Truck GPS Data to Support Transportation Planning

Presentation at Tennessee Model User's Group

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Contents

- Commercial Vehicle GPS Data
- Data Description
- Tools to support probe vehicle use in transportation planning
- Freight Performance Measures

Commercial Vehicle GPS Data

GPS devices are widely deployed in cell phones, and trucks

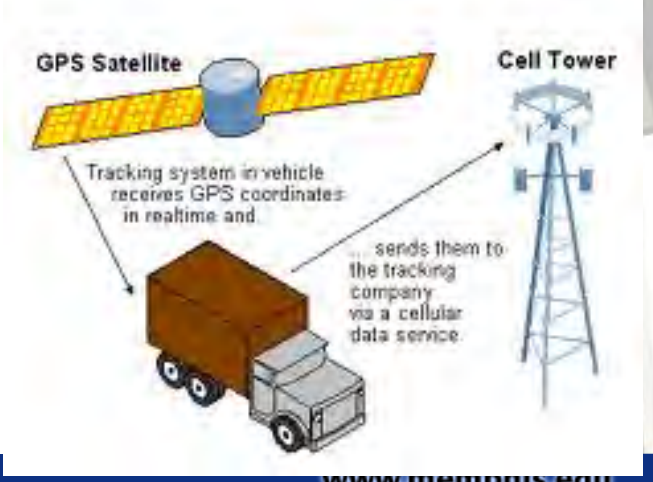
Truck fleet operators subscribe to GPS services for operational and maintenance purposes

Automatic Vehicle Location (AVL); Events Activated Tracking Systems (EATS); Fleet Telematics Systems (FTS)

Entities (e.g., ATRI) collect and store historical GPS from operators (2004 to present)

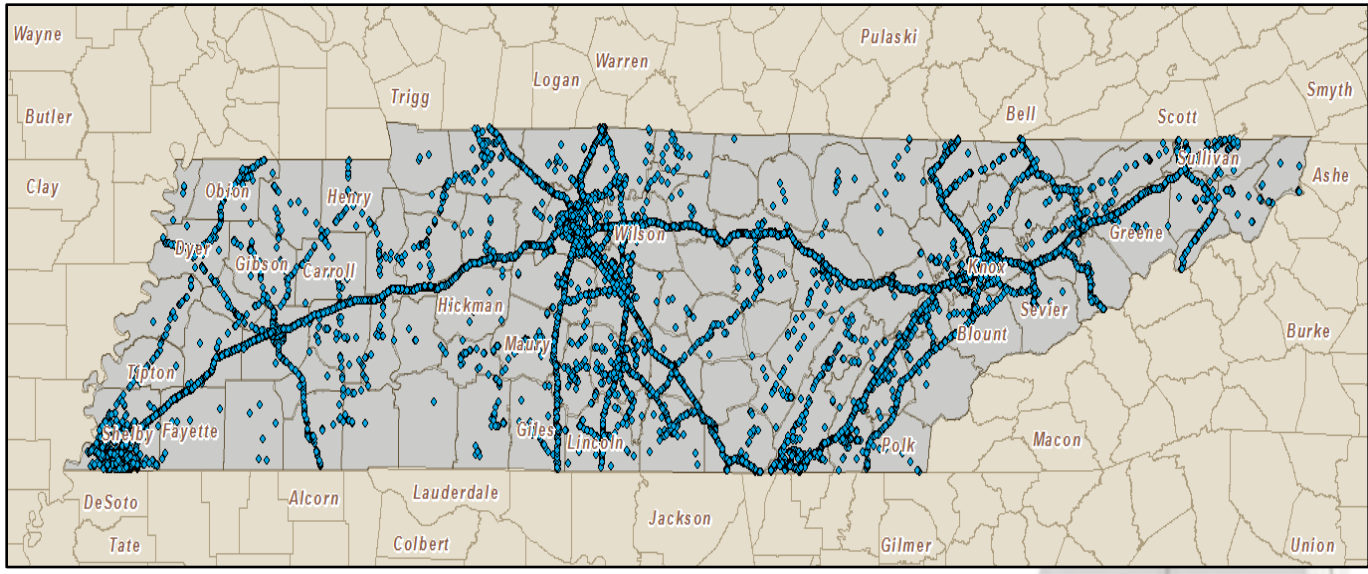
Condition of dissemination is that truck ID's are anonymized

GPS information should be processed before it can be used for truck travel models



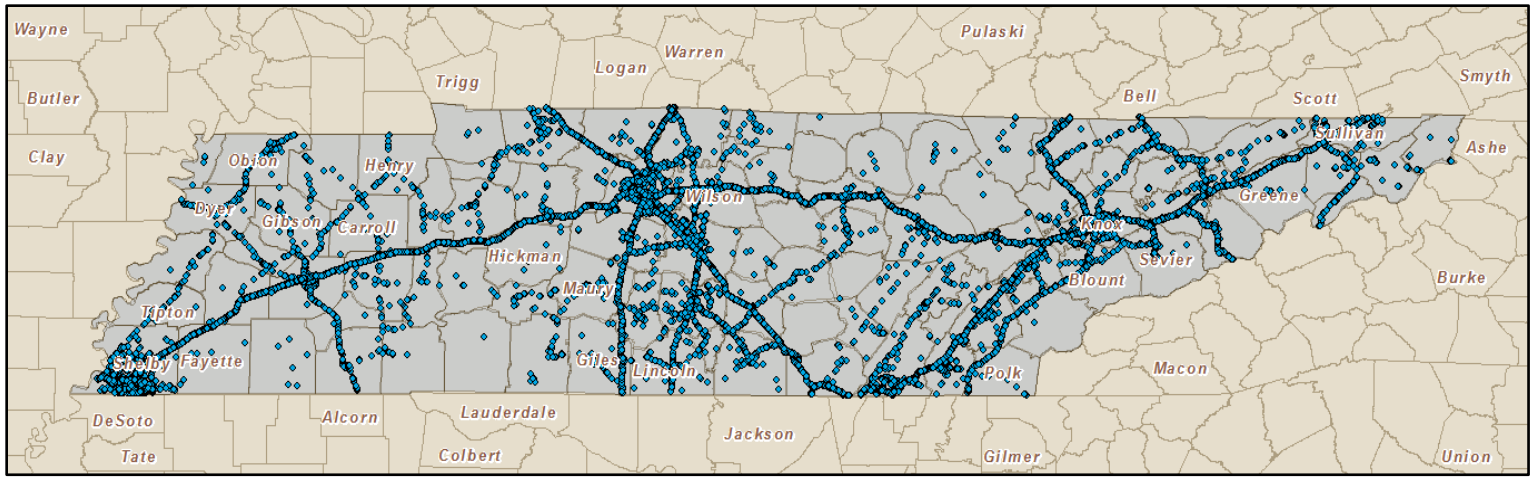
What do GPS devices provide?

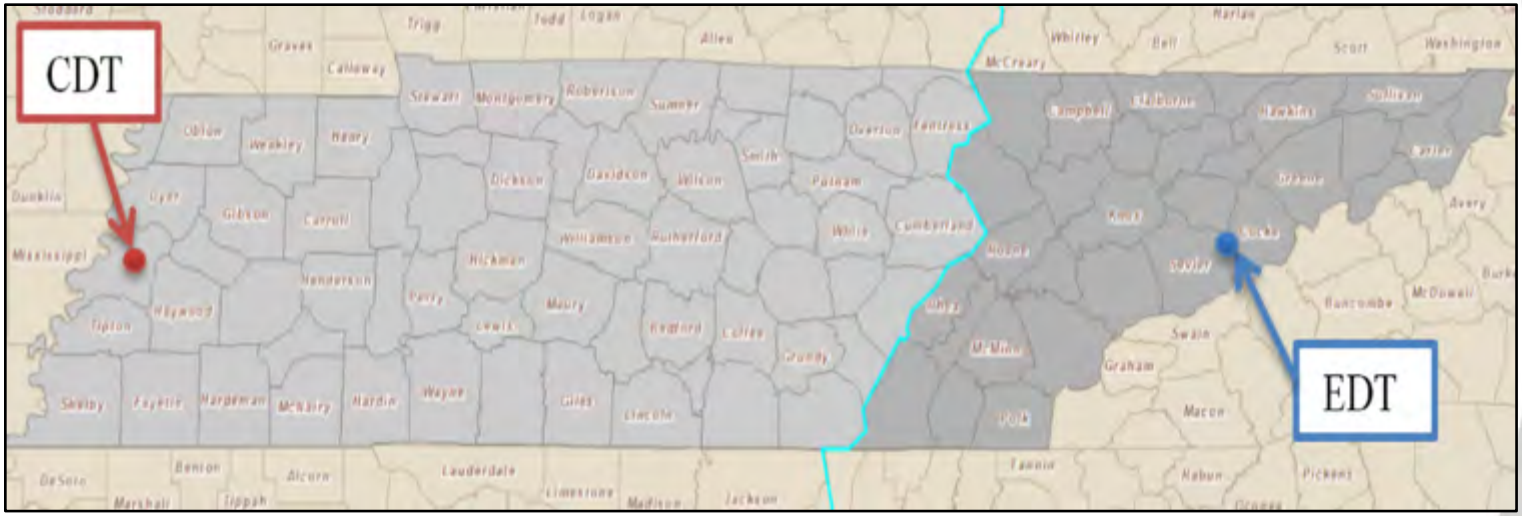
- X and Y coordinates
- time stamp
- heading
- spot speed
- Vehicle ID



- Other data (e.g., emissions exist but not provided)

One Day of GPS Data





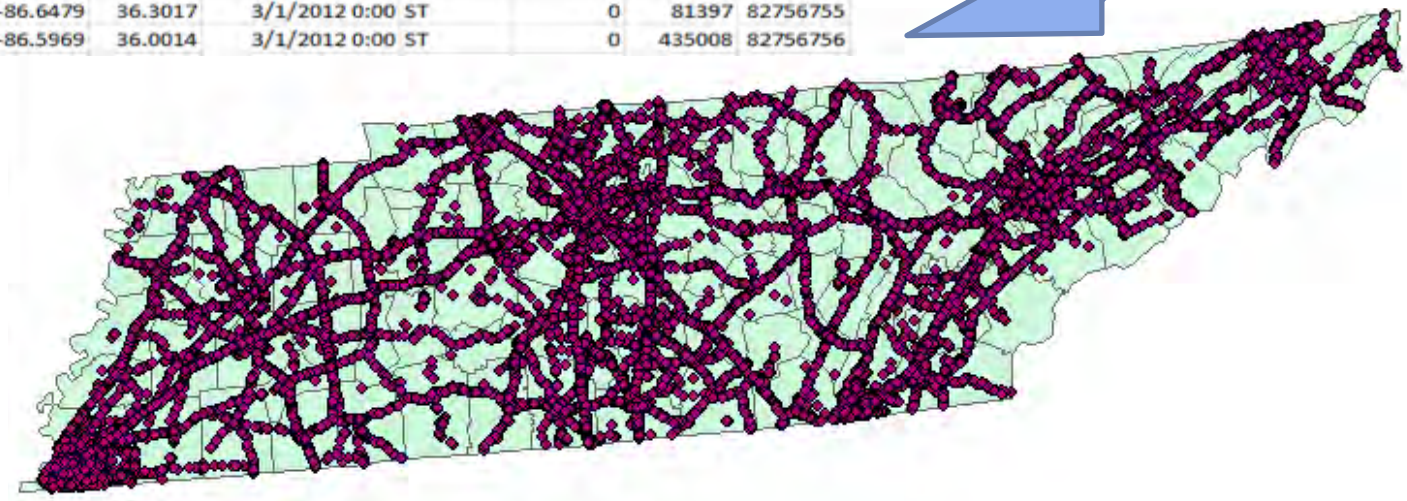
Statistics

- 60,962 unique truck id's (whole 2012)
- 104,232,699 observations
- Maximum number of observations for a truck in a day: 1501
- Maximum hourly observations for a truck: 394(stopped),356 (moving)

