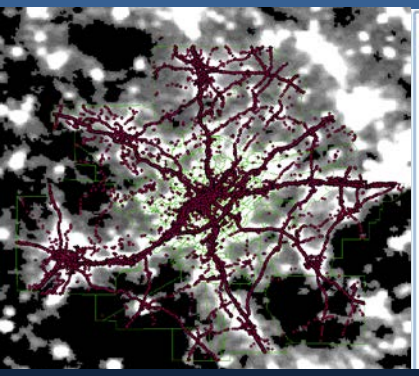
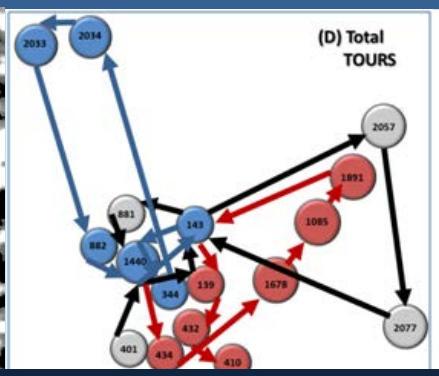
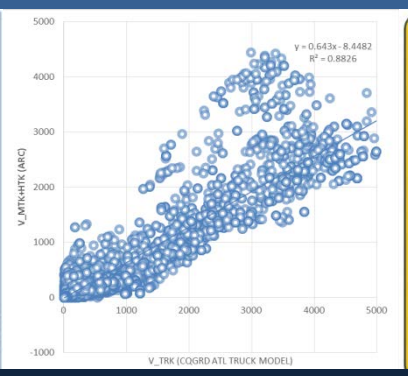






Another Way to Think About Regional Truck Movement: GPS Tour-Based Truck Modeling Approach

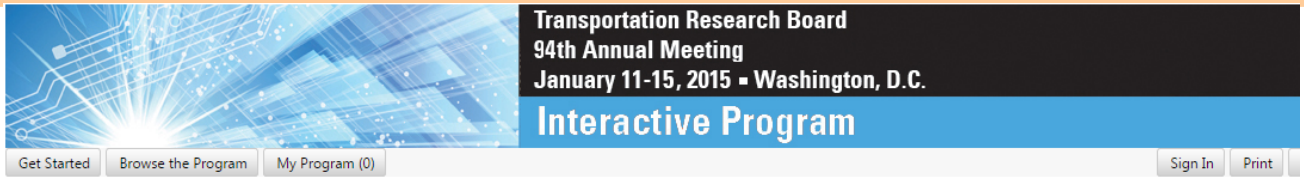
Center for Quality Growth and Regional Development
Georgia Institute of Technology

LEE, David Jung-Hwi

Atlanta Model Users Group,
Friday, February 27, 2015 - 9:30am

Georgia Tech CQGRD Center for Quality Growth and Regional Development

Session 552 at TRB……



Annual Meeting Event Detail | Return to Program

Add to My Program | How do I add this?

Session 552

Developing Truck Origin-Destination Flows from GPS Data

Tuesday, January 13, 2015 10:15AM - 12:00PM Signin to Reveal Location

Lectern Session | Practice Ready Papers

Data and Information Technology, Freight Transportation, Planning and Forecasting

Gregory Giaimo, Ohio Department of Transportation, presiding

Sponsored By:

Statewide Multimodal Transport
Transportation Demand Forecas
Trucking Industry Research (AT
Statewide Travel Demand Forec

Estimation of Statewide Origin-Destination Truck Flows Using Large Streams of GPS Data: Application for Florida Statewide Model 15-5463**
Akbar Bakhshi Zanjani, University of South Florida
Abdul Rawoof Pinjari, University of South Florida
Mohammadreza Kamali, University of South Florida
Aayush Thakur, Cambridge Systematics, Inc.
Jeffrey Bradford Short, American Transportation Research Institute
Vidya Mysore, Federal Highway Administration
Frank Tabatabaee, Florida Department of Transportation

Expanding Truck GPS-Based Passive Origin-Destination Data in Iowa and Tennessee 15-4687**
Vincent L. Bernardin, RSG
Steven Trevino, RSG
Jeffrey Bradford Short, American Transportation Research Institute

Analysis of Freight Corridors Using Truck GPS Data 15-2244**
Mania Flaskou, University of Memphis
Maxim A Dulebenets, University of Memphis
Mihalis M. Golias, University of Memphis
Sabyasachee Mishra, University of Memphis
Robert Rock, Tennessee Department of Transportation

Global Positioning System-Based Truck Modeling for Regional Travel Demand Forecasting 15-4658**
David Jung-Hwi Lee, Georgia Institute of Technology
Catherine Ross, Georgia Institute of Technology

Georgia Tech CQGRD Center for Quality Growth and Regional Development

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

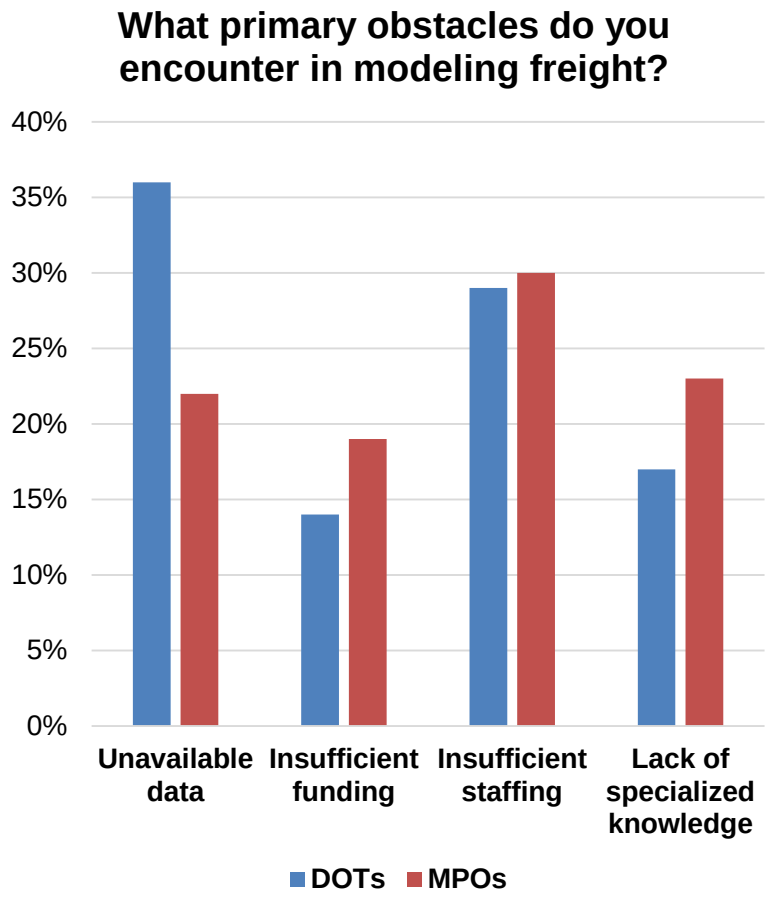
- Study best practices and extent of usage of GPS data in freight modeling
- Build prototype tour-based truck models with GPS-based truck data
- Test model improvements compared with existing models

