Using HERE – NPMRDS Data for Model Development at the Atlanta Regional Commission: Lessons Learned

Presented to:
TMIP Webinar
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What is NPMRDS?

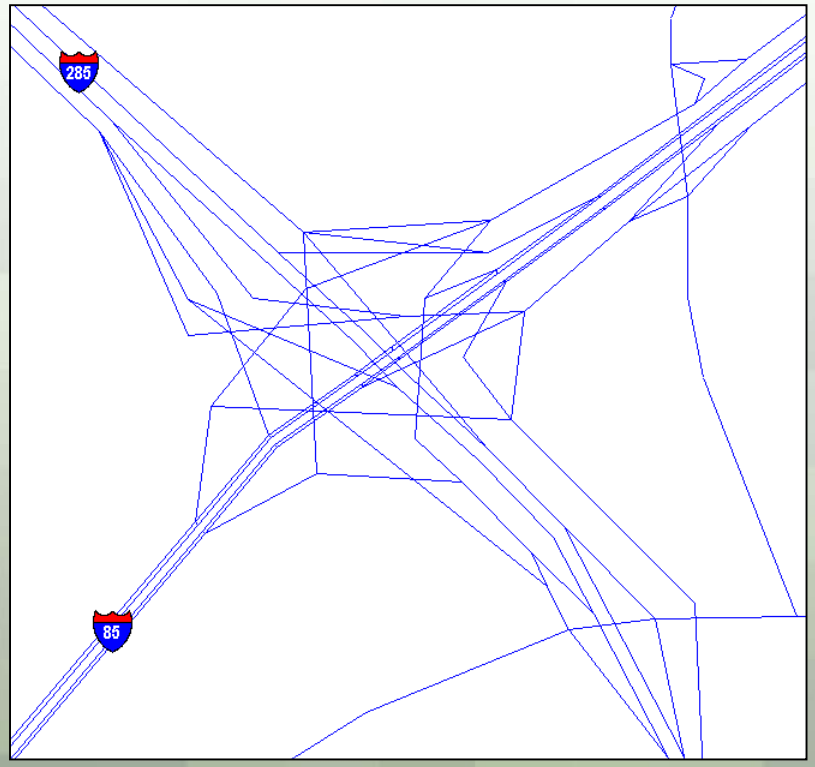
- National Performance Management Research Data Set
- Vehicle Probe Data of Average Travel Times Acquired by FHWA from HERE (formerly Nokia/NAVTEQ)
- Available to MPOs & State DOTs
- To Sign Up for Data Access: Heretraffic.nhsdata@here.com

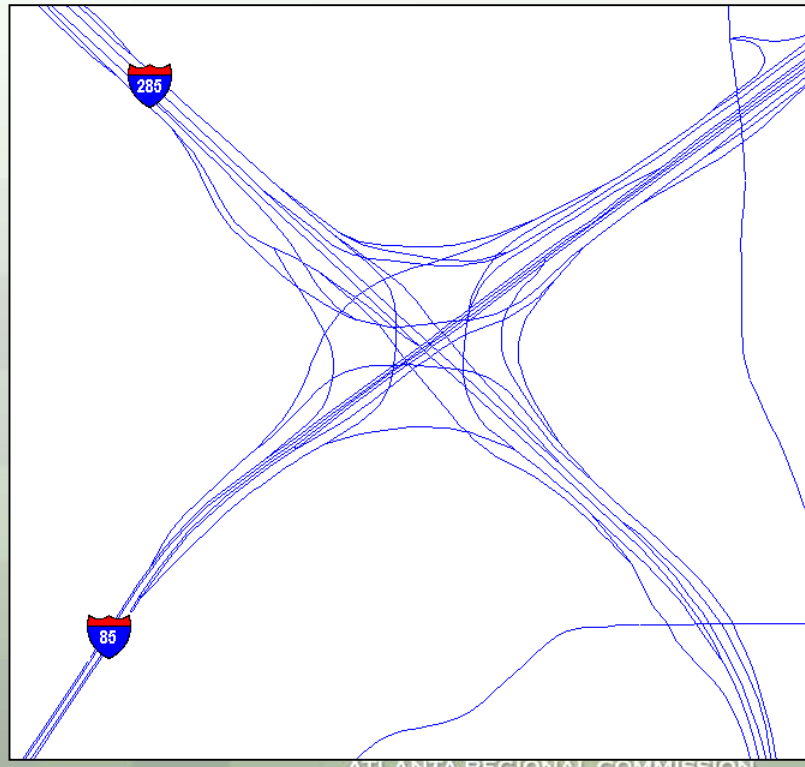
ARC Modeling Needs for Planning-Level Network Data

- Leverage HERE Data Provided via FHWA's NPMRDS Data Program
- ARC's Travel Demand Model Network already Conflated to NAVTEQ Street Centerline File for "True-Shape" Display
- Lesson Learned #1: Must Have Model Network Conflation (No "Stick" Figure Network)
- HERE Travel Time Data for Atlanta Metro:
  - 7,086 Traffic Message Channels (TMC Segments)
  - Data available in 5-minute Increments (EPOCHS) for every Day of the Month of October 2013 (Representative of Typical Traffic Patterns)
- Lesson Learned #2: TMC Segments & Model Network Links Geometries Do Not Always Match Perfectly (Cardinal Orientation & Traffic Flow Directionality), can't use Simple GIS Spatial Join