Quarter	Percentage
Jan-March	22.27%
April-June	24.86%
July-Sept	26.2%
Oct-Dec	26.67%

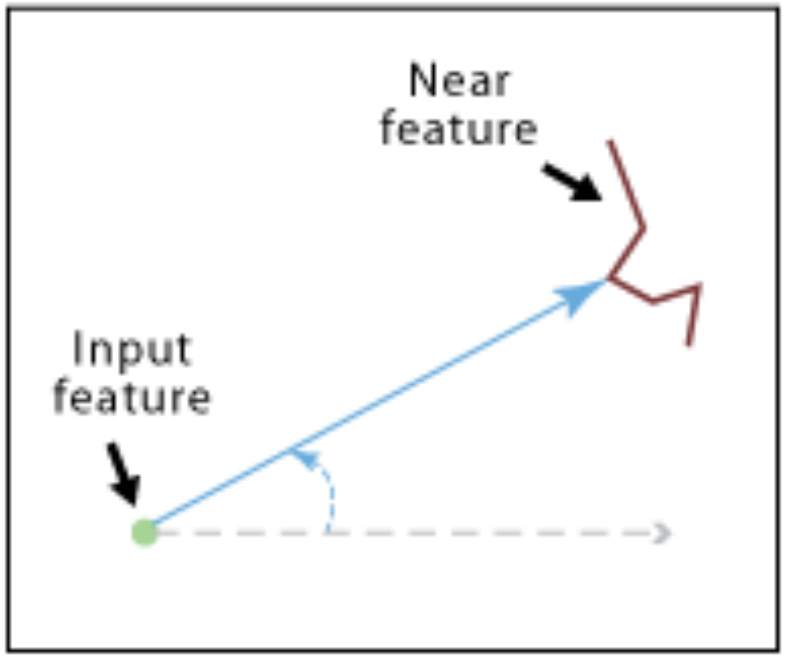
From txt to shp file

XC	YC	readdate	heading	speed	truckid	iid
-87.0411	35.197	3/1/2012 0:00	ST	0	283986	82756739
-88.3409	35.9182	3/1/2012 0:00	ST	0	79099	82756740
-86.8661	36.1722	3/1/2012 0:00	ST	0	290046	82756741
-90.0062	35.0638	3/1/2012 0:00	ST	0	499909	82756742
-90.0059	35.0636	3/1/2012 0:00	ST	0	499903	82756743
-89.9481	35.2753	3/1/2012 0:00	ST	0	499906	82756744
-86.7747	36.0416	3/1/2012 0:00	ST	0	213920	82756745
-87.0417	35.1967	3/1/2012 0:00	ST	0	284000	82756746
-90.0057	35.0636	3/1/2012 0:00	ST	0	499911	82756747
-90.0054	35.0639	3/1/2012 0:00	ST	0	499914	82756748
-88.3387	35.6354	3/1/2012 0:00	ST	0	372340	82756749
-86.6479	36.3017	3/1/2012 0:00	ST	0	303270	82756750
-88.4135	35.658	3/1/2012 0:00	W	23	89472	82756751
-86.6481	36.3017	3/1/2012 0:00	ST	0	146036	82756752
-86.6483	36.3017	3/1/2012 0:00	ST	0	81383	82756753
-86.6479	36.302	3/1/2012 0:00	ST	0	93392	82756754
-86.6479	36.3017	3/1/2012 0:00	ST	0	81397	82756755
-86.5969	36.0014	3/1/2012 0:00	ST	0	435008	82756756



Observation to Link

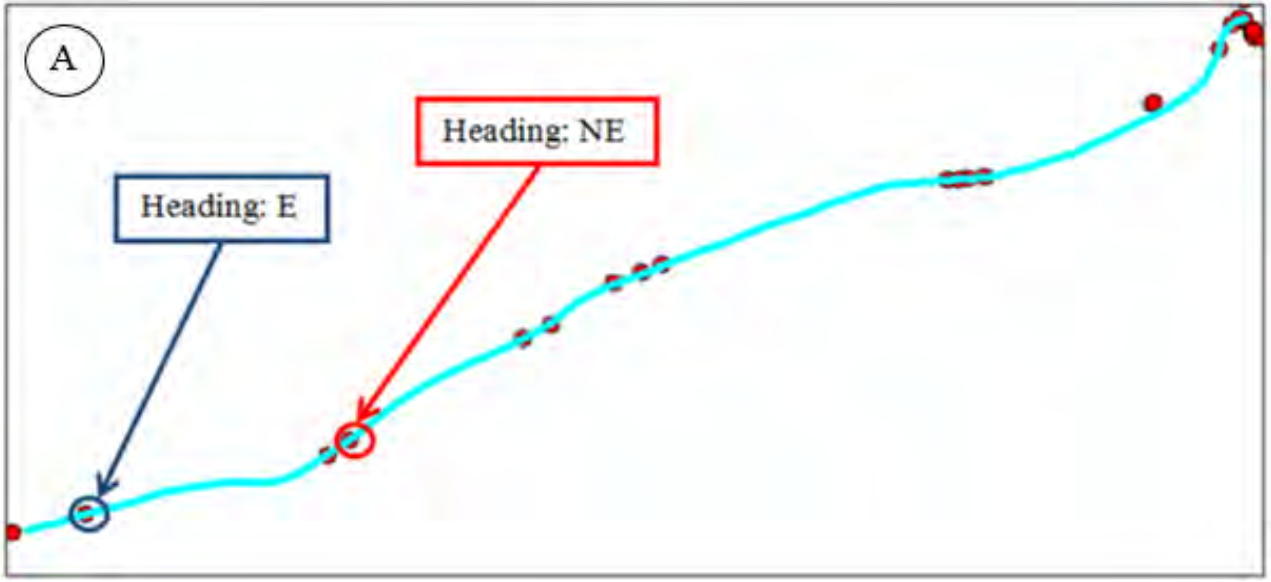
- Use function “NEAR” to associate (or snap) an observation with the closest link



Source: ArcGIS Resource Center

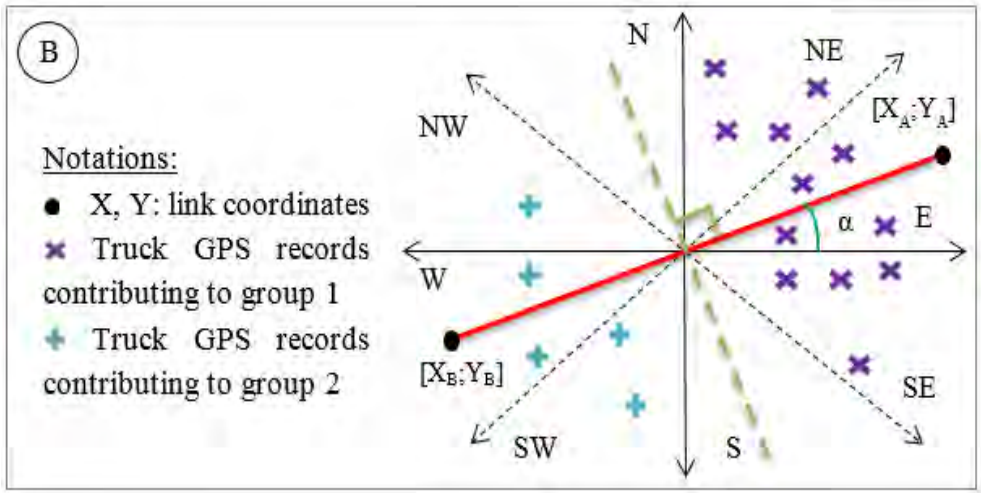
Direction Assignment

- Up to eight possible headings can be associated with a link: E, W, N, S, NE, NW, SE, and SW.



Direction and Outlier Identification (DOI)

- Designed to separate snapped observations in two groups
- Estimates bi-directional link freight performance measures (FPMs)



Data Processing

- Handle large datasets (4-5GB)
- Descriptive information
- Develop GIS and Excel files
- Query by Year, Month, Day, Time of Day
- Adjust for Time Zone

FPM

File View

Files

Input :/CFIRE_2013_MAP21/Tools/PreprocessingTool/TennesseeD2_small.csv Choose

Output opbox/CFIRE_2013_MAP21/Tools/PreprocessingTool/TN_Example.shp Choose

Match fields | Import and Process

Span

Split by none

Save ShapeFile | Save CSV | Export

Console

```
processor count: 8
****************************************

2015-07-08 11:46:04 Importing N:/Dropbox/CFIRE_2013_MAP21/Tools/
PreprocessingTool/TennesseeD2_small.csv, size: 148MB



3.367000 sec
2637446 records processed and imported.
0 records ignored
```

Preview

Filters

Filter by Year

Select All

Year	Count
2011	1685000
2014	952500

Filter by Day of Week

Select All

Day	Count
Sunday	177400
Monday	377300
Tuesday	366700
Wednesday	222700
Thursday	322800
Friday	731500
Saturday	439100

Filter by Month of Year

Select All

Month	Count
January	0
February	0
March	1685000
April	0
May	0
June	0
July	0
August	0
September	0
October	952500
November	0
December	0

