EXPANDING TRUCK GPS-BASED PASSIVE ORIGIN-DESTINATION DATA IN IOWA AND TENNESSEE

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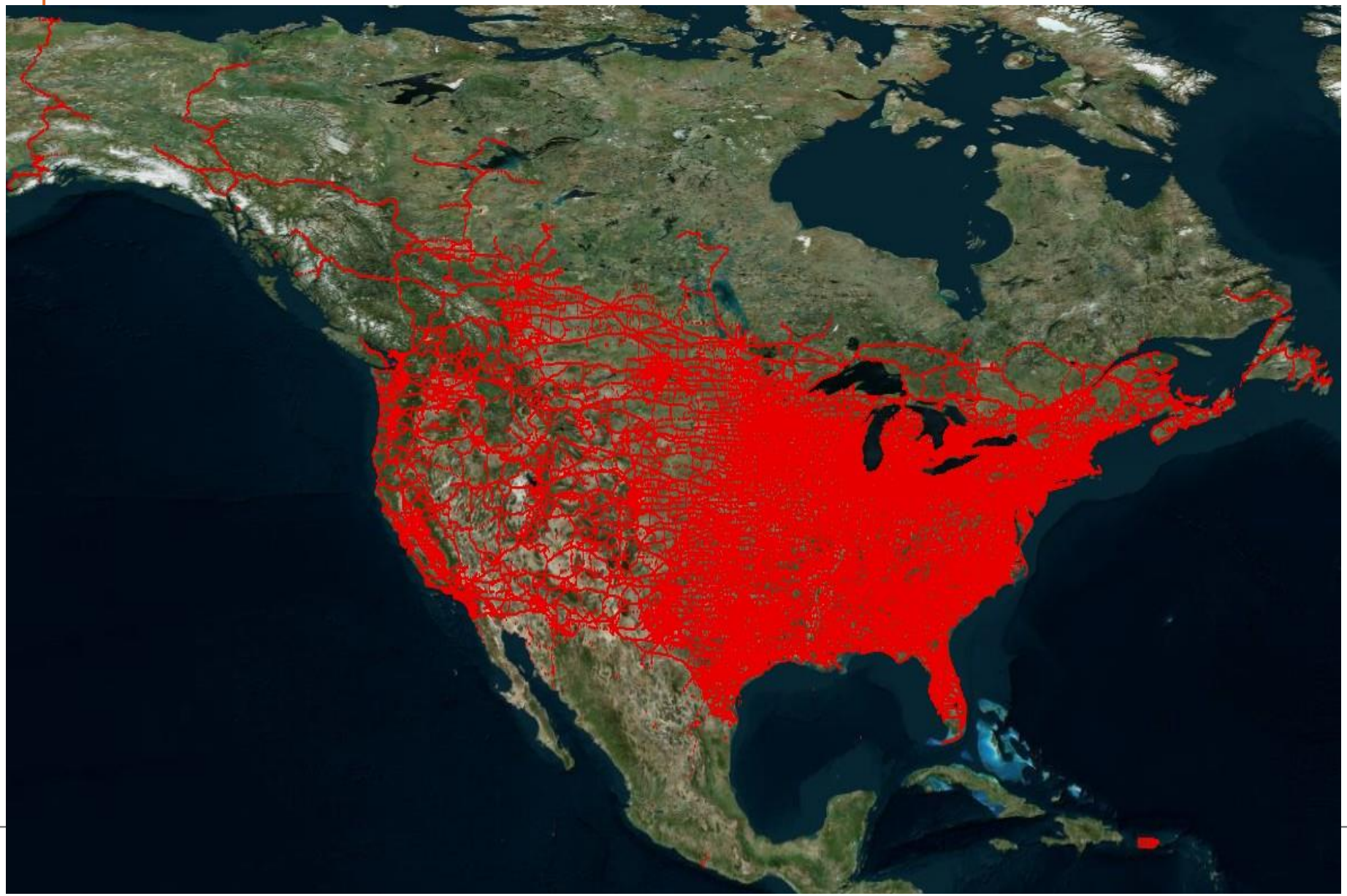
ATRI Board of Directors

ATRI Truck GPS Dataset

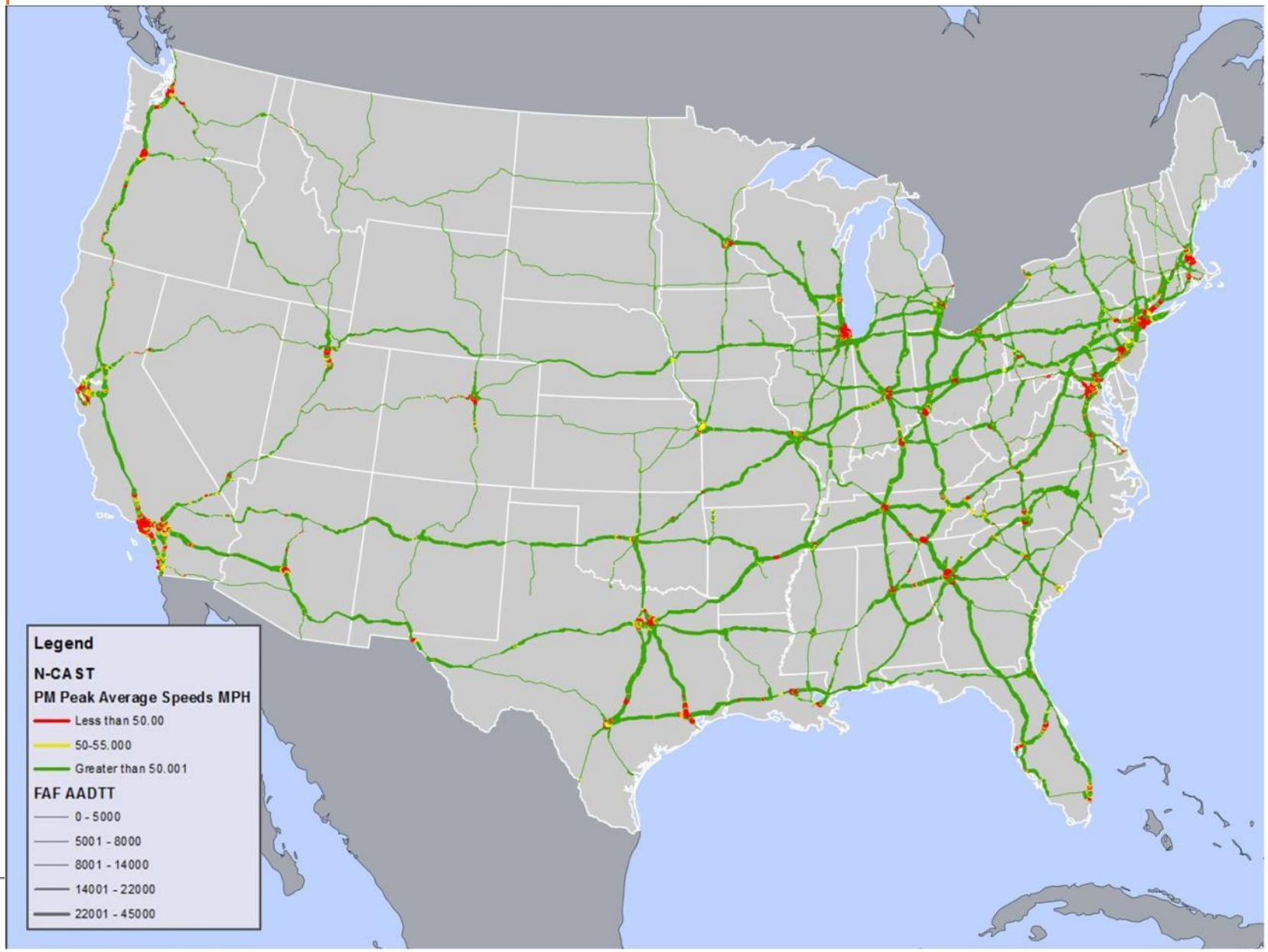
ONGOING TRUCK GPS DATA RESEARCH BEGINNING IN 2001

- Comprehensive North American Truck GPS dataset
- “Big Data”
  - Real time data feeds/ significant hardware and software
  - Currently near **100 million** data points **per day**
  - Will approach **1 billion points per week** later this year
- Fully deployed applications
  - Performance measurement/management
  - Freight flow and truck trip modeling
- Key research areas
  - Economic competitiveness and supply chains
  - Truck volume/intensity/national travel patterns
  - Weather, parking, emergency events

