, local trips require greater use of secondary roads because the freeway system is not within close proximity to the origin or the next stop. Regardless, this is significant because of the impact of these larger vehicles on pavement wear, safety, emissions, and congestion on the nonfreeway system.

Figure 3 depicts the distribution of trips by vehicle type for four land use types at the trip destination. As may be expected, trips to residential land uses are widely dispersed with no obvious pattern to the distribution. Similarly, retail trips follow a widely dispersed pattern with only minor clustering along freeway corridors. Trips to industrial land uses, however, are more noticeably oriented along the freeway system and these trips exhibit greater concentration within the more urbanized areas of the region.

Also of interest in this analysis is the relative use of heavy-duty vehicles within the government and industrial categories. Heavy-duty vehicles make approximately 37 percent of trips to government facilities and 34 percent of trips to industrial areas. However, in both cases the light-duty category comprises the largest percentage for

TABLE 14 Vehicle Class by a.m./p.m.

	Vehicle Type			
Trip Length	Auto	Light-duty Truck	Medium-duty Truck	Heavy-duty Truck
A.M. Period	60.6%	46.4%	55.4%	50.2%
P.M. Period	39.4%	53.6%	44.6%	49.8%
Total	100.00%	100.00%	100.00%	100.00%

Base: All vehicles reporting a trip

TABLE 15 Vehicle Activity by Time of Day

	Cumulative Percent	
Time	Departure	Arrival
Midnight	0.1%	0.0%
1:00 A.M.	0.3%	0.3%
2:00 A.M.	0.5%	0.5%
3:00 A.M.	0.7%	0.6%
4:00 A.M.	1.5%	0.9%
5:00 A.M.	2.5%	1.4%
6:00 A.M.	6.0%	3.6%
7:00 A.M.	12.0%	9.0%
8:00 A.M.	21.0%	17.1%
9:00 A.M.	30.3%	27.9%
10:00 A.M.	40.8%	38.8%
11:00 A.M.	50.5%	48.8%
Noon	60.5%	60.1%
1:00 P.M.	69.5%	69.7%
2:00 P.M.	78.0%	78.2%
3:00 P.M.	54.4%	85.7%
4:00 P.M.	90.9%	90.8%
5:00 P.M.	95.4%	94.8%
6:00 P.M.	97.1%	96.7%
7:00 P.M.	98.1%	97.8%
8:00 P.M.	98.5%	98.4%
9:00 P.M.	99.2%	99.0%
10:00 P.M.	99.5%	99.5%
11:00 P.M.	100.0%	100.0%

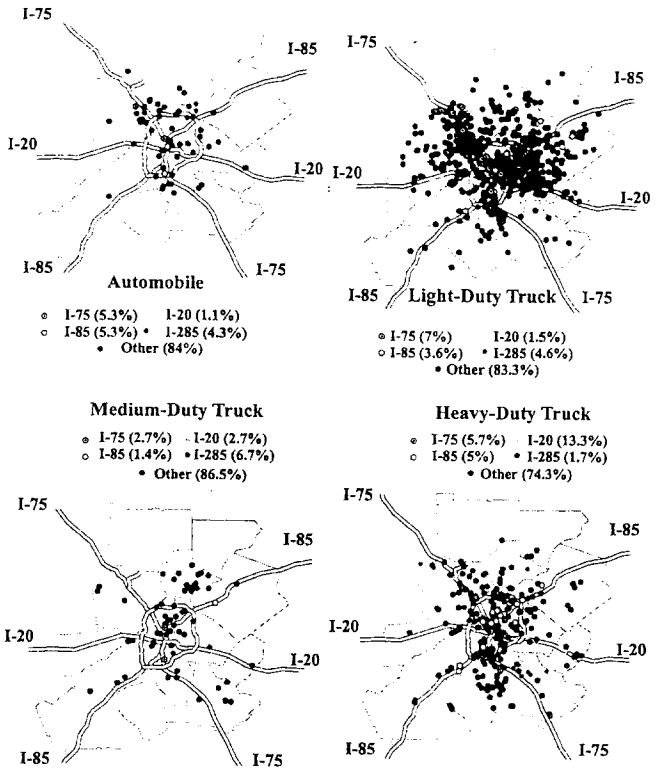

FIGURE 2 Vehicle class by route.