Filter by Time of Day

Select All

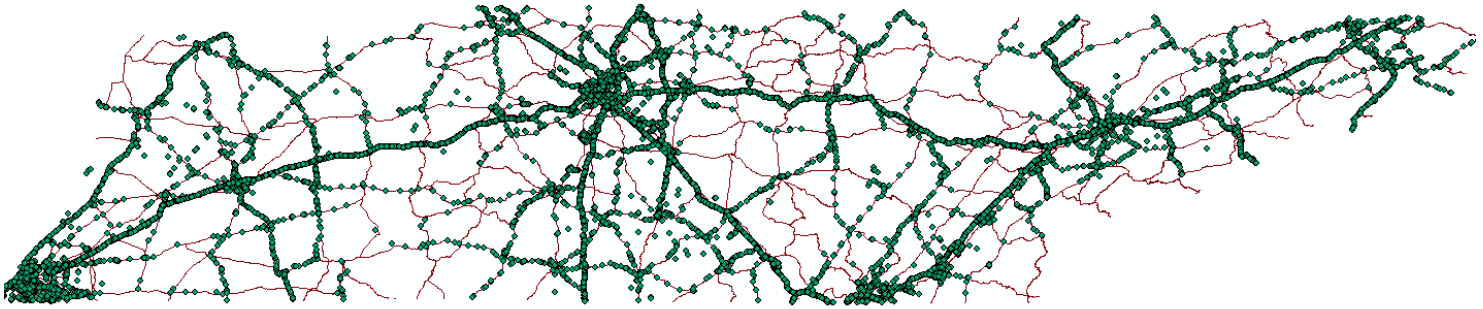
Time	Count
0 - 1	67600
1 - 2	63600
2 - 3	64800
3 - 4	63600
4 - 5	69400
5 - 6	93200
6 - 7	100300
7 - 8	125700
8 - 9	133200
9 - 10	145000
10 - 11	147400
11 - 12	154700
12 - 13	155400

Options Filters

100%

2637500 / 2,637,446

Connect data

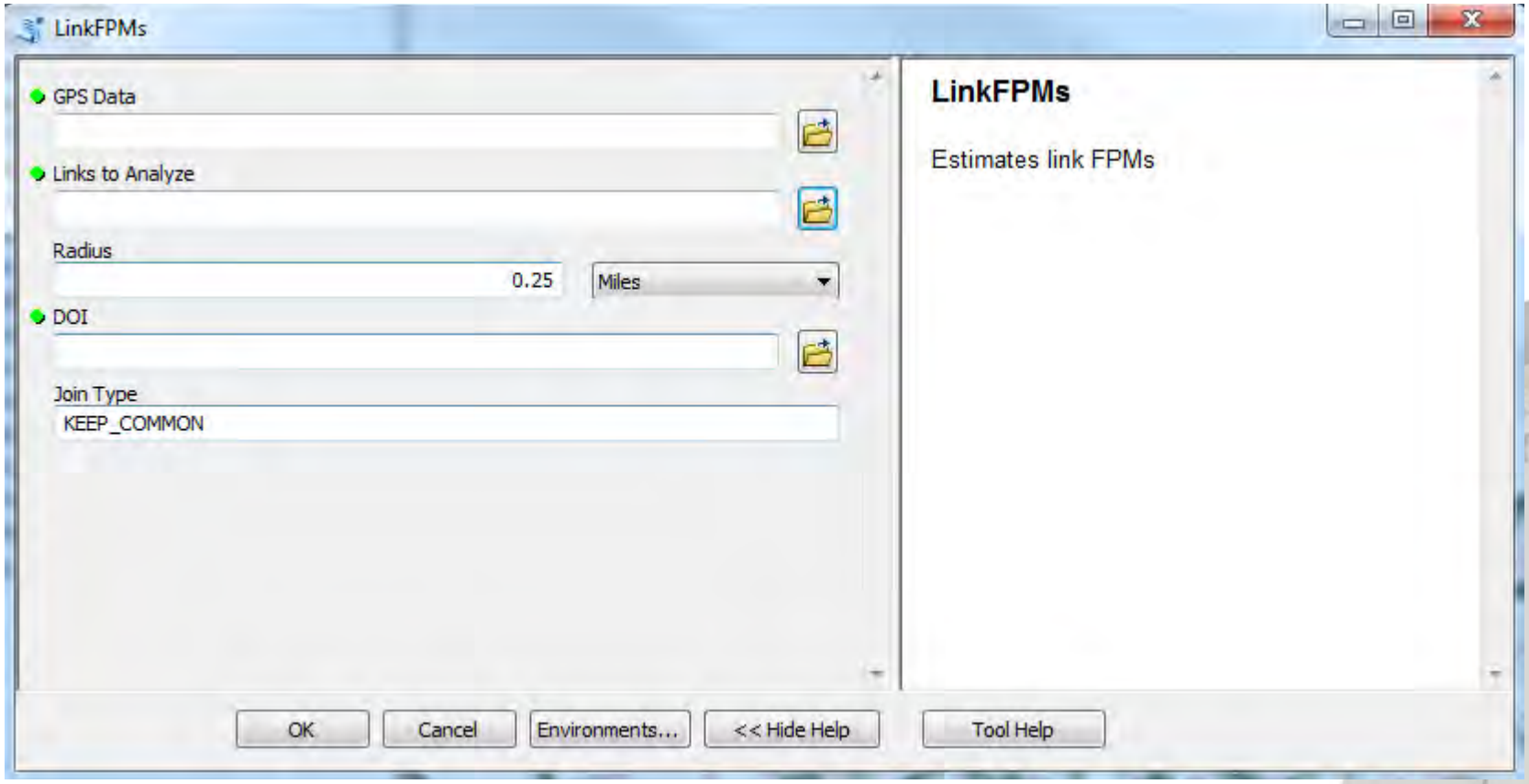


VOLa	VOLb	TSa	TSb	TTa	TTb	TTp90a	TTp90b	TTp95a	TTp95b	BTTa	BTTb	BIa	BIb	TTStDa	TTStDb	TTCVa	TTCVb	TTRa	TTRb	MMRa
1	2	53	53.5	0.341485	0.338293	0.341485	0.348052	0.341485	0.348052	<Null>	0.009758	<Null>	0.028846	<Null>	0.013424	<Null>	0.039682	<Null>	0.018985	1
23	10	45.826087	57.5	0.084775	0.067563	0.193701	0.074737	0.342785	0.076175	0.25801	0.008611	3.043478	0.127451	0.106224	0.005191	1.253012	0.076833	0.492326	0.015473	1.20019
2	3	32	35	0.529028	0.483683	0.529028	3.38578	0.529028	3.38578	<Null>	2.902097	<Null>	6	<Null>	1.759303	<Null>	3.637307	<Null>	3.047202	1
3	1	26.333333	22	0.050165	0.060045	0.165125	0.060045	0.165125	0.060045	0.11496	<Null>	2.291667	<Null>	0.073791	<Null>	1.470978	<Null>	0.130362	<Null>	1.253165
2	3	24.5	32	0.207294	0.158709	0.253935	0.175128	0.253935	0.175128	0.046641	0.016418	0.225	0.103448	0.055725	0.023947	0.268822	0.150886	0.078807	0.041478	0.966264
1	3	32	28	0.104309	0.119211	0.104309	0.196347	0.104309	0.196347	<Null>	0.077136	<Null>	0.647059	<Null>	0.060468	<Null>	0.507233	<Null>	0.120486	1
1	0	25	<Null>	0.082712	<Null>	0.082712	<Null>	0.082712	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	1
3	9	60.666667	45.777778	0.021926	0.029058	0.024633	0.067474	0.024633	0.0739	0.002707	0.044842	0.123457	1.54321	0.002304	0.020652	0.105083	0.710717	0.004479	0.052786	1.021978
3	2	65.333333	51	0.219608	0.281327	0.231415	0.29891	0.231415	0.29891	0.011807	0.017583	0.053763	0.0625	0.010444	0.023485	0.04756	0.083478	0.020419	0.033212	1.010204
0	1	<Null>	27	<Null>	0.773441	<Null>	0.773441	<Null>	0.773441	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
3	0	36.666667	<Null>	0.150889	<Null>	0.230525	<Null>	0.230525	<Null>	0.079636	<Null>	0.527778	<Null>	0.064141	<Null>	0.425089	<Null>	0.128069	<Null>	0.872727

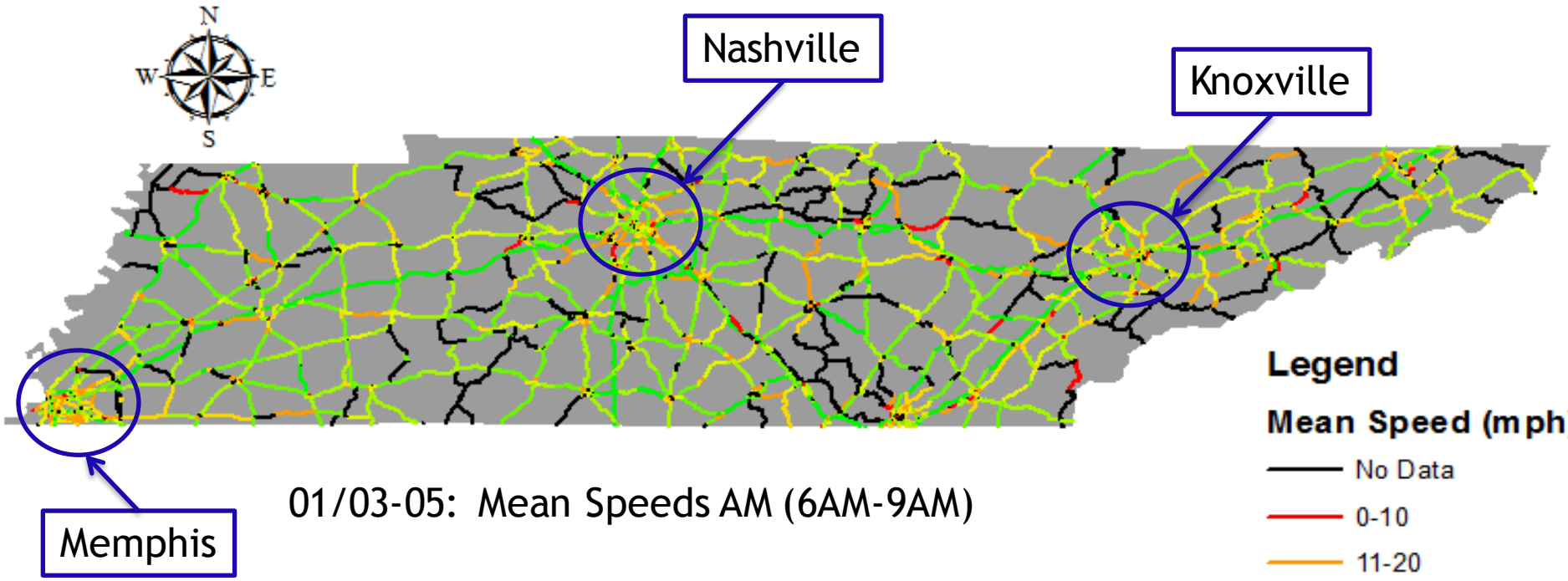
Estimated FPMs

- Travel Speed (in each direction)
- Travel Time (TT)
- TT reliability measures
  - 90th percentile TT
  - 95th percentile TT
  - Buffer TT (BTT)
  - BTT index (BI)
  - TT standard deviation
  - TTCV
  - TT range
  - mean/median TT ratio