ATRI Truck GPS Dataset – One Day



ATRI Truck GPS Dataset



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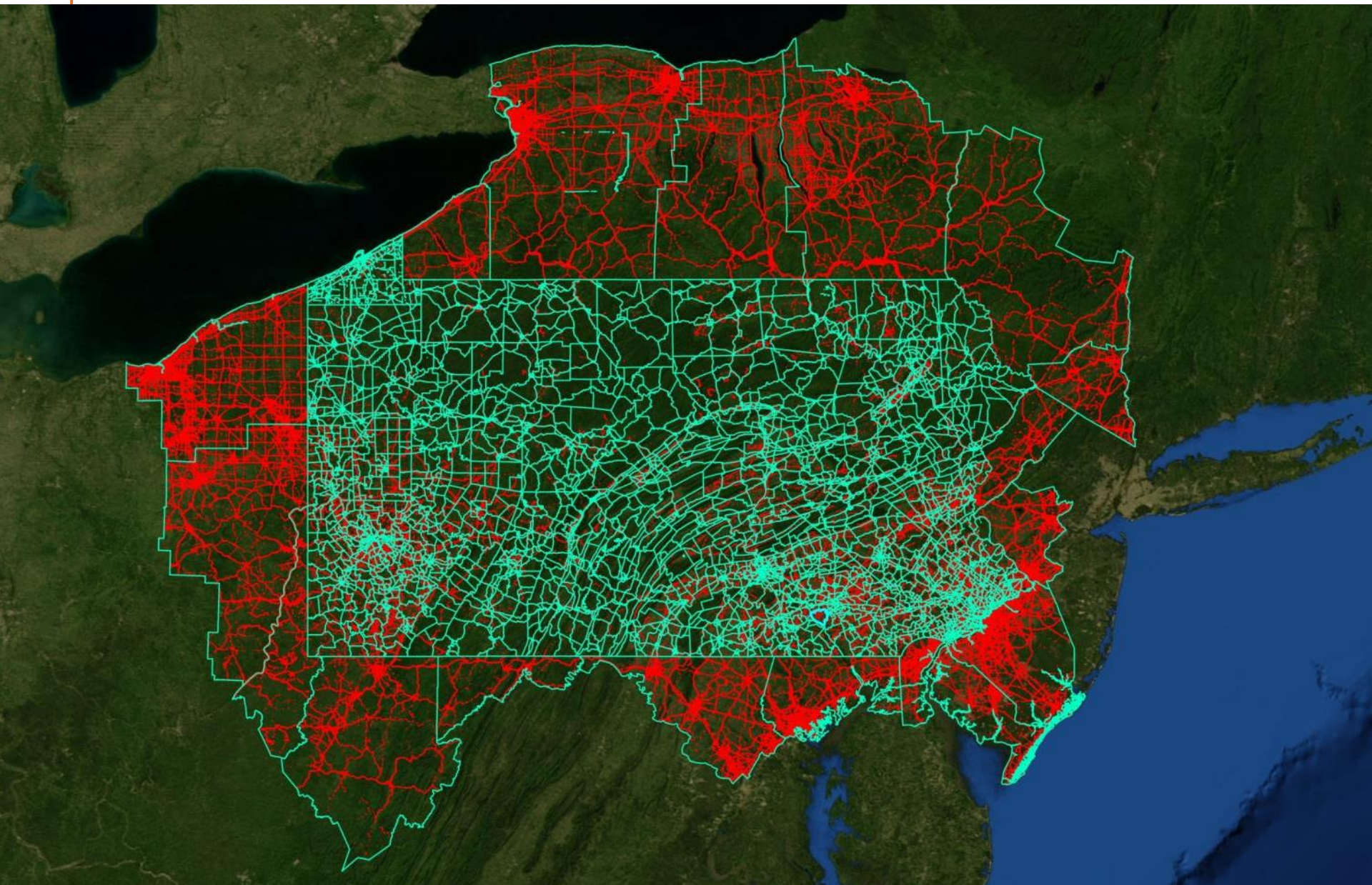

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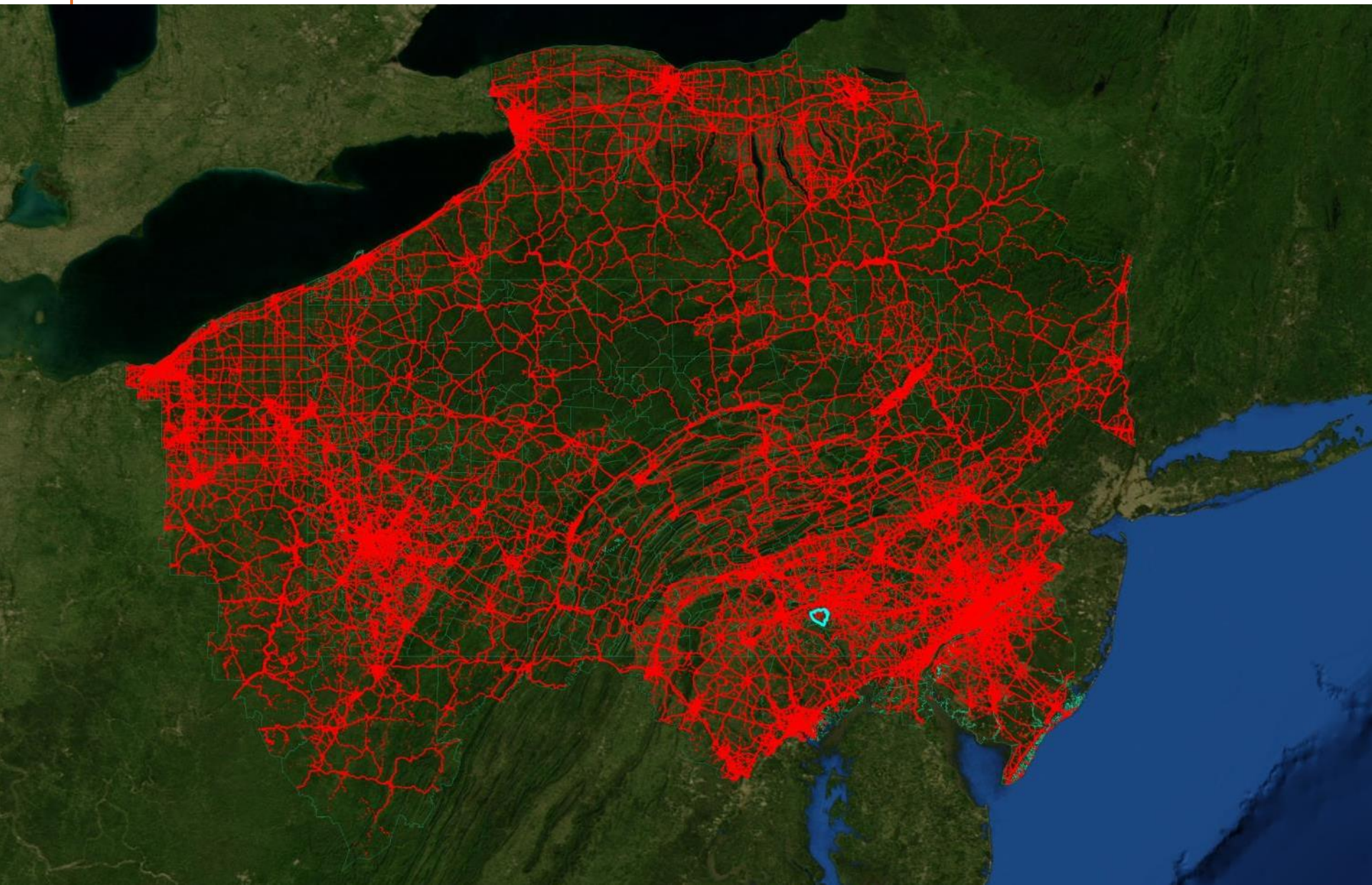