Problem Statement

- Few Practical Freight Demand 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

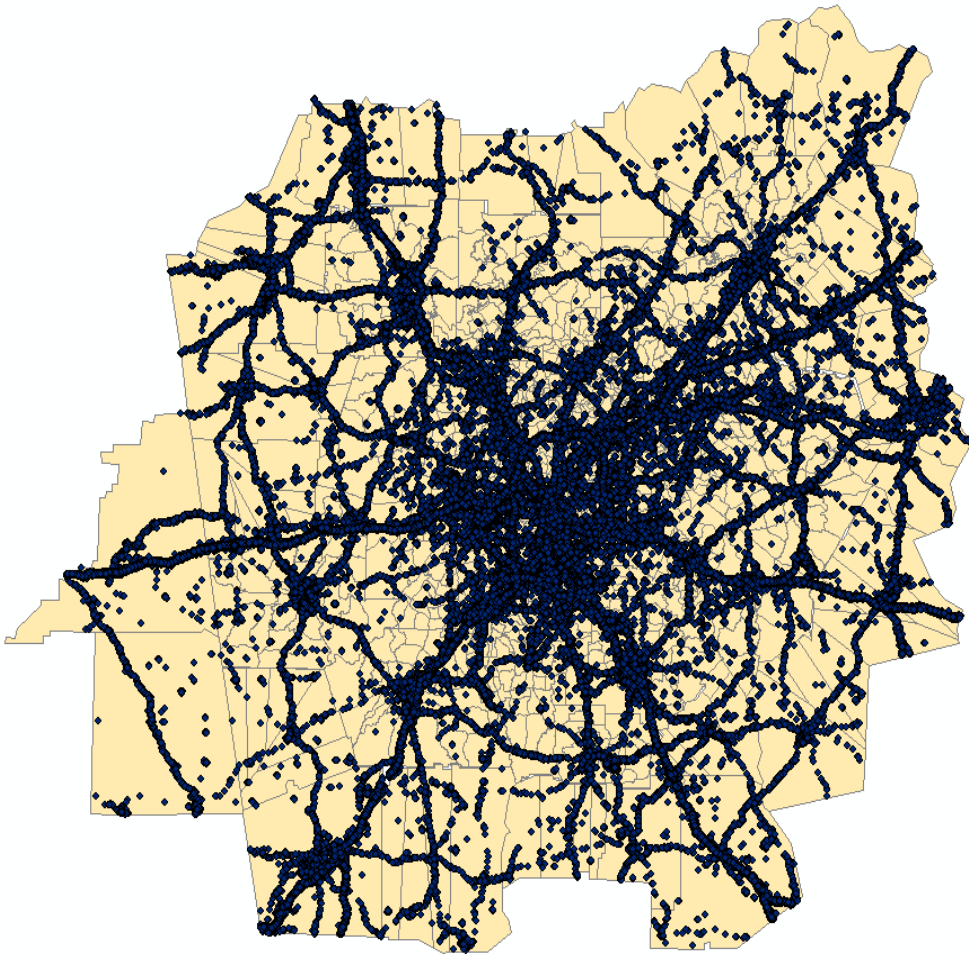
DOT and MPO Survey
Summary of Results

- 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



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
Truck Records

1	TRUCKID	DATEFROM	TAZFROM	PARKFROM	DATETO	TAZTO	PARKTO	DISTANCE	HRFROM	HRTO	TIME	SPEED	DAY	WEIGHT	STATUS
1770	001482704223548202399 2	02-16-11 04:09:36	1440	0	02-16-11 04:10:16	1440	0	0.000000000	4.1600	4.1711	0.0111	0.0	16	0.0526	
1771	001482704223548202399 2	02-16-11 04:11:27	1440	0	02-16-11 05:19:35	1440	0	0.000000000	4.1908	5.3264	1.1356	0.0	16	0.0526	
1772	001482704223548202399 2	02-16-11 05:19:35	1440	0	02-16-11 06:28:00	1440	0	0.000000000	5.3264	6.4667	1.1403	0.0	16	0.0526	
1773	001482704223548202399 2	02-16-11 06:28:00	1440	0	02-16-11 07:36:25	1440	0	0.000000000	6.4667	7.6069	1.1403	0.0	16	0.0526	
1774	001482704223548202399 2	02-16-11 07:36:59	1440	0	02-16-11 08:10:59	1440	0	0.230731253	7.6164	8.1831	0.5667	0.4	16	0.0526	
1775	001482704223548202399 2	02-16-11 08:10:59	1440	0	02-16-11 08:15:20	1440	0	1.058156708	8.1831	8.2556	0.0725	14.6	16	0.0526	D
1776	001482704223548202399 2	02-16-11 08:15:20	1440	0	02-16-11 08:32:09	840	0	8.268395127	8.2556	8.5358	0.2803	29.5	16	0.0526	
1777	001482704223548202399 2	02-16-11 08:32:09	840	0	02-16-11 08:38:21	841	0	0.475977923	8.5358	8.6392	0.1033	4.6	16	0.0526	
1778	001482704223548202399 2	02-16-11 08:38:21	841	0	02-16-11 08:41:01	841	0	1.272169127	8.6392	8.6836	0.0444	28.7	16	0.0526	
1779	001482704223548202399 2	02-16-11 08:41:01	841	0	02-16-11 08:55:54	139	0	3.233089901	8.6836	8.9317	0.2481	13.0	16	0.0526	
1780	001482704223548202399 2	02-16-11 08:55:54	139	0	02-16-11 09:05:34	139	0	0.077771064	8.9317	9.0928	0.1611	0.5	16	0.0526	A
1781	001482704223548202399 2	02-16-11 09:05:34	139	0	02-16-11 09:05:54	139	0	0.083963224	9.0928	9.0983	0.0056	15.0	16	0.0526	D
1782	001482704223548202399 2	02-16-11 09:05:54	139	0	02-16-11 09:08:34	139	0	0.091833785	9.0983	9.1428	0.0444	2.1	16	0.0526	A
1783	001482704223548202399 2	02-16-11 09:08:34	139	0	02-16-11 09:11:28	143	0	0.250102859	9.1428	9.1911	0.0483	5.2	16	0.0526	D
1784	001482704223548202399 2	02-16-11 09:11:45	139	0	02-16-11 09:28:53	143	0	0.172724998	9.1958	9.4814	0.2856	0.6	16	0.0526	A
1785	001482704223548202399 2	02-16-11 09:28:53	143	0	02-16-11 09:55:37	143	0	0.100710025	9.4814	9.9269	0.4456	0.2	16	0.0526	
1786	001482704223548202399 2	02-16-11 09:55:37	143	0	02-16-11 10:04:41	143	0	0.276205890	9.9269	10.0781	0.1511	1.8	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