ArcGIS Toolbox

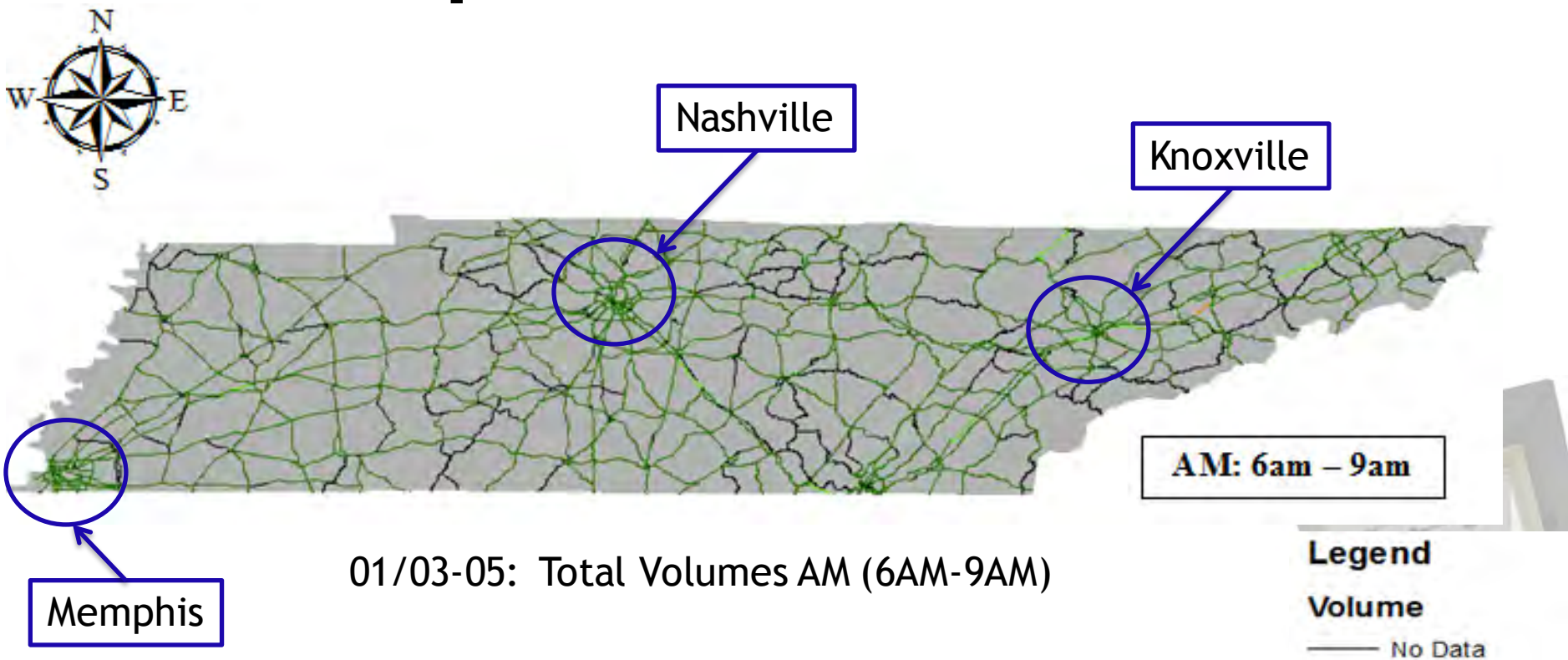


FPM Example: Mean Speed Link



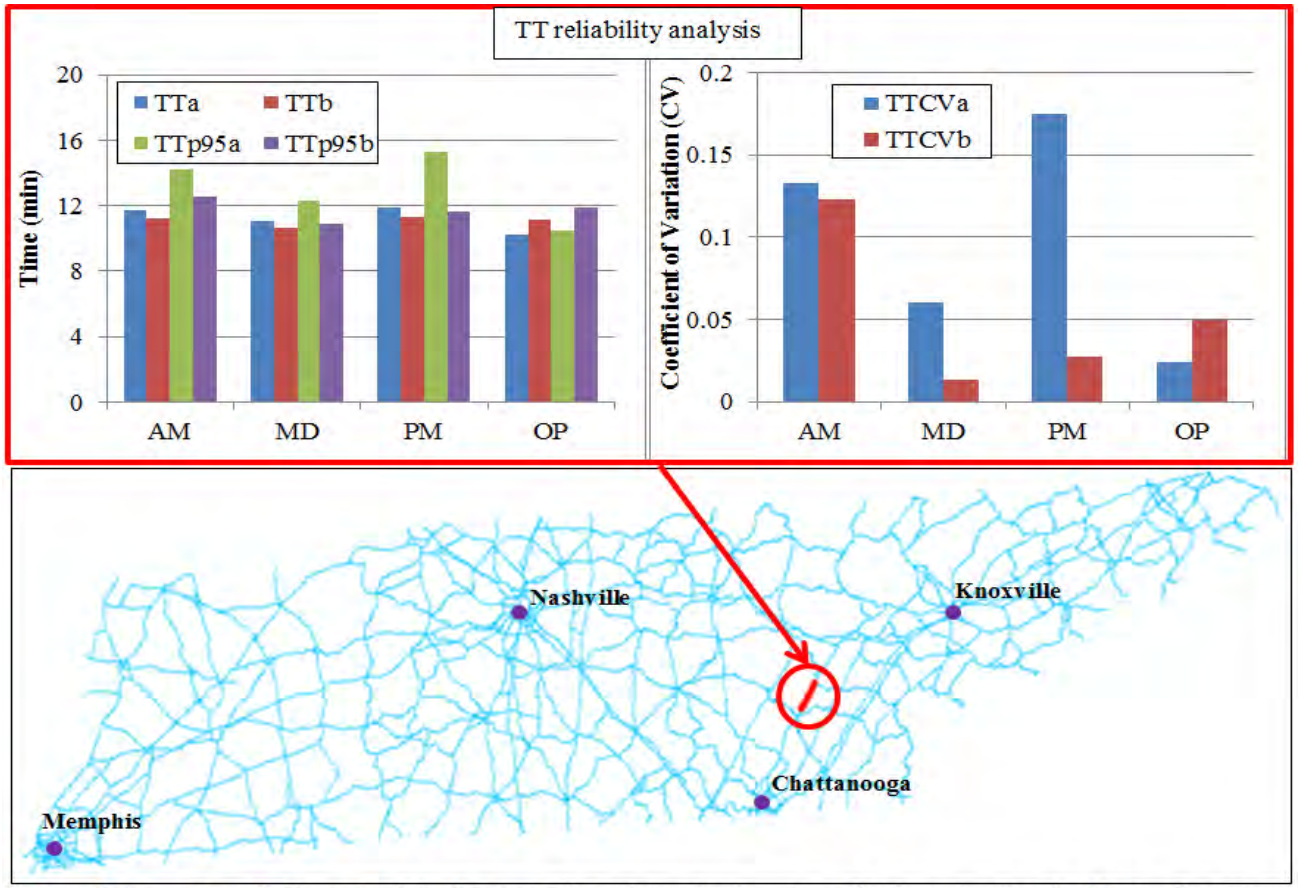
01/03-05: Mean Speeds AM (6AM-9AM)

FPM Example: Link Total Volumes



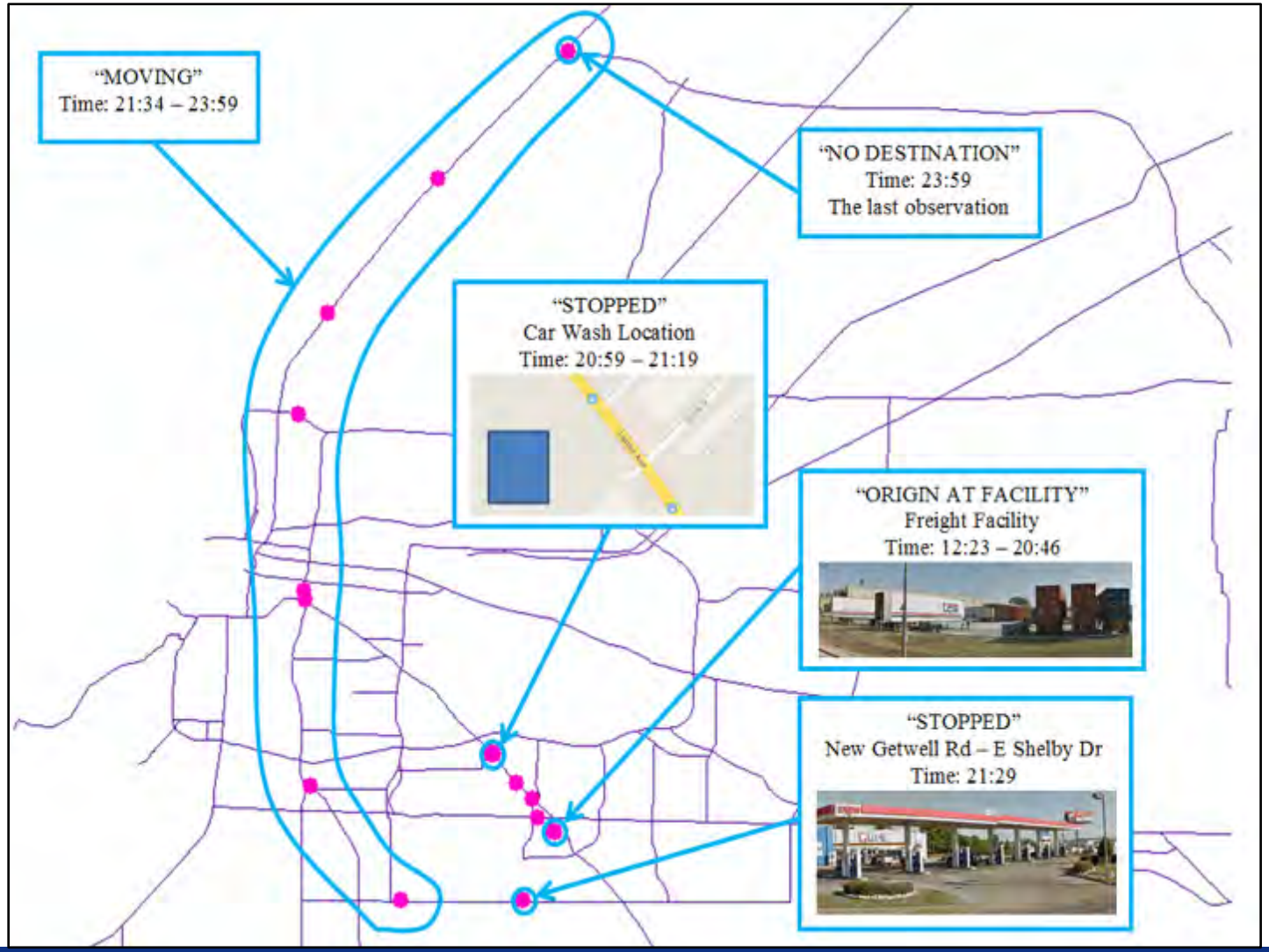
01/03-05: Total Volumes AM (6AM-9AM)