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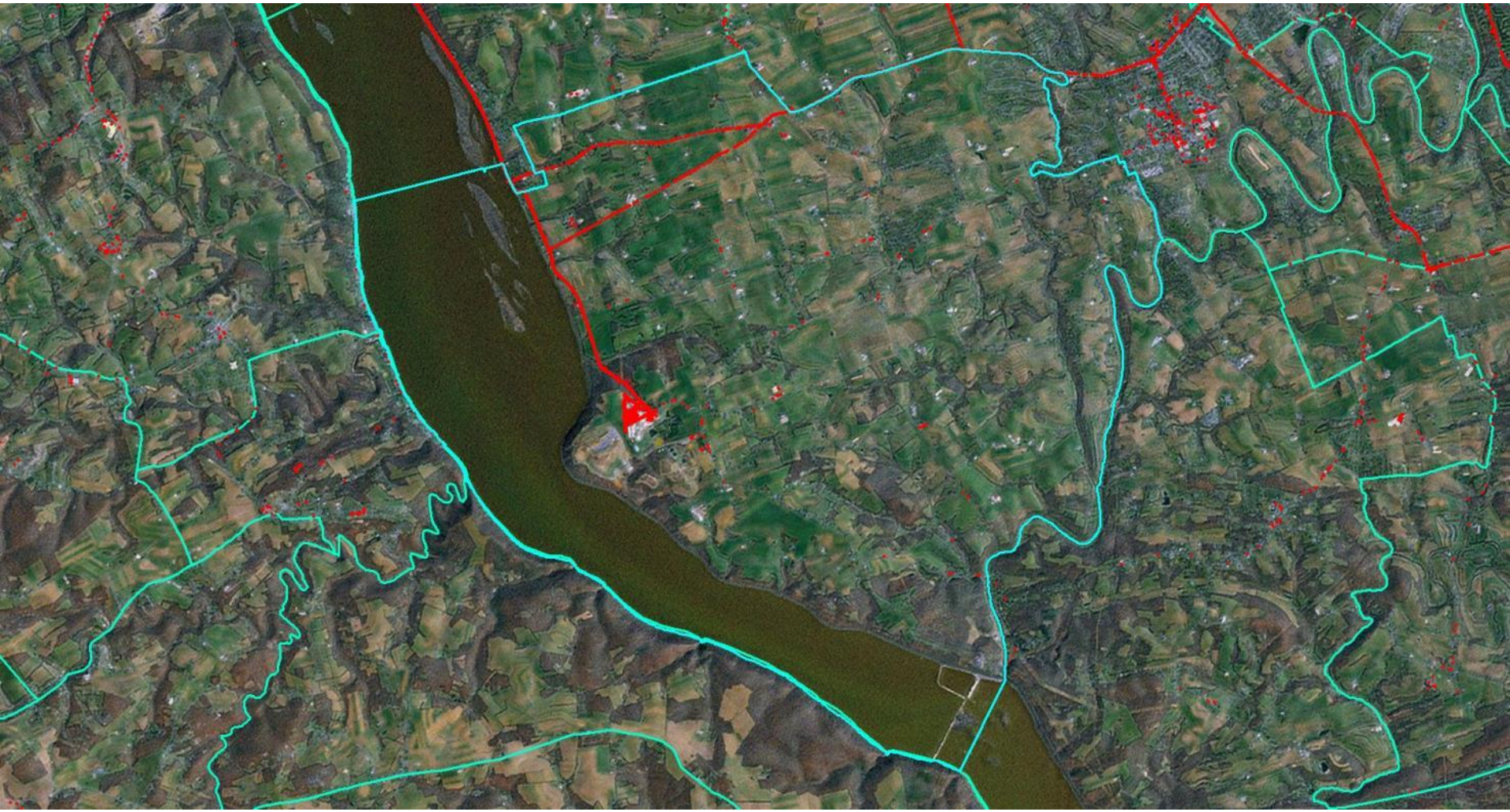

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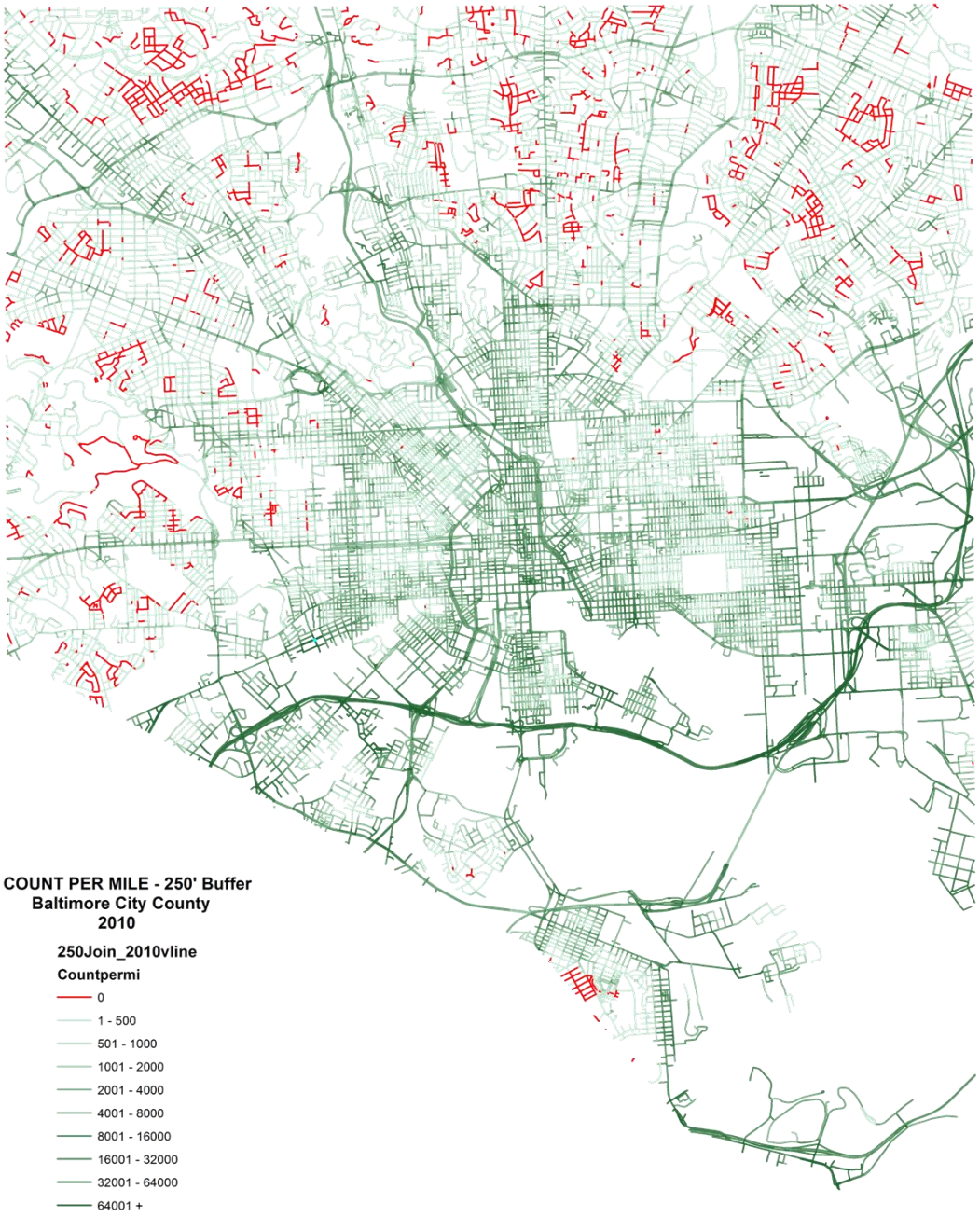
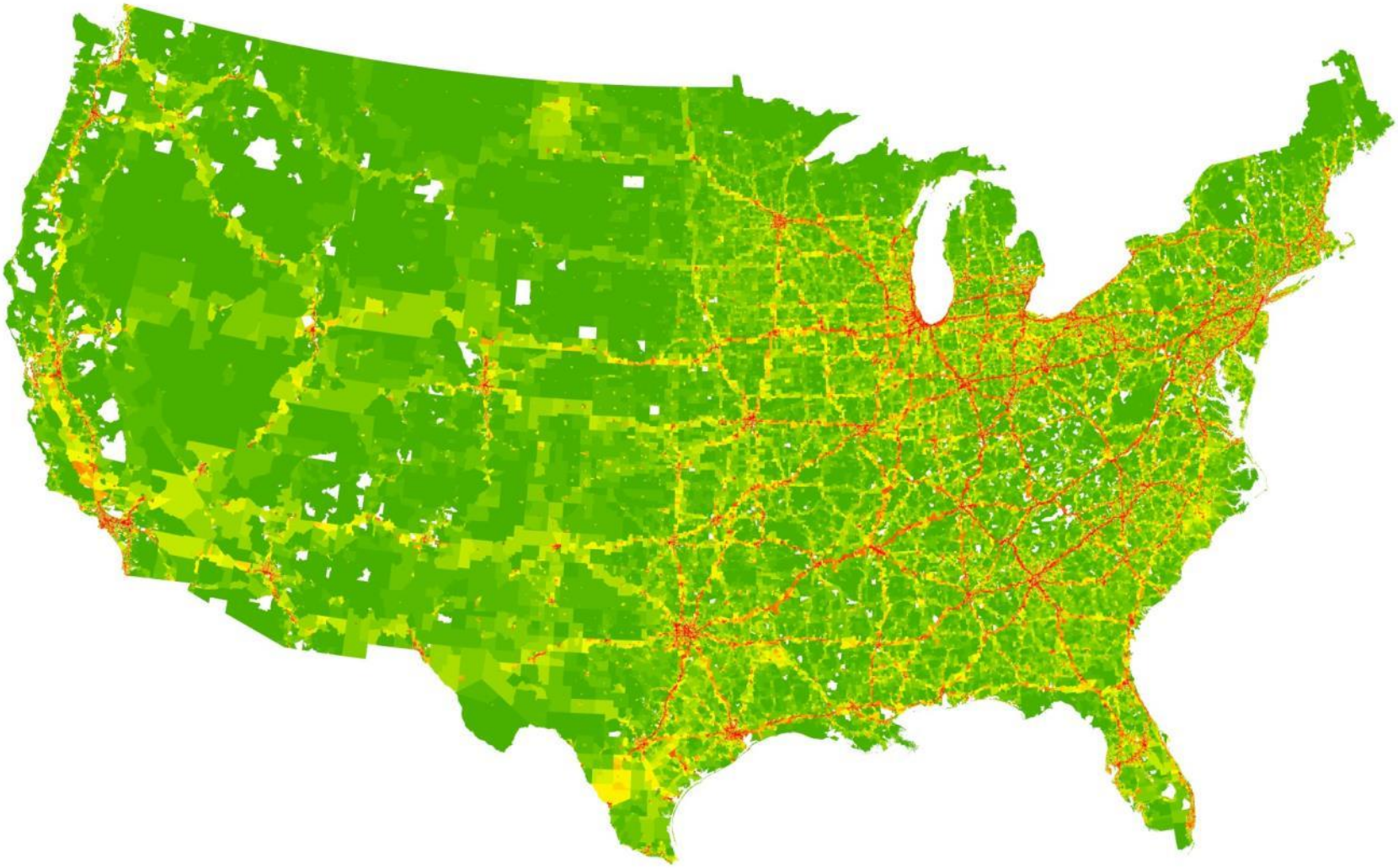