Conflated Networks Needed Prior to Using NPMRDS Data with TMC Segmentation

- True-Shape Display
- NAVTEQ Street Centerline File



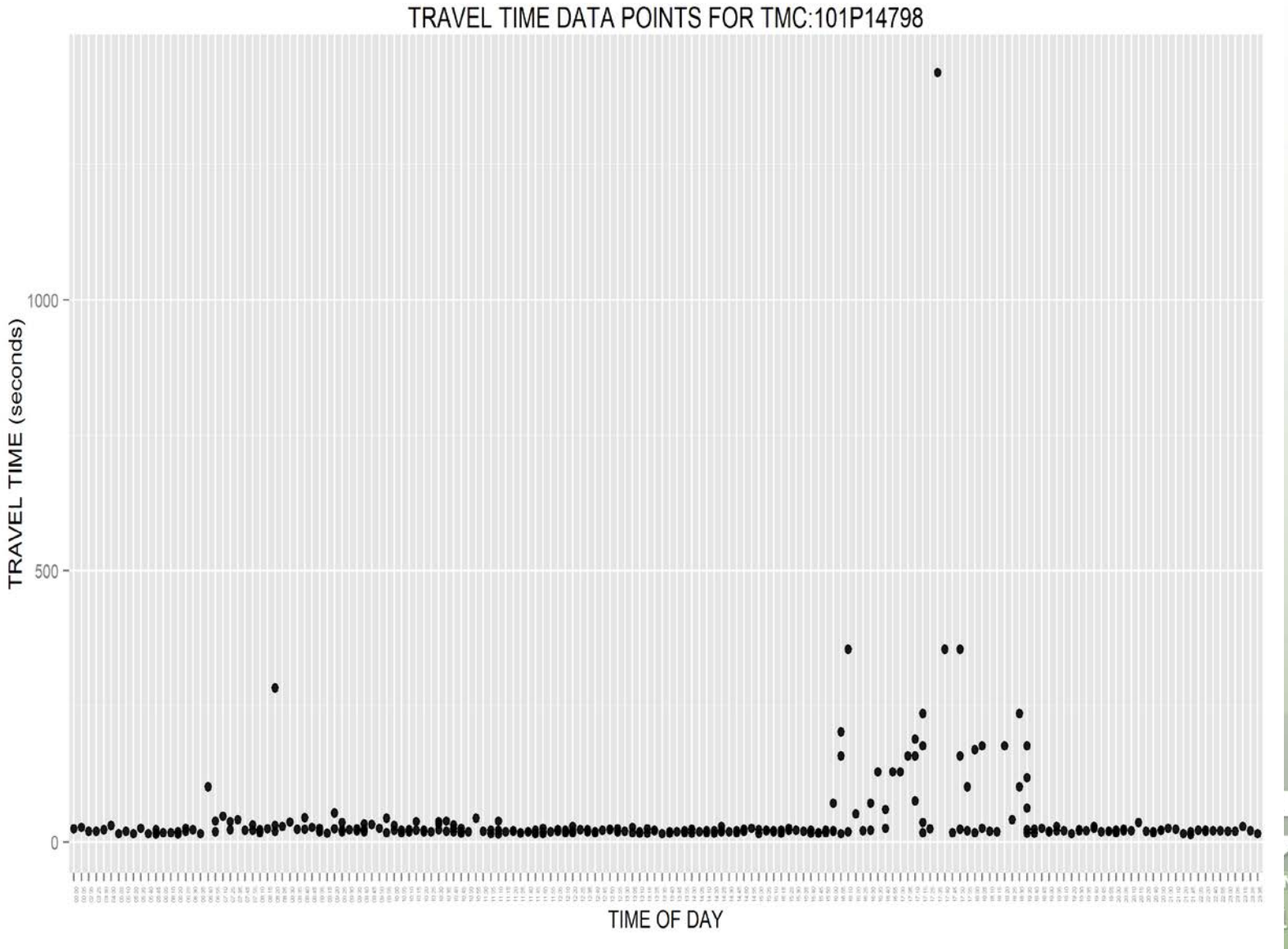


ARC Network Attributes – HERE links

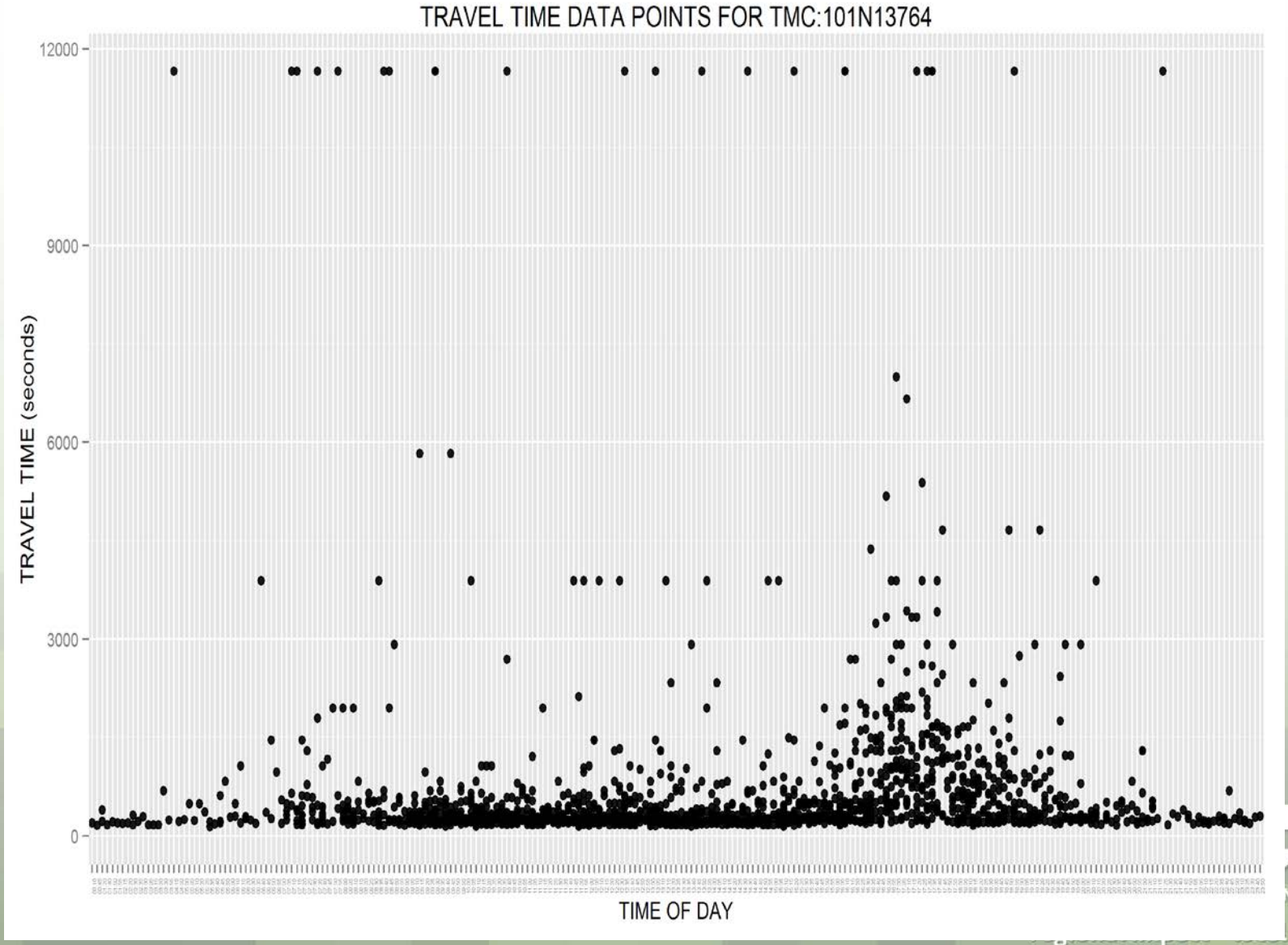
HERE NPMRDS Data Exploration

- Data collected on Weekends Filtered Out
- Remaining Data Grouped into ARC ABM Time of Day Periods:
  - Early AM: 03:00 to 06:00
  - AM Peak: 06:01 to 10:00
  - Mid--Day: 10:01 to 15:00
  - PM Peak: 15:01 to 19:00
  - Evening / Night: 19:01 to 02:59 + 1 day
- Travel Times Plotted for Remaining Valid Data Points