GPS Data

Conversion of Truck Records to Trips

TRUCKID	TRIP	ORIG	DEST	STARTTIM	ENDTIM	STARTDAY	ENDDAY	TTIME	WEIGHT
001482704223548202399 2	1	401	1440	0.1511	0.8281	16	16	0.6770	0.0526
001482704223548202399 2	2	1440	139	8.1831	8.9317	16	16	0.7486	0.0526
001482704223548202399 2	4	139	143	9.1428	9.1958	16	16	0.0530	0.0526
001482704223548202399 2	5	143	2057	10.2092	11.5389	16	16	1.3297	0.0526
001482704223548202399 2	6	2057	2077	12.7664	16.0878	16	16	3.3214	0.0526
001482704223548202399 2	7	2077	143	16.5136	18.1831	16	16	1.6695	0.0526
001482704223548202399 2	8	143	881	18.7583	19.4053	16	16	0.6470	0.0526
001482704223548202399 2	9	881	1440	19.6050	19.8092	16	16	0.2042	0.0526
001482704223548202399 2	10	1440	434	13.7839	14.4539	17	17	0.6700	0.0526
001482704223548202399 2	11	434	1678	14.5969	15.2872	17	17	0.6903	0.0526
001482704223548202399 2	12	1678	1085	15.4139	15.8242	17	17	0.4103	0.0526
001482704223548202399 2	13	1085	1891	16.6300	17.2433	17	17	0.6133	0.0526
001482704223548202399 2	14	1891	143	20.1175	21.3272	17	17	1.2097	0.0526
001482704223548202399 2	15	143	139	21.5153	21.8633	17	17	0.3480	0.0526
001482704223548202399 2	16	139	432	22.1658	23.1906	17	17	1.0248	0.0526
001482704223548202399 2	17	432	410	23.3414	23.3761	17	17	0.0347	0.0526
001482704223548202399 2	18	143	1440	0.4756	1.3042	18	18	0.8286	0.0526
001482704223548202399 2	20	1440	344	11.5547	11.9069	18	18	0.3522	0.0526
001482704223548202399 2	21	344	2034	12.4506	13.9633	18	18	1.5127	0.0526
001482704223548202399 2	22	2034	2033	17.8239	18.1881	18	18	0.3642	0.0526
001482704223548202399 2	23	2033	882	18.9717	21.4567	18	18	2.4850	0.0526
001482704223548202399 2	24	882	1440	21.7108	21.8264	18	18	0.1156	0.0526
001482704223548202399 2	25	1440	143	23.3469	23.9867	18	18	0.6398	0.0526

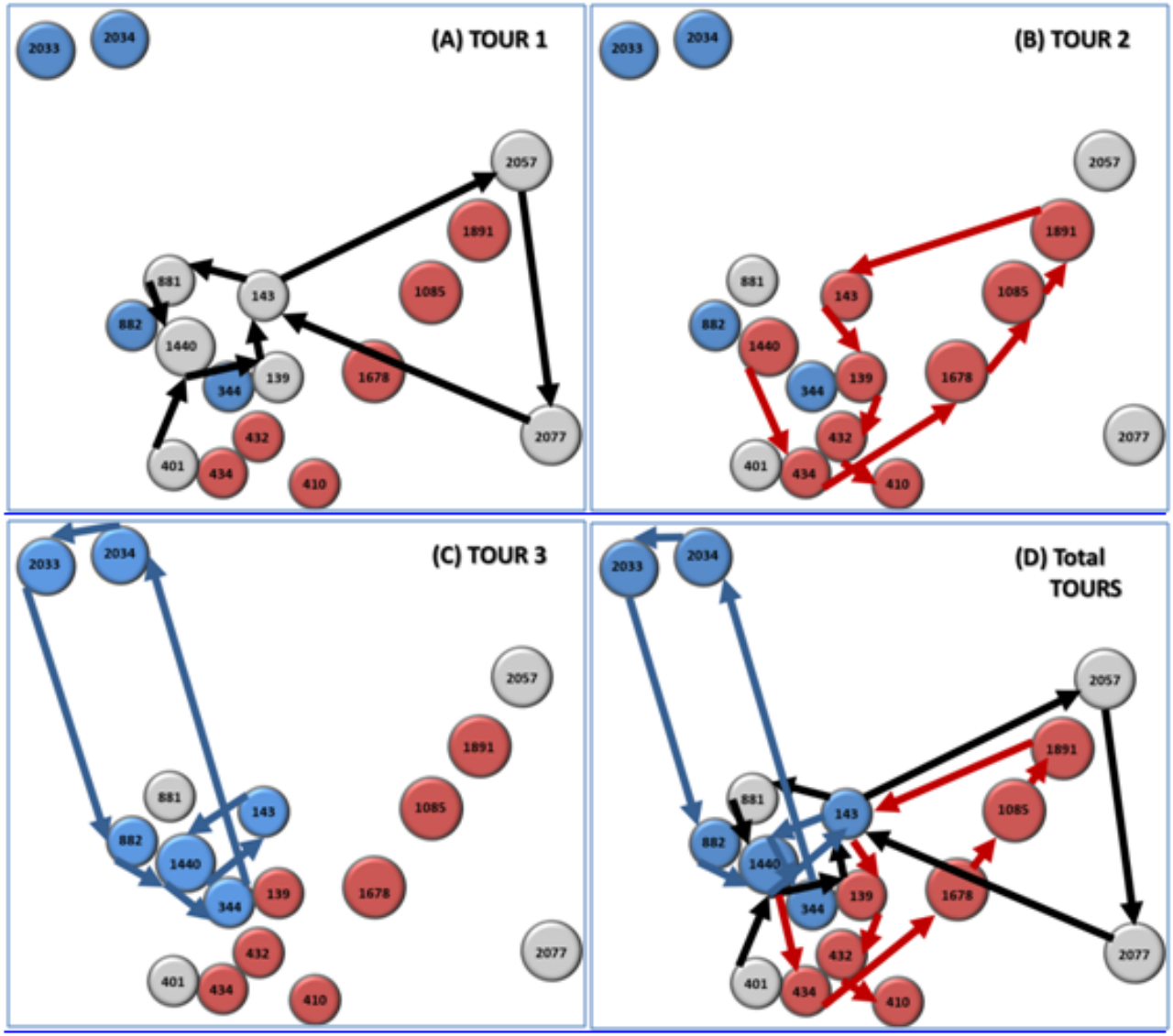
GPS Data

Conversion of Trips to Tours

TRUCKID	TORIG	TDEST	TSTART	TEND	TDAY	TRIPS	WEIGHT	STOP01	STOP02	STOP03	STOP04	STOP05	STOP06	STOP07	STOP08
001457024219103347538	2055	1329	19.6200	20.9797	8	3	0.0526	410	434	0	0	0	0	0	0
001457024219103347538	2061	1329	18.4717	20.1506	9	2	0.0526	434	0	0	0	0	0	0	0
001457024219103347538	1329	434	9.5656	10.1239	10	3	0.0526	434	2057	0	0	0	0	0	0
001457024219103347538	2057	1329	18.9950	20.1333	11	3	0.0526	434	432	0	0	0	0	0	0
00147704916385437	2100	1348	21.0561	22.9272	16	1	0.0526	0	0	0	0	0	0	0	0
001482704223548023992	401	1440	0.1511	0.8281	16	8	0.0526	1440	139	143	2057	2077	143	881	0
001482704223548023992	1440	410	13.7839	14.4539	17	8	0.0526	434	1678	1085	1891	143	139	432	0
001482704223548023992	143	143	0.4756	1.3042	18	7	0.0526	1440	344	2034	2033	882	1440	0	0
00150423475485122051	969	361	0.9625	1.6681	7	2	0.0526	2057	0	0	0	0	0	0	0
0015187328240287071808264058	614	2077	4.0828	4.1133	14	1	0.0526	0	0	0	0	0	0	0	0
0015187328240287071808264058	2077	1741	0.2478	2.2569	15	1	0.0526	0	0	0	0	0	0	0	0
00155700409164502427	1695	2100	20.5694	20.9350	16	2	0.0526	1687	0	0	0	0	0	0	0
0015612466444996411614936 82	343	2090	12.6658	13.3475	10	3	0.0526	428	1351	0	0	0	0	0	0
0015612466444996411614936 82	2077	1687	12.3353	15.1522	11	3	0.0526	1904	1704	0	0	0	0	0	0