COUNT PER MILE - 250' Buffer
Baltimore City County
2010
250Join_2010vline
Countpermi
0
1 - 500
501 - 1000
1001 - 2000
2001 - 4000
4001 - 8000
8001 - 16000
16001 - 32000
32001 - 64000
64001 +

ATRI Truck GPS Dataset



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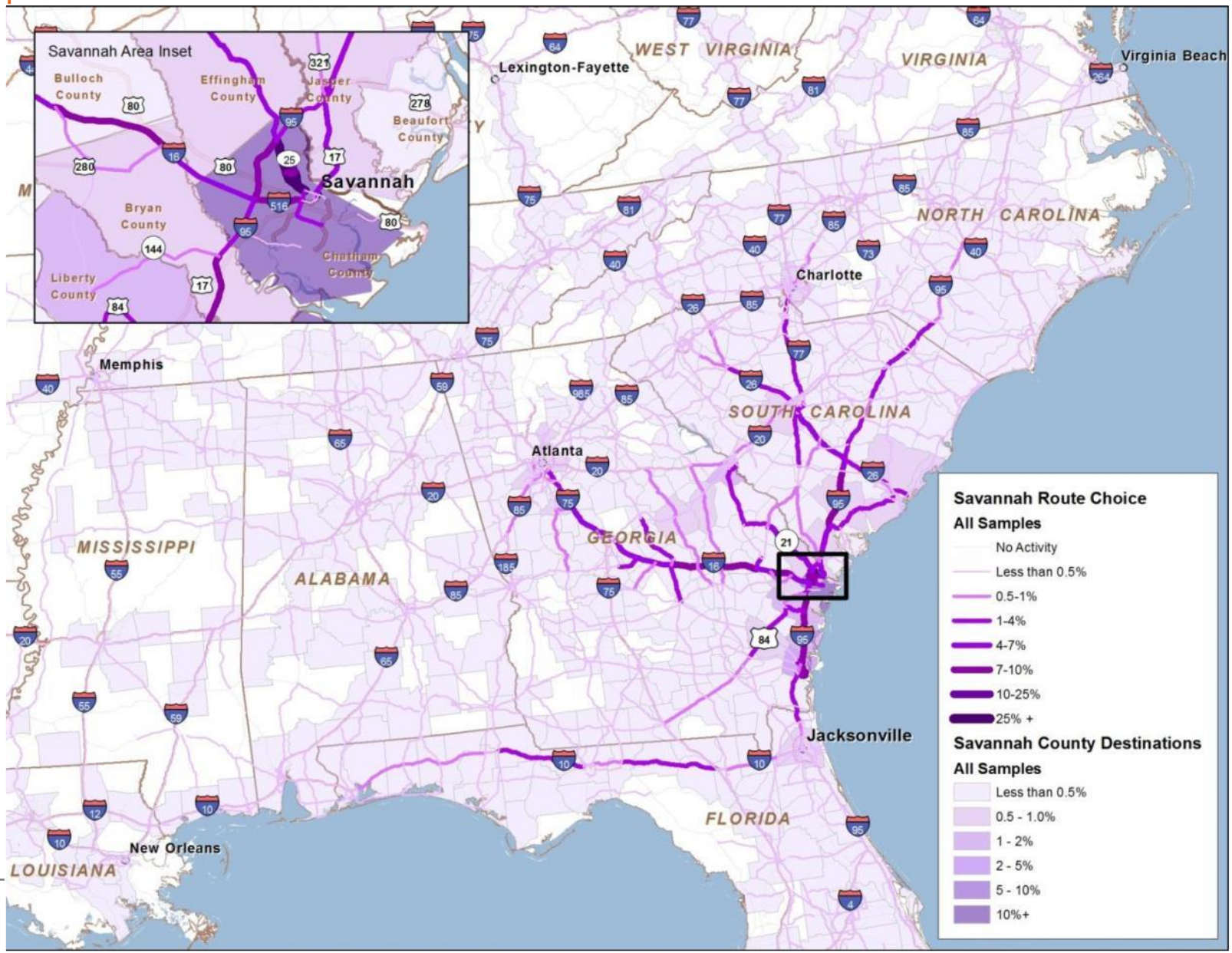

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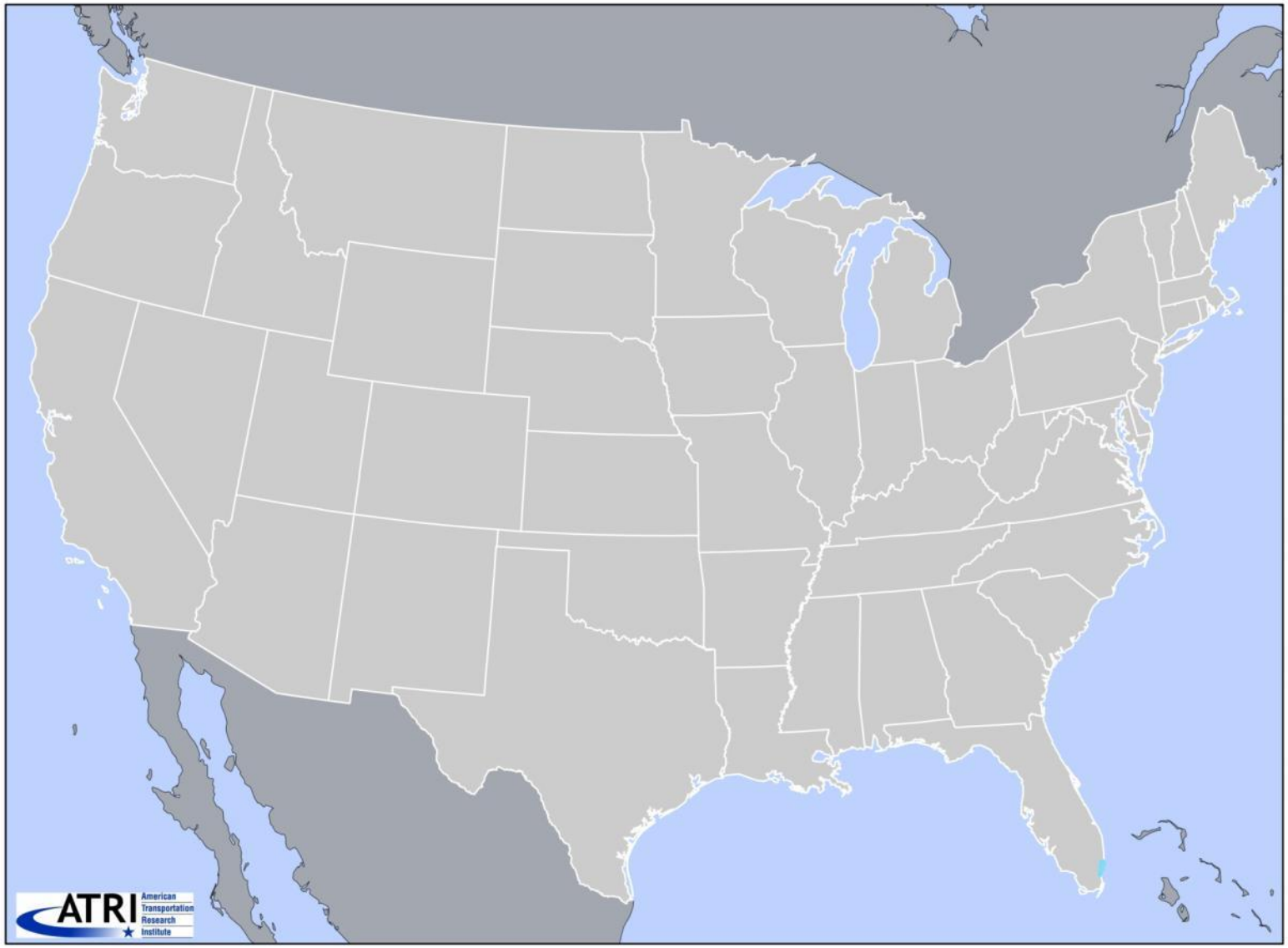