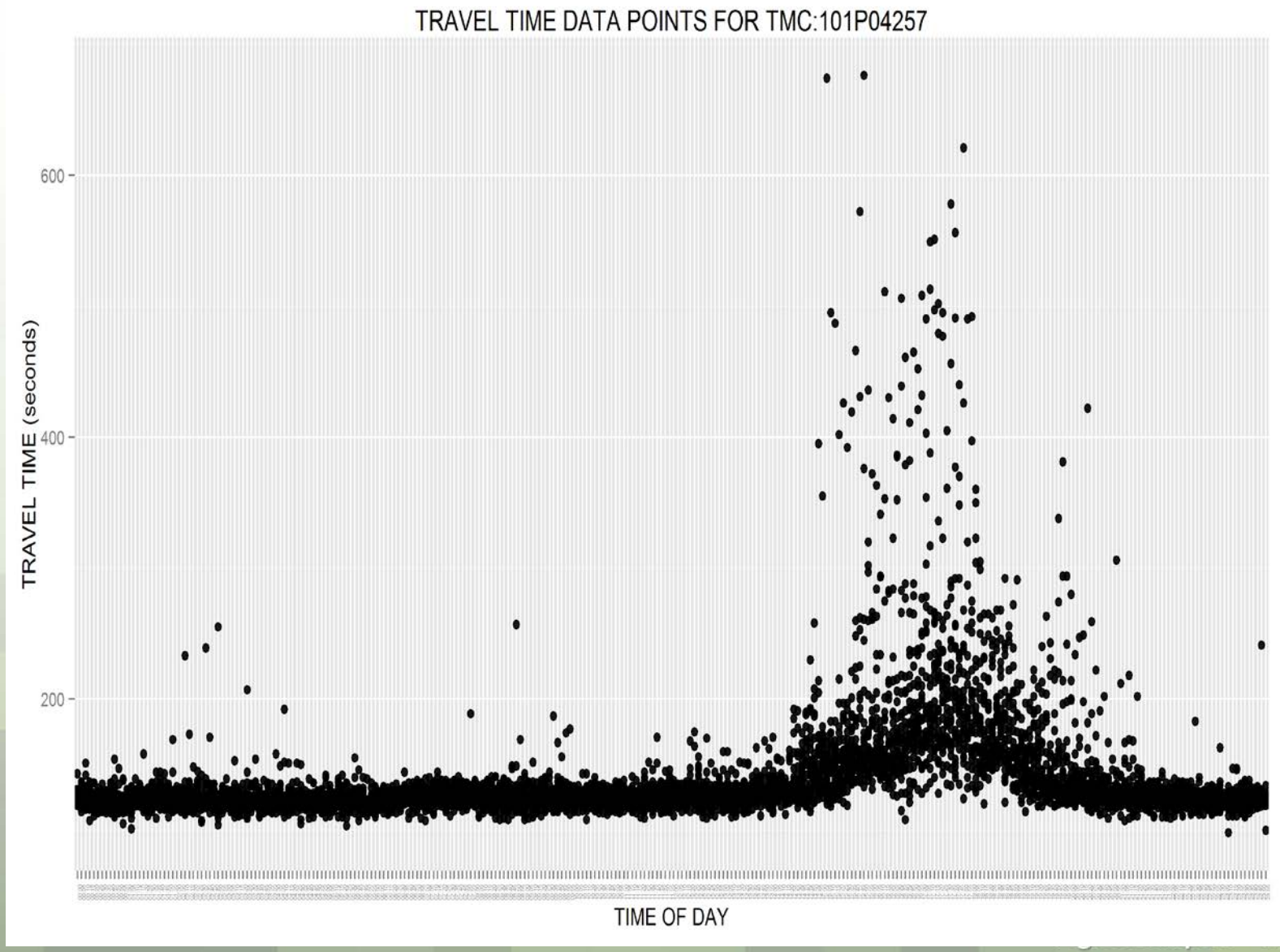
TMC 101P14798: Ramp



TMC 101N13764: Arterial



TMC 101P04257: Interstate



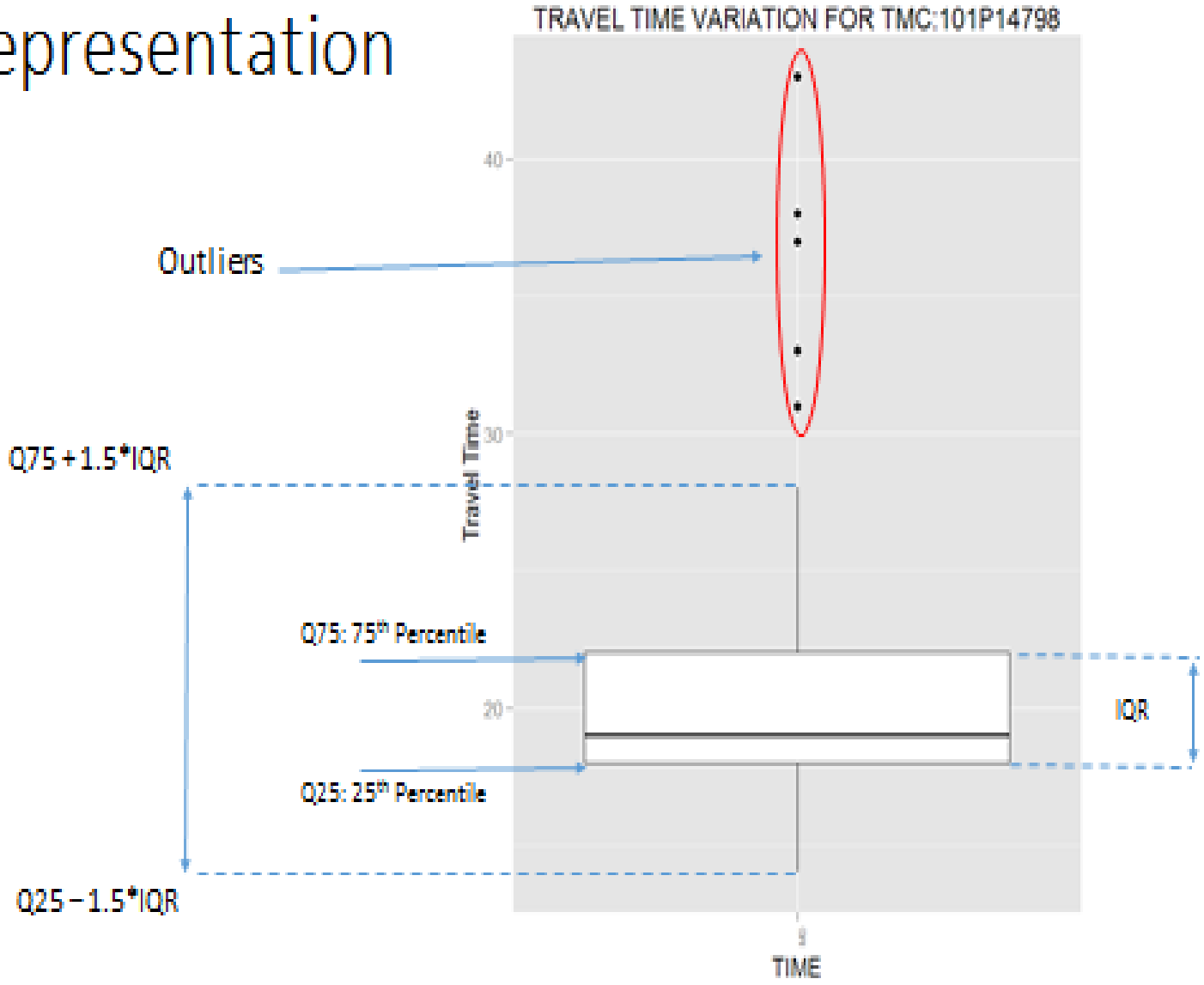
Initial / Preliminary Observations

- More Data Points for Higher Facility Types
- Data Has High Travel Time Values Coded in Some Cases:
  - Some Form of Default Values Being Used
    - Clearly Outliers
    - Filtering Process Implemented in SQL and 64-bit version of R scripting, with data loaded into memory, so 16GB of RAM needed
- Lesson Learned #3: Need & Necessity to Identify & Filter Outliers

Outlier Detection Process

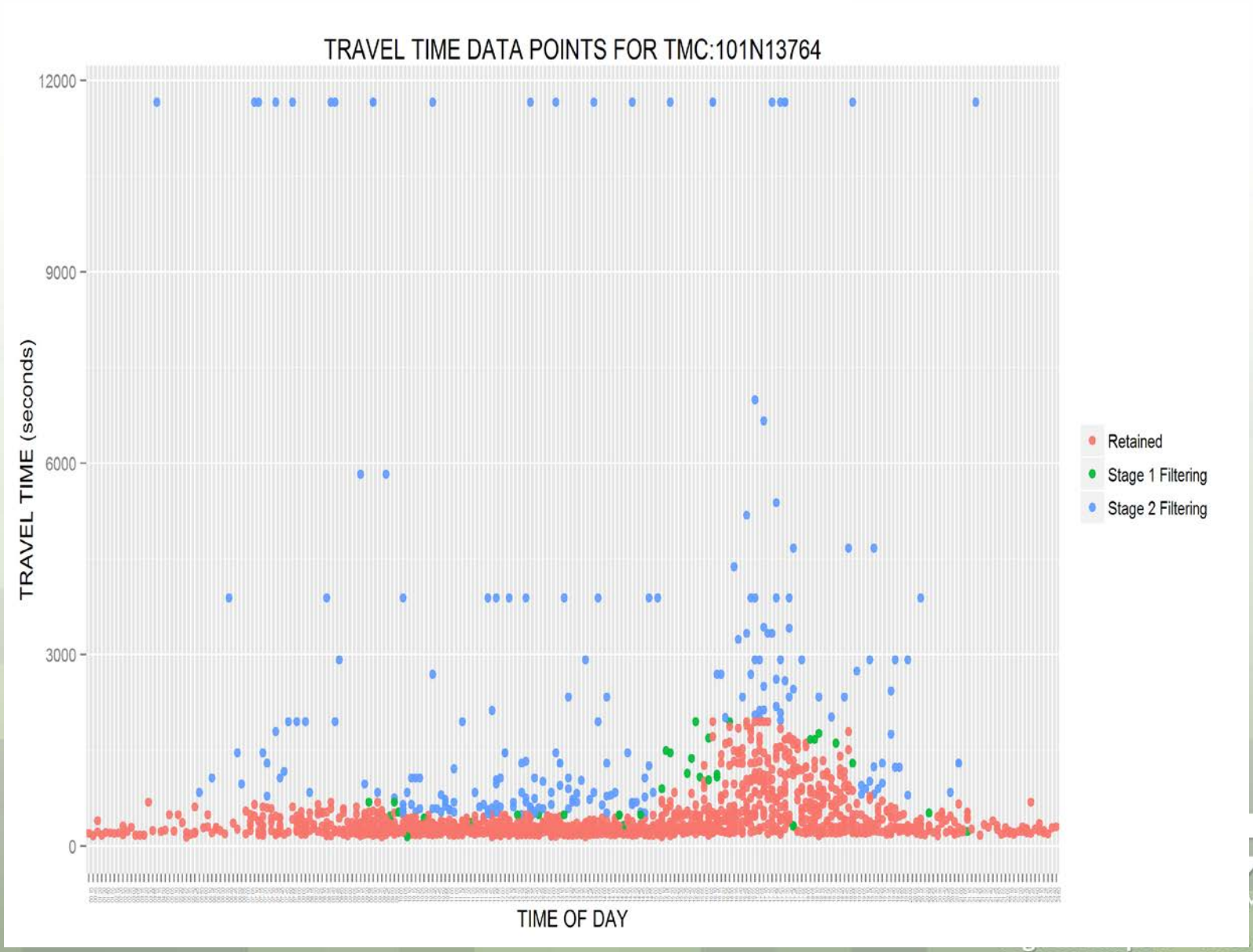
- Outlier Detection Performed in 2 Stages:
  - Stage 1: Check for Outliers within 5-Minute EPOCH Period
  - Stage 2: Check for Outliers in 4 Broad ARC Activity-Based Model Time Periods:
    - AM, MD, PM, EA + EV (To Get enough Data Points)
- Rules to Classify Outliers:
  - 25th and 75th Percentile (Q25 and Q75 respectively) is Calculated and then……
  - Data is Considered Valid if it Falls in between (Q25 – 1.5*IQR) and (Q75 + 1.5*IQR).
  - IQR is Inter Quartile Range (Q75-Q25)