Truck Tours

ID 82023992 during Feb. 16~18, 2011



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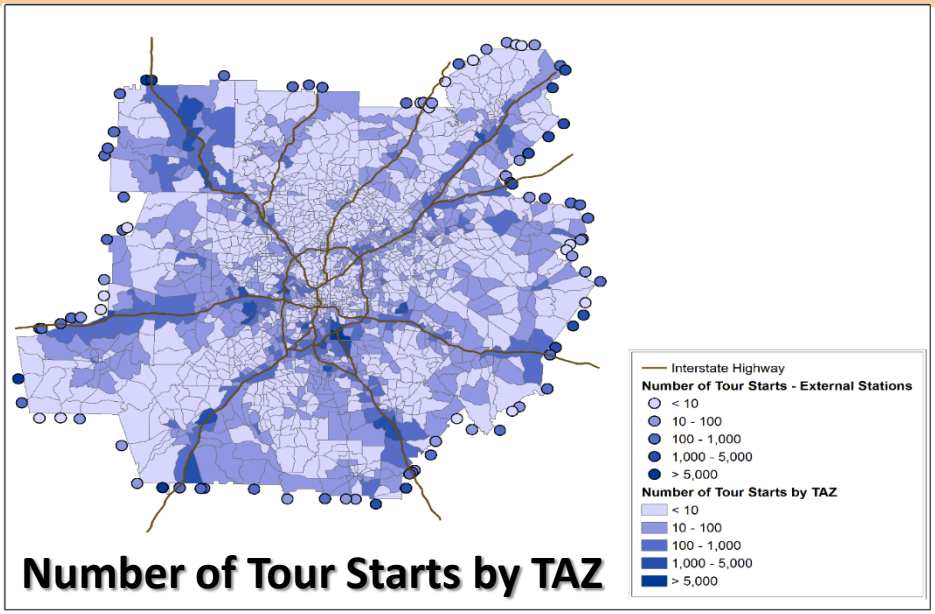
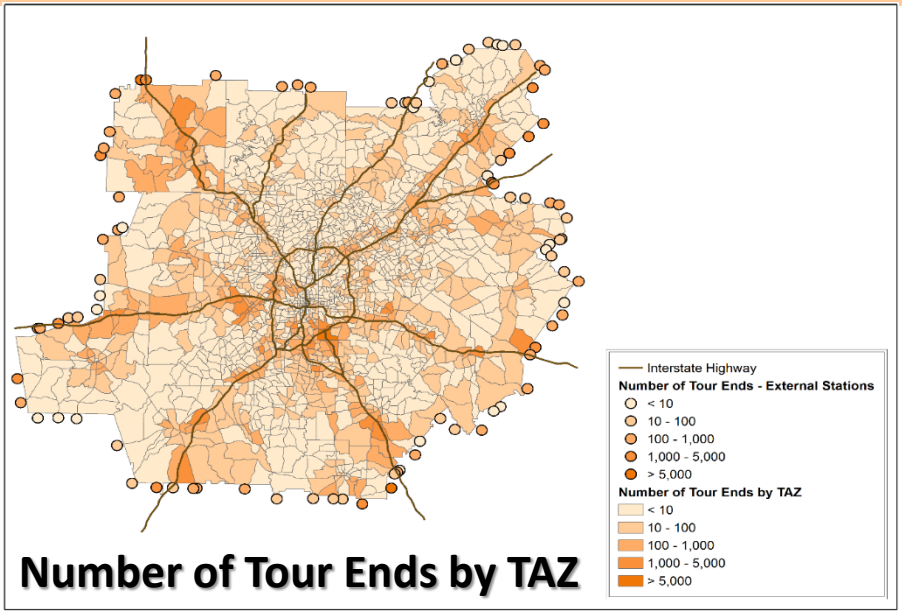
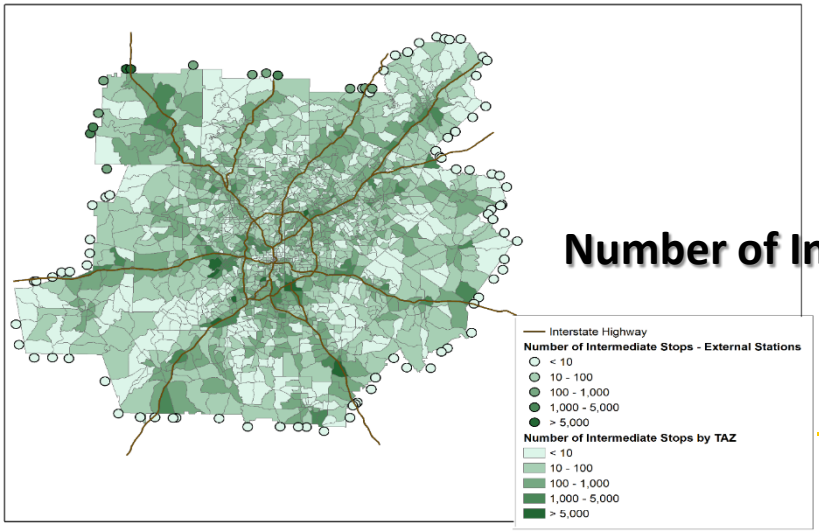
Tour Statistics