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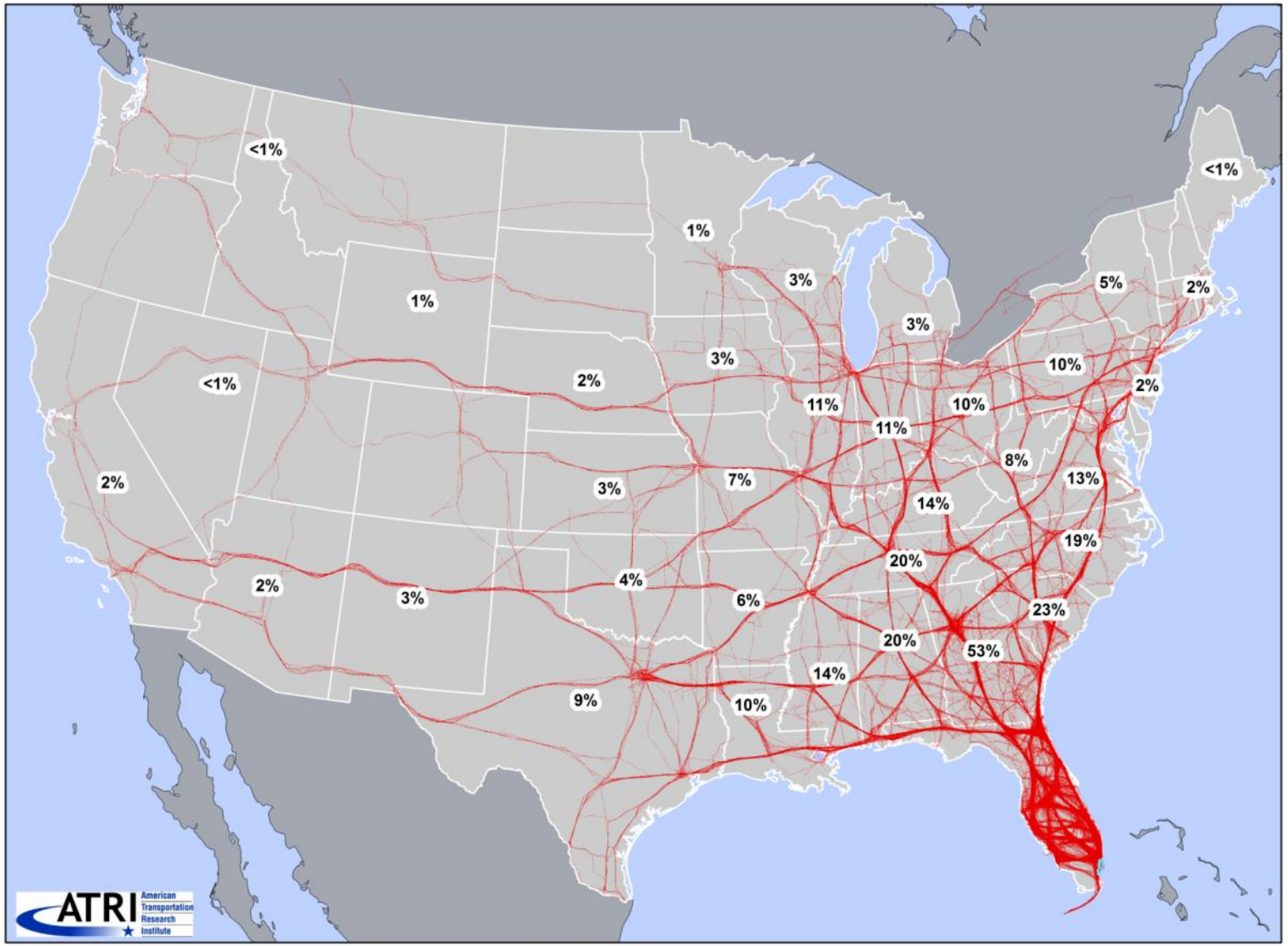
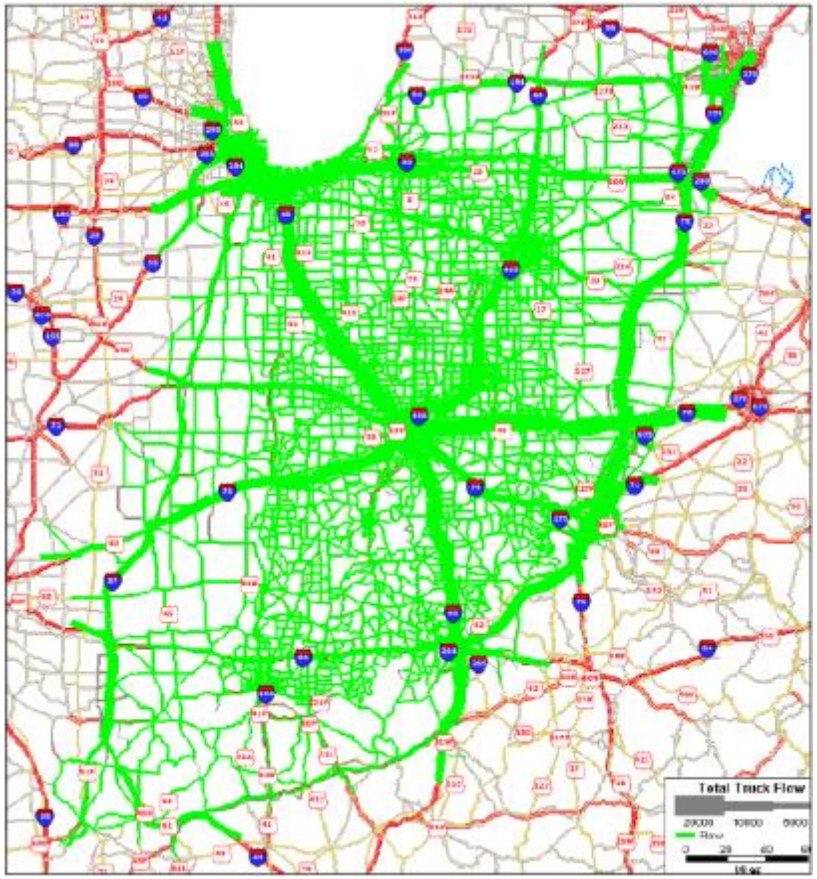


Modeling Applications

PRIOR USAGE OF ATRI TRUCK GPS DATA

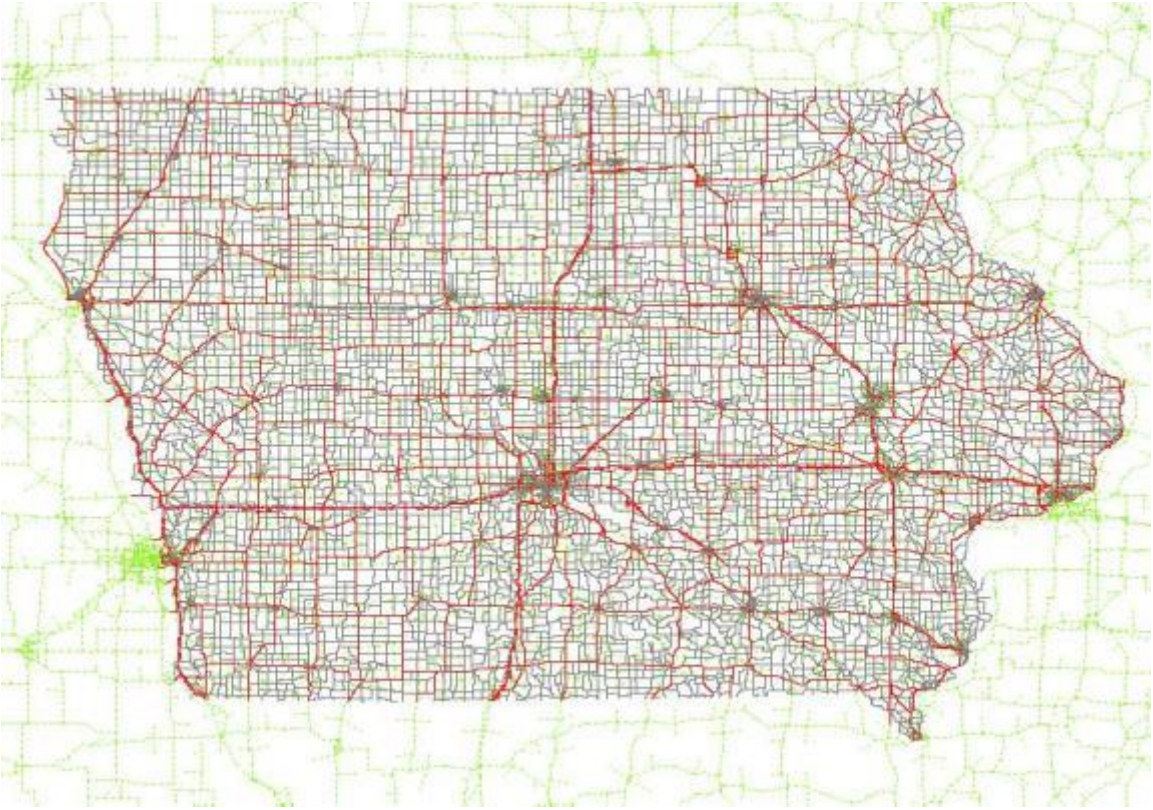
- 2012 Indiana Statewide Travel Demand Model Update
  - RMSE: 69.3% to 60.6%
  - MAPE: 74% to 42%