Visual Representation



TMC 101P14798: Ramp

TMC 101N13764: Arterial



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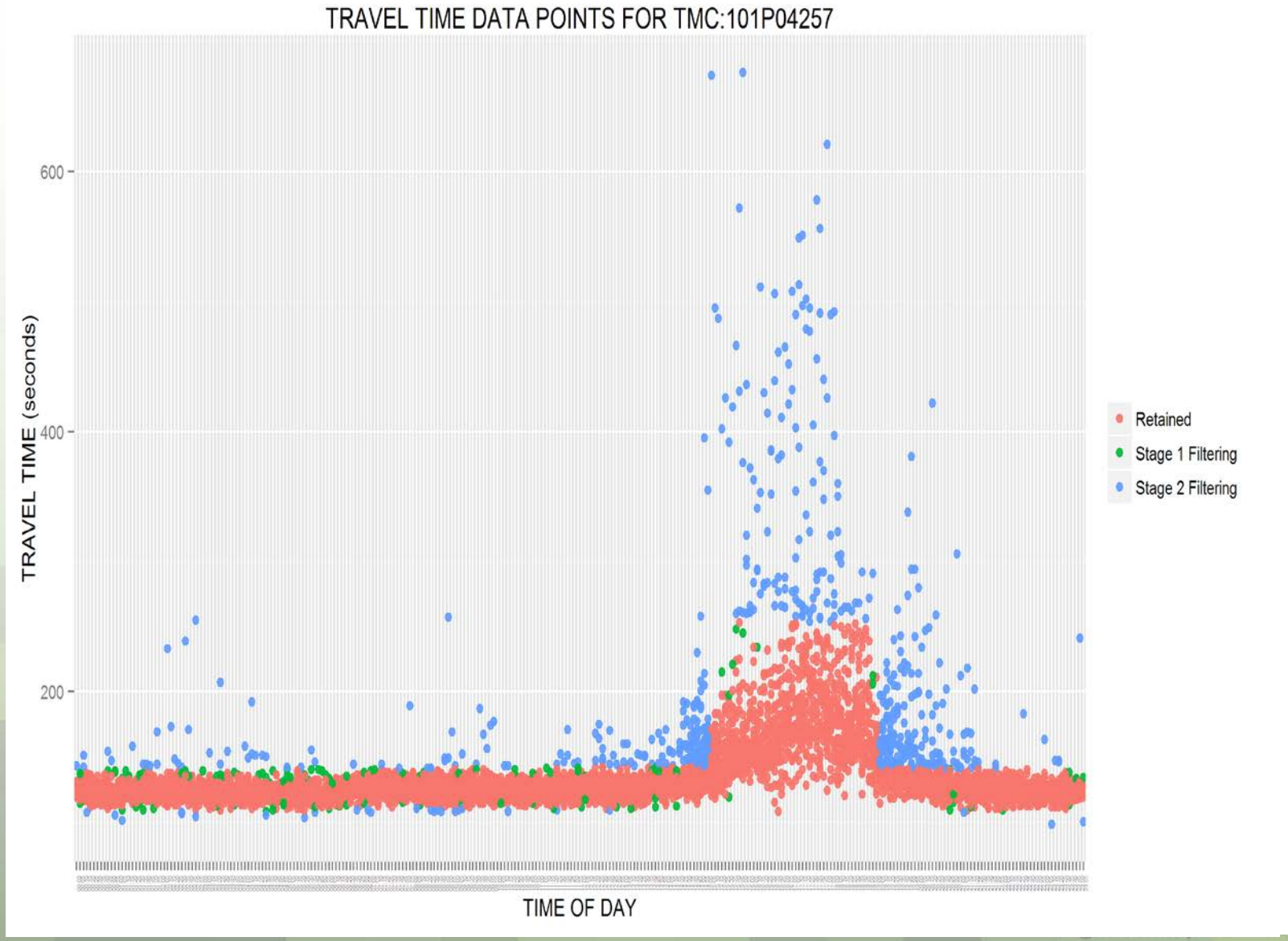
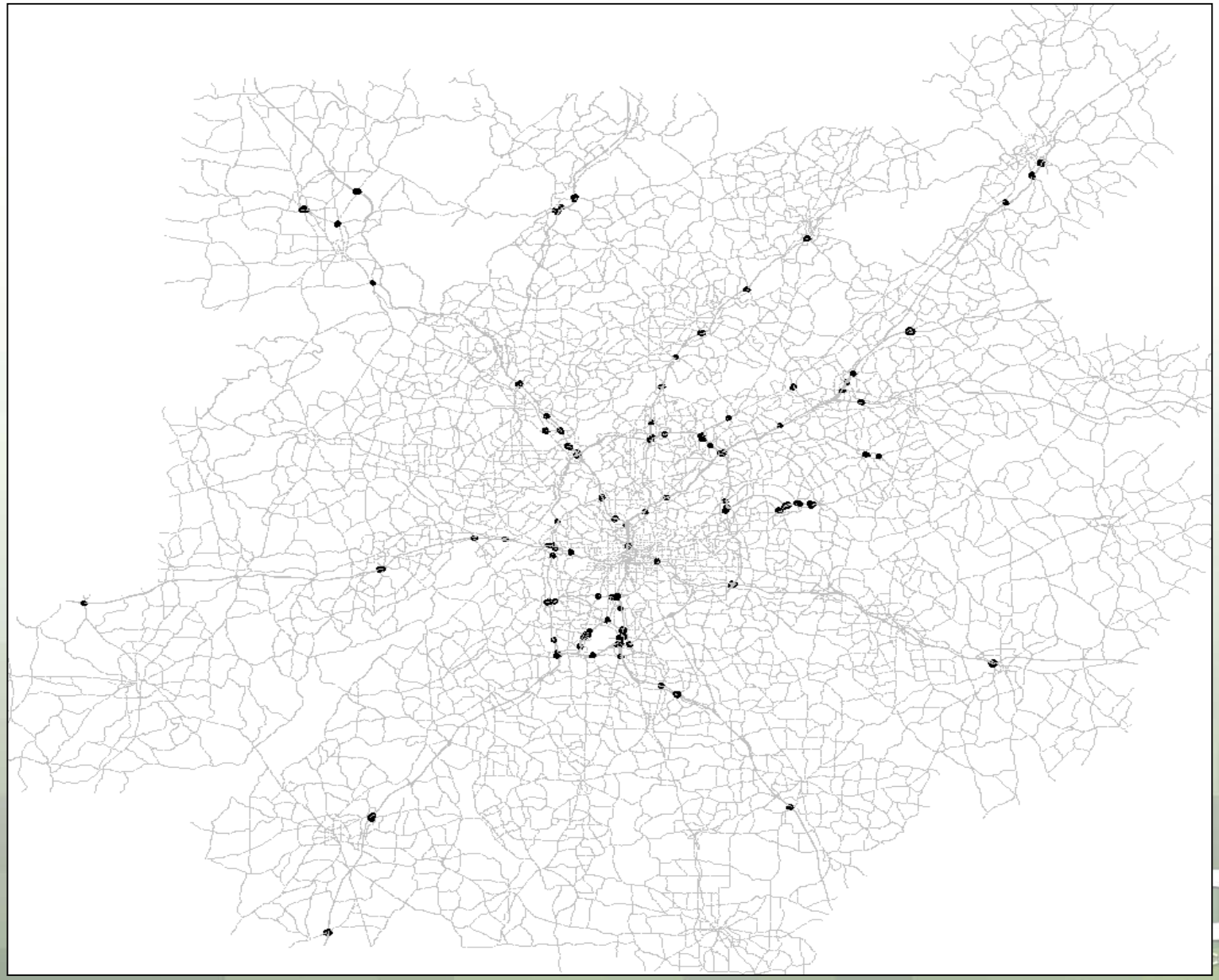


ARC Network & Model Updates Using NPMRDS

- Network Attributes:
  - HERE Data (TMC, Speeds by Time of Day Period)
  - Lesson Learned # 4: Necessity to Add NPMRDS TMC Code to Model Highway Network

- Free-Flow Speeds:
  - Updated Free-Flow Look-Up Speed Table based on early AM observed HERE speeds
  - Principal arterial CBD area type varies free-flow speeds by # lanes
  - Ramps with tight curves have lower free-flow speed
  - Lesson Learned #5: Need to Identify (Flag) Loop Ramps with Tight Curves in Model Network
  - Average of early AM HERE speeds and lookup table where HERE links available

ARC Network Attributes: Loop Ramps



ARC Network & Model Updates Using NPMRDS

- Capacity:
  - Capacities reduced for interstate weaving sections with large number of lanes
  - Model was over-estimating speeds on weaving sections with high number of lanes
  - Lesson Learned #6: Need to Identify (Flag) Areas with Wide Weaving Sections in Model Network (Interstate Approaches & Departures at Major Interchanges)
  - Period capacity factors based on GDOT hourly count data

- Volume-Delay Function Curves:
  - All curves updated
  - Parameter for speeds at capacity computed based on HERE speed ratios near link capacity
  - New curve for interstate weaving links (speeds decrease at lower V/C ratios and lower at capacity than basic interstate segments)
  - Lesson Learned #7: NPMRDS Instrumental to Update VDF Curves

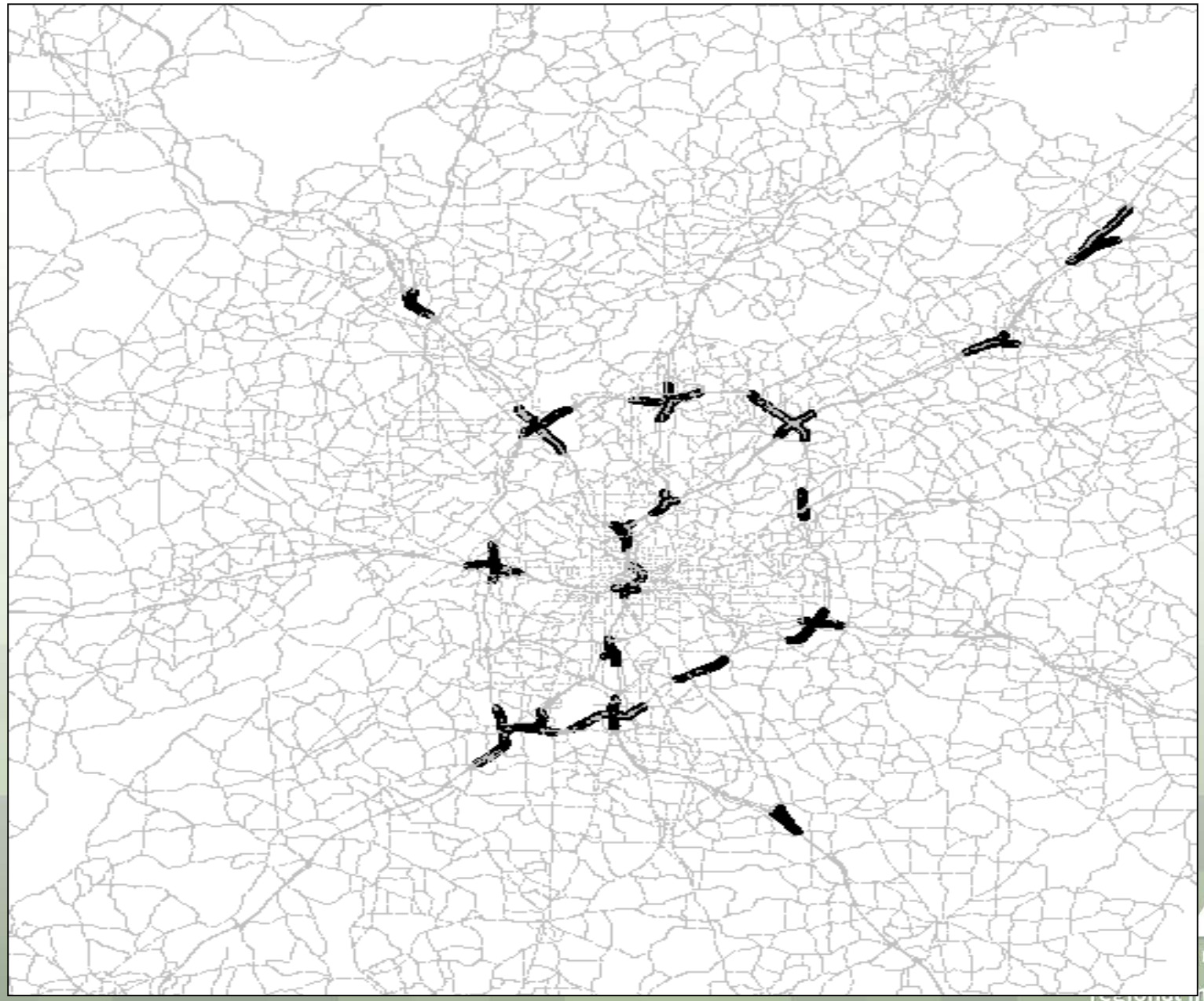
NPMRDS / HERE Data for VDF

HERE DATA AVERAGE SPEED RATIOS NEAR LINK CAPACITY				
Facility Type	**AM***	**PM***	**AM/PM***	**VDF****
Interstate Basic	0.62	0.70	0.66	0.67
Interstate Weave	0.71	0.48	0.63	0.41
Arterials	0.79	0.74	0.76	0.74
Collectors	0.80	0.65	0.72	0.74