Number of Tour Starts by TAZ



Number of Tour Ends by TAZ



Number of Intermediate Stops

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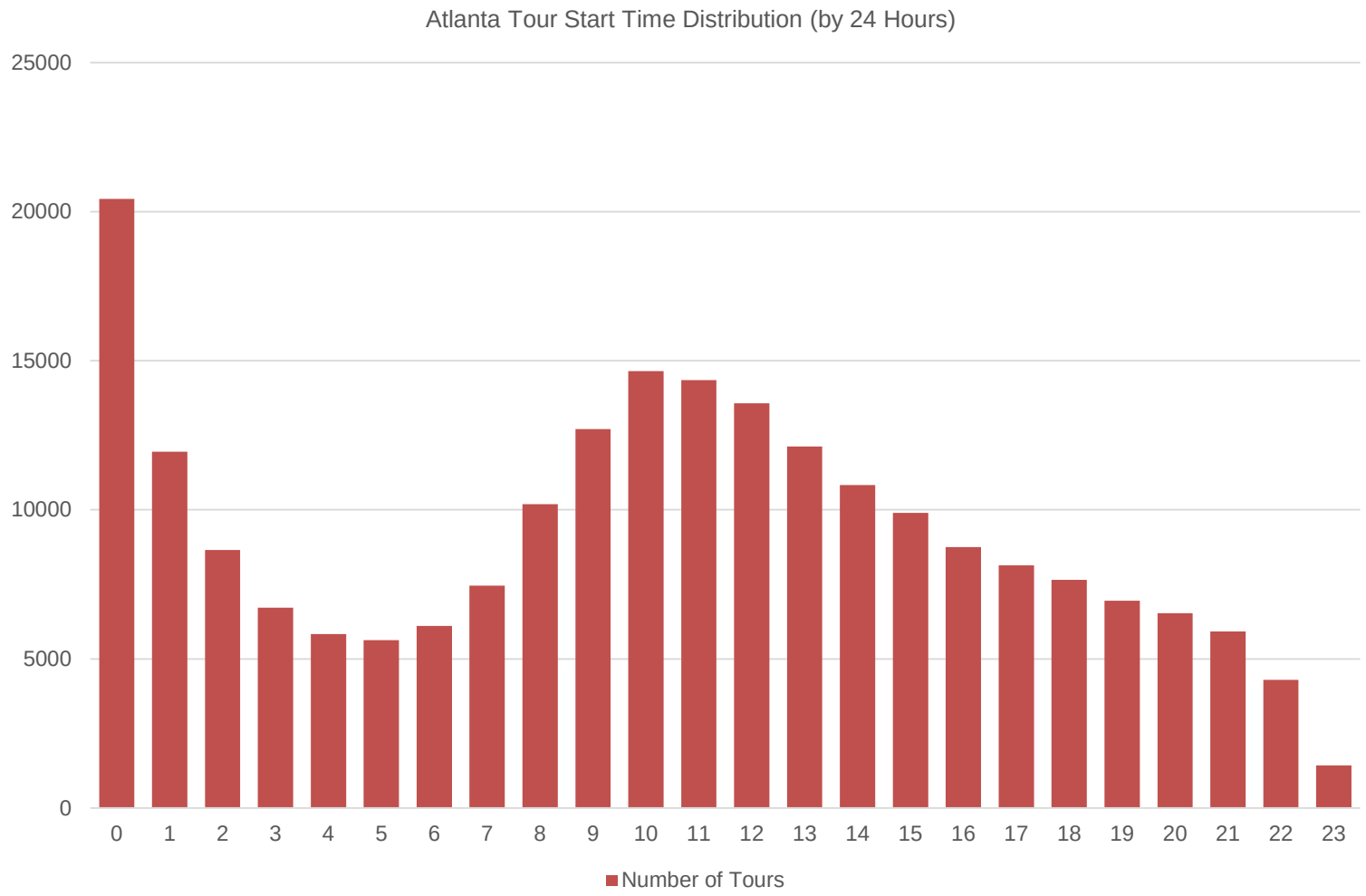
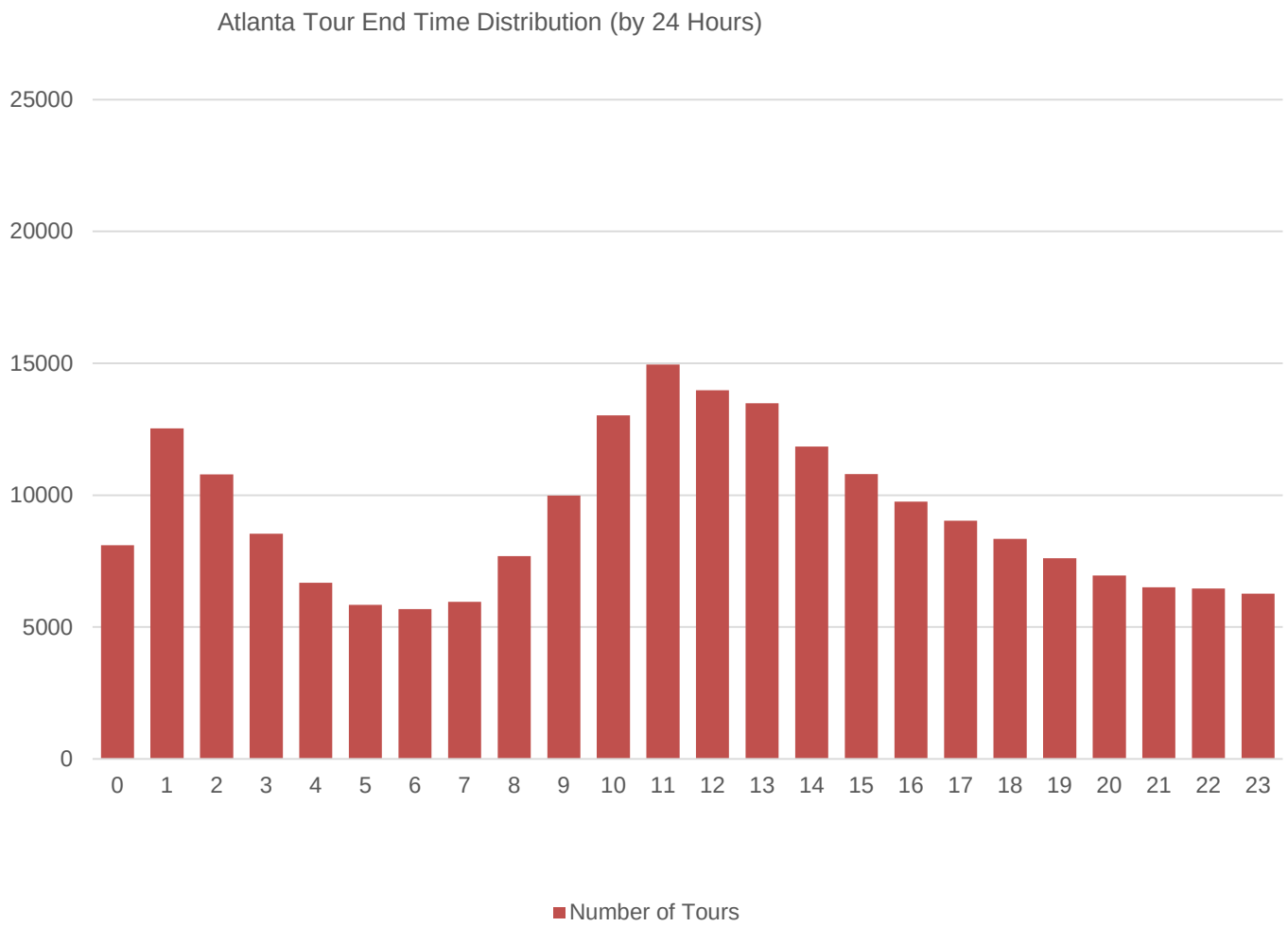
Tour Statistics

