



JOINT FLORIDA  
Model Task Force & Transportation  
Data and Analytics Workshop



# A Daily Traffic Sample: Analyzing Variability Between Telemetered Traffic Monitoring Sites (TTMS) and Intelligent Transportation Systems (ITS)

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## Summary

- Goals and Objectives
- Data Sources and Site Locations
- Data Processing, Auditing, and Cleaning
- Variation Calculation and Analysis (With Examples)
- Average % Variation Per Year Comparison
- Valid Counts Trend Analysis
- Conclusions and Going Further
- Q&A





## Goals and Objectives

Observe variability between two different types of technologies

Compare reliability of other technologies for collecting traffic volume counts





**What data was used?**



## Data Sources



Source: FDOT Traffic Monitoring Handbook

### TTMS

- Inductive loops with piezoelectric sensors
  - Pavement-invasive
  - Data from Central Office



Source: Wavetronix HD User Manual

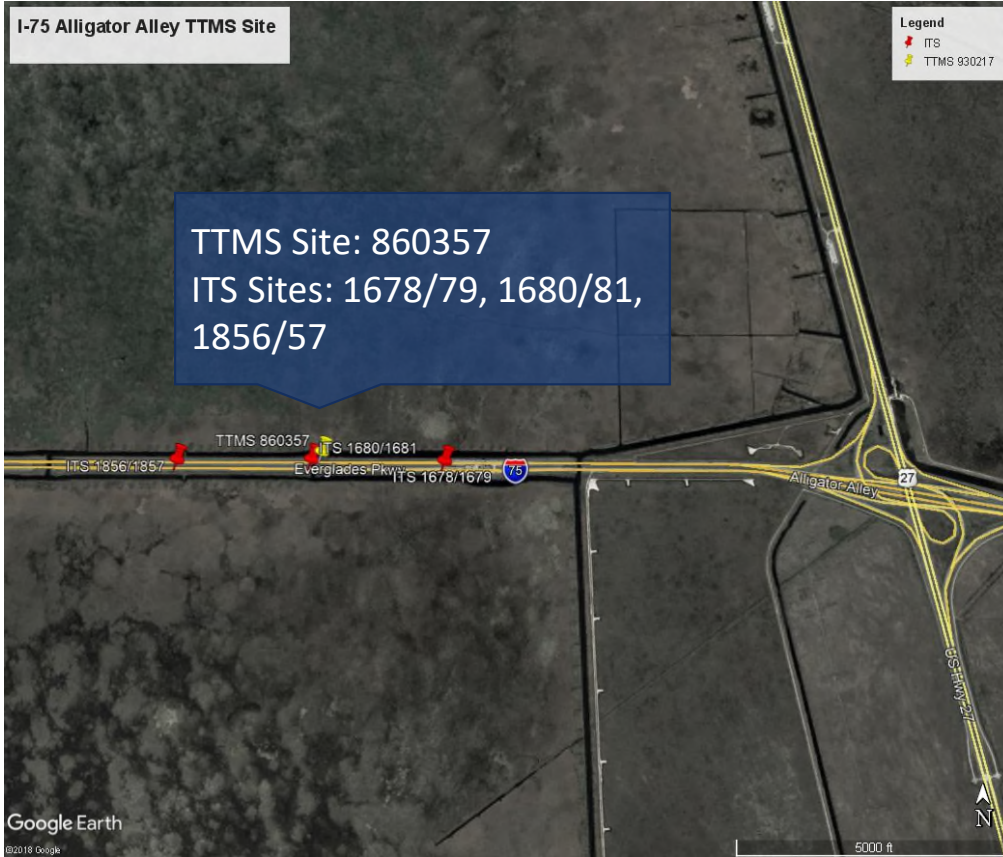
### ITS (MVDS)