TT Reliability Measures

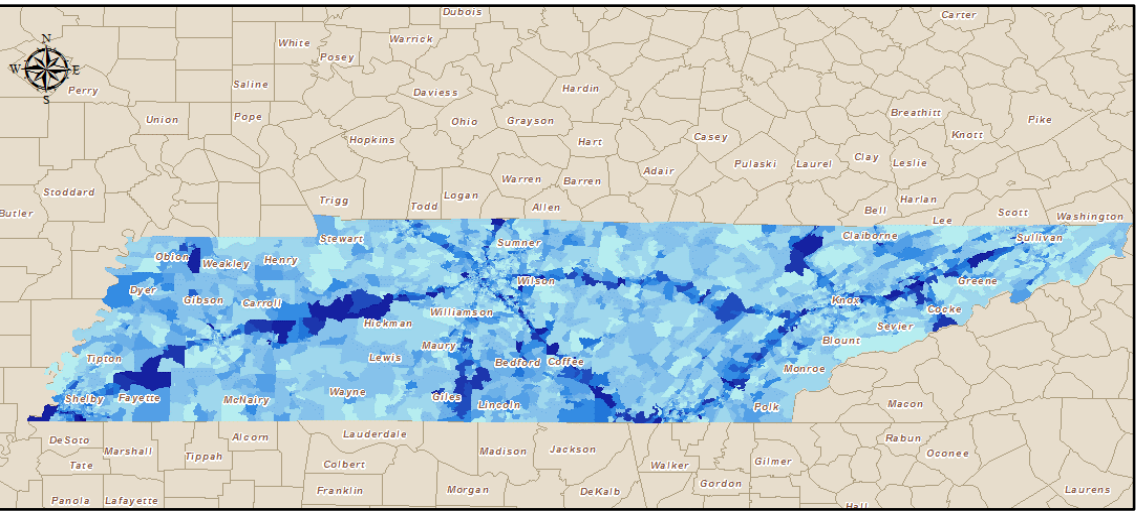


Note: TTa – travel time in North East direction; TTb – travel time in South West direction; TTp95a – 95th percentile travel time in North East direction; TTp95b – 95th percentile travel time in South West direction; TTCVa – travel time coefficient of variation in North East direction; TTCVb – travel time coefficient of variation in South West direction;

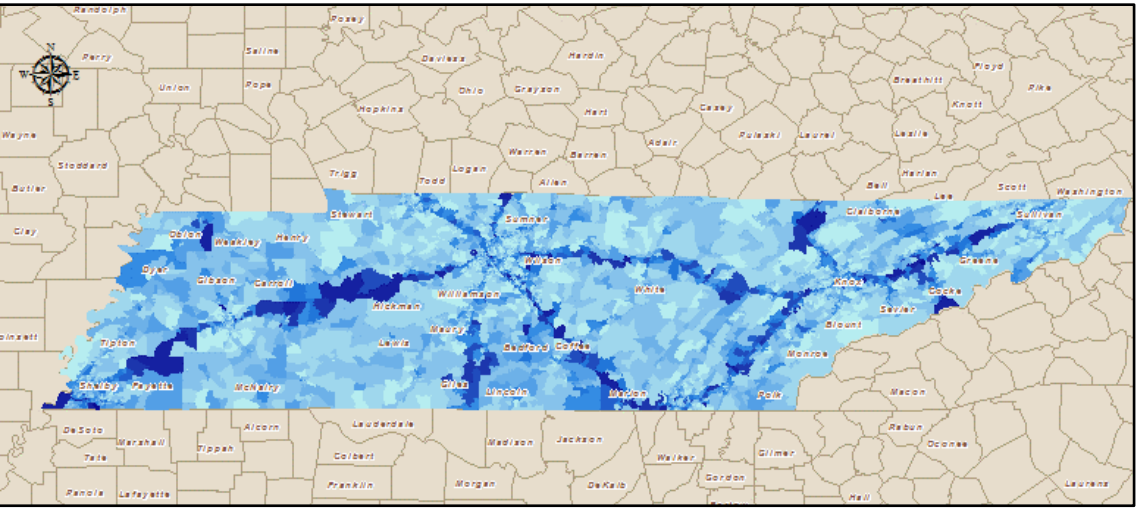
Trip Detection



Origin-Destination



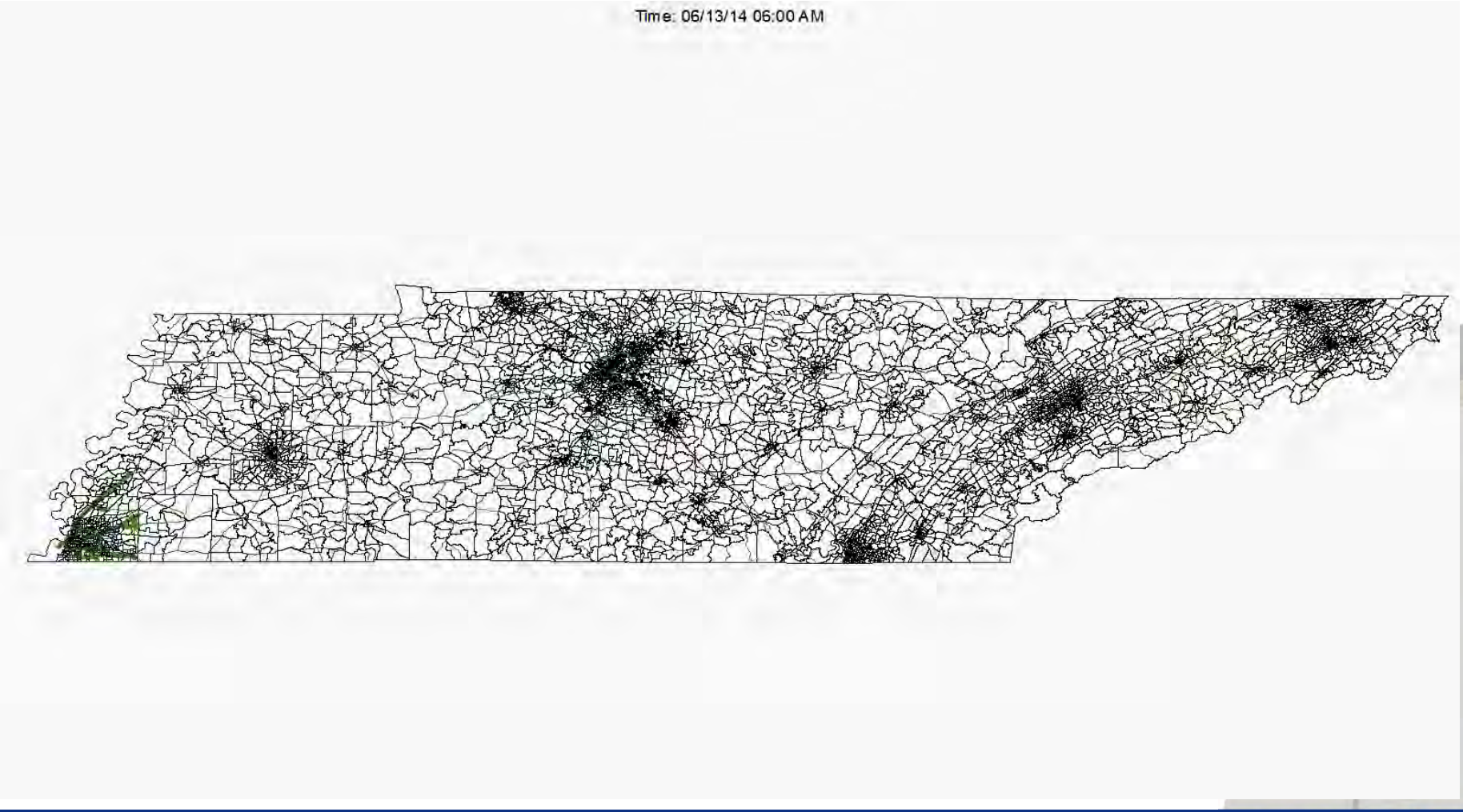
Number of Origins by TAZ for January 2012



