



Bringing Freight Components into Statewide and Regional Travel Demand Forecasting

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Research Overview

Need

DOTs and MPOs need freight demand models that are reliable, accurate, and approachable.

Purpose

- Leverage new data sources
- Benchmark freight modeling best practices
- Develop long-term guidelines for freight demand models

Project Goals

- Study best practices and extent of usage of GPS data in freight modeling
- Build prototype tour-based truck models with GPS-based truck data
- Test model improvements compared with existing models

Problem Statement

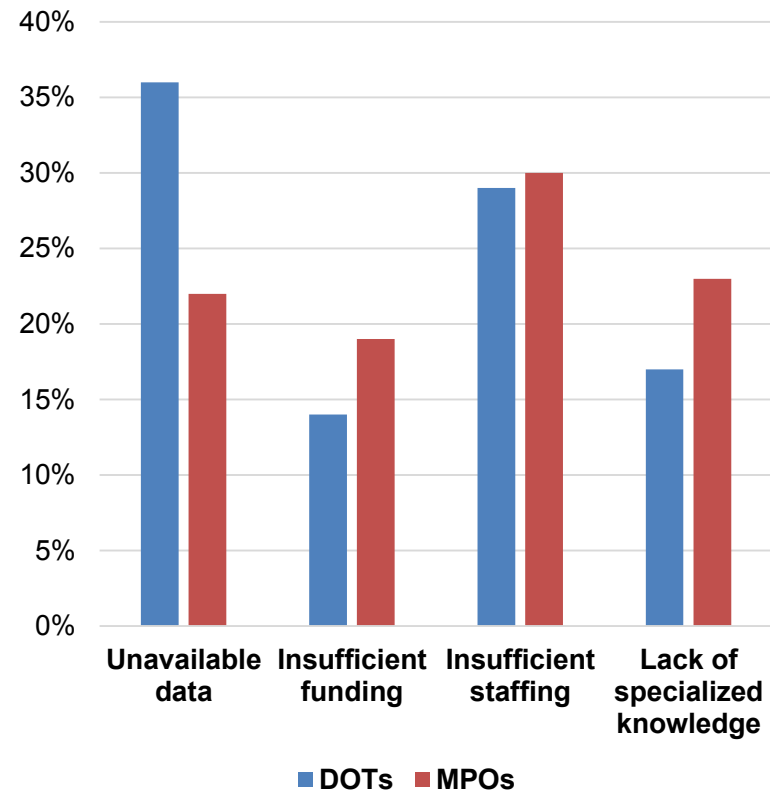
- Lack of Urban Freight Demand Models
- Few practical freight forecasting models
- More significant in small and medium-sized MPOs
- Models missing freight component could overestimate capacity
- Incapability to provide adequate info to decision makers

DOT and MPO Survey

Summary of Results

- Freight models are still relatively rare – about half of DOTs and one quarter of MPOs
- Most models are vehicle-based
- GPS data remains rare – used in about one in five vehicle models
- Lack of data remains a large obstacle to freight modelers – GPS data can help

What primary obstacles do you encounter in modeling freight?