- Microwave Radar Detectors
  - Non-pavement invasive
  - Ritis.org



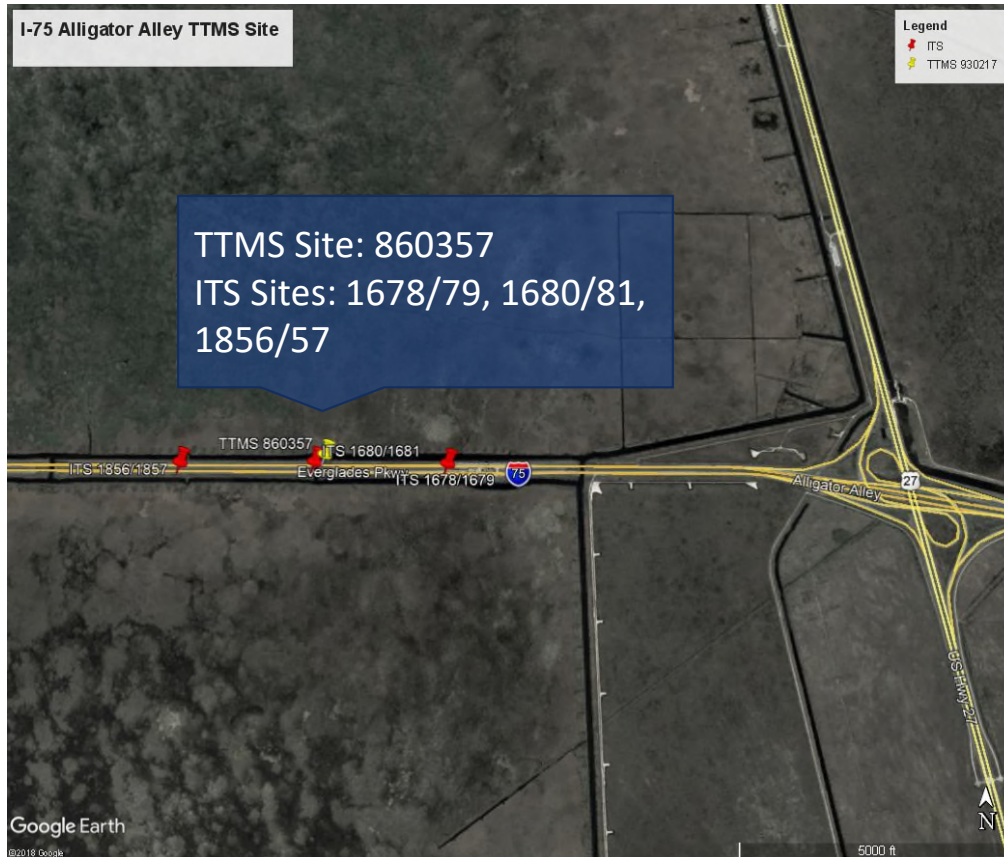


# Site Locations





## I-75 Alligator Alley, W of US-27 in Broward County



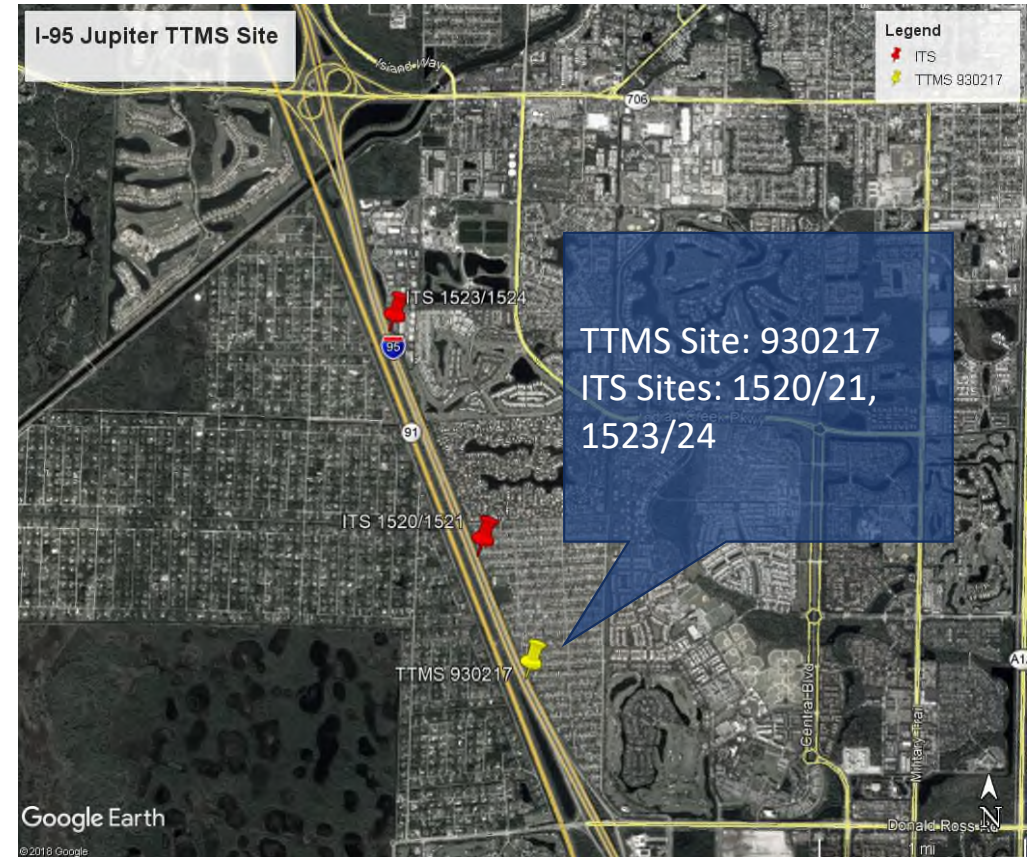
- January 2017 – December 2018
- Rural Principal Arterial Interstate
  - AADT (2018): 28803
  - LOS (2018): B
- Four devices analyzed:
  - TTMS 860357
  - ITS FLD4075NB/SB025.1
  - ITS FLD4075NB/SB25.6
  - ITS FLD4075NB/SB26.1