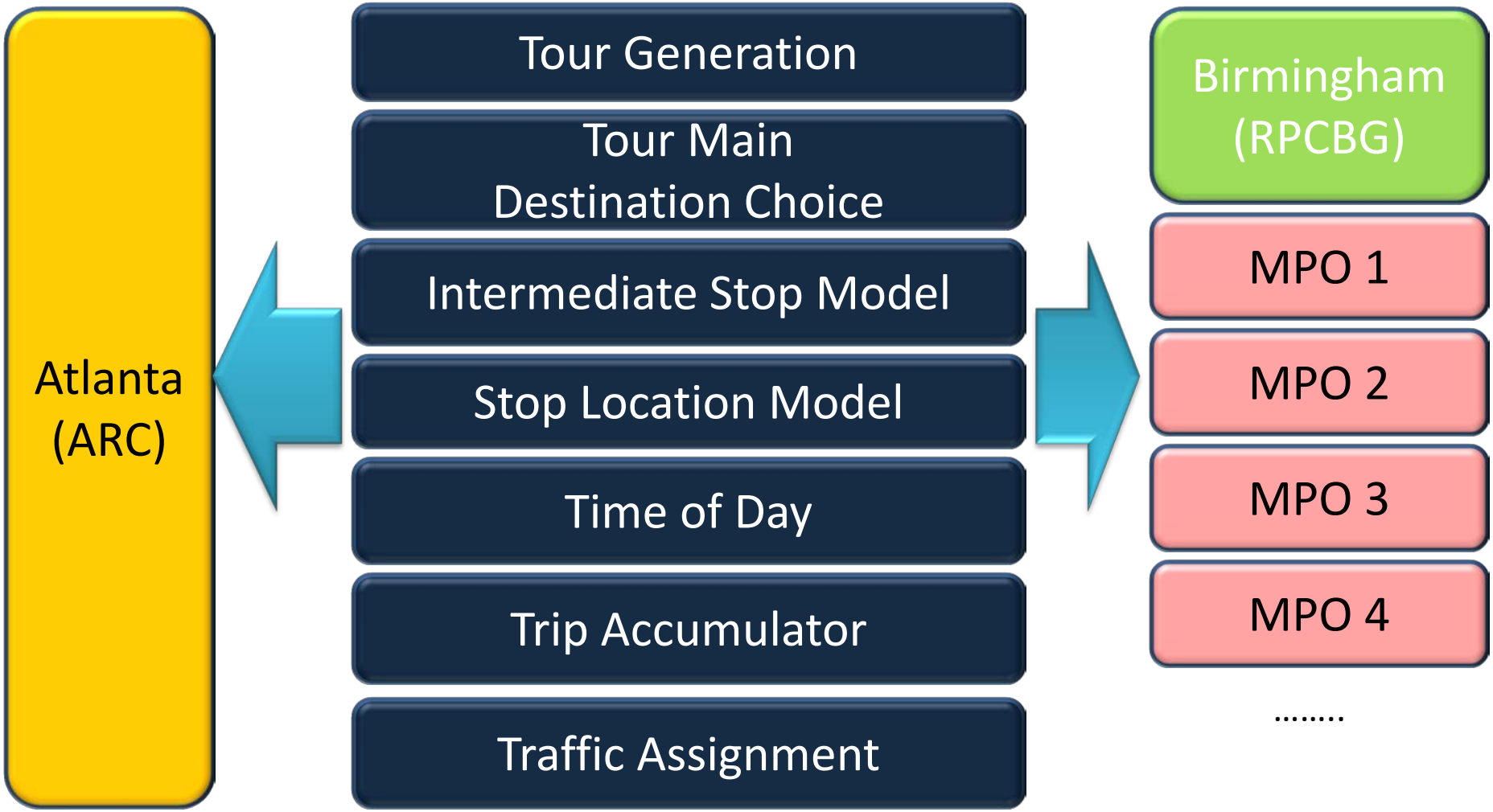
Start Time Distribution



Tour Statistics
End Time Distribution

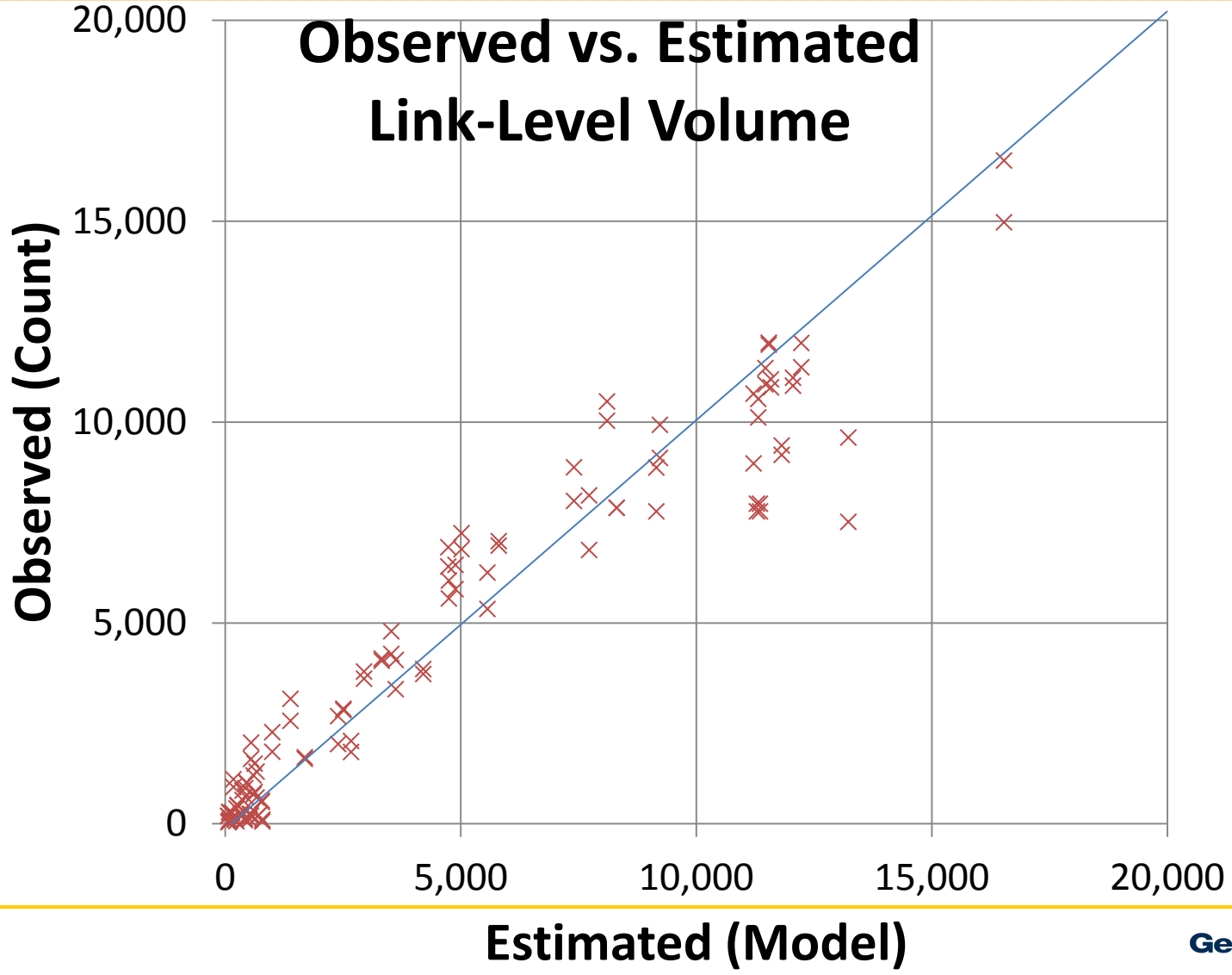


Tour-based Truck Model
Conceptual Framework