Number of Destinations by TAZ for January 2012

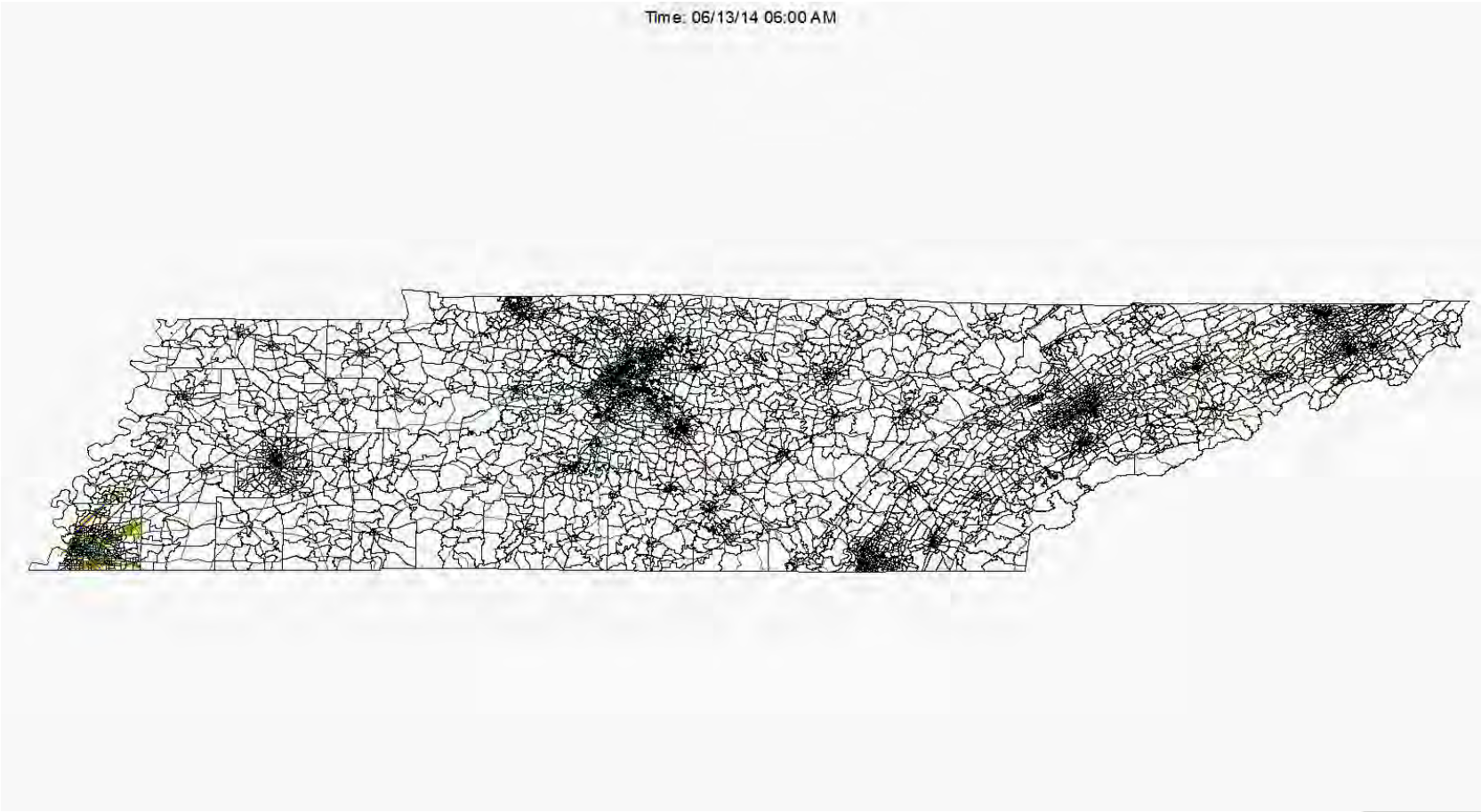
Mobility

Leaving Shelby 6-7am

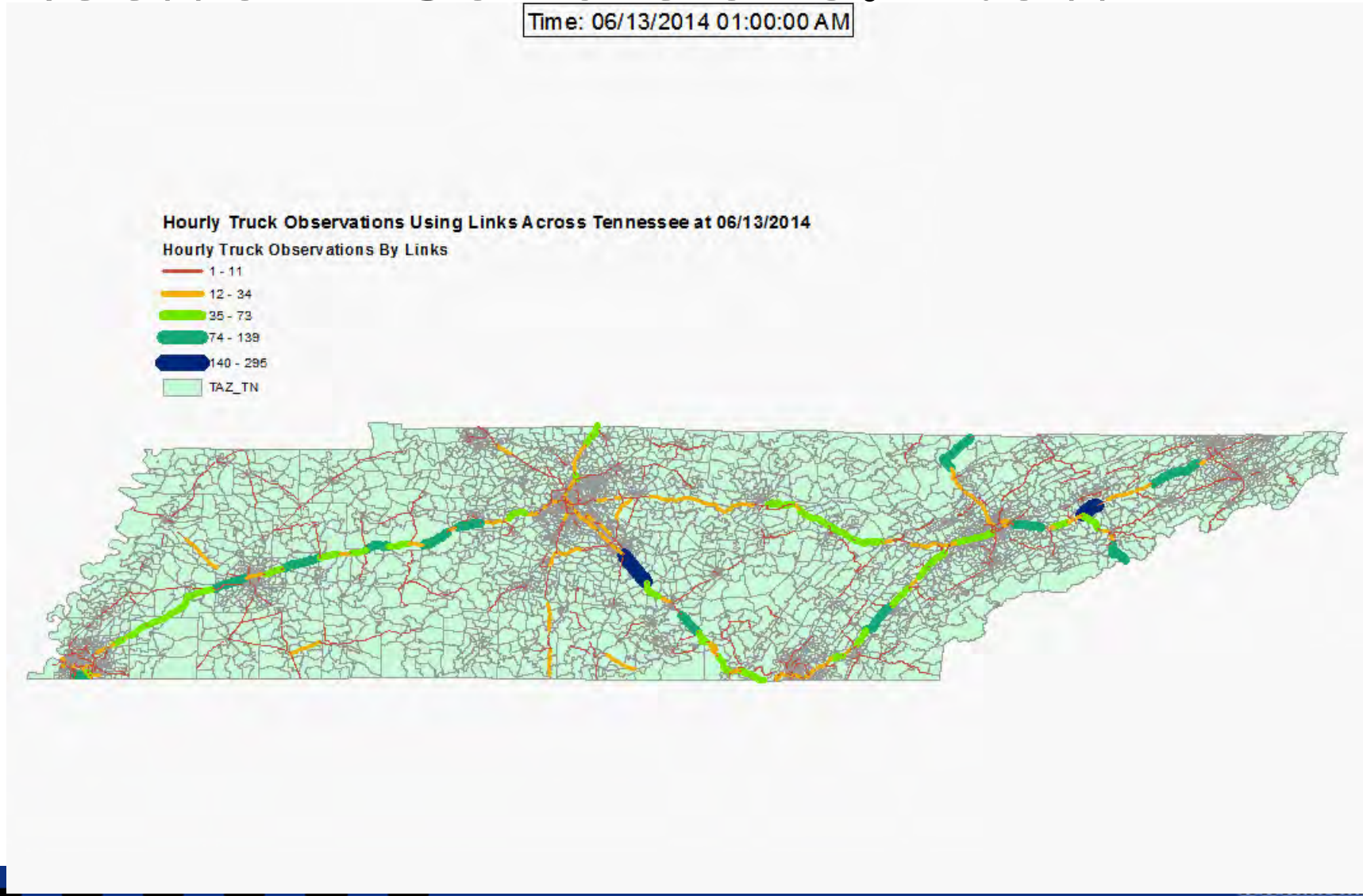


Flows

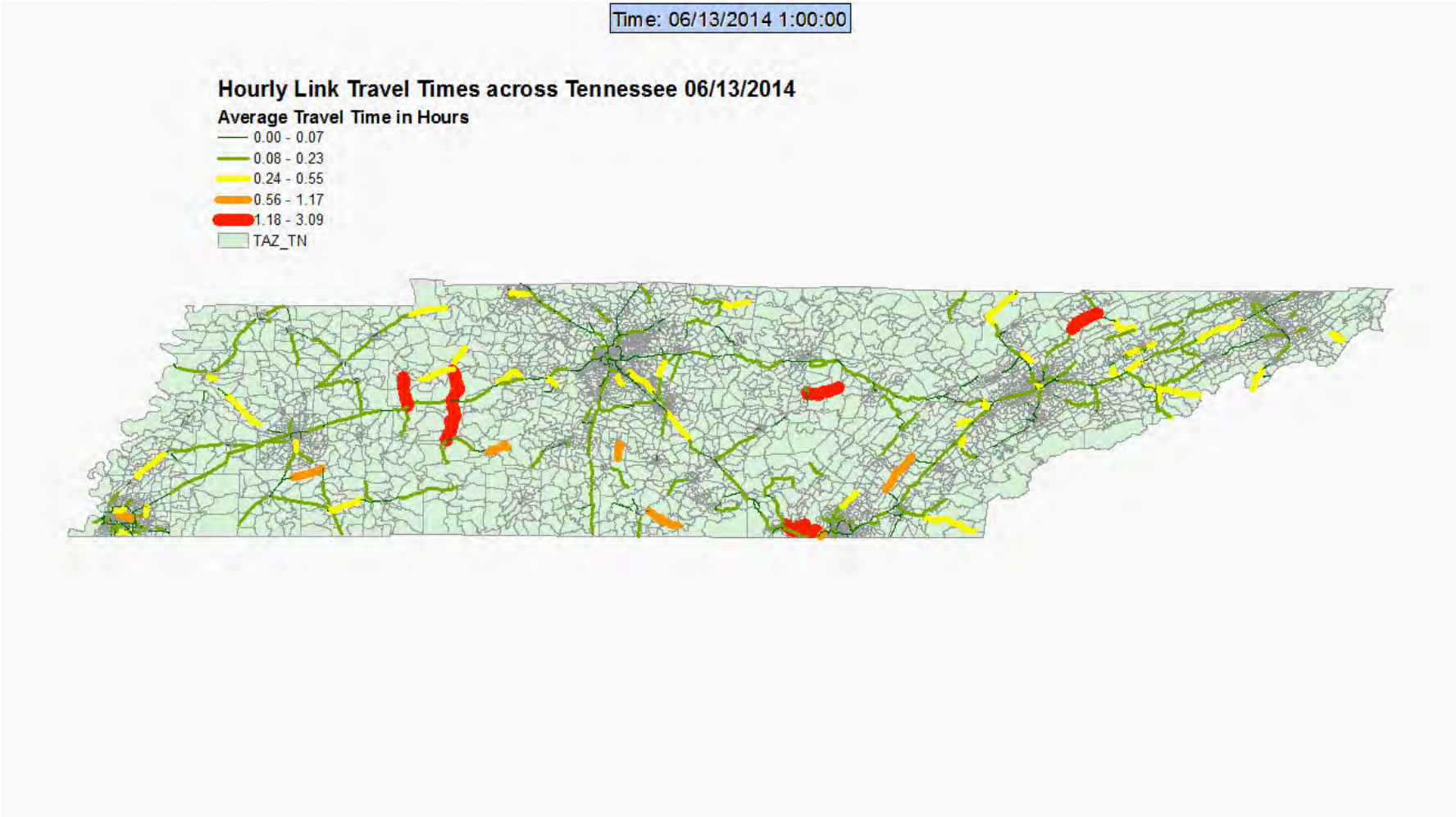
Leaving Shelby 6-7am



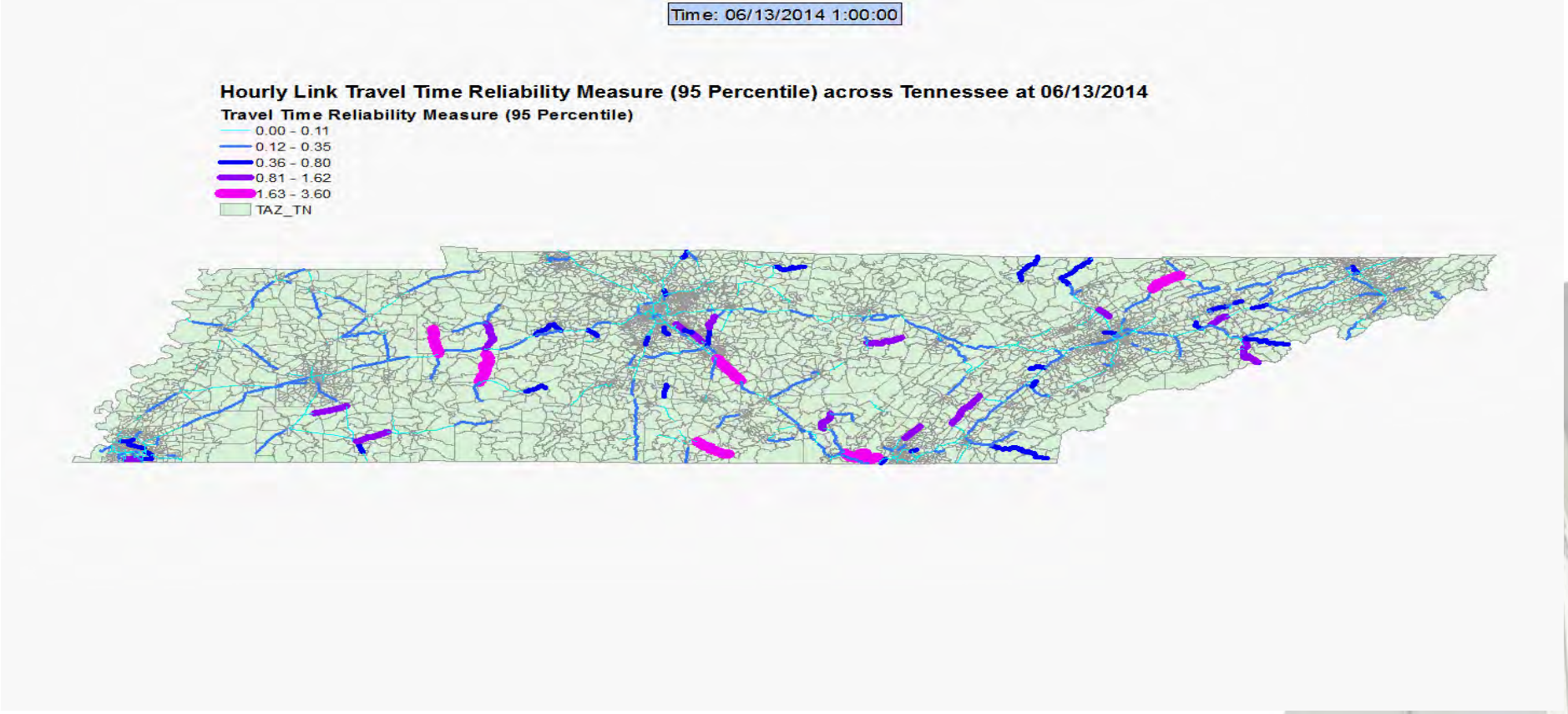
Network Conditions: Flow



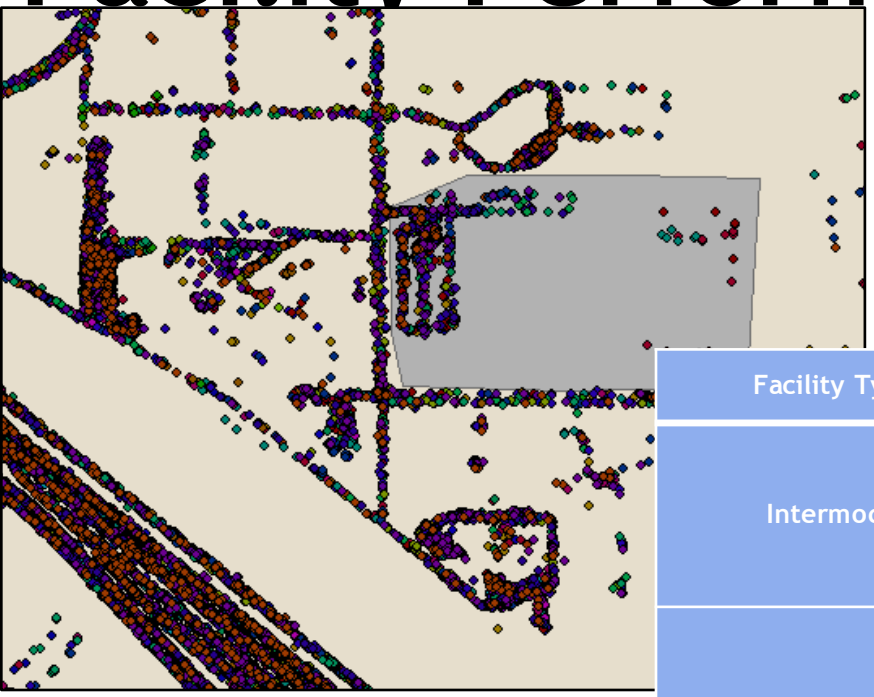
Network Conditions: Travel Time



Network Conditions: Travel Time Reliability (95th percentile)

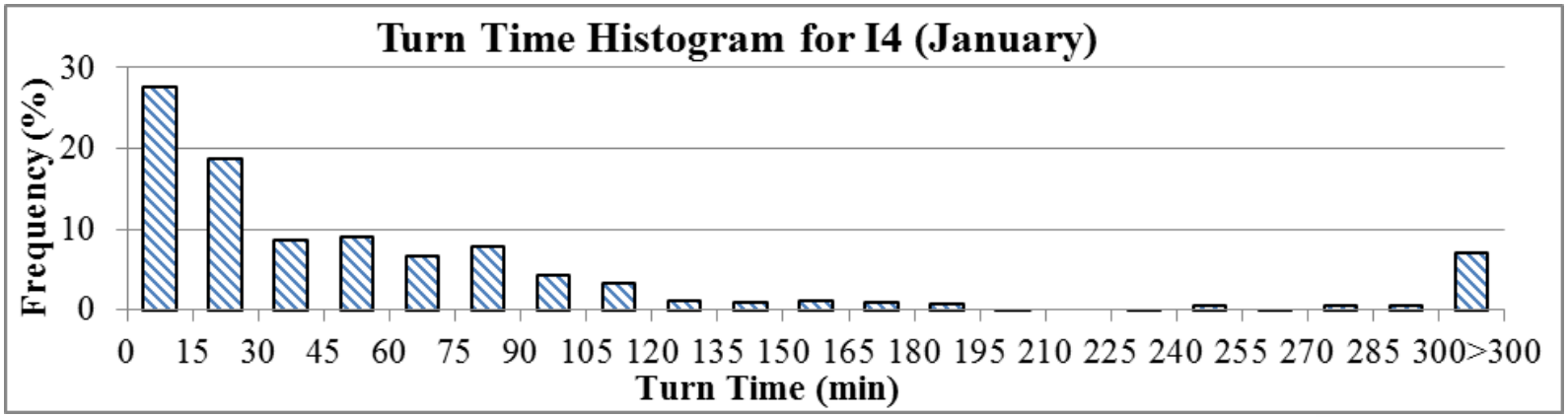


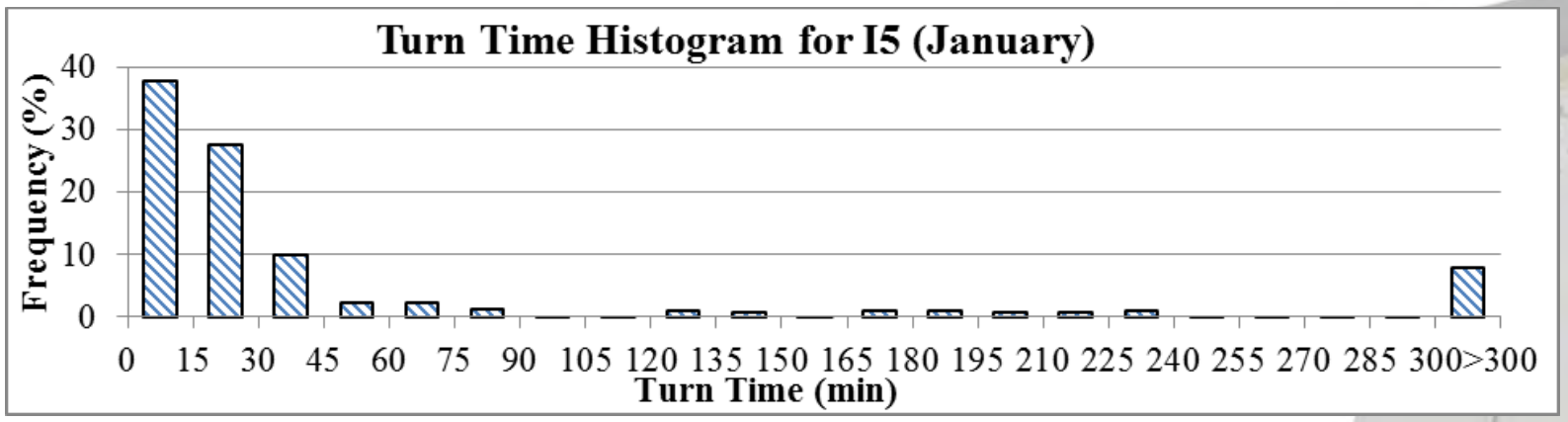
Facility Performance Measure