## I-95 Jupiter, N of Donald Ross Rd. in Palm Beach County

- January 2014 – December 2018
- Urban Principal Arterial Interstate
  - AADT (2018): 116433
  - LOS (2018): D
- Three devices analyzed:
  - TTMS 930217
  - ITS FLD4095NB/SB084.7
  - ITS FLD4095NB/SB085.4







## Preprocessing, auditing, and cleaning



## Data Processing

- TTMS hourly continuous counts
- ITS 15-minute interval counts
- Generated uniform aggregate data
  - Per day, per direction for each device

Date	Direction	TTMS	ITS 1520/1521	ITS 1523/1524
1/7/2014	S	50581	48672	48179
1/7/2014	N	49854	48584	49468
1/8/2014	S	48987	46997	46648
1/8/2014	N	48843	47666	48185
1/9/2014	S	49647	47512	46813
1/9/2014	N	49488	47872	48497
1/10/2014	S	49477	47424	47016
1/10/2014	N	50935	49720	50179
1/11/2014	S	42075	40400	39972
1/11/2014	N	41880	41187	41525
1/12/2014	S	38338	36955	36198
1/12/2014	N	36498	36111	36164
1/13/2014	S	51313	49465	48156
1/13/2014	N	49649	48320	49102

Figure 1: Sample uniform aggregate data (I-95 Jupiter)





# Data Auditing

Date	Direction	TTMS	ITS 1520/1521	ITS 1523/1524
1/3/2018	S	59464	57589	53531
1/3/2018	N	58940	55064	57452
1/4/2018	S	60474	60186	57399
1/4/2018	N	61366	60000	60569
1/5/2018	S	65333	64827	61671
1/5/2018	N	65368	63810	64392
1/6/2018	S	52723	52339	50092
1/6/2018	N	53941	53150	53537
1/7/2018	N	45281	44732	45086
1/7/2018	S	0	49031	46667
1/8/2018	S	60007	59127	56305
1/8/2018	N	57273	55833	56667

Figure 2: Sample of anomaly detection results

- TTMS
  - Only days flagged "N" (normal)
- Discover anomalies and missing readings
  - No valid reading (=0)
  - Count outside of interquartile range (IQR, middle 50% of data)
  - Cross-checked
    - ✓ Scheduled construction
    - ✓ Special events (ex. Hurricanes)





## Data Cleaning

- Summary of auditing results
- Removal of anomalies from analysis calculations
  - TTMS discrepancy – entire **day** directional count (no variance calculation)
  - ITS discrepancy – **device's** day directional count

Quartile	Result	Notes
1	23736	25th percentile
2	26740	50th percentile
3	32815.25	75th percentile
IQR:	9079.25	
Upper Bound:	46434.125	
Lower Bound:	10117.125	
<b># of outliers:</b>	66	

Figure 3: Example of anomaly audit summary (I-75)





## Calculating variation and analysis



## Calculating Variation

- Percent variation formula:

$$\frac{(ITS \text{ daily count} - TTMS \text{ daily count})}{TTMS \text{ daily count}}$$

- Calculated within same format for easy analysis
- Removed respective outliers from average calculation