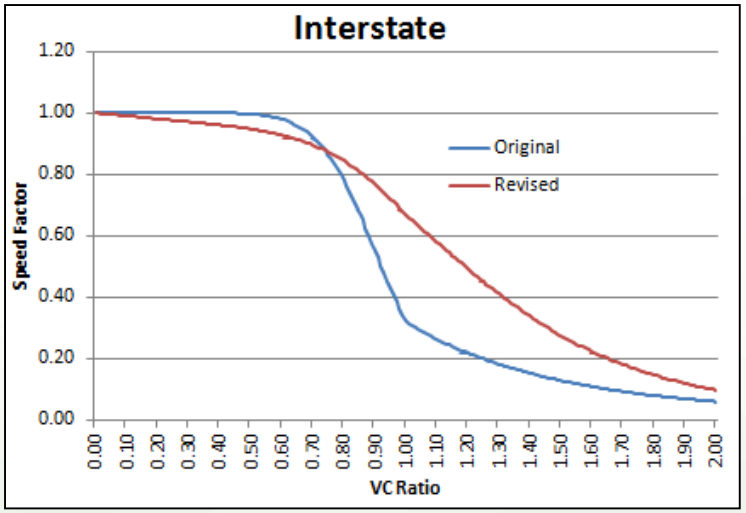
* HERE data speed ratios averaged for modeled VC ratios = 0.95-1.05

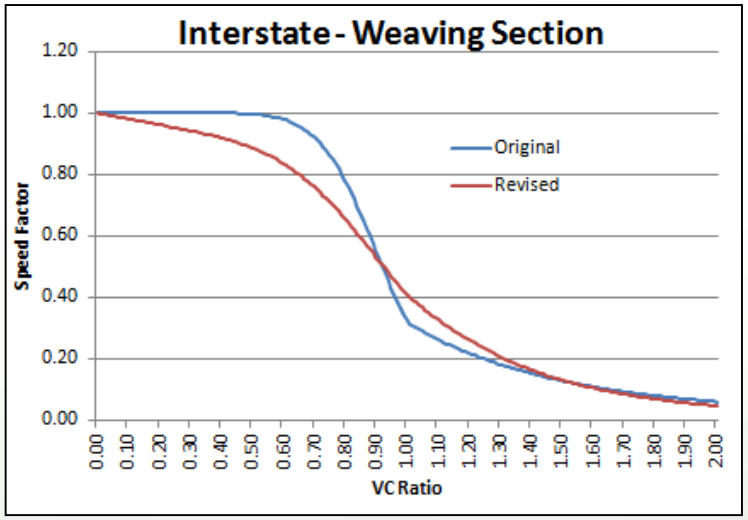
** Updated VDF curve speed ratio where VC ratio = 1.00

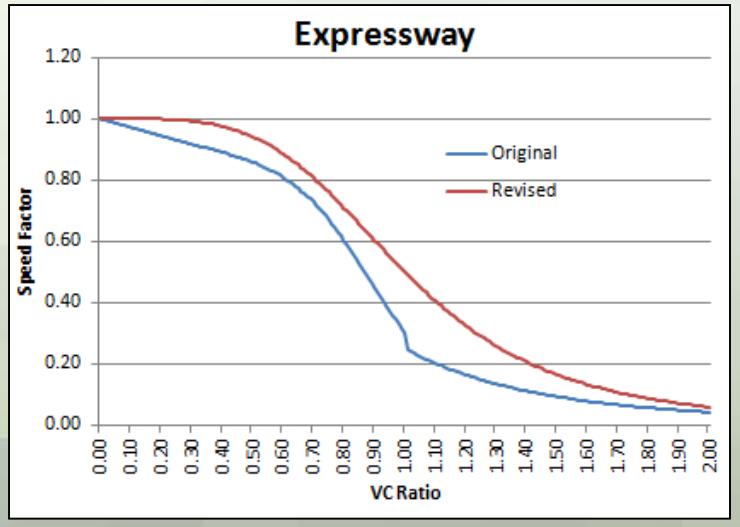
ARC Network Attributes: Weaving Sections

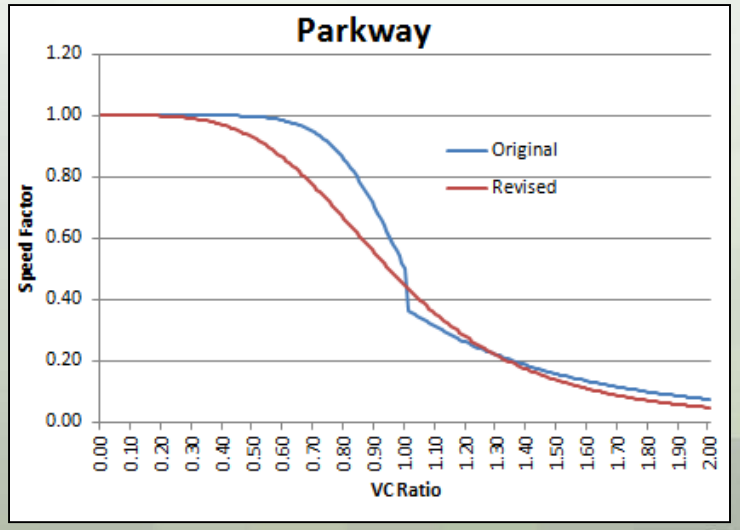


VDF Curves by FT Before & After NPMRDS









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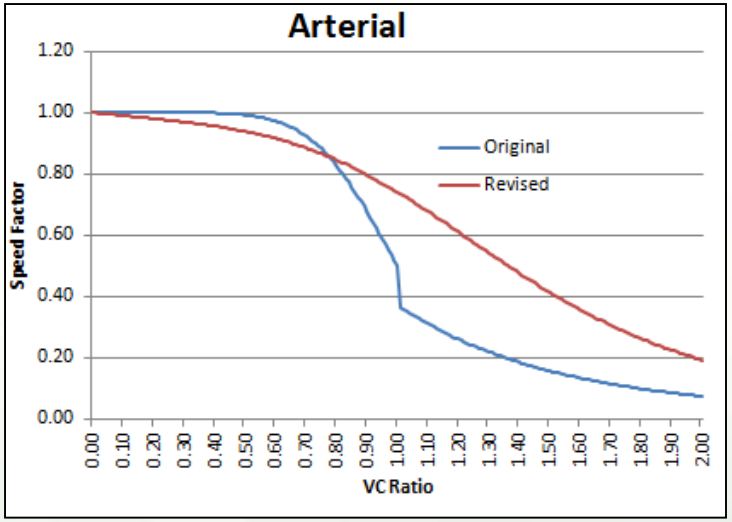
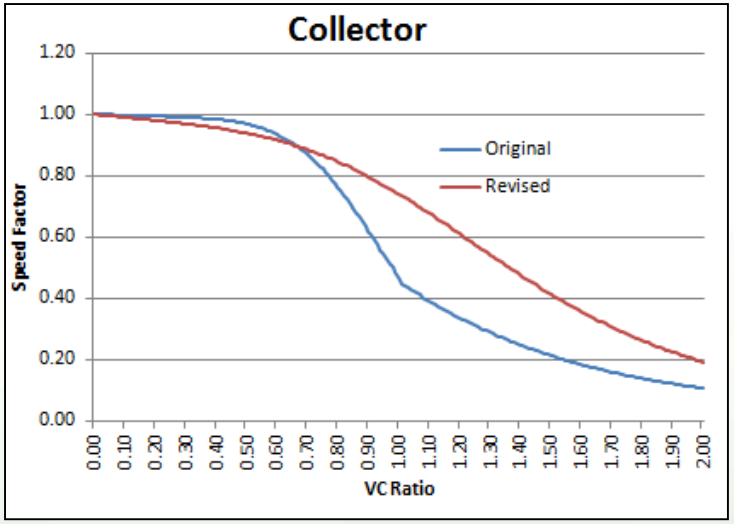
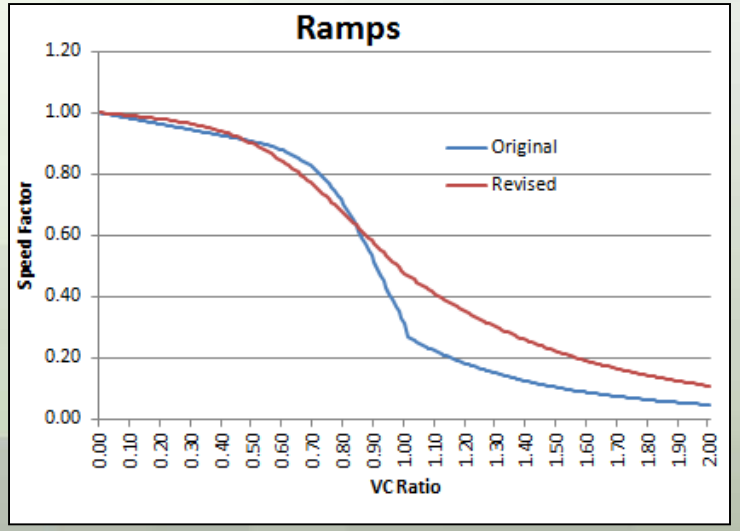
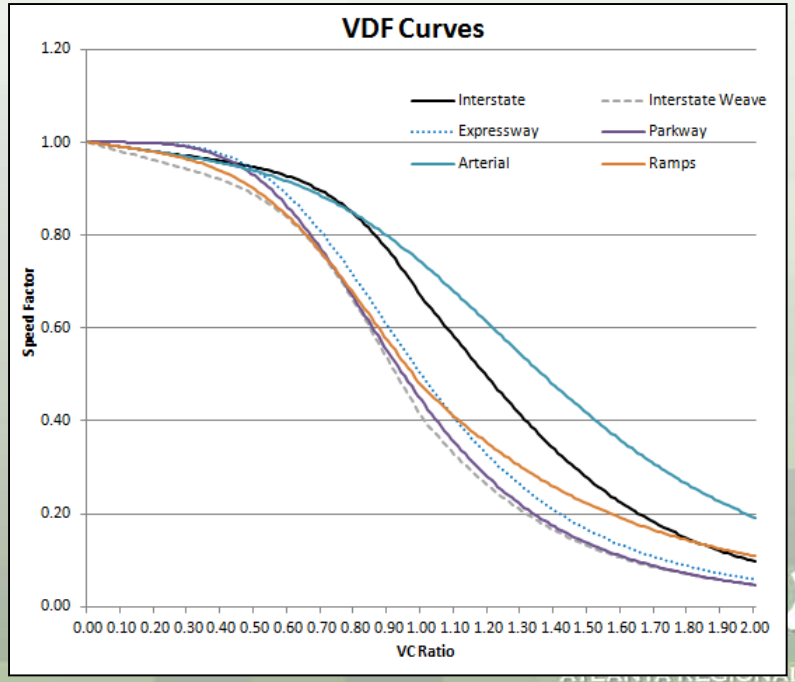
VDF Curves by FT Before & After NPMRDS