Tour-based Truck Model

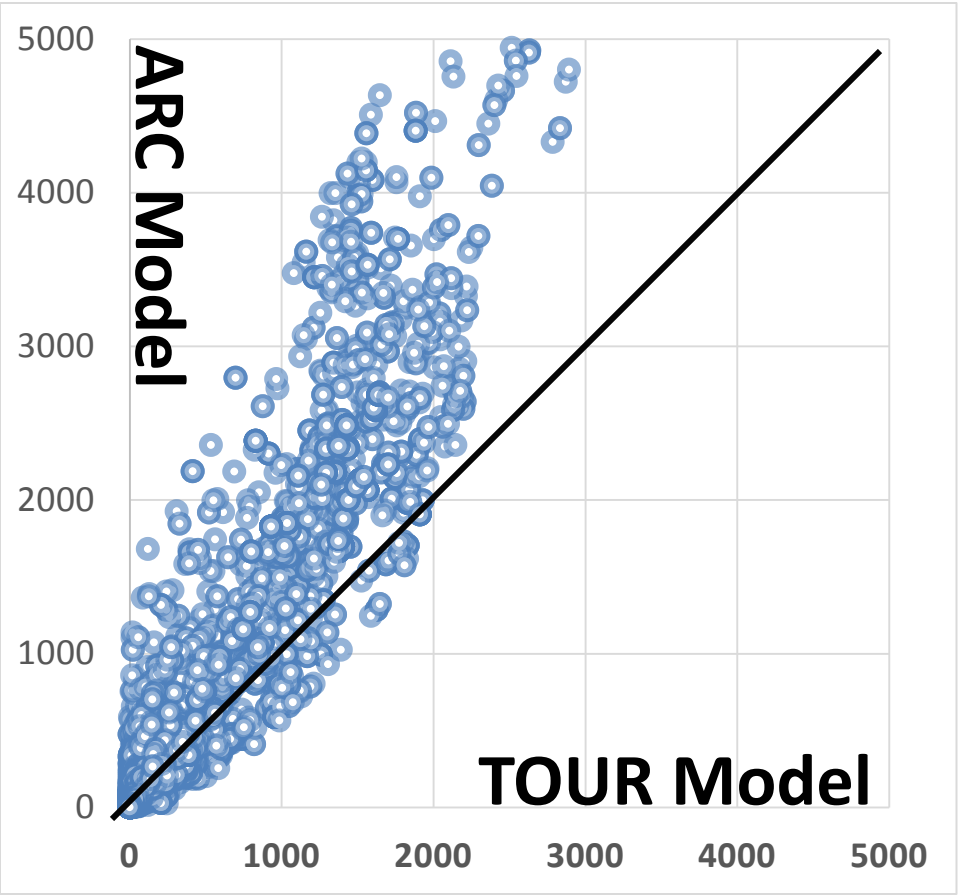
Assignment Validation



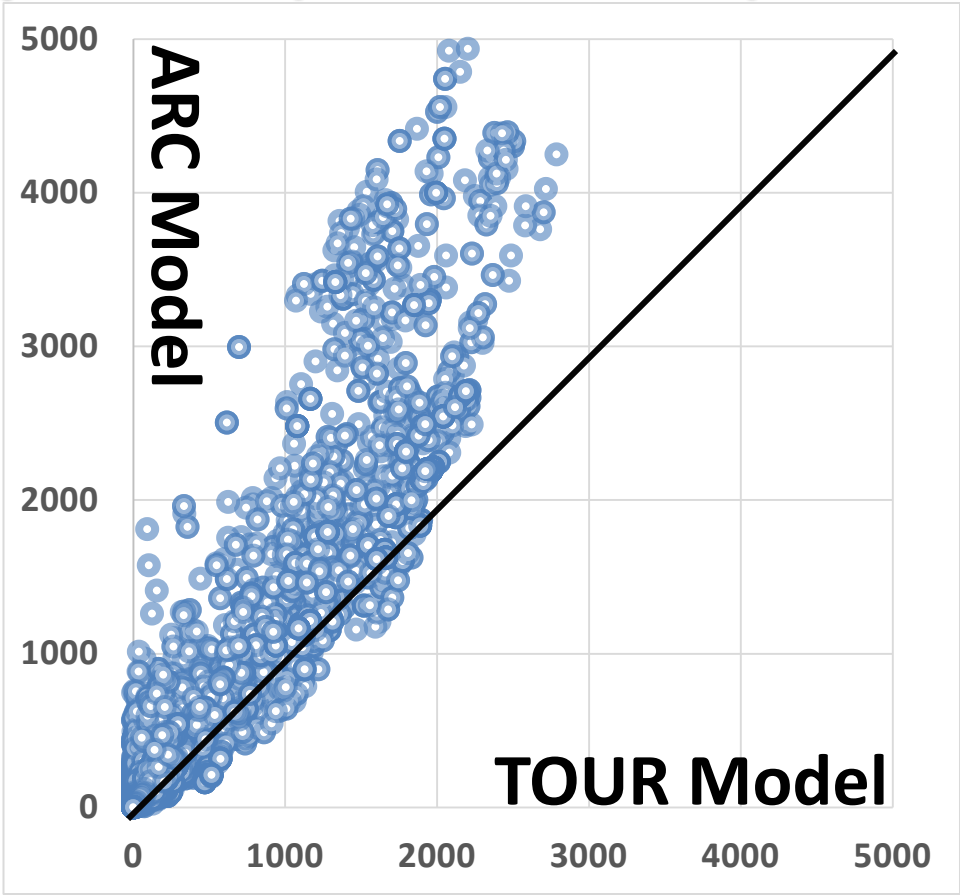
Trip-based vs. Tour-based Model

Atlanta

Link Volume Comparison (54,560 Links)