Date	Direction	TTMS	ITS 1520/1521	ITS 1523/1524	%Var 1520/21	%Var 1523/24
1/3/2018	S	59464	57589	53531	-3.15%	-17.82%
1/3/2018	N	58940	55064	57452	-6.58%	-2.52%
1/4/2018	S	60474	60186	57399	-0.48%	-5.08%
1/4/2018	N	61366	60000	60569	-2.23%	-1.30%
1/5/2018	S	65333	64827	61671	-0.77%	-5.61%
1/5/2018	N	65368	63810	64392	-2.38%	-1.49%
1/6/2018	S	52723	52339	50092	-0.73%	-4.99%
1/6/2018	N	53941	53150	53537	-1.47%	-0.75%
1/7/2018	N	45281	44732	45086	-1.21%	-0.43%
1/7/2018	S	0	49031	46667		
1/8/2018	S	60007	59127	56305	-1.47%	-6.17%
1/8/2018	N	57273	55833	56667	-2.51%	-1.06%

Figure 4: Sample of variance calculation (I-95)





# Variation Distribution (I-75 Alligator Alley)

- Calculated daily % variation between each ITS and TTMS site on I-75 Alligator Alley
  - After removal of anomalies
- Majority of variation within a +/- 5%

*Average % Variation Per ITS Device*

ITS 1678/79	ITS 1680/81	ITS 1856/57
0.62%	-0.03%	-0.41%

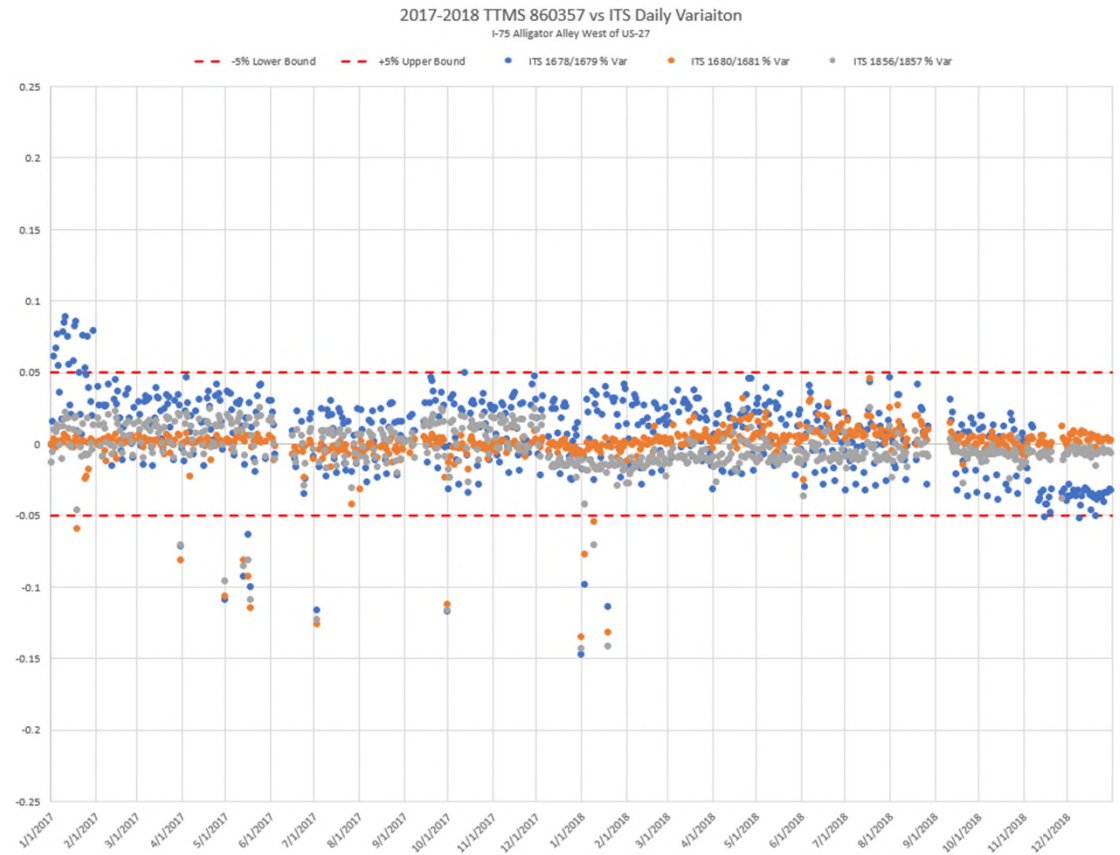


Figure 5: I-75 ITS % Variation 2017-2018





# Average Variation Per Year (I-95 Jupiter)

Average % Variation of ITS vs TTMS Per Year  
I-95 (Jupiter) between Donald Ross Rd. And Indiantown Rd.