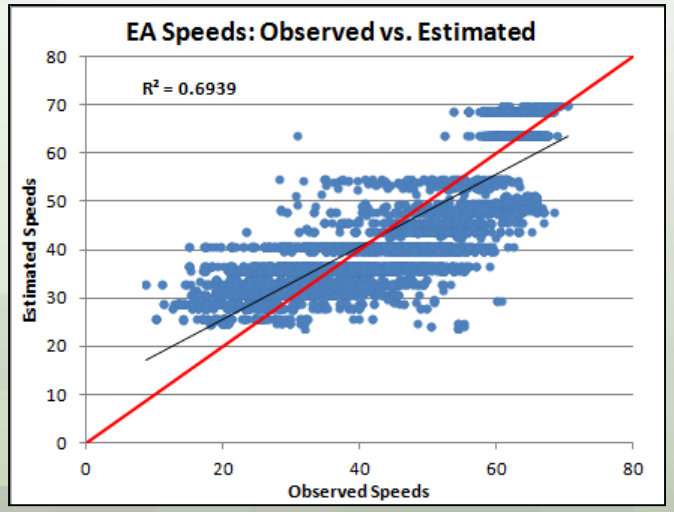




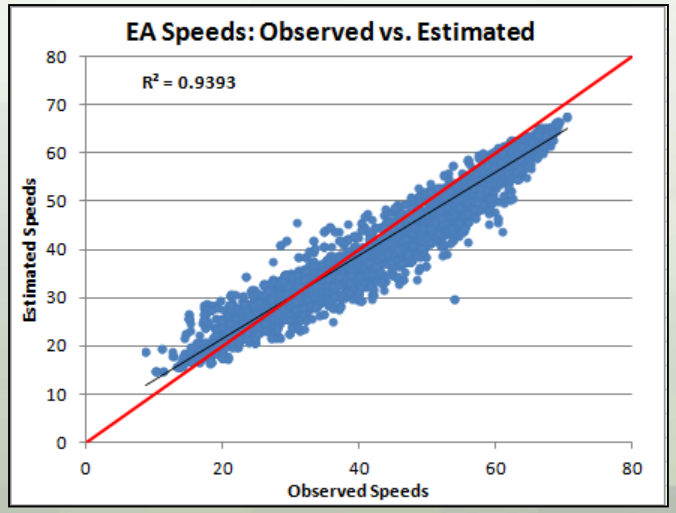
Congested Speeds by TOD Before & After NPMRDS

- Scatterplots by facility type and time period
  - Significant improvements across facility types and time periods
  - Still locations where the model does not match speed data but much tighter grouping around observed values
  - Interstate and ramp r-squared values still low but substantially better than current model
    - These facility types are most affected by operational issues as merge/diverge/weaving/queues have significant speed impacts
    - Not possible to replicate all these issues in a static equilibrium assignment

Current Model



Updated Model



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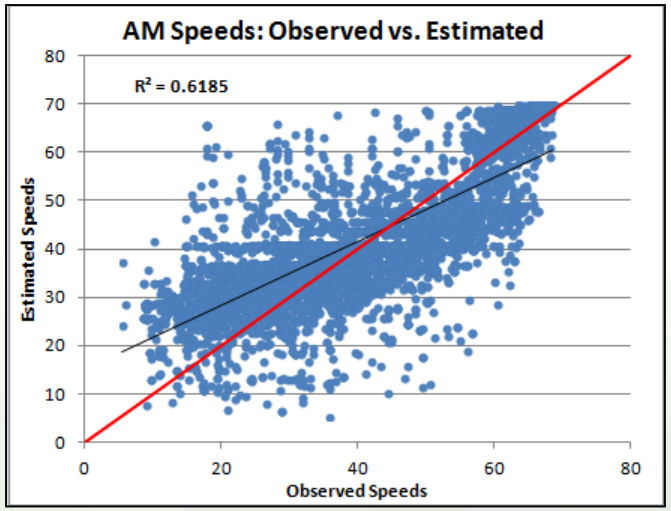

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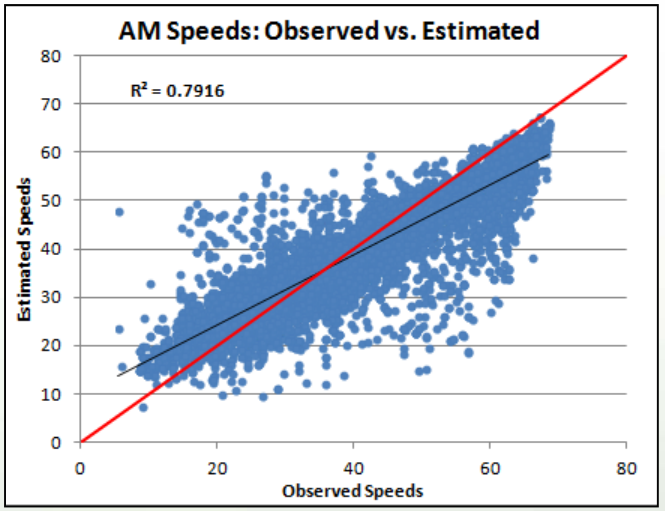

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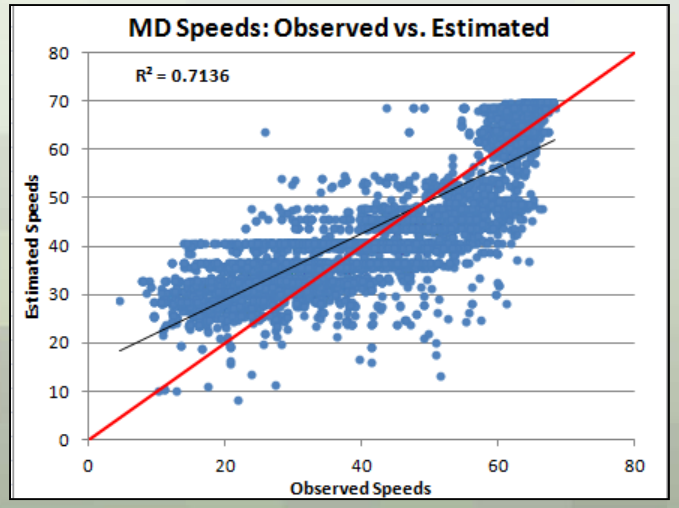

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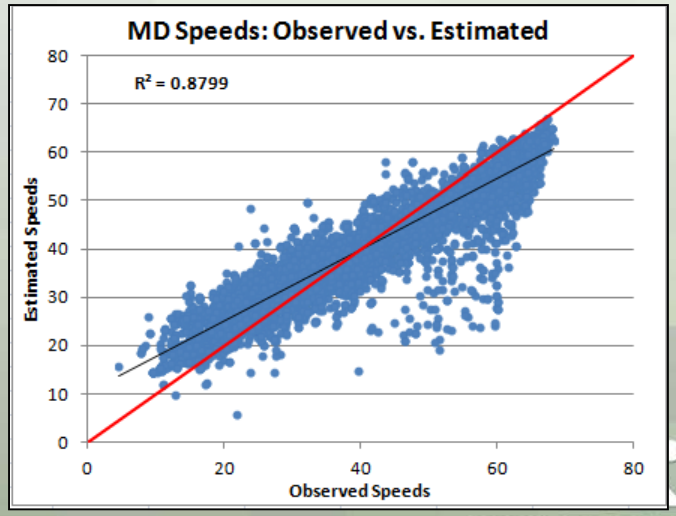

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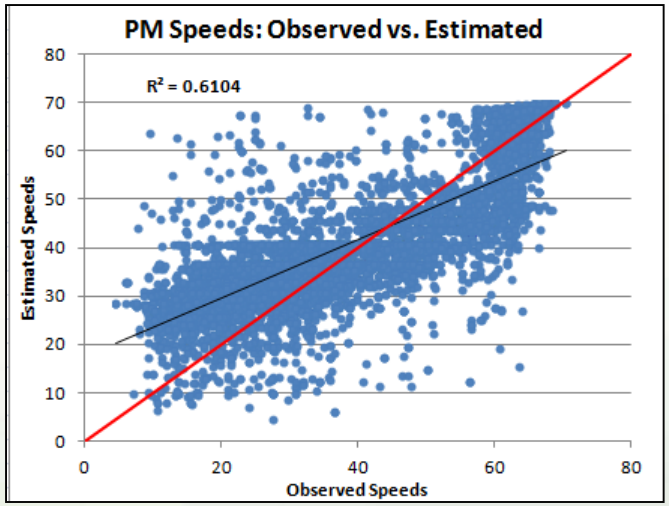