Tour-based Truck Model

Conceptual Framework

Tour Generation

Tour Main
Destination Choice

Intermediate Stop Model

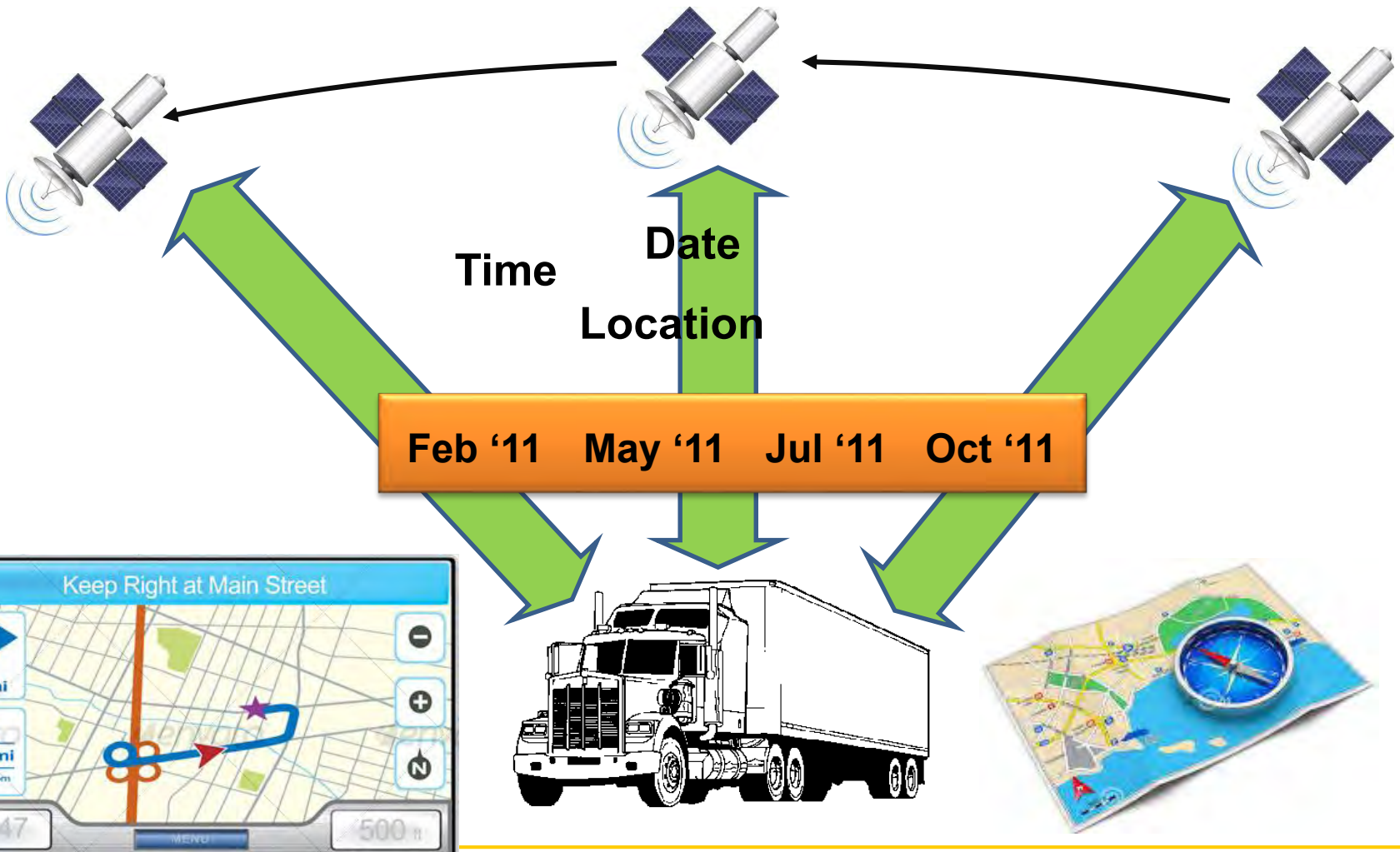
Stop Location Model

Time of Day

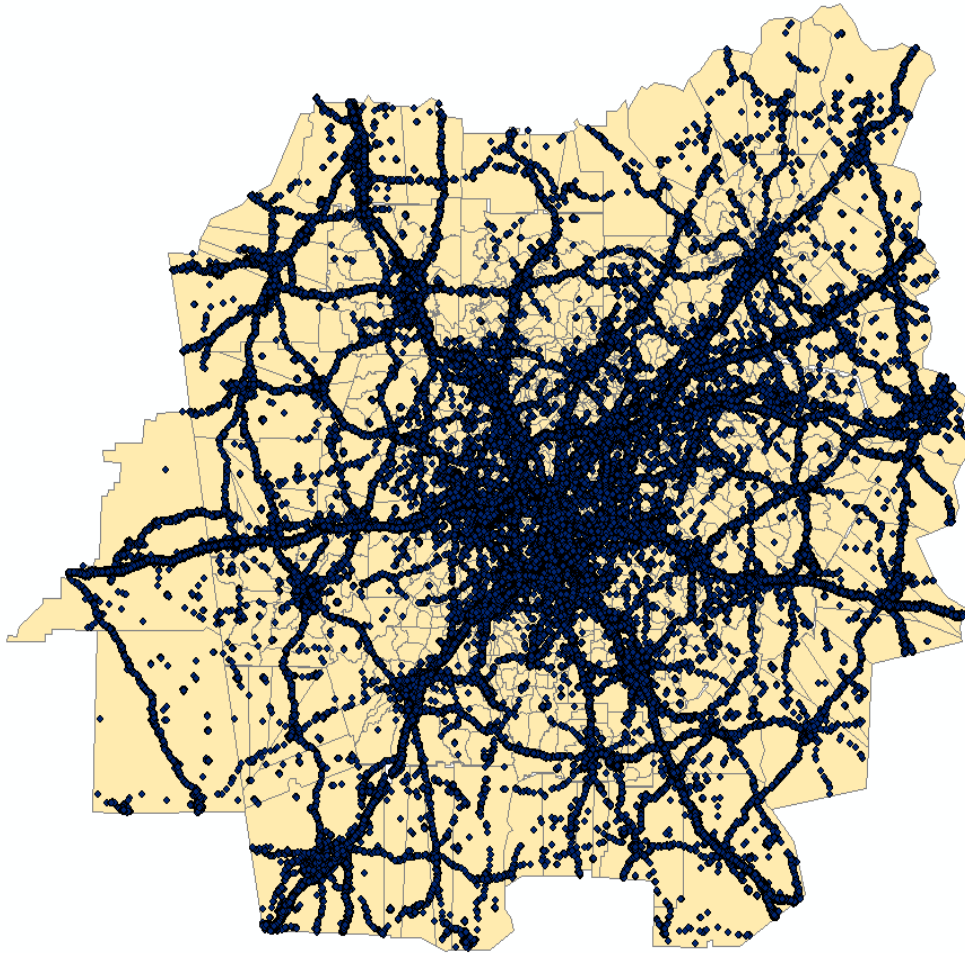
Trip Accumulator

Traffic Assignment

GPS Data Source



GPS Data Source



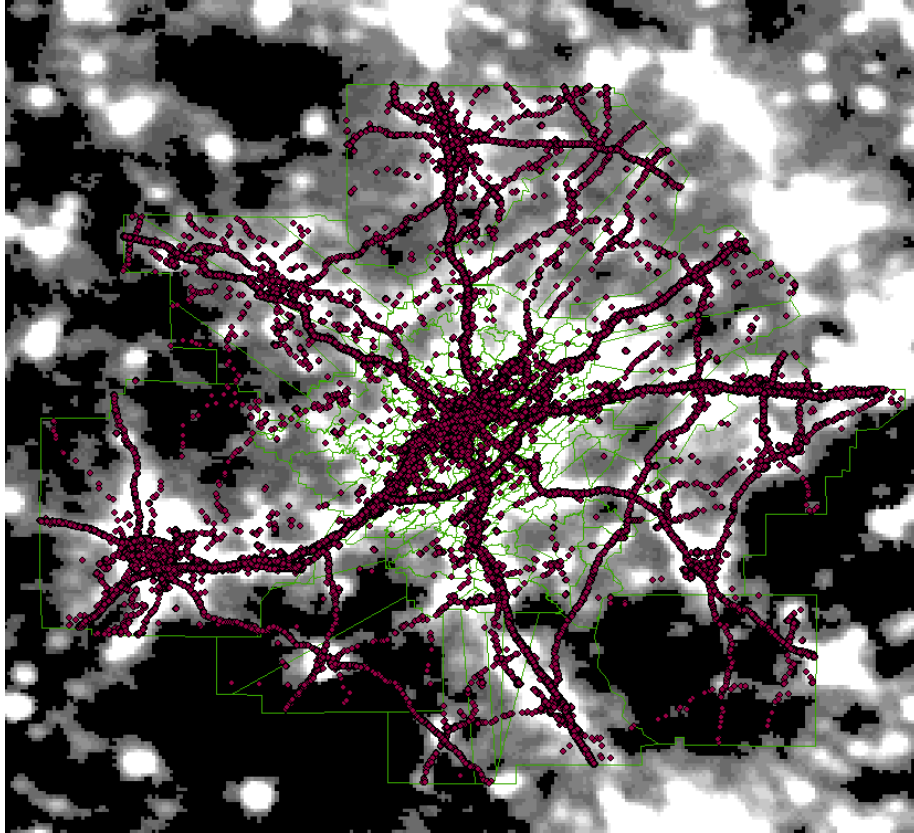
Atlanta TRUCK RECORD:

- ATL_1A_02.2011 (1,717,004 records)
- ATL_1A_05.2011 (1,540,362 records)
- ATL_1A_07.2011 (1,452,661 records)
- ATL_1A_10.2011 (1,349,400 records)
- ATL_1B_02.2011 (1,507,129 records)
- ATL_1B_05.2011 (1,973,480 records)
- ATL_1B_07.2011 (2,201,814 records)
- ATL_1B_10.2011 (2,321,084 records)

Total 14,062,934 records

ATRI provide 8 weeks of truck GPS data for 5,000 different trucks in 2011 (2 weeks in each season).

GPS Data Source



Birmingham TRUCK RECORD:

- BMH_1A_02.2011 (497,762 records)
- BMH_1A_05.2011 (465,937 records)
- BMH_1A_07.2011 (387,992 records)
- BMH_1A_10.2011 (400,817 records)
- BMH_1B_02.2011 (570,629 records)
- BMH_1B_05.2011 (688,292 records)
- BMH_1B_07.2011 (721,516 records)
- BMH_1B_10.2011 (755,895 records)

Total 4,488,840 records

ATRI provide 8 weeks of truck GPS data for 5,000 different trucks in 2011 (2 weeks in each season).

GPS Data

Truck Records

- **Truckid:** This is a unique truck ID.
- **Parking_from:** This indicates if the vehicle is in a known truck stop at the first point: 1 = at a truck stop, 0 = not at a truck stop
- **Readdate_from:** This is the first date/time stamp in a series
- **TAZ_2000_from:** This is the TAZ ID for the first position read in a series.
- **To_readdate:** This is the second time stamp in a series
- **To_TAZ_200:** This is the second TAZ ID in a series
- **To_Parking:** This indicates if the vehicle is in a known truck stop at the second point: 1 = at a truck stop, 0 = not at a truck stop
- **Distance traveled:** This is distance traveled in miles from point A to point B. It uses the great circle distance equation (i.e. it is not snapped to a roadway).

1	TRUCKID	DATEFROM	TAZFROM	PARKFROM	DATETO	TAZTO	PARKTO	DISTANCE	HRFROM	HRTO	TIME	SPEED	DAY	WEIGHT	STATUS
1757	00147704916385437	02-17-11 10:59:34	1348	0	02-17-11 12:08:04	1348	0	0.000000000	10.9928	12.1344	1.1417	0.0	17	0.0526	L
1758	0014827042235482023992	02-16-11 00:09:04	401	0	02-16-11 00:15:27	433	0	2.919259241	0.1511	0.2575	0.1064	27.4	16	0.0526	F
1759	0014827042235482023992	02-16-11 00:15:27	433	0	02-16-11 00:15:49	433	0	0.020680091	0.2575	0.2636	0.0061	3.4	16	0.0526	
1760	0014827042235482023992	02-16-11 00:15:49	433	0	02-16-11 00:46:05	1440	0	16.713765120	0.2636	0.7681	0.5044	33.1	16	0.0526	

GPS Data Processing

Delete records on weekends and holidays.

Remove records with improper geocoding

Determination on Stopped; Starting to move; in motion; or coming to stop

Converting TRUCK records to TRIPS

Converting TRIPS records to TOURS

Define "TOUR"

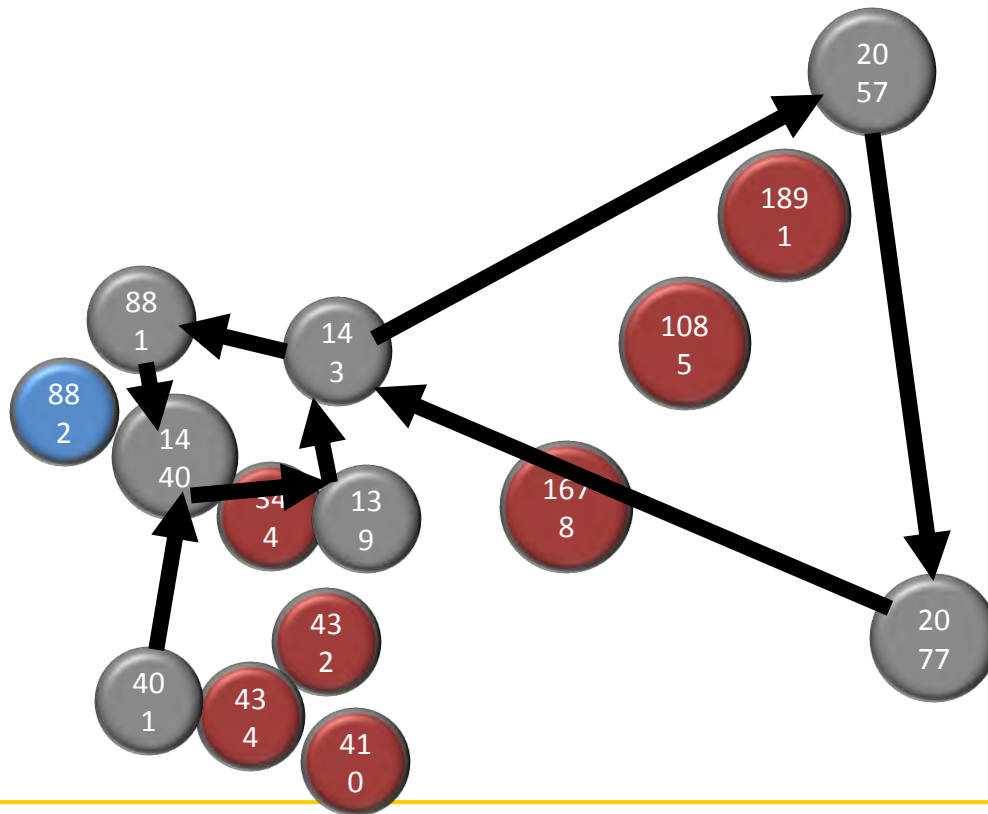
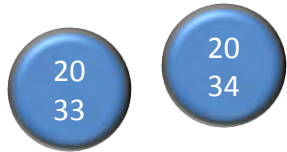
- All the movements from a Start location until the truck return to the same location
- From a Start location until midnight of that day
- Multi-day tours were NOT considered