Iowa Dataset

DETAILS OF ATRI TRUCK GPS DATA WITHIN IOWA

- Four 2-week samples from each quarter of 2012
- Over 135,000 individual trucks



Data Processing

ATRI PING DATASET MUST BE PROCESSED TO TRIP O-D PAIRS

- Identifying movement for all records
- Determine trip O-Ds, travel time, VMT

from TAZ	to TAZ	distance	time	elapsed time	speed	status1	status2
10	101032	66.0	57.7	57.7	68.6	moving	moving
101032	101033	16.3	14.3	72.0	68.6	moving	moving
101033	101015	26.8	27.9	99.9	57.5	moving	moving
101015	101015	0.0	5.0	5.0	0.0	stopped	stopped
101015	101015	0.2	2.7	7.7	5.2	stopped	stopped
101015	101015	0.3	9.8	17.5	2.0	stopped	stopped
101015	101015	0.1	0.3	0.3	28.2	moving	*stopped?*
101015	2035	37.1	60.0	60.3	37.1	moving	moving
2035	18099	67.8	65.4	125.7	62.2	moving	moving
18099	27006	5.9	5.4	131.1	65.3	moving	moving
27006	18023	10.0	15.9	147.0	37.8	moving	moving
18023	18023	0.0	5.0	5.0	0.0	stopped	stopped

Trip	O	D
1	10	101015
2	101015	18023

Data Processing

Data Cleaning

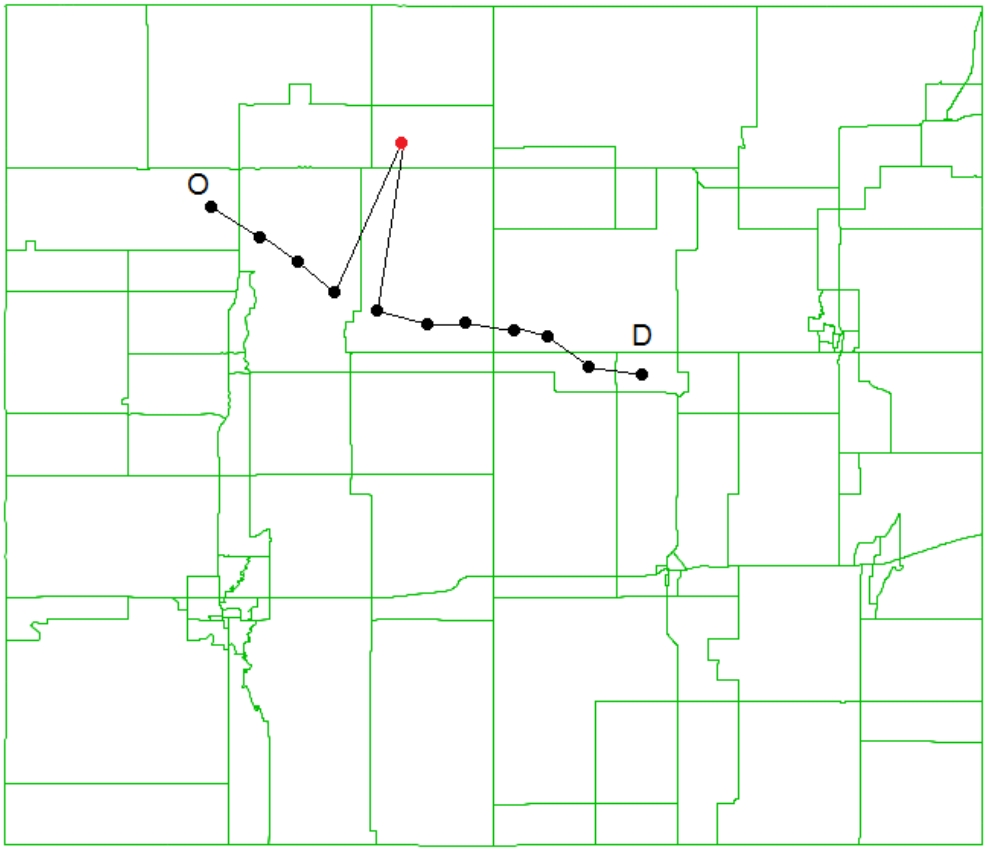
METHODS INTRODUCED TO IMPROVE PROCESSING

- Over 50 million movement records from 135,000 trucks

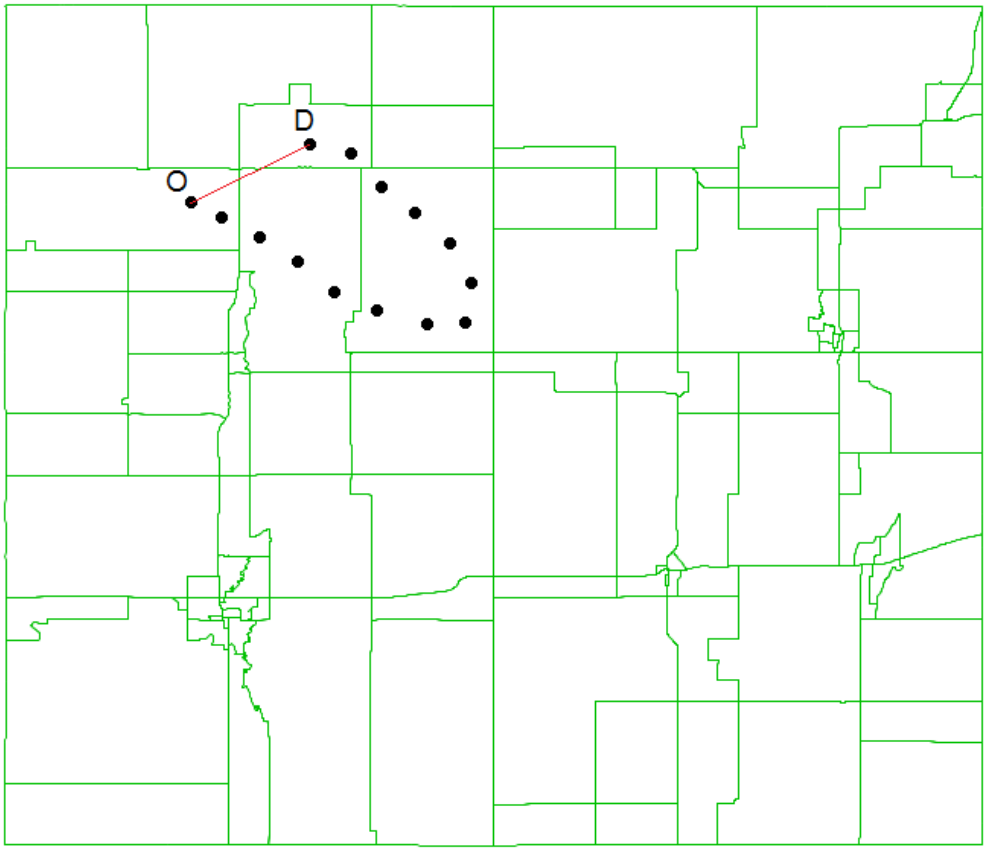
- Data Filtering:
  - GPS jumps – urban canyons, mountains, spatial joins, etc.
  - Missing data – spatial joins
  - Study period edges – trips in progress
  - Duration & OD mismatch – missed stops, GPS jumps

- Applied conservative filtering methods in Iowa
- Working on more intelligent filters