AM

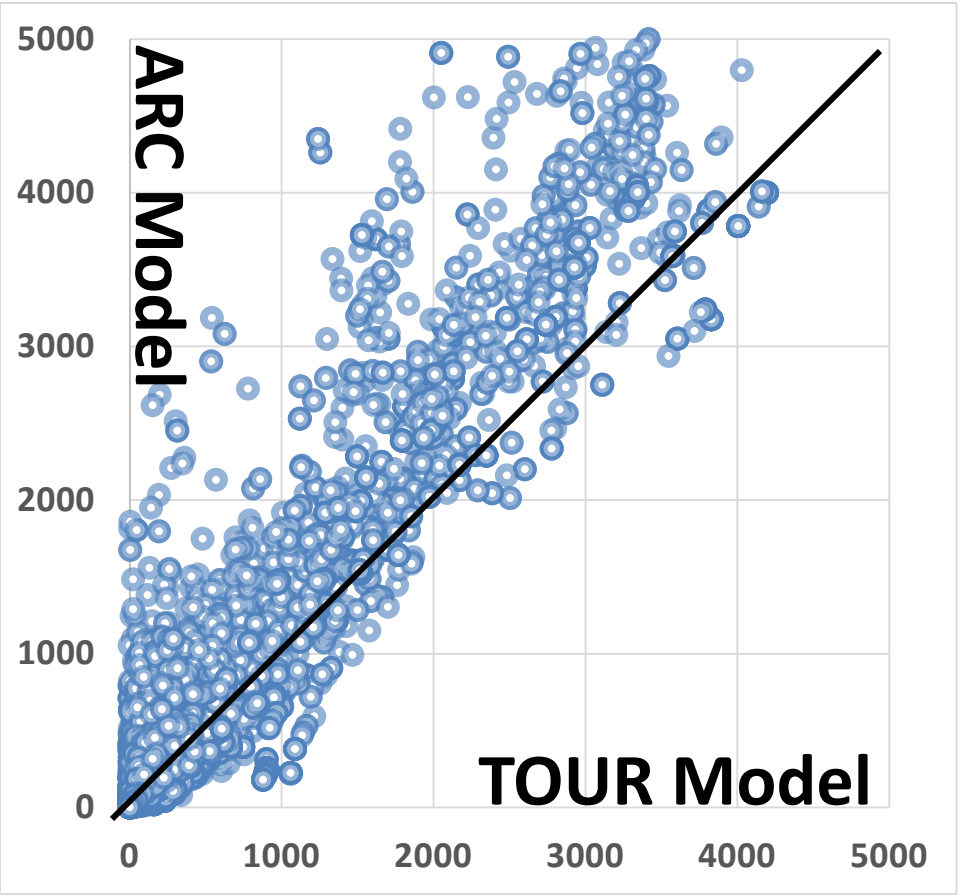


PM

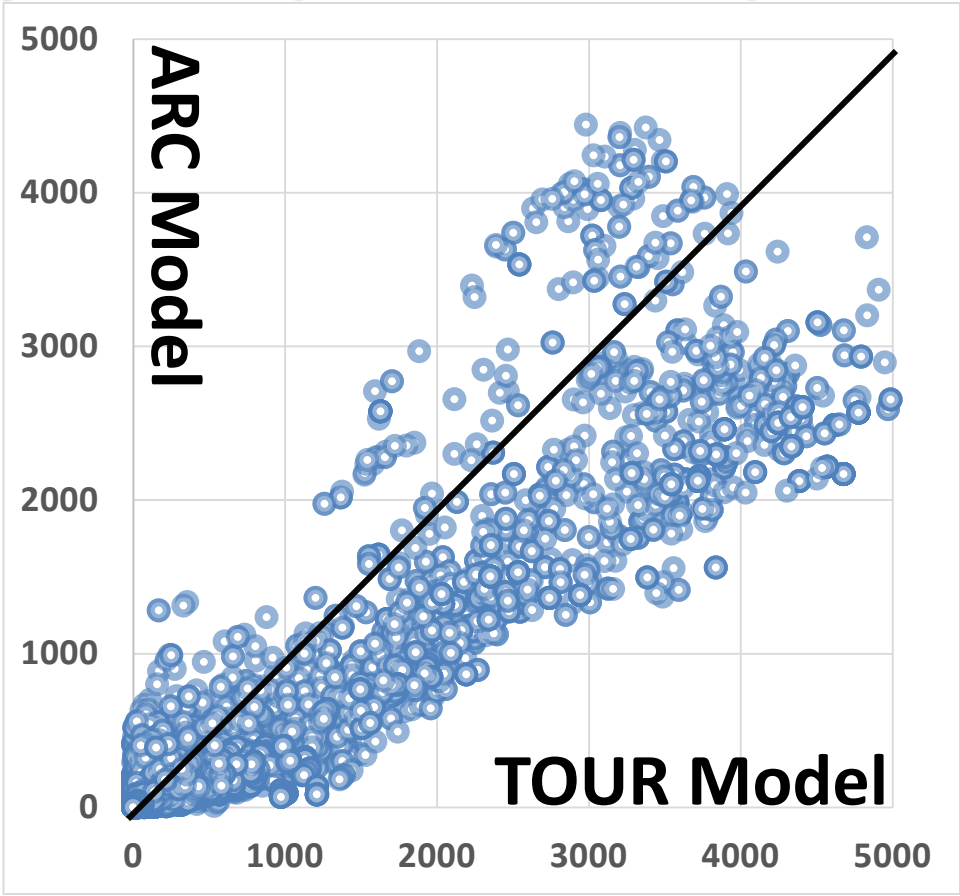
Trip-based vs. Tour-based Model

Atlanta

Link Volume Comparison (54,560 Links)



MD



NT

Benefits of GPS truck data

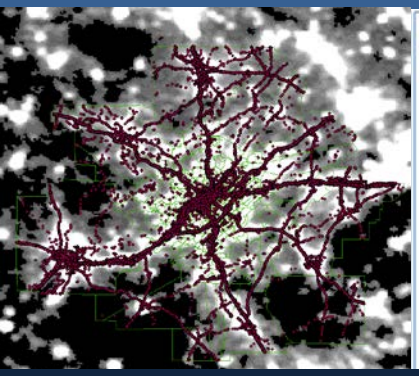
- Cost Effective Data Collection Method for longer time periods.
- Integrating GPS data with other GIS-based information
- Greater Positional Accuracy

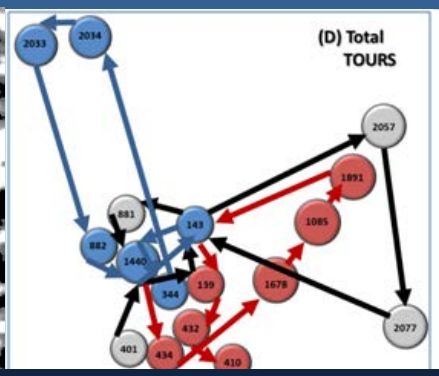
Benefits of Tour-based Model

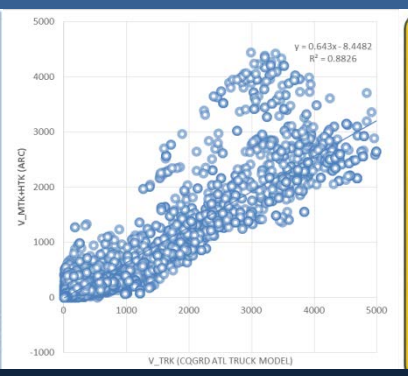
- Increasing need for tour-based and supply-chain models
- Better disaggregate input to dynamic traffic simulations.
- More accurate means of traffic impact analysis

Future Research

- Truck Characteristics
- Wide-ranging applications
- Round-trip Tours vs. One-way Tours
- Sequence of Intermediate Stops







Another Way to Think About Regional Truck Movement: GPS Tour-Based Truck Modeling Approach

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