12,701,995 TRUCK Records
713,306 TRIPS
220,752 TOURS

	Tours	Stops	Stops/Tour
I/I	111,424	333,899	3.00
I/X	25,751	39,990	1.55
X/I	50,845	69,858	1.37
X/X	32,732	48,802	1.49
Total	220,752	492,549	2.23

Truck Tours

Example



TRUCK ID:

0014827042235482023
992

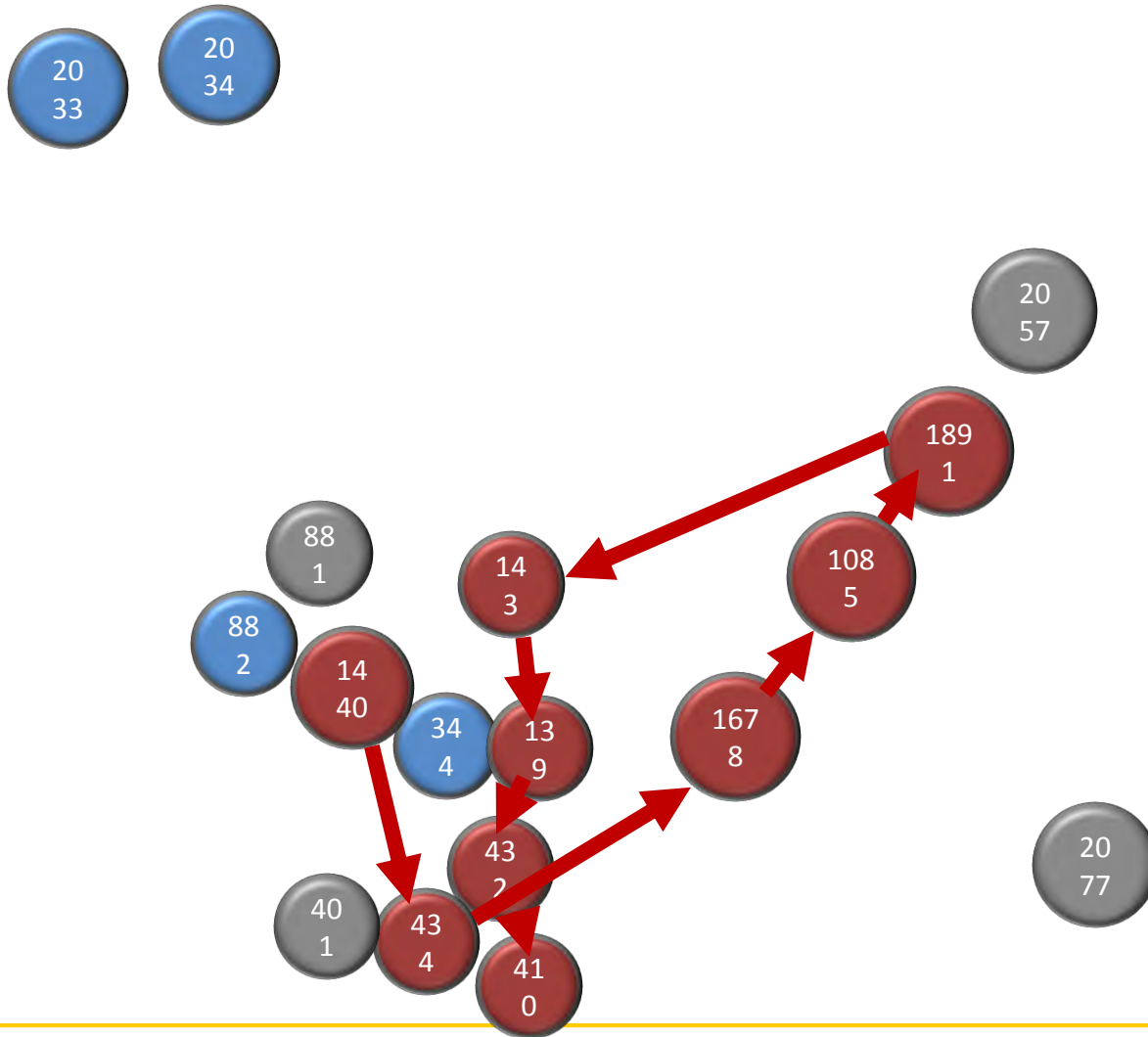
DATE: Feb. 16, 2011

TOUR 1:

- Starting from zone 401
- Taking stops at:
1440, 139, 143, 2057,
2077, 143, 881
- Ending at zone 1440

Truck Tours

Example



TRUCK ID:

0014827042235482023
992

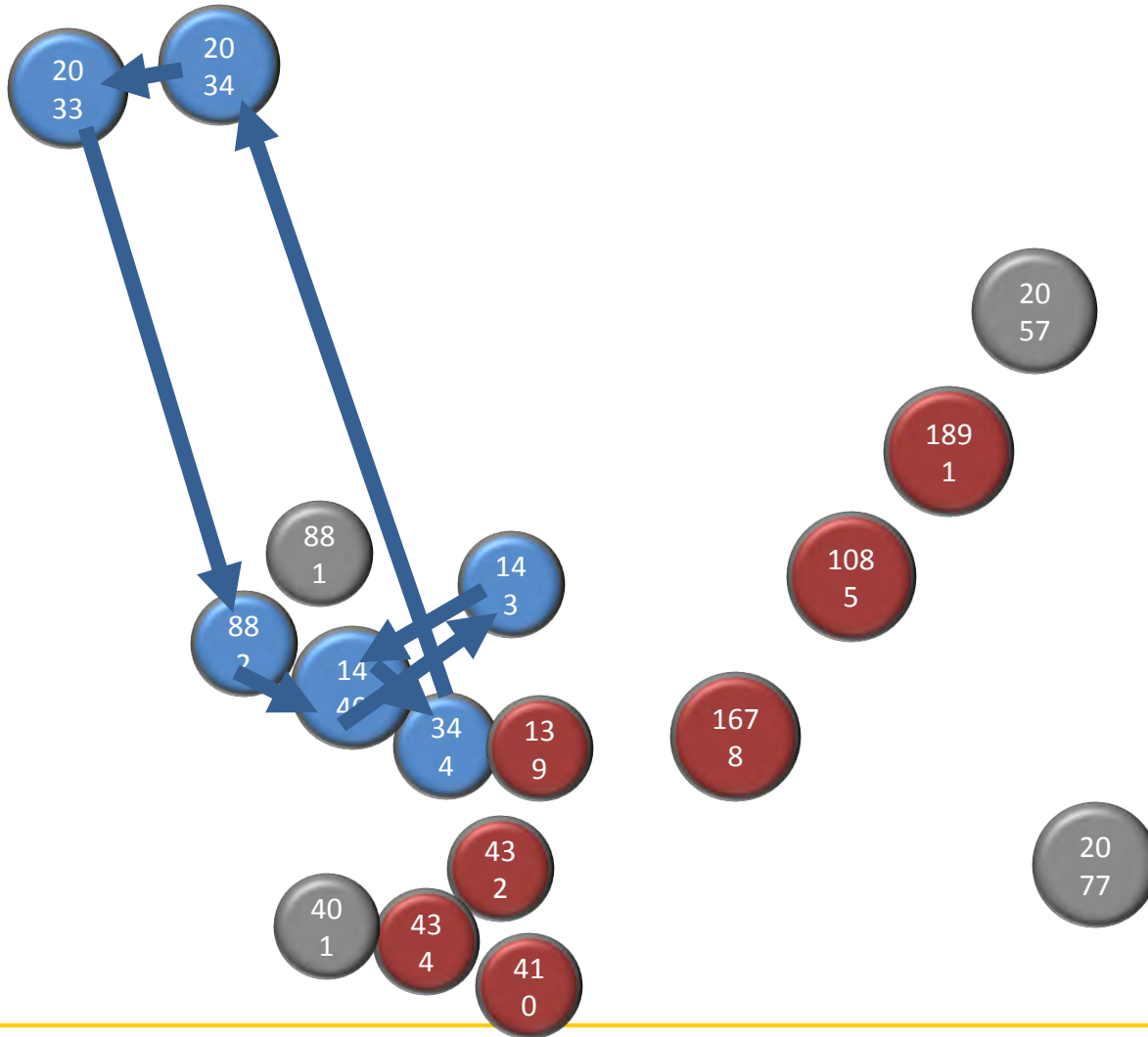
DATE: Feb. 17, 2011

TOUR 2:

- Starting from zone 1440
- Taking stops at:
434, 1678, 1085,
1891, 143, 139, 432
- Ending at zone 410