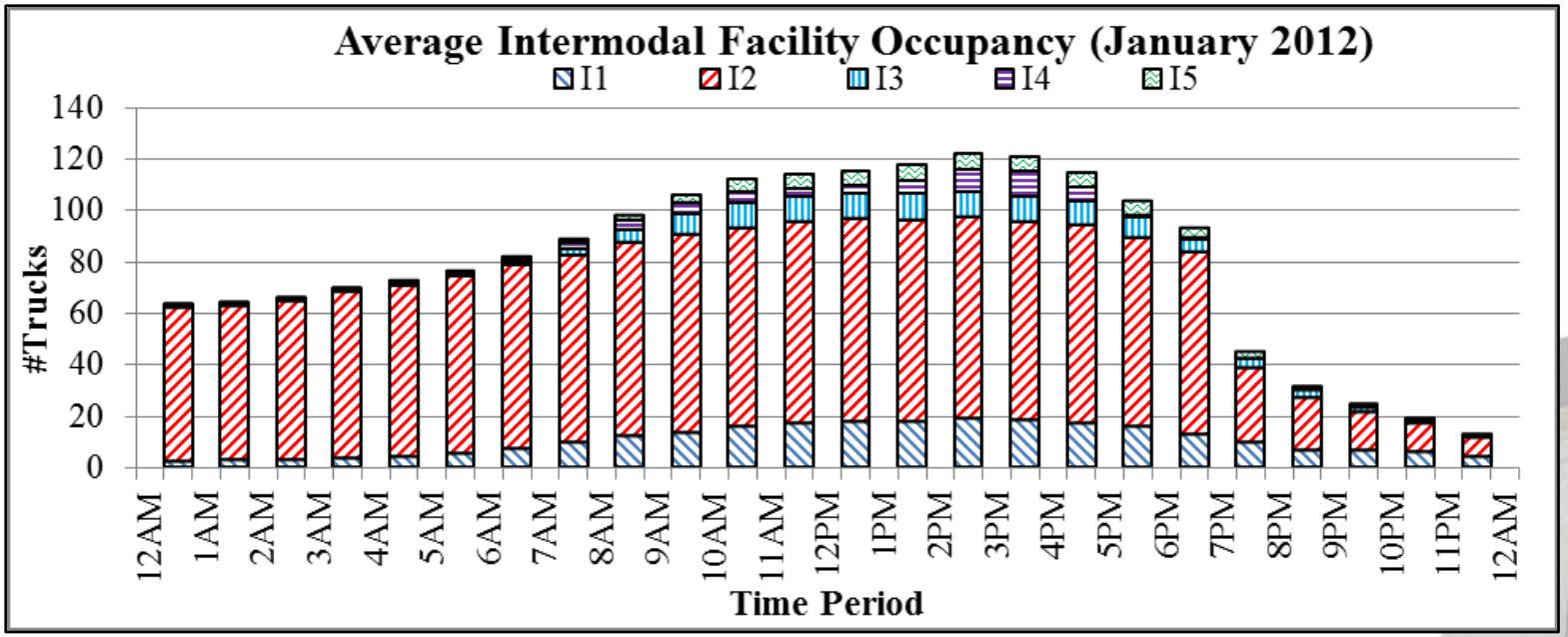
Facility Type	Facility ID	Total Trucks	Avg. Turn Time (min)	Turn Time SD	Turn Time CV
Intermodal	I1	2078	158	252	1.59
	I2	3643	689	509	0.74
	I3	1102	116	171	1.47
	I4	664	81	131	1.62
	I5	782	73	134	1.84
Distribution	D1	70	35	39	1.11
	D2	163	902	459	0.51
	D3	272	89	157	1.76
	D4	357	66	159	2.41
	D5	155	526	503	0.96
	D6	65	129	153	1.19
Warehouse	W1	26	47	74	1.57
	W2	185	454	490	1.08
	W3	62	209	225	1.08
	W4	3	237	328	1.38
	W5	176	85	96	1.13
	W6	3972	569	474	0.83
	W7	1510	550	404	0.73
	W8	30	48	27	0.56
	W9	5	8	8	1.00