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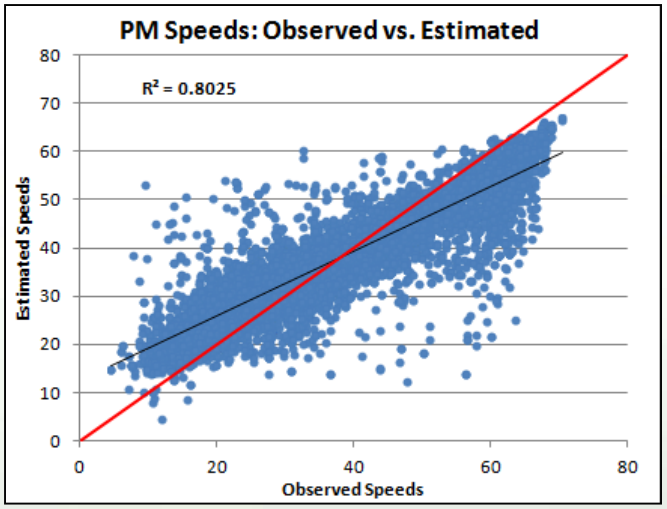

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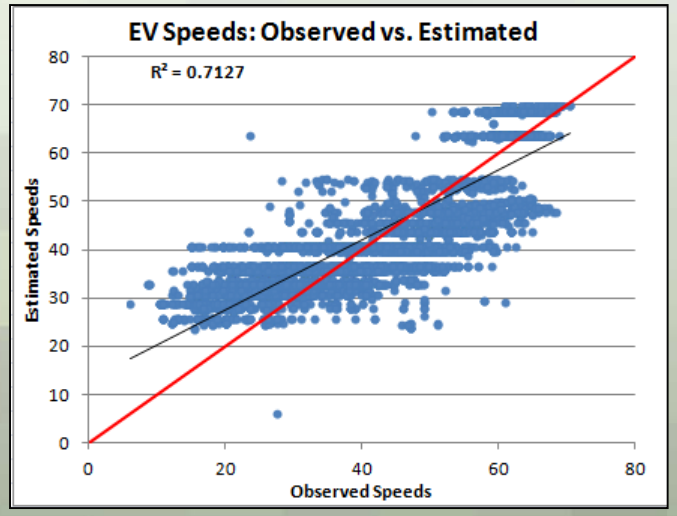

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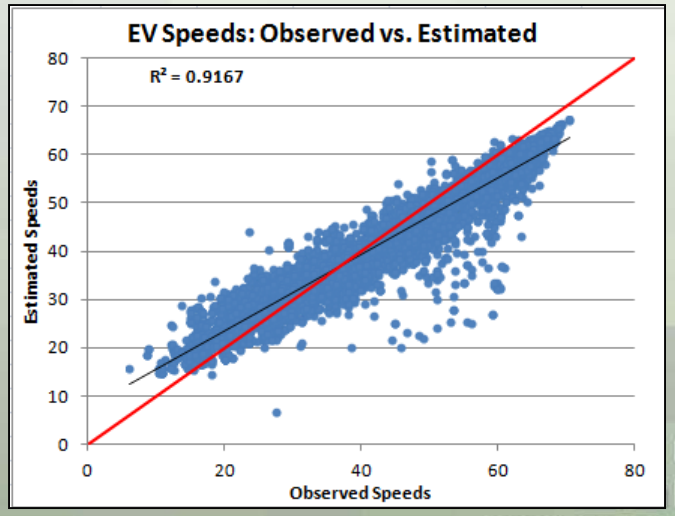
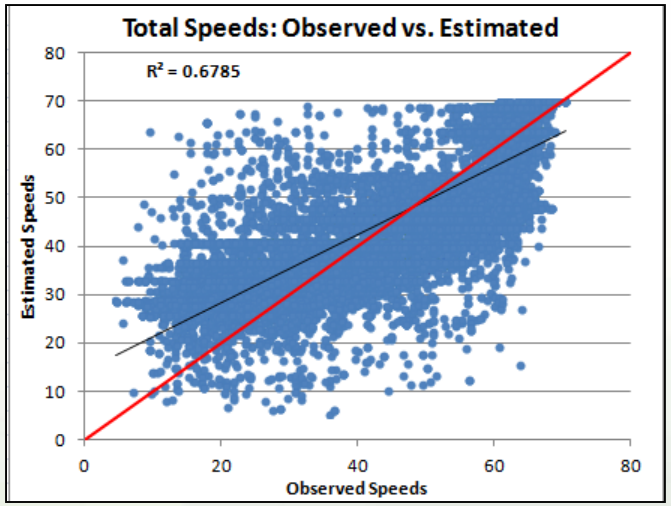


Congested Speeds by FT Before & After NPMRDS

Current Model



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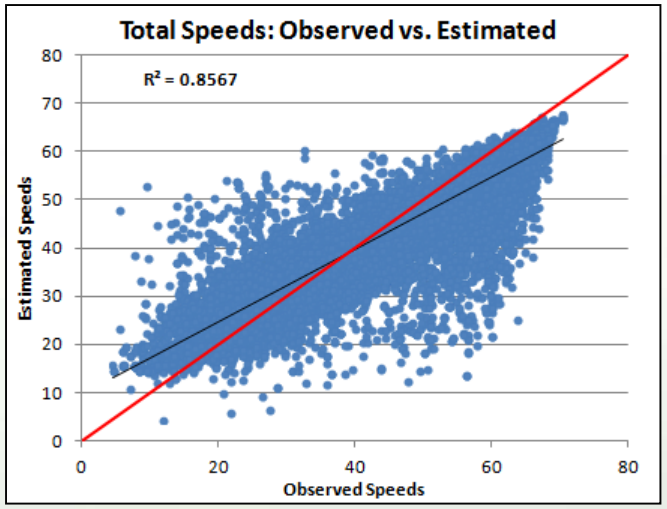

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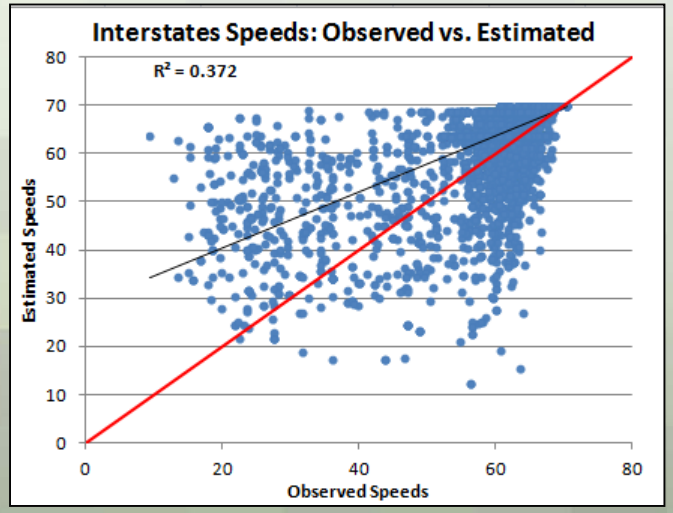

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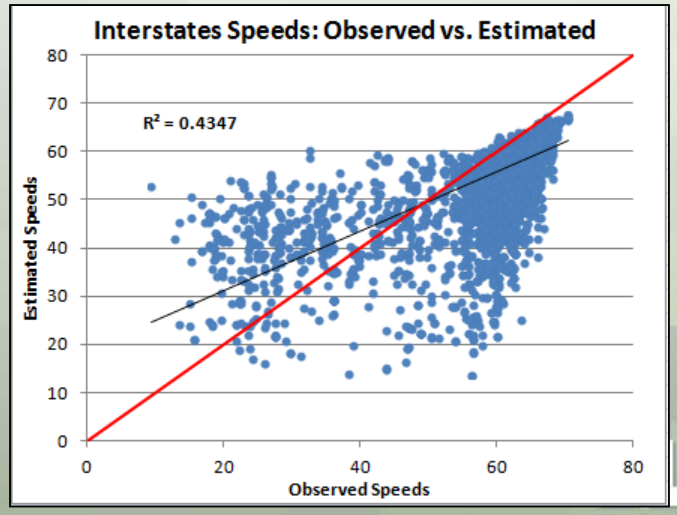

Congested Speeds by FT Before & After NPMRDS

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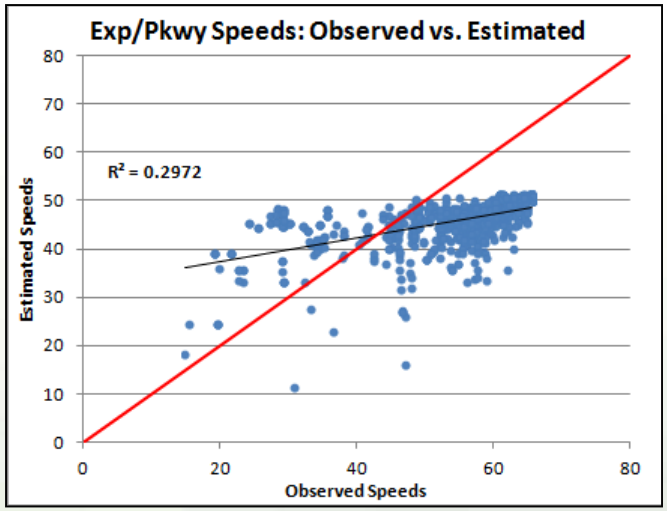