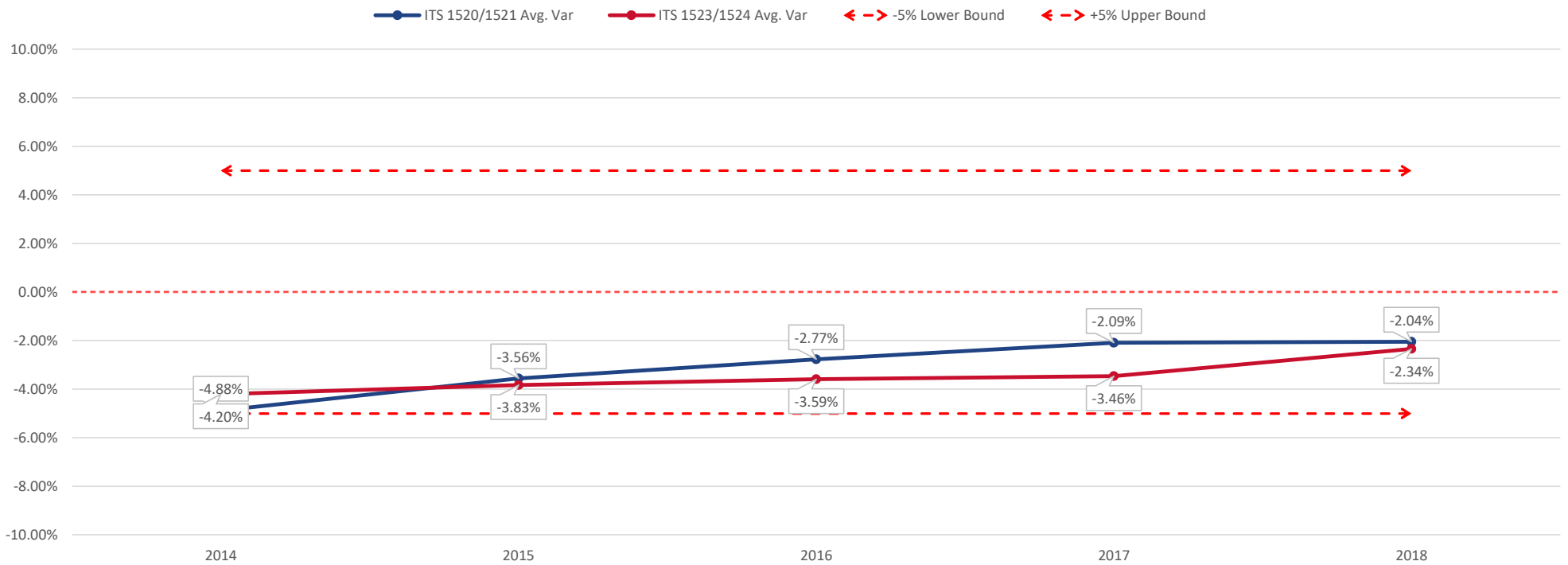


Figure 6: I-95 Average Percent Variation Per Year Per Device 2014-2018







# Average % Variation Per Year Comparison (I-95 & I-75)

Average Percent Variation Per Year (ITS vs TTMS)  
I-75 Alligator Alley West of US-27 & I-95 Jupiter between Donald Ross Rd. and Indiantown Rd.