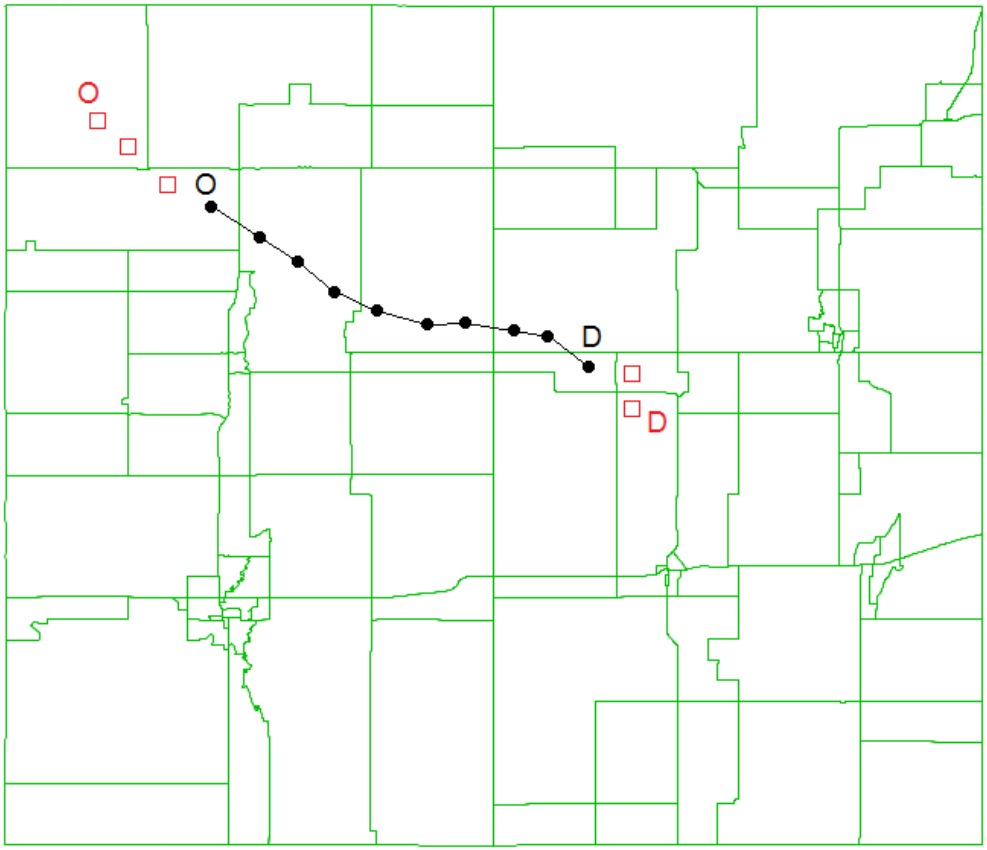
GPS Blips



Circuity



Start & End Time



Processing Results & Scaling

DATA CAPTURES ROUGHLY 10% OF TRUCKS OVER 56 DAYS

- Processed data contains:
  - 2.8 million truck trips over 56 days
  - 60,656,488 truck VMT within Iowa
  - 1,083,152 average daily truck VMT
  - 10,731,507 Iowa DOT estimated 2012 daily truck VMT
  - **Sample rate of 10.1%**

- Factored raw data by 0.1769 to represent daily preliminary seed OD table

Weighting & Expansion

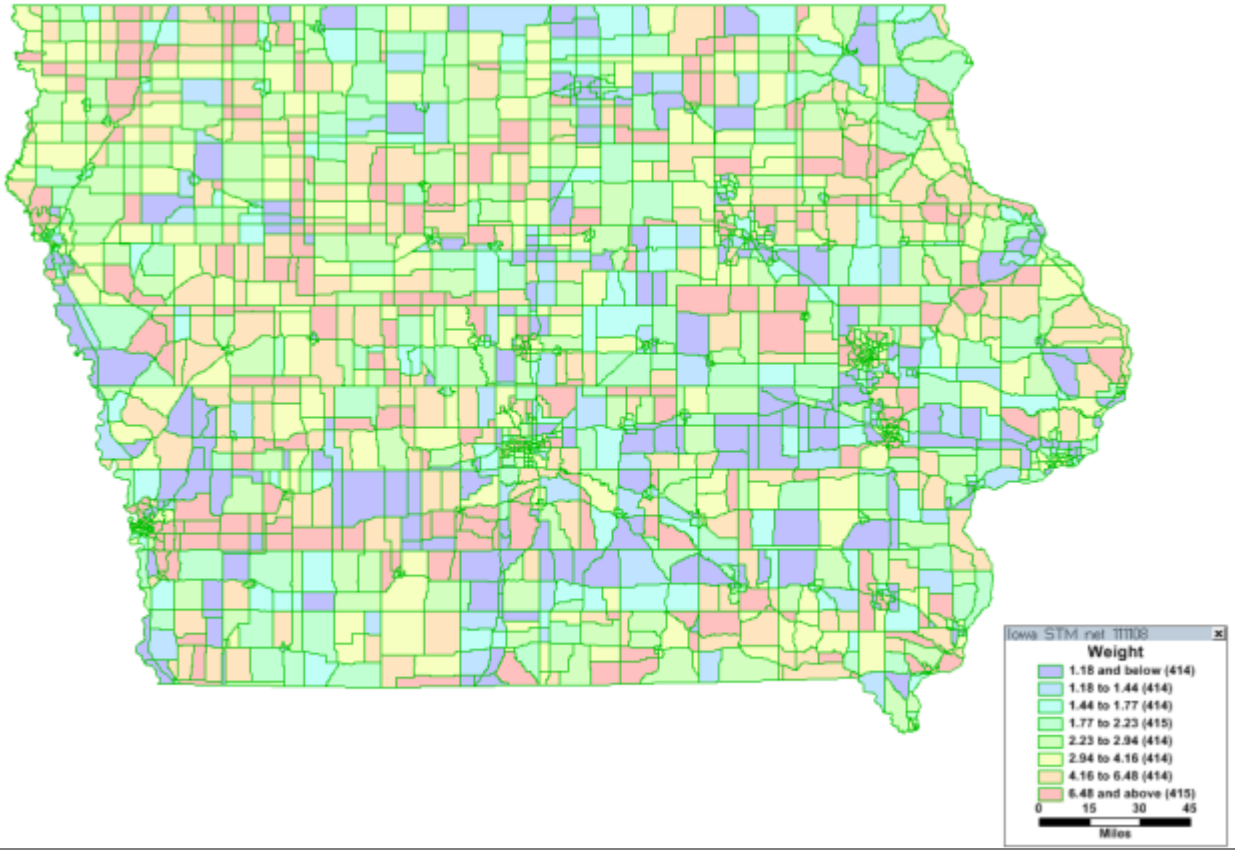
GOAL FOR IOWA TO MOVE BEYOND SIMPLE SCALING

- Initial statewide truck modeling application of ATRI data in Indiana stopped with scaling, ultimately used ODME
- ATRI data is not a random sample – suspected some biases
- Anecdotal evidence for geographic/regional & trip-length (short-haul) biases
- Developed a weighting scheme to address these sample biases by analyzing ODME

Geography

NO EVIDENCE OF SYSTEMATIC GEOGRAPHIC BIAS

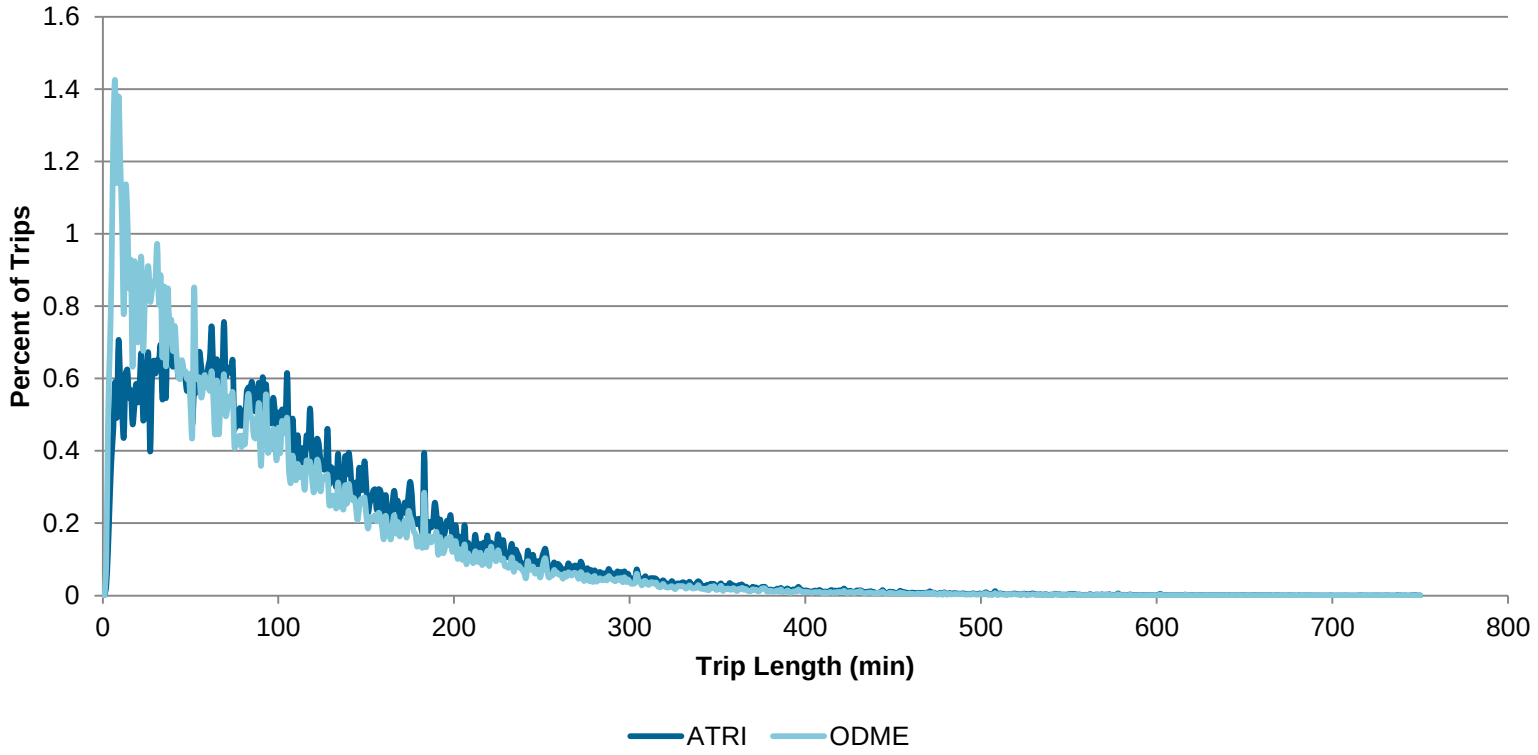
- Geographic differences of sample coverage in Iowa / Halo area