Freight Facility Turn Times

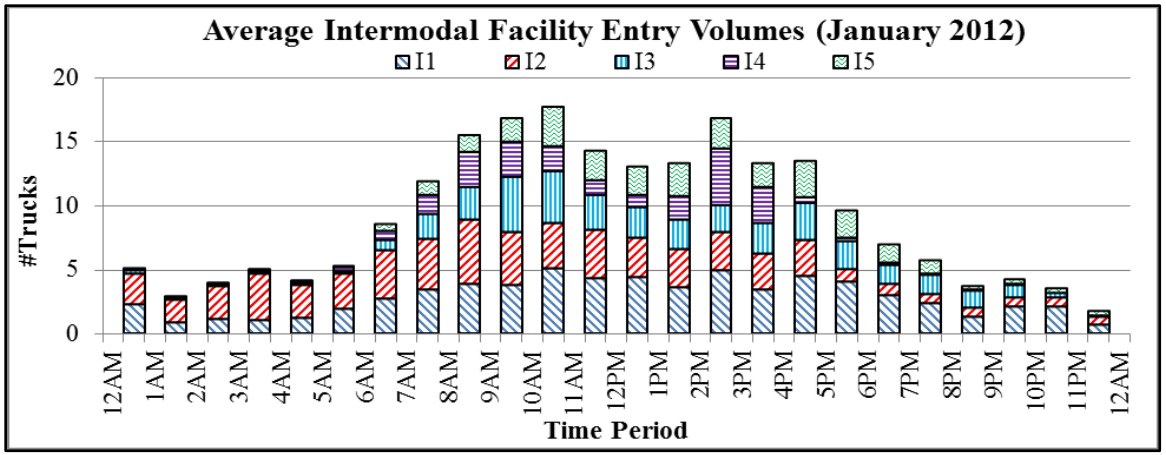


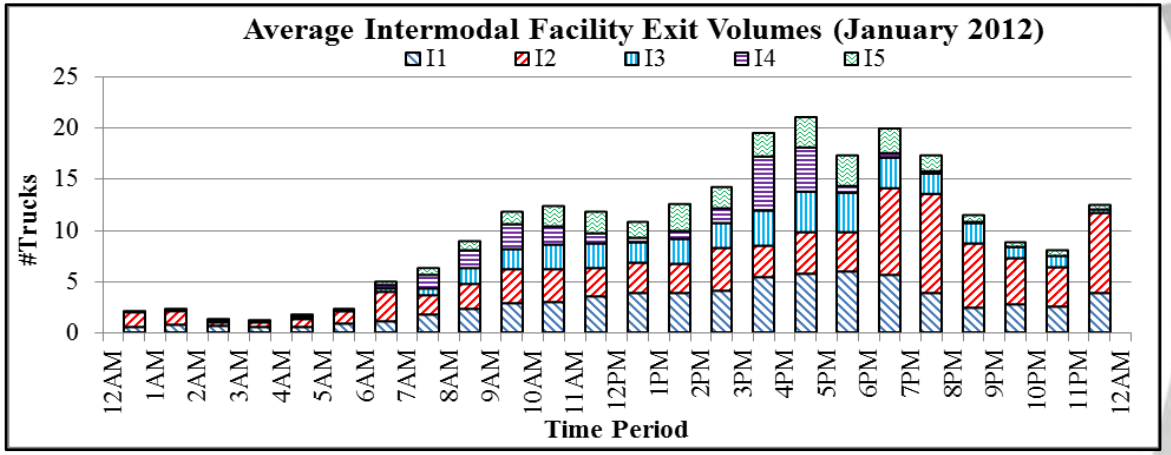


Freight Facility Occupancy



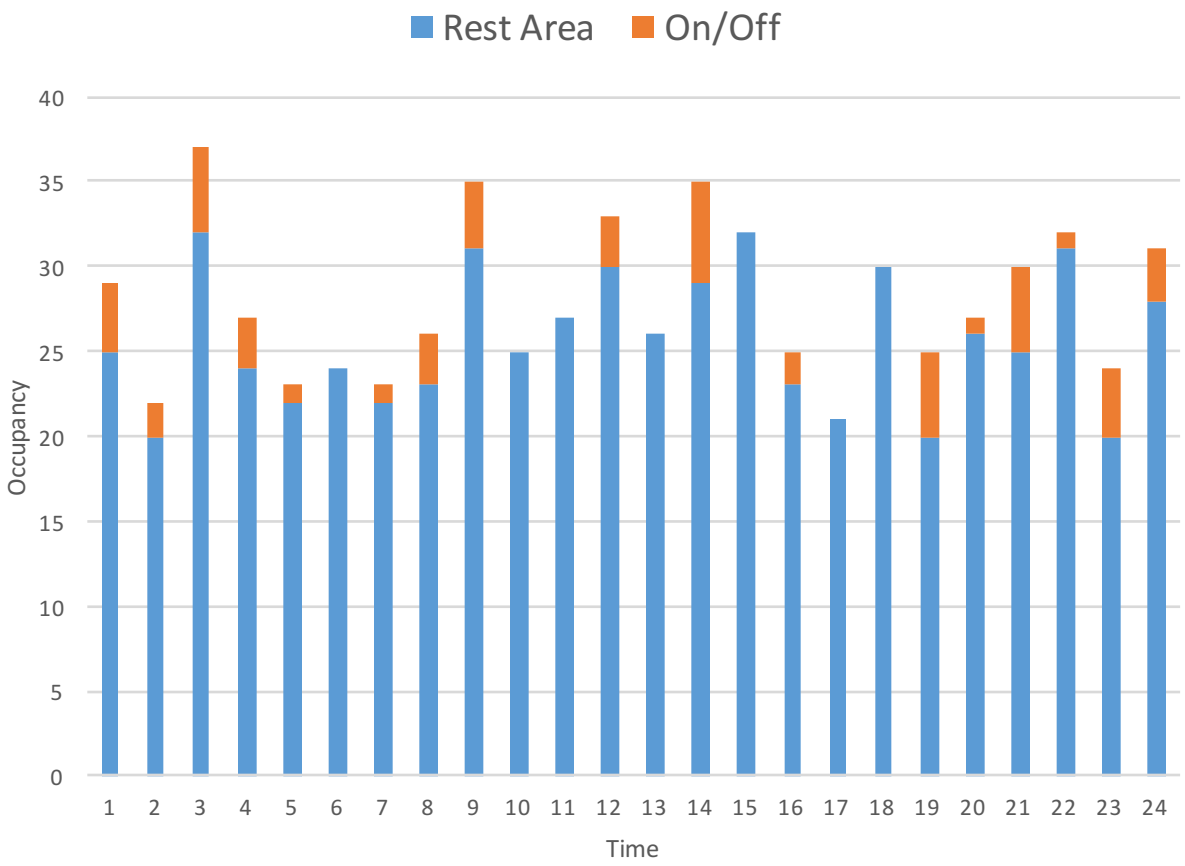
Freight Facility Entry/Exit Volumes

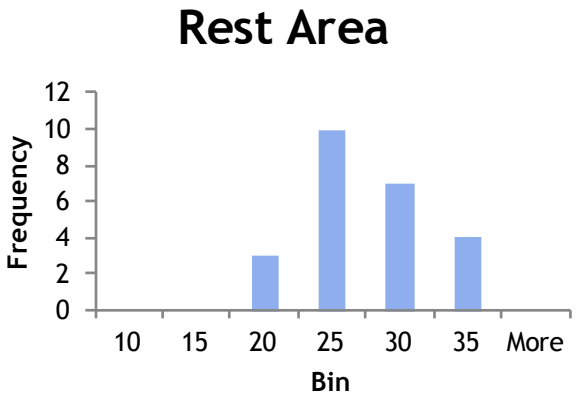


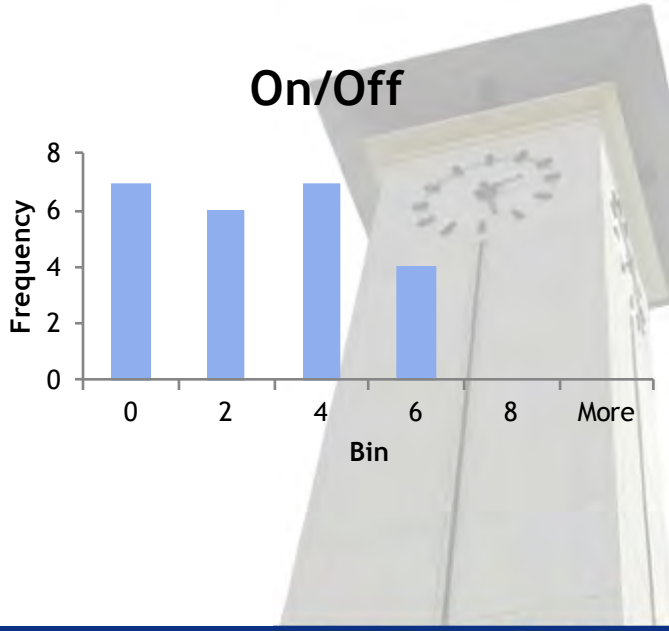


Truck Parking

Truck Parking at SB I-75 MM16







Limitations of GPS Data

- Sample size (small and varies by area)
- Error in GPS devices
- Limited attributes
  - Proprietary nature of the data

In progress

- Truck parking utilization (on- and off- site)
- Safety
- Capacity reliability
- Recurring and non-recurring freight corridor reliability
- Freight and land use integration
- TDM Calibration/Validation

Agency Acknowledgement

- Tennessee Department of Transportation
- Federal Highway Administration
- American Transportation Research Institute
- Wisconsin Department of Transportation

Thank you for your time

Q/A

Graduate Student Acknowledgment
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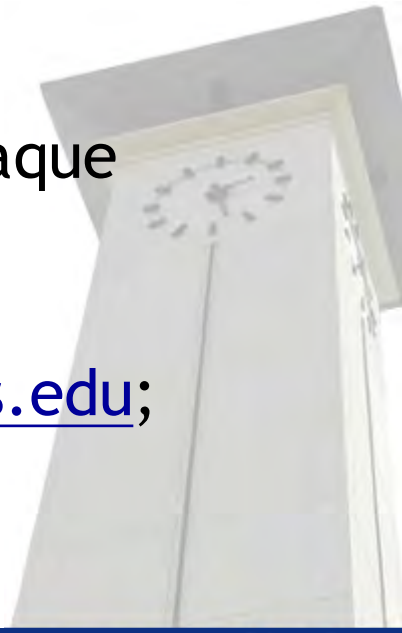
mdlbnets@memphis.edu



Truck GPS Data to Support Transportation Planning

Presentation at Tennessee Model User's Group

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