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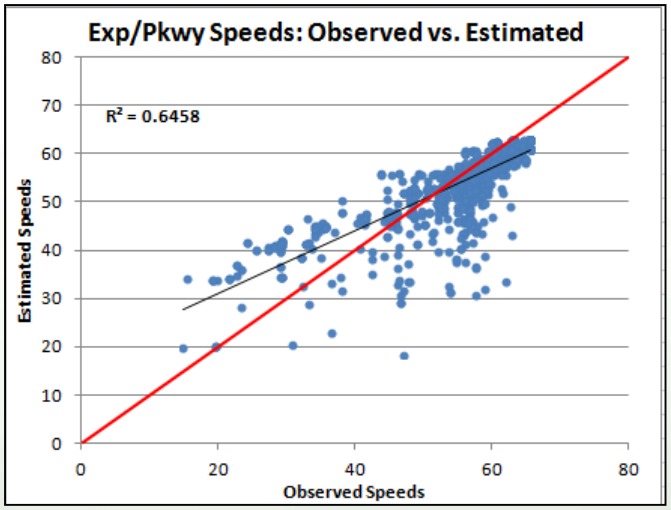

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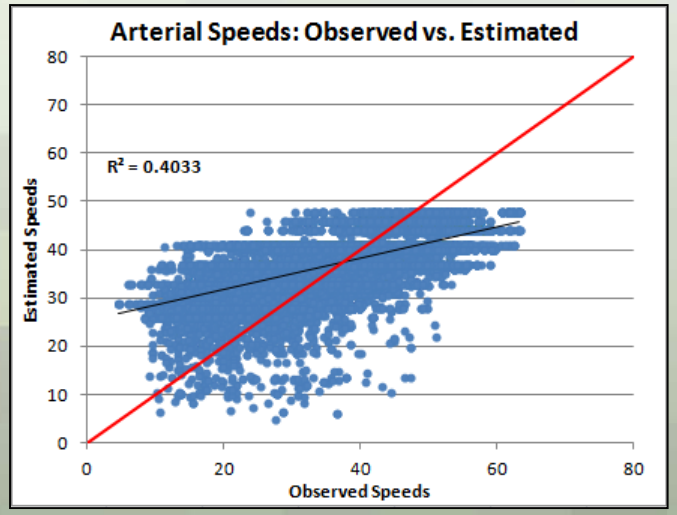

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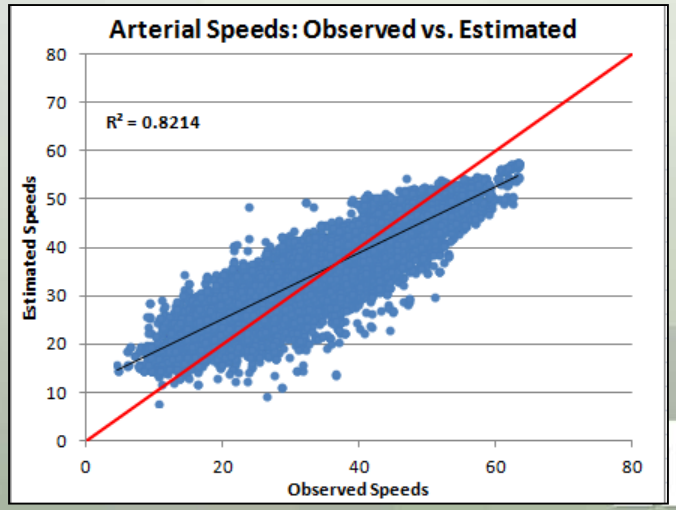

Congested Speeds by FT Before & After NPMRDS

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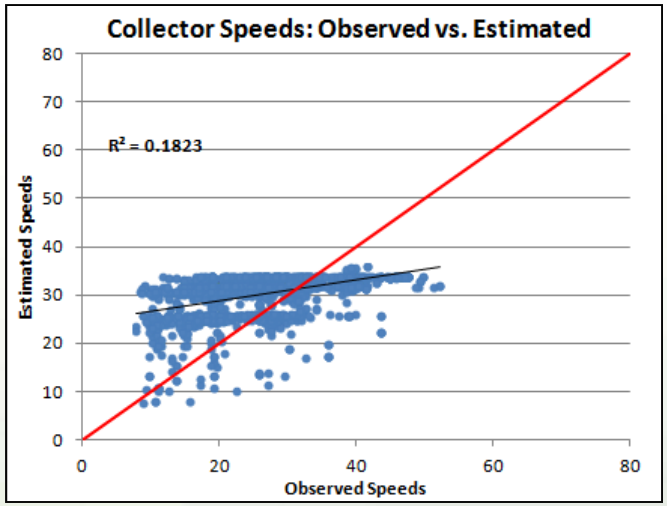

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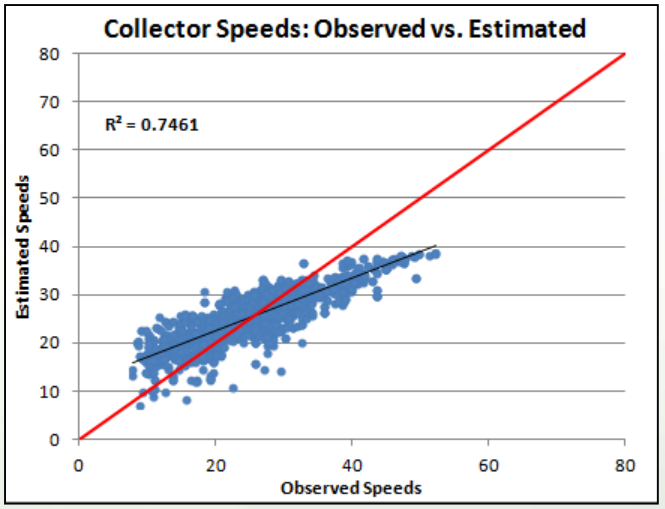

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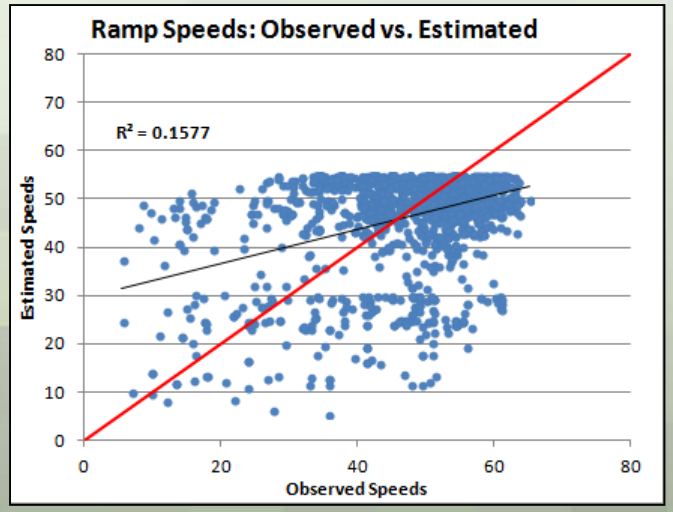

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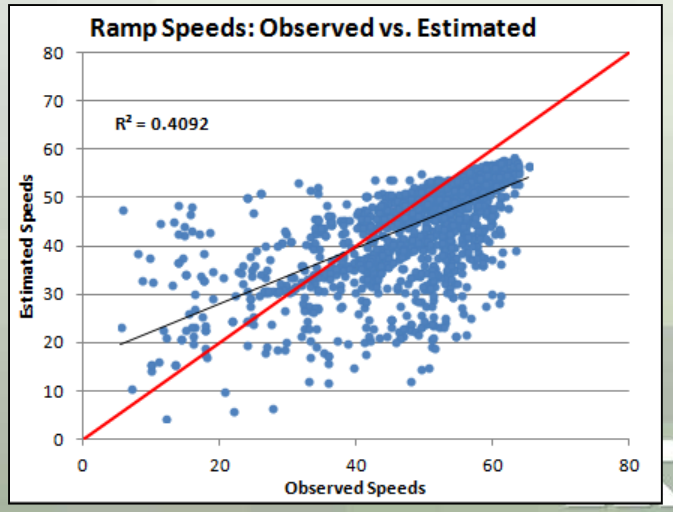

VHT Comparison to NPMRDS / HERE Data

- HERE data speeds on model links
  - Can compute congested VHT using HERE observed speeds and modeled volumes
  - Compare against model estimated congested VHT for same links
  - Model overestimates total delay as compared to HERE (primarily a function of the EA and EV periods)
  - Good matches compared to AM and PM time periods

	HERE Data			Model Data		
PERIOD	Congested VHT	Free Flow VHT	Delay	Congested VHT	Free Flow VHT	Delay
EA	50,441	49,851	590	53,155	49,851	3,304
AM	420,139	339,409	80,730	430,634	339,409	91,225
MD	370,012	339,385	30,627	386,100	339,385	46,715
PM	482,869	383,774	99,095	481,932	383,774	98,158
EV	225,253	214,929	10,324	236,679	214,929	21,750
Total	***1,548,714***	***1,327,348***	***221,366***	***1,588,500***	***1,327,348***	***261,152***

	Difference			% Difference		
PERIOD	Congested VHT	Free Flow VHT	Delay	Congested VHT	Free Flow VHT	Delay
EA	2,714	0	2,714	5%	0%	460%
AM	10,495	0	10,495	2%	0%	13%
MD	16,088	0	16,088	4%	0%	53%
PM	-937	0	-937	0%	0%	-1%
EV	11,426	0	11,426	5%	0%	111%
Total	***39,786***	***0***	***39,786***	***3%***	***0%***	***18%***

More Lessons Learned

- Lesson Learned #8: NPMRDS Data almost Necessary for Proper Model Calibration

- Lesson Learned # 9: NPMRDS Data is a First Step in the Direction of Implementing Regional Dynamic Traffic Assignment

- Lesson Learned #10: Data Fusion between NPMRDS and other sources such as INRIX provides an enhanced dataset for Model Development

Acknowledgements

- Work Performed by ARC Staff, PB & Atkins

Questions?

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