Truck Tours

Example



TRUCK ID:
00148270422354820
23992

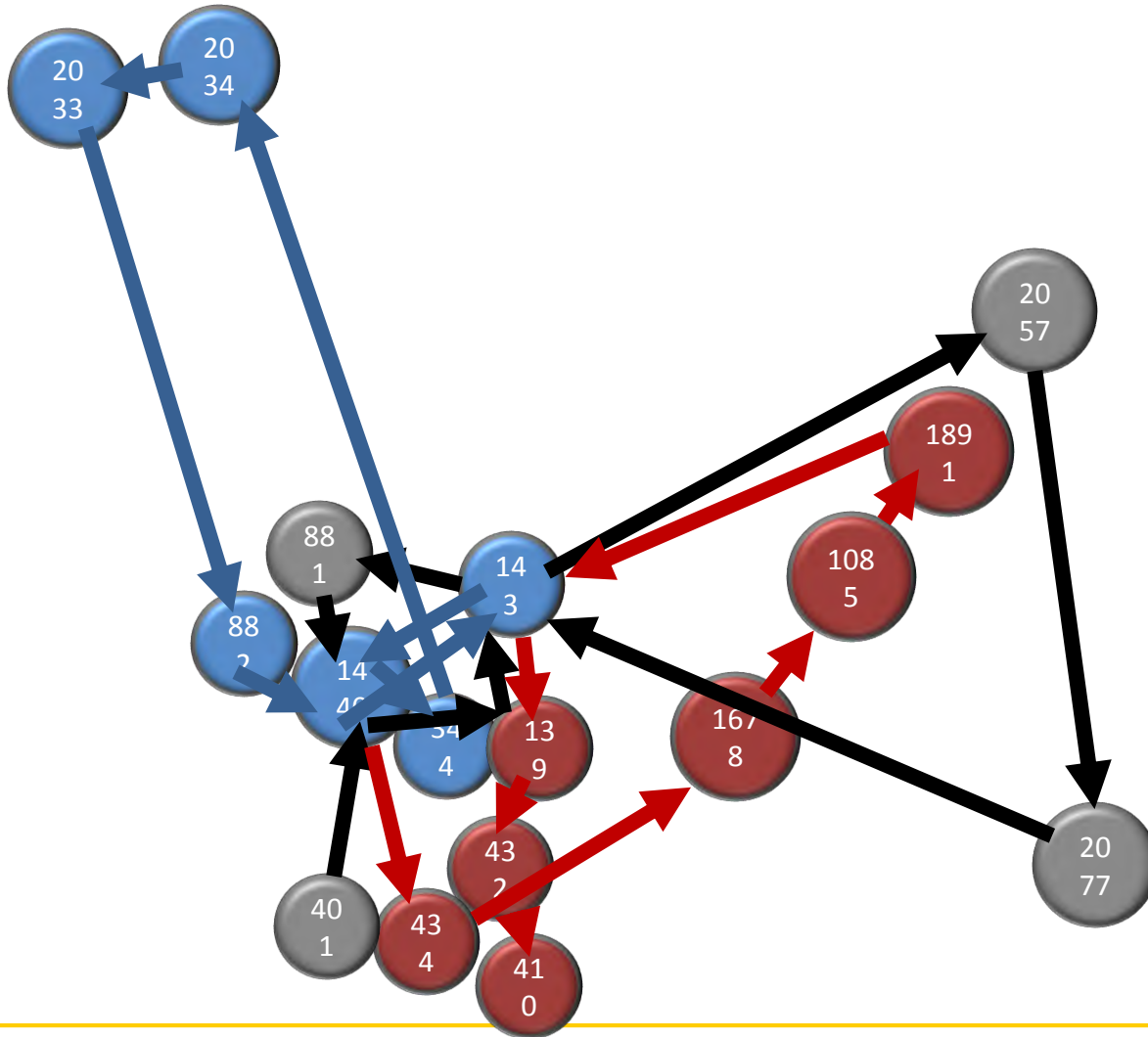
DATE: Feb. 18, 2011

TOUR 3:

- Starting from zone 143
- Taking stops at:
1440, 344, 2034,
2033, 882, 1440
- Ending at zone 143

Truck Tours

Example



TRUCK ID:

00148270422354820
23992

DATE: Feb. 16~18,
2011

TRUCK:

- 224 cleaned Truck Records

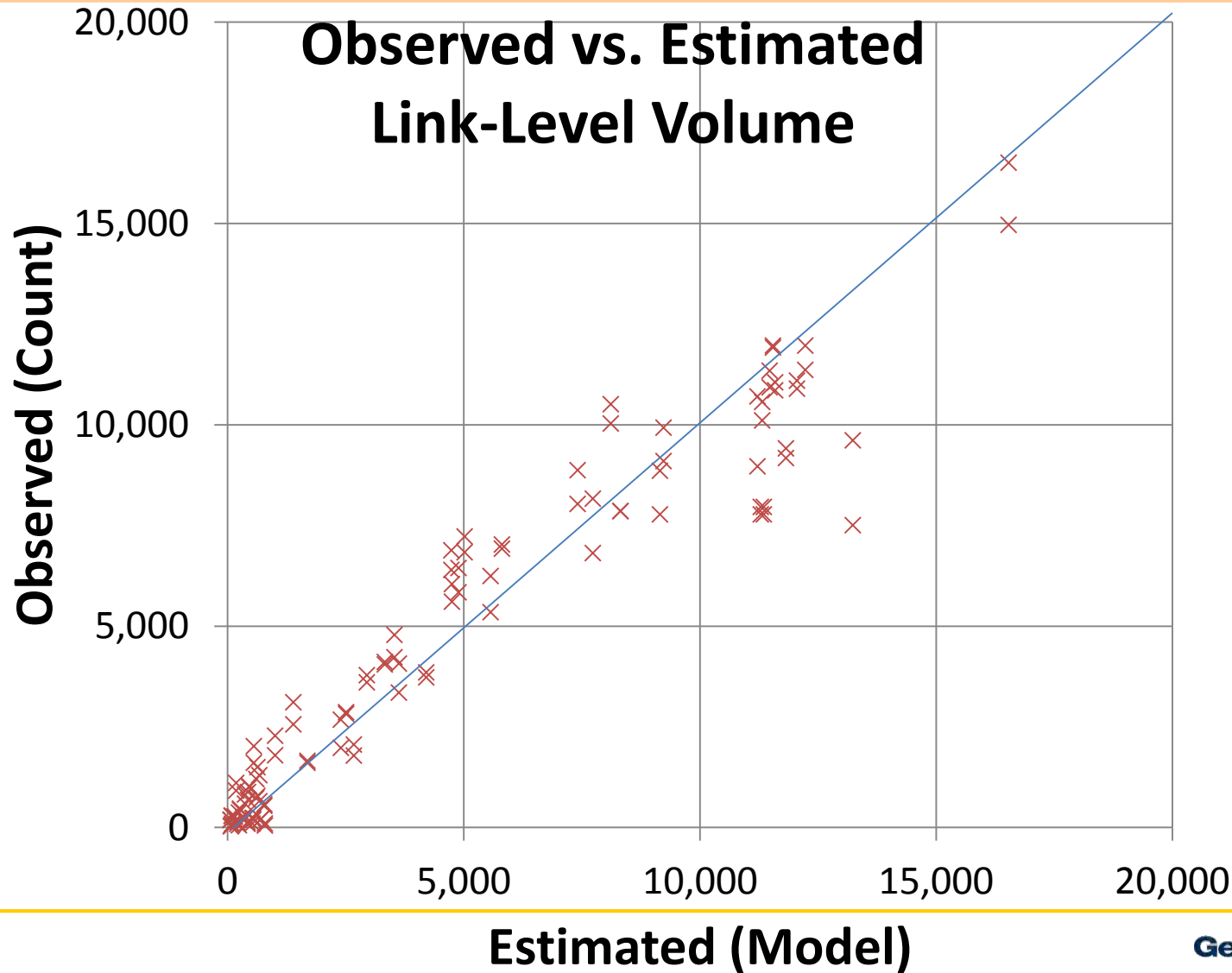
TRIPS:

- 23 trips

TOURS:

- 3 tours

Tour-based Truck Model Validation



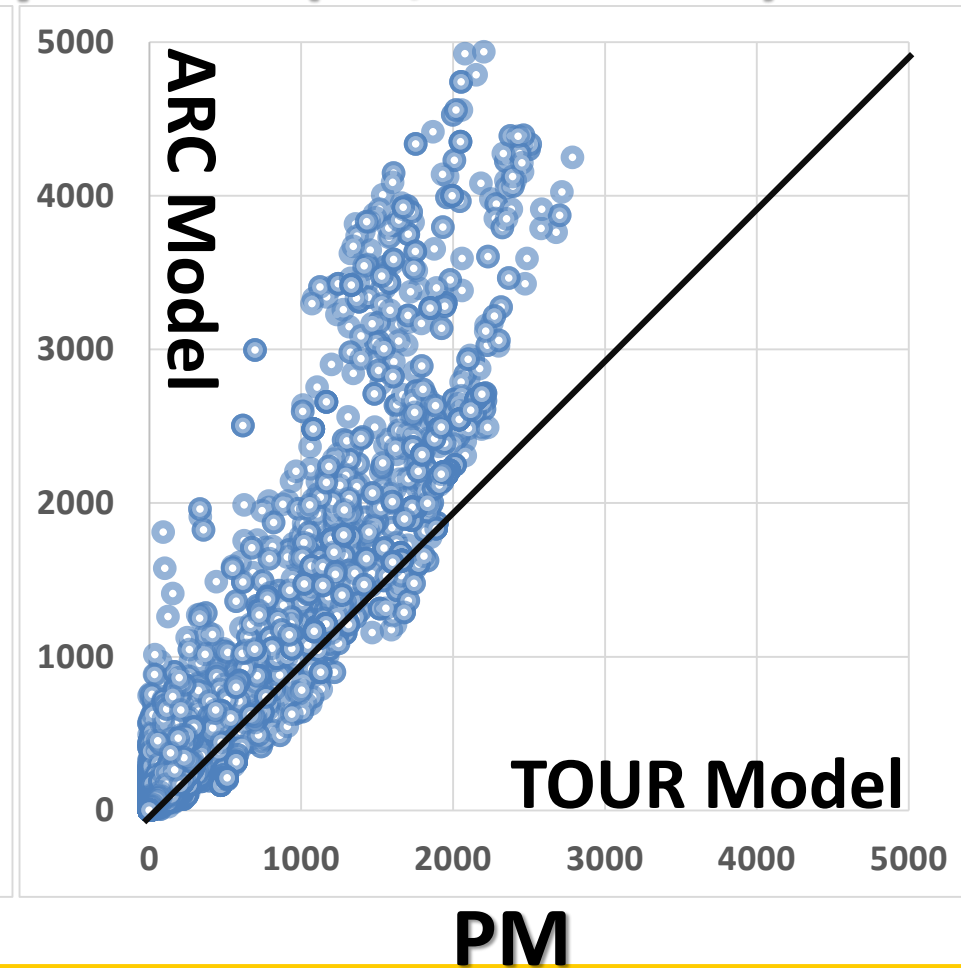
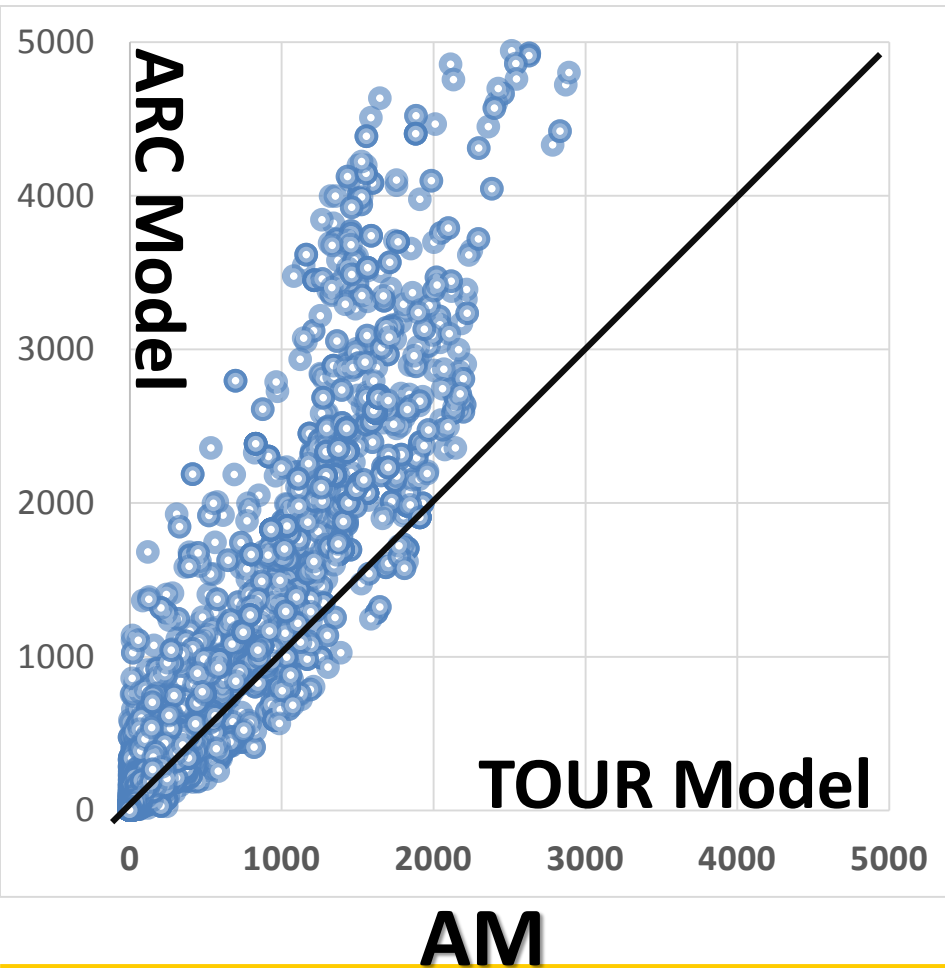
Key Obstacles and Challenges

- GPS data is inconsistent
- Nothing is known about GPS sampling
- We have no description of truck or operator
- External station geocoding was not sufficiently accurate