Trip Length – Short Haul / Long Haul

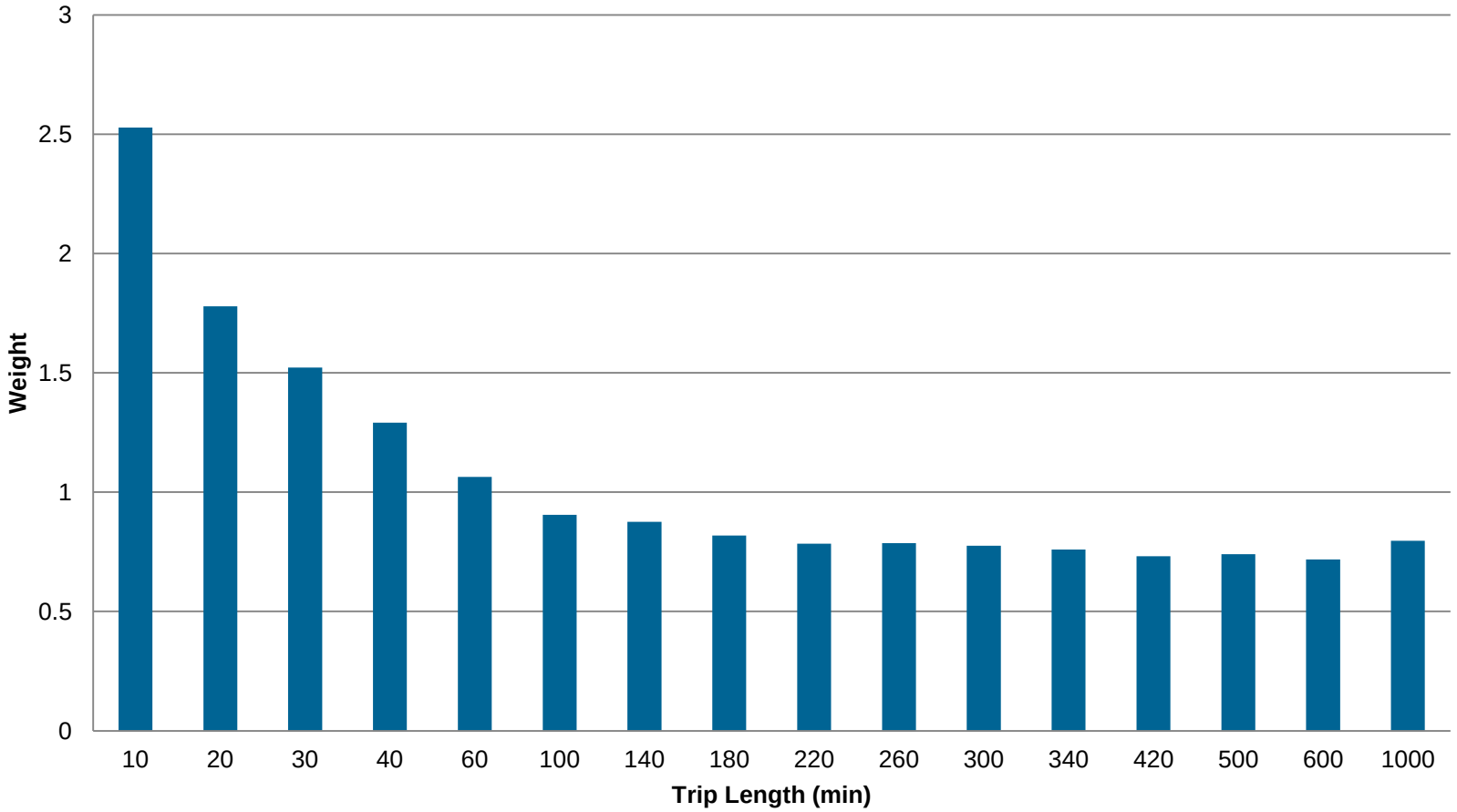
BIAS TOWARDS LONG HAUL

- Confirmed suspected bias of long-haul over short-haul truck trips
- Bias was not as strong as some may have supposed



Weighting Scheme

WEIGHTING SCHEME BASED ON TRIP LENGTH



Truck Assignment Tests

TRUCK ASSIGNMENTS MADE FOR TESTING PURPOSES ONLY

- ATRI data used as one component of truck model
- Assignment used to assess count consistency, weighting effectiveness, goodness-of-fit bounds

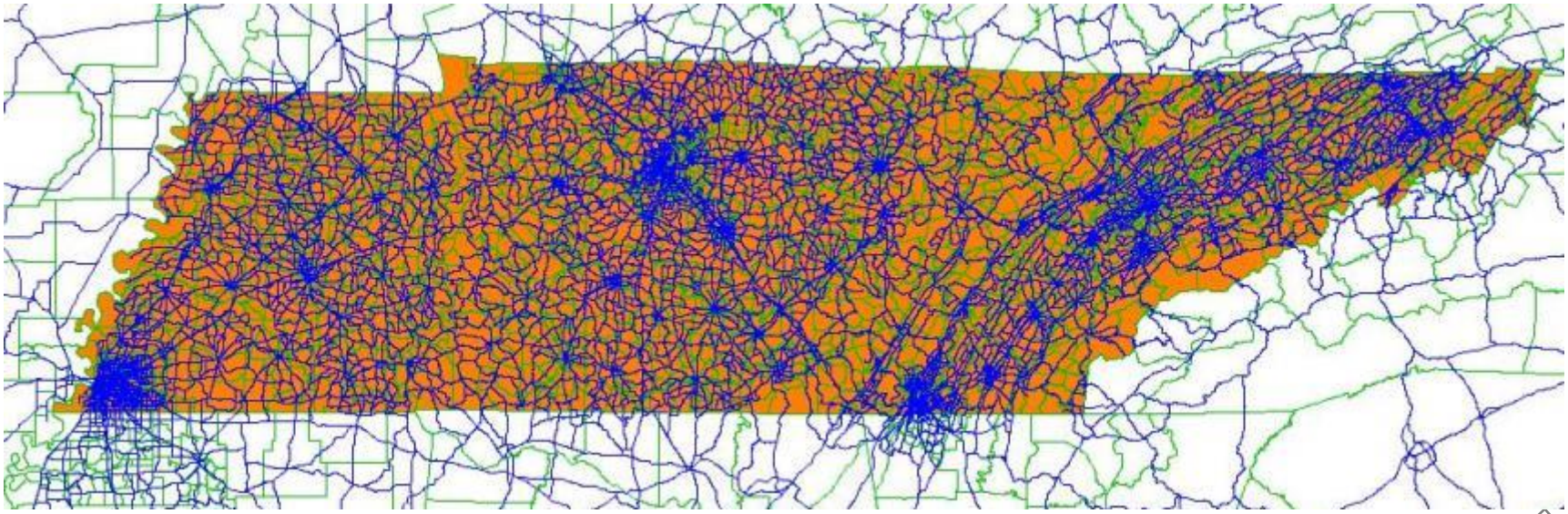
Assignment Type	RMSE
Scaled Data	116%
Weighted Data	92%
ODME on Data	58%

- Previous model used ODME to achieved 81% RMSE for trucks

Tennessee

ATRI DATA SAMPLE FOR TENNESSEE (PRELIMINARY)

- Similar four 2-week samples over 2013 quarters
- 235,000 unique trucks
- 138 million records processed to 5.8 million trips
- 84,147,030 truck VMT within TN
- **Sample rate of 6.5%**



Conclusions

- ATRI's truck GPS data provides a rich and growing source of information on truck travel patterns
- It is a LARGE sample – but still a SAMPLE
- Failure to properly expand it could lead to under-representation of short-haul movements and faulty analysis or false conclusions
- Weighting offers both an understanding of ODME
  - Confirmation and measurement of long-haul bias
  - Mixed findings on geographic sample rates

  and an alternative to ODME
  - No ODME uncertainty or individual OD adjustments

- **Better data + better analysis = better models + better planning**