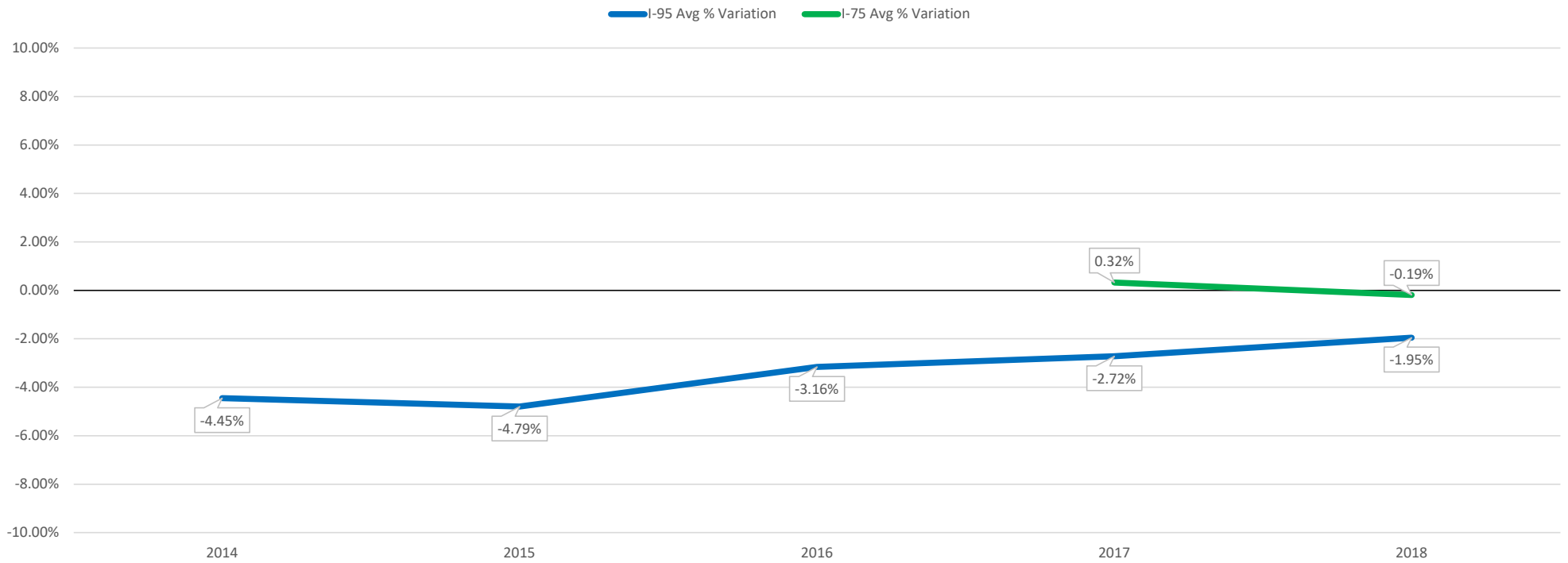


Figure 7: Both sample sites, average % variation per year





# Valid Counts Trend Analysis

I-95		2014	2015	2016	2017	2018
AADT		98785	104991	110401	112855	116433
Average Variation		-4.45%	-4.79%	-3.16%	-2.72%	-1.95%
I-95 Total Valid Counts		856	1070	1177	1117	1023
Count within 5%		572	794	952	901	937
I-95 Percentage (in 5%)		66.82%	74.21%	80.88%	80.66%	91.59%
Count within 3%		234	475	670	784	872
I-95 Percentage (in 3%)		27.34%	44.39%	56.92%	70.19%	85.24%
Count within 2%		90	288	472	590	651
I-95 Percentage (in 2%)		10.51%	26.92%	40.10%	52.82%	63.64%
Count outside 10%		52	1	4	5	0
I-95 Percentage (out 10%)		6.07%	0.09%	0.34%	0.45%	0.00%
I-95 Minimum Variation		-13.42%	-10.21%	-11.37%	-11.77%	-9.82%
I-95 Maximum Variation		-0.39%	1.02%	0.58%	0.91%	-0.09%
I-75		2014	2015	2016	2017	2018
AADT		23715	25537	27103	27770	28803
Average Variation					0.32%	-0.19%
I-75 Total Valid Counts					939	972
Count within 5%					899	960
I-75 Percentage (in 5%)					95.74%	98.77%
Count within 3%					838	872
I-75 Percentage (in 3%)					89.24%	89.71%
Count within 2%					724	780
I-75 Percentage (in 2%)					77.10%	80.25%
Count outside 10%					14	3
I-75 Percentage (out 10%)					1.49%	0.31%
I-75 Minimum Variation					-14.78%	-14.21%
I-75 Maximum Variation					8.85%	4.61%

Figure 8: Per Site Average Variation Trends

- Trend over sample period within various thresholds
  - +/- 5 % variation
  - +/- 3 % variation
  - +/- 2 % variation
- Percentage of ITS volume counts that were more than +/- 10% different
- I-95 Sample (2014-2018)
  - From 52 counts (6.07%) to 0 counts higher than 10% variation





## Conclusions and Going Further

- Downward trend in % variability between TTMS and ITS in the cases studied
- As technology continues to converge, we gain consistency between using either device for traffic volume counts
  - Potential use in place of missing TTMS data
- Expanding availability of ITS data allows for further comparisons
  - More network coverage, arterials
- New non-intrusive technologies = more opportunity





**Thank you for your time! – Q&A**