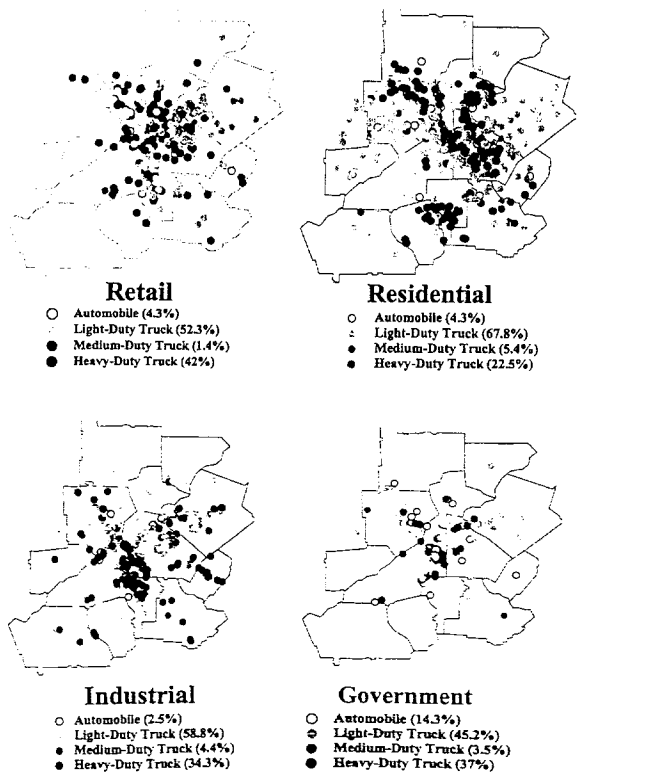

FIGURE 3 Land use by vehicle type.

trips to these land uses. This may be the result of local deliveries necessitating smaller, more maneuverable delivery vehicles. Alternatively, the use of larger trucks for government deliveries may be a function of multiple just-in-time deliveries made by large trucks during the course of the day.

CONCLUSIONS

This spatial and statistical analysis of commercial vehicle activity in the metropolitan Atlanta area began to document truck activity and fleet characteristics in a manner that previously had not been attempted in the region. The study also preliminarily outlined the potential impact of these vehicles on the transportation system and has implications for improving emissions modeling and inventory. The survey provided statistical information about vehicle class, vehicle age, cargo, land use, and trip times.

Light-duty trucks made the majority of all trips (72.4 percent), especially for trip destinations with industrial, residential, retail, and home base land uses. Heavy-duty trucks made approximately 17 percent of trips. In addition, the majority of trips (51 percent) were made by vehicles 0 to 3 years old. This was particularly true for trips over 160 km. Surprisingly, 31.6 percent of all trips were made in vehicles carrying no cargo. A reduction in the number of trips made by commercial vehicles not carrying cargo may have significant implications for emissions modeling. The level of efficiency achieved within each company and by cargo category may translate into much greater efficiency when all companies and all cargo categories in the region are summed. The study also indicated that the majority of trips are less than 16 km in length for all vehicle types. Heavy-duty trucks generally carry a greater proportion of cargo for trips longer than 81 km.

The spatial analyses also indicated extensive use of routes other than the interstate system for the delivery of cargo. Shorter, local trips require greater use of secondary roads, with significant impact on pavement wear, safety, emissions, and congestion for the non-interstate system. Trips to industrial land uses are more oriented along the interstate system than the more widely distributed residential and retail trips. There also is greater use of heavy-duty vehicles within the government and industrial land use categories. Heavy-duty vehicles make approximately 37 percent of trips to government facilities and 34 percent of industrial trips.

Trips appear evenly distributed by time of day over the interstate system. Approximately 80 percent of all commercial vehicle trips take place between 8:00 a.m. and 4:00 p.m. Little activity occurs during the traditional commuter morning and evening peak periods. Interestingly, the majority of trips are made along roads that are not part of the interstate system, regardless of time period.

Because of low response rate and other limitations, the results of this study are not sufficiently robust to generalize to other metropolitan areas. However, these findings warrant further study regarding the use of heavy-duty trucks, particularly for regions failing to meet conformity requirements. In addition, the findings present a more detailed picture of commercial vehicle activity than has been available previously, and they raise a number of issues and questions regarding commercial vehicle activity in metropolitan areas. Lastly, the findings indicate the need for refinements to data collection methodologies if the maximum benefit from these undertakings and the data necessary to implement the next generation of air quality models are to be gained (*8*).

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