Trip-based vs. Tour-based Model

Atlanta

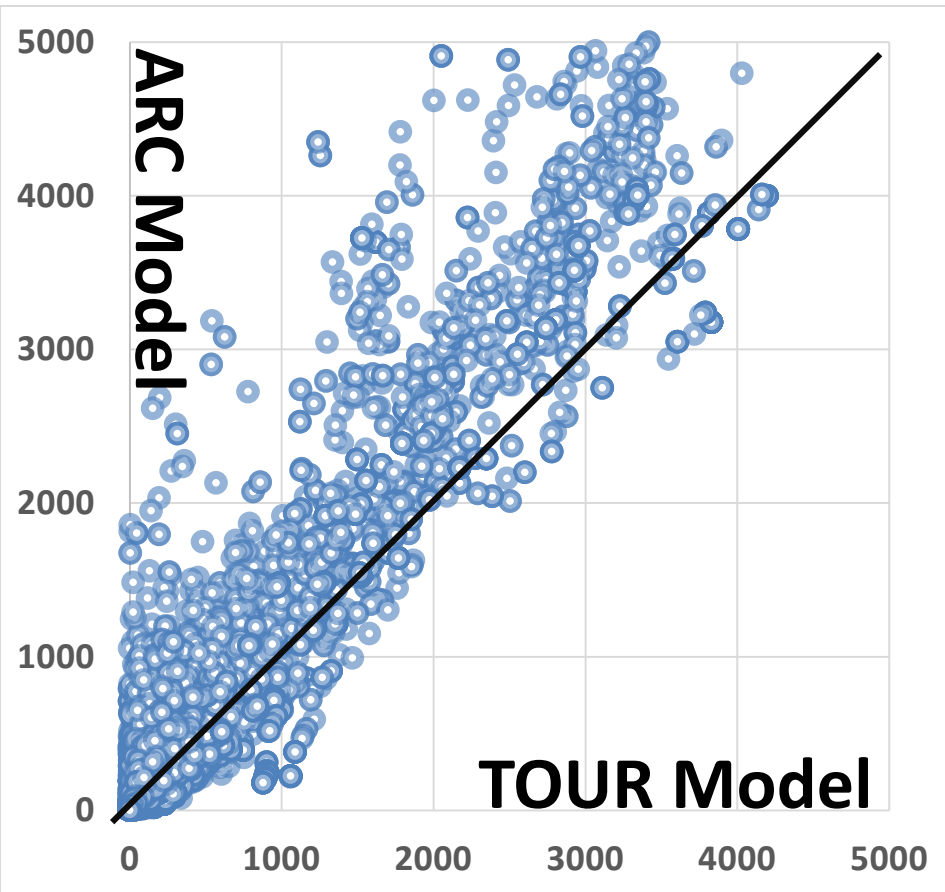
Link Volume Comparison (54,560 Links)



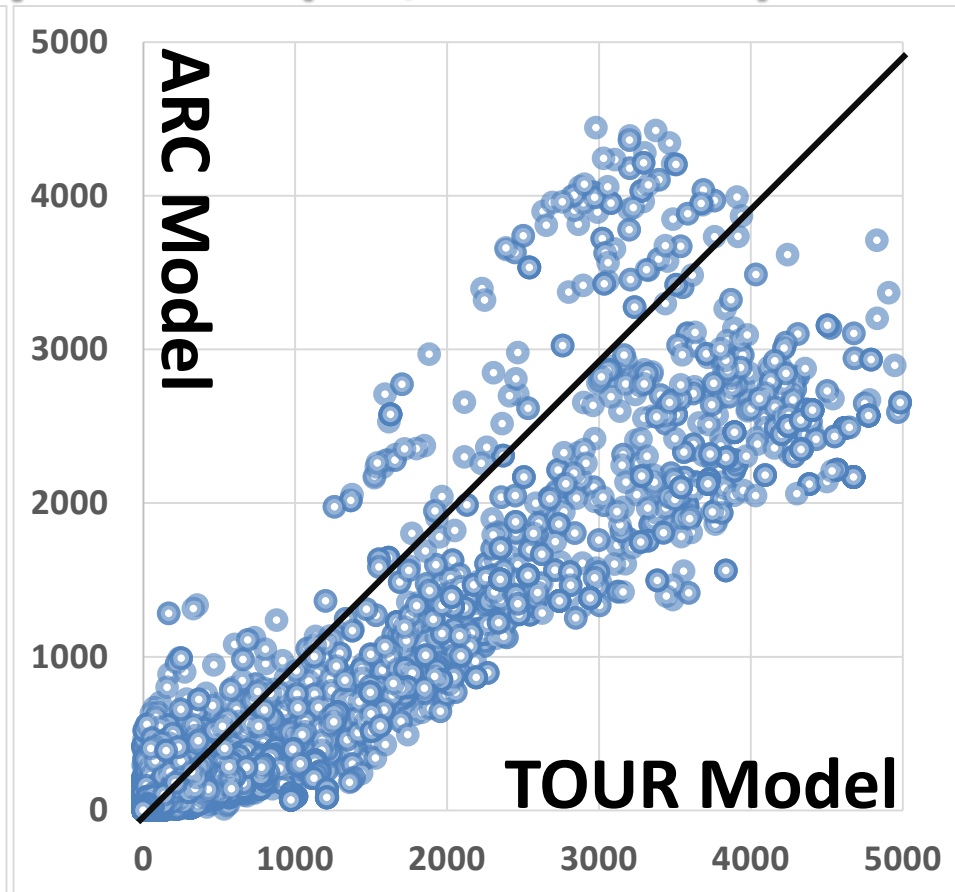
Trip-based vs. Tour-based Model

Atlanta

Link Volume Comparison (54,560 Links)



MD



NT

Conclusions and Future Research

Conclusions

- GPS data can create robust tour-based freight models
- GPS data requires extensive processing to be useful
- Tour based structure reflects truck travel more accurately.
- Future steps will compare truck model results with existing freight models in Atlanta and Birmingham.
- The results are likely to provide new improvements and directions for future research.

Future Research

- Develop methodology and GPS data source that distinguishes different types of trucks
- Work with modelers in practice to implement tour-based truck models with GPS data
- Examine usefulness for wide-ranging applications – air quality models, traffic congestion forecasts, and investment decision making